ANNUAL SUMMARY REPORT

FOR 1978 HYDROGRAPHIC STUDIES

OFF HAMPTON BEACH, NEW HAMPSHIRE

TECHNICAL REPORT X-2

PREOPERATIONAL ECOLOGICAL MONITORING STUDIES

FOR SEABROOK STATION

Conducted for

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
Manchester, New Hampshire

by

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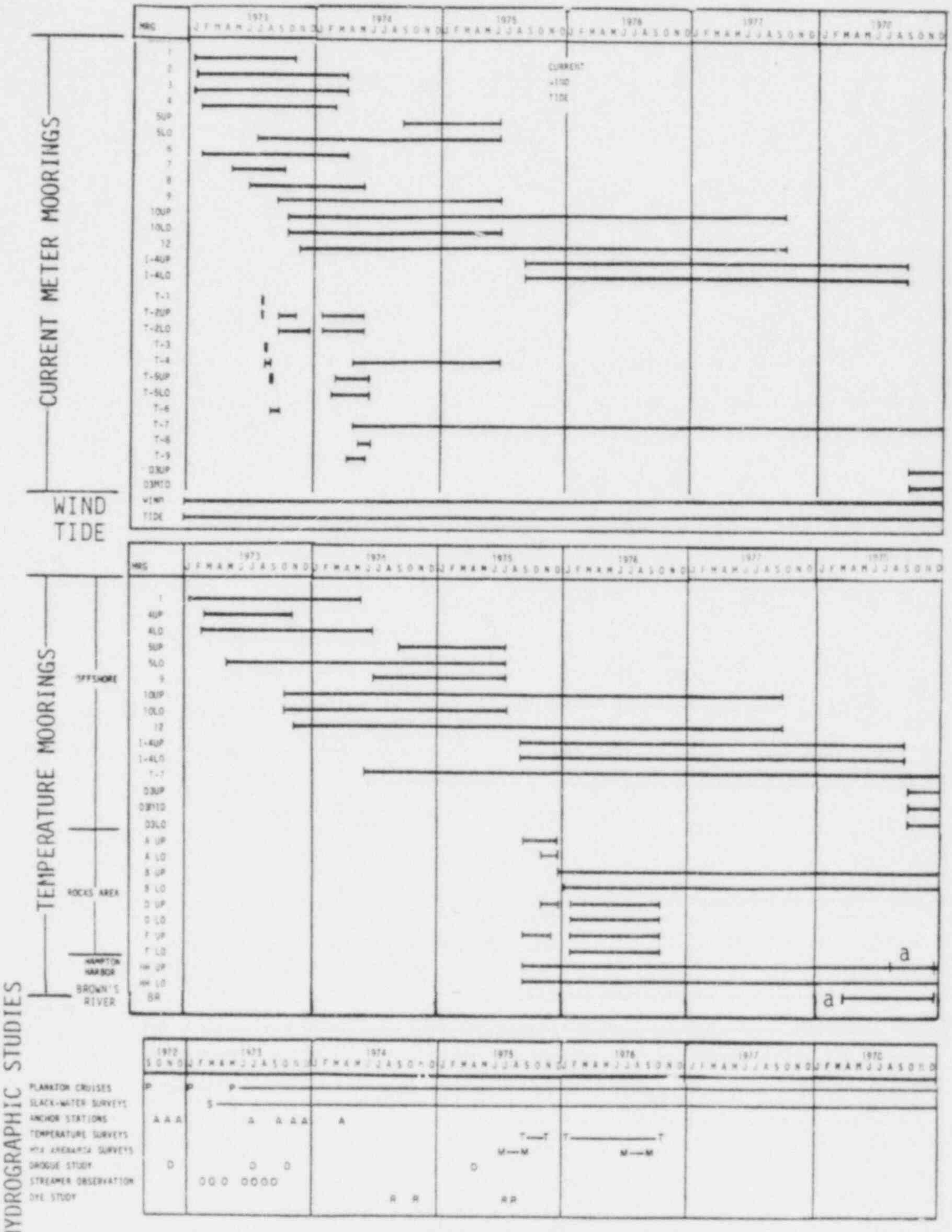
1.0 INTRODUCTION

This report presents the results from the 1978 hydrographic and meteorologic studies conducted as part of the ecological monitoring program for Public Service Company of New Hampshire's (PSNH) Seabrook Station. These studies characterize the general preoperational hydrographic conditions of the coastal waters of the Gulf of Maine off Hampton Beach, New Hampshire, and the estuarine waters of the Hampton-Seabrook estuary. Seabrook Station, when operational, will use coastal water from about 1 nm (1.9 km) off Hampton Beach for once through condenser cooling and then release the water into the ocean through a submerged diffuser about 1 nm offshore. Hydrographic, meteorologic and sedimentologic studies for the Seabrook Station have been conducted since 1972 by Normandeau Associates, Inc. (Figure 1.0-1). Results of those previous studies are given in NAI, 1975a, 1975b, 1977a, 1977b, 1979a and 1979b.

The 1978 program was designed to describe existing hydrographic conditions and characterize ambient temperature at the diffuser and the intake sites. Water currents, temperature, conductivity, tides and wind were monitored continuously in 1978. Supplemental spatial surveys delineated tidal and seasonal variations in local distributions of water temperature, salinity, density, and dissolved oxygen.



[a]Conductivity recorded continuously along with temperature

Figure 1.0-1. Diagram showing hydrographic studies which have been conducted in Hampton Harbor and off Hampton Beach, New Hampshire, from 1972 through 1978. Seabrook Annual Hydrographic Report, 1978.

The exchange between Hampton Harbor and coastal waters is of particular concern to biologists with regard to mixing of estuarine and coastal biota. The spatial survey data were used to determine the extent of the Hampton Harbor ebb tidal plume. The approach was to examine the uniformity of the coastal waters, to identify the processes which cause changes in the temperature and salinity characteristics, and to determine if offshore sampling stations were influenced by the Hampton Harbor ebb tidal plume.

2.0 MATERIALS AND METHODS

2.1 STUDY DESIGN

The design for the 1978 Seabrook studies focused on continuous measurement of water temperature, current speed and direction, salinity and wind. These parameters exhibit the greatest spatial and seasonal variability and give the best description of the hydrographic environment off Hampton Beach. Sampling locations were selected at the intake and discharge sites to monitor the ambient conditions prior to operation. Tide height was measured continuously to provide background tidal information for Hampton Harbor and vicinity.

Conductivity, density and dissolved oxygen were measured monthly during slack-water surveys and plankton cruises. Sites were chosen at locations in the estuarine oceanic mixing zone and at locations likely to be affected by the thermal plume. The results were used to supplement the data base and to provide a better hydrographic description of the waters off Hampton Beach.

2.2 FIELD METHODS

2.2.1 Temporal Monitoring

Continuous recording instruments, mounted on moorings measured water temperature and current speed and direction. The three-point moored buoy systems held instruments at a fixed depth below the water surface. Configurations of the subsurface moorings are described in detail in NAI, 1977a.

Current speed and direction were measured with Bendix Model Q-15 or Q-15R ducted current sensors with 10-ft (3-m) directional vanes and Bendix Model 270 recorder/power supply units. The current data were recorded on dual channel Rustrak Model 291 DC recorders within a Bendix

Model 270 housing. Bulova Model TE-11 Accutron cycle timers provide marks every 3 hrs on the strip charts. Electrical power was supplied with 14-day rechargeable battery packs. Instrument specifications are listed in Table 2.2-1.

Water temperature was measured using NAI Model 1000 and 1001 Temperature Monitors, with a Rustrak Model 2133 DC recorder and matched Model 1332 thermistor probes. Moorings were serviced by SCUBA divers every 2 weeks as weather permitted. During each servicing, functional electronic tests were conducted. Every three months, sensors and recorders were returned to Naico's instrumentation laboratory for routine maintenance and calibration per NAI Technical Procedures Manuals and manufacturer's specifications.

The locations of all offshore buoy systems mobilized in 1978 are shown in Figure 2.2-1. The approximate latitude and longitude, water depth, sensor depth and operational dates for all 1978 moorings are summarized in Table 2.2-2. Operational performance for each mooring is summarized in Appendix Table 7.1-1 for temperature and 7.1-11 for current and wind.

Tide elevation in Hampton Harbor was measured continuously at the Hampton Beach Marina using a Marsh-McBirney Model 100 water-level gauge and a Rustrak Model 288 single-channel, DC strip-chart recorder. All measurements were referenced to mean low water (MLW) from surveyed bench marks keyed to the U.S. Army Corps of Engineers 1929 geodetic elevation datum. The times and heights of high and low water were determined and compared to the predicted tide information (NOAA-NOS, 1978). Direct measurements in the Harbor also documented extremely high tides associated with major storms.

Local wind speed and direction were measured continuously in the Hampton Beach State Park using an R.M. Young Model 6405 field recording wind set.

TABLE 2.2-1. SPECIFICATIONS FOR PRIMARY INSTRUMENTATION UTILIZED IN THE NAI MONITORING STUDIES OFF HAMPTON BEACH, NEW HAMPSHIRE. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

SENSOR/RECORDER				SPECIFICATIONS			RECORDING			
MANUFACTURER	MODEL	PARAMETER MEASURED	TYPE OF SENSOR	MEASUREMENT THRESHOLD	RANGE	ACCURACY	MEDIUM	SAMPLING PERIOD	SAMPLING FORMAT	REMARKS
CURRENT VELOCITY										
BENDIX	Q-15, Q-15A and Q-16	Speed	Ducted Impeller	0.04 kns	0 to 1 kn 0 to 5 kns switch selectable	± 3% or ± 0.05 kns whichever is greater	Strip chart	16 days	Continuous	Rustrak Model 291 DC recorder
	Current Sensors/ 270 Recorder	Direction	Vane with potentiometric direction transducer and compass (Q-16 only No compass)		0° → 360°	± 12°				
		Time	Bulova Model TE-11 Accutron Cycle Timer	N/A	N/A	± 2 sec/day			3-hr cycling switch	3-hr event marks
TEMPERATURE										
NAICO	1001-T Temperature Monitor	Temperature	Fenwall H72/UUA32J3 Mod.Fast TC; SS Housing		Single channel 50F(25 to 75F) Dual channel 20F(variable)	± 1.0 F or ± 0.46 C	Strip chart	16 days	Continuous	Rustrak Model 2133 DC recorder
		Time	Bulova Model TE-11 Accutron Cycle Timer	N/A	N/A	± 2 sec/day			3-hr cycling switch	3-hr event marks
TIDE LEVEL										
MARSH-McBIRNEY Water-level Gauge	100	Tide Elevation	Gradient wire		17 ft	± 0.2 ft	Strip chart	16 days	Continuous	Rustrak Model 288 DC recorder
		Time	Bulova Model TE-11 Accutron Cycle Timer	N/A	N/A	± 2 sec/day			3-hr cycling switch	3-hr event marks
WIND										
R M Young Field recording Wind set	6405	Speed	3 cup anemometer	1.5 kns	0 to 50 kns	± 1.0 kn	Strip chart	16 days	Continuous	Rustrak DC recorder built into unit
		Direction	Vane with potentiometer	N/A	0° to 360°	± 7°				
		Time	Bulova Model TE-11 Accutron Cycle Timer			± 2 sec/day			3-hr cycling switch	3-hr event marks
HYDROGRAPHIC PROFILES										
BECKMAN	RS5-3	Temperature	Thermistor		0 to 40 C	± 1.0 C	Manual Dial Reading		Instantaneous readings	Field readings entered onto data sheets
		Conductivity	Inductive		0 to 60 mmhos/cm	± 1.0 mmhos/cm	Manual Dial Reading			
		Salinity	D.C. Wheatstone Bridge Circuit utilizing temperature and conductivity input		0 to 40 ‰	± 0.3 ‰	Manual Dial Reading		3-hr cycling switch	
SALINITY										
Beckman	RS7-C	Salinity	Inductive		0 to 40 ‰	±0.003 equivalent salinity	Digital Readout			Instrument measures the conductivity ratio of the sample reference to standard seawater
TEMPERATURE/CONDUCTIVITY										
Naico	Data Logger	Temperature	Resistance		-5°C to +40°C	±.5°C	Cassette	30 Days	3 times/hr.	
		Conductivity	Induction		0-50 mmhos	±.5 mmhos	Cassette	30 Days	3 times/hr.	

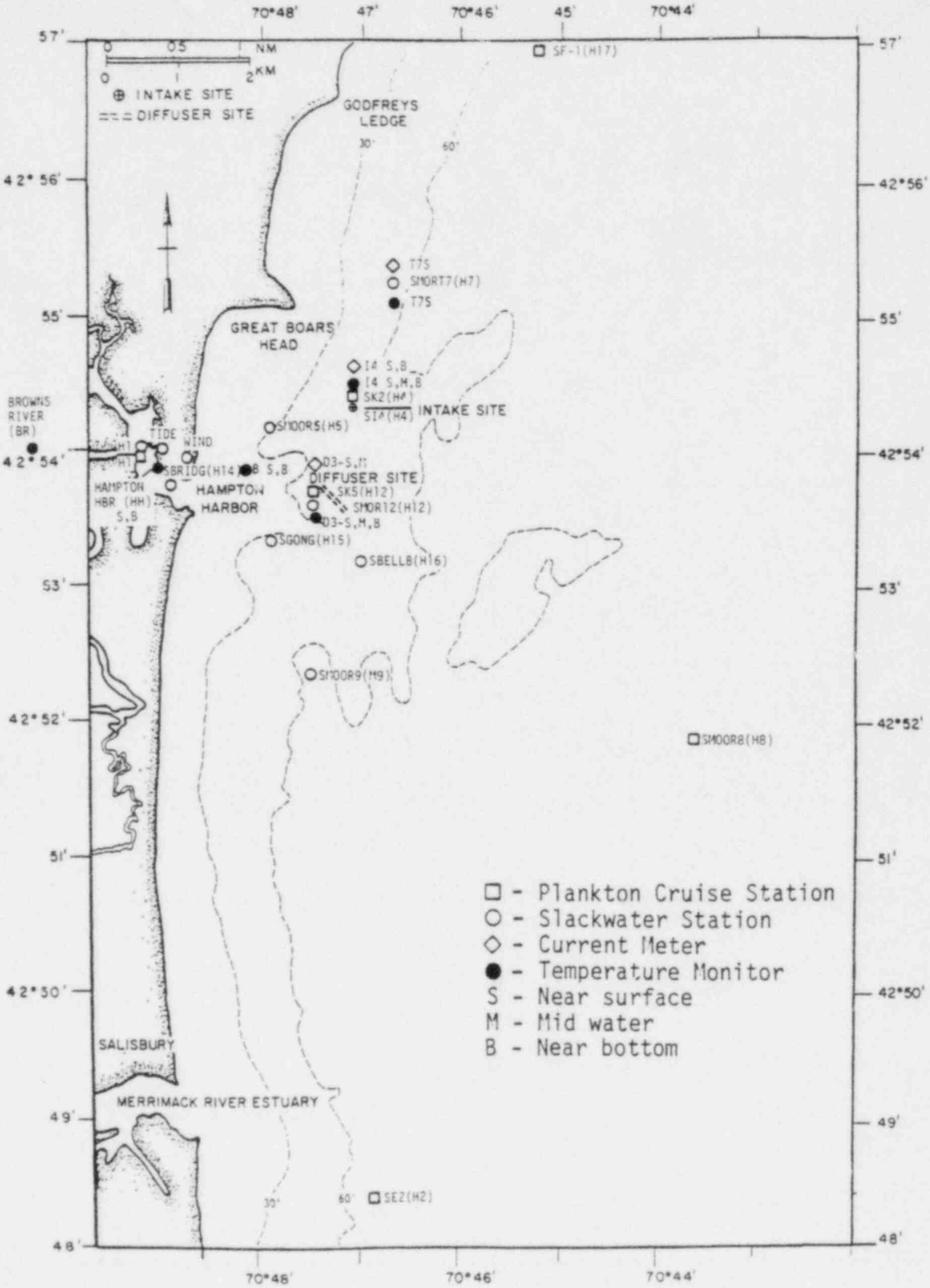


Figure 2.2-1. Location map of hydrographic sampling stations off Hampton Beach, New Hampshire, for 1978 Ecological Study Program. Seabrook Annual Hydrographic Report, 1978.

TABLE 2.2-2. OPERATIONAL DATES AND SAMPLING DEPTHS FOR 1978 NAI CURRENT METERS AND TEMPERATURE MONITORS OFF HAMPTON BEACH, NEW HAMPSHIRE. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

						SENSOR DEPTHS BELOW INSTANTANEOUS SEA SURFACE			
MOORING DESIGNATION	MOORING LOCATION LATITUDE N	LONGITUDE W	WATER DEPTH AT MLW, FT	(M)	DATES OPERATIONAL, 1978	CURRENT METERS FT	(M)	TEMPERATURE MONITORS FT	(M)
	Reference Site								
T-7	42°55'15"	70°46'46"	60.0	(18.3)	Jan 1 to Dec 31	5.7	(1.7)	2.0	(0.6)
	Diffuser Site								
D3 HP	42°53'36"	70°47'53"	75.0	(22.9)	Sep 21 to Dec 31	10.0	(3.0)	1.8	(0.6)
D3 MID					Sep 27 to Dec 31	20.0	(6 1)	35.0*	(10.7)
D3 LO					Sep 21 to Dec 31			73.0*	
	Offshore Intake Site								
I-4 Upper	42°54'20"	70°47'09"	55.0	(16.8)	Jan 1 to Sep 20	5.2	(1.6)	2.2	(0.7)
I-4 Mid								20.0*	(6.1)
I-4 Lower						44.0*	(13.4)	48.6	(14.8)
	Rocks Area								
B Upper	42°53'49"	70°48'00"	15.0	(4.6)	Jan 1 to Dec 31	N/A		1.0	(0.3)
B lower								13.0	(4.0)
	Hampton Harbor Estuary				Naico 10C1-T				
HH Upper	42°53'59"	70°49'09"	4.0	(1.2)	Jan 1 to Apr 4	N/A		1.0	(0.3)
HH Lower					Naico Data Logger Apr 5 to Dec 5[a]			4.0*	(1.2)
BR	Browns River (Plant Site)		2.0	(0.6)	Mar 8 to Dec 15[b]	N/A		2.0*	(0.6)
	Hampton Beach State Park								
Wind	42°53'58"	70°48'46"			Jan 1 to Dec 31	35.5	(10.8)+		
	Hampton Beach Marina								
Tide	42°54'08"	70°49'06"			Jan 1 to Dec 31	N/A			

*Depths below mean low water (MLW)

+Height above mean sea level

[a]Conductivity (surface only) also recorded Aug 12-Dec 5

[b]Conductivity also recorded Mar 8-Dec 15

Temperature and conductivity were measured at 20 min intervals at Browns River and in Hampton Harbor as specified in Table 2.2-2. The Naico Model 0265 Data Acquisition and Logging System was used, with two remote thermistor units (one only at Browns River), one remote conductivity unit, a Model 3243B Memodyne Data Logger and a power supply. Data were recorded on digital cassettes backed up by a Datel thermal printer. The instrument was serviced every two weeks and removed at regular intervals for calibration and any necessary maintenance.

2.2.2 Spatial Surveys

Monthly hydrographic surveys measured seasonal and tidal variations in water temperature, salinity, density and dissolved oxygen. Data were collected during slack-water surveys and plankton cruises. The slack-water surveys had two sampling runs, one during high-water slack and the other during low-water slack. At each sampling station, (Figure 2.2-2), vertical profiles of temperature and conductivity were made with a Beckman RS5-3 salinometer. Sampling depths were the surface, 3.3 ft (1 m), 6.6 ft (2 m) and thereafter, every 6.6 ft (2 m) to bottom. Water samples from near surface and near bottom were obtained using Kemmerer or Niskin water samplers. Duplicate samples were used for laboratory determination of dissolved oxygen by Azide modification of the Winkler method (U.S. Environmental Protection Agency, 1974), and for determination of salinity with a Beckman Model RS7C Induction Salinometer referenced to standard seawater samples. Plankton cruises were conducted similarly, but without regard for tide stage. Field methods were the same as for slack-water surveys.

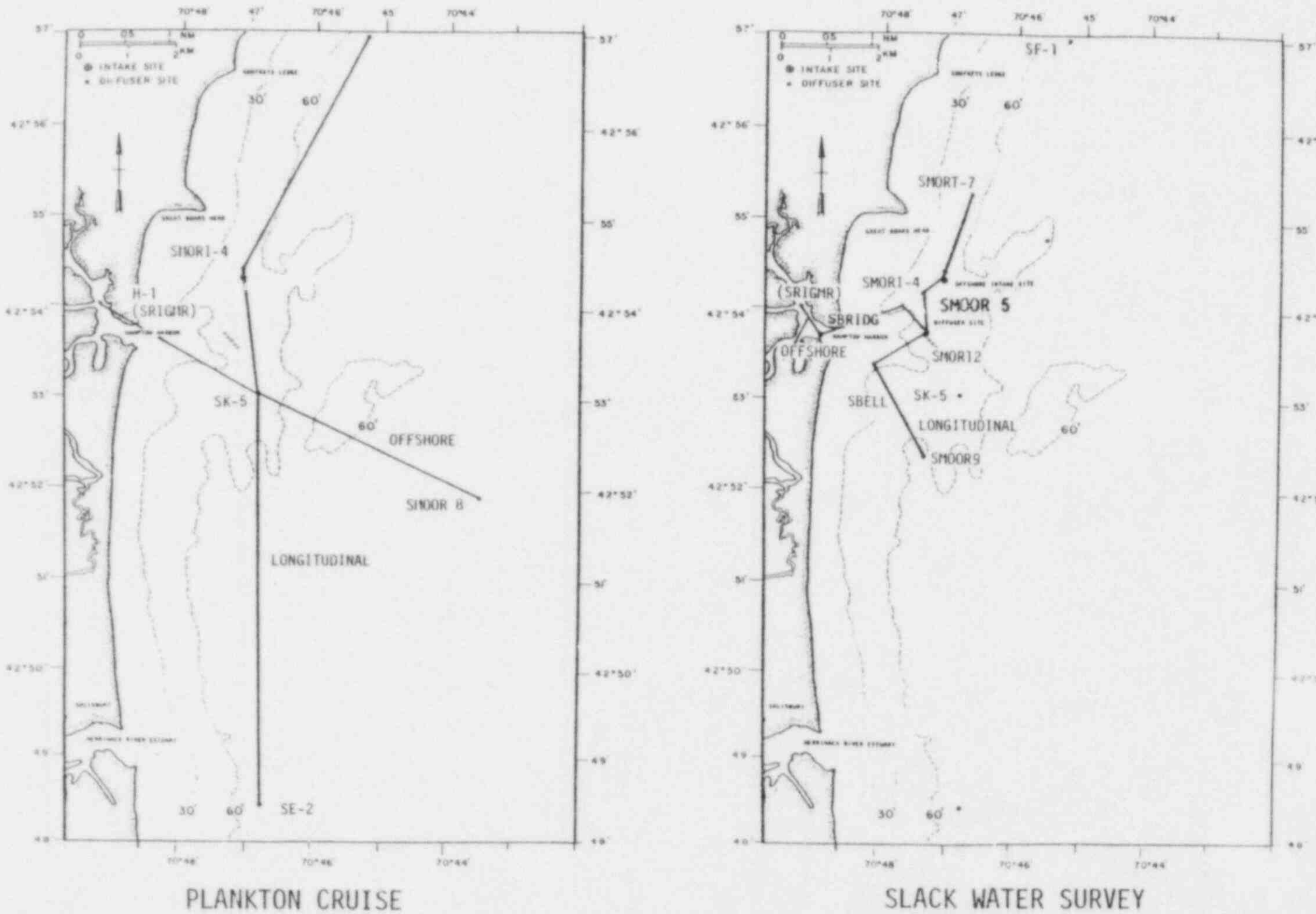


Figure 2.2-2. Locations of longitudinal and offshore profiles of temperature and salinity, taken from slack water surveys and plankton cruises during 1978. Seabrook Annual Hydrographic Report, 1978.

2.3 LABORATORY AND DATA PROCESSING METHODS

2.3.1 Temporal Monitoring Data

Current, temperature, tide elevation and wind data strip charts were verified for correct start and end times, and agreement with field checks. Possible instrument malfunctions were also identified. Time basing was done by using the known start and end times and the 3-hr timer marks. Current and wind data were reduced to 20-min visual averages of speed and direction using standard conversion tables. The time and height of each high and low water were determined from the tide chart. Data were keypunched, listed and reviewed. Current flow types were defined by visual averages of data from all operational current meters.

Temperature strip charts were digitized onto magnetic cassette tapes using a Numonics Model 274-133 Electronic Graphics Calculator, a Numonics Model 310 Interface and a Techtran Model 8400 Read/Write Unit. Tapes were then computer processed and listed. Data were tabulated and hourly average values punched onto cards. Data were processed by the PSNH Engineering Department, using a standard series of plot and tabulation software.

Temperature and conductivity data from Browns River and Hampton Harbor collected during the periods specified in Table 2.2-2, were computer processed directly from the digital cassettes or the back up thermal tapes. These data were then compiled with the time of high and low water measured at the tide gauge in Hampton Harbor. Daily high and low water salinity and temperature values were plotted, exclusive of data gaps.

2.3.2 Spatial Survey Data

Field data sheets from slack-water surveys and plankton cruises were checked for accuracy and completeness. Dissolved oxygen samples were processed in the laboratory and results entered on the field sheets. The data were keypunched and listed. The data were then sent to PSNH, where temperature conversions, salinity, sigma-t and dissolved oxygen values were calculated by computer. The salinity and dissolved oxygen values were compared to results obtained during field sampling.

Discrete temperature measurements were made surface to bottom during monthly plankton cruises and slack water surveys. The slack water surveys were conducted in two sampling runs, once during low water and again at high water. Plankton cruises were not tied to any tidal stage. Using slack water survey data (surface and bottom measurements, only), temperature contours were prepared for an offshore transect (SRIGMR to SMOR12), and a longitudinal transect, (SMORT7 to SMOOR9). Locations of the stations sampled are shown on Figure 2.2-2.

2.4 ANALYTICAL METHODS

Temperature and salinity data from nine slack-water survey stations (Figure 2.2-2) were analyzed to determine the water mass characteristics of the coastal water and Hampton Harbor water at low slack tide. The data used for this analysis are from 55 slack water surveys between June 1974 and December 1978 and are presented in several NAI data reports (NAI 1975a, 1977a, 1979a and 1979b. Data were plotted by station and by depth on T-S diagrams. Scatter plots were then compared to a water-mass model proposed in Parsons *et al.* (1976) to determine how well the model predicted the observed T-S characteristics. After determining the T-S distribution for the coastal water stations, a simple bivariate model was used to assess the influence of local physical processes in modifying this coastal water mass.

2.5 OTHER DATA

Air temperature data from U.S. Weather Bureau stations at Portland, Maine and Boston, Massachusetts for 1978 were obtained from NOAA-Environmental Data Service (NOAA-EDS 1973-1978) summaries. Monthly means of daily maximum and daily minimum temperatures were then calculated.

Mean daily and monthly average runoff data for 1978 from the Merrimack River, the Piscataqua River basin (based upon the Lamprey River) and the Saco River basin were obtained from the U.S. Geological Survey. The discharge rates into the western Gulf of Maine by these rivers were determined.

3.0 RESULTS

3.1 CIRCULATION

3.1.1 Currents

3.1.1.1 Current Types

The currents in the coastal waters near Hampton Beach, New Hampshire have been divided into two predominant types: tidal and non-tidal (Figure 3.1-1). Flow governed by the effects of the tide were further divided into weak tidal and reversing flood and ebb tidal flows. Weak tidal flows are characterized by very low speeds with a rotary change in directions. During 1978, 12.3% of all flows were weak tidal. Reversing ebb and flood tidal currents have a northward flowing flood component and a southward flowing ebb component. A direction reversal takes place every 6 to 7 hrs with a short slack period. Of all flows, 41.7% were reversing tidal currents. Tidal flow accounted for 54.0% of the current flows in 1978.

Currents dominated by non-tidal flow were subdivided into flow toward the south and flow toward the north. Although the direction of flow will persist for several tidal cycles, tidal influences were observed in the current speed. Both north and south currents are divided into moderate and strong flows. Moderate flows have speeds from 0.2 to 0.3 kn (10.3 to 15.4 cm/sec). Strong currents exceed 0.3 kn (15.4 cm/sec). Moderate flows to the north were recorded on 18.9% of the days on which data were collected. Fourteen and three-tenths percent of the non-tidal currents had moderate flows to the south. The remaining 12% of data were evenly divided between strong northward and southward flow. The distribution of current types for 1973 to 1977 is presented in Appendix Figures 7.0-1 and Appendix Tables 7.1-2 to 7.1-10; the 1978 summary is shown in Figure 3.1-2.

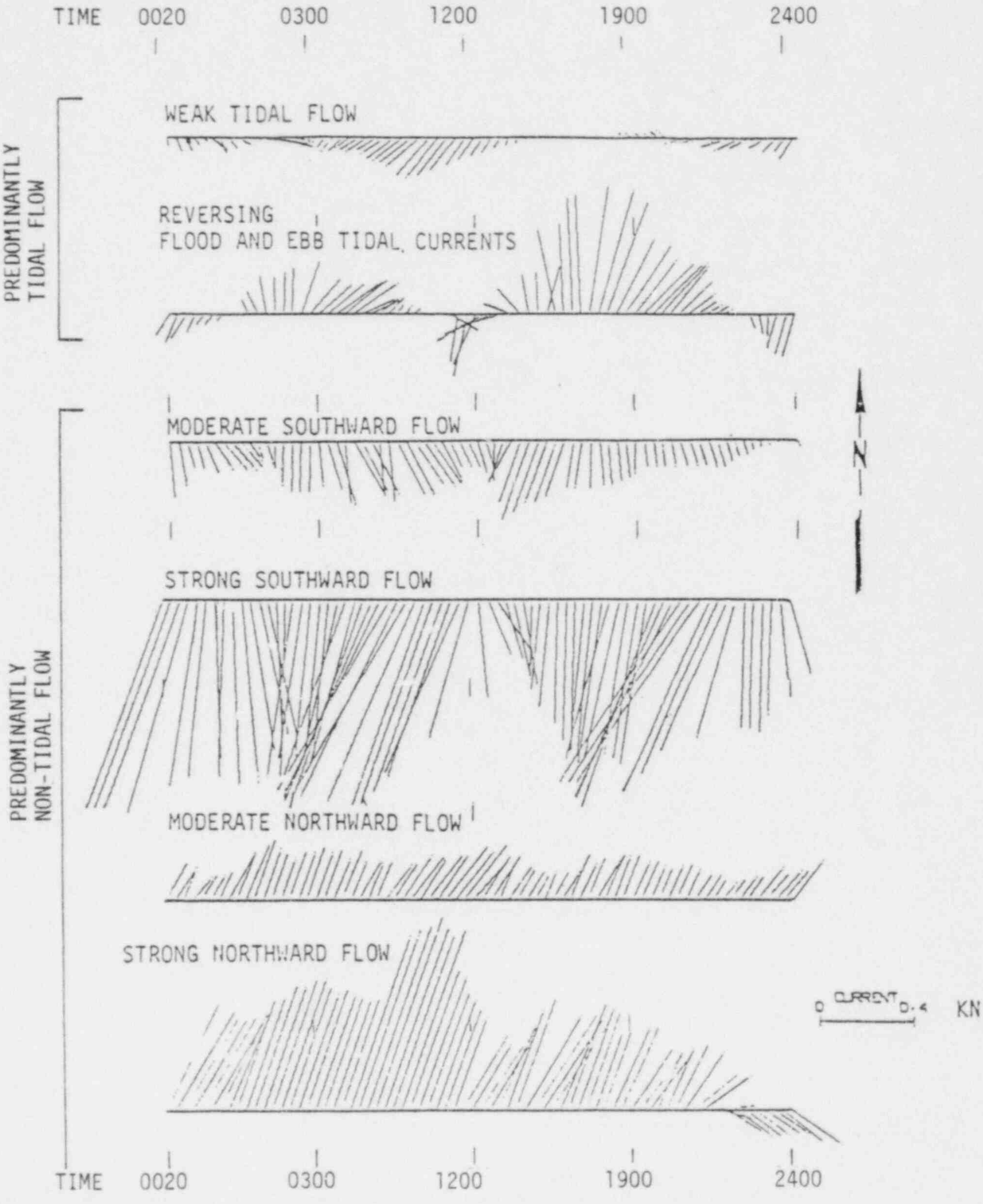


Figure 3.1-1. Predominant current types observed in the coastal waters off Hampton Beach, New Hampshire.
Seabrook Annual Hydrographic Report, 1978.

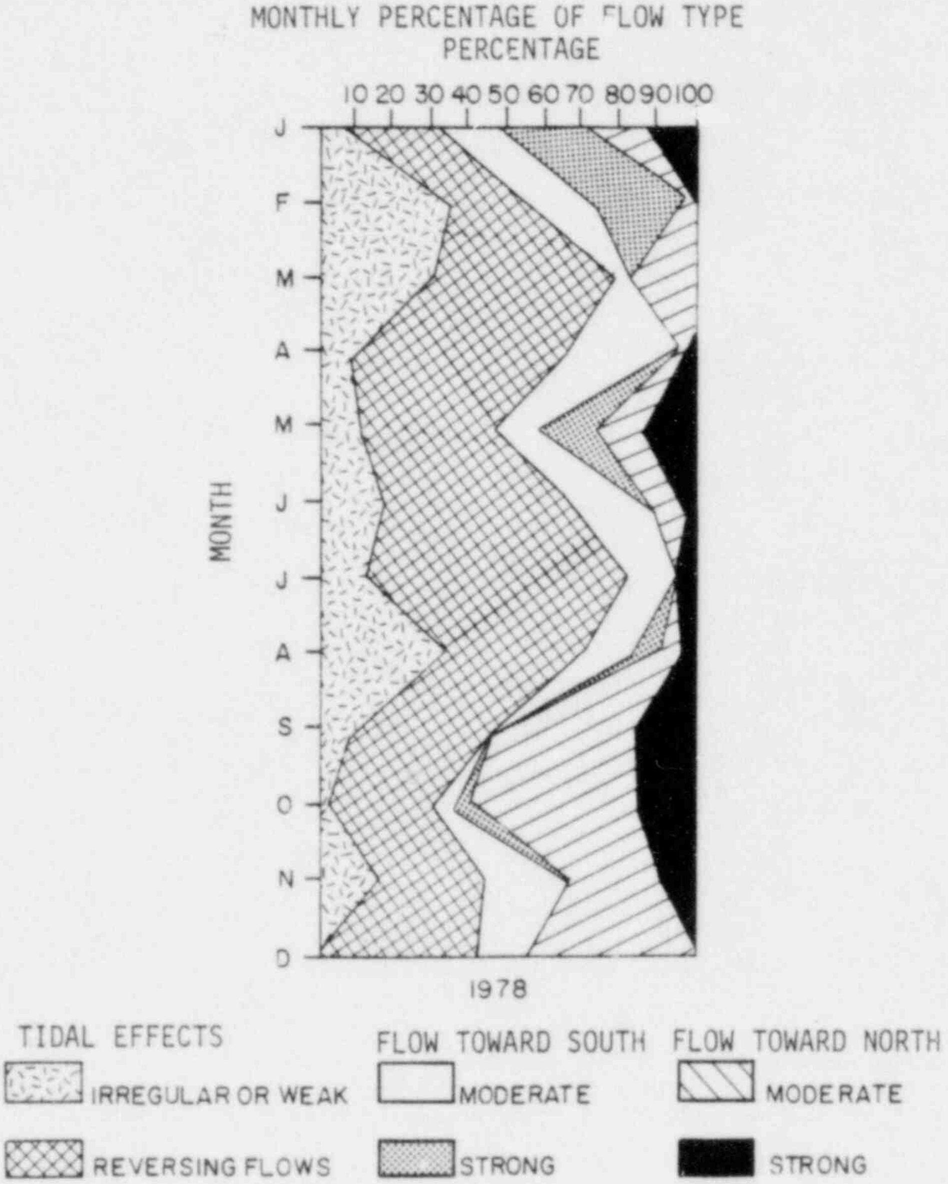


Figure 3.1-2. Tabulation of monthly percentages of flow types off Hampton Beach, New Hampshire during 1978. Seabrook Annual Hydrographic Report, 1978.

3.1.1.2 Temporal Trends

There was seasonality among the flow types (Figure 3.1-2). Tidal flows were predominant during most of the year. Only in the fall did non-tidal currents make up greater than 50 percent of the flows. Reversing flows dominated the tidal category. Irregular and weak flows were observed more frequently in winter and summer. Flows to the south were more frequent during the winter and spring. Conversely, flows to the north occurred more frequently in the summer and fall. Of the four seasons, spring had the greatest percentage of moderate southerly flows. Winter had the most strong southerly flows. Moderate northerly flows were greatest in the fall, as were strong northerly flows.

From the flow statistics, several current characteristics were established. Currents respond primarily to tidal forces. Southerly flows were strongest in the winter and spring. Strong southerly flow episodes tended to be associated with strong winds toward the south (Appendix 7.0-3). Northerly flows were greatest in the late summer and fall, when winds were strong from the southwest. Tidal flows were greatest in the summer when local wind velocity was low and from the southwest quadrant.

3.1.1.3 Spatial Trends

Current meters measured speed and direction at three locations during 1978. These data were recorded at two depths at Moorings I-4 and D-3. A seasonal summary of current meter data in the form of rose diagrams, is presented in Figure 3.1-3. Rose diagrams of monthly current observations, with a procedure for interpretation, are provided in Appendix 7.0-2. Hourly average sequential vector plots are presented in Appendix 7.0-3.

