Section 4
Existing Water Quality Data

4.1 Introduction

This section reviews and summarizes existing water quality data in Harwich in order to assess areas which may be impaired due to nutrient loading or other factors. This information is evaluated to help identify the critical needs in Harwich and guide the development of wastewater management scenarios. The focus of this section is on data that is not already incorporated into the freshwater ponds and MEP analyses, described in detail in Sections 5 and 6, respectively.

This section addresses the quality of the Town's groundwater resources and drinking water supply, recreational water quality at freshwater and marine beaches, MassDEP eelgrass mapping studies, and the attainment of designated uses in water bodies in Harwich.

4.2 Drinking Water Supply and Groundwater Quality

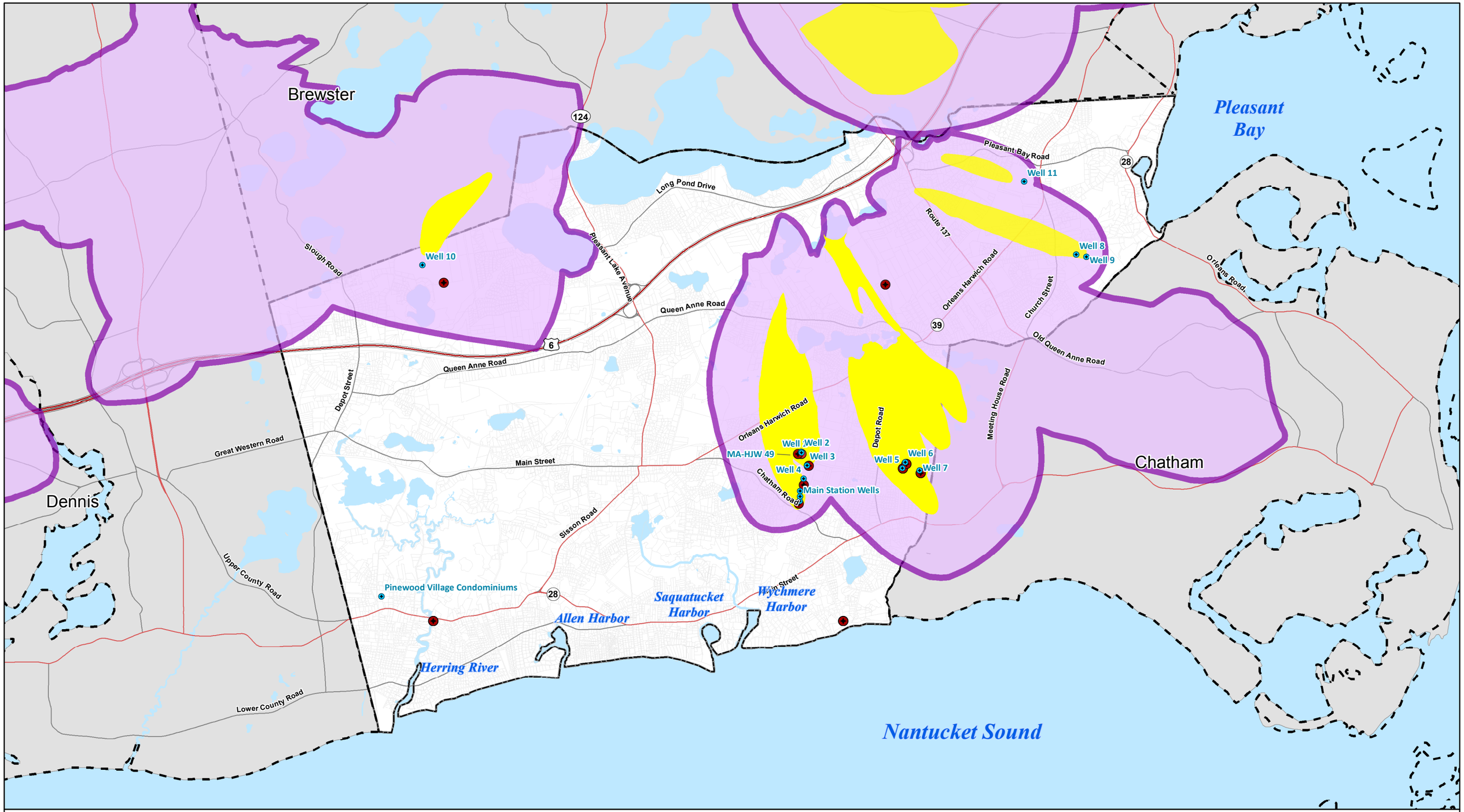
Information discussed in this section originates from the Harwich Water Department and the United States Geological Survey (USGS) National Water Information System (NWIS) Database (waterdata.usgs.gov/nwis).

4.2.1 Harwich Public Water Supply Wells and Treatment

Drinking water for the Town of Harwich is supplied from fourteen gravel-packed groundwater wells to more than 9,800 public water accounts. These wells are located in southeast, northeast and northwest areas of Harwich, as shown on Figure 4-1. Each well draws water from the Monomoy lens, one of six areas of elevated groundwater that comprise the Cape Cod Aquifer. In 2011, the fourteen wells pumped approximately 683 million gallons of raw water, and in 2010 they pumped approximately 770 million gallons which averages to be around 2.0mgd

Table 4-1 lists the fourteen public water supply wells and their locations. Seven of the fourteen wells are located off of Chatham Road in the southeastern portion of town, behind the Water Department's main office, in what is referred to as the "Main Station" tubular well-field. The other seven wells are spread among four different locations, as listed in Table 4-1 and shown on Figure 4-1. These include three wells off of Depot Road in South Harwich, two off of Bay Road in East Harwich, one in North Harwich off of Westgate Road on the Brewster town line, and one off of Pleasant Bay Road in East Harwich.

The fourteen supply wells are grouped into five Zone II Well Protection Areas. The Zone II is the primary recharge area for a supply well or wells. Specifically, a Zone II is defined as the contributing area to a well based on 180 days of pumping at the MassDEP approved yield (maximum pumping rate) for the well with no recharge from precipitation. MassDEP has approved the Town's Zone II delineations.



