Great Bay Estuarine Field Program
1975 Data Report

Part 2: Temperature, Salinity and Density

UNH Sea Grant
Technical Report UNH-SG-163

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Part 2: Temperature, Salinity and Density

Andrew L. Silver
Department of Mechanical Engineering

Wendell S. Brown
Department of Earth Sciences

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Abstract

This report contains data summaries from a cooperative program between the University of New Hampshire and the National Ocean Survey to measure temperature, salinity and density in the Great Bay Estuary System, New Hampshire. The data is presented in two parts. In the first part, time series measurements are used to construct maps of vertically averaged temperature, salinity and sigma-t variability at lunar hourly intervals over a tidal cycle. In the second part we present vertical profiles of these variables at a number of locations to show the vertical variability for different phases of the tide. This presentation is intended to provide some perspective to the interpretation of the previous horizontal distributions.

I. Introduction

A major portion of the data described in this data report was obtained by the chemical oceanography team at UNH and is described in some detail by Loder and Glibert (1977). What follows is a summary of the pertinent details of that data acquisition and analysis work.

During July, August and September of 1975, temperature and salinity measurements were taken at six locations in the Great Bay Estuary System. The station locations are given in Figure 1, and Table 1 summarizes the station abbreviations. For each cruise there was one main and several secondary stations. The main station was a transect comprised of three or four sites. Samples were taken at each site while it was occupied by the R/V Jere A. Chase. The secondary stations, which were clustered in certain sections of the estuary, were occupied at varying time intervals with smaller boats; the NOS J/O Boat, R/V Explorer, R/V Microboat and a Normandeau Associates, Inc. boat.

II. Measurement Methods

At the main station samples were taken from the output of a 24-volt submersible pump (Benthos Model #5013) and a plastic hose. Sample bottles were filled from a 5-port manifold with an inset thermometer. The procedure for filling the bottles consisted of lowering the pump and hose to a surface depth (between 10 and 20 cm below the surface) and allowing the hose to flush. At a specified depth, the bottles were filled and the temperature was recorded to the nearest 0.1°C with an accuracy of ±0.5°C, during a 1 to 2 minute period. The hose was then lowered to the next depth for sampling and recording. Because of high tidal currents at certain times, wire angles were measured at all depths and the actual depth was estimated by multiplying the cosine of the wire angle times the length of the wire. The error in depth estimate varied with the depth, the

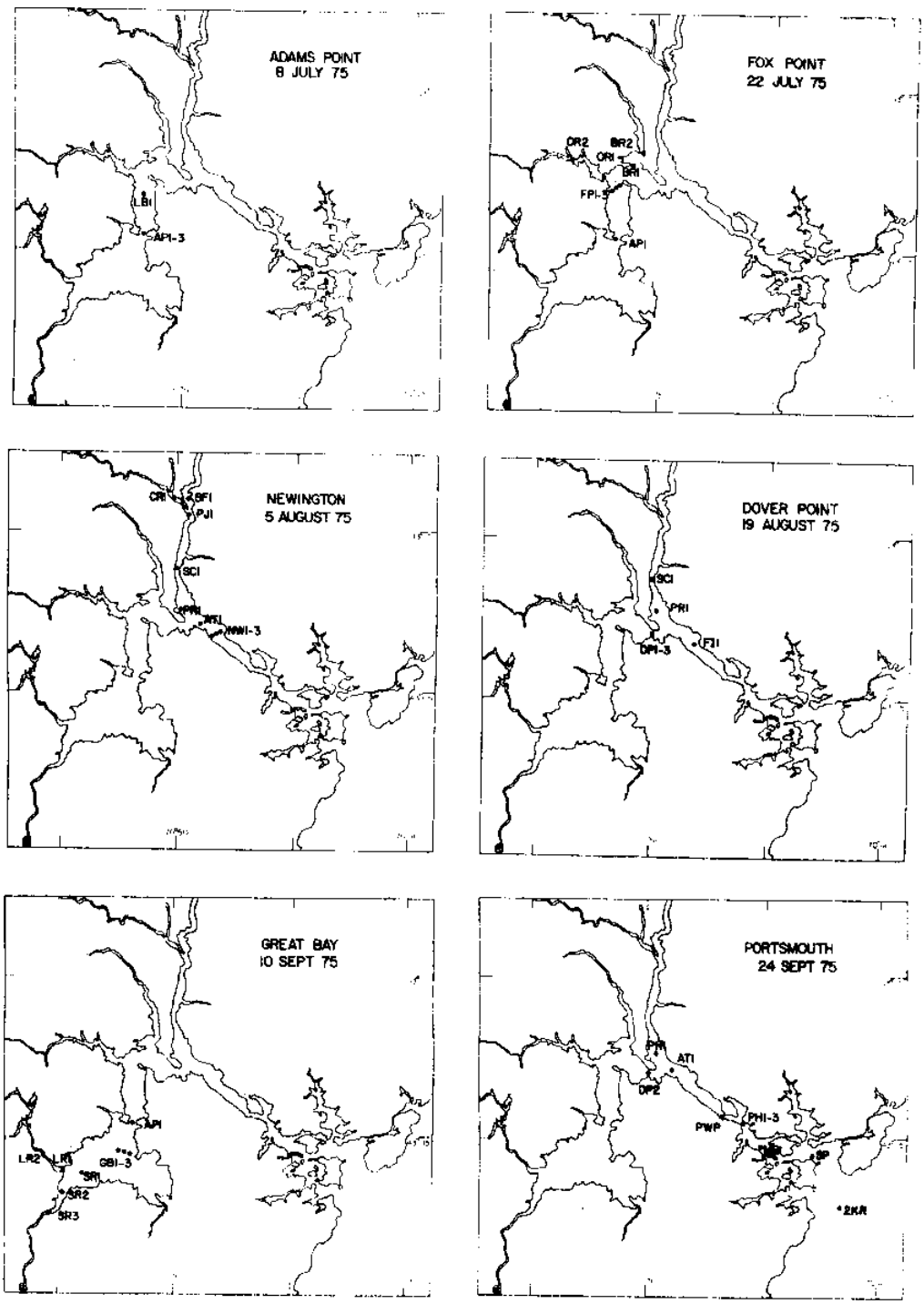

Figure 1 Sample locations for summer 1975 experiment. The 13-hour UNH current transects are indicated by the triple station designation ... 1-3.

TABLE 1

Guide to Station Name Abbreviations

Adams Point

AP1-3: Adams Point transect sites 1,2,3

LB1: Little Bay

Newington

NW1-3: Newington transect sites 1,2,3

AT1: Atlantic terminal
PR1: Piscataqua River
SC1: Sturgeon Creek
PJ1: Piscataqua Junction
SF1: Salmon Falls River
CR1: Cocheco River

Great Bay

GB1-3: Great Bay transect sites 1,2,3

AP1: Adams Point site 1
SR1: Squamscott River site 1
SR2: Squamscott River site 2
SR3: Squamscott River site 3
LR1: Lamprey River site 1
LR2: Lamprey River site 2

Fox Point

FP1-3: Fox Point transect sites 1,2,3

AP1: Adams Point site 1
BR1: Bellamy River site 1
BR2: Bellamy River site 2
OR1: Oyster River site 1
OR2: Oyster River site 2

Dover Point

DP1-3: Dover Point transect sites 1,2,3

FI1: Frankfurt Island
PR1: Piscataqua River
SC1: Sturgeon Creek

Portsmouth

PH1-3: Portsmouth Harbor Transect sites 1,2,3

2KR: 2KR Buoy
SP: Salamander Point
MB: Memorial Bridge
PWP: Power Plant
AT1: Atlantic Terminal
PR1: Piscataqua River
DP2: Dover Point site 2

wire angle readings, and the strength of the current, from a minimum of ± 0.05 meters near surface to a maximum of ± 0.5 meters near the bottom. Samples at the secondary stations were obtained by using either an onboard 12-volt pump (Simer Model No. BW85) and a hose or from a standard Niskin, Van Dorn or Nansen sampling bottle. Each station was sampled at several depths with the number depending upon the strength of the current and water depth. The samples were analyzed for salinity within several days of collection using a Guideline Autosal salinometer (Model 8400). The error involved in this analysis was 0.003 $^{o}/oo$ or 0.01% based on the average standard deviations of numerous sets of replicate samples run at the same time.

III. Results

The temperature, salinity, and sigma-t data are presented as (i) time series of unweighted vertical averages made at each station of the Great Bay, Fox Point, Dover Point, Newington and Portsmouth Harbor cruises; (ii) horizontal spatial distributions of these vertical averages, and (iii) vertical profiles at each of the main stations and selected river locations.

Time series plots of temperature, salinity and sigma-t for the Newington and Dover Point; Great Bay and Portsmouth Harbor; and Fox Point cruises are shown in Figures 2, 3, and 4 respectively and are based on data listed in Tables 3 through 7 (Appendix A). The temperature and salinity values obtained at each station were averaged to provide the results plotted. The scales corresponding to a particular station, which is identified to the right, have been shifted for purposes of clarity. The dashed lines are extrapolation estimates from the sampled data. These data clearly demonstrate that water density (σ_t) in this estuary depends principally on salinity.

The time series data have been used to construct pseudo-synoptic contour plots of temperature, salinity and sigma-t values at lunar hour intervals (1 lunar

hour = 1/12 x M_2 tidal period or 1/12 x 12.42 hours). The period between slack high water (SHW) and slack low water (SLW) was divided into the 12 lunar intervals and the appropriate values were determined from the time-series plots. The spatial distributions of these values have been hand contoured for each time and experiment and are shown in Appendix B. Figures 5 to 14 show the spatial distribution of temperature with the solid isotherms drawn in 1.0°C intervals and the dashed isotherms indicating 0.5°C intervals where appropirate. On the salinity distribution charts (Figures 15-24) the solid isopleths were drawn in intervals of 1 °/oo and the dashed isopleths indicate a 0.5 °/oo change where appropriate. Figures 25-34 show the sigma-t distribution with the solid isograms drawn at intervals of one sigma-t unit and the dashed isograms showing intervals of 0.5 sigma-t units.

Salinity data from the entire set of summer 1975 cruise was compiled to construct a "typical" tidal sequence of salinity distribution for the entire Great Bay estuary. The composite salinity distribution sequence shown in Figures 35 and 36 is an approximation to summer conditions when the total river flow into the estuary is nearly steady at about 0.225 x 10^6 M^3 per tidal cycle and the Gulf of Maine salinity is about 31.5 °/00. A more thorough discussion of these conditions is discussed by Brown and Arellano (1979). The important point to note from this sequence is that the largest horizontal salinity gradients are found near the locations where the principal rivers enter the estuary.

Vertical profiles of temperature, salinity, and sigma-t are shown in Figures 37-44 which are found in Appendix C. The profiles nearest in time to slack low water (SLW), mid-flood (MF) slack high water (SHW), and mid-ebb (ME), were plotted to show the vertical spatial variability of the parameters for different phases of the tide. The stations that were plotted included the middle sampling sites of the Great Bay, Fox Point, Newington and Portsmouth

Harbor transects and locations in the Squamscott (SR2), Lamprey (LR1), Bellamy (BR1), and upper Piscataqua (SC1) Rivers. These profile data provide some perspective to the interpretation of the horizontal distribution of vertically averaged salinities. For example, profiles from the main channels of the estuary (Figures 37 through 40) are vertically well mixed in T, S, and sigma-t throughout the tidal cycle particularly during mid-flood. In contrast, the data shown in Figures 41-44 suggest a much greater salinity (hence density) stratification at the river stations during the entire tidal cycle. This is more clearly shown in Table 2 in which the mean vertical gradients are summarized.

Thus the combined pictures of summertime horizontal and vertical salinity distributions show that the principal estuarine salinity fronts are relatively diffuse by estuarine standards and are confined to the regions where rivers enter the estuary. This is due to the combined effects of vigorous tidal mixing throughout much of the estuary and the relatively low fresh water inflow during this apparently typical summer. The reader is referred to Brown and Arellano (1979) for a more detailed discussion of salinity mixing in the Great Bay Estuary.

IV. Acknowledgements

We would like to acknowledge the tremendous effort required on the part of the UNH chemical oceanography group in acquiring and analyzing the data described in this report. Ted Loder is to be complemented on his leadership role in that work and his cooperation in making the data available to us. Kathy Arata provided valuable assistance in composing many of the maps and we thank her.

This research was supported by the University of Maine/University of New Hampshire Cooperative Institutional Sea Grant Program (4-20237 R/EM-2).

Table 2 Mean vertical salinity, S_z, and density, D_z, gradients at slack low water (SLW), mid flood (MF), slack high water (SHW) and mid ebb (ME). The salinity and density gradient estimates are given in units of $^{o}/oo$ per meter and sigma-t units per meter respectively.

		SLW	MF	SHW	ME
Great Bay(GB2)	S_z	0.018	0.001	0.005	0.045
	D_z	0.017	0.010	0.004	0.051
Fox Point(FP2)	S_z	0.011	0.009	0.042	0.012
	D_z	0.013	0.010	0.052	0.028
Newington(NW2)	S_z	0.020	0.008	0.009	0.002
	D_z	0.019	0.010	0.010	0.007
Portsmouth(PH2)	S_z	0.010	0.005	0.010	0.000
	D_z	0.007	0.006	0.012	0.000
Squamscott R.(SR2)	S_z	0.00	0.26	0.56	0.70
	D_z	0.00	0.20	0.60	0.60
Lamprey R.(LR1)	S_z	1.20	0.16	0.10	0.16
	D_z	0.38	0.18	0.08	0.05
Bellamy R.(BR1)	S_z	0.65	0.03	0.04	0.18
	D_z	0.73	0.17	0.08	0.33
U. Piscataqua R.(SC1)	S_z	0.55	0.46	0.05	0.49
	D_z	0.50	0.43	0.10	0.51

V. References

Brown, W.S. and E. Arrellano M., 1979, "The Application of a Segmented Tidal Mixing Model to the Great Bay Estuary, N.H.", University of New Hampshire Sea Grant Report UNH-SG-162, 47pp.

Loder, T.C. and P.M. Glibert, 1977, "Great Bay Estuarine Field Program, 1975 Data Report, Part 3: Nutrient Chemistry", University of New Hampshire Sea Grant Report UNH-SG-159

Swenson, E., W.S. Brown and R. Trask, 1977, "Great Bay Estuarine Field Program, 1975 Data Report, Part 1: Currents and Sea Levels", University of New Hampshire Sea Grant Report UNH-SG-157.

Appendix A

Time series plots of temperature, salinity and density for Newington, Dover Point, Great Bay, Portsmouth Harbor and Fox Point cruises and associated tables of data.

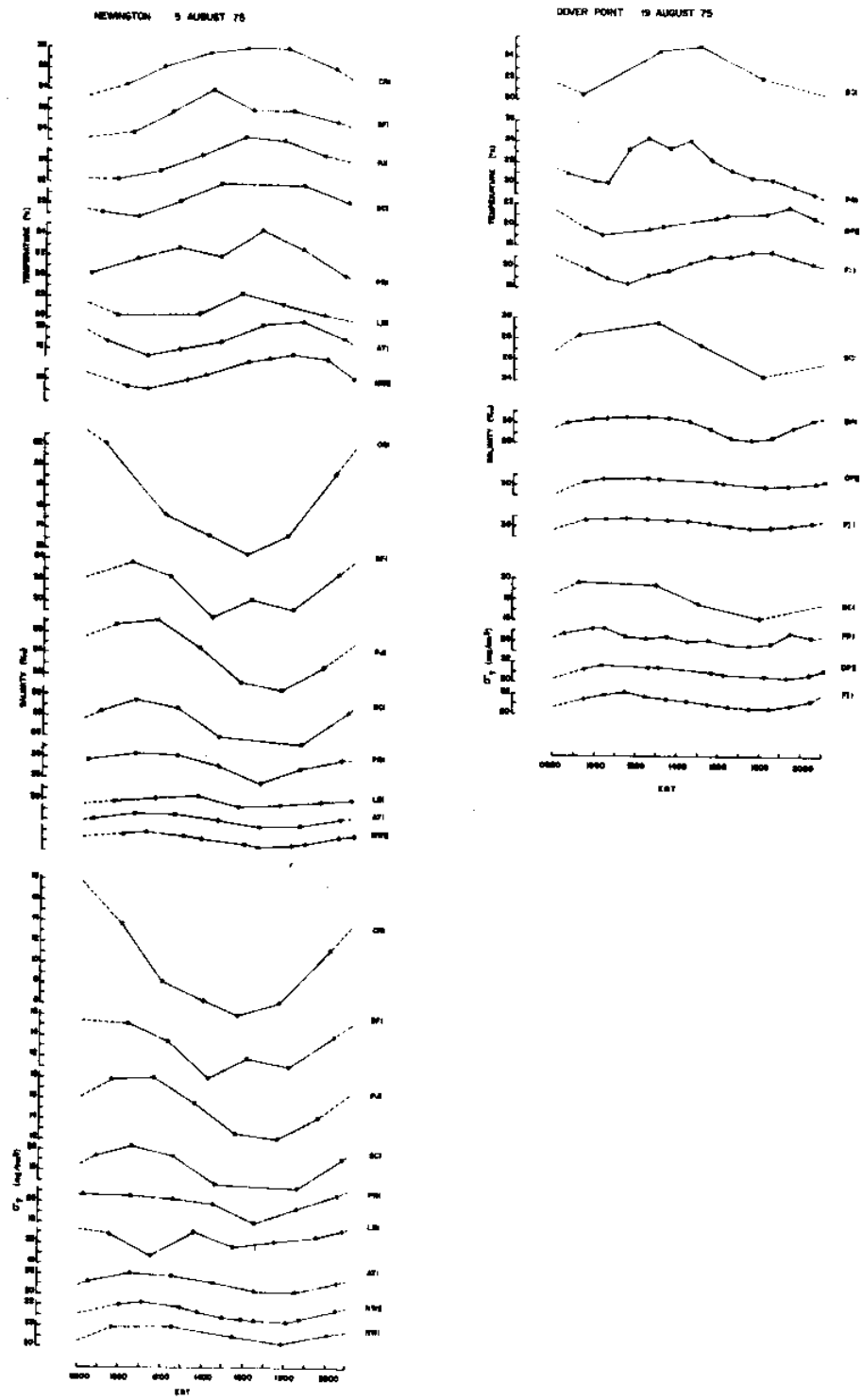

Figure 2 TIME SERIES PLOTS of temperature, salinity, and sigma-t for Newington and Dover Point cruises for one tidal cycle.

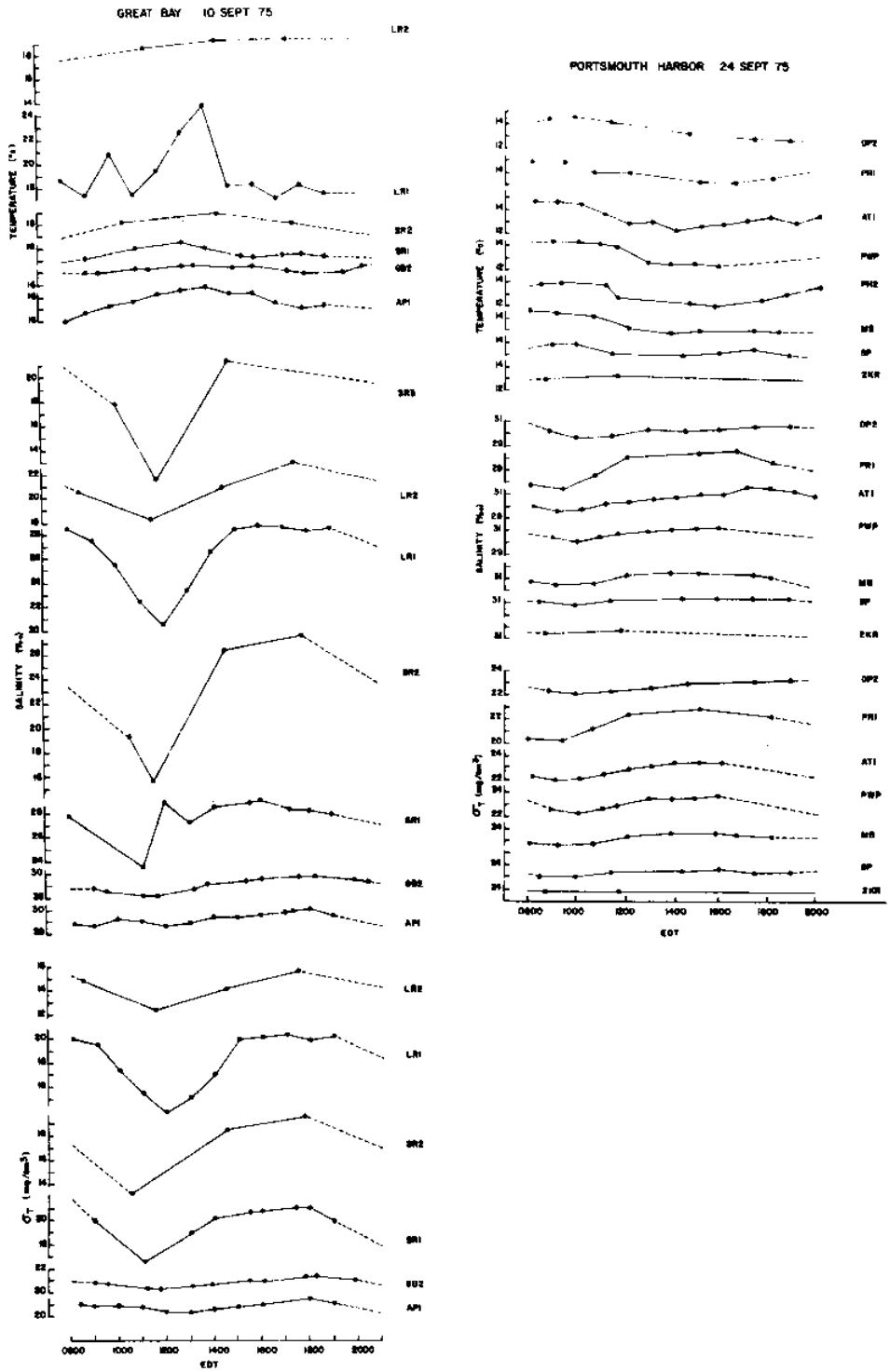

Figure 3 TIME SERIES PLOTS of temperature, salinity and sigma-t for Great Bay and Portsmouth Harbor cruises for one tidal cycle.

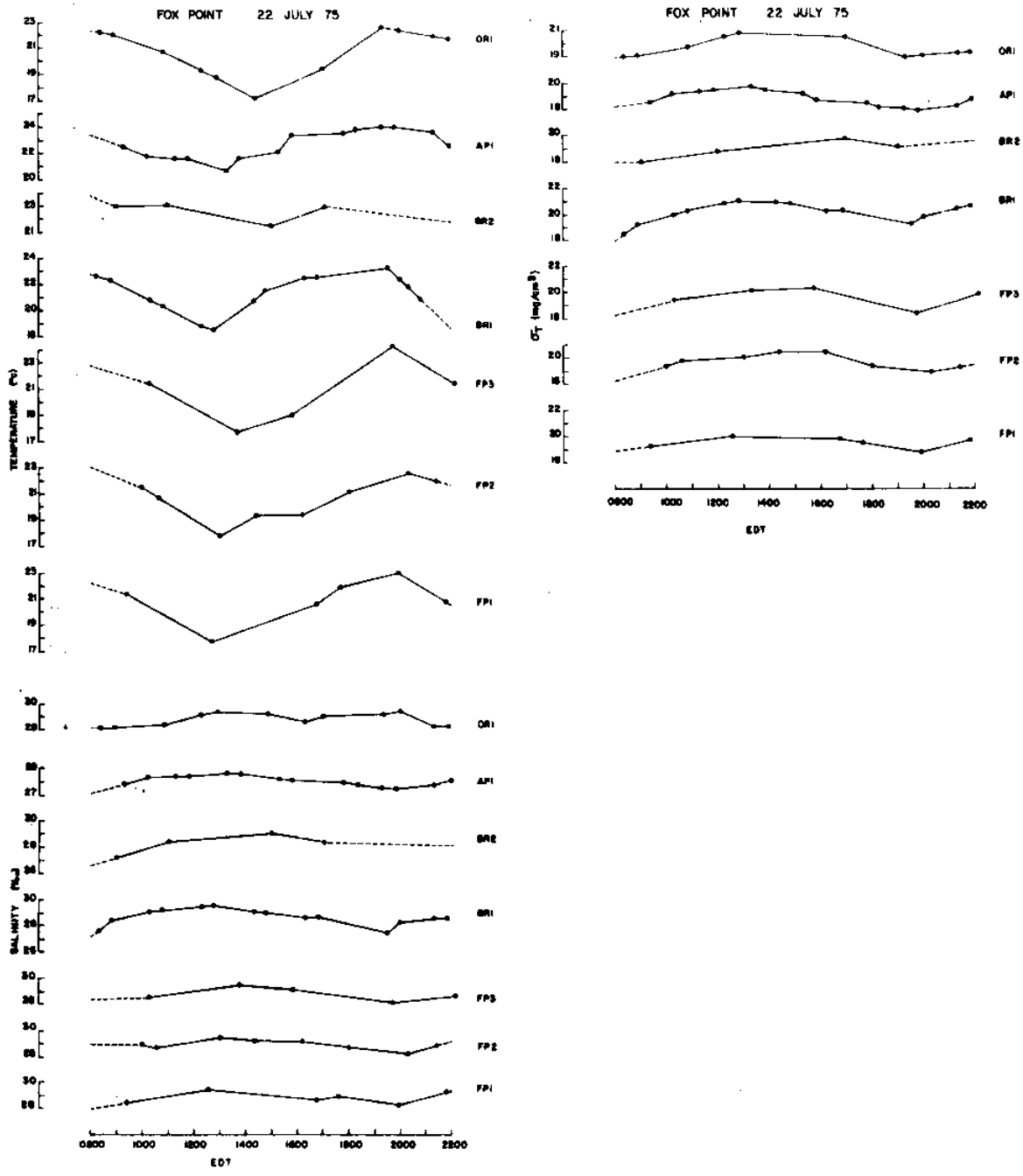

Figure 4 TIME SERIES PLOTS of temperature, salinity and sigma-t for Fox Point cruise for one tidal cycle.

