

DRAFT FINAL

2005 CZM Coastal Nonpoint Source Assessment Final Report

**Assessment of Potential and Actual Sources of Nonpoint
Source Pollution in the Good Harbor Drainage Area**



This Project is the result of the collaboration of the City of Gloucester Health Department, Conservation Commission, Shellfish Department, and Engineering Department as well as the generous funding from Coastal Zone Management (CZM) Nonpoint Source Pollution Grant

December 31, 2005

Deliverables

Items	Location
Definition of Terms Used to Describe Good Harbor Watershed Drainage Area	Definitions
Summary (introduction) of how assessment tasks were completed and their outcomes	Task Descriptions (Tasks 1-8).
Topography-based, GIS watershed delineation map	Map 1 “Outfall, Catch Basin and Sampling Locations”
GIS outfall map (base map should be aerial photography or USGS topography)	
GIS catch basin map	
Description of methodology for historical water quality/rainfall comparisons and created tables/graphs	Task Description 1-B and Graphs 3-1 thru 3-11
GIS septic system location map	Map 2 “Vacant, Sewer and Onsite Sewer Lots”
GIS map showing water quality sampling locations in the sub-watersheds	
Tabulated water quality data and data analysis	Task 7, “Water Quality Sampling”
Discussion regarding nonpoint source control/remediation management recommendations	Task 8 “Prepare Preliminary Recommendations”
What Worked and What Didn’t Work	Task X

Definitions- See Map 1 regarding Sampling Location references

West Creek Branch: Includes the Creek passing under Thatcher Road by the Shopping Center (Sampling Location 1), the Creek passing under Hartz Street (Sampling Location 1C), Sampling Location 1D (at the Yankee Division Highway), Sampling Location 1A, and the Creek passing under Eastern Avenue alongside Abbott Road.

Northeast Creek Branch: Includes the Creek under Thatcher Road by the Good Harbor Parking area (Sampling Location 3), Sampling Location 2, the Creek by #48 Witham Street (Sampling Location 3C), the Creek by #10 Witham Street (Sampling Location 3E), and the outfall of the Creek from Pond Road below Eastern Avenue (Sampling Location 3F).

East Creek Branch: Includes the Creek under Witham Street (Sampling Location 3AD) and the Creek under Thatcher Road by Rockport Road (Sampling Location 3AC).

Good Harbor Creek at the Footbridge: Includes the Creek under the footbridge at Nautilus Road (Sampling Location 0).

Good Harbor Beach: Includes the waters of Good Harbor Beach.

Task 1. *Project Summary*

This project was a critical first step in providing long term protection for the Good Harbor Drainage Area and Good Harbor Beach by assessing and identifying actual as well as potential sources of non-point pollution within the drainage area. Previous studies of the area documented water quality problems in association with stormwater runoff and non-point source pollution. As a result, Saratoga Creek (the Creek) and part of the beach in the Good Harbor Drainage Area are closed to shellfishing by the Massachusetts Division of Marine Fisheries (DMF) and have historically been closed to swimming by the Gloucester Health Department. Good Harbor Beach is a tremendous natural resource for the City of Gloucester, and the tourists it attracts provide significant revenues to the City. The Good Harbor Drainage Area includes very diverse sources of potential non-point source pollution including sewer and non-sewered residential areas, highway, commercial and industrial areas, construction, a golf course, and dog walking areas. Due to the dramatic increase in land value in the past few years, a large number of construction projects associated with single family home and commercial expansion have ensued. Some known pollution sources within the Good Harbor Drainage Area reaffirm the likelihood of non-point pollution sources: sewer overflow into inadequately sized sewer systems, failed septic systems, waterfowl congregating in several areas throughout the drainage areas, inconsistent highway maintenance activities, use of lawn care and other chemicals at residential and commercial properties, excessive use of the beach off-season as a dog play yard with most walkers not picking up the dog waste, and improper waste disposal and littering especially during peak tourist season.

The goals of the project were:

- To better characterize and evaluate the potential and actual contamination to reduce the drainage of contaminants into coastal waters;
- To look for the potential to install or implement structural or non-structural best management practices (BMP's);
- To involve the public in pollution prevention practices; and
- To develop a local ordinance pertaining to infiltration of runoff from new impervious surfaces.

These goals were met through a thorough physical assessment of the Drainage Area to evaluate land uses and the related sources of potential pollution.

Note: Although use of the CZM Water Quality Database was included within the project scope of the grant, the database was not ready for use during the 2005 project year.

Task 2. *Inventory and Review of Previous Pollution Assessments*

A. Historic Problems

The Good Harbor Drainage Area (approximately 1,100 acres) is immense and does encompass a vast diversity of potential pollution sources. The following descriptions of filed incident reports by the Gloucester Health Department and Conservation Commission document some of these issues:

Table 2-1: The following hazardous waste releases within the Good Harbor Drainage Area have been reported to the Department of Environmental Protection (DEP):

Location	Site Name	Release Tracking Number (RTN) or Other	Notification Date	Chemical Released
44 Bass Avenue	Essex Oil Company	3-14325	October, 1996	Gasoline Underground Storage Tanks (USTs) (Oil)
85-89 Bass Avenue		3-13633	March, 1996	Oil
Blackburn Drive		3-0015060	June, 1997	Oil
9 Blackburn Drive	Nutramax Company	3-11062	May, 1994	Oil
9 Blackburn Drive	Blackburn Industrial Park	3-14774	January, 1997	Oil and Hazardous Material
22 Blackburn Drive	Omni Wave	3-20646	April, 2001	PCB (Hazardous Material)
22 Blackburn Drive	RCM Corp FMR	3-4154	October, 1993	Not Indicated
144-148 Eastern Avenue	Next to Mt Pleasant Memorials	3-23911	June 2004	Volatile Hydrocarbons
107 Eastern Avenue	Foster From Gloucester	Gloucester-ERB-N9100138	February, 1991	Diesel Fuel
150 Eastern Avenue	Gloucester Dispatch, Inc.	Gloucester- ERB-N92-0867	July, 1992	Diesel fuel
8 Pond Road	Morse Industrial Park	3-10407	January, 1994	Oil
6 Thatcher Road	Area of "WTG Realty Trust" and "Nor'East Cleaners, Inc."	3-23899, 3-22232	October, 2002 and May, 2004	Chlorinated Solvent
18 Witham Street	Bursaw Oil Corporation Facility	3-12887	September, 1995	Oil

Table 2-2: The following properties within the Good Harbor Drainage Area were reported to the Gloucester Health Department with sewer overflow incidents:

Location	Incident Date(s)	Sewer Overflow Location	Reason for sewer overflow	Actions performed by City of Gloucester DPW
76 Witham Street	December, 2003; March, 2005; April, 2005; June, 2005	Basement plumbing fixtures.	At-capacity sewer, no backflow preventor on building sewer, and sewer pump station and	Homeowner was encouraged to put a backflow preventor on the building sewer line ^{1,2}

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			associated alarm malfunction.	and pump station upgrade.
Catch basin(s) in front of 76 Witham Street	December, 2003; March, 2005; April, 2005; June, 2005	Two (2) catch basins on Witham Street. One catch basin potentially discharged sewer waste directly to Saratoga Creek (the Creek).	Sewer pump station and associated alarm malfunction.	Pump station upgrade.
12 Neptune Place	July, 2004 and June, 2005	Basement plumbing fixtures.	At-capacity sewer and no backflow preventor on building sewer.	Homeowner was encouraged to put a backflow preventor on the building sewer line ¹ .
Catch basin in front of 12 Neptune Place	July, 2004 and June, 2005	One catch basin on Neptune Place. Sewer waste flowed directly to the Saratoga Creek- West (West Creek Branch).	At-capacity sewer.	Top grate of catch basin was plugged.

- (1) The houses surrounding the above properties do have backflow preventors on the building sewers.
- (2) Installation of a backflow preventor at 76 Witham Street is complicated by the fact that the building has a basement apartment. Addition of a backflow preventor could make the basement apartment unusable.

Table 2-3: The following are samples of information from the Conservation Commission files regarding the Good Harbor Drainage Area:

Location	Type of project	Project Summary	Impact Potential	Pollution prevention measures/action
Briernneck Rd	Notice of Intent – 28-98	Sewer line installation	While immediate sewerage impacts are alleviated, the impact potential is connected to longer term more devastating impacts associated with additional development	
Blackburn Industrial Park Blackburn Rd, Heritage Way, Great Republic Drive and	Notice of Intents 28-1738, 1672,1478142 9,13891047, 935, 114, DoA #'s 392, 512, 576, 677	Industrial Park development and expansion	The development of the industrial park on a 130 + acre site has led to the loss of approximately 2/3 of the vegetation on site, with that area almost all paved/structure or impervious. While stormwater structures are designed and implemented, the actual and potential impact on water quality is still unknown	Stormwater detention basins and other water quality controls
Stop and Shop Bass Ave and Thatcher Rd	Notice of Intent 28-1510	Shopping Center	The redevelopment of the Ames Plaza into a Stop and Shop with CVS, and other retail business while very well designed and maintained, contributes pollution potential associated with parking areas.	Stormwater treatment structures, revegetation, salt marsh restoration
Bass Rocks Golf Course, Beach Road	Notice of Intent 28-796, 976, 1146, 1313,1442150	Private Golf Course and Recreation Area.	Water quality impacts associated with chemicals used to maintain the greens, bacteria associated with large goose population and use of the area by residents for off-season dog walking. The golf course has multiple wetlands and streams running	Management is working with the Commission to improve water quality on and off site and to implement

Location	Type of project	Project Summary	Impact Potential	Pollution prevention measures/action
	6,1662		through the property which all discharge directly into Good Harbor Beach via a stream with limited or no treatment. The golf course predates the wetlands protection act.	BMPs associated with the Audubon programs for golf courses.
Nugent Farms Condo-miniums	Notice of Intent 28-	Multiple unit condominium development	The development of this condominium complex removed the majority of the vegetation and trees on the hill overlooking good harbor beach from the west. The units were spread throughout the site rather than being clustered in one area. In addition the condominium association continues to sell individual small sections of land on Witham St to increase revenues resulting in the construction of additional homes along riverways that lead to Good Harbor Beach. Housing developments increase potential and known impacts to watersheds through long term residential use, ie, lawn chemicals, vehicular fluids, sand and salt for roadways, dog and pet wasted. Etc.	Stormwater controls and dedication of a portion of the land to open space. The dedicated land is tucked in between developed areas and is segmented from the harbor and rivers.
Dunkin Donuts, Eastern Ave	28-1739	Site expansion for parking and drive through	Pollution associated with parking areas, waste associated with fast food drive through and loss of vegetation and pervious surface	Detention basin, stormwater structures and vegetation planting
Fosters Service Station and storage, Eastern Ave	none	Service Station Truck stop,	The long term use of this site which predates the Wetlands Protection Act for vehicle service and storage of multiple contaminants directly above lower days pond, salt marsh and tidal river to Good Harbor Beach presents an unknown number of hazardous pollutants and contaminants to the watershed	None known

B. Historic Data

The analysis of documented water quality impairments in the Good Harbor Watershed has been performed by the Environmental Protection Agency and the Massachusetts Division of Marine Fisheries. Also, water quality monitoring of Saratoga Creek (the Creek) and Beach has been performed by the Gloucester Health Department. The 2005 CZM Non-Point Source Pollution Grant allowed the City of Gloucester to analyze all of these historic data sources in order to determine what areas of the watershed were pollution hotspots.

Unfortunately the different sources of the Good Harbor Drainage Area historic testing data could not be compared because of potential differing limits. Such differing limits were used in the historic data from the Division of Marine Fisheries. Before October 2001 the maximum limit of fecal coliform was 2401fc/100mL and after December 2001 the maximum limit was 51fc/100mL.

