UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

EDISON, NEW JERSEY 08837

March 4, 1983

51864

Captain George F. Ireland
COTP-Providence, Rhode Island
John O. Pastore Federal Building
Providence, Rhode Island 02903

Dear Captain Ireland:

Enclosed is the draft of our final report, which encompasses all results from our work performed in the January studies. No major changes have been noted since the Technical Task Group met to review the results in February.

The quantity of PCB's being transported from the Acushnet River estuary is significant, even when compared to other discharges in the New Bedford area. However, developing mitigative options to control contamination at the source will undoubtedly be a complex and difficult task. Royal and I are looking forward to discussing the New Bedford issue at the upcoming Regional Response Team meeting on March 9th.

Sincerely yours,

George R. Prince Jr.

George R. Prince, Environmental Scientist
Environmental Impact Section
Environmental Response Team

SDMS DocID 51864

AEROVOX PCB DISPOSAL SITE
ACUSHNET RIVER AND NEW BEDFORD HARBOR, MA

TIDAL CYCLE AND PCB MASS TRANSPORT STUDY
JANUARY 10-12, 1983

DRAFT

FINAL REPORT -- MARCH 4, 1983

BY THE

ENVIRONMENTAL RESPONSE TEAM
and the
TECHNICAL ASSISTANCE TEAM

Edison, N.J.

HISTORICAL BACKGROUND

New Bedford is a harbor city finding its origins as a major center for the worlds whaling industry. With the decline of the whaling industry in the late 1800's the city became more reliant on commercial fishing, harvesting and marketing a broad variety of saltwater fish and shellfish. With the advent of the industrial revolution, New Bedford became a home for manufacturers of textiles, electrical components, metals and alloys. In addition to area landfills, the Acushnet River estuary and adjacent harbor provided a convenient place for discharging manufacturing wastes.

Aerovox Industries, Inc. and Cornell-Dubilier Electronics Corp. manufactured electronic capacitors containing PCB oils as a fluid for heat transfer. Elevated levels of PCBs and portions of reject capacitors discovered in sediments and mud flats surrounding Aerovox Industries' sewer outfalls provide bleak testimony to disposal techniques practiced in the past. When disturbed these sediments produce a substantial oil sheen which indicates the presence of the carrier oil containing oil-soluble PCBs (see Interim Report #1, December 22, 1982).

STUDY BACKGROUND

A survey conducted by the U.S. Coast Guard, Captain of the Port in Providence, RI (COTP-PROV) detailed the location of PCB contaminated sediments in the Acushnet River basin directly adjacent to Aerovox Industries plant location. Concentrations of PCBs ranged from 100 ppm to greater than 10,000 ppm. The regional response team (RRT) was convened in August 1982 to determine the course of action which should be taken to assess and mitigate the documented threats to surrounding populace and estuarine environment posed by these highly contaminated sediments.

The RRT recommended that a short-term study be conducted to determine if the high levels of PCBs entrained in sediments near Aerovox were leaching or being scoured from the bottom, thereby entering the water column and being transported into New Bedford harbor and Buzzards Bay. Such action by tides or rainfall events would pose a threat to the overall water quality in the New Bedford area.

In response to RRT recommendations, the USCG (COTP-Providence) and the EPA (Environmental Response Team) joined forces in September 1982 to conduct field and laboratory studies to evaluate the mass transport of PCBs from the Acushnet River Basin to the Lower New Bedford harbor. A technical review of study results was held in December 1982 at the EPA Region I laboratory in Lexington, MA.

Laboratory studies evaluated the concentration of PCBs leaching from sediments during quiescent and turbulent conditions. Studies under turbulent conditions revealed that the bulk of PCB contaminated

sediments settled out of suspension in about 30 minutes. The residual concentrations of PCBs remaining adsorbed to suspended particulates after two hours of testing were positively correlated to the original PCB concentration of Acushnet River sediments. An oil phase was also released during turbulent mixing studies, indicating that PCB co-solubility in oil provides another mechanism for PCBs to enter the water column. PCBs were also found to leach into overlying even under quiescent water conditions. The PCB concentration in the water column was also directly related to sediment concentration.

Field studies revealed some interesting phenomena that indicate the difficulties encountered when characterizing an estuary on the basis of only one complete tidal cycle, conducted under clear weather conditions. A brief reversal of tide flow was apparent in both the flood and the ebb tide. Higher concentrations of particulate PCBs occured in the flood tide when compared to the ebb tide. Low level contamination of fresh waters feeding the Acushnet River was discovered.

The Technical Task Group which met in December 1982 indicated that some observations made during the September study may be anamolous. On this basis the following recommendations were made:

A. The mixing patterns of this water mass needed more study.
B. A mass transport study balance for PCB's in this water mass was needed.
C. New studies should attempt to encompass a major rainfall event.
D. New studies should be used to determine if the September efforts are representative of transport mechanisms in effect in New Bedford Harbor.

ADDENDUM STUDIES

To accomodate the recommendations of the December Task Group, a more comprehensive study on the upper reaches of the Acushnet River and New Bedford Harbor was planned. On January 10-12, 1983 a joint USCG COTP-PROV and EPA (ERT) effort was conducted to continuously monitor the water mass passing through the Coggeshall bridge for three complete tidal cycles (39 hours). Examining three consecutive tidal cycles minimizes the potential for anomalies in one tidal cycle to bias overall study results. Comparisons between the January and September studies may also be made to clarify the September results.

A major objective of the January studies was to provide a more detailed investigation of the mixing patterns and characteristics of the water mass passing beneath the Coggeshall Bridge. This objective was achieved through the design of a more intensive sampling scheme which partitioned the cross-section of the water mass below the bridge into a 3 x 3 grid. Combining the data from the grid sections provided a better characterization of the whole water mass than the September study provided.

SAMPLING PROCEDURES

The timing of water sampling and measurement of physical characteristics is shown graphically in Figure 1. Sampling efforts were designed to characterize the highest flow periods of both the ebb and the flood tide, for each of the three tidal cycles studied. To achieve this end, samples and measurements were collected at all stations and depths during high flow periods. Additional samples were collected only at station B.2 (center of the bridge) during slack water periods.

The Coggeshall Street Bridge was used to delineate three sampling stations (Figure 2). Each station was marked by a steel-cable, suspended vertically from the north side of the bridge and anchored with 100 lb. weights. The cables were placed at equal distances across the channel, dividing it into thirds. The cables served as guidelines for lowering the instruments, probes and samplers to prevent these devices from being carried off by the swift current under the bridge. The cables were delineated as station B.1, B.2, B.3 for the eastern, center, and westernmost cables, respectively. An additional cable was centered in the channel on the south-side of the bridge. This cable was used to tether the continuous flow meter and the plankton net.

To provide for a synoptic survey of the estuary, two more sampling stations were located 1.4 miles north and 0.5 miles south of the Coggeshall Bridge. A standard navigational aid, Nun Buoy #4, marked the southern sampling location (S) and a temporary buoy marker was used to identify the north sampling station (N).

To adequately characterize the entire water column at the various sampling stations, each station was divided by depth into a surface third, a middle third, and a bottom third. At the appropriate times designated in Figure 1, the following sampling and physical measurement scheme was conducted at stations B.1 (Bridge-East) and B.3 (Bridge-West).

(1) Physical measurements, including all of the parameters mentioned above, were taken at three discrete depths to characterize the surface, middle, and bottom third of the water column.

(2) Water samples were taken with a brass Kemmerer sampler. Three, one-liter glass jars with teflon-lined caps were filled with water from the surface, middle, and bottom third of the water column. These samples were composited in the mobile laboratory. In addition to the composite sample, a discrete water sample was taken from the bottom third of the water column.

The following procedures were followed at stations N and S:

(1) Physical parameters were measured at discrete locations in the surface, middle, and bottom third of the water column.

(2) Two or three, one-liter water samples were collected to represent the various sections of the water column.

The more intensive sampling which occurred at the center bridge station, B.2, can be described as follows:

(1) Physical parameters were measured as described for the above stations.

(2) Two, one-liter water samples were collected from three discrete depths within the surface, middle, and bottom third of the water column. Each set of two samples from a particular layer in the water column was composited in the mobile laboratory, resulting three discrete samples from this location.

On-scene operations began at 1200 hours on January 10, 1983 and were completed by 2000 hours on January 12, 1983.

LABORATORY PROCEDURES

USCG research and development personnel conducted the following activities in their mobile laboratory to prepare samples for analysis of total suspended solids (TSS) and polychlorinated biphenyls (PCBs).

The two, one-liter discrete samples and the composited samples were individually vacuum-filtered through 0.45 mu x 47mm Milipore® glass fiber filter pads, which were dried and tared prior to on-site response. Between one and two liters of the filtered water was then placed into a hexane-rinsed bottle. Any residual particulate materials in the original sample bottles was washed onto the filter pad with HPLC grade distilled water. The filter pad was then placed into a petri dish filled with silica gel and taped shut. Approximately two-thirds of all the water samples taken were filtered by the above manor in the mobile laboratory. In most cases, one-liter of filtered water was extracted with four, 20 ml portions of pesticide grade hexane. The hexane extracts were combined into hexane-rinsed glass vials for storage. Fifty percent of the filtered water samples were extracted in the mobile laboratory. Mystic River water and HPLC grade distilled water was used for blanks.

RESULTS AND DISCUSSION

A compilation of all chemical and physical data collected at particular sampling locations during the January, 1983 tidal cycle survey are presented in Table 2. Included in the data base are over 190 analysis of PCBs from the filterable (>6.5u) and non-filterable (<6.5u) fraction of water samples collected, as well as PCBs from sediments, and plankton net samples. Over 133 measurements of physical parameters, including transmissivity, conductivity, salinity, temperature, dissolved oxygen, and current velocity were made at designated locations throughout the three-day study period.

In addition to the chemical and physical data from discrete locations, the continuous meter on the south-side of the Coggeshall Bridge compiled readings of conductivity, salinity, temperature, current direction and velocity at two-minute intervals throughout the three-day study period. This amounted to over 1,400 measurements of the aforementioned parameters.

Given the magnitude of this data base, it becomes readily apparent that a variety of statistical and graphing techniques are necessary to present and evaluate the data. The techniques used are presented below.

STORM EVENT

Official records from the City of New Bedford indicated that the rainfall event encompassed by the tidal study began at 2200 hours on January 10, 1983 and was completed by 1030 hours on January 11, 1983. On site observations indicated that the majority of rain fell heavily between 0200 and 0600 on the 11th. These heavy rains were preceeded and followed by heavy fog and mist which were probably included as part of the precipitation event recorded in City records. One-half inch of rain fell during the storm. The mean annual rainfall in the New Bedford area is about 40 inches. Although New Bedford received one inch or more rain during two other January storm events, the 0.5 inch rainfall could be considered representative of an average storm event.

Winds were predominantly from the South during the storm, with gusts reaching up to 70 mph at times. These strong southerly winds coupled with the incoming morning tide and the low barometric pressure to produce the highest tide level encountered during the study. This peak morning tide was from .9 to 1.5 feet higher than the following high tides.

Continuous Flow Meter

The continous meter located on the south-side of the Coggeshall Bridge, five-feet off the channel bottom, recorded data on a magnetic tape within the meter. Data was later plotted at two-minute intervals on the graphs shown in Figure 3. Current velocity reached up to 1.68

knots on the flood tide and up to 3.64 knots on the ebb tide. The mean velocity for the flood tide was 0.66 knots (1.11 ft/sec), while on the ebb tide it was 1.0 knot 1.69 ft/sec. Data on current direction indicated that several reversals in flow direction were occuring. These current reversals were present predominantly on the flood tide, with a duration from 2 to 26 minutes. Current reversals of short duration (2 to 6 minutes), may have been due to strong eddy currents at the bottom of the channel which formed as the incoming tide rushed through the constricted channel at the bridge. However, current reversals lasting more than six minutes involved the entire water mass under the bridge, as indicated by individual observations made throughout the water column with the remote current meter and the significant current velocities (up to 1.3 knots) occuring in the opposite direction of the flood tide. This phenomena was also encountered during flood tides of the September survey. These current reversals may be due to the numerous constrictions placed on the water mass, including the hurricane barrier, Route I-195 Bridge, and the Coggeshall Bridge.

Measurements of current obtained at all depths, at stations B.1, B.2, and B.3 with the remote meter were comparable in velocity and direction to measurements taken by the continuous (stationary) meter located five feet off the bottom of the center of the bridge channel. This is indicative of a uniform, turbulent flow which would be expected in a constricted area, such as that beneath the Coggeshall Bridge.

The effects of the storm event are evidenced by data on water temperature and salinity (Figure 3). The influx of freshwater during the morning hours of January 11th resulted in an increase in water temperature which lasted until early morning on the 12th. Water temperature increased again on the afternoon of the 12th, despite colder air temperatures, because of the influence of stormwater runoff. Salinity showed an overall decrease after the storm event with conductivity following suit to a lesser extent.

Synoptic Survey

Data from the synoptic survey, which was designed to provide a longitudinal perspective of water column characteristics in the upper harbor, are presented in Appendix A. The aerial locations of the north, bridge, and south stations are shown in Figure 4.

The synoptic surveys conducted during each tide stage took an average of 2 hours to complete due to the sheer logistics of sampling at five different locations from a single vessel. This time factor and the dynamics of an estuary system undoubtedly had an effect on the isopleths and isohalines shown in Appendix A.

Isohalines were drawn to depict the movement of salt and fresh water into the estuary system during flood and ebb tides. After the storm event occuring in the early hours of 1/11/83, an influx of fresh water was observed in the waters of the upper harbor. This effect of

a freshwater wedge is notable on the ebb cycle of the synoptic surveys. Floating debris present after the rainfall event also indicate the effects of stormwater runoff.

During the ebb tide cycles occuring at 2318 hours on 1/11/83 and 1045 hours on 1/12/83, surface salinity measurements at the center bridge station were 23.9 ppt and 12.3 ppt, respectively. Respective total PCB concentrations associated with this freshwater were 3.43 ug/l and 2.91 ug/l. Aside from the PCBs found in a grab sample of a surface oil sheen (4.03 ug/l), these were the highest PCB concentrations encountered during the survey. Elevated PCBs in the freshwater layer indicate that during storm events PCBs entrained in contaminated sediments and exposed tidal flats of the upper estuary are being disturbed and transported by tidal action to the lower harbor.

Also presented in Appendix A are concentration isopleths for total suspended solids, total PCBs, and particulate (filterable,>6.5u) PCBs. Approximate lines of equal percent transmissivity were also drawn for data comparison purposes. In general no consistent trends can be noted for these parameters on a longitudinal scale.

Cross-sectional Area

Plots of the cross-sectional area at the bridge are presented in Appendix B. A graphic representation of how the water body beneath the bridge was segmented and evaluated can be seen by using these plots. These plots indicate the tide height prevalent during each high-flow flood, high-flow ebb, and slack water sampling period. Physical and chemical data are presented with respect to their sampling location, providing a visual comparison of the characteristics of the water beneath Data on PCB concentrations in composite samples taken from three depths at stations B.1 and B.3, is evaluated for the upper two-thirds and the lower third.

Statistical Analysis

A variety of statistical tests including linear regression, multiple regression, F and student's t test were employed to evaluate the numerous data points and determine if any significant relationships between physical and chemical parameters existed. Correlation coefficients resulting from the linear regression analysis are presented in Table 3.

Data were compared using all possible combinations of data bases and all combinations of physical and chemical parameters. Correlation factors greater than .45 were listed in the table for comparison purposes and to indicate trends, however only correlation coefficients approaching .6 or greater should be considered significant.

The only consistantly strong correlation recurring over the entire data base was a positive correlation (.79-.91) between total PCBs and non-filterable (<6.5u) PCBs. This same trend did not exist for

particulate PCBs vs. total PCBs, indicating that soluble or PCBs contained on non-filterable materials, such oils, best represent the expected total concentration of PCBs in any given sample. Notable but inconsistent trends existed over the entire data base between the following parameters: total PCB vs. transmissivity attenuation coefficient, transmissivity attenuation coefficient vs. total suspended solids, and salinity vs. particulate PCBs (negative correlation).

It is likely that certain outlying points within a particular data set are scewing the overall data base and consequently lowering the correlation coefficient. These outlying points may be due to the time lag occuring between sampling points or to natural dynamics of the estuary system.

Except for flood tide data, no significant relationship between total PCB concentration and total suspended solids was present. This lack of a correlation was also noted in the September study. A graphic presentation of September and January data (Figure 5) also shows no relationship between total PCB vs. total suspended solids at station B.2, two-thirds off the bottom. All this data leads to the conclusion that PCBs are being transported by other mechanisms in addition to adsorption to particulates.

Data was segmented using results from the four flood tides monitored and three ebb cycles monitored, to compare trends between flood and ebb tide stages. Both the flood and the ebb tide showed positive correlations between total PCB vs. transmissivity attenuation coefficient, total PCB vs. non-filterable PCB, salinity vs. transmissivity attenuation coefficient, and total suspended solids vs. transmissivity. These correlations indicate that transmissivity is a relatively good indicator of overall physical and chemical characteristics of the water body.

Correlations on the ebb tide also existed between all measurements of PCB concentration. This indicates that PCBs being transported out of the Acushnet River esturary in both the water and particulate phases in the water column. Note that no correlation between total PCB vs. TSS exists on the ebb tide. This reflects the fact that PCBs are probably associated with a specific fraction of the total particulate population. These PCB bearing particulates do not increase linearly as the total suspended particulate load increases.

Transmissivity was a good indicator of all measurements of PCB concentration on the ebb tide. This parameter may be useful in future studies as an inexpensive, real-time monitor of total PCB transport out of the upper harbor during the ebb tide cycle.

The seven physical and chemical parameters discussed above were compared using multiple regression analysis. The strong correlation between total PCB and non-filterable PCB overwhelmed any secondary or tertiary correlations which may have been present. A multiple regression using other combinations may prove useful in the future.

Looking at the raw data, there appear to be differences between total PCB concentration as sample depth changes. No significant relationships between any of the above parameters, excepting possibly salinity, and depth were noted. However, this does not mean that no differences exist between average total PCB concentrations of samples taken from various depths.

An F or a student's t test can be used to determine if differences exist between the average total concentration of PCBs at the surface, middle and bottom third of the water column at station B.2. The average total PCB concentrations for the surface, middle, and bottom third were .98 ug/l, .77 ug/l, and .82 ug/l, respectively. The F and t statistical tests revealed that all means were significantly different from each other at the 99% confidence level.

The highest concentrations of PCBs were found in the surface third (.18 ug/l > the bottom third), which could indicate that a substantial portion of the PCBs are being washed out of tidal flats and contaminated sediments by runoff from the recent storm event. Runoff commonly contains oils from streets or improperly disposed waste materials which would allow for the co-solubility of PCBs in oils entrained in the freshwater runoff. These PCBs are then transported out of the estuary with the freshwater "wedge" during the ebb tide.

Data from J.W. Farrington presented in an unpublished study conducted in September 1982, also showed consistently elevated levels of PCBs in surface layers of the inner harbor when compared to bottom layers at the same location. No mid-layer samples were obtained in this study. The PCB Concentration levels encountered (surface .67 ug/l and bottom .48 ug/l) were on the same order of magnitude, although lower than ERT study values. This was probably due to an increase of PCBs in the water column during the January storm event. The difference between surface and bottom layers was almost exactly the same (ERT -.18 ug/l vs. JWF - .19 ug/l). This indicates that the PCB transport increases in magnitude during a storm event, yet the mechanism is the same under a variety of weather conditions.

Partitioning of PCBs

During ERT's September 1982 tidal study, a laboratory study was performed to determine the partitioning of PCBs between contaminated sediments during quiescent, low turbulent conditions. The partition coefficient (k) determined in this study using a sample containing sediments contaminated with 500 ppm of PCBs was 1.113×10^5. Hypothesizing that sediment to water partitioning is the major PCB transport mechanism, the average concentration of PCBs in sediments north of the bridge can be estimated using the average concentration of non-filterable PCBs during the ebb tide (.75 ug/l). Since k = concentration of PCBs in sediment/PCB concentration of water, the calculated average concentration of PCBs in the sediments of the harbor above the Coggeshall Bridge would be 83 ppm. Using the k value (5.6×10^4) determined by Holter and Johnson in 1977, the calculated average concentration of

PCBs in the top layer of sediments north of the Coggeshall Bridge would be 42 ppm. These values agree quite closely with actual PCB concentrations (15.2 ppm and 45.6ppm) found in two sediment samples collected from just below the bridge in January 1983.

Other Samples

During the January study ERT collected plankton net, sediment, and surface oil slick samples. The analytical data from these sampling efforts are presented in Table 4.

The plankton net had a mesh size of 143u as compared to the 6.5u mesh glass-fiber filters used to determine filterable particulates present in discrete and composite water samples. Given the area of the net opening, sampling duration, dry weight of particulates collected, and PCB concentration of the collected particulates, the average water concentration due to particles greater than 143u can be calculated. Table 4 shows that these concentrations are orders of magnitude lower than data from discrete and composite water samples. Larger particulates, therefore, are responsible for very little of the total PCBs being transported by the particulate phase. Sonification tests performed in the laboratory revealed that the PCBs that were present were adsorbed onto particulates, and not contained within plankton cells.

A ten-inch, sediment core sample #63332 was collected in the flats between the Coggeshall Bridge and the Interstate-195 Bridge because the channel just below the Coggeshall Bridge was scoured clean of sediment. PCB concentrations generally increased with depth in this sample. The second sediment core sample #63333 was collected southwest of the Interstate near the western shoreline. This also showed elevated levels of PCBs (45.6 to 64.0 ppm) which increased with depth. Surface concentrations in the first core sample are similar to the concentrations of PCBs in the total suspended solids collected during the January. Some of these particulates are probably settling out in these area off of the main channel. The increasing PCB concentrations with depth indicate that particulates transported in the past were of significantly higher concentration.

Throughout the tidal cycle study, particularly after the rainfall event on the 11th, surface debri, scum and oil were noticed floating on the surface. Using a standard 1-liter jar, a sample of this material was grabbed on the afternoon of the 12th. This sample contained the highest PCB concentration (4.03 ug/l) recorded during the entire study, demonstrating that surface oils provide the relatively water-insoluble PCBs with a means to be transported from the upper harbor.

Mass Transport of PCBs

Calculations of the total quantity of PCBs being transported beneath the Coggeshall Bridge during the three tidal cycles studied in January by ERT are presented in Table 5. The major factors affecting the total transport include average velocity, tide duration, and average

PCB concentration. Differences in these values are depicted graphically in the histogram in Figure 6. It is important to note that average velocity and tide durations were obtained from the stationary meter which compiled data on two-minute intervals, providing a very solid data base to determine averages. Extreme care was also taken in the sampling, preparation and chemical analysis of water and sediments to prevent any potential cross-contamination or interferences. These factors lend credibility to the mass transport calculations discussed below.

The net quantities of PCBs being transported out of the Acushnet River estuary are significant. Net PCB transport during tidal cycle I, II, & III amounted to 2.5 Kg (5.5 lbs), 1.3 Kg (2.7 lbs), and 1.4 Kg (3.1 lbs), respectively. The elevated quantity of PCBs being transported out of the during the first tidal cycle can be attributed to the half-inch of rain which fell during the flood stage of this cycle. The second and third tidal cycles may also have been affected by residual runoff from the storm event, although the net transport of PCBs do appear to be leveling off during this period. This daily export of PCBs is significant, particularly when compared to the allowable NPDES dischage limits of .001 Kg/day average and .01 Kg/day maximum, established for an electrical plant on the Hudson River in New York State.

To calculate PCB loadings on a yearly basis, certain assumptions must be made. Assuming PCBs are only discharged during rainfall events (which would be the most liberal posture) over three antecedant tidal cycles, and that 0.5 inches of rain falls 80 times a year to achieve the average annual precipitation for New Bedford of 40 inches/year, then a yearly total of 424 Kg (933 lbs) of PCBs leave the upper harbor.

Another more conservative approach would be to assume that the 2.5 Kg export which occurred during the first tidal cycle represents a typical discharge during a rainfall event and the lowest export on the remaining cycles (1.3 Kg) represents the normal discharge of PCBs during any given tidal cycle during the year. This scenario is partially supported by Farrington's data from a clear-weather study which showed PCB concentrations 58% to 68% of our total PCB concentrations. Multiplying .58 times the 2.5 Kg storm transport value results in 1.45 Kg of PCB being transported, which is very similar to our values of 1.3 and 1.4. Note that other factors such flow can significantly effect total transport. Given the above scenario, the yearly export of PCBs from the upper harbor would approach 972 Kg (2,138 lbs).

Neither of the above scenarios include the PCBs which were determined to be in surface oil slicks in relatively large concentrations. Regardless of which of the transport scenarios is chosen, large quantities of PCBs will continue to move from the Acushnet River estuary to contaminate the lower harbor and potentially Buzzard's Bay.

TABLE 1: PERSONNEL

U.S. COAST GUARD

Marine Safety Office, Providence, R.I.

Ted Harrington	Lieutenant Junior Grade
Chris Oelschlegel	Lieutenant Junior Grade
John O'Connor	Quartermaster, First Class
Tom Marton	Machine Technician, Second Class
Christopher Blake	Port Securityman, Second Class
Russel Boyton	Machine Technician, Second Class
David Cate	Boatswain, Third Class

U.S.C.G. Research and Development Center, Groton, CN

Bob Hildebrand	Ph. D
Dick Jadamac	Chemist
Mike Sweetman	Marine Science Technician Chief

U.S. EPA-ERT

Royal Nadeau	Ph. D
George Prince	

WESTON, INC.

Phil Campagna
Charles Atwood

ENDECO, INC.

Nelson Adams
Edward Blainard III

TABLE 3: CORRELATION COEFFICIENTS FOR ERT'S NEW BEDFORD HARBOR TIDAL STUDY - JANUARY 1983

VARIABLE #	PARAMETERS	DATA BASE B1,B2,B3	DATA BASE B1	DATA BASE B2	DATA BASE B3	DATA BASE B1,B3	FLOOD B1,B2,B3	EBB B1,B2,B3
1 vs 2	Total PCB vs Depth							
1 vs 3	Total PCB vs Trans Atten.	0.550	0.759	0.623			0.625	0.766
1 vs 4	Total PCB vs Salinity							
1 vs 5	Total PCB vs TSS						0.647	
1 vs 6	Total PCB vs TSP-PCB		0.560	0.912				0.877
1 vs 7	Total PCB vs NF-PCB	0.886	0.799	0.912	0.911	0.854	0.806	0.912
2 vs 3	Depth vs Trans. Atten.							
2 vs 4	Depth vs Salinity			0.482				0.594
2 vs 5	Depth vs TSS		0.502		0.489	0.487		
2 vs 6	Depth vs TSP-PCB							
2 vs 7	Depth vs NF-PCB							
3 vs 4	Trans Atten. vs Salinity		-0.493		0.585	0.445	0.608	0.540
3 vs 5	Trans Atten. vs TSS	0.572	0.763	0.653			0.738	0.526
3 vs 6	Trans Atten. vs TSP-PCB		0.588	0.629	-0.669	-0.554		0.609
3 vs 7	Trans Atten. vs NF-PCB			0.508				0.763
4 vs 5	Salinity vs TSS		-0.656	0.532	-0.553			0.720
4 vs 6	Salinity vs TSP-PCB	-0.485			-0.971	-0.956	-0.512	
4 vs 7	Salinity vs NF-PCB							
5 vs 6	TSS vs TSP-PCB		0.674		0.598			
5 vs 7	TSS vs NF-PCB							
6 vs 7	TSP-PCB vs NF-PCB			0.664				0.627

TABLE 4: PLANKTON SAMPLES

Sample No.	Dry Wt.mg	ug/mg PCB's	Total ug PCB's	Calculated Avg. Water Conc. ug/l
63326	174.80	0.05	8.74	.00055
63327	415.40	0.03	12.5	.00047
63328	1086.68	0.06	65.2	-
63329	858.88	0.07	60.12	.005
63330	106.87	0.11	11.76	-
63331	617.52	0.08	49.4	.0014

SEDIMENT CORE SAMPLES

Sample No.	Section	ppm of PCB's
63332	0-1"	15.2
	5.5 - 6.5"	11.6
	10-11"	59.9
63333	0-1"	45.6
	5.5-6.5"	58.4
	9-10"	64.0

OIL SLICK GRAB SAMPLE

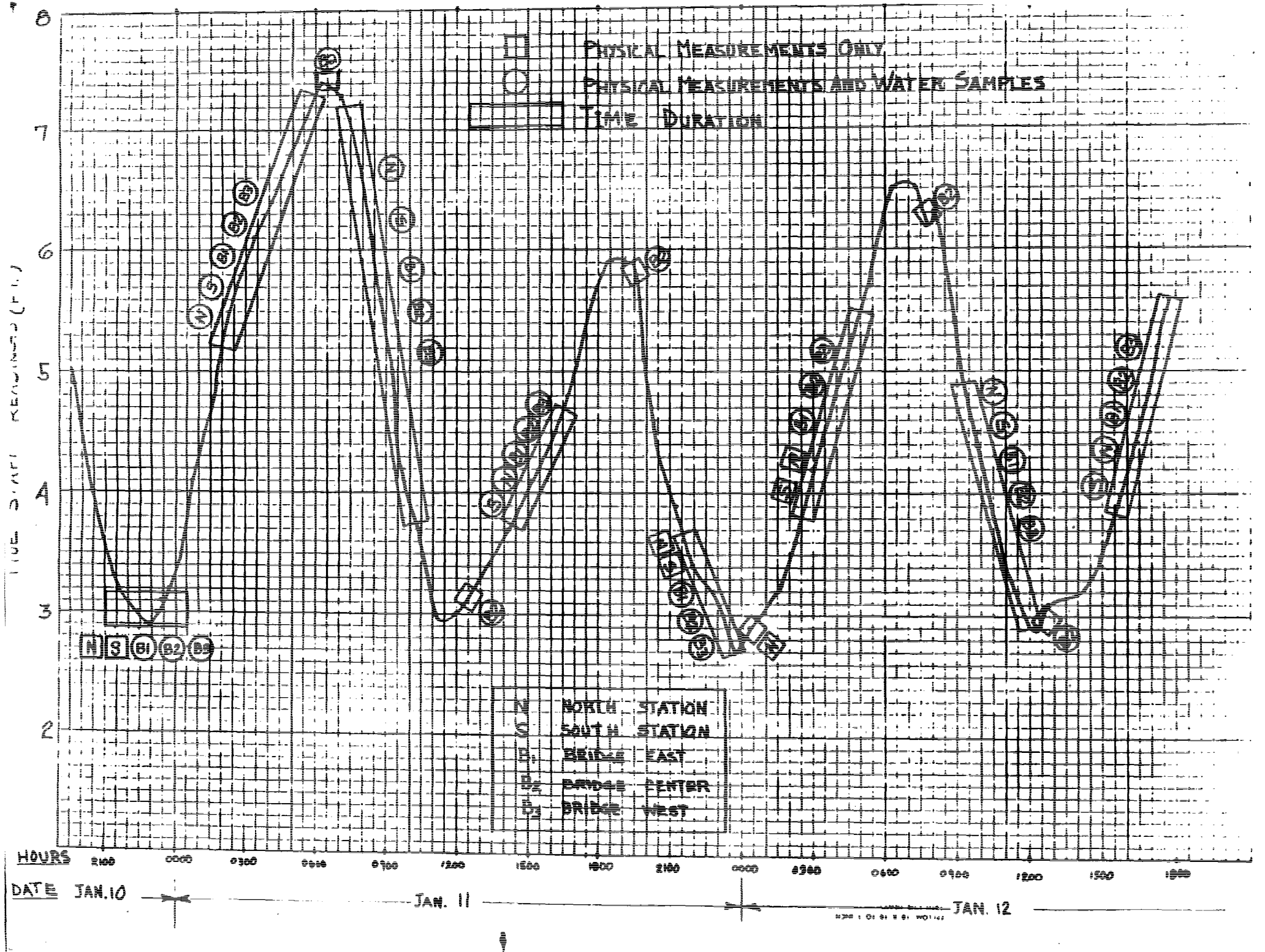
Sample No.	TSS mg/l	TSP PCB's ug/l	PCB's Water ug/l	Total PCB's ug/l
1182	98.0	3.82	0.21	4.03

AEROVOX INDUSTRIES PCB STUDY
ACUSHNET RIVER ESTUARY
NEW BEDFORD, MA.

TABLE 5: MASS TRANSPORT OF PCBs BENEATH THE COGGESHALL BRIDGE DURING THREE CONSECUTIVE TIDAL CYCLES
A JOINT EFFORT BY THE ENVIRONMENTAL RESPONSE TEAM AND THE U.S. COAST GUARD
JANUARY 1983

TIDE STAGE	AVG. VELOCITY x	MEDIAN AREA =	AVG. FLOW x	DURATION OF TIDE STAGE =	TOTAL WATER VOLUME x	AVG. PCB CONC. =	TOTAL PCB TRANSPORTED
	Feet/Second	Square Feet	Cubic Ft./Sec.	Seconds	Cubic Feet	ug/cu.ft.	Kg PCB
FLOOD 1 1/10 - 1/11 2254 - 0622 (7:28) 8/4/12*	1.23	3,237	3,981	26,880	1.07×10^8	25.2	2.7
EBB 1 1/11/83 0623 - 1130 (5:07) 8/2/10/2*	1.88	3,240	6,091	18,420	1.12×10^8	46.0	5.2
FLOOD 2 1/11/83 1131 - 1848 (7:17) 18/20/14/14/6	.96	3,157	3,031	26,220	0.79×10^8	31.4	2.5
EBB 2 1/11/83 1849 - 2352 (5:03) no reversals	1.47	3,139	4,614	18,180	0.84×10^8	44.7	3.8
FLOOD 3 1/11 - 1/12 2353 - 0718 (7:25) 26 min.	1.2	3,172	3,806	26,700	1.02×10^8	18.7	1.9
EBB 3 1/12/83 0719 - 1212 (4:53) no reversals	1.72	3,181	5,471	17,580	0.96×10^8	34.3	3.3

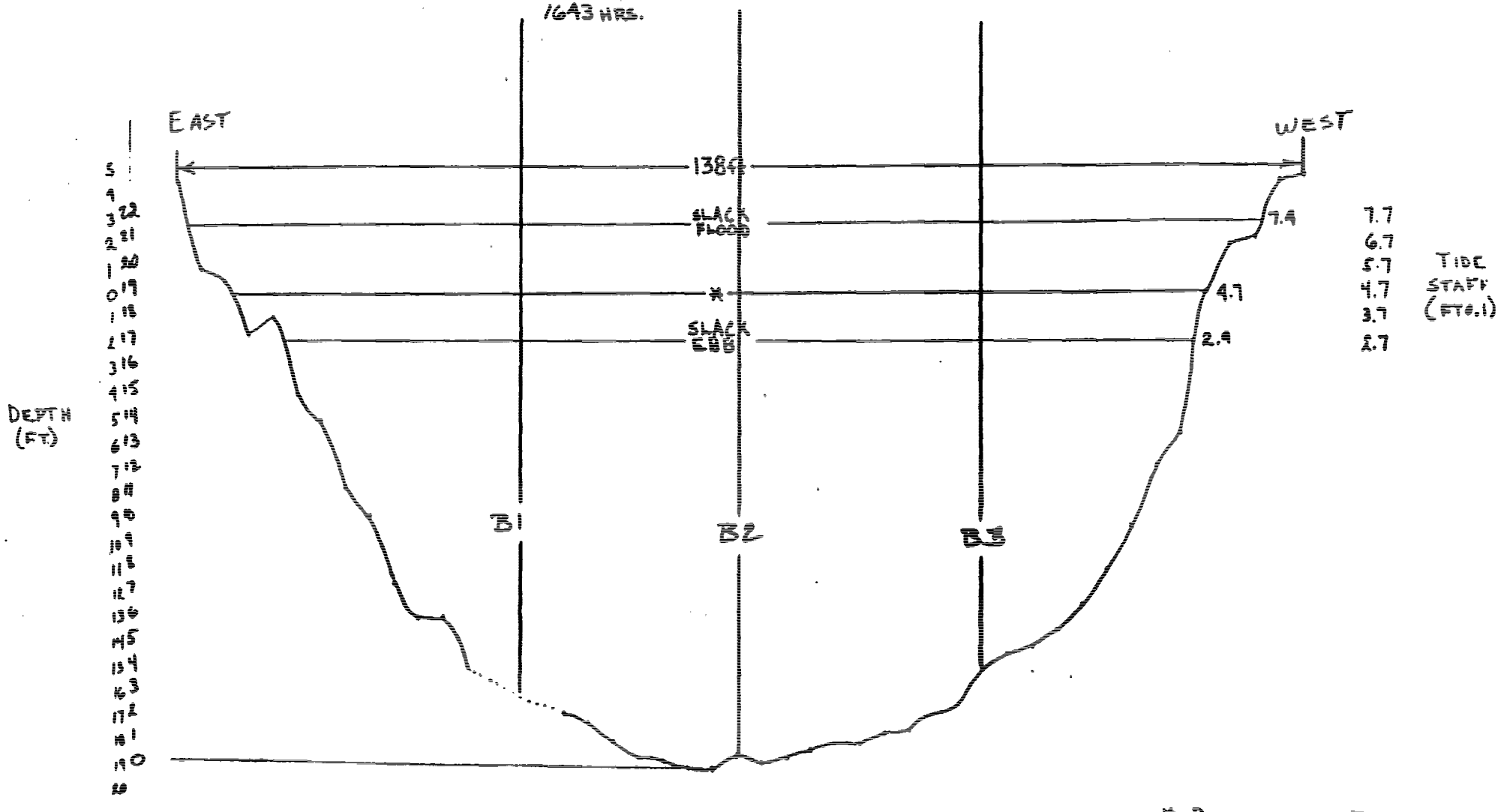
*Indicates each occurance and the duration (minutes) of flow reversals recorded by the stationary flow meter, located 5 feet off the bottom in the center of the channel. Flow meter deviations of more than 90° from the predominant flow direction constituted a flow reversal.


