Hempstead Harbor Protection Committee

Long Island, New York

2017 Water-Quality Report Hempstead Harbor

(Full Report, Including Appendices)

prepared by

Coalition to Save Hempstead Harbor

FUSS & O'NEILL

Cover photos, left to right:

Black Skimmers at Bar Beach Sand Spit - Carol DiPaolo
Bald Eagles in Tree Overlooking Lower Hempstead Harbor - Isaac Schlesinger
Osprey Chicks in a Nest in Lower Hempstead Harbor - Mark Ring
(large background photo) Tilley's Boat House in Sea Cliff - Carol DiPaolo

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- The United Civic Council of Glen Head and Glenwood Landing

CSHH crew members with TNH Public Safety Officer Erik Paterson (l) and TOBAY Environmental Resources staffer Antonio Alfieri (r) (photos by Carol DiPaolo, 5/31/17 and 10/17/17)

Introduction

About 30 years ago, the view of Hempstead Harbor was much different from what it is today. The harbor was suffering from air, water, and land-based problems that resulted from past industrial activities along its shores. These problems were the impetus for the formation of a citizens' activist group in 1986, the Coalition to Save Hempstead Harbor (CSHH). CSHH established Hempstead Harbor's **Citizens Water-Monitoring Program** in 1992 and initially funded the program through membership support, grants from local foundations and businesses, and volunteer services. The program became widely recognized by other monitoring groups and agencies around Hempstead Harbor and Long Island Sound and quickly was able to garner support from local municipalities and government agencies.

As the program continued, positive changes were occurring not only on the landscape around the harbor, but also on the political landscape, as citizens and government learned to work collaboratively to achieve environmental goals. In 2006, the Hempstead Harbor Protection Committee (HHPC) (a municipal organization formed in 1995) was able to step up to fund the harbor's water-monitoring program through a Long Island Sound Study grant administered by the National Fish and Wildlife Foundation. The grant enabled the completion of an EPA-approved **Quality Assurance Project Plan** (QAPP), which further enhanced the credibility of the monitoring program and enabled the HHPC to obtain future federal funds for the program. (The QAPP was updated and approved by EPA in 2011 and 2014.)

The completion of the QAPP proved timely. During 2007, a copy of the QAPP, water-quality data, and other information from the water-monitoring program was requested for two separate shellfish-related projects. The information was used to help fill out the New York State Department of Environmental Conservation's (DEC's) data on the level of pathogens in Hempstead Harbor and to determine whether the harbor could be opened to shellfish harvesting in the near term.

The results of the DEC's rigorous water-quality testing showed that dramatic water-quality improvements had been achieved in Hempstead Harbor. On June 1, 2011, the efforts of all parties that worked for years to improve conditions in the harbor culminated in the **reopening of 2,500 acres of shellfish beds for harvesting** in the northern portion of the harbor–a success story that has been highlighted all around Long Island Sound and beyond.

Program Initiation

By 1990, there had been a history of chronic sewage spills from the failing wastewater treatment plants that were sited along Hempstead Harbor's shoreline. These spills along with cutbacks in Nassau County Department of Health's water-quality monitoring program were the factors that motivated CSHH to create a citizens water-monitoring program for Hempstead Harbor. The program was intended as a springboard for public education and outreach, to foster increased awareness of environmental issues, and to encourage public participation in local conservation efforts.

In the early 1990s, at the same time that CSHH developed the water-quality monitoring program for Hempstead Harbor, concerns about the health of Long Island Sound gained increased attention. CSHH recognized that the priorities established under the Long Island Sound Study's **Comprehensive Conservation and Management Plan** (CCMP) (1994) were the same priorities that had to be addressed for Hempstead Harbor, perhaps to a different extent. These priorities were low dissolved oxygen (hypoxia), toxic-substance contamination, pathogen contamination, habitat degradation, and floatable debris. At the start, Hempstead Harbor's water-quality monitoring program, therefore, included dissolved oxygen as a critical monitoring parameter (among others).

CSHH worked hard to develop a credible water-testing program that could be relied on to indicate the health of the harbor. However, the primary purpose in establishing the program was to encourage all who live, work, and enjoy recreational activities around Hempstead Harbor to renew their interest in the harbor, as well as in Long Island Sound, and to participate in restoration efforts. An important component of the program since its start has been to involve citizens in observing changing conditions around the harbor and notifying CSHH as well as appropriate municipal and environmental agencies of any unusual events affecting the harbor.

Program Expansion

Over the years, the scope of the water-monitoring program has expanded, as has the network of partners that have supported it. The number of testing parameters and stations has increased.

Scudder's Pond restoration and construction work: coir banks for stream from upper pond (l) and new stormwater basin for country club cottages(r) (photos by Carol DiPaolo, 3/11/14)

As described in later sections of this report, Scudder's Pond had been identified as a major contributor of bacteria to Hempstead Harbor through stormwater runoff. In 2009, in anticipation of restoration work planned for the pond to mitigate the effects of stormwater runoff, two new monitoring stations were established. The stations are located at the weir that drains water from the pond directly to the harbor and at the outfall across the road that carries pond water as well as runoff from the larger area around the pond. At the same time, a new station was also established at the powerhouse drain outfall, which had been identified as the second largest contributor of bacteria to the harbor.

Winter view of Scudder's Pond, post-restoration (photo by Michelle McAllister, 3/16/17)

The years of monitoring these stations established a baseline of bacteria levels that occur from May to November. In 2013, the program was expanded to include winter monitoring (November to May) of the pond and powerhouse outfalls. Monitoring these outfalls during the winter will help us to understand what happens to bacteria levels during cold winter months as well as to examine changes in bacteria levels as construction work at the pond proceeded and following the completion of the restoration in June 2014. Although the final winter monitoring for Scudder's Pond ended with the 2015 program (in April 2016), samples were collected periodically for the winter 2017 program (November 2017 through April 2018) to check on conditions as we continued winter monitoring of the powerhouse outfall.

In addition to the shoreline winter monitoring, three new stations were added in 2015 to the outer harbor for the regular monitoring season. These stations are located within the area of the certified shellfish beds of Hempstead Harbor and are important for obtaining more detailed information on water-quality conditions in this section of the harbor.

Municipal Watershed-Based Management

As CSHH continued its monitoring efforts, the nine municipalities that share jurisdiction over Hempstead Harbor recognized they also shared the harbor's water-quality problems but did not, individually, have the resources to tackle large harbor issues. It became increasingly evident that they needed a mechanism to overcome the complexities of municipal boundaries and facilitate a more coordinated government approach to water-quality problems. In 1995, the Hempstead Harbor Protection Committee was created and became Long Island's first watershed-based intermunicipal organization, specifically formed to protect and improve the water quality of Hempstead Harbor. CSHH became the first environmental organization to join the committee–as a nonvoting member and technical adviser.

HHPC first focused on abatement of stormwater runoff as it developed a comprehensive Hempstead Harbor Water-Quality Improvement Plan (1998). CSHH implemented the plan's water-quality monitoring component. Also, in recognition of the need to balance the diverse uses of Hempstead Harbor, the HHPC secured a grant to prepare the Harbor Management Plan for Hempstead Harbor (2004), which was adopted by all nine HHPC municipalities.

CSHH and HHPC Profiles and Activities

The Coalition to Save Hempstead Harbor and the Hempstead Harbor Protection Committee continue to work closely together on improving Hempstead Harbor's water quality. Each organization has offered separate and valuable contributions to improving conditions around the harbor. At the same time, the two organizations illustrate the great successes that can result from creating valuable partnerships that can pool resources and maximize results to benefit the environment and local communities.

CSHH

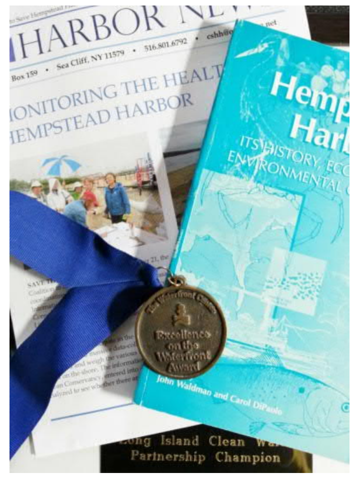
CSHH's mission, to identify and eliminate environmental threats to Hempstead Harbor and surrounding communities, is longstanding. When CSHH first formed in 1986, it was in response to reports of continued degradation of Hempstead Harbor on a number of fronts. CSHH joined with other community members and successfully prevented a new incinerator from being built on the harbor's western shore and shut down a failing incinerator that was operating on its eastern shore. CSHH sponsored the development of a townwide recycling plan for the Town of North Hempstead, offering a solution to problems of solid-waste management, and became a critical watchdog for the harbor as remediation plans were formulated to clean up contaminated sites.

As CSHH developed its Citizens Water-Monitoring Program, it also participated in the meetings and hearings that led to the completion of the Long Island Sound Study's Comprehensive Conservation and Management Plan (1994). More recently, CSHH participated in the meetings leading up to the 2015 revision and update of that plan. (CSHH has been a member of the Long Island Sound Study's Citizens Advisory Committee since 1992 and served for three years as chair of its Communications Subcommittee.)

In 1996, CSHH initiated the creation of the **Water-Monitoring Work Group**, a soundwide network of environmental agencies and nonprofits connected with water-monitoring programs around Long Island Sound. The work group provided a forum for reviewing current testing parameters, methodologies, and equipment used by members and for examining testing results in a broader context. Among the work group's achievements was completion of the **Long Island Sound Mapping Project** (July 1998), which mapped sites monitored around Long Island Sound and identified the agencies and other organizations responsible for testing at those sites. The project was funded through a grant awarded to CSHH, on behalf of the work group, by EPA/Long Island Sound Study. The soundwide network established as a result of the work group remains an important resource to determine the location and extent of various water conditions around the sound.

In 1998, CSHH published ***Hempstead Harbor: Its History, Ecology, and Environmental Challenges***. The book supports the goals of the water-monitoring program in encouraging community members to learn about Hempstead Harbor as an important habitat for marine life and other species. It also describes the critical relationship between the ecology of the harbor and sound and the quality of life (as well as the economy) of surrounding communities.

In 2000, CSHH became a partner in **EPA's Environmental Monitoring for Public Awareness and Community Tracking** (EMPACT) program. CSHH worked with the Marine Sciences Department of the University of Connecticut to maintain a telemetry link at the EMPACT Web site at www.MYSound.uconn.edu, so that water-quality data from Hempstead Harbor could be viewed on the Web. The Town of Oyster Bay became an important partner in this project, having contributed the stationary probe and use of a boat and staff to assist with probe maintenance. In 2005, logistical problems and lack of funding to purchase and maintain necessary new equipment prevented the continuation of this program.



In 2001, CSHH received the prestigious **Clearwater Award**, announced by The Waterfront Center, a Washington, DC-based educational organization with worldwide membership. CSHH was commended for the scope of its activities in working to improve conditions in and around Hempstead Harbor. Particularly noted were CSHH's book (mentioned above) and the expansion of its water-monitoring program.

In 2002, CSHH was asked by the US EPA Long Island Sound Study Office to plan and coordinate a **Stormwater Workshop** to help prepare Long Island communities to meet the requirements of the EPA Phase II Stormwater Regulations. CSHH received a grant to host the workshop, which was cosponsored by the EPA Long Island Sound Office, Long Island Sound Study, and the New York Sea Grant Program.

More recently, CSHH has served on review committees for restoration-plan proposals such as the Scudder's Pond Restoration Program and Glenwood Road/Powerhouse Drain Stormwater Pollution Abatement Plan. In 2009, CSHH initiated a work group of local community organizations to focus on development of a townwide land-preservation plan. The work group considered various land-use planning vehicles. It also considered a proposal to review the Town of Oyster Bay's Groundwater and Open Space Protection Plan (2006) in light of current local land-use and harbor preservation efforts. A first step toward a broader land-use preservation plan is to determine the feasibility of a watershed-protection overlay district for Hempstead Harbor. The scope of the Glenwood Road/Powerhouse Drain Stormwater Pollution Abatement Plan (HHPC, 2013) was expanded to include this element.

Also in 2009, CSHH became a member of the newly formed Long Island Sound/New York State Sentinel Site Work Group, which was charged with addressing climate change and ways to measure the impacts on Long Island Sound. (This was part of a bistate–New York and Connecticut–approach to understanding climate-change indicators for Long Island Sound and selecting appropriate sites to measure them. In 2011, the *Sentinel Monitoring for Climate Change in the Long Island Sound Estuarine and Coastal Ecosystems of New York and Connecticut* was completed; in 2013 a pilot program was implemented to monitor key climate change indices (sentinels) at locations within Long Island Sound and evolved into the current Climate Change and Sentinel Monitoring Program.)

In April 2011, CSHH organized an emergency cleanup of plastic disks that were accidentally released from an aeration tank at the Mamaroneck sewage treatment plant. The cleanup resulted in the collection of over 27,000 disks from five beaches around Hempstead Harbor and helped convince Westchester County to send crews to continue cleanup efforts. Throughout the rest of the season, disks continued to wash up on Hempstead Harbor beaches as well as along the shores of other bays around Long Island Sound. In September 2017, CSHH coordinated local activities as part of the International Coastal Cleanup, as it has for all but two years since 1992.

Volunteers at the International Coast Cleanup at Tappen Beach included members of the Glen Cove Boys and Girls Club, Girl Scouts, and local residents (photos by Carol DiPaolo, 9/16/17)

CSHH continues to work with other environmental groups and agencies around Hempstead Harbor and Long Island Sound. For example, in November 2011, CSHH helped to scope out the density of blue mussels at a site in Hempstead Harbor; the site had been used as part of the National Status and Trends Mussel Watch program since 1986 (a project sponsored by the National Oceanic and Atmospheric Administration (NOAA)). In March 2012, CSHH was asked to scope out the density of ribbed mussels in Hempstead Harbor as part of another NOAA project.

CSHH has also participated on advisory committees that have been created to develop local revitalization plans for harbor communities. CSHH served as a member of the Glen Cove Creek Reclamation Committee, Glenwood Landing Steering Committee, the Roslyn Waterfront Committee, the Glen Cove Waterfront Citizens' Planning Committee, and the Glen Cove Master Plan Task Force, among others.

In 2013, CSHH and HHPC were invited to participate in a project that would establish a report-card system to communicate the health of Long Island Sound. Hempstead Harbor and Norwalk Harbor were selected to have the first embayment report cards to serve as pilot projects to help launch the larger, soundwide report-card system. Both harbors were selected because of their longstanding and credible water-quality monitoring programs and availability of the necessary water-quality data. The project, developed by scientists from the University of Maryland and funded by a 2013 Long Island Sound Futures Fund grant award, was completed in 2015.

In 2016, CSHH was asked to participate in the Unified Water Study (UWS) for Long Island Sound embayments. The goal of the study is to standardize testing parameters and operating procedures among groups monitoring bays and harbors around Long Island Sound so that an embayment report card can be developed comparing ecological conditions in bays around Long Island Sound. In 2017, CSHH again participated in the UWS, coordinating the biweekly program in Hempstead Harbor separate from the harbor's weekly core monitoring program.

CSHH's programs and activities are supported by special fund-raising events, member contributions, and grants–including those awarded from EPA's Long Island Sound Office, Long Island Sound Study, NY Sea Grant, The New York Community Bank Foundation, the North Country Garden Club, the New York Community Trust, Long Island Community Foundation, and local businesses.

HHPC

The idea for addressing Hempstead Harbor's water-quality issues on a harborwide basis was conceived in the mid-1990s by NYS Comptroller Tom DiNapoli (then-NYS Assemblyman) and former Sea Cliff Mayor Ted Blackburn.

In 1995, funds were sought and received from the NYS Department of State, and the HHPC (Long Island's first inter-municipal watershed organization) was born. The funds were used to hire a part-time director and to hire coastal experts to prepare an in-depth **Hempstead Harbor Water Quality Improvement Plan** (completed in 1998). Each of the nine municipalities signed an intermunicipal agreement to work cooperatively and to contribute financially to the HHPC.

HHPC's municipal members include County of Nassau, the Towns of Oyster Bay and North Hempstead, the City of Glen Cove, and the Villages of Sea Cliff, Roslyn Harbor, Roslyn, Flower Hill, and Sands Point. The committee accomplishes its mission to protect and improve the harbor's water quality through planning studies, capital-improvement projects, educational outreach, water-quality monitoring, information and technology sharing, development of model ordinances, coordination of enforcement, and working with other governmental agencies as well as environmental, educational, community, and business groups. HHPC's executive director serves on the Long Island Sound Study's Citizens Advisory Committee, the Board of Directors of the Nassau County Soil and Water

Conservation District, and on the Board of Directors of Friends of Cedarmere. These ties and cooperative effort save each municipality expenses and provide a coordinated approach to solving harbor problems and a year-round focus on harbor issues.

The HHPC prepared **the Scudder's Pond Subwatershed Plan** (2006) and has secured nearly $2.5 million toward the implementation of its recommendations, which began in November 2013 and was completed in June 2014. This subwatershed (located in Sea Cliff) had been identified as one of the most significant contributors of bacteria-laden stormwater runoff to the harbor. A similar study for the **Powerhouse Drain subwatershed** in Glenwood Landing was completed in December 2013.

In 2007, HHPC applied for federal **No Discharge Zone (NDZ)** designation for Hempstead Harbor; the US EPA approved the application on November 6, 2008. The NDZ designation affords the harbor the necessary legal basis to restrict boaters from discharging their wastes into the harbor and strengthens avenues for enforcement. On September 6, 2011, New York State, following Connecticut's example, banned vessel sewage discharges from its portion of Long Island Sound, making the entire sound a no-discharge zone.

The HHPC has also established a website (www.HempsteadHarbor.org) and a Facebook page to serve as harbor resources. **Ongoing educational efforts** include the production of professional coastal interpretive signage; the production of a series of three television programs; the purchase of a portable display unit that is used at area fairs, festivals, libraries, and town and village halls; and the installation of pet-waste stations around the harbor.

The HHPC was instrumental in expanding the harbor's designation as a NYS Significant Coastal Fish and Wildlife Habitat Area to encompass the entire harbor. It has also played a role in having harbor trails and land acquisition added to the state's Open Space Plan; having the harbor designated by the Long Island Sound Study as an inaugural "Long Island Sound Stewardship Site"; and having the harbor designated as part of Audubon New York's "Important Bird Areas of New York State." The HHPC has been a great success and has spawned the creation of other intermunicipal efforts, including the Manhasset Bay Protection Committee, the Oyster Bay/Cold Spring Harbor Protection Committee, the Northport Water Quality Protection Committee, and the Peconic Estuary Protection Committee.

Section of Hempstead Harbor shoreline trail and signage (photos by Carol DiPaolo, 5/20/15)

Since 1995, the HHPC has received over 25 grants, which have covered much of the committee's costs. The balance of the HHPC's budget (including monetary matches for the grants) is made up of annual dues received from the nine member municipalities.

In 2012, the HHPC received an Environmental Quality Award from the US EPA Region 2 for its efforts in improving water quality in Hempstead Harbor to the point where 2,500 acres of the harbor were reopened to shellfish harvesting for the first time in 45 years. Since the water-quality standards to support shellfish harvesting are the highest of all water-quality standards, this achievement unquestionably demonstrated the water-quality improvements that the HHPC was created to seek. In so doing, Hempstead Harbor also became the first major water body in New York State to achieve this status in several decades. The HHPC continues to work to achieve this for the remaining portions of the harbor.

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1 Harbor Overview

Hempstead Harbor lies along the north shore of Long Island, bordering the western portion of Long Island Sound, between Manhasset Bay to the west and Oyster Bay to the east. The V-shaped harbor is about 5 miles long from mouth to head, and its shoreline extends about 14 miles from Prospect Point on the west at its mouth to Matinecock Point on the east. For the most part, the harbor presents a beautiful water body that is quiet and uncrowded, though it has widely mixed uses.

Industrial or commercial enterprises were historically concentrated in four areas along the harbor's shoreline. They remain currently, to a much lesser degree, in three areas of the harbor. The former industrial sites degraded the harbor's shorelines, wetlands, and water quality with the effects of oil spills, sewage spills, toxic contamination, stormwater runoff, air pollution, and industrial discharges. The worst of these effects were noted in the mid-1980s.

Powerhouse drain at low tide adjacent to site where the brick building and power plant substation stood until 2015 (l) and view looking west at the Bar Beach sand spit (r) (photos by Carol DiPaolo, 3/3/16)

Efforts to restore the harbor resulted in the closure of a landfill, two incinerators, and a sewage treatment plant. Dramatic changes around the harbor have resulted in improved water quality.

One sewage treatment plant (in Glen Cove) remains and in 2003 was upgraded, using a biological process to remove nitrogen from its discharge. In late 2006, an ultraviolet (UV) light disinfection system was installed to replace the chlorination system. (In 2008, Nassau County purchased the plant from the City of Glen Cove, and in January 2015 United Water Long Island began operation of the plant along with other county-owned plants.) In June 2009, after a backup generator was installed at the STP to make the UV system fully operational, the chlorine vats were emptied and CSHH ceased chlorine testing at the STP outfall, CSHH #8. The replacement of the chlorination system with the UV disinfection system offers a significant benefit for water quality because it removes the risks posed by chlorine by-products, which can have an adverse impact on marine life. (See also *Section 3.9.3.*)

The remediation of some hazardous waste sites has been completed, and remediation of others is still underway. Also, revitalization plans are being implemented for sections of the waterfront that suffered the most abuse, such as along Glen Cove Creek and the eastern shore in Glenwood Landing.

Wetland-restoration planting at Bar Beach lagoon in 2003 (l) and in 2005 (center) (photos by Kevin Braun) and view from the completed section of the shoreline trail (r) (photo by Carol DiPaolo, 5/2/15)

Wetlands restoration projects have been expanded on the western shore of the harbor, south of the former Bar Beach Park, which is now part of the larger North Hempstead Beach Park. (In September 2007, Nassau County transferred ownership of the Hempstead Harbor Beach Park to the Town of North Hempstead, which merged it with the adjacent town-owned Bar Beach Park; in May 2008, the combined beaches were renamed North Hempstead Beach Park.) In 2015, the section of the trail along the western shore just south of the former Bar Beach was completed.

Despite the harbor's impaired condition during the 1980s, in 1987 New York State designated Hempstead Harbor a **Significant Coastal Fish and Wildlife Habitat** area, which included the upper portion of Hempstead Harbor, from Mott Point on the west to the Glen Cove breakwater on the east. Over the last 30 years, the harbor's ecosystem has vastly improved, containing a diversity of marine life and water birds. Wetland grasses have recovered a large portion of the lower harbor south of the North Hempstead Beach Park, once again providing a nursery and healthy habitat for marine species and bird populations. Reflecting Hempstead Harbor's dramatic turnaround, its designation as a Significant Coastal Fish and Wildlife Habitat was modified in October 2005 to include the lower portion of the harbor, extending south to the Roslyn viaduct.

By 2009, water quality had improved so dramatically in Hempstead Harbor that the results of water-quality testing undertaken by the NYS Department of Environmental Conservation (DEC) indicated that a portion of the outer harbor could be certified for shellfish harvesting. (The harbor had been restricted for shellfish harvesting for over 40 years.) The testing and regulatory process was completed in 2011, and on June 1, 2011, 2,500 acres of shellfish beds that form a band across the outer harbor were officially reopened for harvesting.

Today, Hempstead Harbor continues to support many diverse uses and activities. Fuel is transported to the Glenwood Landing terminal (Global Partners LP) that is adjacent to a power plant that has operated since the early 1900s. Farther north, tugboats tow barges to and from a sand and gravel transfer station on the western shore of the harbor and into Glen Cove Creek, which flows from the harbor's eastern shore. In contrast to these commercial uses, the recreational uses continue to flourish and expand as the harbor's water quality improves. Marinas, yacht clubs, and fishing clubs, which are concentrated in the northern portion of the harbor, are thriving. Town, city, village, and small private beaches are also located along the harbor's shore. As the harbor environment has continued to improve, there has been increased pressure to develop properties along the shoreline, which in time could exacerbate the problems that are currently being mitigated.

Glen Cove Anglers Club closed in 2017 to be rebuilt and relocated farther east along the north side of Glen Cove Creek (photo by Carol DiPaolo, 5/31/17)

A challenge that must be met in planning for the future of Hempstead Harbor is to balance these diverse and often competing interests. The Harbor Management Plan for Hempstead Harbor (Hempstead Harbor Protection Committee, 2004) offers a comprehensive strategy for the municipalities that share jurisdiction over Hempstead Harbor to "work cooperatively to address issues related to the wise use and protection of the harbor's surface waters, natural resources, underwater lands, and shorefront." Specific environmental challenges and priorities that remain for Hempstead Harbor include stormwater runoff abatement; continued improvements in water quality and reductions in bacteria levels; prevention of inappropriate land use and development, particularly along the shore; and continued remediation of contamination from former industrial activities.

2 Methods

It is difficult to draw direct relationships among all the variables that affect water quality, and this is the challenge presented every year in attempting to analyze the past season's water-quality data. The graphs presented in the full copy of this report and the electronic version compare parameters (such as rainfall and bacteria levels) that show expected correlations but also noticeable variability. The data collected over the years are a critical resource as we look for trends that point to the health of the harbor.

Assessing the health of Hempstead Harbor, as well as Long Island Sound, is complicated. There are many variables. Some things we can control–such as nitrogen discharges and other pollution from both point and nonpoint sources; other things we can't control–such as rainfall and temperature. However, all of these factors have critical relationships that have an impact on the ecological health human use of our waters, including swimming, fishing, and other recreational pursuits.

The data collected through the water-monitoring program help us learn about the interrelationships that occur in Hempstead Harbor. This information enables us to work with others on a harborwide and soundwide basis to discover causal effects of human activities, so that we can plan and implement best management practices to assure a healthy environment for the future.

2.1 Quality Assurance Project Plan

In 2006, a Quality Assurance Project Plan (QAPP) was prepared by the consulting engineering firm of Fuss & O'Neill, Inc., for the Hempstead Harbor Water-Monitoring Program, on behalf of the Coalition to Save Hempstead Harbor (CSHH) and the Hempstead Harbor Protection Committee. The QAPP documents the quality assurance and quality control (QA/QC) procedures implemented in the CSHH program. QAPP revisions were approved by EPA to reflect changes in the program in 2011 and 2014.

The approval of the QAPP by the US Environmental Protection Agency, Region 2, broadens the use of the program's data by additional outside organizations, enables the program to receive federal funding for future monitoring efforts, reiterates the ongoing commitment of CSHH to provide high-quality monitoring data for Hempstead Harbor, and demonstrates the reliability of the data presented in this and previous water-quality reports.

2.2 Location of Testing Stations

The principal CSHH stations that are sampled weekly during the monitoring season for all program parameters are located in the northern portion of the harbor, between the sand spit of the former Bar Beach (now part of the 36.2-acre North Hempstead Beach Park) and Long Island Sound, as well as in Glen Cove Creek. *Table 1* includes the latitude/longitude points for the monitoring stations.


CSHH #17A
CSHH #17
CSHH #16
CSHH #2
CSHH #13
CSHH #12
CSHH #8, 9, 10, 11
CSHH #3
CSHH #15 & 15A
CSHH #15B
CSHH #1
CSHH #14 & 14A
CSHH #4
CSHH#5
CSHH #6
CSHH #7
Glen Cove
Sea Cliff
Port Washington
Glenwood Landing
East Hills
CSHH Points
0
2.55
Miles
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmyindia, © OpenStreetMap contributors, and the GIS User Community

Table 1
Latitude/Longitude Points for Monitoring Stations (NAD 83 Datum)

Station ID	Latitude N	Longitude W
Upper-Harbor Stations		
CSHH #1, Beacon 11 (Corresponds to 2017 UWS station HEM-0-01)	40.83189	073.65353
CSHH #2, Bell 6 (Corresponds to 2017 UWS station HEM-0-03)	40.86099	073.67362
CSHH #3, red channel marker (Corresponds to UWS station HEM-0-02)	40.85373	073.65202
CSHH #8, adjacent to STP outfall pipe	40.85849	073.64204
CSHH #9, 10 ft west of #8	40.85850	073.64195
CSHH #10, 20 ft west of #8	40.85846	073.64198
CSHH #11, 50 ft east of #8	40.85852	073.64141
CSHH #12, 100 ft east of #8	40.85947	073.64054
CSHH #13, 60 ft from Mill Pond weir	40.86165	073.63583
CSHH #15, about 50 yds from Scudder's Pond outfall, north of Tappen Beach pool area	40.83820	073.65355
CSHH #15A, at outfall north of Tappen Pool	40.83837	073.65263
CSHH #15B, at Scudder's Pond weir	40.83709	073.65144
CSHH #16, north of Bell 6 (Corresponds with 2017 UWS station HEM-0-04)	40.87349	073.67493
CSHH #17, just outside the Crescent Beach restricted shellfish area (Corresponds to 2017 UWS station HEM-0-05)	40.88365	073.65016
CSHH #17A, inside Crescent Beach restricted shellfish area, just off shoreline	40.88343	073.64819
Lower-Harbor Stations		
CSHH #4, east of North Hempstead Beach Park (formerly Bar Beach) sand spit	40.82815	073.65015
CSHH #5, Mott's Cove	40.82197	073.64619
CSHH #6, east of Port Washington transfer station	40.81114	073.65008
CSHH #7, west of Bryant Landing (formerly site of oil dock)	40.80596	073.65065
CSHH #14, about 50 yds from Powerhouse Drain outfall	40.82848	073.64840
CSHH #14A, at Powerhouse Drain outfall	40.82872	073.64776

At the end of the 2004 monitoring season, CSHH #9, #10, #11, and #12 were added in the vicinity of the Glen Cove sewage treatment plant outfall (CSHH #8) (in Glen Cove Creek) specifically to provide additional samples for bacteria analysis by the NCDH. These stations were added to track the frequency and source of unusual dry- and wet-weather flows that were noticed at discharge points west of the STP outfall and that, on testing, indicated high levels of bacteria; the four stations became a permanent part of the program in 2005.

CSHH #13 was also established to monitor bacteria levels at the head of the creek and became a permanent part of the program in 2007. In 2008, CSHH #13 was set at 60 feet west of the Mill Pond weir to avoid shifting the sampling location as access to the weir varied due to tidal cycles. Samples collected at CSHH #13 can help indicate whether the restoration of Mill Pond is curtailing bacteria inputs to Glen Cove Creek.

In 2009, the water-monitoring program was greatly expanded. CSHH and the NYS Department of Environmental Conservation worked together on a plan to survey mid- and lower portions of the harbor for bacteria levels relative to water-quality standards for shellfish harvesting. Thirteen of the stations that were set up in 1988 as sampling points for DEC's shellfish growing area (SGA) #50 were reestablished, five new stations were added (#1A, 14, 15, 15A, 15B) Samples were also collected at the Glen Cove STP outfall. CSHH collected samples once or twice a week (depending on tidal cycles) at these points from August to early November, and the samples were delivered to the DEC lab for analysis. This component of the program was added to determine whether the opening of these areas of the harbor for shellfish harvesting would be feasible in the near future. Unfortunately, the results of this intensive sampling showed that all but two of the stations failed DEC shellfish standards on a regular basis. The stations that were monitored by CSHH in 2009 will not be monitored again for DEC until there are further water-quality improvements in areas of the mid- and lower harbor.

Large school of bunker in Glen Cove Creek between Glen Cove ferry terminal and Brewer Marina (photo by Carol DiPaolo, 9/21/16)

CSHH continues to collect samples at stations #14, 15, 15A, and 15B for bacteria analysis by the Nassau County Department of Health (using water-quality standards for bathing beaches) as an alternative way to monitor discharges from the powerhouse drain and Scudder's Pond. Both subwatersheds were identified as the largest contributors of bacteria to Hempstead Harbor, and remediation plans were developed for both areas and implemented for Scudder's Pond (pond restoration was completed in June 2014). The samples collected established a benchmark of bacteria levels before, during, and after restoration of Scudder's Pond and will be used similarly for the powerhouse subwatershed.

In 2010, CSHH station #14A was established as an additional sampling site for the powerhouse-drain system. Samples from this station are taken directly from the large outfall at the bottom of Glenwood Road. The water samples are analyzed by the Nassau County Department of Health.

In 2015, CSHH stations #16, #17, and #17A were added to the monitoring program to further evaluate the water quality in the outer harbor.

CSHH #17A is off shore of the stream that flows alongside Crescent Beach and into Hempstead Harbor (photo by Carol DiPaolo, 9/17/17)

Upper-harbor CSHH monitoring stations also include those by outfalls in Glen Cove Creek and near Scudder's Pond:

- CSHH #1, at Beacon 11 (between Tappen Beach Marina on the east shore and North Hempstead Beach Park on the west shore)
- CSHH #2, at Bell Buoy 6 (a stationary marker at the harbor mouth, east of Mott Point)
- CSHH #3, at the red channel marker C-1, at the mouth of Glen Cove Creek, between the Hempstead Harbor Club and Sea Cliff Beach
- CSHH #8, at the Glen Cove sewage treatment plant (STP) outfall pipe

- CSHH #9, about 10 ft west of CSHH #8
- CSHH #10, about 20 ft west of CSHH #8, at the end of the seawall
- CSHH #11, about 50 ft east of CSHH #8, at the end of the floating dock
- CSHH #12, about 100 ft east of CSHH #8, in the middle of the creek, north of the bend in the south seawall
- CSHH #13, 60 feet from the Mill Pond weir
- CSHH #15, about 50 yds from Scudder's Pond outfall, at northwest corner of the Tappen Beach pool area
- CSHH #15A, at the Scudder's Pond outfall pipe, north of the Tappen Beach pool area
- CSHH #15B, at the Scudder's Pond weir on the east side of Shore Road
- CSHH #16, a central point in the outer harbor (corresponds with DEC shellfish monitoring station #24)
- CSHH #17, outside Crescent Beach restricted shellfish area across from white beach house
- CSHH #17A, within the Crescent Beach restricted area across from the stream that runs alongside the beach

Aerial view of mouth of Glen Cove Creek; Sea Cliff Beach (foreground), Sea Cliff Yacht Club and dock, Glen Cove marinas, and Glen Cove STP (7/08) (photo by Joel Ziev)

The five lower-harbor stations are often inaccessible during low tides and are monitored less frequently. The locations of the lower-harbor stations are as follows:

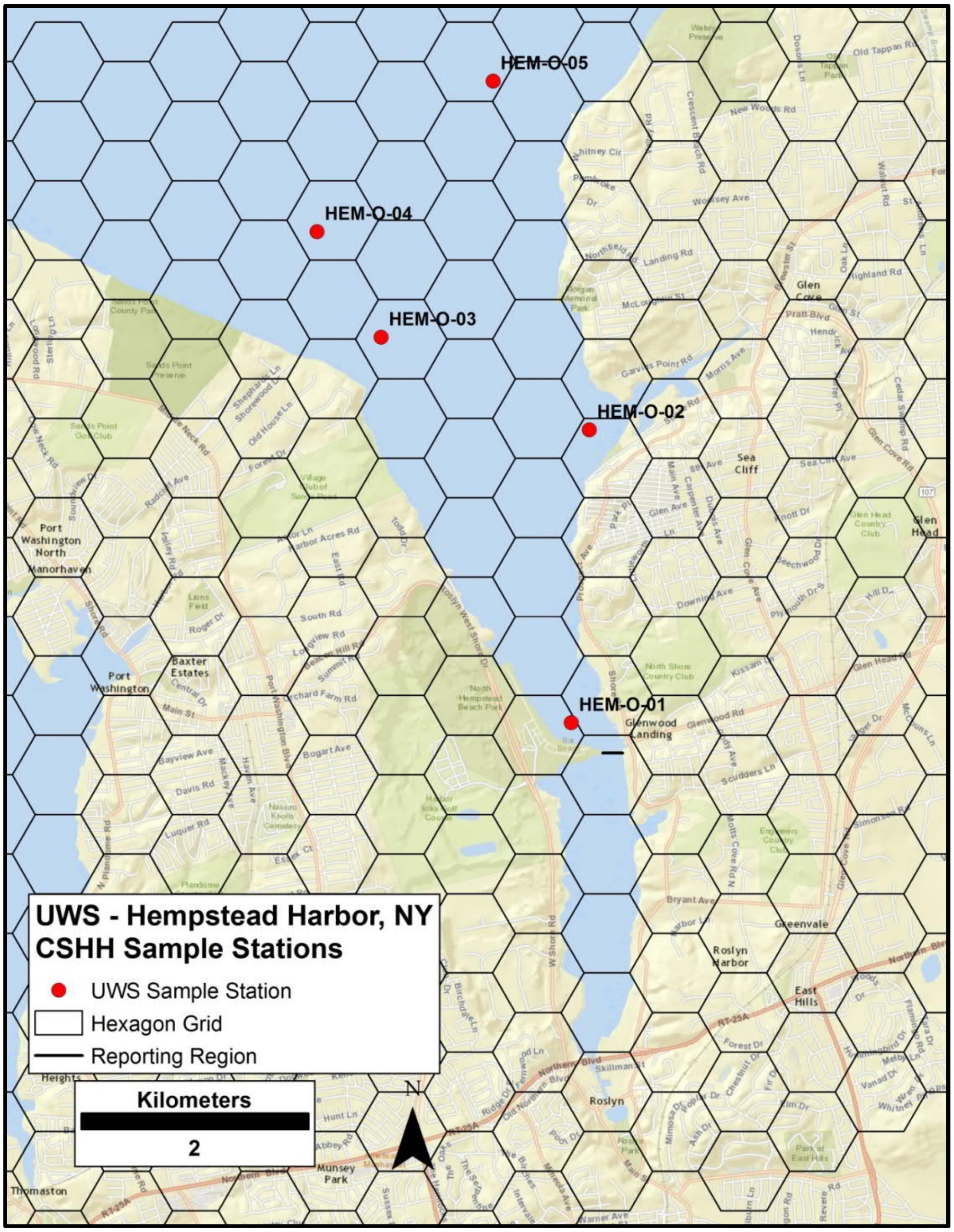
- CSHH #4, at the North Hempstead Beach Park (formerly Bar Beach) sand spit
- CSHH #5, at Mott's Cove
- CSHH #6, at a point east of the site of the former Town of North Hempstead incinerator, now the waste-transfer station
- CSHH #7, the station farthest south in the harbor, on the east shore just before the walkway for the Sterling Glen and Horizon communities (totaling 208 senior rental

units at Bryant Landing) and just north of the Roslyn viaduct. (The former marker for this station was a portion of an old oil dock, which was removed during the construction of the Sterling Glen and Horizon buildings.)
- CSHH #14, about 50 yds from powerhouse outfall
- CSHH #14A, directly from the powerhouse outfall

2.2.1 UWS Station Locations

In 2017, the Coalition to Save Hempstead Harbor participated in the *Unified Water Study: Long Island Sound Embayment Research* (UWS), funded by the Long Island Sound Funders Collaborative and coordinated by Save the Sound. CSHH was one of 12 groups that participated in the program, which engages citizen scientists who all use uniform equipment and methodology to collect biweekly samples throughout Long Island Sound from May through October. In 2017, 24 locations were included in the study, ranging geographically from Queens, NY, to Stonington, CT. Five CSHH stations were included in the UWS study, which are coded "HEM":
- HEM-0-01 #1, same as CSHH #1
- HEM-0-02, same as CSHH #3
- HEM-0-03, same as CSHH#2
- HEM-0-04, same as CSHH#16
- HEM-0-05, same as CSHH#17.

Data from the 2017 UWS sampling is included in *Appendix E*.



Location of the Hempstead Harbor UWS stations sampled in 2017
(provided by PeterLinderoth, Save the Sound)

2.3 Frequency of Testing and Testing Parameters

Testing for the core Hempstead Harbor monitoring program is conducted weekly from May through October, generally on the same day of the week and at the same time (beginning at approximately 7 AM and typically continuing for 5 hours. Beginning in 2013, weekly collection of water samples during the winter, from November through April, at CSHH #15A (outfall that drains from Scudder's Pond and Littleworth Lane, north of Tappen Pool),

#15B (Scudder's Pond weir), and #14A (powerhouse outfall) was added to the monitoring program. The water samples were delivered to Nassau County Department of Health for bacteria analysis (fecal coliform and enterococci). This component of the monitoring program corresponded with the start of the restoration work (November 2013) at Scudder's Pond. (Phragmites removal, dredging of the pond bottom, installation of a new storm-water basin at Littleworth Lane to curtail future sedimentation of the pond, and planting of native plants were included in the restoration work, and the anticipated result was to diminish bacteria loading to Hempstead Harbor.)

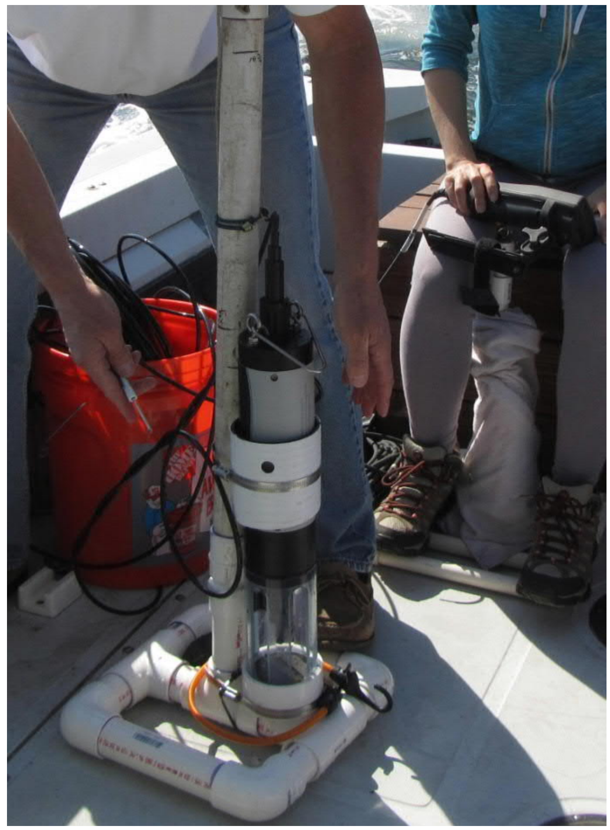
The purpose of the winter monitoring was to assess (1) changes to bacteria levels in the pond during cold weather and (2) the efficacy of the pond restoration work to reduce bacteria levels of water discharged from the pond to Hempstead Harbor. It also establishes a benchmark for future work that is anticipated for the powerhouse drain subwatershed to address similar problems of bacteria loading to Hempstead Harbor.

For the regular monitoring season, CSHH collects water samples and conducts water-quality tests with the assistance of volunteers as well as municipal staff for onboard testing and boat transportation to sampling sites. Water samples are collected (weather and tidal cycles permitting) from 21 testing stations for bacterial analysis by the NCDH. In addition, tests for dissolved oxygen (DO), salinity, water temperature, pH, and turbidity are conducted weekly at CSHH #1, #2, #3, #8, #13, #16, and #17 and every three to four weeks at CSHH #4, #5, #6, #7, #14, and #15. Because of the September 2016 closing of the facility that was used to do the analysis for nitrite and nitrate samples, nitrogen samples were not collected for 2017. However, samples were collected to onboard ammonia testing. Because detectable amounts of ammonia were found at most stations at the beginning of the season, ammonia testing continued weekly at CSHH #1, #2, #3, #8, #16, and #17 and less frequently at CSHH #4, #5, #6, #7, #14, and #15. In some instances, time constraints for monitoring events and the development time needed for each test prevented testing a certain stations on some dates. A summary of the samples collected and analyses performed is presented in *Table 2*.

Physical observations are recorded regarding weather conditions, wind direction and velocity, water surface, air temperature, floatables, and wildlife and human activities. Whenever possible, floatable debris is retrieved and brought back to shore for disposal.

Dissolved oxygen, salinity, water temperature, and pH are recorded with an electronic meter. In 2017, the Eureka Manta+ 35, which was provided to all groups participating in the UWS, was used by CSHH for both the core Hempstead Harbor monitoring program and the UWS program. (The YSI ProPlus meter, which had been used since 2014, was maintained as a backup instrument.) For the core program, the electronic meter is used at 1-meter-depth increments at every station. A sample of bottom water is also tested for DO using the Winkler titration method at the first station that is monitored for the day (generally CSHH #1) as a quality-assurance check of the electronic meter. A quality assurance test is also performed for pH using a LaMotte test kit–a wide-range indicator that uses a color comparator.

In 2017, the Eureka Manta+ 35 was also used to measure turbidity (the LaMotte 2020e portable turbidity meter, which had been used previously, was maintained as a backup instrument). The Eureka Manta+ 35 also measures chlorophyll a (Chl a), which is not a parameter that is required for the core Hempstead Harbor monitoring program butt is a "Tier 1" parameter for the UWS. Because the same multiparameter meter is maintained and calibrated for both programs, and because monitoring events for both programs are scheduled for consecutive days, Chl a levels were recorded for the core monitoring program as merely a frame of reference (see *Section 3.6*).



Water-monitoring crew members Mark Ring and Michelle McAllister the new platform created for the Eureka Manta+ 35 and the smaller platform (background) for the YSI ProPlus (photos by Carol DiPaolo, 5/17/17)

Table 2
CSHH Monitoring–Program Parameters

Parameter	Location	Analyzer or Method	Location of Analysis
Dissolved Oxygen	Vertical profiles starting half meter below surface and then 1-meter intervals at CSHH #1-8, 13, 14, 15, 16, and 17	Eureka Manta+ 35	Field
Dissolved Oxygen	One location for electronic meter validation	LaMotte 7414	Field
Water Temperature	Vertical profiles starting at half meter below surface and then 1-meter intervals at CSHH #1-8, 13,14, 15, 16, and 17	Eureka Manta+ 35	Field
Water Temperature	One station for electronic meter validation	Calibrated thermometer	Field
Air Temperature	One measurement at each station during monitoring	Calibrated electronic thermometer	Field
Salinity	Vertical profiles starting at a half meter below surface and then 1-meter intervals at CSHH #1-8, 13, 14, 15, 16, and 17	Eureka Manta+ 35	Field
pH	Vertical profile starting at a half meter below surface and then 1-meter intervals at CSHH #1-8, 13, 14, 15, 16, and 17	Eureka Manta+	Field
pH	One station for electronic meter validation	LaMotte 2218 reagent	Field
Turbidity	Vertical profiles starting at a half meter below surface and then 1-meter intervals at CSHH #1-8, 13, 14, 15, 16, and 17	Eureka Manta+ 35	Field
Clarity	CSHH #1-8, 13, 14, 15, 16, and 17	LaMotte Secchi disk	Field
Chlorophyll a	Vertical profiles starting at half meter below surface and then 1-meter intervals at CSHH #1-8, 13, 14, 15, 16, and 17	Eureka Manta+ 35	Field
Ammonia	At most stations, as tidal cycles and time allow	LaMotte 3304 (salicylate method)	Field
Fecal Coliform Bacteria	Grab sample half-meter depth at CSHH #1-13, 14, 15, 16, 17, and 17A and just below surface or from outfall flow at 14A, 15A, and 15B	Membrane filter	Nassau County Department of Health
Enterococci	Grab sample at half meter depth at CSHH #1-13, 14, 15, 16, 17, and 17A and just below surface or from outfall flow at 14A, 15A, and 15B	Membrane filter	Nassau County Department of Health
Precipitation	Village of Sea Cliff	Visually read rain gauge	Field

2.3.1 UWS Testing Parameters

As mentioned above, UWS monitoring is conducted on a biweekly basis, from May through October. As per UWS protocols, sampling must be completed within three hours of sunrise and so generally begins at approximately 6 AM.

For the UWS, the Eureka Manta+ 35 is used by most participating groups to measure water temperature, salinity, dissolved oxygen, chlorophyll a, and turbidity. UWS protocols specify collecting data at half a meter below surface and at half a meter off the bottom for stations that have a total depth of fewer than 10 meters; for deeper stations, data is recorded at mid-depth as well. At the end of each survey, two chlorophyll filtrations are completed along with taking meter readings from the same water that is filtered, and the filters are sent to a laboratory for analysis (see S*ection 3.6*).

The program also includes a macrophyte (aquatic plant, or seaweed) assessment that must be conducted on three days (ideally a week apart) from July 15 to August 7, within three hours of low tide. (In 2017, a rain storm on August 7 caused the postponement of the assessment to the following day.) The assessment may be from a soft shoreline or from a submerged area (from a dock or boat). For Hempstead Harbor, CSHH selected unraked areas of three beaches: Sea Cliff Beach, Tappen Beach, and North Hempstead Beach Park. A photo assessment was completed for each area, and seaweed was categorized by color and general growth type (e.g., sheet, twig-like, or hair-like).

View looking north from North Hempstead Beach Park (l) and close-up of section of the wrack line for UWS macrophyte assessment (photos by Carol DiPaolo (8/8/17)

3 Monitoring Results

This section summarizes results of the CSHH sampling program. Where possible, data from the CSHH program from 1995-2016 are compared with 2017 data. *Appendices A, B, C,* and *D* include graphs and tables constructed with the data collected during this period.

3.1 Dissolved Oxygen

Key Findings – Dissolved Oxygen

- Healthy DO levels (greater than 5.0 ppm) were observed in 64.1% of all measurements taken in 2017.
- Hypoxic conditions (less than 3.0 ppm, adverse impacts to aquatic organisms are expected) were observed in 11.4% of 2017 readings and at 8 of 13 stations sampled.
- In 2017, hypoxic conditions occurred from mid-July to early September.
- There were no anoxic (less than 1.0 ppm) readings in 2017.
- Station CSHH #13 tends to have lower than typical DO levels.
- In 2017, DO levels were higher than those in the previous year, but similar to the long-term average.

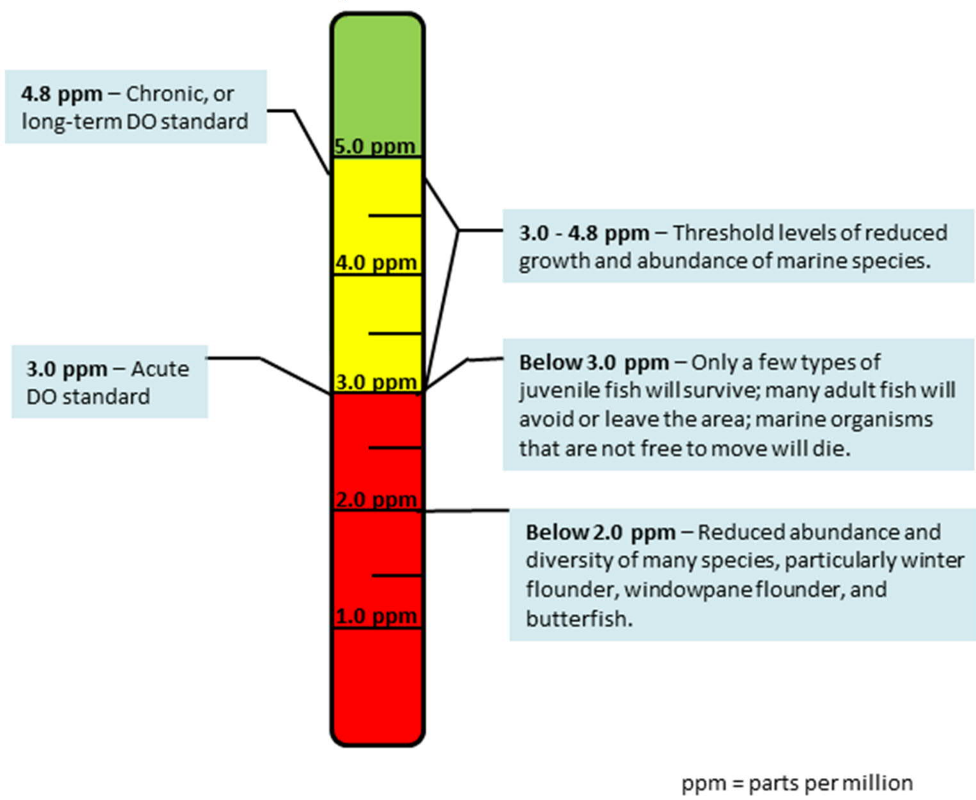
Dissolved oxygen (DO), the form of oxygen that marine life needs to survive, is an important indicator of the health of our Long Island Sound estuary. Hypoxia (low oxygen) and anoxia (no oxygen) are water-quality problems that commonly occur during the summer in Hempstead Harbor and in other areas in and around Long Island Sound, particularly in the western sound. DO is indirectly affected by nutrient enrichment, particularly nitrogen, which can enter Hempstead Harbor through stormwater runoff, discharges from sewage treatment plants, or leaching from failing septic systems. Nitrogen accelerates the growth of phytoplankton or algae and increases the density of organisms that grow. The increased number and growth rate cause frequent or prolonged "blooms." When the cells in the plankton blooms die off, the decomposition process depletes dissolved oxygen that fish, shellfish, and other aquatic organisms need to survive. The larvae of these organisms are often especially sensitive to low DO concentrations. In addition to these direct effects of low DO levels, indirect effects can also occur. Low DO levels can cause some bacteria to produce hydrogen sulfide, which is a gas that can be toxic to fish.

Although many algal species produce oxygen during their growth stage through photosynthesis, algal mortality and subsequent decay generally influence DO levels more strongly, especially later in the summer when more organic matter is decaying and rates of photosynthesis are declining. Therefore, productive aquatic ecosystems with larger nutrient loads are more prone to low DO levels. The impact of temperature and salinity on DO levels in these ecosystems is generally of secondary importance. Generally, as temperature and salinity increase, the dissolved oxygen concentration decreases. Because the majority of organic-matter decay occurs at the estuary bottom, DO levels tend to be higher at the surface and lower at the bottom of the water column. Density-dependent stratification, such as elevated salinity levels at the harbor bottom, inhibits mixing and exaggerates this effect.

Prior to 2018, DO levels above 5.0 ppm were considered healthy; DO levels below 5.0 ppm were considered to cause various adverse impacts (related to growth, reproduction, and survival of organisms). The severity of impacts, and threshold DO levels where impacts occur, are strongly species dependent. (For example, bottom-dwelling marine species would be more affected by low DO than species that can move more easily to higher-oxygen areas.)

A revised dissolved oxygen standard was implemented by the NYSDEC on February 16, 2008. For estuarine waters such as Hempstead Harbor, the chronic, or long-term, DO standard is 4.8 ppm. This means DO levels of 4.8 ppm and above are considered to be protective of most marine aquatic species. The acute DO standard is 3.0 ppm, which means that if DO concentrations fall below 3.0 ppm, conditions are considered hypoxic; under hypoxic conditions, most juvenile fish will not be able to survive, many adult fish will avoid or leave the area, and species that cannot leave the area will die. For DO concentrations that are equal to or greater than 3.0 ppm and less than 4.8 ppm, the growth and abundance of certain marine species will be affected. The impact of hypoxia on marine life depends on the duration and area over which low DO levels occur; water temperature, salinity, and distribution and behavioral patterns of resident species also play a role in how marine organisms react to hypoxic conditions.

Figure 1
DO Standards and Effects of Depleted DO on Marine Life



However, states often interpret effects of environmental conditions on marine life differently; for example, Connecticut's DO standard was 5.0 ppm through 2010 (it was changed to 4.8 ppm in 2011), and it specified maximum periods for which exposure to low DO is allowed. These standards are similar to the New York standards, although not completely consistent.

Percent saturation of dissolved oxygen is also monitored in Hempstead Harbor. Percent saturation is a measure of the amount of oxygen currently dissolved in water compared with the amount that can be dissolved in the water, and it is influenced by variability in water temperature and salinity. In a marine system such as Hempstead Harbor, which has abundant nutrients and organisms, dissolved oxygen levels near the surface can be oversaturated during the day (greater than 100%) due to photosynthesis by algae, and undersaturated at night (50% or lower) due to decay of dead organic matter (respiration).

This report evaluates DO measurements collected at the bottom of Hempstead Harbor, which are considered critical because bottom-dwelling marine life have more difficulty than other marine species in trying to escape low DO conditions. Hypoxic conditions (low DO, interpreted to be less than 3.0 ppm in this report) and anoxic conditions (no DO, which, for purposes of this report, is less than 1.0 ppm) have been implicated in fish kills in Hempstead Harbor, particularly of Atlantic menhaden (commonly known as bunker) but also of juvenile flounder and other species.

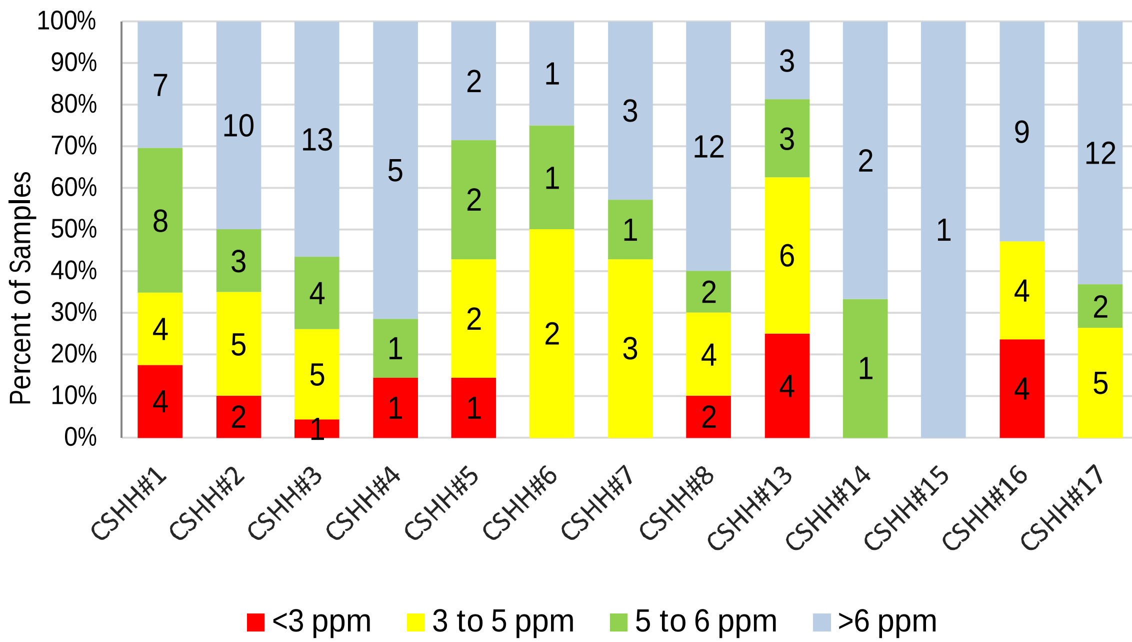
(No fish kills occurred during 2001 through 2004 despite extended periods of hypoxia. A clam kill occurred in 2005 south of Bar Beach, near CSHH #5, but this kill reportedly resulted from lunar/tidal effects and not hypoxia. A small, localized fish kill occurred in August 2006 from an unusual condition off of Morgan Beach–low DO and hydrogen sulfide produced by sulfur bacteria present in the decomposition of algal cells. No fish kills in Hempstead Harbor were observed or reported in 2007-2014. Two limited bunker kills occurred late in the season in 2015 when DO levels had increased−in October and November–and corresponded with the large bunker populations that remained in the harbor through the beginning of January 2016. No fish kills were reported in Hempstead Harbor in 2016-2017.

Lower DO levels may be the result of a variety of factors, including anthropogenic influences such as nutrient enrichment from wastewater-treatment-plant discharges; overuse of fertilizers in home gardening and golf-course maintenance; and residual oxygen demand in bottom sediments from past industrial activities. Changes in air and water temperature and the physical nature and chemistry of the water can also influence DO levels, although typical effects are relatively minor (see *Sections 3.2 and 3.3*). It is also possible that differences in wind patterns could affect vertical mixing within the water column, resulting in a well-mixed water column during some years, and a more stratified water column in others.

Of the 13 stations where bottom dissolved oxygen was measured in 2017, 5 had no measurements indicative of hypoxic conditions, whereas 2 stations (CSHH #13 and CSHH # 16) exhibited hypoxic conditions on over 20% of the monitoring days (4 days in each case; *Figure 2*). There is no discernible spatial pattern to the distribution of hypoxic conditions; both the stations with no hypoxic conditions and those with the highest percentage of hypoxic observations were spread throughout the harbor. This suggests that both the lower and outer harbor experience similar fluctuations in DO, and more locally specific factors are likely the driver behind hypoxic conditions. Overall, across all monitoring stations, 11.4% of all 2017 observations exhibited hypoxic conditions (where DO < 3.0ppm; *Figure 3*), 24.6% of observations fell in the 3.0-5.0ppm range, 16.2% fell in the 5.0-6.0ppm range, and 47.9% of observations showed bottom DO levels above 6.0ppm.

The percentage of DO measurements with hypoxic conditions in 2017 (11.4% or 19 measurements for bottom DO; 3.6% or 6 measurements for surface DO) was substantially lower than the previous three year's percentages for bottom DO, and somewhat lower for surface DO. Overall, however, the 2017 percentages are not unusually low. Lower percentages of hypoxic conditions have been observed in 7 of the preceding 13 years for bottom DO, and 9 of the preceding 13 years for surface DO (*Figure 3*).

Figure 2
2017 Average Bottom Dissolved Oxygen for Stations in Hempstead Harbor
Each vertical bar represents one of CSHH's monitoring sites. Colored bars indicate percentage of all samples taken at a location that fall into each of the four color-coded categories. Numbers inside the bars indicate the number of observations (sample size) within each bar segment. Red bars are representative of hypoxic conditions.



Anoxic conditions (< 1 ppm) were not observed in 2017. Since 2004, anoxic conditions have been observed for 25 bottom DO readings and 1 surface DO reading. A large portion of these anoxic observations occurred at CSHH #13 (24% of bottom DO anoxic readings as well as the sole anoxic surface DO reading). Forty percent of anoxic bottom DO readings have occurred at stations within or near Glen Cove Creek (CSHH #3, #8, and #13). An equal number (10 observations or 40%) occurred at CSHH #2, in the outer harbor.

All of the hypoxic conditions recorded in 2017 occurred from mid-July through early September. This is consistent with the previous year's observations, as well as with periods of higher air and water temperatures when the solubility of oxygen in water decreases. The period of hypoxic and anoxic conditions may lengthen in the future based on climate projections for warmer overall air temperatures. A comparison of the number of days and months in which hypoxic conditions are observed may be a useful indicator of changing temperature conditions.

There are no obvious temporal trends in bottom DO levels over the period of record (1995 to present). At most locations, average bottom DO fluctuates between 4ppm and 7 ppm; the overall average bottom DO reading over time for all stations has been 5.7 ppm (7.5 ppm for surface DO). However, there is some indication of spatial variation in DO levels in the harbor (Figure 4). Station CSHH #13, located at the head of Glen Cove Creek, is the most obvious outlier, with lower than typical DO levels.

Figure 3
Percent of Observations with Hypoxic Conditions over Time
Monitoring-season averages are shown for both bottom dissolved oxygen and surface dissolved oxygen.

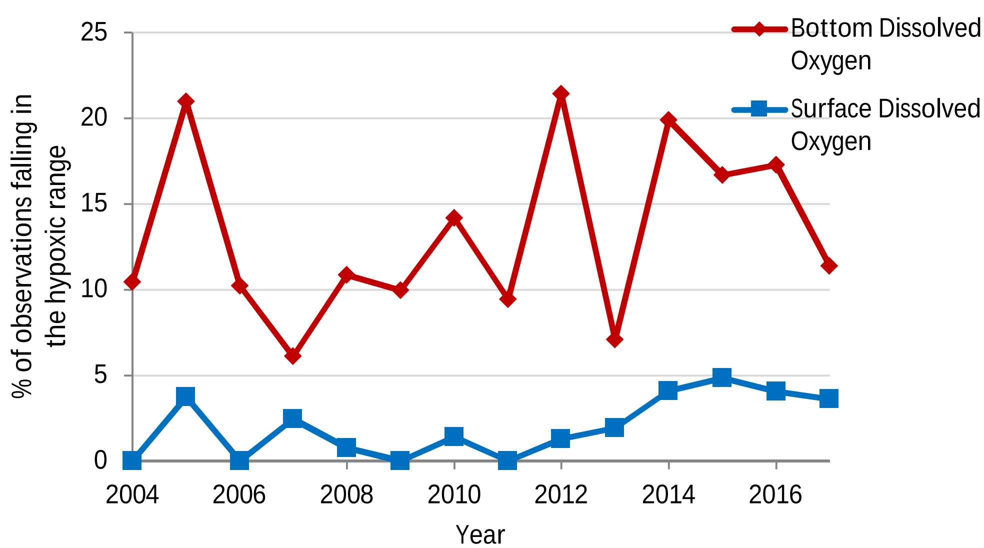
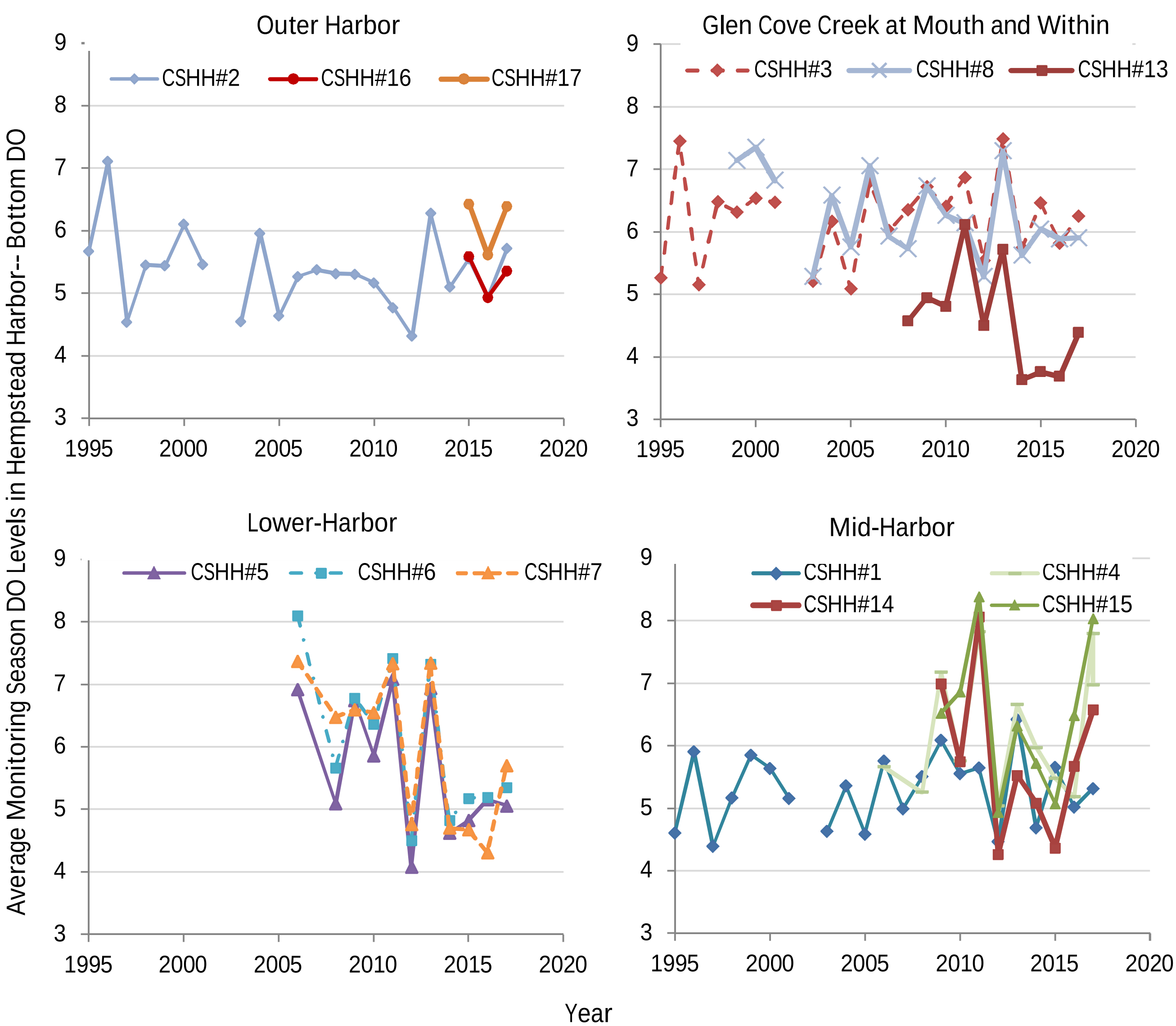


Figure 4

Average Monitoring–Season DO Levels in Hempstead Harbor

Monitoring-season averages are depicted for each station since 1995 (or since inception of data collection for that station). Stations are grouped according to their proximity to one another and loosely by region of the harbor, to allow for inspection of spatial patterns. Within each grouping, each station is represented with a unique color and symbol. Connected dots indicate the trajectory of a given station's measurements over time.



3.2 Temperature

Water temperature is monitored to record seasonal and annual changes of temperature within the harbor and to determine whether temperature could be affecting marine life, especially organisms in the harbor that are in the southernmost limit of their habitat. As stated by the Long Island Sound Resource Center (referencing a 2010 report by J. O'Donnell), a warming trend has been observed in Long Island Sound (about 1.8°F [1°C] warmer per century), when temperatures are averaged throughout the sound. A difference has also been observed between the western and eastern portions of the sound: the western portion, influenced most by fresh water inputs, is cooler than the eastern portion, influenced most by ocean water. The water temperature effects of climate change are not discernible in Hempstead Harbor probably because the shallower water and tidal flushing are affected most by the cooler water of western Long Island Sound.

Key Findings – Temperature

- Water and air temperatures are least variable at CSHH stations in the outer harbor and within the area of Glen Cove Creek and most variable in the lower harbor.
- Average water temperature at CSHH stations in 2017 was 1.3% warmer than the long-term average.
- Average 2017 air temperature at CSHH stations was 3.8% (0.82 ºC) cooler than the long-term average.

Water temperature is also used to determine the percent saturation of DO within the harbor. As described previously, percent saturation is a measure of the amount of oxygen currently dissolved in water compared with the amount that can be dissolved in the water. Percent saturation is strongly influenced by temperature: the lower the temperature, the higher the DO level must be to reach 100% saturation, and vice versa. For example, at 32ºF (0ºC), DO reaches 100% saturation concentration in water when it is present at a level of 14.6 ppm, whereas at 68ºF (20ºC), 100% DO saturation concentration is reached at 9.2 ppm, and at 77ºF (25ºC), it is reached at 8.3 ppm.

Additionally, temperature monitoring tells us whether the water column is stratified or well mixed. Stratification is a naturally occurring condition whereby water at the surface is warmer while water at the bottom stays cold. Because the colder water is denser, it stays at the bottom and cannot mix easily with the warmer water. This colder water becomes isolated from the surface where the majority of oxygen transfer occurs, which prevents replacement of DO lost through consumption by organisms. Hempstead Harbor does not generally exhibit pronounced stratification; because the harbor is relatively shallow and strongly influenced by tides, vertical mixing continues through much of the season.

View of Tilley's boat house, looking south in Hempstead Harbor (l), and northeastern view from Sea Cliff boardwalk (r) (photos by Carol DiPaolo, 2/13/17)

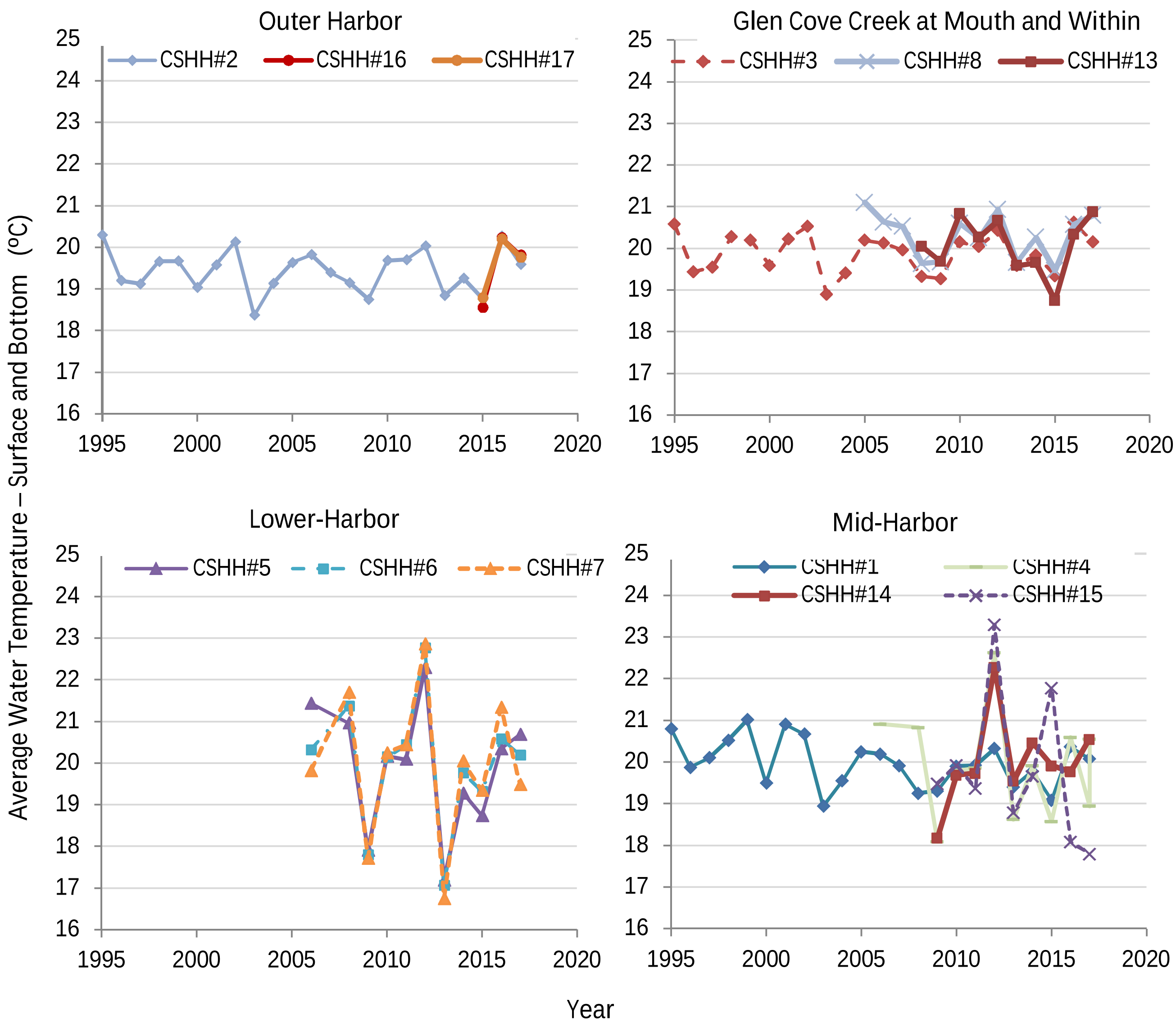
See *Figure 5* for average annual water temperature for each monitoring location for the period of record. Many factors affect water temperature, but it is representative more of conditions that occur over several days and is not heavily influenced by daily variation in air temperature.

Average water temperatures tend to be least variable in the outer harbor and the area around and within the mouth of Glen Cove Creek and most variable in the lower harbor (*Figure 5*). Station CSHH #1, in the middle section of the harbor, appears to have a more stable average temperature than the surrounding stations. Overall, 2017 surface water temperature averaged 20.4 ºC, and average bottom water temperature was 19.8 ºC. The long-term average water temperature over all years since 1995 is 19.9 ºC; 2017 average water temperature was 1.3% higher than the long-term average. Surface and bottom water temperatures were significantly different from one another in 2017 (as per statistical analysis via a paired t-test, p-value <0.0001), with bottom temperatures 0.6 ºC cooler, on average, than their surface water counterpart. (See *Appendix A* for additional water temperature monitoring data).2

Air temperature affects aquatic temperature, which affects both DO concentrations and biological activity within an aquatic system. Because CSHH records temperature data only during monitoring events, temperature more strongly indicates the time of day that CSHH monitored a certain location. However, because monitoring events began at similar times each season and have similar durations, changes in temperature averaged between sites during a season could be indicative of annual variability in weather conditions.