Table 2 Time series of vertically averaged temperature, salinity and corresponding sigma-t values for each station during the Newington cruise on 5 August 1975. The times are EDT.

	Time	T°C	S 0/00	σ_t
NW1	0940	17.90	30.55	21.92
	1237	18.00	30.72	22.00
	1530	19.78	30.16	21.16
	1752	20.79	29.61	20.48
	2010	19.47	30.08	21.18
NW2	1000	17.52	30.71	22.13
	1105	17.39	30.83	22.25
	1255	18.20	30.59	21.88
	1345	18.60	30.21	21.49
	1550	20.00	29.87	20.88
	1627	20.26	29.75	20.73
	1805	20.69	29.69	20.57
	1840	20.30	29.81	20.76
	2030	18.50	30.46	21.71
	2114	18.07	30.63	21.94
	2155	17.59	30.53	21.98
NW3	1044	17.52	30.75	22.16
	1320	18.00	30.62	21.95
	1610	19.93	30.01	21.01
	1821	20.65	29.71	20.60
	2053	18.60	30.39	21.63
AT1	0830	18.90	30.05	21.30
	1030	17.51	30.61	22.06
	1230	18.11	30.51	21.84
	1430	18.97	30.16	21.36
	1630	20.53	29.59	20.54
	1830	20.72	29.60	20.60
	2030	19.30	30.13	21.26
CR1	0955	24.50	22.80	13.80
	1150	26.10	15.35	8.31
	1355	27.50	13.42	6.46
	1545	28.00	11.75	5.07
	1745	28.00	13.48	6.35
	2000	26.00	19.46	11.41
SF1	1015	24.00	23.81	15.24
	1210	25.90	22.36	13.61
	1410	28.00	18.59	10.16
	1600	26.00	20.21	11.97
	1800	26.10	19.26	11.23
	2015	25.00	22.75	14.16
SC1	0845	21.13	28.42	19.49
	1030	20.83	29.50	20.39
	1230	22.37	28.79	19.44
	1430	24.00	26.02	16.89
	1830	24.03	25.49	16.43
	2040	22.23	28.53	19.28
PJ1	0930	22.37	26.83	17.96
	1130	23.15	27.24	18.06
	1330	24.75	24.65	15.66
	1530	26.45	21.39	12.72
	1730	26.15	20.52	12.16
	1930	24.90	22.83	14.25
PR1	0815	20.34	29.77	20.72
	1030	21.78	30.28	20.67
	1230	22.85	30.20	20.37
	1430	22.00	29.35	19.96
	1630	24.60	27.74	18.02
	1830	22.90	29.04	19.48
	2030	20.25	29.90	20.84
LB1	0930	20.25	29.98	20.90
	1130	27.80	30.19	18.87
	1330	20.53	30.35	21.11
	1530	22.40	29.39	19.88
	1730	21.40	29.65	20.35
	1930	20.43	29.80	20.72
	2145	19.03	30.22	21.39

Table 3 Time series of vertically averaged temperature, salinity and corresponding sigma-t values for each station occupied during the Dover Point cruise 19 August 1975. The times are EDT.

	Time	T°C	S 0/00	σ_t
DP1	0843	20.80	29.97	20.75
	1517	20.68	30.38	21.09
	1757	21.80	30.04	20.54
DP2	0930	09.80	30.39	21.33
	1022	19.10	30.62	21.65
	1227	19.76	30.63	21.52
	1312	19.92	30.57	21.44
	1545	20.64	30.28	21.03
	1619	21.10	30.23	20.87
	1815	21.08	30.01	20.71
	1920	21.86	30.02	20.51
	2027	20.85	30.22	20.93
	2105	20.36	30.38	21.18
DP3	0955	19.93	30.27	21.21
	1205	20.44	30.40	21.17
	1255	15.13	30.55	22.54
	1605	21.00	30.25	20.91
	1832	21.94	29.98	20.46
	2012	21.50	29.98	20.57
	2049	20.82	30.23	20.94
SC1	0915	20.37	28.39	19.67
	1300	24.57	29.63	19.45
	1505	23.03	27.48	17.69
	1800	22.12	24.46	16.24

	Time	T°C	S 0/00	σ_t
PR1	0835	21.10	30.08	20.76
	0950	20.33	30.37	21.18
	1030	20.18	30.39	21.23
	1130	23.38	30.62	20.54
	1230	24.40	30.62	20.24
	1330	23.45	30.53	20.45
	1535	22.40	29.76	20.16
	1430	24.05	30.21	20.04
	1630	21.43	28.79	19.69
	1730	20.73	28.48	19.64
	1830	20.43	28.58	19.79
	1930	19.50	29.73	20.90
	2030	19.03	30.15	20.35
FT1	0935	19.93	30.66	21.15
	1030	19.00	30.82	21.86
	1130	18.45	30.99	22.12
	1230	19.25	30.79	21.77
	1330	19.73	30.71	21.59
	1430	20.43	30.59	21.32
	1530	21.00	30.43	21.05
	1630	21.10	30.19	20.84
	1730	21.50	30.02	20.60
	1830	21.60	30.01	20.57
	1930	21.00	30.22	20.89
	2030	20.45	30.44	21.20

Table 4 Time series of vertically averaged temperature, salinity and corresponding sigma-t values for each station during the Great Ray Cruise on 10 September 1975. The times are in EDT.

	Time	T°C	S 0/00	σ_t
GB1	0831	17.23	29.00	20.89
	1049	17.00	28.48	20.55
	1257	17.50	28.79	20.67
	1511	17.50	29.22	21.00
	1712	17.37	29.26	21.06
	1931	17.67	29.38	21.08
GB2	0900	17.16	28.96	20.88
	0933	17.03	28.82	20.80
	1107	17.38	28.28	20.31
	1144	17.23	28.25	20.32
	1308	17.50	28.86	20.73
	1351	17.50	29.01	20.84
	1527	17.40	29.29	21.08
	1601	17.60	29.34	21.07
	1738	17.05	29.65	21.43
	1818	16.92	29.64	21.54
	1952	17.06	29.31	21.17
	2031	17.40	29.16	20.98
GB3	0917	17.10	29.23	21.10
	1125	17.60	28.26	20.25
	1336	17.50	28.88	20.74
	1546	17.50	29.30	21.06
	1758	16.96	29.58	21.39
	2007	17.10	29.23	21.10
LR1	0800	18.88	28.42	20.06
	0905	17.40	27.48	19.10
	1000	20.90	25.52	17.36
	1100	17.52	22.23	15.68
	1200	19.58	20.73	14.07
	1300	22.63	23.29	15.23
	1400	24.78	26.57	17.09
	1500	18.10	28.26	20.13
	1700	17.05	28.51	20.56
	1800	18.30	28.37	20.17
	1900	17.45	28.61	20.55

	Time	T°C	S 0/00	σ_t
LR2	0830	14.98	20.63	14.98
	1130	18.75	18.38	12.48
	1430	19.30	20.99	14.33
	1730	19.30	22.94	15.81
AP1	0820	17.00	28.99	20.94
	0900	17.00	29.05	20.99
	1000	17.20	29.24	21.08
	1103	17.70	29.18	20.92
	1200	18.15	28.86	20.57
	1300	18.60	28.93	20.52
	1400	18.80	29.39	20.82
	1500	18.37	29.34	20.89
	1600	18.35	29.54	21.04
	1655	17.60	-	-
	NOTE 1705-1730 left out because of missing temperature data			
	1800	17.00	29.95	21.67
	1900	17.20	29.46	21.52
SR1	0900	17.20	27.89	20.01
	1110	18.00	23.60	16.61
	1200	-	28.88	-
	1300	18.70	27.11	19.11
	1400	17.95	28.49	20.34
	1530	17.50	28.88	20.74
	1600	17.35	28.99	20.86
	1715	17.50	29.26	21.03
	1800	17.40	29.29	21.08
	1900	17.25	27.96	20.10
SR2	1030	18.30	19.29	13.27
	1130	-	15.48	-
	1425	18.95	26.58	18.65
	1740	18.12	27.63	19.64
SR3	1010	18.80	17.66	11.93
	1145	-	11.75	-

Table 5 Time series of the vertically averaged temperature, salinity and corresponding sigma-t values for each station during the Portsmouth Harbor cruise on 24 September 1975. The times are EDT.

	Time	T°C	S 0/00	σ_t
PH1	0750	13.35	32.62	24.50
	1053	13.95	32.35	24.17
	1438	12.77	32.91	24.84
	1740	12.28	33.19	25.15
	2055	13.68	31.35	23.46
PH2	0835	13.84	32.43	24.43
	0920	14.00	32.31	24.13
	1118	13.80	32.50	24.32
	1148	12.93	32.79	24.72
	1455	12.23	33.33	25.27
	1550	12.15	33.12	25.12
	1758	12.68	32.16	24.28
	1852	13.00	31.32	23.57
	2028	13.65	30.47	22.79
PH3	0900	13.82	32.39	24.23
	1138	13.75	32.45	24.29
	1528	12.20	33.26	25.22
	1834	12.72	31.48	23.75
	2007	13.35	31.59	23.71
AT 1	0815	14.78	30.03	22.22
	0915	14.73	29.83	22.08
	1015	14.46	29.89	22.18
	1115	13.63	30.16	22.55
	1215	12.96	30.43	22.89
	1315	13.00	30.72	23.11
	1415	12.33	30.88	23.36
	1515	12.73	31.05	13.41
	1615	12.83	31.07	23.41
	1715	13.03	30.08	23.15
	1815	13.37	30.72	23.03
	1915	12.94	30.42	22.88
	2015	13.57	29.99	22.43
SP	0845	13.00	31.59	23.78
	1150	13.27	31.74	23.84

	Time	T°C	S 0/00	σ_t
MB	0812	14.77	30.71	22.74
	0915	14.60	30.49	22.61
	1045	14.23	30.62	22.79
	1215	13.10	31.07	23.36
	1400	12.93	31.42	23.66
	1515	13.00	31.43	23.65
	1645	13.00	31.00	31.38
	1815	13.00	31.17	23.45
PR1	0805	14.93	27.67	20.30
	0925	14.90	27.51	20.38
	1045	14.17	28.62	21.26
	1215	14.00	30.13	22.46
	1515	13.35	30.54	22.89
	1645	13.33	13.61	9.89
	1815	13.67	29.84	22.29
PWP	0900	14.39	30.40	22.65
	1010	14.38	30.12	22.37
	1103	14.24	30.48	22.68
	1145	13.94	30.76	22.95
	1302	12.71	31.05	23.42
	1400	12.70	31.08	23.44
	1500	12.62	31.19	23.54
	1600	12.32	31.33	23.71
DP2	0856	14.30	30.09	22.33
	1000	14.43	29.83	22.14
	1130	14.07	29.95	22.30
	1300	-	30.41	-
	1441	13.23	30.62	22.98
	1730	12.93	30.74	23.14
	1900	12.87	30.78	23.18
2KR	0830	13.87	31.02	23.17
	1000	13.87	30.90	23.07
	1130	13.13	31.18	23.44
	1430	13.00	31.33	23.58
	1600	13.10	31.43	23.63
	1730	13.67	31.28	23.41
	1900	13.00	31.23	23.50

Table 6 Time series of vertically averaged temperature and salinity and corresponding sigma-t values for each station occupied during the Fox Point Cruise on 22 July 1975. The times are EDT.

	Time	T°C	S 0/00	σt
FP1	0926	21.41	28.54	19.51
	1235	17.83	29.49	21.13
	1645	20.67	28.77	19.88
	1739	21.93	28.99	19.71
	1955	23.04	28.26	18.85
	2145	20.85	28.68	19.76
FP2	1001	21.58	28.99	19.43
	1039	20.78	28.68	19.78
	1300	17.94	29.53	21.13
	1423	19.46	29.18	20.49
	1613	19.52	29.14	20.45
	1800	21.21	28.67	19.66
	2017	22.72	28.31	18.98
	2122	22.02	28.96	19.29
FP3	1019	21.49	28.66	19.58
	1344	17.78	29.56	21.19
	1550	19.07	29.12	20.55
	1940	23.42	28.16	18.67
	2208	20.47	28.75	19.92
BR1	0820	22.73	27.65	18.48
	0850	22.23	28.46	19.23
	1023	20.90	29.02	20.01
	1050	20.23	29.16	20.29
	1220	18.96	29.52	20.89
	1250	18.68	29.60	21.01
	1420	20.84	29.14	20.00
	1450	21.58	29.06	19.85
	1620	22.63	28.74	19.33
	1650	22.60	28.60	19.23
	1930	23.27	27.61	18.30
	2000	22.43	28.35	18.99
	2120	21.9	28.58	19.41
	2150	21.03	28.67	19.72
BR2	0900	23.00	27.22	18.08
	1100	23.20	28.45	18.96
	1500	21.50	29.15	19.95
	1705	23.00	28.55	19.09
OR1	0825	22.27	28.21	19.07
	0855	22.10	28.25	19.10
	1050	20.83	28.68	19.78
	1220	19.40	29.16	20.52
	1255	18.90	29.32	20.79
	1425	17.33	-	-
	1455	-	29.30	-
	1620	-	28.78	-
	1700	19.53	29.06	20.49
	1920	22.75	28.32	18.99
	2000	22.50	28.42	19.14
	2120	22.03	28.52	19.33
	2150	21.90	28.55	19.40
OR2	0945	-	22.87	-
	1120	-	26.34	-
	1525	-	20.96	-
	1700	-	20.13	-
AP1	0917	22.59	27.94	18.74
	1012	21.91	28.29	19.19
	1117	21.69	28.45	19.37
	1147	21.71	28.49	19.46
	1317	20.84	28.70	19.79
	1349	21.71	28.65	19.51
	1517	22.23	28.34	19.13
	1547	23.46	28.31	18.78
	1747	23.63	28.07	18.54
	1817	23.91	27.91	18.35
	1917	24.09	27.64	18.10
	1947	24.13	27.54	18.01
	2117	23.73	27.92	18.41
	2155	22.72	28.22	18.91

APPENDIX B

Pseudo-synoptic contour plots of temperature, salinity and sigma-t during the 1975 Great Bay experiment.

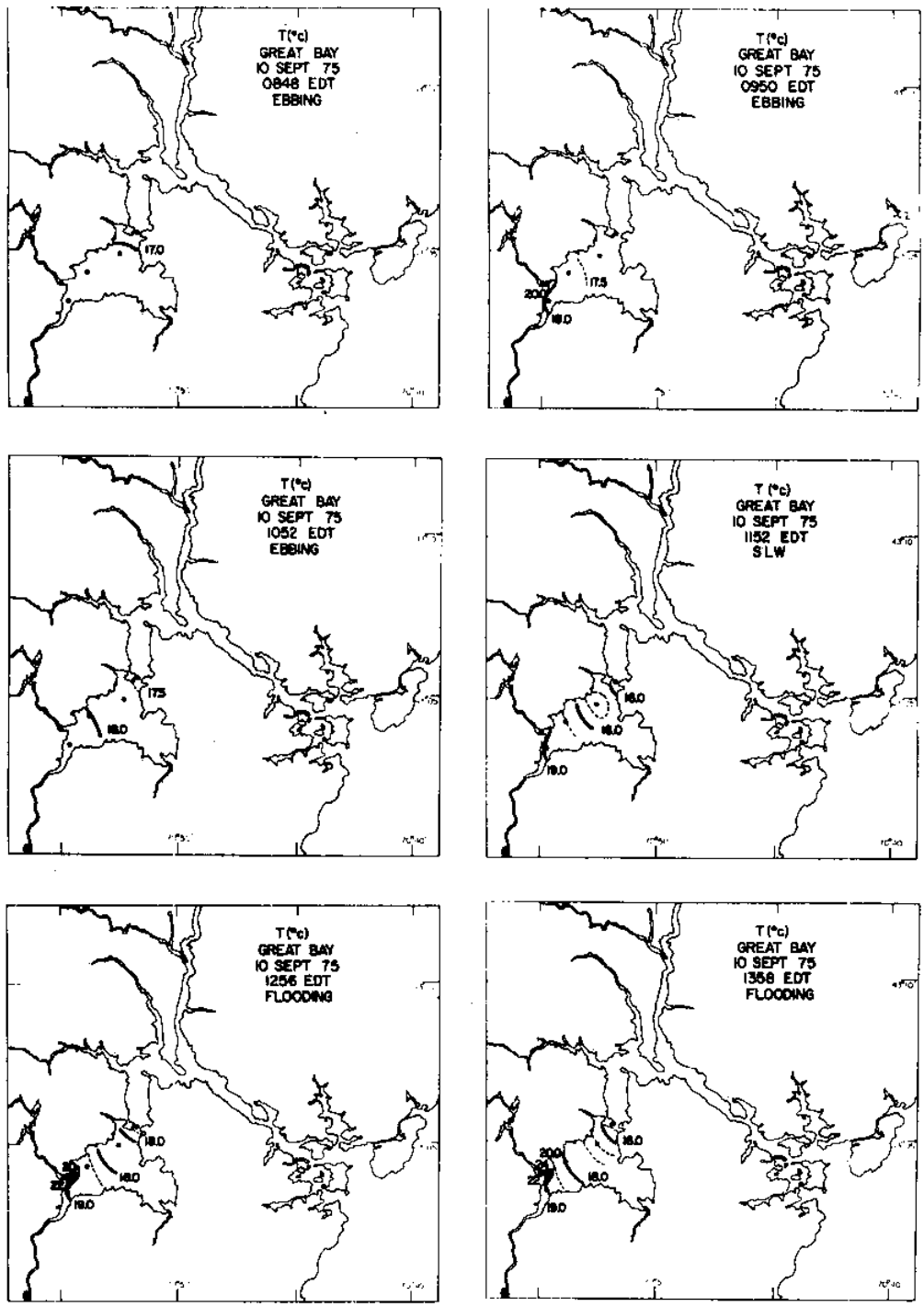

Figure 5 GREAT BAY TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at $1^{o}C$ intervals over one tidal cycle.

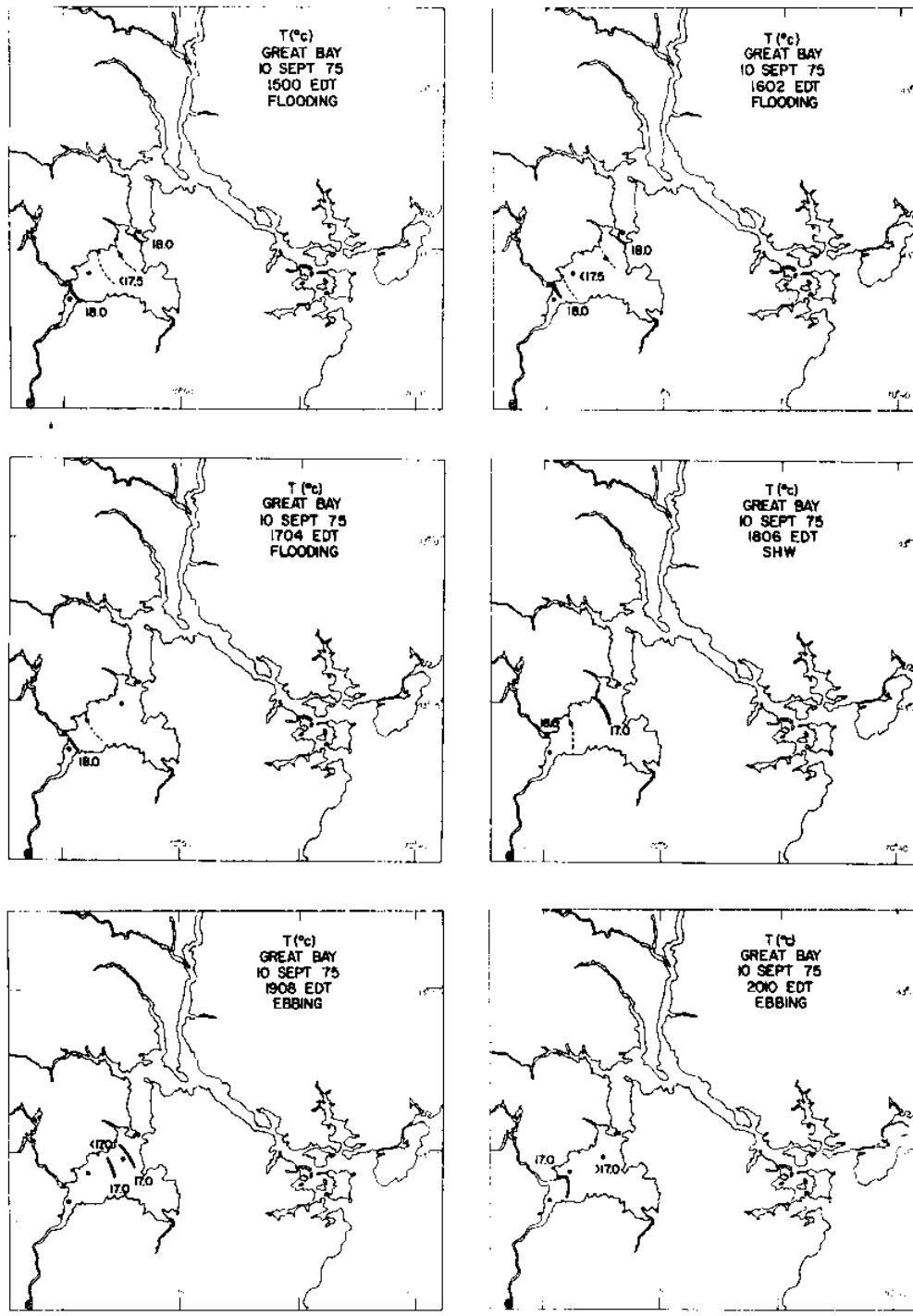

Figure 6 GREAT BAY TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at $1^{0}C$ intervals over one tidal cycle.

