JUNE 1983

DRAFT

INTENSIVE WATERSHED STUDY
THE CHESTER RIVER BASIN

by

Charles Bostater
Stephanie Berlett
Diane McCraney
Mike Davis
Bruce Nierwinski
Aftab Hassan
Maryland Department of Natural Resources
Annapolis, Maryland 21401

Grant No. R806343

Project Officer

James Smullen
EPA, Chesapeake Bay Program
2083 West Street, Suite 5G
Annapolis, Maryland 21401

Environmental Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Gulf Breeze, Florida

DISCLAIMER

FOREWORD

This study was designed by the U.S. EPA Chesapeake Bay Program Eutrophication Work Group for providing data concerning non-point source loads from land use activities in the Chesapeake Bay, and for providing comprehensive estuarine water quality data for the Chester Estuary. This report represents a coordinated effort by State, Federal and private researchers to provide data that will be invaluable for future quantitative modeling of the estuary. This report represents an initial interpretation of the data, and insight into the watershed processes.

L. E. Zeni, Administrator
Tidewater Administration

ABSTRACT

This study was one of five intensive watershed studies designed to provide detailed non-point source loading rates and ambient water quality data within the Chesapeake Bay drainage area.

The study consisted of estuarine slack tide surveys, intensive twenty-four hour water quality surveys, phytoplankton non-point source monitoring at five subwatersheds, current speed and direction measurements as well as rainfall quantity measurements.

This report was submitted as partial fulfillment of the Maryland Department of Natural Resources Grant No. R806343 under sponsorship of the U.S. Environmental Protection Agency, Chesapeake Bay Program.

CONTENTS

Section

Appendices

FIGURES

Number Page

Number Page

Number Page

Number Page

TABLES

Number Page

Number Page

Number Page

LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

BOD5 --biochemical oxygen demand in five days
BOD20 --biochemical oxygen demand in twenty days
BOD30 --biochemical oxygen demand in thirty days
CA --cross-sectional area
COD --chemical oxygen demand
CFD --cummulative frequency distribution
CV --coefficient of variation
DA --drainage area
DN,FTOTN --dissolved nitrogen
DO --dissolved oxygen
DOC --dissolved organic carbon
DOD --dissolved oxygen deficit
DOS --dissolved oxygen saturation
DP,TFPHOS --dissolved phosphorus
ft/sec --feet per second
GPD --gallons per day
HD --hydraulic depth
IWQS --intensive water quality surveys
kg --kilograms
lb/acre --pounds per acre
lb/acre/in --pounds per acre per inch of rain
lb/acre/year --pounds per acre per year
MGD --million gallons per day
mg/l --milligrams per liter
MPN --most probable number
NH_3 --ammonia
NO_2 --nitrite
NO_3 --nitrate
N:P --the ratio of nitrogen to phosphorus, by weight
NPS --non-point source
NPDES --national polutant discharge elimination system
PO_4 --phosphate
ppt --parts per thousand
r --regression coefficient
R^2 --squared correlation coefficient
RPD --relative percent difference
SA --water surface area
SD --standard deviation
STP --sewage treatment plant
TKN --total kjeldahl nitrogen
TN,TOTN --total nitrogen
TOC --total organic carbon
TON,TORGN --total organic nitrogen
TP,TPHOS --total phosphorus
TPN,PARN --total particulate nitrogen
TPP,PARPHOS --total particulate phosphorus
TSS,SUSSOL --total suspended solids

TW --water surface width
ug/l --micrograms per liter
USGS --United States Geological Survey
V --volume
FLDPH --pH
TOTSOL --total solids
ORGN --total organic nitrogen
FORGN,DISORGN --dissolved organic nitrogen
FORTHOP --dissolved orthophosphorus
ORTHOD --total orthophosphorus
DOC,PAROCAR --particulate organic carbon
FTKN,TKND --dissolved kjeldahl nitrogen
CHLORAC --chlorophyll-a corrected
PHEOP --pheophytin-a
DISSOL --dissolved solids
FINORGN --dissolved inorganic nitrogen
TINORGN --total inorganic nitrogen
RCHLOPP --ratio of chlorophyll-a to particulate phosphorus
RCHLOPN --ratio of chlorophyll-a to particulate nitrogen
RFINORH --ratio of dissolved inorganic nitrogen to dissolved orthophosphors; by weight
RINORHP --ratio of total inorganic nitrogen to total orthophosphoros; by weight
RPCPN --ratio of particulate carbon to particulate nitrogen
RPNPC --ratio of particulate nitrogen to particulate carbon
RCHLOPC --ratio of chlorophylll-a to particulate carbon

Section 1

Introduction

This study was one of five intensive watershed studies funded by the Environmental Protection Agency's Chesapeake Bay Program (CBP). The study was designed by the CBP Eutrophication Working Group in order to provide data concerning nutrient enrichment in the Chesapeake Bay System and for providing data concerning nutrient export from different land use activities. The Chester River Basin was selected for study by the CBP and the Maryland Department of Natural Resources because of concern due to anoxic conditions in the River reported by Cooney et.al., 1979 and because of the role the Chester Estuarine System plays in maintaining economically viable finfish and shellfish resources.

This report was submitted in partial fulfillment of EPA Grant Number R806343. Careful and complete documentation of the sampling program has been included in this report for future nutrient enrichment modeling. This report represents an initial interpretation and evaluation of water quality conditions and relationships in the Chester Estuary. The monitoring program and results described herein represent one of the most intensive water quality studies of a Chesapeake Bay subestuary.

Executive Summary

Water quality monitoring was conducted in the Chester River Basin from June 1980 through September 1981. The major sampling programs consisted of (a) slack water surveys in the Chester Estuary and tidal river; (b) 24 hour intensive surveys; (c) entire river system surveys; (d) biological assessments consisting of longitudinal phytoplankton collection and enumeration; (e) bathymetric survey; and nutrient export monitoring from eight subwatersheds.

Figure 2-8 shows the location of the nine slack water stations located in the mainstem of the estuary. Monthly surveys were conducted and provide an intensive data base suggesting the Chester Estuary may be experiencing nutrient enrichment. Chlorophyll-a concentrations were above 50 ug/1 on several occassions (Figure 7-35) and occurred above 100 ug/1 on several occassions (Figures 9-19 and 8-12). Although the cumulative frequency distribution for chlorophyll-a indicates that only approximately 2% of the time chlorophyll is equal to or exceeds 40 ug/1, 20% of the time chlorophyll-a is equal to or exceeds 20 ug/1. Chlorophyll-a values tended to be higher during periods when the water column was stratified.

Conservative mixing diagrams were evaluated in order to indicate potential sources and sinks of water quality variables. None of the water quality variables shown in Figures 11-43 through 11-52 indicate conservative behavior when stations mean values are plotted against average salinity from the slack survey data. A total phosphorus sink is indicated in the lower estuary, and a possible source from Chesapeake Bay. The same trend is apparent for NO_2, however a mid-river sink is also apparent. A source of suspended solids is indicated in the expected region of the turbidity maximum near Chestertown. A source of ammonia is also indicated in the turbidity maximum region, a sink in the lower estuary, followed by a potential source from Chesapeake Bay. A plot of the redfield ratio (N:P) shown in Figure 11-51 indicates the upper river near the town of Millington is phosphorus limited. As one moves downstream the system appears to become nitrogen limited followed by a shift to a phosphorus limited condition at the mouth of the estuary. The above nutrient limiting conditions are based upon mean station values, however N:P ratios calculated from the individual slack surveys (Figure 7-38) indicate the extreme variability from month to month. For example, on August 6, 1981 the estuary appeared nitrogen limited in the upper tidal river area and phosphorus limited in the lower estuary. On September 22, 1981 the river indicated the limiting nutrient to be nitrogen in the lower river and phosphorus in the upper tidal river.

In order to more clearly indicate the major sources of nutrient sources to the estuarine system, budgets were calculated for $NO_2 + NO_3$, total nitrogen, dissolved ortho-phosphorus, dissolved phosphorus, and ammonia. Figures 5-1 through 5-5 show the results of the simple mass-balance budgets. In general, point sources are relatively insignificant on a basin basis for $NO_2 + NO_3$, NH_3, total nitrogen, ortho-phosphorus, as well as dissolved and total phosphorus. The largest potential source of $NO_2 + NO_3$ comes from chemical export due to storm runoff. No source of $NO_2 + NO_3$ is indicated as coming from Chesapeake Bay. The major sources of ammonia appear to be approximately equally distributed between Chesapeake Bay, the sediments and to a lesser degree, storm runoff. The major source of total nitrogen is indicated as coming from base flow followed by chemical export during storm events. For dissolved ortho-phosphorus the major source is export during storm events. The second major source of ortho-phosphorus appears to be from the sediments. The major source of dissolved phosphorus is chemical export during storm events. Therefore, the major source of phosphorus appears to occur during storm events. For nitrogen, the major source appears to depend upon the chemical species.

Based upon the non-point source subwatershed monitoring from two forested sites, two urban sites and four agricultural sites, the ratio of the average agricultural export to the average forested export (lbs/acre/in of rain) was 51 for total suspended solids, 45 for NO_3, 1 for $NO_2 + NO_3$, 34 for total phosphorus and 29 for ortho phosphorus. The ratio of agricultural export to urban export is 2 for total suspended solids, 2 for $NO_2 + NO_3$, 1.4 for NH_3, 1 for TKN, 2.8 for total phosphorus, and 7 for ortho-phosphorus. Detailed chemical export loading rates were developed from the monitoring data and are presented in Tables 6-5 through 6-39. In addition, cumulative frequency distributions are presented which indicate the percent of time a given loading rate would be expected to occur (see Figures 6-1 through 6-25). Regression analysis was performed in order to determine the relation between the chemical export (lbs/acre) and the gallons of storm runoff. In most instances, as expected, the loading rates were highly correlated with size of the storm runoff volume as indicated in Table 6-44. Multiple regression analysis indicated that loading rates correlated quite well in many cases with the size of the storm event, i.e., inches of rain, average storm intensity, suspended solids and alkalinity concentrations. Since the Chester River Basin sustains approximately 65-75% agricultural land use activities one might expect from the above agricultural to forested loading rate ratios that phosphorus would be a major chemical exported from agricultural land to the river. The fact that the phosphorus budgets indicate a relatively high source during storm events strengthens the view that phosphorus export from agricultural land use activities is a major source.

During the course of the study the longitudinal salinity profile varied substantially, (see Figures 7-1 to 7-2) with salinity varying at the mouth of the estuary from approximately 9.7 ppt to 14.5 ppt. Estuary salinity increased during the study period as a result of below normal rainfall in July of 1980 followed by increasing rainfall during the fall and spring months. On two occassions during the slack tide surveys salinity was higher at the surface indicating potential upwelling of bottom water. During the September 1981 24-hour monitoring survey a salinity inversion occurred during high tide.

Longitudinal profiles of water quality variables observed during slack tide surveys are discussed in Section 7 of the report. Twenty-seven slack tide surveys were conducted during the study. The slack survey data were used to develop the average location and fraction or percent of freshwater and Chesapeake Bay water in the estuary. Figure 4-20 shows that at river mile 27 there is, on the average, approximately 50% freshwater and Chesapeake Bay water. This area is the region of the estuary approximately where the salinity gradient is at a maximum. This is also the general location of the region of the estuary where the rate of change of water depth reaches its maximum (see Figure 4-6).

The flushing time of the estuary was estimated from simplistic mixing theory to be around 80 days under average inflow conditions. Freshwater inflow during 1980-1981 indicate very clearly that average freshwater flow conditions rarely exist for more than two weeks as shown in Figures 4-10 and 4-11. Estimated flushing time as a function of freshwater inflow was calculated and shown that during extreme low flow conditions the flushing time may increase to 150 to 200 days, and during high flow conditions (based upon data from the Morgan Creek USGS gage) flushing time may decrease to around 10-40 days, depending upon the estimation procedure used.

Based upon the average salinity profile from the 27 slack water surveys, the average salinity at the mouth of the estuary was 11.57 ppt. A major analysis of one dimensional steady state dispersion characteristics was conducted using the data. Tables 4-8 and 4-9 show the temporal and spatial values of dispersion coefficients, which ranged from 3.1 ft^2/sec from nautical mile 28 to 41 up to 2,349.5 ft^2/sec from nautical mile 8.5 to 13.2. The high temporal and spatial variability of one dimensional dispersion coefficients is indicated in Table 4-8, as well as the average dispersion characteristics. The average dispersion coefficients ranged from 428 ft^2/sec in the lower estuary to 12.2 in the upper tidal river.

Dispersion coefficients were estimated using three different methods based upon different approaches of estimating the salinity distribution and by using the assumption of a constant or variable cross-sectional area. The results of the theoretical one-dimensional steady state dispersion coefficients are shown in Tables 4-10 and 4-11. The values have been plotted in Figures 4-26 through 4-29. These tables and graphs clearly show, as is well known, that the dispersion coefficients are dependent upon freshwater inflow. More interesting is the result which shows that the analytical dispersion function using the variable cross-sectional area formulation indicates a maximum dispersion coefficient in the expected area of the turbidity maximum region, where dispersion would be expected to be greatest. In addition, the area of maximum dispersion coefficients coincide with the region of the estuary where the salinity gradient reaches a maximum. Other analyst have indicated that the turbidity maximum region is a region of turbulent mixing where dispersion should increase. The formulation for calculating Chester estuary dispersion coefficients clearly supports this view. Estimated steady state one dimensional dispersion coefficients in the lower estuary showed extreme variability as mentioned earlier. This may be a function of complex circulation in the lower estuary. Specifically, data collected for this study by Boicourt (18) may indicate a potential three layer flow pattern. A potential three layer flow pattern is also indicated by data reported by previous studies conducted by Westinghouse, Inc. 1975.

The slack tide water quality surveys indicate the estuarine system supports very high chlorophyll-a concentrations in the upper tidal river and mid-estuary. Total suspended solids are highest in the lower reaches of the expected turbidity maximum (around nautical mile 27). Turbidity is also highest in this region, and secchi disc measurements are at a minimum. On several occassions nitrate in the upper river (0-3 ppt salinity) was quite high, resulting in a mean nitrate concentration of 1.1 mg/l. Nitrate values in the upper estuary did not appear to be extremely high, with a mean of 0.02 mg/l in the 0-3 ppt salinity region. Ammonia was quite high in the upper tidal river (0-3 ppt) with a mean of 0.09 mg/l. Particulate phosphorus was 2-3 orders of magnitude greater in the upper tidal river with a mean of 0.32 mg/l. Since inorganic nitrogen was also an order of magnitude higher in the upper estuary, but organic carbon and nitrogen did not show order of magnitude differences in the upper tidal river, it could be inferred that the material high phosphorus was inorganic and associated with sediment. The pH in the upper tidal river (0-3 ppt) showed the lowest mean of 7.2 but the greatest variation (± .7) BOD_5 and BOD_{20} and BOD_{30} was also greatest in the upper estuary, i.e. 3.7 ± 3.8 mg/1, approximately 33% higher than the other estuarine salinity regimes. Ortho-phosphorus was three times higher in the 0-3 ppt salinity range with a mean of 0.04 ppt when compared to the lower and mid estuary. Comparatively, it appears that the upper estuary maintains relatively high levels of inorganic nitrogen and phosphorus. This is consistent with the budget that indicates the major sources of phosphorus and total nitrogen comes from upland fluvial sources during storm and base flow periods.

Dissolved oxygen stratification and associated low dissolved oxygen approaching anoxic conditions was not uncommon in the lower estuary. During a twenty four hour intensive survey on May 29, 1981 bottom water dissolved oxygen remained low during the 24 hours, with an average of 1.95 mg/1 ± 1.22 mg/1. Dissolved oxygen was not as low during the July 24, 1981 survey at the bottom (4.39 ± 1.3 mg/1) and due to very windy conditions on September 24, 1981, no strong dissolved oxygen stratification or salinity stratification was observed.

If one assumes that nutrient enrichment will result in depressed dissolved oxygen, the trends of nutrient enrichment may be detected by evaluating historical dissolved oxygen trends. Historical dissolved oxygen data was obtained from various historical studies and data bases in order to determine historical trends. Figure 10-4 shows that low dissolved oxygen was observed as early as 1949 in the lower portion estuary. Dissolved oxygen deficits around 6.5 mg/1 were observed in 1949, which corresponded to dissolved oxygen near 1 mg/1. Dissolved oxygen near 1 mg/1 or less was not observed again until 1958, 1975 and 1976. Since this study produced a very intensive data set, the number of occurrances of low dissolved oxygen observations near anoxic conditions increased. The development of cumulative frequency distributions of dissolved oxygen values indicate that in the upper estuary (salinity 10.00 ppt) a low dissolved oxygen trend may be occurring (see Figures 10-26 and 10-50).

If dissolved oxygen deficit frequency distributions are analyzed in a similar manner, as shown in Figure 10-47, a trend towards greater oxygen saturation is observed for the months of July and August.

Regression of yearly mean dissolved oxygen deficits also support the view that the upper tidal river is experiencing greater deficits (lower dissolved oxygen), see Figure 10-14. Regression of yearly mean dissolved oxygen deficits in the lower estuary indicate a trend towards higher saturation of water. Higher dissolved oxygen at the 0-10 feet depth range is indicated by comparison of historical data as shown in Figure 10-31 cumulative frequency distributions. When lower estuary data for July and August are combined to form cumulative frequency distributions for 0-10 feet and greater than 10 feet, it can be seen that at depths of 30 or more feet, 80% of the time dissolved oxygen is expected to be at or below 4 mg/1 (see Figure 10-33) based on historical data. In the upper estuary, only around 40% of the time, would one expect dissolved oxygen to be less than or equal to 4 mg/l at depths at or below 30 feet. Figure 10-43 also indicates that in the lower estuary at depths of 41 or more feet, 20 percent of the time dissolved oxygen would be expected to be 2 mg/l or less.

In order to attempt to relate environmental conditions to biological resources an analysis was performed to estimate the strength of association between a juvenile finfish spawning index and water quality and climatic variables. Step-wise multiple curvilinear regressions were performed which indicate that 86-87% of the variability of the apparent spawning success of bluefish and spot as well as 78% of the variability of apparent spawning success of striped bass can be explained by various climatic variables such as yearly annual snowfall, degree days, precipitation and air temperature. In addition, the variability of the juvenile finfish index was found to be associated with water quality variables also. For example, the variability of the striped bass index was associated with annual Chester River water temperature, and annual air temperature from Baltimore Washington Airport. The juvenile index for shad was strongly associated with annual Chester River water temperature, and Patuxent River NO_3 with a stepwise multiple regression yielding a significant r^2 of 0.816.

In order to discriminate zones or reaches of similar water quality characteristics an application of Duncan's multiple range test was applied to the slack tide survey station data. Figures 11-20 through 11-42 show the results of this simple clustering technique applied to the data. Unlike the Patuxent estuary the Chester River did not show a unique location in the turbidity maximum zone for temperature, however the turbidity maximum zone was identified as a unique region for turbidity, salinity, total solids, suspended solids, total nitrogen, ammonia, dissolved NO_3, NO_2, total phosphorus, ortho-phosphorus, total particulate nitrogen, total particulate phosphorus, particulate carbon, pheophytin-a, and secchi-disc. The upper most portion of the tidal river indicated it may be a unique river reach for the following water quality variables: turbidity, pH, salinity, BOD_5, total solids, total nitrogen, dissolved NO_2, organic nitrogen (both dissolved and total), total phosphorus, ortho-phosphorus, total particulate nitrogen and total particulate phosphorus, chlorophyll-a, pheophytin and dissolved oxygen. In the lower estuary near the mouth, a unique reach was indicated for secchi-disc, ammonia, total solids, salinity and turbidity.

During this survey a very detailed phytoplankton evaluation was performed. Bacillariophyta tended to dominate the class of phytoplankton species except during the months of May, June, and July. In May, 1981, nanoplankton dominated the cell counts but in June the pyrophyta class dominated. In July the nanoplankton and the Pyrrophyta dominated the cell counts as shown in Figure 11-80. Figures 11-81 through 11-86 show the dominant classes indicated by cell counts at one meter depth. High variability is obvious. Cell counts were highest at the upper tidal river station in August, 1981, near 18,000 cells per m. Nanoplankton and bacillariophytes were the dominant forms present. At the lower estuary station at the mouth of the estuary the July 27, 1981 survey showed maximum cell counts near 11,000 cells/ml, dominated by nanoplankton. At the station located in the turbidity maximum region of the estuary, Pyrrophytes dominated the phytoplankton species on May 27 and on August 20, 1981 the nanoplankton dominated the phytoplankton.

Summary

Chester estuary nutrient concentrations for nitrate, total nitrogen, ortho-phosphorus, and dissolved phosphorus appear to be dominated by the major source inputs from fluvial inputs during base flow and storm flow regime. The major ammonia sources may be the sediments and Chesapeake Bay, as indicated by simple mass balance analysis. Chemical export from agricultural land is much higher than forested land indicated from the subwatershed monitoring. The upper tidal river maintains very high chlorophyll-a concentrations which are indicative of a nutrient rich environment. The region of the turbidity maximum zone shows high concentrations of suspended material and turbidity as expected. An evaluation of dispersion coefficients by various methods indicated that given the assumptions, of one dimensional steady state conditions, dispersion is greatest in the region of the turbidity maximum. Dissolved oxygen concentrations reach near anoxic conditions in the lower estuary. From a historical perspective, there is a trend for lower dissolved oxygen concentrations in the upper portion of the estuary. In the lower estuary there is a trend for more saturated waters in general. Deeper waters may be experiencing a greater degree of low dissolved oxygen concentrations however a consistent and detailed historical data prevent conclusive evidence. A multiple stepwise regression analysis indicated a strong association between apparent baywide spawning success of major finfish species (indicated by the juvenile index) and water quality variables such as water temperature, NO_3 concentrations and pH in the Chester and or Patuxent River Estuaries. In addition, nanoplankton appears to dominate the phytoplankton community more than previously thought.

Conclusions

- A historical trend is apparent for lower dissolved oxygen in the upper estuary.
- A historical trend is apparent for higher saturation conditions for dissolved oxygen in the lower portion of the estuary when data from all depths are considered.
- At depths of 30 feet or greater in the lower estuary, 80% of the time dissolved oxygen may be expected to be 4 mg/l or less, based upon existing data.
- One dimensional dispersion coefficients are shown to be dependent upon freshwater inflow, and reach a maximum in the turbidity maximum zone.

- Dissolved oxygen concentrations in 1980-1981 indicate concentrations near anoxic conditions do not occur infrequently.
- Chlorophyll-a concentrations in the upper tidal river are occassionally above 100 ug/l and in general indicate a nutrient enriched environment.
- Suspended solids and turbidity are highest in the turbidity maximum zone, as well as other nutrient variables.
- The major source of ammonia to the estuarine system may be the sediments as well as Chesapeake Bay.
- The major source of other nutrient variables as indicated by a simple mass-balance appear to be chemical export during base flow conditions or during storm flow regimes.
- Nanoplankton dominate the phytoplankton community quite frequently.
- Water quality variables such as water temperature, NO_3 in the Chester Estuary, pH and NO_3 in the Patuxent estuary are associated with the juvenile index, an indicator of the spawning success of finfish which inhabit Chesapeake Bay.

Recommendations

- Data collected during this study should be used for calibration and validation of a real-time water quality model, both one dimensional and two dimensional (in the vertical) for the estuarine system.
- A statistically based monitoring program should be implemented in order to validate the magnitude of the dissolved oxygen trends, especially in the lower estuary near oyster bars.
- Fluvial sources of nutrients should be monitored intensively in the upper tidal river in order to indicate subwatersheds contributing major loads to the upper river.
- A review of the upper river POWT's should be made to insure nutrient limitations are being met, and are not responsible for the high chlorophyll-a values observed.
- Sediment oxygen demand and nutrient flux data should be monitored in the upper and lower river in order to validate the simple box-models.

- Consideration should be given to establishing continued water quality surveys in order to validate the relation between water quality variables and the juvenile index indicated in this study.

- All monitoring implemented as a result of this study should take advantage of existing biological resource monitoring efforts.

- A land runoff model such as HSPF should be developed for indicated major land segments contributing nutrient loads to the estuarine system.

- Output from real-time models should be analyzed in order to indicate potential effects upon shellfish and finfish resources.

SECTION 2.0

METHODS

BATHYMETRIC SURVEY OF THE CHESTER RIVER

River bed profiles were recorded on July 31, August 1 and 2, 1980 at twenty-two transects. Transects were positioned from the mouth of the Chester River to the headwaters (about one mile above Crumpton, Maryland). The transects are shown in Figure 2-1 and are described precisely by latitude and longitude in Table 2-1. Transect crossections are included in Normandeau Associates report prepared for this study (11).

The purpose of conducting the survey was to provide information about the physical shape of the river bed and river depth at any point on a transect under a standard tidal condition at Mean Low Water (MLW). Bottom profiles were obtained using a recording fathometer. The transducer of the recording fathometer was mounted on the boat transom one foot below actual water level. The fathometer was calibrated both before and after the survey using a marked and weighted polypropylene sounding line.

Recorder chart speed was always the maximum, about 1 cm per minute. Boat speed was maintained constant throughout any one run, though not necessarily from transect to transect, by running the engine at 1000 RPM and using wind and current measurements to confirm that those two forces had remained relatively constant throughout the run. Trueness-of-course was monitored on the longer transects (20, 21, 22) by triangulation of position using berings to navigational aids and landmarks, and on all other transects by use of visual ranges resulting in rigid lines of reference. Profile depths were normalized to Mean Low Water (MLW) at the stage height indicator nearest the transect. For more details concerning the calculation of the MLW depth at each transect see reference 1 (p 2-4).

Calibration of the fathometer before and after the survey showed the instrument to be accurate, the only adjustment needed being the addition of one foot to correct for the transducer being run one foot beneath the surface.

Portions of transects 2 and 3 did not appear on the fathometer recording. The first 200 yards and last 50-60 yards of profile 2 and the last 300 yards of profile 3 were too shallow to use the engine making uniform boat speed impossible. These areas were poled over and found to be of relatively uniform depth (11).

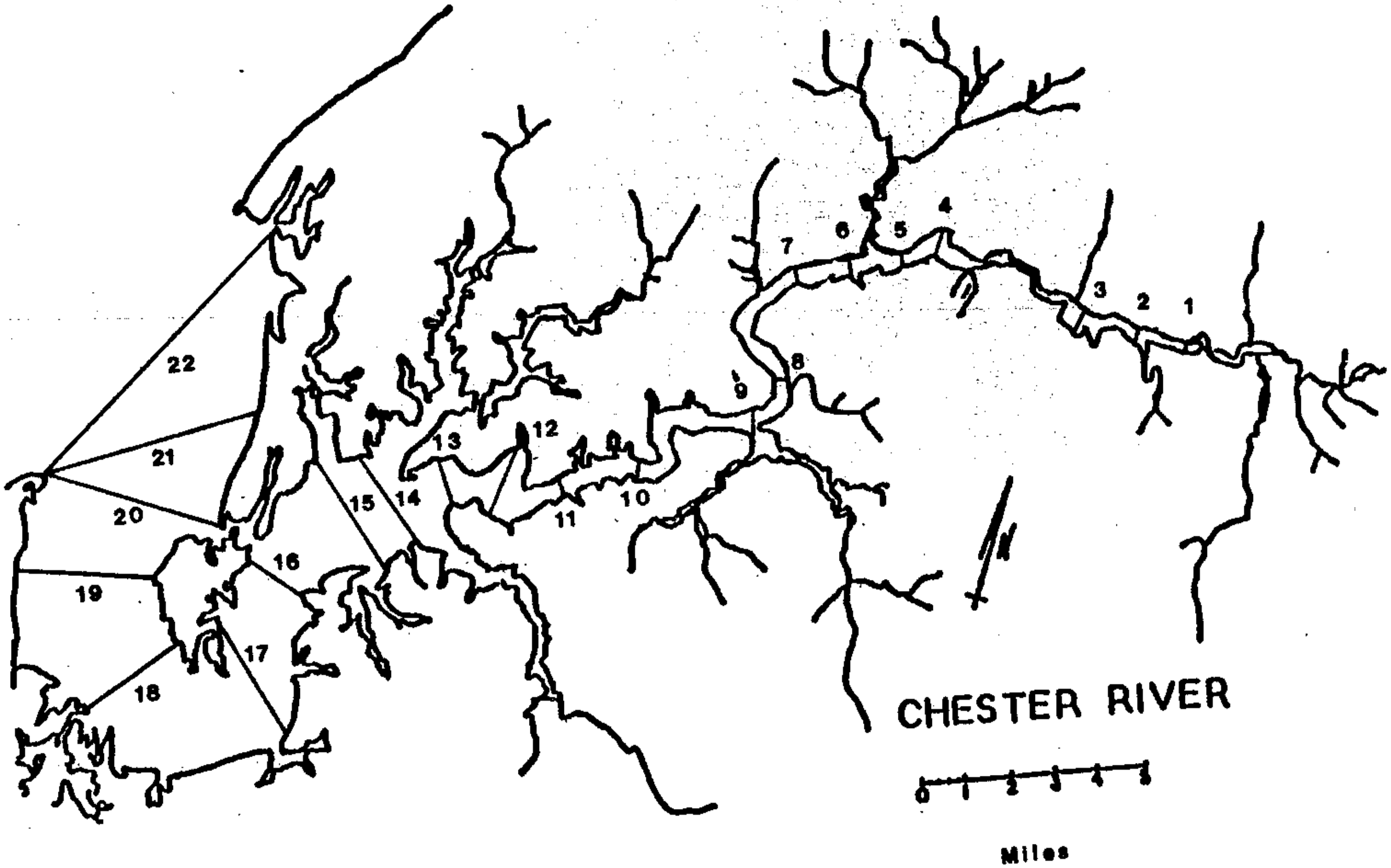


Figure 2-1 General location of Chester River Bathymetric Survey Transects.

Table 2-1 Chester River Bathymetric Survey Transects

Transect No.	QA County Side		Kent County Side	
	N. Latitude	W. Longitude	N. Latitude	W. Longitude
1	39 14 58	75 53 45	39 14 53	75 53 44
2	39 14 39	75 55 03	39 14 45	75 55 06
3	39 14 07	75 56 22	39 14 33	75 56 20
4	39 14 12	76 00 31	39 14 41	76 00 30
5	39 13 40	76 01 07	39 13 47	76 01 19
6	39 13 05	76 02 11	39 13 18	76 02 33
7	39 12 31	76 03 19	39 12 44	76 03 26
8	39 10 39	76 02 21	39 10 30	76 02 44
9	39 09 24	76 02 34	39 09 53	76 03 05
10	39 07 45	76 04 43	39 08 03	76 05 06
11	39 06 50	76 06 19	39 06 58	76 06 40
12	39 05 50	76 07 40	39 07 10	76 07 40
13	39 05 35	76 08 43	39 06 16	76 09 38
14	39 04 45	76 09 02	39 05 39	76 11 19
15	39 03 40	76 09 27	39 05 07	76 12 15
16	39 02 38	76 10 46	39 02 41	76 12 34
17	39 00 17	76 09 49	39 01 36	76 12 45
18	38 58 50	76 14 37	39 00 49	76 13 09
19	39 00 17	76 17 34	39 01 36	76 14 28
20	39 02 22	76 18 07	39 02 48	17 13 53*
21	39 02 22	76 18 07	39 05 24	76 14 01
22	39 02 22	76 18 07	39 08 25	76 15 45

Positions stated in degrees, minutes, seconds as read from NOAA+NOs chart 12272, 18th ed., 1979.

*This position is about 400 yards SE of the one indicated by the client as end of transect No. 20.

Transect number 1 was not recorded because shallow water and vegetation made passage of the boat upriver to that point impossible.

STAGE HEIGHT MEASUREMENTS

The selection of sites for stage height measurement was based on accessibility and distribution throughout the estuary. Three factors were considered in selecting the sites. These factors included (1) location near water quality survey transects so that they could be easily checked by the survey teams, (2) at a place that offers good support for the instruments or stakes, and (3) proximity to a benchmark or other known elevation. Seven stage height marker stakes were permanently installed at locations shown in Figure 2-2 and Table A-2-2. From May through September, 1981, continuous level recorders were installed at Love Point and Chestertown. As the recorders and stakes were installed, the site number was clearly marked at each site, as well as marked on a topographic map. Latitude-Longitude of continuous level recorders were: Love Pt. (39° 02' 05" N. Lat x 76° 18' 07" W, Long.), Chestertown (39° 12' 15" N. Lat. x 76° 03' 30" W. Long.).

Stage height readings were taken visually by each survey team (with the exception of the four continuous recorders) and referenced to mean sea level. This datum was surveyed at each station at the time of installation and twice during the study using benchmarks or other known elevations (manhole covers, building foundations) as reference points. Stage height measurements were used to show the progression of tidal cycles up and down the entire estuary.

The stage height at each station was read every three hours, coinciding with sample collections for the intensive and 24 hour surveys. The ISCO continuous stage height recorders were checked every three hours and the record obtained at the end of the survey. Data have been stored in STORET.

Calibration of instruments involved installing the stage height stakes and recorders and surveying their elevation from a known point, preferably a benchmark. The water level recorders were calibrated according to manufacturer's instructions. The expected uncertainty involved is less than 0.05 foot.

Maintenance and calibration of the stage height stakes was minimal, requiring visual inspection prior to each survey. Stage height recorders were calibrated from temporary benchmarks close to the installation points. Surveying and calibration of the stage height stakes followed standard land surveying methods utilizing an automatic level and a stadia rod graduated in 0.01-foot intervals. Tide stage height indicator staff calibration results appear in Table A-2-2. Stage height records thus reflect water level above or below mean sea level.

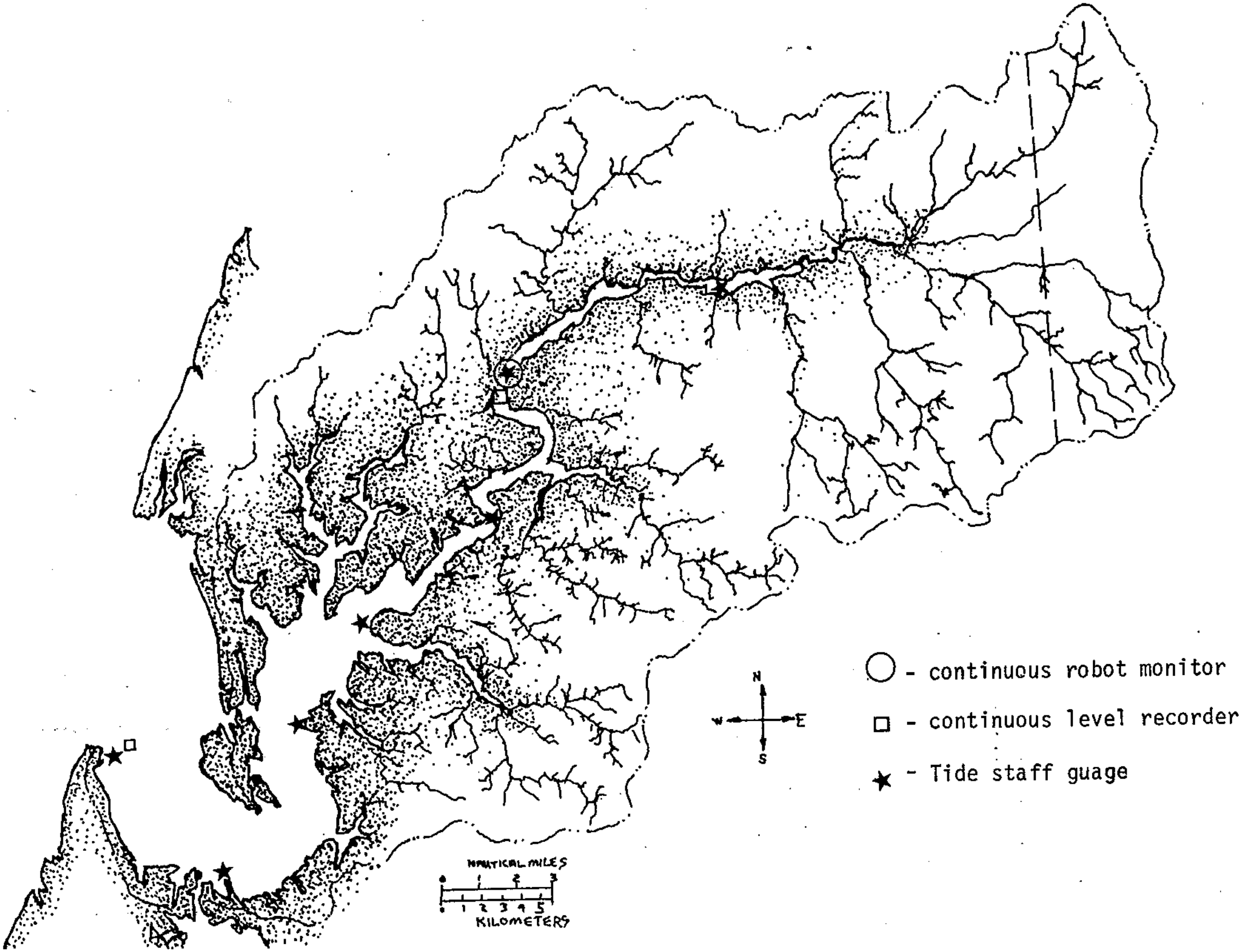


Figure 2-2 Location of Tide staff gauges, continuous water level recorder and robot monitor during the Chester River water quality surveys.

CURRENT SPEED/DIRECTION MEASUREMENTS

Current measurements were obtained during intensive water quality surveys. Ten sites were selected (uniformly distributed along the estuary) from the locations sampled during the intensive surveys and are shown in Figure 2-3.

The transducer end of the system was dropped overboard from a boat anchored at the station, lowered to the appropriate depth, and a measurement of current direction and velocity was obtained from a direct readout onboard. Each site was sampled once every three hours or 8 times during the survey. Readings were taken at surface, mid-, and bottom depths, giving a total of 24 readings per site. A total of 240 readings were generated for each intensive survey. Table 2-3 shows the instruments used at each station during each intensive 24-hour survey.

Calibration of the internal standard in each current meter was performed according to the manufacturer's instructions before field operation, and zero-set to the standard at each station during the survey. The calibration of the internal standard was also checked after the survey.

The expected uncertainty for velocity variations are less than 1 ft/s. Directional variations ranged as high as 10°.

ADVECTIVE FLOW MEASUREMENTS

Sixteen advective flow stations were sampled as shown in Figure 2-4. These stations were selected to examine tidal effects in small tributaries of the estuary. Flow measurements were obtained at each of the 16 stations with a Marsh-McBirney (M-M) Model 201 direct reading flow meter. Prior to each survey, all stations were visited to measure stream channel geometry, mark appropriate measuring points, and inspect the stream height indicators.

The transducer of the meter was placed in the stream at 1-foot intervals across the width of the stream, thereby obtaining a representative cross-sectional flow at each station. A General Oceanics meter was anchored in the stream at a given depth, and the meter hydrodynamically aligned itself with the flow in the stream. Since the meter was run over a 2-5 minute interval, a representative sample of flow conditions at that depth was obtained.

Advective flow measurements were taken once per station during the Lower Estuary Homogeniety Survey of July 15, 1980, and once every three hours during the May and July 1981 Intensive River Surveys. The three-hour interval was based on the minimum amount of time needed for the survey team to sample all other sites and return to the station. Data recording and calibration procedures were the same as stated in the previous section, except for the General Oceanics meter, which required no external calibration (its mechanical counter is pre-set). Table A-2-4 provides the

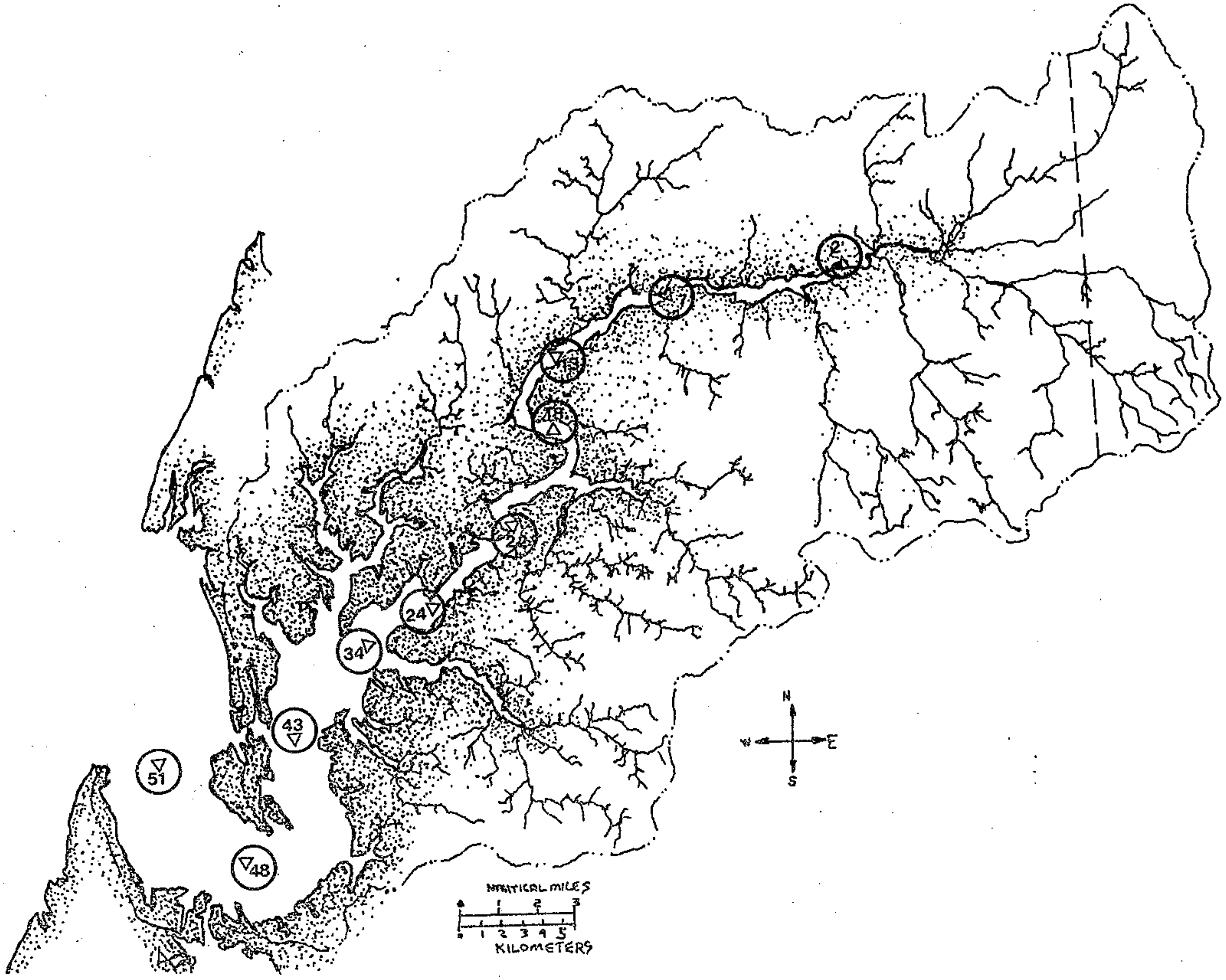


Figure 2-3 Location of Current Speed/Direction Stations in the Chester River sampled during the intensive River Surveys.

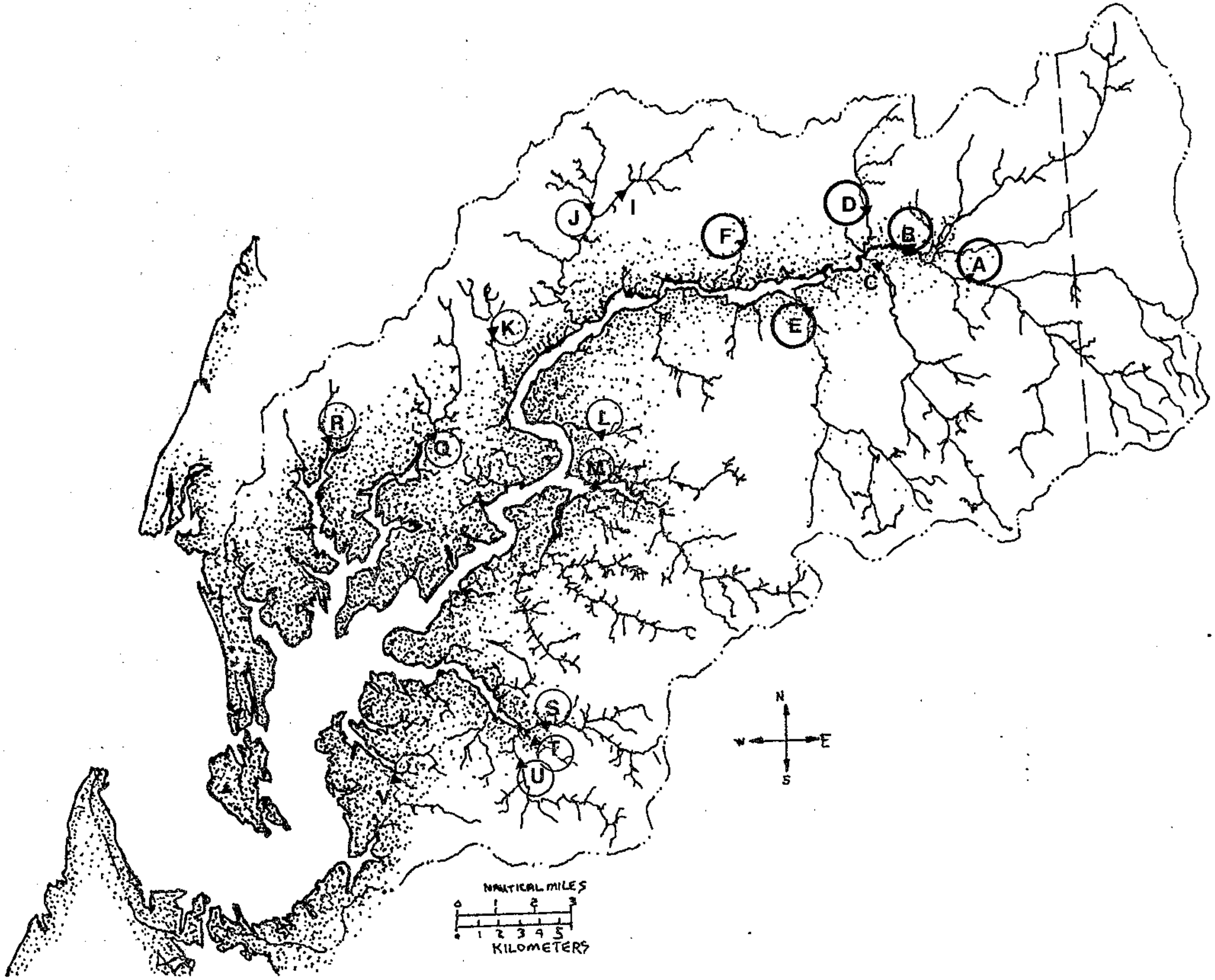


Figure 2-4 Location of Chester River Advective Flow Monitoring Stations.

Table 2-3

Equipment Type Used to Record Current Speed/Direction During Intensive River Surveys

Station No.	5/29-30/81	7/24-25/81	9/24-25/81
	Survey Date		
0051	Hydroproducts 950	Endeco 110	Endeco 110
0048	Endeco 110	Endeco 110	Endeco 110
0043	Endeco 110	Hydroproducts 950	Hydroproducts 950
0034	Endeco 110	Hydroproducts 950	Hydroproducts 950
0024	Marsh-McBirney 710	Endeco 110	Endeco 110
0022	Marsh-McBirney 710	Endeco 110	Endeco 110
0018	Marsh-McBirney 710	Endeco 110	Endeco 110
0013	Marsh-McBirney 710	Endeco 110	Endeco 110
0007	Marsh-McBirney 710	Endeco 110	Endeco 110
0002	Marsh-McBirney 710	Endeco 110	Endeco 110

All data has been stored into STORET.

location of advective flow stations, station letters and state ID codes, and surveyed elevations and benchmarks. Gage height data as well as advective flow measurements were taken during the July 1980 Lower Estuary Homogeniety Survey, the May 1981 and July 1981 Intensive River Surveys. DATA has been placed into STORET.

UPPER ESTUARY AND MORGAN CREEK DYE STUDIES

Sites for measuring dye concentrations were selected at six easily accessible locations along the "upper estuary," between Crumpton and Chestertown, Maryland, and at six locations along Morgan Creek (see Figures 2-5 and 2-6). The site selection criteria, in addition to accessibility, included equidistant spacing along the length of stream expected to be traveled by the dye, absence of onshore disturbances, such as a storm sewer outfall, and flow conditions that appeared similar to the stream sections immediately adjacent to the site. Each site was described geographically and marked on a topographic map. In addition, small stakes with flagging tape attached were driven into the stream bank at each for triangulation by the survey team. Water samples were taken with a peristaltic pump from up to three different depths at each site, and composited in a 1-liter container for analysis. This was to insure that a representative sample was obtained if the dye was not uniformly dispersed in the water.

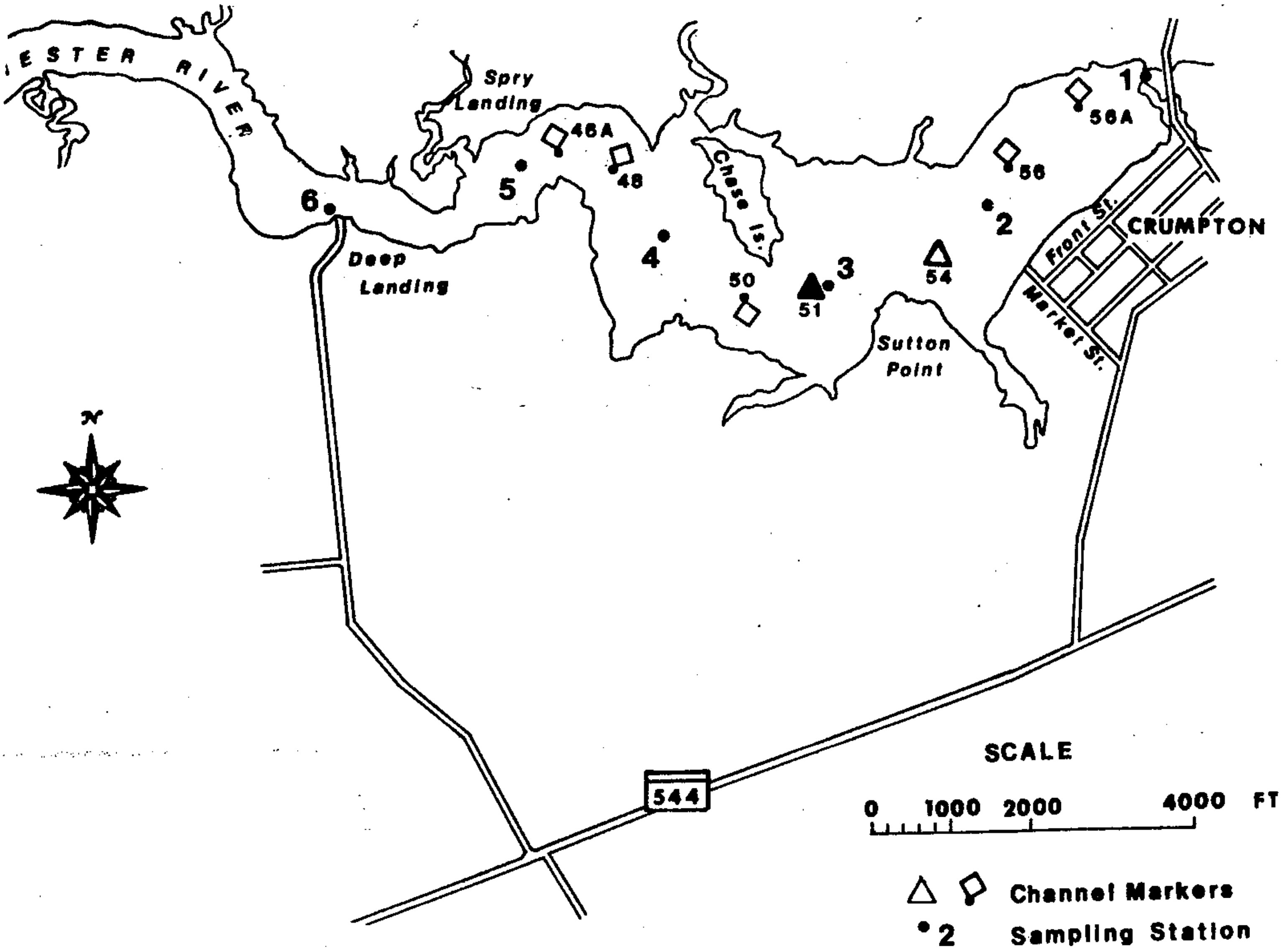


Figure 2-5 Upper Chester Estuary Dye Study Station Locations

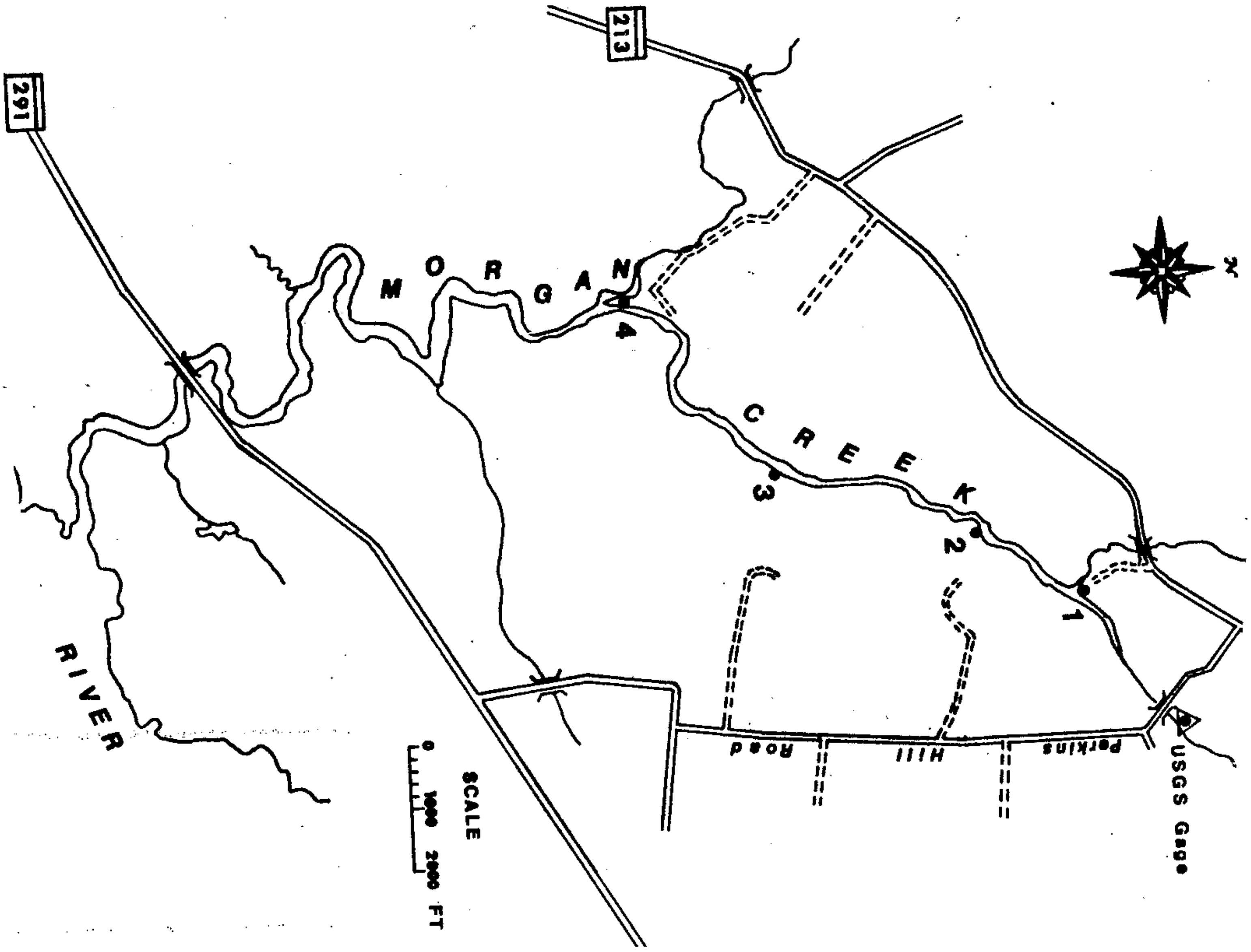


Figure 2-6 Morgan Creek Dye Study Station Locations

The movement of dye in the estuary was expected to be slow and thus was monitored for six tidal cycles. Each station was monitored hourly except when the dye slug was passing the station. Samples were collected every 10 minutes for 30 minutes before and one hour after the dye passed each monitoring station. Drogues placed in the water at the time of dye release served as visual indicators of the location of the dye slug. The sampling period was determined by projecting information from tide tables and current charts, sampling team observations. The passage of the dye past a given station depended on many factors, therefore approximately 200 samples for each study were collected. Composite samples were labeled with station number, time and date of collection, and purpose of sample using standard Versar sample labels. Samples were stored in darkness, since the dye was somewhat light-sensitive. No other preservation techniques were required.

The dye was instantaneously released at the upstream station at low slack tide. Intracid Rhodamine WT liquid was used for both the "upper estuary" and Morgan Creek. Personnel recorded sample collection parameters such as weather conditions, tide stage, temperature, and other field data in bound field notebooks. Since the actual sample collection was accomplished quickly, sample containers were pre-labeled and the field log set up in table form, therefore the sampling crew spent a minimum amount of time between sampling stations.

Sample analysis was performed with a Turner Model 430 Spectrofluorometer calibrated from a calibration curve with at least five standard reference points. Calibration curves were prepared daily during analysis of dye study samples. A reference sample of quinine sulfate, supplied with the fluorometer, was used for calibration. Samples of estuarine or stream water were collected the day before the dye study to obtain a representative background fluorescence. Background values were subtracted from each sample analyzed to obtain actual dye concentration. The variability of the calibration standard was ±1%, or 0.02 ppb. This variability had negligible effects on the results of the study. Calibration and maintenance data were recorded in the bound notebooks taken into the field. Data are included in Appendix I.

EVALUATION OF SEDIMENT OXYGEN DEMAND

The purpose of these analyses was to determine the relative sediment oxygen demand of the bottom substrate at six stations. Sediment samples were collected at stations shown in Table 2-5 and Figure 2-7. Samples were collected twice during the first year of the study and once during the second year at stations XIH2463, XHH5301 and XGG9572. The exact sampling points were determined in the field to assure a representative sampling point. The criteria used for the determination of sampling points was the following: outside of shipping lanes (i.e., navigational buoys) and clear from private and commercial boat docks. Once the sampling stations were determined they were marked on a navigational chart for use during subsequent surveys.

Samples were taken with an Eckman Dredge in accordance with procedures described in the EPA Great Lakes Region, Committee on Analytical Methods (1969). Sediment from the top 6 cm was placed in a labeled plastic container, packed in ice, and analyzed within twenty-four hours.

Seven replicates at three different dilutions (0.01g, 0.05g, and 0.1g sediment per BOD bottle on a wet weight basis) were set up for each station sampled and twelve replicates for the 0.01g/BOD bottle dilution aliquots were weighed and placed in BOD bottles, filled with dilution water, aerated, the initial DO measured and placed in a 20°C BOD incubator. One of the seven replicates for each of the three dilutions was removed and the final DO recorded on day 2, day 5, day 10, day 15, day 20, day 25, and day 30. If the oxygen level in a bottle was depleted below 2.0 ppm, then that bottle was not included in the results. By having twelve replicates of the 0.01g/BOD bottle dilution, at least two readings were assured for each station for every day the final DO was measured.

PHYTOPLANKTON RESPIRATION STUDY

Gross and net primary production was measured at six stations, shown in Table 2-5. Two seasonal measurements were made at stations XIH2463, XHH5301, and XGG1537 during the first year of the program and during June of the second year. Exact sampling points were determined once in the field to assure a representative sampling point. The criteria used for determination of sampling points was: outside navigational buoys, representative area and depth, and clear of private and commercial boat docks.

One dark and two light BOD bottles at three different depths at each station were incubated (with the exception of Station B where only the surface and three foot depths were used). These incubation depths were surface, three and six foot depths. A 6-liter vertical Beta bottle was used to collect a representative sample at these respective depths for incubation. During incubation, each bottle was held horizontally by a PVC bottle holder attached to a buoy. These samples were incubated for a 4-hour period between 0900 and 1500 hours. The dissolved oxygen levels intially and after incubation were measured with a YSI Model 57 dissolved oxygen meter with BOD self-stirring probe. The DO meter was calibrated using D.O. saturated water prior to each survey.

The net photosynthesis, respiration, and estimated gross primary production rate were calculated based on the average of the replicate samples..

WATER QUALITY SURVEYS

The purpose of the river/estuary water quality surveys was to provide data necessary for evaluating water quality enrichment in the Chester Estuary and to provide data for evaluating water quality models. The study consisted of the folowing surveys: one lower estuary homogeniety survey, entire river system surveys, slack tide surveys, and twenty-four hour

Table 2-5

Study Station Number and State ID Codes for Sediment Oxygen Demand Samples Phytoplankton Respiration Measurements and Sediment

Station Number	Maryland ID Code
000B	CYR0004
0013	XIH2563
0022	XHH8354
0034	XHH5301
0048	XGG9572
0051	XHG1537

monitoring surveys. With the exception of the automatic robot monitor sampling, which occurred before and during the inensive and 24 hour surveys, the collection methodology and parameters to be analyzed were the same for each survey (Table A-2-9). The location of the stations sampled during the twentyfour hour and slack surveys are shown in Figures 2-7 and 2-8 respectively.

SLACK WATER SURVEYS

Water quality surveys were conducted approximately monthly except during the winter months. Surveys were conducted within ± one hour of predicted slack water (based upon predicted minimum currents) estimated from published NOAA tide and current records. Table 2-6 shows the location of the nine slack tide stations. All stations were located within the mainstem of the river/estuarine system except station 33 which was located near the mouth of Langford Creek. This station was located in this location in order that water quality conditions typical of the larger tributary systems could be indicated. Analysis of data in this report show the relative difference in water quality variables at this station thus supporting the need for such station data. Stations 43, 42, and 34 were located closer together in order to represent the transition between the lower estuary and tidal river portion of the estuary.

During each survey, dissolve oxygen, temperature, conductivity/salinity and pH were collected at three depths (surface, mid-depth and bottom). A single water sample was collected from each station after compositing equal aliquots of water from the three depths. From June 1980 through September 1980 water samples were analyzed for variables shown in Table 2-8. After September 1980 through September 1981, water samples were analyzed for the variables shown in Table 2-9.

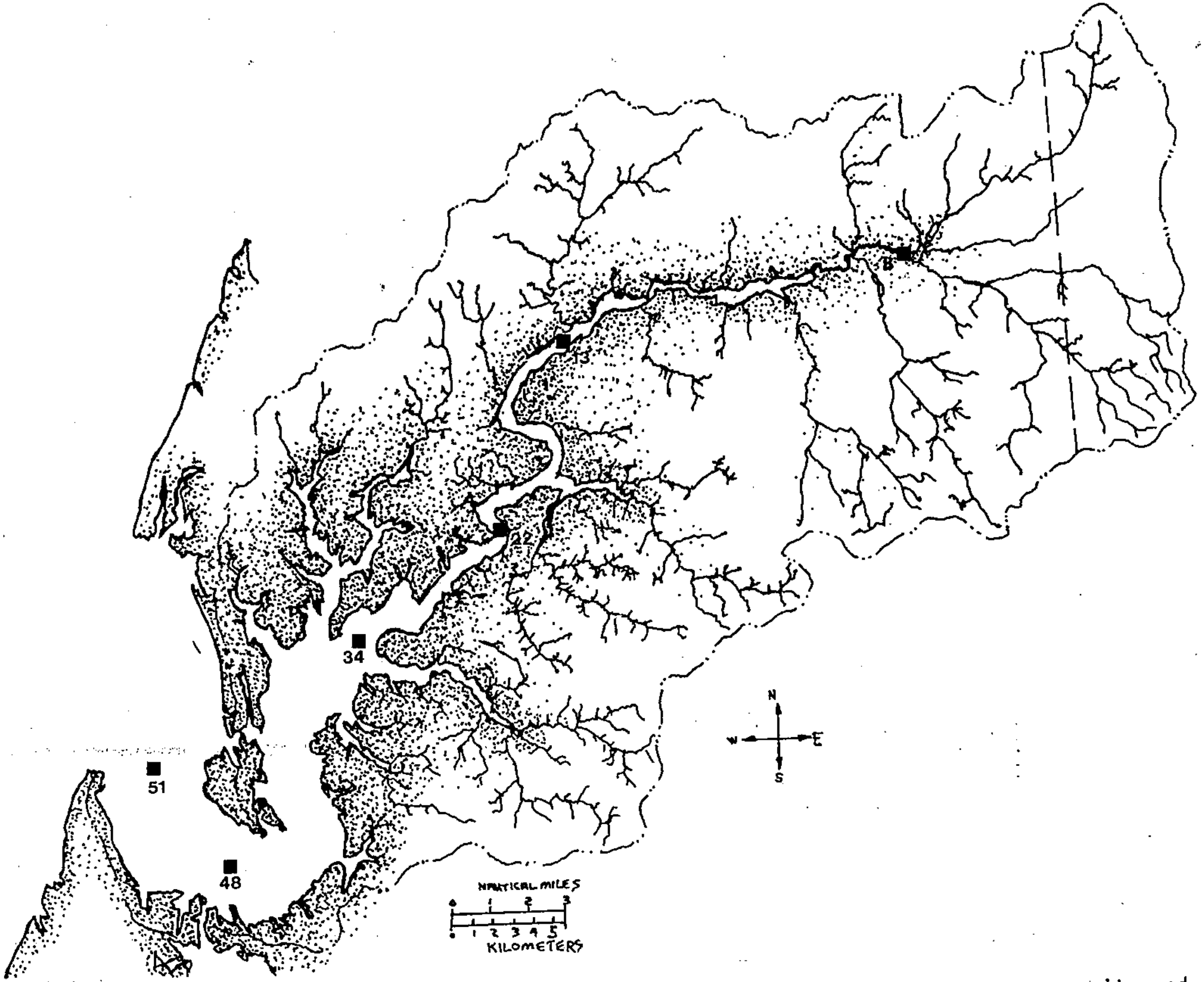


Figure 2-7 Location of sediment oxygen demand; nutrient exchange; phytoplankton community and respiration; and 24 hour monitoring stations in the Chester River.

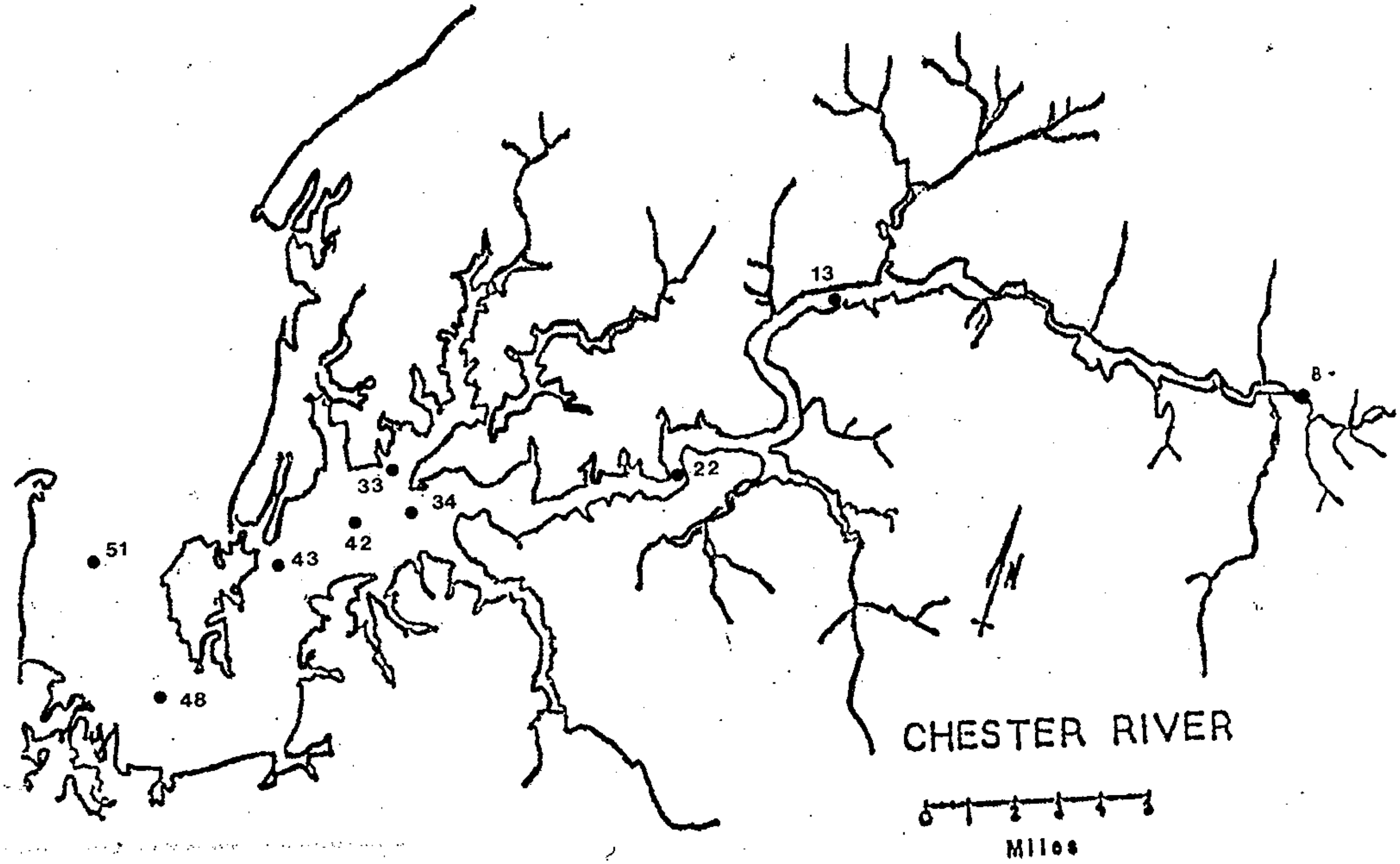


Figure 2-8 Location of Stations for the Chester River Slack Survey
(refer to Table 2-6 to obtain Storet ID No.)

Table 2-6

Slack Water Survey Stations for the Chester River

Station No.	STORET ID No.	Storet Agency Code	Nautical Mile
B	CYR0004	21MDEXP	41
13	XIH2463	21MD	28
22	XHH8354	21MDEXP	21.3
34	XHH5301	21MDEXP	16
33	XHG6094	21MDEXP	15.5*
42	XHG4893	21MD	15
43	XHG3078	21MDEXP	13.2
48	XGG9572	21MD	8.5
51	XHG1537	21MDEXP	5.5

*This station was located outside of the mainstem river.

LOWER ESTUARY HOMOGENIETY SURVEY

This one-time effor was performed on 15 July 1980 to determine the lateral and vertical uniformity of waters in the lower estuary. The July sampling at 15 stations (Figure 2-9 and Table 2-7) was conducted at the same time frame of the EPA Chesapeake Bay Program bay-wide nutrient assessment.

Water samples for water quality variable anaylses and <u>in situ</u> parameters were recorded at four depths (near surface, 0.3 x depth, 0.6 x depth, and 0.9 x depth) at each of the 15 stations (see Table 2-8 for chemical variable list). Samples and data were collected at high slack tide during daylight hours. (Slack tide conditions defined as ±1 hour of the high slack, adjusted to each station.)

Yellow Springs Instrument Company's Model 57/54 dissolved oxygen meters and Model 33 SCT meters were used. Hydrogen ion concentration (pH) and turbidity of each sample were determined at the field laboratory using a Corning No. 610A pH meter and a Hack Model 2100A turbidimeter.

All instruments were calibrated prior to sampling according to manufacturers' specifications. Meters were rechecked during sampling to insure consistency and accuracy.

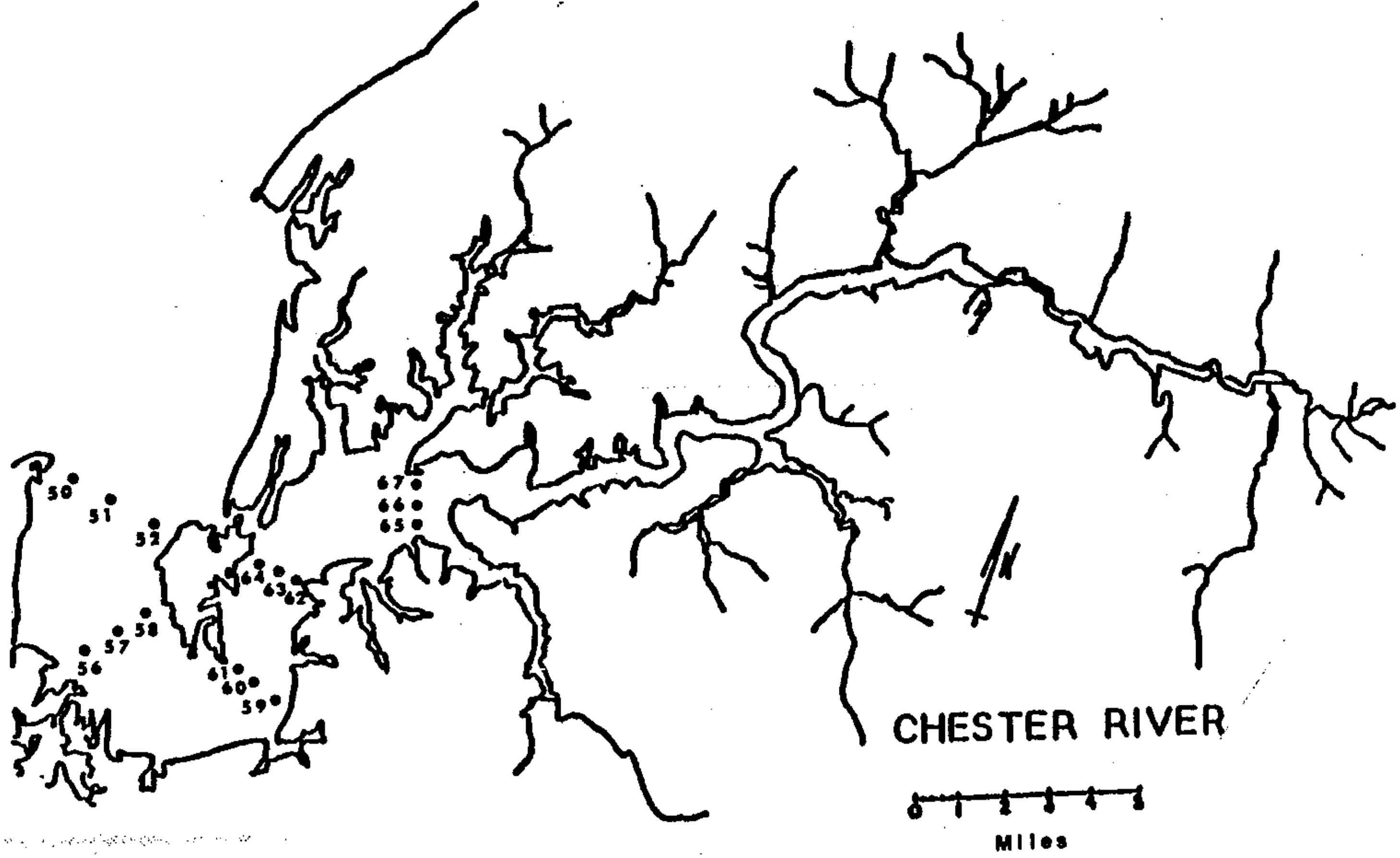


Figure 2-9 Location of Chester Lower Estuary homogeniety water quality stations.

Table 2-7

Station Numbers and Maryland State ID Codes
for Lower Estuary Homogeniety Survey Conducted July 15, 1980

Station Number	State ID Code
0050	XHG1228
0051	XHG1537
0051	XHG1545
0056	XGG9649
0057	XHG0153
0058	XHG0556
0059	XHG0396
0060	XHG0591
0061	XHG0786
0062	XHG2886
0063	XHG2881
0064	XHG2878
0065	XHH5206
0066	XHH5403
0067	XHH5602

Water samples from each depth were collected in 4-liter Van-Dorn bottles. Withdrawn water was placed in plastic containers containing the appropriate preservatives. All samples were packed in ice-filled chests and, upon completion of the lower estuary homogeniety survey, all samples except chlorophyll-a were air-shipped to TI's (Texas Instruments) Dallas laboratory for analysis.

Two 1-liter samples for chlorophyll-a analysis were returned (on ice) to the field laboratory, filtered through Whatman GF/A glass-fiber filters, and frozen at -20^0C. Filtration volumes were recorded and frozen samples were shipped to TI's Dallas laboratory, for extraction and analysis of chlorophyll-a and phaeophytin-a.

ENTIRE RIVER INTENSIVE SURVEYS

Three entire river intensive surveys were performed during the Chester River study; each of the surveys consisted of depth composited samples at each of 50 stations (Figure 2-10). These surveys were conducted on May 29, July 24, and September 24, 1981.

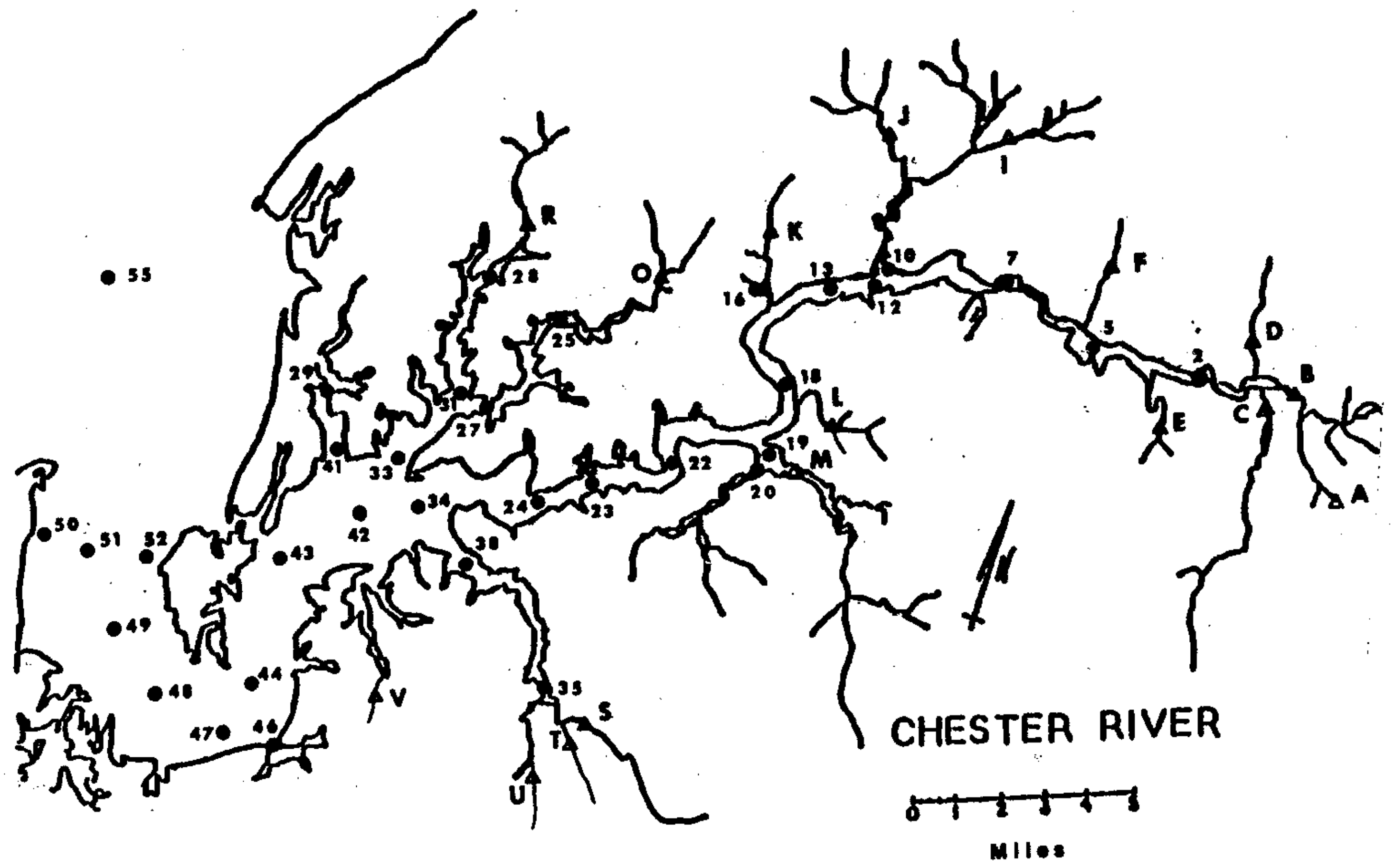


Figure 2-10Location of Chester River Estuarine River Intensive Water Quality Survey Stations

Table 2-8

Water Quality Variables and Methods for Analysis of Chester River Lower Estuary Homogeniety Samples

Variable	Reference	
Ammonia	EPA, 1979	350.1
Nitrate	EPA, 1979	353.2
Nitrite	EPA, 1979	353.2
Total Kjeldahl nitrogen	EPA, 1979	351.2
Total phosphorus	EPA, 1979	365.4
Total phosphorus (filtered)	EPA, 1979	365.4
Orthophosphate	EPA, 1979	365.1
Total suspended solids	EPA, 1979	160.2
Total dissolved solids	EPA, 1979	160.1
Total organic carbon	EPA, 1979	415.1
Chlorophyll a	Strickland and Parson, 1972 Vollenweider, 1974	

All samples were collected at slack tide during daylight hours. Water was collected at four depths (near surface, 0.3 x depth, 0.6 x depth, and 0.9 x depth) at each station, composited and thoroughly mixed, and subsampled for the analysis of variables listed in Table A-2-9. Samples were appropriately preserved, placed in iced containers and shipped to NAI's Dallas laboratory. BOD samples were analyzed by Versars laboratory facilities.

Surface, mid-depth, and near-bottom in situ measurements were taken at the fifty stations for water temperature, pH, dissolved oxygen, specific conductance, secchi depth and salinity. Instruments were calibrated before and after each survey. Storet station numbers are listed in Table A-2-10.

AUTOMATIC ROBOT MONITOR SAMPLING

A single Schneider Instruments RM 25 automatic monitor was used to measure and record water level, pH, specific conductance, dissolved oxygen, temperature, and solar radiation at Chestertown, Md. during each intensive survey (see Figure 2-2). Sampling began with the slack tide survey before the entire river intensive survey and continued through the duration of the intensive river survey and 24-hour survey and ended after the slack tide survey following the intensive river and 24-hour survey. The automatic monitor was calibrated according to the procedures discussed later in this section. The data has been placed into STORET.

TWENTY-FOUR HOUR MONITORING

On the same day of the three entire river surveys, water quality samples were collected at six stations (B, 13, 22, 34, 48, and 51) at approximately three-hour intervals. The sampling intervals corresponded to low slack, flood, high slack, and ebb tide stages over two complete tidal cycles. In situ measurements were taken at near-surface, mid-depth, and near-bottom depths at each of the stations. Water samples were collected at near-surface and near-bottom depths. The variables analyzed are shown in Table A-2-11. Current speed and direction was measured at each station with recording flow meters from an anchored, stationary boat. The flow meters were calibrated before and after each 24-hour survey effort with calibration of other meters as described earlier.

Table A-2-12 provides the dates and start/end times of each 24-hour monitoring survey.

SEDIMENT-WATER NUTRIENT EXCHANGE

The purpose of this subtask was to study indicate the gross potential of sediment nutrient release in the Chester River system. Sediment samples were collected four times during the survey in connection with sediment oxygen demand evaluating at stations shown in Figure 2-7 and Table 2-5. Sediment samples were collected, filtered, and the filtrate was analyzed for ammonia, nitrite, nitrate, total nitrogen, total phosphorous, and orthophosphorous levels.

During each survey one sediment sample was collected at each station for nutrient analysis. All samples were taken with an Eckman dredge in accordance with EPA Great Lakes Region, Committee on Analytical Methods (1969). Sediment from the top 6 cm was placed in 2-liter plastic containers, labeled, packed in sn ice-filled chester, and returned to Versar's laboratory within twenty-four hours for analysis.

PHYTOPLANKTON EVALUATION (Community Composition)

Water samples were collected with 5-L Nisken water bottles and analyzed for phytoplankton density, biomass (Biovolume), and chlorophyll-a concentrations. Cell densities were determined for total phytoplankton and the major divisions (diatoms, green algae, and blue-green algae). Densities (greater than 5 percent) of the dominant taxa also are reported.

Phytoplankton samples were collected during summer and fall 1980 and spring kand summer 1981 at stations shown in Table 2-5. Two 4-liter water samples were collected 1.0 meter below the water surface in PVC Van-Dorn water bottles. The two samples were composited, and four 1-liter subsamples were withdrawn and preserved with acid-Lugol's solution for phytoplankton species identification and enumeration and biomass determinations. An additional 2-liter subsample was withdrawn from the remaining composite sample volume and placed in two 1-liter bottles for chlorophyll-a analysis. These subsamples were placed on ice in the dark to retard degradation. Surface temperatures were settled and centrifuged at the field laboratory before identification and enumeration. After receipt of samples in the laboratory and analyses began, samples were settled for 24 hours in glass cylinders in a final concentration of 1 percent acid-Lugol's solution, the upper 1800 milliliters and then carefully siphoned from each sample, and the remaining 200 milliliters concentrated by careful successive centrifugations on a high-volume centrifuge at 2000 revolutions per minute for 12 minutes. (It should be noted that only 2 liters of the 4-liter field sample is settled; the remainder served as a backup until shipment to Dallas and lab analysis was completed). After each centrifugation, the upper layers of liquid in the centrifuge tube were carefully decanted, the remainder was agitated with a Vortex Junior mixer, and the contents of each tube poured into a labeled sample vial. As a precaution, several milliliters of 6:3:1 preservative were added to each sample vial. The final sample volume was not always constant, but the concentration of algal cells was approximately constant and representative of the original volume settled. The final volume to which the cells was concentrated and recorded to permit back-calculation to original volumes (to determine concentration factors).

After the concentration sample was fully mixed, two subsamples were placed in Palmer cells and the algae in 20 fields (10 per subsample) were identified to the lowest practical level (usually species) and enumerated at 400X magnification. Density (number of cells per milliliter) was determined for total phytoplankton, major divisions, and dominant organisms. In addition, diatoms were identified and enumerated at 1000X after clearing and mounting in Hyrax medium.

NITROGEN FIXATION

Samples for evaluation of nitrifying bacteria were collected during summer, fall and winter 1980 and spring 1981 (two samples each time for both water and sediment) using a Nisken sampler for water and Ekman dredge sampler for sediment. The upper 1-3 centimeters of the bottom sediment sample was removed for evaluation. One water sample per station was filtered through 64m mesh to remove the phytoplankton for bacterial evaluation only. Samples were immediately transferred into a gas-tight serum or vaccine bottles and placed on ice for return to the field lab.

In addition, 2 liters of river water were collected, placed on ice, and returned to the laboratory. This water was filtered through 0.2-m membrane filters and added to the sediment reaction vessels so that water just covered the sediment in the bottom of the container. After partial evacuation, the reaction was initiated with the addition of acetylene (C_2H_2), 0.2 to 0.4 atmosphere higher than the outside pressure. The affinity of the nitrifying and N_2-fixing organism's system for acetylene is sufficiently high so that, if 0.2 atmosphere of C_2H_2 is injected into a bottle filled with air, the N_2 does not compete effectively and reduction of C_2H_2 is virtually the same as in the absence of N_2 (6). Samples were incubated at the field laboratory for up to 8 hours (preliminary runs were made to determine the most appropriate incubation time). Incubation temperatures ($\pm$2-3°C) approximated those noted at the time of collection. At the end of the the incubation a sufficient volume of the gas mixture above the water and/or sediment material was withdrawn and injected into a partially evacuated serum bottle. These labeled, gas-filled bottles were then shipped on ice to Dallas. After properly being logged in, gas was removed from the serum bottles and injected directly into the gas chromatograph (Porapak R., 80-100 mesh) for determination of the acetylene (C_2H_2) and ethylene (C_2H_4) that was formed. Data is reported as nannograms C_2H_4 per cubic centimeter per hour for both sediment and water samples.

POINT SOURCE EFFLUENT ASSESSMENT

The objective of this effort was to characterize the conventional pollutant concentrations from effluents that contribute pollutant loads to the Chester River.

Site selection criteria was established to assure that target point sources represented the spectrum of the major point sources on the Chester River system. The first and major criterion for site selection was the amount of effluent discharged. A factor which precluded selection of a site based on amount of discharge is the nature of the discharged cycle. Facilities with intermittent, as-needed batch discharges, or whose operations result in atypical discharges were not included as target point discharges in this survey.

Inherent to site selection (based on size of discharge) was consideration for the presence of properly installed primary flow devices, or existing in-line flow monitoring instruments and accessibility of those discharges. Minimal masking of target discharge due to excessive non-point discharges and/or the presence of a non-target point discharge in close proximity to the target point discharge was considered prior to selection of sampling sites.

Representative samples were obtained by use of flow proportioned composite ISCO samplers.

Point source discharges that were considered for monitoring are shown in Table 2-13.

A combination of only five point sources were sampled during each intensive survey. When a facility was not selected for sampling during a survey it was because their discharge characteristics were not typical. Sampling dates and times appear in Table A-2-12.

Table 2-13. Chester River Point Sources

Point Source	Maryland ID Code
Millington STP	740166001
Centerville STP	740116001
Chestertown STP	750592001
Campbell Soup Co.	770009001
Tenneco Chemical	780014001
Queenstown STP	750737001
Rock Hall STP	750575001

Two sampling methods were available for collecting flow proportioned composites. Whenever a primary flow measuring device was installed on a point source discharge, portable flow meters and data recorders were interfaced with a composite sampler. These instruments were programmed to take an appropriately sized sample aliquot upon the discharge of a pre-determined volume of effluent.

If, for example, a target discharge was rated at 1.0 million gallons per day (MGD), the flow measuring and sample collection train was programmed to collect a sample every 20,000 gallons. This program resulted in collection of a sample approximately every one-half hour.

To determine the concentration of wastewater discharges and major point source pollutant loads contributing to the Chester River water qualiy during the lower estuary homogeniety survey and the river intensive surveys point source surveys were conducted the day before and the day of the intensive surveys. Separate 24-hour composites were collected for both days at each of the five selected point sources.

Based on historical flow data or direct instantaneous flow determinations, samplers were programmed to take a sample aliquot from approximately each 0.02 (1/48) of the total daily discharge. The average sample aliquot was taken every one-half hour. This frequency was selected to standardize all sampling systems at each of the point source discharges.

ISCO automatic samplers and flow meters were used to collect flow proportioned samples at the selected point discharges. The model of sampler used depended upon the presence of a primary flow measuring device. In cases where a primary flow measuring device was installed at the discharge, an ISCO Model 1580 sampler was used to collect direct flow proportioned composite samples. Flow data obtained from the facility was used to assure the flow meter operated correctly.

Where primary flow measuring devices were available, an ISCO Model 1870 flow meter or an ISCO Model 1700 flow meter combined with a Model 1710 printer was interfaced with the automatic sampler.

The ISCO Model 1580 Wastewater Sampler collected a composite sample, into a single 3-gallon glass container at programmed flow proportioned (or time) intervals. The container was situated in an insulated base section with sufficient capacity to contain 10-15 pounds of ice.

The sampler was pumped under flow at all times of sample collection, at a rate of 1400/ml/min (2.42 ft./sec.). This is adequate to prevent settling of solids during sample collection. The suction line was purged before and after each sample is taken to minimize cross-contamination.

The ISCO Model 1870 and 1700 flow meters were used to measure flow and control sample collection at point source discharges which have primary flow measuring devices. These flow meters used an air bubbling tube which was anchored in the discharge stream at the appropriate point in the primary flow measuring device. The air pressure in the bubble line was proportional to the liquid level in the discharge stream. This air pressure is measured by an internal pressure transducer and is integrated into the general flow equation by solid state circuitry. The Model 1870 converts liquid level to flow rate through use of a Primary Device Characterization Module (PDCM) specific to a particular primary flow device.

The following sequence of procedures were performed upon each visit to the sampling site to insure proper operation of equipment:

(a) If line power (110V) was not being used, nickel-cadmium batteries on sampler and flow meter were changed. Batteries being replaced were labeled to indicate time, date, and duration of use.

(b) Desiccant cartridges were checked and changed if color indicator showed 30% relative humidity or greater.

(c) Sampling and bubbler lines were inspected for kinks, frays, cuts, or obstructions. Lines were replaced if damaged.

(d) Sampling bottles were placed in base of sampler with 15 pounds of chipped ice.

(e) The actual head depth was measured and compared to head depth display on flow meters. Flow rate was computed based on actual head depth and compared to strip chart/printer flow rate data. Readjustments were made by manipulating the zero adjust control and all changes noted in the operator's field logbook.

(f) Sample collection volume was checked by initiating "manual" cycle and intercepting flow to sample bottle with a graduated cylinder.

(g) Sampling frequency was checked by inspection of sample event marks on strip chart and by determination of sample interval.

(h) Strip Chart was replaced, dated, and labeled with site identification.

All field data and BOD_5 data were reported on logsheets. Samples were obtained from sampling stations within one hour after the 24-hour sampling period and taken to the centralized field center for processing and preservation. Each composited sample was divided into four aliquots for analysis of BOD_5, TOC, total solids, total suspended solids, ammonia, nitrate, nitrite, orthophosphorous, and total phosphorous. The BOD_5, solids, and nutrient aliquots were placed in 1-quart linear polyethylene containers and preserved in accordance with EPA-approved methods (2).

The list of parameters analyzed for the one 1980 survey and the three 1981 surveys appears in Table A-2-14.

NON POINT SOURCE SAMPLING PROGRAM

Site Selection

Nine NPS sites were selected for monitoring and analysis in the Chester River Watershed. Site selection was conducted in cooperation with the Kent Soil Conservation District, the EPA project officer, Versar Inc., and the USGS district office. The subwatersheds selected were representative of the major land use, soil associations and slopes in the watershed. Potential subwatersheds in the Chester River Basin were categorized according to the following characteristics:

(a) Land use.

(b) Absence/presence of road crossings.

(c) Factors in the Universal Soil Loss Equation (rainfall, soil erodibility, slope length, slope gradient, crop management, erosion control practices).

(d) Drainage area.

(e) Accessibility.

(f) The stream sites were to be non-tidal to avoid the confounding effects of inputs from downstream during flood tide.

(g) There were to be no point source discharges upstream of the site.

(h) The stream channel was to have a fairly uniform cross-section or existing flow control structure to facilitate calibration of a stage-flow curve.

(i) The site should have the availability of AC power hookup which would eliminate the use of batteries and the problems which could affect quality assurance inherent in their use.

Final selection was based upon land use and soil association. The actual monitoring points selected were to provide the quality and quantity of data required over the duration of the project. Each NPS station location met the following criteria:

(a) The channel and/or existing control was straight and of uniform cross-section and slope to ensure parallel and non-turbulent flow and to reduce the chance of abnormal velocity distribution. For the most part, the length of straight was at least three times the channel width with the measuring section mid-way, but where this was not possible the measuring section was within the downstream half of the reach. The sites were also remote from any natural or artificial obstructions on the banks or in the channel likely to cause disturbance, distortion, or reversal of flow.

(b) The depth and velocity of water at minimum flow and the velocity and turbulence at maximum flow was within the limits imposed by the type of measuring equipment used.

(c) The physical characteristics of the channel ensured a substantially consistent and stable relationship between stage and discharge. The channel itself was stable and there was limited variable backwater such as from tidal influences, downstream tributaries, locks, sluices, off-takes and other structures.

(d) The channel and flow control structures were free from weed growth during all seasons.

(e) Flows at all stages were confined to a well-defined channel or channels or within an unobstructed floodway having stable boundaries.

(f) NPS stations were accessible at all times and at all stages of flow.

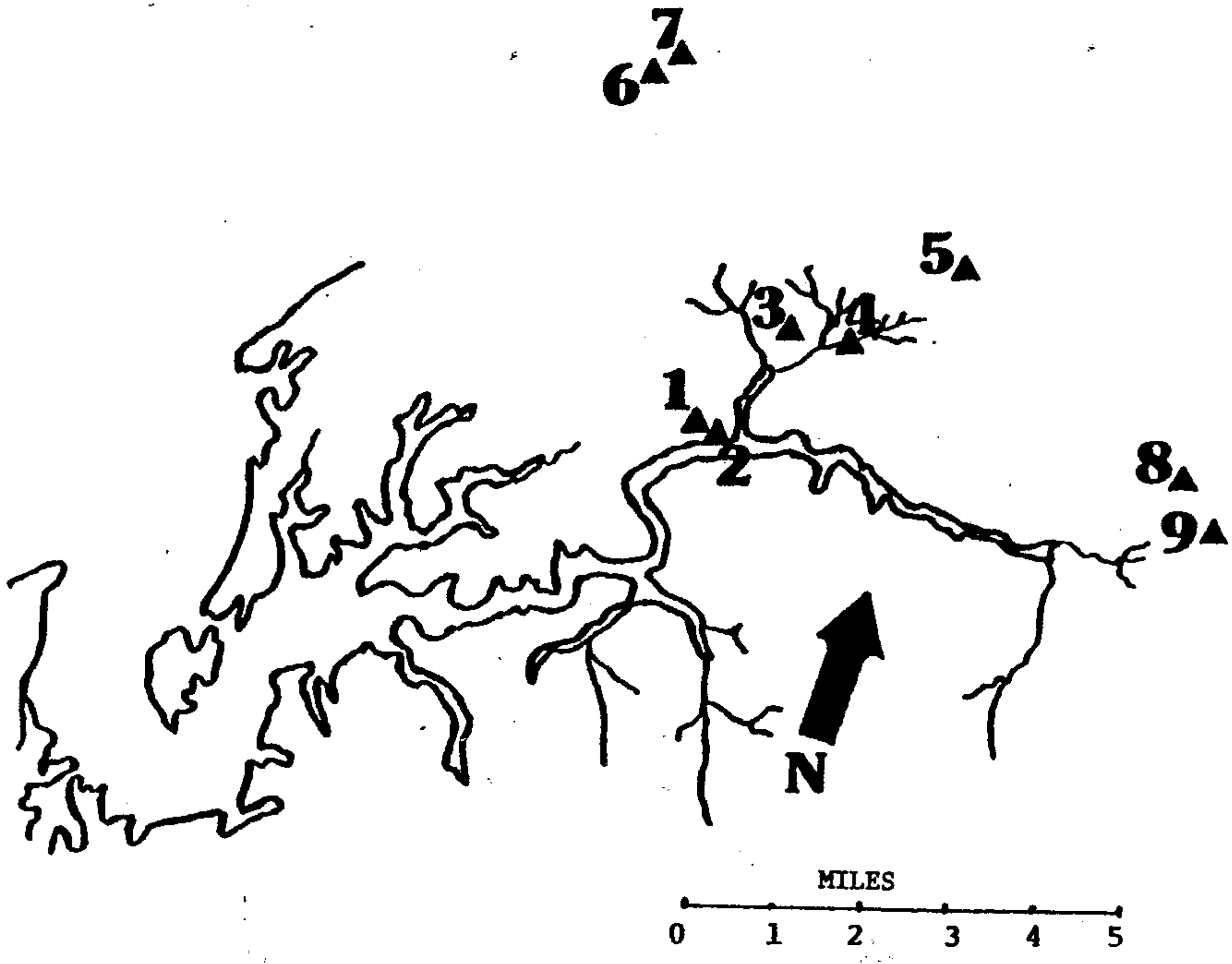


Figure 2-11 Approximate location of Chester River Non-Point Source Subwatershed monitoring stations.

(g) The flow control structure were sensitive, so that a small increase in discharge produced a relatively large increase in stage.

Nine watersheds were selected for NPS monitoring. Two watersheds represented the residential land use category in Chestertown; two forested watersheds were selected in the Millington Wildlife Management area located at the headwaters of the Chester River and the remaining five sites represented the various agricultural practices common to the Chester River Basin. Table 2-15 summarizes the nine basins monitored during the NPS project, the Versar identification number, the STORET assigned station identification number, and the predominant land use characteristics and approximate size of each basin studied. Figure 2-11 illustrates the approximate locations of the nine stations within the Chester River Basin.

NPS Stream Flow Measurements and Instrumentation

Continuous flow measurements were required for each of the NPS sites. Continuous flow measurements avoid the inherent difficulties and sources of error that may arise when instantaneous discharge measurements are extrapolated with time to provide the required total storm flow data. Flow was continuously monitored at each of the NPS sites.

Stream flow measuring devices varied depending on the hydrological characteristics of the designated NPS site. The two methods used were either:

(a) the installation of primary flow control devices such as flumes and V-notch weirs with empirical relations for measuring stream flow,

or (b) the rating, via area-velocity measurements, of existing structures such as a drain culvert or a stable channel section of the stream and subsequent calculation of the stage-discharge relation.

Table 2-16 shows the type of primary flow devices and meters installed at each site. Five of the NPS study sites were instrumented with artificial primary flow control devices in order to provide a standard stage-discharge relationship for the purpose of monitoring flow. The artificial primary flow control devices also increased the sensitivity of the site, that is, a small increase in discharge resulted in a larger increase in stage, thus increasing the resulting flow reduction and accuracy of measurement. Flow devices used at each site are discussed below.

H-type flumes for gauging runoff were installed at the Browntown Road, Harris Farm, Still Pond, and Millington B Watersheds. H-type flumes are particularly suited for gauging runoff from small watersheds and were selected for the following reasons:

Table 2-15
Non-Point Source Subwatersheds in the Chester River Basin

BASIN	Field ID	STORET ID	LAND USE	APPROX. ACRES
Chestertown A	CH #1	XIH 2630	Residential	50
Chestertown B	CH #2	XIH 2832	Residential	50
Sutton Farm	CH #3	XIH 6375	Mixed Agric.	800
USGS Station (Morgan Creek)	CH #4	XIH 6891	Mixed Agric.	13.6 sq. mi.
Browntown Road	CH #5	XII 7728	Agricultural (single land use-field corn)	350
Harris Farm	CH #6	XJH 1130	Agricultural (single land use-field corn with minimum tillage)	14
Still Pond	CH #7	XJH 0930	Agricultural (single land use-field corn with minimum tillage)	29
Millington A	CH #8	XIJ 8131	Forested	1200
Millington B	CH #9	XIJ 7134	Forested	270

(a) Minimal head loss required.

(b) Operate across a large range of flow conditions (0 to 84 cfs).

(c) No stilling pond is created which could ultimately undercut the structure due to pressure.

(d) Operate with up to 50% submergence (ratio of downstream to upstream head).

(e) Self-cleaning, thus reducing the deposition of sediment within or behind the structure.

Flumes were fabricated of sheet metal and installed at the sites according to specifications (10). Installation of these flumes was made with approach boxes and extending wing-walls where the flow was dispersed. This assured that no flow bypassed the structure and that the water approaching the flume crest was of a uniform, non-turbulent nature. Flume floor was level and the crest elevation was tied to a permanent benchmark by survey techniques.

A sharp crested 120° V-notch weir with rectangular overflow was used at the Sutton Farm site where the existing structure facilitated its installation and where base flow was difficult to gauge. The 120° V-notch increased base flow sensitivity; however, it did not significantly reduce the culvert capacity. When stormflow exceeded the notch capacity, the flow was gauged by the rectangular overflow. Essentially a compound weir was created that facilitated both low and high flow monitoring. Support for these plates was provided by the culvert outlet's concrete apron and wingwalls. The notch was positioned approximately 12 inches above the stream bed. Actual position depended upon the characteristics of the nappe after the plate was installed. The plate was raised to a point where the nappe experienced freefall and was aerated on all sides. Although the secondary flow monitoring instrument was factory calibrated according to the empirical formula for the V-notch weir with rectangular overflow, the stage-discharge relationship was periodically verified with field current meter measurements.

Where the installation of primary flow control devices was considered as unsuitable, stream flow was measured at the existing structure, such as the drain culvert at Millington Site A by (1) direct field measurement of stage discharge, (2) calculation of the formula for this relation, and (3) factory calibration for the flow monitoring instruments. Calculation of the stream "rating" curve was accomplished by taking field measurement of instantaneous discharge using the area velocity method. The stream stages measured were representative of the entire range of stream heights for the NPS site.

Area-velocity measurements were also used to verify the function of the H-type flumes and V-notch weirs installed at the NPS study sites.

The area-velocity method for the calculation of stream flow is the summation of the products of the partial areas of the stream cross-section and their representative average velocities.

The formula:

$$Q = (AV)$$

represents the computation where Q is total discharge, A is an individual cross-section area, and V is the corresponding mean velocity of the flow normal to the partial area. The instantaneous discharge calculated by this method was related to the theoretical device discharge recorded as a quality assurance/quality control check on flow data reliability. When rating the existing structure, such as Millington Site A, the instantaneous discharge calculated by this method was related to a measured stream height and the combined result represents one point in the stage-discharge relation or rating curve. This procedure was repeated for a series of stages until the entire relationship was known. The stage-discharge relationship was determined using the following procedures:

(a) Staff (height) gauges were installed at each designated NPS site. Staff gauges were referenced to a USGS benchmark or other control point that was stable for the period of study.

(b) Verticals and horizontals for the measurement of stream cross-section profile and for velocity measurements were determined on site. A minimum of 20 sections was established. This number was increased if site characteristics indicated that a greater number of verticals were required to accurately determine stream cross-section and horizontal distribution flow.

(c) At each vertical, velocities were measured utilizing Marsh-McBirney Model 201 Current Meters. These devices were factory calibrated semi-annually to an accuracy of ±2%.

(d) Since all water depths were less than 2.5 feet, velocity was measured utilizing the six-tenths depth method developed by USGS.

(e) All data, including supplemental notes concerning date, time, names of field personnel, weather, etc. were recorded for total flow calculation.

(f) Flows were measured as often as possible at each site to provide points for calibration checks. Flows were measured at several stages of storm flow to insure that the theoretical rating relation of the device was accurate for all flow conditions.

(g) When rating the existing structure, the stage discharge data for the site was plotted on log-log paper and the equation of the rating curve calculated. Once the stage discharge relation was determined, flow monitoring was accomplished by continuous monitoring of stream depth. Stream depth measurements were converted to flow using the calculated stage-discharge relationship.

(h) When the theoretical discharge was found to be in error, the device was immediately inspected for damage or improper operation. Repairs were instituted immediately and no flow or stream sampling occurred until the device operation was corrected and verified.

One of the monitored NPS sites was the USGS gauging station on Morgan Creek (CH #4). The stage-discharge relationship for the overflow structure at this site was calculated by USGS personnel using the previously described method. This stage-discharge relationship or rating curve was used to calibrate the flow meter used to monitor flow at the site. During the course of the Chester River NPS study, USGS simultaneously collected stage data at this site and the information provided a cross reference for the comparison and quality assurance of the flow data recorded by instruments.

The velocity modified flow method was used at Chestertown Sites A & B. This method of continuously monitoring volumetric flow utilizes a Marsh-McBirney Corporation Velocity Modified Flow Meter (VMFM). This device is ideal for difficult open channel measurements such as existing drain culverts and in urban stormwater systems. This instrument was placed at the inlet to the urban storm drain beneath Route 213 in Chestertown (Chestertown A) and at the utility commission storm drain culvert in Chestertown B). Since the method for monitoring flow and the instrument are synonymous, they are discussed together in this section.

The features of this device and reasons for its selection included the following:

(a) Records true volumetric flow.

(b) No empirical equations were necessary.

(c) Easily installed in the existing pipes.

(d) Unaffected by diluted acids or suspended solids.

(e) No flumes or weirs were required.

(f) Capable of monitoring reverse flows.

(g) Accuracy was maintained in surcharge conditions.

(h) Simple operation in partial or filled pipe applications.

(i) Linear sensors.

(j) Accuracy of measurement was not dependent upon knowledge of pipe slope and interior roughness.

The VMFM is based on the principle that flow (Q) is equal to the average velocity (V) times the flow areas (A). The VMFM is equipped with a solid-state electromagnetic sensor which measures flow velocity. There are velocity variations throughout each cross-section which change slightly with varying depths; however, the VMFM is designed to minimize these effects. Level is obtained by use of a bubbler-type level transducer. The level measurement signal passes through a pipe diameter plug-in module which converts the signal to represent the area of flow in the pipe. This signal was then applied to a computer circuit which multiplied the area times the sensed velocity to yield a result that was directly proportional to the volumetric flow rate. The sensor is attached to a stainless steel mounting band that was recessed into the pipe and expanded to the interior wall. The expandable band held the sensors rigidly inside the pipe. At the Chestertown A site, this sensor was placed approximately 20 ft. downstream from the culvert entrance and approximately 3 ft. upstream of the storm drain inlet at the Chestertown B site. This helped to ensure that any extreme turbulent flow caused by storm water passing through the culverts was reduced and of a uniform nature as it passed over the probe. The VMFM was connected to a high speed RUSTRAK strip chart recorder to continuously record flow. Chart speed was two inches per hour. The flow meter also emitted a signal proportional to flow which was interfaced with an ISCO automatic sampler for the collection of volume integrated composite samples.

In order to insure the quality of the flow data recorded by the VMFM flow meter, field personnel conducted calibration checks a minimum of once a month. The procedure used for field verification was as follows:

(a) Function selector switch was rotated to the level position and depth of water in the pipe and was recorded from the LED display.

(b) Depth of water in the pipe was physically measured, by portable staff or previously installed staff gauge calibrated to the contour of the pipe, and compared to the level recorded by the meter. When the difference in readings was greater than ±2% the meter was adjusted accordingly.

(c) Function selector switch was rotated to the velocity position and water velocity in the pipe recorded.

(d) Using a portable current meter the velocity of water in the pipe was recorded. When the difference in these two readings was greater than +2% the flow meter was adjusted accordingly.

(e) Finally, cross-sectional area for the water depth measured was obtained from an office calculated table and multiplied by the measured velocity to obtain total flow. This value was compared to that recorded by the chart paper and adjustments were made when necessary.

ISCO Model 1870 Flow Meters were used at all Chester River NPS sites except the two residential sites previously discussed to continuously monitor stream flow. These flow meters monitored stream depth using a bubble tube system. A small inside diameter tube was submerged in the stream bed or in a stilling well constructed at the site. Air, supplied by an internal compressor is bubbled out of the tube at a constant rate, resulting in a pressure in the tube proportional to the level in the stream. A transducer measures this pressure and converts it into a digital electronic signal proportional to liquid level. Level to flow rate conversion is accomplished by a Primary Device Characterization Module and a signal proportional to flow rate is produced. Flow rate was recorded on a built-in strip chart recorder and total flow displayed on a six digit resettable totalizer. A chart speed of two inches per hour was used to continuously record flow. The ISCO Model 1870 produces a signal proportional to flow rate allowing liquid samplers to collect a flow proportional composite sample. An event mark was placed on the chart record each time a sample was collected for the composite sample. Table 2-16 summarizes the primary devices and flow meters used at each of the NPS stations during the course of the study effort.

Water Sampling for Calculating Chemical Export

The Chester River NPS Study effort was designed to characterize chemical export during storm events from various land uses. In order to accurately monitor chemical export, the collection of flow proportioned samples was required. The flow measuring and sampling instruments were designed to provide this capability. Alternative methods included simple grab samples to time integrated samples. Grab sampling is indicative of only an instantaneous measurement. Furthermore, grab sampling is frequently biased towards low flow periods, and, as a result, may greatly underestimate loadings.

Extrapolation is required to calculate total chemical export. Time integrated samples also require manipulation of the collected samples to adequately represent the actual flow conditions. Time integration may also miss stream surges carrying significant pollutant loads. Flow composited sampling overcomes this problem. No extrapolation or manipulation of the sample or derived data was required after collection. The result was a more accurate characterization of chemical export from the watershed.

The study was also designed to sample as many storm events at each NPS site as was possible. A storm runoff event was defined by the interval from (a) the occurrence of measurable flow in a previously dry conveyance, or (b) an increase in flow above base flow of approximately 10% -- to the point when the flow dropped back to 10% to 25% in excess of previously measured base flow or, (c) for a previously dry channel, the time when flow dropped to 10% of the peak observed value. Four seasonal 24-hour base flow water samples were conducted for sites where a base flow occurred. The collected samples were analyzed for the following parameters:

(a) Alkalinity
(b) Soluble Ammonia
(c) Soluble Nitrate & Nitrite
(d) Total and Soluble Kjeldahl Nitrogen (TKN)
(e) Particulate and Soluble Total Phosphorous (TP)
(f) Soluble Ortho-phosphate (PO_4^{-3})
(g) Total Organic Carbon (TOC)
(h) Suspended Solids (TSS)
(i) Biological Oxygen Demand (BOD_{30})
(j) Chemical Oxygen Demand (COD)

An ISCO Model 1580 automatic sampler coupled with an ISCO Model 1640W sample actuator was used for water sampling. The model 1580 sampler pumps uniform small sample increments (at least 100ml) into a single receptacle at flow proportioned intervals. Accurately calibrated switches allow precisely sized samples to be taken without involved computations. Actual

Table 2-16
Primary Flow Control Devices and Flow Meters Installed
at Each NPS Site

SITE	PRIMARY DEVICE	FLOW METER
Chestertown A (CH #1)	Direct flow measurement of 48 inch culvert	VMFM Model 250
Chestertown B (CH #2)	Direct flow measurement of 24 inch culvert	VMFM Model 250
Sutton Farm (CH #3)	120° V-notch weir (0-2 ft) with 10 foot rectangular overflow without end contractions to 4 ft.	ISCO Model 1870
USGS Gage (CH #4)	USGS Rating Table	ISCO Model 1870
Browntown Rd. (CH #5)	3.0 foot H-type Flume	ISCO Model 1870
Harris Farm (CH #6)	1.5 foot H-type Flume	Sigmamotor LMS-400
Still Pond (CH #7)	2.0 foot H-type Flume	Sigmamotor LMS-400
Millington A (CH #8)	Channel Rating	ISCO Model 1870
Millington B (CH #9)	4.0 foot H-type Flume	ISCO Model 1870

sample size was determined on site and depended on the volume and duration of anticipated runoff. The model 1640W sample actuator initiated the sampling program when stream flow rose to a predetermined height by activating a detector. The detector could be staked at any level in the stream bed or control structure. Once the sampling was initiated the compositer collected flow incremental samples across the entire storm hydrograph and terminated when stream height dropped below the detector. Each time a sample was collected for compositing, an event mark was placed on the strip chart record. The mark was used to corroborate the operation of the sampler and sample collected. For example, if 10 event marks were noticed on the hydrograph and the sampling increment volume was 100 ml, one liter should have been contained in the receptacle. Any deviation resulted in the elimination of the sample. The mark was also used to further corroborate that flow proportional sampling was occurring. This was accomplished by integrating total flow between event marks. When the sampling sequence was set, for example, at every 1000 cubic feet, the hydrograph should have totaled this value between each mark. Any deviation resulted in the elimination of the sample.

The sampler intake tube was routed through a metal pipe and emerged at the lowest point in the stream bed or control structure. In order to take a sample that was well mixed, the intake tube was placed in a mixing box positioned downstream of the primary device crest where mixing naturally occurred. This avoided the necessity of collecting a depth integrated sample. The actual samples withdrawn were composited with a 2 1/2 or 5-gallon polyethylene container within the ISCO sampler.

Immediately before certain predicted storm events, field personnel visited each NPS site to insure that all instruments were functioning properly, that the flow meter was calibrated, and that the sampling action would commence when the stream stage rose to the predetermined height. Site visits were also conducted during storm events to verify that sampling had been initiated and to apply corrective measures should the systems be failing. This not only permitted the opportunity of applying corrective measures to ensure that sampling took place, but provided practical experience in the problems that arose. The knowledge gained was applied to ensure the quality of data from future events. The field crew also added ice to the sample compartments in order to keep the samples cooled to near 4°C during each storm composite sample collection.

Following each storm event or within 24 hours of sampling initiation, whichever came first, Versar personnel visited the NPS sites for sample collection. The time and date of visit was marked on the hydrograph strip chart and in the log book maintained at each NPS station along with all other relevant information such as name, volume of sample, sampling frequency, etc. The sample container was removed and immediately split into separate shipment containers as illustrated in Figure 2-12.

Each sample container was immediately labeled with the station number, name, time and date, and sampler's signature. The container was also labeled with the parameters to be analyzed and any preservation techniques employed. The samples were then placed in a cooler filled with ice. After all samples had been collected and stored for shipment they were immediately delivered to Versar's laboratory for analysis. Filtering and preservation of samples in accordance with EPA approved procedures was performed by Versar laboratory personnel (as discussed in the laboratory QA discussion).

All samples were collected within 24 hours of sampling initiation to insure samples were analyzed within EPA required holding times (7). When the runoff event continued more than 24 hours (flow had not receded to the predetermined point) the cycle was allowed to continue for additional 24 hour increments, or until the stage height dropped to the defined point. These additional samples were analyzed separately from the first sample. Results were presented for both the entire storm and separate 24 hour storm increments.

NPS Site Maintenance

Each NPS site had an instrument housing installed as close to the monitoring point as possible. Each housing had enough room to readily

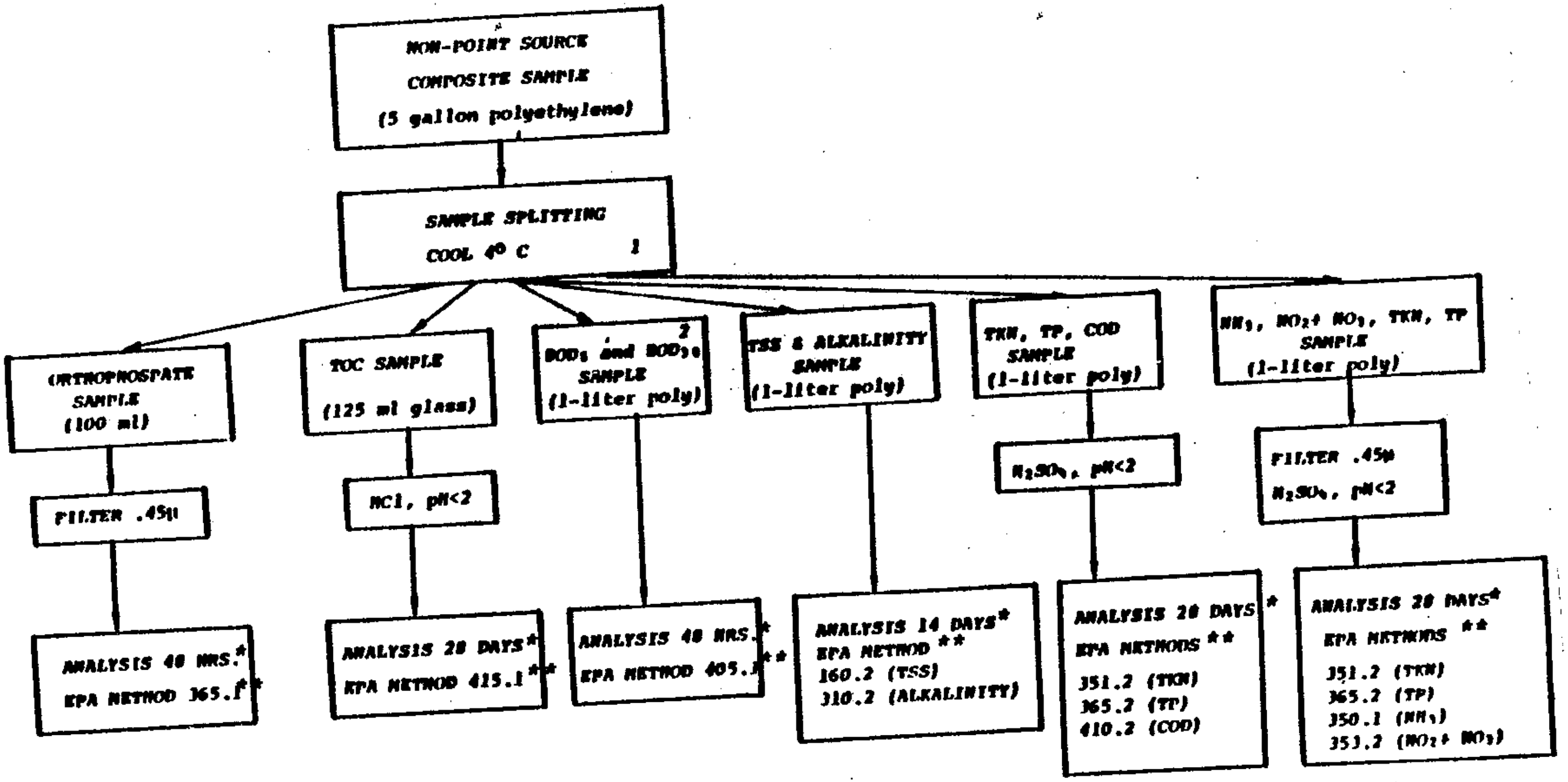


Figure 2-12 sample splitting, preservation, holding times, and analysis method for collected NPS samples. Notes: (1) All samples maintained at 4oC during collection,delivery and until final analysis; (*) CRF Vol. 44, Part 136, December 3, 1979; (**) U.S. EPA, 1979, Methods for Chemical Analysis of water and wastes.

contain the flow meter, sampler, 12 volt batteries and additional room for tool storage and log books. The housing units were constructed of steel to minimize the chance of damage and weather-proofed. They were securely mounted at the site with concrete fasteners attached to a poured concrete foundation, or to wood posts which had been anchored to the ground with concrete. Each unit had a case hardened padlock and hasp to discourage vandalism.

Where available, the sites were provided with direct AC hookup. The Del-Mar-Va Power Company and Choptank Electric Cooperative provided hookup to within 100 feet of the existing utility line. Utility poles were erected and power lines extended to the sites. The direct use of electricity eliminated the need for battery power operation and the problems inherent in their use.

Each NPS site was visited a minimum of once a week during the NPS monitoring study. During these visits sampling personnel performed the following quality control checks:

(a) Strip chart removal and replacement.

(b) Calibration checks on time clocks and level recorders (i.e., adjustment of pen to correct stream level).

(c) Verification of instrument functions and application of corrective actions should they be required.

(d) Replacement of batteries where required.

(e) Documentation of equipment condition and recording of all required adjustments.

Time, date, name of field personnel, and pertinent information relating to the above operations were recorded. Strip charts removed were labeled with station name and time and date of removal. Routine maintenance of flow meters was performed monthly in acordance with the manufacturer's recommendations.

Each NPS station was supplied with a logbook, the purpose of which was to keep a continuous record of all activities performed at the station. At each visit the date, time, name of field personnel, etc., along with the pertinent information relating to the above operations was recorded in the logbook.

Copies of logbooks which detail the number of storms monitored, problems during each storm monitored, number of storms monitored at each site and flow data tapes are available from the Tidewater Administration.

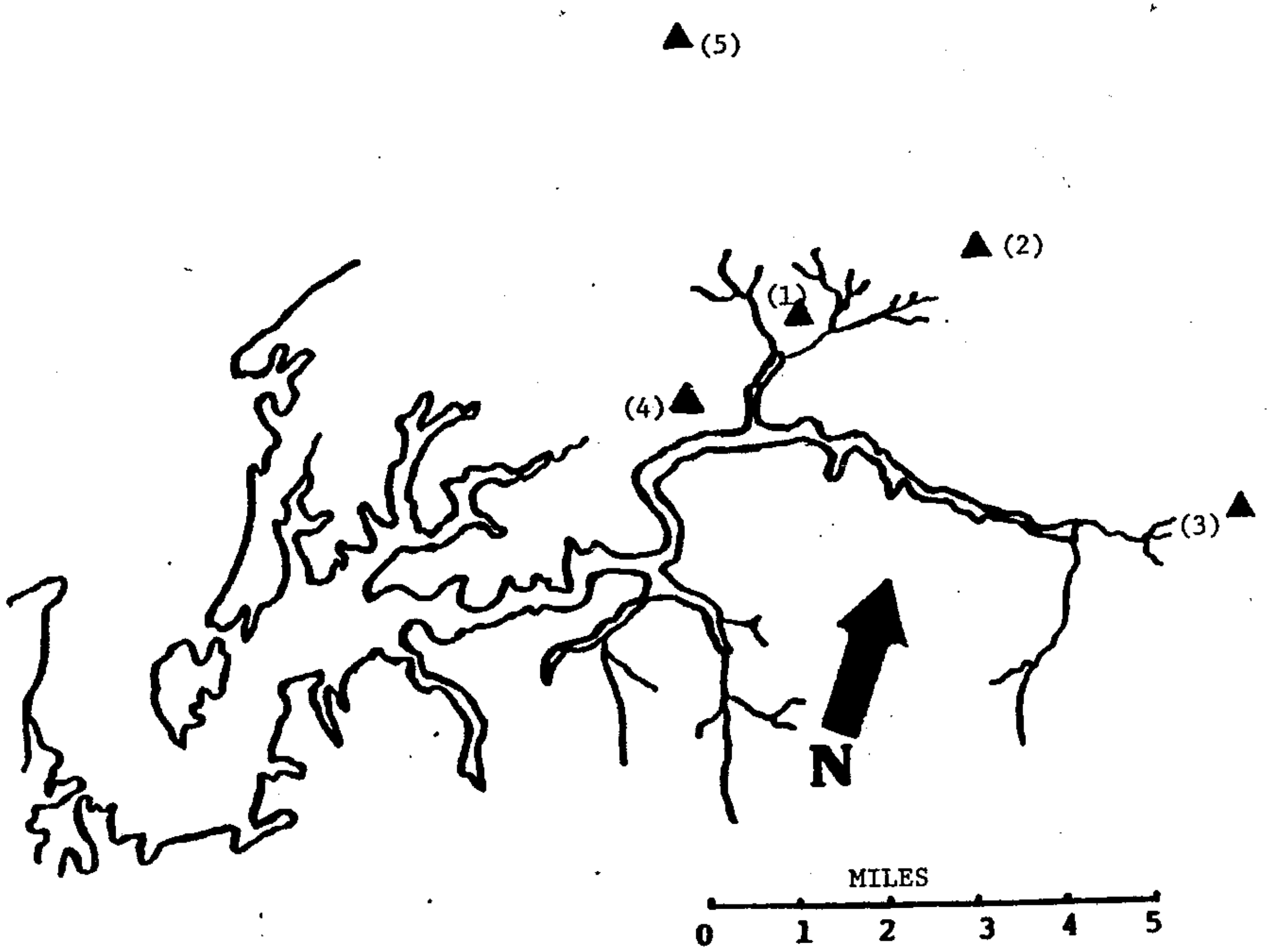


Figure 2-13 Location of Chester River Basin rainguages.

RAINFALL GAUGE PLACEMENT AND MONITORING

All existing precipitation monitoring sites were identified from U.S. Weather Service records for each selected watershed. The placement sites of recording precipitation gauges (e.g. Stevens Type) on four watersheds were selected based on density and location of existing stations. The identified sites were (Figure 2-13):

(a) Site on Brownstown Road (adjacent to the NPS site)

(b) Sutton Farm site on Rt. 213 (adjacent to the NPS site)

(c) Lower Millington Forest site on Massey-Del-Line Road (adjacent to the NPS site)

(d) Chestertown at the Agricultural Service Center (near the NPS site)

Additionally, a strip chart raingauge (weathermeasure) was installed and operated at Stillpond Road. Table 2-17 gives latitude and longitude of rain gauge site locations. These tipping bucket gauges were checked weekly and after significant rainfall events.

The manufacturer's specifications for the Stevens tipping bucket rain gauges used stated that the device maintain stable calibration over long periods (years). This was found to be the case. The gauges were calibrated at the factory; they exhibited within-limits calibration upon initial check-out at the field site and they showed no need for recalibration nor any indication of calibration drift. When calibration checks were performed, the recorder was disconnected, the gauge cover removed, the buckets wiped clean and dry. A burette was used to introduce water to the bottom of the stainless steel inner funnel so that it dripped into the buckets as it would if the gauge were actually operating. The flow rate was no more than 10 ml. per minute. As the tenth tip occurred, the burette stopcock was closed and the volume of distilled water required was recorded and compared to the calculated volume required to register 0.10 in. of rain through a 100 mm orifice (79.81 ml). Recalibration is required if the result deviates more than $\pm 2\%$ from the calculated volume.

When routine checks of rain gauges were performed, the results were entered directly into the site log. Copies of rainfall data collection QA/QC activities sheets and site logs are available from the Tidewater Administration. The gauge and recorder were examined for: day and time-of-day synchronization, amount of paper tape remaining, battery condition, funnel clear of debris, punching interval (5 min.), time of examination and recorder readout at that time, recorder and gauge ID, gauge level, the tape serial number of the day being punched (this is checked for agreement with previous serial numbers, if previous S/N plus number of days elapsed equals today's S/N, then day synch is O.K.), proper solenoid function, and any other information as a note. The gauge at Chestertown was located a few feet from a brass U.S. Weather Bureau type manual gauge

Table 2-17

Latitude and Longitude of Rain Gauges Installed in Chester River Basin

SITE	N-LAT Deg.	Min.	Sec*	W-LONG Deg.	Min.	Sec*
Chestertown	39	23	55	76	03	45
Sutton Farm	39	16	35	76	02	10
Browntown Road	39	17	40	75	56	40
Millington	39	18	25	75	47	35
Stillpond	39	21	00	76	06	55

*Seconds (±5)

operated a National Weather Service official observer. Comparisons of daily rainfall results from the two gauges were favorable. Typical of these comparisons was that of the rainfall occurring on the morning of September 5, 1980: The NWB gauge read 0.66 inches, the tipping bucket gauge read 0.69 inches.

The gauge at the Millington Wildlife Management Area and on Harris' farm near Stillpond were both fitted with heating devices on January 13. These two gauges remained heated until the possibility of freezing condition and frozen precipitation was past. These gauges operated unaffected by freezing conditions as the interior and measurement mechanism were maintained above freezing temperatures and the collection funnel was heated so that any frozen precipitation collected melted immediately. Daily precipitation data for the Chestertown site was obtained from the National Weather Service observer who recorded all forms of precipitation as rainfall equivalent. The three unheated gauges (including Chestertown) were handled in the following manner:

When current temperature and predictions indicated no frozen or freezing precipitation or freezing conditions at ground level, no unusual action was taken. The unheated gauges should have functioned properly.

When current temperature and predictions indicated only frozen precipitation with freezing conditions at ground level so that any precipitation collected will remain frozen until arrival of personnel, an early morning check of these three gauges occurred. The interior of the rain gauge was warmed by a portable 12 V car window defogger type device (heated forced air) so that the precipitation in the collection chamber melted and was measured by the warmed tripping bucket mechanism. The amount was recorded by the pulse counting recorder and a record of the date, time, amount recorded, type of precipitation melted, probable period of time in which it fell, and technique used entered into the site log and data file.

When current temperature and predictions indicated mixed or partially frozen precipitation, or when freezing conditions may not have been maintained at the gauge, weather records kept at the field office in Grasonville and by the NWS observer in Chestertown allowed the identification of data recorded under these conditions. These data were flagged and qualification stated as to possible inaccuracy in the measurements caused by ice formation in the tipping buckets, etc.

Table 2-18 displays qualifications of rainfall data obtained during 6/24/80 - 8/22/80, and Table 2-19 provides an explanation of missing data from all stations from startup through completion of monitoring efforts.

Table A-2-20 identifies all 0000-2359 hour (24 hr) periods above freezing conditions were recorded at the Chestertown or Millington NWS stations. If the minimum temperature for the period was less than or equal to 32°F then the date is listed indicating that the rainfall data collected during that period may be inaccurate. On days when maximum temperature was well above freezing, it was assumed that rainfall data collected during daylight hours was accurate (i.e. any day in November except the 17th). Heating devices were installed at Millington and Stillpond gauges on 1/13/81. There were no interruptions in heating at these two gauges; therefore, all data collected after 1/13/81 2100 at these two gauges can be considered accurate.

Data were recorded on punched paper tape at 5 minute intervals. Punched tapes were then read onto a Hewlett-Packard punch paper tape reader and transferred onto nine-track magnetic tape encoded in the NRZI mode at a density of 800BPI at a tape speed of 45IPS. Data tapes were then transported to NAI facilities in Dallas where those tapes were transferred to a TI 990 computer system. Data was then transformed to a density of 1600 BPI with a logical record length and block size of 80 characters and coded in EBCDIC representation.

HISTORIC RAINFALL INFORMATION COLLECTION

For each rainfall recording station in the Chester River NPS study area, historical precipitation data was collected (if available), and analyzed. Local, state and government agencies were contacted, and all pertinent data (i.e. watershed - specific or regionally applicable) were acquired.

Table 2-19

Explanation of Data Gaps for Rain Gauges Operated in Chester River Subwatersheds during 1980-81.

A - TIME SLIGHTLY OFF - timer set exactly on 6/24, initial station startup; on 7/6 at 1840 hrs. the 1850 punch was observed, timer 10 min. fast, reset to correct time.

B - TIME OFF - on 7/16 at 1050 the 0835 punch was observed, timer slow; reset to correct time.

C - TIME OFF - On 7/19 at 1800 the 1205 punch was observed, recorder taken out for repair.

D - STATION DOWN - recorder timer shipped off for repair, replacement rush ordered and purchased, station reactivated on 7/23; repaired original timer kept as backup should problem ever reoccur.

E - RECORDER JAM-UP - Recorders at Chestertown and Browntown were found to have paper jamming the punch drive, were removed for repair 8/6. Not able to repair recorders and reactivate stations until 8/22.

F - BAD SET OF BATTERIES - recorder at Suttons found down on 8/22, batteries dead after only 15 days operation, new batteries installed. Dry cell batteries deemed unreliable, all gauges converted to 12V storage battery power to prevent reoccurrance of this problem.

Available historical precipitation data for the Chester River NPS subwatershed study area were collected and used to calculate average precipitation for each watershed on an annual, seasonal, and monthly basis, as data permitted.

The only precipitation monitoring devices operating in Kent and Queen Anne's Counties are NOAA's National Weather Service stations at Chestertown, Millington, and Centerville, Maryland. Monthly and seasonal averages were computed from data compiled from NOAA records for Chestertown and Millington. Only data for 1976 could not be located in annual summary form; data for this year were compiled from NOAA monthly data.

Yearly averages were computed from NOAA climatological data for Maryland and Delaware summary data and again for 1976 from NOAA monthly data extending the summaries through 1979.

Tables A-2-21 through A-2-23 summarize the historical monthly and seasonal precipitation data obtained.

Table 2-19

Explanation of Data Gaps for Rain Gauges Operated in Chester River Subwatersheds during 1980-81.

A - TIME SLIGHTLY OFF - timer set exactly on 6/24, initial station startup; on 7/6 at 1840 hrs. the 1850 punch was observed, timer 10 min. fast, reset to correct time.

B - TIME OFF - on 7/16 at 1050 the 0835 punch was observed, timer slow; reset to correct time.

C - TIME OFF - On 7/19 at 1800 the 1205 punch was observed, recorder taken out for repair.

D - STATION DOWN - recorder timer shipped off for repair, replacement rush ordered and purchased, station reactivated on 7/23; repaired original timer kept as backup should problem ever reoccur.

E - RECORDER JAM-UP - Recorders at Chestertown and Browntown were found to have paper jamming the punch drive, were removed for repair 8/6. Not able to repair recorders and reactivate stations until 8/22.

F - BAD SET OF BATTERIES - recorder at Suttons found down on 8/22, batteries dead after only 15 days operation, new batteries installed. Dry cell batteries deemed unreliable, all gauges converted to 12V storage battery power to prevent reoccurrance of this problem.

Available historical precipitation data for the Chester River NPS subwatershed study area were collected and used to calculate average precipitation for each watershed on an annual, seasonal, and monthly basis, as data permitted.

The only precipitation monitoring devices operating in Kent and Queen Anne's Counties are NOAA's National Weather Service stations at Chestertown, Millington, and Centerville, Maryland. Monthly and seasonal averages were computed from data compiled from NOAA records for Chestertown and Millington. Only data for 1976 could not be located in annual summary form; data for this year were compiled from NOAA monthly data.

Yearly averages were computed from NOAA climatological data for Maryland and Delaware summary data and again for 1976 from NOAA monthly data extending the summaries through 1979.

Tables A-2-21 through A-2-23 summarize the historical monthly and seasonal precipitation data obtained.

Table 2-19

Explanation of Data Gaps for Rain Gauges Operated in Chester River Subwatersheds during 1980-81.

A - TIME SLIGHTLY OFF - timer set exactly on 6/24, initial station startup; on 7/6 at 1840 hrs. the 1850 punch was observed, timer 10 min. fast, reset to correct time.

B - TIME OFF - on 7/16 at 1050 the 0835 punch was observed, timer slow; reset to correct time.

C - TIME OFF - On 7/19 at 1800 the 1205 punch was observed, recorder taken out for repair.

D - STATION DOWN - recorder timer shipped off for repair, replacement rush ordered and purchased, station reactivated on 7/23; repaired original timer kept as backup should problem ever reoccur.

E - RECORDER JAM-UP - Recorders at Chestertown and Browntown were found to have paper jamming the punch drive, were removed for repair 8/6. Not able to repair recorders and reactivate stations until 8/22.

F - BAD SET OF BATTERIES - recorder at Suttons found down on 8/22, batteries dead after only 15 days operation, new batteries installed. Dry cell batteries deemed unreliable, all gauges converted to 12V storage battery power to prevent reoccurrance of this problem.

Available historical precipitation data for the Chester River NPS subwatershed study area were collected and used to calculate average precipitation for each watershed on an annual, seasonal, and monthly basis, as data permitted.

The only precipitation monitoring devices operating in Kent and Queen Anne's Counties are NOAA's National Weather Service stations at Chestertown, Millington, and Centerville, Maryland. Monthly and seasonal averages were computed from data compiled from NOAA records for Chestertown and Millington. Only data for 1976 could not be located in annual summary form; data for this year were compiled from NOAA monthly data.

Yearly averages were computed from NOAA climatological data for Maryland and Delaware summary data and again for 1976 from NOAA monthly data extending the summaries through 1979.

Tables A-2-21 through A-2-23 summarize the historical monthly and seasonal precipitation data obtained.

Instruments were calibrated before and after each survey and at least once in any 12 hour period. An Instrument Calibration Record was used to record the instrument ID, probe ID, parameter calibrated, standard(s) used and their values, calibration result, and approval of the instrument/calibration for use. This record was also used to record the time of sample arrival at the field lab, the time of filtration for filtered nutrients, the time of other sample preparation, and any other processing information deemed appropriate.

Calibration procedures used for pH, D.O., conductance, and temperature are found in Standard Methods, 14th edition (8). Two buffers were used for pH standardization, pH 7.00 and pH 4.01. Dissolved oxygen meters were of the temperature and salinity compensating type. Routine calibration was performed using the air saturated distilled water method taking into account barometric pressure as reported by NOAA weather radio (VHF channel WX-2). Distilled water was treated for no less than 15 min., the instrument was turned on at the start of areation so that the probe was well polarized before calibration. The instrument was not turned off until post survey calibration confirmation had been accomplished. The modified azide D.O. method as described in Standard Methods was employed periodically to confirm the accuracy of the air saturated water method. Conductance measurements were standardized using distilled water and 0.20 molar KCL which have conductances of "indistinguishable from zero" and 24,820 umho/cm respectively. The instrument converts conductance and manually sets temperature to salinity. A nomograph was used to check the accuracy of the salinity result. Table 2-24 lists the calibration procedure references.

The continuous monitor which was used during intensive surveys was a Schneider Model RM 25. The unit is the property of the State of Maryland and was used for the duration of the program. Six parameters were monitored: PH, conductance, temperature, D.O., water level, and solar radiation intensity (SRI). The monitor was set up at the station to be monitored and the pump and electronics turned on 2-3 days before any calibration was attempted. This insured that the system was chemically and electronically stable before calibration. Operation and calibration information was supplied by the manufacturer in Operation and Service Manual for Model RM-25 Robot Monitor, August 1973. Calibration was performed in accordance with the service manual although in some instances a prescribed action failed to achieve the desired effect (and sometimes had no effect at all). Calibration of PH involved two buffers, one at two different temperatures. Conductance also required two standards, one at two temperatures. River water from the monitored site either spiked with KCL or diluted slightly with distilled water and then analyzed for conductance using a freshly calibrated YSI SCT meter were used as working standards. Temperature was calibrated against an NBS traceable thermometer. Dissolved oxygen was standardized against river water samples which had been agitated to increase D.O. or boiled and then cooled in a container filled to the brim and covered with plastic film to reduce D.O., a freshly calibrated YSI D.O. meter was then used to determine the

Table 2-24

References to procedures used in instrument calibration.

PARAMETER	PART	PAGE
PH	424	460
D.O.	422 B, F	443, 450
Conductance	205	71
Temperature	212	125

dissolved oxygen content of these working standards. SRI couldn't be calibrated as such, the meter was simply adjusted to zero and full scale, the sensor employed by the SRI parameter 1S is primary standard. Water level was calibrated against the state height staff nearest to the monitored station. Surveying results were used to then relate water level to the Geodetic Datum. Calibration curves determined for the RM-25 located at Chestertown during the intensive surveys of May 29-30, July 24-25, and September 24-25, 1981 (12). Table A-2-25 shows the procedure for calibration of the continuous monitor.

Field activities were verified and implemented through field and laboratory procedures. Figures A-2-14 through A-2-19 describe the major field program activities and methods used to insure quality data collection and sample preservation techniques.

The analytical laboratory quality control program was an integral part of the overall quality assurance plan for this study. An integral part of analytical laboratory quality control is method performance assurance which involves insuring and confirming that a method/instrument is performing properly before and during analysis of samples. To accomplish this goal reagents were prepared using only reagent-grade chemicals unless lower grades were specifically allowed by the method. Stock standards were prepared using reagent-grade or primary-standard-grade chemicals. All reagents and standards were labeled to indicate: (1) method, (2) reagent name, (3) composition or reference to specific method, (4) expiration time limit, (5) preparation date, and (6) initials of preparer.

Results of duplicate analyses and spiked sample analyses were compared to historical performance in the form of control charts. The construction and use of control charts is detailed in Standard Methods (8). Batches of approximately 10 samples were analyzed, followed by duplicate analyses of one sample and duplicate analyses of the same sample after being spiked (at least 20 percent increase in concentration). If the difference between duplicates on the recovery of the spike fell outside of control limits as indicated by the control chart, results of the entire batch of samples were rejected and the batch reanalyzed. If failure of QC by two successive batches occurred analyses were halted and the system examined to determine the cause of the difficulty; corrective action followed.

The Chester River Program laboratory files were structured such that results for samples received at one time were placed in a separate folder. The folder was labeled with program name, date of sample receipt, task(s) represented, and lab-internal identification numbers. The program files will be maintained by Normandeau, Inc. for at least two years after completion of the final report, after which they may be transferred to NAI's record storage facility. The files will be maintained in record storage for at least an additional eight years constituting a record maintenance period of not less than 10 years.

The methods used to analyze Chester River water quality variables are listed in Tables 2-8, A-2-9, and A-2-11. Once samples were received in the laboratory, an inventory was taken and samples place in a -20°C freezer and stored until analysis (3 weeks maximum).

Samples were unfrozen on the same day of analysis. After analysis, the samples were refrozen and held until program administration issues disposal notice. Ten percent of the samples were spiked, replicated and blanks run. Two standards were used and controls run for NO_3, NO_2, NH_3, O-phos, t-phos, TKN.

Digestion for TKN and total phosphorus analyses were carried out in combination. Ten (10) ml of sample and 2 ml of digestion reagent were heated at 200°C for 30 minutes, then at 300°C for 30 minutes. Total time for heating (digestion) is 90 minutes (30 minutes are required to bring the mixture from 200 to 300°C). This combined digestion includes the filling of the dilution loop with 3.5% NAOH (9).

This procedure is a modification of the 1975 EPA TKN method that utilizes a continuous digestor. The only modification to this EPA procedure is the substitution of the BD-40 block digestor in place of the outdated continuous digestor. (The BD-40 digestor is used in the EPA 351.2 method.)

After receiving the updated Technicon procedures for T-phos/TKN, they were employed beginning with the March sample set. The Technicon method numbers are 376-75 W/B for preparation of the samples using the BD-40 block digestor, and 319-74 W/B for the analysis of the samples. This method is the same as EPA method 351.2.

The QC for all the TKN samples were acceptable. No changes in the range of TKN was observable.

Chlorophyll and Phaeopigments were analyzed using the procedure outlined below:

(1) Filter (GF/A) thawed and placed in test-tube
(2) Covered with known volume of 90-10 acetone-water
(3). Sonicated for 15 minutes
(4) Measured on narrow-band spectrophotometer at 665-and 75 nannometers wavelength before and after sample acidification
(5) Calculations made using the following modified equation (3), (4), (13).

The equations used to calculate the phytoplankton pigments are:

Chlorophyll a (g per sample) = $(D_b-D_a)\ R/(R-1)\ (V/1)\ (10^3/a_c)$

$= 11.9 \times 2.43\ (D_b-D_a)\ (V/1)$

Phaeopigment (ug per sample) = $11.9\ (V/1)\ (1.7\ D_a)$ - Chl. a

where

D_a = optical density of samples after acidification = D_{665} - D_{750} (acidified)

D_b = optical density of sample before acidification - D_{665} - D_{750} (unacidified)

ac = specific absorption coefficient for chlorophyll a (in grams 11.9 per centimeter)

V = volume of solvent used to extract the sample (milliliters)

1 = path length in centimeters

R = D_b/D_a for pure chlorophyll a = 84 (Talling and Driver 1963)

To convert to micrograms per liter, the chlorophyll a value was divided by the number of liters of water filtered.

The phytoplankton species identification procedure is outlined below:

(1) Samples (preserved) were settled for 24 hours at the field laboratory.

(2) Upper 90% of sample drawn off.

(3) Remaining sample agitated and decanted into centrifuge tubes, spun at 2000 rpm for 12 minutes.

(4) Decant upper volume of each tube (2-5 mls of sample and the pellet remains in each).

(5) Each tube placed on a tube mixer mixed for 20-30 seconds.

(6) Contents of all tubes for a given sample are recombined into a vial with 4 mls of 6:3:1 (water, 95% ethanol and 38-40% formaline) added.

(7) Tubes were rinsed into the sample vial for a final volume of 25-30 ml. Labels were attached.

(8) Initiate Sample Analysis.

(9) Adjust sample volume using entire concentrated sample and graduated cylinder.

(10) Shake thoroughly and transfer aliquot to a Palmer counting chamber.

(11) Settle for 8-10 minutes.

(12) Count a 400X (using Wipple grid). Only cells apparently viable at the time of collection were identified to most specific possible taxon.

(13) Twenty (20) randomly selected fields were examined for each sample for non-diatom valves enumerated at 1000X.

(14) Scientific name, taxon code, number of cells of each will be recorded on the Phytoplankton Sample Analysis Data Sheet in addition to general provenience data on the samples.

(15) Data is then transferred for key punch and computer entry of density calculation and table development.

Density of sample = $(x/f)\ (s/v)$

x = number of organisms within the microscopic fields (or aliquot analyzed)

f = total volume of the microscopic fields (or aliquot analyzed)

s = volume of lab sample

v = Total volume of water sample

Total Particulate Nitrogen and particulate Organic Carbon are analyzed on a Perkin Elmer CHN Analyzer Model #240 with GC Column Separation and dual thermal conductivity detectors (3). Sample filters are sectioned to provide a subsample consistent with instrument detection range and incinerated. The combustion products, together with a carrier gas are drawn into the GC separator columns, drawn off to the paired sample/blank thermal conductivity detectors and differences between the carrier gas and separated combustion products/carrier gas mixture recorded. QA/QC for these analyses included:

(a) Instrument standardization

(b) Blank filter runs

(c) Analysis of a portion of the outer edge (no sample passed through this section)

(d) Replicates (2) were run for each batch of samples (27) analyzed.

Nitrogen Fixation samples were analyzed in the following manner:

(1) Samples received on ice in serum vials, inventoried (storage for not more than 72 hours).

(2) Atmosphere (1 cc) above sediment or water withdrawn.

(3) Injected into Porapak R column of the gas chromatograph (Helium carrier 25/ml/min. - FID detector.

(4) Calibration standard - 1000 ppm Acetylene
Primary Standard - 100 ppm Ethylene
1 ml, 500 ul, 10 ul - curve

(5) Two replicates run for each sample.

(6) Replicates, spikes, blanks were run for QC.

Table A-2-26 lists the method number for both EPA 1979 and Technicon detection limits and published standard deviation for each parameter tested. Detection limits correspond to one chart unit when the highest standard reads 90% of full scale and the baseline reads 10%.

Prior to October 1980, samples were analyzed by the manufacturer's suggested procedures of using a single standard to calibrate the instrument (Technicon AA II). This calibration was tested using a prepared control. If the control deviated by more than ±20% the run was started over. The Technicon method book states "The use of multiple working standards is only to establish linearity. For day to day operation, a single standard is recommended for instrument calibration."

Beginning in October 1980, the NAI QC program was increased to include 3 standards, 10% spikes and duplicates, and control. This change in the QC program was implemented internally so as to establish a more objective criteria for data acceptance. While matrix interference was not a factor in the Chester River project, other more complex matrices warranted this change.

The following is a discussion of items which were common to all parameters run on the Auto Analyzer II (nitrate, nitrite, ammonia, TKN, orthophosphorus and total phosphorus):

Ninety percent of the malfunctions of the auto analyzer can be determined before samples are run. First, a reagent baseline was established and checked for drift. After the baseline was stabilized, standards were run and checked for linearity by linear regression. Three different concentrations for each parameter were made up to bracket the expected range of the samples. The high standard was adjusted to 90% of full scale and the baseline set at 10% of full scale. A commercially prepared control was run with the standards. Using the regression line of the standards, the value of the control was determined. By cross checking the in-lab standards with the commercial control, the concentrations of the standards were confirmed. This also insured the accuracy of the results of the samples.

If the regression of the standards was determined to be non linear, the system was determined to be out of control. Also, if the control was not ± 15% of its calculated value, the system was out of control.

In addition, 10% of the samples were spiked and run in duplicate. If the spike recovery was not within ±15% or the duplicate values were not within ±15% of each other, the samples failed the QC criteria.

When the standard curve (linear regression) was out of control, the standards were remade and run again. If the spiked samples fail QC they were rerun. If the spikes were consistently out of control, it was determined that a matrix interference existed and the whole set is rerun after correcting for the interference.

Standards and reagents were prepared from ACS certified analytical grade chemicals. Reagents were never held past the shelf life recommended by Technicon. Stock standards were prepared from primary standard grade chemicals, oven dried at 105± 2 C, and cooled in a desicator for 1 hour. The required amount is weighed to 0.1 mg on a Metler H-30 analytical balance. The balance was calibrated before use with Class S metric weights and serviced annually by a qualified service technician. Table 2-27 lists the amount of chemical weighed and the resulting concentration of the stock standard when dissolved in 1 liter of water. Working standards were prepared daily from the stock standards. A simple formula was used to determine the amount of stock standard needed to obtain the desired concentrations:

$$(C_1)(V_1) = (C_2)(V_2)$$

For example, to make up a .1 mg/1 standard in a 1 liter volumetric flask.

$$(C_1)(V_1)/(C_2) = V_2$$

$$\frac{(0.1\ \text{mg/l})(1000\ \text{ml})}{1000\ \text{mg/l}} = 0.1\ \text{ml}$$

Therefore 100 ul of stock standard is diluted to 1000 ml with deionized water. These small volumes were pipetted using calibrated Eppendorf pipets.

Normandeau Inc. did not utilize intermediate standards to avoid pipetting small volumes of stock standards. The Eppendorf pipets were maintained by lab personnel and checked for accuracy quarterly. The pipets were checked for accuracy by pipetting ultrapure water (at 4°C) onto a Mettler five-place balance that has been calibrated with Class S metric weights. Four to five replicate pipettings were performed. The replicates must be within 1% of each other, and the average must be within .00005 grams of the theoretical weight. If these conditions are not met, the pipet is sent out for recalibration. The pipets were also checked if we noted erroneous results in the analyses.

The QC program was based on 10% reruns and spikes. This is not meant to uncover all possible matrix interferences in each sample, but rather to determine whether there are broad interferences in a given set of samples. An effort was made to spike samples of each matrix type, e.g. slack tide survey samples point source, and 24 hr. samples. In this way, it was determined whether the different sets of samples contained matrix interferences. The concentrations used for spikes, were within the linear range of the standards curve. Spike recovery was used to detect masking or enhancement of the parameter being analyzed. Since the samples were spiked at random within a set, the spikes were sometimes much higher than the sample concentration, but we are still able to determine whether there is masking or enhancement of the spike in the sample.

When a spike recovery exceeded Normandeau Inc. QC limits, several types of things actions were taken. The instrument settings were checked, the reagents were checked and remade if necessary, and the samples in that group were repeated with additional spikes and duplicates.

When a matrix interference was discovered, the first attempt to correct the problem involved dilution of the sample. A 2X dilution was performed and spiked. If the spike recovery was acceptable, all the samples in that set were diluted by 2X. If further dilution was necessary, the final dilution would have a concentration high enough to be at least twice as high as our lower limit of detection. If this procedure did not correct for interference, an extraordinary event/noncomformity form is prepared, filed, and was sent to the project manager for action. No such reports were necessary.

All glassware is acid-washed with 10% HCl, rinsed several times with deionized water (ASTM Type I, 18Mohm) filled and stored with DI water to leach out contaminants. Before use, the glassware was emptied and standards were prepared using fresh deionized water. All volumetric glassware was Class A and calibrated to NBS capacity tolerances.

Non-Point Source Program Quality Assurance and Control

Primary, secondary, and working standards were prepared in accordance with the procedures specified by EPA (2) for each of the parameters analyzed in runoff from non-point sources. The primary stock standards were prepared using analytical grade chemicals supplied by Fisher Scientific. The working standards were preserved in the same manner as samples. Whenever new standards were prepared, they were recorded in a standards logbook.

Standards used were reference standards, method standards, and calibration curve standards. Method standards are deionized water preserved as required and spiked with a reference standard for a parameter of interest and carried through the analysis. This provided the accuracy of the method, under optimum conditions, excluding any chemical interference from sample matrix. Calibration curve standards were used to determine the amount of analyte of interest in each sample. Check standards were analyzed in the same manner as samples to validate the currently used standard calibration curves. Calibration curve standards were prepared prior to each day's analysis for a selected parameter. At least one check standard and one method standard were analyzed with every batch of samples to verify the instrument's response. Reference standards were analyzed at least semi-annually to establish the accuracy of each method.

