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Mt. Hope Bay Sanitary Survey:

Microbiological; 1986-1987 99 pp

Rippey & Watkins (FDA, Northeast Technical Services Unit)

Narragansett Bay Estuary Program

MT. HOPE BAY
Sanitary Survey - Microbiological
1986-1987
Final Report

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EXECUTIVE SUMMARY

A study of the Mt. Hope Bay estuary was conducted to determine whether the sanitary quality of waters in the bay has improved sufficiently to allow commercial harvesting of shellfish. Both sanitary surveys along the shorelines and microbiological analyses of samples were performed for this purpose. The results obtained for water samples showed that the southwestern portion of Mt. Hope Bay could be managed as a conditionally approved shellfish growing area, provided that several additional concerns could be addressed and resolved. Specific recommendations were made regarding the future management of the area. The study was a cooperative effort involving sample collection by the Wickford Fishermen's Alliance and survey and sample analyses by the Food and Drug Administration.

The technical approach to this sanitary survey project consisted of the following: selection of sample stations based on the results of monitoring during dry weather tidal cycles; performance of sanitary surveys during favorable (dry) and unfavorable (wet) weather; identification and characterization of major point souces of contamination; determination of environmental conditions critical for any reclassification of the area; seasonal sampling to further examine the indicators in surface and bottom waters, sediments, and shellfish; provide recommendations concerning the future management of the area. Each of these phases of the project and all related tasks were accomplished on schedule and without major difficulties.

The majority of Mt. Hope Bay was found to exceed the National Shellfish Sanitation Program (NSSP) standards for approved status. Several significant point sources of contamination were identified during survey work, and their relative contributions (source strengths) to the bay were estimated from the

microbiological results obtained from samples taken during wet and dry weather. Point souces of primary concern (according to source strength) were the Quequechan River discharge, the Taunton River, several of the combined sewer overflows (CSOs) discharging from Fall River, Massachusetts, a few rain-related discharges occurring along the western shoreline of the bay just South of the Kickamuit River, and the Somerset wastewater treatment effluent. These are the sources of contamination to Mt. Hope Bay which merit the highest consideration for any resources allocated to future pollution abatement measures. Contrary to initial suspicions, discharges from the Fall River wastewater treatment facility did not appear to be a major factor in degrading water quality of the bay during dry weather, and were judged to be only a moderate influence during wet weather.

Overall results of this project show that a portion of the estuary qualifies for further consideration as a conditionally approved shellfish growing area according to the requirements of the NSSP. In essence, conditional management can be premised on seven-day closures for any 0.5 inch rainfall in a 24 hour period, and longer closures (to be determined empirically by water analyses) for any 1.0 inch or greater rainfall in 24 hours. Still, additional determinations are necessary before changes in classification and shellfish management can be executed.

Further field and analytical determinations are recommended to insure the following: (1) time of travel of contaminants from major point sources to that portion of the bay under consideration for 'conditionally approved' status allows sufficient time to notify commercial shellfishmen of a closure before the overlying harvest waters are impacted; (2) any boundary established to define a conditionally approved portion of Mt. Hope Bay is clearly demarcated for harvesters, and enforcement of management criteria is reasonable and practical for conservation officers charged with this critical responsibility; (3) shellfish meats in the proposed conditional area are found to be within written guidelines for chemical contaminants, principally toxic and pesticide residues and metals; and, (4) the results of additional sampling and analyses in the proposed conditional area, combined with results from this study, demonstrate that the area's water quality under defined hydrographic conditions continues to meet NSSP standards for the conditionally approved classification.

MOUNT HOPE BAY

Sanitary Survey, 1986-87

INTRODUCTION

Principal Objectives The overall objective of this project was to determine whether the sanitary quality of waters in Mount Hope Bay has improved sufficiently to permit commercial harvesting of shellfish. Specific tasks to be accomplished included a 3-4 day screening study, a dry-weather and a wet-weather sanitary survey, 2-day seasonal monitoring (all seasons) of three selected stations, sanitary reconnaissance and evaluation of point sources of contamination, data analyses, data submission and coordination with modeling projects, and a final report with specific recommendations regarding commercial shellfishing, management of the area, and actions to improve water quality.

Participants

The Food and Drug Administration (FDA), Northeast Technical Services Unit, Davisville, RI and the Wickford Fisherman's Alliance (WFA), North Kingstown, RI were to conduct this study jointly. The cooperative effort and responsibility for the project rested primarily with the FDA and Drs. William D. Watkins and Scott R. Rippey.

TECHNICAL APPROACH

The study tasks designed to accomplish the main objectives were as follows:

a. Select sample stations in Mt. Hope Bay and its tributaries for screening, survey and monitoring work. The sampling network should emphasize hard clam growing areas and major point sources of contamination.

b. Screen up to fifty (50) different stations to identify areas which, under favorable hydrographic conditions, might meet the bacteriological standard for approved status, and those which can be eliminated from further consideration because of excessive fecal coliform levels. Sampling and assays were to be performed for at least 3 consecutive days during dry weather (<0.25 inches of rainfall during the previous 7 days and during the 3-day screening) using rapid enumeration methods for determining fecal coliform, Escherichia coli, enterococci, and Clostridium perfringens spore densities. Samples were to be obtained routinely on ebb tide and, one day, on flood tide.

c. Select up to fifteen (15) key stations identified in (b) above with potential for approved or conditional status and, together with stations proximal to major sources of identifiable contamination, perform a microbiological sanitary survey under favorable meteorological conditions (dry weather). Stations were to be sampled and assays performed for 10 days on ebb tide, and on flood tide for 2-3 days. Assay procedures prescribed by the National Shellfish Sanitation Program's (NSSP) Manual of Operations, Part 1, for fecal coliforms were employed. Data from these assays were to be statistically analyzed to determine which areas, if any, qualify as approved for shellfishing based upon criteria specified in the

NSSP manual.

d. Locations found to have waters of acceptable sanitary quality in (c) above were to be subjected to a second sanitary survey under the least favorable hydrographic and pollution conditions (rainfalls of 0.5 inches or greater within a 24 hour period, ebb tide, etc.). Bacteriological data obtained during these conditions would dictate whether these areas could be considered as approved or conditionally approved for shellfish harvest. As before, stations were to be sampled and assays performed for 10 days, or until water quality returned to that found during dry weather. Assay procedures and data analysis were those prescribed by the NSSP guidelines.

e. During the wet and dry study periods, shoreline reconnaisance was to be conducted to assess point and non-point source pollution. Flows during wet and dry periods would be determined, when possible, and microbiological assays for all indicators would be performed on samples collected from these sources.

f. Recommendations made on the management of shellfishing in Mt. Hope Bay to the states of Rhode Island and Massachusetts would be based upon the results of the sanitary surveys. These would include both the type of classification and the environmental conditions critical for management. Measures that would improve water quality in these areas of the Bay which could be identified in this study also were to be recommended to the states.

g. To supplement similar data obtained for stations in upper Narragansett Bay, microbial indicator densities found in the water column (surface and bottom), sediments, and shellfish were to be determined at least twice seasonally (8 times per year) at 3-4 key sample sites. The sites for this monitoring were to be selected after the intial screening in (a) above and, if possible, would reflect varying levels of surface water contamination (from highly to moderately polluted). Densities of fecal coliforms, *E. coli*, enterococci, *C. perfringens* spores and male-specific bacteriophage (f2) would be determined. Data collected from these stations were expected to provide information on which area of the water/sediment column best reflects the sanitary quality of the shellfish. The seasonal sampling schedule would provide information on the survival of indicators in shellstock during periods of inactivity.

DESCRIPTION OF THE AREA

Mount Hope Bay forms the northeast corner of the Narragansett Bay estuary and covers an area of about 14 square miles. The Rhode Island - Massachusetts State boundary traverses the area in a southeasterly direction and, although over 70% of Mt. Hope Bay is located in Rhode Island, over 90% of its drainage basin is located in Massachusetts. The drainage area covers more than 570 square miles. Five rivers discharge into the Bay; these are the Taunton, Cole, Lee, Kickamuit, and Quequechan. Each of these originate and terminate in Massachusetts, with the exception of the Kickamuit, which crosses into and terminates in Rhode Island waters.

Mt. Hope Bay empties into the East Passage of Narragansett Bay and the Sakonnet River. Approximately 70% of the Bay has a mean low water depth of 18 feet or less. The mean tide range is about 4.4 feet; the maximum tide range of 5.5 feet occurs during the spring. The average currents are approximately 0.4 and 0.5 knots on flood and ebb tides, respectively. Wind direction strongly influences the Bay water's mixing patterns, with the greatest mixing provided by southerly winds.

The vast majority of known pollution sources impacting the Bay are located in Massachusetts. These include municipal and industrial wastes, combined sewer overflows, and heated effluents. Over a dozen municipal wastewater effluents and more than six dozen industrial effluents discharge into the watershed. The most significant influences on the sanitary quality of Mt. Hope Bay are the river waters and sewage effluents which flow directly into the Bay proper. Heated effluents from the Brayton Point Power Plant may also be an important factor in the dispersal of contaminants. Measures have been taken during the past decade to improve the quality of wastewater effluents from several sewage treatment facilities in the watershed, most notably at the Fall River Plant which discharges directly into the Bay on its eastern side. The extent to which the sanitary quality of Mt. Hope Bay may have improved in recent years was one major focus of the project proposal.

Current Classification

With the exception of the Kickamuit River, there are no areas that are currently classified as approved for shellfish harvesting within the Mt. Hope Bay estuary.

Conditions During the Survey Periods

The study was designed to examine the area under widely varying meteorological conditions. Sampling was conducted during periods of wet and dry weather and for extended periods following certain rainfall events. Table 1 provides rainfall data for the selected study periods.

In addition to sampling during ´dry´ and ´wet´ periods, sampling was conducted following periods of rainfall which exceeded 0.5 inches to determine when the water quality of the area would return to its ´dry´ weather condition.

Although some sampling was conducted during high tide, most samples were collected at times bracketing mean low water to assess conditions under periods of least contaminant dilution.

Table 1. Rainfall Data - 1986, 1987. Data reported by Green Airport.

Year	Date		Rain (in.)	Remarks
1986	June	18	-	
	"	19	-	
	"	20	0.17	
	"	21	-	
	"	22	-	
	"	23	0.02	Screening study begins
	"	24	-	
	"	25	-	
	"	26	-	Screening study concludes
	July	17	-	
	"	18	-	
	"	19	0.31	
	"	20	-	First sanitary survey begins - predominately ´dry´ weather
	"	21	0.36	
	"	22	-	
	"	23	-	
	"	24	-	
	"	25	-	
	"	26	0.03	
	"	27	1.28	
	"	28	-	
	"	29	0.30	
	"	30	0.17	
	"	31	-	First survey ends
	Nov.	15	-	
	"	16	0.01	
	"	17	-	Three stations sampled; surface and bottom water, sediment, shellfish.
	Nov.	22	-	
	"	23	0.05	
	"	24	0.21	Three stations sampled; surface and bottom water, sediment, shellfish.
1987	Feb.	23	0.10	
	"	24	-	
	"	25	-	Three stations sampled; surface and bottom water, sediment, shellfish.
	Feb.	28	-	
	Mar.	1	1.60	
	"	2	0.11	Three stations sampled; surface and bottom water sediment, shellfish.
	Mar	28	0.30	
	"	29	-	
	"	30	0.13	
	"	31	3.15	
	Apr.	1	0.39	
	"	2	-	
	"	3	-	

Table 1. (cont.) Rainfall Data - 1986, 1987. Data reported by Green Airport.

Year	Date		Rain (in.)	Remarks
	Apr.	4	1.61	
	"	5	0.41	
	"	6	0.76	Second sanitary survey begins-´wet´ weather
	"	7	0.12	
	"	8	0.10	
	"	9	-	Second survey concludes
	"	10	-	
	May	1	-	
	"	2	-	
	"	3	0.30	
	"	4	0.70	
	"	5	0.50	
	"	6	-	
	"	7	-	
	"	8	0.03	
	"	9	-	
	"	10	-	
	"	11	-	Area sampled to assess possible return to ´dry´ weather water quality
	"	12	0.01	
	"	13	-	
	"	15	0.05	
	"	16	-	
	"	17	-	
	"	18	0.13	
	"	19	0.01	Area sampled to assess possible return to ´dry´ weather water quality
	May	30	-	
	"	31	-	
	June	1	-	
	"	2	-	
	"	3	-	
	"	4	0.08	
	"	5	0.15	
	"	6	-	
	"	7	0.68	
	"	8	0.17	
	"	9	-	Area sampled to assess ´wet weather impact.
	"	10	-	
	"	11	-	Area sampled to assess possible return to ´dry´ weather quality

SAMPLING AND ANALYTICAL METHODS

I. Field Sampling

Water samples were collected in sterile, 1 l. polypropylene sample containers. Sewage sample bottles included sodium thiosulfate which resulted in a final concentration of 100 mg/l for chlorine inactivation. Surface waters were collected at about 0.5 m depth. Bottom water samples were obtained using a Kemerrer 2 liter sampler about 0.5 m from the sediment. Sediment samples were collected with a Petersen dredge. Shellfish samples were collected by hand raking. Total chlorine residuals were measured using the DPO colorimetric methods (Standard Methods for Examination of Water and Wastewater, 16th edition, 1985). All samples were held at 4°C prior to analysis. Temperatures and salinities were recorded using a Beckman induction salinometer. Table 2 summarizes sampling procedures.

II. Microbiological Analyses

Several microbial indicator organisms were enumerated depending on the nature of the sample. The included the fecal coliform group, *E. coli*, the enterococcus group, *Clostridium perfringens*, and f2 coliphage. These indicators were selected for the reasons described below.

Fecal coliforms are the classical bacterial indicator group used for determining the sanitary quality of water. These organisms are found in the feces of man and animals and, therefore, are present both in wastewater effluents and storm water runoff. They are relatively sensitive to disinfection by chlorination. Decreases in waterborne fecal coliform populations occur with distance from their sources, reflecting

Table 2. Sampling Parameters.

Parameter	Sample Size	Sample Container	Remarks
Microbiological			
Water	1 liter	polyethylene	Store in dark on ice
Shellfish	1 dozen	polyethylene	Store in dark on ice
Sediment	200 gm	polyethylene	Store in dark on ice
Temperature	-	-	Record to nearest 0.1°C
Salinity	-	-	Record to nearest 0.5 ppt
Depth	-	-	Record to nearest 0.1 m
Tide	-	-	Record time sample collected to determine tide stage

dilution, dieoff and sedimentation.

E. coli is one of the major components of the fecal coliform group. Presently, this species is considered to be a more specific indicator of fecal contamination than is the entire fecal coliform group. In the future, sanitary bacteriology may utilize this species in place of the fecal coliforms.

Enterococci, a subcomponent of the fecal streptococcus group, are presently employed by the US Environmental Protection Agency as the standard health effects indicators for marine and fresh recreational waters. These organisms are found primarily in feces, and are present in wastewater and runoff. They are relatively sensitive to disinfection and decrease with distance from sources due to dilution, dieoff and sedimentation.

C. perfringens is widely used as a conservative indicator of contamination. Vegetative cells of this anaerobic species are quite sensitive to oxygen and die off rapidly. However, the spores produced by this organism are present in wastewater and runoff, survive substantially longer than other indicator bacteria, and are highly resistant to conventional chlorination practices. Thus, decreases in this organism with distance from contaminant sources primarily reflect dilution and sedimentation.

Male-specific coliphage are viruses whose host range is limited to a specific biotype of E. coli. As such, they have been suggested as a simulant for enteric viruses of public health concern. Large numbers of these phage are found in wastewater effluents, but their occurrence in runoff waters has not been investigated. These phage are resistant to chlorination and they survive longer in the environment than most bacterial indicators. Decreases in the number of bacteriophage with distances from sources mainly reflect dilution.

The following methods were used for biological analyses:

A. Membrane filtration procedures. Methods are referenced. Table 3 summarizes microbiological analyses.

i. Fecal coliforms and _E. coli_. Dufour A.P. et al. 1981. Membrane filter method for enumerating _Escherichia coli_. Appl. Environ. Microbiol. _41_:1152-1158.

ii. Enterococci. Levin, M.A. et al. 1975. Membrane filter technique for enumeration of enterococci in marine waters. Appl. Microbiol. _30_:66-71.

iii. _Clostridium perfringens_. Bisson, J.W. and V.J. Cabelli. 1979. Membrane filter enumeration method for _Clostridium perfringens_. Appl. Environ. Microbiol. _37_:55-66

B. MPN Procedures

i. Fecal coliforms and _E. coli_. APHA-MPN (EC) procedure, in: _Standard Methods for the Examination of Water and Wastewater_. APHA, 16th ed., 1985.

Table 3. Microbiological Analyses - Mt. Hope Bay Project.

Parameter	Matrix	Units	Method	Maximum Holding time
Fecal coliform	Water	density/100 ml	MF[a]	8hr[c]
	Shellfish	density/100 gm	MPN[b]	8hr
	Sediment	density/gm	MPN	8 hr
Escherichia coli	Water	density/100 ml	MF	8hr
	Shellfish	density/100 gm	MPN	8hr
	Sediment	density/gm	MPN	8hr
Enterococci	Water	density/100 ml	MF	8hr
	Shellfish	density/100 gm	MPN	8hr
	Sediment	density/gm	MPN	8hr
Clostridium perfringens	Water	density/100 ml	MF	8hr
	Shellfish	density/100 gm	MPN	8hr
	Sediment	density/gm	MPN	8hr
Male-specific coliphage (f_2)	Water	density/100 ml	MF	8hr
	Shellfish	density/100 gm	MPN	8hr

[a] Membrane filtration technique
[b] Most Probable Number procedure
[c] Interval between collection and assay

ii. Enterococci. Azide-dextrose broth method, in: <u>Standard Methods for the Examination of Water and Wastewater</u>. APHA, 16th ed., 1985.

iii. <u>Clostridium perfringens</u>. Iron milk method. St. John, W.D., Matches, J.R. and M.M. Wekell. 1982. Use of iron milk for enumeration of <u>Clostridium perfringens</u>. J. Assoc. Off. Anal. Chem. 65:1129-1133.

C. Bacteriophage Assay

Male specific coliphage (f2) were enumerated by a proprietary method developed by Dr. Victor Cabelli and associates. (Dept. Microbiol., Univ. Rhode Island). The method is currently unpublished.

RESULTS

Water Quality

Screening Survey (June 23-26, 1986)

Forty (40) stations (Figure 1, Table 4) were initially selected for dry weather sampling to determine which of these sites might meet the bacterial standard for an approved shellfish harvest area and which could be eliminated from consideration because of high fecal coliform levels. It was felt that sites which failed to meet the standard during favorable weather conditions could not be expected to improve during wet weather or more unfavorable meteorological conditions. Some very interesting results were revealed when lines were drawn between sites representing similar fecal coliform densities. On June 23, (Fig. 2) it appeared that the major source of pollution into the growing area originated from the Fall River Sewage Treatment Plant. However, on June 24 (Fig. 3) and 25 (Fig.4) the areas of heaviest contamination were at sites north of the treatment plant. This was curious because, on each of these days, sampling was conducted on an outgoing tide. It suggested that there were other significant sources of pollution in the Fall River area. It is also evident from these figures that a major portion of the Bay (particularly on the eastern side) is impacted by sources in Massachusetts, even during dry weather (see following section on sanitary reconnaissance). The distribution of pollutants is maximal during ebb tide. Flood tide data (June 26, Fig. 5) were not unexpected as contaminated waters appeared to be pushed up the bay by the incoming tidal water toward the Fall River-Taunton River Area. It is apparent from these figures that: (i) low tide does indeed represent the worst hydrographic conditions in Mount Hope Bay; (ii) pollution sources other than the Fall River STP would have to be located and evaluated to account for the levels of contamination seen in the estuary; and (iii)

MT. HOPE BAY

All Bay Stations

FIGURE 1

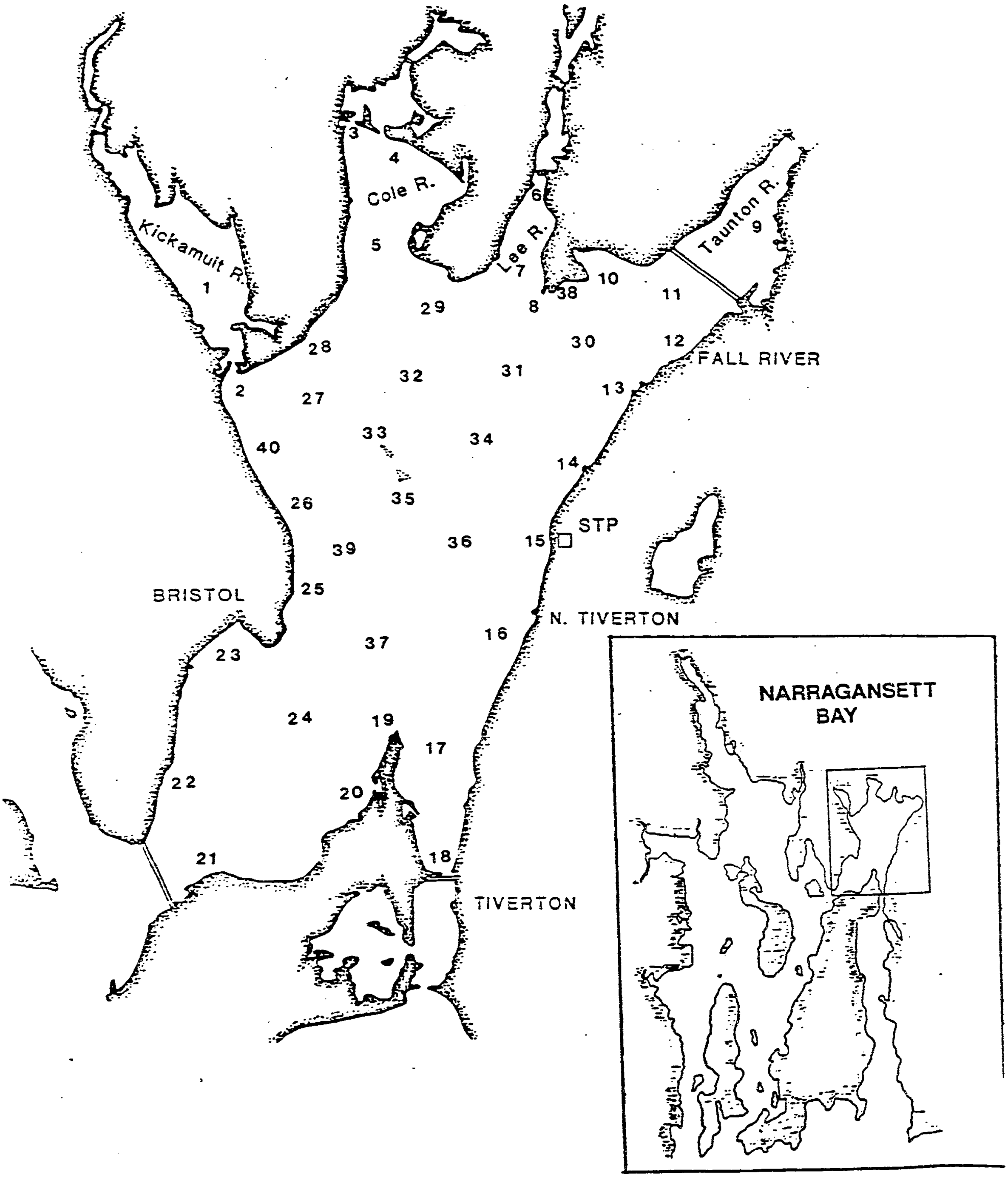
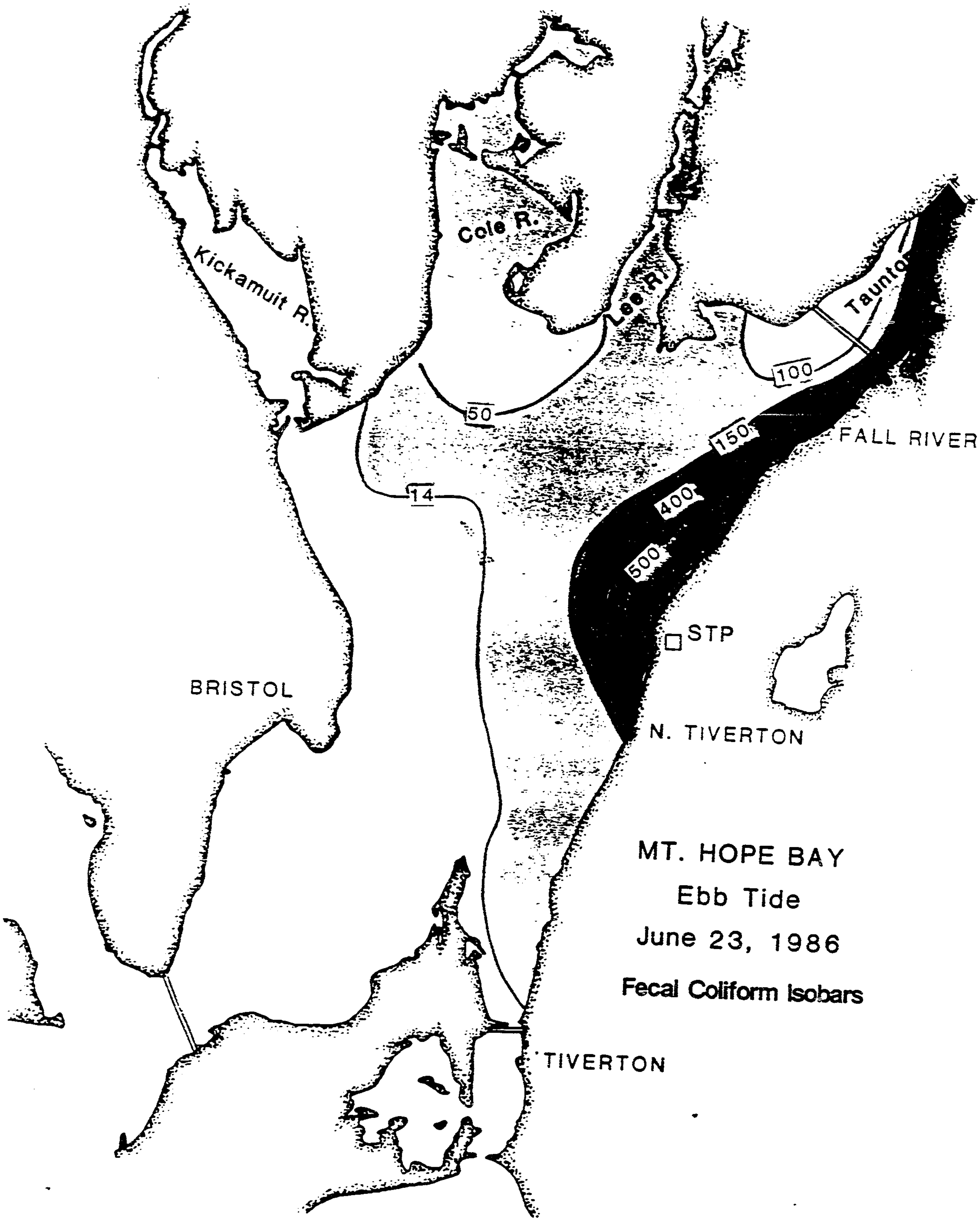


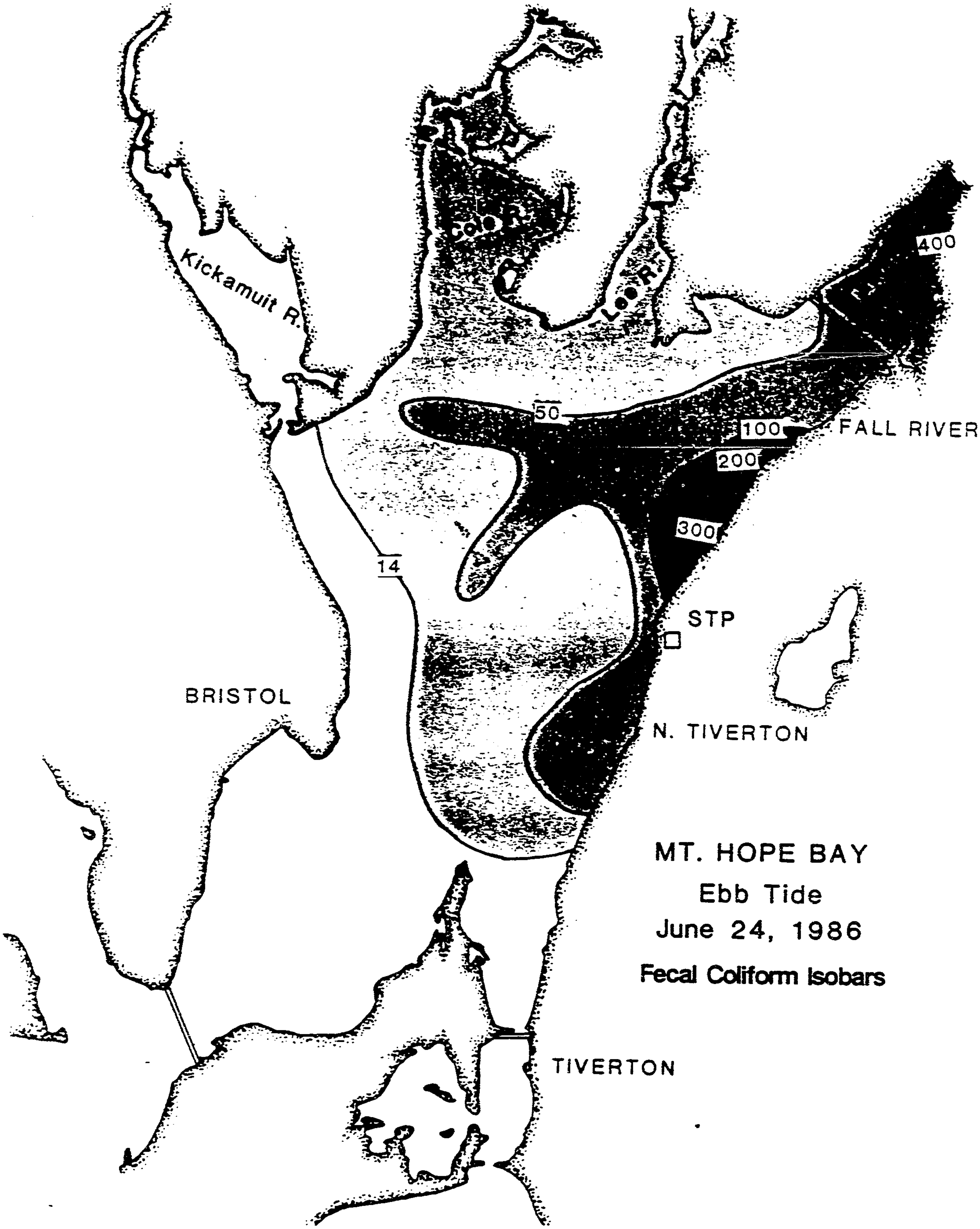
Table 4. Mt. Hope Bay - Bay Station locations by longitude and latitude.