Town of Harwich
Comprehensive Wastewater
Management Plan

Figure 4-1
Public Water Supply and Wells

CDM Smith

\\Camgissvr1\Projects\Harwich\Harwich_cwmp\MXD\Section_4\Figure4_3_II LIG 12062012

Table 4-1
Harwich Drinking Water Wells

Source Name	Source ID	Location of Source
Wells 1 through 3	4126000-01G	Off Chatham Road
Well 2	4126000-02G	Off Chatham Road
Well 3	4126000-03G	Off Chatham Road
Main Station	4126000-04G	Off Chatham Road
Well 4	4126000-05G	Off Chatham Road
Well 5	4126000-06G	Off Depot Road
Well 6	4126000-07G	Off Depot Road
Well 7	4126000-08G	Off Depot Road
Well 8	4126000-09G	Off Bay Road
Well 9	4126000-10G	Off Bay Road
Well 10	4126000-11G	Off North Westgate Road
Well 11	4126000-12G	Off Pleasant Bay Road

Note: Insert text here

In addition to the Zone II delineations, the MEP estimated water supply well zones of contribution (ZOC's). These are based on the actual average annual pumping rates, which are less than the pumping rates used for the Zone II areas. Modeling to develop the ZOC areas also includes average annual recharge. The combination of the lower pumping rates and the inclusion of annual recharge means that the contributing areas are smaller than the Zone IIs as shown on Figure 4-1.

Harwich's raw groundwater supply is treated with potassium hydroxide (KOH) and sodium hypochlorite (chlorine). KOH is added at very low concentrations to increase the pH of the water and reduce its natural corrosivity. High pH can stain plumbing fixtures and degrade drinking water quality by leaching copper and lead out of private service lines.

Since 2004, Harwich has seen a steady increase in the concentrations of iron and manganese in its drinking water supply from the wellfield off of Chatham Road – the source of about 60 percent of the Town's water supply. While these constituents do not present health concerns, they create aesthetic issues that are displeasing to customers. As a result, in 2010, the Town began construction of the new Bruce Cahoon Water Treatment Facility, designed to treat 6.5 million gallons per day using green sand filtration to remove iron and manganese. This facility was completed and brought online in November 2011. With the operation of the new water treatment facility, Well No. 4, which had previously been removed from service due to high iron and manganese levels, is now back online.

4.2.2 Harwich Public Drinking Water Supply Quality

Quality of drinking water supply is regulated under the federal Safe Drinking Water Act (SDWA). As detailed below, water quality from Harwich's wells is very high, and the Town's drinking water has met or exceeded the requirements of the SDWA during the last five years.

The Town of Harwich provides information about water quality testing and results in their Annual Water Quality Report, which is sent to all public water supply customers. The 2011 Town of Harwich Annual Water Quality Report includes the measurements of 20 different compounds. These various compounds were measured at levels that met, or exceeded, the parameters set forth in the SDWA. Table 4-2 summarizes the levels of the various constituents measured, as reported in the 2007 through 2011 Annual Water Quality Reports, to create a representative picture of the water quality of Harwich drinking water over a span of five years. Note that some parameters do not need to be tested every year, based on state regulation. Where the results reported on a particular annual water quality report are from a prior year, the year is indicated in parentheses. In earlier years, when tests were not taken for a particular parameter in that year, the data were not reported and are shown as such.

Table 4-2 represents an overall view of the high quality of drinking water in Harwich. Over the five year period shown, none of the parameters were in violation of the SDWA. Levels of iron and manganese in 2008 through 2011 exceeded the "recommended level" of those compounds, but the newly operational water treatment plant will bring these levels down in future years.

Table 4-2
Data Reported on Harwich's Annual Water Quality Reports, 2007 through 2011

Parameter	Source	MCL/ MCLG	Annual Range – Lowest to Highest Measured Value				
			2011	2010	2009	2008	2007
Inorganic Contaminants							
Nitrate as N (ppm)	Septic Systems, fertilizers, erosion	10/10	1.40 – 2.00	1.40 – 2.00	0.58-1.80	ND – 2.30	0.1 – 0.1
Turbidity (NTU)	Soil runoff	TT/NA	ND – 0.86	ND – 0.86 (2009)	ND – 0.86	not reported	ND – 2.30
Sodium (ppm)	Road salt	NA/28	14.0 – 31.0	14.0 – 31.0	8.9 – 32.0	10.0 – 28.0	8.9 – 23.0
Radioactive Contaminants							
Gross Alpha Activity (pCi/L)	Natural erosion	15/NA	1.6 – 1.6 (2003)				
Radium-226 (pCi/L)	Natural erosion	5/NA	0.1 – 0.1 (2005)				
Radium-228 (pCi/L)	Natural erosion	5/NA	0.4 – 0.4 (2005)				
Microbiological Contaminants							
Total Coliform Bacteria (#/100 mL)	Naturally present	5% or <40/NA	0 – 1	0 – 1 (2009)	0 – 1	not reported	not reported
Disinfection Contaminants							
Haloacetic Acids (ppb)	Disinfection byproduct	60/NA	ND – 1.00	ND – 1.00	not reported	not reported	not reported
Total Trihalomethanes (ppb)	Disinfection byproduct	80/NA	ND – 7.70	ND – 7.70	ND – 3.40	ND – 5.70	2.0 – 5.80
Unregulated Contaminants							
Bromoform (ppb)	Disinfection byproduct	NA/NA	ND – 3.60	ND – 3.60	ND – 1.70	not reported	ND – 2.20
Chloride (ppm)	Weathering rocks	250/250	13.0 – 34.0	13.0 – 34.0 (2009)	13.0 – 34.0	10.0-30.0	not reported

Table 4-2 (Cont'd)
Data Reported on Harwich's Annual Water Quality Reports, 2007 through 2011