The autoanalyzer was calibrated daily using a minimum of three (3) working standards and a reagent blank. First the baseline was set by pumping the reagents through the system. Then the instrument was calibrated using midscale working standards. The slope, intercept, and correlation coefficient for a standard curve was 0.995 or better. At least one check standard was analyzed in a sample batch to establish the validity of original standard calibration curves. Standard calibration settings on the autoanalyzer were between those levels recorded during preparation of the quality control limit charts. For example, ammonia (NH_3-N) standard calibration settings were between 3.50 and 4.80.

Calibration for the spectrophotometer and total organic carbon (TOC) analyzer required preparation of a standard curve at the beginning of each day of analysis. Check or method standards were analyzed with each sample batch to establish the validity of the standard calibration curve. The TOC analyzer zero, gain, and tune were recorded in the TOC instrument logbook. The tune must be $\pm$1% $\pm$2%.

The temperature of the refrigerator used for storage of samples was recorded daily in the temperature control logbook. All thermometers used in the incubator, refrigerator, or oven were calibrated monthly using NBS traceable thermometers. The calibrations were recorded in a thermometer calibration logbook. All the analytical balances were levelled and zeroed before each use and calibrated once a month using Class "s" weights. Balance calibration records were maintained in a Balance Calibration logbook.

All analytical equipment received maintenance on a monthly or semi-annual basis in accordance with manufacturer's recommended procedures.

Filtering of ammonia, nitrate + nitrite, ortho-phosphate, total phosphorus, and total nitrogen was performed upon receipt. Sample analyses were initiated immediately. Samples were initially preserved and analyzed in accordance with the procedures documented by EPA (2). During January 1981, after approval of the proposed preservation and holding times (7) the sample handling procedures were changed accordingly (see Table A-2-27). Table A-2-28 lists the parameters, the method analysis and holding times prior to and after January 30, 1981. Results of laboratory analyses for each parameter including reagent blanks, standards, duplicates, and spikes were entered into the Hewlett Packard Model 1103/RL01 Computer by the chemist who performed the analysis. The computer was programmed to produce an analysis report which tabulated the data, evaluated precision and accuracy of analysis against stored control chart data, and indicated whether results met the accept/reject criteria for analyses of that parameter. Specific quality control procedures and accept/reject criteria are defined in Section C4. Each analysis report was forwarded to the Laboratory Section Chief for his review. He determined whether results were acceptable, compared laboratory notebook, parameter request sheets, and chain-of-custody records to the analysis report, and if necessary, decided which analyses would be repeated. Once the Laboratory Section Chief signed off a sample batch (all analyses included on the parameter request sheet had been completed) and completed his analysis control chart, laboratory results were forwarded to the Laboratory Manager for his review and to Versar's Program Manager for the Chester River water quality data acquisition program for evaluation and reporting of data.

A quality control document was used to maintain all intra-laboratory quality control data for each batch of samples. This document is organized by parameter. After 10 batches of samples had been analyzed for a parameter, quality control data for these batches was combined and used to calculate new quality control limit charts.

The analytical batch consisted of (1) a group of samples to be analyzed for a specific parameter; (2) control samples used to monitor the quality of analyses in terms of recovery and precision; and (3) quantitative standards used to determine the amount of the analyte of interest in each sample. Specific components of each analytical batch include:

- Samples - All samples collected during that storm event. The amount of samples collected depended on the amount of non-point source runoff. The number of samples ranged from 2 to 5 samples per batch.

- Reagent Blank - Deionized water preserved as required and carried through the analysis. This checks for reagent or lab contamination and also helped to determine the detection limit.

- Method Standard - Deionized water preserved as required, spiked with a calibration curve standard for a parameter of interest, and carried through the analysis. This provided the accuracy of the method, under optimum conditions, excluding any chemical interference from sample matrix.

- Spiked Sample - One of the original samples split with one split spiked with a calibration curve standard. This provided the spike recovery of the sample, including any chemical interference from the sample matrix.

- Duplicate Sample - One of the original samples split into a sample pair. The comparison of these analyses determined the laboratory precision.

- Reference Standard - A sample with a known amount of the parameter of interest carried through the analyses (ex. from EPA, ERA, NBS). This provided the accuracy of the method. Standard curves were also generated using the reference standard.

- Check Standard - A calibration curve standard instrumentally analyzed in the same manner as samples to establish the validity of the original standard curve.

Prior to the analysis of samples, a standard curve that covers the entire working range of the method was constructed with the required number of five standards, including one near the upper limit of the concentration range and one near the lower limit of the concentration range. The other standards were equally spaced throughout the operating concentration range.

Each day, if operation was continuous, or prior to analyzing each group of samples if operation was non-continuous, Versar analyzed a minimum of two check standards to establish the validity of the original standard curve. These standards represented the range of the standard curve, i.e., one above and one below the mid point of the standard curve. If these check standards fell outside the established limits, a new standard curve was constructed. These limits were established by the analyst.

To determine the precision of the method, a regular program of analyses of duplicate aliquots of environmental samples was carried out. The precision control limits were developed from 20 sets of duplicate results accumulated over a period of time during the routine analysis program. Duplicate aliquots of a well-mixed sample were analyzed with each sample batch and comprised at least 10 percent of the samples. The duplicate data was obtained for each parameter of interest. Initially, samples selected for duplicate analyses were those that were most representative of the interference potential of the sample type. As the program progressed, samples representing the entire range of concentrations and potential interferences were designed into the duplicate analyses program.

After 20 duplicate results were obtained, control limits for each parameter of interest were updated. The control limits for accept/reject were ±28. If the precision was not within the control limits, the system was checked for problems. If problems existed, they were resolved before repeating rejected analyses or continuing with routine analysis.

The data obtained from the duplicate analysis for each batch were recorded with each analysis report and were also included in the QC document.

In addition to the initial determination of the precision of the method, a program was maintained to verify that the method accuracy continued under control. The program was carried out by preparing method standards and analyzing them according to the method. At least one method standard was analyzed with each sample batch or comprised at least 10 percent of the samples. The method samples were approximately equal to the concentration found in routine samples.

After 20 method standard results had been obtained, the relative percent difference (RPD) for method standards was calculated and the control limits for each parameter of interest established. The control limits were +2 (standard deviation). If the RPD for succeeding method standards was not within the control limits, the system was checked for problems. If problems existed, they were resolved before repeating rejected analyses or continuing with routine analysis. The data obtained from the analysis of the method standard was recorded with each analysis report and was also included in a QC document.

The Laboratory Receiving/Storage Logbook and Standard Stock Solution and Reagent Logbooks were maintained until all pages were filled. The dates covered by each logbook were entered on the cover by the Laboratory Sample Custodian and filed in Versar's laboratory central file where they are maintained for ten (10) years. The Chester River laboratory project files are now maintained in the laboratory central file by Versar Inc.

Section 3

Point Sources

Point sources were studied to determine if problems exist in the Chester River due to nutrient input from Sewage Treatment Plants (STP) and industrial facilities. Information concerning the status of approved permit limits for eight STP's and four industrial facilities were obtained (Tables B-3-1 and B-3-2). The imposed limits for these twelve sites gives an idea of where possible major point sources are located.

Only five of the major STP's and two industrial sites were selected for the 1980-81 sampling period (Table 2-13). The average concentrations and corresponding statistics were computed from this data and are shown in Table B-3-3. The Chestertown and Centreville STP's were the largest point source contributers of nitrogen (N) and phosphorus (P). However, N and P loading from point sources was minimal compared to fluvial runoff. Because the drainage basin is primarily agriculture, the fluvial runoff is high for nutrients. Impacts on the Bay due to agricultural runoff have proved that nutrient and sediment loadings are substantial (15). It is not surprising to find fluvial runoff as the largest contributer of nutrients. Point sources contributed only 0.9% of the total N and 0.6% of the total P loaded into the Chester River during May to September 1981. These percentages were obtained from the mass budget computations in Section 5. Because the percentage of N and P added to the Chester River was low for point sources, little adverse effect can be associated to point source N and P loading in general.

The residual chlorine was one parameter not measured during the 1980-81 study of the Chester River. Hypochlorus acid (HOCl) is added to effluent as a disinfectant that kills harmful bacteria and viruses. "It is now well established that by-products are produced whenever chlorine is used as a disinfectant or a biocide" (17). This reactive form of chlorine also reacts with ammonia and organic nitrogens to form mono-, di- and triamines (14). While the ecosystem of the Chester may be able to assimilate nutrients, it may be adversely effected by small amounts of chlorine. Future studies of point sources should give more notice to the chlorination of wastewater.

Section 4

Physical Characteristics of the Chester River Basin

The Chester river basin geology, relief, soils, vegetation, rainfall tidal effects and other parameters interact to create a river and estuarine valley which drains approximately 429 square miles of land surface area. The river/estuarine system is approximately 41 nautical miles long (east to northeast) and, on the average, 3252 yards wide and 11.7 feet deep. The general flow of water is to the southwest. A tidal-nontidal interface (fall zone) occurs near the Route 213 bridge at the town of Millington. The drainage area lies in the Maryland counties of Queen Annes and Kent and approximately 55 square miles lies within the state of Delaware. The upper watershed is characterized by poorly drained soil types covered predominantly by coastal plain forestland and agriculture, while the soils below the fall line and towards the mouth of the estuary drain relatively sandy soils covered with agricultural cover type and small woodland areas.

The topography is influenced by the Coastal Plain province which provides a relatively flat surface with small broad streams many of which are tidal, densely vegetated along the banks, and underlain by alluvial deposits and wetlands. The upper estuarine area has been filled by alluvial deposition of eroded material over the last two to three hundred years. More recently, within the last 5-30 years, the sedimentation has reached a point where the upper estuarine river is only slightly navigable by small power boats.

Geomorphological Relations

Geomorphological relations have been developed to characterize the Chester Estuary. During this study a bathymetric survey of the tidal estuary was conducted. Data from this survey (described in the Methods Section), and data taken from nautical charts for comparison, has been used to calculate geomorphological functional relations. Supplemental data from Maryland Department of Natural Resources, Geological Topographic Maps was also used to calculate drainage area relations. These sources of data were used to determine empirical relations of drainage area, hydraulic depth, water surface area, top width, cross-sectional area and volume of water at mean low sea water level.

Hydraulic depth was calculated as follows:

$$HD = CA/TW \qquad (4\text{-}1)$$

where:

CA = Cross-sectional area (yd^2)
TW = Water surface width (yd)
HD = Hydraulic Depth (yd)

Water surface area was calculated from water surface widths and nautical mile designations as follows:

$$SA_i = ((TW_1 + TW_2)/2)*X_{12} \qquad (4-2)$$

where:

TW_1, TW_2 = top widths at river nautical miles 1 and 2 respectively (yd)

X_{12} = longitudinal distance between transects 1 and 2 (yd)

SA_i = Surface Area (yd^2)

The volume of water between cross-sectional areas was calculated from cross-sectional areas and longitudinal nautical miles as follows:

$$V_i = ((CA_1 + CA_2)/2)*X_{12} \qquad (4-3)$$

where:

CA_1, CA_2 = cross-sectional area at transects 1 and 2 respectively

V_i = volume between transects 1 and 2 (yd^3)

X_{12} = longitudinal distance between transects 1 and 2 (yd)

The BMDP statistical package P6D was used to regress longitudinal values of calculated surface areas, volumes, widths, hydraulic depth and drainage area.(26) The regression functions mentioned below were linearized and the geomorphological variables mentioned above were regressed using least squares regression.

(a) $y = mX+c$
(b) $y = K \exp (aX)$
(c) $X = K \exp (ay)$
(d) $y = KX^a$

In applying the above regression functions the dependent variable (y) was the geomorphological variable and the independent variable (X) was nautical mile. Each linearized function was applied to the longitudinal river data of the geomorphic variables using least squares regression giving r^2 (squared correlation coefficient). The regression functions giving the highest correlation coefficient were selected and are shown below:

$$DA = 0.494356*(X**0.70324), \quad r^2=0.198 \qquad (4-4)$$

where: DA = drainage area (see Figure 4-3(b)) from bathymetry survey data:

$$TW = (\ln X-3.5088)/(-0.00027), \quad r^2=0.925 \tag{4-5}$$

$$CA = 95552.66*\exp(-0.15477108*X), \quad r^2=0.941 \tag{4-6}$$

$$HD = (-0.14655*X)+6.2886, \quad r^2=0.771 \tag{4-7}$$

$$SA = (\ln X-3.3247)/(-1.0E-08), \quad r^2=0.805 \tag{4-8}$$

$$V = 3.0292627*(10**08)*\exp(-0.15815*X), \quad r^2=0.904 \tag{4-9}$$

from nautical charts:

$$TW = (\ln X-3.4137)/(-0.00026), \quad r^2=0.893 \tag{4-10}$$

$$CA = 81545*\exp(-0.14190975*X), \quad r^2=0.939 \tag{4-11}$$

$$HD = (-0.12620*X)+6.5163, \quad r^2=0.517 \tag{4-12}$$

$$SA = (\ln X-3.1697)/(-1.0E-07), \quad r^2=0.7815 \tag{4-13}$$

$$V = 5.8225258*(10**9)+(X**(-2.492), \quad r^2=0.869 \tag{4-14}$$

These equations can be used to approximate the respective geomorphic variable at a given nautical mile with various degrees of accuracy. Plots of selected geomorphic variable functions are shown in Figures C-4-1 through C-4-6.

Cumulative functions of these geomorphic variables were also determined for the Chester Estuary by regression of the linearized functions listed above. The advantage of developing cumulative functions of the morphological variables is that a smoothed functional relation is obtained, resulting in a higher r^2 than the discrete step functions shown above. The second advantage of developing a cumulative function for a morphological variable is that the derived function can be differentiated with respect to longitudinal distance in nautical miles to obtain an instantaneous function of the variable at that mile. In essence, the cumulative function can be used to approximate the morphological variable at a particular longitudinal mile and at the same time can be used to determine the difference as well as the rate of change of the morphological variable between any two transects or locations in the longitudinal direction. The best fit cumulative geomorphological functions for the previously described variables are as follows:

$$CDA = 557.2422*\exp(-0.3715*X), \quad r^2=0.904 \tag{4-15}$$

from bathymetric survey data:

$$CTW = 93339.36*\exp(-0.12536*X), \quad r^2=0.974 \tag{4-16}$$

$$CCA = 635393.6*\exp(-0.18786*X), \quad r^2=0.967 \tag{4-17}$$

$CHD = (\ln X-3.7262)/(-0.03591),\ r^2=0.878$ (4-18)

$CSA = ((-7.0E+07)*(\ln X))+2.0E+08),\ r^2=0.982$ (4-19)

$CV = ((-3.0E+08)*(\ln X))+1.0E+09,\ r^2=0.966$ (4-20)

from nautical chart data:

$CTW = 280407.7*\exp(-0.13796*X),\ r^2=0.958$ (4-21)

$CCA = 1865426*\exp(-0.18146*X),\ r^2=0.957$ (4-22)

$CHD = (\ln X-3.629)/(-0.00779),\ r^2=0.832$ (4-23)

$CSA = 2.6813469*(10**8)*\exp(-0.14228*X),\ r^2=0.964$ (4-24)

$CV = (\exp 21.22)*\exp(-0.18039*X),\ r^2=0.962$ (4-25)

Figures C-4-1 through C-4-6 shows plots of the various morphological variables at longitudinal locations along the estuary.

Freshwater Inflow

Figures C-4-7 and C-4-8 show freshwater inflow at the Morgan Creek USGS surface water gauge (Gauge Number 01493500) during this study. The average flow for the period of record at this gauge is 10.7 cubic feet per second or 0.8425 cfs/sq.mi. It can be seen that during the later half of 1980 very little freshwater inflow occurred due to storm events. During 1980 and 1981 inflow increased during several storm events in the early summer period. Day one of these graphs coincide with January 1 of each year.

For comparitive purposes, similar graphs have been presented for an average water year (1975), an average dry water year (1966) and an average wet year (1974) (See Figures C-4-9, C-4-10, C-4-11). Thus, by visual comparison, 1980 freshwater inflow represented below average conditions. Figure C-4-12 shows the 30 year average monthly inflow measured at the Morgan Creek USGS gauge, the standard deviation of the mean monthly flow from the observed USGS records along with 1980 mean monthly flow (cfs) indicating the below average inflow which occurred during the beginning of this study. Also shown for comparative purposes are cumulative frequency distributions (flow-exceedence) curves of mean daily cfs for the years 1966, 1974 and 1975 (see Figures C-4-13, C-4-14, and C-4-15).

Estuarine Hydrographic Measurements

Section 2 discusses the methodology employed for measuring current speed and direction during the 1980-1981 surveys conducted during this study. In addition, the Chesapeake Bay Institute conducted flow measurements in the lower Chester Estuary at two moorings deployed on June 27, 1980 and recovered on August 7, 1980, resulting in a 42 day record. This data has been placed into STORET. The two moorings, CH1 and CH2 were located at latitude 39°59'47", longitude 76°16'38" (CH1) and latitude 39°02'30", longitude 76°12'00" respectively. These locations are shown in Figure C-4-16. Five instruments were placed at 5, 12, 20, 28 and 36 foot depths at CH1 and at 8 1/2 and 31 feet at CH2. The CH1 instrument at 5 feet was an Environmental Devices Model 174 (3.7 meters) which measures current speed/direction, temperature and salinity. No data was retrieved from this instrument due to a magnetic tape jam. Similarly, the 11 foot Endeco 105 instrument jammed and provided only a 4 day record.

The details of the initial data reduction have been reported by Boicourt, 1981.(18) The records were filtered with a lowpass, half-power point at 3 hours followed by a low-lowpass filter with a half-power point at 34 hours. The band-pass record therefore consisted primarily of the tidal energy between 34 hr. and 3 hr. periods. The low-lowpass signal provided information on the time variability of currents driven by winds, by variations in gravitational circulation and by tidal height variations in the Chesapeake Bay proper. Figure C-4-17 shows the mean velocity profiles at the two locations. The most striking result from these diagrams is the indication of a three layer flow pattern at CH1, indicating the fresh water flow is relatively small and that the water mass in the upper layers are in communication with lower salinity bay water. This has been further supported by review of historical salinity profiles in the lower Chester Estuary where it is not uncommon for upper layers to have a higher salinity on the surface and lower salinity water at mid-depth. The record from station CH2 indicates a typical two layer estuarine flow pattern.

Boicourt rotated the coordinates of the principal axes where current variance is maximized in one horizontal coordinate and minimized in the orthogonal direction.(18) Figure C-4-18 shows the low-frequency components of the velocity distributions measured in the Chester Estuary and Table C-4-1 shows the u' and v' directions. Table C-4-1 indicates that the primary forcing of the observed fluctuations in flow is wind and atmospheric pressure as indicated by the variance of the mean velocities in the coordinates of the principal axes (u' and v').

Boicourt reported that the Chester River's response to wind-driven motion appears roughly two layered as viewed in Figure C-4-17, however observation of Figure C-4-18 indicates the upper layer instrument at 2.6m at CH2 suggests an inverse correlation with the instruments at 6.1m and 8.5m at CH1, thus indicating the upper layer frequency fluctuations at CH2 are directed along the channel axis in the same sense as the lower layer fluctuations at CH1. Therefore, when the lower layer wind-driven flow at CH1 is directed up the estuary, the upper layer flow at CH2 is also directed up the estuary. Boicourt also states that the axial component of the upper layer flow in the lower estuary station CH1 does not appear correlated with the deeper layer flows at the same station. The cross-axis component (u') however, is inversely correlated with the axial component in the lower layers and probably represents the majority wind-driven component of the flow in this layer. The reason for this behavior is that in the wide lower reaches of the Chester River, the upper layer gravitational wind-driven components of the circulation are apparently not confined to flow along the principal axis of the tidal currents, which are weak (of the order of 10-15 cm/s) where the estuary has a large cross-sectional area. The cross-axis component in the upper layer at CH1 is inversely correlated with the lower layer currents at CH2. An examination of the coordinate directions (Table C-4-1) shows that the upper layer wind-driven flow at CH1 is flowing in the same axial direction as the lower layer flow at CH2. How can these flow variations be reconciled? The simplest explanation arises from the large bend in the channel, around Eastern Neck. The bend is sufficiently large that the down-estuary direction in the reach at Station CH2 is approximately 170° from the down-estuary direction in the lower reach at Station CH1. For certain wind directions (NNW, SSE) the surface flow driven by local winds will be down-estuary at CH2 while it will be up-estuary at CH1 and vice versa. Winds of other directions will drive a substantial upper-layer flow in the lower reaches, while driving little flow at CH2 because the wind is directed cross-estuary. A north-northwest wind, then, will drive the flow at CH2 down-estuary, with answering up-estuary flow in the lower layer. The same wind will drive an up-estuary flow in the lower reaches, at Station CH1, with answering down-estuary flow in the lower layer. These two flows must therefore create a convergence in the surface layer near the turn off Eastern Neck, and a corresponding divergence in the lower layer. Continuity must therefore be satisfied with downward vertical motion in the convergence region. This indicated local wind-driven motion must be examined more carefully, with the specific wind stress variation taken into account (18).

The principal preliminary findings from these flow measurements on the Chester River are therefore reported by Boicourt as follows:

(1) The fresh water inflow to the Chester River was sufficiently low and the Chesapeake Bay's surface salinity off the mouth of the Chester was sufficiently low, that a three-layer circulation was set up in June 1980.

(2) The large bend in the Chester River allows separate, oppositely directed two-layer flows in the two reaches on either side of Eastern Neck. The existence of these flows implies a convergence region in the region of the bend.

(3) The gravitational or wind-driven component of the flow is not necessarily confined to flow in the direction of the principal axes of the tidal currents in wide reaches of an estuary with large cross sectional area.

Boicourt also states that increased spatial coverage will be necessary to examine the wind-driven circulation and to explore the suggested convergence region, which has important consequences to the transport and mixing processes.

The three layer flow pattern indicated by the above described deployments conducted during this study are also supported by measurements taken in 1972 during the Chester River Study, conducted by Westinghouse, Inc. (19). During this study funded by the Maryland Department of Natural Resources, the National Oceanographic and Atmospheric Administration conducted current meter/direction measurements at several moorings. Two of the five current velocity profiles of net flow taken during 1972 also indicate a potential three layer flow pattern in the lower Chester estuary.

Salinity data collected during the slack tide water quality surveys during 1980 and 1981 are shown in Figures F-7-1, F-7-2, and F-7-3. Depth averaged values of salinity were calculated at each station for each survey in order to determine the depth averaged salinity at a station during the study period. Least squares regression of salinity versus nautical mile gives a polynomial function describing salinity as a function of nautical mile along (longitudinal axis), with the y intercept taken as the average salinity at the mouth of the Chester estuary. The salinity distribution is described by the following function:

$$S_x = -0.01077 * X^{1.9} + 12.262 \qquad (4\text{-}26)$$

where: S_x = estimated salinity at given nautical mile
X = nautical mile (longitudinal axis of estuary)

Figure C-4-19 shows the observed and calculated longitudinal salinity profile using the above equation as well as estimated salinity profile using other methods described later. This function can also be used for approximating the percent of Chesapeake Bay water and Chester River freshwater at any mainstem longitudinal location in the estuary by using the relation:

$$P_x = (S_x/So)(100) \qquad (4\text{-}27)$$

where: P_x = percent freshwater or Chesapeake Bay water at nautical mile X
S_x = estimated or observed salinity at X
So = salinity at the mouth of the estuary

Figure C-4-20 shows the results of this simple calculation, i.e. estimated percent freshwater and Chesapeake Bay water from nautical mile zero to 41 using equations 4-26 and 4-27. The location of the 50% mixing of these two water types occurs at approximately the location of an upper estuary sill where the water depth becomes relatively deeper on either side of the sill (see Figure C-4-6).

Estimating the flushing time of an estuary is useful in approximating the time period a conservative substance might remain in the entire estuary or an estuary segment. The steady state, depth averaged flushing time of the Chester Estuary for average freshwater inflow and mean low water volume can be approximated by the definition of the flushing time (T_f) as follows:

$T_f = V_f/Q_f$ (4-28)

where: V_f = freshwater volume between transect X_1 and X_2 (ft^3)

Q_f = freshwater flow rate into the volume (cfs)

This calculation does not include the effects of tidal flushing which can be important in removal of a substance through tidally induced dispersion and mixing. Using volumes calculated from (a) the data taken from nautical charts; (b) the percent of a given volume of freshwater by applying equation 4-27 and (c) determination of the freshwater input at a given longitudinal location (calculated by multiplying the average freshwater flow rate, cfs/sq.mi. times the drainage area (sq.mi.) at a longitudinal location), the freshwater flushing time of the Chester can be approximated as shown in Figure C-4-21. The total flushing time obtained using this method is 81 days. Due to the assumptions of depth average salinity, average freshwater inflow, mean low water volume and no tidal forcing, this value is more likely to be an approximation of the maximum flushing time. Figure C-4-22 shows the same calculation except volumes of water segments were estimated from the 1980 bathymetric survey. The difference between the total flushing time for the estuary using both methods of calculating volumes is approximately 2 days. The nautical chart data calculations used 55 segments and the bathymetry survey data calculation used 20 segments.

Figure C-4-23 shows the effect of varying the average freshwater discharge on the calculation of the total mainstem river flushing time (see curve b). Curve (a) on Figure C-4-23 is taken from work reported by Ambrose (20), where a net advective one dimensional transport model (WASP) was used to estimate the flushing time of the Chester Estuary under various inflow conditions. It can be seen that the simplistic method described above (curve b) shows considerably lower flushing estimates at higher freshwater inflow rates and a higher flushing time at low inflow rates. More importantly, it can be seen that the two methods predict similar flushing times near low flow values. Table 4-2 is modified after Ambrose, 1980 showing a comparison of the flushing times for the Chester River by several methods and the simplistic flushing method described above.

Table 4-2. Comparison of Flushing Times for Chester Estuary

Method	Flushing Time (days) High Flow	 Low Flow	Ref.
Tidal Prism	5.3	5.3	20
Modified Tidal Prism	143	134	20
Fraction of Freshwater	13.6	381	20
Net Flow Simulation (WASP)	40	144	20
Simple Mixing	10	208	this study

Table 4-3 shows the flushing times for the Chester River and tributaries calculated by the tidal prism and modified tidal prism method (22)

Table 4-3. Flushing times for the Chester River and selected tributaries (from reference 22)

River/Creek	Volume cu.ft.	Flushing Time (days) Tidal Prism Method	Modified Tidal Prism Method High	Low	Ratio MTP/TP Method High	Low
Langford Creek						
(East Fork)	7.31 E+8	4.3	16.7	69	3.9	16.0
(West Fork)	6.21 E+8	5.0	17.7	59	3.5	11.8
Corsica River	4.20 E+8	2.2	9.8	18.1	4.5	8.2
Gray's Inn Creek	1.30 E+8	3.8	15.0	26.4	3.9	6.9
Chester River	2.61 E+10	6.4	140.1	136.4	21.9	21.3

Evaluation of Chester Estuary Steady State Salinity Distribution and Estimating Steady State Dispersion Coefficients

Various mathematical models or functional relations were used to determine (a) the steady state salinity distribution in the Chester River and (b) steady state dispersion coefficients in the Chester River, which is essentially a variable area, variable discharge estuary. The salinity is used as the conservative substance which is being circulated from the ocean to Chester estuary. The salinity distribution in the estuary permits the determination of steady state dispersion coefficients (one dimensional) in the longitudinal direction of the estuary.

Estimation of Salinity Distribution

This analysis assumes that under conditions of constant freshwater discharge into an estuary and constant tidal range, a steady-state salinity distribution exists in an estuary. This steady-state distribution of salinity is valid when the upstream nonconvective mass transfer due to turbulent diffusion plus the upstream mass transfer due to the density difference between ocean and fresh water is balanced by the downstream convective mass transfer due to the freshwater flow.

Table 4-3 shows the flushing times for the Chester River and tributaries calculated by the tidal prism and modified tidal prism method (22)

Table 4-3. Flushing times for the Chester River and selected tributaries (from reference 22)

		Flushing Time (days)				
		Tidal Prism	Modified Tidal Prism Method		Ratio MTP/TP Method	
River/Creek	Volume cu.ft.	Method	High	Low	High	Low
Langford Creek						
(East Fork)	7.31 E+8	4.3	16.7	69	3.9	16.0
(West Fork)	6.21 E+8	5.0	17.7	59	3.5	11.8
Corsica River	4.20 E+8	2.2	9.8	18.1	4.5	8.2
Gray's Inn Creek	1.30 E+8	3.8	15.0	26.4	3.9	6.9
Chester River	2.61 E+10	6.4	140.1	136.4	21.9	21.3

Evaluation of Chester Estuary Steady State Salinity Distribution and Estimating Steady State Dispersion Coefficients

Various mathematical models or functional relations were used to determine (a) the steady state salinity distribution in the Chester River and (b) steady state dispersion coefficients in the Chester River, which is essentially a variable area, variable discharge estuary. The salinity is used as the conservative substance which is being circulated from the ocean to Chester estuary. The salinity distribution in the estuary permits the determination of steady state dispersion coefficients (one dimensional) in the longitudinal direction of the estuary.

Estimation of Salinity Distribution

This analysis assumes that under conditions of constant freshwater discharge into an estuary and constant tidal range, a steady-state salinity distribution exists in an estuary. This steady-state distribution of salinity is valid when the upstream nonconvective mass transfer due to turbulent diffusion plus the upstream mass transfer due to the density difference between ocean and fresh water is balanced by the downstream convective mass transfer due to the freshwater flow.

Table 4-3 shows the flushing times for the Chester River and tributaries calculated by the tidal prism and modified tidal prism method (22)

Table 4-3. Flushing times for the Chester River and selected tributaries (from reference 22)

River/Creek	Volume cu.ft.	Flushing Time (days) Tidal Prism Method	Modified Tidal Prism Method High	Modified Tidal Prism Method Low	Ratio MTP/TP Method High	Ratio MTP/TP Method Low
Langford Creek						
(East Fork)	7.31 E+8	4.3	16.7	69	3.9	16.0
(West Fork)	6.21 E+8	5.0	17.7	59	3.5	11.8
Corsica River	4.20 E+8	2.2	9.8	18.1	4.5	8.2
Gray's Inn Creek	1.30 E+8	3.8	15.0	26.4	3.9	6.9
Chester River	2.61 E+10	6.4	140.1	136.4	21.9	21.3

Evaluation of Chester Estuary Steady State Salinity Distribution and Estimating Steady State Dispersion Coefficients

Various mathematical models or functional relations were used to determine (a) the steady state salinity distribution in the Chester River and (b) steady state dispersion coefficients in the Chester River, which is essentially a variable area, variable discharge estuary. The salinity is used as the conservative substance which is being circulated from the ocean to Chester estuary. The salinity distribution in the estuary permits the determination of steady state dispersion coefficients (one dimensional) in the longitudinal direction of the estuary.

Estimation of Salinity Distribution

This analysis assumes that under conditions of constant freshwater discharge into an estuary and constant tidal range, a steady-state salinity distribution exists in an estuary. This steady-state distribution of salinity is valid when the upstream nonconvective mass transfer due to turbulent diffusion plus the upstream mass transfer due to the density difference between ocean and fresh water is balanced by the downstream convective mass transfer due to the freshwater flow.

In reality steady state is rarely achieved because of random fluctuations due to turbulent diffusion and periodic tidal fluctuations.

To begin this one dimensional analysis, the Chester River was divided into different functional segments or reaches along the mainstem length from zero to forty-one nautical miles. The average salinity in each reach was calculated from slack tide survey measurements (1980-1981) of salinity in the longitudinal direction and averaged in the vertical direction. A continuous salinity distribution function was then determined, based on the observed spatial data. This distribution can be used to evaluate the relative accuracy of existing salinity distribution models and can also yield a calibrated salinity function for Chester Estuary representing the 1980-1981 data. A large variety of spatial salinity distribution functions can be used to determine average salinity at any nautical mile. Knowing the salinity gradient at any given nautical mile, estimation and comparison of resulting steady state dispersion coefficients at any longitudinal point along the mainstem of the estuary can be made.

A theoretical solution to find dispersion coefficients using hydrodynamic equations coupled with the general diffusion equation does not currently exist. Currently, various proposed and published models are based on a compromise between the observed values and simplified forms of the diffusion equation. Some of the simplistic solutions for commonly used models have been applied to data taken during this study and evaluation of each model relative to the available data is presented. The calibrated salinity functions define the salinity variation in the longitudinal direction. These functions are used to estimate and compare dispersion coefficients.

Application of the Error Function Model

The steady state solution of the one dimensional turbulent diffusion equation is the standard error function (1) which is a Gaussian function related to the longitudinal spatial distance along the estuary. This function is generally represented by

$$S = f\ (S_o,\ e^{-kx^2}) \qquad (4\text{-}29)$$

where k = estuary coefficient determined from suitable boundary and initial conditions, S = Salinity at any given river mile, S_o = Boundary salinity at mouth, x = Distance of a section/reach in nautical miles measured upstream from the mouth of the estuary.

A steady-state solution (1) of the one dimensional turbulent diffusion equation gives a Gaussian function for the salinity profile measured from the mouth of the estuary,

$$S/S_o = \exp[(-U_f/2BE_o)(x + B)^2] \qquad (4\text{-}30)$$

For the Chester Estuary the average salinities for 1980-81 at two points along the length are given by,

S = salinity at any given nautical mile

S_1, S_2 = salinities at two points along the estuary

$S_o = S = (S_{min} + S_{max})/2$ or an estimated value of salinity at the mouth of the estuary (bay boundary)

x = Distance of section from mouth of estuary measured upstream

x_1, x_2 = Distances measured from mouth of Chester Estuary upstream

B = Theoretical distance from mouth in opposite direction (downstream)

E_o = Dispersion coefficient (estimated at the bay boundary)

U_f = Estimated fresh water velocity

Calculations of constants S_o, B, E_o, U_f are needed for Chester Estuary to determine the dispersion coefficients. These constants are evaluated for the Chester River in the following section. $S_o = 11.57$ (assuming this is the annual, vertically averaged value of salinity at the mouth of the estuary, observed at station 51 during 1980-81)

Rewriting equation 4-30 for two points along the mainstem of the river gives:

$$\ln S_1 - \ln S_2 = (U_f/2BE_o)\,[(x_2 + B)^2 - (x_1 + B)^2] \qquad (4\text{-}31)$$

where: $$E_o = U_f\,[(x_2 + B)^2 - (x_1 + B)^2]/[2B\ln(S_1/S_2)] \qquad (4\text{-}32)$$

and:

$\ln S_2 - \ln S_o = -(U_f/2BE_o)(x_2 + B)^2$ Applying equation (4-30) to two points at $x = 0$ and $x = x_2$ respectively one obtains:

$$\ln S_o/S_2 = (U_f/2BE_o)(x_2 + B)^2 \qquad (4\text{-}33)$$

$$E_o = U_f(x_2 + B)^2 \,/\, 2B\ln(S_o/S_2) \qquad (4\text{-}34)$$

Dividing equation 4-32 with equation 4-34 and rearranging terms,

$$\ln(S_1/S_2)/\ln(S_o/S_2) = [(x_2+B)^2 - (x_1+B)^2]/(x_2+B)^2 \qquad (4\text{-}35)$$

Equations 4-34 and 4-35 can be solved for B and E_o and used for salinity profile evaluation. From Chester River data the following values were obtained:

S_o = 11.57 parts per thousand (ppt)

x_1 = 5.5 nautical miles (33418 ft)

x_2 = 28.0 nautical miles (170128 ft)

$S_1 = 11.57 \text{ ppt} = S_0$

S_2 = 5.04 ppt

$\ln(1157/5.04)=0.3101$

$$U_f = \overline{Q}/A = \frac{361.9}{84107.8889} = 0.004303 \text{ fps}$$

where:

$\overline{Q}$ = average annual discharge into Chester River Watershed in cubic feet per second (cfs) based on 28 year records from observations at Morgan Creek and extrapolated to the basin

A = Average cross-sectional area = 84107.889 ft^2 (from nautical chart data.)

From equation 4-35: B = -5.5 nautical miles = -33418 feet

x_2 = 28 nautical miles = 170128 feet

From equation 4-34: $$E_o = \frac{.004303(170128-33418)^2}{2(-33418)(0.8310)} = -1447.956 \text{ ft}^2/\text{sec}$$

From equation 4-30: $$S = S_o \exp[(-U_f/2BE_o)\ (x + B)^2] \qquad (4\text{-}36)$$

Substituting constants obtained for Chester River in this equation yields:

$$S = 11.57 \exp\left[\frac{(-.004303)(x - 33418)^2}{2(-33418)(-1447.956)}\right]$$

The final simplified form of the salinity profile for steady state estimation for the Chester Estuary using the Error function is:

$$S = 11.57 \exp\ [-4.4464 \text{ E-11 } (x-33418)^2] \qquad (4\text{-}37)$$

where: S = salinity at any given nautical mile x

In this analysis, 5.5 x 41.0 (i.e. Salinity values between mouth (0 miles) and 5.5 miles are assumed constant and equal to 11.57 ppt). Conversions of "X" should be made from nautical mile to feet.(6076 ft/nautical mile)

Salinity Distribution Using O'Connor's Relation

O'Connor (3) gives a method for estimating the Salinity profile equation for a variable area estuary, by the following:

$$S = S_o \exp\ [(-U_o/E_oa)\ (e^{ax} - 1)] \qquad (4\text{-}38)$$

where: S = salinity at any section x

x = distance measured in nautical miles from the mouth (positive upstream from bay boundary)

a = coefficient for areal expansion (exponent) for a variable area estuary (nautical mile $^{-1}$)

S_o = salinity at mouth of the estuary (ppt)

E_o = dispersion coefficient at mouth of the estuary (ft^2/sec)

U_o = average fresh water velocity at the mouth of the estuary=Q/A_o

For the Chester estuary S_o = 11.57 (salinity at the mouth of the estuary), A_o = 428796 sq. ft. (cross-sectional area from nautical chart data at the mouth of the estuary), therefore:

$$U_o = \frac{\overline{Q}}{A_o} = \frac{361.9 \text{ cfs}}{428796 \text{ ft}^2} = .000844 \text{ fps}$$

Substituting U_o into equation 4-38 gives:

$$S = 11.57 \exp \left[(-\overline{Q}/A_oE_oa)\ (e^{ax} - 1)\right] \tag{4-39}$$

Defining S_1, S_2 as in the previous section from field data gives:

$S_1 = 11.57$, $x_1 = 5.5$ nautical miles

$S_2 = 5.04$, $x_2 = 28.0$ nautical miles

and rewriting equation 4-38 for sections 1 and 2 gives:

$$S_1 = S_o \exp \left[\frac{-U_o}{E_oa}\ (\exp(ax_1)-1)\right] \tag{4-40a}$$

$$S_2 = S_o \exp \left[\frac{-U_o}{E_oa}\ (\exp(ax_2)-1)\right] \tag{4-40b}$$

These two equations can be used to estimate the dispersion E_o at the mouth. Equations 4-40a and 4-40b are combined to give:

$$S_1/S_2 = \frac{\exp \left[\frac{-U_o}{E_oa}\ (\exp(ax_1)-1)\right]}{\exp \left[\frac{-U_o}{E_oa}\ (\exp(ax_2)-1\right]} \tag{4-41}$$

As calculated from the Chester Estuary Morphological analysis, the cross-sectional area can be expressed as a function of nautical miles (see equation 4-11). The cross-sectional area versus nautical mile regression (using nautical chart data) gives:

$$A=81545 \exp(-.141909675X) \tag{4-42}$$

where:

x = distance measured in nautical miles from the mouth (positive upstream from bay boundary)
a = -.14190975 (nautical mile $^{-1}$)
A = Cross-Sectional area at any nautical mile 'x' (yd^2)

Substituting appropriate values into equation 4-41 gives:

$$\frac{11.57}{5.04} = \frac{\exp\left[\left(\frac{-.000844(6076)}{E_o(-.14190975)}\right)\left(\exp^{-.14190975*5.5}-1\right)\right]}{\exp\left[\left(\frac{-.000844(6076)}{E_o(-.14190975}\right)\left(\exp^{-.14190975*28.0}-1\right)\right]}$$

$$2.296 = \exp\left(\frac{-19.580}{E_o}+\frac{35.457}{E_o}\right)$$

$$E_o = 19.1 \text{ ft}^2/\text{sec.}$$

Substituting the values of U_o, E_o, a and S_o into equation 4-39 gives:

$$S = 11.57 \exp\left[\left(\frac{-.000844(6076)}{19.1(-.14190975)}\right)\left(\exp^{-.14190975\ x}-1\right)\right]$$

Simplifying one obtains the relation:

$$S = 11.57 \exp\left[\left(\bar{Q}/191.284\right)\left(\exp^{-.14190975\ x}-1\right)\right] \tag{4-43}$$

Equation 4-43 is O'Connor's equation for estimating the longitudinal steady state salinity distribution in the Chester Estuary

Salinity Best-Fit Equation

The observed temporally and spatially averaged salinity values were regressed versus nautical miles to obtain a least squares function. The correlation coefficient from the least squares regression and the estimated boundary salinity values were used to determine the best fit functional model. Seventeen linearizable functions were regressed, each using the salinity and nautical mile data obtained during this study. The BMDP Statistical linear regression program (BMDP-6D) was used.(26) Table 4-4 is a list of the mathematical functions used for Salinity versus nautical mile regression and the corresponding correlation coefficient (r^2).

The reason for conducting the regression analysis was to obtain a statistically derived function based upon the squared correlation coefficient and to estimate a better fit for the observed average slack water salinity profile in Chester River.

Based on Table C-4-4, the following best equations based on the optimized maximum correlation coefficient are presented below.

(a) Polynominal Type: $S = ax + b$ from (1)$r^2 = .9293$

$S = ax^2 + b$ from (5)$r^2 = .9781$

$S = ax^3 + b$ from (7)$r^2 = .9448$

$S = ax^{2.5} + b$ from (9)$r^2 = .9663$

$S = ax^{1.9} + b$ from (11)$r^2 = .9801$

$S = ax^{1.8} + b$ from (16)$r^2 = .9801$

The best fit is either $S = ax^{1.8} + b$ or $S = ax^{1.9} + b$. The intercept "b" will decide the best value at x = o,

$S = ax^{1.8} + b$ gives $S_o = 12.44$

$S = ax^{1.9} + b$ gives $S_o = 12.26$

therefore the best fit polynominal, is with

$S_o = 12.26$ and a=-0.01077, b=12.262 based upon estimating the salinity at the mouth of the estuary more accurately.

(b) Error function type:

$\ln S = ax^2 + b$ from (6), $r^2 = 0.9025$

$\ln S = ax^3 + b$ from (8), $r^2 = 0.9722$

$\ln S = ax^{2.5} + b$ from (10), $r^2 = 0.9448$

The best fit error function is $S = B\,e^{ax^3}$, $B = e^b$, with $S_o = 15.03$ (very high). Thus salinity predicted at the mouth is higher than the supporting data from the slack surveys.

(c) Logistic curve type:

$S = 1/(b + e^{ax^2})$ from (14), $r^2 = 0.9025$

$S = 1/(b + e^{ax^3})$ from (15), $r^2 = 0.9722$

$\ln (1/S) = ax^3 + \ln b$

The best logistic curve fit is $S = 1/(b + e^{ax^3})$ with So = 15.03 which is higher than the observed average salinity at the mouth of the estuary.

From the three types of functions above, the best fit linearized function based on bay boundary salinity, and correlation coefficient and the most simplistic curve is

$$S = ax^{1.9} + b,\ S_o = 12.26,\ r^2 = 0.9801$$

The salinity profile equations, based on an average annual value of salinity for the Chester River as developed in the previous subsection (Estimation of Salinity Distribution), are summarized below:

Error Function Model:

$$S = 11.57 \exp [[-\overline{Q}(4.53558\ E{-}06)](x - 5.5)^2] \qquad (4\text{-}44)$$

5.5 x 41 (in nautical miles)

$\overline{Q}$ = average freshwater discharge at mouth in cfs for the total drainage area (cfs)

O'Connor's Model:

$$S = 11.57 \exp [(\overline{Q}/191.284) (\exp(-.14190975x)-1.)] \qquad (4\text{-}45)$$

x = distance measured from mouth upstream in nautical miles (positive)

$\overline{Q}$ = average freshwater discharge at mouth (cfs)

Tidewater Least Square Model:

$$S = ax^{1.9} + b \qquad (4\text{-}46)$$

S_o = Salinity at mouth = 12.26, a=-0.01077, b=12.262

$r^2 = 0.9801$

Equations 4-44, 4-45 and 4-46 can now be used to develop one dimensional, steady state dispersion coefficients for the Chester River. Table C-4-5 shows the salinity values calculated for Chester River by the three methods stated above.

Figure C-4-24 shows the longitudinal salinity (depth averaged) distribution obtained during the 1980 slack water surveys for reference. Figure C-4-19 shows the observed and calculated longitudinal salinity profiles from the different functions described above. Figure C-4-25 shows the salinity distributions for the error function and O'Connors function based upon changes in the percent of average freshwater inflow given constant salinity at the mouth of the estuary.

Evaluation of Dispersion Coefficients

Most tidal river and estuaries have variable cross-sectional areas, variable flow rates along the length, fluctuating discharge at a given cross section and dispersion coefficients which vary both in space and time.

However, for a steady state application, the general dispersion function (using a one dimensional analysis) is determined from the following equation.

$$E(x) = \frac{Q(x)\ S(x)}{A(x)\ \frac{dS(x)}{dx}} \tag{4-47}$$

Where $Q(x)$ = Variable freshwater discharge (cfs)

$A(x)$ = Cross-sectional area (ft^2)

$S(x)$ = Steady state salinity (ppt)

$dS(x)/dx$ = Gradient of salinity profile (ppt/ft)

$E(x)$ = Dispersion coefficient at a given location x (x = o is assumed at the mouth of the estuary) calculated from equation (4-47) (ft^2/sec)

The discharge Q, the cross-sectional area A, and the concentration of salinity S are obtained by measurement at a given location in the estuary. The salinity gradient is more difficult to evaluate since it requires extensive data in order to accurately describe the spatial profile. Measurements of Chester River salinity were obtained from eighteen of the slack tide surveys conducted during 1980-81 at nine locations along the estuary. Figure C-4-24 shows the vertically averaged salinity observations from nautical mile 5.5 to 41.0 nautical miles for each slack tide survey. Each of these values is an average obtained from three measurements taken at three points in the vertical. The spatial and temporal mean salinity were computed as shown in Table C-4-6. The quality of the observed salinity data collected is fairly uniform, shown by a fairly consistent standard deviation, both at different stations and at different times during the year.

Figure C-4-3 shows the variation of drainage area in a longitudinal direction. The drainage area for any station can be found and used to extrapolate the discharge Q(x) at that station for use in calculating dispersion coefficients. For this analysis a total discharge of 361.9 cfs for a total drainage area of 429 square miles was used. The discharge extrapolation was based on USGS discharge records at Morgan Creek.

From USGS records, the Morgan Creek average discharge is 10.7 cfs, 28 year average Q and the Morgan Creek drainage area = 12.7 square miles (3).

Based on a linear extrapolation for Chester River, the total Chester freshwater river discharge is approximately 361.9 ft^3/sec.

The average freshwater velocity (U_o) can be found for any cross-section using the Continuity equation.

$$U_o = \frac{\text{average freshwater flow at x}}{\text{Cross-Sectional area at longitudinal location x}}$$

An attempt was made to determine the time and space varying dispersion coefficients using variable cross-sectional area (longitudinally) and time and space varying salinity values. Chester River is a variable cross-sectional area estuary and the area decreases exponentially from the mouth (0 nautical miles) to upstream (41 nautical miles) as shown in Figure C-4-4. The only method which uses a variable cross-sectional area approach is O'Connor's method (2). The method has been used in discrete increments of longitudinal distance x, for applying it to the unequally spaced stations. A brief derivation of the dispersion equations presented based on O'Connor's method of areal expansion follows. This method can be used for unequally spaced stations.

Derivation of discrete step O'Connor's dispersion relation:

The basic one-dimensional equation defining the time rate of change of salinity in an estuary is stated as,

$$\frac{\partial S}{\partial t} = \frac{E}{A} \frac{\partial}{\partial X} \left(A \frac{\partial S}{\partial X} \right) - \frac{\overline{Q}}{A} \frac{\partial S}{\partial X} = 0 \text{ (for steady state)} \qquad (4\text{-}48)$$

Introducing an exponential function for cross-sectional area increasing in the seaward direction, the salinity distribution equation derived from equation 4-48 can be stated as,

$$S(x) = S_o \exp \left[\frac{-\overline{Q}}{AEa} (e^{ax} - 1) \right] \qquad (4\text{-}49)$$

Applying the salinity distribution equation to two consecutive locations (defining a reach or segment) x_1 and x_2 respectively one obtains:

$$S_1 = S_o \exp \left[\frac{-\overline{Q}}{\overline{A}E_{12}a} (e^{ax_1} - 1) \right], \qquad (4\text{-}50)$$

$$S_2 = S_o \exp \left[\frac{-\overline{Q}}{\overline{A}E_{12}a} (e^{ax_2} - 1) \right], \qquad (4\text{-}51)$$

Dividing equation 4-50 with 4-51 gives:

$$\ln(S_1/S_2) = (U_{12}/aE_{12})(e^{ax_2} - e^{ax_1}), \qquad (4\text{-}52)$$

where:

U_{12} = Average freshwater velocity between sections 1 and 2 (fps),

E_{12} = Average steady state (estimated) dispersion coefficient between sections 1 and 2 (ft^2/sec),

$\overline{Q}$ = Average freshwater discharge (cfs),

$\overline{A} = (A_1 + A_2)/2$ = Average cross-sectional area for a reach

a = Coefficient of areal expansion for estuary (nautical mile $^{-1}$)

S_o = Salinity at mouth of the estuary (ppt).

S_1, S_2 = Salinities at sections 1 and 2 respectively (ppt).

The final discrete step dispersion equation can be then written as:

$$E_{12} = U_{12}(e^{ax_2} - e^{ax_1})/[(a \ln(S_1/S_2)] \qquad (4\text{-}53)$$

Based on semi-log regression of the cross-sectional area versus nautical miles in the Chester River as mentioned earlier, the following equation was established using data (see Figure C-4-4):

$$A(x) = 733905 \exp(-.14190975x) \qquad (4\text{-}54)$$

with $r^2 = 0.9389$ and where, $A(x)$ = Cross-sectional area at nautical mile 'x' (ft^2).

The exponent of this equation is the value needed to use O'Connor's equation 4-53 with $a = -0.14190975$ (nautical mile^{-1}). Table 4-7 gives the basic data used in solving equation 4-52 for different stations by using the following equation:

$$E_{12} = K_x/\ln(S_1/S_2) \qquad (4\text{-}55)$$

Table C-4-8 shows estimated dispersion coefficients (absolute values) evaluated for each slack survey at all data stations using equation 4-55. Statistical averages and standard deviations were computed to show the excess variability of the dispersion coefficients calculated from the slack tide data. The last column gives an estimated yearly average dispersion coefficient based on annual average salinity values.

Table C-4-9 shows dispersion coefficients (absolute values) evaluated for each slack survey at all data stations where discharge values (Q) were selected from the discharge hydrograph observed at Morgan Creek for 1980-81. It was assumed that it takes a fraction of the flushing time for the salinity mixing to be completed. Average values of discharges were calculated with a time lag of seven days before the slack survey. Dispersion coefficients calculated indicate a significant change. The last column shows dispersions coefficients based on one yearly average of discharge and salinity observations using the discrete salinity/dispersion coefficient equations [see equations 4-52 and 4-53].

Dispersion Coefficient Equations

As explained by equation 4-47 of this analysis, the dispersion equation can be written as,

$$E = (QS/A)/(dS/dx) \qquad (4\text{-}56)$$

This equation can be used with different salinity functions described earlier to estimate constant area and variable area dispersion coefficients.

Table 4-7

Chester Estuary Constants Used for Calculating Dispersion Coefficients* from Slack Tide Water Quality Surveys

Miles from Mouth	Cross-Sectional Area (sq ft)	Average Fresh Water Velocity (fps)	K_x**
5.5	336257.1		
		.0012926	7.639761
8.5	219674.5		
		.0021617	11.718048
13.2	112749.8		
		.0035915	4.627758
15.0	87333.4		
		.0044055	2.580589
16.0	75779.2		
		.0064450	13.089114
21.3	35719.7		
		.0145104	16.092565
28.0	13803.3		
		.0449457	26.486484
41.0	2181.7		

$*E_{12} = U_{12}[\exp(ax_2) - \exp(ax_1)]/ a \ln(S_1/S_2)$ (as shown by eqn. 4-53)

$**K_x = U_{12}[\exp(ax_2) - \exp(ax_1)]/(a)$ therefore $E_{12} = K_x/\ln(S_1/S_2)$ (as shown by eqn. 4-55) where:

$a = (-.14190975/6076) = 2.3356 * 10^{-5}\ \text{ft}^{-1}$

Constant Area Models

Equation 4-56 can therefore be used to find constant area dispersion coefficients (E), knowing the salinity distribution (S), freshwater discharge (Q) and the cross-sectional area (A). Using the Error Function Equation for salinity where:

$$S = 11.57 \exp[-\overline{Q}(4.5678E\text{-}06)(x - 5.5)^2], \qquad (4\text{-}57)$$

and substituting:

(a) $Z = -\overline{Q}\,(4.5678E\text{-}06)(x - 5.5)^2,$

(b) $\frac{dS}{dx} = (-1.05698E - 04)(x - 5.5)\,\overline{Q}\exp(Z),$

one obtains the following function using (a), (b), and equations (4-56) and (4-57),

$$E = \frac{\overline{Q}\,(11.57)\exp(Z)}{\overline{A}\,(-1.05698E - 04)\,(x - 5.5)\exp(Z)\,\overline{Q}} \qquad (4\text{-}58)$$

Rearranging the final equation calibrated error function model for dispersion coefficients for Chester River is given by.

$$E = \frac{(109462.81)(6076)}{\overline{A}\,(x - 5.5)}, = \frac{6.65096 \exp 08}{\overline{A}\,(x\text{-}5.5)} \qquad (4\text{-}59)$$

where:

x = River miles upstream of mouth.

$\overline{A}$ = Average Cross-Sectional area (sq ft) 84107.9 ft^2
E = Dispersion coefficient (ft^2/sec).

Using O'Connors relation for the salinity distribution in Chester River or:

$$S' = 11.57 \exp\left[(\overline{Q}/191.284)(e^{-.14190975x} - 1)\right] \qquad (4\text{-}60)$$

and substituting:

(a) $Z = (\overline{Q}/191.284)(e^{-.14190975x} - 1)$, $T = -.14190975\ x$

(b) $\frac{dS}{dx} = (11.57)\ (\overline{Q}/191.284)\ (-.14190975) \exp(Z) \exp(T)$

one obtains:

$$\frac{s}{\frac{dS}{dx}} = \frac{-\ 1347.93}{Q \exp(-.14190975\ x),} \qquad (c)$$

and finally, substitution gives the dispersion coefficient function:

$$E = \frac{1347.93\ (6076)}{\overline{A} \exp(-.14190975\ x)} = \frac{-8190008}{\overline{A} \exp(-.14190975X)} \qquad (4\text{-}61)$$

Using the least squares Tidewater Polynomial Model for salinity or:

$$S = 12.262 - 0.01077\ x^{1.9},$$

and differentiating:

$$\frac{dS}{dx} = (-0.01077)(1.9)\ x^{0.9} = -0.020463\ x^{0.9} \qquad (4\text{-}62)$$

substituting into equation 4-56 yields:

$$E = \frac{\overline{Q}\ [12.262 - 0.01077\ x^{1.9}]}{\overline{A}\ [-0.020463\ x^{0.9}]} \qquad (4\text{-}63)$$

simplifying one obtains:

$$E = \left[\frac{48.86869\ Q}{\overline{A}}\right]\left[\frac{12.262}{x^{0.9}} \quad -0.01077\ X\right](6076), \qquad (4\text{-}64)$$

where for the Chester Estuary $\overline{Q}$ = 361.9 ft^3/sec average annual discharge and the average cross-sectional area $(\overline{A})$ is 84108 ft^2.

Variable Area Models

Using the regressed cross-sectional area and nautical mile relation based on bathymetric data, one obtains:

$$A = 733905 \exp(-.14190975\ x) \tag{4-54}$$

where: A = cross-sectional area (ft^2)

The general expression for area is substituted into the basic dispersion equation (13) to give an area-variable dispersion relations as given below.

For the Error function model:

$$E = \frac{(109462.81)(6076)}{733905\ (x - 5.5) \exp(-.14190975\ x)}\ ,$$

and simplifying gives:

$$E = \frac{(906.24)}{(x - 5.5) \exp(-.14190975\ x)}\ , \tag{4-65}$$

For O'Connor's Model:

$$E = \frac{-1347.93(6076)}{733905\ e^{-.28381950x}}\ ,$$

and simplifying:

$$E = \frac{-11.1595}{e^{-.2838195x}}\ , \tag{4-66}$$

Tidewater polynomial model substitution gives:

$$E = \frac{\overline{Q}\ (12.262 - 0.01077\ x^{1.9})}{733905 \exp(-.14190975\ x)(-.020643\ x^{0.9})}$$

and simplifying one obtains:

$$E = \frac{\overline{Q}\ (6076)}{15017.898 \exp(-.14190975\ x)} \left[\frac{12.262}{x^{0.9}} - 0.01077\ x\right] \tag{4-67}$$

Figure C-4-26, a graphical presentation of the calculated dispersion coefficients for the Chester Estuary, is derived from the constant cross-sectional area models described above. Figure C-4-27 is the dispersion coefficients estimated from the Tidewater least squares regression equation for the salinity function with various average freshwater discharge rates (Q). Obviously, the dispersion coefficient is a function of Q. Figure C-4-28 shows the calculated dispersion coefficients using the variable cross-sectional area models derived above. The derivations of these three models vary considerably. Figure C-4-29 shows the Tidewater least squares dispersion function changes with various values of freshwater inflow (Q).

The calculated values are quite different as expected. Future work should involve the application of these values in a computer simulation of one dimensional transport in order to show which model provides the best fit between observed and simulated salinity with time varying inflow.

In addition, the Tidewater least squares model does indicate that dispersion is great in the region of the expected turbidity maximum of the estuary. This same river region (of predicted higher dispersion) coincides with the region where Figure C-4-20 indicates there is maximum mixing of fresh and salt water (i.e., 50% salt and freshwater) and where the slope of the salinity gradient is maximum. Evaluation of these dispersion coefficients in a transport model would enable some verification if the polynomial form of the dispersion equation is a better approach. It should be noted that Ambrose 1980 performed a time varying model calibration for the Chester Estuary using (WASP) a net advective simulation model(20). His reported dispersion coefficients ranged in the same magnitude as the average values calculated and shown in Tables C-4-10 and C-4-11. His work would indicate that the dispersion coefficients using a constant area or variable area function, as described above, produces considerably higher values. Boicourt, 1981 (personal communication), indicated that other mass transport studies have indicated the lack of model sensitivity to longitudinal dispersion coefficients and that vertical dispersion is a more important process controlling the salinity distribution in an estuary. In fact, Boicourt reports that changing the longitudinal dispersion coefficient by a factor of 100 or more made very little difference in the salinity distribution calculated for the Patapsco Estuary.

Section 5

Sources of Nitrogen and Phosphorus to the Chester River

The purpose of this section was to estimate the major sources of nitrogen and phosphorus entering the Chester Estuary. Each source was transformed into a mass load to form a mass balance box model. The box models characterize magnitude of the various source loads to the Chester River and provides an initial screening tool for water quality management. The Chester River is also a good example of an eastern shore river on the Chesapeake Bay, and the box models provide insight into nutrient cycling present there.

Description of Sources

A major task in developing the box models was to organize a consistent time frame for all the input data. The data collected during May through September 1981 was selected for the time frame. The inputs (NPS, average fluvial discharge, point source, rainfall, sediment flux and the Chesapeake Bay) were the sources used for the box model during the stated five month period. There was inadequate data to conduct the sediment flux and rainfall quality computations and assumptions were made in order to estimate their loads.

Sediment flux loads were computed from data obtained from reference 27. This report included data taken near the mouth of the Chester River. The spring and summer values were averaged. Because section CB-3 only had data for ammonia and orthophosphorus, the values for NO_2+NO_3 and TN were computed by taking 3.6% and 55% respectively of the ammonia flux. These percentages were present for the Patuxent River (28) and it was assumed that the Chester had these same sediment characteristics. There was no data concerning the water quality of the rain water for the Chester Basin during 1980-1981. Therefore the loading rates developed for the Patuxent Basin were used (28).

Other inputs include point and non-point sources, average fluvial discharges and the net exchange with the Bay. Loading rates from point sources were computed from concentrations and flows reported in section 3. For STP's where data was not available average concentrations and flows were obtained from EPA-CBP. The NPS calculations used loading rate from section 6. Average fluvial inputs were computed from measurement made at fifteen advective flow stations. Advective flow measurements were collected by Normandeu Associates Inc. for this study (11). Physical characteristics such as drainage area, water surface area, estimates of sediment surface area and river volume were obtained from section 4. The equation describing the net exchange with the Bay was developed by assuming a two flow condition near the mouth of the Chester River and using salinity as a conservative constituent (28).

$$(S_B)(Q_B) = (Q_T + Q_B)(S_T) \qquad (5\text{-}1)$$

where: Q_T = fluvial flow (cfs)
Q_B = Chesapeake Bay flow into Chester (cfs)
S_T = Average surface salinity
S_B = Average bottom salinity

The equation was rearranged to calculate the unknown flow coming in from the Chesapeake Bay. The salinity values were taken from the 1981 averages at station XHG1537 which was 5.5 nautical miles from the mouth.

therefore: $Q_B = (Q_T\ S_T)/(S_B - S_T)$

The averaged values for N and P at the surface and bottom were multiplied by the surface and bottom flows respectively to calculate the mass loads.

Nitrogen and Phosphorus Budgets

The five nutrients analyzed for mass loading to the Chester River were total dissolved nitrogen, dissolved nitrite & nitrate, dissolved ammonia, total dissolved phosphorus and dissolved orthophosphorus. The major source of NO_2+NO_3 to the Chester River was fluvial input, primarily during storm events (Figure D-5-1). Fluvial sources were estimated to be 270,000 pounds of NO_2+NO_3 into the Chester River from May to September 1981. The mass balance model indicates a large portion of this input was flushed out into the Chesapeake Bay (110,000 pounds). Rainfall was another significant source of NO_2+NO_3 to the Chester River. Rainfall may supply 13.2% of the total budget. Inputs from sediment flux and point sources were negligible.

The three major sources of ammonia were fluvial input, sediment flux and the Chesapeake Bay adding 38.1%, 31.0% and 29.4% respectively (Figure D-5-2). Ammonia appears to be the only major nitrogen source coming from the Bay. This source may be due to the sediment release of ammonia from the Chesapeake Bay. If this is the case, then the source from the Bay is actually a sediment source.

Figure D-5-3 shows most of the total dissolved nitrogen load into the Chester comes from fluvial discharge. From the 1,257,000 pounds of nitrogen inputted from freshwater runoff, 229,000 pounds were lost to the Chesapeake Bay. Therefore approximately 18-20% of the total nitrogen loaded into the Chester is flushed into the Bay.

In summary, of the three nitrogen budgets, the major source of nitrogen to the Chester River comes from fluvial discharge (NPS and average freshwater inflow). Most of this fluvial input is in the form of nitrates and organic nitrogen. Some of the fluvial nitrogen is flushed out into the Chesapeake Bay. The sediments eventually releases nitrogen in the form of ammonia which is a readily available nutrient for phytoplankton. Of the gross amounts inputted to the Chester during the five month budget, 28%, 75% and 46% of NO_2+NO_3, NH_4 and Total Diss. N respectively was utilized within the aquatic ecosystem.

Figure D-5-4 showed fluvial inputs contributed 76% of the dissolved ortho-phosphorus loaded in the Chester River. Most of the fluvial input occurred during storm events. The next largest source of ortho-phosphorus was the sediment flux at 20.8%. The net exchange with the Bay showed there was no flushing of ortho-phosphorus out of the Chester. This budget was similar to NH_3 which also had a source from the Bay and a large sediment flux.

The total phosphorus budget indicated freshwater runoff (avg. flow and stormflow) contributed 439 thousand pounds to the Chester River (Figure D-5-5). The box models indicates 108 thousand pounds or around 25-30% of its TP load is flushed into the Chesapeake Bay. Total phosphorus concentrations were dependent on the hydrological condition (fluvial runoff) and therefore fluvial input is a major controlling factor in the phosphorus budgets.

Freshwater runoff is high in composition of suspended material. Since TP is attached to sediments, controlling erosion would also control excessive loading of nutrients to the Chester River. This is especially important for the Chester Basin because the land use is primarily agricultural.

Section 6

Non-Point Source and Meteorological Sub-Watershed Monitoring

This section describes the monitoring of chemical export from nine subwatersheds draining into the Chester River. A description of each site is provided, and statistical results are presented that describe estimated loading rates and relationships between rainfall and non-point source loads.

Subwatershed Site Description

Nine watersheds were selected for monitoring chemical export during storm events. All sites lie in the Coastal Plain Province. Figures 2-10 and 2-11 show the location of the watersheds and raingauges used in this study.

Table E-6-1 shows the relevant characteristics of the two urban sites, Chestertown A and B. The sites are adjacent to each other on either side of U.S. 213. The impervious area was calculated as the sum of the total street acreage plus the estimated total house and driveway area, plus an estimated amount of miscellaneous impervious area. The area weighted hydrologic soil group was 3.1 for site A and 2.83 for B. Therefore these sites represent hydrologic soil group C.

Millington A and B are both forested sites. Table E-6-2 gives a breakdown of their respective acreage, landuse, etc. Although 25% of the Millington A site acreage consists of old field and grassland, neither of these sites has been farmed for the last 20-30 years. Both are representative of forested areas and may be used for comparative purposes.

The agricultural sites studied are named Perkins Hill (USGS GAGE), S Farm, Browntown Road, H Farm, and Still Pond Farm. The main crops grown on the various farms in the Perkins Hill watershed are field corn and rye. Approximately 8% of the land at this site is forested. Table E-6-3 gives land characteristics for all the agricultural sites.

The S-Farm agricultural site was predominantly cultivated with field corn and soybeans. The Browntown Road site was predominantly field corn. The H-Farm was cultivated for no-till corn and the Still Pond site was minimum till field corn. Table E-6-4 shows the STORET station codes and the basin size for each subwatershed.

Statistical Summary of Measured Chemical Export

This section describes the methodology used to characterize the chemical export of water quality variables from the various watersheds described above. A total of 189 storm samples were analyzed in order to determine the flow weighted concentration for each of the 15 variables studied. Storm loads for each storm event were then calculated by multiplying concentration times the storm volume. Resulting loads were normalized to the size of storm (inches of rain) and size of watershed (acres). Univariate statistics were calculated and are shown in the Appendix (Tables E-6-5 to E-6-39) as lb/acre/inch of rain, lb/acre and lb/acre/year (assuming an average of 42 inches of rain per year).

The number of storm samples taken at each site during this study were: Millington A-22; Millington B-26; USGS Gage-27; Chestertown A-31; Chestertown B-27; S Farm -33; Browntown Road -15; H Farm -3; and Still Pond Road -5.

The data collected during this study period indicates that chemical export from agricultural sites is generally higher than forested sites. Table E-6-40 shows the ratio of the average lbs/acre/in between these site groupings. It should be noted that in May of 1981 there were several large storms at S Farm from which unusually high concentrations (mg/l) of TSS, TPHOS, TPHOSD, and DPO_4 were observed. The reader must keep in mind that only 19 values were recorded in conjunction with rainfall data for this variable, thus its significance is questionable. Table 6-41 shows similar ratios between the agricultural and urban sites.

Figures E-6-1 to E-6-14 are cumulative frequency distribution plots of all the variables (lbs/acre) in this study. Values from all sites (forested, urban, and agricultural) are compared to each other in these plots. Each point on the plots does not represent an observation from a single storm event, but a value that the variable has taken on one or more times. Mention has already been made of the fact that several very large concentrations of phosphorus were observed at S Farm. Removal of these values from the data set at plotting time was necessary to make the figures meaningful. These plots indicate that, in general, the measured lbs/acre chemical export for each land use varies substantially, especially during larger storm events which occur less frequently.

Figures E-6-15 to E-6-17 are cumulative frequency distribution plots of the rainfall data. In general, urban sites experienced less rainfall/storm than the other sites but the rainfall intensity was higher. The forested sites received less intense rainfall during the study period. Figures E-6-18 through E-6-21 show the cumulative frequency distributions for all sites for lbs/acre export during storm events. Figures E-6-22 through E-6-25 indicate the cumulative frequency distribution of chemical export in lbs/acre/inch of rain. The greatest differences between sites occurred for dissolved and orthophosphorus when the data are analyzed in this fashion.

Statistical Relationships

Least square linear regression was applied to the chemical export and rainfall data. Chemical variables (lbs/acre/in.) were regressed versus storm flow (gallons) for each site individually as well as for the various site groupings. Logarithmic transformations were applied to the dependent and independent variables. Selected equations are presented in Table E-6-42 for each of the chemicals. Equation selection criteria throughout this study was based on the highest correlation coefficients (r). There are no equations shown for Still Pond Road or H Farm because of limited number of observations. When all sites are combined for regression, the correlation coefficient is less than the correlation between lbs/acre/in. versus gallons of storm flow. This is probably a result of site specific characteristics of the channel, land use activity and resulting differences in overland subsurface flow regimes. These equations could be used to estimate loads (lbs/acre/in) based upon knowledge of storm volume at a site, however the user must be continued.

Regression was also applied to the calculated lbs/acre (dependent variable) chemical export versus various linear combinations of total rainfall, average storm intensity (in/hour) and maximum storm intensity (in/hour)). Selected logarithmic transformations were also taken before regression. The best equations are shown in Table E-6-43. BOD5 regression coefficients (r) were high at the two urban sites and at S-Farm and the USGS sites (r's ranged from 0.9 at S-Farm to 0.58 at Chestertown B). In most cases BOD5 correlations were highest when the independent variables were total rainfall (inches) and maximum intensity (inches/hour). In general, this multiple curvilinear regression analysis indicated higher r's at the S-Farm and USGS site for all chemicals. These two sites were the only sites where continuous base flow occurs. This regression analysis also indicates that at these two sites total rainfall and rainfall intensity explains approximately 60-90% of the variability of the storm loads measured in lb/acres depending on the water quality variable. Phosphorus species, total suspended solids and BOD5 loads (lbs/acre) were the variables which showed the highest correlation among all sites.

Lbs/acre (dependent variable) chemical export was regressed versus total storm volume (gallons) and with linear combinations of other factors that normalized flow to the size of the watershed and/or size of the storm event. The result of this analysis is shown in Table E-6-44.

Comparison of these regression results reveals that BOD5 and BOD30 are strongly dependent upon storm flow. Highest correlations were obtained when (lbs/acre) values were regressed versus storm volume, i.e., r's ranging from 0.82 to 0.98. Total suspended solids also show similar high correlations. It is interesting to note that, while (lbs/acre/in) versus gallons showed fairly high correlations for most stations, low r's were obtained when data from all sites by land use type was combined, thus indicating site specific dependence. Lbs/acre versus storm volume regressions for all sites showned no similar pattern. NO_2 and NO_3 are regression equations with less significance due to small degrees of freedom. This regression analysis with associated transformations of the independent variables produced the highest correlation coefficients as expected.

Multiple curvilinear regression techniques were applied to chemical export (lbs/acre) with independent variables of chemical export of other chemicals and rainfall variables. Correlations (r) higher than .9 were not uncommon. The results of this regression analysis supports the view that flow weighted composite sampling of storm events for estimating watershed chemical export is a very useful method of collecting data for developing statistically derived functions for estimating lbs/acre chemical export from watersheds.

Selected multiple stepwise linear regressions, based upon Mallows Cp criterion, (see BMDP, P9R, 1979) indicated that for every function selected, total rainfall, maximum storm intensity or average intensity was one of the first variables selected, thus indicating higher correlation. All multiple regression coefficients were very high (most were above $r^2=0.95$), which again indicates utility of applying the sampling methods used in this study. Appropriate transformation of the data made little difference upon the variables selected and r^2's. Table E-6-45 shows the results of this analysis. Table E-6-46 shows similar results with lbs/acre versus rain or storm characteristics (total rainfall, average and maximum intensity) plus two easily measured parameters, suspended solids and alkalinity. Again, these equations indicate the ability to estimate chemical export from watersheds given a flow composited sample and analysis of the sample for total suspended solids, alkalinity and the storm characteristics.

Section 7

Description of Longitudinal Slack Survey Results

Twenty-seven slack water surveys were conducted from 7-7-80 to 9-27-80. The nine slack stations along the Chester River ranged from nautical mile 5.5 (XHG1537) to 41.0 (CYR0004) and are shown in Figure 2-6. All the stations were in the mainstem of the river except for XHG6094 (at 15.5) which was located at the mouth of Langford Creek. Langford Creek is the largest tributary to the lower Chester River. Each nutrient parameter was plotted against nautical mile for every survey date. Temperature, salinity, pH and DO were measured at surface, middle and bottom depths. These plots show the change in concentration longitudinally, with depth and seasonal variability. The plots assume that station XHG6094 is in the mainstem of the river and it is interesting to note the changes in nutrient levels at this station.

Figures F-7-1, F-7-2 and F-7-3 show the 1980 and 1981 averages of the salinity profiles. Salinity was near detection limits at the most upstream station, at nautical mile 41.0. The rate of change of the longitudinal salinity profile is fairly stable in the lower reach of the estuary; however above nautical mile 21.3 (XHH8354) a large drop in salinity was observed. Another major decrease was present between nautical mile 28 (XIH2463) and 41 (CYR0004) in the tidal fresh region. When individual slack survey data are plotted at various depths (Figure F-7-4) the largest stratification is observed in the lower estuary. Bottom waters show higher salinity values with the exceptions occurring on April 8, 1981 and July 24, 1981. Therefore the Chester estuary has a net seaward flow in the surface layer and a net landward flow in the bottom layer as expected. The higher surface salinities may have been due to a possible upwelling or three layer flow patterns. While salinity is controlled significantly by tidal action, the dominance of advective and diffusive mixing processes are seen between nautical mile 21.3 and 41.0 where stratification decreases. Looking at the seasonal trends in salinity it is noted that lower salinity values were observed during the summer months of June and July. Averages for these months were 6.9 - 8.5 ppt while the overall average was 9.4 ppt.

Figure F-7-5 shows the temperature profiles of the river. The largest stratification between the surface and bottom layers is in the lower estuary except between nautical mile 15-16 where Langford Creek enters the Chester. Langford Creek's outflow causes greater mixing between surface and bottom waters and may reduce stratification in this shallow region of the lower estuary. Late spring and early summer surveys show the largest temperature stratification. By August the temperature stratification is negligible. The estuary stayed thermally stable until September. The average temperature of the Chester was 19.51 ± 7.749°C during the study period.

Turbidity (FTU) plots can be seen in Figure F-7-6. Turbidity was measured for only 8 of the 27 survey dates. These plots indicate a turbidity maximum region near nautical mile 28.0 (XIH2463). The turbidity maximum zone can also be verified by the suspended solids (Figure F-7-7) and the secchi disc (Figure F-7-8) plots. A bottom sediment sill also occurs at this location. The overall slack mean value for suspended solids was 56.92 mg/l. The longitudinal maximum average occurred at nautical mile 28.0 (X1H2463) and the minimum average occurred at mile 5.5 (XHG1537) with 127.8 mg/l and 40.3 mg/l respectively. At various times between August and December of 1980 the Chesapeake Bay may have been a source of suspended solids because increased levels were present at XHG1537 (5.5). Secchi disc measurements are low in the turbidity maximum region especially during the months of July and August.

The DO plots are shown in Figure F-7-9. As expected, dissolved oxygen concentrations are low during the summer with a large difference between the surface and bottom values. The surface values stay around 8 mg/l while the bottom values go below 1-2 mg/l and reach values near zero on several occassions. The lowest bottom concentration was observed on July 22, 1981 (0.20 mg/l). The low DO levels observed during the summer of 1981 coincide with a period of low freshwater discharge reflecting little rainfall. It is interesting to note the Langford Creek station DO. Little or no stratification is seen there and DO is generally higher. Average DO levels were 8.64 ± 2.56 for 1980 and 7.61 ± 2.76 for 1981. Dissolved Oxygen Saturation profiles are shown in Figure F-7-10. Bottom waters show DOS falling to 15% during the summer. The mean value for DOS was 87.82 ± 17.37% during the study period. During the May 29, June 28, July 9, 24 and 27, 1981 slack surveys DOS reached above 150% at various locations in the estuary. The May 29 survey was preceded by a large storm event around May 16-17. On June 26, 1981 the largest mean daily freshwater inflow for the year was recorded at the Morgan Creek USGS station. On June 28 the DOS was above 160% around mile 21. On July 5 a storm event occurred and on July 9 DOS was above 150% in the lower estuary. These measurements indicate slugs of highly productive nutrient rich waters travel through the system in response to storm events. On July 24 and 27, 1981 supersaturation (DOS of 150-180%) was observed in the lower estuary and upper river following a 20 day period of extremely low flows following the storm event. Thus, low flow periods may also result in supersaturated DO in the lower estuary surface waters and extremely low DOS in bottom waters.

The BOD_5 plots are presented in Figure F-7-11. Biochemical Oxygen Demand does not show a consistent longitudinal trend for the Chester River. During 7-7-81, 7-10-81 and 7-16-81 the BOD levels are high in the lower portion of the Chester and decrease up the river. The other dates, however, tend to show a trend of increasing BOD values in the upper Chester.

The average profile of the river indicates a slight peak at Langford Creek (XHG6094) and higher BOD values at the headwaters of the river (C4R0004) with an average BOD of 2.88 mg/l and 3.86 mg/l respectively. The mean BOD_5 concentration was 2.75 ± 1.70 mg/l. In Table F-7-2 the highest BOD were obtained in April and August. This is also true for chlorophyll-a. Longitudinally, chlorophyll-a was higher at the upper stations.

Limited plots for BOD_{20} and BOD_{30} are available (Figure F-7-12 and F-7-13). No general trend towards higher values was observed in the upper river. BOD_{20} and BOD_{30} mean values were 4.83 ± 1.72 mg/l 5.0 ± 1.74 mg/l respectively.

The pH longitudinal plots can be seen in Figure F-7-14. The average profile of the river (Table F-7-4) shows a peak at nautical mile 15.5 (XHG6094, Langford Creek) of 7.58 ± 0.41. The pH gradually decreases in the mainstem of the river on either side of Langford Creek. The upper and lower river have greater variation, while the middle river is more stable. It is not uncommon for pH to drop below 7 and sometimes below 6 pH units.

TKN is a chemical analysis to determine the total organic nitrogen plus ammonia present in the river (Figure F-7-15). At the turbidity maximum zone (XIH2463) a peak was observed. The average concentration for all surveys was 0.7045 ± 0.3911 mg/l. Filtered TKN (Figure F-7-16) is the concentration of the dissolved components of organic nitrogen and ammonia present in the river. There was not a peak at nautical mile 28.0 (XIH2463). This indicates that the peak observed in total TKN may have been in particulate nitrogen. Plots of total particulate nitrogen substantiate this fact. The mean value for filtered TKN was 0.6717 ± 0.2467 mg/l.

Total organic nitrogen and dissolved organic nitrogen are shown in Figure F-7-17 and Figure F-7-18 respectively. Mean concentrations for dissolved organic nitrogen was 0.584 ± 0.246 mg/l. During late spring through summer organic nitrogen concentrations on the average were higher, especially in the lower river. This is probably due to higher productivity in the river during the summer, causing more organic matter to be present. The source during this time is the Chesapeake Bay. On the other hand, upper river values increased during early spring. This is possibly related to winter thaw and increased land runoff contributing sources of detrital matter to the estuary.

Total and dissolved inorganic nitrogen represent the sum of ammonia, nitrite and nitrate (Figures F-7-19 and F-7-20). During the study period dissolved inorganic nitrogen was greatest at nautical mile 41.0, the last station in the upper river (1.22 ± 0.90 mg/l). The minimum mean value of dissolved inorganic nitrogen was at Langford Creek (0.13 ± .14 mg/l). This is close to a ten fold difference in longitudinal minimum and maximum of the river. Inorganic nitrogen levels appear to be dependent on advective flow to the estuary. Where the estuary is wider and dilution is greater the concentrations are low. During the survey dates of 7-22-81, 7-27-81, 8-6-81 and 8-20-81 the plots show inorganic nitrogen higher in the lower estuary. During this period rainfall was very low and freshwater discharge was low slow. It could be inferred that little inorganic nitrogen was input to the upper section of the river and the inorganic nitrogen has gradually moved down to the lower river, or it could be suggested that during low flow conditions the Chesapeake Bay is a source of inorganic nitrogen to the Chester.

Total and dissolved ammonia longitudinal profiles are shown in Figures F-7-21 and F-7-22. There are generally higher concentrations in the upper river with river maximums occurring near or at the turbidity maximum zone (survey dates 3-11-81, 4-8-81 and 5-29-81). This could be due to an increase in breakdown of detrital organic nitrogen which is dominantly present in the upper river during the spring or to sediment fluxes. The lower estuary had higher concentrations for survey dates 7-22-81, 7-27-81, 8-6-81 and 8-20-81 during low flow conditions. Again indicating the Bay serves as a source of nutrients during low flow conditions. Mean values for total and dissolved ammonia are 0.044 ± 0.036 mg/l and 0.088 ± 0.083 mg/l respectively.

Total and dissolved nitrite longitudinal plot shown in Figure F-7-23 and F-7-24 follow along the same patterns as inorganic nitrogen. Peaks at nautical mile 28.0 (XIH2463) are observed for March 11, 1981 and April 8, 1981. The increased freshwater input to the upper estuary during the spring could cause these higher values. The average estuary dissolved nitrite concentration is 0.021 ± 0.029 mg/l.

In Figures F-7-25 and F-7-26 the total and dissolved nitrate longitudinal plots are presented. Nitrate does not have a peak at the turbidity maximum zone during the spring as observed for ammonia and nitrite. Concentrations are significantly higher at CYR0004, the last station in the upper river (1.108 ± 0.869 mg/l). The exceptions occur at 8-20-81 and 9-27-81 when levels become extremely low during a low flow period when the Chesapeake Bay appears to be a source of nitrate. The average value for dissolved nitrate is 0.225 ± 0.448 mg/l.

TPN or total particulate nitrogen has a peak at the turbidity maximum zone as expected. The mean value for TPN is 0.2569 ± 0.1648 mg/l (Figure F-7-27).

Total and dissolved phosphorus plots are shown in Figures F-7-28 and F-7-29. Total phosphorus is the combination of both organic and inorganic phosphorus. The maximum levels are observed either at 28.0 or 41.0 nautical miles. When looking the overall mean longitudinal profile of total phosphorus a definite maximum of 0.317 mg/l is observed at CYR0004 (nautical mile 41.0). Although dissolved phosphorus has higher concentrations in the upper river, the difference along the longitudinal direction is not as pronounced as nitrogen. Levels of dissolved phosphorus are higher in October and then again in March. This is probably due to greater freshwater inflows during these months.

Orthophosphorus plots are presented in Figures F-7-30 and F-7-31. The average concentrations for dissolved orthophosphorus is 0.0244 ± 0.0507 mg/l. The longitudinal minimum occurred at Langford Creek (nautical mile 15.5) and the mean maximum value right after it at nautical mile 16.0 (XHH5301). Although mile 16.0 has the highest mean value it also has a large standard deviation. In the 0-3 ppt salinity range (oligohaline) high values were observed from May to September. This suggests that a major source of orthophosphorus during this period is from land runoff.

In most cases a peak at the last two stations was observed for total particulate phosphorus in Figure F-7-32. A maximum mean level of 0.2518 mg/l was observed at nautical mile 41.0. The lowest concentrations were at nautical miles 8.5 and 13.2 before Langford Creek where a peak was observed. Overall average of all dates and stations is 0.0864 ± 0.261 mg/l.

Total Organic Carbon (TOC) was analyzed during the first five surveys. A maximum peak occurred near Langford Creek. The mean value for TOC was 7.923 ± 2.789 mg/l (Figure F-7-33).

Particulate carbon plots are shown in Figure F-7-34. A peak dominates most plots at the turbidity maximum zone. The average 1980-81 value for TPC is 1.921 ± 1.09 mg/l.

Chlorophyll-*a* plots are shown in Figure F-7-35. Mean values of chlorophyll-*a* is 11.08 ± 18.09 mg/l. Higher concentrations were observed in the lower salinity ranges while higher salinity had lower levels of chlorophyll-*a*. Chlorophyll-*a* correlated well with salinity with a R^2 of 0.755. In late July a large increase in chlorophyll-*a* is observed indicating an algal bloom. It is not until September that levels of chlorophyll-*a* resume to lower levels.

Pheophytin plots are shown in Figure F-7-36. Outcrops in high levels in pheophytin are spotty with the highest levels observed on November 24, 1980 and July 27, 1981. The average estuarine value was 8.319 ± 15.44 mg/l. On the average a maximum pheophytin-a concentration occurred at the turbidity maximum zone. Pheophytin-a does not correlate well with salinity.

The plots in Figure F-7-37 and F-7-38 are the relation between inorganic nitrogen to orthophosphorus (Redfield ratio). The longitudinal profile for all data indicate the upper and lower portions of the river are phosphorus limited while the middle of the river from nautical miles 13.2 to 21.3 may be nitrogen limited. A maxima occurs at nautical mile 41.0 with 65.6 and the mean minimum ratio was at Langford Creek with 8.6. During the fall and winter extremely high ratios were obtained in the upper most station (CYR0004), indicating phosphorus limitation. From late June through September the Chester estuary seems to be nitrogen limited suggesting that more phosphorus is being released and supplied.

Tables of statistics for the slack surveys were developed. Table F-7-1 shows the statistical average for each survey date. The monthly statistics for each salinity range are in Table F-7-2. The overall statistical average for each nutrient parameter and the corresponding salinity regimes are in Table F-7-3. Table F-7-4 provides the longitudinal average profile for each parameter. Table F-7-5 is the raw data of the slack surveys. Table F-7-6 gives the correlation of the nutrient variable during the slack survey to salinity.

SECTION 8

Temporal Characteristics of Water Quality Variables

The following section is a discussion of the temporal trends of various water quality parameters using both the slack and twenty-four hour survey data. There were 27 surveys conducted from July 1, 1980 to September 27, 1981 with three 24-hour surveys. When possible the surface, middle and bottom values were plotted. During intensive surveys the minimum and maximum values were plotted to indicate the variability present during a 24-hour period. These plots show the variability in seasonal trends as well as the variability observed during the slack and 24-hour data.

Salinity values during 1981 were higher than the 1980 values due to reduced rainfall (Figure G-8-1). Higher values were observed in the fall and winter months, especially in the lower river. However in the upper regions of the Chester Estuary higher salinity concentrations were observed during the late summer. During periods of low freshwater inflow, a trend existed for greater stratification in the water column. The data indicate that higher flows reduced stratification. Comparison of station salinity observed during the slack surveys to the 24-hour surveys indicate little difference in the range of values, except at station XIH2463 in the turbidity maximum region.

The dissolved oxygen plots are shown in Figure G-8-2. From May to September the D.O. values were much lower. During these months the polyhaline zone (greater than 10 ppt) had the lowest D.O. The deeper bottom layers became depleted of oxygen during these months in the lower estuary. The highest monthly average D.O. was observed in March 1981 (12.30 mg/l). In general, the minimum and maximum value observed at a station during the study was measured during the 24-hour surveys.

The pH values do not seem to have any temporal trend (Figure G-8-3). The pH changed considerably during a 24-hour period (see Section 9). The Chester River had a slightly basic but stable pH. The monthly averages range from 7.04 to 8.04 and for the majority of the time it was below 7.5. The 24 hour surveys clearly show that values approaching a pH of 6 are not uncommon.

The mean monthly statistics for ammonia (Figure G-8-4) show that maximum values were present in the early spring, and in the summer from July through September. In the lower estuary, from nautical mile 5.5 to 16.0, the maximum value occurred during summer with concentrations around 0.12 mg/l.

The lower estuary stations also had increased concentrations in the early spring. In the mid estuary or mesohaline zone; the maximum values were in March and April with peaks occasionally occurring in July and September. Station CYR0004, at nautical mile 41.0, had maximum values during May and June.

Monthly nitrite concentrations are presented in Figure 8-5. Nitrate levels in the lower and middle estuary were at a maximum during August and September. However, in the upper estuary the maximum nitrite concentrations occurred in November, May and June.

Temporal nitrate station trends are shown in Figure G-8-6 and statistics of the slack survey means are presented in Table 8-1. Nitrate concentrations inceased during the spring (March to May). The maximum mean value occurred in March at nautical mile 28 (0.62 mg/l). Concentrations declined during the summer to a mean low of 0.50 mg/l during August. At nautical mile 41.0, nitrate levels were very high and a summer nitrate minimum was not apparent. At this location there was a nitrate maximum in December. The 24-hour survey data indicate that slack survey trends should be interpreted with care.

A particulate nitrogen plots show maxima occurred in the summer (Figure G-8-7). Average monthly values were usually higher in the mesohaline zone (3.1-10. At nautical mile 28.0 no temporal trend was apparent, with values being high during all months.

Dissolved phosphorus temporal plots are shown in Figure G-8-8. High concentrations occurred in October and March. Over half of the monthly averages had a concentration of 0.04 or less which is the "buffering" range of phosphate suggested by Butler and Tibbites (1972). They suggested that phosphorus lacked variability due to buffering reactions with the sediment. The large increases in concentration during October and March are probably due to higher spring and fall runoff.

The monthly statistics of orthophosphorus indicate maximum concentrations occurred during March and May although individual station plots (Figure G-8-9) do not stress this trend. In the first four stations from nautical mile 5.5 to 21.3 the concentrations were low except for high values in March, July and September. The variability which occurred during the 24-hour survey was very limited in the lower estuary, especially during May. Variability increased during the summer in the upper river. At the upper station (CYR0004) all the monthly values were high with highest concentration and greater variability in the spring.

Total particulate phosphorus trends are shown in Figure G-8-10. The maximum concentrations for total particulate phosphorus occurred in March 1981, October 1980 and July 1981 with concentrations of 0.87, 0.14 and 0.12 mg/l respectively. At the two upper stations a maximum also occurred in March. The upper river concentrations are higher than the lower estuary centrations.

Observations of the total particulate organic carbon are shown in Figure G-8-11. Maximum concentrations occurred in the summer but occasionally winter and spring levels were increased. Concentrations were usually higher in the mesohaline zone (3.1-10 ppt). Summer maximums occurred at the first three lower estuary stations and the last upper station (XHG1537, XGG9572, XHH5301, CYR0004). The mid estuary stations at nautical mile 21.3 and 28.0 had higher values during early spring (May) and mid summer. Mean concentrations for the entire estuary during July and August were 2.46 mg/l and 2.69 mg/l respectively.

Temporal characteristics of chlorophyll-a are shown in Figure G-8-12 Maximum mean river values during July and August of 1981 were 36.3 mg/l and 29.7 mg/l respectively. This monthly trend correlated well with BOD_5 average monthly values. The stations at nautical mile 8.5 and 41.0 follow this average monthly trend the closest. Concentrations are quite variable on a monthly basis. Station XHG1537 (at nautical mile 5.5) had the highest concentration of chlorophyll-a during July 1980 and May, July and August of 1981. At nautical mile 16.0, 21.3 and 28.0 the monthly trend was similar but higher values during August and September of 1980 were also present. Highest chlorophyll-a values occurred at nautical mile 41 where concentrations above 100 ug/l occurred on several occasions.

November had the overall highest monthly mean concentrations of pheophytin-a, (Figure G-8-13) but values were also high during July (18.98 mg/l) and August (13.52 mg/l) of 1981. These high pheophytin concentrations coincides with higher chlorophyll-a and BOD_5 levels. Maximum monthly levels were usually present in the mesohaline zone.

Statistics of the temporal data are presented in Table G-8-1. The data was divided into salinity regime of 0-3 ppt, 3.1-10 ppt and greater than 10 ppt.

Section 9

Twenty-Four Hour Water Quality Survey Variable Results

Twenty four hour surveys were conducted at six stations in the mainstem of the Chester for three dates. At each station a sample was taken approximately every three hours. Although longitudinal and temporal plots say a lot about the character and variability of nutrient concentrations, the 24 hour surveys bring to light the dynamic nutrient characteristics existing in an estuary.

Salinity plots for the 24 hour surveys are shown in Figure H-9-1. Salinity does not vary greatly over a 24 hour period. As expected, values decrease as they go up the river. Most of the stratification occurred at the lower stations, especially in May. May's higher degree of stratification could be due to a large temperature difference also present. The cooler bottom water is denser with a higher salinity while the surface is warmer, and less saline. Stratification was negligible for the July and September surveys coinciding with less stratification in temperature. The salinity values increased during high tide during the May survey at station XHH5301 (16.0). Stratification was observed more often at slack tide conditions. Although salinity was relatively uneffected in a 24 hour period, it varied significantly with season and flow conditions. Occasional inversions between mid-water and bottom water were observed.

Temperature plots in Figure H-9-2 do not vary much over a 24 hour time span. As mentioned above, the May survey had more stratification. Since there was more variability during the May survey, it was looked at more closely. At night the temperature tends to decrease slightly, especially the surface values. The one exception occurred at station XGG9572 (8.5) where the bottom reacted oppositely showing an increase in temperature during night.

Suspended solids (Figure H-9-3) vary significantly during the 24 hour surveys. Of the three surveys, September had the highest values. This may be due to the windy conditions which were prevalent during this survey. For all surveys the bottom values were usually greater than the surface values, but occassionally surface values were higher. When looking at the average surface and bottom values for each salinity range (Table H-9-4) it can be seen that the surface waters are more homogeneous or consistent. Although the surface and bottom have increased levels in the mesohaline zone (3.1 - 10 ppt) where the suspected turbidity maximum zone was, the increase in the surface was not as dramatic as the increase in the bottom layer. During July at nautical mile 21.3 (XHH8354) the surface and bottom values inversed between each other four times. Although there were considerable fluctuations between the surface and bottom values, the water column average remained relatively unchanged during the 24-hour period. In the lower portion of the Chester River the peaks and increased stratification generally occurred at slack tides, especially after a flood tide. This suggests that suspended solid levels were dependent on the tidal cycle. Since water movement was minimized during slack tides, the suspended solids settled to the bottom and caused bottom concentrations to increase. Surface values were relatively stable. Longitudinally, all three surveys were very consistent, indicating the highest concentration at nautical mile 28.0 (XIH2463). The average concentration at this station was 58 mg/l. The overall river mean value for suspended solids was 39 ± 25 mg/l with 4 mg/l and 203 mg/l as the minimum and maximum values respectively.

It was interesting to note the fluctuations that occur in pH during the 24 hour surveys (Figure H-9-4). For an estuary like the Chester, a slightly basic pH was expected and the average value of 7.38 ± 0.64 reflects this. The minimum and maximum values were 3.5 and 9.5 respectively and they both appear during the May survey at station XHH8354 (21.3). To have the minimum and maximum value occur on the same day and same station verifies that one slack pH measurement is not indicative of the general river conditions at that location on a given day. The pH measurements ranging from 5 to 9 were regarded as safe and the Chester, except for the May survey at 21.3, was well within this range. The pH levels were on the slightly acidic side during May at XGG9572 (6.43 ± 0.39) and CYR0004 (6.79 ± 0.32) and during September at CYR0004 (6.30 ± 0.41). Stratification was more prevalent in May and July. During September the Chester Estuary showed a better chemical equilibrium and a greater buffering capacity which resisted large changes in pH. High wind conditions present during September's survey could have caused greater equilibrium in the water column through reaeration processes. The stratification observed during the May (more so) and July surveys coincide with a more acidic bottom layer. (This could be a result of less photosynthetic activity at the bottom because pH shifts due to biological uptake of CO_2.)

The average dissolved oxygen observed during the three 24-hour surveys, as shown in Figure H-9-5, was 7.30 ± 2.2 mg/l. Most of the stratification occurred in the lower river, especially during May and July. At times the bottom layer fell to onoxic low levels. The largest stratification occurred on the 5-29-81 survey at mile 5.5 with the mean surface and bottom values being 9.66 and 1.95 mg/l respectively. For the various salinity ranges the polyhaline zone (greater than 10 ppt) had the highest surface average of 8.6 mg/l and the lowest bottom average of 6.0 mg/l (Table H-9-4). Almost no stratification was observed during the September 24 hour surveys, with values generally above 6 mg/l. Windy conditions that occurred during 9-24-81 were probably the cause of destratification and elevated bottom DO concentrations. There was not a larger DO range observed during the 24 hour surveys (1.0 mg/l - 14.5 mg/l) which could not be obtained during the individual slack surveys (0.2 mg/l - 15.0 mg/l). This implies that DO for a particular station could be represented fairly well by collecting a single slack sample per depth for that day. Average dissolved oxygen concentrations for the May, July and September surveys were 6.42 mg/l, 7.16 mg/l and 8.48 mg/l respectively.

Dissolved oxygen saturation plots are shown in Figure H-9-6. The highest mean DOS values were reached on 7-24-81 at XHH5301 (16.0) with the average value being 131.13% ± 45.87% and mean surface and bottom values ranging from 140.13% to 118.23%. During this July survey high levels were not reached until midway in the survey. Bottom levels jumped from approximately 40% to 180%. This increase and inversion of surface and bottom values may have been caused by bottom upwelling. Very high DOS percents were obtained during 9-24-81. The levels in DOS were surprisingly dependent on wind conditions.

During the 24-hour survey total particulate organic nitrogen samples were analyzed every six hours instead of every three hours (Figure H-9-7). Total nitrogen had an average concentration of 0.60 ± 0.55 mg/l with 0.09 mg/l and 2.8 mg/l as the minimum and maximum values, respectively. There was stratification present during all three survey dates with no strong evidence toward destratification on windy days. On 9-24-81 there was an inversion between surface and bottom concentrations. Bottom values were generally lower for April and July while the opposite was true for September. The changes in concentration appear to be governed by the tidal cycle with stratification occurring more often during slack tide.

Dissolved nitrogen levels are shown in Figure H-9-8. Stratification was present for all dates with minimum and maximum values being 0.01 mg/l and 2.6 mg/l respectively. Levels of dissolved nitrogen increased up the river and a sink appears to occur in the middle of the river. This sink was present at nautical mile 21.3 for May, at mile 8.5 for July and at mile 16.0 for September. In July the concentrations in dissolved nitrogen were very low in the lower river with a dramatic jump occurring at station CYR0004 (41.0). The average concentration for dissolved nitrogen was 0.31 mg/l ± 0.49 mg/l.

The dissolved organic nitrogen plots in Figure H-9-9 show much higher concentrations during the July survey. May had the highest average values at station CYR0004 (0.83 mg/l), July at XHH5301 (1.58 mg/l) and September at XIH2463 (0.92 mg/l); as shown in Table H-9-1. Peaks were observed during July at nautical miles 5.5 and 16.0, May at 8.5 and 21.3 and during September at 16.0 and 41.0. When comparing these peaks to the tidal cycle it was noticed that they appear during a slack tide. Bottom values rose when the slack occurred after a flood tide while the surface values increase after an ebb tide.

Inorganic nitrogen fluctuates during a 24 hour period as shown in Figure H-9-10. There was significant stratification for all three survey dates, especially in the lower river. In the middle section of the estuary the bottom layer had higher inorganic nitrogen measurements, suggesting remineralization processes on the bottom. Longitudinally the last upper station on the Chester River had the highest concentrations for each 24 hour survey. This implies that the freshwater inflow was a dominant source of inorganic nitrogen. The mean value at CYR0004 was 1.54 mg/l ± 0.43 mg/l. The concentration of inorganic nitrogen does not change considerably due to night fall. This lack of dependency on the sun's radiation suggests that inorganic nitrogen is not utilized photosynthetically as expected.

Dissolved ammonia (Figure H-9-11) was the most abundant component of inorganic nitrogen present in the lower estuary and it appears to dictate the patterns of inorganic nitrogen there. When comparing the ammonia concentrations at various salinity levels, the lower and upper estuary had the highest concentrations with a sink occurring in the middle. Usually the surface values were higher in the Chester Estuary. The values for the surface were 0.14 mg/l, 0.08 mg/l and 0.16 mg/l for the lower, middle and upper sections of the estuary, respectively. Bottom values were 0.12 mg/l, 0.08 mg/l and 0.09 mg/l, respectively. There is a reversal in nutrient stratification between nautical mile 8.5 to 16.0 where the sink appears to occur. Bottom levels had higher concentrations at these sinks suggesting increased benthic activity. The July survey was unique in that the bottom layer was always more concentrated, indicating that benthic remineralization may be greater in the mid summer rather than in late spring or early fall.

Nitrite was the least abundant form of inorganic (Figure H-9-12). The concentrations rarely follow the inorganic nitrogen trends. The changes in concentration and stratification was not a result of the tidal cycle since concentration changes do not follow changes in stage height. Values for dissolved nitrite were low and the mean concentration for all three surveys was 0.03 ± 0.03 mg/l with the minimum and maximum of 0.001 mg/l and 0.11 mg/l respectively. The three surveys were inconsistent in their longitudinal characteristics. May and July showed a minimum (sink) in the mesohaline zone (3.1 - 10 ppt) with concentrations increasing in the upper and lower estuary. September data indicated a sink in the upper station with increasing levels in the lower estuary. Lower than average concentrations were observed in July with higher than average values obtained in September.

Average dissolved nitrate values were considerably higher in the upper river with the middle and lower river showing greater variability (Figure H-9-13). Nitrate was the dominant inorganic nitrogen in the upper river stations at 21.3, 28.0 and 40.0 nautical mile. Most of the time nitrate concentration changed with the tidal cycle with a decrease in concentration during high tide and an increase in concentration during low tide, thus during high tide, a dilution effect caused levels to drop. Some examples of this tidal effect occurred in May at 28.0 and 41.0, and July at 41.0 where a high tide resulted in a drop in nitrate levels. In September at 21.3 and 5.5 a low tide resulted in an increased nitrate concentration. Also, stratification generally increased during a slack tide and destratification was the effect of an ebb or flood tide. High winds present during the September survey did not effect the nitrate stratification as was suggested for DO. The dissolved nitrate mean for all the 24 hour surveys was 0.28 ± 0.49 mg/l with 0.01 mg/l and 2.55 mg/l being the minimum and maximum values respectively. In the lower and upper portions of the river the mean surface values were higher but in the middle section the mean bottom concentration was higher. The July survey mean nitrate concentrations were lower than the May and September concentrations. The discharge flow rate during the July survey was also higher.

Unlike the nitrogen nutrients discussed, the total phosphorus plots in Figure H-9-14 do not show dependence upon stage height. Since the variability of total phosphorus does not appear to be selected to any physical characteristic (weather, flow rate or tidal cycle) the variability may be dependent on sources and sinks. Although there was stratification, there was no trend to have higher concentration at the bottom of the water column. Frequently the surface and bottom values inversed, while the average levels in the water column remained fairly stable. The mean value for total phosphorus was 0.09 ± 0.07 mg/l with 0.01 mg/l and 0.62 mg/l as the minimum and maximum.

Dissolved phosphorus concentrations showed a stronger dependence with stage height (Figure H-9-15). The strongest tidal influences occurred during May at nautical mile 28.0, in July at nautical miles 28.0 and 41.0, and in September at nautical mile 16.0. As was noticed for total phosphorus, dissolved phosphorus had no definite water column trend because of surface and bottom concentration inversions. Each survey date had a different average longitudinal trend. The peak concentrations for May, July and September were at 41.0, 21.3 and 8.5 nautical miles respectively, while sinks occurred at 21.3 and 28.0 for May, 5.5 and 16.0 for July and 41.0 for September. There appeared to be a gradual longitudinal movement in the peaks and sinks of dissolved phosphorus. During late spring a Chester River dissolved phosphorus source was indicated in the upper estuary with a sink appearing right below it in the upper middle section of the river. By the summer, the potential source had moved down the river to the middle of the estuary and the sink moved down to the lower mid section. September brought about a complete longitudinal change and a source was indicated in the lower estuary and a sink in the upper river.

Dissolved orthophosphorus is shown in Figure 9-16. Tidal effects seemed to have an effect on the orthophosphorus concentration especially in the middle to upper estuary. An increase in concentration was observed after an ebb tide for all three survey dates at nautical miles 41.0 and 28.0 and during May and July at 21.3 nautical miles. During May there was little or no stratification in the lower stations with a gradual but spotty stratification occurring in the upper stations. Looking at the water column for all three 24 hour surveys the bottom values were generally greater than surface values, especially in the 0-3 ppt salinity range. Statistically, the July data has greater value in the bottom layer which coincides with ammonia. This fact supports the view that increased benthic remineralization occurred in the July summer survey. Longitudinally the three 24 hour surveys were very consistent with each other with maximum level in the upper estuary and minimum value in the lower estuary. The maximum and the minimum averages for May were 0.063 mg/l and 0.01 mg/l and were at stations CYR0004 (41.0) and XGG9572 (8.5) respectively. During

July and September the maximums (0.056 and 0.067 mg/l) and minimums (0.019 and 0.017 mg/l) were at 21.3 and 5.5 nautical miles respectively. At night the orthophosphorus levels decreased during May at 21.3, July at 16.0 and 28.0 and September at 8.5 and 16.0.

Total particulate phosphorus had its longitudinal maximum at nautical mile 28.0 (Figure H-9-17). The turbidity maximum region in July varied slightly from this mean trend with higher concentrations occurring in the upper most station, CYR0004. The changes in concentration of TPP appear to be governed by tidal forces. When the tide was high levels of TPP usually increased, especially during May. Stratification was present at all stations. During the May survey the surface values were greater while during the July survey bottom values were greater.

Particulate organic carbon in Figure H-9-18 also had its mean longitudinal maximum at the turbidity maximum zone. This trend was consistent for all three survey dates. Stratification was present and for a majority of the time surface values were greater. The average value for POC is 2.00 ± 1.62 mg/l with 0.001 mg/l and 11.30 mg/l as the minimum and maximum respectively.

When looking at chlorophyll-a in Figure H-9-19, note should be taken to the different scales used. The average chlorophyll-a value for all 24-hour survey data was 16.97 ± 37.02 ug/l. Longitudinally the mean maximum value appeared at nautical mile 41.0. In Table H-9-4 the oligohaline zone (0-3 ppt) showed the greatest difference in the surface and bottom values. The statistics were somewhat deceiving because an algae bloom was present in July at 41.0 causing the concentration at the surface to be extremely high (i.e. note the scale); yet during this same survey at CYR0004 no bottom values were taken. Stratification and destratification was present during all surveys and appears partially dependent upon tidal forces.

For the phaeophytin-a plots in Figure H-9-20, the average concentration was 5.36 ± 10.21 ug/l. Pheophytin was not as concentrated as chlorophyll yet it still appeared to be dependent on stage height. There was no trend longitudinally to have higher surface or bottom values (Table H-9-2) although Table H-9-4 indicated the values were higher at the surface. The greater depth difference was at 0-3 ppt region due again to the lack of bottom values during the July survey.

Table H-9-1 shows the univariate statistics for each 24 hour survey. Table H-9-2 shows longitudinal statistics for the surface and bottom values. The salinity regimes are represented in Table H-9-4 with statistics grouped by depth. Regressions correlating the water quality variables to salinity and Dissolved Oxygen are presented in Tables H-9-3 and H-9-5 respectively.

Section 10

Historical Analysis of Dissolved Oxygen and Dissolved Oxygen Deficits

Historical Dissolved Oxygen

Historical dissolved oxygen (DO-mg/l) data from the Chester River was consolidated into one file. Sources of data for this file included the Maryland Department of Natural Resources, Water Quality File, the Chesapeake Bay Institute, and "An Evaluation of Chester River Oyster Mortality", a Maryland Department of Natural Resources report. The sampling dates spanned from 1949 to 1981.

For purposes of analysis, the river was divided into an upper and lower zone. These divisions were based on salinity. The lower zone salinity was between 10.01 and 20.0 ppt. Data in the upper zone had DO observations and salinity between 0.2 and 10.0 ppt. This division of brackish water is similar to the classification proposed by Ekman, 1953.

The data was grouped by years and DO vs salinity was linearly regressed. Table I-10-1 shows the univariate statistics for DO as well as the correlation coefficients from the regressions. This table reflects the whole estuary (salinity= .2 to 20.0 ppt). A plot of DO means vs year is shown in Figure I-10-1. The plot shows no clear linear historical DO trend although regression of the yearly mean DO would indicate a trend towards supersaturated water. Figure I-10-2 and Table I-10-2 show the same information in the two estuary salinity zones. Again, no strong linear trend is evident, although the regression line would indicate a downward trend. The same data for the lower river is presented in Figure I-10-3 and Table I-10-3. A strong linear trend is not evident, however this grouping of data shows a stronger linear trend towards higher DO than the previous figures. It should be noted that many of the years, particularly the 60's have little or no data. For this reason these three plots may be misleading. Plots of the actual DO values vs salinity, by years, are shown in Figure I-10-4. These plots indicate that DO around 1 mg/l was observed in 1949 and 1958 in the lower estuary. Low DO was not again measured until 1975 and 1976 when detailed sampling occurred in the lower river by the Department of Natural Resources. Data from 1980 and 1981 also show DO near or below 1 mg/l.

The data was split into four groups (by decades) and regressions of DO vs salinity were again performed. Statistical results from the whole estuary, and the upper and lower salinity zones are shown in Tables I-10-4, I-10-5, and I-10-6, respectively. This grouping of the data would indicate a lower estuary trend towards increasing DO values in the 70's and 80's. The upper estuary mean DO increased in the 60's and fell in the 70's and 80's. The estuary as a whole reflects this characteristic and thus no linear trend. This trend may reflect partly the fact that more samples were taken in the upper zone than in the lower. Since random sampling procedures were never applied, more sophisticated statistical techniques applied to the data may be misleading.

It is difficult to make any definitive statement regarding DO trends based on the preceding information. Dissolved oxygen is a variable that is influenced by temperature, salinity, and varies according to depth of the water, tidal fluctuations, seasons, time of the day, and many other chemical and biological factors.

Tables I-10-7, I-10-8, and I-10-9 show univariate statistics and the results of regressing DO vs salinity for various depth ranges for the entire estuary, the upper zone, and the lower zone. As expected, DO averages decrease as depth increases, with the lower estuary deeper water average of 5 mg/l. The standard deviations for DO in the lower river are also generally higher than their counterparts in upper river. This increased range of DO is probably due to the greater influence of water column stratification found in the lower estuary and the resulting utilization of oxygen during stratified conditions by organic material decomposition.

DO and salinity were grouped by month. Tables I-10-10, I-10-11 and I-10-12 show the univariate statistics and regression results. Figure I-10-5 is a plot of DO means vs month for the whole river. As expected, the lower estuary shows lower monthly DO in the summer months. Chemical and biological processes which utilize oxygen increase during these summer months. The temperature also increases and this lowers DO. This trend is clearly illustrated in the plots. Examination of the DO standard deviations during the warmer months shows another important trend, i.e., while the means have decreased, the ranges have increased. This most likely is due to the fact that biological processes which utilize oxygen, such as phytoplankton productivity, are higher and diurnal cycles show greater variability, causing greater "swings" in the dissolved oxygen during summer months. The relatively low DO mean for January (as compared to December and February) is attributed to the small number of observations.

An analysis of DO by time of day was carried out. These results are shown in Table I-10-13, I-10-14, and I-10-15. Figure I-10-6 is a plot of the DO means vs time of day for the whole river. Figure I-10-7 shows averages from the upper and lower river. The L's indicate low salinity (upper river) and the H's indicate high salinity (lower river). In the upper river DO shows an increase around 3 A.M., falls to a low between 6 and 8 A.M., and then increases to its' highest point of the day around noon. It starts falling around 7 P.M. Discounting the extreme low around 9 P.M. (which represents only 18 observations), it would appear that DO fluctuates less on a daily basis in the upper estuary than in the lower estuary. This is probably due to the greater tidal mixing which occurs in the high salinity region. In both figures a DO minimum appears around 5 A.M.

In an effort to further refine the analysis, the data was grouped by seasons and by years. The seasonal divisions were as follows: winter (December, January, February), spring (March, April, May), summer (June, July, August), and fall (September, October, November). Tables I-10-16, I-10-17, I-10-18, and I-10-19 show DO statistics by year for the four seasons. There appears to be a slight historical trend towards higher DO in the winter months, although this is questionable due to the limited number of observations. Spring mean values indicate no trend. The summer season DO values are lowest, as expected, followed by fall, spring, and then winter. No trend through the years is observed during the spring, summer, or fall values when all estuary data is combined to calculate statistics. No trend is evident of changing standard deviations for different seasons.

Seasonal DO univariate statistics and regression results are shown for the upper river or estuarine zone in Tables I-10-20, I-10-21, I-10-22, and I-10-23. No trend during the winter is obvious, especially considering the paucity of data. During the spring as well as the summer mean DO values, no strong trend appears except that standard deviation shows a slight increase over the years. Table I-10-23 shows the fall mean DO by year with no apparent trend.

In the lower river, Tables I-10-24, I-10-25, I-10-26, and I-10-27 indicate that a trend may exist in winter towards higher DO, but data is available for only three years. During the spring, summer and fall, no distinct trend is observed using these simple statistical relations.

Historical Dissolved Oxygen Deficits

Temperature and salinity affect the solubility of oxygen in water. This characteristic should be taken into account when analyzing DO trends. Another variable called the dissolved oxygen deficit (DOD - mg/l), sometimes known as apparent oxygen utilization, was calculated as follows:

DOD = SDO - MDO

where: SDO = calculated saturation value of DO. SDO is a function of salinity and temperature.

MDO = measured dissolved oxygen corrected for temperature and salinity.

DOD was calculated whenever DO measurements were present in the file in conjunction with temperature and salinity measurements. The method of calculating the saturation value is based on the algorithm used in the Maryland Water Quality file.

In some cases salinity was not present but a conductivity measurement was available. In these instances salinity was calculated as a function of conductivity. The equation used was given by Pritchard and reported by Westinghouse, 1972. This calculated salinity was then used in the previously mentioned algorithm.

Negative values of DOD represent water that is supersaturated with oxygen. Positive values indicate oxygen utilization.

Tables I-10-28, I-10-29, and I-10-30, show univariate statistics for DOD by years for all data, the lower zone and upper river or estuary zone, as well as correlation coefficients obtained from least squares regression of DOD vs salinity. Figures I-10-8, I-10-9, and I-10-10, are plots of the means vs year. A general trend indicates greater supersaturation trends for the entire river system (r = -.380). There is a small linear decrease of DOD's in the upper river indicating a small trend towards supersaturation (r = -.149). The plot for the lower estuary also shows a slight trend towards saturation (lower DOD's) in the later years (r = -0.490). This correlates well with the findings of slightly greater DO's (Figure I-10-3, Table I-10-3).

Tables I-10-31, I-10-32, and I-10-33 give the statistics for DOD for the years 1949-59, 1960-69, 1970-79, and 1980-81. Using this temporal grouping, a trend towards saturation values is indicated in the lower river. The upper estuary shows little change from the 50's to the 80's.

DOD was grouped by depth ranges: 0-5, 6-10, 11-20, 21-40, and greater than 41 feet. As expected, Tables I-10-34, I-10-35, and I-10-36, clearly show greater deficits at increasing depths.

Figure I-10-11, is a plot of DOD means vs month for the upper and lower river. The H's refer to the high salinity zone and the L's refer to low salinity zone. Tables I-10-37, I-10-38, and I-10-39 give the corresponding statistics for the monthly averages.

DOD was analyzed by time of day, i.e. data was analyzed using 2-hour periods. Tables I-10-40, I-10-41, and I-10-42, show results for the whole upper, and lower river system. Figure I-10-12 shows that DOD in the upper river zone (L) falls to a low around 3 A.M., reaches the maximum high for the day around 5 A.M., and then steadily decreases to its' minimum value around 7 P.M. (i.e. increasing saturation), then increases, reaching a high around 12-1 A.M. (larger positive deficits). The lower estuary (H) data indicates a less variable cycle. The deficits rise to a high around noon and remain high until 9 P.M. They then decrease to their maximum low around midnight. This is the reverse of what we expected, i.e. lower deficits during the day and greater deficits in the early morning and evening hours. All data for the river (see Table I-10-40) indicate a trend towards saturation in the late afternoon period and early evening, and large deficits from 6-8 A.M. in the early morning, as expected.

Results of the seasonal DOD analysis is shown in Tables I-10-43-54. The winter values indicate a potential trend towards supersaturation, however this may be a spurious trend due to limited number of observations. No linear DOD trend is obvious in the spring season. During the summer months no total river trend in DOD is observed. In the lower estuary a slight trend is indicated by the greater standard deviations, indicating

potentially larger swings in the dissolved oxygen (see Table I-10-51). In the upper estuary (see Table I-10-50) a trend towards larger deficits are indicated as well as an increase in the standard deviations through the years. In the fall season, a strong linear trend is apparent for the total estuary analysis (see Table I-10-52). No trend is apparent in the upper estuary, however a trend towards supersaturation is noted in the lower estuary. It's significance is not clear.

Figures I-10-13 through I-10-18 show the yearly mean seasonal DOD versus year. It is interesting to note the change in trend of summer DOD (Figure I-10-16) around 1972, after tropical storm Agnes occurred. Thus, the season values indicate a general trend towards supersaturated conditions.

Figure I-10-19 shows the DOD plotted against salinity for each year. Although deficits around 6.5 mg/l were observed as early as 1949 and continue to be observed in 1981 near the same magnitude, negative DOD (indicative of supersaturated conditions) were observed at a greater frequency in later years, probably due to increased sampling frequency as concern for water quality conditions increased.

Cumulative frequency distributions (CFD's) can be useful tools for evaluating changes in water quality, especially changes from a given criteria or standard. CFD's have been developed for dissolved oxygen and dissolved oxygen deficits for historical and new data. Figure I-10-20 shows the dissolved oxygen CFD based upon combining all data for various years. Based upon data from 1949-1981, 50% of the time dissolved oxygen has been approximately 7.0 mg/l. Data taken during 1960-1969 was higher, i.e. 50% of the time observed D.O. was slightly greater than 8.0 mg/l. The 1949-1959 data indicated that 10 percent of the time one would expect D.O. to be less than 5.0 mg/l and only 8% of the year one would expect D.O. to be less than 4.0 mg/l. Figure I-10-20 could be interpreted as indicating low dissolved oxygen occurring less frequently around 1959, higher D.O. occured more frequently from 1960-1969. In addition, Figure 10-20 indicates one might expect D.O. from around 8 to 10 mg/l to occur less frequently. This figure also supports the view that higher D.O. occurs less frequently now than historically.

Figure I-10-21 shows data for the entire Chester estuary during the months of July and August. Data are grouped before 1969, between 1970-1981 and 1980-1981 data. This plot indicates that during the months of July and

August one can expect D.O. to be around 6 mg/l 50% of the time and about 8% of the time (during July and August) D.O. is below 4.0 mg/l. This information can be compared with data in the upper estuary (low salinity region) where Figure I-10-22 indicates a D.O. below 4 mg/l occurs less than 4-5% of the time, however around 5.2 mg/l occurs 50% of the time. In other words, in the upper estuary D.O. tends to be lower by 1 mg/l 50% of the time and D.O. below 4 mg/l occurs less frequently than one would estimate for the entire river.

In the lower estuary (high salinity zone) Figure I-10-23 indicate historically D.O. less than or equal to 4 mg/l occurs less than or equal to 20% of the time and D.O. of 6 mg/l occurs approximately 50% of the time. In addition, low DO (0-2 mg/l) occurs less often. Also, the median D.O. is lower in the upper estuary compared to the lower estuary by around 0.8 mg/l. The probability of D.O. less than 4 mg/l doubles in the lower estuary during July and August, compared to the upper estuaries zone. Figure I-10-24 shows the CFD for the lower estuary (all months) by decades. Fifty percent of the time D.O. is around 6.0 mg/l. Figure I-10-25 indicates a trend towards lower dissolved oxygen in the upper estuary based upon the CFD. Figures I-10-26 and I-10-27 show the change in the D.O. CFD in the upper and lower estuary when the months of July and August are compared to data from all months. Figure 10-28 indicates that when all data are used to create a simple CFD, data taken from 1949-1959 has a greater frequency of low dissolved oxygen than data from 1980-1981, thus supporting the previous linear regression trends.

Calculation of dissolved oxygen CFD's for various depth ranges is shown in Figure I-10-29. This figure clearly shows a high frequency of low dissolved oxygen at water depths greater than 20 feet. Specifically, all historical data indicates that at a depth greater than 40 feet, 20% of the time D.O. is less than 3 mg/l. Figure I-10-30 shows that all data taken at a depth greater than 30 feet in 1980-1981 indicates 20% of the time D.O. would be expected to be at or below 2 mg/l during the months of June, July and August. Figure 10-31 indicates, as expected, that very rarely does surface DO occur less than 5 mg/l occur, although occassionally D.O. approaching 3 mg/l was observed in surface waters (0-10 feet) in 1980-1981.

Figures 10-31 and 10-32 are noteworthy in that the CFD's for the upper and lower estuary during July and August are compared using all historical data. In the upper estuary a D.O. of 3.3 would be expected to occur approximately 20% of the time, and Figure 10-33 shows that a D.O. of around 1.0 mg/l occurred 20% of the time in waters greater than 30 feet during the months of July and August.

CFD's have also been developed for the dissolved oxygen deficit and comparisons are shown in Figures I-10-34 through I-10-38. Figure I-10-34 shows the historical trends to be very clearly in the deficit. No obvious deviation is apparent through the years. Larger negative deficits have been observed, but less frequently compared to the 1949-1959 data. Still there is no large deviation through the years, and the biological significance between the 1980-81 and 1949-1959 CFD's cannot be determined. Figure I-10-35 also substantiates the view that little change in the DOD has been observed over the last two decades. Figures I-10-39, I-10-40 and I-10-41 indicate as expected, the larger deficits (low D.O.) especially in the lower river in deeper waters. Figures I-10-42 through I-10-46 show the uniqueness of dissolved oxygen at depth ranges.

D.O. deficit CRD's are shown in Figures I-10-47 through I-10-49 and indicate no large deviations through the years, however larger deficits did occur in the low salinity region (see Figure I-10-48) during this 1980-1981 study. In the high salinity region there is indication of a trend towards supersaturation. The greatest evidence for degraded water quality is highlighted by Figure I-10-50 which indicates that the 1980-1981 CFD in the upper river in July and August showed relatively higher deficits than all other time periods except 1960-1969.

Section 11

RESULTS AND DISCUSSION

Juvenile Finfish Index for Chesapeake Bay and its relation to environmental variables.

An analysis of the Chesapeake Bay juvenile finfish index was made in order to more fully address the relation between water quality, environmental variables and biological resources. Before beginning this analysis consideration was given to various techniques of time series analysis and multiple linear regression. The review showed that a key element in quantitative analysis of time series is the analysis of residual phenomena. For example, Draper and Smith, 1981 reference Herschel and K. Bart, 1849, as stating the following:

> "Almost all the greatest discoveries in astronomy have resulted from the consideration of what we have elsewhere termed residual phenomena, of a quantitative or numerical kind, that is to say, of such portions of the numerical or quantitative results of observation as remain outstanding and unaccounted for after subducting and allowing for all that would result from the strict application of known principles."

This statement highlights an underlying theme used in the analysis which is described below.

Results of the Baywide juvenile index for finfish, monitored by the Maryland Department of Natural Resources, and reported by J. Boone, in the Estuarine Fish Recruitment Survey, 1980(4), were used. This report gives the yearly results of inshore seining in major spawning and nursery grounds for estuarine species. Combined site data was obtained from the monitoring program for the years 1959 through 1979 which represents a bay-wide juvenile finfish index (Maryland portion of the Chesapeake Bay). The index has been used as an indicator of the abundance of estuarine spawning and ocean spawning finfish species and has also been interpreted to reflect future year classes of estuarine finfish in Chesapeake Bay. In addition, the index has been used to indicate the potential spawning success of estuarine and ocean spawning finfish species.

Although this index lacks repetitive station sampling at a given station in order to statistically characterize the variance of the abundance of juvenile species, it is one of the only field monitoring studies of juvenile finfish species in the Chesapeake Bay Region which has been conducted on a yearly basis for more than twenty years. If the assumption is made that the index is an indicator of the spawning success of finfish, it can be correlated with other environmental time series data in order to make inferences regarding factors affecting spawning success. This analysis was therefore performed in order to indicate positive correlations or associations between the juvenile index, climatic variables and water quality variables.

Climatic time series of yearly mean rainfall, heating degree days and air temperature was obtained from published National Weather Service, Climatological Summaries for Baltimore Washington Airport, Maryland. Water quality time series were obtained from retrieval of data stored in the US EPA Storage and Retrieval System (STORET). STORET data was stored and retrieved in two subestuaries of Chesapeake Bay, the Chester and Patuxent Rivers within Maryland. Data from these systems were selected because of the historical data availability, familiarity of the data bases in these systems, and because these rivers are known to support the spawning of estuarine finfish.

Time series for the above data from 1959 to 1979 were standardized according to the procedure suggested by Salas, et. al. 1980 (6). All time series were normalized by the following transformation:

$$Z_i = \frac{X_i - M}{S}, \qquad (11\text{-}1)$$

where: M = the mean of the time series.
S = the standard deviation of the time series.
X_i = the value of the time series for period i.
Z_i = normalized value of the time series for period i.

In essence, this transformation is a very simple method of creating a residual time series which has been standardized with respect to the mean and standard deviation. The result (Z_i) is a unitless residual time series. Application of the transformation allows the comparison of original time series representing different variables and units of measurements, i.e., fish and rainfall, fish and water quality variables etc. Figure J-11-1 shows the actual juvenile striped bass index for Chesapeake Bay, the index after the mean is subtracted and the standardized juvenile index time series.

Another advantage of this transformation is that both positive and negative values (Z_i) are produced. Therefore, when the values are accumulated or summed, one can detect trends in departure from the normalized mean of the series. Figure J-11-2 indicates cumulative departures from the mean (X_i-M) for Maryland Precipitation Data produced by the National Weather Service for Maryland. Although this plot is not standardized, it clearly shows the drought which occurred in the mid and late 1960's. This plot also shows that in mid 1969 and 1970 the trend of below normal rainfall ended. This period coincided with a peak in the Baywide juvenile index for most species.

studies of juvenile finfish species in the Chesapeake Bay Region which has been conducted on a yearly basis for more than twenty years. If the assumption is made that the index is an indicator of the spawning success of finfish, it can be correlated with other environmental time series data in order to make inferences regarding factors affecting spawning success. This analysis was therefore performed in order to indicate positive correlations or associations between the juvenile index, climatic variables and water quality variables.

Climatic time series of yearly mean rainfall, heating degree days and air temperature was obtained from published National Weather Service, Climatological Summaries for Baltimore Washington Airport, Maryland. Water quality time series were obtained from retrieval of data stored in the US EPA Storage and Retrieval System (STORET). STORET data was stored and retrieved in two subestuaries of Chesapeake Bay, the Chester and Patuxent Rivers within Maryland. Data from these systems were selected because of the historical data availability, familiarity of the data bases in these systems, and because these rivers are known to support the spawning of estuarine finfish.

Time series for the above data from 1959 to 1979 were standardized according to the procedure suggested by Salas, et. al. 1980 (6). All time series were normalized by the following transformation:

$$Z_i = \frac{X_i - M}{S}, \qquad (11\text{-}1)$$

where: M = the mean of the time series.
S = the standard deviation of the time series.
X_i = the value of the time series for period i.
Z_i = normalized value of the time series for period i.

In essence, this transformation is a very simple method of creating a residual time series which has been standardized with respect to the mean and standard deviation. The result (Z_i) is a unitless residual time series. Application of the transformation allows the comparison of original time series representing different variables and units of measurements, i.e., fish and rainfall, fish and water quality variables etc. Figure J-11-1 shows the actual juvenile striped bass index for Chesapeake Bay, the index after the mean is subtracted and the standardized juvenile index time series.

Another advantage of this transformation is that both positive and negative values (Z_i) are produced. Therefore, when the values are accumulated or summed, one can detect trends in departure from the normalized mean of the series. Figure J-11-2 indicates cumulative departures from the mean (X_i-M) for Maryland Precipitation Data produced by the National Weather Service for Maryland. Although this plot is not standardized, it clearly shows the drought which occurred in the mid and late 1960's. This plot also shows that in mid 1969 and 1970 the trend of below normal rainfall ended. This period coincided with a peak in the Baywide juvenile index for most species.

Cumulative plots of Z_i for the environmental time series were developed. Selected ones are shown in Figures J-11-3 through J-11-6. Following the development of the cumulative Z_i plots, it was noted that ocean and estuarine spawners showed reverse trends. This fact can be observed by comparing the cumulative Z_i plots for finfish species in Figures J-11-7 through J-11-12. An average ocean spawning and average estuarine spawning species index also shows this trend (see Figure J-11-13). These indices were calculated by averaging the cumulative Z plots for the individual ocean spawning species and the estuarine spawning species, respectively.

Thus, Figures J-11-3 through J-11-13 show selected plots of the observed cumulative standardized time series which were then used in a multiple linear stepwise regression analyses. Based upon the graphs of the cumulative normalized (Z) time series, variables which showed possible correlations were selected for regression analysis using the BMDP-P9R statistical program (26).

Several types of multiple stepwise regression analyses were performed. Dependent variables used were the Baywide juvenile index for each species, the standardized cumulative juvenile index for each species or the cumulative "average" ocean spawner and estuarine spawner index. The independent time series used in the stepwise multiple regression analysis were climatic variables (actual time series or the standardized cumulative series), as well as water quality variables (actual time series or the standardized cumulative series).

The results of the regression analyses are presented in the various figures and tables. Figures J-11-14 through J-11-19 graphically show the results of the stepwise multiple linear regression for blueback herring, shad, striped bass, bluefish, and menhaden. These figures show the observed baywide juvenile index and the predicted baywide juvenile index calculated from the derived regression equation, with and without use of the standardizing transformation. These figures clearly demonstrate the validity of the transformation. In essence, the transformation analysis involved the following steps:

(a) normalization of the time series (where $Zi=((Xi-m)/s)$,

(b) developing a cumulative normalized time series,

(c) performing stepwise multiple linear regression using the cumulative normalized time series (in this case we used BMDP-P9R with selection based upon Mallows (C_p)score and the associated multiple r^2),

(d) calculation of the predicted standardized cumulative juvenile index using a selected multiple linear regression function,

(e) detrending or de-cumulating the predicted time series by subtraction,

(f) de-transforming the predicted Z_i, i.e., calculating the predicted yearly juvenile index by rearranging equation 11-1 as follows:

$$X_{ip} = SZ_{ip} + M \qquad (11\text{-}2)$$

where: M = mean of original dependent variable time series.
S = standard deviation of the original dependent variable time series.
Z_{ip} = predicted standardized dependent variable (juvenile index) for each time period.
X_{ip} = predicted dependent variable (i.e. juvenile index) for each time period.

Tables J-11-1 and J-11-2 show the derived multiple regression equations for the cumulative standardized baywide juvenile finfish index series using selected cumulative standardized climatic variables as independent variables only or using all of the selected environmental cumulative standardized variables (i.e. climatic variables, water quality variables and the average estuarine and ocean spawner (species) index, as described above). Table J-11-3 shows the selected stepwise regression equations and the associated squared multiple correlation coefficients (r^2) when the dependent variable is the calculated average index of species which spawn in the ocean (CZ01, CZ02) and the average index of species which spawn in estuarine spawning areas (CZA1, CZA2). The CZA1 and CZ01 time series were calculated from averaging respective Z_1 for the anadromous and ocean species. The CZA2 and CZ02 were calculated from averaging the cumulative standardized time series for anadromous spawning species and ocean spawning species.

Future work should consider the use of other variables as independent variables, especially additional water quality or nutrient variables in the mainstem of the Chesapeake Bay as well as freshwater inflow from representative locations in the bay. Rainfall reflects freshwater inflows as well as transport mechanisms in Chesapeake Bay. In the Patuxent and Chester rivers, only NO_3 or NO_2+NO_3 were indicated as being correlated to the juvenile index.

Table J-11-3 indicates that 50% of the residual variability of the average cumulative normalized juvenile index for estuarine spawning species can be explained by standardized mean yearly residual variability of precipitation. For ocean spawning species, 84% of the standardized residual variability can be explained by the standardized residual variability of yearly snowfall, yearly precipitation and air temperature. Figures J-11-7 through J-11-12 show the plots of the observed cumulative standardized, juvenile index for various species. Comparison of these plots versus the decumulated predicted juvenile index plots (Figures J-11-14 through J-11-19 highlight the utility of this transformation for use in multiple linear regression or correlation analysis of residual variability of time series. In addition, the detrending or decumulating of the predicted values does produce some errors due to the absence of some of the yearly independent variables for the 20 year period. The figures showing predicted cumulative standardized juvenile finfish are more representative of the analysis results. The estimated mean computer error (due to roundoff) varied from 1.7 to 50% depending upon the finfish index.

In summary, this analysis indicates the residual variability of Chester River nitrate (NO_3 - N mg/l) and water temperature (^{o}C) as well as Patuxent River pH correlated with the abundance and by inferrence, the variability of the spawning success of the Baywide juvenile finfish index. Further analysis is needed, using water quality variable time series from other Chesapeake Bay Regions in order to determine if the correlations between these water quality variables and others are not spurious. This analysis does support, as other researchers have shown, that climatic variables can be statistically associated with the abundance of juvenile finfish in Chesapeake Bay. In addition, this analysis quantitatively shows the relation of variability of environmental variables to the variability of the Baywide juvenile index. This analysis supports the use of a simple but logical data transformation before statistical regression analysis is performed in order to determine how residual variability of time series are correlated.

Longitudinal Characterization of Water Quality Variables

In order to classify longitudinal zones of similar water quality characteristics, the Duncan multiple range test was applied to the slack water and intensive mainstem station data. The results of applying this statistical test are shown in Figures J-11-20 through J-11-42, and indicate areas (i.e., by stations) in the mainstem estuary and river, which have similar concentrations or characteristics. Stations that are not significantly different are shaded similarly. These figures also show the mean value at each station for the respective water quality variable and nautical miles. The depth profile of the Chester River has also been shown on these figures to emphasize the general water depth of the river.

Figure J-11-20 indicates that the river water temperature (^{o}C) is fairly constant throughout the river. This is contrasted to the same test applied to the Patuxent estuary to similar data during the same time frame. In the Patuxent River, the maximum mean temperature coincided with the expected turbidity maximum region. This figure also shows the turbidity (FTU) zones with the area of the turbidity maximum observed between nautical mile 25 to 35. A lower estuary region where several stations overlap, shows a transition from a tidal river to a predominant two layer flow in the estuary (around miles 18-8).

Figure J-11-21 indicates relatively constant average dissolved oxygen values throughout the river system where the Duncan's multiple range test is applied, however distinct zones of higher DOS are characterized in the upper river and lower estuary. The slack water station at the mouth of Langford Creek indicates this area as a distinct region of highest mean DOS.

Figure J-11-22 indicates the possibility of two overall zones in the river for pH, with interaction between them in the middle region of the estuary. This figure also indicates each station represented a unique river zone for salinity characterization. Higher mid-estuary mean salinity is observed above a region of lower salinity. This may either be a reflection of the particular station location, i.e. to deeper water in the region, or that the upper station higher salinity values may be due to the upwelling of denser Chesapeake Bay water or fresh water flow into the mainstem is substantial. It is believed that this region of low salinity is probably a result of freshwater inflow in a region where the station was not deep, and was bound on either side by deeper waters.

Unlike the values for turbidity, secchi disc zones of dissimilarity are not indicated in Figure J-11-23. The upper river mean value of secchi depth is lowest in the area of the expected turbidity maximum. This figure also shows that BOD_5 (mg/l) is highest at the head of the river, making this a unique zone within the mainstem river. In fact, the BOD_5 mean value of 5.26 is higher than the same value for the Patuxent River (4.2 mg/l), indicating high oxygen demanding waters enter the Chester River.

Figure J-11-24 shows the zones characterized for total solids. The total solid levels increase as it moves down the river towards the mouth. This figure shows that suspended solids or the total residue is higher in the region of the expected turbidity maximum (i.e. 89.80 mg/l) and in the lower estuary in a region where the rate of change of depth is maximum. This may be indicative of a second turbidity maximum in the estuary.

Figure J-11-25 indicates a unique station and region for total nitrogen (mg/l) in the upper river with a mean concentration of 1.62 mg/l near Millington. This compares to the mean value of 3.57 mg/l at a similar region in the Patuxent River, Md. Thus, headwater concentrations of nitrogen are apparently higher by a factor of two times in the Patuxent, but higher BOD5 in the Chester. An area of higher dissolved nitrogen is indicated in the upper estuary, with the rest of the river being similar.

During a few surveys water samples were analyzed for total (unfiltered) NH_3, the results are shown in Figure J-11-26. High concentrations are indicated in areas of highest turbidity. Most of the slack survey samples were analyzed for dissolved NH_3 where upper river and lower estuary values being highest. The highest water column zone for dissolved NH_3 is in the lower estuary, indicating a potential source of NH_3 from Chesapeake Bay water, lower river tributaries or the sediments. Values of dissolved NH_3 in the lower estuary are higher than respective values in the lower Patuxent River by a factor of two. However the upper river in Patuxent is approximately nine times higher than the upper Chester River (i.e., 0.91 mg/l in Patuxent).

Nitrate (NO_3-N mg/l) values are shown in Figure J-11-27. Again, fewer total nitrate values were analyzed but are shown, and indicate an upper zone and lower zone. The maximum dissolved NO_3 zone is shown in the upper river region and a mid-estuary minimum dissolved NO_3 zone is apparent. This same trend occurred in the Patuxent River study. Again, values are higher at the mouth of the estuary after the mid-estuary minimum.

Dissolved nitrite is much lower in the Chester River than Patuxent Estuary by about a factor of 10. Figure J-11-28 shows that a minimum zone of nitrite occurs in the region of the turbidity maximum and a maximum zone occurs in the middle of the lower estuary.

Figure J-11-29 shows total organic nitrogen from a few of the summer, 1980 slack surveys. No unique zone in the system is observed. Dissolved organic nitrogen characterization for the Chester River indicate two zones which overlap and alternate from higher to lower zones.

Figure J-11-30 shows the results of the multiple range test applied to limited total inorganic nitrogen data indicates an upper and lower zone. The same two zones are characterized by the multiple range test for dissolved inorganic nitrogen. Figure J-11-31 indicates water column zones for total TKN and filtered TKN data during 1980-1981 dissolved TKN data indicates alternating regions of upper and lower concentrations also.

Figure J-11-32 indicates three total phosphorus zones while no distinct zones are indicated by dissolved phosphorus. The maximum zone for total phosphorus is located in the turbidity maximum region. However, Figure J-11-33 shows unique zones for limited total ortho-phosphorus and dissolved ortho-phosphorus data, with the upper estuary indicative of higher values. Upper river mean concentrations of dissolved ortho-phosphorus values are 12 times lower in the Chester River than Patuxent River, however the values in the lower estuaries are approximately equal.

Figure J-11-34 shows the results of the range test for total particulate nitrogen and total particulate phosphorus. Three TPP zones are indicated with values decreasing towards the mouth of the estuary. Total particulate nitrogen however shows the zone of highest values coincide with the expected region of the turbidity maximum. A zone of the TPN minimum occurs in the mid-estuary and is followed by an increase near the mouth of the estuary similar to the region above the minimum zone.

Figure J-11-35 shows no unique estuarine zone for the limited total organic carbon data. However, particulate carbon data clearly show a maximum in the region of the expected turbidity maximum, with decreasing zones on either end of this region. A zone of minimum particulate carbon coincides in the general region of the minimum for Total particulate nitrogen. Chlorophyll-a (corrected for presence of pheophytin) from all survey data indicate the upper river is a unique zone. Figure J-11-42 shows data for chlorophyll-a from only the slack survey data and indicate a third zone in the upper river. Pheophytin characterization areas are shown in Figure J-11-36. Highest values are observed in the zone of the turbidity maximum followed by a peak in the region where TPC, TPN and TPP reach a minimum and following the zone where a chlorophyll-a minimum changes to a lower estuary maximum.

Figure J-11-37 shows the results of the total nitrogen and phosphorus ratio and the redfield ratio (dissolved NH_3+NO_2+NO_3/Ortho-p). Both plots indicate only two zones within the river based upon the range test. Mean values indicate phosphorus limitation from approximately mile 15 to the mouth of the river and from around mile 25 to 40, indicating a mid-estuary nitrogen limitation if one assumes a ratio less than 10 is indicative of a nitrogen limited environment. Figures J-11-38 and J-11-39 show ratios of chlorophyll-a to various water quality variables and the resulting application of the Duncan multiple range test.

Figures J-11-41 through J-11-42 show the same types of plots when only the slack water data are used for characterizing zones of the estuary. Obviously, some differences are noted, however the previous plots from the slack surveys are representative of over one year of monthly slack surveys.

Conservative Mixing of Water Quality Variables

The identification of conservative or non-conservative mixing of water quality variables can be simplistically characterized by scatter plots of a water quality variable versus salinity (9). It is clear that identification of the non-conservative behavior is affected by temporal variations of the inputs, changes in the residence time of the water column or when complex circulation affects the ambient concentration by inducing concentration gradients in the vertical or lateral directions. This technique for identifying the conservative nature of an estuary tends to become more difficult and tentative when two end members are evident (10). Statements regarding potential sources or sinks of nutrients discussed below should be considered in light of the above limitation of this analysis. The following figures represent the mean salinity at a station and the given mean of the water quality variable from the slack survey data, 1980-1981. It should be noted that all stations are mainstem river stations except the fifth station from the mouth of the estuary which is located near the mouth of Langford Creek just outside of the mainstem.

Figure J-11-43 shows the plots of pheophytin and particulate phosphorus versus salinity. A peak concentration of pheophytin is located in the turbidity maximum region. A minimum is observed around nautical mile 15 and a source is observed in the lower estuary. Particulate phosphorus appears to follow the trend of conservative mixing in the upper river, with a potential source at the mouth. Overall, the upper estuary serves as a source of pheophytin and the estuary tends to be a sink for particulate phosphorus.

Figure J-11-44 indicates a unique source of dissolved orthophosphorus in the lower estuary, followed by an upriver sink. The same type of source in the approximate region is indicated for dissolved phosphorus.

Plots of D.O. versus salinity are shown in Figure J-11-45. Although dissolved oxygen is not a conservative substance these plots do indicate the general profile of dissolved oxygen and dissolved oxygen saturation.

Figure J-11-46 indicate the increased turbidity and decreased secchi depth in the expected turbidity maximum region. Conservative mixing plots are shown in Figure J-11-47 for total phosphorus and dissolved total nitrogen. A source for both chemicals are observed in the lower estuary. Figure J-11-48 indicates a source of nitrate in the lower estuary and a potential sink in the upper estuary. Nitrite conservative mixing is not as obvious, with an upper river and lower river sink indicated as well as a mid-river source of nitrite. The lower river sink is indicated by the station at the mouth of Langford Creek. Figure J-11-49 indicates a mid-river source of suspended solids in the region of the turbidity maximum as expected. At the same location, a source of ammonia is indicated. A source of nitrogen in the lower river is indicated by high concentrations at the mouth of the estuary and a sink in the middle region of the estuary. Figure J-11-50 indicates a lower river source of total organic carbon and at the same location, a minimum of chlorophyll-a. Both water quality variables indicate water from Chesapeake Bay may be a source.

A source of dissolved inorganic nitrogen is indicated by Figure J-11-51 and for dissolved organic nitrogen. A lower river maximum of dissolved organic nitrogen is observed at the mouth of Langford Creek and at the mainstem stations around nautical mile 15.

Water Quality Variable Cumulative Frequency Distributions

Cumulative frequency distributions are useful in order to describe not only the general nature of the statistical distribution of a water quality variable but also have been suggested to be used to compare and evaluate variables against a water quality criterion and/or a water quality standard (11). To date no CFD's have been developed for the Chester River. Cumulative frequency distributions are useful because they provide information concerning the extreme values, median concentrations and provide insight into what percent of the time one would expect to observe a value or a concentration range to be exceeded, equal to or less than another value or a standard. Water quality variables are known not to follow a normal distribution, although published literature concerning this fact is quite limited. Due to this fact, care must be taken in applying parametric statistical tests, which in many cases are dependent upon the population being normally distributed.

Figures J-11-52 through J-11-74 show the cumulative frequency distribution plots from the slack water surveys, 1980-1981 conducted for this study. In some instances, rounding values were made in order to provide adequate graphical representations. Each plotting symbol represents a class or grouping. It can be seen that very few of the variables show the s-shape curve representing a normal distribution.

These curves are useful for comparing different aquatic systems. For example, 5 mg/l dissolved oxygen would be expected to occur less than or equal to 10% of the time in the Chester River. The same type of data collected in the Patuxent River during 1980-1981 indicate 5 mg/l dissolved oxygen would be expected to occur less than or equal to 20% of the time. Indicating from this type of quantitative analysis that critical levels of dissolved oxygen occur twice as frequently in the Patuxent River when compared to the Chester River (see Figure J-11-53). Figure J-11-73 indicates chlorophyll-a values of 40 ug/l occur less than or equal to 5% of the time in the Chester River.

Phytoplankton Composition and Abundance*

Section 2 describes the methods used for characterization of the phytoplankton community data collected by Normandaeu Associates, Inc. Samples were collected on October 28, 1980, April 8, 1981 and May 8, 1981. Figures J-11-75 through J-11-79 show the results of the identification of dominant classes of data at the six stations in the mainstem of the estuary.

Additional and more detailed phytoplankton composition and abundance analysis was performed in conjunction with the slack water surveys by Linda Davidson, EPA-CBP, and is discussed below.

Estuaries are characterized by a highly versatile group of environmental variables that under most conditions support a diverse population of phytoplankton species. The more diversified the community of algae is, the more likely it will be useful to a greater variety of organisms which feed upon it. Algae are one of the most important groups due to their position at the base of the food web and their ability to convert inorganic substances into complex organic compounds through photosynthesis. Because of their trophic level position and because they ultimately provide food for commercially important species, it is important to know phytoplankton seasonal distribution and abundance.

Primary producers, such as phytoplankton, clearly reflect chemical changes in water since they use the minerals present as a source of nutrition. Under polluted conditions, shifts in species may occur. Those species that are more tolerant of adverse conditions, or which exploit the abundance of some particular constituent then become dominant. Often the dominant species which occur under these circumstances are undesirable organisms, such as some blue-green algae, which can form noxious blooms such as those reported in the tidal fresh portions of the Potomac River (48). These blooms can represent major changes in the trophic structure of

*written by Linda Davidson, EPA, CBP

an estuary. With the ever-increasing threat of excessive nutrient enrichment in the sub-estuaries of Chesapeake Bay, phytoplankton monitoring becomes imperative. Frequently, the first observable effect of excessive nutrient enrichment is increased standing stocks of algae (49).

To date, no published literature exists which describes an annual phytoplankton cycle on the Chester River. However, Seliger et al. (50) studied phytoplankton populations in the river and adjacent areas of the Bay in relation to "seasonal frontal" and "interfrontal regions" which serve as delivery and retention mechanisms.

As part of a complete watershed study of the Chester River, this project was designed to provide baseline information about the quantitative seasonality of phytoplankton communities in fresh and saltwater portions of the river; and to meet the following specific objectives:

1) To determine the spatial and temporal distribution (composition and abundance) of phytoplankton in surface waters;

2) To determine, at selected sites, the difference between surface and bottom phytoplankton;

3) To ascertain phytoplankton diversity (spatially and temporally); and

4) To determine which classes of phytoplankton are dominant during the annual cycle.

During eight sampling surveys in which each of the seasons was represented the Chester River was sampled at six stations from the freshwater portion to the mouth of the river. Total cell counts and seasonal dominant class information were compared to other estuaries.

Between November 1980 and September 1981 eight sampling surveys were conducted at six stations (Figure 2-7, Table 2-5) in the Chester River. One set of water samples was taken at 1 meter depth with a 5-liter PVC Nisken water bottle. A 2-liter sample was drawn and preserved with acid-Lugol's solution. Bottom samples were taken concurrently at selected stations during the months of May and August and preserved in the same manner as the 1 meter samples. All samples were taken during high slack tide. Temperature, salinity, dissolved oxygen and pH measurements were also obtained.

Samples were concentrated by settling in a graduated cylinder for at least 24 hours, siphoning off all but 150-200 mls, and centrifuging at 2000 rpm for 15 minutes (47). The upper volume in the centrifuge tubes was decanted until 20 mls of the sample remained. Formaldehyde (2.2 mls) was added to insure preservation. Samples were stored in the dark until they could be examined.

Before examinations were made, each sample was diluted to a volume of the 25 mls. Identification and enumeration were done at 400X on an inverted microscope. A Palmer-Maloney cell cavity was filled with an aliquot of the 25 ml sample. Twenty randomly selected fields (Whipple grids) were examined for each sample (47). Phytoplankton greater than 10 um was recorded by genera (species where possible) in numbers of organisms per ml. Cells less than 10 um were counted only. All filamentous and colonial organisms were counted as one individual even though each one contained three or more cells. The density of organisms per ml was calculated as follows:

$$C \times \frac{1,000\ m^3}{A \times D \times F}, \qquad (11\text{-}3)$$

Where:

C = number of organisms counted
A = area of a field (Whipple grid image), mm^2
D = depth of a field (Palmer-Maloney cell depth), mm
F = number of fields counted (American Public Health Assoc. 1975).

This number was divided by a correction factor (80) to adjust for concentration of the sample.

Statistical Analysis

The Shannon Weaver Diversity index (45) was computed for each station and month combination (at the genus level) using the following formula:

$$H = -(n_i/N)\log(n_i/N)$$

$$= -Pi \log Pi$$

where:

n_i = importance value for each species
N = total of importance values
Pi = (n_i/N)=importance probability for each species

Measures of similarity of taxonomic composition, at the genus level, were computed for all possible station pairs for each month sampled. The Bray-Curtis index was employed to compute similarity percentages based on raw counts, percent of total cell number and the natural log of the count plus one (51).

Table J-11-4 lists the phytoplankton genera found in the Chester River during the eight month survey. Stations at nautical mile 5.5, 8.5, 16, 21.3 and 28 were fairly similar in the types of phytoplankton seen, showing some differences depending on the salinity. As expected, Station CYR0004 (at nautical mile 41.0), located in the tidal freshwater area did have many typically freshwater genera which did not occur at the other stations and many more individuals representative of the green (Chlorophyta) and blue-green (Cyanophyta) algal groups.

Figure J-11-80 summarizes the estimated phytoplankton cells per ml for the entire river over the sampling periods from November 1980 to September 1981. The river experienced two peaks in phytoplankton numbers, one in winter due to large blooms of diatoms (Bacillariophyta) and nannoplankton (cells less than 10 um), and again in the late summer due to a diverse population of phytoplankton. Because of an oversite, nannoplankton were not counted in the November sample, therefore, these numbers could be much higher. The December cell count was highest with approximately 60,000 cells/ml and the June count of approximately 21,000 cells/ml was the lowest.

Dominant classes of phytoplankton shift with the changing of the season. Diatoms dominate in the months of November, December, and March with dinoflagellates (Pyrrophyta) as subdominants. It is likely that diatoms dominate throughout the winter season including January and February (two months in which were not sampled). Warmer temperatures in May, June and July help shift the dominant position to the dinoflagellates. Diatoms regain dominant status toward the end of summer and hold it throughout August and September. Nannoplankton were present in fairly good proportions throughout all the sampling periods and were at their peak during the month of December.

Samples for the months of March and May showed that blue-greens were relatively more abundant than for other months. This is due to the presence of a single genus, tentatively called Synechocystis sp. which averaged approximately 1600 and 1400 cells/ml in March and May respectively. Normally this organism was sited in groups of four cells but was counted as one organism. Therefore, the number reported could be as high as four times that amount in cells/ml. All filamentous and colonial organisms including Skeletonema costatum were counted as one individual even though each one contained three or more cells. This method of counting phytoplankton is very common, and it is important to note that this practice leads to bias when phytoplankton biomass estimates are attempted.

Skeletonema costatum reached bloom conditions during November and December at all stations, except station B with cell counts ranging from 1600 to 12,700 cells/ml. By March S. costatum had virtually disappeared from the river. Melosira sp. a pollutant-tolerant individual (Parrish 1975), was ubiquitous in the river at all seasons of the year and reached maximum cell density in March at stations XHG1537 and XGG9572 with cell counts of 3900 and 4200 cells/ml respectively and in August at stations XHG1537 (3400 cells/ml), XGG9572 (4800 cells/ml), XHH5301 (3900 cells/ml), and XHH8354 (2700 cells/ml). Station CYR0004 experienced blooms of Chlamydomonas sp. (5600 cells/ml) in July and Cyclotella sp. (3300 cells/ml) and Thalassiosira (3100 cells/ml) in August. Oscillatoria sp. was seen in fairly small numbers at all stations throughout the spring and summer but in July at station XIH2463, its numbers escalated to approximately 2700 cells/ml.

Figure J-11-80 summarizes the estimated phytoplankton cells per ml for the entire river over the sampling periods from November 1980 to September 1981. The river experienced two peaks in phytoplankton numbers, one in winter due to large blooms of diatoms (Bacillariophyta) and nannoplankton (cells less than 10 um), and again in the late summer due to a diverse population of phytoplankton. Because of an oversite, nannoplankton were not counted in the November sample, therefore, these numbers could be much higher. The December cell count was highest with approximately 60,000 cells/ml and the June count of approximately 21,000 cells/ml was the lowest.

Dominant classes of phytoplankton shift with the changing of the season. Diatoms dominate in the months of November, December, and March with dinoflagellates (Pyrrophyta) as subdominants. It is likely that diatoms dominate throughout the winter season including January and February (two months in which were not sampled). Warmer temperatures in May, June and July help shift the dominant position to the dinoflagellates. Diatoms regain dominant status toward the end of summer and hold it throughout August and September. Nannoplankton were present in fairly good proportions throughout all the sampling periods and were at their peak during the month of December.