Station #	41°N Latitude	71°W Longitude	Station #	41°N Latitude	71°W Longitude
1	42´38"	15´00"	21	38´27"	15´06"
2	41´43	14´42"	22	38´51"	15´16"
3	43´34"	13´30"	23	39´40"	14´47"
4	43´22"	13´13"	24	39´16"	14´16"
5	42´41"	13´20"	25	40´23"	14´00"
6	43´09"	11´46"	26	40´57"	14´04"
7	42´37"	11´58"	27	41´34"	14´05"
8	42´19"	12´04"	28	42´03"	13´39"
9	42´55"	09´45"	29	42´16"	12´53"
10	42´30"	11´06"	30	42´04"	11´36"
11	42´25"	10´45"	31	41´47"	12´16"
12	42´05"	10´29"	32	41´45"	13´04
13	41´37"	11´10"	33	41´27"	13´19"
14	41´13"	11´31"	34	41´20"	12´25"
15	40´43"	11´53"	35	40´57"	13´15"
16	39´55"	12´19"	36	40´36"	12´58"
17	39´12	12´50"	37	39´55"	13´22"
18	38´24"	12´50"	38	42´22"	11´46"
19	39´29"	13´16"	39	40´42"	13´42"
20	38´52"	13´45"	40	41´21"	14´21"



MT. HOPE BAY
Ebb Tide
June 23, 1986
Fecal Coliform Isobars

Figure 2



MT. HOPE BAY
Ebb Tide
June 24, 1986
Fecal Coliform Isobars

Figure 3

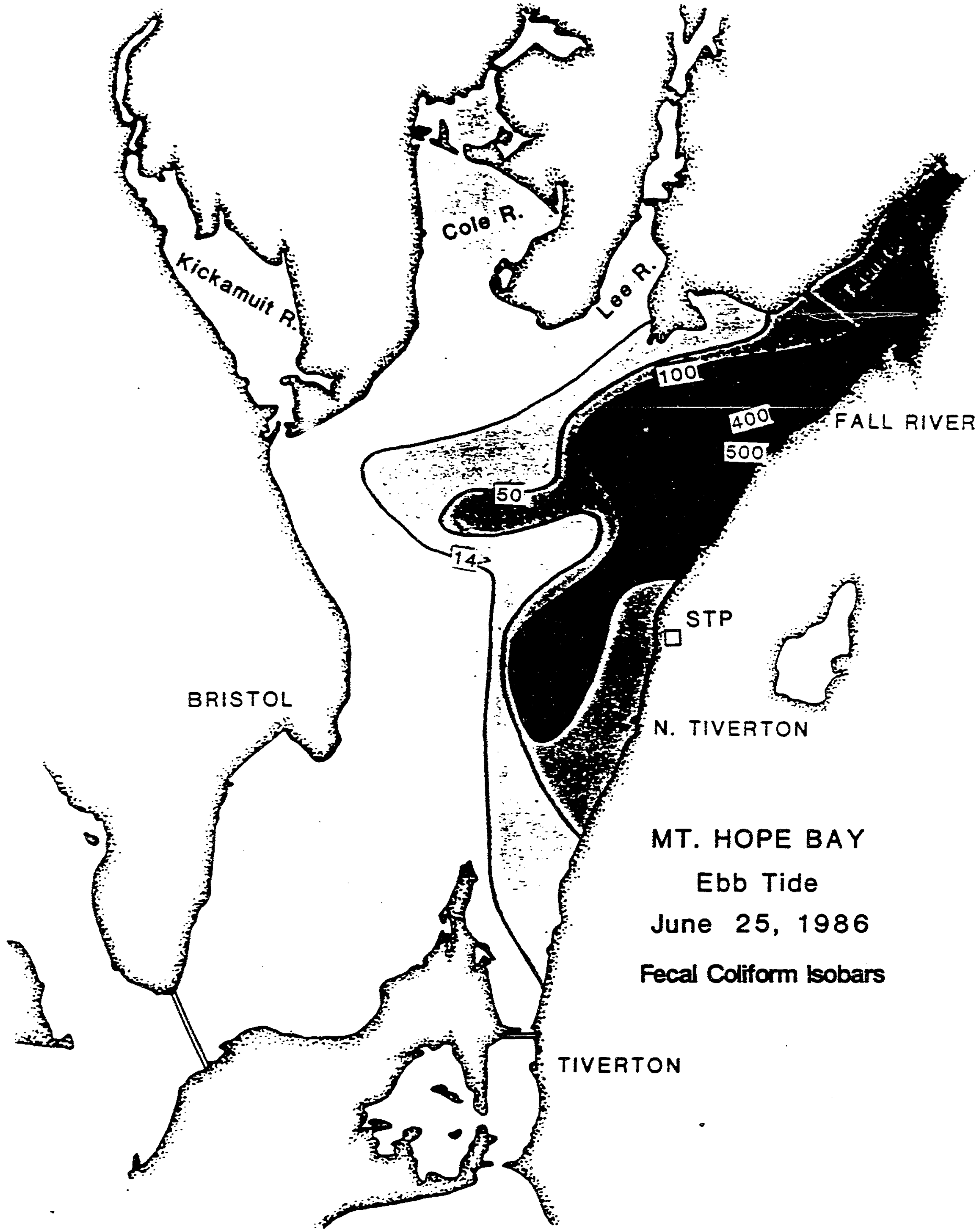
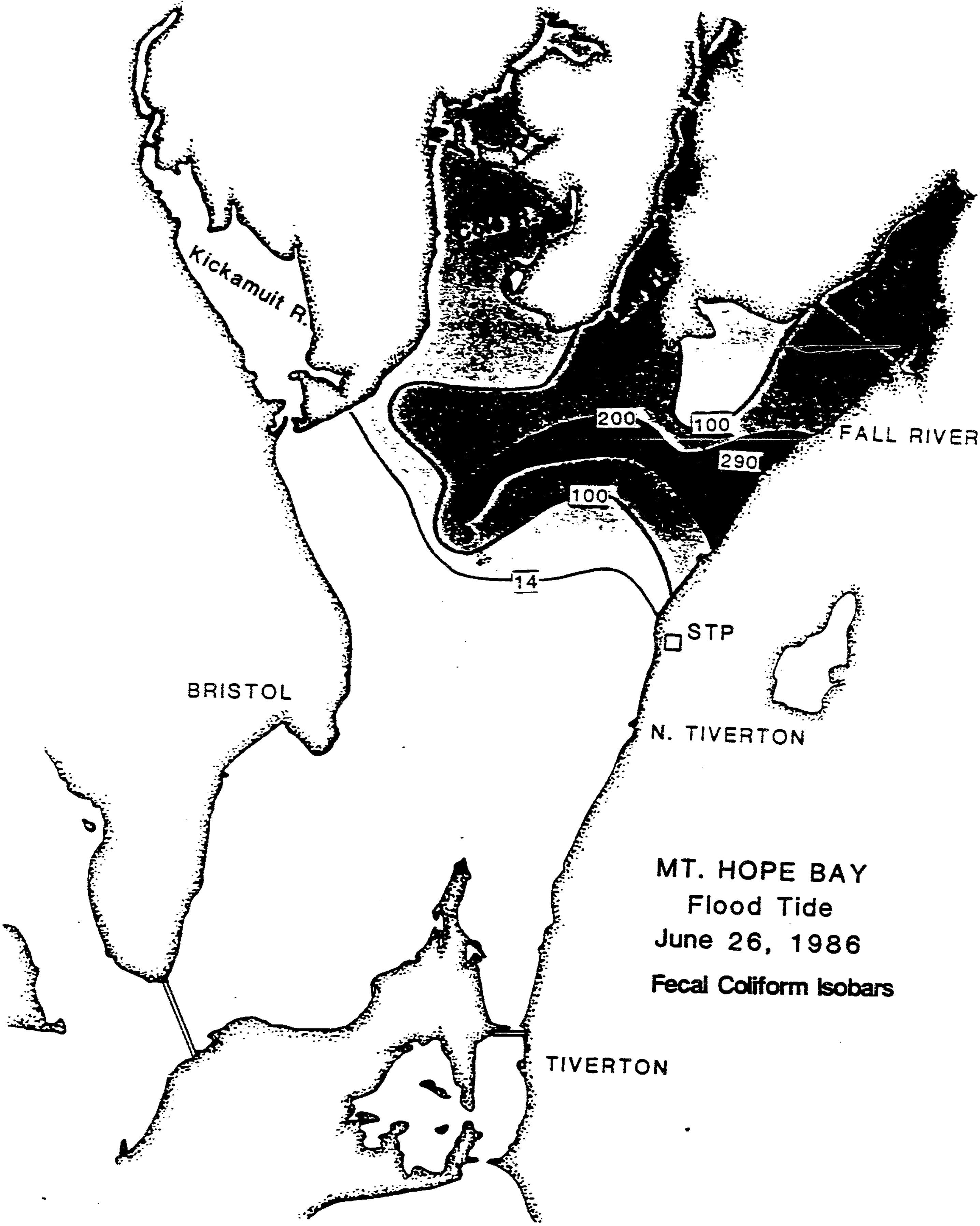

Kickamuit R.
Cole R.
Lee R.
100
400
500
50
14
FALL RIVER
STP
BRISTOL
N. TIVERTON
TIVERTON
MT. HOPE BAY
Ebb Tide
June 25, 1986
Fecal Coliform Isobars

Figure 4



MT. HOPE BAY
Flood Tide
June 26, 1986
Fecal Coliform Isobars

Figure 5

under favorable (dry) weather conditions, only a portion of the Bay could be considered open for shellfishing.

Dry Weather Sanitary Survey

After the initial screening, the number of sample stations was reduced to 22 and concentrated on the western side of the Bay. Dry weather was encountered during the period July 21-27 and represents the optimal conditions for the Bay's water quality. Following at 1.28" rainfall during the night of July 27, three additional sample days were added (July 28, 29, 31) and considered 'wet' weather data. Also included as 'dry' weather are data for Nov. 17 and 24, 1986, Feb. 25, 1987, May 11 and 19, 1987 and June 11, 1987. The results for the dry weather periods are shown in Table 5 and Figure 6. According to the criteria specified by the National Shellfish Sanitation Program, an area may be classified as approved if either the median or the geometric mean fecal coliform density does not exceed 14/100 ml of surface water and not more than 10% of the samples examined (P90) exceed 43/100 ml (based on a 5-tube, multiple dilution MPN procedure). Of the 22 stations examined, 14 would meet this criteria <u>during dry weather</u>. This would encompass the area from the Mt. Hope Bridge to a line that runs from the tip of Common Fence Pt. to Toweset Pt., including the Kickamuit River (see Fig. 6). No other stations were found to be acceptable.

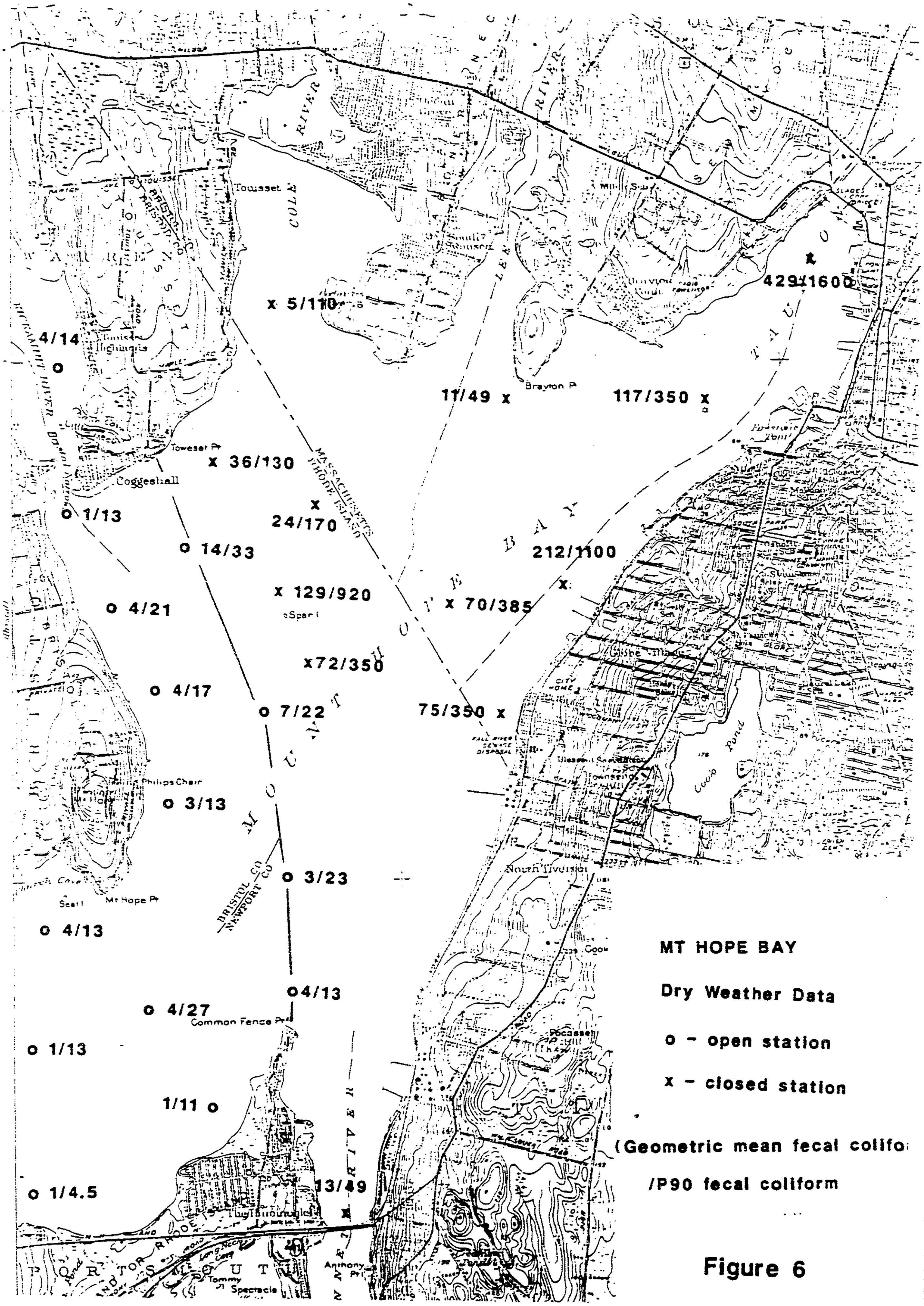
Wet Weather Sanitary Survey

For the purposes of this study, the criterion selected to define a 'wet' weather event was greater than 0.5 inches of rainfall within a 24 hr. period. This is the same criterion used by the State of Rhode Island for managing the conditional shellfish growing area in upper Narragansett Bay. As such, the following dates were considered wet weather periods: July 28, 29, and 31,

TABLE 5. MT. HOPE BAY STATIONS, DRY WEATHER DATA FOR FECAL COLIFORMS AND E. COLI.

STA	N	MIN FC	MAX FC	P90 FC	GM FC	MIN EC	MAX EC	P90 EC	GM EC
01	3	2.0	14.0	14.0	4	2.0	9.3	9.3	4
02	11	0.2	14.0	13.0	1	0.2	9.3	4.5	1
05	11	0.2	130.0	110.0	5	0.2	110.0	17.0	2
08	11	0.2	79.0	49.0	11	0.2	79.0	23.0	7
09	11	79.0	1600.1	1600.0	429	49.0	1600.1	920.0	297
11	3	33.0	350.0	350.0	117	33.0	130.0	130.0	52
14	12	33.0	3500.0	1100.0	212	13.0	1700.0	700.0	105
15	11	4.0	540.0	350.0	75	1.9	240.0	79.0	25
18	11	2.0	79.0	49.0	13	2.0	79.0	49.0	13
19	11	0.2	17.0	13.0	4	0.2	7.8	7.8	2
20	10	0.2	14.0	10.9	1	0.2	7.8	7.3	1
21	11	0.2	7.8	4.5	1	0.2	7.8	4.5	1
22	11	0.2	49.0	13.0	1	0.2	49.0	13.0	1
23	11	0.2	170.0	13.0	4	0.2	33.0	9.3	2
24	11	0.2	79.0	27.0	4	0.2	27.0	14.0	1
25	11	0.2	540.0	13.0	3	0.2	49.0	28.4	1
26	10	0.2	220.0	17.0	4	0.2	95.0	54.0	2
27	11	3.7	79.0	33.0	14	3.7	33.0	13.0	7
28	3	14.0	130.0	130.0	36	11.0	79.0	79.0	21
32	11	0.2	350.0	170.0	24	0.2	130.0	79.0	11
33	3	17.0	920.0	920.0	129	6.8	350.0	350.0	60
34	10	13.0	540.0	385.0	70	4.5	350.0	230.0	36
35	4	7.8	350.0	350.0	72	0.2	350.0	350.0	18
37	11	0.2	49.0	23.0	3	0.2	33.0	23.0	1
39	11	0.2	130.0	22.0	7	0.2	33.0	17.0	3
40	11	0.2	130.0	21.0	4	0.2	79.0	14.0	2

STA = station number
N = number of samples
MIN FC (or EC) = minimum fecal coliform (or E. coli) density
MAX FC (or EC) = maximum fecal coliform (or E. coli) density
P90 FC (or EC) = density of fecal coliforms (or E. coli) exceeded 10% of the time for that station
GM FC (or EC) = geometric mean fecal coliform (or E. coli) density



x 5/110
4/14
o
429/1600
11/49 x
117/350 x
x 36/130
x
24/170
o 1/13
o 14/33
212/1100
x
x 129/920
o 4/21
x 70/385
x72/350
o 4/17
o 7/22
75/350 x
o 3/13
o 3/23
o 4/13
o4/13
o 4/27
o 1/13
1/11 o
o 1/4.5
13/49
x
Touisset
COLE RIVER
LEE RIVER
Brayton P
Towser Pt
Coggeshall
MASSACHUSETTS
RHODE ISLAND
MOUNT HOPE BAY
Spar
Philips Chair
Mt Hope Pt
BRISTOL CO
NEWPORT CO
North Tiverton
Cook
Pocasset
Common Fence Pt
Anthony Pt
Tommy
Spectacle
MT HOPE BAY
Dry Weather Data
o - open station
x - closed station
(Geometric mean fecal colifo
/P90 fecal coliform

Figure 6

1986; March 2, 1987; April 6-9, 1987; and June 9, 1987. Again, according to the criterion noted above, if the median or geometric mean fecal coliform density exceeds 14/100 ml of surface water, or if 10% of the values obtained exceed 43/100 ml (for a 5-tube, multiple dilution MPN procedure), shellfish are not allowed to be harvested from the area for direct consumption. As can be seen from Table 6 and Fig. 7, all stations substantially exceeded these criteria and therefore would not meet approved area status. It is apparent that rainfalls in excess of 0.5 in. exert a significant influence on the water quality of the Bay.

Follow-up to Rainfall Events

Since such a significant impact on Bay water quality was observed during periods of wet weather, it was of interest to determine the time required, following a rainfall event, for the area to return to its dry weather baseline. Two separate events were followed. The first occurred during May, 1987. Following a three day event (May 3-5) of 1.05 in. of rain, the area was sampled on May 11 (7 days post rainfall) and again on May 19 (15 days post-rainfall). It is important to note that this entire period followed some extremely wet weather (referred to by local meteorologists as a ´5 year event´) when, during the period March 28 - April 29, 1987, approximately 10.5 inches of rain were recorded at Green Airport, Warwick. River stages were at flood for extended periods and CSO inputs and run-off dramatically affected Mt. Hope Bay. As seen in Fig. 8, only 5 of 14 stations in the area potentially open to shellfish harvest met the criterion of 14 fecal coliforms/100 ml of surface water within 7 days of the rainfall. Only after 15 days following this rain did the area substantially return to one that could be considered acceptable for the harvest of shellfish used for direct consumption (Fig. 9).

TABLE 6. MT. HOPE BAY STATIONS, WET WEATHER DATA FOR FECAL COLIFORMS AND E. COLI.

STA	N	MIN FC	MAX FC	P90 FC	GM FC	MIN EC	MAX EC	P90 EC	GM EC
01	5	11.0	330.0	330.0	82	11.0	330.0	330.0	72
02	8	7.8	490.0	490.0	59	7.8	230.0	230.0	47
05	8	33.0	920.0	920.0	150	17.0	920.0	920.0	121
08	8	11.0	1300.0	1300.0	138	4.0	790.0	790.0	70
09	8	240.0	2800.0	2800.0	1022	130.0	9200.0	9200.0	846
11	5	350.0	2400.0	2400.0	823	79.0	1300.0	1300.0	540
14	8	33.0	3500.0	3500.0	653	23.0	3500.0	3500.0	548
15	8	17.0	7900.0	7900.0	1187	11.0	5400.0	5400.0	853
17	1	95.0	95.0	95.0	95	180.0	180.0	180.0	180
18	8	1.9	1700.0	1700.0	118	1.9	1700.0	1700.0	70
19	8	4.5	2400.0	2400.0	266	2.0	2400.0	2400.0	172
20	8	2.0	1400.0	1400.0	62	2.0	1400.0	1400.0	54
21	8	0.2	430.0	430.0	28	0.2	430.0	430.0	18
22	8	0.2	790.0	790.0	31	0.2	790.0	790.0	28
23	7	11.0	790.0	790.0	100	6.8	1300.0	1300.0	100
24	7	2.0	1400.0	1400.0	93	0.2	1100.0	1100.0	55
25	9	14.0	920.0	920.0	177	11.0	1400.0	1400.0	162
26	8	4.5	330.0	330.0	77	4.5	330.0	330.0	46
27	7	7.8	700.0	700.0	190	7.8	490.0	490.0	161
28	5	7.8	490.0	490.0	130	7.8	490.0	490.0	122
32	8	7.8	790.0	790.0	142	7.8	790.0	790.0	92
33	5	4.5	2400.0	2400.0	295	4.5	2400.0	2400.0	247
34	8	22.0	1700.0	1700.0	349	22.0	1700.0	1700.0	249
35	5	6.8	1300.0	1300.0	121	2.0	1300.0	1300.0	119
37	8	20.0	1300.0	1300.0	154	6.8	1300.0	1300.0	115
39	8	7.8	1300.0	1300.0	154	4.5	1300.0	1300.0	124
40	8	13.0	1300.0	1300.0	165	13.0	1300.0	1300.0	124

STA = station number
N = number of samples
MIN FC (or EC) = minimum fecal coliform (or E. coli) density
MAX FC (or EC) = maximum fecal coliform (or E. coli) density
P90 FC (or EC) = density of fecal coliforms (or E. coli) exceeded 10% of the time for that station
GM FC (or EC) = geometric mean fecal coliform (or E. coli) density

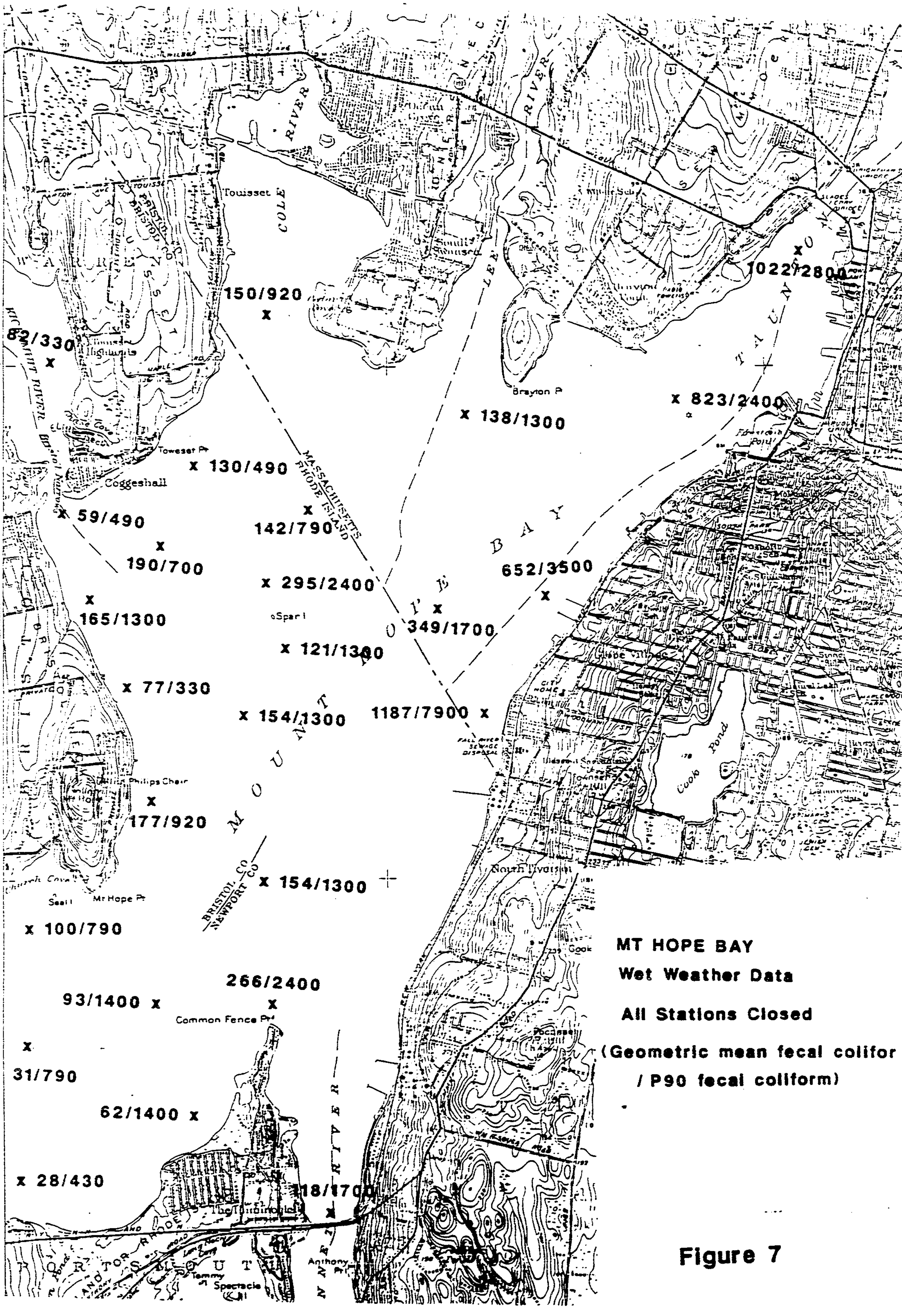
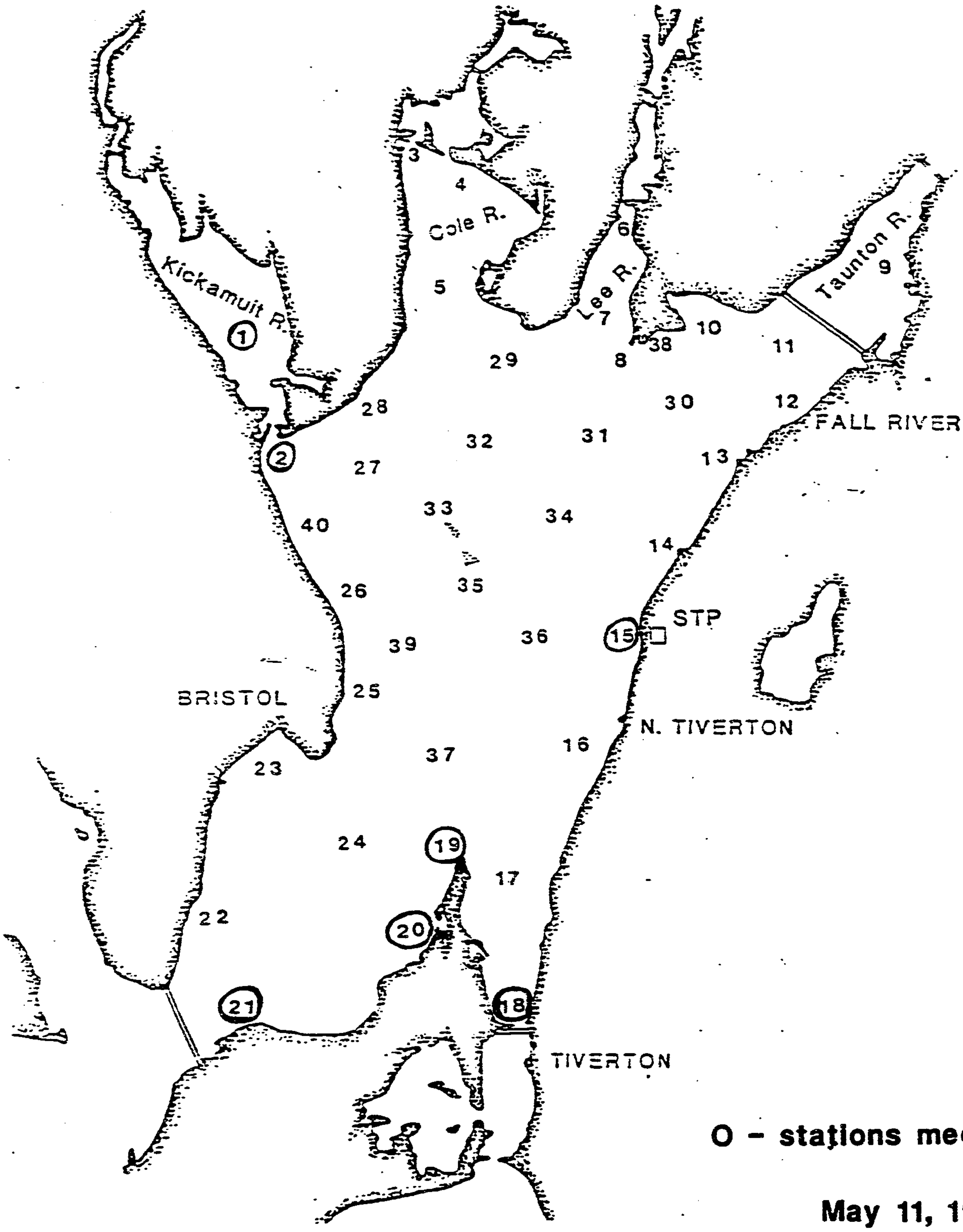

MT HOPE BAY
Wet Weather Data
All Stations Closed
(Geometric mean fecal colifor
/ P90 fecal coliform)
150/920
82/330
1022/2800
823/2400
138/1300
130/490
59/490
142/790
190/700
295/2400
652/3500
165/1300
349/1700
121/1300
77/330
154/1300
1187/7900
177/920
154/1300
100/790
266/2400
93/1400
31/790
62/1400
28/430
118/1700
Touisset
COLE RIVER
LEE RIVER
TAUNTON
Brayton Pt
Coggeshall
MASSACHUSETTS
RHODE ISLAND
MOUNT HOPE BAY
Spar I
Cook Pond
North Tiverton
BRISTOL CO
NEWPORT CO
Mt Hope Pt
Common Fence Pt
Anthony Pt
Spectacle I

Figure 7

MT. HOPE BAY

All Bay Stations

Figure 8



O - stations meeting standar

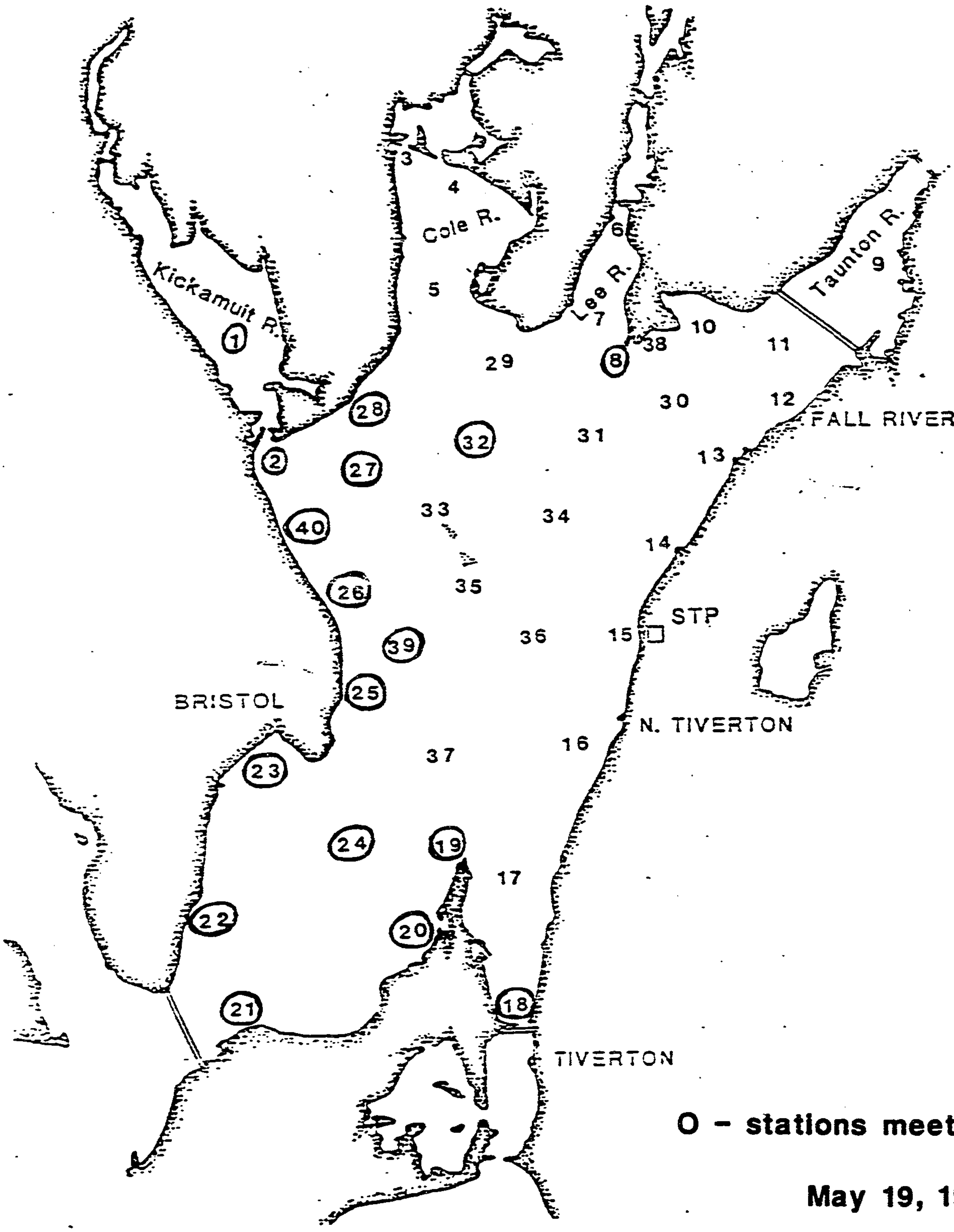
May 11, 1987

(7 days following rainfall)

MT. HOPE BAY

All Bay Stations

Figure 9



O - stations meeting standard

May 19, 1987

(15 days following rainfall)

In direct contrast to the above data, a second event (0.85 in., June 7-8, 1987) was also followed with the area sampled at 2 and 4 days following the rain. The event differed from the one described above as the period of May 6 through June 6 had been relatively dry (see Table 1). On June 9, 2 days following the event, 12 of the 14 stations sampled in the potentially open area met the bacterial standard for an approved growing area (Fig. 10). By June 11 (4 days), the area had essentially returned to its dry weather baseline (Fig. 11).