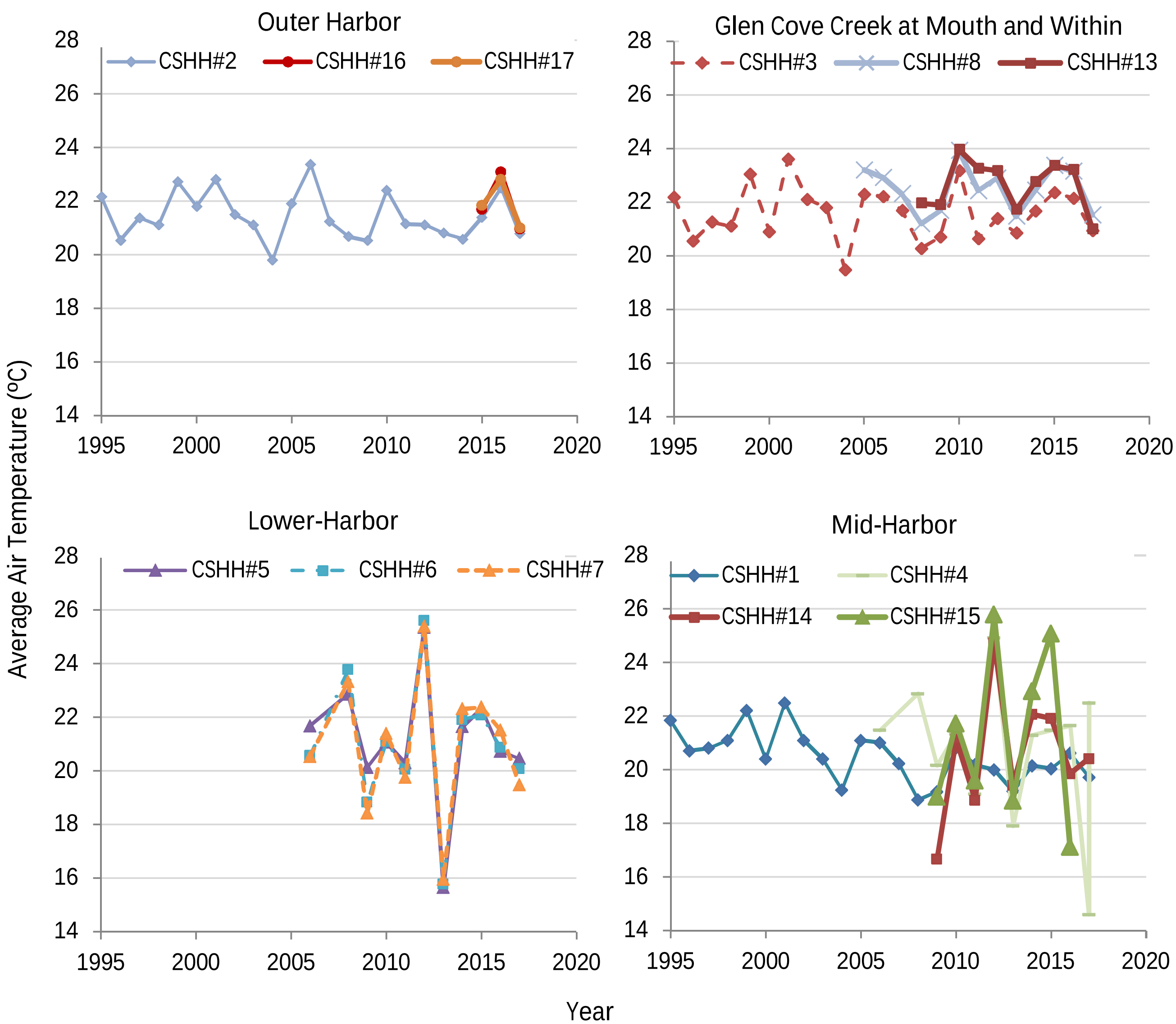
Figure 6 presents average monitoring-season air temperatures recorded at all stations since 1995. As with water temperature, air temperature is least variable in the outer harbor and the area around and within the mouth of Glen Cove Creek, where average monitoring season temperatures have stayed within a narrow 4 ºC window from approximately 20 ºC to 24 ºC (*Figure 6*). Average air temperatures in the lower harbor and midharbor have been much more variable, ranging from about 14.5 ºC to almost 26 ºC. As was seen with water temperature, within the mid-harbor group, station CSHH #1 is less variable than nearby stations; its pattern is more similar to that of the outer harbor and stations within and near Glen Cove Creek. The 2004 monitoring season was the coolest on record, with an average

Figure 5
Average Water Temperature Recorded During Seasonal Monitoring Events
Monitoring-season averages are depicted for each station since 1995 (or since inception of data collection for that station). Stations are grouped according to their proximity to one another and loosely by region of the harbor, to allow for inspection of spatial patterns. Within each grouping, each station is represented with a unique color and symbol. Connected dots indicate the trajectory of a given station's measurements over time.



temperature of 19.5ºC recorded at the three stations. Conversely, 2001 was, on average, the hottest at 23.0ºC. 2017 average air temperature across all stations was 20.6 ºC. The long-term average air temperature across all years since 1995 is 21.4 ºC. Average 2017 air temperature was 3.8% (0.82 ºC) cooler than the long-term average.

Figure 6
Average Air Temperature Recorded During Seasonal Monitoring Events
Monitoring-season averages are depicted for each station since 1995 (or since inception of data collection for that station). Stations are grouped according to their proximity to one another and loosely by region of the harbor, to allow for inspection of spatial patterns. Within each grouping, each station is represented with a unique color and symbol. Connected dots indicate the trajectory of a given station's measurements over time. (An outlier for CSHH #15 in 2017 has been removed—the unusually low 'average' temperature of 8.8 ºC was an artifact of the fact that only one observation was taken at the station and it took place in mid-October.)



3.3 Salinity

Monitoring salinity assists in determining whether the harbor is being influenced by tidal water or, instead, by freshwater from the watershed (i.e., from streams, stormwater, wastewater, or other discharges). Like temperature, salinity is an indicator of the water's oxygen-holding capacity and whether the water column is stratified.

Salinity affects DO levels; there is lower DO saturation in salt water than in fresh water. For example, the saturation level of dissolved oxygen at 25 ppt salinity is equal to approximately 85% of the saturation level of dissolved oxygen for freshwater. In Long Island Sound, salinity generally ranges between 21 ppt and 28 ppt (as compared with the typical salinity level of 32-38 ppt in the open ocean). Salinity levels within an estuary are generally affected by proximity to freshwater inflows, such as rivers or discharges from sewage treatment plants, and through direct precipitation and runoff.

Key Findings – Salinity

- At 24.40 ppt, the average salinity level across all stations in 2017 was 3.8% lower than the long-term average.
- Stations CSHH #13 and CSHH #8 in Glen Cove show a different pattern of salinity values than many of the other stations.
- Salinity at stations close to shore (especially CSHH #4, CSHH #8 and CSHH #13) is linked to the previous day's rainfall, confirming the localized influence of stormwater runoff on near-shore salinity and overall water quality.

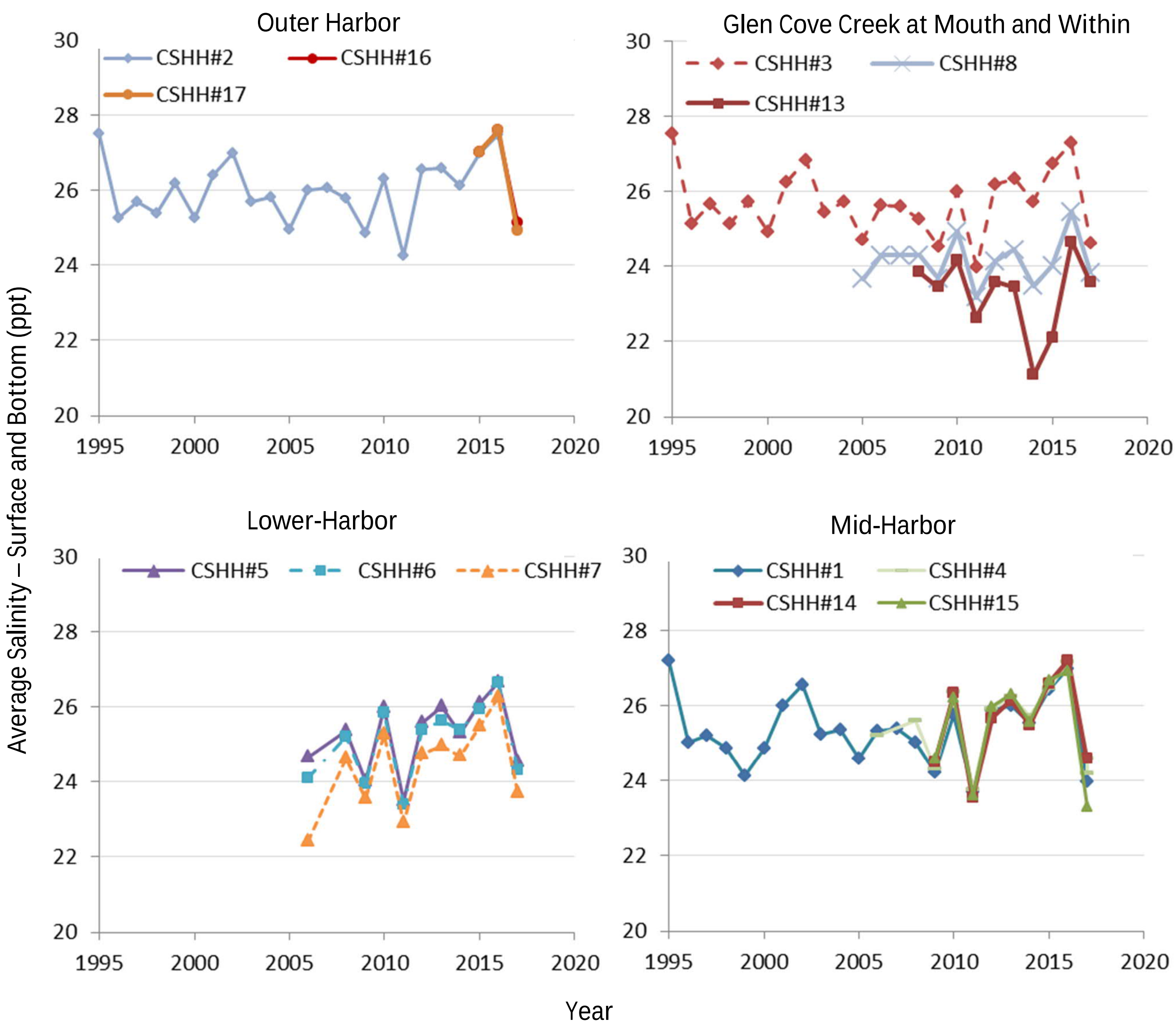
Figure 7 presents average annual salinity levels at all monitoring stations for the period of record. Salinity levels in Hempstead Harbor generally vary less than in Long Island Sound. During the 2017 testing season, salinity readings at the Hempstead Harbor monitoring stations range from 19.44 ppt to 27.17 ppt.

Additionally, salinity levels measured at the bottom of the harbor are generally higher than those near the surface, because high-salinity water is denser and tends to sink. As expected, in 2017, statistical analysis performed via a paired t-test indicates that surface and bottom salinity values were significantly different from one another ($p\text{-value} < 0.0001$), with surface salinity levels 0.636 ppt lower on average than bottom salinity levels. This further suggests that slight stratification is occurring in the harbor.

The long-term average salinity level within the harbor during the monitoring season since 1995 is 25.72 ppt, with annual averages ranging from a low of 23.5 ppt in 2011 to a high of 27.43 ppt in 1995. Average salinity level across all stations in 2017 was 3.8% lower than the long-term average, at 24.40 ppt.

As with several other indicators, the stations within or near Glen Cove Creek seem to follow a different pattern than many of the other stations (this is particularly true of CSHH #13 and CSHH #8, because CSHH #13 is near a large outfall that drains stormwater and fresh water from Cedar Swamp Creek, and CSHH #8 is below the large outfall for the Glen Cove STP; see *Figure 7*). Station CSHH #13's 2017 average was 3.4% lower than the overall 2017 average salinity; CSHH #8 was 2.3% lower than the overall 2017 average. See *Appendix A* for additional salinity data results.

Figure 7
Measured Average Salinity in Hempstead Harbor
Monitoring-season averages are depicted for each station since 1995 (or since inception of data collection for that station). Stations are grouped according to their proximity to one another and loosely by region of the harbor, to allow for inspection of spatial patterns. Within each grouping, each station is represented with a unique color and symbol. Connected dots indicate the trajectory of a given station's measurements over time



Taken as a whole, the 2017 monitoring season data indicate only a very weak relationship between salinity and precipitation. The relationship for the data as a whole is similar when salinity is compared either to the previous day's rainfall (24-hour rainfall) or to the previous two day's rainfall (48-hour rainfall). However, three stations demonstrate relatively strong dilution effects from precipitation. Roughly 8-10% of the variation in salinity at stations CSHH #8 and CSHH #13 can be explained by differences in previous day's rainfall (statistical analysis indicates R^2=0.081 and R^2=0.102, respectively). The effect is even more pronounced at station CSHH #4 (statistical analysis indicates R^2=0.661; though this may be partly a statistical artifact of the fact that there are fewer data points at this site). These relationships become weaker when salinity is compared with 48-hour rainfall rather than 24-hour rainfall.

Collectively, these results suggest that near-shore salinity is influenced by contributions of stormwater runoff and other freshwater inputs from the harbor watershed. This makes sense, as all three stations are close to shore, CSHH #8 is located near the discharge from the sewer treatment plant, and CSHH #13 is located near an outfall pipe that discharges a mix of stormwater and freshwater into Glen Cove Creek. Other stations near the shore (e.g., CSHH #14 and CSHH #15) may experience the same effect, but there were not enough observations in 2017 to establish a meaningful correlation at those locations. On the other hand, salinity at stations located further from shore does not appear to be affected by precipitation in a measurable way.

3.4 pH

Figure 8 presents averaged surface and bottom pH for all monitoring stations from years 2005-2017.

Key Findings – pH

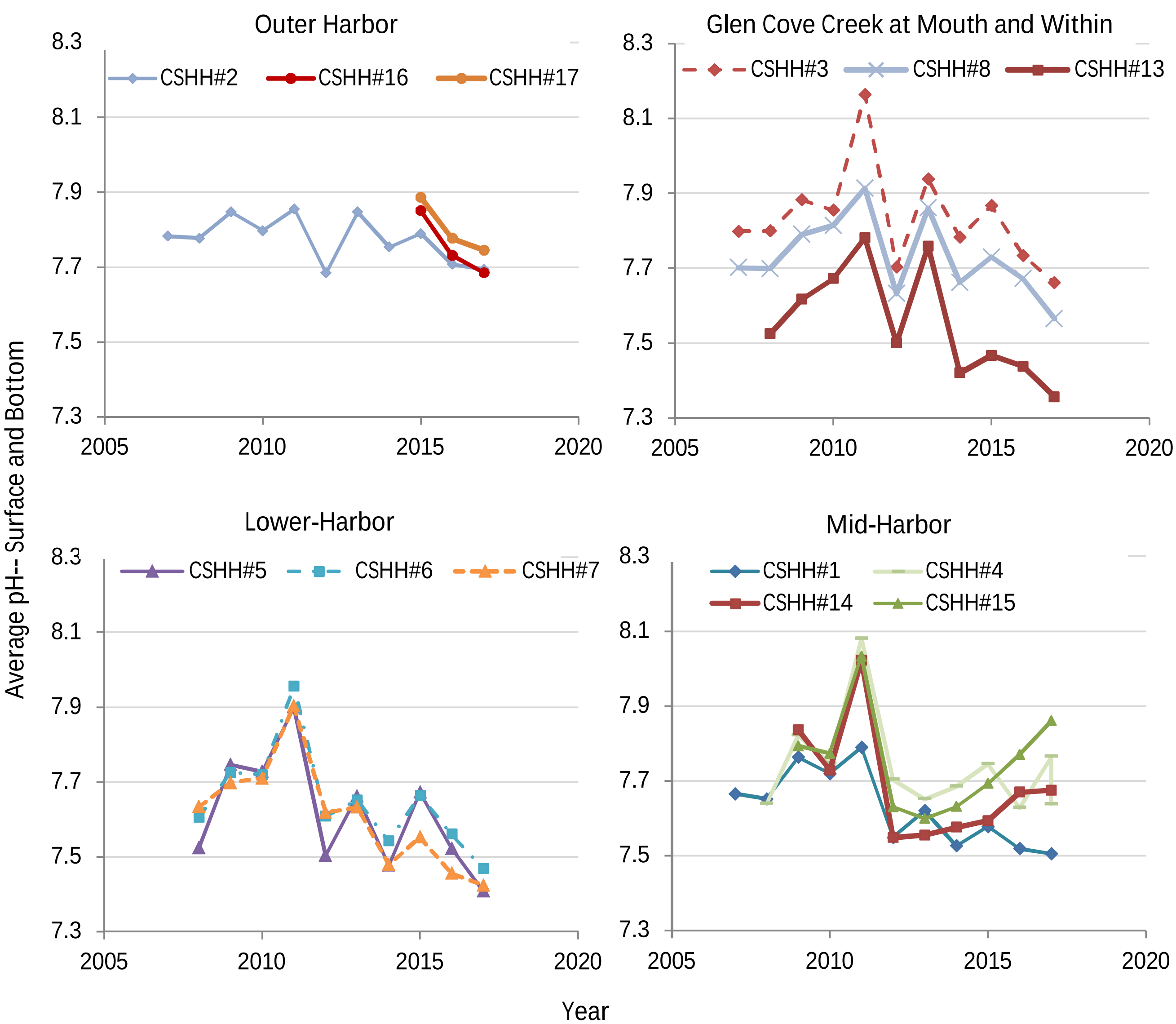
- 2017 pH levels were 1.5% lower than the long-term average.
- Overall, average pH has been decreasing (i.e., becoming more acidic) for the past three seasons.
- CSHH #14 and CSHH #15 show an opposite trend, with consistent increases in pH for the past 5 to 6 seasons.

Monitoring pH (a measure of acidity or alkalinity) helps in following trends in aquatic life and water chemistry. Carbon dioxide (CO_2) released by bacteria respiration and uptake via plant photosynthesis affect aquatic pH over short periods (hours to days), whereas the increase in atmospheric CO_2 may affect aquatic pH over decades. Also, recent research has linked the combination of both low pH and low DO levels with having a more detrimental impact on marine life than low DO alone. [See *Gobler, C.J., et al. (8 January 2014). Hypoxia and acidification have additive and synergistic negative effects on the growth, survival, and metamorphosis of early life stage bivalves. Retrieved from* http://www.plosone.org/article/info:doi/10.1371/journal.pone.0083648.]

Average pH levels in Hempstead Harbor in 2017 were 7.67 for surface pH and 7.52 for bottom pH, both approximately 1.5% below the long-term averages of 7.78 and 7.63. Overall average pH across all monitoring stations has been decreasing (i.e., becoming more acidic) for the past three seasons (2015 through 2017), and this pattern is seen for most individual stations as well. Several stations in 2017 even experienced the lowest average pH values over the period of record. In contrast, two stations in the mid-harbor group (CSHH

#14 and CSHH #15) have been exhibiting gradually increasing average pH for the last 5-6 years (*Figure 8*).

Figure 8
Measured Average pH in Hempstead Harbor during Seasonal Monitoring Events
Monitoring-season averages are depicted for each station since 2005 (or since inception of data collection for that station). Stations are grouped according to their proximity to one another and loosely by region of the harbor, to allow for inspection of spatial patterns. Within each grouping, each station is represented with a unique color and symbol. Connected dots indicate the trajectory of a given station's measurements over time.



3.5 Turbidity/Water Clarity

In general, turbidity is a measure of water clarity. Suspended solids, dissolved organic matter, and plankton can cause increases in turbidity or the cloudiness of the water and may vary due to natural events such as tidal flux, rainfall, seasonal algae blooms, and ice melt. Human activities that cause eutrophication (excess nutrients) and sediment loading (e.g., from uncontrolled construction-site runoff) also increase turbidity.

Key Findings – Turbidity/Water Clarity

- 2017 Secchi-disk readings indicated improved water clarity over typical harbor conditions.
- Average turbidity readings in 2017 were 73.1% higher than the long-term average.
- Average turbidity was influenced by three unusually high readings in mid-June.

3.5.1 Secchi-Disk Measurements

Water clarity is commonly monitored through the use of a Secchi disk–a white (or white and black) plastic disk that is lowered into the water to determine the lowest depth at which ambient light can penetrate the water column. In most nutrient-rich waters, such as Hempstead Harbor and Long Island Sound, the depth at which the Secchi disk is visible is limited by the amount of plankton, algae, or other suspended matter in the water (these give the harbor its usual green to brown color). Secchi readings are typically 1 to 2 meters for Hempstead Harbor during the summer months and from 0.25 to 3 meters during the monitoring season. For 2017, the range of Secchi readings (0.3 to 3.8 meters) for the monitoring season indicated an improvement over typical readings. The average Secchi reading in 2017 across all stations was 1.28 meters, an average reading approximately 9.7% deeper (indicating greater water clarity) than the long-term average for the harbor.

3.5.2 Turbidity-Meter Measurements

Although research related to the effect of turbidity on the marine environment is limited, there has been increased recognition of its significance and the need to standardize measurements of turbidity levels. For example, excessive increases in turbidity may cause harm to fish growth and survival as well as affect gill function in both naturally low and highly turbid waters.

The US EPA's Quality Criteria for Water report (1986) stated that turbidity could affect both freshwater and marine species of fish in the following ways:

1. Kill the fish or reduce their growth rate, resistance to disease, etc.
2. Prevent the successful development of fish eggs and larvae
3. Modify natural movements and migrations of fish
4. Reduce the abundance of food available to the fish

Elevated turbidity is generally harmful in most aquatic environments and for most species. Although some species may benefit (e.g., small increases in turbidity may afford some species increased camouflage), this increased advantage would be at the expense of other species (e.g., larger predators) and may upset the ecological balance.

It is thought that the effect of additional turbidity from human-generated sources on water bodies depends on the determined "background" turbidity level of the water body (see, e.g., Johnson and Hines 1999; Meager 2005). (At this time, regulatory agencies have not articulated a background turbidity level for Hempstead Harbor and Long Island Sound.)

In New York, the water-quality standard for marine waters is that there shall be "no increase that will cause a substantial visible contrast to natural conditions."

Because of the previously cited significance of turbidity on the marine environment, turbidity sampling was initiated for Hempstead Harbor stations in July 2008. At each station monitored, turbidity is measured in nephelometric turbidity units (NTUs). (Prior to 2017, a LaMotte 2020e meter was used, requiring grab samples, which were collected generally at two depths–at a half meter below the surface and at Secchi-disk depth; in 2017, a multiparameter meter was used for a vertical profile of the water column.)

Given that the Secchi-disk depth decreases as the water sampled gets harder to see through, it follows that turbidity measurements should generally be inversely related. Measures of conditions at Hempstead Harbor stations clearly indicate an inverse relationship; that is, the greater the number for the depth at which the Secchi disk could be seen below the surface (the greater the transparency), the lower the number measured by the meter in NTUs (the lower the turbidity).

In 2017, turbidity ranged from 0.9 to 62.79 NTUs at the sampling depth of one-half meter, with an average reading of 5.26 NTUs and a median of 3.48 NTUs. The 2017 average turbidity was 73.1% higher than the long-term average for the harbor. This is partially driven by three unusually high measurements in 2017 (62.79 NTUs at CSHH #8, 62.37 NTUs at CSHH #2, and 54.41 NTUs at CSHH #3); all three readings occurred over two sampling dates in in mid-June. In 2016, the range of turbidity readings was 0.17 to 10.84 NTUs. The overall range of readings since 2008 (when turbidity monitoring began) is 0.11 to 62.79 NTUs. See *Appendix A* for additional turbidity data.

3.6 Chlorophyll

Chlorophyll is a photosynthetic pigment that causes the green color in algae and other plants. Chlorophyll a (Chl a) is the most abundant form of chlorophyll (others include type b, c, and d). Chlorophyll is essential to the process of photosynthesis, when energy from the sun converts carbon dioxide and water into oxygen and organic compounds. The concentration of chlorophyll present in water is directly related to the amount of suspended phytoplankton (a subset of algae) living in it. Chlorophyll is also present in cyanobacteria, often called "blue-green algae" although they are bacteria, not algae. Phytoplankton can be used as indicator organism to determine the health of a water body, and measuring chlorophyll is a direct way of tracking algal growth. Excessive concentrations of algae, typically accompanied by high concentrations of nutrients (e.g., nitrogen), can cause the water to have a green, brown, or red appearance and decrease the overall clarity. Significant concentrations of algae are considered a "bloom" and can cause the depletion of dissolved oxygen and may cause fish kills. In addition to being simply aesthetically unpleasing because of discoloration of the water, some species of algae and cyanobacteria produce toxins that affect fish, shellfish, humans, livestock, and wildlife.

The Long Island Sound Water Quality Monitoring Program (CTDEEP) reported that between 1991 and 2011 Long Island Sound had an average Chl a of 13.4 µm/L.

Chlorophyll a has only been measured as part of the CSHH monitoring program for two seasons, beginning in July 2016, when a FluoroSense handheld fluorometer was used. The process to determine Chl a generally requires a field reading and then filtering a representative sample, collected during the monitoring event, to extract algae. This filter is analyzed by a laboratory with a calibrated fluorometer or spectrophotometer to determine the correlation between the extracted concentration and value recorded in the field. This correlation is then applied to all field readings for that monitoring event. In the case of the 2016 data, field readings were recorded, but filtrations were completed for only two monitoring events, and so the data are considered incomplete. In 2017, Chl a field readings are recorded for the core monitoring program and used only as a frame of reference. For the 2017 UWS, field readings were recorded and two filtrations were completed for each monitoring event. The data were corrected following the the completion of the lab analysis of the filters. The UWS Chl a field readings are included in *Appendix A*.

3.7 Nitrogen

Ammonia, nitrate, and nitrite are three nitrogen-based compounds that are commonly present in marine waters. Other nitrogen-based compounds include organic nitrogen and nitrogen gas.

3.7.1 The Nitrogen Cycle

Nitrogen is generally made available to a marine ecosystem from the atmosphere (called fixation) and from the watershed. Nitrogen fixation is usually a smaller source of nitrogen than the watershed sources. Inputs of nitrogen from the watershed are in the form of ammonia, nitrite, or nitrate. (*Figure 9* presents a diagram of the nitrogen cycle in the water environment.)

Webb Institute on the east shore of Hempstead Harbor (photo by Carol DiPaolo, 11/6/13)

Ammonia and nitrate generally originate from fertilizer and human or animal wastes that can end up in water bodies from old or failing septic systems and wastewater treatment plants and from stormwater runoff. Nitrate is also a product of properly functioning treatment plants, which convert ammonia to nitrate.

Ammonia and nitrate are important for organisms, which require nitrogen for growth and reproduction. Nitrogen forms amino acids, proteins, urea, and other compounds that are needed for life. These forms of nitrogen are referred to as organic nitrogen.

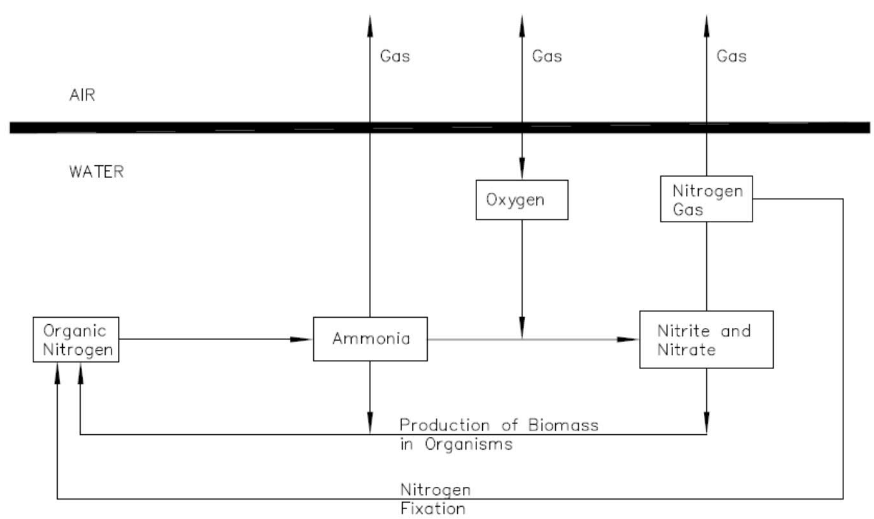
Many forms of organic nitrogen are quickly converted to ammonia in water. One form of ammonia can form a gas and be released into the atmosphere. Some forms are toxic to marine life in high concentrations.

Ammonia can also be converted to nitrite in the presence of oxygen as part of the nitrification process, but as more oxygen is added, nitrite (which is highly unstable) quickly transforms to nitrate. When anoxic conditions form, certain bacteria convert nitrate into nitrogen gas, which is released to the atmosphere.

Sewage treatment plants can be upgraded to provide biological nutrient (nitrogen) removal. The Glen Cove treatment plant was upgraded to do so. Older wastewater treatment plants blow oxygen into the wastewater to promote the growth of microorganisms, which decay carbon-based waste rapidly and produce carbon dioxide. Ammonia is converted into nitrate as a byproduct. Treatment plants with nitrogen removal upgrades have an anoxic zone in the wastewater treatment tanks and circulate wastewater that has been treated with oxygen already. Highly specialized bacteria remove the oxygen from the nitrate, releasing nitrogen gas and removing the nitrogen from the wastewater stream.

Figure 9
Nitrogen in Marine Environments

(Adapted from: Surface Water Quality Modeling, Steven Chapra, McGraw-Hill, 1997)



3.7.2 Nitrogen Monitoring by CSHH

Through September 2016, CSHH collected samples weekly at CSHH #1, #2, #3, #8, #13, #16, and #17 and, when tidal and weather conditions allow, at CSHH #4-7, #14, and #15 to test for ammonia, nitrite, and nitrate. In 2004-2006, the samples that were sent to the town lab for ammonia analysis produced results that indicated interferences from possibly the saltwater, turbidity, or water color, so ammonia testing was conducted in the field using a LaMotte test kit. Through September 2016, nitrite and nitrate samples continued to be analyzed at the Town of Oyster Bay lab, by Lockwood, Kessler and Bartlett, Inc., using an electronic Hach kit. Beginning in 2012, only the salicylate method was used in the field for ammonia testing (rather than both the Nessler and salicylate methods as was used in previous years). In October 2016, closure of the town lab and the absence of resources necessary to go to another facility for sample analysis prevented further nitrite and nitrate testing through 2017. Ammonia samples continued to be tested in the field.

The presence of ***ammonia (NH_3)*** in the harbor can indicate nutrient enrichment. Ammonia is usually only detected when wastewater systems, including septic tanks, cesspools, and publicly owned treatment works (POTWs), are malfunctioning and discharging to the harbor. However, elevated ammonia levels can also be present in the harbor from stormwater discharges or may even indicate a large presence of fish. Typically, ammonia is measured at CSHH #1, #7, and #8. If ammonia is detected at CSHH #1, a midpoint in the harbor, ammonia levels are then measured at other locations. If ammonia is not detectable at CSHH #1, it is unlikely that ammonia will be detectable at other locations except CSHH #8 (due to the discharge from the Glen Cove STP). In 2016, ammonia was detected between June and November at various sampling locations in Hempstead Harbor. However, most of the occurrences of detectable ammonia were at CSHH #1, which was somewhat unusual compared with earlier years, when CSHH #8 typically had the most occurrences. This coincided with a large presence of Atlantic menhaden throughout the harbor and a reformulation of the LaMotte test kit for ammonia. In 2017, ammonia was detected at most stations, with levels ranging from 0.05 ppm to 0.50 ppm, with a majority of the results at the 0.10-0.25 ppm levels. This coincided with another year in which there was a large presence of Atlantic menhaden throughout the harbor.

As stated above, ammonia represents the end-product of protein metabolism, but what is important for water-quality concerns is whether it is present in the un-ionized form as free ammonia, NH_3, which is toxic to fish (both freshwater and marine) or in the ionized form, NH_4+, which is innocuous. The relative concentration of each form is pH and temperature dependent (and to a small extent the fraction of un-ionized ammonia is inversely related to salinity). Higher pH and temperature are associated with increased levels of the more toxic, free ammonia (NH_3). pH has the largest effect on increasing ammonia toxicity.

Nitrate (NO_3) and ***nitrite (NO_2)*** occur in later stages of the nitrogen cycle and are normally present in the estuary. However, high concentrations indicate enrichment problems and can also be used to anticipate algal blooms and hypoxia.

Nitrogen contamination can potentially pose problems for drinking water quality as well. Excess nitrate levels present in groundwater due to fertilizers, septic systems, and manure can lead to "blue-baby" syndrome in infants. Nitrogen contamination of groundwater has the highest potential for health impacts in places like Long Island, where drinking water comes solely from groundwater.

Following years of studies and modeling around Long Island Sound, nitrogen discharge limitations were imposed on sewage treatment plants all around the sound to reduce nitrogen inputs, thereby reducing algal blooms and the frequency and duration of low oxygen levels throughout the sound. However, reducing stormwater inputs is more complicated because the sources of nitrogen and other pollutants are so diffuse.

Plots showing all years of nitrogen data are included in *Appendix C*. Across years, there was little variability in most locations in 2006-2009 but significant variability in 2012-2013. Overall, nitrate is more variable than nitrite. Ideally, in order to confirm any possible trends, nitrogen data should continue to be collected and analyzed with prior years' data.

3.8 Bacteria

For Hempstead Harbor, Nassau County Department of Health and New York State Department of Environmental Conservation are the agencies that have jurisdiction in opening or closing swimming beaches and shellfish beds, respectively. Both agencies use ***fecal indicator bacteria levels*** and other factors to determine whether beaches or shellfish beds require temporary or extended closures.

Coliform and **enterococci bacteria** are the types that are measured and used as indicators for water-quality standards. They are typically found in human and warm-blooded animals and are, therefore, used as the indicators of fecal contamination and the potential for the existence of other organisms that may have an adverse impact on human health. **Total coliform bacteria** are widely present in the environment, whereas **fecal coliform** is most commonly found in the intestines of warm-blooded animals and birds, and **enterococci** are most prevalent in the human digestive system.

Key Findings – Bacteria

- Fecal indicator bacteria levels at the outer harbor stations are generally lower than other stations, as they are less influenced by discharges from shore.
- Among area beaches, Tappen Beach had the highest average fecal indicator bacteria levels in 2017, whereas Sea Cliff Beach had the lowest.
- Beaches were preemptively closed due to precipitation on 14 days.
- Bacteria levels for Scudder's Pond-related outfalls continue to indicate a downward trend, following the pond restoration.
- The Powerhouse Drain outfall has consistent exceedances of bacteria levels.

3.8.1 Beach-Closure Standards

In October 2000, Congress enacted the Beaches Environmental Assessment and Coastal Act of 2000 (BEACH Act), which gave US EPA the authority to set and impose water-quality standards for coastal beaches throughout the United States and compelled all states to adopt new criteria for determining beach closures by April 2004.

In response, New York State instituted revised beach-closure standards on June 23, 2004, presented in NYCRR Title 10, Section 6-2.15. The standards for marine water include the following thresholds:

1. Based on a single sample, the upper value for the density of bacteria shall be:
   a. 1,000 fecal coliform bacteria per 100 ml; or
   b. 104 enterococci per 100 ml.
2. Based on the mean of the logarithms of the results of the total number of samples collected in a 30-day period, the upper value for the density of bacteria shall be:
   a. 2,400 total coliform bacteria per 100 ml; or
   b. 200 fecal coliform bacteria per 100 ml; or
   c. 35 enterococci per 100 ml.

Although coliform and enterococci are present in the human intestine and also in the intestines of warm-blooded animals and birds, EPA considers the enterococcal standard to be more closely correlated with human gastrointestinal illnesses and, therefore, more protective of human health.

Tappen Beach Park and marina at eastern shore of Hempstead Harbor (7/08) (photo by Joel Ziev)

In 2008, enterococcus became the sole indicator organism recommended by the EPA and required by the New York State Sanitary Code for Bathing Beaches (Subpart 6-2) for evaluating the microbiological quality of saline recreational beach water. NCDH, therefore, discontinued analyzing beach water samples for fecal coliform.

On July 31, 2014, EPA issued an updated version of its National Beach Guidance and Required Performance Criteria for Grants. Key changes in the 2014 Beach Guidance include:

- Updating the science on pathogens, fecal indicator bacteria (FIB), and health concerns
- Updating the science on beach water-quality monitoring
- Providing guidance on when to issue or remove a notification

- Describing new beach notification and communication tools, such as social media, e-mail, and text messages
- Adding new performance criterion

The guidance was partially implemented, most notably with regard to communication and notification of precautionary administrative beach closures. In 2015, NCDH started issuing "advisories" to close beaches rather than administrative or preemptive closures when rainfall exceeds a half inch in a 24-hour period.

3.8.2 Beach Monitoring for Bacteria Levels

Each beach season, samples for bacteria testing are collected twice a week by the Nassau County Department of Health at beaches around the harbor. These bacteria samples are analyzed at the NCDH laboratory in conformance with beach-closure standards that were implemented in 2004. (Although, NCDH discontinued the analysis of fecal coliform for beach closures in 2008, it continued both fecal coliform and enterococci analyses for the midharbor samples collected by CSHH to allow for more consistency in the comparison of data.)

During the 1980s, chronic raw sewage spills into Hempstead Harbor caused elevated levels of bacteria, affecting shellfish beds and recreational use of the harbor. Between 1986 and 1990, beaches around Hempstead Harbor were closed an average of eight days each beach season due to high coliform counts. Beach closures dropped off significantly during the early years of CSHH's monitoring program, and, for beach seasons 1994-1999, there were no beach closures due to high bacteria levels.

However, in 2000, NCDH initiated a preemptive (or administrative) beach-closure program. This means that in addition to closing beaches based on high bacteria sample results, NCDH closes beaches as a precautionary measure following rain events that exceed a threshold level and duration of precipitation. That threshold is established at the beginning of each season based on previous sample results, but typically, the threshold is ½ inch or more of rain in a 24-hour period. Therefore, even though water quality has improved remarkably, beach closures started to increase because of the preemptive closures.

In 2017, area beaches were closed as a precautionary measure on 14 days (based on a threshold of ½-inch of precipitation over a 24-hour period). The dates of closure included 6/18, 6/20, 6/24, 7/7, 7/14, 7/15, 7/23, 7/24, 7/25, 8/8, 8/18, 8/23, 8/30, and 9/3. The total Beach Days Closed for the 2017 season was 194 days. (Note that in calculating Beach Days Closed for each season, NCDH totals the number of days that each beach is closed, even if several beaches around the harbor are closed for the same rain event). NCDH also continues to monitor Crescent Beach, a private beach in Glen Cove, which has been closed since 2009 due to failing septic systems that are upland of the beach and that contribute bacteria to a stream that runs alongside the beach.

Monthly average beach data is presented in *Table 3.* In addition, time series plots of bacteria-monitoring results are presented in *Appendix B*. Given the inherent variability in microbial water quality, these data are most useful for determining whether certain monitoring locations have consistently higher or lower bacteria concentrations or whether a monitoring location is particularly influenced by rainfall, wind, and currents.

3.8.3 Monitoring CSHH Stations for Bacterial Levels

CSHH collects samples for bacteria analysis at 21 CSHH monitoring stations in Hempstead Harbor (14 stations on a weekly basis and others depending on weather and tidal conditions). Five of these sites (CSHH #9-13) started as temporary sites but became part of the regular sampling program to test for the presence of bacteria from discharge pipes in Glen Cove Creek in the vicinity of the STP. In 2015, CSHH #16, #17, and #17A were added to assess the water quality in the certified shellfishing area located in the outer harbor as well as near and in the restricted area off of Crescent Beach.

Unusual discharges from some of the outfall pipes monitored in Glen Cove Creek were noted in 2004-2006 and were brought to the attention of Glen Cove city officials, NCDH, HHPC, NC Department of Public Works (DPW), and DEC. In 2006, representatives from Glen Cove, the city's consultants, and CSHH arranged a boat trip to view the discharge pipes along the creek. Also in 2006, Glen Cove received a NY Department of State grant to map and source the outfalls along both the north and south sides of the creek. As several water samples from the area continued to show high levels of fecal coliform and enterococci, further investigation was needed.

In 2007, a follow-up meeting prompted further testing by NCDPW and NCDH, but there were no definitive answers as to the source of the bacteria. In 2008, NCDPW further investigated the discharge pipes in question using a camera, and NCDH did dye testing at a possible source, but efforts by both county departments and the City of Glen Cove provided inconclusive results.

Brown discharge from north bulkhead outfall, Glen Cove Creek (l); white discharge from CSHH #10 (center); brown discharge at CSHH #9 (r) (photos by Carol DiPaolo, 5/17/17 and 10/11/17, respectively)

CSHH continues to monitor all of the stations in the creek and inform Glen Cove, NCDPW, NCDH, and NYS DEC of any unusual conditions. Occasionally, a white flow is observed from CSHH #10 and noted on both the CSHH data sheets and those delivered to NCDH with the bacteria samples. In 2015, NCDH further investigated possible sources of the white flow. In 2017, unusual discharges were noted several times throughout the monitoring season: from an outfall on the north bulkhead of Glen Cove Creek and on the south bulkhead near the STP outfall, at CSHH #9 and CSHH # 10. NYS DEC and NCDPW dye tested possible pathways for the discharges, but the results as to the sources of the discharges remain inconclusive.

Dye testing to identify sources of discharges in Glen Cove Creek
(photos by Carol DiPaolo, 6/7, 6/13, 11/28/17, (l-r)

Also, as mentioned previously, despite upgrades to the Glen Cove sewage treatment plant, power failures have caused system failures within the STP, resulting in sewage spills into Glen Cove Creek in June 2010 (900,000 gallons) and March 2011 (89,373 gallons). Corrective actions were taken to prevent future incidents. Also, in response to concerns about inadequate communication of sewage spills, Nassau County started an opt-in program whereby residents can request (through the county website) to be notified when sewage releases occur at county sewage treatment plants.

Other areas of concern that CSHH regularly monitors for bacteria levels are the outfalls draining Scudder's Pond (CSHH #15A and #15B) and the outfall at the bottom of Glenwood Road and Shore Road (CSHH #14A) that drains what is referred to as the powerhouse drain subwatershed. As previously stated, these stations have been monitored since 2009 during the regular monitoring season, but were the focus of the winter monitoring conducted for the Hempstead Harbor water-monitoring program in 2013 through 2017.

In 2013, years of planning finally culminated in the implementation of the Scudder's Pond Subwatershed Plan (2006). The winter monitoring of CSHH #15A and #15B in 2013 was intended to help determine what happens to bacteria levels from the pond during cold winter months as well as observing levels during the construction period at the pond. Monitoring continued through 2017 to help determine whether the structural changes made to the pond help diminish stormwater runoff and are effective in decreasing bacteria loading to Hempstead Harbor. CSHH #14A was included in the winter monitoring program to address similar bacteria loading to Hempstead Harbor from the powerhouse drain subwatershed. The data from earlier monitoring of the sites has established a benchmark for comparison. See *Section 3.9.4* below.

3.8.4 Comparing Bacteria Data

Variability in bacteria concentrations from samples collected at individual beaches on a particular day is presented in the data contained in *Appendix B*. Although rainfall can increase bacteria in a water body, it is difficult to see clear and consistent influences from rainfall when rainfall dates are plotted against coliform counts, as presented in *Appendix B* as well. It is also important to note that changes in government regulations, testing protocols, and methodologies for sample analysis make it difficult to compare water-quality conditions relating to bacteria levels over time. For example, the method used for enterococci analysis by the NCDH laboratory changed from the 2004 to 2005 monitoring seasons, making comparisons between data from the two years difficult.

In 2017, monthly average bacteria results for enterococci at area beaches ranged from 1.90 CFU (colony forming units)/100 ml at Sea Cliff Beach in April to 105.84 CFU/100 ml at Tappen Beach in July. Overall, in 2017, Tappen Beach had the highest average bacteria levels, whereas Sea Cliff Beach had the lowest (see *Table 3* below; see *Appendix D* comparing previous years). During the 2017 beach season, Tappen Beach had an unusual number of consecutive days of beach closures due to high bacteria levels. In trying to determine the cause, it was unclear which had the stronger influence: a large presence of geese on the beach or an aging beach septic system, which was also serving a beachside restaurant. Following NCDH recommendations, the Town of Oyster Bay initiated new protocols that were put into place for the rest of the beach season: town Geese Peace dogs were used to chase the geese away from the beach, the beach septic system was pumped out weekly, and the beach sand was “sanitized” (raked with a finer blade). The combination of actions proved successful in preventing additional beach closures due to high bacteria levels.

The time series plots in *Appendix B* also show bacteria results for CSHH monitoring stations. In general, bacteria levels at CSHH #2, #4, #16, #17, and #17A are lower than other locations. CSHH #2, #16, and #17 are located in the outer harbor and are thus less influenced by discharges from the watershed, which are likely the largest source of bacteria to the harbor. The reason for the low levels at CSHH #4 is unclear, given its location south of the former Bar Beach. Only 7-9 samples were collected at CSHH #4, #6, #7, and #15, which makes seasonal evaluation using time series plots difficult.

For a few of the sampling events, concentrations of the two indicator organisms–fecal coliform and enterococci–were often noticeably different with low concentrations of one organism and high concentrations of the other (this has been noted in past monitoring seasons as well). Although this difference in the behavior of the two indicator organisms is counterintuitive because one would expect that all indicators of fecal pollution should behave similarly, it is not uncommon. Scientific studies have found that though fecal coliform and enterococci are both used as fecal indicator organisms they are not highly correlated to each other. Both parameters indicate contamination, but the lack of correlation between the two may be related to bacteria source, the differing decay rates for the two species, and the possibility that they may have differing potential for regrowth in the watershed.

Table 3
Monthly Average for Beach Enterococci Data for 2017

	Units in CFU/100 ml*	Sands Point Golf Club	North Hempstead Beach (N) (former Hempstead Harbor Beach)	North Hempstead Beach (S) (former Bar Beach)	Tappen Beach	Sea Cliff Beach
Apr.	Enterococci	3.38	11.57	10.17	10.05	1.90
May	Enterococci	14.46	14.68	37.80	13.24	20.26
Jun.	Enterococci	17.01	56.89	10.51	35.02	19.53
Jul.	Enterococci	95.13	71.90	44.78	105.84	14.89
Aug.	Enterococci	11.33	12.02	15.10	18.27	52.28
Sept.	Enterococci	--	--	--	59.75	--
Season Average	Enterococci	30.36	34.44	24.73	44.25	24.63

**The New York State standard sets the upper limits of enterococci at 104 colony forming units (CFU) per 100 milliliters of water for a single sample and 35 CFU for the 30-day logarithmic average; the units in the table above are calculated as an arithmetic average.*

The Hempstead Harbor water-monitoring program has established levels of bacteria at various midharbor stations and stations in Glen Cove Creek during the regular season. The winter monitoring, which specifically targeted Scudder's Pond (CSHH #15A and #15B) and the powerhouse drain subwatershed (CSHH #14A) now has five years of data for comparison of bacteria levels.

The results of the analysis for winter water samples showed that the bacteria levels did not decline significantly solely as a result of the colder temperatures during the first winter season. Although there was some expectation that bacteria levels would decrease in the colder temperatures, there are factors that may have contributed to the continued higher numbers during the winter: lower temperatures and UV conditions during winter months promote slower decay and longer survival rates of the bacteria species. And while exceedances in bacterial levels generally remained high throughout both winter and summer seasons at the powerhouse subwatershed outfall (where no improvements have been undertaken), the data indicates significant improvement in conditions at the Scudder's Pond outfall as a result of the restoration. See *Table 4* below and time series plots in *Appendix B*.

Table 4
Stations Exceeding Bacteria Standards–Summer and Winter Monitoring

CSHH Stations	#15A		#15B		#14A[1]	
% of CFU[2] Exceedances	FC[3]	EC[4]	FC	EC	FC	EC
5/5/13-11/13/13	17%	45%	29%	69%	32%	68%
11/18/13-5/14/14	13%	58%	13%	58%	50%	85%
Scudder's Pond Restoration Completed June 2014						
5/21/14-11/5/14	8%	36%	20%	28%	25%	100%
11/13/14-4/29/15	8%	33%	10%	30%	--[5]	--[5]
5/7/15-11/4/15	23%	31%	19%	23%	60%	64%
11/11/15-4/27/16	20%	15%	15%	10%	68%	89%
5/1/16-10/26/16	0%	29%	0%	24%	92%	69%
11/9/16-4/26/17	0%	23%	23%	15%	50%	75%
5/10/17-10/27/17	0%	26%	0%	17%	4%	67%
11/1/17-5/4/18	25%	38%	25%	25%	44%	59%
Average–Summer Post-Restoration	8%	31%	10%	23%	45%	75%
Average–Winter Post-Restoration	13%	27%	18%	20%	54%	74%

[1]Percent of exceedances may not reflect the monitoring events when samples are collected during high tide and the discharge is mixed with harbor water and, thus, diluted.
[2]CFU: colony-forming units
[3]FC: fecal coliform
[4]EC: enterococci
[5]Only one sample collected during this period.

3.8.5 Shellfish Pathogen TMDLs

Shellfish beds in most areas around western Long Island Sound have been restricted or closed to harvesting for between 40 and 70 years. In 2011, a portion of the shellfish beds in the northern section of Hempstead Harbor were reopened because of water-quality improvements. However, a large area of the harbor remains restricted from shellfish harvesting. Pathogen contamination is the main concern with shellfish beds because of the risk to humans who consume shellfish contaminated by harmful bacteria or viruses present in the water. Fecal coliform is the indicator organism that is used to determine whether certain water bodies are safe for shellfish harvesting. It is associated with human and animal waste and is used to indicate the presence of other more harmful bacteria, similar to the processes used to measure water quality for beaches (see the Beach Closure Standards in *Section 3.9.1* above).

In August 2007, DEC announced the release of a report on "Shellfish Pathogen TMDLs for 27 303(d)-listed Waters." Under Section 303(d) of the federal Clean Water Act, states are required to develop plans to decrease the total maximum daily loads of all pollutants that cause violations of water-quality standards. The DEC had listed 71 "Class SA" water bodies as being pathogen impaired, which therefore made them impaired for shellfishing; 25 of these water bodies were included in a 2006 TMDL report, and 27, including Hempstead Harbor, were described in the 2007 report. Class SA is the highest classification given to marine and estuarine waters and is applied to waters that are considered to have ecological, social, scenic, economic, or recreational importance. Class SA waters are offered the highest level of protection and must, by law, be suitable for recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, and as habitat for fish and other marine life.

The TMDL report called for a 95% load reduction, which contradicted DEC test results that showed that a portion of the harbor's shellfish beds could be reopened. At an October 16, 2008 meeting, DEC stated that the ultimate objective of the TMDL is to open the harbor to shellfishing, and, therefore, in the event that the entire area of Hempstead Harbor's Class SA waters is opened, the TMDL would be satisfied and no additional remedial actions (other than monitoring) would be required. However, there may be a portion of the harbor's SA waters that will not be reopened–even in the long term. Therefore, efforts to reduce coliform will be required along with continued monitoring.

3.8.6 Monitoring Shellfish Growing Area

In 2009, in an attempt to assess water quality and determine whether opening mid- and lower sections of the harbor to shellfish harvesting should be pursued, CSHH partnered with DEC to collect water samples. Thirteen of the 19 stations sampled were the same stations established by DEC in 1988 for shellfish growing area (SGA) #50; five stations were new to SGA #50. The samples were delivered to the DEC lab in East Setauket, where they were analyzed for fecal coliform. The results showed that the sampling stations exceeded single-sample standards (49 FC/100ml) 37% of the time with DEC #13 (outside of Glen Cove Marina in Glen Cove Creek) exceeding at the highest rate, 53%.

Before this type of testing can be initiated once again, there would have to be some indication of additional water-quality improvements, e.g., from structural changes completed around the harbor to reduce runoff and bacteria loading.

3.8.7 Certified Shellfish Beds in Outer Harbor

June 1, 2011, was opening day for the newly certified shellfish beds in Hempstead Harbor. After five years of rigorous water-quality testing, as well as testing of samples of hard-shell clams from the area, DEC and the NYS Department of Health determined that 2,500 acres of the outer portion of Hempstead Harbor could be reopened for shellfish harvesting year-round. For the first time in more than 40 years, clams, oysters, mussels, and scallops can be taken from this area by both commercial and recreational clammers, consistent with the size and quantity limits set for state waters. The rest of the harbor and East Creek, West Pond, and Dosoris Pond, which empty into the outer harbor, remain closed to shellfishing. Additionally, a small semicircular area around Crescent Beach is closed to shellfishing. (As mentioned previously, Crescent Beach has been closed for swimming since 2009 due to high bacteria levels caused by failing septic systems that drain into a stream that runs alongside of the beach and empties into the harbor.)

The DEC will continue to monitor the water quality of the newly reopened shellfish area and make necessary changes to the area's classification as conditions warrant. The DEC follows a protocol for temporarily closing shellfish beds after a threshold (3 inches) and duration of rainfall, similar to that used by NCDH for closing beaches, to protect against health risks associated with high bacteria levels caused by stormwater runoff. There were no closures in 2017.

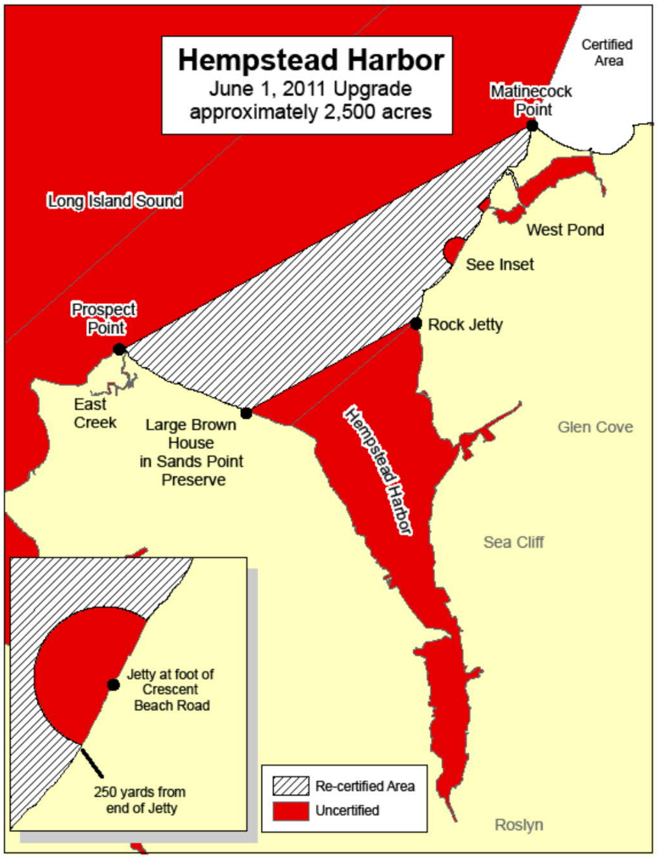
Since the opening of the shellfish beds in 2011, CSHH has visited the area during weekly water monitoring to record the number of boats harvesting clams throughout the season. In 2016, we saw about 8-17 clam boats on any of our sampling dates and fewer in 2017: 3-14 on sampling dates. Most of the clammers work the area near Matinecock Point and fewer are near Crescent Beach. We noticed clammers working the central portion of the certified beds in Hempstead Harbor more frequently than previously.

According to an updated NYSDEC report, the 2014 haul of hard clams from Hempstead Harbor totaled 17,424 bushels. That represented the second largest harvest of hard clams for that year out of all of the harvest areas (30) around Long Island, with an economic value of over $1.36 million. For the following two years, the report has shown a decrease in the hard clam haul from Hempstead Harbor. In 2015, the haul for hard clams from the harbor had decreased to 9,421 bushels, with an economic value of nearly $860,000 (the fourth largest haul out of the 28 harvest areas). In 2016, the hard-clam haul for Hempstead Harbor decreased for a second year (to 4,446 bushels), but the soft-clam haul (39 bushels) and oyster haul (27 bushels) increased; this represented a total economic value of $384,439. In 2017, however, the NYS Shellfish Landing Annual Report showed increases not only in the hard-clam haul for the harbor (5,134 bushels, representing an economic value of $386,645), but also in the hauls for other shellfish: 236 bushels of soft clams, 379 bushels of oysters, and one bushel of mussels; this represented a total economic value of $434,635 for all shellfish landings in Hempstead Harbor.

3.8.8 Bacteria Source Tracking

In March 2010, CSHH and HHPC developed a proposal to expand the water-monitoring program to include bacteria source tracking at midharbor stations as well as at specific outfalls that are suspected of contributing high levels of bacteria to Hempstead Harbor. The goal of the proposal was to determine whether most of the bacteria entering the harbor are primarily from human or nonhuman sources. The plan was to send water samples collected from Hempstead Harbor to a laboratory that does specialized genetic testing using a bacteroides marker. Unfortunately, funding was not available for the proposed bacteria source tracking.

Because water quality has greatly improved over the years, increasing numbers of water birds are now seen on and around the harbor, and there is a question as to whether the birds are a significant factor in bacterial levels in Hempstead Harbor. Bacteroides analysis, along with other types of monitoring, would help answer that question so that appropriate strategies could be formulated.



NYSDEC's map of Hempstead Harbor showing the recertified and uncertified shellfishing areas

Aerial view of the Crescent Beach closure line (provided by NYSDEC, 2011)

Clam boats in upper harbor (photo by Carol DiPaolo, 7/24/13)

3.9 Precipitation

Precipitation affects Hempstead Harbor water quality directly on the harbor's surface and through stormwater runoff. Both of these inputs can reduce the harbor's salinity. Direct precipitation tends to also dilute the quantity of pollutants within the harbor, although it can carry airborne pollutants. Stormwater runoff increases pollutant loads by washing bacteria, chemicals, and nutrients that have accumulated on the ground surface in the watershed into the harbor.

CSHH collects precipitation data using a rain gauge located in Sea Cliff (note that 25.4 mm is equivalent to approximately 1 inch). *Table 5* presents monthly total precipitation for June through October 1997 through 2017.

Total precipitation measured during the 2017 monitoring season (585.0 mm or 23.0 inches) was 33.8 mm (1.3 inches) or 5.5% lower than the average total precipitation during the previous 19 monitoring seasons (618.8 mm or 24.4 inches).Typically, the distribution of precipitation varies from month to month. In 2017, September was the driest month (64.8 mm), whereas October was the wettest month of the monitoring season (145.5 mm). There were five precipitation events during the monitoring season that produced over 25mm (1 inch) of rain (30.7 mm or 1.21 inches on 6/17, 39.1mm or 1.54 inches on 6/19, 38.6 mm or 1.52 inches on 6/24, 55.6 mm or 2.19 inches on 7/7, and 78.7 mm or 3.1 inches on 10/29). Precipitation on these dates may have influenced water quality measurements occurring on or shortly after those days.

Links between precipitation and salinity are discussed above in Section 3.3. The strongest relationships between precipitation (indicated by previous day's rain) and bacteria were seen at Stations CSHH #7, CSHH #8, CSHH#13, CSHH#14, and CSHH#15, where bacteria increased with increasing precipitation. All of these stations are near the shoreline, highlighting the influence of stormwater runoff on near-shore fecal indicator bacteria levels and overall water quality.

Table 5
Monthly Rainfall Totals for the 1997-2017 Monitoring Seasons, in mm

	June	July	August	September	October	Total
2017	124.7	118.4	131.6	64.8	145.5	585.0
2016	36.6	134.1	141.9	75.9	147.1	535.6
2015	130.3	75.7	76.2	75.2	156.5	513.9
2014	81	78.5	93.5	59.5	112	424.5
2013	235	69	59	75.5	8.5	447
2012	175.5	140.5	140.5	117.5	92.5	666.5
2011	127.5	48.5	381.5	163	122	842.5
2010	50.5	103.5	61.5	97	146	458.5
2009	294	150.5	83	69	175	771.5
2008	79.5	91	205.5	177.5	118	671.5
2007	159.5	198.5	132.5	36.5	136	663
2006	262	148	89	105	166.5	770.5
2005	45	81	41	28.5	460.5	656
2004	95	214	91	310.5	40	750.5
2003	291.5	87	88	194.5	134	795
2002	180.5	22.5	175.5	116.5 (9/15-30)	180	675+
2001	167	70.5	165	94	19.5	516
2000	146	159	158	125	6	594
1999	31	21	135	323	92	602
1998	191	59	145	90	97	582
1997	47	232	141	84	27 (10/1-15)	531+

4 Observations

The 2017 water-monitoring season for Hempstead Harbor began on May 17 and extended through October 27 (monitoring for the Unified Water Study began on May 18 and extended through October 18); winter monitoring of shoreline outfalls ran from November 1, 2017, through May 4, 2018.

During all monitoring surveys, wildlife observations are noted. These observations along with information from local residents and formal fish surveys and reports help fill out the picture of the health of the harbor's habitat. Local residents help us by reporting what they see not only in and on the water, but also close to the harbor’s shores. The section below offers an example of how our local fishing and wildlife reporters provide important information on conditions in Hempstead Harbor.


A 3-inch elver (juvenile eel) found in Scudder’s Pond and a 15-inch black sea bass caught in an outer section of Hempstead Harbor (photo by Carol DiPaolo, 3/16/16, and Paul Boehm, 5/2/16, respectively)

4.1 ‘Saladbacks’–A Local Phenomenon

In 2016, unusual conditions occurred early in the year with the large Atlantic menhaden (bunker) population. The mild temperatures of the preceding autumn seemed to have kept the large population of bunker in the harbor much later than usual, and it was thought that some schools may have stayed the winter in Long Island Sound.

In mid-December 2015, local resident and aquatic conservation biologist John Waldman had first observed bunker having parasitic copepods streaming off of them along with red algae and ulva that seem to be directly attached to the parasites. He referred to these fish as “saladbacks,” and they were seen again in the same area on December 24, despite the drop in the temperature.

On January 4, 2016, although most of the fish had left Glen Cove Creek, a large number of bunker swam between the bulkhead and the dock near the STP outfall. Large adult fish were swimming with juveniles that were about 5-6 inches long; the juveniles had red and green algae attached to them. Both groups also had parasitic copepods attached to them.

Photos and descriptions of the saladbacks were sent to a wide group of scientists, and the consensus was that this was a very unusual phenomenon. CSHH arranged to meet NYSDEC staffers at the dock on Glen Cove Creek on January 8, 2016, and they were able to collect a few fish with a drop net.


Peanut bunker with parasitic copepods (l) and a "saladback" bunker (r) with algae attached to the copepods (photos by John Waldman, 12/15/15)

John Waldman netted about a hundred juvenile bunker over the course of two weeks from mid-December 2015 to January 2016. Below is his description of these fish.

> *Some of the specimens appeared normal. Others had one or more, red, tubular creatures attached to their bodies, heads, and even their mouths; a commonly seen parasite known as anchor worms. What was remarkable was that many had masses of algae growing off of the parasites' bodies.*
>
> *Back in my lab at Queens College, I found that two-thirds of the menhaden displayed anchor worms (some fish with as many as three parasites on them) and, of these, 69% had visible trailing algae, as long as twice the fish's body length. The seaweed was mainly of two kinds, a red algae that puffed out, and a green algae that trailed like a ribbon. This occurrence appears never to have been noted, based on the reactions from a number of marine scientists I showed photos to….. The fish "loses" both from the parasite feeding on it and the substantial water drag imposed by the algae; the parasite gains from feeding on the fish but is neutral concerning its serving as an algal attachment site; and the algae gains from obtaining an attachment site and, possibly, from being carried by a surface-dwelling fish that affords it sunlight for photosynthesis.*
>
> *I don't know exactly why this phenomenon occurred or if we'll ever see it again–but I can speculate. The year 2015 was unusual in two ways that may have interacted. There was extraordinary reproduction of menhaden in the northeast, including in Hempstead Harbor…; this abundance would have allowed the parasite to flourish. Infections by this parasite are reported to peak in September, and juvenile menhaden normally leave our harbor by late November as waters cool, but it's known from elsewhere that heavily parasitized and other aberrant individuals may not migrate at*

all, suffering whatever consequences befall them. El Nino brought on an extremely warm November and December which kept water temperatures far above normal through New Year's Day, which may have promoted algal growth on the parasite of a fish species that normally would have migrated elsewhere."

In 2016, the bunker started to return to Hempstead Harbor in April. A small number of the saladbacks were seen only in May at Tappen Marina and a few in Glen Cove Creek in early June.

In 2017, a large population of bunker was present throughout the harbor and stayed through November. A large school of juvenile menhaden (4-5 inches long) was observed in Glen Cove Creek on June 1; a few had algae attached to them.

In November 2017, the story of the saladbacks was included in a prestigious journal, *Ecology*, published by the Ecological Society of America; see John Waldman's article "A Novel Three-Way Interaction Among a Fish, Algae, and a Parasitic Copepod" (Ecology, 98(12), 2017, pp. 3219–3220).

4.2 Fish-Survey Reports

4.2.1 Entrainment and Impingement Monitoring Report and Impact of Power Plant Substation Removal

In 2015, the old brick powerhouse building was demolished, following the dismantling of the adjacent Substation 3 (in 2013) at the Glenwood Landing power plant. The substation operated at minimum capacity as a "peaking plant" and was the subject of a marine-life monitoring report–the Glenwood Power Station Entrainment and Impingement Monitoring Report (by ASA Analysis & Communication, Inc., September 2005). The power station monitoring report has been referenced in the Hempstead Harbor annual water-monitoring reports since 2005 because it provides a baseline of marine species that live in Hempstead Harbor.

The one-year biological monitoring program that KeySpan Generation LLC was required to conduct from January 14, 2004, to January 5, 2005, found that a staggering number of fish and invertebrates were drawn into the plant's water intake. The "once-through cooling water system" to cool steam electric-generating units in the plant drew in various species of marine life that would become either trapped in the system or impinged on the intake screen. **Thirty-four types of fish and several other marine animals** were found in the samples that were collected weekly March through September and biweekly during the rest of 2004.

In June 2012, LIPA and National Grid released the Environmental Impact Statement (EIS) for the demolition of the peaking plant (see http://www.hempsteadharbor.org/applications/

DocumentLibraryManager/HHPCupload/Glenwood_EIA_Final%20June%202012%20.pdf). The EIS projected that the demolition of the plant would provide water-quality improvements by virtue of the elimination of the thermal discharge from the plant and preservation of 11 to 18.5 million gallons annually of freshwater that no longer had to be pumped from on-site wells and the municipal system. Also, it was estimated 5,300 fish and 190 million fish eggs, larvae, and early juveniles would no longer be destroyed annually in the plant's intake system. It's possible that the increase in fish populations noted over the last few years is a result of this change in Hempstead Harbor.

4.2.2 A Study of the Striped Bass in the Marine District of New York State

Seine surveys for the NYDEC's striped-bass study have been conducted in western Long Island bays since 1984 and in the Hudson River since 1979. Every year, the DEC prepares a report on the previous season's surveys entitled "A Study of the Striped Bass in the Marine District of New York State," which encompasses the information from the western Long Island beach-seine surveys and the Hudson River young-of-the-year striped-bass surveys.

The DEC had found that striped bass generally spend their first year of life in the lower Hudson River, but over recent years the nursery for young-of-the-year striped bass has been expanding. In spring, yearling fish can be found not only in the Hudson River, but also in bays around western Long Island. And although the purpose of the study is to examine the striped bass that have migrated out of the Hudson River as one- and two-year-old fish, the report provides important information on other species as well.

Most of the seining for western Long Island occurs in Jamaica, Little Neck, and Manhasset Bays, but Hempstead Harbor, Cold Spring Harbor, and Oyster Bay are also surveyed. The crew seines at six stations in Hempstead Harbor monthly, May through October.

The 2017 catch totals for the harbor included in the table below were provided by Jesse Hornstein, Marine Biologist at the NYSDEC Bureau of Marine Resources, Diadromous Fisheries Unit. The numbers for many of the fish caught in Hempstead Harbor were up from 2013 (the year that the power plant substation that was located along the shore of the lower harbor was dismantled; see the previous section on the Glenwood power station monitoring report). Most significantly, the Atlantic menhaden (young of the year), which were not included the 2013 catch, were up to a stunning count of 203,932 in 2015 (the 2016 catch of 394 was similar to that of 2014). In 2017, the total for the season was 12,086. Other significant increases in catches in Hempstead Harbor since 2013 include those for blackfish, killifish, scup, silversides, and striped bass. An interesting difference in 2017 totals included 89 northern pipefish (up from 49 in 2016). Although not reflected in the seine hauls, fishing reporters have observed an increase in sea robins and dogfish.

Table 6
NYSDEC Western Long Island Beach-Seine Survey–Hempstead Harbor 2017

NYS DEC Western Long Island Beach Seine Survey - Hempstead Harbor 2017

Type	Common_name	AGE	Month						Total
			5	6	7	8	9	10	
Diadromous:	BLUEBACK HERRING	99	1						1
	HICKORY SHAD	99		1					1
	STRIPED BASS	0			1				1
	STRIPED BASS	1	1	4	1	2	8	4	20
Marine:	ATLANTIC MENHADEN	0		444	56	44	68	11474	12086
	ATLANTIC MENHADEN	1			1	3			4
	BAY ANCHOVY	99					151	117	268
	BLACKFISH (TAUTOG)	0			1	8	25	1	35
	BLACKFISH (TAUTOG)	1	12	21	8	21	9		71
	BLUEFISH	0			232	249	4	3	488
	CUNNER	99		2	1		1		4
	FEATHER BLENNY	99		1	1	2	2		6
	GRUBBY SCULPIN	99			2	1	1		4
	NAKED GOBY	99	5	1	2	3	3		14
	NORTHERN KINGFISH	99						1	1
	NORTHERN PIPEFISH	99	20	23	12	12	20	2	89
	NORTHERN PUFFER	99				1	2		3
	NORTHERN SEAROBIN	99					3		3
	OYSTER TOADFISH	99			1	6	1		8
	SAND LANCE SPP.	99		1					1
	SCUP	99				1313	22	2	1337
	SILVERSIDE SPP.	99	1132	310	838	4224	2436	753	9693
	SMALLMOUTH FLOUNDER	99				1			1
	SPOTTED HAKE	99	8						8
	STRIPED SEAROBIN	99			1	12			13
	SUMMER FLOUNDER	99		1	3				4
	WEAKFISH	99				1			1
	WHITE MULLET	99					1		1
	WINDOWPANE FLOUNDER	99	1						1
	WINTER FLOUNDER	0		2	10	3	1	3	19
	WINTER FLOUNDER	1					1		1
Estuarine:	KILLIFISH SPP.	99	45	17	5	124	82	49	322
Invertebrates:	BLUE CRAB	1			1	2	2		5
	CALICO (LADY) CRAB	99	1	7	10	1	8	7	34
	HORSESHOE CRAB	99	12	13	1	2	1	1	30
	ASIAN SHORE CRAB	99		1	2	1			4
	MUD CRAB	99	4	1	15	46	2		68
	ROCK CRAB	99			1				1
	SPIDER CRAB	99	4	21	21	36	3		85
	MOON SNAIL	99	1	1					2
	CHANNELED WHELK	99				1			1
	SEA STAR	99		2		2			4
		# of Hauls	6	6	6	6	6	6	36

* 0 = young-of-the-year ; 1 = older ; 99 = unknown

4.3 Field Observations and Recreational-Fishing Reports

Bald eagles over Mott's Cove (photo by Isaac Schlesinger, 2/20/17)

Before our regular monitoring season had even started, our fish and wildlife reporters provided descriptions of their observations around the harbor. Two adult bald eagles sighted in February near Mott's Cove and one in March flying over Bay Avenue in Sea Cliff with a rodent in its talons. About two dozen buffleheads were seen in the lower harbor on February 24. There were several reports during the last week of March of ospreys returning to their nests and building a new nest on a platform that was erected along Shore Road near the power plant.

April

Bald eagle sightings continued in April, and on April 5 an immature bald eagle was seen perched in a tree along the Roslyn Harbor shoreline. Also on April 4, Sebastian Li reported seeing gannets diving into the harbor off of Bay Avenue. On April 24, we received reports from our fishing contacts that a large school of bunker was seen off of Tappen Beach the week before and that striped bass had been caught in Hempstead Harbor since the beginning of the month. We were also told by NYSDEC Federal and Interstate Marine Fishery Management Coordinator Steve Heins that DEC shellfish water samplers saw huge schools of bunker at the entrance to Hempstead Harbor.

Lion's mane jellyfish near Sea Cliff Beach
(photo by Kareem el-Heneidi, 4/9/17)

May
Weekly surveys for the season began in mid-May (May 17, 24, and 31). On two of the survey dates—May 17 and May 31, we noticed unusual discharges from outfalls in Glen Cove Creek, as described previously in *Section 3.8.3.*

On May 17, we saw only a few comb jellies at our first testing station (CSHH #1) and only a few for the entire season. Since 2013, comb jellies have been decreasing in the harbor, possibly as a result of the increasing menhaden population since that time. One moon jelly was observed on May 31 near the outfall of the Glen Cove sewage treatment plant.

In May, we saw the usual variety of birds that frequent the harbor during the spring and summer: cormorants, mallards, egrets, Canada geese, ospreys, and swans. On May 24, we saw three small osprey chicks that had recently hatched in a nest on pilings in the lower harbor.

Osprey nest and chicks (photos by Carol DiPaolo, 5/24/17)

June
There were five water-monitoring surveys in June (June 7, 14, 21, and 28). On June 7, we saw the dye that remained from an early morning test on June 7. *(See Section 3.8.3.)*

On June 14, we noticed unusual conditions that seemed indicative of an algal bloom in process—supersaturated DO levels at surface with thick green water color throughout most of the harbor. Although no samples had been taken for identification, Theresa Hattenrath, a marine biologist at Stony Brook University, stated that it was likely Eutreptiella (a type of algae that had been observed previously in Hempstead Harbor, including during the 2016 monitoring season). On June 21, there was a pollen slick on the surface of most of Mott's Cove and water color variations from green to brown in different parts of the harbor and Glen Cove Creek. We also noticed four dead bunker in the lower harbor.

Paul Boehm sent a photo of a large sand shark he caught during nighttime fishing at the outer harbor on June 8. Large schools of Atlantic menhaden were seen breaking the surface in different areas of the harbor on June 14, 21, and 28. On June 14, while grabbing water samples near an outer-harbor station (CSHH #16), we were surrounded large splashes of water at the surface, and it seemed that larger fish were attacking the bunker. When the commotion settled, we saw shimmering scales in the water all around us.


Three black skimmers (l) (photo by Carol DiPaolo, 6/7/18) and local fisherman with a large sand shark (courtesy of Paul Boehm, 6/8/17)

Among the usual shore birds around the harbor (including cormorants, mallards, egrets, Canada geese, ospreys, and swans), we saw three black skimmers on June 7 on the Bar Beach sand spit. On June 21, we counted about four dozen geese at the Bar Beach end of the North Hempstead Beach Park and two dozen geese on Tappen Beach; on June 28, there were about four dozen geese on the beach near Tappen Pool.

July

Weekly monitoring surveys were conducted on July 5, 12, and 26 (boat problems prevented our scheduled survey for July 19). As was the case for June, no comb jellies were observed on survey dates.

The usual variety of birds was noted during surveys, including cormorants, mallards, egrets (both great and snowy), Canada geese, ospreys, and swans. However, Canada geese were regularly seen at Tappen Beach and Town of North Hempstead Beach Park. On July 5, two dozen Canada geese were on the Bar Beach sand spit, and dozens were on Tappen Beach seemingly fed and led by someone affiliated with a crew filming an episode of the TV series *Mozart in the Jungle* at the rocks north of the Harry Tappen Beach Pool. The presence of geese at the beach corresponded with high bacteria levels at Tappen Beach on July 8, which resulted in the closure of the beach and implementation of procedures to ensure the beach reopened, including using dogs on the beach to chase the geese. On July 26, about two dozen geese were near the navigational light (CSHH #1) at the start of the survey and later in the morning were seen on Tappen Beach.

Atlantic menhaden and smaller baitfish populations in Hempstead Harbor were building during July. On July 27, local resident and fisherman Sebastian Li reported seeing "wall to wall bunker tonight, as far as the eye can see."

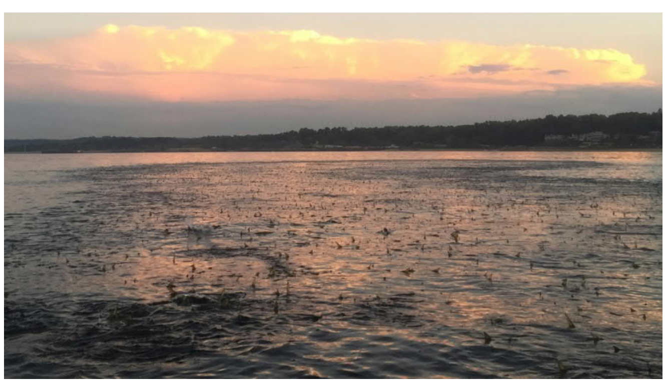
Great egret and swans in cove south of North Hempstead Beach Park and cormorants on docks in Glen Cove Creek (photos by Carol DiPaolo, 7/15/18 and 7/26/17, respectively)

August

Survey dates were August 2, 9, 16, 24, and 30, and only a few comb jellies were observed on two of these dates: one in Tappen Marina and a few at the station near Crescent Beach (CSHH #17) on August 9 and about a dozen at CSHH #17 on August 24. (On August 21, 2017, a solar eclipse was visible over most of North America and occurred as a partial eclipse in our area.)

Large schools of menhaden and smaller bait fish were seen throughout the harbor on each of the survey dates—similar to conditions in August 2016. However, following about three inches of rain from events on August 18 and 24, we observed conditions that indicated a probable algal bloom in different areas of the harbor. On August 20, Mark Ring, one of our CSHH monitoring crew members, reported that the water in the harbor looked murky following the rain storm, and he saw 40-50 dead bunker between Sea Cliff Beach and the red bell marker (CSHH #2). On August 24, we saw two bunker floating in Glen Cove Creek and two on the beach at Sea Isle being eaten by gulls. While returning to the marina, we noticed a strong fishy smell off of Bay Avenue.

The large population of menhaden and the relatively small number of dead fish observed on August survey dates in Hempstead Harbor was similar to observations for the same month in 2016.



Bunker finning in Hempstead Harbor at dusk
(photo by Sebastian Li, 8/6/16)

On August 25, Sebastian Li reported:

> *I've been on the water a lot and fishing and have noticed some dead bunker here and there with no visible signs of being hooked or bitten. I did notice that fishy smell, very rank. Also water was very murky after storm, thought more so than usual after a heavy rain….*
>
> *I've been catching lots of sea robins, which it turns out are really good eating—sweet, mild, firm white flesh, similar to fluke…. Also catching some fluke, which I eat sashimi style—like butter! Snappers just started—on the small side…No blues or bass bending my rod. From the deck, the bunker pods appear undisturbed for the most part.*

We had noticed that blue-claw crabs were starting to show up on beaches and bulkheads beyond survey dates as well as on August 24 and 30. We had reports from boat owners at Brewer Marina in Glen Cove and Tappen Marina that blue crabs were frequently seen on bulkheads and pilings. *Karen Papasergiou sent the photo on the left of blue crabs collected at Brewer Marina on August 31*. A sea star was seen on August 9.

The usual bird species we see around the harbor were observed on monitoring dates in August, including cormorants, mallards, egrets, Canada geese, blue herons, ospreys, swans, and terns. A belted kingfisher was seen on August 16 and 30.

September

As was the case in 2016, no comb jellies were observed at any of the stations during the September surveys. Similar to the conditions during the previous three monitoring seasons, large schools of bunker—both adults and juveniles—and baitfish continued to be observed throughout the harbor on each of the survey dates—September 7, 13, 21, and 28.