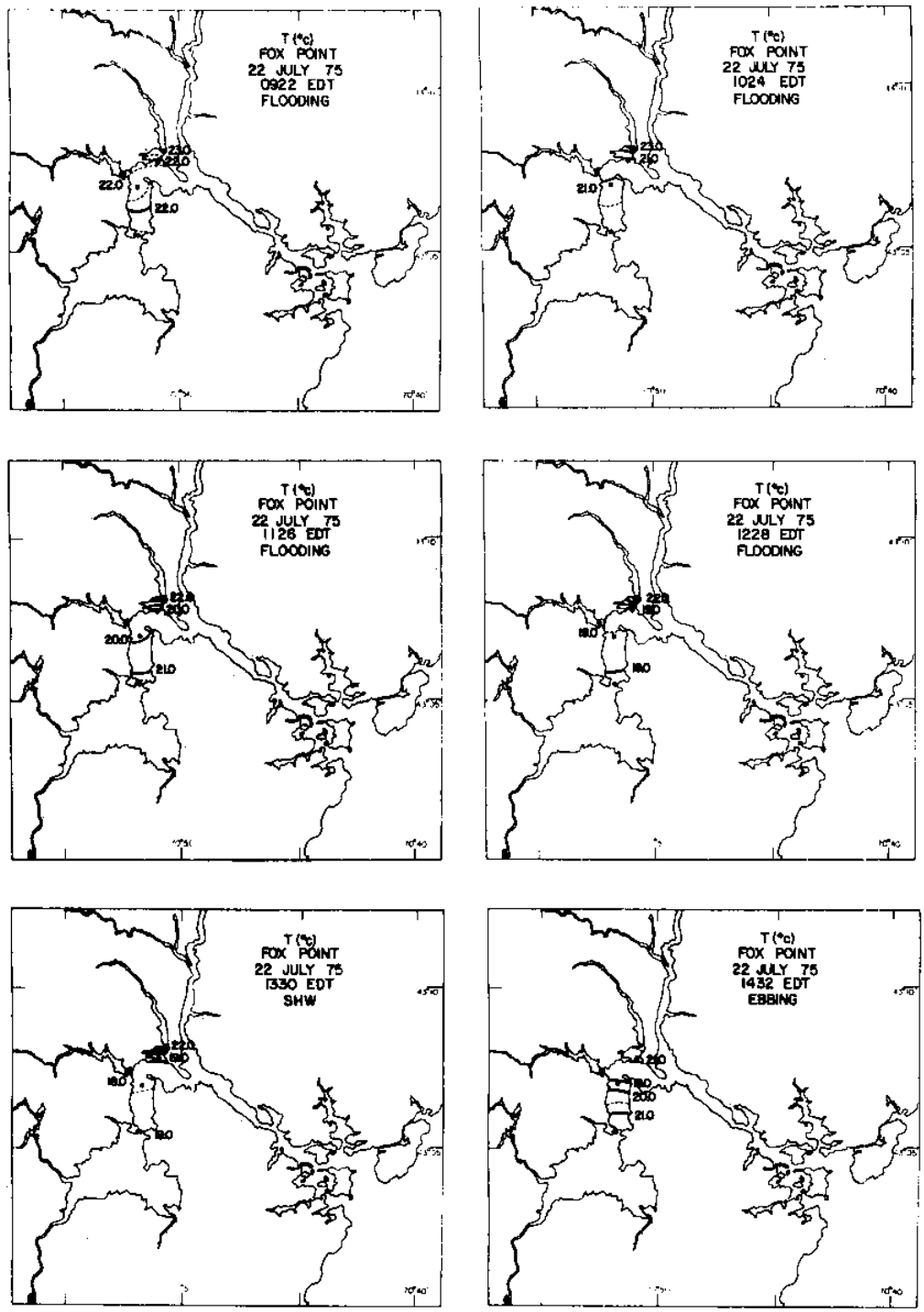

Figure 7 FOX POINT TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at $1^{o}C$ intervals over one tidal cycle.

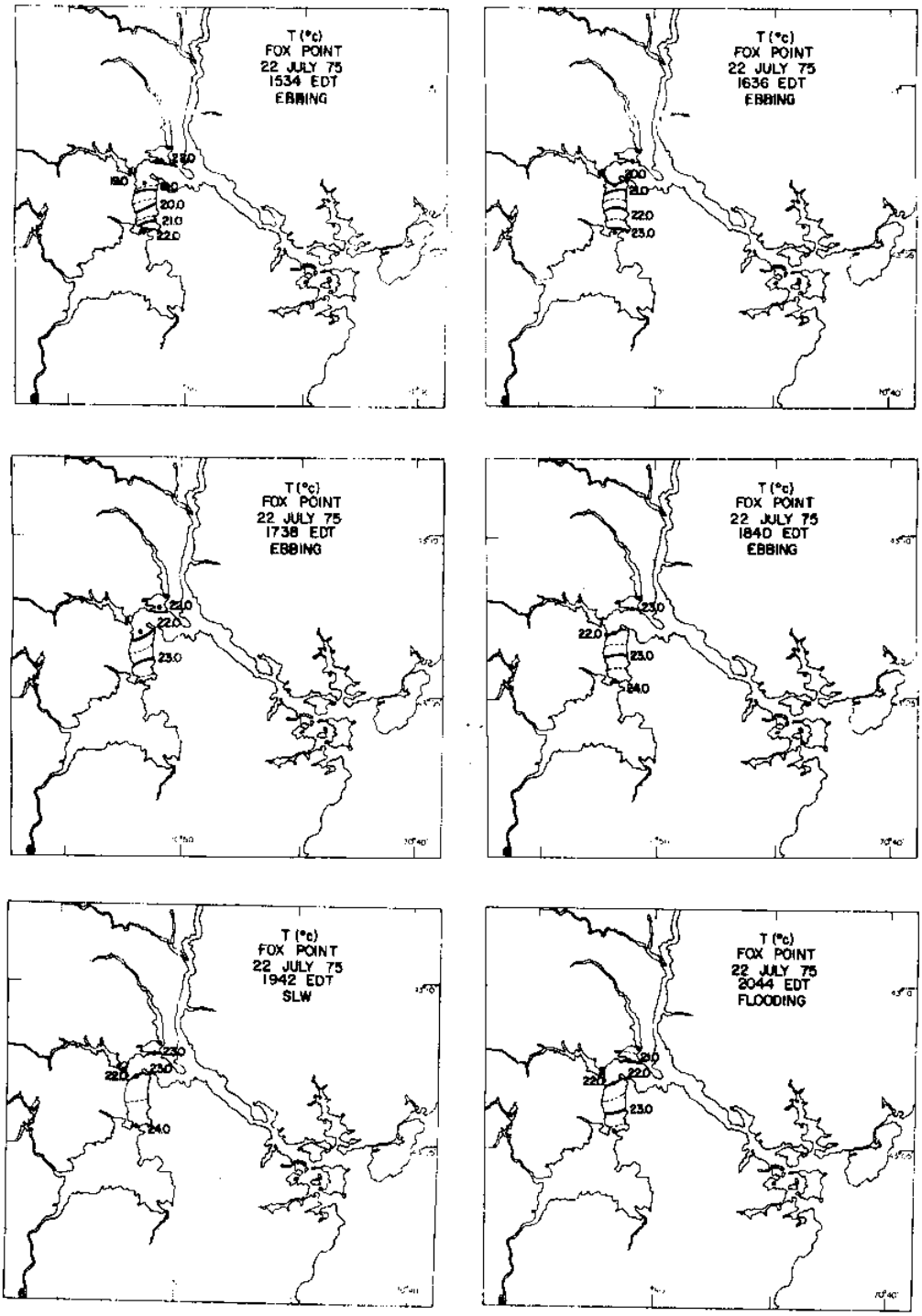

Figure 8 FOX POINT TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at 1°C intervals over one tidal cycle.

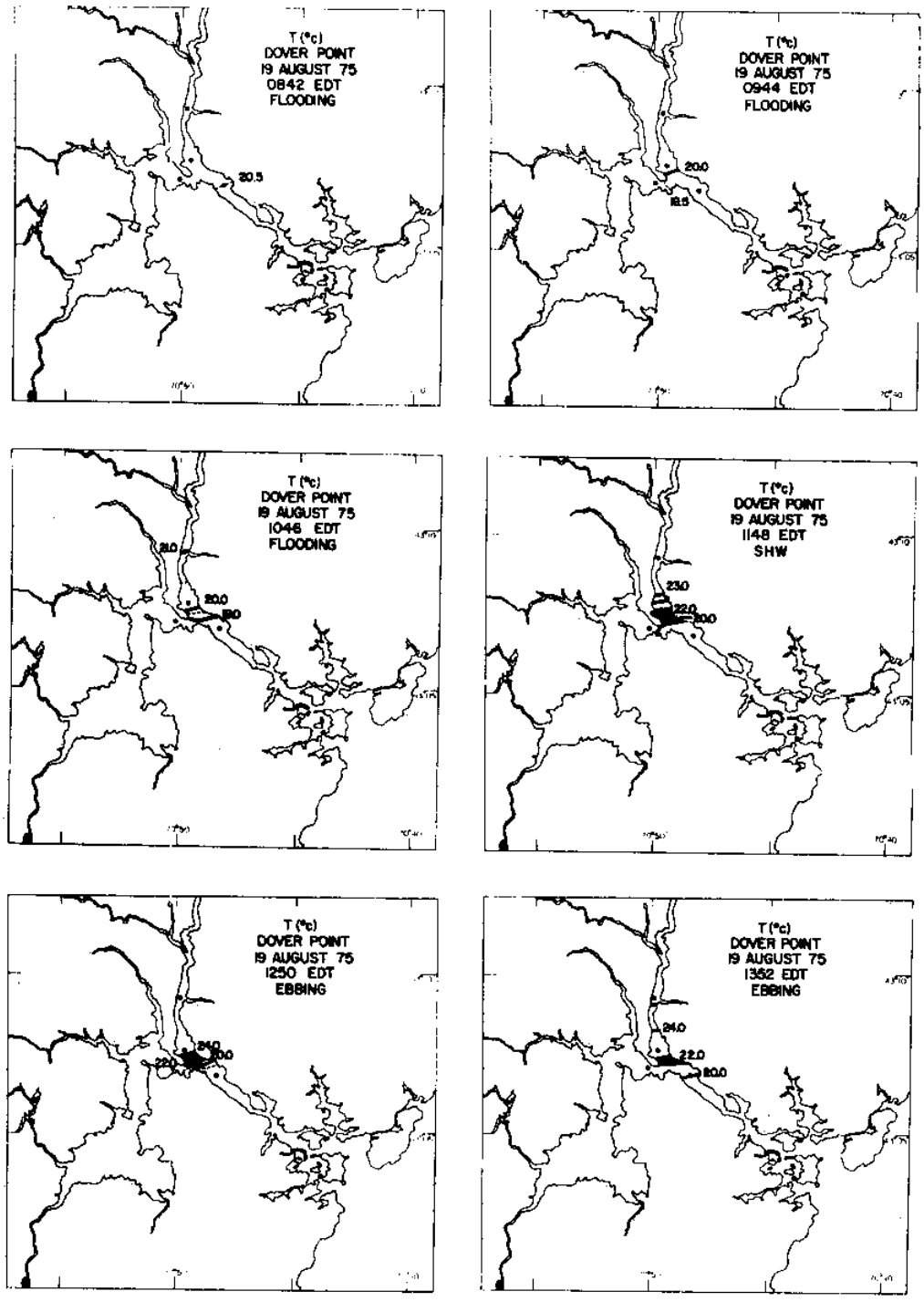

Figure 9 DOVER POINT TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at $1^{o}C$ intervals over one tidal cycle.

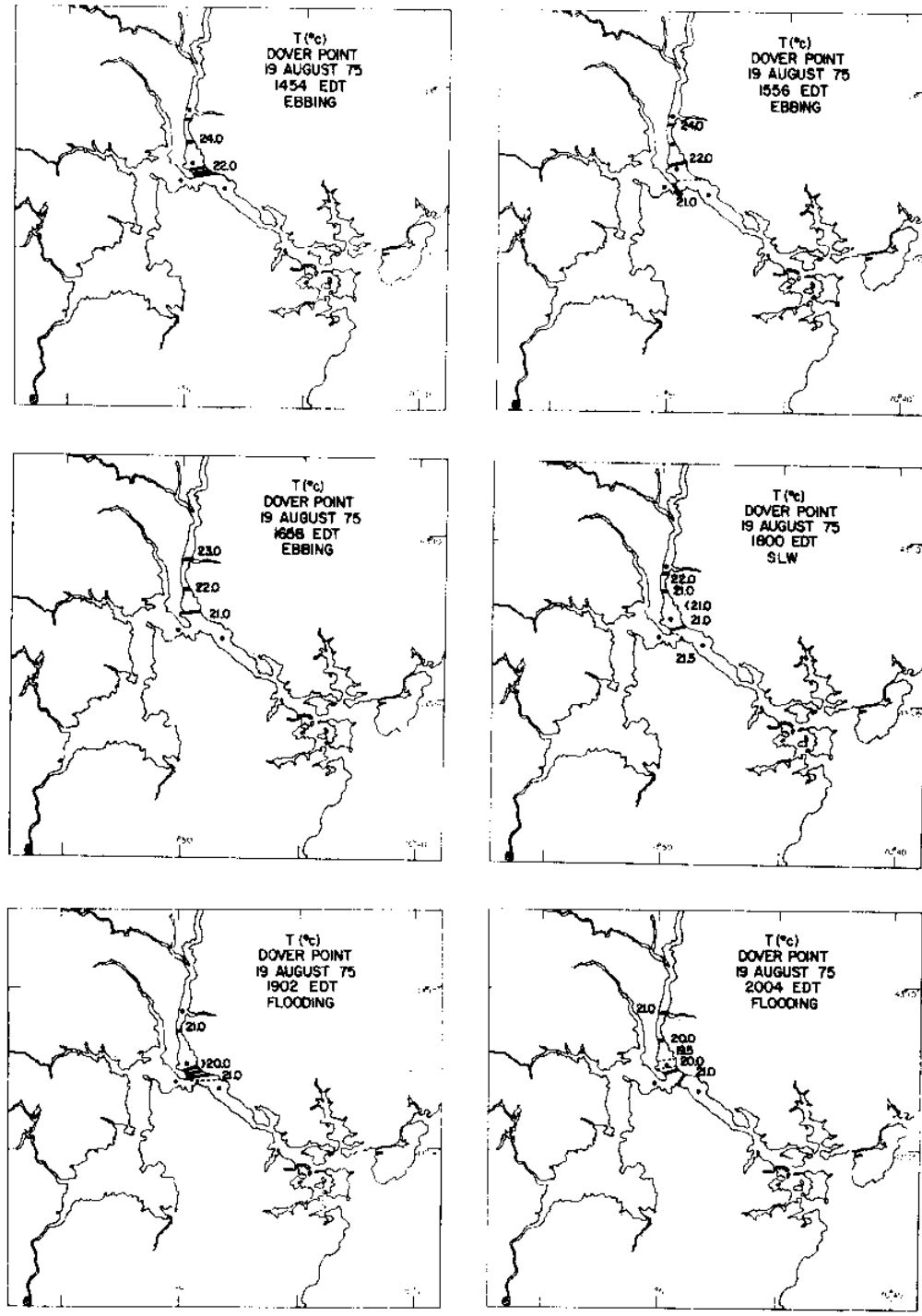

Figure 10 DOVER POINT TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at $1^{o}C$ intervals over one tidal cycle.

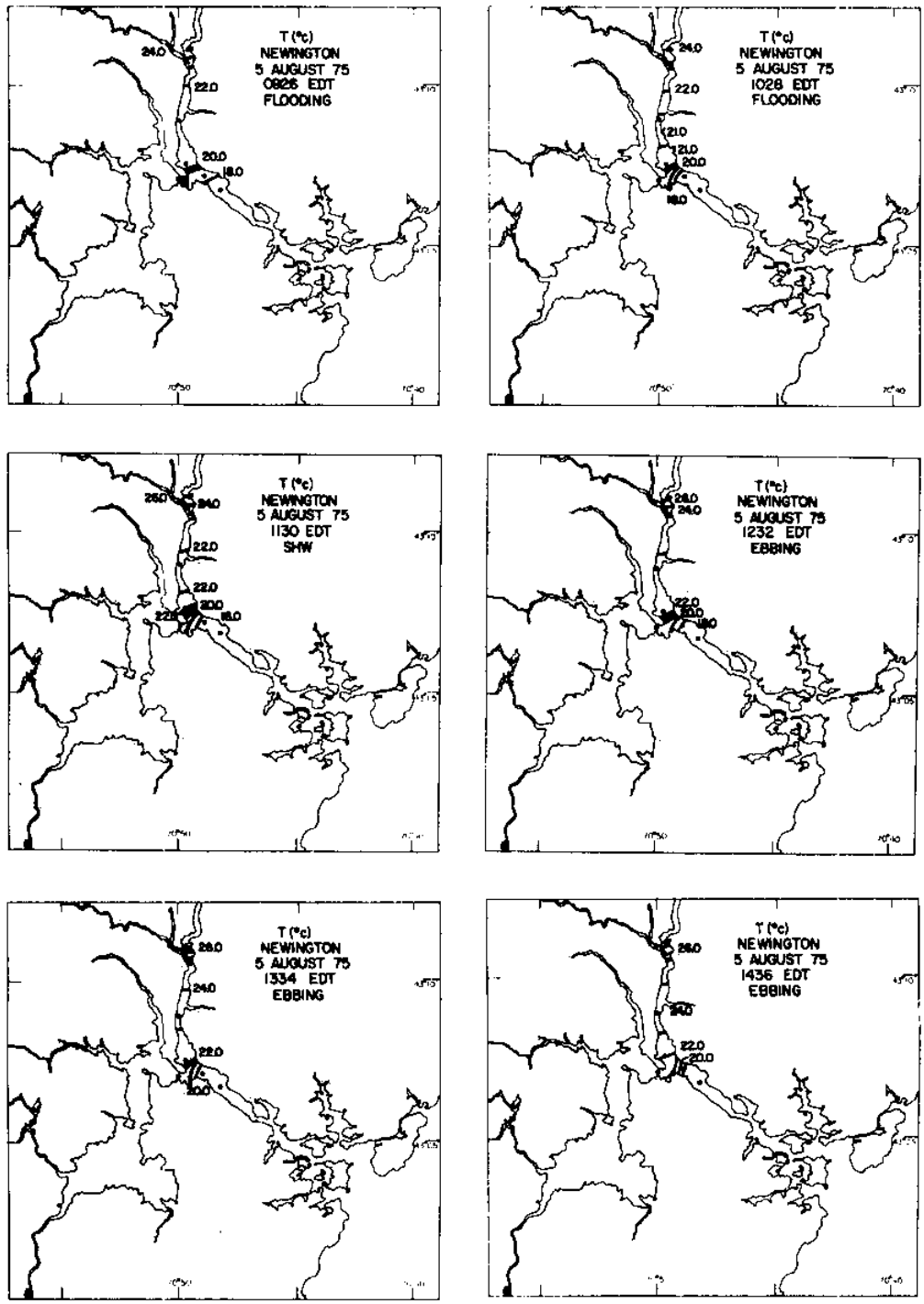

Figure 11 NEWINGTON TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at 1°C intervals over one tidal cycle.

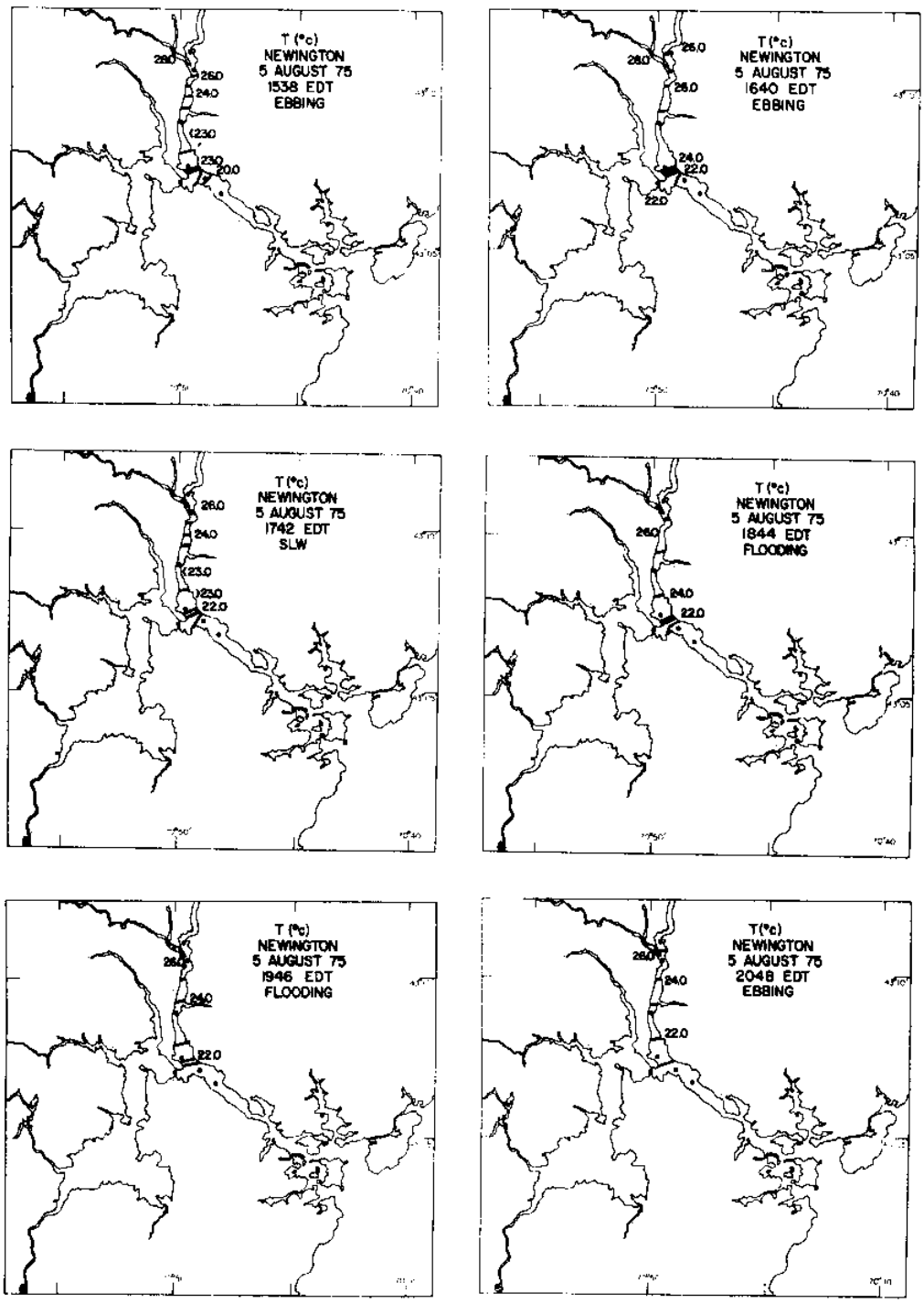

Figure 12 NEWINGTON TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at $1^{o}C$ intervals over one tidal cycle.

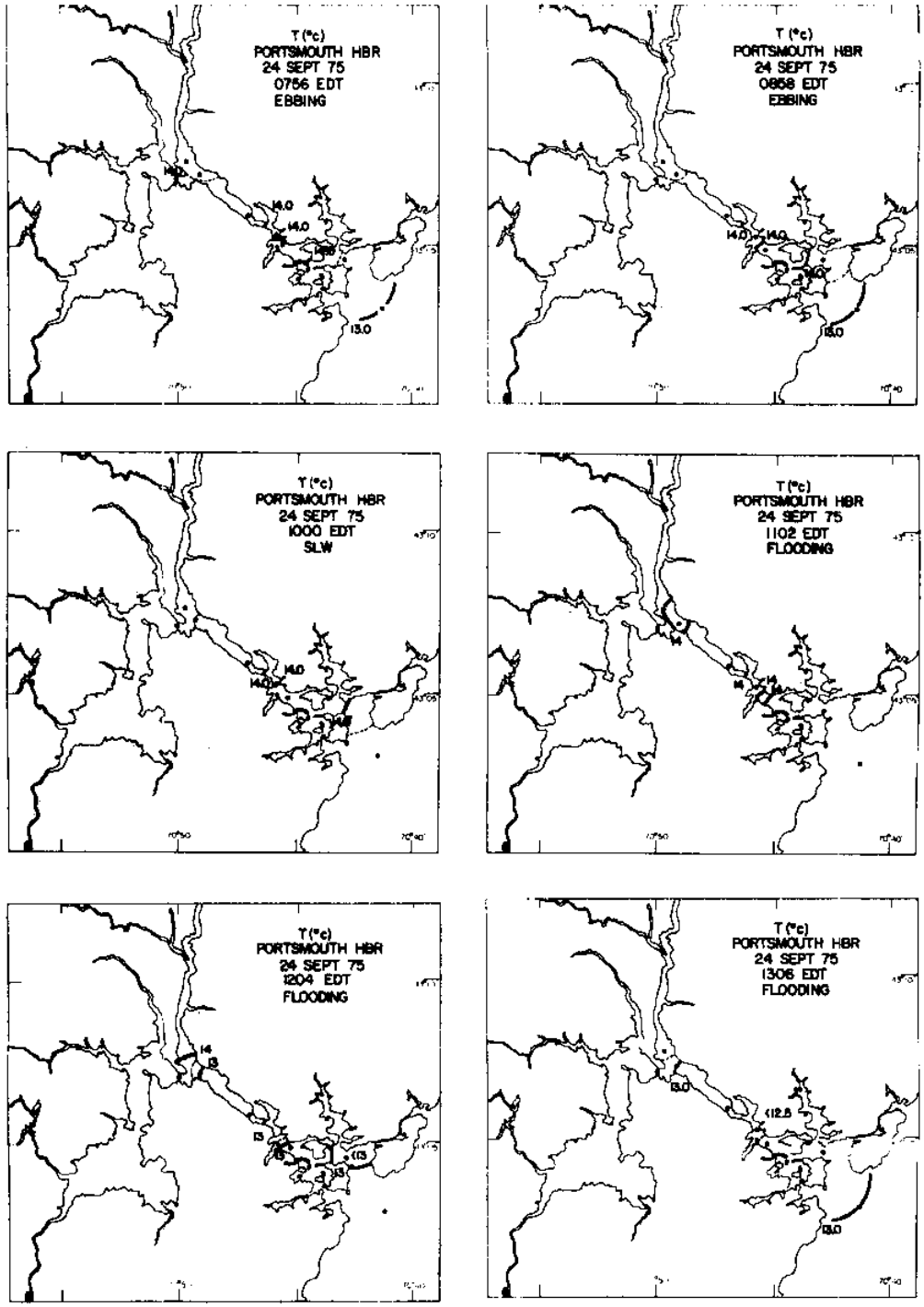

Figure 13 PORTSMOUTH HARBOR TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at $1^{o}C$ intervals over one tidal cycle.