It is apparent from these data that the magnitude of the rainfall event influences the rate at which the Bay 'cleans up.' A 'normal' event of less than 1" of rain adversely impacted the area for 4 days or less. An extraordinary event such as that occurring in the late spring adversely affected the area for a period of about two weeks. Decisions regarding the management of this area must take into account the magnitude and duration of the rainfall event(s).

POLLUTION SOURCES

The major sources which contribute to pollution of the study area include: 1) the Fall River Sewage Treatment Plant (STP); 2) the Somerset, MA STP; 3) several combined sewer overflows in the Fall River Area; 4) several point discharges (primarily during wet weather) just south of the Bristol Narrows on the western side of the Bay; and 5) the Taunton River which drains a heavily populated watershed of some 570 sq. miles.

Sewage Treatment Plants

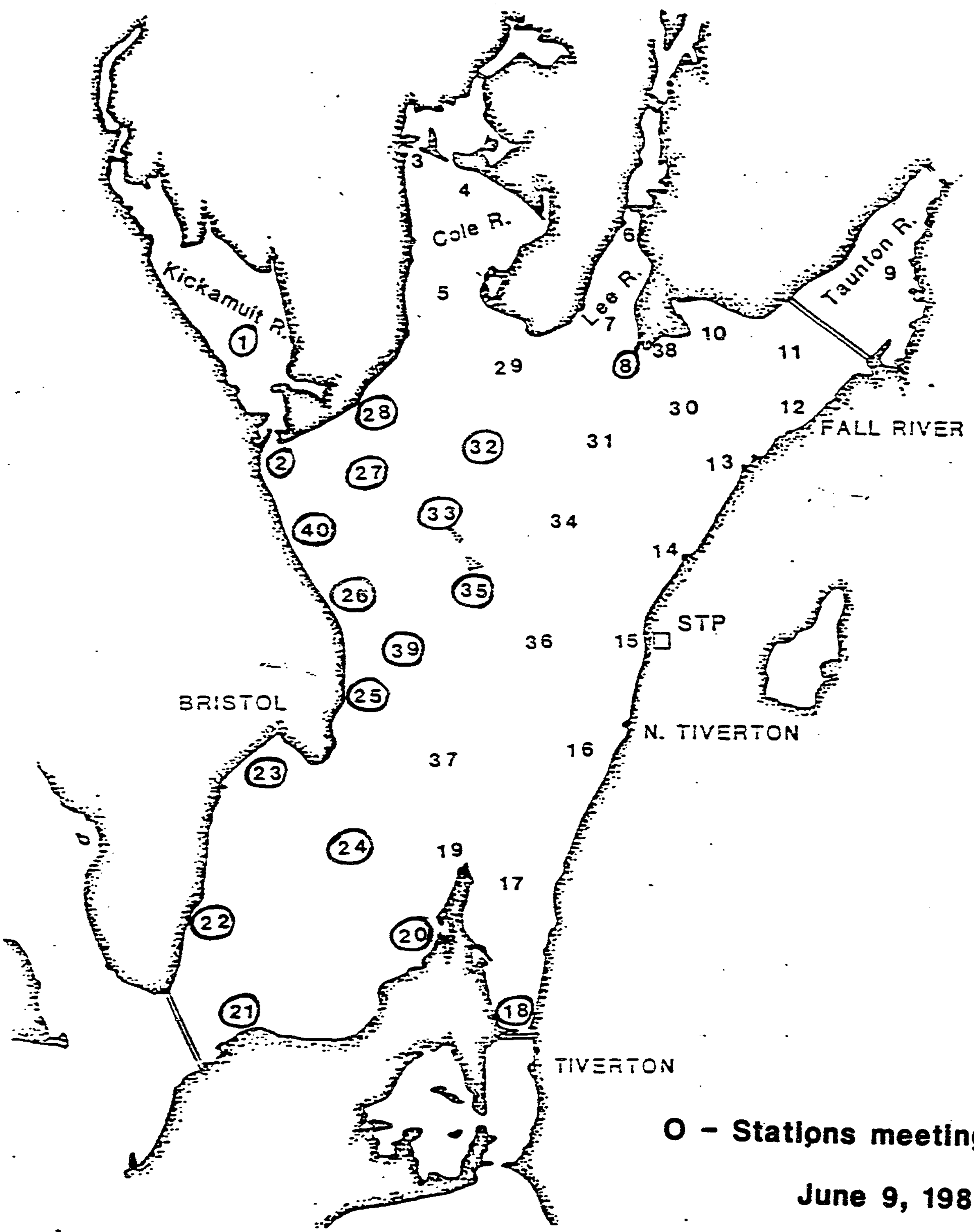
Fall River STP

This plant was completely renovated in 1982. Treatment consists of aeration (using pure oxygen) with secondary settling and disinfection (chlorination).

MT. HOPE BAY

Figure 10

All Bay Stations



O – Stations meeting standard

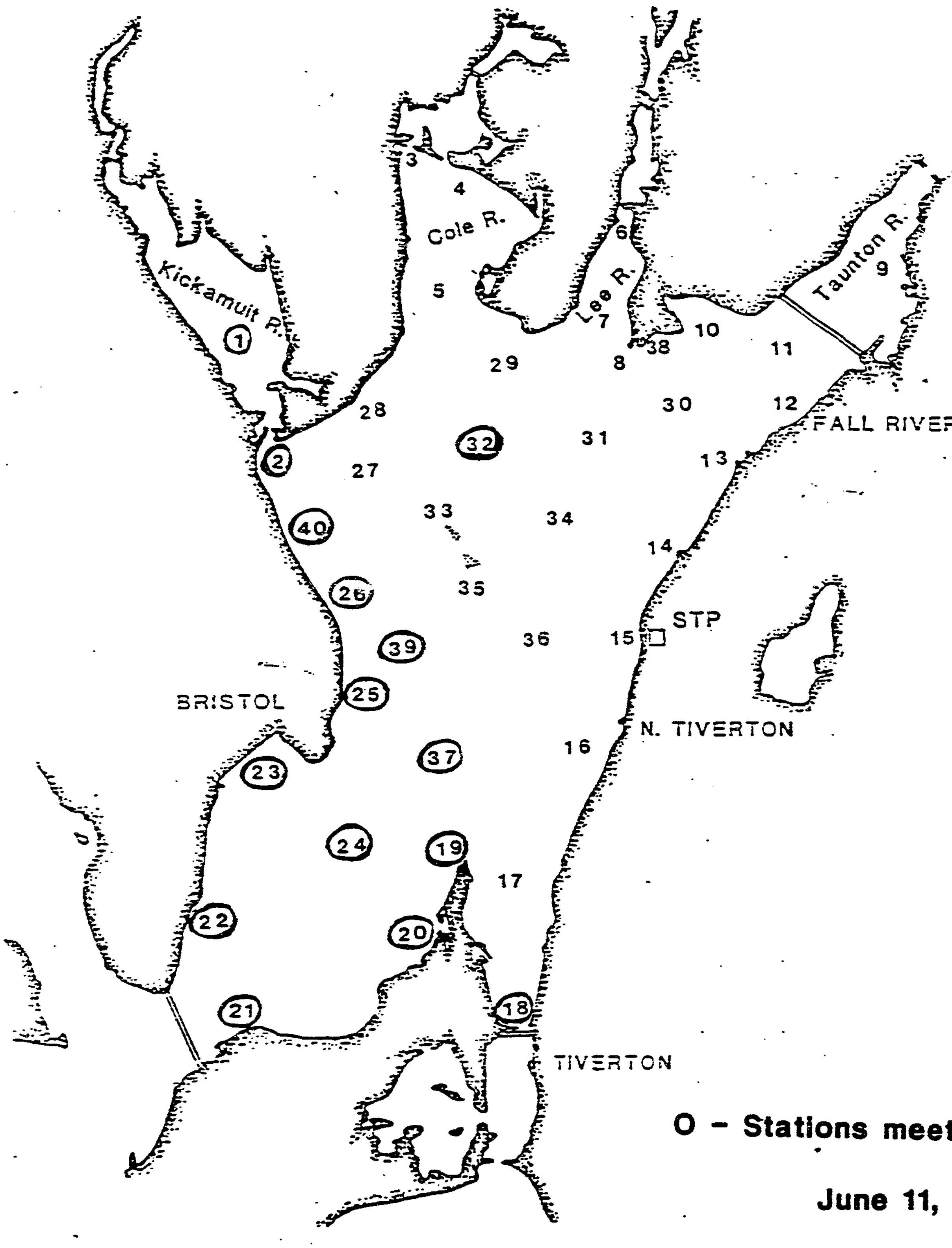
June 9, 1987

(2 days following 0.85" rain)

MT. HOPE BAY

All Bay Stations

Figure 11



O – Stations meeting standard

June 11, 1987

(4 days following 0.85" rain)

Chlorine residuals are maintained at 1.5 ppm (day) and 1.0 ppm (evening) during the week. On weekends, the target residuals are 1.0 ppm (day) and 0.6 ppm (evening). The reason for the high weekday residuals is to offset the effects of occasional sludge dumping from local mills.

During the dry weather sampling period flows ranged from 27-32 mgd, whereas flows of 46 mgd were reported during wet weather periods. Bacteriological quality and flow estimates are given in Table 7. While the fecal coliform and E. coli densities indicate a relatively high quality effluent, the densities of C. perfringens, phage and, to some extent, enterococci indicate that the chlorine contact (detention) time is not adequate to properly disinfect these effluents (see discussion in Summary and Recommendations section).

Somerset STP

The design flow for the Somerset STP is approximately 1.6 MGD. On the day samples were collected, the flow was 7.5 MGD. Apparently the plant has infiltration problems, illegal foundation drains, and inflow from marshy areas which result in excess flow to the plant. During the visit, wastewater was going only through the secondary tanks and being chlorinated. In addition, there are about 12 lift stations in the collection system. There are no overflows at these stations. On occasion, with infiltration, the two lift stations nearest the STP cannot handle the flow. Sewage surcharges the system and backs up into some houses. To alleviate this problem, portable pumps are used to dewater these lift stations which then discharge into the Taunton River. There were reportedly 2 hours of bypass to date in April as a result of heavy rains.

The quality of the treated effluent (Table 7) on the day of sampling was poor.

Table 7. Sewage Treatment Plant Summary

Date	Time	Rain[a]	Flow (mgd)	Chlorine Residual(ppm)	Fecal Coliforms[b]	E. coli[b]	C. perfringens[b]	Enterococci[b]	Phage[b]
Fall River									
7/21/86	1414	D	32	1.5	<1.0	<1.0	$2.7x10^3$	23.0	ND[d]
7/23/86	1512	D	27	1.2	<1.0	<1.0	TNTC[c]	192.0	ND
7/25/86	1455	D	29	0.75	6.0	4.0	$5.6x10^2$	40.0	ND
7/28/86	1507	D	28	0.3	7.0	7.0	$7.5x10^3$	37.0	ND
4/06/87	1428	W	46	1.2	4.0	4.0	$1.2x10^4$	9.0	2660
4/06/87	1431	W	46	1.2	6.0	5.0	1.2x104	70.0	2940
Somerset									
4/13/87	1151	W	7.5	1.2	2100	2000	$6.6x10^4$	$2.8x10^4$	$9.5x10^4$

a Rain reported as D (<0.5") or W (>0.5" in 24 H period)
b Density/100 ml
c Too numerous for count
d Not determined

Elevated densities of all indicator organisms were found. Presumably this was a result of the excess flow at the plant which well exceeded plant capacity. Disinfection, even at a level of 1.2 ppm residual chlorine, was inadequate.

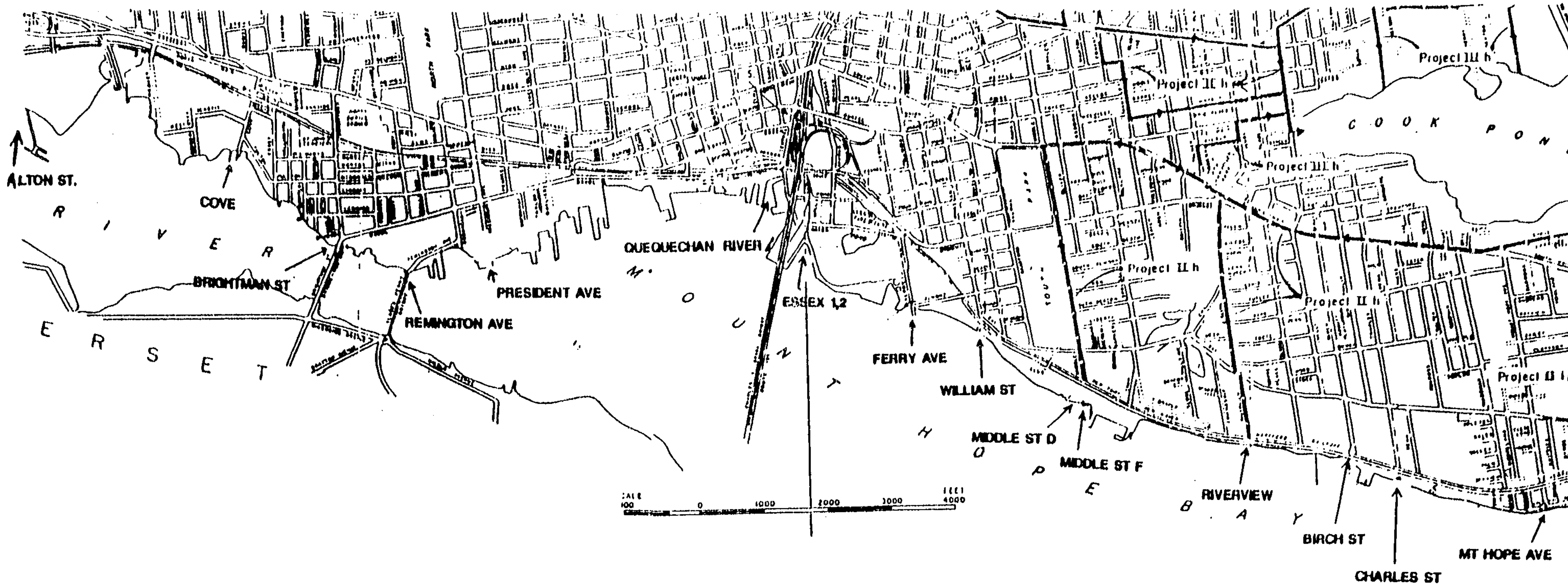
Apparently there is funding available to build a new STP in the city. Planning work has been completed, and the city feels that the project should begin soon.

Combined Sewer Overflows (CSO)

There are several combined sewer overflows (CSO) and two non-CSO effluents located in the city of Fall River (Fig. 12, Table 8). These are described below and are roughly ranked (as listed) starting with the effluents of greatest magnitude (Table 9 lists the source strengths by daily input of fecal coliforms from least to greatest). All flow determinations were calculated from cross sectional measurements, and velocity measurements or estimates. All MGD values given are instantaneous flow determinations converted to a daily flow.

Quequechan River

Three CSO's discharge directly into the Quequechan River (Plymouth Avenue, Lowell St, and Quequechan St.). These discharges were not sampled directly so that the magnitude of the input of any one of these three is unknown. However, the River was treated as a single source and several samples were collected on different days of the month. The flow rates ranged from 13.2 to 73.3 mgd (Table 8). Very high levels of all indicator organisms were found on all sample days. On July 28, 1986, during a dry period, the levels of all indicators approximated that which would be found in raw sewage. The Quequechan River consistently ranked as the major source of contamination to



FALL RIVER, MASSACHUSETTS

COMBINED SEWER OVERFLOWS AND OTHER POINT SOURCES

Figure 12

TABLE 8. MOUNT HOPE BAY - CSO's AND OTHER POINT SOURCES.

-- ALTON ST --

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
1	04/13/87	W	2.04	240000.0	230000.0	12000.0	111000.0	3660.0	13.2682	11.9672

-- BIRCH ST --

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
2	07/23/86	D	0.08	380.0	150.0	25.0	19.0	.	9.0613	7.3965
3	07/28/86	D	0.70	29000.0	14000.0	410.0	3500.0	.	11.8859	10.0363
4	04/06/87	W	30.20	380000.0	260000.0	75000.0	200000.0	6650.0	14.6382	13.3335
5	04/13/87	W	2.74	23000.0	9000.0	15000.0	9.0	1040.0	12.3779	12.1922

-- ESSEX1 --

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
6	07/22/86	D	2.00	290000.0	211000.0	1100.0	1040.0	.	12.3418	10.9208

-- ESSEX2 --

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
7	07/22/86	D	.	0.9	0.9	0.9	0.9	.	.	.
8	07/23/86	D	0.04	0.9	0.9	0.9	0.9	.	6.1347	6.1347

-- FERRY ST --

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
9	07/22/86	D	.	10000.0	3400.0	590.0	430.0	.	.	.
10	07/24/86	D	.	270.0	210.0	210.0	7.0	.	.	.
11	07/28/86	D	.	34000.0	21000.0	40.0	7400.0	.	.	.
12	04/06/87	W	.	260000.0	240000.0	56000.0	127000.0	13160.0	.	.
13	04/13/87	W	.	240000.0	230000.0	14000.0	52000.0	10010.0	.	.

-- MIDDLE ST D --

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
14	07/28/86	D	.	167000.0	105000.0	830.0	4200.0	.	.	.
15	04/06/87	W	15.30	360000.0	320000.0	6200.0	52000.0	1410.0	14.3194	12.5555

MIDDLE ST F

OBS	DATE	RAIN	FLOW	mF-FC	mF-BC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
16	07/23/86	D	1.60	350.0	310.0	26.0	119.0	.	10.3266	9.1975
17	07/28/86	D	.	290.0	230.0	11.0	52.0	.	.	.
18	04/06/87	W	5.10	1600.0	1400.0	350.0	540.0	190.0	11.4901	10.8300

MT HOPE ST

OBS	DATE	RAIN	FLOW	mF-FC	mF-BC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
19	04/06/87	W	0.02	9.0	9.0	60.0	30.0	10.0	6.8337	7.3576
20	04/06/87	W	2.50	460000.0	350000.0	37000.0	169000.0	109400.0	13.5391	12.5445
21	04/13/87	W	1.20	230000.0	200000.0	25000.0	7900.0	48320.0	13.0193	12.0726

PRESIDENT ST

OBS	DATE	RAIN	FLOW	mF-FC	mF-BC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
22	07/25/86	D	.	150.0	110.0	170.0	49.0	.	.	.

QUEQUESEAN RIVER

OBS	DATE	RAIN	FLOW	mF-FC	mF-BC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
23	07/21/86	D	38.80	63000.0	10000.0	3300.0	4800.0	.	13.3666	12.6857
24	07/22/86	D	.	209000.0	153000.0	5500.0	2400.0	.	.	.
25	07/22/86	D	.	221000.0	161000.0	4500.0	2200.0	.	.	.
26	07/24/86	D	13.20	48000.0	31000.0	4800.0	8000.0	.	13.3802	12.3802
27	07/28/86	D	18.40	2390000.0	2010000.0	6800.0	1.4	.	15.2216	12.6757
28	04/06/87	W	73.30	17000.0	13000.0	3200.0	5100.0	1910.0	13.6739	12.9487
29	04/13/87	W	54.30	180000.0	170000.0	17000.0	42000.0	5770.0	14.3685	13.5436

REMINGTON AVE

OBS	DATE	RAIN	FLOW	mF-FC	mF-BC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
30	07/25/86	D	.	440.0	400.0	100.0	100.0	.	.	.

RIVERVIEW ST

OBS	DATE	RAIN	FLOW	mF-FC	mF-BC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
31	07/23/86	D	.	210.0	130.0	17.0	97.0	.	.	.
32	07/24/86	D	.	79.0	63.0	7.0	320.0	.	.	.
33	07/28/86	D	.	4800.0	3100.0	140.0	510.0	.	.	.
34	04/06/87	W	.	89000.0	80000.0	20000.0	141000.0	5430.0	.	.
35	04/13/87	W	.	200000.0	200000.0	14000.0	55000.0	34080.0	.	.

STATE AVE

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
36	07/24/86	D	0.08	250.0	120.0	59.0	710.0	.	8.8794	8.2523
37	07/28/86	D	0.12	12200.0	99.0	7.0	100.0	.	10.7439	7.5027

FALL RIVER STP (POST-CHLOR)

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
38	07/21/86	D	32.00	0.9	0.9	2700.0	23.0	.	9.0378	12.5149
39	07/23/86	D	27.00	0.9	0.9	.	192.0	.	8.3640	.
40	07/25/86	D	29.00	6.0	4.0	560.0	40.0	.	9.3189	11.7890
41	07/28/86	D	28.00	7.0	7.0	7500.0	37.0	.	8.8707	12.9006
42	04/06/87	W	46.00	4.0	4.0	12000.0	9.0	2660.0	9.3432	13.3203
43	04/06/87	W	46.00	6.0	5.0	12000.0	70.0	2940.0	10.0193	13.3203

FALL RIVER STP (RAW)

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
44	04/06/87	W	.	170000.0	130000.0	43000.0	99000.0	14880.0	.	.

SOMERSET STP (POST-CHLOR)

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
45	04/13/87	W	7.50	2100.0	2000.0	56000.0	28000.0	94840.0	11.7757	13.2730

SOMERSET STP (RAW)

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
46	04/13/87	W	.	390000.0	340000.0	70000.0	580000.0	220160.0	.	.

TAUNTON RIVER

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
47	07/28/86	D	419.00	388.0	249.0	51.8	35.0	40.0	12.7894	11.9149
48	04/11/87	W	821.00	1020.0	845.0	126.0	207.0	58.7	13.5013	12.5931

W1

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
49	04/06/87	W	.	2900.0	2100.0	6000.0	7300.0	9.0	.	.

W2

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
50	04/06/87	W	116.00	210.0	200.0	620.0	290.0	30.0	11.9651	12.4352
51	04/13/87	W	116.00	2200.0	2200.0	2900.0	1900.0	.	12.9853	13.1053

W3

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
52	04/06/87	W	0.58	380.0	370.0	3500.0	980.0	9.0	9.3216	10.3353

W4

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
53	04/06/87	W	4.30	2200.0	2000.0	1600.0	590.0	40.0	11.5543	11.4160
54	04/13/87	W	4.32	1600.0	1500.0	4800.0	1700.0	.	11.4180	11.8951

W5

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
55	04/06/87	W	0.14	34000.0	30000.0	6200.0	18000.0	1710.0	11.2560	10.5169

W6

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
56	04/06/87	W	5.80	129.0	117.0	290.0	170.0	20.0	10.4524	10.7899
57	04/13/87	W	.	520.0	500.0	1100.0	730.0	.	.	.

WILLIAMS ST

OBS	DATE	RAIN	FLOW	mF-FC	mF-EC	mF-CP	mF-ENT	PHAGE	LSSFC	LSSCP
58	04/06/87	W	2.10	2700.0	2200.0	7200.0	15000.0	9.0	11.3320	11.7579

RAIN - D=dry W=wet

. not determined

FLOW = MGD

mF-FC = fecal coliforms/100ml (mTEC method)

mF-EC = E. coli/100ml (mTEC method)

mF-CP = C. perfringens/100ml (mCP method)

mF-ENT = enterococci/100ml (mE method)

PHAGE = F2 coliphage/100ml

LSSFC, LSSCP - see Table 9

TABLE 9. MT. HOPE BAY, POINT SOURCES AND SOURCE STRENGTHS SORTED ON LOG FECAL COLIFORM SOURCE STRENGTH.

OBS	DATE	RAIN	STATION	FLOW	LSSFC	LSSCP
1	07/22/86	D	FERRYST	.	.	.
2	07/22/86	D	ESSEX2	.	.	.
3	07/22/86	D	QUEQUESH	.	.	.
4	07/22/86	D	QUEQUESH	.	.	.
5	07/23/86	D	RIVERVIE	.	.	.
6	07/24/86	D	RIVERVIE	.	.	.
7	07/24/86	D	FERRYST	.	.	.
8	07/25/86	D	REMINGTO	.	.	.
9	07/25/86	D	PRESIDEN	.	.	.
10	07/28/86	D	RIVERVIE	.	.	.
11	07/28/86	D	MIDDLEF	.	.	.
12	07/28/86	D	MIDDLED	.	.	.
13	07/28/86	D	FERRYST	.	.	.
14	04/06/87	W	W1	.	.	.
15	04/06/87	W	RIVERVIE	.	.	.
16	04/06/87	W	STPFRRAW	.	.	.
17	04/06/87	W	FERRYST	.	.	.
18	04/13/87	W	W6	.	.	.
19	04/13/87	W	STPSOMRA	.	.	.
20	04/13/87	W	FERRYST	.	.	.
21	04/13/87	W	RIVERVIE	.	.	.
22	07/23/86	D	ESSEX2	0.04	6.1347	6.1347
23	04/06/87	W	MTHOPEST	0.02	6.8337	7.6576
24	07/24/86	D	STATEAVE	0.08	8.8794	8.2523
25	07/23/86	D	STPFRPOS	27.00	8.9640	.
26	07/21/86	D	STPFRPOS	32.00	9.0378	12.5149
27	07/23/86	D	BIRCHST	0.08	9.0613	7.8965
28	07/25/86	D	STPFRPOS	29.00	9.8189	11.7890
29	04/06/87	W	STPFRPOS	46.00	9.8432	13.3203
30	07/28/86	D	STPFRPOS	28.00	9.8707	12.9006
31	04/06/87	W	W3	0.58	9.9216	10.8859
32	04/06/87	W	STPFRPOS	46.00	10.0193	13.3203
33	07/23/86	D	MIDDLEF	1.60	10.3266	9.1975
34	04/06/87	W	W6	5.80	10.4524	10.7890
35	07/28/86	D	STATEAVE	0.12	10.7439	7.5027
36	04/06/87	W	W5	0.14	11.2560	10.5169
37	04/06/87	W	WILLIAMS	2.10	11.3320	11.7579
38	04/13/87	W	W4	4.32	11.4180	11.8951
39	04/06/87	W	MIDDLEF	5.10	11.4901	10.8300
40	04/06/87	W	W4	4.30	11.5543	11.4160
41	04/13/87	W	STPSOMPO	7.50	11.7757	13.2730
42	07/28/86	D	BIRCHST	0.70	11.8859	10.0363
43	04/06/87	W	W2	116.00	11.9651	12.4352
44	04/13/87	W	BIRCHST	2.74	12.3779	12.1922
45	07/28/86	D	TAUNTON	419.00	12.7894	11.9149
46	04/13/87	W	W2	116.00	12.9853	13.1053
47	04/13/87	W	MTHOPEST	1.20	13.0193	12.0726
48	04/13/87	W	ALTONST	2.04	13.2682	11.9672
49	07/22/86	D	ESSEX1	2.00	13.3418	10.9208
50	07/24/86	D	QUEQUESH	13.20	13.3802	12.3802
51	04/11/87	W	TAUNTON	821.00	13.5013	12.5931
52	04/06/87	W	MTHOPEST	2.50	13.6391	12.5445
53	04/06/87	W	QUEQUESH	73.30	13.6739	12.9487
54	07/21/86	D	QUEQUESH	38.80	13.9666	12.6857
55	04/06/87	W	MIDDLED	15.30	14.3194	12.5555
56	04/13/87	W	QUEQUESH	54.30	14.5685	13.5436

OBS	DATE	RAIN	STA	FLOW	LSSFC	LSSCP
57	04/06/87	W	BIRCHST	30.20	14.6382	13.9335
58	07/28/86	D	QUEQUESH	18.40	15.2216	12.6757

RAIN: D=dry W=wet
STATION - see Table 8 for complete name
FLOW = MGD
LSSFC = log10 of the total number of fecal coliforms input/day
LSSCP = log10 of the total number of C. perfringens input/day
. = not determined

the estuary (Table 8) with a daily fecal coliform input always exceeding 10^{13} organisms. In fact, on July 28, 1986 (a 'dry' day) the fecal coliform input exceeded 10^{15} organisms for that one day. The Quequechan can best be characterized as a river of sewage.