On September 13, while collecting samples at the stations adjacent to the STP outfall in Glen Cove Creek, we observed a milky white flow from CSHH #10, the outfall that has previously had similar discharges, including this season in May. (*See Section 3.8.3.*)

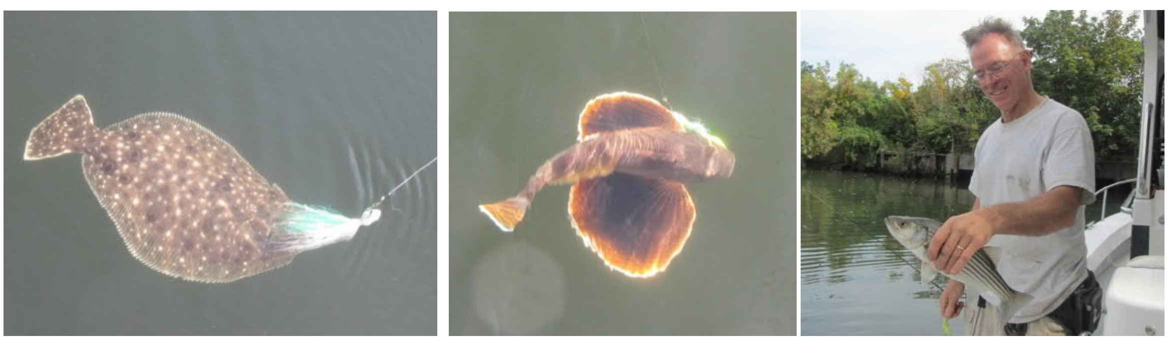
On September 16, Sebastian Li reported that *"Bluefish were in all last week hitting hard on bunker schools—very active towards the end of the day."*

On September 18, Sebastian Li reported:

> *"Was kayak fishing yesterday. Blues hitting hard all day shredding bunker schools and ripping my hooks off. Water quality better. Caught a 28" blue."*

Bunker swimming at the head of Glen Cove Creek in opaque green water (photo by Carol DiPaolo, 9/13/17)

On September 13 and 21, local resident and fisherman Paul Boehm filled in as our boat captain and brought his fishing poles with him. On September 13, we saw large schools of baitfish and snappers in Glen Cove Creek and bunker in Tappen Marina and the outer harbor. Paul managed to catch a 13-inch fluke and three sea robins (which were all released). On September 21, Paul caught a 14-inch striped bass near the head of Glen Cove Creek.



Fluke, sea robin, and striped bass caught in Glen Cove Creek (photos by Carol DiPaolo, 9/13/17 and 9/21/17)

The usual variety of birds were observed on monitoring dates in September; they included blue herons, cormorants, mallards, egrets, Canada geese, ospreys, swans, and terns. The cormorants often congregate in the lower harbor on a group of pilings left from the old sand-mining operation on the western shore; on September 21, we saw about four dozen cormorants in this area and another two dozen in the upper harbor and Glen Cove Creek. We saw one belted kingfisher on September 13 and two on September 28.

October

During all monitoring dates in October (October 4, 11, 17, and 27), comb jellies were observed at various stations but in very small numbers. (None were observed in October

2015 and October 2017.) On October 4, a total of 24 comb jellies were seen at five sampling stations; on October 11, 15 were seen at six station locations; on October 17, 17 were seen at 5 locations; and on October 27, only one comb jelly was seen at an outer-harbor station, CSHH #16. All of the comb jellies observed during the survey dates were the sea walnut variety.

On all of our sampling dates in October we observed large schools of fish throughout the harbor and birds working the water to get them. The large schools of menhaden that were observed in Brewer and Tappen Marinas had visible scars from their contact with larger, predatory fish.

Large school of bunker in Brewer Marina (photo by Elaine Neice, 10/3/17)

The usual variety of birds were observed on monitoring dates in September, including blue herons, cormorants, mallards, egrets, Canada geese, ospreys, swans, and terns. We saw one belted kingfisher on October 4 and 17. Ospreys and cormorants were seen diving for fish and cormorants would stretch their necks to swallow their catch whole. As is common in October, large numbers of Canada geese were seen on local beaches or flying over various areas of the harbor; over five dozen were at the south end of North Hempstead Beach Park on October 11, and about eight dozen geese were at the north end of North Hempstead Beach Park on October 27. On October 27, Sebastian Li reported seeing a bald eagle fight an osprey for a bunker; the bunker dropped, and the osprey flew off.

November – December

Although our water-monitoring surveys ended in October, our fish and wildlife reporters kept us informed with their harbor observations through the end of the year. Bald eagle activity around the harbor stepped up at this time. On November 15, Sanjay Jain reported:

> *"I just saw a pair of bald eagles yesterday−one had a large stick in its talons that I presume he or she will be using to build or reinforce a nest. Bald eagles have been*

visiting regularly over the past few years, and it is nice to see that they may be nesting now as well."

Also on November 15, Sebastian Li reported:

> *"Tons of bait still in the harbor with schoolie bass and cocktail blues feeding on peanut bunker. Water is so clear that I can see large bait balls of large and small bunker move throughout the water from my deck.*
>
> *Lots of migrating waterfowl and all types of seabirds feasting dawn to dusk on bait being pushed to the top by bass and blues. I have never seen so much bird activity as I have in the last week.*
>
> *Water surprisingly warm. I got my feet wet with no numbing discomfort."*

Zach Zebrowski was disappointed with results from his fishing outings:

> *"The fishing has been pretty bad compared to last year....no large bluefish....and very few small schoolie bass.....even saw a couple small weakfish caught.....but the fishing seems to have been way down compared to years past."*

In contrast, John Waldman reported on November 17:

> *"Nice blitz going on out by the barges but being boatless, that's just a tease. On way home though, another look, but now fish were close to Tappen Beach. Ran home for gear. Because it was almost low tide I had to wade 75 yards through a trough to the channel and I barely made it because of high waves from a strong NW wind.*
>
> *As usual, the blitz retreated before me, shifting to the opposite shore. But I was already way out there and I thought maybe they'll swing back. And after 10 minutes they did, not close by, but with enough popping up here and there that I had pretty fast action, with four doubleheaders too.*
>
> *…after an hour, hands barely functional and bleeding, I waded back. Then when I got to the parking lot I could see fish were up against the beach along Shore Road. I had to go home that way. You can't drive past breaking fish. So I got out and caught a few more. Ended up with 24 stripers and 2 hickories."*

On a mild November 28, a large school of bunker was in Glen Cove Creek circling between the dock below The Cove restaurant and the ferry terminal. (DEC conservation officers who were patrolling that day said they saw bunker as they entered the harbor and also at the head of the creek.) Some of the bunker in the creek had bites taken out of them. A few had parasitic copepods attached to them.

Bunker with pink ribbon-like parasitic copepods (photo by Carol DiPaolo, 11/28/17)

On December 13, Carole Berglie reported:

> *"This morning, for about 10 minutes, I had two mature bald eagles skimming the water. At one point, one hit the water but failed to bring up a fish. They were magnificent. That's the first time I've seen them in the harbor in front of me, and they were so close to shore−about 15 feet out, near a boat mooring. Waves were about a foot high, quite choppy but no whitecaps*."

On December 10, the day after a snowfall, about a half a dozen fishermen were casting lines off of the sand spit just south of Bar Beach, and there seemed to be crazy fish activity at the surface of the water. John Waldman described the scene:

> *"There were still schoolie stripers chasing peanut bunker around the harbor. The day before, during the snow I caught some while they were blitzing off Tappen Beach. And they were around as of yesterday; I saw gulls working over stripers about a half mile out diagonally from Sea Cliff Beach."*

Birds working the water over striped bass (photo by John Waldman, 12/9/17)

4.4 Crustaceans

An assortment of crustaceans can be seen around Hempstead Harbor. This group of marine organisms is characterized by, among other things, a segmented body, paired appendages, and a hard external skeleton that has to be shed to accommodate growth. Crabs, lobsters, shrimp, and barnacles are examples of this group of marine creatures.

We mention a variety of crabs that are either seen during weekly sampling or caught during the DEC seining that is conducted around the harbor; the crabs include blue-claw, lady (or pink calico), green, spider, mud, fiddler, and Asian shore crabs. Some are walking crabs, and some are swimmers, like the blue-claw crabs, which have back legs that are shaped like paddles. The Asian shore crab is an invasive species that started showing up around Long Island Sound in the late 1990s; it can tolerate a wide range of salinity and may be pushing out native species.



Lady/calico crab (l), blue-claw crab (m), and spider crabs (r) (photos by Michelle Lapinel McAllister (7/27/17), Carol DiPaolo (7/15/17), and by Paul Boehm (5/2/16), respectively)

Although **blue-claws** have always been present in Hempstead Harbor, particularly in the lower harbor, they appeared in remarkable numbers in 2007. We didn't see blue crabs in 2008 or 2009, and the 2009 DEC seines recorded only two blue crabs–one in July and one in October. Blue-claw crabs returned in large numbers in 2010, but the population did not match the quantity recorded in 2007. We saw no blue-claw crabs during the 2011-2012 monitoring dates, but the DEC seine crew for the striped-bass survey caught four in 2011 and seven in 2012. In 2013 we saw one blue-claw crab, and the DEC seine catch for Hempstead Harbor included two–one in May and one in July. In 2014-2016, no blue-claw crabs were noted on monitoring dates, but two were caught in the 2015 Hempstead Harbor seine hauls by DEC. In 2017, blue claws were present in greater numbers than in the previous year and were seen in local marinas and on bulkheads and beaches and were caught in DEC seine hauls in July-September.

Although horseshoe crabs are included in the group of crustaceans seen around the harbor, they are not true crabs but more closely related to spiders. They are noted most during the spring mating season and in the fall when the beaches are covered with molted shells.

The ubiquitous acorn barnacle is so plentiful that it is overlooked in weekly monitoring reports. These barnacles take up residence on rocks, bulkheads, pilings, docks, and boat bottoms all around the harbor.

Mantis shrimp found in a striped bass (photo by Peter Emmerich, 6/6/14)

A rarely seen crustacean in Hempstead Harbor and Long Island Sound is the mantis shrimp. That's because mantis shrimp hide at the bottom in rock formations or burrow several feet into the bottom of the harbor or sound. They have been nicknamed thumb-splitters because of their strong front claws, and they should be approached cautiously. We saw one many years ago during a low DO event that drove mantis shrimp and other bottom-dwelling creatures to the surface for air. In 2007, four small mantis shrimp were raked from the bottom during a shellfish survey, and a large one was brought up from a November 2013 shellfish survey. Increasingly, mantis shrimp have been found in the bellies of striped bass caught by local fishermen. Paul Boehm noted on June 30, 2014:

> *The bass' stomachs are always full of mantis shrimp early in the season. In addition, I've caught fluke full of mantis shrimp, and one of the black sea bass I caught hit a plastic mantis shrimp. So the shrimp are a major, perhaps the major, forage species in the area.*

On August 24, 2016, numerous tiny crabs (about 0.7 cm) were observed in the water column at one of the outer-harbor stations (CSHH #16). Samples were collected, and an attempt was made to preserve the crabs, which seemed to include two larval stages. The crabs had prominent front claws that were very long compared with the rest of the body. We later identified the crabs as long-claw porcelain crabs, megalops stage; this was confirmed by a marine-invertebrates expert, David Lindeman. Although porcelain crabs are found along the Atlantic coast, this sighting in Hempstead Harbor was considered very unusual.

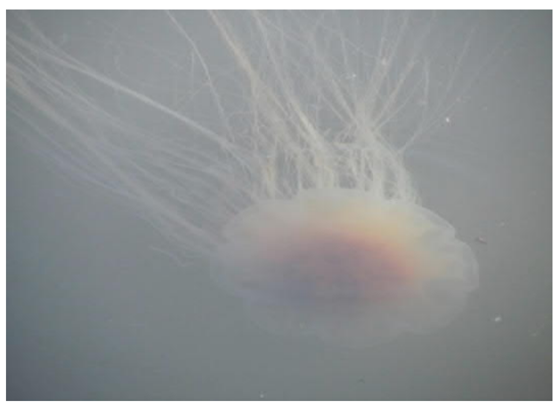
Long-claw porcelain crab (photo by Michelle Lapinel McAllister, 8/24/16)

4.5 Jellies

Two types of **comb jellies** (which are classified separately from the stinging-celled jellyfish) are seen in Hempstead Harbor: the larger egg-shaped sea walnuts and the tiny, rounder sea gooseberries. The **sea walnuts** have lobes that are rimmed with short comb-like appendages that are phosphorescent. They can be seen at night glowing as the water is moved around them, as in the wake of a boat. **Sea gooseberries** have a tail-like appendage that can be seen when they are up close to the surface. Comb jellies do not sting.

Comb jellies had usually appeared in large numbers in Hempstead Harbor in late June and through mid-October. In 2011, they were noted a little earlier in the season (in May) and were seen during monitoring dates for the last time on October 6. In 2012, we observed only a few comb jellies on each of two monitoring dates–the first on August 22 and the second and last time on September 7. The comb jellies were back in 2013 and were noted throughout the entire season. In 2014, there seemed to be a late arrival (July), fewer numbers over the season, and an early departure (no comb jellies were observed on any of the October monitoring dates). In 2015, no comb jellies were observed on monitoring dates, and in 2016 and 2017, a small number of comb jellies were observed on only a few monitoring dates and at only a few monitoring stations. The large population of bunker in the harbor and around the sound may have had an impact on the comb-jelly population.

Two types of tentacled jellyfish that may be seen in the harbor are the purple-brown **lion's mane jellyfish**, with long tentacles that sting, and the round, bell-shaped **moon jellfyish** that has short tentacles around its rim that do not produce a stinging sensation**.** Moon jellies are easily identified by the four, whitish, horseshoe-shaped gonads on the top of the bell. Both types of jellyfish are usually observed earlier in the season in Hempstead Harbor. In 2013, we saw both lion's mane jellyfish and moon jellies in Hempstead Harbor, but the lion's mane had an orange coloring to them. Mixed among these, we saw hundreds of unfamiliar jellies that were identified as **salps**. In 2016, we didn't see lion's mane or moon jellyfish on monitoring dates. In 2017, one moon jelly was seen by the STP in Glen Cove Creek.



Lion's mane jellyfish seen in Tappen Marina; the thin white lines visible at left are the internal structures in barrel-shaped salps (photos by Carol DiPaolo, 5/22/13)

4.6 Shellfish

June 1, 2011, marked the first time in over 40 years that the shellfish beds in the northern section of Hempstead Harbor were reopened for harvesting. The 2,500 acres of recertified shellfish beds extend in a wide strip from the east to west shore of the harbor. The recertification of the beds is important not only because this area is now productive for both commercial and recreational harvesting, but also because this is the best indicator of the incredible water-quality improvements that have been made in Hempstead Harbor.

Baymen with full bags of clams (l) from Hempstead Harbor and sorted clams on board (r) (photos by Carol DiPaolo, 6/1/11)

The southern boundary of the recertified area extends from a rock jetty north of the Legend Yacht and Beach Club community (the site of the former Lowe estate) on the east shore to the large "brown house with chimneys" on the west shore (noted on navigational charts), which is Falaise, part of the Sands Point Preserve. (All areas south of this line remain closed to shellfishing.) The northern boundary of the recertified area runs from Matinecock Point on the east shore to Prospect Point on the west shore. However, Dosoris Pond, West Pond, and a semicircular area extending 250 yards off of Crescent Beach on the east shore remain closed to shellfishing. East Creek on the west shore near Prospect Point also remains closed. (See the map at *Section 3.9.7*.)

Shellfishing is historically significant for Hempstead Harbor, because it was an important commercial endeavor from about the first quarter of the nineteenth century into the first quarter of the twentieth century. Clams and oysters were shipped regularly from Hempstead Harbor to New York City, until restrictions were imposed because of dwindling resources. By 1928, the lower portion of the harbor was closed to shellfishing because of increasing levels of bacteria in the water (as was the case for most bays in western Long Island Sound and other New York waters). For a time, clam dredgers were harvesting clams in Hempstead Harbor and then transporting them to the Peconic Bay, where they were transplanted and remained for several weeks for purification so they could be sold commercially.

By the late 1990s, clams, oysters, and mussels were abundant throughout the harbor, and because of improved water quality, it seemed time to pursue one of our longstanding goals of reopening the harbor's shellfish beds. But the long, complex process of recertifying shellfish beds required tremendous collaboration as well as adherence to strict protocols for water-quality testing and retesting.

In 1998, CSHH initiated the first step and worked with the Interstate Environmental Commission, DEC, Town of North Hempstead (TNH), and local baymen to conduct a **hard-clam density survey** to determine the extent and condition of the clam population; the survey showed a healthy population of hard clams. From 2004 through 2008, DEC collected water samples from Hempstead Harbor. Several samples of the shellfish from the harbor were collected and tested for chemical contamination, but the results from those analyses were not completed and released until 2010.

On September 28, 2009, DEC-Bureau of Marine Resources (BMR) in conjunction with the US Food and Drug Administration (FDA) conducted a **hydrographic dye study** in Glen Cove Creek and Hempstead Harbor to test the dilution, dispersion, and time of travel of the sewage effluent discharged by the Glen Cove STP. A shoreline survey of the harbor was completed in the autumn of 2010, and at that point everything was lined up for the reopening of the shellfish beds in Hempstead Harbor in 2011.

4.6.1 Shellfish Landings

Just three years after the opening of the Hempstead Harbor shellfish beds, NYSDEC reported that, for 2014, Hempstead Harbor took in the second largest number of hard clams (17,424 bushels) out of all of the shellfishing areas (26) around Long Island, providing an economic benefit valued at over $1.36 million. In 2015 and 2016, the number of hard clams taken commercially from Hempstead Harbor decreased significantly—down to 4,446 bushels in 2016, with an economic value of $379,371. The 2017 state landings report indicated an increase in the number of shellfish taken from Hempstead Harbor; not only had the haul for hard clams increased (to 5,134 bushels), but also the hauls for soft clams (236 bushels) and oysters (379 bushels) increased. In 2017, Hempstead Harbor produced the seventh largest haul of hard clams out of 30 growing areas around Long Island. (See also http://www.dec.ny.gov/outdoor/36800.html for shellfish areas.)

4.6.2 Monitoring and Enforcement for Hempstead Harbor Recertified Shellfish Beds

In the first few weeks after the opening of the shellfish beds in Hempstead Harbor, large numbers of clam boats could be seen daily, clustered in essentially the same northeast area of the recertified beds; they were loaded with large mesh bags of clams. CSHH began incorporating a trip to the area during weekly monitoring surveys to count the number of boats in the area.

Concerns began to surface regarding the potential for overharvesting the area, the public's confusion over what area of the harbor had been recertified (some thought all of Hempstead Harbor had been recertified), and the difficulty of determining, from the water, exactly what area around Crescent Beach was closed to shellfishing. On June 20, 2011, a meeting coordinated by the HHPC brought all agency, municipal, and environmental representatives together to discuss, among other things:

- Jurisdiction–who can or should enforce?
- Area boundaries of shellfish beds (whether there is a need for markers)
- Regulations (hours, catch, equipment, permits, etc.) and measures that could ensure sustainability
- Communications (re: closures, etc.)
- Public education
- Interagency coordination and assistance

As a result of the meeting, signs were prepared to post along the shoreline in areas that remain uncertified, and buoy markers were placed outside of Crescent Beach to delineate the 250-yard radius around the beach that remained closed to shellfishing.

One of three buoys marking the closed area around Crescent Beach (l) and a posting for the area closed to shellfishing at Tappen Marina (r) (photos by Jim Moriarty and Carol DiPaolo, 6/15/11 and 9/21/11, respectively)

NYS DEC issues temporary closures of the shellfish beds (generally precautionary, following rain events of three inches or more), and releases that information through a recorded message available by phoning 631-444-0480, on its website http://www.dec.ny.gov/outdoor/7765. html, and through press releases to local media outlets. In 2014, the shellfish beds were closed twice–in May and December–following heavy rain. In 2015 and 2016, there were no temporary closures for Hempstead Harbor shellfish beds. However, in 2017, following over 4 inches of rain on October 30-31, Hempstead Harbor shellfish beds were closed until November 9.

4.6.3 Shellfish-Seeding Projects

The first shellfish-seeding project for Hempstead Harbor was conducted on October 9, 2007, as a joint initiative that included Nassau County, the TNH, TOBAY, Cornell Cooperative Extension, Frank M. Flower & Sons Oyster Company, as well as HHPC and CSHH, and was intended to add biomass to the harbor using a resource that could help improve water quality–each clam and oyster can filter 1 to 2.5 gallons of water per hour, with daily estimates (for oysters) of 30 to 60 gallons.

The shellfish stock for the seeding project came from Cornell Cooperative Extension and Frank M. Flower & Sons Oyster Company, and included more than 1.3 million seeds, consisting of two types of hard-shell clams (*Mercenaria mercenaria* and *M. mercenaria notata*) and oysters. (The *M. mercenaria notata* has markings that are different from the northern quahog stock normally found in Hempstead Harbor, which would later help in gauging the survival rate of the seeds.)

On October 15, 2009, Nassau County conducted the second shellfish seeding in Hempstead Harbor, which included 1.1 million clams and oysters. Funding for the 2009 shellfish-seeding operation was provided by the Long Island Sound Study, through the Long Island Sound Futures Fund.

Following the opening of the shellfish beds in Hempstead Harbor in 2011, the prospect of reseeding the beds was raised as a measure of sustainability, but finding the necessary funding for such a project is problematic.

4.6.4 Surveys to Assess Survival of Seed Clams and Oysters

In late summer 2008, CSHH requested a permit from DEC to conduct a shellfish-density survey in the area of the 2007 seeding project in Hempstead Harbor to gauge the survival rate of the seeds. We selected seven of the GPS points previously recorded for raking. The area seeded in 2007 included a transition from thick, muddy bottom to a harder, sandier bottom.

In the areas of thick, black mud (the deeper-water stations), we did not find hard-shelled clams and oysters; instead, we found an abundance of the very small surf clams referred to as "duck feed." As the bottom transitioned to sand closer to shore, we found a variety of clam sizes, from littlenecks to chowder, and the largest number in one raking included 10 clams. We also found a variety of other clams, some crabs, 4 small mantis shrimp, small snails, oyster drills, and broken shells of oysters, clams, and crepidula (slipper shells). A few seed clams of both types of clams used in the seeding project–*Mercenaria mercenaria* and *M. mercenaria notate*–were found, but they seemed to be naturally occurring because they were too small to have been from the 2007 seeding project.

In autumn 2008, the Town of Oyster Bay and the HHPC coordinated a broader shellfish population density survey, including 61 stations in Hempstead Harbor.

In preparation for Nassau County's 2009 shellfish seeding in Hempstead Harbor, Cornell Cooperative Extension, Marine Division, staffers Matthew Sclafani, Neal Stark, and Gregg Rivara completed a Sediment Suitability Assessment of Hempstead Harbor for Nassau County's Shellfish Restoration Program (October 14, 2009). The assessment helped determine suitable sites to plant seed clams and oysters in the area off of Morgan Park. The team chose a scuba survey to evaluate the bottom and delineate the boundaries between mud and harder-type of bottom such as sand and sand-mud-shell mixes.

During the sediment assessment, a natural population of predominately hard clams (*Mercenaria mercenaria*) was observed in the central and southern area of the survey. They were also present in the northern survey area but not as frequently. (The report stated that these observations validate the effort to enhance shellfish in this area because the area currently supports shellfish.)

Also during the sediment assessment, the team observed and collected clam shells of the *notata* variety, which they felt were most likely from the 2007 seed plantings and originated from Frank M. Flower's and Son shellfish stock. *Notata* clams are not common in the area (typically < 1% frequency) and are easy to distinguish from the white clam variety by the dark zig-zag striped patterns on the shell. The average size of the 10 *notata* shells the Cornell team found was 27 mm. (The *notata* were between 8-12 mm at the time of the 2007 planting.)

In October 2013, a shellfish-density survey was conducted by the Town of Oyster Bay over a two-week period and replicated the 2008 survey. The survey involved collecting 120 bottom grab samples at the same 61 stations used in the 2008 survey. The findings in the survey report (July 9, 2014) included the following: (1) hard clams in the harbor were widespread and fairly abundant; (2) although clam density was lower than in the 2008 survey, it had not changed significantly; (3) the density of seed clams decreased and represented a smaller percentage of the overall clam population; (4) the density of the clam population in the certified area of the harbor is less than what it was in 2008 but not by a statistically significant amount; (5) overall, the size of the clams were larger than in the 2008 survey and this could be because commercial harvesting focuses on the smaller little neck clams. A cautionary note concerned the decline in seed clams; a decline over several consecutive years could indicate an overall decline in the resource. Further studies would be needed to determine whether the 2013 seed-clam decline was an anomaly or part of an ongoing condition.

4.6.5 Mussel-Watch Project

As part of the Long Island Sound Study's indicators program, blue mussels were collected in November 2011 to continue previous efforts through the National Oceanic and Atmospheric Administration's (NOAA) Mussel Watch project to measure levels of contaminants in local blue mussels. A site in Hempstead Harbor off of the Village Club of Sands Point (formerly the IBM Country Club/Guggenheim Estate), was used as part of NOAA's National Status and Trends Mussel Watch program since 1986. Data from a 2000 mussel collection showed abundant blue mussels at the site with a dramatic decrease in contaminant levels for a variety of heavy metals, pesticides, and hydrocarbons. Prior to the November mussel collection, CSHH visited the site to determine access to and the density of the current mussel population. The site seemed to have a healthy population of mussels, despite reports from local residents that the mussel beds had shrunk after Tropical Storm Irene hit in late August 2011.

In March 2012, CSHH helped locate potential sites to collect **ribbed mussels** in Hempstead Harbor in preparation for another NOAA mussel-collection program. Ribbed mussels were present on the eastern shore of Hempstead Harbor, just south of Rum Point (north of the Tappen Beach Park and Pool). They continue to be densely packed around spartina roots in that area but are also present on the western shore below the Bar Beach sand spit.

Ribbed-mussel colonies on the eastern shore of Hempstead Harbor (l) and close-up of mussels around spartina roots in cove south of Bar Beacb (r) (photos by Carol DiPaolo, 3/30/12 and 7/15/17)

4.7 Birds

Over the last 20 years or so, we have seen a variety of birds that have become residents of or regular visitors to Hempstead Harbor. **Belted kingfishers, blue herons, cormorants, gulls, mallards, Canada geese, snowy and great egrets, ospreys, swans,** and **terns** are generally observed throughout the season, along with the usual swallows, pigeons, crows, and other land-based birds that are frequently seen along the shores of the harbor but not counted or specifically noted on data sheets during monitoring. On monitoring dates in 2014-2017, red-winged blackbirds were noticed occasionally around the edges of Scudder's Pond and grassy areas on top of the bulkhead near the head of Glen Cove Creek.

Black-crowned night heron on Glen Cove Creek dock
(photo by Carol DiPaolo, 6/24/15)

Barn swallows are so common and in such large numbers around the shore and marina bulkheads that we don't report sightings of them. In 2014-2017, barn swallows seemed to be increasing along Glen Cove Creek.


Barn swallows at Tappen Marina on the railing of the monitoring boat (l) and on a nest under the marina bulkhead (r) (photos by Jim Moriarty, 5/16/12)

Each year we see new, young members of the harbor's duck, Canada goose, and swan populations. Although the adult Canada goose population remains high, we have seen fewer numbers of young birds over the last few years. We have also observed fewer swans than in previous years. In 2010, for example, approximately 30 swans were noted plus 11 cygnets on August 18, and 55 swans were noted in the lower harbor on October 20. In 2011-2017, we saw swans throughout the season, but generally there were not more than a dozen seen at one time or in one location around the harbor.

Observed less frequently during monitoring are **brants**, **green herons, black-crowned night herons, plover-type birds,** and **hawks** or **falcons**. Sightings of these are included in on weekly data sheets and also noted in the monthly field observations at *Section 4.3.*


A pair of Foster terns on an old piling (l) in the lower harbor and one of four sanderlings at Sea Isle (r) (photos by Jim Moriarty, 5/16/12

Osprey populations**,** once threatened because of the effects of widely used pesticides that were banned in the 1970s, have made a remarkable comeback to Hempstead Harbor and Long Island Sound. These beautiful "fish hawks" can be seen diving for prey in harbor waters. As the harbor's ecosystem improved, the ospreys and other water birds have been able to find plenty of food for them to thrive. The ospreys migrate long distances (to South America), in the fall and return in March–generally to the same nesting places they had been to previously.

Osprey nests have been visible from our monitoring stations in Hempstead Harbor for more than 20 years. Since 2010, there have been some changes and increases in nesting sites. By May 2017, seven osprey nests were within easy view from monitoring stations around the harbor: (1) at Beacon 11, (2) on a recently erected platform on Shore Road by the power plant, (3) on a cell tower behind the power plant, (4) on old pilings on the west shore near the cove of the former Bar Beach, (5) on a nesting platform on the western shore, (6) on another set of old pilings on the western shore, south of the platform, and (7) a private dock on the eastern shore of the lower harbor.

Since about 2004, **peregrine falcons**, a protected species, have been sighted at the Glenwood Landing power plant. On October 28, 2009, we saw a pair of falcons flying to and from a high ledge at the power plant. We did not see the falcons in 2010 or 2011 during monitoring dates, but we saw one flying by the power plant on October 10, 2012. In 2013, a special **nesting box** had been erected south of the Glenwood Landing power plant, to try to attract the falcons away from the top of the brick building that was slated for demolition, but it has not been occupied. In May 2014, the falcons decided to build a nest in one of the white stacks on top of the brick building at the power plant, despite the noise and demolition work that was going on. In July 2016, a peregrine falcon was seen near the site of the old power plant.

Nesting box along the shoreline south of the powerplant and peregrine falcon on ledge of power plant building (photos by Carol DiPaolo, 4/28/14 and 7/23/14, respectively)

Although **red-tailed hawks** are seen often in wooded areas around Hempstead Harbor, we don't usually see them during water sampling. However, on November 3, 2010, three red-tailed hawks with striking coloration circled over the head of Glen Cove Creek and were seen in that location again on June 4 and 8, 2014.

Red-tailed hawk flying over Glen Cove Creek (l) (11/3/10) and osprey in flight (c)(9/11/10)(photos by Jim Moriarty; turkey-vulture photo (r) posted at en.wikipedia.org/wiki/Turkey_Vulture, retrieved 6/17/12, showing the bird's distinctive two-tone feather pattern underneath its wings)

In May 2008, we had our first sighting of a **turkey vulture** flying over Glen Cove Creek. Since then, they have been seen frequently throughout the year near the eastern shore of the harbor, flying over East Hills, Greenvale, Roslyn Harbor, Mott's Cove, and Sea Cliff. In 2015, we saw turkey vultures flying over the harbor on monitoring dates in August and September; on September 25, we were amazed to see nine turkey vultures flying near the western shore of the lower harbor near CSHH #6. In August 2016, we saw three turkey vultures flying over the lower harbor. None were seen on survey dates in 2017.

Immature bald eagle in Roslyn Harbor (photo by Sanjay Jain, 4/5/17)

There have been some unusual visitors over the years as well, such as the young **bald eagle** that was seen over Glen Cove and then landed on Tappen Beach in August of 2004, and the young (about 1 year old) **great horned owl** that was rescued from the water at the Glen Cove Marina in Glen Cove Creek on August 9, 2009. During 2011, there were also some unexpected visitors: on April 9, two **northern gannets** were seen on Tappen Beach; on August 28, a **south polar skua** (a dark, gull-like bird), showed up on Sea Cliff Beach, brought in with the hurricane winds; and in mid-December, a **brown pelican** was seen off of Sands Point at the Execution Rock lighthouse.

Bald eagles have been moving west, and we started receiving reports of them around Hempstead Harbor in 2015 during the regular monitoring season. Also, a Roslyn Harbor resident saw an immature bald eagle perched in a tree on his property in December 2015 and also in April 2017 (it takes about four years for bald eagles to mature into their distinctive white and dark, brown-black coloration). A mature pair of bald eagles was seen in this area on February 20, 2017.

4.8 Diamondback Terrapins

Diamondback terrapins are the only turtle found in estuarine waters and generally grow up to about 10 inches long. In spring of 2005, diamondbacks were observed in large numbers in the lower harbor, near the Roslyn viaduct. Diamondbacks typically converge by the hundreds in one area in the spring and mate for several weeks, and information about their presence in Hempstead Harbor was used to support efforts to extend Hempstead Harbor's designation as a "significant coastal fish and wildlife habitat" to include the area south of the Roslyn viaduct.

In 2006, dramatic changes occurred in the area near the viaduct with the construction of the senior communities at Bryant Landing and the start of construction for the new viaduct (which was completed in 2011). Although there were no diamondback sightings reported for the lower harbor since 2006, they had been seen in other parts of the harbor since then, particularly around Brewer's Marina and the Sea Isle sand spit.

A diamondback terrapin below the outfall north of Tappen Beach Pool
(photos by Carol DiPaolo, 6/27/12)

In June 2008, the DEC seine crew caught an adult diamondback terrapin (255 mm across and 275 mm long–about 11 inches long–which is longer than the average size recorded) near the bar at the southern end of the North Hempstead Beach Park). On July 11 and August 19, 2009, a diamondback turtle was seen in Brewer's Marina. In 2010, a large (about a foot long) diamondback was seen swimming in Brewer's Marina near Sea Isle. The diamondback pictured above was seen on June 27, 2012, north of the Tappen Beach pool and was more than a foot long. The last report received of a diamondback terrapin sighting in Hempstead Harbor was at Brewer Marina on June 17, 2014.

Occasionally, large sea turtles have made their way into Long Island Sound and have been spotted in local bays. On August 2, 2011, we had a report that a large sea turtle was seen at the Shelter Bay Yacht Club in Manhasset Bay. On October 24, 2011, we received a report from Paul Boehm, who was fishing for black fish about a half a mile north of the Glen Cove breakwater, that he had seen a large sea turtle, which he identified from photos as being a **Kemps ridley turtle.** On August 13, 2015, a large sea turtle was seen in Long Island Sound near Hempstead Harbor.

4.9 Algal Blooms

The color and turbidity of water within Hempstead Harbor vary by season. Hempstead Harbor Secchi-disk depths (an indicator of light penetration into the water column and therefore water clarity) in the harbor most often range from 0.5 m to 3.0 m, with the higher numbers in the range generally recoded in spring and autumn. Lower Secchi-disk depths along with supersaturated DO levels are strong indicators of the presence of algal blooms. Algae absorbs more light and is present in greater quantities than other particulate material, and when it is in the growth phase it gives off oxygen. The dominant type of algae present in the harbor gives the water its color, which is typically brown or green.

In 2017, the range of Secchi depths was 0.5 m to 2.25 m, as compared with to 0.75 m to 3.8 m in 2016. On April 19, 2016, marine biologist John Waldman observed commented on the unusally clear conditions in spring 2016:

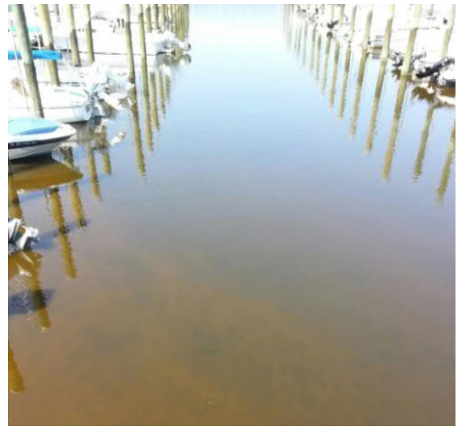
> *No doubt you've noticed how extraordinarily clear LIS is this spring…. Looks positively Caribbean, dramatically better than I've ever seen it…. (It's also been noticed for the Chesapeake; several articles online about it.)*

By mid-June 2017, there were noticeable brown and green algal blooms in Hempstead Harbor. On June 14, the water in Tappen Marina was abnormally brown but in most other areas in the harbor the water color was very green. There were indications of a probable algal bloom--supersaturated DO levels at surface with thick green water color throughout most of the harbor.

As mentioned previously in the monthly observations, conditions were similar to what had occurred in 2016, and Theresa Hattenrath, a marine biologist at Stony Brook University, stated that it was likely Eutreptiella (a type of algae that has been observed previously in Hempstead Harbor). On June 21, 2017, indications of a likely algal bloom combined with pollen slicks occurred in different parts of the harbor. The abnormal murky green coloration was evident again in different parts of the harbor on July 5 and 12, August 16, 2017.

On August 24, the water in Tappen Marina looked coffee brown, again similar to conditions that occurred in 2016 when sample results showed cells of Dinophysis (which can cause a brown to rust color). (When Dinophysis cells are present in a high density, they can cause diarhhetic shellfish poisoning if shellfish taken from the affected area are ingested by humans.) Heterosigma akashiwo and Prorocentrum minimum are types of algae that also have been present in Hempstead Harbor, also can turn the water brown, and have been implicated in fish kills in many regions around the world.

August 30, the lower harbor appeared to have an abnormal brown coloration with foam patches. For the rest of the 2017 season, the water color in the harbor was judged to be normal brown or green, although at times suspended particles were evident in the water column. A mix of algal cells with other vegetation occurs at Scudder's Pond and creates a mat at the surface that generally persists through the warmer months.

Surface of Scudder's Pond (l) and brown bloom in Tappen Marina (r) (photos by Michelle Lapinel McAllister, 7/7/17, and Carol DiPaolo, 6/24/16, respectively)

There have been instances in previous seasons as well when algal blooms have caused unusual coloration or conditions in parts of Hempstead Harbor. One of the most dramatic appearances of a brown algal bloom in Hempstead Harbor occurred in May 2015. Decaying pollen mixed with algae cells created a mat on the water surface that some local residents had reported as "sludge."


Pollen slicks–not sludge–in Hempstead Harbor (photos by Carol DiPaolo, 5/7/15)

On May 7, 2015, a long, thick pollen slick stretched from an area just outside of Sea Cliff Beach to Hempstead Harbor Club. A water sample taken from the slick showed hardly detectable amounts of bacteria; no sewage or other spill was implicated in this event.

In 2010, unusual red-brown water color was observed on three occasions in Hempstead Harbor. On August 31, 2010, the water in sections of Tappen Marina had turned red; a water sample we collected and that was analyzed by the NCDH contained a mix of dinoflagellates, some that could cause red coloration along with other types of algae, none of which were toxin producers. The most dominant species was *Prorocentrum micans,* followed by *Prorocentrum triestinum*, *Gyrodinium* sp., and *Scripsiella trochoidea*.

Excess amounts of nitrogen released from failing septic systems, over fertilization of lawns and gardens, and other sources, have been implicated in causing more frequent and longer-lasting algal blooms in waters around Long Island and other areas. These blooms can affect other marine species through light reduction and oxygen depletion. Some types of algae contain biotoxins, and if the algal cells are present in high densities, these harmful algal blooms (HABs) may cause a risk to human health through consumption of shellfish taken from affected areas.

Water-Monitoring Data Sheet

Collection Date : ______________________ **Time :** ______________________

Monitor Name : ____

Site Name : CSHH #1, Beacon 11 **Location :** Hempstead Harbor

Weather : ❑ fog/haze ❑ drizzle ❑ intermittent rain ❑ rain ❑ snow ❑ clear ❑ partly cloudy

% Clo d Cover : ❑ 0% ❑ 25% ❑ 50% ❑ 75% ❑ 100% other ________

Wind Direction : ❑ N ❑ NE ❑ NW ❑ S ❑ SE ❑ SW ❑ E ❑ W **Velocity :** ______ kt (mph)

		Date	Amount
Rainfall : Previous 24 hrs accumulation	_____._ mm	________	________
Previous 48 hrs accumulation	_____._ mm	________	________
Previous week's accumulation	_____._ mm	________	________

Tidal Stage : ❑ incoming ❑ outgoing hours to high tide : ____________

Water Surface : ❑ calm ❑ ripple ❑ waves ❑ whitecaps

Water Color : ❑ normal : ❑ brown ❑ green other ________
❑ abnormal : ❑ brown ❑ green other ________

Water Observations : ❑ jelly fish ❑ dead fish ❑ dead crabs ❑ algal bloom
❑ odors ❑ sea weed ❑ bubbles ❑ foam
❑ oil slick ❑ floatables ❑ ice
❑ submerged aquatic vegetation (SAV) ❑ turbidity (suspended particles)

Comments ____

____

____

____

____

Plankton count ________ type ________ sample taken : ❑ surface ❑ below surface

Human Activities

☐ Barges/tugs, Pt. W. gravel op.____________Gladsky__________Raison____________
DiNapoli__________Global/fuel____________other____________

☐ Boats, power__________sailboats__________kayaks__________crew____________

☐ Anglers, at beaches____________________at piers____________________

☐ Other____

Floatables Observations (type, approximate number…)

☐ Bottles, glass_______plastic________☐ Cans________☐Paper________☐Plastic bags/pieces________

☐ Styrofoam, cups________pieces________☐Wood, boards__________pieces____________

☐ Other____

Water Monitoring Data Sheet

Air Temperature : ________ °C

Station : **Time : ________________** **Date:**

Wind ________

Air °C ______

Depth (meters)	Temp °C	Salinity (ppt)	DO (ppm)	pH	Secchi (meters)	Nitrogen (ppm) NO$_2$	NO$_3$	NH$_3$
Surface								
0.5								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Station : **Time : ________________**

Wind ________

Air °C ______

Depth (meters)	Temp °C	Salinity (ppt)	DO (ppm)	pH	Secchi (meters)	Nitrogen (ppm) NO$_2$	NO$_3$	NH$_3$
Surface								
0.5								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Station : **Time : ________________**

Wind ________

Air °C ______

Depth (meters)	Temp °C	Salinity (ppt)	DO (ppm)	pH	Secchi (meters)	Nitrogen (ppm) NO$_2$	NO$_3$	NH$_3$
Surface								
0.5								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Water-Monitoring Data Sheet

Wildlife Observations

Date ____________

BIRDS

	Upper Harbor	Lower Harbor
☐ Cormorants		
☐ Ducks, mallards	ducklings	ducklings
☐ Egrets, great		
snowy		
☐ Geese, Canada	goslings	goslings
brandts		
☐ Gulls, hooded		
☐ Herons, blue		
night, green		
☐ Kingfisher, belted		
☐ Ospreys		chicks
☐ Plover-type, killdeer		
☐ Swans, mute	cygnets	cygnets
☐ Other		

JELLIES/JELLYFISH

☐ Comb, sea walnuts: CSHH stations ☐#1_____ ☐#2_____ ☐#3_____ ☐#4_____ ☐#5_____ ☐#6____ ☐#7_____

☐#8-10_____ ☐#11____ ☐#12___ ☐#13______________

sea gooseberries: CSHH stations ☐#1_____ ☐#2_____ ☐#3_____ ☐#4_____ ☐#5_____ ☐#6____ ☐#7_____

☐#8-10_____ ☐#11____ ☐#12____ ☐#13______________

☐ Lion's mane: CSHH stations ☐#1_____ ☐#2_____ ☐#3_____ ☐#4_____ ☐#5_____ ☐#6____ ☐#7__________

☐ Moon: CSHH stations ☐#1_____ ☐#2_____ ☐#3_____ ☐#4_____ ☐#5_____ ☐#6____ ☐#7__________

FISH

☐ Baitfish ______________

☐ Blue ______________

☐ Bunker ______________

☐ Striped bass ______________

☐ Small shrimp ______________

CRABS

☐ Asian shore ______________

☐ Blue-claw ______________

☐ Horseshoe ______________

OTHER ______________

Nassau Co. DOH PHL 209 Main Street Hempstead, NY 11550	FORM NAME: □ QC □ Equip Maint □ Training □ Comp Doc □ Other	
LABORATORY SECTION □ Chemistry □ Environmental Microbiology □ Clinical Microbiology	Form. No.:	Rev: 0
	Date:	Created By: CONNIE IANNUCCI

Beach Monitoring Daily Sampling Log

COALITION TO SAVE HEMPSTEAD HARBOR

Elap ID #10339

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF PuBLIC HEALTH LABORATORIES
209 MAIN STREET, HEMPSTEAD, NY 11550
RODGER P. SILLETTI Ph.D., D (ABMM), DIRECTOR TELEPHONE (516) 572-1202 FAX (516) 572-1206

COLLECTOR'S NAME **DATE**

ALL SAMPLES SUBMITTED IN STERILE POLYSTYRENE VESSELS CONTAINING SODIUM THIOSULFATE (UNLESS OTHERWISE SPECIFIED)

Field No.	Area No.	Point No.	Sample Type	Location	Time	Temperature		Wind	Weather	Wave Height	Laboratory Use Only			
						Air	Water				Lab Number	Fecal Coliforms	Enterococci	Comments
CSHH-1	10		5	BEACON ELEVEN										
CSHH-2	10		5	BELL BUOY 6										
CSHH-3	10		5	RED MARKER GLEN COVER CREEK										
CSHH-4	10		5	BAR BEACH SPIT										
CSHH-5	10		5	MOTT'S COVE										
CSHH-6	10		5	EAST OF FORMER TNH INCINERATOR										
CSHH-7	10		5	BRYANT LANDING										
CSHH-8	10		5	GLEN COVE STP										
CSHH-9			5	FIRST PIPE WEST OF STP OUTFALL										
CSHH-10			5	PIPE AT CORNER OF SEAWALL WEST OF STP OUTFALL										
CSHH-11			5	50 YARDS EAST OF STP OUTFALL										
CSHH-12			5	EAST OF STP OUTFALL BY BEND IN SEAWALL										
CSHH-13			5	60 FEET WEST OF MILL POND WEIR										

COMMENTS/REMARKS

*ESTIMATED COUNTES: ALL COUNTS ARE ABOVE UPPER ACCEPTANCE LIMIT (20-60), OR NO COUNTS WITHIN ACCEPTANCE LIMIT (20-60)
TNTC = "TOO NUMEROUS TO COUNT"

DATA ENTRY PROOFED

TEST	METHOD	CODE
Fecal Coliform/100 ml.	Membrane Filtration	SM-18-20 9222 D
Enterococci/100 ml	Membrane Filtration	EPA Method 1600

TEMP CONTROL: TIME RECEIVED: DATE ANALYZED:

DATE RECEIVED:

SAMPLE ACCEPTABLE: YES ☐ NO ☐ ANALYSIS SUCCESSFUL: YES ☐ NO ☐

LABORATORY ACCREDITATION NOTICE:
The results provided on this report have been produced in compliance with "NELAC" (National Environmental Laboratory Accreditation Conference) standards and relate only to the identified sample. Any deviations from the accepted "NELAC" collection requirements for non-potable samples are appropriately noted. This rpeort shall not be reproced except in full without the written approval of the laboratory. Current New York State laboratory certification status is maintained under ELAP ID #10339.

VERIFICATION REVIEW

Name: **Title:** **Date:**

Comments:

Nassau Co. DOH PHL 209 Main Street Hempstead, NY 11550	FORM NAME: COALITION TO SAVE HEMPSTEAD HARBOR □ QC □ Equip Maint □ Training □ Comp Doc ☑ Other	
LABORATORY SECTION □ Chemistry ☑ Environmental Microbiology □ Clinical Microbiology	Form. No.: Beach Monitoring Daily Sampling Log - 1 Date: 4/8/2011	Rev: 2 Created By: CONNIE IANNUCCI

Beach Monitoring Daily Sampling Log

COALITION TO SAVE HEMPSTEAD HARBOR

Elap ID #10339

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF PUBLIC HEALTH LABORATORIES
209 MAIN STREET, HEMPSTEAD, NY 11550

COLLECTOR'S NAME **DATE**

ALL SAMPLES SUBMITTED IN STERILE POLYSTYRENE VESSELS CONTAINING SODIUM THIOSULFATE (UNLESS OTHERWISE SPECIFIED)

THOMAS EDWARDS, LEAD TECHNICAL DIRECTOR; CONNIE IANNUCCI, MICROBIOLOGY TECHNICAL DIRECTOR TELEPHONE (516) 572-1202 FAX (516) 572-1206

Field No.	Area No.	Point No.	Sample Type	Location	Time	Temperature Air	Temperature Water	Wind	Weather	Wave Height	Laboratory Use Only: Lab Number	Fecal Coliforms CFU/100 mL	Enterococci CFU/100 mL	Comments
CSHH-14	10			NW CORNER OF POWER PLANT ~ 50 YARDS FROM CEMENT OUTFALL										
CSHH-14A	10			CEMENT OUTFALL ADJACENT TO POWER PLANT										
CSHH-15	10		5	NW CORNER OF TAPPEN POOL										
CSHH-15A	10		5	SCUDDER'S POND OUTFALL @ SEAWALL N. OF TAPPEN POOL										
CSHH-15B	10		5	SCUDDER'S POND WEIR										
TRIP BLANK														

COMMENTS/REMARKS

REPORT TO: **RECREATIONAL FACILITIES**
200 COUNTY SEAT DRIVE
MINEOLA, NY 11501

***ESTIMATED COUNT**

TNTC = "TOO NUMEROUS TO COUNT"

24hr rain: **48hr rain:**

DATA ENTRY PROOFED

TEST	TECHNOLOGY	METHOD
Fecal Coliform CFU/100 ml.	MF-QN	SM 9222 D-97, -11
Enterococci CFU/100 ml	MF-QN	EPA 1600

TEMP CONTROL: TIME RECEIVED: DATE ANALYZED:

DATE RECEIVED:

SAMPLE ACCEPTABLE: YES ☐ NO ☐ ANALYSIS SUCCESSFUL: YES ☐ NO ☐

LABORATORY ACCREDITATION NOTICE:
The results provided on this report have been produced in compliance with "NELAC" (National Environmental Laboratory Accreditation Conference) standards and relate only to the identified sample. Any deviations from the accepted "NELAC" collection requirements for non-potable samples are appropriately noted. This rpeort shall not be reproced except in full without the written approval of the laboratory. Current New York State laboratory certification status is maintained under ELAP ID #10339. **Page 1 of 2**

VERIFICATION REVIEW		
Name:	**Title:**	**Date:**
Comments:		

Appendix A

2017 CSHH Field-Monitoring Data
2017 Weekly Graphs for Water-Quality Parameters
2017 Turbidity and Secchi-Disk Transparency Graphs
1996-2017 Dissolved Oxygen Graphs

2017 CSHH Field-Monitoring Data

CSHH Water-Monitoring Program 2017

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
CSHH #1 - Beacon 11														
10/27/17	15.92	16.46	22.95	23.13	6.99	6.69	7.62	7.64	10.6	1.3	10.28	5.28	4.36	8:10
10/17/17	18.00	18.09	23.57	23.57	8.30	8.28	7.80	7.79	7.7	1.0	29.24	6.20	4.54	8:10
10/11/17	21.34	21.36	25.01	25.71	5.73	5.48	7.58	7.60	18.4	1.2	21.88	3.50	4.19	8:05
10/4/17	19.91	20.65	25.58	26.27	6.54	5.32	7.58	7.62	14.5	1.5	31.98	3.46	3.41	8:05
9/28/17	23.40	22.77	25.48	25.95	8.01	5.24	7.78	7.35	23.3	1.0	70.81	3.14	5.95	8:05
9/21/17	21.47	21.45	25.17	25.45	6.38	5.03	7.37	7.35	22.3	1.0	20.78	4.13	3.49	6:55
9/13/17	20.54	20.78	22.36	23.01	6.41	5.49	7.53	7.48	17.8	1.7	25.41	2.39	4.79	8:08
9/7/17	21.05	21.07	24.63	25.26	5.42	3.95	7.35	7.31	18.3	1.25	25.99	4.51	2.83	8:10
8/30/17	22.04	22.06	23.17	23.24	2.35	1.92	7.15	7.14	19.1	1.5	16.52	2.72	5.74	8:50
8/24/17	23.65	23.64	22.59	22.78	6.46	5.58	7.40	7.38	21.0	1.25	34.39	4.16	2.85	8:00
8/16/17	22.89	22.56	23.25	27.00	6.15	1.86	7.36	7.05	25.2	1.75	45.52	N/A*	5.22	8:00
8/9/17	22.64	22.61	24.42	24.76	2.72	2.43	7.02	7.01	21.8	1.75	13.81	2.91	2.51	8:20
8/2/17	23.72	22.77	25.22	25.58	7.43	3.16	7.60	7.15	26.7	0.8	119.7	5.32	4.62	9:25
7/26/17	21.85	21.74	22.72	22.98	2.57	2.45	7.13	7.13	21.7	1.9	11.70	2.42	1.68	8:05
7/19/17	No survey because of boat problems; picked up shoreline bacteria samples only.													
7/12/17	22.06	21.99	24.96	25.35	5.09	4.70	7.27	7.33	26.2	1.0	38.73	6.47	1.46	8:20
7/5/17	21.82	17.85	22.58	23.51	10.03	3.07	7.99	7.13	22.5	0.75	93.26	5.22	4.60	8:10

2017 CSHH Field-Monitoring Data

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
6/28/17	19.33	19.26	22.38	22.53	5.45	5.28	7.36	7.39	20.1	N/A	42.84	3.83	2.52	9:15
6/21/17	20.71	19.92	22.37	25.27	8.73	5.87	7.94	7.63	26.3	1.0	105.02	10.70	4.34	8:15
6/14/17	21.79	20.92	21.24	22.26	8.57	9.52	7.97	7.87	24.1	0.75	49.95	6.27	2.81	10:15
6/7/17	16.23	16.17	22.40	22.46	8.14	7.05	7.72	7.63	12.9	0.9	41.92	4.71	3.50	7:55
5/31/17	15.33	15.27	25.12	25.19	7.10	6.90	7.59	7.59	14.7	1.25	14.98	5.53	3.52	7:50
5/24/17	15.36	14.27	22.28	22.94	11.41	8.49	8.12	7.78	15.4	1.25	37.87	2.53	4.85	8:50
5/17/17	14.95	13.76	23.69	25.28	8.30	8.55	7.77	7.91	22.8	1.5	13.47	5.13	4.11	8:30
CSHH #2 - Bell Marker 6														
10/27/17	17.41	17.14	23.79	23.69	7.26	7.13	7.71	7.66	11.3	2.0	9.53	2.16	8.69	8:40
10/17/17	No survey because of wind and waves.													
10/11/17	21.74	21.27	26.31	26.37	7.45	5.70	7.83	7.68	19.6	2.0	18.92	1.18	7.15	8:36
10/4/17	20.21	20.18	26.26	26.27	8.11	7.55	7.88	7.85	16.0	1.75	24.97	1.70	9.45	8:30
9/28/17	No survey - high wind and waves.													
9/21/17	21.38	21.37	26.84	26.85	6.36	6.28	7.59	7.59	23.3	1.75	18.77	1.85	5.57	8:06
9/13/17	20.53	20.56	23.06	23.39	7.66	7.69	7.72	7.73	20.4	2.0	21.18	1.77	6.78	8:40
9/7/17	21.35	21.35	26.12	26.05	6.44	5.78	7.65	7.58	18.1	1.25	23.23	3.09	8.26	8:35
8/30/17	No survey because of high wind and waves.													
8/24/17	23.52	23.07	23.22	23.31	6.36	3.32	7.57	7.23	20.9	1.50	23.40	1.67	6.67	8:40
8/16/17	22.95	22.35	26.83	27.13	6.79	2.89	7.61	7.22	23.0	1.50	21.39	N/A*	8.5	8:31
8/9/17	22.47	21.72	25.57	26.09	4.48	1.89	7.28	7.08	20.7	1.75	13.29	1.97	6.33	8:38
8/2/17	24.15	22.64	25.46	25.66	10.90	6.59	8.04	7.45	28.7	0.80	45.8	3.10	8.00	10:05
7/26/17	21.56	21.48	23.53	23.94	4.68	3.69	7.40	7.39	21.9	1.75	12.21	3.17	5.80	8:40
7/19/17	No survey because of boat problems; picked up shoreline bacteria samples only.													
7/12/17	22.38	20.07	25.96	26.24	9.05	3.45	7.93	7.29	27.0	1.25	26.03	3.36	6.85	9:00
7/5/17	21.85	17.49	26.10	26.42	10.17	6.93	8.21	7.43	23.2	1.6	15.22	1.76	8.07	10:15

2017 CSHH Field-Monitoring Data

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
6/28/17	18.61	17.49	23.13	23.34	6.49	3.64	7.66	7.37	21.4	N/A	29.57	2.39	6.15	9:50
6/21/17	20.31	17.48	24.70	25.57	10.25	4.10	8.17	7.52	25.6	1.0	51.89	3.58	8.5	10:15
6/14/17	23.14	15.67	22.35	23.32	13.81	5.71	8.64	7.49	23.8	0.75	51.38	62.37	6.26	10:45
6/7/17	15.80	15.46	22.90	22.03	8.22	7.52	7.87	7.82	15.1	1.5	12.46	2.13	8.35	9:45
5/31/17	15.33	14.86	25.48	25.67	8.37	7.85	7.81	7.76	15.2	1.3	27.94	2.74	6.58	8:30
5/24/17	15.21	13.59	25.10	25.62	11.97	8.41	8.24	7.86	17.4	1.5	41.52	7.71	9.27	11:20
5/17/17	15.42	12.86	25.04	25.46	10.60	8.14	8.08	7.89	23.1	2.25	7.97	3.06	8.02	9:33
CSHH #16 - Outer Harbor, Midway E/W Shore and N/S Boundary of Shellfish Harvesting Area														
10/27/17	17.80	17.81	23.69	23.72	7.88	7.34	7.73	7.73	11.9	2.25	9.57	2.15	9.06	9:00
10/17/17	No survey because of wind and waves.													
10/11/17	21.54	21.26	26.33	26.39	7.37	6.19	7.82	7.70	20.0	2.0	11.71	1.02	8.52	9:00
10/4/17	20.60	20.84	26.43	26.52	7.91	7.26	7.91	7.84	16.9	1.75	21.79	1.77	10.27	8:55
9/28/17	No survey because of wind and waves.													
9/21/17	21.32	21.32	26.94	26.98	7.05	6.32	7.63	7.63	22.9	1.30	16.63	1.91	8.97	8:40
9/13/17	20.87	20.73	23.04	23.55	9.59	7.42	7.99	7.75	23.0	2.0	18.17	0.90	9.26	9:08
9/7/17	21.25	21.21	26.12	26.14	6.83	6.64	7.70	7.68	18.4	2.0	9.95	1.55	9.09	9:00
8/30/17	No survey because of high wind and waves.													
8/24/17	23.45	22.70	23.26	23.44	6.65	2.76	7.61	7.22	21.2	1.50	25.68	1.32	8.43	9:06
8/16/17	22.99	22.24	27.00	27.29	7.30	2.61	7.71	7.27	24.6	1.5	34.65	N/A*	9.87	9:11
8/9/17	22.38	21.65	25.62	26.12	6.29	2.40	7.43	7.14	23.9	1.6	20.54	3.06	8.76	9:04
8/2/17	23.75	21.96	25.45	26.00	10.26	4.01	8.01	7.33	25.7	1.0	46.25	3.42	10.09	10:25
7/26/17	21.52	21.45	23.78	23.96	5.63	4.74	7.54	7.50	22.4	1.5	28.10	2.57	8.37	9:15
7/19/17	No survey because of boat problems; picked up shoreline bacteria samples only.													
7/12/17	22.70	19.30	25.81	26.27	9.91	2.74	8.01	7.22	26.9	1.25	34.34	2.91	8.62	9:25
7/5/17	No survey--ran out of time.													

2017 CSHH Field-Monitoring Data

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
6/28/17	18.36	17.27	23.18	23.42	7.32	3.64	7.74	7.37	20.6	N/A	10.03	1.28	8.25	10:13
6/21/17	20.68	15.32	24.98	26.14	10.67	3.75	8.22	7.49	26.3	1.0	46.69	4.39	10.48	10:45
6/14/17	Abandoned station because of wind and rain--picked up bacteria sample only.													
6/7/17	15.84	15.45	22.90	23.03	7.95	7.61	7.87	7.83	15.1	1.75	8.20	2.69	10.59	10:10
5/31/17	15.22	14.67	25.38	25.48	8.81	7.69	7.88	7.76	14.5	1.4	30.40	2.22	8.81	9:00
5/24/17	No survey--ran out of time because of late start due to morning rain.													
5/17/17	15.28	12.70	24.77	25.67	10.41	7.99	8.12	7.91	21.9	2.0	8.87	3.43	8.39	10:05
CSHH #17 - Outer Harbor, Just Outside Restricted Crescent Beach Boundary														
10/27/17	17.65	17.65	23.75	23.76	7.33	7.36	7.74	7.74	11.7	1.5	8.41	11.29	4.45	9:30
10/17/17	19.18	18.95	23.70	23.72	8.24	8.05	7.91	7.87	9.9	1.5	12.83	2.49	7.08	10:45
10/11/17	21.24	21.27	26.46	26.52	6.98	6.14	7.76	7.73	19.9	1.4	12.27	3.12	6.13	9:23
10/4/17	20.56	20.39	26.42	26.44	8.52	8.11	7.99	7.89	16.9	1.75	23.77	1.39	7.85	9:15
9/28/17	No survey because of high wind and waves.													
9/21/17	21.25	21.24	27.04	27.00	6.78	6.15	7.58	7.57	23.3	1.75	13.64	2.68	5.93	9:15
9/13/17	21.16	20.81	23.18	23.63	10.61	7.95	8.08	7.78	23.7	1.75	10.80	1.39	5.74	10:00
9/7/17	21.32	21.24	26.25	26.25	6.90	6.54	7.69	7.67	18.6	2.0	10.05	2.07	5.49	9:23
8/30/17	No survey because of high wind and waves.													
8/24/17	23.41	23.31	23.30	23.28	5.90	5.41	7.51	7.48	22.2	1.5	18.67	2.41	6.00	9:38
8/16/17	23.18	22.35	26.98	27.25	7.79	3.39	7.71	7.27	24.3	1.25	27.16	N/A*	7.03	9:50
8/9/17	22.49	22.22	25.64	25.75	5.93	5.49	7.41	7.37	23.4	1.5	15.01	1.85	6.59	9:20
8/2/17	24.32	21.95	25.63	26.00	10.85	4.40	8.17	7.38	27.8	1.5	20.86	2.85	7.45	10:50
7/26/17	21.64	21.36	23.91	23.92	4.52	3.73	7.45	7.39	22.5	1.25	14.66	3.74	6.08	9:40
7/19/17	No survey because of boat problems; picked up shoreline bacteria samples only.													
7/12/17	22.22	21.54	25.86	25.94	10.04	9.62	8.01	7.88	26.9	1.0	53.36	3.09	5.76	9:45
7/5/17	No survey--ran out of time.													

2017 CSHH Field-Monitoring Data

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
6/28/17	19.11	17.69	22.88	23.26	7.83	6.71	7.84	7.58	24.3	N/A	9.84	1.53	5.78	10:40
6/21/17	20.50	15.26	24.96	26.20	11.50	3.92	8.28	7.51	27.5	0.8	62.20	4.51	8.02	11:10
6/14/17	19.94	15.38	22.59	23.49	12.63	4.27	8.36	7.53	24.6	0.75	21.57	5.60	7.11	11:20
6/7/17	15.45	15.37	23.01	23.07	7.88	6.89	7.79	7.72	15.2	1.3	10.20	2.86	8.38	10:30
5/31/17	14.96	14.65	25.39	25.52	8.46	7.69	7.83	7.77	15.1	1.25	23.85	3.32	6.00	9:25
5/24/17	No survey--ran out of time because of late start due to morning rain.													
5/17/17	14.68	13.58	24.85	24.76	8.98	9.63	8.05	8.02	21.2	2.25	6.14	3.17	3.01	10:30

Red numbers indicate that the readings were unusually low or high but reflect station conditions.

CSHH #3 - Glen Cove Creek, Red Marker

Date	Water Temp Surface	Water Temp Bottom	Salinity Surface	Salinity Bottom	DO Surface	DO Bottom	pH Surface	pH Bottom	Air Temp (°C)	Secchi (m)	Chlor a 1/2 m/ mg/l	Turbidity 1/2 m/ NTUs	Depth(m) (Bottom)	Time (AM)
10/27/17	17.04	17.20	23.40	23.77	6.63	6.73	7.68	7.68	12.6	1.0	8.26	4.84	3.47	9:55
10/17/17	18.33	18.60	23.42	23.68	8.97	8.15	7.96	7.89	9.8	1.25	16.56	2.81	5.46	11:10
10/11/17	21.58	21.42	25.62	26.38	6.91	6.29	7.79	7.70	20.3	1.5	22.05	1.62	3.25	10:03
10/4/17	20.02	20.36	25.89	26.10	7.95	7.13	7.86	7.80	17.8	1.75	17.26	1.79	5.17	9:35
9/28/17	23.03	22.35	25.69	26.35	8.19	5.79	7.81	7.48	22.2	1.5	27.54	2.09	4.55	8:43
9/21/17	21.38	21.45	26.01	26.15	6.83	5.54	7.50	7.44	22.2	1.25	23.24	3.10	3.13	7:30
9/13/17	21.14	20.79	22.60	23.32	7.75	7.37	7.73	7.61	23.8	1.75	11.07	1.75	3.38	10:30
9/7/17	21.29	21.28	25.90	25.92	5.24	4.63	7.49	7.46	19.1	N/A	26.25	5.91	4.36	9:53
8/30/17	21.93	21.95	23.14	23.45	3.90	3.57	7.32	7.30	19.3	1.75	9.54	2.87	4.48	9:25
8/24/17	23.67	23.67	22.96	23.11	6.63	5.64	7.59	7.45	21.0	1.5	24.02	1.99	3.10	10:03
8/16/17	23.32	22.45	26.33	27.16	6.23	2.43	7.49	7.16	24.8	1.30	16.28	N/A*	4.21	10:27
08/09/17	22.86	22.56	25.25	25.43	4.88	3.43	7.17	7.15	21.5	1.5	19.49	2.56	3.82	9:46
08/02/17	24.16	22.67	24.89	25.70	9.23	6.14	7.85	7.31	25.8	1.2	29.69	3.34	4.38	11:05
7/26/17	22.09	21.75	23.34	23.50	4.04	3.24	7.25	7.28	21.4	2.25	9.79	1.66	3.17	10:10
7/19/17	No survey because of boat problems; picked up shoreline bacteria samples only.													
7/12/17	22.73	22.33	25.57	25.65	8.41	8.81	7.87	7.79	27.6	1.25	36.79	3.05	3.48	10:15

2017 CSHH Field-Monitoring Data

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
7/5/17	22.36	17.69	25.47	26.36	12.12	4.06	8.19	7.20	25.4	1.1	31.01	2.81	5.24	10:30
6/28/17	19.94	19.51	22.52	22.68	8.34	8.46	7.87	7.75	22.5	N/A	20.80	12.34	3.04	11:15
6/21/17	21.48	19.36	23.96	25.93	9.33	6.33	8.06	7.52	27.3	1.0	8.73	4.79	4.79	11:35
6/14/17	21.94	17.77	22.13	22.81	14.68	8.00	8.49	7.48	25.1	0.75	50.60	54.41	3.96	11:50
6/7/17	16.19	15.65	22.52	22.86	8.36	5.74	7.86	7.57	14.8	1.1	28.30	2.76	5.24	9:30
5/31/17	15.36	15.11	25.00	25.26	8.40	7.89	7.77	7.75	15.1	1.25	15.71	3.62	3.31	9:45
5/24/17	15.76	13.99	24.09	25.53	12.15	8.67	8.24	7.81	17.9	1.25	32.79	2.81	5.53	11:45
5/17/17	15.47	14.12	24.48	25.02	10.14	9.79	8.07	7.91	24.0	2.0	12.19	3.55	3.20	10:55
CSHH #8 - Glen Cove Sewage Treatment Plant Outfall														
10/27/17	18.15	17.34	21.98	23.42	5.21	4.97	7.46	7.60	12.1	1.0	9.60	4.93	2.0	10:12
10/17/17	18.94	18.51	22.15	23.44	7.03	7.14	7.77	7.84	9.9	1.25	15.26	5.29	4.0	11:30
10/11/17	20.73	21.69	25.49	25.86	6.12	6.36	7.69	7.73	20.2	1.5	18.48	1.37	1.76	10:30
10/4/17	21.08	20.25	25.33	25.89	7.54	6.50	7.68	7.73	17.5	1.25	29.68	3.52	3.86	10:00
9/28/17	23.48	23.01	25.64	26.04	8.39	7.40	7.82	7.61	22.4	1.5	21.30	1.40	2.95	9:10
9/21/17	21.52	21.46	26.00	26.27	6.78	5.41	7.48	7.48	24.2	1.25	25.46	3.56	3.45	10:05
9/13/17	21.35	21.16	21.94	22.66	6.16	6.76	7.55	7.64	25.4	1.50	10.49	2.45	2.11	11:05
9/7/17	21.41	21.51	18.01	25.78	6.28	4.48	7.34	7.36	19.0	1.0	6.52	15.60	3.30	10:20
8/30/17	22.29	22.32	22.43	23.47	3.14	2.51	7.25	7.23	19.3	1.25	12.54	3.78	3.07	9:50
8/24/17	23.86	23.78	21.88	22.85	5.52	4.14	7.43	7.33	22.8	1.25	32.54	3.01	2.49	10:22
8/16/17	23.45	23.24	25.55	26.38	5.62	5.12	7.44	7.38	26.2	0.80	39.71	N/A*	2.35	10:58
08/09/17	22.94	22.76	24.58	25.16	4.92	3.03	7.14	7.11	22.9	N/A	15.65	3.65	3.0	10:05
8/2/17	24.07	23.67	24.50	25.42	8.16	6.87	7.83	7.63	29.4	1.0	53.61	3.42	3.52	11:30
7/26/17	22.04	21.79	22.82	23.43	3.17	2.44	7.23	7.20	24.6	1.6	11.85	2.89	2.40	10:40
7/19/17	No survey because of boat problems; picked up shoreline bacteria samples only.													
7/12/17	23.52	22.45	23.04	25.42	7.87	6.70	7.78	7.48	28.2	0.75	3.44	4.50	2.68	10:40

2017 CSHH Field-Monitoring Data

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
7/5/17	22.99	19.65	24.05	26.14	14.10	7.36	8.23	7.47	25.8	0.75	65.36	3.82	4.09	10:55
6/28/17	20.90	19.91	20.89	22.85	7.88	6.56	7.71	7.47	22.9	N/A	29.74	3.63	1.85	11:38
6/21/17	No survey--ran out of time.													
6/14/17	No survey--ran out of time.													
6/7/17	15.89	15.74	21.26	22.70	7.42	6.31	7.61	7.58	14.4	1.25	19.83	62.79	3.0	9:10
5/31/17	15.70	15.49	24.34	24.92	8.30	7.74	7.72	7.72	16.2	1.0	33.81	5.53	2.10	10:25
5/24/17	No survey--ran out of time because of late start due to morning rain.													
5/17/17	16.28	15.29	18.96	24.43	8.06	10.21	7.77	8.08	27.0	1.25	11.23	19.42	1.04	10:25
CSHH #13 - 60' West of the Mill Pond Weir														
10/27/17	17.83	17.70	20.94	23.41	5.53	4.14	7.28	7.45	12.6	1.0	6.60	5.21	1.55	10:35
10/17/17	19.51	19.67	22.43	22.88	7.20	6.65	7.72	7.70	10.6	0.75	20.83	7.61	2.30	11:53
10/11/17	21.51	21.51	24.94	25.28	4.38	3.95	7.35	7.35	20.9	0.75*B	8.76	3.44	0.87	10:53
10/4/17	20.84	20.76	21.71	25.57	5.82	5.02	7.34	7.58	18.1	1.25	29.18	4.75	2.45	10:15
9/28/17	22.96	23.06	25.42	25.70	6.02	5.45	7.33	7.45	21.8	1.5	12.85	3.67	1.84	9:30
9/21/17	21.36	21.48	25.05	26.24	5.68	3.21	7.20	7.25	23.8	1.0	32.05	6.16	2.40	10:40
9/13/17	21.27	21.19	21.68	22.51	6.10	5.60	7.39	7.50	25.7	1.25	6.60	3.95	1.37	11:35
9/7/17	20.15	21.70	18.74	25.49	3.63	2.52	7.15	7.18	20.2	1.5	30.98	4.19	2.20	10:40
8/30/17	22.26	22.52	21.33	23.20	1.87	1.40	7.10	7.13	19.9	1.25	5.84	4.74	1.14	10:15
8/24/17	23.29	23.72	20.99	22.63	3.74	2.99	7.23	7.16	23.7	1.25	40.54	4.52	1.20	10:50
8/16/17	23.24	23.27	25.09	25.53	5.23	3.92	7.22	7.18	27.0	0.3	54.11	N/A*	0.69	11:23
08/09/17	No access--head of creek blocked by tug.													
8/2/17	No access because of tide.													
7/26/17	21.96	21.89	21.53	23.43	2.35	1.91	7.12	7.17	25.7	1.8	8.89	3.33	2.24	11:00
7/19/17	No survey because of boat problems; picked up shoreline bacteria samples only.													
7/12/17	22.39	22.37	22.87	25.14	6.97	3.43	7.29	7.07	28.5	0.75	49.88	6.97	2.27	10:58

2017 CSHH Field-Monitoring Data

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
7/5/17	22.20	22.03	25.10	25.54	9.34	8.49	7.92	7.75	25.3	0.9	63.27	4.33	2.46	11:15
6/28/17	Late start--boat problems--could not get to CSHH #13.													
6/21/17	No survey--ran out of time.													
6/14/17	No survey--ran out of time.													
6/7/17	16.46	16.12	22.24	22.70	6.29	4.67	7.49	7.31	15.0	1.25	18.71	3.18	2.84	8:45
5/31/17	15.91	15.67	24.16	24.83	7.47	6.81	7.68	7.36	17.3	0.6	45.50	10.33	1.75	10:55
5/24/17	No survey--ran out of time because of late start due to morning rain.													
5/17/17	No survey --ran out of time--discharge from outfall east of CSHH #8.													
CSHH #14 - 50 yds from Powerhouse Drain														
10/17/17	17.82	17.86	23.49	23.47	7.78	7.82	7.84	7.83	9.1	1.0	27.67	4.94	2.39	9:30
10/4/17	No survey - ran out of time.													
9/7/17	No survey - ran out of time.													
8/30/17	No survey - ran out of time.													
8/2/17	23.49	22.91	25.33	25.53	6.36	4.60	7.45	7.20	26.6	0.75	137.57	5.73	3.85	8:55
6/21/17	20.89	20.31	24.83	24.85	8.64	7.30	8.00	7.73	25.6	0.75	112.00	6.23	4.51	9:30
CSHH #15 - 50 yds from Scudder's Pond Outfall, North of Tappen Pool														
10/17/17	17.56	18.04	23.17	23.45	8.38	8.03	7.86	7.86	8.8	1.0	18.20	4.67	2.31	10:08
10/4/17	No survey - ran out of time.													
9/7/17	No survey - ran out of time.													
8/30/17	No survey - ran out of time.													
8/2/17	No access because of tide.													
CSHH #4 - Bar Beach Spit														
10/17/17	17.61	17.74	23.36	23.39	9.47	9.53	7.83	7.81	9.2	1.0	25.03	5.32	3.0	9:50

2017 CSHH Field-Monitoring Data

Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
10/04/17	20.23	20.16	25.73	25.90	7.34	6.06	7.75	7.67	20.0	1.25	60.65	4.23	5.17	11:30
9/7/17	No survey - ran out of time.													
8/30/17	21.95	21.97	23.05	23.08	3.45	1.65	7.13	7.11	18.8	1.5	15.83	3.21	4.75	8:35
8/2/17	23.45	23.06	25.31	25.52	6.58	5.62	7.38	7.26	26.2	0.75	84.60	4.91	1.92	9:10
7/5/17	22.07	21.73	22.54	22.63	9.80	9.56	7.90	7.84	24.5	0.75	91.81	5.16	2.01	8:40
6/21/17	20.50	20.38	24.90	24.90	7.55	7.33	7.83	7.80	25.8	0.75	50.61	4.65	2.33	9:45
5/24/17	15.45	14.96	24.92	25.13	10.33	10.72	8.15	7.98	17.2	1.25	41.06	2.46	2.09	10:48

Red numbers indicate that the readings were unusually low or high but reflect station conditions.