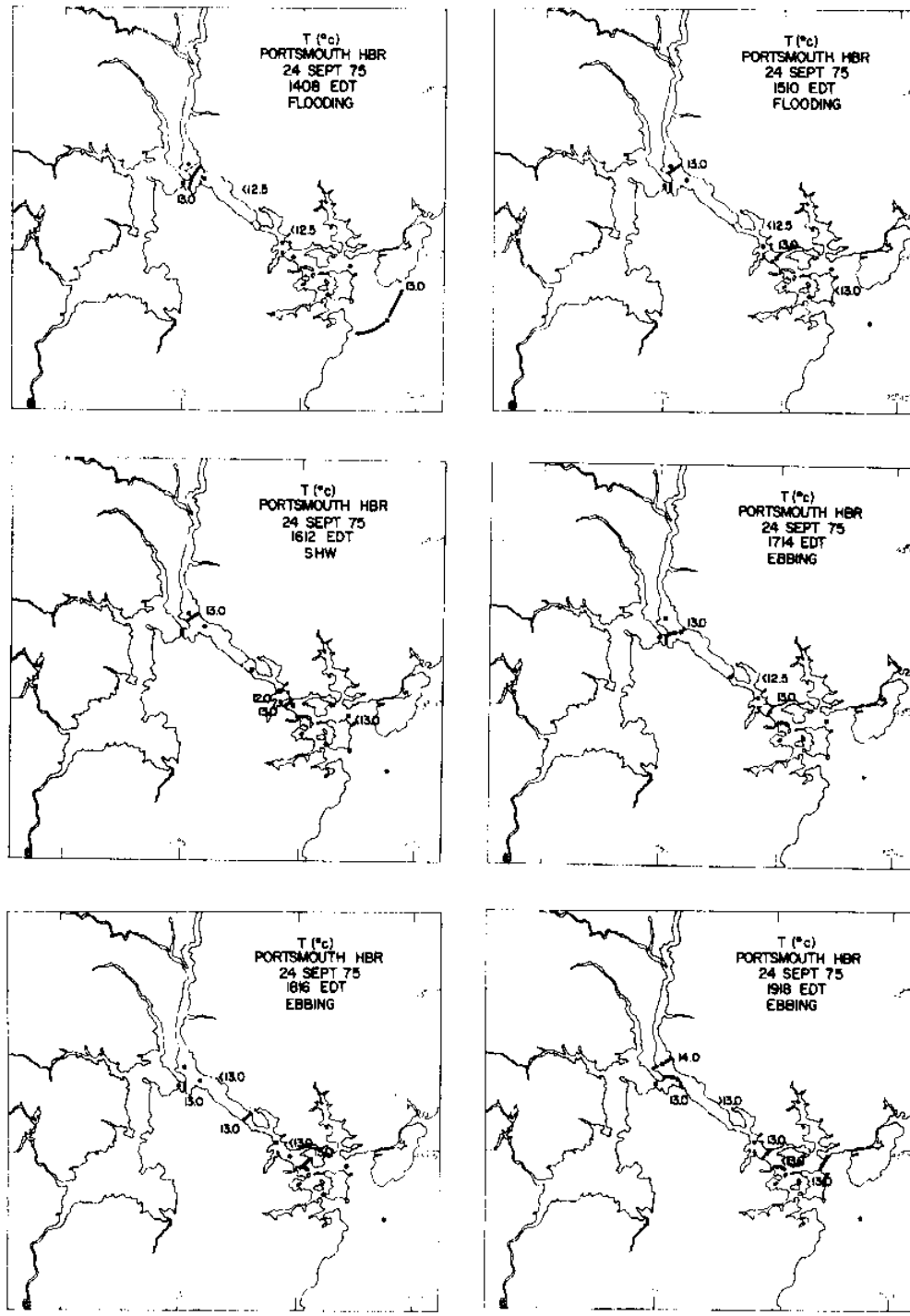

Figure 14 PORTSMOUTH HARBOR TEMPERATURE CONTOUR PLOT showing spatial distribution of isotherms at $1^{o}C$ intervals over one tidal cycle.

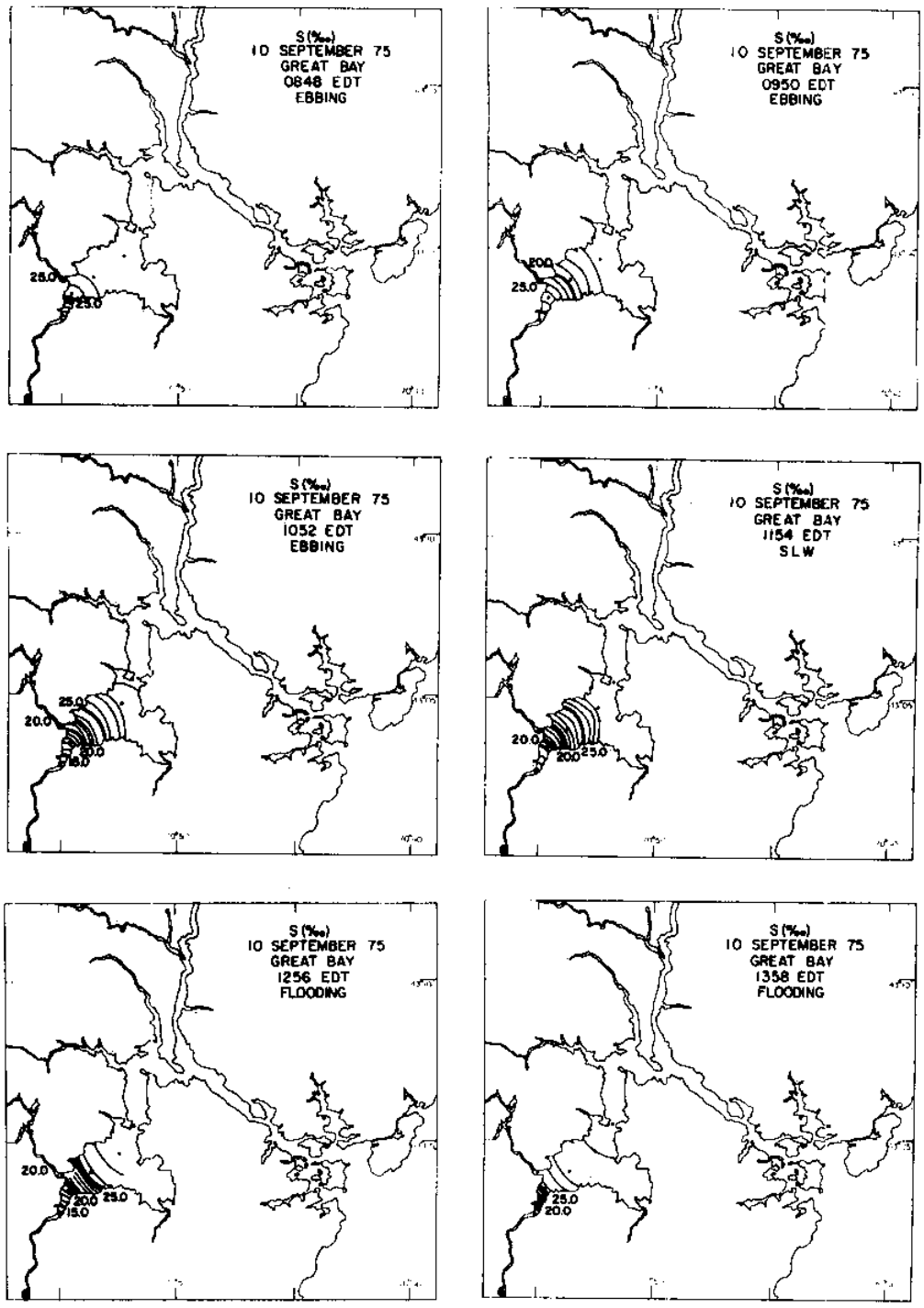

Figure 15 GREAT BAY SALINITY CONTOUR PLOT showing spatial distribution of isohalines at $1^{0}/oo$ intervals over one tidal cycle.

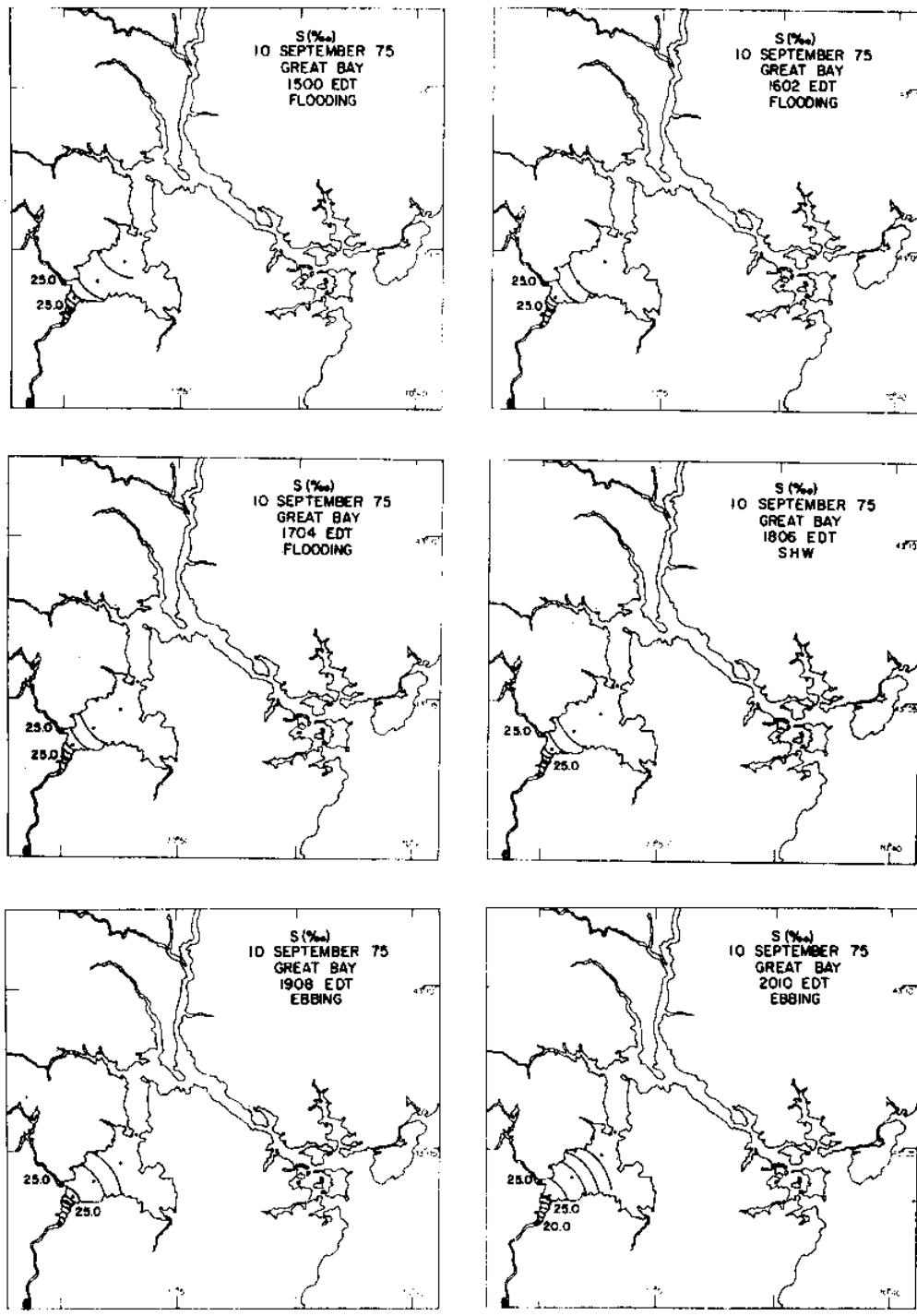

Figure 16 GREAT BAY SALINITY CONTOUR PLOT showing spatial distribution of isohalines at 1‰ intervals over one tidal cycle.

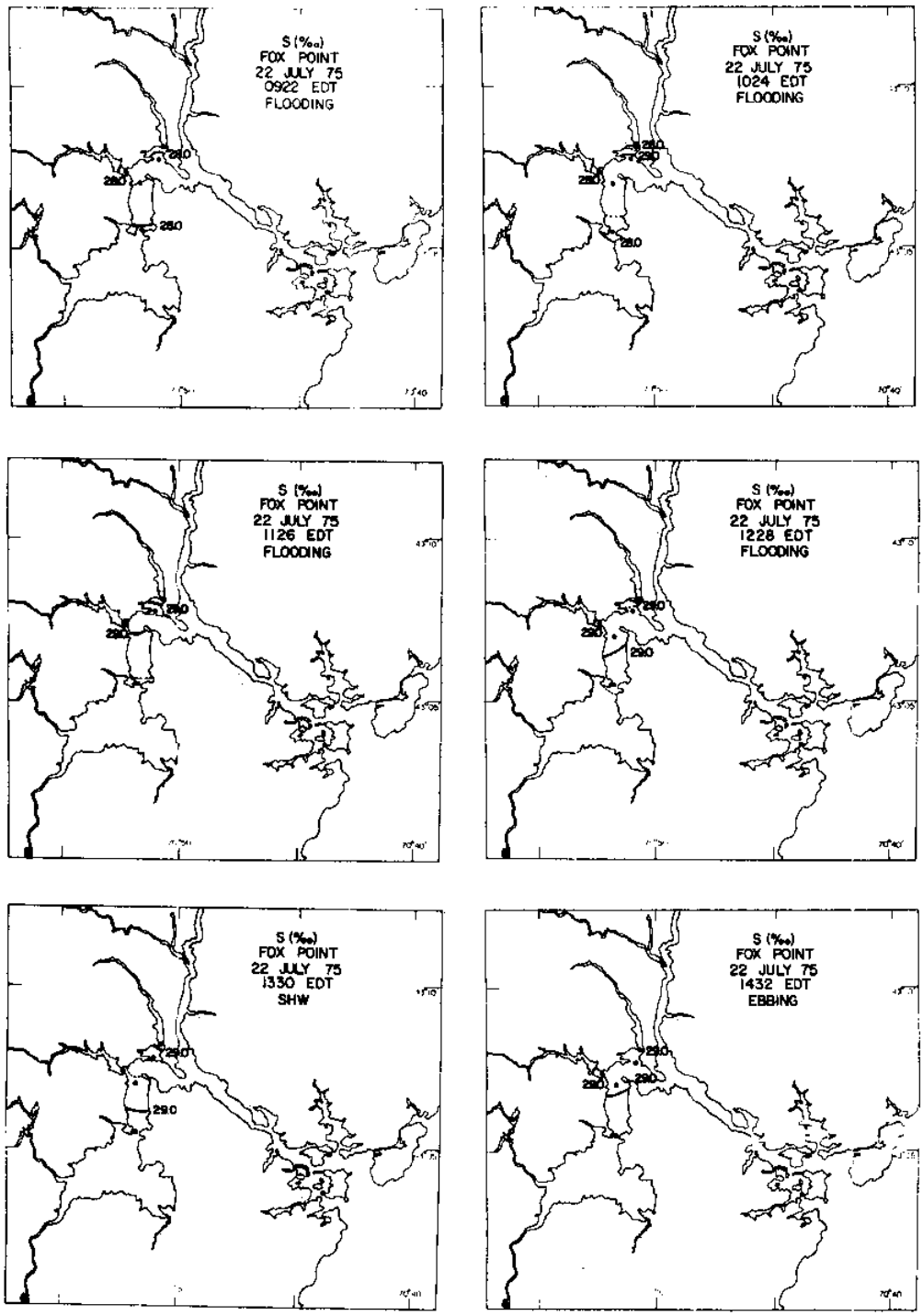

Figure 17 FOX POINT SALINITY CONTOUR PLOT showing spatial distribution of isohalines at $1^{0}/oo$ intervals over one tidal cycle.

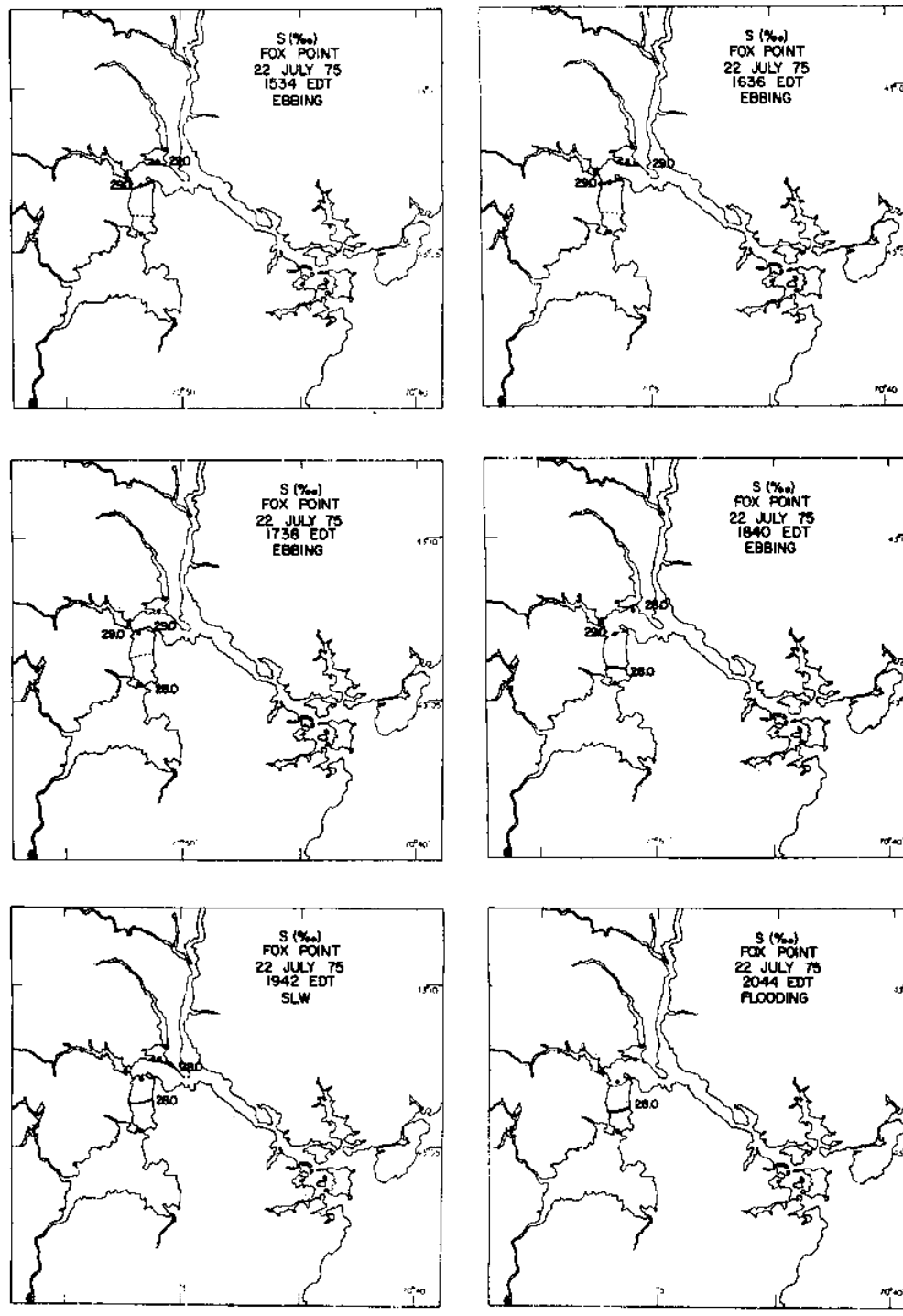

Figure 18 FOX POINT SALINITY CONTOUR PLOT showing spatial distribution of isohalines at $1^{0}/oo$ intervals over one tidal cycle.

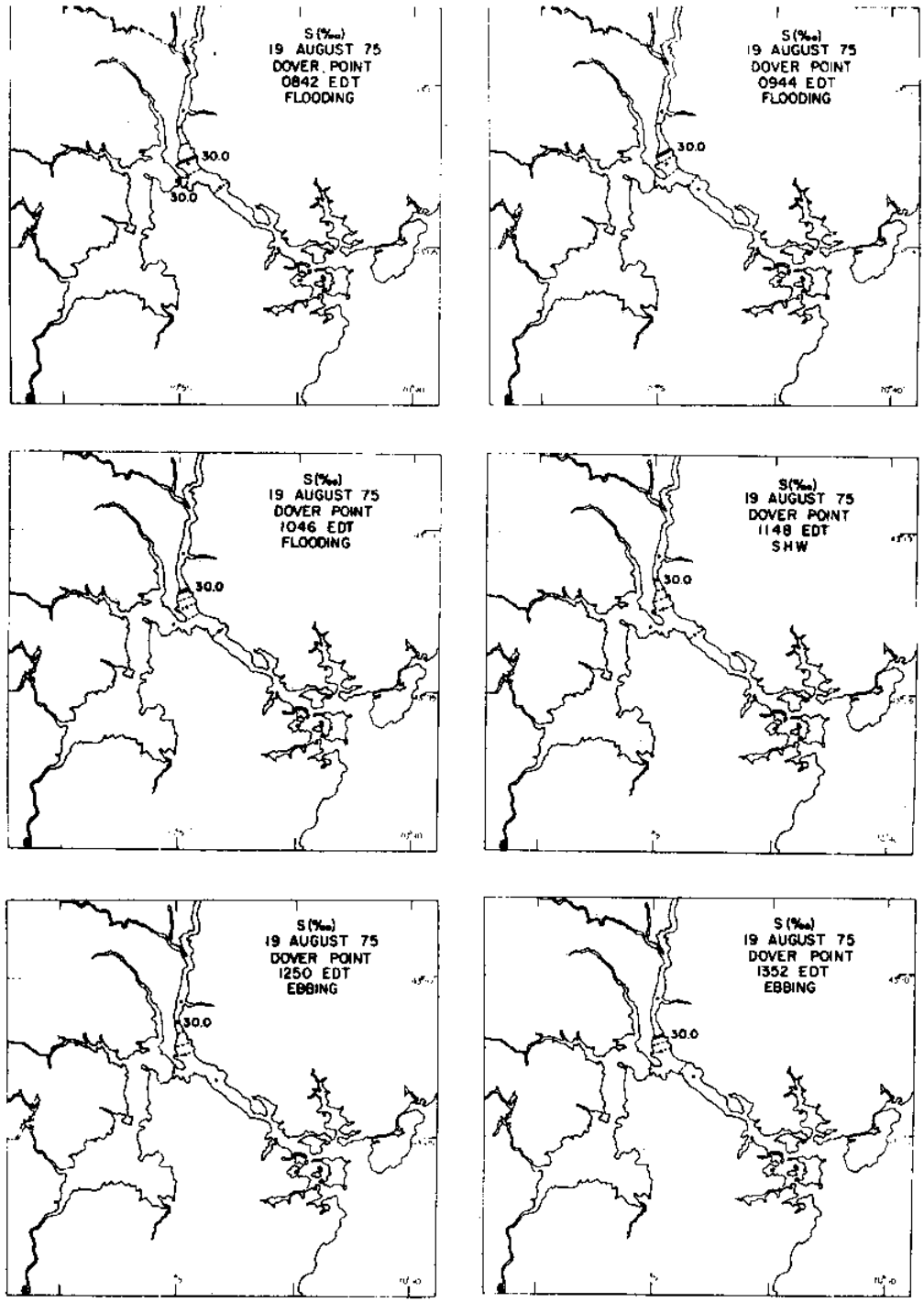

Figure 19 DOVER POINT SALINITY CONTOUR PLOT showing spatial distribution of isohalines at $1^{0}/oo$ intervals over one tidal cycle.