Birch St.

The flow rates of the Birch St. overflow were highly variable and rainfall dependent ranging from 0.08 mgd to 30.2 mgd (Table 8). This CSO was discharging during both wet and dry periods. During one wet period (April 6, 1987), the daily fecal coliform input to the estuary from this source exceeded 10^{14} organisms. This ranked second only to the Quequechan River in regard to source strength. The field sampler noted '. . . one of the worst of the typical overflows including solids. . . grey color. It stinks.'

Middle Street

Two effluents (D and F) were sampled at Middle St. (see figure 12). At site D a slight flow (non-measurable) was detected during dry weather (7/28/86) whereas a substantial flow of 15.3 mgd was measured during heavy rainfall (4/6/87). The source strength of over 10^{14} fecal coliforms/day during the wet period ranked this effluent third in magnitude behind the Quequechan River and Birch St. This source was described by the field sampler as a 5' brick structure.

A somewhat lower flow was determined for site F during wet weather (5.1 mgd); however, there was a measurable flow determined during the dry weather period (1.6 mgd on 7/23/86). Both of these point sources contribute significant numbers of fecal coliforms to Mt. Hope Bay.

Mt. Hope St.

This CSO was sampled during wet and dry weather. A small flow (~.4 mgd) was measured during the dry period. The flow increased measurably during wet weather to 2.5 mgd. This flow, coupled with the very high fecal coliform densities found therein, resulted in a daily input of fecal coliforms to the estuary which exceed 10^{13} organisms per day.

Alton St.

This overflow was sampled only during the wet weather period (4/13/87) when a flow of 2.04 mgd was estimated. Again, high densities of all indicator organisms were found in this effluent and the source strength during this period exceeded 10^{13} fecal coliforms per day. In addition, personnel from Shell Oil Co. (in the vicinity of the discharge pipe) stated that there often was flow from this pipe during dry weather periods.

Williams St.

No flow was detected at this CSO during the dry weather period (7/28/86). During the heavy spring rains, the flow was calculated to be 2.1 mgd. Compared with the above sources, the bacterial indicator densities were relatively low and the source strength was of considerably lesser magnitude.

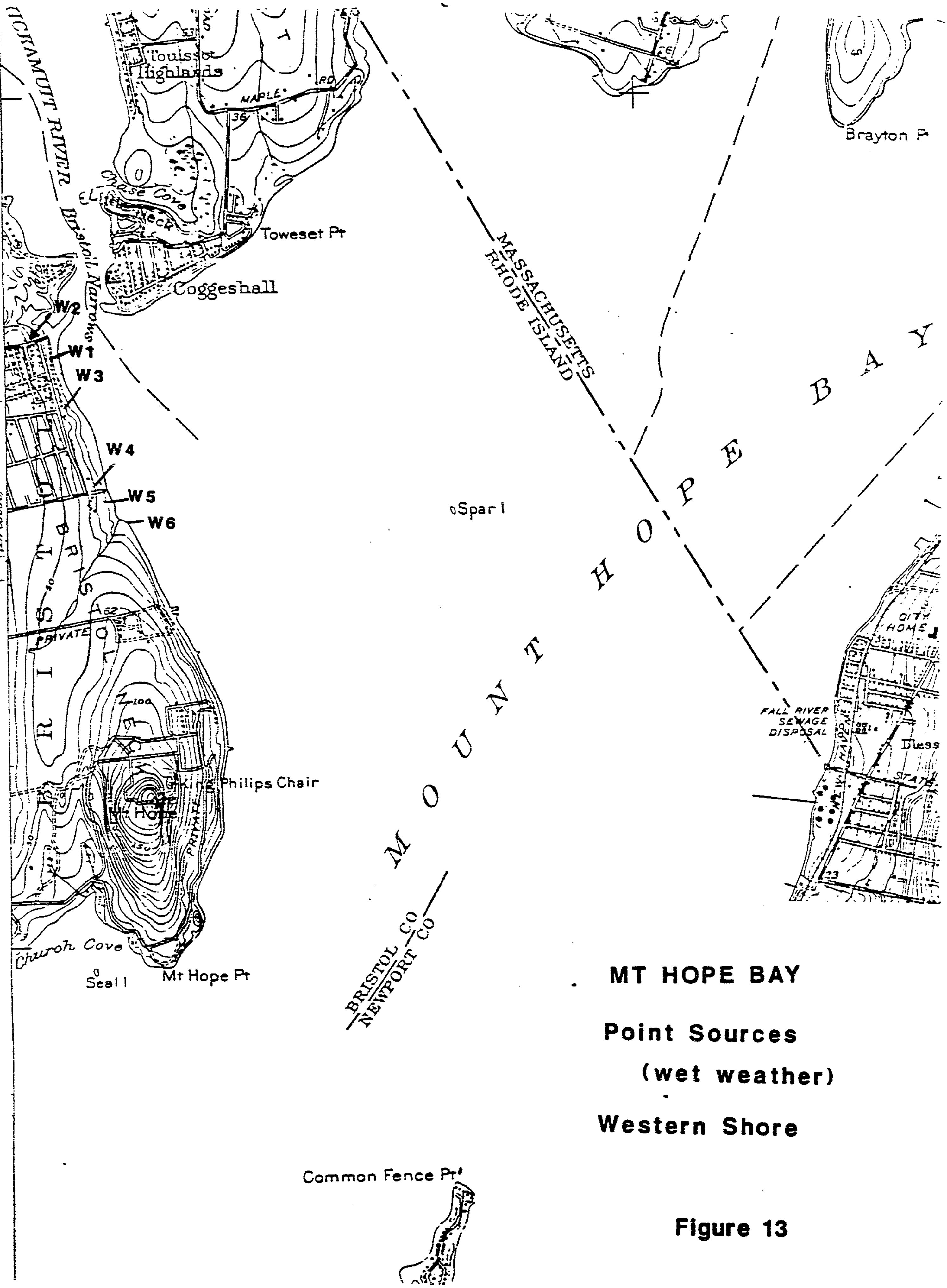
Other CSO's

The overflow locations at Riverview St., Ferry St., President Ave., and Remington Ave. are constructed in built-up rock jetties or in bulkheads. The pipes are submerged and flows could not be determined accurately for any of these four overflows. The field sampler did note that, during wet weather, there appeared to be a considerable amount of flow from both the Riverview and Ferry St. CSO's. Because the densities of all indicator organisms were very high in the vicinity of these two sources during wet weather, they are presumed to be significant inputs into the Bay. The areas near the President St. and Remington Ave. CSO's were sampled only during dry weather and indicator levels were fairly low. They were not resampled during wet weather events.

Other Point Sources (non-CSO)

Two sources at the city pier adjacent to the Essex Chemical Co. were sampled during dry weather (see Fig. 12, Table 8). The source designated Essex 1 flowed from a circular pipe about 24 inches in diameter. A flow of 2 mgd was estimated at this source and very high levels of fecal coliforms and *E. coli* were found in the effluent. This source is also a significant contributor of contamination to the Bay. The other source, designated Essex 2, flows from a 12 inch pipe located in a wooden structure at a brick factory. This is probably only a minor source (at least during dry weather), since the flow was estimated to be 0.04 mgd and the densities of all indicator organisms were very low.

Several discharges were found on the western side of Mt. Hope Bay during the wet weather period and are noted as sites W1 through W6 (Table 8 and Figure 13). These sources are of concern because they directly impact the northern part of that area which could be considered conditionally approved. The major source to the Bay from this area was at site W2, a small stream about 6 ft wide and 2 ft deep. The field sampler estimated the flow on two separate sample days (wet) at 116 mgd. Elevated indicator densities were found on both sample days. Although these densities were considerably lower than those found at several Fall River CSO's, this source was significant in regard to daily fecal coliform input (Table 9) because of its high wet weather flow.



MT HOPE BAY

Point Sources
(wet weather)

Western Shore

Figure 13

Other sources and source strength estimates from this area are noted in Table 9.

Taunton River

The Taunton River was considered a single point source although it drains a 562 square mile area with a multitude of point and nonpoint sources. Flow rates from the Bridgewater, MA gauge for wet and dry weather were obtained from the U.S. Geological Survey, Boston (K. Ries). Estimates used are based on 25th percentile (dry) and 75th percentile (wet) flows averaged over an entire 12 month period, and multiplied by a factor of 2.18 to account for the entire drainage area. Samples were collected at station 9 (Fig. 1). Geometric mean densitities of indicator organisms were determined for 'dry' and 'wet' weather periods (see Appendix A, Tables 5 and 6). As with the above data, source strengths were calculated based on the daily flow multiplied by the mean fecal coliform densities found for a given period. Obviously, however, these estimates differ from those of the point sources as they are average calculations over time, not instantaneous assessments. From Table 9, the source strength (based on daily fecal coliform inputs) of the Taunton River was significant during wet weather but it was exceeded by CSO inputs at Mt. Hope St., Middle St., the Quequechan River, and Birch St. Moreover, during the wet weather period, the contribution by the Taunton River (fecal coliforms) was about 3% of that input from all other wet weather CSO sources in the Fall River area during worst case conditions (one day). The input from the Taunton River was somewhat lower during the dry weather period and was exceeded by the sources at Essex 1 and the Quequechan River. Again, its contribution (in terms of daily fecal coliform input) was only about 0.4% of that input from all other dry weather CSO sources in the Fall River area during conditions when dry weather flow was greatest (one day).

INDICATOR RELATIONSHIPS

Indicator Densities in Shellfish, Waters, and Sediments

One of the more fundamental questions addressed during this study was the nature of the relationships of the densities of a variety of microbiological indicators in shellfish to those in overlying waters and sediments. The National Shellfish Sanitation Program historically has classified growing areas based on surface water quality as this presumably represents one facet of ´worst case conditions´ (´fresh´ contaminated wastes from run-off or point sources of pollution ride over denser, saline, estuarine waters). Considerable controversy has arisen periodically as to whether this practice is appropriate for indexing the actual sanitary quality of the shellfish themselves.

Data were collected twice a season over all four seasons at three stations which represented different levels of contamination (stations 11,21, 26 - see Fig. 1). Five indicators (fecal coliforms, E. coli, C. perfringens, enterococci, and bacteriophage) were measured in surface (0.5 m depth) and bottom (0.5 m above the sediments) waters, and hard clams. Four indicators (including the above and excepting the bacteriophage) were measured in the sediments (the top centimeter was assayed).

Log transformed data were subjected to regression and correlation (Pearson) analyses (SAS Procedures, SAS Institute, Cary, NC). Analyses were conducted for shellfish indicator densities versus those in surface waters, bottom waters, and sediments (Table 10) for the entire data set and for only those data for which bottom temperatures exceeded $10^{\circ}C$ (as water temperatures descend below $10^{\circ}C$, hard clam activity declines rapidly, and animals are

Table 10. Regression analyses for indicator organism densities in shellfish relative to surface and bottom waters and sediments.

Regression		n[a]	Fecal Coliforms	*E. coli*	*C. perfringens*	Enterococci	Phage
			R - values				
Surface Water -v- Shellfish	All Data	30	0.26 p=.17	0.19 p=.32	*-0.44 p=.01	-0.01 p=.94	*0.52 p=.004
	Warm Water	18	*0.48 p=.05	0.26 p=.29	-0.31 p=.21	0.39 p=.11	*0.53 p=.04
Bottom Water -v- Shellfish	All Data	30	0.28 p=.13	0.25 p=.18	*-0.41 p=.02	0.06 p=.73	0.26 p=.17
	Warm Water	18	*0.50 p=.04	0.32 p=.20	-0.31 p=.21	*0.52 p=.03	0.19 p=.45
Sediment -v- Shellfish	All Data	30	*0.35 p=.06	0.21 p=.27	*0.39 p=.03	-0.18 p=.34	- -
	Warm Water	18	*0.49 p=.04	0.36 p=.14	0.42 p=.08	0.14 p=.59	- -

*Significant at 95% confidence interval (Pearson test)
[a]Number of sample pairs

essentially inactive at about 3°C).

Based on the regression analyses, it is apparent from these data that there is little to no linear predictive ability among any of the indicators examined. Some of the higher correlations observed were for the fecal coliform group using the warm water data. It is curious that similar correlations were not observed for E. coli, one component of the fecal coliform group. Perhaps even more curious are the inverse correlations observed for C. perfringens densities in surface and bottom waters relative to shellfish. These observations suggest that certain, if not all, of these 'stronger' relationships may be purely coincidental and a function of a relatively limited data set. If and when these data are combined with those for upper Narragansett Bay (V.J. Cabelli), the relationships may become more enlightening. However, as it stands now, the way to assess the sanitary quality of M. mercenaria is to examine the quality of the shellfish themselves.

Seasonal Effects on Indicator Densities in Shellfish

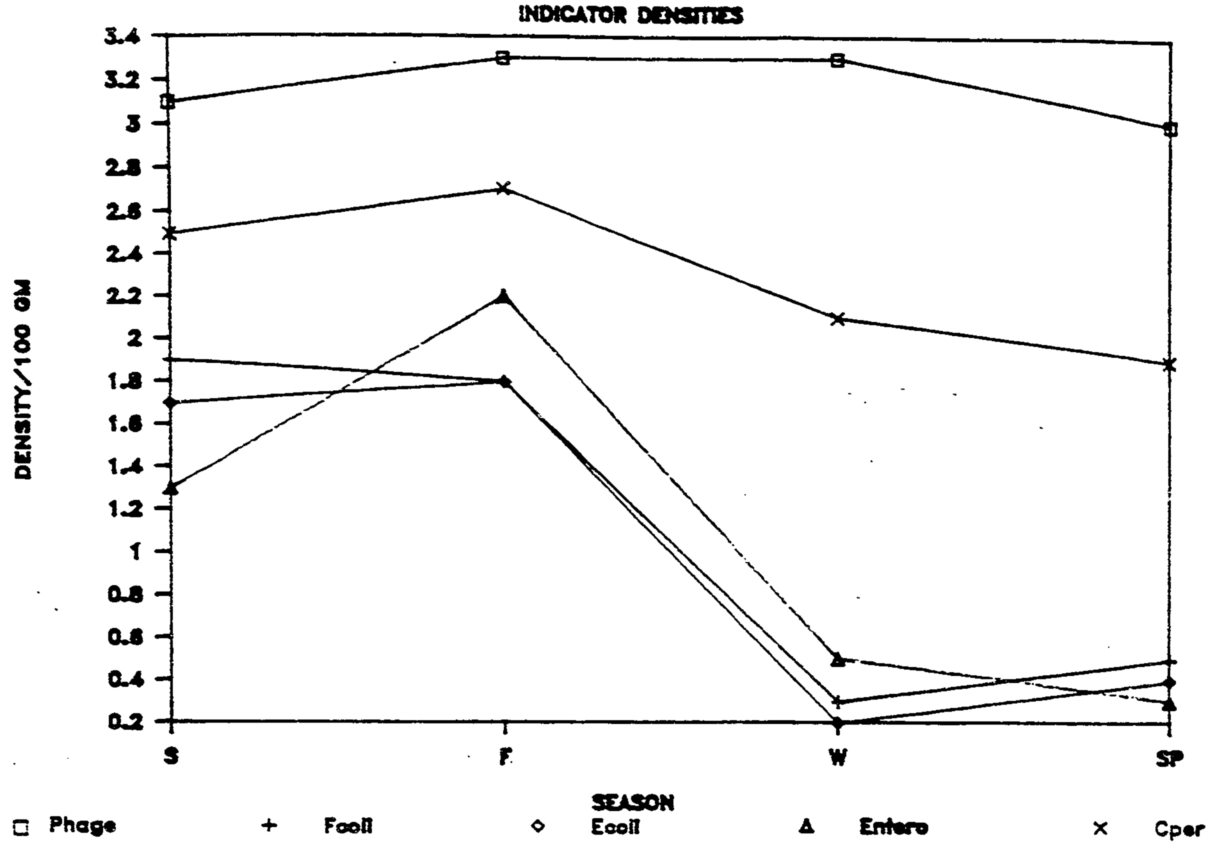
The densities of all indicators in shellfish were determined seasonally over the course of a year. Historically, a major problem with the fecal coliform group has been that the levels of this indicator drop appreciably by the late fall, and remain depressed through the winter to late spring. As such, the fecal coliform group reflects neither the quality of the waters from which they were harvested nor the quality of the animals themselves.

The densities of five indicators at three stations over four seasons are shown in Fig. 14. (Densities are geometric means for the period in question.) Two

Figure 14. Seasonal effects on indicator densities in shellfish at three stations in Mt. Hope Bay.

Figure 14

SHELLFISH – STATION 11



SHELLFISH – STATION 21

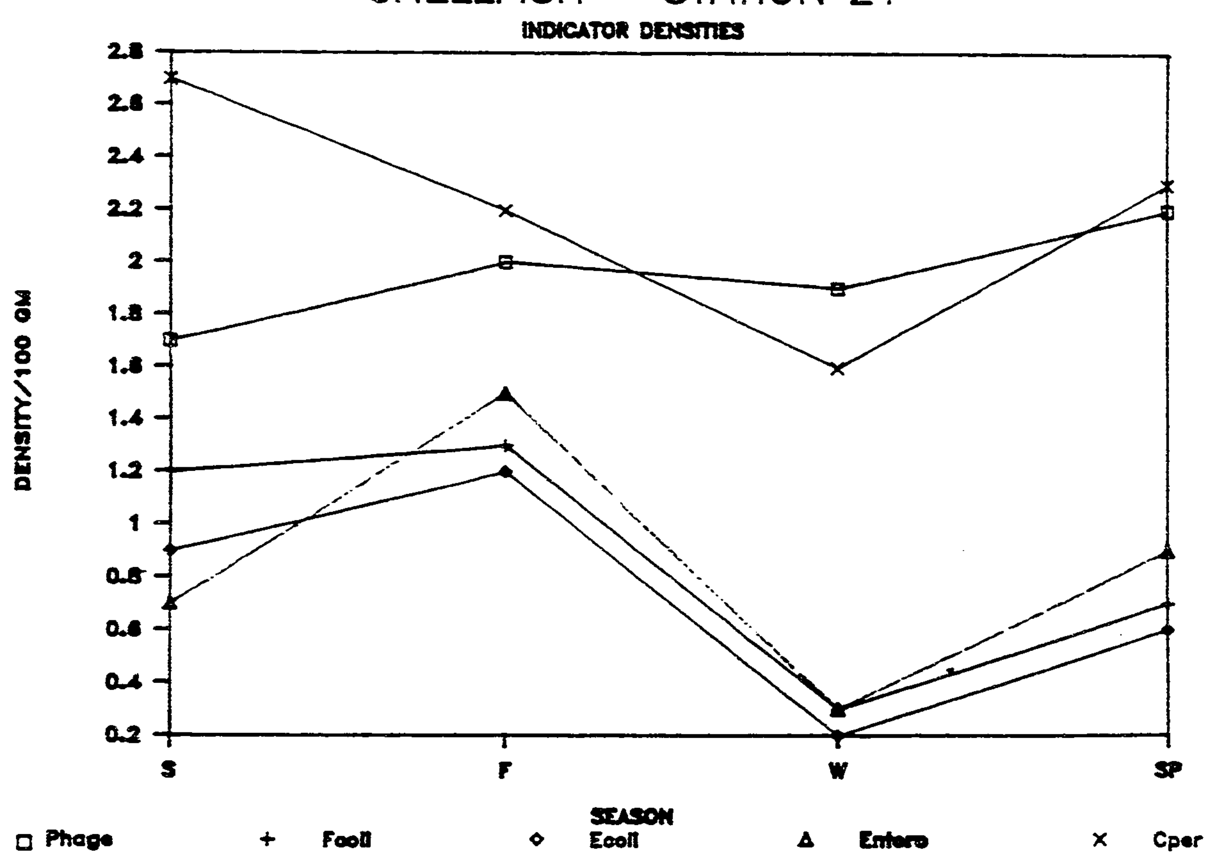
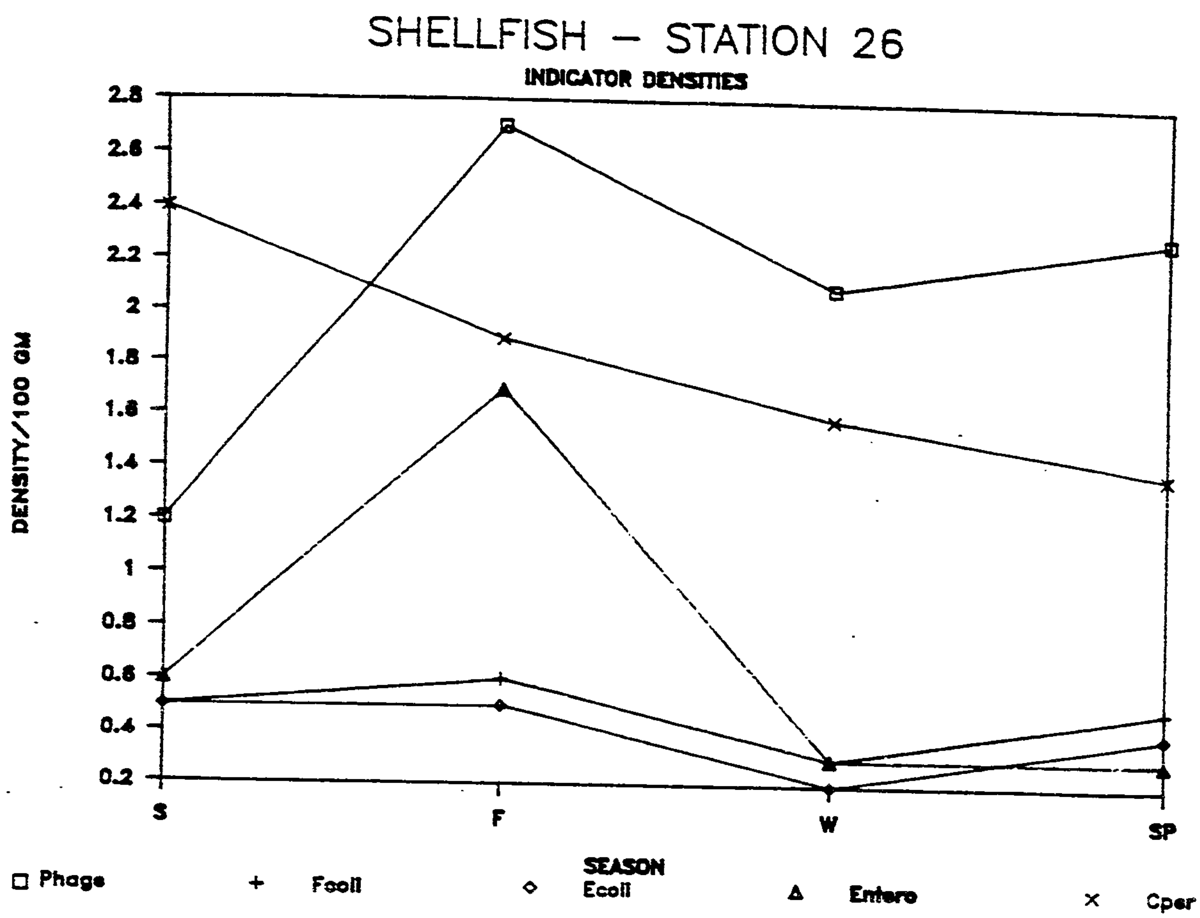


Figure 14



<u>Legend</u>

Phage = f2 bacteriophage
Fcoli = Fecal coliforms
Ecoli = *Escherichia coli*
Entero = Enterococci
Cper = *C. perfringens*

Season: S = Summer
F = Fall
W = Winter
Sp = Spring

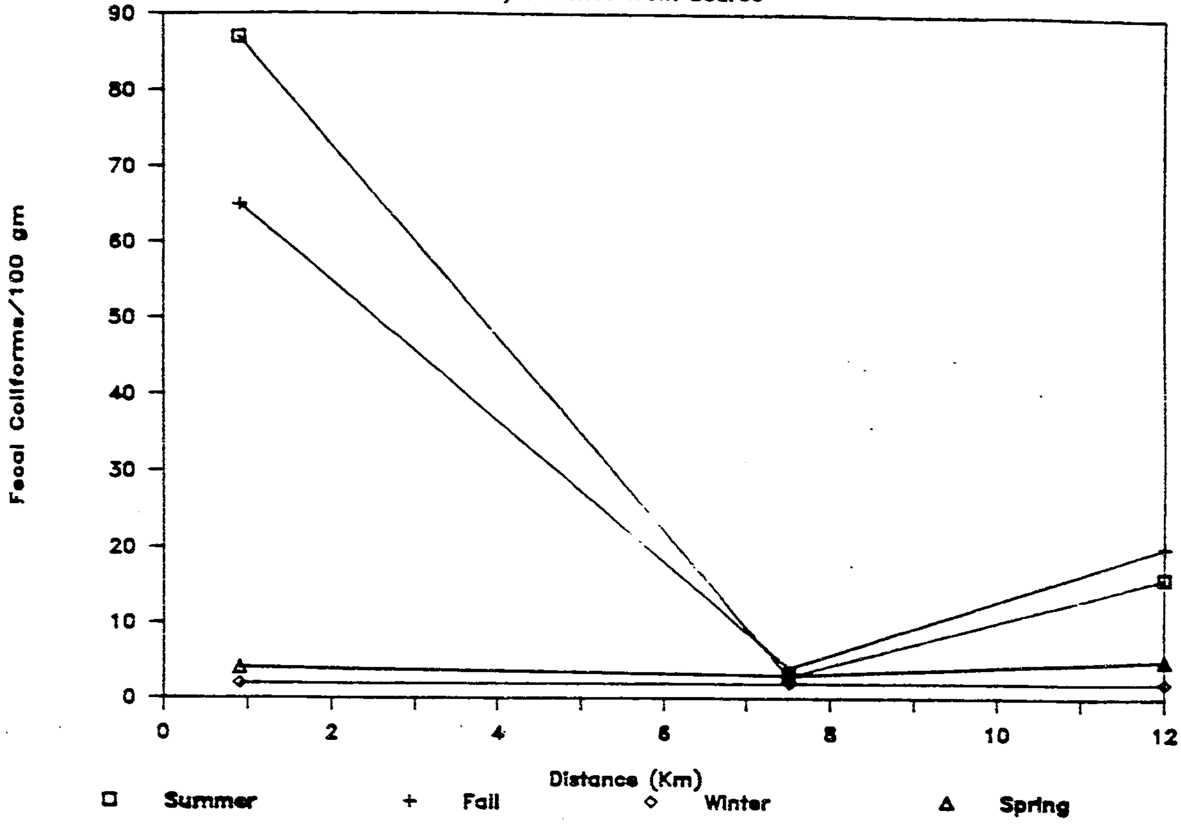
very different results are observed. The densities of those groups/species composed of vegetative bacteria (fecal coliforms, E. coli, enterococci) dropped substantially during the winter period (season '3') and did not return to their summer maxima by that following spring (season '4', April 1987). In contrast, the densities of the sporeformer (C. perfringens) and the bacteriophage (f2) remained relatively stable over all four seasons at all stations. When examining the indicator densities by distance from major sources (Fig. 15; for the purposes of this treatment of the data, distance is calculated from the mouth of the Quequechan River), the phage levels in shellfish appear to best reflect these distances over all seasons examined. Fecal coliform and E. coli densities are instructive for the summer/fall period but are of little use during the winter and spring. Enterococcus densities provide no useful information. The C. perfringens data are interesting in that, for three of the seasons examined, the densities are higher at the most distant station (#21) than at the intermediate distance (#26). This may be due to the very conservative (i.e. persistent) nature of the indicator itself, and suggest that there are 'old' sources of contamination entering Mt. Hope Bay from the waters south and west of the Mt. Hope Bay Bridge. Unfortunately, the appropriate information was not collected during this study to address this hypothesis.

These figures may suggest that the phage, and to a lesser extent C. perfringens, may better index the market quality of shellfish harvested from cold, temperate waters. This is especially true in light of the fact that one class of agents of primary concern to public health are the viruses, and Norwalk agent in particular. These pathogenic viruses may show survival and retention characteristics similar to the conservative C. perfringens and coliphage indicators in saline waters and shellfish and, therefore, they may

Figure 15. Indicator densities in shellfish by distance from major sources of contamination (Quequechan River) by season in Mt. Hope Bay.