Parameter	Source	MCL/ MCLG	Annual Range – Lowest to Highest Measured Value				
			2011	2010	2009	2008	2007
Unregulated Contaminants (Cont'd)							
Chloroform (ppb)	Disinfection byproduct	NA/NA	ND – 1.80	ND – 1.80	ND – 3.50	0.6 – 4.00	0.540 – 3.20
Dibromochloro-methane (ppb)	Disinfection byproduct	NA/NA	ND – 1.70	ND – 1.70	ND – 0.66	not reported	ND – 0.76
Unregulated Contaminants (continued)							
Methyl Tertiary Butyl Ether (ppb)	Fuel additive	NA/NA	ND – 3.00 (2009)	ND – 3.00 (2009)	ND – 3.00	ND – 1.00	0.001 (2004)
Sulfate (ppm)	Natural	250/250	5.70 – 11.0	5.30 – 8.10 (2009)	5.30 – 8.10	5.00 – 8.70	4.20 – 9.30
Chlorine (free, ppm)	Disinfection		0.01 – 0.30	0.01 – 0.30 (2009)	0.01 – 0.30	0.01 – 0.30	0.010 – 0.50
Secondary Contaminants							
Total Iron (ppm)	Natural	300/0.3	ND – 1.40	ND – 0.33 (2009)	ND – 0.33	ND – 0.58	not reported
Total Manganese (ppm)	Natural	50/0.05	0.004 – 0.18	0.008 – 0.26 (2009)	0.008 – 0.26	ND – 0.19	not reported
Lead and Copper							
Lead (ppb)	Plumbing corrosion and natural erosion	15/0	0* (2009)	0* (2009)	0*	2*	2*
Copper (ppm)	Plumbing corrosion and natural erosion	1.3/1.3	0* (2009)	0* (2009)	0*	5*	0*

* = Number of tested sites above the EPA action level; these values do not constitute a violation of the standard

MCL = Maximum contaminant level, which is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

MCLG = Maximum contaminant level goal, which is the level of contaminant in drinking water below which there is no known or expected risk to human health. MCLGs allow for a margin of safety.

ND = Not detected

NA = Not applicable

TT = Treatment technique, which refers to a required process intended to reduce the level of a contaminant in drinking water.

Results presented in RED indicate a violation of the SWDA standard.

4.2.3 Nitrate in Drinking Water

Of particular interest for wastewater planning are nitrate concentrations. Of the many compounds tested for, detected levels of nitrate are important because they can serve as an indicator of fertilizer run-off, stormwater recharge, and leachate from septic tanks entering the water supply. As shown in Table 4-2, other constituents measured do not typically originate from septic systems and therefore cannot be managed by a change in wastewater handling methodology.

A June 2007 Stearns and Wheler report entitled, "Town of Harwich Evaluation of Wastewater Management Options for Freshwater Ponds" and a case study report for the Great Sand Lakes, reviewed 10 years of water supply monitoring data for Harwich Wellfields No. 1 and 2. These studies found an average of 0.58 mg/L of nitrate in the water pumped from Wellfield No. 1 and an average of 0.47 mg/L of nitrate in the water pumped from Wellfield No. 2. The report determined that these low concentrations, which are desirable, are due to the large amount of protected land in the supply well watersheds and may also be due to nitrogen removal (natural attenuation) that occurs as the groundwater flows through the Great Sand Lakes.

More recent data suggest a slight rise in nitrate levels, though still well below required and suggested regulatory limits. The 2012 average nitrate concentration in the wells in the same vicinity (off Chatham Road) was 0.73 mg/L. The average nitrate concentration detected in 2011 across all public water supply wells was 1.1 mg/L, and in 2010 it was 1.8 mg/L. Both values are well below the SDWA primary Maximum Containment Level (MCL) of 10 mg/L and the Cape Cod Commission goal of 5 mg/L.

Figure 4-2 shows the nitrate levels measured by the Harwich Water Department at each drinking water well in the period of 1987 through 2004, with additional data shown from March 2012. As seen in Figure 4-2, Pleasant Bay watershed sampling stations #8 and #9 (at Well Nos. 8 and 9) tend to have the highest nitrate concentrations, while all readings from other wells within the system have consistently been below 2.0 mg/L. The other Pleasant Bay watershed well (Well No. 11) has the next highest nitrate concentration indicating the contributing areas have more development within them.

4.2.4 USGS Groundwater Monitoring Wells

Historic groundwater data were obtained from the USGS NWIS Database for twenty-one groundwater monitoring wells in Harwich, as shown on Figure 4-3. Note that these are different from water supply wells and are located both within and outside of Zone II areas. Groundwater samples from nineteen of these wells were analyzed for nitrate. Sample frequency varies, but data is available between 1972 and 1986. The historic groundwater data are useful in providing a context and an understanding of past conditions. Nitrate concentrations ranged from non-detect to 3.8 mg/L, with a measured concentration of 6.2 mg/L in one water sample. The nitrate detection of 6.2 mg/L was measured in a water sample from well MA-HJW 49 (near wells 1 and 2 off Chatham Road) collected in January 1975. Nitrate was measured at a concentration of 1 mg/L in the most recent round of sampling conducted in March 1985 at this same well.