PHYSICAL MEASUREMENTS ONLY
PHYSICAL MEASUREMENTS AND WATER SAMPLES
TIME DURATION
N NORTH STATION
S SOUTH STATION
B1 BRIDGE EAST
B2 BRIDGE CENTER
B3 BRIDGE WEST
HOURS
DATE JAN. 10
JAN. 11
JAN. 12

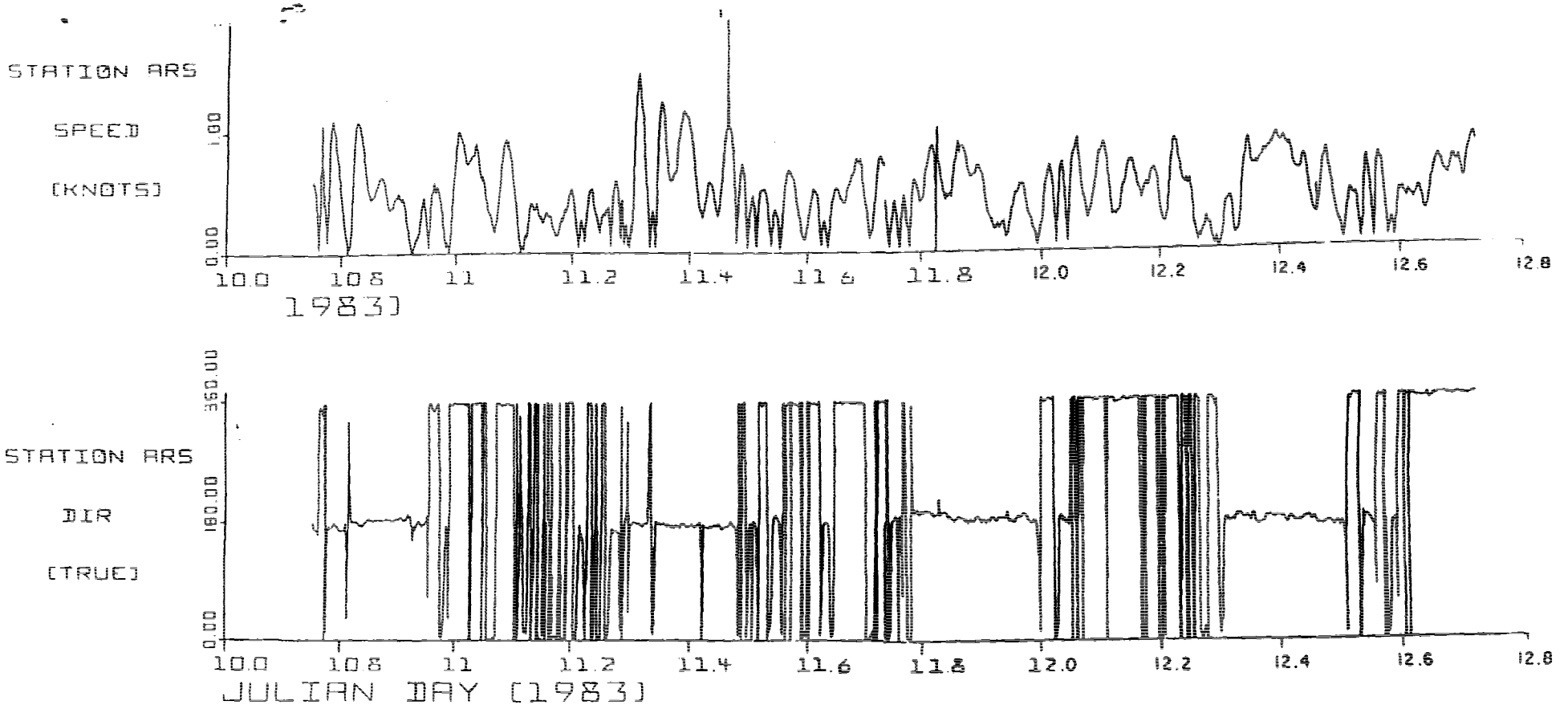
ACUSHNET RIVER

COGGASHALL STREET BRIDGE

12 JANUARY 1983
1643 HRS.

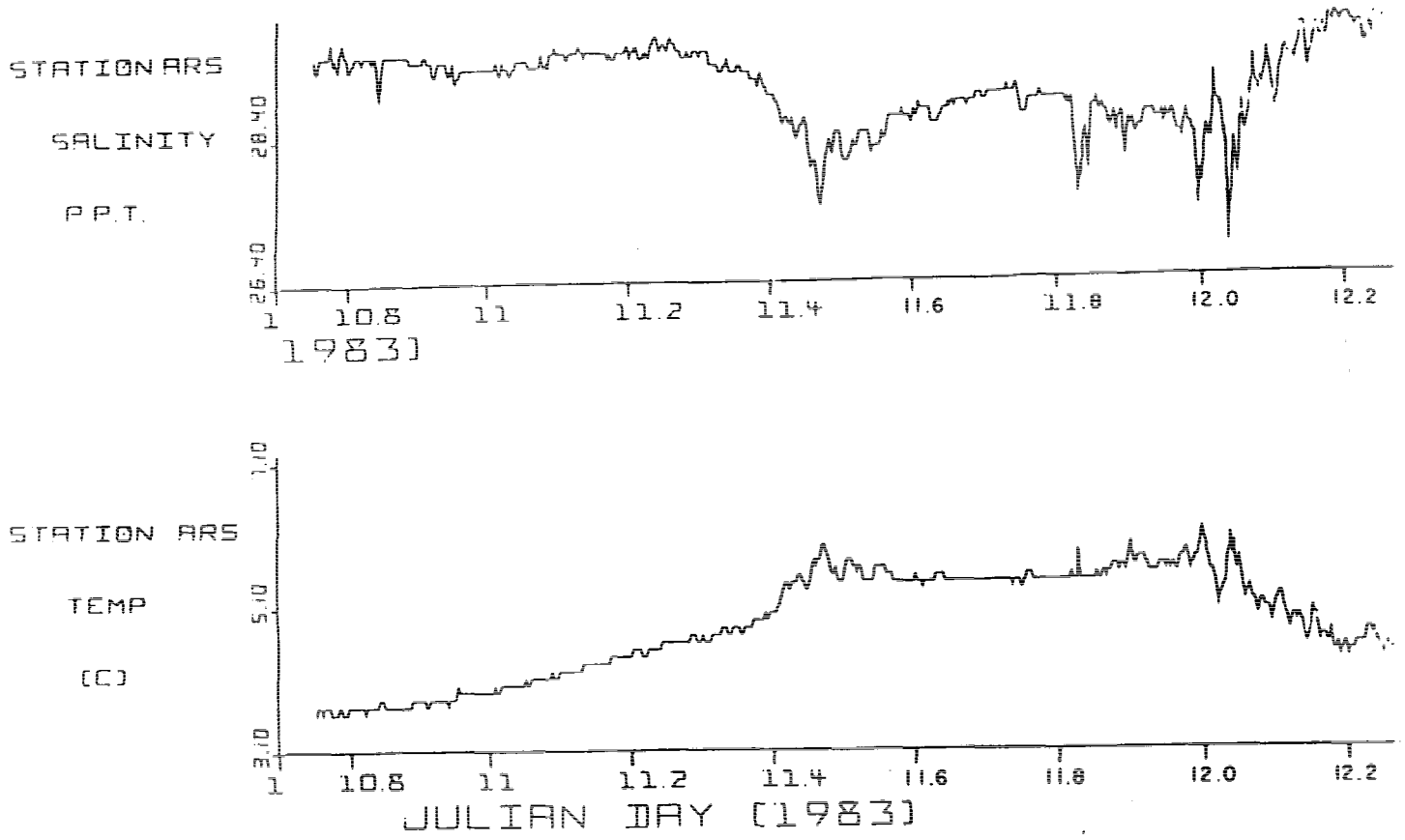


* REPRESENTS THE TIDE HEIGHT AT TIME OF BATHYMETRIC MEASUREMENTS



ACUSHNET RIVER SURVEY

FIGURE 3 NEW BEDFORD, MASSACHUSETTS



ACUSHNET RIVER SURVEY

NEW BEDFORD, MASSACHUSETTS

FIGURE 3

ACUSHNET
CITY
OF
NEW BEDFORD
Acushnet River
X N.S.
OXFORD
COG. BR.
I-195
I-195
X
NUN
BUOY
Upper New Bedford
Harbor
SCALE
1 inch = 1481 ft

FIGURE 4

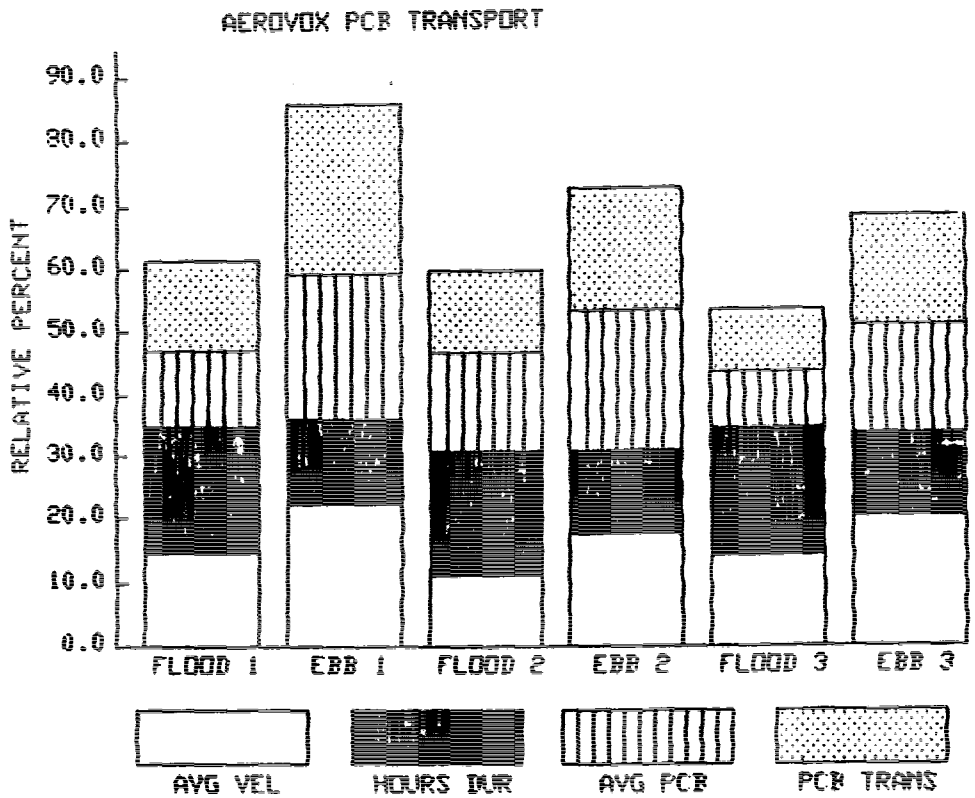

AEROVOX PCB TRANSPORT
RELATIVE PERCENT
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
FLOOD 1
EBB 1
FLOOD 2
EBB 2
FLOOD 3
EBB 3
AVG VEL
HOURS DUR
AVG PCB
PCB TRANS

FIGURE 5

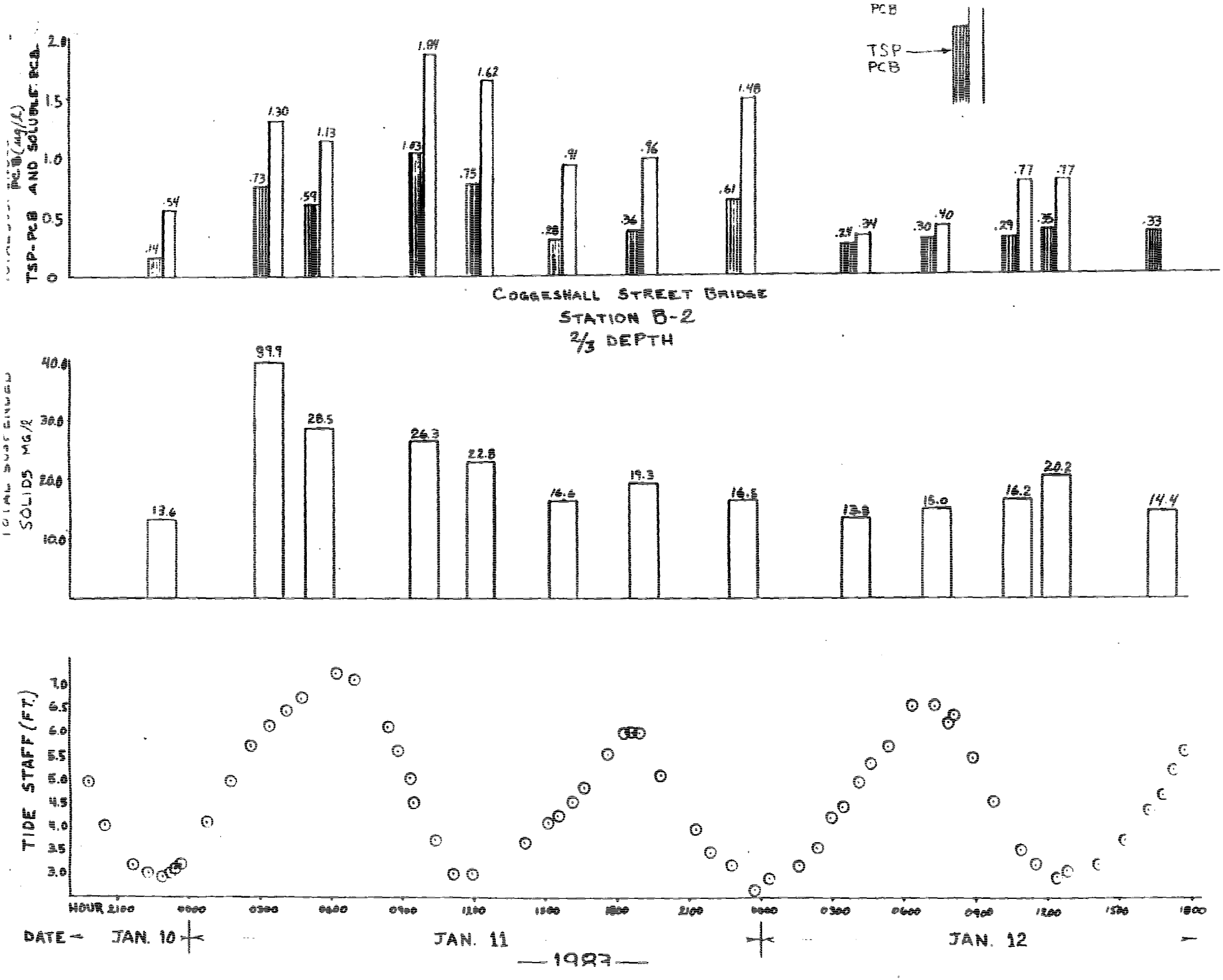
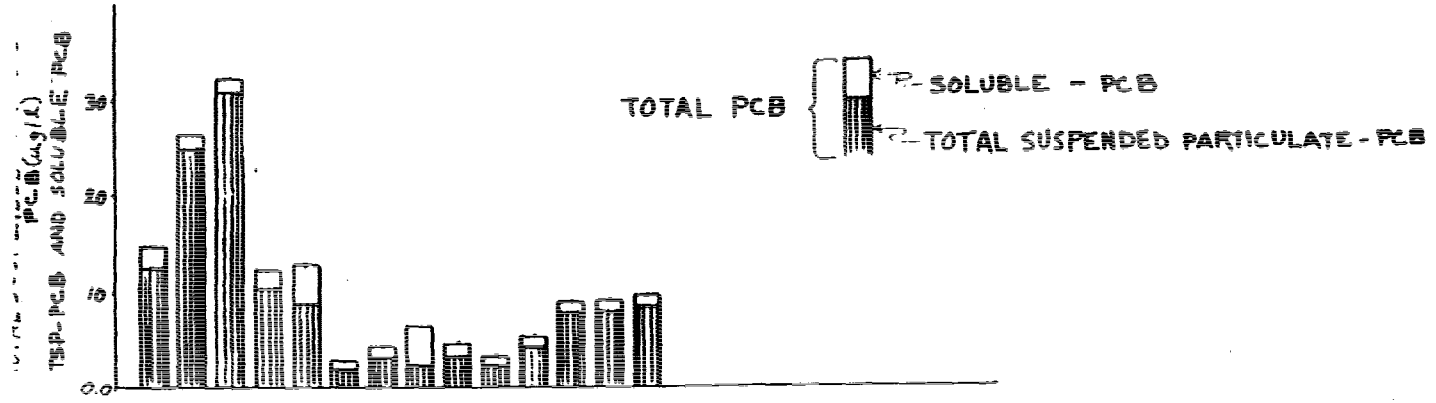
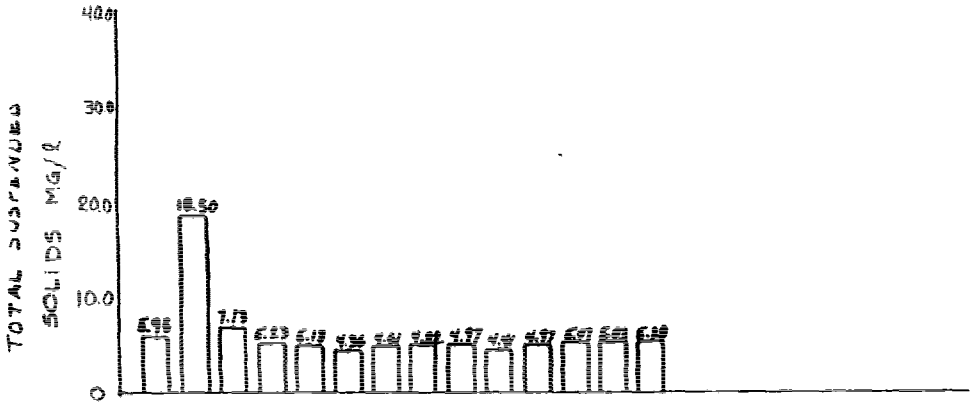
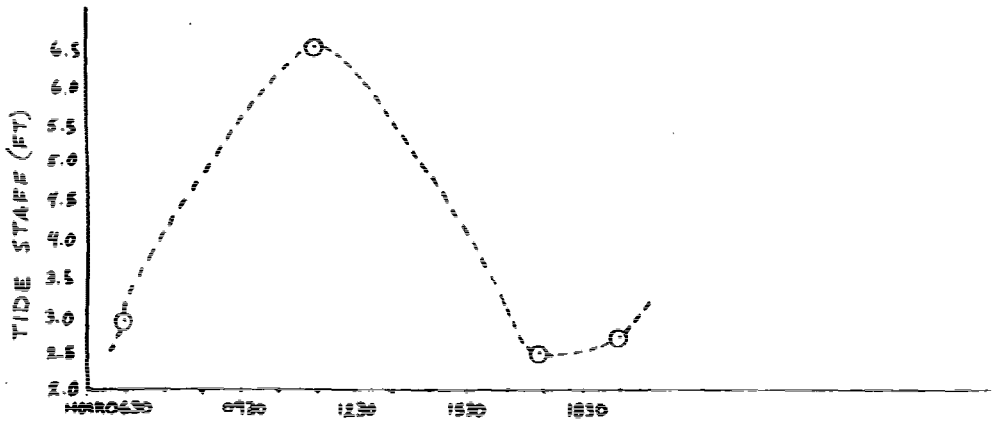

PCB
TSP
PCB
TSP-PCB AND SOLUBLE PCB (µg/L)
2.0
1.5
1.0
0.5
0
.14
.54
.73
1.30
.59
1.13
1.03
1.94
.75
1.62
.28
.91
.36
.96
.61
1.48
.24
.34
.30
.40
.29
.77
.35
.77
.33
COGGESHALL STREET BRIDGE
STATION B-2
2/3 DEPTH
SOLIDS MG/L
40.0
30.0
20.0
10.0
13.6
39.9
28.5
24.3
22.8
16.6
19.3
16.5
13.8
15.0
16.2
20.2
14.4
TIDE STAFF (FT.)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
HOUR 2100
0000
0300
0600
0900
1200
1500
1800
2100
0000
0300
0600
0900
1200
1500
1800
DATE — JAN. 10
JAN. 11
JAN. 12
— 1987 —

FIGURE 6







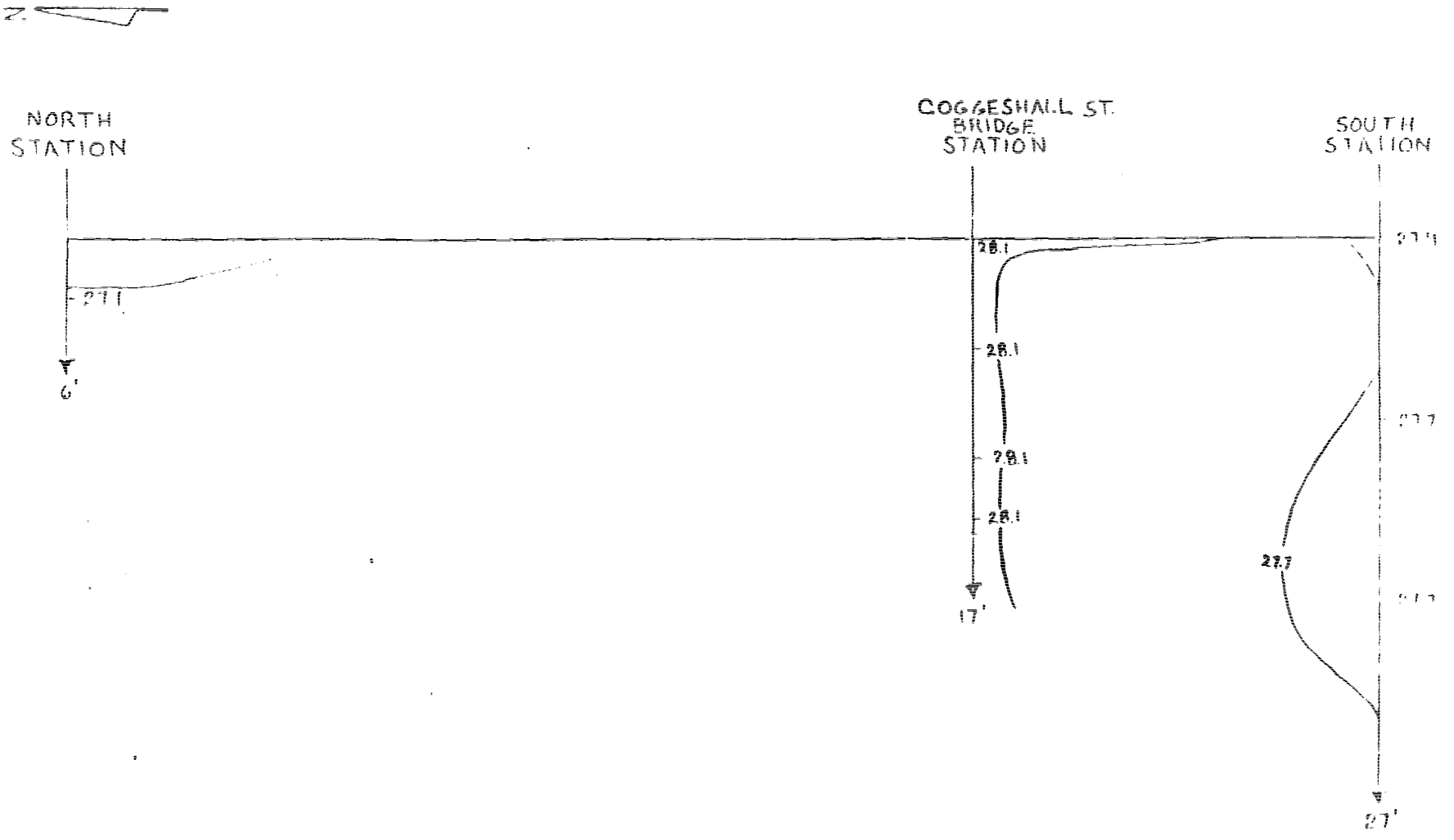
SEPTEMBER 21, 1982

APPENDIX A:

LONGITUDINAL TRANSECTS OF STUDY AREA
AND
CONCENTRATION ISOPLETHS

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: SALINITY (‰)

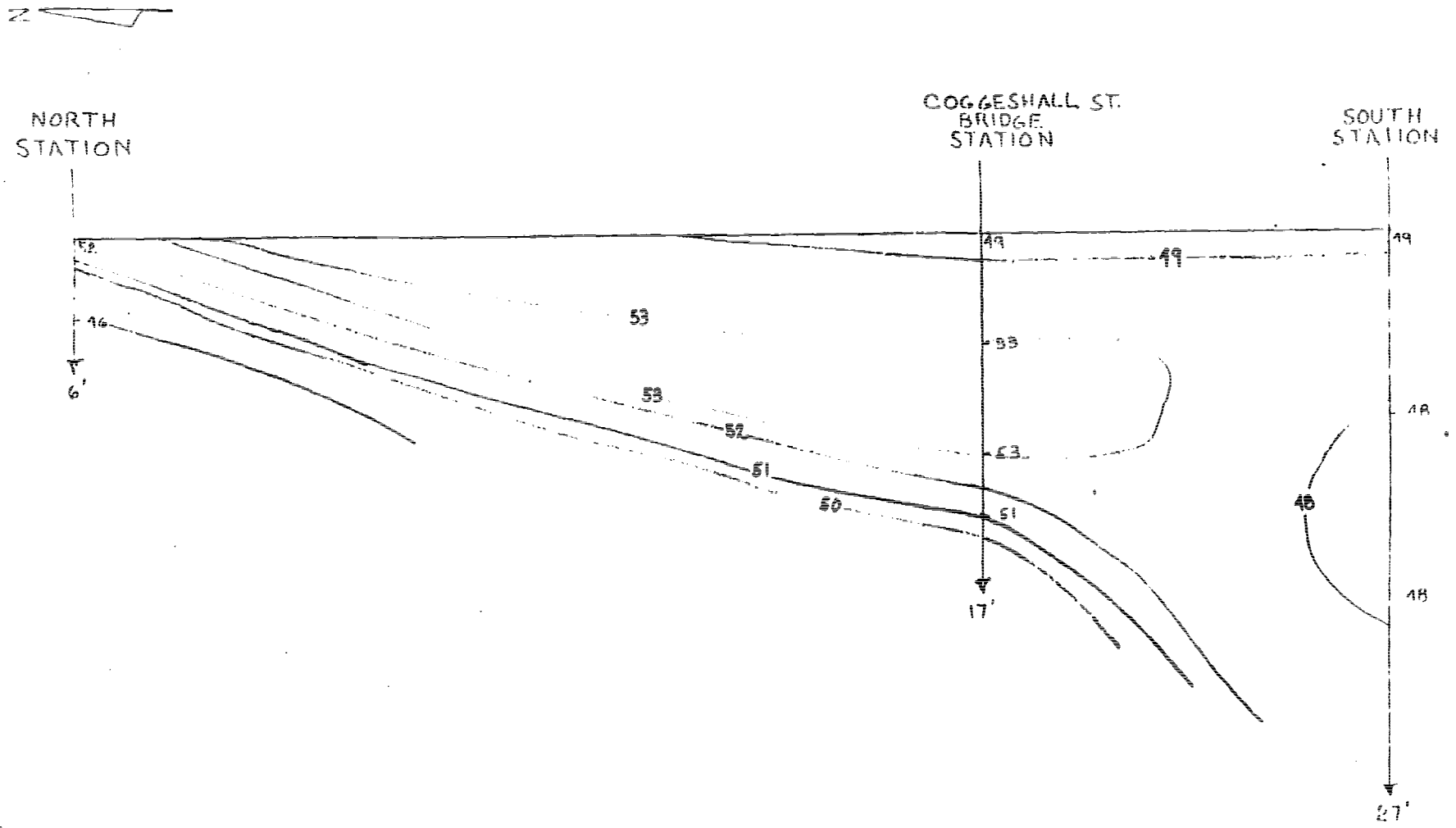
10-11 JANUARY 1983 2056-0038 HOURS

TIDE STAGE: SLACK EBB AVG STAFF 3.0

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT : TRANSMISSIVITY (%)

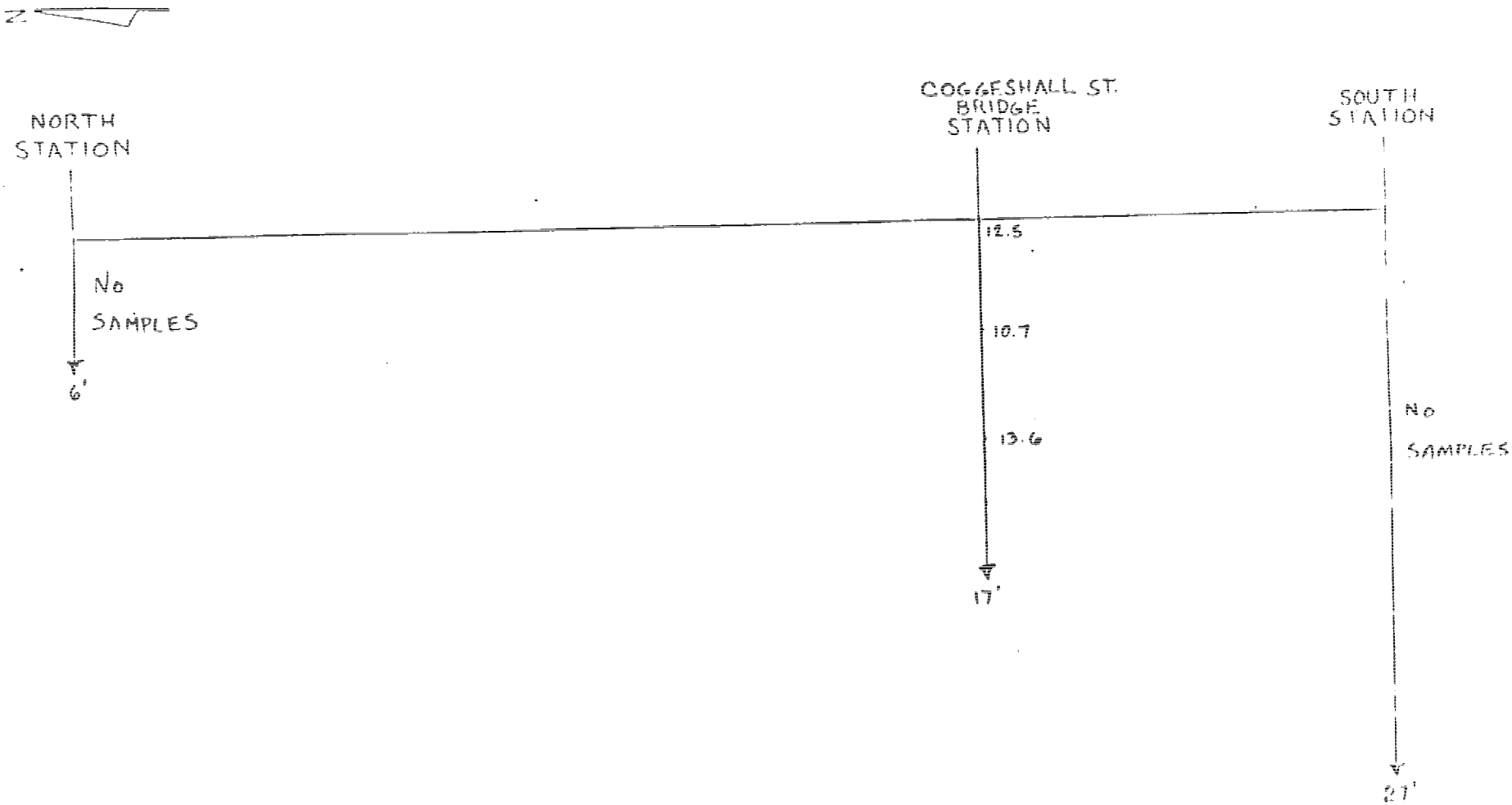
10-11 JANUARY 1983 2056-0038 HOURS

TIDE STAGE: SLACK EBB AVG STAFF 3.0

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL SUSPENDED SOLIDS mg/L

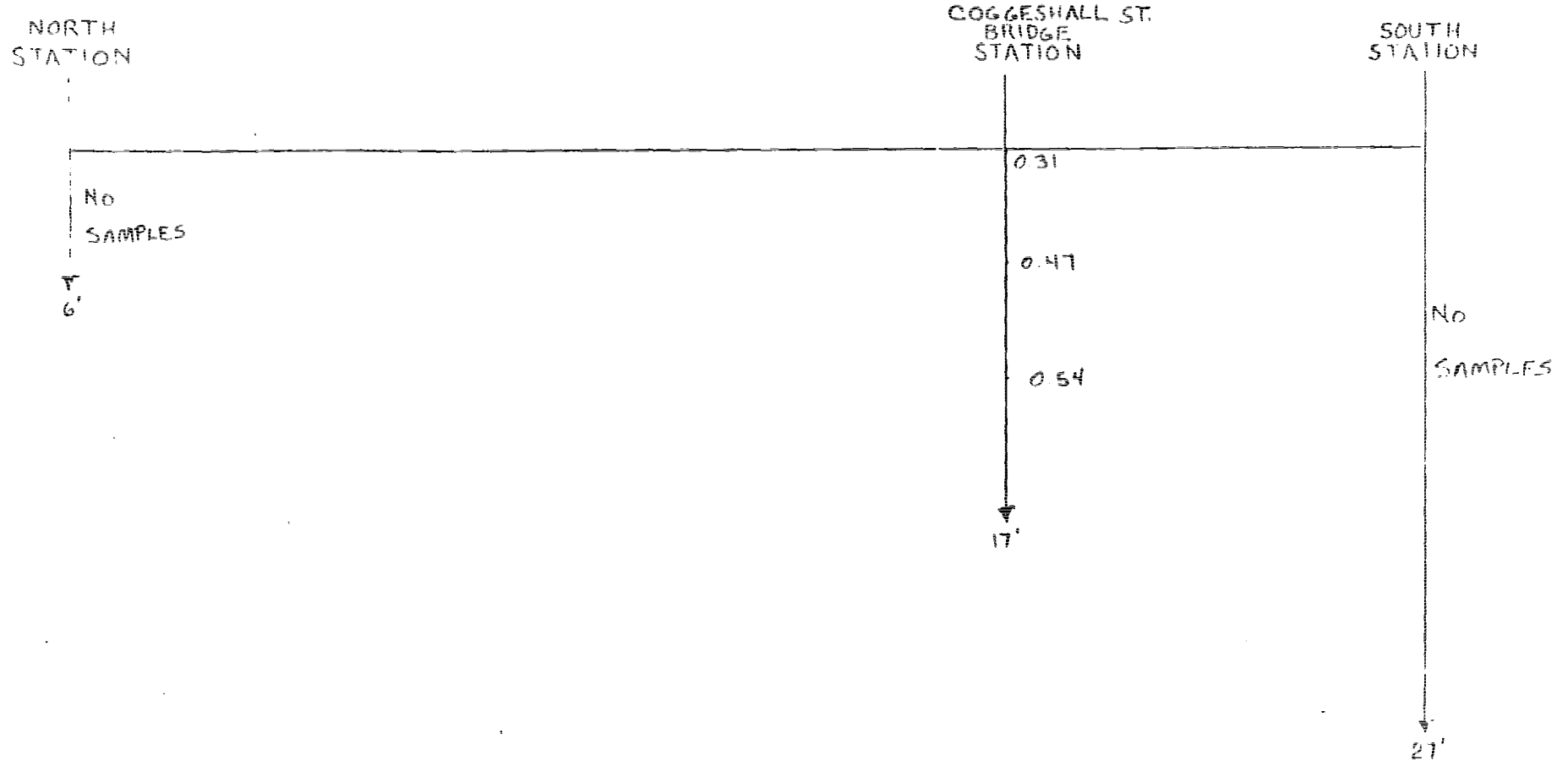
10-11 JANUARY 1983 2056-0038 HOURS

TIDE STAGE: SLACK EBB AVG STAFF 3.0

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL PCB ug/L

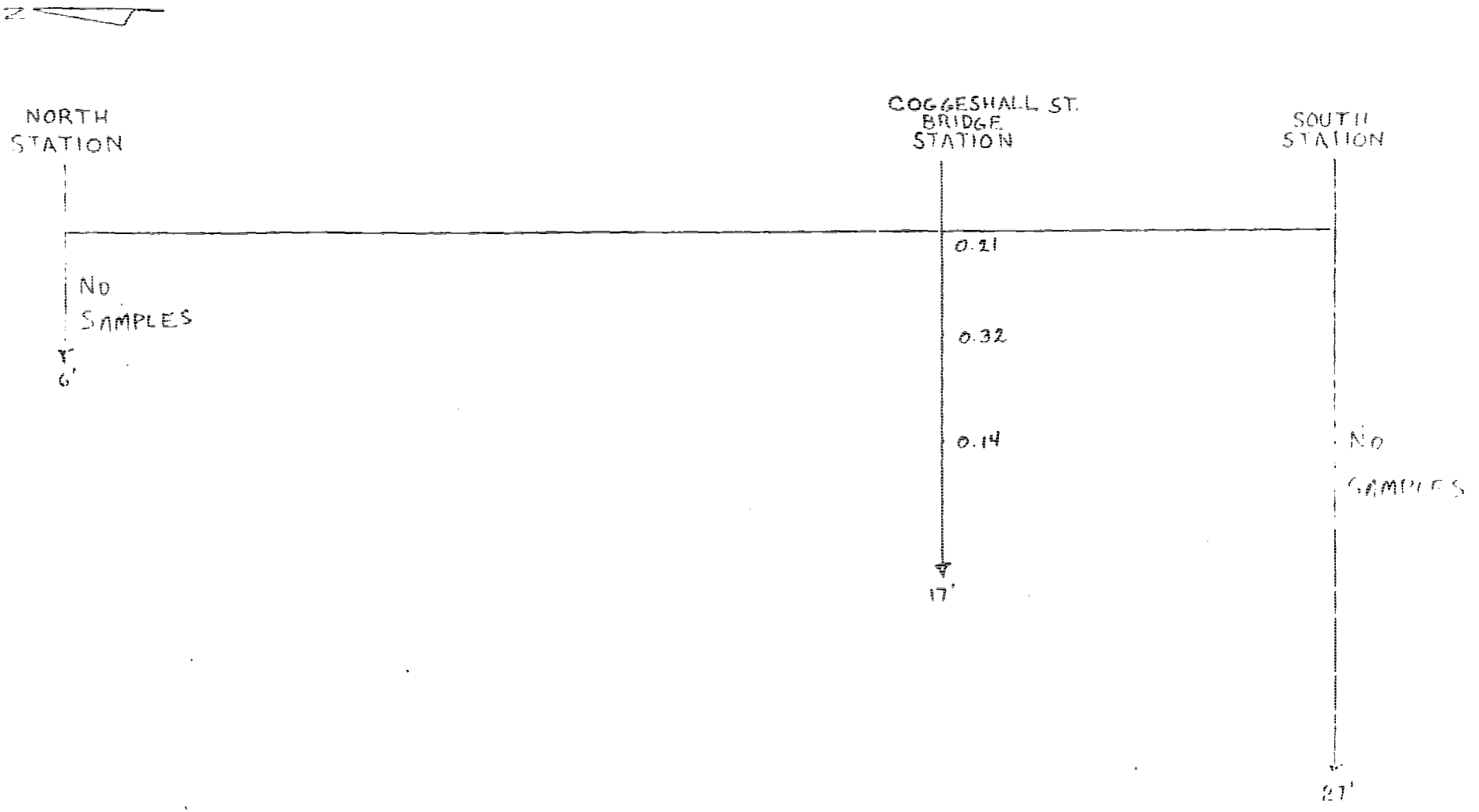
10-11 JANUARY 1983 2056-0038 HOURS

TIDE STAGE: SLACK EBB AVG STAFF 3.0

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT : TSP - PCB ug/l

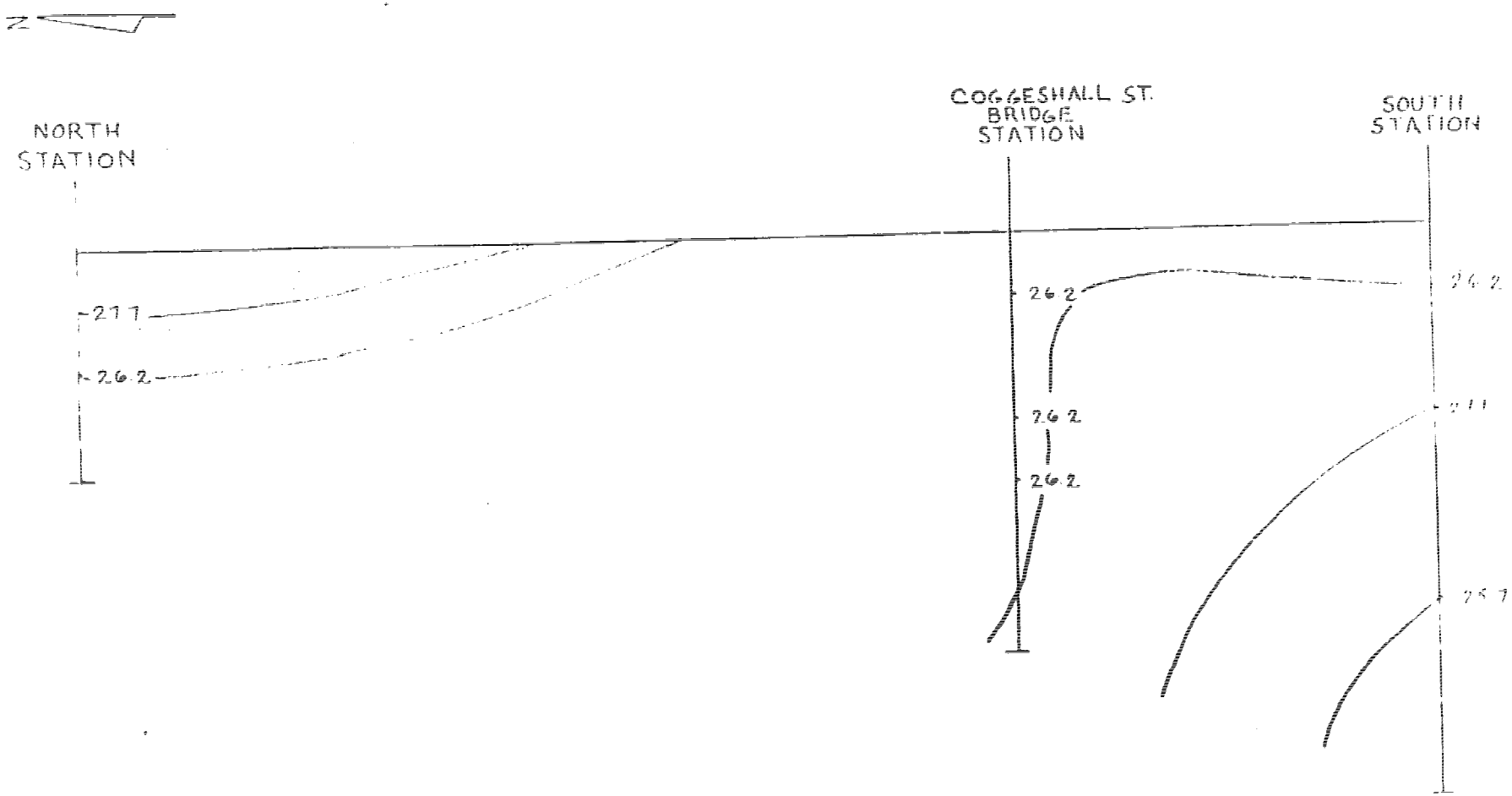
10-11 JANUARY 1983 2056-0038 HOURS

TIDE STAGE: SLACK EBB AVG STAFF 3.0

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: SALINITY (‰)