Samples for the months of March and May showed that blue-greens were relatively more abundant than for other months. This is due to the presence of a single genus, tentatively called Synechocystis sp. which averaged approximately 1600 and 1400 cells/ml in March and May respectively. Normally this organism was sited in groups of four cells but was counted as one organism. Therefore, the number reported could be as high as four times that amount in cells/ml. All filamentous and colonial organisms including <u>Skeletonema costatum</u> were counted as one individual even though each one contained three or more cells. This method of counting phytoplankton is very common, and it is important to note that this practice leads to bias when phytoplankton biomass estimates are attempted.

<u>Skeletonema costatum</u> reached bloom conditions during November and December at all stations, except station B with cell counts ranging from 1600 to 12,700 cells/ml. By March <u>S. costatum</u> had virtually disappeared from the river. Melosira sp. a pollutant-tolerant individual (Parrish 1975), was ubiquitous in the river at all seasons of the year and reached maximum cell density in March at stations XHG1537 and XGG9572 with cell counts of 3900 and 4200 cells/ml respectively and in August at stations XHG1537 (3400 cells/ml), XGG9572 (4800 cells/ml), XHH5301 (3900 cells/ml), and XHH8354 (2700 cells/ml). Station CYR0004 experienced blooms of Chlamydomonas sp. (5600 cells/ml) in July and Cyclotella sp. (3300 cells/ml) and Thalassiosira (3100 cells/ml) in August. Oscillatoria sp. was seen in fairly small numbers at all stations throughout the spring and summer but in July at station XIH2463, its numbers escalated to approximately 2700 cells/ml.

Stations at nautical miles 5.5 and 8.5 were very similar in phytoplankton class dominance analysis (Figures J-11-81 and J-11-82). Nannoplankton were dominant at both stations during July. Since individuals from this group were counted only, their classifications are uncertain. Aside from the nannoplankton counts, every month showed dominance by diatoms except May, which showed co-dominance of blue-greens and dinoflagellates, and June where dinoflagellates were paramount.

Stations at nautical miles 16.0 and 21.3 (Figures J-11-83 and J-11-84) revealed similar patterns in their class dominance. Dinoflagellates dominated during May, June and July with blue-greens as a co-dominate at nautical mile 16.0 during July. Another increase of dinoflagellates occurred in September at nautical mile 16.0 monopolized by the presence of a species of uncertain genus (Heterocapsa sp. or Glenodinium sp.). Diatoms dominated in all other months. Nannoplankton counts were greatest in December at nautical mile 21.3 and in July at nautical mile 16.0.

The upper two estuary stations (CYR0004 and XIH2463) (Figures J-11-85 and J-11-86) stand alone in their profile analyses; that is, they are significantly different from the other stations and different from each other. Diatoms were dominant at nautical mile 28 during the months of November, December, August and September. The November numbers were elevated due to the presence of Skeletonema costatum in bloom proportions (5800 cells/ml). The blue-greens monopolized this station during March with blooms of Synechociptis sp. (3300 cells/ml). As a group, the nannoplankton dominated in December and May at both upper stations. Diatoms dominated at station CYR0004 in all months except May, when there were larger numbers of blue-greens and in July when the green algae proliferated. Most of the diatoms found at this station have been described as pollutant-tolerant individuals (EPA 1975) such as Nitzchia sp., Melosira sp., and Cyclotella sp.. The large numbers of green algae present in July were a result of blooms by Chlanydomonas sp. (5600 cells/ml). This July survey also revealed large cell counts of a green algae, Oscillatoria subbrevis (1013 cells/ml) and a dinoflagellate Glenodinum sp. (3300 cells/ml).

Table J-11-5 summarizes the dominant phytoplankton individuals for each sampling period. Prolific diatoms were Skeletonema costatum and Melosira sp. from nautical mile 5.5 upriver to nautical mile 28 and Cyclotella sp. and Melosira sp. at station B. Among the dinoflagellates which subjugated the river during May and June, Prorocentrum minimum and Gyrodinium estuariale occurred most frequently and in the greatest numbers.

During May and August bottom samples were collected at stations XHH5301 (8 meters), XGG9572 (8 meters) and XHG1537 (9 meters). In May at station XHH5301 (Figure 11-87) the bottom sample had equal numbers of diatoms and dinoflagellates where as at one meter the dinoflagellates were dominate. In August the dinoflagellates had virtually disappeared from the bottom waters and were beginning to diminish at the one meter depth. Both depths were dominated by diatoms.

Dinoflagellates comprised the largest percentage of the phytoplankton in bottom waters at nautical mile 8.5 (Figure J-11-88) in May. Very few diatoms were present. At one meter, all classes were represented. By August both depths were dominated by diatoms, however, the bottom waters were devoid of dinoflagellates.

Station XHG1537, at nautical mile 5.5, (Figure J-11-89) demonstrated the same pattern as shown at nautical miles 8.5 16.0, i.e., dinoflagellates being numerous in bottom waters during May and virtually disappearing by August. The major dinoflagellate in these bottom waters was *Prorocentrum minimum*. *Prorocentrum* moves up the Chesapeake Bay entrained in the northward-flowing bottom waters. By late spring, it reaches the upper Bay and its tributaries and is eventually pushed toward the surface where blooms occur. Significant numbers of *P. minimum* were present in the surface waters of the Chester River during May and June 1981.

Phytoplankton identified from the six stations in the Chester River were classified in eight taxonomic categories: Cyanophyta, Chlorophyta, Chrysophyta, Bacillariophyta (Centrales and Pennales), Pyrrophyta, Euglenophyta, Cryptophyta, and Nannoplankton. One group, the nannoplankton, is not a formal category. It consists of single celled phytoplankton, less than 10 um in size, that are too small and too obscure for accurate identification. If their classifications were known, it is likely that many of these tiny phytoplankters would fit into the other seven categories.

Most aquatic systems experience two seasonal peaks in phytoplankton abundance, one in spring and a lesser one in the fall. Estuarine phytoplankton tend to alter this pattern somewhat due to high turbidity and rapid circulation preventing the development of thermoclines in the estuary (52). Spring is generally accompanied by high phytoplankton growth which increases throughout the summer until temperatures and light intensity begin to decline in the fall (52). This pattern was the case in the Pataspco River in 1970-1971 (53). The Chester River in 1980-1981 altered this pattern. Maximum cell counts (averaged for all stations) occurred in December (10,000 cells per ml) with the next highest counts occurring in summer (July and August) (8,000 cells per ml). The lowest total cell counts occurred during June at 3,500 cells per ml. A recent study of the Patuxent River (28) showed average phytoplankton cell counts as high as 12,600 per ml in July 1980 and 13,170 per ml in April 1981.

Nannoplankton

The nannoplankton were not identified but it was felt that they should be counted and included in the total counts. The importance of these small organisms should not be overlooked. In many surveys they are ignored totally. Their importance as food for oysters was demonstrated by Gaarder

(1933), Haven and Morales-Alamo (1970)(54)(55). Their importance in the total phytoplankton productivity was pointed out by McCarthy et al. (1974), Van Valkenburg and Flemer (1974) who stated that the nannoplankton can comprise between 75-93 percent of the phytoplankton population (56)(57).

Studies in Narragansett Bay, Rhode Island found that the net phytoplankton dominated during the winter-spring bloom but the nannoplankters were equally as important as the net phytoplankton during the rest of the year (58). In Gales Creek, North Carolina, the nannoplankton (microflagellates) dominated the phytoplankton most of the year (59). This latter observation was also the case in the Chester River during the 1980-1981 sampling survey.

Table 11-6 lists nannoplankton percentages of the phytoplankton population.

TABLE 11-6. PERCENT NANNOPLANKTON (CELLS LESS THAN 10 uM IN PHYTOPLANKTON SAMPLES FROM THE CHESTER RIVER

	Stations (in nautical mile)**					
Date	41.0	28.0	21.3	16.0	8.5	5.5
December 15, 1980	76	71	60	30	18	24
March 11, 1981	24	79	59	39	29	27
May 27, 1981	77	51	51	40	41	49
June 18, 1981	9	27	29	32	22	14
July 27, 1981	0.4	18	8	52	57	63
August 20, 1981	32	30	27	9	16	35
September 27, 1981	15	5	7	17	12	22

*Percentages include the blue-green, Synechocystis
**For station ID's look at Table 2.5

Diatoms

Blooms of diatoms may occur once or several times a year in Chesapeake Bay (60). Often these blooms are associated with spring and fall. Riley (1959) found a winter pulse between January and March in Long Island Sound as well as an autumn bloom between August and October (61). This was also the case in the Chester River during 1980 and 1981. The November, December, and March pulse of diatoms was due primarily to blooms of Skeletonema costatus and the August, September flowering to Melosira sp.

Although it has been noted that S. costatum prefers cool water for its best development, in a 1964 survey of the James River estuary, S. costatum was the most abundant species during several months of the year including (62)(63). In the Chester River, S. costatum was dominant during the winter season and was replaced by Melosira sp. during the months when water temperatures were warmer. Marshall reported that phytoplankton in the James estuary were most abundant in January through March (63). This was also true in the Chester River. In the James River estuary the diatom succession was from S. costatum to Asterionella japonica and Nitzschia pungens. In the Chester River, Melosira, along with Cyclotella and Thalassiosira followed S. costatum.

Dinoflagellates

Gyrodinium estuariale, Prorocentrum minimum, Gymnodinium sp. and Amphidinium sp. were the most numerous dinoflagellates in the river. All of these were abundant in the river from May to July. G. estuariale and P. minimum were the two most common species to be seen.

G. estuariale is a euryhaline species found in waters from 5 to 31 ppt salinity (59). In the Chester River it was found in samples of salinity from 4 to 14 ppt (Figure J-11-90).

P. minimum is also a euryhaline species found in waters from 1 to 33 ppt salinity (59). It was found in the Chester River in every month sampled. The growth rate of P. minimum is dependent on temperature and salinity which helps to restrict its year-round distribution to the high-salinity waters of the southern Bay (46). In summer when temperatures rise and there is an increased tolerance to low salinities, P. minimum can move up the Bay. Tyler and Seliger described the mechanism by which P. minimum is transported up the Bay (46). This mechanism is the northward flowing bottom waters. P. minimum can assimilate carbon at low light intensities and maintain a reduced respiration rate in winter temperatures. This enables them to survive throughout the subsurface transport. The warm water temperatures enable P. minimum to survive in lower salinities found in the upper Bay. In 1976, P. minimum was delivered up Bay too early when water temperatures were still low. Growth rates were, in turn, greatly reduced (46). In summer the surface waters are nutrient poor, but P. minimum is able to migrate at night to the nutrient rich bottom waters below the pycnocline (46).

Tyler and Seliger report that P. minimum is absent from low salinity waters of the upper Bay during winter, however, this was not the case in the Chester River during 1980-1981 when it was present in every month sampled. Allison sited P. minimum at Kent Narrows in eastern Bay and in the main Bay at Sandy Point in December, 1981 (64).

Green Algae

Each of the six stations had some representatives of the green algae. The upper estuary stations, at nautical miles 41.0 and 28.0 had the greatest numbers of different genera occurring throughout the year but being most numerous during the summer. Ankistrodesmus falcatus and Scenedesmus sp. were common at station B and station 13 and were seen occasionally at the more saline stations.

In September an unidentified colonial green was the dominant species at nautical mile 16.0 (916 cells per ml) and nautical mile 21.3 (434 cells per ml). It ranges in size from 17.5 to 20 um and has an invagination on one side. It looks very much like a stage of Eudorina involved in plakeal development (65). However, no other stages of Eudorina were seen.

In general, green algae are usually restricted to the more fresh water regions. Table 11-7 shows the green algae percentages for all stations with the larger figures at nautical mile 41.0 (.01 - 1 ppt salinity) and nautical mile 28.0 (4.0 to 8.3 ppt salinity). The only exception to this observation was at nautical mile 21.3 (5 - 12 ppt salinity) and nautical mile 16.0 (9.6 - 14.6 ppt salinity) which had 38 percent and 24 percent green algae, respectively, during September, 1981. This was due to the appearance of the unidentified colonial green described above, which was most numerous in this area of the river.

TABLE 11-7. PERCENT GREEN ALGAE IN PHYTOPLANKTON SAMPLES FROM THE CHESTER RIVER

	Stations (in nautical mile)					
Date	41.0	28.0	21.3	16.0	8.5	5.5
November 24, 1980	9	0.6	0	0	0	0
December 15, 1980	1	6	1	0	0.4	0.6
March 11, 1981	10	1	0	2	2	2
May 27, 1981	8	4	2	2	7	13
June 18, 1981	37	5	0	0	3	2
July 27, 1981	53	7	0	2	0	0.9
August 20, 1981	11	4	0	4	1	0
September 27, 1981	14	9	38	24	16	9

Blue-Green Algae

Twelve genera of blue-greens were represented in the Chester River. Anabaena sp. and Calothrix sp. were the only heterocyst forming genera present. Heterocysts are differentiated cells found in some blue-greens and are believed to be involved in nitrogen fixation (66). The ability to fix nitrogen from the atmosphere can give blue-greens an advantage in a situation where nitrogen is the limiting nutrient in the water column. Both Calothrix sp. and Anabaena sp., however, were very rare and seen only at station B during July.

Some non-hetreocystous blue-greens have also been reported to be capable of nitrogen fixation (66). Among those cited were Oscillatoria sub-brevis and Chroococcus sp., both of which were also seen in the Chester River. Chroococcus sp. was rare and seen only at nautical miles 28.0 and 16.0 during July (289 and 820 cells per ml, respectively). Oscillatoria sub-brevis, however, was only slightly more numerous (1,013 cells per ml) and found only at station B in July.

An unknown species of Oscillatoria with cell dimensions of 2.5 x 5 um was present at every station except XHH5301 (at nautical mile 16.0). It was found in greatest numbers at nautical mile 28.0 with the maximum count at 2,749 cells per ml in July. This small species has been sited in other areas of the upper main Bay and the Gunpowder River in recent surveys (Jim Allison, personal communication; Kevin Sellner, personal communication).

The most prolific blue-green was what we are tentatively calling Synechocystis sp. (67). It is a coccoid species, 4 um in size, with no visible gelatinous envelope, and is usually seen in groups of four cells. It was present at all stations and reached maximum cell density (3,376 cells per ml) in March at nautical mile 28.0.

Each of the six sampling stations had at least two different blue-greens present at some time during the eight surveys with the upper stations CYR0004 and XIH2463 having the greatest numbers of different genera. As a group the blue-greens dominated the phytoplankton at nautical mile 5.5 in May and nautical mile 28.0 in March and July.

Increases in nutrient enrichment are frequently expressed by increases in standing stocks of algae (49). If the algae produced are beneficial species which are readily used for food by zooplankton and other higher trophic level organisms, then enrichment can be a positive matter. However, increased enrichment, especially in the more fresh water regions, often causes blooms of nuisance and/or noxious algae such as many of the blue-greens. These types of blooms can represent major shifts in the trophic structure.

A good example of the effects of excessive nutrient enrichment followed by persistent blooms of bluegreens has been seen in the Potomac River. Under maximum bloom conditions in September 1978 the blue-greens amounted to 80 percent of the phytoplankton population with total cell counts ranging from 60 to 80 million cells per liter (48). The Chester River has not yet apprached this scenario, however, nutrient enrichment has been on the increase (68) and if it continues we can expect to see changes from the present phytoplankton species succession.

Other Algae

Euglenophyta, Cryptophyta, and Chrysophyta were listed under the category, "other algae", (Figures J-11-90 to J-11-95) since they are not major contributors to the Chester River phytoplankton population. This is not meant to imply that they are not important species but simply that their numbers were very small.

Euglenophyta--

Euglenophyta was represented by three genera: Eutreptia sp., Phacus sp., and Euglena sp. Phacus sp. was seen only once during the sampling period and thus is not statistically significant. Euglena sp. occurred in relatively small numbers (579 cells per ml.) at station CYR0004 in the September sample. Eutreptia sp. was the most common of the three Euglenoids occurring at all stations except CYR0004 during different months of the year but in very small numbers (never more than 145 cells per ml.).

Euglenoids are widely distributed, occurring in freshwater, and brackish as well as marine waters. Euglena and Phacus are generally found in freshwater although some species of Phacus may be found in marine waters (Bold and Wynne 1978). Eutreptia is a Euglena-like organism with two flagella as opposed to one flagella in Euglena. It occurs mostly in marine and brackish waters.

Cryptophyta--

This division contains a relatively small group of biflagellate organisms which may be found in freshwater as well as marine habitats. In the Chester River, Chroomonas was the only genus representing the Cryptophytes, however, there were at least two different species. It was found at all stations during most of the summer months sampled. The highest concentrations were at station CYR0004 in September (723 cells per ml) and at station XHH5301 (627 cells per ml) and XGG9572 (531 cells per ml) in June.

Chrysophyta--

The golden algae were represented solely by Ochromonas sp. which occurred at stations XHH5301 and XGG9572 during July. These single celled, biflagellate algae are capable of heterotrophy as well as photosynthesis. Normally they appear to be teardrop shaped, however, this shape will become more oval after the cells have engulfed food (Bold and Wynne 1978).

Diversity and Similarity

Shannon Wiever diversity indices are listed in Table 11-8. Analysis of variance indicated strong evidence (significance level 0.0002) to support the existence of differences in diversity means between dates but not between stations. Several post hoc multiple comparison tests were employed. The results of Boniferroni's t-test (significance level 0.05) were as follows:

1. Diversity on November 24, 1980 was significantly less than on June 24, 1981 and September 27, 1981.

2. Samples from March 11, 1981 were less diverse than those from September 27, 1981.

Although diversity was low in November, the total cell count was among the highest for the sampling period. Genera richness, based on numbers of different individuals present, (Figure J-11-92) for most of the stations increased throughout the summer and reached a peak in September. The peak for stations 51 and 34, however, was in July.

TABLE 11-8. SHANNON-WIEVER DIVERSITY INDICES FOR PHYTOPLANKTON SAMPLES FROM THE CHESTER RIVER

	Stations (in nautical mile)					
Date	41.0	28.0	21.3	16.0	8.5	5.5
November	2.3	1.0	0.8	0.8	1.2	1.5
December 15, 1980	2.0	2.1	1.3	1.3	1.4	1.5
March 11, 1981	2.1	1.2	1.4	1.4	0.8	1.2
May 27, 1981	1.6	2.1	2.3	1.5	2.0	1.6
June 18, 1981	2.3	2.5	1.9	1.8	2.3	1.6
July 27, 1981	1.5	1.6	2.2	2.5	1.8	2.5
August 20, 1981	2.3	2.1	1.6	1.0	1.5	1.5
September 27, 1981	2.8	2.6	2.4	2.0	2.5	2.5

The Bray-Curtis index was employed to compute similarity percentages based on (1) raw counts, (2) percent of total cell number, and (3) the natural log of the count plus one (51). The results of these three tests differed slightly due to inherent biases. The similarity based on raw counts test is dominated by numerically abundant genera, while the natural log method is very sensitive to less abundant genera. The method based on the percentage of total cells ignores differences in absolute abundance and focuses on proportions.

Raw counts--

On November 24, 1980 stations at nautical miles 21.3 and 16.0 showed the highest degree of similarity (85.7 percent) of all the station pairs for each date.

Percent of total cell number--

Station pairs XHH8354/XIH2463, XHH8354/XHH5301 and XIH2463/XHH5301 showed high degrees of similarity on November 24, 1980 (92.4, 94.8 and 87.6 percent respectively). Station pair XGG9572/XHG1537 was 86.7 percent and 86.2 percent similar on March 11, 1981 and August 20, 1981, respectively.

Natural log of count plus one--

The highest degree of similarity (85.5 percent) was shown between stations XGG9572 and XHG1537 on September 27, 1981.

During the November 1980 to September 1981 phytoplankton sampling period, the Chester River demonstrated a somewhat different seasonal pattern than is normally reported for other sub-estuaries. Instead of the usual peaks which occur in spring and late summer, the Chester River experienced a major peak in winter and a lesser one in summer. The river was dominated by diatoms during the winter and early spring, dinoflagellates during May and June, and diatoms toward the end of summer.

Nannoplankton percentages ranged from 0.4 to 79 percent. The highest percentages were found from stations at nautical miles 41.0 through 21.3 during December, March and May. The highest percentages for the more saline stations, XHH5301, XGG9572, XHG1537 were recorded in July.

Although Prococentrium minimum is generally thought to be restricted to the lower Bay during winter, it was seen in the Chester River in every month sampled during 1980-1981.

Most of the green and blue-green algae were restricted to the two stations (CYR0004 and XIH2463) closest to the head waters of the river, however, all stations at one time or another did have representatives of these two groups.

Total cell counts in the Chester River were not as high as those reported in the Patuxent River (28) or in some areas of the upper Bay (64). Since the author is unaware of other phytoplankton data that may exist for the Chester River, it is impossible to ascertain whether or not total cell counts have begun to increase due to increased nutrient enrichment. However, in comparison to other estuaries, total cell counts in the Chester River during this survey do not appear to be extremely high. In addition, there were no persistent blooms of blue-green algae although this group was well represented throughout the sampling period and even at the more saline stations near the mouth of the river.

Percent of total cell number--

Station pairs XHH8354/XIH2463, XHH8354/XHH5301 and XIH2463/XHH5301 showed high degrees of similarity on November 24, 1980 (92.4, 94.8 and 87.6 percent respectively). Station pair XGG9572/XHG1537 was 86.7 percent and 86.2 percent similar on March 11, 1981 and August 20, 1981, respectively.

Natural log of count plus one--

The highest degree of similarity (85.5 percent) was shown between stations XGG9572 and XHG1537 on September 27, 1981.

During the November 1980 to September 1981 phytoplankton sampling period, the Chester River demonstrated a somewhat different seasonal pattern than is normally reported for other sub-estuaries. Instead of the usual peaks which occur in spring and late summer, the Chester River experienced a major peak in winter and a lesser one in summer. The river was dominated by diatoms during the winter and early spring, dinoflagellates during May and June, and diatoms toward the end of summer.

Nannoplankton percentages ranged from 0.4 to 79 percent. The highest percentages were found from stations at nautical miles 41.0 through 21.3 during December, March and May. The highest percentages for the more saline stations, XHH5301, XGG9572, XHG1537 were recorded in July.

Although Prococentrium minimum is generally thought to be restricted to the lower Bay during winter, it was seen in the Chester River in every month sampled during 1980-1981.

Most of the green and blue-green algae were restricted to the two stations (CYR0004 and XIH2463) closest to the head waters of the river, however, all stations at one time or another did have representatives of these two groups.

Total cell counts in the Chester River were not as high as those reported in the Patuxent River (28) or in some areas of the upper Bay (64). Since the author is unaware of other phytoplankton data that may exist for the Chester River, it is impossible to ascertain whether or not total cell counts have begun to increase due to increased nutrient enrichment. However, in comparison to other estuaries, total cell counts in the Chester River during this survey do not appear to be extremely high. In addition, there were no persistent blooms of blue-green algae although this group was well represented throughout the sampling period and even at the more saline stations near the mouth of the river.

Percent of total cell number--

Station pairs XHH8354/XIH2463, XHH8354/XHH5301 and XIH2463/XHH5301 showed high degrees of similarity on November 24, 1980 (92.4, 94.8 and 87.6 percent respectively). Station pair XGG9572/XHG1537 was 86.7 percent and 86.2 percent similar on March 11, 1981 and August 20, 1981, respectively.

Natural log of count plus one--

The highest degree of similarity (85.5 percent) was shown between stations XGG9572 and XHG1537 on September 27, 1981.

During the November 1980 to September 1981 phytoplankton sampling period, the Chester River demonstrated a somewhat different seasonal pattern than is normally reported for other sub-estuaries. Instead of the usual peaks which occur in spring and late summer, the Chester River experienced a major peak in winter and a lesser one in summer. The river was dominated by diatoms during the winter and early spring, dinoflagellates during May and June, and diatoms toward the end of summer.

Nannoplankton percentages ranged from 0.4 to 79 percent. The highest percentages were found from stations at nautical miles 41.0 through 21.3 during December, March and May. The highest percentages for the more saline stations, XHH5301, XGG9572, XHG1537 were recorded in July.

Although Prococentrium minimum is generally thought to be restricted to the lower Bay during winter, it was seen in the Chester River in every month sampled during 1980-1981.

Most of the green and blue-green algae were restricted to the two stations (CYR0004 and XIH2463) closest to the head waters of the river, however, all stations at one time or another did have representatives of these two groups.

Total cell counts in the Chester River were not as high as those reported in the Patuxent River (28) or in some areas of the upper Bay (64). Since the author is unaware of other phytoplankton data that may exist for the Chester River, it is impossible to ascertain whether or not total cell counts have begun to increase due to increased nutrient enrichment. However, in comparison to other estuaries, total cell counts in the Chester River during this survey do not appear to be extremely high. In addition, there were no persistent blooms of blue-green algae although this group was well represented throughout the sampling period and even at the more saline stations near the mouth of the river.

REFERENCES

1. Normandeau Associates, Inc. Evaluation of Water Quality in the Chester River Basin: Data Acquisition. Prepared for DNR, Tidewater Administration, Annapolis, Maryland, 1982.

2. Environmental Protection Agency. Methods of Chemical Analysis of Water and Wastes. EPA 625/6-74-003 and EPA 600/4-79-020, U.S. Environmental Protection Agency, Cincinnati, Ohio, 1974, 1979.

3. Strickland, J.D.H. and T.R. Parsons. A Practical Handbook of Seawater Analysis. Bull. No. 167, Fisheries Research Board, Ottawa, Canada, 1972. 310 pp.

4. Vollenweider, R.A. Manual of Methods for Measuring Primary Production in Aquatic Environments. IPB Handbook No. 12, Blackwell Scientific Publications, Oxford, England, 1974. 34 pp.

5. Culno, R.F. Automatic Micro Determination of Carbon, Hydrogen and Nitrogen; Improved Combustion Train and Handling Techniques. Mikrochim Acta, 1975.

6. Sorokin, T.I. and H. Kadota. Techniques for the Assessment of Microbial Production and Decomposition in Fresh Water. IBP Handbook No. 23, Blackwell Scientific, Oxford, England, 1972. 112 pp.

7. Environmental Protection Agency. CFP Federal Register, Volume 44, Part 136, 1979.

8. Standard Methods for the Examination of Water and Wastewater. 14th Edition, APWA, AWWA, WPCF, Washington, D.C., 1975.

9. Jirka, A.M. Ultramicro Semi Automated Method for Simultaneous Determination of Total Phosphorus and Total Kjeldahl Nitrogen in Wastewaters. Environmental Science and Technology, Vol. 10, October, 1976.

10. U.S. Dept. of Agriculture. Manual of Agricultural Hydrology, 1979.

11. Normandeau Associates, Inc. Evaluation of Water Quality in the Chester River Basin; Data Appendices, Volume I. Prepared for DNR, Tidewater Administration, Annapolis, Maryland, 1982.

12. Schneider Instruments. Operations and Service Manual for Schneider Robot Monitor Model RM-25, August, 1973.

13. Talling and Driner 1963.

14. Chanlett, E.T. Environmental Protection. McGraw-Hill, Inc., New York, NY, 1979.

15. Ayars, J.E., J.C. Inman, and G. McClung. Nonpoint Contributions from Agricultural Activities in the Maryland Piedmont. In: Nonpoint Pollution Control; Tools and Techniques for the Future. Flynn, K.C. ed. Rockville, MD, 1981. 74 pp.

16. Potter, N. A Local Urban Perspective on Nonpoint Pollution Control. In: Nonpoint Pollution Control, Tools and Techniques for the Future. Flynn, K.C. ed. Rockville, MD, 1981. 30 pp.

17. Glaze, W.H., J.L. Burleson, J.E. Henderson IV, P.C. Jones, W. Kinsley, G.R. Peyton, R. Rawley, F.Y. Saleh and G. Smith. Analysis of Chlorinated Organic Compounds Formed During Chlorination of Wastewater Products. EPA-600/S4-82-072 Environmental Research Laboratory, Athens, GA, 1983.

18. Boicourt, W.C. Flow Measurements in the Patuxent and Chester Rivers, Summer 1980. Interior Report to Tidewater Administration, Maryland Department of Natural Resources, Chesapeake Bay Institute, Johns Hopkins University, 1981. 19 pp.

19. Joint Investigation by the Maryland Department of Natural Resources and Westinghouse Electric Corporation, Chester River Study, Volume II, Clark W.D. and H.D. Palmer, eds. 1972.

20. Ambrose, R.B. and D.W. Dallas. Comparison of Simple Methods for Predicting the Fate of Chemicals in the Chester River. In: Proceedings Symposium of the Development Use and Value of Water Quality Standards. Bell B. and C.R. Bostater eds. Washington, D.C., 1980. 300 pp.

21. Davis, M.J., M.K. Snyder and J.W. Nebgen. River Basin Validation of the Water Quality Assessment Methodology for Screening Nondesignated 208 Areas. Volume II. In: Chesapeake-Sandusky Nondesignated 208 Screening Methodology Demonstration. EPA 600/S3-82-057 Environmental Research Laboratory, Athens, Ga., 1982.

22. Dean 1981 (flushing time)

23. Ippen, A.T. Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, NY, 1966.

24. U.S. Environmental Protection Agency. Basic Models of Natural Water Systems. Contract No. 68-01-5919, Manhattan College, NY, 1980.

25. Delaware/Maryland (USGS Morgan Creek data report)

26. University of California. BMDP Biomedical Computer Programs, P-Series. University of California Press, Los Angeles, California, 1979.

27. Environmental Protection Agency. Chesapeake Bay Program Technical Studies: A Synthesis. EPA-CBP, Annapolis, Maryland, 1982.

28. Bostater, C., D. McCrancy, S. Berlett and D. Pushkar. Intensive Watershed Study; The Patuxent River Basin. DNR, Tidewater Administration, EPA-CBP, Annapolis, Maryland, 1982.

29. Normandeau Associates, Inc. Evaluation of Water Quality in the Chester River Basin. Data Appendices, Volume II. Prepared for DNR, Tidewater Administration, Annapolis, Maryland, 1982.

30. O'Connor, D.J. Modeling of Eutrophication in Estuaries. In: Estuaries and Nutrients, B.J. Neilson and L.E. Cronin, eds. Humana Press, Clifton, New Jersey, 1981. pp. 183-223.

31. Monbet, Y., F. Manaud, P. Gentien, M. Pommepuy, G.P. Allen, J.C. Salomon and J. L'Yavanc. The Use of Nutrient, Salinity and Water Circulation Data as a Tool for Coastal Zone Planning. In: Estuaries and Nutrients, B.J. Neilson and L.E. Cronin, eds. Humana Press, Clifton, New Jersey, 1981, pp.

32. Jaworski, N.A. Sources of Nutrients and the Scale of Eutrophication Problems in Estuaries. In: Estuaries and Nutrients, B.J. Neilson and L.E. Cronin, eds. Humana Press, Clifton, New Jersey, 1981, pp.

33. Bostater, C.R., R.B. Ambrose and B. Bell. Modeling the Fate and Transport of Chemicals in Estuaries: Current Approaches and Future Needs. In: Aquatic Toxicology and Hazard Assessment, Branson and Dickson, eds. ASTM, PCN 04-7-37000-16, Philadelphia, Pa., 1979.

34. U.S. Dept. of Commerce, NOAA. Climatological Data for Maryland and Delaware; May, June, July, August, September. Daily Precipitation Records, 1981.

35. Liss, P.S. Conservative and Non-Conservative Behaviour of Dissolved Constituents during Estuarine Mixing. In: Estuarine Chemistry, J.D. Burton and P.S. Liss, eds. Academic Press, New York, New York, 1976, pp. 93-126.

36. Pomeroy, L.R., E.E. Smith and C.M. Grant. The exchange of phosphates between estuarine water and sediments. Amer. J. Sci. 272, 1965, pp. 150-160.

37. Dyrssen, D. and M. Wedborg. Major and Minor Elements, Chemical Speciation in Estuarine Waters. In: Chemistry and Biogeochemistry of Estuaries, E. Olausson and I. Cato, eds. John Wiley & Sons Ltd. New York, New York 1980. pp. 71-116.

38. Aston, S.R. Nutrients, Dissolved Gases and General Biogeochemistry in Estuaries. In: Chemistry and Biogeochemistry of Estuaries, E. Olausson and I. Cato eds. John Wiley & Sons Ltd., New York, New York, 1980. pp 233-262.

39. Butler, E.I. and S. Tibbitts. Chemical Survey of the Tamar Estuary I. Properties of the Water. J. Mar. Biol. Ass. U.K. 52, 1972. pp. 681-699.

40. Ikman 1953

41. Boone, J. Md. DNR Report on Juvenille Index for Finfish in Estuarine Fish Recruitment Survey. Annapolis, Maryland, 1980.

42. Draper - Smith. 1981. ref. Herschel & K Bart 1849

43. National Weather Service, Climatological Summaries for BWI

44. Salas 1980

45. Zar, J.H. Biostatistical Analysis. Prentice-Hall, Inc. Englewood Cliffs, N.J. 1974. 620 pp.

46. Tyler, M.A. and H.H. Selinger. Selections for a Red Tide Organism: Physiological Responses to the Physical Environment. Limnology and Oceanography. 1981. 26(Z):310-324.

47. American Public Health Association, American Water Works Assoc., and Water Pollution Control Federation. Standard Methods for the Examination of Water and Wastewater. 14th ed. Washington, D.C. 1975 1193 pp.

48. Clark, L.J., S.E. Rolsch and M.M. Bray. Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary. EPA. Annapolis, Maryland 1980. 91 pp.

49. Hunle, D.R., C.F. D'Elia, J.L. Taft, J.S. Wilson, M. Cole-Jones, A.B. Caplins and L.E. Cronin. Historical Review of Water Quality and Climatic Data from Chesapeake Bay with Emphasis on Effects of Enrichment. Ches. Res. Consort. Pub. No. 84. 1980. 238 pp.

50. Seliger, H.H., K.R. McKinley, W.H. Biggley, R.G. Rivkins and K.R.H. Aspen. Phytoplankton Patchiness and Frontal Regions. Marine Biology. 1981. 61:119-131.

51. Bolsch, Donald F. Applications of Numerical Classification in Ecological Investigations of Water Pollution. Scientific Report No. 77, Virginia Institute of Marine Science. Gloucester Point, Va. 1980. 113 pp.

52. Perkins, E.J. The Biology of Estuaries and Coastal Waters. Academic Press, New York. 1974. 678 pp.

53. Bowman, Gene. Phytoplankton of Baltimore Harbor and Adjacent Chesapeake Bay. Prepared for Maryland Department of Water Resources. Annapolis, Md. 1971, 56 pp.

54. Gaarder, T. and R. Sparck. Hydrographisch-Biochemische Untersuchungen in Norwegischen Austernpollen. Bergeno Mus. Arbok. Naturv. Rekke No. 1:1-144 1933.

55. Haven, D.S. and R. Morales-Alamo. Filtration of Particles from Suspension by the American Oyster, Crassostrea virginica. Biol. Bull. 139(2):248-264. 1970.

56. McCarthy, J.J., W.R. Taylor and M.E. Loftus. Significance of Nannoplankton in the Chesapeake Bay Estuary and Problems Associated with the Measurement of Nannoplankton Productivity. Marine Biology. 24:7-16. 1974.

57. Van Valkenburg, S.D. and D.A. Flemer. The Distribution and Productivity of Nannoplankton in a Temperate Estuarine Area. Estuarine and Coastal Marine Science. 2:311-322. 1974.

58. Durbin, E.G., R.W. Krawiec, and T.J. Smayda. Seasonal Studies on the Relative Importance of Different Size Fractions of Phytoplankton in Narraganset Bay (U.S.A.). Marine Biology. 32:271-287. 1975.

59. Campbell, P.H. The Phytoplankton of the Gales Creek with Emphasis on the Taxonomy and Ecology of Estuarine Phytoflagellates. In: Studies on Brackish Water Phytoplankton. Sea Grant Publ. NC-SG-73-07. UNC, Chapel Hill, NC. 1973. 407 pp.

60. Patten, B.C., R.A. Mulford, and J.E. Warinner. An Annual Phytoplankton Cycle in the Lower Chesapeake Bay. Chesapeake Science. 4(1):1-20. 1963.

61. Riley, G.A. Environmental Control of Autumn and Winter Diatom Flowerings in Long Island Sound. Intern. Oceanog. Congr. Preprints. 1959. pp. 850-851.

62. Allen, W.E. Review of Five Years of Study on Phytoplankton at Southern California Piers, 1920-1924 Inclusive. Bull. Scripps Inst. Oceanog. Tech. Ser., 1:351-401. 1928.

63. Marshal, H.G. Plankton in James River Estuary, Va. III. Phytoplankton in the Lafayette and Elizabeth Rivers (Western and Eastern Branches). Castanea 33:255-258. 1968.

64. Allison, J. Phytoplankton Sampling Results Technical Brief. Maryland Office of Environmental Programs. Annapolis, MD 1981.

65. Gottlieb, B. and M.E. Goldstein. Colchicine-Induced Alterations in Colony Development in Eudoria Elegans (Volvocales, Chlorphyta). Journal of Phycology 15(3). 1979. pp. 260-265.

66. Carr, N.G., and B.A. Whitton. The Biology of Blue-Green Algae. University of California Press. Berkley, Ca. 1973. 676 pp.

67. Desikachary, T.V. Cyanophyta. Indian Council of Agricultural Research, New Delhi. 1959. 686 pp.

68. Maryland Department of Natural Resources. Maryland Water Quality 1980. Prepared by the Water Resources Administration. 208 Planning Division. 1980.

APPENDIX A

FIGURES AND TABLES FOR METHODS

SECTION 2

Table 2-2
Tide Stage Height Indicator (SHI) Staff Calibration Results

SHI #	Location	Elevation (ft.) of SHI Zero Mark Above GD
1	Marker 51 West of Crumpton	1.925
2	Chestertown Bridge	1.758
3	Booker's Wharf	2.732
4	Spaniard's Point	1.610
5	Piney Point	1.0*
5A	2500 ft. SW of Gordon Point	1.412
6	Long Point	2.893
7	Love Point	2.671

Table 2-4
Summary of Station Location/Survey Information for
Advective Flow Surveys, July 1980, and May & July 1981

Station	State ID Code	Location	Elevation Feet	Resurveyed From Ref. Points (7-21-81)	Benchmark Used
A	AND0010	Sudlersville Cemetery Rd. at Andover Branch	30.740	30.038	Q78
B	CYR0004	Rt. 291 west of Millington at unnamed stream	5.312	5.292	62.02 (PRR)
C	UNI0007	Rt. 313 south of Millington at Unicorn Branch	15.222	15.232	62.02 (PRR)
D	MZB0006	Chesterville-Millington Rd. at Mills Branch	15.623	14.822	Nail at Rt. 301/291
E	RBL0013	Red Lion Branch Rd. at Red Lion Branch	13.801	13.821	T71
F	UVE0013	Rt. 291 east of Chestertown at unnamed stream	8.555	8.115	C72
I	MGN0043	Perkins Hill Rd. at Morgan Creek	4.812	5.092	K115
J	UWW0011	Rt. 213 at Morgan Creek (west branch)	14.967	Not checked too muddy	K115
K	RAD0025	Rt. 20 at Radcliffe Branch	7.668	No longer used	L114
L	HAB0028	Rolph's Wharf Rd. at Hambleton Cr.	10.036	9.086	J71
M	XHH9584	Southeast Creek Landing	2.211	No marker	A122
Q	EFL0070	Langford-Brice's Mill Rd at East Branch Langford Creek	2.365	2.435	M114
R	WFL0052	Ricaud's Branch-Langford Rd. at West Branch Langford Creek	2.332	2.602	78 (USGS)
S	TBB0005	Rt. 213 at Three Bridges Branch	3.523	3.763	H122
T	GVL0002	Rt. 213 at Gravel Run	4.030	Not checked	G122
U	OMS0014	Rt. 18 southwest of Centerville	51.331	Not checked	L122
V	REE0038	Tilghman Neck Rd.at Reed Creek	3.742	Not checked	L122

Table 2-9
Water quality Variables and Methods for Analysis of Chester River Entire River Intensive Surveys During 1981

Parameter	Reference
Total Suspended Solids	EPA, 1979* 160.2
Total Dissolved Solids	EPA, 1979 160.1
Total Phosphorus	EPA, 1979 365.4
Total Kjeldahl Nitrogen	EPA, 1979 351.2
Chlorophyll a	Strickland and Parsons 1972**
Phaeophytin a	Vollenweider, 1974***
Total Phosphorus (filtered)	EPA, 1979 365.1
Ammonia (filtered)	EPA, 1979 350.1
Nitrate (filtered)	EPA, 1979 353.2
Nitrite (filtered)	EPA, 1979 353.2
Orthophosphorus (filtered)	EPA, 1979 365.1
Total Kjeldahl Nitrogen (filtered)	EPA, 1979 351.2
Total Particulate Phosphorus	calculated
Soluble Inorganic Nitrogen	calculated
Soluble Organic Nitrogen	calculated
Total Particulate Nitrogen (25 selected stations)	Culno, 1975****
Particulate Organic Carbon (25 selected stations)	Culno, 1975
BOD_5 (13 selected stations)	EPA, 1979 405.1
BOD_u (13 selected stations)	EPA, 1979 405.1

---

* EPA 1979 Methods for Chemical Analysis of Water and Wastes. Pub. No. EPA 600/4-79-020.

** Strickland, J.D.H., and T.R. Parsons 1972. A Practical Handbook of Seawater Analysis, Bull. 167., 2nd ed. Fish. Res. Bd. Canada, pg. 153

*** Vollenweider (ed). 1974. A Manual on Methods for Measuring Primary Production in Aquatic Environments, 2nd ed. Blackwell Scientific Publications. Oxford, England.

****Culno, R.F., 1975, 1969. Automatic Micro Determination of Carbon, Hydrogen, and Nitrogen; Improved Combustion Train and Handling Techniques. Mikrochim Acta.

Table 2-10
Station Numbers and Maryland State ID Codes For The Chester River Intensive Survey

Station Number	State ID Code	STORET Agency Code
0055	XHG5819	21MDEXP
0050	XHG1122	21MDEXP
0051	XHG1537	21MDEXP
0052	XHG2051	21MDEXP
0049	XHG0651	21MDEXP
0048	XGG9572	21MD
0047	XGG9992	21MDEXP
0046	XGH9900	21MDEXP
0044	XHG0688	21MDEXP
0041	GYI0001	21MDEXP
0043	XHG3078	21MDEXP
0042	XHG4893	21MD
0033	XHG6094	21MDEXP
0034	XHH5301	21MDEXP
0038	XHH4822	21MDEXP
0024	XHH6529	21MDEXP
0023	XHH7239	21MDEXP
0022	XHH8354	21MDEXP
0019	XHH9678	21MDEXP
0018	XIH0873	21MDEXP
0013	XIH2463	21MD
0012	XIH3072	21MDEXP
0010	MGN0006	21MDEXP
0007	CHE0327	21MDEXP
0005	CHE0359	21MDEXP
0002	CHE0392	21MDEXP
000B	CYR0004	21MDEXP
000A	AND0010	21MDEXP
0025	EFL0037	21MDEXP
000Q	EFL0070	21MDEXP
000T	GVL0002	21MDEXP
0029	GYI0017	21MDEXP
000L	HAB0028	21MDEXP
000I	MGN0043	21MDEXP
000D	MZB0006	21MDEXP
0004	OMS0014	21MDEXP
0016	RAD0006	21MDEXP
000E	RBL0013	21MDEXP
000V	REE0038	21MDEXP
000S	TBB0005	21MDEXP
000C	UNI0007	21MDEXP
000F	UVE0013	21MDEXP
000J	UWW0011	21MDEXP

Table 2-10 (continued)
Station Numbers and Maryland State ID Codes For The Chester River Intensive Survey

Station Number	State ID Code	STORET Agency Code
0028	WFL0037	21MDEXP
000R	WFL0052	21MDEXP
0035	XHH3554	21MDEXP
0031	XHH7600	21MDEXP
0027	XHH7607	21MDEXP
0020	XHH9276	21MDEXP
000M	XHH9584	21MDEXP

Table 2-11
Water Quality Variables and Methods of Analysis for Chester River 24 - Hour Intensive Surveys 1981

Parameter	Reference
Total Suspended Solids	EPA, 1979* 160.2
Total Dissolved Solids	EPA, 1979 160.1
Total Phosphorus	EPA, 1979 365.4
Total Kjeldahl Nitrogen	EPA, 1979 351.2
Chlorophyll <u>a</u>	Strickland and Parsons 1972**
Phaeophytin <u>a</u>	Vollenweider, 1974***
Total Phosphorus (filtered)	EPA, 1979 365.1
Ammonia (filtered)	EPA, 1979 350.1
Nitrate (filtered)	EPA, 1979 353.2
Nitrite (filtered)	EPA, 1979 353.2
Orthophosphorus (filtered)	EPA, 1979 365.1
Total Kjeldahl Nitrogen (filtered)	EPA, 1979 351.2
Total Particulate Phosphorus	calculated
Soluble Inorganic Nitrogen	calculated
Soluble Organic Nitrogen	calculated
Total Particulate Nitrogen (one tidal cycle only)	Culno, 1975****
Particulate Organic Carbon (one tidal cycle only)	Culno, 1975
BOD_5 (12 selected stations)	EPA, 1979 405.1
BOD_u (12 selected stations)	EPA, 1979 405.1

* EPA 1979 Methods for Chemical Analysis of Water and Wastes, Pub. No. EPA 600/4-79-020.

** Strickland, J.D.H., and T.R. Parsons 1972, A Practical Handbook of Seawater Analysis, Bull. 167, 2nd ed. Fish. Res. d. Canada, pg. 153.

*** Vollenweider (ed). 1974. A Manual on Methods for Measuring Primary Production in Aquatic Environments, 2nd ed. Blackwell Scientific Publications. Oxford, England.

**** Culno, R.F., 1975, 1969. Automatic Micro Determination of Carbon, Hydrogen, and Nitrogen; Improved Combustion Train and Handling Techniques. Mikrochim Acta.

Table 2-12
Summary of Dates and Times of Chester River Water Quality Surveys

Survey	Date	Times (durations)
Slack Tide Survey	7/7/80	1345-1715
Pre-Intensive Slack Tide Survey	7/10/80	0510-0925
Phytoplankton Evaluation Survey	7/10/80	0925-1100
Lower Estuary Homogeniety Survey	7/15/80	0830-1200
Phytoplankton Respiration Survey	7/15/80	0915-1300
Sediment-Nutrient Exchange Survey	7/15/80	0915-1300
Special Sediment-Oxygen Demand Survey	7/15/80	0915-1300
Point-Source Monitroing Survey	7/15-16/80	24 hours
Post Intensive Slack Tide Survey	7/16/80	0930-1225
Slack Tide Survey	7/28/80	0707-1040
Bacterial Nitrification Survey	7/28/80	1040-1200
Bathymetric Survey	7/31-8/2/80	daylight hours
Bacterial Nitrification Survey	9/15/80	daylight hours
Slack Tide Survey	10/10/10	0730-1100
Phytoplankton Respiration Survey	10/21/80	0933-1320
Sediment-Water Nutrient Exchange Special SOD Survey	10/21/80	0933-1320
Slack Tide Survey	10/28/80	0840-1300
Bacterial Nitrification Survey	10/28/80	1300-1430
Phytoplankton Evaluation Survey	10/28/80	1300-1430
Slack Tide Survey	11/13/80	0845-1545
Bacterial Nitrification Survey	11/13/80	0845-1545
Slack Tide Survey	11/24/80	0631-1140
Bacterial Nitrification Survey	11/24/80	0631-1140
Slack Tide Survey	12/15/80	1000-1400
Bacterial Nitrification Survey	12/15/80	1000-1400
Slack Tide Survey	3/11/81	1045-1510
Bacterial Nitrification Survey	4/7/81	1020-1620
Slack Tide Survey	4/8/81	0810-1250
Phytoplankton Evaluation Survey	4/8/81	0810-1250
Slack Tide Survey	5/8/81	0850-1435
Phytoplankton Evaluation Survey	5/8/81	0950-1535
Bacterial Nitrification Survey	5/8/81	0930-1200
Pre-Intensive Slack Tide Survey	5/27/81	1140-1845
Twenty-Four Hour Monitoring Survey	5/29-30/81	1600-1530
Advective Flow Survey	5/29-33/81	1515-1625
Entire River Intensive Survey	5/29-30/81	1351-0530
Tide Stage Height Measurements	5/29-30/81	1200-1625
Robot Monitor Data Collection	5/28-30/81	1400-1400
Pt. Source Monitoring Survey	5/29-30/81	1300-1730
Current Speed-Direction Survey	5/29-30/81	0425-1630
Post Intensive Slack Tide Survey	6/1/81	1650-2020
Slack Tide Survey	6/18/81	0610-0845
Sidiment-Water Nutrient Exchange/SOD Survey	6//8/81	0930-1205

Table 2-12 (continued)
Summary of Dates and Times of Chester River Water Quality Surveys

Survey	Date	Times (durations)
Phytoplankton Respiration Survey	6/18/81	0940-1120
Bacterial Nitrification Survey	6/26/81	1020-1630
Slack Tide Survey	6/28/81	1410-1655
Phytoplankton Evaluation Survey	6/28/81	1510-1755
Slack Tide Survey	7/09/81	1208-1530
Pre-Intensive Slack Tide Survey	7/22/81	0850-1130
Entire River Intensive Survey	7/24/81	1018-1738
Twenty-Four Hour Monitoring Survey	7/24-25/81	1125-1035
Advective Flow Survey	7/24-25/81	1220-1255
Current Speed-Direction Survey	7/24-25/81	1155-1123
Pt. Source Monitoring Survey	7/23-25/81	1100-1245
Robot Monitor Data Collection	7/23-25/81	1100-1100
Tide Stage Height Measurements	7/24-25/81	1200-0900
Post Intensive Slack Tide Survey	7/27/81	1400-1622
Slack Tide Survey	8/06/81	0930-1215
Phytoplankton Respiration Survey	8/06/81	845-1045
Sediment-Water Nutrient Exchange/SOD Survey	8/06/81	1050-1535
Slack Tide Survey	8/20/81	0826-1130
Pre-Intensive Slack Tide Survey	9/22/81	1310-1605
Entire River Intensive Survey	9/24/81	1038-2000
Twenty-Four Hour Monitoring Survey	9/24-25/81	1525-1605
Current Speed-Direction Survey	9/24-25/81	1440-1537
Pt. Source Monitoring Survey	9/24-25/81	1320-1830
Robot Monitor Data Collection	9/23-25/81	1700-1700
Tide Stage Height Measurements	9/24-25/81	1600-1300
Post Intensive Slack Tide Survey	9/27/81	0545-0850

Table 2-14
Water Quality Variables for Point Source Sample Analysis (1980-1981)

1980 Lower Estuary Homogeniety Survey

Total Suspended Solids
Total Dissolved solids
Turbidity
Ammonia
Nitrite
Nitrate
Total Phosphorus
TOC
Orthophosphorus (filtered)
Total Kjeldahl Nitrogen
Total Phosphorus (filtered)
BOD5

1981 Intensive River Surveys

Total Suspended Solids
Total Dissolved Solids
Total Phosphorus
Total Kjeldahl Nitrogen
Total Phosphorus (filtered)
Ammonia (filtered)
Nitrate (filtered)
Total Kjeldahl Nitrogen (filtered)
Total Particulate Phosphorus
Soluble Inorganic Nitrogen
Soluble Organic Nitrogen
Orthophosphorus (filtered)
Nitrite (filtered)
BOD5

Table 2-18
Rainfall Reported in Climatological Data for Periods When Monitors Were Not in Operation

Explanation	Date	*Rainfall Reported		Gauge Affected			
		Centvl	Chestn	Chtn	Sutt	Bntn	Mill
A	6/24 - 7/6/80	-	-		X		
B	7/6 - 7/16/80	-	-		X		
C	7/16 - 7/19/80	-	-		X		
D	7/19 - 7/23/80	-	-		X		
E	7/29/80	0	0			X	
E	7/30/80	0	0	X		X	
E	7/31/81	0	0	X		X	
E	8/1/80	.17	0	X		X	
E	8/2/80	0	0	X		X	
E	8/3/80	0	.19	X		X	
E	8/4/80	.48	0	X		X	
E	8/5/80	0	.04	X		X	
E	8/6/80	.07	0	X		X	
E	8/7/80	0	0	X		X	
E	8/8/80	0	0	X		X	
E	8/9/80	0	0	X		X	
E	8/10/80	0	.53	X		X	
E	8/11/80	.06	.05	X		X	
E	8/12/80	.31	.14	X		X	
E, F	8/13/80	0	0	X	X	X	
E, F	8/14/80	0	0	X	X	X	
E, F	8/15/80	.11	.23	X	X	X	
E, F	8/16/80	.34	0	X	X	X	
E, F	8/17/80	0	0	X	X	X	
E, F	8/18/80	.03	.07	X	X	X	
E, F	8/19/80	.06	.64	X	X	X	
E, F	8/20/80	0	.05	X	X	X	
E, F	8/21/80	0	0	X	X	X	
E, F	8/22/80	.02	0	X	X	X	

* At NWS stations in Centreville and Chestertown

Table 2-20
Rainfall Recorded on Days (0000-2359) When Freezing Temperatures Occurred in Chester River Study Area during 1980-81 Study

From - Inclusive Date	To	Year	Chtn	Stations Affected = X Sutt	Bntn	Mill	Stpd
11/3	-	1980	X	X	X	X	X
11/6	-	1980	X	X	X	X	X
11/16	11/17	1980	X	X	X	X	X
11/19	11/23	1980	X	X	X	X	X
11/26	11/28	1980	X	X	X	X	X
12/3	12/6	1980	X	X	X	X	X
12/11	12/12	1980	X	X	X	X	X
12/14	12/28	1980	X	X	X	X	X
12/30	12/31	1980	X	X	X	X	X
1/1	1/12	1981	X	X	X	X	X
1/13	1/26	1981	X	X	X	H	H
1/28	1/31	1981	X	X	X	H	H
2/1	2/16	1981	X	X	X	H	H
2/28	-	1981	X	X	X	H	H
3/2	3/8	1981	X	X	X	H	H
3/10	3/12	1981	X	X	X	H	H
3/14	3/26	1981	X	X	X	H	H
3/28	-	1981	X	X	X	H	H
4/7	-	1981	X	X	X	H	H
4/16	-	1981	X	X	X	H	H
4/21	4/22	1981	X	X	X	H	H

H indicates gauge was heated, NOT affected.

Table 2-21
Monthly and Seasonal Precipitation Averages for Millington Subwatershed 1975-1979.

		Inches Rain											
Millington	Total	J	F	M	A	M	J	J	A	S	O	N	D
1979	54.89	7.97	5.53 15.94	2.44	2.13	2.67 9.07	4.27	6.87	6.01 20.24	7.36	4.08	4.02 9.64	1.54
1978	43.64	6.23	1.73 13.29	5.33	2.03	5.04 9.65	2.58	5.10	5.05 11.78	1.63	1.42	2.51 20.70	4.99
1977	57.05	1.73	1.41 5.62	2.48	2.65	1.83 8.19	3.71	2.02	3.88 7.34	1.44	4.13	5.77 15.90	6.00
1976	35.85	5.41	1.24 8.81	2.16	1.12	3.20 6.08	1.76	4.95	2.95 11.31	3.41	8.48	.65 9.65	2.52
1975	52.77	4.26	2.94 12.44	5.24	3.02	5.73 12.66	3.91	6.58	2.85 17.86	8.43	3.45	3.16 9.81	3.20
Monthly Avg.		5.12	2.57	3.53	2.10	3.69	3.25	5.10	4.15	4.45	3.91	3.22	3.65
Seasonal Avg.			11.22			9.13			13.71			13.14	

50 Year Annual Average = 43.48 inches

Table 2-22
Monthly and Seasonal Precipitation Averages for Chestertown Subwatershed, 1975-1979

		Inches Rain											
Chestertown	Total	J	F	M	A	M	J	J	A	S	O	N	D
1979	53.40	8.10	5.21 16.09	2.78	3.02	2.60 10.49	4.87	3.22	6.59 17.28	7.47	4.41	3.63 9.54	1.50
1978	43.37	7.12	1.33 13.72	5.27	1.51	5.61 8.65	1.53	5.66 12.19	5.52	1.01	1.18	2.40 8.81	5.23
1977	40.27	1.81	.76 5.44	2.87	2.96	1.26 8.84	4.62	2.45	5.27 8.93	1.21	3.87	7.07 17.06	6.12
1976	33.38	5.12	1.62 8.85	2.11	1.09	3.66 6.57	1.82	3.23	2.31 8.84	3.30	5.94	.21 9.12	2.97
1975	54.06	4.23	3.03 12.49	5.23	2.94	5.01 13.15	5.20	8.57	2.79 18.82	7.46	2.94	2.63 9.60	4.03
Monthly Avg. (in)		5.28	2.39	3.65	2.30	3.63	3.61	4.63	4.50	4.09	3.67	3.19	3.97
Seasonal Avg. (in)			11.32			9.54			13.21			10.83	

43 Year Annual Average = 44.22 inches

Table 2-23
Monthly and Seasonal Precipitation Averages for Centreville Subwatershed, 1975-1979

		Inches Rain											
Centreville	Total	J	F	M	A	M	J	J	A	S	O	N	D
1979	46.75	6.50	5.11 12.58	.97	2.70	3.03 10.39	4.66	3.19	4.59 **13.57**	5.79	5.15	4.02 10.21	1.04
1978	--	7.49	1.56 14.94	5.89	1.35	4.93 9.82	3.54	6.01	3.13 11.40	2.26	1.33	--	--
1977	33.96	2.36	.58 5.10	2.16	2.94	1.14 6.41	2.33	3.39	2.43 6.97	1.15	5.04	5.45 15.48	4.99
1976	--	6.74	2.36 10.41	1.31	1.24	3.59 7.24	2.41	2.70	3.45 11.13	4.98	5.31	.73 --	--
1975	54.52	4.78	3.47 13.52	5.27	3.39	4.85 11.35	3.11	7.69	4.77 20.34	7.88	3.63	2.37 9.31	3.31
Monthly Avg.		5.57	2.62	3.12	2.32	3.51	3.21	4.60	3.67	4.41	4.09	--	--
Seasonal Avg.			11.31			9.04			12.68			--	

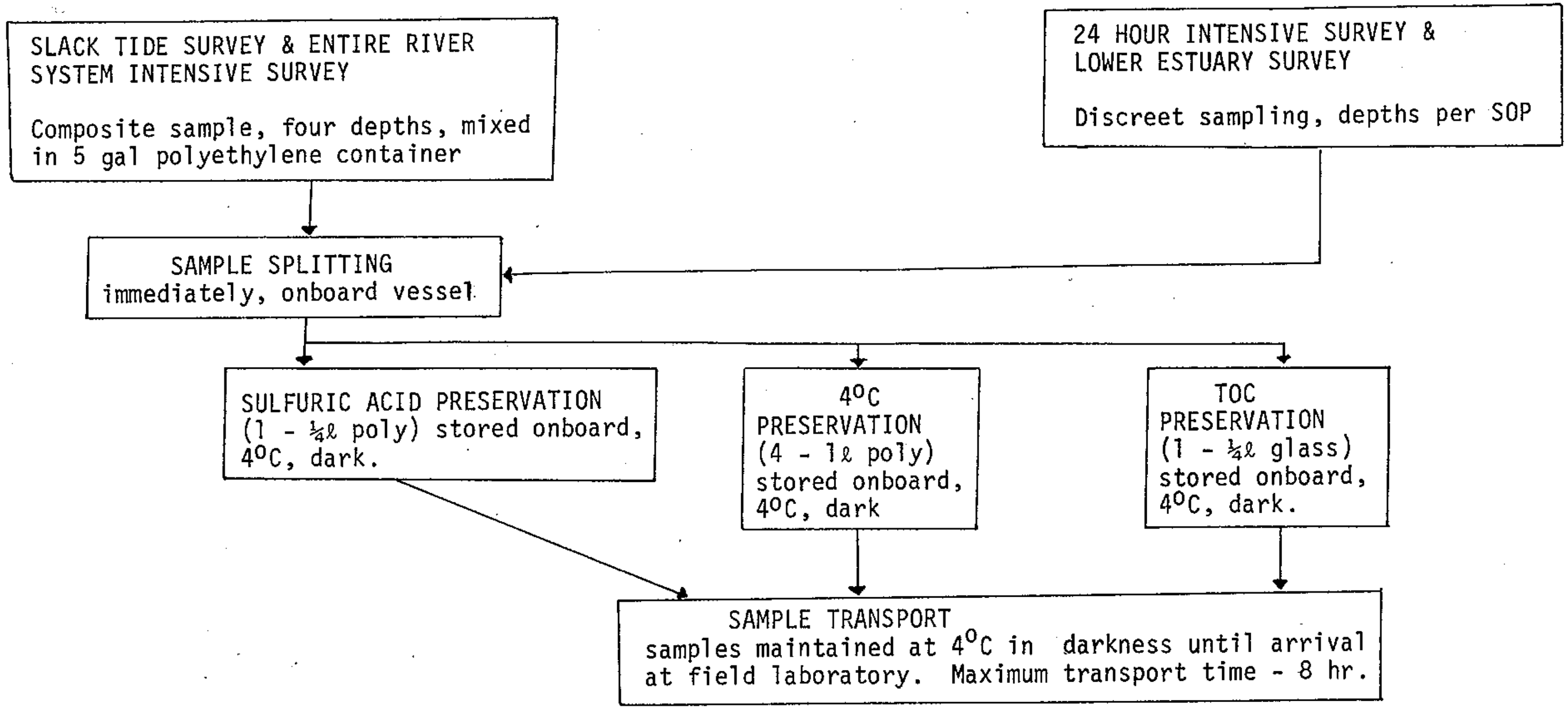


Figure 2-14 Flowchart of Sample Acquisition and Transport Methods (For composite sampling, in situ measurements obtained at near surface, mid-depth, and near bottom. For discreet sampling, at depths sampled. In situ parameters measured are conductance, salinity, temperature, D.O., secchi depth, and pH. During the 24 hour survey, current speed and direction are also measured. During the lower estuary survey pH & turbidity were determined at the field lab.

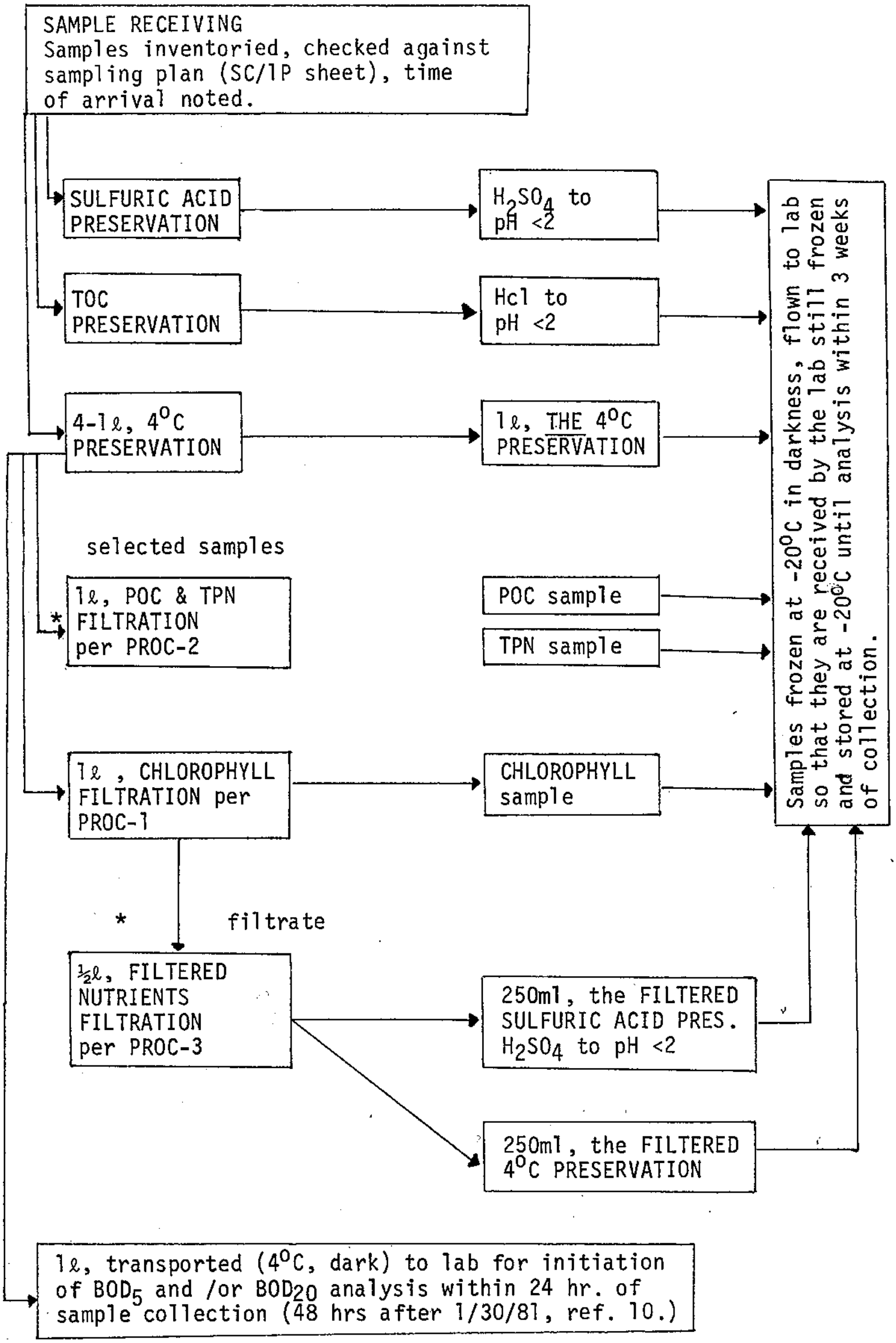


Figure 2-15 Flowchart of sample preservation techniques used in the Chester River Study (*Not applicable to the Lower Estuary Survey)

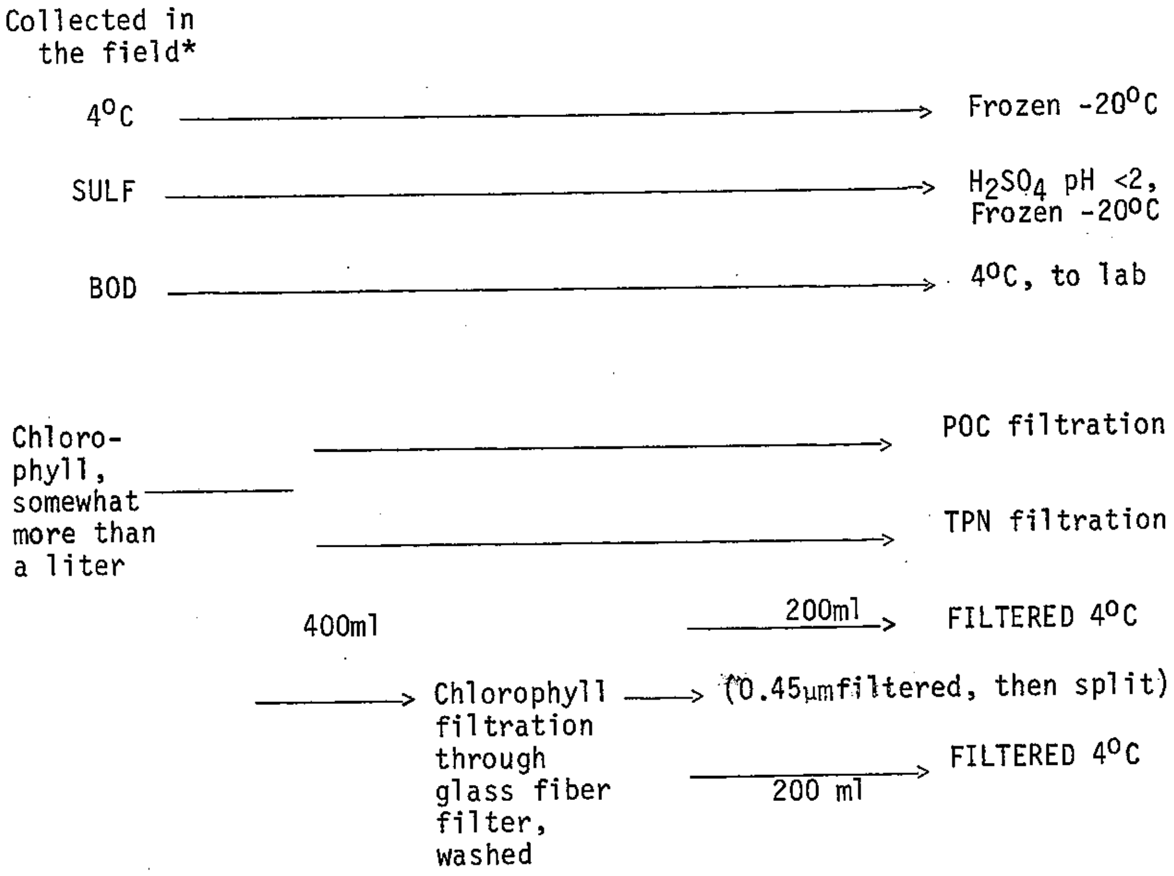


Figure 2-16 Sample splitting, aliquot amounts filtered and preservation technique flow chart. Samples were shaken thoroughly before splitting.

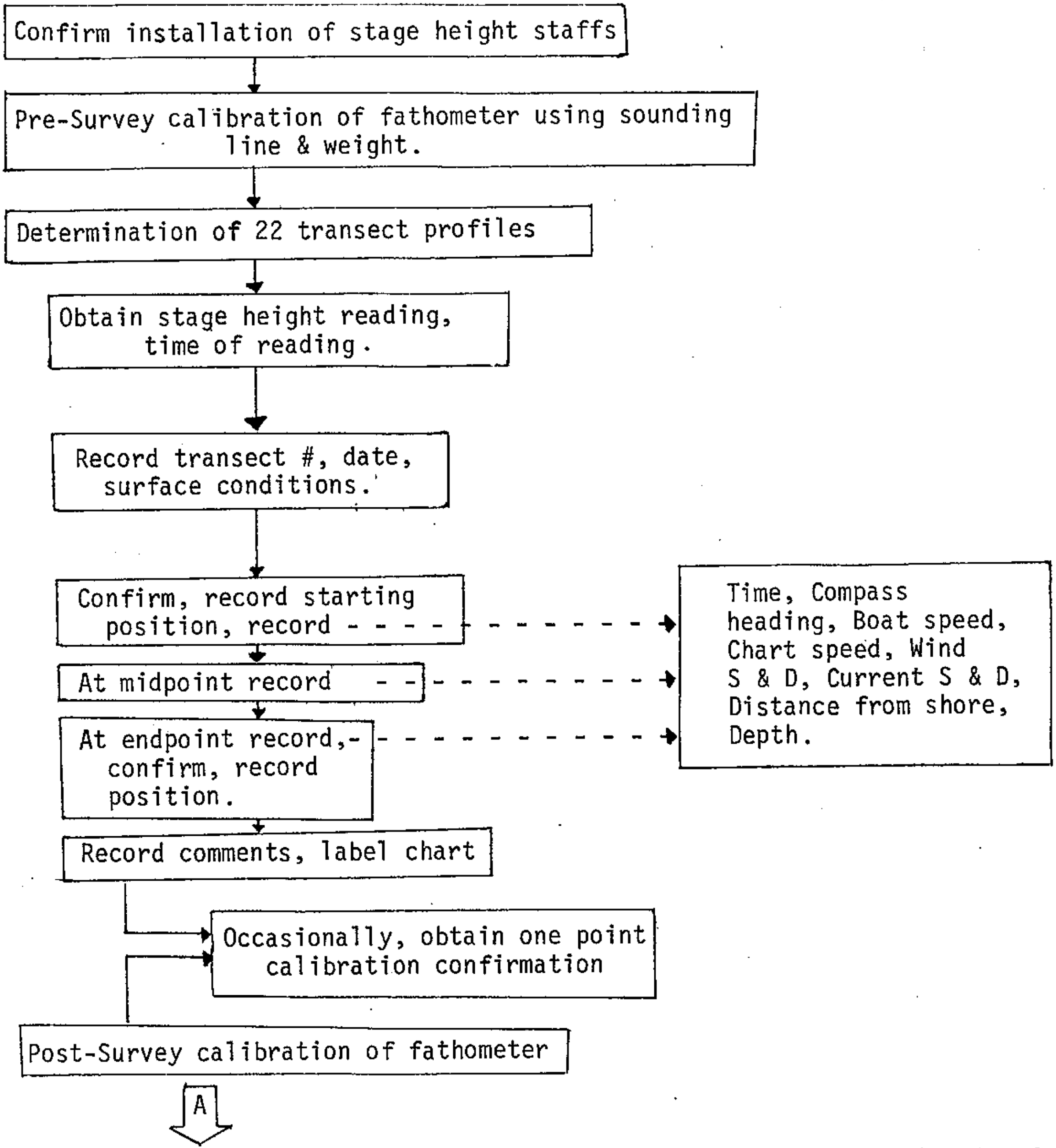


Figure 2-17 Flowchart describing the field operations for a Bathymetry Survey

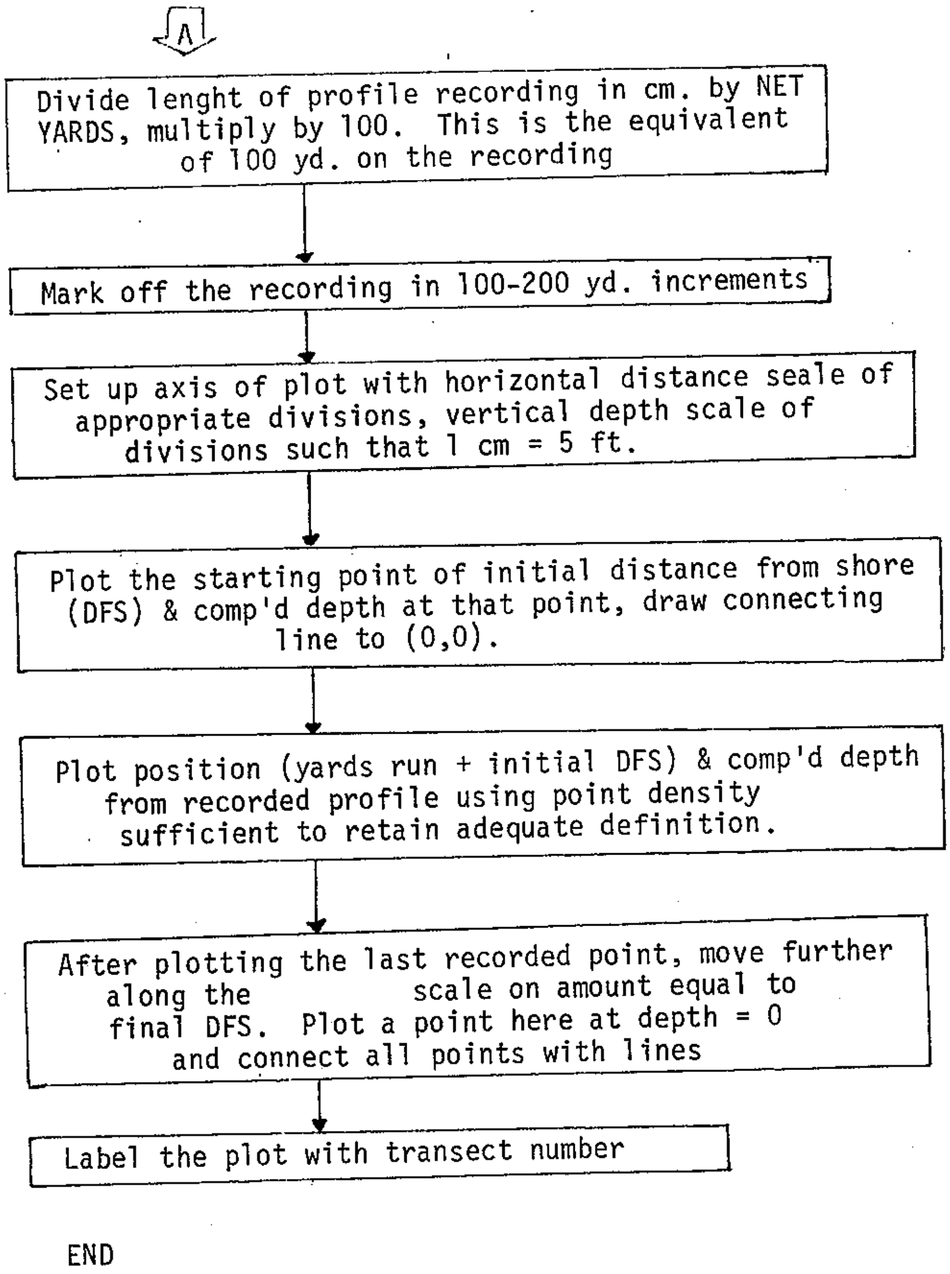


Figure 2-17 (continued) Flowchart describing the field operations for a Bathymetric Survey

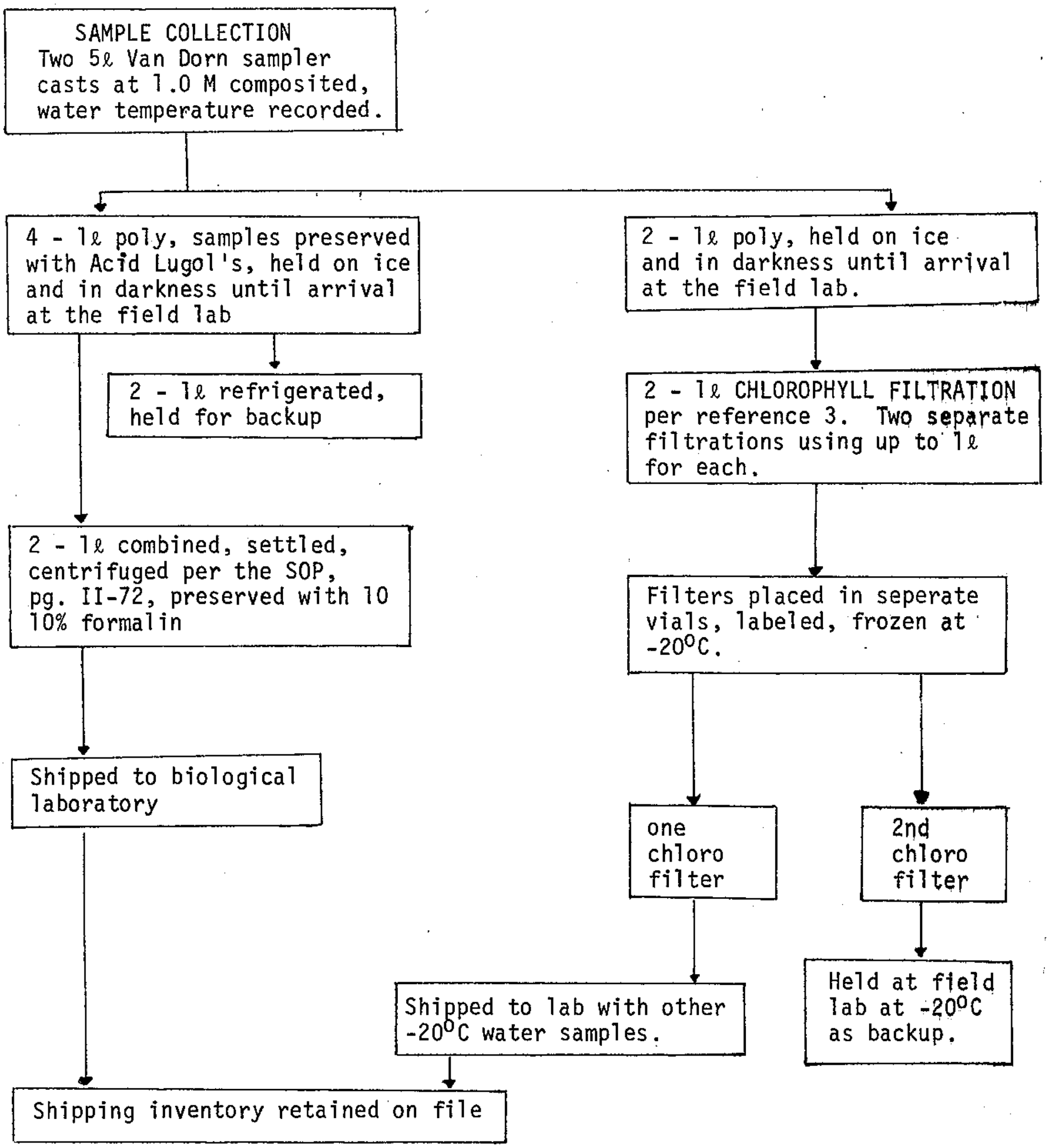
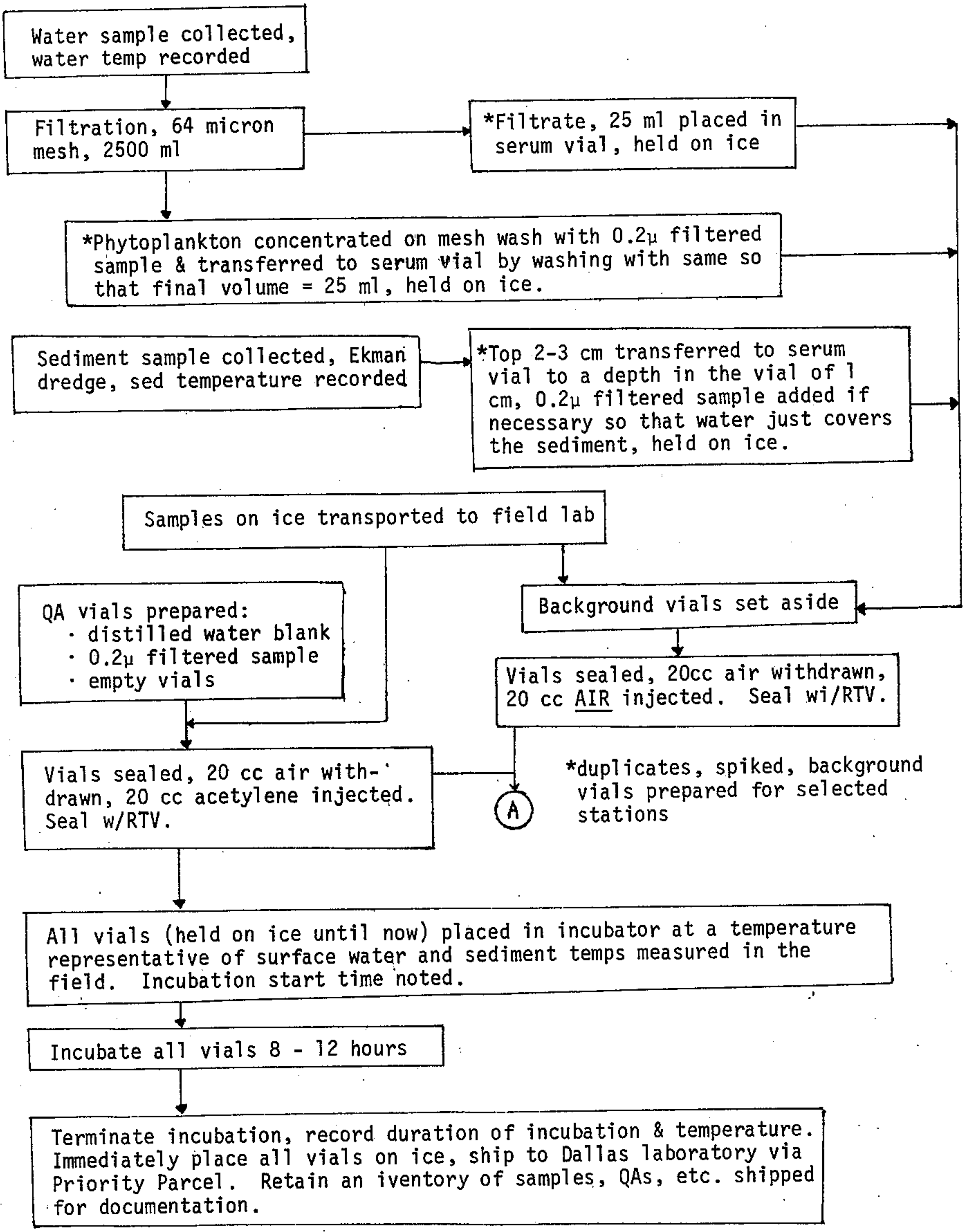


Figure 2-18 Flowchart describing Phytoplankton collection field processing.



Water sample collected, water temp recorded

Filtration, 64 micron mesh, 2500 ml

*Filtrate, 25 ml placed in serum vial, held on ice

*Phytoplankton concentrated on mesh wash with 0.2μ filtered sample & transferred to serum vial by washing with same so that final volume = 25 ml, held on ice.

Sediment sample collected, Ekman dredge, sed temperature recorded

*Top 2-3 cm transferred to serum vial to a depth in the vial of 1 cm, 0.2μ filtered sample added if necessary so that water just covers the sediment, held on ice.

Samples on ice transported to field lab

QA vials prepared:
- distilled water blank
- 0.2μ filtered sample
- empty vials

Background vials set aside

Vials sealed, 20cc air withdrawn, 20 cc AIR injected. Seal wi/RTV.

Vials sealed, 20 cc air withdrawn, 20 cc acetylene injected. Seal w/RTV.

*duplicates, spiked, background vials prepared for selected stations

All vials (held on ice until now) placed in incubator at a temperature representative of surface water and sediment temps measured in the field. Incubation start time noted.

Incubate all vials 8 - 12 hours

Terminate incubation, record duration of incubation & temperature. Immediately place all vials on ice, ship to Dallas laboratory via Priority Parcel. Retain an iventory of samples, QAs, etc. shipped for documentation.

Figure 2-19 Flowchart describing sample collection and preservation for Nitrogen Fixation.

Table 2-25
Quality Assurance Activities Related To Operating Continuous Monitor (Schneider RM-25)

---

(1) PREPLACEMENT CHECKOUT - 6 weeks before use.
electrical & mechanical systems (recorder, power supply, etc.)
pump
parametric systems.
necessary repairs/replacements made

(2) MONITOR PLACEMENT - 5-7 days before use
trailer positioned on site
SRI, water level sensors and pump deployed
110V power supplied
pump and monitor turned on

(3) INITIAL CALIBRATION - 1 day after placement
sample flow adjusted to proper rate
calibration of all parametric systems performed per RM-25 manual and project SOP, calibrated using both panel meters and recorder
necessary adjustments/repair /replacements made
successful calibration of all parameters obtained

(4) PRE SURVEY CALIBRATION - to initiate monitoring
sample flow rate checked, adjusted if necessary
all parametric systems calibrated per RM-25 manual and projects SOP, points of calibration precisely marked and calibration information recorded on a strip chart including date & time
successful calibration of all parameters obtained
any observations concerning system performance recorded

(5) POST SURVEY CALIBRATION - to terminate monitoring
sample flow rate checked, recorded as being proper/too rapid/too slow
all parametric systems subjected to calibration standards, results marked precisely and calibration confirmation
any system found to be out of calibration subjected to trouble-shooting procedures, problem defined, data examined to ascertain whether any of it can considered valid &/or extent of error over time determined. All findings documented on strip chart.
pump and monitor shut down

(6) MONITOR RETRIEVAL - any time after shutdown
110V power removed
SRI and water level sensors retrieved
pump retrieved, flushed with fresh water
all gear, wires, hoses stowed securely
all water removed from monitor flow cells, inlets, and discharges
trailer removed from site

(7) DATA HANDLING
calibration curves constructed using both pre and post survey calibration info
any non-valid data sections identified
keypunch data forms coded with date, time, and parameter values at intervals of 15 minutes
coding QC'd by spot check, etc.
data forms, calibration material, and recorded observations copied, copies retained at field site, originals sent to program management

---

Table 2-26
EPA and Technicon Method Numbers, Detection Limits and Standard Deviations for Nutrient Parameters

Parameter	EPA	Technicon	Detection limit (mg/l)	Standard Deviation
NO_2	353.2	161-71W	.005	.012
NO_3	353.2	100-70W	.005	.012
NH_3	350.1	154-71W	.005	.005
PO_4^{-3}	365.1	155-71W	.005	.019
TKN	351.2	329-74W	.005	.007
TP	365.4	329-74W	.005	.01
TSS	160.2	--	4[1]	--
TDS	160.1	--	.10	--
Chlorophyll a	--	--	--	--

1) Detection limit is a function of the amount of sample filtered.

2) Stickland and Parsons, Handbook of Seawater Analysis, p. 185.

Table 2-27
Point and NPS Sampling Preservation Techniques

Sampling Activity	Sample Type	Parameters	Preservation
NPS	1 liter polyethylene	BOD_5, BOD_{30}, TSS, Nutrients that need to be filtered	4°C
	1 liter polyethylene	TKN, TP, COD	H_2SO_4, 4°C
	125 ml glass	TOC	HCl, 4°C
Sediment	1 liter polyethylene	Nutrients	4°C
Point Source	1 liter polyethylene	BOD_5	4°C
River Surveys	1 liter polyethylene	BOD_5, BOD_{30}	4°C

* U.S. Environmental Protection Agency, 1979. Methods for the Chemical Analysis of Water and Wastes. Environmental Monitoring and Support Laboratory, ORD, Cincinnati, Ohio.

Table 2-28
Chester River NPS Parameters Analyzed, Analysis, Method and Holding Times Prior To and After 1/30/81

Parameters	Method Analysis*	Holding Times Prior To 1/30/81	Holding Times After 1/30/81**
Ammonia (filtered)	350.1	24 hrs.	28 days
Nitrate + Nitrite (filtered)	353.2	24 hrs.	28 days
Total nitrogen (Kjeldahl) (filtered & unfiltered)	351.2	24 hrs.	28 days
Total phosphorus (filtered & unfiltered)	365.1	24 hrs.	28 days
Orthophosphate (filtered)	365.1	24 hrs.	48 hrs.
BOD_5	405.1	24 hrs.	48 hrs.
BOD_{30}	405.1	24 hrs.	48 hrs.
Total Suspended Solids	160.2	7 days	14 days
Total Organic Carbon	415.1	24 hrs.	28 days
Chemical Oxygen Demand	410.2	7 days	28 days
Sediment Oxygen Demand	405.1	24 hrs.	24 hrs.
Alkalinity	310.2	24 hr.	14 days

* U.S. Envirommental Protection Agency, 1979. Methods for the Chemical Analysis of Water and Wastes. Environmental Monitoring and Support Laboratory, ORD, Cincinnati, Ohio.

** CFR Vol. 44, Part 136, December 3, 1979.

*** Sediment samples from Task 1.6 were extracted prior to nutrient analyses in accordance with USDA procedures.

APPENDIX B

TABLES FOR POINT SOURCES

SECTION 3

Table 3-1 Municipal NPDES Permit Effluent Limits

Effluent Characteristics	Centreville	Chestertown	Eastern Correctional Camp	Kennedyville
BOD				
Loading Rate (lbs/day)	31	225.18	5.0	12.5
Monthly Avg. (mg/l)	10	30	30	30
TSS				
Loading Rate (lbs/day)	31	675.54	5.0	12.5
Monthly Avg. (mg/l)	10	90	30	30
Fecal Coliforms				
Max (MPN/100 ML)	200	70	200	200
Total Residual Chlorine				
Max (mg/l)	0.5	0.5	0.03	0.1
D.O.				
Min (mg/l)	5.0	5.0	5.0	5.0
pH				
Range	6.0-8.5	6.0-8.5	6.5-8.5	--
Flow*				
MGD	.375	.90	.02	--

Effluent Characteristics	Millington	Queenstown	Rock Hall	Sudlersville
BOD				
Loading Rate (lbs/day)	11.7	20 (17)+	62.6	22.5
Monthly Avg. (mg/l)	20	20 (30)	30	30
TSS				
Loading Rate (lbs/day)	11.7	20 (17)	187.8	67.5
Monthly Avg. (mg/l)	20	40 (30)	90	90
Fecal Coliforms				
Max (MPN/100 ML)	200	14	70	200
Total Residual Chlorine				
Max (mg/l)	0.5	4.0 (.50)	0.5	0.5
D.O.				
Min (mg/l)	5.0	5.0	5.0	5.0
pH				
Range	6.0-8.5	6.5-8.5	6.0-8.5	6.0-8.5
Flow*				
MGD	.07	0.06	0.25	0.09

*Design flow used in waste load calculations; Not a limitation.
+numbers in parentheses indicate effluent limitations effective Oct. 1, 1984 - June 30, 1987 .

Table 3-2 Industrial NPDES Permit Effluent Limits

Effluent Characteristic	Tenneco	Holiday & Jones Gulf & Oil	Getty Oil Co. Inc.	Campbell Soup
BOD				
Monthly Avg. (lb/day)	22	-	-	-
Daily Max (lb/day)	47.7	-	-	50
TSS				
Monthly Avg. (lb/day)	20.5	-	-	-
Daily Max (lb/day)	40.9	-	-	61
COD				
Monthly Avg. (lb/day)	113.3	-	-	-
Daily Max (lb/day)	226.4	-	-	-
pH				
Range (units)	6-9	-	-	6-8.5
Fecal Coliforms				
Max (MPN/100 ML)	-	-	-	200
Total Residual Chlorine				
Max (mg/l)	-	-	-	-
Oil & Grease	-	-	-	0.2
Yearly Avg. (mg/l)	-	20	20*	
Daily Avg. (mg/l)	-	20	20	33

*monthly average.

Table 3-3 Chester River Point Source Characteristics (1980-1981)

	Water Quality Variables (mg/l)									
	BOD5	DISS. NO2	DISS. NO3	RESIDUE TOT. NFLT.	DISS. ORTHO-P	TOT. P	DISS. NH3+NH4	DISS. Org. N.	PARTICULATE P	GPDX 10^5 (gallons)
					Centerville STP					
N	10	8	8	10	10	10	8	8	6	6
MAX	10.0	.44	79.0	68.0	5.4	7.14	14.7	6.0	5.2	3.12
MIN	1.0	.001	.7	16.0	.73	.11	.91	.04	.001	1.23
MEAN	5.0	.23	13.9	30.4	3.9	3.9	5.1	3.4	1.4	1.93
STD. DEV.	2.9	.16	26.4	15.1	1.6	2.4	4.2	2.1	2.0	0.78
					Rockhall STP					
N	2	--	--	2	2	2	--	--	--	2
MAX	25.0	--	--	76.0	1.5	1.7	--	--	--	0.81
MIN	1.0	--	--	57.0	1.03	1.6	--	--	--	0.81
MEAN	13.0	--	--	66.5	1.3	1.63	--	--	--	0.81
STD. DEV.	17.0	--	--	13.4	.33	.04	--	--	--	0.00

Table 3-3 (cont.) Chester River Point Source Characteristics (1980-1981)

	Water Quality Variables (mg/l)									
	BOD5	DISS. NO2	DISS. NO3	RESIDUE TOT. NFLT.	DISS. ORTHO-P	TOT. P	DISS. NH3+NH4	DISS. Org. N.	PARTICULATE P	GPDX 10^5 (gallons)
					Millington STP					
N	6	6	6	6	6	6	6	6	5	6
MAX	17.0	0.64	4.14	49.0	5.2	6.4	4.78	6.09	3.4	0.80
MIN	3.0	0.02	0.01	14.0	1.5	1.7	1.27	0.58	0.001	0.26
MEAN	9.0	0.32	1.98	35.6	3.6	3.6	3.41	2.17	0.68	0.48
Std. Dev.	5.2	0.23	1.72	12.9	1.5	1.7	1.3	2.09	1.53	0.18
					Queenstown STP					
N	10	8	8	8	10	10	8	8	6	8
MAX	14.0	.58	3.19	48.0	6.1	10.9	15.7	14.9	3.4	0.63
MIN	1.0	.002	.01	6.0	.98	.09	2.5	2.6	.001	0.30
MEAN	7.1	.23	1.68	29.6	4.0	4.8	10.1	7.1	1.4	0.47
Std. Dev.	4.7	.23	.89	13.4	1.4	3.6	4.6	4.7	1.3	0.15

Table 3-3 (cont.) Chester River Point Source Characteristics (1980-1981)

	Water Quality Variables (mg/1)									
	BOD5	DISS. NO2	DISS. NO3	RESIDUE TOT. NFLT.	DISS. ORTHO-P	TOT. P	DISS. NH3+NH4	DISS. ORG. N.	PARTICULATE P	GPDX 10^5 (gallons)
Chestertown STP										
N	6	6	6	6	6	6	6	6	4	4
MAX	9.0	1.04	.72	138.0	2.73	4.83	6.7	6.6	2.1	4.84
MIN	1.0	.021	.23	79.0	.05	.25	.86	2.6	.025	2.88
MEAN	4.7	.37	.61	94.7	1.75	2.4	2.3	3.9	1.5	3.70
STD. DEV.	3.0	.42	.19	22.4	1.25	1.98	2.2	1.5	.97	0.98
Cambell Soup										
N	6	4	4	6	6	4	4	4	2	4
MAX	47.0	.08	24.73	32.0	2.68	.6	1.74	8.12	.32	0.25
MIN	1.0	.002	1.14	16.0	.14	.05	.27	.33	.001	0.11
MEAN	15.7	.05	12.44	21.7	1.15	.24	.71	3.11	.16	0.17
STD. DEV.	21.0	.04	12.58	7.0	1.07	.26	.7	3.64	.23	0.07

Table 3-3 (cont.) Chester River Point Source Characters (1980-1981)

	Water Quality Variables (mg/1)									
	BOD5	DISS. NO2	DISS. NO3	RESIDUE TOT. NFLT.	DISS. ORTHO-P	TOT. P	DISS. NH3+NH4	DISS. ORG. N.	PARTICULATE P	GPDX 10^5 (GALLONS)
					TENNECO					
N	10	8	8	10	10	9	8	8	6	8
MAX	25.0	.19	.55	133.0	6.28	11.6	6.35	6.51	3.42	0.66
MIN	1.0	.001	.06	13.0	.01	.17	.11	.49	.001	0.25
MEAN	10.4	.044	.25	60.0	1.27	2.63	2.51	2.95	.81	0.50
STD. DEV.	7.26	.065	.2	35.5	2.46	4.44	2.05	2.0	1.39	0.17

APPENDIX C

FIGURES AND TABLES PRESENTING PHYSICAL CHARACTERISTICS

SECTION 4

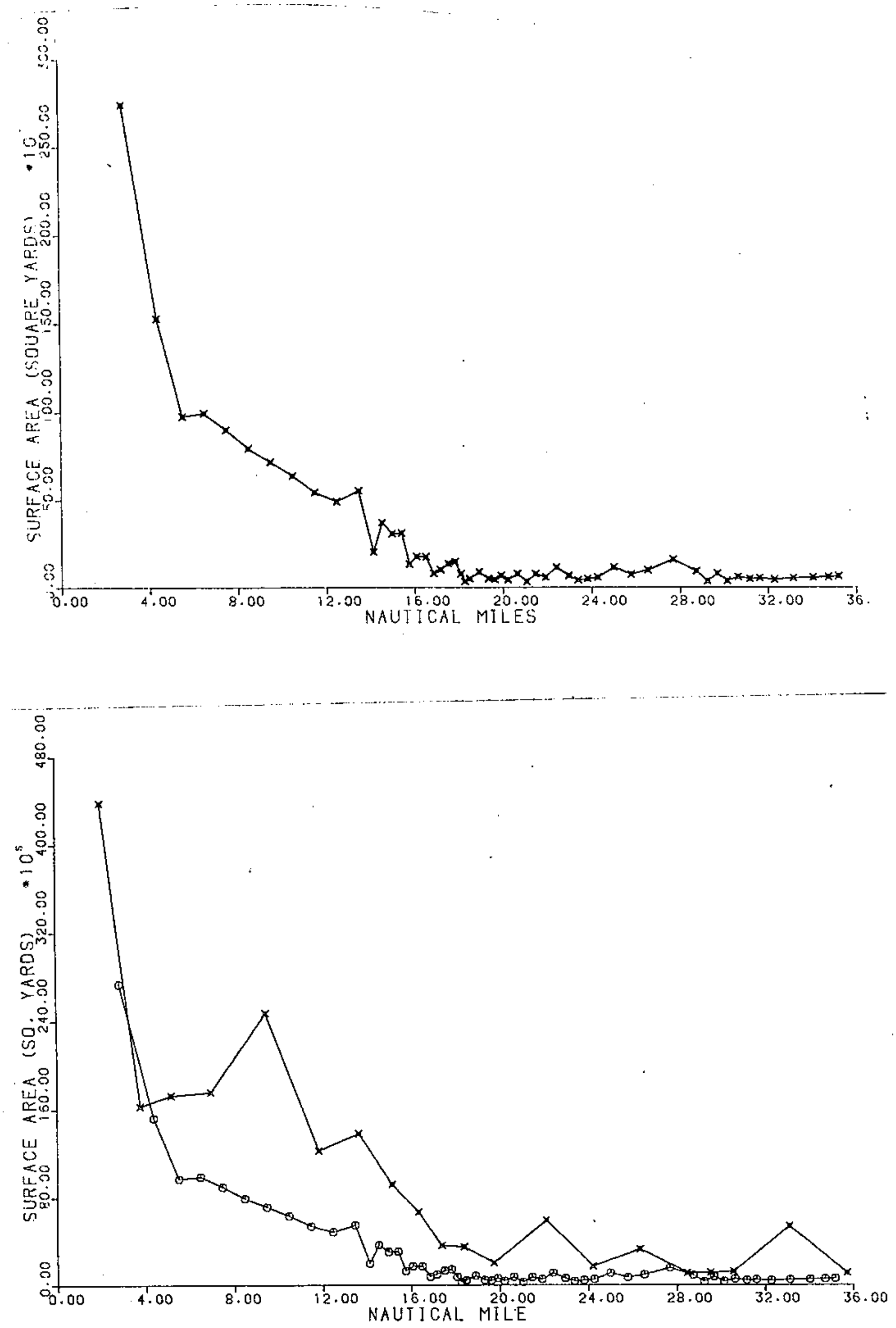


Figure 4-1 Chester River water surface area at mean low water calculated from (a) nautical charts and (b) comparison between nautical chart and bathymetric data.

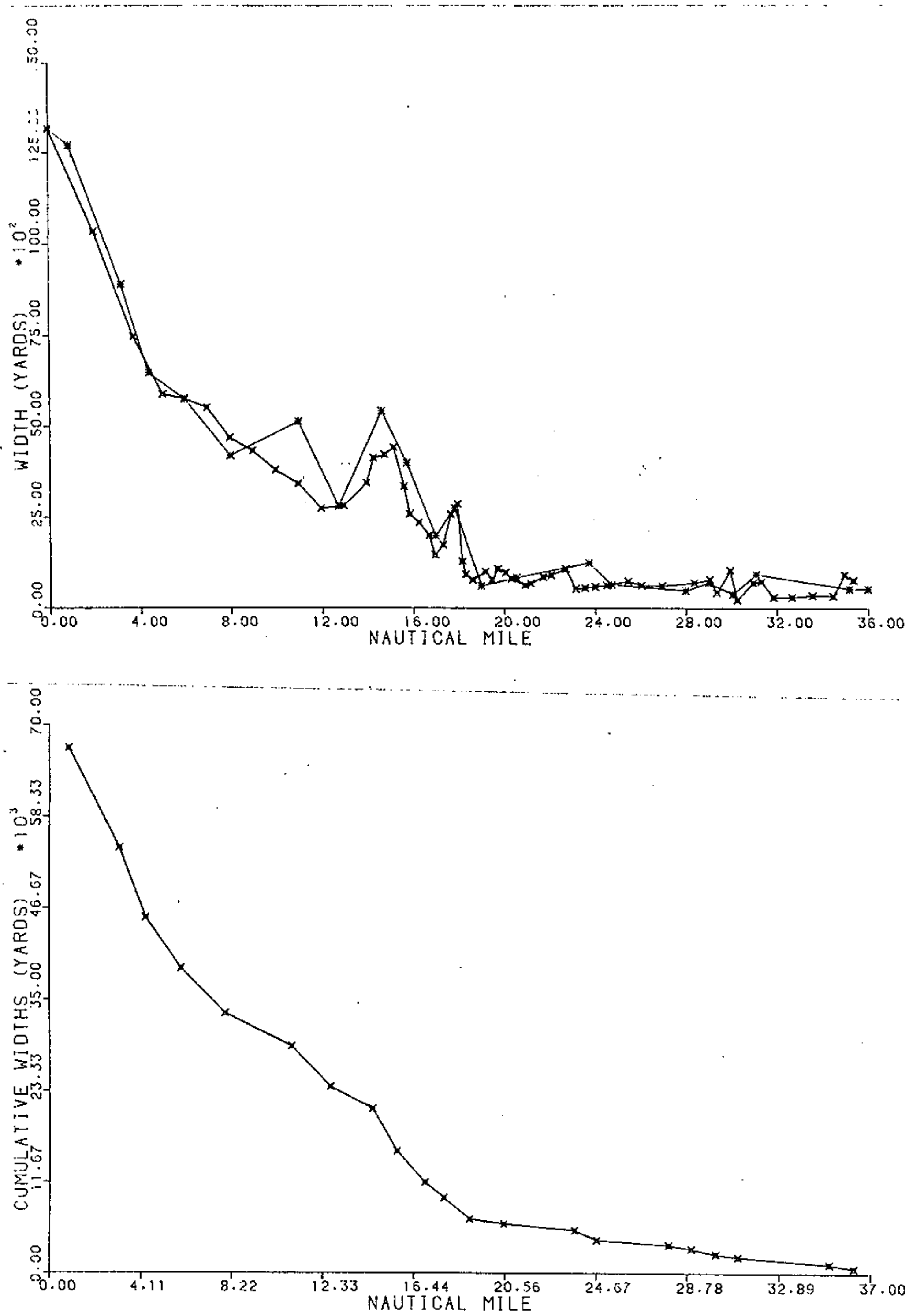


Figure 4-2 Chester River width and cumulative river width from bathymetry survey and nautical chart data.

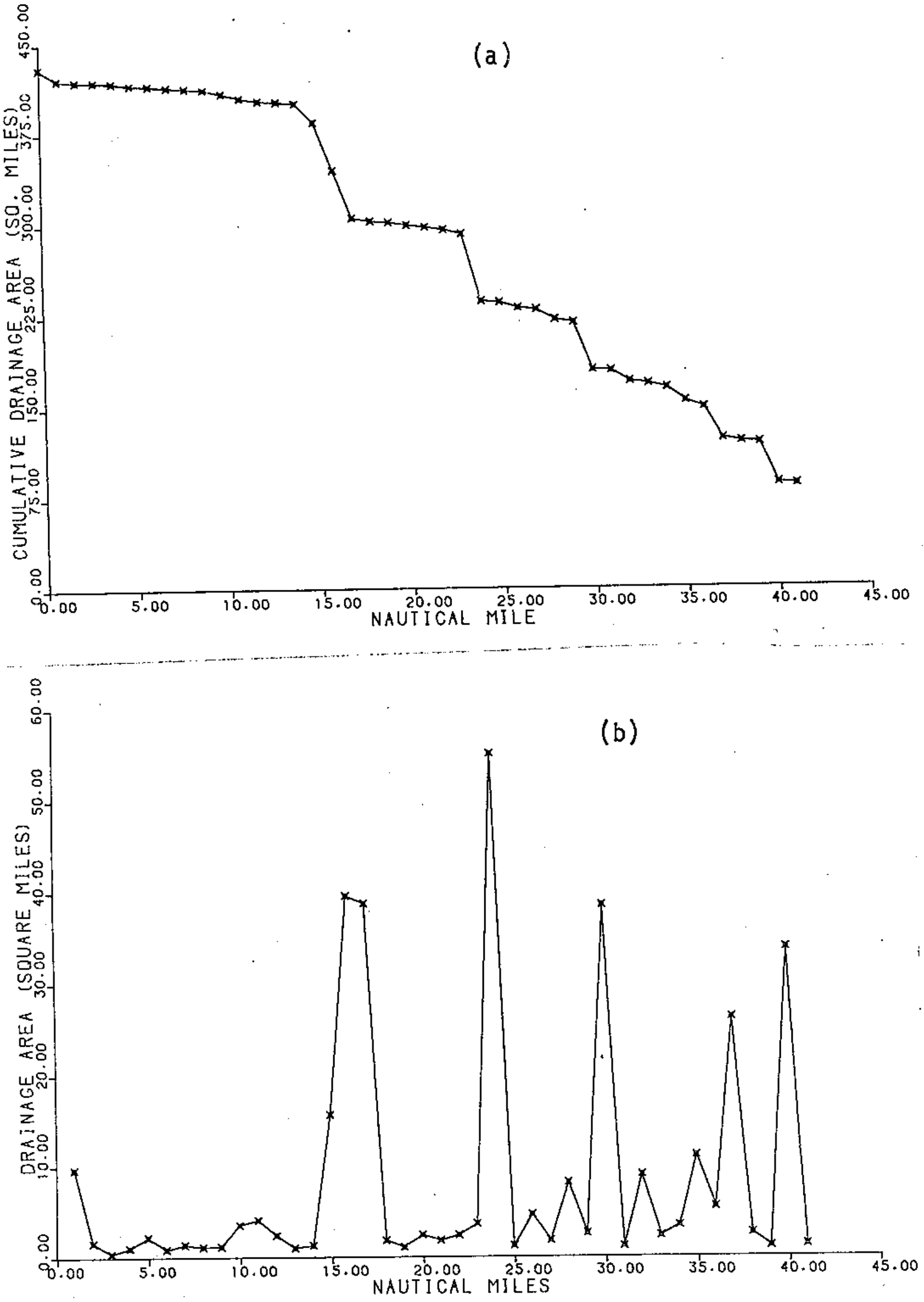


Figure 4-3 Chester River drainage area and cumulative drainage area taken from topographic map.

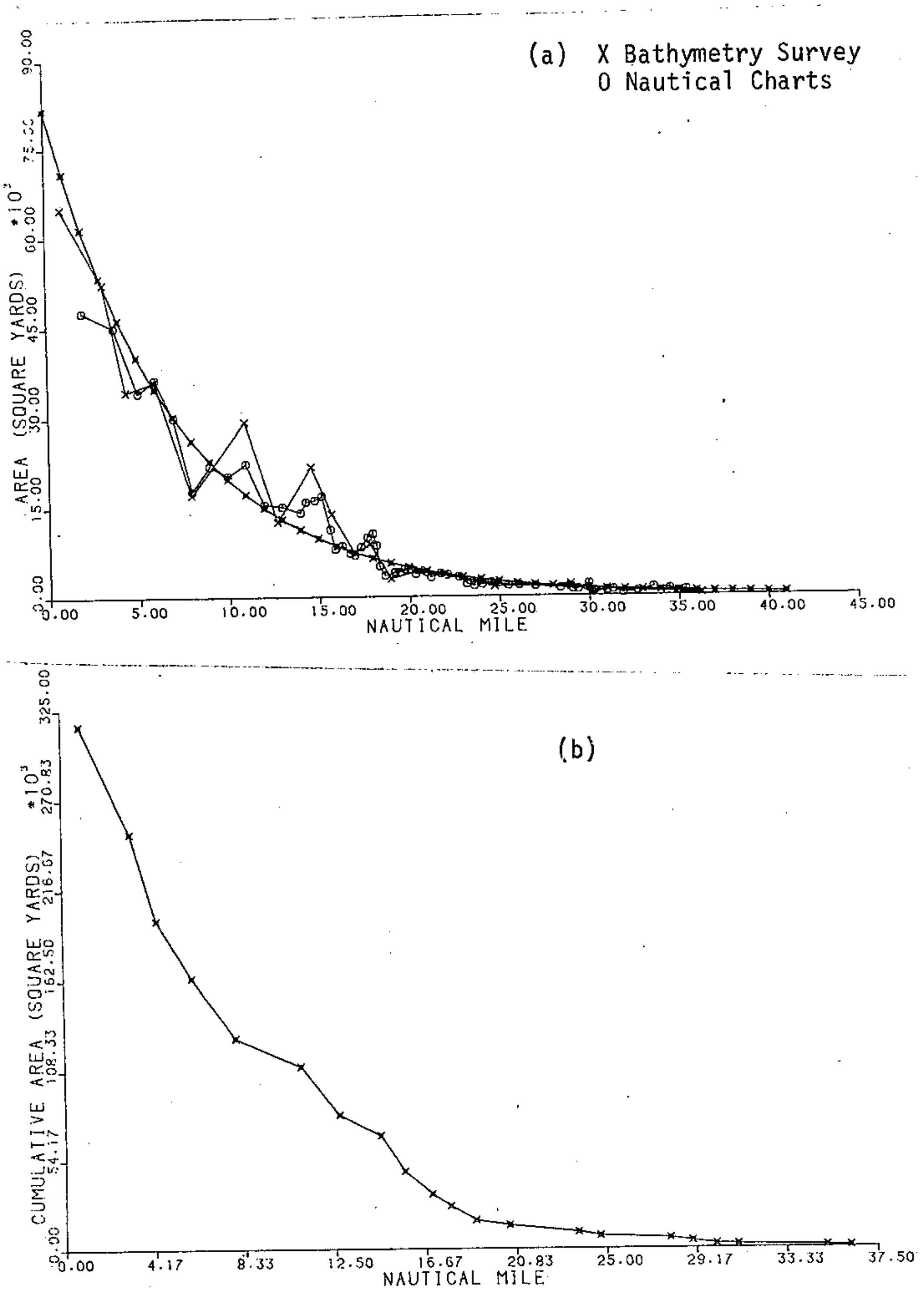


Figure 4-4 Chester cross sectional area at mean low water from bathymetry data (b) and comparison between bathymetry and nautical chart data (a).

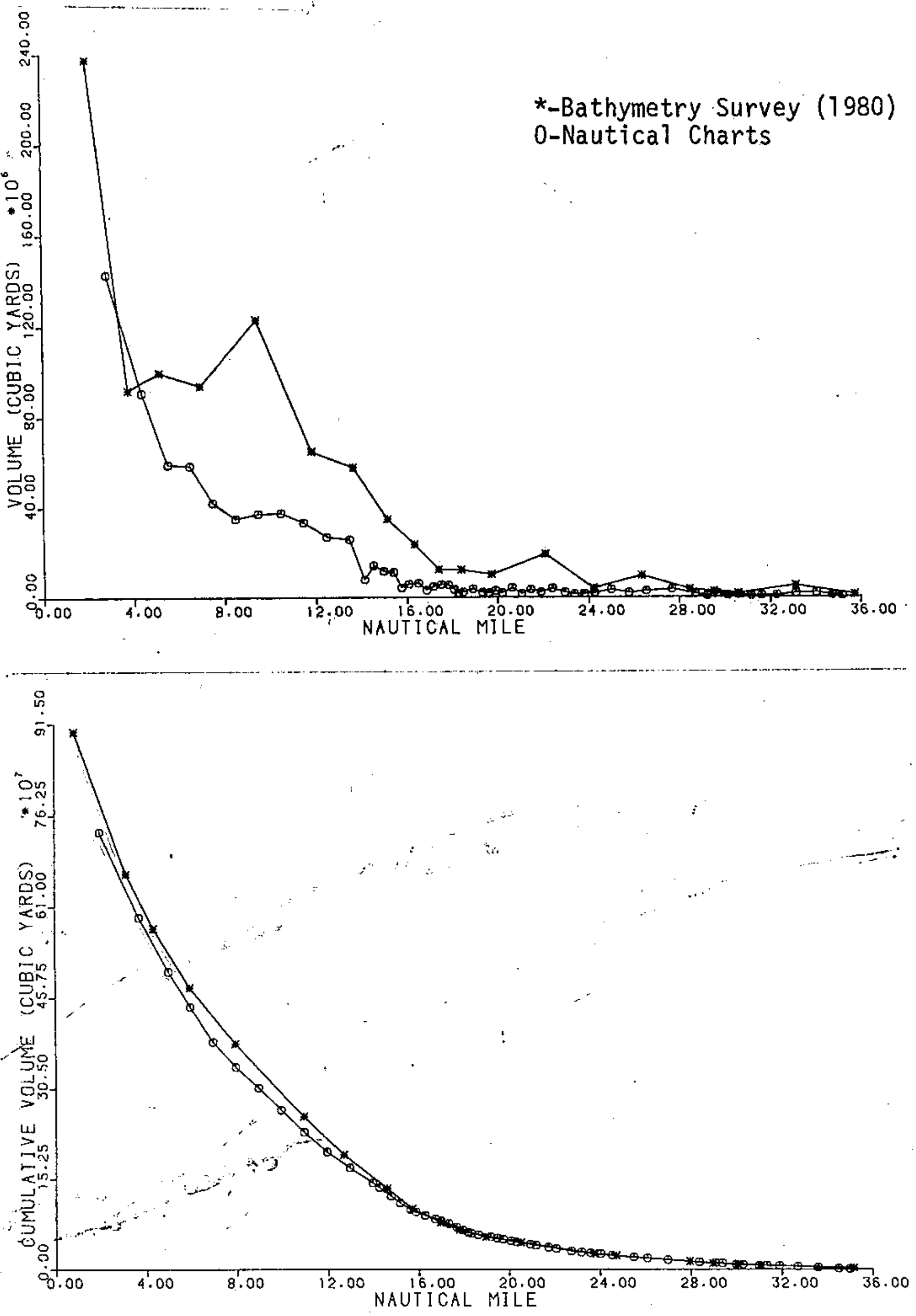
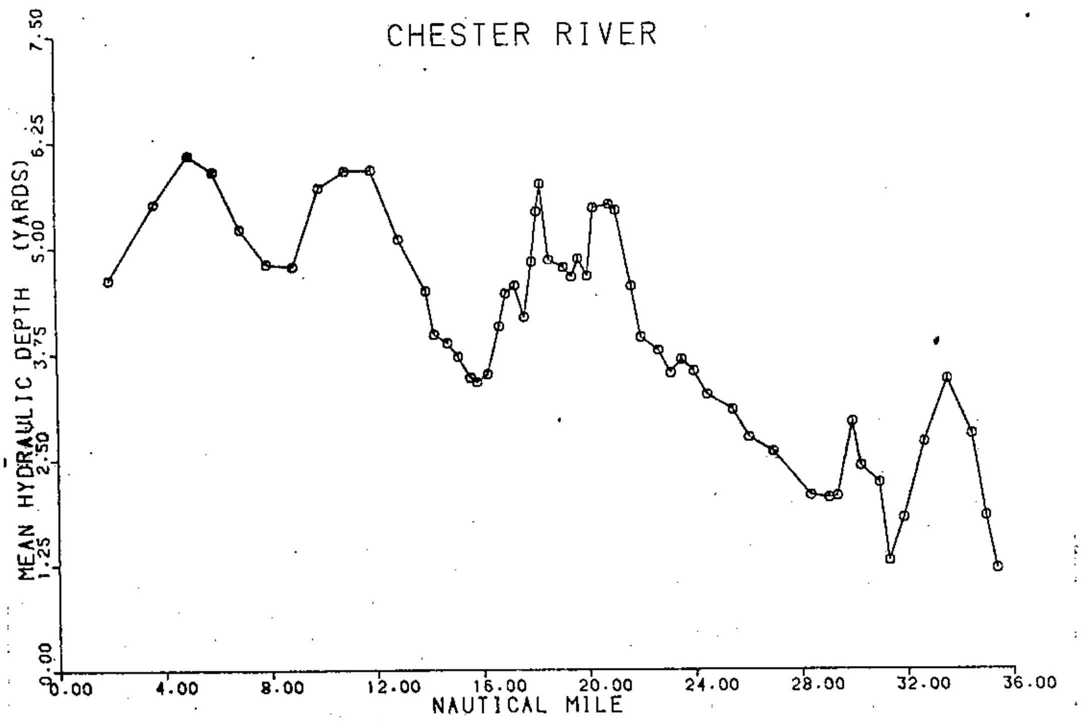


Figure 4-5 Calculated water volume and cumulative water volume at mean low water in Chester River from bathymetry survey data and nautical chart data.



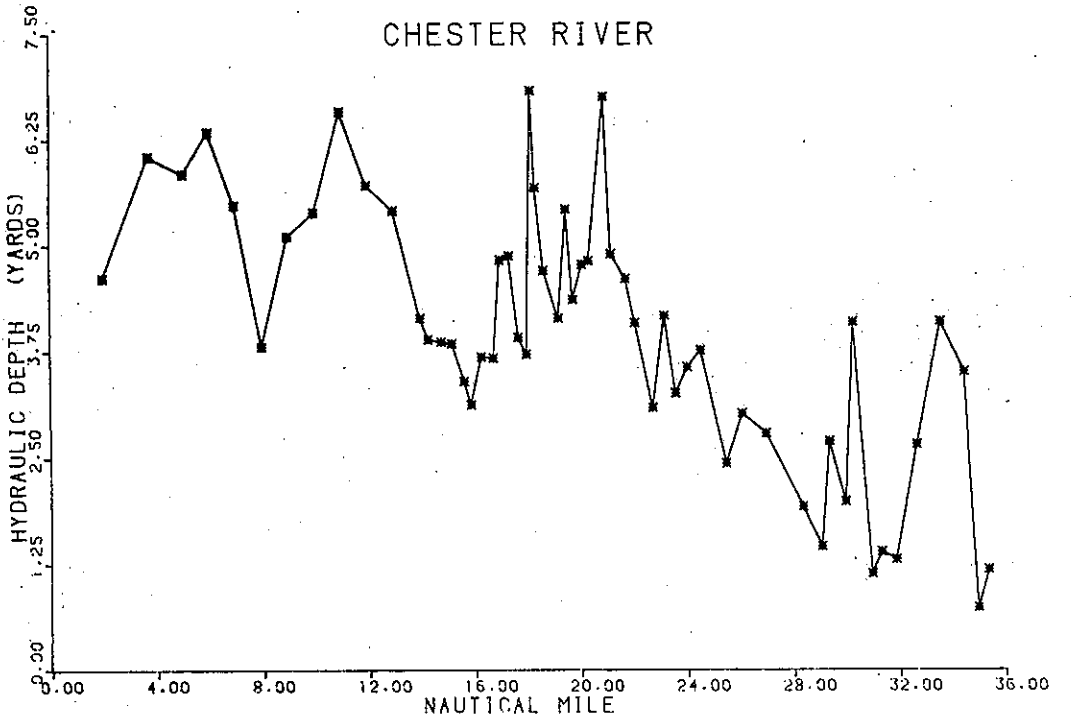


Figure 4-6. Chester River Mean Hydraulic Depth and Hydraulic Depth.

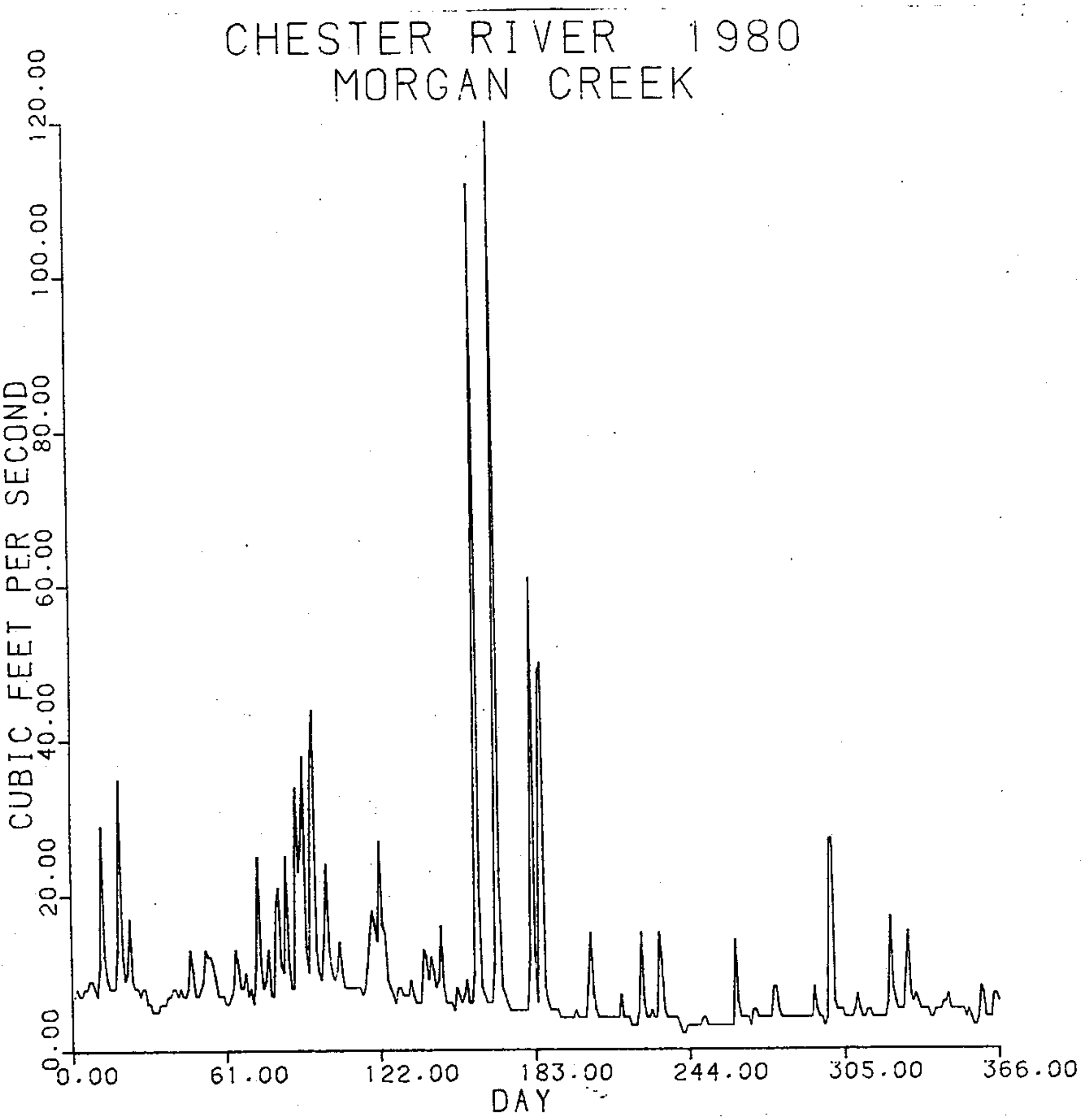


Figure 4-7 Freshwater inflow (cubic feet per second) during the 1980 study period at the Morgan Creek USGS gauge, station 01493500.

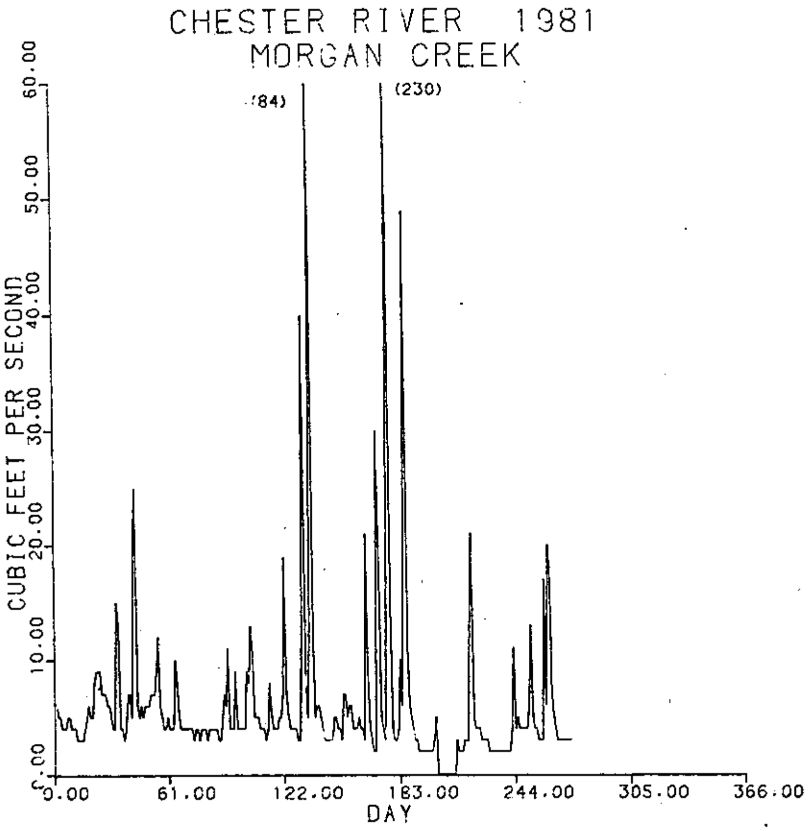


Figure 4-8 Freshwater inflow (cfs) during 1981 study period at the Morgan Creek USGS guage, station 01493500.

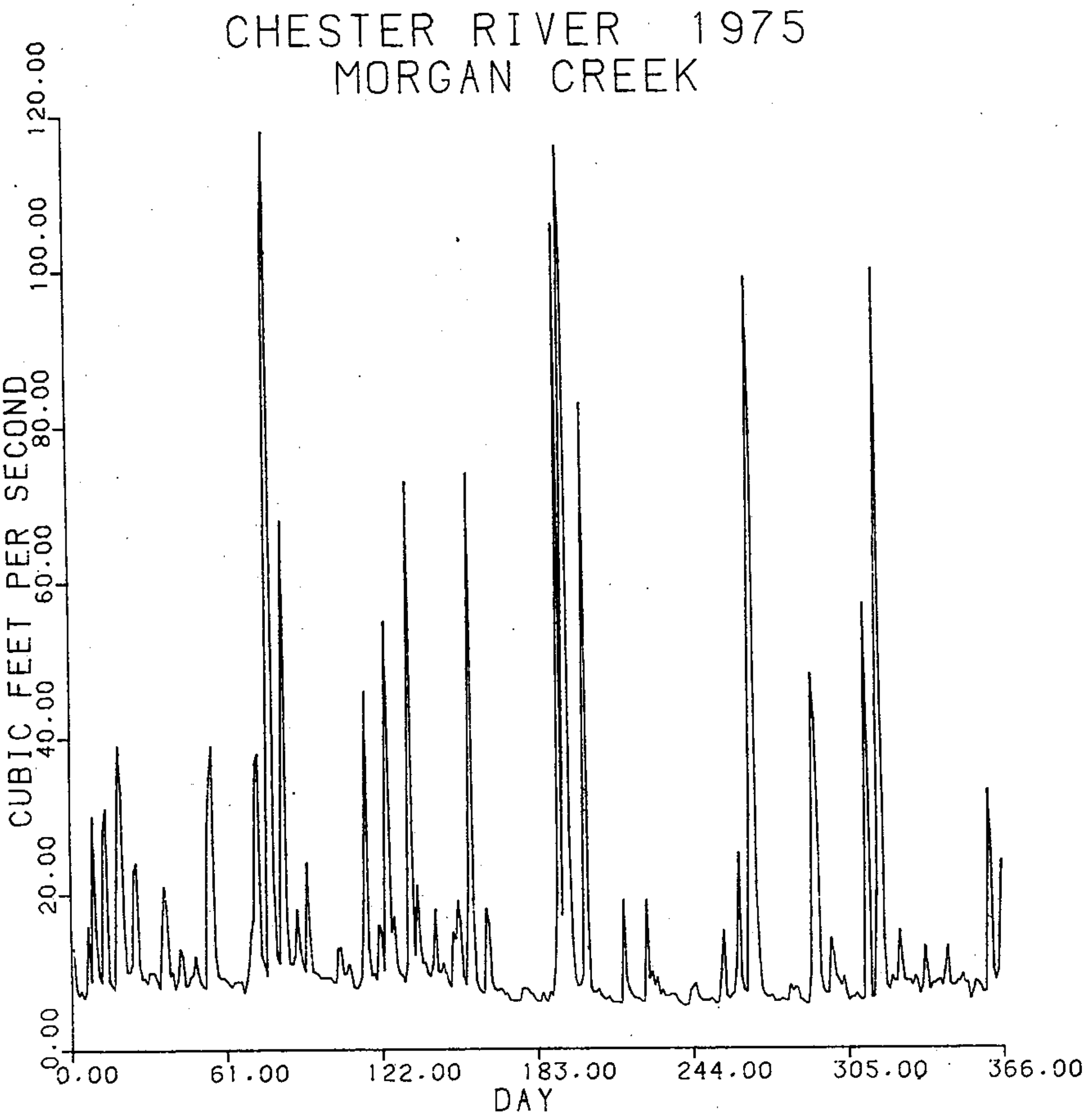


Figure 4- 9 Freshwater inflow (cubic feet per second) during the 1975 study period at the Morgan Creek USGS gauge, station 01493500.

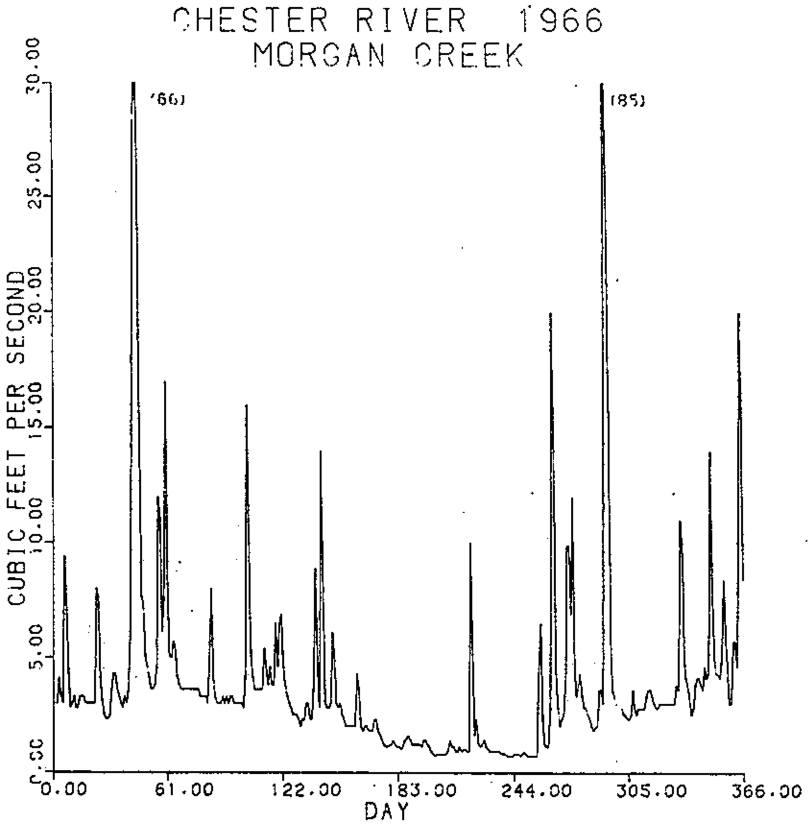


Figure 4-10 Freshwater inflow (cubic feet per second) during 1966 study period at the Morgan Creek USGS gauge, station 01493500.

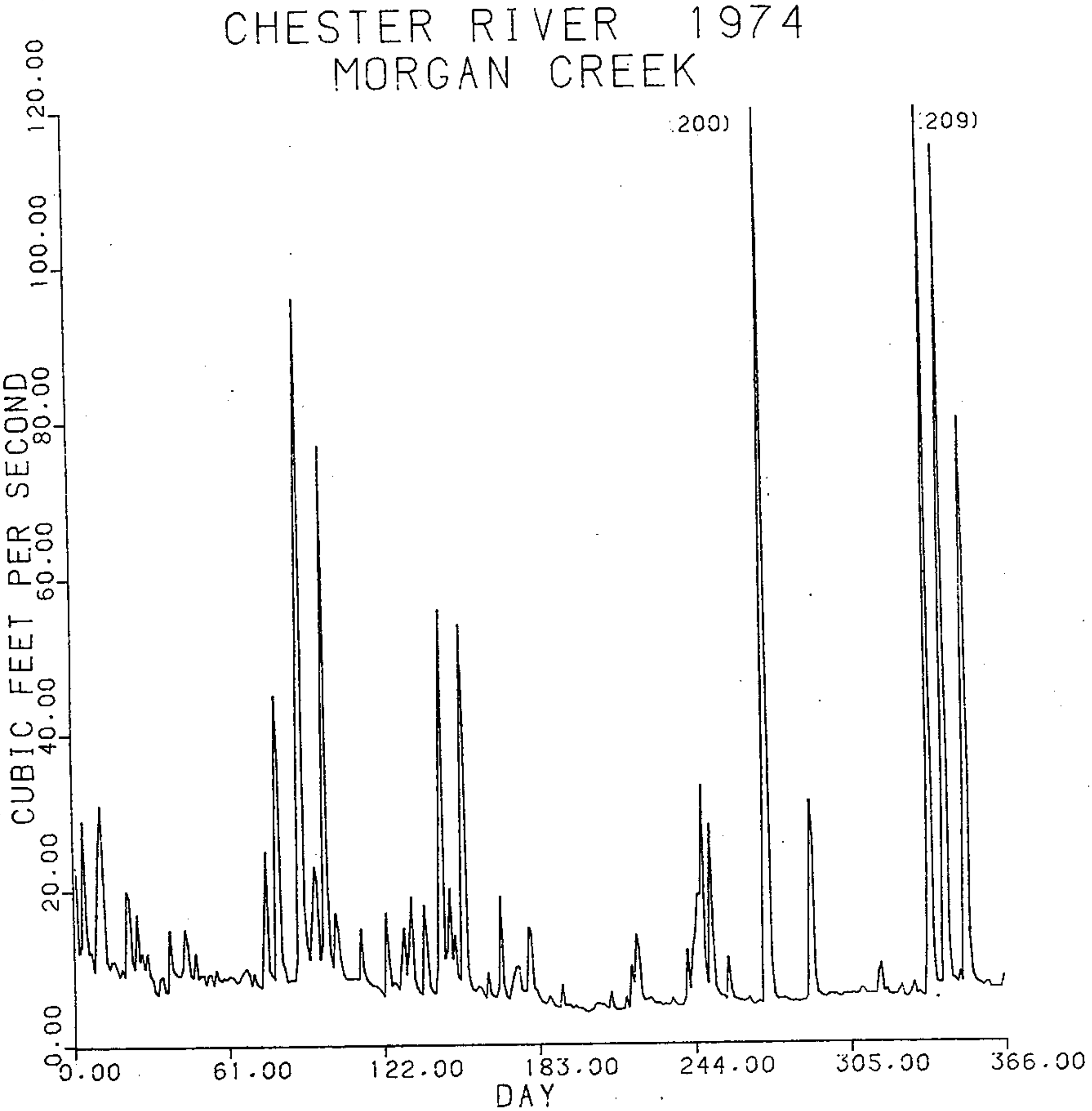


Figure 4-11 Freshwater inflow (cubic feet per second) during the 1974 study period at the Morgan Creek USGS gauge, station 01493500.

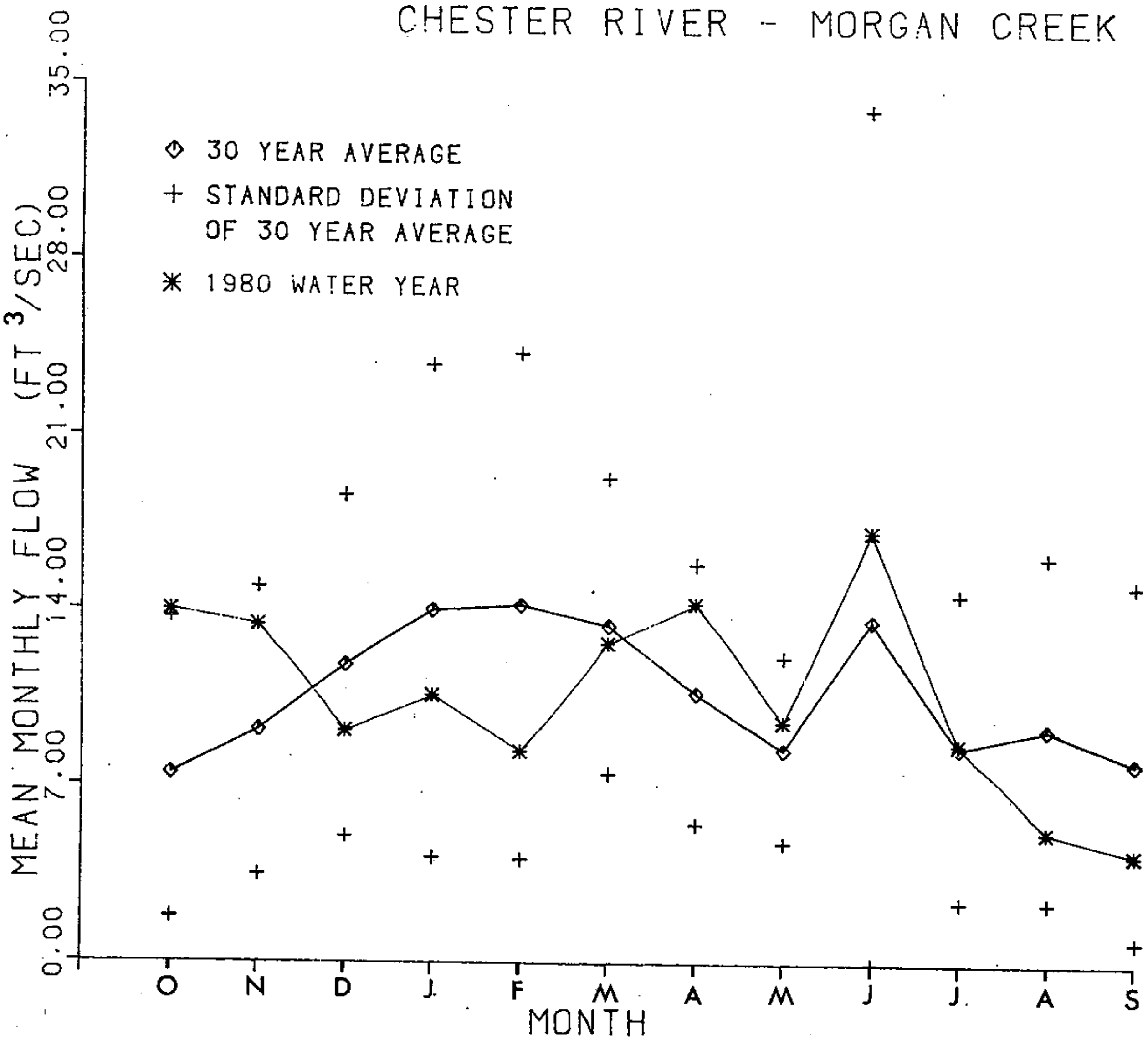


Figure 4-12 Chester River mean monthly flow from historical data and for water year 1980.

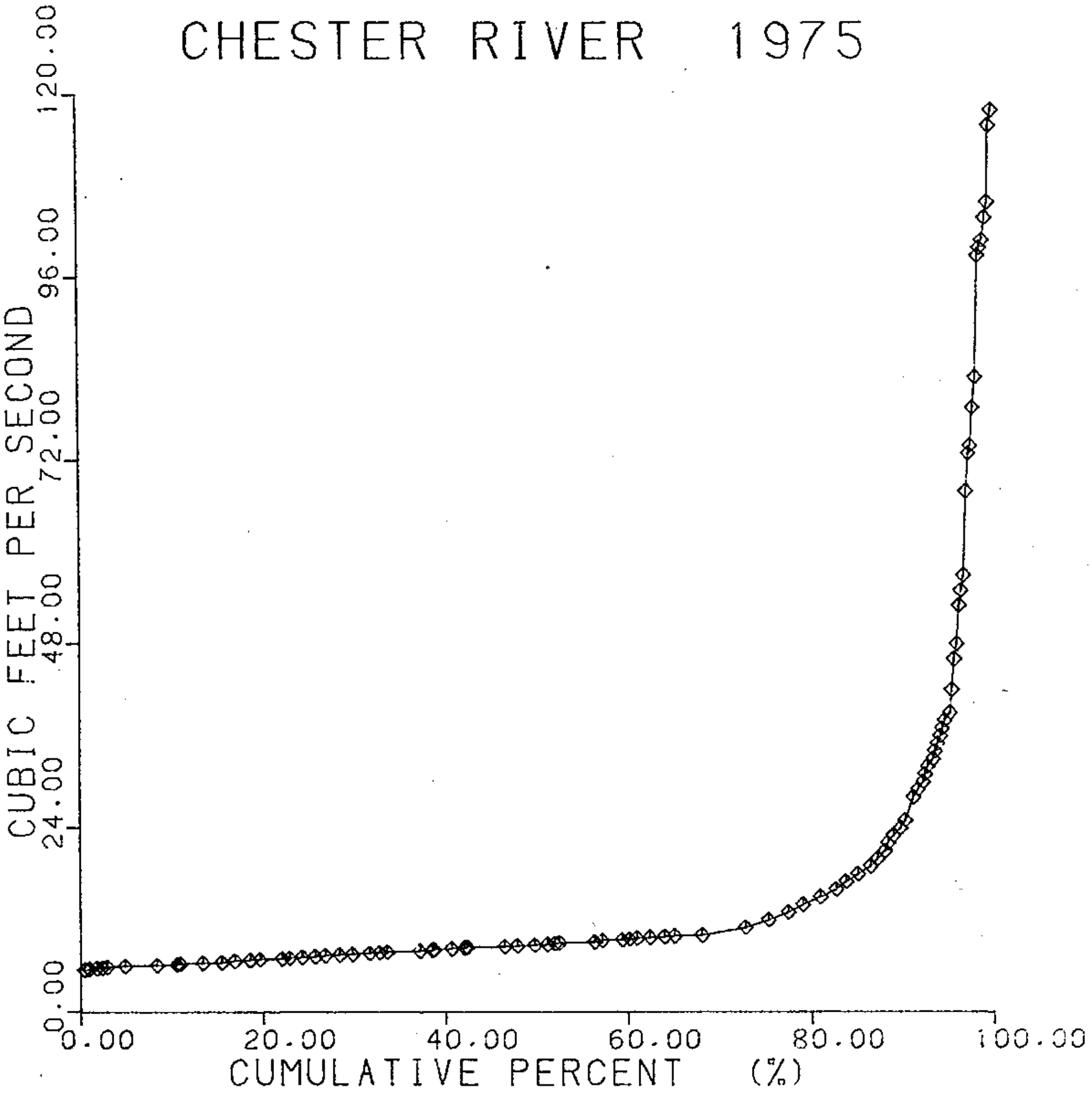


Figure 4-13. Chester River Cumulative Frequency Distribution Curves of Mean Daily cfs Flow for 1975.

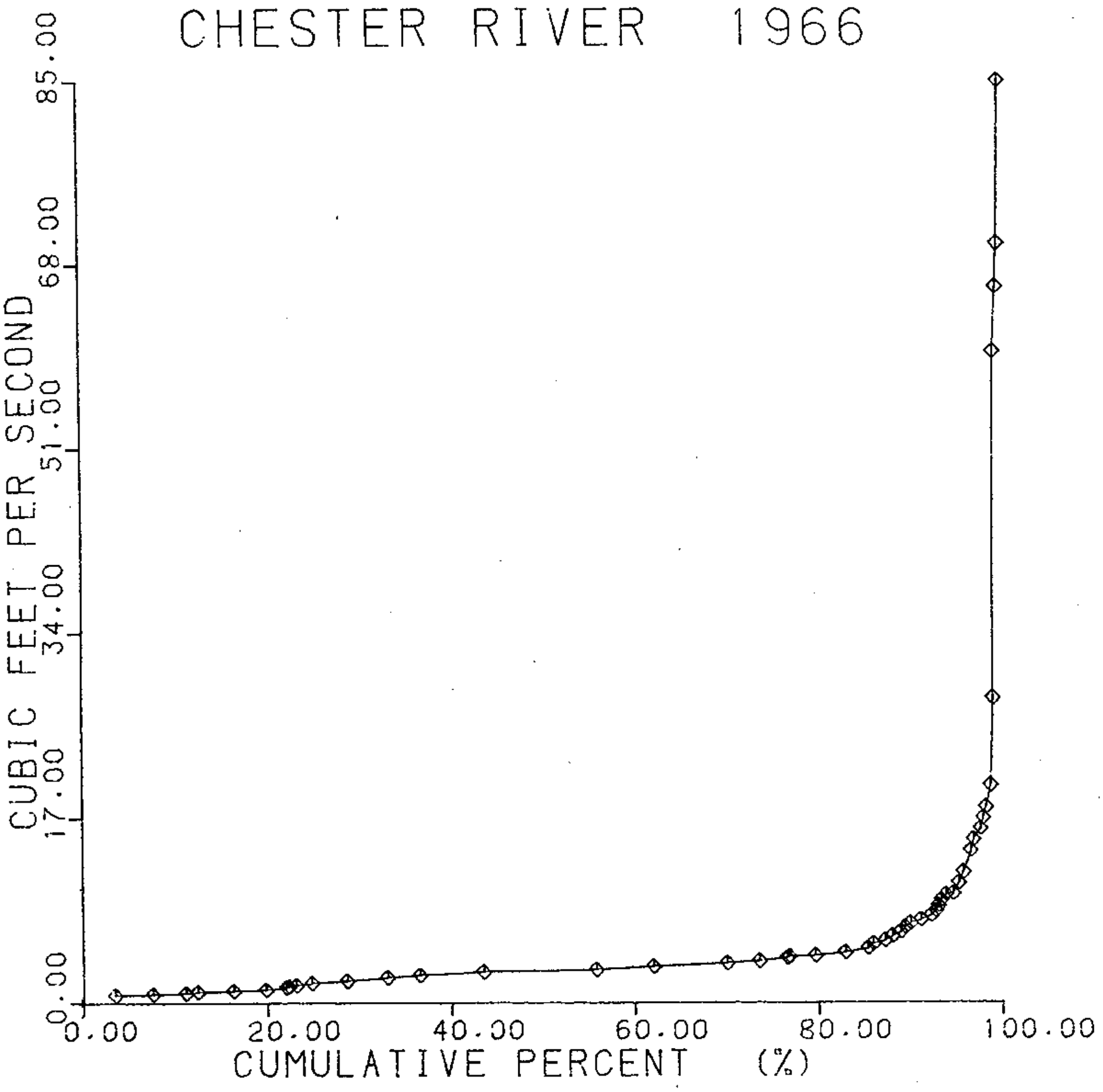


Figure 4-14. Chester River Cumulative Frequency Distribution Curves of Mean Daily cfo Flow for 1966.

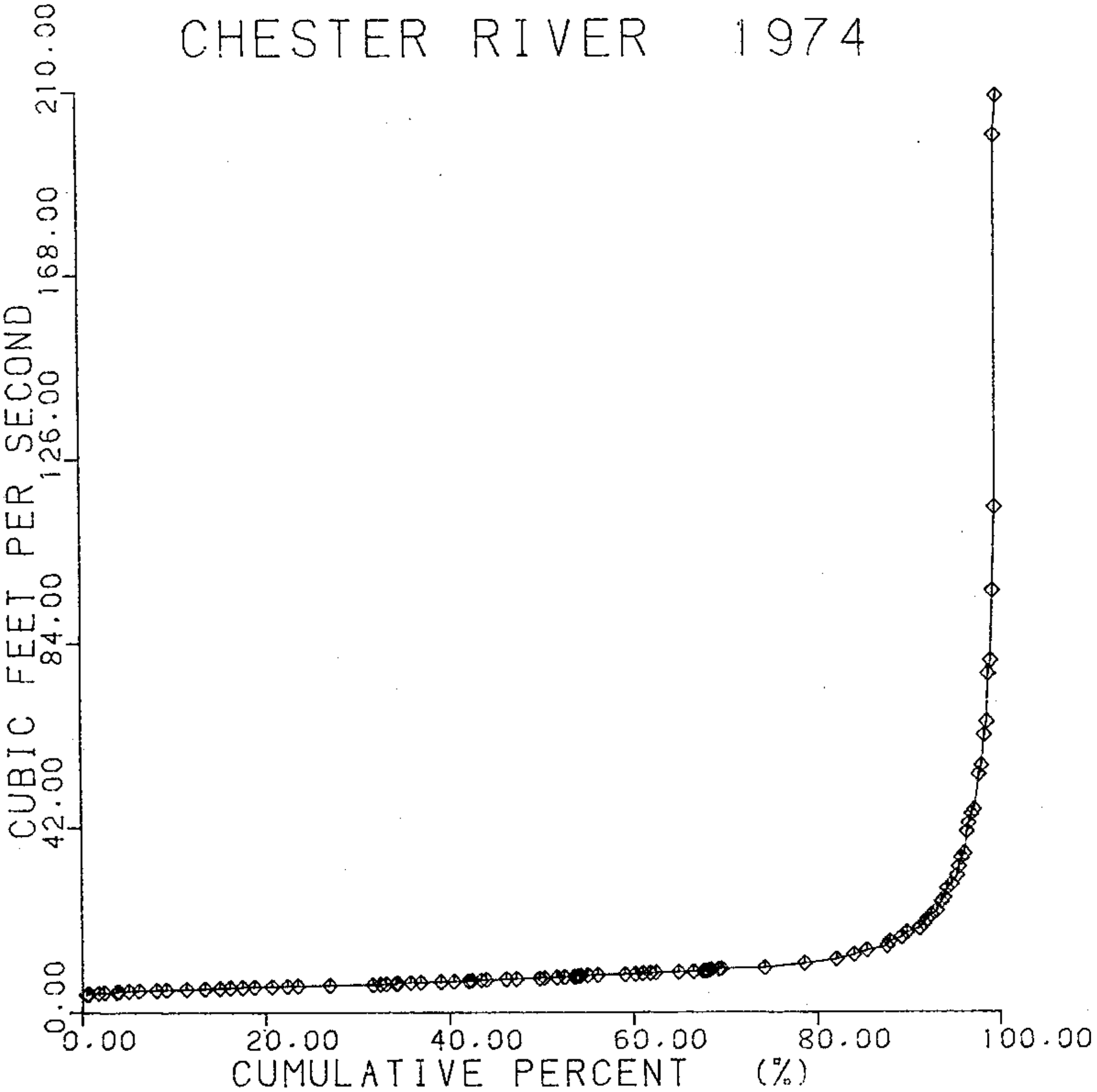


Figure 4-15. Chester River Cumulative Frequency Distribution Curves of Mean Daily cfo Flow for 1974.