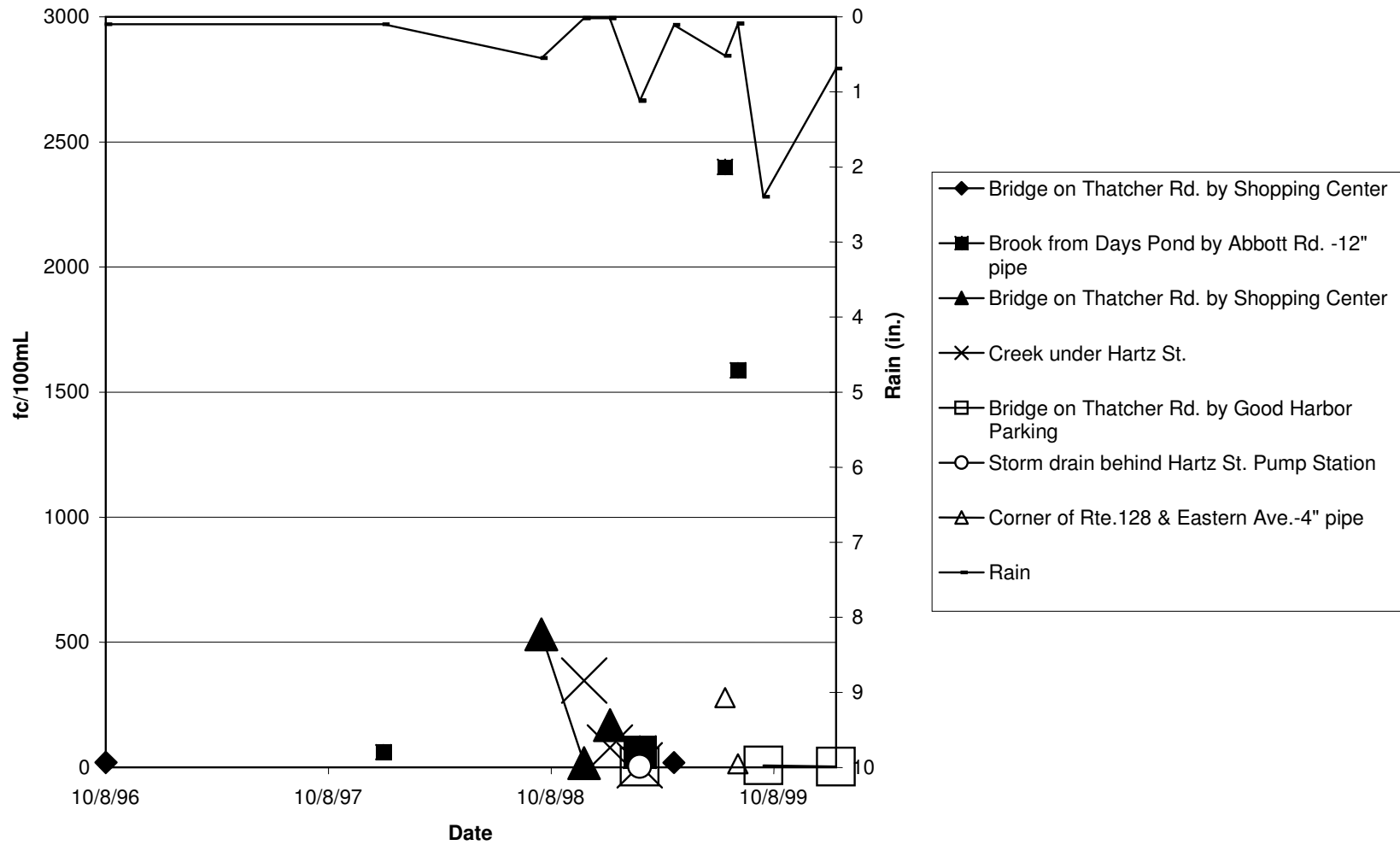
Also EPA data from the drainage area is included in Appendix A for reference, however the quantity of data was not applicable to be graphed.

The drainage of the Good Harbor Drainage Area flows either through Saratoga Creek (the Creek) system or directly to the ocean. See the attached “Map 2” for the delineation of the Drainage Area. The analysis of historic data was categorized according to the area where the testing was performed. These areas were labeled: “West Creek Branch”, “Northeast Creek Branch”, “East Creek Branch”, “Creek Upstream of the Good Harbor Footbridge (Downstream of the Creek Branches)”, Good Harbor Beach, and Saratoga Creek at the Footbridge.

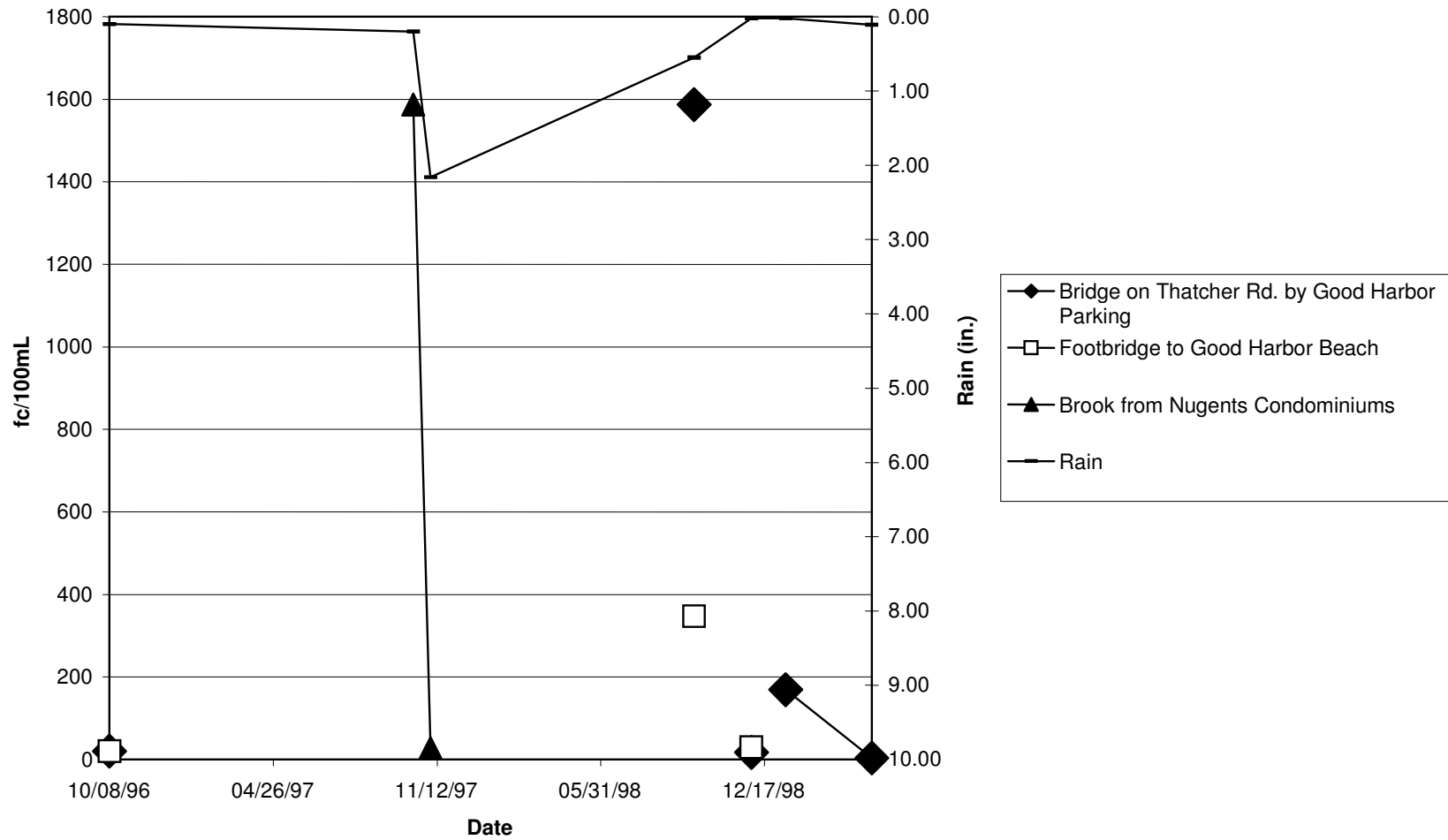
Task 3. *Compare Bacterial Exceedances with Rainfall Data*

The historic data graphs were organized (and labeled) according to the association that performed the testing and the area where the testing was performed. See attached Graphs 3-1 thru 3-12. Graphs 3-1 thru 3-11 show the relationship of stormwater to enterococci or fecal coliform historical data for the different areas of the Good Harbor Drainage Area. Graph 3-12 shows a comparison of fecal coliform historical data and salinity measurements.

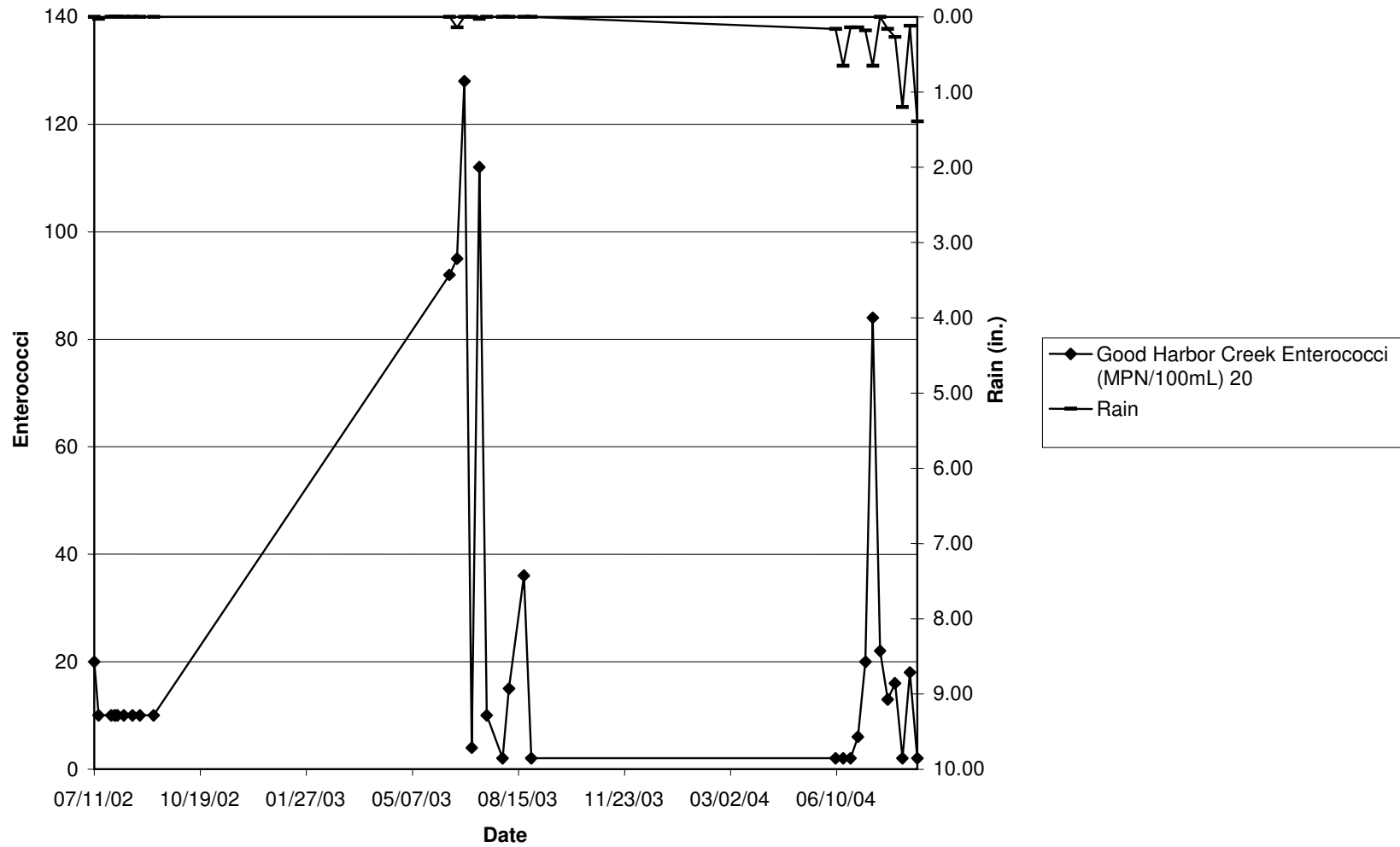
Graph 3-1: Health Department Historic Data for West Creek Branch



