THE GREAT BAY COAST WATCH

2006 ANNUAL REPORT

June 2007

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Acknowledgements for Support of GBCW's 2006 Annual Report

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Volunteers:
We would like to thank all of the GBCW volunteers for their contributions. This program would not be possible without dedicated and reliable volunteers. A complete list of the 2006 GBCW volunteers is available at the GBCW office located at Kingman Farmhouse, Madbury, NH.

Technical Advisory Committee:
We would like to thank all of the Technical Advisory Committee members for their assistance and sound advice. A complete list of the 2006 Technical Advisors and their credentials is available at the GBCW office located at Kingman Farm House, Madbury, NH.

University of New Hampshire:
Cooperative Extension, NH Sea Grant, NH Estuaries Project (NHEP), Jackson Estuarine Laboratory, Center for Freshwater Biology

Agencies:
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Municipalities:
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Executive Summary

Great Bay Coast Watch dedicates the 2006 annual report to the memory of Barbara Baird and Dr. “Bill” Penhale. In 2006, Great Bay Coast Watch (GBCW) volunteers monitored 20 sites in Great Bay Estuary for water quality parameters, seven of which have been monitored since 1990. Currently, the GBCW is New Hampshire’s most wide-ranging program for direct citizen involvement in monitoring estuarine and coastal waters. Information gathered about estuarine water quality from both professional programs and volunteer programs like GBCW support efforts to protect and preserve estuarine waters as well as wetland habitats, which is a top priority of statewide conservation efforts. Monitoring also engages volunteers in water quality issues that affect their own communities. GBCW has completed 17 years of water quality monitoring!

The 2006 GBCW season began early in February with training for bacteria monitoring in Berry’s Brook, Rye, NH. The GBCW Annual Meeting was held early in March and featured guest speaker Sherry Godlewski who spoke about the new Hodgson Brook Restoration Project in Portsmouth, NH. Water quality and Phytoplankton training followed over the next few weeks. Twenty-two new volunteers joined this year. At the May volunteer meeting, horseshoe crab research scientist Sue Schaller presented findings from her studies of Maine horseshoe crab populations. Several GBCW volunteers collected data for her survey and all GBCW horseshoe crab data was collected during monthly sampling at GBCW sites was included in her survey.

The weather proved to be extreme this year. NOAA reports 2006 as being the warmest year on record, following 2005 as the previous warmest. When NH experienced a Nor’easter in May, all of the GBCW sites were still flooded at the time of sampling. In NH, rainfall levels were the highest since GBCW started monitoring in 1990. GBCW data was 98.7% complete in 2006, which is comparable to other years. As of January 1, 2007, the 2006 GBCW Water Quality Data had been requested and provided to: the 2006 Secchi-Dip-In, World Wide Monitoring Day (WWMD), NHDES - One Stop Menu and reports, NH Fish and Game – Sue Schaller and Clare McBane, NH Public Television, Dr. Stephen Jones of UNH and Natalie Landry, GOMC, and the Town of Newmarket. With a grant from NHDES, GBCW volunteers were trained for the “GBCW Storm Sampling at Berry’s Brook, Rye, NH” project, and then they monitored Berry’s Brook for fecal coliform bacteria during storm events. The GBCW web site re-design grant was started in 2006 year and will be completed in 2007.

GBCW phytoplankton volunteers monitor five coastal sites for harmful algal blooms (HAB’s) weekly from April through October. The goals of the phytoplankton-monitoring program are to act as an early warning system for HAB’s, commonly known as red tides, by identifying the presence of potentially toxic phytoplankton species in coastal waters. In the spring of 2006, shellfish resource managers around the Gulf of Maine were concerned that the record 2005 bloom of the toxic cell *Alexandrium spp.* had set the stage for a similar event in 2006. Instead, during June sampling *Pseudonitzchia spp*. was observed in record numbers.

A specially trained team of laboratory volunteers processes the water samples for the presence of fecal coliform in the evenings of water quality monitoring days. GBCW uses a filtration method to detect fecal coliform colonies in the sample water and GBCW has been investigating the usefulness of this test. Overall, bacteria levels increased this year, though not to previous highs. 24% of GBCW samples were >40 counts/100ml, compared to 20% in 2005. In 2006, GBCW data showed that there were 13 instances of fecal coliform geomean results above the 40 counts/100 mL limit, compared to two in 2005. Appendix A, Site Data, provides all of the water quality data collected in 2006.

Great Bay Coast Watch dedicates the 2006 annual report to the memory of Barbara Baird and Dr. “Bill” Penhale. Both served “the Watch” as water quality monitors, mentors to new members, and leaders of their teams, respectively at: Site 5, Portsmouth Country Club at the fourth fairway, on the shore of the Winnicut River and site 2, UNH Jackson Estuarine Laboratory (JEL), located at Furber Strait, Durham, NH. Barbara and Bill were loyal, long-term, and dedicated members of GBCW since its inception in 1990.

Barbara kept her teammates Sue McCarthy and Don Chamberland on track by keeping the golf cart ready, checking the data sheets very carefully, and making sure the supplies were complete for sampling days. When the call to do a mating horseshoe crab survey went out, Barbara took on the assignment with enthusiasm. She learned how to raise eggs to the swimming stage in her home incubator.

Bill, known to many of us as “Mr. Great Bay,” was a constant student of “What’s Great about Great Bay.” I could count on him to know the latest researcher at JEL, who would give us an informative talk. For his final Bay Lines article, in *Great Bay Matters*, he requested the GBCW bacteria data from the rainy May 2006.

As we monitor the 2007 season, we will miss the energy, enthusiasm, and vitality of Barbara and Bill, but know that their contributions to GBCW will guide visions of the Great Bay’s future and the protection of its hidden treasures.

Ann S. Reid

Dedication

Figure 1 – Barbara Baird at Portsmouth Country Club

Figure 2 – Bill Penhale "Mr. Great Bay" (right)

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Introduction

In 2006, Great Bay Coast Watch (GBCW) volunteers monitored 20 sites in Great Bay Estuary for water quality parameters, seven of which have been monitored since 1990. In 1999, additional monitoring for toxic phytoplankton, or “red tides,” was added at five coastal sites. During that time, GBCW efforts have been supported by funding from UNH Cooperative Extension, NH Sea Grant, yearly grants from the NH Coastal Program (NHCP), periodic grants from the NH Estuaries Project (NHEP), and several other grants. More than 600 volunteers have participated in this program throughout the years. During the 2006 season, approximately 105 volunteers donated over 2,500 hours of service and drove 24,000 miles. Over 700 hours of that time were spent in training or at educational programs.

During the past 17 years, volunteer monitors have driven thousands of miles and have given over 150,000 volunteer hours to monitoring and outreach efforts. They have educated students of all ages, conducted public meetings, and collected valuable water quality and phytoplankton data, which is being used by researchers and government agencies. Some of the data has been used to identify bacteria laden areas, track pH changes in the estuary, and provided early waning signals for harmful algal blooms (HABs). The involvement of area schools has been integral to the program since 1990. As a result of these interactions, GBCW has become an educational outreach team and volunteer data collection resource throughout the NH Seacoast area.

Figure 3 – Quality Assurance/Quality Control (QAQC) at Kingman Farm House
From Left to Right: Ron Morales, Sherri Townsend, Nikolas Townsend, Dick Ferarro, and Barbara Winter

A. The Great Bay Coast Watch Mission

Great Bay Coast Watch

Currently, the GBCW is New Hampshire's most wide-ranging program for direct citizen involvement in monitoring estuarine and coastal waters. An extension specialist, Mark Wiley, and coordinator, Ann Reid, from UNH Cooperative Extension/NH Sea Grant, manage GBCW. Volunteers include adults from all occupations, as well as students and teachers from local schools and parents and students from home schooled families.

The Great Bay Coast Watch is citizen volunteers, working within the UNH Cooperative Extension/Sea Grant Program, protecting the long-term health and natural resources of New Hampshire's coastal waters and estuarine systems through monitoring and education projects.

Figure 4 – Great Bay Coast Watch Mission Statement

GBCW was formed as Great Bay Watch in 1990, with funding from National Oceanic and Atmospheric Administration (NOAA), in response to the Great Bay National Estuarine Research Reserve Management Plan. This plan listed the formation of a citizen estuarine monitoring program as one of its objectives. GBCW has been a part of the educational efforts of UNH Cooperative Extension/NH Sea Grant for the past 17 years. In 1999, "Coast" was added to the organization's name to reflect more accurately the growing involvement of our volunteers in coastal shoreline surveys and phytoplankton monitoring projects. The number of monitors has tripled and the number of sites sampled has more than doubled since 1990.

The GBCW mission gives it three specific goals:

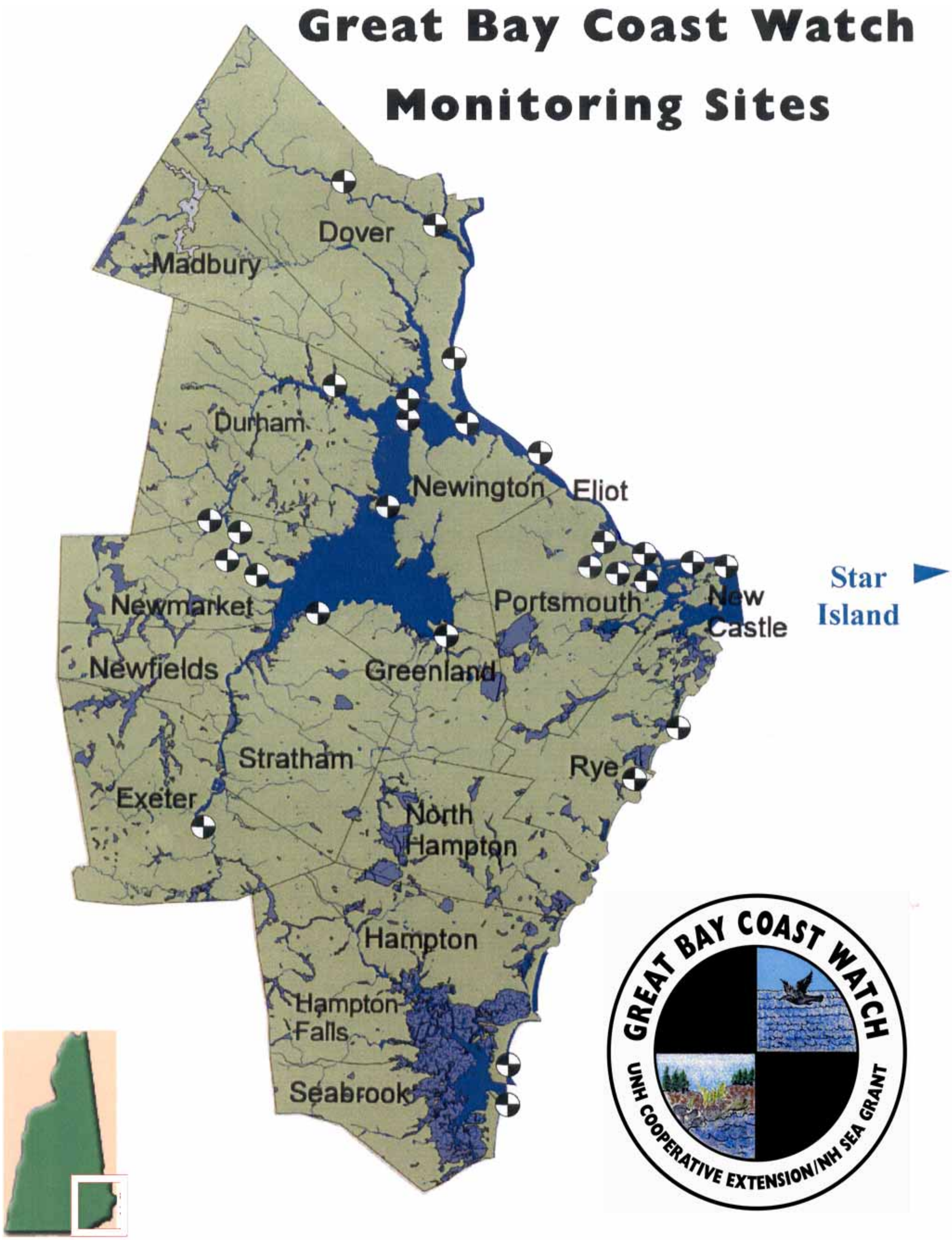
1. To monitor the chemical, physical, and biological systems of the New Hampshire coastal waters and the Great Bay Estuarine System,

2. To educate residents of New Hampshire's coastal and estuarine communities about the ecological status and protection of these seacoast systems, and

3. To develop a management structure that engages volunteers in all aspects of the GBCW and continuously improves the quality of the monitoring and education projects.

The Great Bay Estuary

Figure 5 – NH State Map with GBCW Monitoring Area Map



The Importance of Estuarine Ecosystems

The waters of Great Bay and Little Bay and all the connecting rivers estuarine waters. An estuary is an area where freshwater mixes with seawater. Most estuaries are shallow tidal embayments and contain many types of wetlands, including salt marshes, sea-grass meadows, shellfish reefs, and tidal flats, that play an important role in filtering the waters of the estuary, serve as nursery areas for saltwater fish, provide wildlife habitat, and protect adjacent uplands from flooding. Environmental degradation of the estuary and the lands that surround it will impair wetland functions and lead to a decline in water quality. Information gathered about estuarine water quality from both professional programs and volunteer programs like GBCW support efforts to protect and preserve estuarine waters as well as wetland habitats, which is a top priority of statewide conservation efforts.

Table 1 – Great Bay Coast Watch Sites

Site Name	Site #	Location	Town	1st Yr	Comments
Water Quality Sites					
Peninsula	1	Oyster River	Durham	1990	
Jackson Estuarine Laboratory (JEL)	2	Great Bay	Durham	1990	
Lamprey River	3	Lamprey River	Newmarket	1990	
Depot Road	4	Great Bay	Greenland/Stratham	1990	Hiqh tide only as of 1993
Portsmouth Country Club (PCC)	5	Winnicut River	Greenland/Stratham	1990	
Fox Point	6	Little Bay	Newinqton	1990	
Cedar Point	7	Little Bay	Durham	1990	
Rakoskes'	8	Piscataqua River	Dover	1990	Inactive as of 1992
Neal's/Scott's	9	Cochecho River	Dover	1990	
Clark's/Peterson's	10	Piscataqua River	Dover	1991	
Coastal Marine Lab	11	Piscataqua River	New Castle	1991	
Newmarket Sewage Treatment Plant (STP)	12	Lamprey River	Newmarket	1992	Inactive as of 2006
Marina Falls Landing	13	Lamprey River	Newmarket	1992	
Fowler's Dock	14	Lamprey River	Newmarket	1992	
Patten Yacht Yard	15	Piscataqua River	Eliot, ME	1993	
Exeter Docks	16	Squamscott River	Exeter	1994	
Dover Foot-Bridge	17	Cochecho River	Dover	1996	
Maplewood Ave.	18	North Mill Pond	Portsmouth	199	
Bartlett Ave.	19	North Mill Pond	Portsmouth	1997	
Junkins Ave.	20	South Mill Pond	Portsmouth	1997	
Pleasant Ave.	21	South Mill Pond	Portsmouth	1997	
Little Harbor	22	Little Harbor	Portsmouth	1998	High tide only
Phytoplankton Sites					
Hilton Park	09HP	Piscataqua River	Dover	1999	Inactive as of 2004
Coastal Marine Lab	09CML	Piscataqua River	New Castle	2000	
Star Island	09S1	Isles of Shoals	Rye	2000	
Parsons Creek	09PC	Parsons Creek	Rye	2000	
Rye Harbor	09RH	Rye Harbor	Rye	1999	
Hampton	09H	Hampton Harbor	Hampton	1999	
Seabrook	09S	Seabrook Harbor	Seabrook	1999	
Sea Coast Science Center	09SSC	Witch Creek	Rye	2003	Intermitently Monitored

The New Hampshire Seacoast is one of the fastest growing areas in New England. Towns in the Great Bay watershed have increased their population markedly every year for the past 30 years. Habitat destruction and pollution due to residential and commercial development strain the ecosystem and lower its ability to rebound from such impacts. The water supply and sewage treatment facilities that serve these surrounding communities are also experiencing an increase in use from the building of many homes along the rivers and bays. Although many of the wastewater treatment facilities periodically upgrade their systems to accommodate increased development, the water quality and path of flow into the estuary is increasingly altered.

The Great Bay Estuarine System is considered one of the most pristine regions by the U.S. Environmental Protection Agency (EPA). Only through improvements in water management, water quality assessments, and conservation efforts on the part of everyone, will the estuary uphold that status. GBCW strives to educate and involve citizens with conservation efforts aimed toward the whole Great Bay Estuarine System and the neighboring Hampton/Seabrook Estuary.