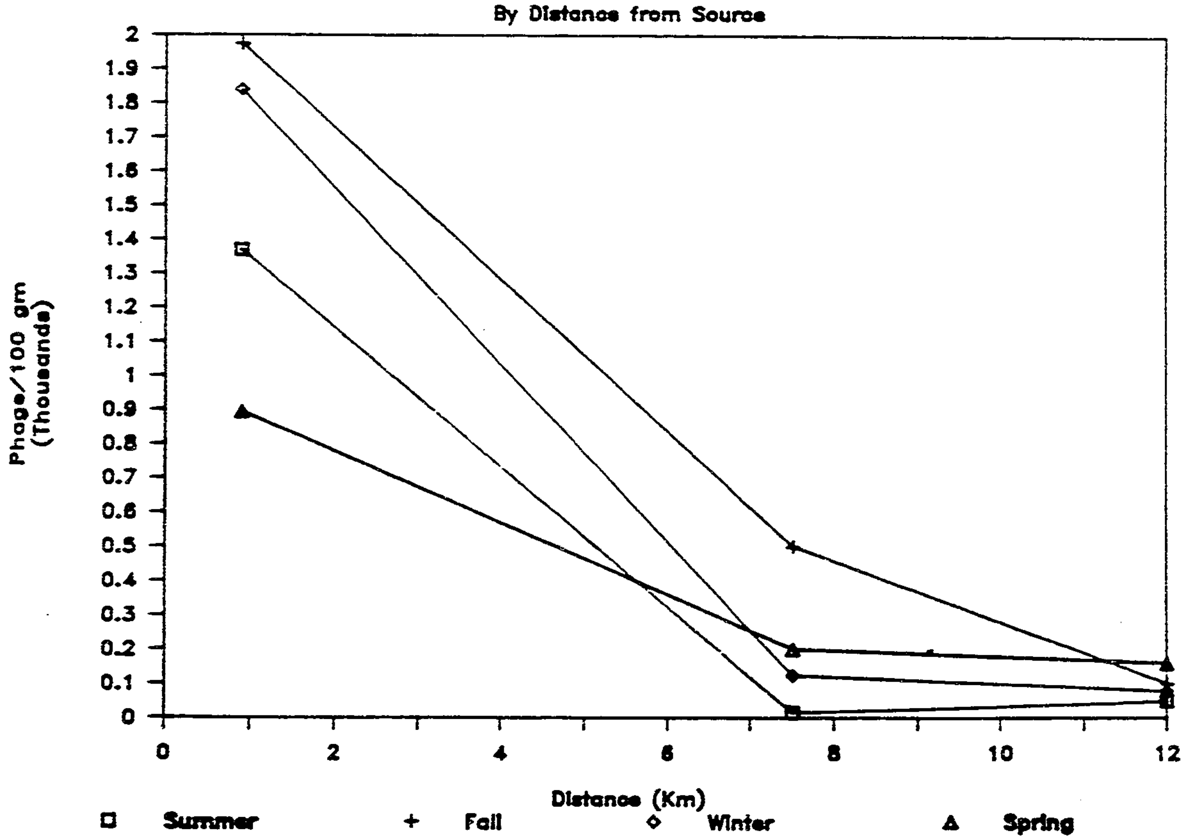
Fecal Coliform Densities – Shellfish

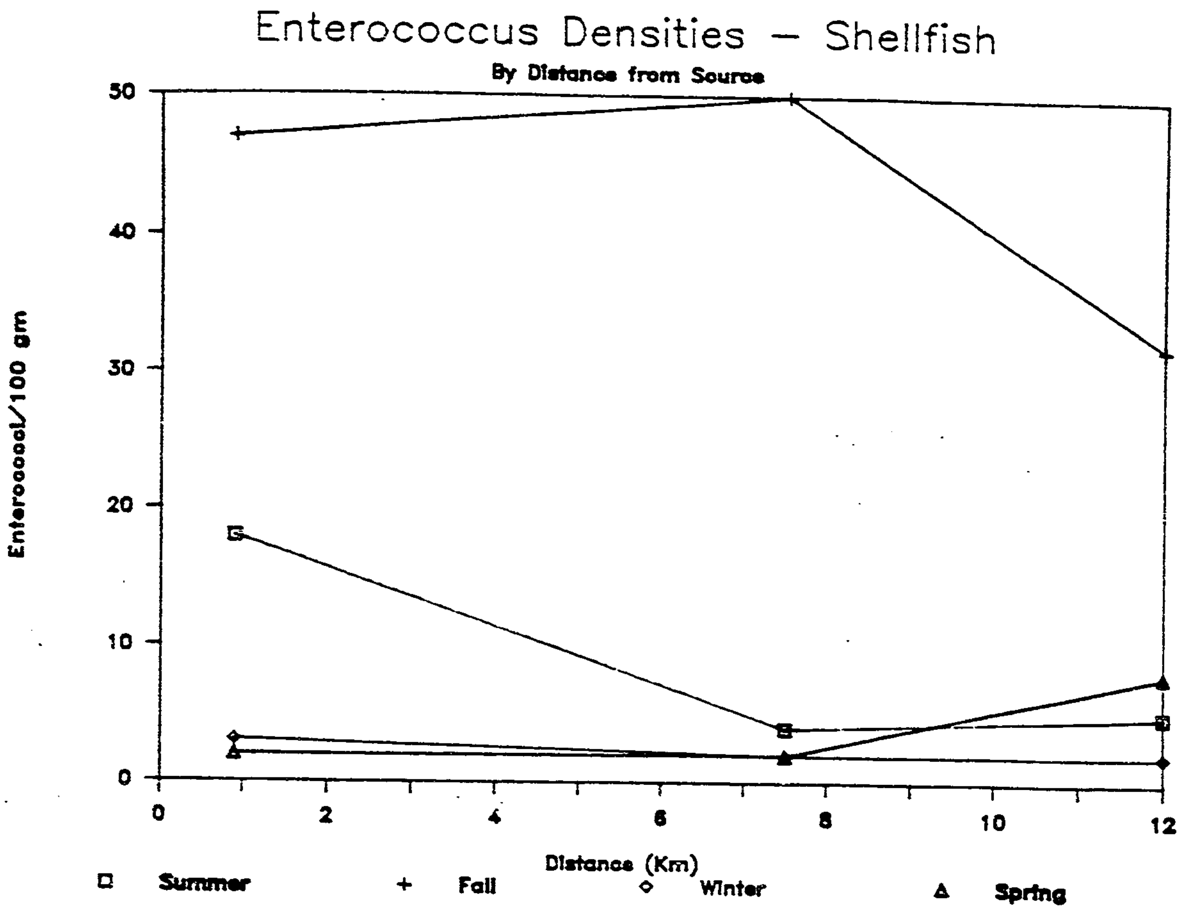
By Distance from Source



Phage Levels – Shellfish

By Distance from Source




Enterococcus Densities — Shellfish
By Distance from Source
Enterococci/100 gm
50
40
30
20
10
0
0
2
4
6
8
10
12
Distance (Km)
Summer
Fall
Winter
Spring

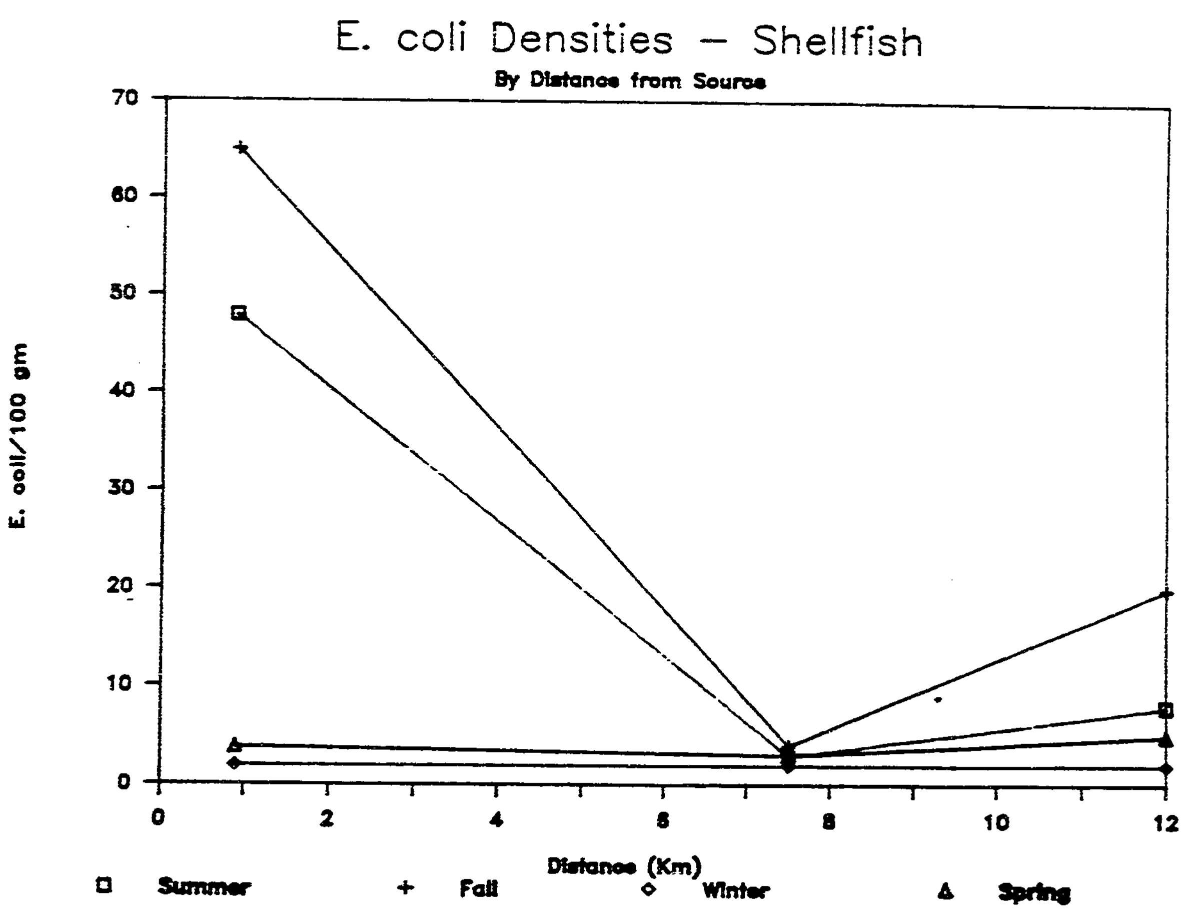
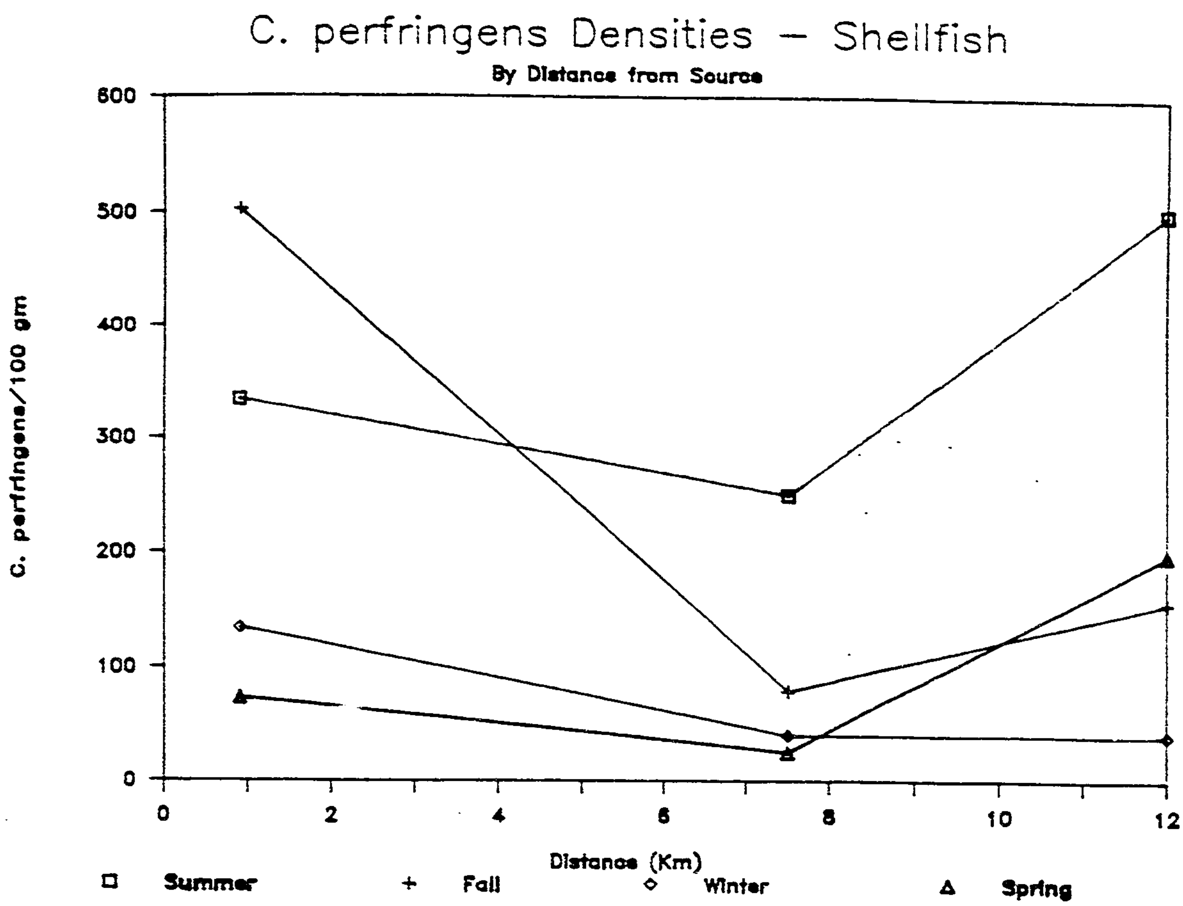

E. coli Densities — Shellfish
By Distance from Source
E. coli/100 gm
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
Distance (Km)
Summer
Fall
Winter
Spring

Figure 15



C. perfringens Densities — Shellfish
By Distance from Source
C. perfringens/100 gm
600
500
400
300
200
100
0
0
2
4
6
8
10
12
Distance (Km)
Summer
Fall
Winter
Spring

prove to be more reliable indicators of potential human health effects than the fecal coliform.

There are no data available at present to support this hypothesis. Most currently available data address the relationships of enteric virus levels in shellfish and shellfish-growing waters relative to the existing standard, fecal coliforms. With few exceptions (Cole, M.T. et al. 1986. Detection of enteroviruses and bacterial indicators and pathogens in Louisiana oysters and their overlying waters. J. Food Prot. 49:596-601), the overwhelming evidence to date demonstrates that fecal coliforms do not reliably index the presence (or absence) of enteroviruses or enteric viral pathogens (Gerba, C.P. and S.M. Goyal. 1978. Detection and occurrence of enteric viruses in shellfish: A review. J. Food Prot. 41: 743-754.; Fugate, K.J. et al. 1975. Enteroviruses and potential bacterial indicators in Gulf Coast oysters. J. Food Prot. 38: 100-104; Ellender, R.O. et al. 1980. Natural enterovirus and fecal coliform contamination of Gulf Coast oysters. J. Food Prot. 43:105-110), at least in Gulf Coast waters and shellfish.

SUMMARY AND RECOMMENDATIONS

(1) Area Classification

The southwestern portion of Mt. Hope Bay could be managed as a conditionally approved shellfish growing area. The boundaries of this area would be the Mt. Hope Bridge north to a line which runs from Common Fence Point to Toweset Point including the Kickamuit River. This area might be managed conditionally under the following stipulations:

(a) Additional sampling and analyses are performed to supplement data obtained in this study, thereby meeting the requirements of the NSSP (in Part 1, Manual of Operations, National Shellfish Sanitation Program) for reclassifying (15 samples per station). The combined results obtained for the proposed conditional area must continue to meet the sanitary standards for an approved area under defined hydrographic conditions.

(b) Shellfish meat samples from the proposed conditional area are analyzed for chemical contaminants (PCBs, mercury) and found below defined action levels.

(c) The area can remain open as long as rainfall does not exceed 0.5" in a 24 hr. period 7 days prior to harvesting;

(d) If between 0.5" and 1.0" of rain falls within a given 24 hr. period, the area should remain closed to shellfish harvesting for a period of seven days following the event.

(e) If greater than 1.0" of rain occurs within a 24 hr. period, the area should remain closed until the results of bacteriological sampling demonstrate that all stations within the conditional boundary meet the approved growing area criteria.

There are two potential problems with managing this area on such a conditional basis. First, the time of travel of contaminants from major point sources (on both the east and west sides of the Bay) was not determined during this survey. If the conditional area is significantly impacted within a short period of time following a rainfall event (less than 24 hr), notices for closing the area could not be made public until after the area has become significantly contaminated. Therefore, a dye study to determine the time of travel from the Fall River/Taunton River area to the conditional area is recommended. In addition, effective communications between personnel at the Fall River sewage treatment facility and the R.I. DEM must be established so that prompt notification of sewage treatment failures can result in proper management of the conditional area.

The second potential problem concerns defining the line from Toweset Pt. to Common Fence Pt. A buoy line has been suggested as a possible solution to this problem. If buoys and other measures are deemed impractical, an alternative boundary is suggested. This alternative is defined by a line from Mt. Hope Point running southeast to Common Fence Point.

All areas outside the conditional boundaries should remain closed to the harvesting of shellfish for direct human consumption, regardless of hydrographic conditions.

(2) Pollution Sources

(a) The major sources of contamination input to Mt. Hope Bay originate in the Fall River area. Of these, the Quequechan River ranks as the worst polluter during both wet and dry weather. Three CSO's discharge into this river. While the magnitude of any of these three is unknown, their inputs result in river quality which is only slightly better than that of raw sewage. Certain other CSO's rank closely behind the Quequechan River by source strength. These include overflows at Birch St., Middle St., Mt. Hope St., Alton St., Williams St., and State Ave. Most of these overflows were found to be discharging during both wet and dry periods. Four CSO effluent flows could not be determined. Two of these (Riverview St. and Ferry St.) are probably very significant sources.

In regard to pollution abatement, there is no question that the CSO problem in the Fall River area should receive the highest priority. These effluents account for greater than 95% of the contamination entering Mt. Hope Bay as indexed by fecal coliform source strength.

(b) Other point sources impact the Bay to varying degrees. These include a non-CSO effluent near the Essex Chemical Co. (denoted Essex 1) in Fall River as well as several point sources located on the west side of Mt. Hope Bay which were discharging during periods of heavy rain (denoted W1 through W6).

(c) Two sewage treatment plants were sampled during the study. The Somerset, MA STP has serious problems with a daily flow which significantly exceeds the plant's capacity. The quality of the treated effluent was poor on the day of sampling. The Fall River Plant, which was completely renovated in 1982, appeared to be operating effectively under all weather conditions since the fecal coliform densities in the finished effluents were quite low. However, if the plant were treating all influents (i.e. there were no CSO's), it is not known how adequately wastewaters could be treated during wet or dry periods. Moreover, high densities of both bacteriophage and *C. perfringens* were found in the treated effluents at both plants during wet weather. These data suggest that disinfection processes at both plants should be re-evaluated since high levels of viruses may be input to receiving waters, at least during rainfall events.

The above assumption is derived from recently published data which compares inactivation rates of certain viral groups and bacterial species by chlorine as a function of concentration and contact time. The data demonstrate the chlorine insensitivity of F-specific phages, and clostridial spores (Havelaar, A.H. and T.J. Nieuwstad. Bacteriophages and fecal bacteria as indicators of chlorination efficiency of biologically treated wastewater. J. Water Poll. Cont. Fed. 57:1084-1088.), and viruses (Berg et al. 1978. Validity of fecal coliforms, total coliforms, and fecal streptococci as indicators of viruses in chlorinated primary sewage effluents. Appl. Environ. Microbiol. 36:880-884) relative to vegetative bacterial cells. Other data have described the comparable chlorine insensitivity of F-specific bacteriophages and the Norwalk virus (Keswick, B.H. et al. 1985. Inactivation of Norwalk Virus in drinking water by chlorine. Appl. Environ. Microbiol. 50:261-264). These data demonstrate that the F2 bacteriophage and, to a lesser extent, the Clostridium spores respond to wastewater disinfection practices in a manner similar to that of the Norwalk virus.

(d) The Taunton River was considered a single point source although it drains a large area of multiple point and nonpoint sources. While this river contributes a substantial amount of contamination to Mt. Hope Bay, it is roughly calculated that the magnitude of the input is only about 3% of that of the Fall River CSO's during wet periods, and about 0.4% under dry weather conditions.

(3) Indicator Relationships

The densities of several different microbiological indicators were measured in shellfish, sediments, surface and bottom waters to determine which menstruum best reflects shellfish quality. The best, although still relatively poor, relationships exist between surface waters and shellfish. The data suggest that to determine shellfish quality with any degree of confidence, one must examine the shellfish themselves.

The results of an examination of the indicators found in the shellfish over an entire year's period suggest two things. First, the currently used indicator group (fecal coliforms) is inadequate for assessing the market quality of shellstock harvested from cold saline waters. Second, the two conservative microbiological indicators (C. perfringens and F2 coliphage) examined during this period are probably much more reflective of shellfish quality and, therefore, may better index potential human health risks.

APPENDIX A

Microbiological Data - All Mt. Hope Bay Stations

STA=01

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	BC	BCMUG	AD	IMM
1	06/23/86	D	L	20.7	28.5	3.0	3.0	.	.	.	.	.	.	.
2	06/24/86	D	L	20.8	28.7	1.0	1.0	.	.	.	.	.	.	.
3	06/25/86	D	L	19.4	28.9	3.0	1.0	.	.	.	.	.	.	.
4	06/26/86	D	H	18.7	29.4	2.0	2.0	.	.	.	.	.	.	.
5	07/23/86	D	L	22.8	29.9	1.0	1.0	7.0	2.0	.	.	.	.	.
6	04/06/87	W	L	8.7	22.9	30.0	30.0	190.0	36.0	10.00	240.0	130.0	.	.
7	04/07/87	W	L	8.0	16.5	.	.	.	.	.	33.0	33.0	.	.
8	04/08/87	W	L	7.7	14.6	.	.	.	.	.	330.0	330.0	.	.
9	04/09/87	W	L	8.1	16.3	.	.	.	.	.	130.0	130.0	.	.
10	05/11/87	D	L	14.4	21.4	.	.	.	.	.	14.0	9.3	.	.
11	05/19/87	D	L	14.9	25.1	.	.	.	.	.	2.0	2.0	.	.
12	06/09/87	W	L	19.5	28.0	.	.	.	.	.	11.0	11.0	.	.
13	06/11/87	D	L	19.1	28.3	.	.	.	.	.	4.0	4.0	.	.

STA=02

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	BC	BCMUG	AD	IMM
14	06/23/86	D	L	19.9	28.5	3.0	3.0	.	.	.	.	.	.	.
15	06/24/86	D	L	20.0	28.8	7.0	4.0	.	.	.	.	.	.	.
16	06/25/86	D	L	19.3	28.6	0.0	0.0	.	.	.	.	.	.	.
17	06/26/86	D	H	18.5	29.4	5.0	1.0	.	.	.	.	.	.	.
18	07/22/86	D	H	22.9	29.4	.	.	.	.	.	13.0	2.0	.	.
19	07/22/86	D	L	24.0	29.7	.	.	.	.	.	2.0	2.0	.	.
20	07/23/86	D	L	24.3	29.9	1.0	1.0	10.0	18.0	.	0.2	0.2	.	.
21	07/24/86	D	L	23.9	29.9	2.0	2.0	8.0	1.0	.	0.2	0.2	.	.
22	07/25/86	D	L	24.6	30.2	.	.	.	.	.	2.0	2.0	.	.
23	07/26/86	D	L	23.9	30.2	.	.	.	.	0.50	0.2	0.2	.	.
24	07/27/86	D	L	24.4	30.0	.	.	.	.	.	2.0	2.0	.	.
25	07/28/86	W	H	25.5	29.6	.	.	.	.	.	130.0	130.0	.	.
26	07/28/86	W	L	24.7	29.8	58.0	15.0	13.0	15.0	6.70	49.0	33.0	.	.
27	07/29/86	W	L	24.8	29.7	.	.	.	.	.	33.0	11.0	.	.
28	04/06/87	W	L	8.2	23.5	49.0	48.0	250.0	59.0	25.00	49.0	79.0	.	.
29	04/07/87	W	L	8.0	24.0	.	.	.	.	.	49.0	49.0	.	.
30	04/08/87	W	L	7.8	22.1	.	.	.	.	.	490.0	230.0	.	.
31	04/09/87	W	L	7.9	16.8	.	.	.	.	.	79.0	79.0	.	.
32	05/11/87	D	L	13.8	23.5	.	.	.	.	.	4.5	2.0	.	.
33	05/19/87	D	L	15.3	25.3	.	.	.	.	.	4.5	4.5	.	.
34	06/09/87	W	L	19.2	28.1	.	.	.	.	.	7.8	7.8	.	.
35	06/11/87	D	L	19.0	28.7	.	.	.	.	.	2.0	2.0	.	.

STA=03

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	BC	BCMUG	AD	IMM
36	06/23/86	D	L	21.0	27.8	210.0	100.0	.	.	.	.	.	.	.
37	06/24/86	D	L	21.4	28.0	20.0	20.0	.	.	.	.	.	.	.
38	06/25/86	D	L	19.7	29.0	13.0	10.0	.	.	.	.	.	.	.
39	06/26/86	D	H	19.1	28.8	50.0	50.0	.	.	.	.	.	.	.
40	07/21/86	D	L	23.2	28.6	5.0	4.0	14.0	24.0	.	.	.	.	.
41	07/23/86	D	L	25.9	29.1	7.0	7.0	9.0	29.0	.	.	.	.	.
42	07/24/86	D	L	26.5	29.2	11.0	5.0	1.0	15.0	.	.	.	.	.

STA=03 (continued)

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
43	07/28/86	W	L	25.0	29.3	90.0	65.0	7.0	66.0	3.20	.	.	.	.
44	04/06/87	W	L	7.8	23.5	570.0	490.0	180.0	270.0	65.00	.	.	.	.

STA=04

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
45	06/23/86	D	L	21.0	28.1	23.0	0.0	.	.	.	.	.	.	.
46	06/24/86	D	L	21.7	28.2	8.0	8.0	.	.	.	.	.	.	.
47	06/25/86	D	L	19.5	29.2	4.0	2.0	.	.	.	.	.	.	.
48	06/26/86	D	H	19.2	28.5	50.0	50.0	.	.	.	.	.	.	.
49	04/06/87	W	L	7.6	23.9	220.0	170.0	160.0	90.0	35.00	.	.	.	.

STA=05

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
50	06/23/86	D	L	20.6	28.0	70.0	70.0	.	.	.	.	.	.	.
51	06/24/86	D	L	20.9	28.2	14.0	12.0	.	.	.	.	.	.	.
52	06/25/86	D	L	20.0	28.5	0.0	0.0	.	.	.	.	.	.	.
53	06/26/86	D	H	19.3	28.7	100.0	70.0	.	.	.	.	.	.	.
54	07/21/86	D	L	23.0	28.4	60.0	50.0	16.0	18.0	.	110.0	110.0	.	.
55	07/22/86	D	H	23.0	29.4	.	.	.	.	.	17.0	17.0	.	.
56	07/22/86	D	L	24.8	28.9	.	.	.	.	.	5.8	2.0	.	.
57	07/23/86	D	L	25.3	29.3	1.0	1.0	6.0	10.0	.	0.2	0.2	.	.
58	07/24/86	D	L	25.5	29.6	1.0	1.0	3.0	5.0	.	0.2	0.2	.	.
59	07/25/86	D	L	25.1	30.0	.	.	.	.	.	0.2	0.2	.	.
60	07/26/86	D	L	25.2	29.4	.	.	.	.	0.50	4.5	4.5	.	.
61	07/27/86	D	L	25.9	30.0	.	.	.	.	.	4.5	2.0	.	.
62	07/28/86	W	H	25.2	29.6	.	.	.	.	.	33.0	17.0	.	.
63	07/28/86	W	L	25.1	29.5	56.0	33.0	6.0	45.0	3.20	34.0	34.0	.	.
64	07/29/86	W	L	24.9	29.3	.	.	.	.	.	78.0	78.0	.	.
65	04/06/87	W	L	7.6	23.7	370.0	350.0	140.0	190.0	55.00	920.0	920.0	.	.
66	04/07/87	W	L	7.4	24.5	.	.	.	.	.	490.0	490.0	.	.
67	04/08/87	W	L	7.5	23.4	.	.	.	.	.	790.0	280.0	.	.
68	04/09/87	W	L	7.9	16.3	.	.	.	.	.	170.0	170.0	.	.
69	05/11/87	D	L	15.2	18.2	.	.	.	.	.	130.0	14.0	.	.
70	05/19/87	D	L	15.7	24.3	.	.	.	.	.	17.0	4.5	.	.
71	06/09/87	W	L	19.8	29.1	.	.	.	.	.	49.0	49.0	.	.
72	06/11/87	D	L	19.1	27.7	.	.	.	.	.	22.0	5.1	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=06

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	MB	PHA	BC	BCMUG	AD	IMM
73	06/23/86	D	L	20.7	28.2	20.0	18.0	.	.	.	.	.	.	.
74	06/24/86	D	L	21.2	28.5	20.0	18.0	.	.	.	.	.	.	.
75	06/25/86	D	L	20.5	28.2	11.0	11.0	.	.	.	.	.	.	.
76	06/26/86	D	H	19.2	28.2	120.0	90.0	.	.	.	.	.	.	.
77	07/21/86	D	L	23.3	28.3	150.0	100.0	8.0	38.0	.	.	.	.	.
78	07/23/86	D	L	25.9	28.7	30.0	30.0	7.0	4.0	.	.	.	.	.
79	07/24/86	D	L	26.4	29.3	12.0	11.0	4.0	1.0	.	.	.	.	.
80	07/28/86	W	L	25.0	29.2	87.0	65.0	10.0	30.0	3.20	.	.	.	.

STA=07

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	MB	PHA	BC	BCMUG	AD	IMM
81	06/23/86	D	L	20.4	29.4	10.0	9.0	.	.	.	.	.	.	.
82	06/24/86	D	L	21.0	28.5	16.0	13.0	.	.	.	.	.	.	.
83	06/25/86	D	L	20.1	29.1	4.0	4.0	.	.	.	.	.	.	.
84	06/26/86	D	H	19.1	28.2	170.0	150.0	.	.	.	.	.	.	.
85	04/06/87	W	L	7.3	24.3	109.0	91.0	160.0	180.0	20.00	.	.	.	.

STA=08

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	MB	PHA	BC	BCMUG	AD	IMM
86	06/23/86	D	L	20.3	28.2	6.0	5.0	.	.	.	.	.	.	.
87	06/24/86	D	L	20.5	28.5	28.0	22.0	.	.	.	.	.	.	.
88	06/25/86	D	L	19.4	29.1	18.0	11.0	.	.	.	.	.	.	.
89	06/26/86	D	H	19.9	28.4	130.0	100.0	.	.	.	.	.	.	.
90	07/21/86	D	L	23.1	29.7	22.0	15.0	11.0	43.0	.	13.0	13.0	.	.
91	07/22/86	D	H	22.4	29.5	.	.	.	.	.	33.0	23.0	.	.
92	07/22/86	D	L	23.2	29.8	.	.	.	.	.	17.0	6.8	.	.
93	07/23/86	D	L	24.7	29.5	9.0	3.0	10.0	2.0	.	5.3	4.0	.	.
94	07/24/86	D	L	25.1	29.7	2.0	2.0	5.0	6.0	.	0.2	0.2	.	.
95	07/25/86	D	L	25.3	28.9	.	.	.	.	.	49.0	4.0	.	.
96	07/26/86	D	L	24.8	30.2	.	.	.	.	0.50	33.0	7.8	.	.
97	07/27/86	D	L	25.3	30.0	.	.	.	.	.	7.8	7.8	.	.
98	07/28/86	W	H	26.0	30.1	.	.	.	.	.	130.0	45.0	.	.
99	07/28/86	W	L	25.5	29.9	28.0	12.0	19.0	11.0	3.20	33.0	23.0	.	.
100	07/29/86	W	L	25.1	29.4	.	.	.	.	.	78.0	45.0	.	.
101	04/06/87	W	L	7.4	23.9	190.0	160.0	160.0	220.0	20.00	130.0	49.0	.	.
102	04/07/87	W	L	7.1	18.4	.	.	.	.	.	1300.0	490.0	.	.
103	04/08/87	W	L	7.3	19.9	.	.	.	.	.	170.0	170.0	.	.
104	04/09/87	W	L	8.0	14.6	.	.	.	.	.	1300.0	790.0	.	.
105	05/11/87	D	L	14.0	20.3	.	.	.	.	.	79.0	79.0	.	.
106	05/19/87	D	L	14.6	25.6	.	.	.	.	.	2.0	4.5	.	.
107	06/09/87	W	L	19.7	28.2	.	.	.	.	.	11.0	4.0	.	.
108	06/11/87	D	L	19.2	27.5	.	.	.	.	.	17.0	17.0	.	.

