

WATER QUALITY MONITORING REPORT
TAYLOR'S POINT
BOURNE, MASS
RE: WPC-MA-476-01

Prepared for Anderson-Nichols & Co., Inc.
by the Bourne Board of Health

T.E. Fantozzi, R.S., C.H.O.
Health Officer

Tracy Warncke
Special Assistant

WATER QUALITY MONITORING PROGRAM
TAYLOR'S POINT, BUZZARDS BAY, MA
RE: WPC-MA-476-01

I. INTRODUCTION

The purpose of the ground and surface water quality monitoring program was to determine the need for sewerage Taylor's Point, in conformance with executive order no. 181. Since Taylor's Point is a promontory of land surrounded on the east by Cape Cod Canal, on the west by the Cohasset Narrows, it is subject to 100 year storm surge and wave energy. Elevations range from a high of 16.0 MSL at the Massachusetts Maritime Academy to a low of 3.0 MSL, with the average land elevation being between 6-7 feet, MSL (see attached map).

There are 142 residential structures, a 100 seat restaurant, and the U.S. Army Corp. of Engineers Canal headquarters that are serviced by individual on-site septic systems. The Mass. Maritime Academy and Taylor's Point Marina are serviced by a small waste water treatment facility at the academy.

II. SANITARY AND STORM WATER TREATMENT

A sanitary survey conducted by the Board of Health determined that since 1981 only 4 Title V septic systems have been installed at the point (3 new, 1 repair). The average lot size is 7000 square feet, with the average unit being a five room 3 bedroom single family year-round home. On site sanitary disposal systems consist of old cesspools with trench-type overflows. The average bottom elevation of a typical leaching facility is +1.0 MSL as determined by the survey. The average age of on-site septic systems

is between 30-40 years. Since Board of Health pumpout records do not indicate failing septic systems at Taylor's Point, an assumption was made that these cesspools are in or near the water table, thus allowing a "flushing" action over the tidal prism. Graphs #1 and #2 show ground water fluctuations over the tidal cycle. All structures on Taylors Point, including residential, commercial and governmental, are serviced by the Buzzards Bay Water District. There are no individual water supplies on Taylor's Point.

Storm water is treated and discharged either through leaching catch basins, a single storm water discharge pipe, or direct runoff to low lying areas (see map of drainage areas). A complete shore line survey was conducted to locate storm water discharge pipes. Only one direct discharge pipe was located, that being a 12" corrugated pipe on Buttermilk Way. All leaching catch basins were located and labelled for sampling purposes.

III. SCOPE OF WORK

A. MONITORING WELLS

The purpose of this study was to determine the extent of fecal contamination from on-site septic systems to both the ground and surface water regimes. To this end, a water quality monitoring program was established to obtain ground water samples. This was accomplished through the installation of two ground water monitoring wells located on town-owned land (see map). Two 4 inch schedule 40 PVC wells were installed using a bobcat excavator to dig through overlying soils into the water table. These wells were 10 ft. in length and consisted of pre-drilled 3/8 inch holes every 90 degrees

on the circumference for the first 3 ft. of the casing. To prevent siltation, the first 4 ft. of the well casing was screened with fine mesh wire screening covered with cheesecloth fabric outside the wire mesh. The wells were backfilled with the material excavated on site, and were capped to prevent vandalism. Water was evacuated from the monitoring wells using a stainless steel well point sampler and/or 3 ft. PVC bailer. All components were washed with a 5 ppm solution of chlorine prior to use and between samples. The well casings themselves were disinfected at time of installation. Sterile water was employed to rinse all equipment between disinfection.

B. CATCH BASINS AND STORM DRAINS

A complete survey was conducted to locate and map all leaching catch basins, storm water discharge pipes, and drainage swails (see map). Elevations of catch basins were determined using Town Engineering Topography maps and the bottom elevations were measured in feet above mean sea level (see table 3). The bottoms of the leaching basins ranged from a high of +4.75 above MSL to a low of -1.66 MSL. Standing surface and ground water samples from these catch basins were obtained using the well point sampler, following the disinfection procedure mentioned previously.