Why Monitoring is Important

Monitoring programs have been implemented in order to follow trends in the condition and health of the Great Bay Estuarine System. Information provided by GBCW volunteers can detect problems before they become critical and damage estuarine resources. Monitoring can also be used to assess the benefits to water quality from management actions and precautionary measures to protect the resource. Monitoring also engages volunteers in water quality issues that affect their own communities.

Monitoring usually consists of repetitive measurements or observations of a system recorded over a period of time. Past scientific studies have shown that long-term monitoring can be very important in acquiring an ecological blueprint of a system because:

- Complex ecological systems require long-term observation and study for understanding.
- A sequence of only two to three years of data can be very misleading about the direction of trends in environmental quality.
- Environments have a "memory" or response time that varies greatly. It may take a decade for lake waters and a century for ground waters and soils to reflect change.

It is for these reasons that the GBCW program is especially important. With a dataset of information collected by volunteers over the past 17 years, a more accurate picture of the environmental state of the NH coastal and estuarine systems is available to communities, educators, scientists, environmental managers, and students.

The NHDES used GBCW dissolved oxygen and pH data in the 2006 305(b) Surface Water Quality Assessment and compiled it with other sources to create the Aquatic Life Use Support assessments. Each year GBCW data is uploaded onto the NHDES “OneStop Menu” web site at http://www.des.state.nh.us/OneStop.htm, where anyone can download the data to their email account. Data collected for the Berry’s Brook project in Rye, NH (See page 24 for details.) will be used to help identify the bacterial contamination issues in that area.

Agencies and Organizations Engaging with Great Bay Coast Watch in 2006

Many other agencies and organizations work with GBCW throughout the year. Some share education resources, some share volunteer efforts, and others ask GBCW for assistance with specific projects. There are so many cross connections made between multiple groups that not all of them can be listed here. Below are some of the groups with which GBCW works closely.

- Advocates of the North Mill Pond – shares data, volunteers, and environmental improvement goals*.
- Cochecho River Watershed Coalition – shares data, volunteers, and environmental improvement goals*.
- Dover Open Land Committee – works with GBCW to further environmental goals and has helped Dover and GBCW to work jointly on grants in the past.
- Great Bay Resource Protection Partnership – shares information about what other environmental groups are doing in the area.
- Great Bay Stewards – Helps with the summer barbecue, shares volunteers, and environmental improvement goals*. The GBCW coordinator is also a member of the board of trustees.
- Gulf of Maine Council (GOMC) – *Supporting GBCW Volunteer Training and Program Management Through Web Site Design* grant.
- Gulf of Maine Marine Education Association (GOMMEA) – a network of marine educators who share ideas and information. The GBCW coordinator is also a member of the board of directors and assisted with planning the National Marine Educators Association (NMEA) Conference 2007 in Portland, ME.
- Gundalow Company – shares education resources and volunteers.
- NHDES – *06-07 NHCP Water Quality and Phytoplankton* grant to support basic program.
- NHDES – *GBCW Storm Sampling at Berry's Brook, Rye, NH* grant for GBCW to assist in the characterization of bacteria sources in Berry's Brook.
- Schools – Marshwood High School, New Franklin Elementary School, Newmarket High School, Oyster River High School, Little Harbour School and UNH.
- The United Way Volunteer Action Center – helps unite potential new volunteers with GBCW, offers office equipment donations, has training courses for volunteers and staff, assists with fundraising and planning activities.

*Environmental Improvement Goals are specific to each organization.

B. The Year in Review

Water Quality

The 2006 GBCW season began early with equipment calibration and training in February for a challenging new project at Berry's Brook, Rye, NH. The GBCW Annual Meeting was held early in March and featured guest speaker Sherry Godlewski who spoke about the new Hodgson Brook Restoration Project in Portsmouth, NH. Water quality and phytoplankton training followed over the next few weeks. The bi-annual Quality Control and Quality Assurance (QAQC) testing was completed in April before the first monitoring day on April 27. Twenty-two new volunteers joined this year. At the May volunteer meeting, horseshoe crab research scientist Sue Schaller presented findings from her studies of Maine horseshoe crab populations. She then asked GBCW volunteers to assist in collecting data for a survey during horseshoe crab mating season. Several GBCW volunteers collected data for the survey and all GBCW horseshoe crab data collected during monthly sampling at GBCW sites was included in the survey. In addition, Clare McBane used GBCW horseshoe crab data for the NH Fish and Game report.

Figure 6 – Flood Photos

Newmarket near Site 13

Newmarket Site 3

Dover Foot Bridge Site 17

Piscataqua River at Dover Point Site 10

The weather proved to be extreme this year. NOAA reports 2006 as being the warmest year on record, following 2005 as the previous warmest. In addition, rainfall extremes within three months made the water levels surge! First, we had the driest March on record in Durham with only 1.14 inches of rain versus a normal of 2.89 inches. Then a Nor'easter arrived in May, flooding all of southern NH about one week before the water quality monitoring day. All of the GBCW sites were still flooded at the time of sampling. "The Northeast region had a record wettest summer exceeding the previous record by more than 1 inch..."1 In NH, rainfall levels were the highest since GBCW started monitoring in 1990. Estuarine systems can be better understood because of the useful data collected by GBCW and other volunteer monitoring groups. The rainfall graphs below show details for each month and total rainfall amounts since 1990 (figures 7 and 8 respectively).

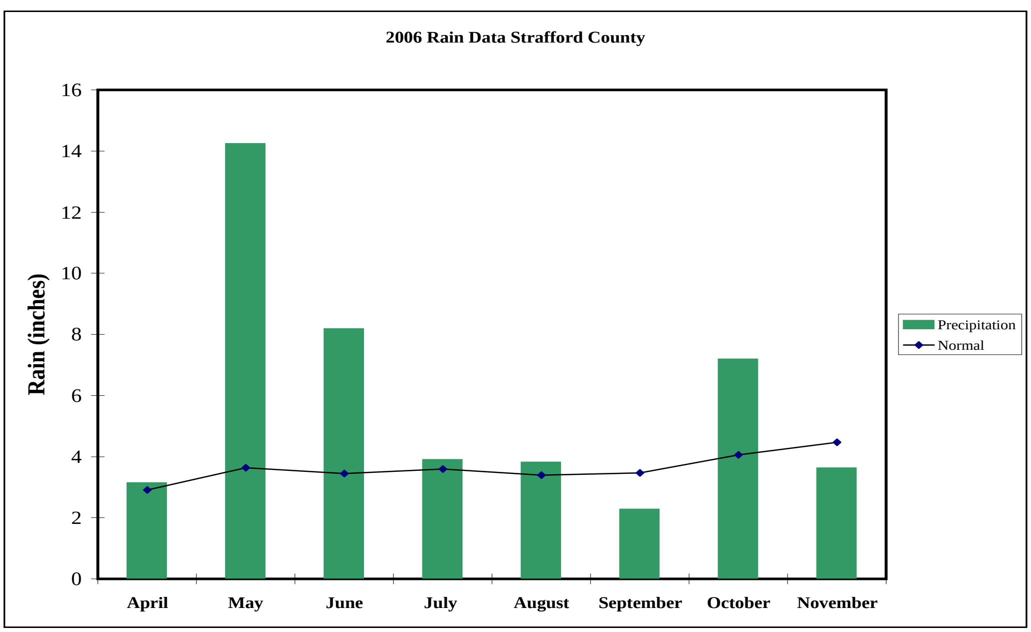
Rainfall affects water quality results by introducing fresh water, agitating the water column and sometimes brings in contaminants. This can reduce transparency and salinity while increasing dissolved oxygen (DO). Bacteria levels are affected by rainfall, however no direct correlations have been observed in the GBCW data collected thus far (according to a data comparison study done in 2004 using all previous GBCW data). This may be due to low rainfall amounts prior to or during GBCW monitoring events. However, data collected during the 2006 GBCW Berry's Brook project in Rye showed in that study location a rainfall of 0.5 inches was enough to generate storm runoff, which introduced significant amounts of bacteria into Berry's Brook. Though this amount can change significantly according to drainage conditions, it is a helpful benchmark

Rainfall "Normal"

The amount of rainfall is important to water quality monitoring because it can have such a large impact on water quality results. In an estuarine system, it has a great influence on how salty the water is, and therefore influences all aquatic life in the system. To compare rainfall from one period of time to the next, scientists use an average called the "normal." It indicates how much rainfall is expected in that period. GBCW uses a yearly "normal" for its comparisons.

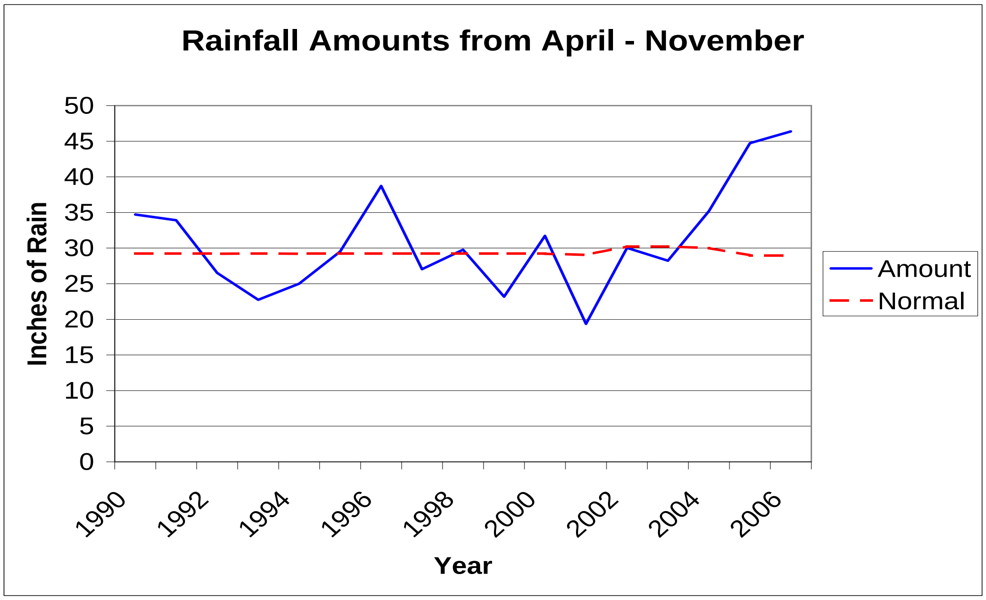
To calculate the "normal" rainfall, the National Weather Service Averages the total rainfall in a selected region over 30 years. They update this number every 10 years. Some weather stations may update this number more often, so different resources can have different results.

Figure 7 – Monthly Rainfall



[1] http://www.ncdc.noaa.gov/oa/climate/research/2006/ann/us-summary.html

Figure 8 – Total Rainfall Summary



to consider. Our water quality monitoring data shows that in the 24 hours before monitoring, this condition was only met in November 2006. This may indicate that a majority of bacteria found in our water samples were introduced by general flood conditions and other mechanisms. Overall, bacteria levels increased this year, though not to previous highs. See the *Fecal Coliform Report* (see page 35) section for more details.

Overall, the data was 98.7% complete in 2006, which is comparable to other years. Program funding levels decreased in 2006 and in response, the number of sites being sampled by GBCW volunteers were reduced. Site 12 was eliminated due to safety concerns and sites 15 and 22 were reduced in the number of times they were monitored. The eliminated sites were not included in the completeness calculation. Most sites were monitored in May just after the flood; however, many depth and transparency readings are missing due to extra deep water from the flooding. It is interesting to note that most sites with water too deep to measure were also reported as having exceptionally clear water, and the bottom was visible.

The graphs in Section C. Water Quality Data Summary (see page 29) provide a quick overview of average parameter results. Appendix A, Site Data, provides all of the water quality data collected in 2006. A complete dataset is available upon request, or can be queried at the NHDES "One Stop Menu" under "Environmental Monitoring Data." The link address for this site is http://www.des.state.nh.us/OneStop.htm. If you have any questions about how to retrieve data from this site, please contact the NHDES.

Area leaders in 2006 were Tom Crosby, Nate Hazen, Clif Horrigan (with help from Muffie Hendricks), and Lydia Scott. These volunteers help organize and offer support to the other GBCW volunteer site monitors, while monitoring their own sites as well. They often participate in many other extra activities, too. Area leaders Nate Hazen and Tom Crosby continued to help Barbara Trow and Ann Reid obtain QAQC replicate samples in the field, and provided volunteers assistance where needed.

As of January 1, 2007, the 2006 GBCW Water Quality Data had been requested and provided to: the 2006 Secchi-Dip-In, World Wide Monitoring Day (WWMD), NHDES - One Stop Menu and reports, NH Fish and Game – Sue Schaller and Clare McBane, NH Public Television, Dr. Stephen Jones of UNH and Natalie Landry, GOMC, and the Town of Newmarket. This is not a complete list, since anyone can obtain

GBCW's data from the NHDES One Stop Menu without identifying themselves and reason for using the data. More requests are expected after this report is released, and requests for past data are frequent.

Phytoplankton

GBCW phytoplankton volunteers monitor five coastal sites for harmful algal blooms (HABs) weekly from April through October. The goals of the phytoplankton monitoring program are to act as an early warning system for HABs, commonly known as red tides, by identifying the presence of potentially toxic phytoplankton species in coastal waters before shellfish meats become toxic. Shellfish are filter feeders and, when ingesting toxic phytoplankton, will concentrate the toxins in their bodies. When these now toxic shellfish are consumed by humans, illness or even death may result. Since toxins are specific to certain species of cells, the collected information can give shellfish managers an indication of which toxin may be present. Decisions regarding the opening or closing of shellfish beds are made by NHDES personnel after testing harvested shellfish meats for accumulated toxins.

Figure 9 – Phytoplankton Training in Maine

Volunteers (Top) Lisa Wolfe, Pete Richardson, Linda Coe, Tony Bower, Dave Bellantone, and (Bottom) Phytoplankton Coordinator Candace Dolan

In the spring of 2006, shellfish resource managers around the Gulf of Maine were concerned that the record 2005 bloom of the toxic cell *Alexandrium spp.* had set the stage for a similar event in 2006. Cells of *Alexandrium spp*. form cysts at the end of their life cycle that then settle into bottom sediments until conditions are right for growing again. It was unknown just what, if any, effect the 2005 event would have on the numbers of potentially toxic cells during the upcoming sampling season.

As in previous years, GBCW phytoplankton monitors joined volunteers from Maine at the Darling Marine Center in Walpole, ME, on April 7th and 8th for spring training. These joint trainings allow both NH and

Maine volunteers to hone their skills by working with cultured live samples of the toxic species they will be looking for during the sampling season. It also provides a forum for the exchange of ideas, techniques, and materials between the programs and scientists who attend and support the volunteer efforts. One presenter at the 2006 training was a scientist from the Woods Hole Oceanographic Institution (WHOI) who requested assistance from both the Maine and NH programs with collecting live samples of the species *Pseudonitzchia spp*. for a study project. Volunteers were asked to report the presence of *Pseudonitzchia spp.* when found in their samples, and then collect and ship concentrated samples of the live cells to WHOI for culturing and subsequent testing for toxicity. During June sampling, *Pseudonitzchia spp.* was observed in record numbers by the GBCW volunteer phytoplankton monitors, the information was forwarded to WHOI and one live sample was collected and delivered for culture.

The dramatic increase in the scope of toxic red tide events in the Gulf of Maine over the past few years prompted a one-day Symposium hosted by the Massachusetts Institute of Technology / Sea Grant Program on April 18, 2006. The purpose of this meeting was to bring together the scientific, regulatory, and fishing communities to share lessons learned from the 2005 bloom and prepare for the 2006 shell-fishing season. Since the 2005 bloom was so widespread, presenters were invited from New Brunswick, Maine, New Hampshire, and Massachusetts. The symposium was open to the public and attended by two GBCW volunteers and the program coordinator.

One of the products of the meeting that had an immediate impact on both the NH and Maine volunteer monitoring programs was the Harmful Algal Bloom "List Serve." It is an enhanced communication network developed to provide early warnings, which is maintained by research and monitoring participants around the Gulf of Maine. The list serve has become a valuable information and educational resource that is contributed to and shared with GBCW phytoplankton monitors. Having access to timely information on observations around the Gulf of Maine during a red tide event reinforced and clarified the role of volunteer monitoring data. For instance, in the middle of June 2006 the previously abundant assemblage of cells in our samples suddenly vanished. Reports from offshore sampling conducted by WHOI indicated that a large number of both *Pseudonitzchia spp.* and *Alexandrium spp.* cells existed offshore. However, samples collected by WHOI in boat transects immediately off the NH coast reflected our volunteer observations. This difference can be explained by the weather patterns. Winds from the southwest or west tend to move surface waters offshore, and that water is replaced along the coast by deep water in a process called upwelling. Deep upwelling water typically does not have many phytoplankton cells in it; because it is generally too dark and too cold. Having access to the WHOI data clarified the situation immediately and reinforced the volunteer's confidence in their field observations.