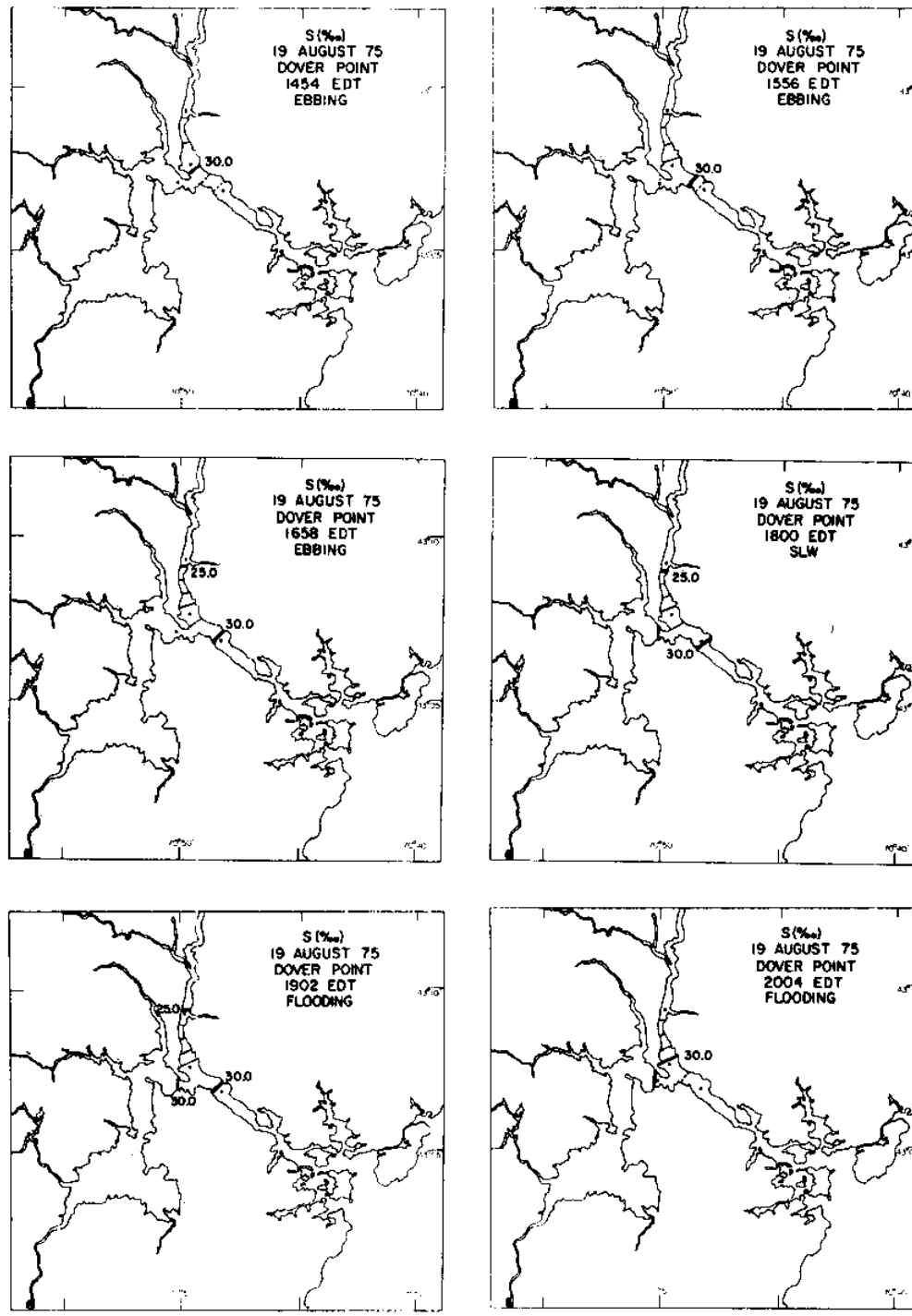

Figure 20 DOVER POINT SALINITY CONTOUR PLOT showing spatial distribution of isohalines at $1^{o}/oo$ intervals over one tidal cycle.

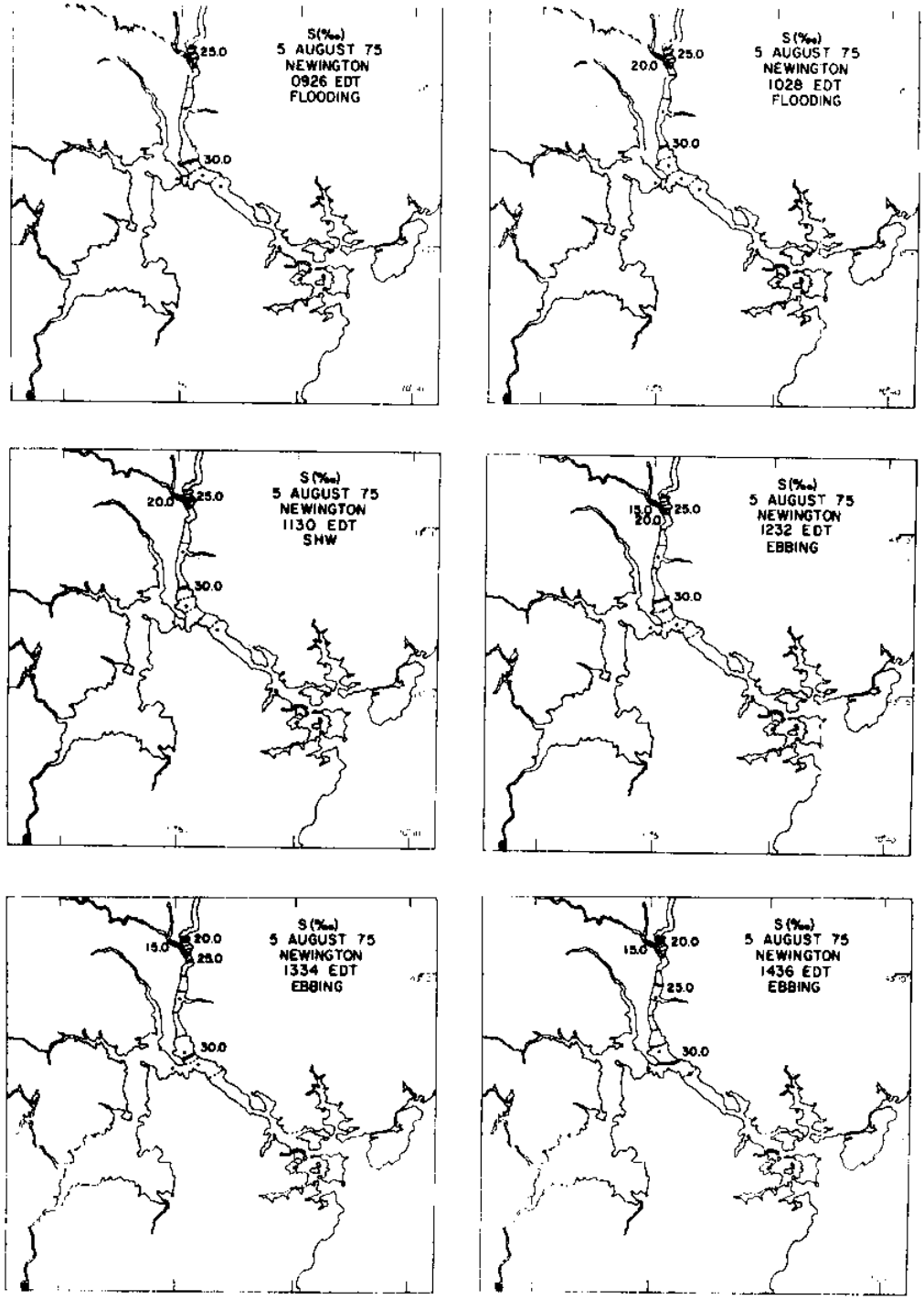

Figure 21 NEWINGTON SALINITY CONTOUR PLOT showing spatial distribution of isohalines at $1^{o}/oo$ intervals over one tidal cycle.

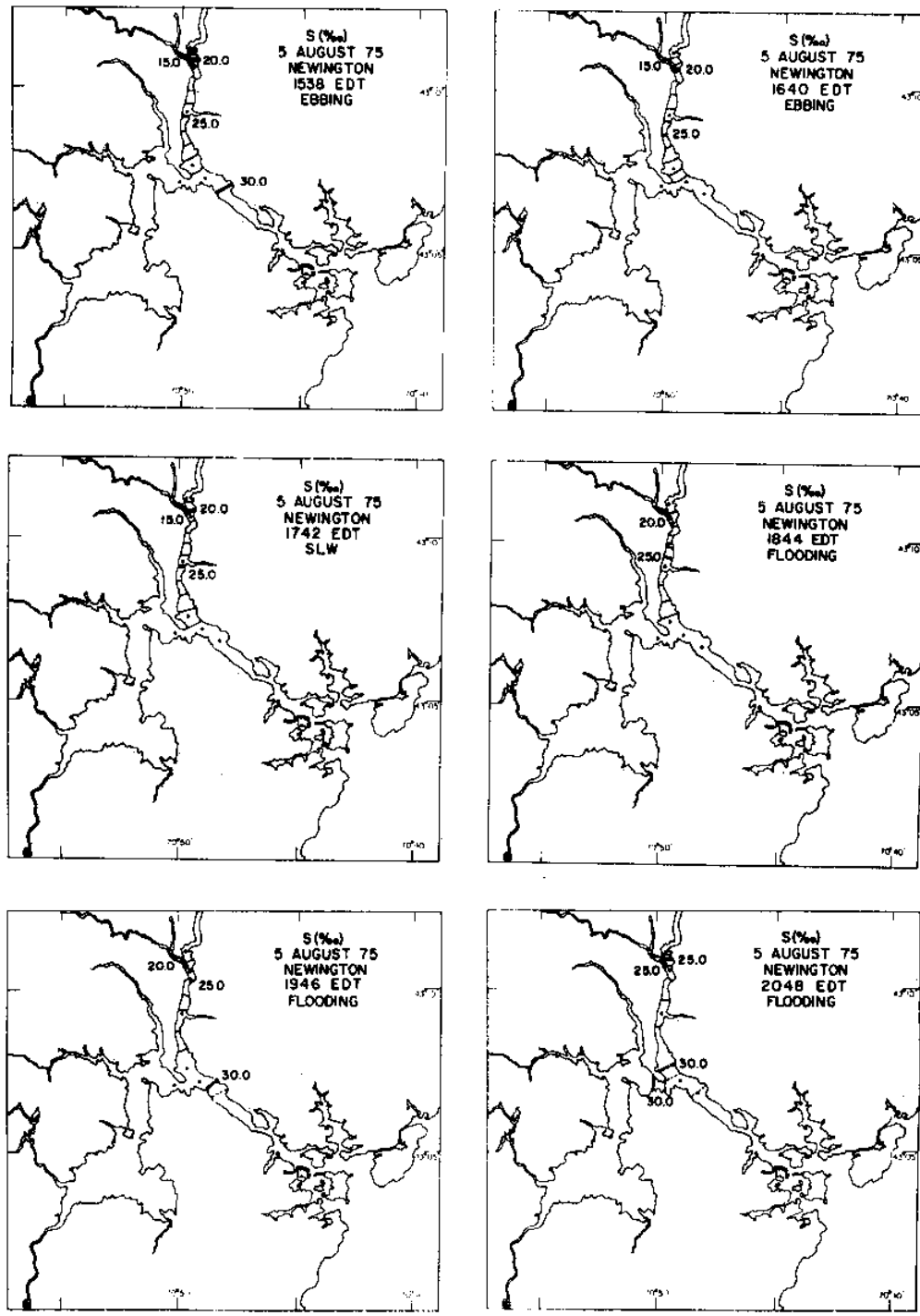

Figure 22 NEWINGTON SALINITY CONTOUR PLOT showing spatial distribution of isohalines at $1^{0}/oo$ intervals over one tidal cycle.

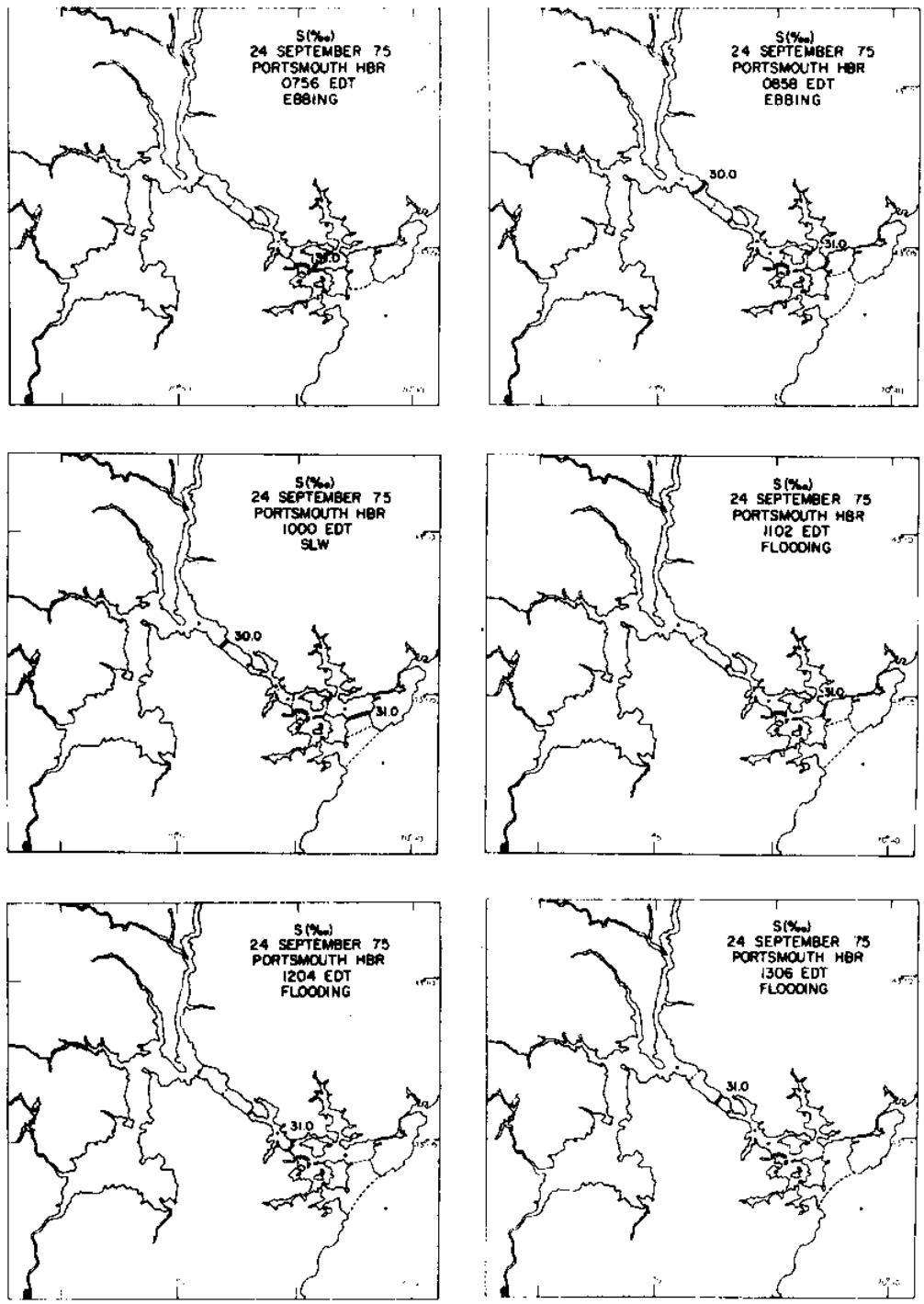

Figure 23 PORTSMOUTH HARBOR SALINITY CONTOUR PLOT showing spatial distribution of isohalines at 1°/oo intervals over one tidal cycle.

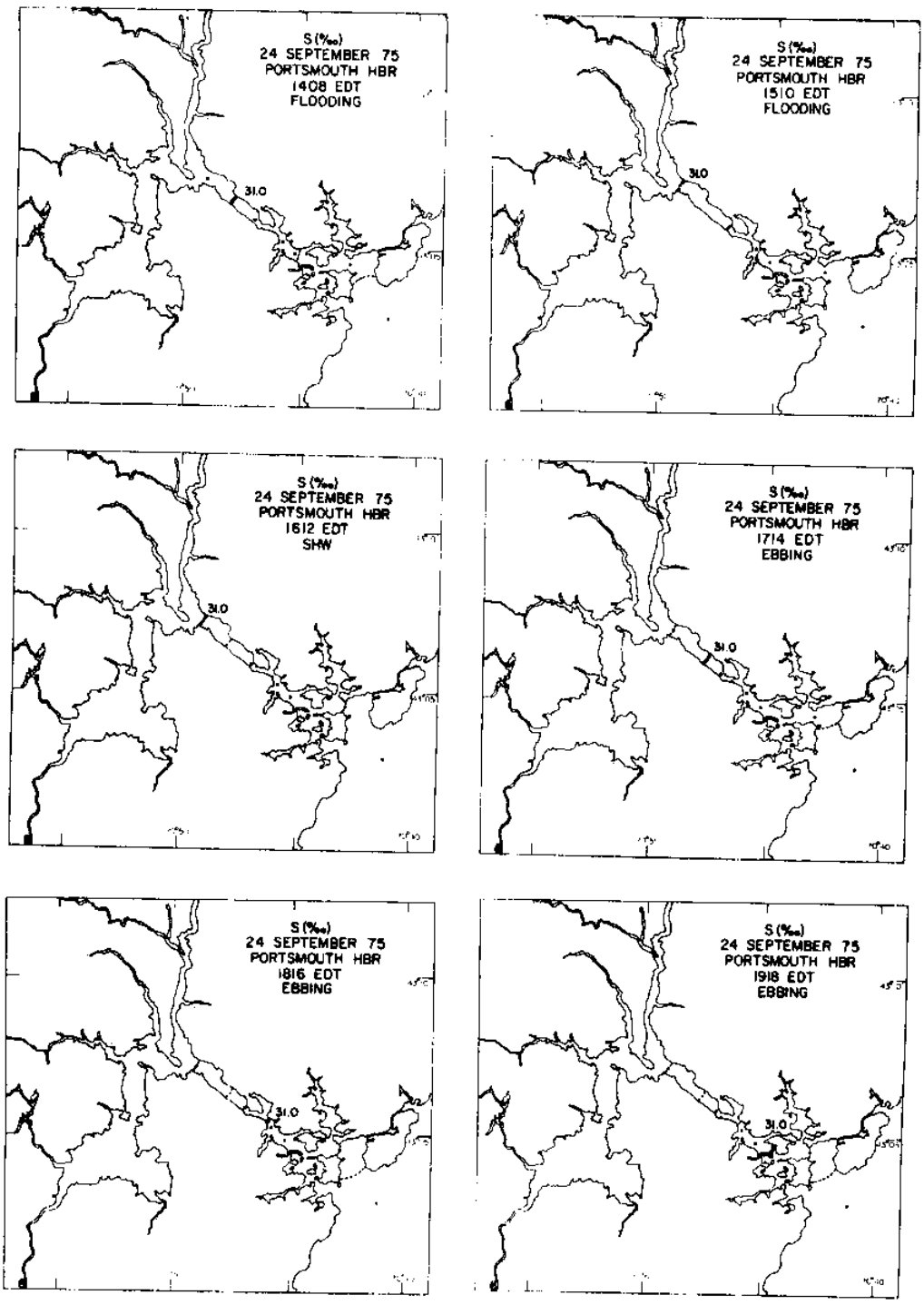

Figure 24 PORTSMOUTH HARBOR SALINITY CONTOUR PLOT showing spatial distribution of isohalines at $1^{0}/oo$ intervals over one tidal cycle.

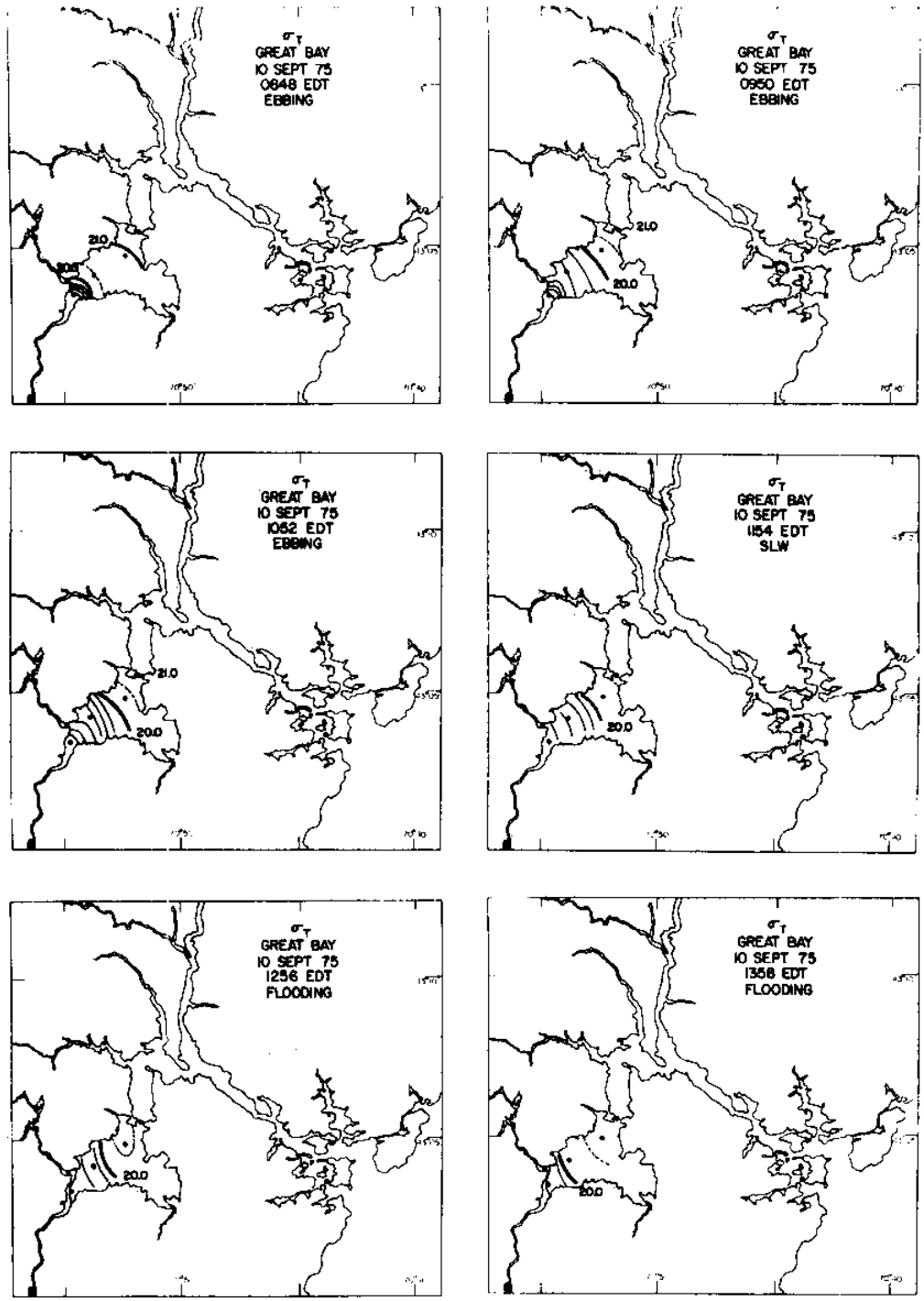

Figure 25 GREAT BAY SIGMA-T CONTOUR PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