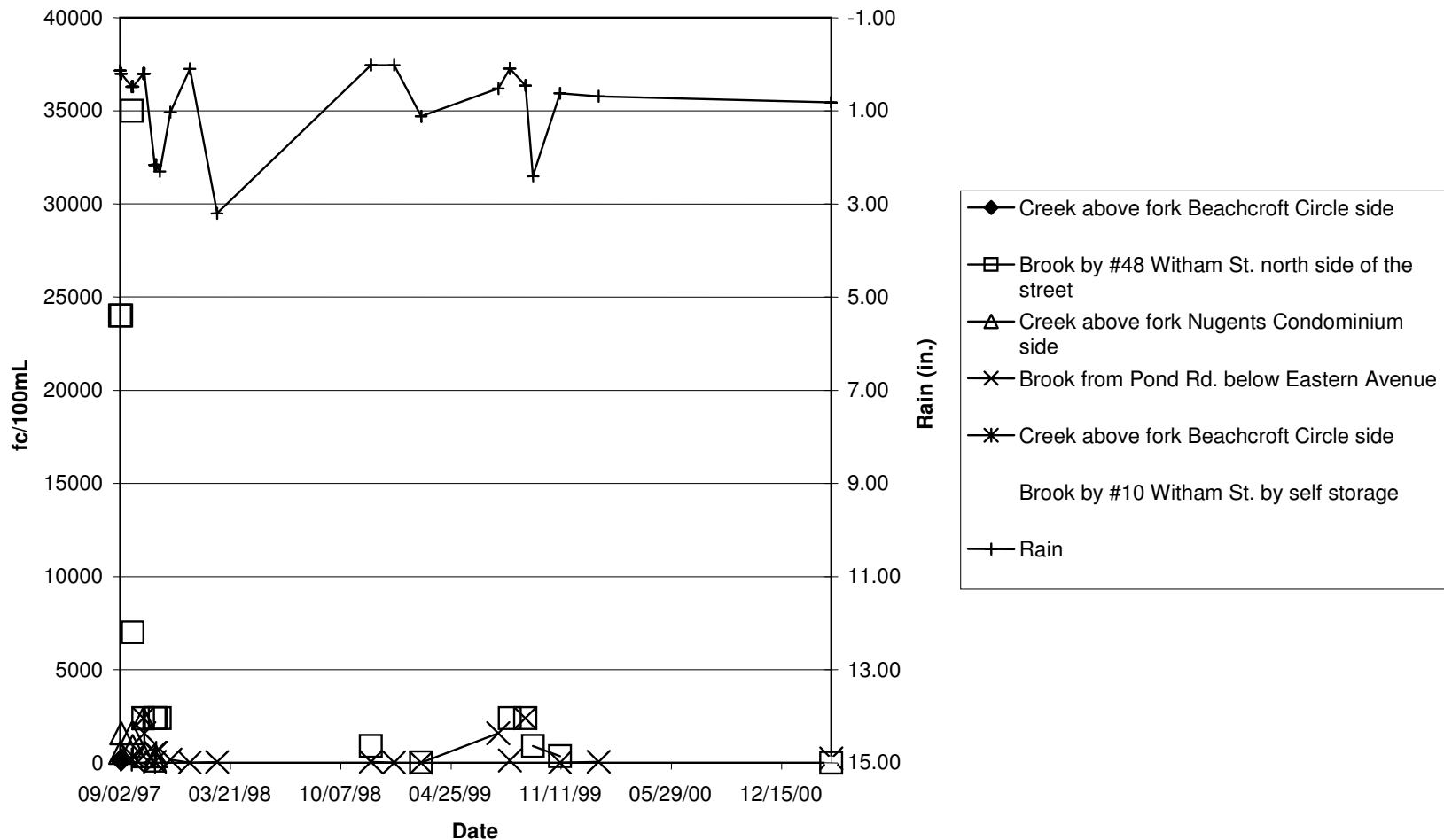
**Graph 3-2: Health Department Historic Data for the Creek, Fecal Coliform
 Footbridge**



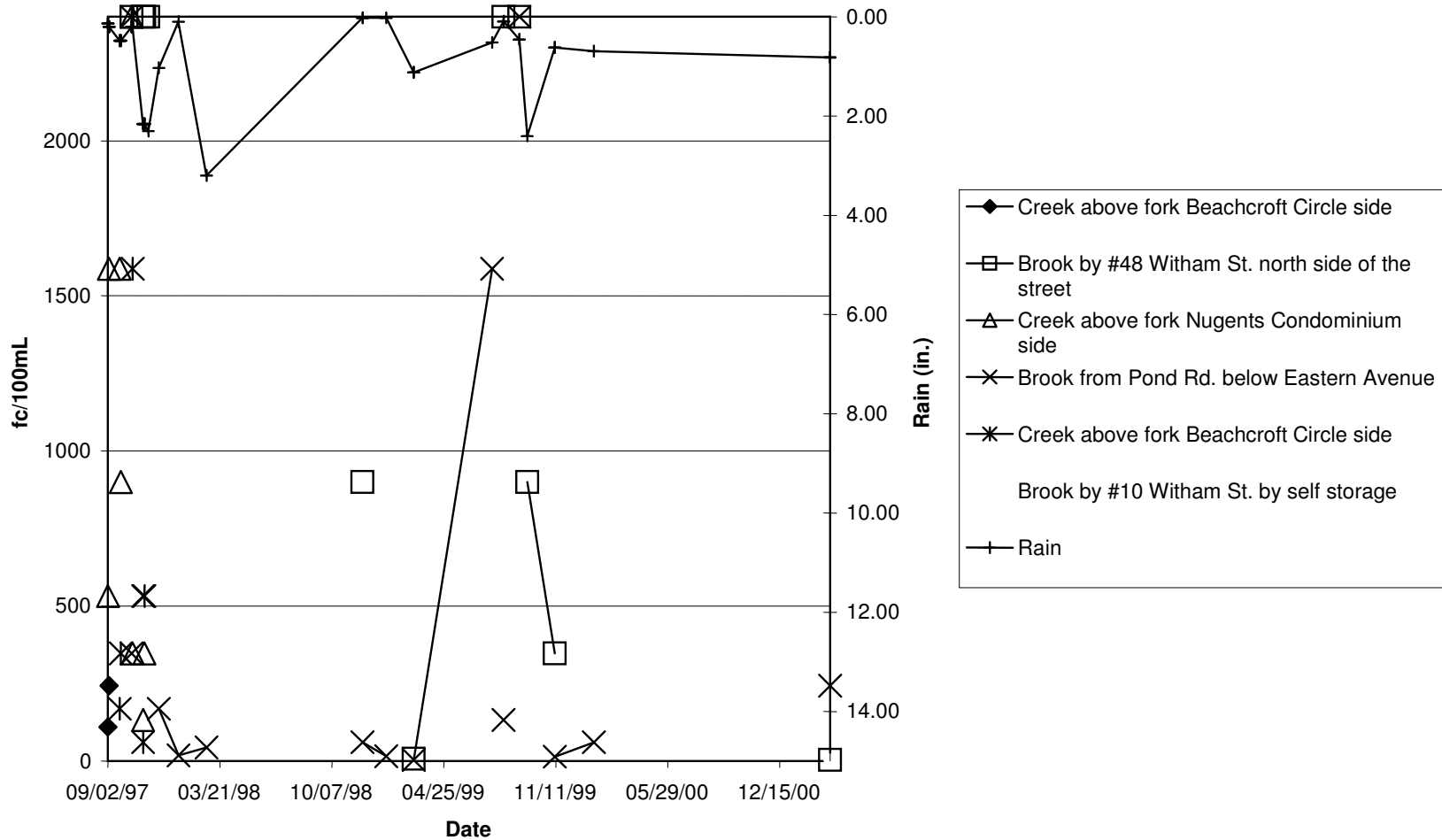
Graph 3-3: Health Department Historic Data for the Creek, Enterococci (MPN/100mL) 20



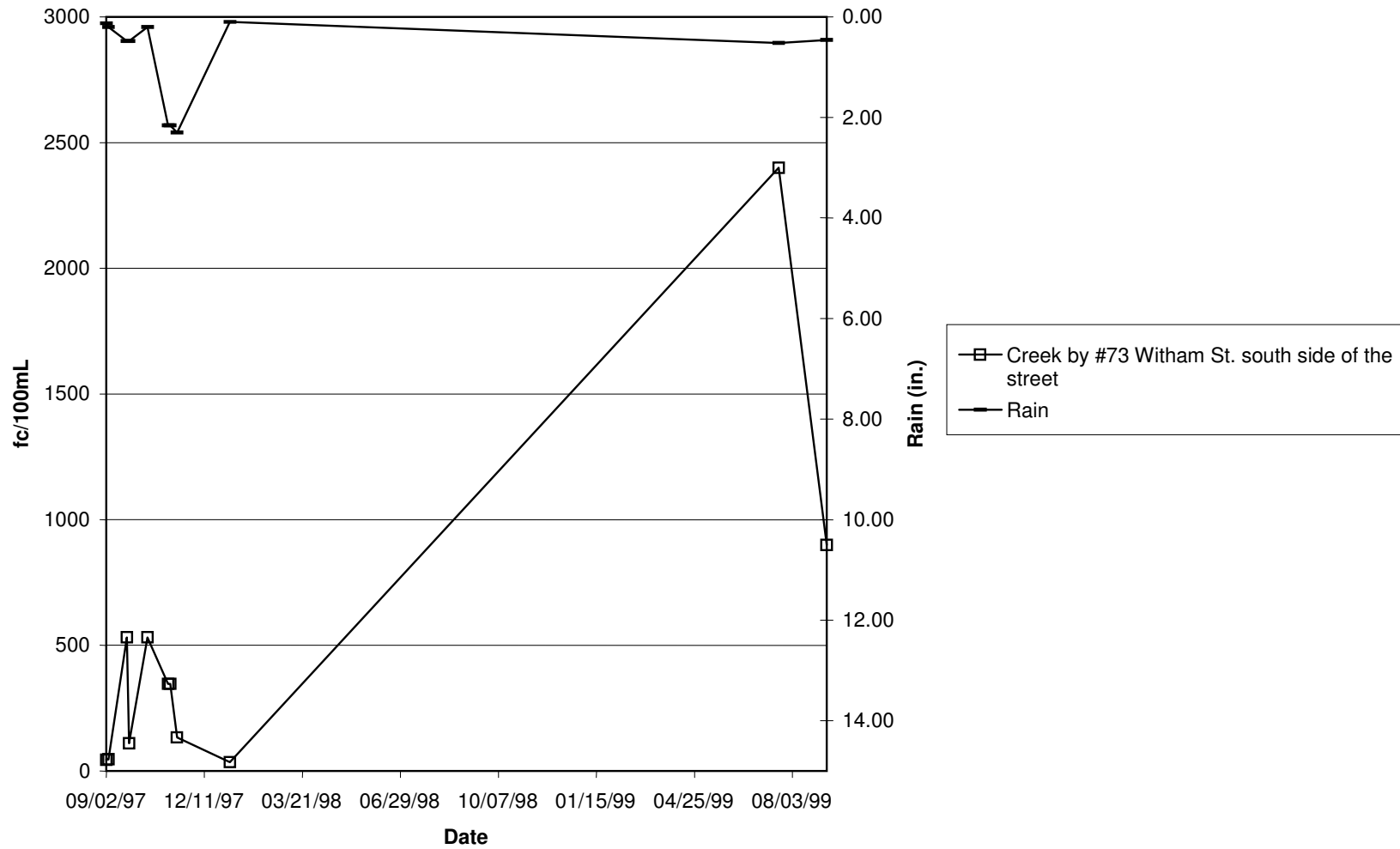
**Graph 3-4: Health Department Historic Data for Northeast Creek Branch
 (Including "Brook by #48 Witham St. north side of the street" limits)**