The predominant flow during the winter months was southerly, seen both at the surface and with depth. Highest mean speeds were

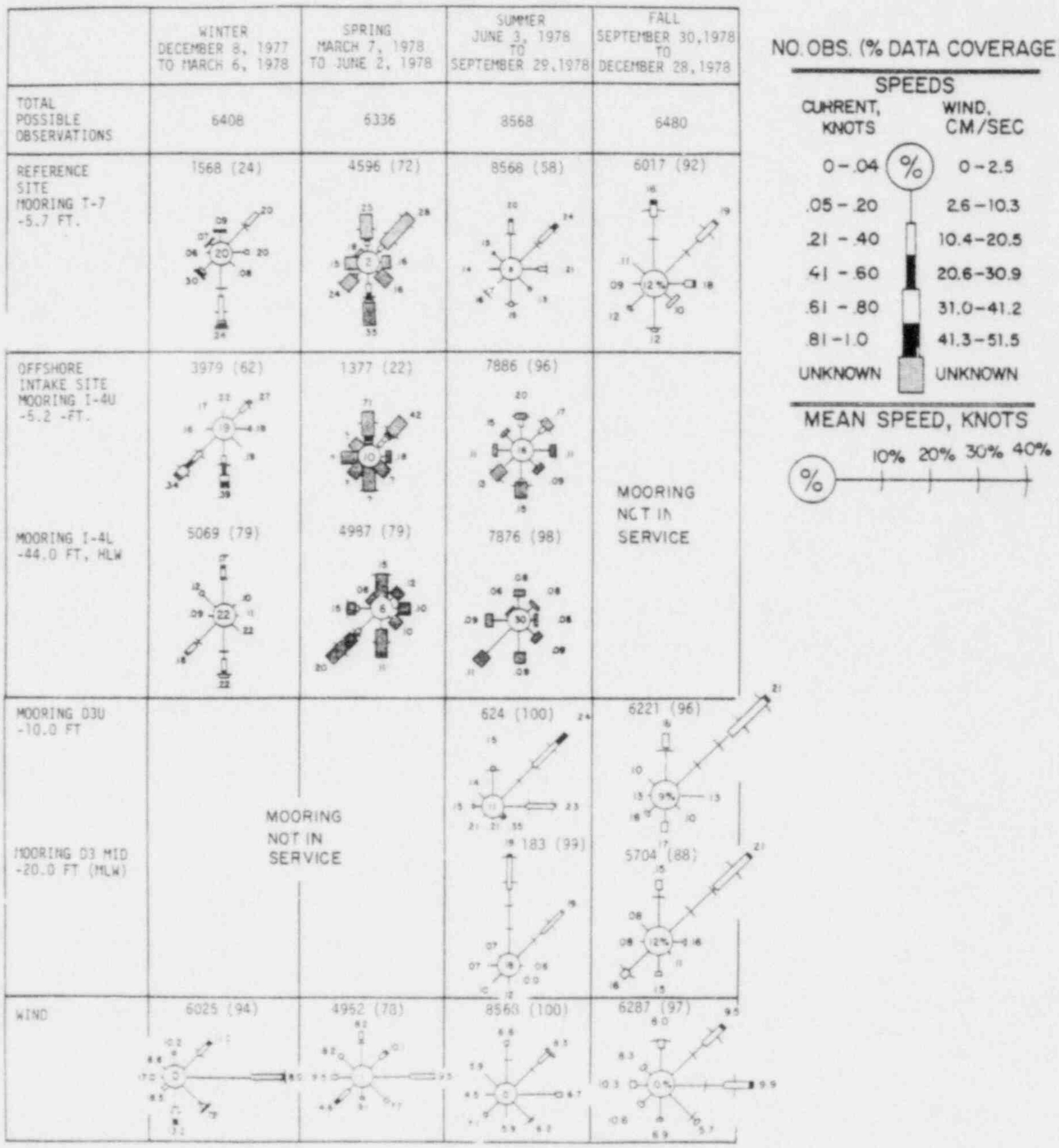


Figure 3.1-3. Seasonal rose diagrams of currents and local winds off Hampton Beach, New Hampshire during 1978. Current and wind diagrams show direction expressed as going toward rather than coming from. Seabrook Annual Hydrographic Report, 1978.

southwesterly, 0.3 kn (15.4 cm/sec) at T-7 and 0.39 kn (20.0 cm/sec) at I-4 upper. The greatest mean speed at I-4 lower was 0.22 kn (11.3 cm/sec) toward the south. Roughly 20% of the current speed recorded during the winter were below threshold, 0.04 kn (2.1 cm/sec).

North and northeasterly components of flow were observed in the spring when the wind was toward the north and northeast. Due to storm problems a large portion of speed data during the spring was questionable. Therefore, mean speed values represent only a small part of the speed data collected. Mean speeds ranged from 0.16 kn (8.2 cm/sec) to 0.42 kn (21.6 cm/sec) at the surface and 0.08 kn (4.1 cm/sec) to 0.20 kn (10.3 cm/sec) at depth. Highest mean speeds were southerly at T-7 and southwesterly at I-4 lower. Six percent of the data were below threshold in the spring.

During the summer months, currents toward the north and northeast had the highest mean speeds both at the surface and at mid-depth at T-7 and D-3. However, speeds were higher at the surface. Mean speeds ranged from 0.20 kn (10.3 cm/sec) toward the north at T-7 to 0.24 kn (12.3 cm/sec) northeasterly at T-7 and D-3 upper. Greatest mean speeds at D3 mid, 0.19 kn (9.8 cm/sec) were north and northeasterly.

Speed data were questionable during a portion of the summer at I-4 upper and lower. Speed and direction distribution were nearly equal in all quadrants at I-4 upper. At I-4 lower, southwesterly mean speeds were slightly higher. For all moorings, twelve percent of the surface data were below threshold, while 24.0% of the measurements at depth were below threshold.

Currents toward the north and northeast continued to predominate throughout the fall. Highest mean speeds were associated with those directions. Maximum mean speeds were 0.19 kn (9.8 cm/sec) northeasterly at T-7 and 0.21 kn (10.8 cm/sec) at D3 upper, also northeasterly. Strong flows were also seen in the north and easterly directions at T-7 and north, south and southwestern quadrants at D3 upper. Mean speeds at D3 mid were highest in the northeasterly direction, 0.21 kn (10.8 cm/sec). High speeds, 0.15 to 0.16 kn (7.8 to 8.2 cm/sec), were also measured in the north, east, south and southwest quadrants. Ten and one-half percent of the data were below threshold speeds at the surface and 12% were below threshold at D3 mid.

Some surface current comparisons can be made between Moorings T-7, I-4 upper and D-3, as they were at approximately the same depths below the surface. Similar current speed and direction data were recorded during much of the time the meters operated. As an example, the speed and direction of the currents were comparable during January at T-7 and I-4 upper. Moderate southeasterly currents changed to strong southwesterly flows. These changes were recorded on both meters. Current speeds were comparable, 0.88 kn (45.2 cm/sec) at T-7 and 0.70 kn (36.0 cm/sec) at I-4 upper. There was also good spatial current comparison in September through December between T-7 and D-3 upper. Speeds and directions were similar, although speeds at T-7 were higher in September and October and D-3 upper speeds were higher in November and December.

Vertical current comparisons were also possible. Mooring I-4 upper and lower were separated by 38.8 ft (11.8 m). Speeds decreased with depth in most instances, approximately 0.1 kn (5 cm/sec) between the upper and lower meters. Current directions were within 30° at any given time during the year.

Meters at D-3 upper and mid were 10 ft (3.0 m) apart. Current direction was comparable during most of the summer and fall. A deviation from this pattern occurred only when shearing between surface water and water at depth occurred. For example, on September 29, surface waters moved toward the southeast, while water at mid-depth flowed toward the northeast. The shearing appeared to be the result of wind toward the southeast affecting the surface waters. A wind shift toward the southwest ended the episode and both meters recorded flow to the northeast. Speeds, at that time, were nearly equal.

3.1.2 Tide

Tide height was measured continuously at the Hampton Harbor Marina during 1978.

Tide measurements agreed closely with predicted tide values. Yearly average tides at Hampton Harbor were within 7 minutes of the predicted semi-diurnal tide. Tidal range was within ± 0.1 ft (0.03 m) of the 8.3 ft (2.5 m) prediction. Table 3.1-1 shows the monthly maximum and minimum tidal ranges at Hampton Harbor. The highest high tide, 12.1 ft (3.7 m) was associated with the "Blizzard of 1978", during which, a large low pressure system stalled offshore of New England from February 6 to 9, 1978. The lowest low tide, estimated at -5.4 ft (-1.6 m) was observed during that storm period. In most cases, extreme tides were associated with spring and neap tides. Where storms influenced the maximum and minimum tide level, it is noted.

TABLE 3.1-1. MAXIMUM AND MINIMUM MONTHLY TIDAL HEIGHTS[a] MEASURED AT HAMPTON HARBOR. SEABROOK 1978 ANNUAL HYDROGRAPHIC REPORT, 1979.

	MAXIMUM HEIGHT			MINIMUM HEIGHT			
MONTH	FT	(m)	DAY	FT	(m)	DAY	COMMENT
J	11.6	(3.5)	9	-3.8	(-1.1)	11	
F	12.1	(3.7)	6	-5.4[b]	(-1.6)	9	storm
M	9.1	(2.8)	9	-1.5	(-0.5)	25,26	
A	9.3	(2.8)	26	-1.5	(-0.5)	23	
M	9.3	(2.8)	24	-2.7	(-0.8)	23	storm
J	10.3	(3.1)	21	-2.9	(-0.9)	24	
J	9.9	(3.0)	19	-3.3	(-1.0)	6	
A	10.3	(3.1)	20	-1.3	(-0.4)	20	
S	9.8	(3.0)	16	-1.6	(-0.5)	14	
O	9.7	(2.9)	14	-1.3	(-0.4)	15	storm
N	9.9	(3.0)	30	-2.3	(-0.7)	2	storm
D	10.4	(3.2)	25	-2.7	(-0.8)	2	storm

[a]Relative to mean low water (MLW).

[b]Extrapolated from stripchart record

3.1.3 Wind

Seasonal variation in local wind speed and direction was observed during 1978 (Figure 3.1-3, Appendix 7.0-3 and 7.0-2f). During the winter months, a westerly wind predominated. Winds from the north and northwest were of secondary importance. Highest wind speeds, with a significant number of observations, were from the north with a mean speed of 13.2 kn (6.8 m/sec). Other mean speeds ranged from 7.8 kn (4.0 m/sec) to 11.2 kn (5.7 m/sec) in the northwest and southwest directions, respectively.

Westerly winds were recorded most frequently in the spring. The highest mean speed was 14.6 kn (7.5 m/sec) from the northeast. This was the highest mean speed value of the year. The mean speed from the southwest was 10.1 kn (5.2 m/sec) and easterly and westerly winds had mean speeds of 9.5 kn (4.9 m/sec).

The wind speeds were lowest during the summer months. Summer wind speeds from the southwest averaged 8.3 kn (4.3 m/sec). The predominant directions were southwest and west.

Wind speeds increased in the fall. Southwest and west were the two most observed directions. Mean speeds from the southwest and west were 9.9 kn (5.1 m/sec) and 9.5 kn (4.9 m/sec), respectively. However, highest mean speeds were from the northeast, 10.6 kn (5.4 m/sec) and east, 10.3 kn (5.3 m/sec).

3.2 WATER TEMPERATURE

3.2.1 Temporal Variation

Water temperature is primarily controlled by solar radiation. Winds, currents, precipitation and estuarine discharge may locally affect water temperature. The interaction of these factors caused the temperature to vary seasonally. Summaries of monthly means of daily maxima, daily mean and daily minima of temperature at Moorings I-4 and T-7 are presented on Figures 3.2-1 and 3.2-2. Data from Moorings D-3, B and HH are presented in Appendix Figures 7.0-4 to 7.0-6. Comparison of 1978 data with all survey years are printed in Appendix 7.0-7.

Lowest surface temperatures were recorded in February, approximately 30 days later than the coldest air temperatures. Strong vertical mixing during the late winter created isothermal conditions throughout the nearshore water column breaking down an inverse (cooler surface water) thermal stratification.

Temperatures began to increase in April and May. A thermocline developed as a result of vertical salinity stratification produced by spring runoff, enhanced the thermocline's development. Subsurface moorings, I-4 mid and lower, showed much slower warming. In summer, the thermocline continued to deepen, as warmer surface waters were mixed vertically. Highest temperatures were recorded in August, approximately 30 days behind the maximum air temperatures. Decline of temperatures began in September and continued through December. During the winter, waters were well mixed by winds. Temperatures were nearly isothermal.

Contours of surface water temperature during low slack water for the offshore transect are shown on Figure 3.2-3. Except during the summer, there was no offshore gradient in surface water temperatures. In all months but February and March, surface water within the harbor was slightly warmer than SMOOR5 and SMOR12. Beginning in late May and extending through September, harbor waters warmed steadily. Offshore waters warmed at a much slower rate and an offshore gradient in temperature was established. Maximum temperatures were reached in August. With decreasing water temperatures in the fall, the offshore gradient of surface water temperature decreased.

Contours of bottom water during low slack water were similar to the surface profiles. Bottom water was generally cooler offshore.

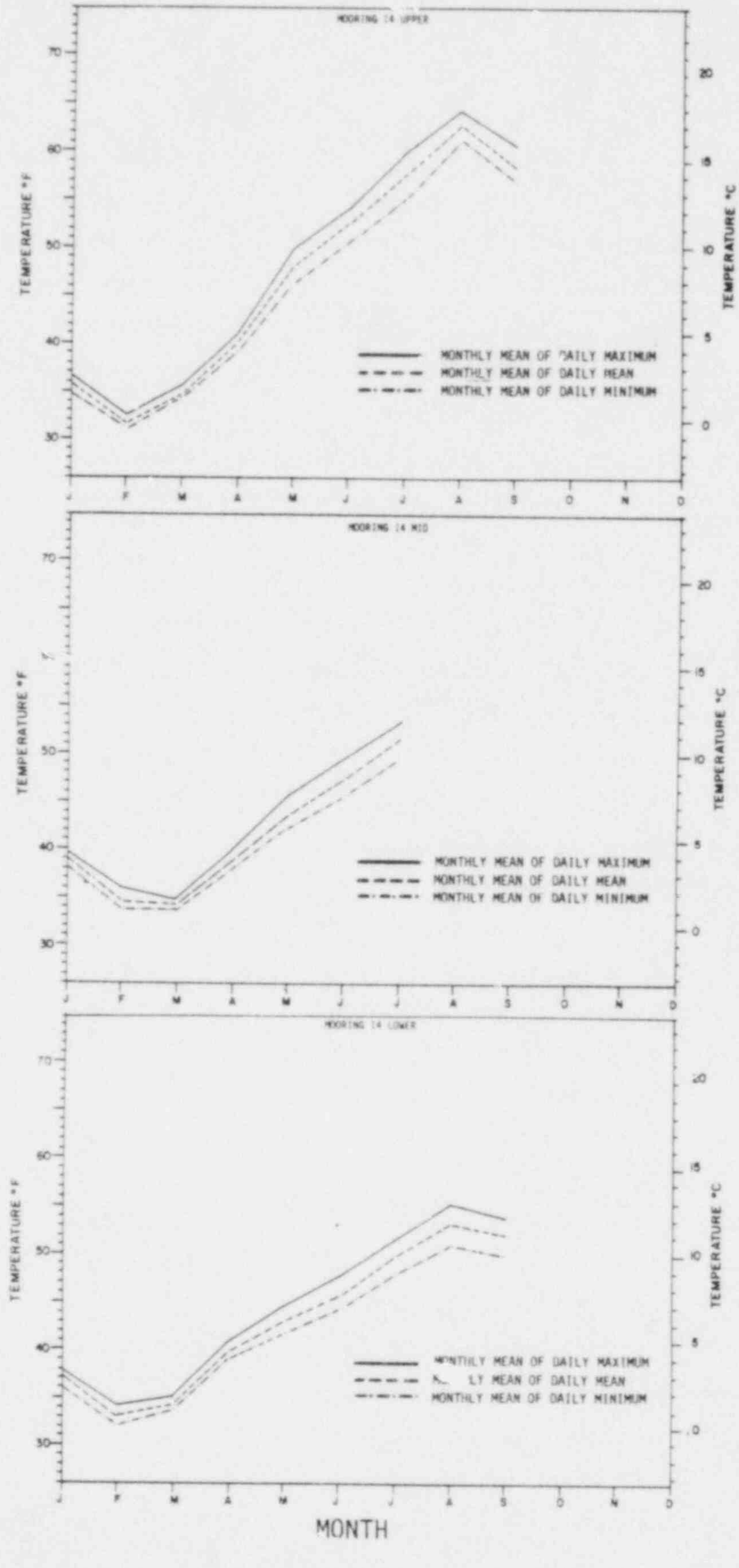


Figure 3.2-1. Summary plots of the monthly means of daily maxima, daily mean and daily minima of temneratures at Mooring I-4 during 1978. Seabrook Annual Hydr... phic Report, 1978.

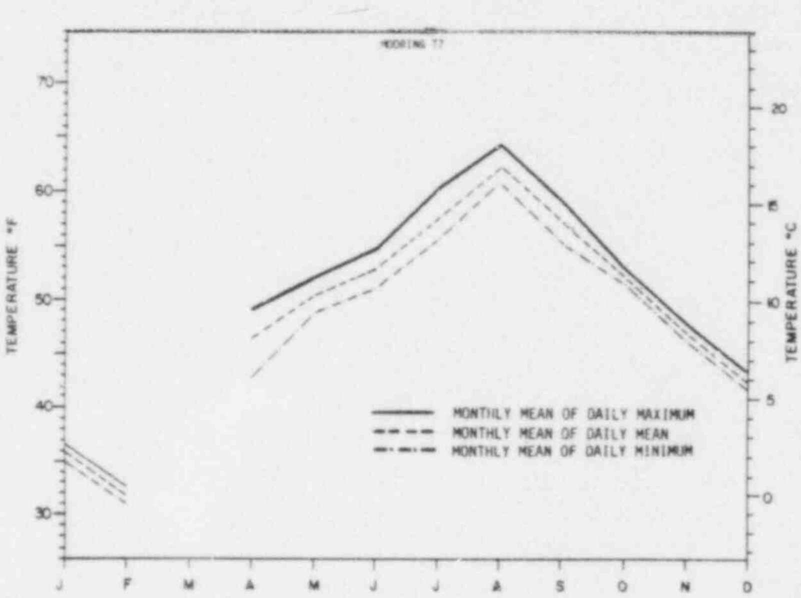


Figure 3.2-2. Summary plots of the monthly means of daily maxima, daily mean and daily minima of temperature at Mooring T-7 during 1978. Seabrook Annual Hydrographic Report, 1978.

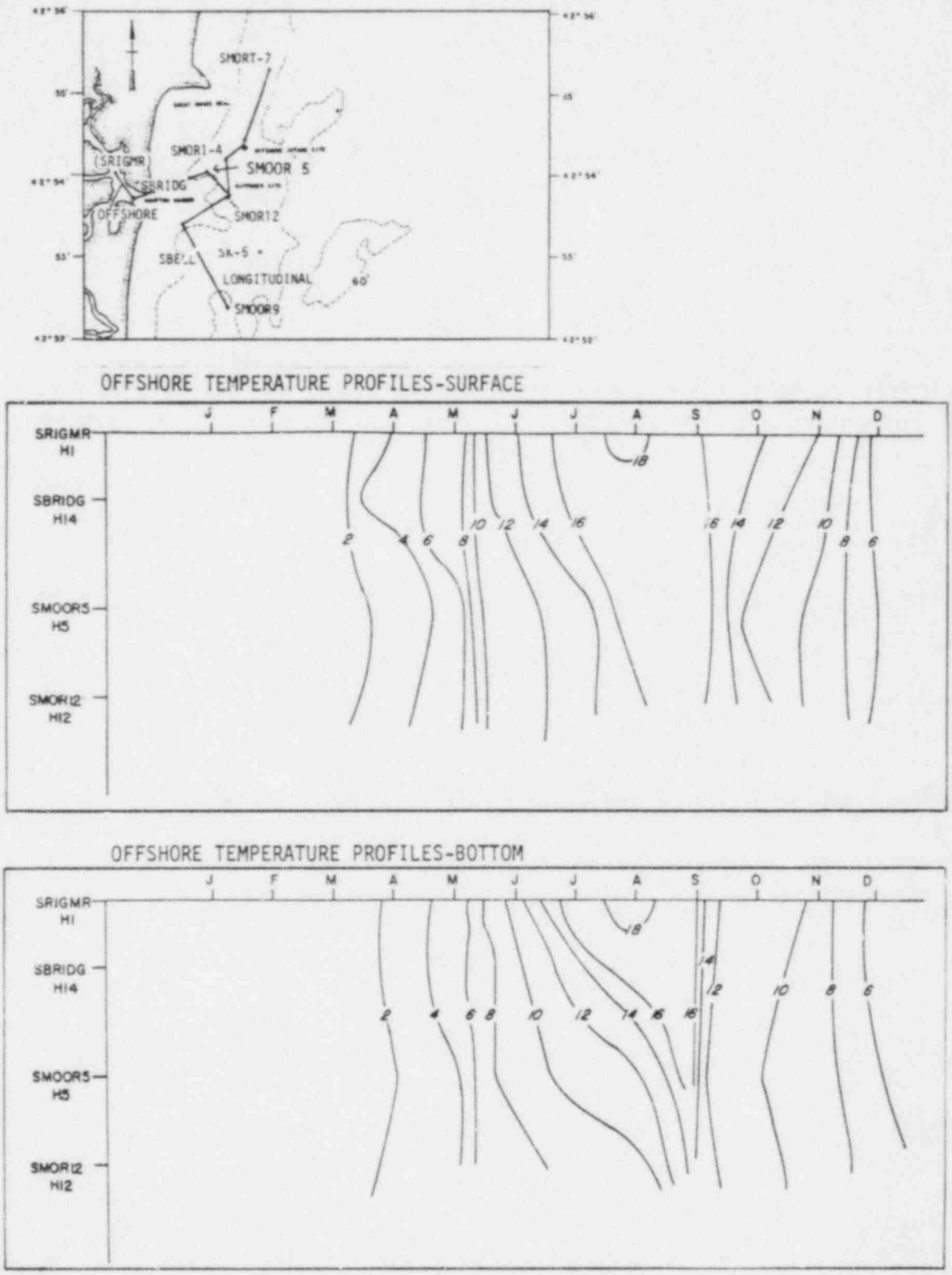


Figure 3.2-3. Offshore temperature profiles from slack water surveys conducted during ebb and low water in 1978. Contour interval is 2C. Seabrook Annual Hydrographic Report, 1978.

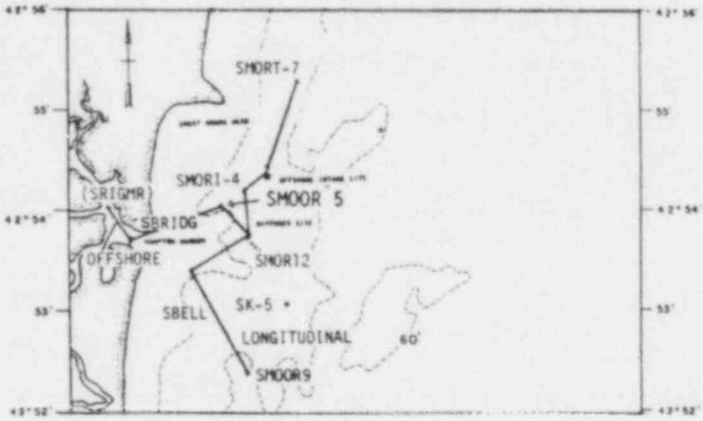
In May, the influence of vertical temperature stratification could be seen and was most pronounced during August and early September. In the fall, the bottom water lacked an offshore gradient indicating vertically isothermal conditions. Variations between surface and bottom temperatures during ebb tide were greatest during August, when the thermocline had not reached sufficient depth to include the bottom water at SMOR12.

The influence of warmer estuarine waters was less pronounced during high slack water (Figure 3.2-4). At the surface, no offshore thermal gradient was observed through late May. Warmer surface water was measured late June through August, although the temperatures were not as high as surface water on the ebb. Warmer estuarine waters were not seen beyond SMOOR5. By September, cooling began and isothermal conditions returned.

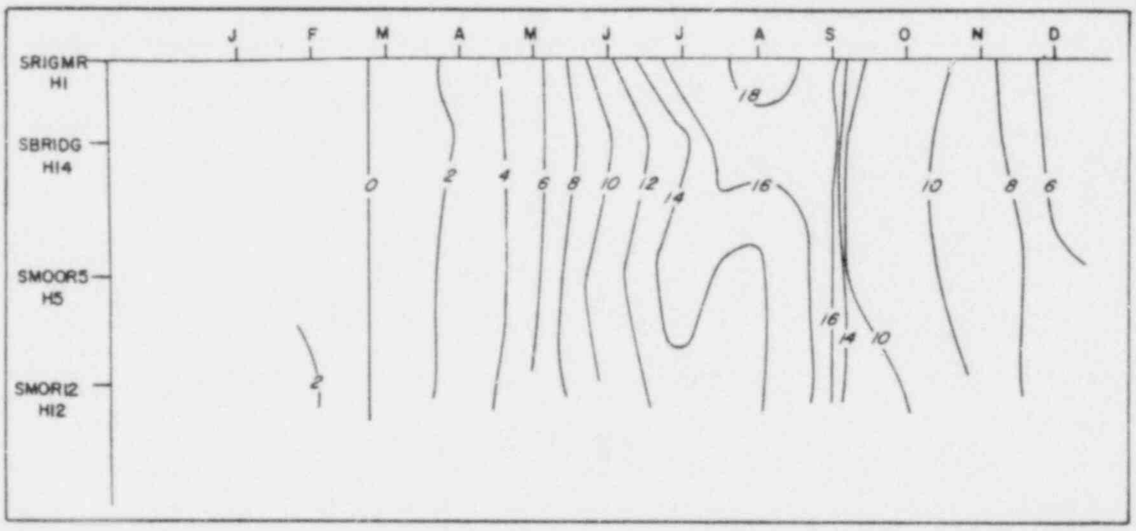
Warmed water at the bottom during high and low water and ebb were seen in the summer. Highest temperatures were measured at SRIGMR, the shallowest station. An offshore gradient extended to SMOOR5 in August, but the water column was isothermal again in the fall.

Longitudinal profiles of temperature were constructed similarly. No alongshore thermal gradient was observed at the surface during low slack water (Figure 3.2-5). The temperature variation between SMORT7 and SMOOR9, a distance of about 3.5 n mi, was less than 1.0°C (1.8°F) throughout the year. Warmest surface temperatures were measured in late August and coldest temperatures in February.

No alongshore thermal gradients were observed at the bottom through June. From July until October, warmer bottom temperatures were seen at the shallower stations. This was pronounced in late August when the temperature at SMORI-4 was 17.0°C (62.6°F) and at SMORT7 to the north, the temperature was 11.5°C (52.7°F). Similar conditions lasted through late October. The absence of the alongshore gradient returned in November.



OFFSHORE TEMPERATURE PROFILES-SURFACE



OFFSHORE TEMPERATURE PROFILES-BOTTOM

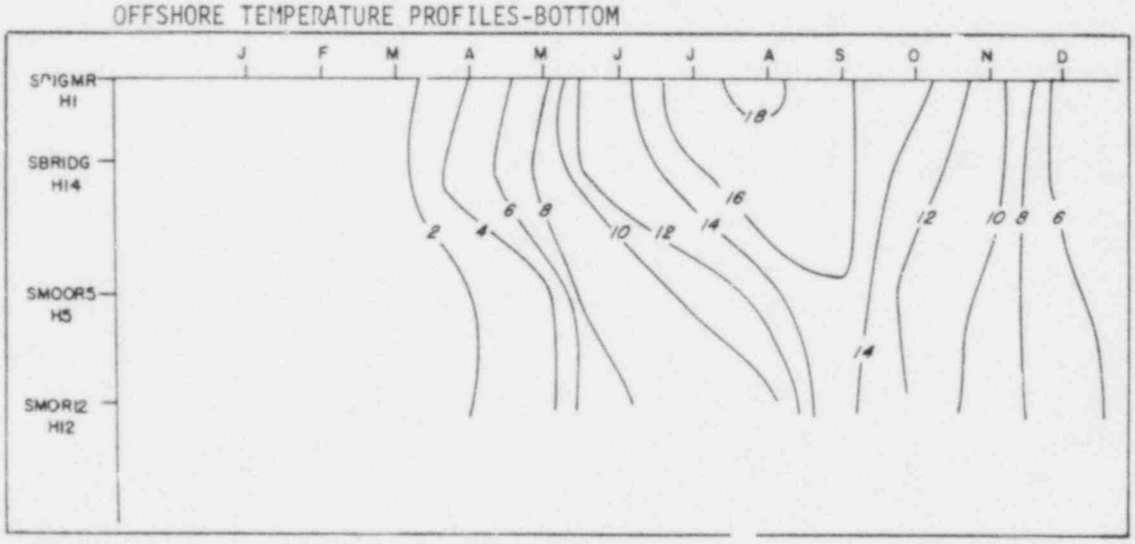


Figure 3.2-4. Offshore temperature profiles from slack water surveys conducted during flood and high water in 1978. Contour interval is 2C. Seabrook Annual Hydrographic Report, 1978.

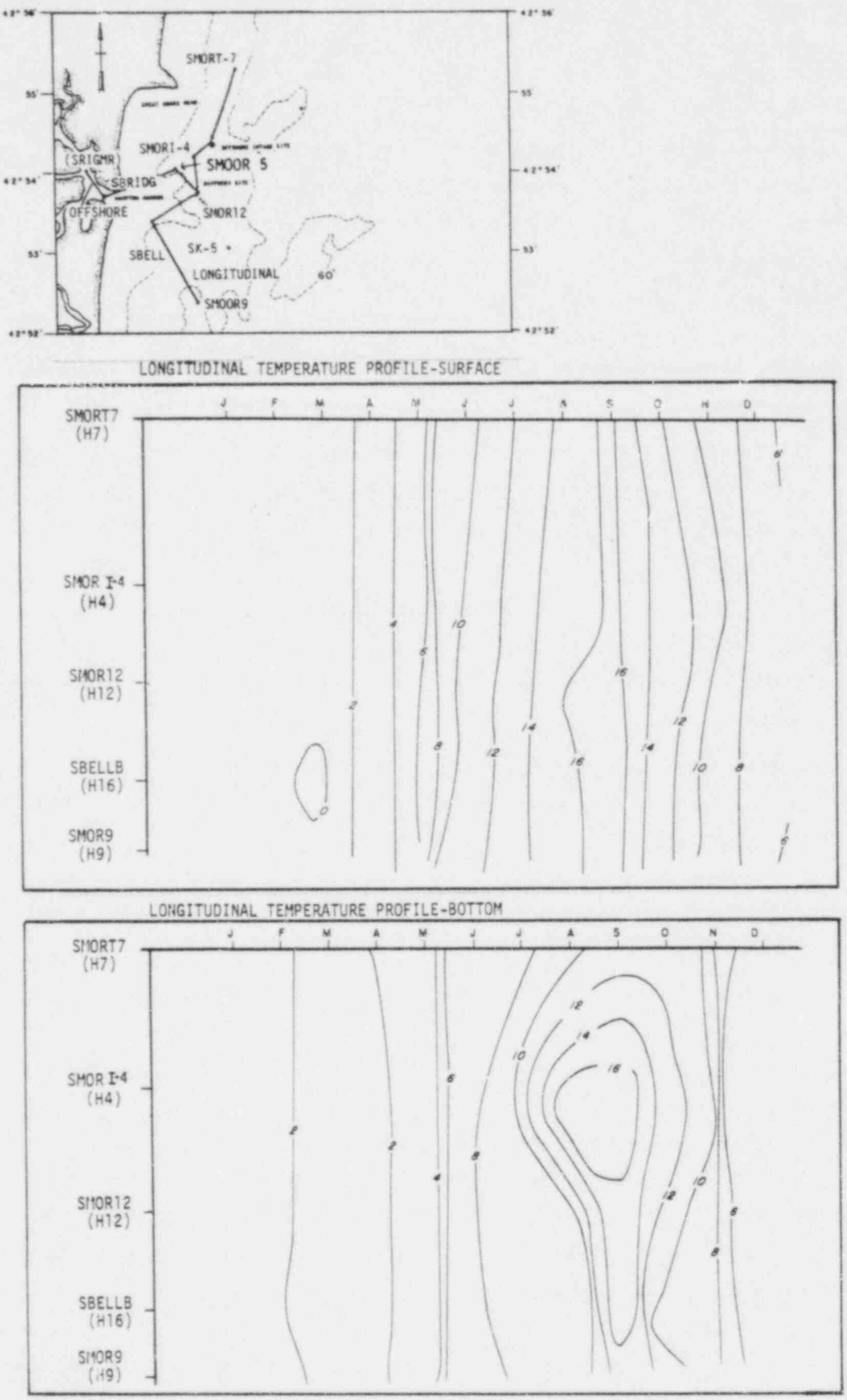


Figure 3.2-5. Longitudinal temperature profiles from slack water surveys conducted during ebb and low water in 1978. Contour interval is 2C. Seabrook Annual Hydrographic Report, 1978.

Temperature contours during high slack water were similar. These profiles are shown on Figure 3.2-6. The surface water showed no alongshore gradient. The bottom profiles showed little gradient except during August and early September when warmest air temperatures were recorded during that time also. Warmer temperatures were measured at SMORI-4 and SMORT7. The depth of the thermocline exceeded the sampling depths at SMORI-4 and SMOR-12 during August and early September. Isothermal conditions throughout the entire local water column returned in late October.

The vertical distribution of temperature observed during the slack water surveys at SMORT7 and SMOR12 is presented on Figure 3.2-7. Vertical thermal stratification was observed late May through September. Except for some slight thermal stratification in early May, the water column was relatively isothermal throughout the year. During periods of maximum thermal stratification, there was at least a 5°C (9°F) vertical gradient in temperature in the upper 8 to 20 m (26.2 to 65.6 ft) of the water column.

3.3 SALINITY

3.3.1 General

Precipitation and discharge greatly affect salinities of the coastal waters in the western Gulf of Maine (Graham, 1970 and NAI, 1979b). Inches of precipitation (water equivalent) measured at Concord, New Hampshire during 1978 is shown on Figure 3.3-1. The region from Cape Ann, Massachusetts northward to Cape Elizabeth, Maine, about 90 percent of the drainage basin is comprised of the Merrimack River, Piscataqua River and Saco River systems. Mean monthly discharge data from the most downstream U.S. Geological Survey gauging stations on each basin were compiled to determine approximate runoff into the coastal waters (Figure 3.3-2).

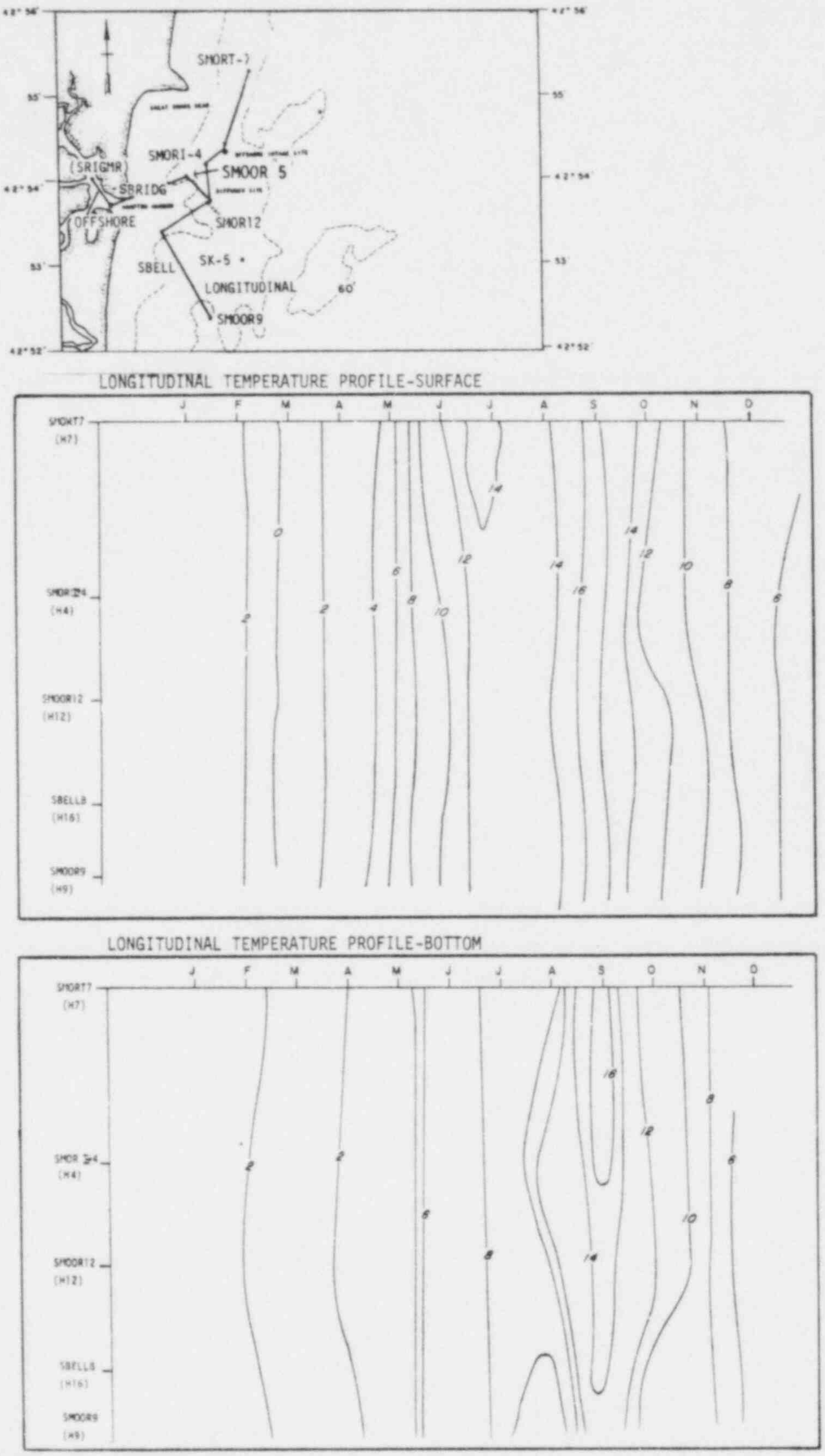


Figure 3.2-6. Longitudinal temperature profiles from slack water surveys conducted during flood and high water in 1978. Contour interval is 2C. Seabrook Annual Hydrographic Report, 1978.