IV. WATER QUALITY ANALYSIS, QUALITY ASSURANCE

All ground and surface water samples were collected in sterilized glass bottles furnished by the Barnstable County Health and Environment Laboratory. As stated previously, samples were collected using either the PVC bailer or well point probe. Samples collected were placed on ice until laboratory analysis. Samples were analyzed either at the Bourne Board of Health Lab

using the MF filter technique or at the Barnstable County Health and Environment Lab using the modified A1 MPN technique. Water samples run at the Bourne Lab. were processed within 1/2 hour of receipt. County samples were received within 1 hour of collection and analyzed the same day, usually within 4-1/2 hours of sampling. The two ground water monitoring were evacuated prior to sample withdrawal, thus assuming a representative ground water sample. There were a total of 12 split samples taken to the County lab. for quality assurance. The Bourne laboratory has been in existence two years, during which time approximately 1000 water samples have been processed. Barnstable County lab. has been used during this period for duplicate analysis, with a resulting standard deviation of both labs. being between 6-12% for MF versus MPN. This actual standard of deviation is well below the anticipated 25% deviation between the two methods. See appendix I for further information on the MF technique.

V. RESULTS

The results of the ground water sampling from monitoring wells #1 and #2 can be found in tables #1 and #2. Well #1 was installed in the lowest area of Taylor's Point, ground elevation 3 ft. MSL. The bottom of monitoring well #1 was at -4.0' MSL. Sample results indicate a severe level of ground water contamination, in the fact that 14 of 17 samples taken showed fecal coliform counts in excess of 560 fecal coliform/100 ml. This could possible indicate a hydrogeologic flow from the surrounding developed higher land towards this lower elevation. The results

of samples from well #2 showed 10 of 17 samples contaminated with fecal coliform, the range being from 75/100 ml to 1520/100 ml. Graphs #3 and #4 display the fecal coliform counts obtained by date.

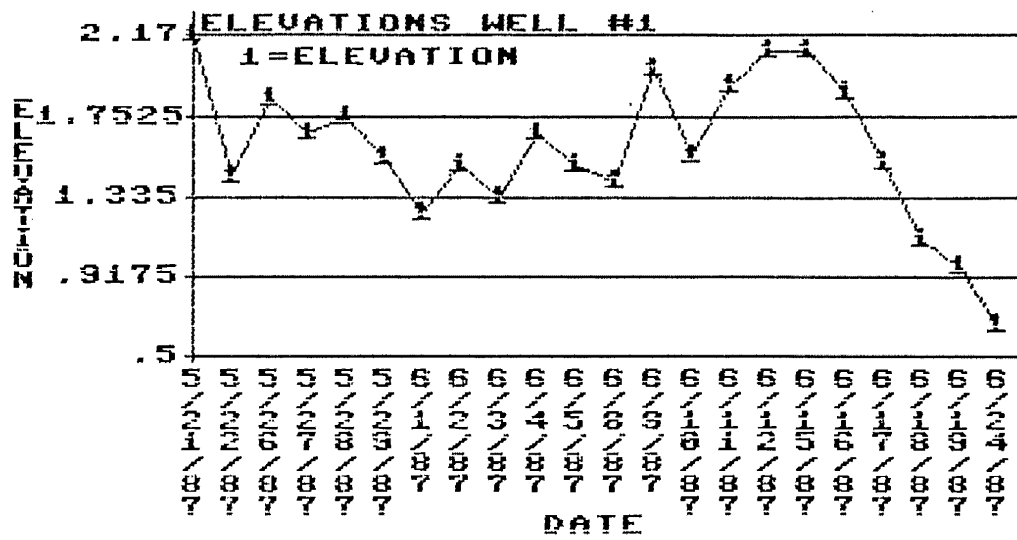
Leaching catch basins were sampled when there was standing water present (see table #4). A total of 17 surface water samples were taken, with the result of 8 samples containing fecal coliforms in excess of 230/100 ml. Due to the lack of precipitation (see table #1) the single storm drainage pipe could only be sampled on one occasion, with the resulting count being 900 fecal coliform per 100 ml, (MPN by County lab).