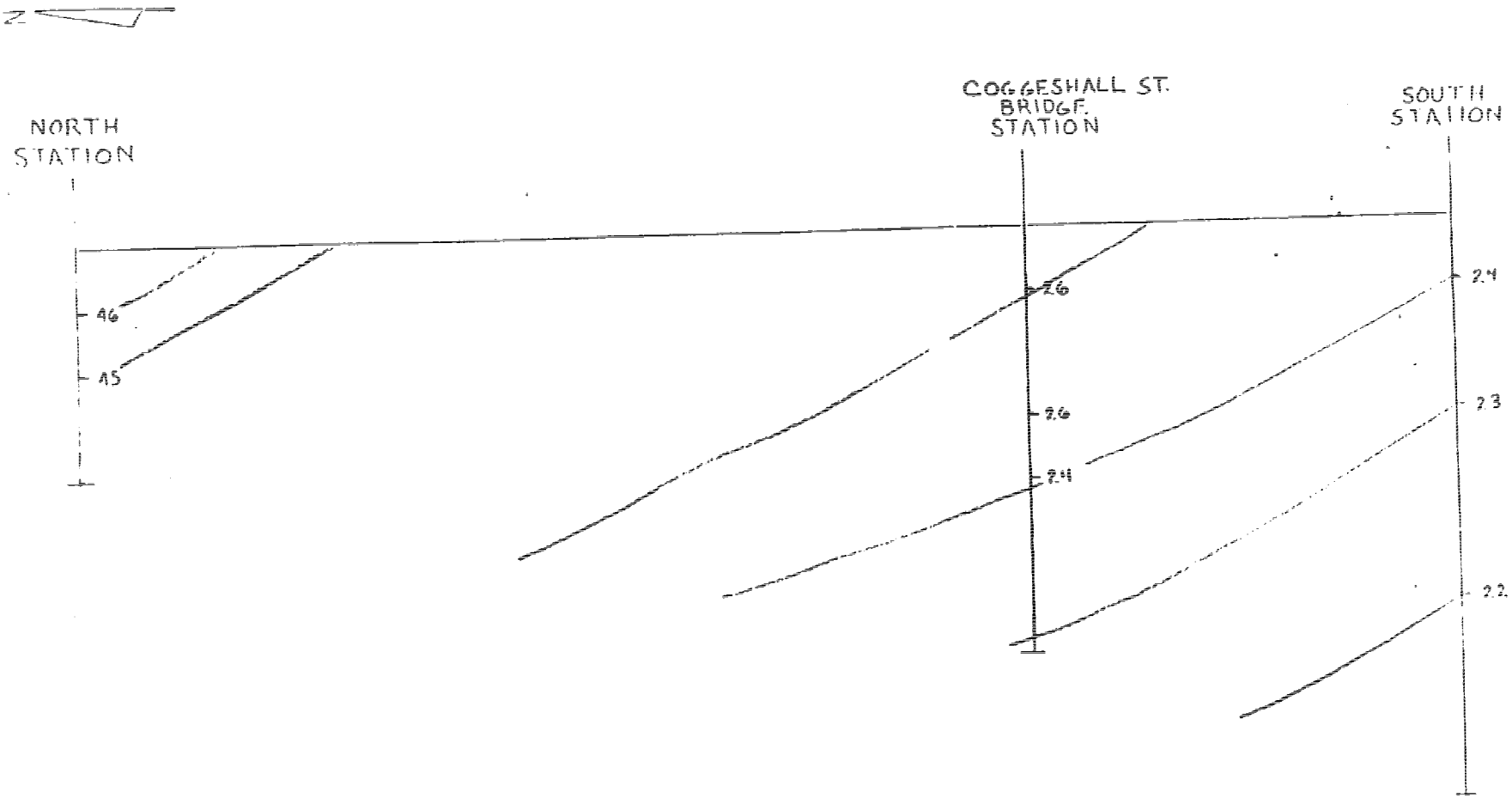
11 JANUARY 1983 0200-0357 HOURS

TIDE STAGE: FLOOD AVG STAFF 6.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TRANSMISSIVITY (%)

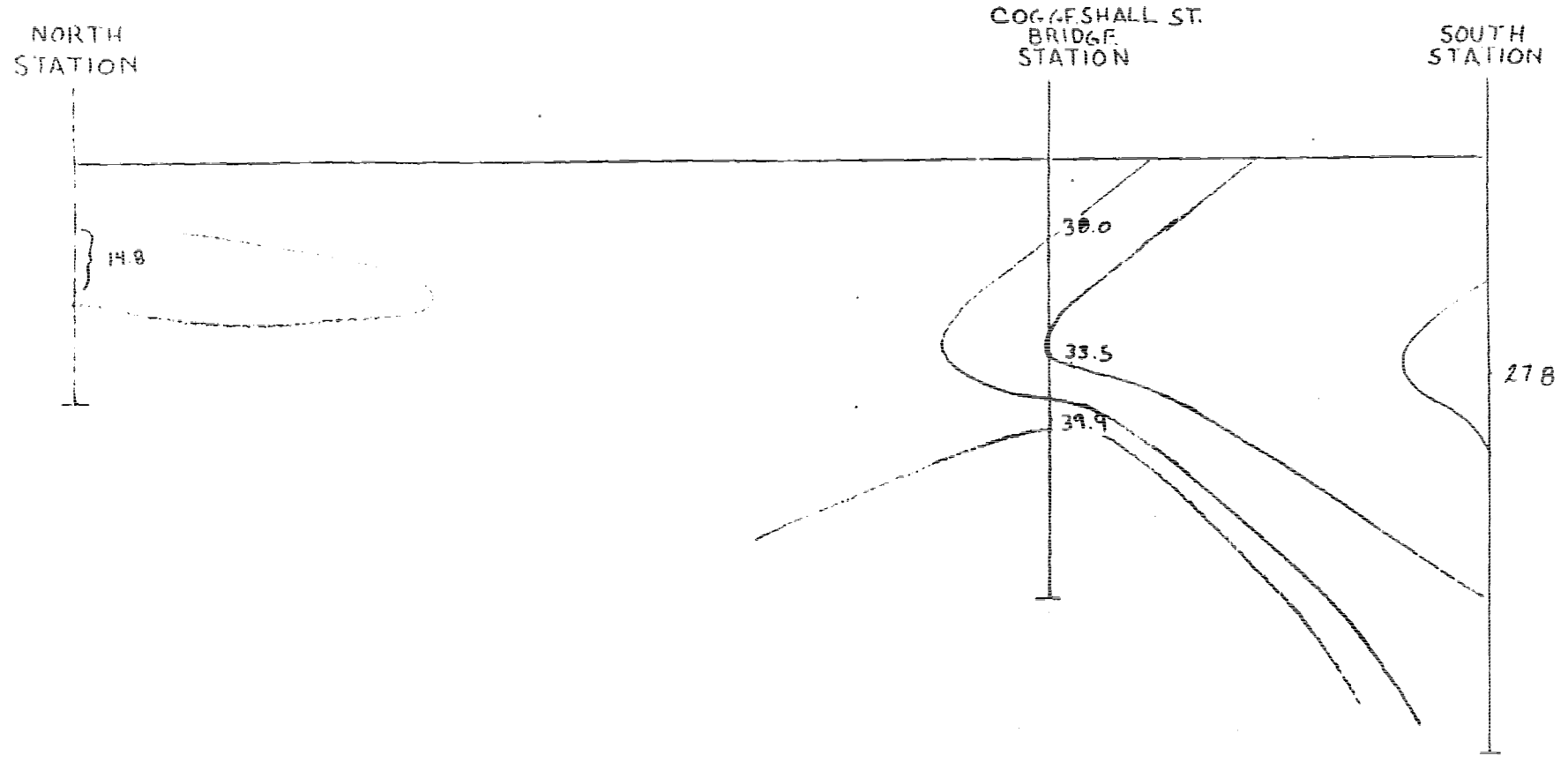
11 JANUARY 1983 0200-0357 HOURS

TIDE STAGE: FLOOD AVG STAFF 6.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL SUSPENDED SOLIDS MG/L

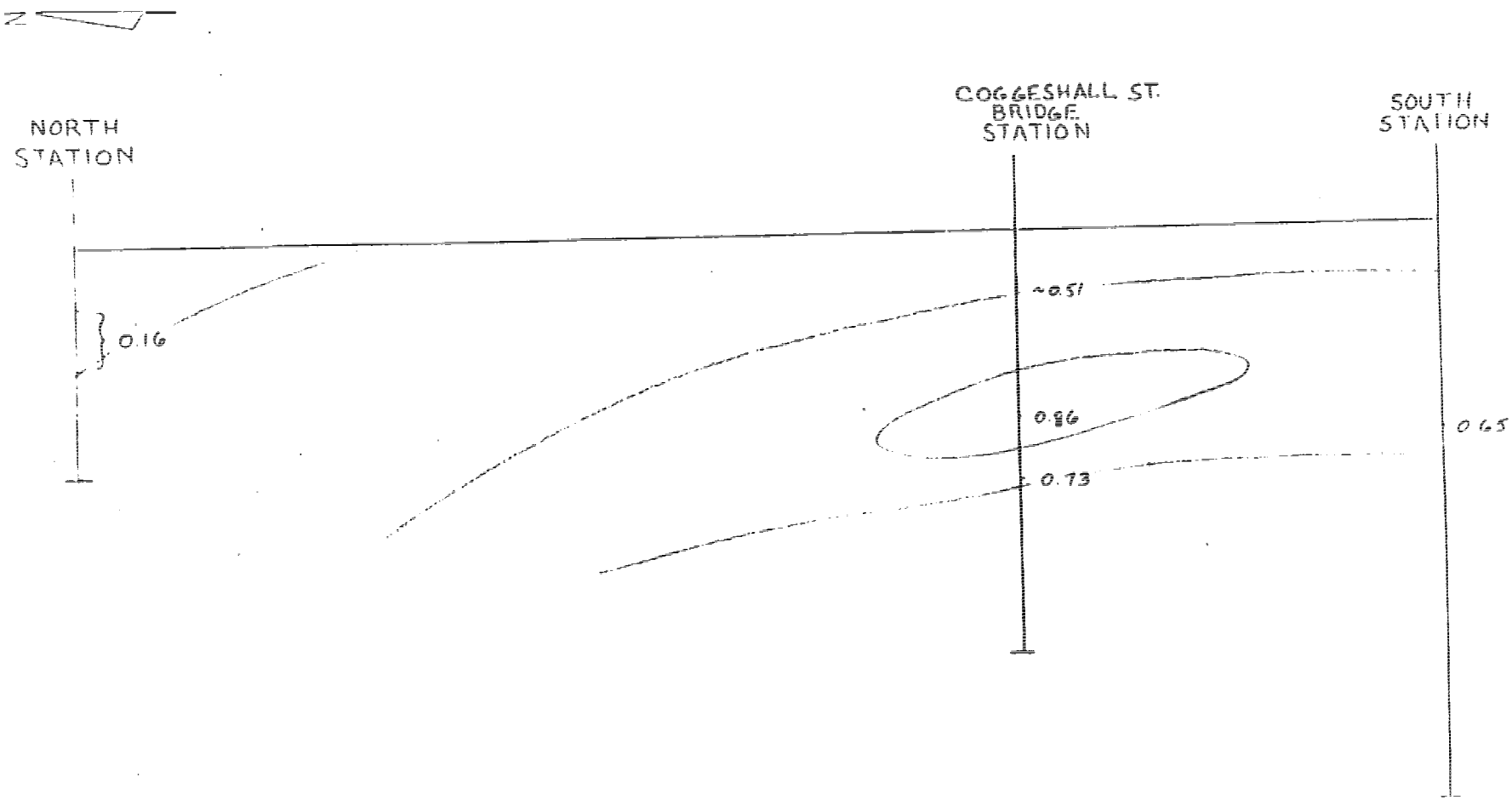
11 JANUARY 1983 0200-0357 HOURS

TIDE STAGE: FLOOD AVG STAFF 5.8

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TSP - PCB µg/l

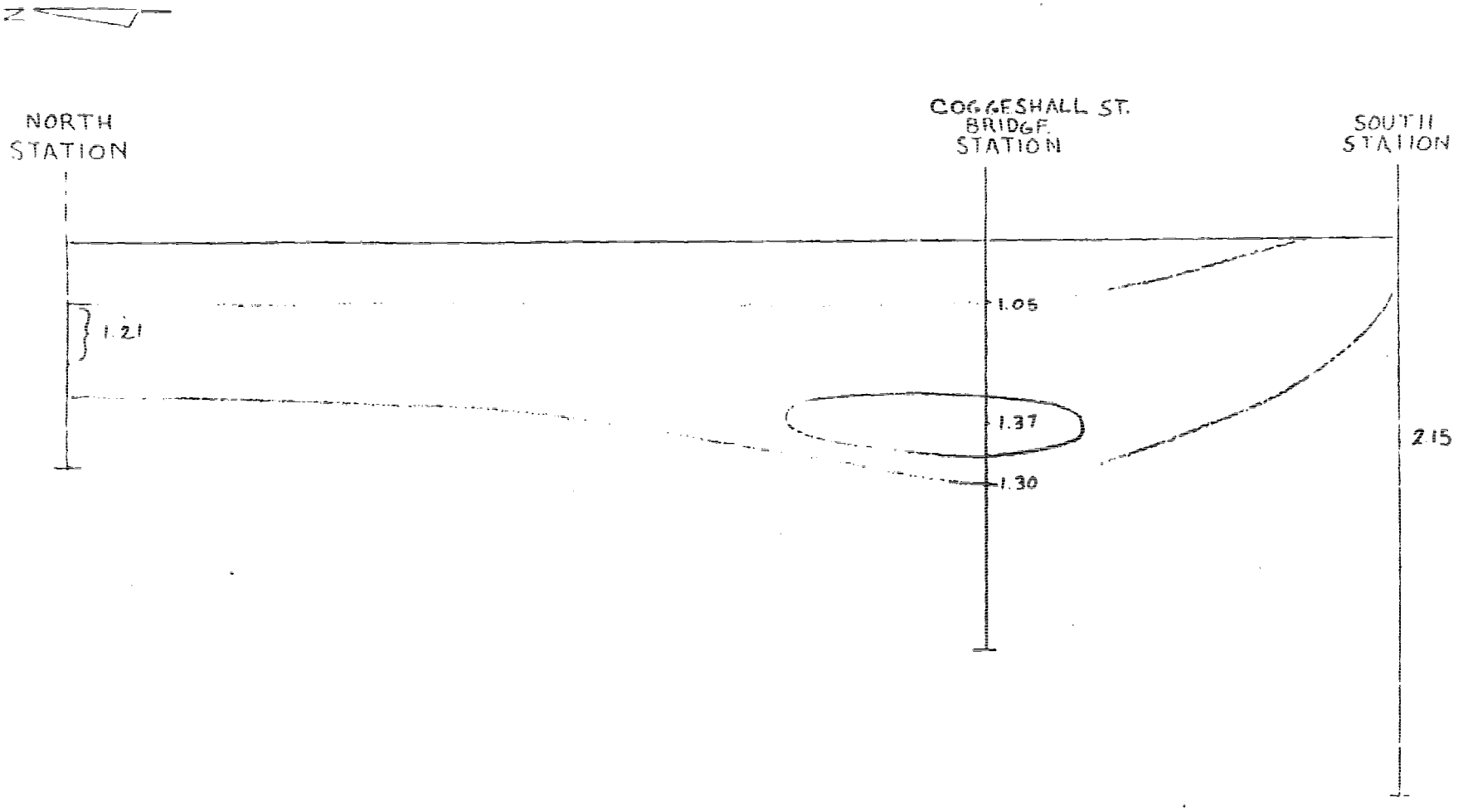
11 JANUARY 1983 0200-0357 HOURS

TIDE STAGE: FLOOD AVG STAFF 5.8

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL PCB µg/l

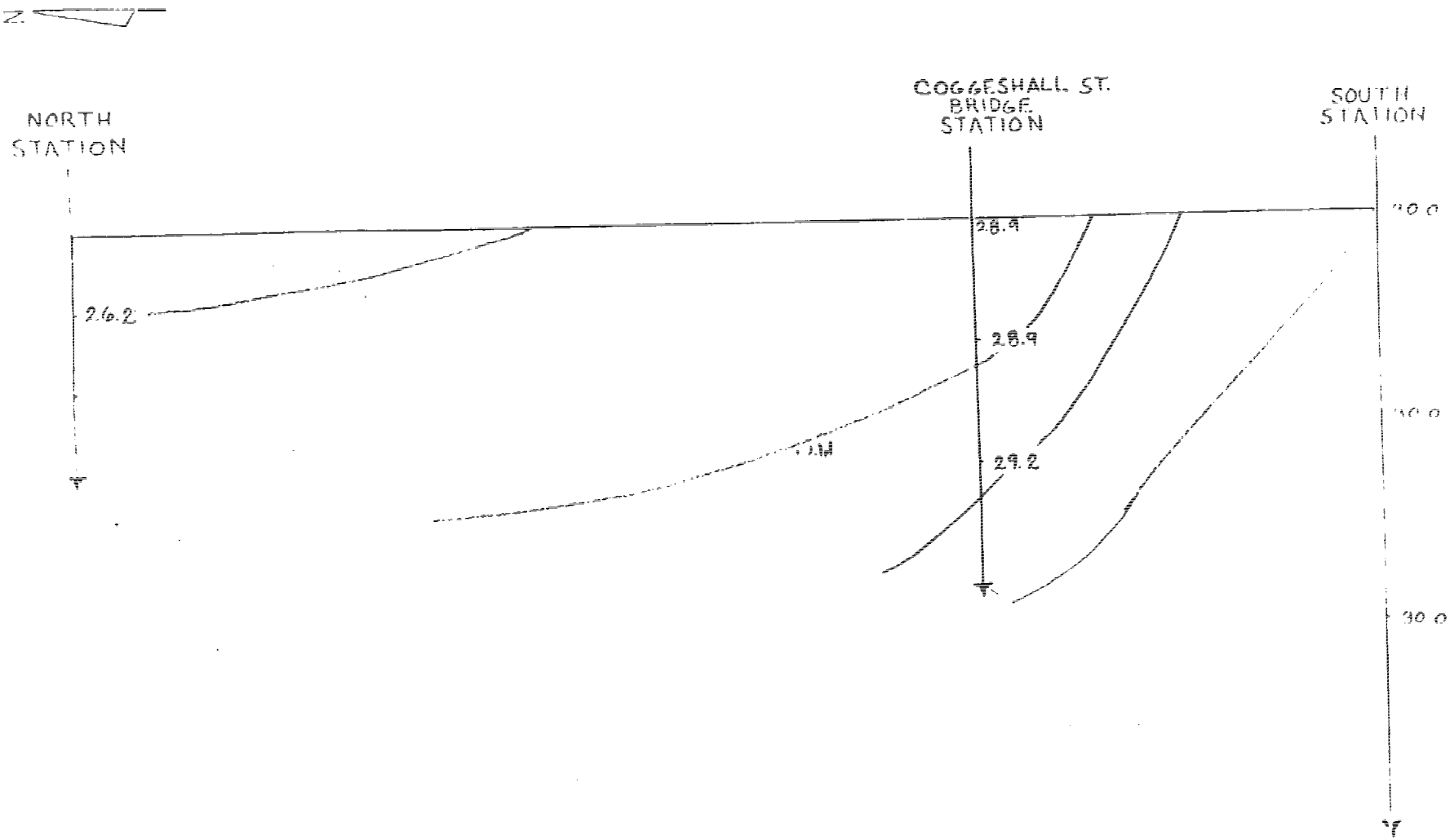
11 JANUARY 1983 0200-0357 HOURS

TIDE STAGE: FLOOD AVG STAFF 5.8

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: SALINITY (‰)

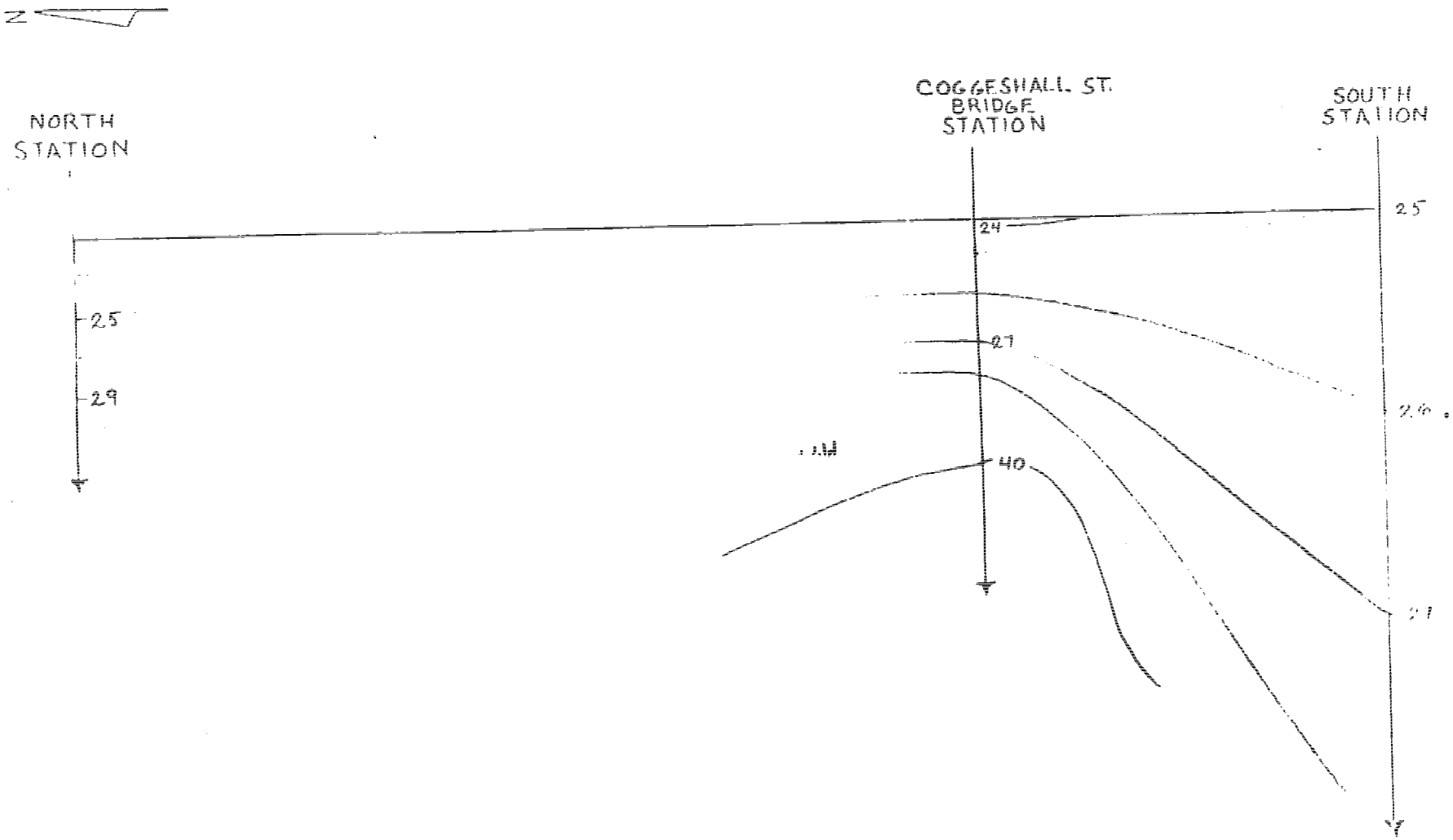
11 JANUARY 1983 0711-1013 HOURS

TIDE STAGE: EBB AVG STAFF 5.5'

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TRANSMISSIVITY (%)

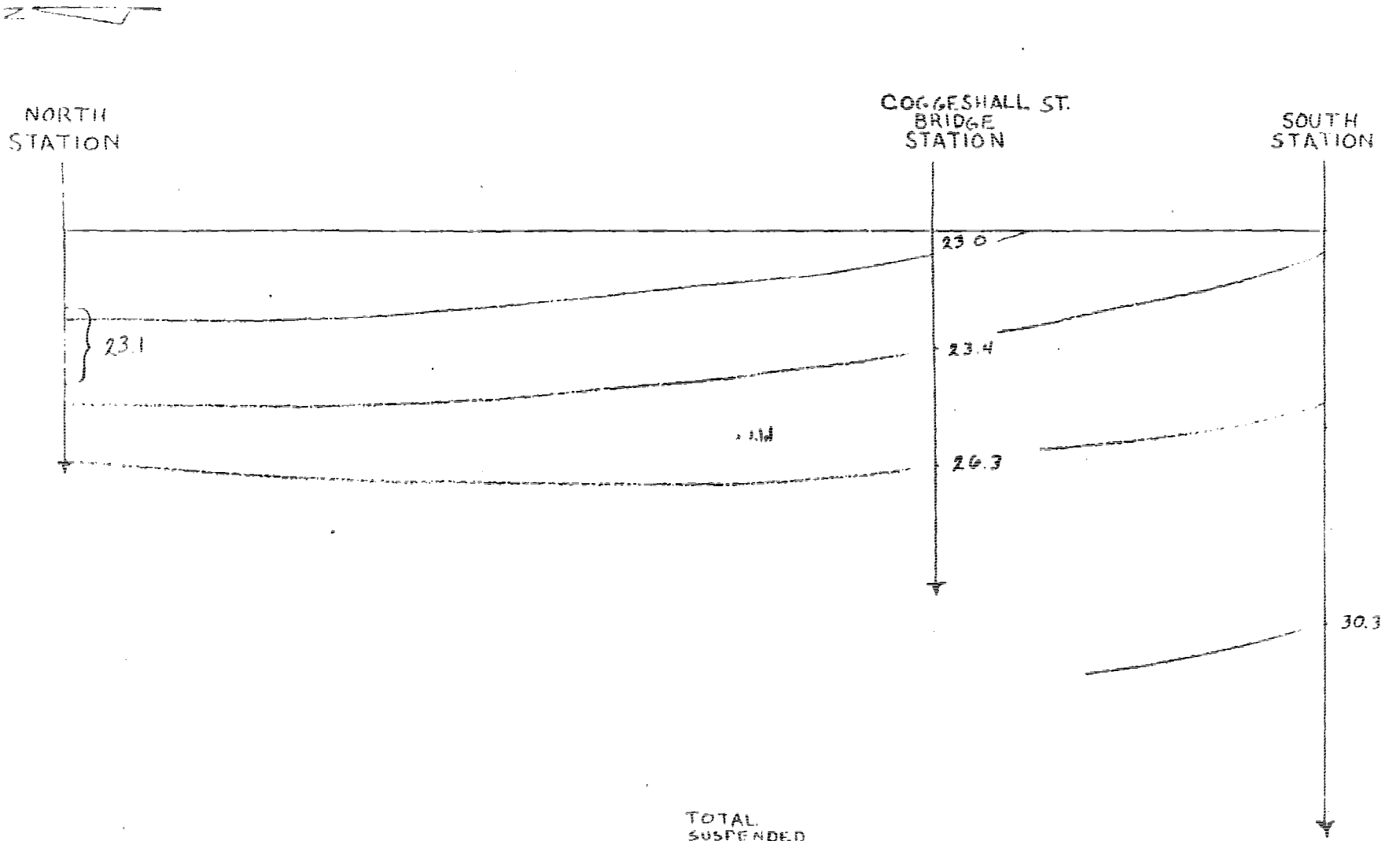
11 JANUARY 1983 0711-1013 HOURS

TIDE STAGE: EBB AVG STAFF 5.5'

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL SUSPENDED SOLIDS MG/L

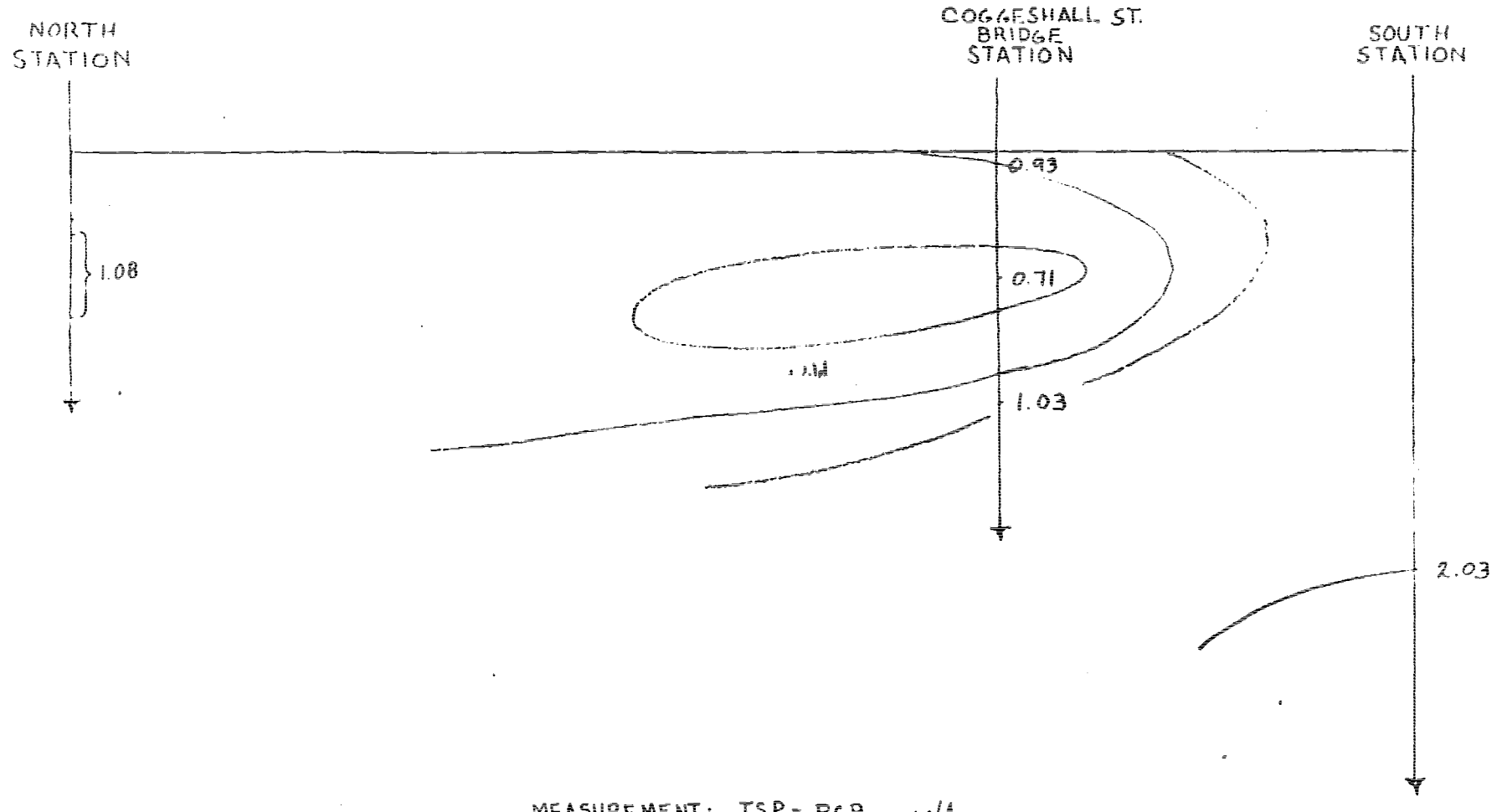
11 JANUARY 1983 0711-1013 HOURS

TIDE STAGE: EBB AVG STAFF 5.5'

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TSP - PCB µg/l

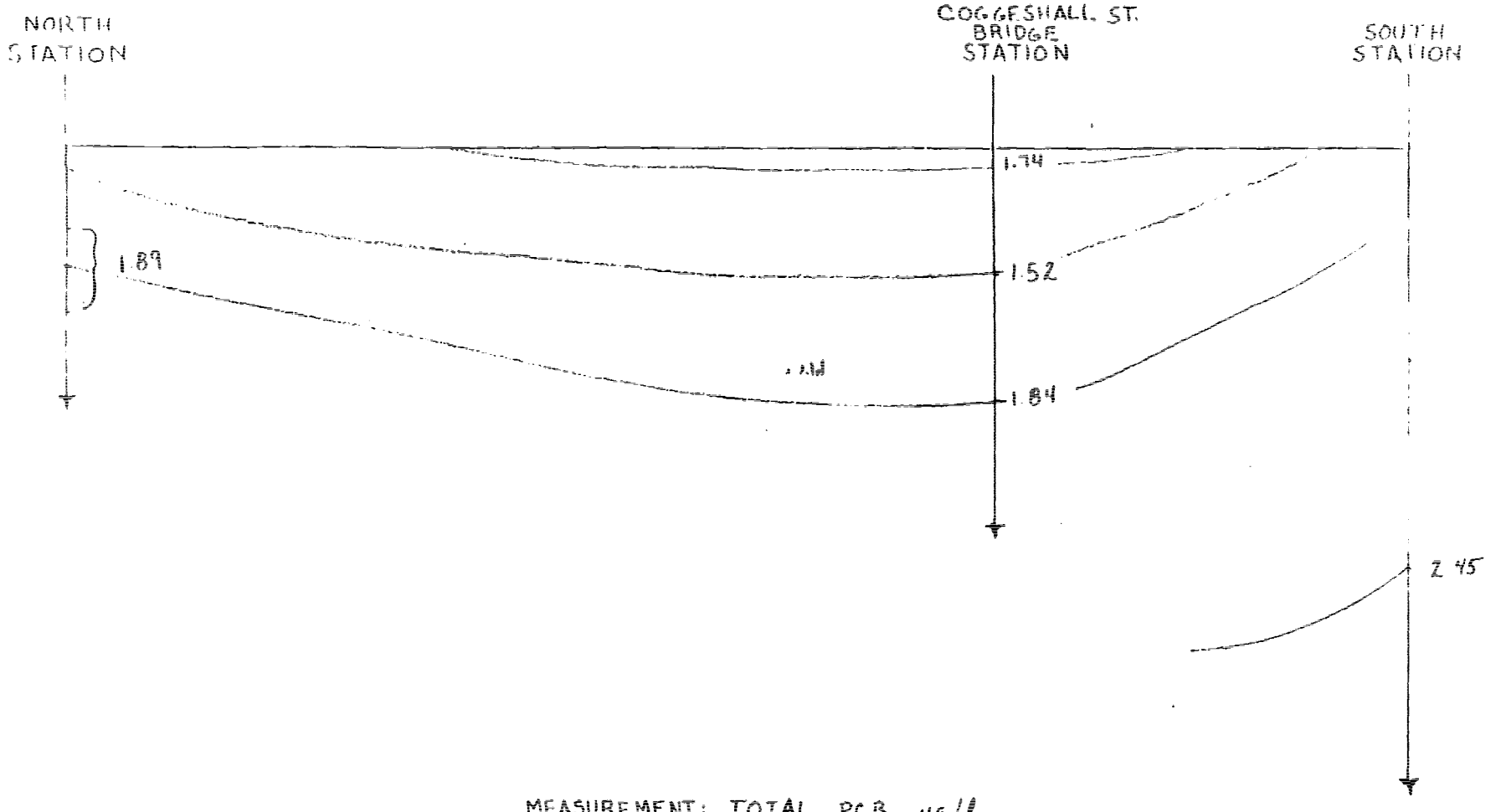
11 JANUARY 1983 0711-1013 HOURS

TIDE STAGE: EBB AVG STAFF 5.5'

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL PCB µg/L

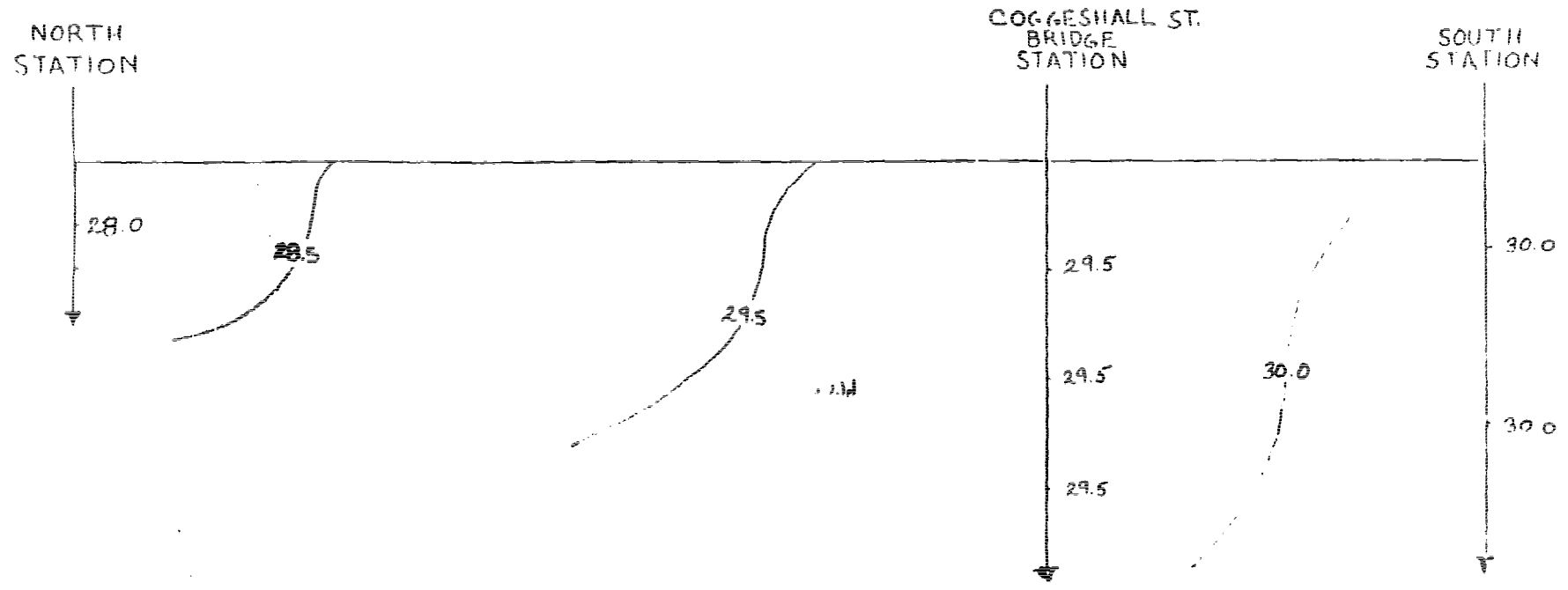
11 JANUARY 1983 0711-1013 HOURS

TIDE STAGE: EBB AVG STAFF 5.5'

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: SALINITY (‰)

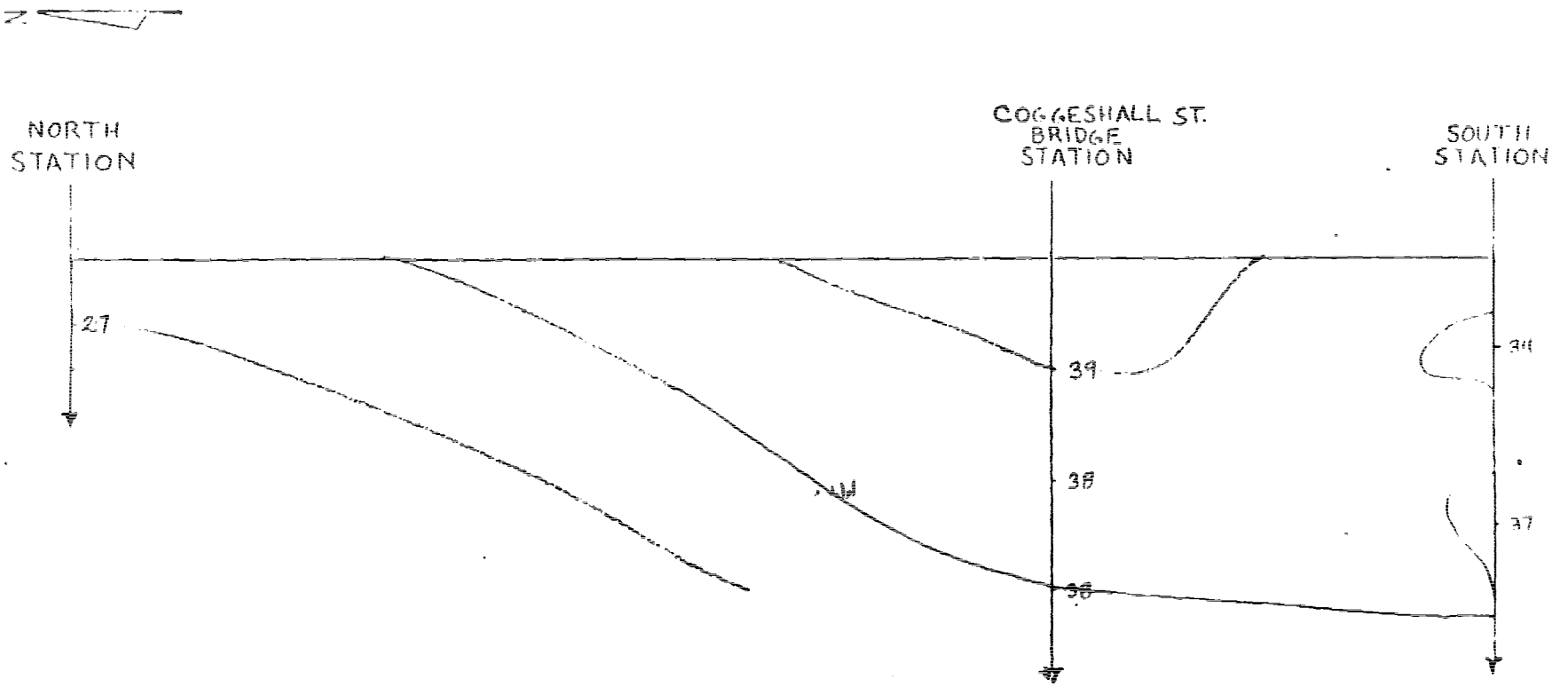
11 JANUARY 1983 1422 : 1630 HOURS

TIDE STAGE: FLOOD AVG STAFF 4.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TRANSMISSIVITY (%)