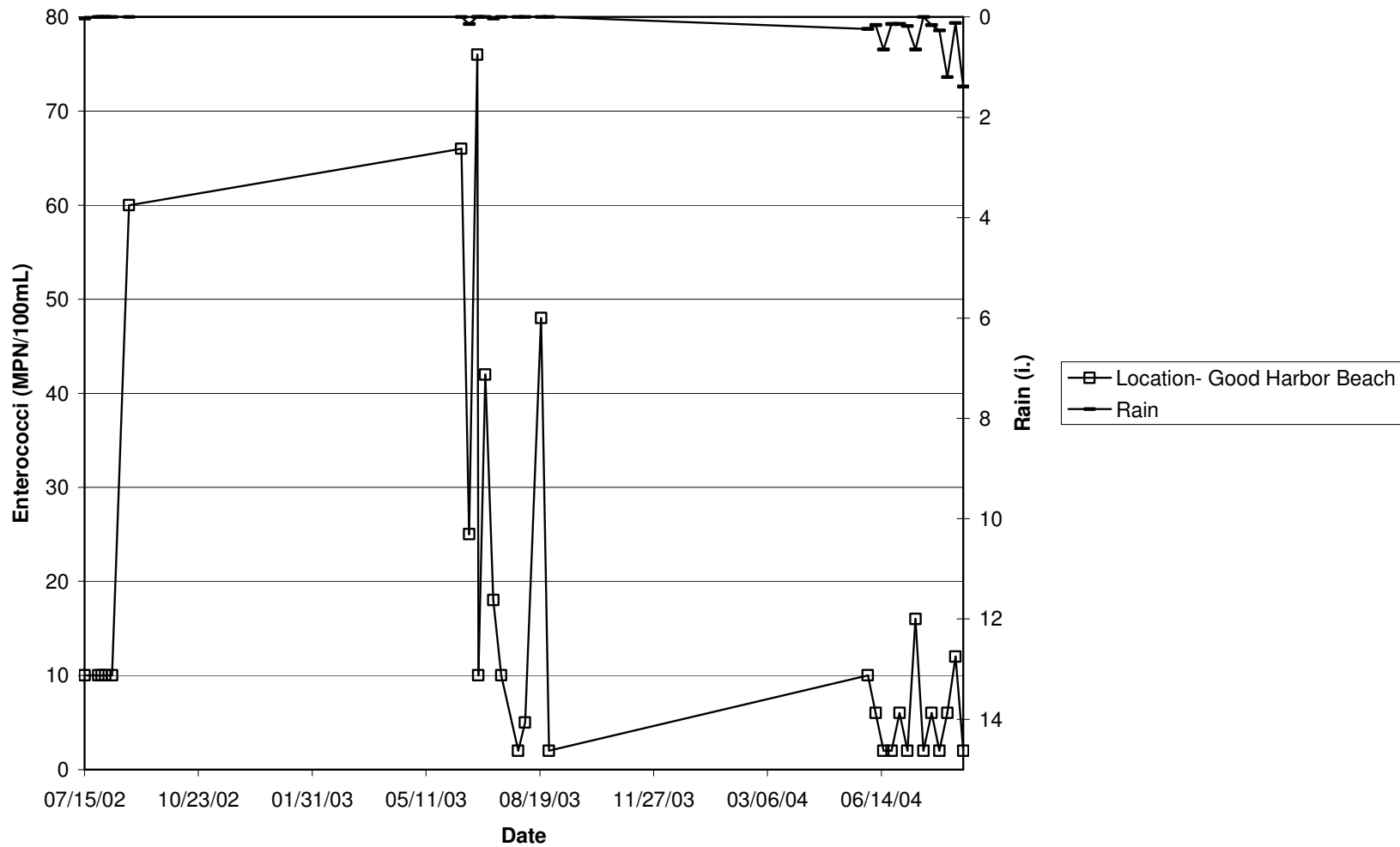
**Graph 3-5: Health Department Historic Data for Northeast Creek Branch
 (Excluding "Brook by #48 Witham St. north side of the street" limits)**



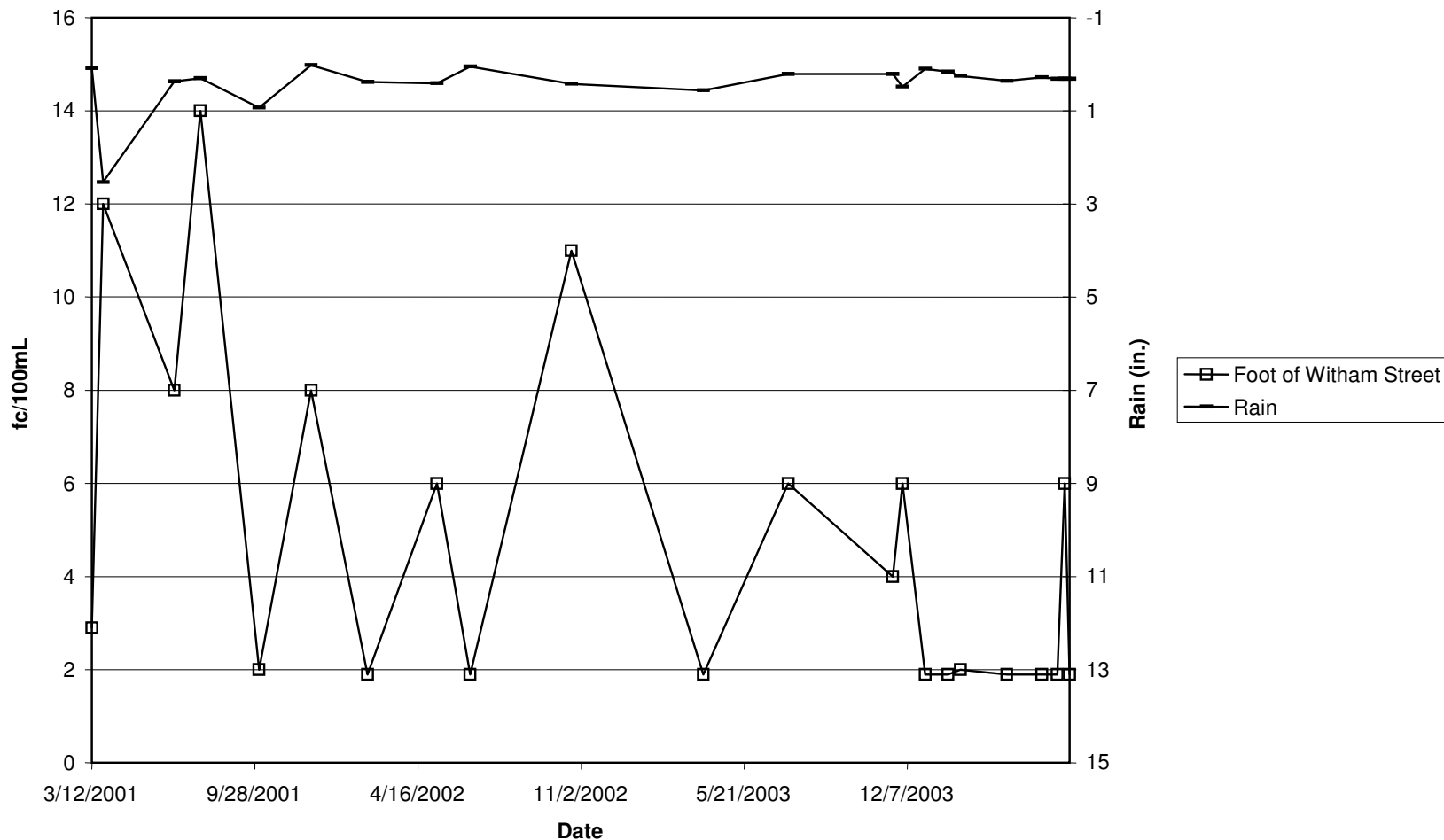
Graph 3-6: Health Department Historic Data for East Creek Branch



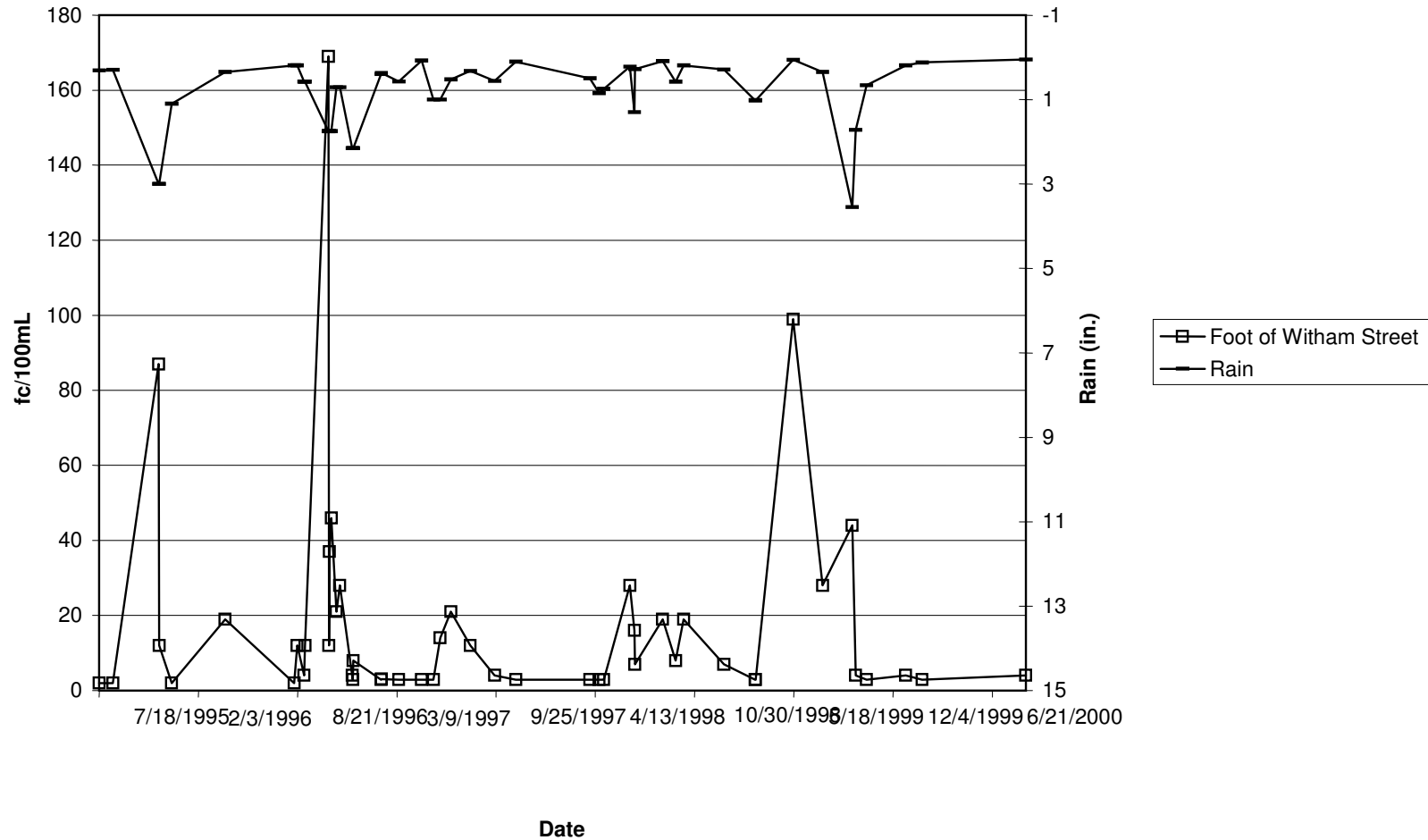
Graph 3-7: Health Department Historic Data for Good Harbor Beach



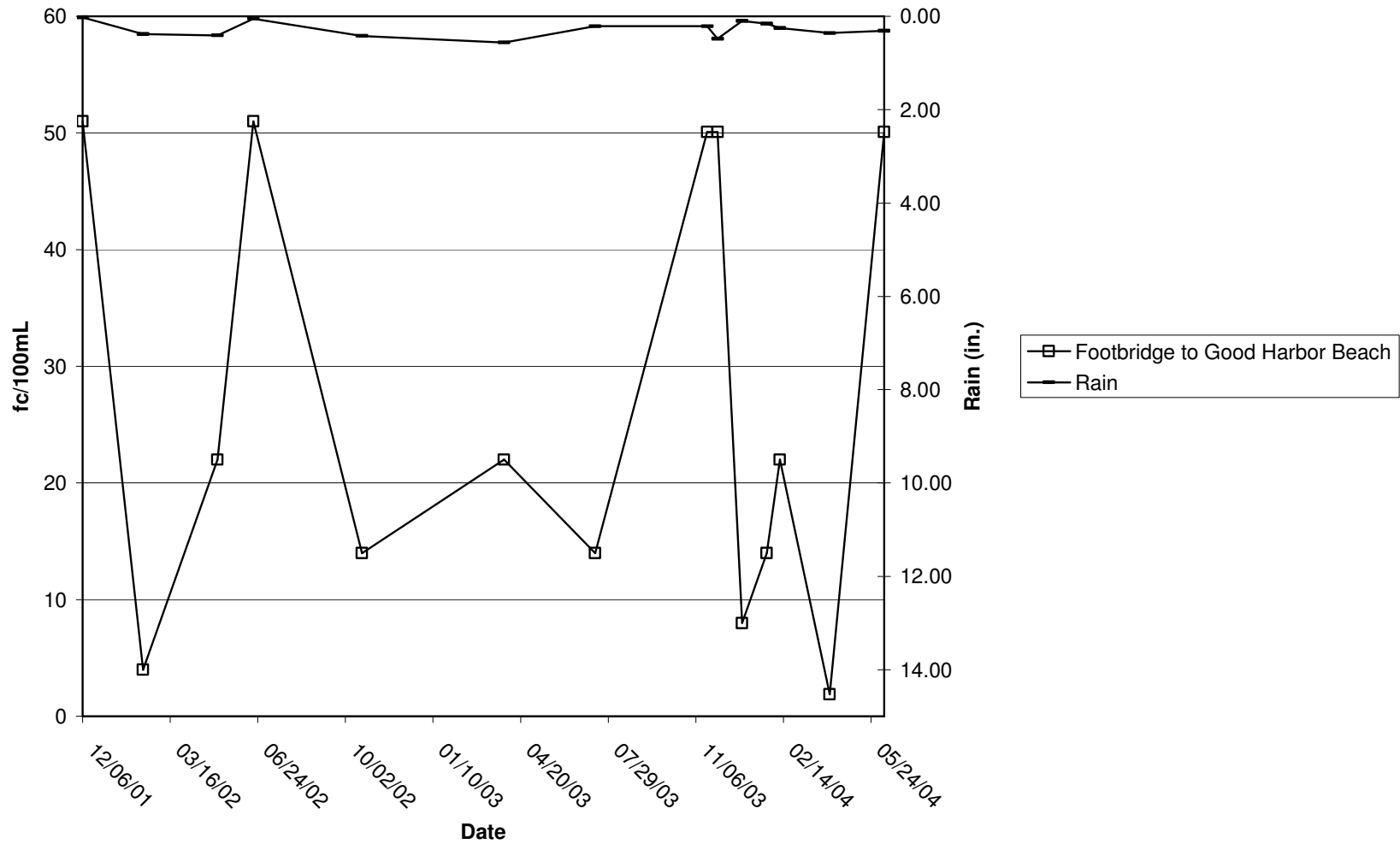
Graph 3-8: Division of Marine Fisheries Historic Data for the Creek Upstream of the Good Harbor Footbridge (after 2001)