VI. CONCLUSIONS

Although the two ground water monitoring wells were not sealed at the surface, it can be concluded that surface infiltration along the casing was not a factor, due to the extremely dry weather conditions. In addition, monitoring well #2 was installed in a road island about a foot higher than the road bed. The majority of high fecal counts in monitoring wells were obtained several hours after high tides (see tables #1 and #2). This would indicate a "flushing" action from cess-pools that were inundated during the tidal cycle. The sampling program has determined ground water contamination from on-site septic systems. This was verified by the catch basin water samples, which determined that those catch basins near or below the water table showed the greatest degree of contamination.

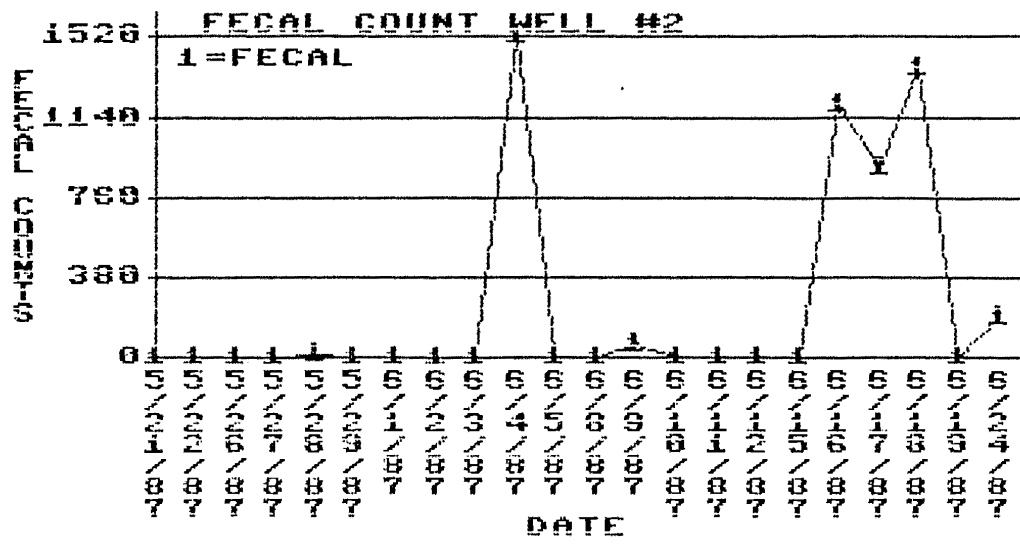
MONITORING WELL #1 TAYLOR'S POINT

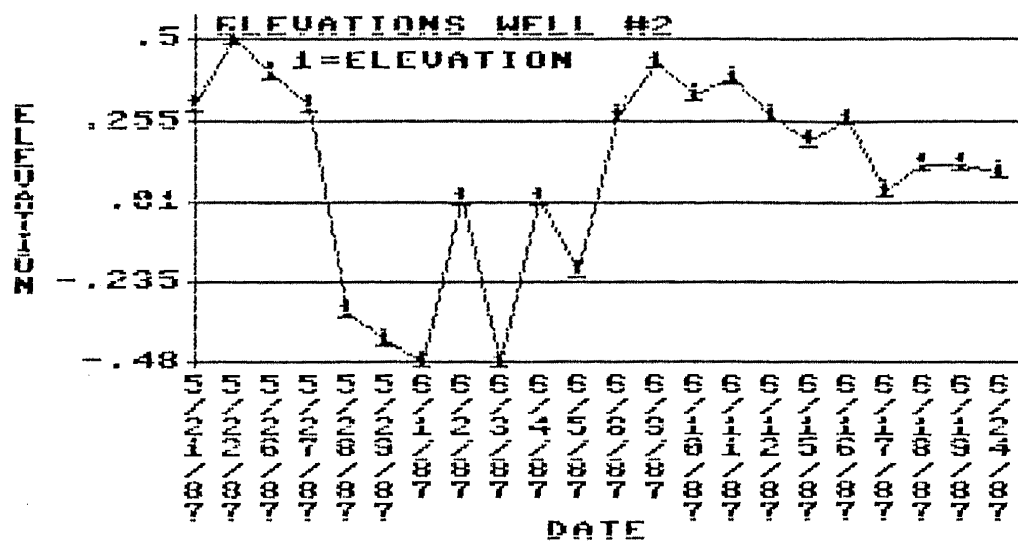
DATE	TIME	ELEVATION	RAIN	HIGH TIDE	TOTAL COLIFORM	FECAL COLIFORM	BARNSTABLE COUNTY (RESULTS MPN FECAL)
5/21	8:35	2.17'	-	0432			
5/22	9:21	1.44'	-	0530			
5/26	9:23	1.84'	-	0848	TNTC	2830	
5/27	10:10	1.67'	-	0930	TNTC	1720	
5/28	10:00	1.75'	-	1012	TNTC	3500	
5/29	8:55	1.54'	-	1054			
6/1	11:17	1.25'	-	0037	300	1	
6/2	10:36	1.5'	-	0124	TNTC	560	600
6/3	10:37	1.34'	-	0215	TNTC	4100	
6/4	11:25	1.67'	.85	0307	TNTC	1520	
6/5	9:37	1.5'	-	0401			
6/8	10:40	1.42'	.55 6/7	0641	TNTC	TNTC	
6/9	10:45	2.0'	-	0732	TNTC	TNTC	3000
6/10	8:55	1.56'	-	0821			
6/11	8:57	1.92'	-	0921			
6/12	9:00	2.09'	-	1003			
6/15	9:30	2.09'	-	0011	TNTC	TNTC	
6/16	9:15	1.87'	-	0106	100	20	22
6/17	9:10	1.52'	-	0205	540	280	
6/18	9:32	1.12'	-	0305	1080	740	
6/19	9:20	.98'	-	0403			
6/24	10:30	.67'	.22 6/23	0824	TNTC	2160	