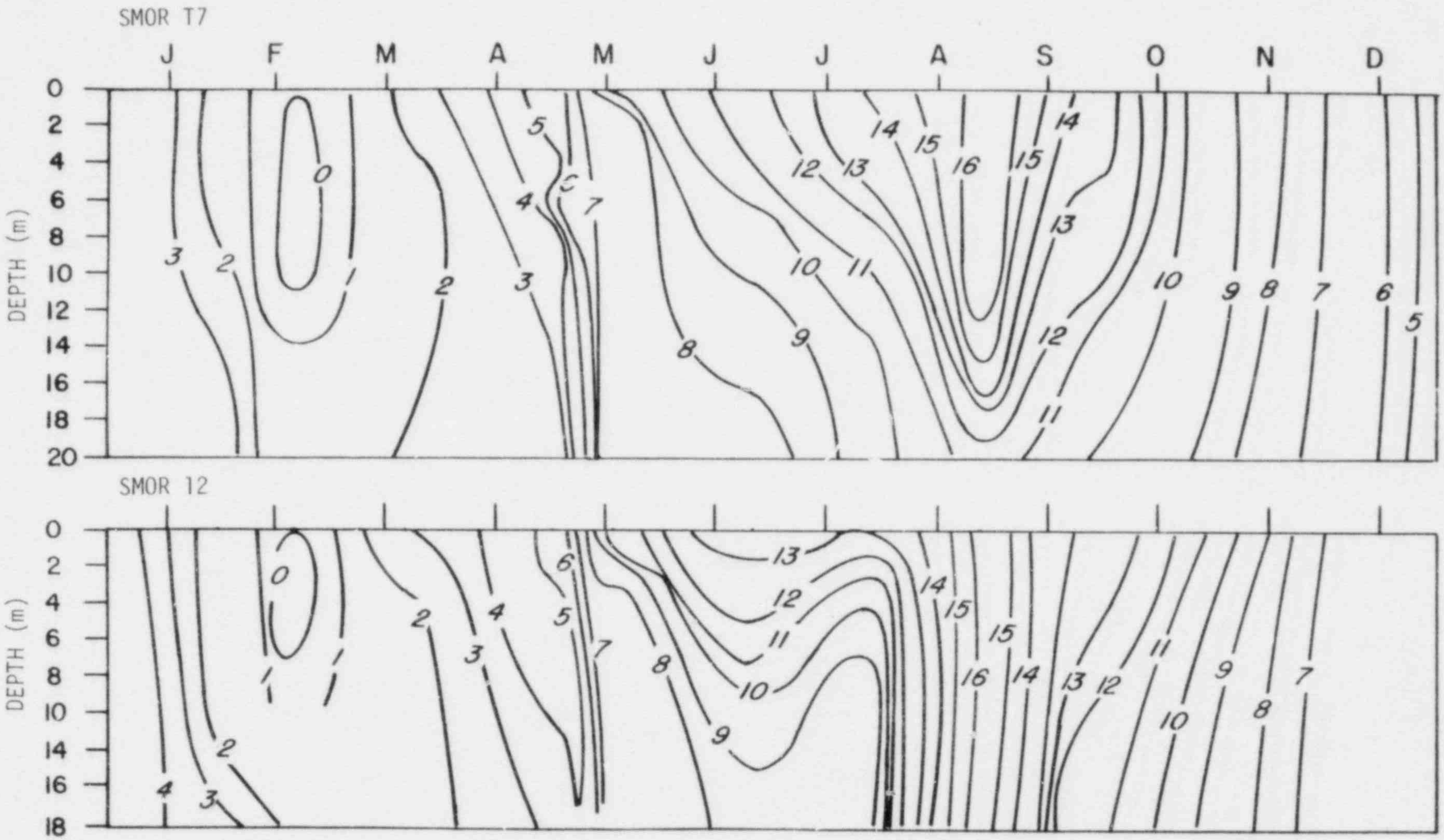


Figure 3.2-7. Vertical distribution of temperature at SMORT 7 and SMOR 12 during 1978. Contour interval is 1C. Seabrook Annual Hydrographic Report, 1978.

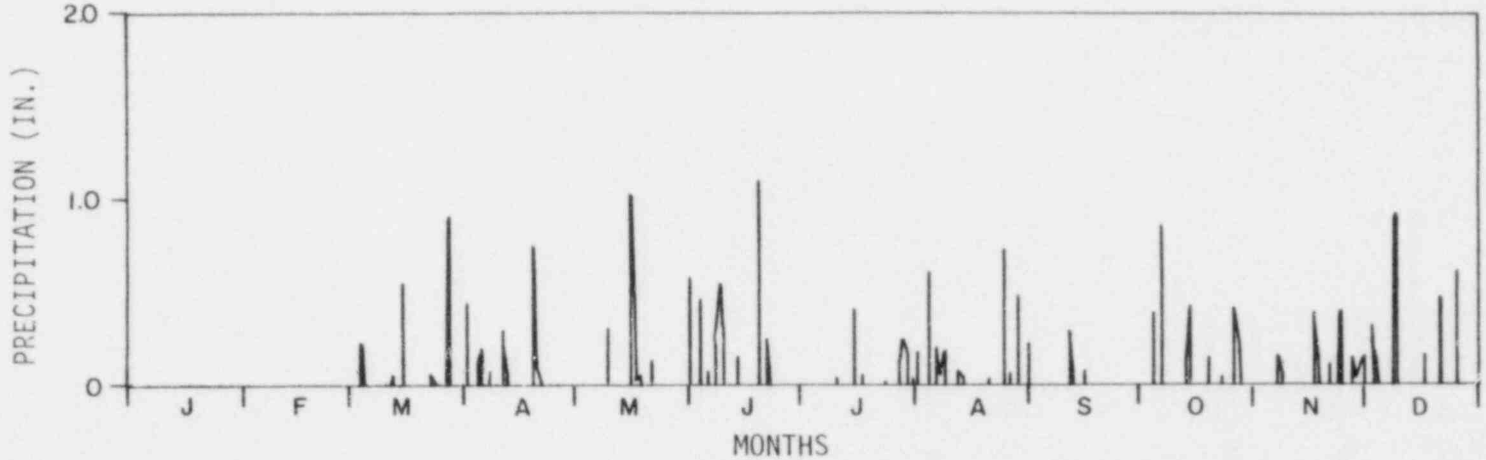


Figure 3.3-1. Daily precipitation (in inches of water equivalent) for Concord, New Hampshire during 1978. Seabrook Annual Hydrographic Report, 1978.

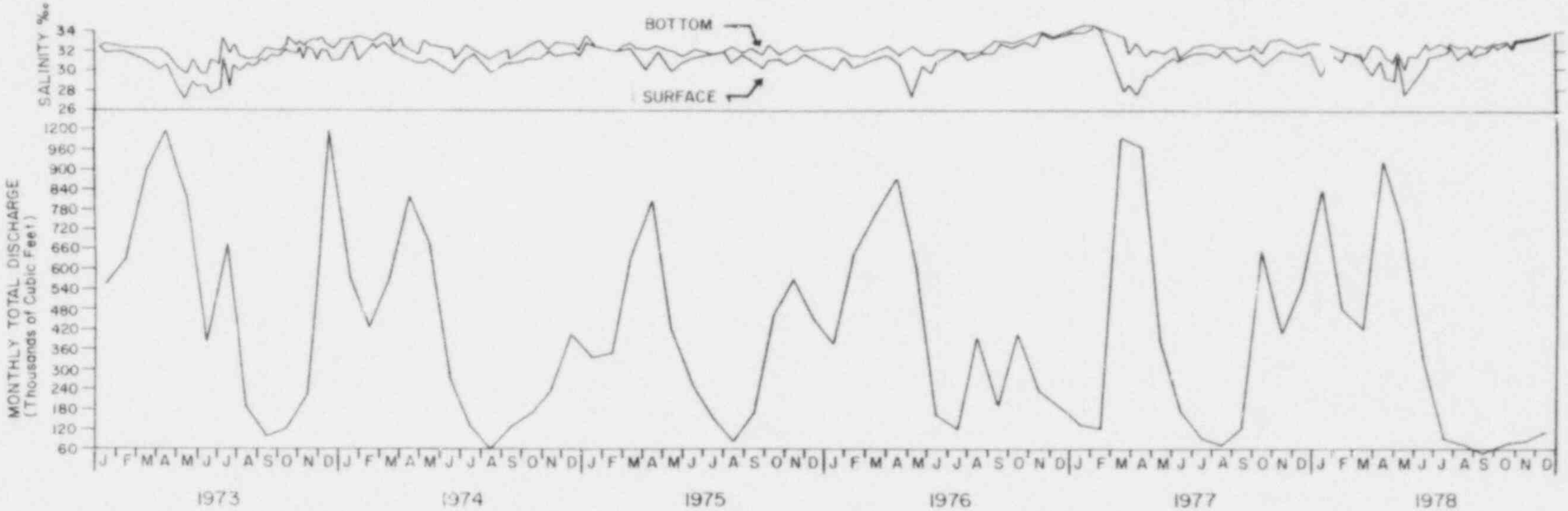


Figure 3.3-2. Plots of mean near-surface and near-bottom salinities from hydrographic surveys of coastal waters off Hampton Beach, New Hampshire and mean monthly discharge from the Merrimack, Piscataqua and Saco Rivers combined for 1973 through 1978. Seabrook Annual Hydrographic Report, 1978.

3.3.2 Temporal Variation

Offshore salinities, measured during slack water surveys, were in the 28% to 34% range in 1978, with values typically between 31% and 33% (Figure 3.3-2). Lowest offshore seasonal values were recorded in May, during the period of maximum local runoff, while maximum values were recorded in December, during the season of lowest discharge. These relationships are similar to those observed in previous years (Figure 3.3-2).

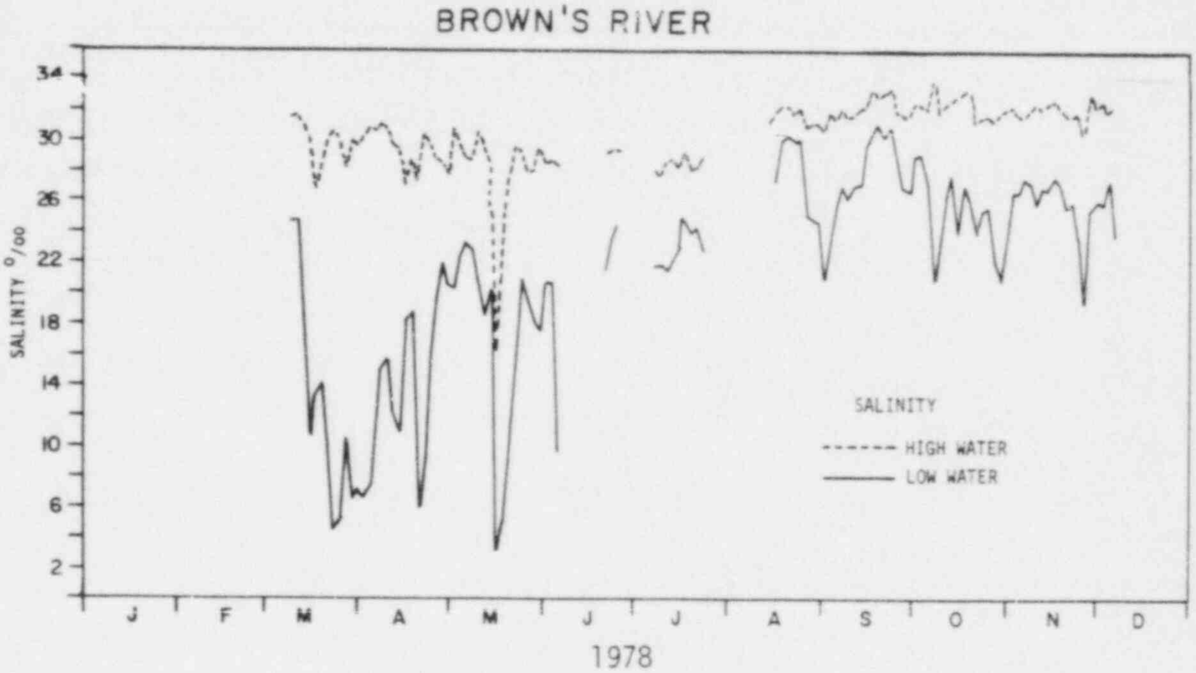
Estuarine salinity, using the *in situ* recorders, was measured partially in 1978 in Browns River and Hampton Harbor (Figure 3.3-3). The available Hampton Harbor data exhibited a similar temporal distribution as observed in Browns River except there was little difference between high and low water during that time of the year (fall).

Low water salinity values in the Browns River varied from season to season. Lowest salinities were recorded in March, April and May when freshwater runoff was greatest; values ranged from less than 5°/oo to 25°/oo. Salinities were higher in the summer, 22 to 26 $^{\circ}$/oo, as freshwater input was minimal. Values continued to rise throughout the fall, reaching a maximum of greater than 31°/oo in September. Salinity values were less variable in the late fall and winter, averaging about 26°/oo.

Salinity measurements from high water varied little throughout the year at Browns River except during heavy spring rainfall periods. Salinity decreased only 2 to 3 $^{\circ}$/oo during the spring period of greatest runoff falling to 17°/oo in May. Highest values were recorded in September and October peaking at 34°/oo. Average salinities in the fall were 32°/oo.

3.3.3 Spatial Variation

Offshore and longitudinal salinity profiles were prepared using slack water survey data. Stations used for salinity contours were identical to those used for the temperature contours. Nearshore salin-



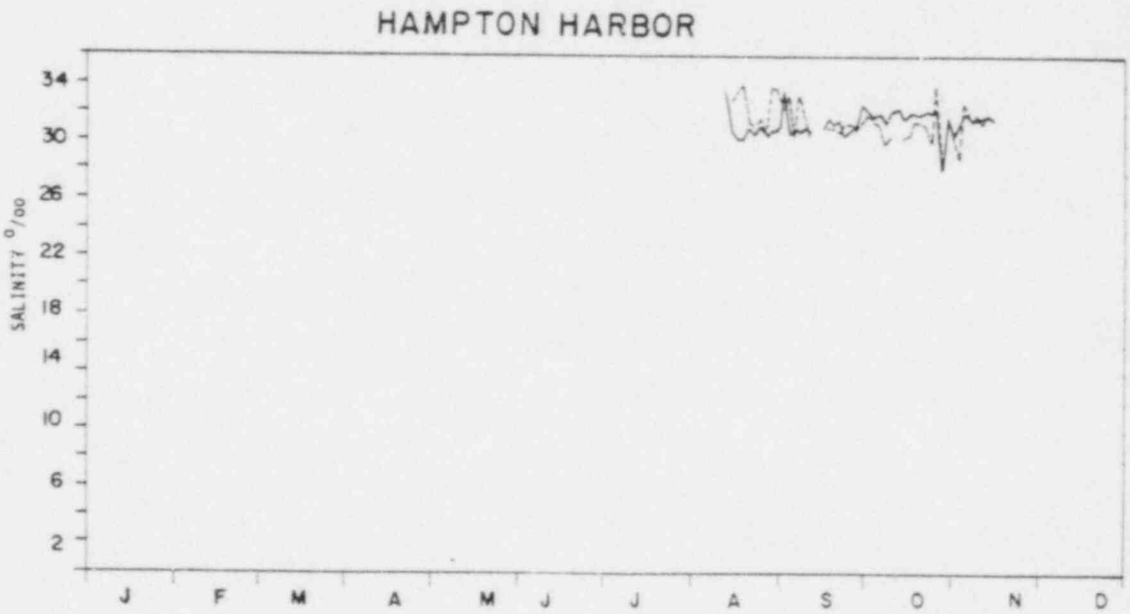


Figure 3.3-3. High and low water salinity (calculated from temperature and conductivity measurements) in Browns River in 1978. Seabrook Annual Hydrographic Report, 1978.

ity was affected by estuarine discharge during periods of spring runoff (Figure 3.3-4). During March, April and May when freshwater runoff was greatest, surface salinities at the Hampton Harbor Station were as low as 15 ^{o}/oo on the ebb tide. However, these less saline surface waters did not extend to SMOOR5 (Figure 3.3-4). The surface water was nearly isohaline during low slack water during the remainder of the year.

Bottom salinities during low slack water were also lowered in response to the spring freshwater runoff period (Figure 3.3-4). Lowest values were in May, 19^{o}/oo, the lower salinity water extended to SMOOR5. Throughout the rest of the year, bottom salinities ranged from 32 to 33 ^{o}/oo.

Offshore contours from high slack water data showed a different salinity pattern. At the surface, salinities varied little between stations (Figure 3.3-5). Salinities ranged from 26 to 33^{o}/oo during most of the year. Some less saline water was noticed at the surface at SMOOR5, but it was attributed to sampling done near the change of tide. During high slack water at the bottom, very little change in salinity was seen throughout the year. Salinities ranged from 29 to 33 ^{o}/oo.

Longitudinal (long shore) profiles from low slack water data are shown on Figure 3.3-6. Isohalines ran alongshore during most of the year. During April, May and June, lower surface salinities, 27 to 29 ^{o}/oo, were measured at SMOOR9 and SBELLB. Lowest salinity values were confined to the surface. Salinities ranged from 31-32 ^{o}/oo at the bottom.

Surface contours constructed from high slack water data were similar to the ebb and low water profiles (Figure 3.3-7). During May, lower salinity water, 28 ^{o}/oo, was seen at the north and south ends of the study area. Lowest salinities were confined to the surface. Bottom salinities varied little throughout the year, 31 to 33 ^{o}/oo.

Salinity stratification was related to freshwater discharge. There was no stratification during the winter months. With the spring

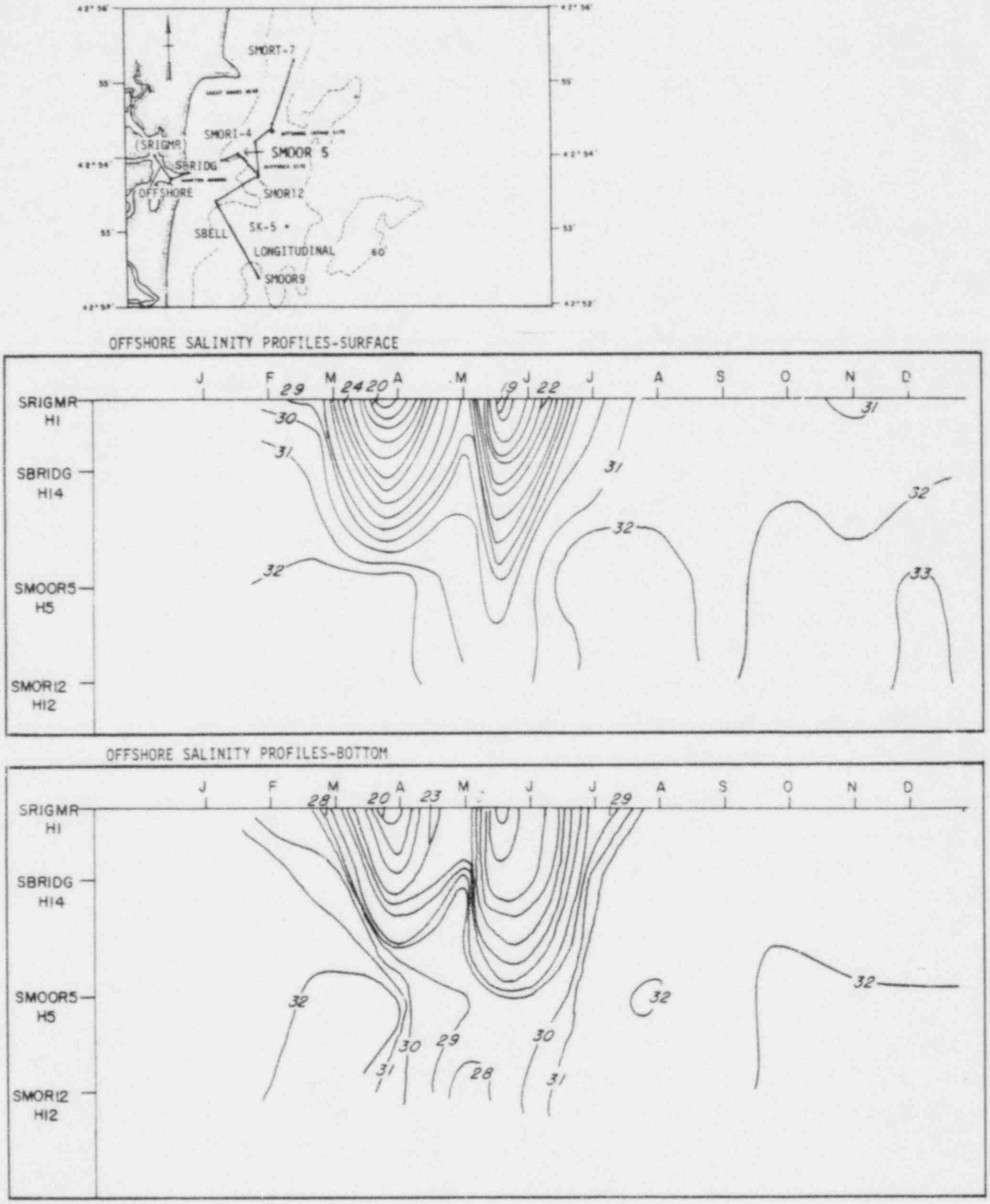


Figure 3.3-4. Offshore salinity profiles from slack water surveys conducted during ebb and low water in 1978. Contour interval of 1 $^{o}/oo$. Seabrook Annual Hydrographic Report, 1978.

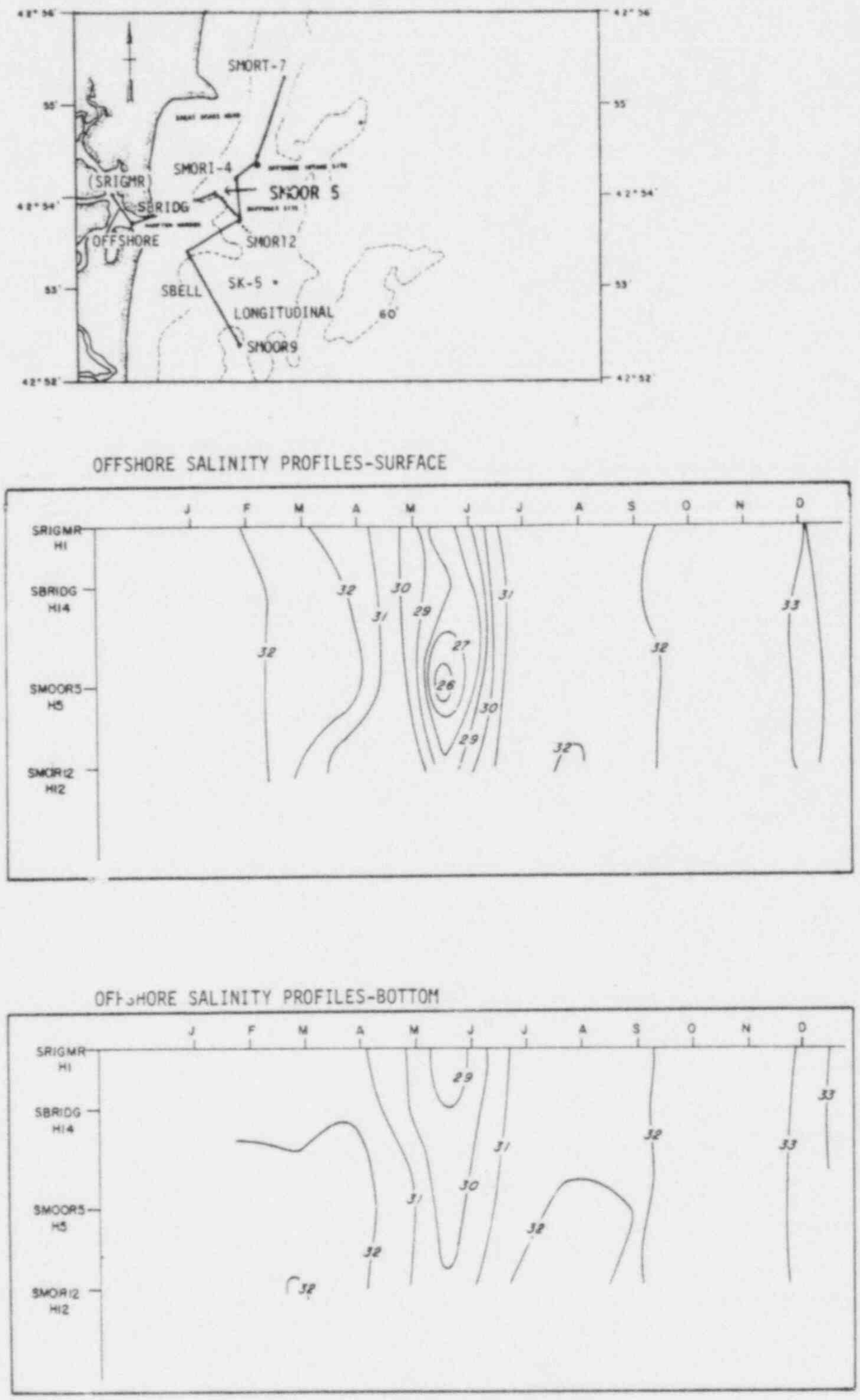


Figure 3.3-5. Offshore salinity profiles from slack water surveys during flood and high water in 1978. Contour interval is 1 $^{o}/oo$. Seabrook Annual Hydrographic Report, 1978.

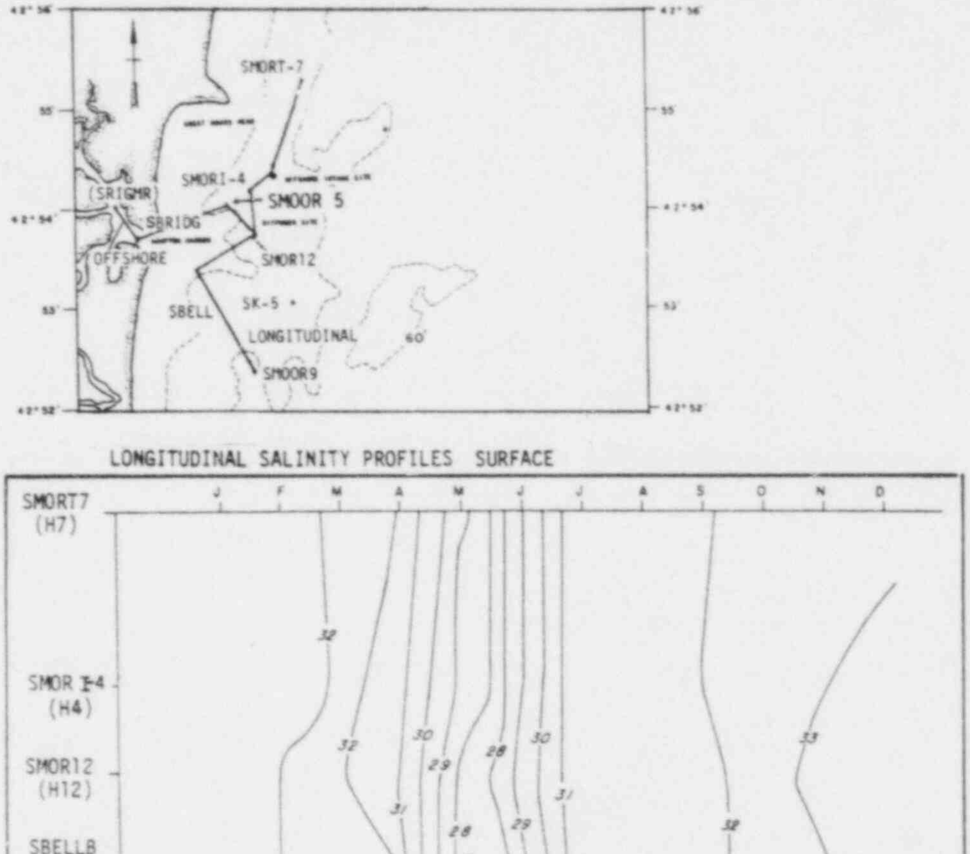


Figure 3.3-6. Longitudinal salinity profiles from slack water surveys conducted during ebb and low water in 1978. Contour interval is 1 ‰. Seabrook Annual Hydrographic Report, 1978.

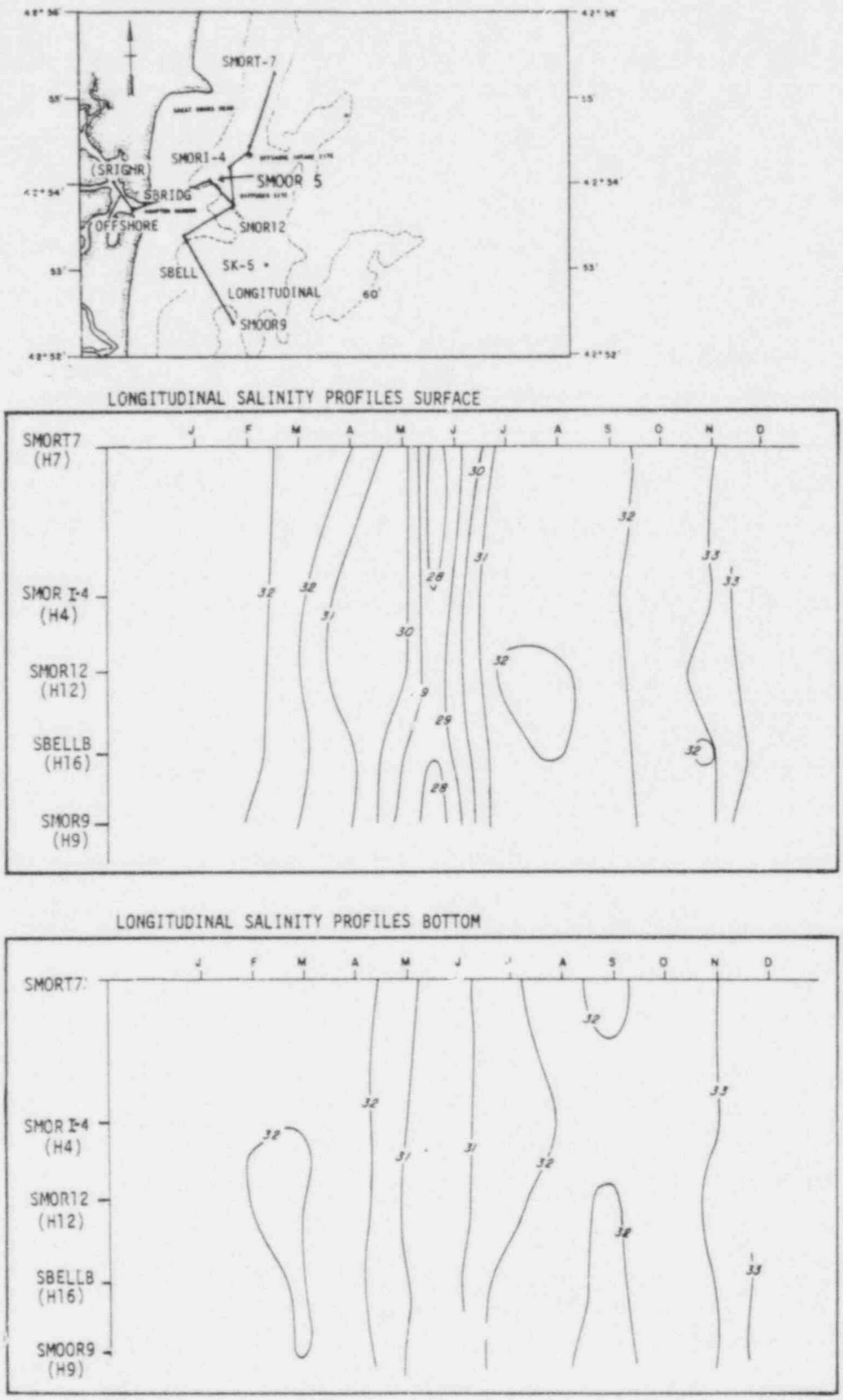


Figure 3.3-7. Longitudinal salinity profiles from slack water surveys conducted during flood and high water in 1978. Contour interval is 1 $^{0}/oo$ Seabrook Annual Hydrographic Report, 1978.

freshwater runoff, however, the halocline developed. Lower salinity water remained at the surface and higher salinities were measured at depth throughout the summer. In autumn, the halocline and thermocline broke down because of very little freshwater discharge and mixing of the surface and bottom water. Isopycnal conditions remained throughout the winter.

3.4 DENSITY

Seawater density is controlled by temperature and salinity. A temperature vs. salinity diagram, Figure 3.4-1, was constructed using surface and bottom data from all low slack water survey stations. To simplify the diagram, only the area encompassing the distribution of data points for each survey are plotted.

During the winter months, the coastal water was cold and very saline. "Stringers" to the left on the diagram indicate warmer temperatures measured within the harbor. In the spring, especially in May, water temperatures increased 5 to 10°C (9 to 18°F) and salinity decreased greatly. These abrupt changes were related to the increased amount of freshwater added to the system. Temperature and salinity rose throughout late spring and summer. Highest water temperatures were measured in August. In September, temperatures began to fall and decreased continuously into December. Salinity values decreased slightly in October, in response to some autumnal runoff. Throughout the rest of the year salinity remained high, 32 to 34 $^{o}/oo$.

Density distributions varied throughout the year. Coastal waters were densest in the late fall and early winter; maximum observed density was 26.3 sigma-t units. During that time there was minimal vertical density stratification (less than 0.5 units at the coastal water stations). The pycnocline developed by late May in response to freshwater entering the coastal waters and atmospheric warming. Vertical density stratification of up to 5.0 units were observed (SGONG). The development of stratification continued throughout the summer. Sigma-t valuve ranged from 21.4 to 25.8 units. In the fall mixing of the water column created isopycnal conditions; vertical variation in density less than 0.8 units at that time.

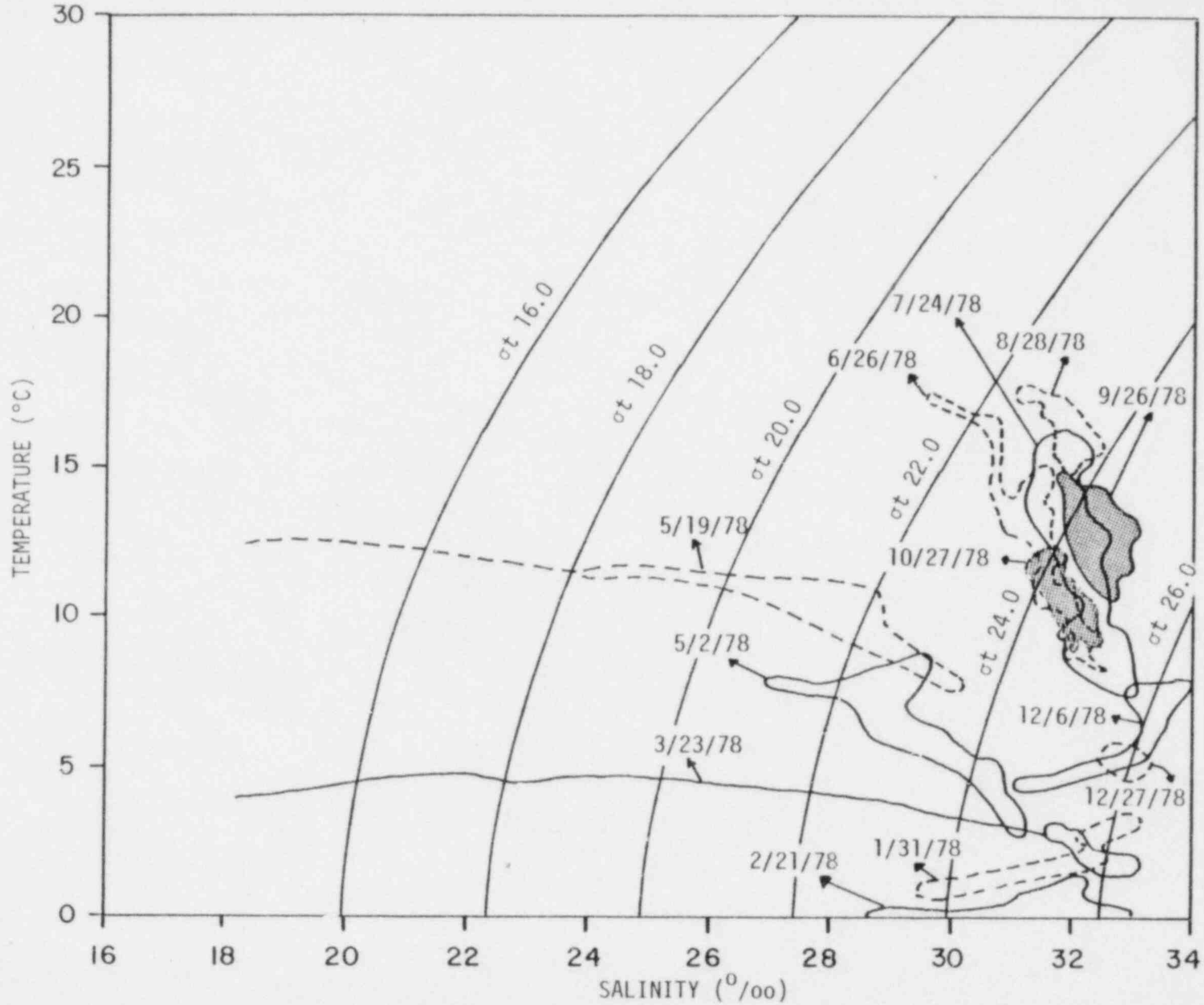


Figure 3.4-1. T-S diagram, with contours of sigma-t, constructed using slack water survey data in 1978, showing density characteristics of the coastal water mass. Seabrook Annual Hydrographic Report, 1978.