LISTSERV

Is "an automatic mailing list server developed by Eric Thomas for BITNET in 1986. When e-mail is addressed to a LISTSERV mailing list, it is automatically broadcast to everyone on the list. The result is similar to a newsgroup or forum, except that the messages are transmitted as e-mail and are therefore available only to individuals on the list.

LISTSERV is currently a commercial product marketed by L-Soft International. Although LISTSERV refers to a specific mailing list server, the term is sometimes used incorrectly to refer to any mailing list server. Another popular mailing list server is Majordomo, which is freeware."
http://www.webopedia.com/TERM/L/Listserv.html

Although we knew from the communications that the *Alexandrium spp*. bloom of 2006 was hovering offshore, we did not see any in our samples until May 4 when the northeast winds delivered a small patch inshore. May 6 reports from the Rye group reported a moderate abundance in their samples. Only shellfish testing could confirm that the cells were present in high enough numbers to cause shellfish harvesting closures. When toxin levels measure above 80 ug/100g shellfish tissue, shellfish harvesting activities are suspended to protect public health. By May 9, blue mussel sampling results for toxins from Star Island/Isles of Shoals samples were in the 200s, closing offshore harvesting, and Hampton/Seabrook was rising but still below 50 ug/100g.

Figure 10 – Photo of a HAB toxic cell *Alexandrium spp.*

On May 12, live counts reported by WHOI on the HAB list serve indicated that there was a significant population of *Alexandrium spp.* still in offshore waters being contained by the prevailing winds. Coincidentally, the detection of this bloom occurred nearly to the day of last year's record bloom. On June10, high numbers of *Alexandrium spp.* were reported offshore and again found in the Hampton Harbor samples collected by GBCW monitors. The toxin levels in the mussels from Star Island responded to the presence of these cells and moved back up to 101 ug/100g from 54 the week before. Within two days, and after reports of continuing high cell counts offshore, there was a major shellfish harvesting closure in all of southern Maine with scores of over 1000 ug/100g in mussels and over 400 in clams. (Mussels filter more water, thus will concentrate toxins more quickly than clams.)

The following week, June 28 offshore scores at Star Island, Isles of Shoals, continued to climb coming back in the 500 – 600 range. Inshore mussels from Hampton/Seabrook continued to show only low levels of toxicity at this time. Mussels collected on June 28 from Star Island began to show decreased levels of toxins down to 300. By July 1, the effects of the 2006 bloom were winding down in NH but were not over in southern New England yet. Areas near the coast within southern Mass Bay and Cape Cod Bay were clear of cells, based on the surface live counts. However, abundant populations were found at a northern boundary – well offshore from Cape Ann. These populations were beginning to undergo a change from asexual division (their active bloom behavior) to cyst formation (indicating a dormant state).

Several observations can be made from the 2006 spring bloom season experiences. The effects of weather events cannot be underestimated; the 2005 NE storms htat delivered record numbers of toxic cells inshore were countered this year by wind conditions that held an equally large bloom offshore for much of the time. On occasion, cell counts at GBCW inshore stations remained low even though just a few miles offshore a large bloom

PSU

Using hydrometers,GBCW measures salinity using temperature and density to determine how much salt is in the water and report results in parts per thousand (ppt). Salinity meters measure practical salinity units (psu) by measuring the temperature and conductivity of the water. For the mathematical definition of psu, see http://www.toptotop.org/climate/psu.php.

The normal salinity range for ocean water is 32 – 37 ppt, averaging at 35 ppt. In contrast, we can see salinity measurements from 37 ppt to as low as 0 ppt, since we monitor the coastline and inside the estuary up into rivers.

waited. Although *Alexandrium spp.* is the cell that traditionally causes the greatest concerns in coastal Gulf of Maine waters, for the first time since this volunteer monitoring program began *Pseudonitzchia spp.* [a cell which under certain circumstances can produce a toxin implicated in amnesiac shellfish poisoning (ASP)] was observed in record numbers at all GBCW phytoplankton sampling sites.

One of the most interesting observations is that significant amounts of low-salinity water [29-30 salinity (or Practical Salinity Units - psu)] were still in the region and located well offshore. Surface salinities in July barely reached 31 psu at the outermost stations. This is likely a reflection of the record rainfall for the combined May and June period in the southern Gulf of Maine watersheds and the upwelling-favorable conditions that shifted the *Alexandrium spp.* population and the low salinity water further offshore and away from the near shore shellfish.

One of the continuing benefits of the phytoplankton monitoring program is the outreach opportunities it provides. In April, a representative from the Provincetown Center for Marine Studies came to NH to be trained in monitoring techniques. In May, students from Northern Essex Community Technical College spent a day in the field in Newburyport and back in the college laboratory conducting water quality tests and identifying cells with the assistance of the GBCW coordinator. Over 160 6th grade students attending the Portsmouth Middle School also had the opportunity to learn about phytoplankton through lectures and using field microscopes. Opening a monitoring station at the Seacoast Science Center (SSC) has provided a venue to engage visitors in learning more about red tides. Additionally, as part of volunteer monitoring training, the SSC held a Phytoplankton Sampling/Red Tide Information Night on Thursday, May 25. During this event, the GBCW phytoplankton coordinator gave a presentation about red tides including information about the 2005 and 2006 harmful algal bloom (HAB's) events and the research taking place around the Gulf of Maine and explained how phytoplankton monitoring can be used in conjunction with SSC visitor programs.

All during the 2006 monitoring season and activities, the new phytoplankton identification key was used and distributed. See the "New Hampshire Marine Phytoplankton Monitoring Program" manual for the key sheet. It is now used by all the volunteer groups around the Gulf of Maine and is available in booklet form through the NH Sea Grant office.

Figure 11 – Berry's Brook Training

From Left: Nate Hazen, Lyn Beattie, Candace Dolan, Natalie Landry, Karen Diamond, Renae Broderick

Ribotyping

Ribotyping is a way for biologists to compare genetic material (DNA). In this project, GBCW volunteers collected samples and sent them to JEL. Any samples found to have fecal coliform bacteria present were allowed to grow the bacteria. When enough bacteria colonies were grown, specific parts of the DNA were extracted and compared to known sources. The known sources of DNA were collected in the local area and entered into a database to ensure that comparisons were accurate. This is called ribotyping and sometimes referred to as "genetic fingerprinting." For a scientific definition go to http://ift.confex.com/ift/2004/techprogram/paper_21404.htm or http://en.wikipedia.org/wiki/Ribotyping

GBCW Storm Sampling at Berry's Brook, Rye, NH

A new project at Berry's Brook in Rye, NH, was conducted in partnership with the NHDES and JEL, entitled *GBCW Storm Sampling at Berry's Brook, Rye, NH*. GBCW worked closely with NHDES to write the *Sampling and Analysis Plan for the Microbial Source Tracking Project with GBCW* (SAP). This document provided all of the information the organizations needed to complete the sampling project. Standard operating procedures (SOPs) were then written by GBCW to supply the volunteers with clear directions on how the sampling was to be completed.

GBCW volunteers were trained for the project, and then they monitored Berry's Brook for fecal coliform bacteria during storm events. The samples were then transported to Dr. Stephen Jones, Associate Professor and Assistant Director for NHSG Research, at JEL to be processed and ribotyped. Those who attended the 2006 "Chili and Chowdah Fest" on November 15th enjoyed a PowerPoint® presentation with preliminary results of this study by Natalie Landry, NHDES-Coastal Watershed Supervisor, and Dr. Jones. The report for this project will be published soon and will be available through the NHDES.

As part of this grant, some volunteers were able to continue to support the NHDES shellfish program by collecting and bagging mussels for transport to the PSP monitoring station located at Star Island, Isles of Shoals. After two weeks of filtering the muscles at Star Island, volunteers returned to collect the mussel bags and delivered them to the NH Department of Health and Human Services laboratory in Concord, NH for testing.

GBCW Web Site Design

GBCW received a grant from the Gulf of Maine Council to update and maintain its web site. GBCW needs some UNH server space and people with the proper skills to reach its final goal of having an up-to-date, informative, and interactive web site. To that end, Karen Diamond, assistant to the Great Bay Coast Watch water quality monitoring program, has completed the Dreamweaver® course I, II and III. Volunteer Lyn Rodger has also taken the Dreamweaver® III course. Meetings with a group of volunteers have been held to review what changes will be made to the web site and several example designs have been tested. Future meetings are planed and when the re-design is completed, it will be posted at the current web site address.

Figure12 – Under Construction!

Events and Activities in 2006

Awards and recognition are always a part of the "Chili and Chowdah Fest." This year three awards were given along with 52 QAQC Certifications and seven Laboratory QAQC Certifications. Several people were recognized for volunteering either over 100 hours or driving over 1000 miles. Clif Horrigan won the Long Hours Award for volunteering the most hours; Laura Parsons won the Long Distance Award for driving the most miles; and Pam Samson won the Late Night Award for spending the most hours in the lab. Pam also took over the laboratory leader position while Karen was out on maternity leave. GBCW would like to give a special thank you to these very dedicated volunteers.

Table 2 – Events and Activities in 2006

Event	Date	Topic	# of Attendees
Equipment Calibration and Secchi Disk Rehab	February 14-15, 17, 20, 22	Calibrate and Fix Equipment, Refill Kits	8
Training for Microbial Source Tracking in Berry's Brook, Rye	February 1	Volunteer Training	9
GBCW Annual Meeting	March 16	Hodgson Brook Restoration Plan and Findings, by Sherry Godlewski	33
Water Quality and Phytoplankton Refresher Course	March 29	Review and update of the Kits, Manuals and Monitoring	16
Water Quality and Phytoplankton Training Part I	March 29	Introduction to the Kits, Manuals and Monitoring	18
Water Quality Training and Refresher Course Part II	March 23	Field Training and Practice in Water Quality Monitoring Techniques	8
QAQC	April 4 - 6	QAQC Training and Testing	49
Kit Pick-Up	April 4 - 6	Volunteers check and pick-up their Monitoring Kits	20
Phytoplankton Training	April 7 - 8	Darling Marine Center, Walpole, ME	6
Phytoplankton Training and Refresher Course	April 13	Review the kits, and Manuals, complete Phytoplankton Monitoring Techniques	13
Student Volunteer Service Day	April 21	Berwick Academy, Coastal Cleanup at Hilton Park	19
Educational Meeting	May 16	National Water Quality Monitoring, by Ann S. Reid, and Horseshoe Crab Studies, by Sue Schaller	12
Annual GBCW BBQ	August 2	GBCW Visioning Session I, Seacoast Science Center	32
Equipment Calibration	August 8	Calibrate and Fix Equipment	8

Event	Date	Topic	# of Attendees
QAQC	August 10	QAQC training and Testing	15
GBCW Visioning Session II	September 15	Planning GBCW's Future, NHDES PEASE Tradeport	13
Newmarket Heritage Festival	September 16	Display	~100
WSBE Training	October 18	Train UNH Service Learning Students	4
GBCW Visioning Session III	October 12	Planning GBCW's Future, NHDES PEASE Tradeport	??
State of the Estuaries Conference	October 27	Display	>100
Chili & Chowdah Fest	November 16	Berry's Brook Results, by Natalie Landry and Steve Jones	24
Kit Inventory	November 21	Kits Inspected and Broken Down	4
Web Site Design	December 11	Outline Creation	5
Web Site Design	December 27	Test Example Pages	5

C. Water Quality Data Summary

Table 3 – Composite Site Data

Parameter	Units	Low Tide	High tide
Water Temperature	Degrees Celsius	15.1	15.9
Salinity	ppt	11.9	15.0
Dissolved Oxygen	ppm	8.7	9.0
Saturated Oxygen	%	90.8	98.6
pH	pH Units	7.3	7.4
Fecal Coliform	Counts per 100 ml	31.4	16.9
Transparency	Centimeters	82	140
Depth	Centimeters	154	284
Air Temperature	Degrees Celsius	16	19

The values for composite site data are based on averaging values of all the sites for each site parameter. For the parameter fecal coliform, the value is a simple average of all the geomeans from each site.

Site Observations

Site comments from volunteers showed their enjoyment of the Great Bay Estuary. Here we try to report events, which may have an effect on the water quality data. All of the sites were affected by the May flood this year, and some observations noted changes in plant and animal populations. Cord grass came in and receded at sites 5 and 4 due to flood conditions. A number of docks were lost or needed repair after the floods; this was noted at sites 1, 3, and 13. Since GBCW monitoring happened one week after the May flood, water transparency increased. The floodwaters had not yet receded, but the sediment had mostly settled out.

Figure 13 – Water Quality Monitoring Site 1

Oyster River High School Student with Teacher Laura Parsons

A mix of fish, horseshoe crabs, and other aquatic organisms were reported as common at sites 6, 7, 14, 18, and 22. Birds were noted in particular at sites 6 and 14. Bacteria levels did not necessarily increase at these sites from the bird populations. Site 7 notes that the water got unusually clear at the end of the season. Volunteers at site 21 have noted that the gate has been open during monitoring all season, which is a change from years past, and improves the tidal flushing. Sites 16 and 17 are public areas creating educational opportunities for people who stop to ask questions. Informational packets with signs that educate and encourage questions or comments would be helpful to volunteers.

Possible contamination observations include an observed oil slick at site 15 in November and site 19, which started the season with clear water and became "smelly and brown" over the course of the summer. These observations continue after 2005, when some repairs to broken pipes were made. Portsmouth has been notified about these observations and other data at this site. Portsmouth officials are continuing to investigate the area with data collected by the Hodgson Brook Restoration Project and GBCW.

More horseshoe crabs were observed this year than in 2005 (when sightings took an unusual dip) and were back to 2004 levels. In 2004, they were reported at sites 2, 4, 6, and 7 (Jackson Estuarine Laboratory, Durham, Depot Road, Greenland, Fox Point, Newington, and Cedar Point, Durham, respectively). In 2006, sites 2, 4, and 6 reported many, while site 7 reported only one. Sue Schaller is researching the reasons for this, and so far it looks like they prefer nice warm sunny days. Just like local human beach goers! She will report her research project findings to GBCW volunteers.

Figure 14 – Water Quality Training Site 17

John Crandall (in background) Pete Richardson (standing) and Dale Goodwin (sitting) at training session at Site 17, Dover Foot Bridge, Dover, NH