CSHH #5 - Mott's Cove

Date	Water Temp Surface	Water Temp Bottom	Salinity Surface	Salinity Bottom	DO Surface	DO Bottom	pH Surface	pH Bottom	Air Temp (°C)	Secchi (m)	Chlor a 1/2 m/ mg/l	Turbidity 1/2 m/ NTUs	Depth(m) (Bottom)	Time (AM)
10/17/17	17.46	17.73	23.19	23.42	8.26	8.74	7.74	7.81	8.1	1.00	27.44	4.76	1.99	9:05
10/04/17	19.98	19.95	25.19	25.46	5.46	5.42	7.53	7.56	19.2	1.25	18.06	3.18	1.80	11:15
9/7/17	21.42	21.37	24.92	25.17	6.01	5.21	7.43	7.43	21.1	1.2	12.75	4.05	1.95	11:50
8/30/17	22.11	22.22	22.58	22.94	1.81	1.51	7.04	7.07	17.8	1.5	25.15	2.24	1.56	8:15
8/2/17	23.00	22.93	24.89	25.35	4.36	3.53	7.10	7.09	25.6	1.25	33.88	6.48	1.5	8:40
7/5/17	20.33	19.71	25.60	25.87	4.95	4.51	7.37	7.26	25.5	0.75	57.06	4.25	1.71	8:55
6/21/17	21.00	20.35	24.16	24.67	7.64	6.46	7.72	7.57	25.9	0.7	65.60	12.25	1.89	9:30

CSHH #6 - East of Former Incinerator Site

Date	Water Temp Surface	Water Temp Bottom	Salinity Surface	Salinity Bottom	DO Surface	DO Bottom	pH Surface	pH Bottom	Air Temp (°C)	Secchi (m)	Chlor a 1/2 m/ mg/l	Turbidity 1/2 m/ NTUs	Depth(m) (Bottom)	Time (AM)
10/17/17	16.18	17.19	22.78	23.10	7.82	6.97	7.59	7.67	8.5	0.75	12.45	7.89	2.22	8:49
10/04/17	19.76	19.84	24.96	24.34	5.89	4.73	7.44	7.44	19.6	1.25	18.00	4.37	2.29	11:05
9/7/17	No survey--ran out of time.													
8/30/17	No survey - ran out of time.													
8/2/17	23.53	23.40	24.94	25.18	4.48	3.77	7.2	7.2	24.9	0.9	101.75	4.44	2.11	8:20
7/5/17	No survey--picked up bacteria sample.													
6/21/17	21.00	20.61	24.50	24.64	6.68	5.94	7.66	7.58	27.3	0.6	96.04	7.68	2.36	9:12

2017 CSHH Field-Monitoring Data

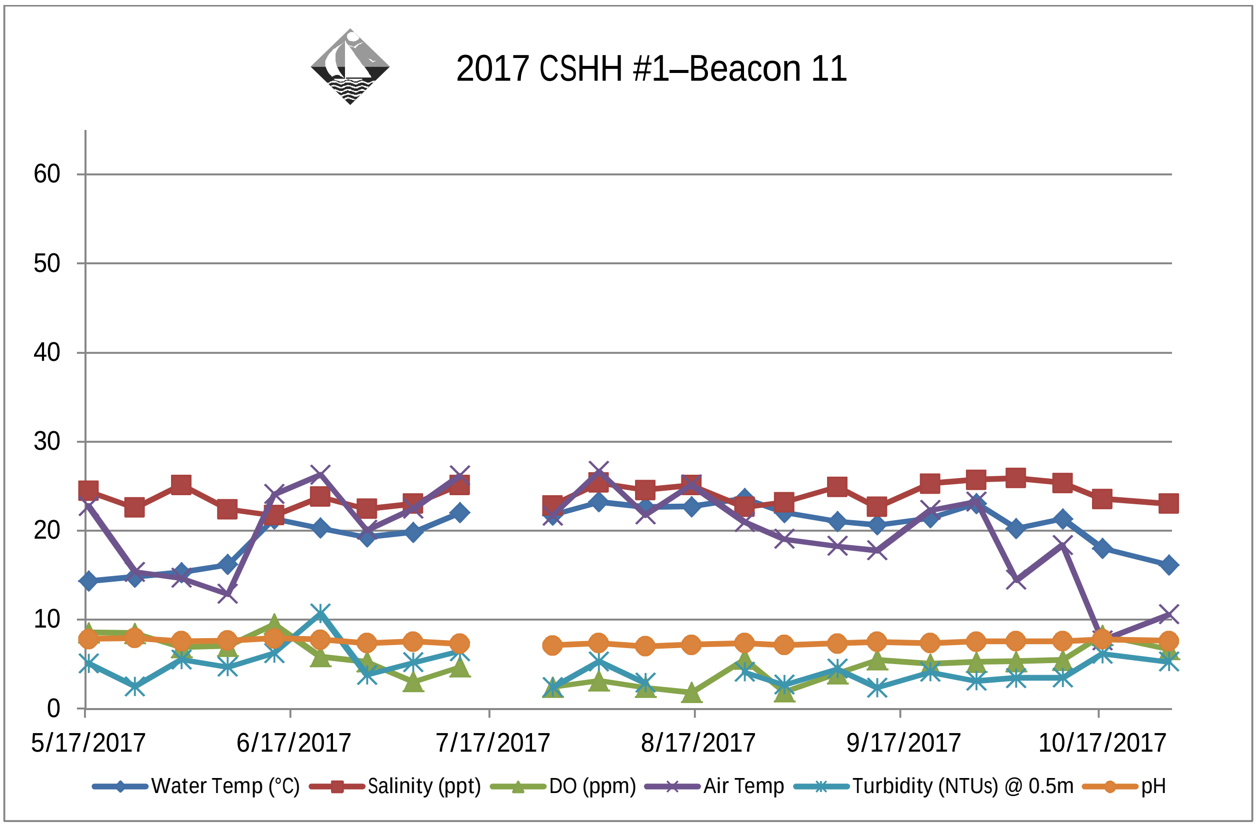
Date	Water Temp (°C)		Salinity (ppt)		DO (ppm)		pH ppm)		Air Temp	Secchi	Chlor a	Turbidity	Depth(m)	Time
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	(°C)	(m)	1/2 m/ mg/l	1/2 m/ NTUs	(Bottom)	(AM)
CSHH #7 - West of Bryant Landing (formerly site of oil dock)														
10/17/17	15.31	15.90	22.48	22.80	7.03	6.60	7.51	7.53	8.5	0.50	12.53	14.03	1.78	8:35
10/04/17	19.49	19.60	24.28	25.04	3.86	4.13	7.32	7.39	19.4	0.80	43.55	5.39	1.70	11:00
9/7/17	21.43	21.38	24.71	24.84	5.01	3.59	7.29	7.26	21.7	1.0	14.95	6.06	1.57	11:33
8/30/17	20.03	20.51	19.71	20.87	4.07	3.04	7.15	7.07	18.1	0.4	341.19	16.65	1.39	7:45
8/2/17	Could not do access because of tide.													
7/5/17	22.93	22.76	25.03	25.16	7.87	8.67	7.41	7.54	25.5	0.75	6.25	7.05	1.45	9:25
6/21/17	21.12	20.91	24.29	24.42	6.33	5.57	7.58	7.50	27.3	0.5	80.09	7.35	1.75	9:00
5/24/17	15.68	15.63	24.17	24.28	8.28	8.31	7.67	7.72	15.8	0.75	21.75	8.34	2.15	9:42

Red numbers indicate that the readings were unusually low or high but reflect station conditions.

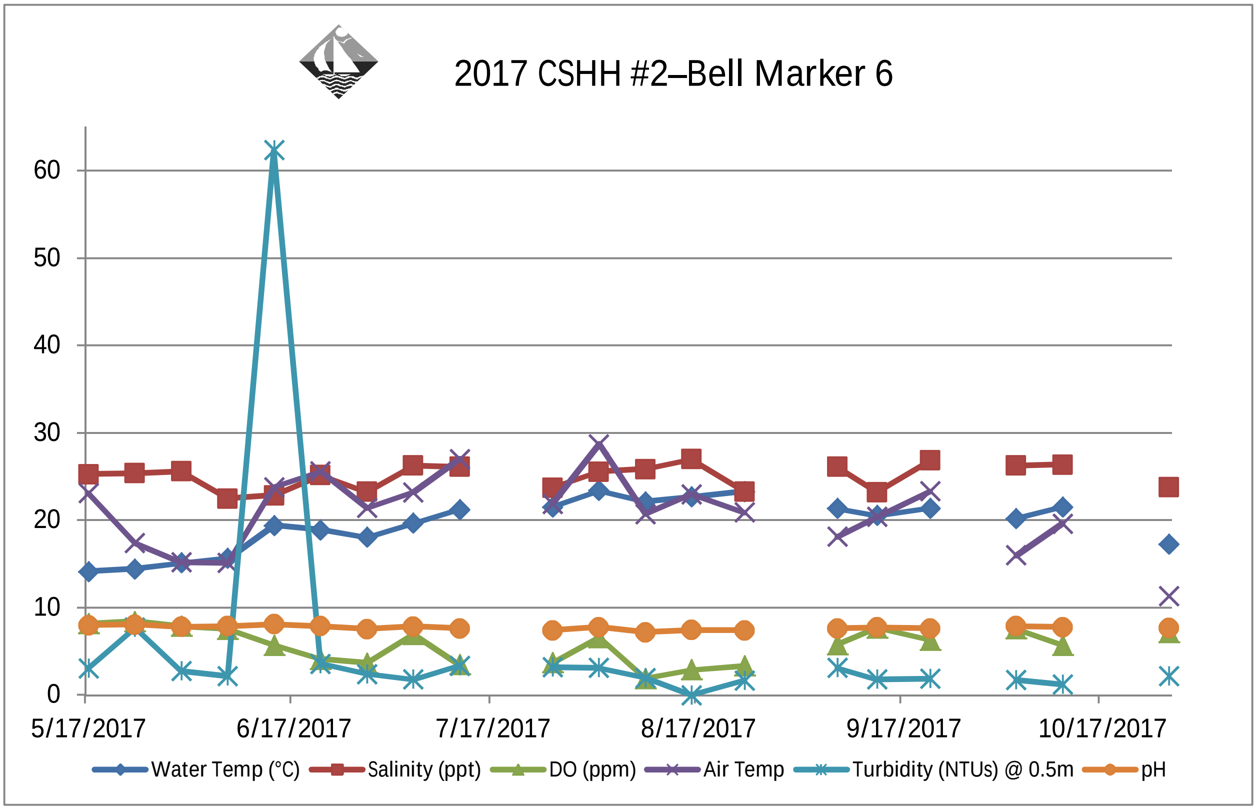
2017 Weekly Graphs for Water-Quality Parameters

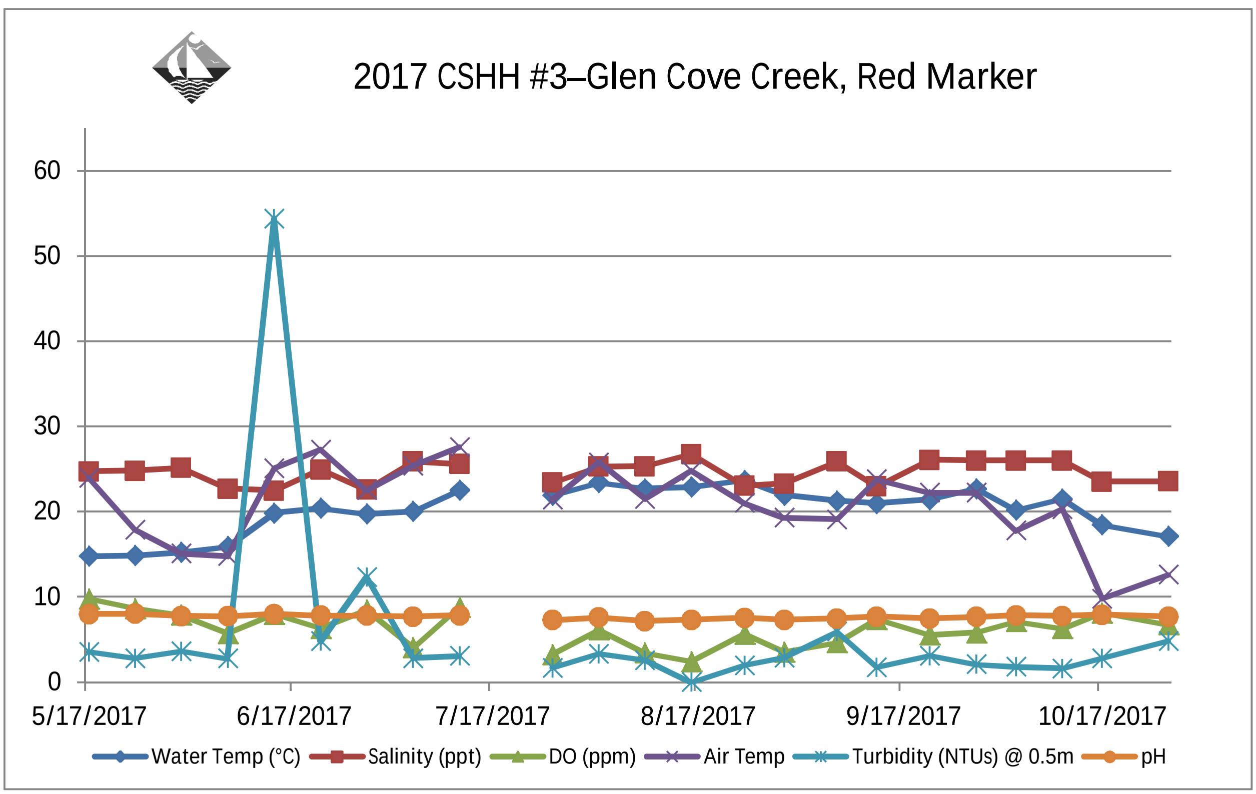
Note: The values graphed below are:

- Water Temperature: the average of the surface and bottom water temperature measurement for that sampling date
- Salinity: the average of the surface and bottom salinity measurement for that sampling date
- DO: the average of the surface and bottom dissolved oxygen measurement for that sampling date
- Air Temp: the measured air temperature at each of the stations on that sampling date
- Turbidity: the turbidity measured at 0.5 meter below the water surface on that sampling date
- pH: the average of the surface and bottom pH measurement for that sampling date

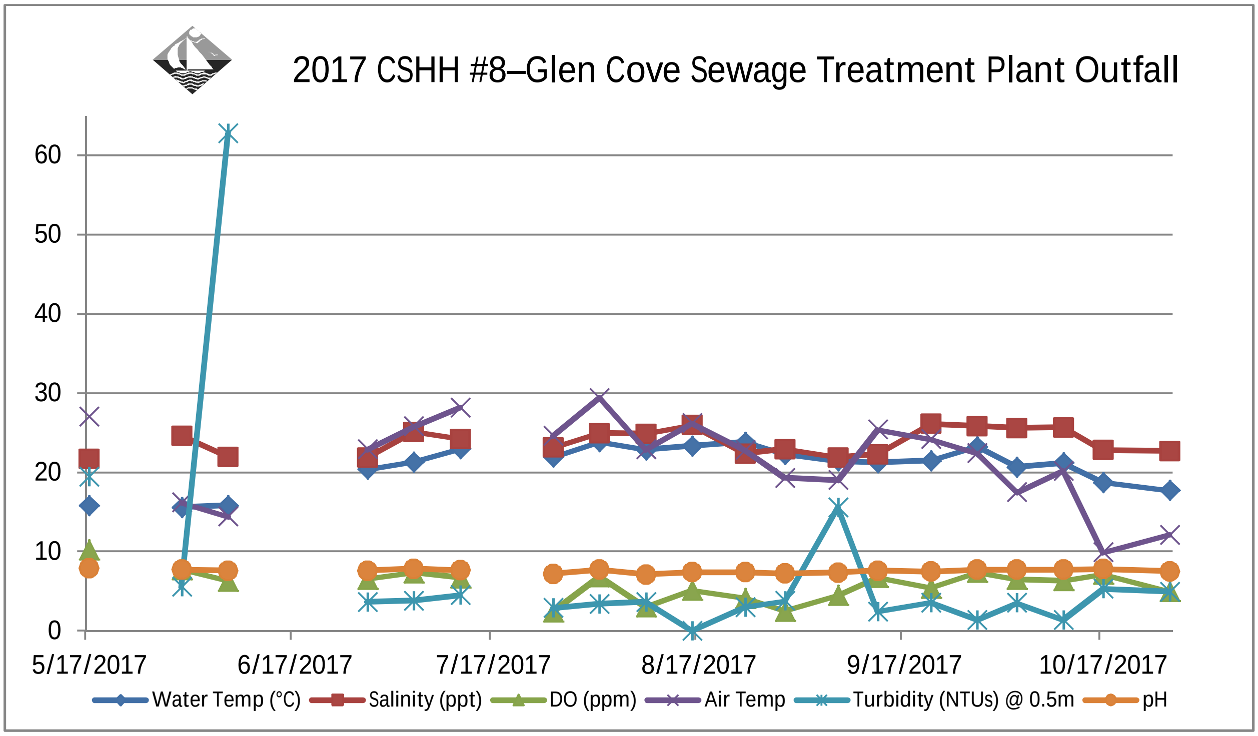


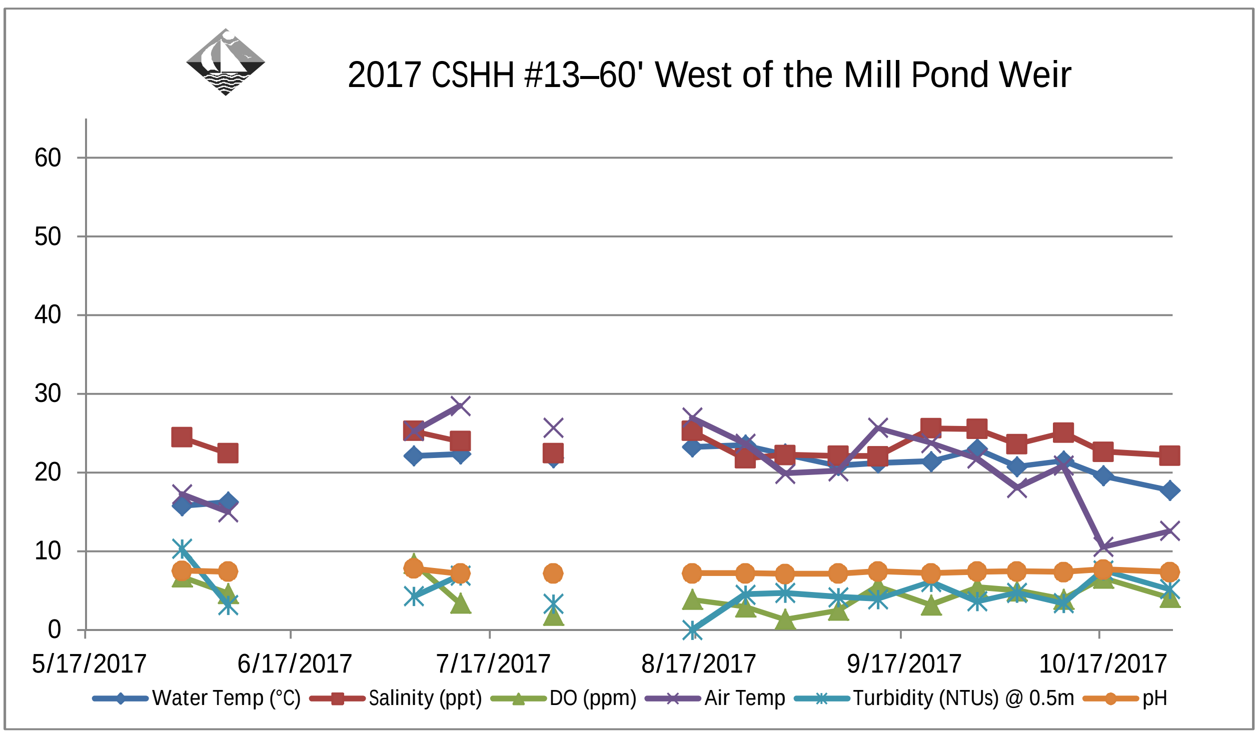
2017 Weekly Graphs for Water-Quality Parameters



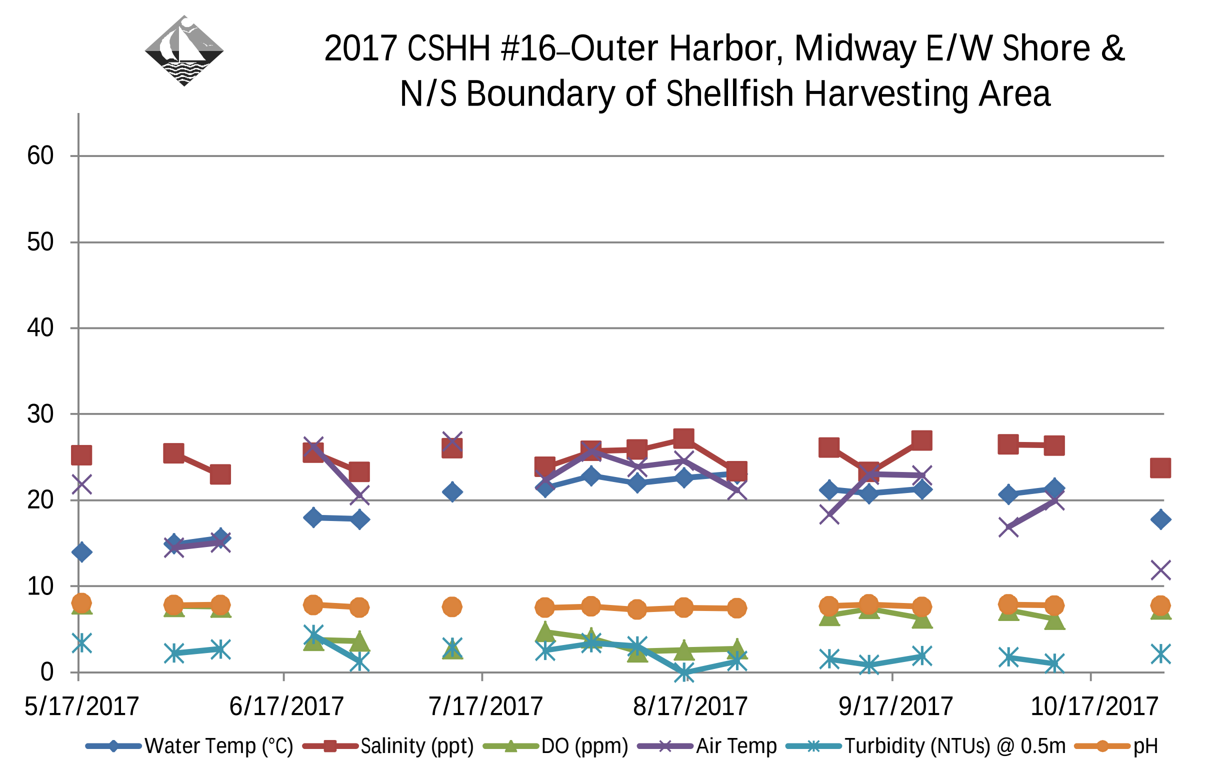


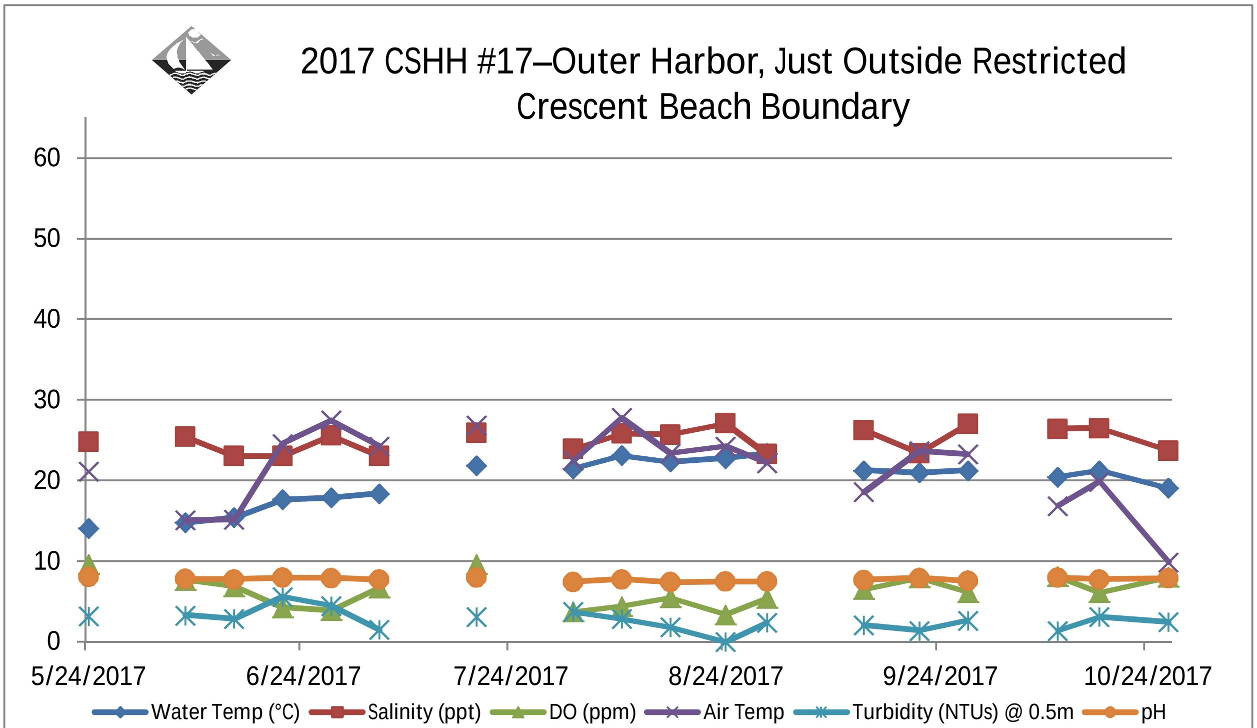
2017 Weekly Graphs for Water-Quality Parameters





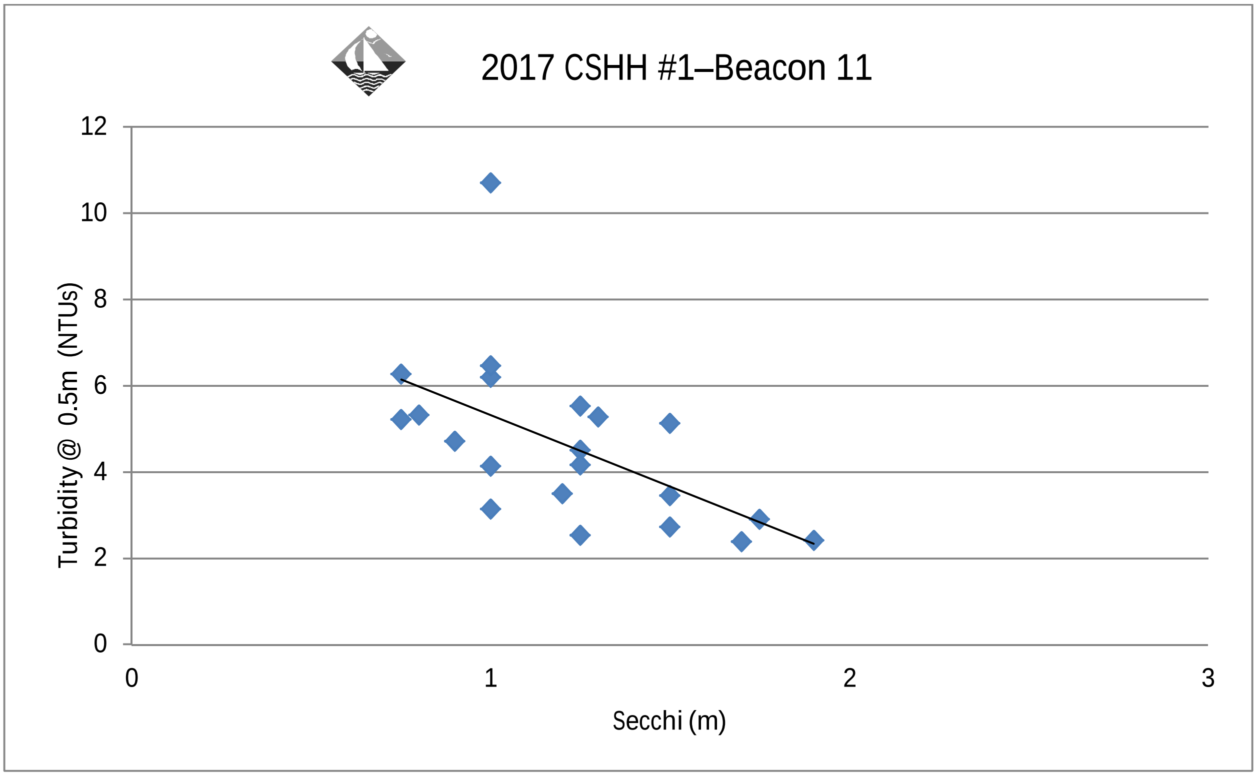
2017 Weekly Graphs for Water-Quality Parameters



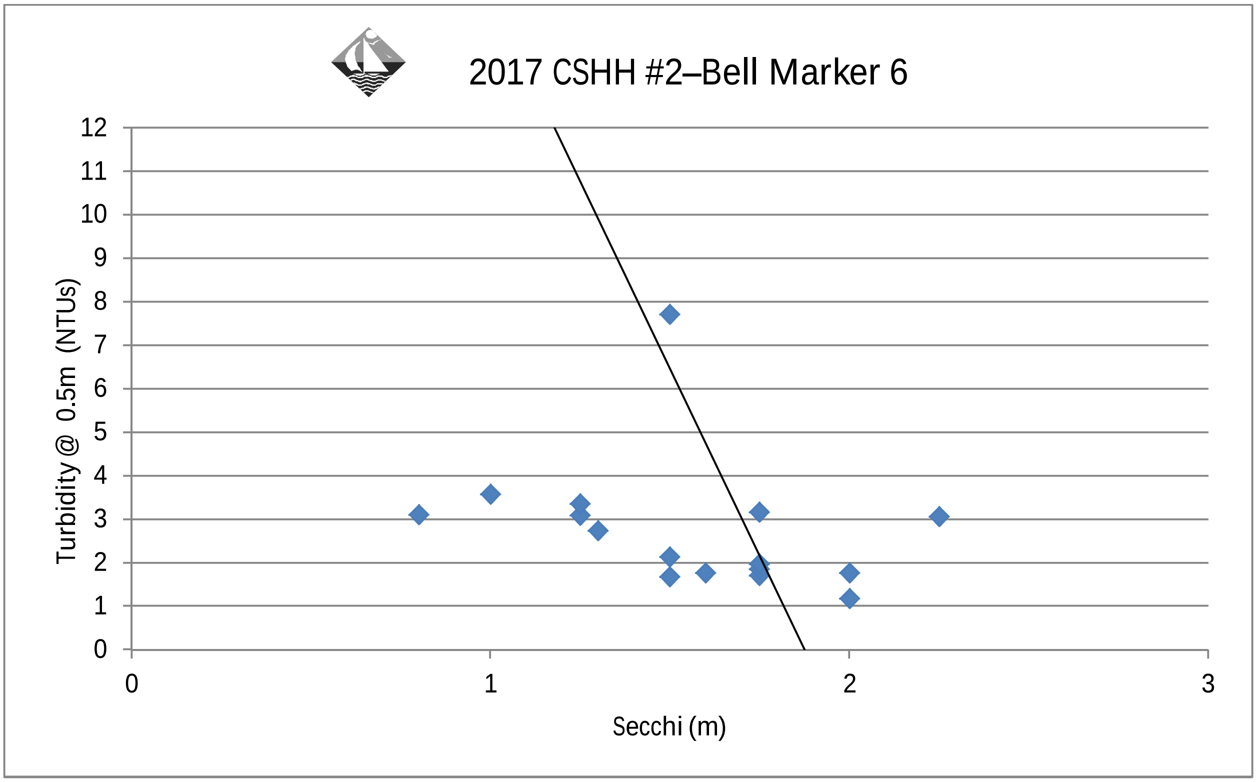


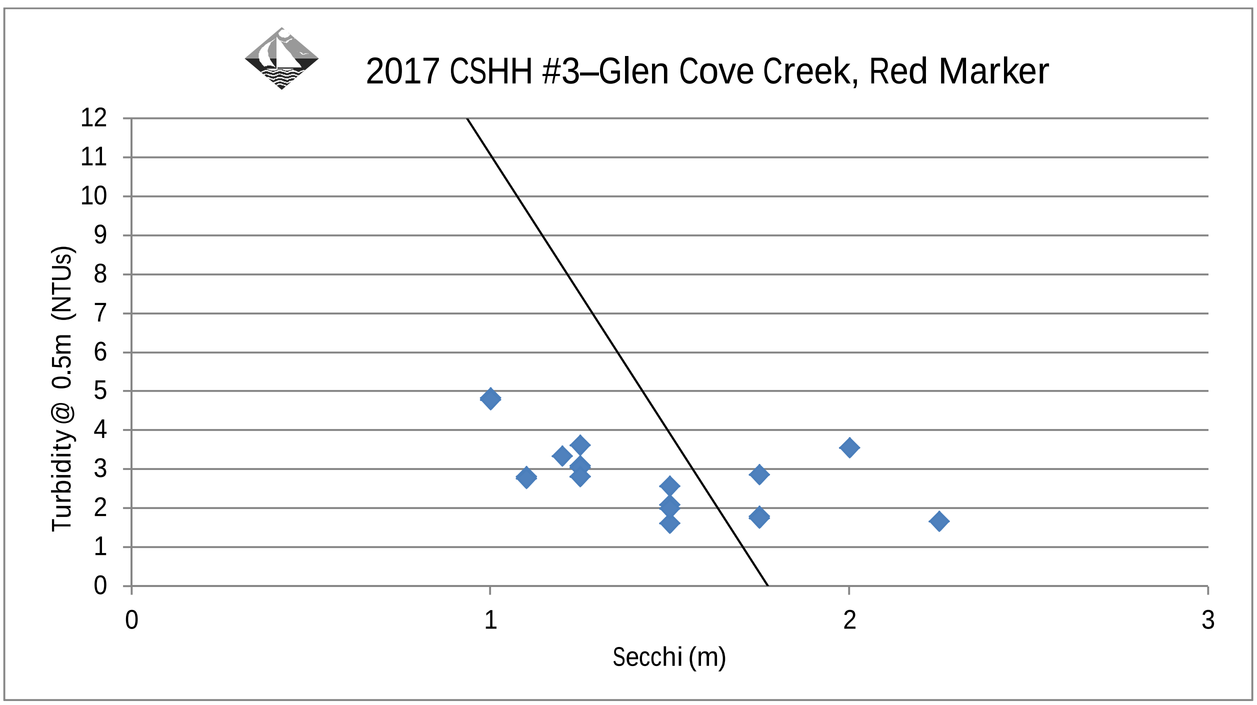
2017 Turbidity and Secchi-Disk Transparency Graphs

Note: A linear trendline, generated by Microsoft Excel, is shown for each graph. This line shows the inverse relationship between Secchi-disk depth and turbidity levels (NTUs), with turbidity measured at 0.5m below the surface. The Secchi-disk is visible to a greater depth when turbidity is lower. Unusually high turbidity measurements may not show on the graph, but still affect the slope of the trendline.

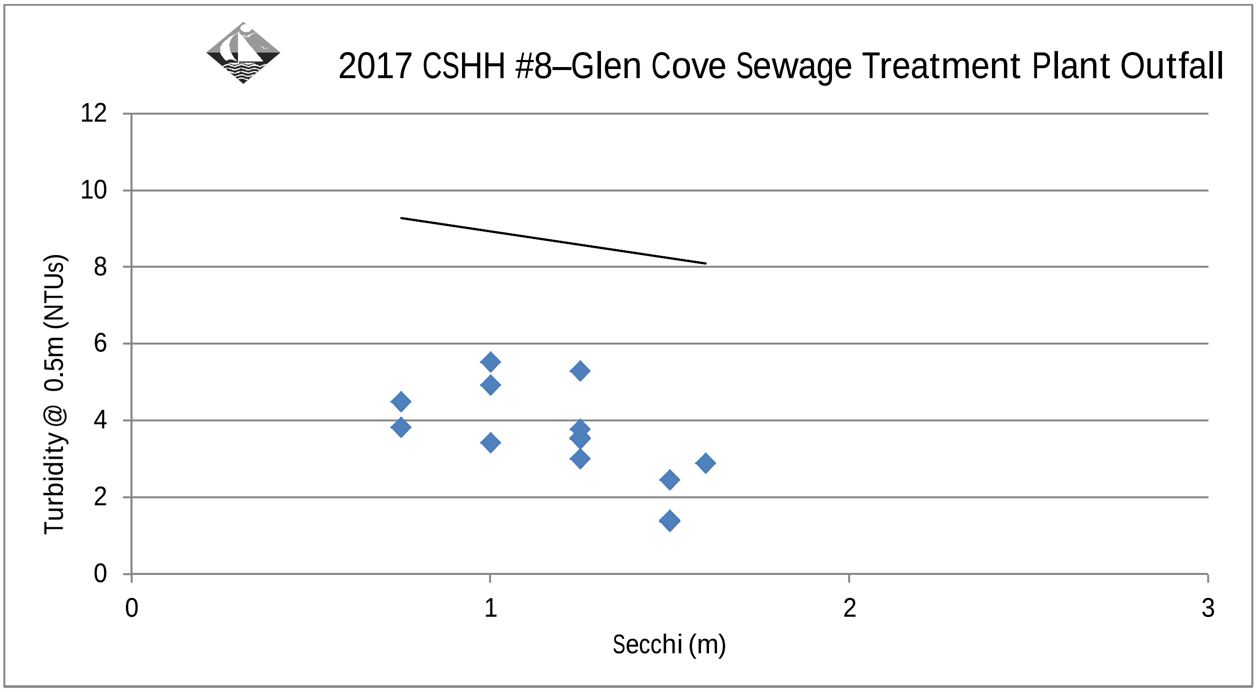


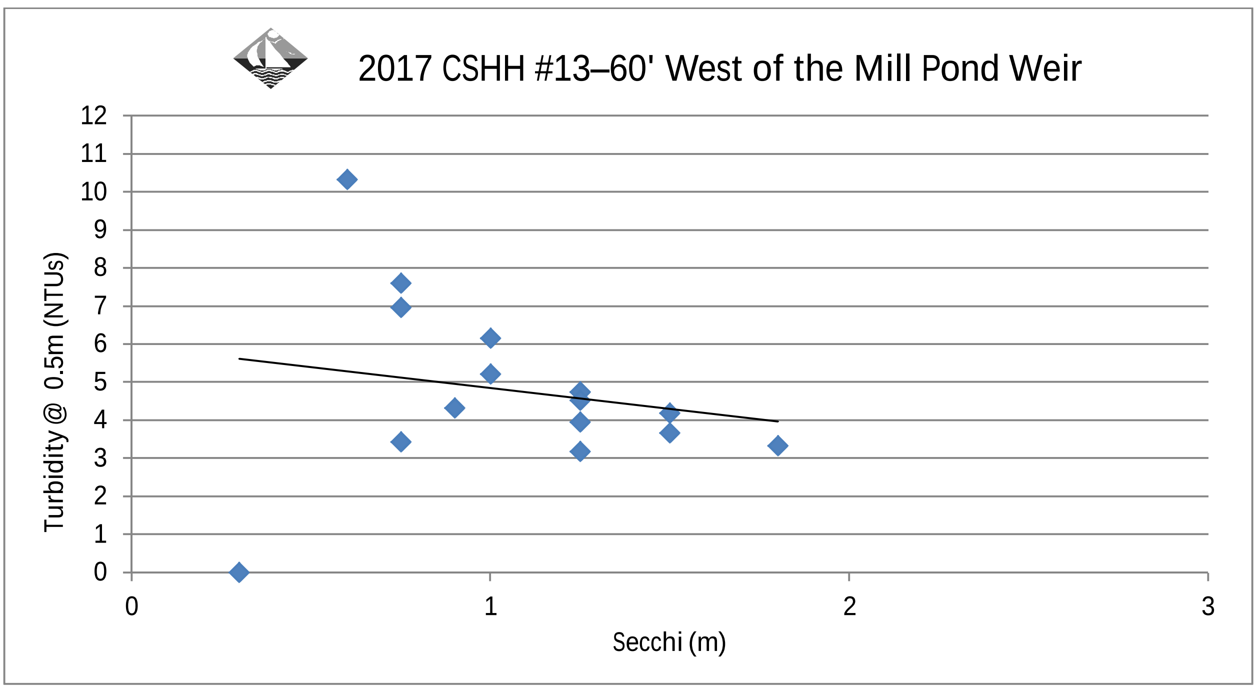
2017 Turbidity and Secchi-Disk Transparency Graphs



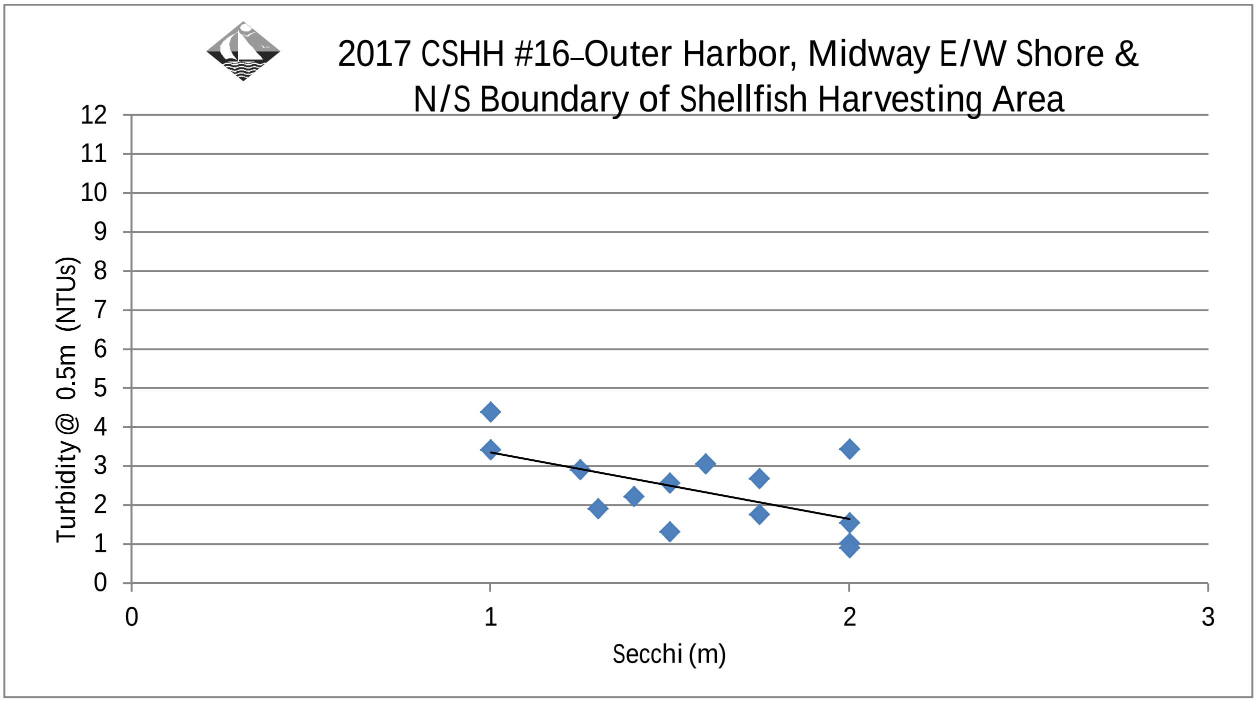


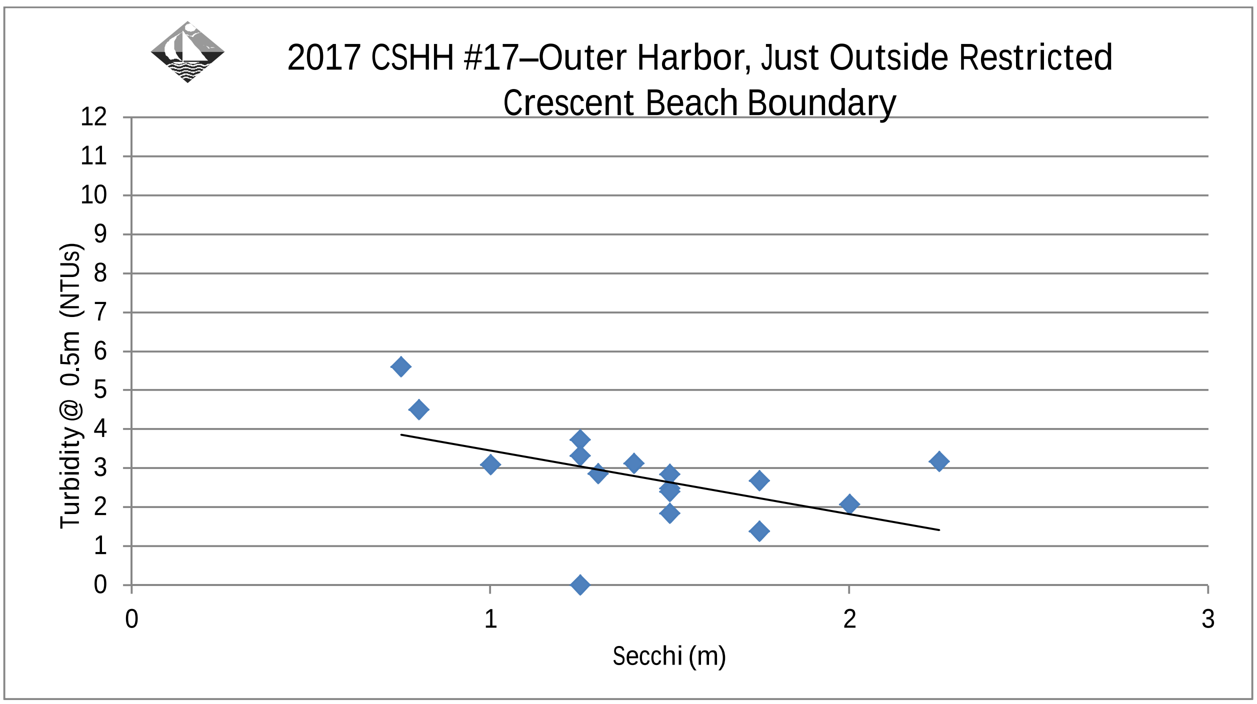
2017 Turbidity and Secchi-Disk Transparency Graphs





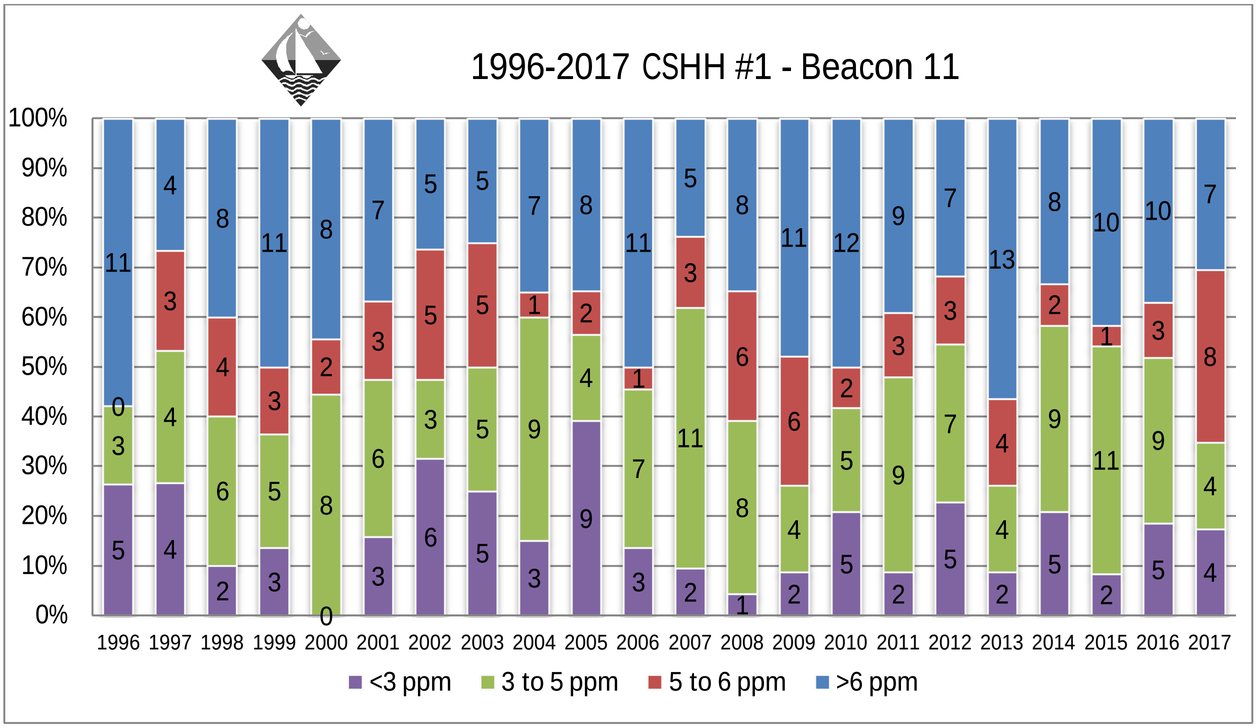
2017 Turbidity and Secchi-Disk Transparency Graphs



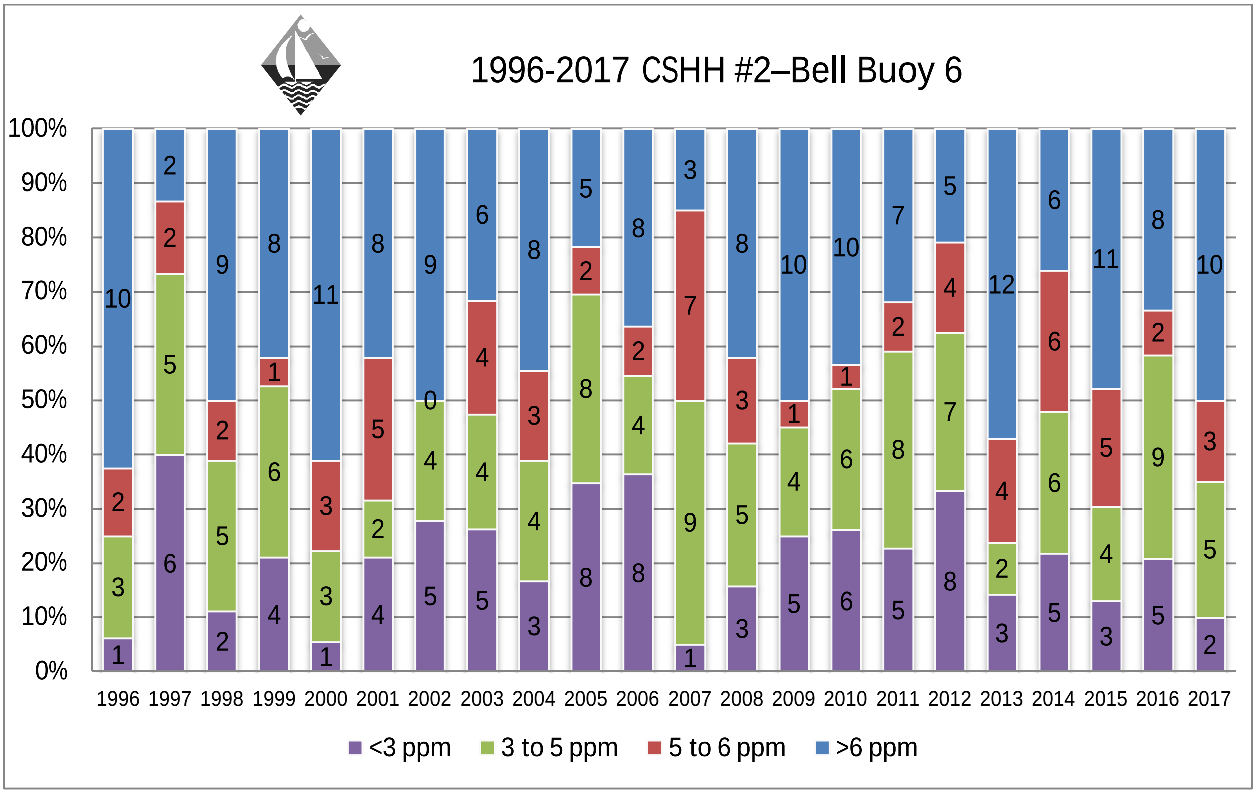


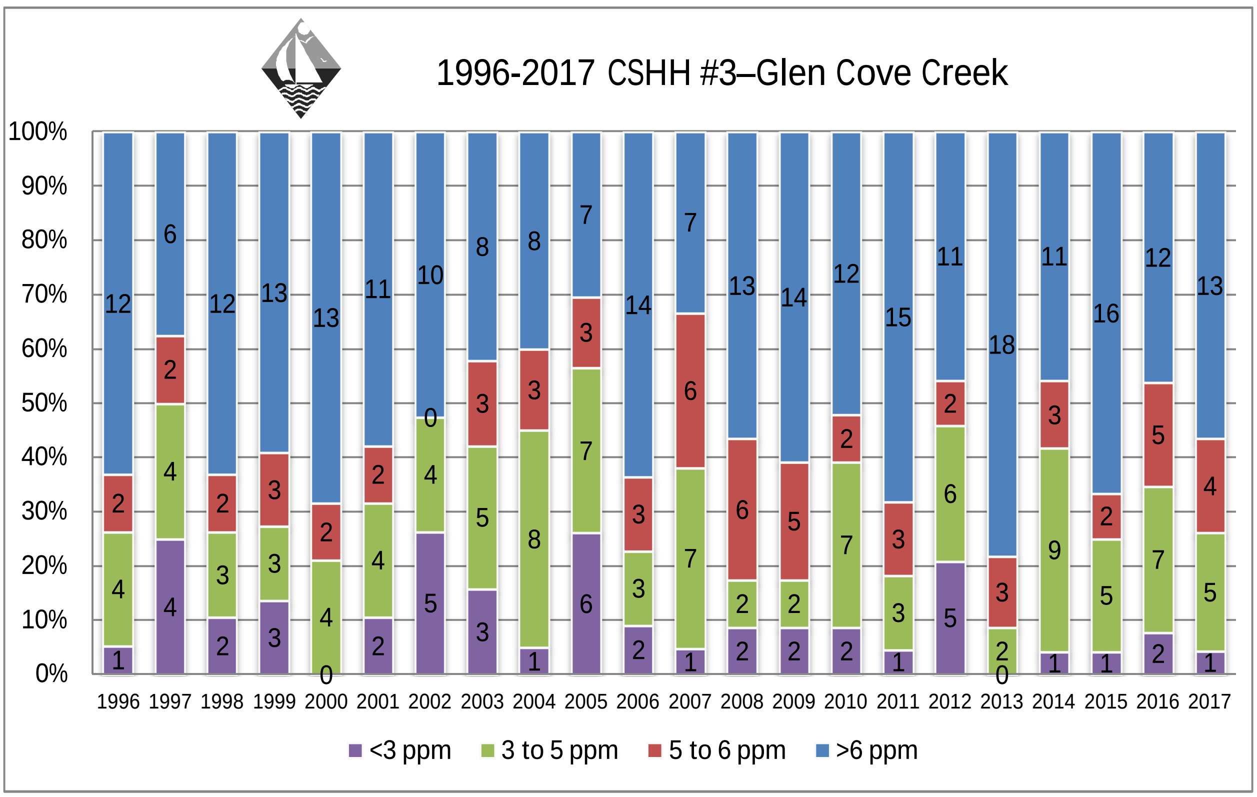
1996-2017 Dissolved Oxygen Graphs

Each vertical bar represents one of CSHH's monitoring sites. Colored bars indicate percentage of all samples taken at a location that fall into each of the four color-coded categories. Numbers inside the bars indicate the number of observations (sample size) within each bar segment. Red bars are representative of hypoxic conditions (DO below 3ppm); DO above 5 ppm is considered a healthy condition.

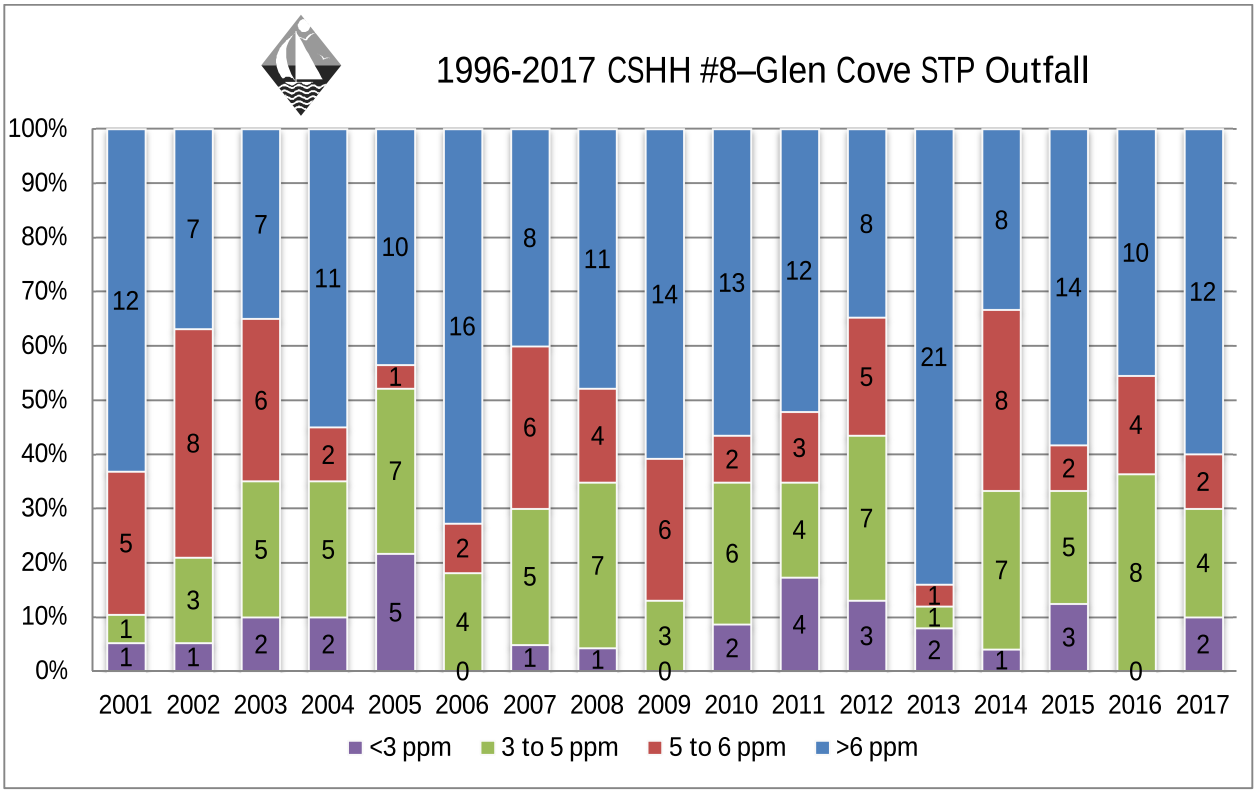


1996-2017 Dissolved Oxygen Graphs





1996-2017 Dissolved Oxygen Graphs



Appendix B

2017 In-Harbor Bacteria Data
2017 In-Harbor Bacteria Graphs
2017 Scudder's Pond and Powerhouse Drain Outfalls Regular Season Monitoring Bacteria Data
2017 Scudder's Pond and Powerhouse Drain Outfalls Regular Season Monitoring Bacteria Graphs
2071-2018 Scudder's Pond and Powerhouse Drain Outfalls Winter-Monitoring Bacteria Data
2017 Beach-Monitoring Bacteria Data
2017 Sea Cliff Precipitation Data
2017 Sea Cliff Precipitation Data (partial)
1997-2017 Monthly Precipitation

2017 In-Harbor Bacteria Data

CSHH #1 - Beacon 11

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	240.00	32.96	19.00	7.81
10/17/17	27.00	30.39	3.00	9.70
10/11/17	100.00	27.02	51.00	8.94
10/4/17	5.00	29.68	5.00	8.19
9/28/17	12.00	44.29	2.00	11.12
9/21/17	160.00	56.07	56.00	15.34
9/13/17	15.00	42.06	2.00	9.46
9/7/17	160.00	47.30	33.00	9.46
8/30/17	37.00	28.18	23.00	2.97
8/24/17	39.00	32.01	10.00	2.76
8/16/17	38.00	30.47	5.00	2.00
8/9/17	27.00	32.47	2.00	3.38
8/2/17	12.00	29.34	0.10	1.60
7/26/17	70.00	35.59	16.00	5.51
7/19/17				
7/12/17	49.00	32.91	41.00	1.77
7/5/17	18.00	30.03	0.10	1.16
6/28/17	26.00	26.14	14.00	1.84
6/21/17	33.00	27.08	3.00	1.68
6/14/17	51.00	28.00	0.10	0.85
6/7/17	31.00	24.10	5.00	1.46
5/31/17	9.00	22.16	1.00	0.97
5/24/17	31.00	34.77	9.00	0.95
5/17/17	39.00	0.00	0.10	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #2 - Bell Marker 6

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	16.00	2.38	0.10	0.10
10/17/17	1.00	2.30	0.10	0.27
10/11/17	1.00	1.29	0.10	0.27
10/4/17	2.00	2.02	0.10	0.27
9/28/17				
9/21/17	14.00	2.24	5.00	0.27
9/13/17	0.10	0.65	0.10	0.10
9/7/17	6.00	1.16	0.10	0.18
8/30/17				
8/24/17	3.00	2.08	0.10	0.31
8/16/17	0.10	1.90	0.10	0.42
8/9/17	1.00	7.61	1.00	0.88
8/2/17	3.00	9.05	0.10	0.49
7/26/17	43.00	3.87	3.00	0.49
7/19/17				
7/12/17	26.00	5.66	2.00	0.18
7/5/17	2.00	1.86	0.10	0.10
6/28/17	0.10	1.86	0.10	0.10
6/21/17	21.00	3.39	0.10	0.10
6/14/17	53.00	2.12	0.10	0.10
6/7/17	0.10	0.95	0.10	0.10
5/31/17	2.00	2.00	0.10	0.10
5/24/17	2.00	2.00	0.10	0.10
5/17/17	2.00	0.00	0.10	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #3 -Glen Cove Creek

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	51.00	38.99	13.00	4.84
10/17/17	6.00	38.68	2.00	5.42
10/11/17	460.00	55.04	34.00	6.76
10/4/17	8.00	34.26	1.00	3.83
9/28/17	80.00	81.78	3.00	7.71
9/21/17	49.00	50.24	23.00	3.91
9/13/17	35.00	45.54	6.00	3.72
9/7/17	43.00	35.45	2.00	1.64
8/30/17	620.00	41.09	33.00	1.43
8/24/17	7.00	24.32	0.10	0.71
8/16/17	30.00	33.20	18.00	1.16
08/09/17	10.00	35.45	0.10	0.74
08/02/17	90.00	35.45	1.00	1.32
7/26/17	45.00	29.12	1.00	1.32
7/19/17				
7/12/17	39.00	67.17	3.00	1.27
7/5/17	10.00	44.54	1.00	0.64
6/28/17	41.00	45.40	1.00	0.85
6/21/17	150.00	62.33	11.00	0.54
6/14/17	570.00	26.28	0.10	0.21
6/7/17	5.00	12.18	0.10	0.25
5/31/17	11.00	16.39	4.00	0.34
5/24/17	200.00	20.00	0.10	0.10
5/17/17	2.00	0.00	0.10	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #4- East of North Hempstead Beach (S) (Former Bar Beach) Sand Spit

	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/17/17	45.00	60.00	3.00	6.93
10/04/17				
09/21/17	80.00	43.42	16.00	10.08
9/7/17	31.00	31.98	4.00	8.00
8/30/17	33.00	31.46	16.00	10.58
8/2/17	30.00	21.91	7.00	3.74
7/5/17	16.00	17.98	2.00	5.65
6/21/17	11.00	21.92	15.00	4.48
6/7/17	33.00	30.94	6.00	2.45
5/24/17	29.00	0.00	1.00	0.00

CSHH #5- Mott's Cave

	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/17/17	510.00	85.14	26.00	13.18
10/04/17	11.00	35.51	4.00	5.60
09/21/17	110.00	63.53	22.00	9.58
9/7/17	37.00	48.28	2.00	6.32
8/30/17	63.00	47.62	20.00	10.00
8/2/17	36.00	44.90	5.00	7.42
7/5/17	56.00	59.28	11.00	11.15
6/21/17	120.00	55.52	21.00	7.96
6/7/17	31.00	37.76	6.00	4.90
5/24/17	46.00	0.00	4.00	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #6- East of the Former Incinerator Site

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/17/17	74.00	57.36	9.00	4.48
10/04/17	15.00	50.99	1.00	3.11
09/21/17	170.00	75.14	10.00	10.35
9/7/17	52.00	49.96	3.00	10.54
8/30/17	48.00	26.83	37.00	1.92
8/2/17	15.00	13.96	0.10	0.32
7/5/17	13.00	34.21	1.00	2.83
6/21/17	90.00	60.00	8.00	9.38
5/24/17	40.00	0.00	11.00	0.00

CSHH #7- West of Old Oil Dock

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/17/17	180.00	96.81	24.00	5.24
10/04/17	42.00	67.49	3.00	1.82
09/21/17	120.00	145.41	2.00	7.94
9/7/17	61.00	160.06	1.00	15.81
8/30/17	420.00	0.00	250.00	0.00
8/2/17				
7/5/17	20.00	50.99	1.00	4.90
6/21/17	130.00	124.90	24.00	15.49
5/24/17	120.00	0.00	10.00	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #8- Glen Cove STP Outfall

	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	210.00	47.18	56.00	11.85
10/17/17	54.00	38.90	17.00	10.78
10/11/17	56.00	32.79	5.00	8.07
10/4/17	23.00	39.93	7.00	12.11
9/28/17	16.00	77.91	7.00	22.36
9/21/17	80.00	100.09	35.00	30.49
9/13/17	23.00	93.86	4.00	33.73
9/7/17	150.00	96.92	38.00	40.51
8/30/17	650.00	95.59	150.00	19.57
8/24/17	56.00	58.12	33.00	11.39
8/16/17	58.00	48.64	58.00	9.45
08/09/17	27.00	77.09	10.00	9.52
8/2/17	140.00	82.98	1.00	9.10
7/26/17	54.00	72.23	10.00	21.86
7/19/17	23.00	95.66	13.00	31.49
7/12/17	580.00	136.62	60.00	39.28
7/5/17	39.00	72.50	8.00	29.47
6/28/17	70.00	75.55	80.00	39.56
6/21/17	220.00	77.50	62.00	31.29
6/14/17				
6/7/17	46.00	34.85	19.00	15.12
5/31/17	46.00	30.33	26.00	13.49
5/24/17				
5/17/17	20.00	0.00	7.00	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #9- First Pipe West of STP Outfall

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
12/11/17	1600.00		4100.00	
10/27/17	480.00	58.02	68.00	20.66
10/17/17	43.00	36.46	26.00	17.17
10/11/17	118.00	38.57	38.00	13.21
10/04/17	30.00	44.08	8.00	12.99
09/28/17	9.00	77.06	7.00	17.93
09/21/17	47.00	127.13	27.00	21.15
09/13/17	57.00	200.63	7.00	25.59
09/07/17	230.00	176.46	35.00	23.93
8/30/2017	490.00	159.78	40.00	14.64
08/24/17	110.00	120.59	16.00	9.66
08/16/17	460.00	85.75	70.00	8.96
08/09/17	30.00	87.54	5.00	7.97
08/02/17	140.00	89.22	3.00	9.65
07/26/17	120.00	74.81	5.00	19.83
07/19/17	20.00	97.87	11.00	45.84
07/12/17	510.00	145.57	39.00	65.50
07/05/17	33.00	77.98	13.00	52.42
06/28/17	58.00	174.11	110.00	136.57
06/21/17	460.00	251.15	330.00	146.79
06/07/17	42.00	111.27	16.00	44.18
05/31/17	820.00	181.11	599.00	73.42
05/17/17	40.00	0.00	9.00	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #10-Pipe at Corner of Seawall West of STP Outfall

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	170.00	62.91	53.00	21.21
10/17/17	43.00	51.08	27.00	15.76
10/11/17	490.00	53.85	120.00	15.52
10/04/17	25.00	49.14	5.00	12.58
09/28/17	11.00	92.81	5.00	32.99
09/21/17	60.00	131.58	12.00	46.22
09/13/17	56.00	204.19	25.00	67.55
09/07/17	310.00	188.95	42.00	50.77
8/30/2017	601.00	180.99	620.00	37.31
08/24/17	63.00	126.44	27.00	14.23
08/16/17	540.00	106.73	80.00	11.89
08/09/17	38.00	107.89	6.00	11.19
08/02/17	250.00	120.85	9.00	12.85
07/26/17	100.00	90.54	5.00	21.92
07/19/17	27.00	126.38	11.00	47.14
07/12/17	570.00	185.90	59.00	67.83
07/05/17	67.00	97.42	12.00	42.39
06/28/17	59.00	178.20	130.00	112.68
06/21/17	530.00	257.59	230.00	107.43
06/07/17	43.00	106.07	9.00	51.95
05/31/17	750.00	166.58	599.00	124.80
05/17/17	37.00	0.00	26.00	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #11-50 Yards East of STP Outfall

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	320.00	192.17	67.00	44.94
10/17/17	150.00	174.93	38.00	48.69
10/11/17	700.00	229.26	600.00	14.84
10/04/17	20.00	222.37	3.00	10.76
09/28/17	390.00	439.19	40.00	19.71
09/21/17	200.00	395.17	100.00	17.16
09/13/17	580.00	419.62	0.10	6.83
09/07/17	601.00	405.70	120.0	26.01
08/30/17	601.00	402.83	62.00	12.44
08/24/17	230.00	355.12	20.00	8.04
08/16/17	270.00	395.85	1.00	6.40
08/09/17	490.00	481.29	80.00	24.08
08/02/17	580.00	284.71	3.00	8.05
07/26/17	320.00	224.59	7.00	11.19
07/12/17	590.00	188.15	200.00	14.14
07/05/17	60.00	64.81	1.00	4.90
06/07/17	70.00	279.97	24.00	166.23
05/31/17	570.00	559.91	330.00	437.49
05/17/17	550.00	0.00	580.00	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #12- Bend in Seawall East of STP Outfall

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	220.00	183.00	61.00	51.43
10/17/17	130.00	183.00	56.00	57.86
10/11/17	800.00	210.21	260.00	16.32
10/04/17	39.00	198.52	15.00	15.64
09/28/17	230.00	343.06	27.00	26.51
09/21/17	220.00	348.83	110.00	26.71
09/13/17	260.00	345.60	0.10	18.59
09/07/17	601.00	372.85	210.00	51.31
08/30/17	601.00	307.69	210.00	17.61
08/24/17	250.00	256.08	28.00	8.92
08/16/17	210.00	257.62	18.00	6.70
08/09/17	380.00	332.11	16.00	10.77
08/02/17	230.00	199.02	1.00	6.40
07/26/17	240.00	189.65	7.00	11.89
07/12/17	580.00	168.58	120.00	15.49
07/05/17	49.00	138.24	2.00	10.77
06/07/17	390.00	398.04	58.00	66.93
05/31/17	330.00	402.12	110.00	71.90
05/17/17	490.00	0.00	47.00	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #13- 60 Feet Downstream of Mill Pond Weir

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	360.00	217.57	120.00	68.49
10/17/17	110.00	215.10	44.00	78.00
10/11/17	540.00	189.90	120.00	72.73
10/4/17	120.00	194.01	58.00	78.87
9/28/17	190.00	267.77	41.00	110.98
9/21/17	340.00	264.89	230.00	118.96
9/13/17	59.00	233.25	31.00	87.67
9/7/17	601.00	328.91	180.00	113.69
8/30/17	601.00	269.03	320.00	97.54
8/24/17	180.00	265.86	58.00	43.30
8/16/17	180.00	323.11	50.00	37.42
08/09/17				
8/2/17				
7/26/17	580.00	311.27	28.00	42.80
7/19/17				
7/12/17	520.00	228.04	200.00	52.92
7/5/17	100.00	69.28	14.00	25.65
6/28/17				
6/21/17				
6/14/17				
6/7/17	48.00	72.66	47.00	65.04
5/31/17	110.00	0.00	90.00	0.00
5/24/17				
5/17/17				

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #14- NW Corner of Power Plant, Approximately 50 Yards from Cement Outfall

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/17/17	27.00	23.24	13.00	8.83
10/4/17	20.00	27.93	6.00	3.46
9/7/17	39.00	132.76	2.00	22.74
8/30/17	120.00	118.88	28.00	18.05
8/16/17	500.00	118.32	210.00	14.49
8/2/17	28.00	60.33	1.00	3.61
7/5/17	130.00	48.89	13.00	6.16
6/21/17	29.00	56.44	3.00	10.80
6/7/17	31.00	78.74	6.00	20.49
5/24/17	200.00	0.00	70.00	0.00

CSHH #15- NW Corner of Tappen Pool

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/17/17	31.00	34.77	6.00	7.35
10/4/17	39.00	62.45	9.00	15.87
9/7/17	100.00	122.47	28.00	34.29
8/30/17	150.00	0.00	42.00	0.00
8/2/17				
7/5/17	12.00	36.33	3.00	7.75
6/7/17	110.00	40.62	20.00	6.32
5/24/17	15.00	0.00	2.00	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #16- Outer Harbor Midway E/W Shore

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	1.00	0.67	0.10	0.10
10/17/17	1.00	0.88	0.10	0.18
10/11/17	2.00	1.05	0.10	0.18
10/4/17	0.10	0.84	0.10	0.22
9/28/17				
9/21/17	3.00	2.62	1.00	0.46
9/13/17	2.00	1.82	0.10	0.22
9/7/17				
8/30/17				
8/24/17	3.00	3.44	1.00	0.25
8/16/17	1.00	3.56	0.10	0.18
8/9/17	2.00	9.90	1.00	0.49
8/2/17	4.00	16.87	0.10	0.39
7/26/17	20.00	10.63	0.10	0.39
7/19/17				
7/12/17	60.00	16.38	6.00	1.48
7/5/17				
6/28/17	1.00	2.61	0.10	0.38
6/21/17	75.00	3.31	80.00	0.53
6/14/17	16.00	0.63	0.10	0.10
6/7/17	0.10	0.22	0.10	0.10
5/31/17	1.00	0.32	0.10	0.10
5/24/17				
5/17/17	0.10	0.00	0.10	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

2017 In-Harbor Bacteria Data

CSHH #17-Outside Crescent Beach Restricted Area

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	4.00	1.86	1.00	0.74
10/17/17	0.10	2.45	1.00	1.20
10/11/17	15.00	6.16	3.00	0.68
10/4/17	2.00	4.90	0.10	0.84
9/28/17				
9/21/17	12.00	5.83	7.00	1.49
9/13/17	4.00	3.13	0.10	0.51
9/7/17	6.00	2.21	7.00	0.51
8/30/17				
8/24/17	4.00	1.74	1.00	0.16
8/16/17	1.00	1.41	0.10	0.10
8/9/17	1.00	2.45	0.10	0.18
8/2/17	1.00	3.30	0.10	0.22
7/26/17	4.00	5.24	0.10	0.22
7/19/17				
7/12/17	9.00	5.30	1.00	0.18
7/5/17				
6/28/17	4.00	5.17	0.10	0.21
6/21/17	22.00	5.51	0.10	0.25
6/14/17	1.00	3.03	0.10	0.25
6/7/17	14.00	4.38	4.00	0.34
5/31/17	3.00	2.45	0.10	0.10
5/24/17				
5/17/17	2.00	0.00	0.10	0.00

Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

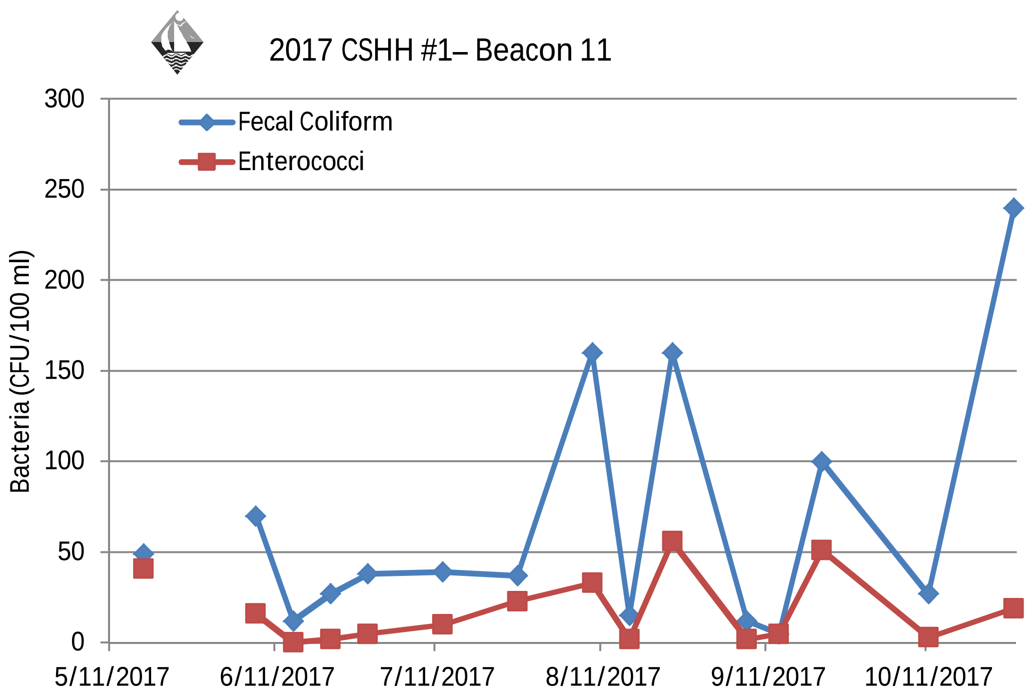
2017 In-Harbor Bacteria Data

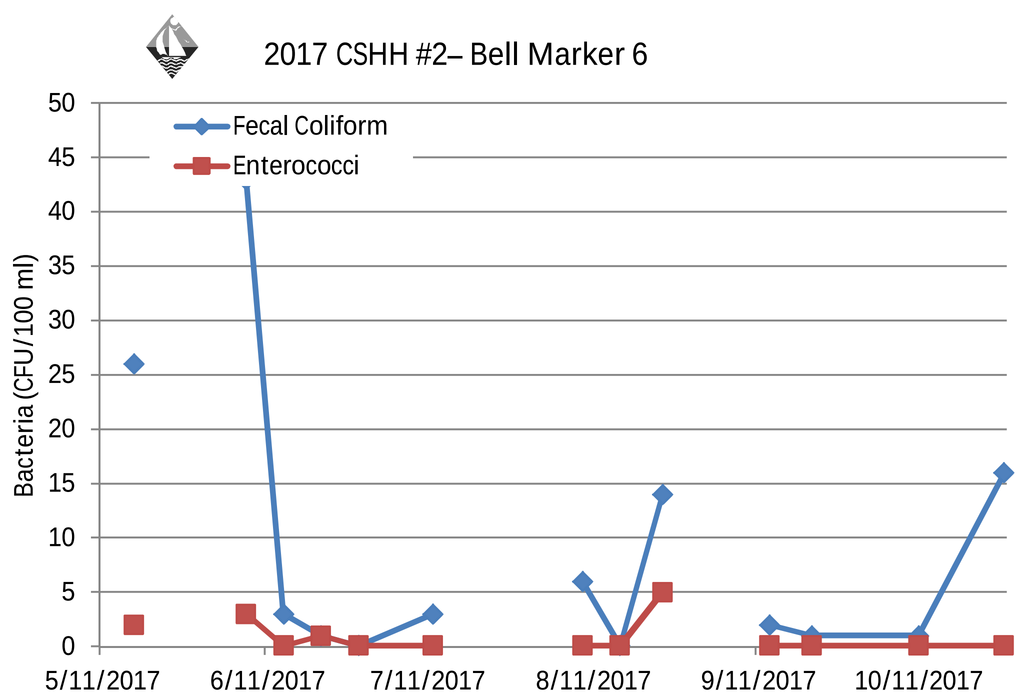
CSHH #17A- Within the Restricted Shellfishing Area

	Fecal Coliform		*Enterococci*	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	2.00	6.63	0.10	0.63
10/11/17	22.00	18.24	4.00	1.89
9/21/17	46.00	18.45	17.00	1.14
9/13/17	6.00	3.98	0.10	0.32
9/7/17	210.00	3.35	10.00	0.32
8/24/17	2.00	1.16	0.10	0.10
8/16/17	0.10	0.97	0.10	0.10
8/9/17	3.00	5.01	0.10	0.10
7/26/17	3.00	7.73	0.10	0.22
7/12/17	14.00	9.07	0.10	0.18
6/28/17	11.00	7.27	1.00	0.35
6/21/17	22.00	6.56	0.10	0.27
6/14/17	2.00	3.60	0.10	0.27
6/7/17	14.00	4.38	5.00	0.37
5/31/17	3.00	2.45	0.10	0.10
5/17/17	2.00	0.00	0.10	0.00

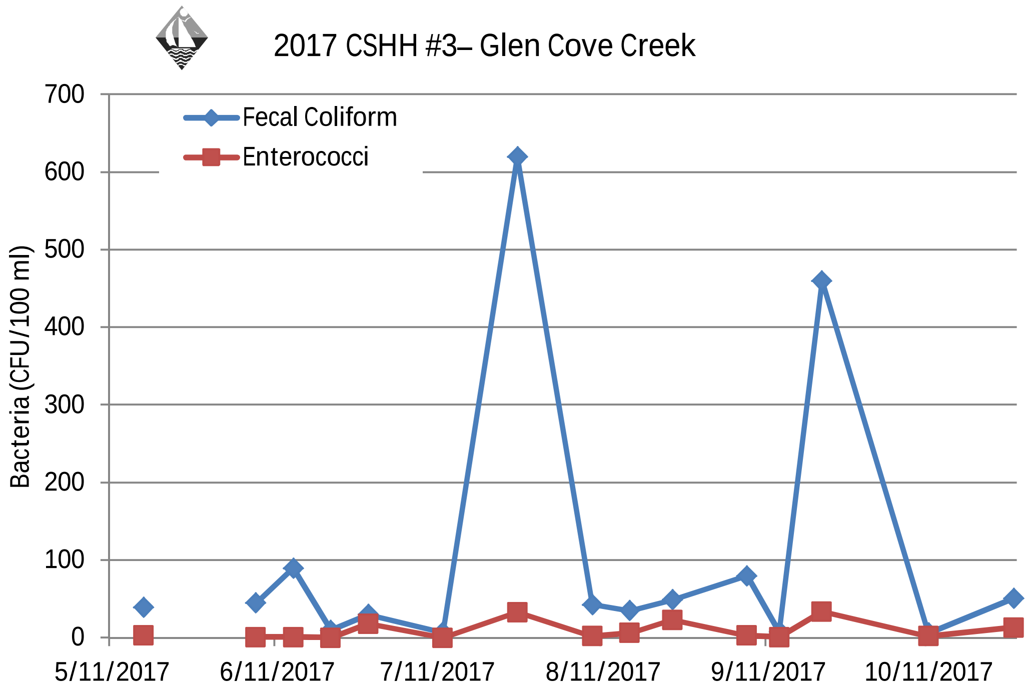
Note: CFU refers to the number of colony forming units, or the number of bacterial cells in the water sample. Log AvgFC (log average for fecal coliform) and Log AvgEnt (log average for enterococci) refer to the running seasonal average of bacteria results at each location. Boldfaced, italicized values exceed the NYS shellfish bed closure standards of 1,000 CFU/100 ml for fecal coliform and 200 Log AvgFC or NYS beach closure standards of 104 CFU/100 ml for enterococci and 35 Log AvgEnt.