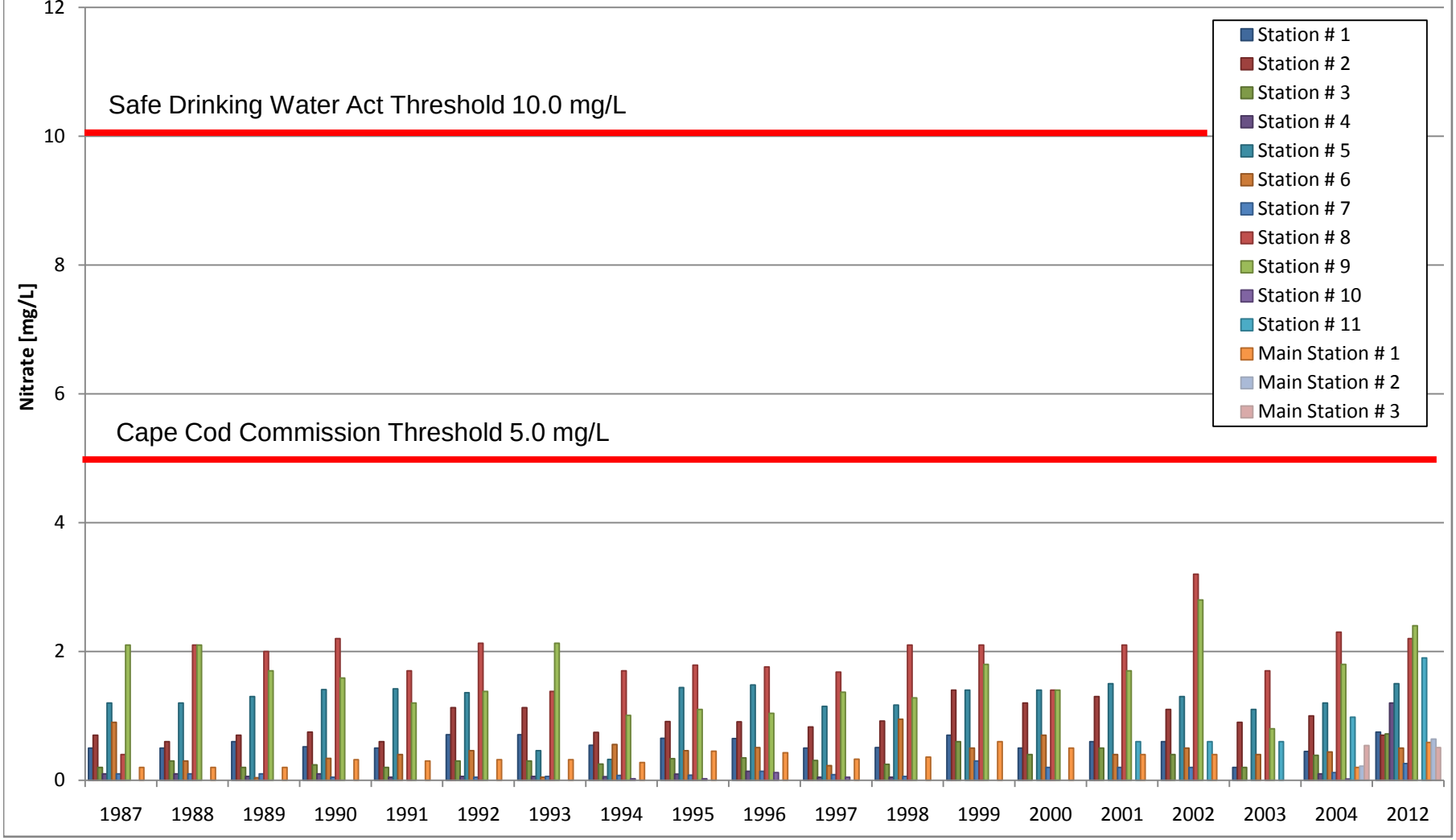
4.3 Harwich Beaches

The sources of the information discussed in this section are the Barnstable County Department of Health and Environment and the Harwich Water Quality Management Task Force, through their respective water quality data collection and reporting programs.

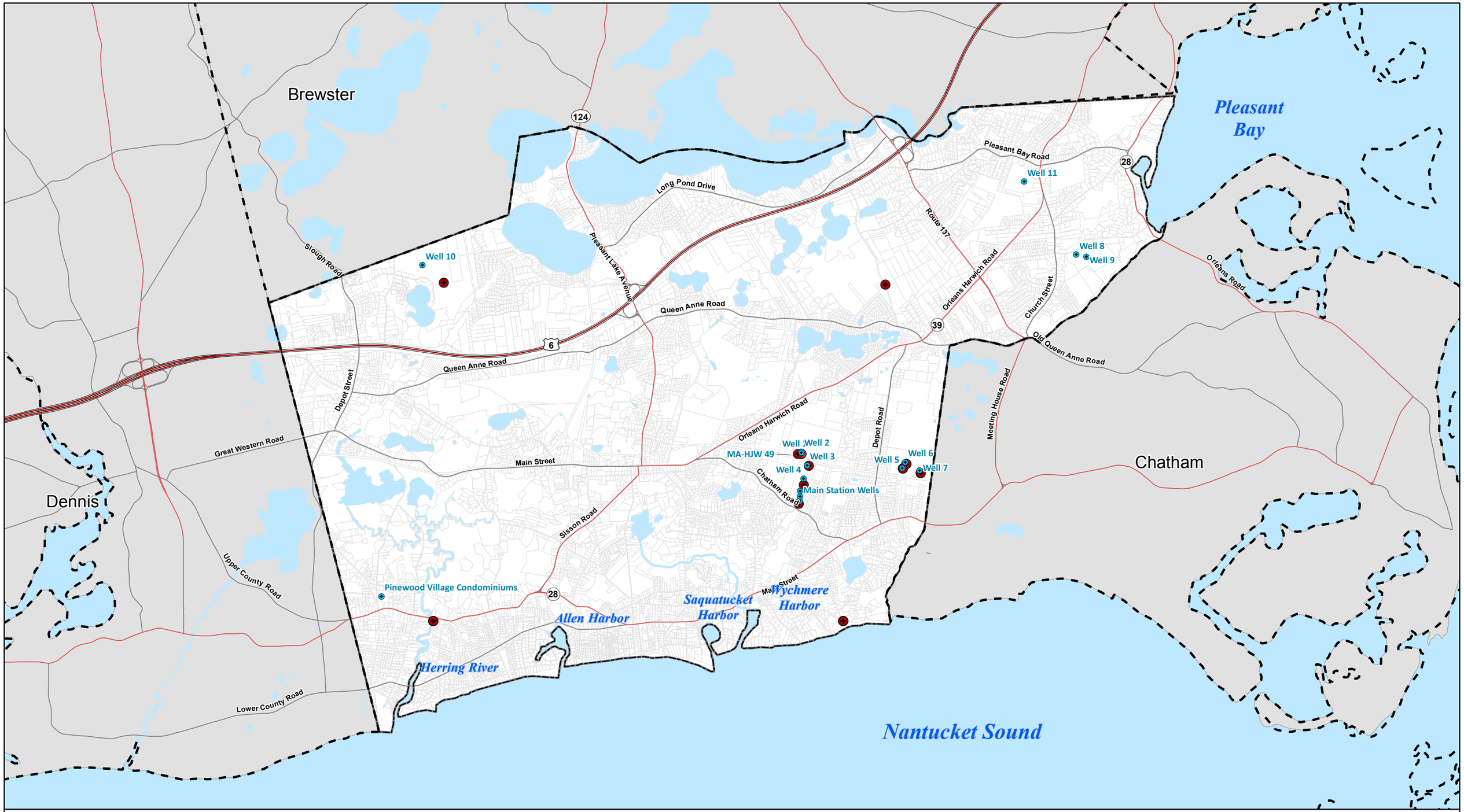
Beaches in Harwich consist of a mixture of saltwater beaches along the coastal shoreline and freshwater beaches that exist along the shores of Harwich's many freshwater ponds. Interviews with local Board of Health officials revealed that the water quality of Harwich's beaches is generally very good. Isolated instances have occurred where the bacterial limits have been exceeded, usually in response to a stormwater discharge after a rainfall event. However, beach water quality is good enough to have warranted a reduction in the sampling frequency of saltwater beaches in Harwich based on state regulations, as described below.