2006 Mean Value Graphs

Figure 15 –

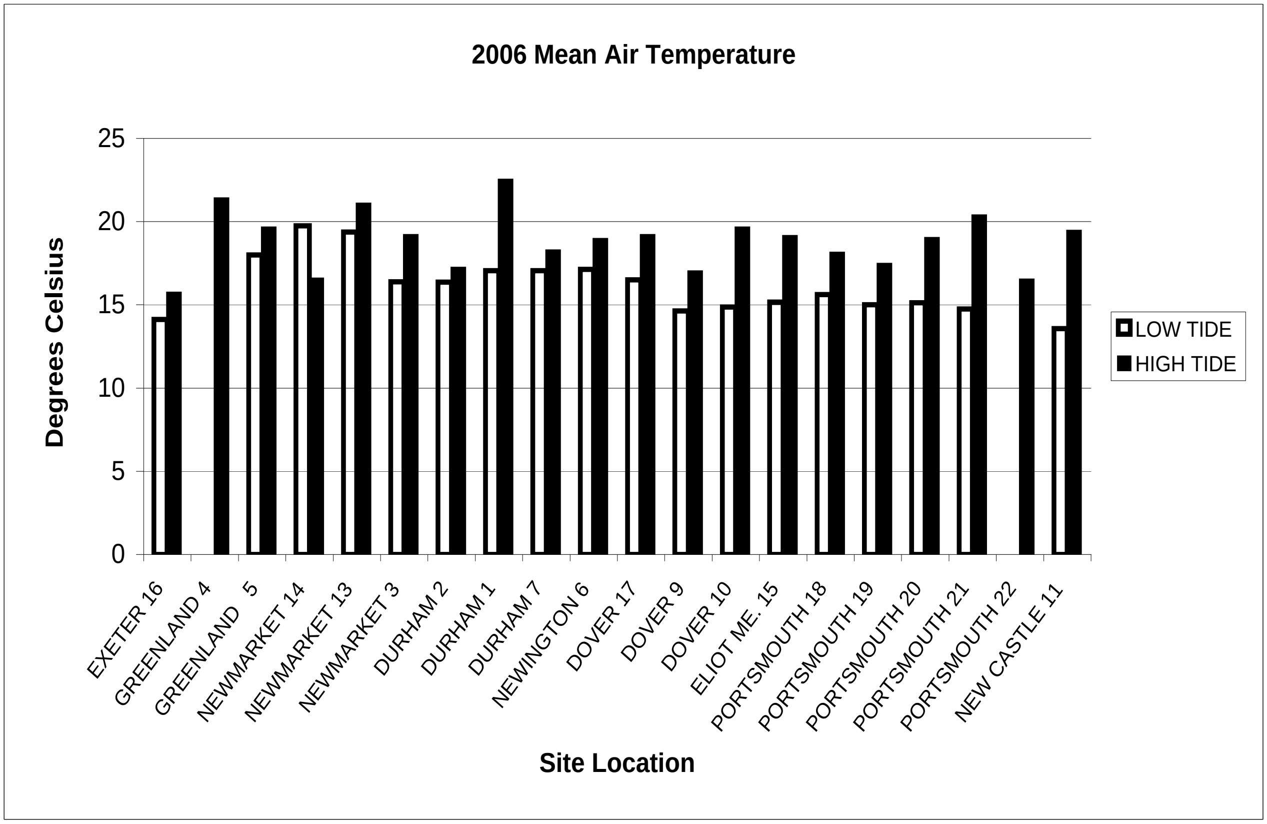


Figure 16 –

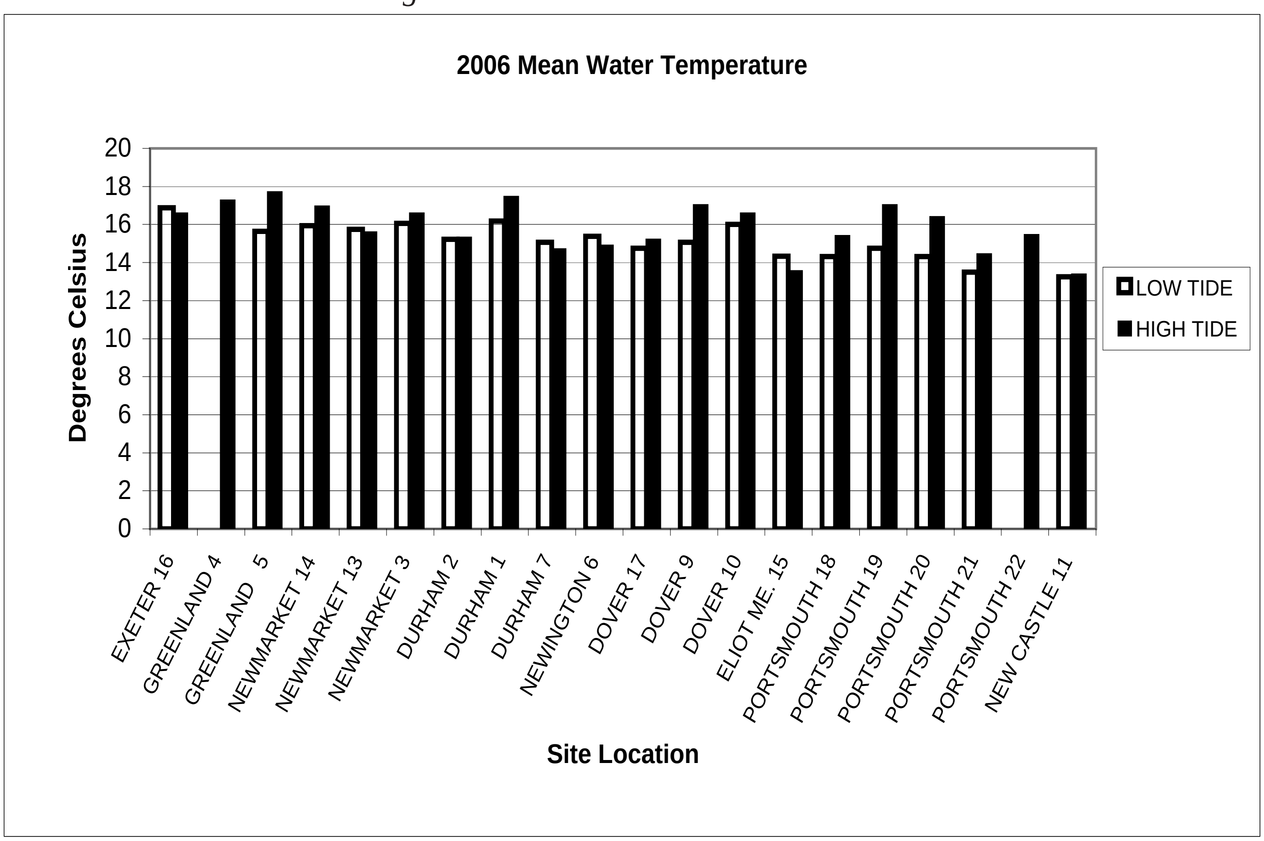


Figure 17 –

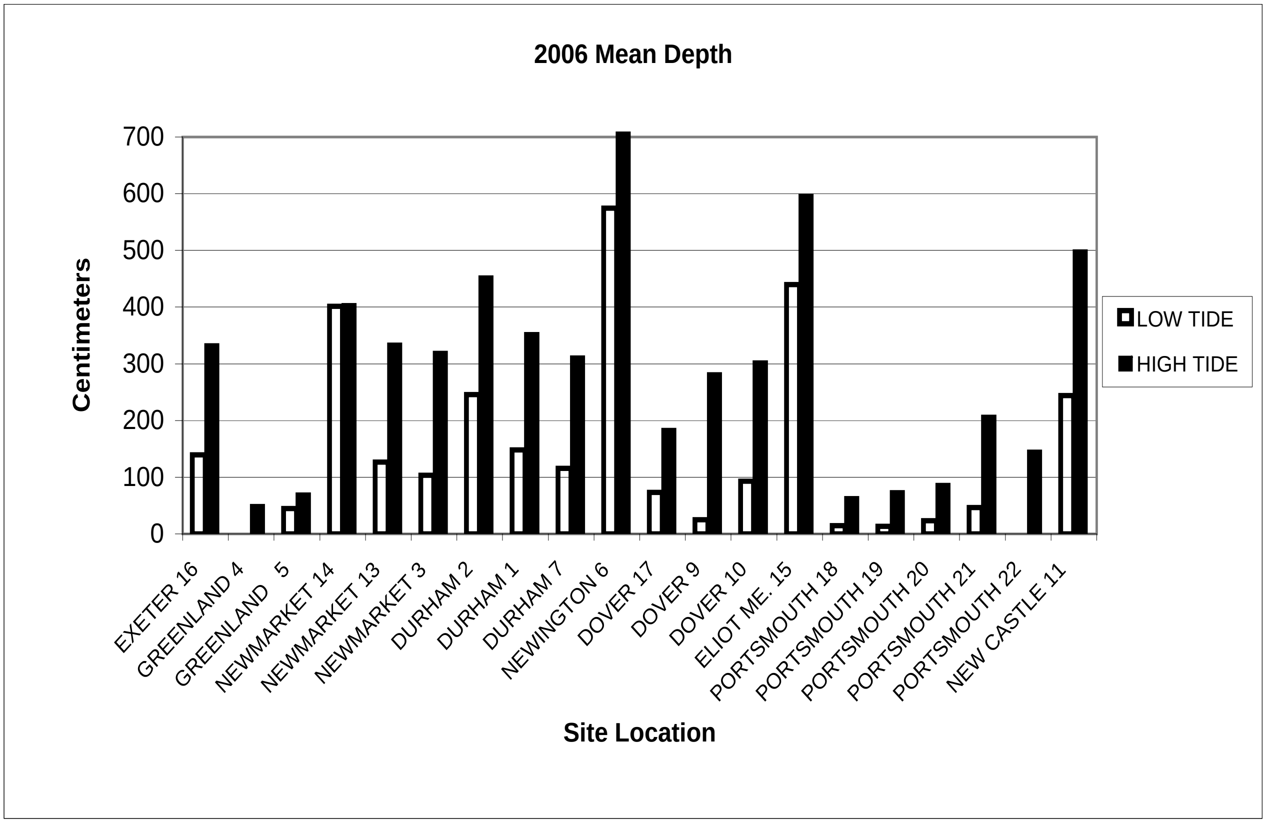


Figure 18 –

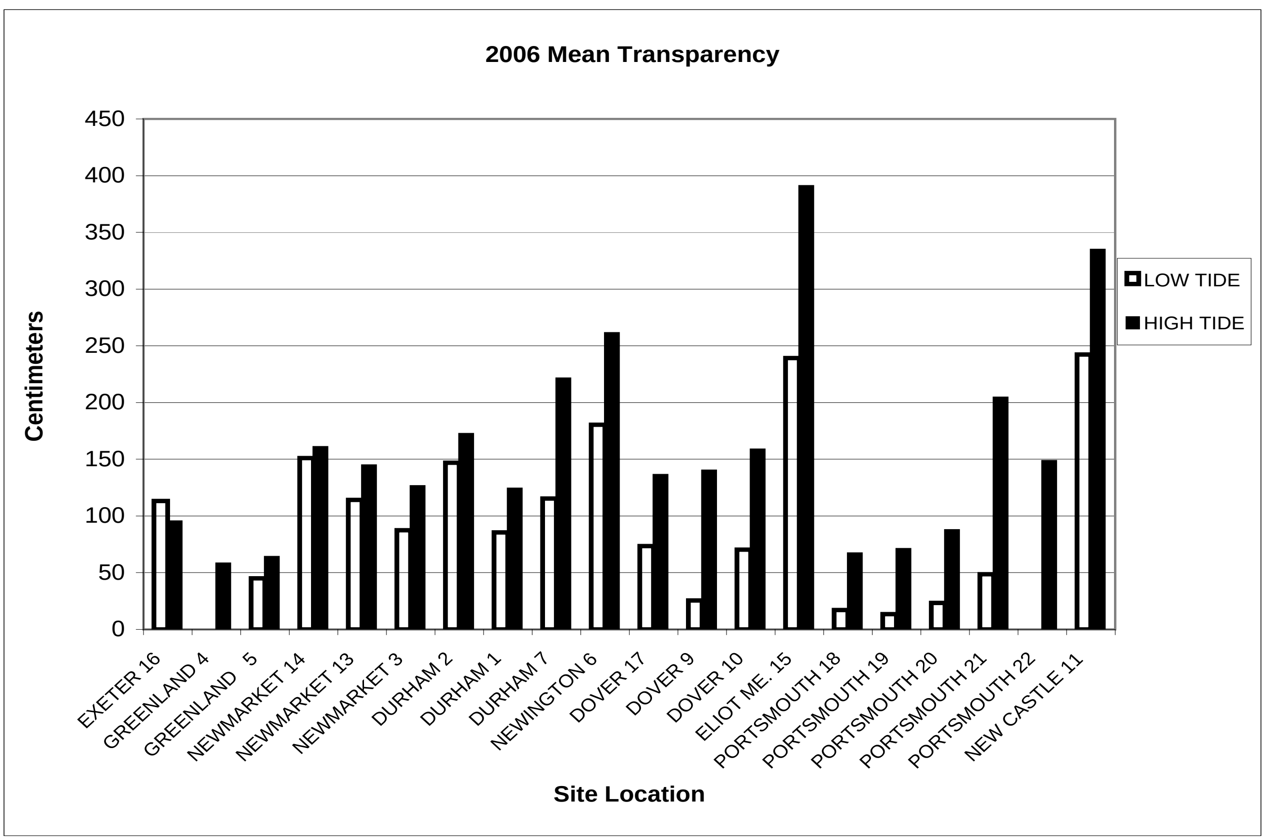


Figure 19 –

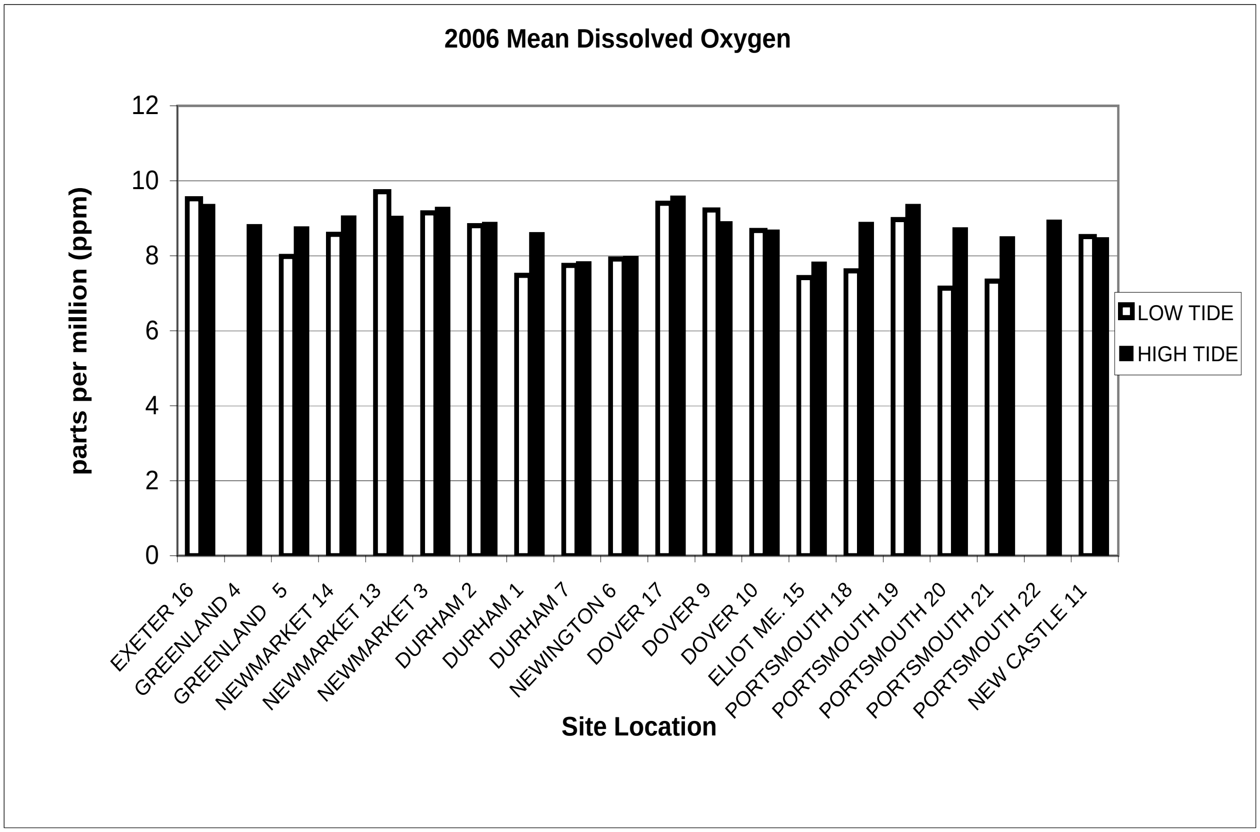


Figure 20 –

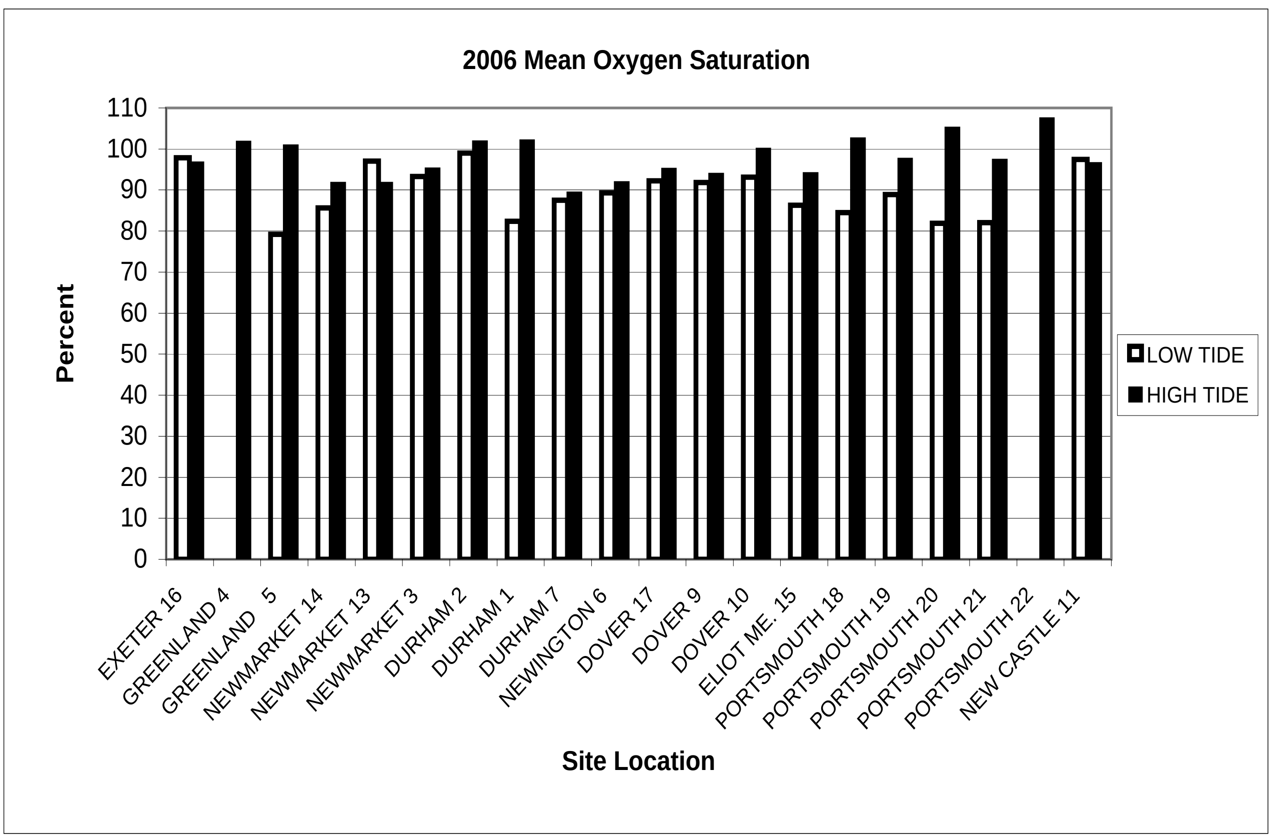


Figure 21 –

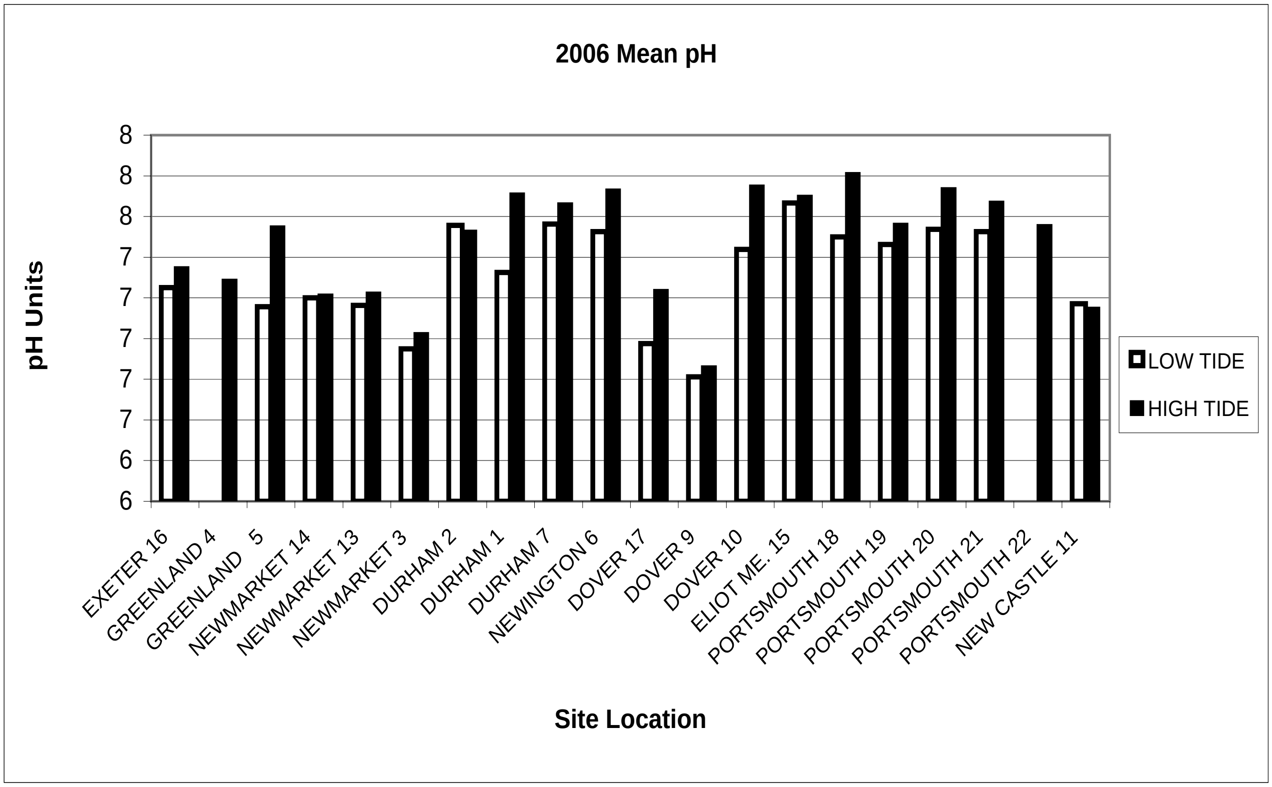


Figure 22 –

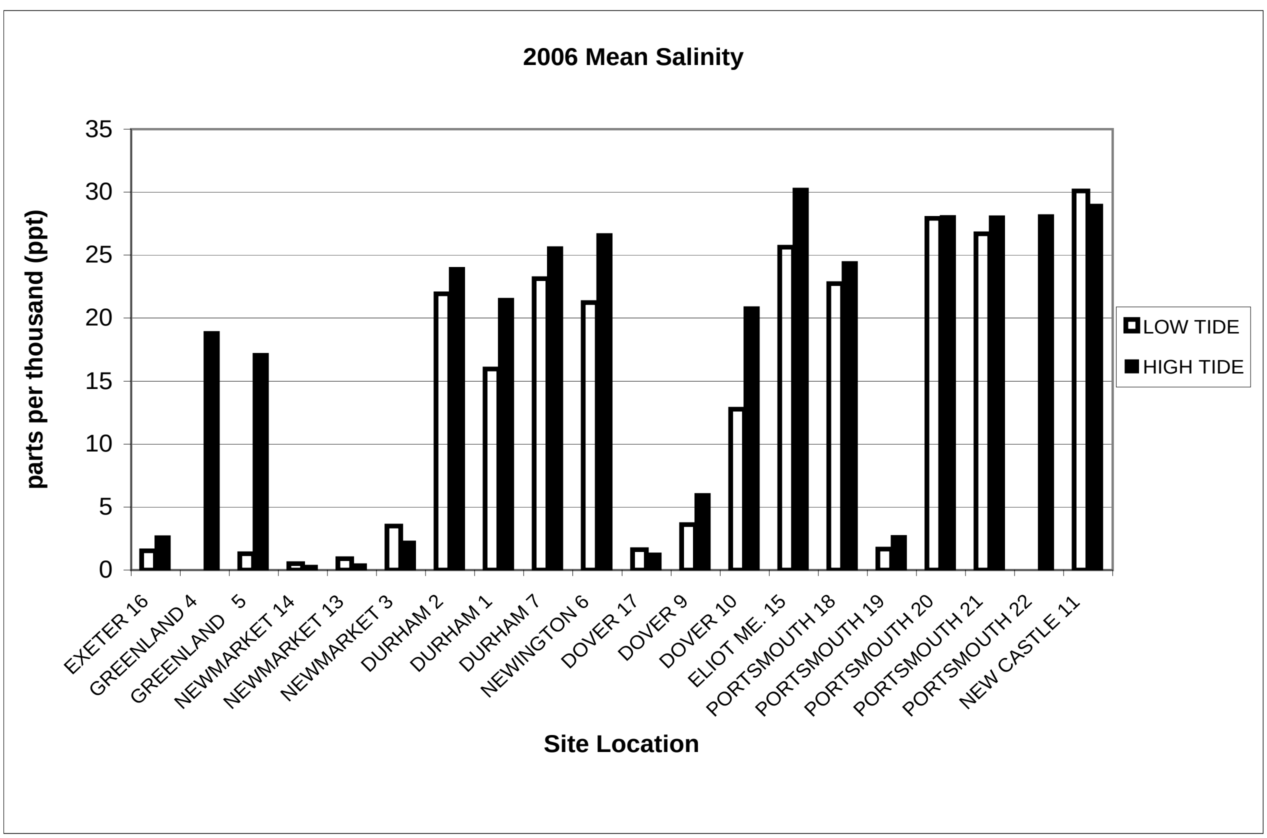
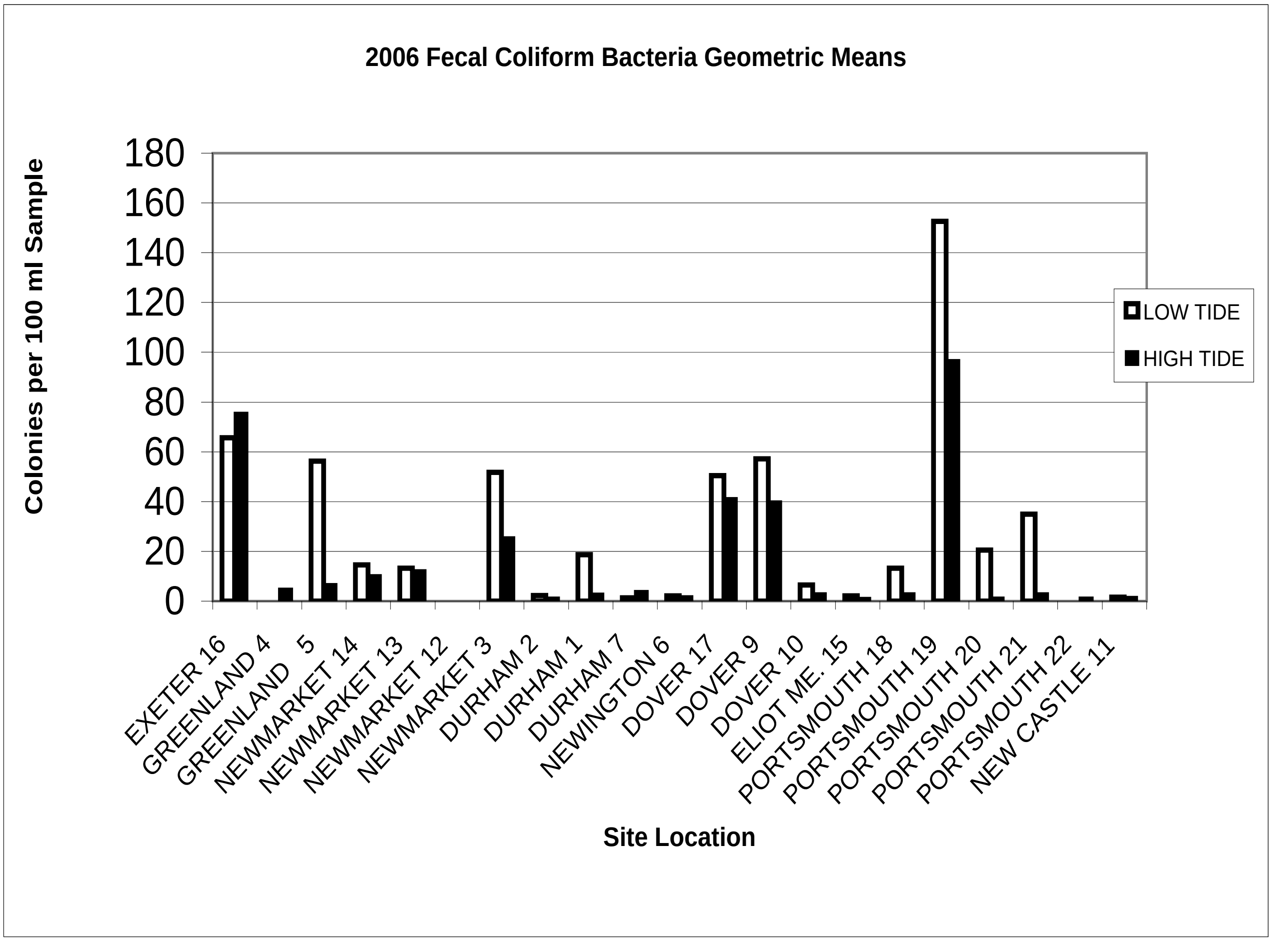


Figure 23 –



Fecal Coliform Report

A specially trained team of laboratory volunteers processes the water samples for the presence of fecal coliform in the evenings of water quality monitoring days. This task requires mental sharpness and endurance. Pam Samson was trained to lead the team while Karen was out on maternity leave. GBCW would like to thank the laboratory team whose members have worked late into the night to process these samples.

The presence of fecal coliform in water is an indication that animal waste is present. The EPA uses the presence of total coliform and *Enterococci coli* (*E. coli*) bacteria as indicators of fecal contamination in fresh water. As a reference for safe bacterial counts, the NHDES closes NH seacoast beaches when *E. coli* bacteria amounts are above a count of 104 counts/100 mL. Shellfish is considered safe for consumption when fecal coliform bacterial levels are below 40 counts/100 mL. These standards are what we will use to look at water quality in relation to bacteria levels.

GBCW uses a filtration method to detect fecal coliform colonies in the sample water. This method was chosen by the EPA as the best method for measuring fecal coliform bacteria at the time GBCW started. Since then, many other methods have been tried by researchers, and GBCW has asked the question “Should we change and use a cheaper method?” Our question was answered in *The Volunteer Monitor, Volume 18, Number 1 Winter 2006*. It seems that GBCW is not the only volunteer organization asking this question, and this entire issue was focused on answering it. The conclusion was that while other methods can detect the presence of bacteria, they are less reliable and in some cases more difficult to use. Copies of *The Volunteer Monitor* are available at GBCW, Kingman Farm.