MONITORING WELL #2 TAYLOR'S POINT

DATE	TIME	ELEVATION	RAIN	HIGH TIDE	TOTAL COLIFORM	FECAL COLIFORM	BARNSTABLE COUNTY (RESULTS MPN FECAL)
5/21	9:02	.3'	-	0432			
5/22	9:55	.5'	-	0530			
5/26	9:45	.4'	-	0848	70	10	
5/27	10:20	.3'	-	0930	360	10	
5/28	10:20	-.32'	-	1012	80	20	
5/29	9:05	-.41'	-	1054			
6/1	11:25	-.48'	-	0037	1	1	
6/2	11:00	.02'	-	0124	CONF	CONF	2
6/3	10:45	-.48'	-	0215	CONF	CONF	
6/4	11:30	.02'	.85	0307	TNTC	1520	
6/5	9:45	-.2'	-	0401			
6/8	10:30	.27'	.55 6/7	0641	100	10	
6/9	9:35	.43'	-	0732	132	75	80
6/10	9:00	.33'	-	0821			
6/11	9:02	.38'	-	0912			
6/12	9:05	.27'	-	1003			
6/15	9:40	-.2'	-	0011	CONF	10	
6/16	9:35	.26'	-	0106	2780	1200	1200
6/17	8:59	.04'	-	0205	1740	900	
6/18	9:20	.13'	-	0305	2480	1380	
6/19	8:35	.12'	-	0403			
6/24	10:35	.1'	.22 6/23	0824	540	200	





LEACHING CATCH BASIN SAMPLE RESULTS

DATE	BASIN LOCATION	TOTAL/FECAL TOWN RESULTS	TOTAL/FECAL BCHL RESULTS
6/2	P2	20/<10	/8
	P1	100/<10	/2
6/8	BU5	80/20	
	BU3	TNTC/TNTC	
	TA1	CONF/CONF	
	P2	300/230	
6/9	BN1	CONF/TNTC	/500
	D1	CONF/<10	/2
	D2	CONF/30	/30
	BU1	CONF/1480	/1600
6/23	PIPE		900/900
	BU2		>1600/900

LEACHING BASIN ELEVATIONS

LEACHING BASIN LOCATIONS	LEACHING BASIN BOTTOM ELEVATION MSL
A1	+4.0
A2	+4.5
A3	+3.10
A4	+3.25
A5	+2.10
A6	+1.5
A7	+2.40
A8	+3.60
A9	+2.25
A10	+1.9
A11	+2.1
A12	+4.75
T1	+1.25
BN1	-0.84
BN2	+1.1
BN3	+3.25
BN4	+0.50
P1	+2.10
P2	-1.66
BA1	+1.0
C1	+2.0
D1	+2.0
D2	+0.70
BU1	+1.70
BU2	+0.66
BU3	+2.20
BU4	-0.40
BU5	+4.60
TA1	+1.0