3.5 DISSOLVED OXYGEN

Highest dissolved oxygen values were observed in late winter, 11.6 mg/l. Lowest values were recorded in late summer, 7.2 mg/l. No consistent relationship was observed between the data and tide stage or depth.

Dissolved oxygen values varied about 6.0 mg/l over the year, and the data did not seem to be salinity dependent. Large variations in salinity did not change dissolved oxygen data.

Temperature had a pronounced effect on the amount of dissolved oxygen in the water column. Dissolved oxygen vs. temperature from the slack water survey stations is plotted on Figure 3.5-1. During the winter and spring, temperatures were low and dissolved oxygen was highest. When temperatures warmed, the dissolved oxygen values decreased and spatial/tidal effects were most noticeable. Minimum D.O. values were measured in July, and August when water temperatures were highest. Temperature effects were most noticeable during the July 24th cruise when high temperature/low D.O. values were observed at the estuarine stations (H1, H14) during low slack tide. Noticeably higher D.O. values were observed at both tide stages in the colder bottom waters (8.2°C) at marine stations H4 and H12; all other station/tide combinations showed intermediate values on that date. Temperatures decreased in the fall, and dissolved oxygen remained nearly constant. The waters off Hampton Harbor were saturated or nearly saturated during all of 1978.

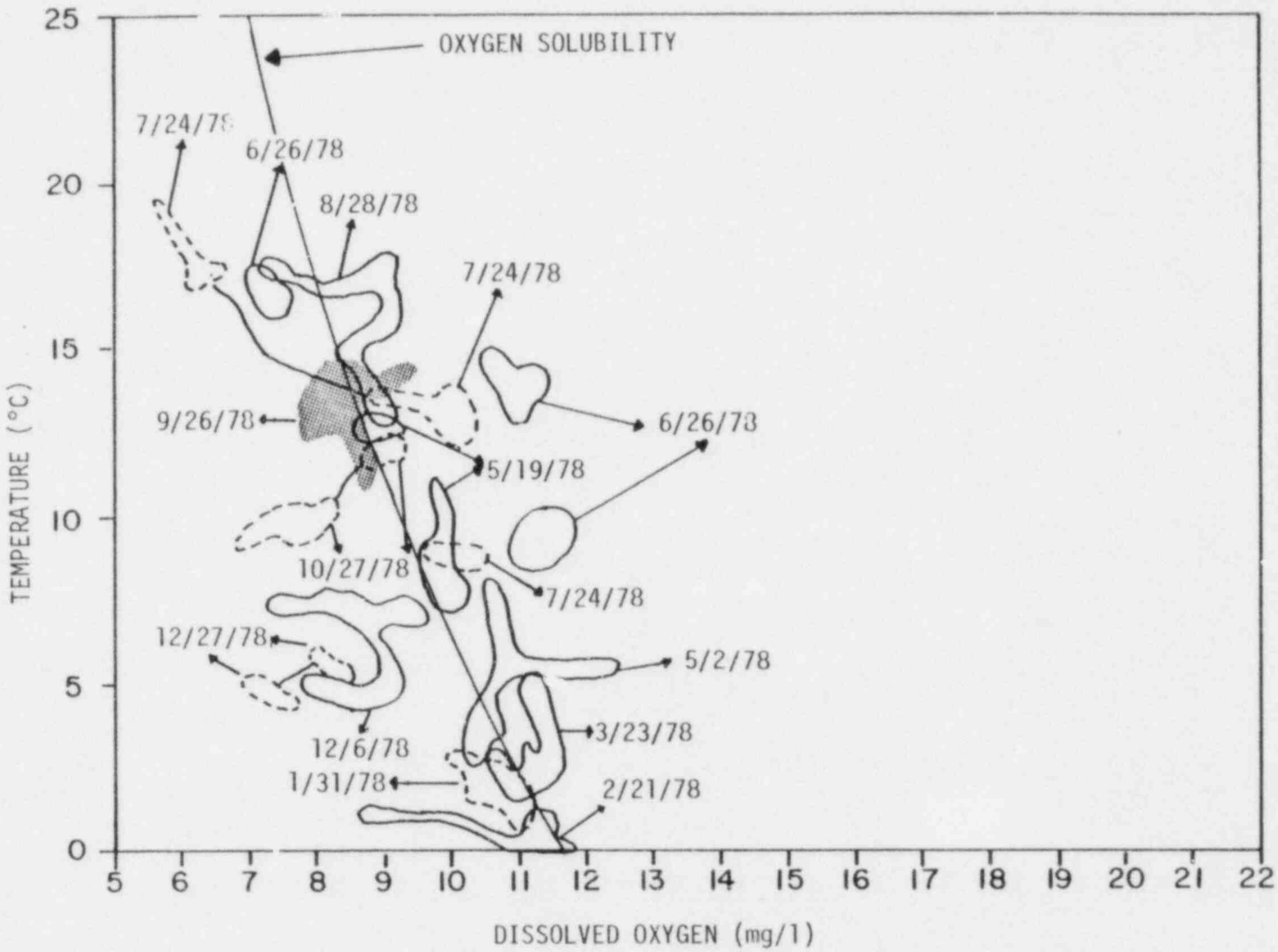


Figure 3.5-1. Dissolved oxygen vs. temperature diagram constructed using slack water survey data collected in 1978. Solid line is Oxygen Solubility with respect to an atmosphere of 29.94% oxygen, 100% relative humidity and water salinity of 32 $^{0}/oo$. Seabrook Annual Hydrographic Report, 1978.

4.0 DISCUSSION

4.1 WATER MASS CHARACTERISTICS

Analysis of all the slack water survey data collected from 1974 to 1978 indicates the surface coastal water off Hampton Harbor fits the model presented in Parsons *et al.* (1976). This model presents four major seasonal water mass types: Winter Water Mass (WWM): Spring Transitional Water Mass (T_SWM); Summer Surface Water Mass (SWM); Fall Transitional Water Mass (T_FWM) which was conceptualized from temperature and salinity data collected in an unrelated study off the New Hampshire coast by Shevenell (1974).

These water mass types can be fit to the slack water survey data collected over the last five years; the descriptive characteristics vary from year to year and expand somewhat as more data are collected. The WWM has salinities ranging from 30.9 to 33.6% and temperatures ranging from 0.9 to 5.0°C. This water mass is present from late December into March. The spring freshet and atmospheric warming result in changes in the T-S characteristics during the spring months (March into May). Salinities in the T_SWM range from 27.7 to 31.0%, and temperatures range from 4.0 to 10.3°C. The T_SWM is characterized by vertical temperature and salinity gradients. Increased atmospheric warming and a decrease in freshwater runoff during the summer months (May into early October) result in the development of the SWM (28.0-32.0 ^{o}/oo and 11.0-20.3°C). Increased storm activity coupled with low runoff results in a transition of the SWM into the WWM. The T_FWM is generally observed from October into December. It is characterized by salinities ranging from 30.8 to 32.3% and temperature of 6.8 to 13.0°C.

The water mass characteristics off Hampton Harbor are dominated by this annual cycle. The T-S characteristics are controlled each year by three physical processes which tend to alter the WWM. Spring runoff initiates vertical density stratification of the coastal waters. Increased atmospheric warming augments vertical stratification of water density. By summer a thermocline and halocline are well developed in the coastal water. The surface water mass is created as the thermocline and halocline deepen. A decrease in freshwater discharge and mixing above the halocline create a relatively uniform salinity distribution in the surface water-mass. Periods of warm weather and low winds will create temporary thermoclines in the near surface waters. These are usually broken down by mixing caused by wave action. The typical meteorological and oceanographic characteristics of this local coastal environment are summarized in Table 4.1-1.

The fall is another transitional period. Atmospheric cooling, relatively low runoff and intense mixing during frequent storm passages tend to break down the surface water mass and create mixing with the bottom water mass (generally observed in water deeper than 30m). By late December the coastal waters are well mixed with a relatively narrow T-S distribution.

Water ebbing from Hampton Harbor can have slightly different T-S characteristics than the contiguous coastal water. During the spring or high runoff periods, estuarine water will have a lower salinity than the coastal waters. During periods of atmospheric warming the estuary, because of its shallow nature and large expanse of intertidal area, may be discharging water, which is warmer than the coastal water.

Comparison of the model to the temperature and salinity observed during low slack water surveys of the surface coastal water from 1974 through 1978 indicate good agreement. Only 2% of all observations (from all surveys) were not conforming with the monthly model predictions (Table 4.1-2). Seventy-four percent of the observations agreed with the monthly prediction with no exception in either salinity or temperature. The remainder of the observations had exceptions. Forty-three temperature observations did not conform, with higher temperatures than predicted observed July through September, accounting for 53% of the exceptions; higher temperatures than normal also occurred in the winter, accounting for another 26% of the exceptions. The remaining nine exceptions (21%) were lower temperatures than the model predicted. Lower salinities than predicted occurred with greatest frequency in May and November, accounting for 12 (20%) of the 59 exceptions (Table 4.1-3).

TABLE 4.1-1. SUMMARY OF METEOROLOGIC AND OCEANOGRAPHIC CHARACTERISTICS OF THE LOCAL COASTAL ENVIRONMENT (BASED UPON DATA COLLECTED 1973 TO 1977). SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

SEASON	WIND	AIR TEMPERATURE	PRECIPITATION AND RUNOFF	CURRENTS	WATER TEMPERATURE	SALINITY	DISSOLVED OXYGEN
WINTER (JANUARY, FEBRUARY, MARCH)	Predominant from West 9.2 kn NW 7.3 kn SW 8.9 kn Highest average speeds from E 9.4 kn NE 10.1 kn	Jan 25F (-4C) Feb 27F (-3C) Mar 35F (2C)	Avg. Precipitation 3.4-4.2 in. Regional total discharge 442,000 cfs.	Southern flows predominant S 37.7% Tidal 32.3% N 30.0% Net drift southward.	Lowest temperature in February. Temperatures vary between 32°F and 38°F at surface	Surface salinities average 31-33 ^{o}/oo.	10.0-11.5 mg/l 90-100% saturated.
SPRING (APRIL, MAY JUNE)	Predominant from W 7.1 kn NW 7.0 kn S 6.5 kn Highest average speeds from NE 10.0 kn	April 46F (8C) May 56F (13C) June 65F (18C)	Avg. precipitation 2.8-3.6 in. Months of maximum annual runoff Regional total discharge 622,000 cfs. Max value observed April 1973 1,022,230 cfs.	Tidal flows most frequent Tidal 45.1% S 36.0% N 18.9% Net drift south.	Development of a seasonal thermocline. Temperature rise rapidly 40°F-50°F at surface.	Greatest variation between surface and bottom 3-5 ^{o}/oo. Surface salinities generally 28 to 31 ^{o}/oo Bottom salinities generally 32 to 34 ^{o}/oo.	10.5-11.3 mg/l. With spring bloom, decrease to 9.0-10.0 mg/l. When 9.0-11.5 mg/l saturated to supersaturated. Near surface value higher than near bottom.
SUMMER (JULY, AUGUST, SEPTEMBER)	Calm and variable predominant W 6.1 kn SW 7.8 kn NW 5.5 kn Average speeds in all directions ±5 kn	July 71F (22C) Aug 69F (21C) Sept 62F (17C)	Avg. precipitation 2.7-3.4 in. Months of minimum annual runoff. Regional total discharge 172,000 cfs. Minimum value recorded in Aug 1974: 79,954 cfs.	Currents primarily tidal Tidal 57.2% S 34.5% N 18.3% Net drift south.	Highest temp. in August. Temperatures at surface >50°F little variation over the 3 months ±2-3°F. Temperature differences surface-bottom greatest 6°F-10°F. In harbor, 0.7F (0.4C) difference between surface and bottom. Highest 72.5F (22.5C).	Surface 29-32 ^{o}/oo near bottom 32.0-34.0 ^{o}/oo in depths greater than 30 m. Values at surface and bottom nearly equal in depths of 10-20m.	8.0-10.0 mg/L lowest values in late summer >7.8 mg/L Near surface supersaturated 100-120%. Near bottom 80-100%.
AUTUMN (OCTOBER, NOVEMBER DECEMBER)	Predominant from W 8.1 kn SW 8.6 kn S 7.7 kn Highest average speeds from E 9.7 kn NE 9.7 kn	Oct 52F(11C) Nov 42F(6C) Dec 30F(-1C)	Avg. precipitation 3.8-4.1 in. for early autumn. Regional total discharge=324,500 cfs. Avg. precipitation 3.5-4.6 in. for late autumn. Regional total discharge=518,500 cfs.	Northerly flows prevalent N 48.4% Tidal 28% S 23.6% Net drift south.	Decline steadily from 50°F-winter temp. of 40°F. Water becomes well mixed--little variation between surface and bottom.	Vertical breakdown of stratification generally late October at early November. Salinities generally 31 to 32 ^{o}/oo.	7.5-10 mg/l values rise sharply in autumn. Slightly unsaturated 90-100%.
DATA SOURCE	Data from monthly rose (wind) diagrams in Appendix 1973-1977	NOAA Climatological Data (monthly average of Boston and Portland).	NOAA Climatological and USGS Water Resources Data (Merrimack, Piscataqua and Saco Rivers).	Data from current flow type into 1973-1977 net drift longshore components (NAI, 1977b).	NAI(1977b)	NAI(1977b)	NAI(1977b)

TABLE 4.1-2. SUMMARY OF COMPARISONS BETWEEN ALL FIELD OBSERVATIONS AND MODEL PREDICTIONS OF SURFACE WATER SALINITY AND TEMPERATURE. SURFACE DATA FROM LOW WATER SLACK SURVEY STATIONS, JUNE 1974 TO DECEMBER 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

MONTH	COASTAL WATER STATIONS					ESTUARY STATIONS				
	TOTAL OBSERVATIONS	BOTH T & S CONFORM	TEMPERATURE CONFORMS	SALINITY CONFORMS	NEITHER T OR S CONFORM	TOTAL OBSERVATIONS	BOTH T & S CONFORM	TEMPERATURE CONFORMS	SALINITY CONFORMS	NEITHER T OR S CONFORM
Jan	28	16	22[6][a]	21	1	8	3	8[0][a]	3	0
Feb	17	12	12[5]	15	2	5	2	3[2]	2	2
Mar	32	28	30[0]	30	0	10	1	10[0]	1	0
Apr	22	16	18[0]	16	4	6	2	4[2]	2	0
May	35	28	34[0]	29	0	9	6	9[0]	6	0
Jun	35	35	35[0]	35	0	9	5	6[3]	5	1
Jul	34	25	27[7]	32	0	10	4	4[6]	4	0
Aug	31	15	15[15]	30	1	8	3	3[5]	3	0
Sep	35	20	34[1]	21	0	9	4	6[3]	4	0
Oct	38	31	37[0]	32	0	11	3	9[0]	3	1
Nov	23	13	23[0]	14	0	8	0	7[0]	0	1
Dec	34	30	34[0]	30	0	10	3	10[0]	3	0
TOTAL	364	269 (74)[b]	321 (88)	305 (84)	8 (2)	103	36 (35)	79 (77)	36 (35)	5 (5)

[a] [ ] Temperatures higher than normal

[b] (Percent of total observations)

TABLE 4.1-3. DISTRIBUTION BY STATION AND MONTH OF OBSERVED SURFACE SALINITIES WHICH WERE BELOW PREDICTED VALUES FROM JUNE 1974 TO DECEMBER 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

	NUMBER OF OBSERVED SURFACE SALINITIES BELOW PREDICTION												
	MONTH												
STATION	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
SMOOR 9	0	0	0	0	2	0	0	0	0	0	1	0	3
SMOOR 12	1	1	0	0	0	0	0	0	0	0	1	0	3
SMOR 5	0	0	1	0	0	0	0	0	0	0	0	0	1
SBELL B	0	0	0	0	2	0	0	0	0	0	1	0	3
SMORI 4	0	0	0	0	0	0	0	0	0	0	1	0	1
SMORT 7	0	0	0	0	0	0	0	0	0	0	1	0	1
SGONG	2	1	1	1	1	0	0	0	0	1	2	1	10
SBRIDGE and SRIG	5	2	9	2	3	2	0	0	2	7	6	6	44

In general, the T-S characteristics for water observed at Hampton-Harbor at low-slack agreed with the model predictions, only 5% of observations did not conform. The estuarine water tended to be less saline than predicted in January and March through May; and warmer than predicted June through September (Table 4.1-2).

4.2 ESTUARINE PLUME ANALYSIS

The slackwater survey data were analyzed to determine if variation from the predicted water-mass characteristics was caused by either low salinity or high temperature water discharged from Hampton Harbor. During the study period, there were 44 surface water observations at the two stations in the Harbor which had lower than predicted salinities. In contrast 22 observations at the seven stations in the adjacent coastal water had salinities lower than predicted (Table 4.1-3). Most observations (10) were at the SGONG station just outside the entrance to Hampton Harbor. The three stations east and south of the entrance, SMOOR 12, SBELLB, and SMOOR 9 had the next most frequent observations (2 to 3) of lower than normal salinities. The stations located north of the harbor entrance, SMOOR 5, SMORT 4, and SMORT 7 had only one observation each (Table 4.1-3).

Higher than predicted temperatures were observed at the two Harbor stations 21 times. Thirty-four observations at the seven coastal water stations indicated higher than predicted temperatures (Table 4.1-2). Stations in the vicinity of the sunk rocks (SMOOR 12, SMOOR 5, SGONG AND SBELLB) had the most frequent (5 to 7) observations of higher than predicted temperatures.

Review of the extreme thermal and salinity events indicate that the salinity events were better at defining the Hampton Harbor ebb tidal plume. It was difficult to differentiate thermal events caused by either Hampton Harbor or warming in the vicinity of the Sunk Rocks. Of the 66 observations of lower than predicted salinities from 1974 through 1978 an estuarine plume could be distinguished during four sampling dates:

November 18, 1975, January 26 and February 27, 1976, and May 19, 1978. The surface salinities, the depth to the salinity which corresponds to the lower limit of the predicted salinity range, and the meteorlogical conditions prevalent are presented in Table 4.1-4.

Analysis of the data collected during the November 1975 survey suggests that the low salinity surface water was the result of presence of stratification in coastal water rather than low salinity water being discharged from Hampton Harbor. The coastal water mass model predicts a breakdown of stratification by late October-early November. During this mid-November cruise, a halocline was observed at 1.5 to 5m below the surface.

The January 1976 survey observed the ebb tidal plume from Hampton Harbor (Figure 4.1-1). The strongest winds were from the west; consequently the plume was observed at SGONG and SMOR 12, the two stations most easterly from the entrance to Hampton Harbor. The plume was less than 0.5 m thick. Surface salinities in the plume were about 1.7 ^{o}/oo lower than the predicted lower limit (29.2 ^{o}/oo), the salinity of water ebbing from Hampton Harbor was 25.1 ^{o}/oo.

The February 1976 survey observed the ebb tidal plume east (SGONG AND SMOR 12) and southeast (SMOOR 9) of the harbor entrance (Figure 4.1-1). Winds were from the west, with strongest winds from the northwest during the survey. The plume was 2m thick at SGONG, 1.5m at SMOR 12 and 0.5 m at SMOOR 9. The salinities in the plume ranged from 1.6 ^{o}/oo to less than 0.6 ^{o}/oo lower at SMOR 12 and SMOOR 9. The salinity of water ebbing from Hampton Harbor was 27.9 ^{o}/oo.

The May 1978 survey observed the ebb tidal plume at SGONG, SMOOR 5, SMOOR 9, and SMORT 7 (Figure 4.1-1). A portion of the plume was observed northeasterly of the entrance, probably due to the winds from the southwest. The plume was 1m or less thick. Surface salinities in the plume were 3.5 ^{o}/oo below the predicted lower limit at SGONG; at SMOOR 5 and SMOOR 9 the salinities were 1.9 and 1.3 ^{o}/oo lower respect-

TABLE 4.1-4. SURFACE SALINITY, THICKNESS OF LOW SALINITY WATER AND METEOROLOGICAL CONDITIONS FOR PERIODS WHEN HAMPTON HARBOR EBB TIDE PLUME WAS OBSERVED. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

DATE	STATIONS																METEORLOGICAL CONDITIONS
	SBRIDG		SSONG		SMOOR 5		SMOOR 9		SBELL 8		SMOR 12		SMOOR T-4		SMOR T-7		
	SAL	DEPTH	SAL	DEPTH	SAL	DEPTH	SAL	DEPTH	SAL	DEPTH	SAL	DEPTH	SAL	DEPTH	SAL	DEPTH	
November 18, 1975 Predicted Lower salinity limit 31.0‰	29.4	2m	29.9	1.5m	31.7	-	30.2	0.5m	30.5	1.5m	29.8	2.5m	30.1	3m	29.8	4.5m	Clear, 10°F warmer than normal day. A significant precipitation event (1.08 in.) occurred five days prior to survey. Winds averaging 9 mph, 18 mph maximum from north to northwest.
January 29, 1976 Predicted Lower salinity limit 30.9‰	25.1	2m	29.2	0.5m	30.9	-	31.9	-	31.7	-	29.3	0.5m	30.9	-	32.3	-	Partly cloudy, 9°F warmer than normal day. Survey followed three days of rain (1.58 in.). Winds averaged 11 mph from the SW with 17 mph maximum from the west.
February 27, 1976 Predicted Lower salinity limit 30.9‰	27.9	2m	29.2	2m	31.7	-	30.8	0.5m	31.0	-	30.3	1.5m	31.3	-	31.8	-	Clear, 16°F warmer than normal day. No precipitation for the five days prior to survey. Winds averaged 12.4 mph from the west with 30 mph maximum from the NW.
May 19, 1978 Predicted Lower salinity limit 27.7‰	18.4	2m	24.2	1m	25.8	0.5m	26.4	0.5m	28.1	-	28.3	-	27.9	-	27.4	1m	Clear about normal temperature. Survey followed three days of rain (3.12 in.). Winds averaged 6.5 mph 19 mph maximum from the SW.

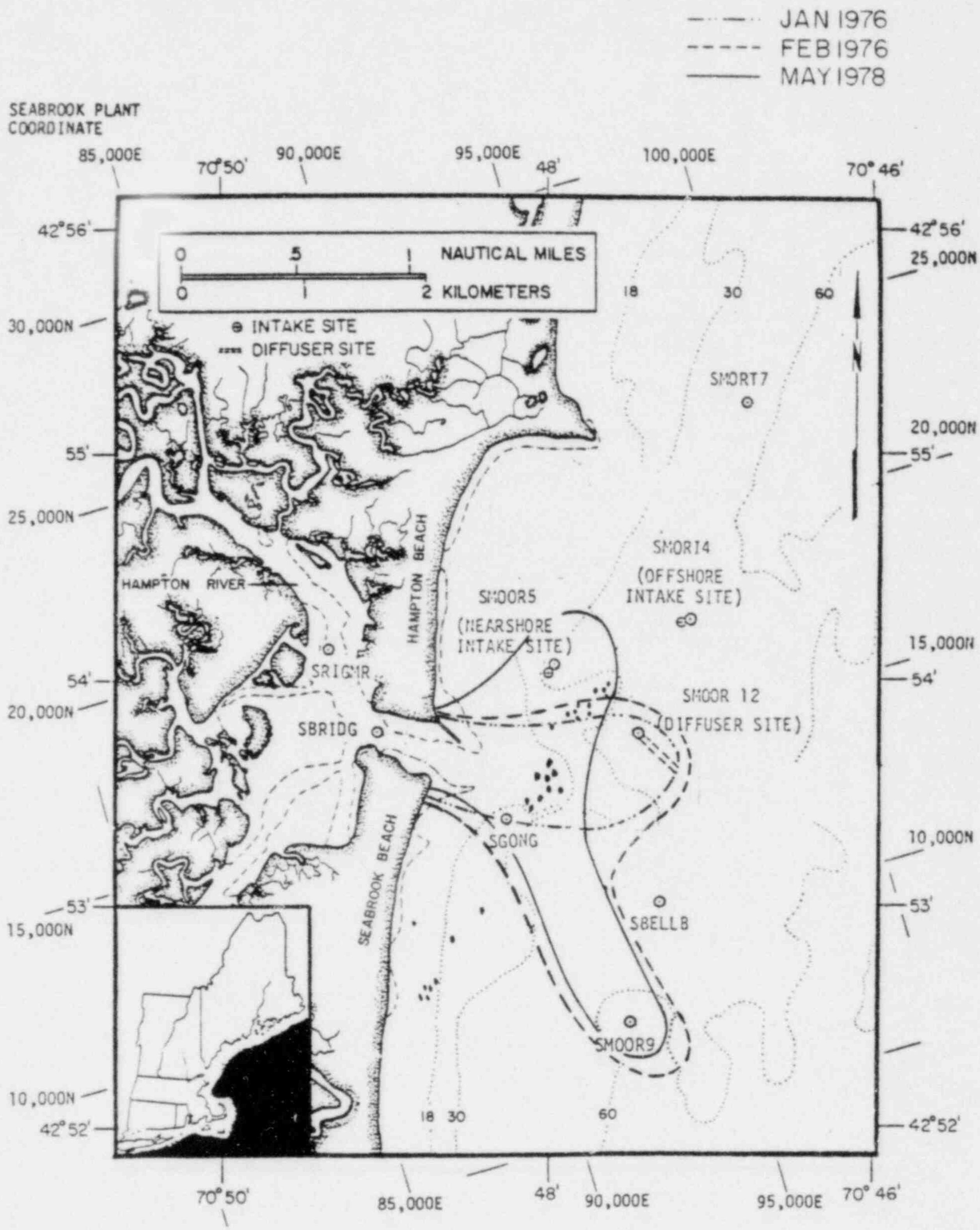


Figure 4.1-1. Schematic of the Observed Ebb Tidal Plumes in January and February, 1976 and May 1978. Seabrook Annual Hydrographic Report, 1978.

ively; and at SMORT 7 the salinity was only 0.3 $^{o}/oo$ lower. It is probable that the Hampton Harbor ebb tidal plume was not responsible for the depressed surface salinity at SMORT 7.

5.0 SUMMARY

The hydrographic data collected during 1978 indicate conditions which exhibit temporal and spatial variability. Coastal water circulation was governed primarily by the tides. Strong northward or southward flows caused by wind action were observed only 12% of the time. The distribution of flow was seasonal.

The observed tides in Hampton Harbor were generally close to those predicted by NOAA-NOS. The extreme tidal event was the "Great Blizzard of 1978" which occurred February 6 to 9, 1978.

The winds exhibited a typical seasonal distribution. Lowest velocities were observed in the summer. During the winter and spring westerly winds predominated.

Temperature and salinity varied over a wide range of time and space scales. In general temperature followed the typical annual cycle. Vertical and offshore density gradients were strongest during the spring (salinity) and summer (temperature).

Dissolved oxygen varied as a function of temperature with lowest values in the summer.

The estuarine analysis indicated that there were relatively few times during which the ebb tidal plume from Hampton Harbor could be identified using salinity as a tracer given this distribution of stations. The thermal characteristics were not a good indicator as warm water generated over Sunk Rocks could not be differentiated from water warmed in Hampton Harbor. Definition of the spatial extent of the plume is open to much interpretation because of the sampling space scale. Recognizing the limitations encountered, the following observations can be made:

(1) the ebb tidal plume orientation is influenced by local wind conditions.

(2) with the wind lacking the plume orientation will be influenced by the southward ebb tidal currents.

(3) with strong winds from the west it appears that the ebb tidal plume can encroach the diffusor location.

(4) using the analytical techniques described in this section and available spatial survey data, the ebb tidal plume was not observed to encroach the intake site (I4).

(5) salinity is better than temperature for indicating the ebb tidal plume from Hampton Harbor.

(6) Out of 55 slack water surveys over 5 years, the estuary plume could be observed extending past the inner Sunk Rocks only 3 times (5%), twice during a winter and once during a spring.

6.0 LITERATURE CITED

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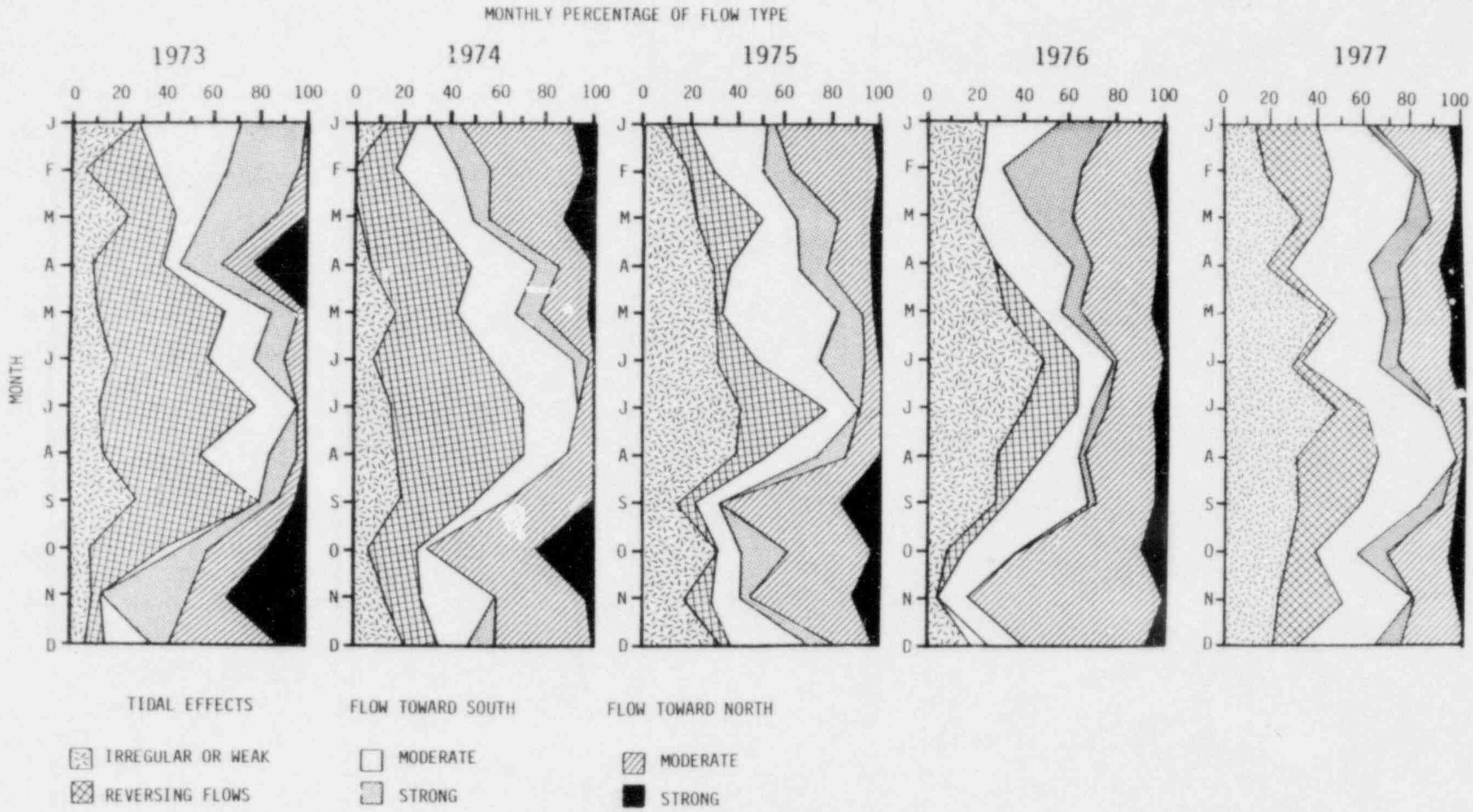
7.0 Appendix Figures

7.0-1. Flow Type Distribution



Appendix Figure 7.0-1. Distribution of monthly percentage of observed current flow types for coastal waters off Hampton Beach, New Hampshire, from 1973 through 1977. Seabrook 1978 Annual Hydrographic Report, 1979.

APPENDIX 7.0-2. SUMMARY ROSE DIAGRAMS

Rose diagrams of current meter and wind-station data are grouped by lunar months or season. Lunar months begin with a day of approximately mean predicted tides 1 or 2 days preceding new moon and continue through first quarter, full moon, last quarter and end just before the next new moon. Seasonal rose diagrams are based on three lunar months taken together.