According to the NHEP 2006 State of the Estuaries Report[2], "The bacteria concentrations in Great Bay have decreased by 73% over the past 16 years, but the trend has slowed recently." This year, 24% of GBCW samples were >40 counts/100ml, compared to 20% in 2005. The months with the greatest number of results over the limit were June and September. June results are likely high from May flooding, and September highs are unexplained by GBCW data. Further research will be needed to explain these results. Low tide increases in bacteria were observed at 13 sites, and only four large decreases were observed. High tide results were interesting. While all of the sites with commonly low bacteria levels increased across the board, seven of the sites with normally high bacteria levels decreased.

In 2006, there were 13 instances of fecal coliform geomean results above the 40 counts/100 mL limit, compared to two in 2005. We use a geometric mean instead of an average since the data is expected to be relative to water flow (go to http://en.wikipedia.org/wiki/Geometric_mean for the mathematical explanation and calculation). It better reflects the tendency of the system than a straight average. Again, flooding is the most likely cause for unusual changes in 2006. See the following geometric mean graphs for a comparison of bacteria levels from the beginning of GBCW monitoring through to 2006.

[2] NHEP *2006 State of the Estuaries Report*, by NHEP, University Of New Hampshire, Hewitt Annex, 54 College Road, Durham, NH 03824-2601, WWW.NHEP.UNH.EDU.

Fecal Coliform Monitoring

Why do we do it?

Coliform bacteria are found in all warm-blooded animals, not just humans. So, why monitor fecal coliform if it comes from other animals too? Answer: It is safe to work with and if there are large amounts of it, there is a good chance that unsafe bacteria are present as well.

There are many types of bacteria; coliform bacteria include hundreds of species. Some species grow better in fresh water, while others grow better in salt water. For fresh water monitoring, the EPA uses total coliform (many coliform species) and *E. coli* as an indicator species. Fecal coliform (a group of coliform species) grows better in marine environments, so that is what we use for estuarine samples, where the water can be either fresh or salty.