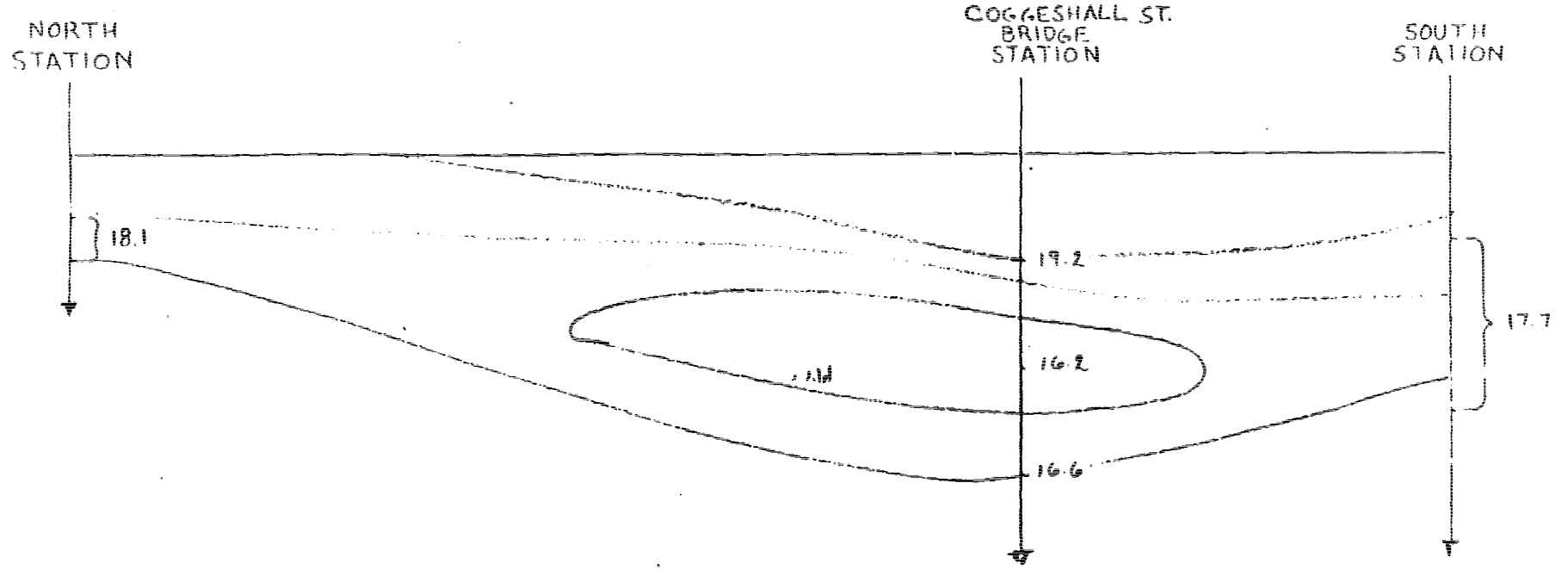
11 JANUARY 1983 1422 : 1630 HOURS

TIDE STAGE: FLOOD AVG STAFF 4.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL SUSPENDED SOLIDS MG/L

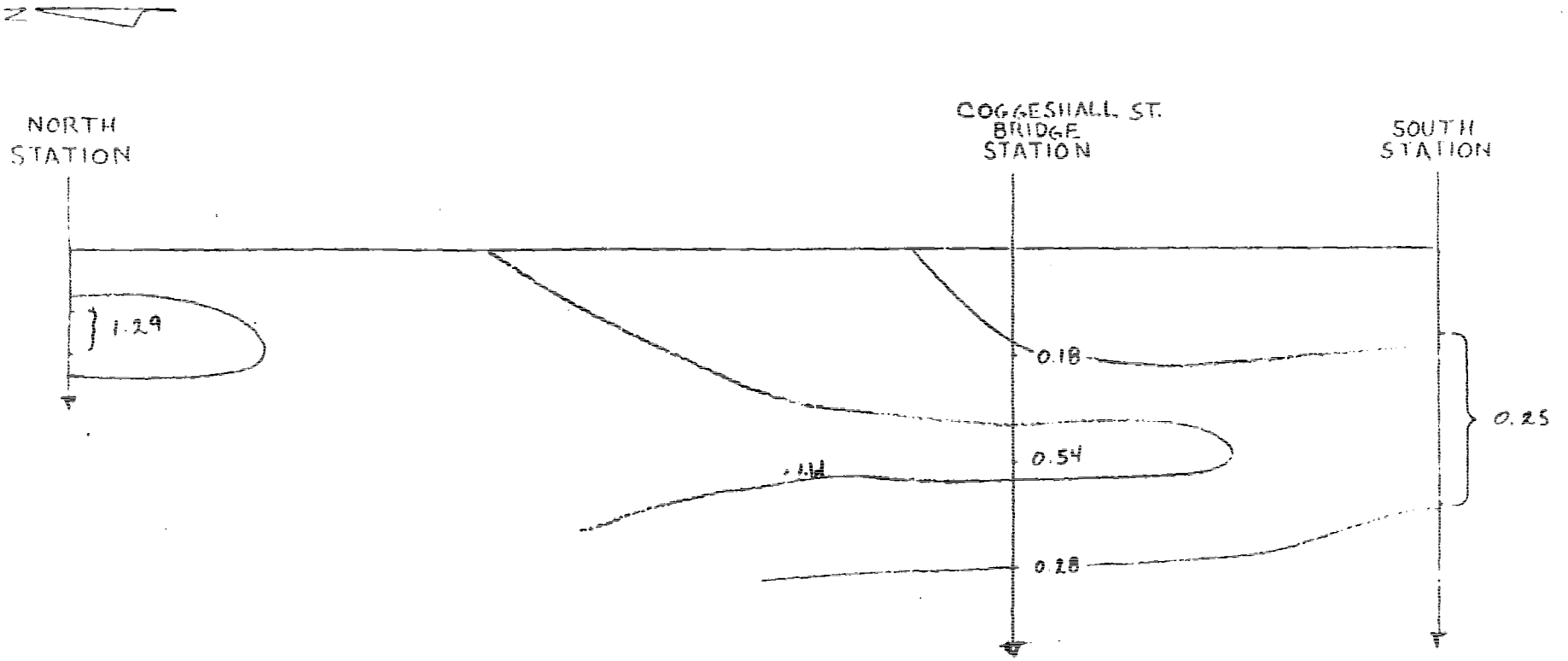
11 JANUARY 1983 1422 - 1630 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TSP - PCB ug/l

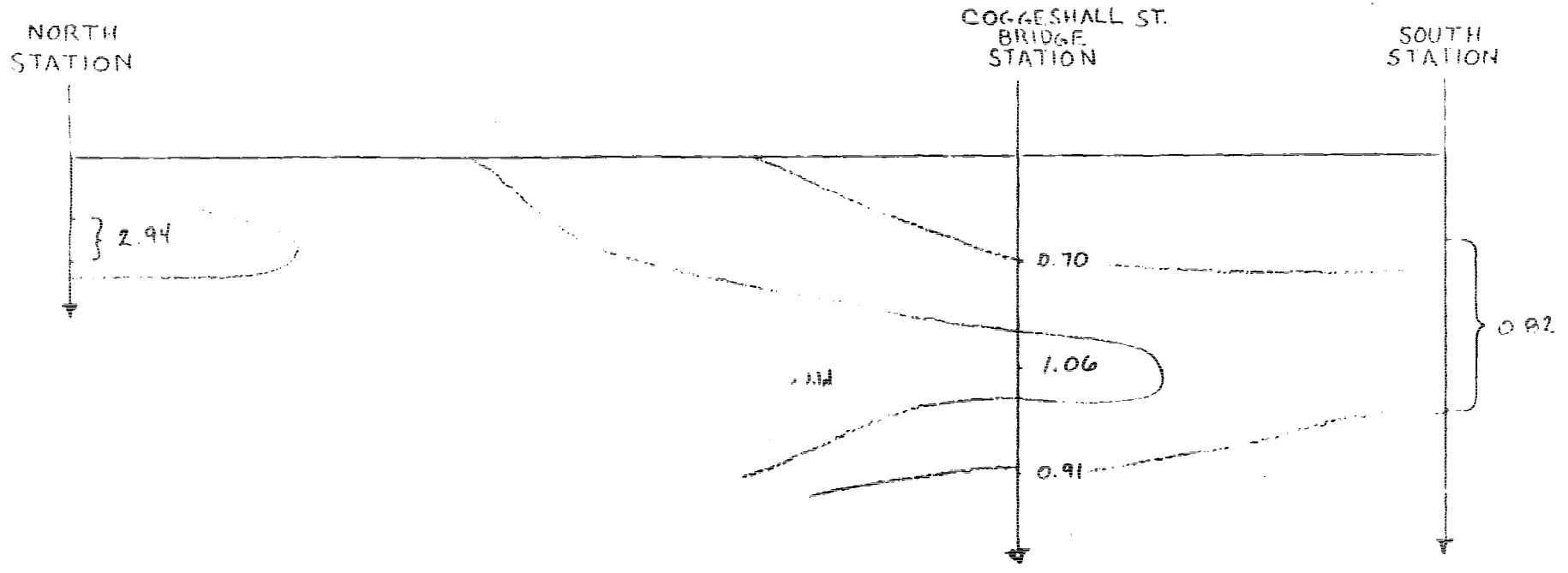
11 JANUARY 1983 1422 : 1630 HOURS

TIDE STAGE: FLOOD AVG STAFF 4.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



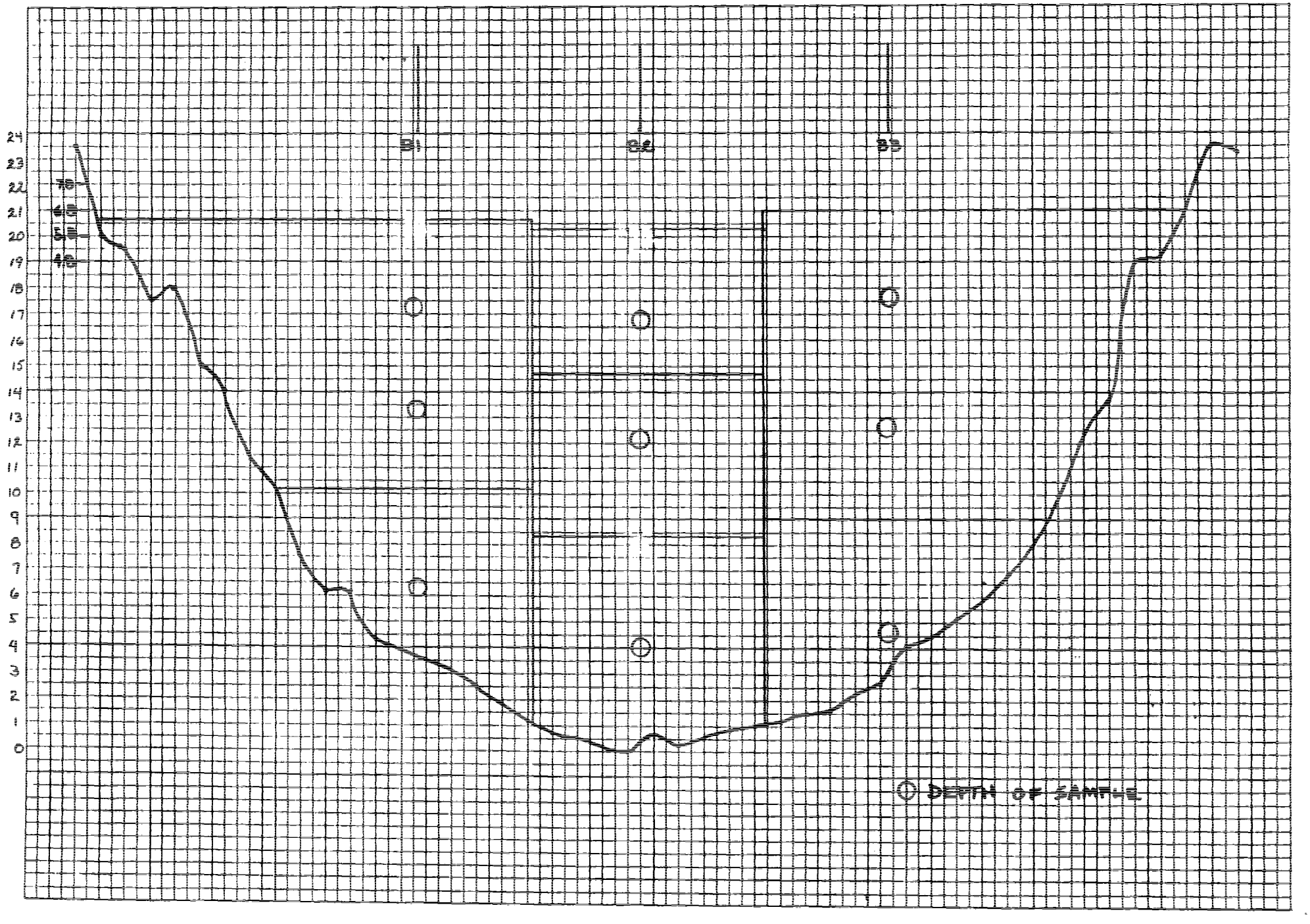
MEASUREMENT: TOTAL PCB µg/l

11 JANUARY 1983 1422 : 1630 HOURS

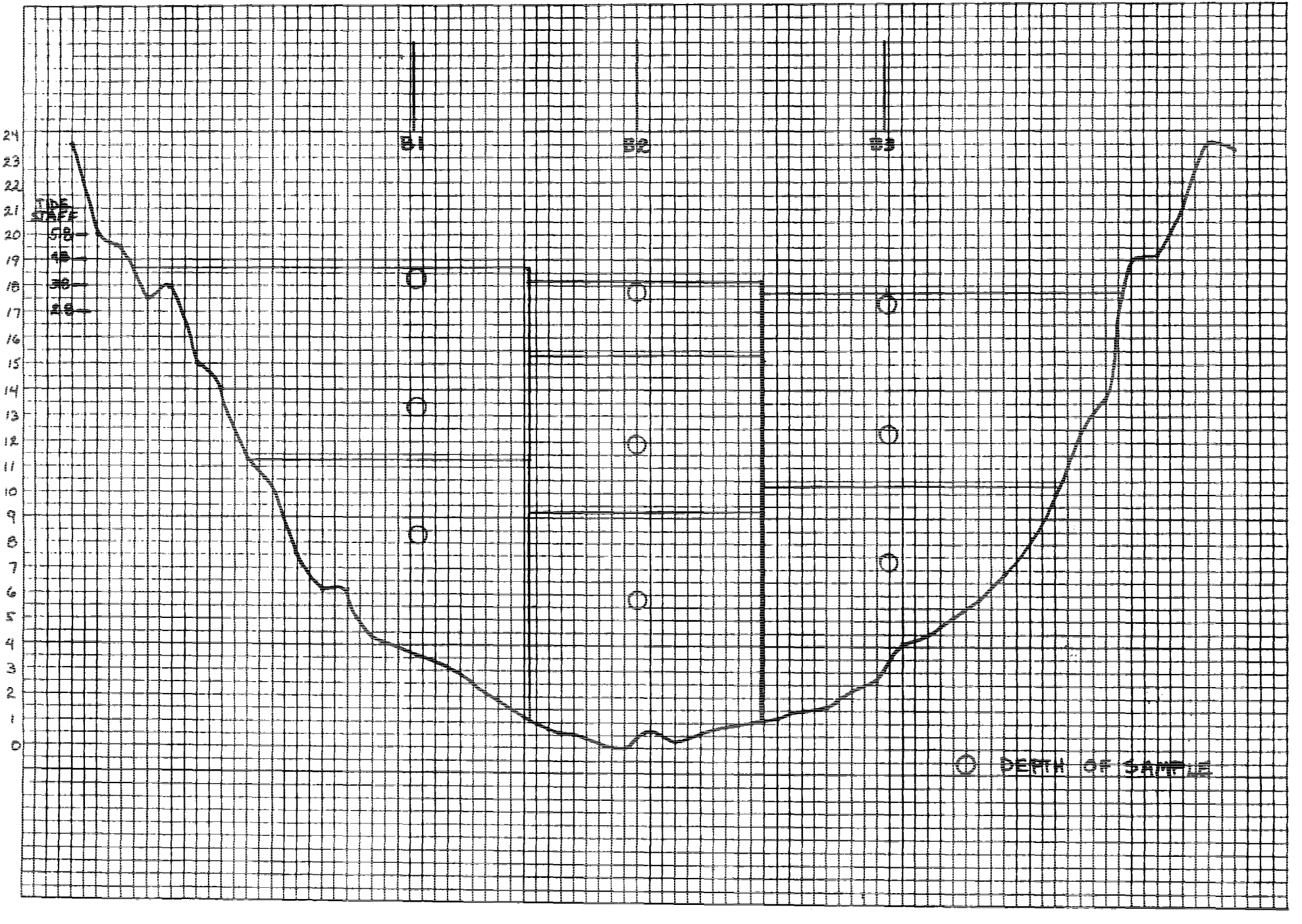
TIDE STAGE: FLOOD AVG STAFF 4.2

APPENDIX A

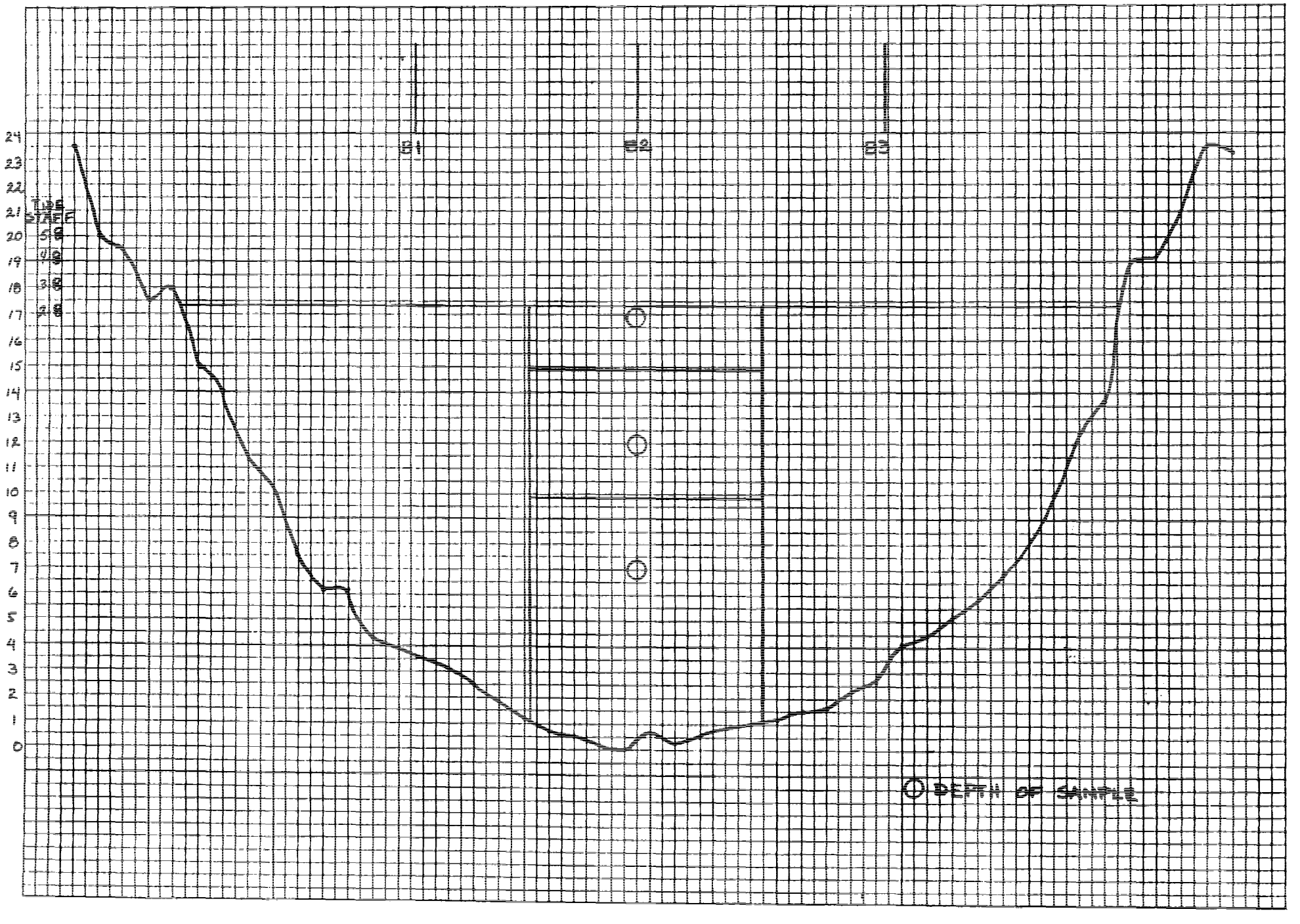
DATE TIME	B1 No of Squares	B1 Sq Ft	B1 Tide Staff	B1 Sample Depth	B2 No of Squares	B2 Sq Ft	B2 Tide Staff	B2 Sample Depth	B3 No of Squares	B3 Sq Ft	B3 Tide Staff	B3 Sample Depth
1-11-83 0328 - 0357	551	413	6.4	3	203	152	6.1	3	648	486	6.8	3
				7	235	176		9				9
	232	175		14	276	207		12	213	160		13
1-11-83 0922 - 1035	389	292	4.5	0	104	78	3.9	0	399	299	3.5	0
				5	218	164		5				5
	250	188		10	330	248		12	264	198		10
1-11-83 1217					93	70	3.1	0				
					187	140		5				
					345	259		10				
1-11-83 1503 - 1630	378	283	4.1	3	260	196	4.3	0	607	455	4.5	4
				5	205	153		5				10
	251	188		10	203	152		10	151	113		12
1-11-83 1910					244	183	5.9	4				
					149	112		9				
					331	249		12				
1-11-83 2257 - 2352	355	266	3.1	0	119	89	3.0	0	287	290	2.8	0
				5	223	167		5				5
	218	164		10	276	207		12	240	180		10
1-12-83 0333 - 0500	501	376	4.5	3	226	167	4.9	3	553	415	5.3	3
				9	167	126		9				9
	146	110		12	295	221		12	240	180		12
1-12-83 0729					225	169	6.4	3				
					223	167		9				
					295	221		15				
1-12-83 1025 - 1130	380	265	3.9	0	106	80	3.6	0	390	293	3.4	0
				5	223	167		6				5
	189	142		10	314	235		12	267	200		10
1-12-83 1220					112	84	2.9	0				
					223	167		6				
					276	207		12				
1-12-83 1616 - 1740	493	370	4.4	3	145	109	4.6	3	491	368	5.1	
				9	223	167		9				
	92	69		13	202	152		15	112	84		


24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
7B
6B
5B
4B
B1
B2
B3
DEPTH OF SAMPLE

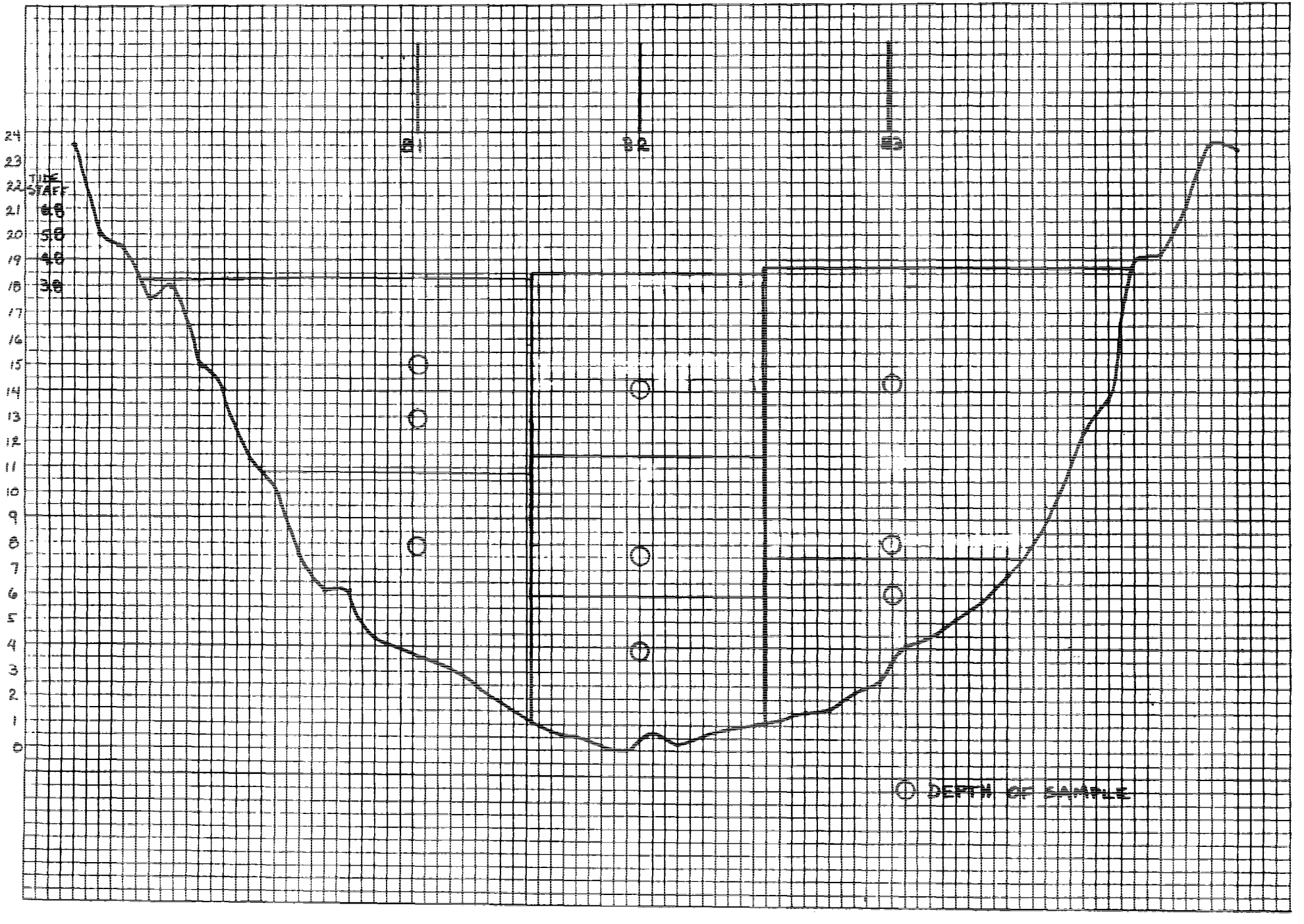
BRIDGE CROSS SECTION 1-11-83 0922 - 1035 HRS



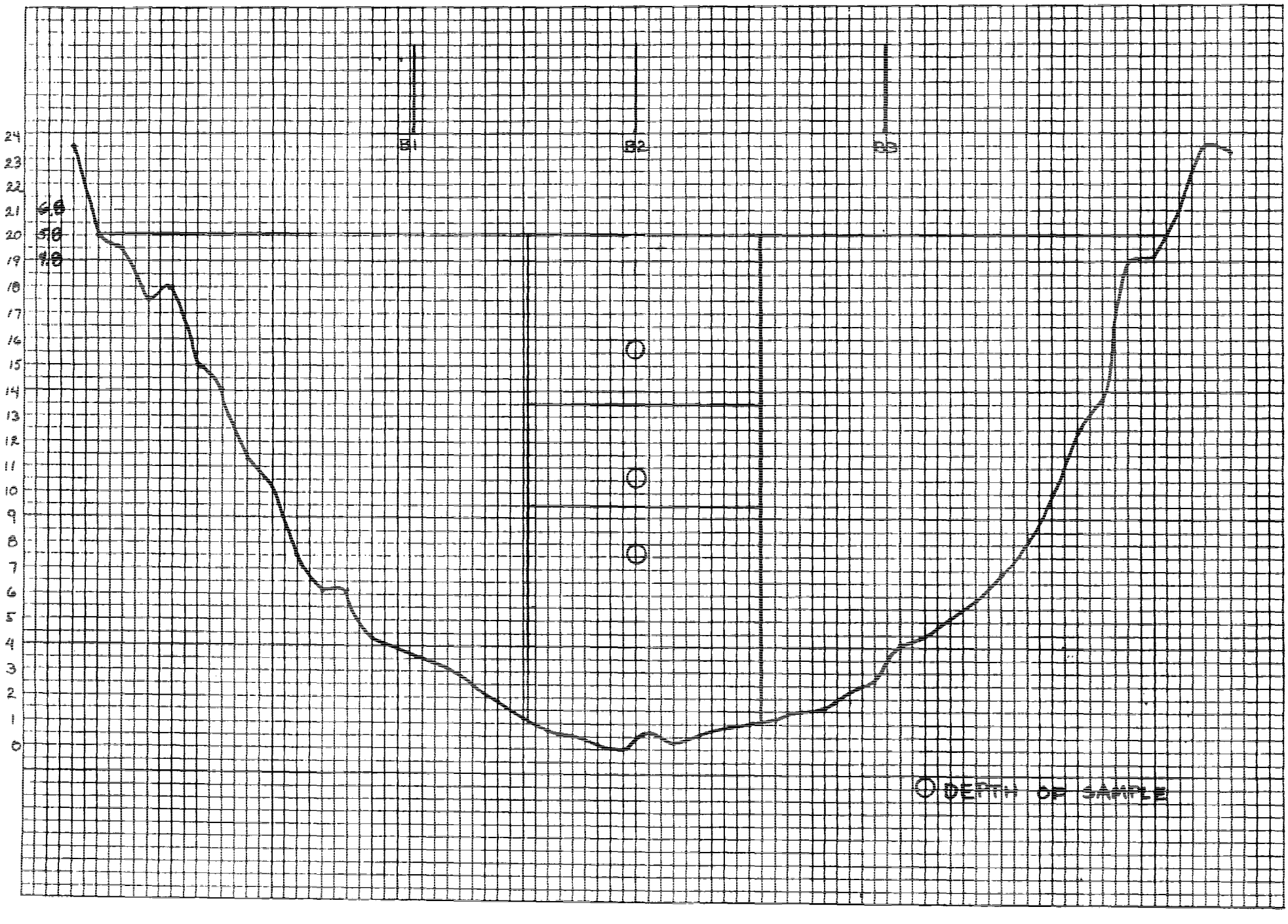
BRIDGE CROSS SECTION

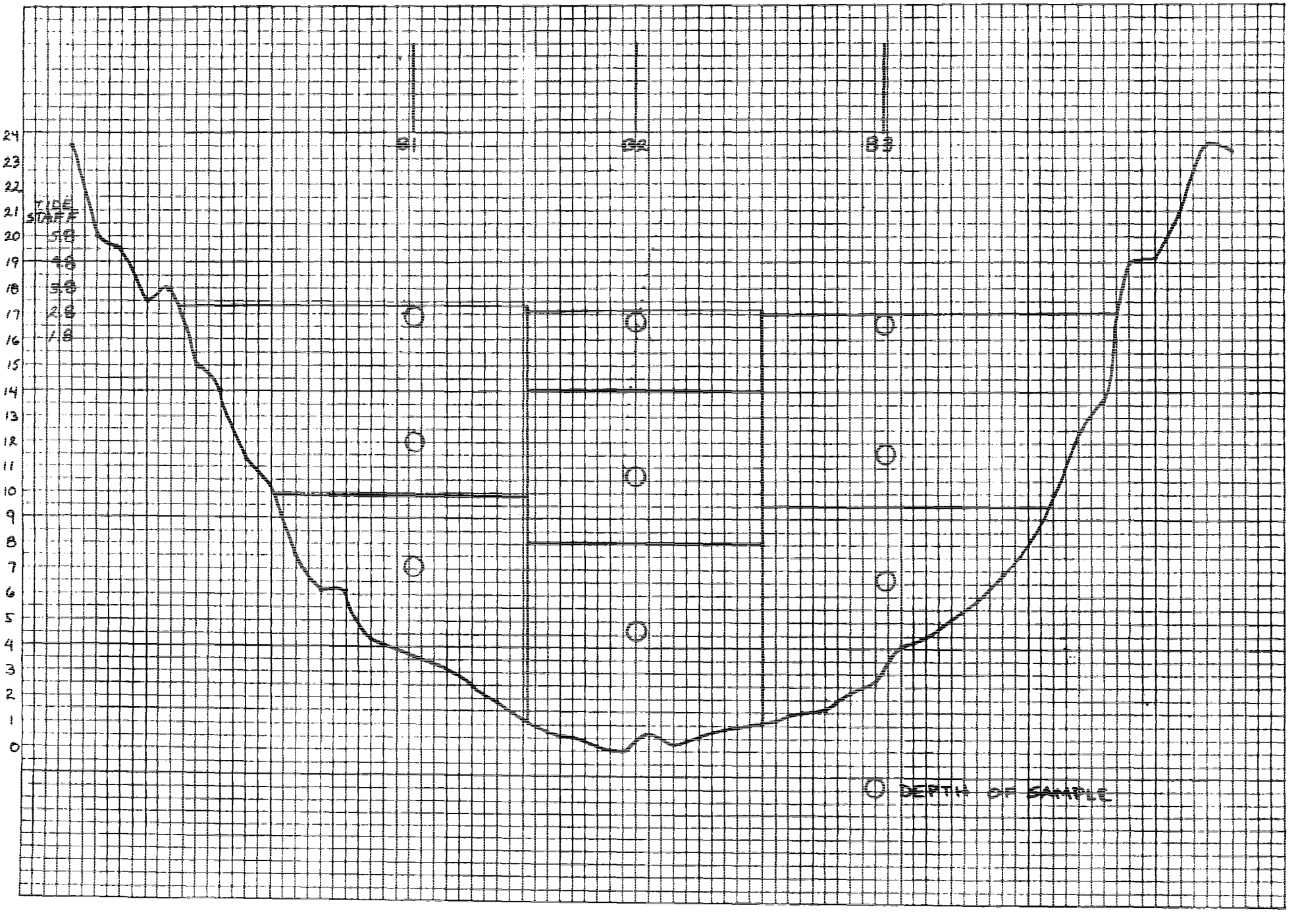


BRIDGE CROSS SECTION 1-11-83 1503-1630 HR



CROSS SECTION




24
23
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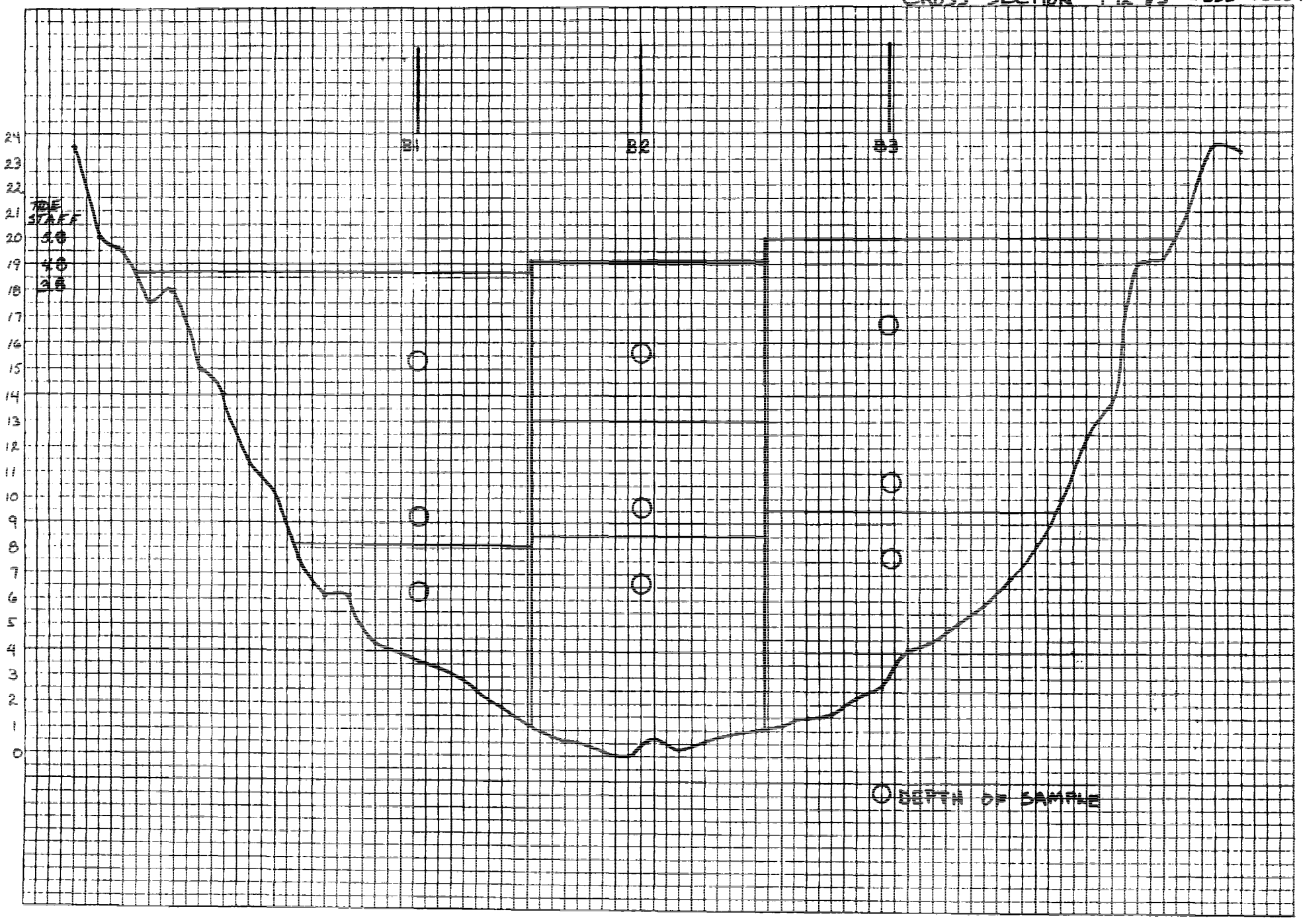
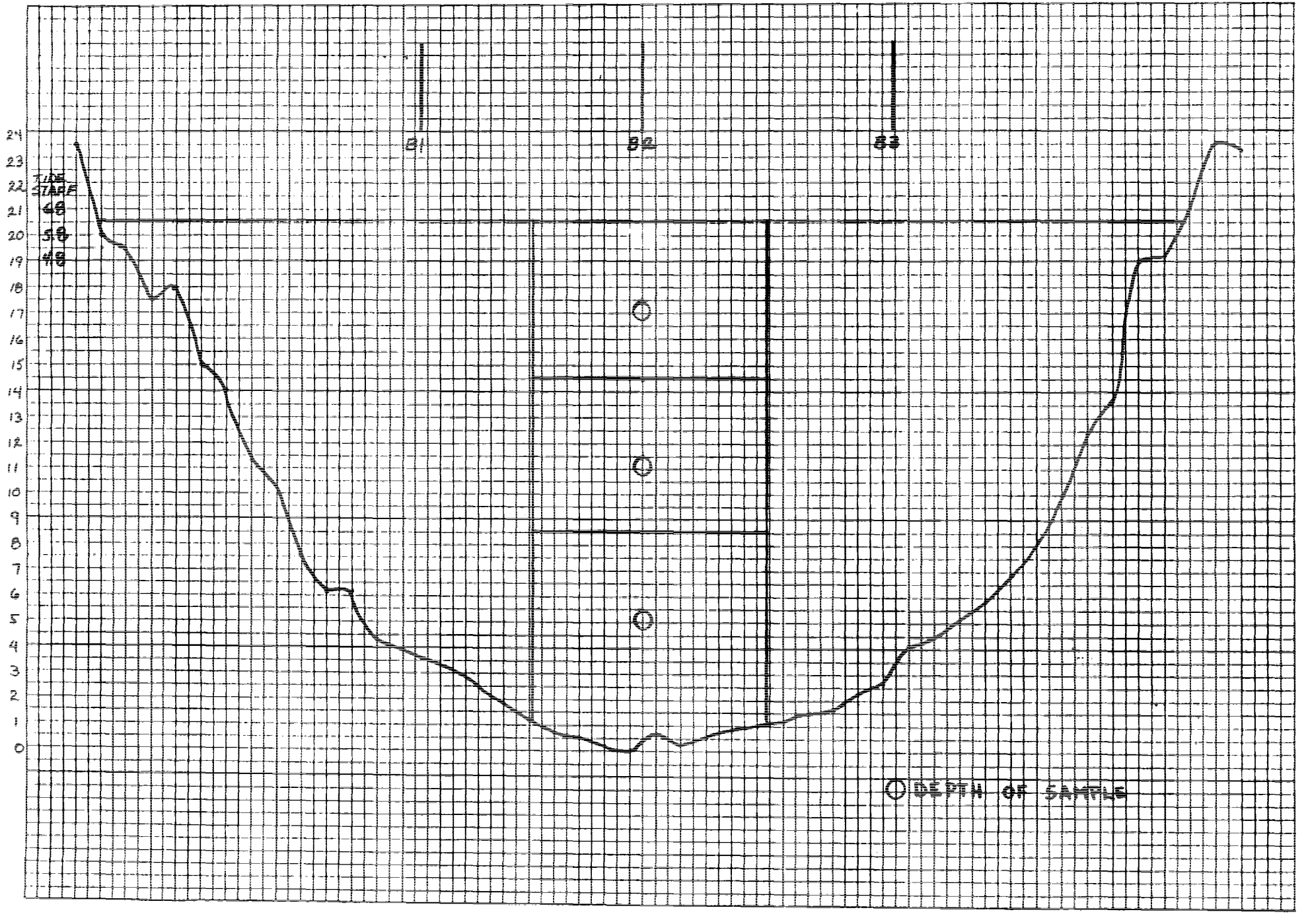
9
8
7
6
5
4
3
2
1
0
TIDE STAFF
5.8
4.8
3.8
2.8
1.8
B1
B2
B3
DEPTH OF SAMPLE