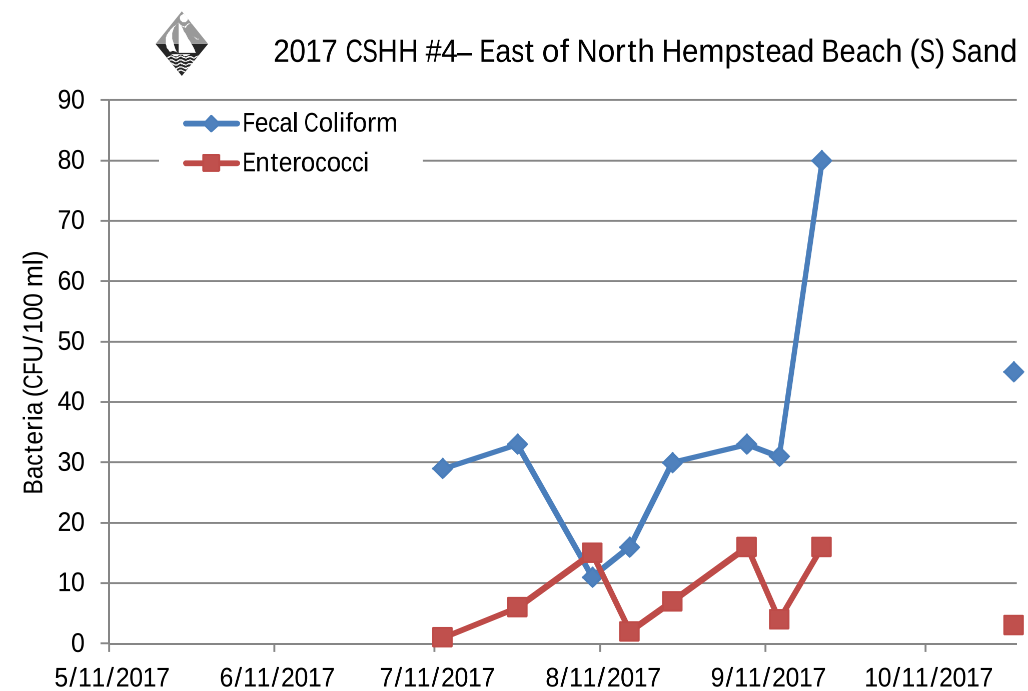
2017 In-Harbor Bacteria Graphs



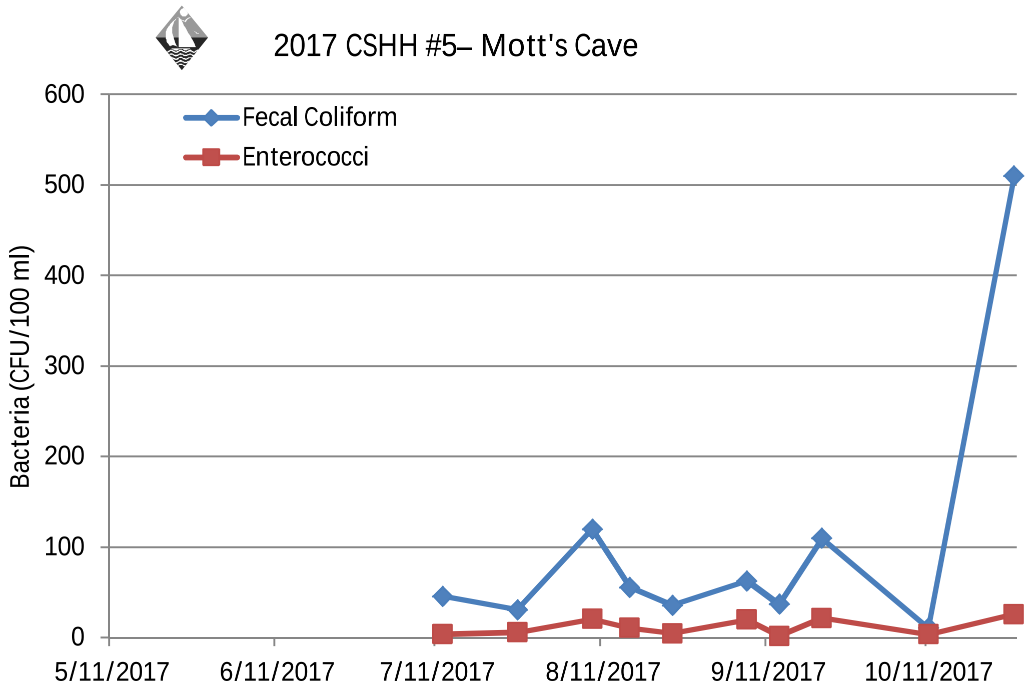


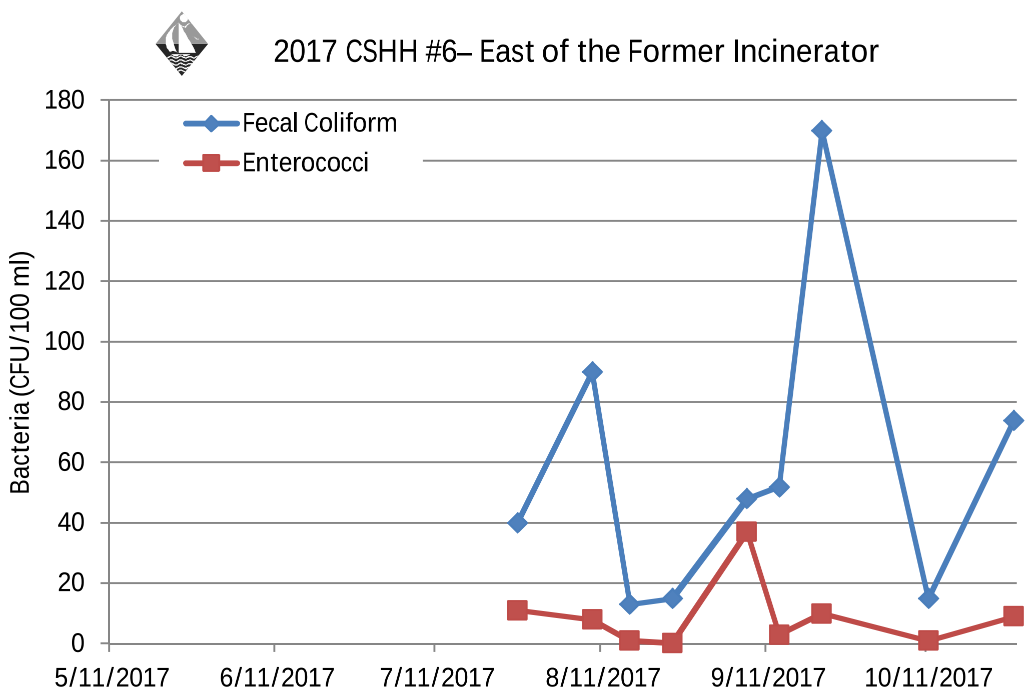
2017 In-Harbor Bacteria Graphs



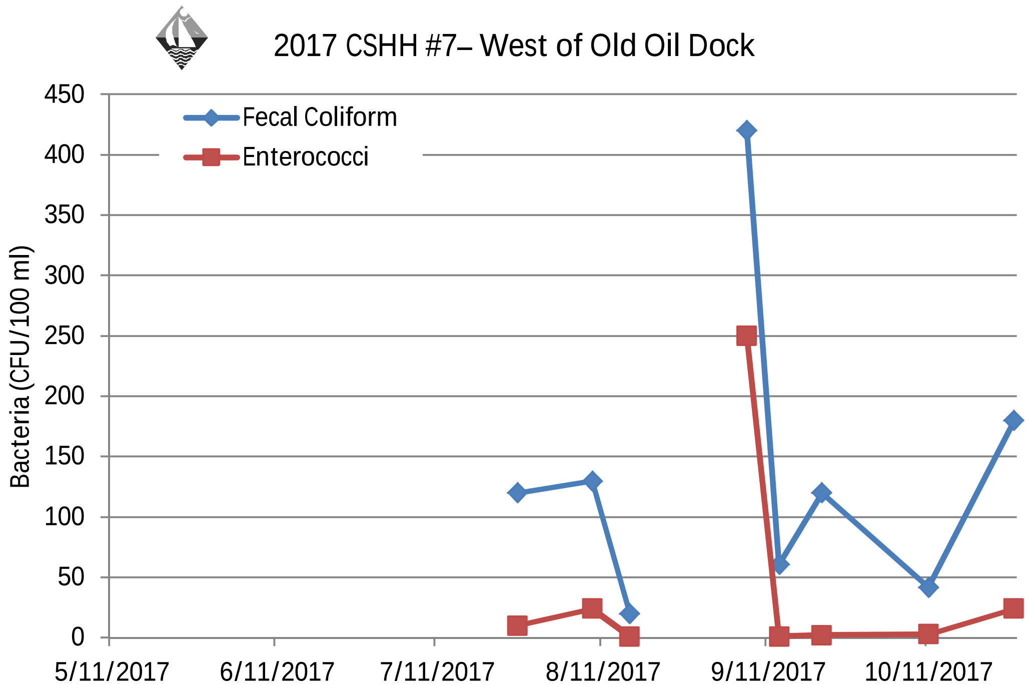


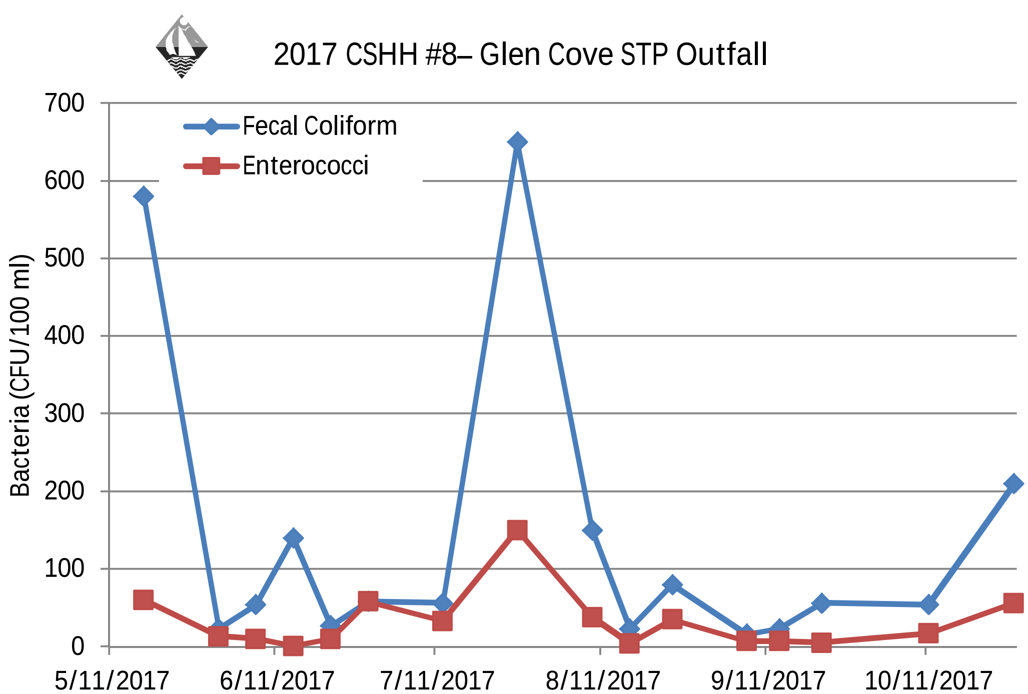
2017 In-Harbor Bacteria Graphs



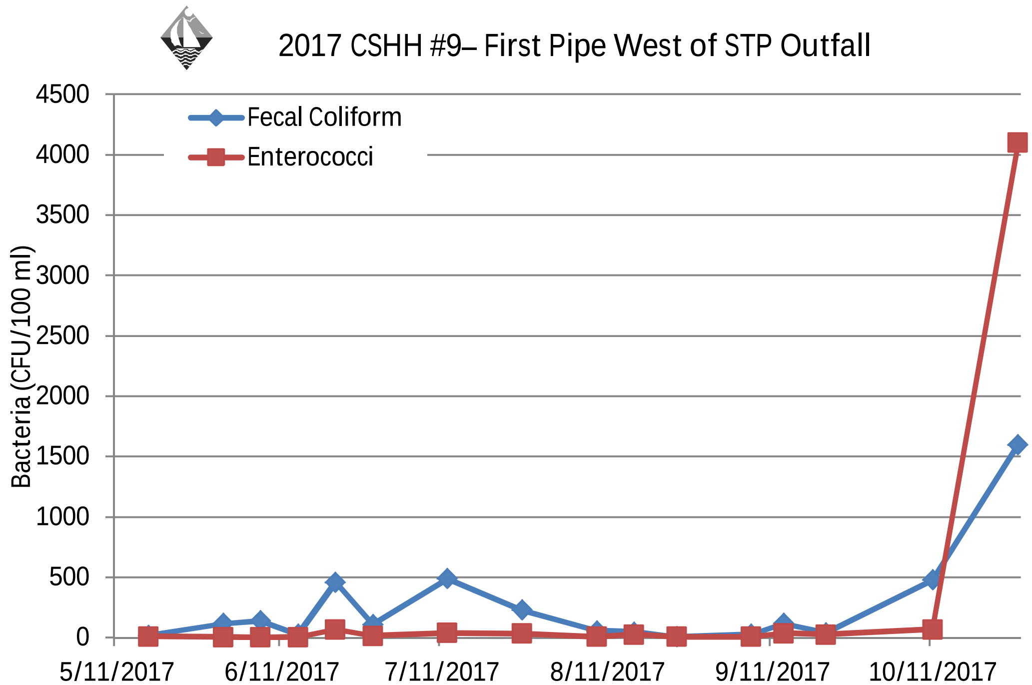


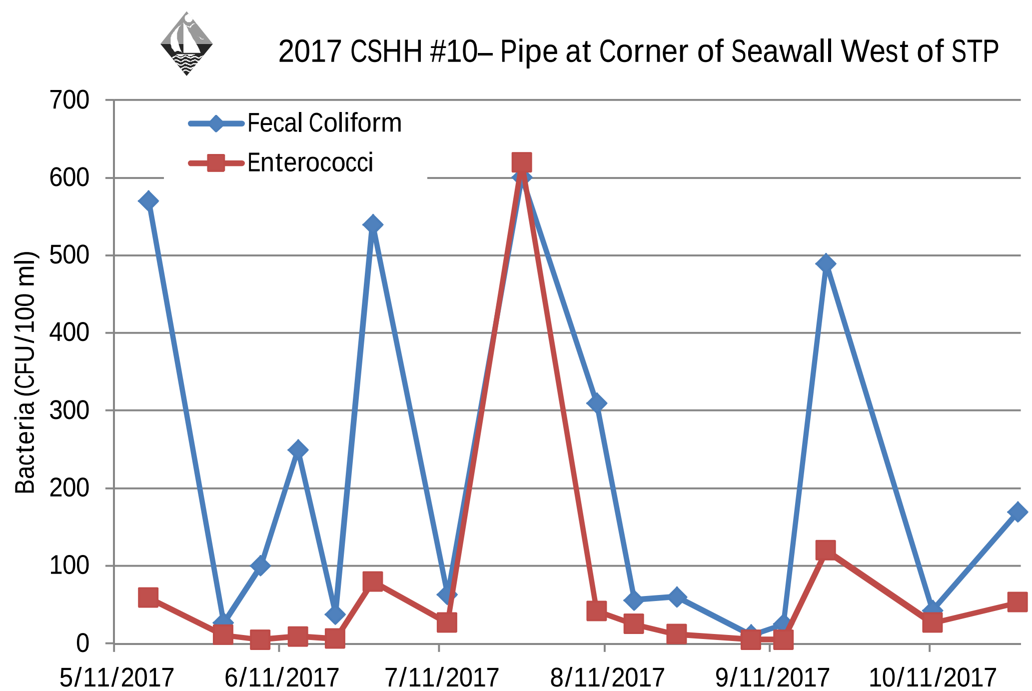
2017 In-Harbor Bacteria Graphs



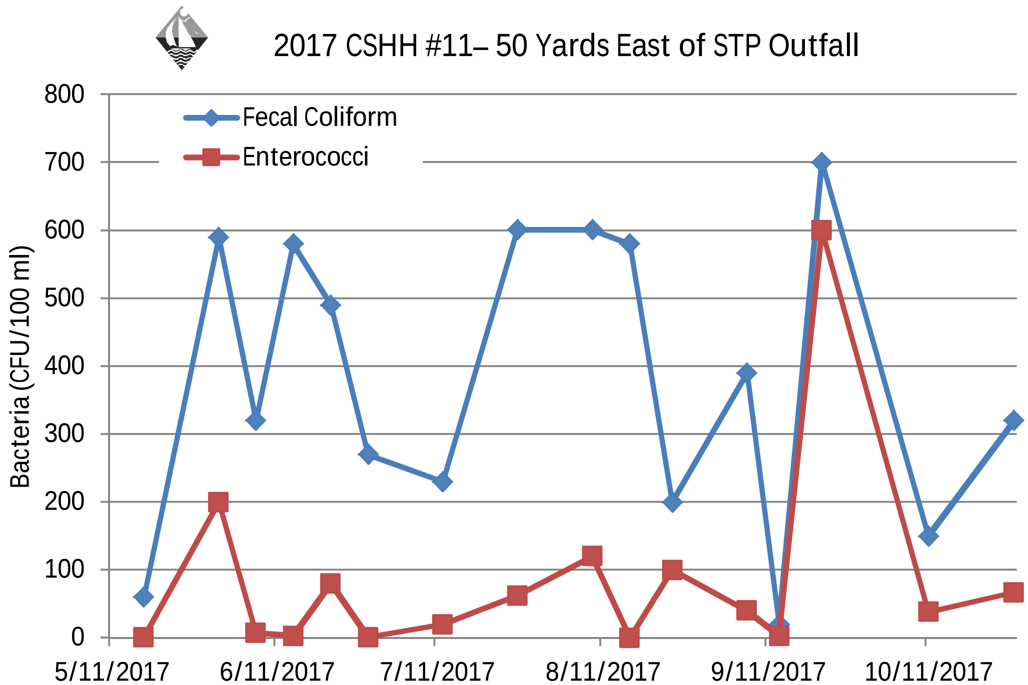


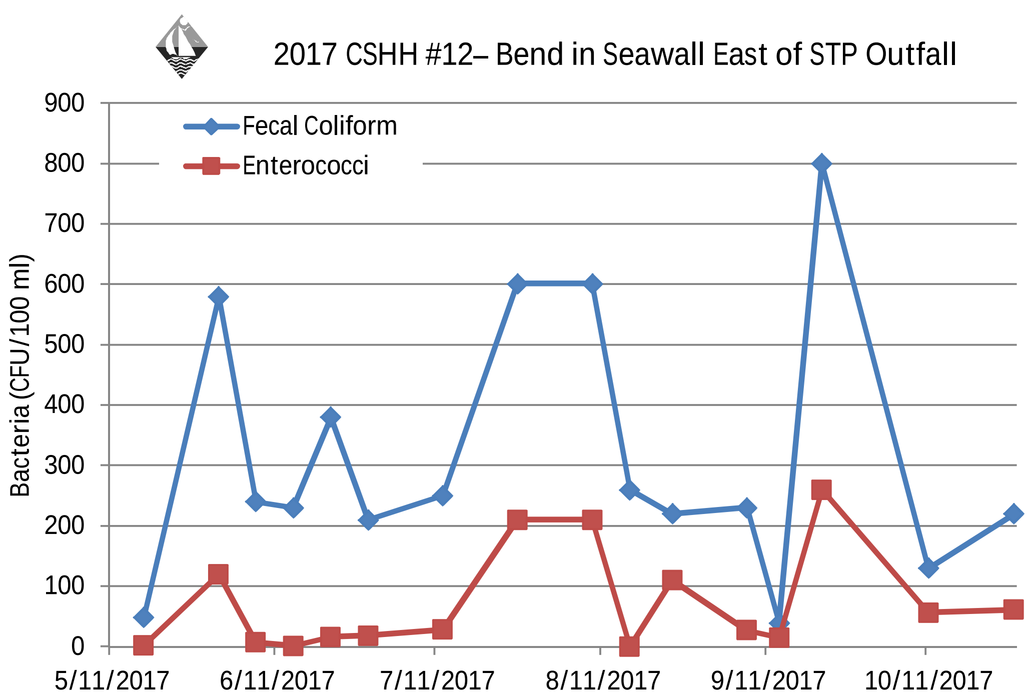
2017 In-Harbor Bacteria Graphs



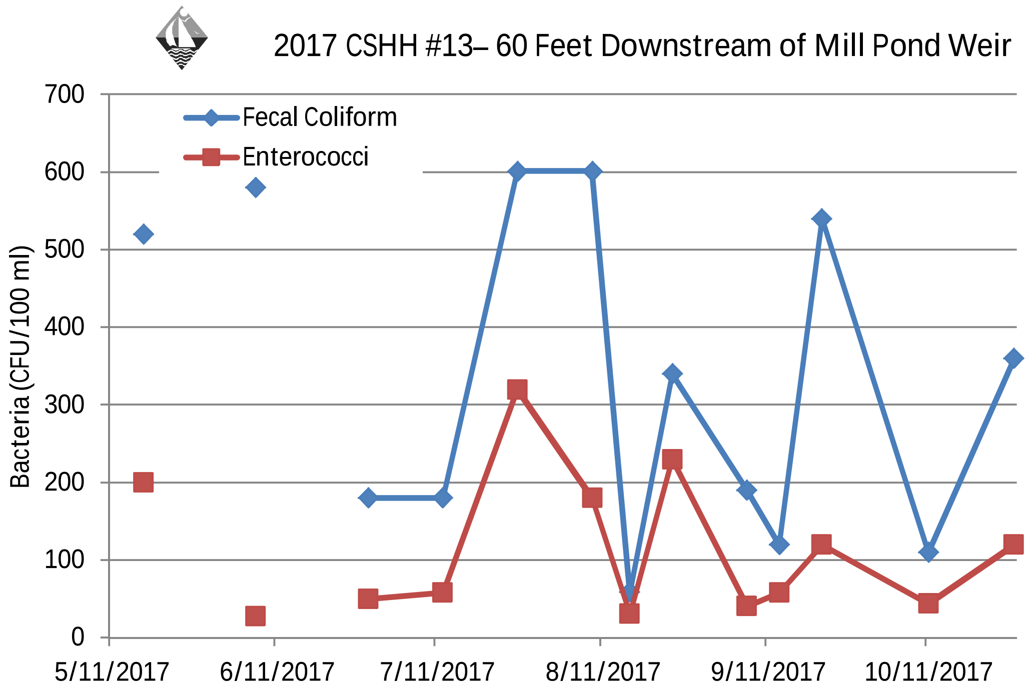


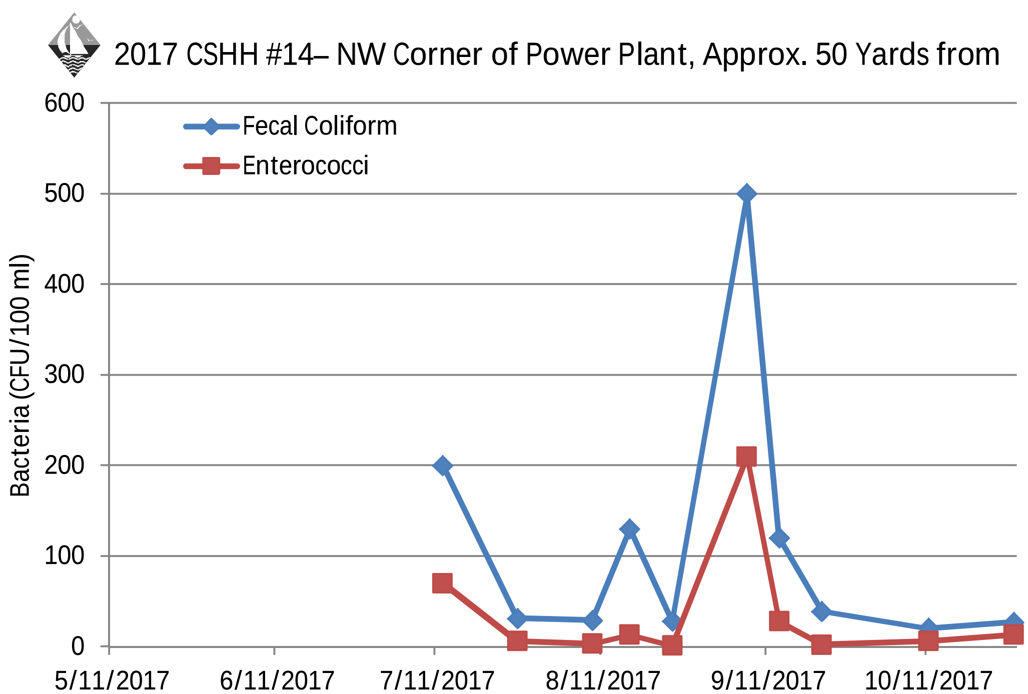
2017 In-Harbor Bacteria Graphs



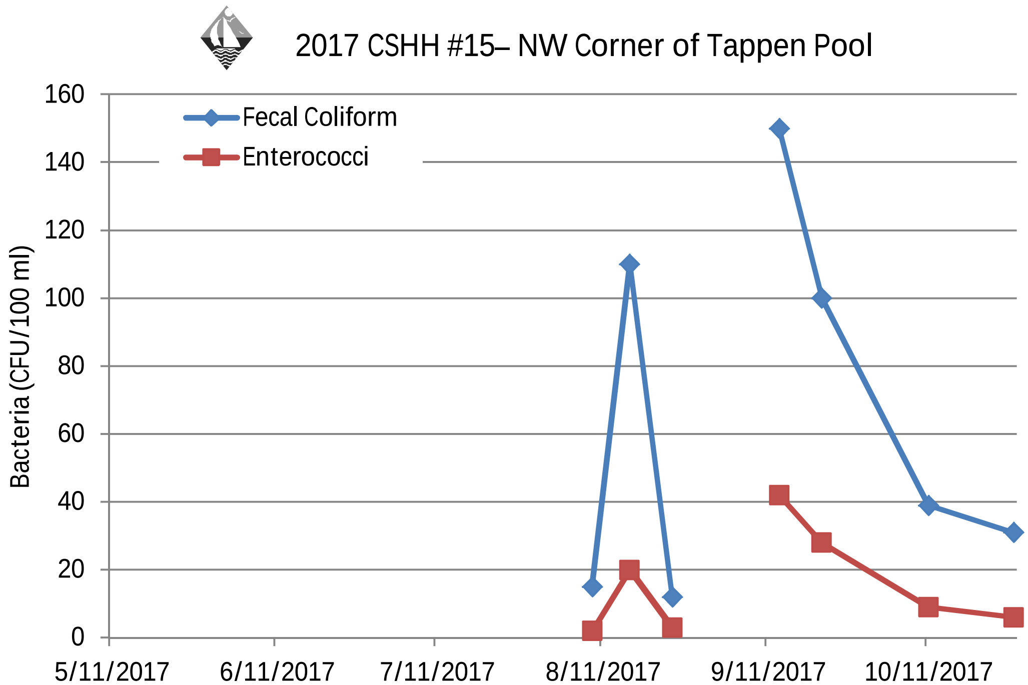


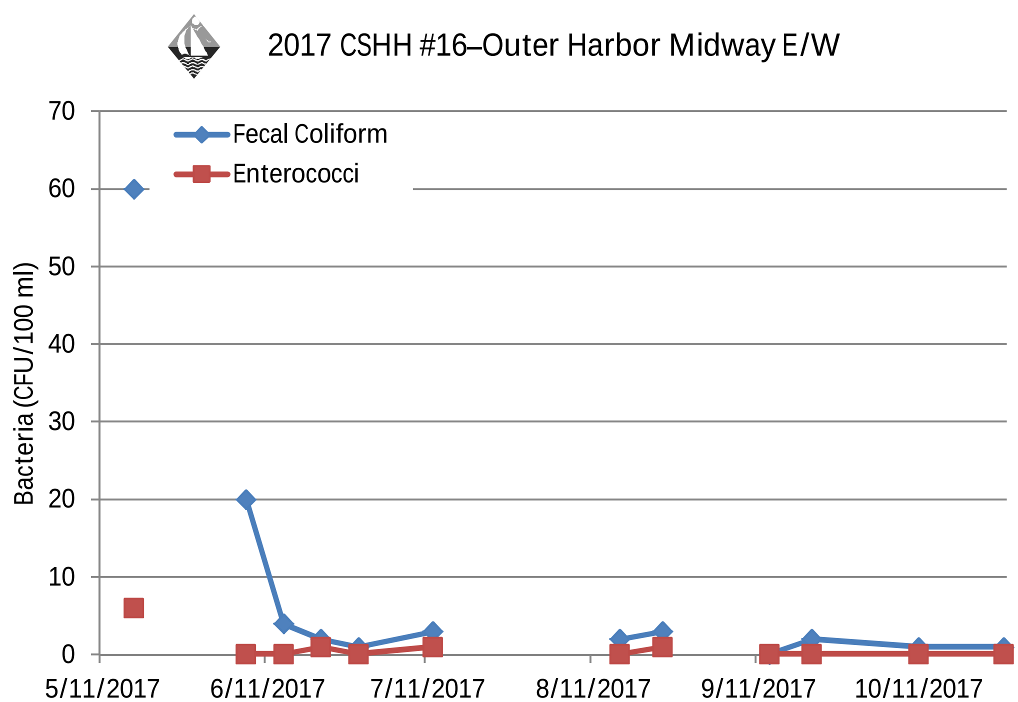
2017 In-Harbor Bacteria Graphs



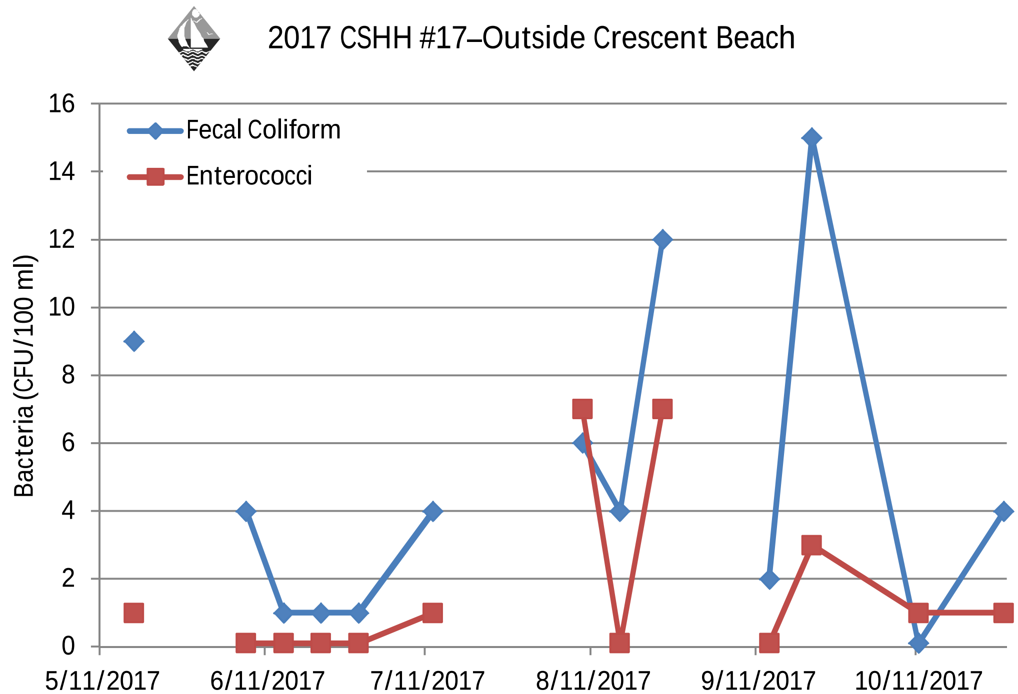


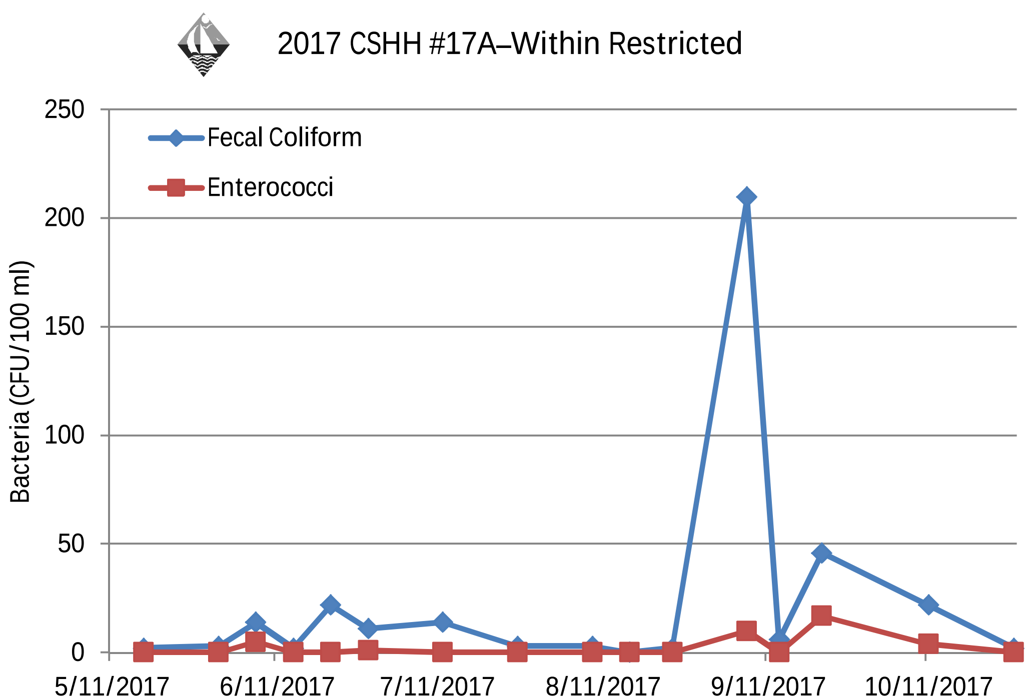
2017 In-Harbor Bacteria Graphs





2017 In-Harbor Bacteria Graphs





2017 Scudder's Pond and Powerhouse Drain Outfalls
Regular Season Monitoring Bacteria Data

CSHH #14A- At Powerhouse Outfall

	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/2017	520.00	484.47	400.00	299.43
10/17/2017	860.00	475.98	170.00	278.52
10/11/2017	2100.00	290.91	590.00	204.08
10/4/2017	580.00	220.25	600.00	151.67
9/28/2017	49.00	196.84	100.00	126.46
9/13/2017	120.00	398.98	49.00	168.11
9/7/2017	690.00	548.63	180.00	266.44
8/30/2017	370.00	284.78	290.00	168.11
8/24/2017	660.00	312.64	250.00	191.76
8/16/2017	500.00	214.35	210.00	132.25
8/9/2017	590.00	220.81	490.00	161.48
8/2/2017	26.00	215.30	18.00	136.31
7/26/2017	590.00	402.00	560.00	246.76
7/19/2017	100.00	353.45	39.00	213.26
7/12/2017	580.00	504.08	570.00	368.41
7/5/2017	520.00	472.57	210.00	354.47
6/28/2017	590.00	420.48	350.00	299.22
6/21/2017	310.00	419.04	270.00	331.02
06/14/17	590.00	462.91	600.00	244.20
06/07/17	420.00	436.54	470.00	123.69
5/31/2017	290.00	440.77	90.00	88.59
5/24/2017	580.00	506.78	580.00	88.13
5/17/2017	510.00	473.71	59.00	34.35
5/10/17	440.00	0.00	20.00	0.00

2017 Scudder's Pond and Powerhouse Drain Outfalls Regular Season Monitoring Bacteria Data

CSHH #15A- Scudder's Pond Outfall Pipe, North of Tappen Beach Pool Area

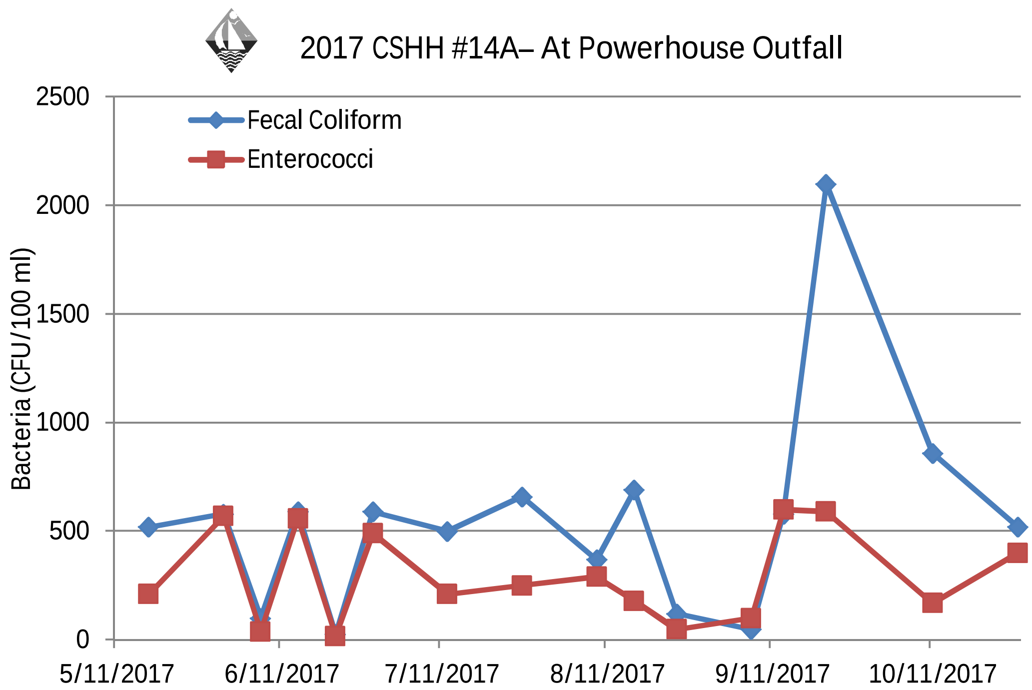
	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	330.00	98.94	46.00	21.63
10/17/17	88.00	66.22	23.00	16.82
10/4/17	30.00	105.68	9.00	23.99
9/28/17	110.00	222.55	23.00	65.82
9/13/17	60.00	253.35	10.00	82.49
9/7/17	630.00	291.02	160.00	98.27
8/30/17	590.00	172.43	510.00	69.35
8/24/17	130.00	123.23	36.00	40.58
8/16/17	360.00	166.19	130.00	65.69
8/9/17	120.00	182.19	24.00	88.89
8/2/17	46.00	203.77	28.00	92.32
7/26/17	110.00	238.00	35.00	98.65
7/19/17	580.00	320.88	400.00	141.16
7/12/17	570.00	273.31	590.00	95.27
7/5/17	210.00	221.66	29.00	60.31
06/28/17	100.00	177.93	39.00	57.58
06/21/17	490.00	187.52	210.00	66.48
6/14/17	260.00	119.27	56.00	45.91
6/7/17	200.00	106.12	60.00	38.09
5/31/17	70.00	90.57	23.00	34.00
5/24/17	130.00	98.69	80.00	38.73
5/17/17	51.00	85.99	33.00	26.94
5/10/17	145.00	0.00	22.00	0.00

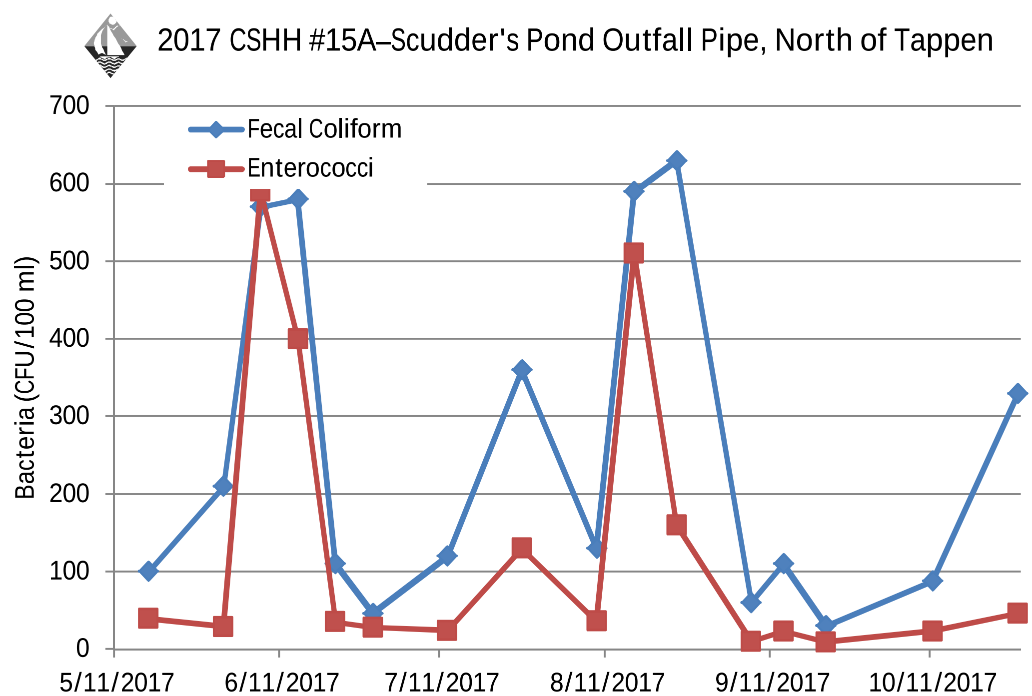
2017 Scudder's Pond and Powerhouse Drain Outfalls Regular Season Monitoring Bacteria Data

CSHH #15B- Scudder's Pond Weir on the East Side of Shore Road

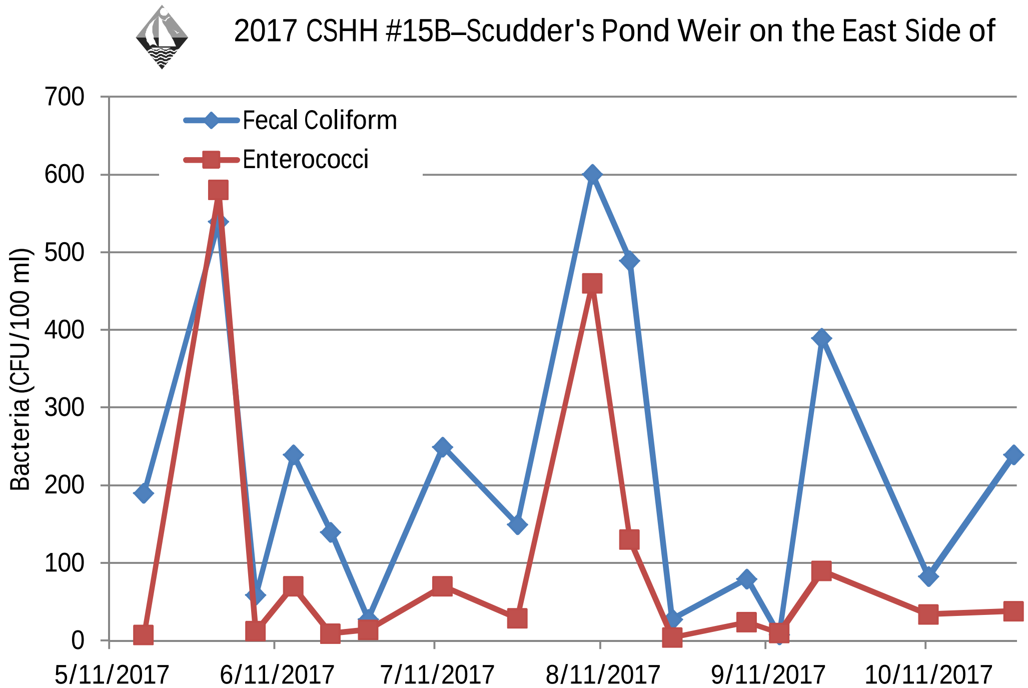
	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
10/27/17	240.00	86.96	38.00	30.84
10/17/17	83.00	67.47	34.00	29.27
10/11/17	390.00	51.42	90.00	17.14
10/4/17	8.00	54.44	10.00	18.80
9/28/17	80.00	160.26	24.00	48.95
9/13/17	28.00	198.63	4.00	54.61
9/7/17	490.00	198.63	130.00	70.16
8/30/17	601.00	154.61	460.00	41.13
8/24/17	150.00	128.68	29.00	28.22
8/16/17	250.00	106.77	70.00	23.66
8/9/17	28.00	124.55	14.00	36.11
8/2/17	140.00	182.67	9.00	31.43
7/26/17	240.00	147.47	70.00	45.79
7/19/17	59.00	170.09	12.00	57.04
7/12/17	540.00	221.31	580.00	87.16
7/5/17	190.00	188.18	7.00	54.01
6/28/17	48.00	154.11	59.00	68.52
6/21/17	490.00	157.78	210.00	54.04
6/14/17	220.00	101.51	100.00	32.29
6/7/17	240.00	98.68	53.00	22.10
5/31/17	70.00	79.02	23.00	17.75
5/24/17	54.00	82.28	18.00	16.29
5/17/17	54.00	101.56	16.00	15.49
5/10/17	191.00	0.00	15.00	0.00

2017 Scudder's Pond and Powerhouse Drain Outfalls Regular Season Monitoring Bacteria Graphs





2017 Scudder's Pond and Powerhouse Drain Outfalls
Regular Season Monitoring Bacteria Graphs



2017-2018 Scudder's Pond and Powerhouse Drain Outfalls Winter-Monitoring Bacteria Data

CSHH #14A- At Powerhouse Outfall

	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
5/4/2018	63.00	575.41	82.00	64.98
4/27/2018	55.00	346.66	6.00	35.52
4/20/2018	3400.00	790.91	280.00	70.88
4/13/2018	582.00	321.95	29.00	39.48
4/6/2018	9200.00	394.12	290.00	52.44
3/30/2018	5.00	209.45	4.00	45.34
3/23/2018	3400.00	747.77	190.00	162.96
3/16/2018	38.00	374.41	15.00	125.27
3/9/2018	1600.00	668.79	120.00	167.44
3/5/2018	390.00	537.75	140.00	181.98
2/23/2018	2900.00	916.51	2400.00	257.88
2/16/2018	107.00	874.99	51.00	107.35
2/10/2018	691.00	1840.00	64.00	274.75
2/2/2018	520.00	1649.43	560.00	119.59
1/25/2018	5800.00	2890.90	260.00	178.08
1/19/2018	2300.00	1811.28	30.00	196.01
1/12/2018	4400.00	1068.09	5600.00	233.51
1/3/2018	400.00	761.40	1.00	121.09
12/29/2017	8600.00	506.30	4100.00	218.21
12/22/2017	560.00	356.57	420.00	123.70
12/15/2017	164.00	434.23	72.00	187.93
12/8/2017	810.00	673.31	210.00	289.08
12/1/2017	52.00	569.29	19.00	345.21
11/24/2017	1490.00	1035.54	240.00	712.71
11/17/2017	1500.00	917.26	3400.00	1024.43
11/10/2017	1470.00	717.29	620.00	562.32
11/1/2017	350.00	0.00	510.00	0.00

2017-2018 Scudder's Pond and Powerhouse Drain Outfalls Winter-Monitoring Bacteria Data

CSHH #15A- Scudder's Pond Outfall Pipe,
North of Tappen Beach Pool Area

	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
3/23/18	86.00	81.32	45.00	37.80
3/5/18	53.00	79.08	80.00	34.64
2/23/18	118.00	71.23	15.00	28.98
1/25/18	43.00	160.92	56.00	147.24
1/19/18	57.00	311.29	15.00	238.75
1/12/18	1700.00	0.00	3800.00	0.00
11/17/17	1200.00	766.81	470.00	328.79
11/1/17	490.00	0.00	230.00	0.00

CSHH #15B- Scudder's Pond Weir on the East
Side of Shore Road

	Fecal Coliform		Enterococci	
Date	CFU/100ml	Log Avg FC	CFU/100ml	Log Avg Ent
3/23/18	43.00	49.23	41.00	24.91
3/5/18	38.00	52.67	29.00	19.42
2/23/18	73.00	52.67	13.00	27.93
1/25/18	38.00	30.38	60.00	18.29
1/19/18	9.00	27.17	6.00	10.10
1/12/18	82.00	0.00	17.00	0.00
11/17/17	1900.00	1630.95	260.00	297.32
11/1/17	1400.00	0.00	340.00	0.00

2017 Beach-Monitoring Bacteria Data

Village Club of Sands Point (Formerly IBM Beach)

		Enterococci
Date	CFU/100ml	Log Avg Ent
4/10/17	0.10	0.00
4/12/17	0.10	0.10
4/17/17	1.00	0.22
4/19/17	0.10	0.18
4/24/17	2.00	0.29
4/26/17	17.00	0.57
5/1/17	2.00	0.68
5/5/17	3.00	0.82
5/8/17	20.00	1.17
5/10/17	11.00	1.46
5/15/17	10.00	3.29
5/17/17	0.10	2.32
5/22/17	22.00	4.64
5/24/17	57.00	5.96
5/31/17	5.00	5.87
6/5/17	27.00	8.84
6/7/17	11.00	9.06
6/12/17	0.10	4.56
6/14/17	2.00	4.16
6/19/17	12.00	6.78
6/21/17	11.00	7.16
6/26/17	25.00	5.61
6/28/17	48.00	7.12
7/3/17	7.00	7.39
7/5/17	22.00	8.24
7/10/17	0.10	4.29
7/12/17	0.10	2.94
7/17/17	6.00	4.84
7/19/17	5.00	4.86
7/24/17	601.00	6.85
7/26/17	210.00	9.65
7/31/17	5.00	6.75
8/2/17	6.00	6.67
8/7/17	9.00	6.01
8/9/17	1.00	5.02
08/14/17	2.00	10.83
8/16/17	15.00	11.19
8/21/17	2.00	10.83
8/23/17	21.00	11.57
8/28/17	1.00	4.12
8/30/17	45.00	5.23

2017 Beach-Monitoring Bacteria Data

North Hempstead Beach Park (N)
(Formerly Hempstead Harbor Beach)

	Enterococci	
Date	CFU/100ml	Log Avg Ent
04/10/17	0.10	0.00
04/12/17	0.10	0.10
04/17/17	0.10	0.10
04/19/17	0.10	0.10
04/24/17	10.00	0.25
04/26/17	59.00	0.62
05/01/17	7.00	0.88
05/05/17	90.00	1.57
05/08/17	3.00	1.69
05/10/17	0.10	1.27
05/15/17	10.00	2.82
05/17/17	3.00	2.83
05/22/17	5.00	6.35
05/24/17	7.00	6.41
05/31/17	7.00	4.81
06/05/17	13.00	3.61
06/07/17	11.00	4.08
06/12/17	1.00	5.66
06/14/17	11.00	6.09
06/19/17	17.00	7.11
06/21/17	400.00	11.13
06/26/17	2.00	10.52
06/28/17	0.10	6.27
07/03/17	0.10	3.91
07/05/17	11.00	4.34
07/10/17	2.00	3.18
07/12/17	16.00	3.73
07/17/17	5.00	3.96
07/19/17	6.00	4.13
07/24/17	601.00	3.69
07/26/17	5.00	3.80
07/31/17	1.00	5.28
08/02/17	6.00	5.35
08/07/17	41.00	9.63
08/09/17	0.10	6.10
08/14/17	24.00	7.22
08/16/17	2.00	6.35
08/21/17	9.00	6.82
08/23/17	23.00	7.70
08/28/17	0.10	3.07
08/30/17	3.00	3.07

2017 Beach-Monitoring Bacteria Data

North Hempstead Beach Park (S) (Formerly Bar Beach)

	Enterococci	
Date	CFU/100ml	Log Avg Ent
4/10/17	0.10	0.00
4/12/17	0.10	0.10
4/17/17	0.10	0.10
4/19/17	0.10	0.10
4/24/17	3.00	0.20
4/26/17	57.00	0.51
5/1/17	5.00	0.70
5/5/17	3.00	0.84
5/8/17	314.00	1.63
5/10/17	0.10	1.23
5/15/17	2.00	2.27
5/17/17	0.10	1.66
5/22/17	1.00	2.93
5/24/17	12.00	3.38
5/31/17	3.00	2.47
6/5/17	7.00	2.51
6/7/17	19.00	3.14
6/12/17	0.10	1.77
6/14/17	2.00	1.79
6/19/17	3.00	2.71
6/21/17	33.00	3.57
6/26/17	3.00	3.52
6/28/17	17.00	4.20
7/3/17	18.00	5.12
7/5/17	26.00	6.02
7/10/17	1.00	4.27
7/12/17	10.00	4.65
7/17/17	9.00	8.42
7/19/17	11.00	8.65
7/24/17	320.00	12.52
7/26/17	6.00	11.63
7/31/17	2.00	10.66
8/2/17	6.00	10.07
8/7/17	9.00	8.39
8/9/17	3.00	7.57
8/14/17	9.00	9.37
8/16/17	12.00	9.60
8/21/17	11.00	9.67
8/23/17	58.00	11.57
8/24/17	10.00	8.18
8/28/17	1.00	6.84
8/30/17	32.00	7.87

2017 Beach-Monitoring Bacteria Data

Tappen Beach

Date	Enterococci CFU/100ml	Log Avg
04/10/17	0.10	0.00
04/12/17	0.10	0.10
04/17/17	1.00	0.22
04/19/17	0.10	0.18
04/24/17	25.00	0.48
04/26/17	34.00	0.97
05/01/17	5.00	1.23
05/05/17	2.00	1.31
05/08/17	58.00	1.99
05/10/17	1.00	1.86
05/15/17	39.00	4.99
05/17/17	0.10	3.38
05/22/17	13.00	6.64
05/24/17	1.00	5.49
05/31/17	0.10	2.43
06/05/17	8.00	2.64
06/07/17	59.00	3.73
06/12/17	0.10	1.98
06/14/17	0.10	1.42
06/19/17	4.00	1.49
06/21/17	110.00	2.41
06/23/17	121.00	3.08
06/26/17	11.00	4.02
06/28/17	2.00	3.75
07/03/17	56.00	7.06
07/05/17	630.00	10.63
07/07/17	220.00	14.36
07/10/17	5.00	11.48
07/11/17	200.00	14.56
07/12/17	2.00	12.50
07/13/17	3.00	16.24
07/17/17	1.00	19.38
07/19/17	10.00	18.49
07/24/17	140.00	18.33
07/26/17	3.00	15.94
07/31/17	0.10	12.81
08/02/17	1.00	10.53
08/07/17	0.10	3.10
08/09/17	1.00	2.82
08/14/17	0.10	1.17
08/16/17	0.10	0.92
08/21/17	48.00	1.08
08/23/17	100.00	1.70

Date	Enterococci CFU/100ml	Log Avg
08/28/17	0.10	0.71
08/30/17	14.00	0.96
09/06/17	80.00	2.01
09/13/17	1.00	2.93
09/20/17	150.00	13.47
09/27/17	8.00	7.16

2017 Beach-Monitoring Bacteria Data

Sea Cliff Village Beach

Date	*Enterococci* CFU/100ml	Log Avg Ent
04/10/17	0.10	0.00
04/12/17	0.10	0.10
04/17/17	2.00	0.27
04/19/17	0.10	0.21
04/24/17	0.10	0.18
04/26/17	9.00	0.35
05/01/17	0.10	0.29
05/05/17	120.00	0.62
05/08/17	16.00	0.89
05/10/17	0.10	0.71
05/15/17	13.00	1.53
05/17/17	0.10	1.16
05/22/17	15.00	1.91
05/24/17	14.00	2.33
05/31/17	4.00	3.02
06/05/17	8.00	3.30
06/07/17	40.00	4.35
06/12/17	2.00	5.38
06/14/17	0.10	3.45
06/19/17	12.00	5.32
06/21/17	90.00	7.29
06/26/17	4.00	5.69
06/28/17	0.10	3.63
07/03/17	2.00	3.36
07/05/17	4.00	3.42
07/10/17	6.00	2.52
07/12/17	5.00	2.70
07/17/17	10.00	4.66
07/19/17	5.00	4.69
07/24/17	80.00	4.17
07/26/17	14.00	4.71
07/31/17	8.00	7.81
08/02/17	220.00	10.90
08/04/17	27.00	14.14
08/07/17	1.00	12.31
08/09/17	0.10	7.95
08/14/17	1.00	6.96
08/16/17	210.00	9.48
08/18/17	38.00	10.71
08/21/17	9.00	11.30
08/23/17	62.00	13.02
08/28/17	2.00	9.25
08/30/17	5.00	8.79

2017 Beach-Monitoring Bacteria Data

Crescent Beach

Enterococci

Date	CFU/100ml	Log Avg Ent	Location Comment
4/11/17	2.00	0.00	Center
4/11/17	1.00	1.41	Left
4/11/17	1.00	1.26	Right
4/18/17	0.10	0.67	Center
4/18/17	0.10	0.46	Left
4/18/17	0.10	0.35	Right
4/25/17	103.00	0.80	Center
4/25/17	93.00	1.45	Left
4/25/17	88.00	2.28	Right
5/1/17	8.00	2.59	Center
5/1/17	34.00	3.27	Left
5/1/17	41.00	4.04	Right
5/2/17	18.00	4.53	center
5/2/17	16.00	4.96	left
5/2/17	4.00	4.89	right
5/3/17	21.00	5.35	Center
5/3/17	16.00	5.71	Left
5/3/17	21.00	6.14	Right
5/8/17	35.00	6.73	Center
5/8/17	50.00	7.44	Left
5/8/17	34.00	7.99	Right
5/9/17	0.10	6.55	Center
5/9/17	0.10	5.46	Left
5/9/17	0.10	4.62	Right
5/10/17	2.00	4.47	Center
5/10/17	4.00	4.45	Left
5/10/17	8.00	4.55	Right
5/15/17	50.00	5.84	Center
5/15/17	33.00	6.24	Left
5/15/17	44.00	6.71	Right
5/16/17	11.00	6.83	Center
5/16/17	5.00	6.76	Left
5/16/17	25.00	7.06	Right
5/17/17	3.00	6.87	Center
5/17/17	4.00	6.75	Left
5/17/17	3.00	6.59	Right
5/22/17	14.00	10.12	Center
5/22/17	32.00	10.49	Left
5/22/17	32.00	10.86	Right
5/23/17	32.00	11.21	Center
5/23/17	47.00	11.67	Left
5/23/17	32.00	12.01	Right
5/24/17	54.00	12.50	Center

CFU/100ml Log Avg Enterococci Ent Location Comment

Date	CFU/100ml	Log Avg Ent	Location Comment
5/24/17	70.00	13.08	Left
5/24/17	48.00	13.53	Right
5/30/17	3.00	11.09	Center
5/30/17	6.00	10.92	Left
5/30/17	7.00	10.79	Right
5/31/17	130.00	11.49	Center
5/31/17	160.00	12.25	Left
5/31/17	100.00	12.88	Right
6/5/17	3.00	11.55	Center
6/5/17	1.00	10.77	Left
6/5/17	0.10	9.46	Right
6/6/17	17.00	9.61	Center
6/6/17	14.00	9.71	Left
6/6/17	11.00	9.74	Right
6/7/17	30.00	10.01	Center
6/7/17	27.00	10.26	Left
6/7/17	49.00	10.65	Right
6/12/17	9.00	15.55	Center
6/12/17	6.00	15.13	Left
6/12/17	2.00	14.31	Right
6/13/17	0.10	12.51	Center
6/13/17	2.00	11.92	Left
6/13/17	0.10	10.55	Right
6/14/17	12.00	10.58	Center
6/14/17	6.00	10.43	Left
6/14/17	37.00	10.75	Right
6/19/17	21.00	10.77	Center
6/19/17	27.00	11.05	Left
6/19/17	14.00	11.13	Right
6/20/17	210.00	12.05	Center
6/20/17	90.00	12.70	Left
6/20/17	41.00	13.09	Right
6/21/17	56.00	13.57	Center
6/21/17	59.00	14.07	Left
6/21/17	54.00	14.53	Right
6/26/17	80.00	11.94	Center
6/26/17	130.00	12.78	Left
6/26/17	110.00	13.57	Right
6/27/17	160.00	14.50	Center
6/27/17	51.00	14.99	Left
6/27/17	67.00	15.58	Right
6/28/17	21.00	15.70	Center
6/28/17	21.00	15.81	Left

2017 Beach-Monitoring Bacteria Data

Crescent Beach (continued)

Date	Enterococci CFU/100ml	Log Avg Ent	Location Comment	Date	Enterococci CFU/100ml	Log Avg Ent	Location Comment
6/28/17	19.00	15.88	Right	8/7/17	2.00	25.22	Center
7/3/17	15.00	14.70	Center	8/7/17	1.00	23.17	Left
7/3/17	5.00	14.29	Left	8/7/17	5.00	22.28	Right
7/3/17	16.00	14.33	Right	8/8/17	24.00	22.32	Center
7/5/17	1.00	13.41	Center	8/8/17	27.00	22.42	Left
7/5/17	5.00	13.09	Left	8/8/17	25.00	22.48	Right
7/5/17	6.00	12.85	Right	8/9/17	5.00	21.71	Center
7/10/17	9.00	15.04	Center	8/9/17	7.00	21.16	Left
7/10/17	9.00	14.82	Left	8/9/17	10.00	20.81	Right
7/10/17	17.00	14.88	Right	8/15/17	23.00	30.01	Center
7/11/17	8.00	14.63	Center	8/15/17	15.00	29.46	Left
7/11/17	0.10	12.83	Left	8/15/17	17.00	29.05	Right
7/11/17	5.00	12.53	Right	8/16/17	230.00	30.59	Center
7/12/17	4.00	12.18	Center	8/16/17	320.00	32.40	Left
7/12/17	6.00	11.97	Left	8/16/17	140.00	33.54	Right
7/12/17	8.00	11.85	Right	8/21/17	9.00	42.59	Center
7/17/17	7.00	17.41	Center	8/21/17	2.00	39.03	Left
7/17/17	12.00	17.22	Left	8/21/17	8.00	37.35	Right
7/17/17	5.00	16.64	Right	8/22/17	22.00	36.82	Center
7/18/17	10.00	16.41	Center	8/22/17	5.00	34.93	Left
7/18/17	36.00	16.76	Left	8/22/17	31.00	34.83	Right
7/18/17	26.00	16.95	Right	8/23/17	1200.00	38.05	Center
7/19/17	6.00	16.51	Center	8/23/17	2200.00	42.01	Left
7/19/17	14.00	16.45	Left	8/23/17	1200.00	45.50	Right
7/19/17	13.00	16.35	Right	8/29/17	8.00	25.40	Center
7/24/17	3300.00	14.47	Center	8/29/17	13.00	24.92	Left
7/24/17	2700.00	16.80	Left	8/29/17	5.00	23.83	Right
7/24/17	2100.00	19.21	Right	8/30/17	37.00	24.12	Center
7/25/17	80.00	19.96	center	8/30/17	25.00	24.14	Left
7/25/17	410.00	21.62	left	8/30/17	40.00	24.45	Right
7/25/17	70.00	22.28	right	9/6/17	80.00	24.23	Center
7/26/17	180.00	23.47	Center	9/6/17	220.00	25.96	Left
7/26/17	160.00	24.60	Left	9/6/17	130.00	27.26	Right
7/26/17	48.00	24.99	Right	9/13/17	1.00	38.43	Center
7/31/17	15.00	19.90	Center	9/13/17	1.00	33.40	Left
7/31/17	12.00	19.62	Left	9/13/17	7.00	31.52	Right
7/31/17	14.00	19.43	Right	9/20/17	70.00	27.10	Center
8/1/17	63.00	20.06	Center	9/20/17	150.00	29.19	Left
8/1/17	32.00	20.31	Left	9/20/17	49.00	29.83	Right
8/1/17	90.00	21.10	Right	9/27/17	33.00	22.77	Center
8/2/17	26.00	21.21	Center	9/27/17	22.00	22.73	Left
8/2/17	41.00	21.55	Left	9/27/17	21.00	22.63	Right
8/2/17	28.00	21.69	Right				

2017 Beach-Monitoring Bacteria Data

Morgan Memorial Beach

Date	Enterococci CFU/100ml	Log Avg Ent
4/11/17	0.10	0.00
4/18/17	0.10	0.10
4/25/17	4.00	0.34
5/1/17	0.10	0.25
5/2/17	0.10	0.21
5/3/17	3.00	0.33
5/8/17	16.00	0.57
5/9/17	4.00	0.73
5/10/17	0.10	0.58
5/15/17	32.00	1.11
5/16/17	2.00	1.17
5/17/17	0.10	0.94
5/22/17	1.00	1.16
5/23/17	7.00	1.34
5/24/17	10.00	1.57
5/30/17	0.10	1.18
5/31/17	36.00	1.51
6/5/17	32.00	2.88
6/6/17	5.00	3.01
6/7/17	15.00	3.37
6/12/17	6.00	4.11
6/13/17	37.00	4.87
6/14/17	17.00	5.32
6/19/17	100.00	8.84
6/20/17	52.00	10.13
6/21/17	130.00	12.16
6/23/17	81.00	17.79
6/26/17	43.00	19.90
6/27/17	5.00	18.03
6/28/17	24.00	18.38
7/3/17	90.00	28.47
7/5/17	1.00	22.78
7/10/17	4.00	22.52
7/11/17	0.10	15.30
7/12/17	19.00	15.52
7/17/17	9.00	14.87
7/18/17	0.10	10.40
7/19/17	12.00	10.50
7/24/17	62.00	6.04
7/25/17	16.00	6.51

Date	Enterococci CFU/100ml	Log Avg Ent
7/26/17	6.00	6.47
7/31/17	3.00	4.75
8/1/17	7.00	4.89
8/2/17	7.00	5.02
8/7/17	4.00	4.47
8/8/17	51.00	5.32
8/9/17	2.00	4.99
8/15/17	6.00	6.27
8/16/17	590.00	8.67
8/18/17	1100.00	17.70
8/21/17	13.00	17.80
8/22/17	1.00	14.49
8/23/17	120.00	16.69
8/25/17	0.10	10.57
8/29/17	7.00	10.69
8/30/17	590.00	13.97

2017 Sea Cliff Precipitation Data

CSHH 2017 (JANUARY-DECEMBER) PRECIPITATION DATA FOR SEA CLIFF

JANUARY	AMT (MM)	AMT (IN)	MARCH	AMT (MM)	AMT (IN)	MAY	AMT (MM)	AMT (IN)	JULY	AMT (MM)	AMT (IN)	SEPTEMBER	AMT (MM)	AMT (IN)	NOVEMBER	AMT (MM)	AMT (IN)
2	7.6	0.30	1	3.3	0.13	2	1.0	0.04	1	1.3	0.05	2C	12.7	0.50	5	2.0	0.08
3	11.7	0.46	7	2.5	0.10	5	53.3	2.10	4	5.6	0.22	3†	8.9	0.35	6	1.3	0.05
4	1.8	0.07	8	2.0	0.08	6	7.9	0.31	6T	0.0	0.0	6	13.0	0.51	7.0	17.5	0.69
6**	2.5	0.10	10*	7.6	0.30	7	0.5	0.02	7B†	55.6	2.19	13	14.5	0.57	10	0.5	0.02
7**	17.8	0.70	14*	40.6	1.60	13	47.0	1.85	8	0.8	0.03	14	2.0	0.08	13	1.3	0.05
11	13.0	0.51	15T	0.0	0.00	14	0.5	0.02	11C	11.4	0.45	18	0.8	0.03	14	0.5	0.02
12	2.3	0.09	18*	2.5	0.10	19	2.5	0.10	12	1.3	0.05	19	9.4	0.37	16	6.9	0.27
14**	2.5	0.10	24	0.3	0.01	22	14.5	0.57	13	2.0	0.08	30	3.6	0.14	18	4.3	0.17
21	1.8	0.07	25	0.5	0.02	24	2.3	0.09	14†	12.4	0.49				19	6.6	0.26
23	14.0	0.55	26	1.3	0.05	25	14.0	0.55	15†	0.3	0.01				22	10.9	0.43
24	25.9	1.02	27	6.6	0.26	26	13.5	0.53	22	0.8	0.03						
26	1.3	0.05	28	23.1	0.91	29	8.9	0.35	23	5.6	0.22						
31**	2.5	0.10	31	45.7	1.80	30T	0.0	0.0	24B†	21.3	0.84						
						31	1.8	0.07	27T	0.0	0.0						
									29T	0.0	0.0						
TOTAL	**104.6**	**4.12**	**TOTAL**	**136.1**	**5.36**	**TOTAL**	**167.6**	**6.6**	**TOTAL**	**118.4**	**4.66**	**TOTAL**	**64.8**	**2.55**	**TOTAL**	**51.8**	**2.04**

FEBRUARY	AMT (MM)	AMT (IN)	APRIL	AMT (MM)	AMT (IN)	JUNE	AMT (MM)	AMT (IN)	AUGUST	AMT (MM)	AMT (IN)	OCTOBER	AMT (MM)	AMT (IN)	DECEMBER	AMT (MM)	AMT (IN)
7	7.4	0.29	1	0.5	0.02	4	1.5	0.06	2	2.3	0.09	8	6.1	0.24	1	1.0	0.04
9*	33.0	1.30	4	39.6	1.56	5	2.0	0.08	4	5.1	0.2	9	8.1	0.32	3T	0.0	0.0
12	12.7	0.5	6	20.1	0.79	6	3.0	0.12	5	5.1	0.2	11	2.0	0.08	5	10.4	0.41
15	0.5	0.02	7	0.8	0.03	14	2.0	0.08	7	13.2	0.52	14	1.0	0.04	9*	22.9	0.9
22T	0.0	0	12	0.8	0.03	16	1.0	0.04	8†	0.3	0.01	15	0.8	0.03	12	1.3	0.05
25	7.1	0.28	19	0.8	0.03	17B†	30.7	1.21	11T	0.0	0	16	0.5	0.02	14**	5.1	0.20
			20	9.4	0.37	19C†	39.1	1.54	12	5.8	0.23	24	16.3	0.64	15**	5.1	0.20
			21	10.9	0.43	21	2.8	0.11	15	10.7	0.42	25	0.8	0.03	18◊	0.5	0.02
			22	2.8	0.11	23T	0.0	0.0	18A†	64.5	2.54	26T	0.0	0.0	23	13.7	0.54
			25	13.2	0.52	24A†	38.6	1.52	23	9.4	0.37	29	78.7	3.10	24+Tsnow	0.3	0.01
			26	3.8	0.15	25T	0.0	0.0	29	6.9	0.27	30	31.2	1.23	25+Tsnow	5.6	0.22
			27	2.0	0.08	27	3.8	0.15	30†	8.4	0.33				30**	2.5	0.10
			28	1.0	0.04												
			29	1.0	0.04												
TOTAL	**60.7**	**2.39**	**TOTAL**	**106.7**	**4.2**	**TOTAL**	**124.7**	**4.91**	**TOTAL**	**131.6**	**5.18**	**TOTAL**	**145.5**	**5.73**	**TOTAL**	**68.3**	**2.69**

Note: Precipitation recorded from midnight to midnight; snow recorded in inches, converted to approximate liq ◊December 18, 23, 24, 25 recorded amounts are from LaGuardia data.
below). "A" designates that about 12.5 mm of rain fell between midnight and 8 AM; "B" designates that the first 12.5 mm of rain fell by 4 PM; "C" designates that the first 12.5 mm of rain fell later in the evening, by midnight (meaningful during beach season).

T=trace amount.

†Advisory closure for rain dates (11 dates for 4 Hempstead Habor beaches): 6/18; 6/24; 7/7; 7/14-15; 7/24-25; 8/8; 8/18; 8/30; 9/3. Crescent Beach closed all season; Tappen Beach closed 9 days for elevated bacteria levels; Morgan Beach closed 4 days for elevated bacterial levels.

*Sleet/rain mix or wet snow converted to approximate liquid equivalent in mm (5 in of wet snow approx. equal to 1 in liquid precip.).

**Snow--powdery--converted to approximate liquid equivalent in mm (10 in of snow equal to approx. 1 in liquid precip.).

Coalition to Save Hempstead Harbor

FUSS & O'NEILL

2018 Sea Cliff Precipitation Data

CSHH 2018 (JANUARY-DECEMBER) PRECIPITATION DATA FOR SEA CLIFF

MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)
JAN			MARCH			MAY			JULY			SEPT			NOV		
4**blizzard	28.19	1.11	1	6.4	0.25	3	1.5	0.06	3	1.0	0.04	0	0.0	0		0.0	
8*	2.54	0.1	2+*	63.8	2.51	10	4.3	0.17	4	0.5	0.02	0	0.0	0		0.0	0
12	27.18	1.07	7*	28.7	1.13	12	6.4	0.25	6	3.3	0.13	0	0.0	0		0.0	
13	4.57	0.18	9T	0.0	0.00	13	3.6	0.14	15A	13.5	0.53	0	0.0	0		0.0	
17*	5.59	0.22	13**	6.4	0.25	14T	0.0	0	17C	26.9	1.06	0	0.0	0		0.0	
22	1.27	0.05	14T**	0.0	0.00	15	9.4	0.37	21	2.5	0.1	0	0.0	0		0.0	
23	11.18	0.44	15*	2.5	0.10	16	16.5	0.65	22A	24.1	0.95	0	0.0	0		0.0	
28	6.86	0.27	16T**	0.0	0.00	17	4.3	0.17	23	1.3	0.05	0	0.0	0		0.0	
29.T	0.00	0	21*	35.6	1.40	19	19.8	0.78	25C	25.7	1.01	0	0.0	0		0.0	
30*	12.70	0.5	22*	25.4	1.00	22	6.4	0.25	27	5.1	0.2	0		0		0.0	
			25T	0.0	0	23	2.5	0.1								0.0	
			29	0.5	0.02	26	10.7	0.42								0.0	
			30	3.6	0.14	27†	15.0	0.59									
						31	2.3	0.09									
TOTAL	**100.1**	**3.9**	**TOTAL**	**172.7**	**6.80**	**TOTAL**	**102.6**	**4.04**	**TOTAL**	**103.9**	**4.09**	**TOTAL**	**0.0**	**0**	**TOTAL**	**0.0**	**0.0**

MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)	MO/DAY	AMT(MM)	AMT(IN)
FEB			APRIL			JUNE			AUGUST			OCT			DEC		
2	6.4	0.25	1T	0.0	0	1	4.6	0.18	1	3.0	0.12	0	0.0	0		0.0	
4	29.2	1.15	2*	38.1	1.5	3	0.8	0.03	2T	0.0	0	0	0.0	0		0.0	
5	1.3	0.05	3	8.4	0.33	4	13.5	0.53	3T	0.0	0	0	0.0	0		0.0	
7	23.9	0.94	4	3.3	0.13	5	0.5	0.02	4B	17.0	0.67	0	0.0	0		0.0	
9T**	0.0	0	6	2.0	0.08	10	0.5	0.02	7	9.1	0.36		0.0			0.0	
10	8.9	0.35	10	1.3	0.05	13	1.5	0.06	8A	10.4	0.41		0.0			0.0	
11	33.0	1.3	15	2.3	0.09	18	2.3	0.09	11B	65.5	2.58		0.0			0.0	
12	0.3	0.01	16	61.7	2.43	19	1.3	0.05	13C	11.4	0.45		0.0			0.0	
14	0.8	0.03	17T	0.0	0	21	22.9	0.9	14C	3.3	0.13		0.0			0.0	
15	5.8	0.23	19	5.6	0.22	22T	0.0	0		0.0	0		0.0			0.0	
16	4.6	0.18	25	9.4	0.37	23	0.8	0.03		0.0	0		0.0			0.0	
17*	25.4	1.0	26	1.3	0.05	24	0.8	0.03		0.0			0.0			0.0	
19	1.3	0.05	27	2.0	0.08	28A	26.7	1.05		0.0			0.0			0.0	
21	2.3	0.09	28T	0.0	0					0.0			0.0			0.0	
22	3.8	0.15	29	3.3	0.13					0.0						0.0	
23	3.3	0.13	30	0.5	0.02					0.0							
24	3.3	0.13								0.0							
25	22.4	0.88								0.0							
TOTAL	**175.8**	**6.92**	**TOTAL**	**139.2**	**5.48**	**TOTAL**	**75.9**	**2.99**	**TOTAL**	**119.9**	**4.72**	**TOTAL**	**0.0**	**0**	**TOTAL**	**0.0**	**0**

Note: Precipitation recorded from midnight to midnight; snow recorded in inches, converted to approximate liquid equivalent (see below). "A" designates that about 12.5 mm of rain fell between midnight and 8 AM; "B" designates that the first 12.5 mm of rain fell by 4 PM; "C" designates that the first 12.5 mm of rain fell later in the evening, by midnight (meaningful during beach season).