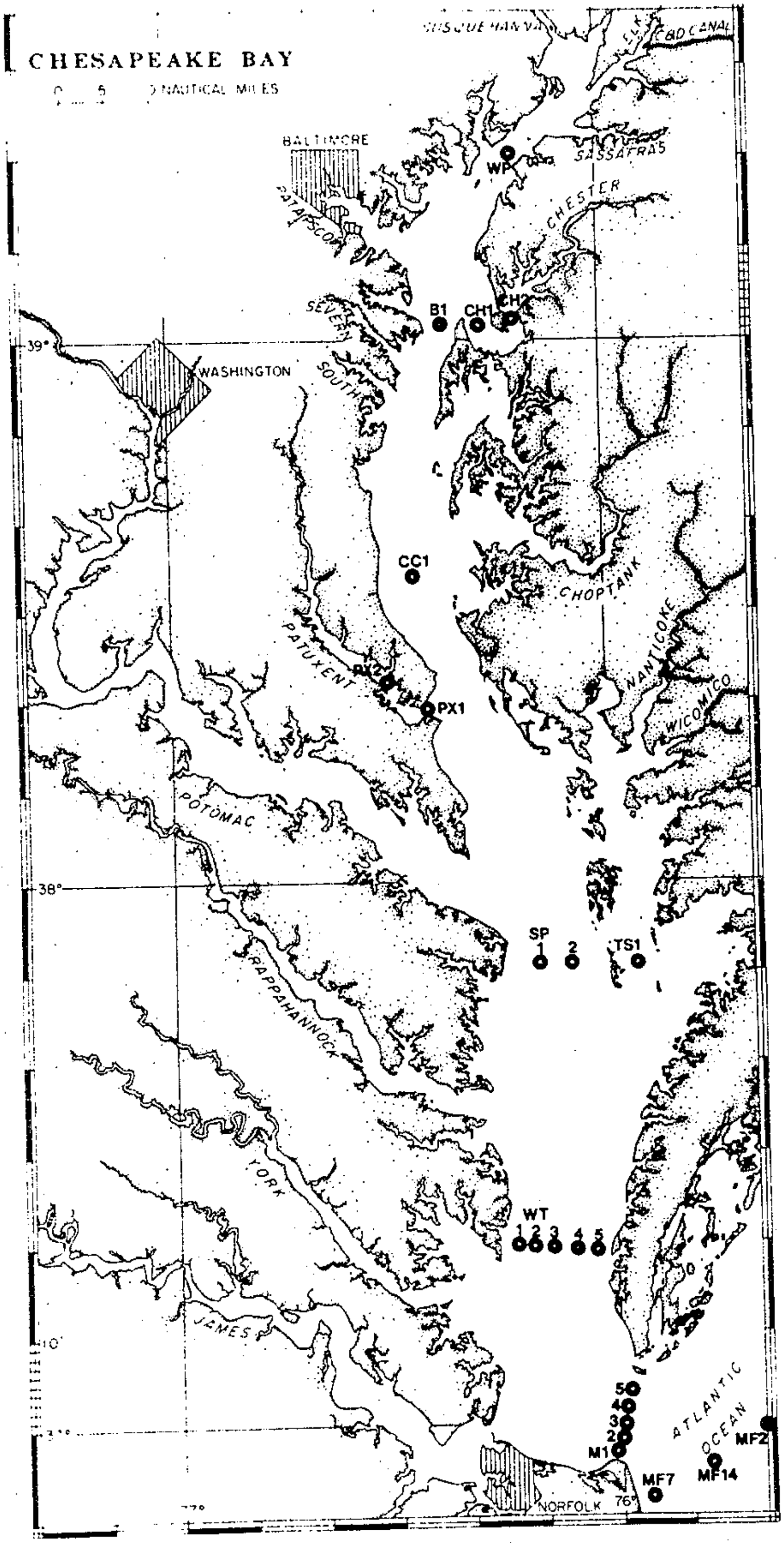


Figure 4-16. Current meter mooring locations for CRIMP80 measurement program.

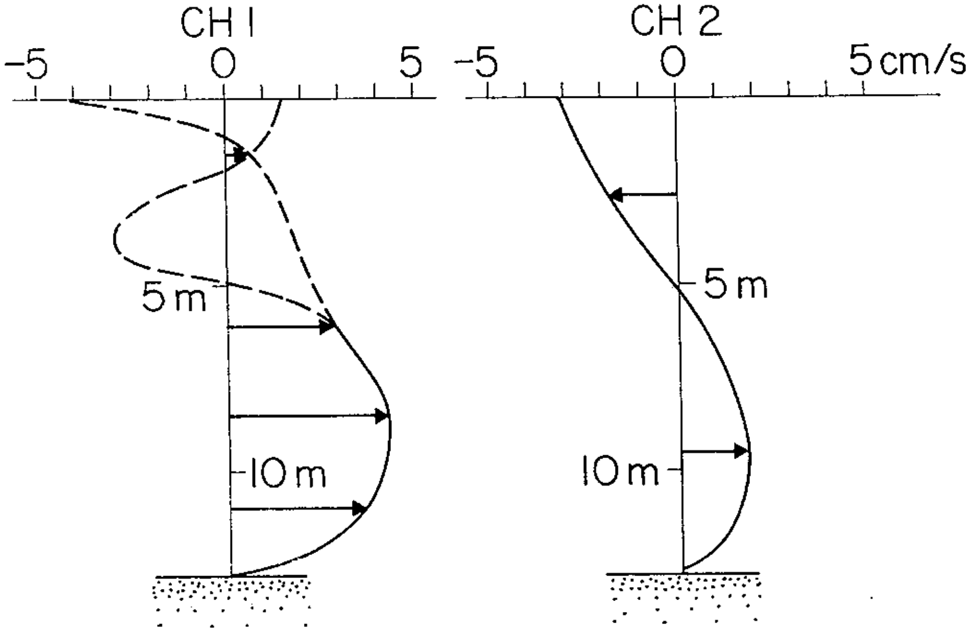


Figure 4-17 Mean velocity profiles for the two Chester River moorings, CH1 and CH2. Positive velocity is directed into the estuary.

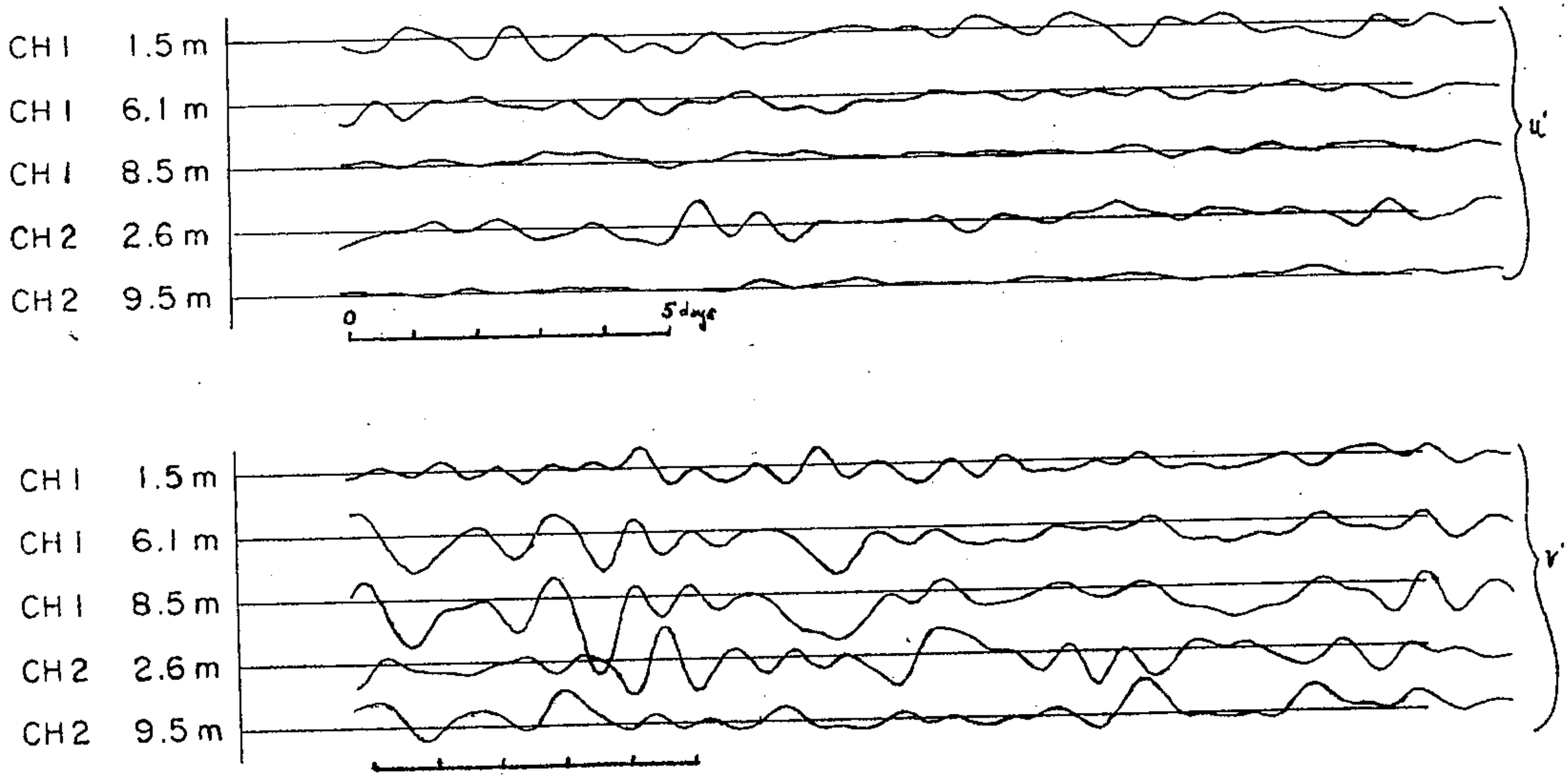


Figure 4-18. Low frequency currents for the Chester River measurements. The component directions are as defined in Table 4-1.

Table 4-1 Flow statistics from the Chester measurements. N is the number of records, T_0 is the initial start time in hours after 0000 23 June 1980, Δt is the averaging interval for each record, and θ is the rotation angle for the principal axis. The next four columns represent the mean velocities in the north and east directions (u and v) and the mean velocities in the coordinates of the principal axes (u' and v'). The last two columns contain the variances in the rotated axes. The principal axis is indicated by an asterisk.

Moorings	Depth m	N	To hr	Δt min	θ o	<u> cm/s	<v> cm/s	<u'> cm/s	<v'> cm/s	$\theta^2_{u'}$ cm^2/s^2	$\theta^2_{v'}$ cm^2/s^2
CH1	1.5	1963	112.25	30	14	-0.95	-0.99	-1.16	-0.72*	33.42	120.81
CH1	6.1	1963	112.25	30	12	-0.84	-3.09	-1.49	-2.83*	17.50	137.58
CH1	8.5	1963	112.25	30	17	2.09	-3.70	0.93	-4.15*	10.14	138.56
CH1	11.0	175	112.75	30	33	0.90	-3.82	-1.31	-3.69*	2.75	112.63
CH2	2.6	1967	111.25	30	9	0.39	-1.76	0.09	-1.80*	43.72	353.68
CH2	9.5	1967	111.25	30	23	-0.03	1.81	0.69	1.67*	11.94	536.97

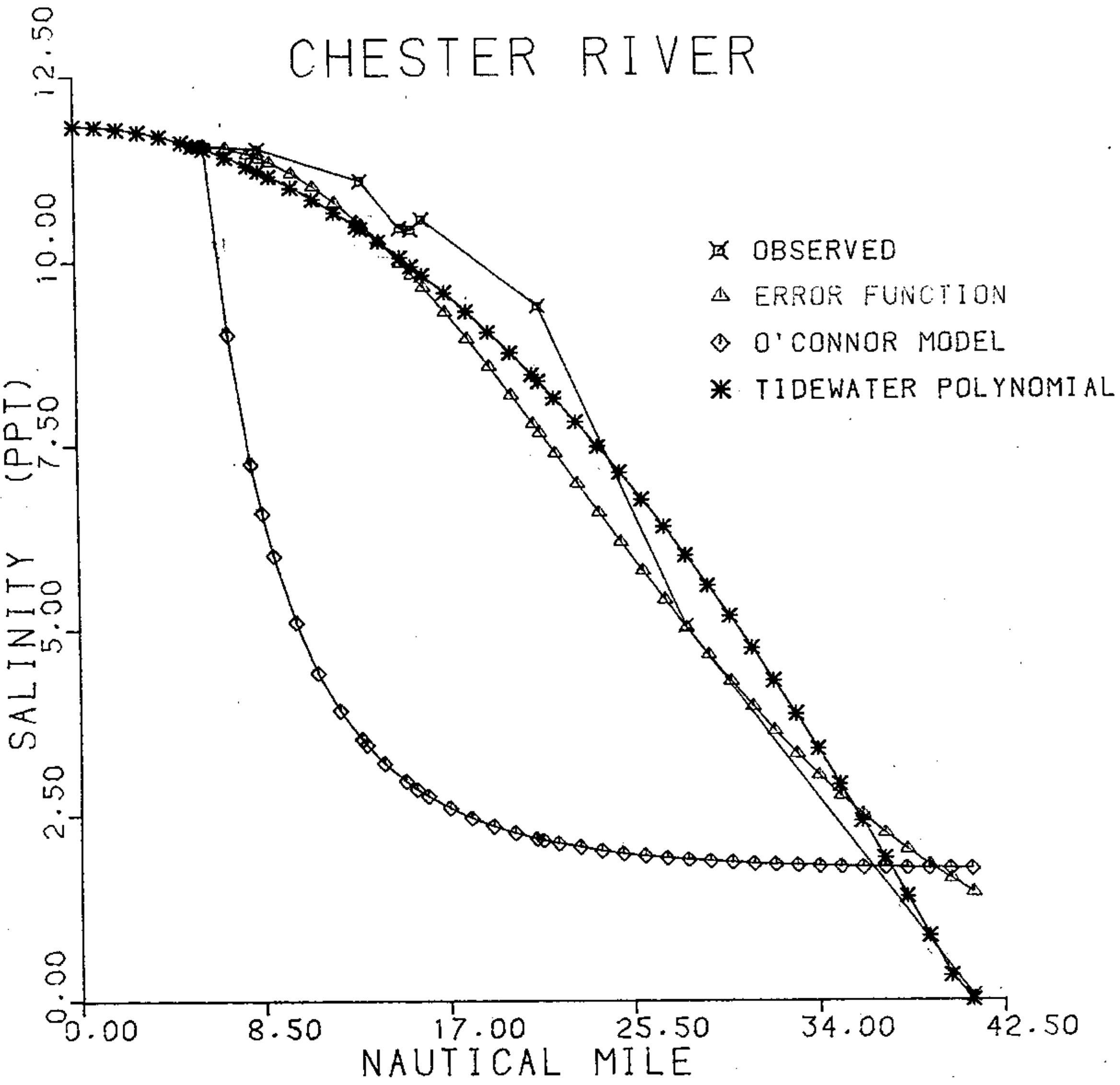


Figure 4-19 Chester River observed and Statistically Estimated Functions of the Salinity Profile for 198-81.

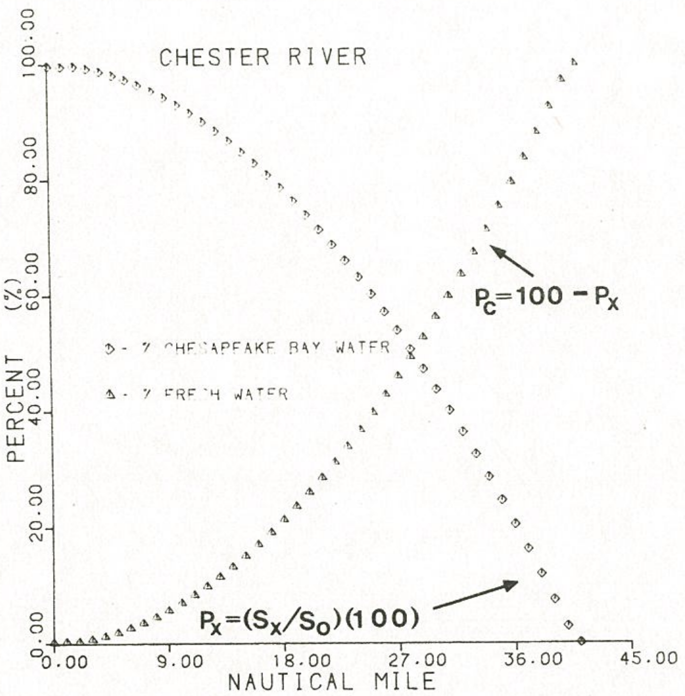


Figure 4-20 Estimated average longitudinal fraction of freshwater and Chesapeake Bay water in the Chester Estuary. (see equation 4-26 and 4-27).

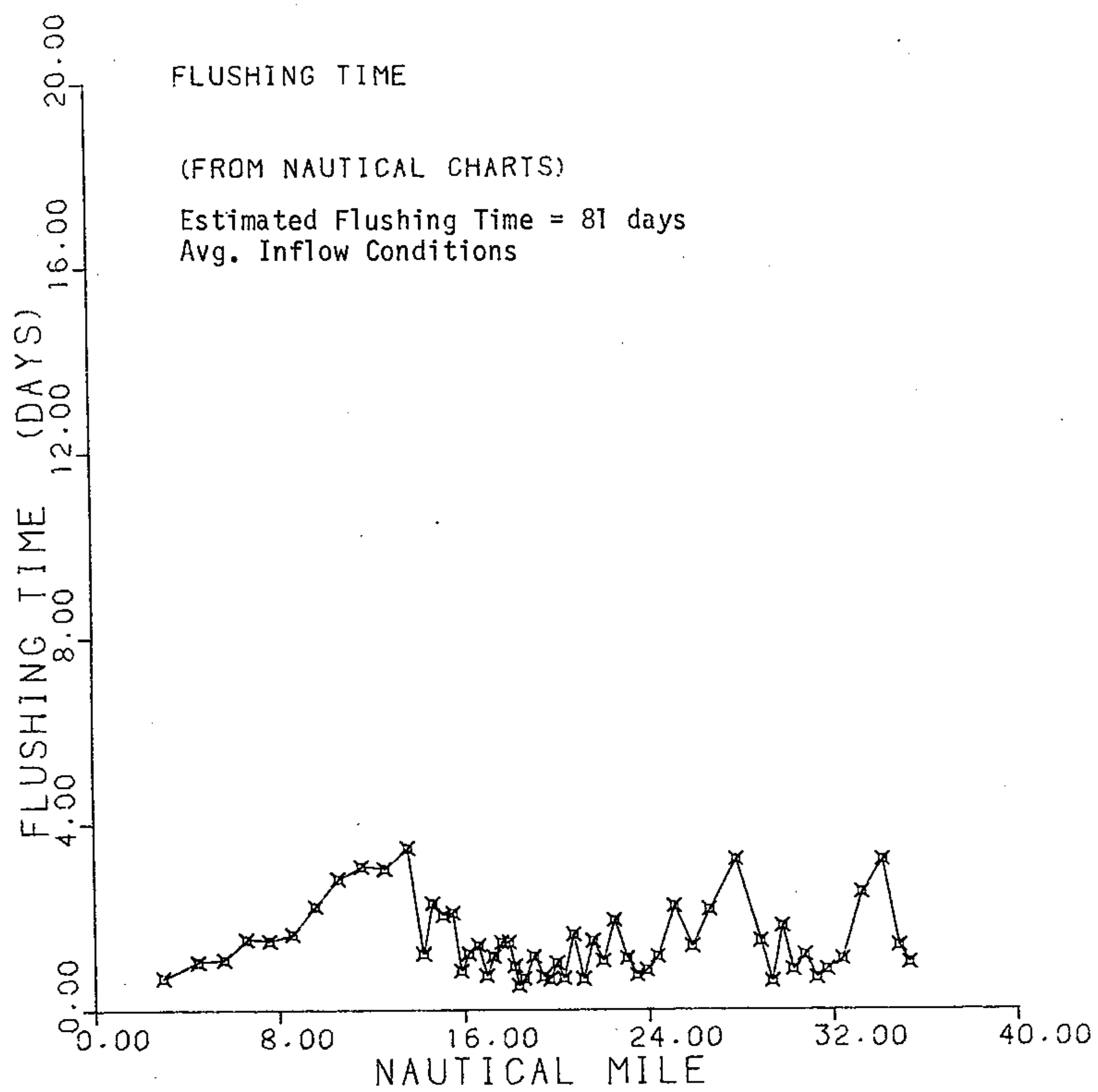


Figure 4-21 Chester River freshwater flushing time versus nautical mile (from nautical chart data).

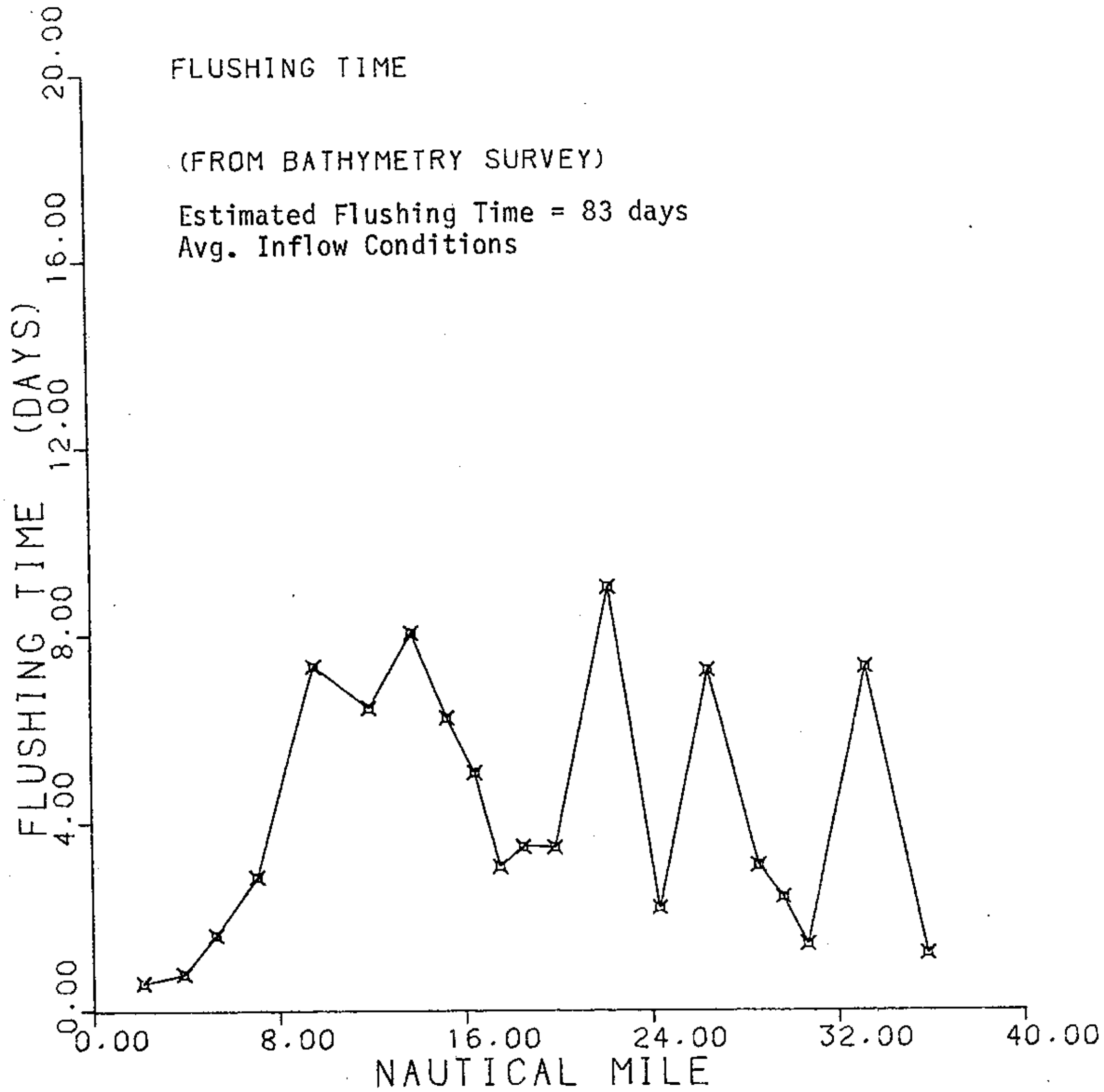


Figure 4-22 Chester River freshwater flushing time versus nautical mile (from bathymetry survey data).

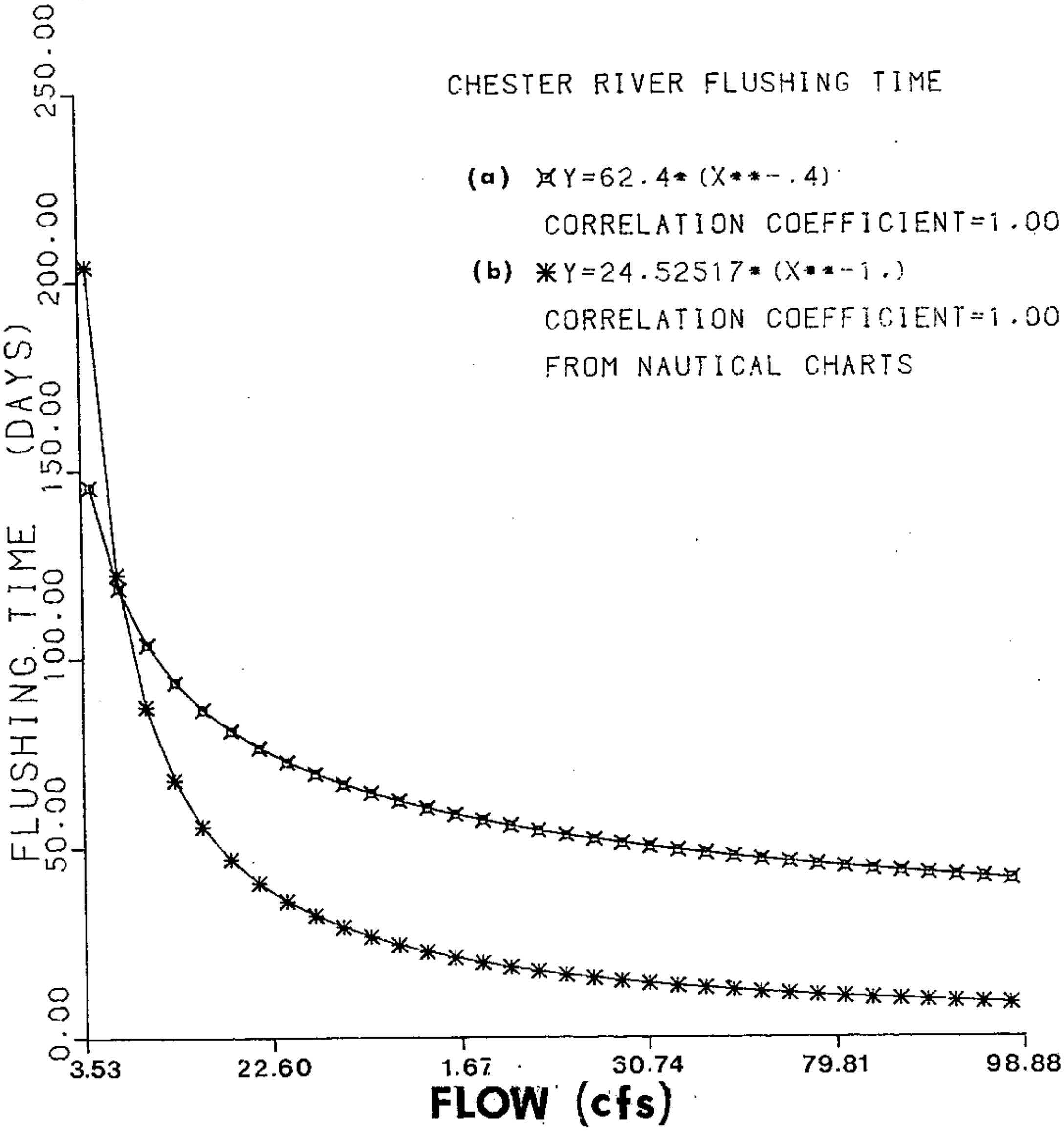


Figure 4-23 Chester River flushing time versus flow.

Table 4-4
Linearized Functions Used In Regression Analysis for Salinity Distribution

Dependent Variable y=salinity	Independent Vairable x = nautical mile	Correlation Coefficient ($r2$)
(1) S ($s = ax + b$)	x	0.9293
(2) ln S ($S = e^b e^{ax}$) ($\ln S = ax + b$)	x	0.7396
(3) S ($S = a \ln X + b$)$\rightarrow$[$x = e^{(S-b)/a}$]	$\ln x$	0.7090
(4) ln S ($\ln S = a \ln x + \ln b$)$\rightarrow$($S = b\, x^a$)	$\ln x$	0.4720
(5) ln S ($S = ax^2 + b$)	x^2	0.9781
(6) ln S ($\ln S = ax^2 + b$)$\rightarrow$($S = e^b e^{ax^2}$)	x^2	0.9025
(7) S ($S = ax^3 + b$)	x^3	0.9448
(8) ln S ($\ln S = ax^3 + b$)$\rightarrow$($S = e^b e^{ax^3}$)	x^3	0.9722
(9) S ($S = ax^{2.5} + b$)	$x^{2.5}$	0.9663
(10) ln S ($\ln S = ax^{2.5} + b$)$\rightarrow$($S = e^b e^{ax^{2.5}}$)	$x^{2.5}$	0.9448

Table 4-4 (cont.)
Linearized Functions Used In Regression Analysis for Salinity Distribution

Dependent Variable y=salinity	Independent Variable x=nautical mile	Correlation Coefficient (r^2)
(11) S $(S = ax^{1.9} + b)$	$x^{1.9}$	0.9801
(12) ln X $(\ln S = ax^{1.9} + b) \rightarrow (S = e^b e^{ax^{1.9}})$	$x^{1.9}$	0.8911
(13) ln (1/S) $[\ln(1/S) = ax + \ln b] \rightarrow [S = 1/(b + e^{ax})]$	x	0.7396
(14) ln (1/S) $[\ln(1/S) = ax^2 + \ln b] \rightarrow [S = 1/(b + e^{ax^2})]$	x^2	0.9025
(15) ln (1/S) $[\ln(1/S) = ax^3 + \ln b] \rightarrow [S = 1/(b + e^{ax^3})]$	x^3	0.9722
(16) S $(S = ax^{1.8} + b)$	$x^{1.8}$	0.9801
(17) ln (S) $[\ln S = ax^{1.8} + b] \rightarrow [(S = e^b e^{ax^{1.8}})]$	$x^{1.8}$	0.8780

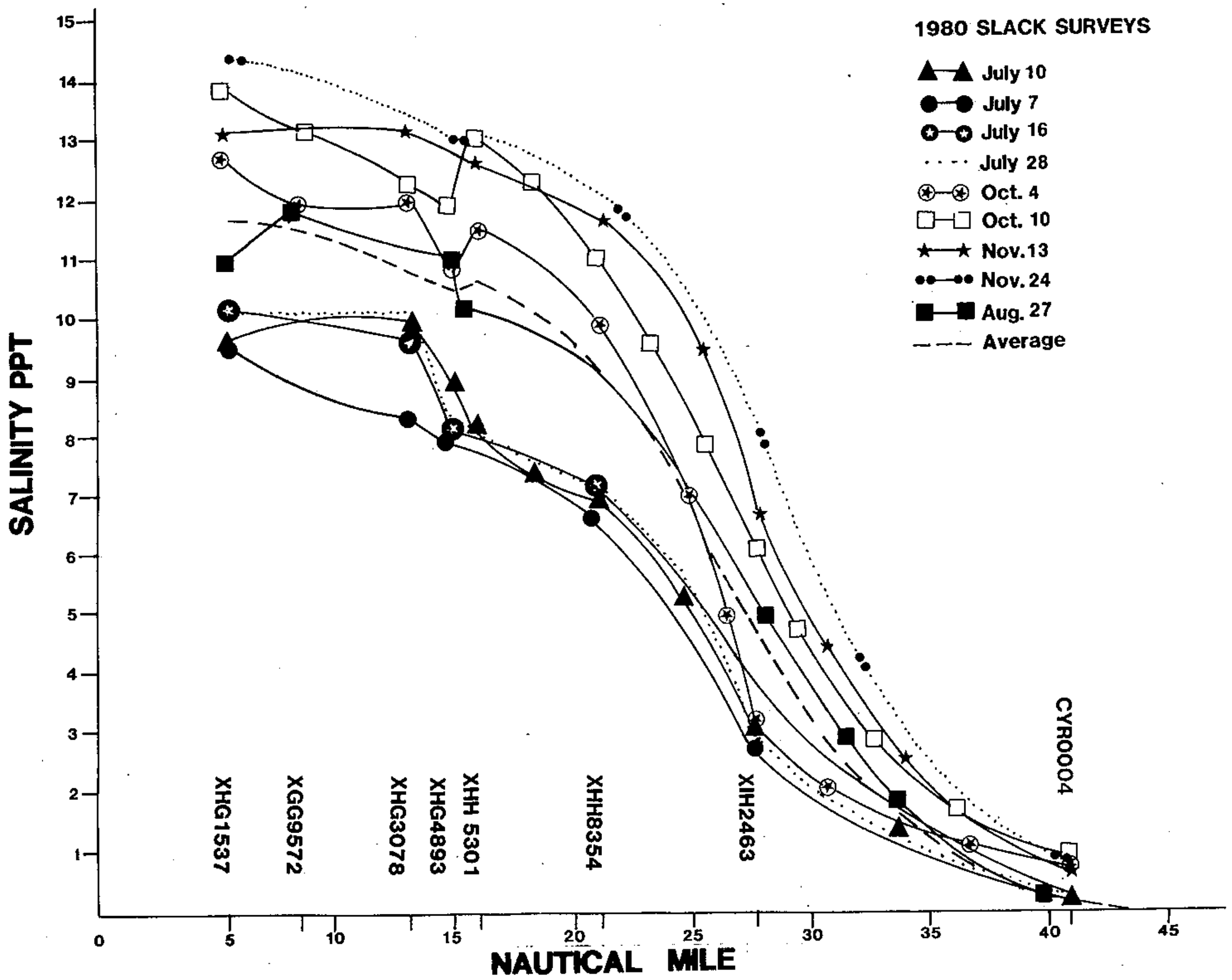


Figure 4-24 Chester River 1980 slack survey salinity profile (depth-averaged).

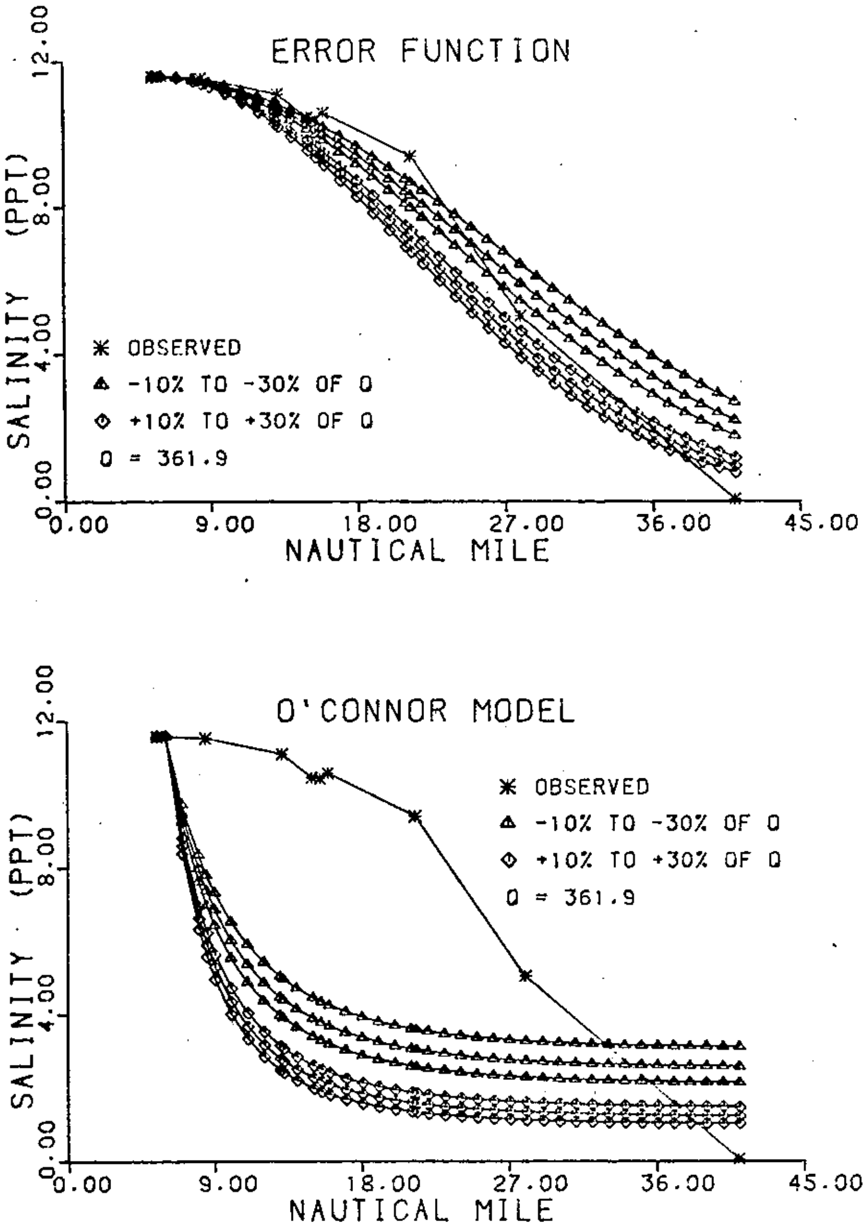


Figure 4-25 Chester River calculated Salinity Profiles for the Error Function and O'Connor Model under various freshwater inflow.

Table 4-5 Salinity Values Calculated for Chester River Using the Different Methods

	Salinity (PPT)			
Nautical Mile	Observed	Error Function	O'Connor Model	Tidewater Model
5.5	11.57	11.57	11.57	11.57
6.0	-	11.57	11.57	11.53
7.0	-	11.53	9.01	11.42
8.0	-	11.45	7.25	11.30
8.5	11.52	11.40	6.58	11.23
9.0	-	11.34	6.00	11.16
10.0	-	11.19	5.10	11.01
11.0	-	11.01	4.42	10.85
12.0	-	10.79	3.91	10.67
13.0	-	10.54	3.52	10.48
13.2	11.09	10.49	3.45	10.44
14.0	-	10.27	3.20	10.27
15.0	10.45	9.97	2.96	10.06
15.5	10.43	9.81	2.85	9.94
16.0	10.57	9.64	2.76	9.82
17.0	-	9.30	2.60	9.58
18.0	-	8.94	2.46	9.32
19.0	-	8.56	2.35	9.04
20.0	-	8.17	2.26	8.76
21.0	-	7.78	2.18	8.46
21.3	9.39	7.66	2.16	8.37
22.0	-	7.38	2.12	8.14
23.0	-	6.97	2.07	7.82
24.0	-	6.57	2.02	7.48
25.0	-	6.17	1.98	7.13
26.0	-	5.78	1.95	6.76
27.0	-	5.39	1.92	6.39
28.0	5.04	5.01	1.90	6.00
29.0	-	4.64	1.88	5.59
30.0	-	4.29	1.86	5.18
31.0	-	3.95	1.84	4.75
32.0	-	3.62	1.83	4.31
33.0	-	3.31	1.82	3.86
34.0	-	3.02	1.81	3.39
35.0	-	2.75	1.80	2.91
36.0	-	2.49	1.79	2.42
37.0	-	2.24	1.79	1.92
38.0	-	2.02	1.78	1.40
39.0	-	1.81	1.78	0.87
40.0	-	1.62	1.77	0.33
41.0	0.05	1.44	1.77	0.00

Table 4-6 Spatial/Temporal Values of Salinity for Chester River, 1980-1981

Nautical Miles	July 7	July 10	July 16	July 28	Aug. 27	Oct. 4	Oct. 10	Oct. 28	Nov. 13	Nov. 24
5.5	9.67	9.57	10.13	9.87	10.87	12.70	13.90	13.80	13.13	14.40
8.5	8.87	9.93	9.87	9.96	11.67	12.00	13.20	14.00	13.20	14.13
13.2	8.37	9.30	9.67	9.90	8.43	12.06	12.17	13.07	13.07	13.27
15.0	7.87	8.90	8.00	7.53	10.83	10.83	11.83	12.13	12.78	13.00
15.5	7.63	7.77	7.80		9.33	10.53	11.77	12.00	12.63	12.67
16.0	8.03	8.10	7.96	8.20	10.10	11.40	13.07	12.23	12.63	13.13
21.3	6.57	6.87	7.13	7.07	9.00	9.90	11.00	10.50	11.67	12.07
28.0	2.60	2.90	3.83	3.03	5.20	3.03	6.10	5.50	6.80	8.20
41.0	0.10	0.001	0.001	0.001	0.10	0.08	0.09	0.11	0.08	0.09
Mean	6.51	6.95	7.07	6.95	8.28	9.00	10.17	10.17	10.42	11.04
Std. Dev.	3.15	3.37	3.28	3.39	3.62	4.43	4.43	4.58	4.39	4.52

Table 4-6 (cont.) Spatial/Temporal values of Salinity for Chester River, 1980-1981

Nautical Miles	Dec. 15	March 3	April 8	May 8	May 27	June 1	June 18	June 28	Mean	Std. Dev.
5.5	13.43	13.20	11.67	11.30	10.47	10.30	10.57	9.33	11.57	1.67
8.5	13.50	12.70	12.77	10.93	10.63	10.40	10.20	9.43	11.52	1.65
13.2	13.10	11.27	12.27	10.60	11.60	10.47	11.03	9.97	11.09	1.55
15.0	12.27	10.63	12.00	10.90	10.10	9.87	10.50	8.17	10.45	1.70
15.5	11.93	12.63	11.10	10.67	9.90	9.63	9.77	9.60	10.43	1.66
16.0	12.27	11.07	11.50	10.77	10.00	9.77	10.17	9.87	10.57	1.69
21.3	10.63	10.00	10.27	10.30	8.87	8.97	9.47	8.77	9.39	1.59
28.0	6.90	6.00	6.00	5.47	4.20	4.97	5.07	4.83	5.04	1.51
41.0	0.09	0.07	0.10	0.001	0.001	0.001	0.001	0.001	0.05	0.05
Mean	10.27	9.37	9.57	8.78	8.23	8.09	8.38	7.55		
Std. Dev.	4.35	4.06	4.10	3.76	3.50	3.63	3.24			

Table 4-8 Spatial/Temporal Values of Dispersion Coefficients for Chester River, 1980-81

Nautical Miles	July 7	July 10	July 16	July 28	Aug. 27	Oct. 4	Oct. 10	Oct. 28	Nov. 13	Nov. 24	Dec. 15
5.5-8.5	88.5	206.9	293.8	841.6	107.6	134.8	147.9	531.0	1436.0	403.6	1469.6
8.5-13.2	202.0	178.8	572.4	1939.3	36.0	2349.5	144.2	170.5	1184.6	186.6	389.6
13.2-15.0	75.1	105.3	24.4	16.9	18.5	43.0	163.3	62.0	206.3	225.1	70.7
15.0-16.0	128.2	27.4	514.8	30.3	37.0	50.3	25.9	314.3	218.6	259.4	-
16.0-21.3	65.2	79.5	118.9	88.3	113.5	92.8	75.9	85.8	165.5	155.5	91.2
21.3-28.0	17.4	18.7	25.9	19.0	29.3	13.6	27.3	24.9	29.8	41.6	37.2
28.8-41.0	8.1	7.9	7.3	7.8	6.7	7.3	6.3	6.8	6.0	5.9	6.1
Mean	83.5	89.2	222.5	420.5	49.8	384.5	84.4	170.8	463.9	182.5	344.1
S.D.	61.6	73.3	222.9	680.5	39.7	803.3	61.8	176.3	544.9	124.4	519.0

Table 4-8 (cont.) Spatial/Temporal Values of Dispersion Coefficients for Chester River, 1980-1981

Nautical Mile	March 3	April 8	May 8	May 27	June 1	June 18	June 28	Mean	Std. Dev.	$\bar{E}$**
5.5-8.5	197.9	84.8	229.5	503.7	790.7	214.4	716.6	466.7	420.5	1764.0
8.5-13.2	98.1	93.4	382.2	134.2	1746.8	149.8	210.4	576.0	696.3	308.0
13.2-15.0	79.2	208.0	165.8	33.2	78.4	94.0	23.2	94.0	67.9	77.9
15.0-16.0	63.6	60.6	215.1	259.4	253.4	80.8	13.7	150.2	135.1	266.0
16.0-21.3	128.9	115.7	292.2	109.2	153.2	183.5	110.8	125.6	51.4	108.8
21.3-28.0	31.5	29.9	25.4	21.5	27.3	25.8	27.0	26.3	6.6	25.9
28.0-41.0	6.0	6.5	3.1	3.2	3.1	3.1	3.1	5.8	1.8	5.7
Mean	86.4	114.1	187.8	152.1	436.1	197.3	157.8	--	--	--
S.D.	59.1	95.1	126.7	165.0	590.4	73.2	238.2	--	--	--

Based on average (28 years) discharge at Morgan Creek of Z = 10.7 ft^3/sec., Drainage Area = 12.7 sq. miles Total Chester Q = 361.9 ft/sec., Drainage Area = 429.59 sq. miles

**Based on yearly average of Salinity

Table 4-9 Spatial/Temporal Values of Dispersion Coefficients for Chester River, 1980-1981

River Miles from mouth	July 7	July 10	July 16	July 28	Aug. 27	Oct. 4	Oct. 10	Oct. 28	Nov. 13	Nov. 24
5.5-8.5	504.5	966.8	164.8	747.3	55.3	50.4	124.4	198.5	671.4	188.6
8.5-13.2	1151.6	835.5	321.0	1721.8	18.5	878.3	121.3	63.7	553.3	87.2
13.2-15.0	428.1	492.1	13.7	15.0	9.5	16.1	137.4	23.2	96.4	105.2
15.0-16.0	730.9	128.0	288.7	26.9	19.0	18.8	21.8	117.5	102.1	242.4
16.0-21.3	371.7	371.5	66.7	78.4	58.3	34.7	63.8	32.1	77.4	72.7
21.3-28.0	99.2	87.4	14.5	16.9	15.1	5.1	23.0	9.3	13.9	19.4
28.0-41.0	46.2	36.9	4.1	6.9	3.4	2.7	5.3	2.5	2.8	2.8
Mean	476.0	416.9	124.8	373.3	25.6	143.7	71.0	63.8	216.8	102.6
Std. Dev.	350.9	342.6	125.0	604.1	20.4	300.3	51.9	65.9	254.7	80.1
$\bar{Q}$ (7 days)	61cfs	50cfs	6cfs	9.5cfs	5.5cfs	4.0cfs	9.0cfs	4.0cfs	5.0cfs	10.0cfs

Table 4- 9 (cont.) Spatial/Temporal Values of Dispersion Coefficients for Chester River, 1980-1981

River Miles from Mouth	Dec. 15	March 3	April 8	May	May	June	June	June	Mean	Std. Dev.	$\bar{E}$ lag
5.5-8.5	824.1	101.7	87.2	407.5	235.4	221.7	72.1	401.8	350.4	283.7	267.6
8.5-13.2	218.5	50.4	301.5	678.7	62.7	489.8	50.4	118.0	428.0	456.2	30.2
13.2-15.0	39.7	40.7	213.8	294.4	15.6	22.0	31.6	13.0	111.5	145.2	19.5
15.0-16.0	-	32.7	62.3	382.0	121.2	71.1	27.2	7.7	141.2	180.1	101.5
16.0-21.3	51.1	66.2	118.9	520.8	51.0	43.0	61.7	62.1	122.3	138.0	9.8
21.3 28.0	20.9	16.2	30.7	45.1	10.1	7.7	8.7	15.1	25.5	25.7	1.9
28.0-41.0	3.4	3.1	6.7	5.5	1.5	0.9	1.0	1.7	7.6	12.2	0.3
Mean	193.0	44.4	117.3	333.4	77.1	122.3	36.1	88.5			
Std. Dev.	291.0	30.4	97.8	225.0	77.1	165.5	24.6	133.6			
$\bar{Q}$ (7 days)	6.0cfs	5.5cfs	11.0cfs	19.0cfs	5.0cfs	3.0cfs	3.6cfs	6.0cfs			

Note: Based linear intepolation of discharge observed at Morgan Creek with a time lag of 7 days. Discharge used was observed 7 days prior to the Slack Survey.

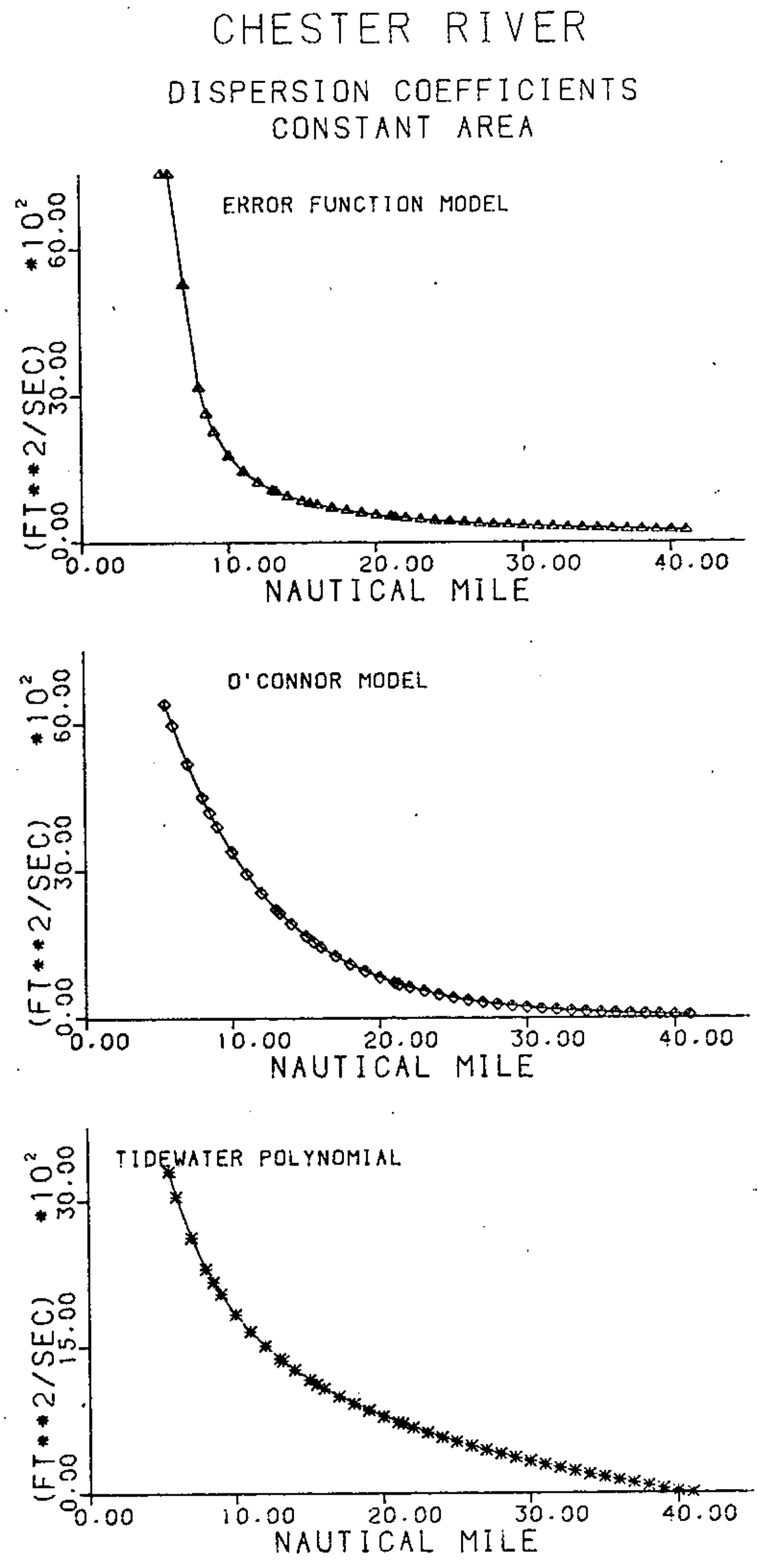


Figure 4-26 Chester River Dispersion Coefficients Using Various Models for Constant Cross Sectional Area.

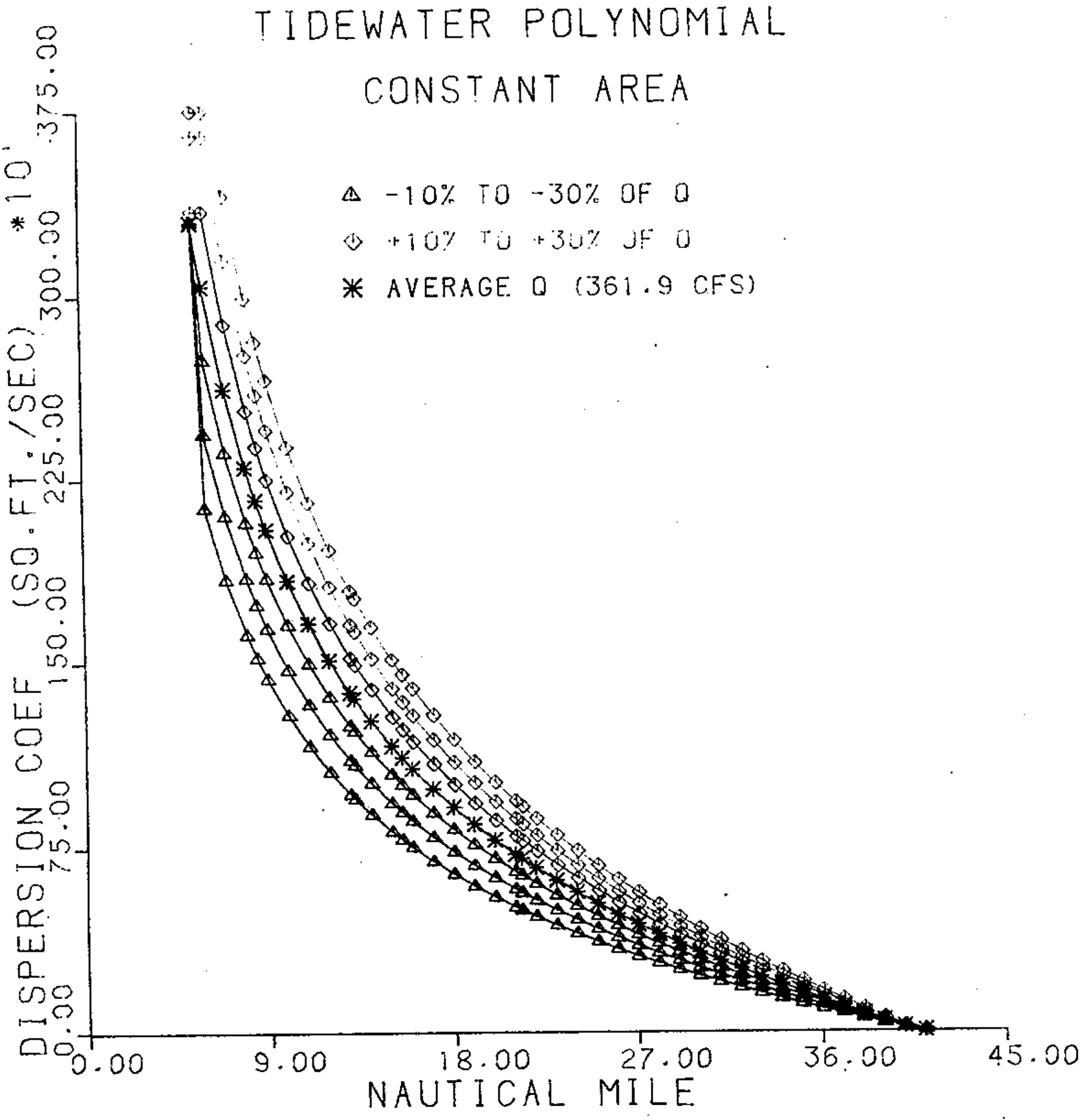


Figure 4-27 Chester River Dispersion Coefficients Derived from Tidewater Polynomial for Constant Cross Sectional area.

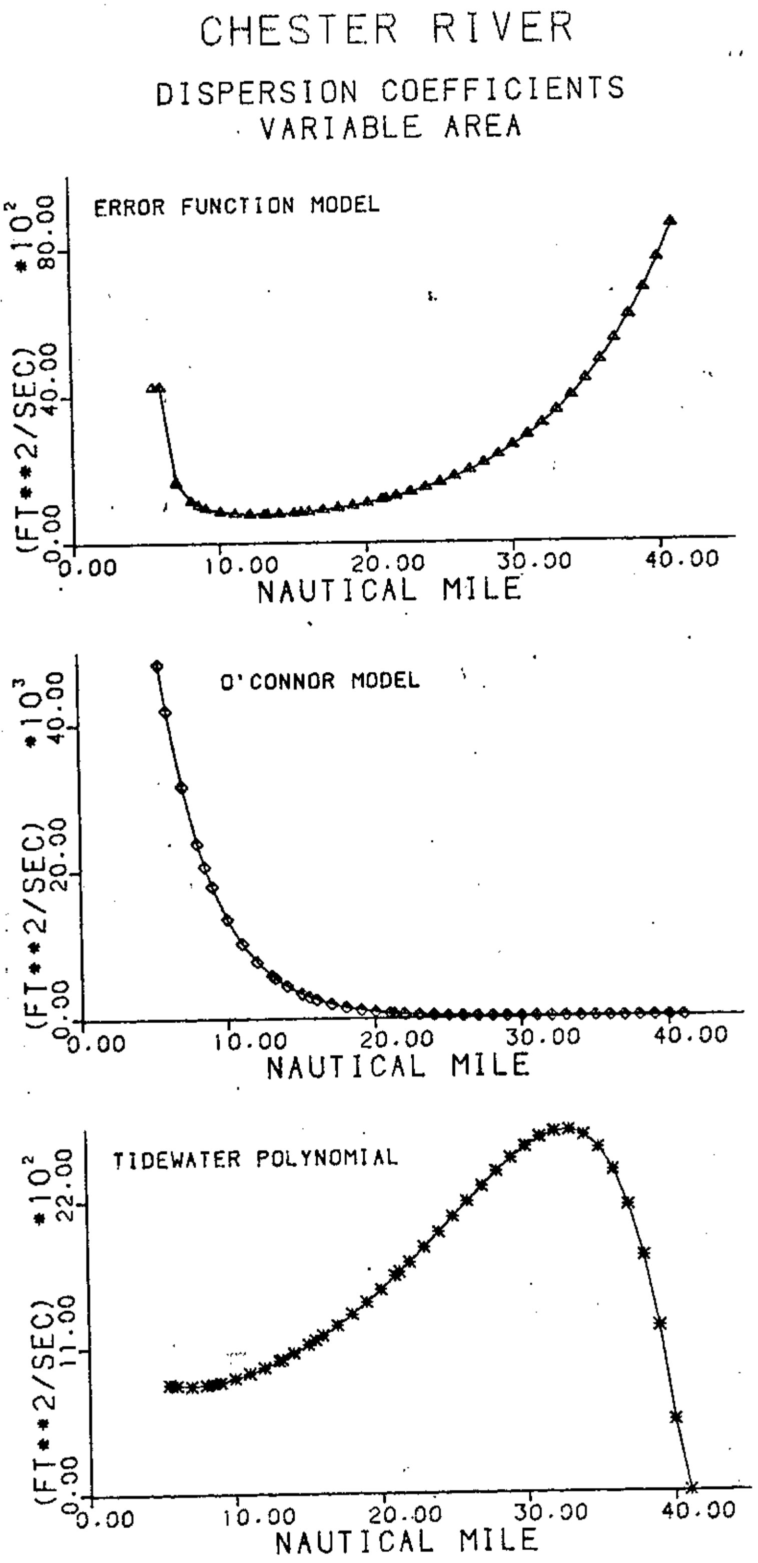


Figure 4-28 Chester River Dispersion Coefficients Using Various Models for Variable Cross Sectional Area.

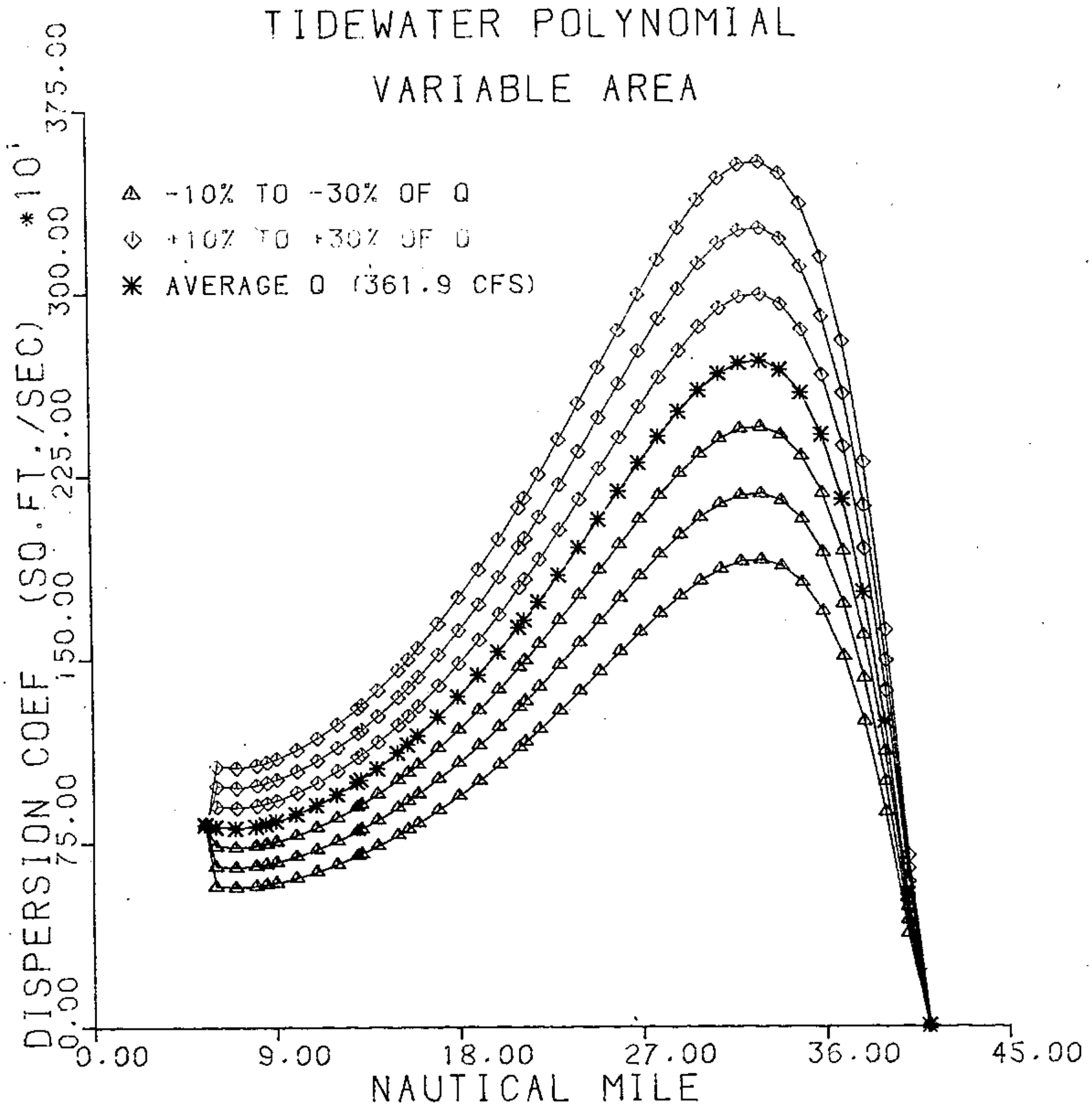


Figure 4-29 Chester River Dispersion Coefficients Derived from Tidewater Polynomial for variable cross sectional area.

Table 4-10 Dispersion Coefficients by Different Methods Using Constant Area

	Dispersion Coefficient* (ft^2/sec)		
Nautical Mile	Error Function	O'Connor	Tidewater
5.5	15814.30	6405.47	3301.56
6.0	15815.30	5966.72	3040.82
7.0	5271.77	5177.32	2622.46
8.0	3163.06	4492.36	2300.83
8.5	2635.88	4184.65	2165.93
9.0	2259.33	3898.02	2044.58
10.0	1757.26	3382.31	1834.65
11.0	1437.75	2934.83	1658.76
12.0	1216.56	2546.55	1508.66
13.0	0054.35	2209.64	1378.57
13.2	1026.97	2147.81	1354.56
14.0	930.31	1917.30	1264.32
15.0	832.38	1663.64	1162.84
15.5	790.77	1549.69	1116.14
16.0	753.11	1443.54	1071.81
17.0	687.62	1252.56	989.45
18.0	632.61	1086.85	914.35
19.0	585.75	943.06	845.40
20.0	545.36	818.29	781.70
21.0	510.17	710.03	722.54
21.3	500.48	680.44	705.58
22.0	479.25	616.09	667.30
23.0	451.87	534.58	615.50
24.0	427.44	463.86	566.72
25.0	405.52	402.49	520.60
26.0	385.74	349.24	476.86
27.0	367.80	303.03	435.22
28.0	351.45	262.94	395.49
29.0	336.50	228.16	357.45
30.0	322.76	197.97	320.96
31.0	310.10	171.78	285.86
32.0	298.40	149.05	252.03
33.0	287.55	129.33	219.36
34.0	277.46	112.22	187.75
35.0	268.06	97.38	157.11
36.0	359.27	84.49	127.36
37.0	251.04	73.31	98.43
38.0	243.31	63.61	70.26
39.0	236.05	55.20	42.80
40.0	229.21	47.90	15.98
41.0	222.75	41.56	0.00

* $\bar{A}$ = 84108 ft^2

Table 4-11 Dispersion Coefficients by Different Methods Using Variable Area

	Dispersion Coefficient* (ft.^{2}/sec.)		
Nautical Mile	Error Function	O'Connor	Tidewater
5.5	4246.75	48289.48	825.94
6.0	4246.75	41900.77	816.53
7.0	1631.42	31547.19	811.56
8.0	1128.10	23751.95	820.59
8.5	1009.21	20609.56	829.28
9.0	928.65	17882.90	840.38
10.0	832.41	13464.08	869.07
11.0	784.91	10137.14	905.56
12.0	765.42	7632.28	949.20
13.0	764.50	5746.36	999.59
13.2	766.08	5429.26	1010.46
14.0	777.42	4326.45	1056.53
15.0	801.64	3257.39	1119.89
15.5	817.56	2826.44	1153.96
16.0	835.88	2452.50	1189.62
17.0	879.56	1846.49	1265.64
18.0	932.58	1390.23	1347.91
19.0	995.16	1046.71	1436.28
20.0	1067.79	788.07	1530.56
21.0	1151.21	593.34	1630.42
21.3	1178.47	544.91	1661.40
22.0	1246.33	446.73	1735.38
23.0	1354.28	336.34	1844.72
24.0	1476.41	253.23	1957.49
25.0	1614.26	190.66	2072.38
26.0	1769.64	143.55	2187.66
27.0	1944.61	108.08	2301.10
28.0	2141.50	81.37	2409.82
29.0	2363.00	61.27	2510.17
30.0	2612.14	46.13	2597.56
31.0	2892.36	34.76	2666.27
32.0	3207.58	26.15	2709.17
33.0	3562.22	19.69	2717.50
34.0	3961.32	14.82	2680.51
35.0	4410.55	11.16	2585.03
36.0	4916.38	8.40	2415.04
37.0	5486.13	6.33	2151.09
38.0	6128.07	4.76	1769.62
39.0	6851.61	3.59	1242.22
40.0	7667.42	2.70	534.66
41.0	8587.57	2.03	0.00

*A = 733905 exp (-0.14190975 X)

APPENDIX D

BOX MODELS

SECTION 5

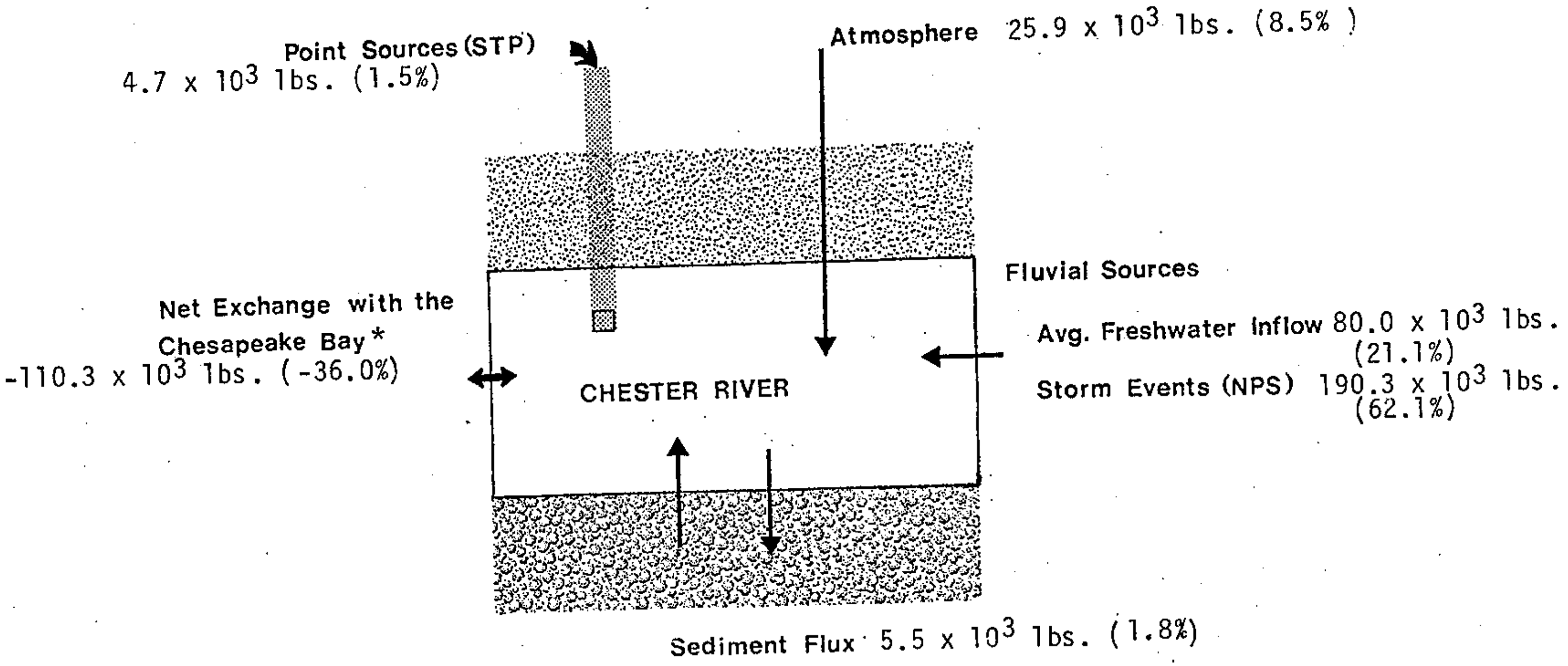


Figure 5-1 Box Model of Dissolved Nitrite and Nitrate (NO_2^- & NO_3^-) for the Chester River. The Major Source was from Freshwater Inflow with a loss to the Chesapeake Bay. The Atmosphere (Rainfall) also contributed a significant amount of NO_2^- & NO_3^-
* when a value is negative, the nutrient is leaving the Chester River.

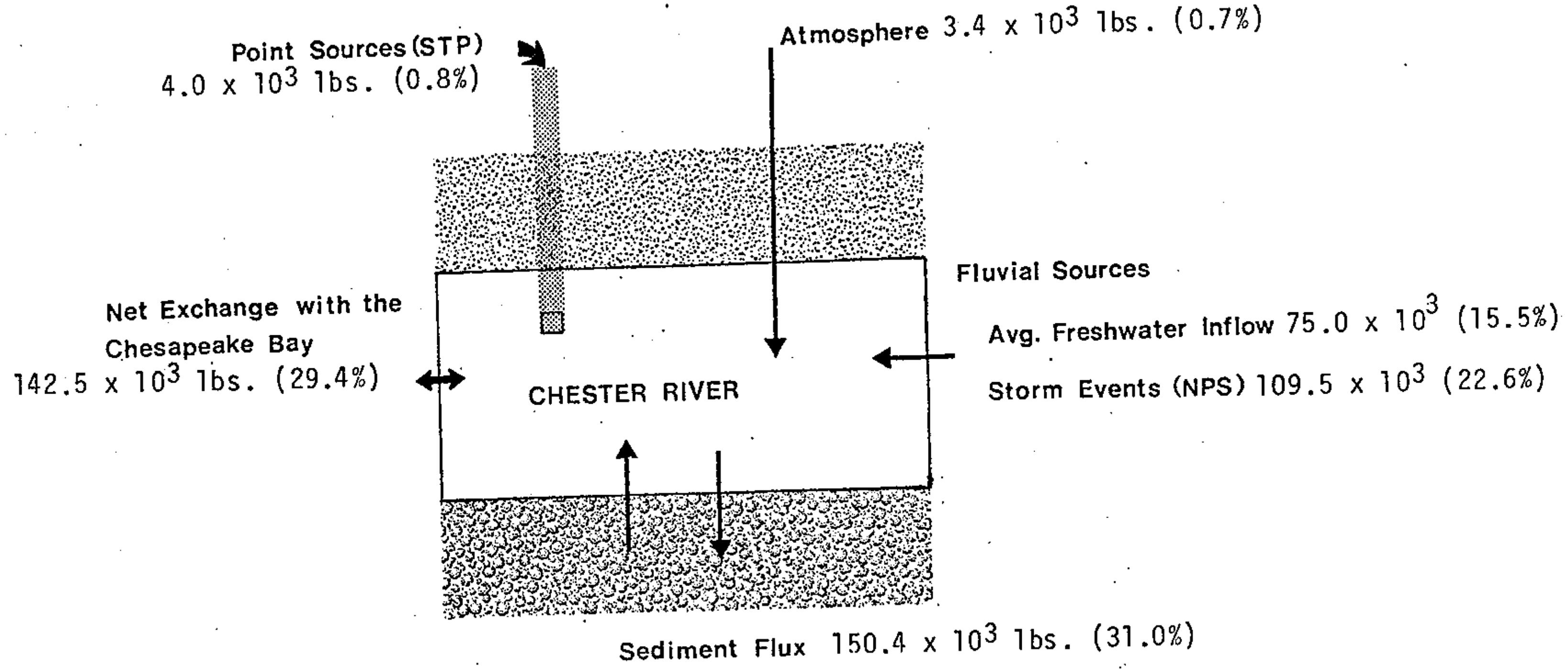


Figure 5-2 Box Model of Dissolved Ammonia (NH_3) for the Chester River. Ammonia had three significant sources; Fluvial Input, Sediment Flux and the Chesapeake Bay.

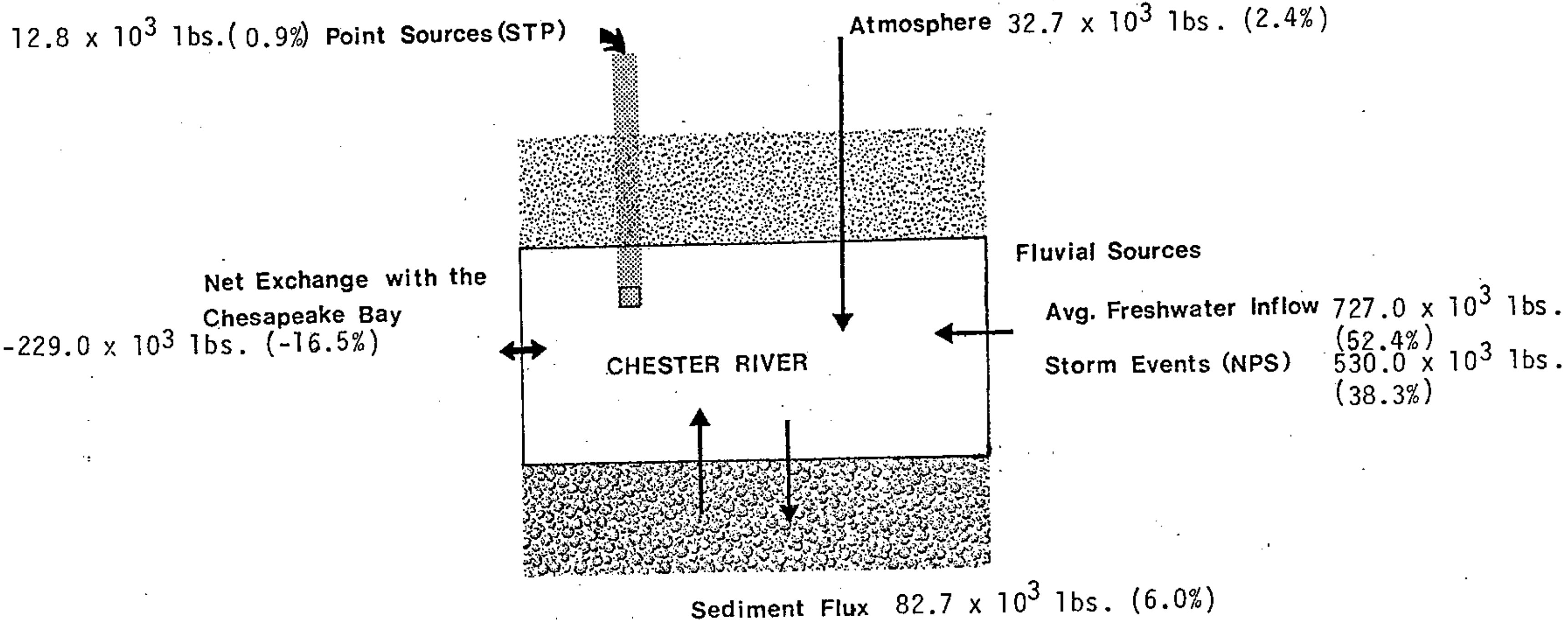


Figure 5-3 Box Model of Total Nitrogen for the Chester River. The Major Source was from Freshwater Runoff with a loss to the Chesapeake Bay.
(*when a value is negative, the nutrient is leaving the Chester River).

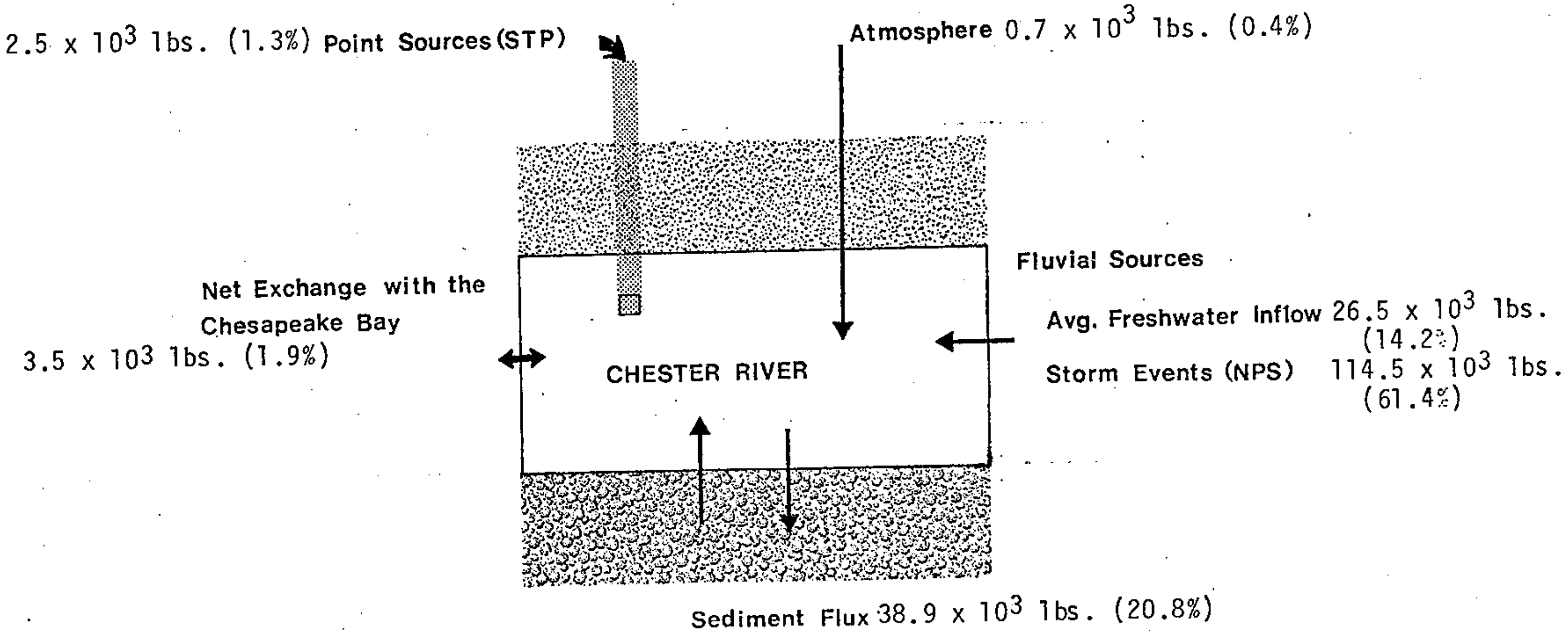


Figure 5-4 Box Model of Dissolved Orthophosphorus for the Chester River. The fluvial sources were the largest contributers of orthophosphorus with sediment flux as the next leading source.

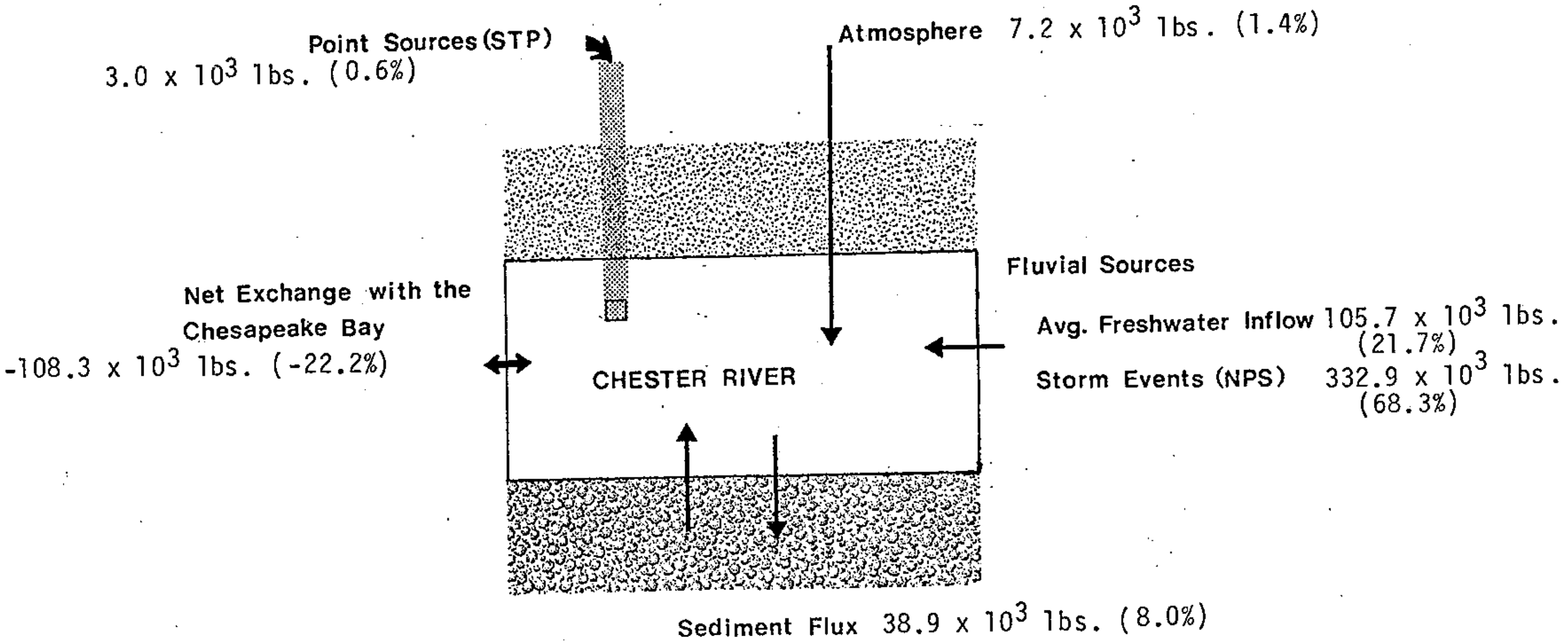


Figure 5-5 Box Model of Total Dissolved Phosphorus for the Chester River. Most of the phosphoros loaded into the Chester come from fluvial runoff.
* when a value is negative, the nutrient is leaving the Chester River.

APPENDIX E

STATISTICAL ANALYSES OF NON-POINT SOURCES

SECTION 6

Table 6-1 Characteristics of Chester River Urban NPS Sites

Characteristic	Chestertown A	Chestertown B
Total acres	50.6 acres	49.1 acres
Principle soil types +	Keyport fine sandy loam - 45% Matapeake silt loam - 34%	Butlertown-Mattapex silt loam - 55% Matapeake silt loam - 32%
Erosion coef (K) +	0.38	0.38
Permeability (in/hr)+	0.4-2.1	0.5-2.85
Moisture holding cap (in/hr)+	0.15-0.21	0.16-0.22
Basin slope (%)+	1-4%	3-6%
Channel slope	-	-
Land use	Residential	Residential
Impervious area +	6.1 acres (13.2%)	8.8 acres (18.0%)
Street acreage	*2.0 acres (4.4%) (0.7 miles)	**5.06 acres (10.3%) (2.0 miles)
Population/ Density	9.1 persons/acre (assumes 4 persons/house)	***6.9 persons/acre (assumes 4 persons/house)
Housing units/ Density	115 units =2.5 units/acre	103 units = 2.1 units/acre
Hydrologic Group	C(3.1)	C(2.83)

*** Population density does not include hospital.
* All streets with curb and gutter.
** 86% of streets with curb and gutter.
(+) values are area weighted.

Table 6-2
Characteristics of Chester River Forested NPS Sites

Characteristic	Millington A	Millington B
Total acres	1179 acres	271 acres
Principle* soil types	Woodstown sandy loam - 34% Elkton silt loam - 24%	Fallsington sandy loam - 45% Woodstown sandy loam - 34%
Erosion* coef. (K)	0.31	0.28
Permeability (in/hr)*	0.5-3.5	0.8-4.2
Moisture holding cap(in/hr)*	0.1-0.2	0.1-0.19
Basin slope (%)*	0.8-2.2	0.8-2.1
Channel slope	-	-
Land Use	Forest - 938 acres Old field/grassland - 240 acres Water - 1.5 acres	Forest - 259.5 acres Old field - 10.1 acres Roads - 1.4 acres
Population/ Density	0	0
Housing units/ density	0	0
Hydrologic* Group	C (3.4)	C (3.46)

*values are area weighted

Table 6-3 Characteristics of Chester River Agricultural NPS Sites

Characteristic	USGS GAGE	S Farm
Total acres	8290 acres * (13 sq. mi.)	804 acres
Principle soil types +	Mattapex - Mattapeake Butlertown silt loam - 44% Mattapeake silt loam - 21%	Mattapeake silt loam - 53%
Erosion coef. (K) +	.34	.31
Permeability (in/hr)	0.5-4.24	0.6-3.89
Moisture holding cap (in/hr) +	0.13-0.20	0.13-0.25
Basin slope (%) +	2.5-6.0%	2.0-5.0%
Channel slope	-	-
Land use	Agricultural (corn and rye predominant) Residential - 75 acres (ex. farmsteads) Forest - 715 acres	Agricultural Field Corn Soybean
Hydrologic group	C (2.54)	B

* USGS records indicate basin size is 12.7 sq. miles.
\+ - values are area weighted.

Table 6-3 (cont) Characteristics of Chester River Agricultural NPS Sites

Characteristic	Browntown Road Farm	H-Farm
Total acres	331 acres	14.1 acres
Principle soil type*	Mattapeake silt loam - 56% Sassafras sandy loam - 20%	Matapex - Metapeake Butlertown silt loam - 81%
Erosion coef. (K)*	0.32	0.37
Permeability (in/hr)*	0.6-5.2	0.4-3.5
Moisture holding cap (in/hr)*	0.12-0.20	0.15-0.20
Basin slope (%)*	1.5-4.3%	1.8-4.7%
Channel slope	-	-
Land use	Agricultural: field corn (except farmstead area)	No Till field corn
Hydrologic* group	B(2.2)	C(2.83)
Farmstead area	3.7 acre	0
Population/ density	1 family	0
Housing units/ density	1 farm units of 6-7 buildings	0

*values are area-weighted

Table 6-3 (cont) Characteristics of Chester River Agricultural NPS Sites

Characteristic	Still Pond Road
Total acres	29 acres
Principle soil type*	Mattapex - Metapeake Butlertown silt loam - 31% Sassafras loam and Sas. sandy loam - 23%
Erosion coef. (K)*	.29
Permeability(in/hr)*	1.0-7.7
Moisture holding cap(in/hr)*	0.11-0.19
Basin slope(%)*	1.6-4.2%
Channel slope	-
Land use	Minimum tillage field corn
Hydrologic Group*	B(2.3)
Population density	0
Housing units	0

* - values are area weighted

Table 6-4 Chester River Subwatershed NPS Water Quality Station Codes

Subwatershed	ID. No.	STORET MD-DNR ID. No.	Basin size (acres)
Chestertown Site A	CH1	X1H 2630	46.4
Chestertown Site B	CH2	X1H 2832	49.1
Sutton Farm	CH3	X1H 6375	804.0
USGS Gage-Morgan Creek	CH4	X1H 6891	8,290.0
Browntown Road	CH5	X11 7728	331.0
Harris Farm	CH6	XJH 1130	14.1
Still Pond Road	CH7	XJH 0930	29.0
Millington Forest Site A	CH8	X1J 8131	1,179.0
Millington Forest Site B	CH9	X1J 7134	271.0

Table 6-5
Chester River NPS Chemical Export (lbs/acre) - All Sites

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.1719	.0328	.3711	.0624	3.4624	.0034
BOD30	.3977	.0668	.8185	.1661	7.9796	4.886E-4
TSS	13.5235	5.2475	69.2192	.4057	693.0204	3.054E-4
NO2	5.257E-4	1.247E-4	5.438E-4	2.388E-4	18.083E-4	0.031E-4
NO3	.0147	.0036	.0156	.0110	.0542	0.244E-4
NO2NO3	.0182	.0027	.0346	.0073	.2222	0.343E-4
NH3	.0131	.0028	.0380	.0022	.3105	0.031E-4
TKN	.0509	.0115	.1557	.0118	1.3970	0.366E-4
TKND	.0228	.0044	.0593	.0070	.6347	0.183E-4
TPHOS	.0806	.0510	.7693	.0026	10.3302	0.031E-4
TPHOSD	.1720	.1693	2.2713	8.182E-4	30.4756	0.012E-4
DPO4	.0354	.0311	.3824	5.184E-4	4.8398	0.006E-4
TOC	.3843	.0514	.6922	.1326	6.6245	4.886E-4
COD	1.4010	.1981	2.6575	.4103	25.4035	.0015
ALKIN	.1906	.0206	.2670	.1071	1.6644	0.611E-4

Table 6-6
Chester River NPS Chemical Export (lbs/acre) - All Forested Sites

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.0646	.0130	.0130	.0304	.4563	.0034
BOD30	.1593	.0299	.2070	.0661	1.0648	4.886E-4
TSS	.2311	.0526	.3641	.0894	1.6902	3.054E-4
NO2	0.705E-4	0.313E-4	0.767E-4	0.509E-4	2.183E-4	0.031E-4
NO3	3.232E-4	1.448E-4	3.547E-4	1.777E-4	9.680E-4	0.244E-4
NO2NO3	.0109	.0054	.0352	.0014	.2222	0.930E-4
NH3	.0026	7.311E-4	.0051	9.476E-4	.0240	0.031E-4
TKN	.0139	.0036	.0249	.0046	.1370	0.366E-4
TKND	.0098	.0024	.0169	.0036	.0913	0.183E-4
TPHOS	.0021	9.043E-4	.0063	4.057E-4	.0426	0.031E-4
TPHOSD	7.053E-4	1.857E-4	2.867E-4	2.192E-4	3.311E-4	0.012E-4
DPO4	3.597E-4	1.047E-4	7.255E-4	1.404E-4	7.652E-4	0.006E-4
TOC	.2968	.0845	.5857	.0911	3.6507	4.886E-4
COD	.9511	.2063	1.4293	.3571	6.8451	.0015
ALKIN	.0246	.0047	.0318	.0100	.1521	0.611E-4

Table 6-7
Chester River NPS Chemical Export (lbs/acre) - All Urban Sites

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.2445	.0512	.2940	.1399	1.4201	.0110
BOD30	.5714	.1084	.6681	.3360	3.4767	.0408
TSS	4.9462	.8535	5.9744	2.5845	21.3710	.0408
NO2	.0011	1.991E-4	3.981E-4	.0011	.0015	5.564E-4
NO3	.0140	.0030	.0060	.0140	.0207	.0070
NO2NO3	.0093	.0017	.0117	.0057	.0682	0.0500E-4
NH3	.0067	.0014	.0103	.0028	.0637	1.416E-4
TKN	.0302	.0047	.0346	.0181	.2137	6.329E-4
TKND	.0143	.0020	.0152	.0089	.0818	4.997E-4
TPHOS	.0147	.0027	.0199	.0065	.1069	1.133E-4
TPHOSD	.0037	.0011	.0080	.0015	.0509	0.266E-4
DPO4	.0023	3.518E-4	.0024	.0015	.0117	0.233E-4
TOC	.3820	.0536	.3975	.2240	1.6370	.0053
COD	1.4955	.2160	1.5880	1.4955	7.2752	.0100
ALKIN	1.8367	.0245	.1717	.1440	.8185	.0042

Table 6-8
Chester River NPS Chemical Export (lbs/acre) - All Agricultural Sites

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.1561	.0360	.4012	.0445	3.4624	.0017
BOD30	.3642	.0790	.9767	.1132	7.9796	.0027
TSS	18.5935	5.6444	75.9380	.5224	693.0204	.0020
NO2	4.485E-4	0.889E-4	4.704E-4	2.296E-4	8.083E-4	0.194E-4
NO3	.0105	.0027	.0140	.0042	.0542	0.194E-4
NO2NO3	.0208	.0028	.0359	.0086	.2220	0.343E-4
NH3	.0131	.0029	.0396	.0015	.3105	0.194E-4
TKN	.0566	.0125	.1713	.0093	1.4070	0.802E-4
TKND	.0209	.0044	.0510	.0047	.6347	0.401E-4
TPHOS	.0968	.0588	.7669	.0024	10.3302	0.427E-4
TPHOSD	.1633	.1612	2.2166	4.830E-4	30.4756	0.100E-4
DPO4	.0333	.0284	.3724	2.842E-4	4.8398	0.049E-4
TOC	.4262	.0693	.9508	.0857	6.6245	6.676E-4
COD	.1597	.3169	4.3450	.2887	34.6440	.0020
ALKIN	.1846	.0209	.2795	.0850	1.6644	.0020

Table 6-9
Chester River NPS Chemical Export (lbs/acre) - Millington A

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.0373	.0084	.0358	.0213	.1172	.0034
BOD30	.0929	.0261	.1195	.0505	.4923	.0005
TSS	.1196	.0364	.1667	.069	.6866	.0003
NO2	.35E-04	.189E-04	.328E-04	.333E-04	.686E-04	.031E-04
NO3	.872E-04	.332E-04	.574E-04	.999E-04	1.371E-04	.244E-04
NO2NO3	.0021	.0012	.005	.0008	.022	.0001
NH3	8.423E-04	2.332E-04	10.69E-04	4.542E-04	45.81E-04	.031E-04
TKN	.0066	.0017	.008	.0026	.027	.366E-04
TKND	.0045	.0012	.0055	.0017	.0186	.183E-04
TPHOS	7.280E-04	3.434E-04	15.74E-4	2.807E-4	73.31E-4	.031E-4
TPHOSD	5.763E-4	3.413E-4	15.64E-4	1.731E-4	73.31E-4	.012E-4
DPO4	3.327E-4	2.225E-4	10.19E-4	.908E-4	47.65E-4	.006E-4
TOC	.1276	.0324	.1486	.067	.5392	4.89E-4
COD	.4269	.1109	.5084	.3087	2.1098	.0015
ALKIN	.0108	.0026	.0115	.0062	.0379	.611E-4

Table 6-10
Chester River NPS Chemical Export (lbs/acre) - Millington B

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.0859	.0214	.1026	.043	.4563	.004
BOD30	.2109	.0472	.2452	.1076	1.6048	.0121
TSS	.3178	.0862	.4477	.1245	1.6902	.0178
NO2	1.061E-4	.572E 4	.991E-4	.691E-4	2.183E-4	.307E-4
NO3	5.593E-4	2.19E-4	3.794E-4	4.917E-4	9.68E-4	2.183E-4
NO2NO3	.0175	.0093	.0456	.0021	.2222	.0002
NH3	.004	.0012	.0064	.0017	.024	.691E-4
TKN	.0195	.0061	.0315	.0082	.1369	.0004
TKND	.0139	.0041	.0212	.0062	.0913	.0004
TPHOS	.0031	.0016	.0082	.0005	.0426	.605E-4
TPHOSD	.0008	.0002	.001	2.766E-4	.0046	.369E-4
DPO4	3.808E-4	.748E-4	3.884E-4	2.059E-4	15.21E-4	.215E-4
TOC	.4284	.1443	.7496	.1588	3.651	.0081
COD	1.3588	.3388	1.7605	.9096	6.8451	.0369
ALKIN	.0356	.0077	.0383	.0215	.1521	.0014

Table 6-11
Chester River NPS Chemical Export (lbs/acre) - USGS Gage

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.3784	.1668	.7646	.1072	3.4624	.0295
BOD30	.8568	.3501	1.679	.2076	7.9796	.0589
TSS	34.398	27.596	137.98	.8208	693.02	.0861
NO2	.0013	.0005	.0007	.0013	.0018	.0009
NO3	.0395	.0147	.0208	.0395	.0542	.0248
NO2NO3	.024	.0049	.0239	.0131	.0904	.0024
NH3	.0355	.0107	.0545	.0099	.2085	.0011
TKN	.1187	.0534	.2723	.027	1.3969	.0072
TKND	.0586	.0244	.1243	.015	.6347	.0038
TPHOS	.4159	.3966	2.0224	.0054	10.3302	.0006
TPHOSD	1.2239	1.2188	6.0941	.0021	30.4756	.268E-4
DPO4	.2326	.2023	.9912	.0011	4.8398	.268E-4
TOC	.4448	.1178	.5892	.1059	2.0944	.023
COD	1.2255	.3006	1.503	.3918	6.188	.1119
ALKIN	.4426	.071	.3404	.2873	1.3328	.0777

Table 6-12
Chester River NPS Chemical Export (lbs/acre) - Chestertown A

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.1971	.0326	.1406	.1421	.5453	.0431
BOD30	.5181	.0931	.4364	.3676	1.8318	.0862
TSS	5.9323	1.0488	5.648	3.8193	19.0608	.2585
NO2	.0011	.0003	.0005	.0013	.0015	5.564E-4
NO3	.0163	.0027	.0047	.0167	.0207	.0114
NO2NO3	.0095	.0017	.0088	.0065	.0303	.0006
NH3	.0059	.0011	.0063	.0035	.0273	.0002
TKN	.0313	.0045	.0248	.0224	.0896	.0022
TKND	.0135	.002	.0113	.0106	.0443	.0009
TPHOS	.0181	.0041	.023	.0069	.1069	.0004
TPHOSD	.004	.0016	.0089	.0021	.0509	.0001
DPO4	.0025	.0004	.0023	.0018	.0117	.0003
TOC	.4485	.0746	.4151	.2814	1.6282	.0237
COD	1.6831	.2743	1.5274	1.3425	6.3751	.0592
ALKIN	.2152	.0296	.1596	.2034	.682	.0042

Table 6-13
Chester River NPS Chemical Export (lbs/acre) - Chestertown B

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.3088	.1126	.4214	.1145	1.4201	.02
BOD30	.6447	.227	.9081	.2339	3.4767	.0408
TSS	3.5163	1.4058	6.2869	.7324	21.371	.0408
NO2	9.91E-4	--	--	9.91E-4	9.91E-4	9.91E-4
NO3	.0069	--	--	.0069	.0069	.0069
NO2NO3	.0091	.0032	.0149	.005	.0682	.5E-4
NH3	.0081	.003	.0142	.0024	.0637	.0001
TKN	.0289	.0091	.0448	.0128	.2137	.0006
TKND	.0153	.0041	.0196	.0067	.0818	.0005
TPHOS	.0104	.0029	.0142	.0034	.058	.0001
TPHOSD	.0032	.0014	.0067	.0014	.0314	.266E-4
DPO4	.002	.0006	.0026	.0012	.0092	.233E-4
TOC	.2962	.0743	.364	.1304	1.6369	.0053
COD	1.2426	.3475	1.6666	.5596	7.2752	.01
ALKIN	.138	.0408	.1822	.083	.8185	.0075

Table 6-14
Chester River NPS Chemical Export (lbs/acre) - S Farm

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.0819	.04	.1876	.0234	.876	.005
BOD30	.2127	.1029	.5345	.0665	2.8031	.0124
TSS	17.2882	14.304	82.17	.1466	473.03	.0104
NO2	5.34E-4	1.13E-4	2.26E-4	5.62E-4	7.81E-4	2.33E-4
NO3	.03	.0038	.0075	.0314	.0375	.0196
NO2NO3	.0206	.0043	.023	.0132	.1119	.792E-4
NH3	.0057	.0019	.0107	.0017	.044	2.056E-4
TKN	.0547	.0371	.2131	.0052	1.2264	1.989E-4
TKND	.0127	.0045	.0256	.0037	.1314	1.74E-4
TPHOS	.041	.0319	.1831	.0012	1.0512	1.268E-4
TPHOSD	.0013	.0005	.0029	.0003	.014	.411E-4
DPO4	9.073E-4	4.83E-4	.0026	2.07E-4	.0131	.411E-4
TOC	.2273	.0834	.4788	.0323	2.4527	.0041
COD	1.3672	.7775	4.4665	.2237	25.403	.0104
ALKIN	.2339	.0553	.3131	.1364	1.6644	.0224

Table 6-15
Chester River NPS Chemical Export (lbs/acre) - Browntown Road

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.1083	.0437	.1236	.0651	.3726	.0057
BOD30	.327	.1293	.409	.1839	1.242	.0124
TSS	40.867	26.807	96.653	6.0282	356.06	.0185
NO2	1.029E-4	.745E-4	1.054E-4	1.029E-4	1.774E-4	.284E-4
NO3	.0064	.0046	.0064	.0064	.011	.0019
NO2NO3	.064	.0253	.0841	.0199	.2219	.343E-4
NH3	.0532	.029	.1044	.0012	.3105	.923E-4
TKN	.1278	.066	.2379	.0265	.8281	.0016
TKND	.0597	.0289	.1041	.003	.294	8.919E-4
TPHOS	.0906	.0376	.1354	.0215	.4216	4.289E-4
TPHOSD	.002	8.26E-4	.003	4.37E-4	.0108	1.16E-4
DPO4	.0022	.0011	.0037	3.22E-4	.0128	.927E-4
TOC	.9286	.4984	1.797	.1655	6.624	.0114
COD	2.8446	1.2789	4.611	.5643	16.147	.041
ALKIN	.1484	.0389	.3025	.0263	1.1179	.0033

Table 6-16
Chester River NPS Chemical Export (lbs/acre) - H Farm

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.5316	--	--	.5316	.5316	.5316
BOD30	1.0631	--	--	1.0631	1.0631	1.0631
TSS	.8121	.0738	.1044	.8121	.8859	.7383
NO2	--	--	--	--	--	--
NO3	--	--	--	--	--	--
NO2NO3	.0416	.0286	.0496	.0244	.0975	.0028
NH3	.0174	.0117	.0202	.0118	.0399	5.611E-4
TKN	.0494	.0263	.0456	.0532	.093	.0021
TKND	.0296	.0141	.0244	.0399	.0473	.0018
TPHOS	.0516	.0316	.0548	.0413	.1107	.0027
TPHOSD	.0122	.0102	.0176	.0027	.0325	.0013
DPO4	.0012	.0003	.0005	.0012	.0015	.0009
TOC	.5001	.253	.4382	.5906	.8859	.0236
COD	1.1409	.7858	1.361	.7383	2.6578	.0266
ALKIN	.4061	.3618	.5116	.4061	.7678	.0443

Table 6-17
Chester River NPS Chemical Export (lbs/acre) - Still Pond Road

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.0739	.0543	.0768	.0739	.1282	.0196
BOD30	.1719	.0965	.1672	.1194	.359	.0372
TSS	34.068	23.995	47.991	16.917	102.177	.2627
NO2	2.388E-4	--	--	2.388E-4	2.388E-4	2.388E-4
NO3	.0091	--	--	.0091	.0091	.0091
NO2NO3	.00961	.0042	.0073	.0115	.0157	.0014
NH3	.0059	.0033	.0066	.0059	.0118	1.551E-4
TKN	.0594	.038	.0759	.0352	.1651	.0022
TKND	.0191	.01	.02	.0181	.0393	.001
TPHOS	.064	.0481	.0961	.0256	.2044	7.133E-4
TPHOSD	.0051	.0027	.0055	.0038	.0126	2.895E-4
DPO4	.0023	.0015	.0025	.0015	.0051	2.59E-4
TOC	.5275	.358	.716	.2577	1.572	0.227
COD	2.4047	1.8421	3.6843	.8485	7.8598	.062
ALKIN	.3764	.2005	.401	.2765	.9432	.0093

Table 6-18
Chester River NPS Chemical Export (lbs/acre/in) - All Sites

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.2098	.025	.27	.1373	1.6955	.0039
BOD30	.4846	.0555	.6477	.2837	3.5465	1.955E-4
TSS	11.6364	3.6224	45.3887	.9053	382.865	1.222E-4
NO2	4.872E-4	1.142E-4	4.57E-4	4.063E-4	14.019E-4	.012E-4
NO3	.012	.003	.0119	.0092	.0338	.098E-4
NO2NO3	.0339	.0087	.1049	.0114	.926	.647E-4
NH3	.0195	.0061	.0785	.0046	.9041	.012E-4
TKN	.0605	.0122	.1564	.02	1.4795	.147E-4
TKND	.0315	.007	.0899	.0123	.9863	.073E-4
TPHOS	.0593	.0297	.3802	.004	4.5912	.012E-4
TPHOSD	.0868	.0836	1.0639	.0018	13.5447	.005E-4
DPO4	.0204	.0151	.1829	.0011	2.151	.002E-4
TOC	.5302	.0768	.9801	.2095	7.1231	1.955E-4
COD	1.8754	.2271	2.89	.892	17.3625	6.108E-4
ALKIN	.2738	.0281	.3458	.1906	2.1412	.244E-4

Table 6-19
Chester River NPS Chemical Export (lbs/acre/in) - All Forested

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.1359	.0241	.1402	.1084	.6108	.0039
BOD30	.342	.0768	.4856	.2113	2.1379	1.955E-4
TSS	.3294	.0647	.4095	.1982	1.5506	1.222E-4
NO2	.764E-4	.552E-4	1.233E-4	.277E-4	2.951E-4	.012E-4
NO3	2.069E-4	.649E-4	1.452E-4	2.075E-4	3.872E-4	.098E-4
NO2NO3	.0396	.0268	.1584	.0033	.926	.647E-4
NH3	.0043	9.614E-4	.0061	.0016	.024	.012E-4
TKN	.0192	.0041	.026	.0099	.1176	.147E-4
TKND	.0148	.003	.019	.0085	.0916	.073E-4
TPHOS	.0023	6.311E-4	.004	.0009	.0174	.012E-4
TPHOSD	.0013	3.926E-4	.0025	4.629E-4	.0122	.005E-4
DPO4	7.064E-4	2.16E-4	13.659E-4	2.459E-4	61.886E-4	.002E-4
TOC	.4275	.0932	.5895	.1574	2.3402	1.955E-4
COD	1.5771	.3334	2.1085	.6953	8.7909	6.108E-4
ALKIN	.047	.0114	.069	.0213	.3054	.244E-4

Table 6-20
Chester River NPS Chemical Export (lbs/acre/in) - All Urban Sites

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.3295	.0591	.3393	.2465	1.6955	.0322
BOD30	.7086	.1131	.6975	.5155	3.3112	.0658
TSS	7.7949	1.6501	11.5504	3.908	56.0612	.0995
NO2	9.739E-4	1.741E-4	3.482E-4	9.342E-4	14.019E-4	6.252E-4
NO3	.0125	.0023	.0047	.0117	.0188	.0077
NO2NO3	.0147	.0025	.018	.0099	.1156	3.154E-4
NH3	.0133	.0043	.0318	.0054	.2141	7.388E-4
TKN	.0564	.0121	.09	.0279	.56	.0017
TKND	.028	.0078	.0571	.0145	.4118	9.402E-4
TPHOS	.0286	.0066	.0494	.0102	.2898	2.686E-4
TPHOSD	.0051	.0011	.0082	.0028	.0476	1.209E-4
DPO4	.003	.0004	.0025	.0028	.0146	.806E-4
TOC	.6721	.1249	.926	.3535	5.6	.0215
COD	2.4581	.4096	3.0102	1.5196	15.9378	.094
ALKIN	.3231	.0521	.3644	.2176	2.1412	.0098

Table 6-21
Chester River NPS Chemical Export (lbs/acre/in) - All Agricultural Sites

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.1601	.0255	.2609	.0698	1.5389	.0073
BOD30	.3795	.0624	.7031	.1592	5.2774	.0218
TSS	16.9086	4.5728	55.253	1.0973	382.865	.0151
NO2	4.478E-4	.714E-4	3.191E-4	3.98E-4	11.063E-4	.355E-4
NO3	.0094	.0024	.0109	.0045	.0338	6.288E-4
NO2NO3	.0317	.0067	.0773	.0156	.8219	.903E-4
NH3	.0182	.0065	.0798	.0026	.9041	.756E-4
TKN	.063	.0141	.1739	.014	1.4795	4.231E-4
TKND	.0262	.0071	.0879	.0077	.9863	3.702E-4
TPHOS	.0788	.0334	.4112	.0038	4.5912	1.586E-4
TPHOSD	.0914	.0891	1.0985	.0007	13.5447	.229E-4
DPO4	.0208	.0157	.1868	.0004	2.151	.159E-4
TOC	.4949	.099	1.2159	.1576	9.2301	.0083
COD	1.7246	.3269	4.0176	.4994	26.7186	.0366
ALKIN	.2667	.0382	.4595	.136	4.2512	.003

Table 6-22
Chester River NPS Chemical Export (lbs/acre/in.) - Millington A (Forested)

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.0964	.0299	.1268	.0498	.4884	.0039
BOD30	.2538	.1043	.4665	.1111	2.0512	1.955E-4
TSS	.1939	.0417	.1864	.1261	.5313	1.222E-4
NO2	.231E-4	.219E-4	.310E-4	.231E-4	.45E-4	.012E-4
NO3	.724E-4	.626E-4	.885E-4	.724E-4	1.35E-4	.098E-4
NO2NO3	.0037	.0016	.0066	.001	.0286	.647E-4
NH3	.0018	.0005	.0022	.0007	.0079	.012E-4
TKN	.0111	.0023	.0104	.0087	.0319	.147E-4
TKND	.0087	.0024	.0105	.0062	.0425	.073E-4
TPHOS	.0012	.0005	.0021	.0007	.0095	.012E-4
TPHOSD	.0011	.0005	.0023	.0003	.0095	.005E-4
DPO4	5.735E-4	3.041E-4	13.601E-4	1.707E-4	61.886E-4	.002E-4
TOC	.2849	.1013	.4529	.1464	1.7002	1.955E-4
COD	1.1478	.4438	1.9846	.3685	8.7909	6.108E-4
ALKIN	.0235	.0068	.0297	.0114	.1063	.244E-4

Table 6-23

Chester River NPS Chemical Export (lbs/acre/in) - Millington B (Forested)

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.1803	.0363	.1452	.1474	.6108	.0048
BOD30	.4302	.1118	.5001	.4156	2.1379	.0054
TSS	.465	.1164	.5204	.2589	1.5506	.0194
NO2	1.119E-4	.917E-4	1.588E-4	.277E-4	2.951E-4	.13E-4
NO3	2.966E-4	.519E-4	.899E-4	2.951E-4	3.872E-4	2.075E-4
NO2NO3	.0775	.0544	.2243	.0039	.926	8.459E-4
NH3	.0069	.0017	.0076	.003	.024	.277E-4
TKN	.0274	.0076	.0338	.0155	.1176	3.631E-4
TKND	.0208	.0053	.0236	.0133	.0916	2.334E-4
TPHOS	.0033	.0011	.0051	.0017	.0174	.443E-4
TPHOSD	.0016	6.013E-4	.0027	5.266E-4	.0122	.156E-4
DPO4	8.393E-4	3.116E-4	13.937E-4	4.767E-4	61.082E-4	.104E-4
TOC	.5701	.1525	.6822	.1832	2.3402	.0093
COD	2.0064	.4898	2.1907	1.0356	7.6353	.0156
ALKIN	.0719	.0209	.0089	.0509	.3054	5.531E-4

Table 6-24
Chester River NPS Chemical Export (lbs/acre/in) - USGS Gage (Agricultural)

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.3036	.0803	.3593	.1763	1.5389	.0252
BOD30	.6762	.1692	.7935	.4384	3.5465	.0504
TSS	18.1464	12.7811	62.6143	1.5994	308.009	.1488
NO2	9.796E-4	1.267E-4	1.791E-4	9.796E-4	11.063E-4	8.53E-4
NO3	.0283	.0027	.0038	.0283	.031	.0256
NO2NO3	.0285	.0046	.0223	.0265	.0946	.0015
NH3	.0292	.0069	.0345	.0167	.1181	.0017
TKN	.0859	.0252	.1259	.0421	.6208	.0062
TKND	.0451	.0114	.0571	.0298	.2821	.0032
TPHOS	.2008	.1831	.9153	.0085	4.5912	.001
TPHOSD	.5693	.5642	2.7638	.0029	13.5447	.229E-4
DPO4	.1204	.0955	.4578	.0022	2.151	.229E-4
TOC	.3711	.082	.4018	.197	1.5747	.0229
COD	1.1438	.2171	1.0637	.847	4.6526	.1259
ALKIN	.5776	.0783	.3671	.5476	1.837	.0664

Table 6-25
Chester River NPS Chemical Export (lbs/acre/in) - Chestertown A (Urban)

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.2642	.0308	.1341	.2436	.5953	.0874
BOD30	.6125	.0764	.3585	.5155	1.7119	.1758
TSS	9.009	2.3106	12.4432	5.4309	56.0612	.5275
NO2	9.314E-4	2.388E-4	4.136E-4	7.672E-4	14.019E-4	6.252E-4
NO3	.014	.0024	.0042	.0126	.0188	.0107
NO2NO3	.0141	.0022	.012	.0101	.0447	.0014
NH3	.0073	.001	.0056	.0053	.0238	.0008
TKN	.0468	.0083	.0459	.0328	.1926	.007
TKND	.0184	.0023	.0129	.0141	.0536	.0028
TPHOS	.0278	.0068	.038	.0131	.1494	.0018
TPHOSD	.0049	.0015	.0083	.003	.0476	.0006
DPO4	.0032	.0004	.0019	.003	.0109	.0006
TOC	.6312	.1212	.675	.3535	2.9219	.0879
COD	2.5712	.58	3.229	1.7003	15.9378	.2575
ALKIN	.3245	.0393	.2118	.2513	.8301	.0098

Table 6-26
Chester River NPS Chemical Export (lbs/acre/in.) - Chestertown B (Urban)

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.418	.132	.4938	.2667	1.6955	.0322
BOD30	.8408	.2485	.9939	.5326	3.3112	.0658
TSS	6.0344	2.2733	10.1663	1.7431	36.222	.0995
NO2	.0011	--	--	.0011	.0011	.0011
NO3	.0077	--	--	.0077	.0077	.0077
NO2NO3	.0154	.0051	.0239	.0098	.1156	.0003
NH3	.0215	.0099	.0477	.0056	.2141	7.388E-4
TKN	.0688	.0258	.1264	.0266	.56	.0017
TKND	.0411	.0178	.0856	.0182	.4118	9.402E-4
TPHOS	.0298	.0127	.062	.0079	.2898	2.686E-4
TPHOSD	.0053	.0017	.0082	.0024	.0346	1.209E-4
DPO4	.0029	.0007	.0032	.002	.0146	.806E-4
TOC	.7248	.2427	1.189	.3355	5.6	.0215
COD	2.3057	.5736	2.751	1.163	12.3309	.094
ALKIN	.321	.116	.5189	.188	2.1412	.0121

Table 6-27
Chester River NPS Chemical Export (lbs/acre/in.) - S. Farm (Agricultural)

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.0757	.0194	.0909	.046	.4	.0108
BOD30	.1816	.0486	.2478	.1056	1.28	.027
TSS	9.1494	6.9519	38.7067	.294	215.995	.0414
NO2	4.797E-4	.736E-4	1.275E-4	4.14E-4	6.267E-4	3.982E-4
NO3	.0257	.0043	.0075	.024	.0338	.0191
NO2NO3	.0309	.0064	.0341	.0227	.1885	2.732E-4
NH3	.0052	.001	.0054	.0028	.0227	6.267E-4
TKN	.0346	.0179	.0995	.009	.56	4.231E-4
TKND	.0117	.0024	.0131	.0067	.06	3.702E-4
TPHOS	.0218	.0154	.086	.0016	.48	4.372E-4
TPHOSD	.0011	2.556E-4	.0014	5.013E-4	.0064	1.621E-4
DPO4	7.341E-4	2.413E-4	12.302E-4	3.542E-4	59.999E-4	1.081E-4
TOC	.1799	.0435	.2423	.0814	1.12	.0166
COD	.9584	.3715	2.0685	.3884	11.5997	.0414
ALKIN	.2772	.05	.2962	.2181	1.6832	.0486

Table 6-28

Chester River NPS Chemical Export (lbs/acre/in.) - Browntown Road (Agricultural)

Variable	Mean	Standard Error	Standard Deviation	Median	Maximum	Minimum
BOD5	.1642	.0668	.1891	.0649	.4932	.01
BOD30	.5693	.3108	.9827	.1248	3.1233	.0268
TSS	54.8188	30.8599	111.267	11.3749	382.865	.0151
NO2	.596E-4	.241E-4	.341E-4	.596E-4	.837E-4	.355E-4
NO3	.0038	.0014	.002	.0038	.0052	.0023
NO2NO3	.1222	.0731	.2426	.0179	.8219	.903E-4
NH3	.107	.0713	.2572	.0022	.9041	.756E-4
TKN	.218	.1245	.44	.0162	1.4795	.002
TKND	.1184	.0765	.2759	.0045	.9863	9.076E-4
TPHOS	.1823	.1183	.4265	.0199	1.5617	6.814E-4
TPHOSD	.0029	.0013	.0047	.0005	.0148	1.664E-4
DPO4	.0031	.0015	.0053	.0004	.0148	1.17E-4
TOC	1.3755	.6937	2.5011	.1986	7.1231	.0341
COD	3.9094	1.645	5.9311	.6565	17.3625	.0852
ALKIN	.211	.1107	.3992	.0277	1.202	.003

Table 6-29 Chester River NPS Chemical Export (lbs/acres/yr) - All Sites

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	8.8012	1.0484	11.3400	5.7650	71.2109	.1630
BOD30	20.3514	2.3327	27.2034	11.9140	148.9572	.0082
TSS	488.7286	152.1412	196.3243	38.0213	16080.3184	.0051
NO2	.0205	.0048	.0192	.0171	.0589	0.513E-4
NO3	.5038	.1248	.4991	.3874	1.4213	4.105E-4
NO2NO3	1.4233	.3634	4.4055	.4804	38.8921	.0027
NH3	.8176	.2582	3.2966	.1938	37.9728	0.513E-4
TKN	2.5425	.5130	6.5708	.8419	62.1373	6.157E-4
TKND	1.3231	.2958	3.7777	.5156	41.4249	3.078E-4
TPHOS	2.4927	1.2470	15.9696	.1688	192.8313	0.513E-4
TPHOSD	3.6462	3.5108	44.6854	.0753	568.8780	0.205E-4
DPO4	.8556	.6337	7.6830	.0445	90.3432	0.103E-4
TOC	22.2698	3.2243	41.1651	8.8000	299.1687	.0082
COD	78.7647	9.5367	121.3820	37.4655	729.2237	.0257
ALKIN	11.4979	1.1819	14.5234	8.0047	89.9301	.0010

Table 6-30 Chester River NPS Chemical Export (lbs/acres/yr) - All Forested Sites

Variable	Mean	St. Error	St. Deviation	Median	Max	Min
BOD5	5.7065	1.0102	5.0984	4.5547	25.6545	.1630
BOD30	14.3638	3.2250	20.3970	8.8732	89.7908	.0082
TSS	13.8351	2.7193	17.1987	8.3241	65.1254	.0051
NO2	.0032	.0023	.0052	.0012	.0124	0.513E-4
NO3	.0087	.0027	.0061	.0087	.0163	4.105E-4
NO2NO3	1.6612	1.1248	6.6543	.1377	38.8921	.0027
NH3	.1814	.0404	.2554	.0652	1.0067	0.513E-4
TKN	.8080	.1730	1.0940	.4174	4.9401	6.157E-4
TKND	.6199	.1264	.7997	.3575	3.8482	3.078E-4
TPHOS	.0961	.0265	.1676	.0365	.7292	0.513E-4
TPHOSD	.0560	.0165	.1043	.0194	.5131	0.205E-4
DPO4	.0297	.0091	.0574	.0103	.2599	0.103E-4
TOC	17.9551	3.9156	24.7582	6.6107	98.2893	.0082
COD	66.2393	14.0023	88.5581	29.2020	369.2192	.0257
ALKIN	1.9755	.4768	2.9100	.0938	12.8273	10.262E-4

Table 6-31 Chester River NPS Chemical Export (lbs/acre/yr) - All Urban Sites

Variable	Mean	St. Error	St. Deviation	Median	Max	Min
BOD5	13.8372	2.4807	14.2507	10.3542	71.2110	1.3540
BOD30	29.7627	4.7522	29.2944	21.6511	139.0690	2.7643
TSS	327.3853	69.3024	485.1169	164.1375	2354.5684	4.1802
NO2	.0409	.0073	.0146	.0392	.0589	.0263
NO3	.5231	.0979	.1958	.4905	.7877	.3237
NO2NO3	.6153	.1070	.7565	.4157	4.8553	.0132
NH3	.5590	.1818	1.3358	.2283	8.9930	.0310
TKN	2.3701	.5097	3.7802	1.1705	23.5202	.0733
TKND	1.1798	.3265	2.3993	.6071	17.2942	.0395
TPHOS	1.2031	.2797	2.0742	.4288	12.1720	.0113
TPHOSD	.2136	.0467	.3435	.1167	1.9972	.0050
DPO4	.1278	.0153	.1036	.1173	.6150	.0034
TOC	28.2667	5.2441	38.8909	14.8479	235.2015	.9026
COD	103.2410	17.2046	126.4276	63.8244	669.3893	3.9490
ALKIN	13.5697	2.1863	15.3040	9.1372	89.3011	.4120

Table 6-32 Chester River NPS Chemical Export (lbs/acres/yr) - All Agricultural Sites

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	6.7262	1.0692	10.9560	2.9302	64.6319	.3078
BOD30	15.9400	2.6205	29.5320	6.6868	221.6494	.9153
TSS	710.1598	192.0563	2320.6250	46.0872	16080.3184	.6353
NO2	.0188	.0030	.0134	.0167	.0465	.0015
NO3	.3943	.1020	.4560	.1884	1.4213	.0264
NO2NO3	1.3317	.2816	3.2480	.6564	34.5207	.0038
NH3	.7645	.2702	3.3524	.1086	37.9728	.0032
TKN	2.6476	.5924	7.3033	.5888	62.1373	.0178
TKND	1.1030	.2986	3.6933	.3235	41.4250	.0156
THHOS	3.0389	1.4008	17.2696	.1589	192.8313	.0067
TPHOSD	3.8378	3.7420	46.1350	.0302	568.8780	9.617E-4
DPO4	.8724	.6609	7.8472	.0160	90.3432	6.662E-4
TOC	20.7837	4.1560	51.0708	6.6187	387.6628	.3498
COD	72.4329	13.7319	168.7398	20.9721	1122.1818	1.5390
ALKIN	11.2008	1.6026	19.2982	5.7112	178.5504	.1253

Table 6-33 Chester River NPS Chemical Export (lbs/acre/yr) - Millington A (Forested)

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	4.0490	1.2554	5.3260	2.0900	20.5122	.1630
BOD30	10.6604	4.3810	19.5923	4.6674	86.1511	.0082
TSS	8.1422	1.7501	7.8270	5.2945	22.3416	.0051
NO2	9.706E-4	9.193E-4	13.0000E-4	9.706E-4	18.899E-4	0.513E-4
NO3	.0030	.0026	.0037	.0030	.0057	4.105E-4
NO2NO3	.1562	.0656	.2781	.0417	1.1996	.0027
NH3	.0746	.0203	.0909	.0274	.3317	0.513E-4
TKN	.4648	.0981	.4389	.3636	1.3388	6.157E-4
TKND	.3646	.0988	.4420	.2584	1.7852	3.078E-4
TPHOS	.0522	.0198	.0885	.0280	.3998	0.513E-4
TPHOSD	.0467	.0217	.0969	.0136	.3998	0.205E-4
DPO4	.0241	.0128	.0571	.0072	.2601	0.103E-4
TOC	11.9667	4.2535	19.0222	6.1471	71.4068	.0082
COD	48.2096	18.6387	83.3550	15.4751	369.2192	.0257
ALKIN	.9878	.2857	1.2455	.4797	4.4630	.0010

Table 6-34 Chester River NPS Chemical Export (lbs/acre/yr) - Millington B (Forested)

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	7.5712	1.5243	6.0974	6.1896	25.6545	.2030
BOD30	18.0673	4.6970	21.0056	17.4563	89.7907	.2287
TSS	19.5280	4.8871	25.8557	10.8734	65.1254	.8137
NO2	.0047	.0040	.0067	.0012	.0124	5.446E-4
NO3	.0125	.0022	.0038	.0124	.0163	.0087
NO2NO3	3.2548	2.2851	9.4215	.1647	38.8921	.0355
NH3	.2883	.0713	.3187	.1250	1.0067	.0012
TKN	1.1512	.3175	1.4198	.6524	4.9401	.0152
TKND	.8752	.2214	.9899	.5571	3.6482	.0098
TPHOS	.1400	.0479	.2140	.0710	.7302	.0020
TPHOSD	.0654	.0025	.1130	.0221	.5131	6.535E-4
DPO4	.0352	.0131	.0585	.0200	.2565	4.357E-4
TOC	23.9436	6.4065	28.6506	7.6934	98.2893	.3921
COD	84.2690	27.5735	92.0077	43.4937	320.6813	.6535
ALKIN	3.0180	.8796	3.7317	2.1391	12.8273	.0232

Table 6-35 Chester River NPS Chemical Export (lbs/acre/yr) - USGS Gage (Agricultural)

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	12.7502	3.3746	15.0919	7.4040	64.6320	1.0580
BOD30	28.4021	7.1051	33.3260	18.4134	148.9527	2.1157
TSS	762.1494	536.8503	2629.7986	67.1728	12936.3818	6.2510
NO2	.0411	.0053	.0075	.0411	.0465	.0358
NO3	1.1879	.1131	.1600	1.1879	1.3001	.0748
NO2NO3	1.1960	.1951	.9357	1.1111	3.9747	.0638
NH3	1.2271	.2901	1.4507	.7017	4.9604	.0717
TKN	3.6067	1.0577	5.2885	1.7698	26.0756	.2597
TKND	1.8924	.4795	2.3976	1.2510	11.8484	.1346
TPHOS	8.4317	7.6885	38.4424	.3552	192.8313	.0423
TPHOSD	23.9105	23.6943	116.0781	.1207	568.8780	9.617E-4
DPO4	5.0585	4.0096	19.2294	.0935	90.3432	9.617E-4
TOC	15.5873	3.4443	16.8736	8.2730	66.1392	.9617
COD	48.0379	9.1191	44.6741	35.5735	195.4113	5.2893
ALKIN	24.2610	3.2875	15.4197	22.9995	77.1554	2.7890

Table 6-36 Chester River NPS Chemical Export (lbs/acre/yr) - Chestertown A (Urban)

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	11.0981	1.2921	5.6320	10.2304	25.0047	3.6078
BOD30	25.7253	3.2101	15.0568	21.6511	71.9014	7.3843
TSS	378.3788	97.0467	522.6125	228.0994	2354.5684	22.1530
NO2	.0391	.0100	.0174	.0322	.0589	.0263
NO3	.5896	.1016	.1760	.5230	.7877	.4511
NO2NO3	.5919	.0951	.5033	.4234	1.8753	.0571
NH3	.3050	.0422	.2353	.2218	1.0002	.0343
TKN	1.9664	.3465	1.9292	1.3772	8.0885	.2954
TKND	.7733	.0976	.5434	.5916	2.2504	.1178
TPHOS	1.1665	.2866	1.5958	.5514	6.2755	.0738
TPHOSD	.2065	.0625	.3480	.1267	1.9973	.0236
DPO4	.1331	.0153	.0794	.1255	.4594	.0258
TOC	26.5120	5.0920	28.3505	14.8480	122.7213	3.6921
COD	107.9907	24.3584	135.6221	71.4142	669.3893	10.8156
ALKIN	13.6293	1.6522	8.8972	10.5543	54.8640	.4120

Table 6-37 Chester River NPS Chemical Export (lbs/acre/yr) - Chestertown B (Urban)

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	17.5547	5.5429	20.7395	11.2022	71.2110	1.3540
BOD30	35.3141	10.4362	41.7447	22.3694	139.0689	2.7643
TSS	253.4446	95.4769	426.9856	73.2096	1521.3260	4.1802
NO2	.0462	--	--	.0462	.0462	.0462
NO3	.3237	--	--	.3237	.3237	.3237
NO2NO3	.6451	.2141	1.0040	.4102	4.8553	.0132
NH3	.9012	.4176	2.0025	.2348	8.9930	.0310
TKN	2.8915	1.0838	5.3096	1.1175	23.5202	.0733
TKND	1.7278	.7495	3.5943	.7657	17.2942	.0395
TPHOS	1.2503	.5313	2.6030	.3309	12.1720	.0113
TPHOSD	.2232	.0720	.3448	.1029	1.4527	.0051
DPO4	.1201	.0304	.1327	.0851	.6150	.0034
TOC	30.4417	10.1932	49.9364	14.0897	235.2105	.9026
COD	96.8392	24.0923	115.5426	48.8400	517.8981	3.9490
ALKIN	13.4829	4.8735	21.7950	7.8941	89.9301	.5077

Table 6-38 Chester River NPS Chemical Export (lbs/acre/yr) - S Farm (Agricultural)

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	3.1799	.8173	3.8167	1.9317	16.7996	.4540
BOD30	7.6276	2.0413	10.4085	4.4351	53.7488	1.1349
TSS	384.2735	291.9812	1625.6824	12.3495	9071.8037	1.7042
NO2	.0201	.0031	.0054	.0174	.0263	.0167
NO3	1.0778	.1818	.3149	1.0093	1.4213	.8028
NO2NO3	1.2986	.2705	1.4313	.9543	7.9178	.0115
NH3	.2180	.0410	.2281	.1170	.9526	.0263
TKN	1.4541	.7506	4.1794	.3797	23.5195	.0178
TKND	.4898	.0988	.5498	.2825	2.5199	.0156
TPHOS	.9170	.6485	3.6106	.0674	20.1596	.0184
TPHOSD	.0477	.0107	.0598	.0211	.2688	.0068
DPO4	.0308	.0101	.0517	.0149	.2520	.0045
TOC	7.5548	1.8279	10.1772	3.4170	47.0390	.6961
COD	40.2529	15.6034	86.8758	16.3140	487.1985	1.7402
ALKIN	11.6405	2.2713	12.4408	9.1609	70.6938	2.0428

Table 6-39 Chester River NPS Chemical Export (lbs/acre/yr) - Browntown Road (Agricultural)

Variable	Mean	St. Error	St. Deviation	Median	Max.	Min.
BOD5	6.8971	2.8074	7.9407	2.7265	20.7124	.4213
BOD30	23.9092	13.0525	41.2755	5.2431	131.1788	1.1235
TSS	2302.3884	1296.1166	4673.2148	477.7449	16080.3184	.6353
NO2	.0025	.0010	.0014	.0025	.0035	.0015
NO3	.1582	.0598	.0846	.1582	.2180	.0984
NO2NO3	5.1318	3.0718	10.1879	.7520	34.5207	.0038
NH3	4.4920	2.9964	10.8038	.0910	37.9728	.0032
TKN	9.1576	5.2307	18.8596	.6825	62.1373	.0835
TKND	4.9738	3.2136	11.5869	.1898	41.4249	.0381
TPHOS	7.6587	4.9682	17.9132	.8342	65.5894	.0286
TPHOSD	.1216	.0550	.1986	.0230	.6214	.0070
DPO4	.1304	.0647	.2242	.0174	.6214	.0050
TOC	57.7698	29.1349	105.0472	8.3416	299.1687	1.4309
COD	164.1961	69.0892	249.1050	27.5720	729.2237	3.5772
ALKIN	8.8625	4.6498	16.7651	1.1626	50.4847	.1253

Table 6-40
Relative Comparison of Estimated Average Agricultural Watershed Chemical Export To Estimated Average Forested Watershed Export In The Chester River, 1980-1981

Variable	Ratio of average agricultural export to average forested export (lbs/acre/in of rain)
BOD5	1.17
BOD30	1.11
TSS	51.33
NO2	5.86
NO3	45.43
NO2NO3	.80
NH3	4.23
TKN	3.28
TKND	1.77
TPHOS	34.26
TPHOSD	70.31
DPO4	29.45
TOC	1.16
COD	1.09
ALKLIN	5.67

Table 6-41
Relative Comparison of Estimated Average Agricultural Watershed Chemical Export To Estimated Average Urban Watershed Export In The Chester River, 1980-81

Variable	Ratio of average agricultural export to average urban export (lbs/acre/in of rain)
BOD5	.49
BOD30	.54
TSS	2.17
NO2	.46
NO3	.75
NO2NO3	2.16
NH3	1.37
TKN	1.12
TKND	.94
TPHOS	2.76
DPO4	6.93
TOC	.74
COD	.70
ALKLIN	.83

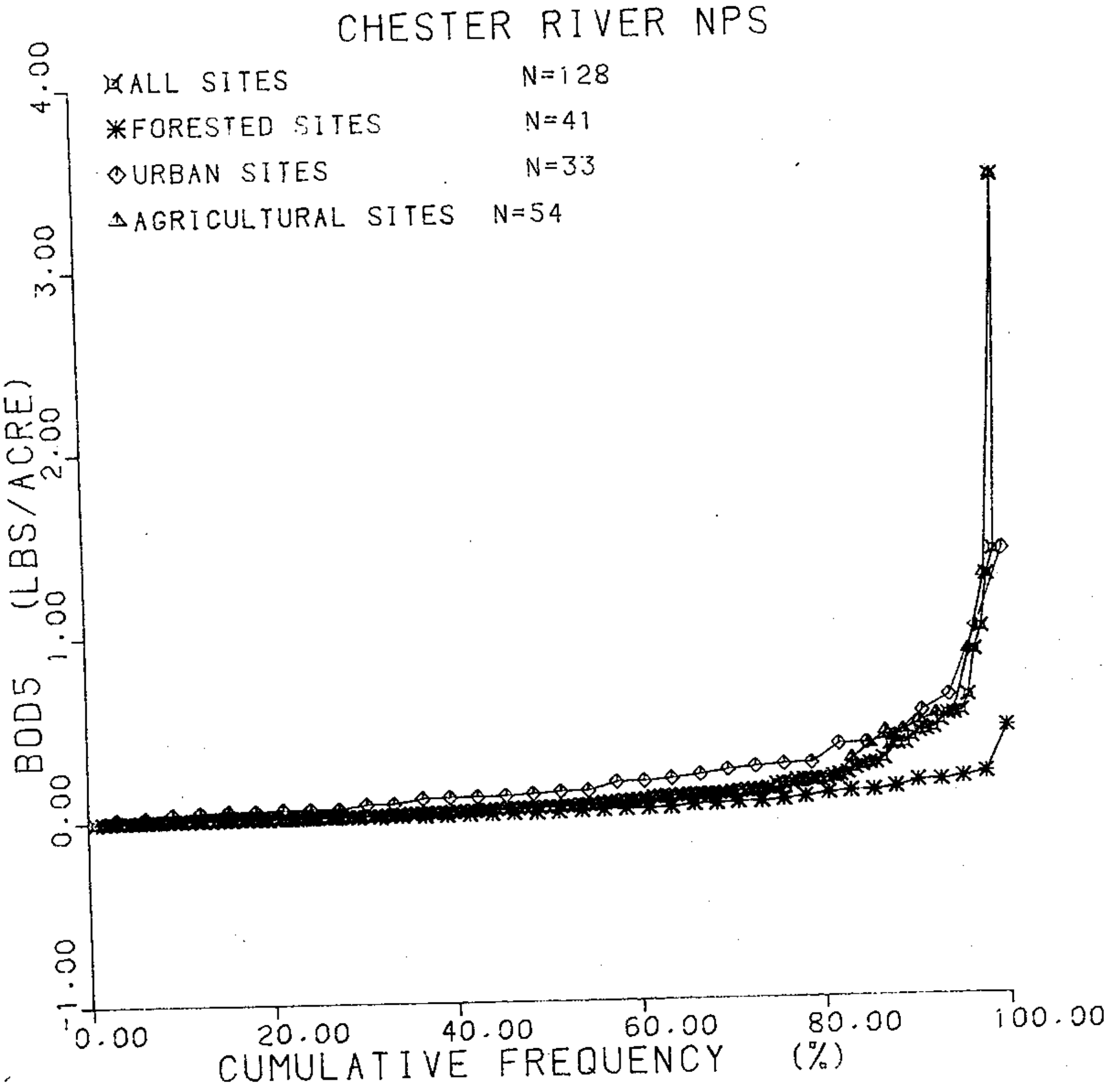


Figure 6-1 Chester River NPS cumulative frequency distributions for BOD5 (lbs/acre).

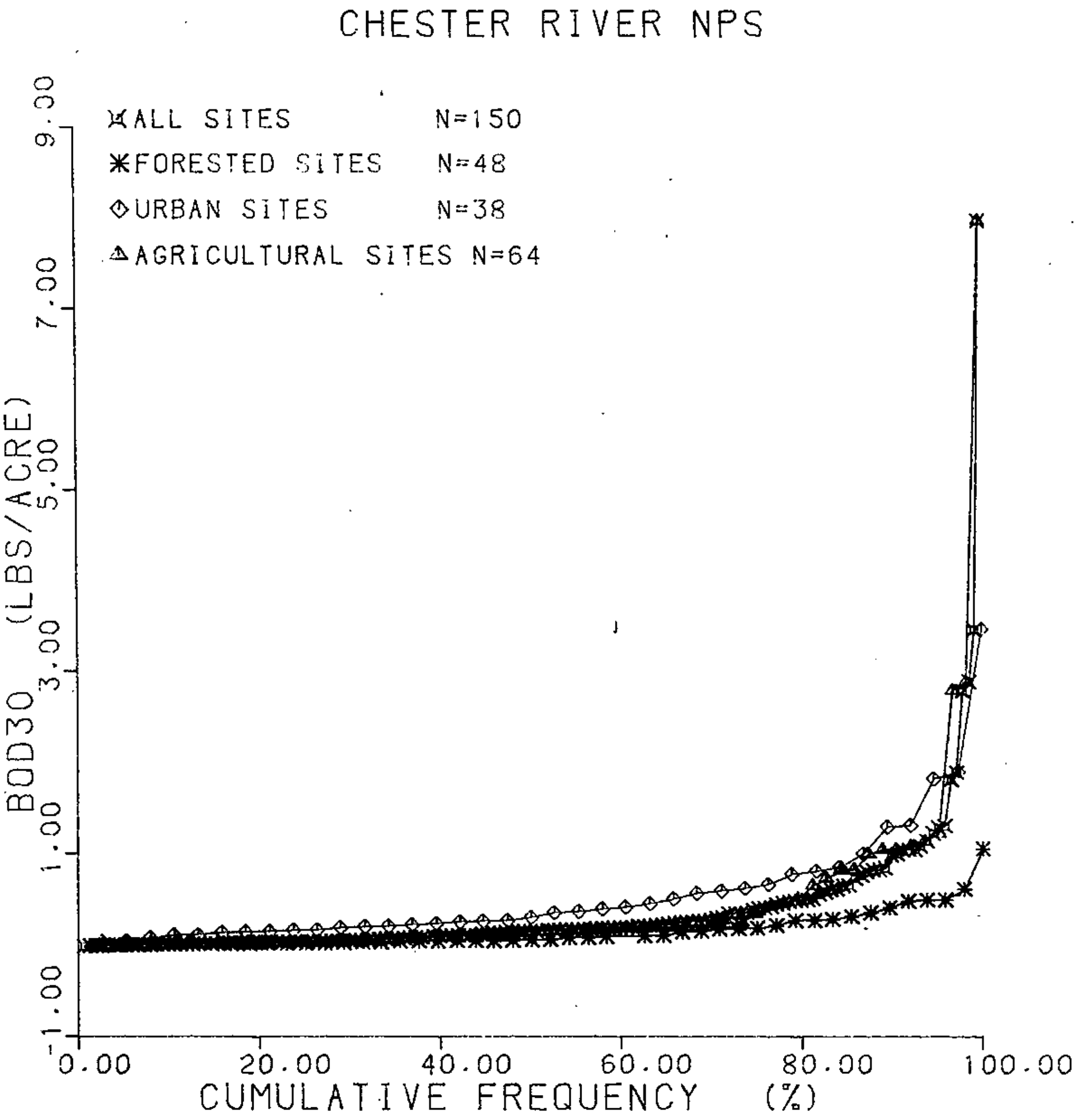


Figure 6-2 Chester River NPS cumulative frequency distributions for BOD30 (lbs/acre).

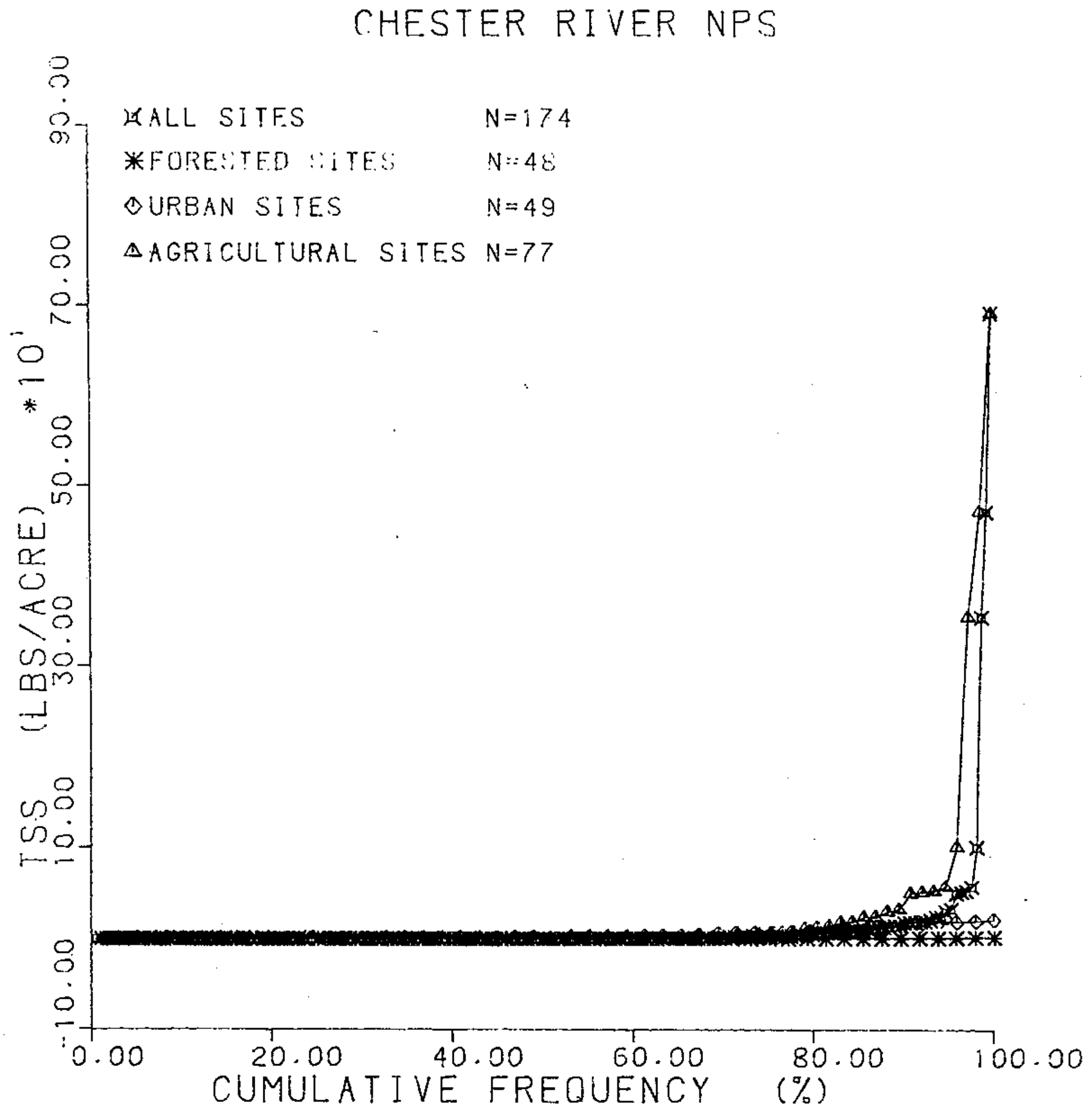


Figure 6-3 Chester River NPS cumulative frequency distributions for TSS (lbs/acre).

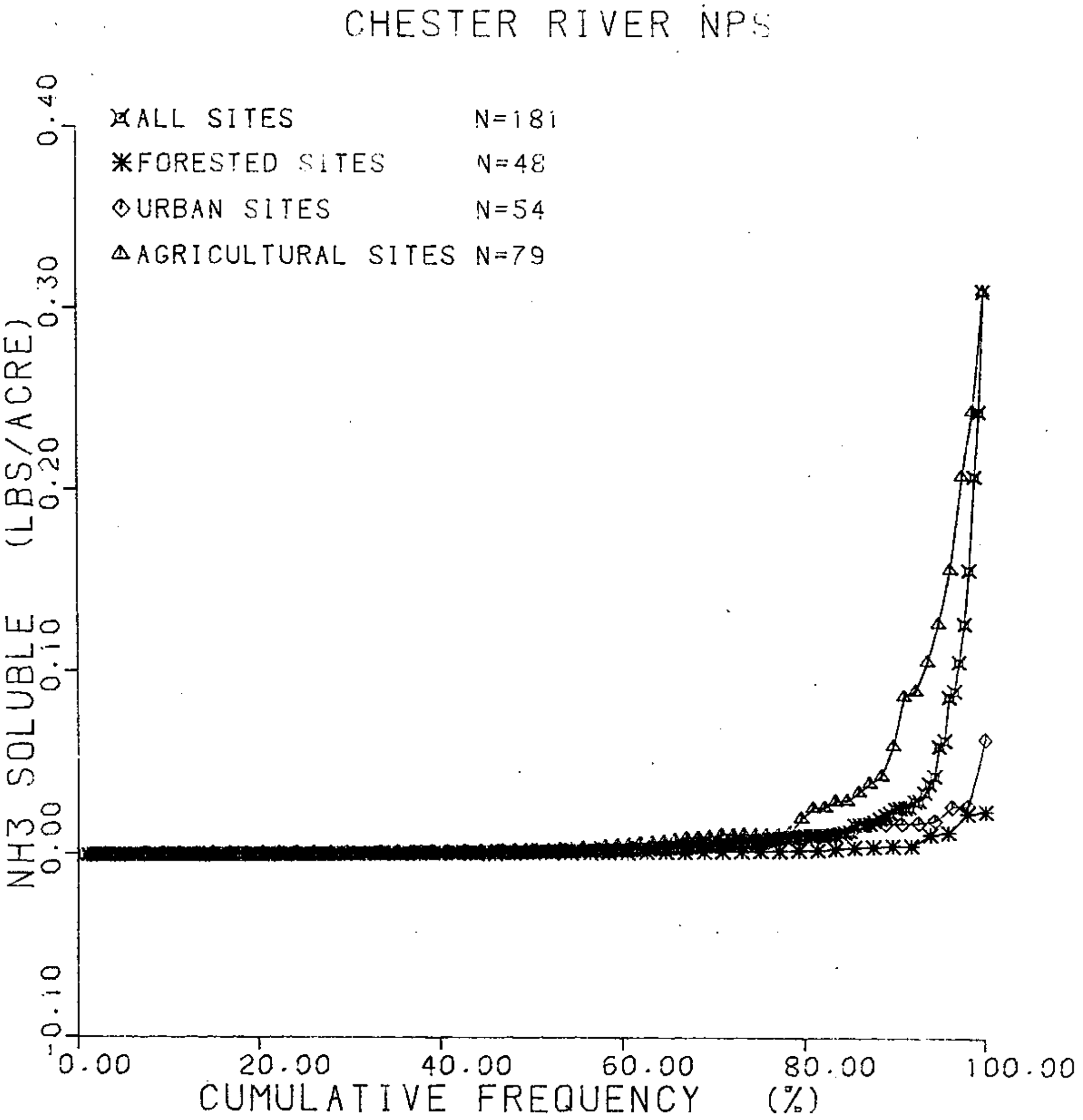


Figure 6-4 Chester River NPS cumulative frequency distributions for NH3 soluble (lbs./acre).

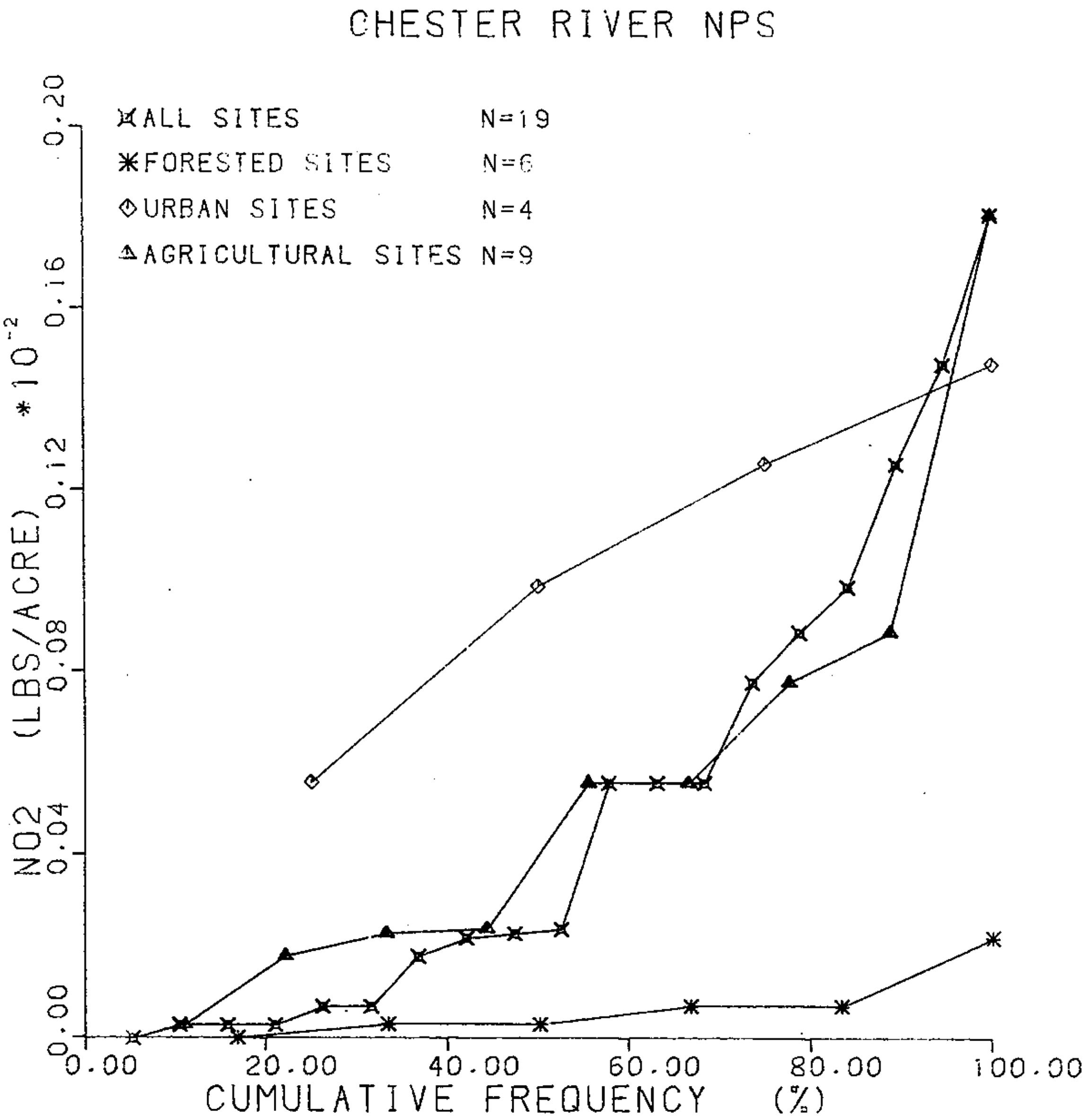


Figure 6-5 Chester River NPS cumulative frequency distributions for NO2 (lbs/acre).