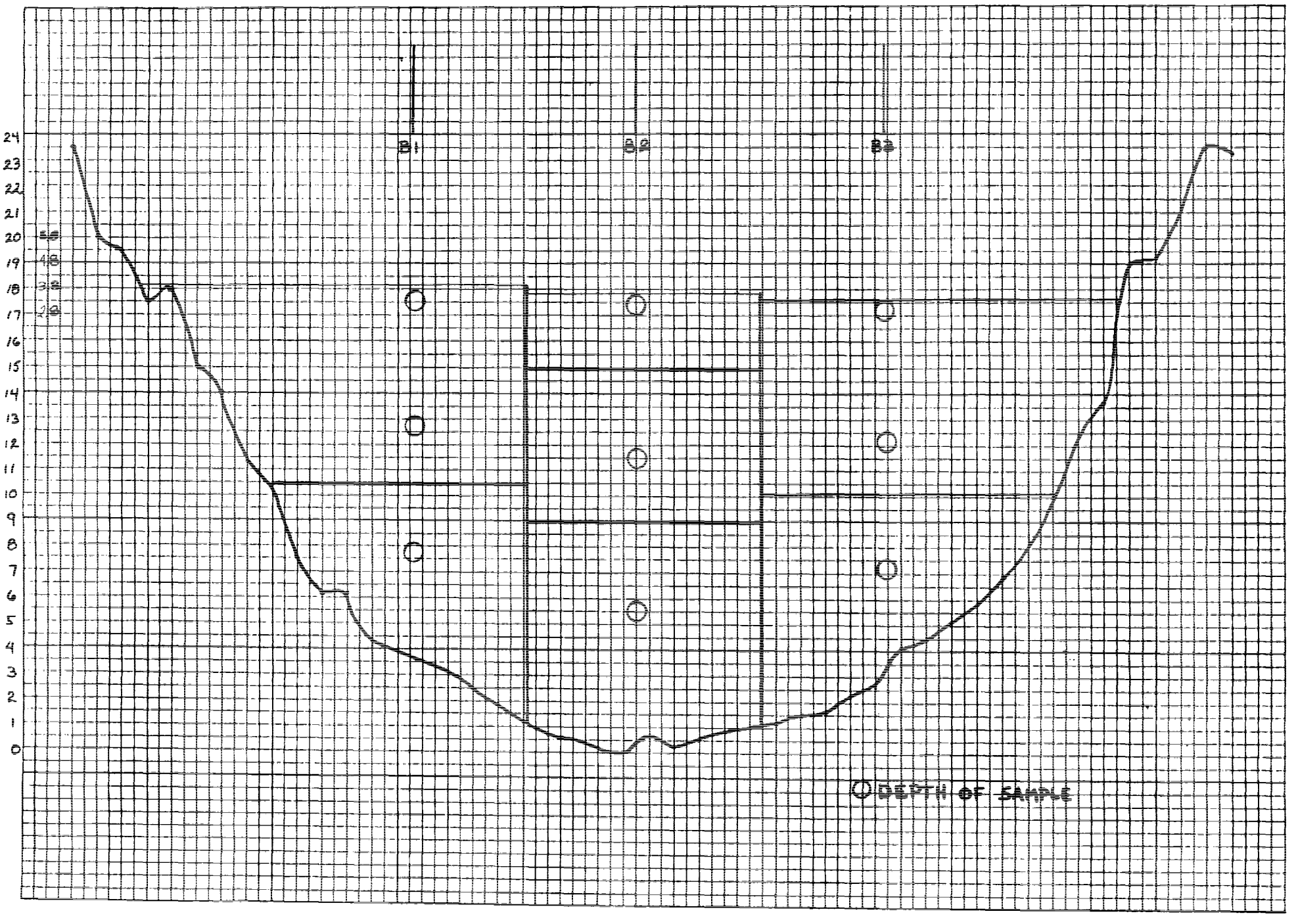
CROSS SECTION 1-12-83 0333-0500 HR



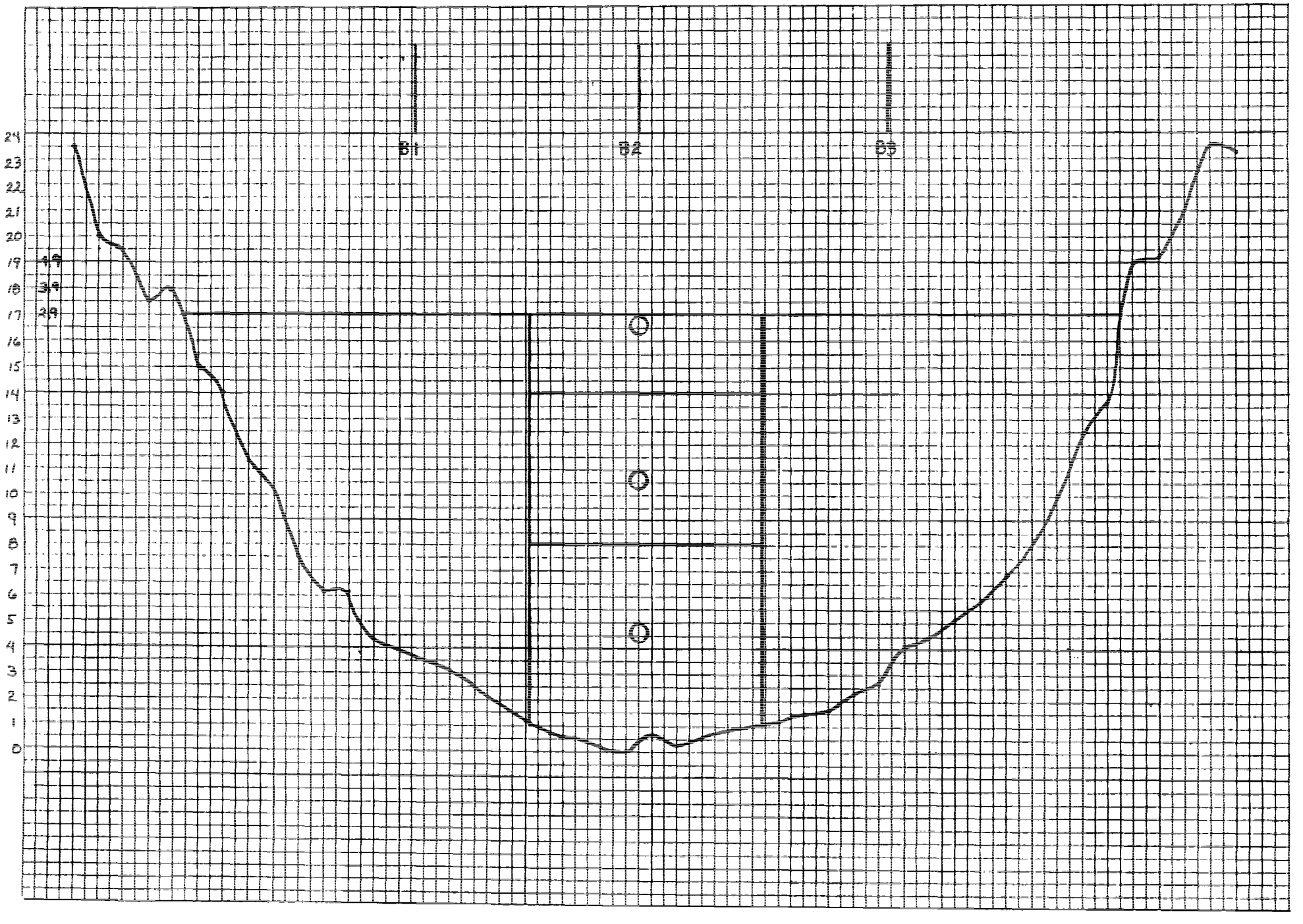
CROSS SECTION 1-12-83 0724 HRS



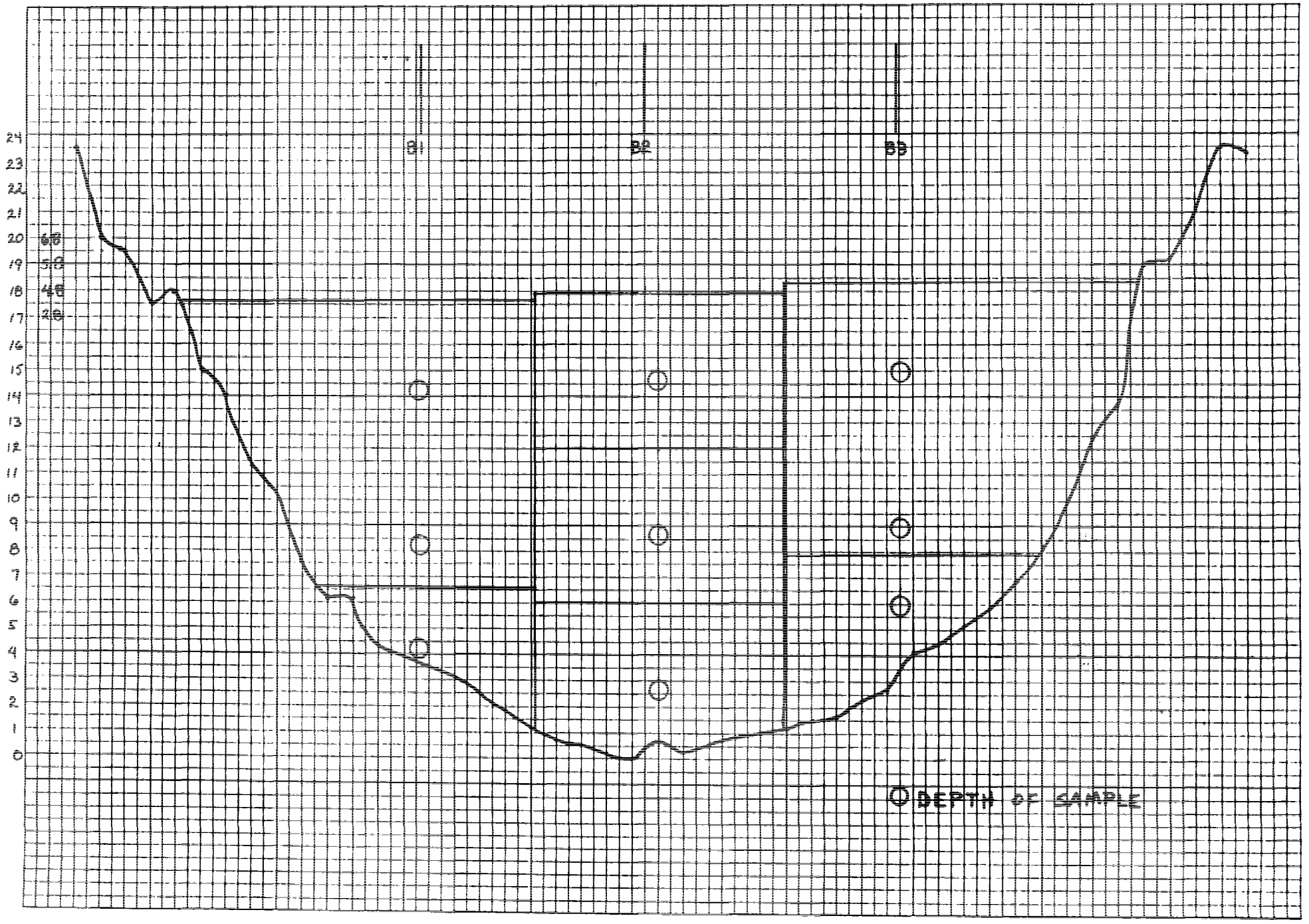
CROSS SECTION



CROSS SECTION 1-12-83



CROSS SECTION 1-12-83 1616 - 1740 HRS



CONTINUOUS FLOW DATA VS. INSTATANEOUS FLOW DATA

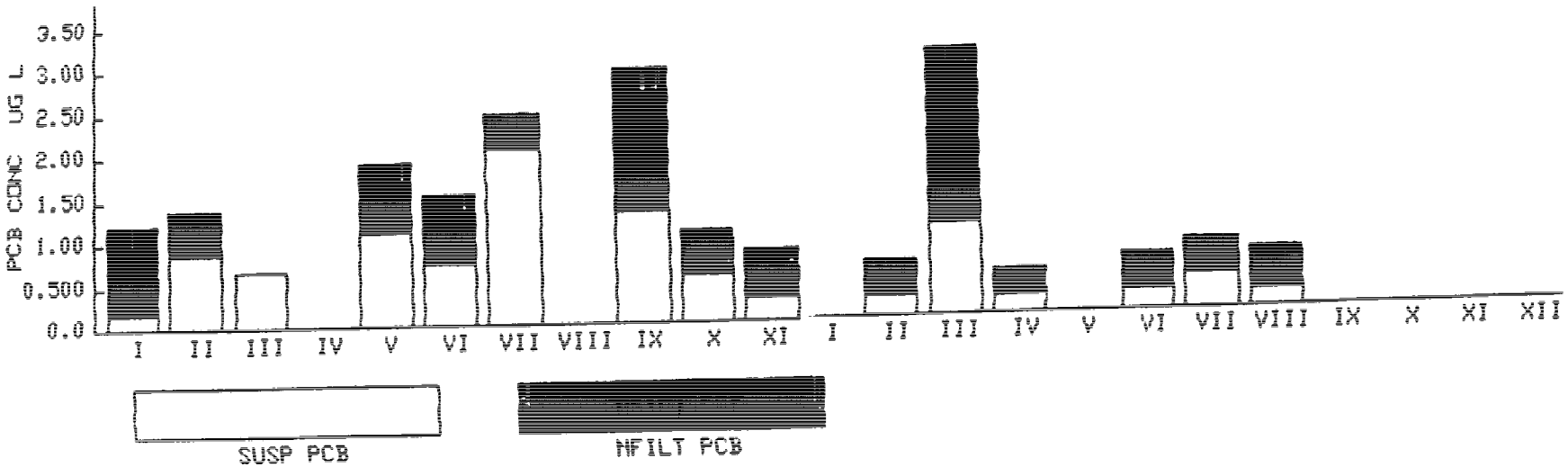
B-2 2/3 DEPTH

CONTINUOUS FLOW TIME	FLOW	DIR	INSTANTANEOUS FLOW TIME	FLOW	DIR.	COMMENTS
2258	.62 KNOTS	354°	S2257			Flow readings were taken approx. 10 minutes into the measurement period
2300	.62	359				
02	.8	359				
04	.88	355				
06	.96	350				
08	1.05	346		.9 KNOTS	015°	
10	1.01	346				
12	.88	350				
14	.99	352				
16	.99	355				
18	.93	356				
20	.92	358				
22	.83	4	F2325			
0328	.54	4	S0328			
30	.49	4				
32	.55	0				
34	.45	3				
36	.42	0		.42	10°	
38	.46	359				
40	.51	359	F0337			
0540	.84	1	S0536			
42	.71	1				
44	.64	2		.6	25	
46	.62	2				
48	.55	357	F0600			

CONTINUOUS FLOW			INSTANTANEOUS FLOW			
TIME	FLOW	DIR.	TIME	FLOW	DIR	COMMENTS
0954	1.00	175	S0953			
56	.88	177				
58	.70	179				
60	.59	181				
62	.59	180		.6	190	
64	.62	179				
66	.55	0				Flow reversal at 0966 - 0965
68	.49	0				
10	.54	177				
12	.62	174				
14	.71	175	F1013			
1226	.75	357	S1227			
1228	.87	357				
1230	.88	358				Slack tide in this time frame.
1232	.90	357		.9	22	There are 2 reversals within
34	.88	350	F1233			~30 minutes of these readings.
1548	.76	356	S1540			
50	.78	353				
52	.72	355				
54	.71	356				
56	.70	356		.7	10	
1600	.72	357	F1600			
02	.71	357				
1920	.83	192	S1910			
22	1.0	190		.95	195	
24	1.13	191				
			?			

CONTINUOUS FLOW			INSTANTANEOUS FLOW			COMMENTS
TIME	FLOW	DIR	TIME	FLOW	DIR	
2326	.70	179	S 2318			
28	.62	178		.6	195	
30	.54	175	F 2332			
0404	.71	1	S 0405	.47	15	* Continuous flow for this time frame ranges from .71 to 1.17 and from 0° to 357°. There is no similarity in flow values here.
	*	*				
0436	1.17	357	F 0435			
0728	.33	174	S 0729			
30	.53	180		.49	200	
32	.66	177				
34	.66	172	0756			
1050	1.01	186	S 1045			
52	.92	174		.95	190	
54	.82	173				
56	.70	176	F 1100			
1226	.66	354	S 1220			
28	.75	358		.7	15	
30	.82	359	F 1245			
1656	1.07	356	S 1640			In each case, the direction seems to be a higher number of degrees for the instantaneous flow reading. Possibly a standardization problem
1658	.99	353				
1700	.93	355				
1702	.95	357		.95	10	
1704	.93	355				
1706	1.09	356	F 1717			

AEROVOX SYNOPTIC STUDY



I. NFLD
II. BFLD
III. SFLD
IV.
V. NEBB
VI. BEBB

VII. SEBB
VIII.
IX. NFLD
X. BFLD
XI. SFLD
XII.

I.
II. NEBB
III. BEBB
IV. SEBB
V.
VI. NFLD

VII. BFLD
VIII. SFLD
IX.
X.
XI.
XII.

$\bar{x}$ - Flood = 96,000,000

$\bar{x}$ Ebb = 97,000,000

Δ = 1,000,000

1.03% Fresh Input

.50"
12.5 HRS

I = .04
A = 11,776
C = .25[illegible]

12[illegible].6 [illegible]

TIDESTAGE	Avg Velocity (2 min intervals) ft/sec	×	Median Area sq. ft. (Tide staff adj.)	=	Avg Flow	× # hours	=	TOTAL VOL. OVER TIDE STAGE cu. ft.	×	Avg. PCB	=	Total PCB Transmitted (mg)
FLOOD 1 1/11/83 1/11/83 (7:28) 8/9/12 min flow reversals	1.23 ft/sec	×	3237 sq. ft. (TS=5.15)	=	3981 cu. ft./sec	× 26,880 sec	=	1.07×10^8 cu. ft. 107,000,000	×	25.2 ug/cu. ft.	=	27. $\times 10^8$ ug PCB
EBB 1 1/11/83 0623 - 1130 (5:07) 8/2/10/2 min flow reversals	1.88 ft/sec	×	3240 sq. ft. (TS-5.175)	=	6091 cu. ft./sec	× 18,420 sec	=	1.12×10^8 cu. ft. 112,000,000	×	46.0 ug/cu. ft.	=	51.5×10^8 ug PCB
FLOOD 2 1/11/83 1131 - 1848 (7:17) 18/20/14/14/6 min flow reversals	.96 ft/sec	×	3157 sq. ft. (TS = 4.5)	=	3031 cu. ft./sec	× 26,220	=	0.79×10^8 cu. ft. 79,000,000	×	31.4 ug/cu. ft.	=	24.8×10^8 ug PCB
EBB 2 1/11/83 (5:03) 1849 - 2352 0 flow reversals	1.47 ft/sec	×	3139 sq. ft. (T.S. = 4.35)	=	4614 cu. ft./sec	× 18,180	=	0.84×10^8 cu. ft. 84,000,000	×	44.2 ug/cu. ft.	=	37.5×10^8 ug PCB
FLOOD 3 1/11/83 - 1/12/83 2353 - 0718 (7:25) 26/min flow reversal	1.2 ft/sec	×	3172 sq. ft. (4.625)	=	3806 cu. ft./sec	× 26,700	=	1.02×10^8 cu. ft. 102,000,000	×	18.7 ug/cu. ft.	=	19.1×10^8 ug PCB
EBB 3 1/12/83 0719 - 1222 (9:53) 0 flow reversals	1.72 ft/sec	×	3181 sq. ft. (4.7)	=	5471 cu. ft./sec	× 17,580	=	$.96 \times 10^8$	×	34.3 ug/cu. ft.	=	32.9×10^8 ug PCB

Hi $\bar{x}$ = 6.6
Low $\bar{x}$ = 2.8

These depths represent water height at tidestaff 4.8

Depth Profile

21'6" water to Bridge rail

Bank - Bridge rail to rock

STA	Feet	STA	Feet
0	4.5 17		
1	-1.0 20'.6"	25	40' 0" 18.5
2	-.5 21	26	39' 8" 18.2
3	1.5 23	27	39' 5" 18
4	1.0 22'.6"	28	39' 4" 17.9
5	4.0 25'.6"	29	39' 0" 17.5
6	5.0 26' 6"	30	38' 10" 17.3
7	7.7 29' 2"	31	38' 2" 16.7
8	8.8 30' 4"	32	37' 10" 16.3
9	11.5 33' 0"	33	36' 5" 14.9
10	12.9 34' 5"	34	36' 0" 14.5
11	12.8 34' 4"	35	35' 4" 13.8
12	14.7 36' 2"	36	34' 8" 13.2
-13	0	37	33' 8" 12.2
-14		38	32' 2" 10.7
-15		39	30' 6" 9.0
-16	16.5 38' 0"	40	28' 1" 6.6
17	17.1 38' 6"	41	26' 10" 5.3
18	17.8 39' 4"	42	21' 6" 0
19	18.3 39' 9"	43	21' 4" -.2
20	18.5 40' 0"	44	19' 5" -2.1
21	18.6 40' 4"	45	17' 0" -4.5
22	19.0 40' 6"	46	17' 2" -4.3 ABUTMENT
23	18.3 39' 9"		
24	18.7 40' 2"		

Finish 1643 HRS.

Low Trans 1-11 FLOOD 0328 – 0510 – During rain

High TSS

High TOTAL PCB

Rain began – midnight

1-11-83 EBB 2257 – 2400

Low Salinity B1-B2

Storm effects, fresh H_2O

EBB

1-12-83 1025 – 1200

Low Salinity B1-B2

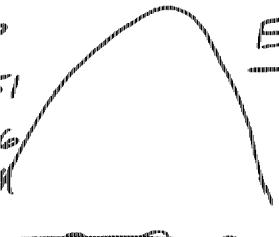
high Total PCB B2 highest, B, however

B has high Salinity

TOTAL PCB

FLOOD

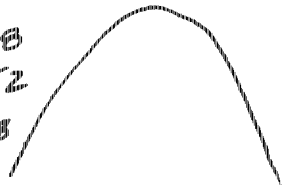
B2	TOTAL	TSP
A	1.05	0.51
B	1.37	0.86
C	1.35	0.84



EBB

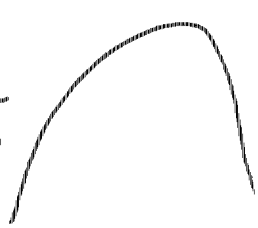
B2	TOTAL	TSP
A	1.74	0.93
B	1.51	0.70
C	1.84	1.03

A	0.70	0.18	
B	1.06	0.52	
C	0.91	0.28	



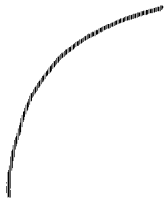
A	3.43	1.92	Salinity 18.5‰, low Trans high TCP-PCB
B	1.68	0.45	low salinity
C	1.48	[illegible] 0.61	low salinity

A	0.93	0.51	
B	0.77	0.35	
C	0.34	0.24	



A	2.91	1.83	low salinity, low trans., low TSS
B	2.06	1.07	
C	0.77	0.29	

A	0.98	0.35
B	0.80	0.41
C	0.43	0.33



- Total PCB always higher during EBB
- high [illegible] at B2-A station at freshwater fl
- " " usually higher at top area [illegible] in B1-B3 in EBB
- PCB appears high during fresh H2O influence!

	Ht. Stg	Time	
1/10/83			
EBB	4.9	1935	AVG HIGH
	4.0	2026	AVG LOW
	3.2	2133	
	3.0	2224	
	2.9	2250	
FLD	3.0	2310	FLD TIDE
	3.1	2325	
	3.2	2342	
1/11/83	4.1	0045	
	4.9	0147	
	5.7	0233	
	6.1	03,22	
	6.4	0406	
	6.7	0444	
	7.4	0612	
EBB	7.3	0703	SLACK EBB
	6.1	0821	
	5.6	0843	
	5.0	0915	
	4.5	0927	
	3.7	1021	
	3.0	1105	
FLD	3.0	1158	

	Tide Staff	Time
	~~3.0~~	~~1105~~
	3.7	1411
	4.1	1503
	4.2	1530
	4.5	1609
	4.8	1637
	5.5	1735
	5.9	1826
	5.9	1834
	5.9	1858 HW Slack
Ebb	5.1	1949
	3.9	2115
	3.4	2157
	3.2	2248
	2.7	2345 LW Slack
Fld	2.9	0020
	3.2	0139
	3.6	~~1430~~ 0220
	4.2	~~1550~~ 0258
	4.4	0328
	4.9	0404
	5.3	0437
	5.7	0525

8 — 2. 11-12

Start 1145 [illegible]

	TIDE STAFF	Time	
	6.5	0621	
	6.5	0719	Flood HSLACK
EBB	6.2	0750	
	6.3	0801	
	5.4	0859	
	4.5	0945	
	3.5	1052	
	3.2	1130	
	2.9	1226	EBBSLACK
	2.1	1247	
	3.2	1412	
	3.7	1518	
	4.3	1612	
	4.7	1639	
	5.2	1715	
	5.6	1741	

TIDE STAFF READINGS

MONDAY 1/10/83

TIME	STAFF (FT)	
1442	3.7 (tide coming in)	
1515	4.0	Flow meter in
1543	4.4	
1606	4.8	
1622	5.0	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

EDISON, NEW JERSEY 08837

February 1, 1983

Captain George F. Ireland
COTP-Providence, R.I.
John O. Pastore Federal Building
Providence, RI 02903

Dear Captain Ireland:

Attached is Interim Report #2 on the Movement of PCB's in New Bedford Harbor which describes our latest round of studies conducted in January to investigate the movement of PCB's in New Bedford Harbor. This report emphasizes the logistics and details associated with the actual conduct of the study effort, including the methodology and techniques used in the collection of the oceanographic data.

Most of the physical data has been received and is presently being reduced for marriage with the results of the PCB analyses which are forthcoming. Dick Jadamec (USCG R&D Laboratory) has indicated that all the analytical work should be completed and supplied to us by February 10th. This will allow us to perform specific statistical tests to correlate the PCB levels observed with certain physical parameters. Once these procedures have been completed, we can then interpret the data and postulate transport mechanisms for the Upper Harbor area, as well as evaluating the representativeness of the data collected during the September study.

Barring any unforeseen difficulties, we should be in good shape to present our preliminary findings at another meeting of the Techical Review Panel on February 17th at EPA Regional Laboratory in Lexington, MA. As previous, we anticipate that this meeting will commence at 1000hours(EST). The comments from the Technical Review Panel will be most helpful in preparing for the RRT meeting.

We expect that a final draft will ready for circulation for comment during the second week in March with a final report completed shortly after the receipt of the comments from the reviewers.

Sincerely yours,

Attachment

Royal J. Nadeau

cc. Ken E. Biglane	EPA Headquarters, Washington, DC.	(w/att)
✓Rick Stanford	EPA Headquarters, Washington, DC.	"
Gerard Sotolongo	EPA Region I, Boston, MA.	"
Ed Conley	EPA Region I, Lexington, MA.	"
Dr. Tudor Davies	EPA Narragansett Laboratory	"
Captain B. Eldridge	USCG-District Hqts, Boston, MA.	"
Richard Jadamec	USCG-R&D, Groton, CT	"

AEROVOX PCB DISPOSAL SITE
ACUSHNET RIVER AND NEW BEDFORD HARBOR, MA

PCB MASS TRANSPORT STUDY

by the
ENVIRONMENTAL RESPONSE TEAM
Edison, N.J.

Second Interim Report
January 1983

sediments settled out of suspension in about 30 minutes. The residual concentrations of PCBs remaining adsorbed to suspended particulates after two hours of testing were positively correlated to the original PCB concentration of Acushnet River sediments. An oil phase was also released during turbulent mixing studies, indicating that PCB co-solubility in oil provides another mechanism for PCBs to enter the water column. PCBs were also found to leach into overlying even under quiescent water conditions. The PCB concentration in the water column was also directly related to sediment concentration.

Field studies revealed some interesting phenomena that indicate the difficulties encountered when characterizing an estuary on the basis of only one complete tidal cycle, conducted under clear weather conditions. A brief reversal of tide flow was apparent in both the flood and the ebb tide. Higher concentrations of particulate PCBs occured in the flood tide when compared to the ebb tide. Low level contamination of fresh waters feeding the Acushnet River was discovered.

The Technical Task Group which met in December 1982 indicated that some observations made during the September study may be anamolous. On this basis the following recommendations were made:

A. The mixing patterns of this water mass needed more study.
B. A mass transport study balance for PCB's in this water mass was needed.
C. New studies should attempt to encompass a major rainfall event.
D. New studies should be used to determine if the September efforts are representative of transport mechanisms in effect in New Bedford Harbor.

ADDENDUM STUDIES

To accomodate the recommendations of the December Task Group, a more comprehensive study on the upper reaches of the Acushnet River and New Bedford Harbor was planned. On January 10-12, 1983 a joint USCG COTP-PROV and EPA (ERT) effort was conducted to continuously monitor the water mass passing through the Coggeshall bridge for three complete tidal cycles (39 hours). Examining three consecutive tidal cycles minimizes the potential for anomalies in one tidal cycle to bias overall study results. Comparisons between the January and September studies may also be made to clarify the September results.

A major objective of the January studies was to provide a more detailed investigation of the mixing patterns and characteristics of the water mass passing beneath the Coggeshall Bridge. This objective was achieved through the design of a more intensive sampling scheme which partitioned the cross-section of the water mass below the bridge into a 3 x 3 grid. Combining the data from the grid sections provided a better characterization of the whole water mass than the September study provided.

The weather was perfect to meet study objectives, with a significant rainfall event occurring during the first flood tide studied, between 3:00am and 6:30am on January 11. The storm was accompanied by strong southeasterly winds, resulting in an unusually high early morning tide. Normal sampling runs were conducted by the survey team despite the heavy rains and two to three foot swells.

PERSONNEL/OPERATIONS

Two crews, comprised of five to seven members, worked alternating six hour work shifts to provide continuous monitoring of the water mass. A list of personnel involved in field operation is included in Table 1. Shifts normally overlapped from 15 to 30 minutes to assure smooth operations. At a minimum, a four-man boat crew manned the 21-foot, inboard/outboard aluminum boat provided by the USCG. The crew consisted of two Coast Guard members, an ERT representative and a technician from ENDECO (an oceanographic consulting firm contracted by ERT). All boat crew members wore "Mustang" suits for protection from the elements and to provide flotation in case of mishap.

The command post, a Winnebago stationed in a parking lot west of the bridge, was occupied by one or more personnel responsible for maintaining data logs and continuous radio communication with the boat crew. The CP also provided an area for the transfer of information and debriefing as crews changed shifts.

USCG personnel out of Groton, CN provided support in their mobile laboratory, located adjacent to the command post. While water samples and physical characteristics of the harbor were being measured from the boat, the lab crew filtered previously collected samples and began the extractions necessary to prepare samples for PCB analysis.

PARAMETERS MEASURED

Tide Staff: A fiberglass surveying range-pole, scaled to tenths of a foot, was erected beneath the Coggeshall Bridge to record fluctuations in water level beneath the bridge due to tidal action. Readings were obtained at least every 30 minutes. Staff readings have been plotted against time in Figure 1.

Depth Profile: Direct depth readings were taken from the bridge railing using a weighted rope marked off in one-foot increments. Measurements were taken every three feet between the abutments of the Coggeshall Bridge. The profile was completed within a 30 minute period during the afternoon flood tide on January 12.

Salinity, Conductivity, and Temperature: Salinity, conductivity, and temperature measurements were taken using a Yellow Spring Instrument Co. (YSI) model 33 S-C-T meter. The operating principle of this instrument is based on the ability of ionized substances in the water column (in this case primarily dissolved salt) to carry an electric current between electrodes in the instrument's probe. Since electrolytic conduc-

tivity is temperature dependent, an electrical thermometer having a small thermistor sensing element was also incorporated into the instrument because of its rapid response. This instrument is sensitive to the nearest 10 umhos/cm for conductivity, the nearest part per thousand for salinity and 1°C for temperature.

Dissolved Oxygen: Oxygen concentrations were measured with a YSI model 54 oxygen meter with a battery powered agitator adaptor. The agitator keeps a fresh supply of water moving across the oxygen-sensitive membrane electrodes in the D.O. probe to avoid localized dissolved oxygen depletion around the membrane. The 50-foot cables for the D.O. meter and the S-C-T meter were taped together and lowered as a single unit to achieve simultaneous readings.

Flow Rate and Direction: Two technicians from Endeco, Inc., an oceanographic consulting firm, were contracted by ERT to provide measurements of flow and transmissivity. A stationary Endeco type 174 digital recording current meter system was tethered to a steel cable centered on the south side of the Coggeshall Bridge. The instrument was lowered to a stationary depth five-feet off the bottom of the channel beneath the bridge. Every two-minutes the meter recorded flow rate, flow direction, temperature, conductivity, and salinity. Recordings were made on a magnetic tape contained within the submerged instrument. The deviation of the meter is +/- 3 percent for flow rate and +/- 7.2° for direction when flow rate is greater than .05 knots (2.57 cm/sec). A different flow meter was used to obtain flow readings at each discrete sampling location and depth. This meter provided direct readings of flow and direction to an instrument panel kept on the boat.

Light Transmission: A Sea Tech, Inc. Transmissometer S.N. 102 was used to determine differences in light transmission at all sample locations and depths. The instrument directs a monochromatic light beam through the water column toward a detector over a 25 cm pathlength. Dissolved or particulate matter entrained in the water will scatter or absorb a portion of the light transmitted. The remaining light reaching the detector is converted into electrical current which is read in volts on an onboard instrument panel. After laboratory calibration of the instrument, the voltage reading can be converted to the percent of light transmitted or absorbed. Generally speaking, the higher the transmission of light, the higher the water quality. This particular model has a +/- 0.5 percent accuracy.

Suspended Material: A plankton net was used to collect samples of suspended materials. The 143 um mesh, 12 cm diameter net was attached to the center cable on the south side of the Coggeshall Bridge at a depth of five feet. Samples were collected for up to 2 hours during the high flow periods of both the flood and the ebb tide. The sides of the net were rinsed down into a collection vessel with distilled water. These samples will be extracted and analyzed for PCBs. By knowing the flow rate and the surface area sampled by the plankton net, total suspended particulate loading can be determined for particles greater than 143 um.

SAMPLING PROCEDURES

The timing of water sampling and measurement of physical characteristics is shown graphically in Figure 1. Sampling efforts were designed to characterize the highest flow periods of both the ebb and the flood tide, for each of the three tidal cycles studied. To achieve this end, samples and measurements were collected at all stations and depths during high flow periods. Additional samples were collected only at station B.2 (center of the bridge) during slack water periods.

The Coggeshall Street Bridge was used to delineate three sampling stations (Figure 2). Each station was marked by a steel-cable, suspended vertically from the north side of the bridge and anchored with 100 lb. weights. The cables were placed at equal distances across the channel, dividing it into thirds. The cables served as guidelines for lowering the instruments, probes and samplers to prevent these devices from being carried off by the swift current under the bridge. The cables were delineated as station B.1, B.2, B.3 for the eastern, center, and westernmost cables, respectively. An additional cable was centered in the channel on the south-side of the bridge. This cable was used to tether the continuous flow meter and the plankton net.

To provide for a synoptic survey of the estuary, two more sampling stations were located 1.4 miles north and 0.5 miles south of the Coggeshall Bridge. A standard navigational aid, Nun Buoy #4, marked the southern sampling location (S) and a temporary buoy marker was used to identify the north sampling station (N).

To adequately characterize the entire water column at the various sampling stations, each station was divided by depth into a surface third, a middle third, and a bottom third. At the appropriate times designated in Figure 1, the following sampling and physical measurement scheme was conducted at stations B.1 (Bridge-East) and B.3 (Bridge-West).

(1) Physical measurements, including all of the parameters mentioned above, were taken at three discrete depths to characterize the surface, middle, and bottom third of the water column.

(2) Water samples were taken with a brass Kemmerer sampler. Three, one-liter glass jars with teflon-lined caps were filled with water from the surface, middle, and bottom third of the water column. These samples were composited in the mobile laboratory. In addition to the composite sample, a discrete water sample was taken from the bottom third of the water column.

The following procedures were followed at stations N and S:

(1) Physical parameters were measured at discrete

locations in the surface, middle, and bottom third of the water column.

(2) Two or three, one-liter water samples were collected to represent the various sections of the water column.

The more intensive sampling which occurred at the center bridge station, B.2, can be described as follows:

(1) Physical parameters were measured as described for the above stations.

(2) Two, one-liter water samples were collected from three discrete depths within the surface, middle, and bottom third of the water column. Each set of two samples from a particular layer in the water column was composited in the mobile laboratory, resulting three discrete samples from this location.

LABORATORY PROCEDURES

USCG research and development personnel conducted the following activities in their mobile laboratory to prepare samples for analysis of total suspended solids (TSS) and polychlorinated biphenyls (PCBs).

The two, one-liter discrete samples and the composited samples were individually vacuum-filtered through 0.45 mu x 47mm Milipore® glass fiber filter pads, which were dried and tared prior to on-site response. Between one and two liters of the filtered water was then placed into a hexane-rinsed bottle. Any residual particulate materials in the original sample bottles was washed onto the filter pad with HPLC grade distilled water. The filter pad was then placed into a petri dish filled with silica gel and taped shut. Approximately two-thirds of all the water samples taken were filtered by the above manor in the mobile laboratory. In most cases, one-liter of filtered water was extracted with four, 20 ml portions of pesticide grade hexane. The hexane extracts were combined into hexane-rinsed glass vials for storage. Fifty percent of the filtered water samples were extracted in the mobile laboratory. Mystic River water and HPLC grade distilled water was used for blanks.

STATUS

On-scene operations began at 1200 hours on January 10, 1983 and were completed by 2000 hours on January 12, 1983. Data is currently being compiled and evaluated by ERT. Future reviews, comments, and actions by responsible Federal, State, and local agencies are expected.

TABLE 1: PERSONNEL

U.S. COAST GUARD

Marine Safety Office, Providence, R.I.