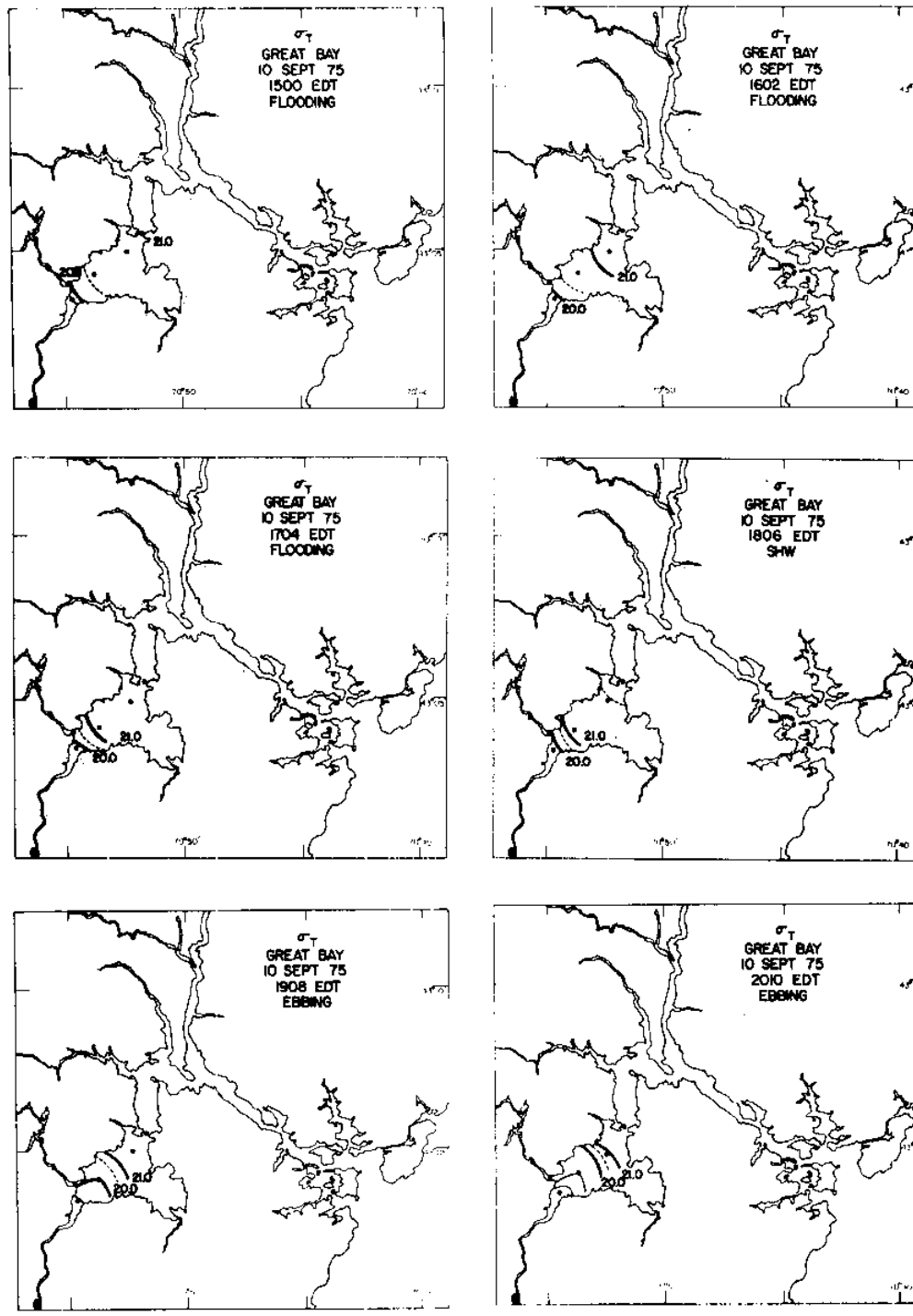

Figure 26 GREAT BAY SIGMA-T CONTOUR PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

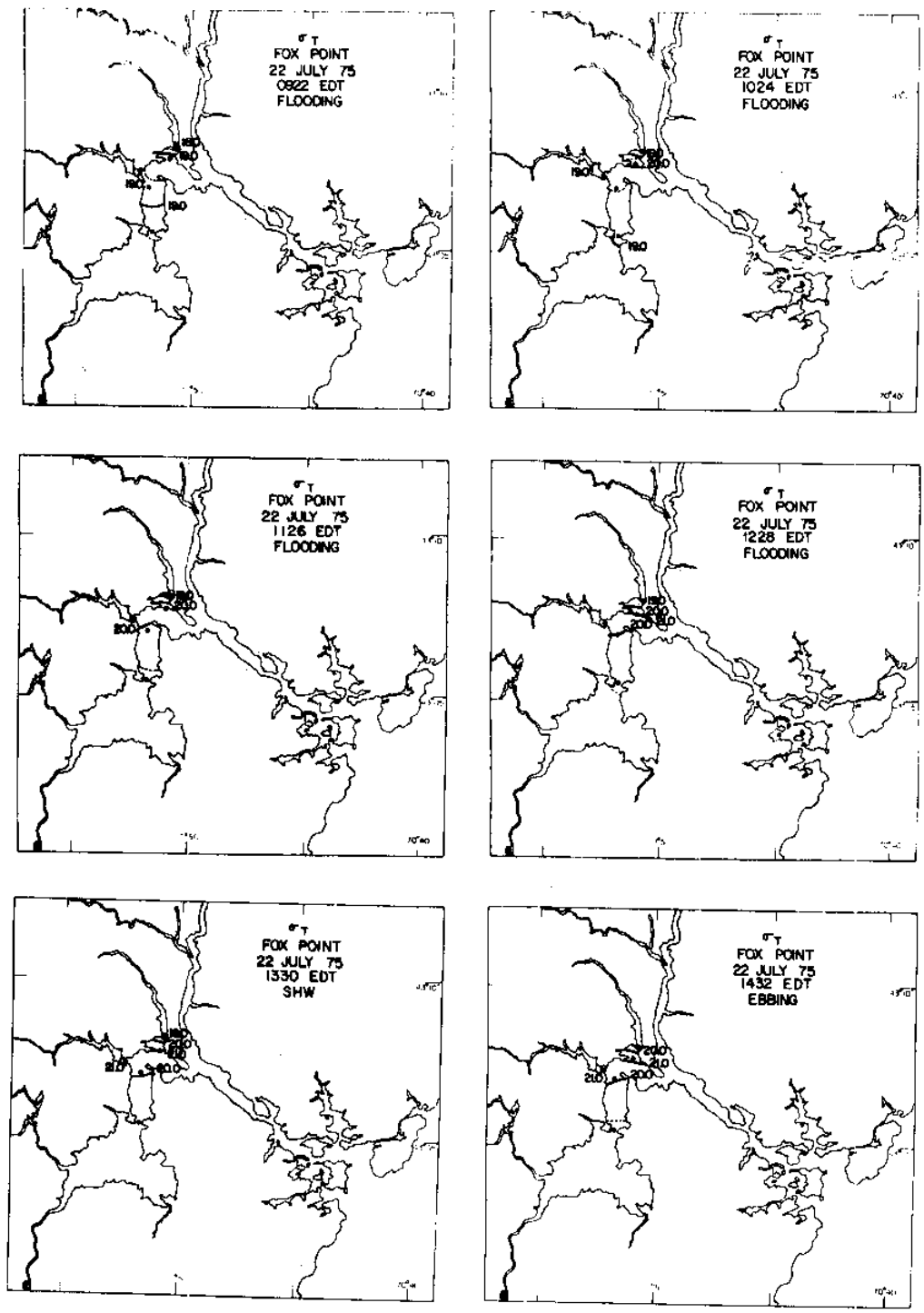

Figure 27 FOX POINT SIGMA-T CONTOUR PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

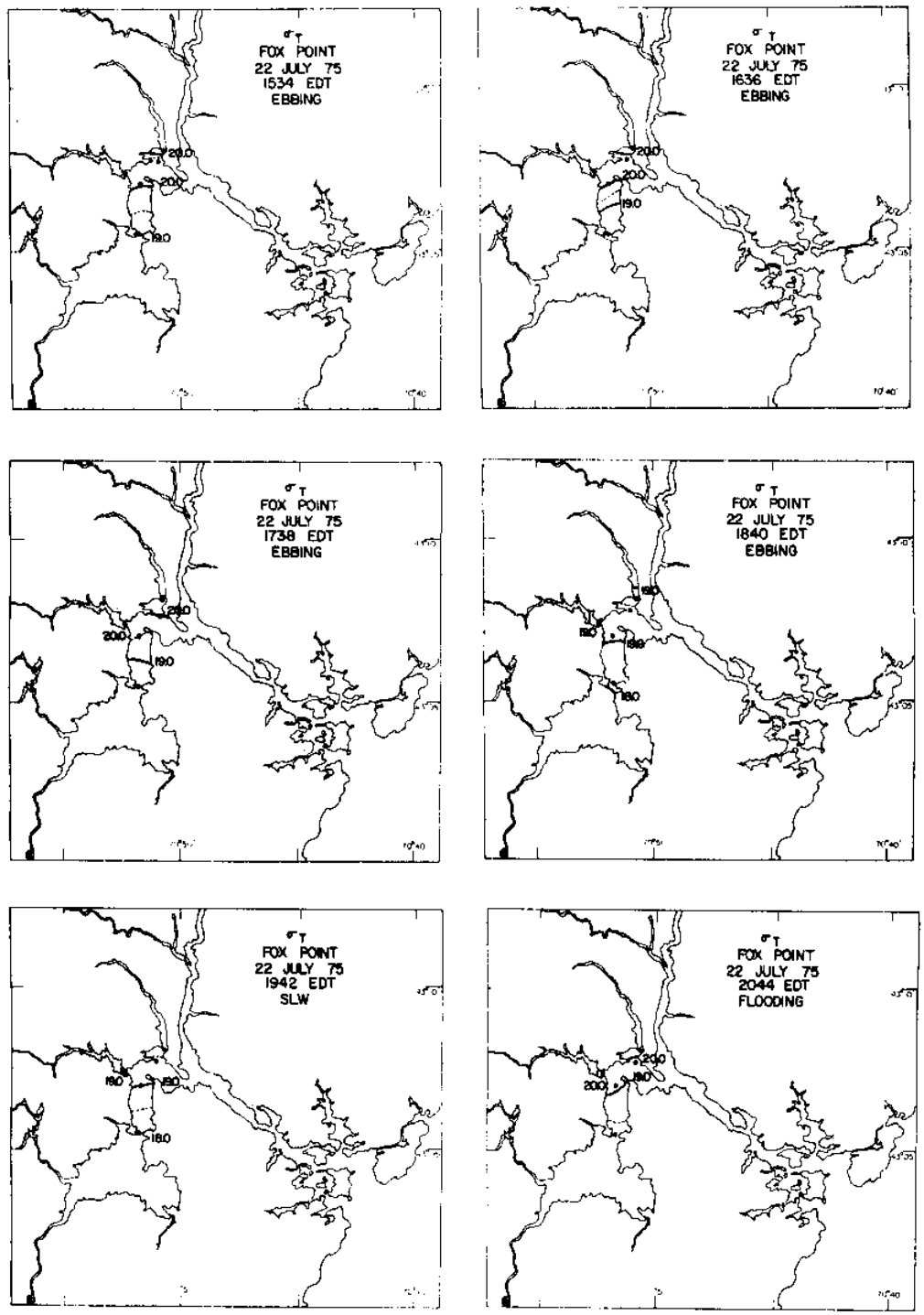

Figure 28 FOX POINT SIGMA-T CONTOUR PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

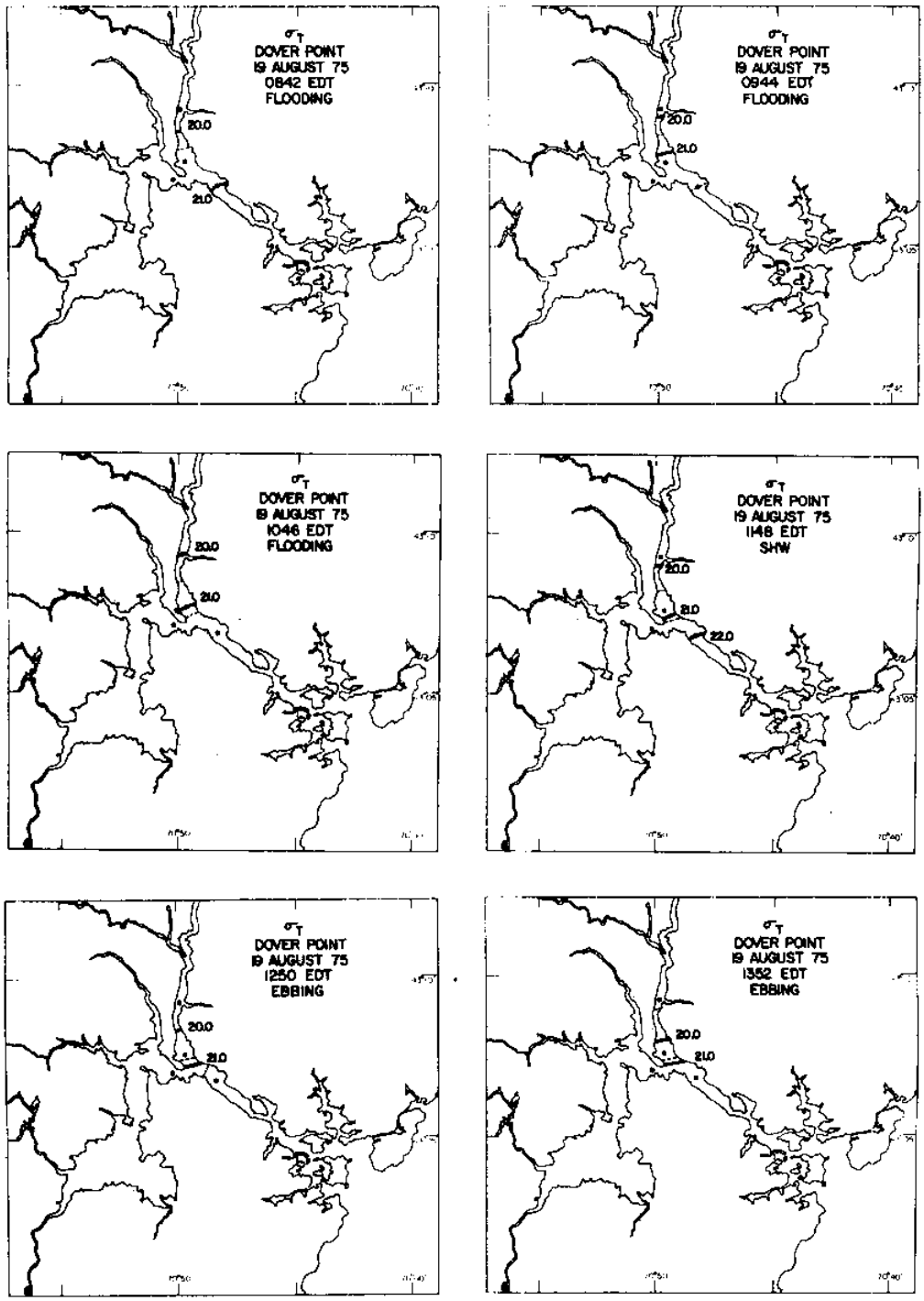

Figure 29 DOVER POINT SIGMA-T CONTOUR PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

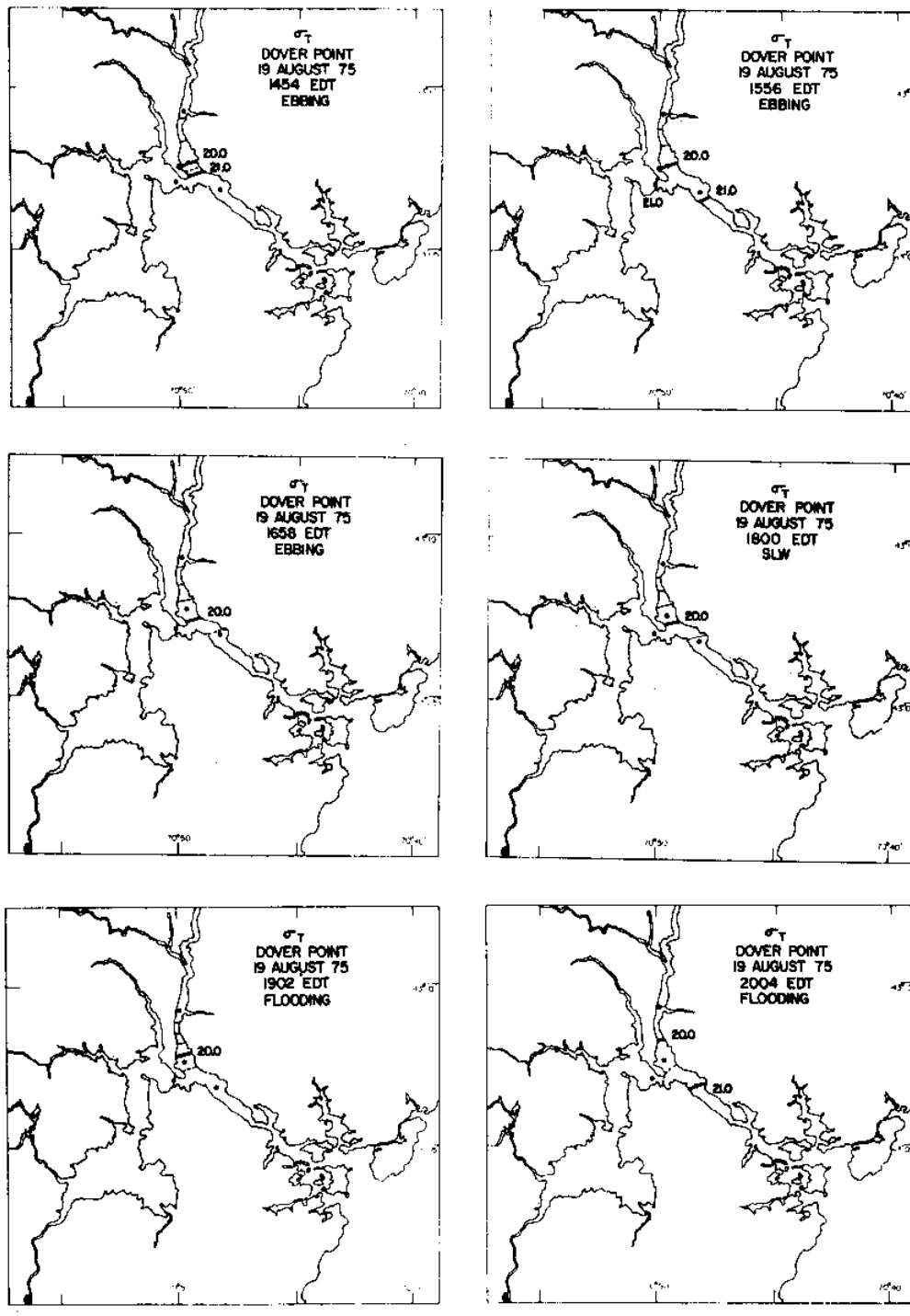

Figure 30 DOVER POINT SIGMA-T CONTOUR PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

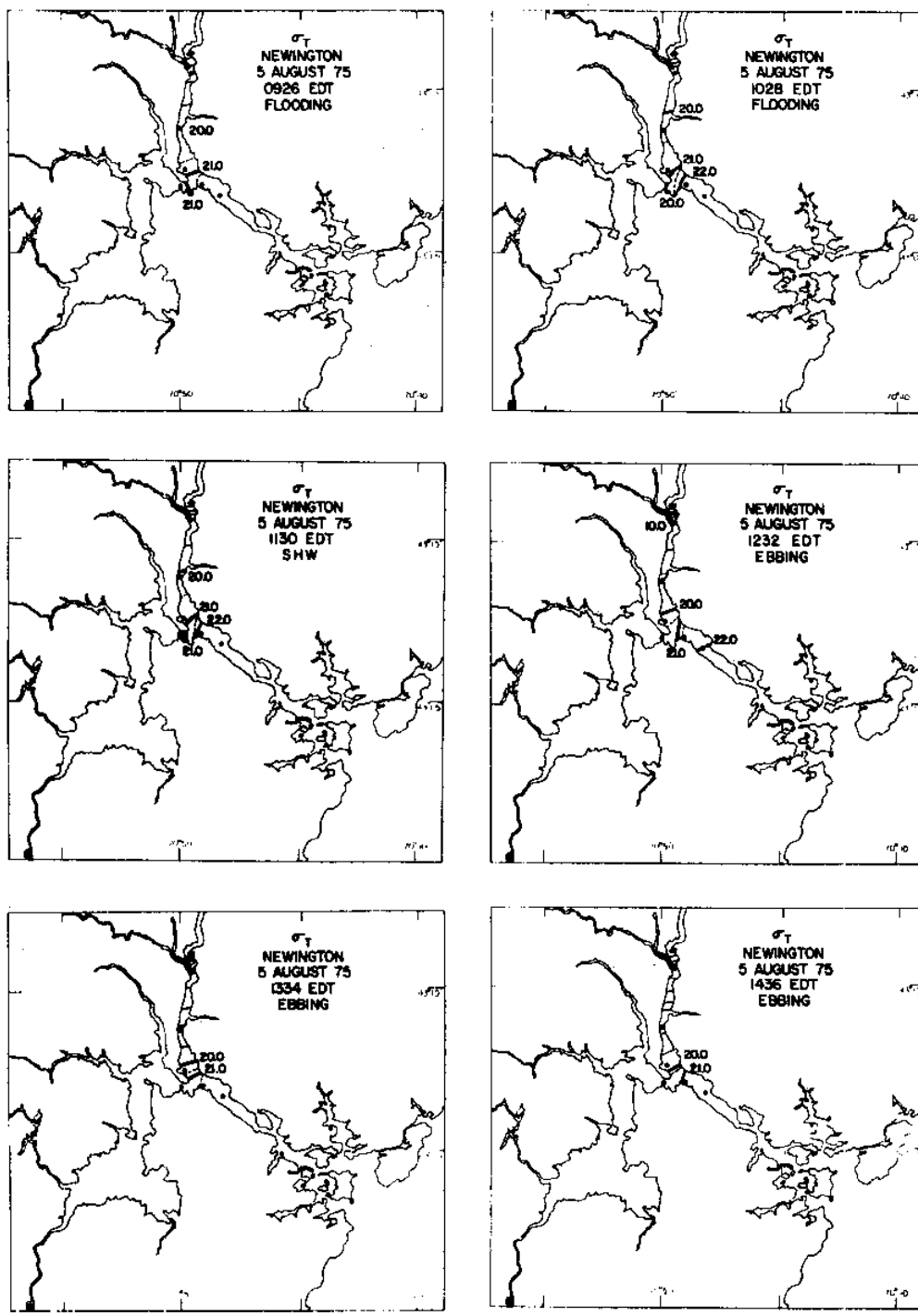

Figure 31 NEWINGTON SIGMA-T CONTOUR PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

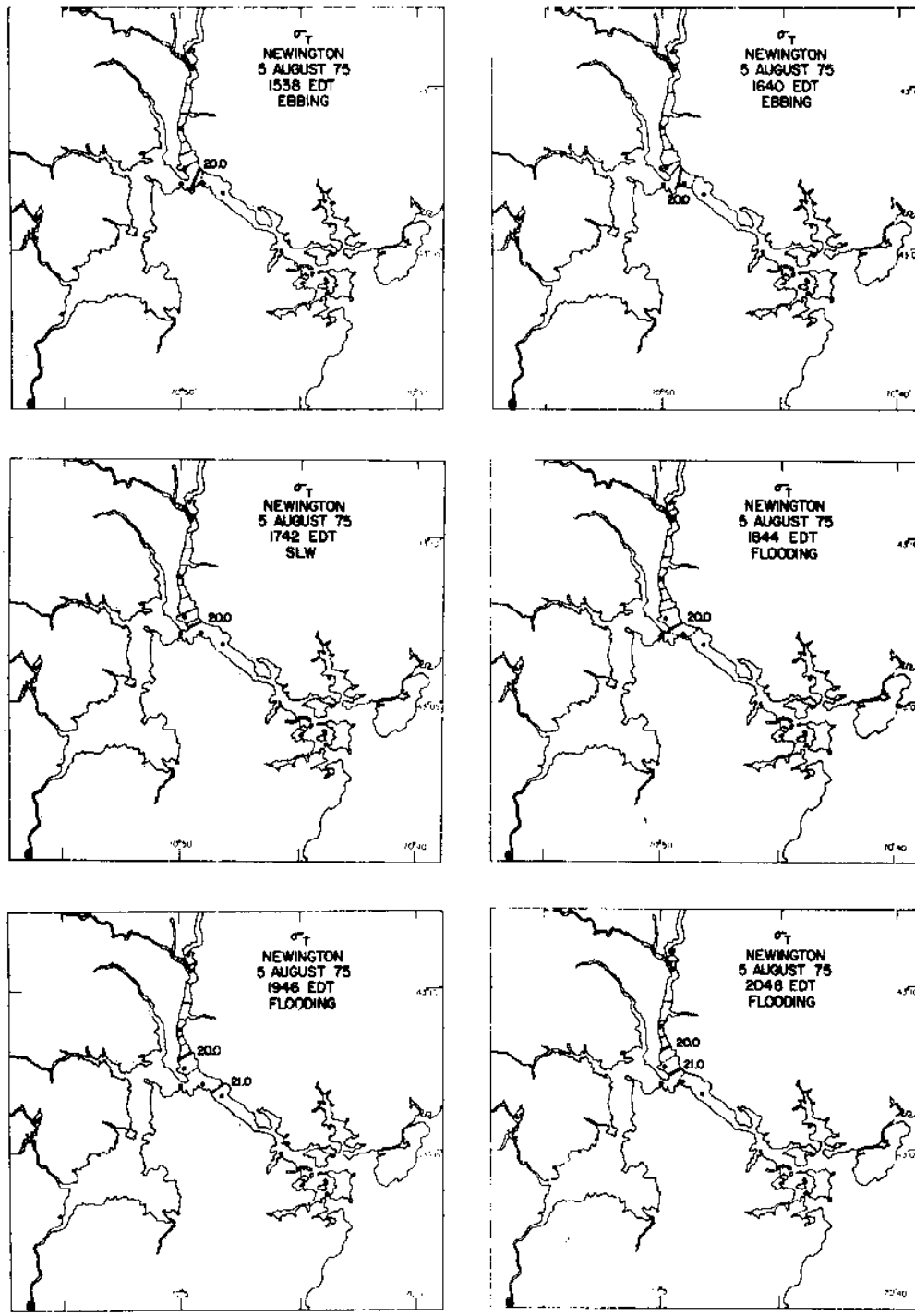

Figure 32 NEWINGTON SIGMA-T CONTOUR PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