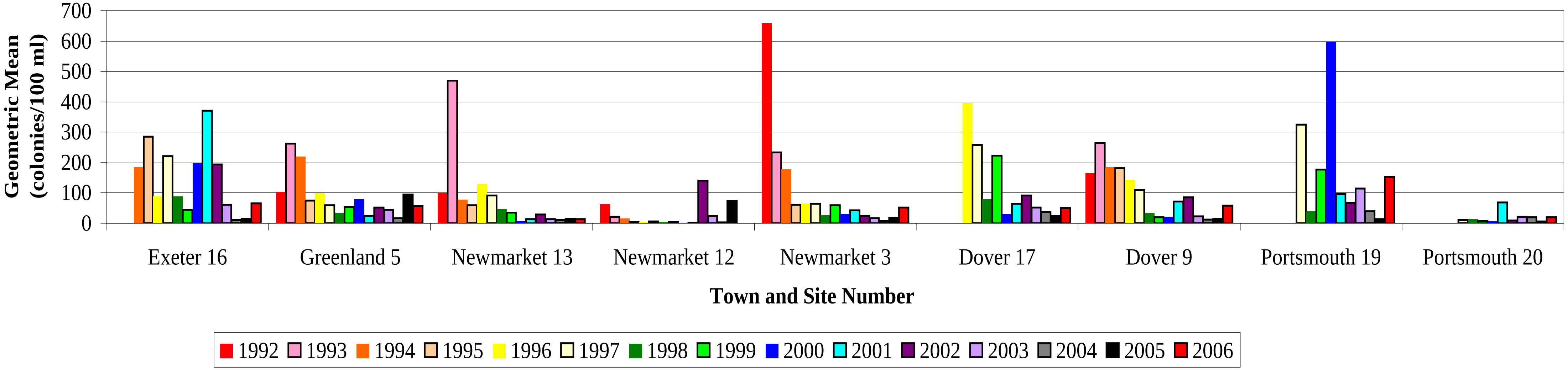
High levels of fecal coliform bacteria make shellfish unsafe to consume and can make it unsafe to swim at beaches. Regular monitoring helps keep everyone safe by closing shellfish beds and beaches when these risks are identified. The bad news is that it takes 24 hours to get a result from the current monitoring process, when people may have already been exposed to dangerous organisms. The good news is that researchers and scientists are working on developing faster methods of measuring bacterial contamination. Explore these web sites to learn more:
http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=243471
http://bcn.boulder.co.us/basin/data/BACT/info/FColi.html

Figure 24 – Processing water samples for the presence of Fecal Coliform

Laboratory Team Volunteers Heather Hochulie and Kathy Watson

Figure 25 –

Yearly Low Tide Sites with Higher Fecal Coliform Geometric Means



Yearly Low Tide Sites with Lower Fecal Coliform Geometric Means

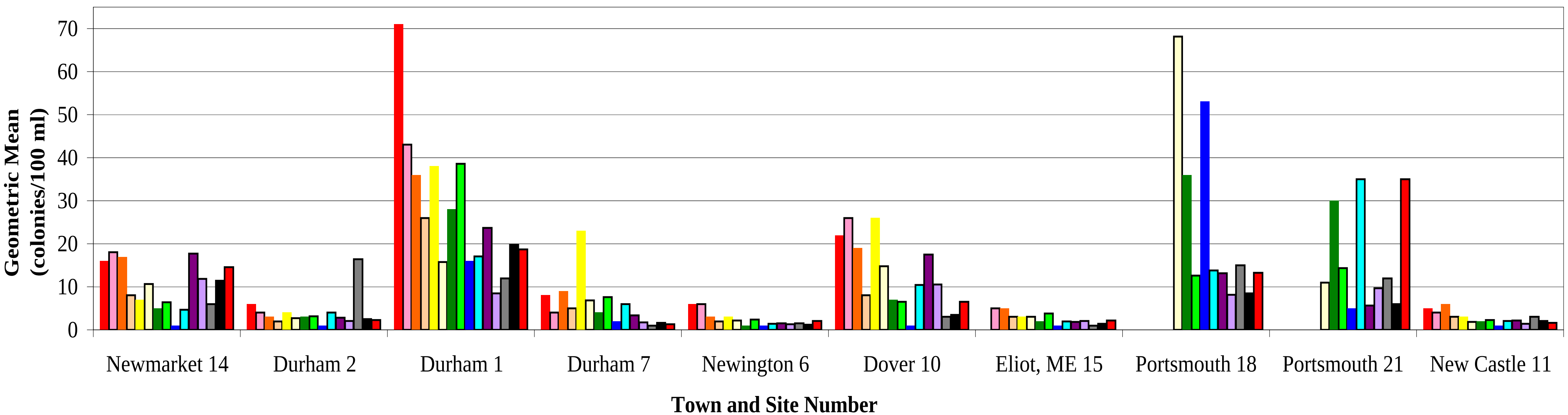
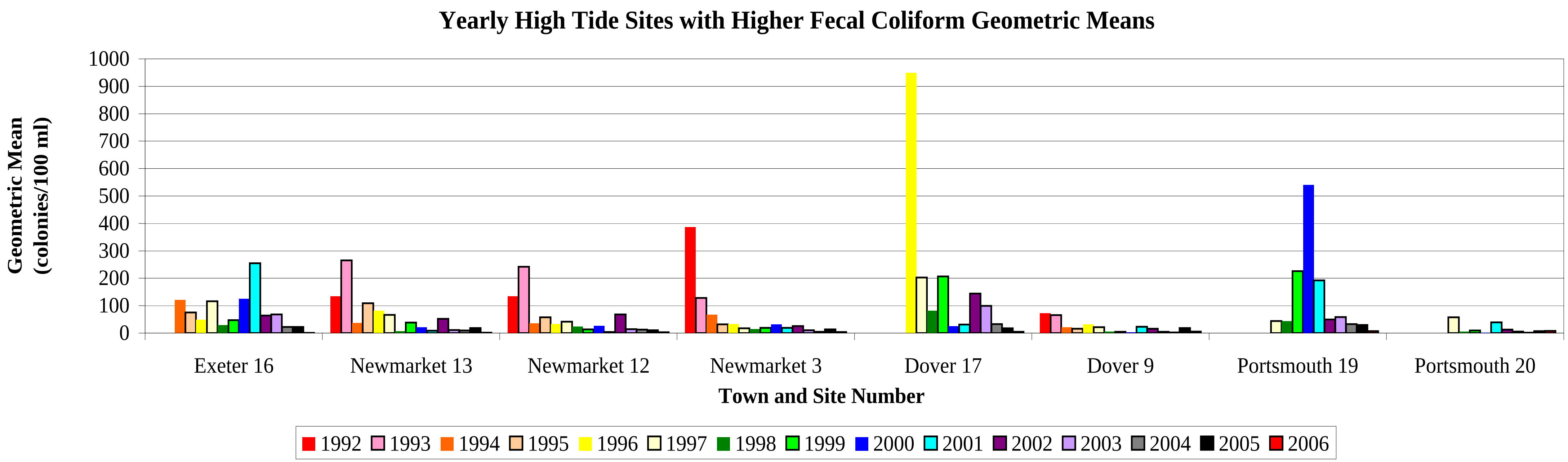
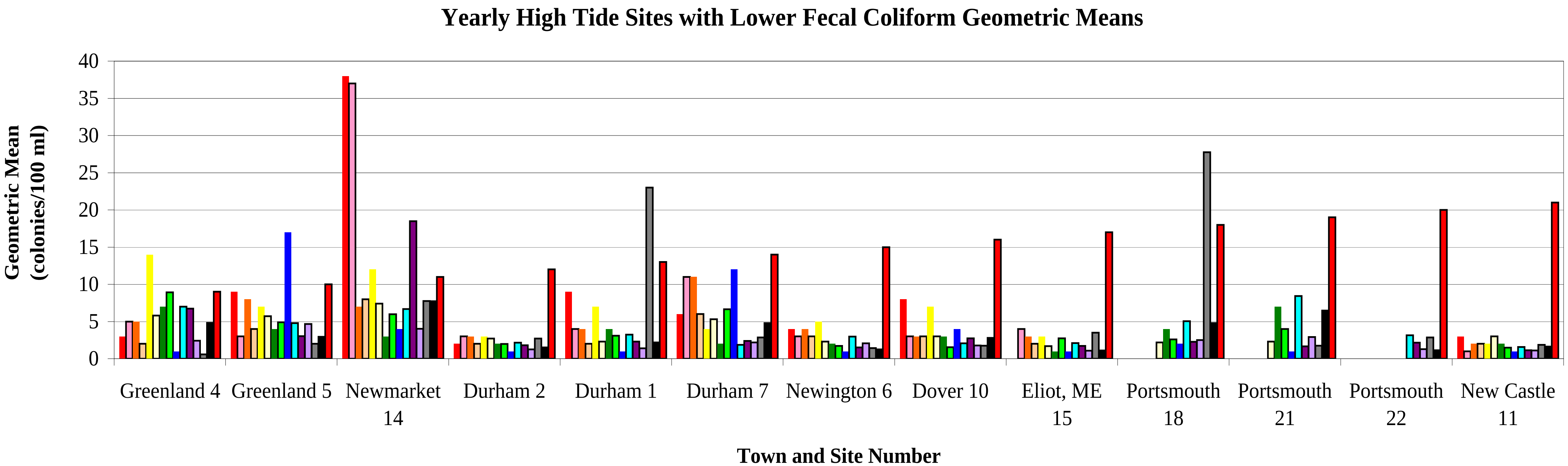


Figure 26 –



Yearly High Tide Sites with Higher Fecal Coliform Geometric Means
Geometric Mean (colonies/100 ml)
1000
900
800
700
600
500
400
300
200
100
0
Exeter 16
Newmarket 13
Newmarket 12
Newmarket 3
Dover 17
Dover 9
Portsmouth 19
Portsmouth 20
Town and Site Number
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006



Yearly High Tide Sites with Lower Fecal Coliform Geometric Means
Geometric Mean (colonies/100 ml)
40
35
30
25
20
15
10
5
0
Greenland 4
Greenland 5
Newmarket 14
Durham 2
Durham 1
Durham 7
Newington 6
Dover 10
Eliot, ME 15
Portsmouth 18
Portsmouth 21
Portsmouth 22
New Castle 11
Town and Site Number

D. GBCW Milestones

Horseshoe Crabs

Figure 27 – Horseshoe Crabs

photo by Sue Schaller

A horseshoe crab may have saved your life! Researchers are very interested in the changes in horseshoe crab populations because they perform a very important role in medicine.
http://www.horseshoecrab.org/med/med.html
"An extract of the horseshoe crab's blood is used by the pharmaceutical and medical device industries to ensure that their products, e.g., intravenous drugs, vaccines, and medical devices, are free of bacterial contamination. No other test works as easily or reliably for this purpose."

Accomplishments

GBCW has completed 17 years of water quality monitoring! This is an important milestone for GBCW and a credit to our dedicated and long serving volunteers. Due to GBCW's stringent QAQC policies, our data is increasingly accepted for research and by government agencies. Educational opportunities are also an important part of the GBCW program, as can be seen in the Table of Events and Activities (see Page #26-27). GBCW sites are now included in the Gulf of Maine Council (GOMC) *ESIP Monitoring Map* of key monitoring efforts in the Gulf of Maine. Explore the map at http://www.gulfofmaine.org/maps/htdocs/

GBCW data is used each year by a variety of researchers, teachers, students, and others. This year the NHDES used GBCW data for dissolved oxygen and pH for the 2006 - 305(b) Surface Water Quality Assessment, and GBCW data was combined with other data to help create the Aquatic Life Use Support assessments. The NH Fish and Game Department (NHFGD) continued to use GBCW – horseshoe crab data and requested our salinity data to develop maps for the Piscataqua River. Sue Schaller, UNH graduate student, collected horseshoe crab data from GBCW monitoring and from GBCW volunteers (monitoring extra sites for horseshoe crabs) to include in "Horseshoe Crab Habitat in the Gulf of Maine." See http://www.fws.gov/r5gomp/gom/habitatstudy/metadata/hscrab83.htm for more information. A CICEET study of eutrophication in the Great Bay Estuary used our data to help model "Assessment of Estuarine Trophic Status" (or ASSETS). Phil Vaun, at NH Public Television, reported on changes due to the May flooding and requested GBCW data to help identify them. The town of Newmarket is creating an open space plan and is including GBCW sites as current water quality monitoring areas.

Future Plans

Although many basic office expenses are covered by UNH Cooperative Extension and NH Sea Grant, it takes many additional resources to keep GBCW in business. As funds from grants are declining, and more groups are competing for similar funds, the 2006 Annual BBQ was redesigned as a “Visioning for the Future” session. Due to severe thunderstorms, the venue for the BBQ was changed to indoors at Seacoast Science Center with BBQ from the Muddy River Smokehouse. Thirty-five attendees ate well and decided how we could start the plan for GBCW’s future. Using open space technology, Deb Maes, from UNH Cooperative Extension, introduced the discussion of GBCW’s plans. After two more meetings of the visioning committee, the team concluded that the best way to proceed was to create an advisory committee. The GBCW advisory committee was formed and began meeting in December.

Recycle First

GBCW participates in the *Recycle First* program, which allows us to raise money by recycling our printer ink cartridges. The more we recycle the more money we raise. We have placed a box in the Kingman Farm classroom to accept ink cartridges from anyone who wishes to bring them in. Please use one clear bag for each cartridge when placing ink cartridges in the box. Bags are provided in the pocket on the front of the box.

For those who prefer to mail them in from home, we have pre-labeled, postage paid bags available next to the box in the classroom. The pre-labeled bags are green and have a bar code on them that ensures our account will be credited for each one you send in. This program costs us nothing, and helps the environment while helping you. If anyone wishes to place boxes or bags in other areas, please inform us and we will obtain extras for you.

E. Appendix

Tidal and Sampling Times for 2006 Season

Site		Tidal Adjustment	27-Apr	30-May	27-Jun	25-Jul	24-Aug	25-Sep	24-Oct	8-Nov
	LOW		5:07	8:05	7:02	6:01	6:15	7:13	6:39	6:30
	HIGH		11:22	14:24	13:18	12:15	12:25	13:24	12:51	12:39
Site 1	LOW	1:34	**6:41**	**9:39**	**8:36**	**7:35**	**7:49**	**8:47**	**8:13**	**8:04**
Peninsula - Oyster River	HIGH	1:29	**12:51**	**15:53**	**14:47**	**13:44**	**13:54**	**14:53**	**14:20**	**14:08**
Site 2	LOW	1:44	**6:51**	**9:49**	**8:46**	**7:45**	**7:59**	**8:57**	**8:23**	**8:14**
Jackson Laboratory	HIGH	1:44	**13:06**	**16:08**	**15:02**	**13:59**	**14:09**	**15:08**	**14:35**	**14:23**
Site 3	LOW	2:44	**7:51**	**10:49**	**9:46**	**8:45**	**8:59**	**9:57**	**9:23**	**9:14**
Lamprey River	HIGH	2:24	**13:46**	**16:48**	**15:42**	**14:39**	**14:49**	**15:48**	**15:15**	**15:03**
Site 4	LOW	2:29	**7:36**	**10:34**	**9:31**	**8:30**	**8:44**	**9:42**	**9:08**	**8:59**
Depot Road (Sandy Pt)	HIGH	2:29	**13:51**	**16:53**	**15:47**	**14:44**	**14:54**	**15:53**	**15:20**	**15:08**
Site 5	LOW	2:24	**7:31**	**10:29**	**9:26**	**8:25**	**8:39**	**9:37**	**9:03**	**8:54**
Portsmouth Country Club	HIGH	2:03	**13:25**	**16:27**	**15:21**	**14:18**	**14:28**	**15:27**	**14:54**	**14:42**
Site 6	LOW	1:44	**6:51**	**9:49**	**8:46**	**7:45**	**7:59**	**8:57**	**8:23**	**8:14**
Fox Point	HIGH	1:44	**13:06**	**16:08**	**15:02**	**13:59**	**14:09**	**15:08**	**14:35**	**14:23**
Site 7	LOW	1:34	**6:41**	**9:39**	**8:36**	**7:35**	**7:49**	**8:47**	**8:13**	**8:04**
Cedar Point	HIGH	1:39	**13:01**	**16:03**	**14:57**	**13:54**	**14:04**	**15:03**	**14:30**	**14:18**
Site 9	LOW	1:04	**6:11**	**9:09**	**8:06**	**7:05**	**7:19**	**8:17**	**7:43**	**7:34**
Cocheco River	HIGH	1:04	**12:26**	**15:28**	**14:22**	**13:19**	**13:29**	**14:28**	**13:55**	**13:43**
Site 10	LOW	1:04	**6:11**	**9:09**	**8:06**	**7:05**	**7:19**	**8:17**	**7:43**	**7:34**
Piscataqua River	HIGH	1:04	**12:26**	**15:28**	**14:22**	**13:19**	**13:29**	**14:28**	**13:55**	**13:43**
Site 11	LOW	0:00	**5:07**	**8:05**	**7:02**	**6:01**	**6:15**	**7:13**	**6:39**	**6:30**
Coastal Marine Lab	HIGH	0:00	**11:22**	**14:24**	**13:18**	**12:15**	**12:25**	**13:24**	**12:51**	**12:39**

C:\GBCW Files\Office Organization\Forms & Originals\2006 Basic Information\Tidal Times 2006