Ted Harrington	Lieutenant Junior Grade
Chris Oelschlegel	Lieutenant Junior Grade
John O'Connor	Quartermaster, First Class
Tom Marton	Machine Technician, Second Class
Christopher Blake	Port Securityman, Second Class
Russel Boyton	Machine Technician, Second Class
David Cate	Boatswain, Third Class

U.S.C.G. Research and Development Center, Groton, CN

Bob Hildebrand	Ph. D
Dick Jadamac	Chemist
Mike Sweetman	Marine Science Technician Chief

U.S. EPA-ERT

Royal Nadeau	Ph. D
George Prince	

WESTON, INC.

Phil Campagna
Charles Atwood

ENDECO, INC.

Nelson Adams
Edward Blainard III

FIGURE 1: TIDAL CYCLE - SAMPLING PATTERN

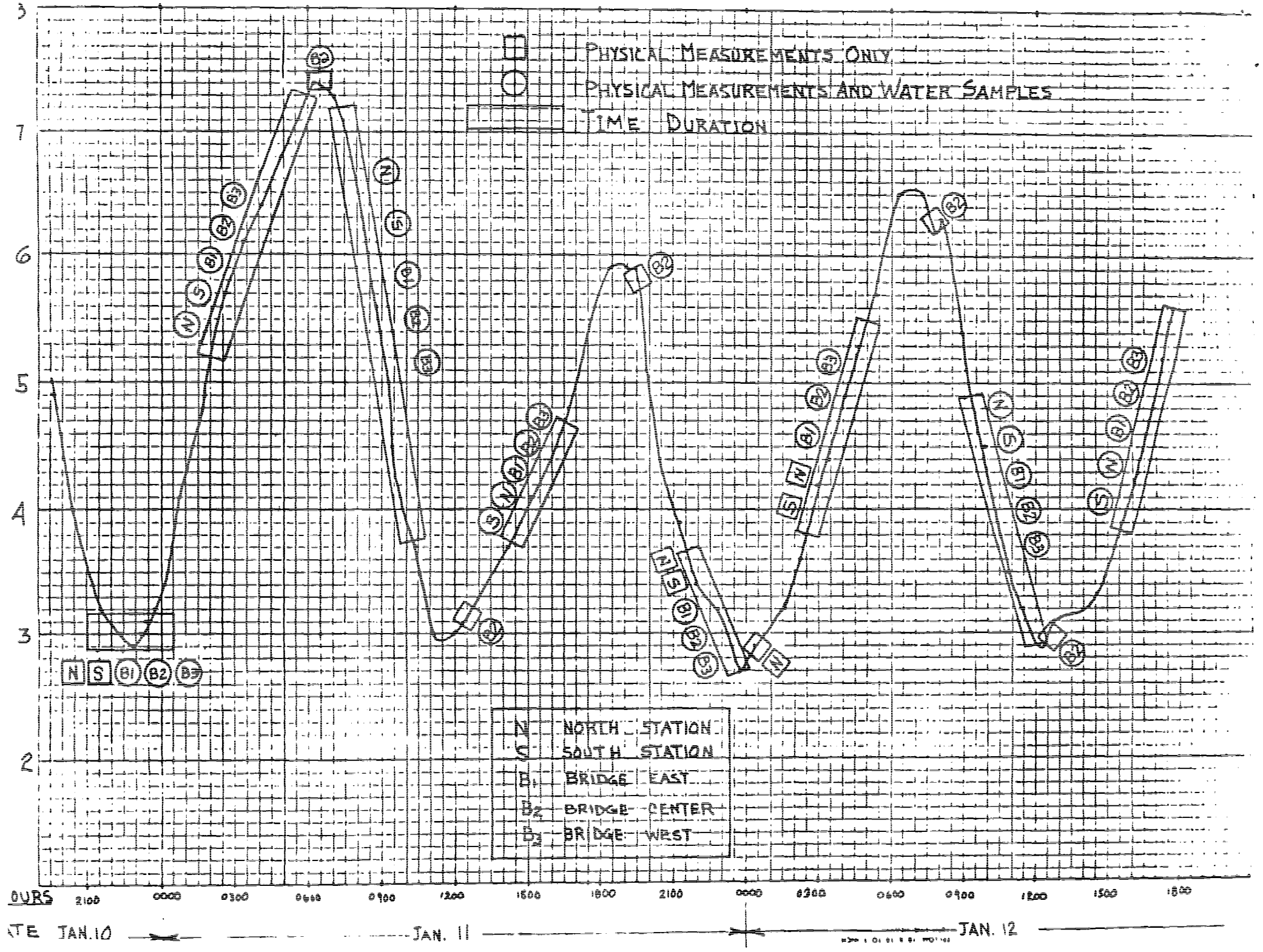
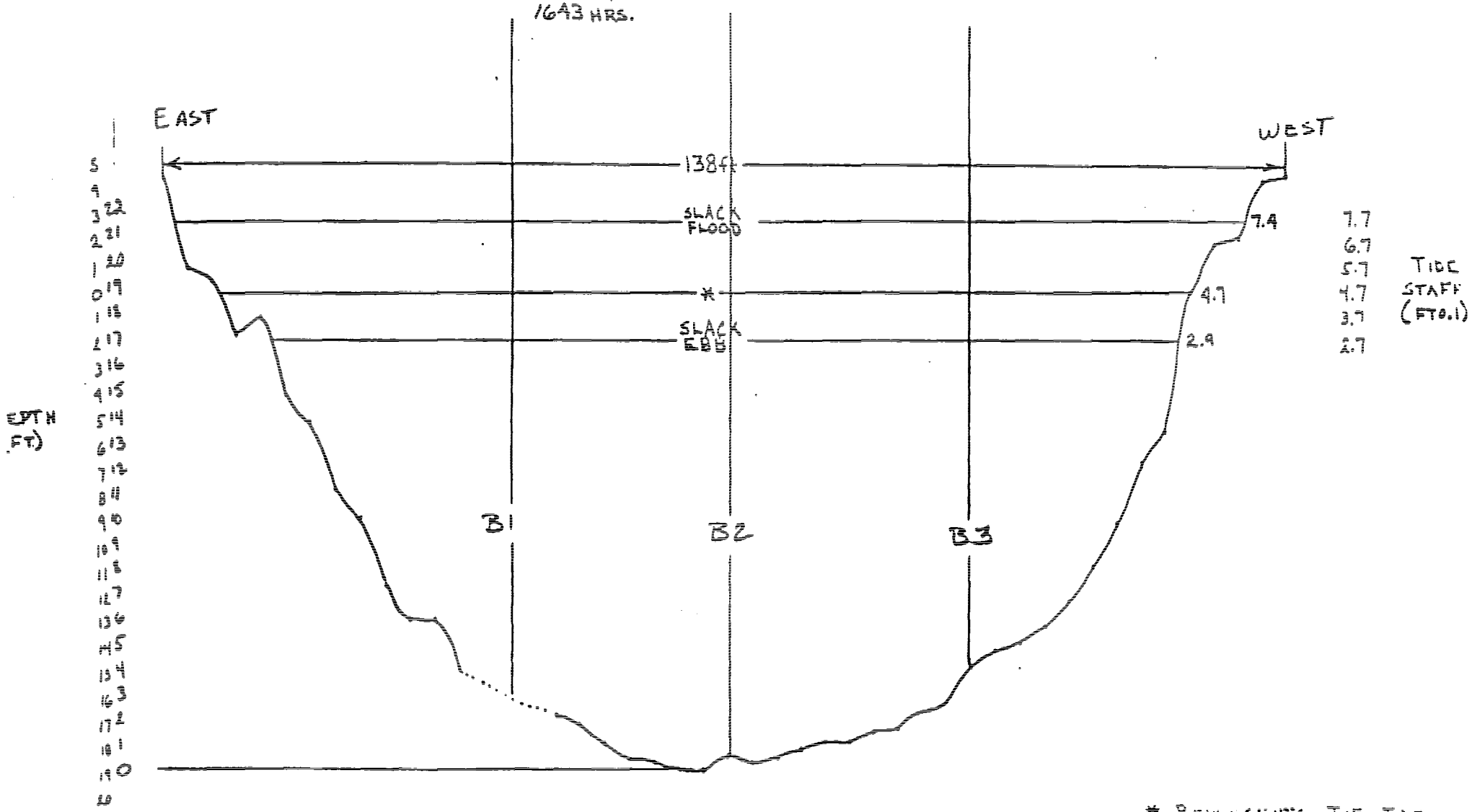


FIGURE 2: CROSS SECTIONAL AREA

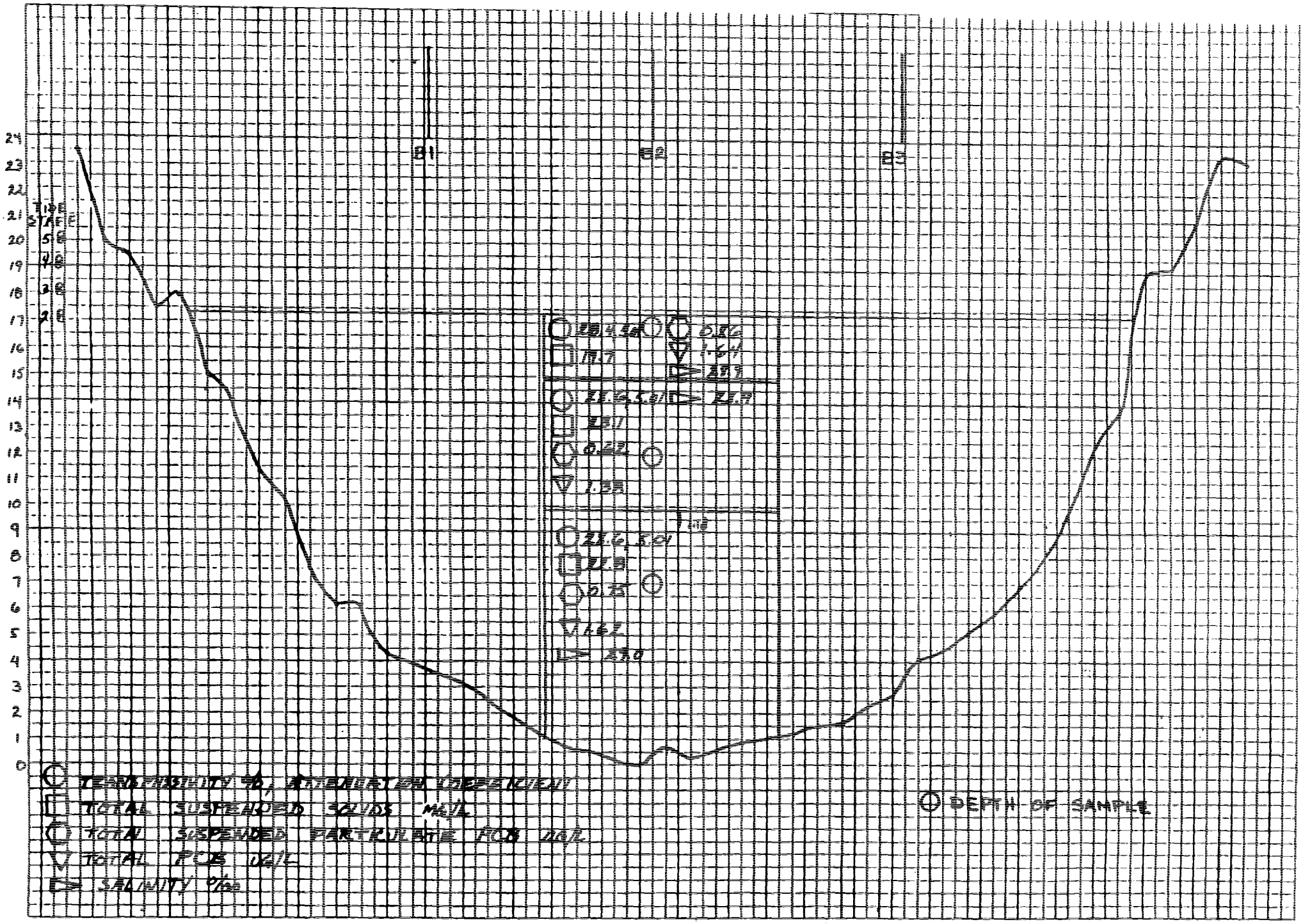
ACUSHNET RIVER

COGGASHALL STREET BRIDGE

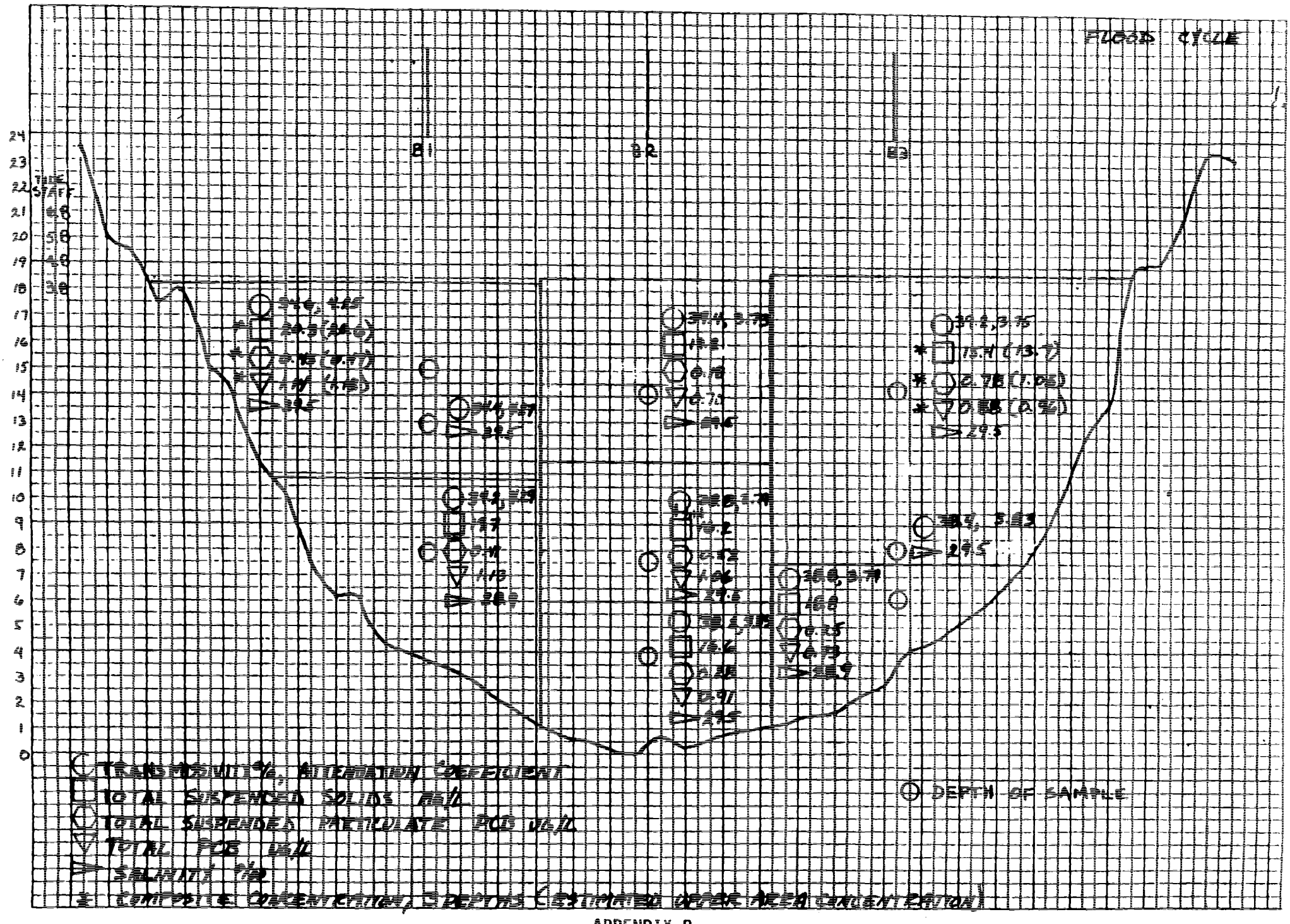
12 JANUARY 1983
1643 HRS.



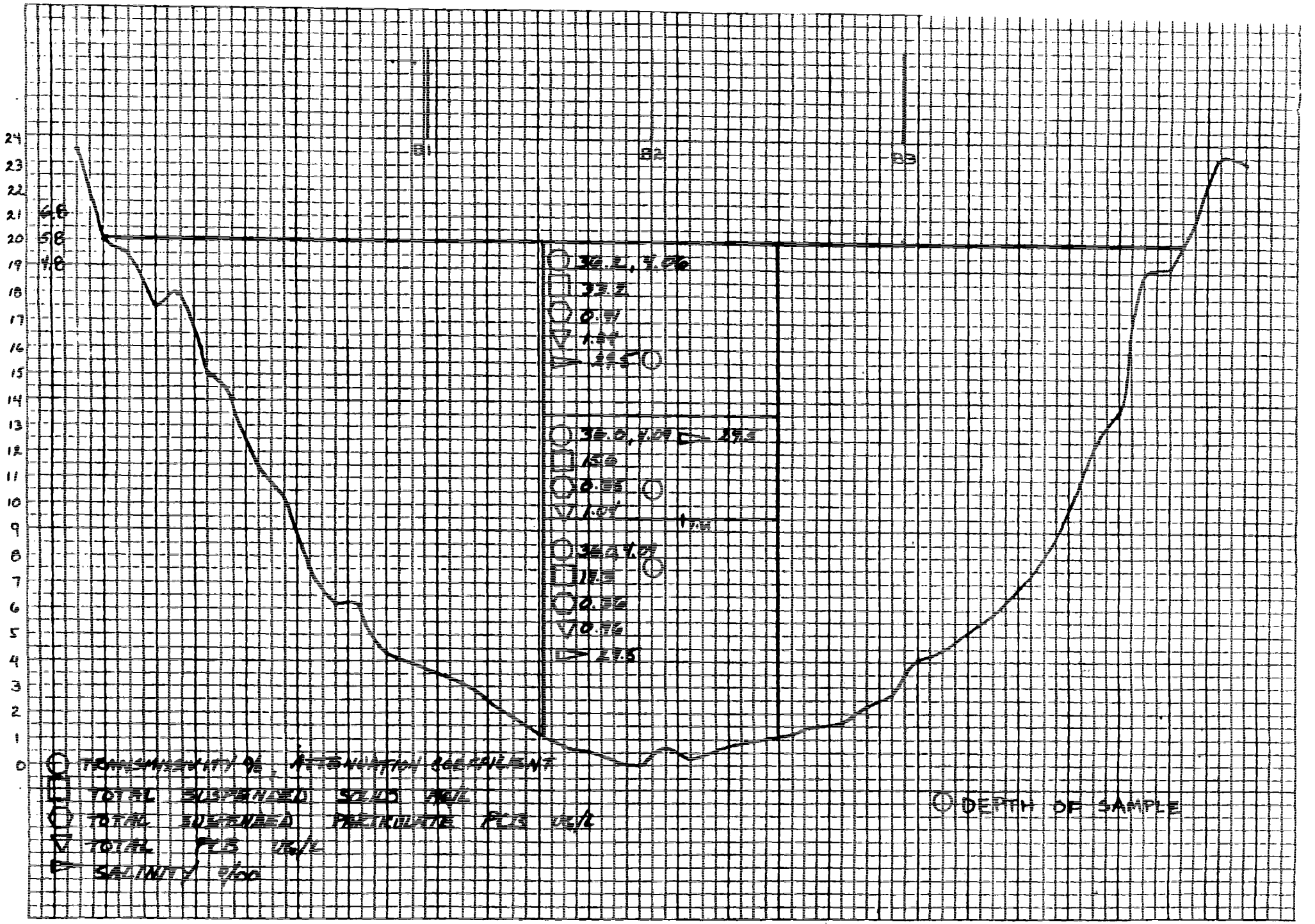
* REPRESENTS THE TIDE HEIGHT AT TIME OF BATHYMETRIC MEASUREMENTS


B1
B2
B3
TIDE STATE
TRANSMISSIVITY %, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS MG/L
TOTAL SUSPENDED PARTICULATE PO4 ug/L
TOTAL PO4 ug/L
SALINITY ‰
DEPTH OF SAMPLE

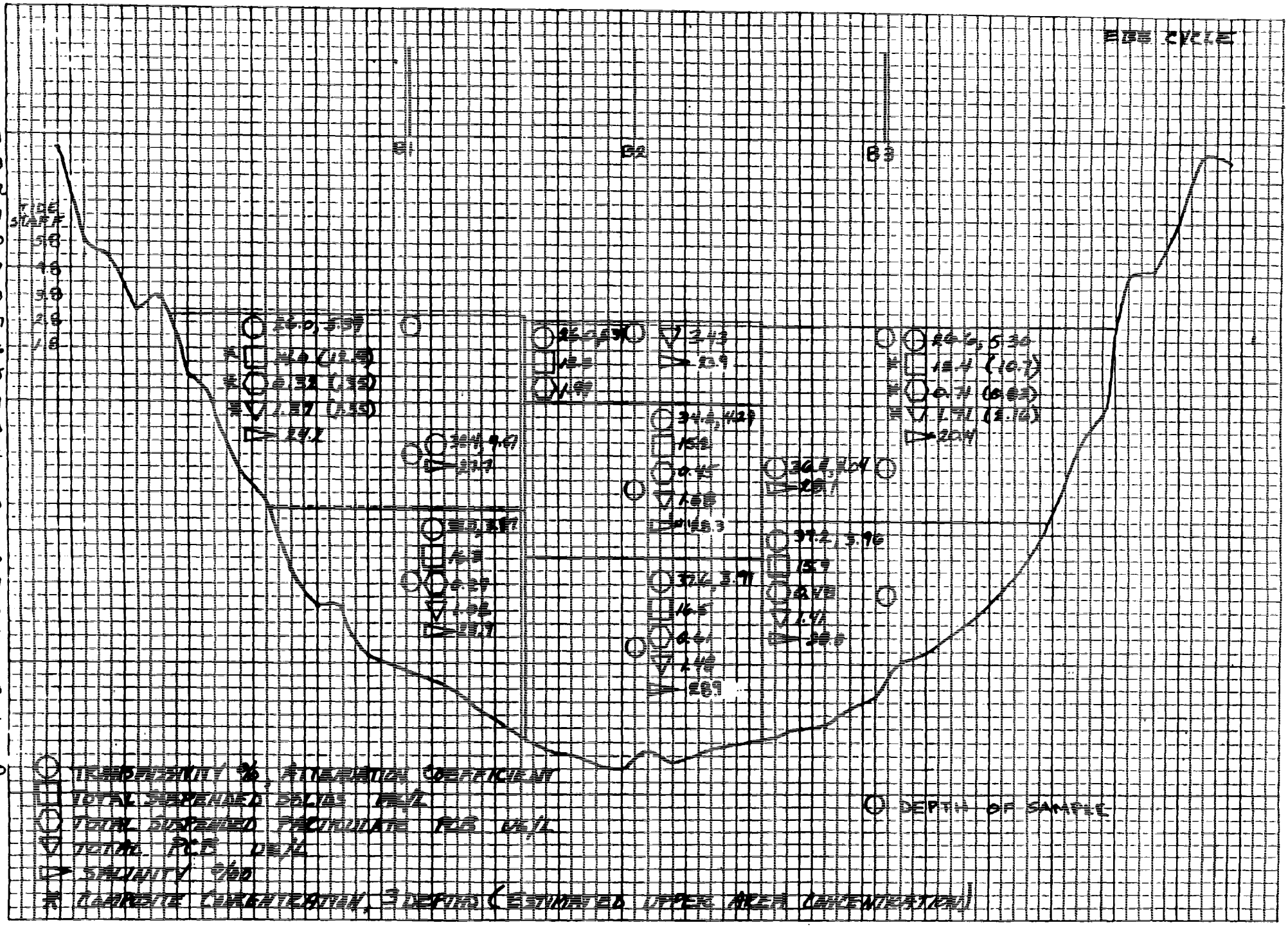
APPENDIX B


FLOOD CYCLE
B1
B2
B3
TIME START
TRANSMISSIVITY, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS mg/L
TOTAL SUSPENDED PARTICULATE POC ug/L
TOTAL POC ug/L
SALINITY ‰
COMPOSITE CONCENTRATION, DEPTHS (ESTIMATED OVER AREA CONCENTRATION)
DEPTH OF SAMPLE

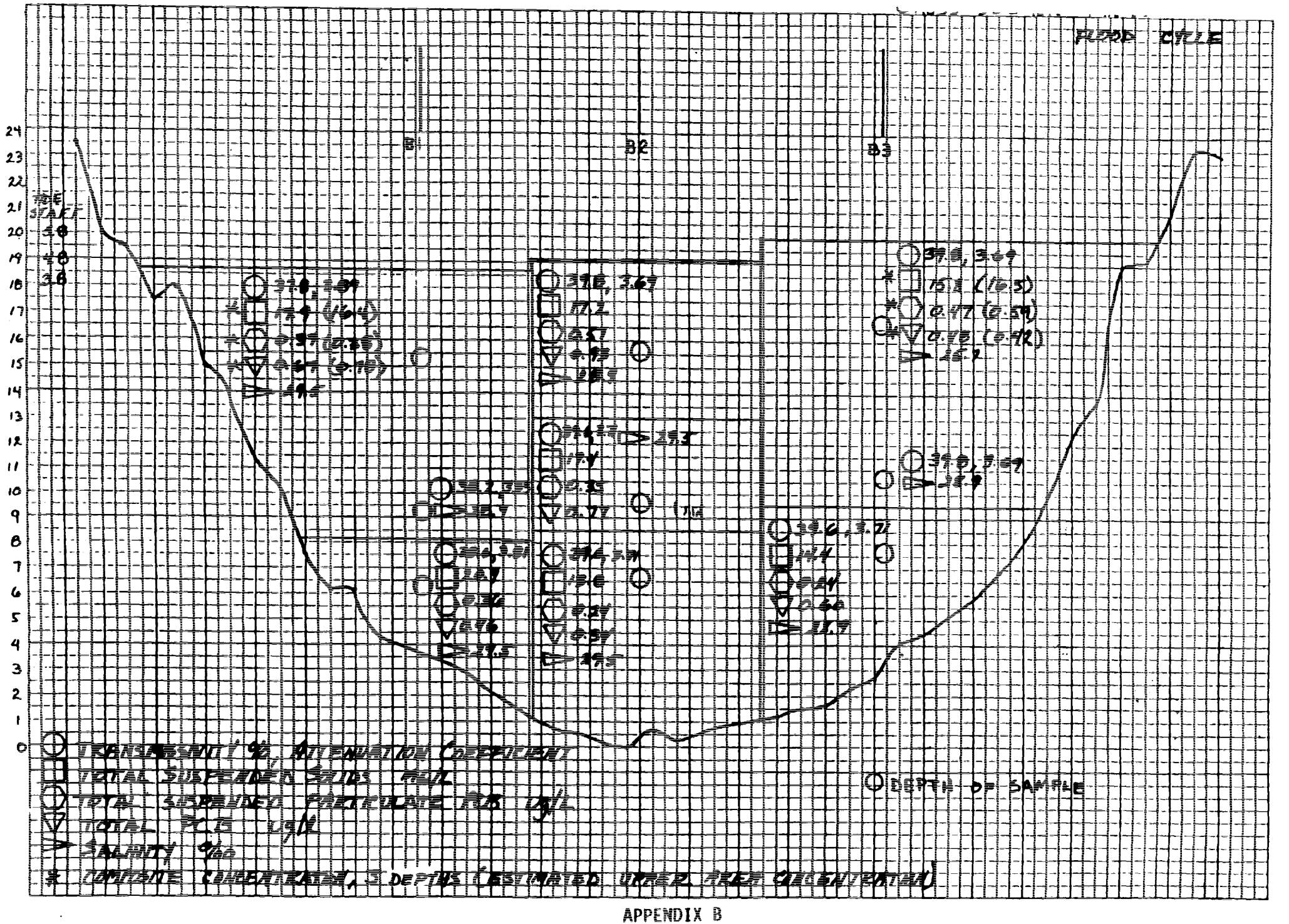
APPENDIX B


B1
B2
B3
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
TRANSMISSIVITY % ATTENUATION EQUIVALENT
TOTAL SUSPENDED SOLID mg/l
TOTAL SUSPENDED PARTICULATE PCB mg/l
TOTAL PCB mg/l
SALINITY ‰
DEPTH OF SAMPLE

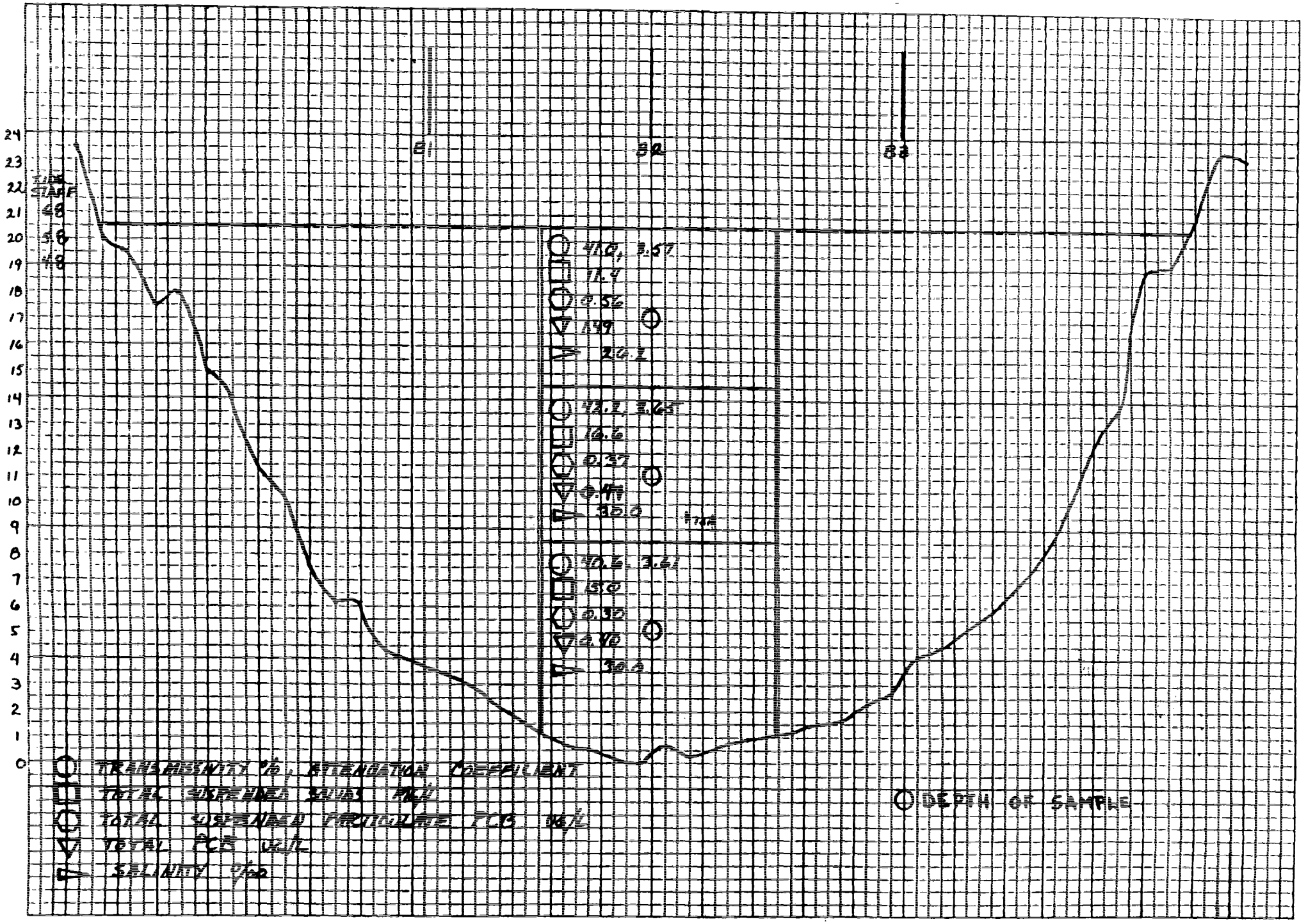
APPENDIX B


EBB CYCLE
B1
B2
B3
TIDE STAGE
TRANSMISSIVITY %, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS mg/L
TOTAL SUSPENDED PARTICULATE PCB ng/L
TOTAL PCB ng/L
SALINITY ‰
APPROXIMATE CONCENTRATION, 3 DEPTHS (ESTIMATED UPPER AREA CONCENTRATION)
DEPTH OF SAMPLE

APPENDIX B

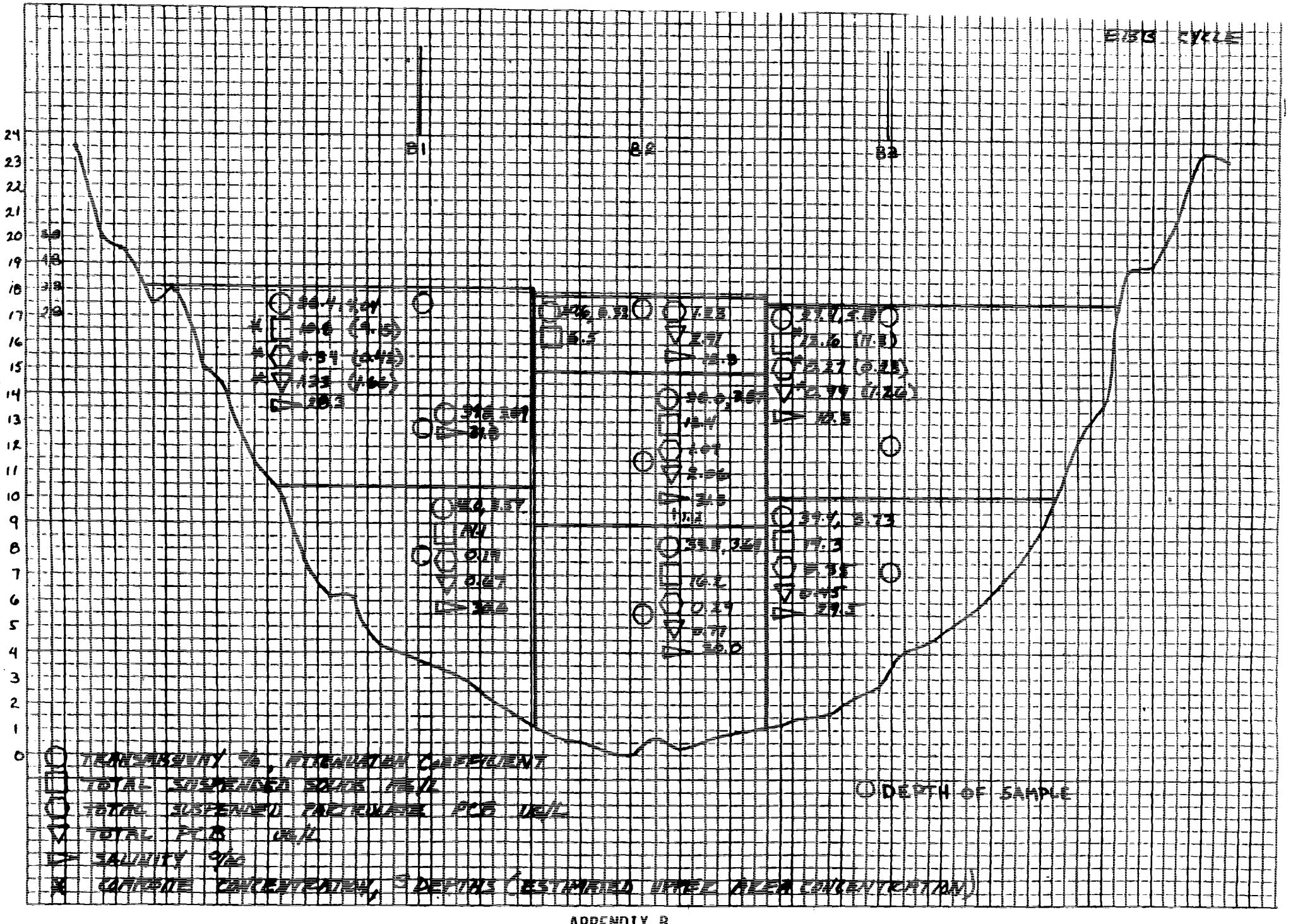

FLOOD CYCLE
B1
B2
B3
TIDE STAFF
TRANSMISSIVITY %, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS
TOTAL SUSPENDED PARTICULATE PCB ug/L
TOTAL PCB ug/L
SALINITY ‰
* COMPOSITE CONCENTRATION, 3 DEPTHS (ESTIMATED UPPER AREA CONCENTRATION)
DEPTH OF SAMPLE

APPENDIX B



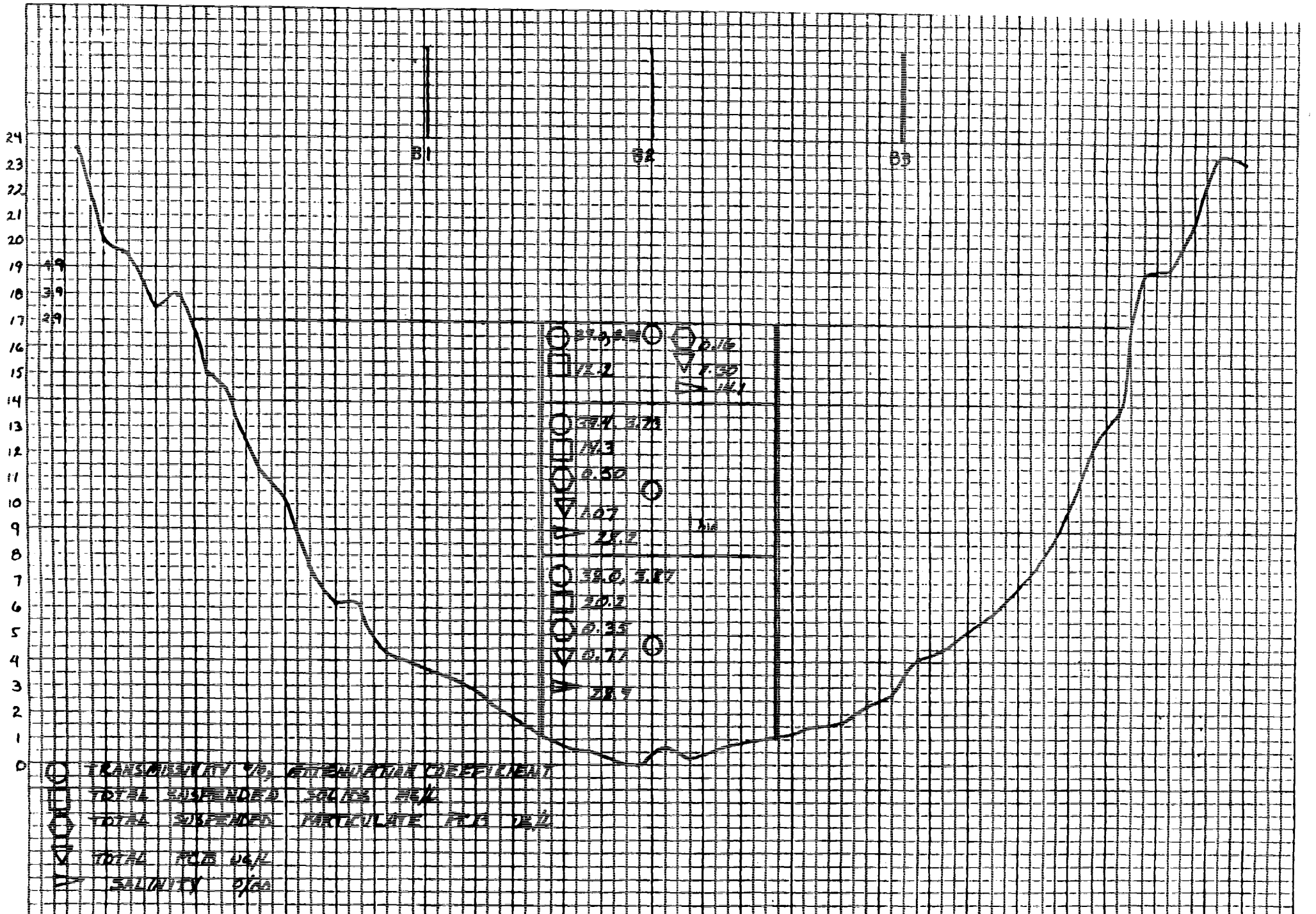
TIDE STAFF
6.8
5.8
4.8
B1
B2
B3
41.0, 3.57
11.4
0.56
1.49
26.2
42.2, 3.65
16.6
0.37
0.41
30.0
40.6, 3.61
15.0
0.30
0.40
30.0
TRANSMISSIVITY %, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS
TOTAL SUSPENDED PARTICULATE PCB
TOTAL PCB
SALINITY
DEPTH OF SAMPLE