T=trace amount.

†Advisory/closure for rain dates ( ):

*Sleet/rain mix or wet snow converted to approximate liquid equivalent in mm (5 in of wet snow approx. equal to 1 in liquid precip.).

**Snow--powdery--converted to approximate liquid equivalent in mm (10 in of snow equal to approx. 1 in liquid precip.).

1997-2017 Monthly Precipitation

Total Precipitation Per Month (mm)

	June	July	August	September	October
2017	124.7	118.4	131.6	64.8	145.5
2016	36.6	134.1	141.9	75.9	147.1
2015	130.3	75.7	76.2	75.2	156.5
2014	81	78.5	93.5	59.5	112
2013	235	69	59	75.5	8.5
2012	175.5	140.5	140.5	117.5	92.5
2011	127.5	48.5	381.5	163	122
2010	50.5	103.5	61.5	97	146
2009	294	150.5	83	69	175
2008	9.5	91	205.5	177.5	118
2007	159.5	198.5	132.5	36.5	136
2006	262	148	89	105	166.5
2005	45	81	41	28.5	460.5
2004	95	214	91	310.5	40
2003	291.5	87	88	194.5	134
2002	180.5	22.5	175.5	116.5 (9/15-9/30)	180
2001	167	70.5	165	94	19.5
2000	146	159	158	125	6
1999	31	21	135	323	92
1998	191	59	145	90	97
1997	47	232	141	84	27 (10/1-15)

Appendix C

2004-2016 Nitrogen Data
2004-2016 Nitrogen Range Graphs

2016 Nitrogen Data

	Nitrate as N (mg/L)																
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#14a**	**CSHH#15**	**CSHH#15a**	**CSHH#15b**	**CSHH#16**	**CSHH#17**
5/11/2016	0.01	0.03	0.06					0.23		0.00						0.02	0.02
5/19/2016		0.01	0.01					0.01	0.23	0.00			0.03		0.55	0.02	0.01
5/25/2016	0.08	0.01	0.01					0.00							0.29	0.01	0.00
6/1/2016	0.00	0.02	0.07					0.19	0.18	0.19		0.55			0.55	0.01	0.02
6/8/2016	0.08	0.02	0.02					0.39		0.55		0.55			0.55	0.01	0.00
6/15/2016	0.00	0.02		0.00	0.09	0.06	0.00					0.55	0.01	0.55	0.55	0.01	0.01
6/22/2016	0.00	0.04	0.01					0.30		0.49				0.34	0.55	0.00	0.03
6/29/2016	0.02	0.04	0.00	0.01	0.08	0.03	0.07	0.33			0.00	0.04		0.55	0.55	0.01	0.02
7/6/2016	0.06	0.02	0.01					0.27		0.55		0.55		0.55	0.55	0.01	0.02
7/13/2016	0.02	0.03	0.07	0.02	0.01	0.02	0.01				0.01	0.55		0.55	0.55	0.01	0.02
7/20/2016	0.05	0.02	0.01					0.20		0.55		0.55		0.05	0.55	0.01	0.02
7/27/2016	0.02	0.01	0.01					0.34	0.17	0.55		0.52		0.43	0.55	0.01	0.02
8/3/2016	0.07	0.03	0.02	0.04	0.07	0.51	0.07	0.18		0.37	0.03	0.55	0.02	0.55	0.55	0.01	0.02
8/10/2016												0.55		0.55	0.55		
8/17/2016	0.05	0.05	0.04		0.15	0.07	0.07	0.27		0.55	0.07	0.55	0.04	0.55	0.07	0.05	0.03
8/24/2016	0.08	0.07	0.07					0.27		0.45		0.55		0.40	0.55	0.01	0.03
8/31/2016	0.11	0.03	0.01	0.03	0.13	0.09	0.11	0.14				0.55		0.55	0.55	0.03	0.03
9/9/2016	0.12	0.12	0.16					0.37		0.55						0.03	0.07
9/14/2016	0.10	0.08	0.09	0.10	0.14	0.14	0.14	0.26		0.55	0.13	0.25	0.12	0.02	0.04	0.09	0.06
9/21/2016	0.09	0.08	0.10					0.03		0.23		0.55		0.55	0.55	0.10	0.08
	0.55	>0.55															

2016 Nitrogen Data

Nitrite as N (mg/L)																	
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#14a**	**CSHH#15**	**CSHH#15a**	**CSHH#15b**	**CSHH#16**	**CSHH#17**
5/11/2016	0.011	0.004	0.003					0.006		0.004						0.005	0.009
5/19/2016		0.003	0.003					0.003	0.005	0.006			0.006		0.047	0.004	0.002
5/25/2016	0.005	0.004	0.004					0.007							0.053	0.003	0.001
6/1/2016	0.001	0.002	0.005					0.006	0.005	0.008		0.010			0.058	0.003	0.001
6/8/2016	0.002	0.002	0.000					0.007		0.019		0.074			0.071	0.000	0.000
6/15/2016	0.002	0.001		0.003	0.003	0.002	0.005					0.008	0.001	0.059	0.055	0.001	0.000
6/22/2016	0.001	0.003	0.005					0.010		0.007				0.073	0.069	0.000	0.002
6/29/2016	0.001	0.000	0.005	0.002	0.003	0.000	0.000	0.008			0.000	0.006		0.034	0.065	0.001	0.002
7/6/2016	0.001	0.001	0.010					0.012		0.007		0.081		0.037	0.043	0.001	0.001
7/13/2016	0.001	0.001	0.002	0.002	0.002	0.002	0.021				0.003	0.028		0.048	0.045	0.001	0.001
7/20/2016	0.001	0.001	0.002					0.001		0.010		0.133		0.055	0.040	0.001	0.002
7/27/2016	0.003	0.002	0.001					0.006	0.002	0.015		0.011		0.048	0.054	0.002	0.003
8/3/2016	0.006	0.003	0.005	0.005	0.006	0.008	0.005	0.007		0.006	0.005	0.119	0.005	0.045	0.056	0.003	0.003
8/10/2016												0.051		0.054	0.045		
8/17/2016	0.013	0.016	0.018		0.016	0.017	0.010	0.011		0.021	0.014	0.151	0.011	0.049	0.051	0.014	0.012
8/24/2016	0.009	0.008	0.021					0.010		0.008		0.051		0.033	0.047	0.005	0.010
8/31/2016	0.021	0.012	0.003	0.012	0.021	0.022	0.026	0.013				0.337		0.038	0.051	0.004	0.005
9/9/2016	0.018	0.029	0.024					0.022		0.007						0.023	0.014
9/14/2016	0.029	0.024	0.021	0.028	0.058	0.053	0.028	0.015		0.012	0.032	0.212	0.025	0.023	0.020	0.026	0.017
9/21/2016	0.021	0.026	0.022					0.017		0.016		0.165		0.023	0.031	0.033	0.027

2016 Nitrogen Data

	Ammonia-Nitrogen																
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#14a**	**CSHH#15**	**CSHH#15a**	**CSHH#15b**	**CSHH#16**	**CSHH#17**
5/11/2016	0.25	0	0					0		0.25						0.10	
5/19/2016	0.25	0	0					0.10		0.25						0	0.05
5/25/2016	0.25	0.25	0.25					0.10								0.10	0.10
6/1/2016	0.10	0.10	0.25					0.25									0.10
6/8/2016	0.25	0.10	0.10					0.25		0.10							
6/15/2016	0.25	0.25		0.25	0.25	0.25	0.30					0.25	0.25			0.25	
6/22/2016	0.25	0.25						0.50								0.25	0.25
6/29/2016	0.25	0.25	0.25													0.25	0.25
7/6/2016	0.10							0.10									
7/13/2016	0.00	0.00	0.00	0.00	0.10	0.10	0.25				0.00					0.00	0.00
7/20/2016	0.00		0.05					0.00		0.05							0.05
7/27/2016	0.00	0.05	0.00					0.10		0.25						0.00	0.05
8/3/2016	0.25	0.10	0.00					0.25		0.50						0.25	0.10
8/10/2016																	
8/17/2016	0.25	0.25	0.25				0.25	0.50		0.50						0.25	
8/24/2016	0.25	0.25	0.25					0.50		0.50						0.25	0.25
8/31/2016	0.25	0.25	0.25				0.50	0.25								0.25	0.25
9/9/2016	0.50	0.25	0.25					0.50		0.50						0.25	0.25
9/14/2016	0.25	0.25	0.25	0.25	0.50	0.25	0.25	0.25		0.50	0.25					0.25	
9/21/2016	0.50	0.25	0.25					0.25		0.50						0.25	0.25

2016 Nitrogen Data

	Total Inorganic Nitrogen (TIN)																	
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#14a**	**CSHH#15**	**CSHH#15a**	**CSHH#15b**	**CSHH#16**	**CSHH#17**
5/11/2016	0.27	0.03	0.06					0.24		0.25						0.13	
5/19/2016		0.01	0.01					0.11		0.26						0.02	0.06
5/25/2016	0.34	0.26	0.26					0.11								0.11	0.10
6/1/2016	0.10	0.12	0.33					0.45									0.12
6/8/2016	0.33	0.12	0.12					0.65		0.67							
6/15/2016	0.25	0.27		0.25	0.34	0.31							0.26			0.26	
6/22/2016	0.25	0.29						0.81								0.25	0.28
6/29/2016	0.27	0.29	0.26													0.26	0.27
7/6/2016	0.16							0.38									
7/13/2016	0.02	0.03	0.07	0.02	0.11	0.12					0.01					0.01	0.02
7/20/2016	0.05		0.06					0.20		0.61							0.07
7/27/2016	0.02	0.06	0.01					0.45		0.82						0.01	0.07
8/3/2016	0.33	0.13	0.03					0.44		0.88						0.26	0.12
8/10/2016																	
8/17/2016	0.31	0.32	0.31					0.78		1.07						0.31	
8/24/2016	0.34	0.33	0.34					0.78		0.96						0.27	0.29
8/31/2016	0.38	0.29	0.26					0.40								0.28	0.29
9/9/2016	0.64	0.40	0.43					0.89		1.06						0.30	0.33
9/14/2016	0.38	0.35	0.36	0.38	0.70	0.44		0.53		1.06	0.41					0.37	
9/21/2016	0.61	0.36	0.37					0.30		0.75						0.38	0.36

2016 Nitrogen Data

	Total Inorganic Nitrogen (TIN)*																
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#14a**	**CSHH#15**	**CSHH#15a**	**CSHH#15b**	**CSHH#16**	**CSHH#17**
5/11/2016	0.27	0.03	0.06					0.24		0.25						0.13	
5/19/2016		0.01	0.01					0.11		0.26						0.02	0.06
5/25/2016	0.34	0.26	0.26					0.11								0.11	0.10
6/1/2016	0.10	0.12	0.33					0.45									0.12
6/8/2016	0.33	0.12	0.12					0.65		0.67							
6/15/2016	0.25	0.27		0.25	0.34	0.31							0.26			0.26	
6/22/2016	0.25	0.29						0.81								0.25	0.28
6/29/2016	0.27	0.29	0.26													0.26	0.27
7/6/2016	0.16							0.38									
7/13/2016	0.02	0.03	0.07	0.02	0.11	0.12					0.01					0.01	0.02
7/20/2016	0.05		0.06					0.20		0.61							0.07
7/27/2016	0.02	0.06	0.01					0.45		0.82						0.01	0.07
8/3/2016	0.33	0.13	0.03					0.44		0.88						0.26	0.12
8/10/2016																	
8/17/2016	0.31	0.32	0.31					0.78		1.07						0.31	
8/24/2016	0.34	0.33	0.34					0.78		0.96						0.27	0.29
8/31/2016	0.38	0.29	0.26					0.40								0.28	0.29
9/9/2016	0.64	0.40	0.43					0.89		1.06						0.30	0.33
9/14/2016	0.38	0.35	0.36	0.38	0.70	0.44		0.53		1.06	0.41					0.37	
9/21/2016	0.61	0.36	0.37					0.30		0.75						0.38	0.36

* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)

2015 Nitrogen Data

	Nitrate as N (mg/L)													
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#15**	**CSHH#16**	**CSHH#17**
5/7/2015	0.03	0.01	0.00					0.01		0.00			0.01	0.01
5/13/2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.03	0.00		0.00	0.00
5/21/2015	0.04	0.02	0.00					0.00		0.04			0.01	0.01
5/27/2015	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01		0.01	0.01		0.02	0.01
6/3/2015	0.09	0.02	0.06					0.48		0.12			0.01	0.01
6/10/2015	0.01	0.01	0.03					0.20		0.55			0.01	0.01
6/17/2015	0.02	0.01	0.00					0.13		0.18			0.02	0.01
6/24/2015	0.03	0.00	0.01					0.29		0.55			0.00	0.00
7/1/2015	0.01	0.00	0.00	0.00	0.01	0.01	0.00				0.00	0.02	0.00	0.00
7/8/2015	0.01	0.02	0.04					0.34					0.02	0.01
7/16/2015	0.02	0.02	0.04					0.13		0.19			0.01	0.00
7/22/2015	0.00	0.02	0.01					0.55		0.01			0.01	0.02
7/29/2015	0.01	0.02	0.03	0.01	0.03	0.02	0.01	0.12		0.39	0.02	0.00	0.02	0.01
8/5/2015	0.07	0.01	0.01					0.20					0.02	0.06
8/13/2015	0.07	0.02	0.01					0.24		0.55			0.01	0.01
8/19/2015	0.02	0.02	0.02					0.01		0.00			0.03	0.00
9/2/2015	0.00	0.00	0.00					0.16		0.00			0.00	0.00
9/9/2015	0.07	0.03	0.04					0.26		0.55			0.04	0.02
9/25/2015	0.02	0.10	0.11	0.03	0.03	0.01	0.02	0.50		0.09	0.03	0.01	0.12	
10/1/2015	0.03	0.07	0.03					0.07		0.02				
10/7/2015	0.12	0.11	0.11	0.09	0.17	0.18	0.32	0.35	0.29	0.29	0.22	0.23	0.14	0.08
10/14/2015	0.18	0.13	0.13					0.23		0.35			0.12	0.12
10/21/2015	0.23	0.24	0.27					0.41		0.43			0.15	0.16
10/29/2015	0.23	0.03	0.18							0.37			0.18	0.14
11/4/2015	0.22	0.04	0.18					0.26		0.52			0.03	0.02

2015 Nitrogen Data

	Nitrite as N (mg/L)													
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#15**	**CSHH#16**	**CSHH#17**
5/7/2015	0.002	0.004	0.004					0.001		0.008			0.004	0.004
5/13/2015	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.035		0.000			0.000	0.002
5/21/2015	0.011	0.003	0.003					0.016		0.045			0.008	0.009
5/27/2015	0.006	0.006	0.004	0.005	0.016	0.005	0.006	0.012		0.023	0.004		0.006	0.007
6/3/2015	0.002	0.001	0.004					0.012		0.001			0.002	0.003
6/10/2015	0.005	0.002	0.004					0.007		0.026			0.004	0.013
6/17/2015	0.006	0.007	0.003					0.015		0.013			0.006	0.000
6/24/2015	0.016	0.004	0.007					0.047		0.033			0.004	0.002
7/1/2015	0.004	0.004	0.002	0.010	0.002	0.005	0.006				0.004	0.002	0.002	0.002
7/8/2015	0.005	0.003	0.006					0.028					0.006	0.004
7/16/2015	0.006	0.000	0.004					0.002		0.017			0.006	0.000
7/22/2015	0.005	0.004	0.005					0.016		0.037			0.000	0.002
7/29/2015	0.005	0.003	0.005	0.001	0.005	0.004	0.008	0.008		0.009	0.001	0.003	0.012	0.002
8/5/2015	0.015	0.001	0.001					0.010					0.005	0.004
8/13/2015	0.012	0.003	0.001					0.009		0.025			0.002	0.003
8/19/2015	0.013	0.002	0.002					0.008		0.007			0.005	0.005
9/2/2015	0.003	0.005	0.001					0.008		0.010			0.005	0.002
9/9/2015	0.020	0.019	0.014					0.012		0.010			0.015	0.013
9/25/2015	0.066	0.065	0.066	0.069	0.062	0.063	0.059	0.059		0.067	0.065	0.063	0.065	
10/1/2015	0.049	0.060	0.057					0.029		0.025				
10/7/2015	0.033	0.038	0.032	0.032	0.031	0.036	0.039	0.032	0.026	0.036	0.043	0.033	0.052	0.034
10/14/2015	0.040	0.045	0.045					0.036		0.024			0.049	0.050
10/21/2015	0.056	0.030	0.049					0.041		0.032			0.074	0.068
10/29/2015	0.061	0.078	0.066							0.028			0.072	0.071
11/4/2015	0.069	0.073	0.071					0.056		0.048			0.073	0.068

2015 Nitrogen Data

							Ammonia-Nitrogen							
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#15**	**CSHH#16**	**CSHH#17**
5/7/2015	0													
5/13/2015	0							0						
5/21/2015	0													
5/27/2015	0						0	0						
6/3/2015	0							0						
6/10/2015	0							0						
6/17/2015	0.50	0						0						
6/24/2015	0							0						
7/1/2015	0							0.5						
7/8/2015	0							0						
7/16/2015														
7/22/2015	0													
7/29/2015	0						0.5	0.5						
8/5/2015	0.25		0					0.25						0
8/13/2015	0.50	0.1						0.1		0.5			0.1	0.25
8/19/2015	0.50	0.25	0.25					0.5		0.25				
9/2/2015	0	0.1	0.25							0.25			0.25	0.25
9/9/2015	0.50	0.5	0.5					0.5		0.5			0.25	0.25
9/25/2015	0.50	0.5	0.5	0.5	0.5	0.5	0.1	0.5			0.5	0.5		
10/1/2015	1.00	0.5						1		1				
10/7/2015	1.00	0.5	0.5	0.5	0.5	1	1	0.5			0.5	0.5	0.5	0.5
10/14/2015	0.50	0.5	0.5					0.5		1			0.5	0.5
10/21/2015	0.50	0.5	0.5					0.5		0.5				0.5
10/29/2015	0.25	0	0							0.25			0	0
11/4/2015	0.10	0	0.25					0.1		0.5			0	0

2015 Nitrogen Data

Total Inorganic Nitrogen (TIN)*														
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#12**	**CSHH#13**	**CSHH#14**	**CSHH#15**	**CSHH#16**	**CSHH#17**
5/7/2015	0.03													
5/13/2015	0.00							0.04						
5/21/2015	0.05													
5/27/2015	0.03						0.02	0.02						
6/3/2015	0.09							0.49						
6/10/2015	0.02							0.21						
6/17/2015	0.53	0.02						0.15						
6/24/2015	0.05							0.34						
7/1/2015	0.01													
7/8/2015	0.02							0.37						
7/16/2015														
7/22/2015	0.01													
7/29/2015	0.02						0.52	0.63						
8/5/2015	0.34		0.01					0.46						
8/13/2015	0.58	0.12						0.35						
8/19/2015	0.53	0.27	0.27					0.52						
9/2/2015	0.00	0.11	0.25											
9/9/2015	0.59	0.55	0.55					0.77						
9/25/2015	0.59	0.67	0.68	0.60	0.59	0.57	0.18	1.06		0.66	0.60			
10/1/2015	1.08	0.63						1.10						
10/7/2015	1.15	0.65	0.64	0.62	0.70	1.22	1.36	0.88		0.83	0.76	0.76		
10/14/2015	0.72	0.68	0.68					0.77						
10/21/2015	0.79	0.77	0.82					0.95						
10/29/2015	0.54	0.11	0.25											
11/4/2015	0.39	0.11	0.50					0.42						
* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)														

2014 Nitrogen Data

Nitrate as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/21/2014	0.04	0.04	0.03					0.15	0.03		
5/28/2014	0.03	0.02	0.03					0.03	0.04		
6/4/2014	0.05	0.03	0.05					0.09	0.16		
6/11/2014	0.05	0.03	0.03	0.04	0.05	0.06	0.07	0.09	0.06	0.04	0.03
6/18/2014	0.05	0.02	0.04					0.41	0.55		
6/26/2014	0.02	0.03	0.02	0.02	0.03	0.03	0.08	0.35	0.50	0.02	0.02
7/2/2014	0.03	0.02	0.02					0.54	0.55		
7/9/2014	0.03	0.01	0.02	0.04	0.10	0.03	0.04	0.41	0.55	0.02	0.02
7/17/2014	0.02	0.02	0.02					0.18	0.03		
7/23/2014	0.05	0.04	0.02	0.02	0.03	0.03	0.04	0.32	0.55	0.01	0.01
7/30/2014	0.04	0.05	0.05					0.03	0.04		
8/6/2014	0.04	0.02	0.02	0.03	0.04	0.05	0.05	0.02	0.02	0.04	0.03
8/14/2014	0.10	0.05	0.07					0.30	0.09		
8/21/2014	0.03	0.03	0.03	0.03	0.06	0.06	0.11	0.20	0.28	0.04	0.04
8/27/2014	0.05	0.03	0.05					0.12	0.50		
9/4/2014	0.03	0.03	0.06					0.06	0.28		
9/10/2014	0.03	0.04	0.05					0.03	0.04		
9/17/2014	0.04	0.03	0.02	0.03	0.05	0.06	0.07	0.08	0.05	0.04	
9/24/2014	0.03	0.04	0.05					0.03	0.04		
10/1/2014	0.10	0.06	0.07					0.20	0.22		
10/9/2014	0.11	0.04	0.03	0.05	0.08	0.07	0.08	0.32	0.45	0.22	0.04
10/15/2014	0.17	0.15	0.20					0.34	0.35		
10/29/2014	0.03	0.02	0.02					0.03	0.03		
11/5/2014	0.22	0.16	0.16	0.15	0.21	0.22	0.01	0.55	0.55		0.12

2014 Nitrogen Data

Nitrite as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/21/2014	0.007	0.006	0.005					0.015	0.011		
5/28/2014	0.011	0.006	0.005					0.008	0.007		
6/4/2014	0.007	0.003	0.007					0.008	0.011		
6/11/2014	0.008	0.007	0.006	0.010	0.035	0.026	0.041	0.011	0.009	0.007	0.006
6/18/2014	0.008	0.003	0.008					0.012	0.010		
6/26/2014	0.011	0.009	0.008	0.007	0.009	0.009	0.012	0.007	0.010	0.013	0.004
7/2/2014	0.006	0.003	0.006					0.009	0.008		
7/9/2014	0.006	0.005	0.003	0.007	0.008	0.008	0.010	0.010	0.013	0.008	0.007
7/17/2014	0.007	0.008	0.004					0.006	0.010		
7/23/2014	0.030	0.002	0.003	0.022	0.008	0.029	0.040	0.018	0.017	0.004	0.007
7/30/2014	0.012	0.012	0.008					0.010	0.013		
8/6/2014	0.007	0.002	0.006	0.007	0.008	0.011	0.010	0.008	0.010	0.006	0.005
8/14/2014	0.023	0.011	0.018					0.018	0.010		
8/21/2014	0.007	0.004	0.005	0.008	0.010	0.013	0.011	0.008	0.013	0.008	0.007
8/27/2014	0.008	0.002	0.005					0.008	0.009		
9/4/2014	0.007	0.005	0.013					0.014	0.013		
9/10/2014	0.012	0.012	0.008					0.010	0.013		
9/17/2014	0.007	0.006	0.005	0.010	0.034	0.026	0.040	0.012	0.008	0.007	
9/24/2014	0.011	0.012	0.008					0.010	0.012		
10/1/2014	0.02	0.012	0.017					0.018	0.015		
10/9/2014	0.013	0.01	0.004	0.014	0.015	0.014	0.013	0.008	0.017	0.018	0.010
10/15/2014	0.053	0.053	0.041					0.046	0.037		
10/29/2014	0.021	0.013	0.02					0.023	0.014		
11/5/2014	0.023	0.024	0.015	0.026	0.022	0.017	0.020	0.027	0.012		0.019

2014 Nitrogen Data

Ammonia-Nitrogen											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/21/2014	0							0			
5/28/2014	0							0			
6/4/2014	0										
6/11/2014	0							0			
6/18/2014											
6/26/2014	0							0			
7/2/2014	0							0			
7/9/2014	0							0			
7/17/2014	0							0			
7/23/2014	0.25	0.25					0.25	0			
7/30/2014	0							0			
8/6/2014	0						0	0			
8/14/2014	0							0.25			
8/21/2014	0						0	0			
8/27/2014	0							0			
9/4/2014	0							0			
9/10/2014	0							0			
9/17/2014	0						0	0.25			
9/24/2014	0							0			
10/1/2014	0							0			
10/9/2014	0							0			
10/15/2014	0							0			
10/29/2014	0							0			
11/5/2014	0						0	0			

2014 Nitrogen Data

Total Inorganic Nitrogen (TIN)*												
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
5/21/2014	0.05							0.17			
5/28/2014	0.04							0.04			
6/4/2014	0.06										
6/11/2014	0.06							0.10			
6/18/2014											
6/26/2014	0.03							0.36			
7/2/2014	0.04							0.55			
7/9/2014	0.04							0.42			
7/17/2014	0.03							0.19			
7/23/2014	0.33	0.29					0.33	0.34			
7/30/2014	0.05							0.04			
8/6/2014	0.05						0.06	0.03			
8/14/2014	0.12							0.57			
8/21/2014	0.04						0.12	0.21			
8/27/2014	0.06							0.13			
9/4/2014	0.04							0.07			
9/10/2014	0.04							0.04			
9/17/2014	0.05						0.11	0.34			
9/24/2014	0.04							0.04			
10/1/2014	0.12							0.22			
10/9/2014	0.12							0.33			
10/15/2014	0.22							0.39			
10/29/2014	0.05							0.05			
11/5/2014	0.24						0.03	0.58			

* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)

2013 Nitrogen Data

Nitrite as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/10/2013		0.008	0.007					0.010	0.017		
5/15/2013	0.011	0.005	0.007					0.011	0.014		
5/31/2013	0.008	0.008	0.008					0.008	0.009		
6/5/2013	0.007	0.005	0.004	0.008	0.007	0.008	0.011	0.009		0.024	
6/12/2013	0.005	0.003	0.005					0.020	0.032	0.021	
6/19/2013	0.006	0.003	0.005	0.004	0.005	0.006	0.017	0.005	0.008	0.002	
6/26/2013	0.003	0.002	0.003					0.026	0.010		
7/3/2013	0.005	0.007	0.007	0.009	0.009	0.002	0.008	0.008	0.019	0.007	0.009
7/17/2013	0.002	0.003	0.003					0.006	0.011		
7/24/2013	0.007	0.005	0.006					0.019	0.026		
7/31/2013	0.005	0.005	0.005	0.005	0.008	0.009	0.012	0.022	0.019	0.010	
8/8/2013	0.026		0.022	0.015	0.024	0.019	0.021	0.013	0.024	0.019	0.021
8/14/2013	0.009		0.008					0.016	0.016		
8/21/2013	0.006		0.005					0.009	0.010		
8/28/2013	0.007	0.005	0.005					0.006	0.007		
9/4/2013	0.011	0.007	0.008					0.010	0.011		
9/18/2013	0.030	0.020	0.028	0.027	0.027	0.025	0.031	0.029	0.027	0.026	0.026
9/25/2013	0.020	0.007	0.011					0.010	0.012		
10/1/2013	0.013	0.009	0.003	0.014	0.016	0.013	0.013	0.007	0.016	0.017	0.009
10/8/2013	0.021	0.013	0.018					0.017	0.016		
10/15/2013	0.024	0.020	0.021	0.027	0.023	0.025	0.027	0.023	0.018	0.024	0.023
10/22/2013	0.035	0.040	0.035					0.033	0.019		
10/29/2013	0.034	0.038	0.040	0.035	0.035	0.031	0.032	0.032	0.033	0.037	0.037
11/6/2013	0.033	0.036	0.035					0.030	0.022		
11/13/2013	0.032			0.029	0.026	0.029	0.034	0.025	0.021		

2013 Nitrogen Data

Nitrate as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/10/2013		0.04	0.04					0.03	0.03		
5/15/2013	0.04	0.04	0.04					0.03	0.03		
5/31/2013	0.04	0.02	0.03					0.13	0.05		
6/5/2013	0.03	0.03	0.03	0.04	0.04	0.05	0.04	0.13		0.04	
6/12/2013	0.04	0.02	0.02					0.54	0.54	0.54	
6/19/2013	0.01	0.02	0.03	0.02	0.02	0.03	0.27	0.25	0.02	0.01	
6/26/2013	0.02	0.03	0.01					0.03	0.01		
7/3/2013	0.04	0.02	0.02	0.03	0.06	0.06	0.04	0.38	0.21	0.05	0.02
7/17/2013	0.02	0.01	0.02					0.15	0.12		
7/24/2013	0.03	0.01	0.02					0.23	0.39		
7/31/2013	0.03	0.03	0.04	0.03	0.03	0.03	0.05	0.35	0.20	0.07	
8/8/2013	0.06		0.03	0.03	0.02	0.03	0.03	0.32	0.54	0.03	0.04
8/14/2013	0.03		0.02					0.30	0.47		
8/21/2013	0.04		0.03					0.03	0.08		
8/28/2013	0.03	0.02	0.01					0.02	0.16		
9/4/2013	0.04	0.03	0.03					0.36	1.06		
9/18/2013	0.13	0.11	0.08	0.03	0.11	0.03	0.12	0.23	0.17	0.08	0.02
9/25/2013	0.08	0.04	0.06					0.10	0.04		
10/1/2013	0.11	0.04	0.02	0.05	0.09	0.06	0.09	0.32	0.46	0.22	0.04
10/8/2013	0.10	0.06	0.08					0.21	0.23		
10/15/2013	0.16	0.15	0.10	0.11	0.14	0.17	0.28	0.28	0.48	0.09	0.07
10/22/2013	0.16	0.15	0.10					0.11	0.14		
10/29/2013	0.15	0.14	0.13	0.16	0.10	0.12	0.11	0.13	0.11	0.13	0.13
11/6/2013	0.18	0.11	0.18					0.40	0.72		
11/13/2013	0.21			0.18	0.43	0.24	0.49	0.29	0.26		
>0.55 = 0.54											

2013 Nitrogen Data

	Ammonia-Nitrogen										
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/10/2013	0	0									
5/15/2013	0							0			
5/31/2013	0							0			
6/5/2013	0							0			
6/12/2013	0							0			
6/19/2013	0							0			
6/26/2013	0								0		
7/3/2013	0.15						0.15	0.25			0.15
7/17/2013	0							0			
7/24/2013	0							0			
7/31/2013	0							0			
8/8/2013	0.5	0.25	0.25	0.25	0.25		0.5	0.5	0.25		
8/14/2013	2.5							0.15			
8/21/2013	0.1		0.25					0.25	0.25		
8/28/2013	0.04	0						0			
9/4/2013	0	0.25	0								
9/18/2013	0.25		0.25			0.25		0.25	0.25	0.25	
9/25/2013	0							0			
10/1/2013	0							0			
10/8/2013	0.25		0.25					0	0.25		
10/15/2013	0						0	0			
10/22/2013	0							0.25			
10/29/2013	0							0			
11/6/2013	0							0			
11/13/2013								0			
<0.05 = 0.04											

2013 Nitrogen Data

Total Inorganic Nitrogen (TIN)*											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/10/2013		0.05									
5/15/2013	0.05							0.04			
5/31/2013	0.05							0.14			
6/5/2013	0.04							0.14			
6/12/2013	0.05							0.56			
6/19/2013	0.02							0.26			
6/26/2013	0.02								0.02		
7/3/2013	0.20						0.20	0.64			0.18
7/17/2013	0.02							0.16			
7/24/2013	0.04							0.25			
7/31/2013	0.04							0.37			
8/8/2013	0.59		0.30	0.30	0.29		0.55	0.83	0.81		
8/14/2013	2.54							0.47			
8/21/2013	0.15		0.29					0.29	0.34		
8/28/2013	0.08	0.03						0.03			
9/4/2013	0.05	0.29	0.04								
9/18/2013	0.41		0.36			0.31		0.51	0.45	0.36	
9/25/2013	0.10							0.11			
10/1/2013	0.12							0.33			
10/8/2013	0.37		0.35					0.23	0.50		
10/15/2013	0.18						0.31	0.30			
10/22/2013	0.20							0.39			
10/29/2013	0.18							0.16			
11/6/2013	0.21							0.43			
11/13/2013								0.32			

* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)

2012 Nitrogen Data

	Nitrite as N (mg/L)										
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/30/2012											
6/6/2012											
6/13/2012	0.008	0.005	0.007	0.008	0.010	0.015	0.024	0.011	0.023	0.014	
6/20/2012	0.006	0.003	0.003					0.005	0.013		
6/27/2012	0.008	0.008	0.007					0.011	0.020		
7/3/2012	0.007	0.005	0.006	0.005	0.006	0.008	0.007	0.007	0.013	0.006	0.003
7/11/2012	0.008	0.008	0.008					0.009	0.012		
7/18/2012	0.006	0.005	0.004	0.006	0.007	0.005	0.014	0.009	0.010	0.008	0.005
7/25/2012	0.007	0.007	0.005					0.011	0.009		
8/1/2012	0.010	0.004	0.009	0.007	0.008	0.021	0.019	0.010	0.014	0.011	0.008
8/8/2012	0.012	0.004	0.004					0.012	0.011		
8/16/2012	0.015	0.010	0.010	0.011	0.016	0.013	0.018	0.014	0.015	0.017	NA
8/22/2012	0.026	0.024	0.021					0.024	0.019		
8/29/2012	0.016	0.030	0.023	0.018	0.021	0.024	0.032	0.023	0.015	0.018	0.018
9/7/2012	0.025	0.030	0.022					0.021	0.029		
9/12/2012	0.040	0.040	0.034	0.045	0.036	0.037	0.107		0.028	0.048	0.033
9/20/2012	0.052	0.055	0.055					0.050	0.046		
10/5/2012	0.054	0.051	0.046					0.051	0.020		
10/12/2012	0.075	0.078	0.075					0.064	0.026		
10/18/2012	0.086	0.107	0.090					0.065	0.060		
10/25/2012	0.088	0.093	0.089					0.076	0.024		

2012 Nitrogen Data

	Nitrate as N (mg/L)										
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/30/2012											
6/6/2012											
6/13/2012	0.02	0.01	0.02	0.02	0.04	0.04	0.06	0.03	0.05	0.02	
6/20/2012	0.05	0.06	0.05					0.06	0.07		
6/27/2012	0.04	0.03	0.02					0.2	0.37		
7/3/2012	0.02	0.02	0.02	0.03	0.04	0.03	0.05	0.1	0.27	0.03	0.02
7/11/2012	0.02	0.02	0.02					0.02	0.02		
7/18/2012	0.02	0.02	0.03	0.02	0.06	0.02	0.11	0.4	0.27	0.03	0.02
7/25/2012	0.04	0.03	0.02					0.08	0.26		
8/1/2012	0.04	0	0.01	0.02	0.03	0.06	0.19	0.05	0.2	0.03	0.02
8/8/2012	0.03	0.02	0.03					0.16	0.12		
8/16/2012	0.08	0.03	0.07	0.07	0.09	0.05	0.06	0.04	0.51	0.07	NA
8/22/2012	0.03	0.03	0.04					0.04	0.04		
8/29/2012	0.04	0.07	0.08	0.06	0.14	0.07	0.07	0.14	0.1	0.06	0.04
9/7/2012	0.1	0.07	0.08					0.2	0.36		
9/12/2012	0.09	0.11	0.07	0.11	0.13	0.13	0.23		0.37	0.14	0.09
9/20/2012	0.03	0.03	0.02					0.02	0.02		
10/5/2012	0.12	0.1	0.14					0.47	0.02		
10/12/2012	0.15	0.13	0.18					0.48	0.55		
10/18/2012	0.22	0.19	0.27					0.55	0.28		
10/25/2012	0.17	0.16	0.22					0.38	0.55		

2012 Nitrogen Data

	Ammonia-Nitrogen										
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/30/2012	0.05	1.00	0.05					0.00	0.00		
6/6/2012	0.25	0.10	0.25					0.25	0.25		
6/13/2012	0.00						0.00	0.00			
6/20/2012	0.00	0.00						0.00			
6/27/2012	0.00							0.00			
7/3/2012	0.00	0.00	0.00				0.00	0.00			
7/11/2012	0.25	0.25	0.25					0.25	0.00		
7/18/2012	0.25	0.25	0.00	0.00	0.00		0.25	0.25	0.00	0.25	0.25
7/25/2012	0.25	0.25	0.25					0.25	0.25		
8/1/2012	0.25	0.25	0.25					0.25	0.25		0.25
8/8/2012	0.50	0.25	0.25					0.50	0.15		
8/16/2012	0.50		0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
8/22/2012	0.25	0.25	0.25					0.50	0.25		
8/29/2012	0.50	0.25		0.50	0.25		0.00	0.25	0.25	0.25	0.25
9/7/2012	0.50	0.25	0.50					0.50			
9/12/2012	0.25	0.25	0.50	0.25	0.25		0.25	0.25		0.25	0.25
9/20/2012	0.50	0.50	0.50					0.50			
10/5/2012	1.00								0.50		
10/12/2012	0.00	0.00	0.00								
10/18/2012	0.00	0.25	0.00					0.00	0.25		
10/25/2012	0.25	0.25	0.25					0.25	0.00		

2012 Nitrogen Data

Total Inorganic Nitrogen (TIN)*											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/30/2012											
6/6/2012											
6/13/2012	0.03						0.08	0.04			
6/20/2012	0.06	0.06						0.07			
6/27/2012	0.05							0.21			
7/3/2012	0.03	0.03	0.03				0.06	0.11			
7/11/2012	0.28	0.28	0.28					0.28	0.03		
7/18/2012	0.28	0.28	0.03	0.03	0.07		0.37	0.66	0.28	0.29	0.28
7/25/2012	0.30	0.29	0.28					0.34	0.52		
8/1/2012	0.30	0.25	0.27					0.31	0.46		0.28
8/8/2012	0.54	0.27	0.28					0.67	0.28		
8/16/2012	0.60		0.33	0.33	0.36	0.31	0.33	0.30	0.78	0.34	
8/22/2012	0.31	0.30	0.31					0.56	0.31		
8/29/2012	0.56	0.35		0.58	0.41		0.10	0.41	0.37	0.33	0.31
9/7/2012	0.63	0.35	0.60					0.72			
9/12/2012	0.38	0.40	0.60	0.41	0.42		0.59			0.44	0.37
9/20/2012	0.58	0.59	0.58					0.57			
10/5/2012	1.17								0.54		
10/12/2012	0.23	0.21	0.26								
10/18/2012	0.31	0.55	0.36					0.62	0.59		
10/25/2012	0.51	0.50	0.56					0.71	0.57		

* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)

2011 Nitrogen Data

Nitrite as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/26/2011	0.018	0.024	0.017	0.018	0.015	0.018	0.017	0.018	0.016	0.018	0.017
6/1/2011	0.007	0.002	0.009					0.007			
6/8/2011	0.007	0.004	0.009					0.010	0.010		
6/15/2011	0.006	0.002	0.009	0.008				0.010	0.008	0.008	
6/22/2011	0.005	0.005	0.013					0.009	0.021		
6/29/2011	0.011	0.007	0.005	0.012	0.009	0.005	0.015	0.011	0.011	0.027	0.004
7/6/2011	0.007	0.007	0.006					0.011	0.008		
7/14/2011	0.008	0.005	0.007	0.009	0.008	0.014	0.018	0.011	0.011	0.008	0.011
7/21/2011	0.006	0.003	0.007					0.008	0.010		
7/27/2011	0.007	0.006	0.004	0.014	0.006	0.007	0.018	0.029	0.012	0.003	0.008
8/3/2011	0.008	0.007	0.007					0.011	0.017		
8/17/2011	0.016	0.008	0.009					0.013	0.018		
8/24/2011	0.005	NA	0.007	0.007	0.009	0.012	0.011	0.010	0.010	0.006	0.007
8/31/2011	0.021	0.020	0.020					0.021	0.020		
9/14/2011	0.028	0.034	0.032					0.032	0.017		
9/21/2011	0.017	0.024	0.013					0.013	0.016		
9/28/2011	0.022	0.019	0.016	0.015	0.019	0.022	0.028	0.023	0.023	0.017	0.017
10/6/2011	0.034	0.032	0.030	0.035	0.035	0.043	0.039	0.038	0.032	0.036	0.035
10/12/2011	0.013	0.022	0.028					0.026	0.009		
10/20/2011	0.035	0.041	0.045					0.026	0.016		
10/26/2011	0.016	0.049	0.016	0.018	0.030	NA	0.023	0.032	0.034	0.032	0.024
11/2/2011	0.043	0.038	0.031					0.044	0.035		
11/9/2011	0.038	NA	0.038	0.037	0.035	0.035	0.035	0.021	0.020	0.036	0.034

2011 Nitrogen Data

Nitrate as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/26/2011	0.03	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.04	0.03
6/1/2011	0.04	0.02	0.03					0.03			
6/8/2011	0.02	0.02	0.02					0.03	0.03		
6/15/2011	0.03	0.01	0.03	0.02				0.03	0.03	0.03	
6/22/2011	0.02	0.02	0.01					0.01	0.01		
6/29/2011	0.05	0.03	0.03	0.04	0.03	0.03	0.06	0.03	0.02	0.06	0.03
7/6/2011	0.03	0.03	0.03					0.03	0.03		
7/14/2011	0.03	0.03	0.02	0.05	0.03	0.04	0.07	0.12	0.21	0.03	0.04
7/21/2011	0.02	0.02	0.03					0.09	0.54		
7/27/2011	0.03	0.03	0.04	0.04	0.04	0.02	0.25	0.27	0.25	0.01	0.02
8/3/2011	0.02	0.03	0.03					0.04	0.06		
8/17/2011	0.05	0.04	0.03					0.03	0.04		
8/24/2011	0.03	NA	0.04	0.02	0.03	0.04	0.03	0.02	0.01	0.03	0.02
8/31/2011	0.08	0.05	0.06					0.16	0.18		
9/14/2011	0.03	0.03	0.03					0.03	0.02		
9/21/2011	0.04	0.08	0.07					0.07	0.11		
9/28/2011	0.07	0.07	0.06	0.02	0.03	0.02	0.06	0.13	0.20	0.02	0.03
10/6/2011	0.04	0.03	0.04	0.03	0.04	0.04	0.04	0.05	0.03	0.03	0.03
10/12/2011	0.04	0.06	0.06					0.02	0.02		
10/20/2011	0.08	0.14	0.08					0.38	0.54		
10/26/2011	0.05	0.12	0.05	0.07	0.12	NA	0.09	0.18	0.36	0.02	0.07
11/2/2011	0.02	0.02	0.04					0.02	0.01		
11/9/2011	0.17	NA	0.12	0.11	0.17	0.04	0.28	0.21	0.03	0.11	0.04
>0.55 = 0.54											

2011 Nitrogen Data

Ammonia-Nitrogen											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/26/2011	0										
6/1/2011	0										
6/8/2011	0							0			
6/15/2011	0							0			
6/22/2011	0							0			
6/29/2011	0						0	0			
7/6/2011	0										
7/14/2011			0					0			
7/21/2011	0							0			
7/27/2011	0						0	0			
8/3/2011	0							0			
8/17/2011	0							0			
8/24/2011	0						0	0			
8/31/2011	0							0			
9/14/2011	0.25	0	0					0			
9/21/2011	0							0.25			
9/28/2011	0.25	0.25	0.25		0.25		0.5	0.25	0.25		
10/6/2011	0.25	0	0	0	0.1	0.25	0.25	0	0		0
10/12/2011	0							0.25			
10/20/2011	0							0			
10/26/2011	0						0	0.25			
11/2/2011	0							0.25			
11/9/2011	0						0	0			
**Salicylate result											

2011 Nitrogen Data

Total Inorganic Nitrogen (TIN)*											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/26/2011	0.05										
6/1/2011	0.05										
6/8/2011	0.03							0.04			
6/15/2011	0.04							0.04			
6/22/2011	0.03							0.02			
6/29/2011	0.06						0.08	0.04			
7/6/2011	0.04										
7/14/2011			0.03					0.13			
7/21/2011	0.03							0.10			
7/27/2011	0.04						0.27	0.30			
8/3/2011	0.03							0.05			
8/17/2011	0.07							0.04			
8/24/2011	0.04						0.04	0.03			
8/31/2011	0.10							0.18			
9/14/2011	0.31	0.06	0.06					0.06			
9/21/2011	0.06							0.33			
9/28/2011	0.34	0.34	0.33		0.30		0.59	0.40	0.47		
10/6/2011	0.32	0.06	0.07	0.07	0.18	0.33	0.33	0.09	0.06		0.07
10/12/2011	0.05							0.30			
10/20/2011	0.12							0.41			
10/26/2011	0.07						0.11	0.46			
11/2/2011	0.06							0.31			
11/9/2011	0.21						0.32	0.23			
* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)											

2010 Nitrogen Data

Nitrite as N (mg/L)											
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
5/20/2010	0.017	0.024	0.015					0.019			
5/26/2010	0.030	0.010	0.010					0.015			
6/2/2010	0.011	0.007	0.008					0.011	0.012		
6/9/2010	0.008	NA	0.007					0.005	0.007		
6/16/2010	0.008	0.003	0.007					0.006	0.010		
6/23/2010	0.008	0.003	0.005					0.012	0.019		
6/30/2010	0.009	0.013	0.002					0.008	0.012		
7/7/2010	0.005	0.005	0.002					0.007	0.004		
7/15/2010	0.007	0.025	0.004					0.005			
7/21/2010	0.005	0.004	0.005					0.007	0.010		
7/28/2010	0.007	0.005	0.005					0.011	0.011		
8/4/2010	0.008	0.004	0.005					0.009	0.005		
8/11/2010	0.012	0.007	0.007					0.009	0.015		
8/18/2010	0.013	0.005	0.008					0.008	0.012		
8/26/2010	0.030	0.018	0.021	.				0.018	0.017		
9/2/2010	0.012	0.020	0.011					0.018	0.011		
9/8/2010	0.043	0.033	0.039	0.038	0.040	0.042	0.044	0.037		0.035	0.038
9/15/2010	0.039	0.061	0.039					0.023	0.015		
9/22/2010	0.024	0.029	0.021					0.013	0.018		
9/29/2010	0.027	0.024	0.025					NA	0.013		
10/13/2010	0.058	0.058	0.056					0.035	0.042		
10/20/2010	0.075	0.069	0.070					0.059	0.051		
10/28/2010	0.053	0.051	0.056					0.031	0.013		
11/3/2010	0.053	0.050	0.052	0.054	0.050	0.052	0.049	0.047	0.024	0.051	0.050

2010 Nitrogen Data

	Nitrate as N (mg/L)										
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/20/2010	0.01	0.01	0.09					0.01			
5/26/2010	0.02	0.02	0.03					0.02			
6/2/2010	0.03	0.02	0.03					0.05	0.04		
6/9/2010	0.04	NA	0.03					0.04	0.04		
6/16/2010	0.02	0.01	0.01					0.06	0.02		
6/23/2010	0.03	0.02	0.03					0.01	0.55		
6/30/2010	0.03	0.03	0.03					0.02	0.01		
7/7/2010	0.02	0.02	0.02					0.02	0.02		
7/15/2010	0.03	0.03	0.03					0.03			
7/21/2010	0.03	0.02	0.03					0.03	0.03		
7/28/2010	0.07	0.02	0.03					0.04	0.02		
8/4/2010	0.02	0.02	0.01					0.02	0.03		
8/11/2010	0.04	0.02	0.04					0.02	0.04		
8/18/2010	0.04	0.04	0.05					0.05	0.05		
8/26/2010	0.02	0.02	0.02					0.02	0.01		
9/2/2010	0.05	0.03	0.04					0.04	0.02		
9/8/2010	0.03	0.01	0.02	0.02	0.02	0.02	0.03	0.02		0.05	0.02
9/15/2010	0.03	0.01	0.03					0.03	0.02		
9/22/2010	0.02	0.02	0.01					0	0.01		
9/29/2010	0.01	0	0.01					NA	0		
10/13/2010	0.03	0.03	0.02					0.02	0.03		
10/20/2010	0.03	0.02	0.02					0.02	0.04		
10/28/2010	0.03	0.01	0.01					0.03	0.01		
11/3/2010	0.02	0.02	0.01	0.03	0.02	0.01	0.02	0.02	0.01	0.02	0.02

2010 Nitrogen Data

Ammonia-Nitrogen											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/20/2010	0	0.2	0					0			
5/26/2010	0	0	0					0			
6/2/2010	0		0					0	0		
6/9/2010	0						0	0			
6/16/2010	0	0						0			
6/23/2010	1	0						0	0		
6/30/2010	0							0	NA		
7/7/2010	0							0.10	0.05		
7/15/2010	0.1	0						0			
7/21/2010	0	0					0	0	0		
7/28/2010	0							0			
8/4/2010	0							0			
8/11/2010	0						0	0	NA		NA
8/18/2010	0	0						0	0		
8/26/2010	0							0			
9/2/2010	0		0					0			
9/8/2010	0						0	NA	NA		
9/15/2010	0							0			
9/22/2010	0							0	0		
9/29/2010	0							0	0		
10/13/2010	0							0	NA		
10/20/2010	0							0	0		
10/28/2010	0							NA	NA		
11/3/2010	0	NA	NA		NA	NA	0	0			
**Salicylate result											

2010 Nitrogen Data

Total Inorganic Nitrogen (TIN)*											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/20/2010	0.03	0.23	0.11					0.03			
5/26/2010	0.05	0.03	0.04					0.04			
6/2/2010	0.04		0.04					0.06	0.05		
6/9/2010	0.05							0.05			
6/16/2010	0.03	0.01						0.07			
6/23/2010	1.04	0.02						0.02	0.57		
6/30/2010	0.04							0.03			
7/7/2010	0.03							0.13	0.07		
7/15/2010	0.14	0.06						0.04			
7/21/2010	0.04	0.02						0.04	0.04		
7/28/2010	0.08							0.05			
8/4/2010	0.03							0.03			
8/11/2010	0.05							0.03			
8/18/2010	0.05	0.05						0.06	0.06		
8/26/2010	0.05							0.04			
9/2/2010	0.06		0.05					0.06			
9/8/2010	0.07						0.07				
9/15/2010	0.07							0.05			
9/22/2010	0.04							0.01	0.03		
9/29/2010	0.04								0.01		
10/13/2010	0.09							0.06			
10/20/2010	0.11							0.08	0.09		
10/28/2010	0.08										
11/3/2010	0.07						0.07	0.07			
* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)											

2009 Nitrogen Data

Nitrite as N (mg/L)												
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**	**CSHH#10A**
5/13/2009	0.003	0	0					0	0.001			
5/20/2009	0.009	0.006	0.008					0.008	0.014			
5/27/2009	0.012	0.020	0.009					0.010	0.008			
6/3/2009	0.031	0.010	0.011					0.018	0.016			
6/10/2009	0.010	0.009	0.008					0.012	0.016			
6/17/2009	0.006	0.006	0.005					0.008	0.015			
6/24/2009	0.009	0.005	0.012					0.014	0.016			
7/1/2009	0.008	0.004	0.005					0.009	0.007			
7/8/2009	0.005	0.010	0.005					0.031	0.018			
7/15/2009	0.008	0.003	0.014					0.013	0.012			0.014
7/22/2009	0.006	0.005	0.006					0.005	0.008			
7/29/2009	0.006	0.004	0.006					0.011	0.013			
8/5/2009	0.008	0.003	0.004					0.010	0.008			
8/12/2009	0.016	0.004	0.014					0.013	NA			
8/19/2009	0.010	0.006	0.009					0.011	0.014			
8/26/2009	0.003	0.005	0.007					0.006	0.016			
9/2/2009	0.006	0.010	0.004					0.010	0.010	0.007	0.009	
9/9/2009	0.019	0.015	0.008					0.008	0.011			
9/16/2009	0.032	NA	0.025					0.017	0.017	0.025	0.017	
9/23/2009	0.064	0.068	0.038					0.021	0.020			
9/30/2009	0.037	NA	0.044					0.020	0.012			
10/8/2009	0.046	NA	0.052					0.017	0.014			
10/14/2009	0.037	0.048	0.051					0.043	0.046			
10/21/2009	0.034	0.036	0.030					0.033	0.025			
10/30/2009	0.045	0.036	0.042					0.036	0.041		NA	

2009 Nitrogen Data

Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15	CSHH#10A
	Nitrate as N (mg/L)											
5/13/2009	0	0	0					0	0			
5/20/2009	0.04	0.03	0.04					0.03	0.02			
5/27/2009	0.06	0.05	0.05					0.04	0.04			
6/3/2009	0.03	0.03	0.04					0.03	0.03			
6/10/2009	0.05	0.03	0.04					0.02	0.02			
6/17/2009	0.03	0.02	0.02					0.03	0.03			
6/24/2009	0.03	0.03	0.03					0.02	0.02			
7/1/2009	0.02	0.02	0.02					0.03	0.01			
7/8/2009	0.03	0.03	0.03					0.06	0.04			
7/15/2009	0.04	0.03	0.03					0.04	0.02			0.03
7/22/2009	0.03	0.02	0.02					0.02	0			
7/29/2009	0.01	0.02	0.02					0.01	0.01			
8/5/2009	0.03	0.02	0.04					0.01	0.02			
8/12/2009	0.03	0.03	0.04					0.03	NA			
8/19/2009	0.04	0.04	0.03					0.05	0.05			
8/26/2009	0.04	0.02	0.02					0.03	0.03			
9/2/2009	0.04	0.02	0.03					0.02	0.03	0.04	0.04	
9/9/2009	0.05	0.04	0.05					0.05	0.06			
9/16/2009	0.02	NA	0.01					0.02	0.02	0.02	0.02	
9/23/2009	0.02	0.02	0.02					0.01	0.03			
9/30/2009	0.01	NA	0.03					0.01	0.01			
10/8/2009	0.03	NA	0.02					0.02	0.01			
10/14/2009	0.05	0.02	0.03					0.06	0.07			
10/21/2009	0.07	0.02	0.07					0.01	0.01			
10/30/2009	0.02	0.02	0.03					0.02	0.02		NA	

2009 Nitrogen Data

Ammonia-Nitrogen												
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15	CSHH#10A
5/13/2009	0	0	0					0	NA			
5/20/2009	0	0	0					0.025	NA			
5/27/2009	0.25	0.1	0.1					0.1	0.25			
6/3/2009	0	0.05	0					0	NA			
6/10/2009	0	0	0					0.25	0.25			
6/17/2009	0	0	0					0	0			
6/24/2009	0	0	0					0	0			
7/1/2009	1	0	NA					1	NA			
7/8/2009	0	0	0					0	NA			
7/15/2009	0	0	0					6.1	0			0.5
7/22/2009	0	0	0					NA	0			
7/29/2009	0	0	0					0	0			
8/5/2009	0	0	0					0	0			
8/12/2009	0	0	0					0	0			
8/19/2009	0	0	0					0	0.25			
8/26/2009	0	0	NA					0	0			
9/2/2009	0	0	0					0	NA	0	0	
9/9/2009	0	0	0					0.25	NA			
9/16/2009	0	NA	NA					0.25	NA	NA	0	
9/23/2009	0	0	0					0.10	0			
9/30/2009	0	NA	0					0	0			
10/8/2009	0.25	NA	0					0.25	0.25			
10/14/2009	0	0	0					0	0.10			
10/21/2009	0.25	0	0					0	0			
10/30/2009	0	0.05	0.10					0	0		0.25	

2009 Nitrogen Data

Total Inorganic Nitrogen (TIN)*												
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**	**CSHH#10A**
5/13/2009	0.00	0.00	0.00					0.00				
5/20/2009	0.05	0.04	0.05					0.06				
5/27/2009	0.32	0.17	0.16					0.15	0.30			
6/3/2009	0.06	0.09	0.05					0.05				
6/10/2009	0.06	0.04	0.05					0.28	0.29			
6/17/2009	0.04	0.03	0.03					0.04	0.05			
6/24/2009	0.04	0.04	0.04					0.03	0.04			
7/1/2009	1.03	0.02						1.04				
7/8/2009	0.04	0.04	0.04					0.09				
7/15/2009	0.05	0.03	0.04					6.15	0.03			0.54
7/22/2009	0.04	0.03	0.03						0.01			
7/29/2009	0.02	0.02	0.03					0.02	0.02			
8/5/2009	0.04	0.02	0.04					0.02	0.03			
8/12/2009	0.05	0.03	0.05					0.04				
8/19/2009	0.05	0.05	0.04					0.06	0.31			
8/26/2009	0.04	0.03						0.04	0.05			
9/2/2009	0.05	0.03	0.03					0.03		0.05	0.05	
9/9/2009	0.07	0.06	0.06					0.31				
9/16/2009	0.05							0.29			0.04	
9/23/2009	0.08	0.09	0.06					0.13	0.05			
9/30/2009	0.05		0.07					0.03	0.02			
10/8/2009	0.33		0.07					0.29	0.27			
10/14/2009	0.09	0.07	0.08					0.10	0.22			
10/21/2009	0.35	0.06	0.10					0.04	0.04			
10/30/2009	0.07	0.11	0.17					0.06	0.06			

* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)

2008 Nitrogen Data

Nitrite as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/21/2008	0.140	NA	0.012	0.016	NA	NA	NA	NA			
6/11/2008	NA	0.011	0.009	NA	NA	NA	NA	0.008			
6/19/2008	0.014	0.009	0.008	NA	NA	NA	NA	0.017			
6/25/2008	0.009	0.009	0.009	NA	NA	NA	NA	0.008			
7/2/2008	0.008	0.010	0.008	NA	NA	NA	NA	0.011			
7/9/2008	0.006	0.007	0.009	NA	NA	NA	NA	0.006			
7/17/2008	0.008	0.004	0.006	NA	NA	NA	NA	0.010			
7/30/2008	NA	0.009	0.007	NA	NA	NA	NA	0.006			
8/6/2008	0.011	0.011	0.011	NA	NA	NA	NA	0.007	0.017		
8/13/2008	0.012	0.005	0.007	NA	NA	NA	NA	0.011	0.013		
8/20/2008	0.011	0.008	0.007	NA	NA	NA	NA	0.009	0.008		
8/27/2008	0.01	0.005	NA	NA	NA	NA	NA	0.008	0.007		
9/3/2008	0.011	0.008	0.008	NA	NA	NA	NA	0.008	0.013		
9/10/2008	0.01	0.006	0.009	NA	NA	NA	NA	0.008	0.012		
9/17/2008	0.02	0.016	0.016	NA	NA	NA	NA	0.006	0.011		
9/24/2008	0.006	0.007	0.006	NA	NA	NA	NA	0.010	0.009		
10/2/2008	0.035	NA	0.009	NA	NA	NA	NA	0.015	NA		
10/8/2008	0.043	0.065	0.049	NA	NA	NA	NA	0.039	0.015		
10/16/2008	0.069	0.075	0.073	NA	NA	NA	NA	0.035	0.031		
10/22/2008	0.049	NA	0.046	NA	NA	NA	NA	0.024	0.015		
10/31/2008	0.035	0.038	0.038	NA	NA	NA	NA	0.037	0.012		
11/5/2008	0.036	0.039	0.033	NA	NA	NA	NA	0.025	0.026		

2008 Nitrogen Data

Nitrate as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
5/21/2008	0.02	NA	0.03	0.04	NA	NA	NA	NA			
6/11/2008	NA	0.03	0.04	NA	NA	NA	NA	0.03			
6/19/2008	0.03	0.04	0.04	NA	NA	NA	NA	0.04			
6/25/2008	0.04	0.04	0.03	NA	NA	NA	NA	0.15			
7/2/2008	0.05	0.05	0.04	NA	NA	NA	NA	0.04			
7/9/2008	0.03	0.03	0.04	NA	NA	NA	NA	0.02			
7/17/2008	0.05	0.03	0.02	NA	NA	NA	NA	0.03			
7/30/2008	NA	0.06	0.03	NA	NA	NA	NA	0.04			
8/6/2008	0.05	0.03	0.04	NA	NA	NA	NA	0.03	0.02		
8/13/2008	0.05	0.03	0.03	NA	NA	NA	NA	0.03	0.03		
8/20/2008	0.06	0.04	0.05	NA	NA	NA	NA	0.03	0.04		
8/27/2008	0.04	0.03	NA	NA	NA	NA	NA	0.03	0.03		
9/3/2008	0.05	0.03	0.04	NA	NA	NA	NA	0.03	0.02		
9/10/2008	0.03	0.03	0.03	NA	NA	NA	NA	0.03	0.04		
9/17/2008	0.03	0.03	0.04	NA	NA	NA	NA	0.03	0.03		
9/24/2008	0.04	0.07	0.04	NA	NA	NA	NA	0.04	0.04		
10/2/2008	0.03	NA	0.04	NA	NA	NA	NA	0.04	NA		
10/8/2008	0.02	0.02	0.02	NA	NA	NA	NA	0.02	0.02		
10/16/2008	0.04	0.02	0.03	NA	NA	NA	NA	0.02	0.02		
10/22/2008	0.05	NA	0.04	NA	NA	NA	NA	0.03	0.02		
10/31/2008	0.03	0.02	0.03	NA	NA	NA	NA	0.02	0.01		
11/5/2008	0.02	0.02	0.03	NA	NA	NA	NA	0.02	0.02		

**There are no ammonia-nitrogen readings and, thus, no calculated total inorganic nitrogen (TIN) in 2008.

2007 Nitrogen Data

Nitrite as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
6/21/2007	0.011	0.007	0.007	NA	NA	NA	NA	0.013			
6/27/2007	0.013	0.010	0.012	NA	NA	NA	NA	0.014			
7/5/2007	0.009	0.004	0.011	NA	NA	NA	NA	0.028			
7/16/2007	0.006	0.007	0.004	NA	NA	NA	NA	0.006			
7/20/2007	0.008	0.003	0.012	NA	NA	NA	NA	0.011			
7/25/2007	0.011	NA	0.024	NA	NA	NA	NA	0.009			
8/15/2007	0.008	0.006	0.008	NA	NA	NA	NA	0.010			
8/22/2007	0.016	0.018	0.016	NA	NA	NA	NA	0.014			
8/29/2007	0.016	0.027	0.018	NA	NA	NA	NA	0.011			
9/5/2007	0.013	0.011	0.011	NA	NA	NA	NA	0.010			
9/13/2007	0.029	0.029	0.024	NA	NA	NA	NA	0.025			
9/19/2007	0.038	0.056	0.046	NA	NA	NA	NA	0.040			
9/27/2007	0.052	0.056	0.051	NA	NA	NA	NA	0.026			
10/3/2007	0.039	0.035	0.030	NA	NA	NA	NA	0.025			
10/10/2007	0.032	0.028	0.028	NA	NA	NA	NA	0.029			
10/17/2007	0.021	0.019	0.026	NA	NA	NA	NA	0.016			
10/24/2007	0.024	0.024	0.037	NA	NA	NA	NA	0.021			
10/31/2007	0.021	0.024	0.024	NA	NA	NA	NA	0.018			

2007 Nitrogen Data

	Nitrate as N (mg/L)										
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
6/21/2007	0.04	0.04	0.04	NA	NA	NA	NA	0.66			
6/27/2007	0.04	0.04	0.04	NA	NA	NA	NA	0.23			
7/5/2007	0.02	0.03	0.03	NA	NA	NA	NA	0.07			
7/16/2007	0.02	0.03	0.04	NA	NA	NA	NA	0.29			
7/20/2007	0.04	0.03	0.03	NA	NA	NA	NA	0.07			
7/25/2007	0.03	NA	0.04	NA	NA	NA	NA	0.03			
8/15/2007	0.04	0.02	0.02	NA	NA	NA	NA	0.04			
8/22/2007	0.02	0.02	0.02	NA	NA	NA	NA	0.02			
8/29/2007	0.03	0.02	0.03	NA	NA	NA	NA	0.02			
9/5/2007	0.04	0.03	0.03	NA	NA	NA	NA	0.02			
9/13/2007	0.03	0.02	0.02	NA	NA	NA	NA	0.02			
9/19/2007	0.03	0.04	0.04	NA	NA	NA	NA	0.03			
9/27/2007	0.04	0.03	0.03	NA	NA	NA	NA	0.03			
10/3/2007	0.02	0.02	0.02	NA	NA	NA	NA	0.02			
10/10/2007	0.02	0.02	0.02	NA	NA	NA	NA	0.04			
10/17/2007	0.12	0.10	0.11	NA	NA	NA	NA	0.17			
10/24/2007	0.09	0.08	0.11	NA	NA	NA	NA	0.27			
10/31/2007	0.12	0.07	0.15	NA	NA	NA	NA	0.02			

**There was only one ammonia-nitrogen reading (6/21/07) and, thus, only one date of calculated total inorganic nitrogen (TIN) in 2007.