Figure 4-2. Nitrate Results for All Public Drinking Water Supply Wells

(data from Harwich Water Department)



CDM Smith



N

Legend

- Public Water Supplies
- USGS Groundwater Monitoring Wells

Note: Only the Public Water Supplies within Harwich are shown on this map

Town of Harwich
Comprehensive Wastewater Management Plan

1 inch = 3,750 feet

0 2,500 5,000 10,000 Feet

Figure 4-3
USGS and Groundwater Wells

CDM Smith

\\Camgissvr1\Projects\Harwich\Harwich_cwmp\MXD\Section_4\Figure4_3_II LIG 12062012

4.3.1 Water Quality of Harwich Beaches

The Massachusetts Department of Public Health (MDPH) administers the "Beach Program" for all beaches in the Commonwealth. All beaches are sampled regularly during the bathing season as part of a three-tiered monitoring program. Sampling and monitoring twice weekly is required for beaches classified as Tier 1. Tier 2 beaches require weekly monitoring. A classification of Tier 3 signifies beach waters of "low health concern" and requires less frequent monitoring.

In June 2007, the MDPH determined that the sampling frequency could be reduced due to the good water quality of many of Harwich's saltwater beaches. These beaches meet Tier 3 requirements with no known pollution or health concerns. In MDPHs findings regarding the classification request, they concluded that, "there are no water quality concerns for the beaches. There were no single sample or geometric mean exceedances for the two seasons' worth of data provided with the sanitary surveys submitted by the Harwich Board of Health in support of the frequency reduction."

The beach sampling program measures colonies of *Escherichia coliform* ("E. coli") and enterococci as indicator organisms for water quality, per state regulations listed in 314 CMR 4.00. The maximum single-sample standard for marine waters is 104 colony forming units (cfu) of enterococci per 100 milliliters (100 mL), and the geometric mean of the five most recent bathing season samples cannot exceed 35 cfu/100 mL. For fresh water, either enterococci or E. coli bacteria are used as indicators. The E. coli single-sample limit for recreational fresh water is 235 cfu/100 mL, and the enterococci limit is 61 cfu/100 mL. In addition, the geometric mean cannot exceed 126 cfu/100 mL of E. coli or 33 cfu/100 mL of enterococci in the five most recent bathing season samples according to state regulations.

A list of all Harwich public and semi-public beaches and the sampling results for 2007 through 2011 are provided in Table 4-3. All beaches were tested from June through August, during the height of recreational use. The highlighted cells represent at least one exceedance of recreational water quality standards for a particular beach in a particular year.

Table 4-3
Harwich Beach Sampling Results, 2007 through 2011

Beach Name	Number of Samples/ Number of Exceedances				
	2011	2010	2009	2008	2007
Public Marine Beaches					
Earle Road Beach	13/0	14/1	4/0	4/0	3/0
Pleasant Bay	13/0	5/1	4/0	4/0	4/0
Red River Beach (East)	13/0	6/2	4/0	4/0	4/0
Red River Beach (West)	13/0	14/1	15/1	14/1	13/0
Red River Beach (Middle)	13/0	14/1	15/1	11/1	3/0
Marine Beaches Variances as of 2011 (Reduced Sampling Frequency)					
Atlantic Avenue Beach	4/0	4/0	4/0	4/0	4/0
Bank/Bayview	4/0	4/0	4/0	4/0	5/0
Brooks Beach	4/0	4/0	4/0	4/0	4/0
Grey Neck Beach	4/0	4/0	4/0	4/0	4/0