Tidal and Sampling Times for 2006 Season

Site		Tidal Adjustment	27-Apr	30-May	27-Jun	25-Jul	24-Aug	25-Sep	24-Oct	8-Nov
		LOW	5:07	8:05	7:02	6:01	6:15	7:13	6:39	6:30
		HIGH	11:22	14:24	13:18	12:15	12:25	13:24	12:51	12:39
Site 12	LOW	2:44	**7:51**	**10:49**	**9:46**	**8:45**	**8:59**	**9:57**	**9:23**	**9:14**
Newmarket STP	HIGH	2:44	**14:06**	**17:08**	**16:02**	**14:59**	**15:09**	**16:08**	**15:35**	**15:23**
Site 13	LOW	2:44	**7:51**	**10:49**	**9:46**	**8:45**	**8:59**	**9:57**	**9:23**	**9:14**
Marina Falls Landing	HIGH	2:44	**14:06**	**17:08**	**16:02**	**14:59**	**15:09**	**16:08**	**15:35**	**15:23**
Site 14	LOW	2:44	**7:51**	**10:49**	**9:46**	**8:45**	**8:59**	**9:57**	**9:23**	**9:14**
Fowler's Dock	HIGH	2:44	**14:06**	**17:08**	**16:02**	**14:59**	**15:09**	**16:08**	**15:35**	**15:23**
Site 15	LOW	0:44	**5:51**	**8:49**	**7:46**	**6:45**	**6:59**	**7:57**	**7:23**	**7:14**
Patten Yacht Yard, Inc.	HIGH	0:44	**12:06**	**15:08**	**14:02**	**12:59**	**13:09**	**14:08**	**13:35**	**13:23**
Site 16	LOW	2:34	**7:41**	**10:39**	**9:36**	**8:35**	**8:49**	**9:47**	**9:13**	**9:04**
Exeter Docks	HIGH	2:54	**14:16**	**17:18**	**16:12**	**15:09**	**15:19**	**16:18**	**15:45**	**15:33**
Site 17	LOW	2:34	**7:41**	**10:39**	**9:36**	**8:35**	**8:49**	**9:47**	**9:13**	**9:04**
Dover Foot Bridge	HIGH	2:54	**14:16**	**17:18**	**16:12**	**15:09**	**15:19**	**16:18**	**15:45**	**15:33**
Site 18	LOW	0:45	**5:52**	**8:50**	**7:47**	**6:46**	**7:00**	**7:58**	**7:24**	**7:15**
Maplewood Ave	HIGH	0:45	**12:07**	**15:09**	**14:03**	**13:00**	**13:10**	**14:09**	**13:36**	**13:24**
Site 19	LOW	0:45	**5:52**	**8:50**	**7:47**	**6:46**	**7:00**	**7:58**	**7:24**	**7:15**
Bartlett St.	HIGH	0:45	**12:07**	**15:09**	**14:03**	**13:00**	**13:10**	**14:09**	**13:36**	**13:24**
Site 20	LOW	0:45	**5:52**	**8:50**	**7:47**	**6:46**	**7:00**	**7:58**	**7:24**	**7:15**
Junkins Ave.	HIGH	0:45	**12:07**	**15:09**	**14:03**	**13:00**	**13:10**	**14:09**	**13:36**	**13:24**
Site 21	LOW	0:45	**5:52**	**8:50**	**7:47**	**6:46**	**7:00**	**7:58**	**7:24**	**7:15**
Pleasant St.	HIGH	0:45	**12:07**	**15:09**	**14:03**	**13:00**	**13:10**	**14:09**	**13:36**	**13:24**
Site 22	LOW	0:45	**5:52**	**8:50**	**7:47**	**6:46**	**7:00**	**7:58**	**7:24**	**7:15**
Little Harbor School	HIGH	0:45	**12:07**	**15:09**	**14:03**	**13:00**	**13:10**	**14:09**	**13:36**	**13:24**

2006 Data

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
	Site 1 - Oyster River Peninsula											
01	04/27/06	L	7:45	6	65	125	10.0	17.2	7.8	8.5	83.75	9
01	04/27/06	H	12:55	11	112	360	11.5	23.3	8.0	9.5	100.55	0
01	05/30/06	L	9:45	28	80	135	20.0	15.6	7.2	7.1	85.38	40
01	05/30/06	H	15:45	24	85	325	19.5	16.5	7.6	8.3	99.35	2
01	06/27/06	L	8:30	24	82	170	22.0	10.0	7.3	6.8	82.34	230
01	06/27/06	H	14:30	29	115	340	24.0	17.9	7.8	10.1	132.54	5
01	07/25/06	L	7:50	22	70	135	23.0	17.5	7.4	6.6	84.86	0
01	07/25/06	H	13:50	33	90	340	25.0	22.7	7.8	8.2	112.55	3
01	08/24/06	L	7:51	18	90	130	20.5	22.5	7.5	6.7	84.65	10
01	08/24/06	H	13:50	27	118	345	21.0	24.3	7.8	8.3	106.98	2
01	09/25/06	L	8:40	19	120	160	18.0	21.9	7.4	6.6	79.20	100
01	09/25/06	H	14:45	24	195	355	18.0	27.3	7.8	7.9	97.97	5
01	10/24/06	L	8:46	9	100	180	9.0	11.2	6.9	8.2	76.11	18
01	10/24/06	H	14:25	18	132	375	12.0	20.1	7.3	7.9	82.85	5
01	11/08/06	L	8:04	11	78	150	7.0	11.8	7.1	9.3	82.60	10
01	11/08/06	H	14:08	14	145	390	8.5	20.0	7.6	8.6	83.31	4
	Site 2 - Jackson Lab											
02	04/27/06	L	7:55	18	NA	NA	11.0	22.6	7.7	9.7	101.10	0
02	04/27/06	H	13:20	12	115	515	10.0	26.1	7.8	9.4	98.02	1
02	05/30/06	L	9:49	22	100	240	17.5	16.9	6.9	12.7	146.50	NA
02	05/30/06	H	16:08	17	137	415	18.0	17.7	7.4	12.2	142.82	NA
02	07/25/06	L	NA	23	105	230	22.5	21.8	7.5	6.5	84.87	1
02	07/25/06	H	13:59	30	125	435	22.5	23.0	7.6	7.2	94.66	0
02	08/24/06	L	8:00	17	180	225	21.0	24.8	7.8	7.7	99.54	0
02	08/24/06	H	14:18	21	222	415	20.0	25.9	7.8	7.9	100.91	0
02	09/25/06	L	8:53	63F	215	255	18.0	28.6	7.8	7.3	91.26	6
02	09/25/06	H	15:00	63F	283	440	18.0	28.6	7.4	8.5	106.27	1
02	10/24/06	L	8:25	7	145	280	9.5	20.4	7.6	8.7	86.46	6
02	10/24/06	H	14:35	12	143	470	10.5	23.4	7.1	8.3	85.99	6
02	11/08/06	L	8:20	11	137	245	7.0	18.4	7.6	9.0	83.31	4
02	11/08/06	H	14:25	12	180	485	8.0	23.0	7.6	8.6	83.97	1
	Site 3 - Lamprey River											
03	04/27/06	L	7:50	8	32	75	11.0	3.8	6.9	10.2	94.96	24
03	04/27/06	H	13:45	13	92	330	12.0	0.7	7.0	10.6	99.22	20
03	05/30/06	L	10:45	23	NA	NA	21.0	1.8	6.9	8.3	94.38	270

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
03	05/30/06	H	16:50	19	100	NA	22.0	1.2	7.0	8.2	94.76	40
03	06/27/06	L	9:45	25	73	95	21.0	2.5	7.0	7.9	90.16	60
03	06/27/06	H	15:40	28	130	300	22.0	1.6	7.0	8.1	93.80	70
03	07/25/06	L	8:45	22	70	95	22.0	2.5	6.7	8.1	94.24	40
03	07/25/06	H	14:45	30	98	305	20.5	1.0	6.9	8.2	91.94	40
03	08/24/06	L	9:00	16	100	100	20.0	4.6	6.9	8.1	91.11	39
03	08/24/06	H	14:49	21	135	300	21.0	2.4	6.9	8.2	93.54	16
03	09/25/06	L	9:55	18	112	112	17.5	9.5	6.9	8.0	88.46	50
03	09/25/06	H	16:00	19	203	301	18.0	7.0	7.1	8.5	93.65	50
03	10/24/06	L	9:20	9	115	135	9.5	1.7	7.1	10.5	93.27	28
03	11/08/06	L	9:10	11	110	110	6.5	1.6	7.2	12.1	99.87	60
03	11/08/06	H	15:00	13	130	360	7.0	1.6	7.2	11.9	99.46	5
03	1024/06	H	15:15	12	123	350	10.0	2.5	7.1	10.5	94.81	20
	Site 4 - Depot Road											
04	04/27/06	H	13:51	16	NA	40	11.0	21.2	7.6	11.1	114.68	0
04	05/30/06	H	16:53	19	NA	35	20.0	12.1	7.1	8.6	101.40	0
04	06/27/06	H	15:47	31	NA	40	25.0	16.9	7.3	8.0	106.29	18
04	07/25/06	H	14:44	34	40	40	25.0	20.2	7.6	8.6	116.38	3
04	08/24/06	H	14:54	26	50	50	21.0	22.2	7.4	8.3	105.67	23
04	09/25/06	H	15:53	19	120	120	18.0	27.3	7.4	7.8	96.73	1
04	10/24/06	H	15:20	13	30	30	10.0	14.7	6.9	9.0	87.32	270
04	11/08/06	H	15:08	13	50	50	8.0	16.4	7.0	9.1	85.18	1
	Site 5 - Portsmouth Country Club											
05	04/27/06	L	7:31	10	45	45	9.5	2.5	7.3	8.6	76.74	42
05	04/27/06	H	13:25	12	65	65	12.0	19.9	7.6	9.8	102.65	0
05	05/30/06	L	10:29	22	45	45	21.0	0.0	7.3	7.6	85.61	100
05	05/30/06	H	16:27	17	55	60	22.0	13.0	7.4	8.1	99.71	12
05	06/27/06	L	9:26	26	NA	45	21.0	0.0	7.4	7.3	82.23	35
05	06/27/06	H	15:21	28	60	75	27.0	4.9	7.6	8.0	103.32	72
05	07/25/06	L	8:25	24	NA	45	21.0	1.8	7.0	5.7	64.81	20
05	07/25/06	H	14:18	33	60	60	27.0	19.0	7.8	8.8	122.49	7
05	08/24/06	L	8:39	16	NA	45	18.0	2.3	7.1	6.5	69.81	100
05	08/24/06	H	14:28	24	85	85	20.0	20.6	7.6	7.9	97.78	5
05	09/25/06	L	9:37	18	NA	45	15.0	3.1	7.1	7.6	77.01	180
05	09/25/06	H	15:27	18	45	45	17.0	25.1	7.6	8.4	100.78	5
05	10/24/06	L	9:03	8	NA	NA	8.0	1.8	7.1	9.5	81.46	47
05	10/24/06	H	14:50	12	50	85	9.5	17.1	7.3	8.6	83.71	9

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
05	11/08/06	L	8:54	12	NA	45	5.5	0.1	7.1	11.7	93.35	40
05	11/08/06	H	14:42	13	90	90	7.0	17.6	7.5	10.4	95.78	3
	Site 6 - Fox Point											
06	04/27/06	L	6:51	10	105	540	10.5	24.8	7.8	9.2	96.18	1
06	04/27/06	H	13:06	12	203	780	9.5	27.7	8.1	9.4	97.96	NA
06	05/30/06	L	9:49	22	128	565	17.0	17.1	7.6	7.5	85.76	4
06	05/30/06	H	16:08	18	240	720	15.0	21.9	7.8	8.8	99.44	3
06	06/27/06	L	9:46	27	170	595	19.5	2.0	7.5	7.5	82.88	2
06	06/27/06	H	15:02	26	205	740	18.5	24.3	7.6	7.5	92.20	3
06	07/25/06	L	7:45	26	135	560	22.0	23.2	7.7	6.9	90.01	NA
06	07/25/06	H	13:59	30	230	745	22.0	25.2	7.8	6.8	89.75	0
06	08/24/06	L	7:59	17	205	560	19.0	27.6	7.4	8.0	101.32	1
06	08/24/06	H	14:09	23	380	755	18.0	29.5	7.8	7.9	99.32	0
06	09/25/06	L	8:57	17	330	600	17.0	30.6	7.7	7.2	89.41	1
06	09/25/06	H	15:08	18	422	765	16.0	30.7	7.7	7.0	85.29	0
06	10/24/06	L	8:23	7	165	610	10.0	23.0	7.5	8.2	83.80	NA
06	10/24/06	H	14:35	13	195	780	11.0	25.9	7.6	8.2	87.30	4
06	11/08/06	L	8:14	11	205	565	8.0	21.5	7.0	8.8	85.09	5
06	11/08/06	H	14:23	12	215	785	9.0	28.0	7.5	8.1	83.65	2
	Site 7 - Cedar Point											
07	04/27/06	L	6:47	9	95	95	9.5	24.2	7.6	9.3	94.71	2
07	04/27/06	H	13:00	12	172	325	10.0	27.4	7.8	9.5	99.92	NA
07	05/30/06	L	9:39	26	110	110	17.0	17.4	7.5	7.5	85.91	0
07	05/30/06	H	16:03	18	190	290	15.0	20.9	6.9	8.7	97.15	10
07	06/27/06	L	8:37	24	110	110	20.0	20.9	7.6	7.2	89.02	0
07	06/27/06	H	15:00	22	215	300	18.0	22.5	7.8	7.5	89.73	40
07	07/25/06	L	NA	22	110	110	21.5	23.8	7.4	6.6	85.60	2
07	07/25/06	H	13:54	27	192	300	22.0	24.3	7.8	6.9	90.59	2
07	08/24/06	L	7:50	16	120	120	18.5	26.8	7.8	7.3	91.12	1
07	08/24/06	H	14:00	21	278	300	18.0	28.2	7.9	7.1	88.54	0
07	09/25/06	L	8:47	19	125	125	16.0	29.5	7.8	7.4	89.48	1
07	09/25/06	H	15:03	18	310	310	15.0	30.5	7.8	7.1	84.69	2
07	10/24/06	H	14:00	15	180	342	10.5	25.1	7.6	7.8	81.70	3
07	11/08/06	L	8:04	12	105	105	8.0	19.5	7.4	8.6	81.62	2
07	11/08/06	H	14:18	14	233	335	9.0	26.0	7.7	8.1	82.03	3
07	1024/06	L	8:27	9	148	148	10.0	23.0	7.4	8.1	82.78	0

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
	Site 9 - Neal's/Scott's											
09	04/27/06	L	6:11	4	25	25	9.5	3.7	6.7	10.5	94.34	21
09	04/27/06	H	12:20	12	128	250	11.5	8.3	6.6	9.6	92.75	15
09	05/30/06	L	9:04	21	25	NA	19.5	1.5	6.9	8.5	93.69	25
09	05/30/06	H	15:50	17	105	340	21.0	3.7	6.8	8.1	93.03	12
09	06/27/06	L	8:00	24	20	20	20.0	1.8	6.8	9.1	101.47	90
09	06/27/06	H	NA	25	160	200	24.0	4.2	6.9	7.8	95.07	90
09	07/25/06	L	7:06	23	25	25	21.0	2.4	6.7	7.7	87.83	160
09	07/25/06	H	13:35	27	85	200	25.0	3.6	6.8	7.4	91.58	180
09	08/24/06	L	7:18	15	25	25	20.0	8.5	6.8	7.2	83.22	20
09	08/24/06	H	13:23	18	165	320	20.0	10.1	7.1	8.7	101.45	9
09	09/25/06	L	8:20	15	30	30	16.5	9.2	6.9	7.3	78.96	370
09	09/25/06	H	14:25	16	235	300	18.0	14.2	7.0	8.0	91.77	110
09	10/24/06	L	NA	6	30	>500	8.5	1.6	6.9	10.8	93.62	41
09	10/24/06	H	13:49	10	122	305	9.5	2.4	6.8	10.1	90.07	25
09	11/08/06	L	7:37	9	25	25	5.5	0.2	6.8	12.7	101.38	50
09	11/08/06	H	13:38	11	120	350	7.0	1.6	6.9	11.4	95.28	90
	Site 10 - Clark's/Peterson's											
10	04/27/06	L	6:11	6	65	65	10.0	12.7	7.6	10.6	101.60	17
10	04/27/06	H	12:26	12	125	310	11.0	20.6	8.0	9.7	99.83	NA
10	05/30/06	L	9:09	22	43	85	19.0	7.8	7.4	8.0	90.32	13
10	05/30/06	H	15:28	20	113	280	18.0	15.0	7.6	9.2	106.03	10
10	06/27/06	L	8:06	24	18	80	21.0	10.0	7.5	7.7	91.48	30
10	06/27/06	H	14:22	27	100	290	22.0	20.1	7.8	8.5	108.90	10
10	07/25/06	L	7:05	21	72	75	23.0	8.3	7.4	7.0	85.58	0
10	07/25/06	H	13:20	29	155	275	25.0	17.5	7.8	7.1	94.64	0
10	08/24/06	L	7:19	13	NA	95	20.0	21.3	7.7	8.1	100.67	4
10	08/24/06	H	13:29	24	200	290	20.0	26.7	7.8	8.6	110.38	1
10	09/25/06	L	8:17	14	110	110	18.0	22.0	7.7	6.4	76.85	12
10	09/25/06	H	14:28	21	265	310	17.5	28.6	7.8	8.1	100.28	4
10	10/24/06	L	7:43	9	110	135	10.0	10.0	7.1	11.2	105.63	2
10	10/24/06	H	13:55	14	135	330	11.0	16.8	7.6	8.8	88.46	6
10	11/08/06	L	7:34	10	75	100	7.0	10.0	7.1	10.4	91.36	5
10	11/08/06	H	13:43	10	175	345	8.0	21.5	7.6	9.3	91.36	1
	Site 11 - Coastal Marine Lab (CML)											
11	04/27/06	L	6:30	6	207	210	8.0	29.0	7.4	9.9	100.62	2