2006 Nitrogen Data

Nitrite as N (mg/L)											
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
6/1/2006	0.002	0.005	0.003	NA	NA	NA	NA	0.001			
6/8/2006	0.016	0.025	0.010	NA	NA	NA	NA	0.015			
6/15/2006	0.014	0.016	0.015	NA	NA	NA	NA	0.016			
6/22/2006	0.006	0.013	0.007	NA	NA	NA	NA	0.003			
6/29/2006	0.015	0.009	0.001	NA	NA	NA	NA	0.005			
7/7/2006	0.009	0.013	0.007	NA	NA	NA	NA	0.015			
7/13/2006	0	0	0.001	NA	NA	NA	NA	0.012			
7/20/2006	0.014	0.014	0.006	NA	NA	NA	NA	0.010			
7/27/2006	0.008	0.005	0.006	NA	NA	NA	NA	0.005			
8/2/2006	0.010	0.006	0.007	NA	NA	NA	NA	0.003			
8/10/2006	0.010	0.013	0.015	NA	NA	NA	NA	0.022			
8/17/2006	0.004	0.004	0.013	NA	NA	NA	NA	0.002			
8/24/2006	0.008	0.013	0.008	NA	NA	NA	NA	0.008			
8/31/2006	0.030	NA	0.018	NA	NA	NA	NA	0.016			
9/7/2006	0.029	0.014	0.024	NA	NA	NA	NA	0.014			
9/14/2006	0.012	0.012	0.013	NA	NA	NA	NA	0.015			
9/21/2006	0.010	0.008	0.010	0.009	0.011	0.010	0.016	NA			
9/28/2006	0.009	0.015	0.011	NA	NA	NA	NA	0.013			
10/5/2006	0.010	0.009	0.008	NA	NA	NA	NA	0.008			
10/12/2006	0.008	0.007	0.009	NA	NA	NA	NA	0.011			

2006 Nitrogen Data

Nitrate as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
6/1/2006	0.04	0.06	0.06	NA	NA	NA	NA	0.09			
6/8/2006	0.07	0.07	0.07	NA	NA	NA	NA	0.11			
6/15/2006	0.09	0.01	0.02	NA	NA	NA	NA	0.82			
6/22/2006	0.03	0.02	0.01	NA	NA	NA	NA	0.31			
6/29/2006	0.15	0.07	0.12	NA	NA	NA	NA	0.48			
7/7/2006	0.03	0.04	0.03	NA	NA	NA	NA	0.83			
7/13/2006	0.05	0.04	0.05	NA	NA	NA	NA	0.02			
7/20/2006	0.05	0.07	0.03	NA	NA	NA	NA	0.10			
7/27/2006	0.02	0.05	0.03	NA	NA	NA	NA	0.04			
8/2/2006	0.04	0.05	0.08	NA	NA	NA	NA	0.72			
8/10/2006	0.03	0.03	0.08	NA	NA	NA	NA	0.94			
8/17/2006	0.06	0.03	0.05	NA	NA	NA	NA	0.19			
8/24/2006	0.07	0.02	0.09	NA	NA	NA	NA	0.31			
8/31/2006	0.04	NA	0.01	NA	NA	NA	NA	0.04			
9/7/2006	0.05	0.07	0.05	NA	NA	NA	NA	0.01			
9/14/2006	0.04	0.03	0.08	NA	NA	NA	NA	0.38			
9/21/2006	0.04	0.03	0.14	0.04	0.06	0.02	0.10	NA			
9/28/2006	0.03	0.03	0.03	NA	NA	NA	NA	0.32			
10/5/2006	0.03	0.04	0.17	NA	NA	NA	NA	0.29			
10/12/2006	0.07	0.03	0.05	NA	NA	NA	NA	0.25			

2006 Nitrogen Data

Ammonia-Nitrogen											
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
6/1/2006	2.72	4.24	2.72	NA	NA	NA	NA	1.52			
6/8/2006	1.20	1.28	1.12	NA	NA	NA	NA	0.96			
6/15/2006	1.44	2.32	1.12	NA	NA	NA	NA	1.44			
6/22/2006	2.56	1.68	2.64	NA	NA	NA	NA	1.68			
6/29/2006	2.00	1.68	2.56	NA	NA	NA	NA	0.88			
7/7/2006	2.24	1.36	2.08	NA	NA	NA	NA	2.16			
7/13/2006	1.92	2.32	2.56	NA	NA	NA	NA	1.36			
7/20/2006	1.36	1.60	2.00	NA	NA	NA	NA	1.92			
7/27/2006	2.32	1.92	2.40	NA	NA	NA	NA	1.12			
8/2/2006	2.40	2.80	2.88	NA	NA	NA	NA	1.76			
8/10/2006	0.96	2.64	1.68	NA	NA	NA	NA	1.68			
8/17/2006	2.16	1.52	2.16	NA	NA	NA	NA	1.52			
8/24/2006	1.84	2.00	1.52	NA	NA	NA	NA	1.60			
8/31/2006	2.16	NA	2.40	NA	NA	NA	NA	1.52			
9/7/2006	2.40	2.80	2.16	NA	NA	NA	NA	1.60			
9/14/2006	2.56	2.56	2.80	NA	NA	NA	NA	1.84			
9/21/2006	2.40	1.84	2.32	2.48	2.72	2.40	2.48	NA			
9/28/2006	2.32	2.00	3.12	NA	NA	NA	NA	2.08			
10/5/2006	1.84	2.00	2.00	NA	NA	NA	NA	1.60			
10/12/2006	2.64	2.40	2.00	NA	NA	NA	NA	1.76			

2006 Nitrogen Data

Total Inorganic Nitrogen (TIN)*											
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
6/1/2006	2.76	4.31	2.78					1.61			
6/8/2006	1.29	1.38	1.20					1.09			
6/15/2006	1.54	2.35	1.16					2.28			
6/22/2006	2.60	1.71	2.66					1.99			
6/29/2006	2.17	1.76	2.68					1.37			
7/7/2006	2.28	1.41	2.12					3.01			
7/13/2006	1.97	2.36	2.61					1.39			
7/20/2006	1.42	1.68	2.04					2.03			
7/27/2006	2.35	1.98	2.44					1.17			
8/2/2006	2.45	2.86	2.97					2.48			
8/10/2006	1.00	2.68	1.78					2.64			
8/17/2006	2.22	1.55	2.22					1.71			
8/24/2006	1.92	2.03	1.62					1.92			
8/31/2006	2.23		2.43					1.58			
9/7/2006	2.48	2.88	2.23					1.62			
9/14/2006	2.61	2.60	2.89					2.24			
9/21/2006	2.45	1.88	2.47	2.53	2.79	2.43	2.60				
9/28/2006	2.36	2.05	3.16					2.41			
10/5/2006	1.88	2.05	2.18					1.90			
10/12/2006	2.72	2.44	2.06					2.02			
* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)											

2005 Nitrogen Data

Nitrite as N (mg/L)											
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
6/2/2005	0.011	0.009	0.012	0.019	0.011	0.017	0.011	0.019			
6/9/2005	0	0	0.006	NA	NA	NA	NA	0.007			
6/16/2005	0.004	0.010	0.017	NA	NA	NA	NA	NA			
6/23/2005	0.017	0.011	0.010	NA	NA	NA	NA	0.032			
6/30/2005	0.015	0.006	0.011	NA	NA	NA	NA	0.025			
7/7/2005	0.005	0	0.004	NA	NA	NA	NA	0			
7/14/2005	0.005	0.001	0.002	NA	NA	NA	NA	0.005			
7/21/2005	0.014	0.015	0.004	NA	NA	NA	NA	0.011			
7/28/2005	0.002	0.002	0.003	NA	NA	NA	NA	0			
8/11/2005	0.013	0.006	0.010	0.018	NA	NA	NA	0.007			
8/18/2005	0.004	0	0	NA	NA	NA	NA	0.003			
8/25/2005	0.025	NA	0.011	NA	NA	NA	NA	0.008			
9/1/2005	0.015	0.018	0.019	0.011	0.028	0.020	0.016	0.021			
9/8/2005	0.010	0.007	0	NA	NA	NA	NA	0.006			
9/22/2005	0.024	0.017	0.017	NA	NA	NA	NA	0.023			
9/29/2005	0.021	0.016	0.021	NA	NA	NA	NA	0.010			
10/6/2005	0.036	0.032	0.021	NA	NA	NA	NA	0.019			
10/20/2005	0.023	0.031	0.024	NA	NA	NA	NA	0.020			
10/27/2005	0.038	0.047	0.039	NA	NA	NA	NA	0.028			
11/3/2005	0.053	0.066	0.053	NA	NA	NA	NA	0.040			

2005 Nitrogen Data

Nitrate as N (mg/L)											
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
6/2/2005	0.03	0.07	0.09	0.02	0.10	0.09	0.09	0.23			
6/9/2005	0.01	0.06	0.03	NA	NA	NA	NA	0.07			
6/16/2005	0.02	0.04	0.01	NA	NA	NA	NA	NA			
6/23/2005	0.01	0.03	0	NA	NA	NA	NA	0.07			
6/30/2005	0.03	0.01	0.05	NA	NA	NA	NA	0.19			
7/7/2005	0.01	0.02	0.01	NA	NA	NA	NA	0.24			
7/14/2005	0.02	0	0.22	NA	NA	NA	NA	0.28			
7/21/2005	0.03	0	0	NA	NA	NA	NA	0.38			
7/28/2005	0.05	0.03	0.06	NA	NA	NA	NA	0.30			
8/11/2005	0	0	0.09	0.01	NA	NA	NA	0.40			
8/18/2005	0	0.03	0	NA	NA	NA	NA	0.23			
8/25/2005	0.07	NA	0.07	NA	NA	NA	NA	0.33			
9/1/2005	0.04	0.05	0	0.04	0.03	0.07	0.01	0.55			
9/8/2005	0.04	0.03	0.04	NA	NA	NA	NA	0.10			
9/22/2005	0.11	0.09	0.13	NA	NA	NA	NA	0.45			
9/29/2005	0.09	0.05	0.07	NA	NA	NA	NA	0.16			
10/6/2005	0.05	0.07	0.10	NA	NA	NA	NA	0.12			
10/20/2005	0.03	0.01	0.04	NA	NA	NA	NA	0.01			
10/27/2005	0.02	0.03	0.01	NA	NA	NA	NA	1.20			
11/3/2005	0	0.03	0.19	NA	NA	NA	NA	0.56			

2005 Nitrogen Data

Ammonia-Nitrogen											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
6/2/2005	0.40	1.12	0.56	1.04	1.52	0.56	0.72	1.04			
6/9/2005	1.12	0.80	0.88	NA	NA	NA	NA	0.96			
6/16/2005	0.40	1.12	0.72	NA	NA	NA	NA	NA			
6/23/2005	1.20	0.64	1.12	NA	NA	NA	NA	1.36			
6/30/2005	1.28	1.12	1.84	NA	NA	NA	NA	1.60			
7/7/2005	0.16	0.48	0.64	NA	NA	NA	NA	1.28			
7/14/2005	0.64	0.24	0.64	NA	NA	NA	NA	0.56			
7/21/2005	0.80	0.56	1.12	NA	NA	NA	NA	1.12			
7/28/2005	1.28	1.20	1.20	NA	NA	NA	NA	1.68			
8/11/2005	0.96	1.76	0.96	1.36	NA	NA	NA	0.80			
8/18/2005	0.72	0.80	1.44	NA	NA	NA	NA	1.12			
8/25/2005	0.88	NA	0.40	NA	NA	NA	NA	1.04			
9/1/2005	2.24	1.28	1.68	1.76	2.00	2.00	1.92	1.68			
9/8/2005	0.24	0.64	0.32	NA	NA	NA	NA	0.96			
9/22/2005	1.28	1.12	1.28	NA	NA	NA	NA	0.88			
9/29/2005	0.8	1.04	1.36	NA	NA	NA	NA	0.88			
10/6/2005	1.04	1.52	0.64	NA	NA	NA	NA	1.6			
10/20/2005	1.6	1.52	0.96	NA	NA	NA	NA	1.60			
10/27/2005	1.76	1.36	1.12	NA	NA	NA	NA	1.68			
11/3/2005	0.16	0.96	0.40	NA	NA	NA	NA	0.96			

2005 Nitrogen Data

Total Inorganic Nitrogen (TIN)*											
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
6/2/2005	0.44	1.20	0.66	1.08	1.63	0.67	0.82	1.29			
6/9/2005	1.13	0.86	0.92					1.04			
6/16/2005	0.42	1.17	0.75								
6/23/2005	1.23	0.68	1.13					1.46			
6/30/2005	1.33	1.14	1.90					1.82			
7/7/2005	0.18	0.50	0.65					1.52			
7/14/2005	0.67	0.24	0.86					0.85			
7/21/2005	0.84	0.58	1.12					1.51			
7/28/2005	1.33	1.23	1.26					1.98			
8/11/2005	0.97	1.77	1.06	1.39				1.21			
8/18/2005	0.72	0.83	1.44					1.35			
8/25/2005	0.98		0.48					1.38			
9/1/2005	2.30	1.35	1.70	1.81	2.06	2.09	1.95	2.25			
9/8/2005	0.29	0.68	0.36					1.07			
9/22/2005	1.41	1.23	1.43					1.35			
9/29/2005	0.91	1.11	1.45					1.05			
10/6/2005	1.13	1.62	0.76					1.74			
10/20/2005	1.65	1.56	1.02					1.63			
10/27/2005	1.82	1.44	1.17					2.91			
11/3/2005	0.21	1.06	0.64					1.56			
* TIN = Nitrate + Nitrite + Ammonia (when samples have been collected for all three)											

2004 Nitrogen Data

	Nitrite as N (mg/L)										
Date	CSHH#1	CSHH#2	CSHH#3	CSHH#4	CSHH#5	CSHH#6	CSHH#7	CSHH#8	CSHH#13	CSHH#14	CSHH#15
6/3/2004	0.003	0.019	0.007	0.009	0.009	0.003	0.002	0.019			
6/10/2004	0.017	0.017	0.012	0.017	0.018	0.021	0.014	0.011			
6/18/2004	0.008	0.003	0.019	0.006	0.008	0.009	0.013	0.007			
6/24/2004	0.012	0.006	0.001	NA	NA	NA	NA	0.013			
7/14/2004	0.021	0.007	0.003	0.009	0.018	0.007	0.025	0.011			
7/22/2004	0.009	0.015	0.006	NA	NA	NA	NA	0.007			
7/29/2004	0.005	0.008	0.002	0.008	0.002	0.009	0.017	0.015			
8/5/2004	0.008	0.012	0.008	NA	NA	NA	NA	0.007			
8/11/2004	0.007	0.006	0.001	NA	NA	NA	NA	0.008			
8/19/2004	0.002	0	0.009	NA	NA	NA	NA	0.006			
8/26/2004	0.003	0.015	0.010	0.002	0.015	0.004	0.007	0.002			
9/2/2004	0.012	0.006	0.009	NA	NA	NA	NA	0.011			
9/8/2004	0.012	NA	0.021	NA	NA	NA	NA	0.035			
9/15/2004	0.016	0.016	0.020	0.012	0.019	0.023	0.022	0.011			
9/22/2004	0.024	0.032	0.020	NA	NA	NA	NA	0.023			
9/30/2004	0.005	0.005	0.004	NA	NA	NA	NA	0.010			
10/7/2004	0.020	0.019	0.031	NA	NA	NA	NA	0.046			
10/14/2004	0.014	0.014	0.016	NA	NA	NA	NA	0.024			
10/21/2004	0.015	0.008	0.011	NA	NA	NA	NA	0.011			
10/28/2004	0.014	NA	0.016	NA	NA	NA	NA	0.020			
11/4/2004	0.025	0.018	0.028	NA	NA	NA	NA	0.012			
11/10/2004	0.019	0.028	0.019	NA	NA	NA	NA	0.019			

2004 Nitrogen Data

Nitrate as N (mg/L)											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
6/3/2004	0.12	0.05	0.04	0.08	0.11	0.09	0.11	0.84			
6/10/2004	0.11	0.05	0.19	0.1	0.25	0.15	0.47	0.94			
6/18/2004	0.05	0.05	0.01	0.1	0.07	0.08	0.07	0.48			
6/24/2004	0.07	0.01	0.06	NA	NA	NA	NA	0.48			
7/14/2004	0.03	0.06	0.02	0.05	0.08	0.15	0.55	0.20			
7/22/2004	0.05	0.03	0.01	NA	NA	NA	NA	0.22			
7/29/2004	0.08	0.05	0.08	0.06	0.20	0.03	0.01	0.03			
8/5/2004	0.03	0.04	0.02	NA	NA	NA	NA	0.12			
8/11/2004	0.03	0.04	0.01	NA	NA	NA	NA	0.09			
8/19/2004	0.07	0.03	0.02	NA	NA	NA	NA	0.39			
8/26/2004	0.01	0.01	0.08	0.02	0.65	0.04	0.27	0.07			
9/2/2004	0.06	0.02	0	NA	NA	NA	NA	0.38			
9/8/2004	0.04	NA	0.07	NA	NA	NA	NA	0.11			
9/15/2004	0.11	0.05	0.08	0.09	0.05	0.06	0.07	0.38			
9/22/2004	0.12	0.16	0.11	NA	NA	NA	NA	0.43			
9/30/2004	0.14	0.15	0.16	NA	NA	NA	NA	0.74			
10/7/2004	0	0.07	0.11	NA	NA	NA	NA	0.22			
10/14/2004	0.11	0.04	0.11	NA	NA	NA	NA	0.23			
10/21/2004	0.15	0.05	0.04	NA	NA	NA	NA	0.53			
10/28/2004	0.09	NA	0.03	NA	NA	NA	NA	0.05			
11/4/2004	0.06	0.07	0.12	NA	NA	NA	NA	0.53			
11/10/2004	0	0.07	0.05	NA	NA	NA	NA	0.71			

2004 Nitrogen Data

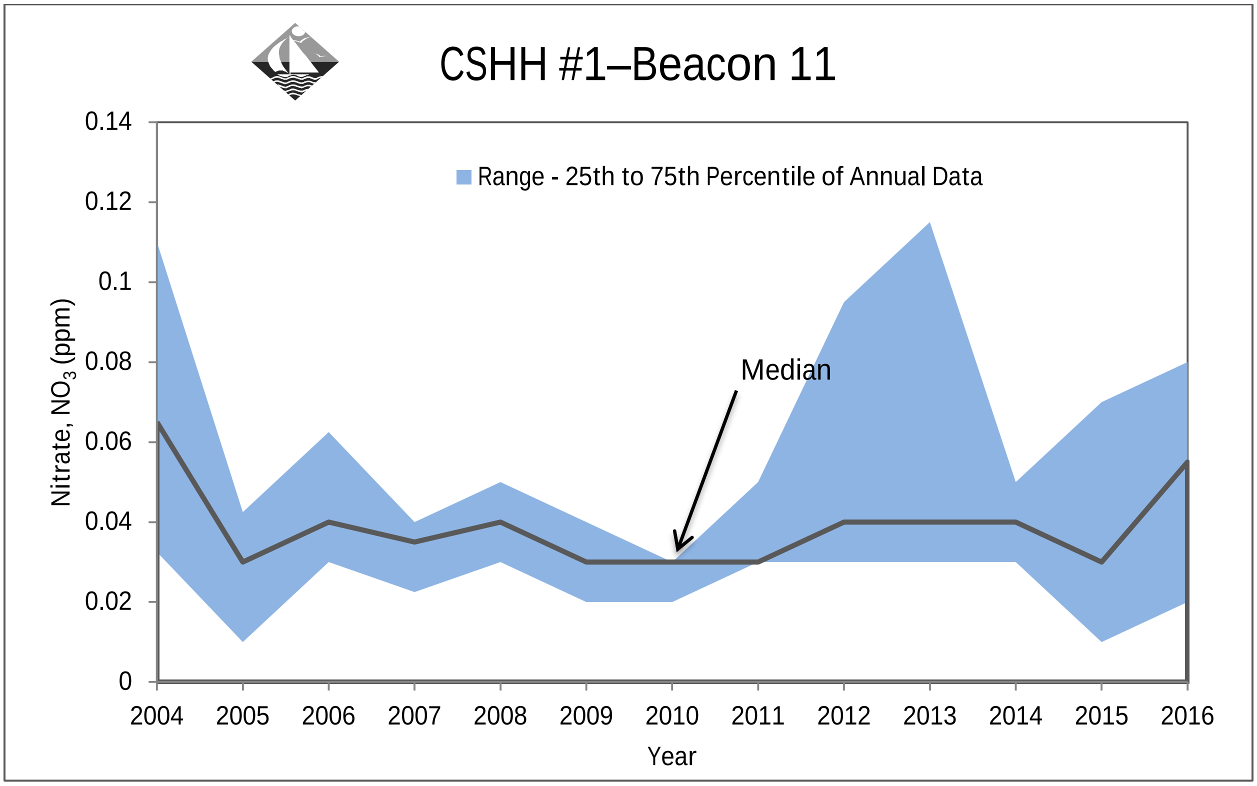
Ammonia-Nitrogen											
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
6/3/2004	2.16	1.92	1.68	1.68	1.68	1.52	2	2.08			
6/10/2004	1.60	1.44	1.60	1.44	1.20	1.28	1.52	1.44			
6/18/2004	1.12	1.12	0.88	0.96	0.64	0.96	1.04	0.96			
6/24/2004	NA	NA	NA	NA	NA	NA	NA	NA			
7/14/2004	1.92	1.84	1.52	2.00	1.84	2.32	2.56	2.24			
7/22/2004	NA	NA	NA	NA	NA	NA	NA	NA			
7/29/2004	0.88	0.24	1.60	1.44	1.60	1.76	2.24	1.12			
8/5/2004	1.52	1.28	1.76	NA	NA	NA	NA	1.52			
8/11/2004	0.56	0.88	0.96	NA	NA	NA	NA	1.12			
8/19/2004	1.44	1.52	1.52	NA	NA	NA	NA	0.96			
8/26/2004	0.72	0.48	0.96	0.72	0.96	0.88	1.36	1.28			
9/2/2004	1.04	1.28	1.36	NA	NA	NA	NA	1.6			
9/8/2004	1.52	NA	1.60	NA	NA	NA	NA	1.20			
9/15/2004	0.96	0.88	0.88	0.88	0.88	0.96	0.48	0.72			
9/22/2004	1.76	1.36	2.08	NA	NA	NA	NA	1.52			
9/30/2004	1.52	0.48	1.28	NA	NA	NA	NA	0.96			
10/7/2004	2.16	1.28	1.28	NA	NA	NA	NA	1.44			
10/14/2004	1.28	1.04	1.04	NA	NA	NA	NA	1.44			
10/21/2004	1.52	1.52	1.28	NA	NA	NA	NA	2.16			
10/28/2004	1.20	NA	1.52	NA	NA	NA	NA	0.88			
11/4/2004	1.20	0.64	1.28	NA	NA	NA	NA	1.04			
11/10/2004	0.88	1.12	1.12	NA	NA	NA	NA	1.68			

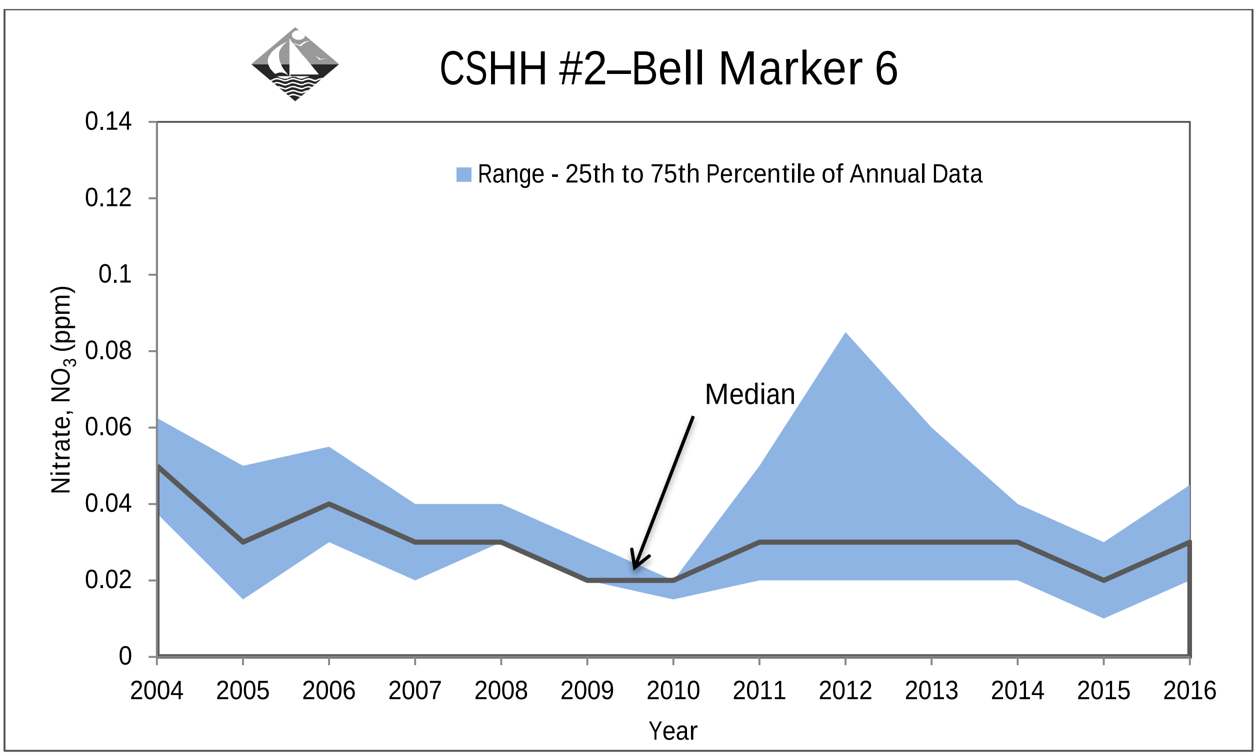
2004 Nitrogen Data

	Total Inorganic Nitrogen (TIN)*										
Date	**CSHH#1**	**CSHH#2**	**CSHH#3**	**CSHH#4**	**CSHH#5**	**CSHH#6**	**CSHH#7**	**CSHH#8**	**CSHH#13**	**CSHH#14**	**CSHH#15**
6/3/2004	2.28	1.99	1.73	1.77	1.80	1.61	2.11	2.94			
6/10/2004	1.73	1.51	1.80	1.56	1.47	1.45	2.00	2.39			
6/18/2004	1.18	1.17	0.91	1.07	0.72	1.05	1.12	1.45			
6/24/2004											
7/14/2004	1.97	1.91	1.54	2.06	1.94	2.48	3.14	2.45			
7/22/2004											
7/29/2004	0.97	0.30	1.68	1.51	1.80	1.80	2.27	1.17			
8/5/2004	1.56	1.33	1.79					1.65			
8/11/2004	0.60	0.93	0.97					1.22			
8/19/2004	1.51	1.55	1.55					1.36			
8/26/2004	0.73	0.51	1.05	0.74	1.63	0.92	1.64	1.35			
9/2/2004	1.11	1.31	1.37					1.99			
9/8/2004	1.57		1.69					1.35			
9/15/2004	1.09	0.95	0.98	0.98	0.95	1.04	0.57	1.11			
9/22/2004	1.90	1.55	2.21					1.97			
9/30/2004	1.67	0.64	1.44					1.71			
10/7/2004	2.18	1.37	1.42					1.71			
10/14/2004	1.40	1.09	1.17					1.69			
10/21/2004	1.69	1.58	1.33					2.70			
10/28/2004	1.30		1.57					0.95			
11/4/2004	1.29	0.73	1.43					1.58			
11/10/2004	0.90	1.22	1.19					2.41			

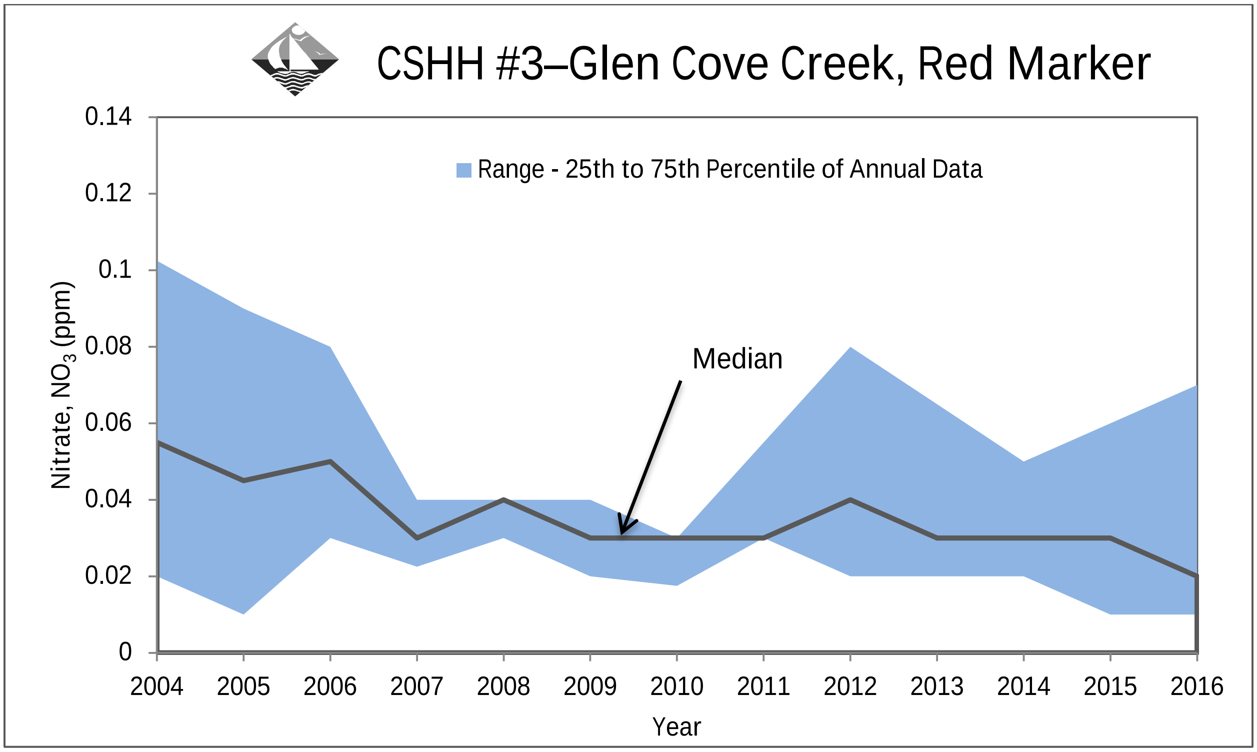
2004-2016 Nitrogen Range Graphs

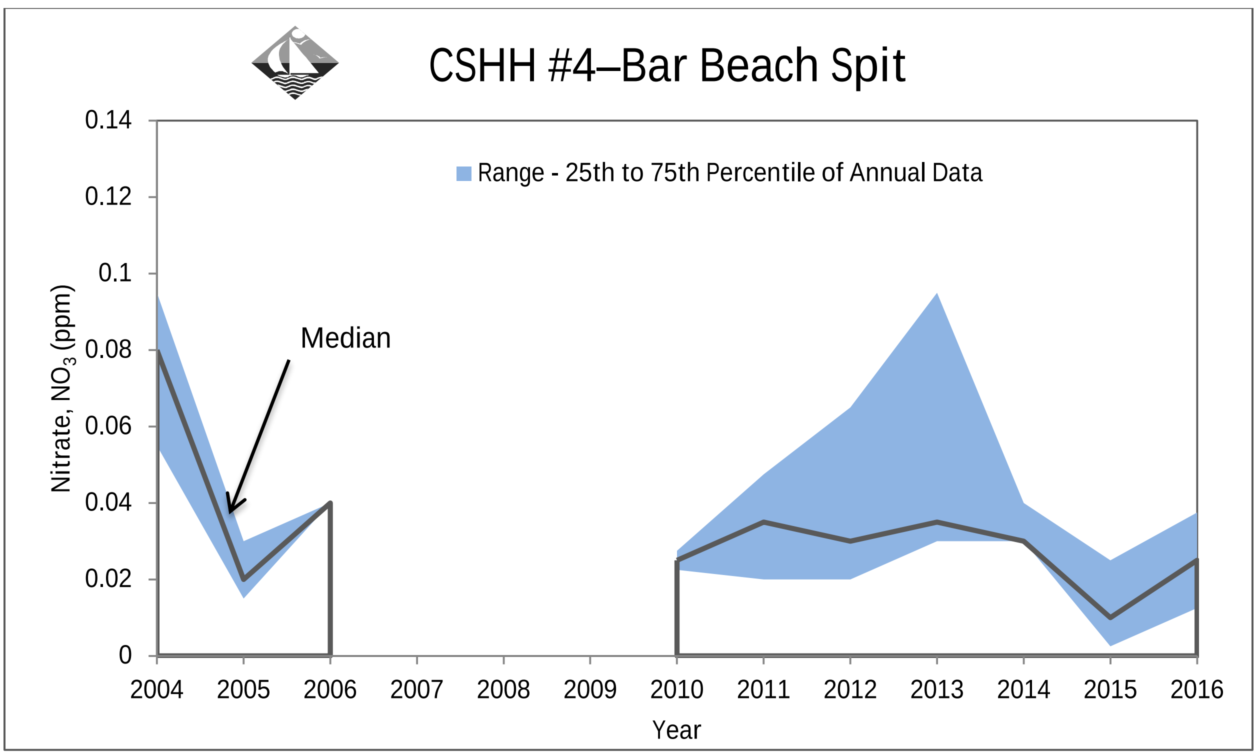
Nitrate



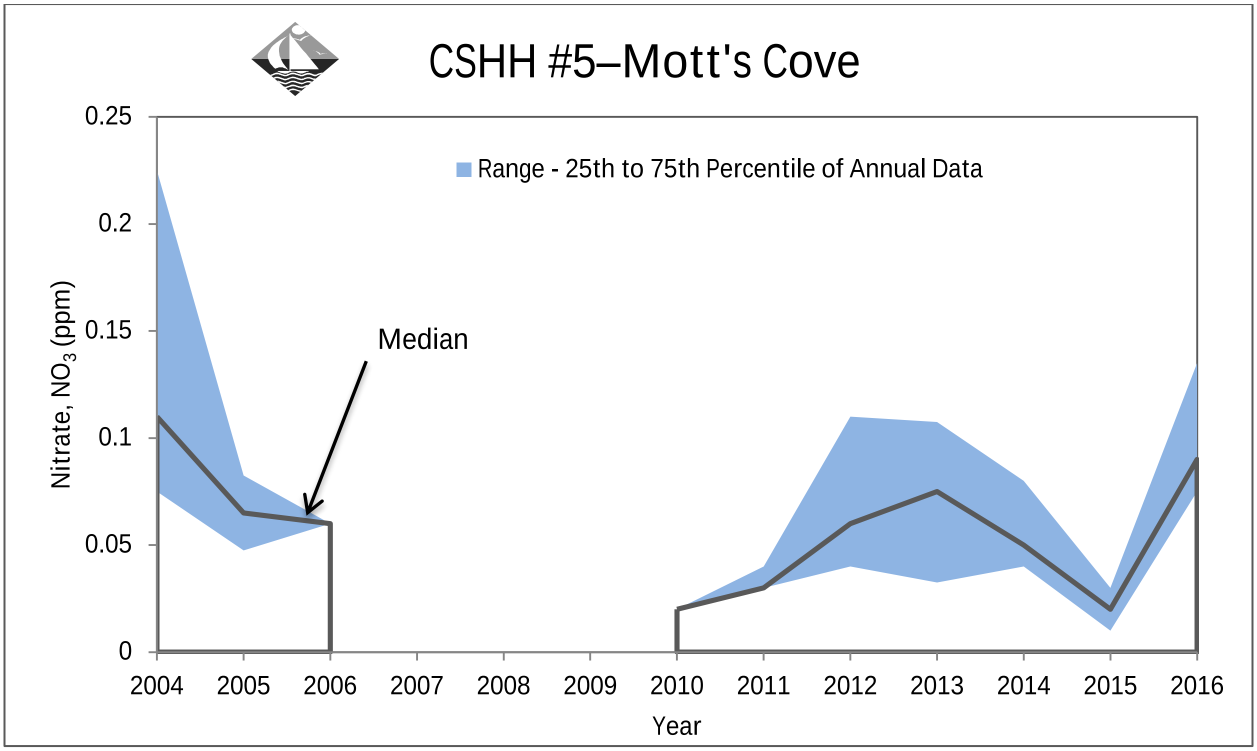


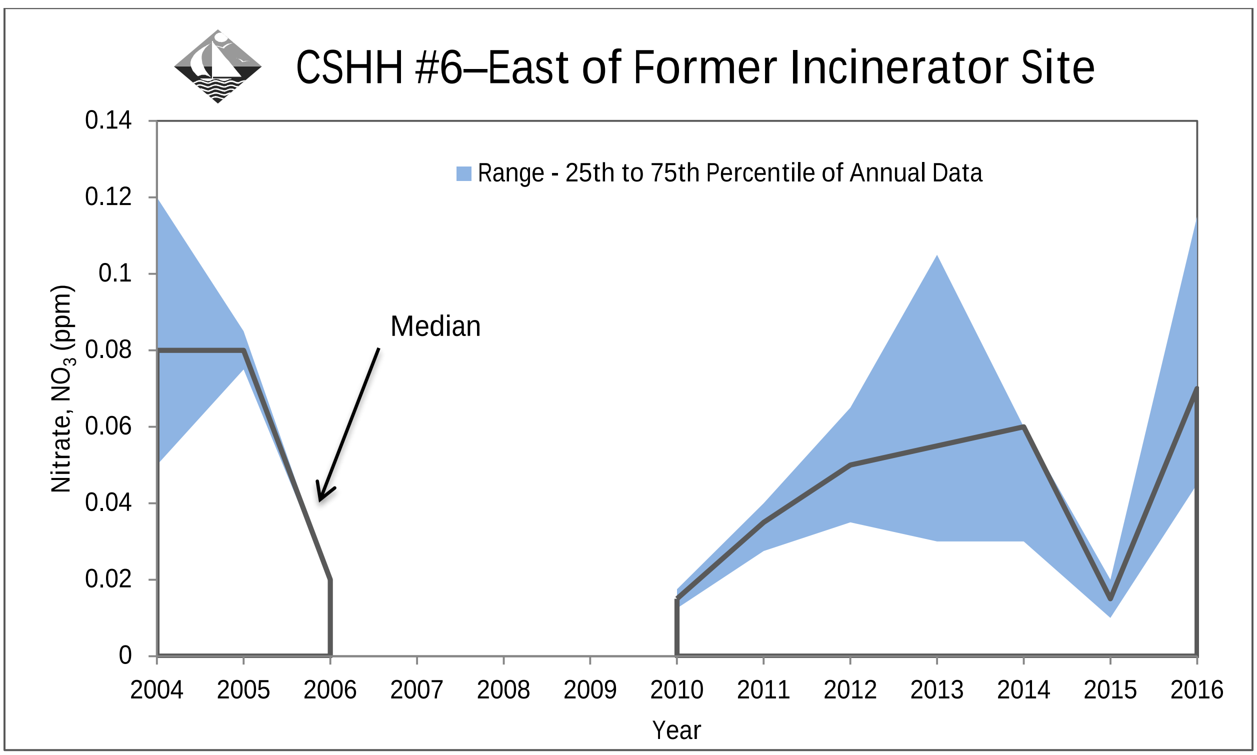
2004-2016 Nitrogen Range Graphs



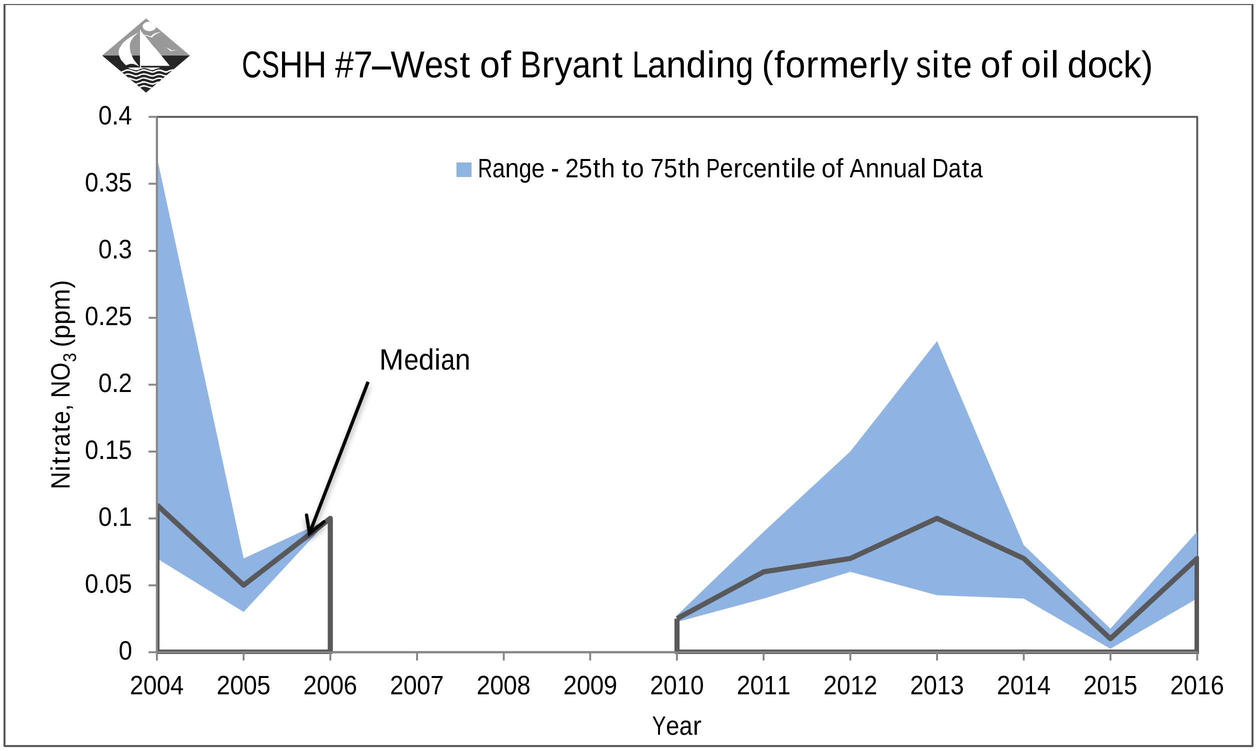


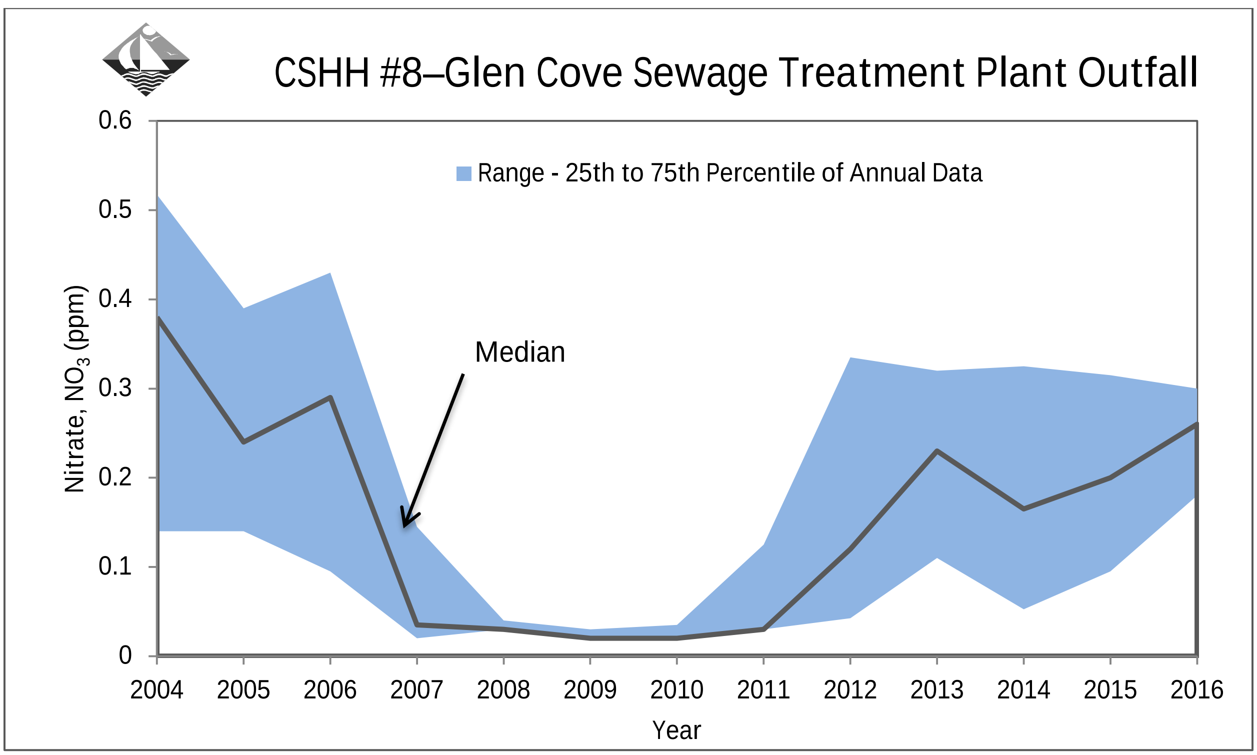
2004-2016 Nitrogen Range Graphs



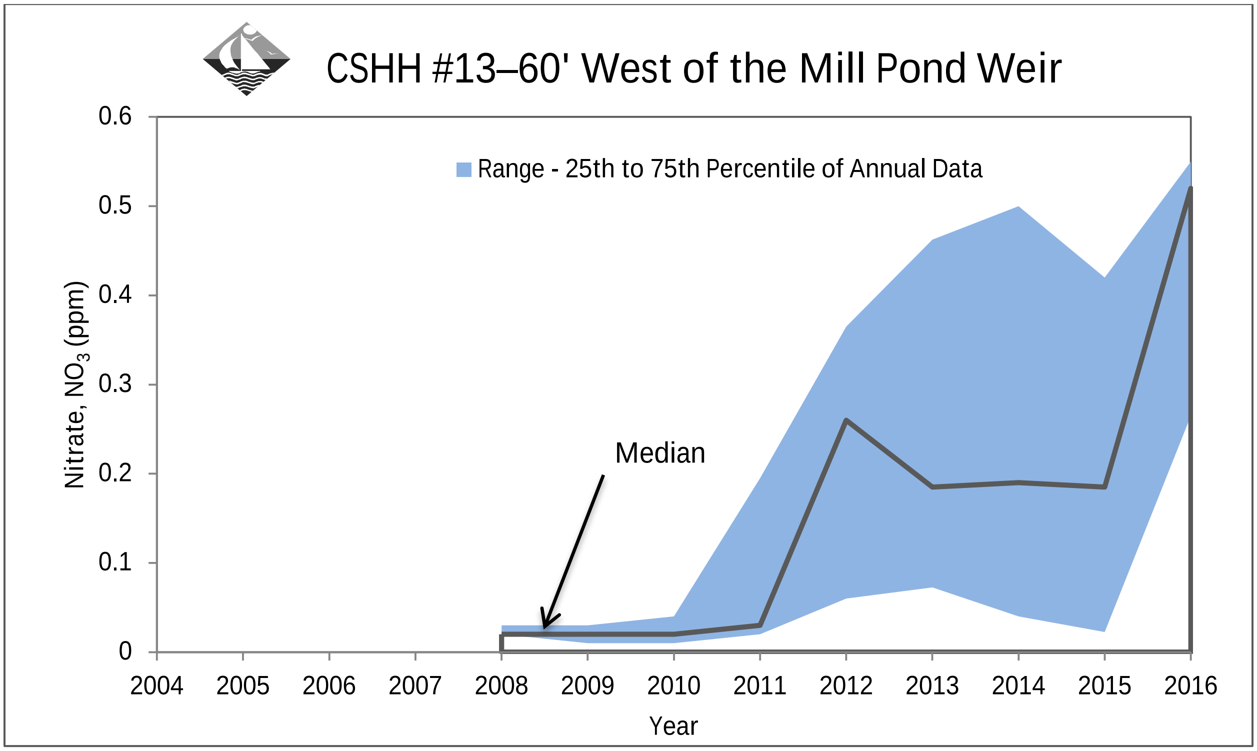


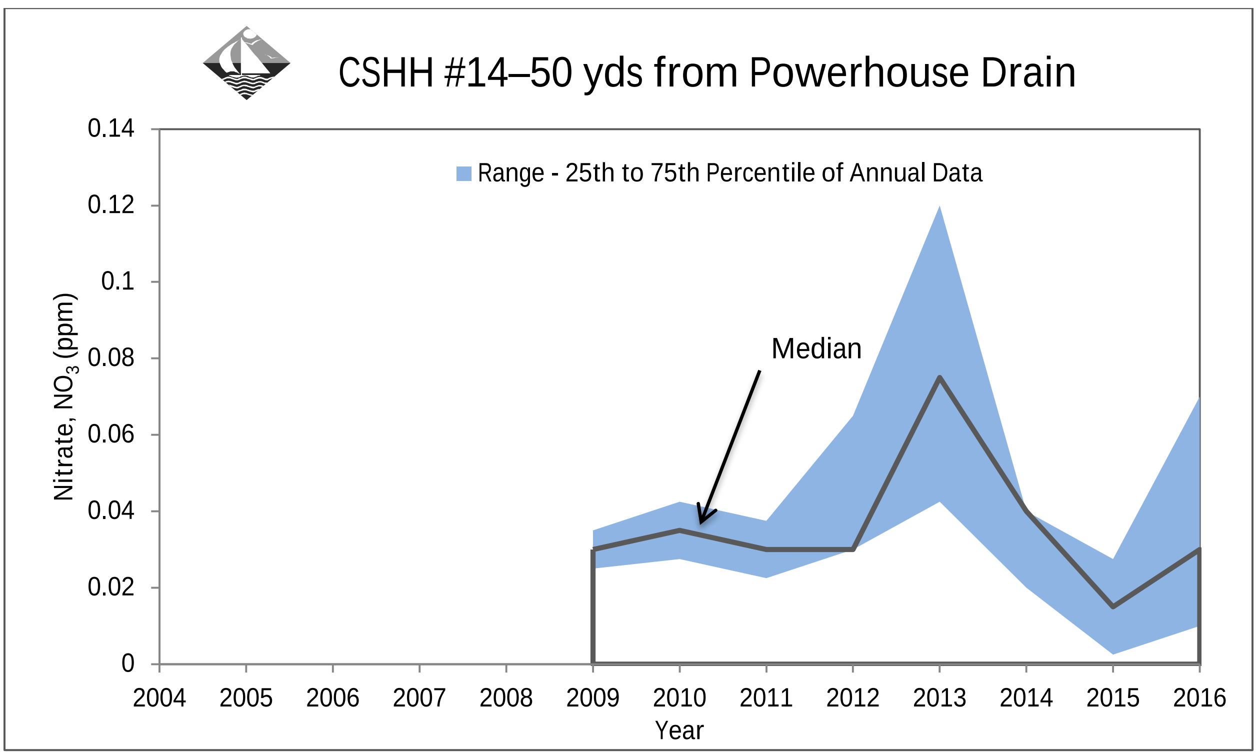
2004-2016 Nitrogen Range Graphs



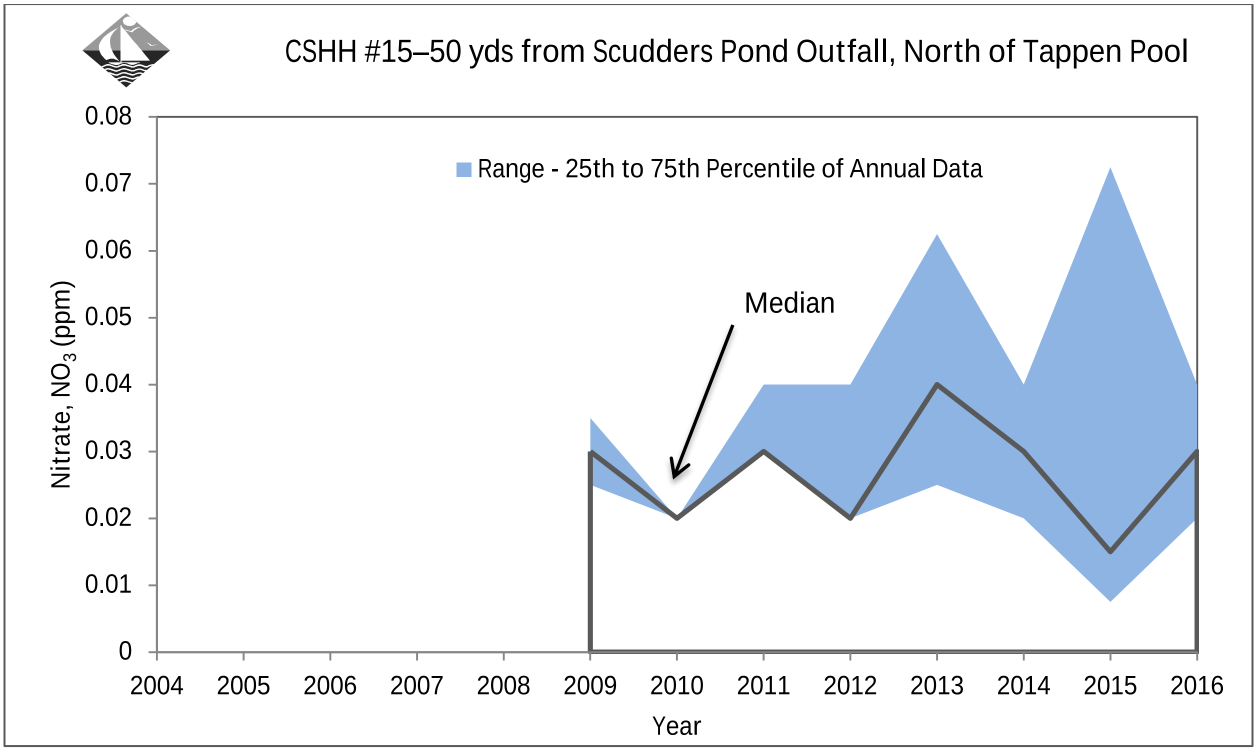


2004-2016 Nitrogen Range Graphs

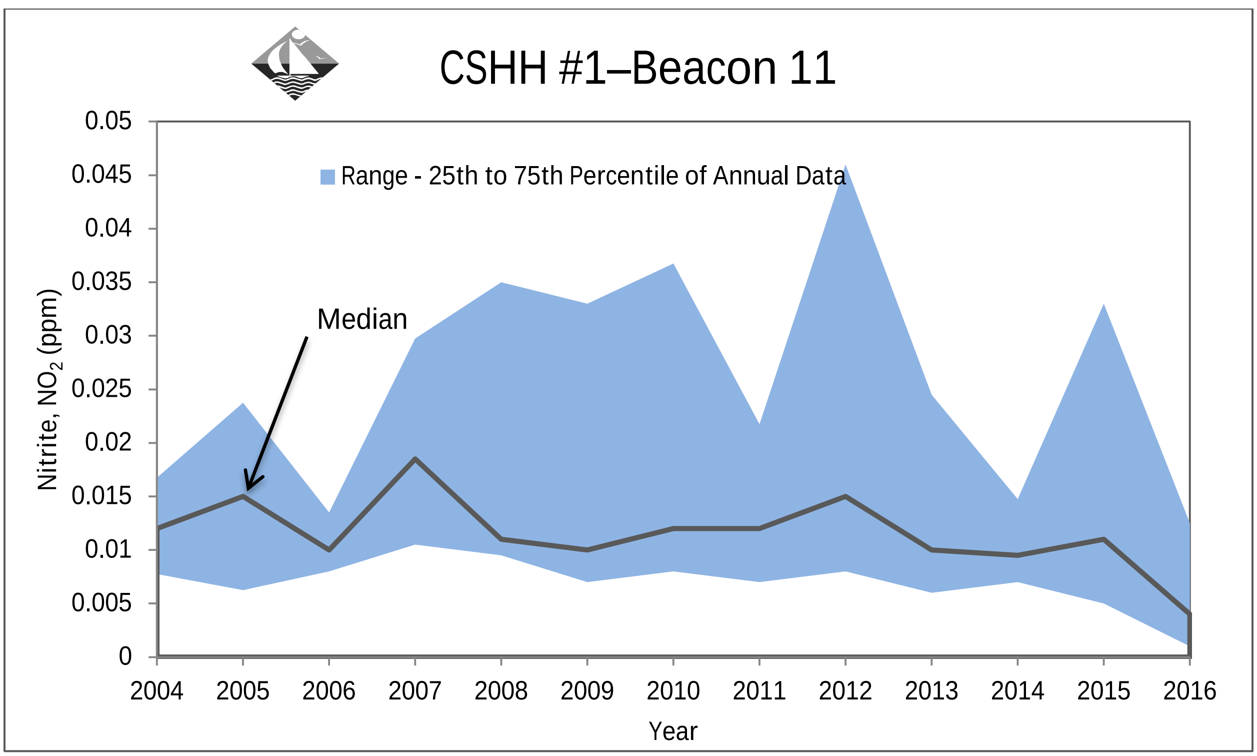




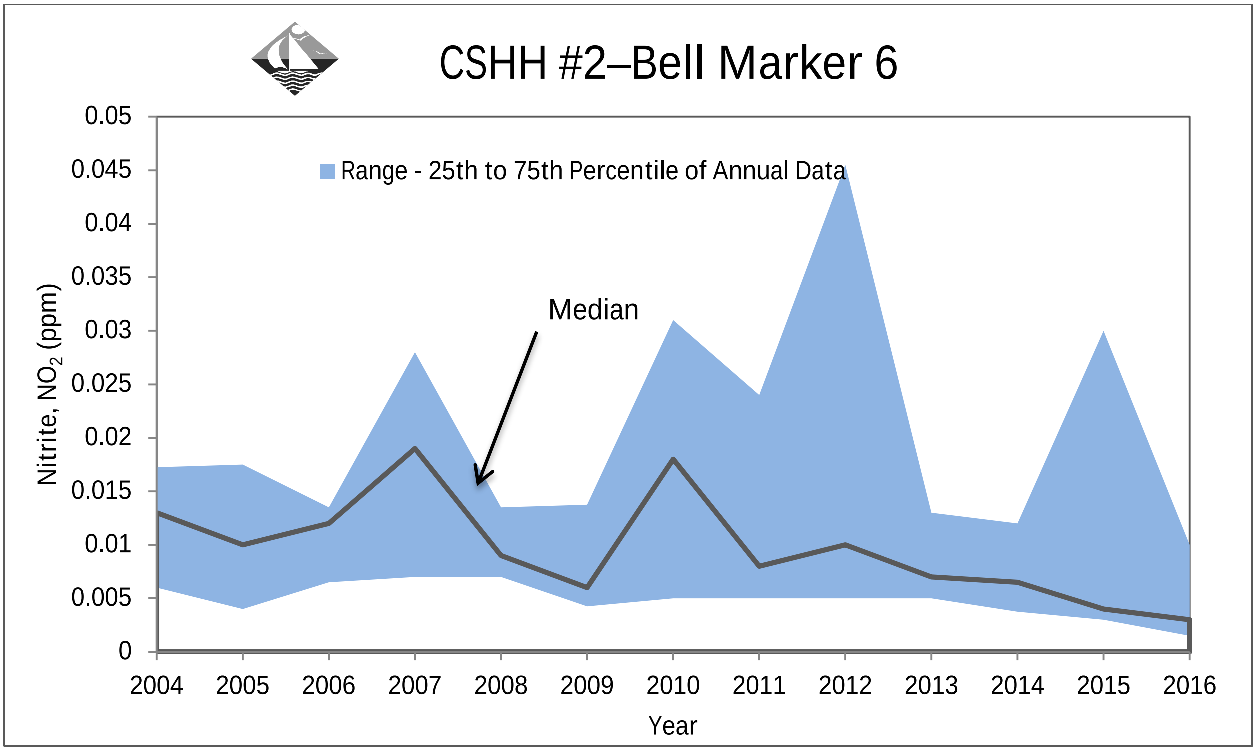
2004-2016 Nitrogen Range Graphs

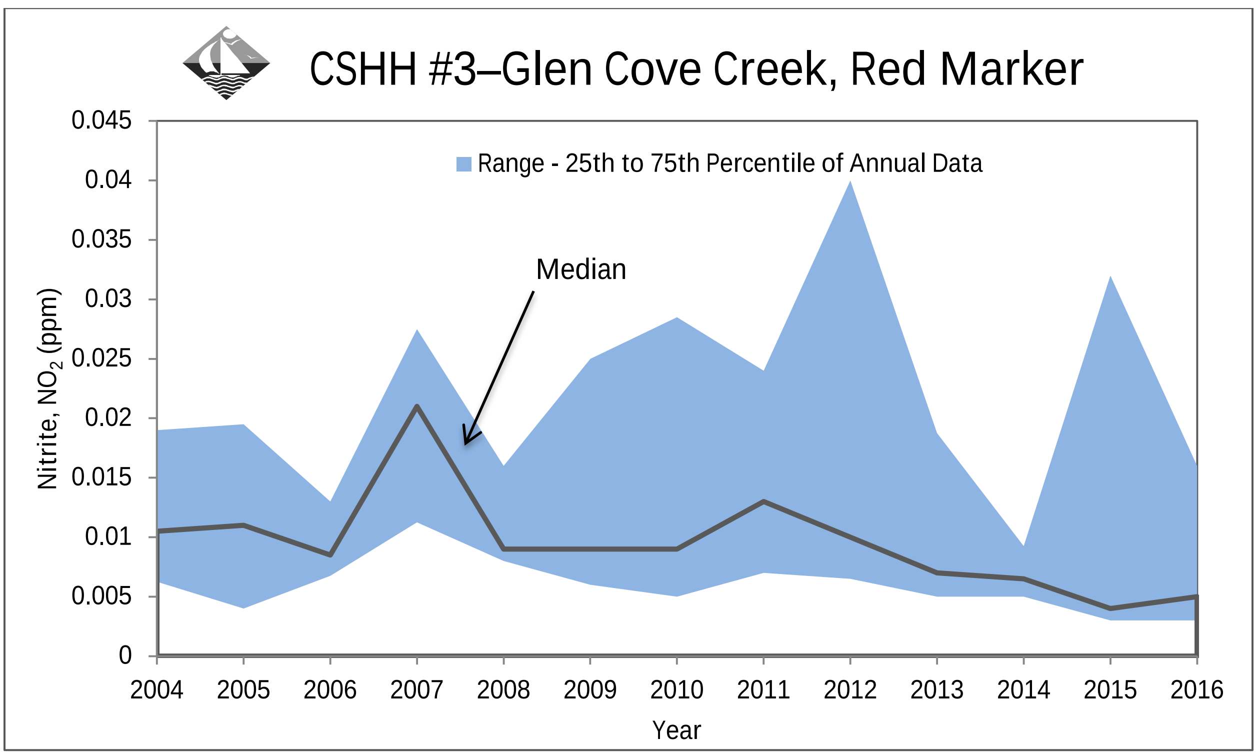


Nitrite

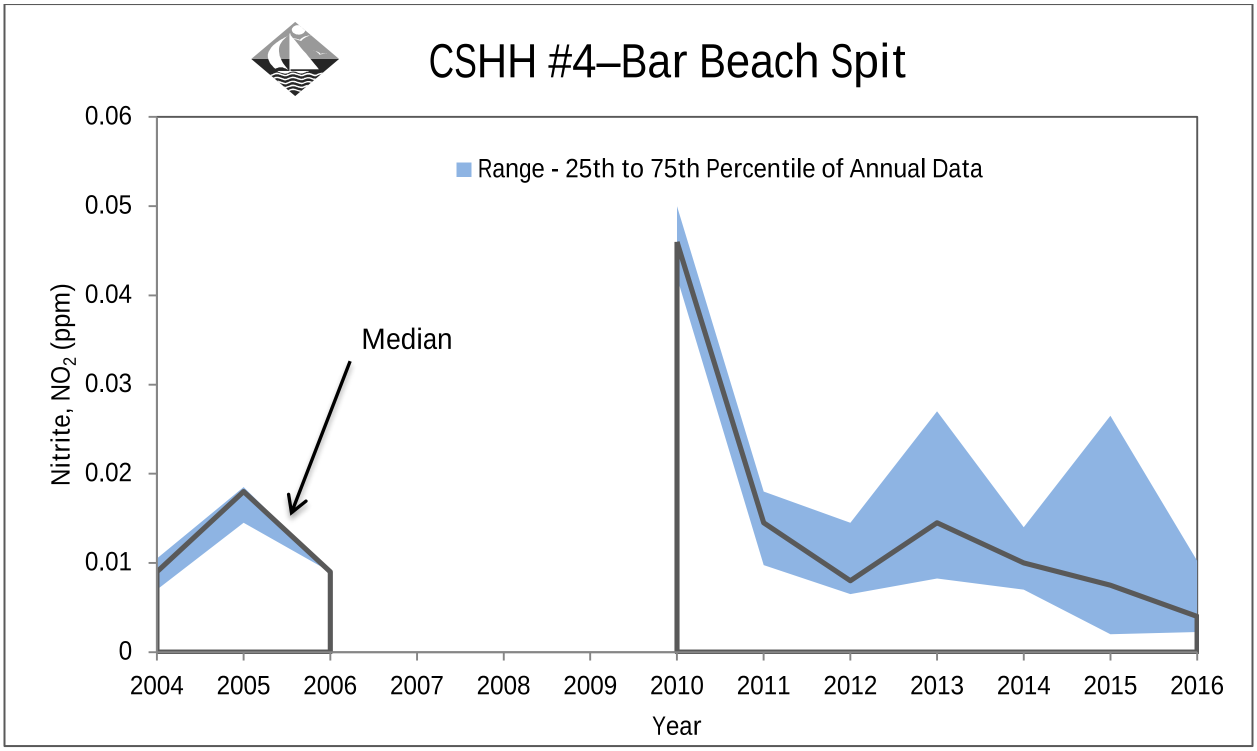


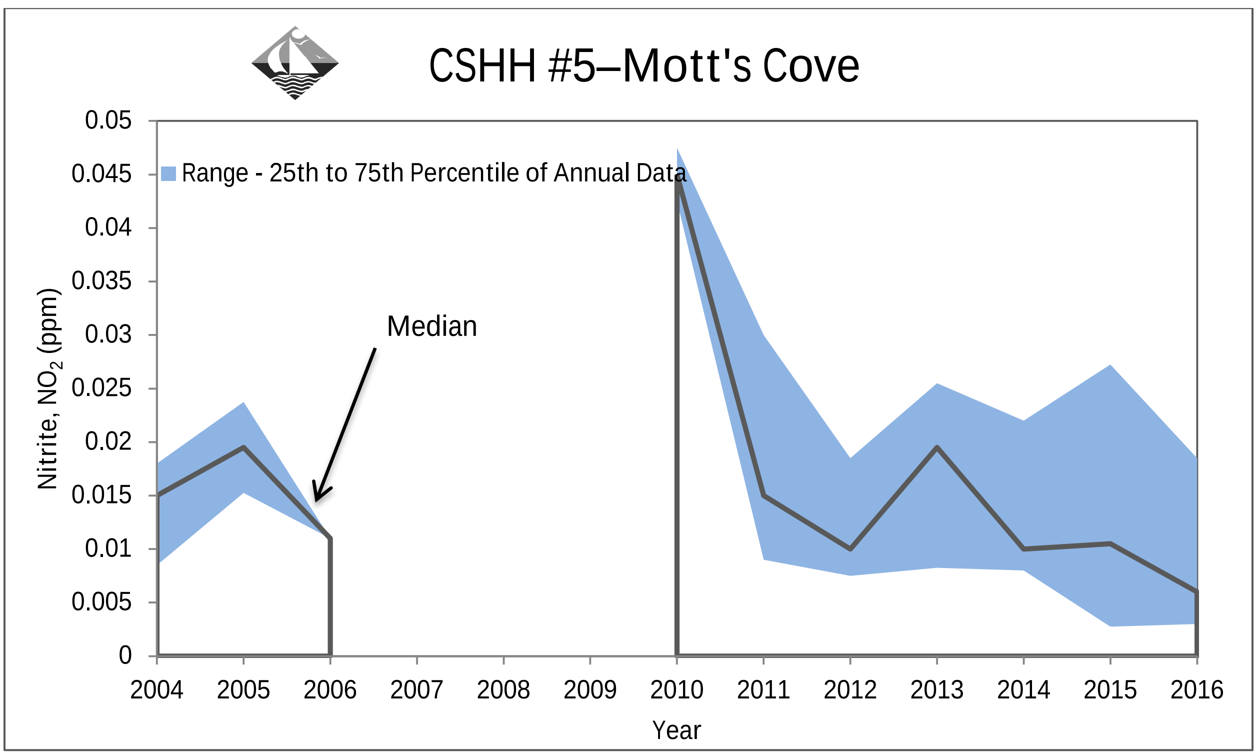
2004-2016 Nitrogen Range Graphs



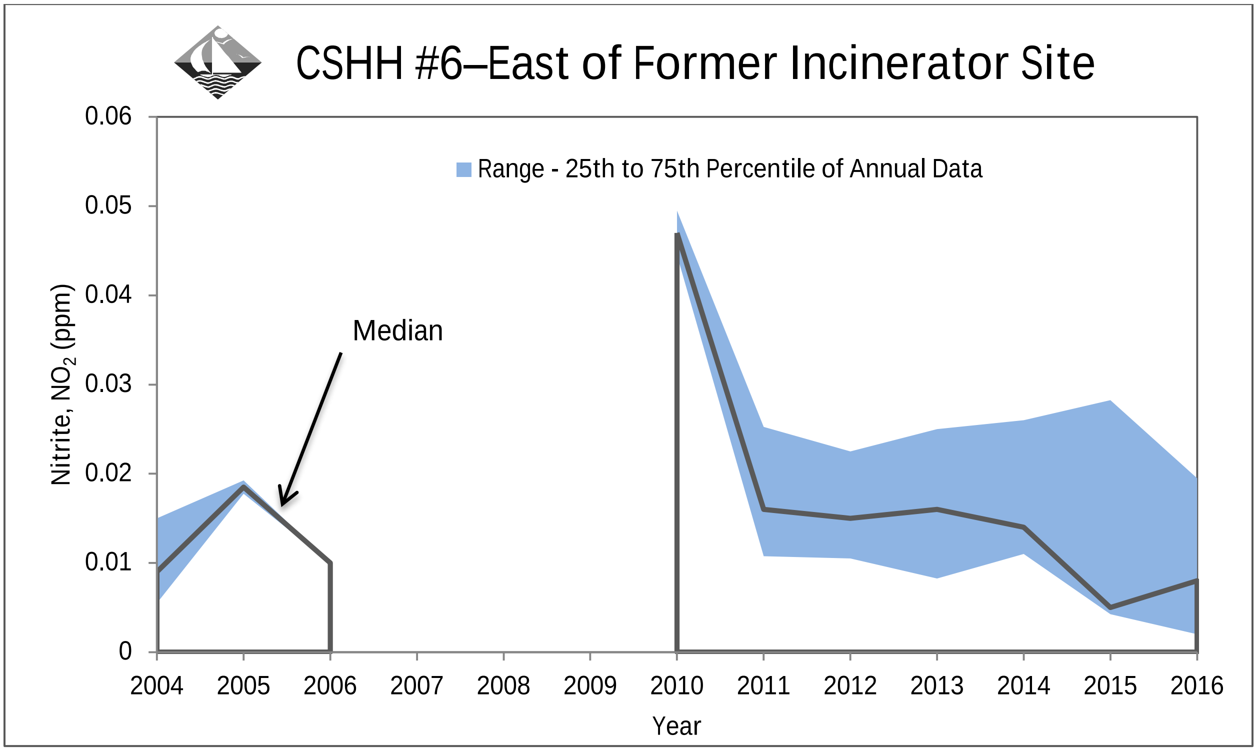


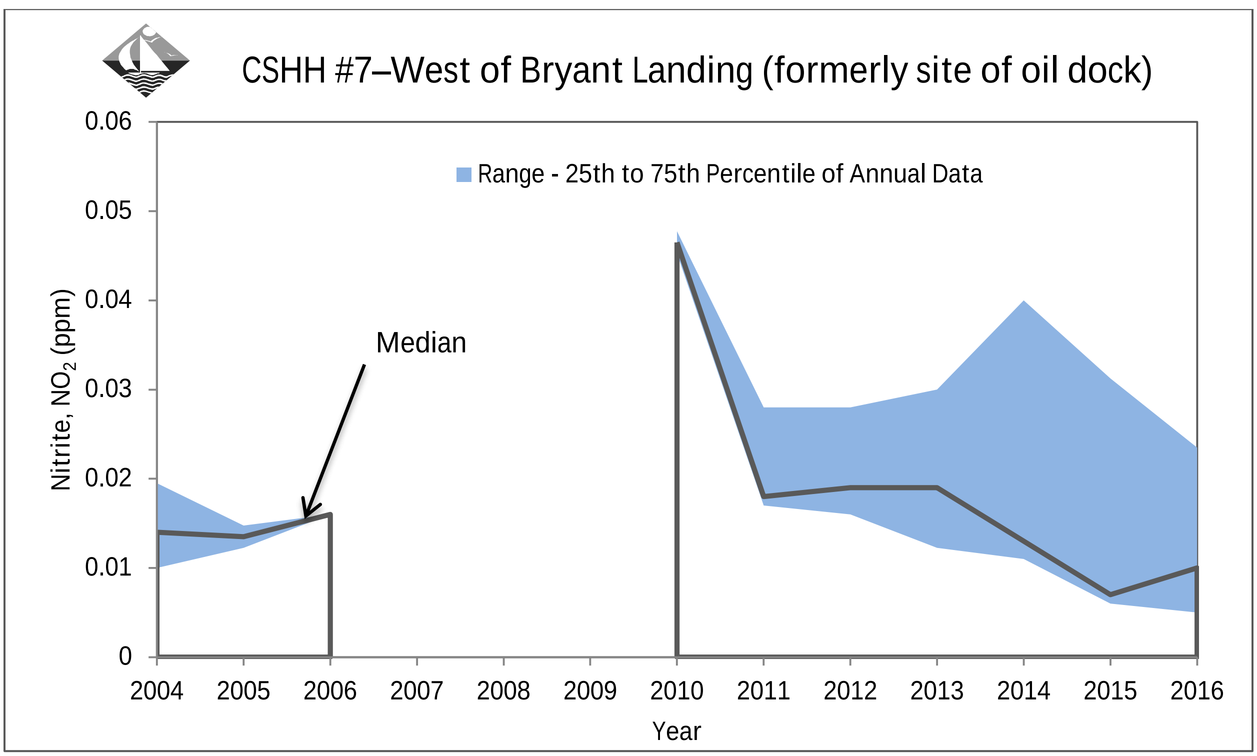
2004-2016 Nitrogen Range Graphs



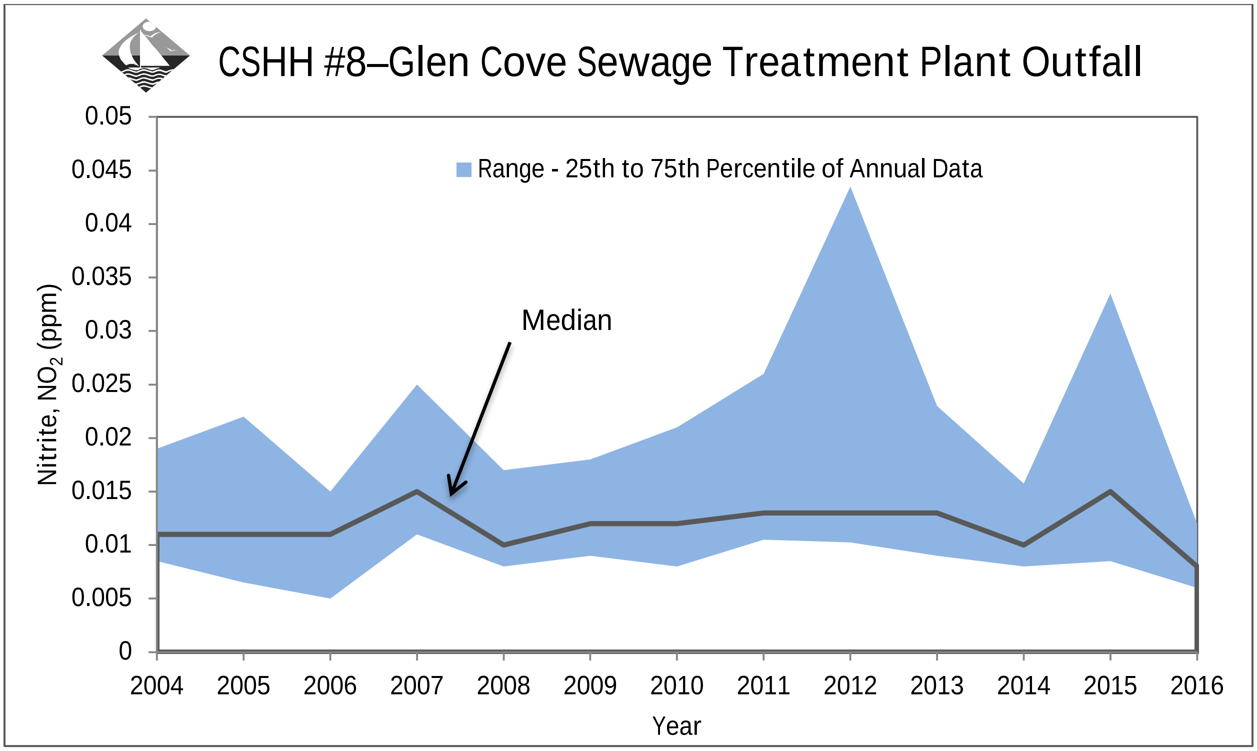


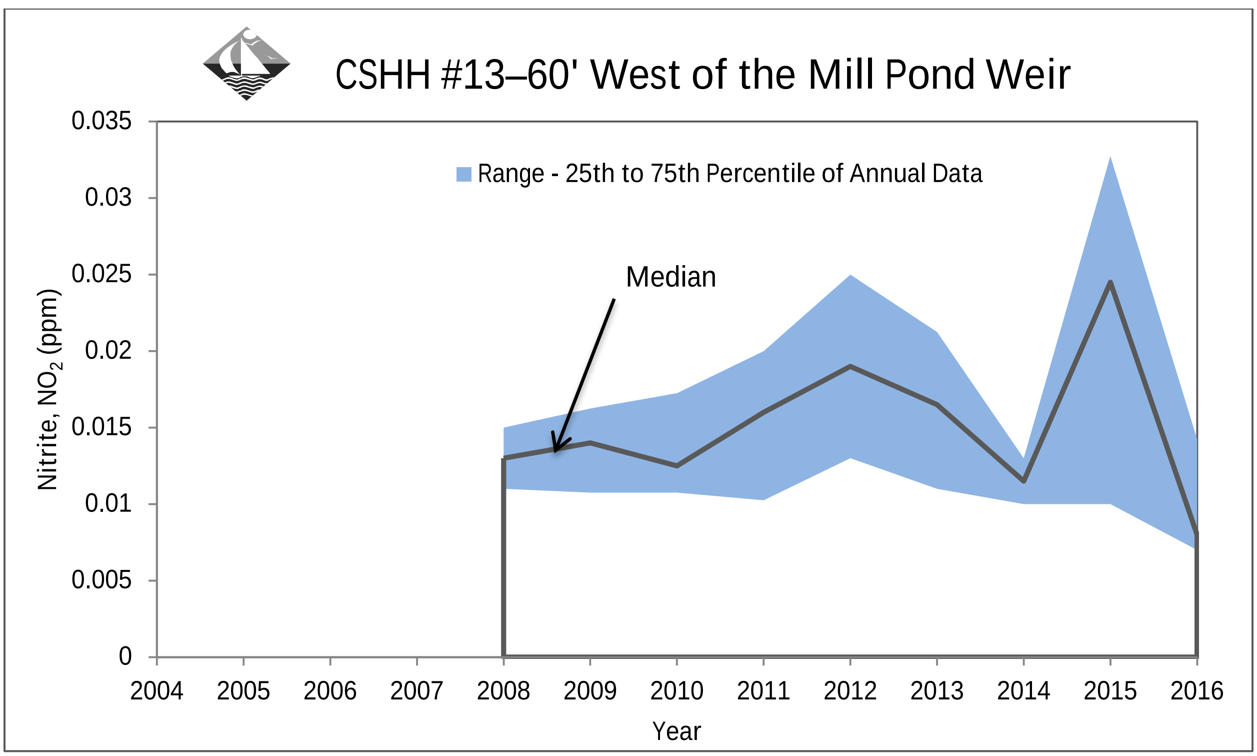
2004-2016 Nitrogen Range Graphs



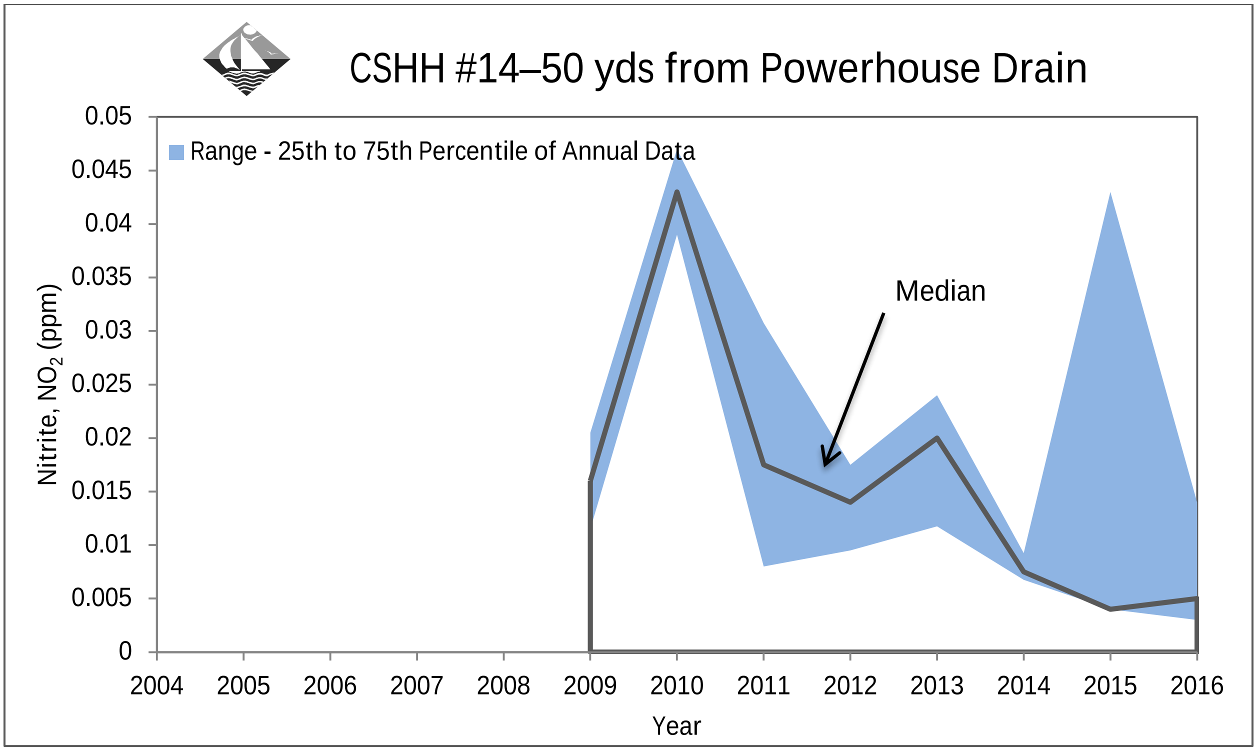


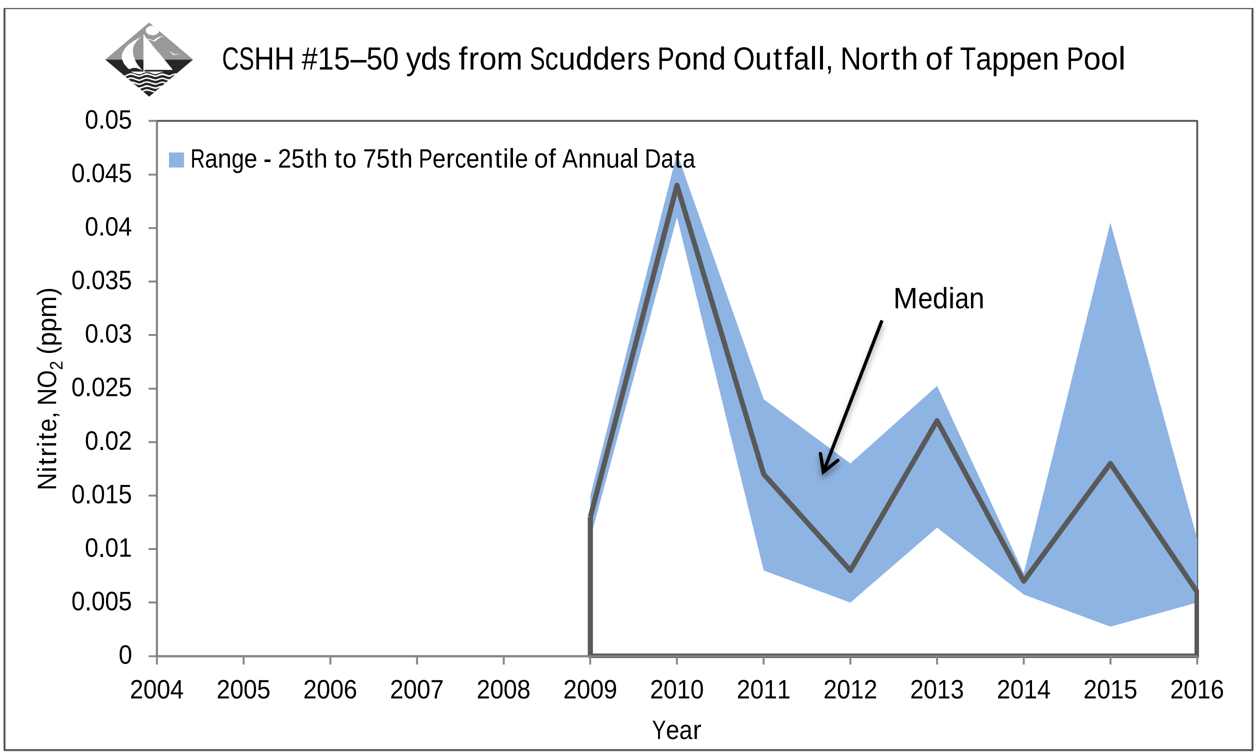
2004-2016 Nitrogen Range Graphs





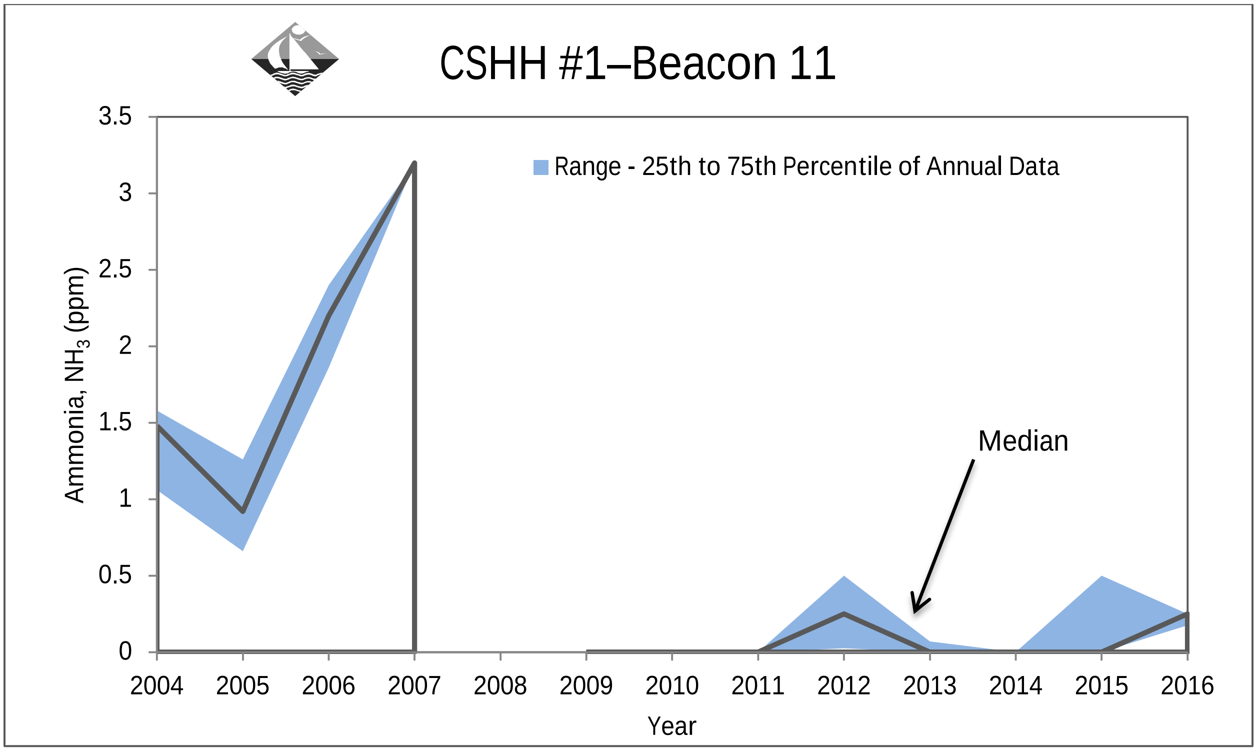
2004-2016 Nitrogen Range Graphs

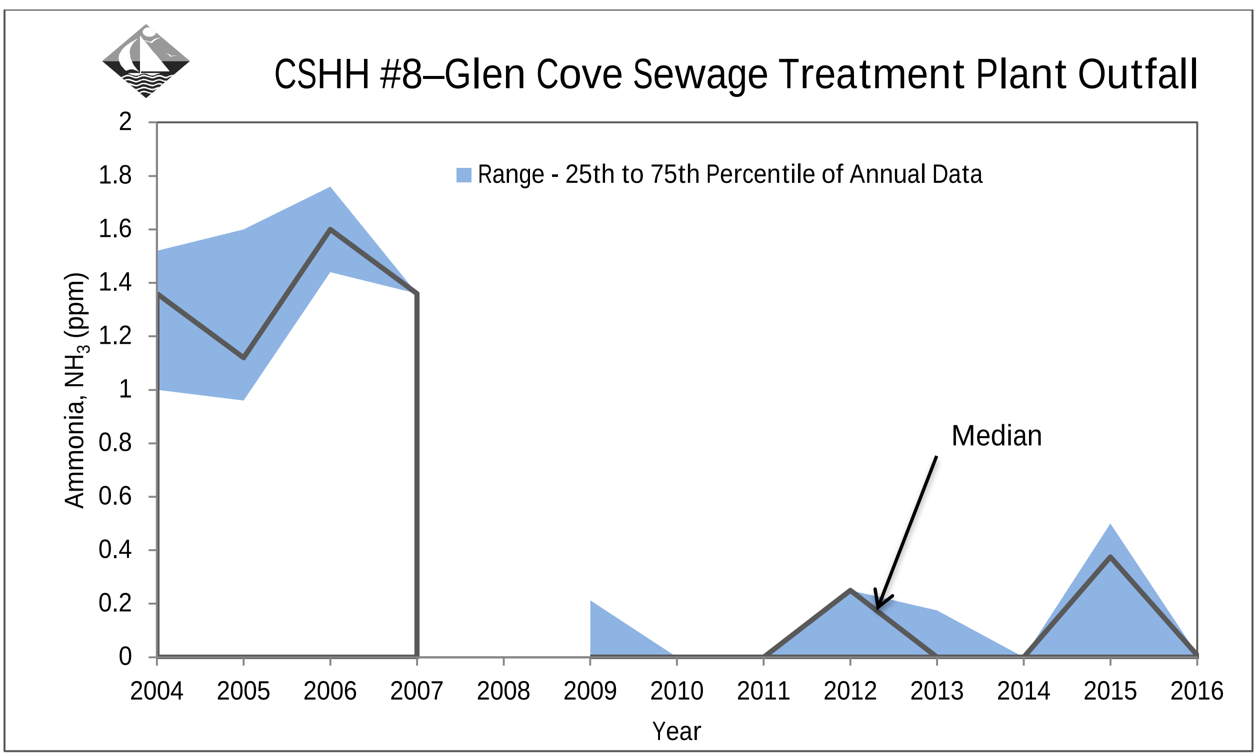




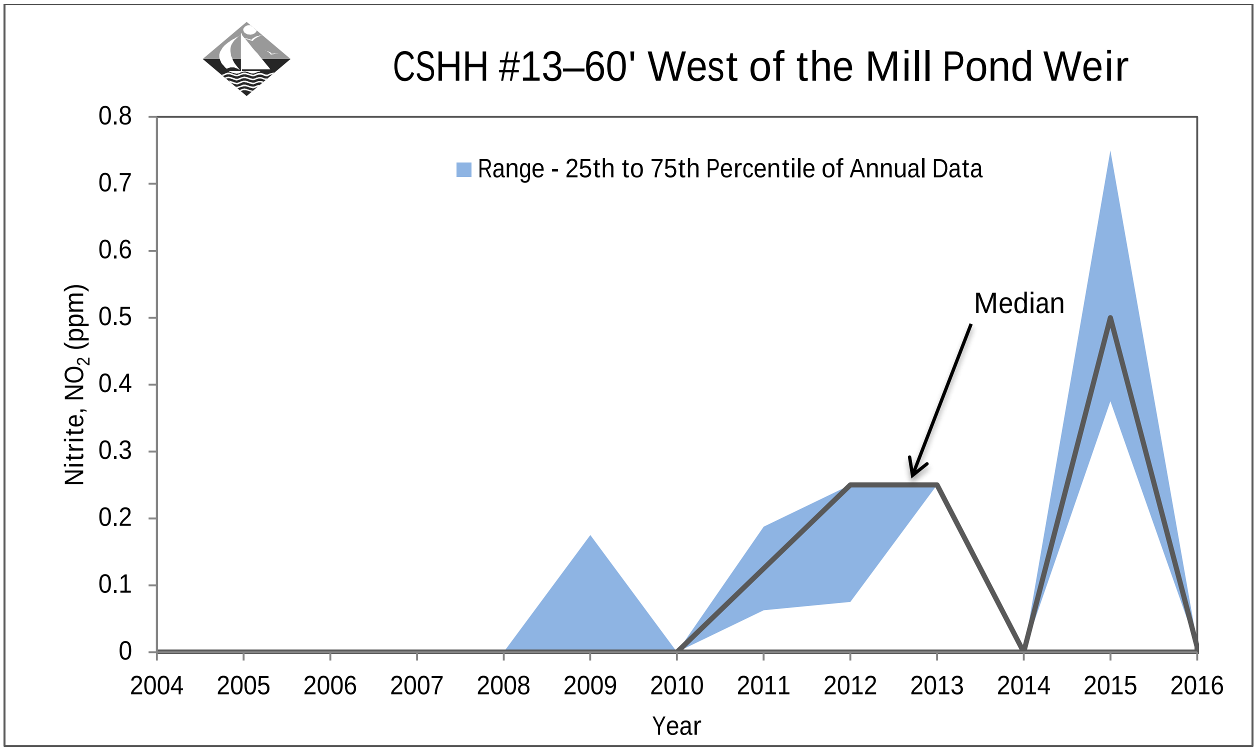
2004-2016 Nitrogen Range Graphs

Ammonia





2004-2016 Nitrogen Range Graphs



Appendix D

Comparison of Averaged Indicator Bacteria Data for Beaches
1995-2017 Water-Quality Data Summary
Seasonal Averages for Selected Water-Quality Parameters

Comparison of Averaged Indicator Bacteria Data for Beaches

2017

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	3.38	11.57	10.17	10.05	1.90	32.03	1.40
May	Enterococci	14.46	14.68	37.80	13.24	20.26	29.94	7.96
June	Enterococci	17.01	56.89	10.51	35.02	19.53	40.48	42.08
July	Enterococci	95.13	71.90	44.78	105.84	14.89	259.23	18.52
August	Enterococci	11.33	12.02	15.10	18.27	52.28	164.89	178.44
September	Enterococci	--	--	--	59.75	--	65.33	--
Season Averages*	*Enterococci*	*30.36*	*34.44*	*24.73*	*44.25*	*24.63*	*111.43*	*60.41*

2016

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	0.58	0.25	0.57	0.88	0.57	0.92	63.67
May	Enterococci	24.17	7.05	10.16	4.89	2.30	76.97	10.43
June	Enterococci	4.58	5.58	2.91	6.57	622.72 **	614.04	16.37
July	Enterococci	12.71	9.30	6.86	3.44	6.31	79.28	7.28
August	Enterococci	113.31	34.42	36.48	32.22	29.46	50.57	69.47
September	Enterococci	--	--	--	--	--	10.70	--
Season Averages*	*Enterococci*	*36.82*	*12.94*	*13.66*	*11.25*	*157.55*	*172.69*	*32.54*

*Averages of all of the data points collected during the monitoring season.
**June monthly average is highly influenced by a single reading that may be an anomaly. Excluding this reading the average for June is 25.13 CFU/100ml and the season average is 15.03 CFU/100ml.