Table 4-3 (Cont'd)
Harwich Beach Sampling Results, 2007 through 2011

Beach Name	Number of Samples/ Number of Exceedances				
	2011	2010	2009	2008	2007
Marine Beaches Variances as of 2011 (Reduced Sampling Frequency) (Cont'd)					
Merkel Beach	4/0	4/0	4/0	4/0	4/0
Neel Road Beach	4/0	4/0	4/0	4/0	4/0
Pleasant Road Beach	4/0	4/0	4/0	4/0	4/0
Seabreeze Road	4/0	4/0	4/0	4/0	4/0
Wah Wah Taysee	4/0	4/0	4/0	4/0	4/0
Zylpha Road Beach	4/0	4/0	4/0	5/0	13/0
Freshwater Beaches					
Bucks Pond	16/3*	13/0	15/1	13/0	13/0
Hinckley's Pond	13/0	13/0	14/0	13/0	13/0
Long Pond 1 (Cahoon Street)	13/0	13/0	14/0	13/0	13/0
Long Pond 2 (Long Pond Drive)	13/0	13/0	14/0	13/0	13/0
Long Pond 3 (Route 124)	13/0	14/1	14/0	13/0	13/0
Robbins Pond	15/2*	13/0	14/0	13/0	13/0
Sand Pond	14/1	13/0	14/0	13/0	13/0
Seymour Pond	13/0	14/1	14/0	13/0	13/0
Skinequit Pond	13/0	13/0	14/0	13/0	13/0
TOTAL PUBLIC BEACHES	**228/6**	**212/8**	**209/3**	**195/2**	**194/0**
Semi-Public Marine Beaches					
Allen's Harbor Assoc. (Dunes Road)	13/0	12/0	12/0	12/0	11/1
Old Mill Point Assoc. (Seaway)	--	12/0	12/0	12/0	12/0
Old Mill Point Assoc. (Strand Way)	13/0	13/1	12/0	14/2	12/0
The Belmont	13/0	12/0	12/0	14/2	12/0
Wequassett Inn Resort	13/0	12/0	13/1	12/0	13/1
Stone Horse Yacht Club	13/0	--	--	--	--
Wychmere Harbor Club	13/0	--	--	--	--
Semi-Public Freshwater Beaches					
Great Sands (Buck's Pond/ Clearwater)	16/3*	13/1	12/0	12/0	12/0
Great Sands (Joseph's – Vacation)	17/3*	12/0	12/0	14/2	12/0
Great Sands (Lakeside Terrace)	2/0	--	12/0	12/0	12/0
Sandy Shore Assoc. (Aunt Edie's)	13/0	12/0	12/0	12/0	12/0
TOTAL SEMI-PUBLIC BEACHES	**126/6**	**98/2**	**109/1**	**114/6**	**108/2**

Note: *These sites were tested for enter occurs rather than E. coli during the exceedances shown, with the exception of one of the three exceedances at Buck's Pond, which was an E. coli exceedance.

Note that in 2011, between the dates of June 29th and July 13th, the testing methodology was changed to utilize enterococci rather than E. coli as the bacteriological water quality indicator for fresh water beaches. This resulted in a marked increase in the number of violations, which brought into question

the validity of the indicator organism. Since that time, side-by-side testing has been performed for both E. coli and enterococci at fresh water beaches, which has supported the belief that the two indicators are not interchangeable, with E. coli measurements consistently low while enterococci samples exhibit more variability.

As shown in Table 4-3, in 2011, of the 15 public saltwater beaches that were tested, all came back with acceptable results within the state limits. Out of the nine freshwater beach locations that were tested, six violations were registered by three separate beaches between mid-June and mid-July, largely attributable to the testing changes described above. Overall, Harwich has seen exceptional beach water quality over the last five years, with consistently low bacterial test results and infrequent closures, especially at public marine beaches.

4.3.2 Harwich Water Quality Management Task Force Bacterial Data

In addition to beach sampling conducted by Barnstable County, bacterial sampling has also been conducted for fecal coliform in Harwich harbors by the Harwich Water Quality Management Task Force. Detections in water samples in 2011 generally did not exceed the typical treated wastewater discharge threshold of 200 cfu/100 mL, although the Massachusetts shellfish harvesting threshold of 14 cfu/100 mL was exceeded in several locations. Fecal coliform sources to Harwich harbors include stormwater discharges, septic system failures, boat waste discharges, wildlife and other sources. Failed septic systems do not appear to be a major contributor to fecal coliform levels in Harwich harbors based on the data collected in 2011 and past years, as shown below.

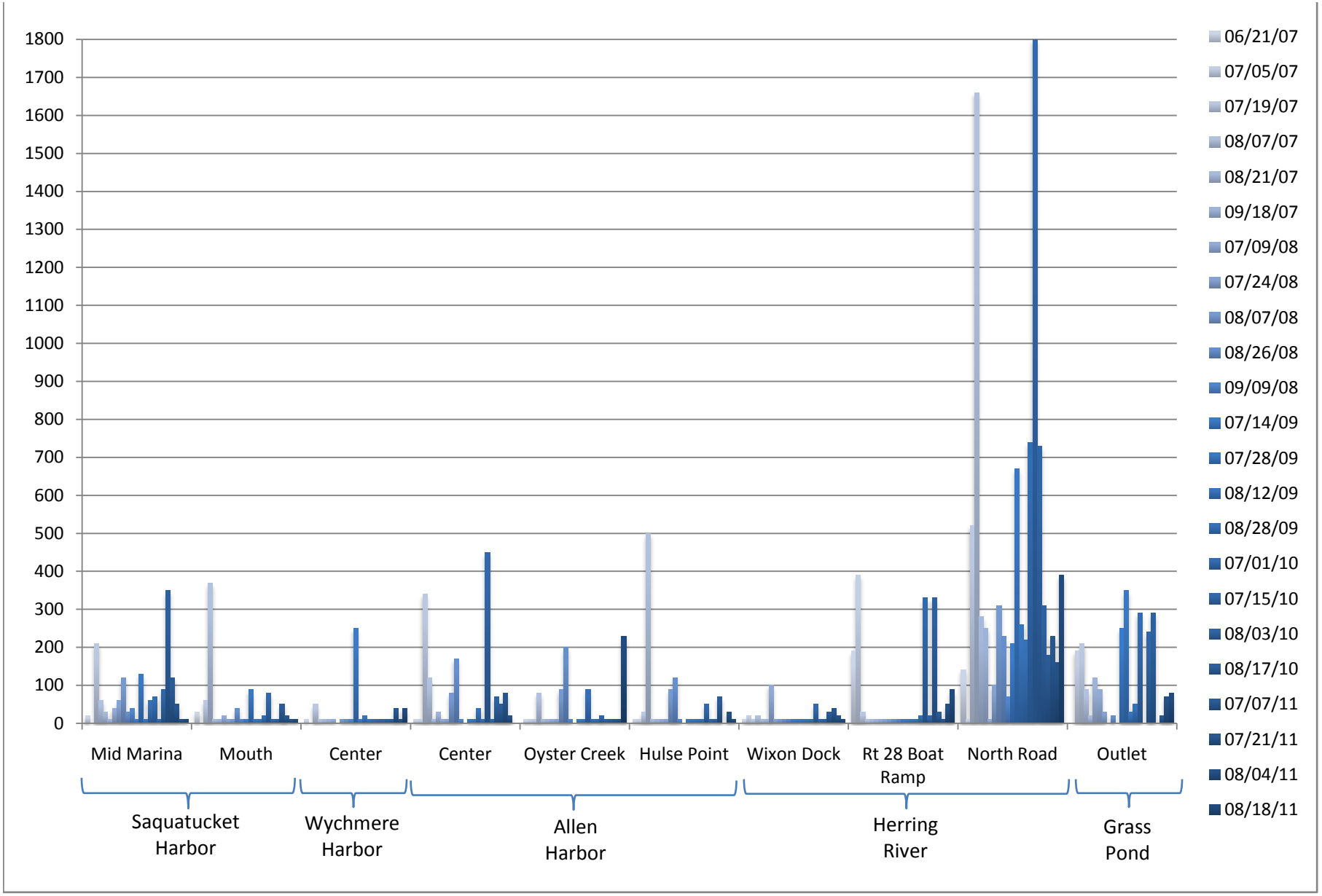
Figure 4-4 provides the long-term fecal coliform sampling results, and the text which follows summarizes the results for each of the MEP watersheds. Note that all samples reported as $\leq$10 cfu/100 mL are shown as 10 cfu/100 mL.