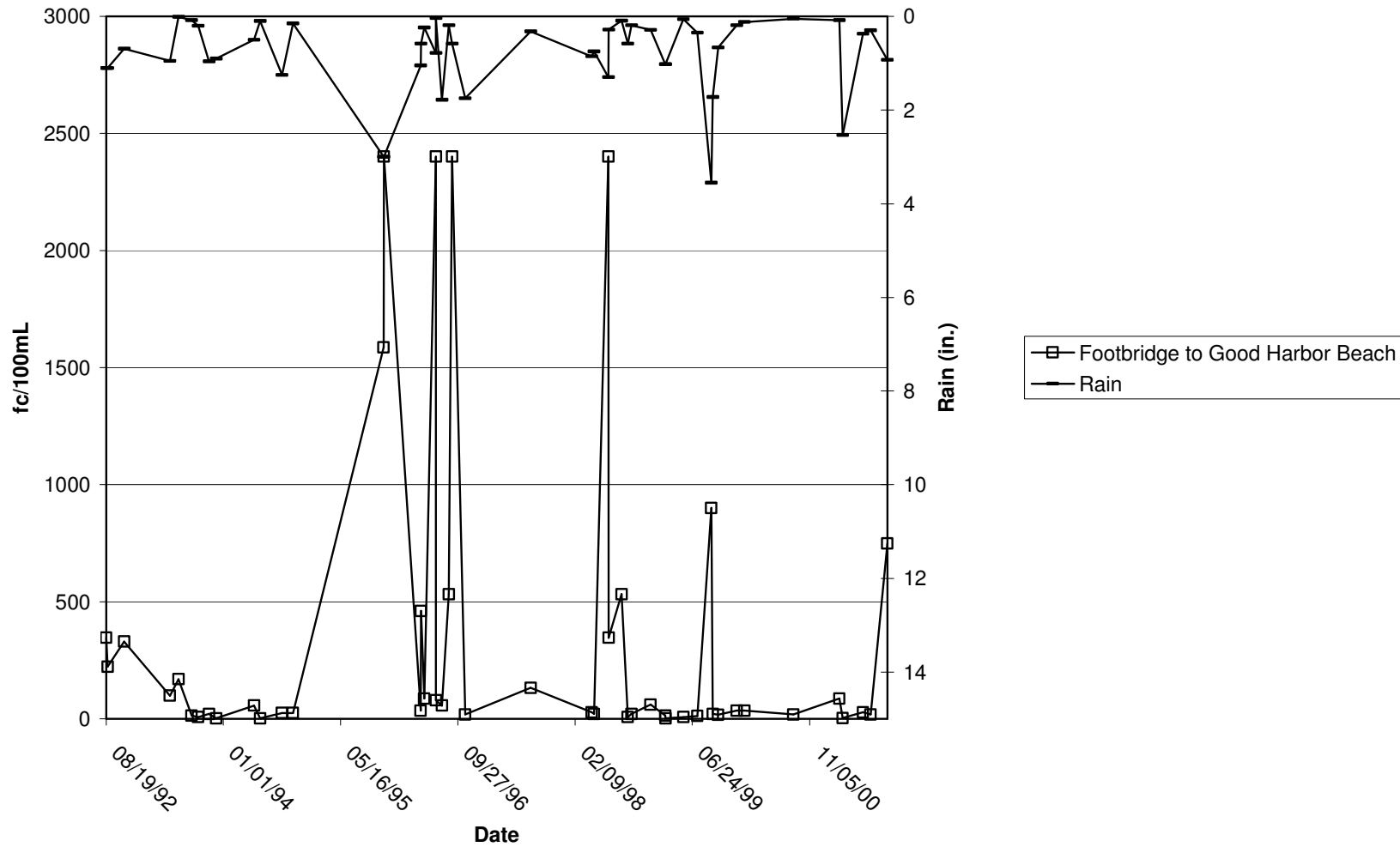
Graph 3-9: Division of Marine Fisheries Historic Data for the Creek Upstream of the Good Harbor Footbridge (Before 2001)



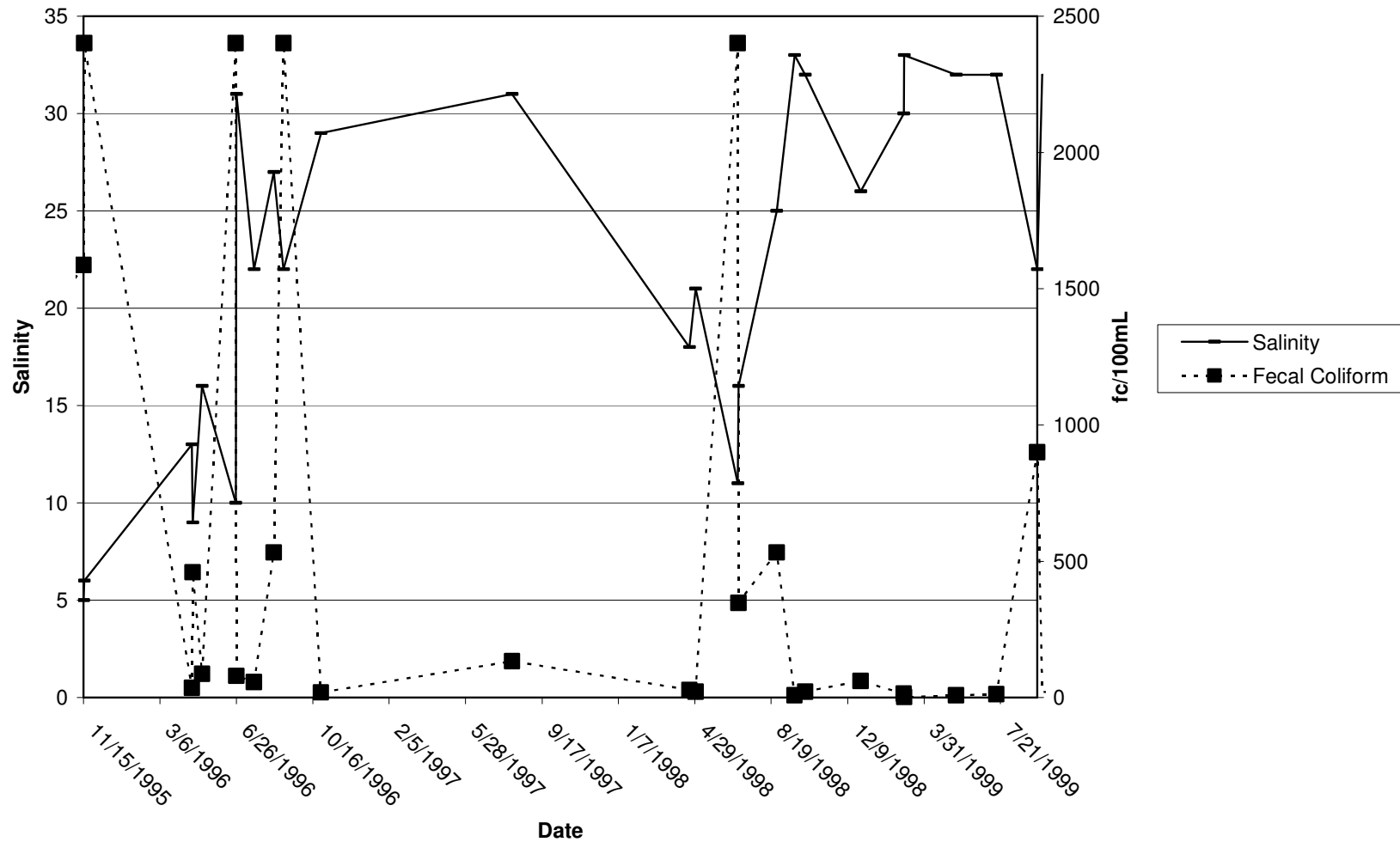
Graph 3-10: Division of Marine Fisheries Historic Data for Good Harbor Beach (After 2001)



Graph 3-11: Division of Marine Fisheries Historic Data for Good Harbor Beach (Before 2001)



Graph 3-12: Salinity and Fecal Coliform at Saratoga Creek (the Creek) (DMF Data)



Analyses of the historic data graphs show the “Good Harbor Beach” and “Saratoga Creek” to have the most positive relationship between bacteria levels and rainfall data. While it can be surmised from this information that bacteria is transported to Saratoga Creek (the Creek) and Beach through stormwater runoff, it does not indicate the location of upstream pollution sources.

Between the late 1990’s and the present, the majority of houses in the Good Harbor Drainage Area discontinued the use of on-site septic systems and are now serviced by the municipal sewer system. Therefore, historic bacterial results that were the result of failing or substandard on-site septic systems do not reflect current bacterial problems that are in some part due to increased stormwater and groundwater flow as the result of increased impervious surface and usage (Note Graphs 3-4 and 3-5 indicating very high bacteria levels on Witham Street, on which less than half of the properties currently have septic systems (see Map 2).

Therefore, the analysis of historic data alone could not be used alone to explain the problems documented by the Division of Marine Fisheries and Gloucester Health Department. Furthermore, this analysis could not directly shape the “Assessment of Potential and Actual Sources of Non-Point Source Pollution in the Good Harbor Drainage Area” sampling program.

From Graph 3-12 it can be inferred that there is an inverse relationship between salinity and fecal coliform in Sarotoga Creek (the Creek): When salinity is low, fecal coliform tends to be high and when salinity is high, fecal coliform tends to be low. Note that water quality measurements in the Creek by the Health Department determine the swimability of the Creek.

Task 4. *Delineate the Drainage Area*

The City of Gloucester contracted with BETA Group, Inc. to collect historic stormwater drainage maps and use a topography-based approach to delineate the Good Harbor Drainage Area to approximate the drainage area boundaries.

Task 5. *Field Reconnaissance*

Drainage Area Mapping

By driving around the outskirts of the entire Drainage Area and looking into catch basins, the City of Gloucester Project Staff (hereafter “Project Staff”) was able to correct the delineation. City personnel found several areas where road berms, roof drains, and catch basins redirected stormwater drainage either into or out of the drainage area.

Also, the Project Staff visited all of the outfalls within the drainage area and, with assistance of BETA Group, Inc., these locations were corrected using Global Positioning System equipment.

The attached “Map 1” is the result of this field verified investigation.

Outfall Quality

In order to further investigate potential pollution sources within the Drainage Area, the Project Staff created a worksheet titled, “Visual Investigation of Outfalls & Catch Basins”, and between July and October 2005 the Project Staff used this worksheet to describe all of the outfalls within the Good Harbor Drainage Area. At each outfall location the Project Staff wrote on the worksheet whether there was odor, sedimentation, oil/grease, scouring, dry weather flow, or any other comments (see attached worksheets).

Though the field investigation, the Project Staff were able to visually see Point Source environmental hazards within the Good Harbor Drainage Area. These pollution sources (see attached photographs) included dog waste, discarded waste, yard clippings, brush and tree trimmings deposited within coastal bank and salt marsh resource areas, sedimentation, oil/grease, improper waste disposal by homeowners and shopping center patrons, blocked/filled catch basins from roadway use and sanding, vehicle traffic, and construction.

The following observations were made during the field investigation exercise:

- Building construction next to “Outfall by #48 Witham Street”
- Vegetation recently cut within the buffer zone behind Long Beach Dairy Queen at the “Pratt” parking area
- Could not locate terminal end of storm drain by #136 Bass Ave.
- Outfall below Barn Lane almost totally blocked by sedimentation
- Couldn’t find outfall from “Wolf Hill” parking lot to Days Pond
- Outfall by #17 Witham Street is clogged and yard is soaked. The clay tile has separated no City easement.
- Outfalls on Rte.128 near corner of Bass Avenue and behind Hartz Street pump station are totally blocked with sediment.