THE MILLIPORE FILTER, GENERAL DESCRIPTION

The Millipore filter, composed of pure clean inert cellulose esters, is a thin porous membrane containing millions of capillary pores of uniform dimension per square centimeter of filter surface. These pores are essentially direct channels through the filter and are evenly distributed over its surface area. Filters are available in different porosity grades ranging from 10 millimicrons to 8 microns. The size of pores in the Millipore filters is controlled to an extraordinary degree. For example, the total range of pore size distribution in the filter whose mean pore size is 0.45 microns plus or minus 0.02 microns. One of the most significant characteristics of these filters is absolute surface retention of all parts larger than its pore size. The pores which pass through the filter occupies only 15-20%. This unique porosity characteristic permits extremely high flow rates for gasses and liquids. For example, the flow of water through a filter with a mean pore size of 0.45 microns is 20 gallons per minute per square foot at a pressure of 15 pounds per square inch (psi). The Millipore filter is stable in the presence of oxygen at temperatures up to 125°C. Conversely, in oxygen free systems it may be used at temperatures up to 200°C. It is also stable at low temperatures and has been used in filtration of liquid helium at -270°C. The flash point of the Millipore filter is in excess of 200°C. It will not absorb or retain within the filter structure significant quantities of soluble components. (Sanitarian's Handbook)

TOTAL COLIFORM

After sampling and filtration, the membrane filter is placed on top of MF-Endo media containing lactose, protein digest, vitamins, selective chemicals, and Schiff's Reagent. As the membrane incubates for 24 hours at 35°C ± 0.5 , the medium diffuses through the pores in the filter, supplying nutrients to the multiplying bacteria. Many kinds of bacteria from the water sample can grow and form colonies under these conditions, but only the coliforms will ferment lactose. One by-product of this reaction is an acid aldehyde complex that will combine with the Schiff's Reagent to form an iridescent green coating over the growing colonies. Thus, the coliforms can be identified as dark red colonies with a greenish-gold "sheen", when seen with 10-20 X magnification and fluorescent illumination. The few non-coliforms that may appear are red in color, lacking the sheen appearance.

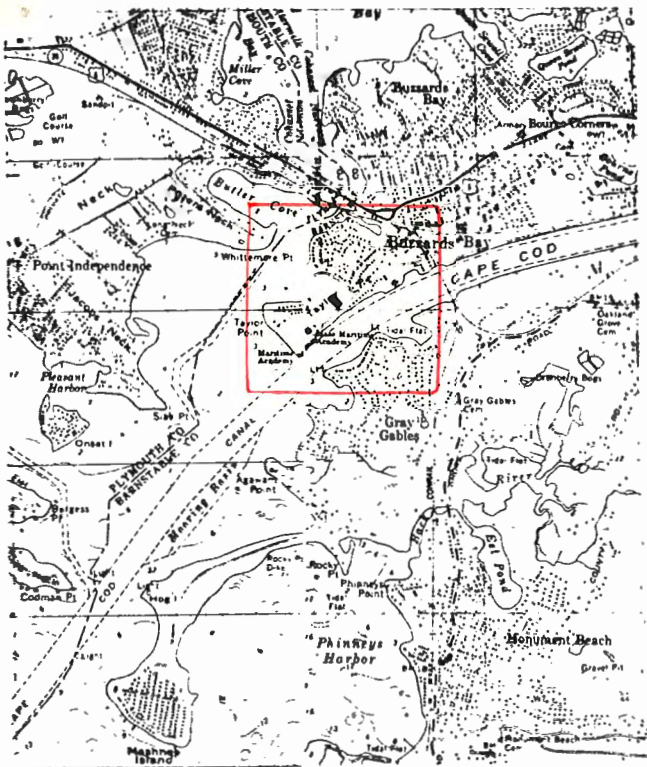
FECAL COLIFORM

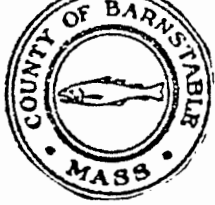
The filtration step is similar to that for total coliform. The medium used for this test is M-FC, containing lactose, protein digest, vitamins, bile salts, selective chemicals, and aniline blue dye. The membrane is incubated for 24 hours at 44.5°C ± 0.2 , allowing only coliforms of fecal origin to grow into visible colonies.