APPENDIX B

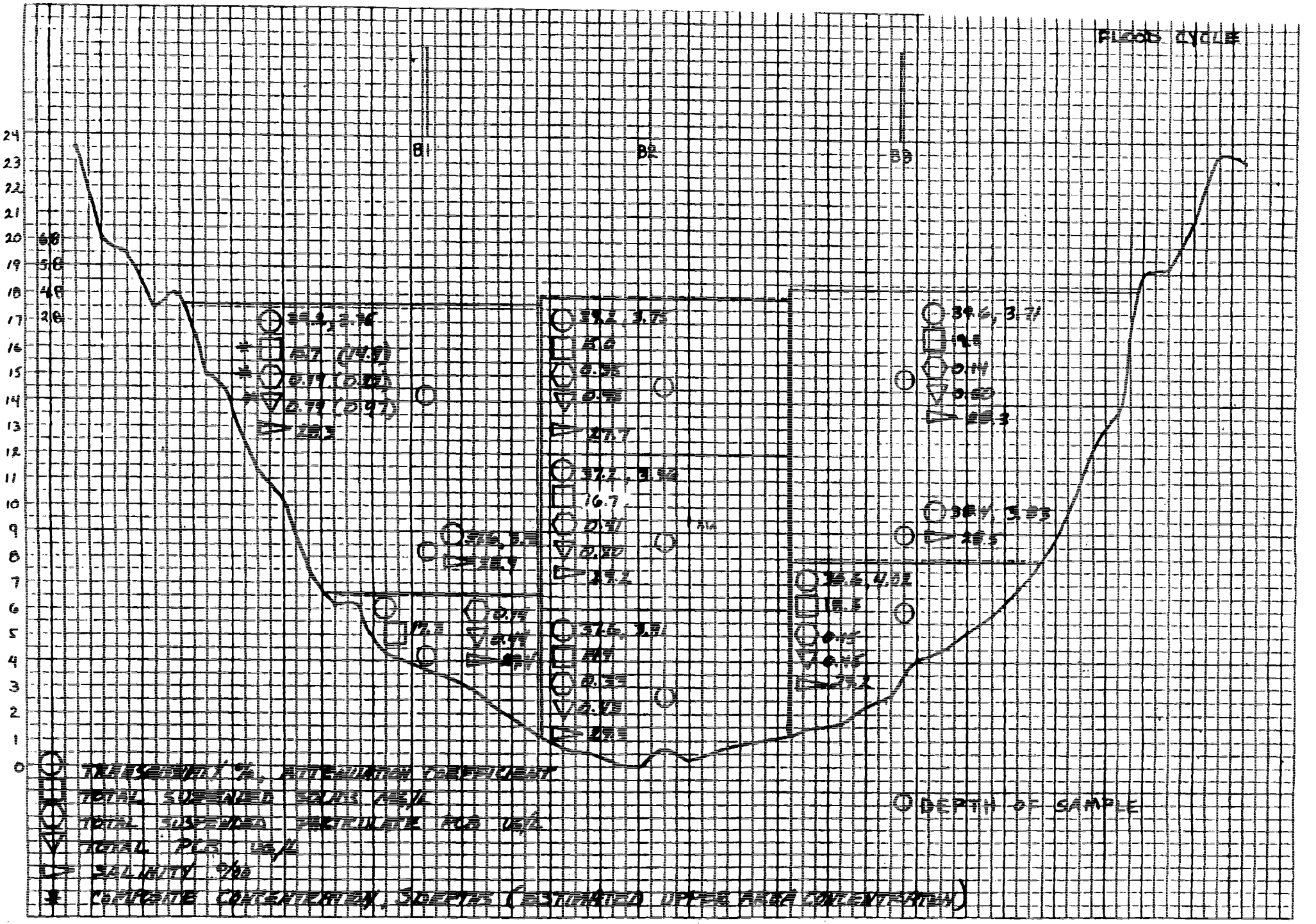


B1
B2
B3
TRANSMISSIVITY %, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS
TOTAL SUSPENDED PARTICULATE PCB
TOTAL PCB
SALINITY
COARSE CONCENTRATION, DEPTHS (ESTIMATED UPPER AREA CONCENTRATION)
DEPTH OF SAMPLE

APPENDIX B


B1
B2
B3
TRANSMISSIVITY %, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS MG/L
TOTAL SUSPENDED PARTICULATE PCB UG/L
TOTAL PCB UG/L
SALINITY O/OO

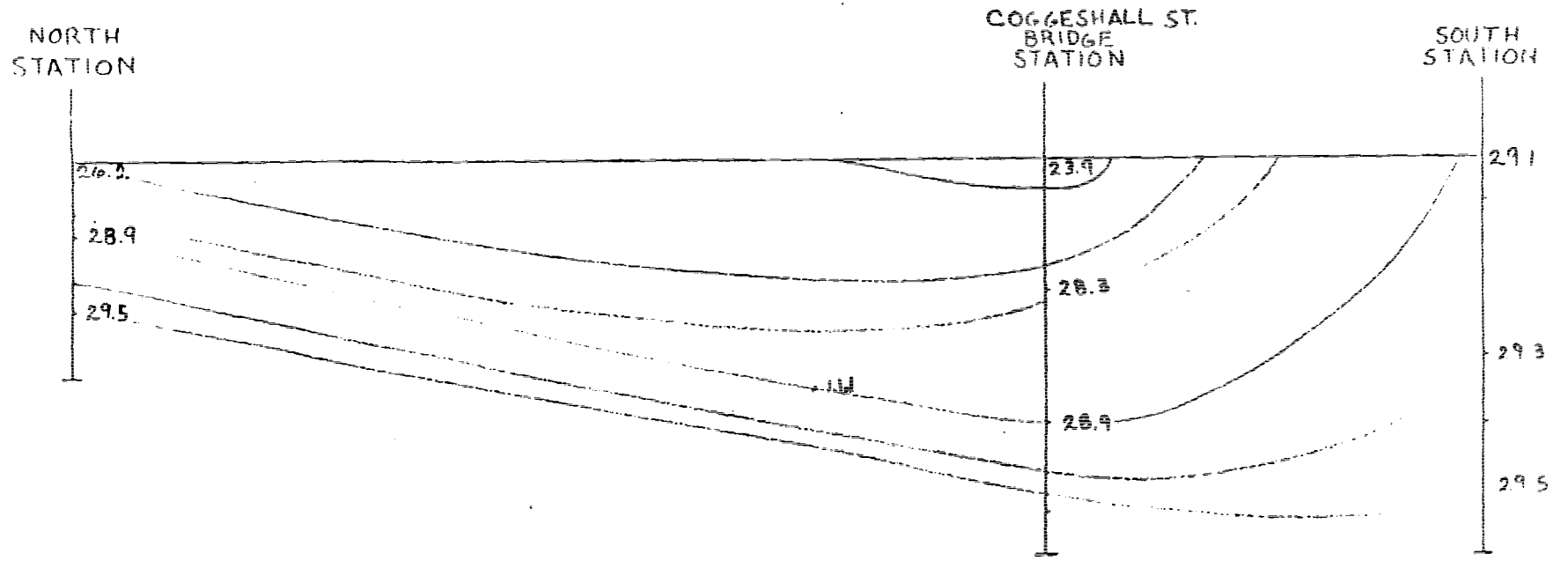
APPENDIX B



APPENDIX B

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: SALINITY (‰)

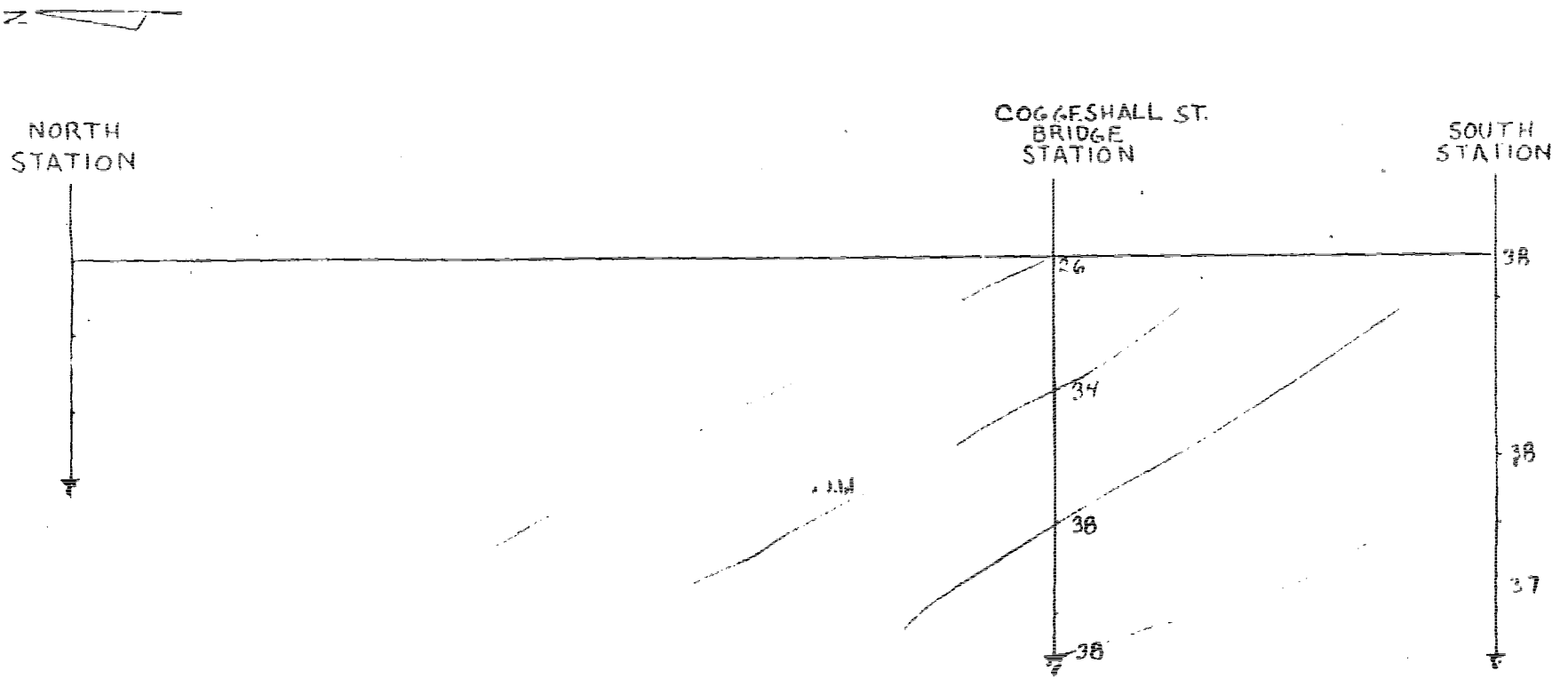
11 JANUARY 1983 2135-2332 HOURS

APPENDIX A

TIDE STAGE: EBB AVG STAFF 3.2

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TRANSMISSIVITY (%)

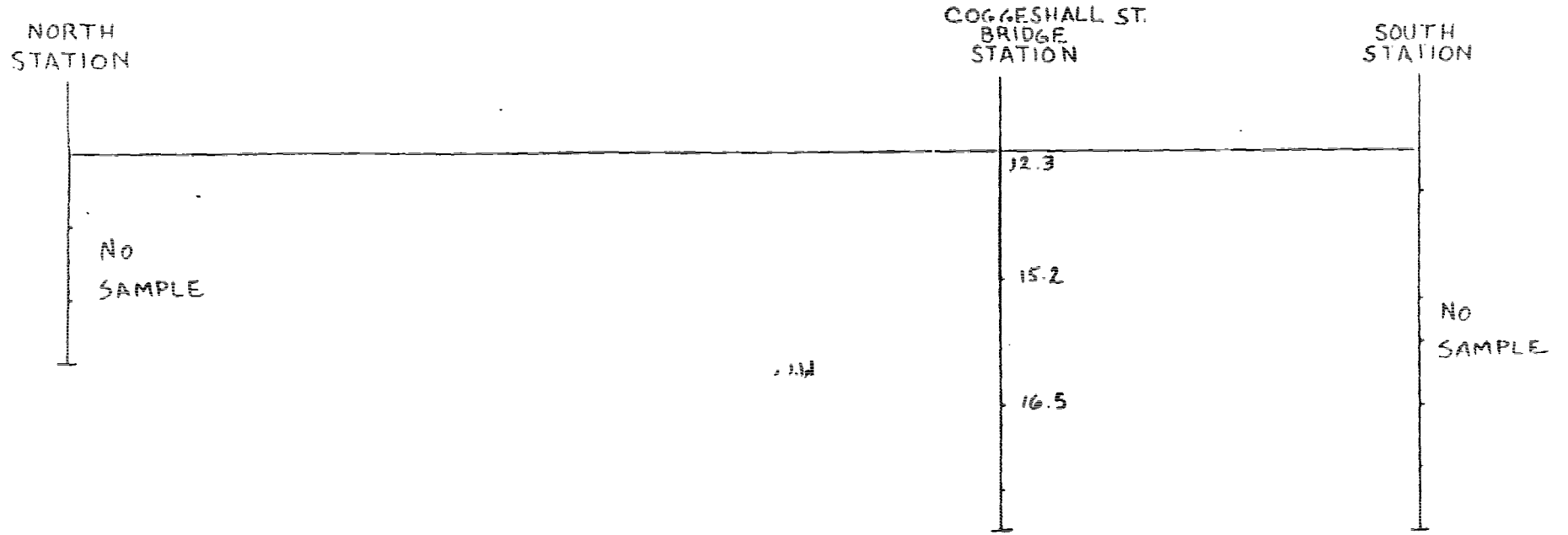
11 JANUARY 1983 2135-2332 HOURS

TIDE STAGE: EBB AVG. STAFF 3.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL SUSPENDED SOLIDS MG/L

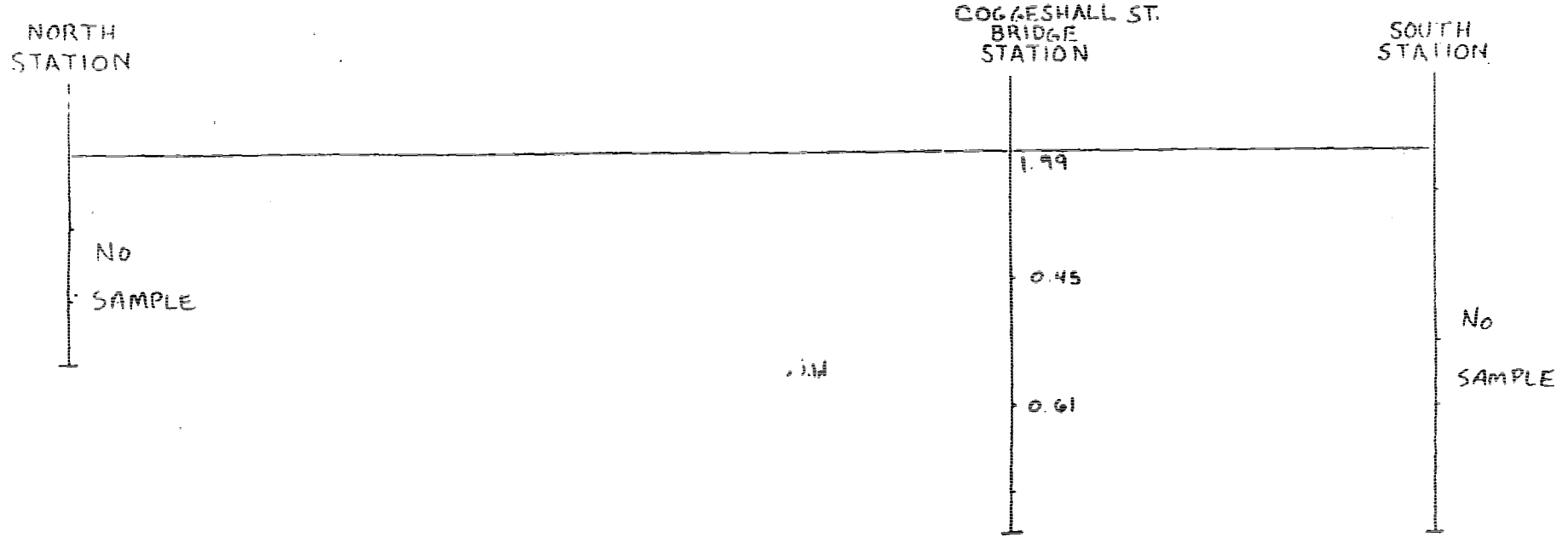
11 JANUARY 1983 2135-2332 HOURS

TIDE STAGE: EBB AVG. STAFF 3.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TSP - PCB µg/l

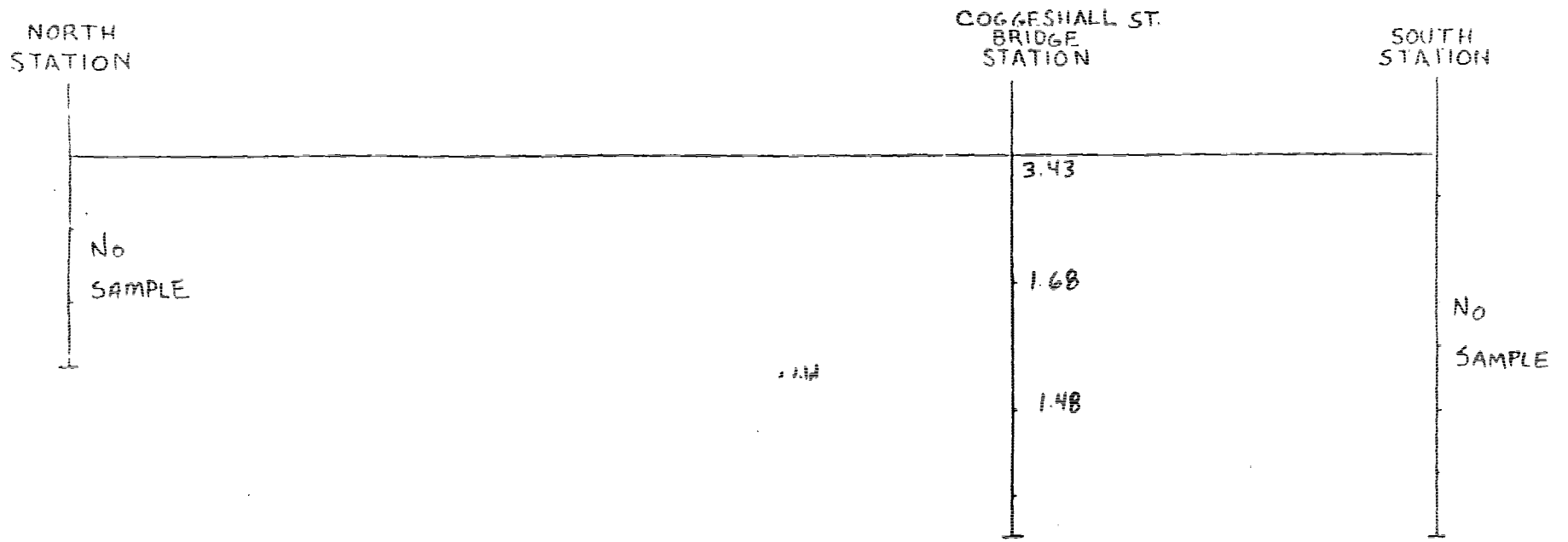
11 JANUARY 1983 2135-2332 HOURS

TIDE STAGE: EBB AVG STAFF 3.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL PCB ug/l

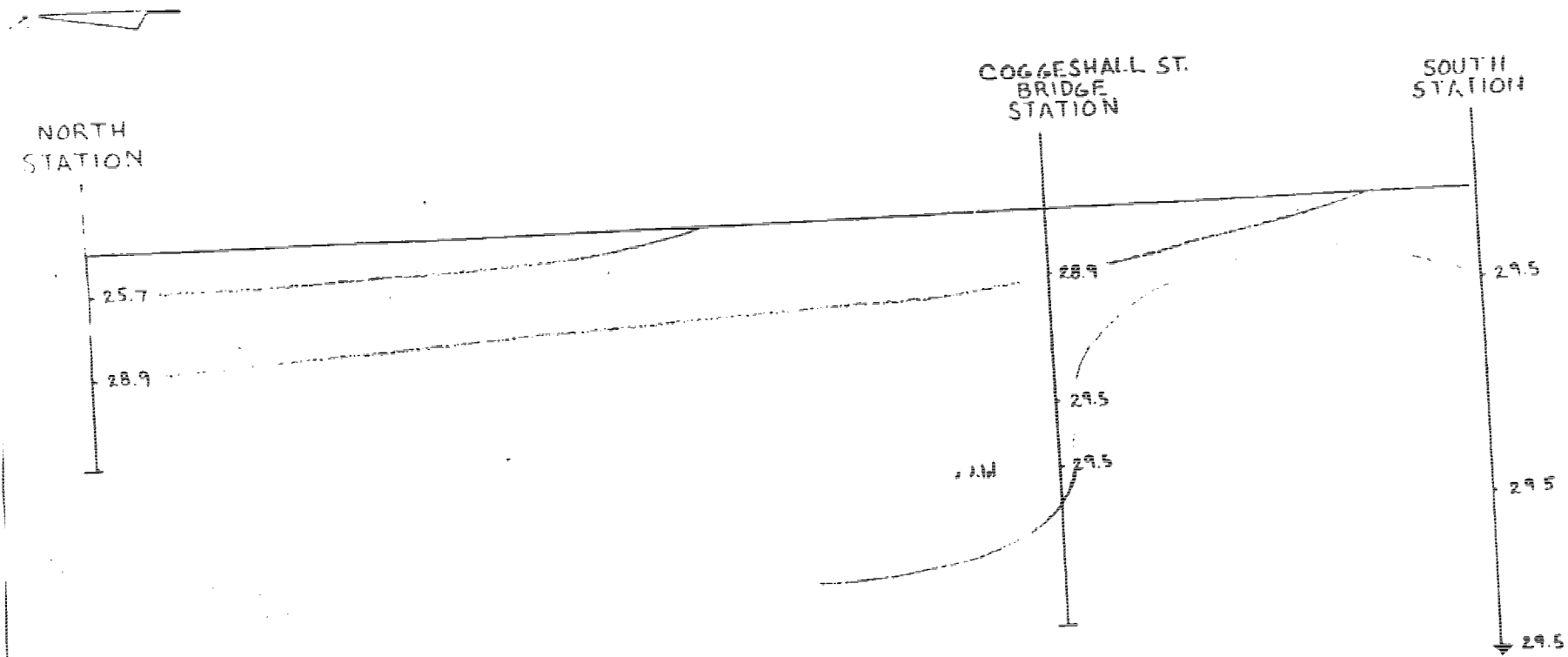
11 JANUARY 1983 2135-2332 HOURS

TIDE STAGE: EBB AVG. STAFF 3.2

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: SALINITY (‰)

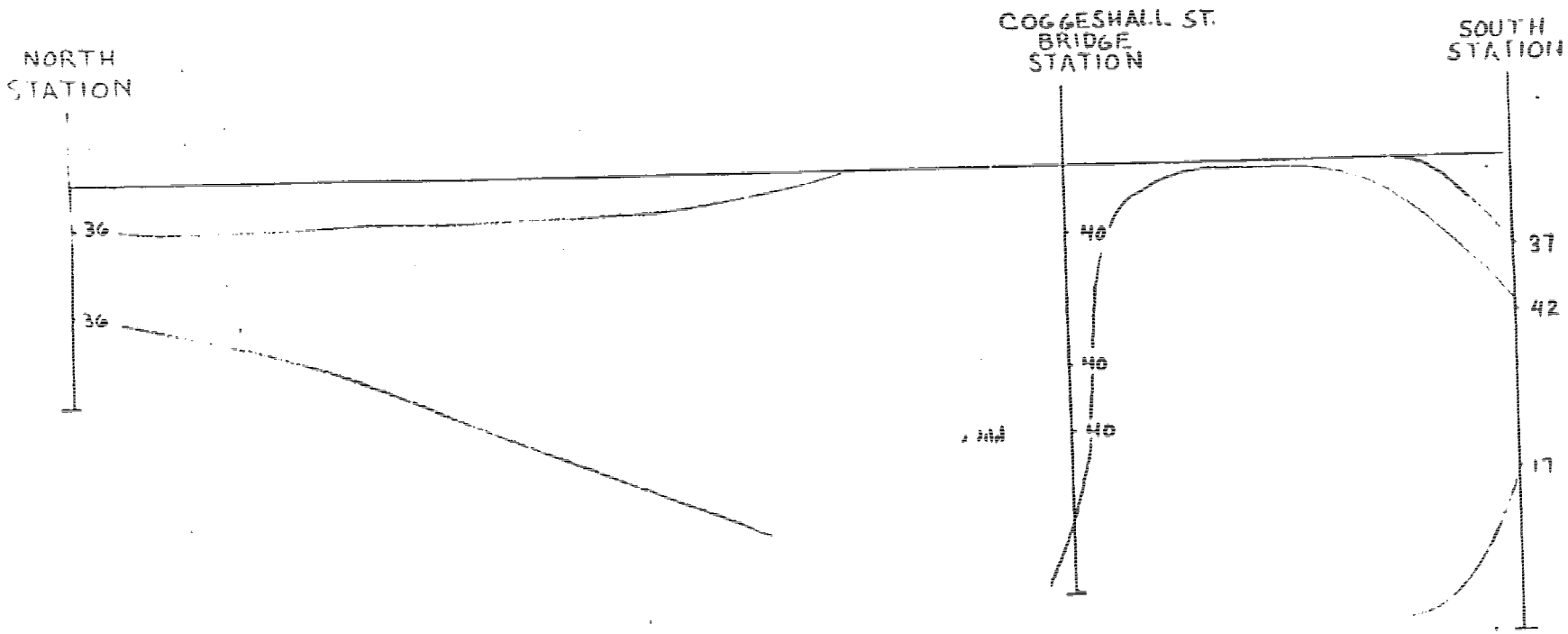
12 JANUARY 1983 0231-0434 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TRANSMISSIVITY (%)

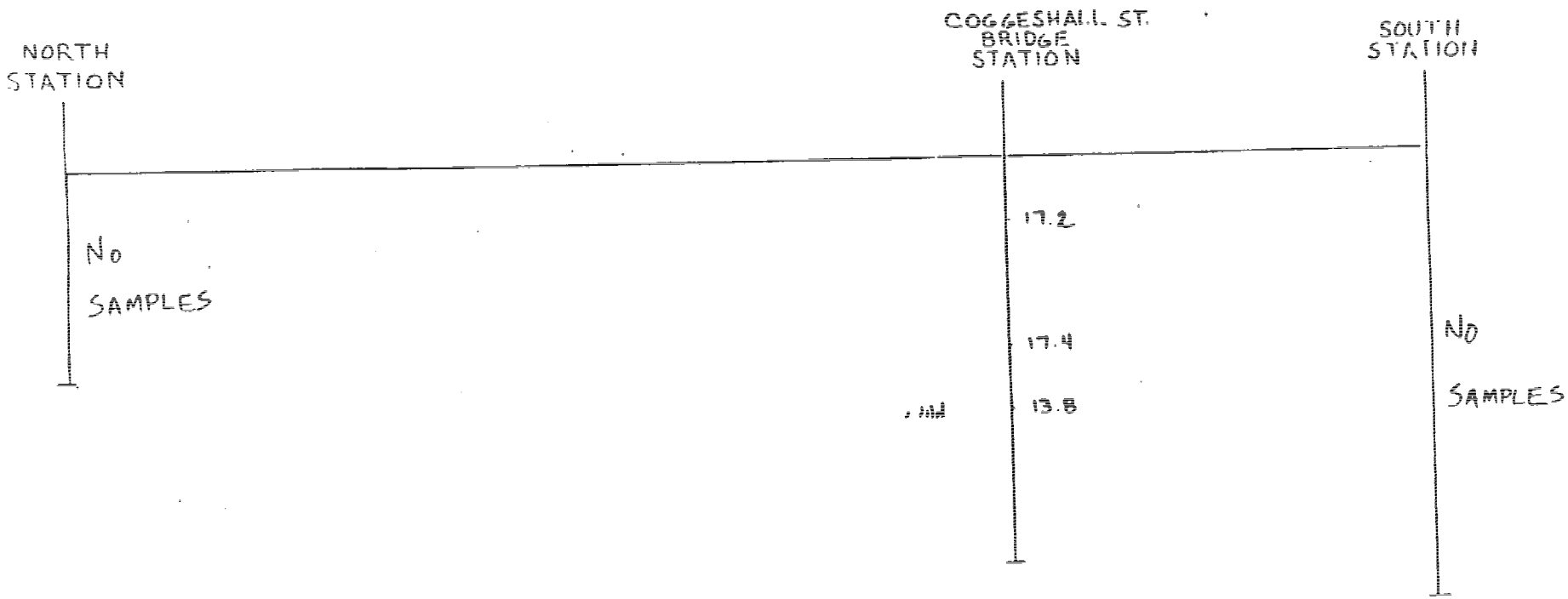
12 JANUARY 1983 0231-0434 HOURS

TIDE STAGE: FLOOD AVG STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL SUSPENDED SOLIDS MG/L

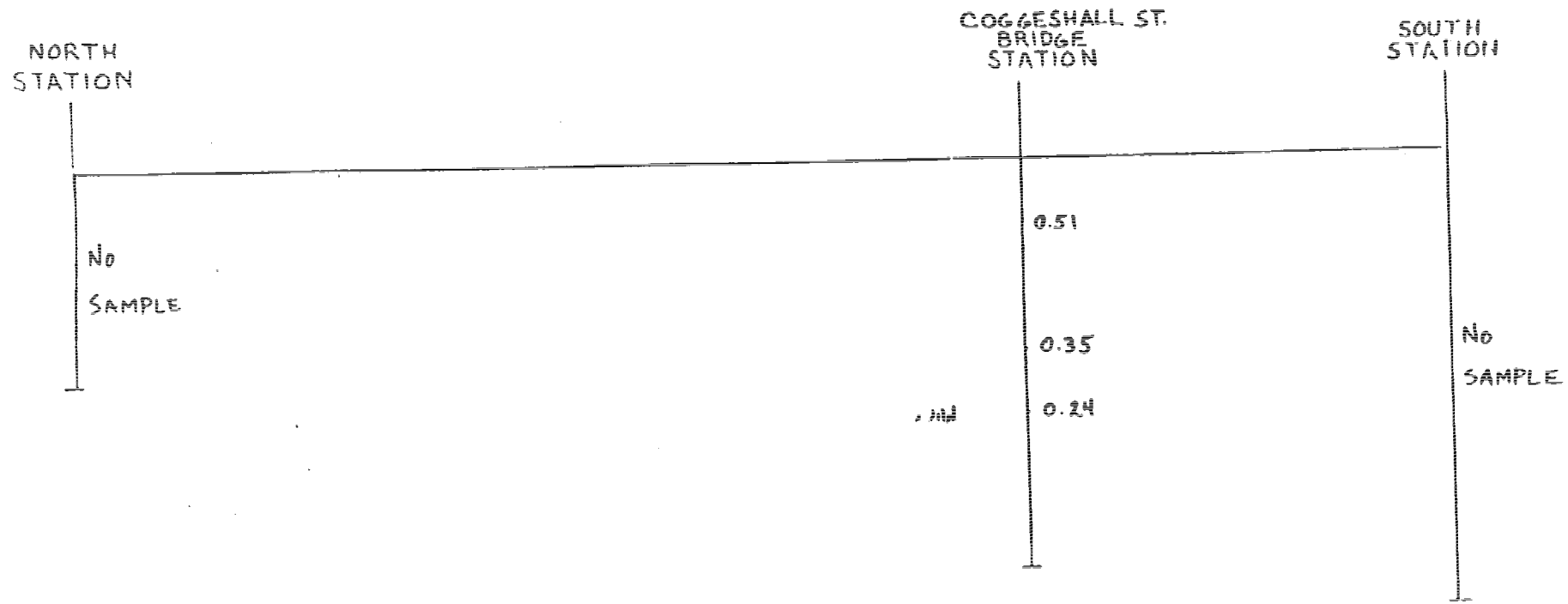
12 JANUARY 1983 0231-0434 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TSP - PCB ug/l

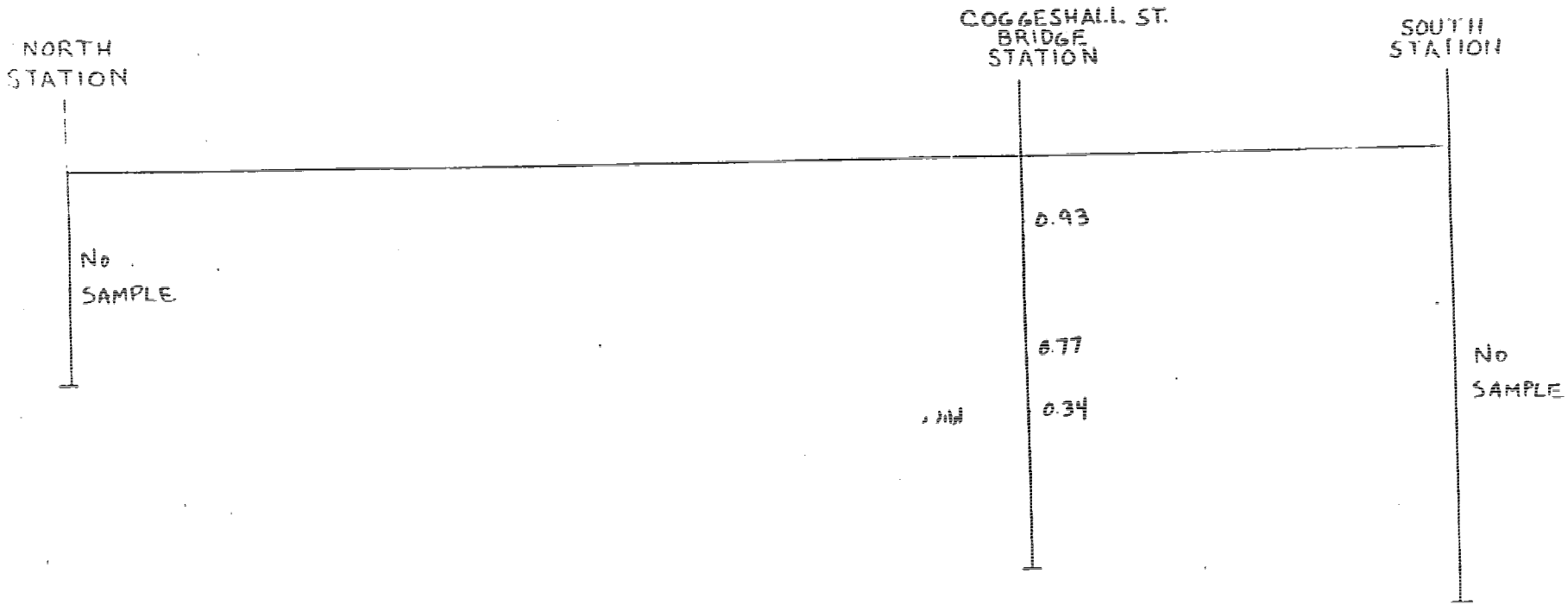
12 JANUARY 1983 0231-0434 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL PCB ug/l

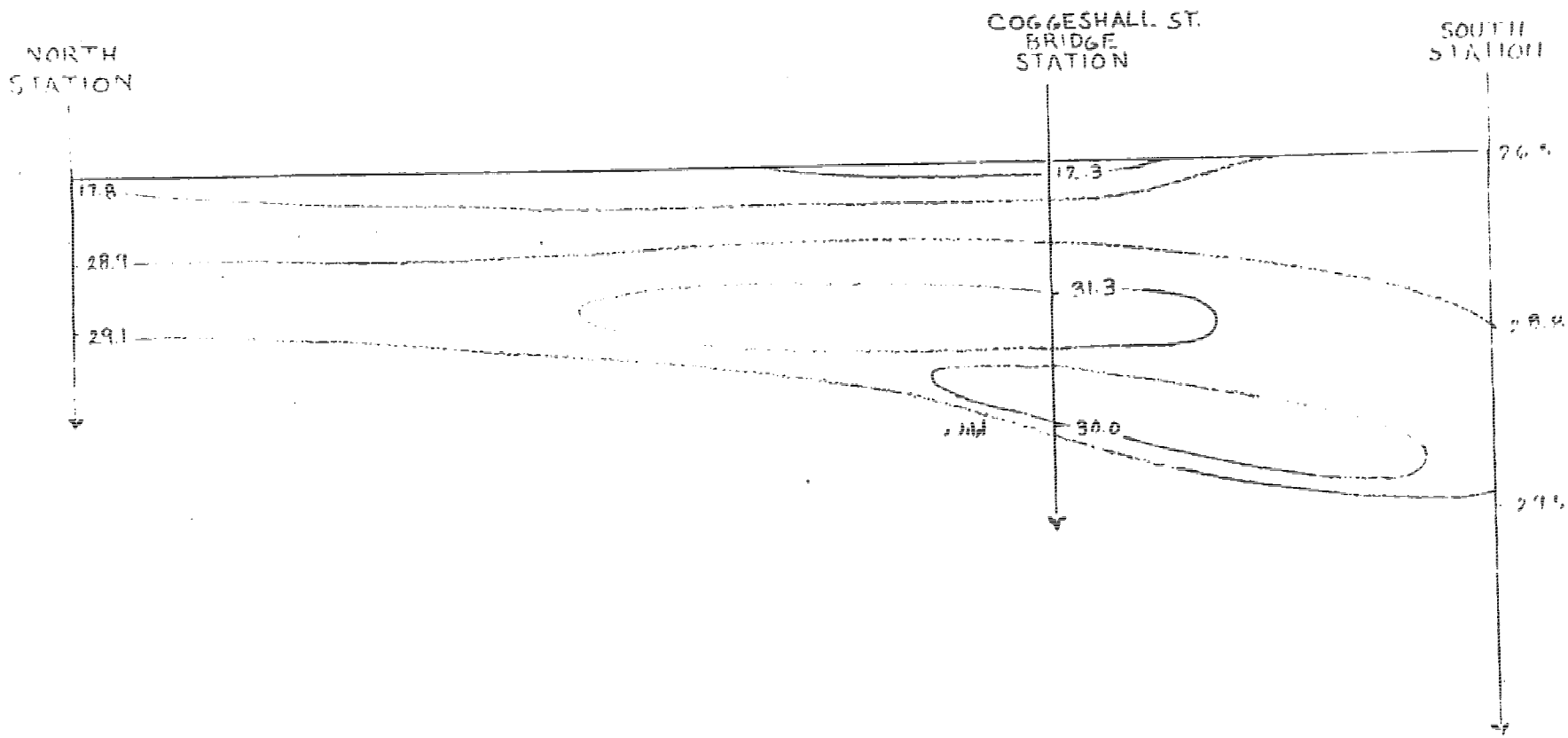
12 JANUARY 1983 0231-0434 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: SALINITY (‰)