STA=09

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
109	06/23/86	D	L	18.8	26.2	150.0	140.0	.	.	.	.	.	.	.
110	06/24/86	D	L	19.5	26.7	420.0	310.0	.	.	.	.	.	.	.
111	06/25/86	D	L	19.2	26.3	1450.0	1180.0	.	.	.	.	.	.	.
112	06/26/86	D	H	19.7	26.1	2400.0	2200.0	.	.	.	.	.	.	.
113	07/21/86	D	L	21.8	27.7	530.0	290.0	51.0	25.0	.	540.0	540.0	.	.
114	07/22/86	D	H	21.9	28.5	.	.	.	.	.	1600.1	1600.1	.	.
115	07/22/86	D	L	23.5	27.9	.	.	.	.	.	700.0	460.0	.	.
116	07/23/86	D	L	23.7	27.2	99.0	93.0	30.0	18.0	.	79.0	49.0	.	.
117	07/24/86	D	L	24.6	27.7	501.0	401.0	91.0	95.0	.	920.0	350.0	.	.
118	07/25/86	D	L	24.3	28.5	.	.	.	.	.	130.0	130.0	.	.
119	07/26/86	D	L	24.1	28.1	.	.	.	.	40.00	170.0	170.0	.	.
120	07/27/86	D	L	25.0	28.3	.	.	.	.	.	460.0	700.0	.	.
121	07/28/86	W	H	24.5	29.2	.	.	.	.	.	490.0	490.0	.	.
122	07/28/86	W	L	24.4	28.2	720.0	430.0	51.0	78.0	23.30	1300.0	490.0	.	.
123	07/29/86	W	L	23.9	27.5	.	.	.	.	.	2400.0	730.0	.	.
124	04/06/87	W	L	7.2	25.1	590.0	540.0	310.0	550.0	150.00	920.0	920.0	.	.
125	04/07/87	W	L	7.3	10.5	.	.	.	.	.	2300.0	9200.0	.	.
126	04/08/87	W	L	7.2	9.0	.	.	.	.	.	1601.0	1501.0	.	.
127	04/09/87	W	L	7.4	8.3	.	.	.	.	.	790.0	730.0	.	.
128	05/11/87	D	L	14.1	16.1	.	.	.	.	.	920.0	920.0	.	.
129	05/19/87	D	L	13.7	23.2	.	.	.	.	.	140.0	70.0	.	.
130	06/09/87	W	L	18.6	25.5	.	.	.	.	.	240.0	130.0	.	.
131	06/11/87	D	L	19.3	25.8	.	.	.	.	.	1600.0	240.0	.	.

STA=10

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
132	06/23/86	D	L	19.9	28.7	99.0	72.0	.	.	.	.	.	.	.
133	06/24/86	D	L	20.3	28.7	180.0	160.0	.	.	.	.	.	.	.
134	06/25/86	D	L	19.4	28.4	46.0	40.0	.	.	.	.	.	.	.
135	06/26/86	D	H	20.0	27.9	90.0	90.0	.	.	.	.	.	.	.
136	07/21/86	D	L	22.9	29.7	90.0	80.0	18.0	13.0	.	.	.	.	.
137	07/23/86	D	L	24.0	29.5	48.0	41.0	17.0	37.0	.	.	.	.	.
138	07/24/86	D	L	24.5	29.1	32.0	17.0	25.0	2.0	.	.	.	.	.
139	07/28/86	W	L	24.8	29.4	1620.0	1520.0	44.0	254.0	3.30	.	.	.	.
140	04/06/87	W	L	7.8	24.7	510.0	420.0	160.0	300.0	130.00	.	.	.	.

STA=11

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
141	06/23/86	D	L	20.0	28.7	54.0	44.0	.	.	.	.	.	.	.
142	06/24/86	D	L	20.4	28.4	42.0	36.0	.	.	.	.	.	.	.
143	06/25/86	D	L	19.2	28.6	69.0	57.0	.	.	.	.	.	.	.
144	06/26/86	D	H	19.6	27.8	120.0	60.0	.	.	.	.	.	.	.
145	07/24/86	D	L	24.5	29.1	14.0	13.0	21.0	1.0	.	.	.	.	.
146	07/28/86	W	L	24.3	28.4	400.0	250.0	48.0	49.0	13.30	.	.	.	.
147	04/06/87	W	L	6.7	25.0	790.0	680.0	460.0	480.0	150.00	920.0	920.0	.	.
148	04/08/87	W	L	7.5	15.3	.	.	.	.	.	700.0	700.0	.	.
149	05/11/87	D	L	13.2	15.5	.	.	.	.	.	33.0	33.0	.	.
150	05/19/87	D	L	13.4	24.1	.	.	.	.	.	350.0	130.0	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=11 (continued)

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
151	06/09/87	W	L	19.1	27.4	.	.	.	.	.	350.0	79.0	.	.
152	06/11/87	D	L	19.2	26.7	.	.	.	.	.	140.0	33.0	.	.

STA=11B

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
153	07/21/86	D	L	21.5	29.2	270.0	120.0	43.0	17.0	699.00	.	.	.	.
154	07/23/86	D	L	23.1	29.5	9.0	8.0	21.0	7.0	33.00	22.0	17.0	.	.
155	07/31/86	W	L	22.0	30.4	470.0	250.0	25.0	22.0	6.60	.	.	.	.
156	11/17/86	D	L	8.6	24.5	29.0	27.0	21.0	13.0	15.00	.	.	.	.
157	11/24/86	D	H	8.5	28.1	130.0	90.0	65.0	67.0	45.00	.	.	.	.
158	02/25/87	D	L	2.2	31.5	160.0	100.0	100.0	160.0	5.00	.	.	.	.
159	03/02/87	W	H	2.6	32.1	190.0	160.0	230.0	155.0	65.00	.	.	.	.
160	04/07/87	W	L	6.8	28.6	200.0	160.0	210.0	68.0	65.00	.	.	.	.
161	04/09/87	W	L	8.1	25.7	230.0	120.0	160.0	42.0	55.00	.	.	.	.

STA=11S

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
162	07/21/86	D	L	.	.	.	.	.	.	.	240.0	240.0	11.0	1600000.0
163	07/23/86	D	L	.	.	.	.	.	.	.	700.0	170.0	20.0	920000.0
164	07/28/86	W	H	.	.	.	.	.	.	.	3300.0	460.0	540.0	110000.0
165	07/31/86	W	L	.	.	.	.	.	.	.	3300.0	790.0	1700.0	79000.0
166	11/17/86	D	L	.	.	.	.	.	.	.	45.0	20.0	45.0	49000.0
167	11/24/86	D	H	.	.	.	.	.	.	.	17000.0	4600.0	7900.0	130000.0
168	02/25/87	D	L	.	.	.	.	.	.	.	13000.0	13000.0	54000.0	490000.0
169	03/02/87	W	H	.	.	.	.	.	.	.	4900.0	1300.0	4900.0	79000.0
170	04/07/87	W	L	6.8	28.6	.	.	.	.	.	1300.0	1300.0	3500.0	230000.0
171	04/09/87	W	L	8.1	25.7	.	.	.	.	.	49.0	49.0	1300.0	330000.0

STA=11SF

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
172	07/21/86	D	L	.	.	.	.	.	.	1806.00	700.0	260.0	130.0	350.0
173	07/23/86	D	L	.	.	.	.	.	.	1600.00	130.0	130.0	19.0	920.0
174	07/28/86	W	H	.	.	.	.	.	.	32640.00	79.0	23.0	21.0	490.0
175	07/31/86	W	L	.	.	.	.	.	.	37.50	9.3	6.8	2.0	79.0
176	11/17/86	D	L	.	.	.	.	.	.	444.00	7.3	7.8	70.0	230.0
177	11/24/86	D	H	.	.	.	.	.	.	8793.00	540.0	540.0	310.0	1100.0
178	02/25/87	D	L	.	.	.	.	.	.	681.00	2.1	2.1	4.5	230.0
179	03/02/87	W	H	.	.	.	.	.	.	4368.80	2.0	2.0	2.1	79.0
180	04/07/87	W	L	6.8	28.6	.	.	.	.	812.50	6.8	6.8	2.0	49.0
181	04/09/87	W	L	8.1	25.7	.	.	.	.	983.00	2.1	2.1	2.0	110.0

MT. HOPE BAY - ALL BAY STATIONS

STA=11T

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
182	07/21/86	D	L	21.7	28.9	510.0	260.0	40.0	31.0	1418.00	.	.	.	.
183	07/23/86	D	L	23.6	29.6	62.0	56.0	13.0	67.0	276.00	.	.	.	.
184	07/28/86	W	H	25.5	28.3	640.0	38.0	0.1	29.9	.	.	.	.	2370.0
185	07/31/86	W	L	22.0	28.9	280.0	220.0	33.0	23.0	26.70	.	.	.	.
186	11/17/86	D	L	8.2	23.1	190.0	150.0	140.0	47.0	85.00	.	.	.	.
187	11/24/86	D	H	9.2	25.8	140.0	100.0	69.0	74.0	45.00	.	.	.	.
188	02/25/87	D	L	1.3	28.3	140.0	60.0	100.0	120.0	25.00	.	.	.	.
189	03/02/87	W	H	3.6	29.7	120.0	110.0	200.0	132.0	60.00	.	.	.	.
190	04/07/87	W	L	7.3	10.5	570.0	460.0	280.0	380.0	190.00	2400.0	1300.0	.	.
191	04/09/87	W	L	7.7	12.4	450.0	390.0	280.0	120.0	175.00	700.0	700.0	.	.

STA=12

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
192	06/23/86	D	L	19.2	27.6	150.0	130.0	.	.	.	.	.	.	.
193	06/24/86	D	L	19.4	26.9	90.0	70.0	.	.	.	.	.	.	.
194	06/25/86	D	L	19.0	26.9	390.0	340.0	.	.	.	.	.	.	.
195	06/26/86	D	H	20.5	28.3	60.0	50.0	.	.	.	.	.	.	.
196	07/21/86	D	L	21.9	27.7	410.0	270.0	58.0	9.0	.	.	.	.	.
197	07/23/86	D	L	23.4	28.1	100.0	60.0	23.0	58.0	.	.	.	.	.
198	07/24/86	D	L	23.8	28.5	50.0	46.0	35.0	2.6	.	.	.	.	
199	07/28/86	W	L	24.5	28.2	510.0	320.0	43.0	59.0	36.70	.	.	.	.
200	04/06/87	W	L	7.2	24.1	560.0	470.0	290.0	480.0	100.00	.	.	.	.

STA=13

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
201	06/23/86	D	L	19.2	23.3	460.0	420.0	.	.	.	.	.	.	.
202	06/24/86	D	L	19.2	28.1	220.0	170.0	.	.	.	.	.	.	.
203	06/25/86	D	L	19.3	27.6	500.0	330.0	.	.	.	.	.	.	.
204	06/26/86	D	H	19.8	26.2	290.0	210.0	.	.	.	.	.	.	.
205	07/21/86	D	L	22.5	28.3	350.0	210.0	31.0	10.0	.	.	.	.	.
206	07/23/86	D	L	22.7	29.2	110.0	90.0	15.0	7.0	.	.	.	.	.
207	07/24/86	D	L	23.5	28.9	78.0	73.0	20.0	4.0	.	.	.	.	.
208	07/28/86	W	L	24.0	29.3	6000.0	5600.0	51.0	105.0	36.70	.	.	.	.
209	04/06/87	W	L	6.6	25.3	3100.0	1900.0	210.0	580.0	200.00	.	.	.	.

STA=14

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
210	06/23/86	D	L	18.9	28.3	530.0	390.0	.	.	.	.	.	.	.
211	06/24/86	D	L	19.3	28.2	310.0	270.0	.	.	.	.	.	.	.
212	06/25/86	D	L	18.9	27.8	250.0	200.0	.	.	.	.	.	.	.
213	06/26/86	D	H	20.5	28.4	120.0	100.0	.	.	.	.	.	.	.
214	07/21/86	D	L	21.7	29.0	.	.	.	.	.	170.0	170.0	.	.
215	07/22/86	D	H	21.2	30.0	.	.	.	.	.	49.0	33.0	.	.
216	07/22/86	D	L	22.5	29.1	.	.	.	.	.	460.0	220.0	.	.
217	07/23/86	D	L	22.9	29.4	120.0	100.0	22.0	67.0	.	490.0	140.0	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=14 (continued)

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
218	07/24/86	D	L	23.3	29.3	.	.	.	.	.	42.0	42.0	.	.
219	07/25/86	D	L	24.3	29.7	.	.	.	.	.	33.0	13.0	.	.
220	07/26/86	D	L	24.4	29.2	.	.	.	.	15.00	1100.0	700.0	.	.
221	07/27/86	D	L	25.5	29.6	.	.	.	.	.	3500.0	1700.0	.	.
222	07/28/86	W	H	26.3	29.4	.	.	.	.	.	33.0	23.0	.	.
223	07/28/86	W	L	23.8	30.1	.	.	.	.	29.90	3300.0	3300.0	.	.
224	07/29/86	W	L	25.5	29.9	.	.	.	.	.	130.0	78.0	.	.
225	04/06/87	W	L	6.4	25.4	720.0	580.0	190.0	460.0	185.00	1600.0	1600.0	.	.
226	04/07/87	W	L	6.9	12.7	.	.	.	.	.	3500.0	3500.0	.	.
227	04/08/87	W	L	7.3	21.6	.	.	.	.	.	2400.0	2400.0	.	.
228	04/09/87	W	L	7.6	12.8	.	.	.	.	.	790.0	790.0	.	.
229	05/11/87	D	L	13.5	23.0	.	.	.	.	.	350.0	110.0	.	.
230	05/11/87	D	L	12.9	25.2	.	.	.	.	.	140.0	26.0	.	.
231	05/19/87	D	L	13.0	25.2	.	.	.	.	.	130.0	79.0	.	.
232	06/09/87	W	L	18.9	27.7	.	.	.	.	.	220.0	130.0	.	.
233	06/11/87	D	L	19.7	28.2	.	.	.	.	.	130.0	79.0	.	.

STA=15

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
234	06/23/86	D	L	19.2	29.4	580.0	470.0	.	.	.	.	.	.	.
235	06/24/86	D	L	19.7	28.8	52.0	46.0	.	.	.	.	.	.	.
236	06/25/86	D	L	19.5	28.9	51.0	35.0	.	.	.	.	.	.	.
237	06/26/86	D	H	19.6	28.5	8.0	8.0	.	.	.	.	.	.	.
238	07/21/86	D	L	21.5	29.6	390.0	220.0	70.0	12.0	.	350.0	240.0	.	.
239	07/22/86	D	H	21.3	30.3	.	.	.	.	.	49.0	17.0	.	.
240	07/22/86	D	L	22.2	30.2	.	.	.	.	.	540.0	79.0	.	.
241	07/23/86	D	L	24.1	29.6	50.0	38.0	21.0	0.1	.	49.0	49.0	.	.
242	07/24/86	D	L	24.4	29.8	3.0	2.0	17.0	1.0	.	4.5	2.0	.	.
243	07/25/86	D	L	24.0	30.0	.	.	.	.	.	79.0	14.0	.	.
244	07/26/86	D	L	25.0	30.0	.	.	.	.	0.50	79.0	33.0	.	.
245	07/27/86	D	L	25.8	30.0	.	.	.	.	.	170.0	78.0	.	.
246	07/28/86	W	H	24.8	30.3	.	.	.	.	.	1100.0	1100.0	.	.
247	07/28/86	W	L	24.0	29.9	5000.0	5800.0	62.0	130.0	20.00	7900.0	4900.0	.	.
248	07/29/86	W	L	24.6	29.7	.	.	.	.	.	1300.0	150.0	.	.
249	04/06/87	W	L	5.5	25.4	500.0	460.0	230.0	270.0	70.00	700.0	700.0	.	.
250	04/07/87	W	L	6.8	15.0	.	.	.	.	.	3500.0	3500.0	.	.
251	04/08/87	W	L	7.0	16.3	.	.	.	.	.	3500.0	5400.0	.	.
252	04/09/87	W	L	7.7	10.9	.	.	.	.	.	2400.0	2400.0	.	.
253	05/11/87	D	L	12.9	26.5	.	.	.	.	.	4.0	1.9	.	.
254	05/19/87	D	L	13.7	26.7	.	.	.	.	.	350.0	79.0	.	.
255	06/09/87	W	L	20.0	28.1	.	.	.	.	.	17.0	11.0	.	.
256	06/11/87	D	L	19.2	26.1	.	.	.	.	.	140.0	14.0	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=16

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
257	06/23/86	D	L	19.1	29.1	25.0	22.0	.	.	.	.	.	.	.
258	06/24/86	D	L	19.3	29.5	86.0	53.0	.	.	.	.	.	.	.
259	06/26/86	D	H	19.4	29.6	7.0	7.0	.	.	.	.	.	.	.
260	07/21/86	D	L	22.3	29.8	94.0	29.0	33.0	4.0	.	.	.	.	.
261	07/23/86	D	L	23.7	30.1	4.0	1.0	20.0	11.0	.	.	.	.	.
262	07/24/86	D	L	23.5	30.5	0.1	0.1	13.0	1.0	.	.	.	.	.
263	07/28/86	W	L	23.1	30.7	380.0	160.0	37.0	43.0	23.30	.	.	.	.
264	04/06/87	W	L	5.7	26.5	340.0	270.0	290.0	210.0	30.00	.	.	.	.

STA=17

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
265	06/23/86	D	L	18.4	29.4	22.0	16.0	.	.	.	.	.	.	.
266	06/24/86	D	L	18.7	29.9	1.0	0.0	.	.	.	.	.	.	.
267	06/25/86	D	L	18.9	29.2	35.0	31.0	.	.	.	.	.	.	.
268	06/26/86	D	H	19.1	29.6	0.0	0.0	.	.	.	.	.	.	.
269	04/06/87	W	L	6.7	25.1	580.0	490.0	220.0	300.0	30.00	.	.	.	.
270	04/07/87	W	L	7.1	22.6	.	.	.	.	.	35.0	130.0	.	.

STA=18

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
271	06/23/86	D	L	18.0	30.5	8.0	6.0	.	.	.	.	.	.	.
272	06/24/86	D	L	18.3	30.5	8.0	7.0	.	.	.	.	.	.	.
273	06/25/86	D	L	18.5	30.2	10.0	9.0	.	.	.	.	.	.	.
274	06/26/86	D	H	18.6	29.8	0.0	0.0	.	.	.	.	.	.	.
275	07/21/86	D	L	20.9	31.0	23.0	23.0	15.0	11.0	.	33.0	33.0	.	.
276	07/22/86	D	H	21.3	30.9	.	.	.	.	.	49.0	49.0	.	.
277	07/22/86	D	L	21.7	30.8	.	.	.	.	.	23.0	23.0	.	.
278	07/23/86	D	L	22.2	31.2	6.0	6.0	9.0	8.0	.	17.0	11.0	.	.
279	07/24/86	D	L	22.5	31.0	12.0	11.0	4.0	22.0	.	13.0	13.0	.	.
280	07/25/86	D	L	22.3	31.1	.	.	.	.	.	17.0	17.0	.	.
281	07/26/86	D	L	22.6	31.3	.	.	.	.	0.50	11.0	11.0	.	.
282	07/27/86	D	L	23.4	31.2	.	.	.	.	.	79.0	79.0	.	.
283	07/28/86	W	H	24.0	30.9	.	.	.	.	.	46.0	6.8	.	.
284	07/28/86	W	L	23.2	30.8	20.0	3.0	4.0	4.0	3.30	21.0	11.0	.	.
285	07/29/86	W	L	23.0	31.2	.	.	.	.	.	42.0	42.0	.	.
286	04/06/87	W	L	6.9	25.1	320.0	300.0	190.0	90.0	45.00	350.0	170.0	.	.
287	04/07/87	W	L	6.6	21.7	.	.	.	.	.	790.0	790.0	.	.
288	04/08/87	W	L	7.1	15.2	.	.	.	.	.	1700.0	1700.0	.	.
289	04/09/87	W	L	7.6	11.1	.	.	.	.	.	1100.0	460.0	.	.
290	05/11/87	D	L	13.3	25.9	.	.	.	.	.	2.0	2.0	.	.
291	05/19/87	D	L	14.2	27.3	.	.	.	.	.	2.1	2.1	.	.
292	06/09/87	W	L	18.5	28.7	.	.	.	.	.	1.9	1.9	.	.
293	06/11/87	D	L	18.1	29.4	.	.	.	.	.	7.8	7.8	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=19

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
294	06/23/86	D	L	19.3	29.0	7.0	5.0	.	.	.	.	.	.	.
295	06/24/86	D	L	18.8	29.5	14.0	12.0	.	.	.	.	.	.	.
296	06/25/86	D	L	19.0	29.2	8.0	6.0	.	.	.	.	.	.	.
297	06/26/86	D	H	18.9	29.7	0.0	0.0	.	.	.	.	.	.	.
298	07/21/86	D	L	22.7	29.9	.	.	.	.	.	17.0	7.8	.	.
299	07/22/86	D	H	21.2	30.3	.	.	.	.	.	7.8	7.8	.	.
300	07/22/86	D	L	24.2	29.9	.	.	.	.	.	13.0	7.8	.	.
301	07/23/86	D	L	24.1	30.1	.	.	.	.	.	2.0	2.0	.	.
302	07/24/86	D	L	23.3	30.5	.	.	.	.	.	7.8	7.8	.	.
303	07/25/86	D	L	22.8	30.8	.	.	.	.	.	0.2	0.2	.	.
304	07/26/86	D	L	22.5	31.1	.	.	.	.	0.50	2.0	0.2	.	.
305	07/27/86	D	L	22.9	31.1	.	.	.	.	.	4.5	4.5	.	.
306	07/28/86	W	H	24.8	30.5	.	.	.	.	.	4.5	2.0	.	.
307	07/28/86	W	L	23.5	30.3	.	.	.	.	36.70	330.0	330.0	.	.
308	07/29/86	W	L	24.0	30.1	.	.	.	.	.	230.0	230.0	.	.
309	04/06/87	W	L	6.9	24.9	320.0	710.0	270.0	390.0	95.00	540.0	540.0	.	.
310	04/07/87	W	L	6.5	21.4	.	.	.	.	.	1100.0	1100.0	.	.
311	04/08/87	W	L	7.0	[illegible]	.	.	.	.	.	2400.0	2400.0	.	.
312	04/09/87	W	L	7.0	16.3	.	.	.	.	.	2400.0	790.0	.	.
313	05/11/87	D	L	13.7	24.9	.	.	.	.	.	11.0	1.9	.	.
314	05/19/87	D	L	14.3	26.3	.	.	.	.	.	4.0	4.0	.	.
315	06/09/87	W	L	18.4	28.3	.	.	.	.	.	22.0	4.5	.	.
316	06/11/87	D	L	19.0	28.5	.	.	.	.	.	4.5	1.9	.	.

STA=20

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
317	06/23/86	D	L	19.0	29.4	2.0	2.0	.	.	.	.	.	.	.
318	06/24/86	D	L	19.2	30.0	10.0	10.0	.	.	.	.	.	.	.
319	06/25/86	D	L	18.4	29.8	2.0	1.0	.	.	.	.	.	.	.
320	06/25/86	D	L	18.9	28.9	70.0	40.0	.	.	.	.	.	.	.
321	06/26/86	D	H	19.0	29.9	0.0	0.0	.	.	.	.	.	.	.
322	07/21/86	D	L	22.1	30.4	3.0	2.0	14.0	12.0	.	.	.	.	.
323	07/22/86	D	H	21.6	30.5	.	.	.	.	.	4.5	4.5	.	.
324	07/22/86	D	L	24.7	29.8	.	.	.	.	.	7.8	7.8	.	.
325	07/23/86	D	L	23.9	30.3	.	.	.	.	.	2.0	2.0	.	.
326	07/24/86	D	L	23.0	30.8	.	.	.	.	.	2.0	2.0	.	.
327	07/25/86	D	L	22.0	31.2	.	.	.	.	.	0.2	0.2	.	.
328	07/26/86	D	L	21.7	31.3	.	.	.	.	0.50	0.2	0.2	.	.
329	07/27/86	D	L	22.4	31.3	.	.	.	.	.	0.2	0.2	.	.
330	07/28/86	W	H	24.6	30.7	.	.	.	.	.	13.0	4.5	.	.
331	07/28/86	W	L	22.7	31.2	.	.	.	.	3.20	2.0	2.0	.	.
332	07/29/86	W	L	24.5	30.2	.	.	.	.	.	33.0	23.0	.	.
333	04/06/87	W	L	7.5	24.1	260.0	210.0	200.0	81.0	20.00	170.0	170.0	.	.
334	04/07/87	W	L	6.7	22.5	.	.	.	.	.	790.0	790.0	.	.
335	04/08/87	W	L	6.9	15.1	.	.	.	.	.	1400.0	1400.0	.	.
336	04/09/87	W	L	7.0	13.0	.	.	.	.	.	700.0	950.0	.	.
337	05/11/87	D	L	13.2	26.0	.	.	.	.	.	4.5	2.0	.	.
338	05/19/87	D	L	14.2	26.6	.	.	.	.	.	14.0	6.8	.	.
339	06/09/87	W	L	17.5	29.5	.	.	.	.	.	2.0	2.0	.	.
340	06/11/87	D	L	17.5	29.7	.	.	.	.	.	2.0	2.0	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=21

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
341	06/23/86	D	L	18.9	29.4	1.0	1.0	.	.	.	.	.	.	.
342	06/24/86	D	L	18.2	30.1	10.0	10.0	.	.	.	.	.	.	.
343	06/25/86	D	L	18.1	30.0	10.0	10.0	.	.	.	.	.	.	.
344	06/26/86	D	H	17.2	30.5	2.0	0.0	.	.	.	.	.	.	.
345	07/22/86	D	H	21.3	30.5	.	.	.	.	.	4.5	4.5	.	.
346	07/22/86	D	L	23.2	29.9	.	.	.	.	.	4.0	4.0	.	.
347	07/24/86	D	L	22.0	31.1	.	.	.	.	.	2.0	2.0	.	.
348	07/25/86	D	L	22.5	31.2	.	.	.	.	.	0.2	0.2	.	.
349	07/26/86	D	L	22.3	31.2	.	.	.	.	0.50	0.2	0.2	.	.
350	07/27/86	D	L	22.5	31.6	.	.	.	.	.	2.0	2.0	.	.
351	07/28/86	W	L	22.7	31.1	.	.	.	.	3.30	0.2	0.2	.	.
352	07/29/86	W	L	24.6	30.2	.	.	.	.	.	79.0	17.0	.	.
353	04/06/87	W	L	7.2	25.6	340.0	300.0	210.0	111.0	55.00	140.0	280.0	.	.
354	04/08/87	W	L	7.0	15.5	.	.	.	.	.	330.0	300.0	.	.
355	05/11/87	D	L	13.5	25.2	.	.	.	.	.	4.5	2.0	.	.
356	05/19/87	D	L	14.7	26.3	.	.	.	.	.	2.0	2.0	.	.
357	06/09/87	W	L	17.3	29.5	.	.	.	.	.	1.8	1.8	.	.
358	06/11/87	D	L	18.7	29.1	.	.	.	.	.	7.8	7.8	.	.

STA=21B

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
359	07/21/86	D	L	21.6	30.6	5.0	1.0	3.0	8.0	0.10	2.0	0.2	.	.
360	07/23/86	D	L	21.3	31.4	0.1	0.1	1.0	1.0	0.10	0.2	0.2	.	.
361	07/28/86	W	H	22.5	31.3	5.0	3.0	12.0	3.0	0.33	4.5	2.0	.	.
362	07/31/86	W	L	22.4	30.6	42.0	37.0	11.0	2.0	6.60	.	.	.	.
363	11/24/86	D	H	8.6	24.7	11.0	10.0	34.0	12.0	10.00	.	.	.	.
364	02/25/87	D	L	.	.	0.1	0.1	5.0	35.0	5.00	.	.	.	.
365	03/02/87	W	L	2.5	32.5	22.0	10.0	69.0	36.0	25.00	.	.	.	.
366	04/07/87	W	L	6.8	25.2	430.0	380.0	220.0	105.0	65.30	.	.	.	.
367	04/09/87	W	L	6.5	28.3	490.0	420.0	210.0	170.0	5.00	.	.	.	.

STA=21S

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
368	07/21/86	D	L	.	.	.	.	.	.	.	110.0	70.0	32.0	1600001.0
369	07/23/86	D	L	.	.	.	.	.	.	.	45.0	45.0	140.0	1600000.0
370	07/28/86	W	H	.	.	.	.	.	.	.	20.0	19.0	110.0	7800.0
371	07/31/86	W	L	.	.	.	.	.	.	.	78.0	20.0	78.0	46000.0
372	11/17/86	D	L	.	.	.	.	.	.	.	2300.0	230.0	1400.0	79000.0
373	11/24/86	D	H	.	.	.	.	.	.	.	130.0	45.0	790.0	33000.0
374	02/25/87	D	L	.	.	.	.	.	.	.	20.0	18.1	490.0	13000.0
375	03/02/87	W	L	.	.	.	.	.	.	.	20.0	20.0	790.0	23000.0
376	04/07/87	W	L	6.8	25.2	.	.	.	.	.	140.0	140.0	490.0	33000.0
377	04/09/87	W	L	6.5	28.3	.	.	.	.	.	130.0	130.0	280.0	79000.0

MT. HOPE BAY - ALL BAY STATIONS

STA=21SF

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
378	07/21/86	D	L	.	.	.	.	.	.	87.50	17.0	17.0	6.8	240.0
379	07/23/86	D	L	.	.	.	.	.	.	87.50	0.2	0.2	2.0	920.0
380	07/28/86	W	H	.	.	.	.	.	.	50.00	11.0	11.0	4.0	790.0
381	07/31/86	W	L	.	.	.	.	.	.	24.00	230.0	22.0	12.0	230.0
382	11/17/86	D	L	.	.	.	.	.	.	113.00	23.0	23.0	6.8	330.0
383	11/24/86	D	H	.	.	.	.	.	.	100.00	20.1	20.1	20.1	78.0
384	02/25/87	D	L	.	.	.	.	.	.	50.00	2.1	2.1	2.1	49.0
385	03/02/87	W	L	.	.	.	.	.	.	118.30	2.1	2.1	2.1	31.0
386	04/07/87	W	L	6.8	25.2	.	.	.	.	158.00	2.1	2.1	2.1	130.0
387	04/09/87	W	L	6.5	28.3	.	.	.	.	181.00	13.0	13.0	33.0	330.0

STA=21T

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
388	07/21/86	D	L	22.4	30.2	2.0	2.0	13.0	1.0	0.10	4.5	2.0	.	.
389	07/23/86	D	L	22.4	31.0	1.0	1.0	6.0	8.0	0.10	0.2	0.2	.	.
390	07/28/86	W	H	24.0	31.0	12.0	7.0	9.0	1.0	3.30	4.0	0.2	.	.
391	07/31/86	W	L	22.4	30.6	76.0	51.0	9.0	0.1	3.20	.	.	.	.
392	11/17/86	D	L	8.5	24.3	8.0	8.0	20.0	1.1	.	.	.	.	3340.0
393	11/24/86	D	H	8.6	23.1	23.0	15.0	34.0	25.0	15.00	.	.	.	.
394	02/25/87	D	L	1.9	29.0	0.1	0.1	7.0	0.1	20.00	.	.	.	.
395	03/02/87	W	L	3.1	32.5	[illegible]	28.0	150.0	102.0	40.00	.	.	.	.
396	04/07/87	W	L	6.8	22.8	390.0	360.0	240.0	101.0	50.00	220.0	330.0	.	.
397	04/09/87	W	L	7.0	14.5	111.0	96.0	260.0	15.0	150.00	430.0	430.0	.	.