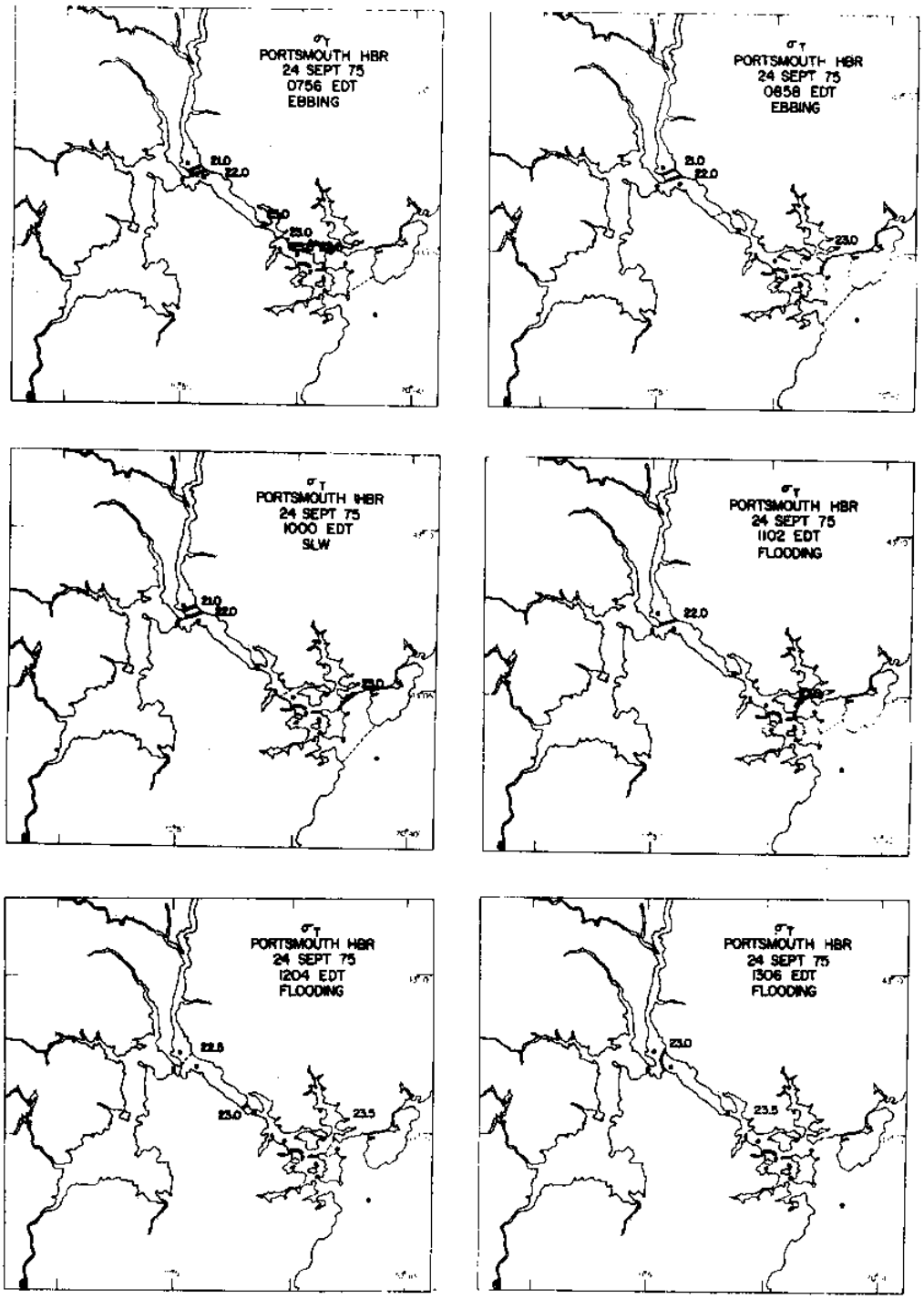

Figure 33 PORTSMOUTH HARBOR SIGMA-T PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

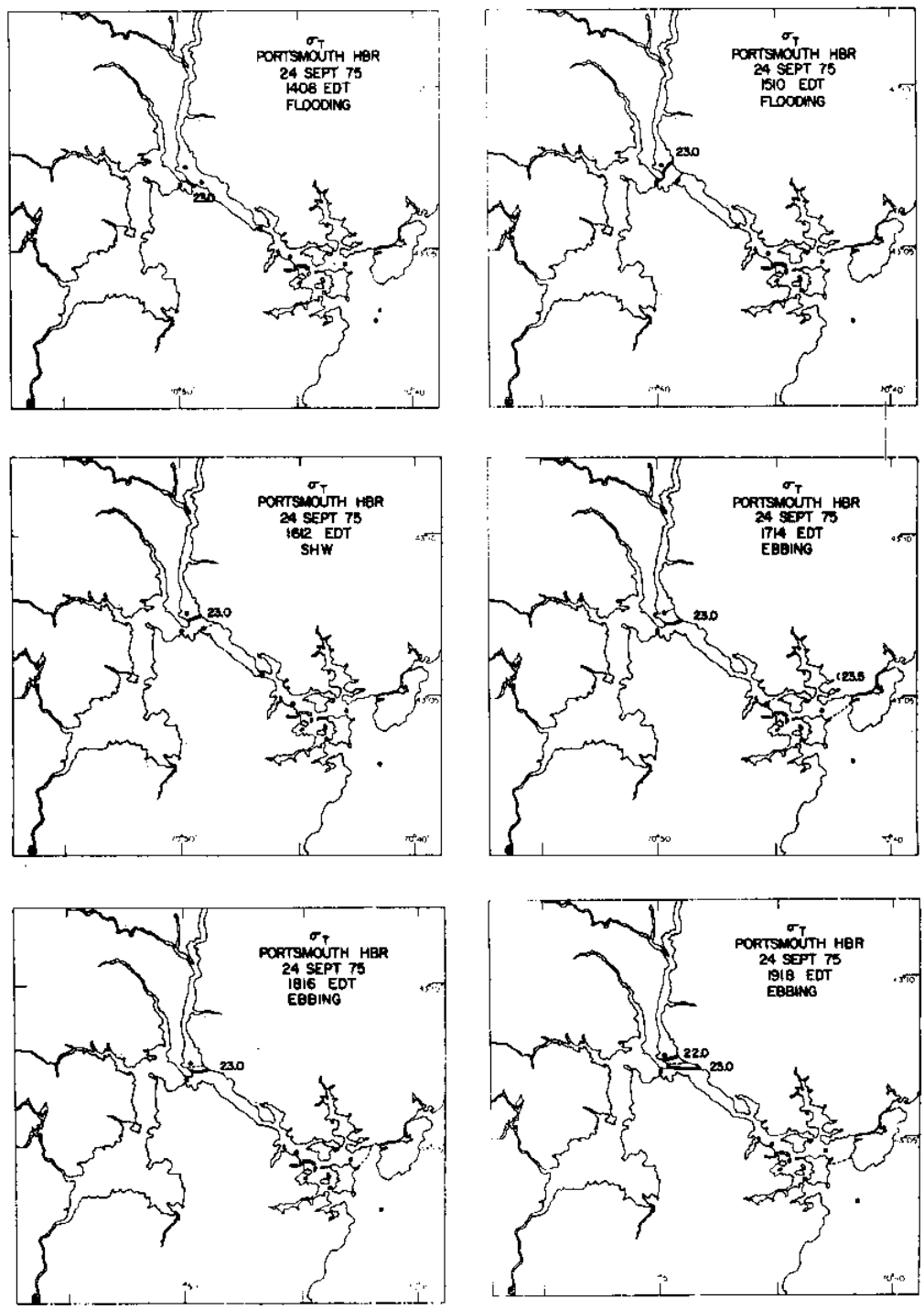

Figure 34 PORTSMOUTH HARBOR SIGMA-T PLOT showing spatial distribution of isopycnals at 1 gm/cm^3 intervals over one tidal cycle.

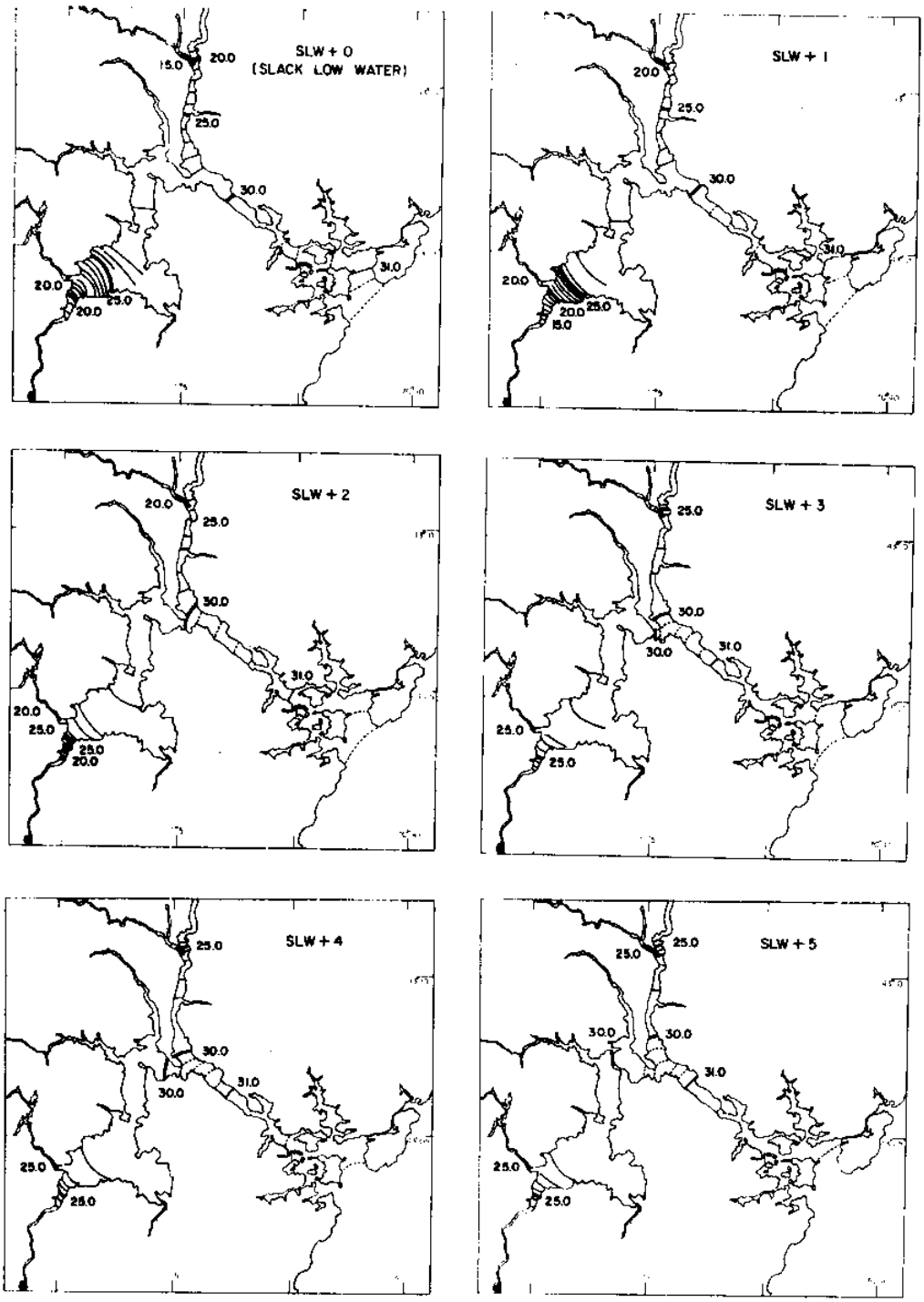

Figure 35 COMPOSITE SALINITY PLOT showing spatial distribution of isohalines at 1°/oo intervals over one tidal cycle.

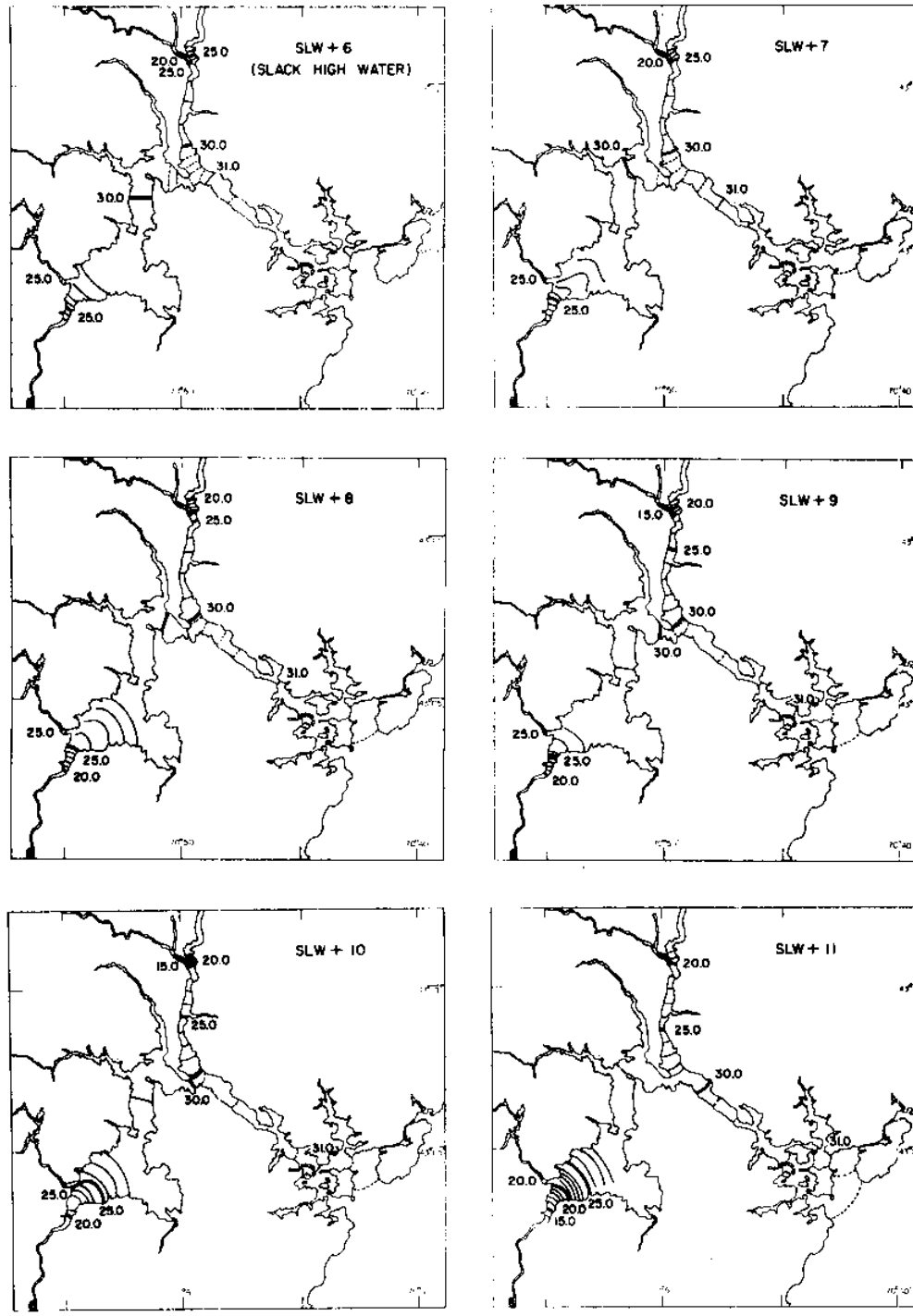

Figure 36 COMPOSITE SALINITY PLOT showing spatial distribution of isohalines at 1°/oo intervals over one tidal cycle.

APPENDIX C

Vertical profiles of temperature salinity and sigma-t for representative estuarine and river stations.

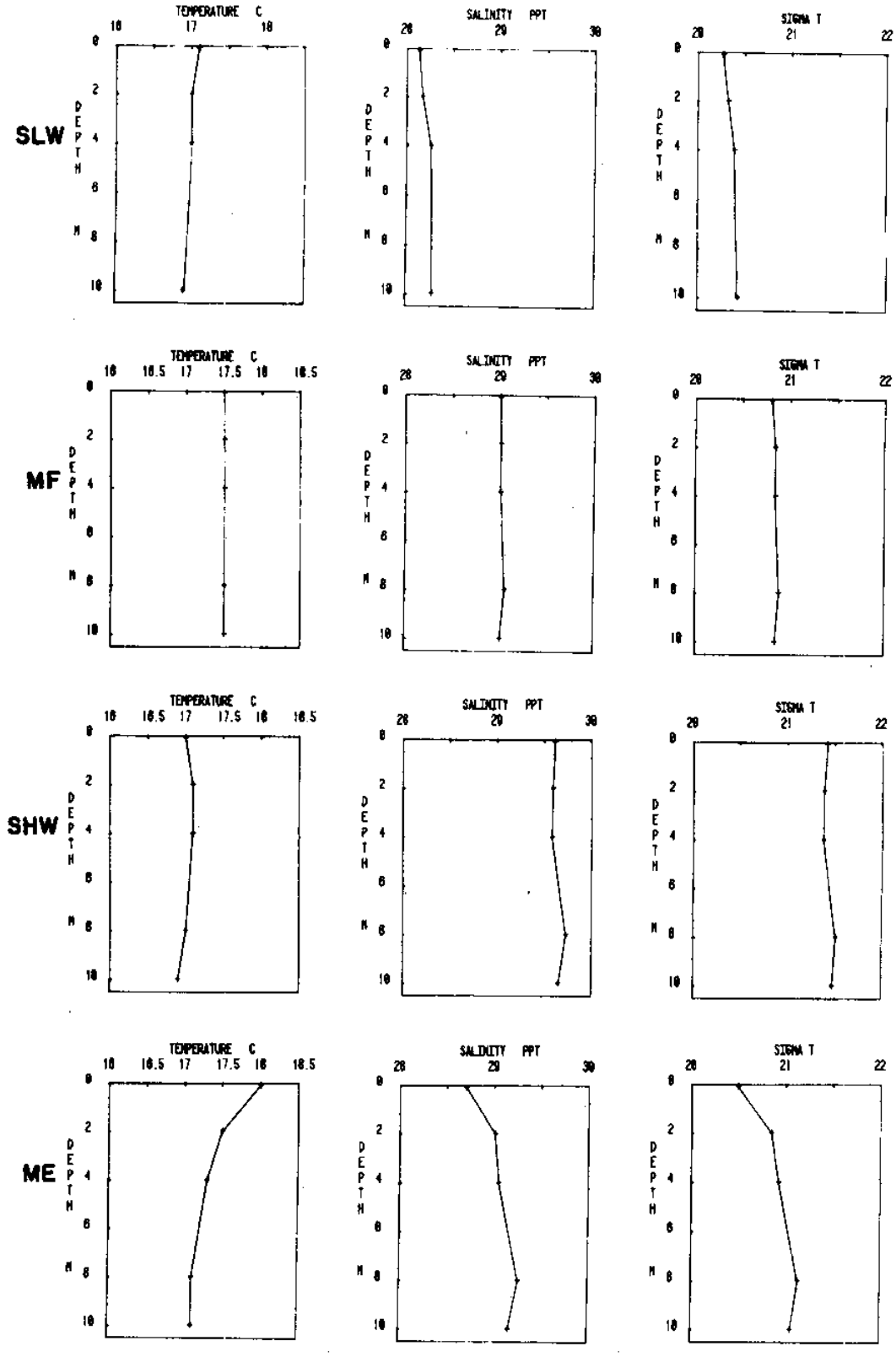

Figure 37 GREAT BAY (GB2) VERTICAL PROFILES showing temperature (^{o}C), salinity ($^{o}/oo$) and sigma-t (gm/cm^3) change with depth (M) over one tidal period. SLW (slack low water), MF (mid flood), SHW (slack high water), ME (mid ebb).

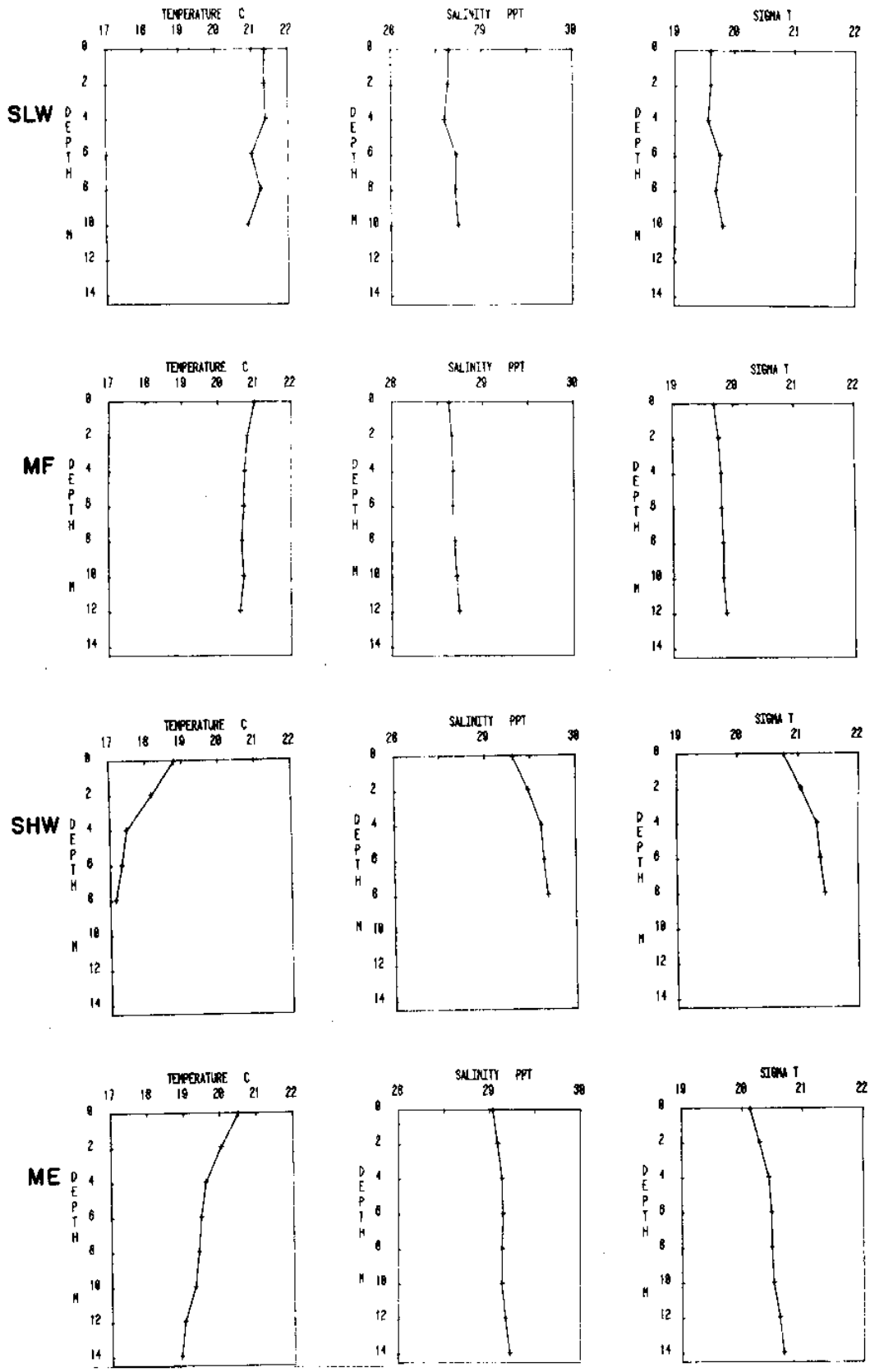

Figure 38 FOX POINT (FP2) VERTICAL PROFILES showing temperature (^{o}C), salinity ($^{o}/oo$) and sigma-t (gm/cm^3) change with depth (M) over one tidal period. SLW (slack low water), MF (mid flood), SHW (slack high water), ME (mid ebb).