- ***Saquatucket Harbor –*** Based on fecal coliform data from 2007 through 2011, concentrations regularly exceed the shellfish limit and occasionally exceed the 200 cfu/100 mL wastewater discharge standard. Exceedences were sporadic and a detailed watershed evaluation would be required to identify the sources. A 2003 Harbors Interim Report indicated that wildlife is a possible source when high fecal coliform concentrations are measured.

- ***Wychmere Harbor –*** Based on fecal coliform data from 2007 through 2011, concentrations occasionally exceeded the shellfish limit and exceeded the 200 cfu/100 mL level once in 2009. Stormwater from Route 28 discharges to the harbor but fecal coliform concentrations have remained low.

- ***Allen Harbor –*** Fecal coliform data from Allen Harbor had exceedences of both standards at all three sampling locations. A detailed study conducted prior to 2007 had concluded that wildlife appears to be the primary source of fecal coliform, as described in more detail below.

Figure 4-4. Long Term Fecal Coliform Sampling Results



- ***Herring River –*** In 2011, the 200 cfu/100 mL standard was only exceeded at the North Road sampling location, while the shellfishing standard was also exceeded at all three locations sampled. Fecal coliform data from 2007 through 2011 had consistent exceedences of the standards for both standards at the North Road location and occasionally at the Route 28 boat ramp. The Wixon Dock sampling location consistently had very low fecal coliform levels. The 2003 Harbors Interim Report indicated that some exceedences in the Herring River appear to be connected to stormwater run-off, though wildlife is also a possible source. Further investigation would be needed to confirm coliform sources.

4.3.3 Allen Harbor Fecal Coliform Study

A study was conducted in 2003 to identify sources of fecal coliform in the Allen Harbor watershed. Results are documented in the *Fecal Coliform Evaluation and Mitigation Planning for the Allen Harbor Watershed* Report (Stearns & Wheler 2003). Water samples from Allen Harbor have been tested for fecal coliform since 1989. High fecal coliform values, typically 1,000 to 3,000 cfu/100 mL were measured north of the Lower County Road Bridge in 2002. The highest values in the study period occurred during the summer of 2002 at Route 28, with fecal coliform values of 5,000 to 38,000 cfu/100 mL. The study did not identify any septic system discharges which reached the harbor directly. According to the study, local wildlife appears to be the primary source of the fecal coliform in this location.

4.3.4 Conclusion for Bacterial Contamination

Wastewater has not been identified as a likely source of elevated levels of fecal coliform in Harwich's harbors, at marine bathing beaches, or in the upper Herring River. Bacteria and pathogens in marine waters are therefore not considered further in the CWMP, as a change in wastewater management strategy does not appear to be necessary to control bacterial contamination. The sources of bacteria at Harwich's freshwater bathing beaches are not well studied. However, since the analysis of freshwater ponds in Section 5 recommends consideration of sewering in areas where other evidence exists of potential wastewater inputs due to nutrient loading, any bacterial inputs originating from septic systems in these areas should also be remedied.

4.4 MassDEP Eelgrass Mapping Program

Eelgrass is used as a biological health indicator to assess the impacts of nutrients on overall ecosystem health. As described further in Section 6, impacts to eelgrass beds were used to assess the health of Harwich's bays, estuaries, and rivers early in the MEP process. Much of this information was based on the MassDEP Eelgrass Mapping Program data described herein (www.mass.gov/dep/water/resources/maps/eelgrass/eelgrass.htm). Eelgrass beds in Harwich estuaries were delineated as part of the MassDEP program in 1995 and 2001. Mapping of this information is available through MassGIS (www.mass.gov/mgis/eelgrass.htm). Aerial photographs from 1951 were compared to the MassDEP maps to estimate the distribution of eelgrass prior to watershed development. Continued mapping of eelgrass beds in future years by MassDEP is anticipated.

Eelgrass was present in the Herring River in 1995 up to the limits of the mapping project at the Route 28 bridge. The eelgrass coverage in the Herring River declined in 2001 and had declined to a negligible

amount in 2010. Eelgrass coverage in Nantucket sound at the Harwich beaches declined from 1995 to 2001 between the Herring River and Wychmere Harbor.

Eelgrass was not present in Allen Harbor, Wychmere Harbor, and Saquatucket Harbor in 1995 or 2001. Saquatucket Harbor is a manmade harbor. The area was dredged in the late 1960s by the Army Corps of Engineers to form the harbor which is used primarily as a marina. Wychmere harbor was formed by dredging the outlet from a freshwater kettle pond to Nantucket Sound. Since all three harbors are regularly dredged, the presence or absence of eelgrass in the harbors is not a good indicator of ecosystem health in those locations.