STA=22

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
398	06/23/86	D	L	18.3	29.1	3.0	3.0	.	.	.	.	.	.	.
399	06/24/86	D	L	18.6	30.1	3.0	3.0	.	.	.	.	.	.	.
400	06/25/86	D	L	17.3	30.3	1.0	1.0	.	.	.	.	.	.	.
401	06/26/86	D	H	17.3	30.4	0.0	0.0	.	.	.	.	.	.	.
402	07/21/86	D	L	20.6	30.8	7.0	5.0	12.0	22.0	.	13.0	13.0	.	.
403	07/22/86	D	H	20.8	30.7	.	.	.	.	.	13.0	7.8	.	.
404	07/22/86	D	L	23.0	30.1	.	.	.	.	.	4.5	4.5	.	.
405	07/23/86	D	L	.	.	2.0	0.1	8.0	7.0	.	2.0	2.0	.	.
406	07/24/86	D	L	22.2	30.0	0.1	0.1	11.0	1.0	.	0.2	0.2	.	.
407	07/25/86	D	L	21.3	31.5	.	.	.	.	.	0.2	0.2	.	.
408	07/26/86	D	L	22.5	31.0	.	.	.	.	0.50	0.2	0.2	.	.
409	07/27/86	D	L	23.3	30.9	.	.	.	.	.	0.2	0.2	.	.
410	07/28/86	W	H	26.2	30.6	.	.	.	.	.	0.2	0.2	.	.
411	07/28/86	W	L	23.9	30.4	13.0	8.0	14.0	3.0	3.20	7.8	4.5	.	.
412	07/29/86	W	L	24.5	30.0	.	.	.	.	.	23.0	13.0	.	.
413	04/06/87	W	L	7.7	24.1	200.0	160.0	290.0	108.0	10.00	350.0	350.0	.	.
414	04/07/87	W	L	6.7	23.5	.	.	.	.	.	220.0	330.0	.	.
415	04/08/87	W	L	7.1	15.6	.	.	.	.	.	790.0	790.0	.	.
416	04/09/87	W	L	7.3	27.6	.	.	.	.	.	230.0	230.0	.	.
417	05/11/87	D	L	13.7	19.7	.	.	.	.	.	49.0	49.0	.	.
418	05/19/87	D	L	14.5	25.8	.	.	.	.	.	9.3	9.3	.	.
419	06/09/87	W	L	17.1	29.5	.	.	.	.	.	2.0	2.0	.	.

STA=22
(continued)

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
420	06/11/87	D	L	18.4	29.0	.	.	.	.	.	1.8	1.9	.	.

STA=23

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
421	06/23/86	D	L	17.6	30.1	1.0	1.0	.	.	.	.	.	.	.
422	06/24/86	D	L	19.0	29.6	0.0	0.0	.	.	.	.	.	.	.
423	06/25/86	D	L	17.2	30.8	1.0	1.0	.	.	.	.	.	.	.
424	06/25/86	D	H	18.0	29.3	0.0	0.0	.	.	.	.	.	.	.
425	07/21/86	D	L	21.0	30.6	.	.	.	.	.	9.3	9.3	.	.
426	07/22/86	D	H	21.8	30.3	.	.	.	.	.	11.0	7.8	.	.
427	07/22/86	D	L	23.3	30.1	.	.	.	.	.	4.5	4.5	.	.
428	07/23/86	D	L	23.7	30.2	.	.	.	.	.	2.0	0.2	.	.
429	07/24/86	D	L	24.0	29.7	.	.	.	.	.	0.2	0.2	.	.
430	07/25/86	D	L	22.6	31.0	.	.	.	.	.	4.5	4.5	.	.
431	07/26/86	D	L	22.8	30.6	.	.	.	.	0.50	13.0	7.8	.	.
432	07/27/86	D	L	24.0	30.7	.	.	.	.	.	0.2	0.2	.	.
433	07/28/86	W	H	25.0	30.4	.	.	.	.	.	33.0	17.0	.	.
434	07/28/86	W	L	23.5	30.5	.	.	.	.	3.20	11.0	6.8	.	.
435	07/29/86	W	L	24.3	30.1	.	.	.	.	.	17.0	17.0	.	.
436	04/06/87	W	L	7.0	24.1	230.0	220.0	210.0	93.0	20.00	240.0	240.0	.	.
437	04/07/87	W	L	7.3	22.9	.	.	.	.	.	110.0	220.0	.	.
438	04/08/87	W	L	7.2	18.6	.	.	.	.	.	790.0	790.0	.	.
439	04/09/87	W	L	7.7	16.0	.	.	.	.	.	790.0	1300.0	.	.
440	05/11/87	D	L	13.5	21.8	.	.	.	.	.	170.0	33.0	.	.
441	05/19/87	D	L	14.5	26.1	.	.	.	.	.	4.5	2.0	.	.
442	06/09/87	W	L	17.3	29.5	.	.	.	.	.	11.0	6.8	.	.
443	06/11/87	D	L	18.3	29.3	.	.	.	.	.	4.0	4.0	.	.

STA=24

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
444	06/23/86	D	L	18.7	29.0	1.0	0.0	.	.	.	.	.	.	.
445	06/24/86	D	L	18.9	29.6	4.0	4.0	.	.	.	.	.	.	.
446	06/25/86	D	L	18.8	29.6	0.0	0.0	.	.	.	.	.	.	.
447	06/26/86	D	H	18.4	29.9	0.0	0.0	.	.	.	.	.	.	.
448	07/21/86	D	L	21.3	30.4	9.0	9.0	13.0	3.0	.	7.8	7.8	.	.
449	07/22/86	D	H	21.3	30.3	.	.	.	.	.	17.0	7.8	.	.
450	07/22/86	D	L	23.1	29.9	.	.	.	.	.	27.0	14.0	.	.
451	07/23/86	D	L	23.7	29.8	0.1	0.1	12.0	2.0	.	0.2	0.2	.	.
452	07/24/86	D	L	22.9	31.0	1.0	1.0	8.0	18.0	.	0.2	0.2	.	.
453	07/25/86	D	L	22.9	31.2	.	.	.	.	.	2.0	0.2	.	.
454	07/26/86	D	L	23.0	30.3	.	.	.	.	0.50	7.8	7.8	.	.
455	07/27/86	D	L	24.2	30.4	.	.	.	.	.	2.0	0.2	.	.
456	07/28/86	W	H	24.6	30.4	.	.	.	.	.	2.0	0.2	.	.
457	07/28/86	W	L	25.0	30.1	51.0	28.0	18.0	6.0	3.20	170.0	68.0	.	.
458	07/29/86	W	L	24.8	29.9	.	.	.	.	.	33.0	23.0	.	.
459	04/06/87	W	L	7.6	24.1	300.0	270.0	180.0	300.0	45.00	1400.0	950.0	.	.
460	04/07/87	W	L	6.8	21.5	.	.	.	.	.	490.0	490.0	.	.

STA=24
(continued)

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
461	04/08/87	W	L	7.0	14.6	.	.	.	.	.	1400.0	1100.0	.	.
462	04/09/87	W	L	7.5	14.4	.	.	.	.	.	490.0	330.0	.	.
463	05/11/87	D	L	13.8	20.8	.	.	.	.	.	79.0	27.0	.	.
464	05/19/87	D	L	14.5	25.7	.	.	.	.	.	7.8	2.0	.	.
465	06/09/87	W	L	18.0	29.1	.	.	.	.	.	2.0	2.0	.	.
466	06/11/87	D	L	18.4	28.9	.	.	.	.	.	2.0	2.0	.	.

STA=25

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
467	06/23/86	D	L	19.3	28.7	7.0	4.0	.	.	.	.	.	.	.
468	06/24/86	D	L	19.5	29.1	4.0	4.0	.	.	.	.	.	.	.
469	06/25/86	D	L	19.0	29.0	2.0	2.0	.	.	.	.	.	.	.
470	06/26/86	D	H	17.9	29.9	3.0	3.0	.	.	.	.	.	.	.
471	07/21/86	D	L	22.3	29.6	.	.	.	.	.	7.8	7.8	.	.
472	07/22/86	D	H	21.4	30.5	.	.	.	.	.	6.8	2.0	.	.
473	07/22/86	D	L	23.8	29.5	.	.	.	.	0.13	7.8	.	.	850.0
474	07/23/86	D	L	24.1	29.8	.	.	.	.	.	0.2	0.2	.	.
475	07/24/86	D	L	23.8	29.9	.	.	.	.	.	0.2	0.2	.	.
476	07/25/86	D	L	23.5	30.7	.	.	.	.	.	4.5	2.0	.	.
477	07/26/86	D	L	24.0	30.1	.	.	.	.	0.50	0.2	0.2	.	.
478	07/27/86	D	L	24.6	30.3	.	.	.	.	.	2.0	2.0	.	.
479	07/28/86	W	H	25.8	29.7	.	.	.	.	.	270.0	790.0	.	.
480	07/28/86	W	L	24.7	29.8	.	.	.	.	3.30	46.0	17.0	.	.
481	07/29/86	W	L	24.8	29.9	.	.	.	.	.	33.0	11.0	.	.
482	04/06/87	W	L	8.3	23.8	280.0	270.0	260.0	113.0	25.30	920.0	920.0	.	.
483	04/07/87	W	L	7.4	22.8	.	.	.	.	.	130.0	130.0	.	.
484	04/08/87	W	L	7.4	18.0	.	.	.	.	.	460.0	460.0	.	.
485	04/08/87	W	L	7.6	19.5	.	.	.	.	.	700.0	490.0	.	.
486	04/09/87	W	L	7.8	17.7	.	.	.	.	.	790.0	1400.0	.	.
487	05/11/87	D	L	13.7	20.7	.	.	.	.	.	540.0	49.0	.	.
488	05/19/87	D	L	14.6	25.5	.	.	.	.	.	7.8	4.5	.	.
489	06/09/87	W	L	18.3	28.6	.	.	.	.	.	14.0	14.0	.	.
490	06/11/87	D	L	19.1	28.1	.	.	.	.	.	13.0	7.8	.	.

STA=26

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
491	06/23/86	D	L	19.6	28.7	5.0	4.0	.	.	.	.	.	.	.
492	06/24/86	D	L	19.6	29.0	2.0	2.0	.	.	.	.	.	.	.
493	06/25/86	D	L	18.8	29.2	4.0	4.0	.	.	.	.	.	.	.
494	06/26/86	D	H	18.7	29.3	10.0	10.0	.	.	.	.	.	.	.
495	07/22/86	D	H	22.7	29.9	.	.	.	.	.	7.8	4.5	.	.
496	07/24/86	D	L	23.8	29.9	1.0	1.0	8.0	1.0	.	4.5	2.0	.	.
497	07/25/86	D	L	24.3	30.4	.	.	.	.	.	0.2	0.2	.	.
498	07/26/86	D	L	24.0	30.4	.	.	.	.	0.50	4.5	2.0	.	.
499	07/27/86	D	L	24.5	30.0	.	.	.	.	.	0.2	0.2	.	.
500	07/28/86	W	L	24.7	29.9	120.0	43.0	9.0	7.0	3.20	110.0	7.8	.	.
501	07/29/86	W	L	24.8	29.7	.	.	.	.	.	49.0	27.0	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=26 (continued)

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
502	04/06/87	W	L	8.3	23.5	370.0	340.0	320.0	105.0	40.00	140.0	140.0	.	.
503	04/06/87	W	L	7.3	24.9	129.0	122.0	160.0	75.0	5.00	.	.	.	.
504	04/08/87	W	L	7.5	17.6	.	.	.	.	.	330.0	330.0	.	.
505	05/11/87	D	L	14.1	19.1	.	.	.	.	.	220.0	95.0	.	.
506	05/19/87	D	L	14.7	25.3	.	.	.	.	.	1.8	1.8	.	.
507	06/09/87	W	L	18.7	28.5	.	.	.	.	.	4.5	4.5	.	.
508	06/11/87	D	L	18.9	28.3	.	.	.	.	.	13.0	7.8	.	.

STA=26B

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
509	07/21/86	D	L	21.9	29.5	22.0	11.0	11.0	10.0	0.10	2.0	0.2	.	.
510	07/23/86	D	L	23.5	30.1	6.0	5.0	8.0	4.0	18.00	11.0	4.5	.	.
511	07/28/86	W	H	22.0	31.6	3.0	3.0	6.0	0.1	3.30	7.8	4.5	.	.
512	07/31/86	W	L	23.2	30.0	210.0	190.0	13.0	5.0	16.70	.	.	.	.
513	11/24/86	D	H	8.5	28.9	30.0	27.0	34.0	34.0	140.00	.	.	.	.
514	02/25/87	D	L	2.0	31.3	8.0	4.0	5.0	13.0	5.10	.	.	.	.
515	03/02/87	W	H	2.3	33.1	3.0	2.0	28.0	11.0	5.10	.	.	.	.
516	04/07/87	W	L	5.9	31.6	114.0	105.0	160.0	31.0	5.10	.	.	.	.
517	04/09/87	W	L	7.4	28.2	59.0	50.0	120.0	15.0	5.10	.	.	.	.

STA=26S

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
518	07/21/86	D	L	.	.	.	.	.	.	.	0.2	0.2	0.2	1600000.1
519	07/23/86	D	L	.	.	.	.	.	.	.	20.0	19.0	45.0	350000.0
520	07/28/86	W	H	.	.	.	.	.	.	.	19.0	19.0	110.0	130000.0
521	07/31/86	W	L	.	.	.	.	.	.	.	170.0	170.0	.	79000.0
522	11/17/86	D	L	.	.	.	.	.	.	.	45.0	78.0	700.0	130000.0
523	11/24/86	D	H	.	.	.	.	.	.	.	68.0	20.0	3300.0	13000.0
524	02/25/87	D	L	.	.	.	.	.	.	.	45.0	45.0	4600.0	330000.0
525	03/02/87	W	H	.	.	.	.	.	.	.	68.0	93.0	4900.0	170000.0
526	04/07/87	W	L	5.9	31.6	.	.	.	.	.	170.0	110.0	490.0	110000.0
527	04/09/87	W	L	7.4	28.4	.	.	.	.	.	79.0	130.0	110.0	130000.0

STA=26SP

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
528	07/21/86	D	L	.	.	.	.	.	.	100.00	6.8	6.8	11.0	350.0
529	07/23/86	D	L	.	.	.	.	.	.	12.50	5.8	11.0	2.0	350.0
530	07/28/86	W	H	.	.	.	.	.	.	0.50	0.2	0.2	4.0	230.0
531	07/31/86	W	L	.	.	.	.	.	.	24.00	1.8	0.2	2.0	170.0
532	11/17/86	D	L	.	.	.	.	.	.	258.00	2.0	2.0	120.0	170.0
533	11/24/86	D	H	.	.	.	.	.	.	875.00	7.0	7.0	17.0	33.0
534	02/25/87	D	L	.	.	.	.	.	.	50.00	2.1	2.1	2.1	79.0
535	03/02/87	W	H	.	.	.	.	.	.	331.30	2.1	2.1	1.8	22.0
536	04/07/87	W	L	5.9	31.6	.	.	.	.	285.00	4.5	4.5	2.1	33.0

MT. HOPE BAY - ALL BAY STATIONS

----- STA=26SP -----
(continued)

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
537	04/09/87	W	L	7.4	28.2	.	.	.	.	145.00	2.0	2.0	2.1	23.0

----- STA=26T -----

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
538	07/21/86	D	L	23.6	29.7	9.0	4.0	10.0	1.0	0.10	13.0	13.0	.	.
539	07/23/86	D	L	24.0	29.8	3.0	2.0	7.0	16.0	0.10	4.0	4.0	.	.
540	07/28/86	W	H	26.0	30.2	44.0	37.0	19.0	0.1	3.30	49.0	23.0	.	.
541	07/31/86	W	L	23.3	29.8	200.0	170.0	13.0	2.0	9.90	.	.	.	.
542	11/17/86	D	L	8.5	22.2	13.0	10.0	10.0	2.0	5.10	.	.	.	.
543	11/24/86	D	H	9.2	27.2	50.0	50.0	54.0	73.0	20.00	.	.	.	3320.0
544	02/25/87	D	L	2.3	31.3	50.0	50.0	4.0	11.0	5.00	.	.	.	.
545	03/02/87	W	H	2.8	30.3	12.0	6.0	60.0	40.0	5.10	.	.	.	.
546	04/07/87	W	L	7.6	23.2	71.0	63.0	160.0	48.0	30.00	70.0	70.0	.	.
547	04/09/87	W	L	7.7	14.4	460.0	400.0	290.0	150.0	155.00	330.0	330.0	.	.

----- STA=27 -----

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
548	06/23/86	D	L	19.4	28.7	18.0	15.0	.	.	.	.	.	.	.
549	06/24/86	D	L	19.3	29.0	41.0	32.0	.	.	.	.	.	.	.
550	06/25/86	D	L	19.3	28.9	17.0	15.0	.	.	.	.	.	.	.
551	06/26/86	D	H	19.6	29.2	0.0	0.0	.	.	.	.	.	.	.
552	07/21/86	D	L	22.4	29.7	7.0	0.1	10.0	0.1	.	7.8	7.8	.	.
553	07/22/86	D	H	.	.	.	.	.	.	.	7.8	4.5	.	.
554	07/22/86	D	L	23.5	29.3	.	.	.	.	.	22.0	6.8	.	.
555	07/23/86	D	L	24.7	[illegible]	7.0	7.0	9.0	45.0	.	13.0	7.8	.	.
556	07/24/86	D	L	24.0	29.3	5.0	4.0	14.0	1.0	.	3.7	3.7	.	.
557	07/25/86	D	L	24.0	30.0	.	.	.	.	.	33.0	11.0	.	.
558	07/26/86	D	L	24.0	30.1	.	.	.	.	0.50	23.0	4.5	.	.
559	07/27/86	D	L	24.7	30.3	.	.	.	.	.	4.5	4.5	.	.
560	07/28/86	W	H	25.1	29.7	.	.	.	.	.	130.0	130.0	.	.
561	07/28/86	W	L	25.1	29.6	1450.0	250.0	26.0	33.0	26.70	490.0	330.0	.	.
562	07/29/86	W	L	24.6	29.5	.	.	.	.	.	170.0	78.0	.	.
563	04/06/87	W	L	7.7	23.7	360.0	310.0	110.0	190.0	60.00	310.0	460.0	.	.
564	04/07/87	W	L	7.1	23.0	.	.	.	.	.	700.0	490.0	.	.
565	04/09/87	W	L	7.7	12.8	.	.	.	.	.	490.0	490.0	.	.
566	05/11/87	D	L	14.0	17.8	.	.	.	.	.	79.0	33.0	.	.
567	05/19/87	D	L	14.4	25.6	.	.	.	.	.	11.0	11.0	.	.
568	06/09/87	W	L	18.3	27.2	.	.	.	.	.	7.8	7.8	.	.
569	06/11/87	D	L	19.1	27.8	.	.	.	.	.	23.0	13.0	.	.

MT. HOPE BAY - ALL BAY STATIONS

-- STA=28 --

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
570	06/23/86	D	L	19.9	28.5	44.0	37.0	.	.	.	.	.	.	.
571	06/24/86	D	L	19.8	28.8	48.0	46.0	.	.	.	.	.	.	.
572	06/25/86	D	L	19.1	29.2	0.0	0.0	.	.	.	.	.	.	.
573	06/26/86	D	H	19.7	28.6	100.0	100.0	.	.	.	.	.	.	.
574	04/06/87	W	L	7.9	23.5	260.0	250.0	160.0	240.0	75.00	130.0	130.0	.	.
575	04/07/87	W	L	6.9	22.9	.	.	.	.	.	490.0	490.0	.	.
576	04/08/87	W	L	7.5	20.2	.	.	.	.	.	230.0	170.0	.	.
577	04/09/87	W	L	8.2	16.6	.	.	.	.	.	330.0	330.0	.	.
578	05/11/87	D	L	14.3	16.5	.	.	.	.	.	130.0	79.0	.	.
579	05/19/87	D	L	13.9	25.3	.	.	.	.	.	14.0	11.0	.	.
580	06/09/87	W	L	19.1	28.4	.	.	.	.	.	7.8	7.8	.	.
581	06/11/87	D	L	19.3	27.8	.	.	.	.	.	26.0	11.0	.	.

-- STA=29 --

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
582	06/23/86	D	L	20.0	28.4	74.0	61.0	.	.	.	.	.	.	.
583	06/24/86	D	L	20.4	28.7	9.0	8.0	.	.	.	.	.	.	.
584	06/25/86	D	L	19.1	28.3	10.0	5.0	.	.	.	.	.	.	.
585	06/26/86	D	H	19.7	28.7	90.0	50.0	.	.	.	.	.	.	.
586	07/21/86	D	L	22.5	29.0	11.0	6.0	11.0	34.0	.	.	.	.	.
587	07/23/86	D	L	24.7	29.6	1.0	1.0	8.0	3.0	.	.	.	.	.
588	07/24/86	D	L	24.6	29.7	0.1	0.1	11.0	2.0	.	.	.	.	.
589	07/28/86	W	L	25.0	29.6	28.0	16.0	8.0	12.0	3.20	.	.	.	.
590	04/06/87	W	L	7.6	23.6	390.0	230.0	140.0	220.0	55.00	.	.	.	.

-- STA=30 --

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
591	06/23/86	D	L	21.4	28.7	84.0	51.0	.	.	.	.	.	.	.
592	06/24/86	D	L	21.5	28.8	56.0	41.0	.	.	.	.	.	.	.
593	06/25/86	D	L	20.8	28.3	38.0	36.0	.	.	.	.	.	.	.
594	06/26/86	D	H	20.1	28.3	70.0	70.0	.	.	.	.	.	.	.
595	07/21/86	D	L	21.7	29.2	160.0	30.0	26.0	5.0	.	.	.	.	.
596	07/23/86	D	L	24.7	29.6	31.0	12.0	11.0	29.0	.	.	.	.	.
597	07/24/86	D	L	26.8	29.7	5.0	4.0	14.0	2.0	.	.	.	.	.
598	07/28/86	W	L	24.2	28.8	490.0	290.0	26.0	42.0	13.30	.	.	.	.
599	04/06/87	W	L	6.7	25.4	340.0	300.0	190.0	280.0	50.00	.	.	.	.

-- STA=31 --

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
600	06/23/86	D	L	21.1	28.7	30.0	26.0	.	.	.	.	.	.	.
601	06/24/86	D	L	19.8	28.7	74.0	66.0	.	.	.	.	.	.	.
602	06/25/86	D	L	19.3	28.4	170.0	170.0	.	.	.	.	.	.	.
603	06/26/86	D	H	20.1	28.3	190.0	190.0	.	.	.	.	.	.	.
604	07/21/86	D	L	22.7	29.6	47.0	32.0	12.0	79.0	.	.	.	.	.
605	07/23/86	D	L	23.8	29.3	100.0	80.0	27.0	12.0	.	.	.	.	.

---------- STA=31 ----------
(continued)

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
606	07/24/86	D	L	25.2	29.8	7.0	6.0	11.0	2.0	.	.	.	.	.
607	07/28/86	W	L	24.2	28.9	640.0	250.0	33.0	39.0	26.70	.	.	.	.
608	04/06/87	W	L	6.8	23.9	270.0	230.0	190.0	340.0	45.00	.	.	.	.

---------- STA=32 ----------

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
609	06/23/86	D	L	20.4	28.7	37.0	30.0	.	.	.	.	.	.	.
610	06/25/86	D	L	19.6	28.9	21.0	17.0	.	.	.	.	.	.	.
611	06/26/86	D	H	19.6	28.9	190.0	150.0	.	.	.	.	.	.	.
612	07/21/86	D	L	22.9	29.5	8.0	8.0	17.0	19.0	.	5.8	6.8	.	.
613	07/22/86	D	H	21.6	29.1	.	.	.	.	.	130.0	130.0	.	.
614	07/22/86	D	L	23.4	29.4	.	.	.	.	.	350.0	40.0	.	.
615	07/23/86	D	L	24.3	29.3	9.0	9.0	16.0	4.0	.	33.0	11.0	.	.
616	07/24/86	D	L	25.7	30.0	6.0	6.0	17.0	8.0	.	0.2	0.2	.	.
617	07/25/86	D	L	24.4	30.1	.	.	.	.	.	95.0	23.0	.	.
618	07/26/86	D	L	24.4	30.1	.	.	.	.	0.50	23.0	13.0	.	.
619	07/27/86	D	L	25.3	30.0	.	.	.	.	.	22.0	7.8	.	.
620	07/28/86	W	H	26.0	29.7	.	.	.	.	.	130.0	20.0	.	.
621	07/28/86	W	L	25.2	29.5	530.0	340.0	26.0	34.0	16.70	700.0	330.0	.	.
622	07/29/86	W	L	24.2	29.5	.	.	.	.	.	49.0	14.0	.	.
623	04/06/87	W	L	7.4	23.4	430.0	320.0	110.0	380.0	70.00	230.0	350.0	.	.
624	04/07/87	W	L	7.0	22.2	.	.	.	.	.	130.0	79.0	.	.
625	04/08/87	W	L	8.0	19.1	.	.	.	.	.	170.0	330.0	.	.
626	04/09/87	W	L	8.0	14.7	.	.	.	.	.	790.0	790.0	.	.
627	05/11/87	D	L	14.0	19.1	.	.	.	.	.	170.0	79.0	.	.
628	05/19/87	D	L	14.3	25.5	.	.	.	.	.	13.0	7.8	.	.
629	06/09/87	W	L	19.3	28.3	.	.	.	.	.	7.8	7.8	.	.
630	06/11/87	D	L	19.6	27.6	.	.	.	.	.	7.8	4.5	.	.

---------- STA=33 ----------

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
631	06/23/86	D	L	19.0	28.9	10.0	6.0	.	.	.	.	.	.	.
632	06/24/86	D	L	19.3	29.0	43.0	36.0	.	.	.	.	.	.	.
633	06/25/86	D	L	19.2	28.8	74.0	68.0	.	.	.	.	.	.	.
634	06/26/86	D	H	19.3	28.9	220.0	220.0	.	.	.	.	.	.	.
635	07/21/86	D	L	22.6	29.5	2.0	2.0	17.0	111.0	.	.	.	.	.
636	07/23/86	D	L	23.9	29.3	22.0	13.0	11.0	34.0	.	.	.	.	.
637	07/24/86	D	L	24.2	29.9	2.0	2.0	14.0	1.0	.	.	.	.	.
638	07/28/86	W	L	24.8	29.3	3500.0	3150.0	34.0	57.0	56.00	.	.	.	.
639	04/06/87	W	L	7.2	23.9	430.0	320.0	130.0	190.0	25.00	540.0	220.0	.	.
640	04/07/87	W	L	7.0	22.6	.	.	.	.	.	490.0	490.0	.	.
641	04/08/87	W	L	7.4	18.4	.	.	.	.	.	790.0	790.0	.	.
642	04/09/87	W	L	7.7	10.6	.	.	.	.	.	2400.0	2400.0	.	.
643	05/11/87	D	L	14.5	19.7	.	.	.	.	.	920.0	350.0	.	.
644	05/19/87	D	L	14.1	24.7	.	.	.	.	.	140.0	95.0	.	.
645	06/09/87	W	L	18.9	28.5	.	.	.	.	.	4.5	4.5	.	.
646	06/11/87	D	L	19.6	28.0	.	.	.	.	.	17.0	6.8	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=34

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
647	06/23/86	D	L	19.4	28.4	150.0	110.0	.	.	.	.	.	.	.
648	06/24/86	D	L	19.9	28.8	37.0	32.0	.	.	.	.	.	.	.
649	06/25/86	D	L	19.7	28.8	45.0	40.0	.	.	.	.	.	.	.
650	06/26/86	D	H	20.0	28.7	34.0	26.0	.	.	.	.	.	.	.
651	07/21/86	D	L	22.3	29.6	270.0	220.0	15.0	36.0	.	540.0	350.0	.	.
652	07/22/86	D	H	21.7	30.1	.	.	.	.	.	49.0	23.0	.	.
653	07/22/86	D	L	23.8	29.2	.	.	.	.	.	230.0	79.0	.	.
654	07/23/86	D	L	24.4	29.7	57.0	42.0	11.0	3.0	.	79.0	79.0	.	.
655	07/24/86	D	L	24.9	29.6	7.0	7.0	13.0	1.0	.	13.0	7.8	.	.
656	07/25/86	D	L	24.7	29.8	.	.	.	.	.	49.0	49.0	.	.
657	07/26/86	D	L	24.9	30.1	.	.	.	.	0.50	13.0	4.5	.	.
658	07/27/86	D	L	25.7	30.0	.	.	.	.	.	170.0	110.0	.	.
659	07/28/86	W	H	26.3	30.2	.	.	.	.	.	78.0	45.0	.	.
660	07/28/86	W	L	24.0	29.5	1620.0	960.0	40.0	47.0	16.70	1700.0	1100.0	.	.
661	07/29/86	W	L	24.8	29.2	.	.	.	.	.	220.0	58.0	.	.
662	04/06/87	W	L	6.7	24.2	460.0	350.0	210.0	410.0	60.00	920.0	540.0	.	.
663	04/07/87	W	L	7.0	22.0	.	.	.	.	.	790.0	790.0	.	.
664	04/08/87	W	L	8.0	18.4	.	.	.	.	.	1700.0	1700.0	.	.
665	04/09/87	W	L	7.6	8.5	.	.	.	.	.	280.0	280.0	.	.
666	05/19/87	D	L	13.5	25.6	.	.	.	.	.	130.0	27.0	.	.
667	06/09/87	W	L	20.5	28.4	.	.	.	.	.	22.0	22.0	.	.
668	06/11/87	D	L	19.6	28.1	.	.	.	.	.	33.0	17.0	.	.

STA=35

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
669	06/23/86	D	L	18.9	28.9	15.0	15.0	.	.	.	.	.	.	.
670	06/24/86	D	L	19.2	29.0	50.0	34.0	.	.	.	.	.	.	.
671	06/25/86	D	L	18.7	29.4	5.0	4.0	.	.	.	.	.	.	.
672	06/26/86	D	H	18.2	29.8	6.0	1.0	.	.	.	.	.	.	.
673	07/21/86	D	L	21.2	30.0	18.0	13.0	21.0	53.0	.	.	.	.	.
674	07/23/86	D	L	23.6	29.8	25.0	19.0	20.0	52.0	.	.	.	.	.
675	07/24/86	D	L	25.1	29.8	4.0	4.0	10.0	30.0	.	7.8	0.2	.	.
676	07/28/86	W	L	24.8	24.8	29.5	133.0	730.0	29.0	45.00	13.0	.	.	.
677	04/06/87	W	L	7.5	24.6	390.0	350.0	250.0	290.0	80.00	460.0	460.0	.	.
678	04/08/87	W	L	7.5	18.0	.	.	.	.	.	1300.0	1300.0	.	.
679	04/09/87	W	L	7.5	12.5	.	.	.	.	.	490.0	170.0	.	.
680	05/11/87	D	L	14.2	22.1	.	.	.	.	.	350.0	350.0	.	.
681	05/19/87	D	L	14.1	24.9	.	.	.	.	.	130.0	79.0	.	.
682	06/09/87	W	L	18.5	28.5	.	.	.	.	.	6.8	2.0	.	.
683	06/11/87	D	L	19.2	28.3	.	.	.	.	.	79.0	22.0	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=36

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
684	06/23/86	D	L	19.1	28.8	30.0	20.0	.	.	.	.	.	.	.
685	06/24/86	D	L	19.5	29.4	35.0	26.0	.	.	.	.	.	.	.
686	06/25/86	D	L	19.1	29.2	110.0	100.0	.	.	.	.	.	.	.
687	06/26/86	D	H	19.2	29.8	2.0	2.0	.	.	.	.	.	.	.
688	04/06/87	W	L	6.8	24.8	390.0	260.0	170.0	240.0	65.00	.	.	.	.