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
11	04/27/06	H	12:15	13	315	<500	10.0	29.6	7.0	10.3	109.93	NA
11	05/30/06	L	8:15	17	188	215	12.0	27.5	7.1	9.3	102.24	0
11	05/30/06	H	14:30	16	200	NA	13.0	25.6	7.4	8.6	95.39	2
11	06/27/06	L	7:18	19	NA	225	16.0	27.8	7.2	8.3	99.28	2
11	06/27/06	H	15:00	23	293	>500	17.0	27.2	7.4	8.0	97.24	1
11	07/25/06	L	6:05	18	230	230	18.0	33.4	NA	8.9	114.70	NA
11	07/25/06	H	12:15	33	312	>500	NA	28.2	7.2	8.0	NA	0
11	08/24/06	L	6:20	16	265	265	16.0	31.3	7.8	7.8	95.41	0
11	08/24/06	H	12:35	18	495	495	17.0	30.6	7.7	9.4	116.73	0
11	09/25/06	L	7:40	14	265	265	15.0	31.8	6.9	7.4	89.02	1
11	09/25/06	H	13:45	18	405	501	14.5	32.4	6.8	7.8	93.25	0
11	10/24/06	H	12:50	16	303	>500	12.5	29.3	6.7	7.6	85.43	3
11	11/08/06	L	7:00	12	250	250	10.0	29.6	6.7	8.1	86.45	8
11	11/08/06	H	13:00	19	355	>500	9.5	29.0	7.0	8.0	89.93	5
11	1024/06	L	6:50	7	292	292	11.0	30.4	7.1	8.4	92.13	1
	Site 13 - Marina Falls Landing											
13	04/27/06	L	7:51	14	110	110	11.0	0.6	7.1	11.4	104.23	20
13	04/27/06	H	14:05	14	140	345	13.0	0.0	7.4	6.1	58.17	13
13	05/30/06	L	10:49	26	110	110	20.0	0.0	7.6	9.8	108.25	17
13	05/30/06	H	NA	NA	135	325	20.0	0.8	7.3	9.6	106.49	26
13	06/27/06	L	9:40	28	NA	120	21.0	0.8	7.4	8.5	96.15	26
13	06/27/06	H	15:50	30	120	325	22.5.	0.6	7.1	8.3	96.53	24
13	07/25/06	L	8:45	28	123	125	23.0	0.0	7.1	7.9	92.48	10
13	07/25/06	H	15:55	32	107	320	23.5	0.0	7.3	7.9	92.75	10
13	08/24/06	L	8:59	18	130	130	20.0	0.0	6.9	8.6	94.99	3
13	08/24/06	H	15:09	24	130	330	21.0	0.0	7.2	8.3	93.50	10
13	09/25/06	L	9:57	19	130	130	17.0	5.2	7.2	8.1	86.58	28
13	09/25/06	H	16:08	21	167	335	17.0	1.5	7.3	8.8	92.19	28
13	10/24/06	L	9:23	10	117	160	9.0	0.5	7.1	10.7	93.30	13
13	10/24/06	H	15:35	14	170	365	9.5	0.5	7.1	10.9	96.16	12
13	11/08/06	L	9:14	12	80	NA	5.0	0.1	6.9	12.7	100.05	10
13	11/08/06	H	15:23	13	187	NA	5.0	0.1	7.1	12.4	97.69	2
	Site 14 - Fowler's Dock											
14	04/27/06	L	7:51	9	155	440	11.0	1.3	7.4	9.9	90.87	17
14	04/27/06	H	14:06	13	160	465	13.0	0.8	7.4	10.0	95.77	NA
14	05/30/06	L	10:00	20	NA	400	20.5	1.0	7.1	8.2	91.94	17
14	06/27/06	L	9:00	22	125	455	21.0	1.2	7.1	7.8	88.42	27

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
14	06/27/06	H	16:25	24	138	425	24.0	0.0	7.2	8.3	99.00	NA
14	07/25/06	L	8:45	22	118	380	22.5	0.3	7.3	6.8	78.96	11
14	07/25/06	H	14:59	27	145	390	25.0	0.6	7.4	7.3	88.97	5
14	08/24/06	L	9:00	15	155	395	20.0	0.0	7.1	7.1	78.43	38
14	08/24/06	H	15:00	19	158	395	21.5	0.6	7.1	7.1	81.01	20
14	09/25/06	L	9:57	16	175	370	18.0	0.3	7.5	7.4	78.64	5
14	09/25/06	H	16:00	15	185	375	18.0	0.3	7.4	7.6	80.76	36
14	10/24/06	L	9:00	4	140	360	9.0	0.0	7.1	10.0	86.95	18
14	10/24/06	H	15:25	8	140	370	10.0	0.0	7.1	9.5	84.58	11
14	11/08/06	L	9:00	50	190	410	5.5	0.0	7.0	11.4	90.90	7
14	11/08/06	H	15:00	10	200	415	7.0	0.0	6.9	13.5	111.79	3
	Site 15 - Patten Yacht Yard											
15	04/27/06	H	12:15	16	348	615	8.0	29.8	8.0	9.6	98.10	NA
15	06/27/06	L	8:35	22	170	420	18.0	22.2	7.8	7.7	92.57	3
15	06/27/06	H	15:00	22	350	610	14.5	28.7	7.8	8.3	96.87	2
15	07/25/06	L	7:00	21	155	420	20.0	23.3	7.4	7.0	88.03	0
15	07/25/06	H	13:00	30	345	>500	19.0	27.6	7.4	7.5	94.99	0
15	08/24/06	L	7:20	15	260	430	17.0	28.4	7.8	7.3	89.40	0
15	08/24/06	H	13:15	20	405	610	15.0	30.7	7.9	7.6	90.77	1
15	09/25/06	L	6:45	13	370	460	14.0	30.8	7.8	6.8	79.64	NA
15	09/25/06	H	14:41	20	475	475	20.2	32.7	7.8	6.7	89.24	1
15	10/24/06	H	14:40	12	388	657	9.5	30.6	7.6	7.4	78.64	0
15	11/08/06	L	7:10	9	280	430	8.0	24.4	7.6	8.3	81.79	3
15	11/08/06	H	15:00	14	425	620	8.5	31.7	7.4	7.6	79.57	2
15	1024/06	L	7:00	11	200	480	9.0	24.7	7.6	no pillows	NA	4
	Site 16 - Exeter Docks											
16	04/27/06	L	7:41	5	105	105	12.0	0.7	7.2	10.6	99.22	200
16	04/27/06	H	14:16	6	122	334	13.0	2.1	7.2	10.5	101.29	50
16	05/30/06	L	10:46	20	130	130	23.0	1.6	7.1	8.9	105.04	60
16	05/30/06	H	17:18	12	95	195	13.0	1.4	7.4	8.7	83.60	120
16	06/27/06	L	9:36	24	105	150	22.0	1.9	7.1	8.4	97.43	120
16	06/27/06	H	16:12	20	75	335	23.5	4.0	7.1	8.1	97.70	170
16	07/25/06	L	8:35	24	100	145	24.0	2.5	7.0	7.8	94.24	0
16	07/25/06	H	15:09	32	83	340	25.0	3.7	7.7	8.0	99.06	60
16	08/24/06	L	8:49	14	128	150	20.5	2.1	7.0	7.9	89.09	70
16	08/24/06	H	15:19	23	75	335	22.0	1.5	7.3	8.3	96.07	80
16	09/25/06	L	9:47	14	108	130	17.0	1.6	7.4	9.9	103.77	30

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
16	09/25/06	H	16:18	NA	95	365	14.0	0.0	7.4	9.0	87.74	30
16	10/24/06	L	9:13	5	95	165	9.5	1.7	7.4	10.5	93.27	370
16	10/24/06	H	15:45	7	77	380	10.0	0.5	7.4	10.6	94.64	60
16	11/08/06	L	9:04	7	135	140	7.0	0.2	7.8	12.2	101.14	310
16	11/08/06	H	15:33	10	140	390	12.0	8.0	7.3	11.6	113.16	120
	Site 17 - Dover Foot Bridge											
17	04/27/06	L	7:14	9	60	60	9.5	1.7	7.0	10.0	88.82	10
17	04/27/06	H	14:17	12	148	175	10.0	1.2	7.4	10.4	93.22	40
17	05/30/06	L	10:40	22	55	55	18.0	1.8	6.9	8.5	91.05	20
17	05/30/06	H	17:18	18	140	170	18.5	1.8	7.1	8.8	95.22	40
17	06/27/06	L	9:36	26	83	83	20.5	1.8	6.9	8.0	90.08	120
17	06/27/06	H	16:12	27	133	165	21.0	1.8	7.0	8.7	98.93	220
17	07/25/06	L	8:35	22	90	90	20.5	1.7	6.6	8.3	93.41	80
17	07/25/06	H	15:09	30	105	185	22.0	1.6	7.3	8.0	92.64	20
17	08/24/06	L	8:49	17	55	55	20.0	2.1	6.7	8.2	91.58	60
17	08/24/06	H	15:22	23	170	170	20.0	0.8	7.2	9.2	102.05	50
17	09/25/06	L	9:47	17	50	50	16.0	2.0	7.1	8.7	89.50	60
17	09/25/06	H	16:18	18	163	190	16.0	1.2	7.3	8.8	90.14	60
17	10/24/06	L	9:13	8	105	105	8.5	0.9	7.2	10.8	93.24	60
17	10/24/06	H	15:45	12	80	205	8.5	1.1	7.2	10.7	92.49	10
17	11/08/06	L	9:03	12	90	90	5.0	0.9	7.4	12.7	100.52	100
17	11/08/06	H	15:33	14	152	220	5.5	0.9	7.4	12.0	96.19	40
	Site 18 - Maplewood Avenue											
18	04/27/06	L	5:55	5	20	20	8.0	27.2	7.5	8.6	86.35	10
18	04/27/06	H	12:00	13	57	57	10.0	28.9	7.9	10.6	112.61	1
18	05/30/06	L	8:50	20	20	20	16.0	22.5	7.6	8.6	99.54	36
18	05/30/06	H	15:00	18	60	60	16.0	24.2	8.0	10.6	123.98	2
18	06/27/06	L	8:45	27	NA	17	19.0	24.7	7.9	7.2	89.59	80
18	06/27/06	H	14:07	25	NA	50	21.0	2.5	8.0	10.1	115.27	43
18	07/25/06	L	6:46	21	NA	NA	20.0	25.9	7.5	6.4	81.75	40
18	07/25/06	H	13:00	29	90	90	24.0	25.8	7.9	8.2	112.58	4
18	08/24/06	L	7:00	16	20	20	17.0	27.7	7.6	6.8	82.91	6
18	08/24/06	H	13:15	19	NA	NA	18.0	29.4	7.3	8.0	100.52	0
18	09/25/06	L	7:50	18	NA	0	15.5	30.6	7.7	6.3	75.95	7
18	09/25/06	H	14:06	19	65	65	16.0	30.0	7.9	7.2	87.34	3
18	10/24/06	H	13:36	11	65	65	9.0	29.8	7.7	8.2	85.71	2
18	11/08/06	L	7:15	11	15	15	9.0	21.6	7.6	8.8	87.14	0

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
18	11/08/06	H	13:27	11	65	65	9.0	24.8	7.8	8.1	81.89	3
18	1024/06	L	7:26	7	10	10	10.0	1.8	6.6	8.1	72.85	20
	Site 19 - Bartlett Avenue											
19	04/27/06	L	5:52	9	11	11	3.5	1.8	7.7	10.0	76.51	1500
19	04/27/06	H	12:07	11	80	80	12.5	2.1	8.0	12.1	115.42	210
19	05/30/06	L	8:58	20	15	15	22.0	2.8	7.7	8.6	100.22	180
19	05/30/06	H	15:09	16	54	54	24.0	2.8	7.6	9.3	112.53	150
19	06/27/06	L	7:47	24	10	10	21.0	2.5	7.4	8.3	94.73	470
19	06/27/06	H	14:03	22	50	50	24.0	4.0	7.8	8.9	108.36	180
19	07/25/06	L	6:45	20	15	15	20.5	1.8	7.5	8.4	94.58	220
19	07/25/06	H	13:00	29	58	58	23.0	1.6	7.5	7.2	84.98	250
19	08/24/06	L	7:00	16	10	10	18.0	1.6	8.0	8.6	92.02	110
19	08/24/06	H	13:10	20	55	55	18.0	3.1	7.4	8.2	88.45	150
19	09/25/06	L	7:58	16	10	10	16.0	1.2	7.4	8.1	82.97	60
19	09/25/06	H	14:09	18	75	75	16.0	5.4	7.4	8.4	88.04	40
19	10/24/06	L	7:24	6	17	17	9.0	1.1	6.9	9.6	83.99	40
19	10/24/06	H	13:36	12	108	108	9.0	1.2	7.4	10.7	93.67	10
19	11/08/06	L	7:15	10	20	20	8.0	0.5	7.1	10.1	85.97	40
19	11/08/06	H	13:24	12	86	120	9.5	1.2	7.4	10.0	88.57	90
	Site 20 - Junkin's Avenue											
20	04/27/06	L	5:50	5	27	27	8.5	28.5	7.8	8.9	91.17	0
20	04/27/06	H	12:05	13	100	100	11.0	28.3	7.9	10.1	109.23	0
20	05/30/06	L	9:00	19	25	25	16.0	26.3	7.8	8.8	104.28	40
20	05/30/06	H	15:00	17	70	70	18.5	25.6	8.0	10.1	125.14	0
20	06/27/06	L	7:50	24	25	25	18.5	28.2	7.7	6.6	83.09	80
20	06/27/06	H	14:00	27	70	70	23.0	26.3	8.0	9.0	121.75	0
20	07/25/06	L	6:50	21	30	30	20.0	27.9	7.6	6.3	81.46	30
20	07/25/06	H	13:10	32	75	75	24.0	27.6	7.6	8.1	112.39	0
20	08/24/06	L	7:00	17	20	20	17.0	31.0	7.2	5.6	69.72	40
20	08/24/06	H	13:00	21	80	80	17.5	30.5	7.7	7.6	95.23	10
20	09/25/06	L	7:58	16	20	20	15.0	31.1	7.4	6.0	71.85	20
20	09/25/06	H	14:00	18	85	85	15.5	31.3	7.5	7.6	92.04	0
20	10/24/06	L	7:45	7	15	15	10.0	28.0	7.4	7.1	74.97	20
20	10/24/06	H	13:30	11	105	105	11.5	27.7	7.6	8.3	90.38	0
20	11/08/06	L	7:20	12	25	25	9.5	22.3	7.4	7.8	78.46	20
20	11/08/06	H	13:40	13	115	115	10.0	27.4	7.6	9.0	94.66	0

SITE	DATE	TIDE	TIME of Sample	AIR Temp. oC	Water Trans. cm	DEPTH cm	WATER Temp. oC	SALINITY ppt	pH	DO ppm	DO % Saturation	FECAL COLIFORM #/100 ML
	Site 21 - Pleasant Avenue											
21	04/27/06	L	6:00	3	50	50	7.0	27.7	7.8	8.6	84.65	1
21	04/27/06	H	12:00	13	220	220	10.0	28.1	8.0	9.9	104.61	0
21	05/30/06	L	9:05	21	20	20	16.5	25.0	7.7	8.5	100.91	7
21	05/30/06	H	15:10	18	220	220	14.0	26.3	8.0	9.6	109.22	1
21	06/27/06	L	7:00	23	NA	30	18.0	26.0	7.5	6.9	84.89	120
21	06/27/06	H	14:13	26	180	180	18.0	26.6	7.5	8.5	104.96	14
21	07/25/06	L	7:00	19	40	40	18.5	26.6	7.6	5.9	73.55	70
21	07/25/06	H	13:15	30	175	175	19.0	26.9	7.8	8.3	104.67	3
21	08/24/06	L	7:14	17	100	100	16.0	28.7	7.4	6.7	80.60	60
21	08/24/06	H	13:10	22	240	240	16.0	29.4	7.6	7.8	94.25	10
21	09/25/06	L	7:30	16	50	50	14.0	30.0	7.5	6.2	72.24	70
21	09/25/06	H	14:00	20	NA	180	15.0	30.5	7.4	7.3	87.08	5
21	10/24/06	H	NA	NA	NA	NA	NA	NA	NA	NA		NA
21	11/08/06	L	7:30	13	50	50	9.0	22.2	7.2	7.9	78.53	170
21	11/08/06	H	14:00	14	190	240	9.0	28.6	7.4	8.0	82.95	1
21	1024/06	L	8:30	7	30	30	9.0	27.3	7.5	7.9	81.20	53
	Site 22 - Little Harbour School											
22	04/27/06	H	12:00	9	175	175	10.0	28.3	7.8	10.6	112.16	0
22	05/30/06	H	14:20	15	170	170	16.0	24.5	7.4	10.5	123.04	0
22	06/27/06	H	14:10	24	NA	135	23.0	25.9	7.8	8.4	113.36	6
22	07/25/06	H	12:30	30	150	150	23.0	29.5	7.1	7.7	106.17	1
22	08/24/06	H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
22	09/25/06	H	13:30	16	170	170	15.5	31.3	7.6	7.1	85.98	1
22	10/24/06	H	13:20	10	135	135	10.5	27.6	7.6	8.5	90.50	0
22	11/08/06	H	12:59	12	90	90	10.0	30.0	7.6	9.7	103.81	TNTC