For each diagram the following are indicated:

(1) Mooring designation

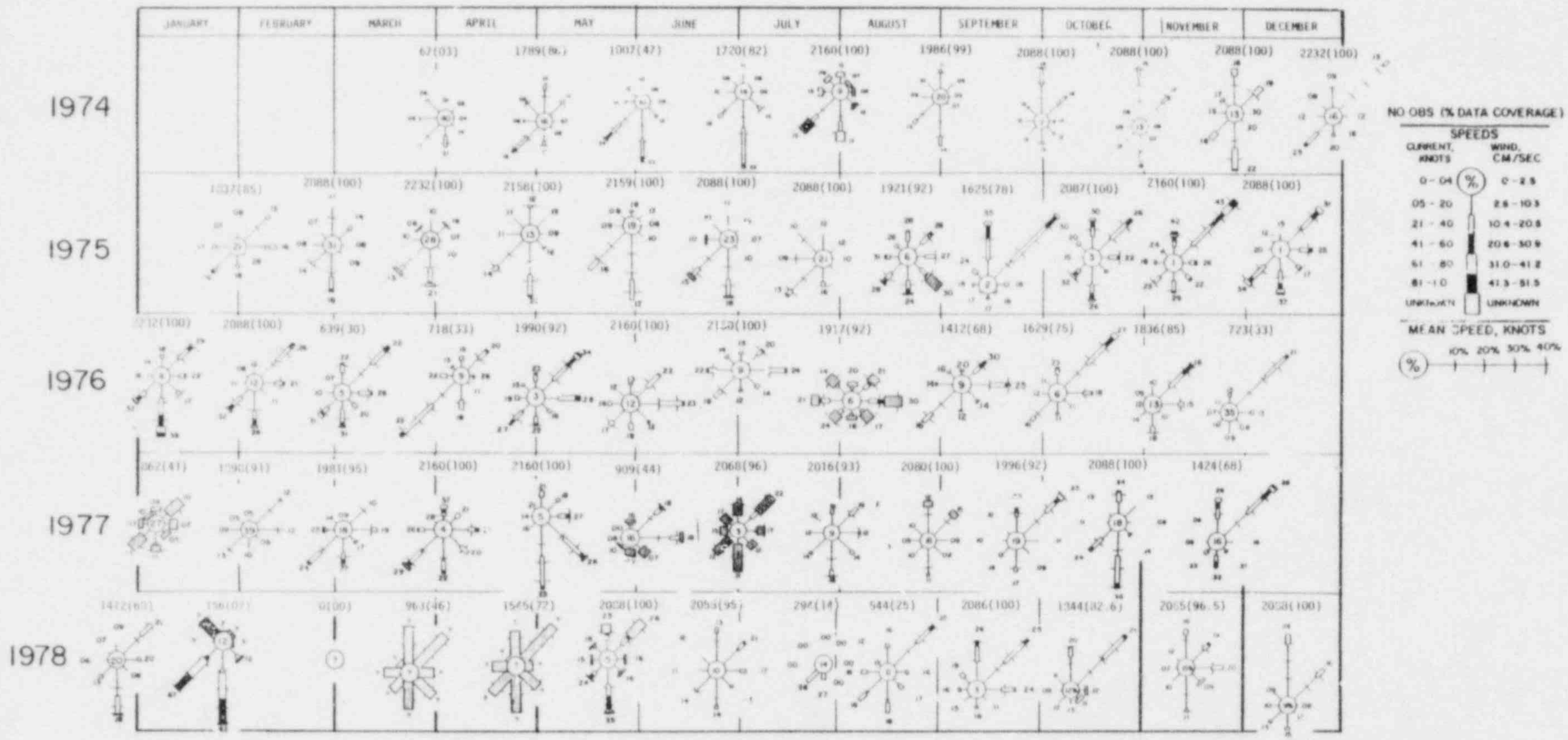
(2) Meter number

(3) Approximate depth of the current-meter duct

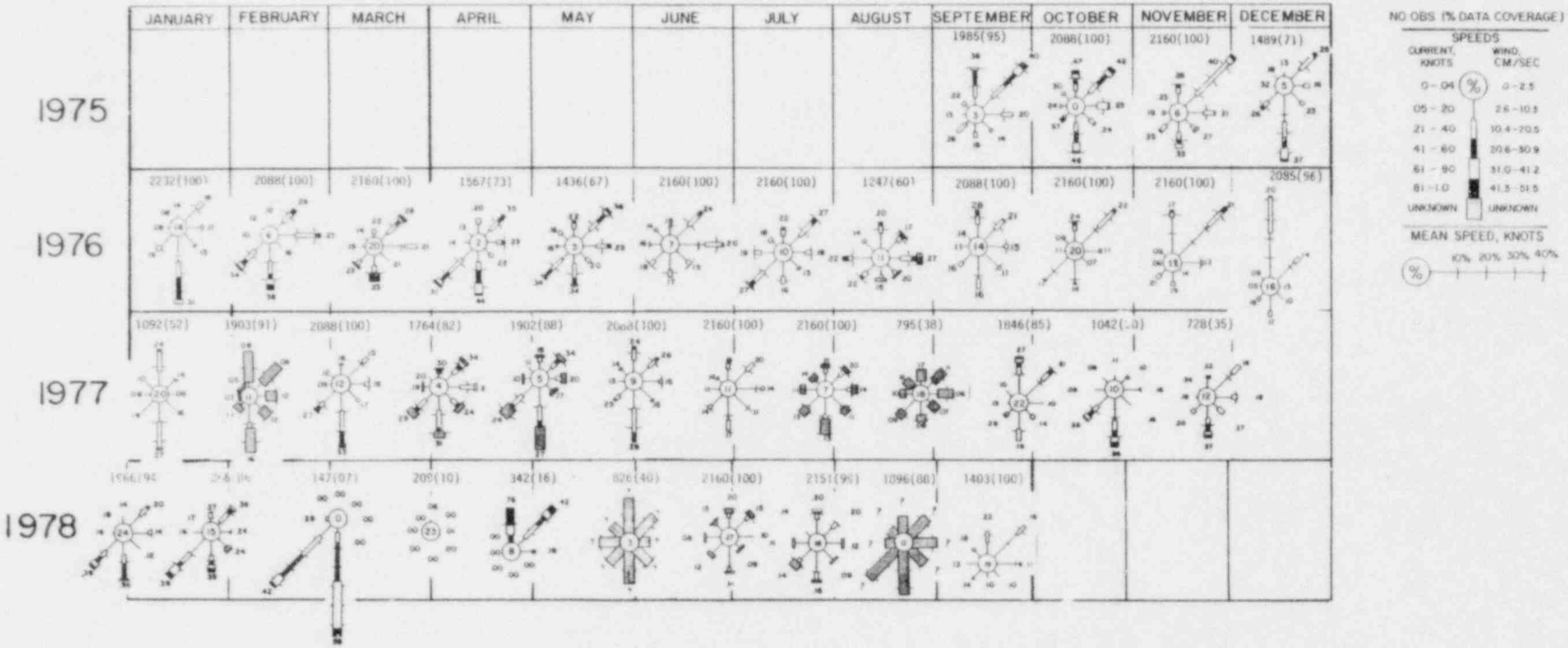
(4) Number of observations

(5) Percentage of time period with data coverage

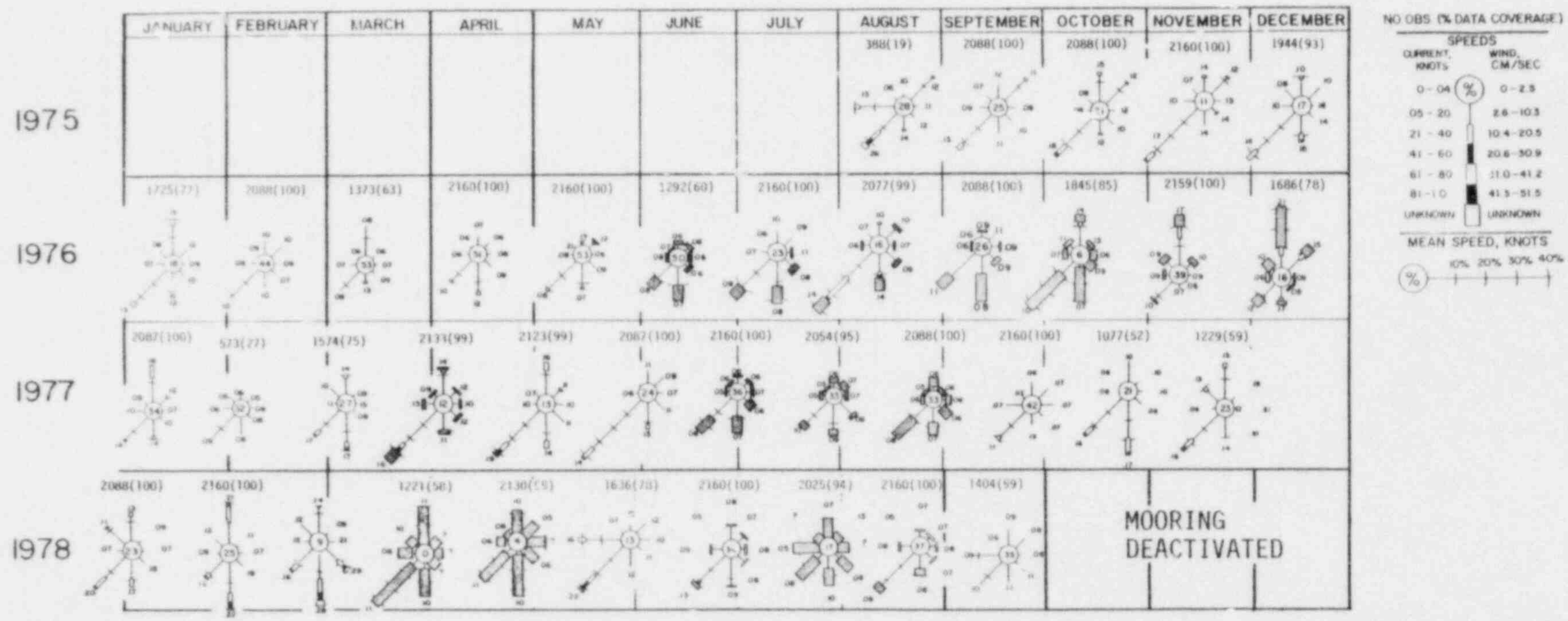
Within the center of each diagram, the percentage frequency of current speeds of 0.04 kn or less is indicated; for wind, the percentage frequency of speeds of 0.0 kn is given. Actual rose diagrams represent percentage frequency of direction in degrees true (referenced to the direction toward which the current was flowing or the wind was blowing) for various speed classes. The mean speed for each direction class is also indicated.



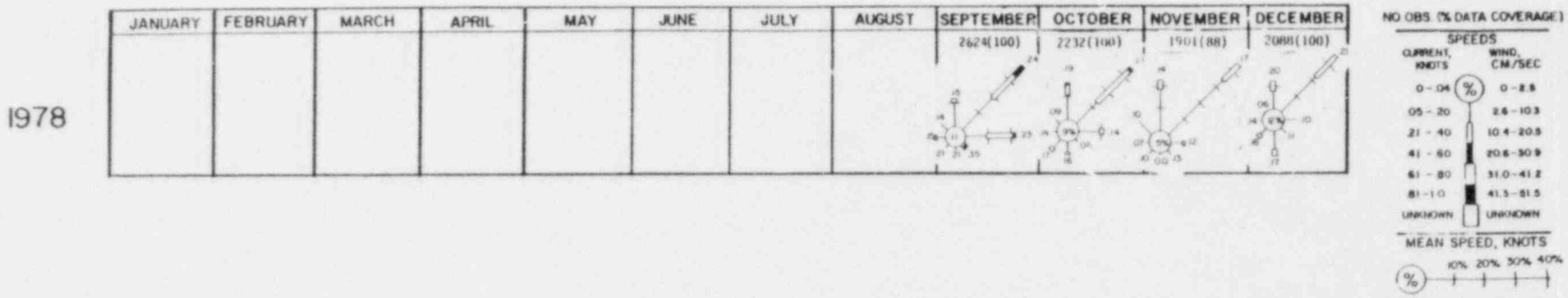
Appendix Figure 7.0-2a. Monthly rose diagrams of near-surface currents at NAI Mooring T-7 for 1974 through 1978. Seabrook Annual Hydrographic Report, 1978.



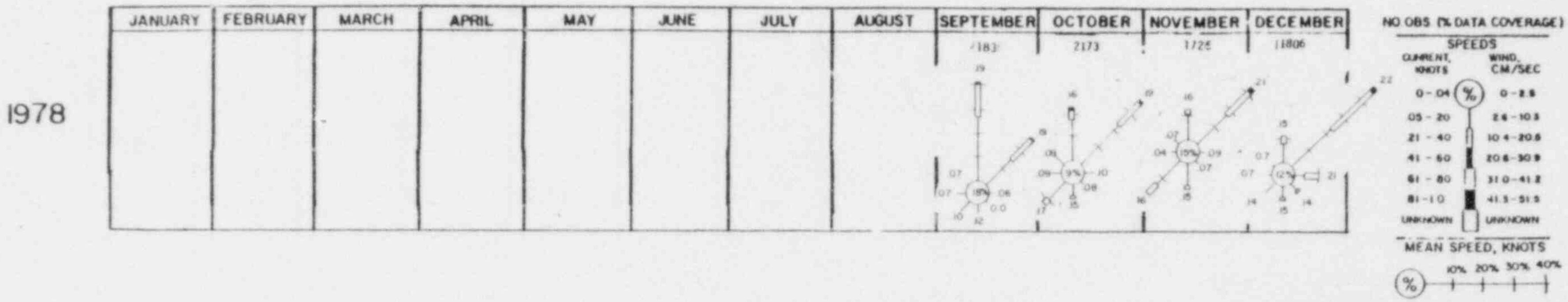
Appendix Figure 7.0-2b. Summary rose diagrams of near-surface currents at NAI Mooring I-4 upper off Hampton Beach, New Hampshire for 1973 through 1978.
Seabrook Annual Hydrographic Report, 1978.



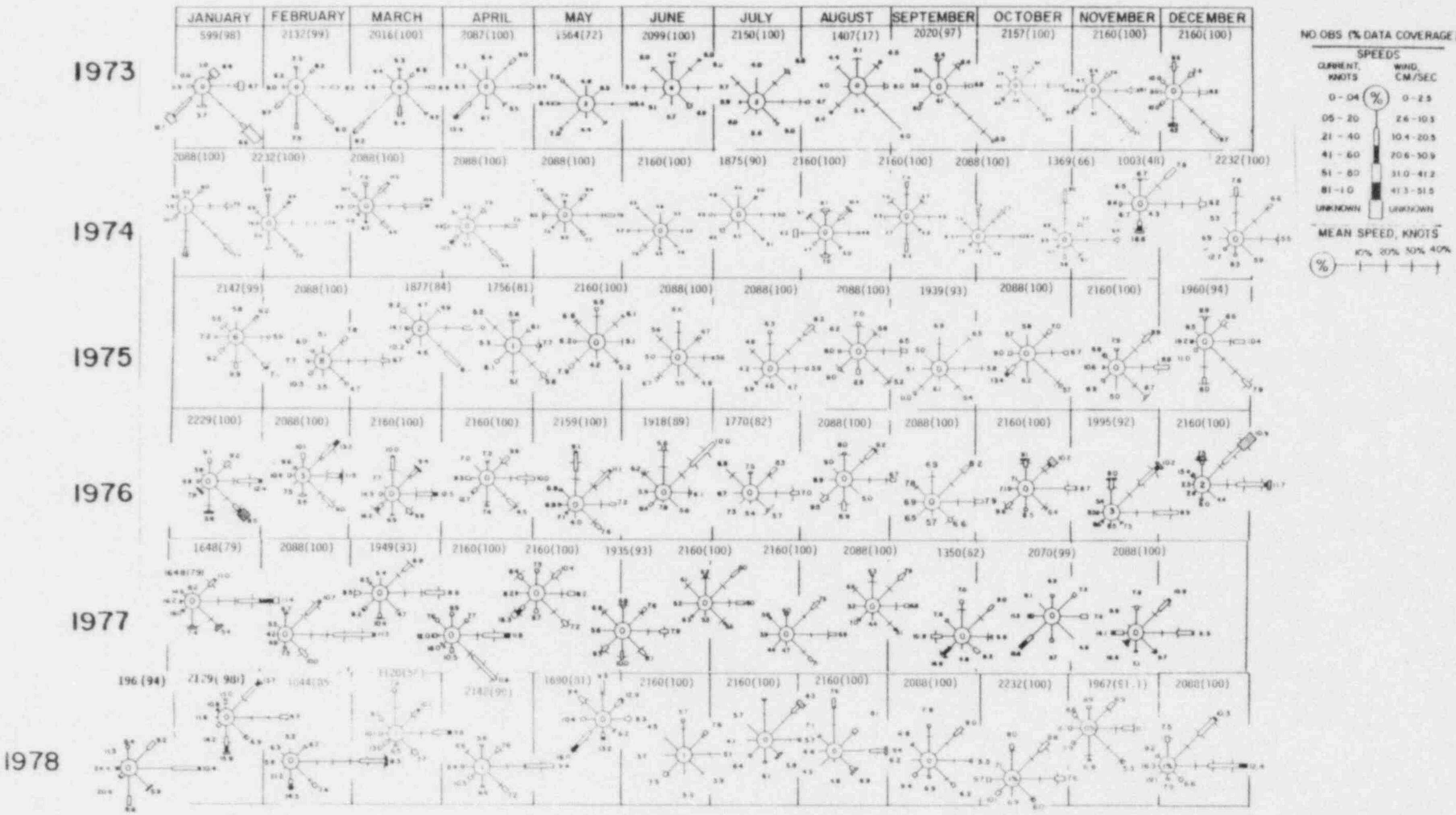
Appendix Figure 7.0-2c. Summary rose diagrams of near-bottom currents at NAI Mooring I-4 lower off Hampton Beach, New Hampshire for 1975 through 1978. Seabrook Annual Hydrographic Report, 1978.



Appendix Figure 7.0-2d. Summary rose diagrams of near-surface currents at NAI Mooring D-3 upper off Hampton Beach, New Hampshire for 1978.
Seabrook Annual Hydrographic Report, 1978.



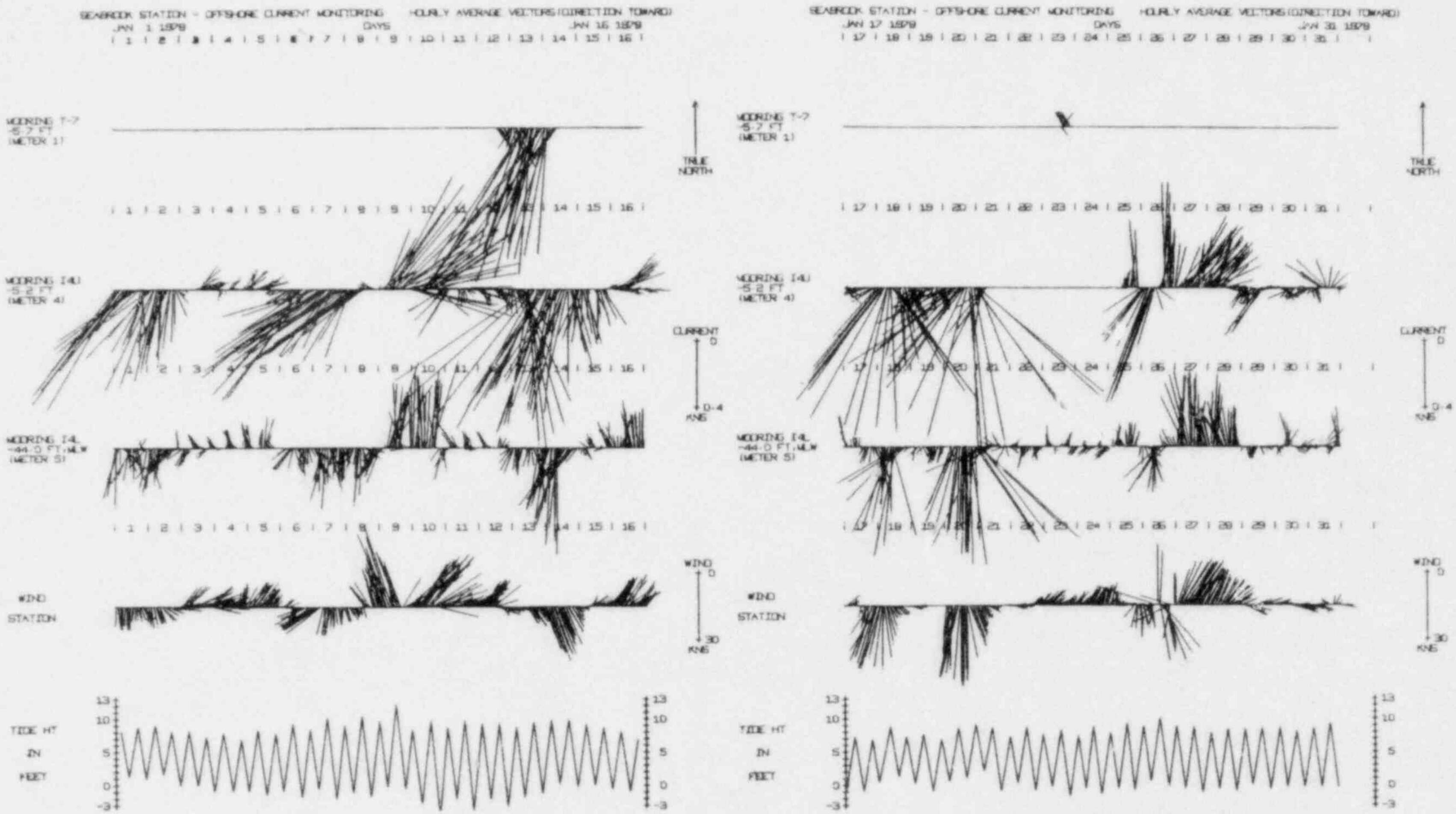
Appendix Figure 7.0-2e. Summary rose diagrams of near-bottom currents at NAI Mooring D-3 Mid off Hampton Beach, New Hampshire for 1973 through 1978. Seabrook 1978 Annual Hydrographic Report, 1978.



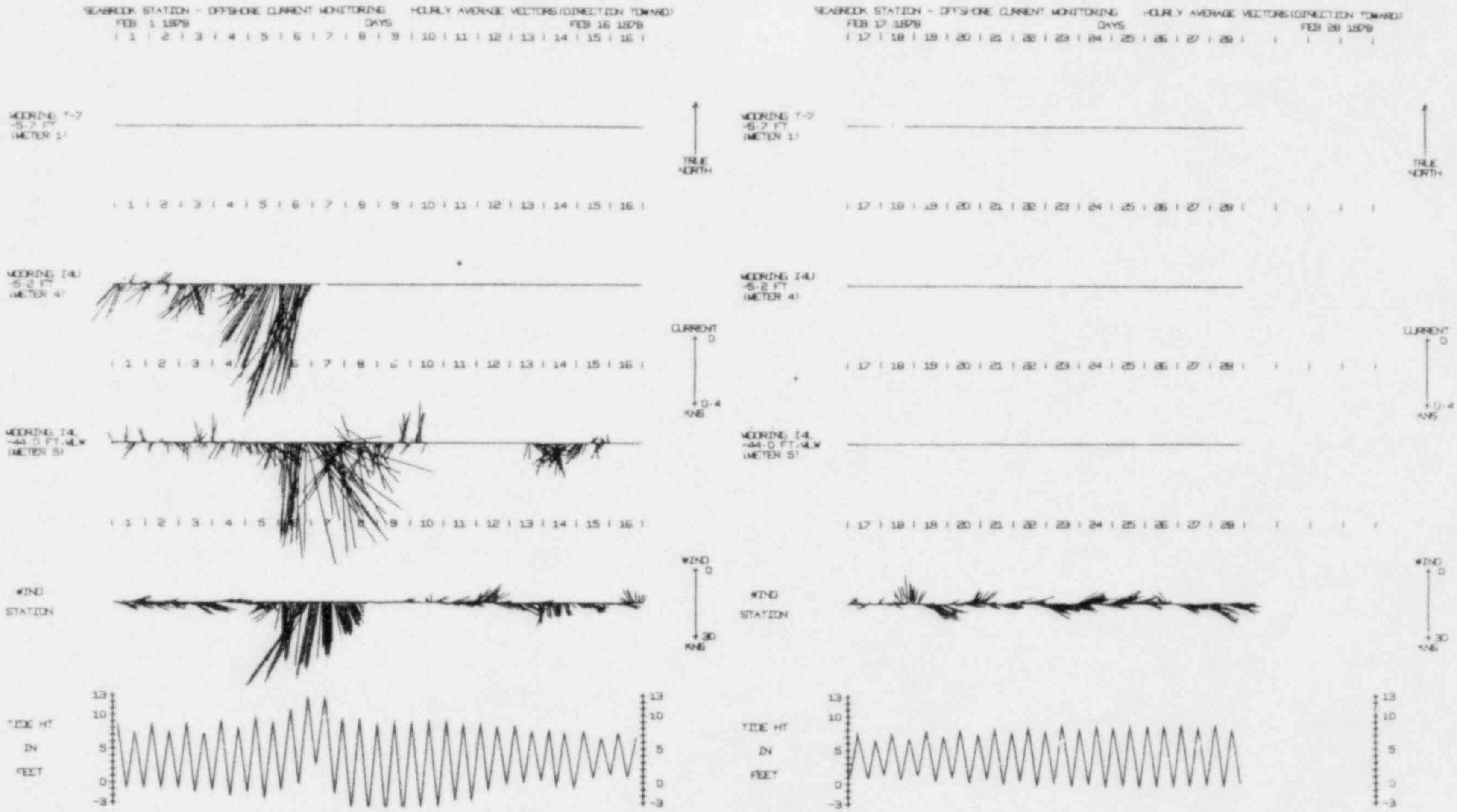
Appendix Figure 7.0-2f. Summary rose diagrams of wind data measured by NAI at Hampton Beach, New Hampshire, from 1973 through 1978.
Seabrook Annual Hydrographic Report, 1978.

APPENDIX 7.0-3.

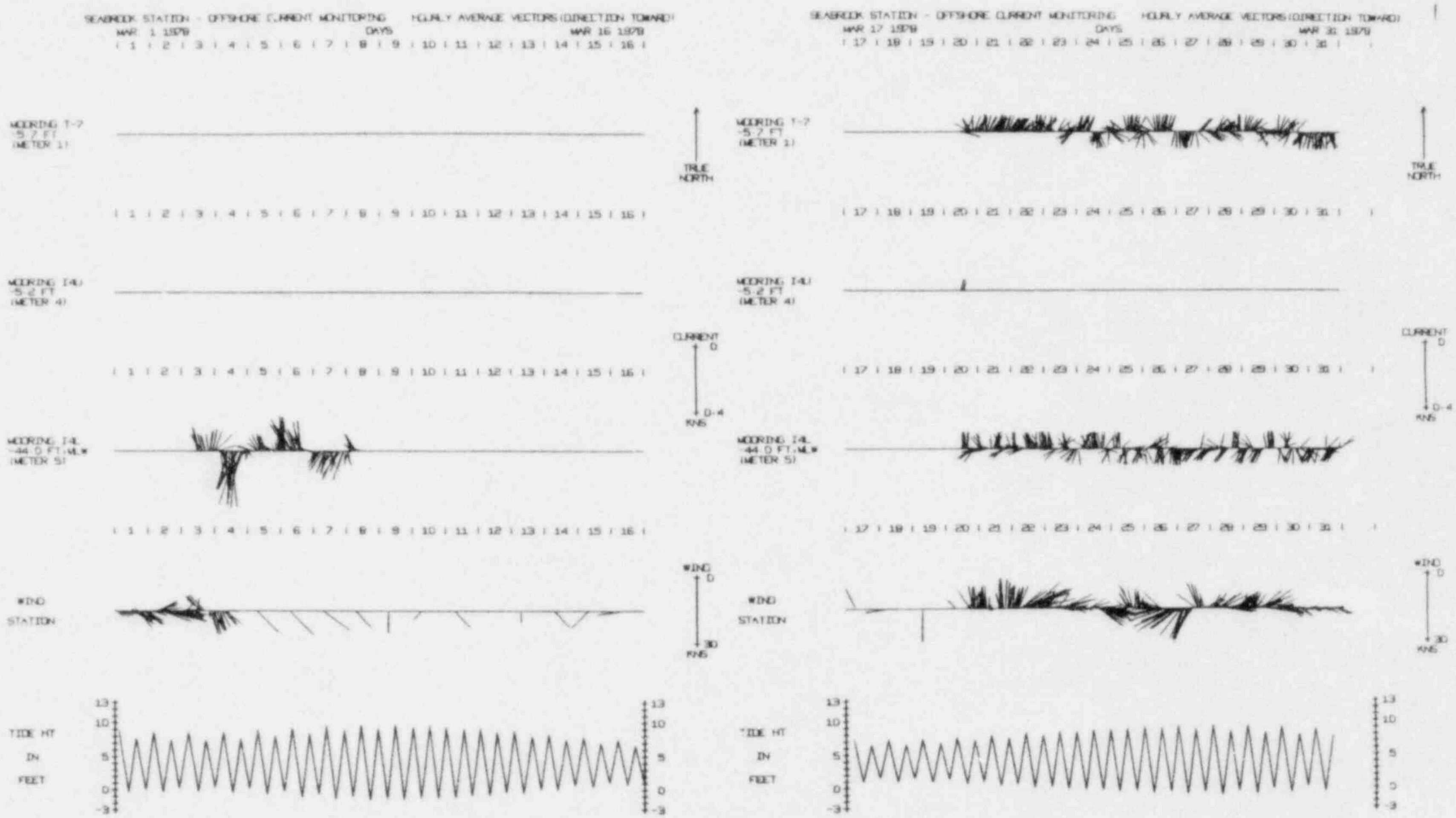
HOURLY SEQUENTIAL VECTOR OBSERVATIONS



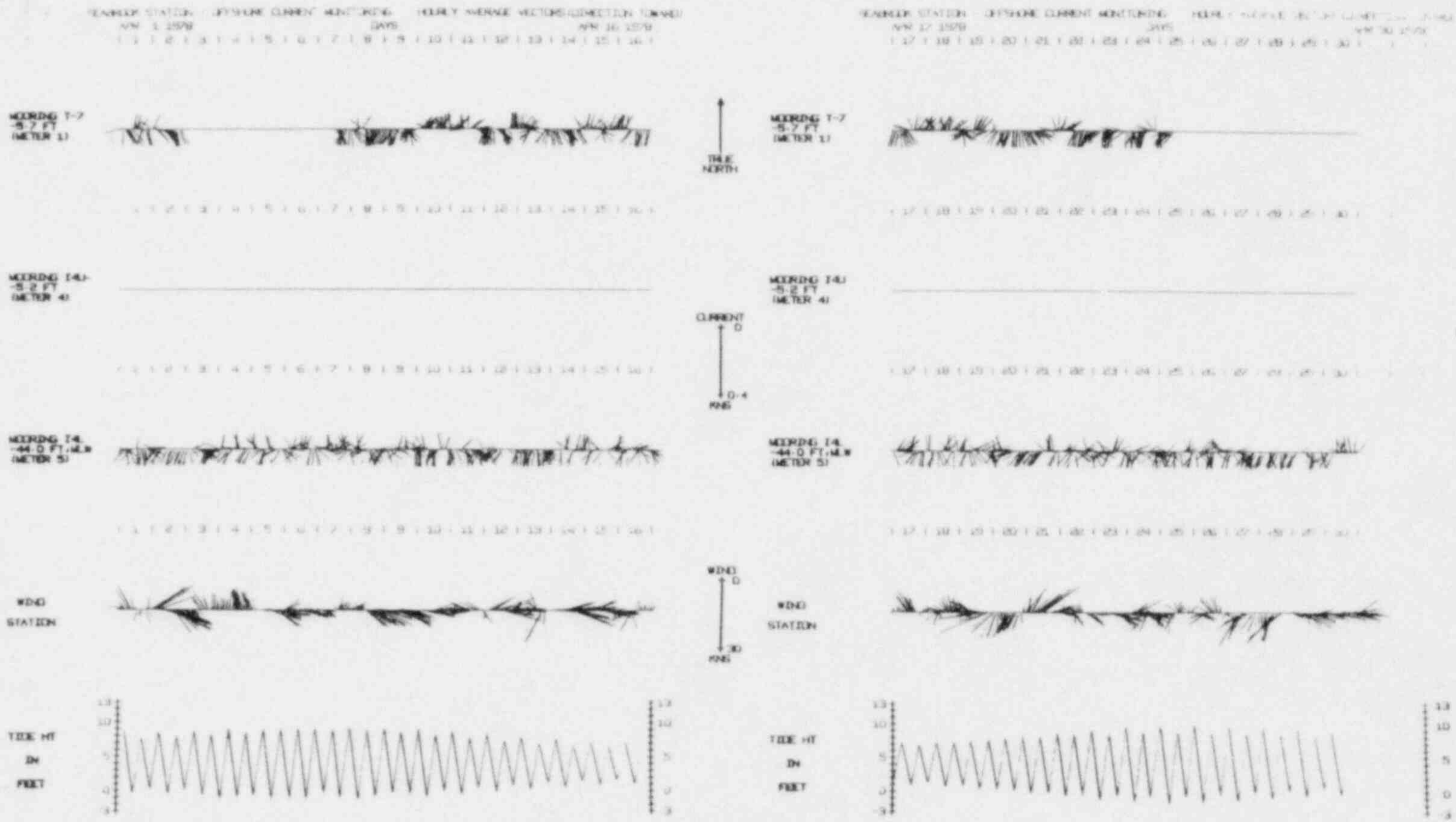
Appendix Figure 7.0-3a. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for January 1978.
Seabrook Annual Hydrographic Report, 1978.



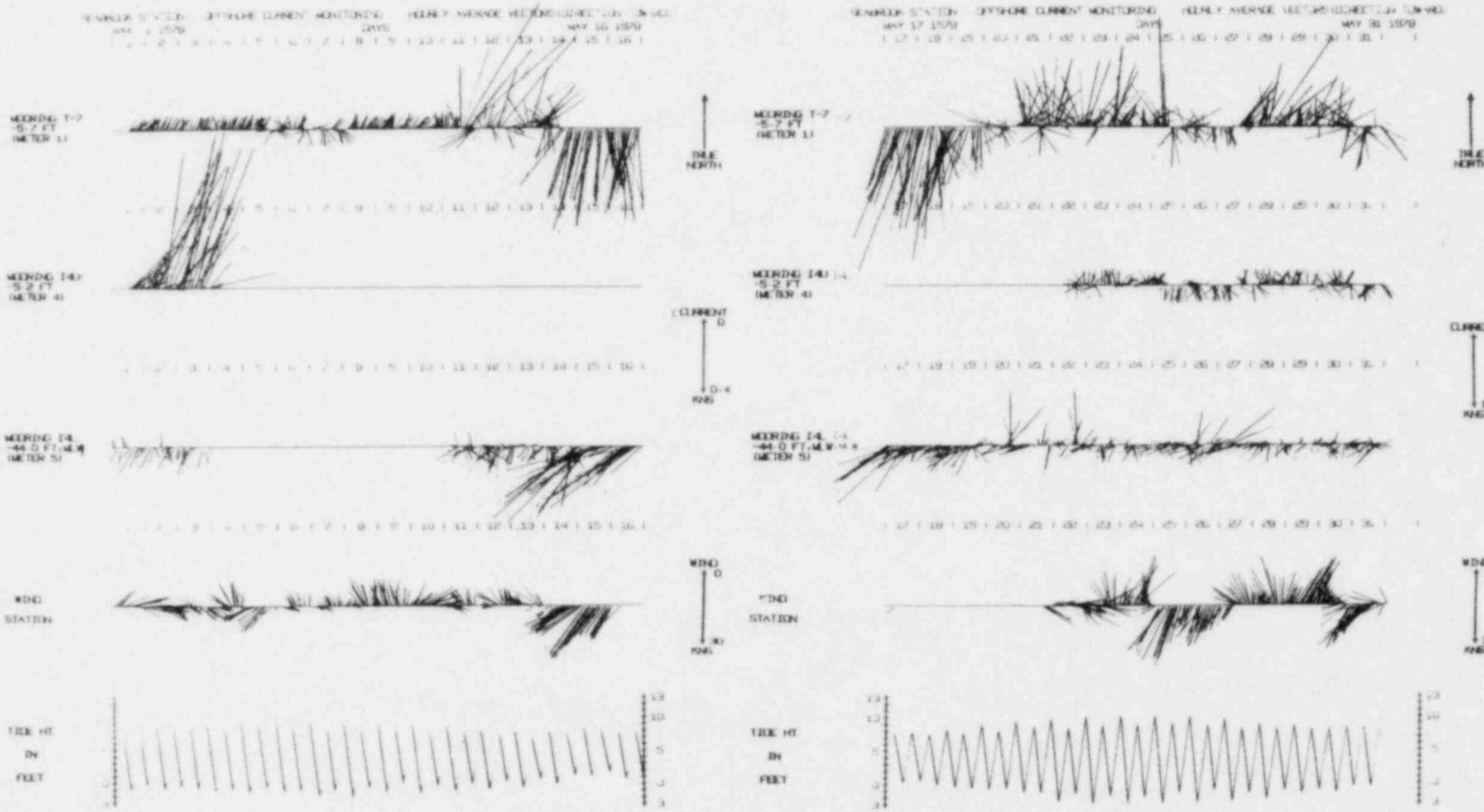
Appendix Figure 7.0-3b. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for February 1978.
Seabrook Annual Hydrographic Report, 1978.



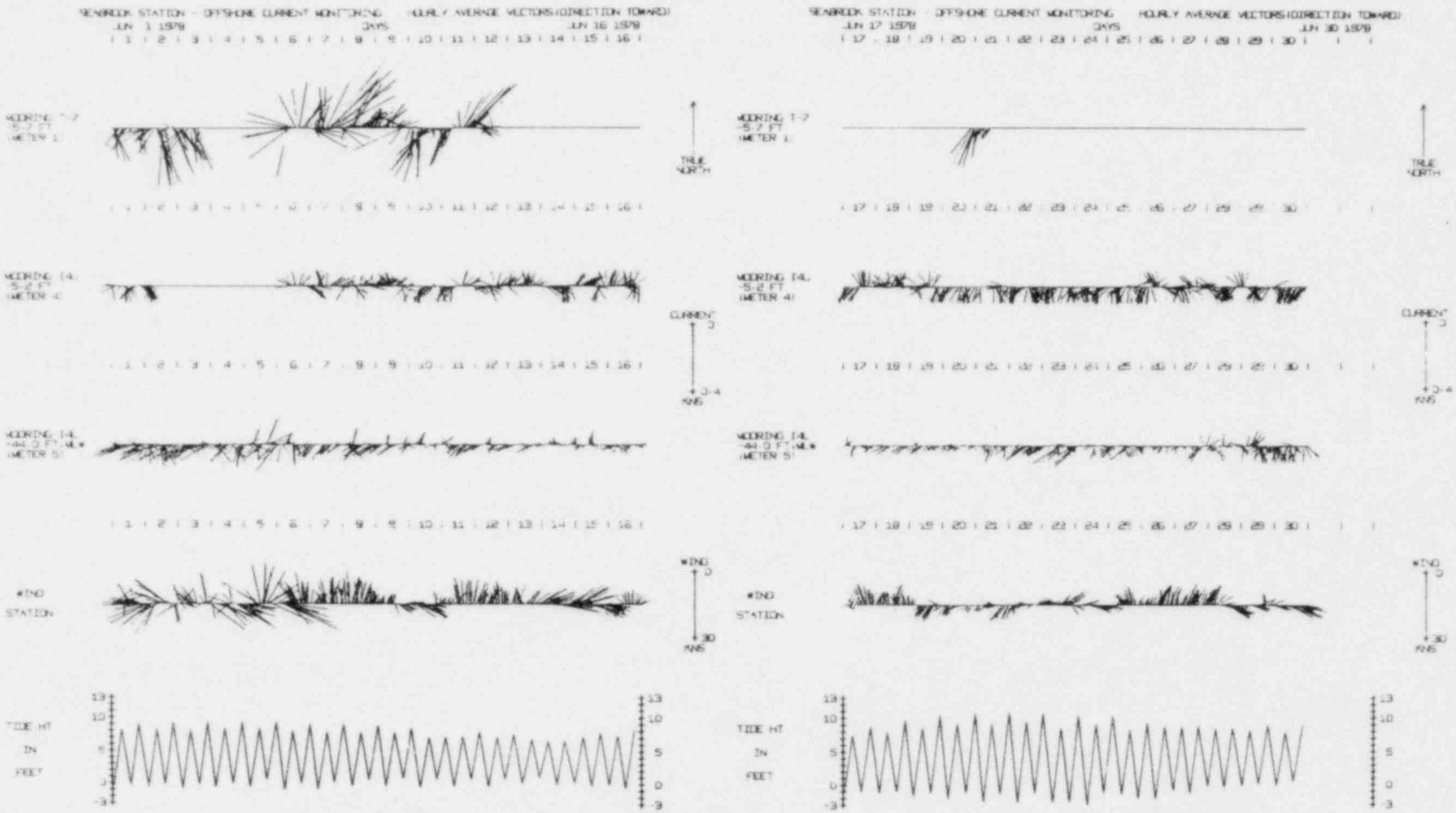
Appendix Figure 7.0-3c. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for March 1978.
Seabrook Annual Hydrographic Report, 1978.