STA=37

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
689	06/23/86	D	L	18.6	29.1	9.0	8.0	.	.	.	.	.	.	.
690	06/24/86	D	L	19.0	29.3	44.0	31.0	.	.	.	.	.	.	.
691	06/24/86	D	L	19.8	29.0	46.0	35.0	.	.	.	.	.	.	.
692	06/25/86	D	L	19.1	29.3	4.0	4.0	.	.	.	.	.	.	.
693	06/26/86	D	H	18.3	29.5	7.0	6.0	.	.	.	.	.	.	.
694	07/21/86	D	L	21.9	30.0	5.0	5.0	22.0	32.0	.	2.0	2.0	.	.
695	07/22/86	D	H	21.8	30.2	.	.	.	.	.	4.5	0.2	.	.
696	07/22/86	D	L	23.3	29.6	.	.	.	.	.	7.3	2.0	.	.
697	07/23/86	D	L	24.7	30.0	0.1	0.1	11.0	1.0	.	2.0	2.0	.	.
698	07/24/86	D	L	24.0	30.1	1.0	1.0	11.0	1.0	.	0.2	0.2	.	.
699	07/25/86	D	L	23.5	30.8	.	.	.	.	.	0.2	0.2	.	.
700	07/26/86	D	L	23.6	30.1	.	.	.	.	0.50	4.5	4.5	.	.
701	07/27/86	D	L	23.9	30.4	.	.	.	.	.	4.5	4.5	.	.
702	07/28/86	W	H	25.7	30.3	.	.	.	.	.	110.0	78.0	.	.
703	07/28/86	W	L	24.9	29.9	100.0	40.0	13.0	2.0	3.20	20.0	20.0	.	.
704	07/29/86	W	L	24.8	29.8	.	.	.	.	.	33.0	33.0	.	.
705	04/06/87	W	L	7.9	24.4	570.0	480.0	320.0	43.0	75.00	700.0	460.0	.	.
706	04/07/87	W	L	6.8	21.7	.	.	.	.	.	310.0	310.0	.	.
707	04/08/87	W	L	7.3	17.2	.	.	.	.	.	490.0	490.0	.	.
708	04/09/87	W	L	7.4	14.2	.	.	.	.	.	1300.0	1300.0	.	.
709	05/11/87	D	L	13.3	19.6	.	.	.	.	.	49.0	33.0	.	.
710	05/19/87	D	L	14.3	25.8	.	.	.	.	.	23.0	23.0	.	.
711	06/09/87	W	L	18.3	28.4	.	.	.	.	.	33.0	6.8	.	.
712	06/11/87	D	L	19.0	28.4	.	.	.	.	.	7.3	2.0	.	.

STA=38

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
713	06/26/86	D	H	26.3	26.9	11.0	7.0	.	.	.	.	.	.	.
714	04/06/87	W	L	9.8	18.9	90.0	81.0	34.0	54.0	10.00	.	.	.	.

MT. HOPE BAY - ALL BAY STATIONS

-- STA=39 --

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	MB	PHA	BC	BCMUG	AD	IMM
715	07/21/86	D	L	21.7	30.0	470.0	350.0	24.0	18.0	.	17.0	17.0	.	.
716	07/22/86	D	H	21.4	29.8	.	.	.	.	.	6.8	4.0	.	.
717	07/22/86	D	L	23.4	29.0	.	.	.	.	.	11.0	2.0	.	.
718	07/23/86	D	L	24.5	30.0	0.1	0.1	14.0	2.0	.	0.2	0.2	.	.
719	07/24/86	D	L	24.1	29.5	7.0	6.0	18.0	3.0	.	22.0	4.0	.	.
720	07/25/86	D	L	23.8	30.6	.	.	.	.	.	4.5	4.5	.	.
721	07/26/86	D	L	23.6	30.4	.	.	.	.	0.50	2.0	0.2	.	.
722	07/27/86	D	L	24.2	30.4	.	.	.	.	.	7.8	7.8	.	.
723	07/28/86	W	H	25.4	29.8	.	.	.	.	.	170.0	130.0	.	.
724	07/28/86	W	L	24.5	30.1	95.0	36.0	22.0	4.0	3.30	79.0	49.0	.	.
725	07/29/86	W	L	24.8	29.6	.	.	.	.	.	170.0	68.0	.	.
726	04/06/87	W	L	7.9	23.8	350.0	250.0	180.0	240.0	45.00	220.0	540.0	.	.
727	04/07/87	W	L	7.6	21.4	.	.	.	.	.	130.0	130.0	.	.
728	04/08/87	W	L	7.5	17.8	.	.	.	.	.	490.0	330.0	.	.
729	04/09/87	W	L	7.7	13.0	.	.	.	.	.	1300.0	1300.0	.	.
730	05/11/87	D	L	13.5	21.4	.	.	.	.	.	130.0	33.0	.	.
731	05/19/87	D	L	14.6	25.5	.	.	.	.	.	7.8	7.8	.	.
732	06/09/87	W	L	18.7	28.7	.	.	.	.	.	7.8	4.5	.	.
733	06/11/87	D	L	19.0	28.1	.	.	.	.	.	7.8	4.5	.	.

-- STA=40 --

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	MB	PHA	BC	BCMUG	AD	IMM
734	07/21/86	D	L	22.6	29.5	.	.	.	.	.	21.0	14.0	.	.
735	07/22/86	D	H	22.7	29.7	.	.	.	.	.	2.0	0.2	.	.
736	07/22/86	D	L	25.0	29.5	.	.	.	.	.	7.8	7.8	.	.
737	07/23/86	D	L	24.1	29.3	.	.	.	.	.	2.0	2.0	.	.
738	07/24/86	D	L	23.9	29.9	.	.	.	.	.	2.0	2.0	.	.
739	07/25/86	D	L	24.3	30.1	.	.	.	.	.	0.2	0.2	.	.
740	07/26/86	D	L	24.1	30.2	.	.	.	.	0.50	4.5	2.0	.	.
741	07/27/86	D	L	24.5	30.6	.	.	.	.	.	4.0	1.8	.	.
742	07/28/86	W	H	26.0	29.9	.	.	.	.	.	330.0	230.0	.	.
743	07/28/86	W	L	24.9	29.9	.	.	.	.	3.30	49.0	49.0	.	.
744	07/29/86	W	L	24.8	29.7	.	.	.	.	.	79.0	79.0	.	.
745	04/06/87	W	L	8.0	23.5	220.0	180.0	250.0	117.0	30.00	350.0	170.0	.	.
746	04/07/87	W	L	7.5	22.2	.	.	.	.	.	330.0	170.0	.	.
747	04/08/87	W	L	7.5	20.1	.	.	.	.	.	230.0	130.0	.	.
748	04/09/87	W	L	8.3	16.3	.	.	.	.	.	1300.0	1300.0	.	.
749	05/11/87	D	L	14.0	17.6	.	.	.	.	.	130.0	79.0	.	.
750	05/19/87	D	L	14.7	25.6	.	.	.	.	.	2.0	2.0	.	.
751	06/09/87	W	L	19.1	23.2	.	.	.	.	.	13.0	13.0	.	.
752	06/11/87	D	L	19.0	28.4	.	.	.	.	.	4.5	4.5	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=41

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
753	04/08/87	W	L	7.2	17.7	.	.	.	.	.	1100.0	490.0	.	.

STA=42

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
754	04/08/87	W	L	7.0	19.1	.	.	.	.	.	230.0	230.0	.	.

STA=43

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
755	04/09/87	W	L	6.9	24.0	.	.	.	.	.	33.0	13.0	.	.

STA=88

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
756	04/09/87	W	L	6.9	20.2	.	.	.	.	.	79.0	79.0	.	.

STA=89

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
757	04/09/87	W	L	7.1	22.5	.	.	.	.	.	17.0	14.0	.	.

STA=9A

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
758	06/11/87	D	L	19.3	24.7	.	.	.	.	.	130.0	79.0	.	.

STA=9AB

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	BCMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
759	06/11/87	D	L	18.7	20.7	.	.	.	.	.	350.0	350.0	.	.

MT. HOPE BAY - ALL BAY STATIONS

STA=W1

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
760	04/06/87	W	L	.	.	2900.0	2100.0	6000.0	7300.0	10.10	.	.	.	.

STA=W2

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
761	04/06/87	W	L	.	.	210.0	200.0	620.0	290.0	30.00	.	.	.	.

STA=W3

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
762	04/06/87	W	L	.	.	[illegible]80.0	370.0	3500.0	980.0	10.10	.	.	.	.

STA=W4

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
763	04/06/87	W	L	.	.	2200.0	2000.0	1600.0	590.0	40.00	.	.	.	.

STA=W5

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
764	04/06/87	W	L	.	.	34000.0	30000.0	6200.0	18000.0	1710.00	.	.	.	.

STA=W6

OBS	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
765	04/06/87	W	L	.	.	129.0	117.0	280.0	170.0	20.00	.	.	.	.

Temp. = ^{o}C
Sal = salinity
FCMT = fecal coliform (mTEC, membrane filtration)
ECMT = E. coli (mTEC, membrane filtration)
MCP = C. perfringens (mCp, membrane filtration)
ME = enterococci (mE, membrane filtration)
PHA = F_2 coliphage
EC = fecal coliform (MPN)
ECMUG = E. coli (MPN)
AD = enterococci (MPN)
IMM = C. perfringens (MPN)
. = Not determined

APPENDIX B

Microbiological Data - Shellfish, Sediments, Waters

MT. HOPE BAY - INDICATOR DENSITIES
SURFACE AND BOTTOM WATERS, SEDIMENTS, AND SHELLFISH

STA	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
11B	07/21/86	D	L	21.5	29.2	270.0	120.0	43.0	17.0	699.00	.	.	.	.
11S	07/21/86	D	L	.	.	.	.	.	.	.	240.0	240.0	11.0	1600000.0
11SF	07/21/86	D	L	.	.	.	.	.	.	1806.00	700.0	260.0	130.0	350.0
11T	07/21/85	D	L	21.7	28.9	510.0	260.0	40.0	31.0	1418.00	.	.	.	.
21B	07/21/86	D	L	21.6	30.6	5.0	1.0	3.0	8.0	0.10	2.0	0.2	.	.
21S	07/21/86	D	L	.	.	.	.	.	.	.	110.0	70.0	33.0	1600001.0
21SF	07/21/86	D	L	.	.	.	.	.	.	87.50	17.0	17.0	6.8	240.0
21T	07/21/86	D	L	22.4	30.2	2.0	2.0	13.0	1.0	0.10	4.5	2.0	.	.
26B	07/21/86	D	L	21.9	29.6	22.0	11.0	11.0	10.0	0.10	2.0	0.2	.	.
26S	07/21/86	D	L	.	.	.	.	.	.	.	0.2	0.2	0.2	1600000.1
26SF	07/21/86	D	L	.	.	.	.	.	.	100.00	6.8	6.8	11.0	350.0
26T	07/21/86	D	L	23.6	29.7	3.0	4.0	10.0	1.0	0.10	13.0	13.0	.	.
11B	07/23/86	D	L	23.1	29.5	9.0	8.0	21.0	7.0	33.00	22.0	17.0	.	.
11S	07/23/86	D	L	.	.	.	.	.	.	.	700.0	170.0	20.0	920000.0
11SF	07/23/86	D	L	.	.	.	.	.	.	1600.00	130.0	130.0	19.0	920.0
11T	07/23/86	D	L	23.6	29.6	62.0	56.0	13.0	67.0	276.00	.	.	.	.
21B	07/23/86	D	L	21.3	31.4	0.1	0.1	1.0	1.0	0.10	0.2	0.2	.	.
21S	07/23/86	D	L	.	.	.	.	.	.	.	45.0	45.0	140.0	1600000.0
21SF	07/23/86	D	L	.	.	.	.	.	.	87.50	0.2	0.2	2.0	920.0
21T	07/23/86	D	L	22.4	31.0	1.0	1.0	6.0	3.0	0.10	0.2	0.2	.	.
26B	07/23/86	D	L	23.5	30.1	6.0	6.0	8.0	4.0	18.00	11.0	4.5	.	.
26S	07/23/86	D	L	.	.	.	.	.	.	.	20.0	19.0	45.0	350000.0
26SF	07/23/86	D	L	.	.	.	.	.	.	12.50	6.8	11.0	2.0	350.0
26T	07/23/86	D	L	24.0	29.3	3.0	2.0	7.0	16.0	0.10	4.0	4.0	.	.
11S	07/28/86	W	H	.	.	.	.	.	.	.	3300.0	460.0	640.0	110000.0
11SF	07/28/86	W	H	.	.	.	.	.	.	32640.00	70.0	23.0	21.0	490.0
11T	07/28/85	W	H	25.5	28.3	640.0	38.0	0.1	29.9	.	.	.	.	2370.0
21B	07/28/85	W	H	22.5	31.3	5.0	3.0	12.0	3.0	0.33	4.5	2.0	.	.
21S	07/28/86	W	H	.	.	.	.	.	.	.	20.0	19.0	110.0	7800.0
21SF	07/28/86	W	H	.	.	.	.	.	.	50.00	11.0	11.0	4.0	790.0
21T	07/28/86	W	H	24.0	31.0	12.0	7.0	9.0	1.0	3.30	4.0	0.2	.	.
26B	07/28/86	W	H	22.0	31.6	3.0	3.0	6.0	0.1	3.30	7.3	4.5	.	.
26S	07/28/86	W	H	.	.	.	.	.	.	.	19.0	19.0	110.0	130000.0
26SF	07/28/86	W	H	.	.	.	.	.	.	0.50	0.2	0.2	4.0	230.0
26T	07/28/86	W	H	26.0	30.2	44.0	37.0	19.0	0.1	3.30	49.0	23.0	.	.
11B	07/31/86	W	L	22.0	30.4	470.0	250.0	25.0	22.0	5.60	.	.	.	.
11S	07/31/86	W	L	.	.	.	.	.	.	.	3300.0	790.0	1700.0	73000.0
11SF	07/31/86	W	L	.	.	.	.	.	.	37.50	9.3	6.8	2.0	79.0
11T	07/31/86	W	L	22.0	28.3	280.0	220.0	33.0	23.0	26.70	.	.	.	.
21B	07/31/86	W	L	22.4	30.6	42.0	37.0	11.0	2.0	6.60	.	.	.	.
21S	07/31/86	W	L	.	.	.	.	.	.	.	78.0	20.0	78.0	46000.0
21SF	07/31/86	W	L	.	.	.	.	.	.	24.00	230.0	22.0	12.0	230.0
21T	07/31/86	W	L	22.4	30.6	76.0	51.0	9.0	0.1	3.20	.	.	.	.
26B	07/31/86	W	L	23.2	30.0	210.0	190.0	13.0	5.0	16.70	.	.	.	.
26S	07/31/86	W	L	.	.	.	.	.	.	.	170.0	170.0	.	79000.0
26SF	07/31/86	W	L	.	.	.	.	.	.	24.00	1.8	0.2	2.0	170.0
26T	07/31/86	W	L	23.3	29.8	200.0	170.0	13.0	2.0	9.90	.	.	.	.
11B	11/17/86	D	L	8.6	24.5	29.0	27.0	21.0	13.0	15.00	.	.	.	.
11S	11/17/86	D	L	.	.	.	.	.	.	.	45.0	20.0	45.0	49000.0
11SF	11/17/86	D	L	.	.	.	.	.	.	444.00	7.8	7.8	70.0	230.0
11T	11/17/86	D	L	8.2	23.1	190.0	150.0	140.0	47.0	85.00	.	.	.	.
21S	11/17/86	D	L	.	.	.	.	.	.	.	2300.0	230.0	1400.0	79000.0
21SF	11/17/86	D	L	.	.	.	.	.	.	113.00	23.0	23.0	6.8	330.0
21T	11/17/86	D	L	8.5	24.3	8.0	8.0	20.0	1.1	.	.	.	.	3340.0
26S	11/17/86	D	L	.	.	.	.	.	.	.	45.0	78.0	700.0	130000.0

MT. HOPE BAY - INDICATOR DENSITIES
SURFACE AND BOTTOM WATERS, SEDIMENTS, AND SHELLFISH

STA	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
26SF	11/17/86	D	L	.	.	.	.	.	.	258.00	2.0	2.0	120.0	170.0
26T	11/17/86	D	L	8.5	22.2	13.0	10.0	10.0	2.0	5.10	.	.	.	3320.0
11B	11/24/86	D	H	8.5	28.1	130.0	90.0	65.0	67.0	45.00	.	.	.	.
11S	11/24/86	D	H	.	.	.	.	.	.	.	17000.0	4600.0	7900.0	130000.0
11SF	11/24/86	D	H	.	.	.	.	.	.	8793.00	540.0	540.0	310.0	1100.0
11T	11/24/86	D	H	9.2	25.8	140.0	100.0	69.0	74.0	45.00	.	.	.	.
21B	11/24/86	D	H	8.6	24.7	11.0	10.0	34.0	12.0	10.00	.	.	.	.
21S	11/24/86	D	H	.	.	.	.	.	.	.	130.0	45.0	790.0	33000.0
21SF	11/24/86	D	H	.	.	.	.	.	.	100.00	20.1	20.1	20.1	78.0
21T	11/24/86	D	H	8.6	23.1	23.0	15.0	34.0	25.0	15.00	.	.	.	.
26B	11/24/86	D	H	8.5	28.9	30.0	27.0	34.0	34.0	140.00	.	.	.	.
26S	11/24/86	D	H	.	.	.	.	.	.	.	68.0	20.0	3300.0	13000.0
26SF	11/24/86	D	H	.	.	.	.	.	.	875.00	7.0	7.0	17.0	33.0
26T	11/24/86	D	H	9.2	27.2	50.0	50.0	54.0	73.0	20.00	.	.	.	.
11B	02/25/87	D	L	2.2	31.5	160.0	100.0	100.0	160.0	5.00	.	.	.	.
11S	02/25/87	D	L	.	.	.	.	.	.	.	13000.0	13000.0	54000.0	490000.0
11SF	02/25/87	D	L	.	.	.	.	.	.	681.00	2.1	2.1	4.5	230.0
11T	02/25/87	D	L	1.9	28.9	140.0	60.0	100.0	120.0	25.00	.	.	.	.
21B	02/25/87	D	L	.	.	0.1	0.1	6.0	35.0	5.00	.	.	.	.
21S	02/25/87	D	L	.	.	.	.	.	.	.	20.0	18.1	490.0	13000.0
21SF	02/25/87	D	L	.	.	.	.	.	.	50.00	2.1	2.1	2.1	49.0
21T	02/25/87	D	L	1.9	29.0	0.1	0.1	7.0	0.1	20.00	.	.	.	.
26B	02/25/87	D	L	2.0	31.3	8.0	4.0	6.0	13.0	5.10	.	.	.	.
26S	02/25/87	D	L	.	.	.	.	.	.	.	45.0	45.0	4600.0	330000.0
26SF	02/25/87	D	L	.	.	.	.	.	.	50.00	2.1	2.1	2.1	79.0
26T	02/25/87	D	L	2.3	31.3	50.0	50.0	4.0	11.0	5.00	.	.	.	.
11B	03/02/87	W	H	2.6	32.1	190.0	160.0	230.0	155.0	65.00	.	.	.	.
11S	03/02/87	W	H	.	.	.	.	.	.	.	4900.0	1300.0	4900.0	79000.0
11SF	03/02/87	W	H	.	.	.	.	.	.	4968.80	2.0	2.0	2.1	79.0
11T	03/02/87	W	H	3.6	29.7	120.0	110.0	200.0	132.0	60.00	.	.	.	.
21B	03/02/87	W	L	2.5	32.5	22.0	10.0	69.0	36.0	25.00	.	.	.	.
21S	03/02/87	W	L	.	.	.	.	.	.	.	20.0	20.0	790.0	23000.0
21SF	03/02/87	W	L	.	.	.	.	.	.	118.80	2.1	2.1	2.1	31.0
21T	03/02/87	W	L	3.1	32.5	29.0	28.0	150.0	102.0	40.00	.	.	.	.
26B	03/02/87	W	H	2.3	33.1	3.0	2.0	28.0	11.0	5.10	.	.	.	.
26S	03/02/87	W	H	.	.	.	.	.	.	.	68.0	93.0	4900.0	170000.0
26SF	03/02/87	W	H	.	.	.	.	.	.	331.30	2.1	2.1	1.8	22.0
26T	03/02/87	W	H	2.8	30.3	12.0	6.0	60.0	40.0	5.10	.	.	.	.
11B	04/07/87	W	L	6.8	28.6	200.0	160.0	210.0	88.0	65.00	.	.	.	.
11S	04/07/87	W	L	6.8	28.6	.	.	.	.	.	1300.0	1300.0	3500.0	230000.0
11SF	04/07/87	W	L	6.8	28.6	.	.	.	.	812.50	6.8	6.8	2.0	49.0
11T	04/07/87	W	L	7.3	10.5	570.0	460.0	230.0	380.0	130.00	2400.0	1300.0	.	.
21B	04/07/87	W	L	6.8	25.2	430.0	380.0	220.0	105.0	65.00	.	.	.	.
21S	04/07/87	W	L	6.8	25.2	.	.	.	.	.	140.0	140.0	490.0	33000.0
21SF	04/07/87	W	L	6.8	25.2	.	.	.	.	158.00	2.1	2.1	2.1	130.0
21T	04/07/87	W	L	6.8	22.8	390.0	360.0	240.0	101.0	50.00	220.0	330.0	.	.
26B	04/07/87	W	L	5.9	31.6	114.0	105.0	160.0	31.0	5.10	.	.	.	.
26S	04/07/87	W	L	5.9	31.6	.	.	.	.	.	170.0	110.0	490.0	110000.0
26SF	04/07/87	W	L	5.9	31.6	.	.	.	.	285.00	4.5	4.5	2.1	33.0
26T	04/07/87	W	L	7.6	23.2	71.0	63.0	160.0	48.0	30.00	70.0	70.0	.	.
11B	04/09/87	W	L	8.1	25.7	230.0	120.0	160.0	42.0	55.00	.	.	.	.
11S	04/09/87	W	L	8.1	25.7	.	.	.	.	.	49.0	49.0	1300.0	330000.0
11SF	04/09/87	W	L	8.1	25.7	.	.	.	.	983.00	2.1	2.1	2.0	110.0
11T	04/09/87	W	L	7.7	12.4	450.0	390.0	280.0	120.0	175.00	700.0	700.0	.	.
21B	04/09/87	W	L	6.5	28.3	490.0	420.0	210.0	170.0	5.00	.	.	.	.

MT. HOPE BAY - INDICATOR DENSITIES
SURFACE AND BOTTOM WATERS, SEDIMENTS, AND SHELLFISH

STA	DATE	RAIN	TIDE	TEMP	SAL	FCMT	ECMT	MCP	ME	PHA	EC	ECMUG	AD	IMM
21S	04/09/87	W	L	6.5	28.3	.	.	.	.	.	130.0	130.0	280.0	79000.0
21SF	04/09/87	W	L	6.5	28.3	.	.	.	.	181.00	13.0	13.0	33.0	330.0
21T	04/09/87	W	L	7.0	14.5	111.0	96.0	260.0	15.0	150.00	430.0	430.0	.	.
26B	04/09/87	W	L	7.4	28.2	59.0	50.0	120.0	15.0	5.10	.	.	.	.
26S	04/09/87	W	L	7.4	28.4	.	.	.	.	.	79.0	130.0	110.0	130000.0
26SF	04/09/87	W	L	7.4	28.2	.	.	.	.	145.00	2.0	2.0	2.1	23.0
26T	04/09/87	W	L	7.7	14.4	460.0	400.0	290.0	150.0	155.00	330.0	330.0	.	.

*See Appendix A for heading explanations.

APPENDIX C

Historical Data

HISTORICAL DATA

Some historical bacteriological data are available for Mt. Hope Bay. A limited sanitary survey (Mount Hope Bay Survey) was conducted in 1969 by the Division of Water Pollution Control, Massachusetts Water Resources Commission, Boston, MA in cooperation with the U.S. Environmental Protection Agency, the Massachusetts Division of Marine Fisheries, the Massachusetts Department of Public Health, the U.S. Public Health Service, and the U.S. Geological Survey. Sampling was conducted over a five day period, four times a day at 10 bay stations. Several physical, chemical and biological parameters were measured. It is unknown whether any rainfall occurred prior to or during this period. An analysis of the fecal coliform data by this laboratory indicates that a portion of the western side of the Bay (particularly near the shoreline) met the bacteriological standards for an area approved for shellfish harvesting. Some attempts were made to characterize point sources of pollution into the estuary. Bacterial levels in these sources were not determined. This data set is much too limited to allow any meaningful comparisons with the present survey.

A more comprehensive document (Report on Pollution to the Interstate Waters of Mt. Hope Bay and Its Tributary Basins) was issued by the U.S. Environmental Protection Agency (Region I, Boston, MA) in December, 1971. This report describes sources of pollution, water quality as related to standards, and the effects of pollution on water uses. The available bacteriological data is, again, somewhat limited. The results of the study show that, out of nine baywide stations sampled, only one (a station at the mouth of the Kickamuit River) could have been approved for shellfish harvesting. The number of samples per station and the hydrographic conditions under which samples were collected were not specified, however. The report does describe the classification of the shellfish areas as of 1971 (Fig.16). All Rhode Island waters, except the Kickamuit River, were closed. In Massachusetts, a portion of the Cole River was open. A substantial area was classified as restricted (shellfish could be harvested for depuration). This is somewhat academic since Massachusetts did not, and does not, have any hard clam depuration facilities. Of interest is the fact that Rhode Island conducted transplants (relay) from Mt. Hope Bay (areas unknown) during the years 1963, 1964, and 1966. This practice has not been continued since that time (Art Ganz, RI DEM, personal communication). The report also describes the potential shellfish resource (hard and soft clams, oysters) in the area. This information should be of use to investigators presently conducting similar studies as part of the Narragansett Bay Project.

No known bacteriological data is available on Mt. Hope Bay prior to the early 1970's. When and why the area was first closed to shellfishing was not known by Rhode Island state officials. Improvements or deterioration in the water quality of the area cannot be determined because the historical microbiological data are too limited. Our best guess is that the water quality (microbiological) of the area has remained unchanged for two decades.

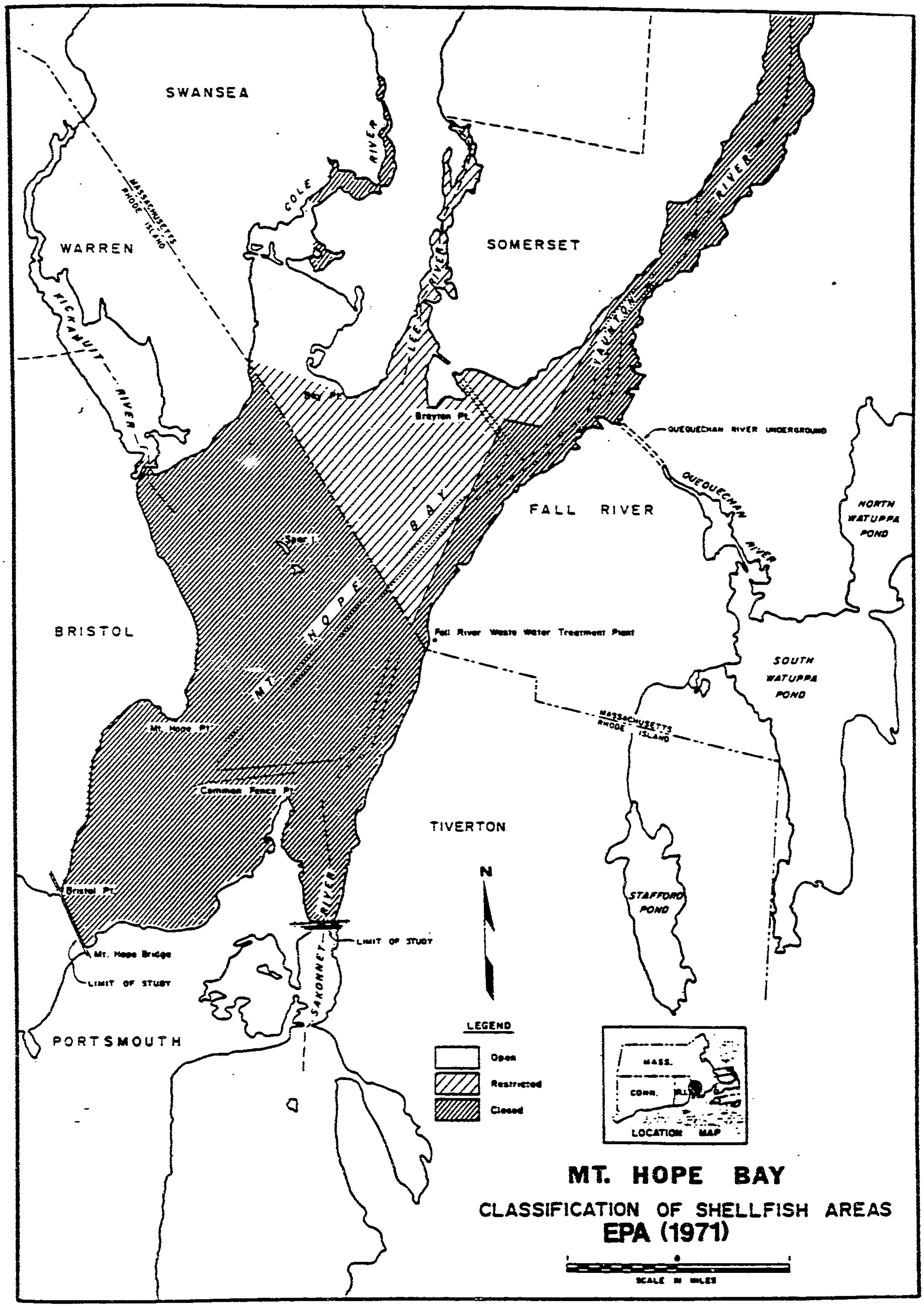

SWANSEA
WARREN
SOMERSET
COLE RIVER
LEE RIVER
TAUNTON RIVER
KICKAMUIT RIVER
MASSACHUSETTS RHODE ISLAND
Brayton Pt.
QUEQUECHAN RIVER UNDERGROUND
QUEQUECHAN RIVER
FALL RIVER
NORTH WATUPPA POND
MT. HOPE BAY
Spar I.
BRISTOL
Fall River Waste Water Treatment Plant
SOUTH WATUPPA POND
Mt. Hope Pt.
Common Fence Pt.
TIVERTON
STAFFORD POND
Bristol Pt.
SAKONNET RIVER
LIMIT OF STUDY
Mt. Hope Bridge
LIMIT OF STUDY
PORTSMOUTH
N
LEGEND
Open
Restricted
Closed
MASS.
CONN.
LOCATION MAP
MT. HOPE BAY
CLASSIFICATION OF SHELLFISH AREAS
EPA (1971)
SCALE IN MILES

Figure 16