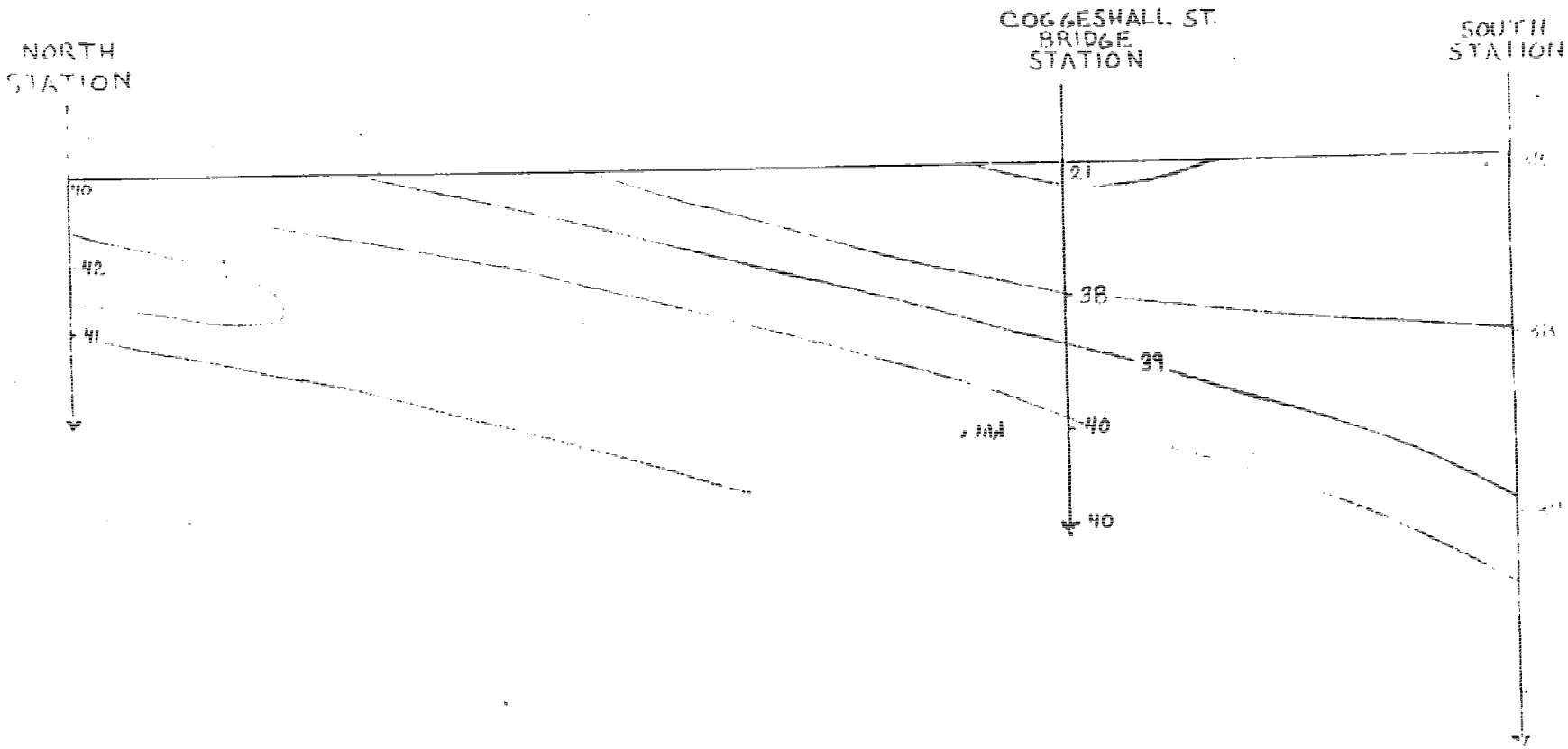
12 JANUARY 1983 0916 - 1100 HOURS

TIDE STAGE: EBB AVG. STAFF 3.9

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TRANSMISSIVITY (%)

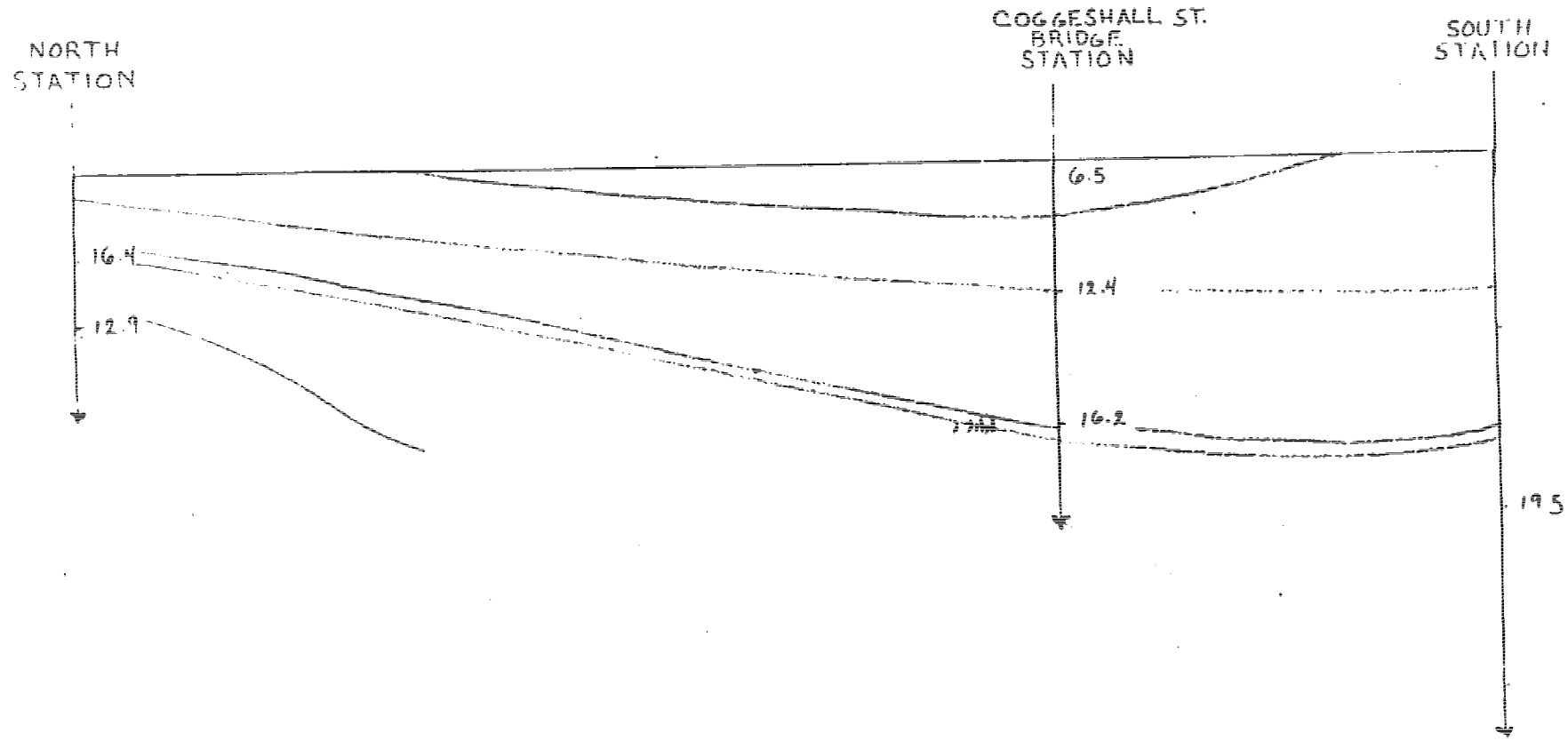
APPENDIX A

12 JANUARY 1983 0916 - 1100 HOURS

TIDE STAGE: EBB AVG. STAFF 3.9

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL SUSPENDED SOLIDS MG/L

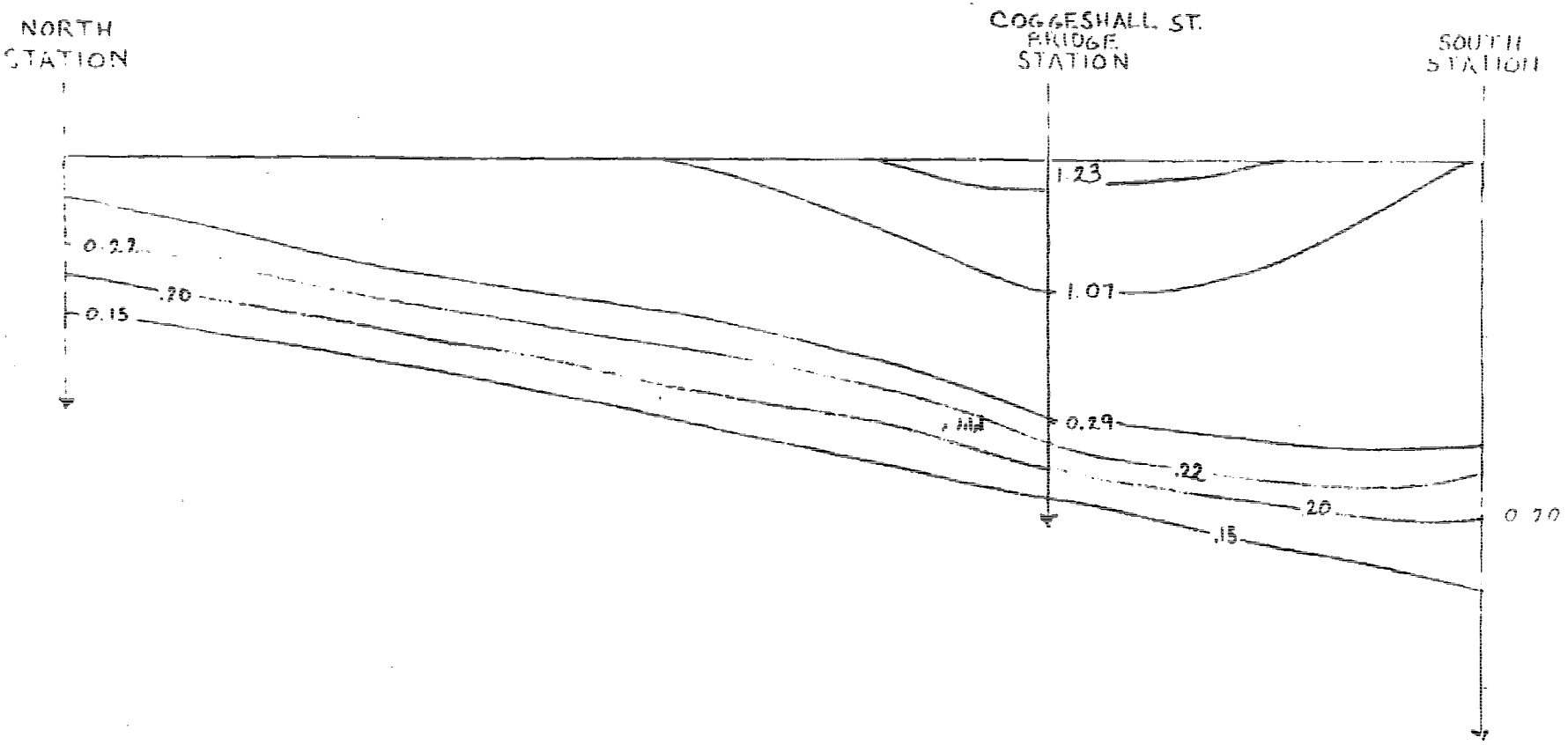
APPENDIX A

12 JANUARY 1983 0916 - 1100 HOURS

TIDE STAGE: EBB AVG. STAFF 3.9

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TSP-PCB µg/l

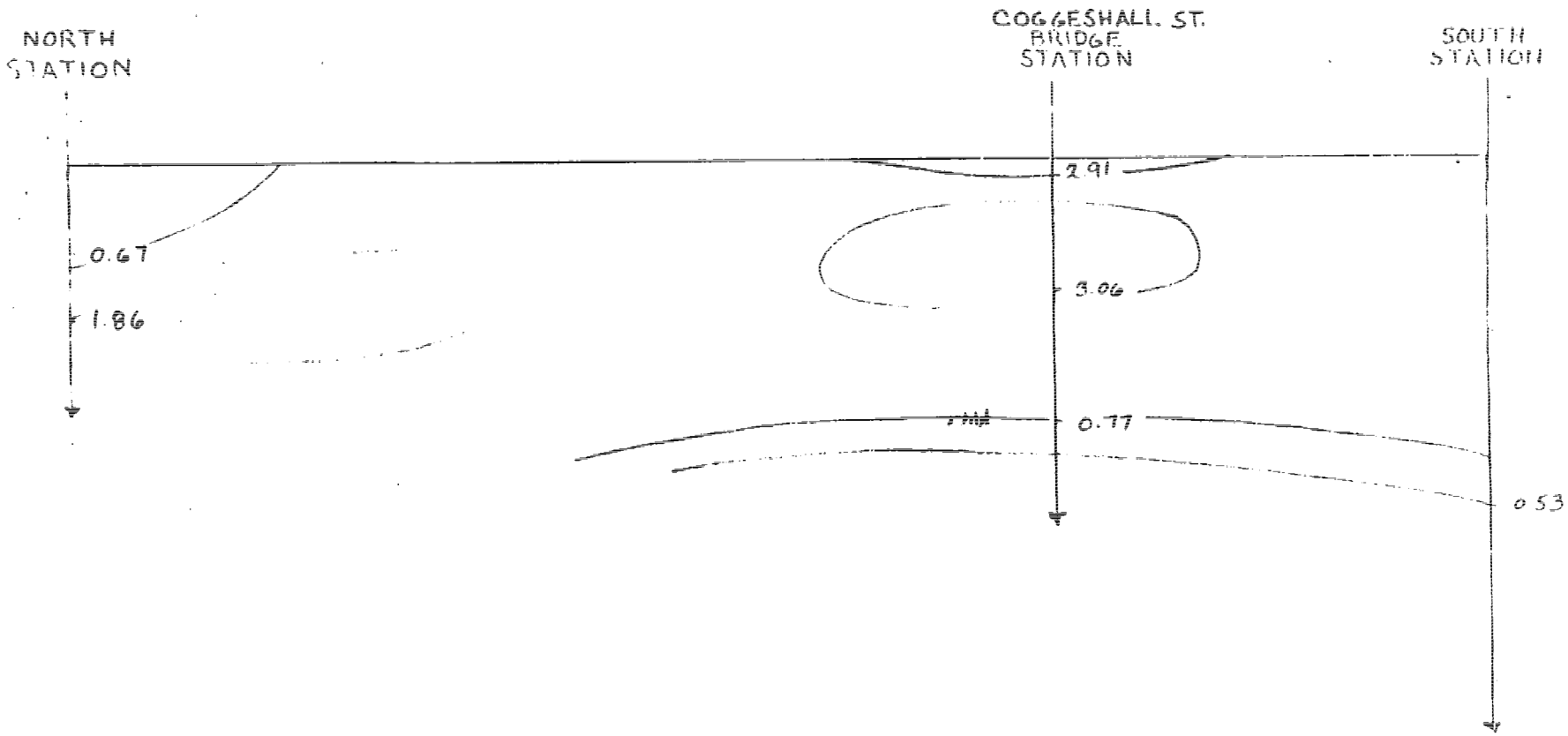
12 JANUARY 1983 0916-1100 HOURS

TIDE STAGE: EBB AVG. STAFF 3.9

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL - PCB µg/l

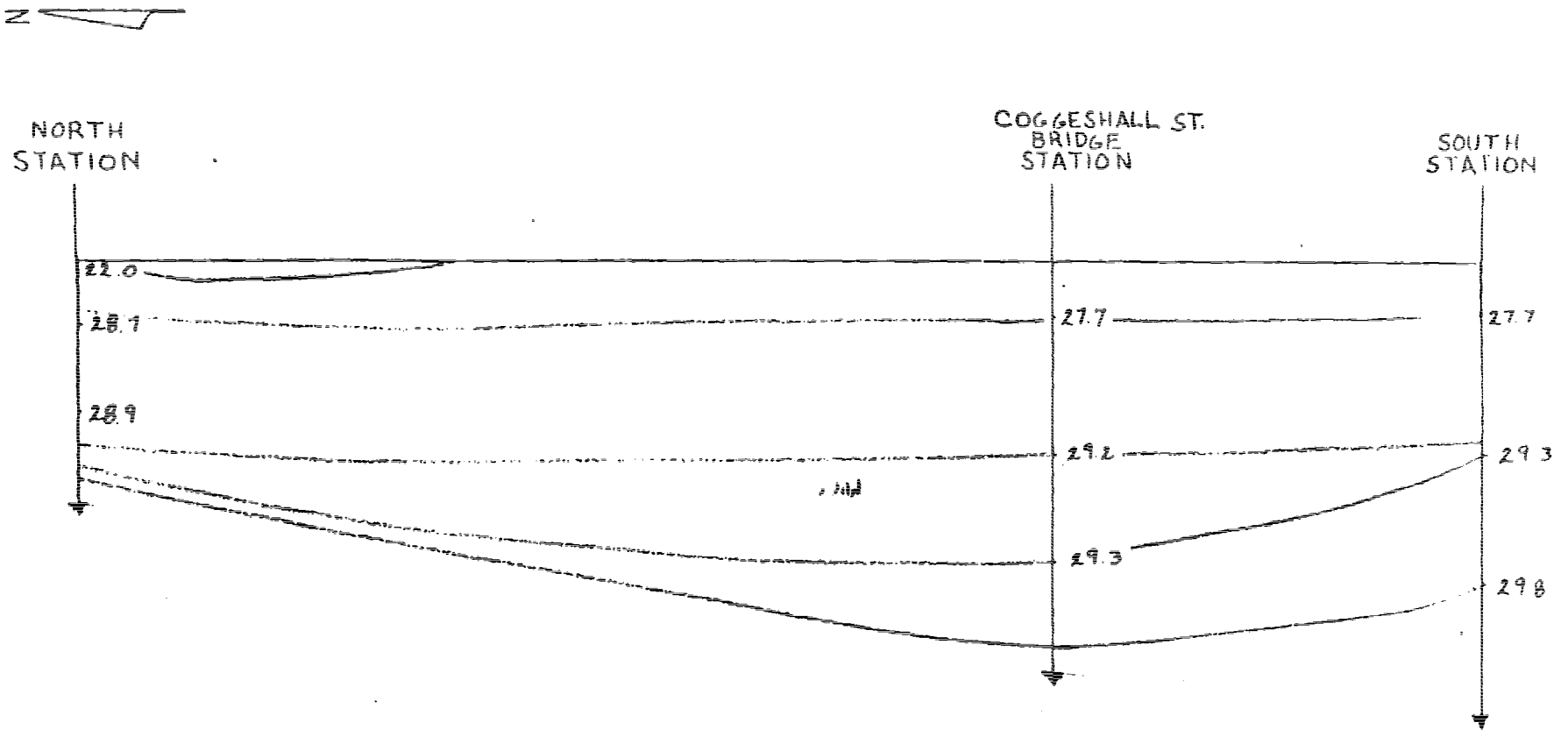
12 JANUARY 1983 0916 - 1100 HOURS

TIDE STAGE: EBB AVG STAFF 3.9

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: SALINITY

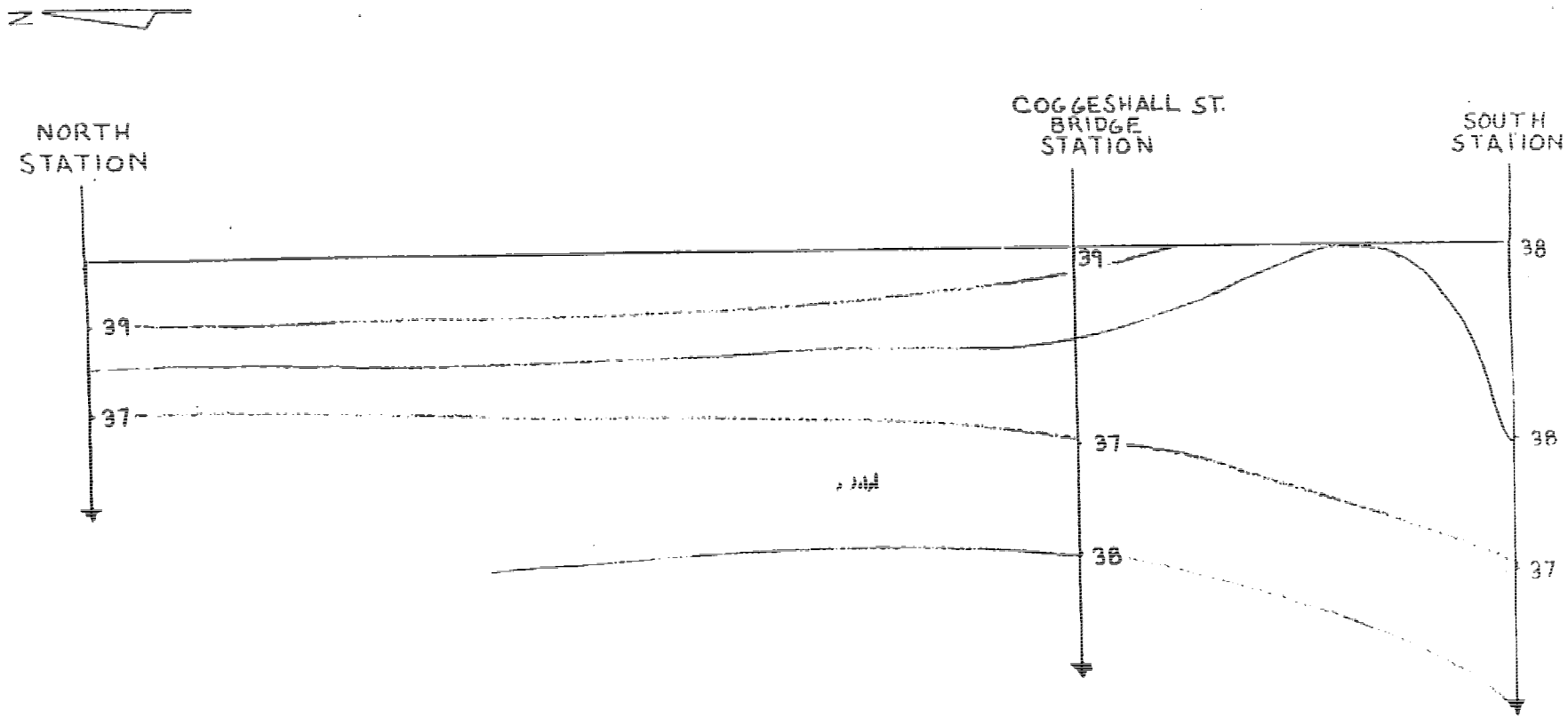
12 JANUARY 1983 1527-1717 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TRANSMISSIVITY (%)

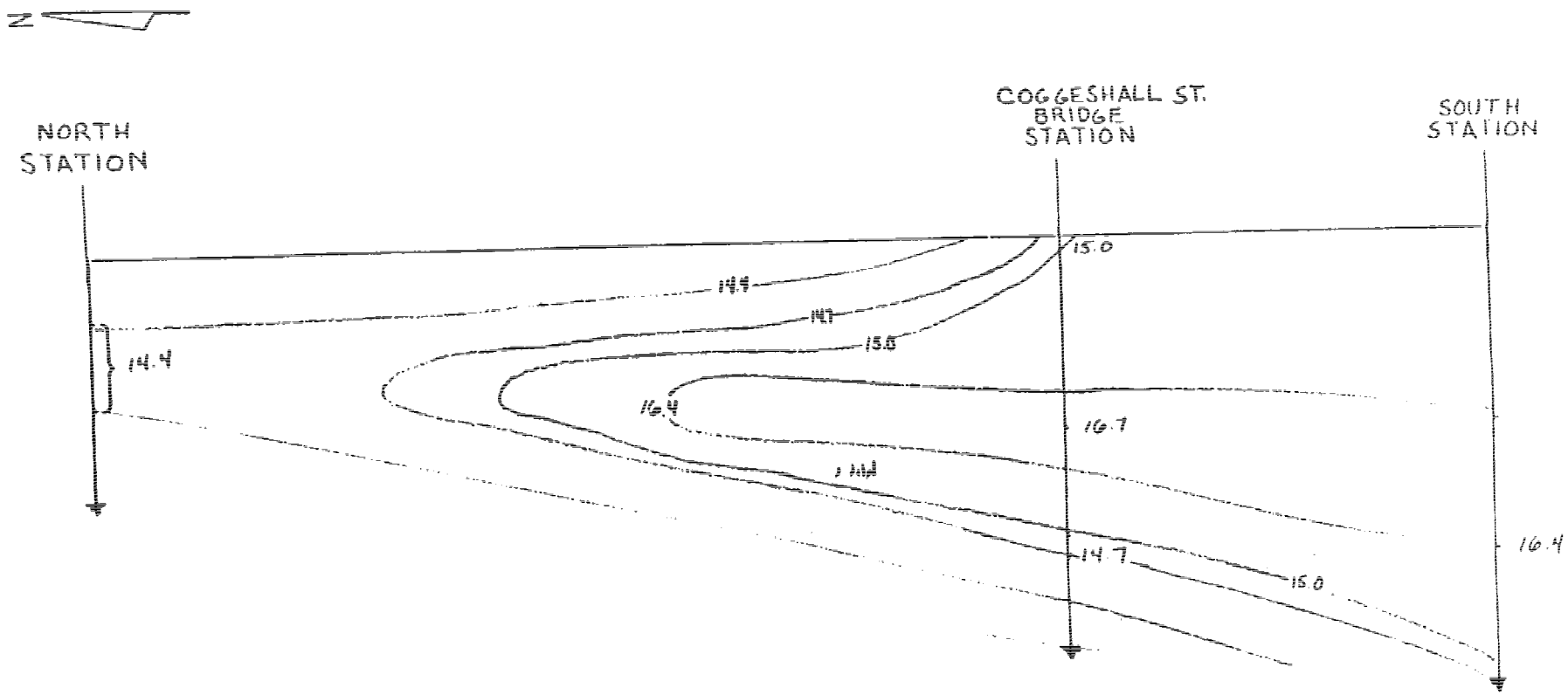
12 JANUARY 1983 1527-1717 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL SUSPENDED SOLIDS MG/L

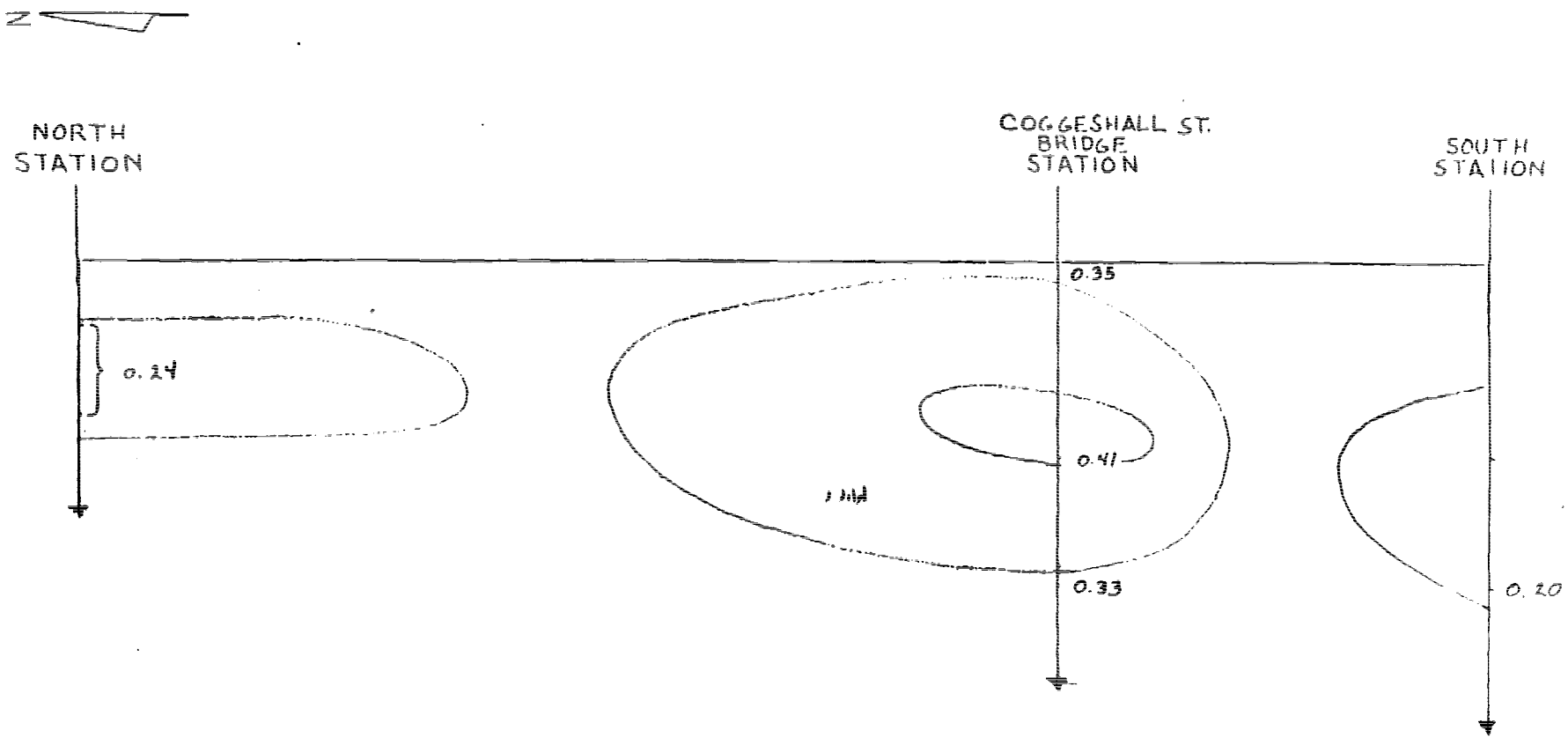
12 JANUARY 1983 1527-1717 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TSP- PCB ng/l

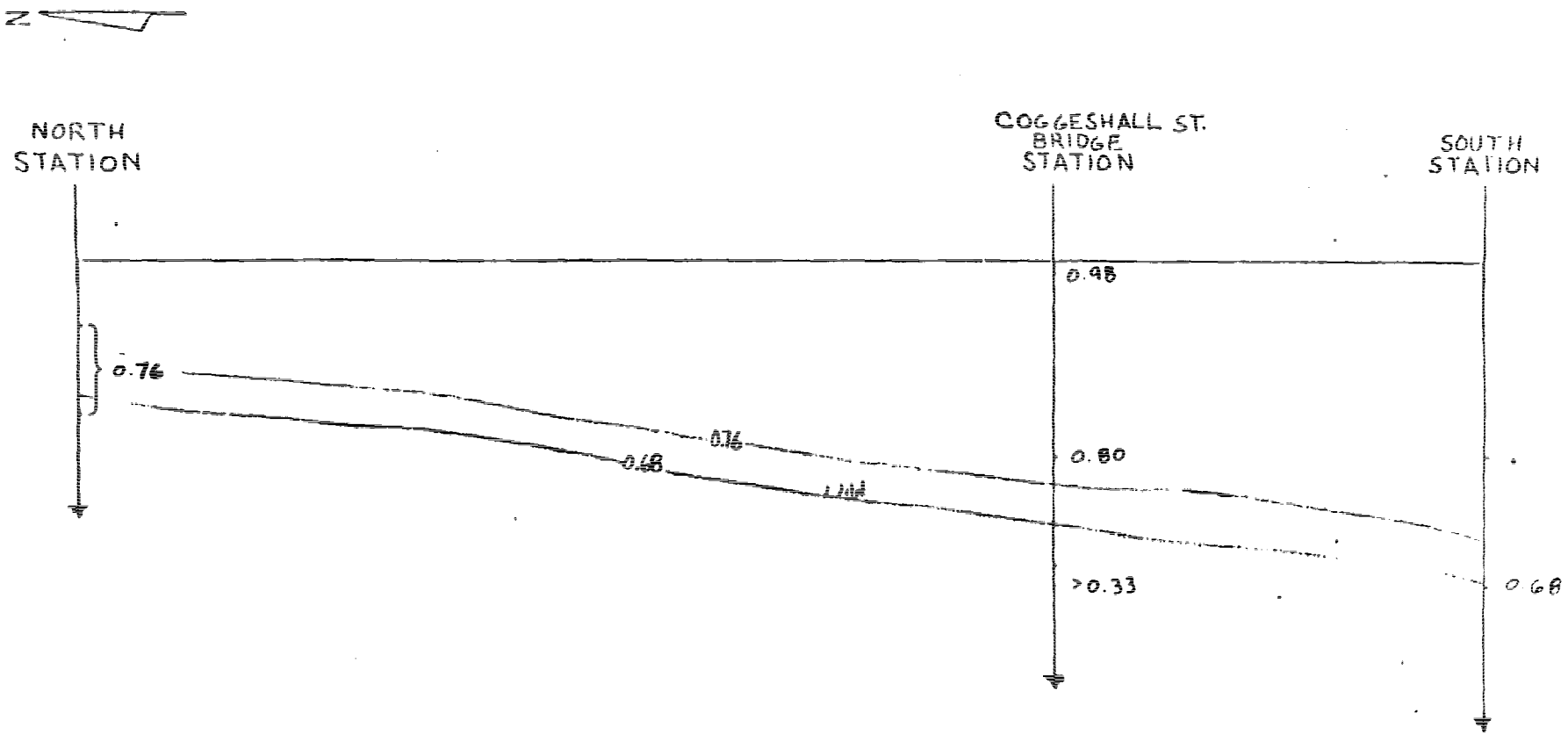
12 JANUARY 1983 1527-1717 HOURS

TIDE STAGE: FLOOD AVG. STAFF 4.7

APPENDIX A

ACUSHNET RIVER PCB STUDY

SYNOPTIC MEASUREMENTS



MEASUREMENT: TOTAL PCB µg/L

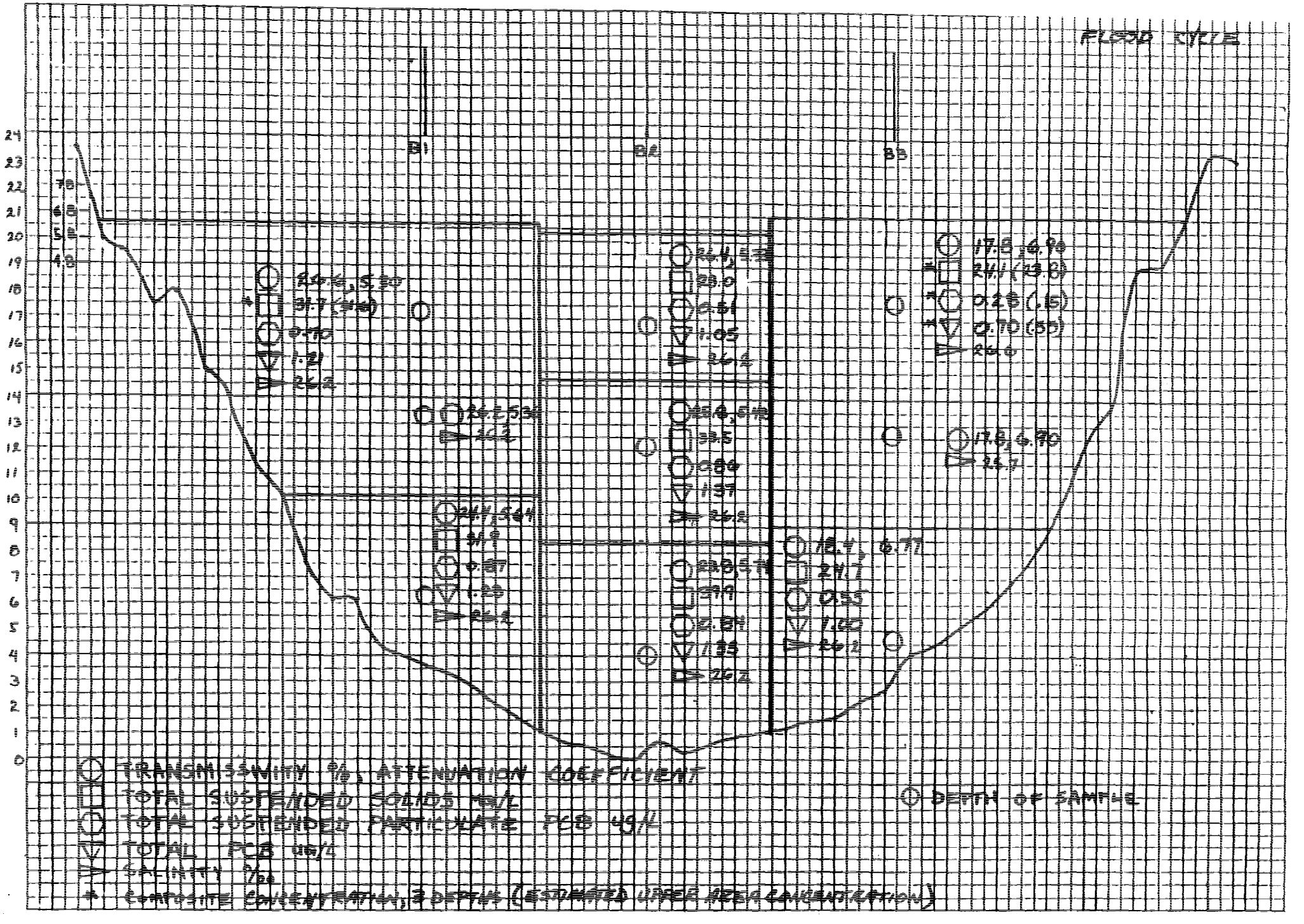
12 JANUARY 1983 1527-1717 HOURS

TIDE STAGE: FLOOD AVG STAFF 4.7

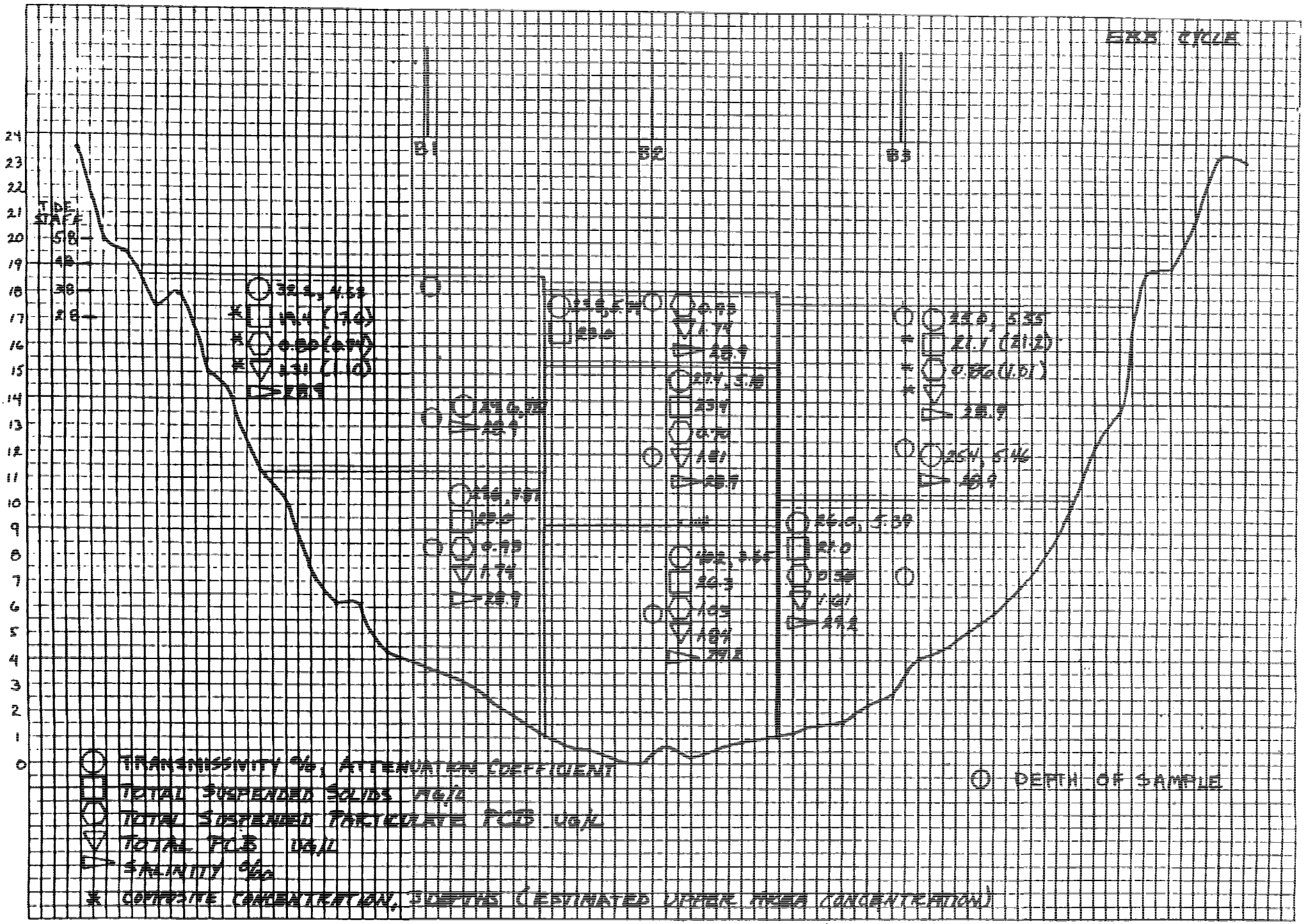
APPENDIX A

APPENDIX B:

CROSS-SECTIONAL TRANSECTS AT THE COGGESHALL BRIDGE INCLUDING PHYSICAL AND CHEMICAL DATA


FLOOD CYCLE
B1
B2
B3
TRANSMISSIVITY %, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS mg/L
TOTAL SUSPENDED PARTICULATE PCB ug/L
TOTAL PCB ug/L
SALINITY ‰
COMPOSITE CONCENTRATION, 3 DEPTHS (ESTIMATED UPPER MEDIA CONCENTRATION)
DEPTH OF SAMPLE

APPENDIX B


EBB CYCLE
B1
B2
B3
TIDE STAFF
TRANSMISSIVITY %, ATTENUATION COEFFICIENT
TOTAL SUSPENDED SOLIDS mg/L
TOTAL SUSPENDED PARTICULATE PCB ug/L
TOTAL PCB ug/L
SALINITY ‰
* COMPOSITE CONCENTRATION, DEPTHS (ESTIMATED UPPER AREA CONCENTRATION)
DEPTH OF SAMPLE

APPENDIX B