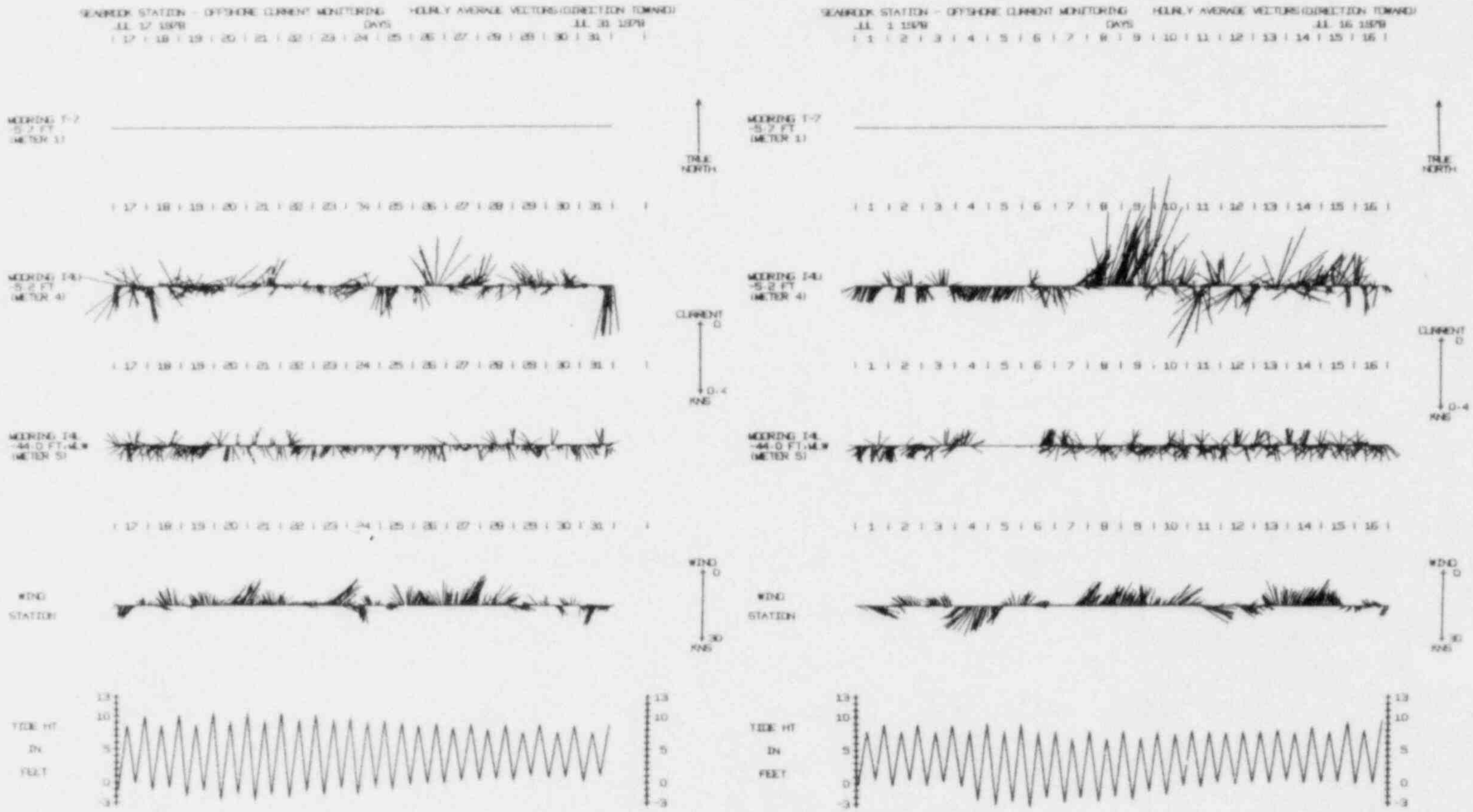
Appendix Figure 7.0-3d. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for April 1978.
Seabrook Annual Hydrographic Report, 1978.



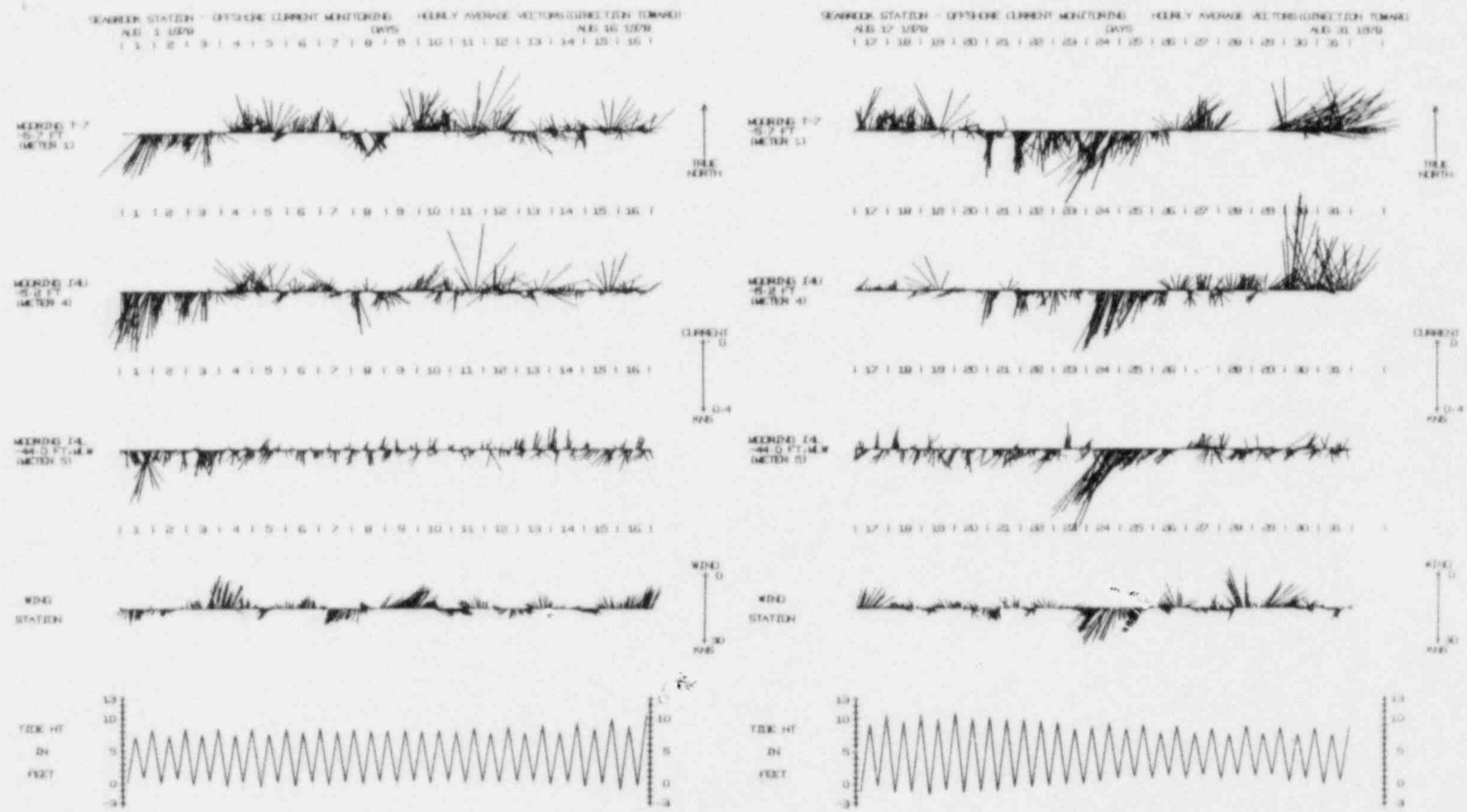
Appendix Figure 7.0-3e. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for May 1978.
Seabrook Annual Hydrographic Report, 1978.



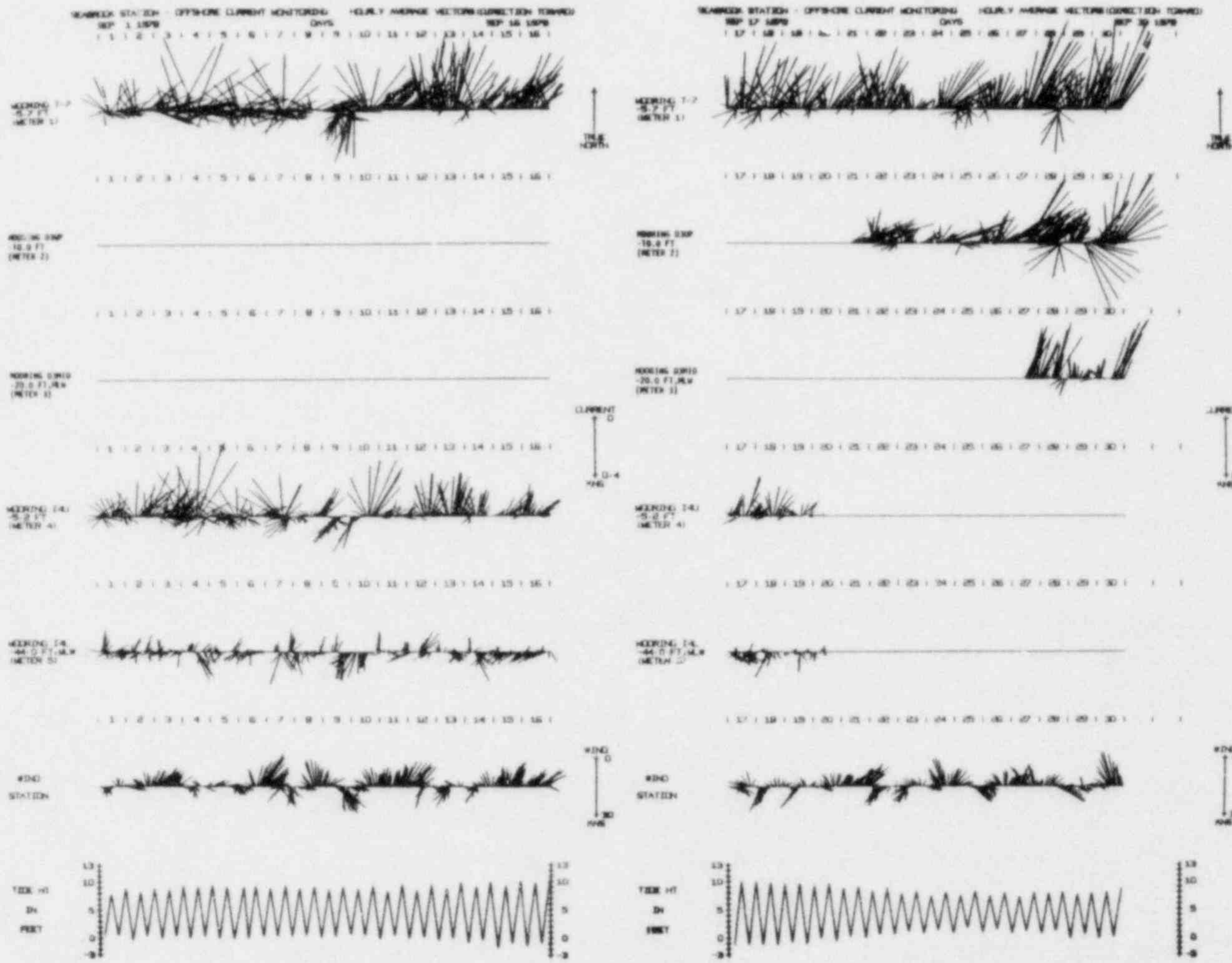
Appendix Figure 7.0-3f. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for June 1978. Seabrook Annual Hydrographic Report, 1978.



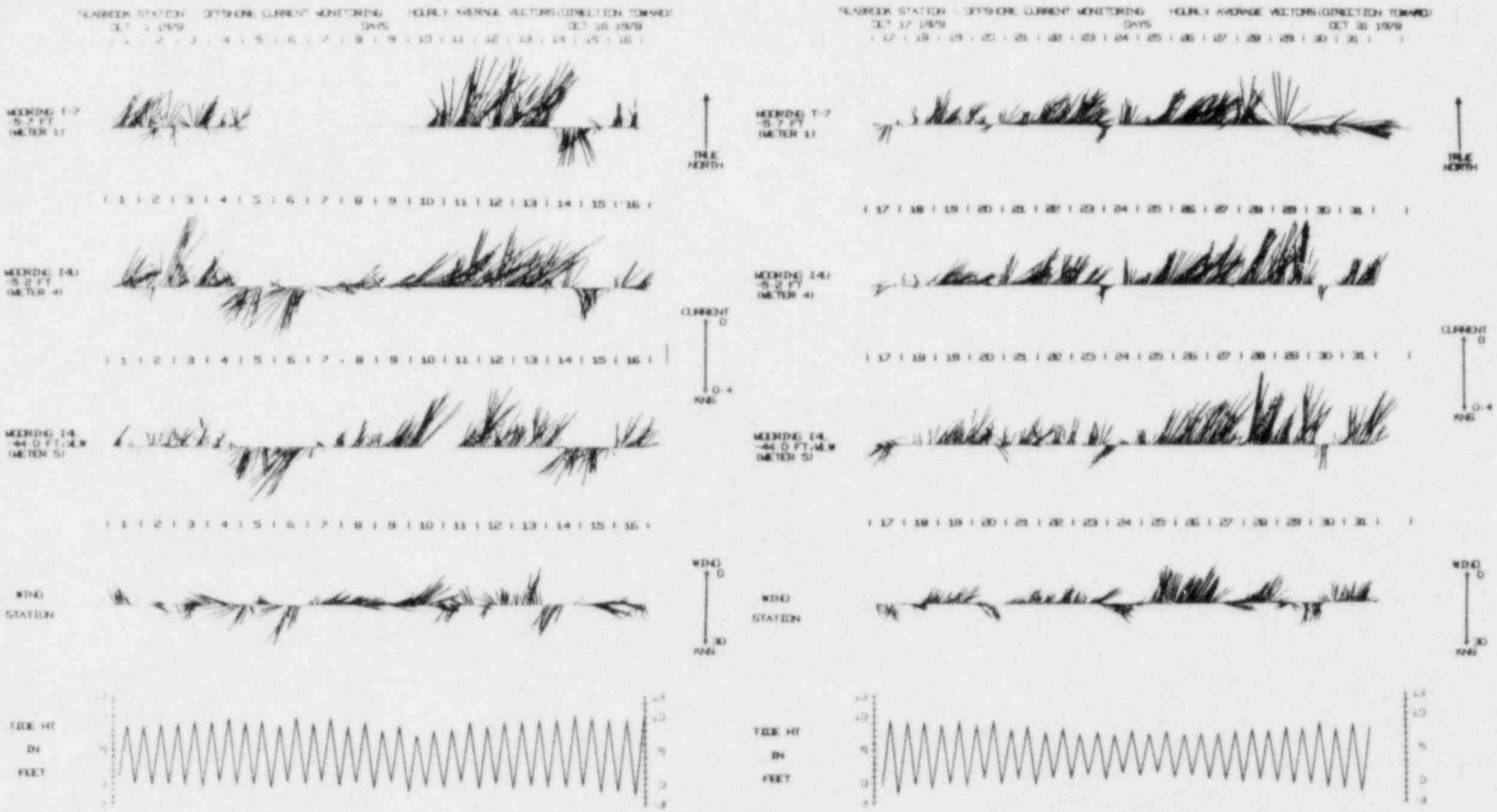
Appendix Figure 7.0-3g. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for July 1978.
Seabrook Annual Hydrographic Report, 1978



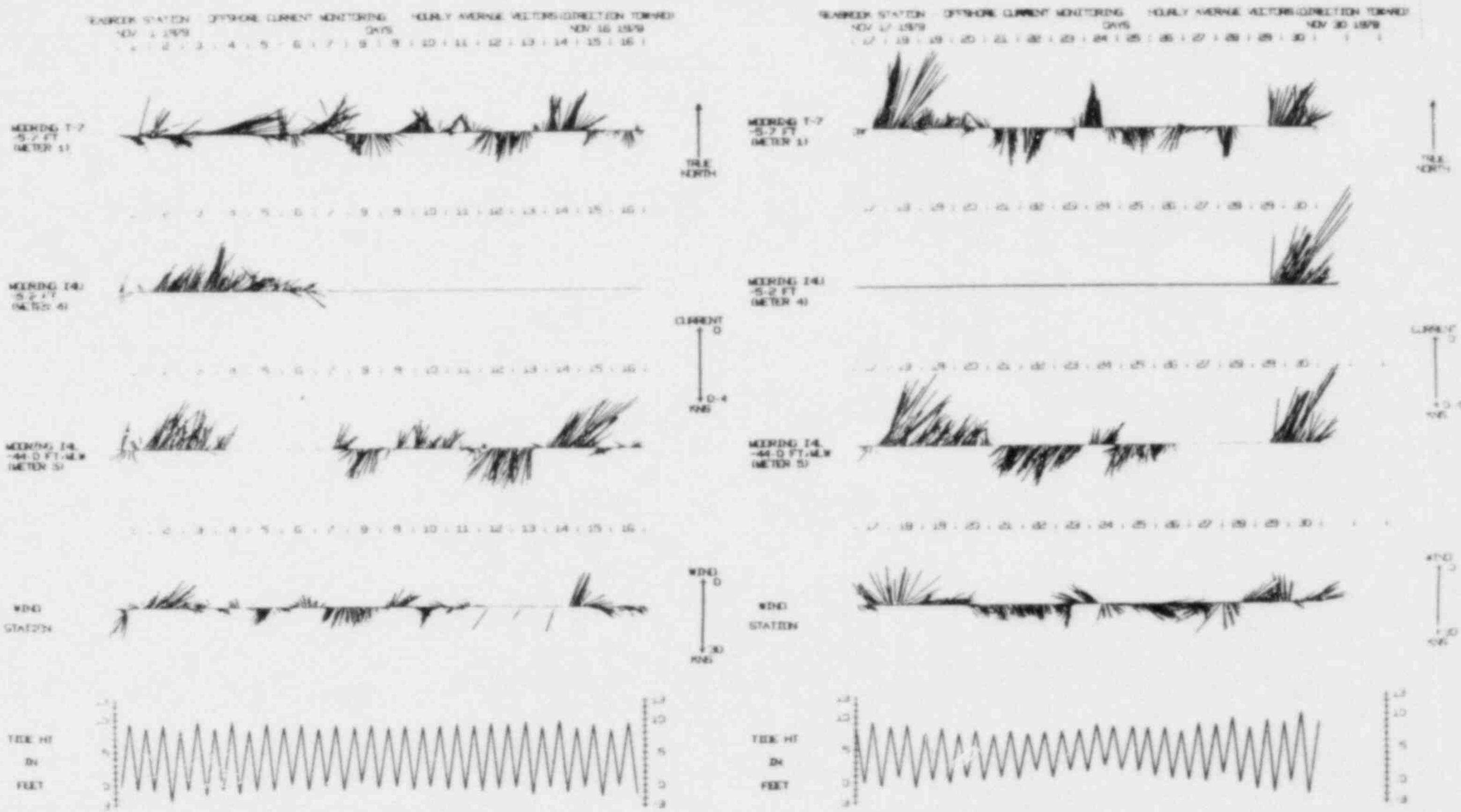
Appendix Figure 7.0-3h. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for August 1978.
Seabrook Annual Hydrographic Report, 1978.



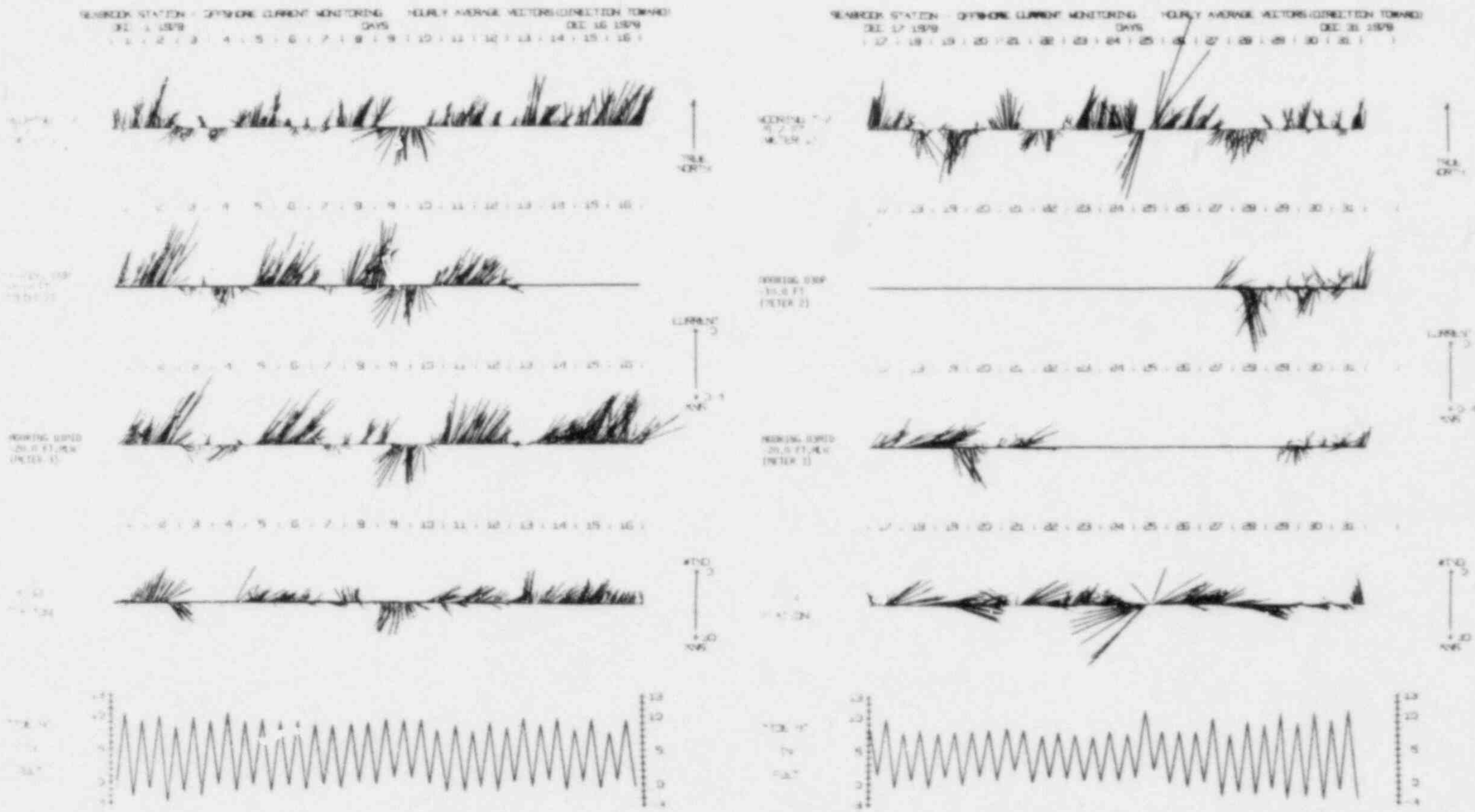
Appendix Figure 7.0-3i. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for September 1978.
Seabrook Annual Hydrographic Report, 1978.



Appendix Figure 7.0-3j. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for October 1978.
Seabrook Annual Hydrographic Report, 1978.



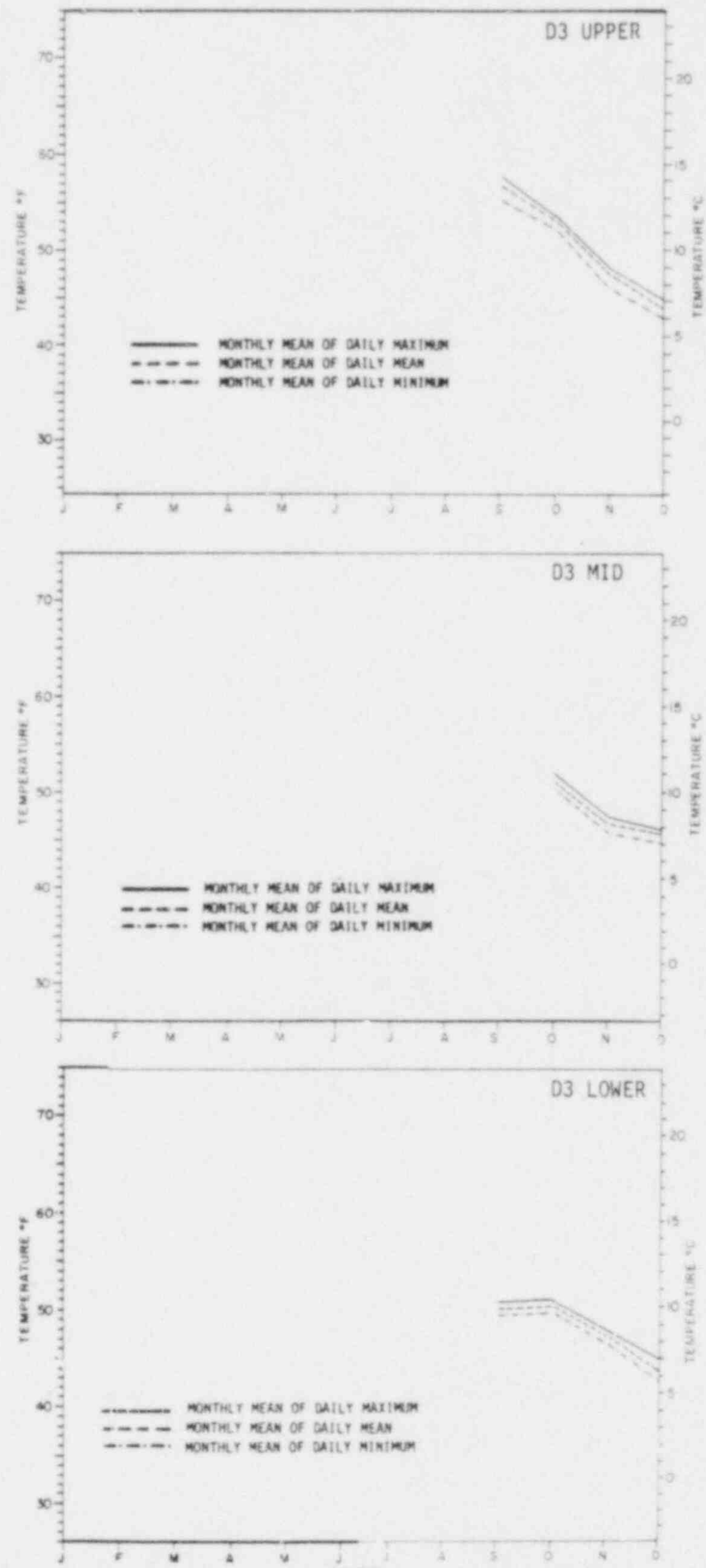
Appendix Figure 7.0-3k. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for November 1978.
Seabrook Annual Hydrographic Report, 1978.



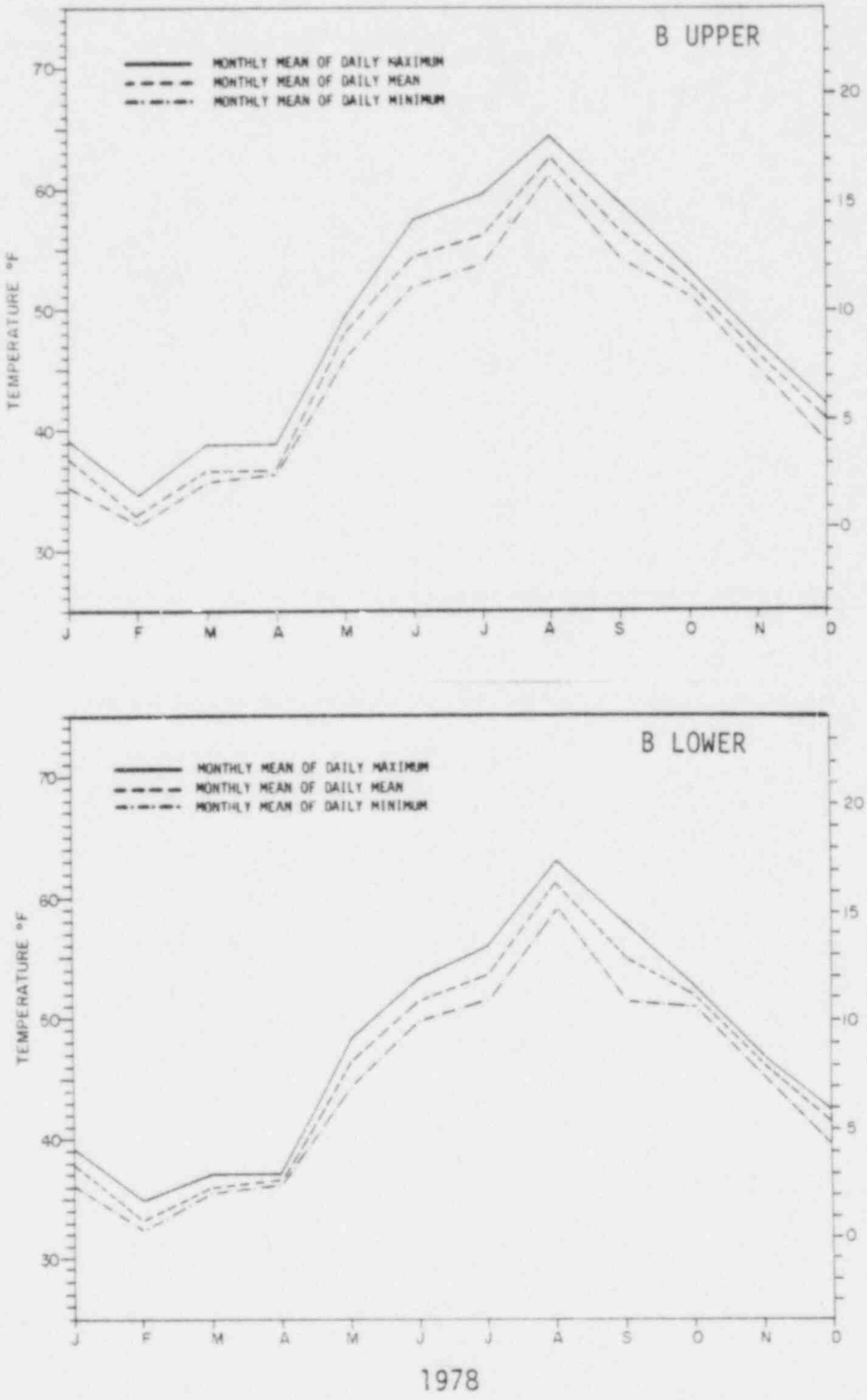
Appendix Figure 7.0-31. Hourly average sequential vector plots of current meter data, wind data (both representing direction toward) and high and low water tide heights for December 1978.
Seabrook Annual Hydrographic Report, 1978.

APPENDIX 7.0-4 TO 6.

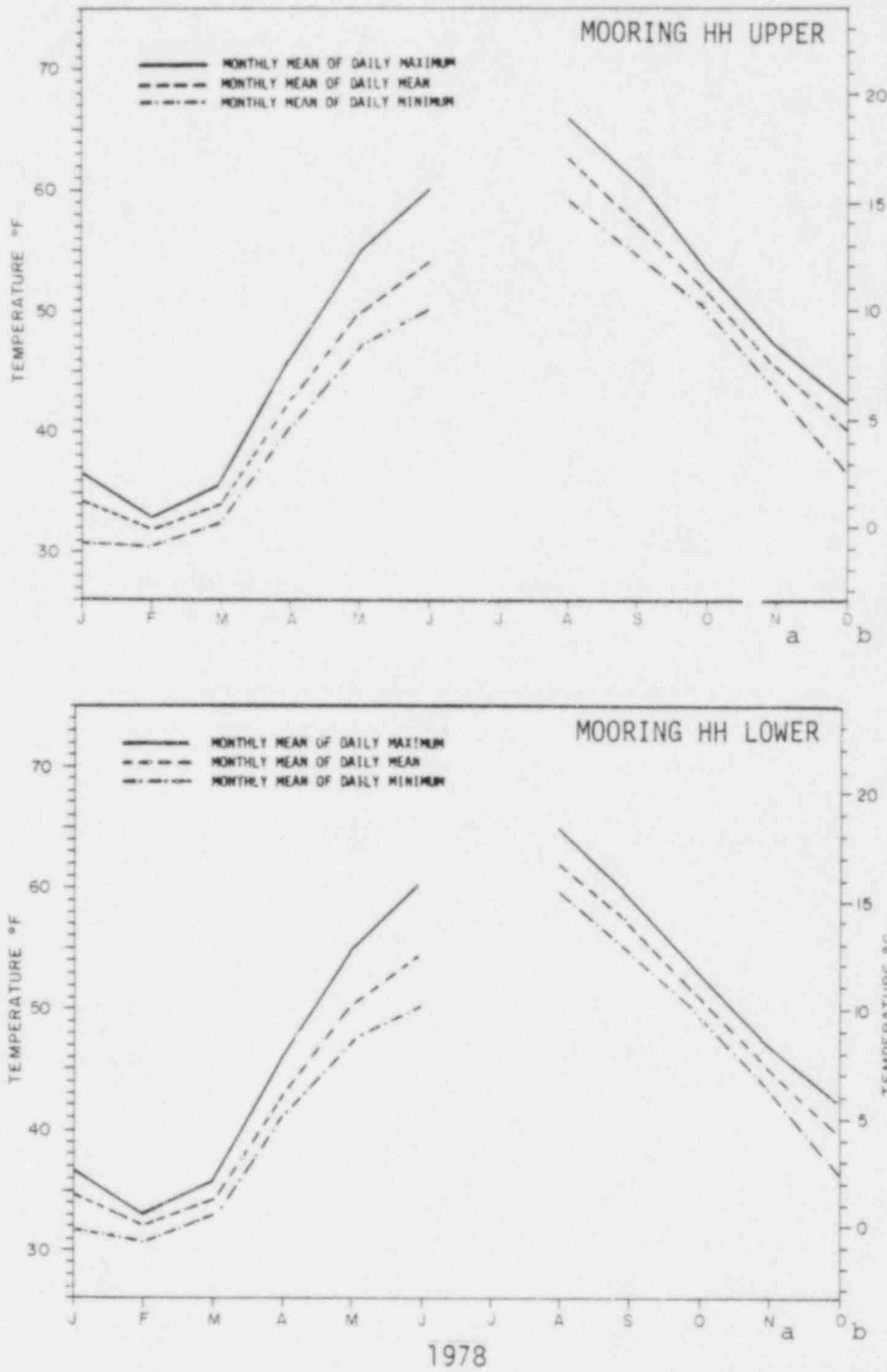
SUMMARY OF CONTINUOUS TEMPERATURE DATA



Appendix Figure 7.0-4. Plots of temperature measured at Mooring D3 upper, mid and lower off Hampton Beach, New Hampshire during 1978. Seabrook Annual Hydrographic Report, 1978.



Appendix Figure 7.0-5. Plots of temperature measured at Mooring B upper and lower off Hampton Beach, New Hampshire during 1978. Seabrook Annual Hydrographic Report, 1978.



[a] Based on 20 days data

[b] Based on 5 days data

Appendix Figure 7.0-6. Plots of temperature measured at Mooring HH Upper and Lower during 1978. Seabrook Annual Hydrographic Report, 1978.

APPENDIX 7.0-7.

CUMULATIVE[a] TEMPERATURE STATISTICS

DEFINITIONS

Maximum for all years: Maximum temperature[b] observed over period[c] of record.

Minimum for all years: Minimum temperature[b] observed over period[c] of record.

Mean Maximum: Ave:age of all monthly means of daily maximum temperatures observed over period[c] of record[d].

Mean Minimum: Average of all monthly means of daily minimum temperatures observed over period[c] of record[d].

1978 Data: Average of daily mean temperatures observed during 1978 only.

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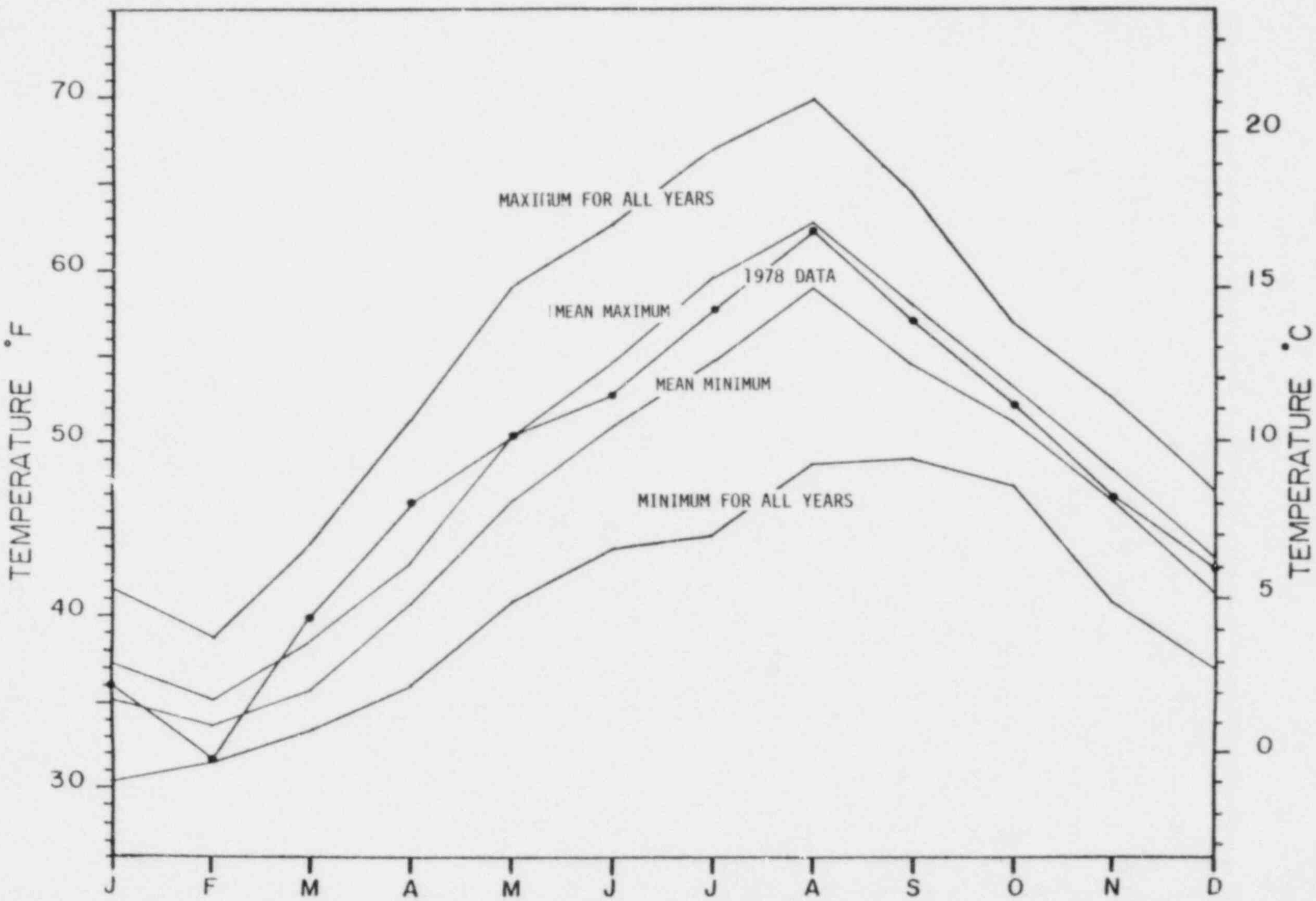
[a] See Figure 1.0-1 for period of record and Table 2.2-2 for mooring information.