A comparison of eelgrass mapping from 1951, 1995, and 2001 for Pleasant Bay reveals that eelgrass coverage has declined 24%. The MEP Pleasant Bay Report also reviewed an additional eelgrass survey by shallow draft boat conducted for the Town of Chatham in 2000. In this study, eelgrass was observed adjacent to the creek inlet in lower Muddy Creek, located on the boundary between Harwich and Chatham.

As stated above, this information was used in the initial MEP analyses and will continue to be used as improved wastewater management strategies are implemented to aid in assessing their success.

4.5 Water Quality Classifications and Impaired Waterways

4.5.1 Massachusetts Water Quality Classifications

Similar to the bacterial sampling described above, other water quality sampling of Harwich harbors and the Herring River has been conducted by the Harwich Water Quality Management Task Force since 2001. Water samples from various locations and depths in Nantucket Sound, Saquatucket Harbor, Wychmere Harbor, Allen Harbor, the Herring River, and West Reservoir were analyzed for nutrients. This data has been used extensively in the MEP evaluations described in Section 6 and is therefore not described in this section except as it pertains to the attainment of assigned water quality classifications and water body impairments.

Tidal and marine waterbodies are divided into various classes according to Massachusetts water quality standards (314 CMR 4.00). For tidal waters, Class SA waters provide excellent habitat for wildlife and suitable water quality for shellfish growth and harvesting. A threshold value of 6 mg/L dissolved oxygen is set for class SA waterbodies to support fish habitat. The following summarizes the water quality data pertaining to dissolved oxygen from the Harwich Water Quality Management Task Force data.

- ***Herring River*** – During the sampling period analyzed (2001 to 2006), dissolved oxygen in the Herring River was below 6 milligrams per liter (mg/L) – the Massachusetts standard for Class SA waters – in 74% of samples collected at Lower County Road, 91% of samples collected at Route 28, 97% of samples collected at North Road, and 96% of samples collected at Lothrop Road. The northern section of the Herring River is a naturally occurring wetland area. Low dissolved oxygen often occurs in wetland areas.

- ***Allen Harbor*** – Dissolved oxygen was below the 6 mg/L standard for Class SA waters in 87% to 92% of samples collected at sampling stations at Hulse Point, the harbor marina and Allen Harbor Creek.

- ***Wychmere Harbor*** - Dissolved oxygen was below 6 mg/L 90% of samples collected from the bottom of the water column and 45% of samples collected in the middle of the water column within the harbor.

- ***Saquatucket Harbor*** - Dissolved oxygen in Saquatucket Harbor was below 6 mg/L in 97% of samples collected from the bottom of the water column and 55% of samples collected in the middle of the water column.

The values below the DO threshold of 6 mg/l are undesirable and indicate nutrient over-enrichment in these waterways, causing algal growth and depleted DO levels. These levels reinforce the needs presented in Section 6 to reduce nitrogen inputs to Harwich's marine waterways through improved wastewater management strategies.

For freshwater bodies, Class A waters are suitable for public water supply and provide excellent habitat for wildlife. Class B waters are similar to Class A waters but may require treatment before use as a public water supply. Dissolved oxygen standards are defined based on the class of water body and the type of fish habitat. Warm water fisheries have mean daily temperatures in the summer months greater of than 68 °F and do not support trout. Most ponds in Harwich would be classified as warm water fisheries. Cold water fisheries have mean daily temperatures of less than 68 °F and support trout. The CCC review of pond data indicates that John Joseph Pond would be classified as a cold water fishery. Detailed discussion of DO sampling results in Harwich's freshwater bodies is provided in Section 5.

4.5.2 Impaired Waterways and Waterbodies

The 2006, 2010, and 2012 "Integrated List of Waters" were reviewed for the inclusion of water bodies in Harwich. These documents list the quality of waters in Massachusetts per Sections 303(d) and 305(b) of the Clean Water Act (CWA). Section 305(b) of the CWA formalizes the review process of waters and their ability to support the designated uses identified in each states' surface water quality standards. Section 303(d) identifies waterbodies in Massachusetts that are not expected to meet surface water quality standards and then schedules them for Total Maximum Daily Loads (TMDLs) to be assigned for specific contaminants or criteria. A TMDL establishes the maximum amount of a pollutant that may be introduced into a water body while still maintaining water quality standards. The formulation of the 303(d) List includes a more rigorous public review and comment process than does reporting under Section 305(b), and the final version of the list must be formally approved by the U.S. EPA. The 2012 list has not yet been approved by EPA.

A review of the 2012 Integrated List of Waters identified the following seven water bodies in Harwich. The reasons for inclusion on the list are also shown below for each water body:

- ***Hinckleys Pond*** – listed as attaining some uses, others not attained (was previously listed as uses not assessed in 2006 and 2010)

- ***Muddy Creek*** – listed due to total nitrogen and fecal coliform

- ***Herring River*** – listed due to fecal coliform

- ***Long Pond*** – listed due to organic enrichment and low dissolved oxygen

- ***Saquatucket Harbor*** – listed due to fecal coliform
- ***Round Cove*** – listed due to total nitrogen
- ***Pleasant Bay*** – listed due to total nitrogen

All of the waterways listed above were investigated in more detail either as part of the freshwater ponds analysis in Section 5 or the MEP analyses in Section 6. Together with the information provided herein, these three sections provide a comprehensive summary of the water quality data gathered and analyzed during the development of this CWMP.

4.6 Conclusions

Based on the above information, the following conclusions can be drawn:

- Harwich public drinking water supply wells appear to be adequately protected from nitrate impacts coming from septic systems. All wells meet the drinking water standards. Three wells in the Pleasant Bay watershed exhibit the highest nitrate levels (2-3 mg/l range) but do not warrant sewering those areas solely for this issue. However, nitrogen reduction in this watershed to address meeting the TMDL should target zones of contribution in the three wells to help maintain nitrate concentrations.
- The water quality at Harwich fresh water and salt water beaches appears to be fine under normal conditions. Bacterial contamination from septic systems does not appear to be a concern. Stormwater best management practices should be employed. Impacts from boat wastes and adjacent wildlife habitats should continue to be evaluated.