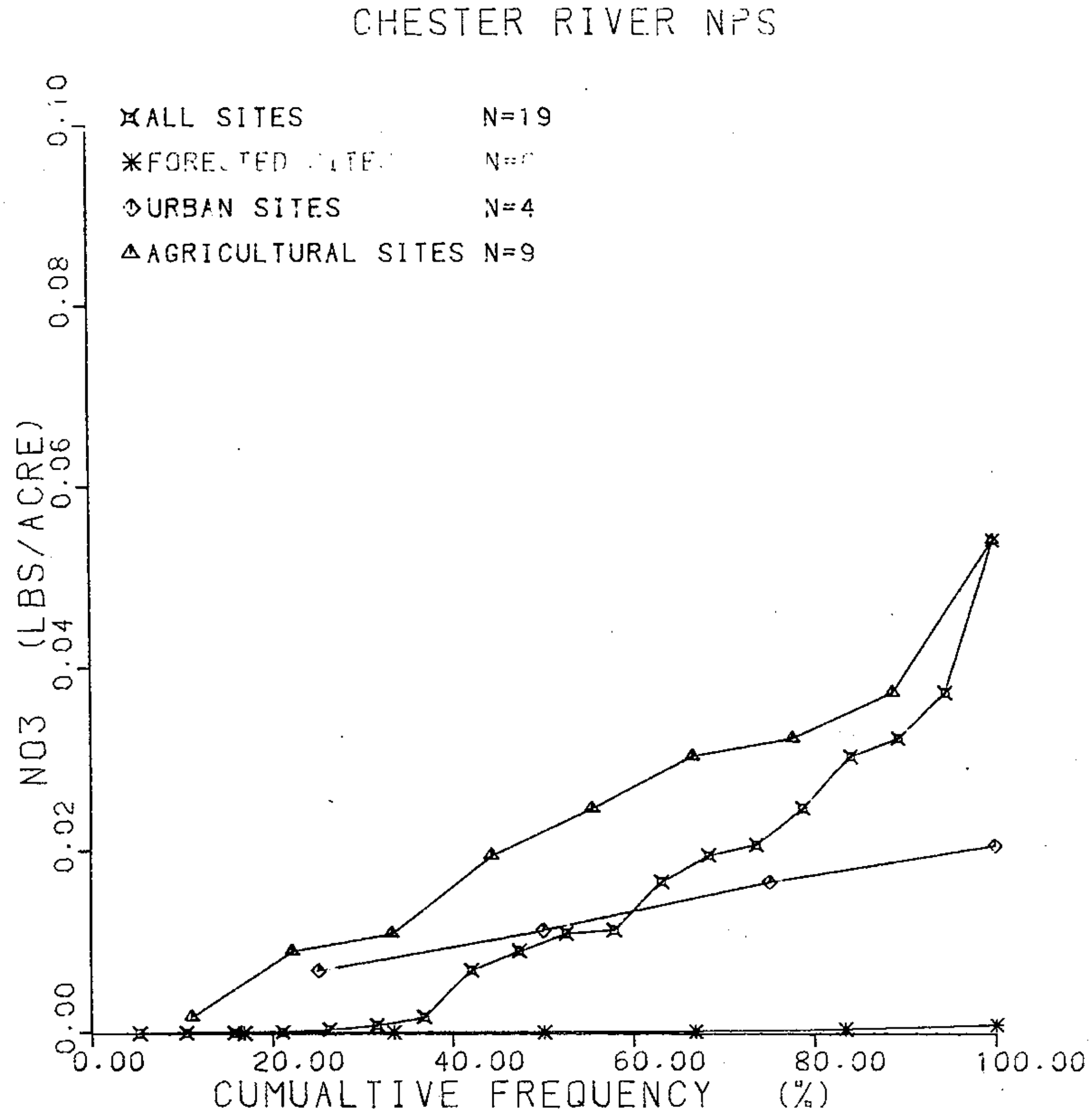


Figure 6-6 Chester River cumulative frequency distributions for NO3 (lbs/acre).

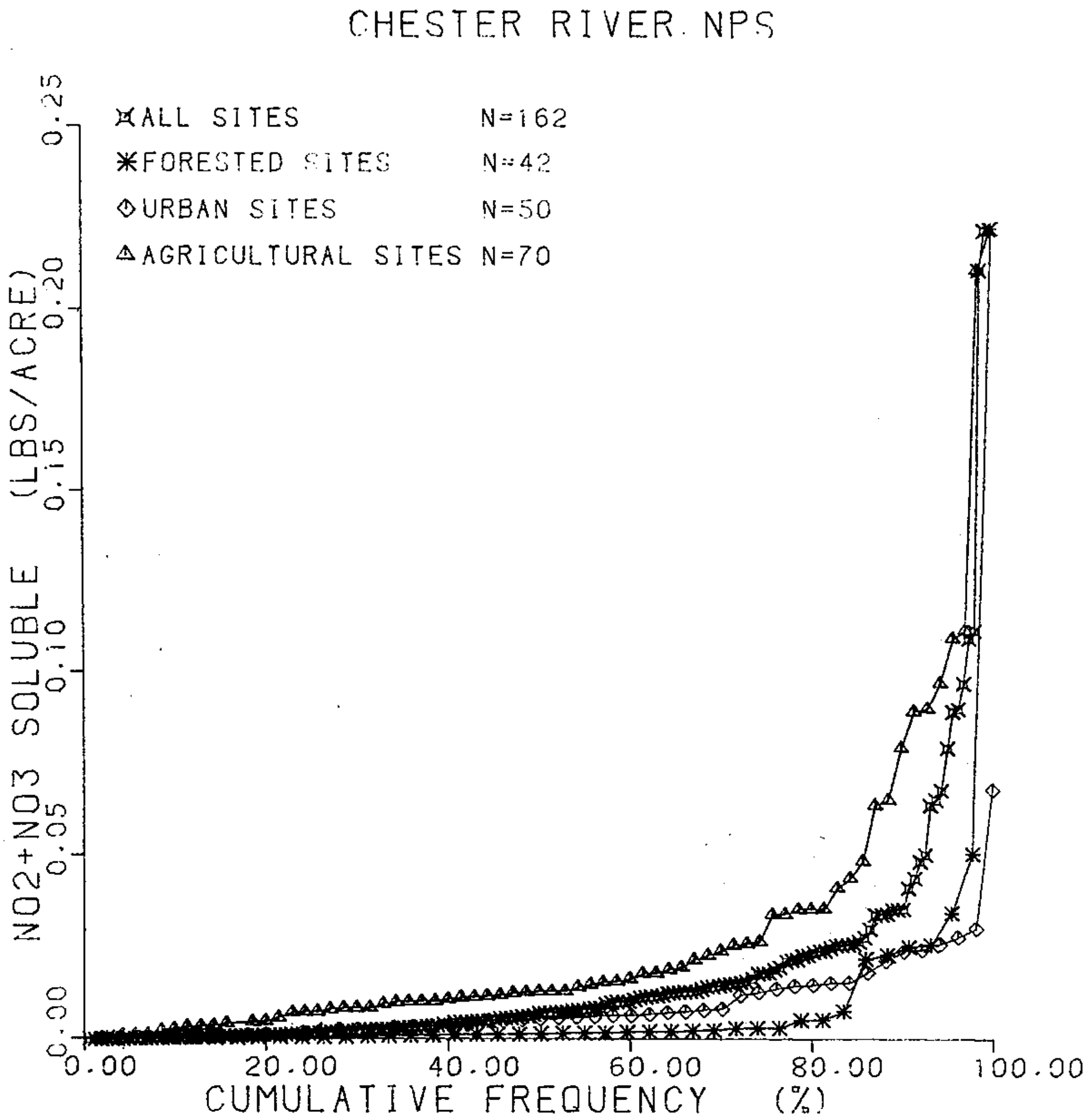


Figure 6-7 Chester River NPS cumulative frequency distributions for NO2 + NO3 soluble (lbs/acre).

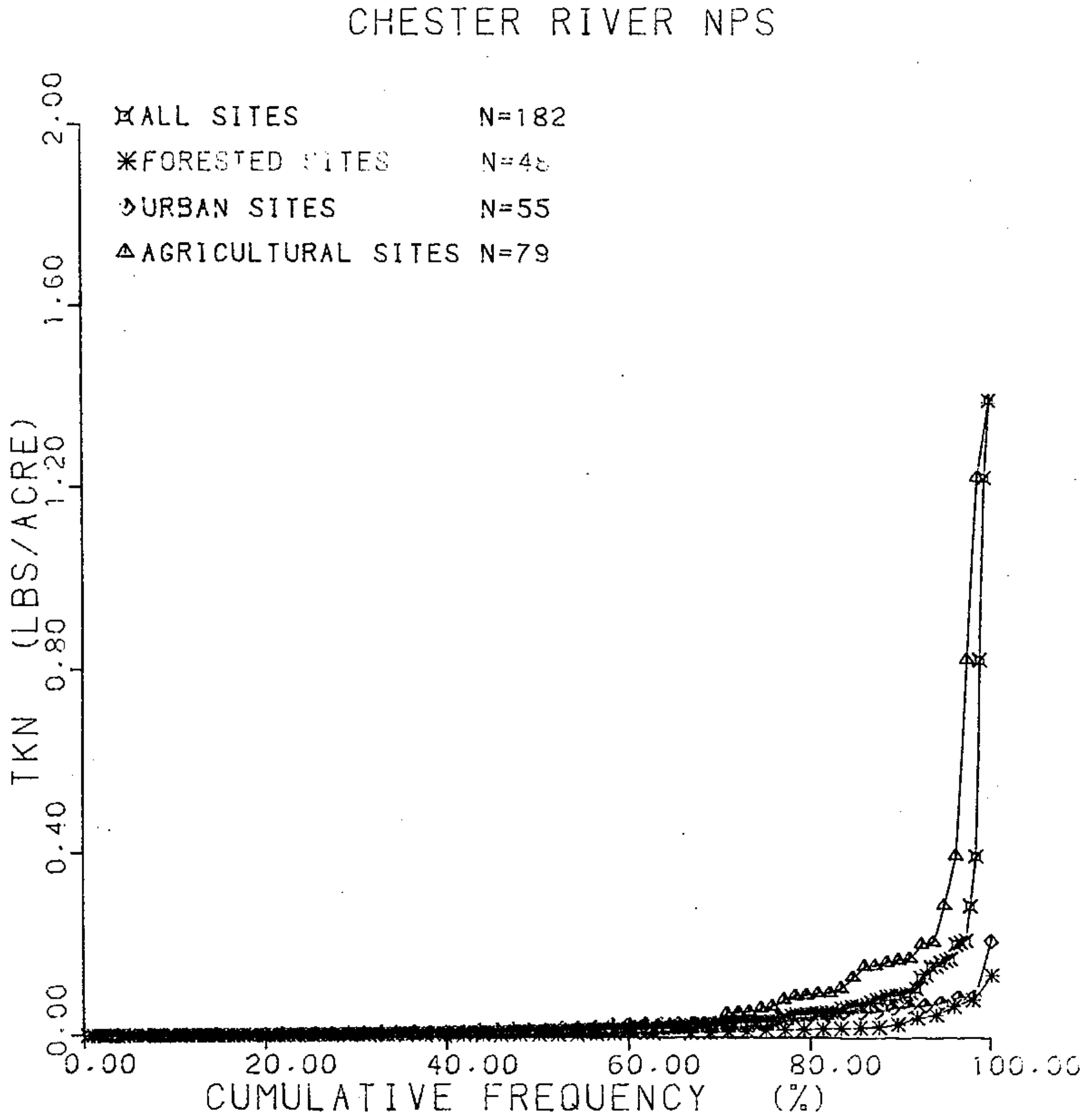


Figure 6-8 Chester River NPS cumulative frequency distributions for TKN soluble (lbs./acre).

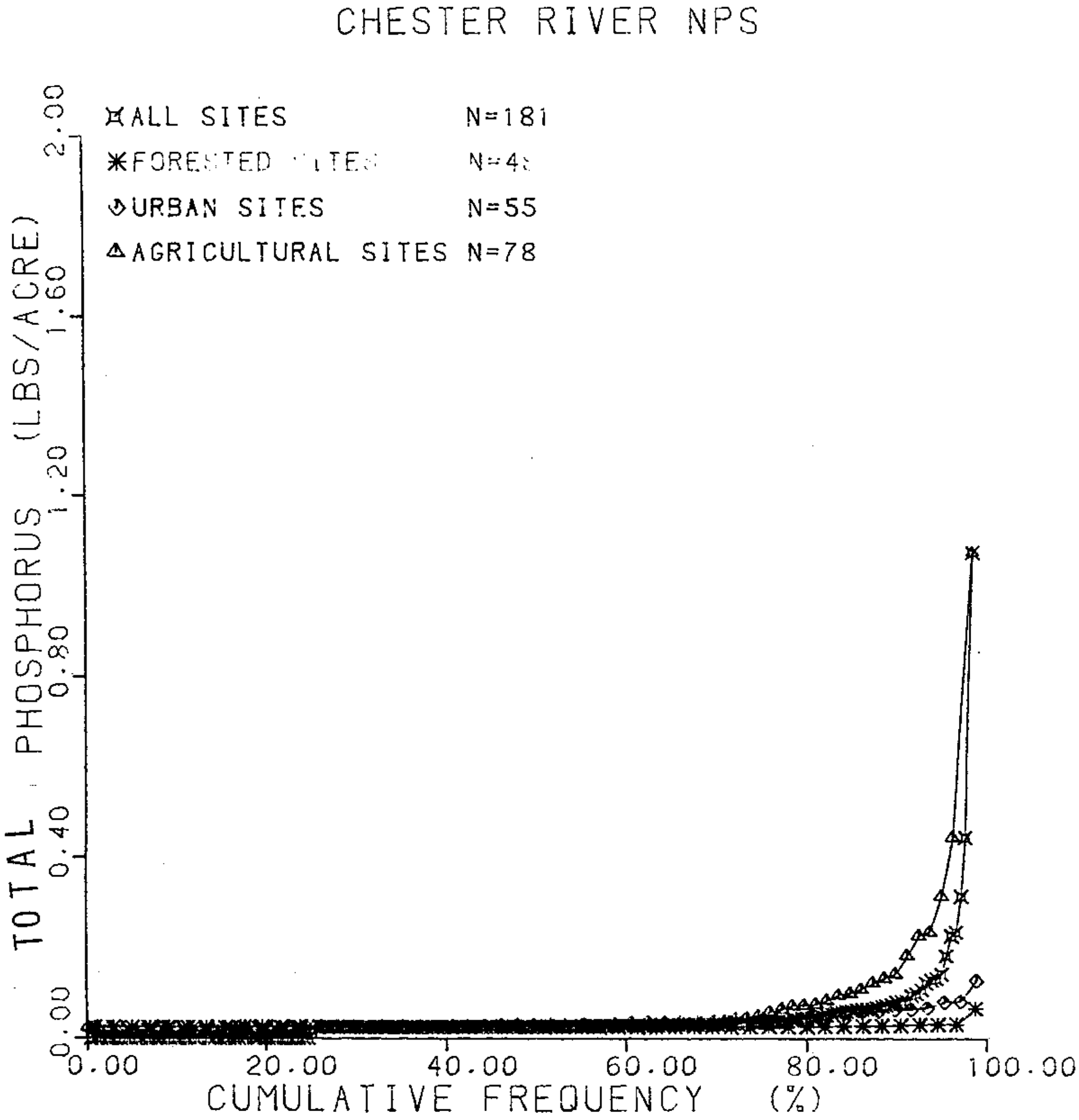


Figure 6-9 Chester River NPS cumulative frequency distributions for total Phosphorus (lbs/acre). Note: The largest storm was not included in this analysis. Removal of this storm allows the CFD difference to be visually observable.

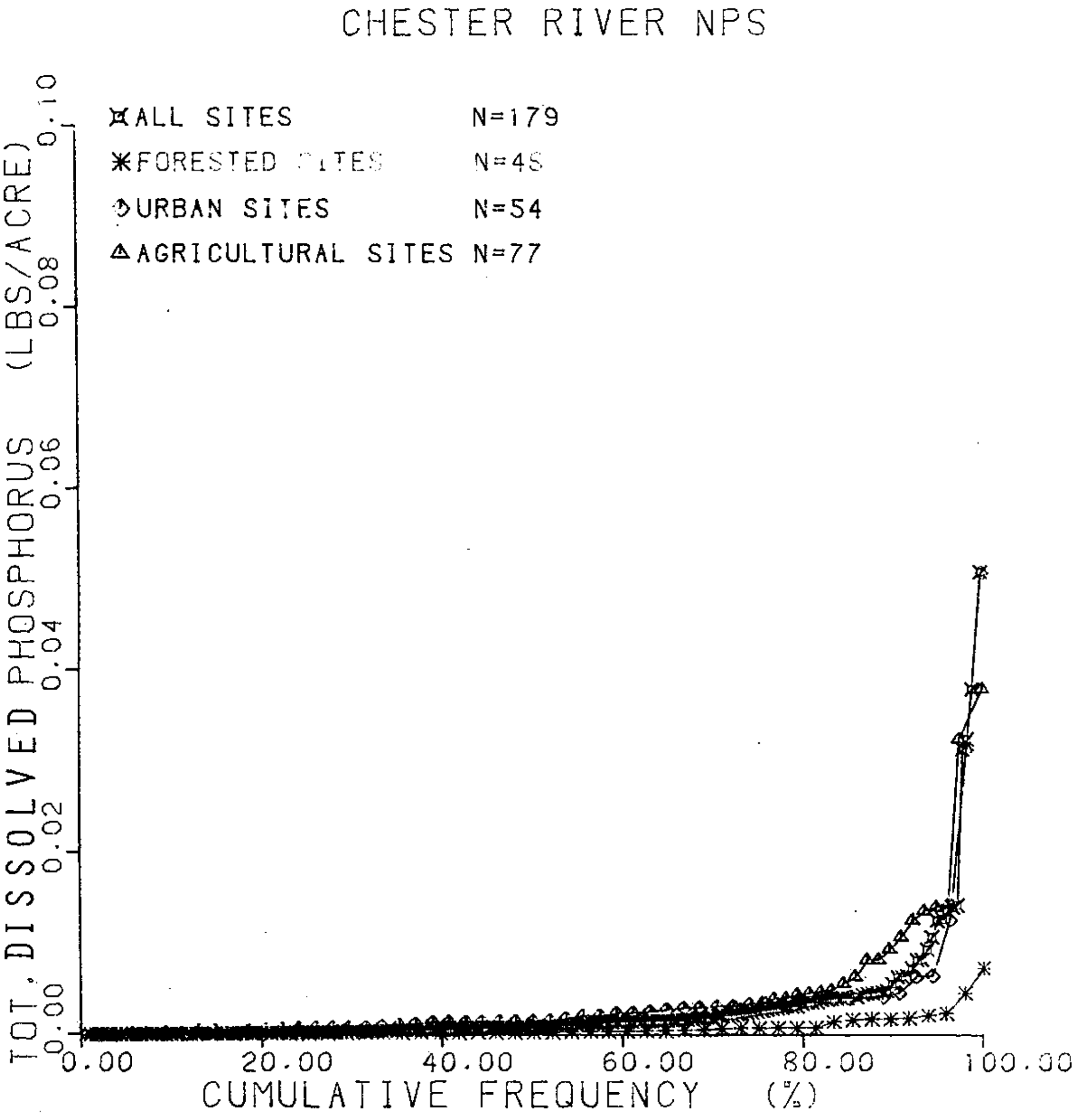


Figure 6-10 Chester River NPS cumulative frequency distributions for total dissolved phosphorus (lbs/acre). Note: The largest storm was not included in this analysis. Removal of this storm allows the CFD differences to be visually observable.

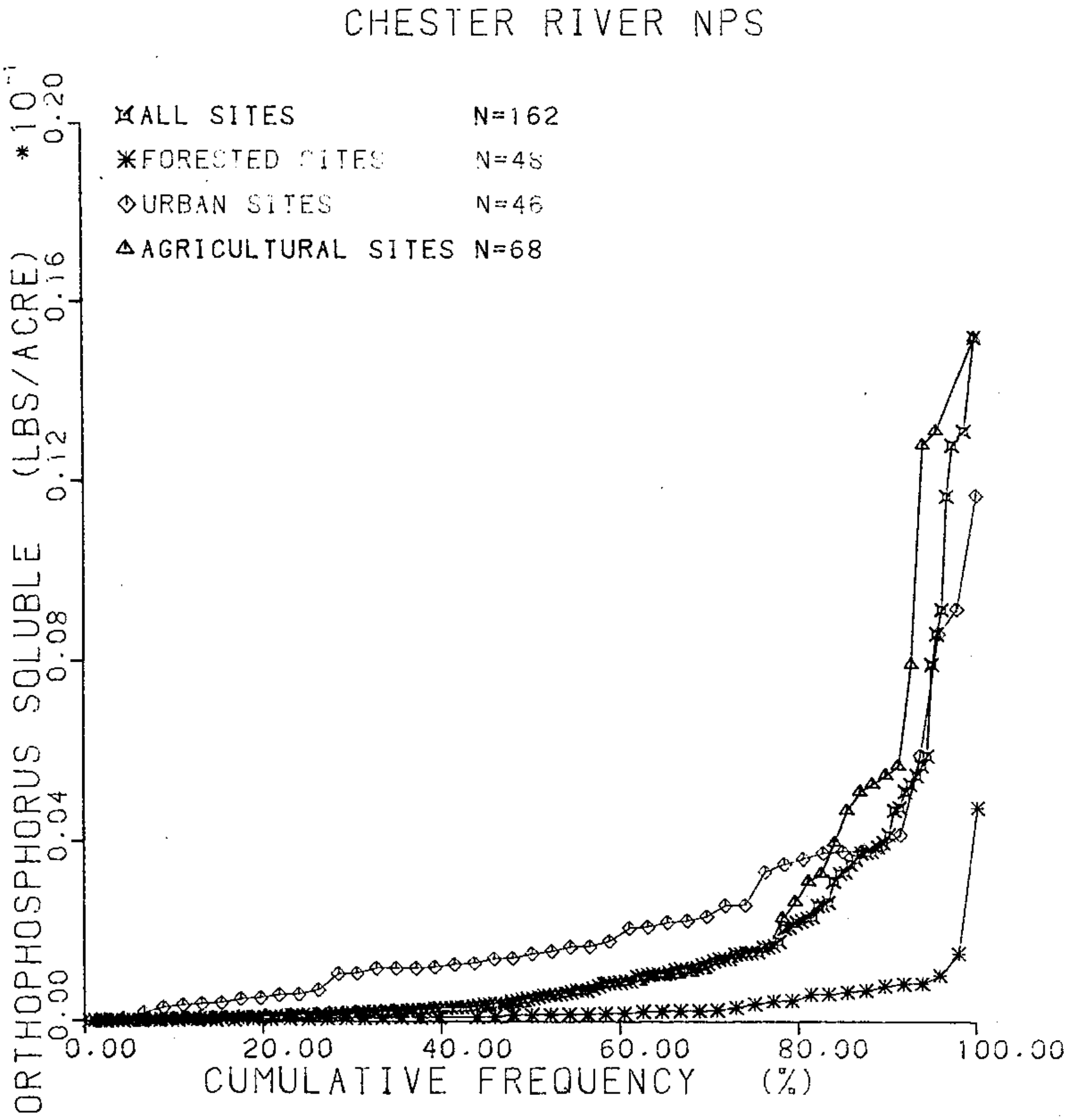


Figure 6-11 Chester River NPS Cumulative frequency distributions for soluble orthophosphorus. Note: The largest storm event was not included in this analysis. Removal of this storm allows the CFD difference to be visually observable.

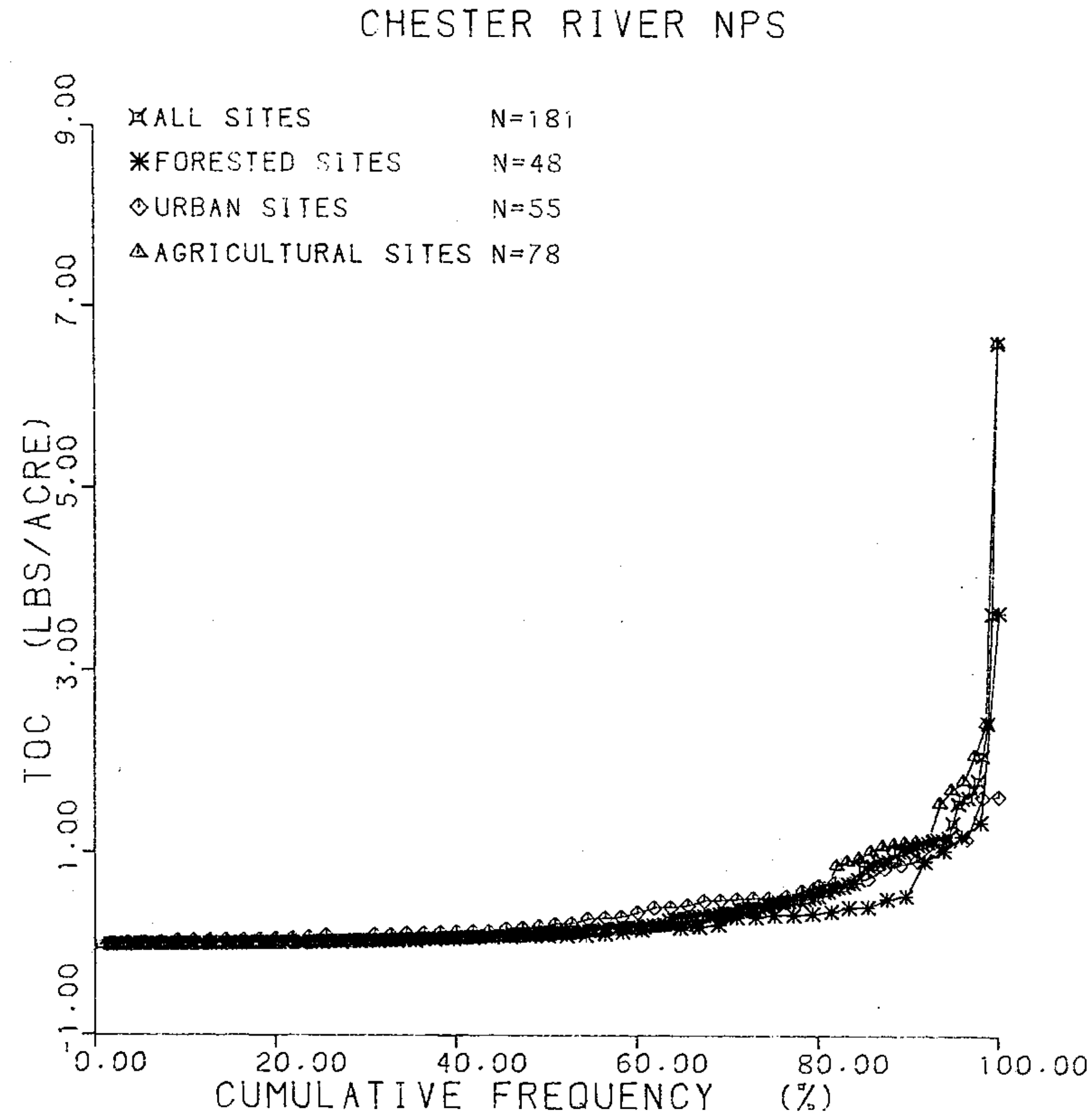


Figure 6-12 Chester River NPS cumulative frequency distributions for TOC (lbs./acre).

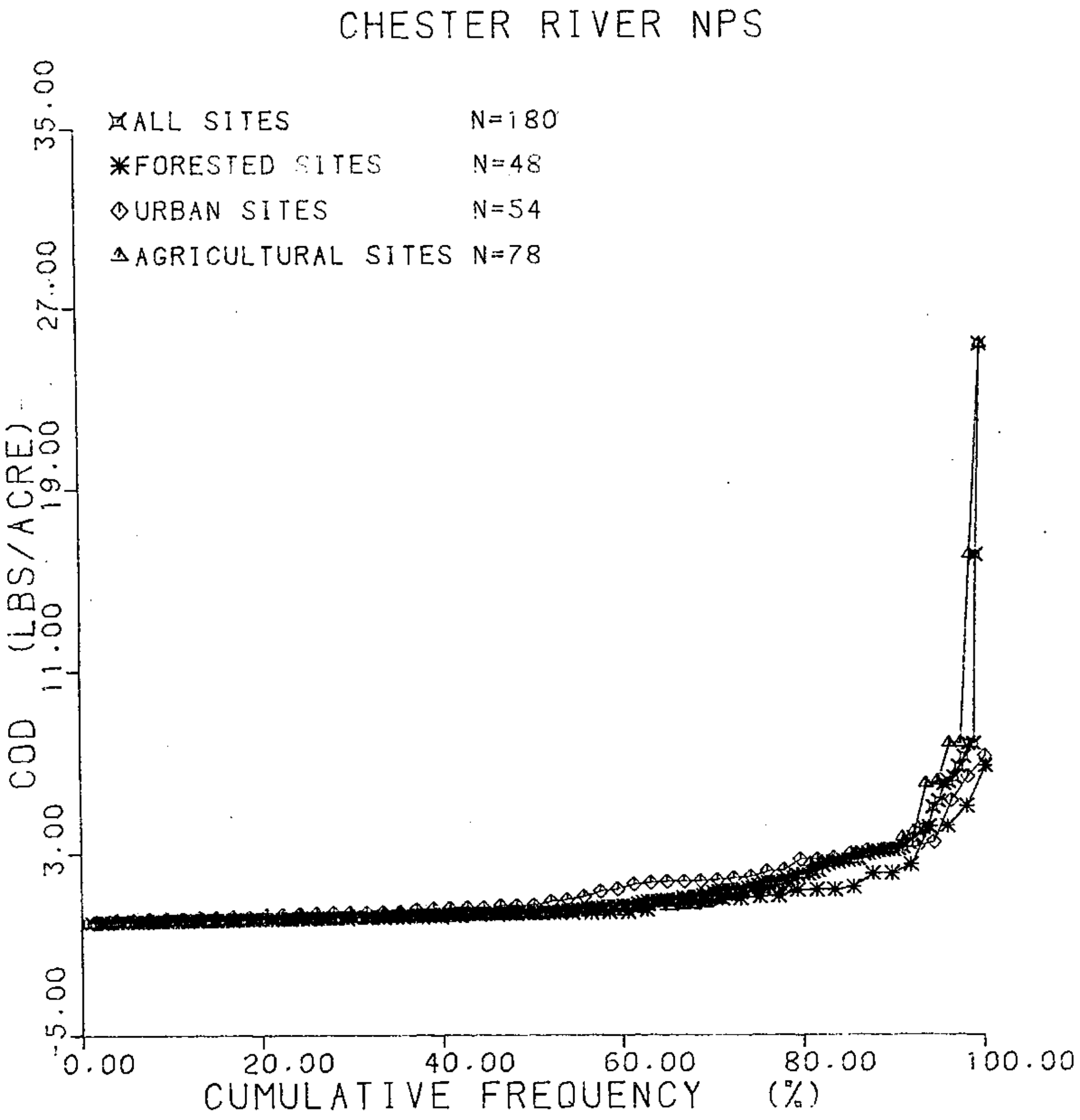


Figure 6-13 Chester River NPS cumulative frequency distributions for COD (lbs./acre).

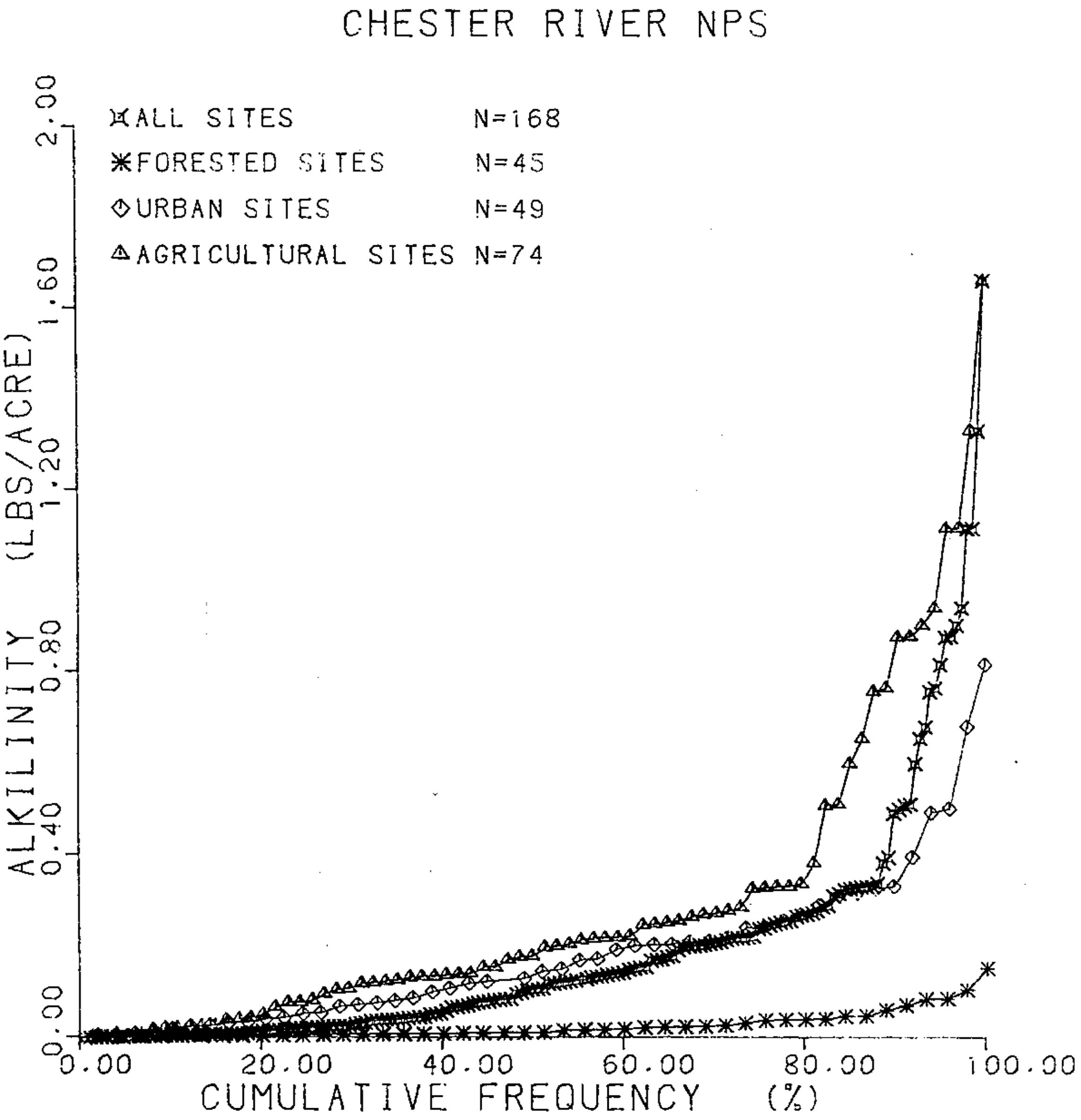


Figure 6-14 Chester River NPS cumulative frequency distributions for alkalinity (lbs/acre).

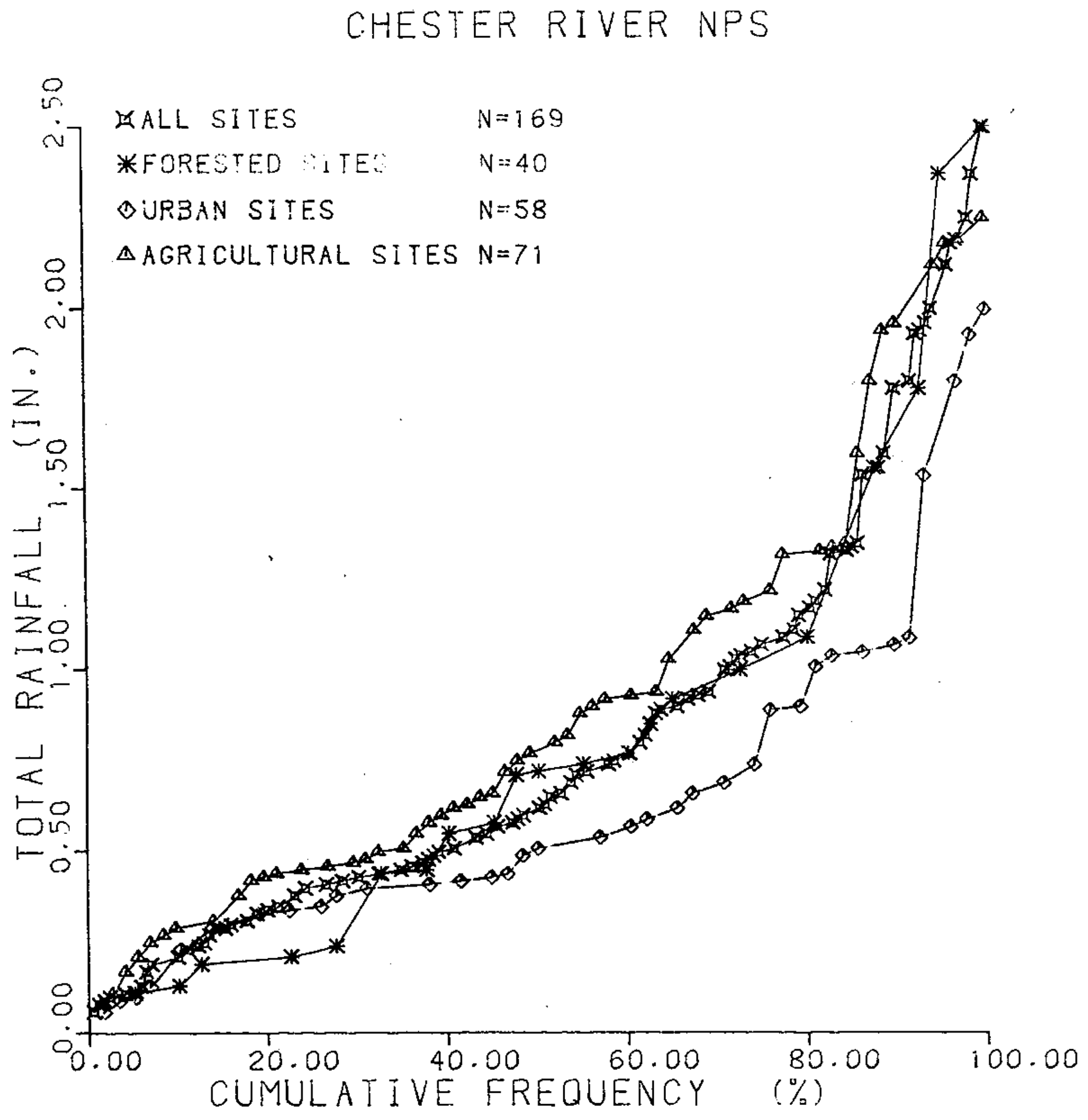


Figure 6-15 Chester River NPS cumulative frequency distributions for total rainfall (ins.) for storm events where quality samples were taken.

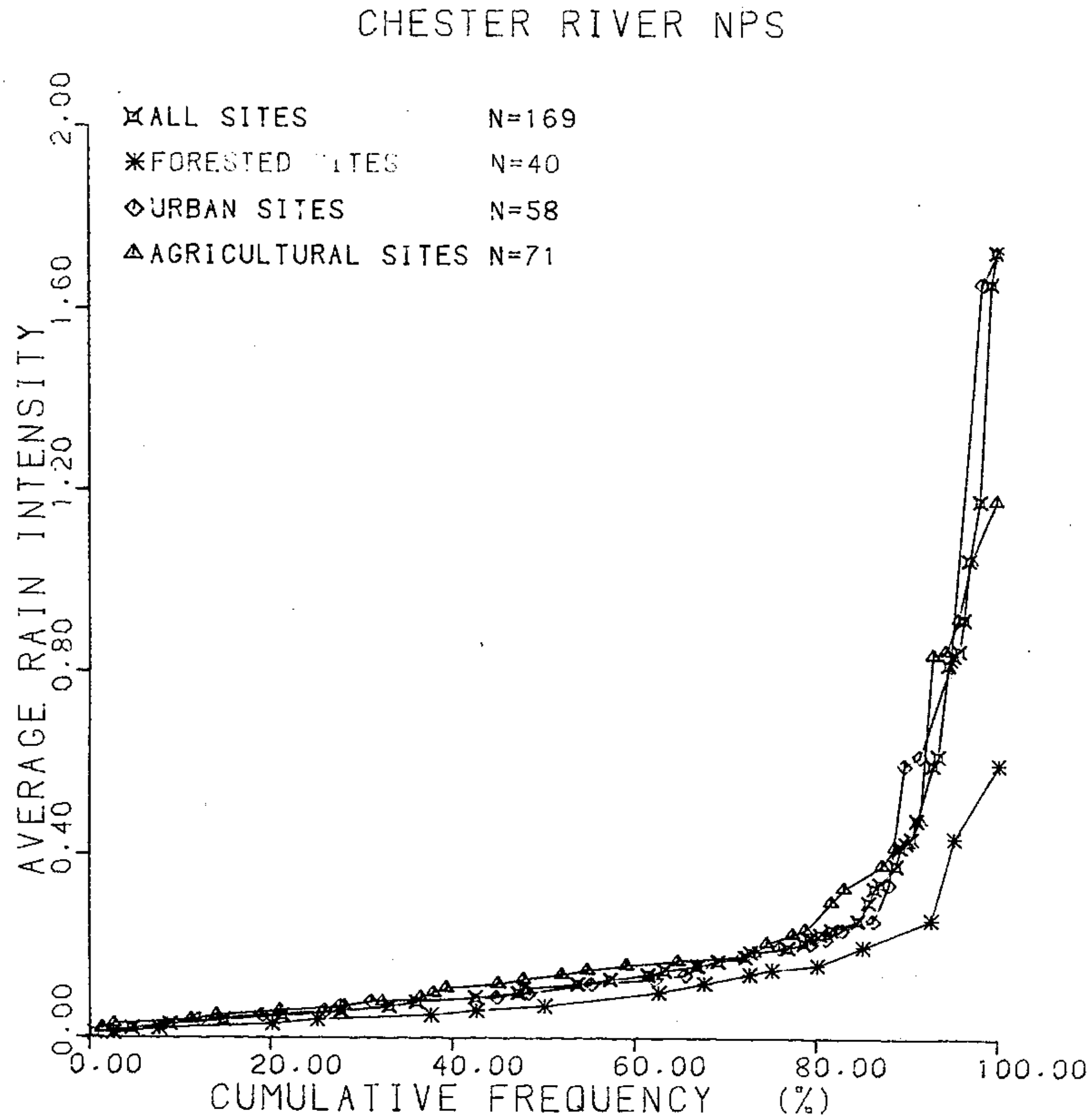


Figure 6-16 Chester River NPS cumulative frequency distributions for average rain intensity (in./hr.) for storm events where quality samples were taken.

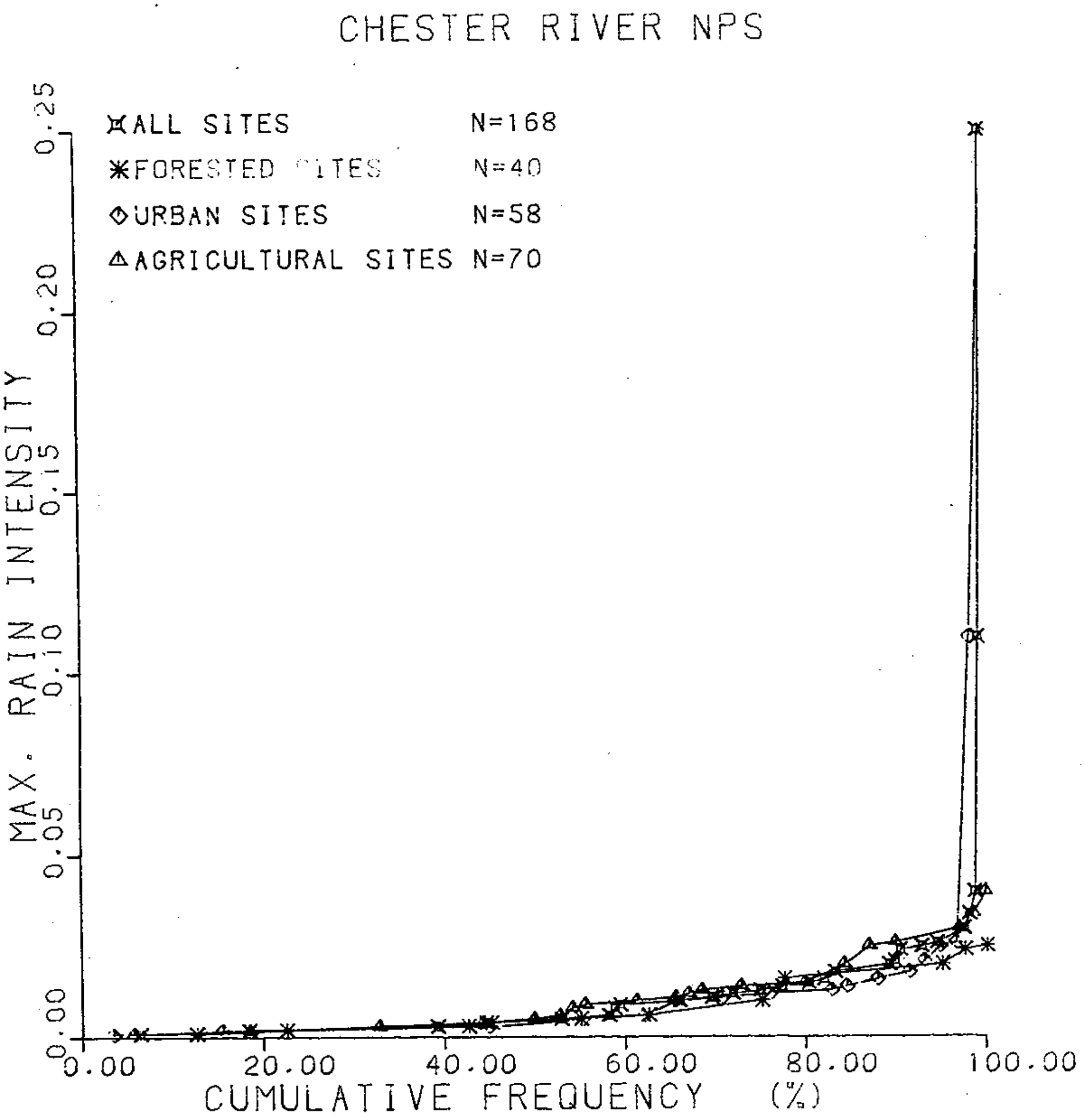


Figure 6-17 Chester River NPS cumulative frequency distributions for maximum rain intensity (in./hr.) for storm events where quality samples were taken.

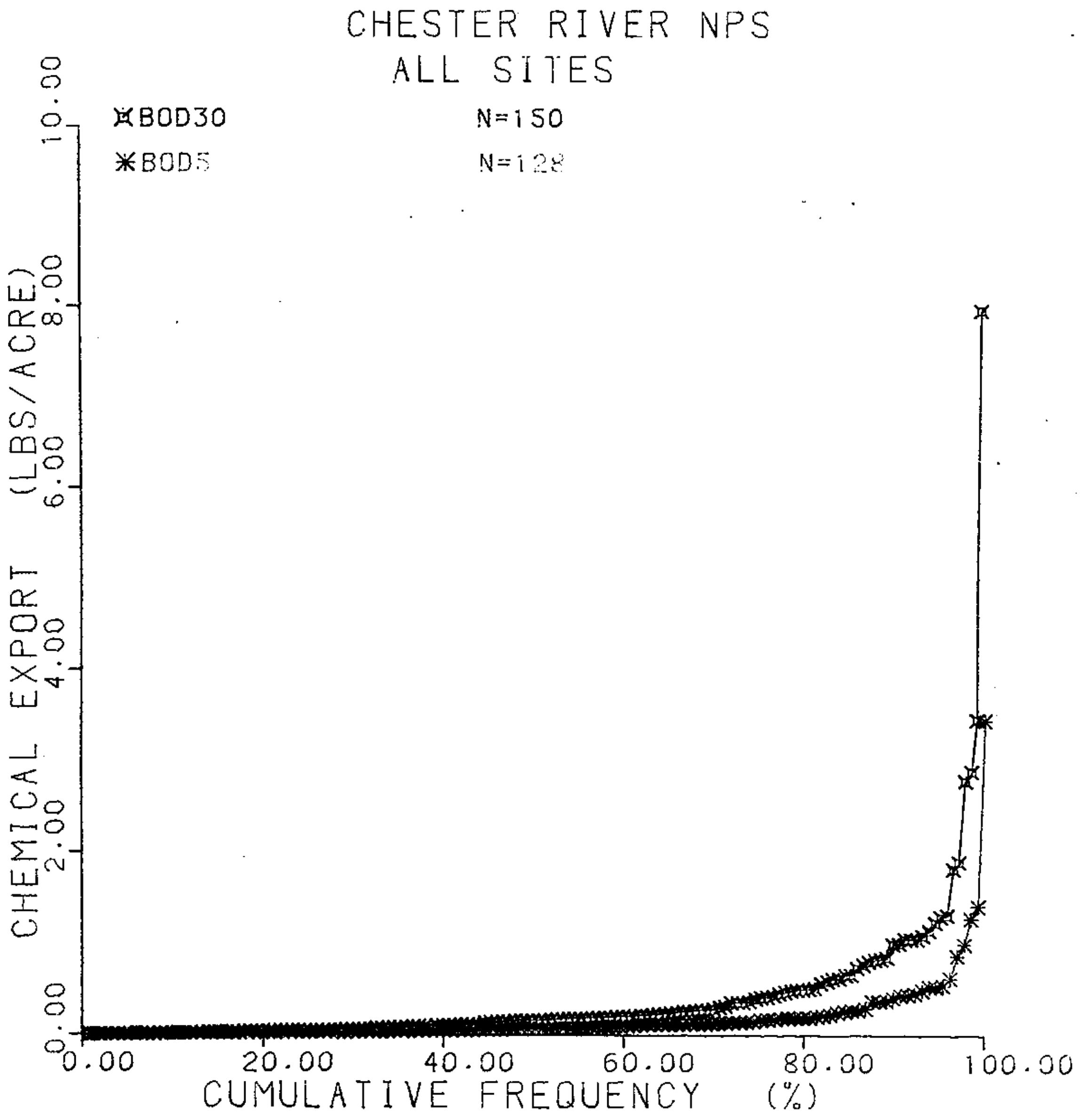


Figure 6-18 Comparison of BOD5 and BOD30 (lbs/acre) cumulative frequency distributions (all sites combined).

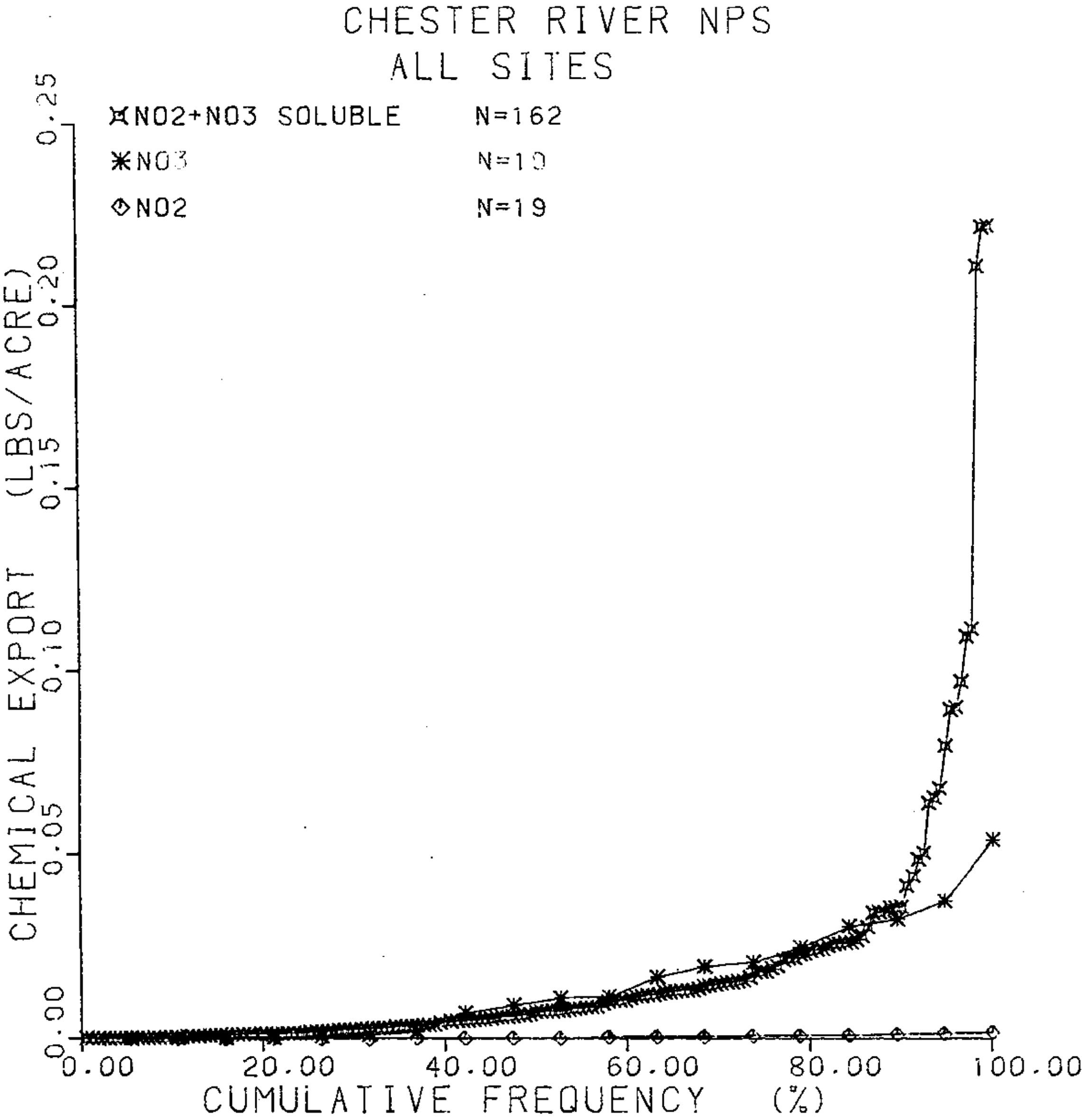


Figure 6-19 **Comparison** of NO2 + NO3, NO2, and NO3 (lbs/acre) cumulative frequency distributions (all sites combined).

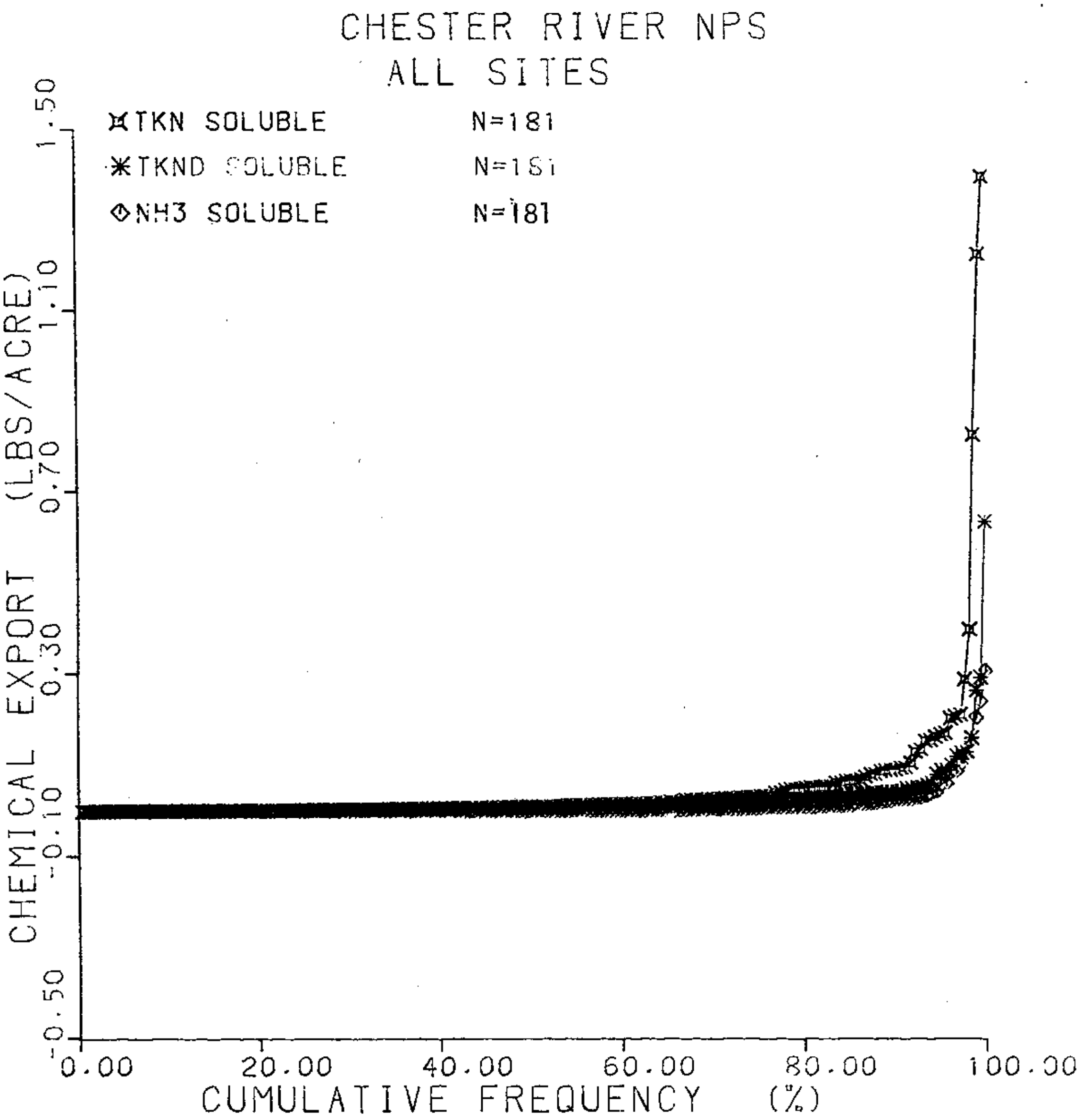


Figure 6-20 Comparison of TKN, TKND, and NH3 (lbs/acre) cumulative frequency distributions (all sites combined).

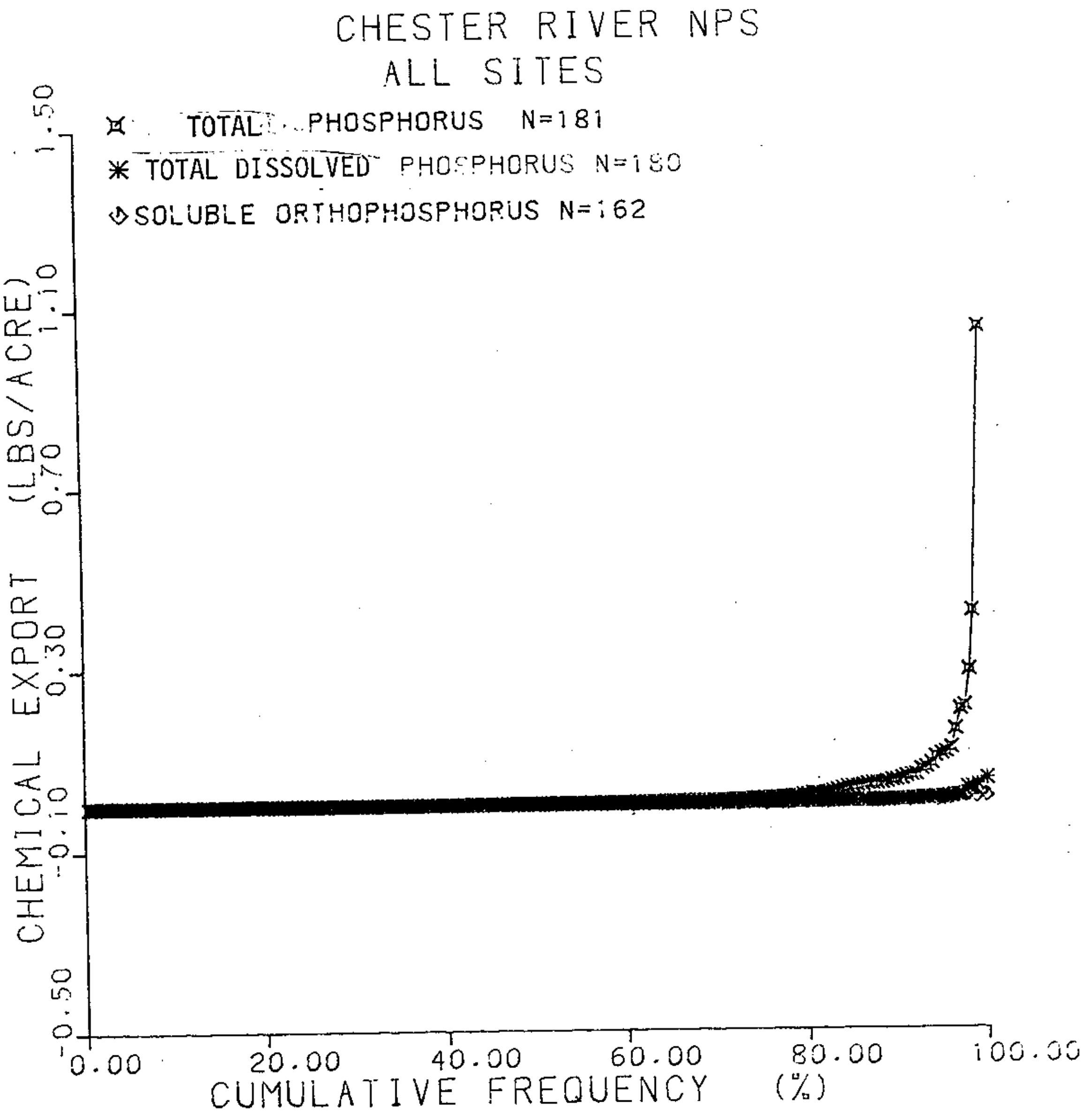


Figure 6-21 Comparison of TPHOS, TPHOSD, and DPO4 (lbs/acre) cumulative frequency distributions (all sites combined). Note: The largest storm was not included in this analysis. Removal of this storm allows the CFD differences to be visually observable.

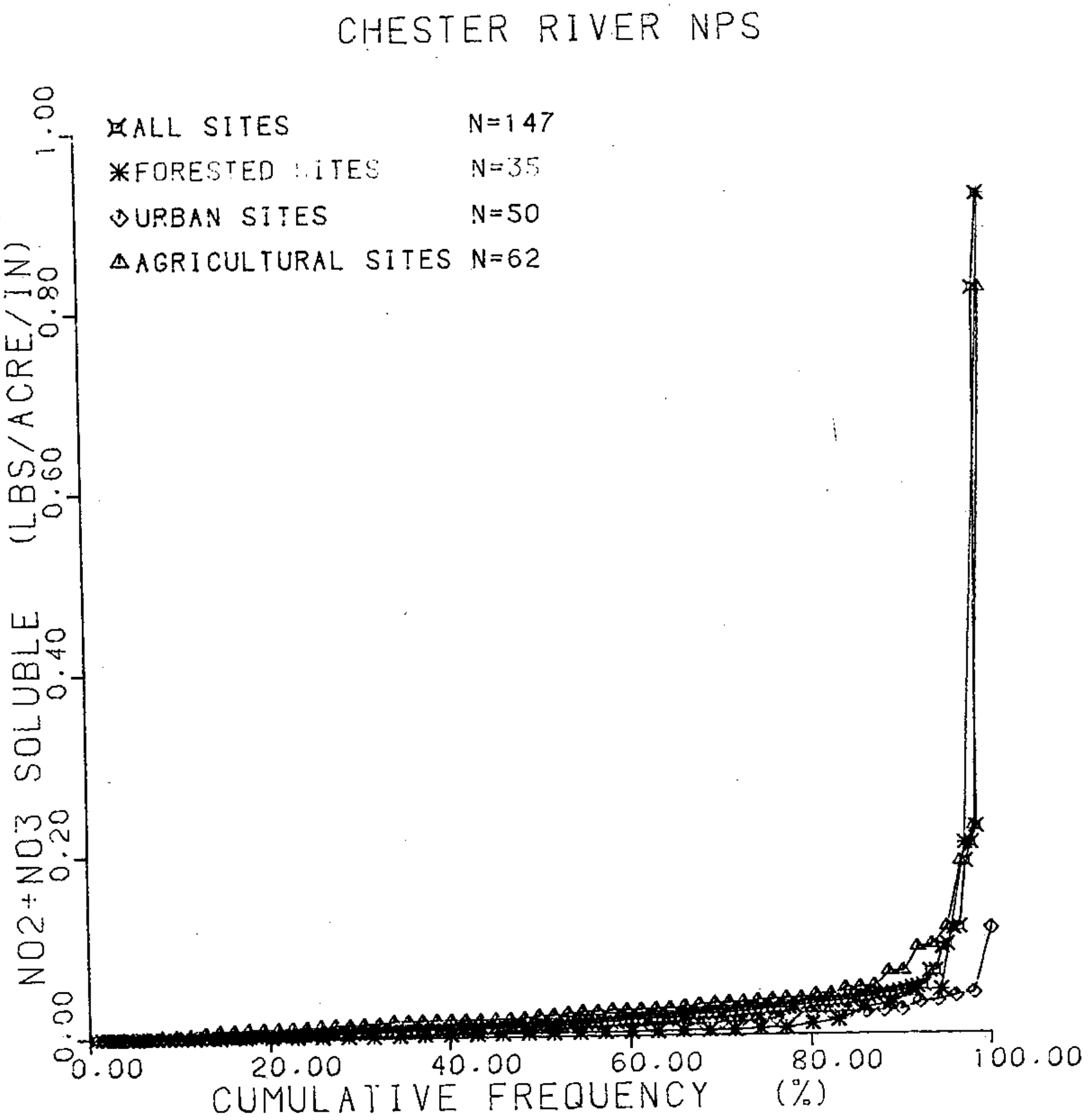


Figure 6-22 Chester River NPS Cumulative Frequency Distributions For NO2+NO3 (lbs/acre/in.).

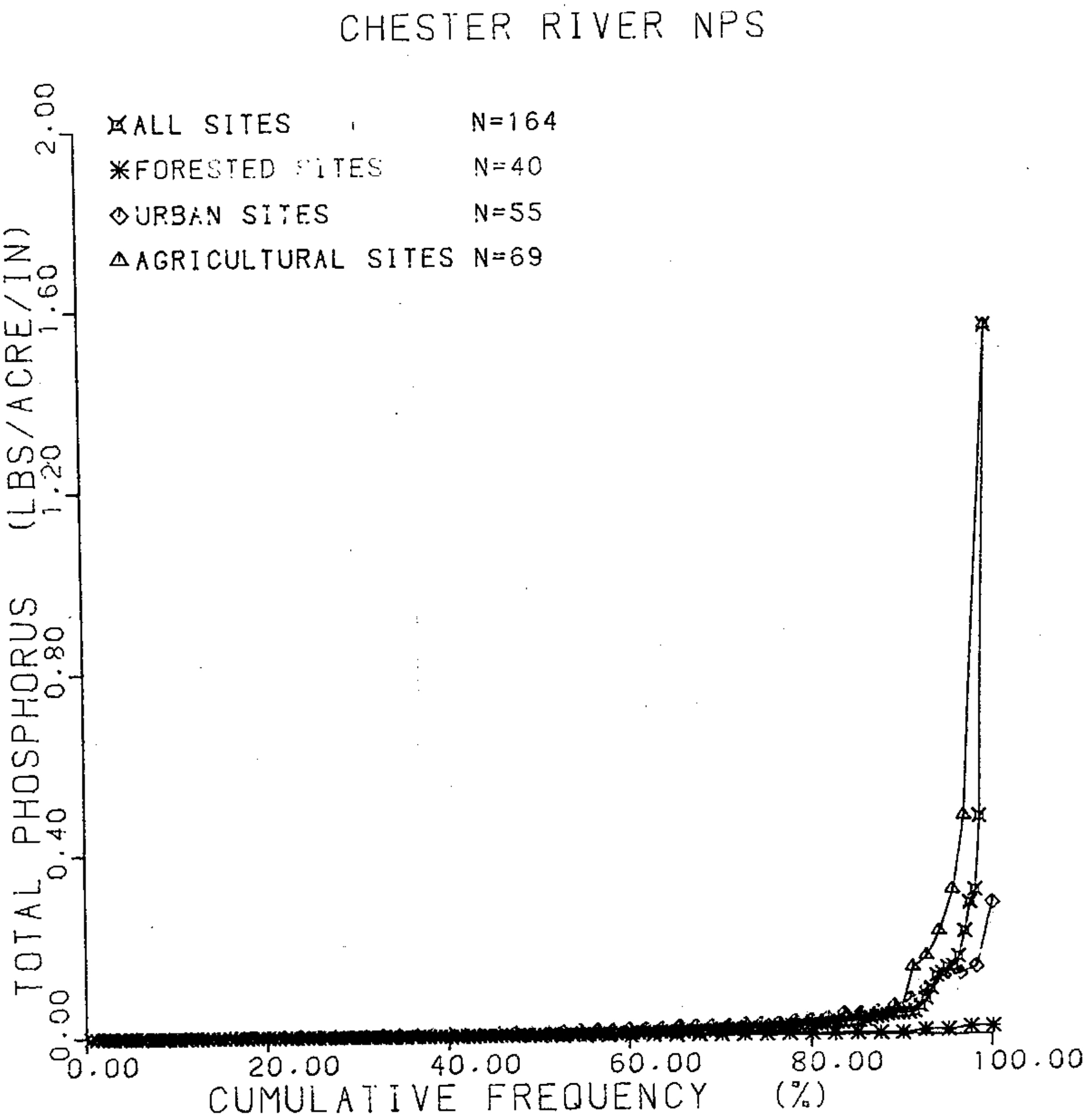


Figure 6-23 Chester River NPS Cumulative Frequency Distributions For Total Phosphorus (lbs/acre/in). Note: The largest storm event was not included in this plot. Removal of this storm allows the CFD difference to be visually observable.

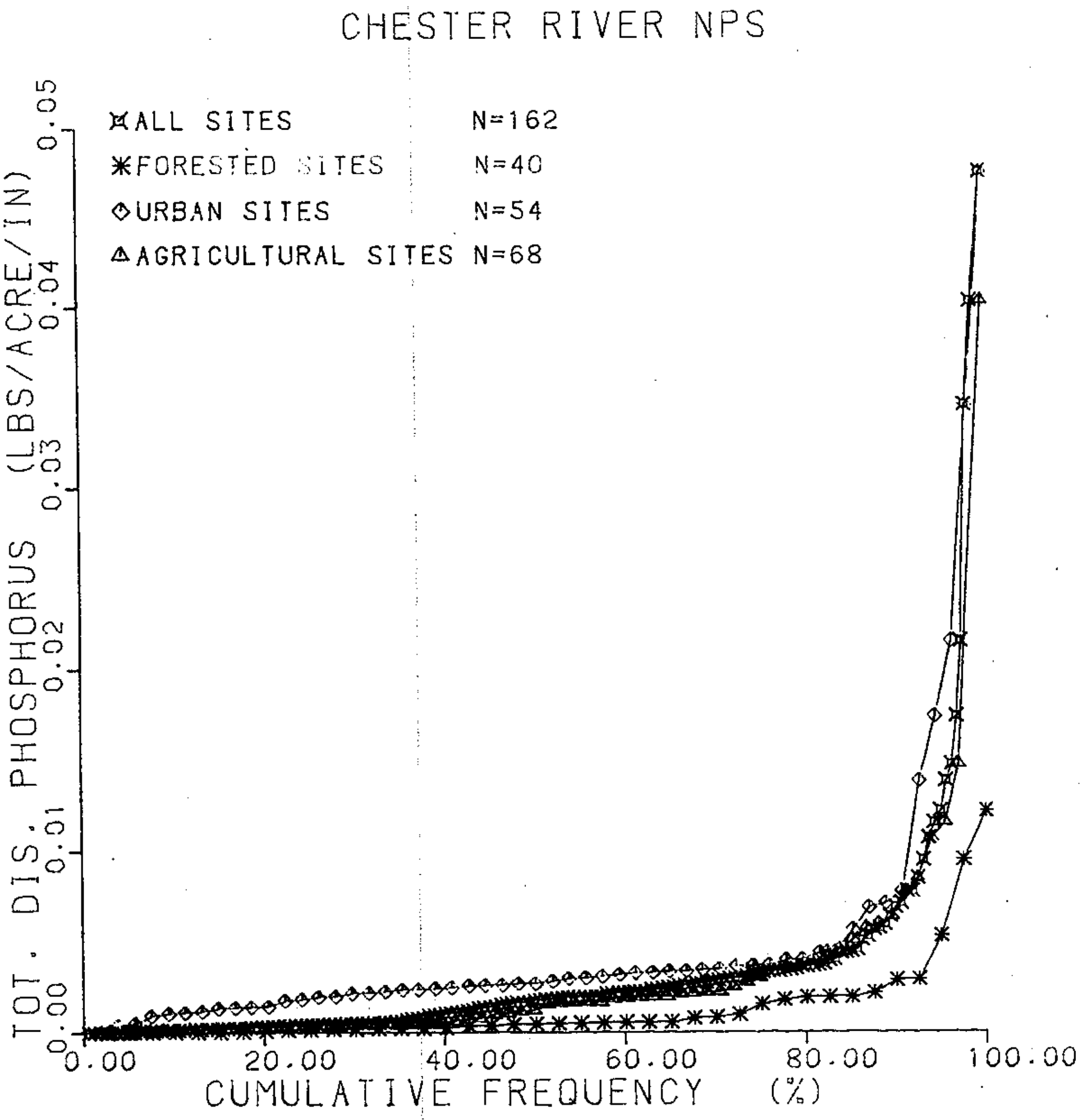


Figure 6-24 Chester River NPS Cumulative Frequency Distributions For Total Dissolved Phosphorus (lbs/acre/in). Note: The largest storm event was not included in this plot. Removal of this storm allows the CFD difference to be visually observable.

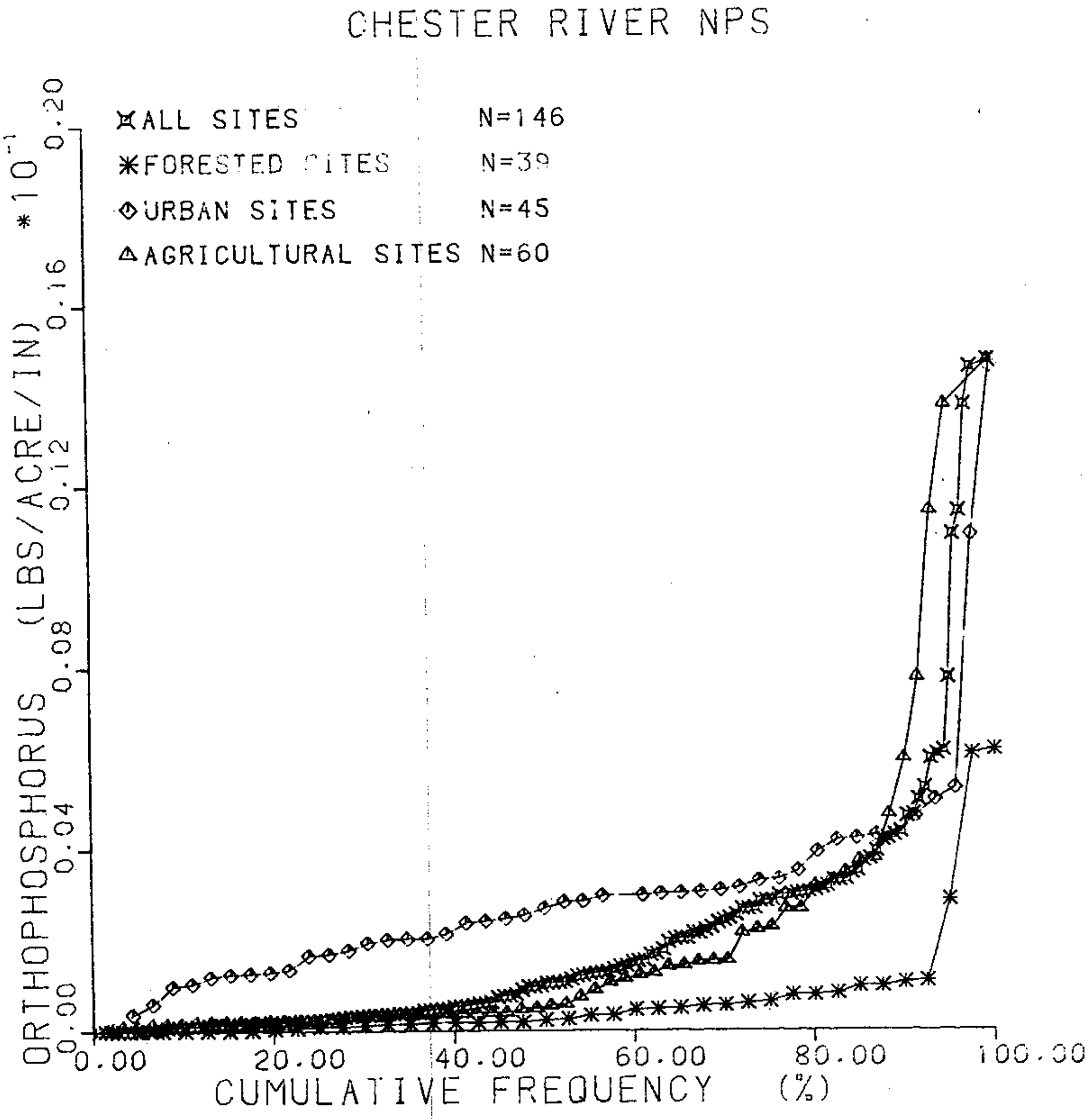


Figure 6-25 Chester River NPS Cumulative Frequency Distributions For Orthophosphorus (lbs/acre/in). Note: The largest storm event was not included in this plot. Removal of this storm allows the CFD difference to be visually observable.

Table 6-42
Chemical Export Functions For The Chester River NPS Watershed (lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
BOD5	$Y = (7.E{-}09)X + .17742$	117	.503	All
	$\ln Y = .7393\ (\ln x) - 12.791$	34	.609	All Forested
	$\ln Y = .55916\ (\ln x) - 7.6562$	33	.634	All Urban
	$Y = (8.E{-}09)X + .10531$	50	.851	All Agricultural
	$\ln Y = /92236\ (\ln X) - 15.922$	18	.689	Millington A
	$\ln Y = .73475\ (\ln X) - 12.056$	16	.787	Millington B
	$Y = (7.E{-}09)X + .13327$	20	.892	USGS Gage
	$\ln Y = .3731\ (\ln X) - 5.6538$	19	.450	Chestertown A
	$\ln Y = .65987\ (\ln X) - 8.6317$	14	.717	Chestertown B
	$Y = (4.E{-}08)X + .0275$	22	.809	S Farm
	$Y = (3.E{-}07)X + .02888$	8	.873	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (cont)
Chemical Export Functions For The Chester River NPS Watershed (lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient (r)	Site
BOD30	Y= (2.E-08)X + .41423	136	.449	All
	lnY= 1.0076 (lnX) - 15.527	40	.814	All Forested
	lnY= 60201 (lnX) - 7.3830	38	.696	All Urban
	lnY= .42606 (lnx) - 7.6677	58	.726	All Agricultural
	lnY= 1.162 (lnx) - 18.287	20	.892	Millington A
	lnY=.99085 (lnX) - 14.628	20	.882	Millington B
	Y= (2.E-08)X + .27601	22	.889	USGS Gage
	Y=(4.E-06)X + .24304	22	.658	Chestertown A
	lnY= .69769 (lnX) - 8.3359	16	.752	Chestertown B
	Y= (1.E-07)X + .02423	26	.891	S Farm
	lnY= .88069 (lnX) - 12.317	10	.855	Browntown Road
	--	--	--	--
	--	--	--	--

Table 6-42

Chemical Export Functions For The Chester River NPS Watershed (lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
TSS	$Y = (1.E-06)X + 6.1429$	157	.499	All
	$\ln Y = .88531 (\ln X) - 13.776$	40	.753	All Forested
	$\ln Y = 91565 (\ln X) - 8.83$	49	.617	All Urban
	$Y = (1.E-06)X + 9.7209$	68	.486	All Agricultural
	$\ln Y = 1.0744(\ln X) - 17.019$	20	.824	Millington A
	$\ln Y = .83699(\ln X) - 12.453$	20	.875	Millington B
	$Y = (2.E-06)X - 18.061$	24	.978	USGS Gage
	$\ln Y = .68419(\ln X) - 5.8967$	29	.583	Chestertown A
	$\ln Y = .00001X - 6.9075$	20	.664	Chestertown B
	$\ln Y=(1.E-06)X - 1.8473$	31	.838	S Farm
	$Y = .00021X - 19.110$	13	.960	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed
(lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
NO2	$Y = .001(\ln X0 - .0081$	16	.536	All
	$\ln Y = 1.6837(\ln X) - 28.547$	5	.960	All Forested
	$\ln Y = .47723(\ln X) - 12.541$	4	.567	All Urban
	$\ln Y = .46934(\ln X) - 14.58$	7	.931	All Agricultural
	$\ln Y = 1.5096(\ln X) - 27.298$	2	1.00	Millington A
	$\ln Y = .00003X - 11.702$	3	.999	Millington B
	$Y = -(1.E-11)X + .00135$	2	-1.00	USGS Gage
	$\ln Y = .46262(\ln X) - 12.422$	3	.579	Chestertown A
	--	--	--	Chestertown B
	$\ln Y = -(6.E-07)X - 6.9685$	3	-.552	S Farm
	$\ln Y = .4682 (\ln X) - 14.969$	2	1.00	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed
(lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation.	N	Correlation Coefficient(r)	Site
NO3	$Y = .00416(\ln X) - .03946$	16	.818	All
	$\ln Y = .9342(\ln X) - 18.885$	5	.718	All Forested
	$Y = -.00838(\ln X) + .11011$	4	-.773	All Urban
	$\ln Y = .33852(\ln X) - 8.9677$	7	.841	All Agricultural
	$\ln Y = 1.099(\ln X) - 21.498$	2	1.00	Millington A
	$\ln Y = .15179(\ln X) - 9.7986$	3	.478	Millington B
	$Y = -(3.E-10)X + .03614$	2	-1.00	USGS Gage
	$\ln Y = -(5.E-06)X - 3.6422$	3	-.998	Chestertown A
	--	--	--	Chestertown B
	$\ln Y = -(9.E-07)X - 2.5466$	3	-.792	S Farm
	$\ln Y = .43409(\ln X) - 1.0435$	2	1.00	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)

Chemical Export Functions For The Chester River NPS Watershed (lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable..	Selected Regression Equation	N	Correlation Coefficient(r)	Site
NO2NO3	$\ln Y = .23434(\ln X) - 7.6673$	147	.316	All
	$\ln Y = .6864(\ln X) - 15.083$	35	.399	All Forested
	$\ln Y = .64884(\ln X) - 11.748$	50	.674	All Urban
	$\ln Y = .19041(\ln X) - 6.6443$	62	.273	All Agricultural
	$\ln Y = 1.119(\ln X) - 22.191$	18	.721	Millington A
	$\ln Y = .69795(\ln X) - 14.047$	17	.471	Millington B
	$Y = .00418(\ln X) - .04009$	23	.185	USGS Gage
	$\ln Y = .48085(\ln X) - 9.9562$	28	.467	Chestertown A
	$\ln Y = .76698(\ln X) - 12.891$	22	.785	Chestertwon B
	$\ln Y - .27267(\ln X) - 7.5552$	28	.254	S Farm
	$\ln Y = 1.425(\ln X) - 21.233$	11	.801	Browntown Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed
(lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
NH3	$\ln Y = .30746(\ln X) - 9.4628$	163	.387	All
	$\ln Y = .9758(\ln X) - 19.595$	40	.747	All Forested
	$\ln Y = .42994(\ln X) - 9.8395$	54	.416	All Urban
	$\ln Y = .4874(\ln X) - 12.038$	69	.587	All Agricultural
	$\ln Y = 1.069(\ln X) - 21.701$	20	.844	Millington A
	$\ln Y = 1.0536(\ln X) - 19.758$	20	.851	Millington B
	$Y = .02189(\ln X) - .33088$	25	.614	USGS Gage
	$\ln Y = .45115(\ln X) - 10.259$	31	.463	Chestertown A
	$\ln Y = .49547(\ln X) - 10.288$	23	.448	Chestertown B
	$Y = (2.E{-}09)X + .00277$	31	.61	S Farm
	$\ln Y = (4.E{-}06)X - 7.0267$	13	.739	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed
(lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
TKN	$\ln Y = .2422(\ln X) - 7.0447$	164	.351	All
	$\ln Y = .93575\ (\ln X) - 17.314$	40	.806	All Forested
	$\ln Y = .52922\ (\ln X) - 9.188$	55	.060	All Urban
	$\ln Y = .42585(\ln X) - 9.8116$	69	.586	All Agricultural
	$\ln Y = 1.0901(\ln X) - 20.007$	20	.903	Millington A
	$\ln Y = .90575(\ln X) - 16.309$	20	.840	Millington B
	$Y = (3.E{-}09)X + .01334$	25	.931	USGS Gage
	$\ln Y = .40496(\ln X)\ 7.8973$	31	.455	Chestertown A
	$\ln Y = .63476(\ln X) - 10.178$	24	.695	Chestertown B
	$Y = (5.E{-}08)X - .02721$	31	.852	S Farm
	$\ln Y = 1.232(\ln X) - 18.021$	13	.883	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)

Chemical Export Functions For The Chester River NPS Watershed (lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
TKND	$\ln Y = .2606(\ln X) - 7.855$	163	.385	All
	$\ln Y = .9532(\ln X) - 17.871$	40	.765	All Forested
	$\ln Y = .37332(\ln X) - 8.2317$	54	.415	All Urban
	$\ln Y = .42964(\ln X) - 10.446$	69	.627	All Agricultural
	$\ln Y = 1.142(\ln X) - 21.134$	20	.867	Millington A
	$\ln Y = .90998(\ln X) - 16.59$	20	.824	Millington B
	$Y = (1.E-09)X + .01298$	25	.909	USGS Gage
	$\ln Y = .30729(\ln X) - 7.6446$	31	.383	Chestertown A
	$\ln Y = .4802(\ln X) - 9.1687$	23	.485	Chestertown B
	$Y=(6.E-09)X + .00442$	31	.759	S Farm
	$\ln Y = 1.2485(\ln X) - 19.294$	13	.793	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed
(lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
TPHOS	$Y = 2.E{-}08X - .01926$	164	.834	All
	$\ln Y = .9097(\ln X) - 19.299$	40	.768	All Forested
	$\ln Y = .66611(\ln X) - 11.723$	55	.55	All Urban
	$Y = (2.E{-}08)X - .06046$	69	.839	All Agricultural
	$\ln Y = 1.0507(\ln X) - 21.884$	20	.865	Millington A
	$\ln Y = .9073(\ln X) - 18.58$	20	.829	Millington B
	$Y = (2.E{-}08)X - .33042$	25	.938	USGS Gage
	$\ln Y = .64269(\ln X) - 11.447$	31	.474	Chestertown A
	$\ln Y = .67174(\ln X) - 11.802$	24	.571	Chestertown B
	$\ln Y = (8.E{-}07)X - 6.8848$	31	.866	S Farm
	$\ln Y = 1.1793(\ln X) - 17.886$	13	.706	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed
(lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
TPHOSD	$Y = 5.E{-}08X - .14641$	162	.890	All
	$\ln Y = 1.1004(\ln X) - 22.538$	40	.844	All Forested
	$\ln Y = .63464(\ln X) - 12.764$	54	.703	All Urban
	$Y = (6.E{-}08)X - .3312$	68	.900	All Agricultural
	$\ln Y = 1.301(\ln X) - 25.864$	20	.921	Millington A
	$\ln Y = 1.0265(\ln X) - 20.952$	20	.880	Millington B
	$Y = (6.E{-}08)X - 1.0424$	24	.935	USGS Gage
	$\ln Y = .5149(\ln X) - 11.473$	31	.589	Chestertown A
	$\ln Y = .73064(\ln X) - 13.728$	23	.768	Chestertwon B
	$Y = (7.E{-}10)X + .00024$	31	.865	S Farm
	$Y = (8.E{-}09)X + .00004$	13	.873	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed
(lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
DPO4	$\ln Y = (5.E{-}08)X - 7.3006$	147	.424	All
	$\ln Y = 1.0355(\ln X) - 22.26$	40	.807	All Forested
	$\ln Y = .60341(\ln X) - 12.696$	46	.782	All Urban
	$Y = (1.E{-}08)X - .04267$	61	.917	All Agricultural
	$\ln Y = 1.2447(\ln X) - 25.746$	20	.893	Millington A
	$\ln Y = .96193(\ln X) - 20.634$	20	.857	Millington B
	$Y = (1.E{-}08)X - .12005$	23	.932	USGS Gage
	$Y = (2.E{-}08)X + .00127$	27	.671	Chestertown A
	$\ln Y = .63348(\ln X) - 13.051$	19	.805	Chestertown B
	$Y = (7.E{-}10)X - .00005$	26	.896	S Farm
	$Y = (9.E{-}09)X - .00017$	12	.913	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed
(lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
TOC	$\ln Y = .14754(\ln X) - 3.4864$	163	.216	All
	$\ln Y = 1.0555(\ln X) - 16.019$	40	.848	All Forested
	$\ln Y = .54336(\ln X) - 6.8461$	55	.611	All Urban
	$\ln Y = .29781(\ln X) - 6.0796$	68	.431	All Agricultural
	$\ln Y = 1.2083(\ln X) - 18.715$	20	.929	Millington A
	$\ln Y = 1.0316(\ln X) - 15.071$	20	.891	Millington B
	$\ln Y = 1.105(\ln X) - 19.582$	24	.796	USGS Gage
	$\ln Y = .55483(\ln X) - 7.0278$	31	.570	Chestertown A
	$\ln Y = .56086(\ln X) - 6.9602$	24	.632	Chestertown B
	$Y = (1.E{-}07)X + .02599$	31	.871	S Farm
	$Y = (5.E{-}06)X - .22386$	13	.924	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)
Chemical Export Functions For The Chester River NPS Watershed (lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
COD	$\ln Y = .14503(\ln X) - 2.0825$	162	.216	All
	$\ln Y = 1.0466(\ln X) - 14.499$	40	.837	All Forested
	$\ln Y = .54257(\ln X) - 5.5251$	54	.582	All Urban
	$\ln Y = .26723(\ln X) - 4.2502$	68	.42	All Agricultural
	$\ln Y = 1.1754(\ln X) - 16.886$	20	.893	Millington A
	$\ln Y = 1.0498(\ln X) - 13.887$	20	.916	Millington B
	$\ln Y = .78236(\ln X) - 12.986$	24	.739	USGS Gage
	$\ln Y = .51764(\ln X) - 5.2557$	31	.518	Chestertown A
	$\ln Y = .56228(\ln X) - 5.7239$	23	.614	Chestertown B
	$Y = (1.E-06)X - .35389$	31	.87	S Farm
	$Y = .00001X + .21727$	13	.899	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-42 (continued)

Chemical Export Functions For The Chester River NPS Watershed (lbs./acre/in. of rain) versus (gallons of storm flow)

Dependent Variable	Selected Regression Equation	N	Correlation Coefficient(r)	Site
ALKIN	$\ln Y = .30729(\ln X) - 6.2005$	151	.353	All
	$\ln Y = 1.0497(\ln X) - 18.156$	37	.819	All Forested
	$\ln Y = .53855(\ln X) - 7.5104$	49	.487	All Urban
	$\ln Y = .49928(\ln X) - 8.629$	65	.754	All Agricultural
	$\ln Y = 1.1417(\ln X) - 20.096$	19	.888	Millington A
	$\ln Y = 1.0469(\ln X) - 17.374$	18	.891	Millington B
	$\ln Y = .35947(\ln X) - 6.576$	22	.433	USGS Gage
	$\ln Y = .3667(\ln X) - 5.4577$	29	.348	Chestertown A
	$\ln Y = .63187(\ln X) - 8.74$	20	.569	Chestertown B
	$\ln Y = .31774(\ln X) - 5.8353$	30	.489	S Farm
	$\ln Y = (3.E-06)X - 4.1636$	13	.838	Browntown Road
	--	--	--	H Farm
	--	--	--	Still Pond Road

Table 6-43
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
BOD5	TRF*AVINT	$Y = .32482X + .08702$	117	.506	All
	TRF*AVINT	$\ln Y = -1.1687X - 3.1970$	34	-.246	All Forested
	TRF	$\ln Y = 1.2780(\ln X) - 1.3080$	33	.613	All Urban
	TRF	$\ln Y = 1.2780(\ln X) - 1.3080$	33	.613	All Urban
	TRF*MINT	$\ln Y = .55293(\ln X) + .27516$	49	.644	All Agricultural
	TRF*MINT	$Y = -.00579(\ln X) + .02009$	18	-.252	Millington A
	TRF	$Y = .07353(\ln X) + .15854$	16	.564	Millington B
	TRF*AVINT	$Y = .98934X - .03088$	20	.85	USGS Gage
	TRF*MINT	$Y = 9.1079X + .10631$	19	.85	Chestertown A
	TRF	$Y = .55057(\ln X) + .60187$	14	.581	Chestertown B
	TRF*MINT	$Y = 8.4781X - .00614$	21	.897	S Farm
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

* TRF=total rainfall (inches); AVINT=average intensity; MINT=maximum intensity

Table 6-43 (cont)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
BOD30	TRF*AVINT	$Y = .74434(\ln X) + .21102$	136	.493	All
	TRF*MINT	$\ln Y = -41.570X - 2.2648$	40	-.407	All Forested
	TRF	$\ln Y = 1.2621(\ln X) - .54958$	38	.637	All Urban
	--	--	--	--	All Agricultural
	TRF*MINT	$\ln Y = -59.313X - 2.5085$	20	-.516	Millington A
	TRF*AVINT	$\ln Y = -2.1737X - 1.9205$	20	-.487	Millington B
	TRF*AVINT	$Y = 2.2463X + .07042$	22	.847	USGS Gage
	TRF	$\ln Y = 1.1482(\ln X) - .57443$	22	.771	Chestertwon A
	TRF	$\ln Y = 1.4780(\ln X) - .46713$	16	.542	Chestertown B
	TRF*AVINT	$Y = .99992X - .01407$	26	.881	S Farm
	TRF*MINT	$\ln Y = .38219(\ln X) - .05451$	10	.413	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

* TRF=total rainfall (inches); AVINT=average intensity; MINT=maximum intensity

Table 6-43

Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
TSS	TRF*AVINT	$Y = 66.308X - 1.6324$	157	.471	All
	TRF	$Y = .09780(\ln X) + .26003$	40	.247	All Forested
	TRF*MINT	$\ln Y = .60311(\ln X) + 2.9919$	49	.560	All Urban
	--	--	--	--	All Agricultural
	TRF*MINT	$Y = .48077X + .05528$	20	.685	Millington A
	TRF	$Y = .1406(\ln X) + .37268$	20	.281	Millington B
	TRF*AVINT	$Y = 250.36X - 29.164$	24	.958	USGS Gage
	TRF*MINT	$\ln Y = .57367(\ln X) + 4.257$	29	.645	Chestertown A
	TRF*MINT	$Y = 38.852X + 2.5099$	20	.617	Chestertown B
	TRF*AVINT	$Y = 169.92X - 17.861$	31	.884	S Farm
	TRF*MINT	$Y = 14.183(\ln X) - 110.63$	13	.233	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

*TRF=total rainfall (inches): AVINT=average intensity; MINT=maximum intensity

Table 6-43 (continued)

Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
NO2	TRF*MINT	$\ln Y = -52.154X - 7.4333$	16	-.529	All
	TRF*MINT	$Y = -.00199X + .00013$	5	-.607	All Forested
	TRF	$Y = .00072(\ln X) + .00101$	4	.693	All Urban
	--	--	--	--	All Agricultural
	TRF*MINT	$\ln Y = -51.599X - 10.119$	2	-1.00	Millington A
	TRF*MINT	$Y = -.00007(\ln X) - .00015$	3	-.998	Millington B
	TRF*MINT	$Y = .04711X + .00081$	2	1.00	USGS Gage
	TRF	$Y = .00075(\ln X) + .00009$	3	.692	Chestertown A
	--	--	--	--	Chestertown B
	TRF*AVINT	$Y = .00129X + .00047$	3	.973	S Farm
	TRF*MINT	$\ln Y = .70920(\ln X) - 5.9038$	2	1.00	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

*TRF=total rainfall (inches); AVINT=average intensity; MINT=maximum intensity

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
NO3	TRF*MINT	lnY = -47.573X - 4.6547	16	-.371	All
	TRF	Y = .00028(lnX) + .00024	5	.480	All Forested
	TRF*AVINT	lnY = .07227(lnX) + .00393	4	.954	All Urban
	TRF*MINT	lnY = .40491(lnX) - 1.9496	7	.468	All Agricultural
	TRF*MINT	lnY = -30.414X - 9.0989	2	-1.00	Millington A
	TRF	lnY = .69886X - 8.9690	3	.919	Millington B
	TRF*MINT	Y = 1.5035X + .02238	2	1.00	USGS Gage
	TRF*AVINT	lnY = 3.7518X - 4.7513	3	1.00	Chestertown A
	--	--	--	--	Chestertown B
	TRF*AVINT	Y = .03790X + .02861	3	.998	S Farm
	TRF*MINT	lnY = .68501(lnX) - 1.8699	2	1.00	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

*TRF=total rainfall (inches); AVINT=average intensity; MINT=maximum intensity

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
NO2NO3	TRF*MINT	lnY = .38793(lnX) - 2.9949	146	.361	All
	TRF*AVINT	Y = 0.00562(lnX) - .0059	35	-.236	All Forested
	TRF	lnY = 1.3452(lnX) - 4.5206	50	.636	All Urban
	TRF*MINT	lnY = .40544(lnX) - 2.1173	61	.440	All Agricultural
	TRF*MINT	Y = .00072(lnX) + .00622	18	.245	Millington A
	TRF*AVINT	Y =-.00923(lnX) - .00902	17	-.288	Millington B
	TRF*MINT	Y = .85377X + .0123	23	.655	USGS Gage
	TRF	lnY = 1.0675*lnX) - 4.5958	28	.556	Chestertown A
	TRF	lnY = 1.4928(lnX) - 4.4837	22	.658	Chestertown B
	TRF*MINT	Y = .76132X - .01222	27	.721	S Farm
	TRF*MINT	lnY = .64237(lnX) - 1.2886	11	.39	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

*TRF=total rainfall (inches); AVINT=average intensity; MINT=maximum intensity

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
NH3	TRF*MINT	$\ln Y = .35651(\ln X) - 3.9771$	162	.329	All
	TRF*MINT	$\ln Y = -26.254X - 6.9146$	40	-.223	All Forested
	TRF	$\ln Y = .99736(\ln X) - 5.1477$	54	.548	All Urban
	TRF*MINT	$\ln Y = .57522(\ln X) - 2.3072$	68	.502	All Agricultural
	TRF*MINT	$\ln Y = -44.671X - 7.3226$	20	-.375	Millington A
	TRF*MINT	$Y = .00113(\ln X) + .01126$	20	.294	Millington B
	TRF*MINT	$Y = 2.4306X + .00305$	25	.794	USGS Gage
	TRF	$Y = .00900X - .00095$	31	.709	Chestertown A
	TRF	$\ln Y = .86221(\ln X) - 5.1440$	23	.459	Chestertown B
	TRF*MINT	$Y = .47793X + .00024$	30	.935	S Farm
	TRF	$\ln Y = -1.2164X - 4.5624$	13	-.274	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

*TRF=total rainfall (inches); AVINT=average intensity; MINT=maximum intensity

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
TKN	TRF*AVINT	$Y = .14911X + .01658$	164	.475	All
	TRF	$Y = .00665(\ln X) + .01647$	40	.243	All Forested
	TRF	$\ln Y = .95321(\ln X) - 3.4724$	55	.566	All Urban
	TRF*MINT	$\ln Y = .77059(\ln X) + .09838$	68	.689	All Agricultural
	TRF*MINT	$Y = .00177(\ln X) + .01206$	20	.34	Millington A
	TRF	$Y = .01086(\ln X) + .02522$	20	.306	Millington B
	TRF*AVINT	$Y = .39116X - .00853$	25	.861	USGS Gage
	TRF	$\ln Y = .98723(\ln X) - 3.3966$	31	.600	Chestertown A
	TRF	$\ln Y = .87843(\ln X) - 3.6166$	24	.497	Chestertown B
	TRF*AVINT	$Y = .44121X - .03602$	31	.886	S Farm
	TRF*MINT	$\ln Y = .58639(\ln X) - .74750$	13	.466	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

*TRF=total rainfall (inches); AVINT=average intensity; MINT=maximum intensity

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
TKND	TRF*AVINT	$Y = .04723X + .01171$	163	.397	All
	TRF	$Y = .00418(\ln X) + .01121$	40	.232	All Forested
	TRF	$\ln Y = .83937(\ln X) - 4.2595$	54	.538	All Urban
	TRF*MINT	$\ln Y = .58876(\ln X) - 1.4640$	68	.585	All Agricultural
	TRF*MINT	$Y = .01015X + .00328$	20	.436	Millington A
	TRF	$Y = .00712(\ln X) + .01734$	20	.307	Millington B
	TRF*AVINT	$Y = .18199X - .00085$	25	.878	USGS Gage
	TRF	$Y = .01557X + .00167$	31	.678	Chestertown A
	TRF	$\ln Y = .73035(\ln X) - 4.3041$	23	.444	Chestertown B
	TRF*MINT	$Y = 1.0467X + .00084$	30	.854	S Farm
	TRF*MINT	$\ln Y = .36728(\ln X) - 2.9041$	13	.269	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
TPHOS	TRF*MINT	$\ln Y = .54705(\ln X) - 2.8029$	163	.418	All
	TRF*MINT	$\ln Y = -24.738X - 7.5102$	40	-.231	All Forested
	TRF	$\ln Y = .93773(\ln X) - 4.5309$	55	.438	All Urban
	TRF*MINT	$\ln Y = 78.396X - 6.39$	68	.679	All Agricultural
	TRF	$\ln Y = -.74424X - 7.5668$	20	-.299	Millington A
	TRF*AVINT	$\ln Y = -1.6159X - 7.0593$	20	-.335	Millington B
	TRF*AVINT	$Y = 2.6952X - .43269$	25	.799	USGS Gage
	TRF	$\ln Y = .92743(\ln X) - 4.3277$	31	.42	Chestertown A
	TRF*MINT	$Y = .11249X + .0079$	24	.724	Chestertown B
	TRF*AVINT	$Y = .37644X - .03676$	31	.880	S Farm
	TRF*MINT	$\ln Y = .72206(\ln X) - .57238$	13	.471	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
TPHOSD	TRF*MINT	$\ln Y = .42605(\ln X) - 4.7839$	161	.373	All
	TRF*MINT	$\ln Y = -32.108X - 8.1453$	40	-.278	All Forested
	TRF	$\ln Y = 1.2361(\ln X) - 5.6838$	54	.687	All Urban
	TRF*MINT	$\ln Y = .7332(\ln X) - 2.0013$	67	.578	All Agricultural
	TRF	$\ln Y = -.91417X - 8.0297$	20	-.310	Millington A
	TRF*AVINT	$\ln Y = -2.1622X - 7.7822$	20	-.447	Millington B
	TRF*AVINT	$Y = 7.9562X - 1.2513$	24	.796	USGS Gage
	TRF	$\ln Y = 1.2428(\ln X) - 5,6312$	31	.699	Chestertown A
	TRF*MINT	$Y = .06601X + .00170$	23	.92	Chestertown B
	TRF	$\ln Y = 2.0321X - 9.5014$	31	.845	S Farm
	TRF*MINT	$\ln Y = .36931(\ln X) - 5.3559$	13	.384	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
DP04	TRF*AVINT	$Y = .26883X - .02846$	147	.346	All
	TRF	$\ln Y = -.76019X - 8.4239$	40	-.311	All Forested
	TRF	$\ln Y = 1.4252(\ln X) - 5.8249$	46	.776	All Urban
	TRF*MINT	$\ln Y = 65.219X - 8.0929$	60	.582	All Agricultural
	TRF	$\ln Y = -.98877X - 8.6070$	20	-.345	Millington A
	TRF*AVINT	$\ln Y = -2.2521X - 8.2899$	20	-.524	Millington B
	TRF*AVINT	$Y = 1.2554\ X - .17820$	23	.788	USGS Gage
	TRF	$\ln Y = 1.2204(\ln X) - 5.7927$	27	.793	Chestertown A
	TRF	$\ln Y = 1.4848(\ln X) - 5.9524$	19	.755	Chestertown B
	TRF	$\ln Y = 2.0253X - 9.9210$	26	.889	S Farm
	TRF*MINT	$\ln Y = .36999(\ln X) - 5.5318$	12	.353	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
TOC	TRF	$\ln Y = .81400(\ln X) - 1.6840$	163	.392	All
	TRF*AVINT	$\ln Y = 1.5220X - 2.3154$	40	-.244	All Forested
	TRF	$\ln Y = 1.0308(\ln X) - .92695$	55	.589	All Urban
	TRF*MINT	$\ln Y = .75229(\ln X) + 1.9130$	67	.705	All Agricultural
	TRF*MINT	$\ln Y = -45.390X - 2.4523$	20	-.348	Millington A
	TRF*AVINT	$\ln Y = -1.6980X - 1.9146$	20	-.315	Millington B
	TRF*MINT	$\ln Y = .73(\ln X) + 2.1065$	24	.740	USGS Gage
	TRF	$\ln Y - 1.2476(\ln X) - .73985$	31	.660	Chestertown A
	TRF	$\ln Y - .8075(\ln X) - 1.2386$	24	.478	Chestertown B
	TRF	$\ln Y = 2.4180X - 4.8946$	31	.879	S Farm
	TRF*Mint	$\ln Y = .50911(\ln X) + 1.0857$	13	.450	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
COD	TRF	$\ln Y = .68813(\ln X) - .36859$	162	.353	All
	TRF*MINT	$\ln Y = -43.294X - .70264$	40	-.409	All Forested
	TRF	$\ln Y = 1.1815(\ln X) + .51447$	54	.656	AllUUrban
	TRF*MINT	$\ln Y = .66020(\ln X) + 2.7815$	67	.665	All Agricultural
	TRF*MINT	$\ln Y = -65.336X - .86765$	20	-.556	Millington A
	TRF*MINT	$\ln Y = -30.095X - .45925$	20	-.327	Millington B
	TRF	$\ln Y = 1.6003X - 1.9374$	24	.747	USGS Gage
	TRF	$\ln Y = 1.1189(\ln X) + .55934$	31	.605	Chestertown A
	TRF*MINT	$\ln Y = .53648(\ln X) + 2.6997$	23	.650	Chestertown B
	TRF*AVINT	$Y = 9.1724X - .50494$	31	.879	S Farm
	TRF*MINT	$\ln Y = .54214(\ln X) + 2.4268$	13	.471	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

Table 6-43 (continued)
Chemical Export Functions For The Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
ALKIN	TRF	$Y = .15600X + .06048$	151	.339	All
	TRF	$\ln Y = -.81855X - 3.9497$	37	-.337	All Forested
	TRF	$Y = .16034X + .07457$	49	.435	All Urban
	TRF	$\ln Y = .28495(\ln X) + .03426$	65	.484	All Agricultural
	TRF*MINT	$Y = .0201X + .00826$	19	.425	Millington A
	TRF*AVINT	$\ln Y = -2.3484X - 3.6539$	18	-.535	Millington B
	TRF*MINT	$Y = 32.704X + .18220$	22	.776	USGS Gage
	TRF	$Y = .15089(\ln X) + .28884$	29	.572	Chestertown A
	TRF	$\ln Y = 1.1224X - 3.3386$	20	.345	Chestertown B
	TRF	$\ln Y = 1.3079X - 3.0695$	30	.817	S Farm
	TRF*MINT	$\ln Y = .43489(\ln X) - 1.2022$	13	.379	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road

Table 6-44 Chemical Export Functions for the Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable*	Selected Regression Equation	N	Correlation Coefficient	Site
BOD5	GAL.	$Y = (2.E{-}08)X + .09708$	128	.837	All
	GAL.	$\ln Y = .82643 (\ln X) - 14.637$	41	.806	All Forested
	GAL.	$\ln Y - .00001X - 2.9899$	33	.806	All Urban
	GAL./IN.	$Y = .00014X - .07295$	54	.956	All Agricultural
	GAL.	$\ln Y = .79753 (\ln X) - 14.756$	18	.854	Millington A
	GAL.	$Y = (8.E{-}08)X - .00968$	23	.923	Millington B
	GAL.	$Y = (2.E{-}08)X - .03652$	21	.985	USGS Gage
	GAL.	$Y = (2.E{-}06)X - .00461$	19	.82	Chestertown A
	GAL.	$\ln Y = .00001X - 3.0555$	14	.811	Chestertown B
	GAL.	$Y = (1.E{-}07)X - .03964$	22	.988	S Farm
	GAL.	$\ln Y = .85585 (\ln X) - 13.412$	8	.967	Browntown Road
	--	--	--	--	H Farm
	GAL.	$\ln Y = .58425 (\ln X) - 8.7143$	2	1.00	Still Pond Road
BOD30	GAL.	$Y = (4.E{-}08)X + .23716$	150	.809	All
	GAL.	$\ln Y = .87713 (\ln X) - 14.285$	48	.876	All Forested
	GAL.	$\ln Y = .93497 (\ln X) - 11.498$	38	.846	All Urban
	GAL./IN.	$Y = .00033X - .16481$	64	.972	All Agricultural
	GAL.	$\ln Y = .94859 (\ln X) - 15.878$	21	.958	Millington A
	GAL.	$Y = (2.E{-}07)X - .00195$	27	.98	Millington B
	GAL.	$Y = (4.E{-}08)X - .11451$	23	.987	USGS Gage
	GAL.	$Y = (6.E{-}06)X - .09446$	22	.897	Chestertown A
	GAL.	$\ln Y = .91069 (\ln X) - 11.138$	16	.842	Chestertown B
	GAL.	$Y = (3.E{-}07)X - .15588$	27	.975	S Farm
	GAL.	$Y = (7.E{-}07)X + .02923$	10	.986	Browntown Road
	--	--	--	--	H Farm
	GAL.	$\ln Y = .70504 (\ln X) - 9.0346$	3	.999	Still Pond Road

*GAL. = Total volume of storm (gallons).
**GAL./ACRE = Total volume of storm/acres of watershed.
***GAL./ACRE/IN. = Total volume of storm/acres of watershed/total rainfall of storm (inches).

Table 6-44 (cont) Chemical Export Functions for the Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
TSS	GAL.	$Y = (3.E-06)X + 1.7443$	174	.705	All
	GAL.	$\ln Y = .77832 (\ln X) - 12.791$	48	.696	All Forested
	GAL.	$\ln Y = 1.3581 (\ln X) - 14.273$	49	.786	All Urban
	GAL./IN.	$Y = .02770X - 27.646$	77	.855	All Agricultural
	GAL.	$\ln Y = .88724 (\ln X) - 15.009$	21	.763	Millington A
	GAL.	$\ln Y = .7626 (\ln X) - 11.995$	27	.811	Millington B
	GAL.	$Y = (3.E-06)X - 46.801$	25	.966	USGS Gage
	GAL.	$\ln Y = 1.2441 (\ln X) - 12.575$	29	.836	Chestertown A
	GAL.	$Y = .00007X - 2.3247$	20	.907	Chestertown B
	GAL.	$\ln Y = 2.2945 (\ln X) - 32.1$	33	.906	S Farm
	GAL.	$Y = .00017X - 19.562$	13	.903	Browntown Road
	--	--	--	--	H Farm
	GAL.	$Y = .00039X - 2.8303$	4	.999	Still Pond Road
NO2	GAL./ACRE/IN.	$\ln Y = .88933 (\ln X0 - 13.748$	16	.971	All
	GAL./ACRE/IN.	$Y = (3.E-07)X + .00002$	5	.973	All Forested
	GAL.	$\ln Y = (1.E-05)X - 8.0829$	4	.997	All Urban
	GAL./IN.	$Y = (4.E-07)X + 0.0$	9	1.00	All Agricultural
	GAL.	$\ln Y = 1.0 (\ln X) - 21.763$	3	1.00	Millington A
	GAL.	$Y = (2.E-09)X + (2.E-1)$	3	1.00	Millington B
	GAL.	$Y = (5.E-11)X - (1.E-10)$	2	1.00	USGS Gage
	GAL.	$Y = (9.E-09)X + (1.E-10)$	3	1.00	Chestertown A
	--	--	--	--	Chestertown B
	GAL.	$Y = (5.E-10)X - 0.0$	4	1.00	S Farm
	GAL.	$Y = (1.E-09)X - (7.E-12)$	2	1.00	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road
NO3	GAL.	$Y = .00583 (\ln X) - .05675$	19	.836	All
	GAL./ACRE/IN.	$\ln Y = .35762 (\ln X) - 9.9911$	5	.499	All Forested
	GAL./IN.	$Y = .01225 (\ln X) + .15564$	4	-.761	All Urban
	GAL./IN.	$Y = .00001X + .00859$	9	.908	All Agricultural
	GAL.	$\ln Y = .56321 (\ln X) - 15.713$	3	.999	Millington A

Table 6-44

Chemical Export Functions for the Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
NO3 (cont.)	GAL./ACRE/IN.	$\ln Y = .0017X - 7.2060$	3	-.869	Millington B
	GAL.	$Y = (2.E{-}09)X - .00347$	2	1.00	USGS Gage
	GAL./ACRE/IN.	$\ln Y = -.00025X - 3.5588$	3	-.860	Chestertown A
	--	--	--	--	Chestertown B
	GAL.	$Y = (2.E{-}08)X - .01233$	4	.990	S Farm
	GAL.	$Y = (7.E{-}08)X + .00014$	2	1.00	Browntown Road
	--	--	--	--	H Farm
	--	--	--	--	Still Pond Road
NO2NO3	GAL.	$\ln Y = .32947 (\ln X) - 9.4435$	162	.423	All
	GAL./ACRE/IN.	$Y = (3.E{-}06)X - .00603$	35	.613	All Forested
	GAL.	$\ln Y = 1.0722 (\ln X) - 16.982$	50	.879	All Urban
	GAL./IN.	$\ln Y = .83624 (\ln X) - 10.092$	70	.702	All Agricultural
	GAL.	$\ln Y = (8.E{-}07)X - 8.4923$	18	.798	Millington A
	GAL./ACRE/IN.	$Y = (3.E{-}06)X - .00733$	17	.615	Millington B
	GAL.	$Y = .01655 (\ln X) - .24596$	24	.671	USGS Gage
	GAL.	$\ln Y = .99612 (\ln X) - 16.185$	28	.806	Chestertown A
	GAL.	$\ln Y = 1.1324 (\ln X) - 17.55$	22	.908	Chestertown B
	GAL.	$Y = .01642 (\ln X) - .19971$	29	.727	S Farm
	GAL./ACRE/IN.	$Y = .05244 (\ln X) - .27597$	11	.905	Browntown Road
	GAL.	$\ln Y = .66150 (\ln X) - 10.354$	3	.885	H Farm
	GAL.	$Y = .00326 (\ln X) - .02534$	3	.999	Still Pond Road
NH3	GAL.	$\ln Y = .40625 (\ln X) - 11.232$	181	.496	All
	GAL.	$\ln Y = .84525 (\ln X) - 18.332$	48	.729	All Forested
	GAL.	$\ln Y = .91878 (\ln X) - 15.818$	54	.744	All Urban
	GAL./IN.	$\ln Y = 1.2009 (\ln X) - 13.761$	79	.771	All Agricultural
	GAL.	$\ln Y = .87805 (\ln X) - 19.634$	21	.839	Millington A
	GAL.	$\ln Y = .90832 (\ln X) - 18.491$	27	.829	Millington B
	GAL.	$Y = (1.E{-}09)X + .00831$	26	.785	USGS Gage
	GAL.	$\ln Y = .99165 (\ln X) - 16.732$	31	.762	Chestertown A
	GAL.	$\ln Y = .91574 (\ln X) - 15.647$	23	.738	Chestertown B
	GAL.	$\ln Y = 1.1293 (\ln X) - 21.444$	33	.804	S Farm

Table 6-44 (continued)
Chemical Export Functions for the Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
NH3 (cont.)	GAL.	Y = (2.E-07)X - .01221	13	.905	Browntown Road
	GAL.	lnY = .00006X - 7.4951	3	.998	H Farm
	GAL.	lnY = 1.1704 (lnX) - 18.743	4	.936	Still Pond Road
TKN	GAL.	Y = (6.E-09)X + .02538	182	.667	All
	GAL.	lnY = .81652 (lnX) - 16.158	48	.753	All Forested
	GAL.	lnY = .95525 (lnX) - 14.459	55	.902	All Urban
	GAL./IN.	Y = .00006X - .03460	79	.844	All Agricultural
	GAL.	lnY = .8957 (lnX) - 17.888	21	.847	Millington A
	GAL.	Y = (2.E-08)X - .00419	27	.851	Millington B
	GAL.	Y = (7.E-09)X - .0519	26	.986	USGS Gage
	GAL.	lnY = .94546 (lnX) - 14.37	31	.85	Chestertown A
	GAL.	lnY = .96925 (lnX) - 14.580	24	.924	Chestertown B
	GAL.	lnY = 1.6510 (lnX) - 27.257	33	.899	S Farm
	GAL.	Y = (5.E-07)X - .03112	13	.965	Browntown Road
	GAL.	lnY = .86091 (lnX) - 12.139	3	.999	H Farm
	GAL.	Y = (6.E-07)X + .00112	4	.997	Still Pond Road
TKND	GAL.	Y = (3.E-09)X + .01112	181	.798	All
	GAL.	lnY = .85959 (lnX) - 17.094	48	.749	All Forested
	GAL.	lnY = .86215 (lnX) - 14.211	54	.814	All Urban
	GAL./IN.	lnY = 1.1340 (lnX) - 12.490	79	.833	All Agricultural
	GAL.	lnY = .97133 (lnX) - 19.375	21	.833	Millington A
	GAL.	Y = (2.E-08)X - .00260	27	.875	Millington B
	GAL.	Y = (3.E-09)X - .01882	26	.981	USGS Gage
	GAL.	lnY = .84779 (lnX) - 14.118	31	.792	Chestertown A
	GAL.	Y = (2.E-07)X - .00103	23	.865	Chestertown B
	GAL.	Y = (1.E-08)X - .00488	33	.956	S Farm
	GAL./ACRE/IN.	lnY = 1.3352 (lnX) - 13.036	13	.905	Browntown Road
	GAL.	lnY = .76867 (lnX) - 11.622	3	.991	H Farm
	GAL.	lnY = .92564 (lnX) - 14.521	4	.973	Still Pond Road
TPHOS	GAL.	Y = (4.E-08)X - .08619	182	.881	All

Table 6-44 (continued)

Chemical Export Functions for the Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
TPHOS (cont.)	GAL.	$\ln Y = .83792 (\ln X) - 18.757$	48	.737	All Forested
	GAL.	$\ln Y = 1.0921 (\ln X) - 16.994$	55	.811	All Urban
	GAL.	$Y = (4.E\text{-}08)X - .18915$	79	.888	All Agricultural
	GAL.	$\ln Y = .84900 (\ln X) - 19.653$	21	.837	Millington A
	GAL.	$\ln Y = .90799 (\ln X) - 19.097$	27	.805	Millington B
	GAL.	$Y = (6.E\text{-}08)X - .7866$	26	.936	USGS Gage
	GAL.	$\ln Y = 2.0145 (\ln X) - 20.364$	31	.828	Chestertown A
	GAL.	$Y = (2.E\text{-}07)X - .00049$	24	.821	Chestertown B
	GAL.	$\ln Y = 1.9535 (\ln X) - 32.728$	33	.93	S Farm
	GAL.	$\ln Y = 1.274 (\ln X) - 19.243$	13	.76	Browntown Road
	GAL.	$\ln Y = .79858 (\ln X) - 11.479$	3	.985	H Farm
	GAL.	$Y = (8.E\text{-}07)X - .00974$	4	.997	Still Pond Road
TPHOSD	GAL.	$Y = (1.E\text{-}07)X - .31807$	180	.883	All
	GAL.	$\ln Y = .96700 (\ln X) - 21.202$	48	.845	All Forested
	GAL.	$\ln Y = 1.1235 (\ln X) - 18.742$	54	.919	All Urban
	GAL.	$Y = (1.E\text{-}07)X - .67978$	78	.892	All Agricultural
	GAL.	$\ln Y = 1.0989 (\ln X) - 23.627$	21	.913	Millington A
	GAL.	$\ln Y = .91999 (\ln X) - 20.075$	27	.909	Millington B
	GAL.	$Y = (1.E\text{-}07)X - 2.4199$	25	.934	USGS Gage
	GAL.	$\ln Y = 1.0554 (\ln X) - 17.946$	31	.878	Chestertown A
	GAL.	$\ln Y = 1.1509 (\ln X) - 19.087$	23	.938	Chestertown B
	GAL.	$Y = (2.E\text{-}09)X - .00066$	33	.979	S Farm
	GAL.	$Y = (6.E\text{-}09)X + .00008$	13	.948	Browntown Road
	GAL.	$Y = .00288 (\ln X) - .01566$	3	.390	H Farm
	GAL.	$Y = (4.E\text{-}08)X + .00091$	4	.992	Still Pond Road
DPO4	GAL.	$Y = (2.E\text{-}08)X - .04716$	163	.916	All
	GAL.	$\ln Y = .91363 (\ln X) - 21.089$	48	.834	All Forested
	GAL.	$\ln Y = 1.0785 (\ln X) - 18.471$	46	.939	All Urban
	GAL.	$Y = (2.E\text{-}08)X - .10009$	69	.922	All Agricultural
	GAL.	$\ln Y = 1.0459 (\ln X) - 23.56$	21	.891	Millington A
	GAL.	$Y = (3.E\text{-}10)X + .00005$	27	.95	Millington B

Table 6-44 (continued)
Chemical Export Functions for the Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
DP04 (cont.)	GAL.	Y = (2.E-08)X - .31378	24	.947	USGS Gage
	GAL.	lnY = 1.0712 (lnX) - 18.36	27	.893	Chestertown A
	GAL.	Y = (3.E-08)X - .00048	19	.975	Chestertown B
	GAL.	Y = (2.E-09)X - .00085	28	.981	S Farm
	GAL.	Y = (7.E-09)X - .00017	12	.95	Browntown Road
	GAL.	Y = -.00015 (lnX) + .00258	2	-1.00	H Farm
	GAL.	lnY = .92707 (lnX) - 15.729	3	.991	Still Pond Road
TOC	GAL./ACRE/IN.	lnY = .68031 (lnX) - 7.1059	163	.543	All
	GAL.	lnY = .95186 (lnX) - 15.052	48	.798	All Forested
	GAL.	lnY = .96939 (lnX) - 12.117	55	.881	All Urban
	GAL./IN.	lnY = 1.1424 (lnX) - 9.9884	78	.775	All Agricultural
	GAL.	lnY = .99621 (lnX) - 16.326	21	.888	Millington A
	GAL.	Y = (5.E-07)X - .13926	27	.855	Millington B
	GAL.	lnY = 1.6763 (lnX) - 29.205	25	-.920	USGS Gage
	GAL.	lnY = 1.0953 (lnX) - 13.501	31	.857	Chestertown A
	GAL.	lnY = .89534 (lnX) - 11.362	24	.894	Chestertown B
	GAL.	Y = (3.E-07)X - .10696	33	.972	S Farm
	GAL.	lnY = 1.911 (lnX) - 15.553	13	.963	Browntown Road
	GAL.	Y = .00001X + .01112	3	1.00	H Farm
	GAL.	lnY = .95413 (lnX) - 11.596	4	.998	Still Pond Road
COD	GAL./ACRE/IN.	lnY = .70357 (lnX) - 5.9116	162	.59	All
	GAL.	lnY = .94206 (lnX) - 13.526	48	.863	All Forested
	GAL.	lnY = 1.0314 (lnX) - 11.504	54	.843	All Urban
	GAL./IN.	lnY = 1.1003 (lnX) - 8.3537	78	.796	All Agricultural
	GAL.	lnY = .97679 (lnX) - 14.704	21	.950	Millington A
	GAL.	Y = (1.E-06)X - .05985	27	.910	Millington B
	GAL.	lnY - 1.3492 (lnX) - 22.538	25	.937	USGS Gage
	GAL.	lnY = 1.0581 (lnX) - 11.729	31	.845	Chestertown A
	GAL.	lnY = .98255 (lnX) - 11.083	23	.826	Chestertown B
	GAL.	Y = (2.E-06)X - 1.4884	33	.891	S Farm
	GAL.	lnY = 1.1516 (lnX) - 13.905	13	.916	Browntown Road

Table 6-44 (continued)
Chemical Export Functions for the Chester River NPS Watershed

Dependent Variable (lbs/acre)	Independent Variable	Selected Regression Equation	N	Correlation Coefficient	Site
COD (cont.)	GAL.	$\ln Y = .00006X - 3.6309$	3	.998	H Farm
	GAL.	$\ln Y = 1.0897 (\ln X) - 11.801$	4	.995	Still Pond Road
ALKIN	GAL.	$Y = (2.E-08)X + .12748$	168	.621	All
	GAL.	$\ln Y = .90707 (\ln X) - 16.621$	45	.847	All Forested
	GAL.	$\ln Y = .98102 (\ln X) - 12.953$	49	.812	All Urban
	GAL./IN.	$Y = .00014X + .04887$	74	.973	All Agricultural
	GAL.	$\ln Y = .96145 (\ln X) - 18.115$	20	.921	Millington A
	GAL.	$Y = (3.E-08)X + .00018$	25	1.00	Millington B
	GAL.	$Y = (2.E-08)X + .06117$	23	.96	USGS Gage
	GAL.	$Y = (2.E-06)X + .0521$	29	.769	Chestertown A
	GAL.	$\ln Y = .96204 (\ln X) - 13.062$	20	.869	Chestertown B
	GAL.	$Y = (2.E-07)X + .00931$	32	.985	S Farm
	GAL.	$Y = (6.E-07)X - .04893$	13	.942	Browntown Road
	GAL.	$\ln Y = -7.0354 (\ln X) + 75.858$	2	-1.00	H Farm
	GAL.	$Y = (3.E-06)X + .07249$	4	.984	Still Pond Road

Table 6-45 Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2		Station
BOD5	$Y = 2.135(X3) - .128E-2(X4) + .819(X5) - .124E-1$	.571	109	All
	$Y = .213E-1(X1) - .109(X2) + 2.299(X5) + .356E-2$	.854	31	All Forested
	$Y = .325E-1(X4) + .844\ E-1$	.393	33	All Urban
	$Y = 2.909(X3) - .134E-2(X4) + .882(X5) - .105$	.886	45	All Agriculture
	$Y = -.141(X2) + .971(X3) + 2.029(X5) + .186E-1$	.606	17	Millington A
	$Y = .225(X1) - .64\ (X2) - .671E-1(X4) + 1.284(X5) + 3.69E-2$	.932	14	Millington B
	$Y = .861E-2(X4) + .692(X5) - .84E-1$	.966	17	USGS Gage
	$Y = .114(X2) + 7.893(X3) + .239(X5) + .253E-1$	.84	19	Chestertown A
	$Y = 1.2(X1) - 4.889(X3) + 1.043(X5) - .534$	.736	14	Chestertown B
	$Y = .435E-1(X2) + 4.776(X3) + .703E-3(X4) + .273(X5) - .254E-1$	.994	20	Sutton Farm
	$Y = .158(X1) - .19(X2) - 2.905(X3) - .247E-2(X4) + 1.10(X5) - .197E-1$	.993	8	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

* Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = total suspended solids X5 = alkalinity

Table 6-45 (cont) Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2		Station
NO2NO3	Y = -.122E-1(X2) + .252E-3(X4) + .257(X5) + .137E-1	.239	134	All
	Y = -.212E-1(X1) + .512(X5) + .153E-1	.201	32	All Forested
	Y = .509E-1(X5) + .789E-4	.587	45	All Urban
	Y = -.184E-1(X1) - .367E-1(X2) + 2.086(X3) + .266E-3(X4) + .257E-1	.374	57	All Agriculture
	Y = -.417E-2(X1) - .333E-1(X2) + .568(X3) + .164E-1(X4) + .154(X5) + .107E-2	.844	17	Millington A
	Y = .924E-1(X1) + .322(X2) - 3.585(X3) + 1.233(X5) + .262E-1	.330	15	Millington B
	Y = .588E-1(X2) - .895E-3(X4) + .784E-1(X5) - .144E-1	.654	20	USGS Gage
	Y = .329E-1(X5) + .161E-2	.444	27	Chestertown A
	Y = .572E-2(X1) - .909E-3(X4) + .102(X5) - .351E-1	.920	18	Chestertown B
	Y = .177E-1(X1) + .702(X3) + .679E-3	.514	26	Sutton Farm
	Y = .189(X5) + .331E-1	.544	11	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

* Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = total suspended solids X5 = alkalinity

Table 6-45
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Varaible (lbs/acre)		Multiple R^2	N	Station
NH3	$Y = -.733E-2(X1) + .26E-3(X4) + .462E-1(X5) + .652E-2$	.351	150	All
	$Y = .574E-2(X2) + .144(X5) - .132E-2$	.655	37	All Forested
	$Y = -.357E-1(X3) + .477E-1(X5) - .101E-2$	.562	49	All Urban
	$Y = -.1376E-1(X1) + 1.824(X3) + .167E-3(X4) + .622E-1(X5) + .152E-1$	.394	64	All Agriculture
	$Y = .598E-1(X5) + .188E-3$	.390	19	Millington A
	$Y = .138E-1(X2) + .16(X5) - .276E-2$	.659	18	Millington B
	$Y = -.282E-1(X1) + .789E-1(X2) + .394E-3(X4) + .69E-1(X5) - .315E-2$	.693	22	USGS Gage
	$Y = .452E-2(X1) + .304E-2(X2) + .211E-1(X5) - .294E-2$	.735	29	Chestertown A
	$Y = -.106E-2(X4) + .105(X5) - .159E-2$	.888	20	Chestertown B
	$Y = .643(X3) - .511E-4(X4) + .258E-1(X5) - .499E-2$	.866	29	Sutton Farm
	$Y = -.687E-1(X1) + .103(X2) - .778E-3(X4) + .543(X5) + .445E-1$	.860	13	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

* Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = total suspended solids X5 = alkalinity

Table 6-45 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
TPHOS	Y = .316E-1(X2) + .146E-2(X4) + .273E-2	.569	150	All
	Y = .35E-1(X5) + .489E-3	.295	37	All Forested
	Y = -.777E-2(X1) + .818E-1(X3) + .237E-1(X4) + .61E-2	.782	49	All Urban
	Y = .118(X2) + .134E-2(X4) - .529E-2	.577	64	All Agriculture
	Y = -.915E-3(X1) - .942E-2(X2) + .171(X3) + .535E-2(X4) + .58E-1(X5) + .28E-4	.858	19	Millington A
	Y = .274E-1(X5) + .882E-3	.231	18	Millington B
	Y = -.19E-1(X1) - .149(X2) + 5.502(X3) - .118E-2(X4) + .836E-1(X5) - .136E-1	.747	22	USGS Gage
	Y = -.13E-1(X1) + .893E-1(X3) + .25E-2(X4) + .275E-1(X5) + .291E-2	.843	29	Chestertown A
	Y = .849E-1(X3) + .163E-2(X4) + .444E-2	.821	20	Chestertown B
	Y = -.128E-1(X2) + .768(X3) + .211E-2(X4) + .261E-1(X5) - .588E-2	.998	29	Sutton Farm
	Y = -.109(X1) + 5.167(X3) + .124	.194	13	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

* Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = total suspended solids X5 = alkalinity

Table 6-45 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
TPHOSD	Y = -.918E-3(X1) + .105(X3) - .143E-4(X4) + .124E-1(X5) - .302E-3	.650	149	All
	Y = -.677E-3(X1) - .491E-2(X2) + .139(X3) + .205E-2(X4) + .302E-3	.537	37	All Forested
	Y = .101(X3) + .66E-2(X5) + .179E-3	.797	49	All Urban
	Y = -.189E-2(X1) + .15(X3) - .235E-4(X4) + .157E-1(X5) - .106E-1	.610	63	All Agriculture
	Y = -.974E-3(X1) - .119E-1(X2) + .187(X3) + .532E-2(X4) + .507E-1(X5) + .193E-3	.860	19	Millington A
	Y = .261E-1(X5) - .116E-3	.864	18	Millington B
	Y = -.405E-1(X2) + 1.241(X3) - .158E-3(X4) + .167E-1(X5) - .422E-2	.824	21	USGS Gage
	Y = .239E-2(X1) + .218E-2(X5) + .174E-3	.681	29	Chestertown A
	Y = -.327E-2(X2) + .153(X3) - .345E-3(X4) + .235E-1(X5) - .475E-3	.987	20	Chestertown B
	Y = -.45E-3(X1) - .109E-2(X2) + .349E-1(X3) + .938E-2(X5) - .485E-3	.967	29	Sutton Farm
	Y = .936E-3(X1) - .173E-2(X2) - .116E-4(X4) + .13E-1(X5) + .121E-3	.952	13	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

* Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = total suspended solids X5 = alkalinity

Table 6-45 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
DPO4	Y = .296E-1(X3) + .411E-5(X4) + .777E-2(X5) - .236E-3	.791	135	All
	Y = -.458E-3(X1) - .255E-2(X2) + .804E-1(X3) + .901E-1(X4) + .215E-3	.414	37	All Forested
	Y = .204E-2(X1) - .821E-3(X2) + .229E-1(X3) + .561E-2(X5) - .482E-3	.792	42	All Urban
	Y = .412E-1(X3) + .919E-2(X5) - .109E-2	.867	56	All Agriculture
	Y = -.679E-3(X1) - .768E-2(X2) + .127(X3) + .384E-2(X4) + .261E-1(X5) + .10E-3	.840	19	Millington A
	Y = -.291E-2(X3) + .992E-2(X5) + .575E-4	.951	18	Millington B
	Y = .82E-3(X1) + .117E-3(X4) + .718E-2(X5) - .15E-2	.957	20	USGS Gage
	Y = .273E-2(X1) - .503E-3(X2) + .15E-2(X5) - .123E-3	.811	25	Chestertown A
	Y = .157E-2(X1) - .705E-2(X2) + .761E-1(X3) - .219E-3(X4) + .152E-1(X5) - .309E-3	.979	17	Chestertown B
	Y = .354E-3(X1) - .544E-3(X2) + .443E-1(X3) + .145E-4(X4) + .315E-2(X5) - .605E-3	.979	24	Sutton Farm
	Y = .787E-3(X1) - .493E-1(X3) - .275E-4(X4) + .209E-1(X5) - .27E-3	.996	12	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

* Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = total suspended solids X5 = alkalinity

Table 6-45 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
TOC	Y = -.248(X2) + 2.668(X3) + .782E-2(X4) + .717(X5) + .175	.524	150	All
	Y = .171(X1) - .561(X2) + .378(X4) + 13.298(X5) - .185	.782	37	All Forested
	Y = .765E-1(X1) - 2.655(X3) + .443E-1(X4) + .46(X5) + .463E-1	.784	49	All Urban
	Y = -.805(X2) + 14.458(X3) + .839E-2(X4) + .534(X5) + .104	.679	64	All Agriculture
	Y = -.655(X2) + 6.254(X3) + 9.179(X5) + .529E-1	.541	19	Millington A
	Y = .215(X1) + .47(X4) + 14.385(X5) - .406	.823	18	Millington B
	Y = .124(X1) + 1.633(X2) - 27.2(X3) + .119E-1(X4) + .876(X5) - .279	.948	22	USGS Gage
	Y = .825E-1(X1) + .48E-1(X4) + .39E-1	.750	29	Chestertown A
	Y = .185(X1) - 3.377(X3) + .383E-1(X4) + .932(X5) + .178E-1	.928	20	Chestertown B
	Y = .168(X1) + .217E-2(X4) + .73(X5) - .118	.931	29	Sutton Farm
	Y = -.303(X1) + 15.12(X3) + .273E-2(X4) + 4.836(X5) + .181	.994	13	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

* Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = total suspended solids X5 = alkalinity

Table 6-45 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
COD	Y = .287(X1) + 5.176(X3) + .422E-1(X4) + 2.157(X5) + .278	.807	150	All
	Y = -1.718(X2) + 29.327(X3) + 1.71(X4) + 23.477(X5) - .985E-1	.865	37	All Forested
	Y = -10.467(X3) + .254(X4) + .393	.726	49	All Urban
	Y = 61.534(X3) + .417E-1(X4) + 1.648(X5) - .238	.936	64	All Agriculture
	Y -1.37(X2) + 26.206(X5) + .249	.663	19	Millington A
	Y = 36.444(X3) + 2.173(X4) + 22.056(X5) - .44	.915	18	Millington B
	Y = 1.74(X2) + .187E-1(X4) + 3.283(X5) - .713	.914	22	USGS Gage
	Y = .618(X1) - 22.567(X3) + .214(X4) + .169	.652	29	Chestertown A
	Y = 1.06(X1) - 19.622(X3) + .315(X4) - .54	.945	20	Chestertown B
	Y = 1.13(X1) + .497E-1(X4) - .457	.985	29	Sutton Farm
	Y = -2.029(X1) + 166.27(X3) + 11.85(X5) + .725	.938	13	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

* Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = total suspended solids X5 = alkalinity

Table 6-46
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
BOD5	Y = .933E-1(X1) + 1.549(X3) - .523(X4) + .957(X5) + .238(X8) + .26E-1	.763	116	All
	Y = -.917E-1(X2) + 9.635(X4) + 1.805(X5) + .151(X7) + 63.542(X8) - 96.764(X9) + .242E-1	.908	34	All Forested
	Y = -29.548(X8) + 173.26(X9) - .389E-1	.637	33	All Urban
	Y = .124*X1) + .566(X5) + .496(X9) - .174E-1	.903	49	All Agricultural
	Y = -.227E-1(X1) - .608E-1(X2) + 2.516(X5) + 7.97(X8) + .381E-1	.597	18	Millington A
	Y = .893E-1(X1) - .298(X2) + 7.046(X4) + 1.157(X5) = 28.19(X8) + .934E-2	.978	16	Millington B
	Y = 10.42(X3) - .813(X2) + 4.641(X5) - .5(X9) + .502E-1	.993	20	USGS Gage
	Y = -.906E-1(X1) + 6.981(X3) + .1(X2) + 1.728(X5) + 1.765(X7) + 38.91(X9) + .134E-1	.952	19	Chestertown A
	Y = -258.1(X8) + .51(X1) + 11.22(X3) - 9.609(X4) + 5.571(X5) - 29.58(X7) + 638.4(X9) - .376	.976	14	Chestertown B
	Y = .236E-1(X1) + 1.12(X3) - .135(X2) - .467(X4) + .892(X5) + .575(X7) + 12.69(X9) - .604E-2	.999	21	Sutton Farm
	--			Browntown Road
	--			Harris Farm
	--			Still Pond Road

*Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

Table 6-46 (cont)

Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*.	Multiple Multiple R^2	N	Station
NO2NO3	Y = -.969E-2(X2) - .93E-1(X4) + .211(X5) + .231E-1(X8) + .139E-1	.354	116	All
	Y = 5.772(X4) + .256(X6) - 59.249(X8) + 85.594(X9) - .803E-3	.261	34	All Forested
	Y = -.314(X3) - .313E-2(X2) + .102(X4) + 1.342(X8) + 5.592(X9) - .933E-3	.881	33	All Urban
	Y = 1.274(X3) - .371E-1(X2) - .811E-1(X4) + .177(X5) + .204E-1(X8) + .167E-1	.517	49	All Agricultural
	Y = -.759E-3(X1) + .619E-1(X3) - .42E-2(X2) + 1.625(X4) + 1.898(X9) + .611E-3	.987	18	Millington A
	Y = 6.339(X4) - 82.21(X8) + 233.4(X9) - .135E-1	.496	16	Millington B
	Y - -.4(X3) + .455(X2) - .352E-1(X4) + .258(X5) + .326E-2	.967	20	USGS Gage
	Y = 3.042(X8) - .548E-2(X2) + 4.157(X9) - .377E-2	.626	19	Chestertown A
	Y = -4.096(X8) + .121E-1(X1) + .226(X3) - .324E-1(X2) + .714E-1(X5) - .173E-1 (X6) + 14.02(X9) - .593E-2	.991	14	Chestertown B
	Y = 13.26(X8) - .928E-2(X1) - .507(X3) - .42(X4) + .4(X6) + .755E-2	.968	21	Sutton Farm
	--	--	--	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

*Independent Variables

X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

Table 6-46
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R2	N	Station
NH3	Y = -.501E-2(X1) - .187(X4) + .219(X5) + .566(X7) + .397E-1(X8) + .126(X9) - 152E-3	.804	116	All
	Y = -.237E-2(X1) + .224(X3) + .207(X5) + .17E-1(X7) - .838(X9) + .162E-3	.787	34	All Forested
	Y = -.154(X4) + .206(X5) + .11E-1(X6) + .3(X7) - .571(X8) - .544E-3	.883	33	All Urban
	Y = -.258E-1(X1) + .267E-1(X2) - .133(X4) + .91E-1(X5) + .324E-1(X6) + 1.118(X7) + .223E-1(X8) + .133(X9) - .154E-2	.948	49	All Agricultural
	Y = -.637E-1(X3) + .359E-2(X2) + .663E-1(X5) + .169E-1(X6) - 2.257(X8) + 3.469(X9) + .385E-4	.71	18	Millington A
	Y = .107E-1(X1) + 454(X3) - .491E-1(X2) + 1.274(X4) + .376(X5) - .16(X6) + 4.651(X8) + .146E-2	.929	16	Millington B
	Y = -.945(X3) - .58E-1(X4) + .338E-1(X6) + 1.405 (X7) + .138(X9) - .679E-2	.987	20	USGS Gage
	Y = .533(X3) + .195(X4) - .13E-2	.753	19	Chestertown A
	Y = 1.89(X8) + .564E-2(X1) - .489E-1(X2) + .113E-1(X6) + .357(X7) + .189E-2	.991	14	Chestertown B
	Y = 1.008(X8) - .438E-1(X3) + .196E-2(X2) - .458E-1(X5) + .749E-1(X7) + 5.485(X9) - .516E-3	.996	21	Sutton Farm
	--	--	--	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

*Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

Table 6-46 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
TKN	Y = .15E-1(X1) + 864(X4) + .117(X6) + 1.005(X7) - .262(X8) - .194E-1	.878	116	All
	Y = .419E-1(X2) - 2.922(X4) + .314(X6) - .686E-2	.831	34	All Forested
	Y = -.843(X3) + .654(X4) + 5.054(X8) + 12.373(X9) - .632E-2	.866	33	All Urban
	Y = .758(X4) + .222(X6) + 1.489(X7) - .237(X8) - .283E-1	.906	49	All Agricultural
	Y = .546E-2(X1) + 10.1(X4) + .96(X6) + 12.65(X8) - 34.19(X9) - .374E-2	.721	18	Millington A
	Y = -.411E-1(X1) - .887(X3) + .19(X2) - 3.915(X4) + .487(X6) - .637E-2	.909	16	Millington B
	Y = .921E-2(X1) + .693E-1(X4) + .116(X6) + 1.567(X7) + .433E-1(X9) - .155E-1	.999	20	USGS Gage
	Y = .805(X4) + .857E-1(X6) + .147E-2	.783	19	Chestertown A
	Y = 8.411(X8) - .431E-1(X1) - .159(X2) + 2.147(X4) + .221E-1(X6) + .305E-1	.987	14	Chestertown B
	Y = -.126E-1(X1) - .705(X3) + .154E-1(X2) + .851(X4) + .543(X6) - 8.3(X9) + .292E-3	.999	21	Sutton Farm
	--	--	--	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

*Independent Variables
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

Table 6-46 (continued)

Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
TPHOS	Y = .301(2) + .69(X5) - .597E-1(X6) - .343(X7) + .313(X8) - .134E-2	.996	116	All
	Y = .291E-2(X2) - .504E-1(X5) + .222E-1(X6) + .104E-1(X7) + 1.078(X9) - .223E-3	.617	34	All Forested
	Y = .133E01(X1) + .114(X3) - .596E-2(X2) + .2(X5) - .253E-2	.686	33	All Urban
	Y = .78E-1(X2) + .739(X5) - .892E-1(X6) - .684(X7) + .313(X8) - .183E-3	.997	49	All Agricultural
	Y = .163E-3(X1) - .246E-1(X3) + .285E-2(X2) + .979E-1(X7) + .758(X8) - .18E03	.995	18	Millington A
	Y = -.58E-1(X5) + .42E-1(X6) + .162E-1(X7) - 4.591(X9) + .856E-3	.603	16	Millington B
	Y = -33.45(X3) + 1.628(X2) + 4.303(X5) - 15.52(X7) + .819(X9) + .691E-1	.998	20	USGS Gage
	Y = -.616E-2(X2) + .444(X5) + .47(X7) - .19E-2	.722	19	Chestertown A
	Y = -2.559(X8) + .16E-1(X1) + .55E-1(X2) + .351(X5) - .517E-2(X6) - .105E-1	.978	14	Chestertown B
	Y = 10.34(X8) - .929E-2(X2) + .78(X5) - .69(X7) + .412E-2	.999	21	Sutton Farm
	--	--	--	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

*Independet Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

Table 6-46 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
TPHOSD	Y = -.705E-1(X2) + 2.529(X4) - 1.706(X5) + .15(X6) + .683(X7) + 1.274(X9) - .409E-2	.997	116	All
	Y = .464E-2(X6) - .274E-2(X7) + 1.47(X9) - .806E-4	.977	34	All Forested
	Y = -.255E-2(X1) + .983E-1(X3) + .129E-1(X5) - .127E-1(X6) + .379E-1(X7) + 1.03(X9) + .805E-3	.980	33	All Urban
	Y = 7.277(X3) + 2.498(X4) - 1.783(X5) + .24(X6) + 1.933(X7) + 1.319(X9) - .959E-2	.997	49	All Agricultural
	Y = -.124E-3(X1) + .152E-1(X3) - .178E-2(X2) + .476(X4) + .82E-2(X5) - .568E-1(X7) + .989(X9) + .152E-3	.997	18	Millington A
	Y = .39E-2(X6) - .317E-2(X7) + 1.784(X9) - .149E-3	.947	16	Millington B
	Y = -.122(X2) + 3.006(X4) - .659(X6) + .877(X7) + .924E-1(X9) + .527E-2	1.00	20	USGS Gage
	Y = .843E-3(X2) + .25E-1(X4) + .668E-1(X7) + .118E-2	.642	19	Chestertown A
	Y = .536E-1(X3) + .74E-2(X5) - .319E-2(X6) - .726E-1(X7) + 2.284(X9) - .62E-3	.999	14	Chestertown B
	Y = .207E-1(X4) - .113E-1(X5) + .52E-2(X6) + .264E-1(X7) - .91E-4	.995	21	Sutton Farm
	--	--	--	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

*Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

Table 6-46 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R²	N	Station
DPO4	Y = .4E-1(X6) + .154(X8) + .123E-3	.981	116	All
	Y = .213E-1(X4) - .297E-2(X6) + .158E-2(X7) + .638(X8) + .493E-4	.971	34	All Forested
	Y = .112E-2(X1) - .103E-1(X4) + .103E-1(X5) + .786E-3(X6) + .444E-1(X7) + .186(X8) - .13E-3	.966	33	All Urban
	Y = 5.283(X3) - .129(X2) + .705E-1(X6) - .487(X7) + .151(X8) + .101E-2	.983	49	All Agricultural
	Y = .562E-3(X1) + .107(X4) - .882E-2 (X5) + .489E-1(X7) + .414(X8) - .558E-4	.997	18	Millington A
	Y = .179E-2(X7) + .334(X8) + .785E-4	.929	16	Millington B
	Y = .121E-2(X1) - .552E-3(X2) + .435E-2(X6) + .311E-1(X7) + .152E-3	.877	19	Chestertown A
	Y = .358(X8) - .212E-2(X3) + .103E-2(X2) + .12E-2(X6) + .405E-1(X7) + .167E-3	.999	14	Chestertown B
	Y = .27(X8) + .11(X6) - .221E-3	.994	21	Sutton Farm
	--	--	--	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

*Indepdndent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

Table 6-46 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
TOC	$Y = .172(X2) - .177(X2) - 5.349(X4) + 6.445(X5) + .298(X6) + 4.28(X7) + .647(X9) - .154E-1$	.828	115	All
	$Y = -25.853(X4) + 11.232(X5) + 3.4(X7) + 854.9(X8) - 1242.3(X9) - .256E-1$	.916	34	All Forested
	$Y = 9.849(X4) + 2.6(X5) + .161(X6) + 4.253(X7) - 39.57(X8) + 85.52(X9) - .691E-2$	.886	33	All Urban
	$Y = -.231(X1) + 18.89(X3) - 4.654(X4) + 5.568(X5) + 7.743(X7) + .833(X9) - .196E-1$	.974	48	All Agricultural
	$Y = 8.607(X3) - .378(X2) + 5.988(X5) + 1.556(X6) + 371.1(X8) - 578.3(X9) - .381E-3$	.837	18	Millington A
	$Y = 11.96(X5) + 3.409(X7) + 869.3(X8) - 1350.X9 - .733E-1$	.92	16	Millington B
	$Y = -7.393(X4) + 2.449(X5) + .596(X6) + 11.58(X7) + 1.291(X9) - .118$	.992	19	USGS Gage
	$Y = -.244(X2) + 7.029(X4) - 2.963(X5) + 2.417(X6) + 3.712(X7) - .872E-1$	.939	19	Chestertown A
	$Y = -33.64(X8) + 3.028(X3) - 1.991(X2) + 33.42(X4) + 1.771(X5) - 25.52(X7) + 243.08(X9) + .128$	.999	14	Chestertown B
	$Y = -.389E-1(X1) - 10.15(X4) + 8.324(X5) + 2.649(X6) - 1.345(X7) + 59.46(X9) - .179E-1$	.999	21	Sutton Farm
	--	--	--	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

*Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

Table 6-46 (continued)
Chester River Chemical Export Functions Developed From Multiple Linear Regression

Dependent Variable (lbs/acre)	Multiple Linear Regression Equation*	Multiple R^2	N	Station
COD	Y = .447(X1) - .47(X2) + 18.452(X5) + 1.72(X6) - 3.72(X9) + .957E-1	.902	115	All
	Y = 16.424(X5) + 5.633(X6) + 6.796(X7) + 1097.3(X8) - 1642.7(X9) + .816E-1	.798	34	All Forested
	Y = -6.267(X3) + 35.24(X4) + 20.(X5) + .994(X6) + .189	.845	33	All Urban
	Y = 106.7(X3) - 1.77(X2) + 1.415(X4) + 18.77(X5) - 10.32(X7) - 4.604(X9) - .828E-1	.971	48	All Agricultural
	Y = 11.746(X6) + .557E-1	.654	18	Millington A
	Y = 5.385(X1) + 63.99(X3) - 18.36(X2) + 237.7(X4) + 59.9(X5) - 38.39(X6) + 1002.9(X8) + 1581.4(X9) + .986E-1	.953	16	Millington B
	Y = -15.84(X3) - 26.6(X4) + 14.7(X5) + 1.283(X6) + 20.93(X7) - 2.0(X9) - .11	.991	19	USGS Gage
	Y = -244.4(X8) + .643(X2) + 50.36(X4) + 36.77(X7) + .696	.727	19	Chestertown A
	Y = -247.79(X8) + 112.2(X4) + 30.8(X5) - 33.(X7) + 225.96(X9) - .425E-1	.998	14	Chestertown B
	Y = -159.8(X8) + 11.14(X5) + 1060.5(X9) + .424E-1	.999	21	Sutton Farm
	--	--	--	Browntown Road
	--	--	--	Harris Farm
	--	--	--	Still Pond Road

*Independent Variables:
X1 = total rainfall X2 = average intensity X3 = maximum intensity X4 = TPHOS X5 = TKN X6 = BOD5 X7 = NO2NO3 X8 = TPHOSD X9 = DPO4

APPENDIX F

LONGITUDINAL SLACK SURVEY FIGURES AND TABLES

SECTION 7

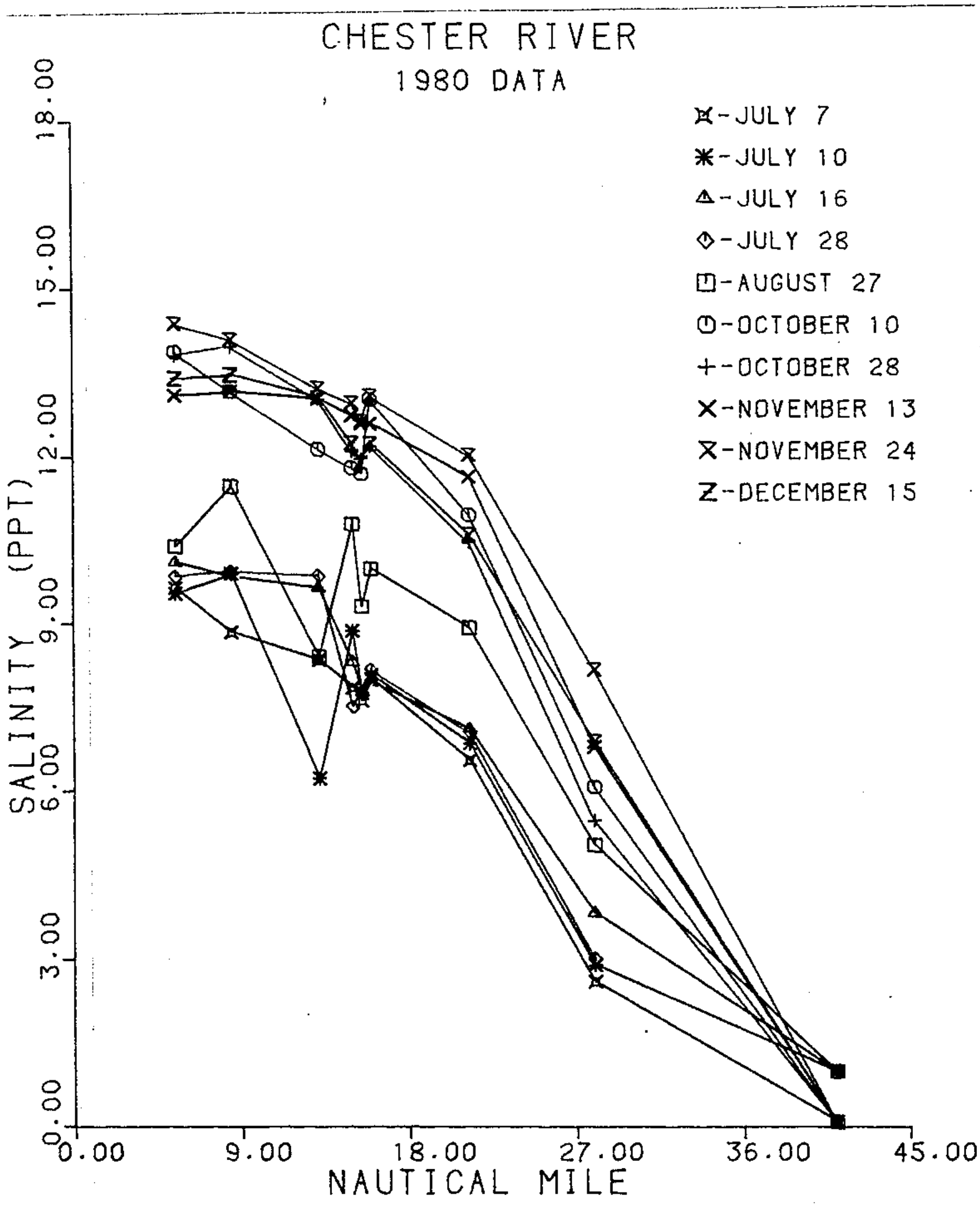


Figure 7-1 Average Chester River salinity (ppt) slack tide profiles for 1980.