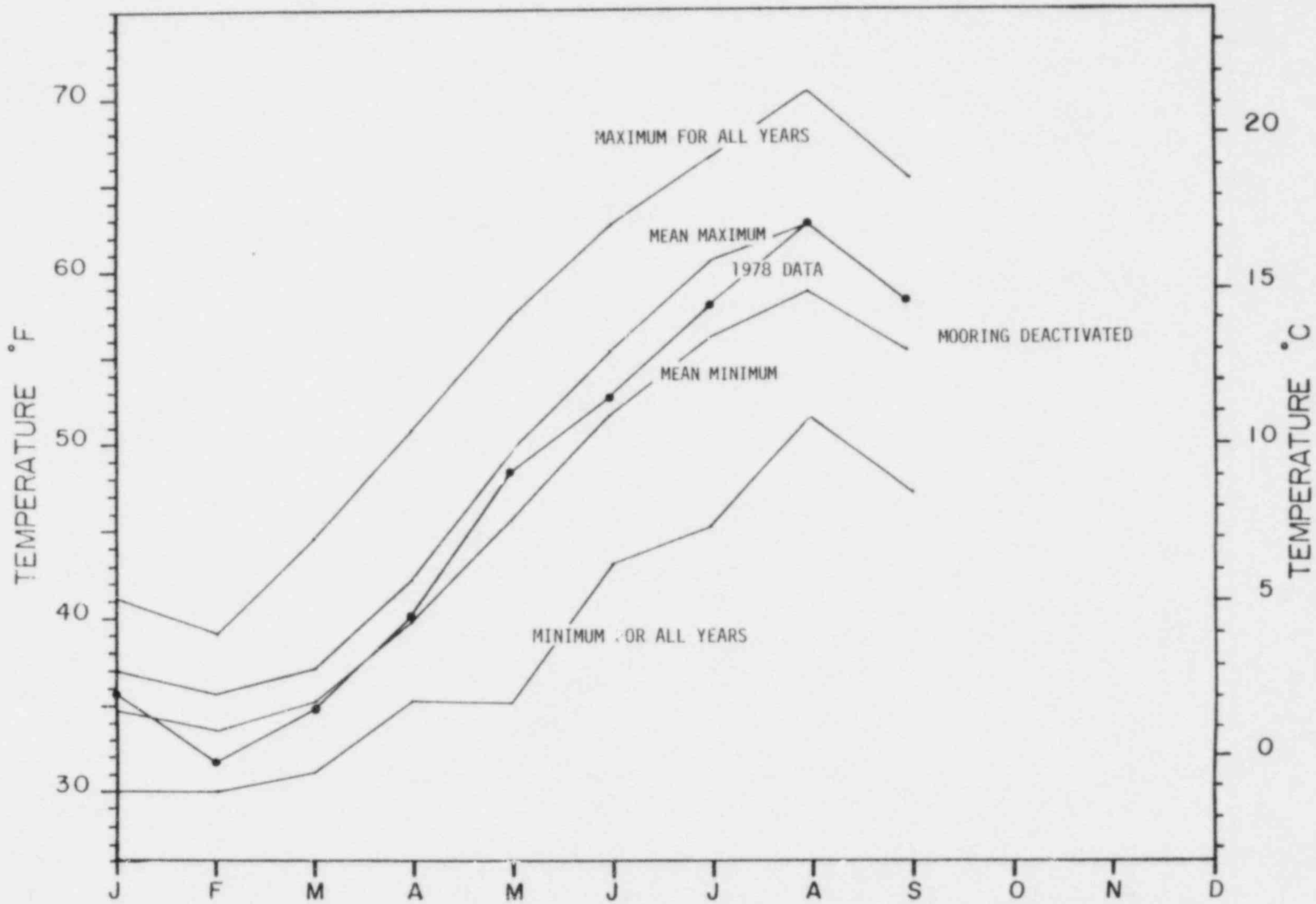
[b] single event

[c] all years

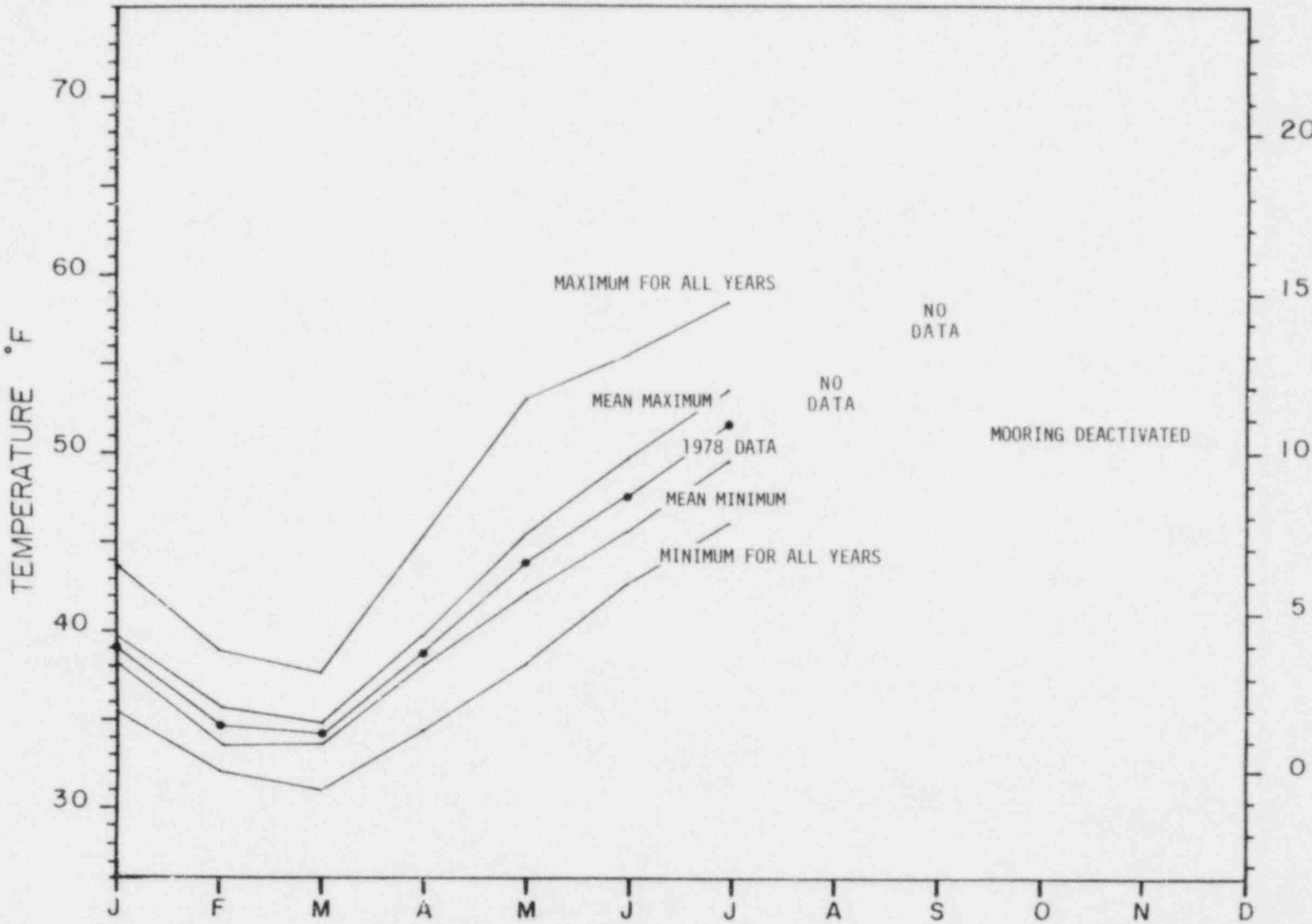
[d] means are weighted according to percent recovery



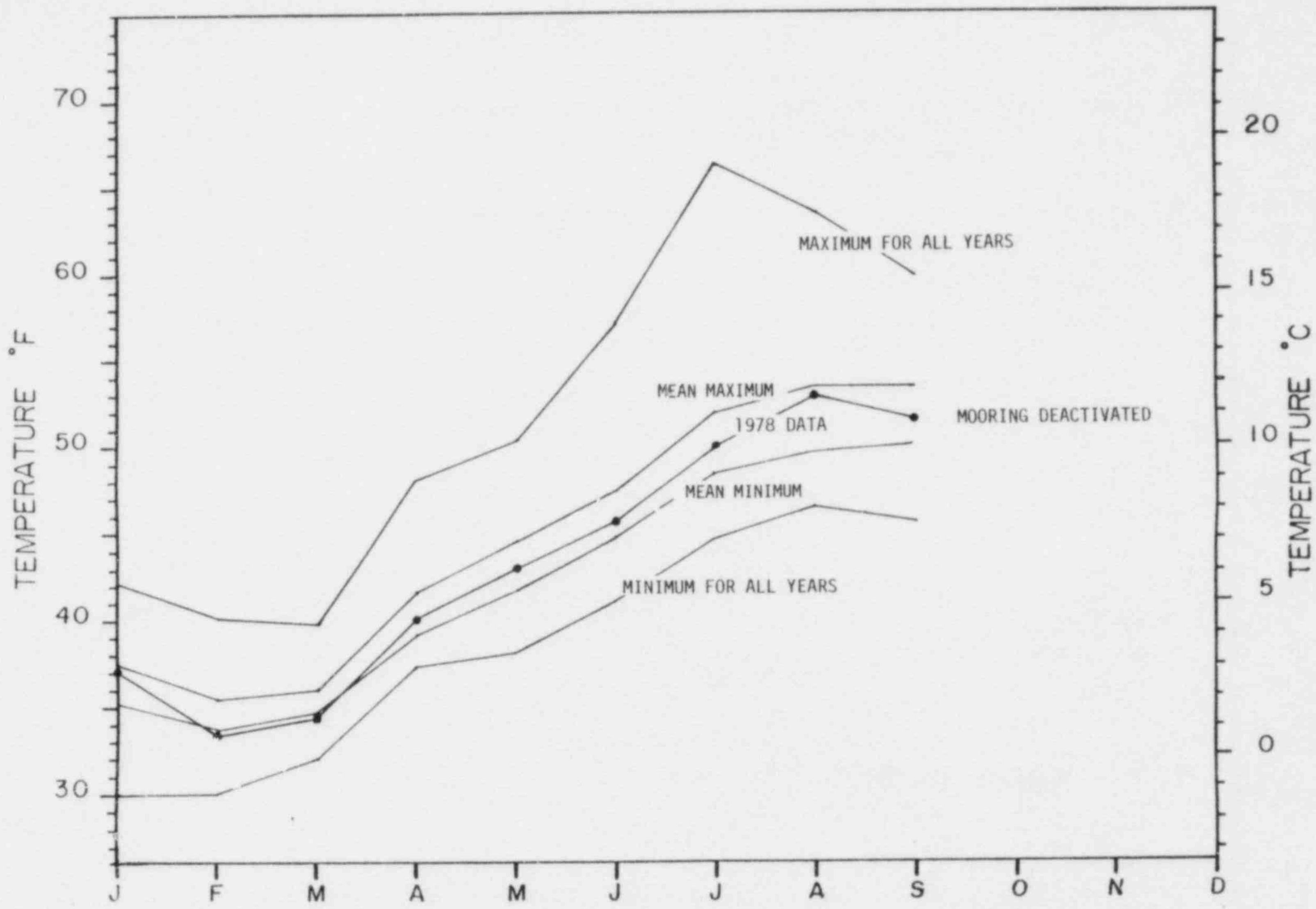
Appendix Figure 7.0-7a. Temperature data collected at Mooring T-7 during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



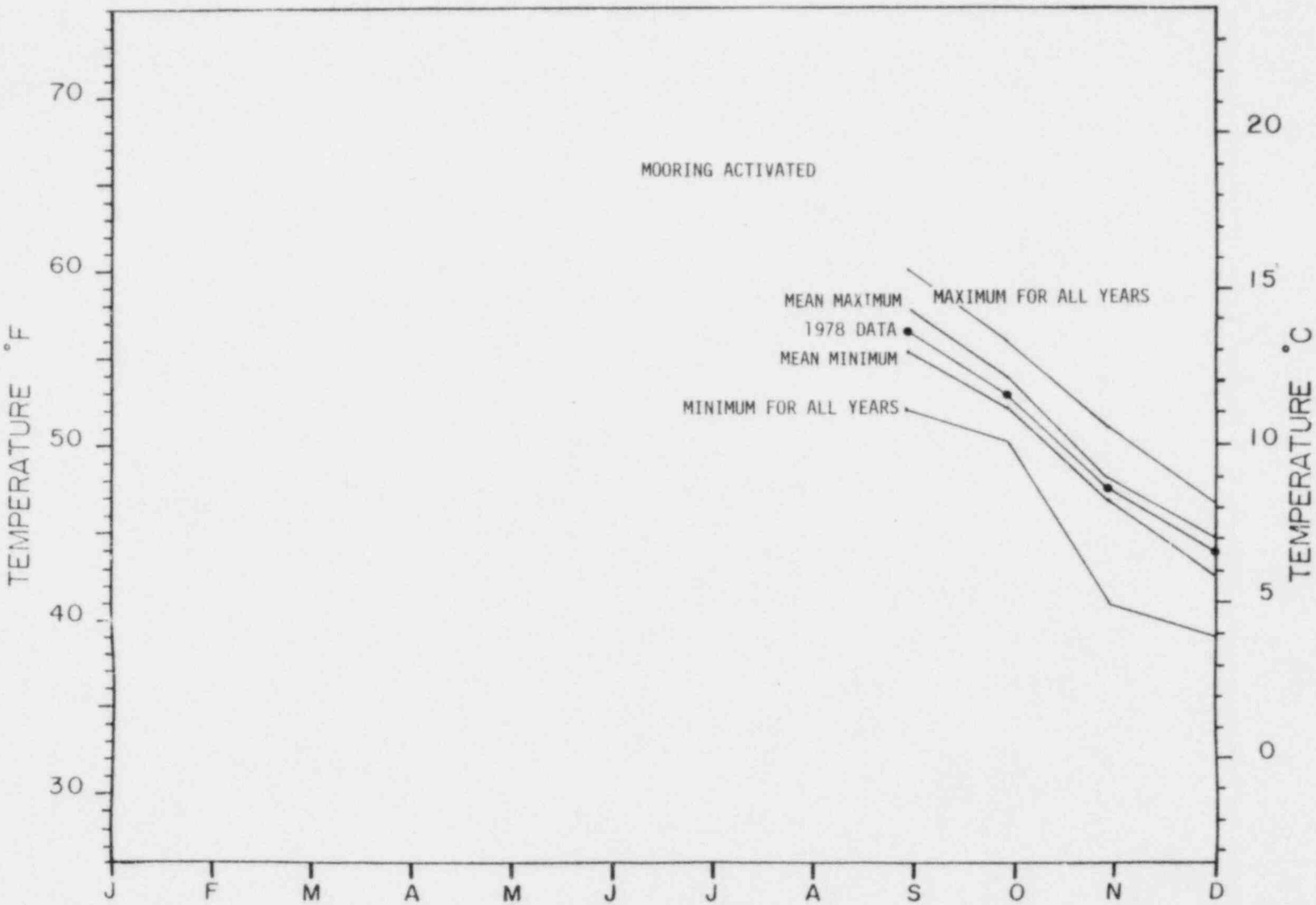
Appendix Figure 7.0-7b. Temperature data collected at Mooring I-4 upper during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



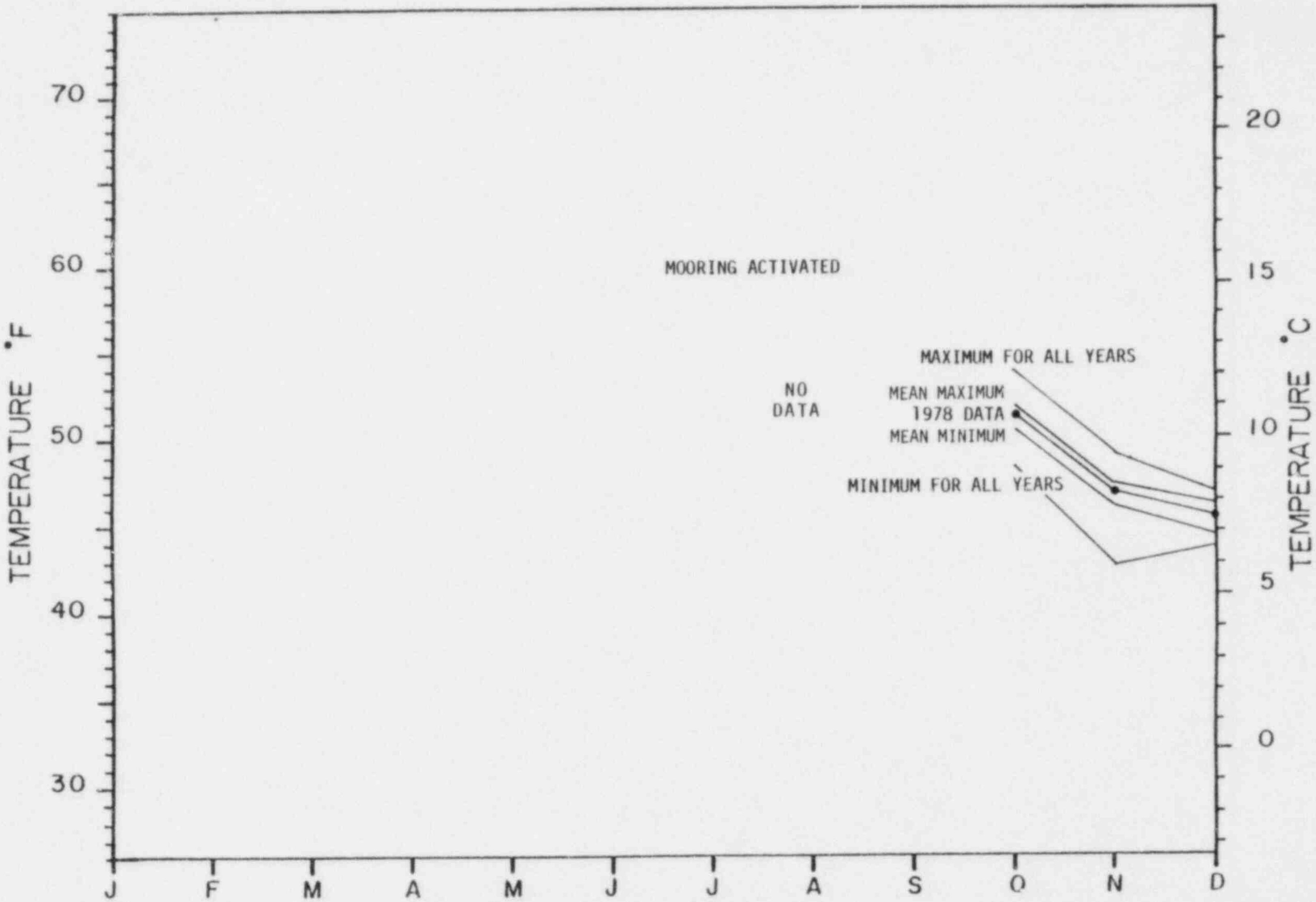
Appendix Figure 7.0-7c. Temperature data collected at Mooring I-4 mid during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



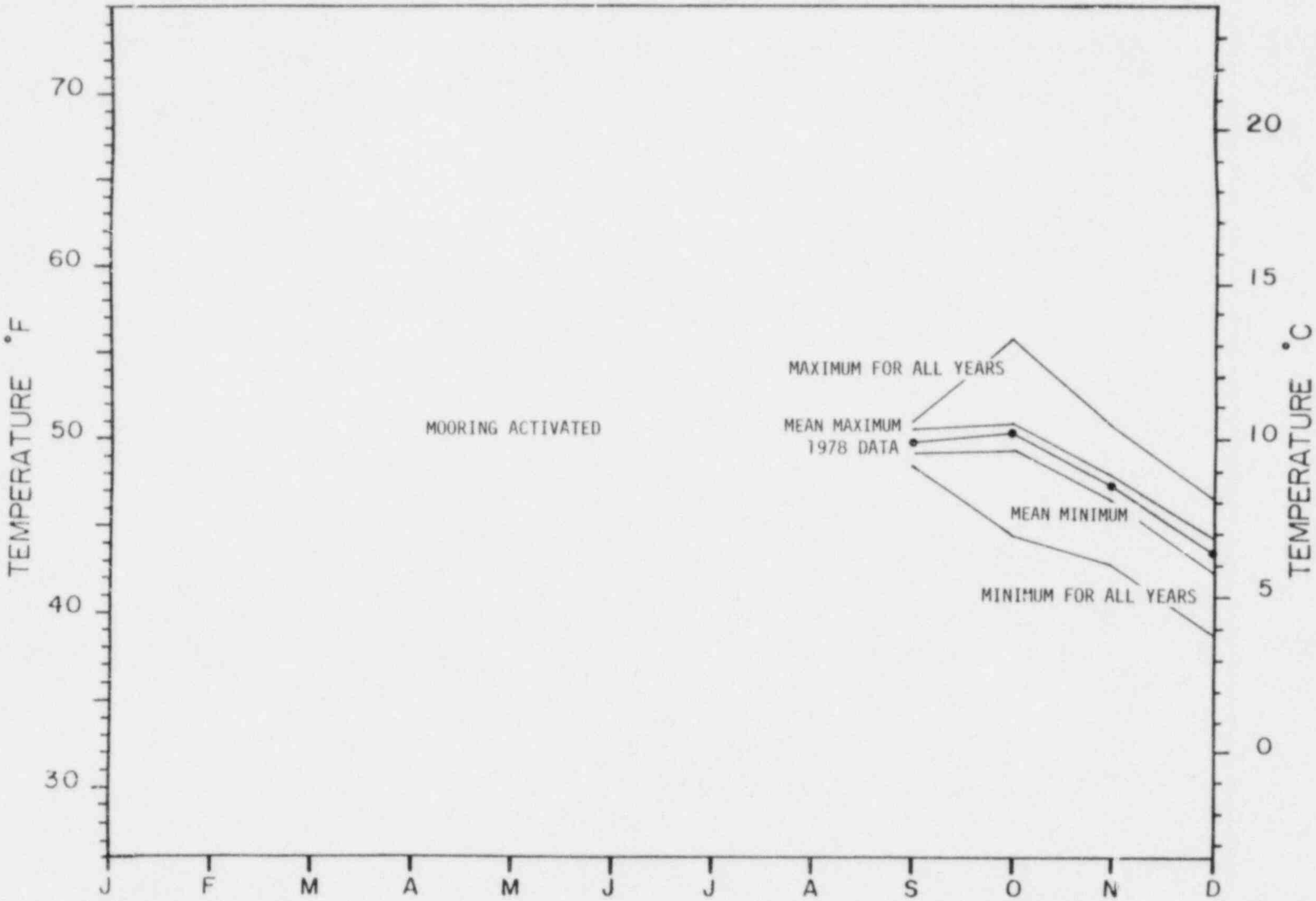
Appendix Figure 7.0-7d. Temperature data collected at Mooring I-4 lower during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



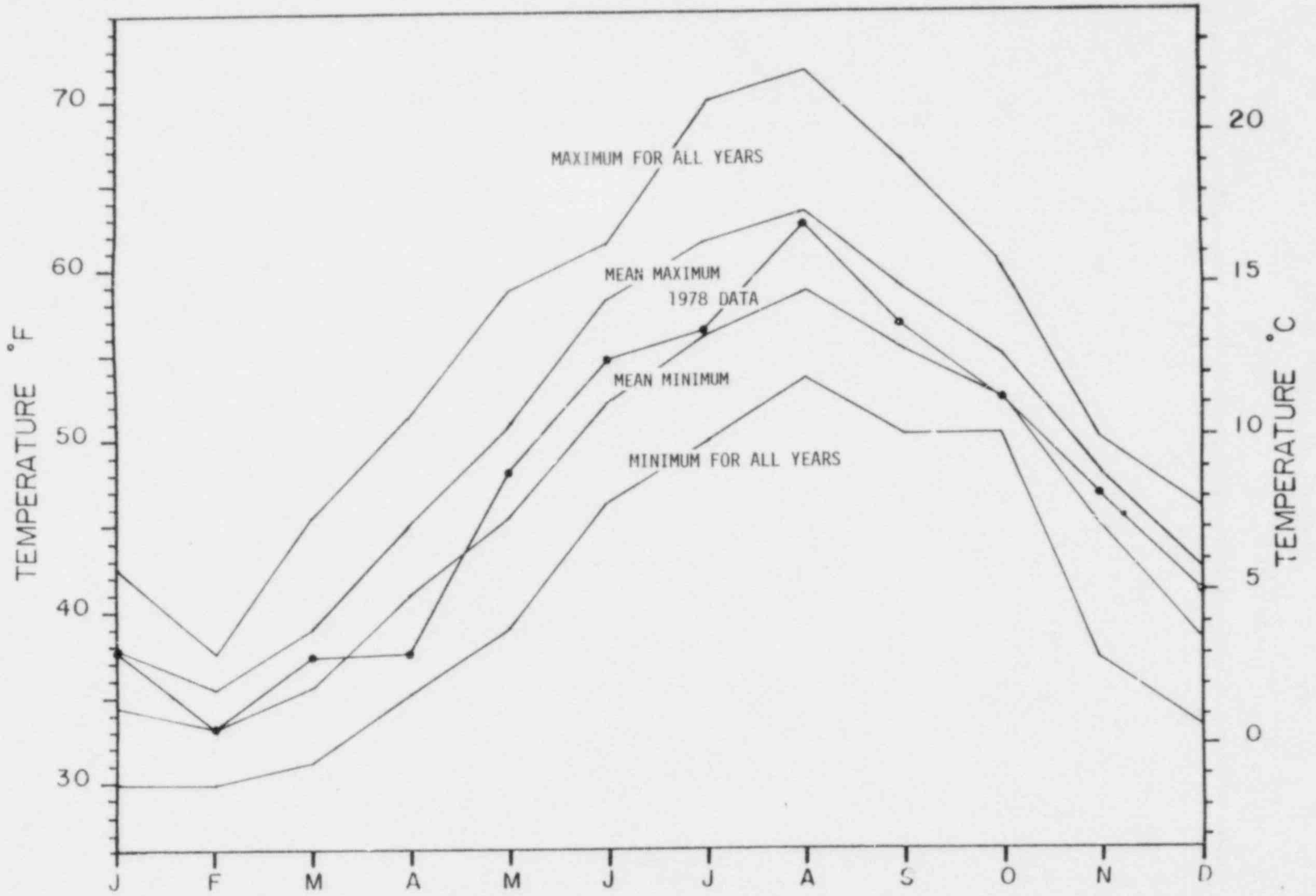
Appendix Figure 7.0-7e. Temperature data collected at Mooring D3 upper during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



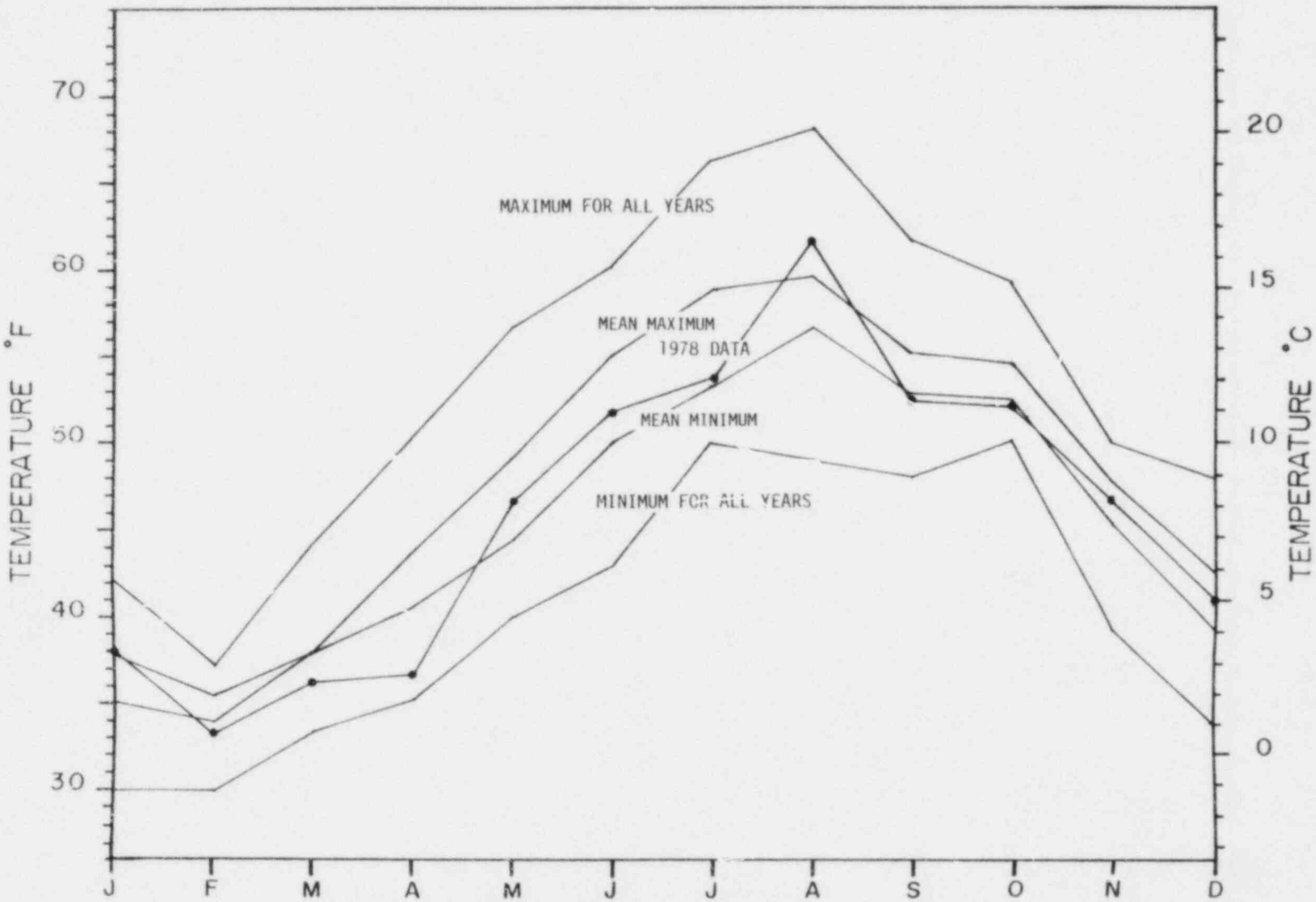
Appendix Figure 7.0-7f. Temperature data collected at Mooring D3 mid during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



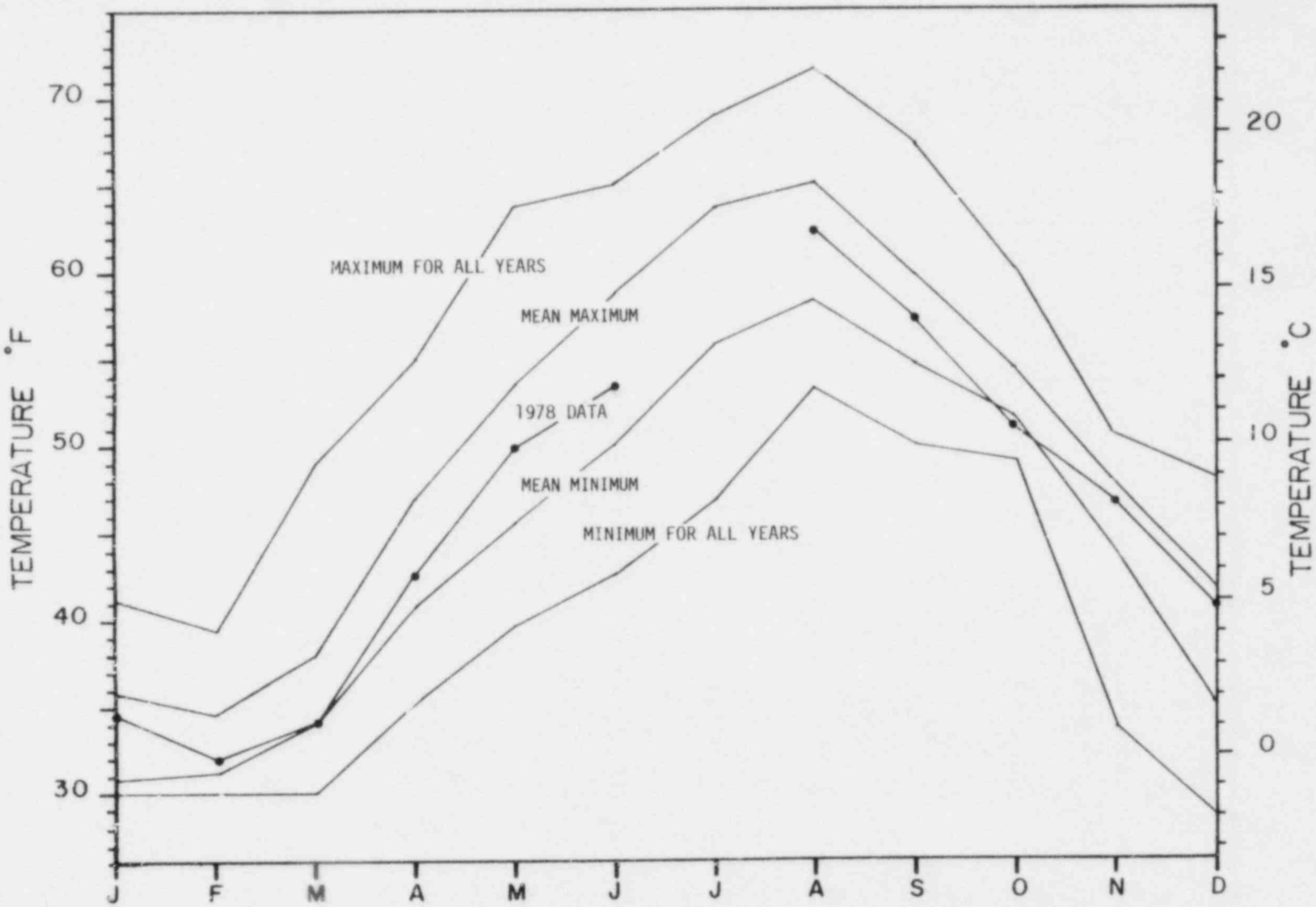
Appendix Figure 7.0-7q. Temperature data collected at Mooring D3 lower during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



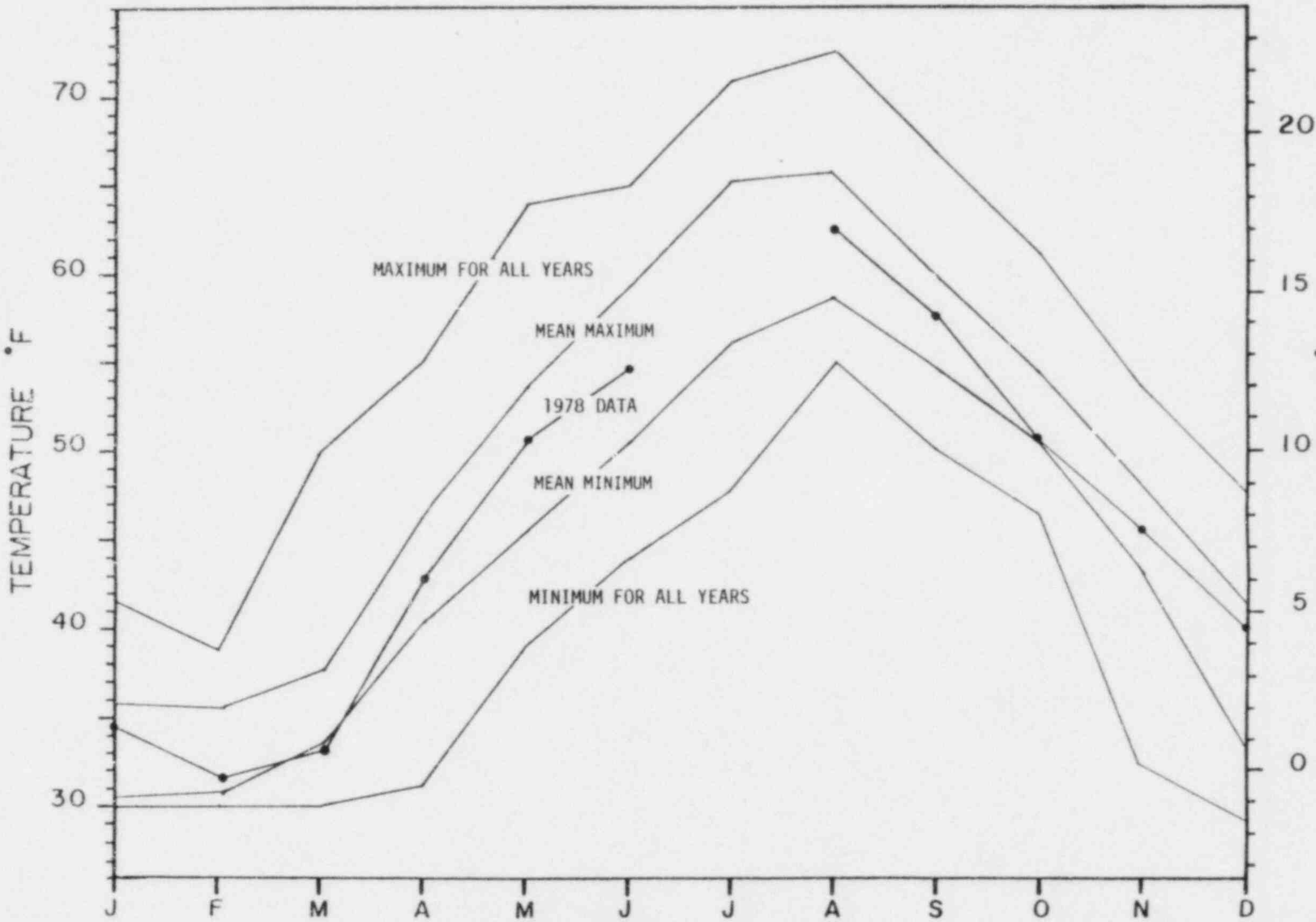
Appendix Figure 7.0-7h. Temperature data collected at Mooring B upper during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



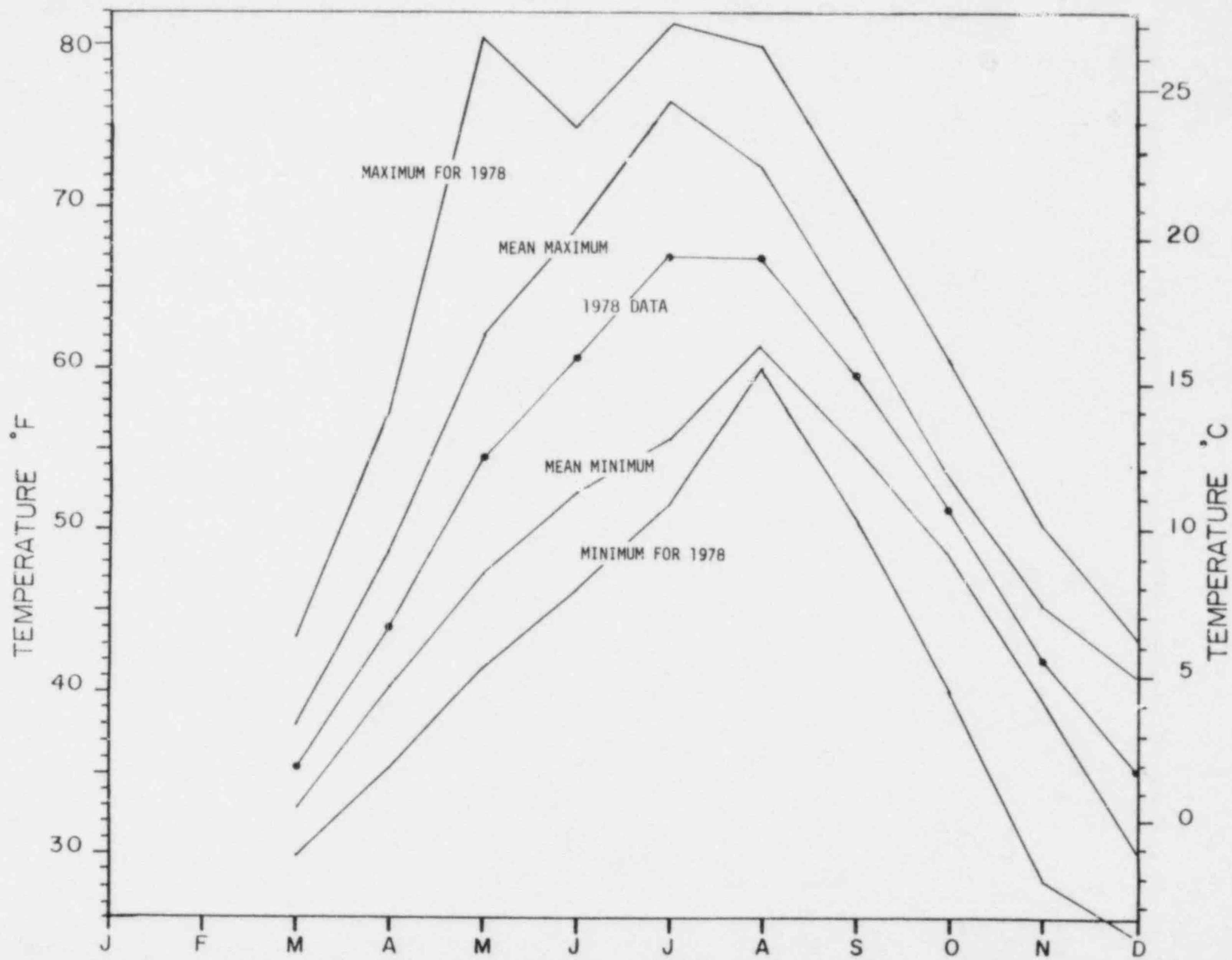
Appendix Figure 7.0-7i. Temperature data collected at Mooring B lower during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



Appendix Figure 7.0-7j. Temperature data collected at Mooring HH lower during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



Appendix Figure 7.0-7k. Temperature data collected at Mooring HH upper during 1978 and showing maximum and minimum for all years, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.