As the fecal coliforms grow, they ferment lactose, producing acid which reacts with the aniline dye to produce a blue color. The non-fecal coliforms, due to heat shock, generally do not grow. When viewed with a stereomicroscope at 10-20 X magnification, all colonies exhibiting a blue color are fecal coliforms. Any non-fecal thermophile colonies appearing on the filter will exhibit a green, grey, or cream color. (Millipore Filter Operations Manual)

LEACHING CATCH BASIN, STORM DRAIN, MONITORING
WELL, AND TOPOGRAPHIC MAP

LOCUS





BARNSTABLE COUNTY HEALTH AND ENVIRONMENTAL DEPARTMENT
Superior Court House
Barnstable, Massachusetts 02630
362-2511 Ext. 331

Date: June 11, 1987

SURFACE WATER LABORATORY ANALYSIS

Mailing Address: Bourne Board of Health
24 Perry Avenue
Buzzards Bay, MA 02532

Telephone: 759-3435

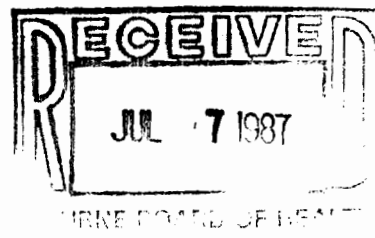
Collector: Tracy Warncke
Time & Date of Collection: 6/9/87, 9:30am - 11:05am
Time & Date of Analysis: 6/9/87, 3:00pm
Date of Last Rain: 6/9/87
Method of Analysis: MPN(Fecal Coliform)

SAMPLE LOCATION(S):	TIDE	BATHER DENSITY	TOTAL COLIFORM /100 ml	FECAL COLIFORM /100 ml (MPN)			MEETS RECOMMENDED LIMITS FOR WATER	
							YES	NO
BN1 Catch Basin				500				
Well #2				80				
Well #1				3000				
D1 Catch Basin				2				
D2 Catch Basin				30				
BU1 Catch Basin				1600				

LIMITS for RECREATIONAL WATER (Mass. Water Quality Criteria) 1,000 Total Coliform/100 ml, 200 Fecal Coliform/100 ml

LIMITS for SHELLFISH WATER (Interstate Shellfish Sanitation Program) MPN 70 Total Coliform/100 ml, MPN 14 Fecal Coliform/100 ml

COMMENTS: RESULTS ONLY



Analyst: Donna M. Callahan ^{EB}

C:

05/22/85



BARNSTABLE COUNTY HEALTH AND ENVIRONMENTAL DEPARTMENT
Superior Court House
Barnstable, Massachusetts 02630
362-2511 Ext. 331

Date: June 25, 1987

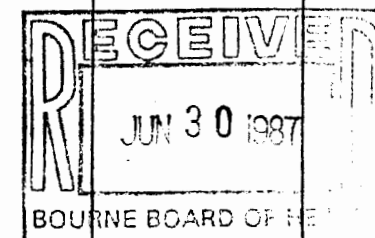
SURFACE WATER LABORATORY ANALYSIS

Mailing Address: Town of Bourne
24 Perry Avenue
Buzzards Bay, MA 02532

Telephone: 759-3435

Collector: T. Warncke
Time & Date of Collection: 6/23/87 8:10 a.m.
Time & Date of Analysis: 6/23/87 11:30 a.m.
Date of Last Rain: 6/23/87
Method of Analysis: MPN

SAMPLE LOCATION(S):	TIDE	BATHER DENSITY	TOTAL COLIFORM /100 ml	FECAL COLIFORM /MPN	E.Coli /MPN	MEETS RECOMMENDED LIMITS FOR WATER	
						YES	NO
Storm Drain				900	900		
Catch Basin				>1600	900		