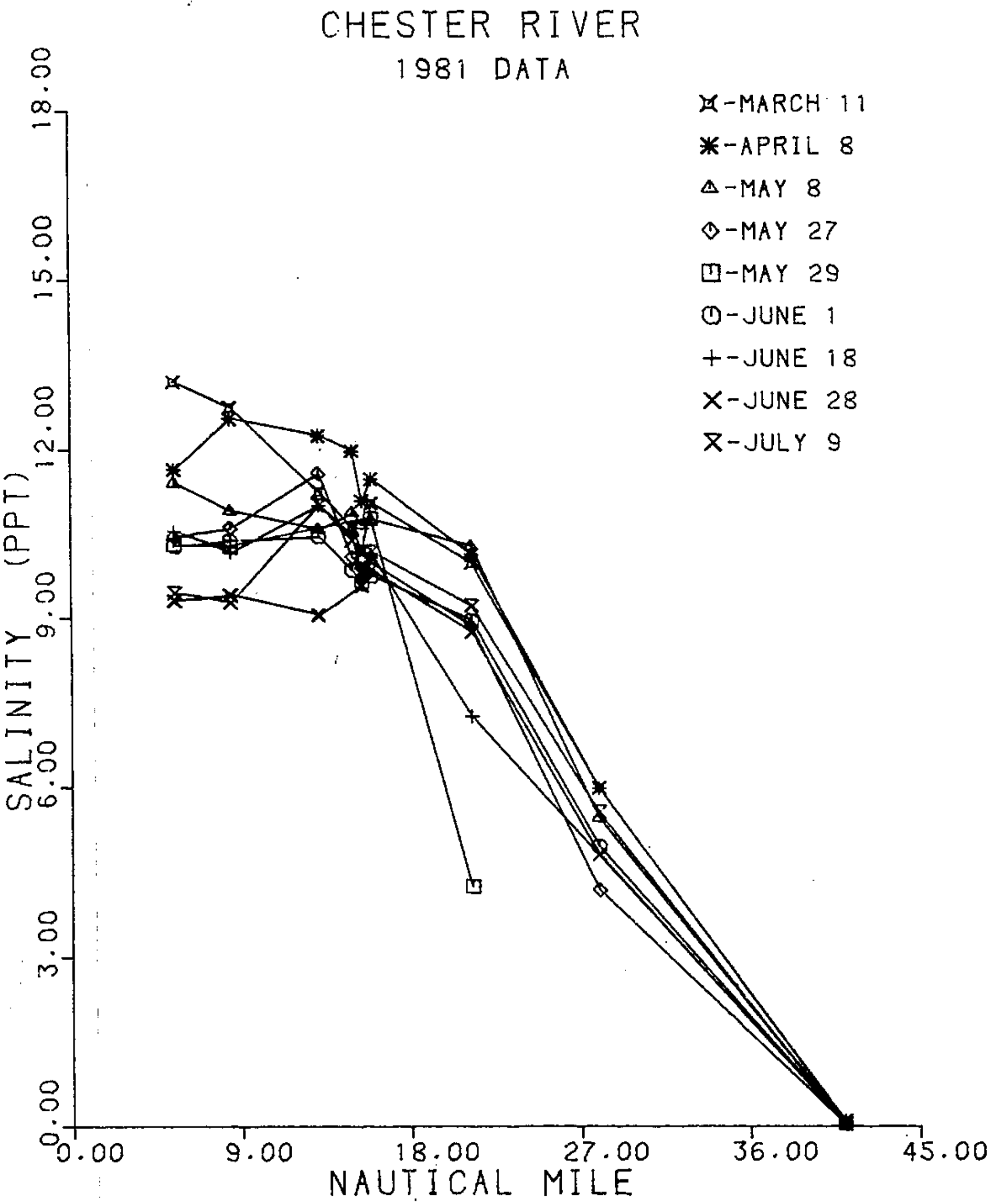


Figure 7-2 Average Chester River salinity (ppt) slack tide profiles for 1981.

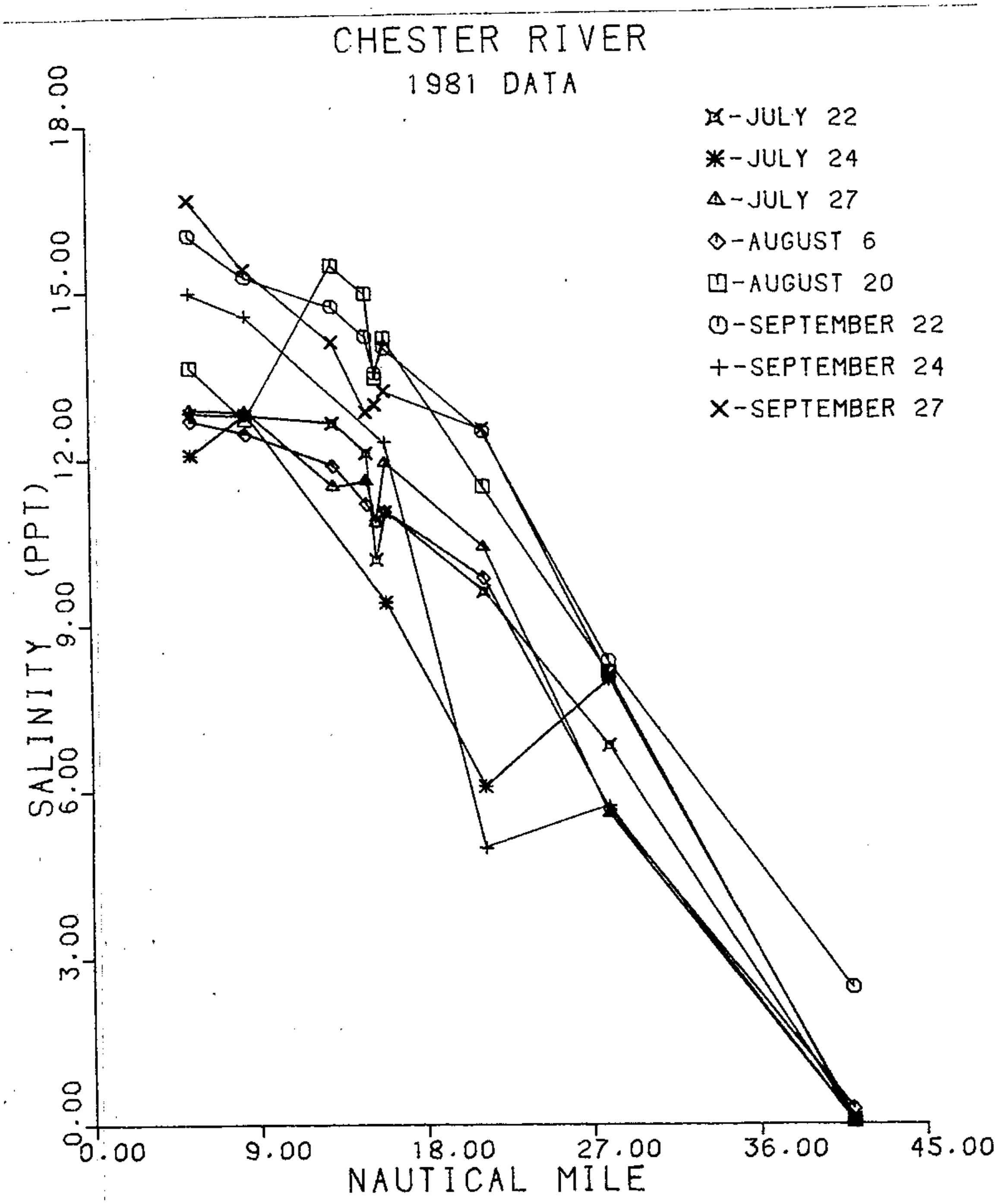
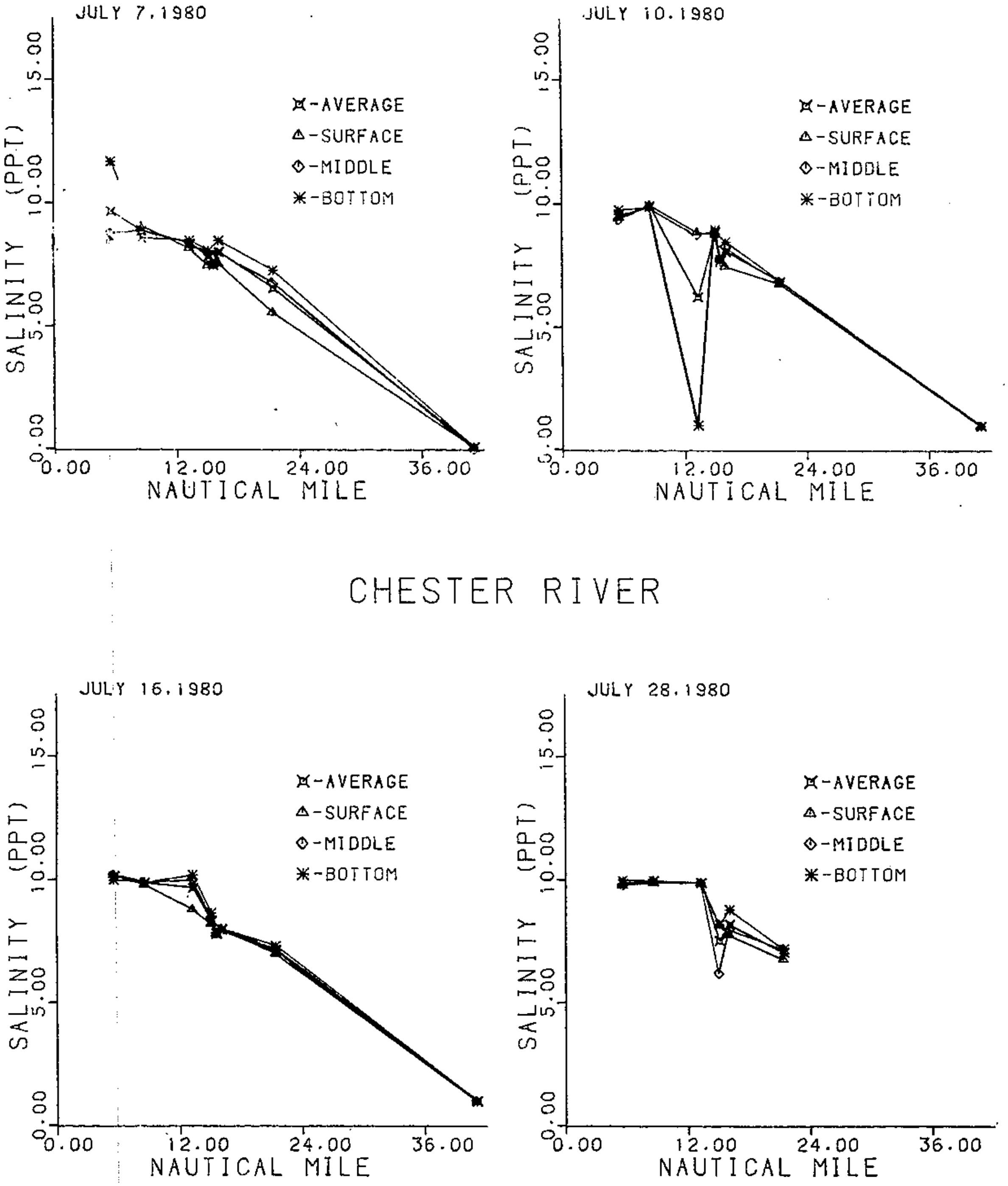
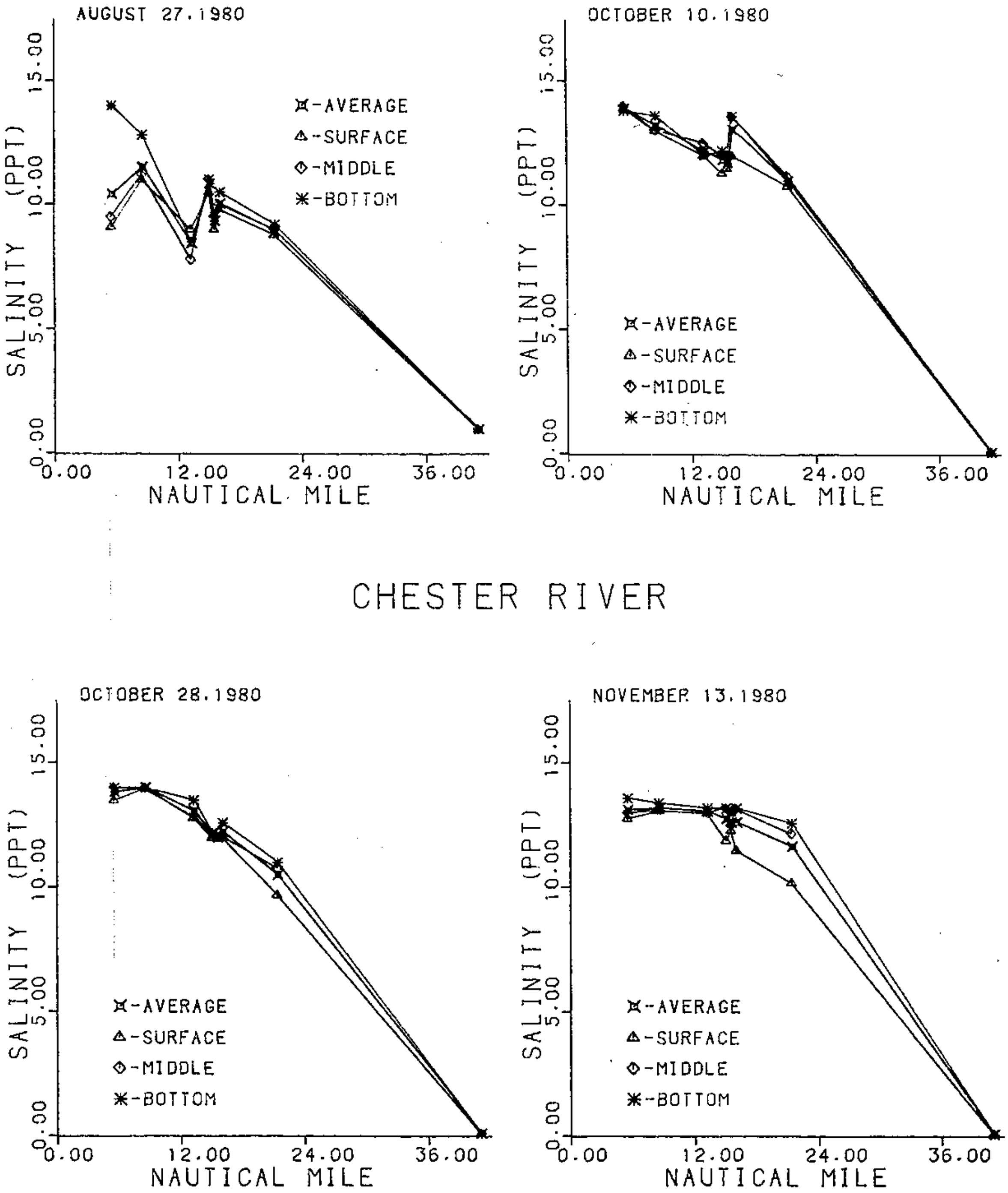


Figure 7-3 Average Chester River salinity (ppt) slack tide profiles for 1981.



CHESTER RIVER

Figure 7-4 Longitudinal slack survey plots for Salinity, (ppt).



CHESTER RIVER

Figure 7-4 Longitudinal slack survey plots for Salinity, (ppt).

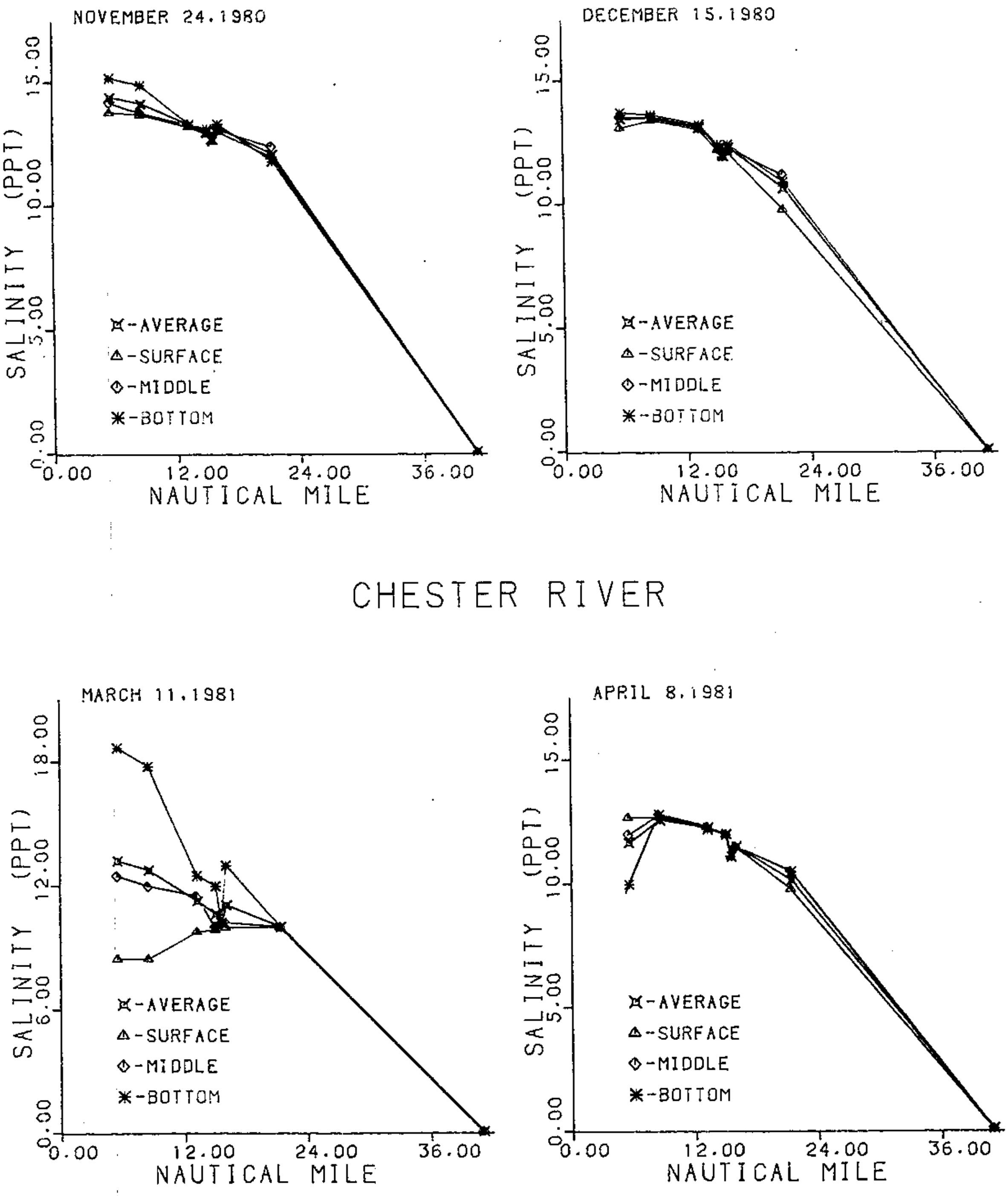


Figure 7-4 Longitudinal slack survey plots for Salinity, (ppt).

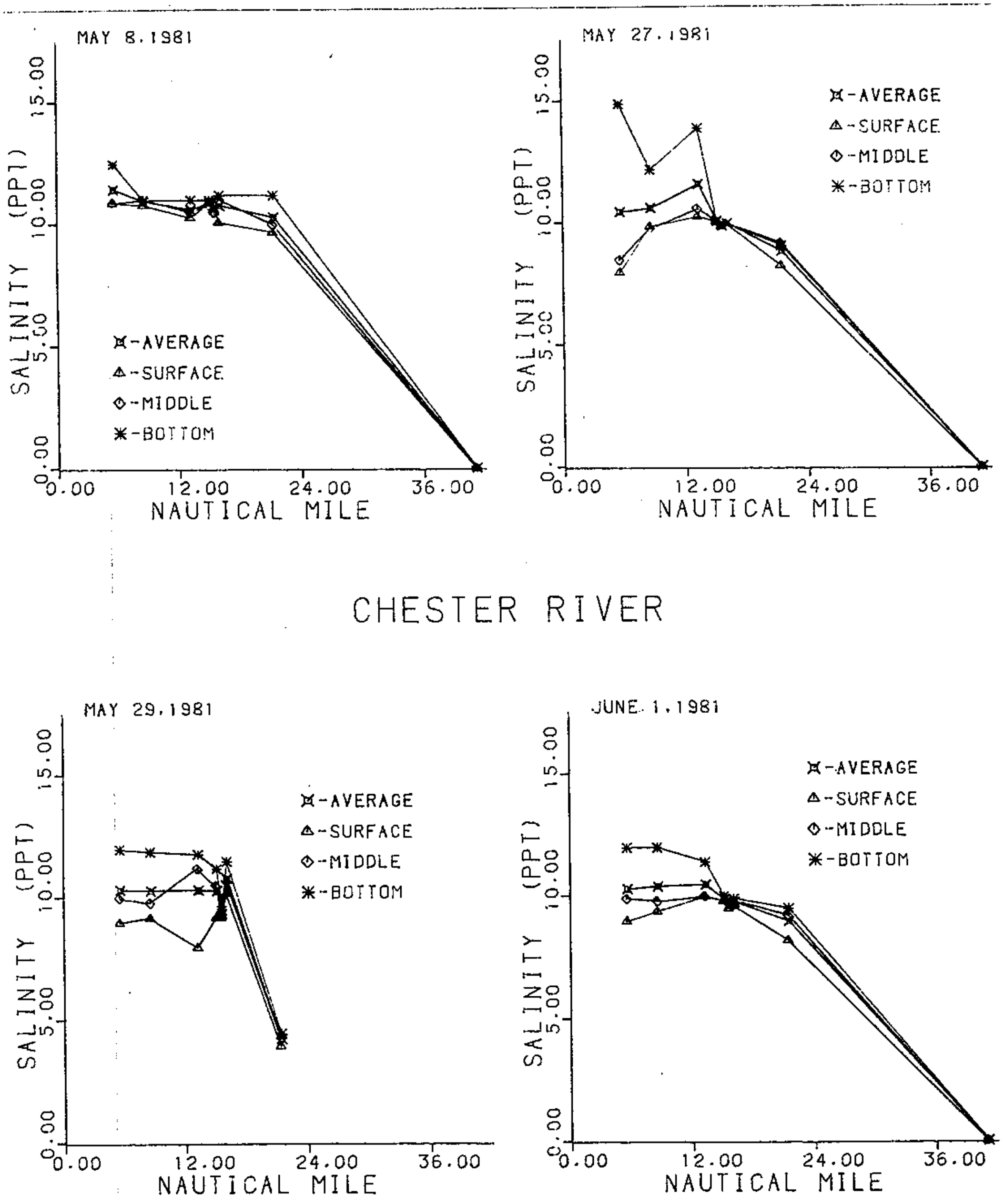


Figure 7-4 Longitudinal slack sruvey plots for Salinity, (ppt).

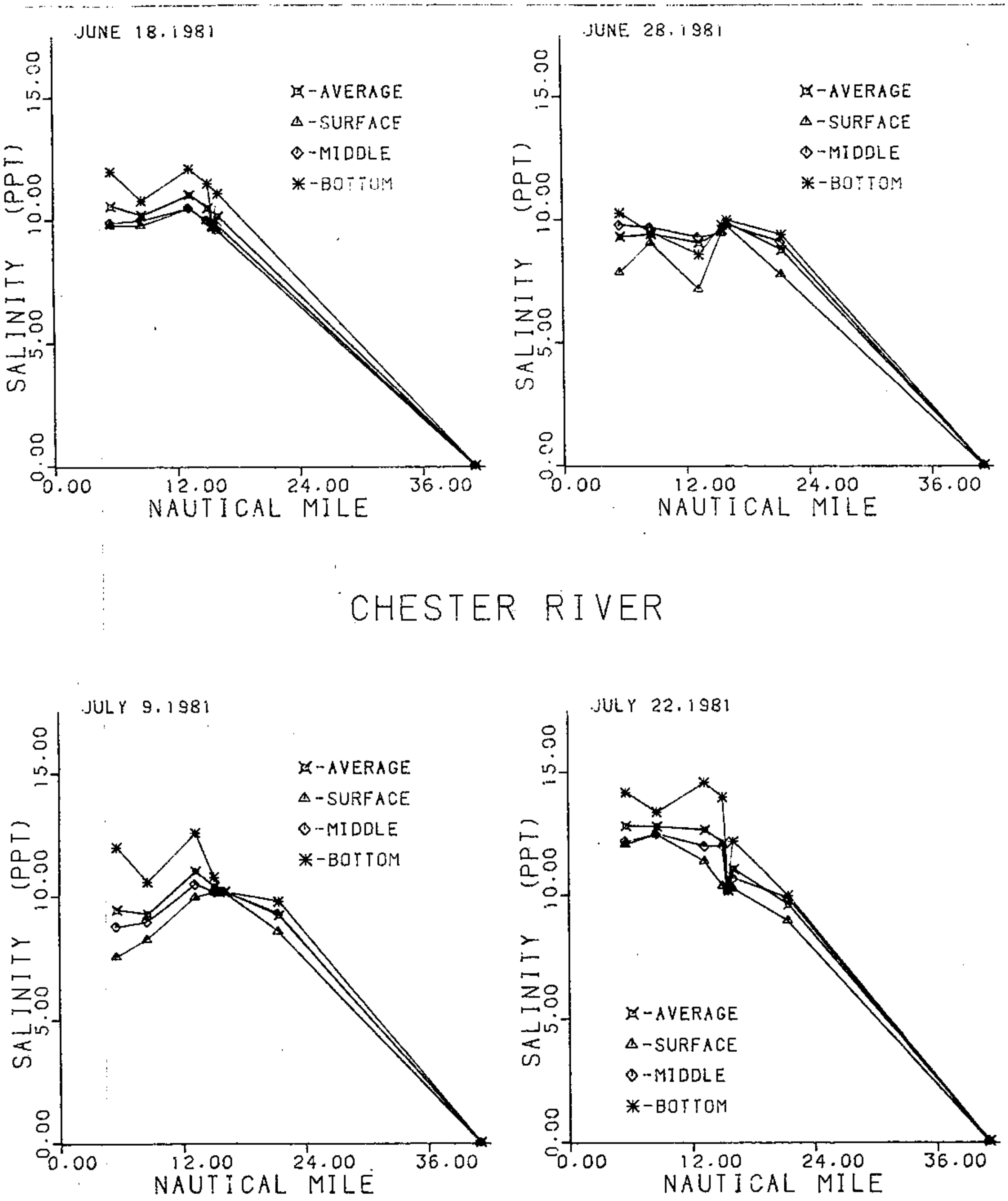


Figure 7-4 Longitudinal slack survey plots for Salinity, (ppt).

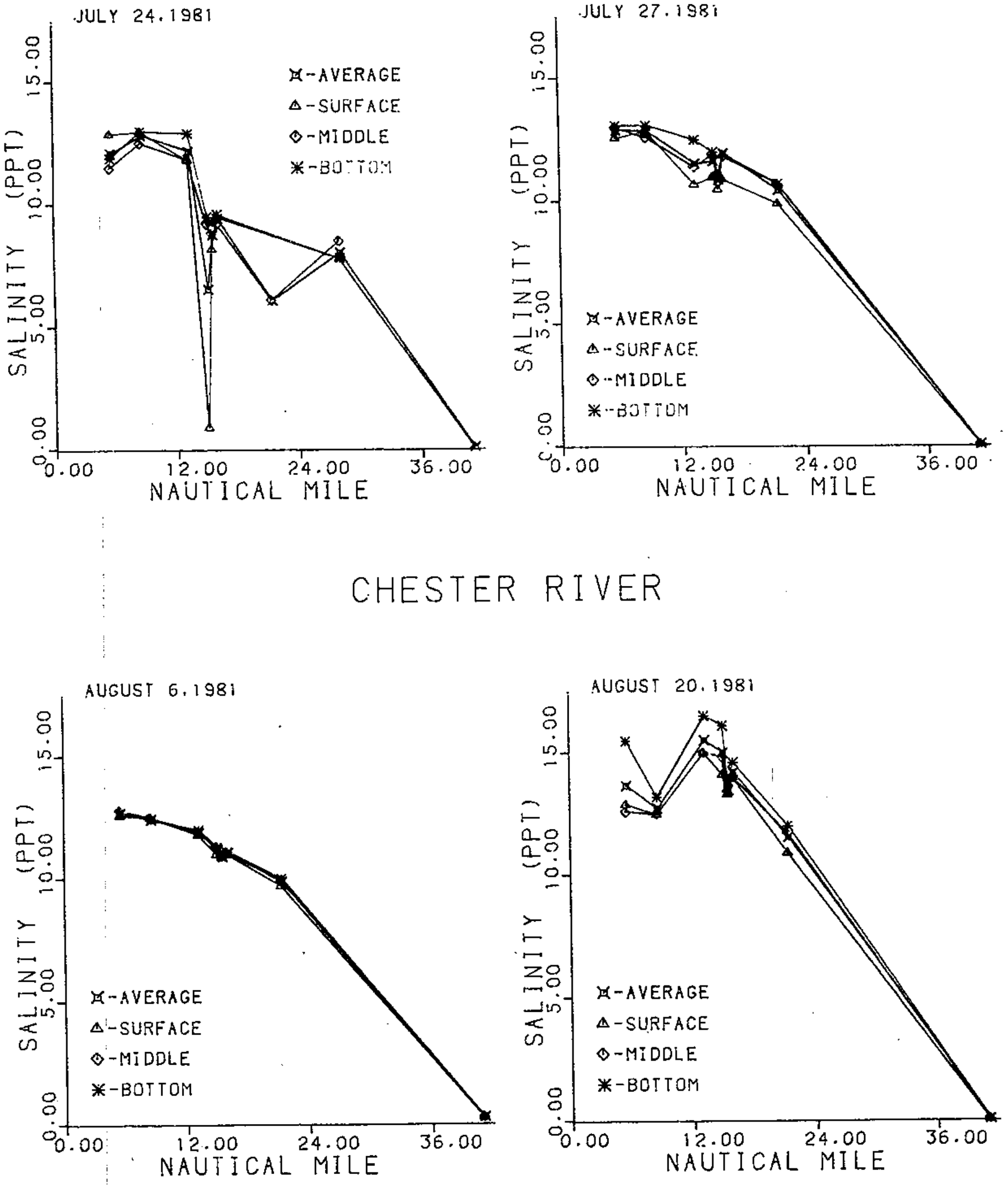

CHESTER RIVER

Figure 7-4 Longitudinal slack survey plots for Salinity, (ppt).

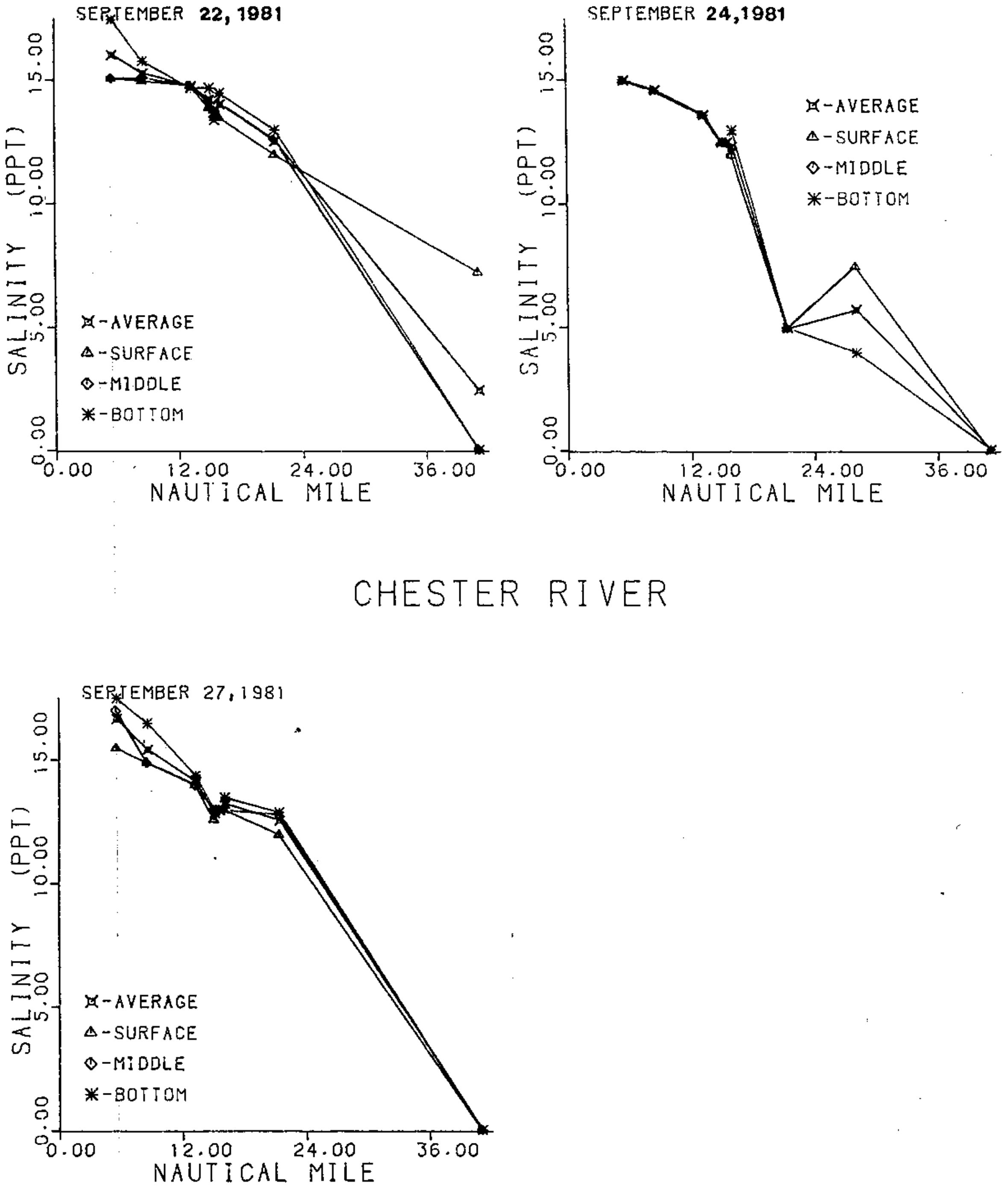


Figure 7-4 Longitudinal slack survey plots for Salinity, (ppt).

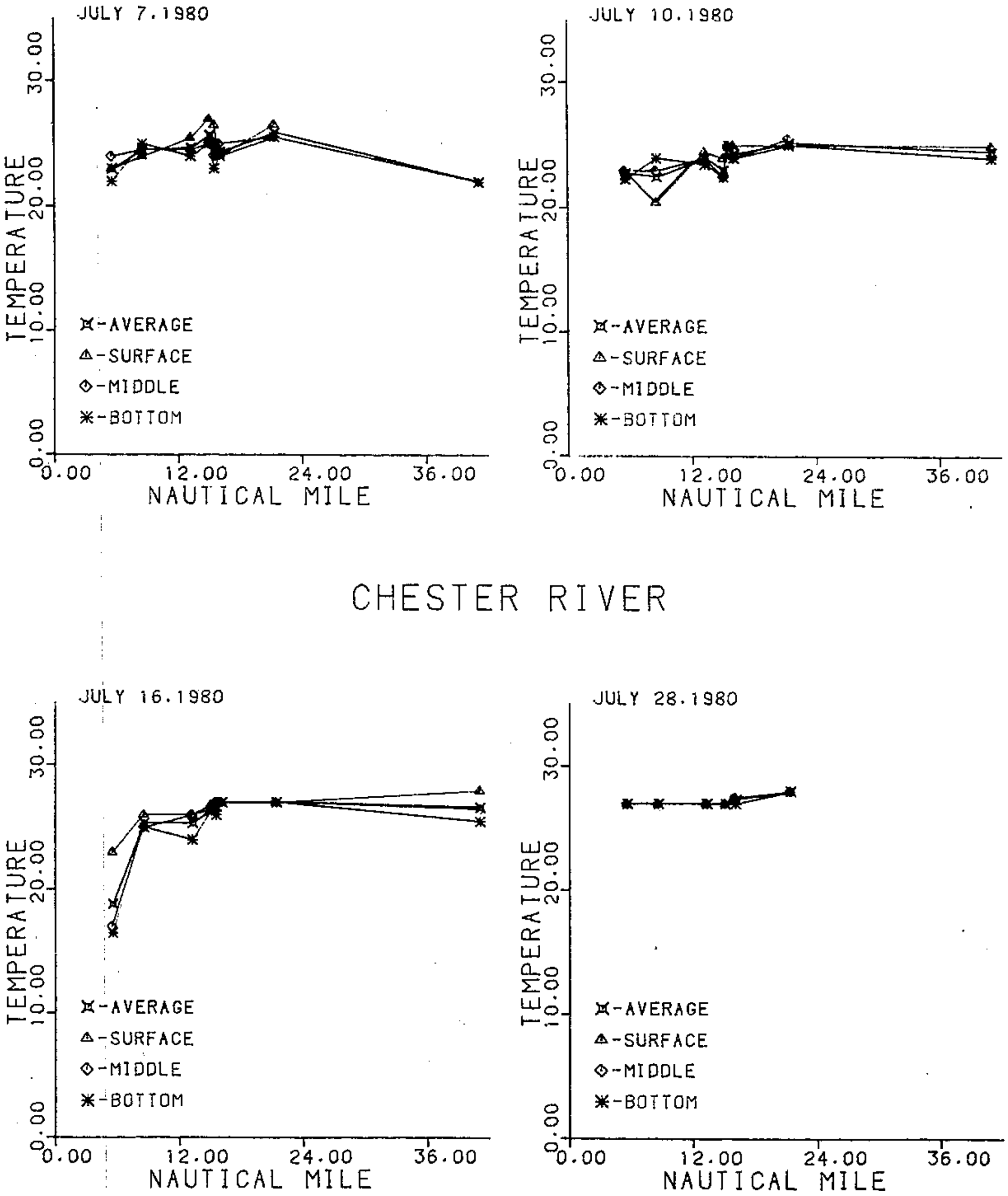


Figure 7-5 Longitudinal slack survey plots for temperature, (centigrade).

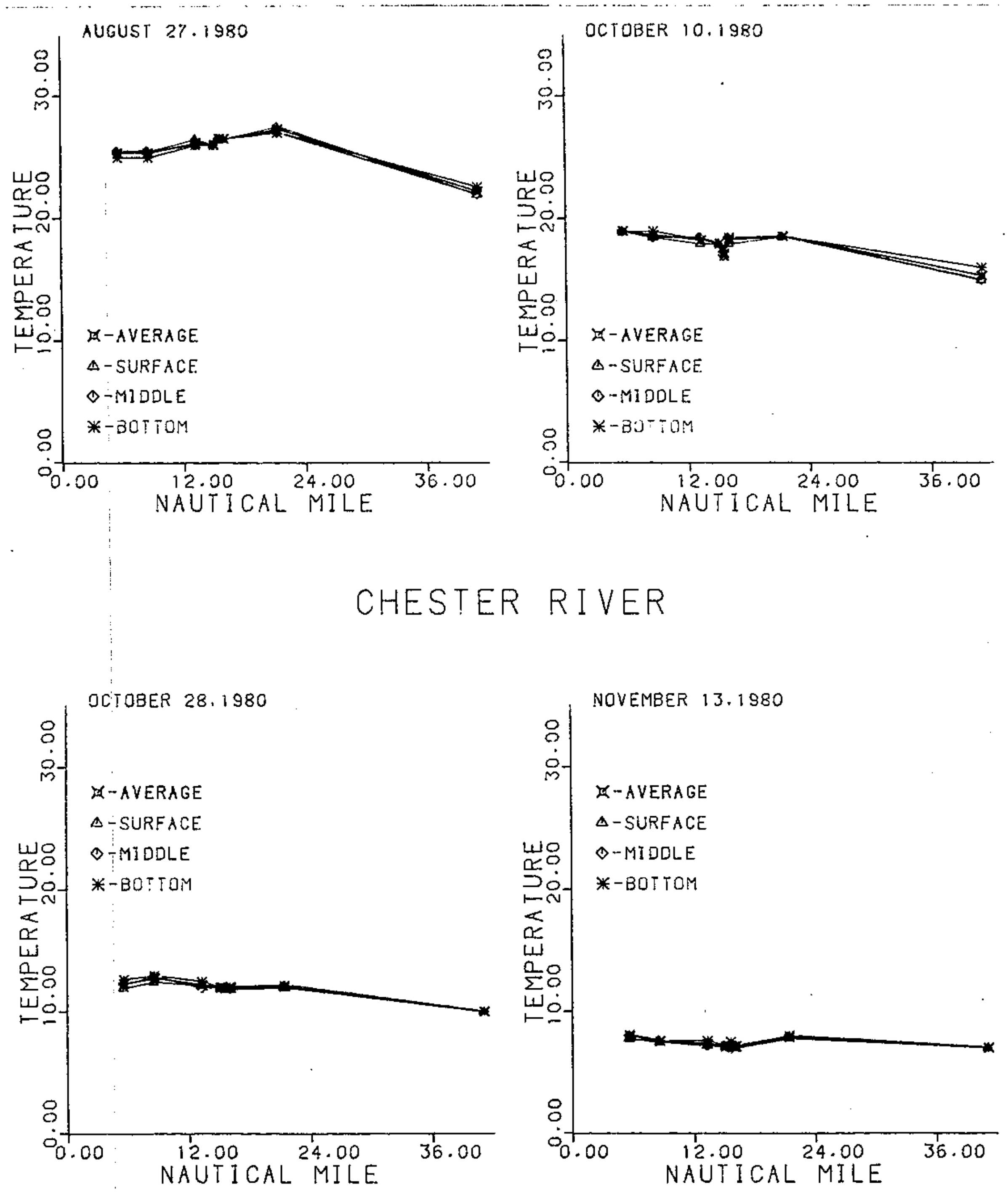


Figure 7-5 Longitudinal slack survey plots for temperature, (centigrade).

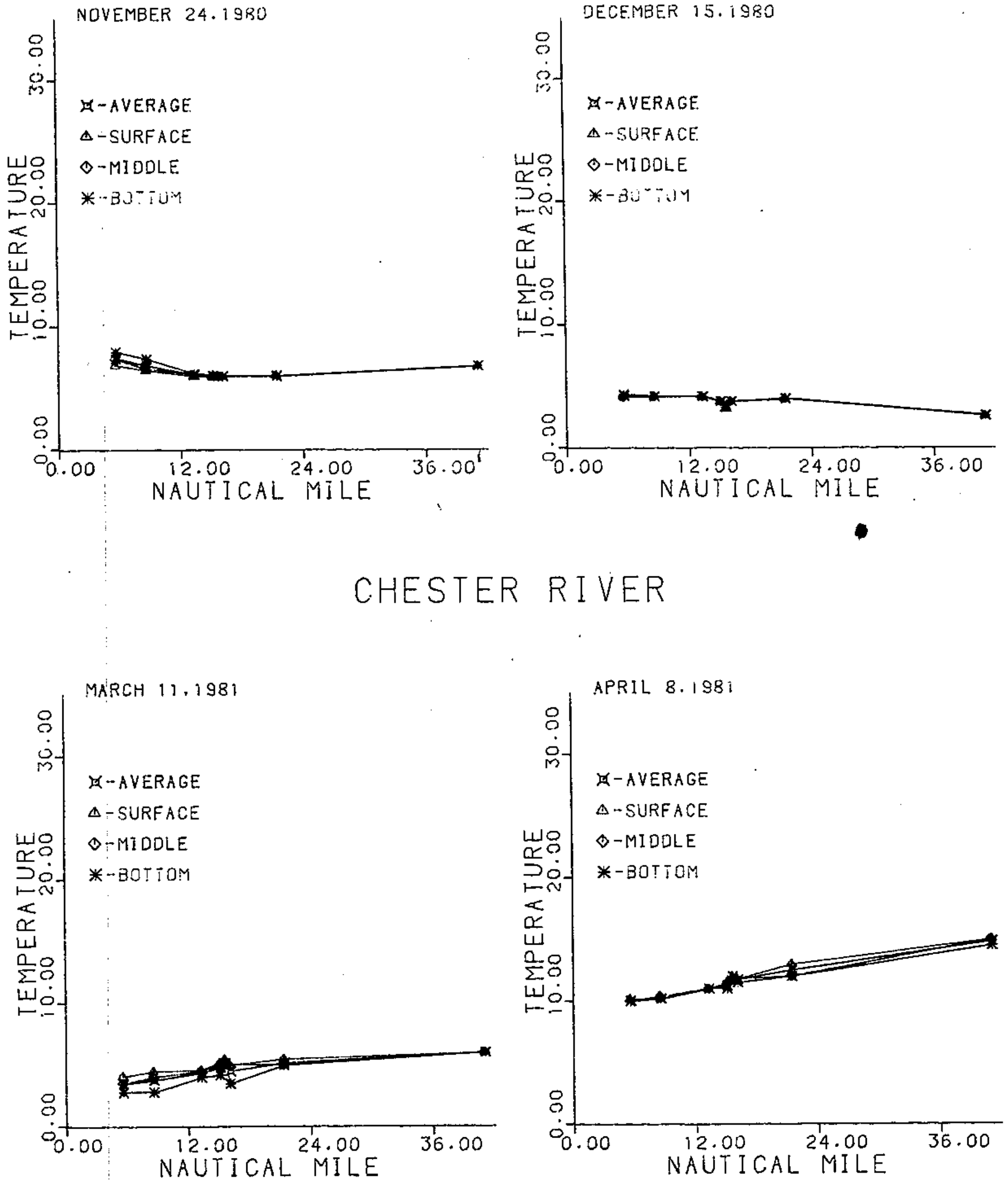


Figure 7-5 Longitudinal slack survey plots for temperature, (centigrade).

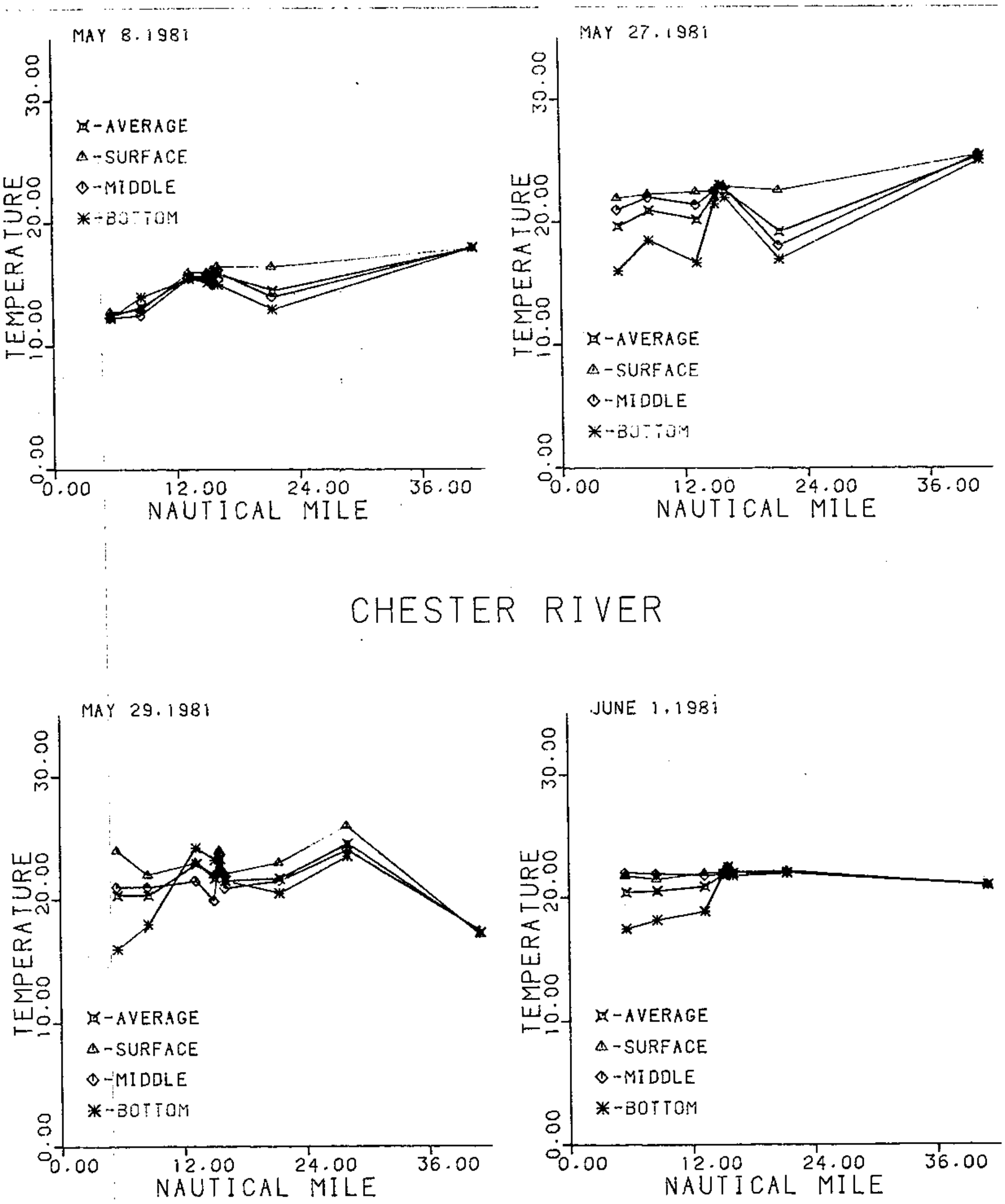


Figure 7-5 Longitudinal slack survey plots for temperature, (centigrade).

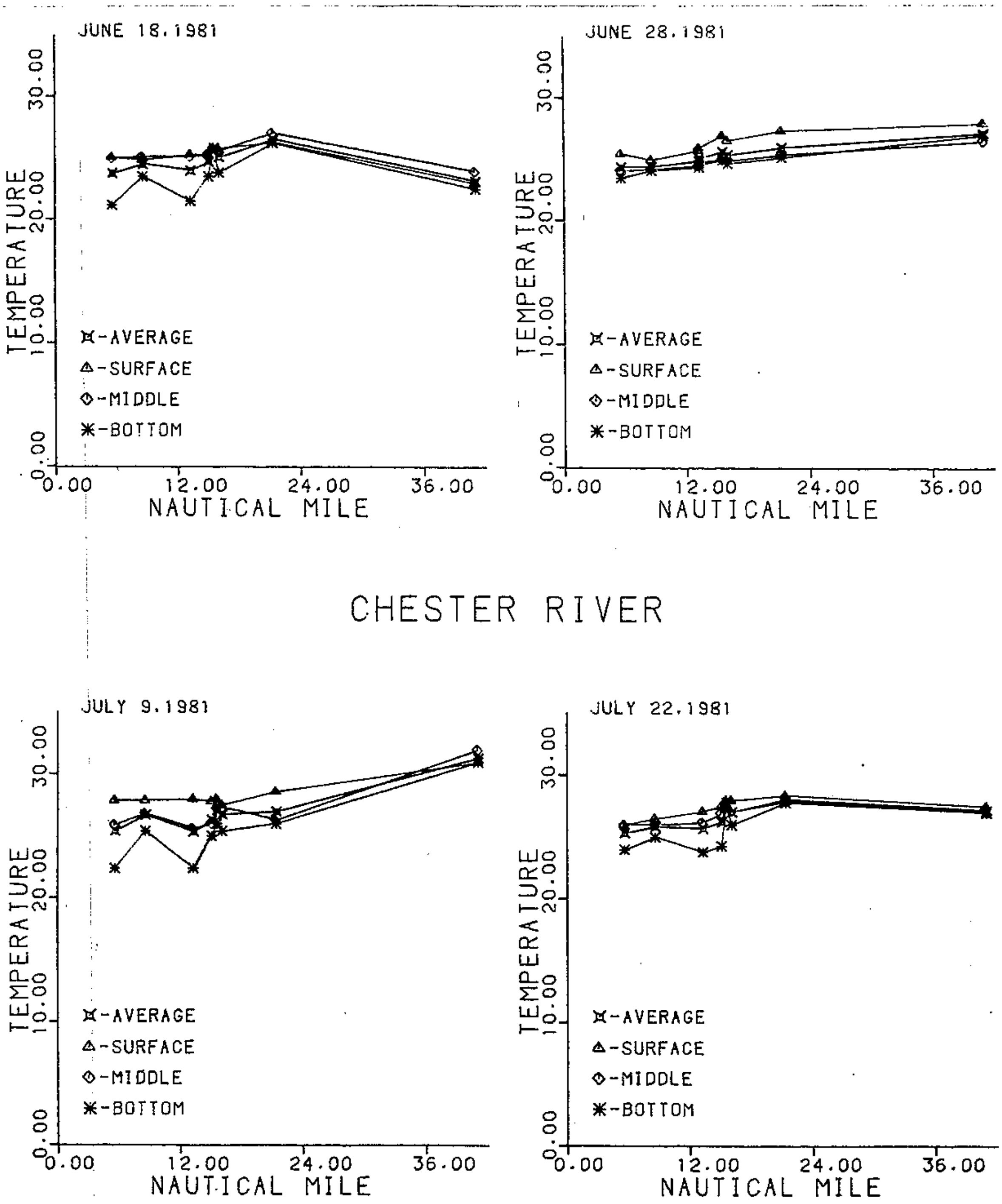


Figure 7-5 Longitudinal slack survey plots for temperature, (centigrade).

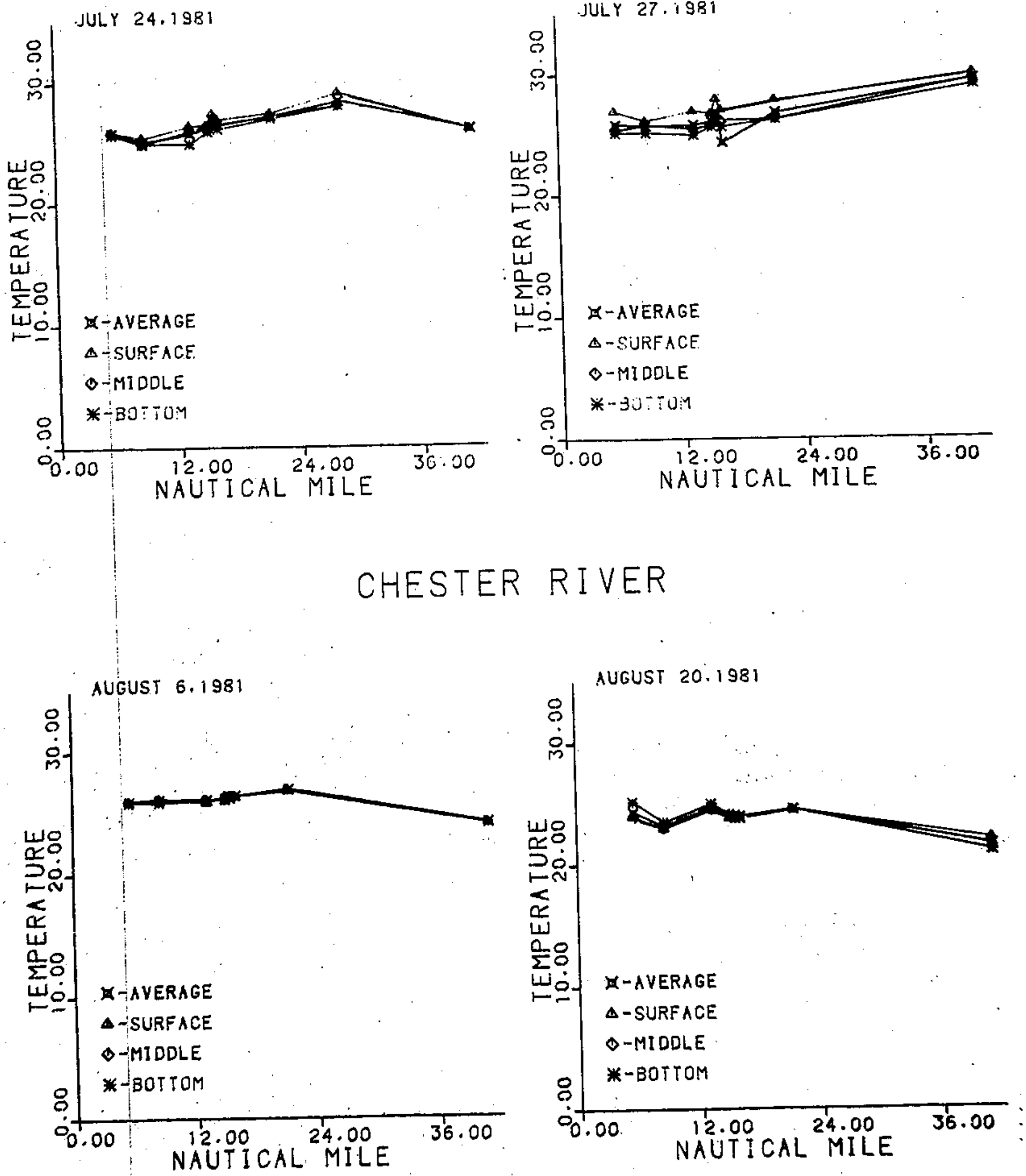
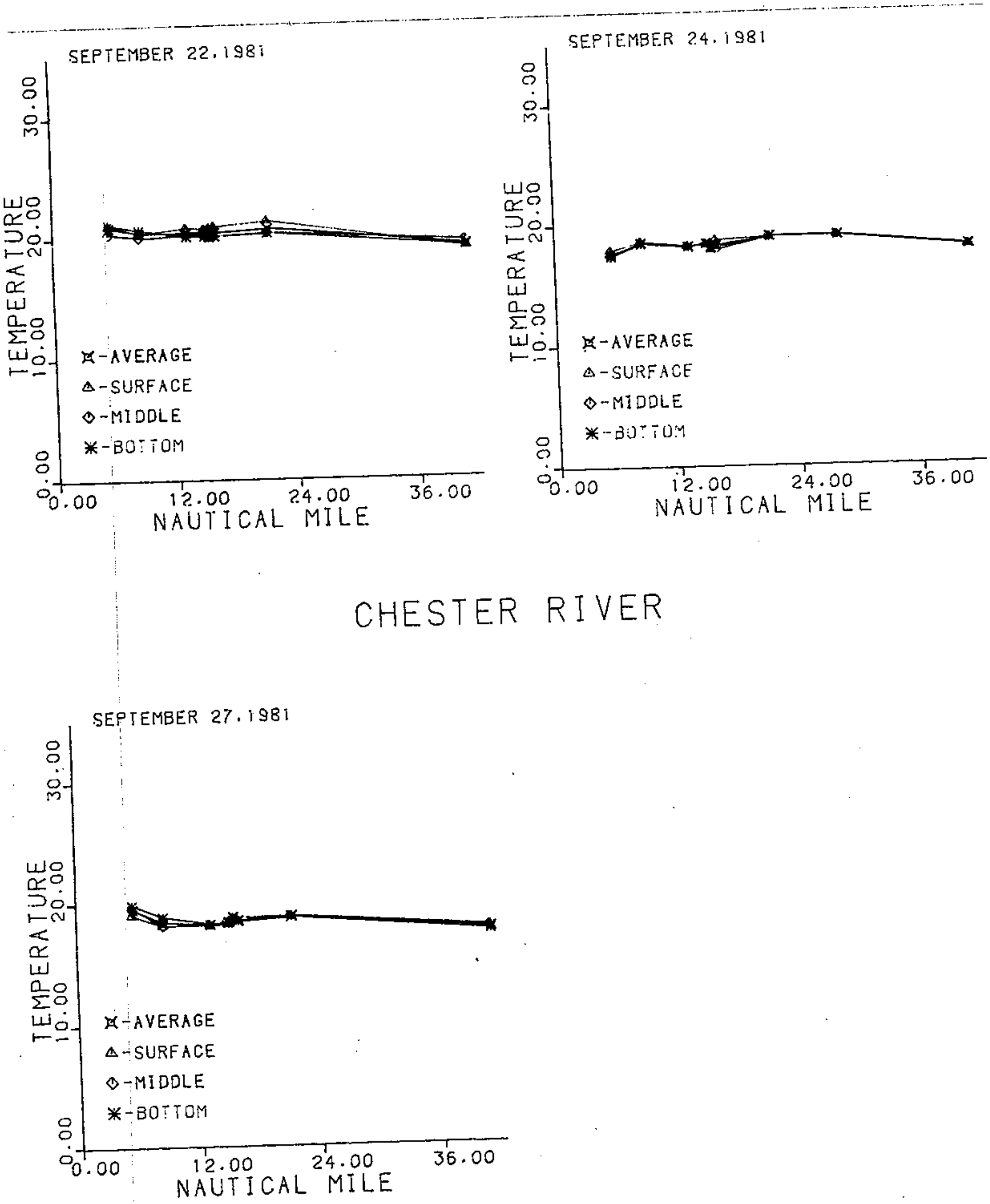


Figure 7-5 Longitudinal slack survey plots for temperature, (centigrade).


SEPTEMBER 22.1981

SEPTEMBER 24.1981

CHESTER RIVER

SEPTEMBER 27.1981

Figure 7-5 Longitudinal slack survey plots for temperature, (centigrade).

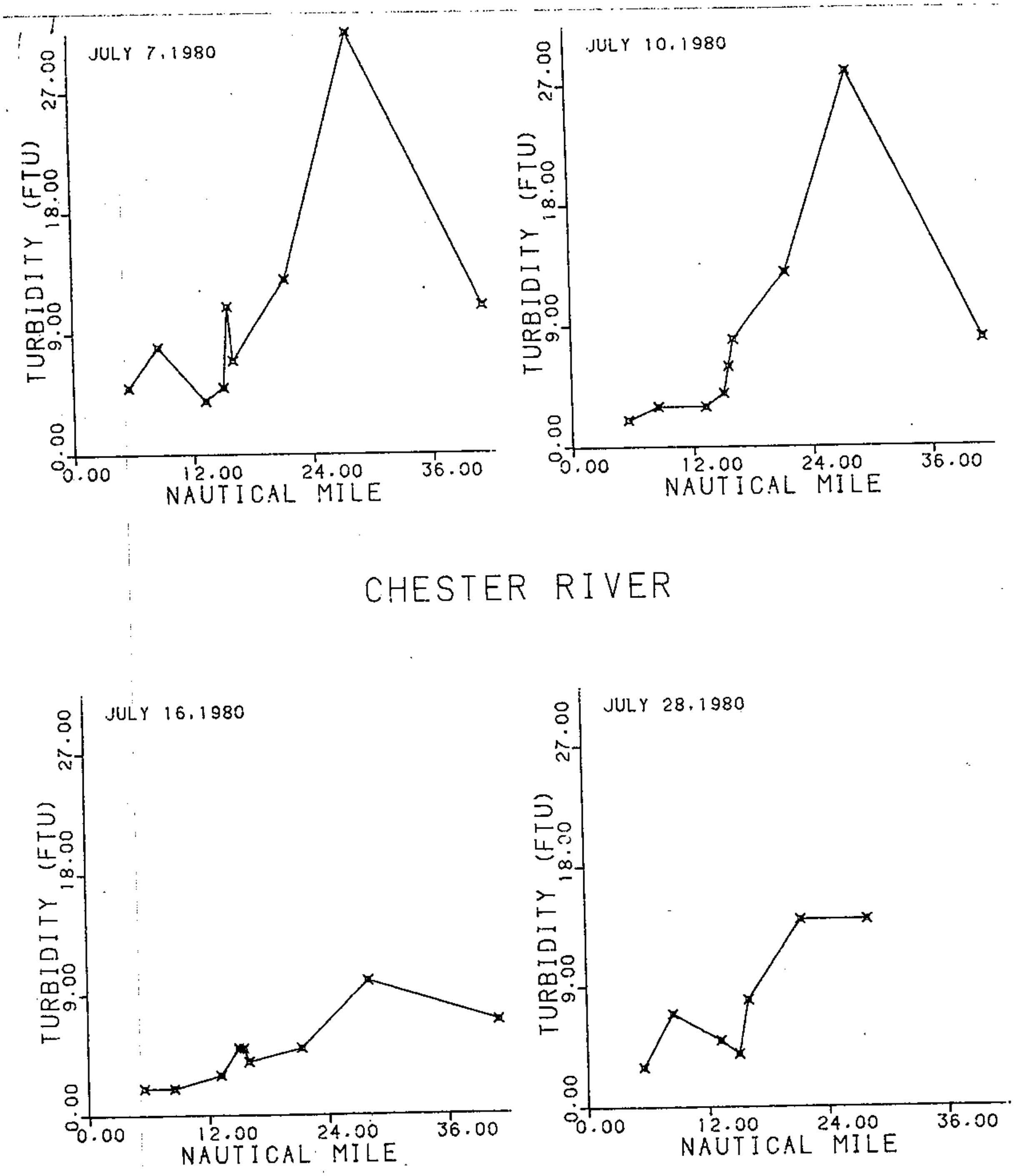


Figure 7-6 Longitudinal slack survey plots for turbidity, (FTU).

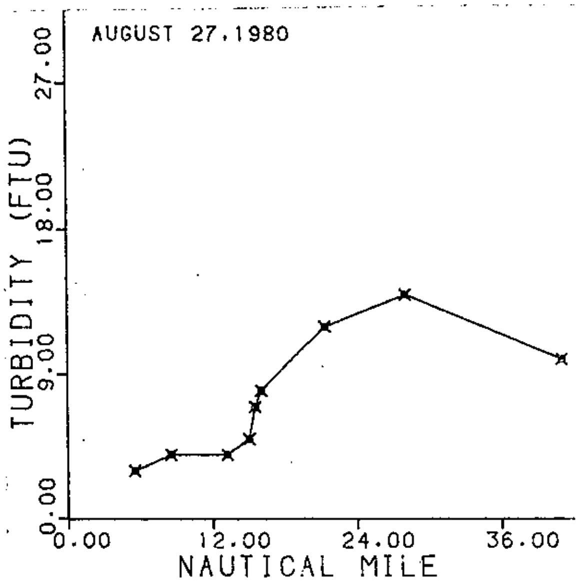


Figure 7-6 Longitudinal slack survey plots for Turbidity (FTU).

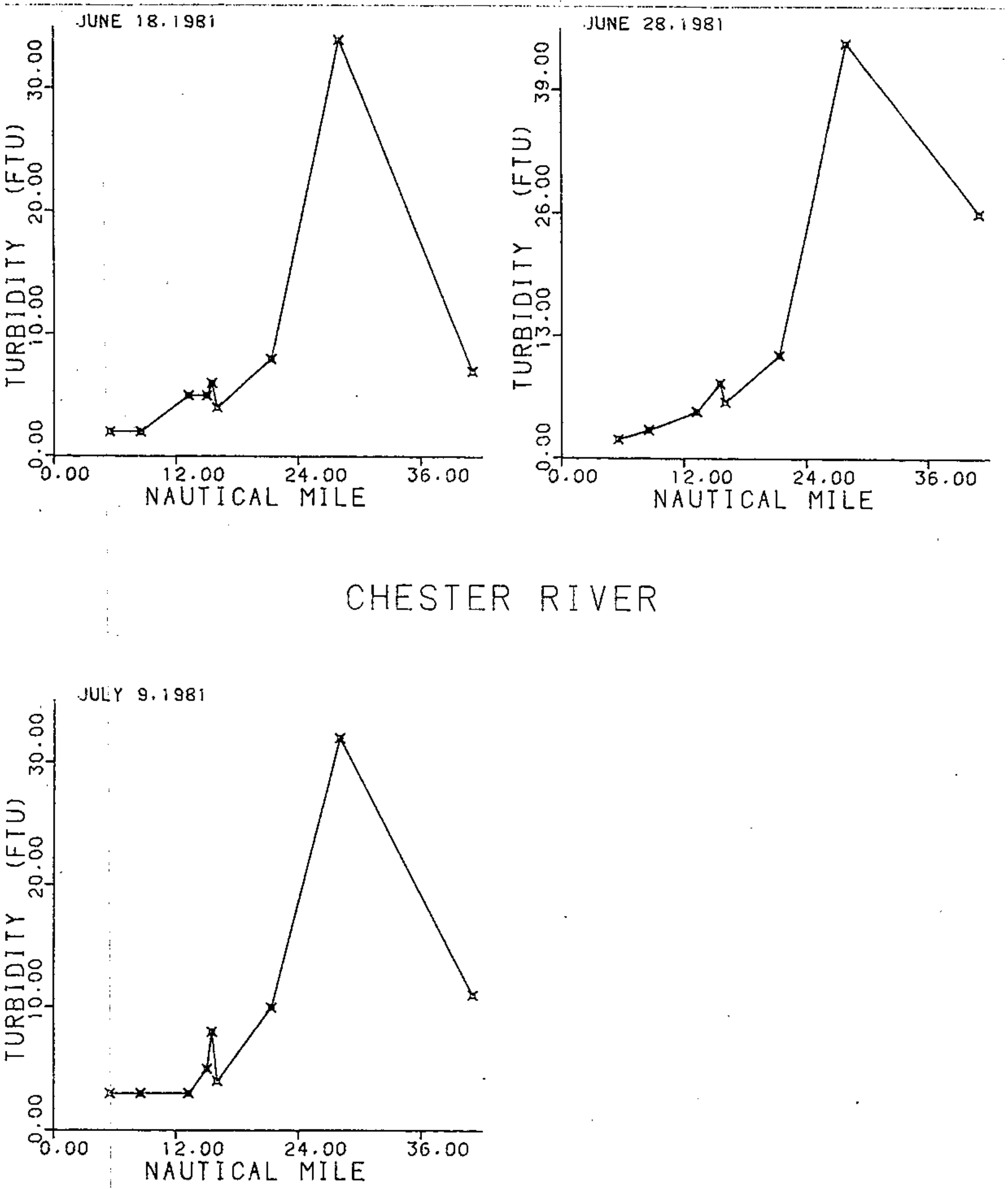
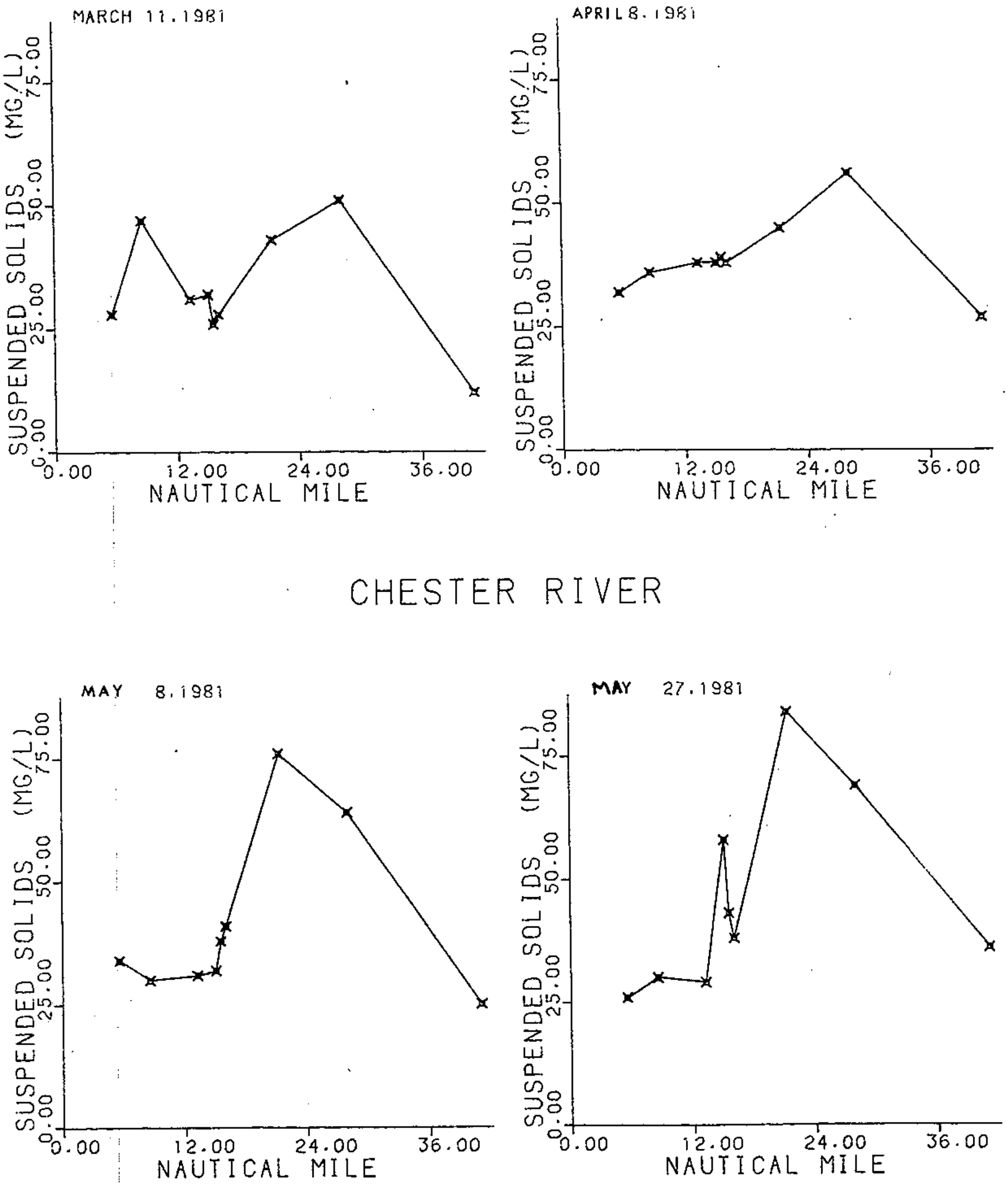


Figure 7-6 Longitudinal Slack survey plots for turbidity, (FTN).



CHESTER RIVER

Figure 7-7 Longitudinal slack survey plots for Suspended Solids or (Total Non-filtered Residues), (mg/l).

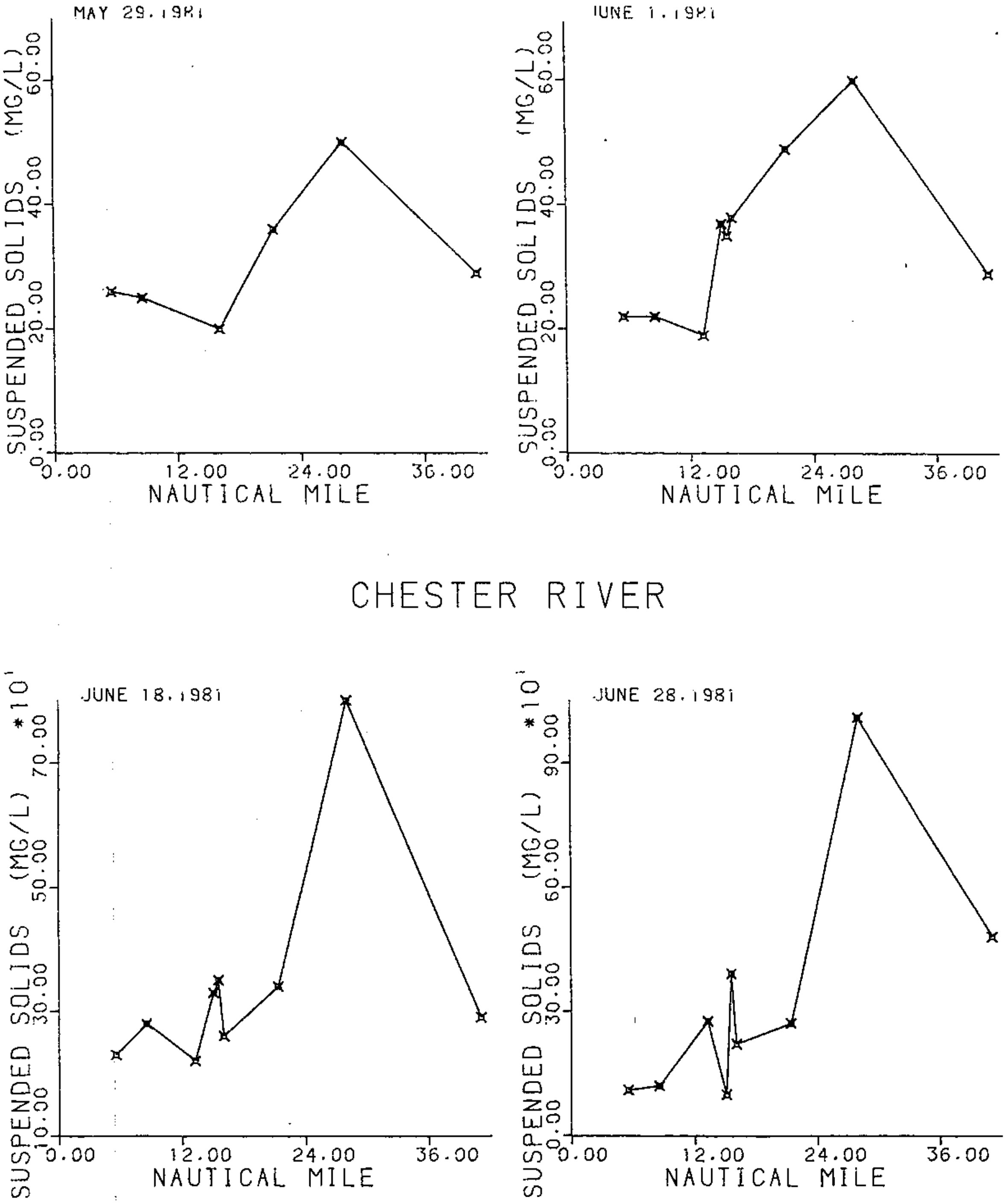


Figure 7-7 Longitudinal slack survey plots for Suspended Solids or (Total Non-filtered Residues), (mg/l).

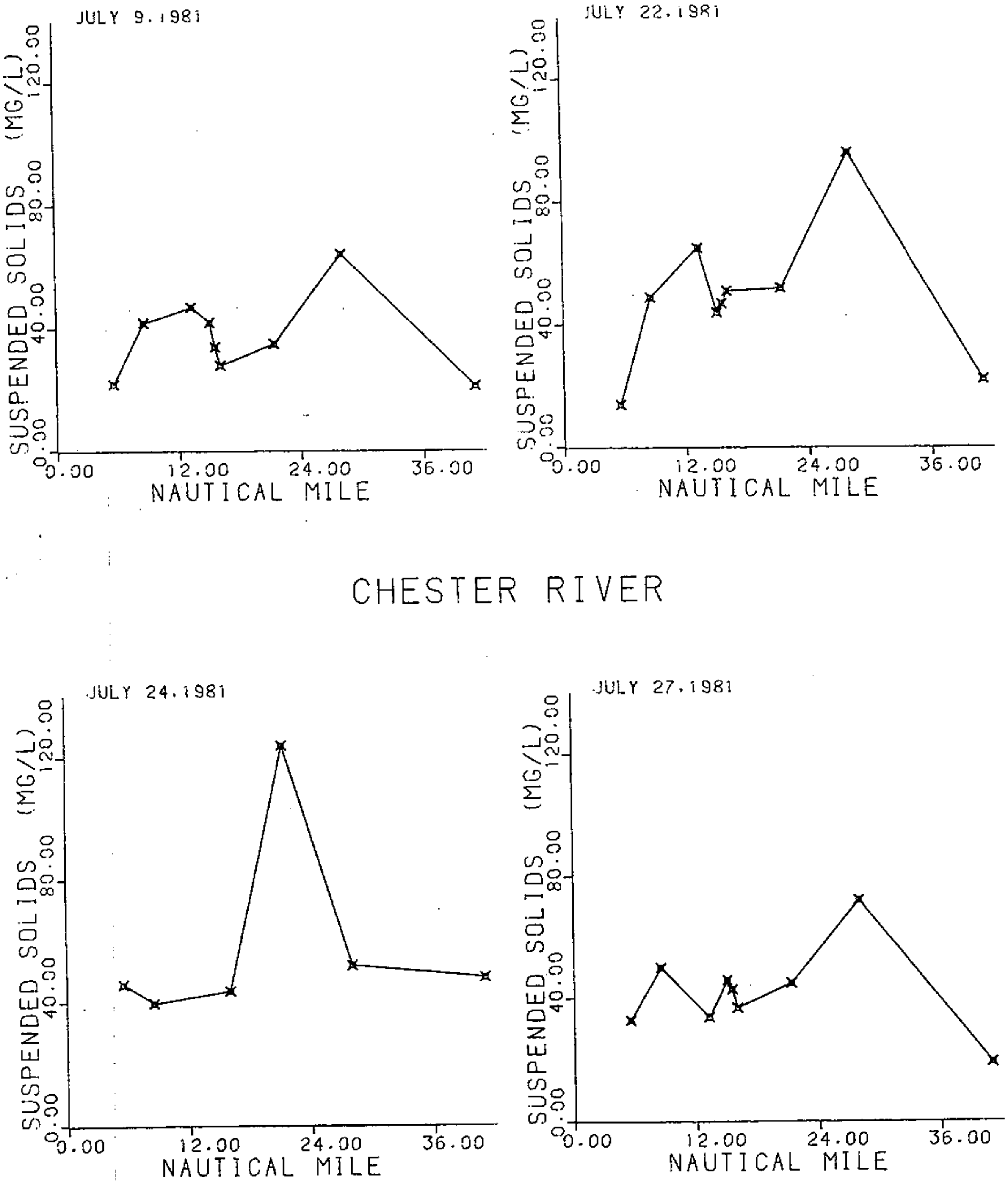


Figure 7-7 Longitudinal slack survey plots for Suspended Solids or (Total Non-filtered Residues), (mg/l).

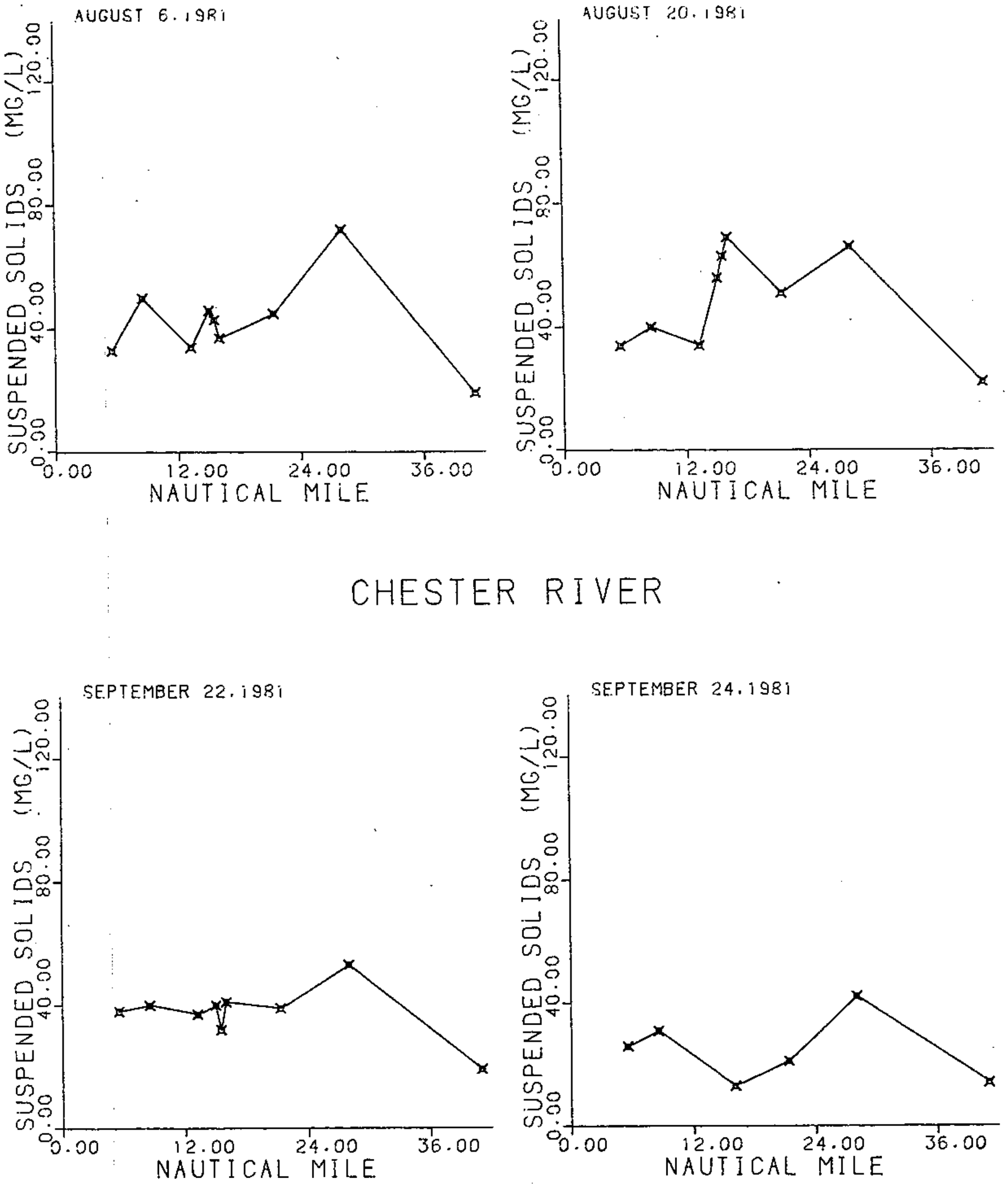


Figure 7-7 Longitudinal slack survey plots for Suspended Solids or (Total Non-filtered Residues), (mg/l).

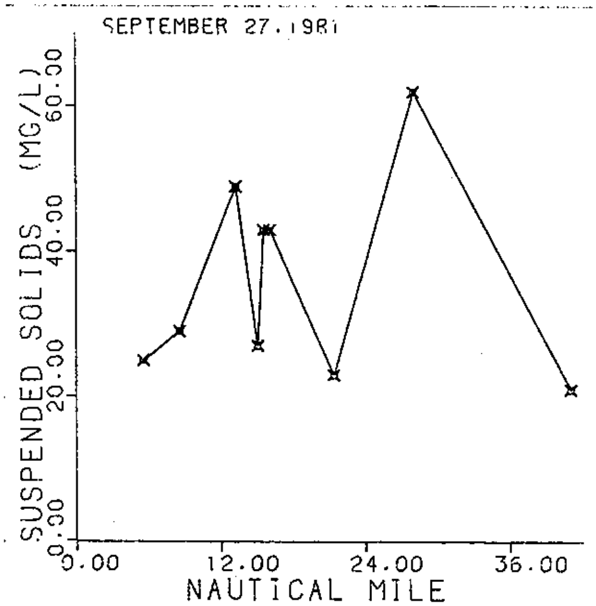
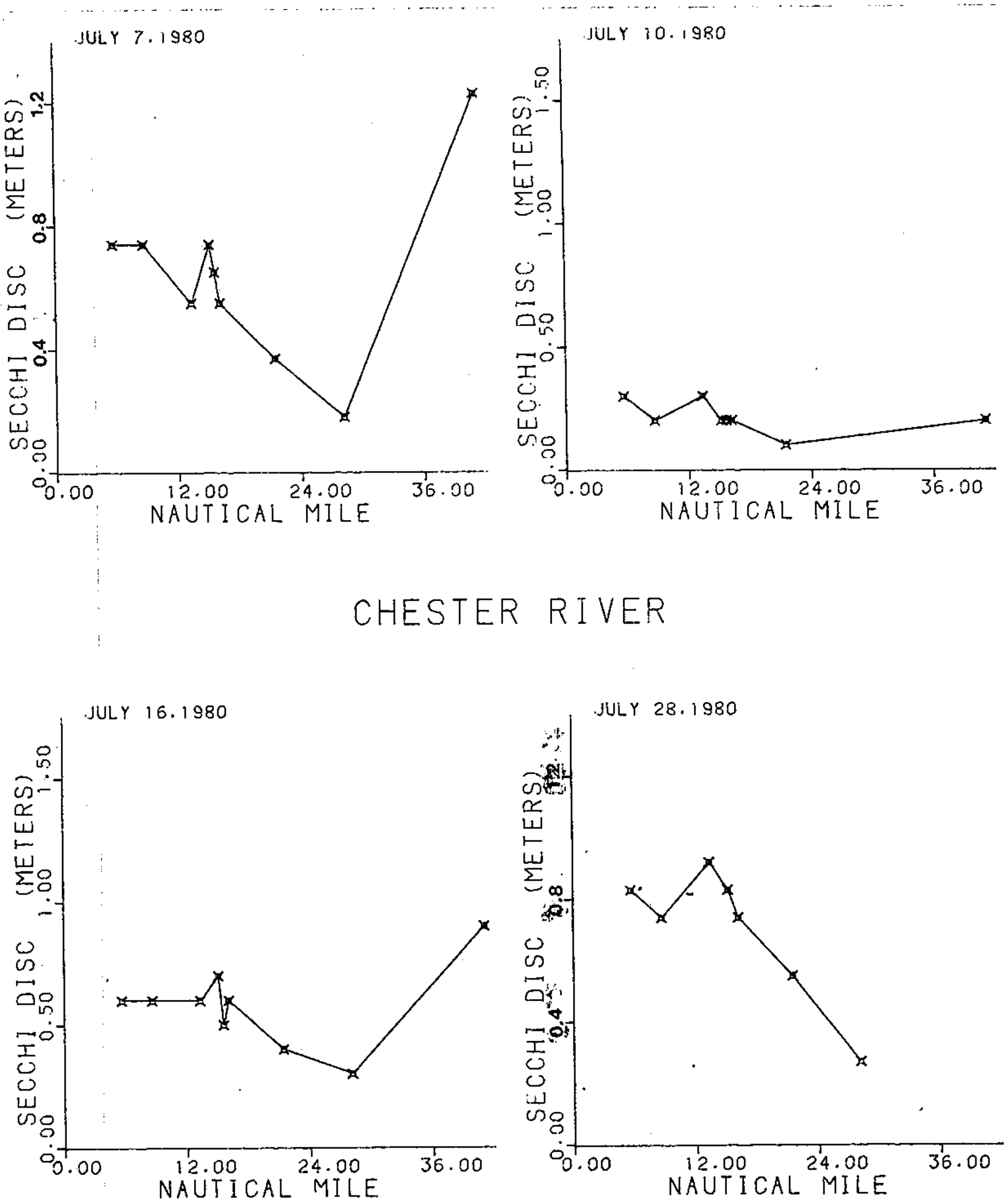


Figure 7-7 Longitudinal slack survey plots for Suspended Solids or (Total Non-filtered Residues), (mg/l).



CHESTER RIVER

Figure 7-8 Longitudinal slack survey plots for Secchi Disc, (meters).

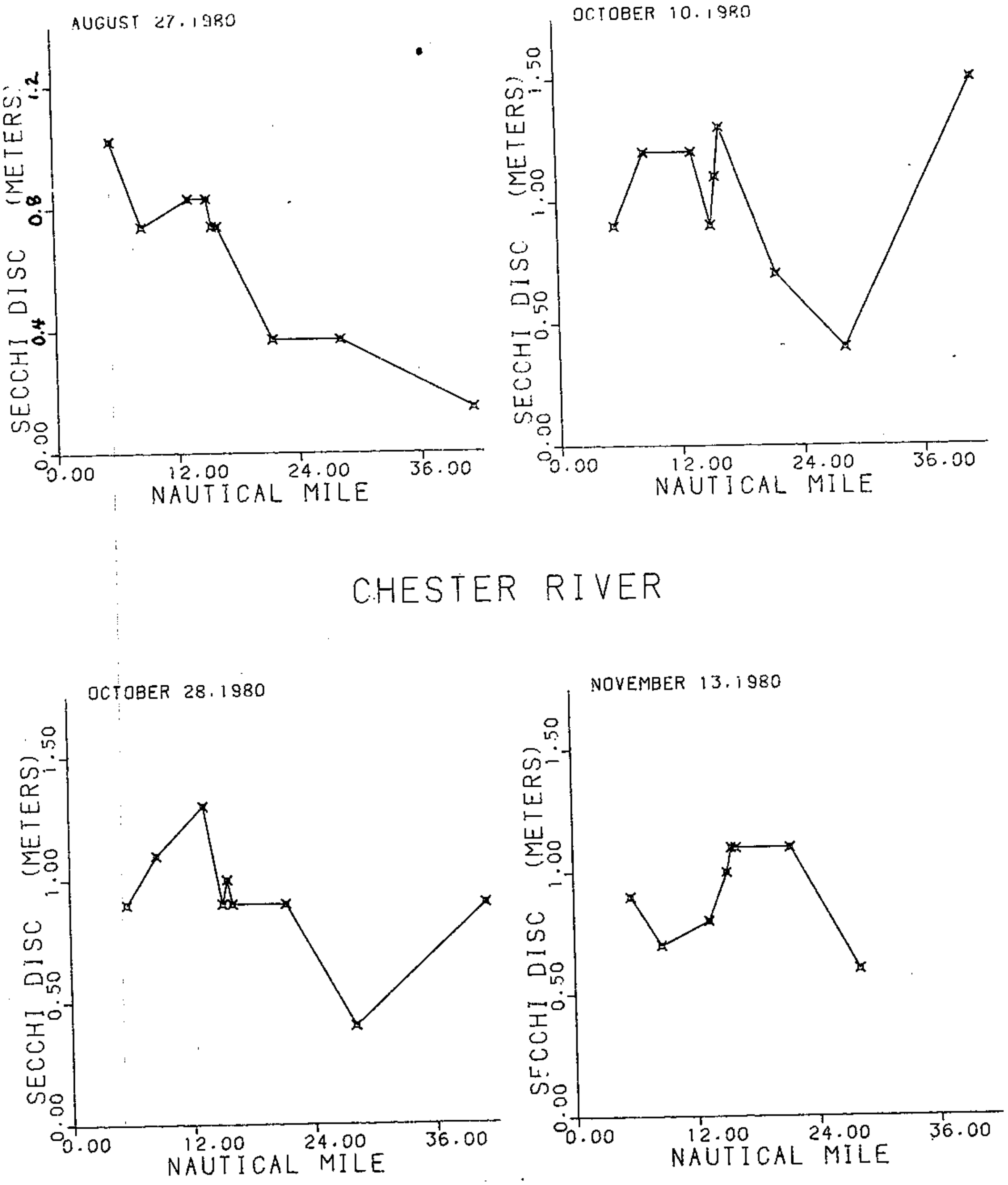


Figure 7-8 Longitudinal slack survey plots for Secchi Disc, (meters).

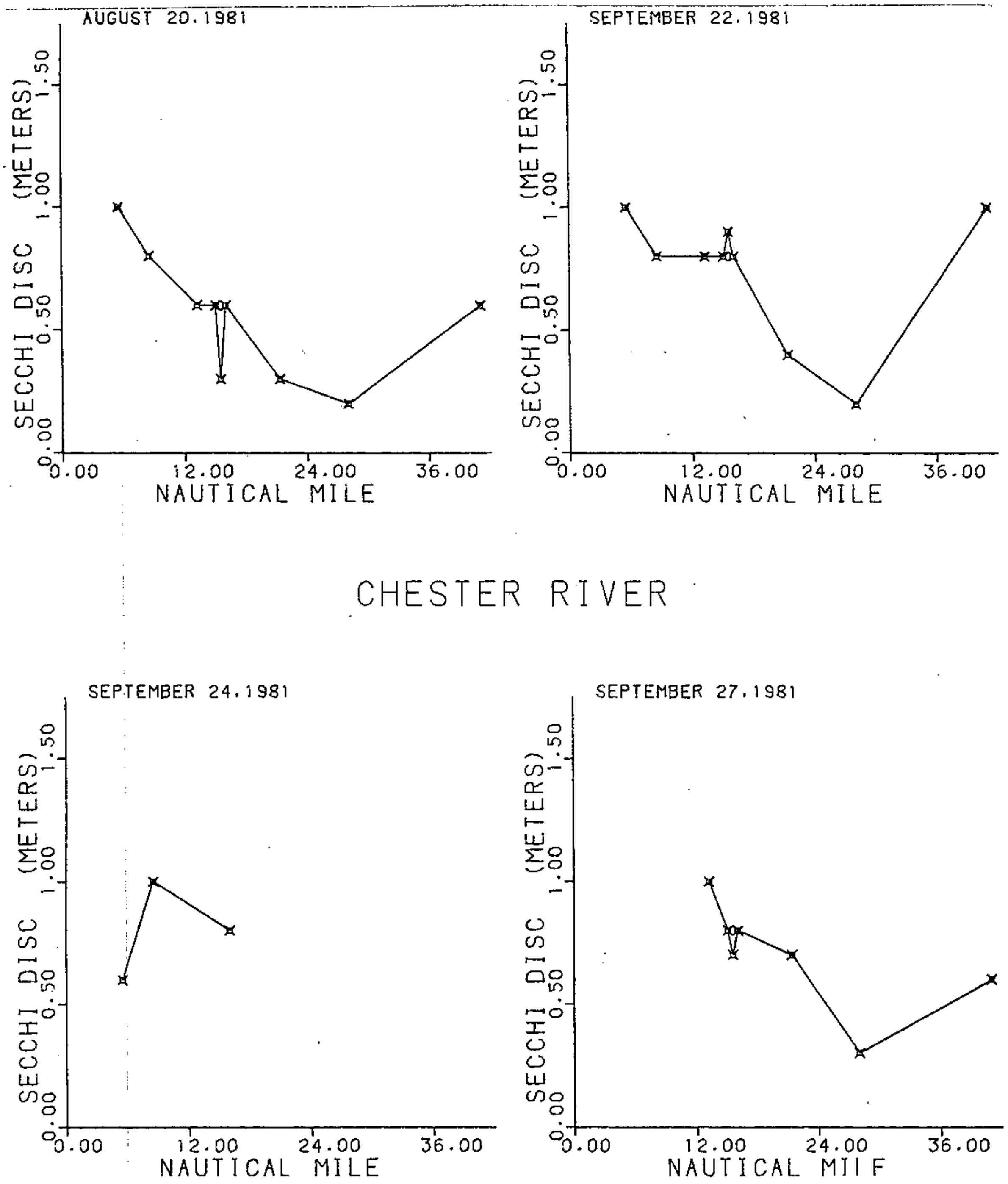


Figure 7-8 Longitudinal slack survey plots for Secchi Disc (meters).

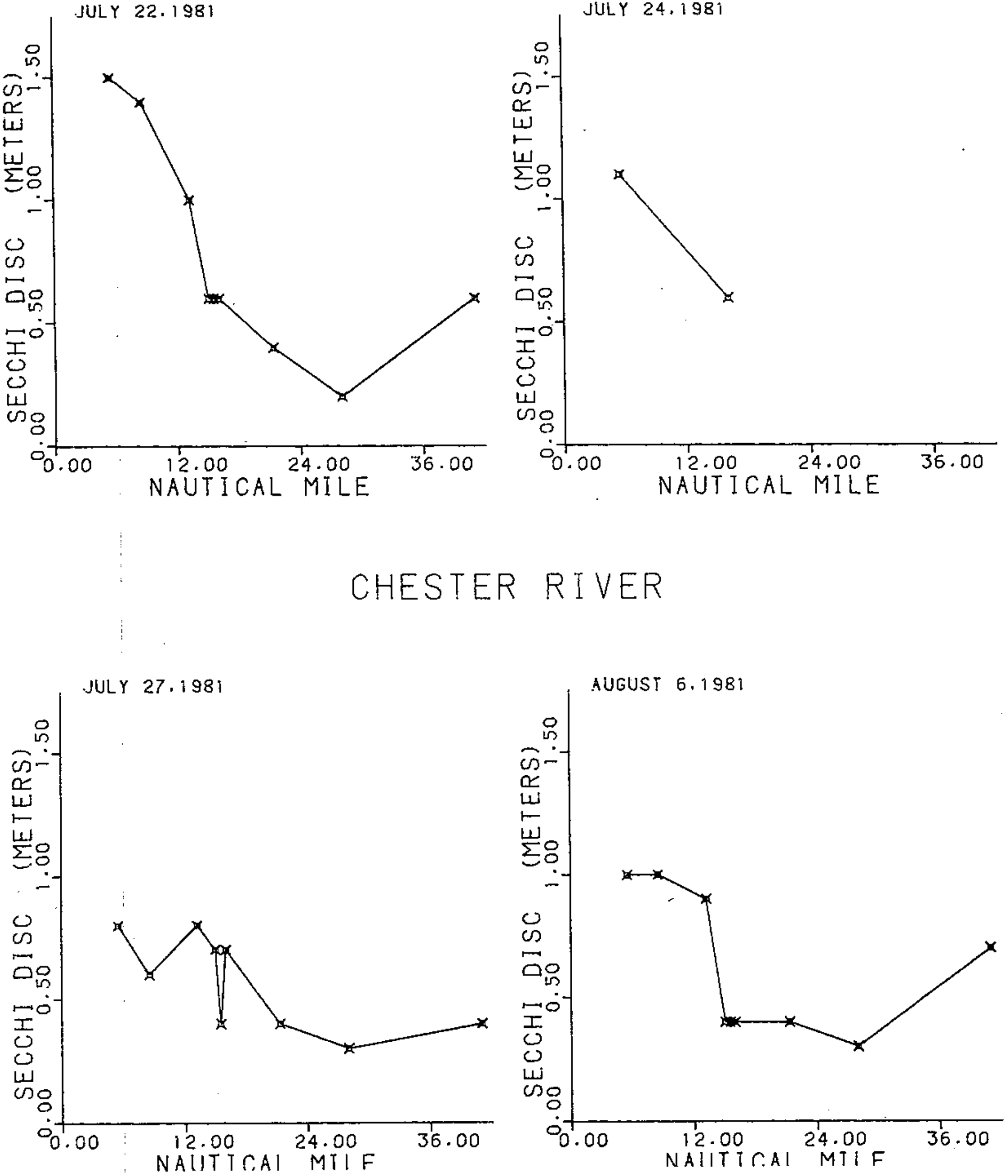


Figure 7-8 Longitudinal slack survey plots for secchi disc (meters).

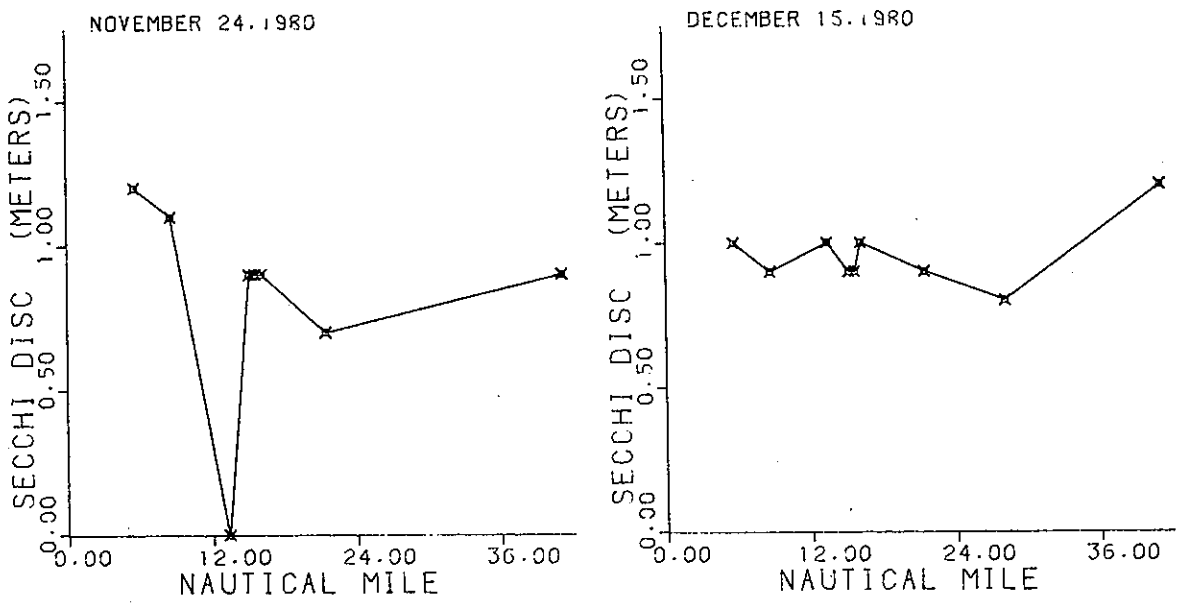
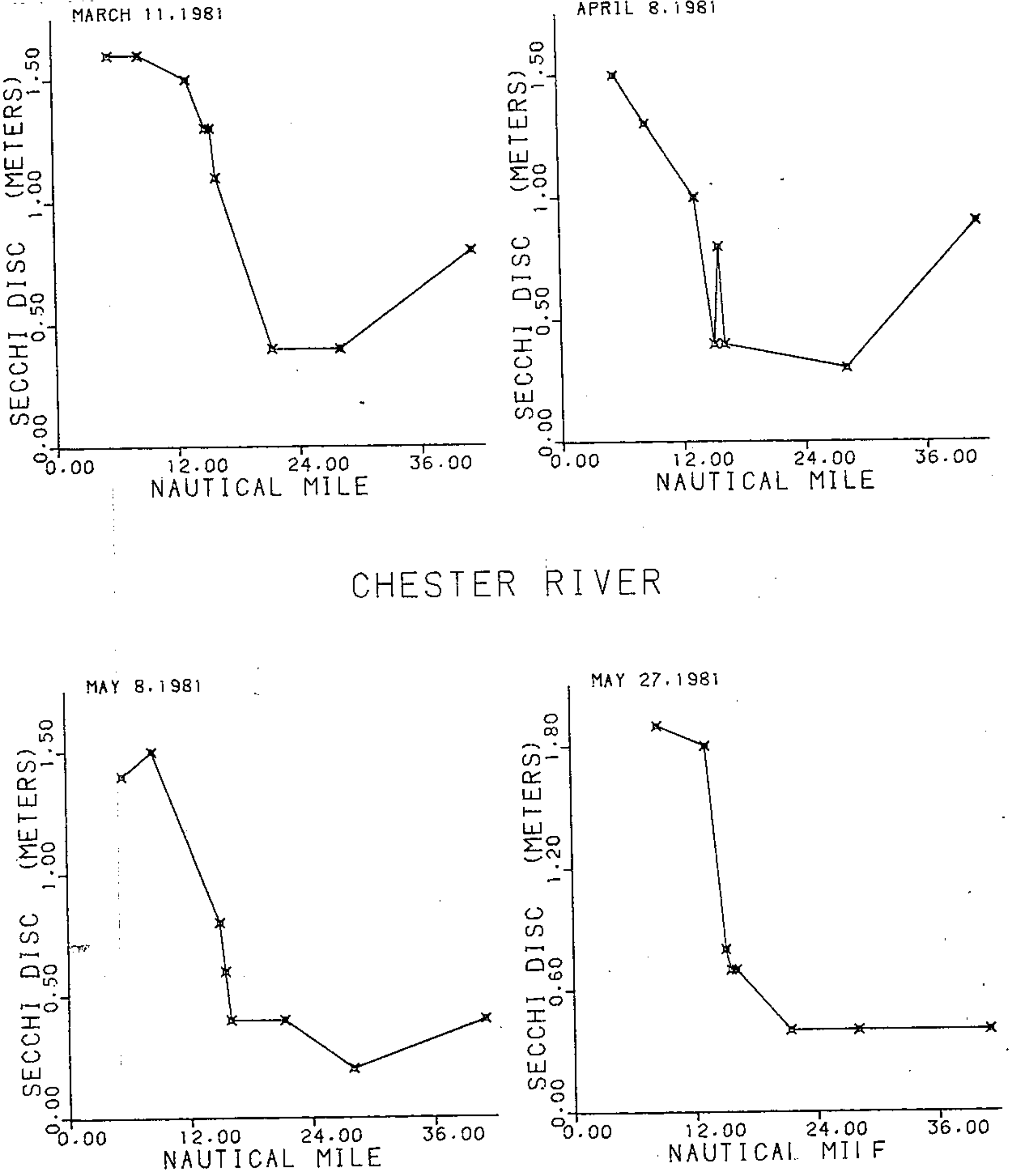


Figure 7-8 Longitudinal slack survey plots for Secchi Disc, (meters).


CHESTER RIVER

F igure 7-8 Longitudinal slack survey plot for Secchi Disc (meters).

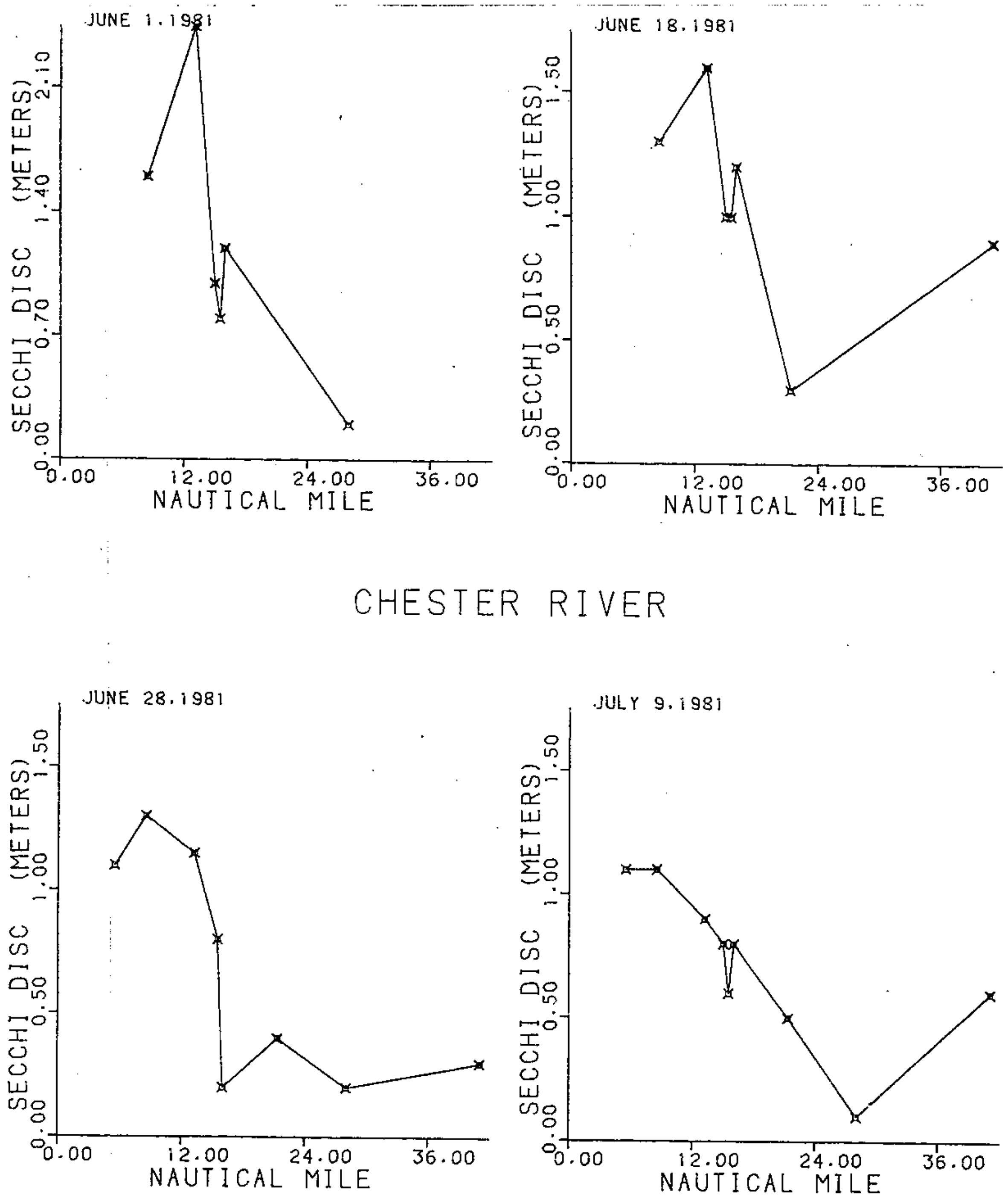


Figure 7-8 Longitudinal slack survey plots for Secchi disc, (meters).

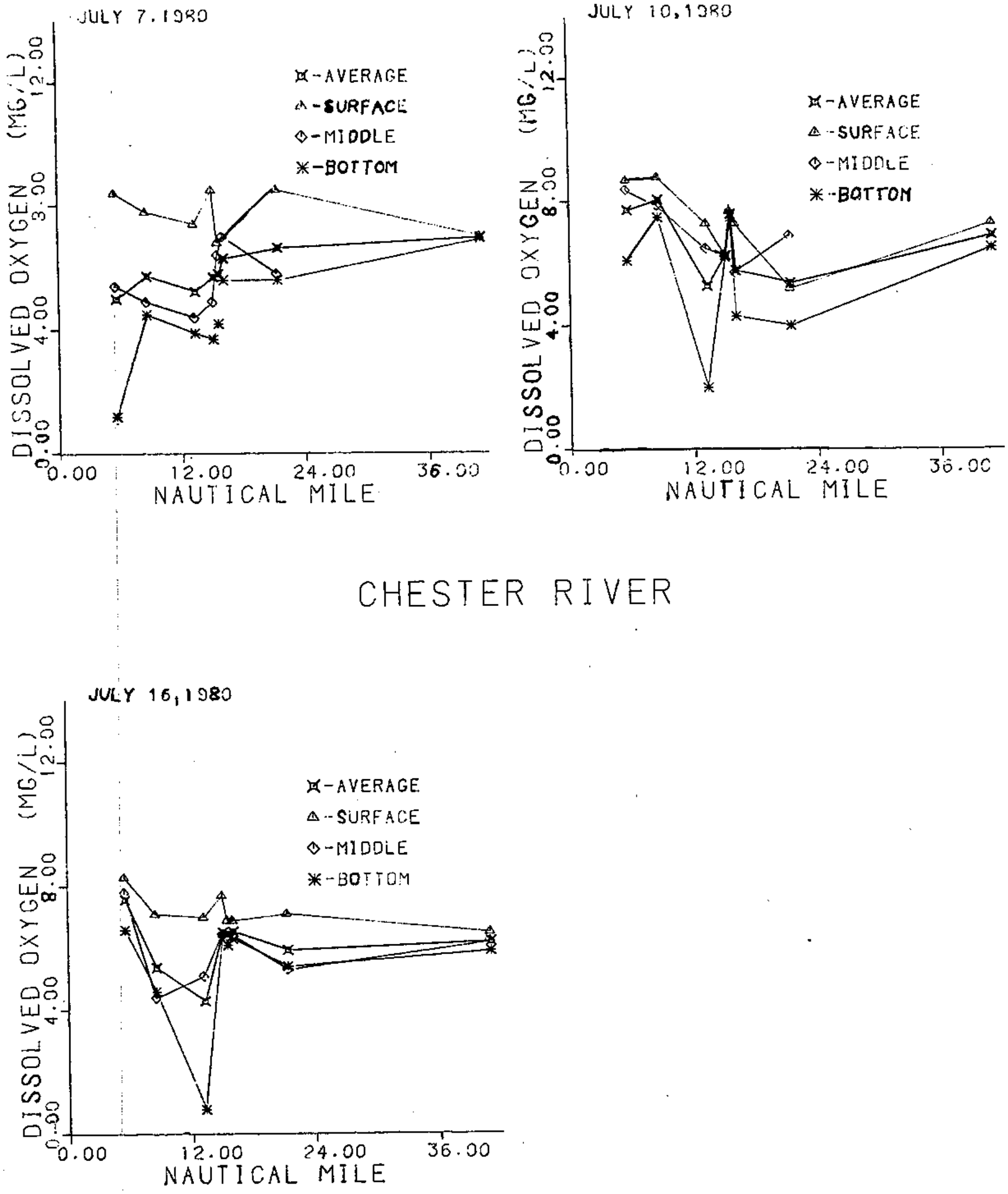
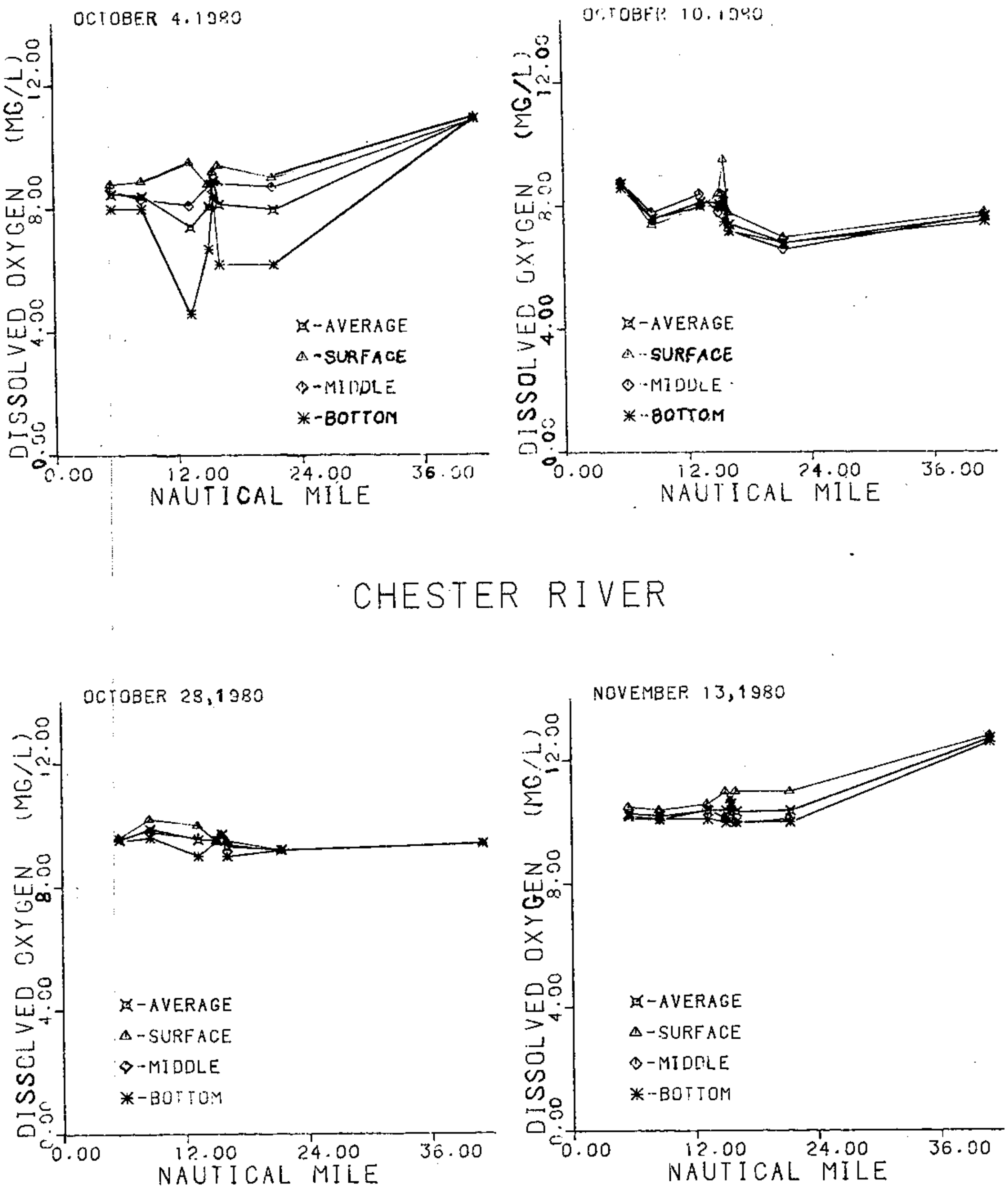

CHESTER RIVER

Figure 7-9 Longitudinal slack survey plots for Dissolved Oxygen, (mg/l).



CHESTER RIVER

Figure 7-9 Longitudinal slack survey plots for Dissolved Oxygen, (mg/l).

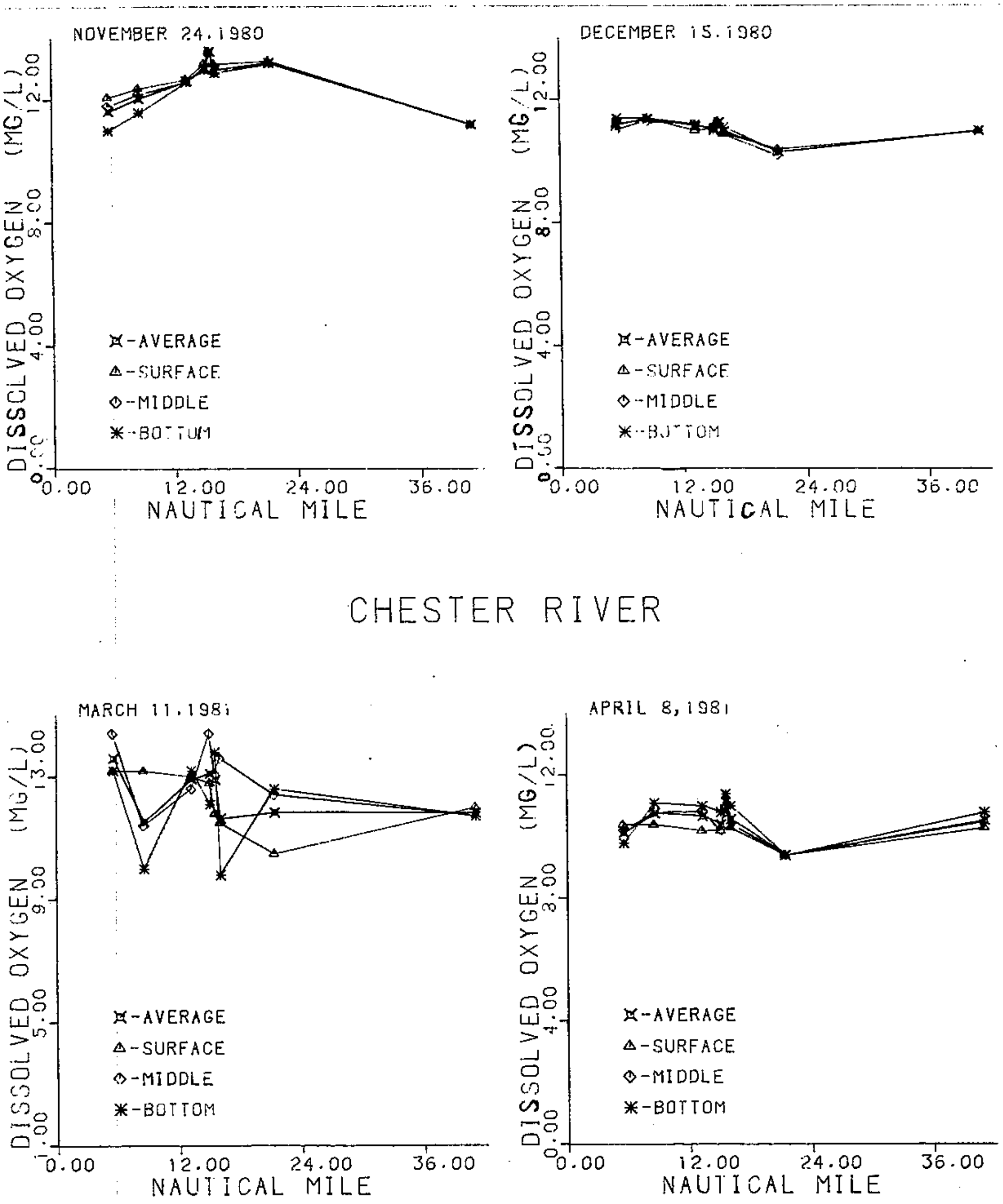


Figure 7-9 Longitudinal slack survey plots for Dissolved Oxyten, (mg/l).

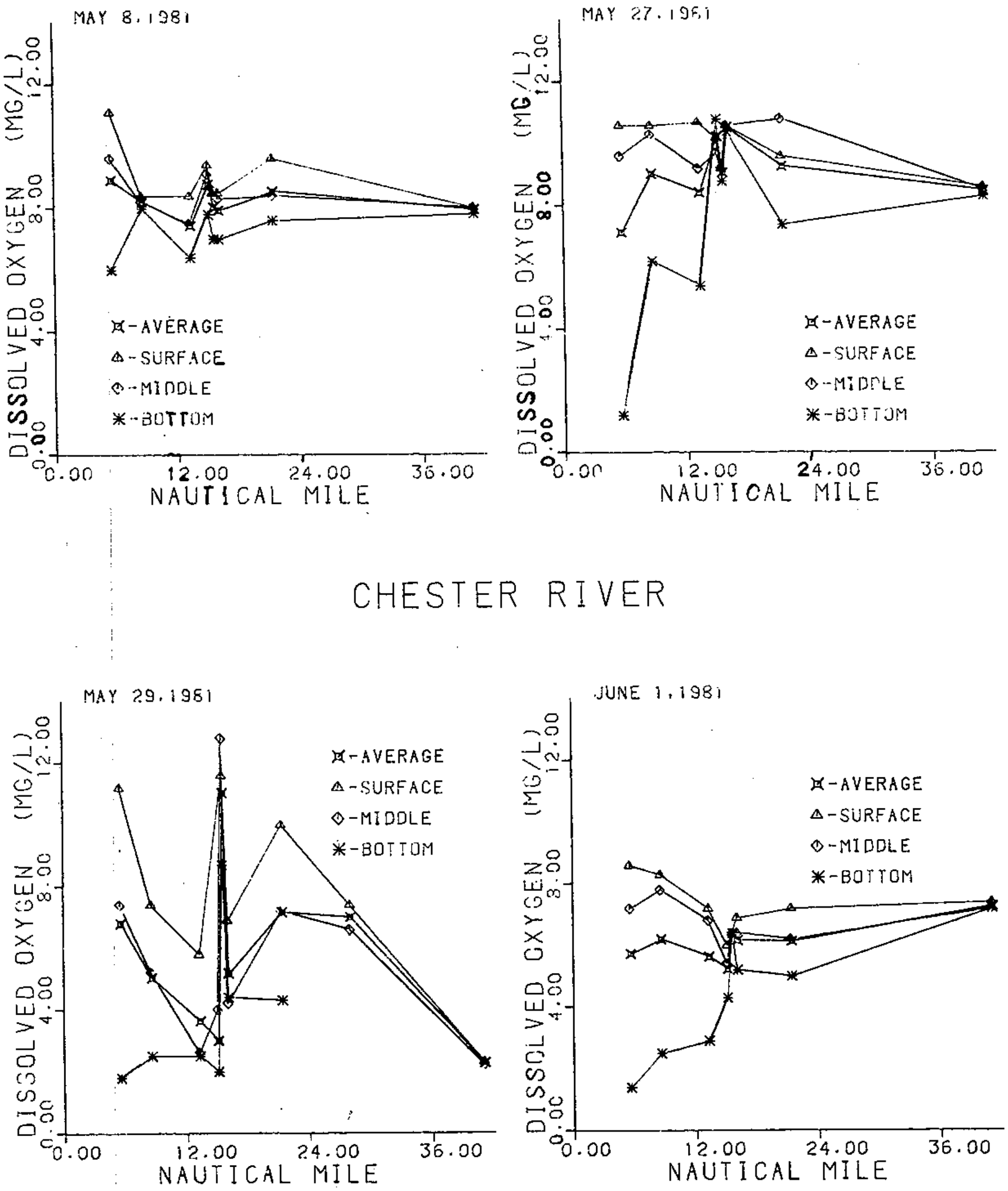
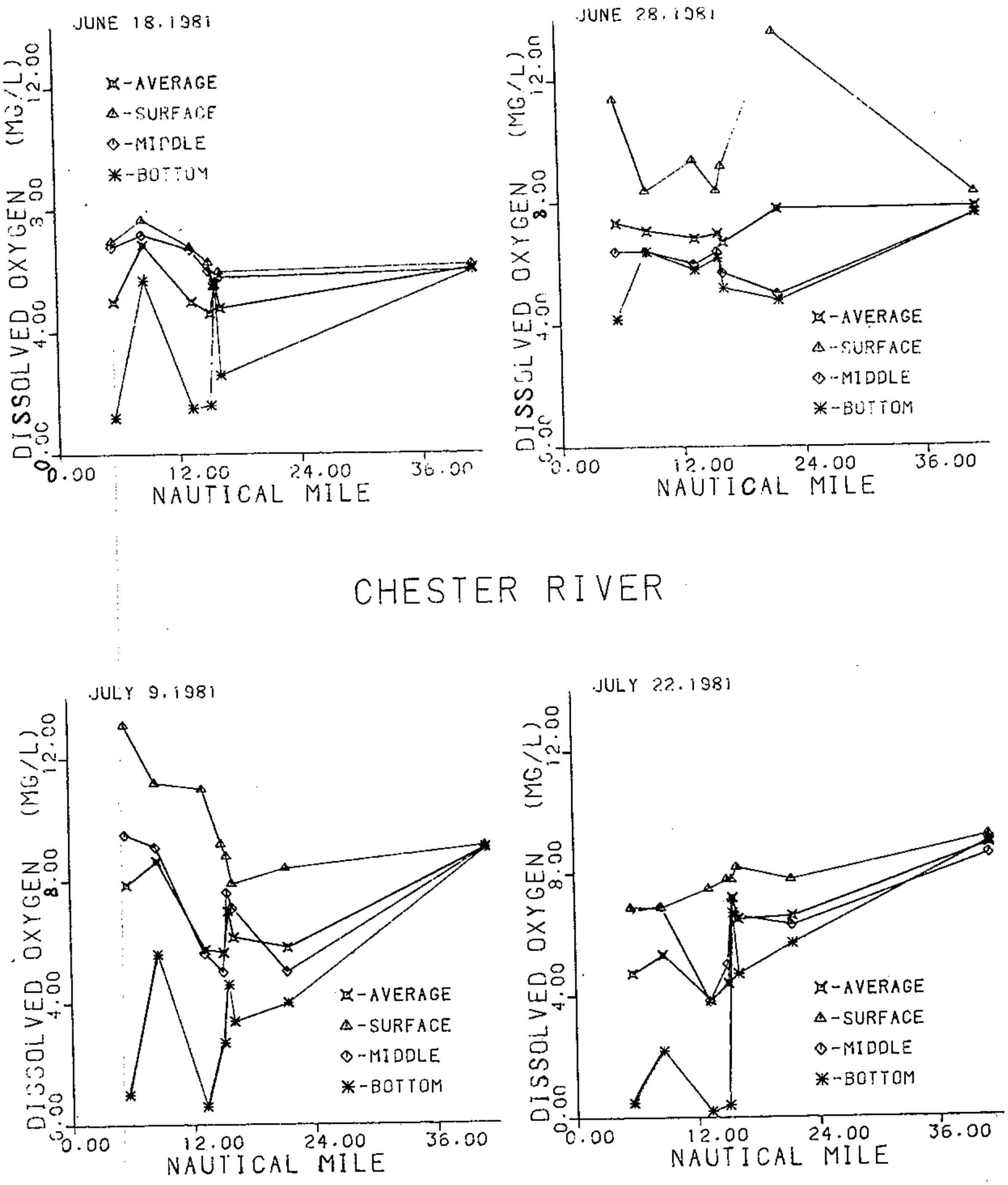


Figure 7-9 Longitudinal slack survey plots for Dissolved Oxygen, (mg/l).



CHESTER RIVER

Figure 7- 9 Longitudinal slack survey plots for Dissolved Oxygen, (mg/l).

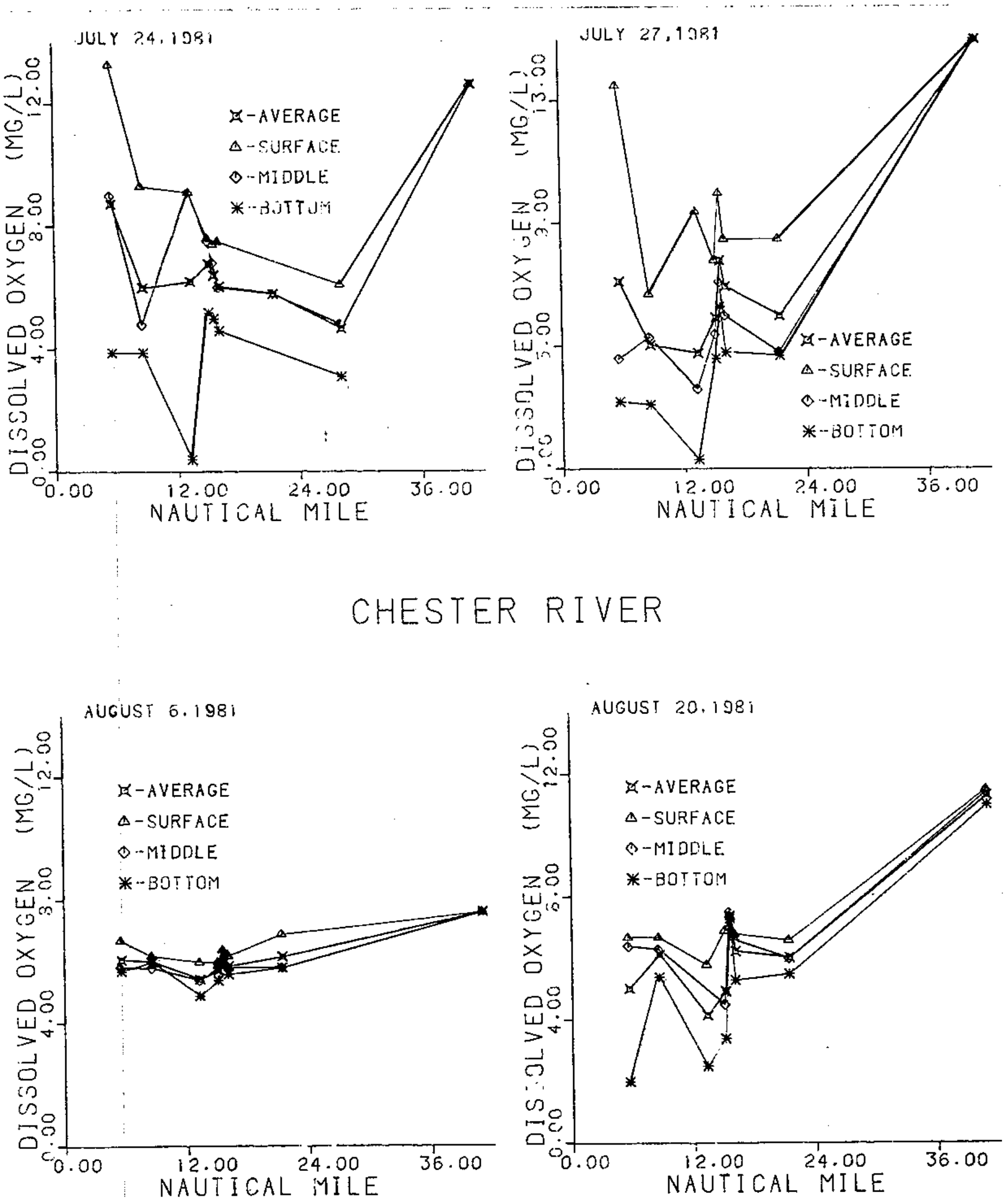
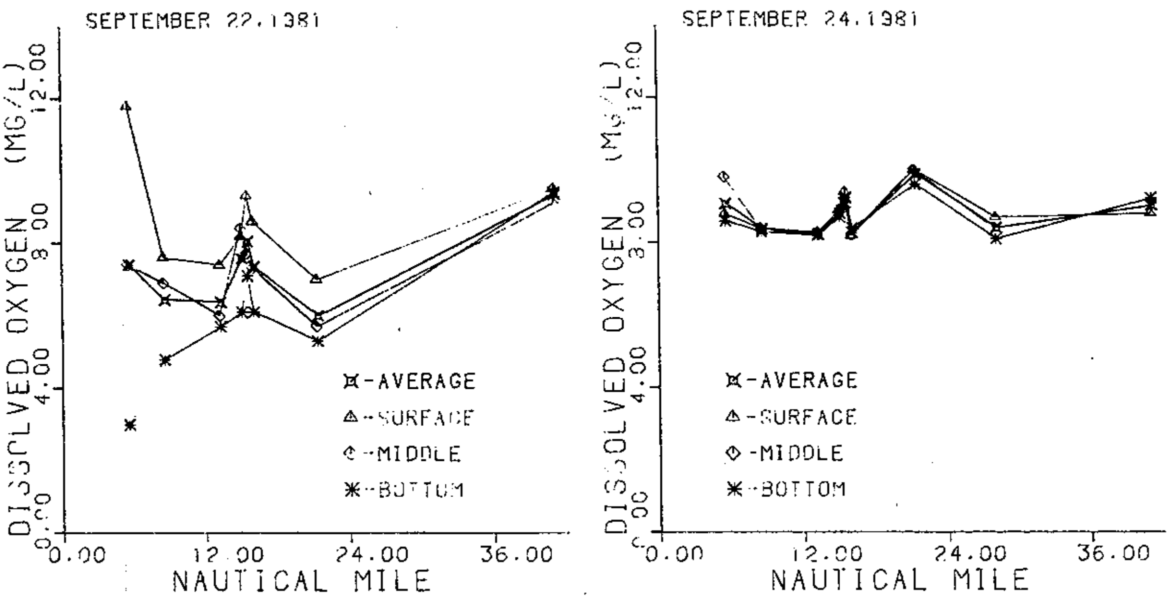


Figure 7-9 Longitudinal slack survey plots for Dissolved Oxygen, (mg/l).



CHESTER RIVER

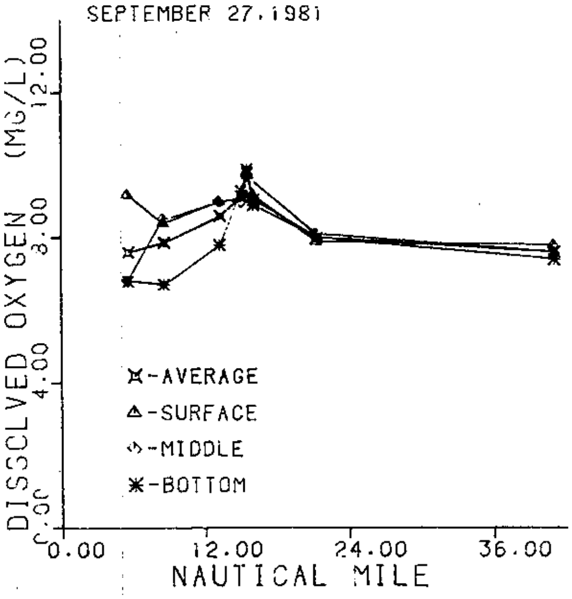


Figure 7-9 Longitudinal slack survey plots for Dissolved Oxygen, (mg/l).

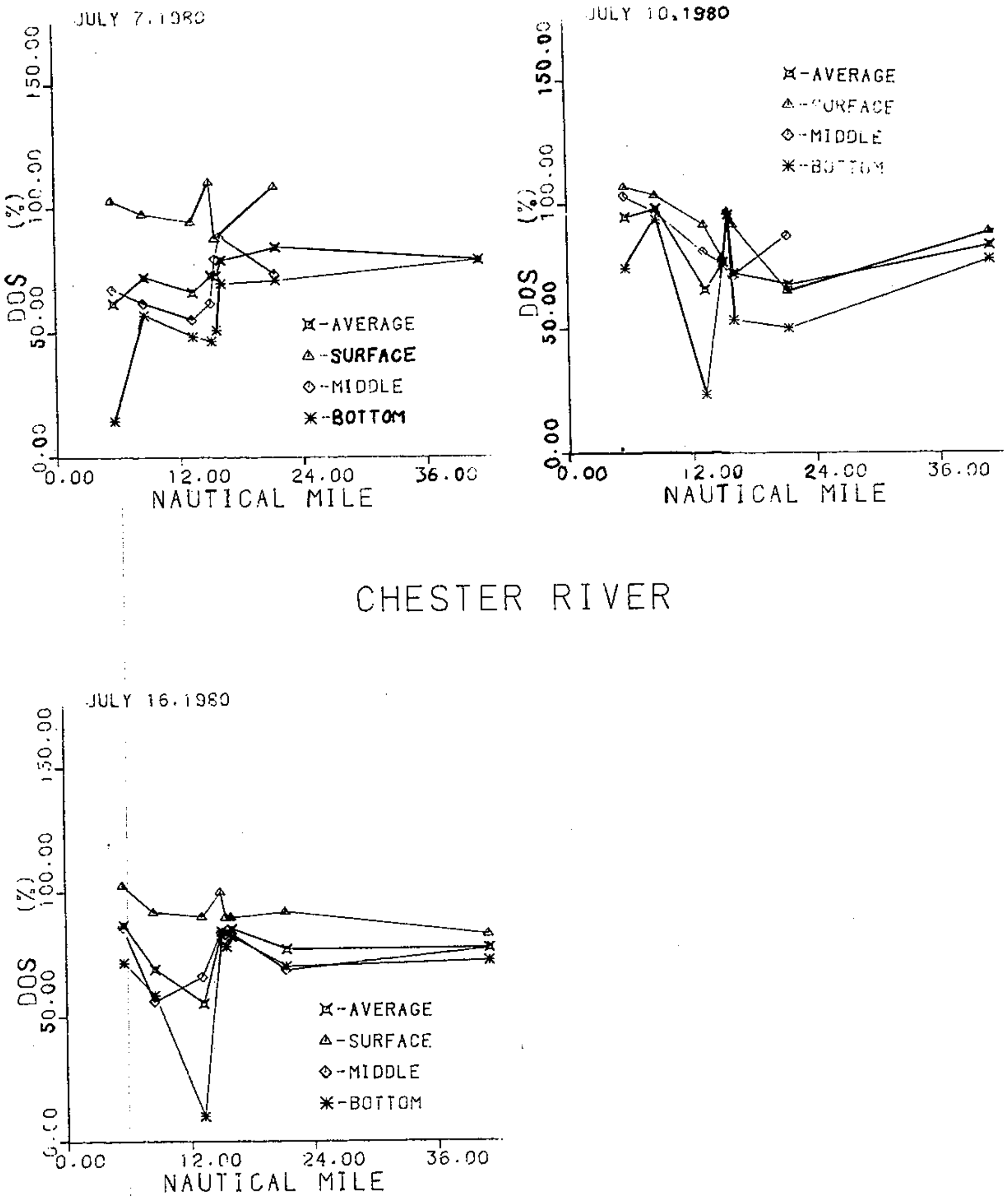


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

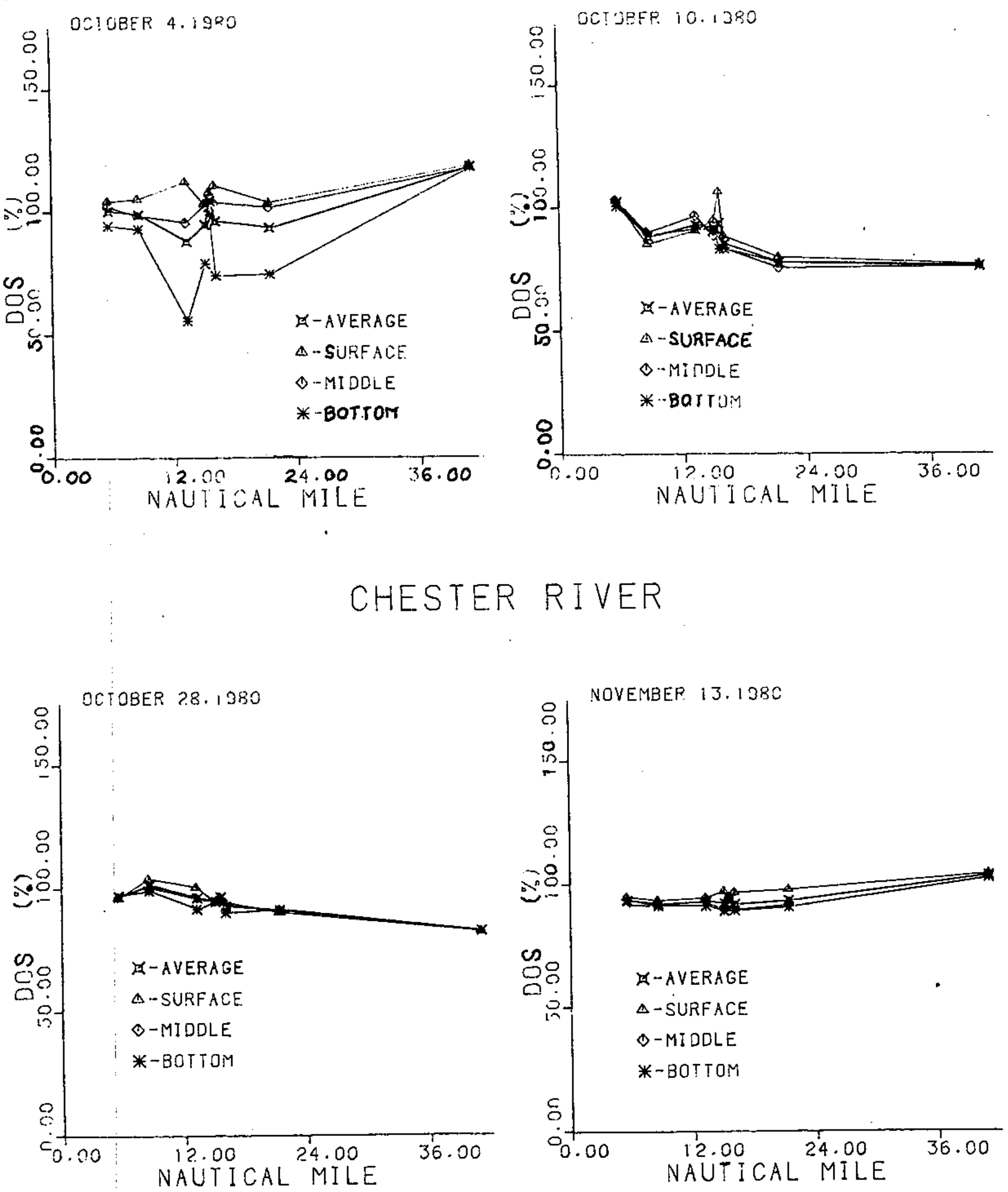


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

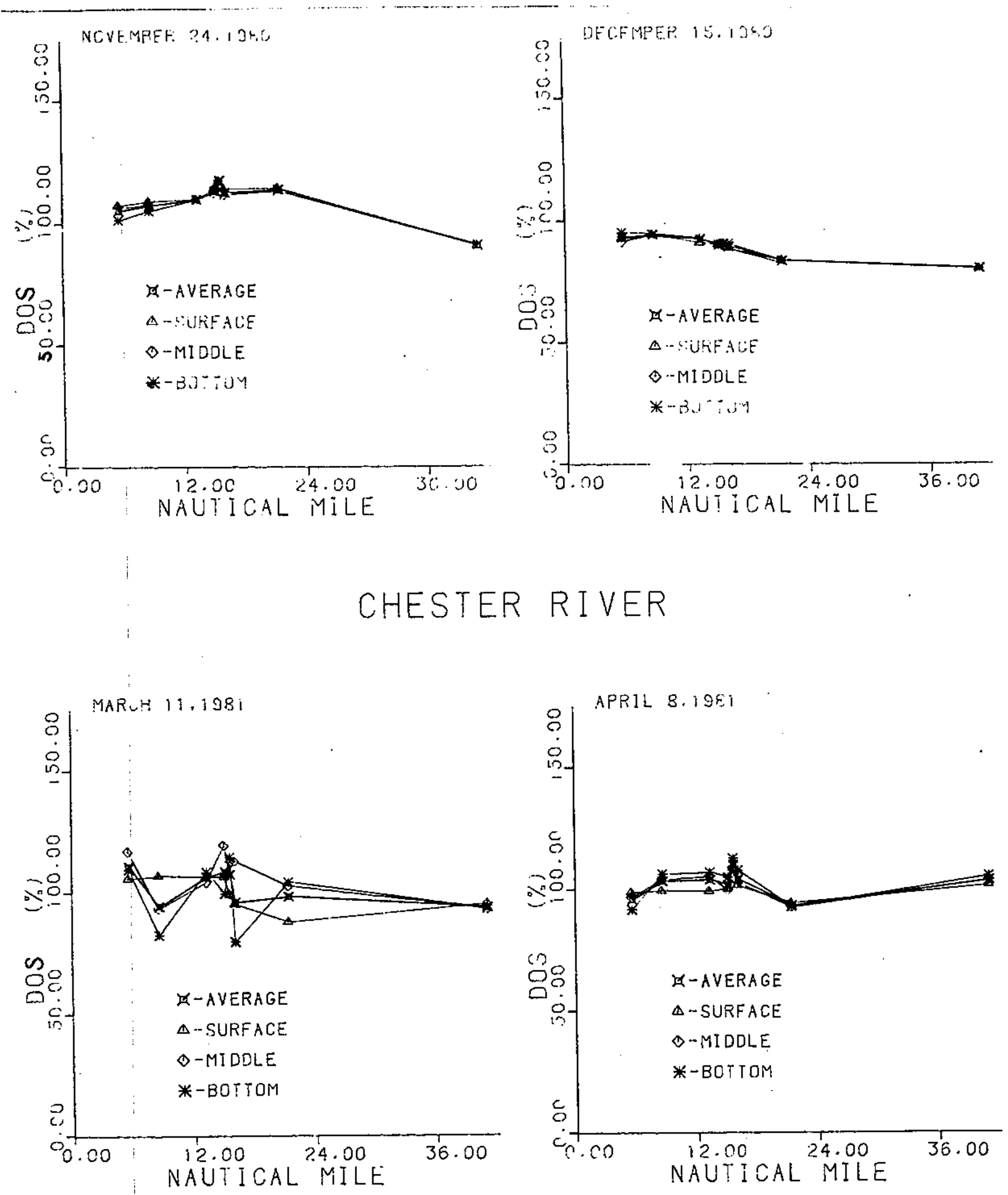


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

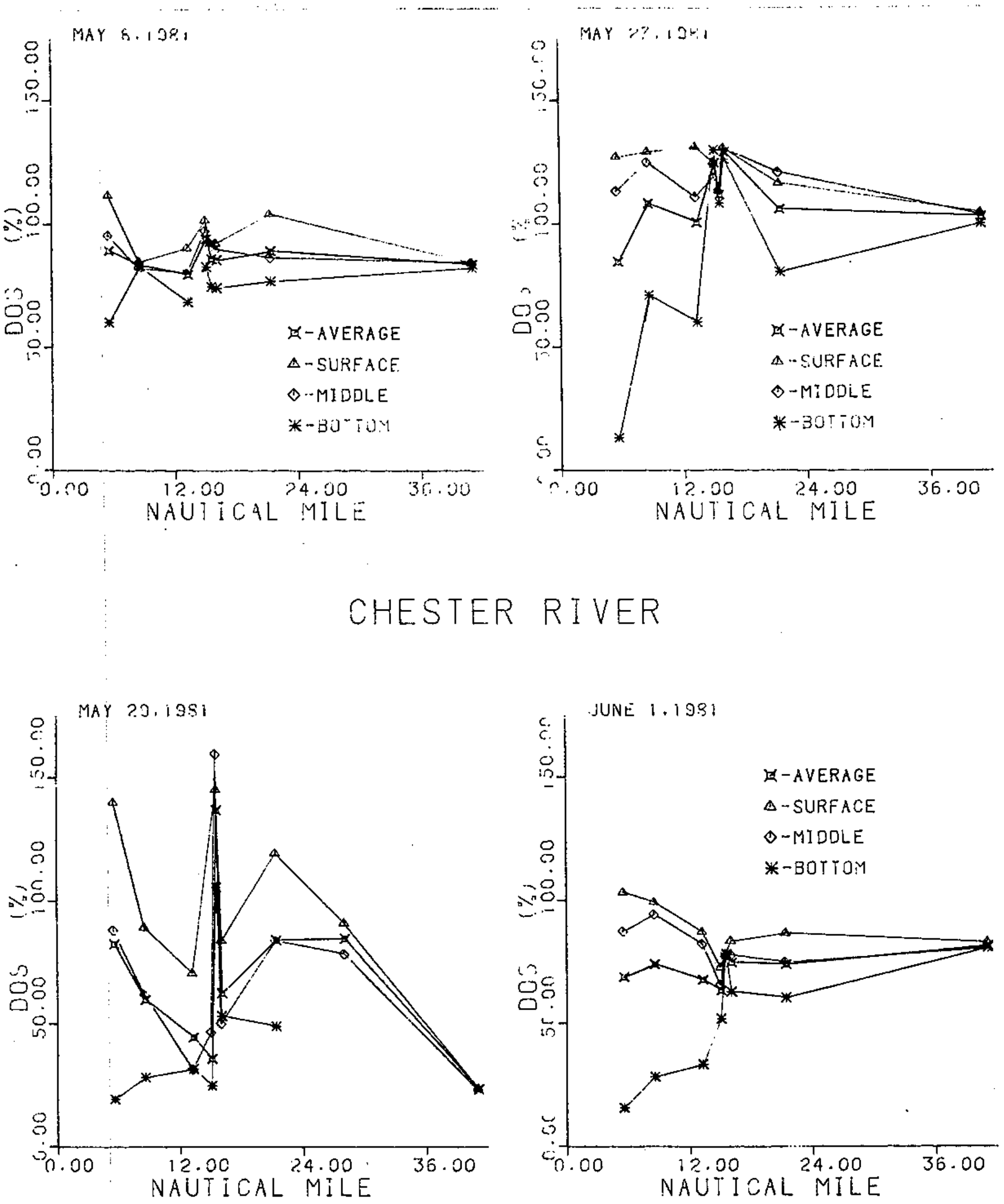

CHESTER RIVER

Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

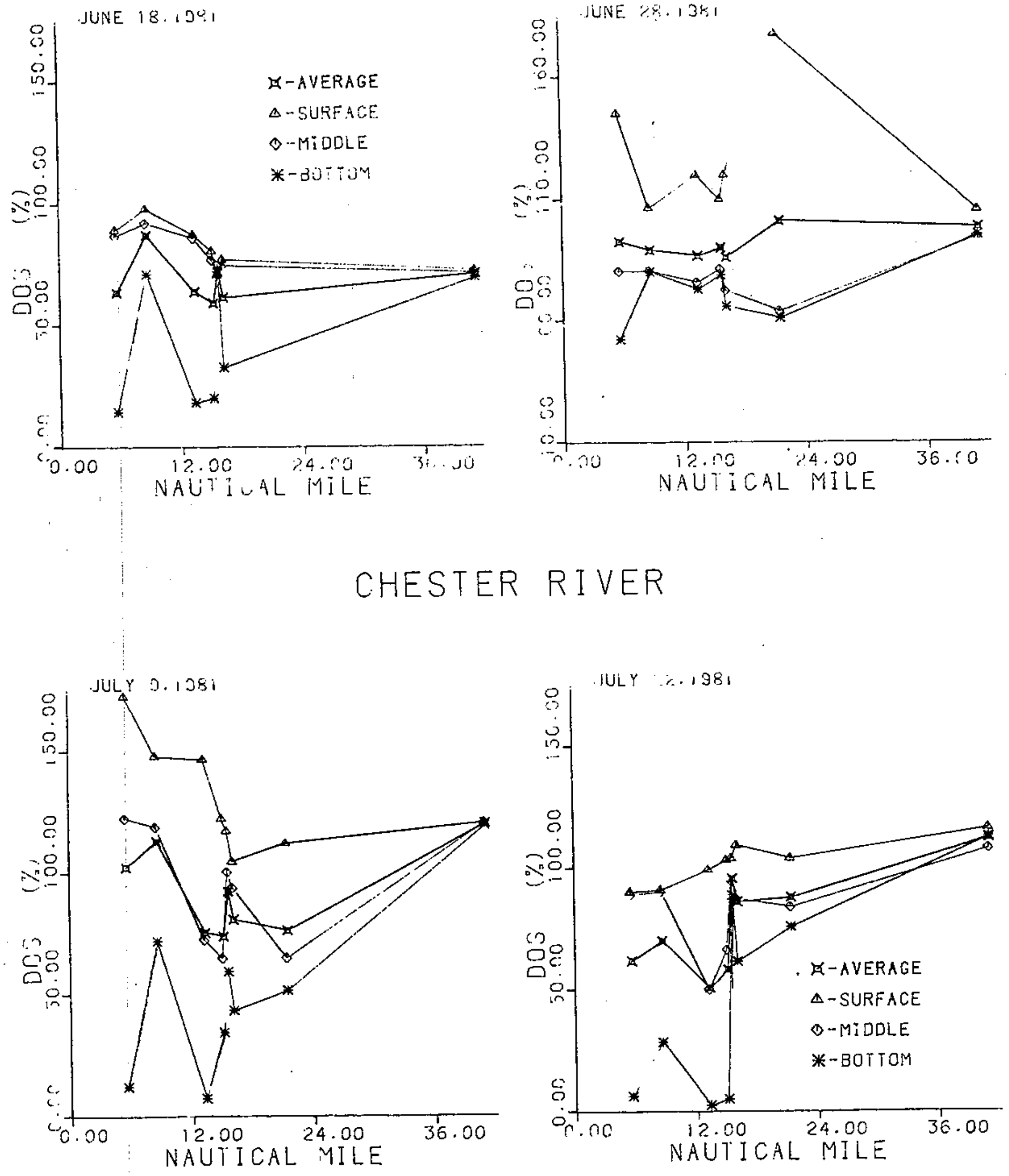


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

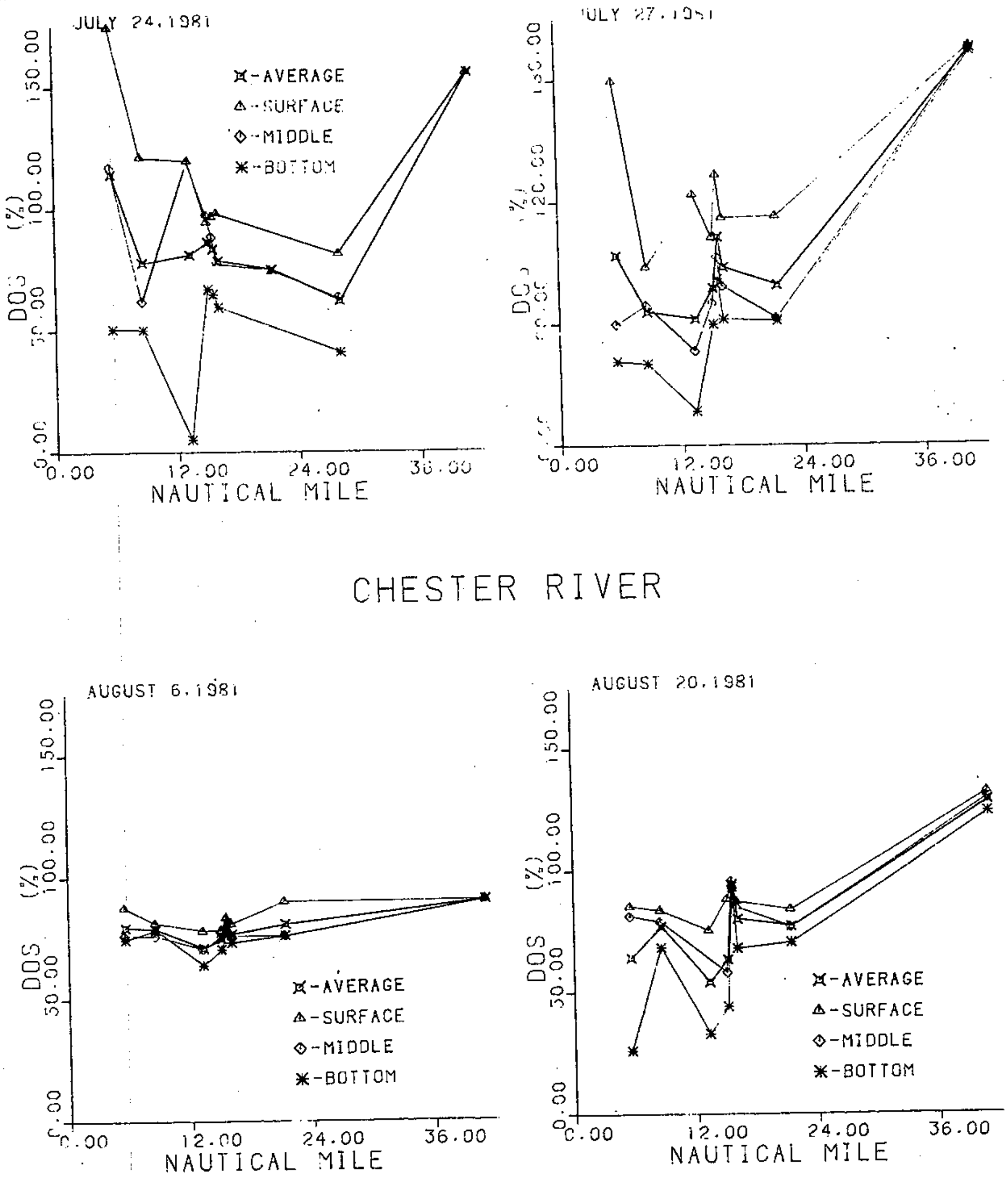


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

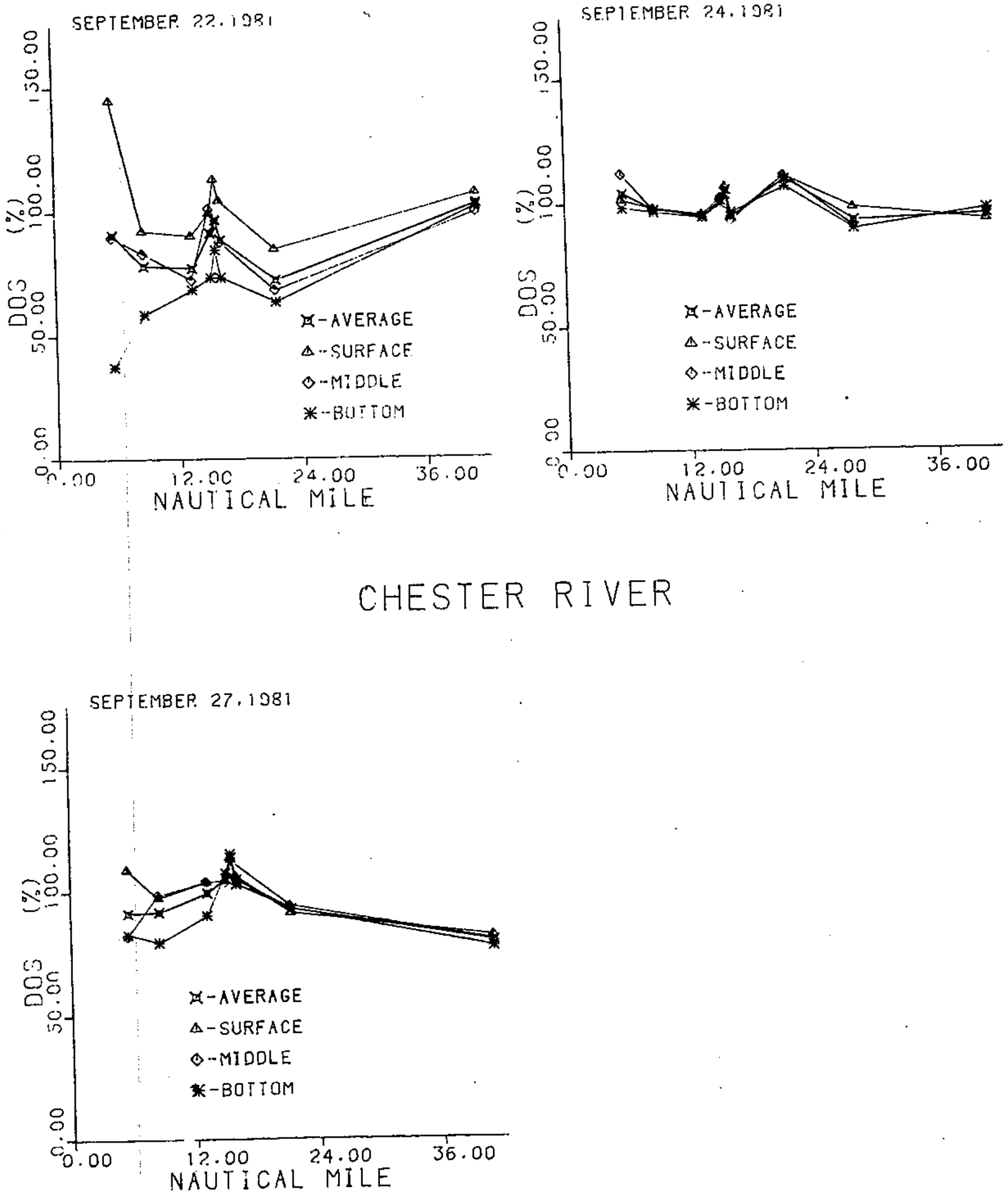


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

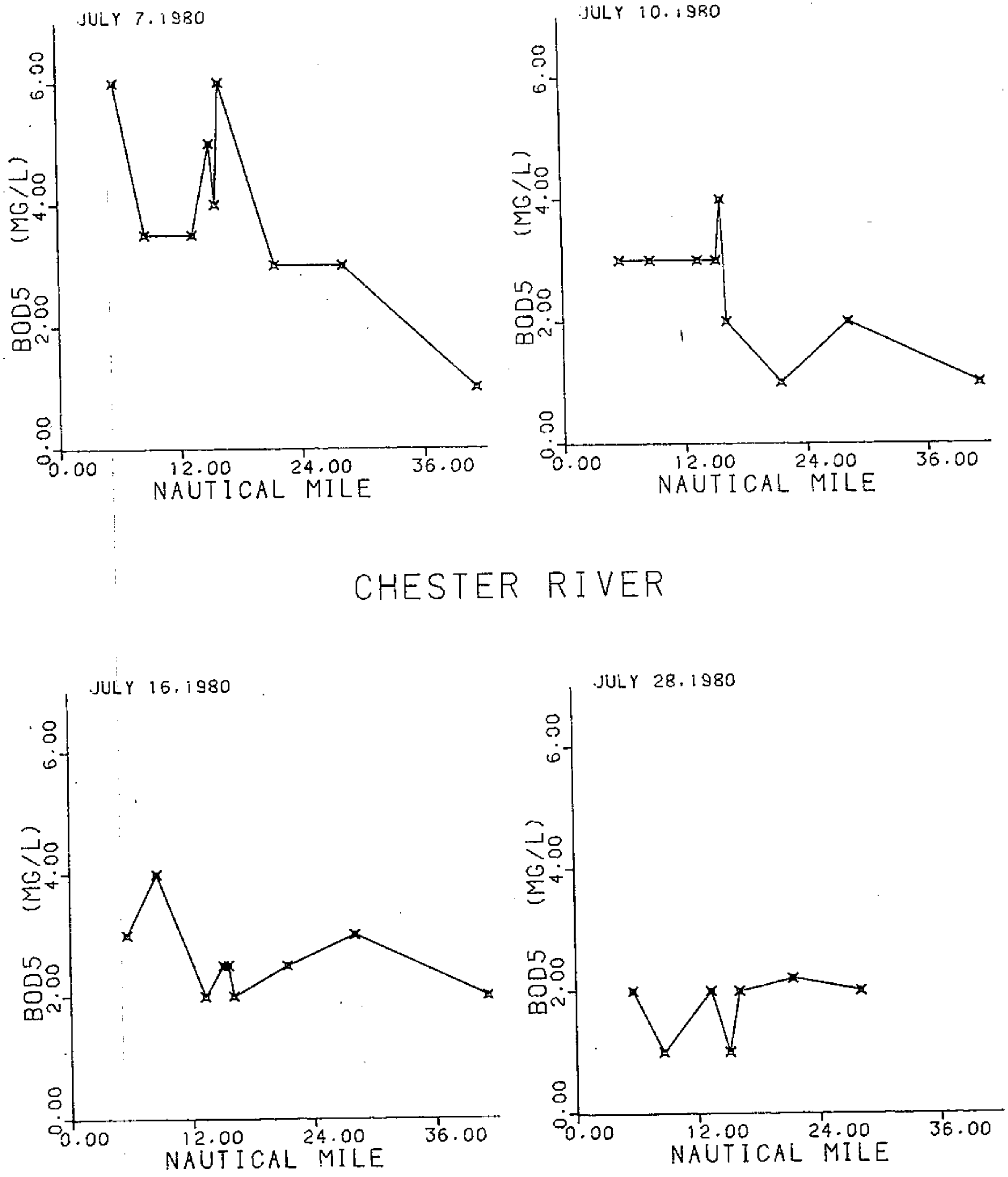


Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).