Also as part of the “Field Reconnaissance” task, the Project Staff found the traces of two building sewers which had not been connected to the municipal sewer system, but had been recorded by both the Engineering Department and the Health Department with a sewer system. Since these properties were not connected to sewer, they were then connected to septic systems. According to local regulation, the Gloucester Health Department is responsible to ensure that the functionality of every on-site septic system is checked at a minimum of every 3.5 years.

Field Work Outreach

As part of the “Field Reconnaissance” task, the Project Staff met with homeowners, the maintenance provider of the Golf Course (Bass Rocks Golf Course), Gloucester Department of Public Works (DPW) personnel, Industrial Park representatives, and local landscapers within the Good Harbor Drainage Area. These meetings occurred both formally and informally, in the field and in the office.

The Project Staff found that when homeowners were approached about potential source pollution issues, most homeowner did not immediately acknowledge the problem. Instead these meetings usually began with a discussion about the source pollution issues at a neighbor's property (as opposed to their own). Some of these meetings were constructive and the homeowner was able to receive personal criticism about their environmental practices, but this was not always the case.

The meeting with the Golf Course maintenance provider was very constructive. The provider was very interested in working with the Project Staff to do whatever could be done to provide environmental protection at the Golf Course. Changes that were discussed included discontinuing some pesticide and herbicide use, use of native grasses requiring less chemical applications, and upkeep of a grassy vegetated buffer area around the pond to reduce the contamination of geese droppings in Saratoga Creek (the Creek). The golf course manager is in process of implementing Best Management Practices and Limited Impact Technologies throughout the course as outlined in the International Audubon Management Plan for golf courses. Working with the Conservation Department, several changes to control and treat stormwater and surface water on site have been implemented.

The Project Staff met in cooperative outreach with DPW personnel to establish a catch basin cleaning and maintenance schedule. This conversation included the potential for retrofitting catch basins to establish initial pretreatment prior to discharge into resource areas.

The Project Staff also initiated conversation and site review with representatives of the EDIC and Blackburn Industrial Park developers and representatives to minimize impacts and improve vegetated buffers throughout the industrial site.

The Project Staff initiated outreach with local landscapers and began discussion about creating brochures and educational handouts to distribute to the public and their clients. Landscapers agreed that a handout should include information regarding organic landscaping, potential long term health risks from use of toxins in residential environments, and use of vegetated buffers and native-non-invasive plantings to control and maintain landscapes.

Task 6. *Review Records & Map Septic Systems*

The Gloucester Health Department, Engineering Department, and BETA Group, Inc. collaborated to identify lots with septic systems, lots serviced by sewer, and vacant lots. This map is attached and is titled, Map 2.

Task 7. *Water Quality Sampling*

Based on the information collected from Tasks 1-6, water sampling locations were selected which were safe and accessible and which would provide an approximate

depiction of the water quality of Saratoga Creek (the Creek) and the Creek Branches. See attached testing results data. This water quality sampling included “Wet” vs. “Dry” weather sampling, optical brightener testing (the presence of bluing agents found in laundry effluent), and salinity measurements.

With approval from the CZM Program Manager, the Project Staff did not analyze the number of samples detailed within the Scope of Services. Instead, samples were taken from seven (7) locations from West Creek Branch, East Creek Branch, and at the footbridge to Good Harbor. (Refer to Map1) The sampling locations were accessible to the Project Staff and strategically located to block in potential contamination zones.

Table 7-1: In order to determine the water quality of Saratoga Creek (the Creek) and the Creek Branches, the following seven (7) locations were tested: (The location ID numbers correlate with those indicated on Map1.)

Location ID	Location Description	Related Area of Good Harbor Drainage Area
#0	Footbridge to Good Harbor Beach	Saratoga Creek (the Creek)
#1	Bridge to Thatcher Road by Shopping Center	West Creek Branch
#1A	Brook from Days Pond by Abbott Road- 12” pipe	West Creek Branch
#1C	Creek under Hartz Street	West Creek Branch
#3	Bridge on Thatcher Road by Good Harbor Parking	Creek Upstream of the Good Harbor Footbridge
#3E	Brook by #10 Witham Street by “Self Storage”	Northeast Creek Branch
#3F	Brook from Pond Road below Eastern Avenue	Northeast Creek Branch

“Wet” vs. “Dry” Weather Sampling

The “Wet” vs. “Dry” weather samples were tested for pH, TSS, Nitrate, and VOC on both “Wet” and “Dry” weather days. The chosen “Wet” day was November 17, 2005 following 0.55 inches of rain and the “Dry” day was December 20, 2005 following 3 days without rain. These samples were tested by Biomarine, a State of Massachusetts certified laboratory.

Table 7-2: The following laboratory results were determined from the “Wet” vs. “Dry” Weather Sampling: (please see attached results)

ID	Sample Location	November 17, 2005				December 20, 2005			
		Rain	pH Value (s.u.)	TSS (mg/L)	Nitrate (mg/L)	Rain	pH Value (s.u.)	TSS (mg/L)	Nitrate (mg/L)
#0	Footbridge to Good Harbor Beach	0.55”	6.52	5.5	0.2	0”	6.68	6	0.62
#1	Bridge to Thatcher Road by Shopping Center		6.67	4	0.3		6.59	7	1.08
#1A	Brook from Days Pond by Abbott Road- 12” pipe		6.52	<1	0.2		6.01	<1	0.8

ID	Sample Location	November 17, 2005				December 20, 2005			
		Rain	pH Value (s.u.)	TSS (mg/L)	Nitrate (mg/L)	Rain	pH Value (s.u.)	TSS (mg/L)	Nitrate (mg/L)
#1C	Creek under Hartz Street		6.63	<1	1.1		6.42	<1	2.0
#3	Bridge on Thatcher Road by Good Harbor Parking		6.27	3	0.2		6.36	10	0.68
#3E	Brook by #10 Witham Street by "Self Storage"		6.15	<1	<0.2		6.03	<1	0.2
#3F	Brook from Pond Road below Eastern Avenue		5.93	2	0.3		5.77	1	0.64

With only one (1) sampling result for "Wet" and "Dry" weather sampling per location, results merely describe the situation at a particular moment in time and therefore cannot definitively describe the dynamics of a particular location. This information can be added to future sampling results to reach more accurate conclusions. However, the following observations were made from the testing: pH values were not consistent- some locations experienced higher and others experienced lower pH during "Wet" weather sampling; Most samples were found to have either consistent or higher TSS concentrations during the "Wet" weather sampling except for the "Brook from Pond Road below Eastern Avenue" location which experienced higher TSS concentrations during the "Dry" weather sampling; and Nitrate was higher in the "Wet" weather sampling; the highest concentrations of nitrate were found in the "Creek Under Hartz Street" and "Bridge to Thatcher Road by Shopping Center" locations (both in the "West Creek Branch").

Research by the Project Staff found that salt water tends to have a pH value between 8-8.4. However all locations during "Wet" and "Dry" weather sampling experienced much more lower (more acidic) pH values, which may be the result of freshwater influence or residential activity. The "Brook by #10 Witham Street by "Self Storage"" and "Brook from Pond Road below Eastern Avenue" locations experienced the most acidic sampling results, which would make sense given that these locations are the most removed from either tidal affects and potentially more affected by residential affects. The difference in the "Wet" and "Dry" weather sampling results for each location did not present decisive results. The results of the pH sampling results should therefore be used to better analyze future sampling results.

The higher TSS concentration within the "Wet" weather sampling at the "Brook from Pond Road below Eastern Avenue" location is of particular concern to the Project Staff. These results, in relation to the location, indicate a greater affect from of siltation most likely from road runoff (sanding operations and vehicle traffic on Pond Road). The higher TSS concentration within "Dry" weather sampling at the "Footbridge to Good Harbor Beach", "Bridge to Thatcher Road by Shopping Center", and "Bridge on Thatcher Road by Good Harbor Parking" locations are more likely the results of dilution in comparison to the "Wet" weather sampling and to tidal affects.

The high nitrate concentration were found within the West Creek Branch (“Creek under Hartz Street” and “Bridge to Thatcher Road by Shopping Center”) and the “Brook from Days Pond by Abbott Road- 12” pipe” location are of particular concern to the Project Staff. The West Creek Branch locations experienced diminish concentrations in the downstream direction. This affect is potentially the result of documented sewer problems which within the area uphill of the “Creek Under Hartz Street” (see Table 2-2).The high nitrate concentrations found at the Days Ponds location are also of concern to the Project Staff. These results may be caused by the health of the Pond itself which has been severely distressed for many years.

Table 7-3: The following locations contained detectable limits of Volatile Organic Compounds (VOC’s) (taken from the Wet vs. Dry Weather Sampling):

Date of Test	Location ID	Sample Location	Rain	Chemical Found	Amount Detected (µg/L)
11/17/05	#1	Bridge to Thatcher Road by Shopping Center	0.55”	Tetrachloroethylene	0.69
11/17/05	#1A	Brook from Days Pond by Abbott Road- 12” pipe	0.55”	Methyl Tertiary Butyl Ether	1.4”
12/20/05	#1	Bridge to Thatcher Road by Shopping Center	0”	Tetrachloroethylene	0.95
12/20/05	#1	Bridge to Thatcher Road by Shopping Center	0”	Chloroform	0.58
12/20/05	#1A	Brook from Days Pond by Abbott Road- 12” pipe	0”	Methyl Tertiary Butyl Ether	1.8”

All VOC contaminates detected within the “Wet” vs. “Dry” Weather Sampling are of concern to the Project Staff. The amount of each of these contaminants appears to have been diluted with the “Wet” weather sampling and the detection of contaminant during “Dry” weather conditions indicates potential groundwater contamination.

The contaminant Methyl Tertiary Butyl Ether was detectable in both “Wet” and “Dry” weather sampling within sampling location #1A, however downstream at sampling location #1, the contaminant was not detected.

Also, the contaminant Chloroform was detected only in “Dry” weather sampling at the downstream location #1 and not at sampling location #1A.

Note in Table 2-1 that a hazardous waste release was reported at 6 Thatcher Road (Area of “WTG Realty Trust” and “Nor’East Cleaners, Inc.”) of Chlorinated Solvent on October, 2002 and May 2004.

Optical Brightener

Optical brightener testing (the presence of bluing agents found in laundry effluent) was performed at each of the water quality sampling locations between July 13 and November

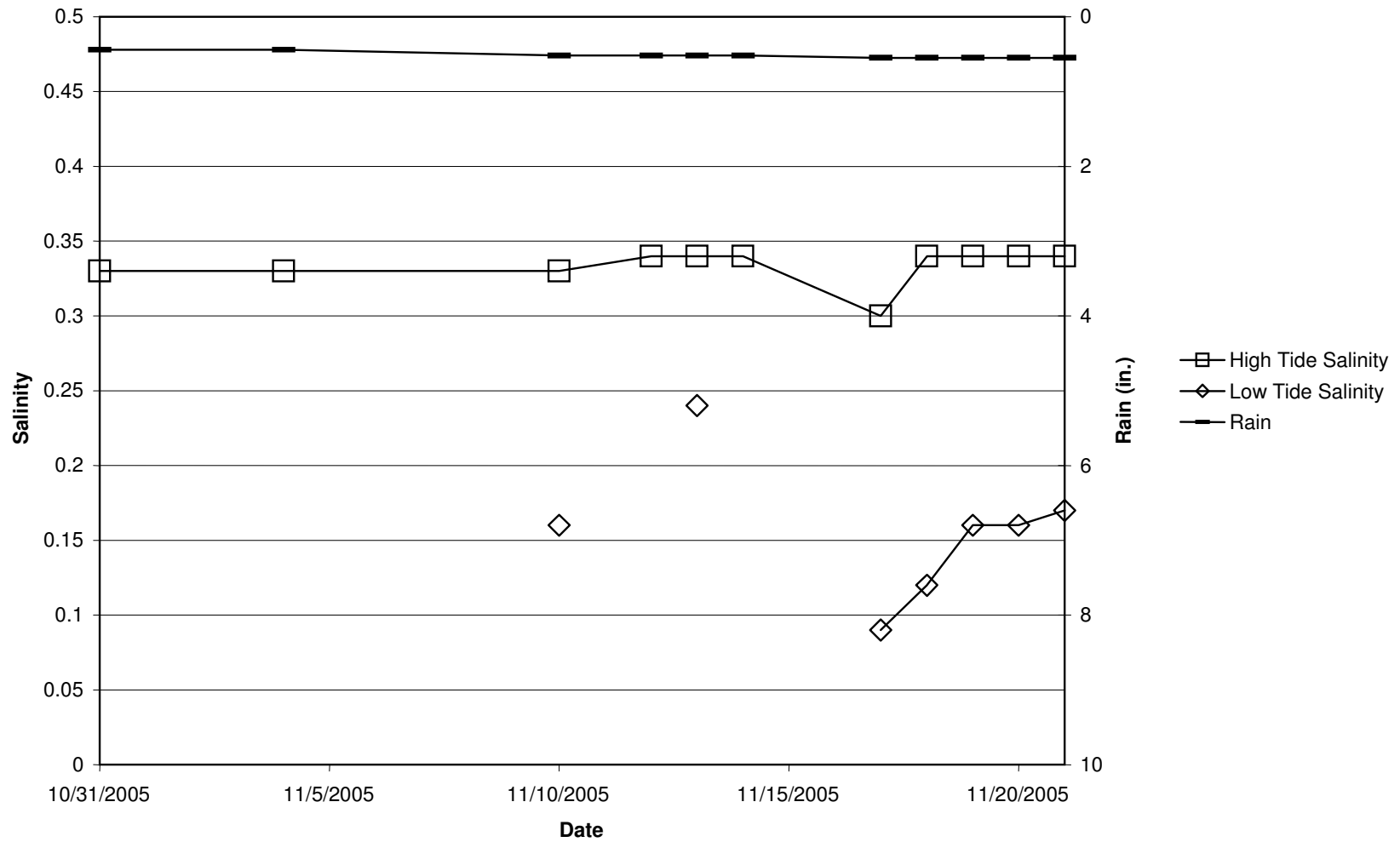
27, 2005 (see attached reports). Although there were not any positive results from optical brightener sampling, it should be noted that many industrial buildings and businesses do not have laundry facilities. The testing exercise provided both qualitative data and again a chance for visual observations. The following observations were made during the optical brightener testing exercise:

- Raccoon droppings at stream opposite Long Beach Dairy Queen location
- Geese and ducks at Thatcher Road by Good Harbor parking location
- Sea gulls and people walking dogs on the beach at the Footbridge to Good Harbor Beach
- Water bubbling out of catch basin opposite #16 Old County Road
- Heavy wrack line and debris (including syringes) next to the Footbridge to Good Harbor Beach.

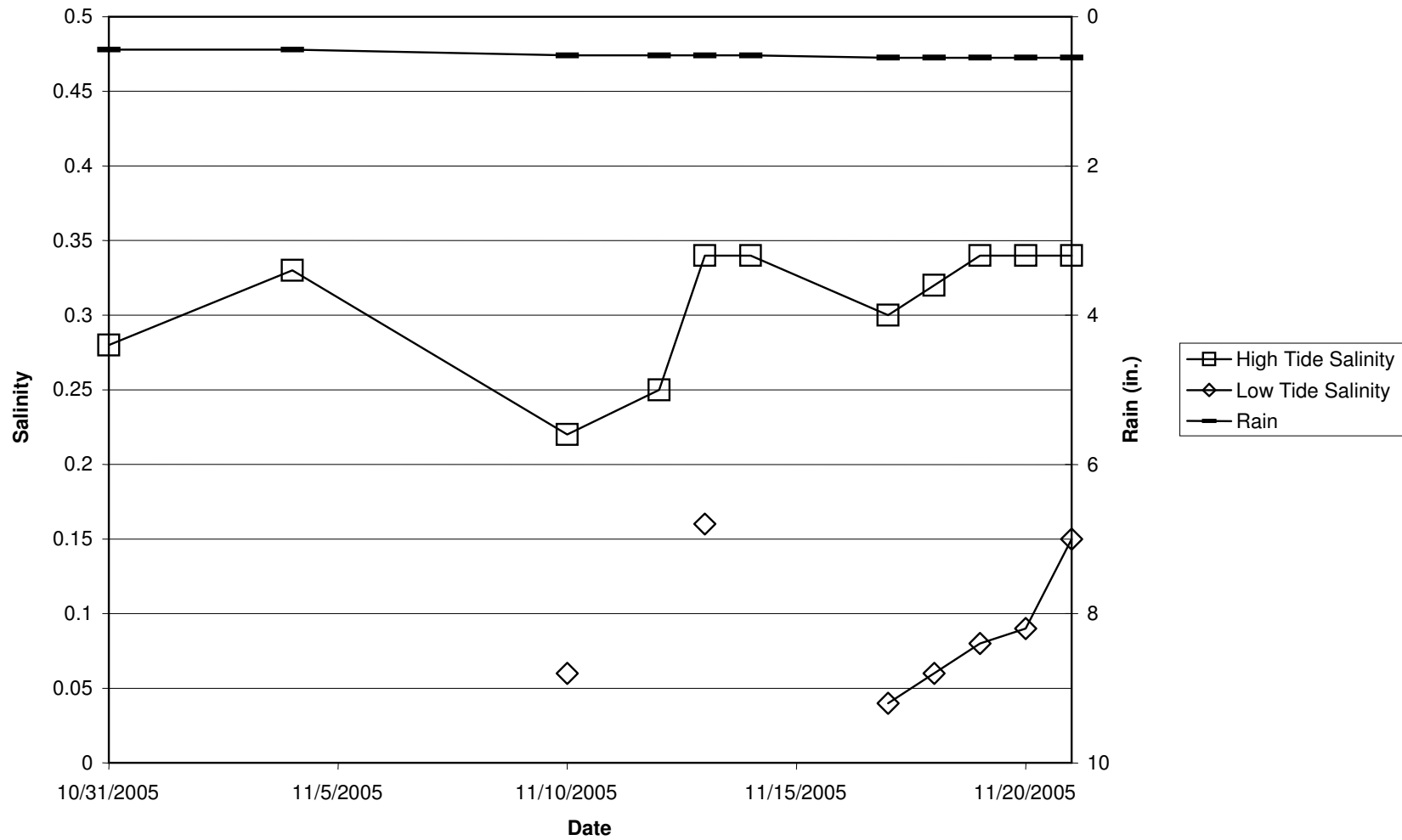
Salinity Measurements

The following graphs reflect salinity measurements (see the following graphs) taken within the Good Harbor Drainage Area:

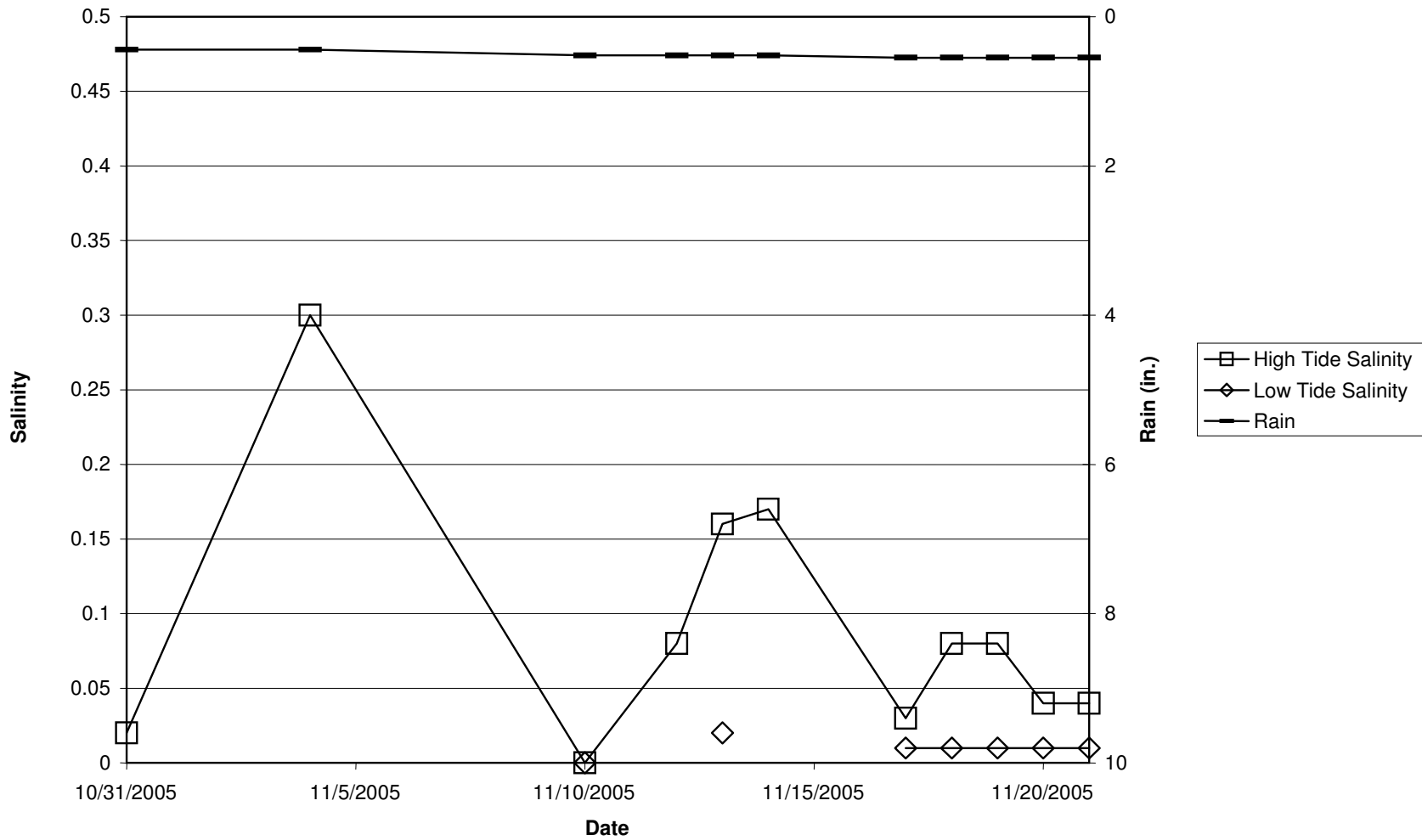
Graph 3-1: Salinity at location #0- Footbridge to Good Harbor Beach



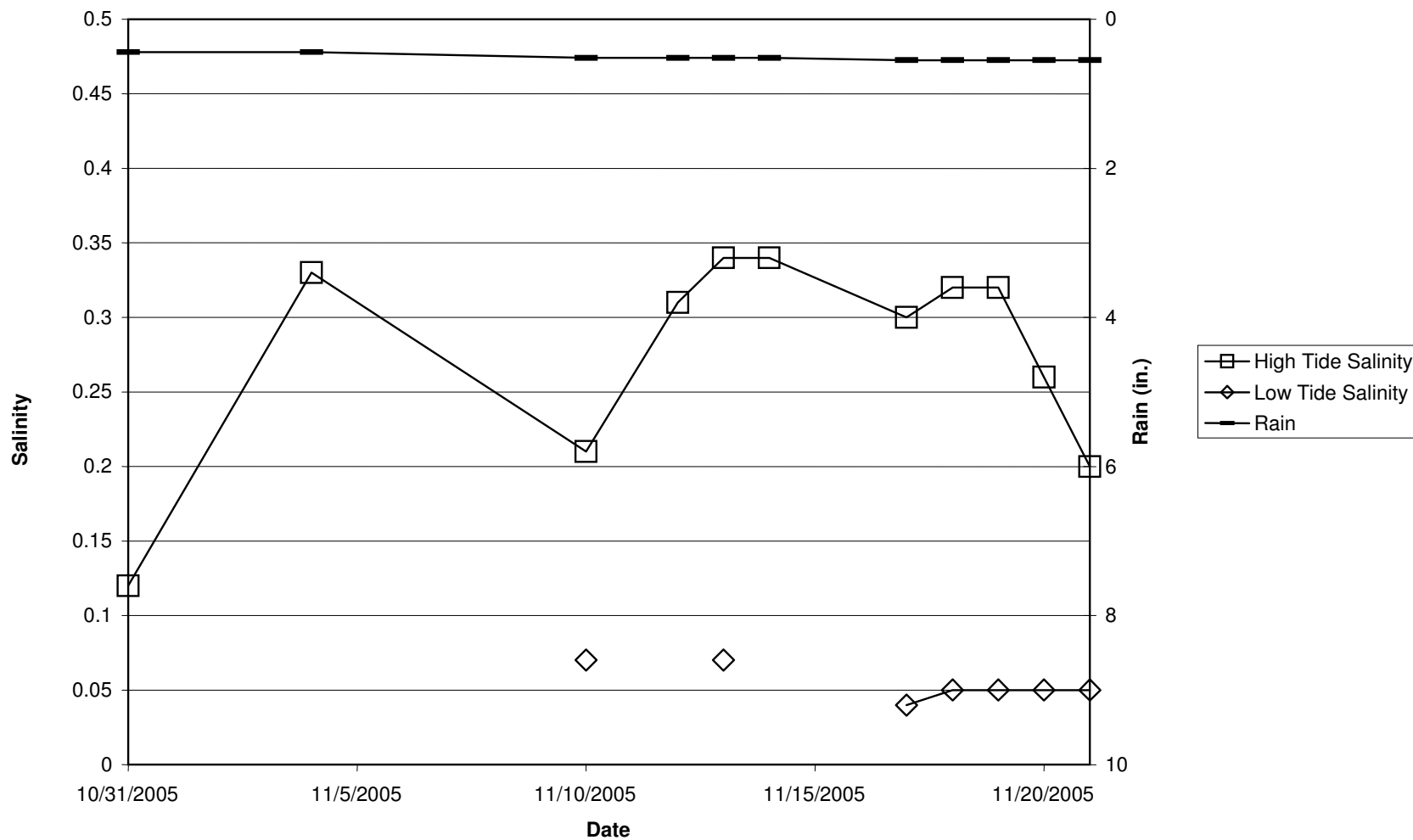
Graph 3-2: Salinity at location #1- Bridge on Thatcher Rd. by Shopping Center



Graph 3-3: Salinity at location #1C- Creek Under Hartz St.