LIMITS for RECREATIONAL WATER (Mass. Water Quality Criteria) 1,000 Total Coliform/100 ml, 200 Fecal Coliform/100 ml

LIMITS for SHELLFISH WATER (Interstate Shellfish Sanitation Program) MPN 70 Total Coliform/100 ml, MPN 14 Fecal Coliform/100 ml

COMMENTS:

Analyst: Sue Walker ^{EB}

CC:

05/22/85



BARNSTABLE COUNTY HEALTH AND ENVIRONMENTAL DEPARTMENT
Superior Court House
Barnstable, Massachusetts 02630
362-2511 Ext. 331

Date: June 22, 1987

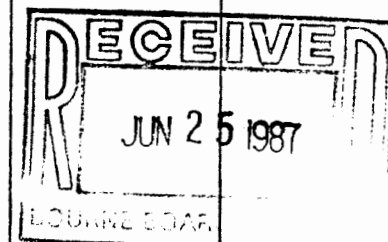
SURFACE WATER LABORATORY ANALYSIS

Mailing Address: Bourne Board of Health
24 Perry Avenue
Town Office
Buzzards Bay, MA 02532

Telephone: 759-3435

Collector: Tracy Warncke
Time & Date of Collection: 6/16/87, 10:00am -10:07am
Time & Date of Analysis: 6/16/87, 2:30pm
Date of Last Rain: _____
Method of Analysis: MPN

SAMPLE LOCATION(S):	TIDE	BATHER DENSITY	TOTAL COLIFORM /100 ml	FECAL COLIFORM /100 ml			MEETS RECOMMENDED LIMITS FOR WATER	
							YES	NO
(Ground Water Monitoring Wells)								
Well #1				22				
Well #2				1300				



LIMITS for RECREATIONAL WATER (Mass. Water Quality Criteria) 1,000 Total Coliform/100 ml, 200 Fecal Coliform/100 ml

LIMITS for SHELLFISH WATER (Interstate Shellfish Sanitation Program) MPN 70 Total Coliform/100 ml, MPN 14 Fecal Coliform/100 ml

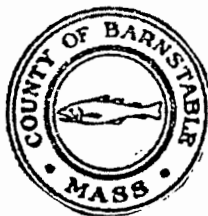
COMMENTS:

RESULTS ONLY

Analyst: [Signature]

cc:

05/22/85



BARNSTABLE COUNTY HEALTH AND ENVIRONMENTAL DEPARTMENT
Superior Court House
Barnstable, Massachusetts 02630
362-2511 Ext. 331

Date: June 10, 1987

SURFACE WATER LABORATORY ANALYSIS

Mailing Address: Town Of Bourne
24 Perry Avenue
Buzzards Bay, MA 02532

Telephone: 759-3435

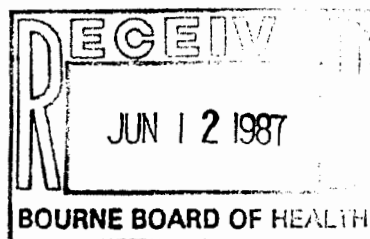
Collector: Tracy Warncke
Time & Date of Collection: 6/2/87 10:35 - 11:00 a.m.
Time & Date of Analysis: 6/2/87 3:15 p.m.
Date of Last Rain: 5/29/87
Method of Analysis: MPN

SAMPLE LOCATION(S):	TIDE	BATHER DENSITY	TOTAL COLIFORM /100 ml	FECAL COLIFORM /100 ml			MEETS RECOMMENDED LIMITS FOR WATER	
							YES	NO
Monitoring Well #1 Taylors Point				600				
Monitoring Well #2 Taylors Point				<2				
Catch Basin #P2				8				
Catch Basin #P1				<2				

LIMITS for RECREATIONAL WATER (Mass. Water Quality Criteria) 1,000 Total Coliform/100 ml, 200 Fecal Coliform/100 ml

LIMITS for SHELLFISH WATER (Interstate Shellfish Sanitation Program) MPN 70 Total Coliform/100 ml, MPN 14 Fecal Coliform/100 ml

COMMENTS: Results only



Analyst: Donna Mc Caffery

cc:

05/22/85