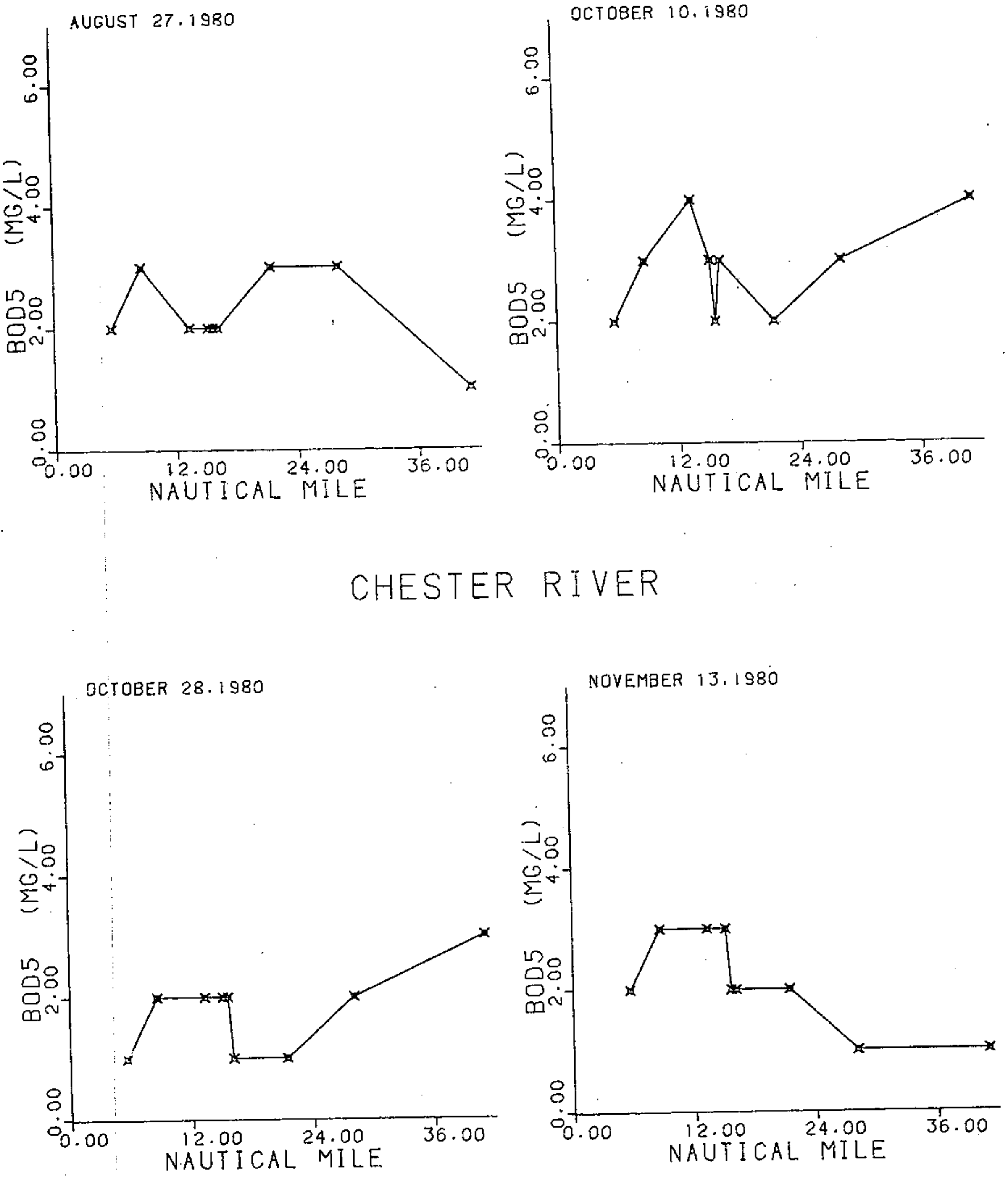


Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).

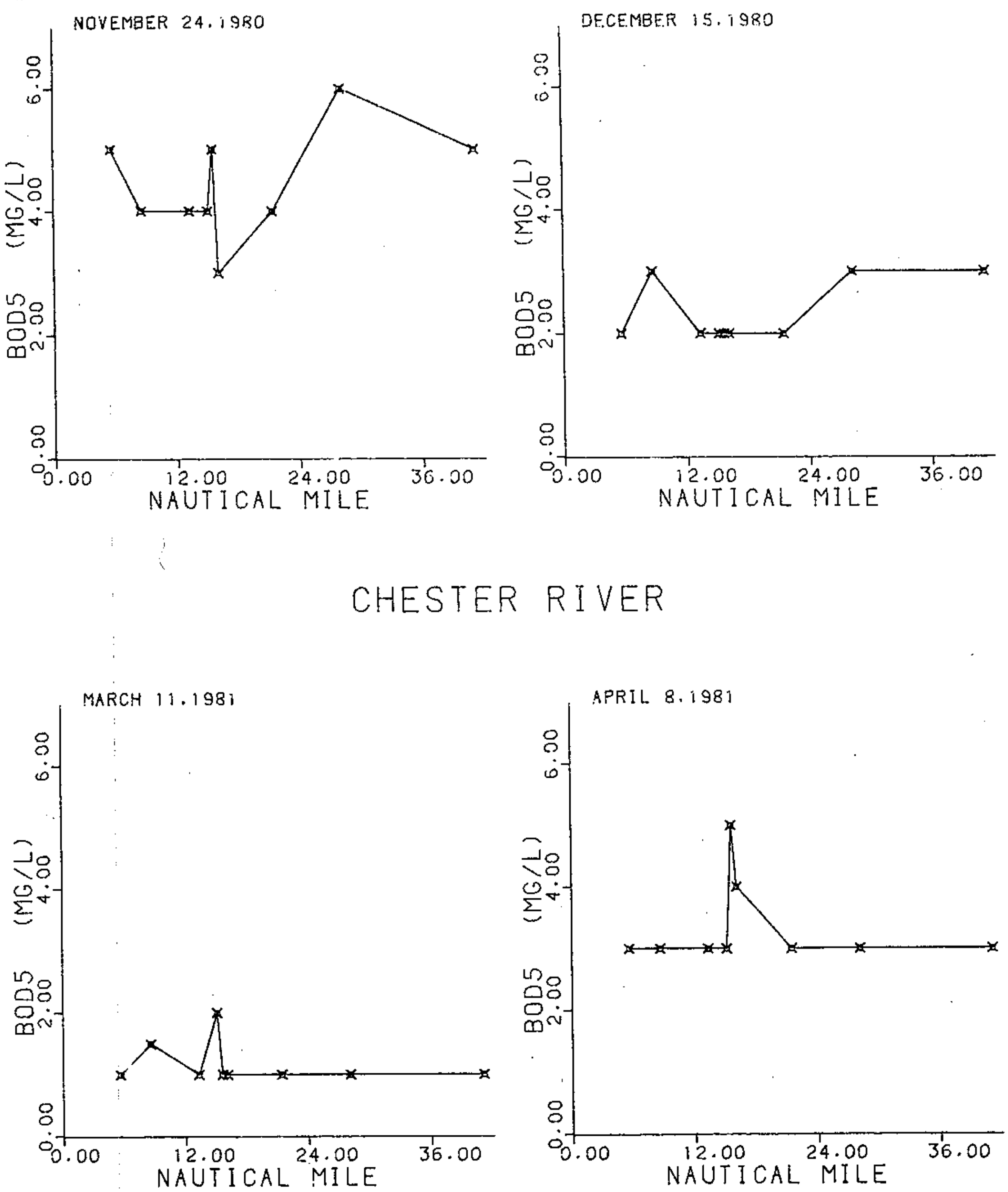


Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).

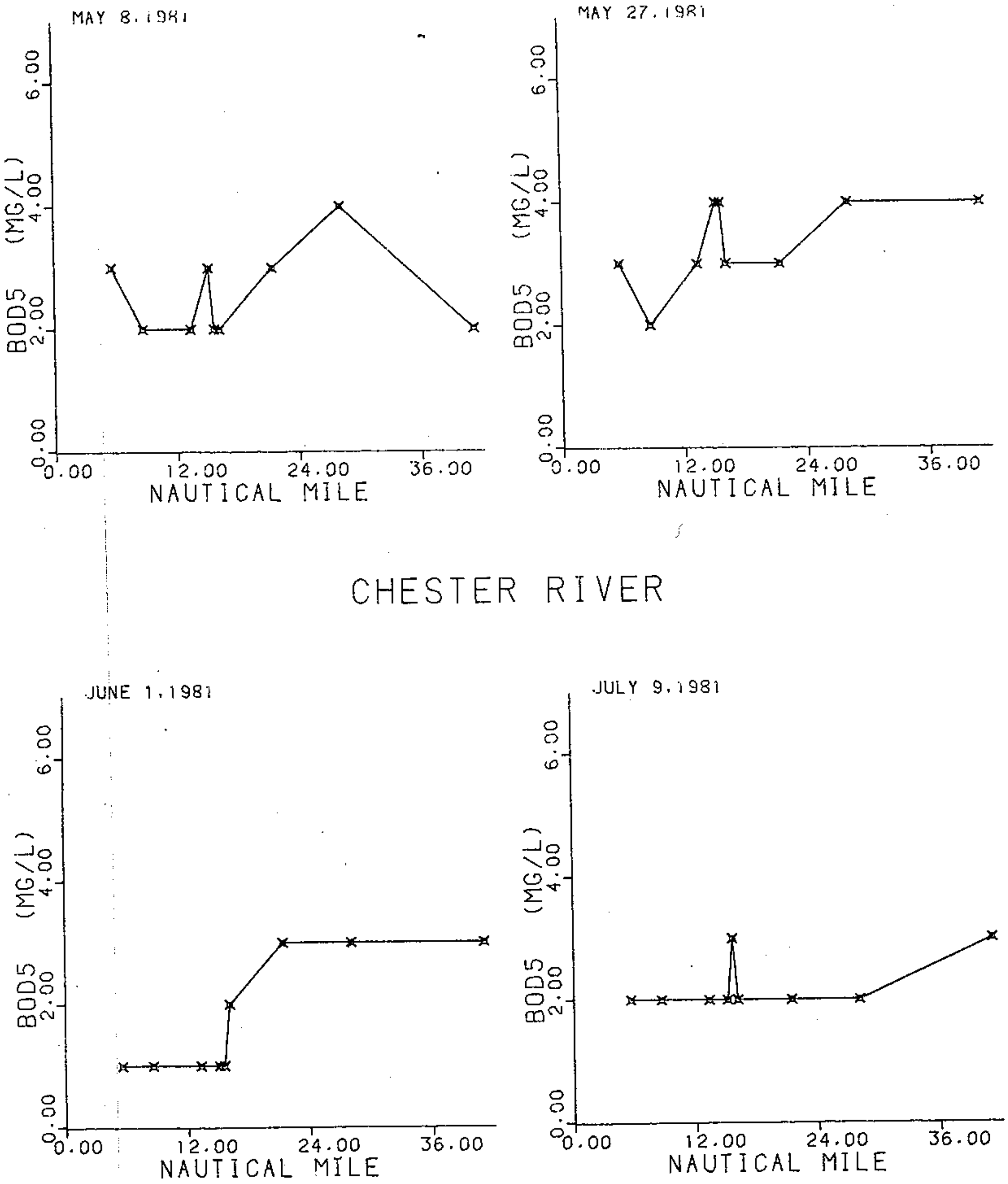


Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).

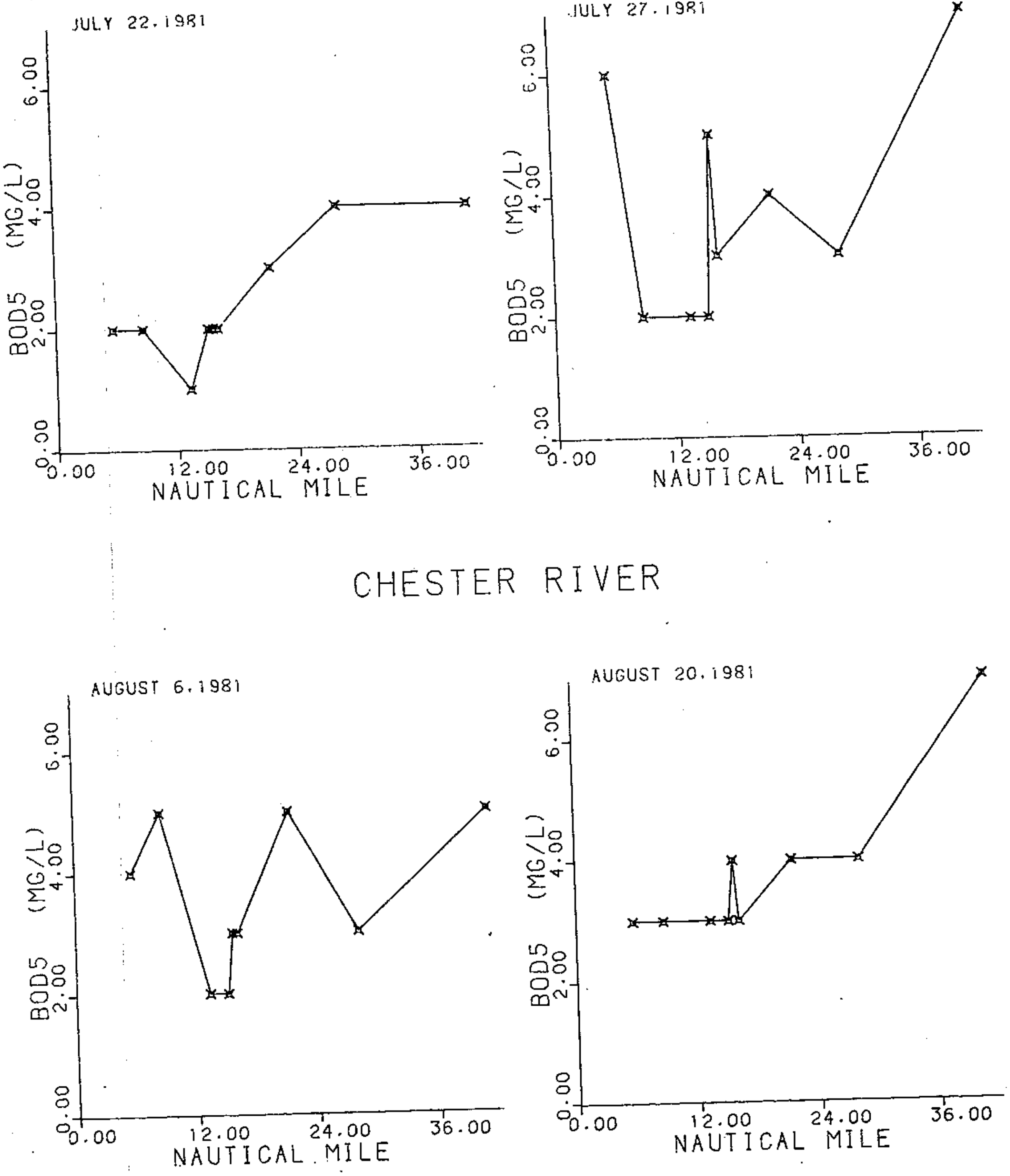
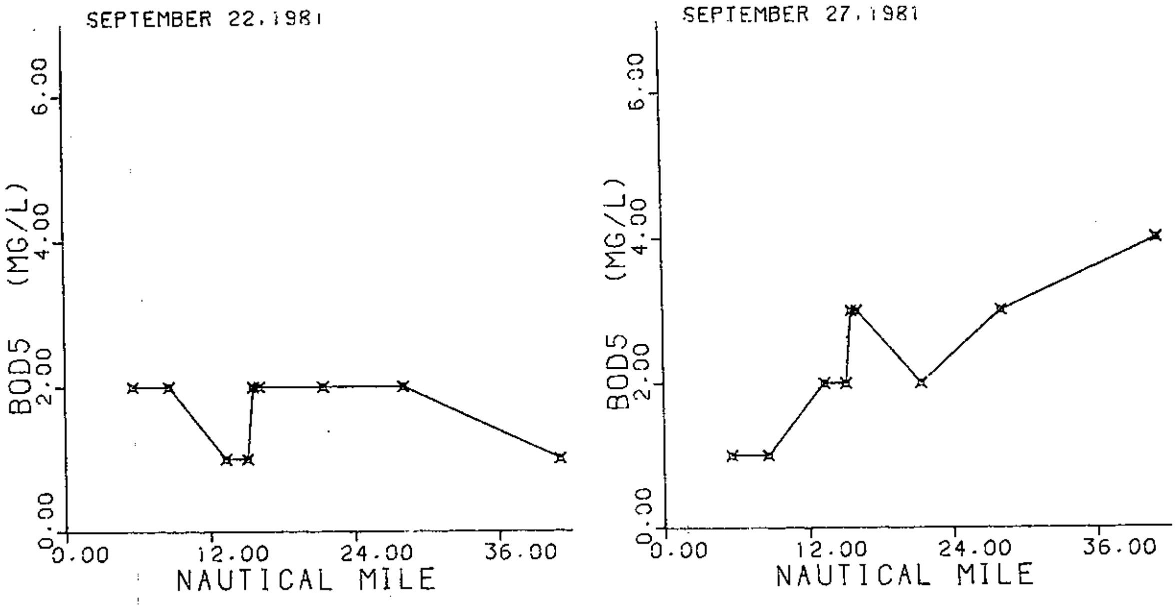
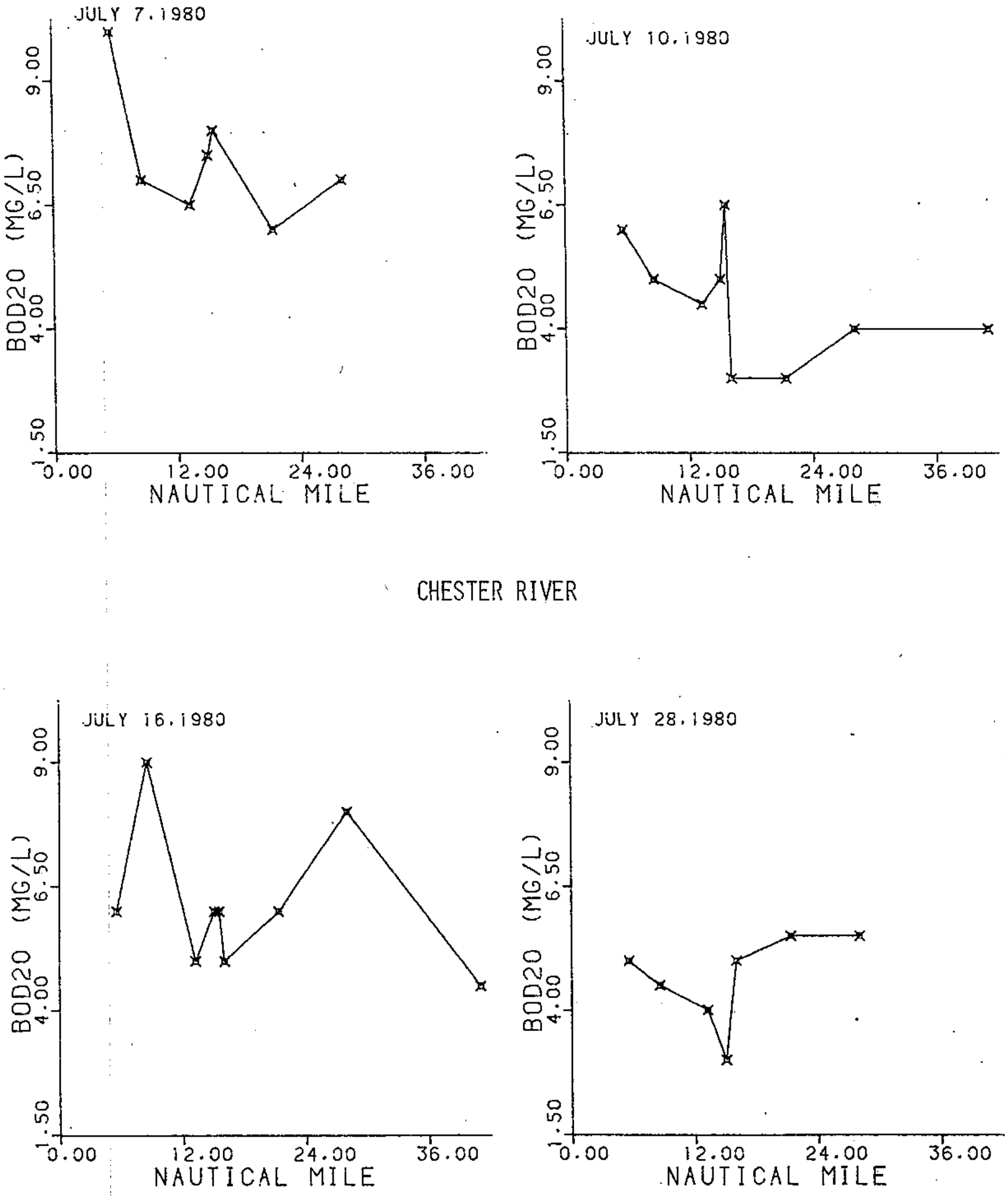


Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).



CHESTER RIVER

Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).



JULY 7,1980

JULY 10,1980

CHESTER RIVER

JULY 16,1980

JULY 28,1980

Figure 7-12 Longitudinal slack survey plots for BOD_{20}, (mg/l).

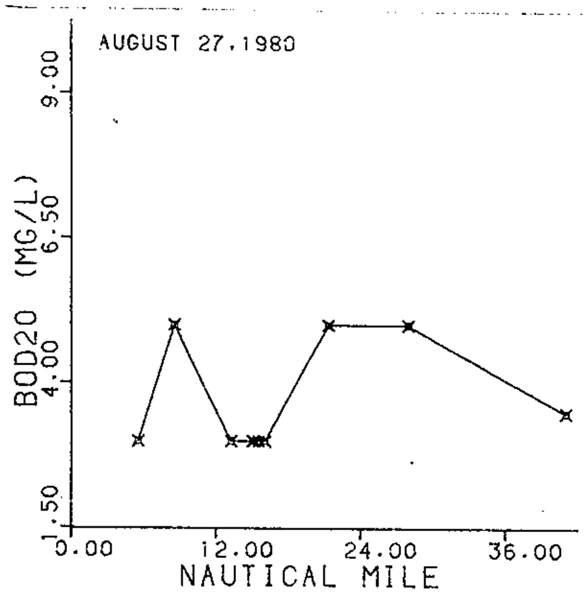


Figure 7-12 Longitudinal slack survey plots for BOD_{20} (mg/l).

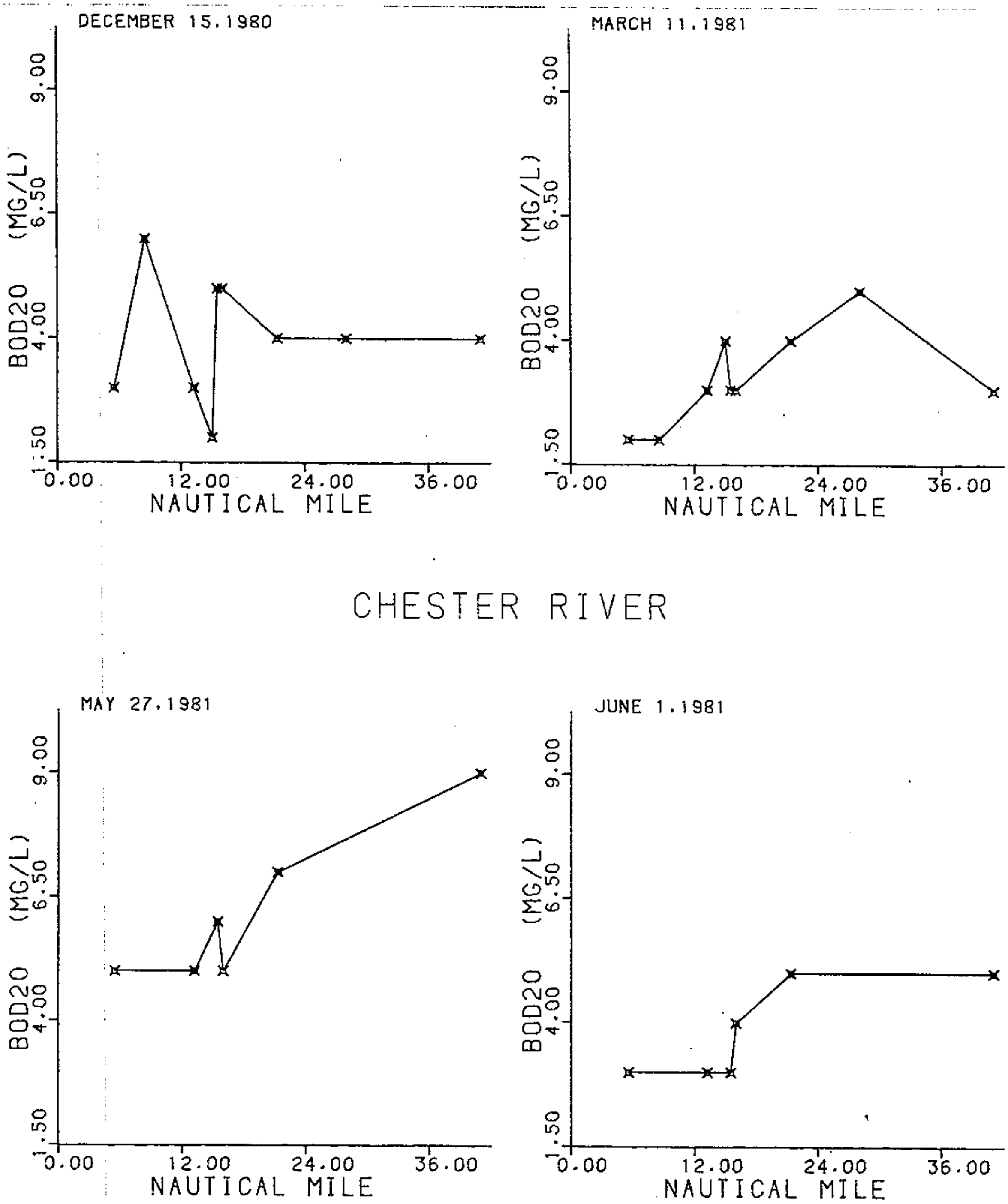


Figure 7-12 Longitudinal slack survey plots for BOD_{20}, (mg/l).

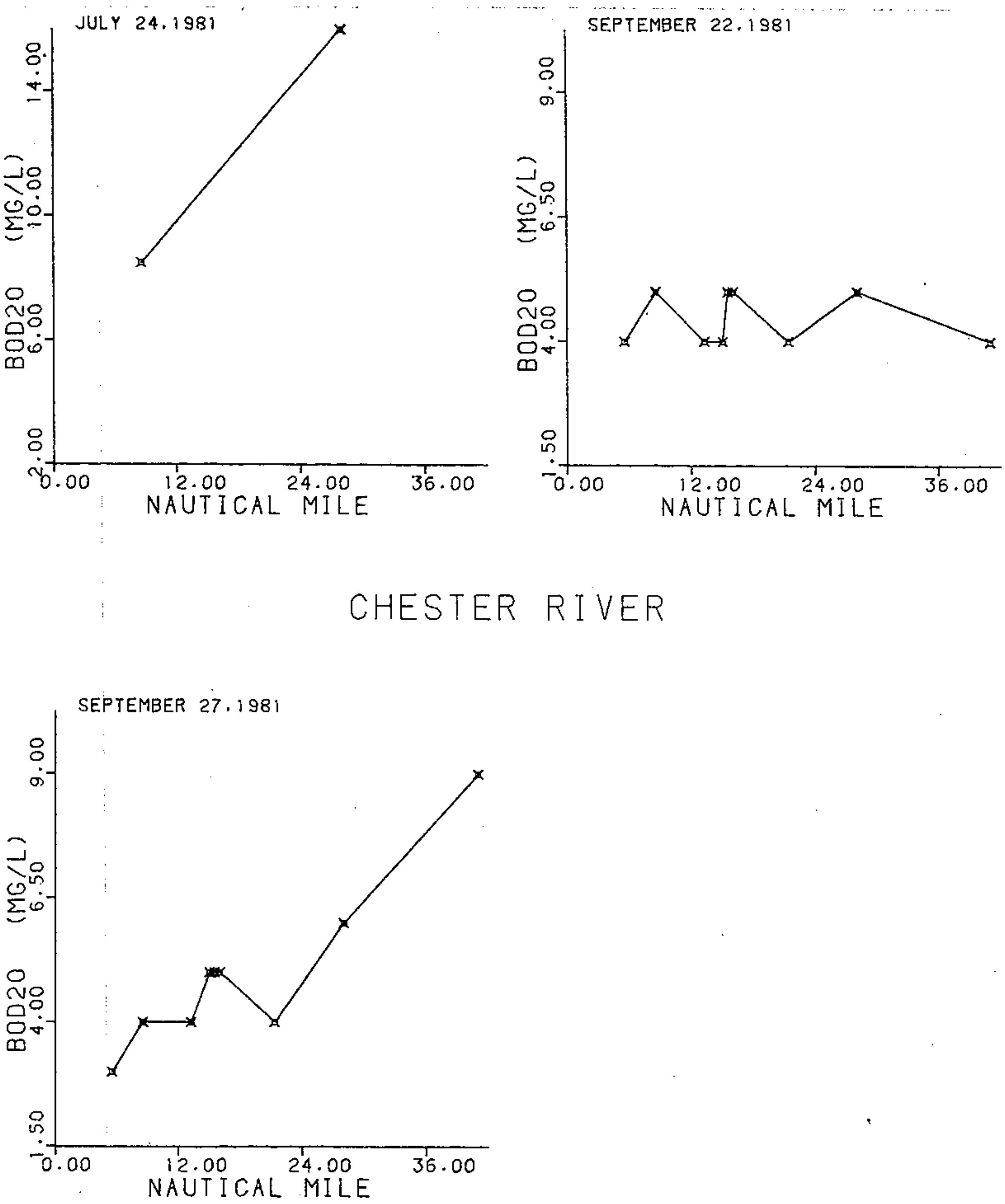


Figure 7-12 Longitudinal slack survey plots for BOD_{20}, (mg/l).

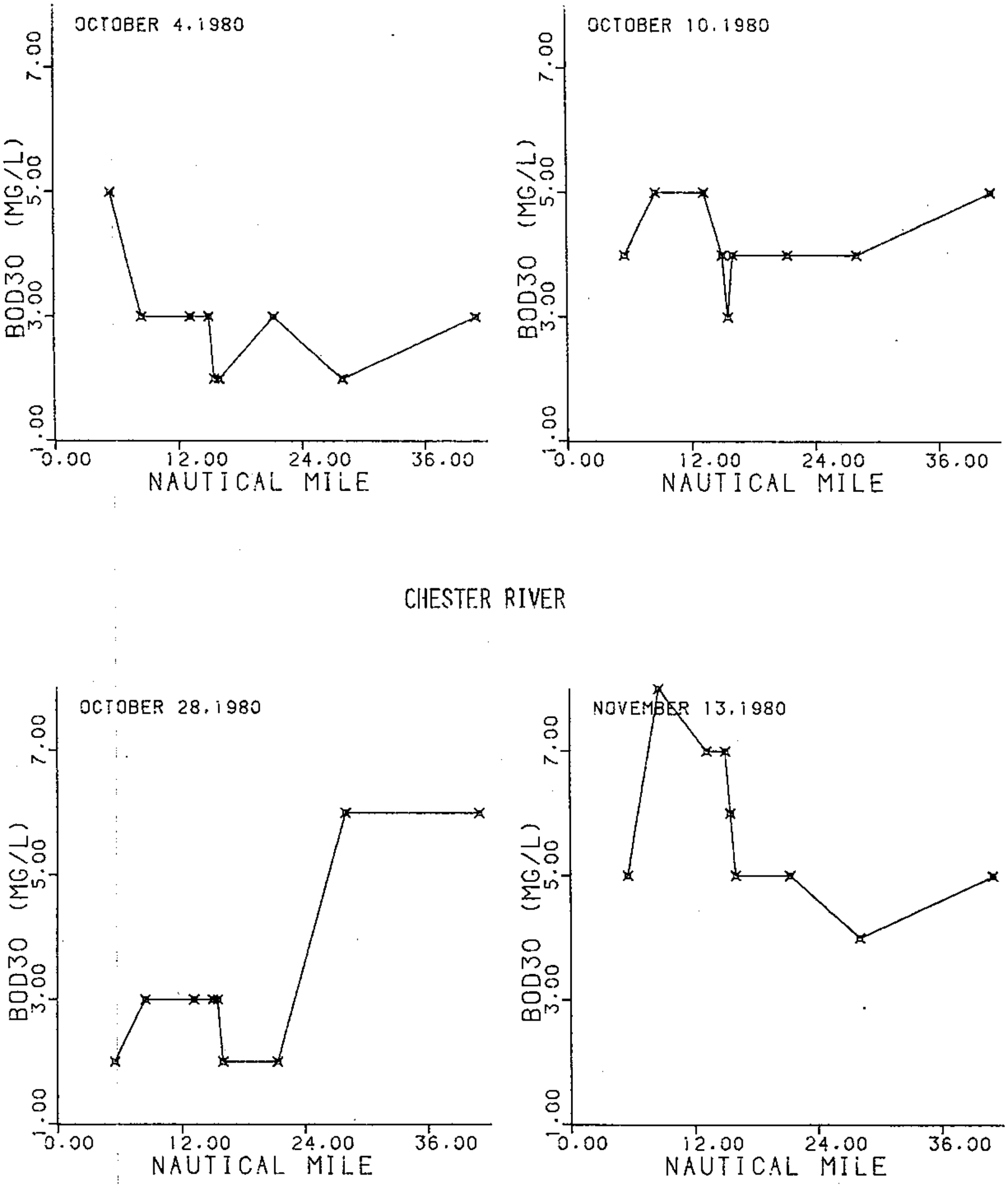


Figure 7-13 Longitudinal slack survey plots for BOD_{30}, (mg/l).

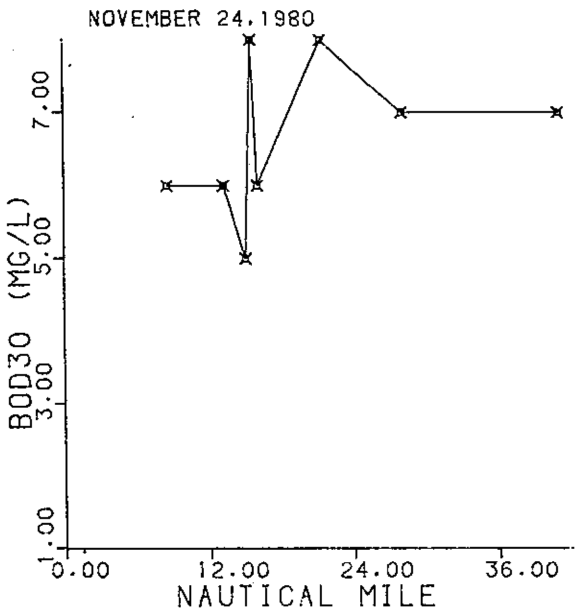
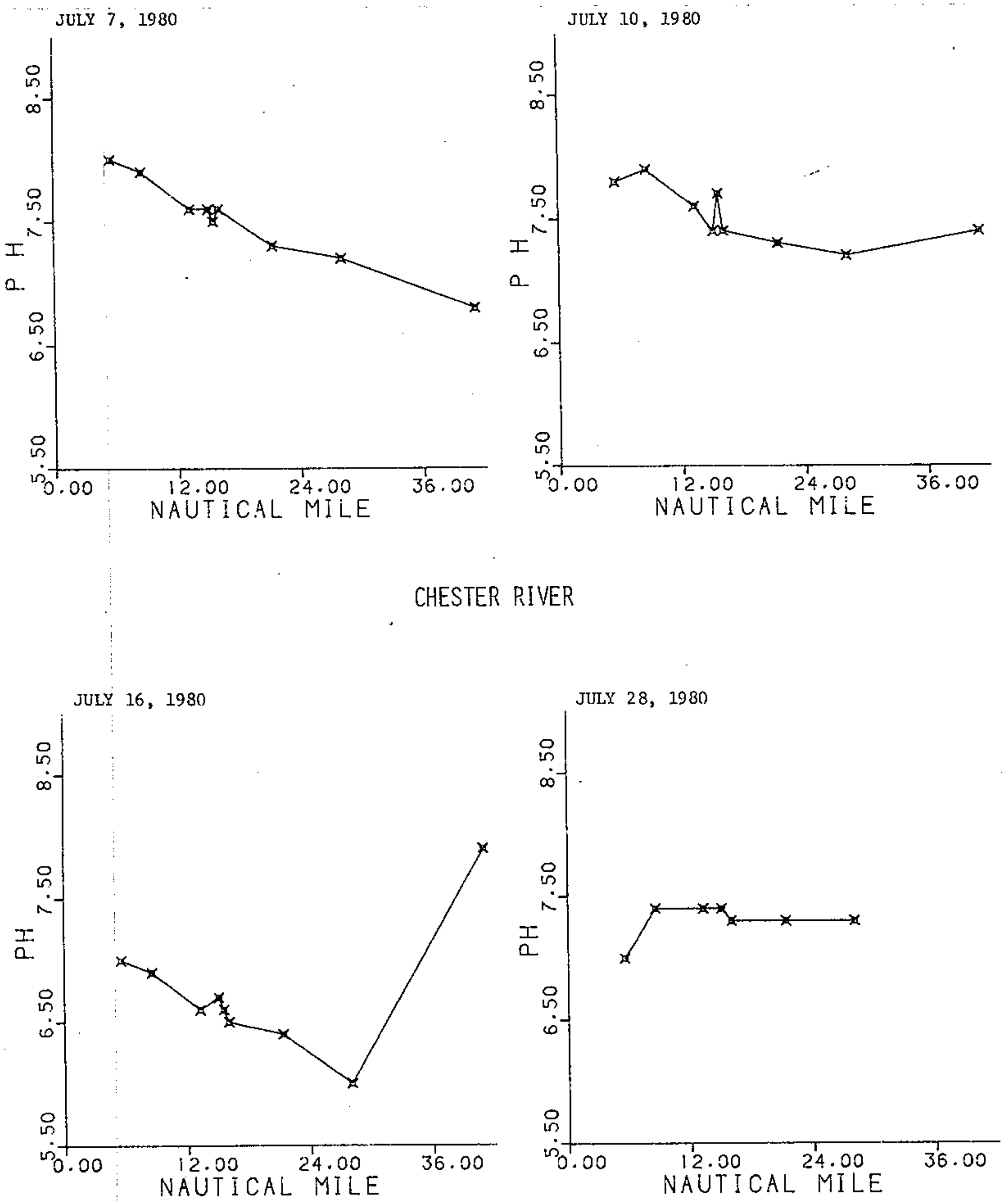


Figure 7-13 Longitudinal slack survey plots for BOD_{30} (mg/l).



CHESTER RIVER

Figure 7-14 Longitudinal slack survey plots for pH.

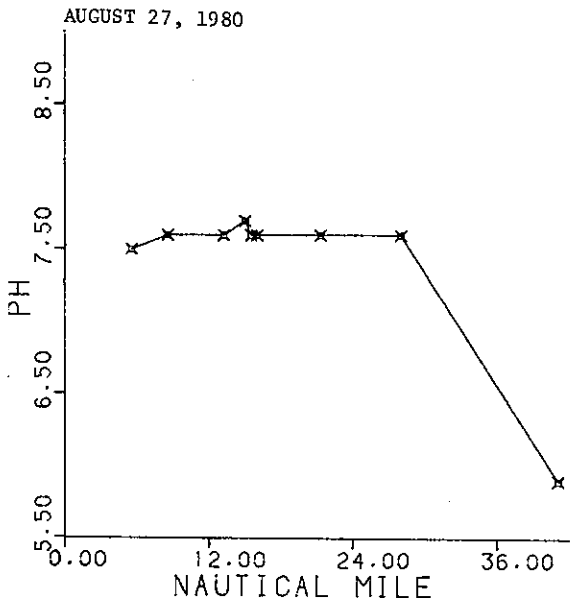


Figure 7-14 Longitudinal slack survey plots for pH.

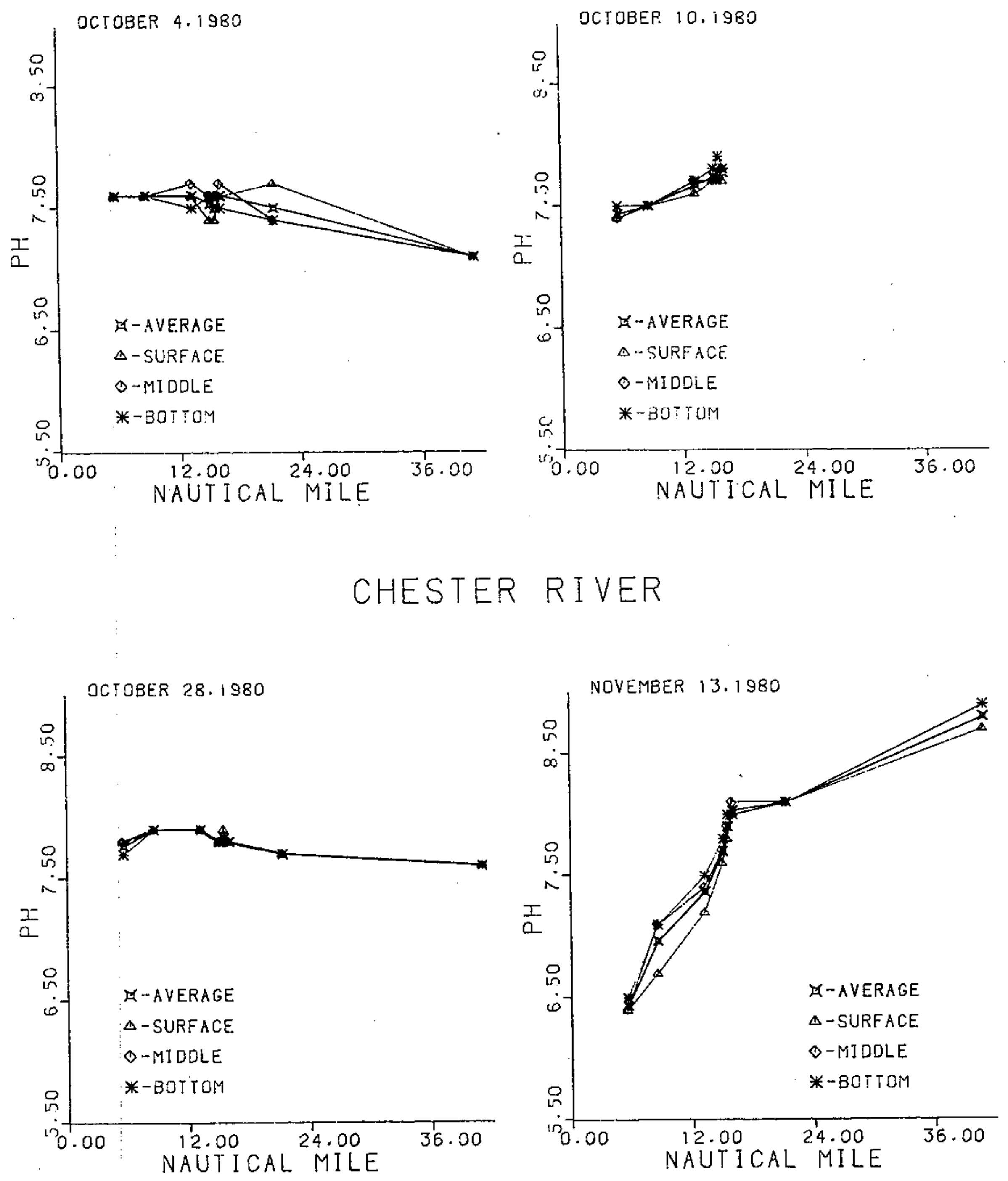
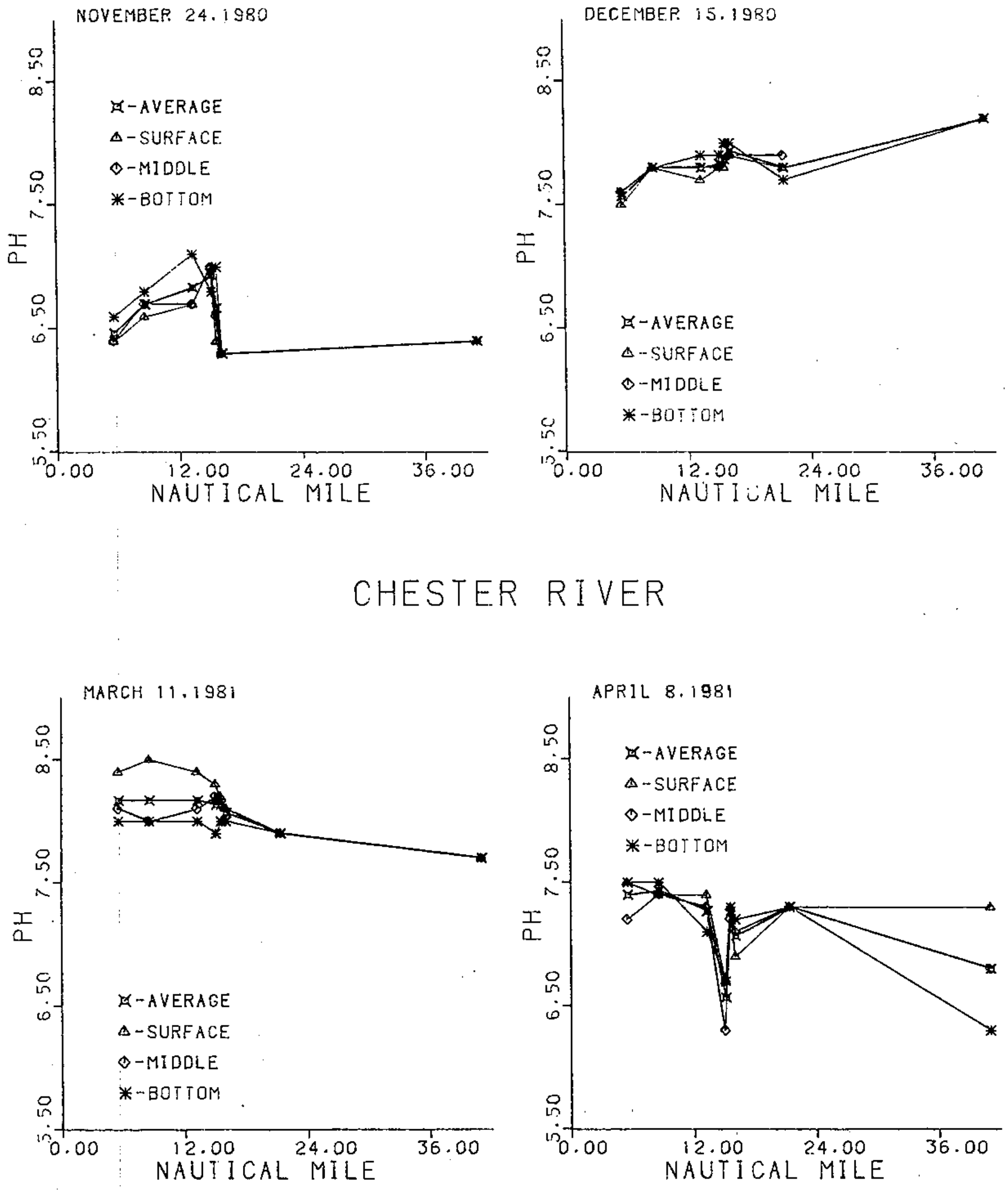
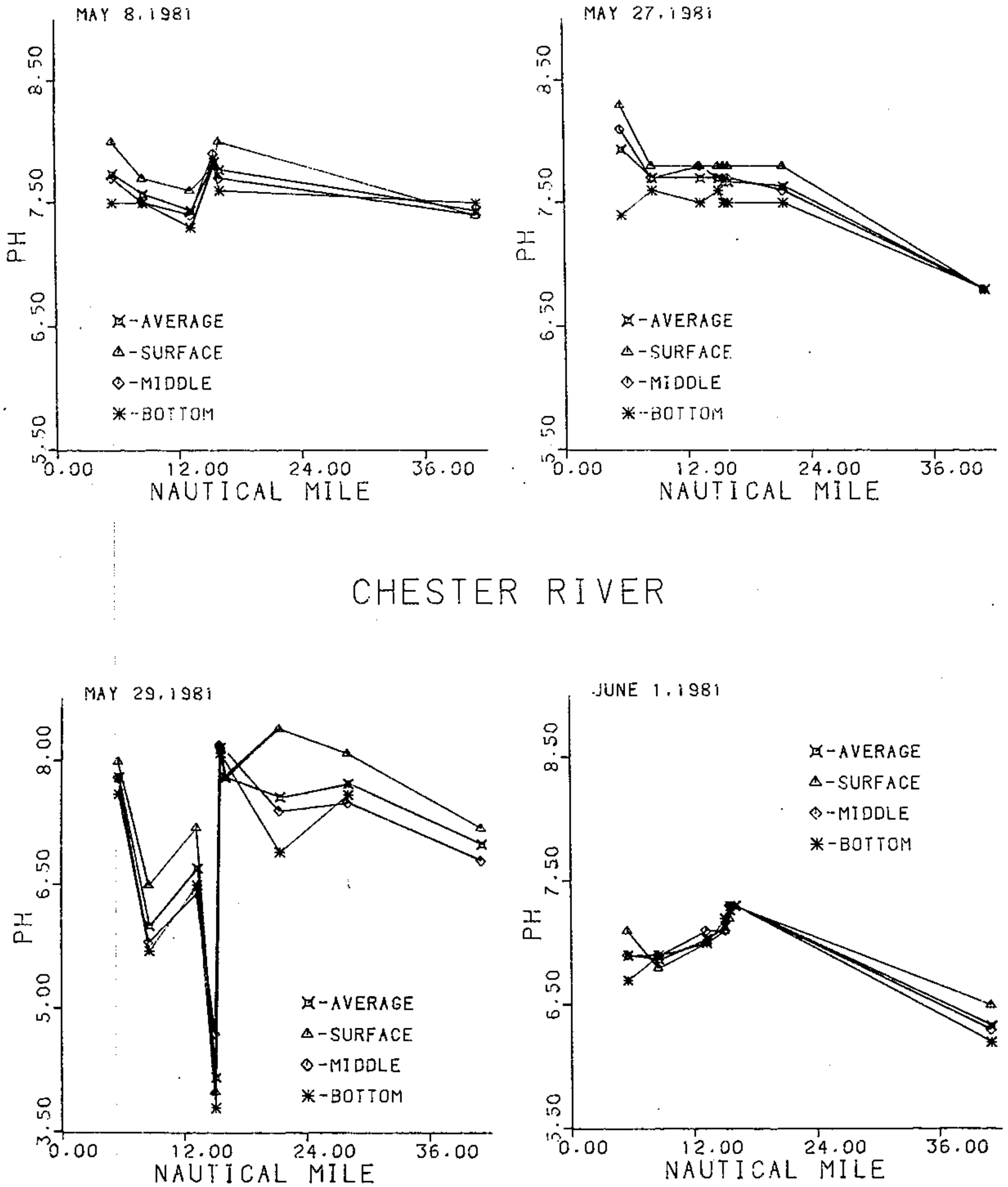


Figure 7-14 Longitudinal slack survey plots for pH.



CHESTER RIVER

Figure 7-14 Longitudinal slack survey plots for pH.



CHESTER RIVER

Figure 7-14 Longitudinal slack survey plots for pH.

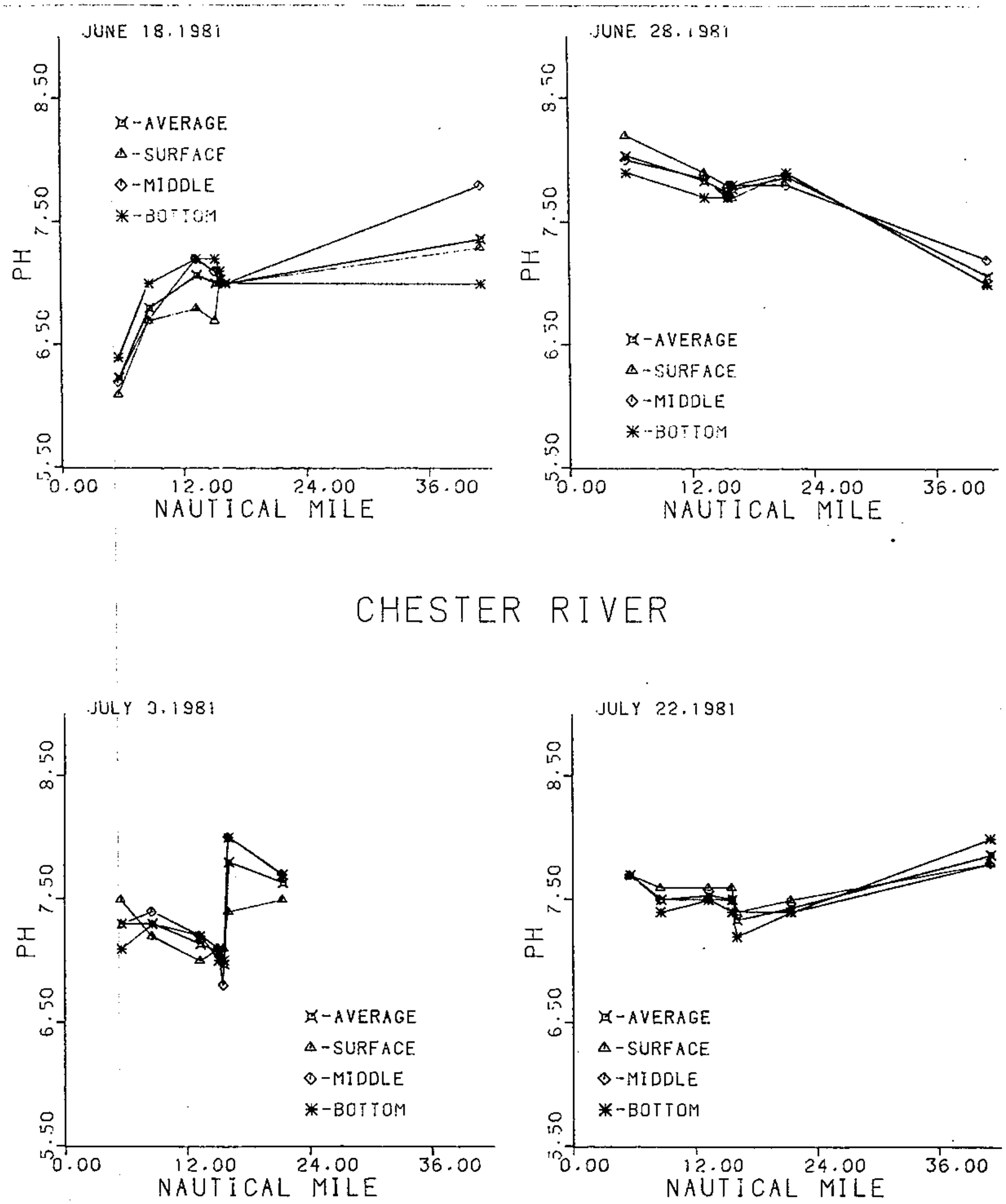


Figure 7-14 Longitudinal slack survey plots for pH.

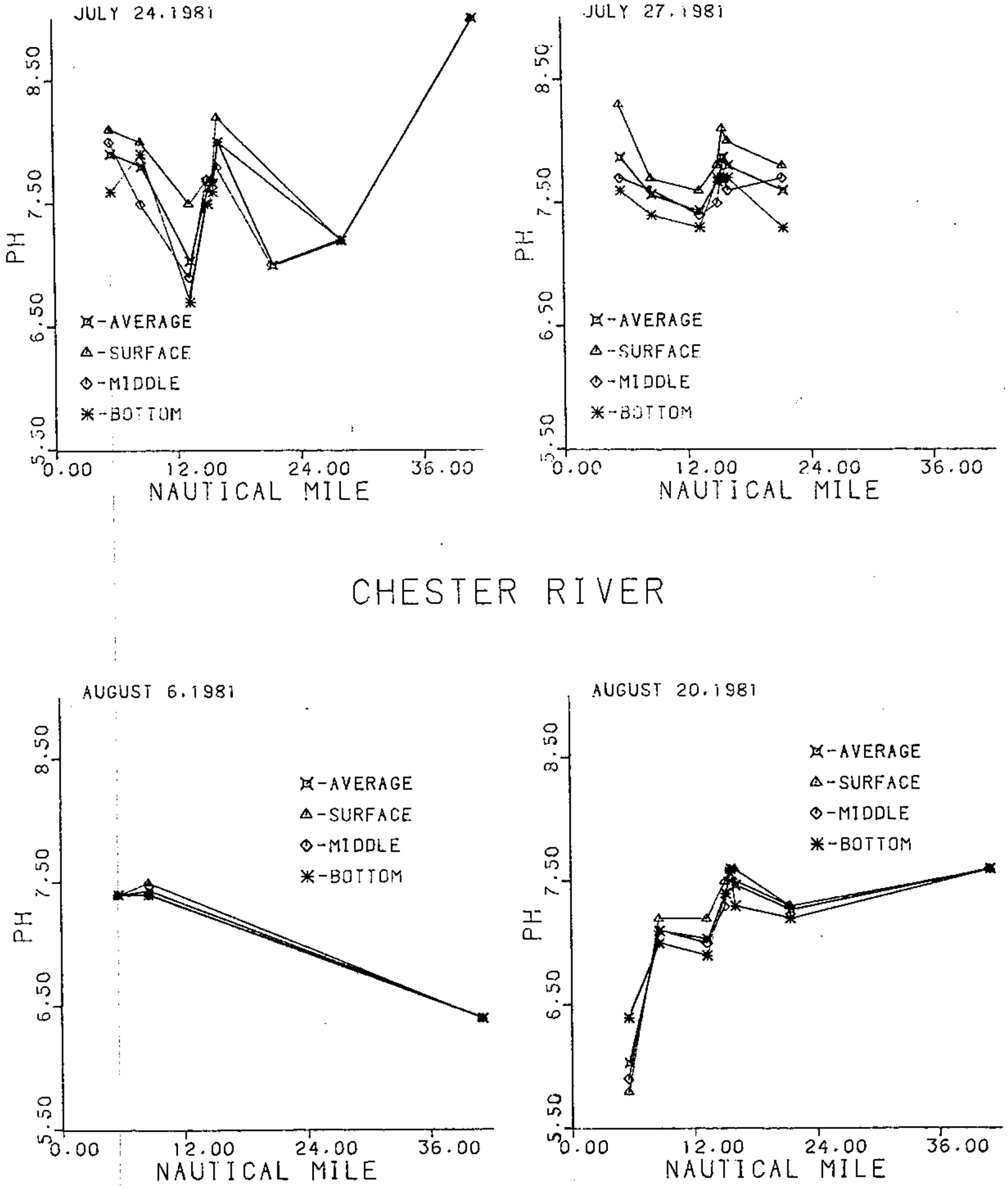
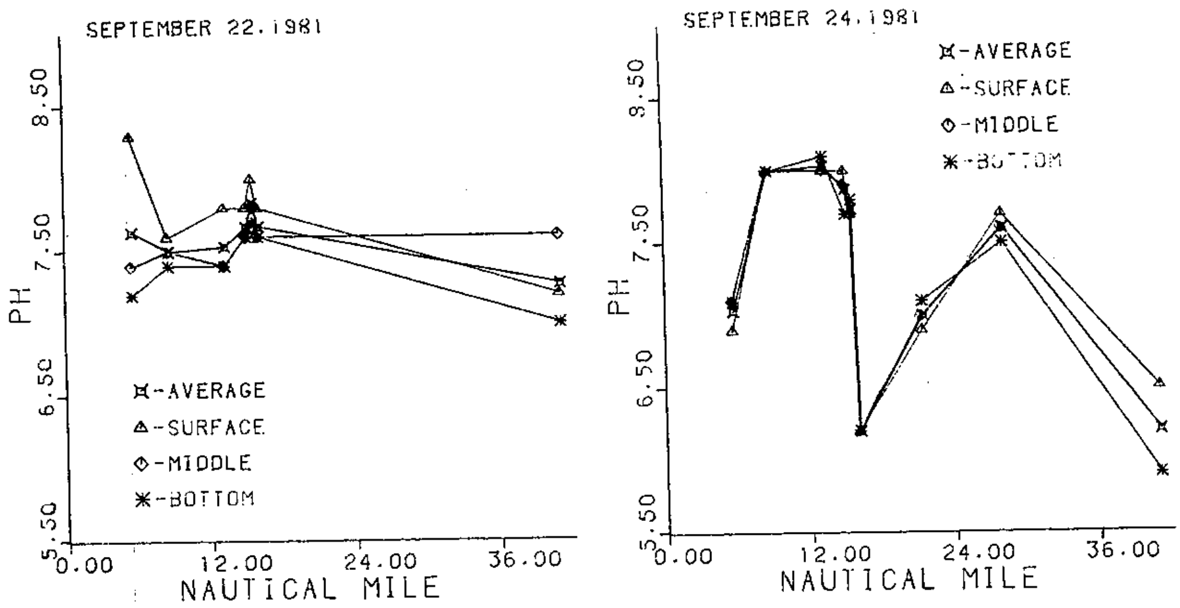


Figure 7-14 Longitudinal slack survey plots for pH.



CHESTER RIVER

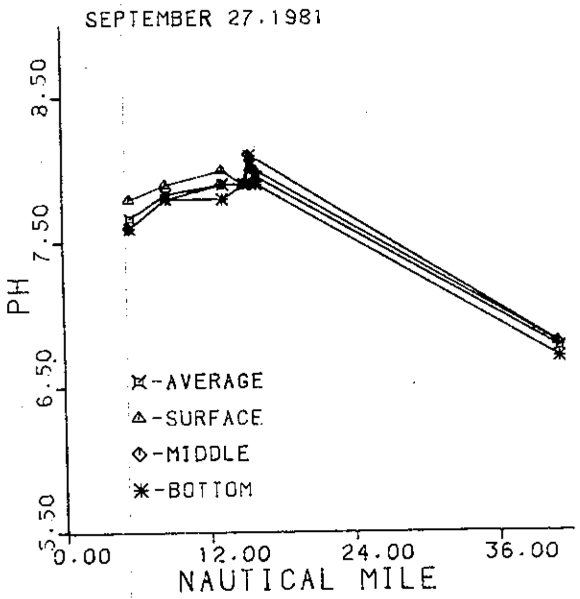


Figure 7-14 Longitudinal slack survey plots for pH.

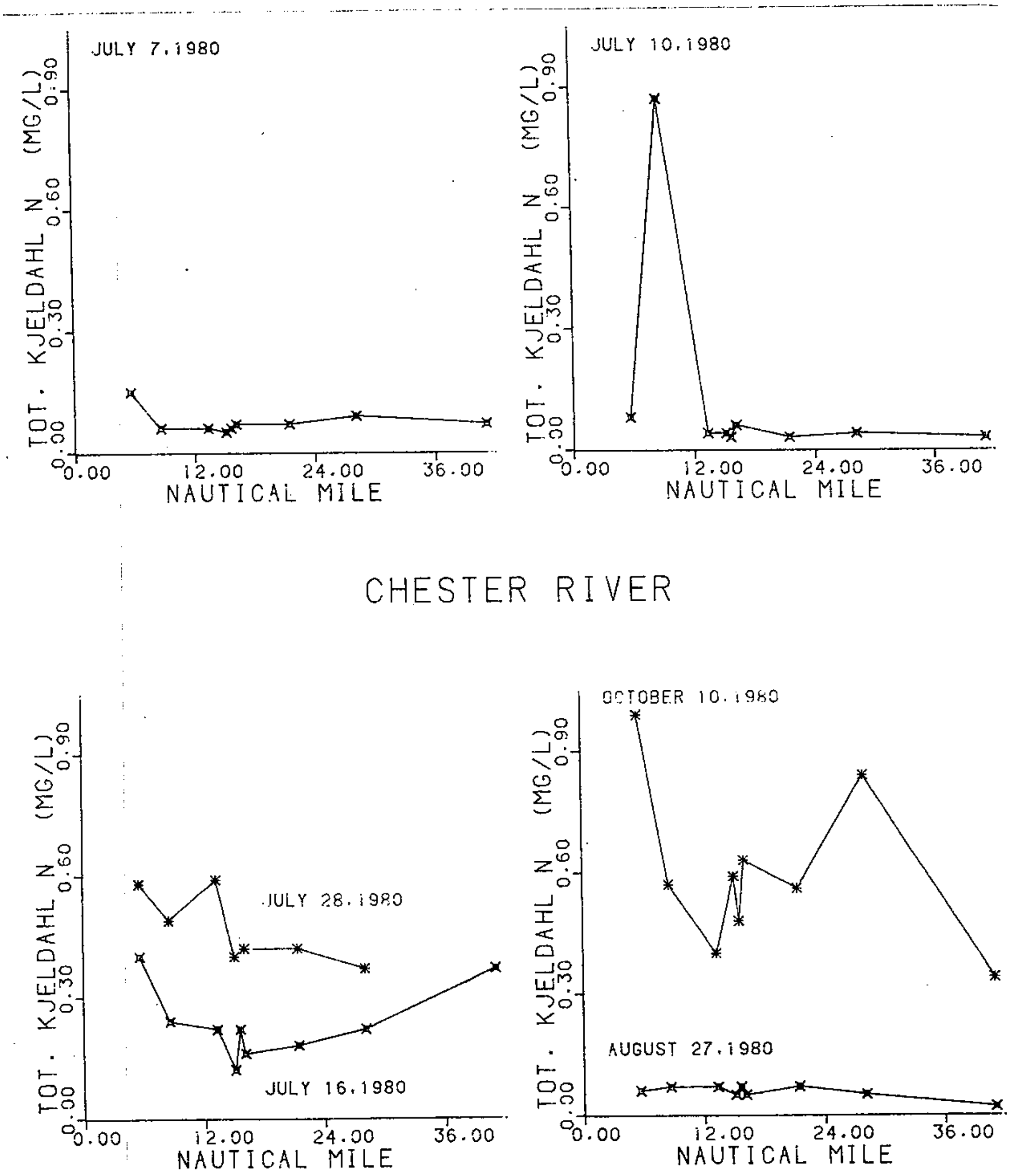


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen (mg/l).

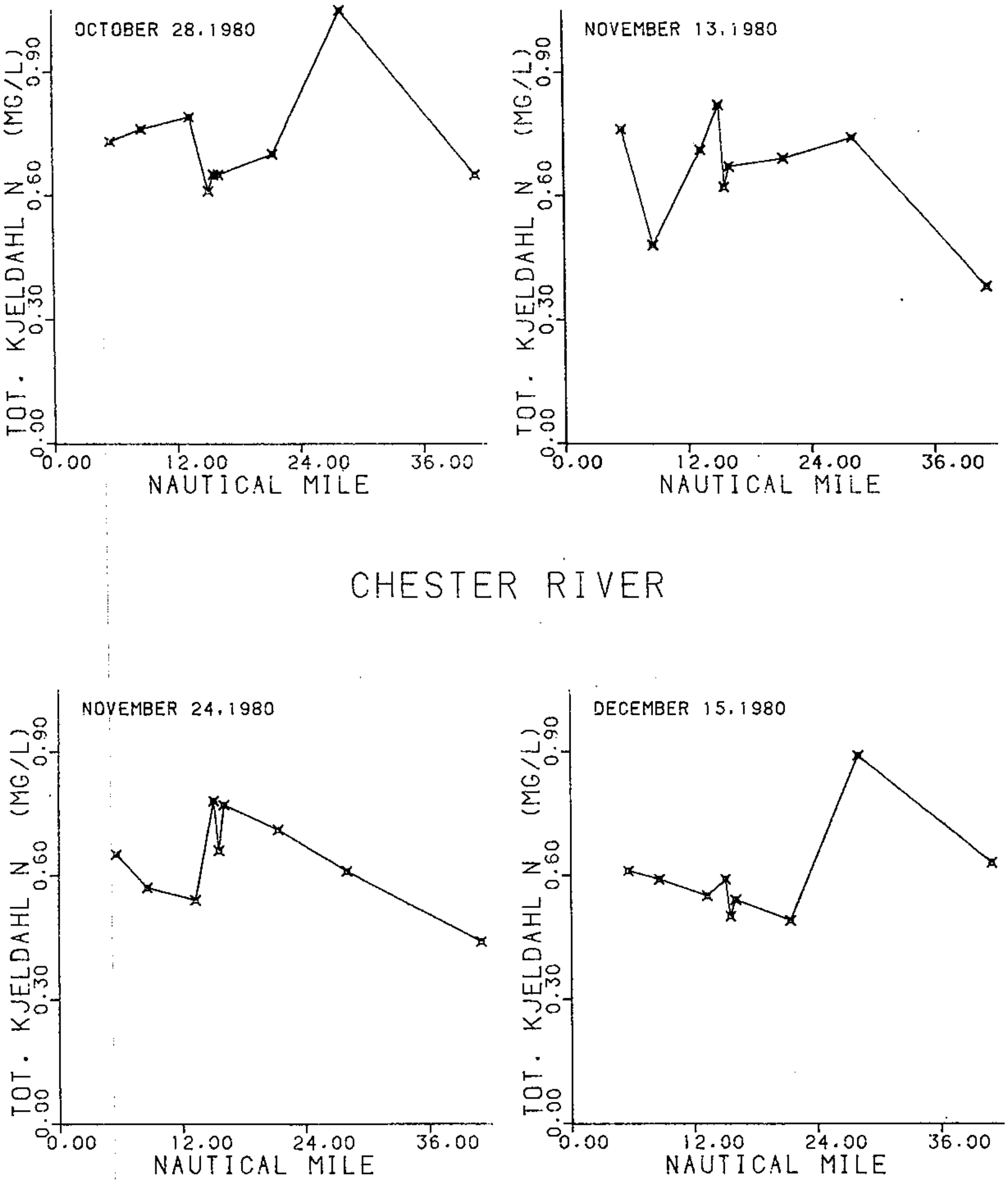


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen (mg/l).

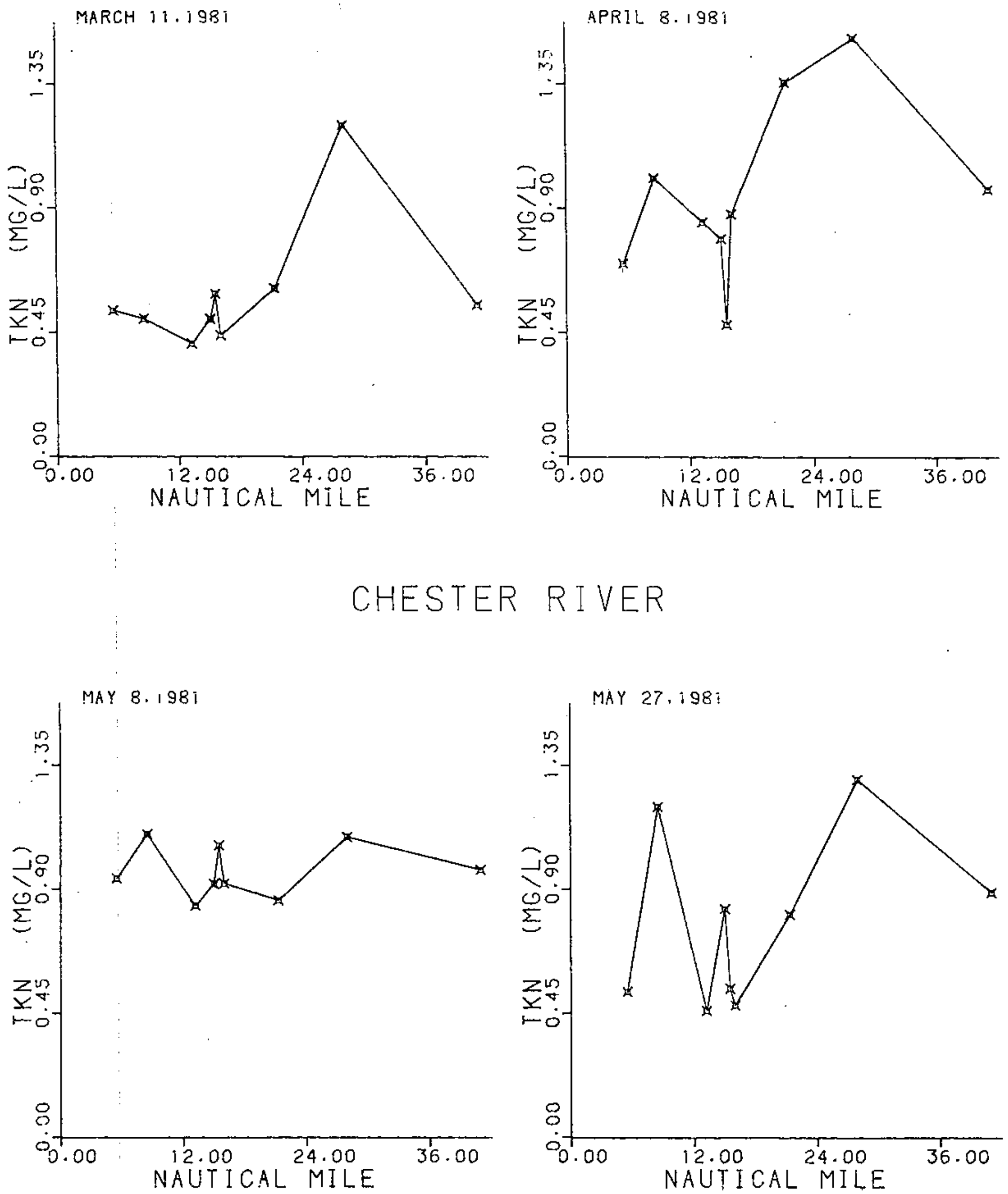
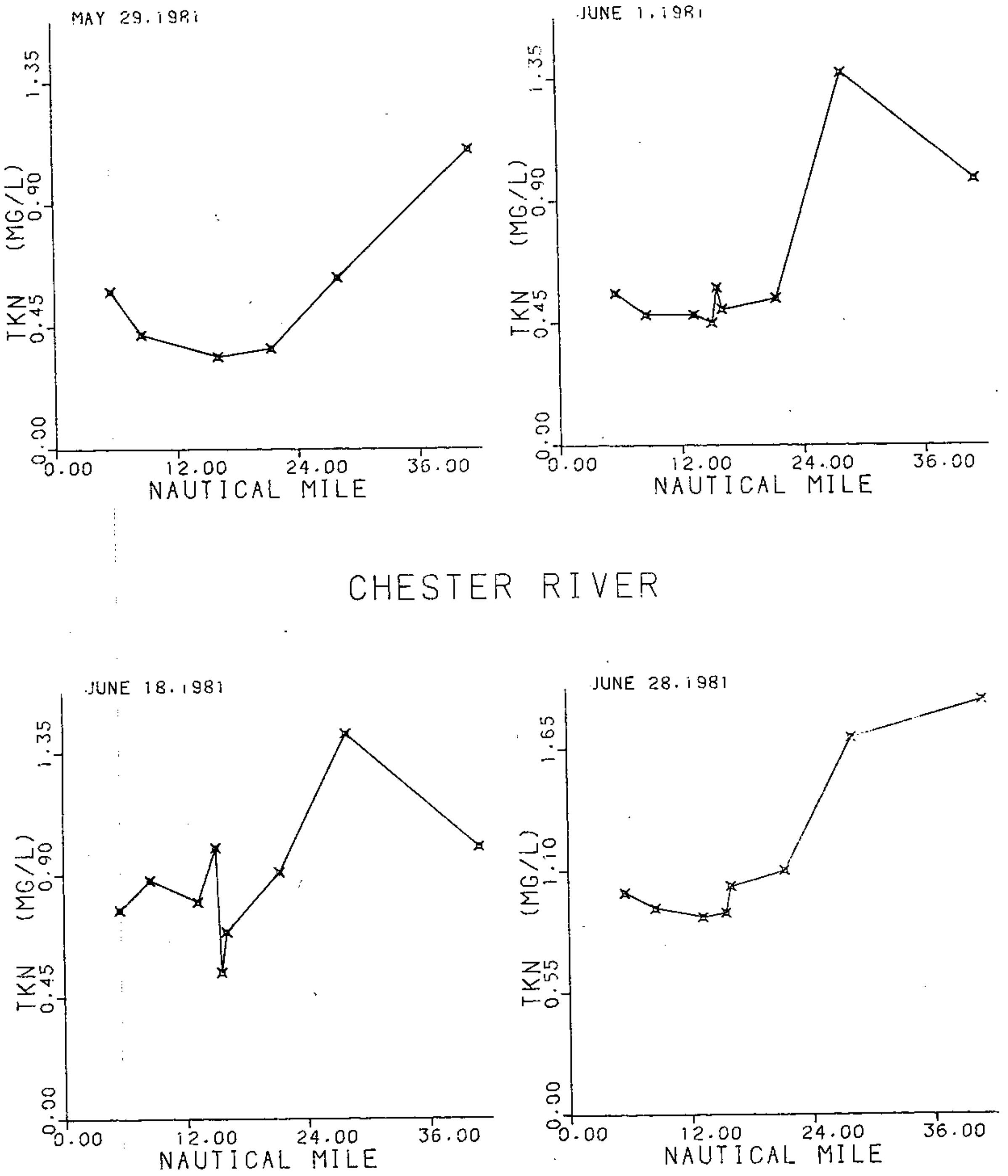


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).



CHESTER RIVER

Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).

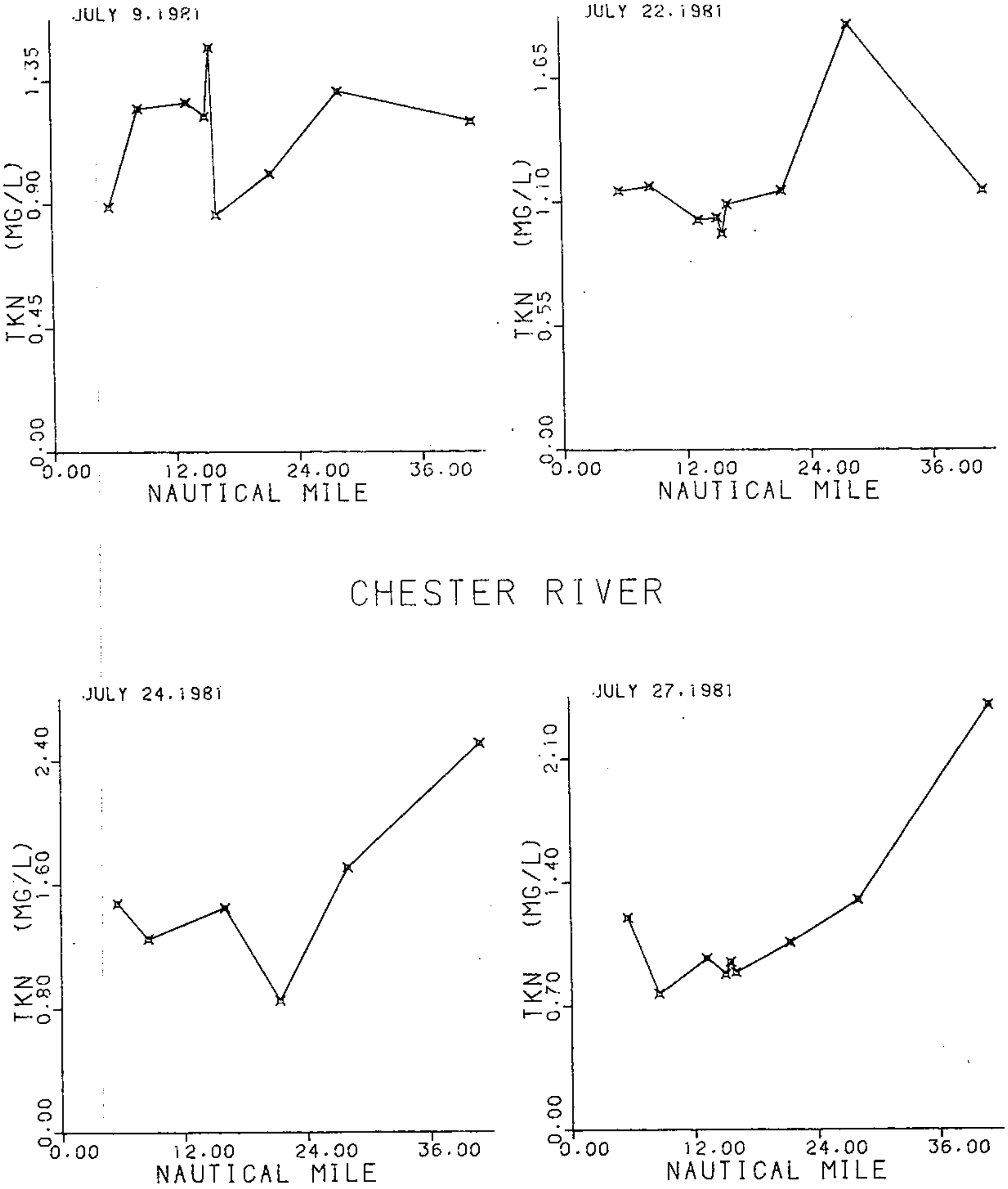
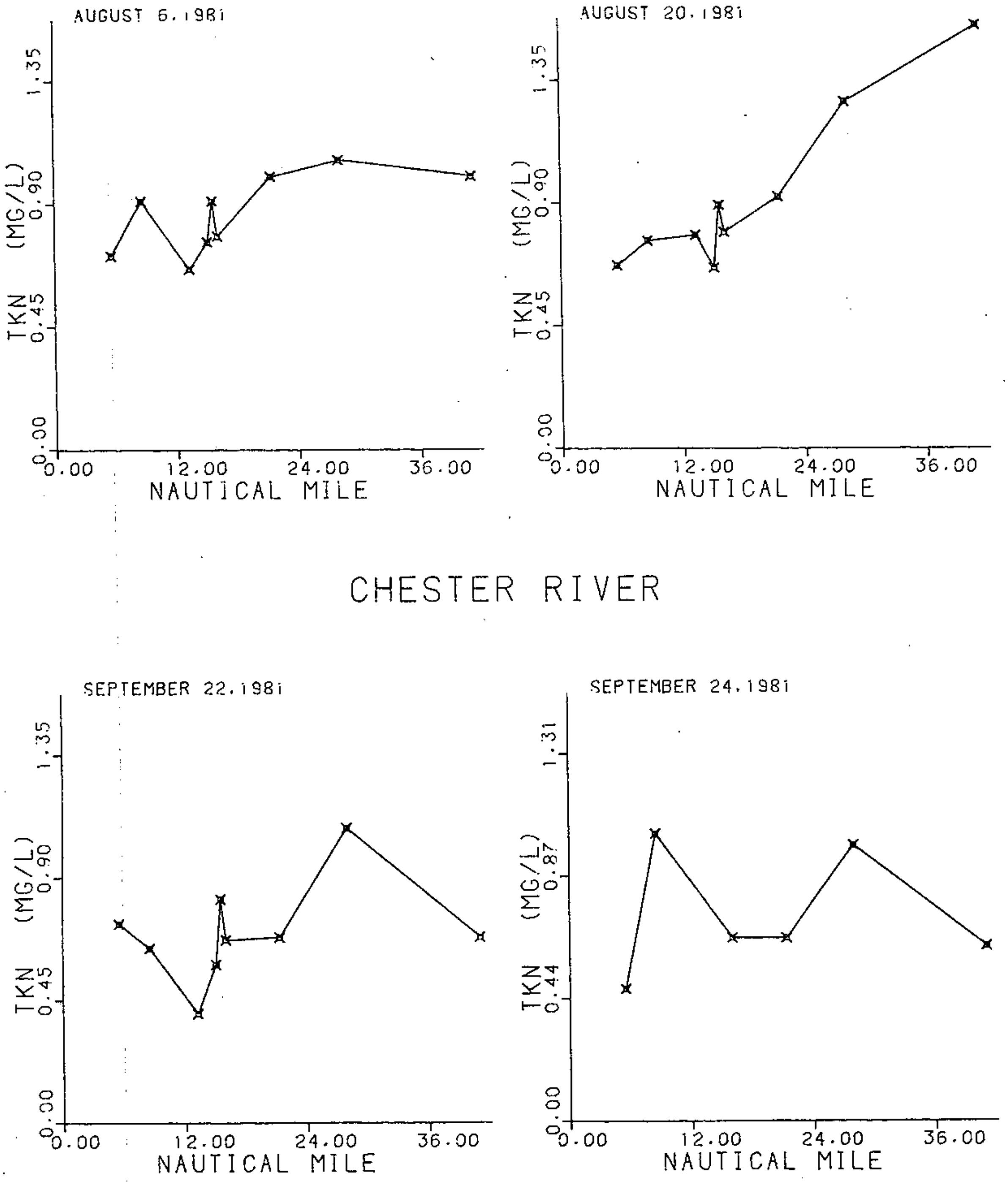
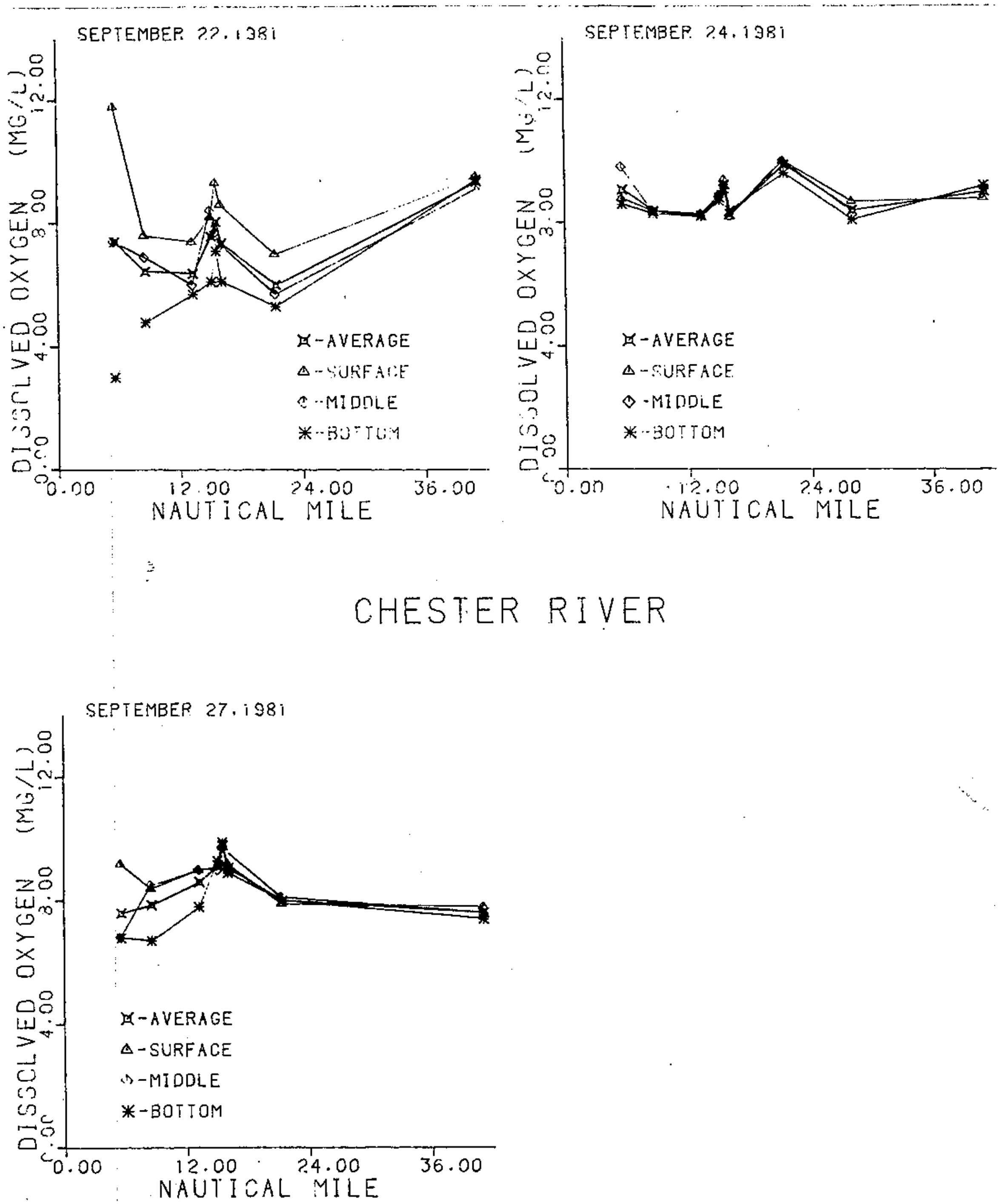


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).



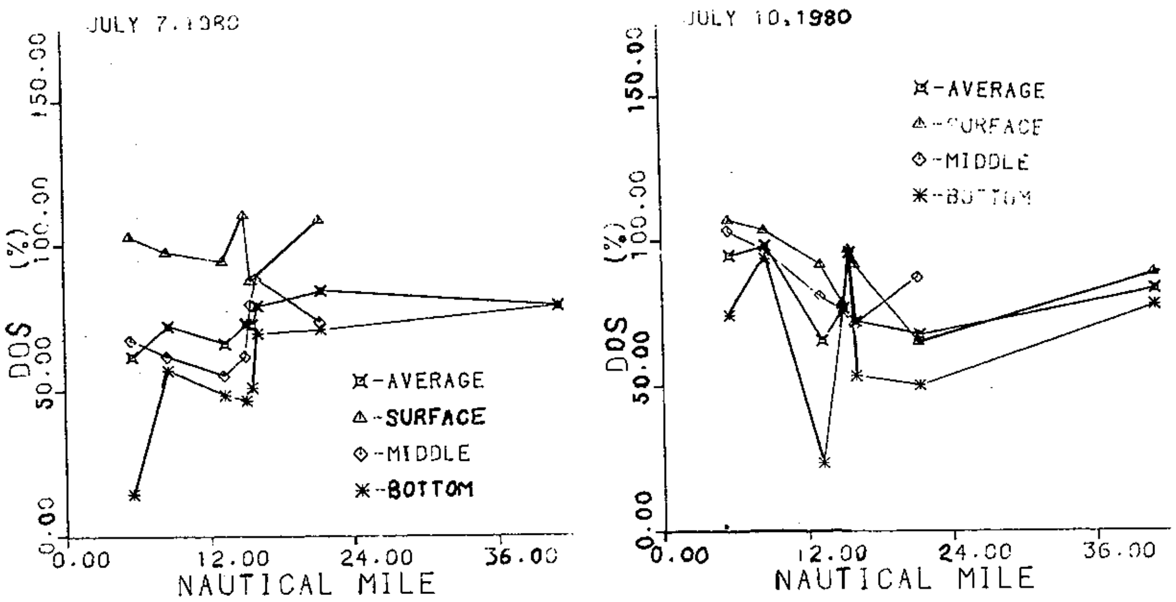
CHESTER RIVER

Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).



CHESTER RIVER

Figure 7-9 Longitudinal slack survey plots for Dissolved Oxygen, (mg/l).



CHESTER RIVER

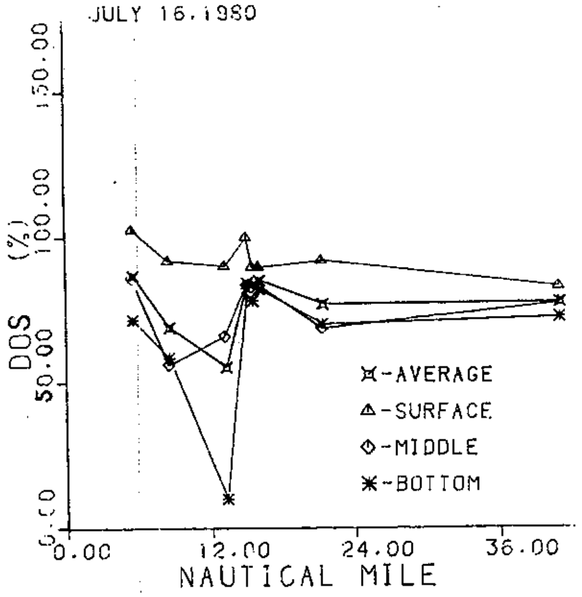


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

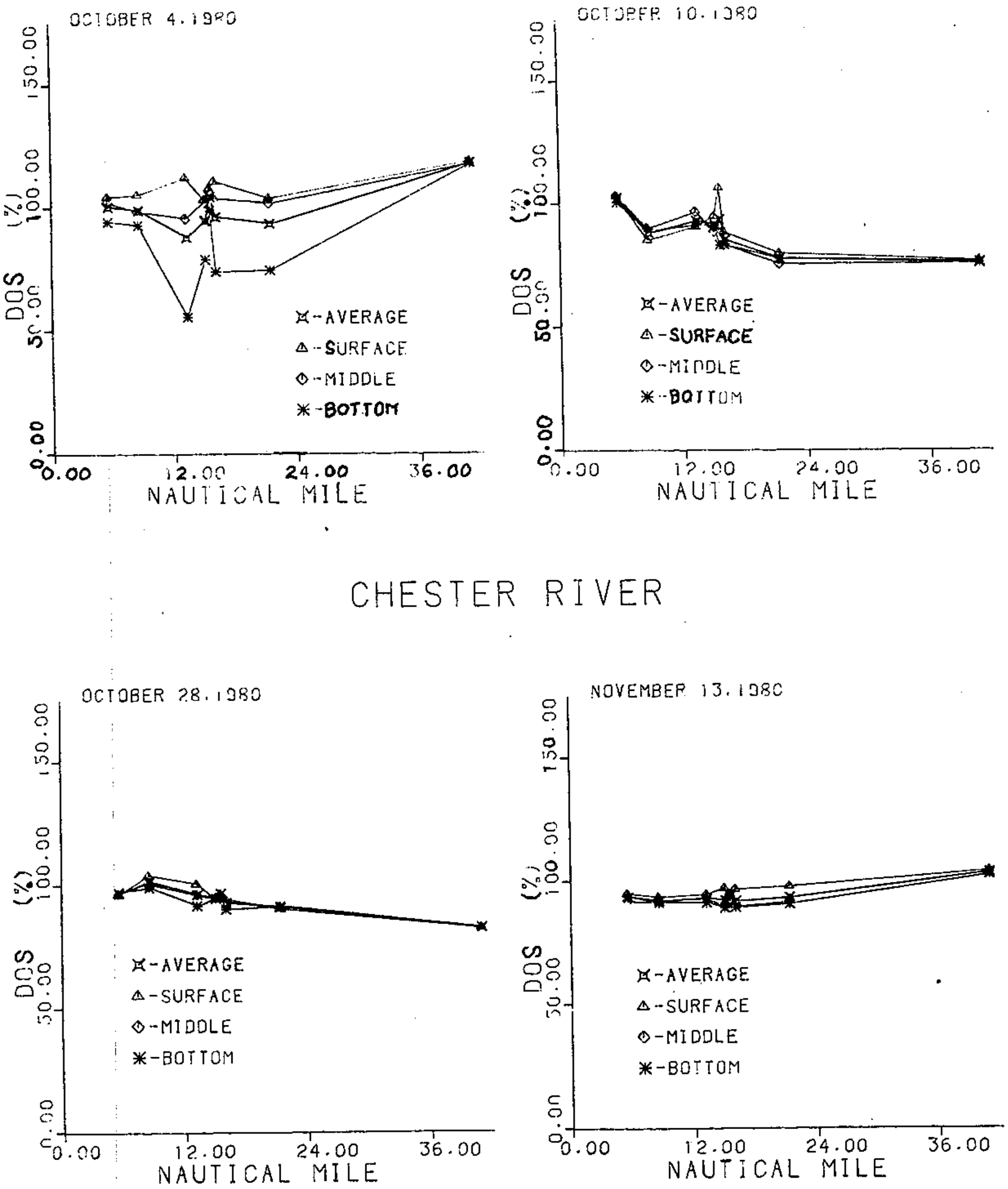


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

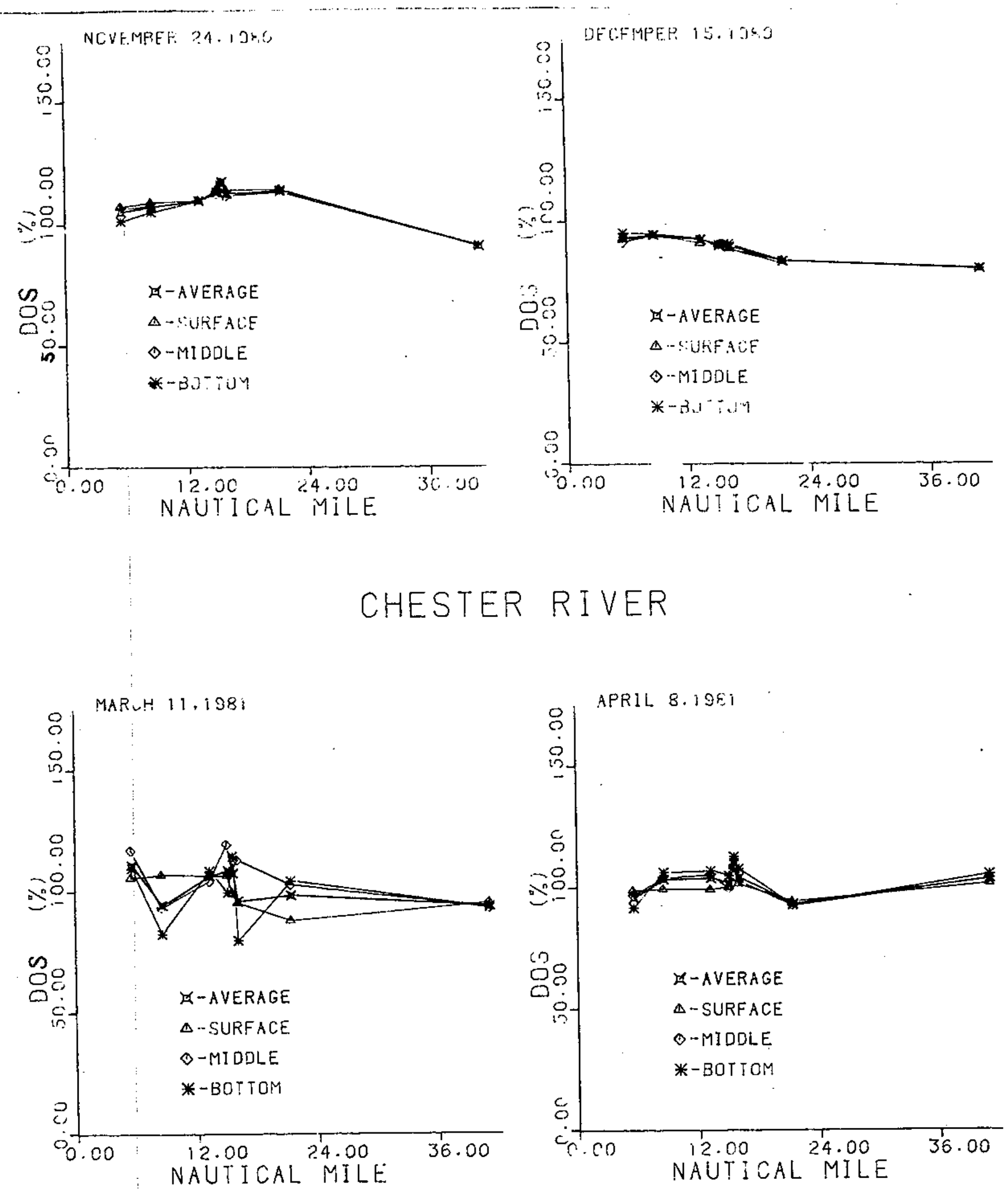


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

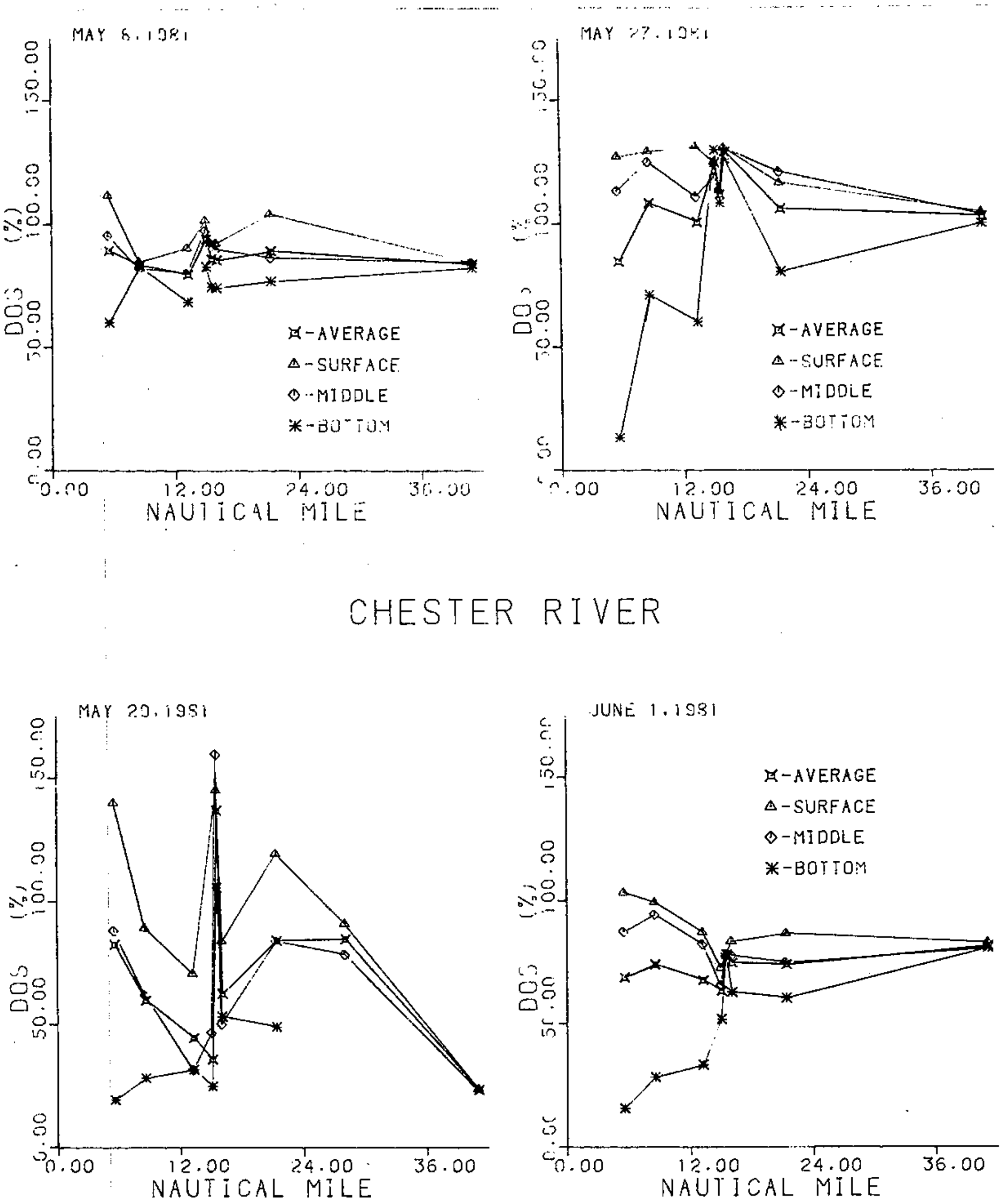
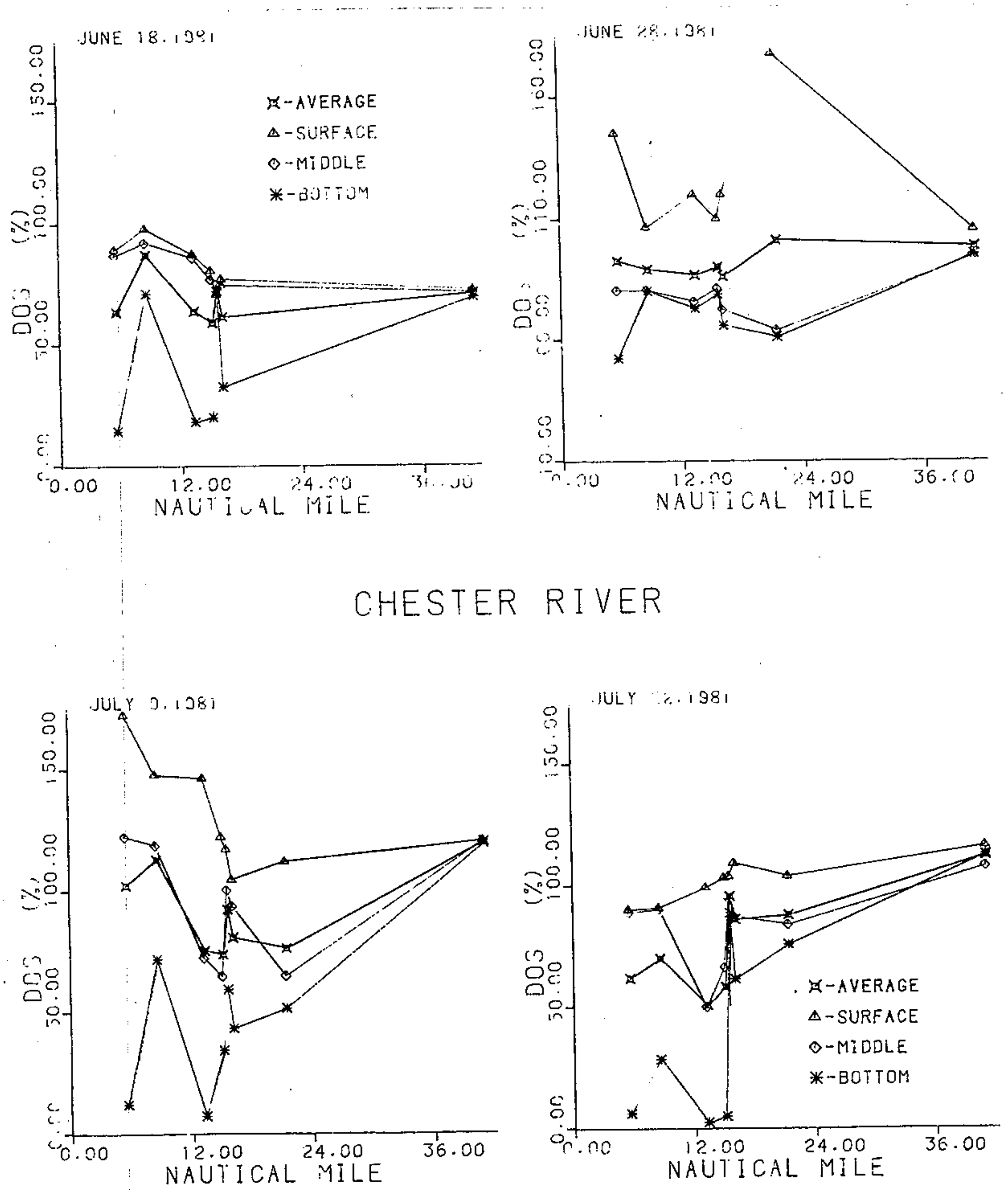


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).



CHESTER RIVER

Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).

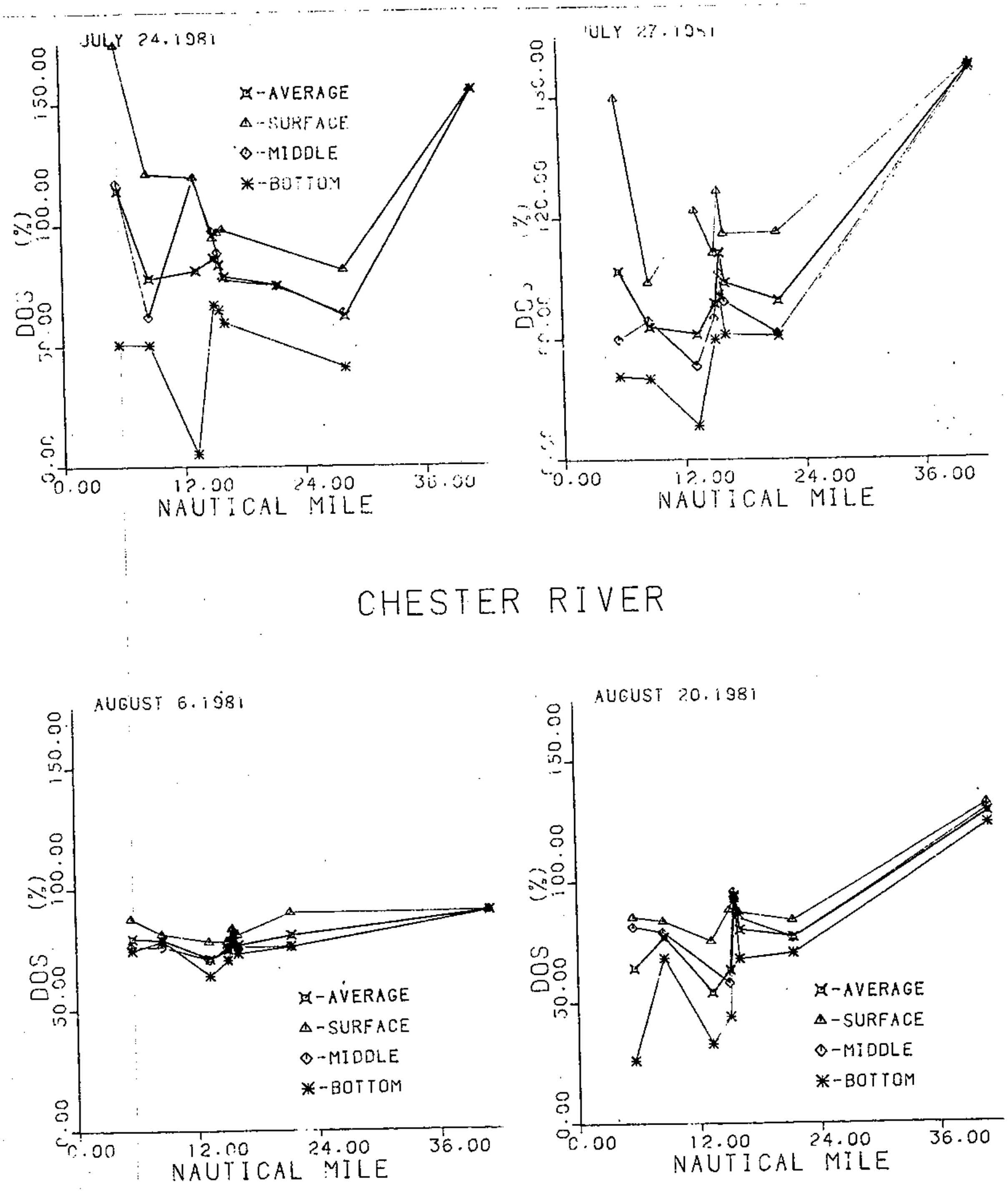
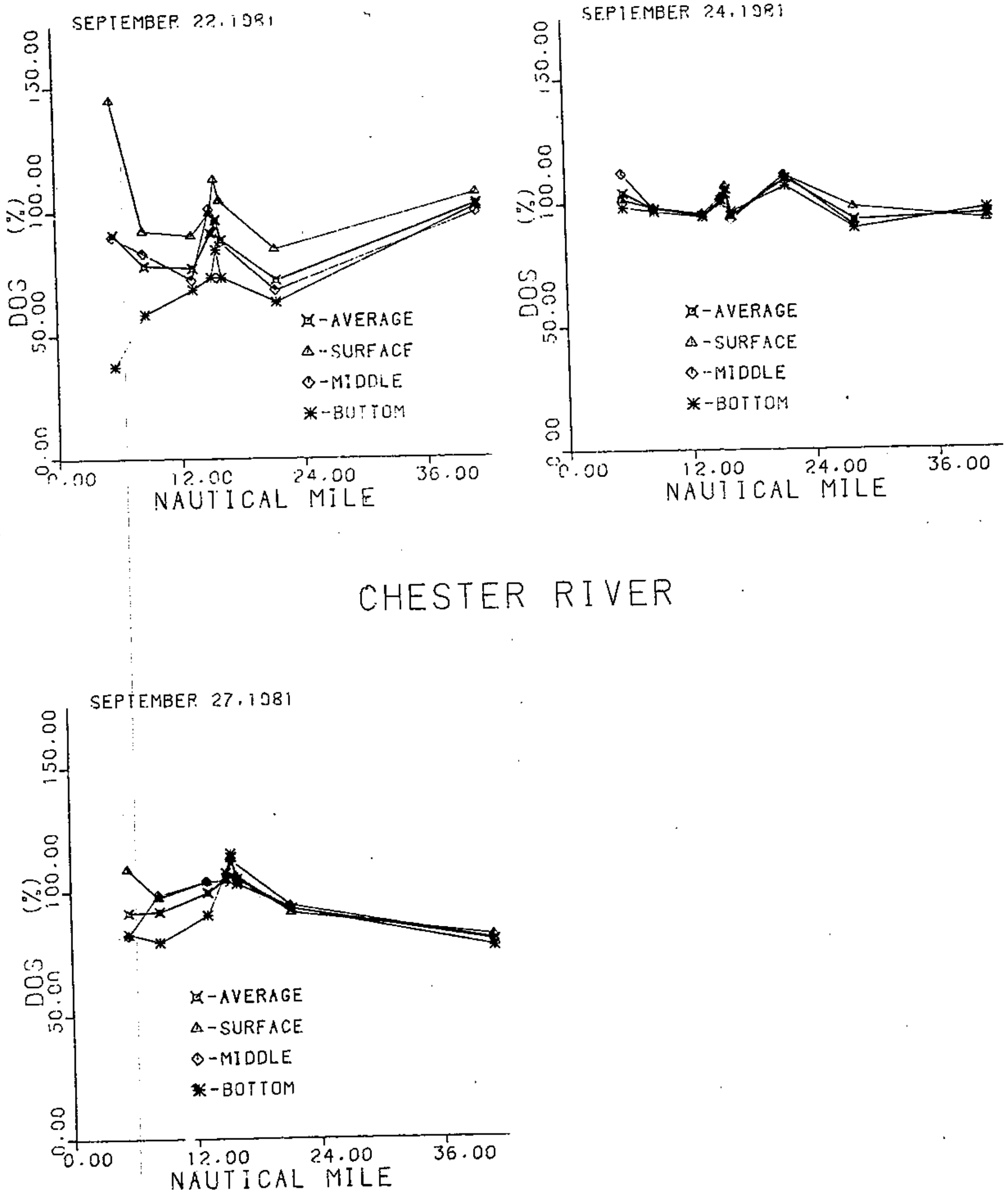
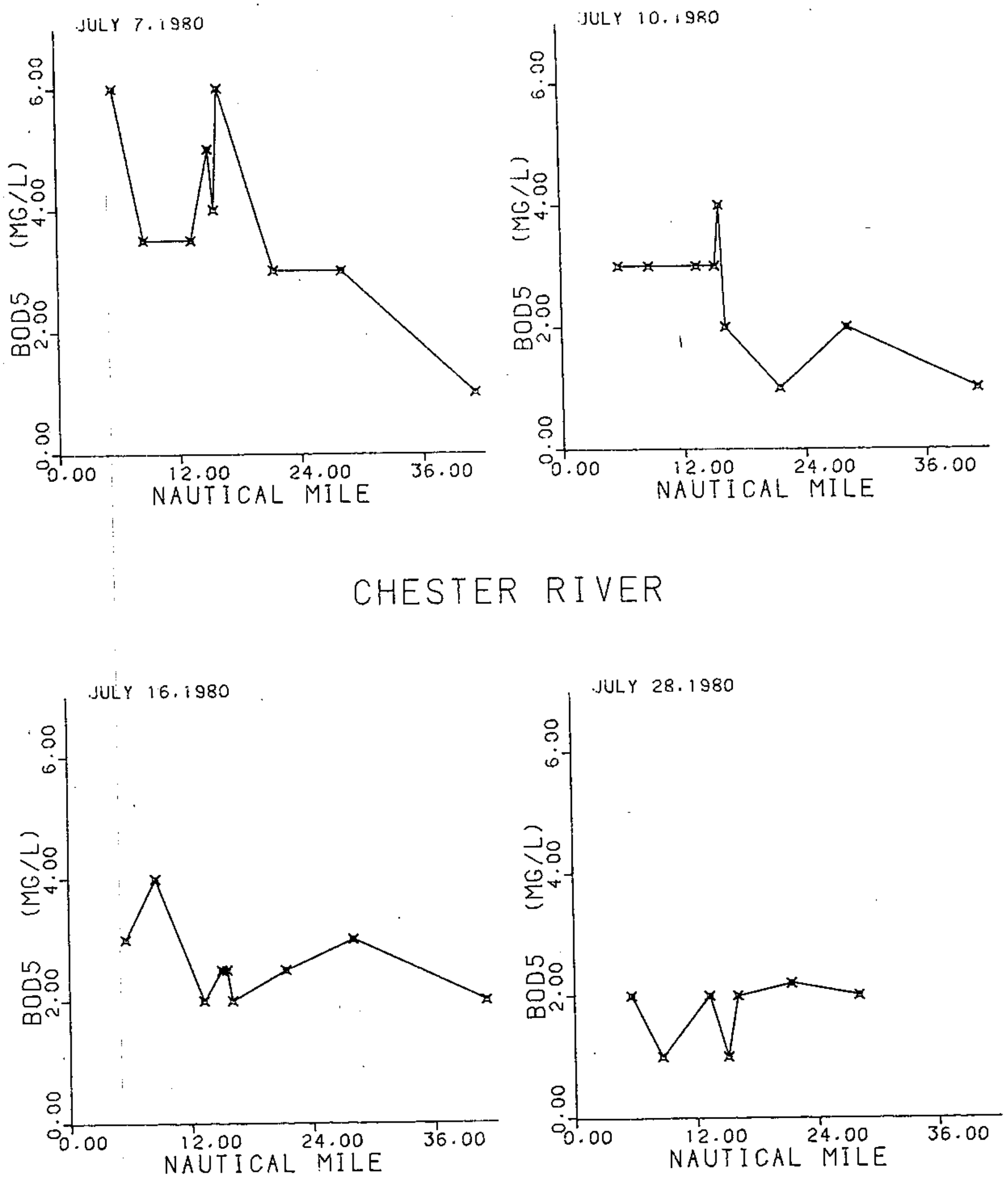


Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).



CHESTER RIVER

Figure 7-10 Longitudinal slack survey plots for Dissolved Oxygen Saturation, (mg/l).



CHESTER RIVER

Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).

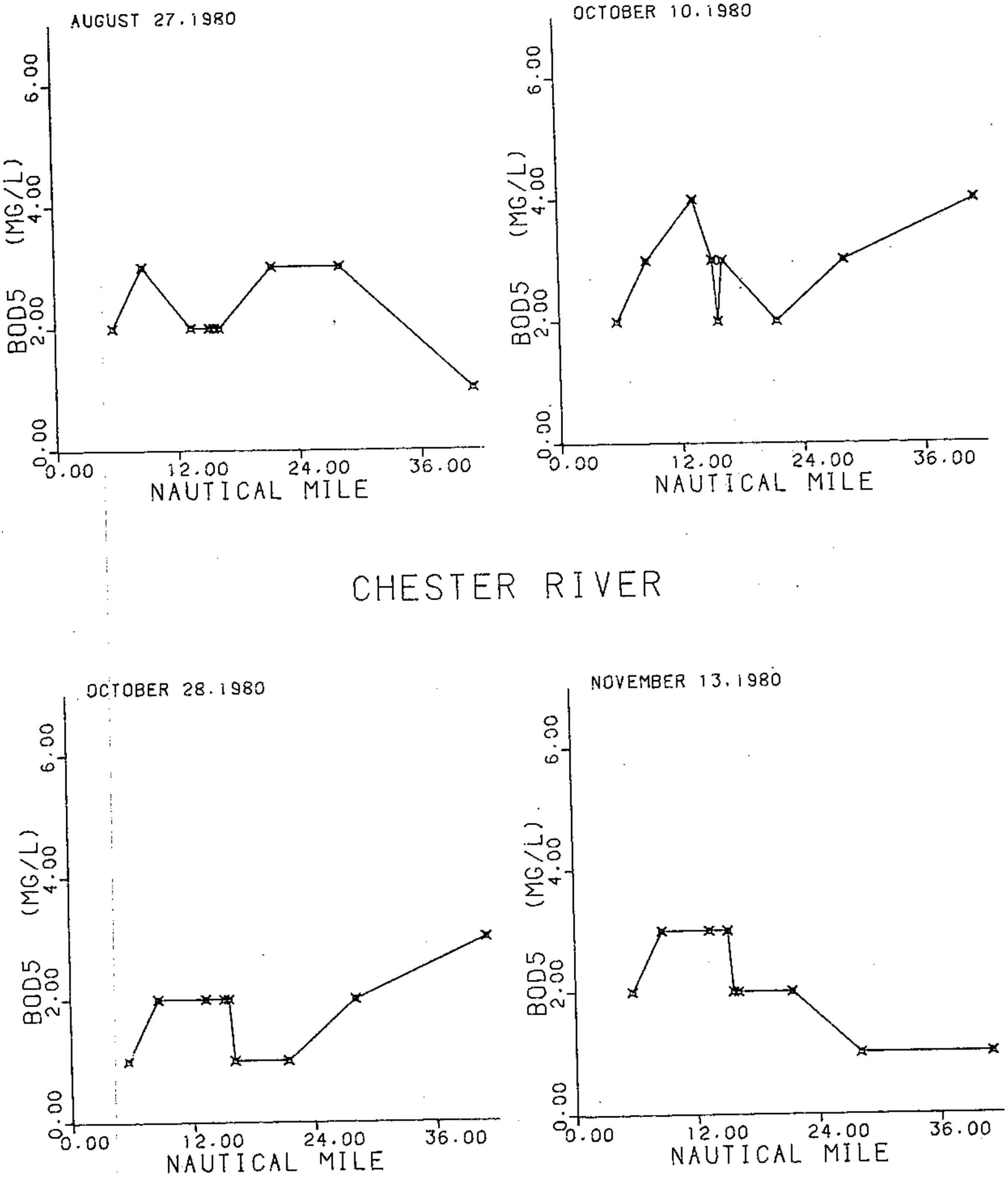


Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).

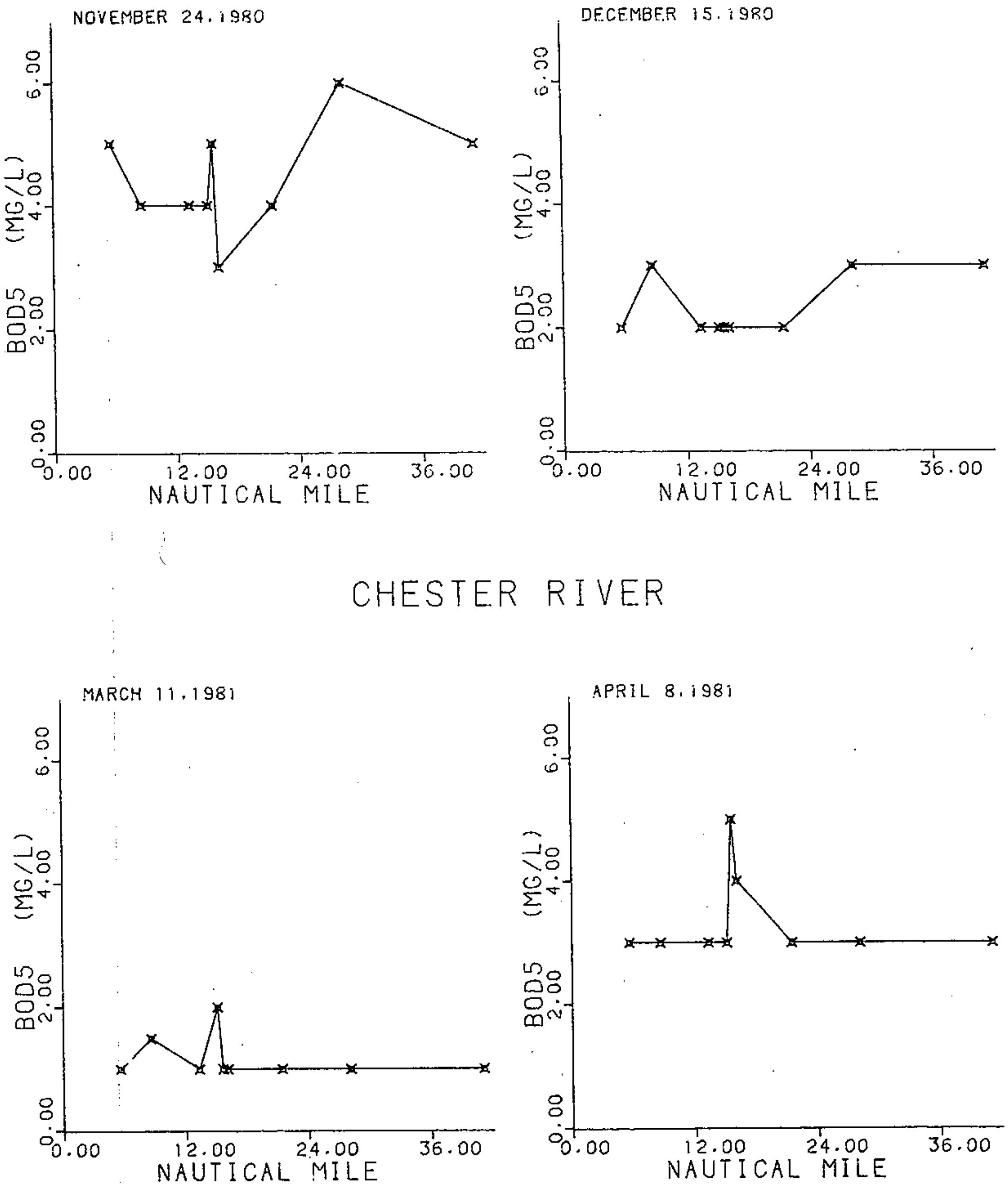


Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).

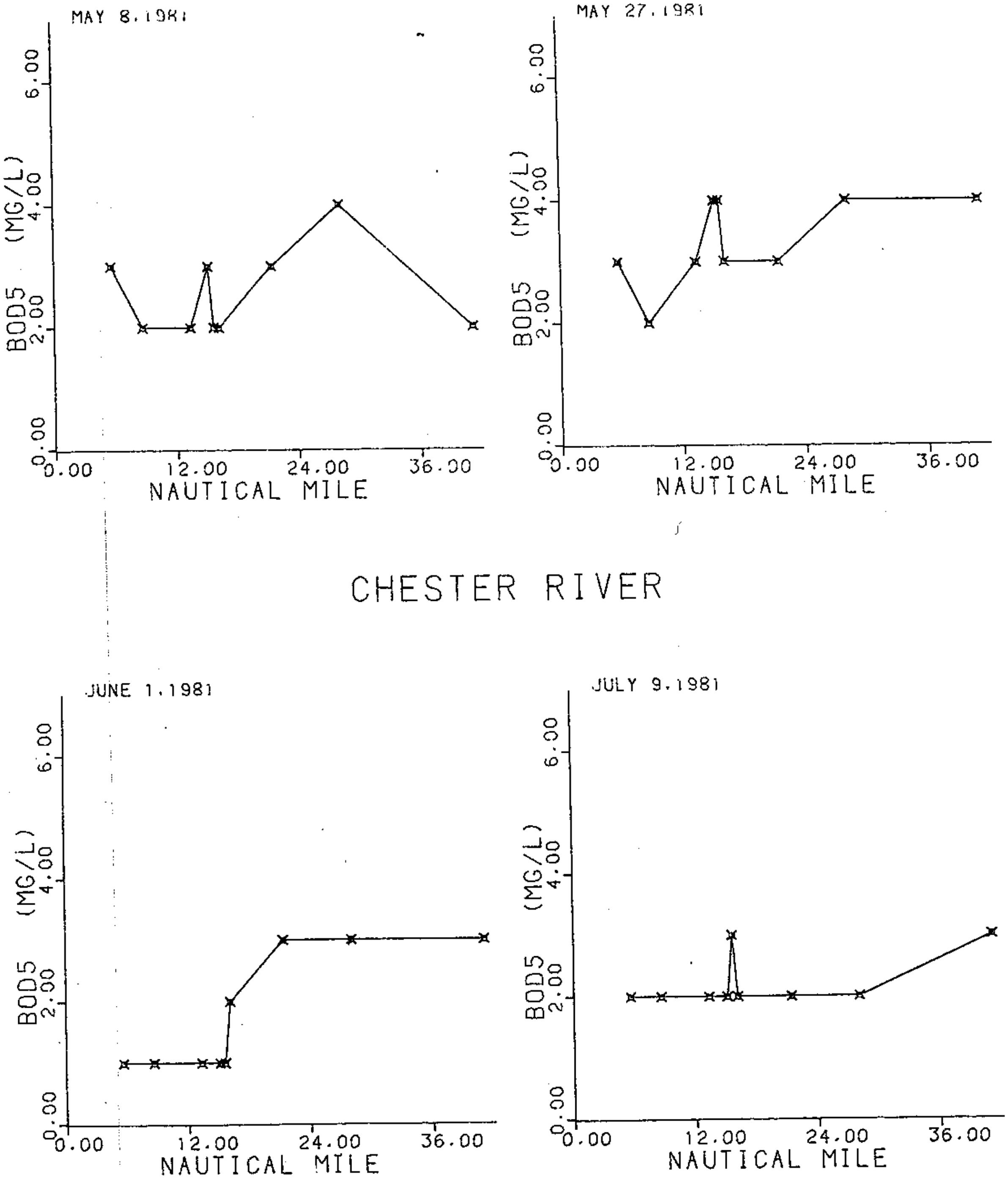


Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).

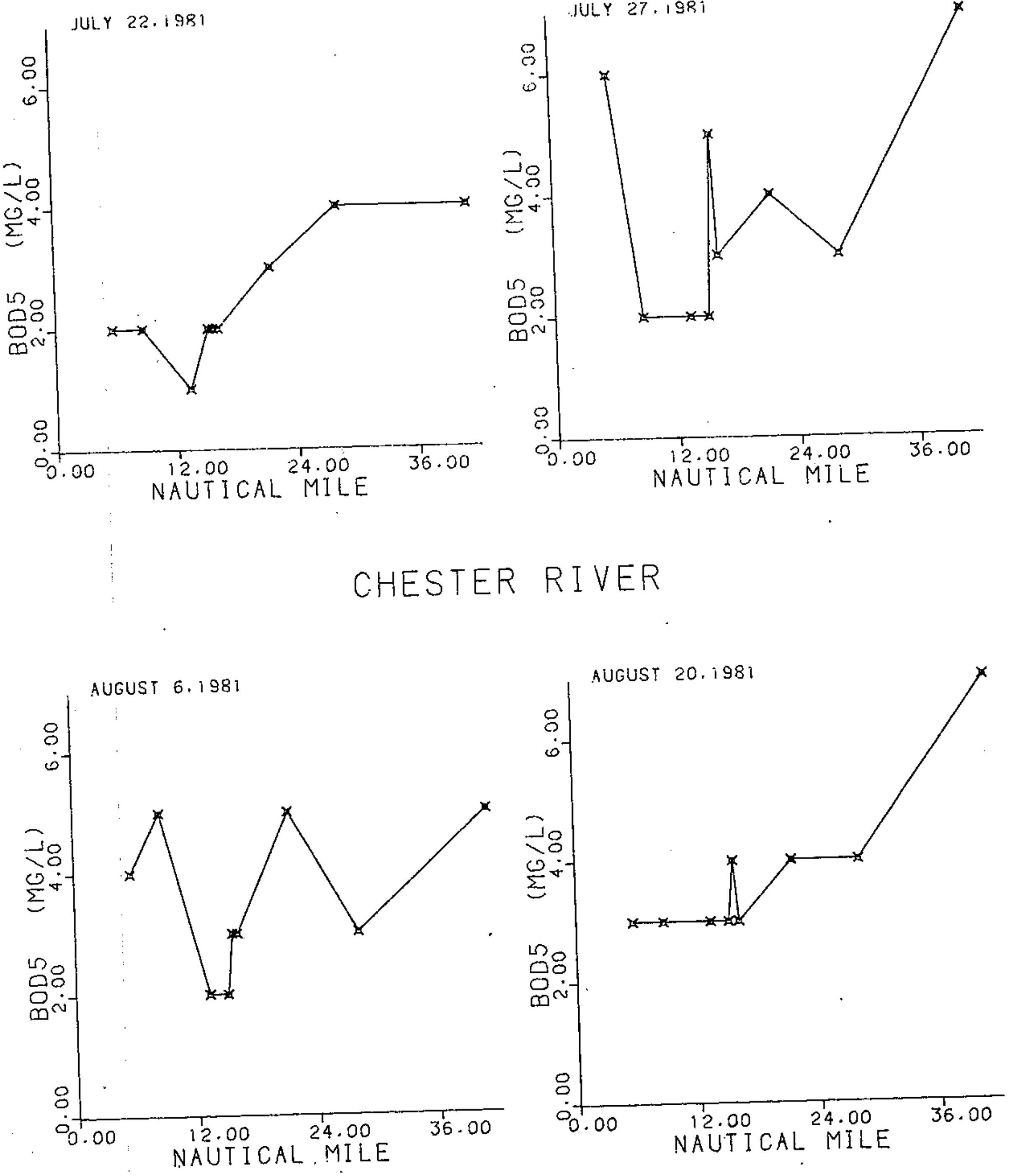
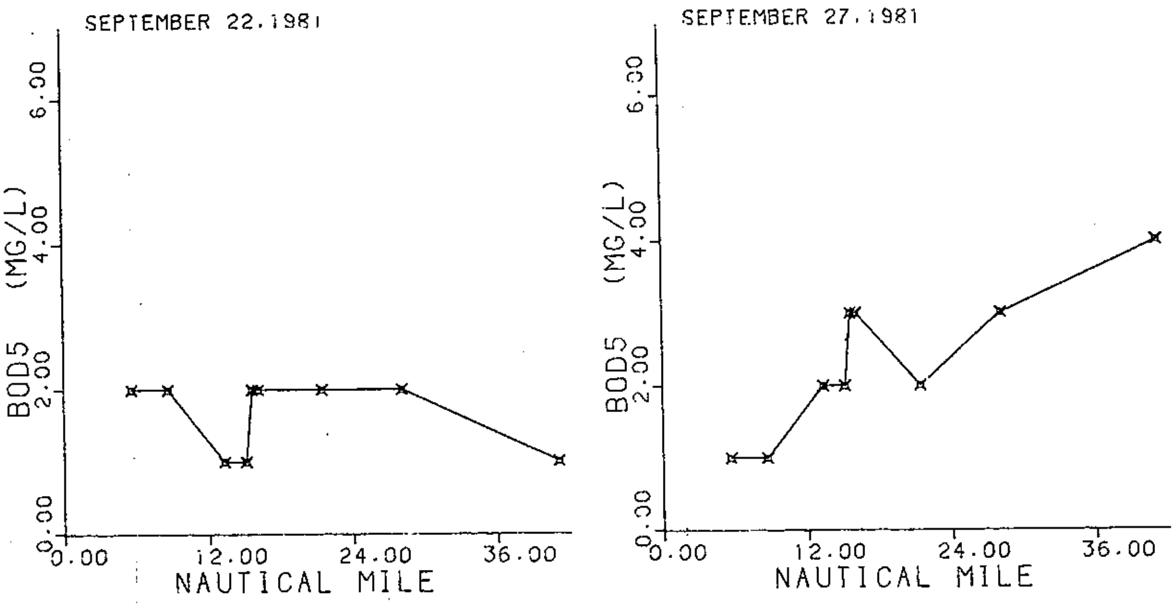


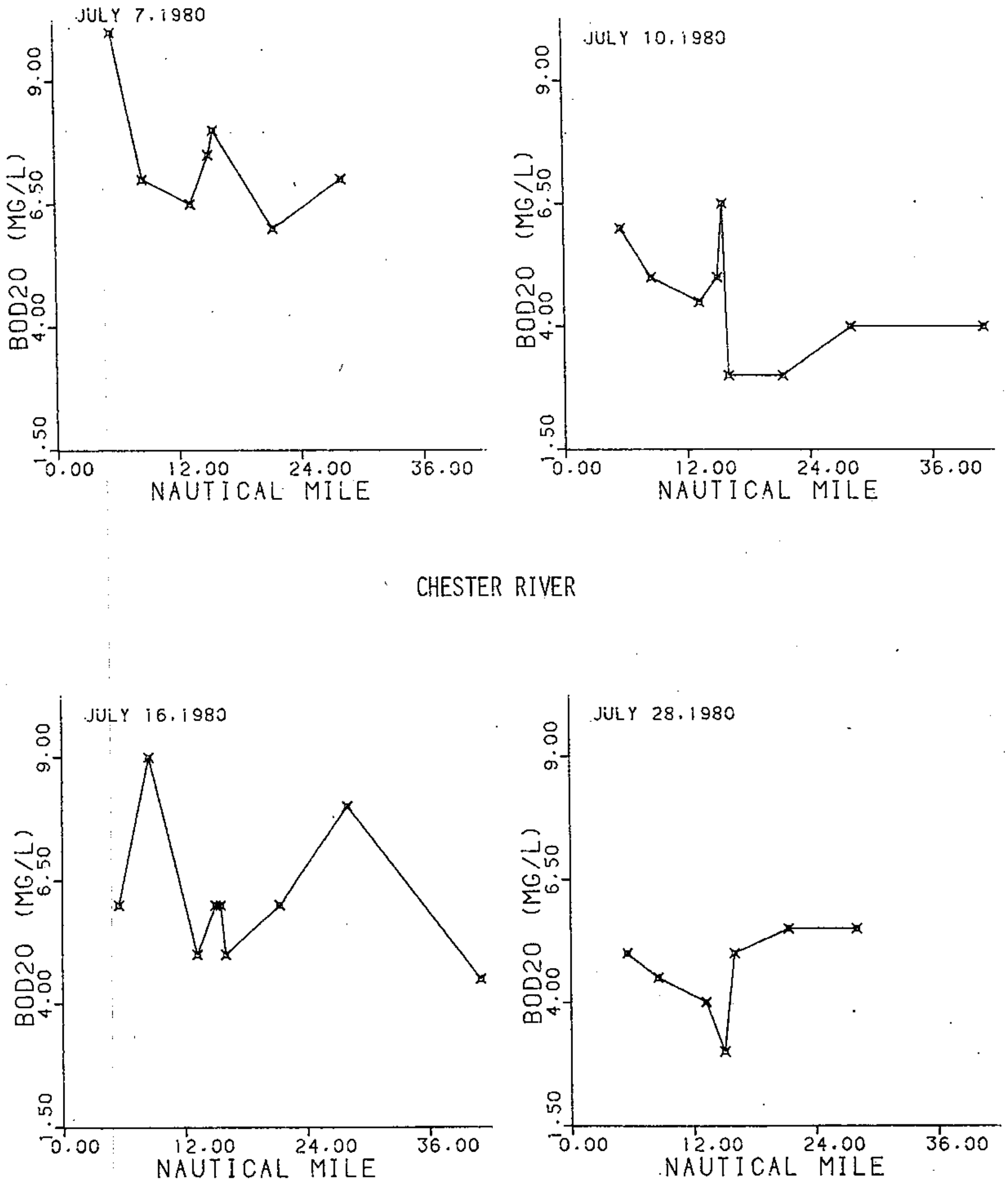
Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).


SEPTEMBER 22,1981

SEPTEMBER 27,1981

CHESTER RIVER

Figure 7-11 Longitudinal slack survey plots for Biological Oxygen Demand after 5 days, (mg/l).



CHESTER RIVER

Figure 7-12 Longitudinal slack survey plots for BOD_{20}, (mg/l).

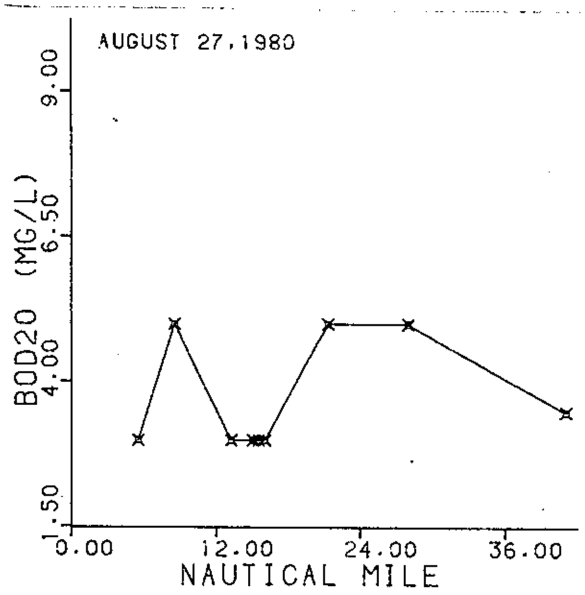


Figure 7-12 Longitudinal slack survey plots for BOD_{20} (mg/l).