Graph 3-4: Salinity at location #3- Bridge on Thatcher Rd. by Good Harbor Parking



As expected, the results of salinity sampling indicate that at high tide salinity is higher than at low tide at all test locations. Dry and wet weather salinity measurements taken at low water indicate that there is a large amount of fresh water that enters this salt marsh environment (presumably from elevated stormwater and groundwater flow). Elevated stormwater and groundwater flows are often encountered when impervious surfaces are increased.

Salinity levels in saltwater marshes are generally lower in the late spring/ early summer and higher in the late summer/ early fall (Burdick and Buchsbaum, 1999). Even though salinity sampling within the Good Harbor Watershed was conducted just after the growing season, it is likely that similar salinities would be present in late spring and early summer. Of particular concern were dry weather results from sampling location #1c - the West Creek Branch under Hartz Street and sampling location #3 - the East Creek Branch at the Bridge on Thatcher by Good Harbor Parking. Not only were dry weather salinities low at these locations, but both sites are just downstream from brackish marsh systems that had at one time had been functioning saltmarsh ecosystems. Salinity within brackish marshes can vary from moderately high (18 parts per thousand) to essentially freshwater (.05 parts per thousand).

Elevated freshwater flow from stormwater runoff diminishes salinity and, over time, can alter a saltmarsh into a brackish marsh that often times is dominated by the common reed (*phragmites australis*). This is of particular concern because *phragmites* dominated wetlands are essentially monoculture that has replaced a more diverse natural plant/ animal community which is the signature of a healthy saltmarsh ecosystem. It should be also noted that saltmarshes provide important spawning and nursery habitat for the recreational and commercially valuable fish and shellfish industries. An estimated 71% of the dockside value of fish landed in the United States is derived from fish species that depend directly or indirectly on coastal wetlands.

Task 8. *Prepare Preliminary Recommendations*

A. Continuation of the Conservation Community Service Program

Through this grant, the Conservation Office began a remediation program for violations within the watershed which requires offenders to complete community service tasks based on remediation. The identified persons evaluate and document impacts, then provide mitigation such as pollution prevention, cleanup, and vegetation planting to increase vegetative buffers between resource and human use areas. The Project Staff recommends that this program become part of Conservation Commission policy.

B. Identification of Impacts of Stress on the Salt Water Watershed

The result of the low salinity measurements within the salt water marsh area, which appears to comprise most of the Good Harbor Drainage Area, is of particular concern to the Project Staff. Stress on a salt water wetland has been proven to not filter nutrient and bacteria loadings, and the concern appears to be very possible within this drainage area.

It is the recommendation of the Project Staff that the following tasks are completed in order to protect the salt water wetland:

- There should be no additional freshwater flow to this watershed.
- An in depth study focusing on mitigating existing freshwater impacts within this watershed should be conducted.
- Salinity measurements should be taken from the same sampling locations throughout the growing season.

C. Change Health Department Sampling Procedure at Saratoga Creek (the Creek)

It was found in Task 3 that bacteria levels in Saratoga Creek (the Creek) are higher with lower salinity. Since the salinity measurements taken as part of the “Assessment of Potential and Actual Sources of Nonpoint” grant showed that low tide exhibits the lower salinity readings, it can be surmised that Health Department bacteria samples to determine swimming conditions should be taken at low tide. Also, the Project Staff noted that children tend to swim in the Creek at low tide when the water is warm and shallow. However, Health Department staff have historically taken these samples at high tide. Therefore, it is the recommendation of the Project Staff that this practice be changed and that samples are instead taken at low tide.

D. Encourage the Public to Remove Dog Waste on Good Harbor Beach

The excess waste observed from the off-season walking of dogs on Good Harbor Beach leads the Project Staff to recommend that the Health Department restore funding for “Mutt Mitts”. These plastic bags should be stored at accessible locations for the public to use. The Project Staff also recommends that an informational kiosk be erected alongside the walking entrance to Good Harbor Beach with a portion describing the contamination potentials of dog waste on the beach.

E. Development of a Beach Management Plan

The Project Staff recommend outreach with Department of Public Works to accelerate development and maintenance of a Watershed Management Plan to include a Beach Management Plan. A Beach Management Plan for Good Harbor Beach could be used as a template for other beaches within the City. This Management Plan should include solutions to educate people about not walking on the dunes and taking care of pet waste on the beach. It should also serve as an educational document for the Department of Public Works (DPW) concerning proper dune restoration activities.

F. Periodic Updating of Existing City Wetland Maps within the Good Harbor Drainage Area

The Project Staff found that the City of Gloucester wetlands maps did not correspond directly with actual wetlands. It is the recommendation that funding be sought to survey the wetlands in order to update the existing maps. As wetlands migrate and change over time, the recommendation includes periodic review and updating of these boundaries as well as tracking of changes over time of both gain and loss of wetland resources. This accuracy and understanding of the changes both natural and human impacted will assist all departments within the City of Gloucester to better protect these resources.

G. Determination of Sewer System Capacity

As the result of the number of sewer overflow problems within the Good Harbor drainage area, the Project Staff recommends that the capacity of the sewer system be determined. The results of an Infiltration/Inflow (I/I) study through the Engineering Department are critical to determine whether existing problems are the result of storm water filling the sewer system.

It is the recommendation of the Project Staff that a moratorium be placed on further connections to the system until this analysis is complete. Such potential connections include some of the currently unsewered houses within the neighboring Town of Rockport abutting the Gloucester Good Harbor Drainage Area and potential development at Brierneck Crossing.

The Project Staff also recommends a format be in place to facilitate communication City Departments regarding sewer complaints, sewer related problems, and sewer related design.

H. Change in Catch Basin Cleaning and Street Sweeping Maintenance Program

It is the recommendation of the Project Staff that the DPW continue to work together with the Conservation Commission and the Engineering Department to establish a working maintenance program for the cleaning of catch basins and street sweeping within the Good Harbor Drainage Area. In order to do this, the Project Staff recommends that a staff person be hired to monitor through a computer program the cleaning a catch basins. This program should be able to track the date and quantity of removed material over time; thereby setting up a schedule of when each catch basins need to be cleaned.

The Project also recommends a stormdrain stenciling program be implemented with a local interest or interested school group as part of a public education program.

I. Local Ordinance Pertaining to Infiltration from New Construction

It is the recommendation of the Project Staff that local ordinance pertaining to infiltration of runoff from new impervious surfaces be strengthened to ensure that property owners investigate appropriate storm water permitting and Best Management Practices (BMPs) prior to construction.

The Project Staff recommend that the ordinance reflect the potential loss of vegetation and habitat and the affects of nutrient loading from additional development.

Information from Recommendation “B”, “Identification of Impacts of Stress on the Salt Water Watershed” regarding the affect of stormwater on the salinity of the watershed should be influence the local ordinance.

J. Implementation of Best Management Practices (BMPs)

As the result of the results of Task 7, it is the recommendation of the Project Staff that soft BMPs be considered for Days Pond and Pond Road. Days Pond experienced high concentrations of “Dry” weather sampling nitrate and a stream leading from Pond Road experienced high “Wet” weather sampling TSS.

K. Further Investigation of Areas Where VOC Contaminants were Detected

It is the recommendation of the Project Staff that the following areas be further identified for VOC contamination:

- Bridge to Thatcher Road by Shopping Center (especially in relation to the hazardous waste release from October, 2002 and May 2004)
- Brook from Days Pond by Abbott Road- 12” pipe

L. Encourage Better Communication and Record Keeping Between the Engineering Department and Health Department

With the location of two (2) properties on septic systems that had been recorded has having connection to City sewer (see Task 5), the Project Staff recommends better communication and record keeping between all City Departments.

In order to best implement this communication and record keeping, it is the recommendation of the Project Staff that a common database be developed to track development. The database should be capable of tracking those properties with septic system upgrades, connection to city sewer, or lot development. In order to provide the best service to the environment and the community, the recommended computer system would be accessible by all City departments.

M. Expand City GIS Capability

The Project Staff found that while the city has GIS capability, the limit on number of users at one time causes it to not be accessible to the majority of staff. The Project Staff recommend that as part of the city wide information database, either all staff receive access to and training for the city GIS system or a separate GIS department is established to input information and data from contributing departments.

The Project Staff recommends that a staff person be hired to support the City’s GIS software capabilities.

N. Encourage Public Education and Outreach

The Project Staff observed that there was very little knowledge of the Good Harbor watershed by local residents and business owners. Through Field Work Outreach of this grant, the Conservation Office initiated a Watershed Volunteer Team similar to the stream team program. This effort of volunteers currently includes the golf course manager, a local contractor and two landowners. In order to build the sense of environmental ownership and develop community interest in the dynamics of the watershed, the Project Staff recommends the continued involvement and the expansion of this team.

The Project Staff also found a dire need for better education of the public including homeowners and business owners in the Good Harbor Drainage Area. It is the recommendation that funding be sought to create and distribute an educational pamphlet regarding what “you” can do to protect the Good Harbor Drainage Area. This pamphlet could be given to Gloucester residents, local businesses, residents purchasing beach stickers and to the general public when they pay for admission to the Good Harbor Beach parking area.

The Project Staff recommends that funding be sought to create educational programming events available to the public. These events could include information about salinities, tidal restrictions, wetland habitat, the watershed, and the environment. These events might be sponsored by the Watershed Volunteer Team in order to encourage participation.

The Project also recommends a stormdrain stenciling program be implemented with a local interest or interested school group as part of a public education program.

Finally, the Project Staff recommends that funding be sought to erect an information kiosk alongside the walking entrance to Good Harbor Beach. The kiosk could serve as an educational site containing information about upcoming educational programming events, storm drain stenciling events, and about the contamination potentials of dog waste on the beach.

Task 8. Reporting

2005 CZM Coastal Nonpoint Source Assessment Final Report: “Assessment of Potential and Actual Sources of Nonpoint Source Pollution in the Good Harbor Drainage Area”

Task X. What Worked and What Didn't Work...

The Project Staff found that analyzing historic water quality data did not give an accurate depiction of present water quality issues and concerns. As the result of changing dynamics, including the installation of sewer, an accurate basis for nonpoint source pollution in the area could not be reached. Also, the many sources of historic data were found to have conflicting limits to which testing was performed between sources. One

source had differing limits over a period of time. Even though the Project Staff began looking at the Good Harbor Drainage Assessment with quite a bit of information, in the end there wasn't really much data to compare. The one result that was observed in the historic data was the relation between salinity and bacteria which proved to be very helpful to the recommendations of the Project Staff.

As a result of the occupations of the Project Staff within the City, the group knew from the beginning of the study which areas were of particular concern. Instead of seeking to find one smoking gun, it was the intention of the Project Staff to record all issues that were of concern and to determine the extent of problems from the areas of particular concern. The Project Staff feels confident that the Project performed met this intent. However considering the time constraints of the grant, it would have been helpful to the Project Staff had the water quality testing been performed much earlier into the grant.

Prologue

The Project Staff were able to work with the Project Scope in order to create this working document. Information within this report should be updated as necessary in order to continue the outlook of the Project Staff to best protect the Good Harbor Watershed. It was the goal of the Project Staff to use the tasks of this report as a template for other watersheds within Gloucester, but it should be noted that change in this procedure may be necessary depending on the requirements of other watersheds.