Appendix Figure 7.0-71. Temperature data collected at Mooring BR during 1978 and showing maximum and minimum for 1978, maximum and minimum mean and 1978 data. Seabrook Annual Hydrographic Report, 1978.

APPENDIX TABLE 7.1-1. OPERATIONAL PERFORMANCE OF NAI TEMPERATURE MONITORS OFF HAMPTON BEACH, NEW HAMPSHIRE, DURING 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

DESIGNATION[a]	DATES OPERATIONAL 1977	TOTAL POSSIBLE DAYS	DAYS DATA	DAYS NO DATA[b]
T-7	Jan 1 to Dec 31	365	281	84
I-4 Upper	Jan 1 to Sep 21	264	233	31
I-4 Mid	Jan 1 to Sep 21	270	230	40
I-4 Lower	Jan 1 to Sep 20	263	203	60
D-3 Upper	Sep 21 to Dec 31	102	101	1
D-3 Mid	Sep 27 to Dec 31	96	64	32
D-3 Lower	Sep 27 to Dec 31	96	84	12
B Upper	Jan 1 to Dec 31	365	215	150
B Lower	Jan 1 to Dec 31	365	199	166
HH Upper/Lower				
1001-T	Jan 1 to Apr 4	94	92	2
Data Logger	Apr 5 to Dec 5	249	167	82
BR (Data Logger)	Mar 8 to Dec 15	286	246	40
TOTAL		2815	2115	700
PERCENTAGE			75.1%	24.9%

[a]All Naico 1001-T units except as designated

[b]No data for >12 hrs on the given day

APPENDIX TABLE 7.1-2. PERCENTAGE-FREQUENCY TABULATION OF CURRENT METER DATA FROM MOORING T-7 OFF HAMPTON BEACH, NEW HAMPSHIRE. DATA ARE FROM APRIL 16, 1974 TO DECEMBER 28, 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

PERCENTAGES ARE BASED ON THE TOTAL VECTOR, DIRECTION ONLY AND SPEED ONLY OBSERVATIONS

DIRECTION CURRENT IS FLOWING TOWARD, DEGREES TRUE

SPEED, KNOTS	N 388-22	NE 23-67	E 68-112	SE 113-157	S 158-202	SW 203-247	W 248-293	NW 293-337	SPEED ONLY	TOTAL	PERCENT FREQUENCY
0.00-0.04	1639	1908	1316	1444	1536	1521	1320	1518	686	12888	12.3
0.05-0.20	7563	10228	4855	4062	9074	8298	4161	3900	2530	54671	52.4
0.21-0.40	2519	5517	2599	1178	4996	3494	772	578	565	22218	21.3
0.41-0.60	605	1471	515	138	1110	808	144	56	23	4870	4.7
0.61-0.80	163	450	59	51	289	237	30	13	4	1296	1.2
0.81-1.00	64	193	3	6	121	123	17	3	0	530	0.5
DIRECTION ONLY	1873	1356	606	893	1156	1054	521	467		7926	7.6
TOTAL	14426	21123	9953	7772	18282	15535	6965	6535	3808	104399	
PERCENT FREQUENCY	13.8	20.2	9.5	7.4	17.5	14.9	6.7	6.3	3.6		100.0

TOTAL POSSIBLE 20-MINUTE OBSERVATIONS = 123845

VECTOR OBSERVATIONS = 92678 (74.8%)

DIRECTION ONLY OBSERVATIONS = 6890 (5.6%)

SPEED ONLY OBSERVATIONS = 3808 (3.1%)

NO DATA = 20469 (16.5%)

APPENDIX TABLE 7.1-3. PERCENTAGE-FREQUENCY TABULATION OF CURRENT METER DATA FROM MOORING I-4 UPPER OFF HAMPTON BEACH, NEW HAMPSHIRE. DATA ARE FROM DECEMBER 29, 1975 TO SEPTEMBER 21, 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

PERCENTAGES ARE BASED ON THE TOTAL VECTOR, DIRECTION ONLY AND SPEED ONLY OBSERVATIONS

DIRECTION CURRENT IS FLOWING TOWARD, DEGREES TRUE

SPEED, KNOTS	N 388-22	NE 23-67	E 68-112	SE 113-157	S 158-202	SW 203-247	W 248-292	NW 293-337	SPEED ONLY	TOTAL	PERCENT FREQUENCY
0.00-0.04	760	977	1006	985	1089	836	731	632	521	7537	12.3
0.05-0.20	2976	4306	3896	2958	4363	3509	1753	1455	1934	27150	44.4
0.21-0.40	1690	2826	1506	544	2836	1886	262	318	7830	13698	22.4
0.41-0.60	404	854	202	77	1023	717	62	17	800	4156	6.8
0.61-0.80	84	155	28	38	459	328	4	0	321	1417	2.3
0.81-1.00	49	80	3	27	225	146	0	0	119	649	1.0
DIRECTION ONLY	875	957	725	659	1539	1069	400	363	0	6587	10.8
TOTAL	6838	10155	7366	5288	11534	8491	3212	2785	5525	61194	100.0
PERCENT FREQUENCY	11.1	16.6	12.0	8.6	18.8	13.9	5.2	4.6	9.0	0	100.0

TOTAL POSSIBLE 20-MINUTE OBSERVATIONS = 71932

VECTOR OBSERVATIONS = 49100 (68.3%)

DIRECTION ONLY OBSERVATIONS = 6624 (9.2%)

SPEED ONLY OBSERVATIONS = 5520 (7.7%)

NO DATA = 10688 (14.8%)

APPENDIX TABLE 7.1-4. PERCENTAGE-FREQUENCY TABULATION OF CURRENT METER DATA FROM MOORING I-4 LOWER OFF HAMPTON BEACH, NEW HAMPSHIRE. DATA ARE FROM DECEMBER 29, 1975 TO SEPTEMBER 20, 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

PERCENTAGES ARE BASED ON THE TOTAL VECTOR, DIRECTION ONLY AND SPEED ONLY OBSERVATIONS

DIRECTION CURRENT IS FLOWING TOWARD, DEGREES TRUE

SPEED, KNOTS	N 388-22	NE 23-67	E 68-112	SE 113-157	S 158-202	SW 203-247	W 248-292	NW 293-337	SPEED ONLY	TOTAL	PERCENT FREQUENCY
0.00-0.04	2245	1948	1605	1769	2561	3118	2067	1617	578	17508	27.1
0.05-0.20	4464	2263	1242	2822	5535	9868	2554	1231	1009	30988	48.0
0.21-0.40	922	133	44	123	739	1065	105	79	106	3316	5.1
0.41-0.60	76	5	3	25	210	366	2	0	0	687	1.1
0.61-0.80	0	0	1	23	51	62	4	0	0	141	0.2
0.81-1.00	0	0	0	5	3	4	0	0	0	12	0.0
DIRECTION ONLY	1627	970	818	1174	2600	3156	912	586	0	11843	184.0
TOTAL	9334	5319	3713	5941	11699	17639	5644	3513	1593	64495	100.0
PERCENT FREQUENCY	14.5	8.2	5.8	9.2	18.1	27.3	8.8	5.4	2.6	0	100.0

TOTAL POSSIBLE 20-MINUTE OBSERVATIONS = 71942

VECTOR OBSERVATIONS = 49353 (68.6%)

DIRECTION ONLY OBSERVATIONS = 11843 (16.5%)

SPEED ONLY OBSERVATIONS = 1693 (2.3%)

NO DATA = 9053 (12.6%)

APPENDIX TABLE 7.1-5. PERCENTAGE-FREQUENCY TABULATION OF CURRENT METER DATA FROM MOORING D3 UPPER OFF HAMPTON BEACH, NEW HAMPSHIRE. DATA ARE FROM SEPTEMBER 21, 1978 TO DECEMBER 28, 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

PERCENTAGES ARE BASED ON THE TOTAL VECTOR, DIRECTION ONLY AND SPEED ONLY OBSERVATIONS

DIRECTION CURRENT IS FLOWING TOWARD, DEGREES TRUE

SPEED, KNOTS	N 388-22	NE 23-67	E 68-112	SE 113-157	S 158-202	SW 203-247	W 248-292	NW 293-337	SPEED ONLY	TOTAL	PERCENT FREQUENCY
0.00-0.04	83	101	107	66	58	35	30	43	86	609	8.9
0.05-0.20	483	1098	358	106	180	145	78	123	965	3536	51.9
0.21-0.40	191	755	128	14	73	68	15	0	1132	2376	34.9
0.41-0.60	21	89	8	7	3	0	0	0	149	277	4.0
0.61-0.80	0	8	0	0	0	0	0	0	6	14	0.2
0.81-1.00	0	0	0	0	0	0	0	0	0	0	0.0
DIRECTION ONLY	0	0	0	0	0	0	0	0	0	4058	0.0
TOTAL	778	2051	601	193	314	248	123	166	2338	6812	100.0
PERCENT FREQUENCY	11.4	30.1	8.8	2.8	4.6	3.6	1.8	2.4	34.3	0	100.0

TOTAL POSSIBLE 20-MINUTE OBSERVATIONS = 7105

VECTOR OBSERVATIONS = 4507 (63.4%)

DIRECTION ONLY OBSERVATIONS = 0 (0.0%)

SPEED ONLY OBSERVATIONS = 2338 (32.9%)

NO DATA = 260 (3.7%)

APPENDIX TABLE 7.1-6. PERCENTAGE-FREQUENCY TABULATION OF CURRENT METER DATA FROM MOORING D3 MID OFF HAMPTON BEACH, NEW HAMPSHIRE. DATA ARE FROM SEPTEMBER 27, 1978 TO DECEMBER 28, 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

PERCENTAGES ARE BASED ON THE TOTAL VECTOR, DIRECTION ONLY AND SPEED ONLY OBSERVATIONS

DIRECTION CURRENT IS FLOWING TOWARD, DEGREES TRUE

SPEED, KNOTS	N 388-22	NE 23-67	E 68-112	SE 113-157	S 158-202	SW 203-247	W 248-292	NW 293-337	SPEED ONLY	TOTAL	PERCENT FREQUENCY
0.00-0.04	146	117	82	57	44	56	66	135	0	703	11.9
0.05-0.20	751	1209	177	110	294	501	160	217	102	3521	59.8
0.21-0.40	205	862	82	14	66	164	0	0	145	1538	26.1
0.41-0.60	18	88	3	0	0	3	0	0	12	124	2.1
0.61-0.80	0	1	0	0	0	0	0	0	0	1	0.0
0.81-1.00	0	0	0	0	0	0	0	0	0	0	0.0
DIRECTION ONLY	0	0	0	0	0	0	0	0	0	0	0.0
TOTAL	1120	2277	344	181	404	72	226	352	259	5887	
PERCENT FREQUENCY	19.0	38.7	5.8	3.1	6.9	12.3	3.8	6.0	4.4		100.0

TOTAL POSSIBLE 20-MINUTE OBSERVATIONS = 6666

VECTOR OBSERVATIONS = 5629 (84.4%)

DIRECTION ONLY OBSERVATIONS = 0 (0.0%)

SPEED ONLY OBSERVATIONS = 259 (3.9%)

NO DATA = 778 (11.7%)

APPENDIX TABLE 7.1-7. PERCENTAGE-FREQUENCY TABULATION OF CURRENT METER DATA FROM MOORING 10 UPPER OFF HAMPTON BEACH, NEW HAMPSHIRE. DATA ARE FROM OCTOBER 12, 1973 TO SEPTEMBER 15, 1977. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

PERCENTAGES ARE BASED ON THE TOTAL VECTOR, DIRECTION ONLY AND SPEED ONLY OBSERVATIONS

DIRECTION CURRENT IS FLOWING TOWARD, DEGREES TRUE

SPEED, KNOTS	N 388-22	NE 23-67	E 68-112	SE 113-157	S 158-202	SW 203-247	W 248-292	NW 293-337	SPEED ONLY	TOTAL	PERCENT FREQUENCY
0.00-0.04	2564	2616	1739	1648	1704	1857	1868	2283	9	16288	18.6
0.05-0.20	9594	9346	3321	3849	8262	8972	3999	4822	3	52168	59.7
0.21-0.40	2944	3555	301	387	4140	3939	244	556	1	16067	18.4
0.41-0.60	210	321	10	102	1089	601	18	36	0	2387	2.7
0.61-0.80	16	21	0	5	293	105	1	6	0	447	0.5
0.81-1.00	5	1	0	20	53	20	0	0	0	99	0.1
DIRECTION ONLY	1250	1688	752	849	1537	2245	1040	1016	0	10377	0.0
TOTAL	16583	17548	6123	6860	17078	17739	7170	8719	13	97833	100.0
PERCENT FREQUENCY	17.0	17.9	6.3	7.0	17.5	18.1	7.3	8.9	0	0	100.0

TOTAL POSSIBLE 20-MINUTE OBSERVATIONS = 103452

VECTOR OBSERVATIONS = 87443 (84.5%)

DIRECTION ONLY OBSERVATIONS = 10377 (10.1%)

SPEED ONLY OBSERVATIONS = 13 (0.0%)

NO DATA = 5619 (5.4%)

APPENDIX TABLE 7.1-8. PERCENTAGE-FREQUENCY TABULATION OF CURRENT METER DATA FROM MOORING 12 OFF HAMPTON BEACH, NEW HAMPSHIRE. DATA ARE FROM NOVEMBER 16, 1973 TO SEPTEMBER 15, 1977. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

PERCENTAGES ARE BASED ON THE TOTAL VECTOR, DIRECTION ONLY AND SPEED ONLY OBSERVATIONS

DIRECTION CURRENT IS FLOWING TOWARD, DEGREES TRUE

SPEED, KNOTS	N 388-22	NE 23-67	E 68-112	SE 113-157	S 158-202	SW 203-247	W 248-292	NW 293-337	SPEED ONLY	TOTAL	PERCENT FREQUENCY
0.00-0.04	714	1118	1186	1189	1136	953	818	779	562	8455	9.8
0.05-0.20	4204	8287	6334	4763	6471	4842	2458	2369	1085	40813	47.5
0.21-0.40	3692	7995	3530	1139	4544	3493	581	737	627	26338	30.6
0.41-0.60	1545	2441	326	150	1618	1517	42	113	117	7869	9.1
0.61-0.80	343	483	10	75	485	423	0	27	22	1868	2.2
0.81-1.00	178	116	4	30	149	179	0	3	3	662	0.8
DIRECTION ONLY	531	852	573	370	640	678	197	217	0	4058	0.0
TOTAL	11207	21292	11963	7716	15043	12085	4096	4245	2416	90063	100.0
PERCENT FREQUENCY	12.8	24.3	13.6	8.8	17.2	13.8	4.7	4.8	0	0	100.0

TOTAL POSSIBLE 20-MINUTE OBSERVATIONS = 100934

VECTOR OBSERVATIONS = 83589 (82.8%)

DIRECTION ONLY OBSERVATIONS = 4058 (4.0%)

SPEED ONLY OBSERVATIONS = 2416 (2.4%)

NO DATA = 10871 (10.8%)

APPENDIX TABLE 7.1-9. PERCENTAGE-FREQUENCY TABULATION OF WIND DATA FROM WIND STATION AT HAMPTON BEACH, NEW HAMPSHIRE. DATA ARE FROM JANUARY 24, 1973 TO DECEMBER 28, 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

PERCENTAGES ARE BASED ON THE TOTAL VECTOR, DIRECTION ONLY AND SPEED ONLY OBSERVATIONS

DIRECTION WIND IS BLOWING TOWARD, DEGREES TRUE

SPEED, KNOTS	N 388-22	NE 23-67	E 68-112	SE 113-157	S 158-202	SW 203-247	W 248-292	NW 293-337	SPEED ONLY	TOTAL	PERCENT FREQUENCY
<1	144	233	296	210	108	60	81	55	10	1197	0.8
1-10	13481	17697	25692	19574	9010	7886	7194	9788	155	110477	74.9
11-20	2744	7113	9109	4151	1895	3261	1498	1160	27	30958	21.0
21-30	141	567	740	119	225	839	390	72	6	3099	2.1
31-40	7	31	22	5	48	154	30	5	1	303	0.2
41-50	2	0	0	0	2	19	2	0	0	25	0.0
DIRECTION ONLY	159	407	152	327	152	84	65	63	0	1409	1.0
TOTAL	16678	26048	36011	24386	11440	12303	9260	111	199	147468	
PERCENT FREQUENCY	11.3	17.7	24.4	16.5	7.8	8.3	6.3	7.6	0.1		100.0

TOTAL POSSIBLE 20-MINUTE OBSERVATIONS = 156174

VECTOR OBSERVATIONS = 148103 (94.8%)

DIRECTION ONLY OBSERVATIONS = 1558 (1.0%)

SPEED ONLY OBSERVATIONS = 199 (0.1%)

NO DATA = 6314 (4.0%)

APPENDIX TABLE 7.1-10. TABULATION OF CURRENT FLOW TYPES IN COASTAL WATERS SEAWARD OF THE OUTER SUNK ROCKS OFF HAMPTON BEACH, NEW HAMPSHIRE, FOR 1973 THROUGH 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

MONTH	NO. OF DAYS IN MONTH	NUMBER OF DAYS PER MONTH (PERCENTAGE)					
		TRANSIENT FLOW		STEADY-STATE FLOW			
		TIDAL EFFECTS		FLOW TOWARD THE SOUTH		FLOW TOWARD THE NORTH	
		WEAK TIDAL FLOW	REVERSING FLOOD AND EBB TIDAL CURRENTS	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN
1973							
January	7	2.0(28.6)	0.0(0.0)	3.0(42.8)	2.0(28.6)	0.0(0.0)	0.0(0.0)
February	28	2.0(7.1)	8.0(28.6)	9.0(32.1)	8.0(28.6)	1.0(3.6)	0.0(0.0)
March	31	8.0(25.8)	6.0(19.4)	3.5(11.3)	10.0(32.2)	3.5(11.3)	0.0(0.0)
April	30	3.0(10.0)	9.0(30.0)	2.0(6.7)	5.5(18.3)	4.0(13.3)	6.5(21.7)
May	31	4.0(12.9)	16.5(53.2)	6.0(19.4)	4.0(12.9)	0.5(1.6)	0.0(0.0)
June	30	6.0(20.0)	12.0(40.0)	5.5(18.3)	4.0(13.3)	2.5(8.3)	0.0(0.0)
July	31	4.5(14.5)	20.0(64.5)	6.0(19.4)	0.0(0.0)	0.5(1.6)	0.0(0.0)
August	31	4.5(14.5)	13.0(41.9)	9.0(29.0)	3.0(9.7)	1.5(4.8)	0.0(0.0)
September	30	8.5(28.3)	16.0(53.3)	0.0(0.0)	2.0(6.7)	2.5(8.3)	1.0(3.3)
October	31	3.0(9.7)	9.5(30.6)	2.0(6.4)	4.0(12.9)	7.5(24.2)	5.0(16.1)
November	30	0.5(1.7)	3.5(11.7)	0.5(1.7)	0.0(0.0)	15.5(51.7)	10.0(33.3)
December	31	2.5(8.1)	3.0(9.7)	5.5(17.7)	2.5(8.1)	14.0(45.2)	3.5(11.3)
TOTAL DAYS	341	48.5(14.2)	116.5(34.2)	52.0(15.2)	45.0(13.2)	53.0(15.5)	26.0(7.6)
PERCENT BY TYPE		(48.4)		(28.4)		(23.2)	

(Continued)

APPENDIX TABLE 7.1-10. (Continued)

MONTH	NO. OF DAYS IN MONTH	NUMBER OF DAYS PER MONTH (PERCENTAGE)					
		TRANSIENT FLOW		STEADY-STATE FLOW			
		TIDAL EFFECTS		FLOW TOWARD THE SOUTH		FLOW TOWARD THE NORTH	
		WEAK TIDAL FLOW	REVERSING FLOOD AND EBB TIDAL CURRENTS	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN
1974							
January	31	4.0(12.9)	3.5(11.3)	2.5(8.1)	3.5(11.3)	14.5(46.8)	3.0(9.7)
February	28	0.0(0.0)	5.0(17.8)	7.0(25.0)	4.0(14.3)	11.0(39.3)	1.0(3.6)
March	31	0.5(1.6)	10.0(32.2)	4.5(14.5)	2.5(8.1)	9.5(30.6)	4.0(12.9)
April	30	2.0(6.7)	12.5(41.7)	8.5(28.3)	3.0(10.0)	4.0(13.3)	0.0(0.0)
May	31	5.5(17.7)	8.0(25.8)	7.5(24.2)	3.0(9.7)	6.0(19.4)	1.0(3.2)
June	30	2.5(8.3)	14.5(18.3)	10.5(35.0)	2.0(6.7)	0.5(1.7)	0.0(0.0)
July	31	5.0(16.1)	17.0(54.8)	7.0(22.6)	0.0(0.0)	2.0(6.4)	0.0(0.0)
August	31	5.5(17.7)	16.5(53.2)	5.5(17.7)	0.0(0.0)	3.5(11.3)	0.0(0.0)
September	30	6.0(20.0)	9.0(30.0)	4.5(15.0)	0.0(0.0)	10.5(35.0)	0.0(0.0)
October	31	2.0(6.4)	6.5(21.0)	1.0(3.2)	0.0(0.0)	14.5(46.8)	7.0(22.6)
November	30	4.0(13.3)	4.5(15.0)	9.5(31.7)	0.0(0.0)	11.0(36.7)	1.0(3.3)
December	31	6.5(21.0)	4.5(14.5)	3.5(11.3)	3.5(11.3)	13.0(41.9)	0.0(0.0)
TOTAL DAYS	365	43.5(11.9)	111.5(30.5)	71.5(19.6)	21.5(5.9)	100.0(27.4)	47.0(4.6)
PERCENT BY TYPE		(42.5)		(25.5)		(32.0)	

(Continued)

APPENDIX TABLE 7.1-10. (Continued)

MONTH	NO. OF DAYS IN MONTH	NUMBER OF DAYS PER MONTH (PERCENTAGE)					
		TRANSIENT FLOW		STEADY-STATE FLOW			
		TIDAL EFFECTS		FLOW TOWARD THE SOUTH		FLOW TOWARD THE NORTH	
		WEAK TIDAL FLOW	REVERSING FLOOD AND EBB TIDAL CURRENTS	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN
1975							
January	31	3.0(9.7)	3.5(11.3)	10.0(32.2)	1.0(3.2)	12.5(40.3)	1.0(3.2)
February	28	5.5(19.6)	3.0(10.7)	6.0(21.4)	3.0(10.7)	10.5(37.5)	0.0(0.0)
March	31	7.0(22.6)	9.0(29.0)	4.0(12.9)	5.5(17.7)	4.5(14.5)	1.0(3.2)
April	30	9.0(30.0)	2.0(6.7)	8.5(28.3)	4.0(13.3)	5.5(18.3)	1.0(3.2)
May	31	9.5(30.6)	1.0(3.2)	15.5(20.0)	3.0(9.7)	1.0(3.2)	1.0(3.2)
June	30	9.5(31.7)	5.0(16.7)	8.0(26.7)	5.5(18.3)	2.0(6.7)	0.0(0.0)
July	31	12.5(40.3)	4.0(12.9)	7.0(22.6)	3.5(11.3)	4.5(14.5)	0.0(0.0)
August	31	12.0(38.7)	4.0(12.9)	7.0(22.6)	3.5(11.3)	4.5(14.5)	0.0(0.0)
September	30	4.5(15.0)	2.5(8.3)	3.0(10.0)	0.0(0.0)	15.0(50.0)	5.0(16.7)
October	31	9.5(30.6)	0.0(0.0)	3.5(11.3)	6.0(19.4)	11.0(35.5)	1.0(3.2)
November	30	5.5(18.3)	3.0(10.0)	4.0(13.3)	1.0(3.3)	13.0(43.3)	3.5(11.7)
December	31	10.5(33.9)	1.0(3.2)	10.5(33.9)	3.0(9.7)	5.5(17.7)	0.5(1.6)
TOTAL DAYS	365	98.5(27.0)	45.0(12.3)	84.0(23.0)	35.5(9.7)	88.0(24.1)	14.0(3.8)
PERCENT BY TYPE		(39.3)		(32.7)		(28.0)	

(Continued)

APPENDIX TABLE 7.1-10. (Continued)

MONTH	NO. OF DAYS IN MONTH	NUMBER OF DAYS PER MONTH (PERCENTAGE)					
		TRANSIENT FLOW		STEADY-STATE FLOW			
		TIDAL EFFECTS		FLOW TOWARD THE SOUTH		FLOW TOWARD THE NORTH	
		WEAK TIDAL FLOW	REVERSING FLOOD AND EBB TIDAL CURRENTS	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN
1976							
January	31	7.5(24.2)	0.0(0.0)	9.5(30.6)	6.5(21.0)	7.5(24.2)	0.0(0.0)
February	29	6.5(22.4)	0.0(0.0)	5.5(19.0)	5.5(19.0)	9.5(32.8)	2.0(6.9)
March	31	5.5(17.7)	0.0(0.0)	7.5(24.2)	5.5(17.7)	11.5(37.1)	1.0(3.2)
April	30	8.5(28.3)	0.0(0.0)	9.5(31.7)	2.5(8.3)	8.5(28.3)	1.0(3.3)
May	31	10.0(32.2)	4.0(12.9)	3.5(11.3)	2.0(6.4)	9.5(30.6)	2.0(6.4)
June	30	14.5(48.3)	4.0(13.3)	4.5(15.0)	0.5(1.7)	6.5(21.7)	0.0(0.0)
July	31	12.5(40.3)	6.5(21.0)	2.5(8.1)	1.5(4.8)	6.0(19.4)	2.0(6.4)
August	31	9.0(29.0)	5.0(16.1)	5.5(17.7)	0.5(1.6)	9.5(30.6)	1.5(4.8)
September	30	8.5(28.3)	1.0(3.3)	11.0(36.7)	0.5(1.7)	7.5(25.0)	1.5(5.0)
October	31	2.5(8.1)	2.0(6.4)	7.5(24.2)	0.0(0.0)	15.5(50.0)	3.5(11.3)
November	30	1.5(5.0)	0.0(0.0)	4.0(13.3)	0.0(0.0)	24.5(81.7)	0.0(0.0)
December	31	6.0(19.4)	1.5(4.8)	5.5(17.7)	0.0(0.0)	15.5(50.0)	2.5(8.1)
TOTAL DAYS	366	92.5(25.3)	24.0(6.6)	76.0(20.8)	25.0(6.8)	131.5(35.9)	17.0(4.6)
PERCENT BY TYPE		(31.8)		(27.6)		(40.6)	

(Continued)

APPENDIX TABLE 7.1-10. (Continued)

MONTH	NO. OF DAYS IN MONTH	NUMBER OF DAYS PER MONTH (PERCENTAGE)					
		TRANSIENT FLOW		STEADY-STATE FLOW			
		TIDAL EFFECTS		FLOW TOWARD THE SOUTH		FLOW TOWARD THE NORTH	
		WEAK TIDAL FLOW	REVERSING FLOOD AND EBB TIDAL CURRENTS	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN
1977							
January	31	4.5(14.5)	8.0(25.8)	6.5(21.0)	0.5(1.6)	10.5(33.9)	1.0(3.2)
February	28	5.0(17.4)	8.0(28.6)	10.0(35.7)	0.5(1.8)	4.5(16.1)	0.0(0.0)
March	31	10.0(32.3)	3.0(9.7)	11.0(35.5)	3.5(11.3)	3.0(9.7)	0.5(1.6)
April	30	5.0(16.7)	3.0(10.0)	10.5(35.5)	4.0(13.3)	5.0(16.7)	5.0(1.6)
May	31	13.0(41.9)	2.0(6.4)	6.5(21.0)	2.0(6.4)	6.0(19.4)	2.5(8.3)
June	30	8.5(28.3)	1.0(3.3)	10.0(33.3)	2.5(8.3)	6.5(21.7)	1.5(4.8)
July	31	14.5(46.8)	4.0(12.9)	9.5(30.6)	0.0(0.0)	3.0(9.7)	1.5(5.0)
August	31	9.0(29.0)	11.0(35.5)	10.5(33.9)	0.0(0.0)	0.5(1.6)	0.0(0.0)
September	30	9.0(30.0)	8.0(26.7)	8.0(26.7)	2.5(8.3)	2.0(6.7)	0.0(0.0)
October	31	8.0(25.8)	4.0(12.9)	5.5(17.7)	3.5(11.3)	8.0(25.8)	0.5(1.7)
November	30	6.0(20.0)	9.0(30.0)	9.0(30.0)	0.0(0.0)	5.0(16.7)	2.0(6.4)
December	31	6.0(19.4)	3.0(9.7)	10.5(33.9)	3.0(9.7)	8.5(27.4)	1.0(3.3)
TOTAL DAYS	365	98.5(27.0)	64.0(17.5)	107.5(29.5)	22.0(6.0)	62.5(17.1)	10.5(2.9)
PERCENT BY TYPE		(44.5)		(35.5)		(20.0)	

(Continued)

APPENDIX TABLE 7.1-10. (Continued)

MONTH	NO. OF DAYS IN MONTH	NUMBER OF DAYS PER MONTH (PERCENTAGE)					
		TRANSIENT FLOW		STEADY-STATE FLOW			
		TIDAL EFFECTS		FLOW TOWARD THE SOUTH		FLOW TOWARD THE NORTH	
		WEAK TIDAL FLOW	REVERSING FLOOD AND EBB TIDAL CURRENTS	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN	MODERATE ABOUT 0.2-0.3 KN	STRONG GENERALLY >0.3 KN
<u>1978</u>							
January	31	2.0(6.4)	7.5(24.1)	5.5(18.0)	8.5(27.0)	6.0(19.0)	1.5(5.0)
February	13	5.0(37.0)	2.7(21.0)	2.0(16.0)	3.0(26.0)	0.0(0.0)	0.0(0.0)
March	18	5.2(29.0)	9.3(51.6)	0.6(3.0)	0.0(0.0)	2.9(16.0)	0.0(0.0)
April	30	1.2(4.0)	18.6(62.0)	9.6(32.0)	0.0(0.0)	0.6(2.0)	0.0(0.0)
May	30	1.8(5.8)	12.5(40.5)	4.0(13.0)	4.0(13.0)	4.5(14.5)	4.0(13.0)
June	30	4.9(16.2)	15.0(50.0)	6.6(22.1)	1.3(4.4)	1.8(5.8)	0.4(1.5)
July	31	3.6(11.5)	22.3(72.1)	3.6(11.5)	0.0(0.0)	0.0(0.0)	1.5(4.9)
August	31	10.6(34.0)	10.9(35.2)	4.1(13.2)	2.0(6.6)	2.4(7.7)	1.0(3.3)
September	30	2.6(8.5)	11.7(39.0)	0.0(0.0)	0.0(0.0)	10.6(35.4)	5.1(17.1)
October	31	0.3(1.1)	8.8(28.3)	1.3(4.3)	17.0(5.4)	13.8(44.6)	5.1(16.3)
November	30	4.1(13.6)	8.6(28.8)	6.8(22.7)	0.0(0.0)	7.3(24.2)	3.2(10.6)
December	31	0.0(0.0)	12.6(40.5)	4.2(13.5)	0.0(0.0)	13.8(44.6)	0.4(1.3)
TOTAL DAYS		41.3(12.3)	140.5(41.7)	48.3(14.3)	20.5(6.1)	63.7(18.9)	22.2(6.6)
PERCENT BY TYPE		(54.0)		(20.4)		(25.5)	

APPENDIX TABLE 7.1-11. OPERATIONAL PERFORMANCE OF NAI CURRENT METERS AND WIND STATION OFF HAMPTON BEACH, NEW HAMPSHIRE DURING 1978. SEABROOK ANNUAL HYDROGRAPHIC REPORT, 1978.

DESIGNATION	DATES OPERATIONAL 1978	TOTAL POSSIBLE OBSERVATIONS	TOTAL VECTOR OBSERVATIONS	DIRECTION ONLY OBSERVATIONS	SPEED ONLY OBSERVATIONS	NO DATA
T-7	Jan 1 to Dec 31	23544	12403	3082	1825	6234
I-4 Upper	Jan 1 to Sep 20	18542	7493	3168	3077	4804
I-4 Lower	Jan 1 to Sep 20	18552	10442	4928	100	3082
D-3 Upper	Sep 21 to Dec 31	7015	4507	0	2388	260
D-3 Mid	Sep 29 to Dec 31	6585	5628	0	259	698
Current Meter Total		74328	40473	11178	7599	15078
Percentage Recovery			54.5%	15.0%	10.2%	20.3%
Wind	Jan 1 to Dec 31	25704	23515	241	196	1752
Percentage Recovery			91.5%	0.9%	0.8%	6.8%