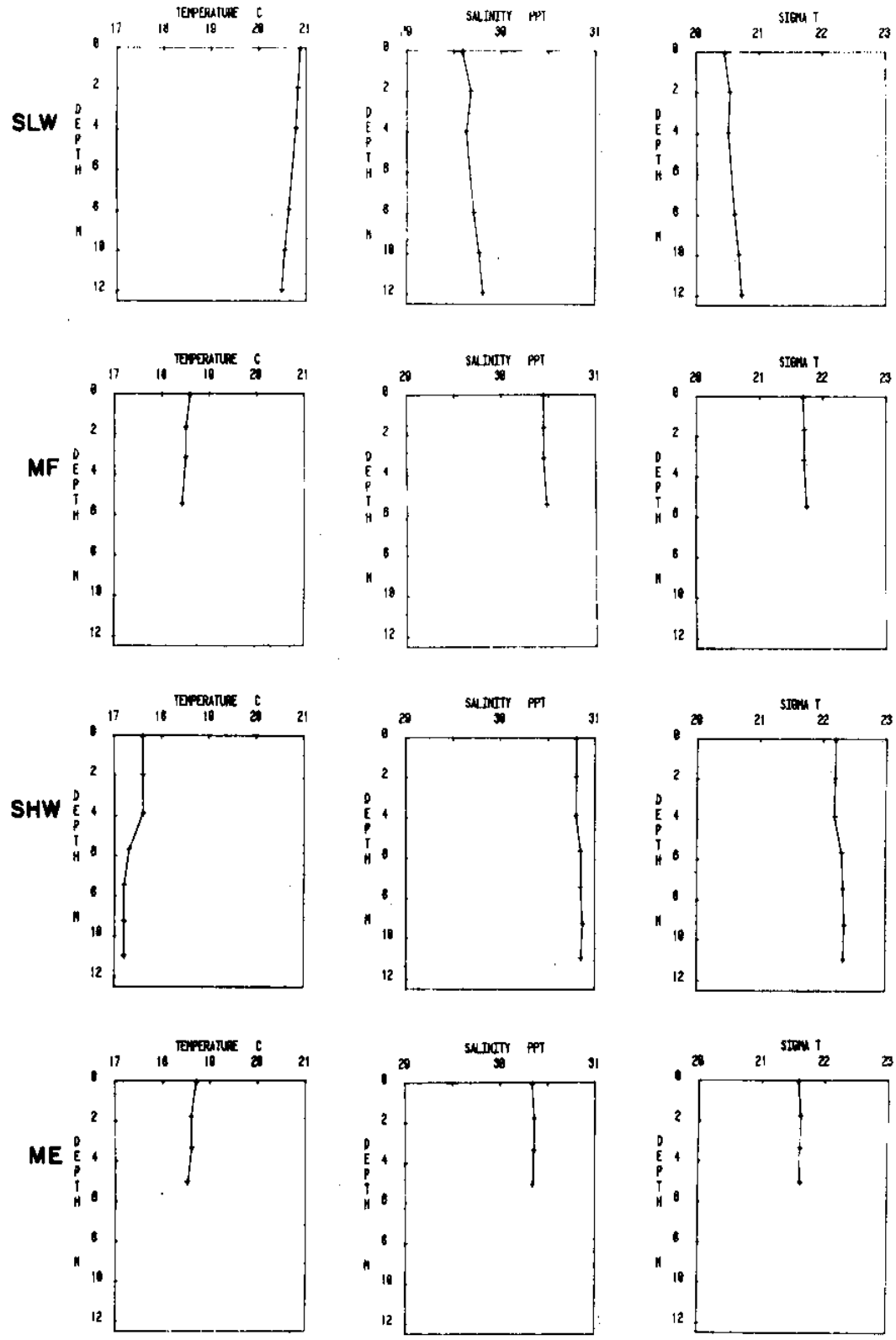

Figure 39 NEWINGTON (NW2) VERTICAL PROFILES showing temperature (^{o}C), salinity ($^{o}/oo$) and sigma-t (gm/cm^{3}) change with depth (M) over one tidal period. SLW (slack low water), MF (mid flood), SHW (slack high water), ME (mid ebb).

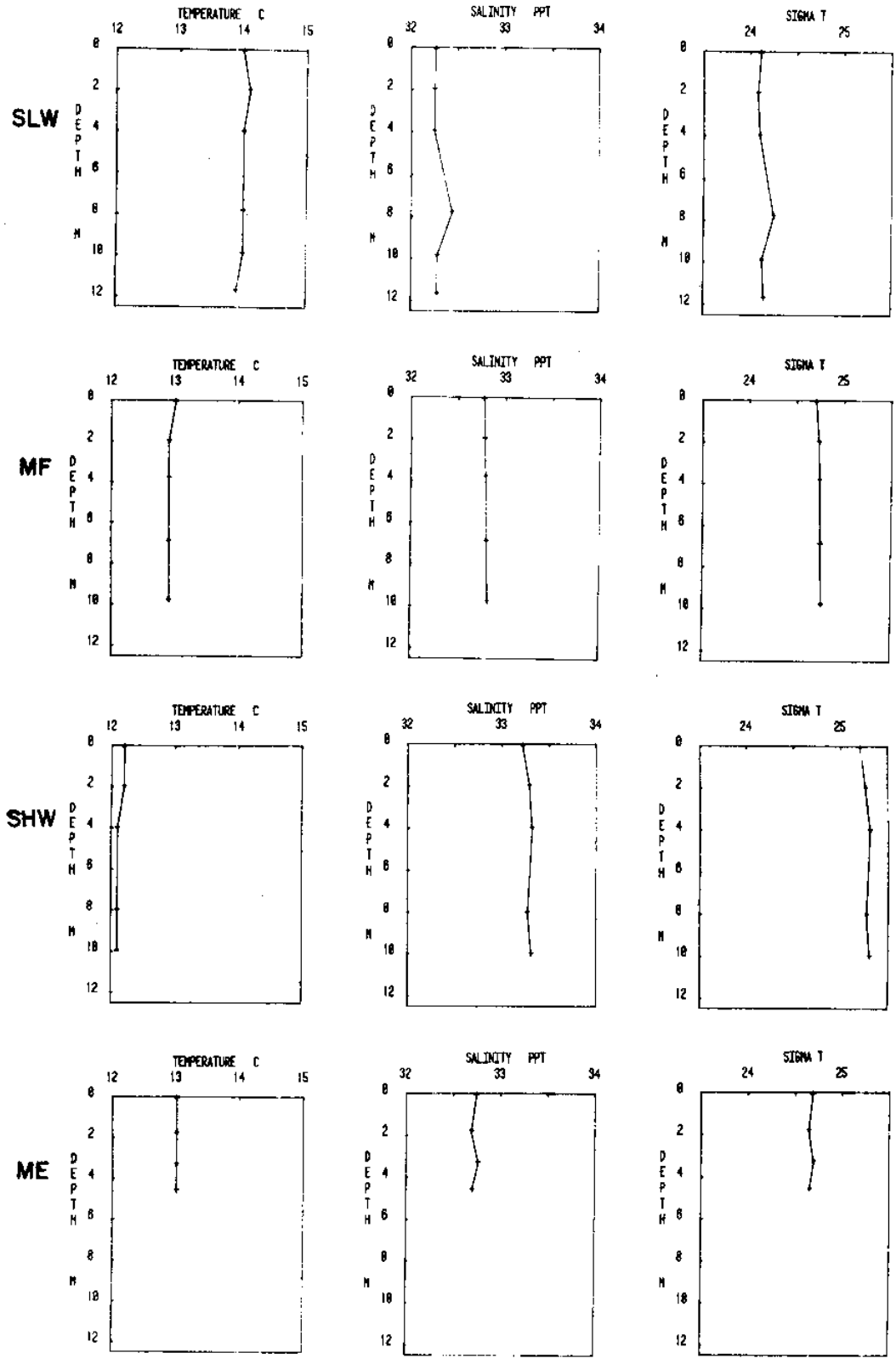

Figure 40 PORTSMOUTH HARBOR (PH2) VERTICAL PROFILES showing temperature (^{o}C), salinity ($^{o}/oo$) and sigma-t (gm/cm^3) change with depth (M) over one tidal period. SLW (slack low water), MF (mid flood), SHW (slack high water), ME (mid ebb).

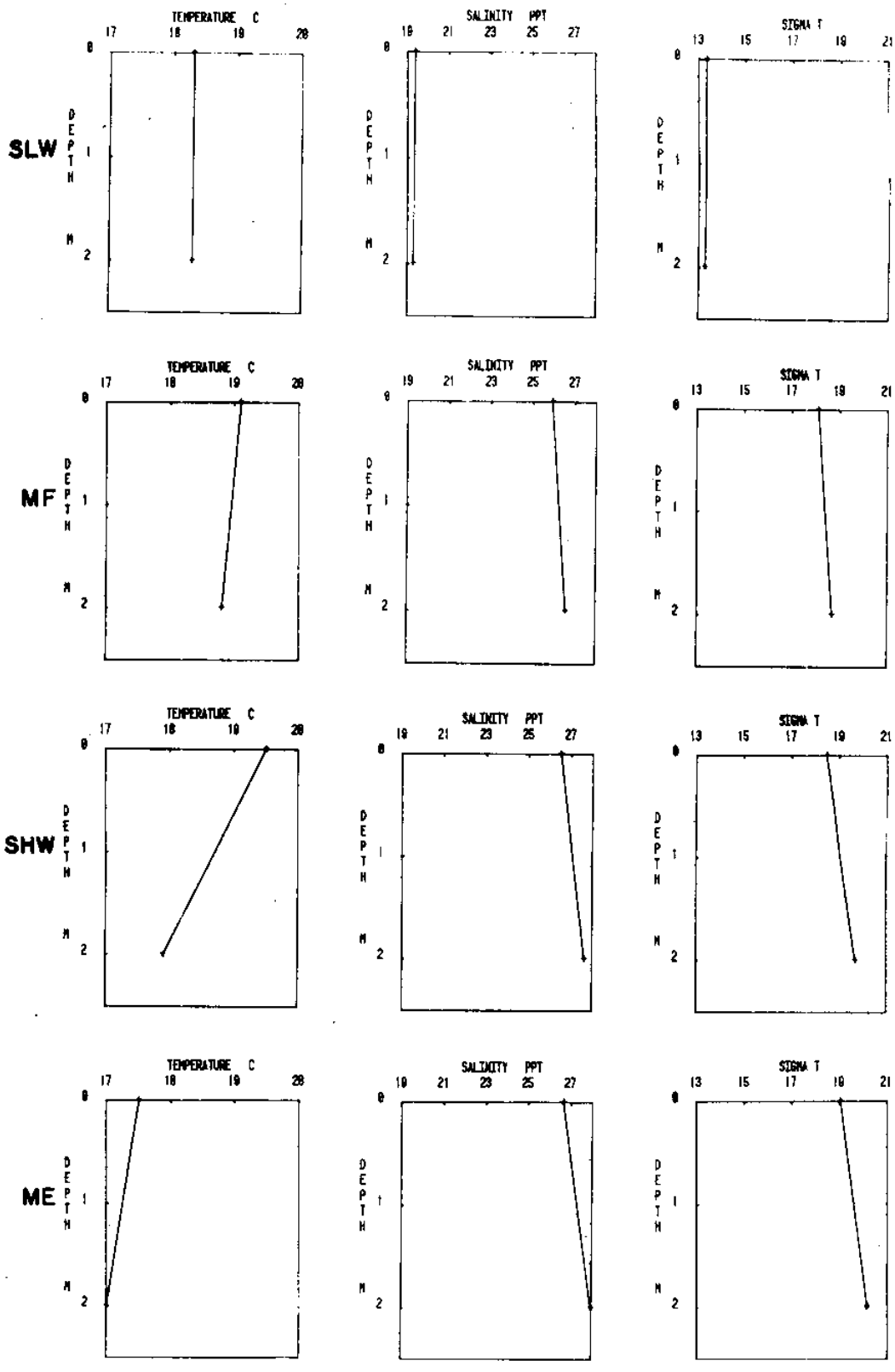

Figure 41 SQUAMSCOTT RIVER (SR2) VERTICAL PROFILES showing temperature (^{o}C), salinity ($^{o}/oo$) and sigma-t (gm/cm^3) change with depth (M) over one tidal period. SLW (slack water), MF (mid flood), SHW (slack high water), ME (mid ebb).

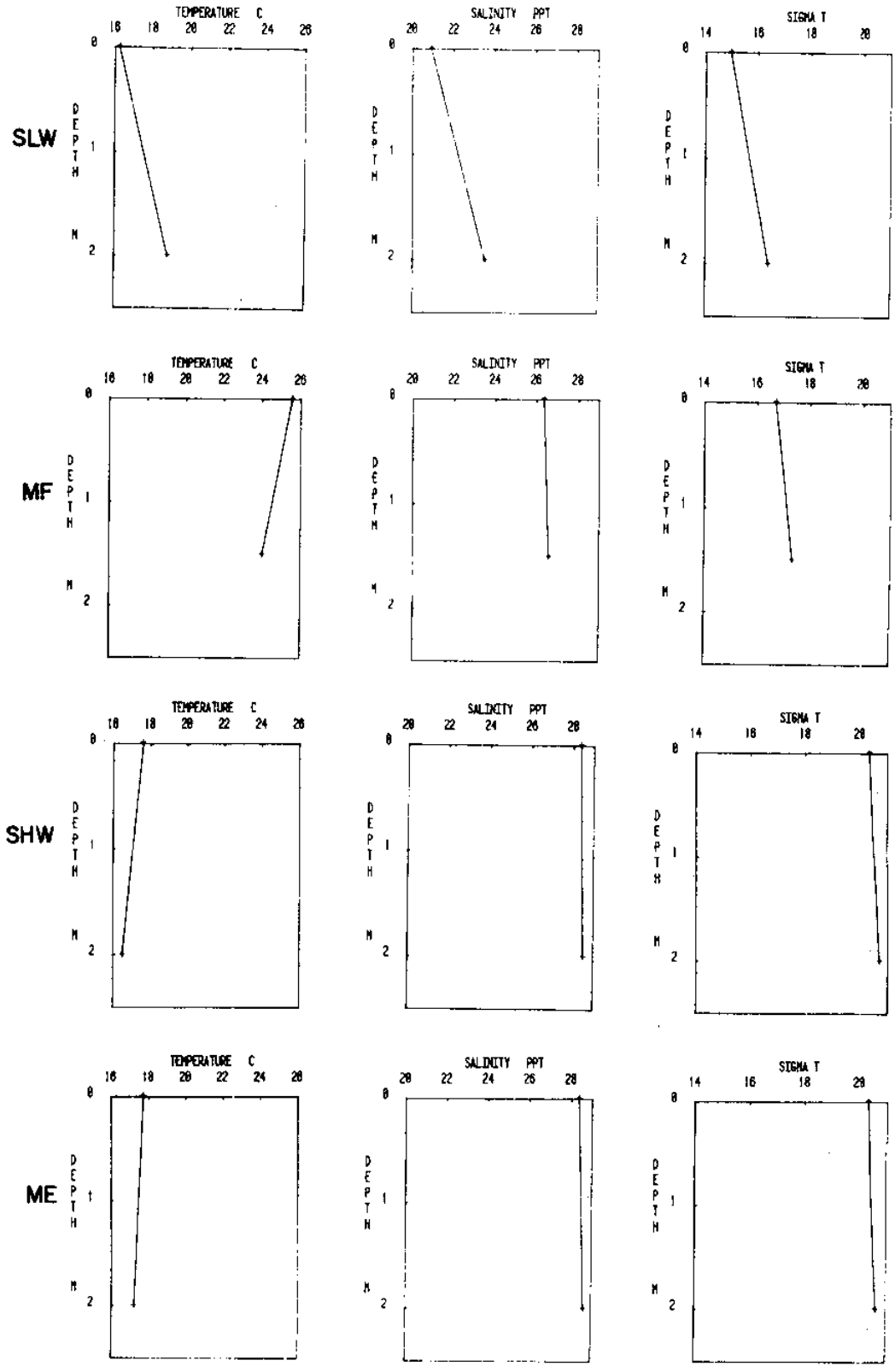

Figure 42 LAMPREY RIVER (LR1) VERTICAL PROFILES showing temperature (^{o}C), salinity ($^{o}/oo$) and sigma-t (gm/cm^3) change with depth (M) over one tidal period. SLW (slack low water), MF (mid flood), SHW (slack high water), ME (mid ebb).

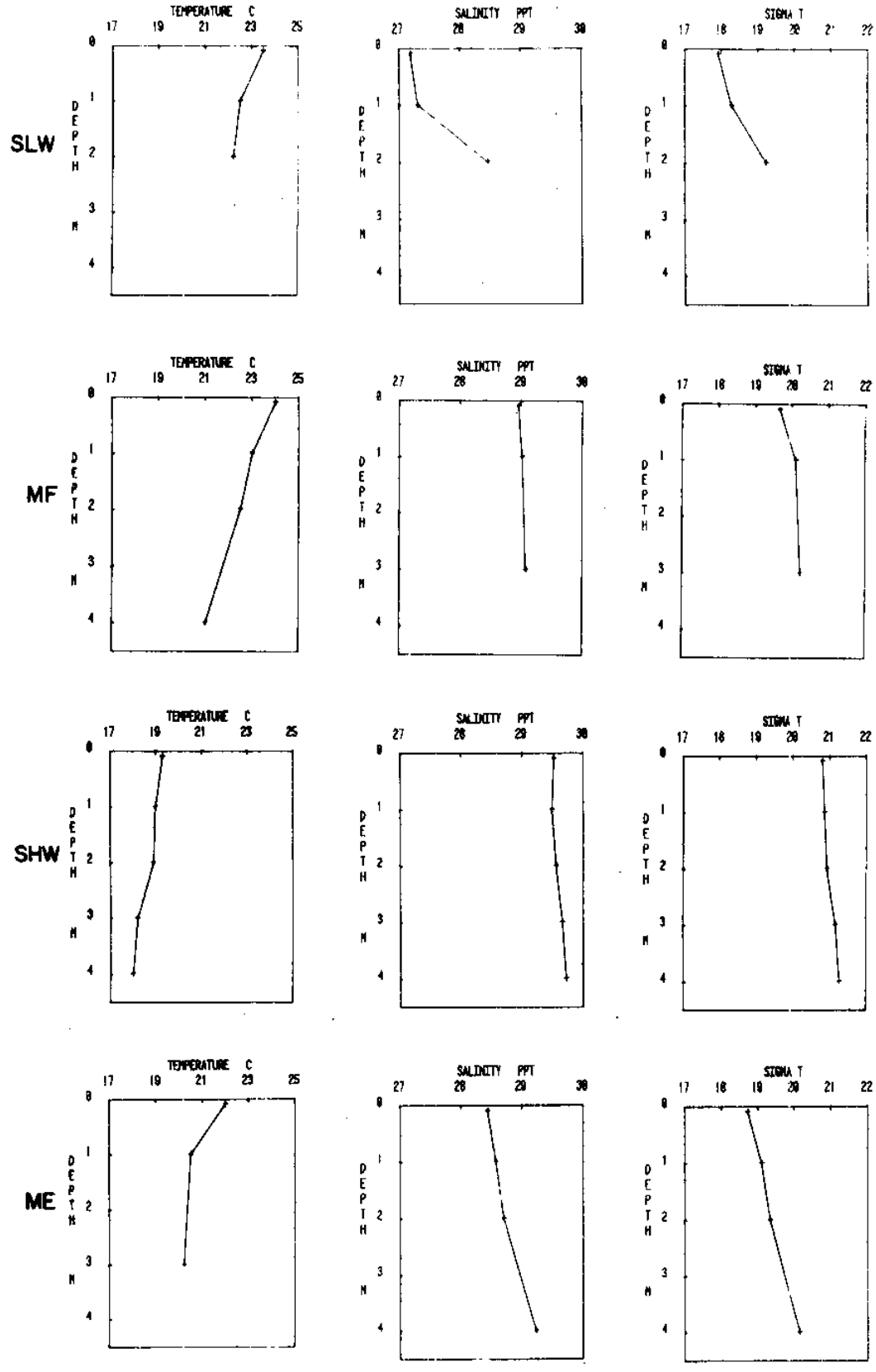

Figure 43 BELLAMY RIVER (BR1) VERTICAL PROFILES showing temperature (^{o}C), salinity (^{o}/oo) and sigma-t (gm/cm^{3}) change with depth (M) over one tidal period. SLW (slack low water), MF (mid flood), SHW (slack high water), ME (mid ebb).

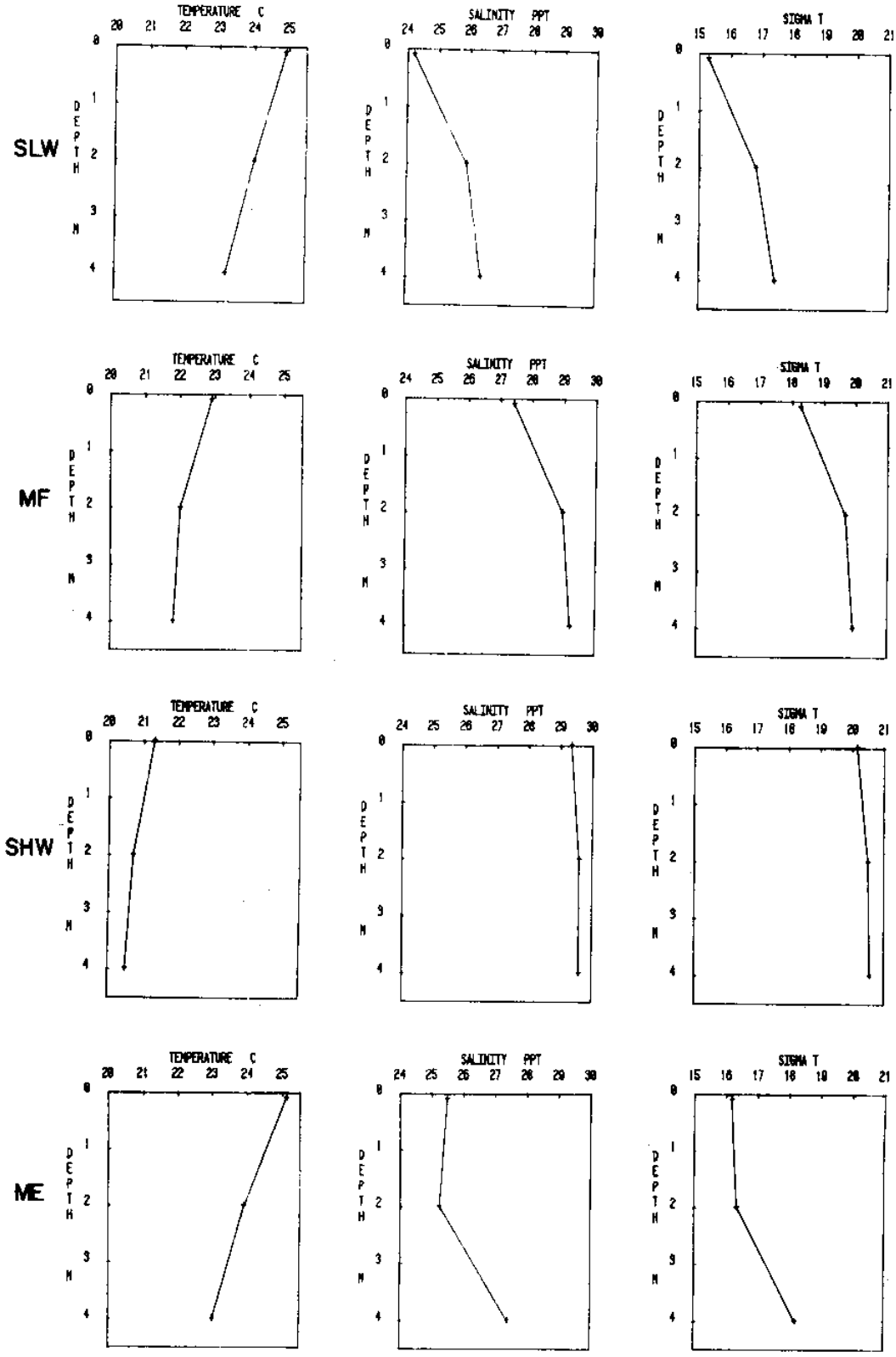

Figure 44 UPPER PISCATAQUA RIVER (SC1) VERTICAL PROFILES showing temperature (^{o}C), salinity ($^{o}/oo$) and sigma-t (gm/cm^{3}) change with depth (M) over one tidal period. SLW (slack low water), MF (mid flood), SHW (slack high water), ME (mid ebb).