Comparison of Averaged Indicator Bacteria Data for Beaches

2015

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	0.26	1.28	1.66	24.46	10.62	2.79	1.26
May	Enterococci	27.44	8.00	19.03	23.87	22.47	12.76	24.29
June	Enterococci	680.51	257.39	60.24	68.33	26.67	86.57	80.87
July	Enterococci	20.90	17.69	34.81	18.01	15.34	28.41	21.37
August	Enterococci	12.13	7.46	7.92	4.76	26.44	15.92	36.17
September	Enterococci	4.00*	11.00*	8.00*	0.10*	4.00*	6.47	1.00*
Season Averages	*Enterococci*	*152.28*	*60.48*	*27.10*	*28.33*	*20.76*	*32.65*	*38.05*

*Only one data point collected in September.
**Averages of all of the data points collected during the monitoring season.

2014

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	20.83	16.05	7.20	8.85	7.55	224.55	14.84
May	Enterococci	223.16	39.91	34.31	37.41	10.33	9.43	14.57
June	Enterococci	103.79	221.71	91.92	74.00	395.65	470.85	78.67
July	Enterococci	8.02	13.68	17.22	24.44	31.44	78.19	865.13
August	Enterococci	139.26	83.51	74.58	96.75	125.79	461.83	41.32
September	Enterococci	na	na	na	na	na	15.02	na
Season Averages*	*Enterococci*	*97.63*	*84.60*	*50.49*	*50.89*	*140.11*	*238.04*	*263.23*

*Averages of all of the data points collected during the monitoring season.

Comparison of Averaged Indicator Bacteria Data for Beaches

2013

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	2.55	1.30	22.80	8.03	6.80	2.13	2.05
May	Enterococci	20.03	10.57	38.76	23.90	20.38	17.39	25.51
June	Enterococci	36.38	6.65	73.12	79.33	20.88	53.47	40.62
July	Enterococci	63.00	21.75	5.11	10.42	5.00	87.59	51.35
August	Enterococci	4.13	7.13	16.13	19.01	15.75	23.53	18.08
September	Enterococci	na	na	na	na	na	129.63	na
Season Averages*	*Enterococci*	*29.85*	*11.00*	*31.78*	*30.61*	*14.03*	*55.43*	*32.67*

*Averages of all of the data points collected during the monitoring season.

2012

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	2.73	9.48	3.63	9.90	12.17	142.11	16.33
May	Enterococci	568.26	21.00	11.13	16.78	12.14	391.34	5.37
June	Enterococci	148.00	72.14	98.01	60.26	76.88	122.06	37.58
July	Enterococci	81.38	26.01	8.89	8.64	6.40	271.13	12.85
August	Enterococci	737.67	199.56	53.22	24.67	50.79	134.05	32.01
Season Averages*	*Enterococci*	*334.27*	*73.59*	*36.22*	*24.42*	*32.64*	*223.67*	*21.65*

*Averages of all of the data points collected during the monitoring season.

Comparison of Averaged Indicator Bacteria Data for Beaches

2011

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	6.50	20.75	92.50	31.60	14.20	12.89	2.67
May	Enterococci	410.40	40.88	89.63	325.63	48.51	458.09	49.50
June	Enterococci	22.60	24.11	72.30	10.46	29.11	209.16	103.07
July	Enterococci	74.50	113.90	63.30	13.44	19.59	50.28	54.24
August	Enterococci	21.22	49.23	28.41	7.52	19.81	199.22	63.44
Season Averages*	*Enterococci*	*122.96*	*52.14*	*64.93*	*77.60*	*27.14*	*223.31*	*65.64*

*Averages of all of the data points collected during the monitoring season.

2010

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	6.82	9.42	12.44	22.60	2.24	24.22	0.10
May	Enterococci	17.88	14.50	8.14	30.89	23.65	338.19	42.01
June	Enterococci	94.37	12.48	17.02	14.01	56.85	78.69	87.34
July	Enterococci	65.00	19.22	14.11	88.23	54.55	286.52	76.10
August	Enterococci	104.34	89.23	77.12	44.13	159.64	113.02	86.84
September	Enterococci	na	7.00*	13.00*	1.00*	11.00*	369.83	0.10*
Season Averages **	*Enterococci*	*65.22*	*29.61*	*26.22*	*40.19*	*67.48*	*208.47*	*68.40*

na = not analyzed

* Only one data point collected in September.

**Averages of all of the data points collected during the monitoring season.

Comparison of Averaged Indicator Bacteria Data for Beaches

2009

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach	Crescent Beach	Morgan Memorial Beach
April	Enterococci	2.20	1.52	1.53	2.52	9.70	4.03	3.73
May	Enterococci	6.78	5.16	4.14	4.03	5.78	20.29	3.74
June	Enterococci	104.24	47.22	290.88	247.31	21.46	634.65	23.86
July	Enterococci	31.03	102.89	206.46	23.24	26.62	231.47	46.34
August	Enterococci	84.00	86.24	16.82	7.37	70.36	282.44	79.14
September	Enterococci	4.00*	120*	90.00*	0.10*	11.00*	19.86	3.00
Season Averages ******	*Enterococci*	*48.69*	*54.70*	*109.23*	*65.02*	*29.97*	*290.61*	*40.35*

* Only one data point collected in September.

**Averages of all of the data points collected during the monitoring season.

2008*

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach
April	Enterococci	0.42	3.53	14.70	3.52	1.72
May	Enterococci	26.04	5.15	33.75	18.65	68.13
June	Enterococci	8.42	77.31	23.81	29.80	54.40
July	Enterococci	85.59	13.41	23.61	47.60	97.41
August	Enterococci	161.00	11.88	427.56	28.51	65.88
Season Averages	*Enterococci*	*56.29*	*22.26*	*104.69*	*25.62*	*57.51*

*First year in which enterococci was the only indicator bacteria monitored.

Comparison of Averaged Indicator Bacteria Data for Beaches

2007

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach
April	Enterococci	7.62	8.82	15.02	35.8	73.42
	Fecal	**8.82**	**14.22**	**12.42**	**89**	**5.64**
May	Enterococci	16.22	35.91	26.36	43.92	9.49
	Fecal	**29.36**	**157**	**84.68**	**49.89**	**17.8**
June	Enterococci	38.39	45.11	46.44	14.89	10.57
	Fecal	**27.38**	**438.56**	**219**	**130.67**	**73.33**
July	Enterococci	143.89	51.33	36.4	16.4	10.52
	Fecal	**890.25**	**877**	**581**	**519.6**	**193.70**
August	Enterococci	297	188.44	68.56	17.78	72.78
	Fecal	**166.11**	**1173**	**272.8**	**248.44**	**358.33**
Season Averages	*Enterococci*	*100.62*	*65.92*	*38.56*	*25.76*	*35.35*
	Fecal	***224.38***	***531.96***	***233.9***	***207.52***	***129.76***

2006

	Units in CFU/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach
April	Enterococci	0.1	0.1	0.1	2	0.1
	Fecal	**7**	**0.6**	**1**	**5**	**0.6**
May	Enterococci	7	16	35	333	73
	Fecal	**16**	**9**	**100**	**20**	**14**
June	Enterococci	6	27	30	33	12
	Fecal	**9**	**98**	**107**	**73**	**68**
July	Enterococci	68	46	40	35	47
	Fecal	**259**	**567**	**154**	**150**	**277**
August	Enterococci	120	46	76	11	65
	Fecal	**106**	**97**	**100**	**94**	**51**
Season Averages	*Enterococci*	*40*	*27*	*36*	*83*	*39*
	Fecal	***79***	***151***	***92***	***69***	***82***

Comparison of Averaged Indicator Bacteria Data for Beaches

2005

	Units in MPN/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach
April	Enterococci	1	5	33	12	1
	Fecal	**12**	**60**	**289**	**19**	**43**
May	Enterococci	8	29	33	19	13
	Fecal	**15**	**89**	**120.23**	**21**	**18**
June	Enterococci	9	20	9	5	3
	Fecal	**77**	**330**	**118**	**87**	**86**
July	Enterococci	17	26	6	15	39
	Fecal	**176**	**561**	**159**	**472**	**596**
August	Enterococci	186	50	79	20	18
	Fecal	**265**	**166**	**256**	**346**	**239**
Season Averages	*Enterococci*	*44.2*	*26*	*32*	*14.2*	*14.8*
	Fecal	***109***	***241***	***188***	***189***	***196***

2004

	Units in MPN/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach
April	Total	57	76	36	265	161
	Fecal	**4**	**71**	**29**	**66**	**25**
May	Total	140	1137	1910	851	22029
	Fecal	**46**	**141**	**822**	**210**	**3859**
June	Total	168	1179	560	701	864
	Fecal	**44**	**615**	**167**	**557**	**298**
July	Total	146	2353	571	790	624
	Fecal	**43**	**460**	**341**	**301**	**222**
August	Total	634	993	445	414	727
	Fecal	**375**	**905**	**383**	**313**	**442**
September	Total	*700*	*22*	*17*	*80*	*230*
	Fecal	***500***	***17***	***11***	***80***	***130***
Season Averages	*Total*	*268*	*1582*	*701*	*682*	*3574*
	Fecal	***126***	***505***	***359***	***337***	***761***

Comparison of Averaged Indicator Bacteria Data for Beaches

2003

	Units in MPN/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach
April	Total	13	140	159	155	19
	Fecal	**8**	**44**	**152**	**19**	**5**
May	Total	161	122	130	154	1277
	Fecal	**62**	**35**	**47**	**88**	**143**
June	Total	197	1747	478	724	915
	Fecal	**80**	**136**	**64**	**255**	**111**
July	Total	239	781	1237	517	1810
	Fecal	**65**	**539**	**874**	**203**	**304**
August	Total	347	678	804	2117	22364
	Fecal	**81**	**344**	**334**	**1904**	**3114**
September	Total	*6567*	*3500*	*1033*	*910*	*1820*
	Fecal	***977***	***1090***	***177***	***274***	***110***
Season Averages	*Total*	*632*	*949*	*816*	*1097*	*8735*
	Fecal	***126***	***370***	***421***	***809***	***1222***

2002

	Units in MPN/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach
April	Total	160	326	157	728	163
	Fecal	**44**	**39**	**11**	**658**	**53**
May	Total	130	145	127	282	194
	Fecal	**76**	**124**	**78**	**169**	**46**
June	Total	560	674	431	1604	750
	Fecal	**123**	**559**	**168**	**1016**	**154**
July	Total	613	1921	964	2770	4779
	Fecal	**246**	**810**	**831**	**1367**	**210**
August	Total	4773	3277	6202	1625	1832
	Fecal	**2593**	**2971**	**2130**	**1278**	**839**
Season Averages	*Total*	*1226*	*1969*	*3096*	*1463*	*1626*
	Fecal	***605***	***1637***	***1133***	***1008***	***451***

Comparison of Averaged Indicator Bacteria Data for Beaches

2001

	Units in MPN/100 ml	Village Club of Sands Point	North Hempstead Beach Park (N) (former Hempstead Harbor Beach)	North Hempstead Beach Park (S)(former Bar Beach)	Tappen Beach	Sea Cliff Beach
April	Total	26	239	68	194	86
	Fecal	**9**	**85**	**36**	**103**	**43**
May	Total	559	486	364	944	1689
	Fecal	**21**	**83**	**106**	**555**	**274**
June	Total	2373	974	1091	1045	494
	Fecal	**157**	**488**	**451**	**365**	**60**
July	Total	242	6025	11526	1308	1501
	Fecal	**44**	**3458**	**11297**	**566**	**399**
August	Total	2183	3360	2594	12230	24148
	Fecal	**124**	**1000**	**1872**	**10285**	**1623**
September	Total	468	348	570	1500	1100
	Fecal	**53**	**110**	**116**	**1308**	**300**
Season Averages	***Total***	***1143***	***2848***	***4187***	***4513***	***9080***
	Fecal	***75***	***1325***	***3754***	***3559***	***717***

1995-2017 Water-Quality Data Summary

CSHH #1–Beacon 11

	2017				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	14.43	24.47	7.98	17.63	4.40
June	19.07	23.13	6.93	20.85	6.38
July	20.53	23.95	3.41	23.47	4.70
Aug.	22.73	24.67	2.99	22.76	3.78
Sept.	21.52	24.92	4.93	20.43	3.54
Oct.	19.14	24.67	6.44	12.80	4.61
Nov.	-	-	-	-	-

	2016					2015				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	13.57	7.94	25.77	16.33	1.89	13.23	9.87	25.64	16.60	2.10
June	18.22	6.22	26.46	20.92	3.20	16.75	6.19	26.15	19.70	3.08
July	22.30	4.10	27.13	23.92	3.04	21.36	4.06	26.38	23.78	3.01
Aug.	23.76	2.26	27.66	24.20	2.79	23.30	3.47	27.14	23.60	2.69
Sept.	22.86	4.34	27.81	22.58	2.72	23.33	3.44	27.35	23.30	3.20
Oct.	17.00	6.75	27.79	12.40	2.71	17.10	6.62	27.22	15.18	4.13
Nov.	-	-	-	-	-	14.30	7.36	27.20	13.30	1.53

	2014					2013				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	16.08	7.92	24.14	17.00	2.61	14.79	7.71	25.82	21.17	3.43
June	18.59	4.52	24.28	22.00	3.31	19.49	7.93	25.07	21.10	3.12
July	20.62	3.92	25.39	23.22	4.53	22.84	4.73	25.33	25.18	1.72
Aug.	22.65	2.96	25.77	21.65	2.78	22.64	4.10	26.31	22.88	1.95
Sept.	21.81	4.46	26.07	18.38	4.08	20.75	7.42	26.60	15.90	3.19
Oct.	17.73	6.05	26.20	17.75	2.73	17.40	6.83	26.81	12.68	1.49
Nov.*	12.15	8.55	27.02	15.00	1.88	11.92	7.61	26.19	9.50	1.24

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #1–Beacon 11

	2012					2011				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	18.91	6.39	24.98	23.20	2.32	15.23	6.67	23.57	23.3	2.86
June	20.09	4.92	24.65	21.85	2.26	17.83	5.84	23.82	22.4	2.55
July	22.35	3.12	25.58	25.18	2.98	22.18	3.95	24.37	23.7	1.49
Aug.	23.92	2.58	26.20	23.92	2.74	23.05	4.60	24.56	24.7	2.74
Sept.	22.52	3.60	26.60	18.77	2.33	21.95	4.36	23.74	21.4	2.12
Oct.	17.36	6.32	26.46	13.85	1.09	17.99	7.08	23.81	14.4	2.85
Nov.*	9.26	8.51	26.43	6.80	1.52	12.84	9.16	23.82	6.9	1.21

	2010					2009				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	13.02	8.50	24.11	18.10	1.50	14.15	8.33	24.54	14.37	1.95
June	18.21	6.68	24.94	21.46	2.70	17.93	7.29	24.00	18.73	2.11
July	22.13	3.48	26.06	27.43	2.35	21.06	5.67	23.99	23.30	1.88
Aug.	22.58	2.96	27.00	24.03	2.19	23.40	3.71	24.55	25.68	2.81
Sept.	21.81	5.45	26.65	22.30	2.19	21.33	5.31	24.80	19.24	3.46
Oct.	17.14	7.05	26.47	13.88	1.04	14.60	7.07	24.75	11.53	2.93
Nov.*	12.83	8.33	27.25	4.00	1.17	-	-	-	-	-

	2008					2007			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
May*	12.93	7.20	23.69	16.80	-	-	-	-	-
June	18.81	7.38	24.27	19.15	-	16.96	6.95	24.11	21.33
July	19.81	3.62	25.75	23.70	2.35	19.08	3.91	25.10	23.90
Aug.	23.25	4.52	25.28	22.00	3.83	22.67	3.61	25.92	21.70
Sept.	22.49	4.86	25.54	20.70	2.68	21.84	5.02	26.26	19.18
Oct.	16.37	6.21	25.96	12.08	2.77	19.3	4.65	26.99	16.64
Nov.*	12.60	7.06	25.85	14.80	1.89	-	-	-	-

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #1–Beacon 11

	2006 Avg. Water Temp. (°C) (Bottom)	2006 Avg. DO (ppm) (Bottom)	2006 Avg. Salinity (ppt) (Bottom)	2006 Avg. Air Temp. (°C)	2005 Avg. Water Temp. (°C) (Bottom)	2005 Avg. DO (ppm) (Bottom)	2005 Avg. Salinity (ppt) (Bottom)	2005 Avg. Air Temp. (°C)
June	17.35	6.81	25.22	22.42	17.19	4.5	22.94	20.22
July	20.78	3.77	25.79	24.18	23.19	4.22	24.52	24.3
Aug.	23.64	3.29	25.64	23.78	23.73	1.85	25.36	24.4
Sept.	20.58	7.28	25.4	18.9	22.54	4.85	26.49	23.6
Oct.	16.41	7.98	25.56	14.78	16.3	7.36	25.09	13.3

	2004 Avg. Water Temp. (°C) (Bottom)	2004 Avg. DO (ppm) (Bottom)	2004 Avg. Salinity (ppt) (Bottom)	2004 Avg. Air Temp. (°C)	2003 Avg. Water Temp. (°C) (Bottom)	2003 Avg. DO (ppm) (Bottom)	2003 Avg. Salinity (ppt) (Bottom)	2003 Avg. Air Temp. (°C)
June	18.3	5.38	25	23.6	17	5.82	23.67	24.6
July	20.87	4.28	25.9	24	18.74	3.6	24.97	21.9
Aug.	22.33	3.86	26.31	24	21.75	2.1	25.79	23.6
Sept.	22.14	3.67	26.15	20.4	21.6	4.32	26.4	22.2
Oct.	16.53	7.66	25.21	12.9	16.49	6.73	25.23	12.8

	2002 Avg. Water Temp. (°C) (Bottom)	2002 Avg. DO (ppm) (Bottom)	2002 Avg. Salinity (ppt) (Bottom)	2002 Avg. Air Temp. (°C)	2001 Avg. Water Temp. (°C) (Bottom)	2001 Avg. DO (ppm) (Bottom)	2001 Avg. Salinity (ppt) (Bottom)	2001 Avg. Air Temp. (°C)
June	18.85	4.82	26.42	24.1	20.31	6.62	24.78	24.1
July	21.28	2.31	26.55	25	19.4	3.8	25.68	25.2
Aug.	24.02	2.91	26.89	25	23.25	2.96	26.19	25.4
Sept.	21.98	5.7	26.5	20.3	22.56	5.45	26.7	20.5
Oct.	17.12	7.13	26.38	13.5	17.05	7.86	26.79	15.8

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #1–Beacon 11

	2000 Avg. Water Temp. (°C) (Bottom)	2000 Avg. DO (ppm) (Bottom)	2000 Avg. Salinity (ppt) (Bottom)	2000 Avg. Air Temp. (°C)	1999 Avg. Water Temp. (°C) (Bottom)	1999 Avg. DO (ppm) (Bottom)	1999 Avg. Salinity (ppt) (Bottom)	1999 Avg. Air Temp. (°C)
June	17.1	5.63	24.43	22.2	19.66	7.07	24.89	23
July	21.8	5.27	25.03	22.2	21.72	3.42	25.78	30
Aug.	22.53	6.41	24.7	24.2	24.35	4.6	25.99	25
Sept.	20.99	4.9	25.07	20.9	21.9	5.57	25.72	22
Oct.	16.78	6.02	25.24	13.2	17.76	8.29	24.7	12

	1998 Avg. Water Temp. (°C) (Bottom)	1998 Avg. DO (ppm) (Bottom)	1998 Avg. Salinity (ppt) (Bottom)	1998 Avg. Air Temp. (°C)	1997 Avg. Water Temp. (°C) (Bottom)	1997 Avg. DO (ppm) (Bottom)	1997 Avg. Salinity (ppt) (Bottom)	1997 Avg. Air Temp. (°C)
June	17.24	6.24	24.18	21.33	18.1	7.01	23.71	24.33
July	21.23	4.89	24.66	24.6	20.83	4.34	24.78	23.5
Aug.	23.95	3.66	24.84	24.5	21.85	1.96	25.96	21.5
Sept.	22.02	4.57	25.48	20.5	22.13	3.26	25.81	19.5
Oct.	17.19	6.84	25.27	13.75	17.45	5.83	26.06	13.67

	1996 Avg. Water Temp. (°C) (Bottom)	1996 Avg. DO (ppm) (Bottom)	1996 Avg. Salinity (ppt) (Bottom)	1996 Avg. Air Temp. (°C)	1995 Avg. Water Temp. (°C) (Bottom)	1995 Avg. DO (ppm) (Bottom)	1995 Avg. Salinity (ppt) (Bottom)	1995 Avg. Air Temp. (°C)
June	19	8.35	N/A	23.25	17.78	5.3	26.27	19.67
July	20.04	3.74	24.66	22.75	20.77	2.66	26.53	25.25
Aug.	21.75	2.88	25.13	22.25	23.78	4.56	27.56	24.7
Sept.	21.7	5.14	25.48	19.83	21.72	4.34	28.05	20.5
Oct.	17.34	9.21	24.97	15.25	17.71	6.9	27.34	16.5

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #2–Bell Marker 6

	2017 Avg. Water Temp. (°C) (Bottom)	2017 Avg. DO (ppm) (Bottom)	2017 Avg. Salinity (ppt) (Bottom)	2017 Avg. Air Temp. (°C)	2017 Avg. Turbidity (NTUs) (0.5 m)
May*	13.77	25.58	8.13	18.57	4.50
June	16.53	23.57	5.24	21.48	17.62
July	19.68	25.53	4.69	24.03	2.76
Aug.	22.45	25.55	3.67	23.33	2.25
Sept.	21.09	25.43	6.58	20.60	2.24
Oct.	19.53	25.44	6.79	15.63	1.68
Nov.*	-	-	-	-	-

	2016 Avg. Water Temp. (°C) (Bottom)	2016 Avg. DO (ppm) (Bottom)	2016 Avg. Salinity (ppt) (Bottom)	2016 Avg. Air Temp. (°C)	2016 Avg. Turbidity (NTUs) (0.5 m)	2015 Avg. Water Temp. (°C) (Bottom)	2015 Avg. DO (ppm) (Bottom)	2015 Avg. Salinity (ppt) (Bottom)	2015 Avg. Air Temp. (°C)	2015 Avg. Turbidity (NTUs) (0.5 m)
May*	12.47	8.11	26.46	18.20	0.48	10.90	8.07	26.48	18.97	1.12
June	17.18	6.41	26.91	21.82	1.76	16.00	6.07	26.44	19.53	1.78
July	20.10	2.17	27.78	24.36	1.69	20.38	3.59	26.87	24.90	2.21
Aug.	23.58	3.22	28.09	24.20	2.21	23.00	4.02	27.56	24.08	1.66
Sept.	23.20	4.97	28.29	24.13	1.85	23.20	3.89	27.74	25.37	2.49
Oct.	17.70	7.61	28.29	18.35	0.98	16.45	7.47	27.80	16.70	1.91
Nov.*	-	-	-	-	-	14.30	7.56	27.52	14.80	0.91

	2014 Avg. Water Temp. (°C) (Bottom)	2014 Avg. DO (ppm) (Bottom)	2014 Avg. Salinity (ppt) (Bottom)	2014 Avg. Air Temp. (°C)	2014 Avg. Turbidity (NTUs) (0.5 m)	2013 Avg. Water Temp. (°C) (Bottom)	2013 Avg. DO (ppm) (Bottom)	2013 Avg. Salinity (ppt) (Bottom)	2013 Avg. Air Temp. (°C)	2013 Avg. Turbidity (NTUs) (0.5 m)
May*	14.88	8.23	24.64	16.35	1.60	14.36	8.97	26.16	22.27	2.52
June	17.48	4.80	24.86	17.03	1.57	17.96	6.51	25.77	20.88	1.73
July	20.16	3.15	25.97	24.98	2.11	22.49	3.10	25.89	26.33	1.09
Aug.	22.53	3.73	26.58	23.48	1.83	22.51	4.18	26.87	26.45	1.33
Sept.	22.04	4.41	26.85	19.35	2.16	21.42	6.86	27.70	18.27	2.50
Oct.	18.00	6.59	26.97	18.88	1.55	17.17	7.63	27.29	15.30	0.97
Nov.*	13.10	8.65	27.75	17.60	1.99	12.81	7.05	27.27	12.40	0.87

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #2–Bell Marker 6

	2012					2011				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	18.08	5.53	25.06	22.30	1.62	14.70	7.64	23.34	19.6	0.57
June	19.32	5.02	25.20	21.90	1.03	16.95	4.95	24.11	22.8	1.18
July	21.94	2.99	26.03	25.30	1.92	19.88	3.39	24.79	24.8	0.83
Aug.	23.26	2.11	26.91	25.72	1.66	22.03	2.86	25.59	23.3	1.93
Sept.	22.92	4.20	27.41	21.10	1.40	21.47	3.91	24.38	22.3	1.48
Oct.	17.68	5.57	27.31	15.25	0.88	18.11	6.93	24.35	16.2	1.71
Nov.*	9.30	9.19	27.33	8.55	1.10	13.75	8.15	24.42	7.2	-

	2010					2009				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	13.07	8.76	24.34	23.80	1.21	12.90	7.94	25.16	16.40	1.88
June	16.88	5.89	25.51	21.60	1.78	16.79	6.58	24.73	19.50	2.45
July	20.21	1.84	26.59	27.95	1.54	18.93	3.80	24.90	23.84	1.39
Aug.	22.09	2.66	27.21	24.70	1.54	21.43	1.34	25.28	25.78	1.94
Sept.	21.69	5.39	27.07	23.22	2.37	21.70	6.17	25.16	21.53	2.38
Oct.	16.82	7.54	27.06	15.00	0.78	14.66	7.90	25.64	12.47	1.58
Nov.*	12.66	10.14	27.43	9.6	1.05	-	-	-	-	-

	2008					2007			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
May*	12.13	8.72	*24.22*	14.20	-	-	-	-	-
June	16.03	6.35	*25.29*	20.80	-	16.03	6.92	24.66	22.53
July	18.69	3.37	*26.06*	25.58	2.62	17.62	4.49	25.88	24.67
Aug.	22.12	4.27	*26.09*	25.13	1.82	21.65	3.28	26.36	22.77
Sept.	22.19	5.34	*26.13*	20.68	2.11	21.55	5.43	26.78	21.48
Oct.	16.30	5.87	*26.55*	13.60	2.50	19.32	5.07	27.65	17.08
Nov.*	12.64	7.98	*26.32*	15.10	1.28	-	-	-	-

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #2–Bell Marker 6

	2006				2005			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
June	16.93	7.74	25.89	22.72	16.8	5.22	23.21	21.9
July	18.67	3.99	26.51	25.5	21.78	4.59	23.03	24.4
Aug.	21.91	1.91	26.42	26.53	23.13	2.07	25.58	26.6
Sept.	20.41	5.98	26.24	20.33	22.8	2.98	27.01	24.2
Oct.	17.66	7.3	26.32	18.89	17.01	6.84	25.91	13.9

	2004				2003			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
June	16.38	5.92	25.41	22.5	15.58	6.35	24.26	22.4
July	19.82	5.11	26.24	24.8	17.16	2.93	25.35	22.9
Aug.	21.47	3.04	26.62	24.1	21.01	1.74	26.14	23.6
Sept.	21.96	6.17	26.33	20.7	21.2	5.38	26.55	22
Oct.	17.37	8.16	25.63	14.3	17.19	6.47	26.03	15

	2002				2001			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
June	18.06	6.13	26.55	23.4	16.67	4.97	25.36	23.2
July	19.91	1.81	26.87	27.4	18.45	5.32	26	26.2
Aug.	22.85	3.08	27.23	25.4	22.33	3.83	26.46	26
Sept.	21.97	5.84	26.89	21.4	21.88	5.8	27.07	21.1
Oct.	17.74	7.68	27.25	13.9	16.94	8.55	27.24	15.9

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #2–Bell Marker 6

	2000 Avg. Water Temp. (°C) (Bottom)	2000 Avg. DO (ppm) (Bottom)	2000 Avg. Salinity (ppt) (Bottom)	2000 Avg. Air Temp. (°C)	1999 Avg. Water Temp. (°C) (Bottom)	1999 Avg. DO (ppm) (Bottom)	1999 Avg. Salinity (ppt) (Bottom)	1999 Avg. Air Temp. (°C)
June	16.45	6.29	24.77	22.4	17.13	6.41	25.42	23
July	20.19	4.8	25.38	22.7	19.62	2.87	26.23	27
Aug.	22.08	6.46	24.95	24.7	22.88	4.29	26.8	25
Sept.	20.89	6.08	25.54	22.3	22.15	5.75	26.84	26
Oct.	16.86	7.18	26.07	16.3	17.18	8.46	26.3	13

	1998 Avg. Water Temp. (°C) (Bottom)	1998 Avg. DO (ppm) (Bottom)	1998 Avg. Salinity (ppt) (Bottom)	1998 Avg. Air Temp. (°C)	1997 Avg. Water Temp. (°C) (Bottom)	1997 Avg. DO (ppm) (Bottom)	1997 Avg. Salinity (ppt) (Bottom)	1997 Avg. Air Temp. (°C)
June	16.39	6.9	24.45	21.33	16.7	9.12	24.14	24.5
July	19.88	4.78	25.13	24.6	18.32	3.12	25.33	23.25
Aug.	22.88	3.3	25.27	24.5	21.12	2.86	26.41	21.37
Sept.	21.62	6.03	25.82	20.5	21.33	3.18	26.79	19.75
Oct.	17.18	6.9	26.27	13.75	18.02	5.22	26.59	14.5

	1996 Avg. Water Temp. (°C) (Bottom)	1996 Avg. DO (ppm) (Bottom)	1996 Avg. Salinity (ppt) (Bottom)	1996 Avg. Air Temp. (°C)	1995 Avg. Water Temp. (°C) (Bottom)	1995 Avg. DO (ppm) (Bottom)	1995 Avg. Salinity (ppt) (Bottom)	1995 Avg. Air Temp. (°C)
June	17.5	7.8	N/A	22	17.61	7.78	26.5	21.25
July	19.15	5.17	24.92	24.5	20.09	4.19	26.93	24.87
Aug.	21.1	4.29	24.99	23.17	22.9	4.87	27.77	25.12
Sept.	22.05	8	25.73	20.17	21.73	5.27	28.44	21.5
Oct.	16.95	9.11	25.34	15.75	17.48	7.72	27.8	15.83

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #3–Glen Cove Creek

2017	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	14.41	25.27	8.78	19.00	3.33
June	18.07	23.57	7.13	22.43	18.58
July	20.59	25.17	5.37	24.80	2.51
Aug.	22.66	24.97	4.24	22.48	2.69
Sept.	21.47	25.44	5.83	21.83	3.21
Oct.	19.40	24.98	7.08	15.13	2.77
Nov.*	-	-	-	-	-

	2016					2015				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	13.63	8.83	26.19	18.60	1.08	12.50	9.45	26.21	19.33	1.89
June	18.30	7.25	26.74	21.10	2.51	16.88	7.04	26.30	20.85	2.41
July	21.60	3.93	27.54	25.76	2.54	21.34	5.06	26.64	26.04	2.56
Aug.	23.90	3.65	27.86	25.06	2.40	23.33	5.10	27.47	26.10	2.03
Sept.	23.08	5.76	28.05	23.62	2.33	23.50	4.56	27.61	26.30	3.41
Oct.	17.30	7.28	28.19	15.58	1.67	17.22	7.28	27.41	17.34	2.84
Nov.*	-	-	-	-	-	14.40	7.98	27.31	17.40	0.84

	2014					2013				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	15.88	9.35	24.17	16.45	2.01	15.04	8.06	26.04	21.87	2.52
June	18.83	6.29	24.36	22.55	2.53	19.69	9.74	25.28	19.45	1.69
July	21.04	4.65	25.64	25.10	3.05	23.37	6.93	25.65	27.18	1.32
Aug.	22.89	4.22	26.10	24.33	2.12	22.87	5.98	26.52	27.10	1.78
Sept.	22.14	4.73	26.42	20.40	2.65	21.25	6.62	27.42	18.07	2.68
Oct.	17.86	6.57	26.50	18.98	1.94	17.62	7.37	27.06	15.72	1.14
Nov.*	12.30	8.54	27.27	16.80	1.15	12.57	6.77	26.83	13.40	0.74

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #3–Glen Cove Creek

	2012					2011				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	19.39	7.39	24.87	22.60	1.93	15.51	8.16	23.28	23.7	0.16
June	19.63	5.94	24.72	22.30	2.06	19.01	8.17	23.90	25.0	1.39
July	22.64	3.02	25.78	26.13	2.19	21.53	5.81	24.55	24.6	1.31
Aug.	23.91	3.82	26.56	25.50	1.95	22.60	4.10	25.13	24.1	2.18
Sept.	22.92	5.37	26.93	21.23	1.44	21.78	6.55	23.69	23.3	2.02
Oct.	17.56	8.06	26.78	15.88	0.59	17.91	8.16	23.96	12.8	1.96
Nov.*	9.64	9.29	27.19	8.30	1.28	13.04	9.20	24.03	9.3	0.91

	2010					2009				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	13.39	8.91	24.18	24.70	0.70	14.10	9.22	24.71	17.40	2.00
June	18.52	7.60	25.25	22.68	1.85	17.60	7.83	24.38	20.40	1.68
July	21.60	3.98	26.29	29.30	1.61	20.50	5.56	24.46	24.54	1.80
Aug.	22.82	4.62	26.80	25.30	1.64	23.13	5.62	24.76	26.83	2.64
Sept.	21.83	5.96	26.88	23.56	2.09	21.27	5.54	25.10	19.64	3.13
Oct.	16.80	8.26	26.62	15.90	0.59	14.98	7.76	25.27	13.80	2.28
Nov.*	12.72	10.25	27.29	9.10	0.80	-	-	-	-	-

	2008					2007			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
May*	12.82	8.58	23.69	15.15	-	-	-	-	-
June	18.23	7.53	24.89	21.60	-	16.82	8.47	24.15	21.98
July	19.39	3.83	25.89	26.33	1.62	19.19	4.75	25.40	24.25
Aug.	23.12	6.08	25.68	24.15	-	22.67	5.98	26.16	23.20
Sept.	22.47	5.74	25.93	21.45	-	21.87	5.18	26.63	22.13
Oct.	16.43	7.25	26.17	13.58	1.67	19.31	4.7	27.59	17.7
Nov.*	12.60	7.49	26.36	15.60	-	-	-	-	-

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #3–Glen Cove Creek

	2006 Avg. Water Temp. (°C) (Bottom)	2006 Avg. DO (ppm) (Bottom)	2006 Avg. Salinity (ppt) (Bottom)	2006 Avg. Air Temp. (°C)	2005 Avg. Water Temp. (°C) (Bottom)	2005 Avg. DO (ppm) (Bottom)	2005 Avg. Salinity (ppt) (Bottom)	2005 Avg. Air Temp. (°C)
June	17.37	8.35	25.6	23.38	17.46	5.46	23.08	22.32
July	20.32	4.51	25.98	25.25	22.32	4.29	24.82	24.8
Aug.	23.19	5.13	26.13	25.46	23.53	2.16	25.67	25.3
Sept.	20.58	7.5	26	19.85	22.76	5.23	26.8	24.8
Oct.	16.91	8.55	26.17	16.03	16.66	8.14	25.58	14.3

	2004 Avg. Water Temp. (°C) (Bottom)	2004 Avg. DO (ppm) (Bottom)	2004 Avg. Salinity (ppt) (Bottom)	2004 Avg. Air Temp. (°C)	2003 Avg. Water Temp. (°C) (Bottom)	2003 Avg. DO (ppm) (Bottom)	2003 Avg. Salinity (ppt) (Bottom)	2003 Avg. Air Temp. (°C)
June	17.67	7.36	25.23	23.4	16.47	7.02	23.97	23.9
July	20.39	4.96	26.15	25.1	18.41	4.25	25.08	22.8
Aug.	22	4.3	26.48	22.8	21.26	3.74	25.92	23.6
Sept.	22.02	4.66	26.34	21.3	21.48	4.81	26.49	22.4
Oct.	16.86	7.62	25.97	13.1	16.97	6.58	25.61	15.6

	2002 Avg. Water Temp. (°C) (Bottom)	2002 Avg. DO (ppm) (Bottom)	2002 Avg. Salinity (ppt) (Bottom)	2002 Avg. Air Temp. (°C)	2001 Avg. Water Temp. (°C) (Bottom)	2001 Avg. DO (ppm) (Bottom)	2001 Avg. Salinity (ppt) (Bottom)	2001 Avg. Air Temp. (°C)
June	19.05	6.36	26.48	23.7	18.45	7.63	25.23	24.4
July	20.71	2.61	26.69	25.4	18.55	4.53	25.92	26
Aug.	23.36	2.49	27.1	26.9	23.09	4.83	26.34	27.7
Sept.	21.78	6.49	26.71	22	22.1	6.92	26.88	21.3
Oct.	17.7	7.98	27.05	14.7	17.02	9.01	27.12	16.3

* Average based on less than full month

1995-2017 Water-Quality Data Summary

CSHH #3–Glen Cove Creek

	2000				1999			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
June	17.69	6.6	24.35	21.6	18.43	6.32	25.09	23
July	21.16	5.87	25.26	23	21.57	5.02	25.89	30
Aug.	22.66	6.44	24.68	23.5	23.82	4.87	26.44	26
Sept.	21.45	6.13	24.99	20.5	21.8	6.16	26.25	23
Oct.	16.69	7.5	25.52	16.7	16.74	8.7	25.81	14

	1998				1997			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
June	17.23	7.25	24.27	21.33	17.36	8.32	24.11	26.5
July	21.03	6.34	24.76	24.6	20.2	6.21	25.07	23.37
Aug.	23.39	3.87	25.14	24.5	21.34	2.29	26.29	21.5
Sept.	21.88	5.76	25.75	20.5	21.61	3.12	26.67	20
Oct.	16.9	7.79	25.88	13.75	17.12	5.69	26.69	13.67

	1996				1995			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
June	18.25	9.35	N/A	22.12	17.82	5.4	26.58	21.5
July	20.32	7.1	24.46	23.67	20.74	4.5	26.87	25
Aug.	21.45	3.2	25.29	22.87	23.24	4.79	27.94	24.7
Sept.	22.09	6.85	25.69	20.83	21.61	4.78	28.22	21
Oct.	16.61	9.88	25.12	15.4	17.4	7.54	27.57	16.5

* Average based on less than full month

1999-2017 Water-Quality Data Summary

CSHH #8–Glen Cove Creek STP Outfall

	2017				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	15.39	24.68	8.98	21.60	12.48
June	17.83	22.78	6.44	18.65	33.21
July	21.30	25.00	5.50	26.20	3.74
Aug.	23.15	24.66	4.33	24.12	3.47
Sept.	21.79	25.19	6.01	22.75	5.75
Oct.	19.45	24.65	6.24	14.93	3.78
Nov.*	-	-	-	-	-

	2016					2015				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	14.20	8.15	25.88	19.87	2.05	13.70	9.08	26.00	21.13	2.60
June	19.23	5.94	26.36	23.43	2.52	17.53	6.68	25.98	23.03	4.40
July	22.67	4.48	27.20	26.60	2.54	22.04	4.64	26.28	27.14	3.59
Aug.	24.55	4.79	27.31	26.48	2.88	23.67	4.31	27.19	26.43	2.61
Sept.	23.10	5.34	27.57	25.83	3.01	24.85	4.37	27.31	28.75	2.85
Oct.	17.25	6.84	27.76	16.78	2.93	17.16	6.01	26.72	18.06	8.81
Nov.*	-	-	-	-	-	14.60	7.05	26.88	18.50	1.44

	2014					2013				
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Turbidity (NTUs) (0.5 m)
May*	16.70	9.43	21.84	18.40	2.61	15.85	8.59	22.92	24.20	3.51
June	19.53	5.58	23.45	23.78	3.47	20.19	8.64	20.44	23.45	2.78
July	21.77	3.64	21.98	26.34	4.35	23.58	7.08	24.14	28.55	2.36
Aug.	23.13	5.17	23.73	24.50	3.19	23.28	5.52	25.81	25.78	1.91
Sept.	22.35	5.52	25.09	20.73	2.96	21.16	7.47	26.29	18.60	3.34
Oct.	17.83	6.07	24.18	19.05	3.25	17.91	6.85	26.27	16.24	1.05
Nov.*	12.70	8.54	24.02	17.80	1.23	11.40	7.46	25.31	8.05	1.29

* Average based on less than full month

1999-2017 Water-Quality Data Summary

CSHH #8–Glen Cove Creek STP Outfall

	2012 Avg. Water Temp. (°C) (Bottom)	2012 Avg. DO (ppm) (Bottom)	2012 Avg. Salinity (ppt) (Bottom)	2012 Avg. Air Temp. (°C)	2012 Avg. Turbidity (NTUs) (0.5 m)	2011 Avg. Water Temp. (°C) (Bottom)	2011 Avg. DO (ppm) (Bottom)	2011 Avg. Salinity (ppt) (Bottom)	2011 Avg. Air Temp. (°C)	2011 Avg. Turbidity (NTUs) (0.5 m)
May*	20.17	6.16	24.14	24.50	3.14	16.64	8.22	22.95	26.1	0.26
June	20.21	5.00	22.43	23.83	2.28	18.75	7.56	23.51	25.5	2.08
July	23.36	4.90	23.87	27.50	2.26	21.96	3.66	24.38	26.0	2.30
Aug.	24.16	4.29	24.44	26.73	2.44	22.99	3.50	24.78	24.9	2.62
Sept.	23.07	4.54	24.95	22.43	2.97	22.17	5.48	23.40	23.6	2.59
Oct.	17.72	5.99	23.93	17.33	1.31	18.01	7.68	23.74	17.2	2.09
Nov.*	9.86	9.18	26.36	8.55	2.01	13.14	9.70	23.86	9.4	1.46

	2010 Avg. Water Temp. (°C) (Bottom)	2010 Avg. DO (ppm) (Bottom)	2010 Avg. Salinity (ppt) (Bottom)	2010 Avg. Air Temp. (°C)	2010 Avg. Turbidity (NTUs) (0.5 m)	2009 Avg. Water Temp. (°C) (Bottom)	2009 Avg. DO (ppm) (Bottom)	2009 Avg. Salinity (ppt) (Bottom)	2009 Avg. Air Temp. (°C)	2009 Avg. Turbidity (NTUs) (0.5 m)
May*	14.40	8.87	23.67	26.10	2.07	14.49	8.46	24.62	19.37	2.78
June	19.11	8.14	25.06	23.90	2.54	18.08	7.71	24.22	20.85	1.74
July	22.78	4.22	26.07	29.90	2.28	21.12	5.23	24.26	25.86	2.58
Aug.	23.35	3.78	26.68	26.10	2.34	24.01	6.65	24.44	28.20	4.27
Sept.	22.25	5.67	26.47	23.90	2.40	21.38	6.21	24.74	20.46	3.15
Oct.	16.68	7.88	26.29	16.40	1.66	15.14	7.03	25.00	14.08	2.88
Nov.*	12.85	9.82	26.96	10.00	1.22	-	-	-	-	-

	2008 Avg. Water Temp. (°C) (Bottom)	2008 Avg. DO (ppm) (Bottom)	2008 Avg. Salinity (ppt) (Bottom)	2008 Avg. Air Temp. (°C)	2008 Avg. Turbidity (NTUs) (0.5 m)	2007 Avg. Water Temp. (°C) (Bottom)	2007 Avg. DO (ppm) (Bottom)	2007 Avg. Salinity (ppt) (Bottom)	2007 Avg. Air Temp. (°C)
May*	13.22	6.81	23.67	19.30	-	-	-	-	-
June	19.08	8.34	24.55	23.80	4.75	17.69	8.75	24.03	22.83
July	20.53	4.83	25.64	28.80	3.02	19.76	4.46	25.26	26.50
Aug.	23.23	4.49	25.46	24.13	2.89	22.76	5.27	25.84	24.33
Sept.	22.67	4.04	25.84	20.80	2.74	22.17	6.05	26.27	21.75
Oct.	16.68	6.67	26.17	13.38	2.14	19.3	5.13	27.59	17.76
Nov.*	12.47	6.34	25.96	15.80	1.53	-	-	-	-

* Average based on less than full month

1999-2017 Water-Quality Data Summary

CSHH #8–Glen Cove Creek STP Outfall

	2006 Avg. Water Temp. (°C) (Bottom)	2006 Avg. DO (ppm) (Bottom)	2006 Avg. Salinity (ppt) (Bottom)	2006 Avg. Air Temp. (°C)	2005 Avg. Water Temp. (°C) (Bottom)	2005 Avg. DO (ppm) (Bottom)	2005 Avg. Salinity (ppt) (Bottom)	2005 Avg. Air Temp. (°C)
June	18.21	7.98	25.27	24.52	18.9	7.1	22.25	23.72
July	21.43	5.08	25.51	26.33	23.07	5.48	24.5	25.5
Aug.	24	8.85	25.71	25.18	24.32	3.45	25.32	27.2
Sept.	20.65	8.25	25.36	20.2	23.24	5.07	26.42	25.2
Oct.	17.12	8.18	25.97	15.57	16.98	7.31	25.28	14

	2004 Avg. Water Temp. (°C) (Bottom)	2004 Avg. DO (ppm) (Bottom)	2004 Avg. Salinity (ppt) (Bottom)	2004 Avg. Air Temp. (°C)	2003 Avg. Water Temp. (°C) (Bottom)	2003 Avg. DO (ppm) (Bottom)	2003 Avg. Salinity (ppt) (Bottom)	2003 Avg. Air Temp. (°C)
June	19.38	8.14	24.8	26.3	17.01	5.92	23.7	25.7
July	21.26	4.52	25.39	27	18.94	4.03	24.94	24.4
Aug.	22.78	5.98	25.89	24.4	22.51	5.23	25.51	26.1
Sept.	22.22	4.66	25.62	22.1	21.58	4.87	25.99	23.5
Oct.	16.6	7.79	25.72	13.4	16.49	6.49	25.1	14.6

	2002 Avg. Water Temp. (°C) (Bottom)	2002 Avg. DO (ppm) (Bottom)	2002 Avg. Salinity (ppt) (Bottom)	2002 Avg. Air Temp. (°C)	2001 Avg. Water Temp. (°C) (Bottom)	2001 Avg. DO (ppm) (Bottom)	2001 Avg. Salinity (ppt) (Bottom)	2001 Avg. Air Temp. (°C)
June	19.89	7.65	26.12	25.5	20.11	7.61	24.57	26.6
July	22.13	4.33	26.27	26.8	20.18	5.56	25.31	27.1
Aug.	24.64	4.85	26.67	27.7	23.82	6.16	25.86	29.2
Sept.	21.91	6.01	26.41	23	22.45	5.74	26.58	22.1
Oct.	17.67	7.69	26.77	16.4	16.67	9.56	26.54	16.7

* Average based on less than full month

1999-2017 Water-Quality Data Summary

CSHH #8–Glen Cove Creek STP Outfall

	2000				1999			
	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)	Avg. Water Temp. (°C) (Bottom)	Avg. DO (ppm) (Bottom)	Avg. Salinity (ppt) (Bottom)	Avg. Air Temp. (°C)
June	18.66	7.13	23.59	23.8	19.99	9.11	24.71	23
July	21.99	6.51	24.93	24.1	22.7	6.03	25.53	30
Aug.	23.58	7.75	24.18	24.5	24.28	5.32	26.19	26
Sept.	21.17	8.63	24.81	23.6	21.78	6.14	25.84	24
Oct.	17.25	7.17	24.87	15.3	16.63	8.63	25.53	15

* Average based on less than full month

Seasonal Averages for Selected Water-Quality Parameters

Salinity Averages (ppt)

	Beacon 11 CSHH #1	Bell 6 CSHH #2	Red Channel Marker, Near Glen Cove Creek, CSHH #3	Glen Cove STP Outfall, CSHH #8
2017	23.97	25.00	24.62	23.83
2016	26.98	27.49	27.32	25.46
2015	26.43	26.99	26.74	24.01
2014	25.48	26.22	25.72	23.48
2013	26.01	26.59	26.34	24.45
2012	25.90	26.56	26.19	24.15
2011	23.71	24.27	23.99	23.18
2010	25.77	26.32	26.00	24.94
2009	24.22	24.87	24.54	23.68
2008	25.01	25.78	25.28	24.29
2007	25.41	26.07	25.62	24.30
2006	25.3	26.0	25.6	24.3
2005	24.60	24.95	24.71	23.66
2004	25.73	26.06	26.04	25.50
2003	25.25	25.70	25.45	25.09
2002	26.56	26.99	26.83	26.47
2001	26.02	26.41	26.27	25.76
2000	24.87	25.28	24.94	24.40
1999	24.15	26.21	25.49	25.49
1998	24.88	25.40	25.16	N/A
1997	25.20	25.69	25.66	N/A

Bottom Dissolved Oxygen Averages (ppm)

	Beacon 11 CSHH #1	Bell 6 CSHH #2	Red Channel Marker, Near Glen Cove Creek, CSHH #3	Glen Cove STP Outfall, CSHH #8
2017	5.32	5.71	6.25	5.90
2016	5.02	4.94	5.82	5.89
2015	5.66	5.55	6.46	6.04
2014	4.83	4.96	5.74	5.62
2013	6.42	6.28	7.49	7.29
2012	4.46	4.31	5.54	5.28
2011	5.64	4.77	6.87	6.14
2010	5.55	5.16	6.41	6.26
2009	6.09	5.30	6.72	6.73
2008	5.50	5.31	6.35	5.73
2007	4.99	5.37	6.02	5.93
2006	5.80	5.30	6.80	7.00
2005	4.59	4.63	5.09	5.76
2004	4.94	5.57	5.76	6.22
2003	4.63	4.55	5.21	5.28
2002	4.64	5.11	5.20	6.11
2001	5.16	5.46	6.47	6.82
2000	5.64	6.10	6.54	7.35
1999	5.85	5.44	6.32	7.14
1998	5.17	5.45	6.48	N/A
1997	4.39	4.54	5.15	N/A
1996	5.90	7.11	7.45	N/A

Seasonal Averages for Selected Water-Quality Parameters

Turbidity at 0.5m Averages (ntu)

	Beacon 11 CSHH #1	Bell 6 CSHH #2	Red Channel Marker, Near Glen Cove Creek, CSHH #3	Glen Cove STP Outfall, CSHH #8
2017	4.57	5.83	5.75	8.13
2016	2.78	1.61	2.12	2.68
2015	3.05	1.84	2.46	4.30
2014	3.39	1.84	2.36	3.27
2013	2.32	1.61	1.71	2.26
2012	2.23	1.37	1.70	2.29
2011	2.33	1.41	1.61	1.61
2010	2.04	1.61	1.51	2.16
2009	2.58	1.93	2.30	2.19
2008	2.87	2.18	1.64	2.81
2007	N/A	N/A	N/A	N/A
2006	N/A	N/A	N/A	N/A
2005	N/A	N/A	N/A	N/A
2004	N/A	N/A	N/A	N/A
2003	N/A	N/A	N/A	N/A
2002	N/A	N/A	N/A	N/A
2001	N/A	N/A	N/A	N/A
2000	N/A	N/A	N/A	N/A
1999	N/A	N/A	N/A	N/A
1998	N/A	N/A	N/A	N/A
1997	N/A	N/A	N/A	N/A
1996	N/A	N/A	N/A	N/A

Water Temperature Averages (ºC)

	Beacon 11 CSHH #1	Bell 6 CSHH #2	Red Channel Marker, Near Glen Cove Creek, CSHH #3	Glen Cove STP Outfall, CSHH #8
2017	20.07	19.59	20.15	20.79
2016	20.36	20.27	20.62	20.57
2015	19.00	18.68	19.25	19.4
2014	19.60	19.41	19.84	20.26
2013	19.39	18.84	19.58	19.66
2012	20.32	20.03	20.43	20.32
2011	19.92	19.70	20.04	20.25
2010	19.90	19.68	20.15	20.60
2009	19.31	18.75	19.27	19.68
2008	19.25	19.15	19.32	19.63
2007	19.9	19.4	19.96	20.53
2006	20.2	19.8	20.1	20.63
2005	20.24	19.63	20.19	21.1
2004	19.55	19.14	19.41	N/A
2003	18.94	18.37	18.9	N/A
2002	20.67	20.13	20.53	N/A
2001	20.90	19.58	20.23	N/A
2000	19.49	19.03	19.59	N/A
1999	21.01	19.67	20.2	N/A
1998	20.52	19.66	20.28	N/A
1997	20.1	19.12	19.55	N/A
1996	19.87	19.2	19.43	N/A
1995	20.8	20.3	20.59	N/A

Seasonal Averages for Selected Water-Quality Parameters

Air Temperature Averages (ºC)

	Beacon 11 CSHH #1	Bell 6 CSHH #2	Red Channel Marker, Near Glen Cove Creek, CSHH #3	Glen Cove STP Outfall, CSHH #8
2017	19.71	20.79	20.93	21.52
2016	20.62	22.49	22.14	23.14
2015	20.04	21.40	22.36	23.4
2014	20.18	20.57	21.68	22.44
2013	19.20	20.80	20.85	21.47
2012	20.00	21.12	21.38	20.0
2011	20.18	21.15	20.64	22.42
2010	20.81	22.40	23.18	23.9
2009	19.18	20.52	20.69	21.7
2008	18.88	20.68	20.27	21.20
2007	20.22	21.24	21.69	22.31
2006	21	23.4	22.2	22.92
2005	21.1	21.91	22.28	23.2
2004	19.24	19.8	19.48	N/A
2003	20.4	21.1	21.8	N/A
2002	21.1	21.5	22.1	N/A
2001	22.5	22.8	23.6	N/A
2000	20.4	21.8	20.9	N/A
1999	22.22	22.73	23.04	N/A
1998	21.1	21.1	21.1	N/A
1997	20.81	21.37	21.25	N/A
1996	20.71	20.53	20.55	N/A
1995	21.84	22.16	22.18	N/A

Appendix E

2017 UWS Monitoring Data

2017 Dissolved Oxygen Graphs

Station	Date	Sample Depth (m)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (%)	digital -Dissolved Oxygen (mg/L)	digital -Chlorophyll-a (ug/L)	Corrected Chlorophyll-a (ug/L)	Turbidity (NTU)
HEM01	5/18/2017	4.67	13.77	25.12	96.8	8.57	16.89	4.13	365.9
HEM02	5/18/2017	4.64	13.5	25.32	106.5	9.46	9.18	2.20	2.59
HEM03	5/18/2017	9.37	12.65	25.83	86.3	7.79	10.16	2.45	5.91
HEM04	5/18/2017	9.66	12.2	26.17	92.2	8.37	7.77	1.85	5.27
HEM05	5/18/2017	7.02	12.43	26.05	96.4	8.7	6.94	1.64	6.55
HEM01	5/30/2017	4.5	15.2	22.45	85.7	7.52	23.05	6.83	7.03
HEM02	5/30/2017	4.15	14.99	25.42	96.9	8.42	22.33	6.62	4.49
HEM03	5/30/2017	8.16	14.6	25.49	88.6	7.76	26.61	7.89	4.12
HEM04	5/30/2017	9.11	14.46	25.62	97.2	8.53	24.93	7.39	5.61
HEM05	5/30/2017	6.28	14.58	25.56	97.4	8.54	20.01	5.93	6.06
HEM01	6/13/2017	2.78	20.15	22.03	110.2	8.77	60.89	163.03	9.31
HEM02	6/13/2017	3.14	19.7	25.27	140.2	11.01	70.88	189.97	8.67
HEM03	6/13/2017	6.33	16.6	25.65	102.1	8	22.97	60.76	7.54
HEM04	6/13/2017	8.32	15.33	26.17	82.9	7.03	9.65	24.84	8.92
HEM05	6/13/2017	5.23	18.3	25.49	140.7	11.33	65.88	176.49	3.5
HEM01	6/30/2017	5.01	17.6	25.89	54.5	4.45	20.73	4.64	6.3
HEM02	6/30/2017	4.88	18.3	25.88	63.6	5.16	19.28	4.32	8.15
HEM03	6/30/2017	7.46	17.63	25.84	61.4	5.01	17.01	3.80	5.12
HEM04	6/30/2017	9.89	16.05	26.28	62.8	5.28	14.01	3.13	11.05
HEM05	6/30/2017	7.19	16.88	26.13	69.9	5.76	22.3	5.00	14.31
HEM01	7/11/2017	2.24	21.89	25.02	71.9	5.44	51.33	4.97	5.5
HEM02	7/11/2017	2.93	21.05	25.56	73.7	5.61	57.3	5.55	7.27
HEM03	7/11/2017	6.83	19.78	25.8	67.2	5.26	50.89	4.93	6.68
HEM04	7/11/2017	7.94	19.53	25.88	81.8	6.35	29.11	2.82	4.69
HEM05	7/11/2017	5.17	21.01	25.66	107.5	8.22	33.13	3.21	4.54
HEM01	7/27/2017	3.12	21.9	22.12	35.5	2.74	17.85	3.47	3.07
HEM02	7/27/2017	3.37	21.8	22.78	49	3.78	17.29	3.36	3.94
HEM03	7/27/2017	7.18	21.5	22.93	52.6	4.06	14.64	2.85	7.98
HEM04	7/27/2017	8.47	21.58	22.94	65.8	5.08	15.07	2.93	6.77
HEM05	7/27/2017	5.82	21.63	22.86	67.3	5.21	15.55	3.03	6.32
HEM01	8/8/2017	2.67	22.36	24.81	32.6	2.45	25.74	7.03	4.96
HEM02	8/8/2017	2.84	22.48	25.56	49.3	3.68	23.72	6.48	4.18
HEM03	8/8/2017	5.79	21.73	26.15	35.7	2.65	7.55	2.05	2.82
HEM04	8/8/2017	8.19	21.6	26.26	42.6	3.18	8.04	2.18	4.32
HEM05	8/8/2017	5.38	22.04	25.75	64.8	4.85	16.96	4.63	2.63

2017 Dissolved Oxygen Graphs

Station	Date	Sample Depth (m)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (%)	digital -Dissolved Oxygen (mg/L)	digital -Chlorophyll-a (ug/L)	Corrected Chlorophyll-a (ug/L)	Turbidity (NTU)
HEM01	8/22/2017	2.27	24	25.15	51	4.59	60.4	21.86	6.01
HEM02	8/22/2017	2.61	23.92	25.59	68.8	6.19	16.74	6.02	5.45
HEM03	8/22/2017	5.43	22.62	26.22	29.3	2.68	9.5	3.40	1.53
HEM04	8/22/2017	7.96	22.31	26.39	24.6	2.27	7.73	2.76	2.42
HEM05	8/22/2017	5.49	22.68	26.26	46.1	4.11	7.1	2.53	2.38
HEM01	9/5/2017	2.5	21.31	25.84	56.3	4.23	9.5	1.59	6.05
HEM02	9/5/2017	3.22	21.29	26.02	71.6	5.4	17.47	2.97	3.7
HEM03	9/5/2017	7.34	21.2	26.37	82.1	6.16	12.2	2.06	4.16
HEM04	9/5/2017	8.82	21.18	26.38	84.1	6.32	7.59	1.26	3.95
HEM05	9/5/2017	6.78	21.42	26.26	89.2	6.7	14.96	2.54	2.77
HEM01	9/21/2017	3.49	21.45	25.45	66.6	5.03	18.85	9.18	8.52
HEM02	9/21/2017	3.13	21.45	26.15	73.8	5.54	18.62	9.07	9.65
HEM03	9/21/2017	5.57	21.36	26.9	83.9	6.3	14.49	7.05	2.09
HEM04	9/21/2017	8.97	21.32	27.01	84.6	6.34	19.97	9.73	3.08
HEM05	9/21/2017	5.93	21.24	27	81.8	6.15	13.53	6.58	2.61
HEM01	10/3/2017	3.73	20.53	23.31	62.5	5.02	28.8	5.27	12.77
HEM02	10/3/2017	4.31	20.24	23.12	88.1	7.02	23.09	4.20	3.14
HEM03	10/3/2017	7.22	20.48	23.46	97.9	7.75	25.6	4.67	1.58
HEM04	10/3/2017	9.94	21.03	23.56	101.1	7.9	24.85	4.53	2.15
HEM05	10/3/2017	7.78	20.7	23.54	109.6	8.65	28.89	5.28	1.44
HEM01	10/18/2017	2.96	16.75	25.58	92	7.64	21	11.22	4.4
HEM02	10/18/2017	3.76	17.74	26.22	101.7	8.24	35.81	19.26	3.97
HEM03	10/18/2017	8.19	18.37	26.48	102.6	8.24	22.13	11.83	2.61
HEM04	10/18/2017	9.46	18.76	26.52	100.9	8.02	22.87	12.24	2.97
HEM05	10/18/2017	7.09	18.77	26.55	103.9	8.24	16.61	8.84	2.44

2017 Dissolved Oxygen Graphs

Station	Date	Sample Depth (m)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (%)	digital -Dissolved Oxygen (mg/L)	digital -Chlorophyll-a (ug/L)	Corrected Chlorophyll-a (ug/L)	Turbidity (NTU)
HEM01	5/18/2017	0.5	15.29	24.71	97.4	8.46	28.32	2.64	133.3
HEM02	5/18/2017	0.5	16.65	24.3	123.8	10.4	27.53	6.80	2.13
HEM03	5/18/2017	0.5	15.92	24.75	121.1	10.29	16.91	4.14	1.97
HEM04	5/18/2017	0.5	15	24.5	110.2	9.56	12.6	3.06	1.9
HEM05	5/18/2017	0.5	16.03	24.71	119.3	10.13	11.36	2.75	20.31
HEM01	5/30/2017	0.5	15.44	22.2	86.2	7.56	20.59	7.03	5.14
HEM02	5/30/2017	0.5	15.37	25.02	99.6	8.61	28.47	8.44	2.85
HEM03	5/30/2017	0.5	15.06	25.27	98.1	8.53	27.27	8.08	2.99
HEM04	5/30/2017	0.5	15.01	25.38	103.8	9.03	30.04	8.90	2.11
HEM05	5/30/2017	0.5	15.03	25.32	103.7	9.04	29.74	8.82	2.47
HEM01	6/13/2017	0.5	20.22	21.99	110.5	8.79	66.9	24.05	7.41
HEM02	6/13/2017	0.5	21.27	24.75	155.6	12.06	80.28	215.32	9.38
HEM03	6/13/2017	0.5	21.56	25.2	139.9	10.79	47.58	127.13	2.68
HEM04	6/13/2017	0.5	20.65	25.31	168.2	13.11	48.17	128.72	5.89
HEM05	6/13/2017	0.5	19.75	25.3	153	12.07	38.1	101.56	2.69
HEM01	6/30/2017	0.5	18.7	25.56	60.9	4.89	38.17	4.99	3.28
HEM02	6/30/2017	0.5	19.8	24.71	72.3	5.75	36.99	8.31	2.91
HEM03	6/30/2017	0.5	18.91	25.54	77.7	6.26	27.17	6.10	2.24
HEM04	6/30/2017	0.5	18.15	25.7	78	6.33	17.51	3.92	1.81
HEM05	6/30/2017	0.5	19.03	25.64	83.9	6.74	24.2	5.43	1.73
HEM01	7/11/2017	0.5	21.93	24.88	71.5	5.41	48.84	2.73	5.7
HEM02	7/11/2017	0.5	21.88	25.16	90.4	6.85	45.08	4.37	4.66
HEM03	7/11/2017	0.5	20.95	25.65	58.3	4.8	50.08	4.85	3.04
HEM04	7/11/2017	0.5	21.48	25.59	96	7.36	34.25	3.32	3.08
HEM05	7/11/2017	0.5	21.74	25.52	108.6	8.27	33.16	3.21	4.43
HEM01	7/27/2017	0.5	21.86	22	37.9	2.91	17.2	2.27	2.73
HEM02	7/27/2017	0.5	21.98	22.37	52	4	20.43	3.98	4.12
HEM03	7/27/2017	0.5	21.6	22.79	57.5	4.47	29.42	5.73	2.35
HEM04	7/27/2017	0.5	21.72	22.77	72.3	5.6	26.77	5.21	2.21
HEM05	7/27/2017	0.5	21.59	22.78	76.1	5.81	14.4	2.80	3.87
HEM01	8/8/2017	0.5	22.28	24.52	30.5	2.29	24.49	3.83	5.1
HEM02	8/8/2017	0.5	22.5	25.29	55.6	4.1	34.41	9.41	3.31
HEM03	8/8/2017	0.5	22.34	25.45	52.9	4.01	26.64	7.28	2.79
HEM04	8/8/2017	0.5	22.2	25.64	54.8	4.16	25.1	6.86	2.49
HEM05	8/8/2017	0.5	22.1	25.7	67	5.03	22.27	6.08	2.07

2017 Dissolved Oxygen Graphs

Station	Date	Sample Depth (m)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (%)	digital -Dissolved Oxygen (mg/L)	digital -Chlorophyll-a (ug/L)	Corrected Chlorophyll-a (ug/L)	Turbidity (NTU)
HEM01	8/22/2017	0.5	24	24.89	51.4	4.65	84.18	38.85	4.93
HEM02	8/22/2017	0.5	24.16	25.22	72.9	6.57	23.16	8.35	10.76
HEM03	8/22/2017	0.5	23.38	25.82	36.5	3.38	22.56	8.14	1.78
HEM04	8/22/2017	0.5	23.43	25.92	42.9	3.94	24.34	8.78	1.85
HEM05	8/22/2017	0.5	23.82	25.79	69.8	6.36	25.24	9.11	2.2
HEM01	9/5/2017	0.5	21.2	25.42	64.9	4.82	77.18	6.58	3.69
HEM02	9/5/2017	0.5	21.42	25.62	76.8	5.79	35.93	6.18	2.62
HEM03	9/5/2017	0.5	21.23	26.19	80.7	6.1	22.17	3.79	1.72
HEM04	9/5/2017	0.5	21.29	26.3	89.5	6.75	11.34	1.91	3.43
HEM05	9/5/2017	0.5	21.42	26.26	91.3	6.86	16.91	2.88	1.82
HEM01	9/21/2017	0.5	21.47	25.17	84.9	6.38	20.78	9.26	4.13
HEM02	9/21/2017	0.5	21.38	26.01	91	6.83	23.24	11.32	3.1
HEM03	9/21/2017	0.5	21.38	26.84	84.9	6.36	18.77	9.14	1.85
HEM04	9/21/2017	0.5	21.32	26.94	94.3	7.05	16.63	8.10	1.91
HEM05	9/21/2017	0.5	21.25	27.04	91.5	6.78	13.64	6.64	2.68
HEM01	10/3/2017	0.5	19.71	22.67	58.2	4.67	31.23	6.40	3.52
HEM02	10/3/2017	0.5	19.91	23	87.3	6.99	20.22	3.67	2.07
HEM03	10/3/2017	0.5	20.42	23.44	97.7	7.75	28.36	5.18	1.43
HEM04	10/3/2017	0.5	20.6	23.4	103.9	8.22	30.22	5.53	1.61
HEM05	10/3/2017	0.5	20.69	23.52	109.6	8.64	29.22	5.34	1.51
HEM01	10/18/2017	0.5	16.74	25.57	92.9	7.71	22.46	8.87	3.62
HEM02	10/18/2017	0.5	17.57	26.14	101.1	8.23	30.78	16.53	3.05
HEM03	10/18/2017	0.5	18.36	26.49	101.3	8.11	21.79	11.65	2.51
HEM04	10/18/2017	0.5	18.75	26.53	99.8	7.92	20.23	10.80	2.3
HEM05	10/18/2017	0.5	18.76	26.57	103.4	8.22	14.62	7.76	2.51

2017 Dissolved Oxygen Graphs

Station	Date	Sample Depth (m)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (%)	digital -Dissolved Oxygen (mg/L)	digital -Chlorophyll-a (ug/L)	Corrected Chlorophyll-a (ug/L)	Turbidity (NTU)
HEM01	5/18/2017								
HEM02	5/18/2017								
HEM03	5/18/2017								
HEM04	5/18/2017	5	14.41	24.73	107.3	9.42	15.79	3.86	1.72
HEM05	5/18/2017								
HEM01	5/30/2017								
HEM02	5/30/2017								
HEM03	5/30/2017								
HEM04	5/30/2017								
HEM05	5/30/2017								
HEM01	6/13/2017								
HEM02	6/13/2017								
HEM03	6/13/2017								
HEM04	6/13/2017								
HEM05	6/13/2017								
HEM01	6/30/2017								
HEM02	6/30/2017								
HEM03	6/30/2017								
HEM04	6/30/2017	5.19	17.98	25.72	78.6	6.4	17.26	3.86	1.78
HEM05	6/30/2017								
HEM01	7/11/2017								
HEM02	7/11/2017								
HEM03	7/11/2017								
HEM04	7/11/2017								
HEM05	7/11/2017								
HEM01	7/27/2017								
HEM02	7/27/2017								
HEM03	7/27/2017								
HEM04	7/27/2017								
HEM05	7/27/2017								
HEM01	8/8/2017								
HEM02	8/8/2017								
HEM03	8/8/2017								
HEM04	8/8/2017								
HEM05	8/8/2017								

2017 Dissolved Oxygen Graphs

Station	Date	Sample Depth (m)	Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (%)	digital -Dissolved Oxygen (mg/L)	digital -Chlorophyll-a (ug/L)	Corrected Chlorophyll-a (ug/L)	Turbidity (NTU)
HEM01	8/22/2017								
HEM02	8/22/2017								
HEM03	8/22/2017								
HEM04	8/22/2017								
HEM05	8/22/2017								
HEM01	9/5/2017								
HEM02	9/5/2017								
HEM03	9/5/2017								
HEM04	9/5/2017								
HEM05	9/5/2017								
HEM01	9/21/2017								
HEM02	9/21/2017								
HEM03	9/21/2017								
HEM04	9/21/2017								
HEM05	9/21/2017								
HEM01	10/3/2017								
HEM02	10/3/2017								
HEM03	10/3/2017								
HEM04	10/3/2017	5.47	20.6	23.43	108.7	8.6	31.42	5.75	1.84
HEM05	10/3/2017								
HEM01	10/18/2017								
HEM02	10/18/2017								
HEM03	10/18/2017								
HEM04	10/18/2017								
HEM05	10/18/2017								

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