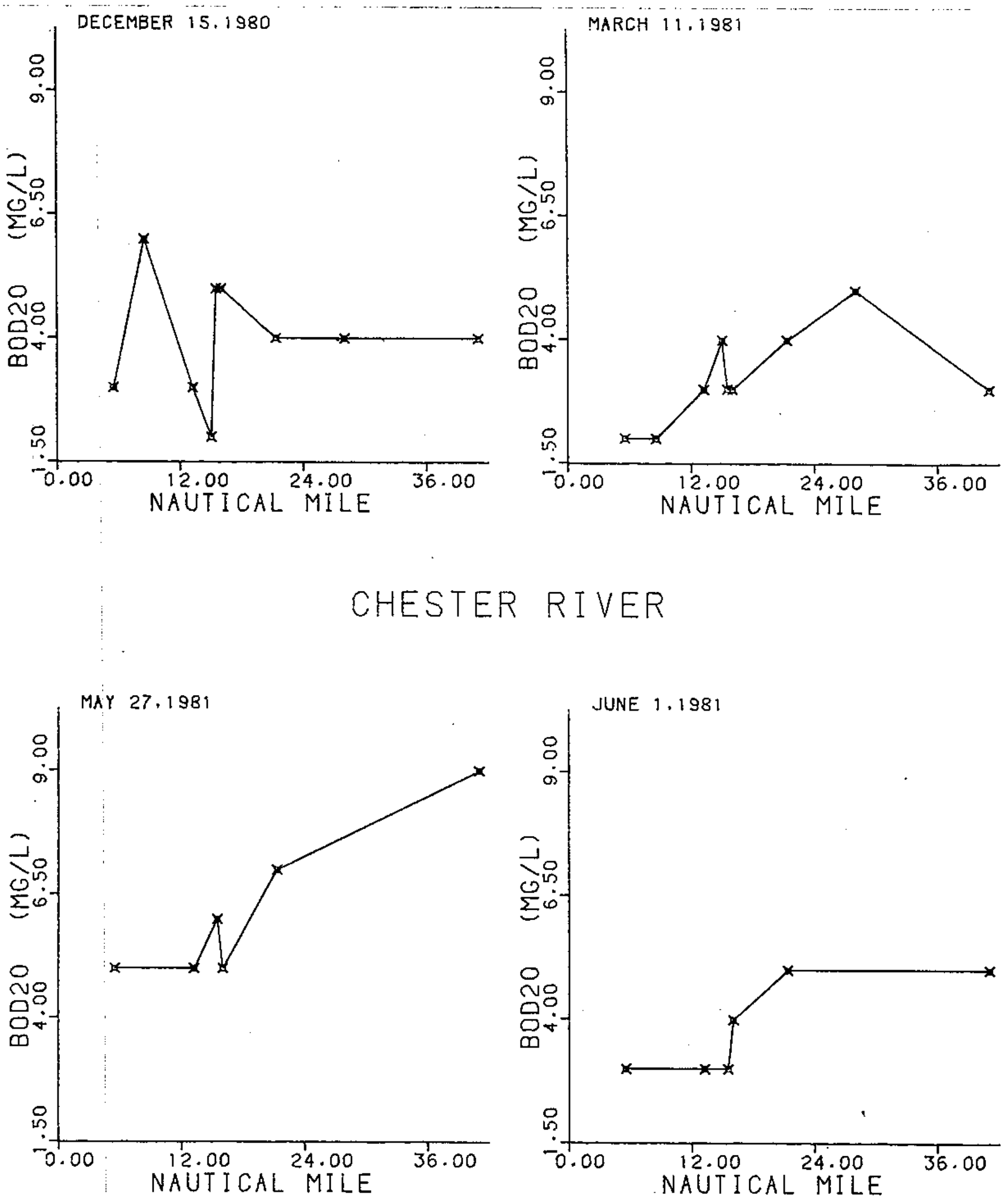


Figure 7-12 Longitudinal slack survey plots for BOD_{20}, (mg/l).

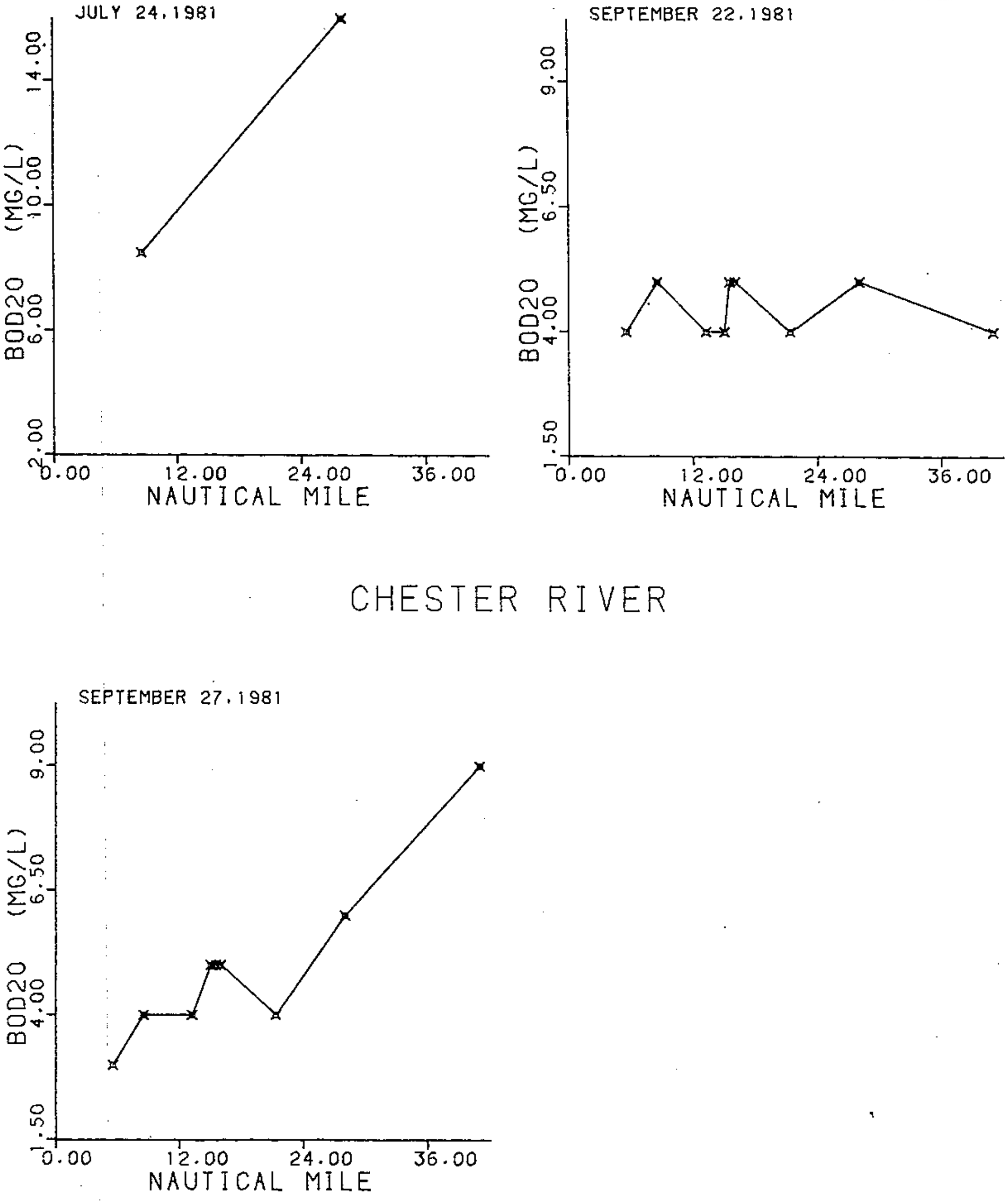
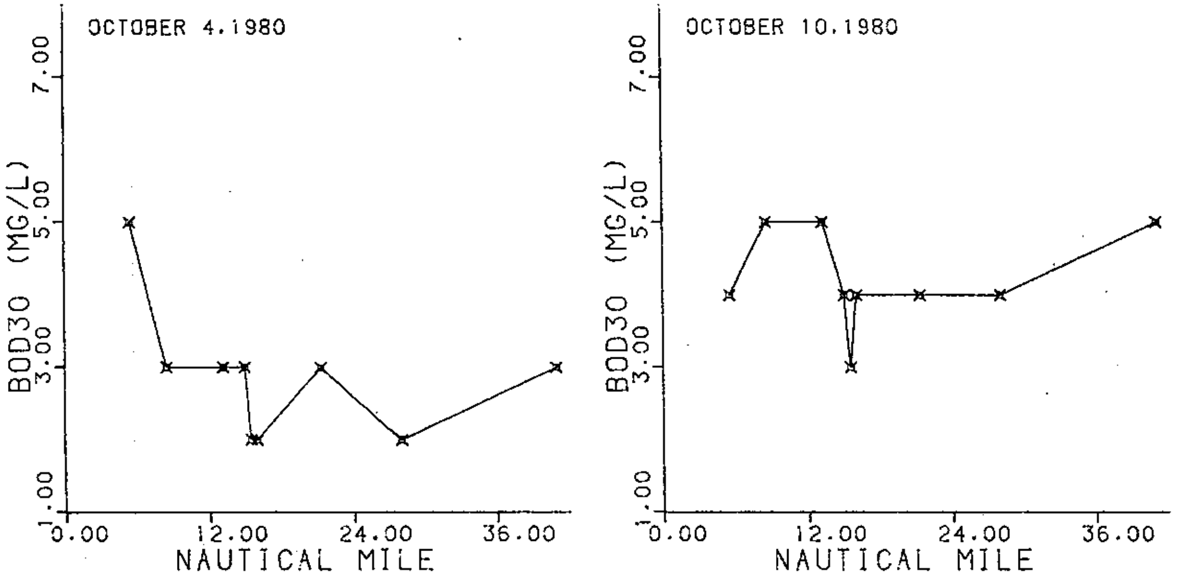


Figure 7-12 Longitudinal slack survey plots for BOD_{20}, (mg/l).



CHESTER RIVER

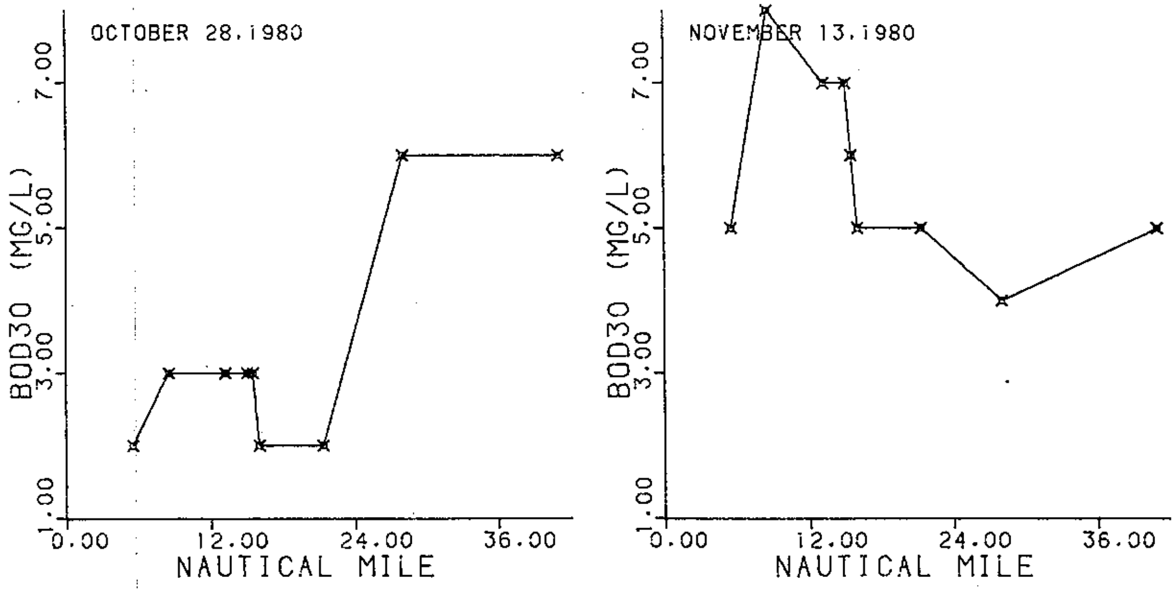


Figure 7-13 Longitudinal slack survey plots for BOD_{30}, (mg/l).

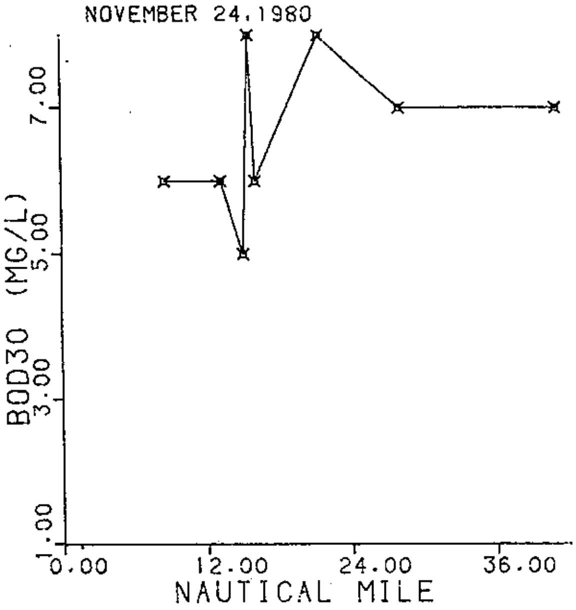
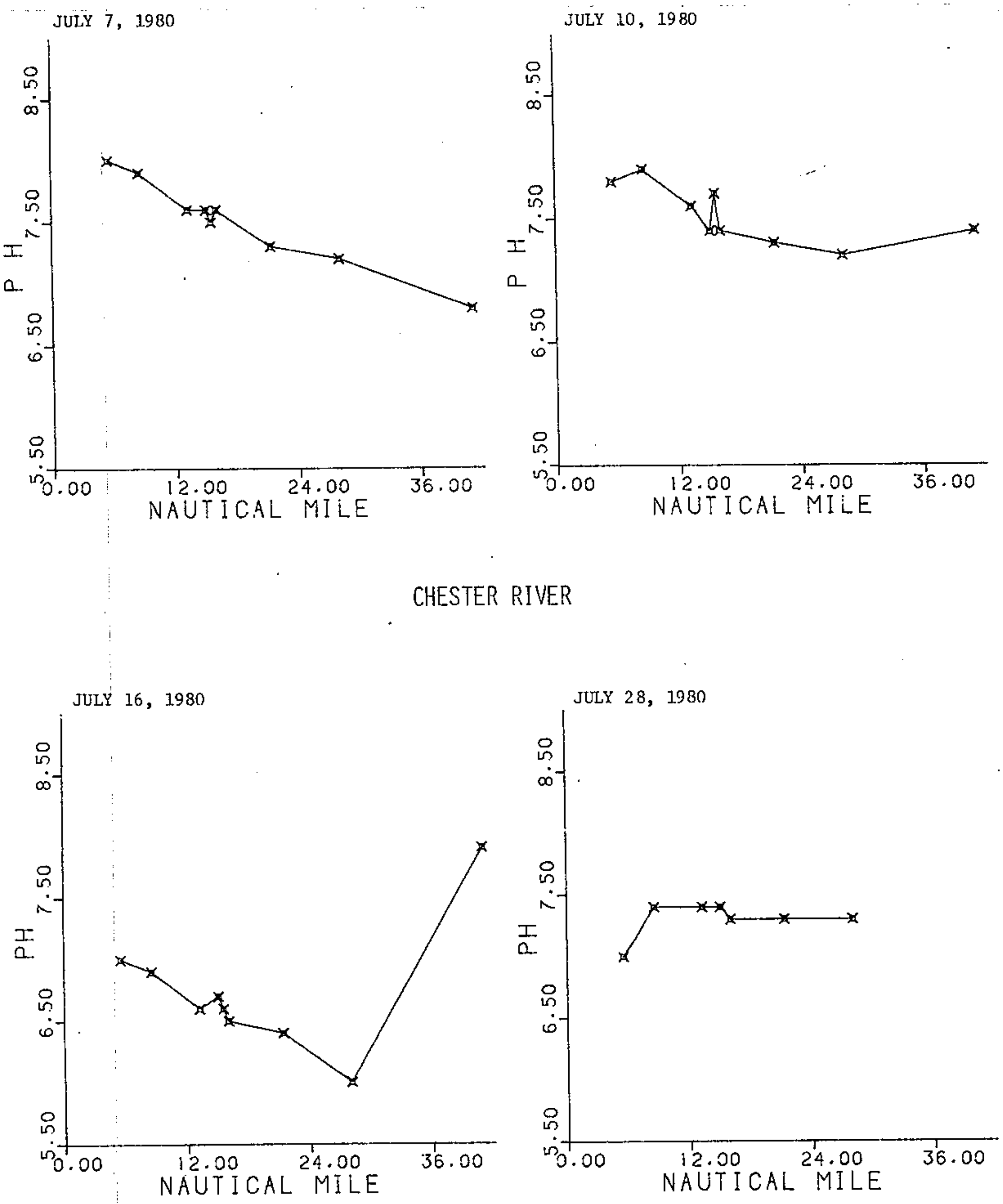


Figure 7-13 Longitudinal slack survey plots for BOD_{30} (mg/l).



CHESTER RIVER

Figure 7-14 Longitudinal slack survey plots for pH.

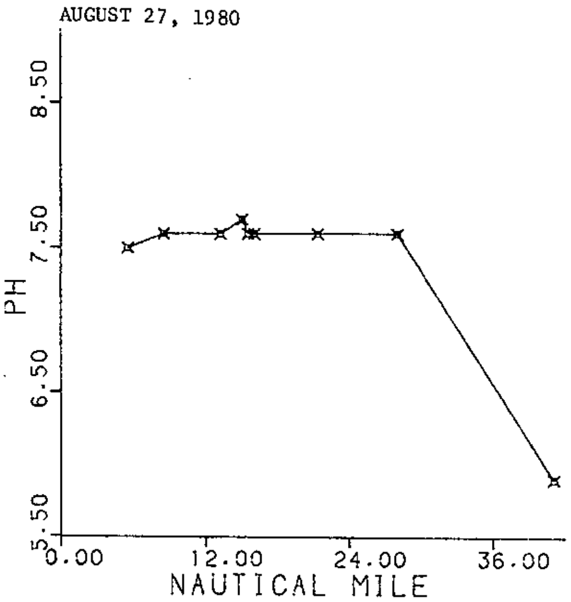


Figure 7-14 Longitudinal slack survey plots for pH.

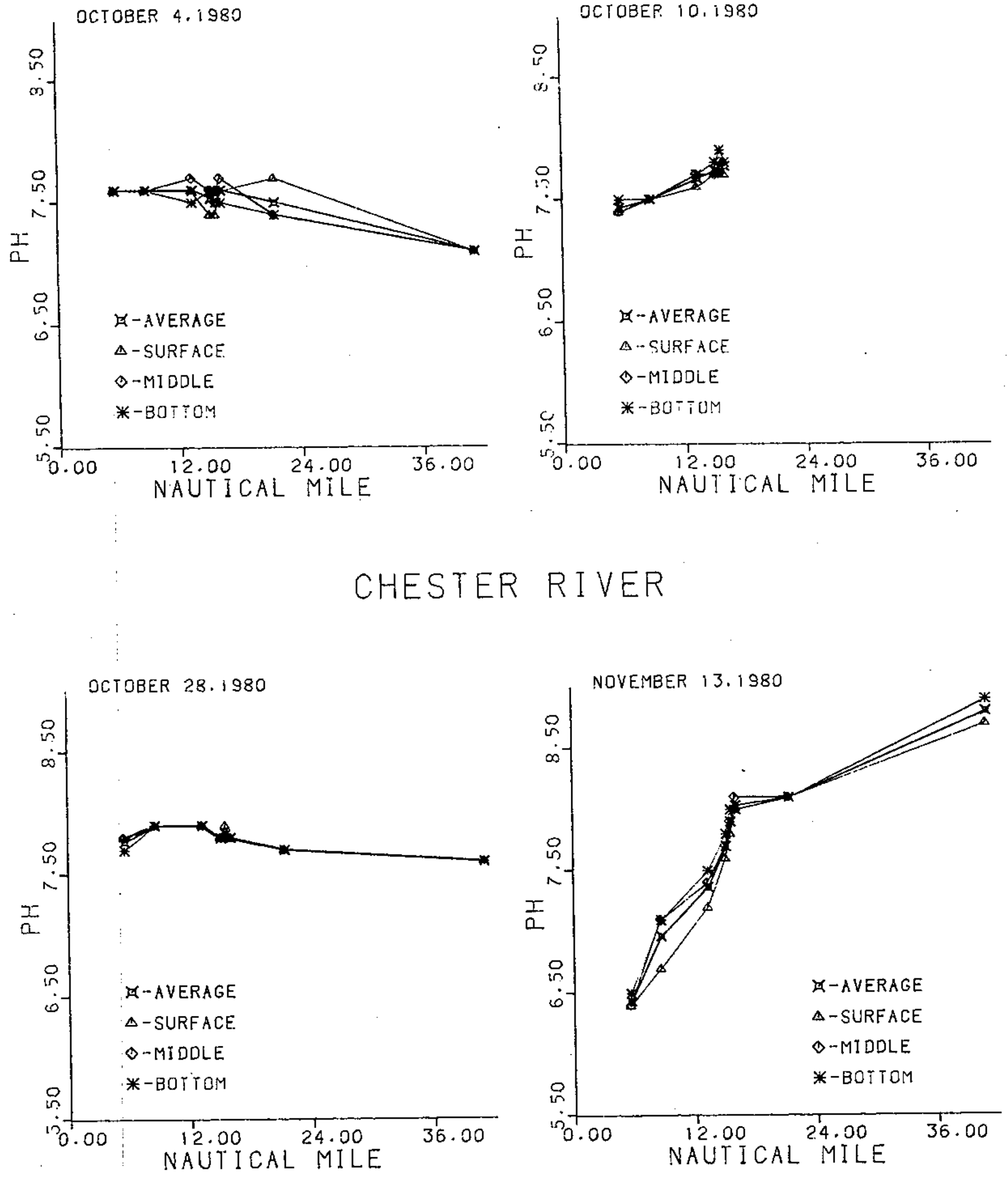


Figure 7-14 Longitudinal slack survey plots for pH.

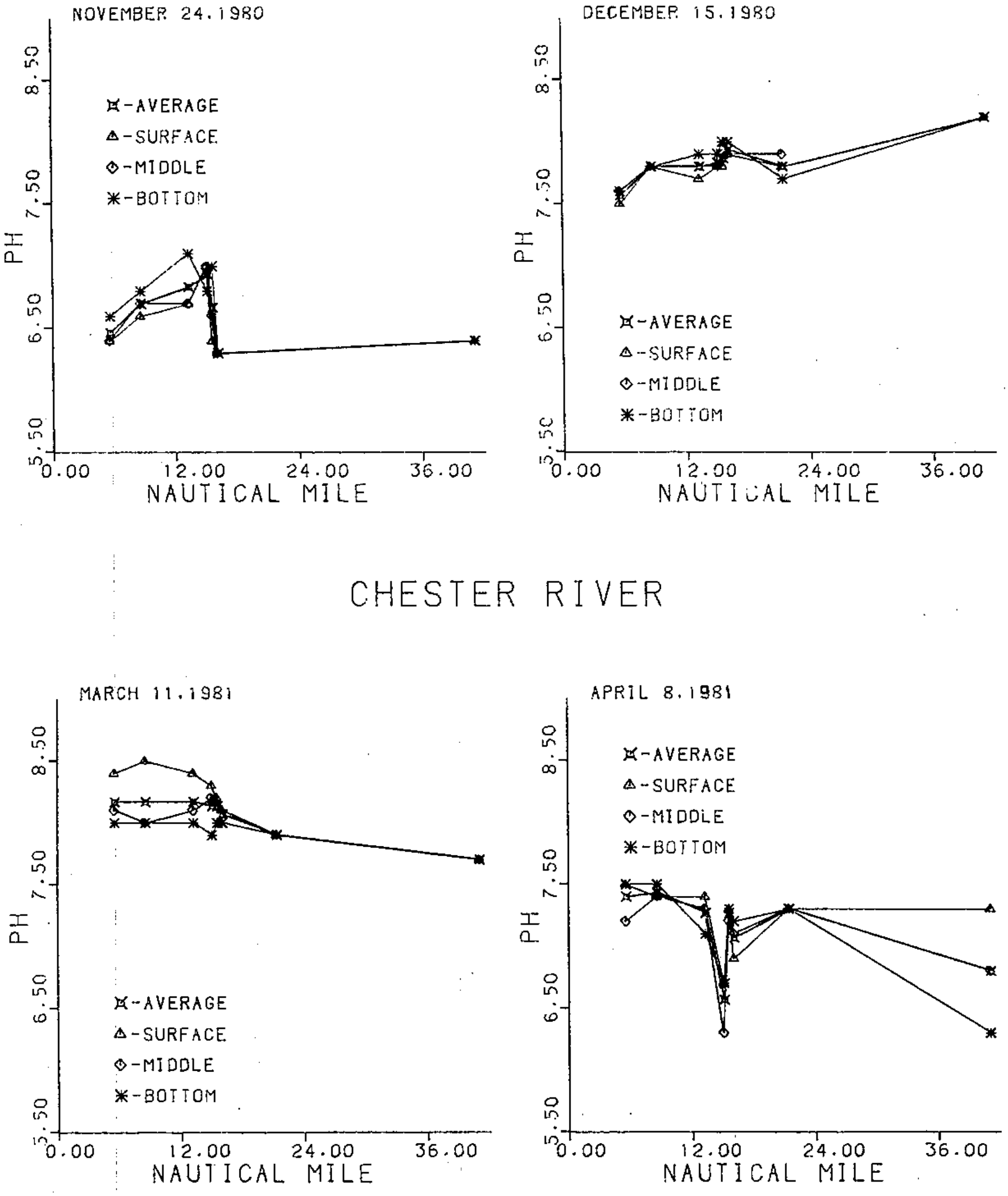


Figure 7-14 Longitudinal slack survey plots for pH.

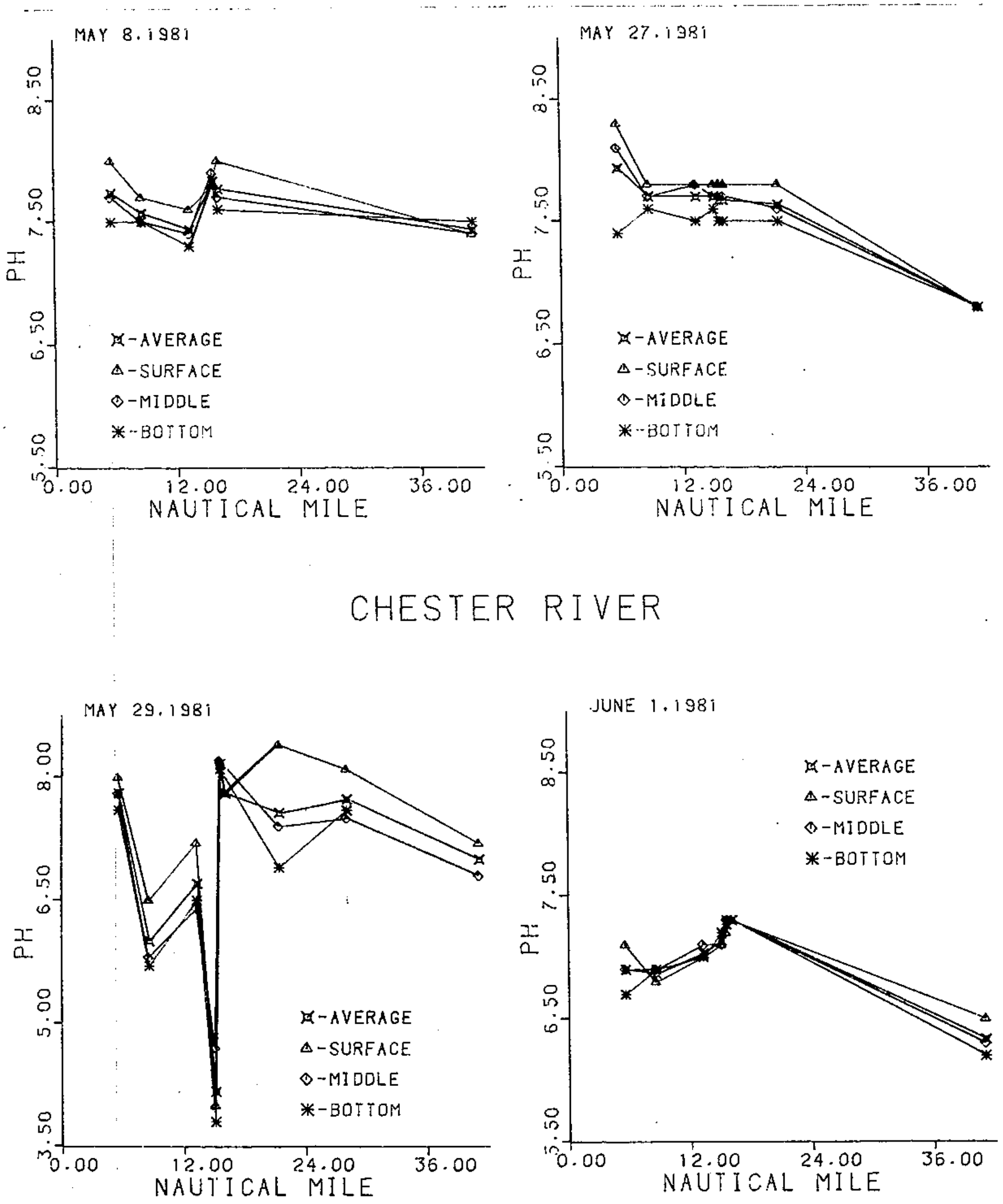


Figure 7-14 Longitudinal slack survey plots for pH.

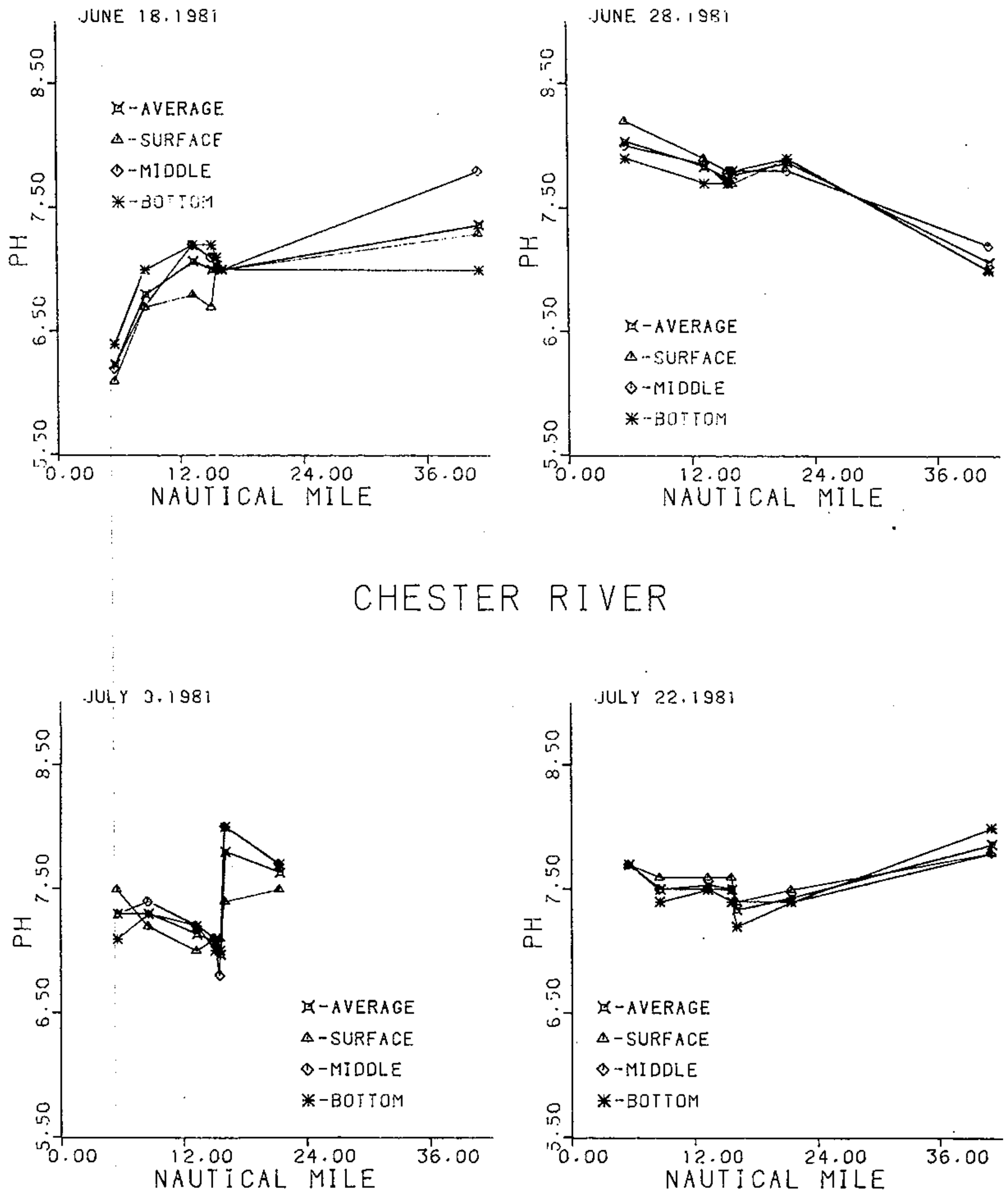
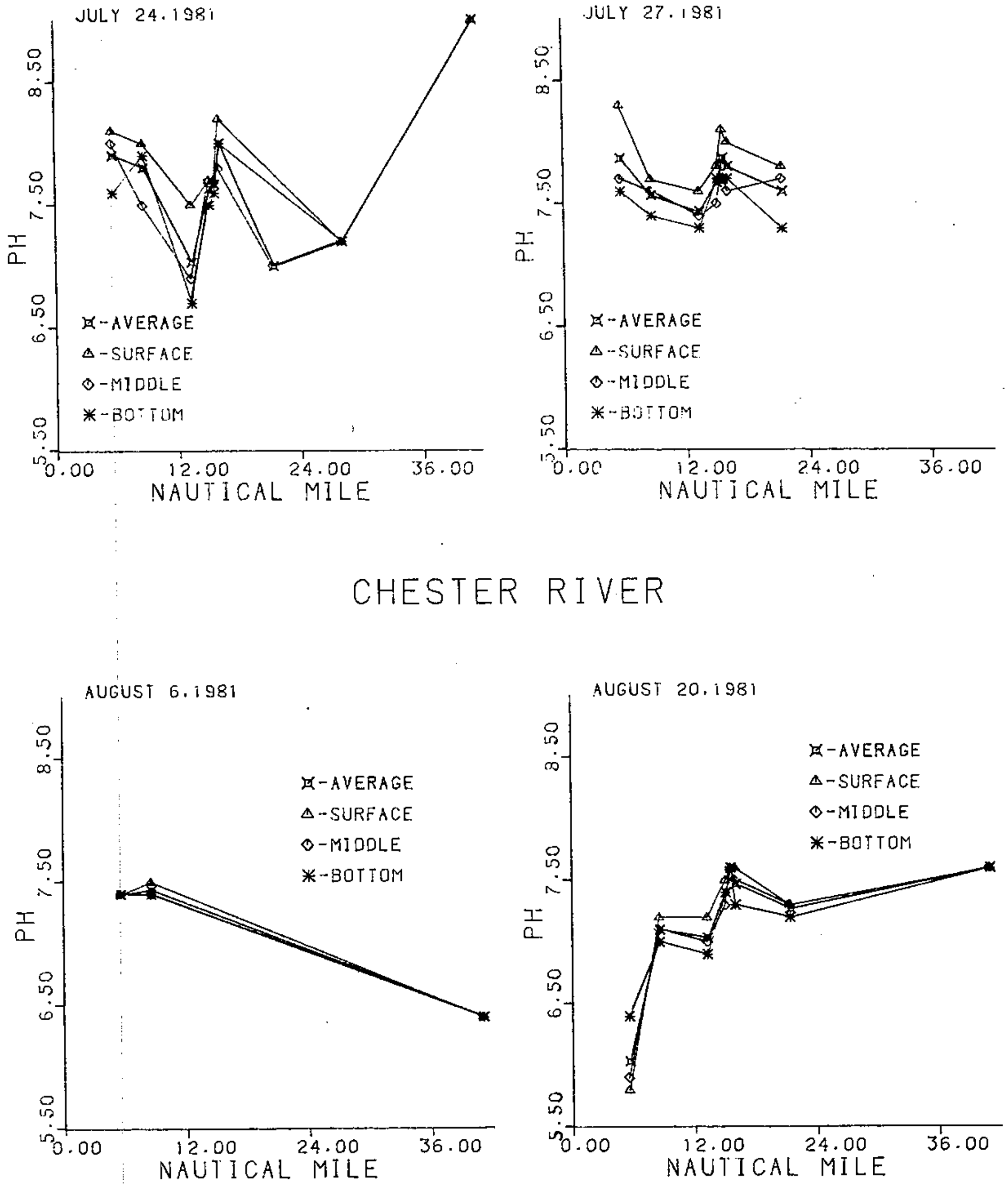


Figure 7-14 Longitudinal slack survey plots for pH.



CHESTER RIVER

Figure 7-14 Longitudinal slack survey plots for pH.

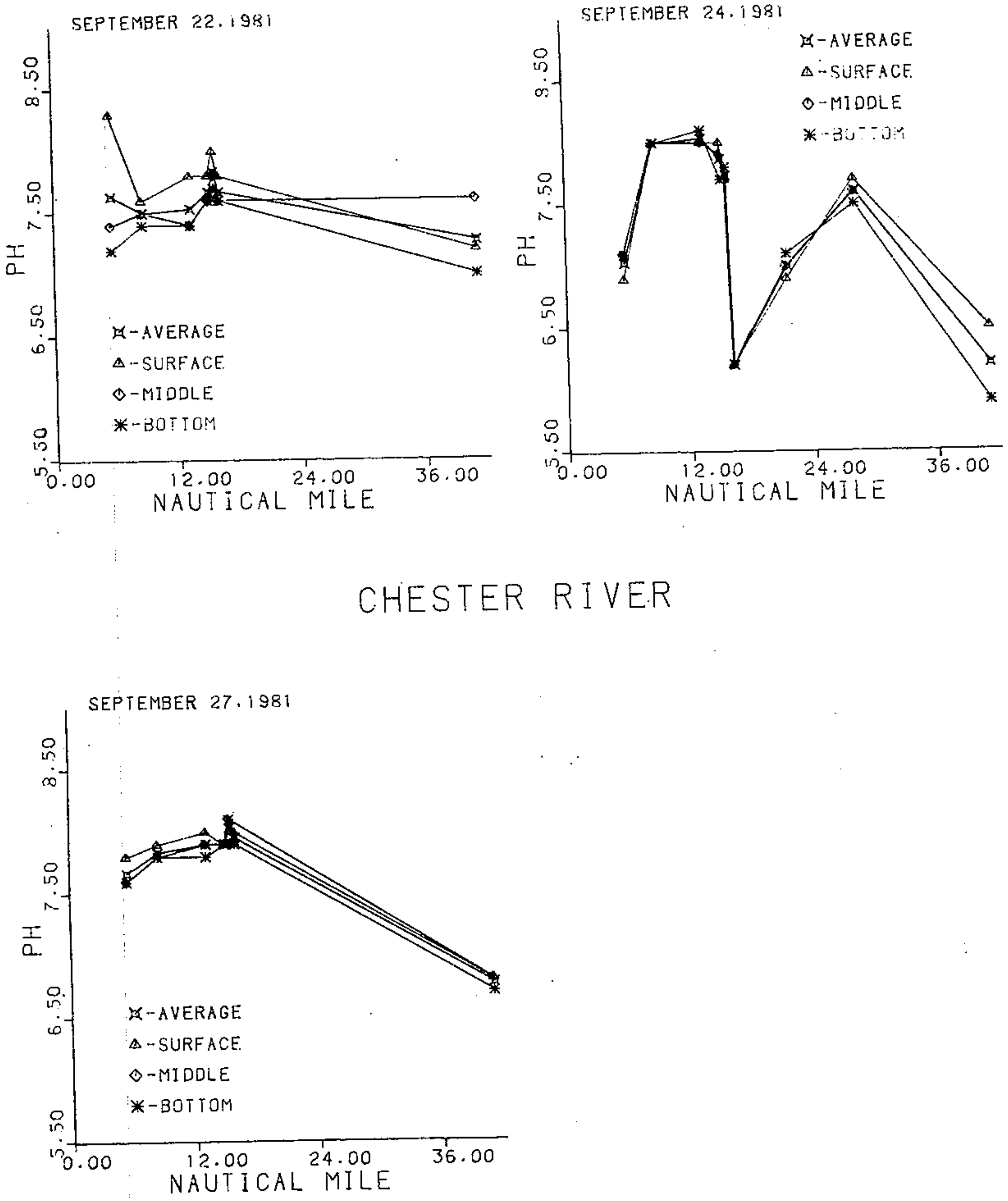


Figure 7-14 Longitudinal slack survey plots for pH.

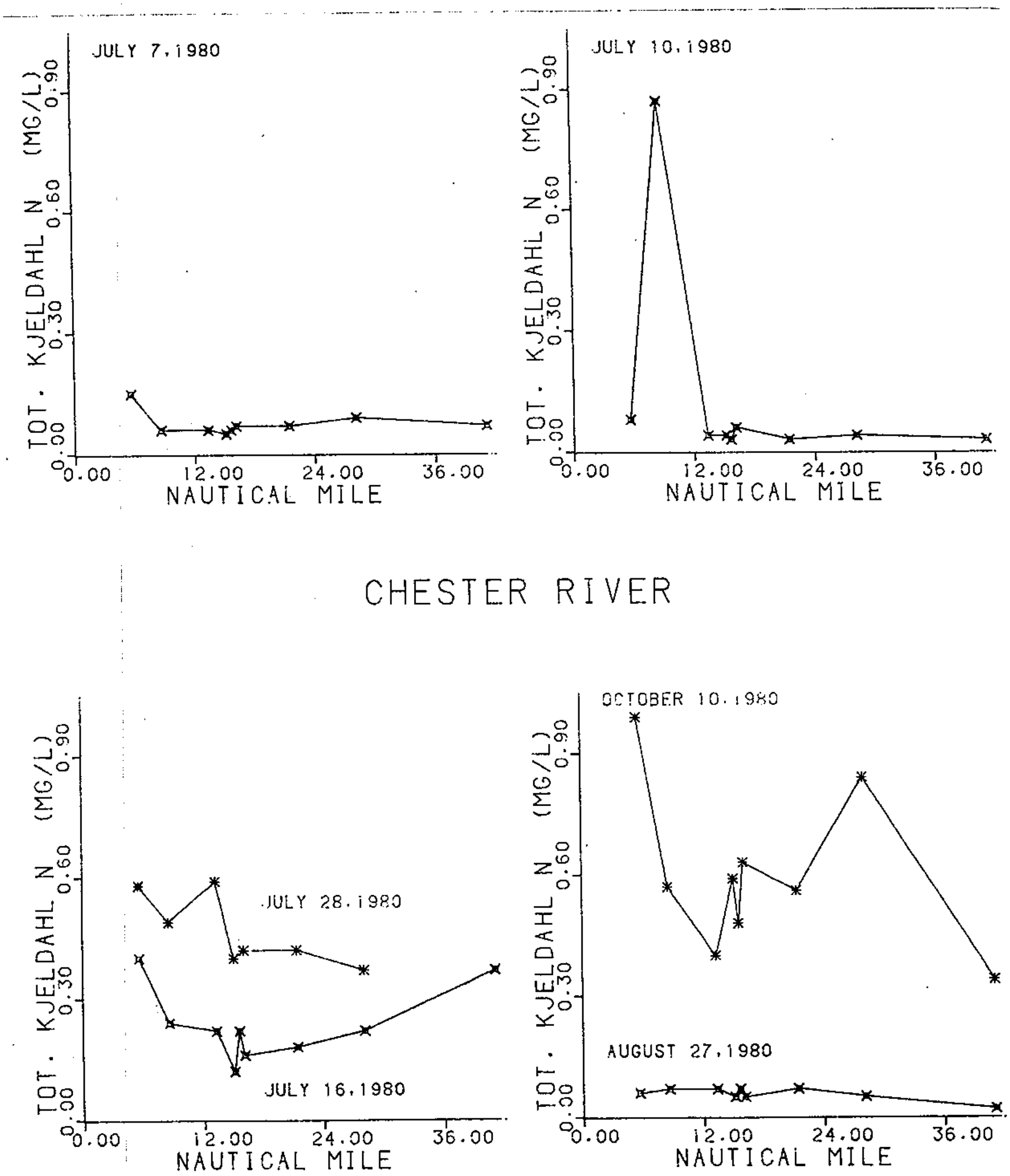


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen (mg/l).

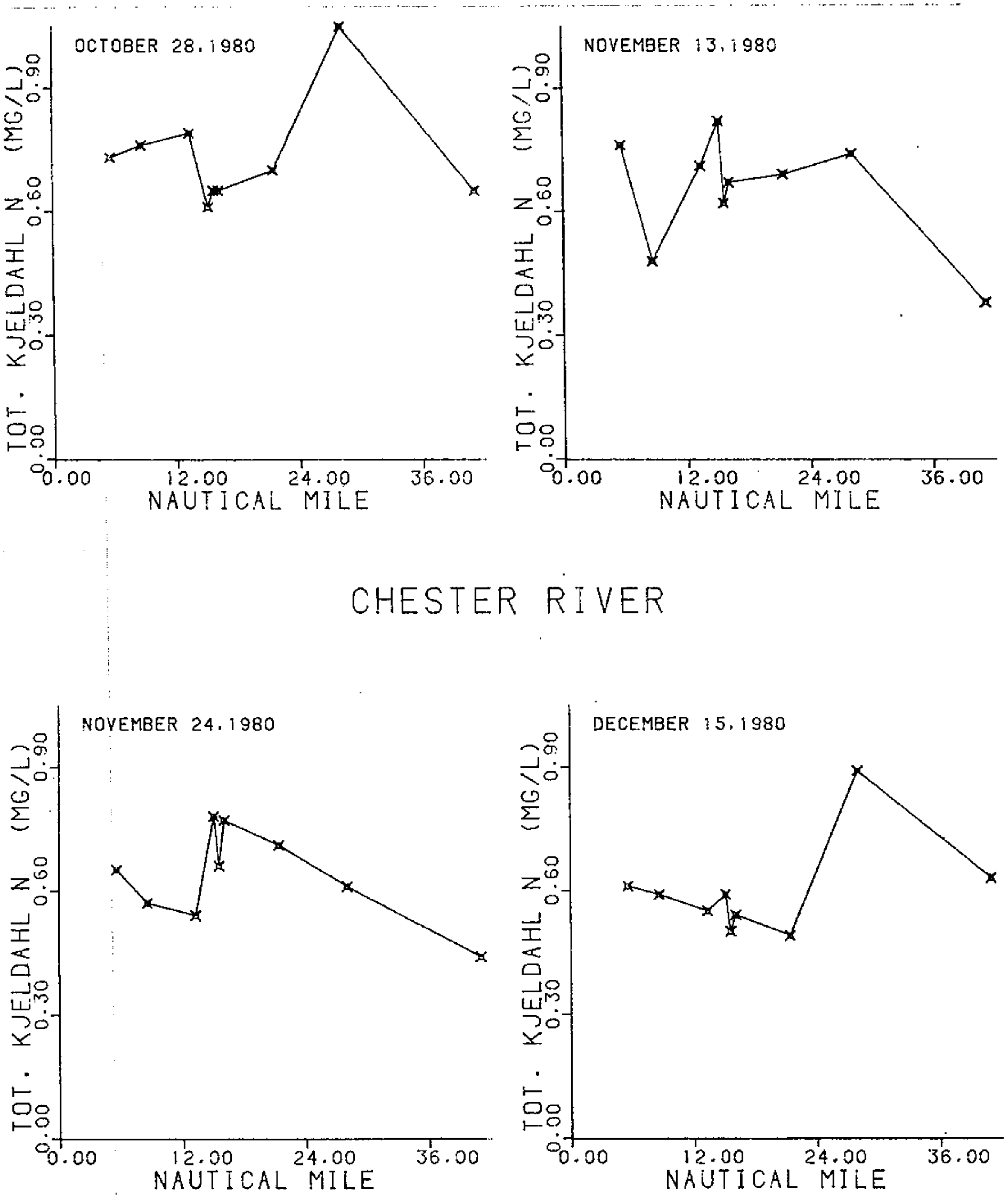


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen (mg/l).

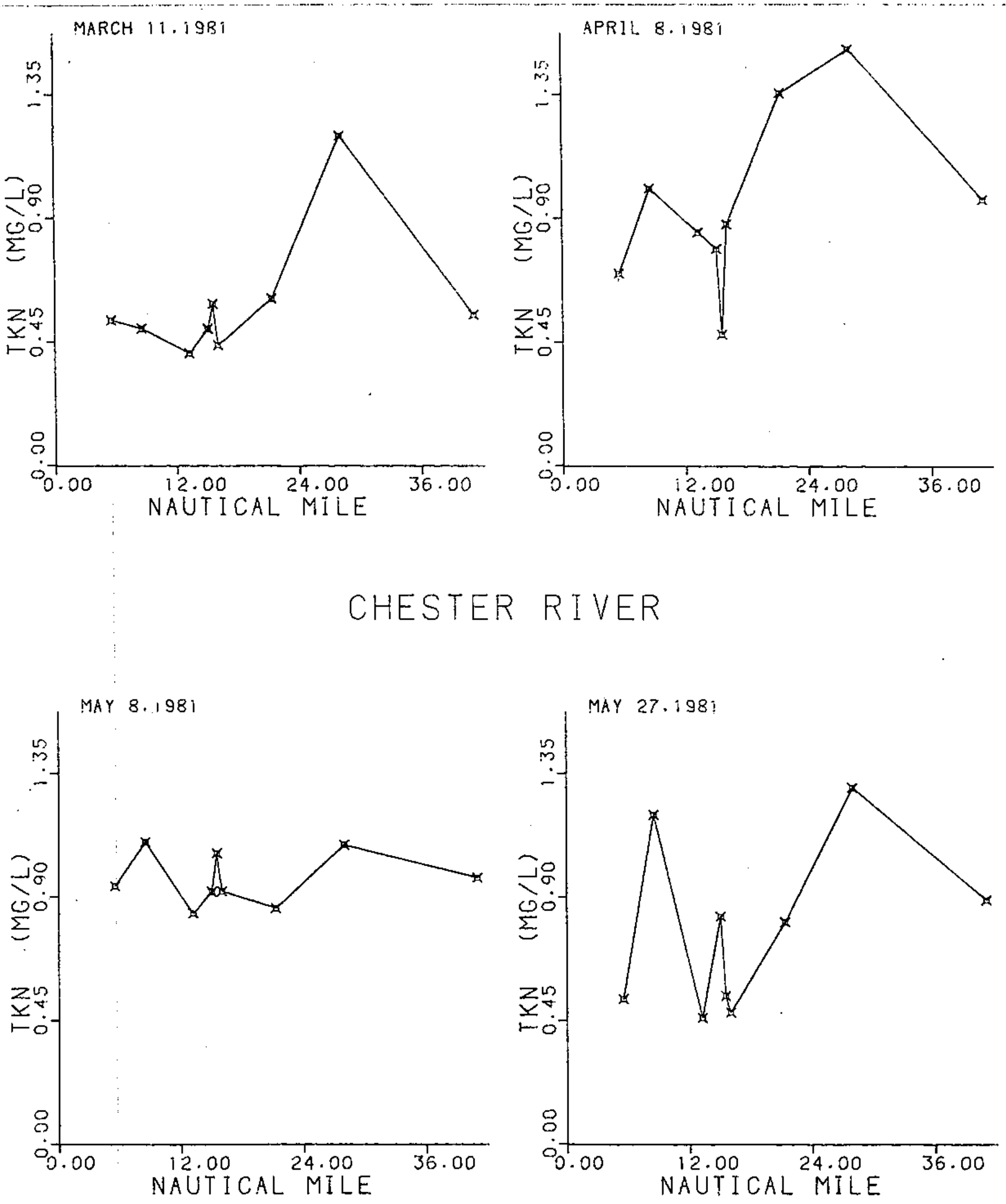


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).

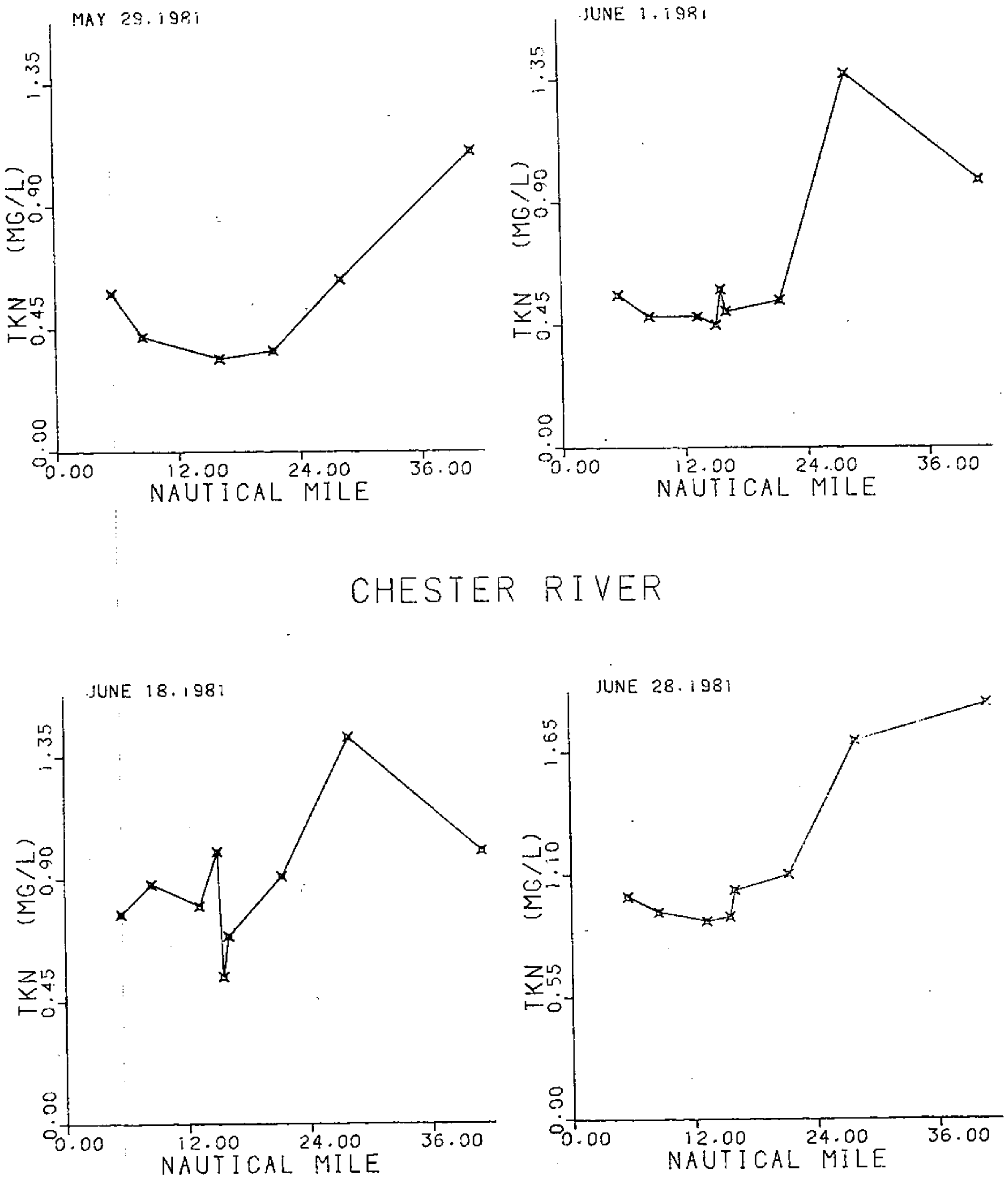


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).

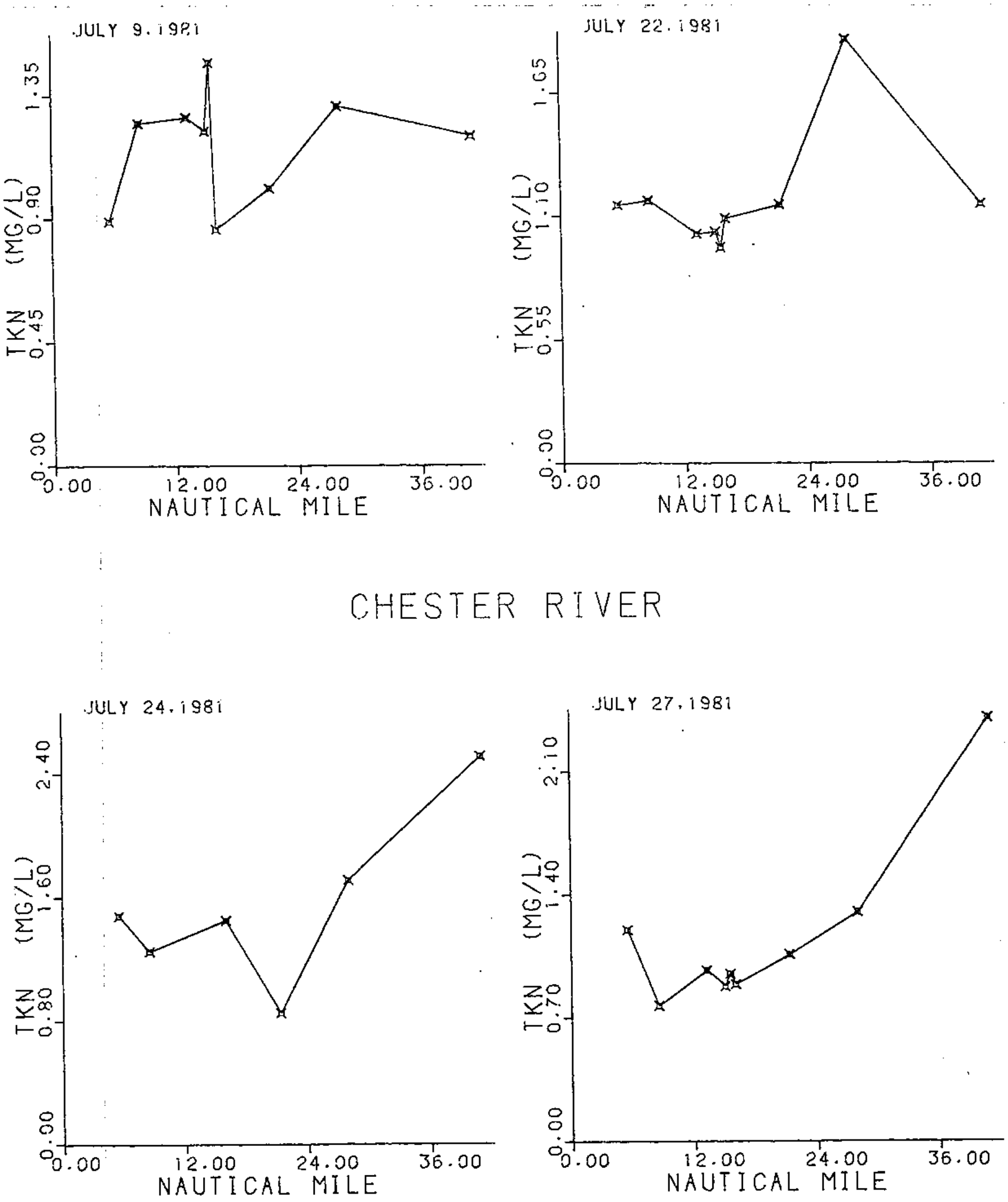


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).

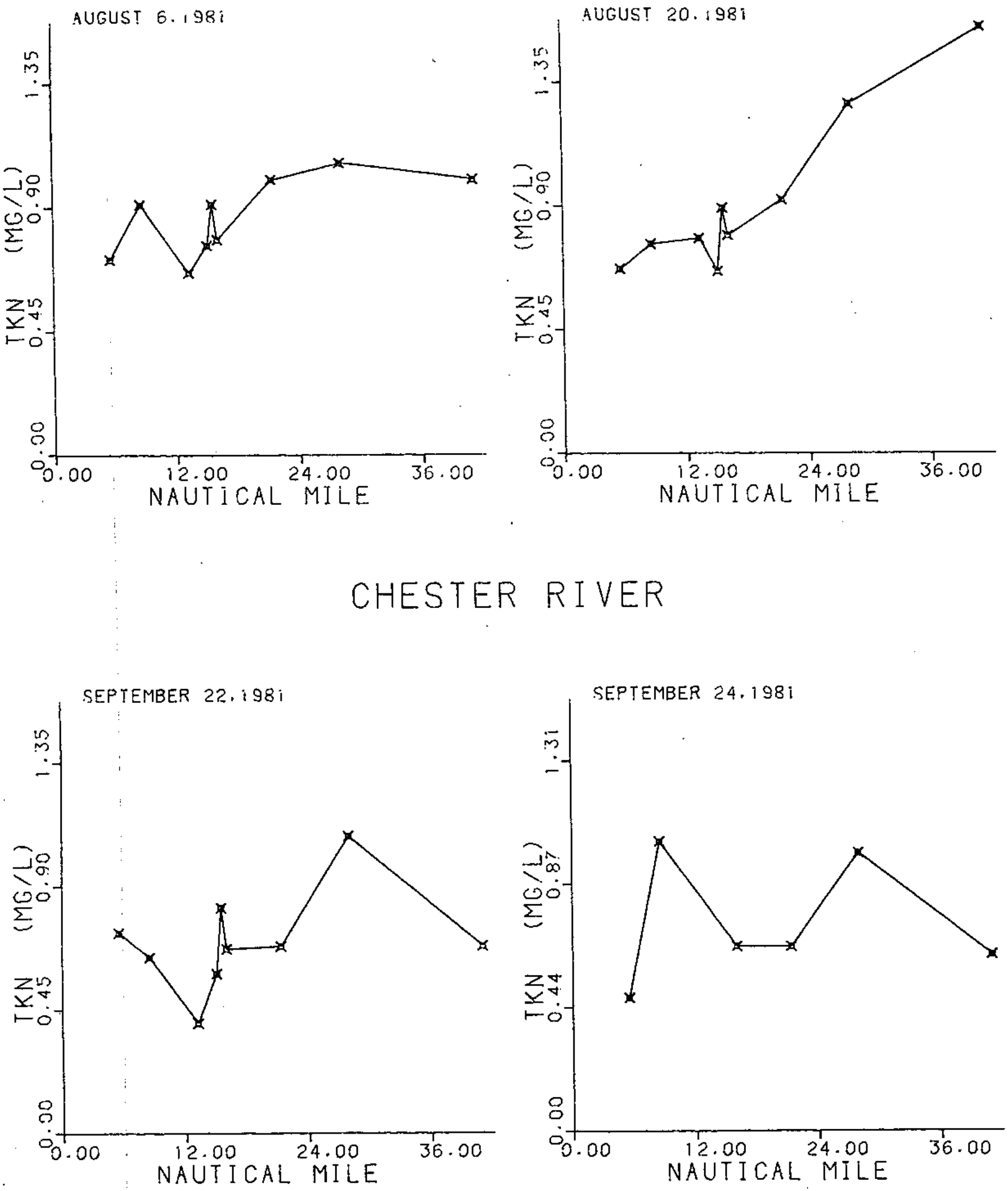


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).

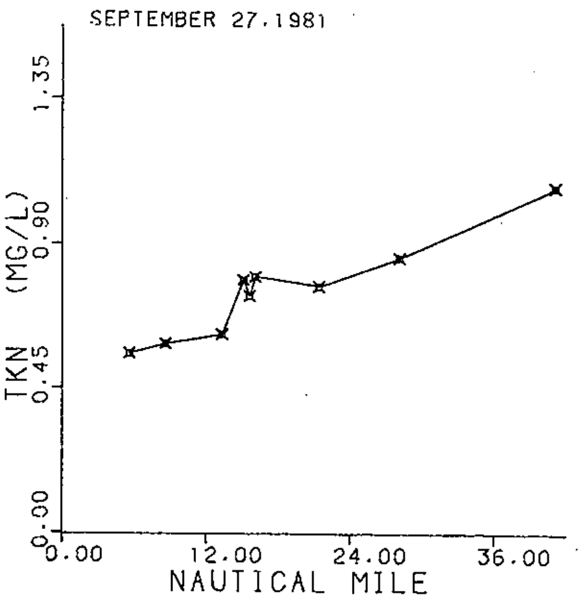


Figure 7-15 Longitudinal slack survey plots for Total Kjeldahl Nitrogen, (mg/l).

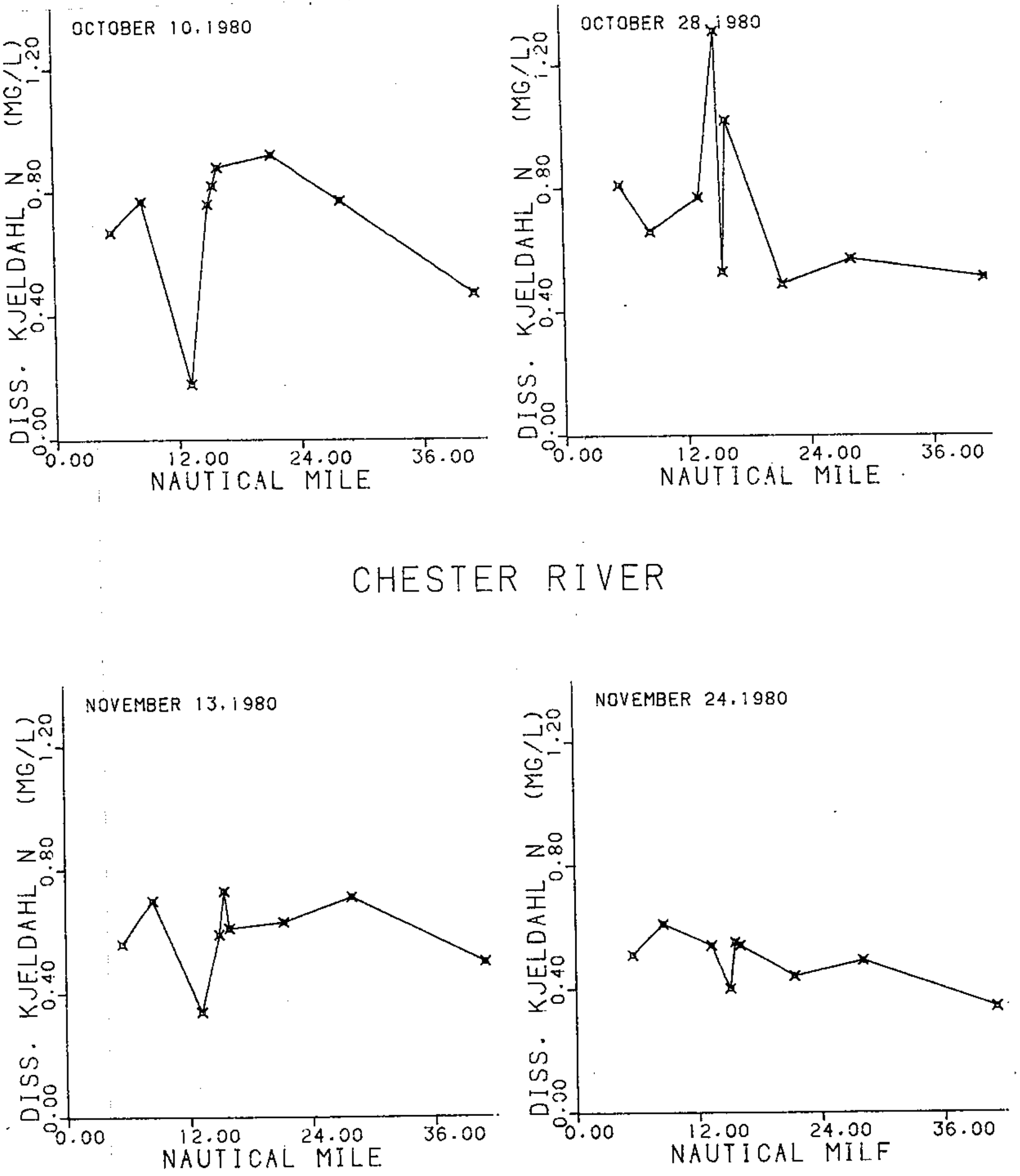


Figure 7-16 Longitudinal slack survey plots for Dissolved Kjeldahl Nitrogen (mg/l).

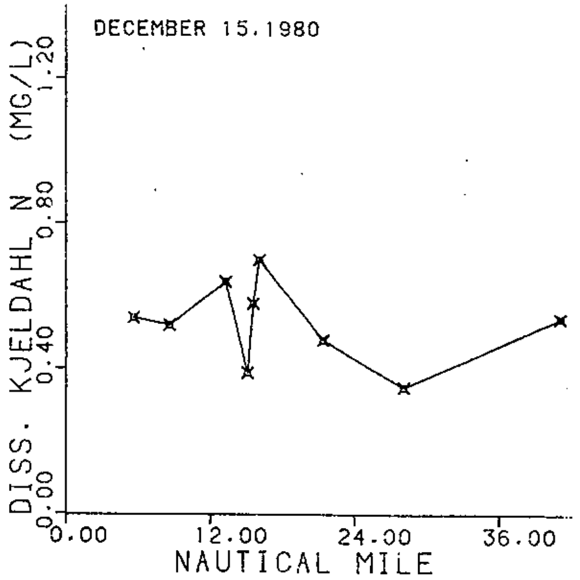


Figure 7-16 Longitudinal slack survey plots for Dissolved Kjeldahl Nitrogen (mg/l).

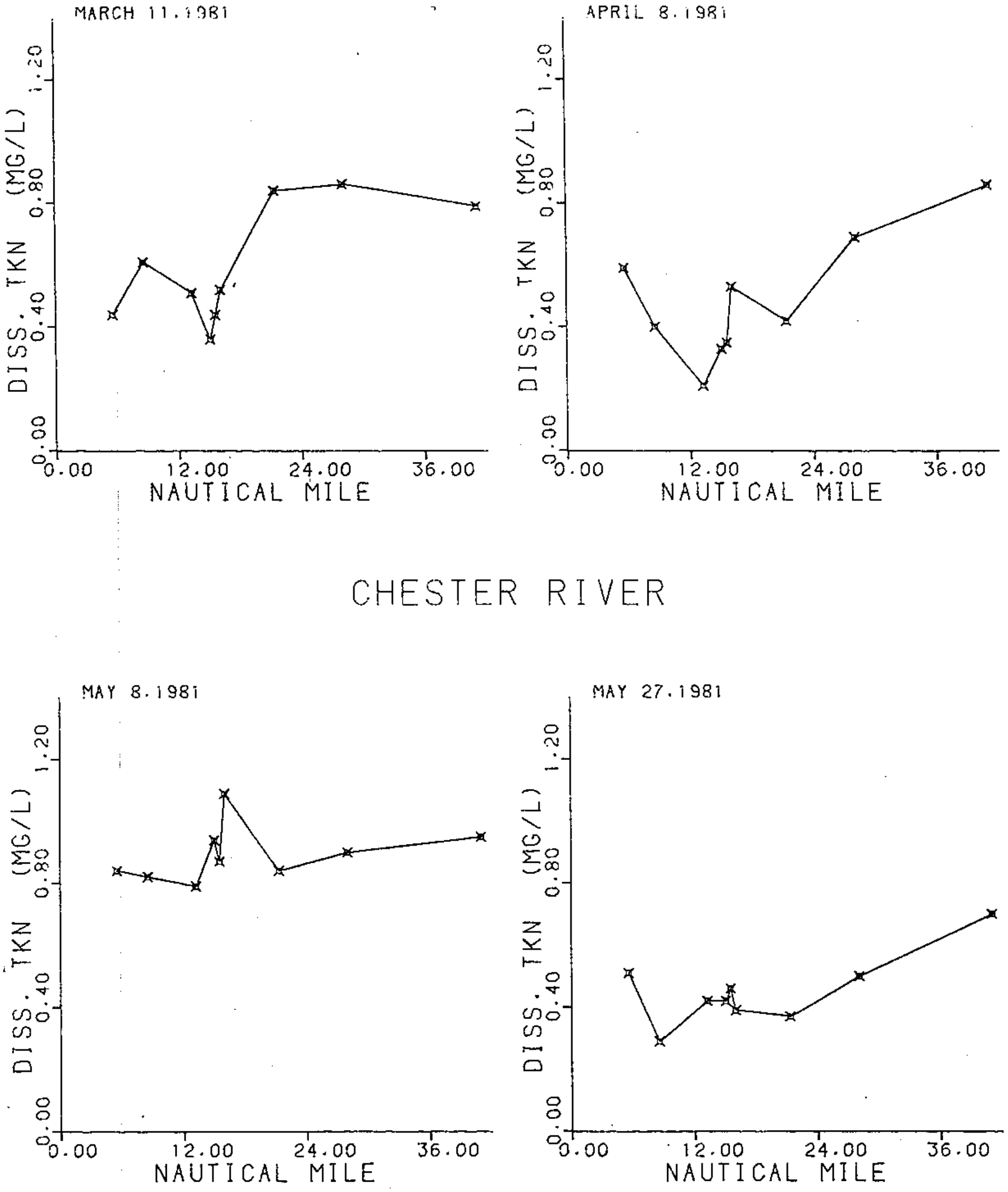


Figure 7-16 Longitudinal slack survey plots for Dissolved Total Kjeldahl Nitrogen, (mg/l).

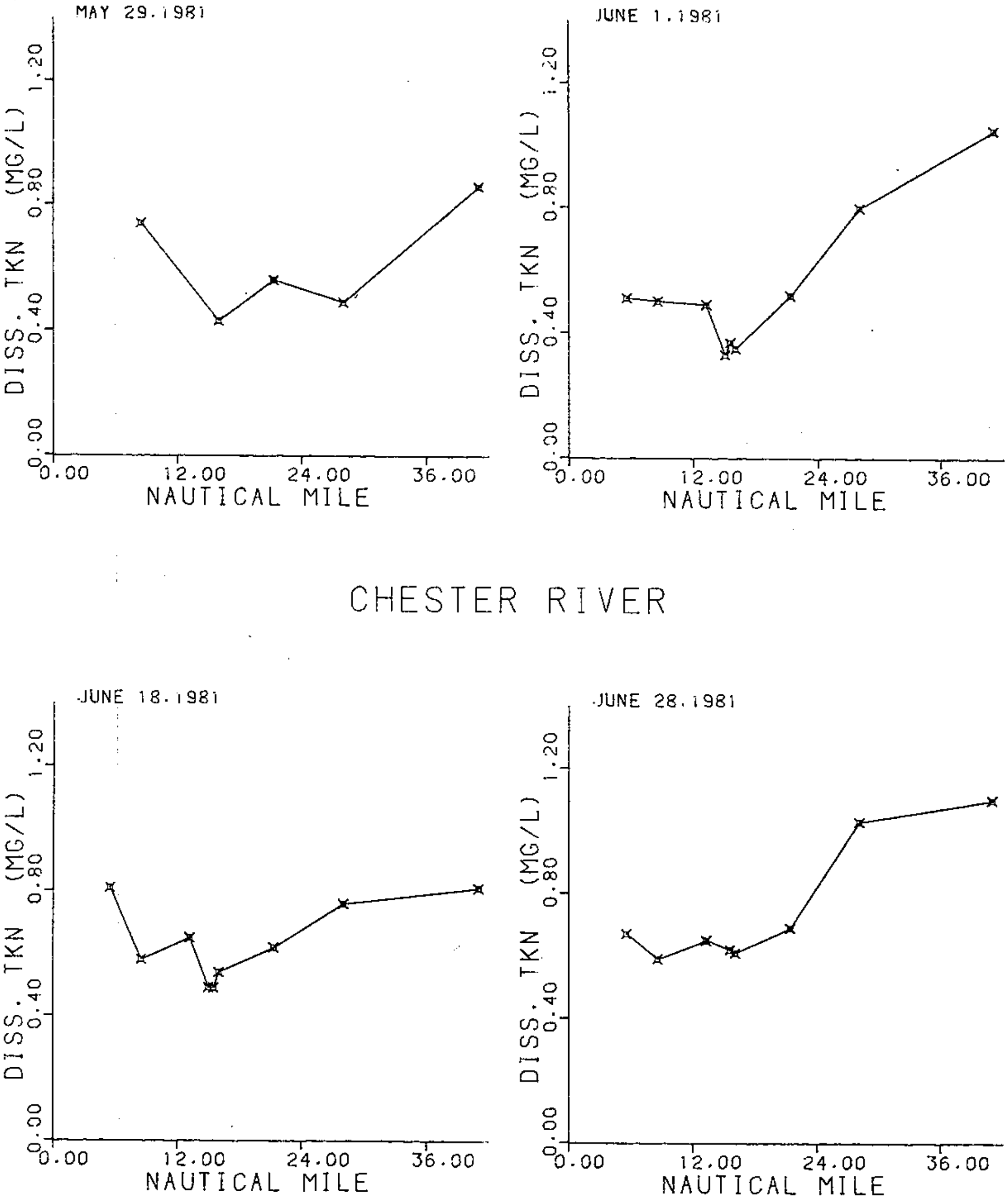


Figure 7-16 Longitudinal slack survey plots for Dissolved Total Kjeldahl Nitrogen, (mg/l).

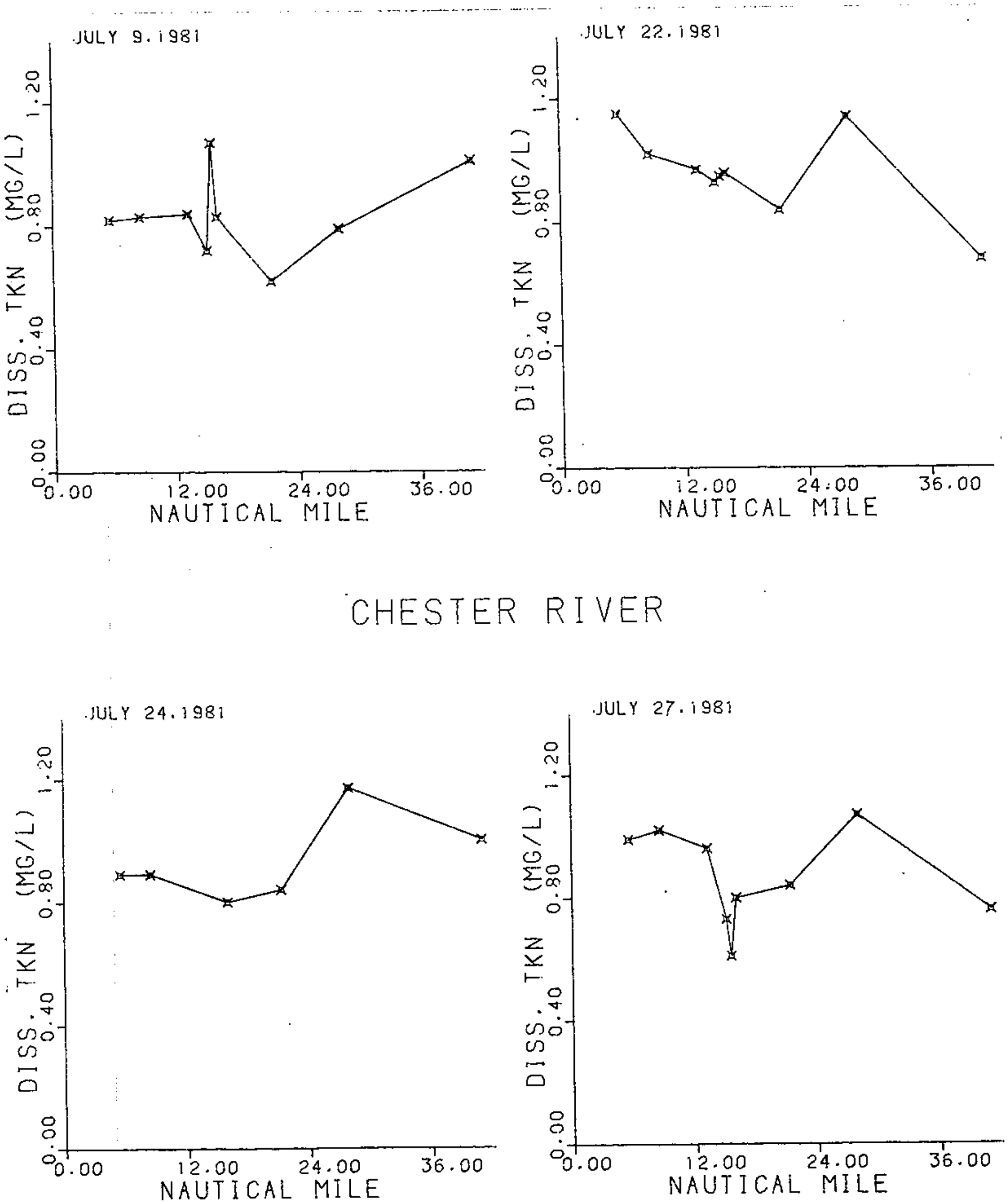


Figure 7-16 Longitudinal slack survey plots for Dissolved Total Kjeldahl Nitrogen, (mg/l).

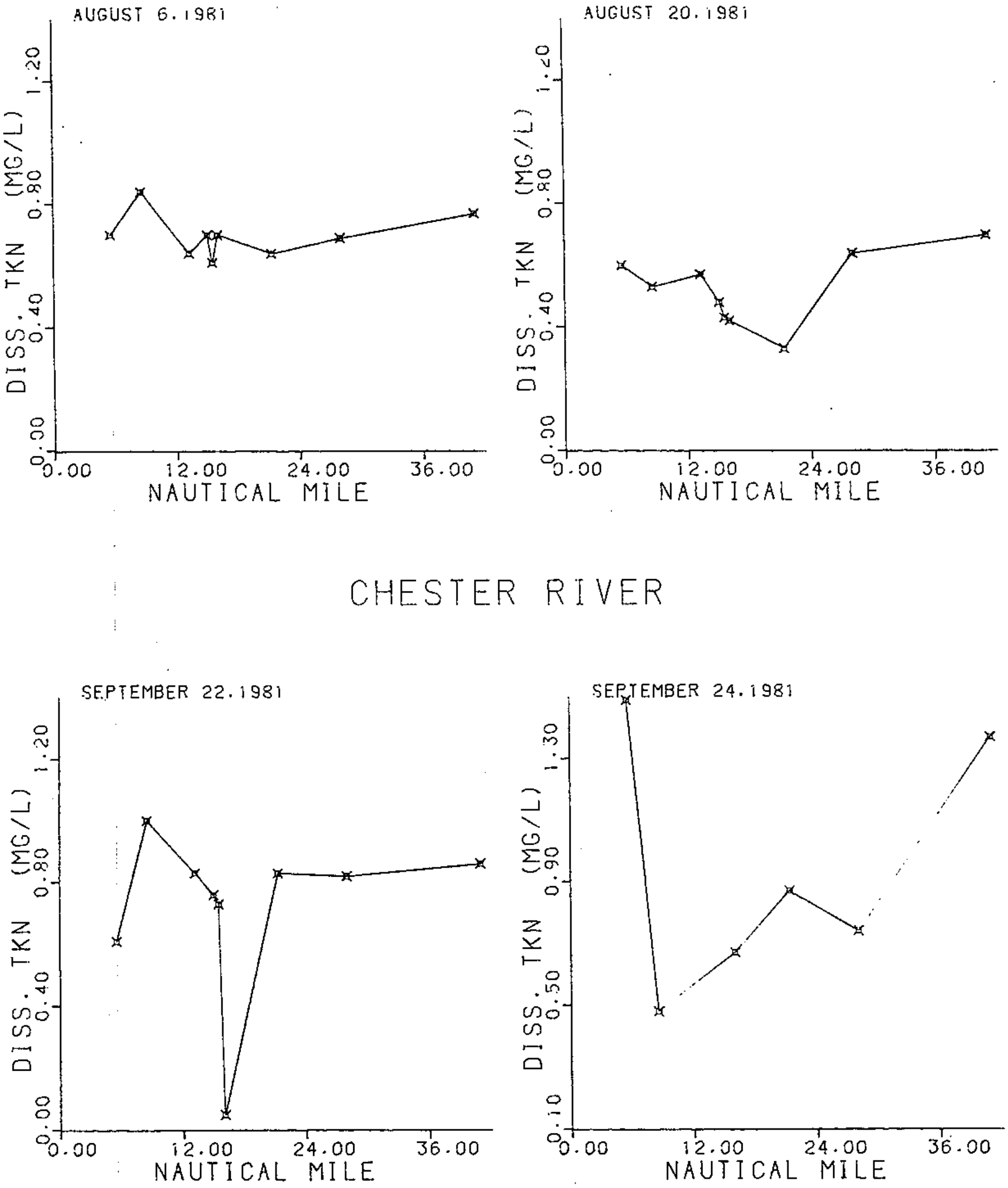


Figure 7-16 Longitudinal slack survey plots for Dissolved Total Kjeldahl Nitrogen, (mg/l).

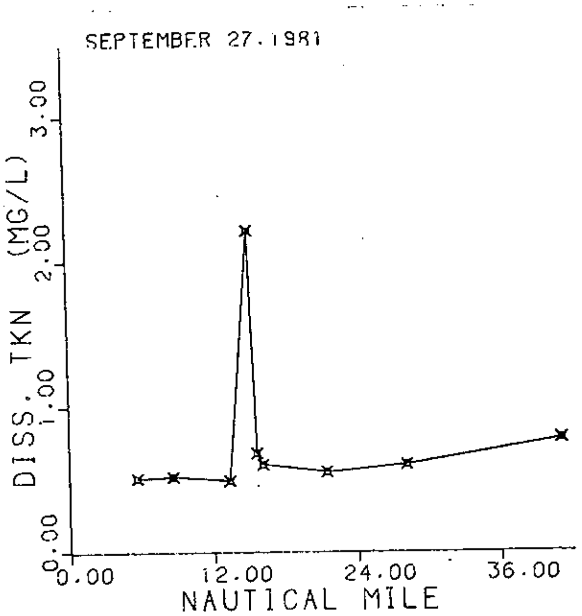


Figure 7-16 Longitudinal slack survey plots for Dissolved Total Kjeldahl Nitrogen, (mg/l).

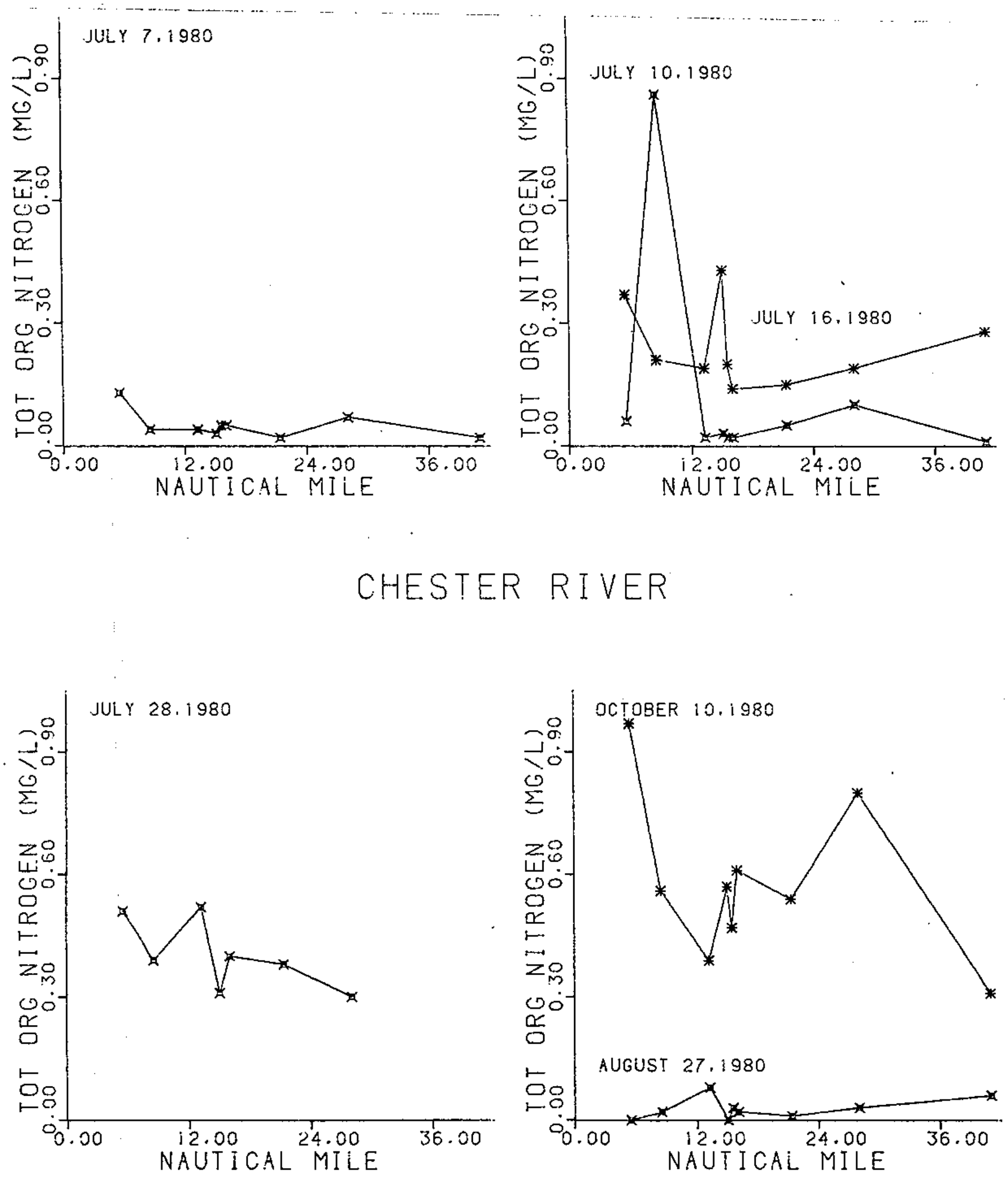


Figure 7-17 Longitudinal slack survey plots for Total Organic Nitrogen (mg/l).

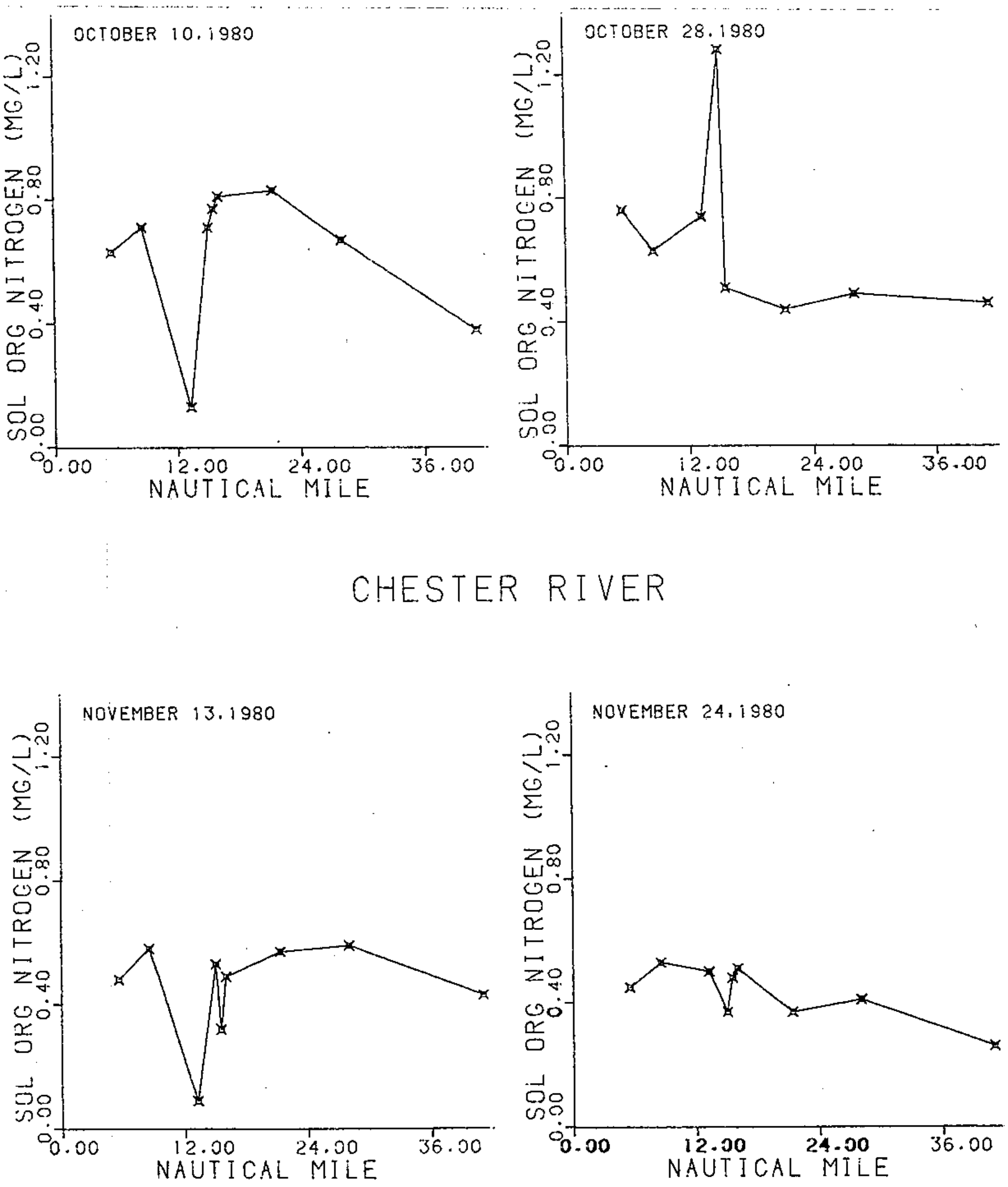


Figure 7-17 Longitudinal slack survey plots for Dissolved Organic nitrogen (mg/l).

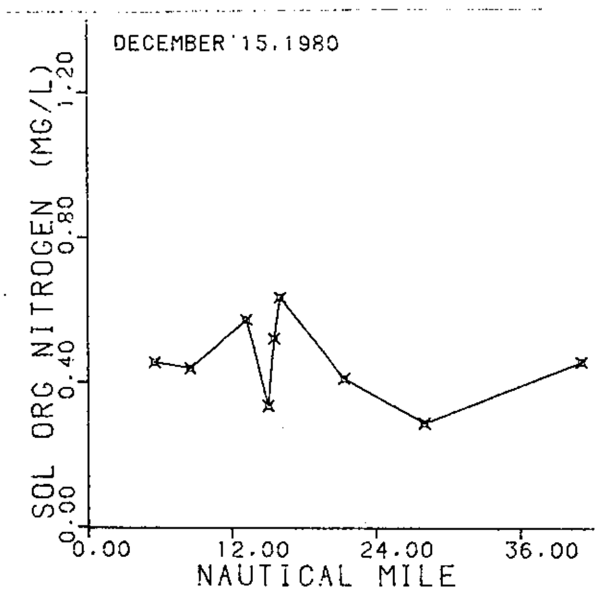


Figure 7-17 Longitudinal slack survey plots for Dissolved Organic Nitrogen (mg/l).

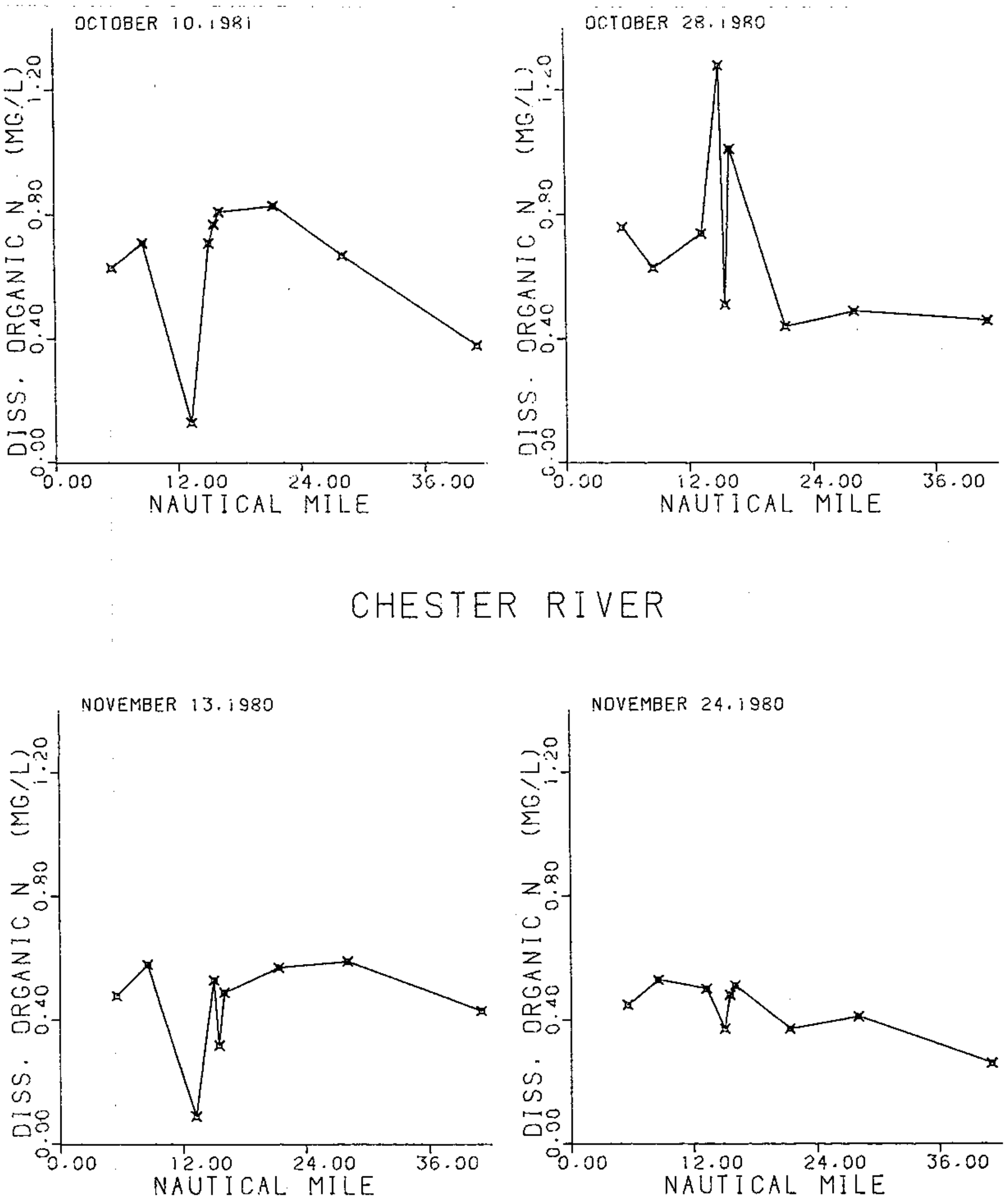


Figure 7-18 Longitudinal slack survey plot for Dissolved Organic Nitrogen, (mg/l).

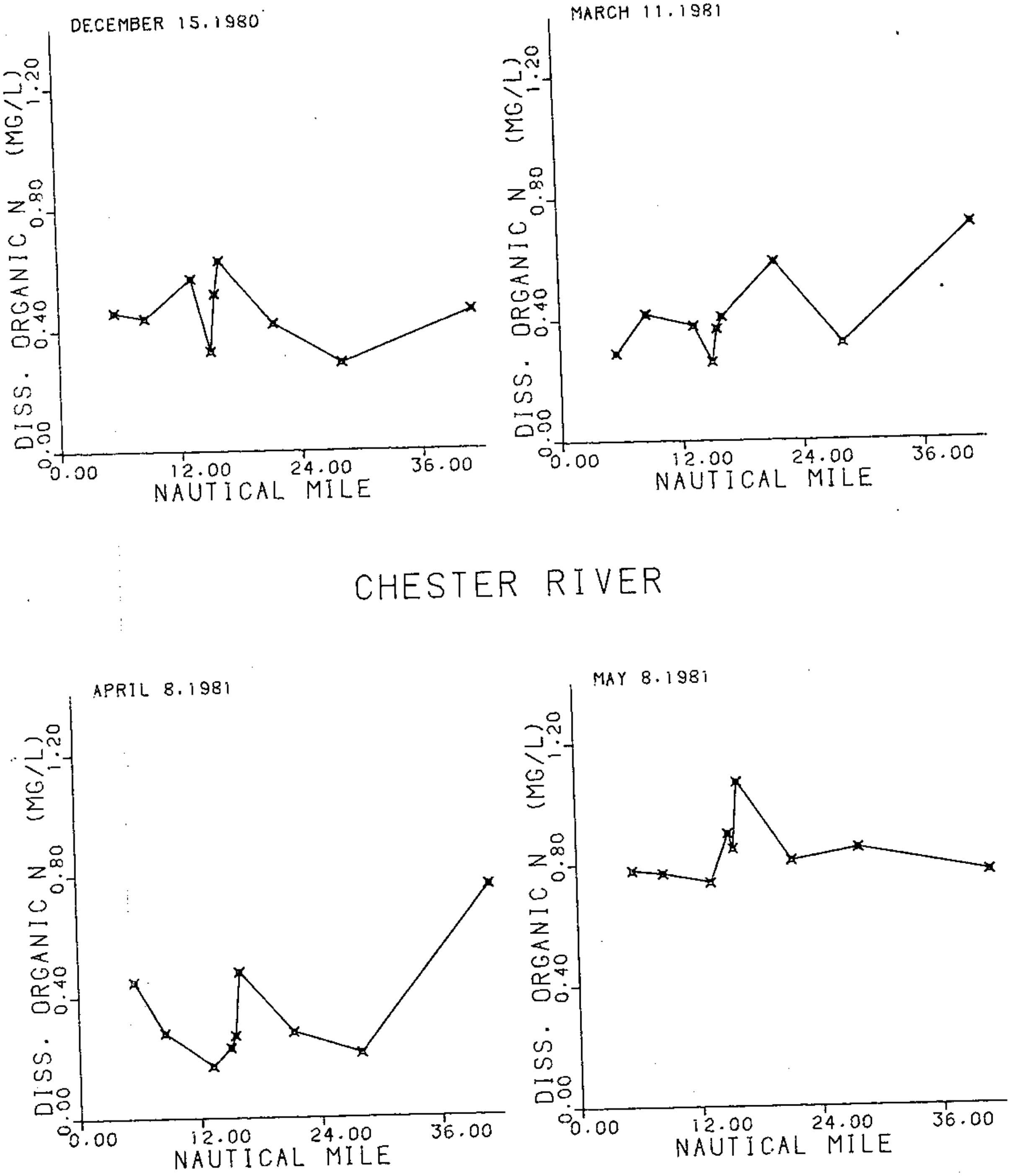
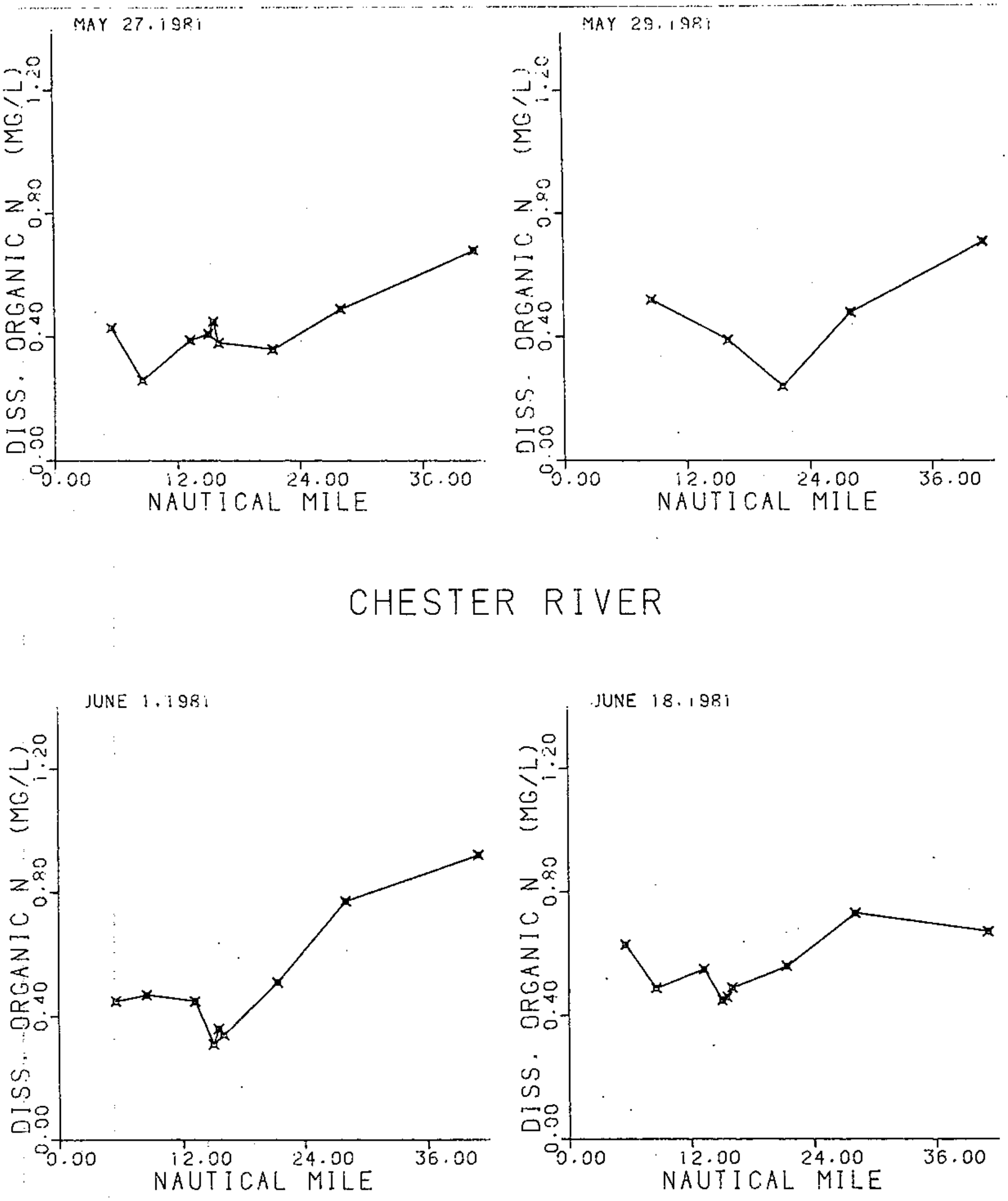


Figure 7-18 Longitudinal slack survey plot for Dissolved Organic Nitrogen, (mg/l).



CHESTER RIVER

Figure 7-18 Longitudinal slack survey plot for Dissolved Organic Nitrogen, (mg/l).

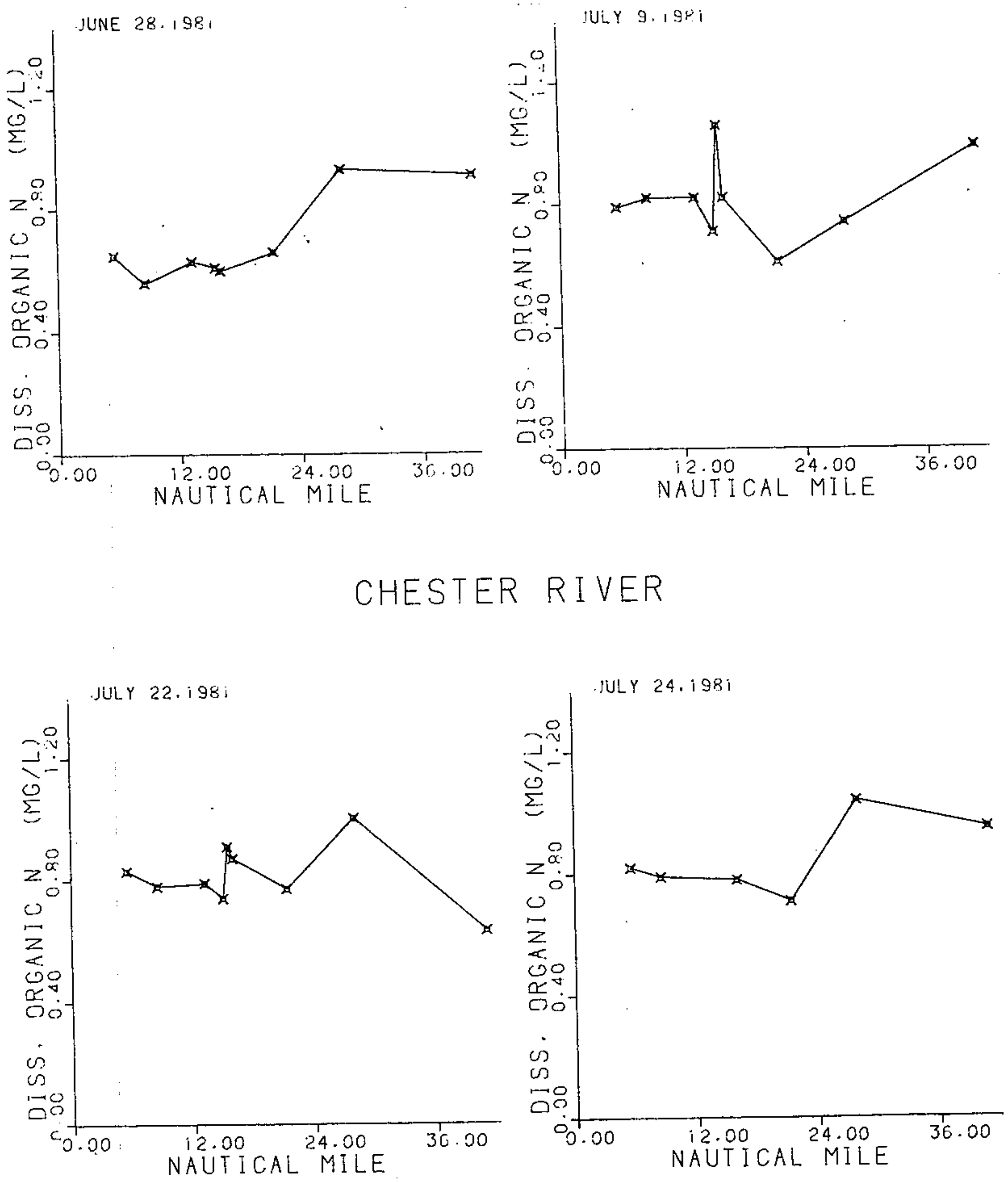


Figure 7-18 Longitudinal slack survey plot for Dissolved Organic Nitrogen, (mg/l).

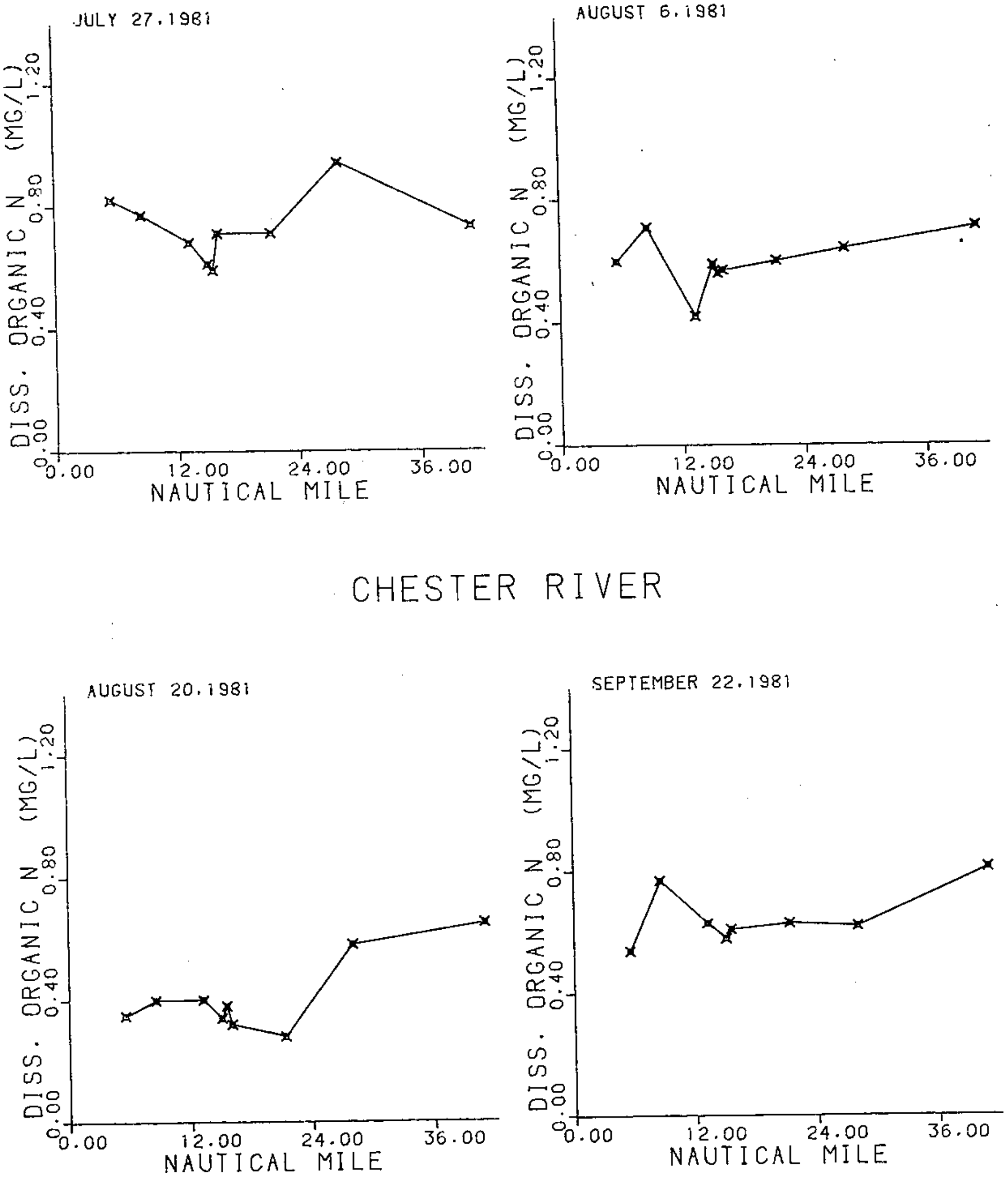
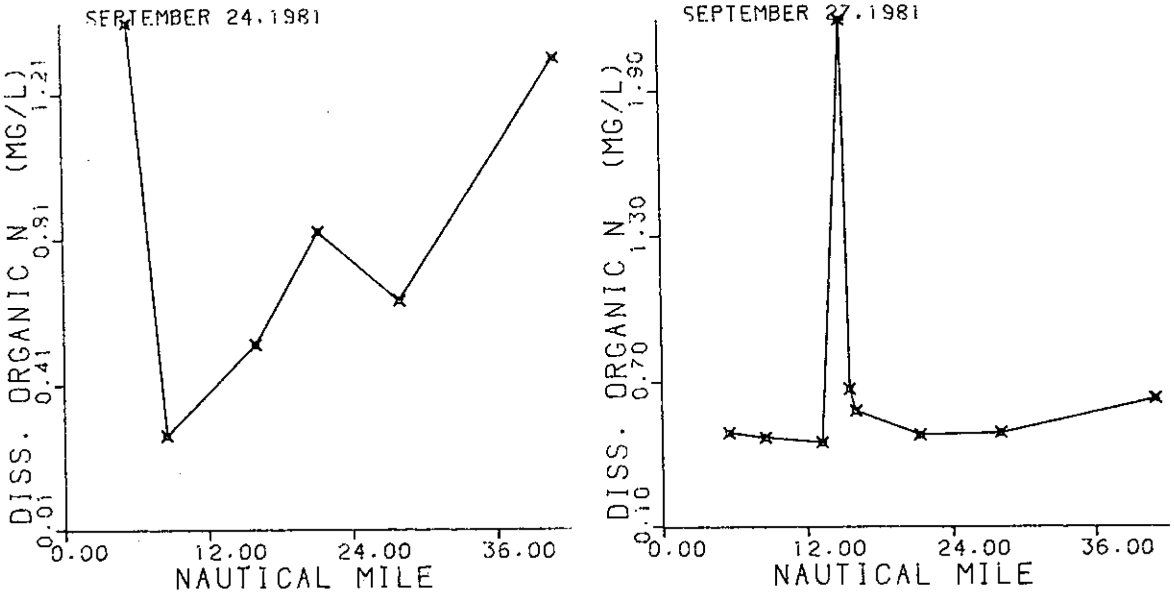


Figure 7-18 Longitudinal slack survey plot for Dissolved Organic Nitrogen, (mg/l).



CHESTER RIVER

Figure 7-18 Longitudinal slack survey plot for Dissolved Organic Nitrogen, (mg/l).

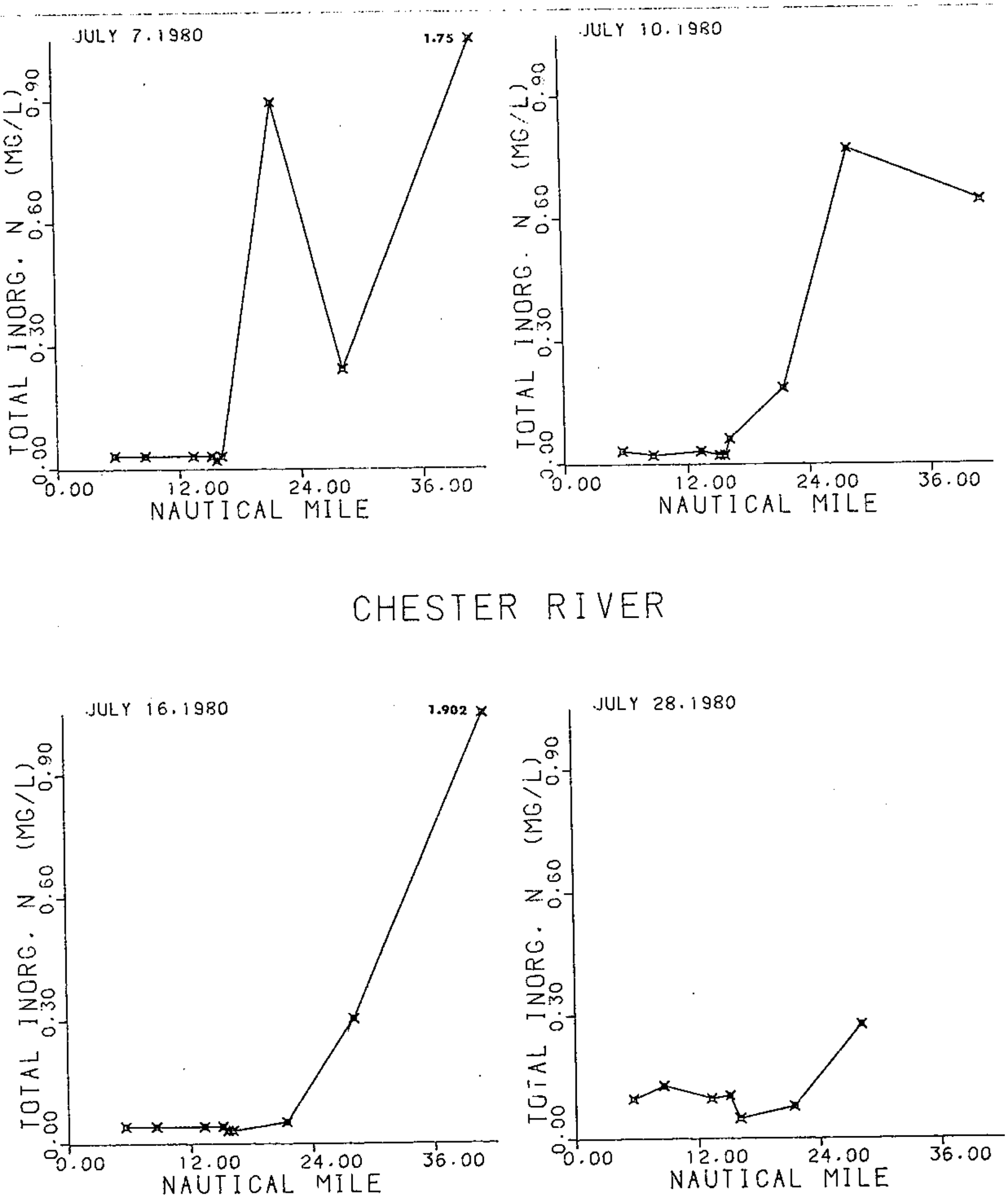


Figure 7-19 Longitudinal slack survey plots for Total Inorganic Nitrogen, (mg/l).

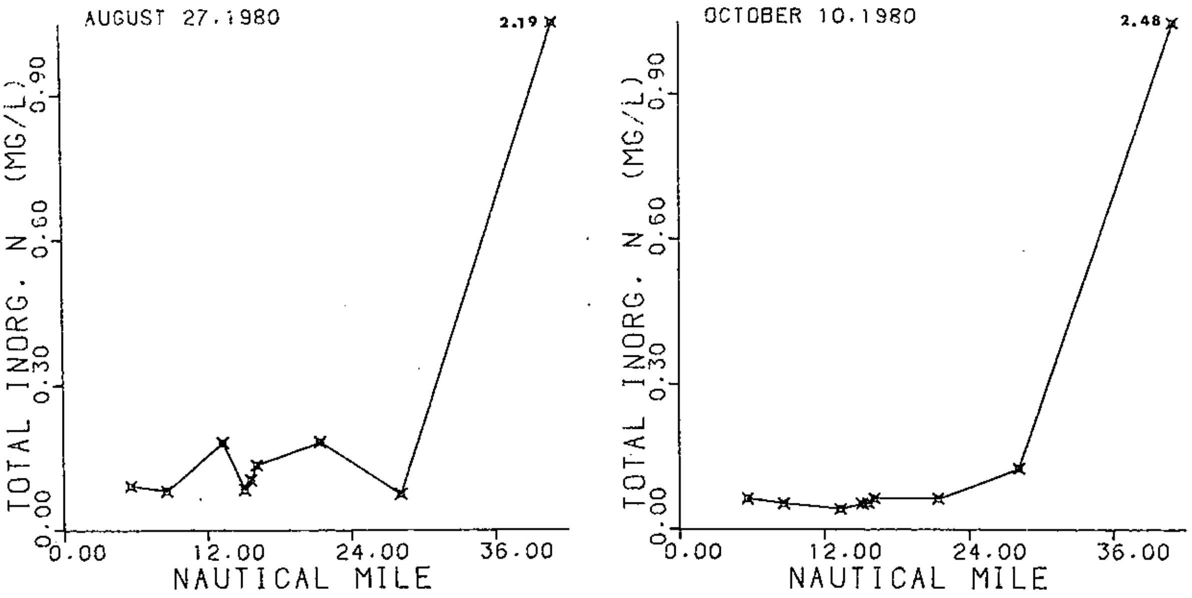
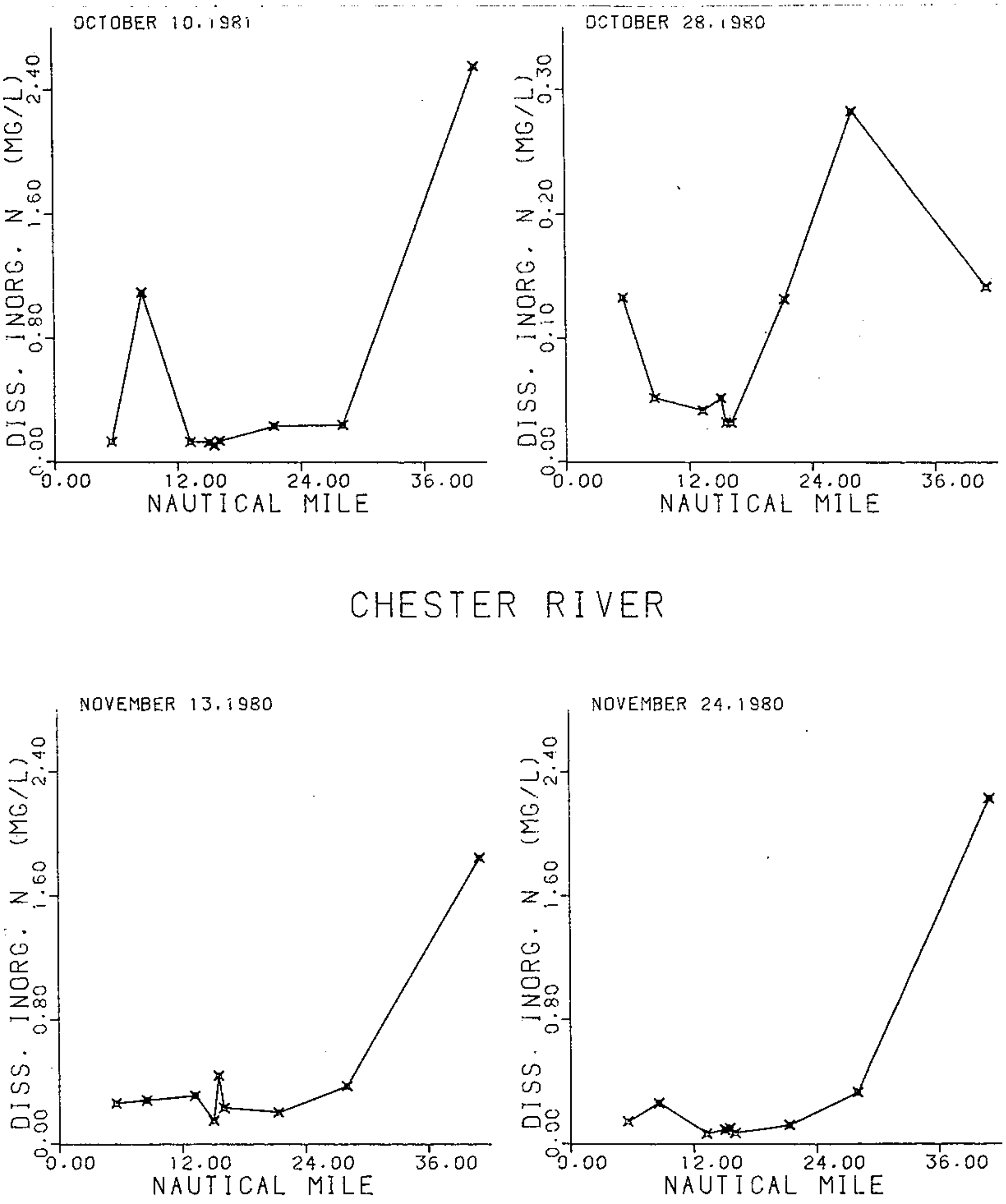


Figure 7-19 Longitudinal slack survey plots for Total Inorganic Nitrogen, (mg/l).


CHESTER RIVER

OCTOBER 10,1981

OCTOBER 28,1980

NOVEMBER 13,1980

NOVEMBER 24,1980

Figure 7-20 Longitudinal slack survey plots for Dissolved Inorganic Nitrogen, (mg/l).

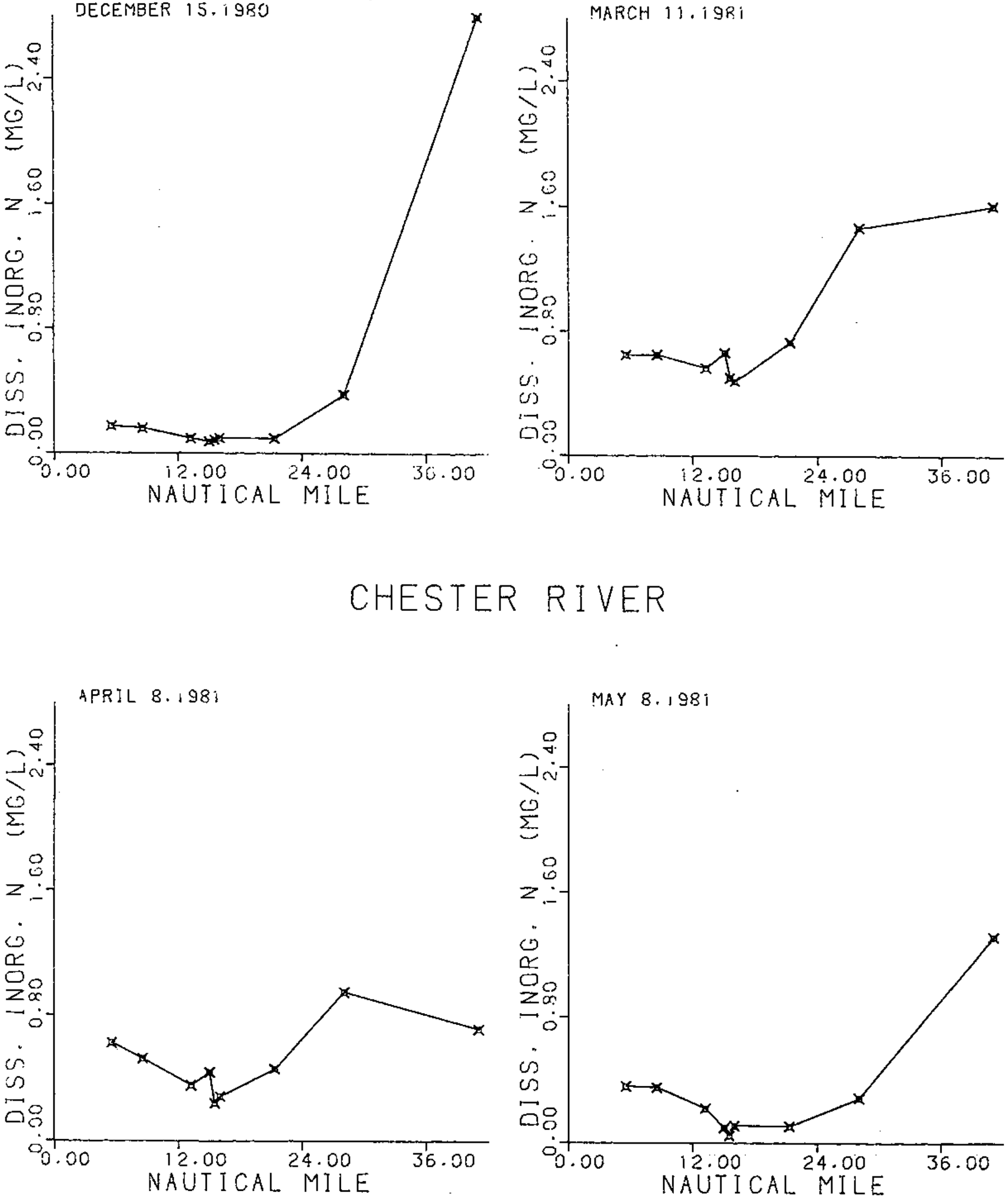


Figure 7-20 Longitudinal slack survey plots for Dissolved Inorganic Nitrogen, (mg/l).

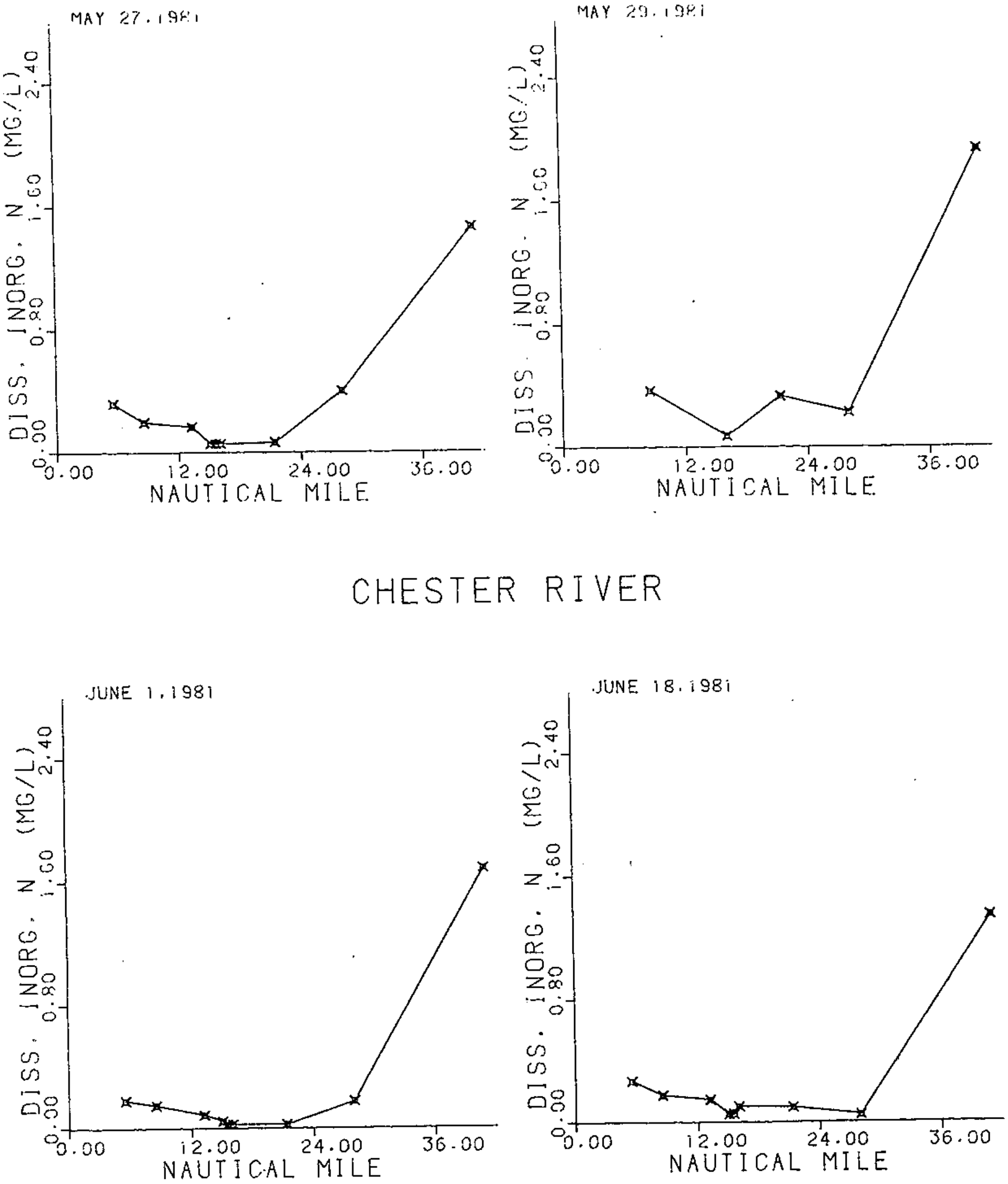


Figure 7-20 Longitudinal slack survey plots for Dissolved Inorganic Nitrogen, (mg/l).

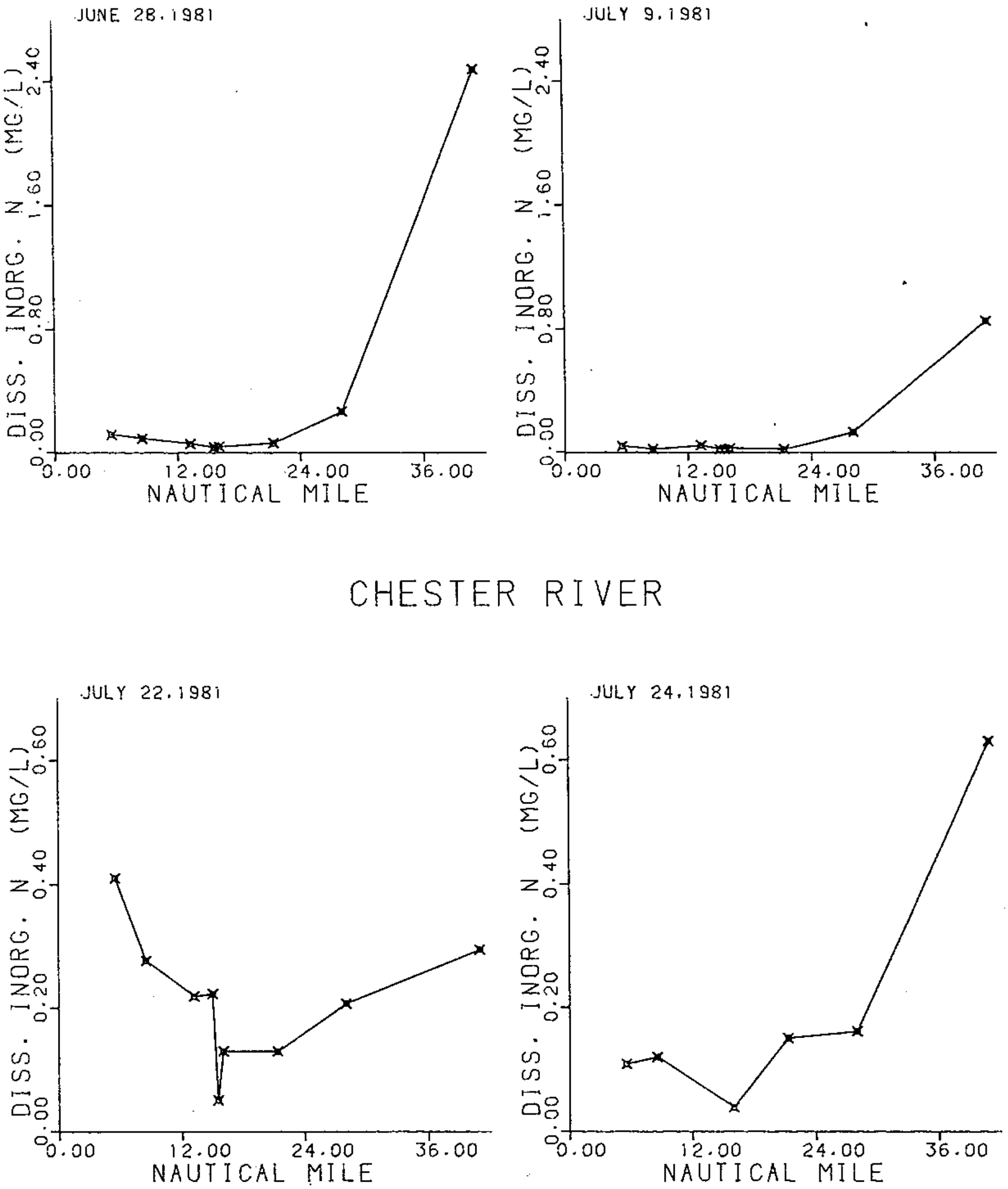
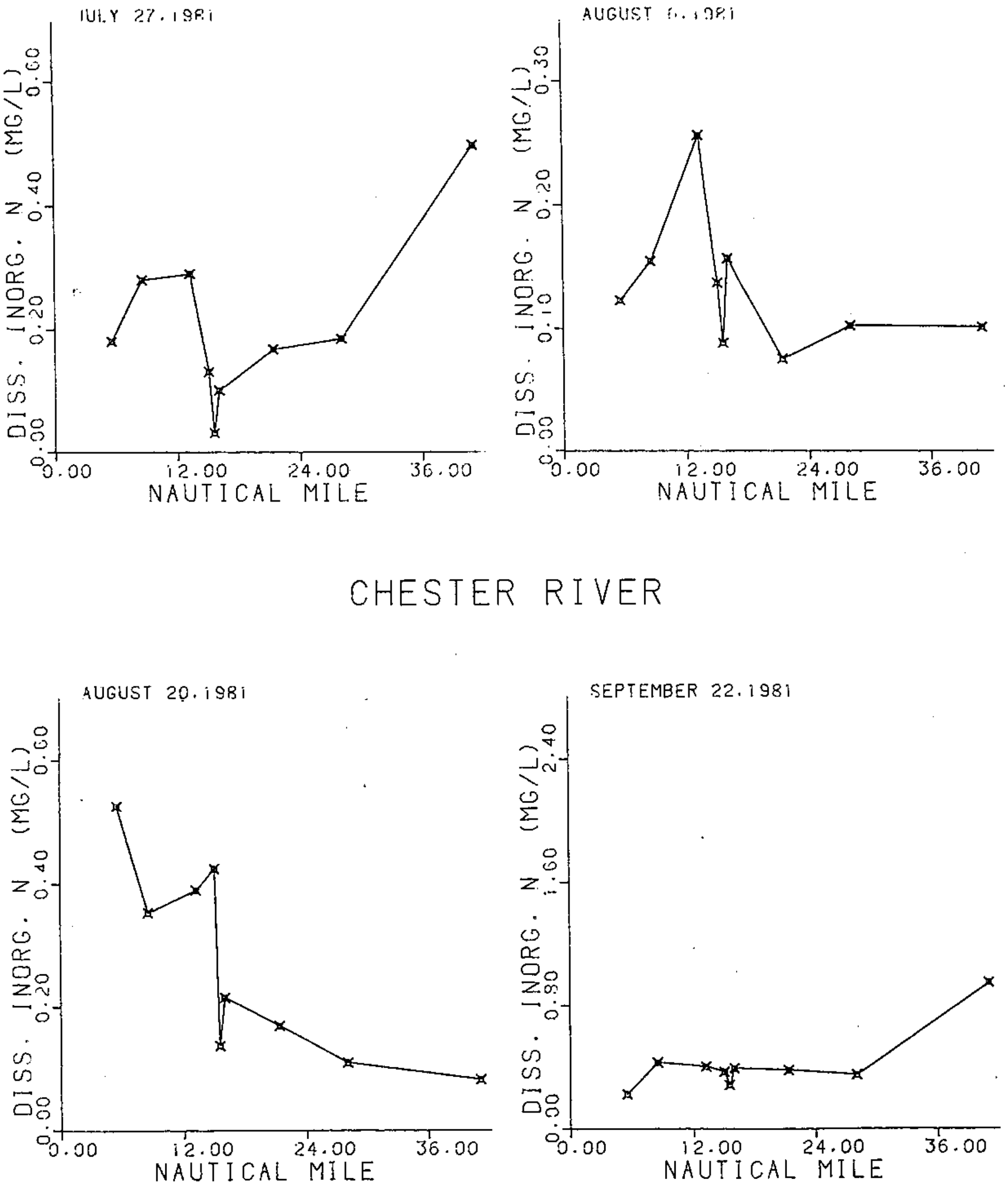
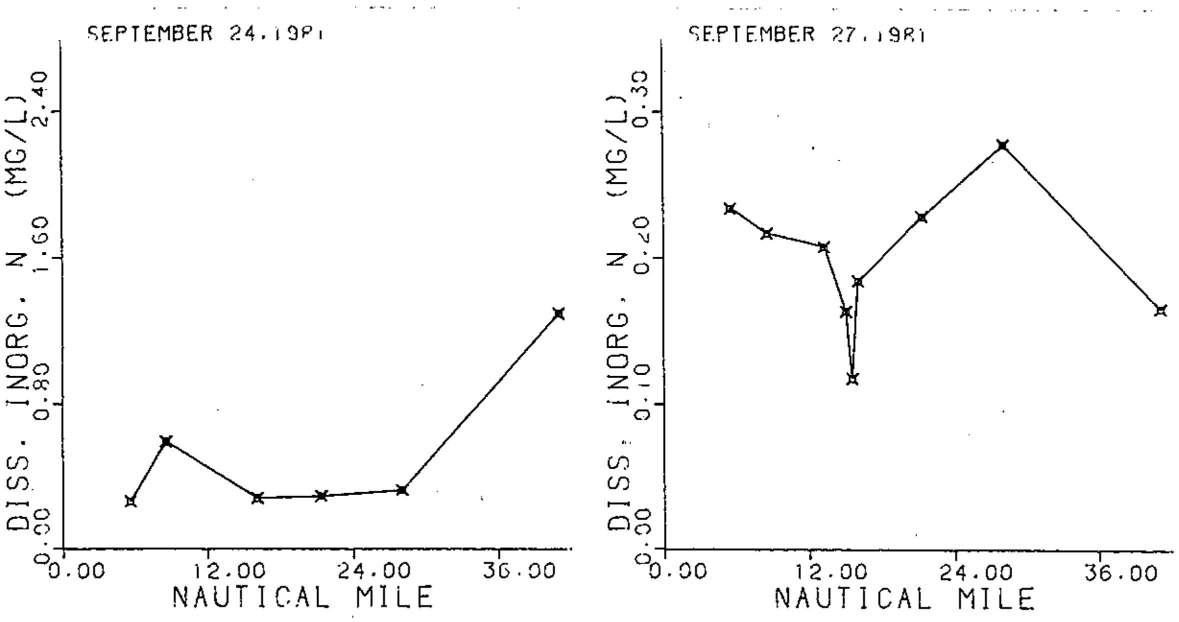


Figure 7-20 Longitudinal slack survey plots for Dissolved Inorganic Nitrogen, (mg/l).



CHESTER RIVER

Figure 7-20 Longitudinal slack survey plots for Dissolved Inorganic Nitrogen, (mg/l).



CHESTER RIVER

Figure 7-20 Longitudinal slack survey plots for Dissolved Inorganic Nitrogen, (mg/l).

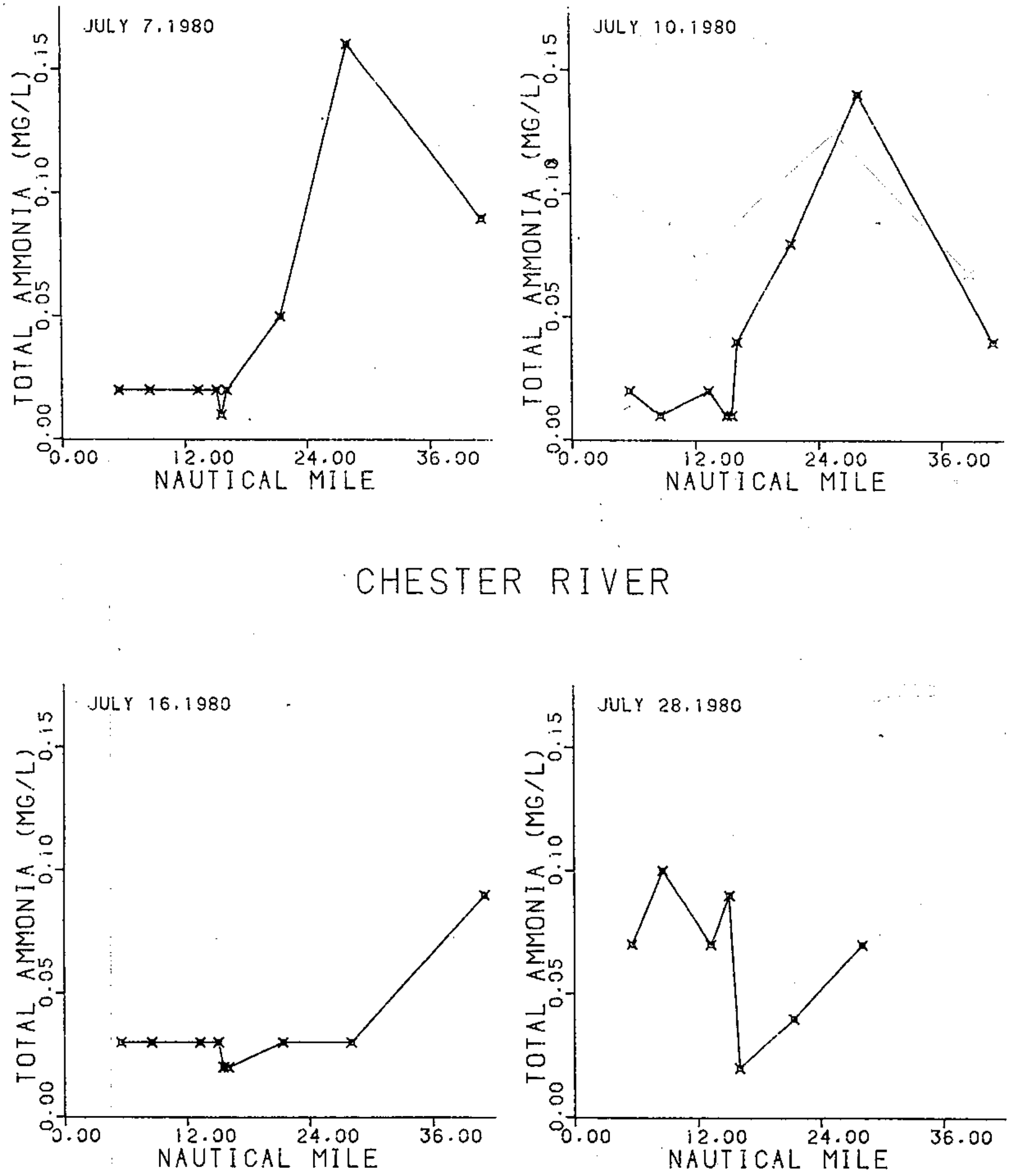


Figure 7-21 Longitudinal slack survey plots for Total Ammonia, (mg/l).

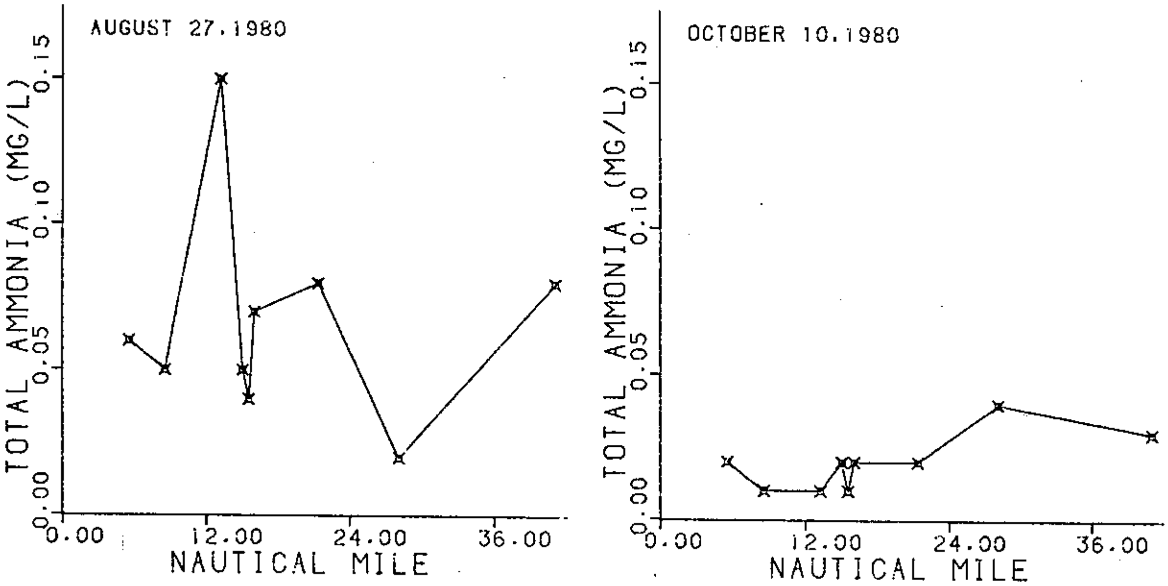


Figure 7-21 Longitudinal slack survey plots for Total Ammonia (mg/l).

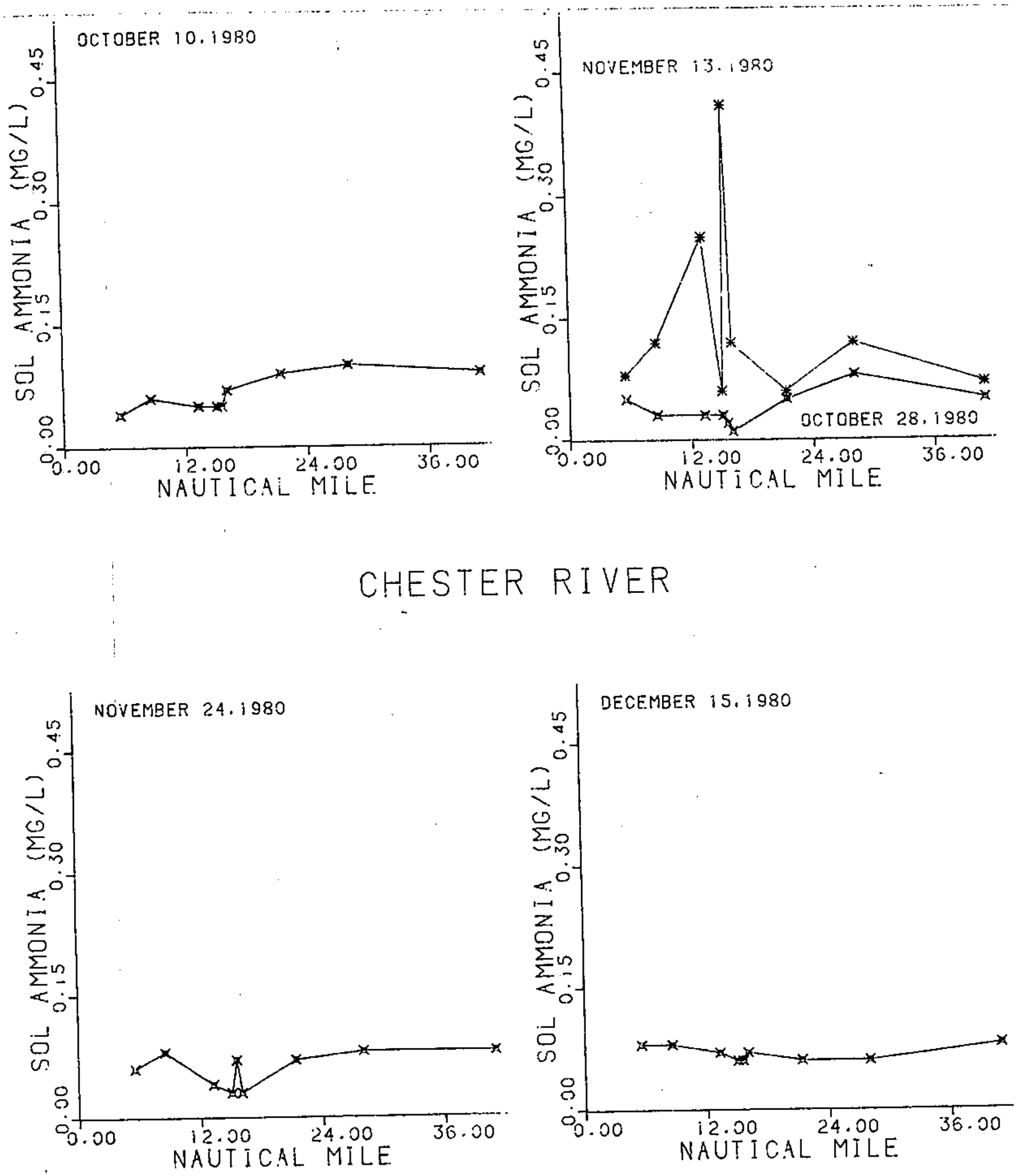


Figure 7-22 Longitudinal slack survey plots for Dissolved Ammonia, (mg/l).

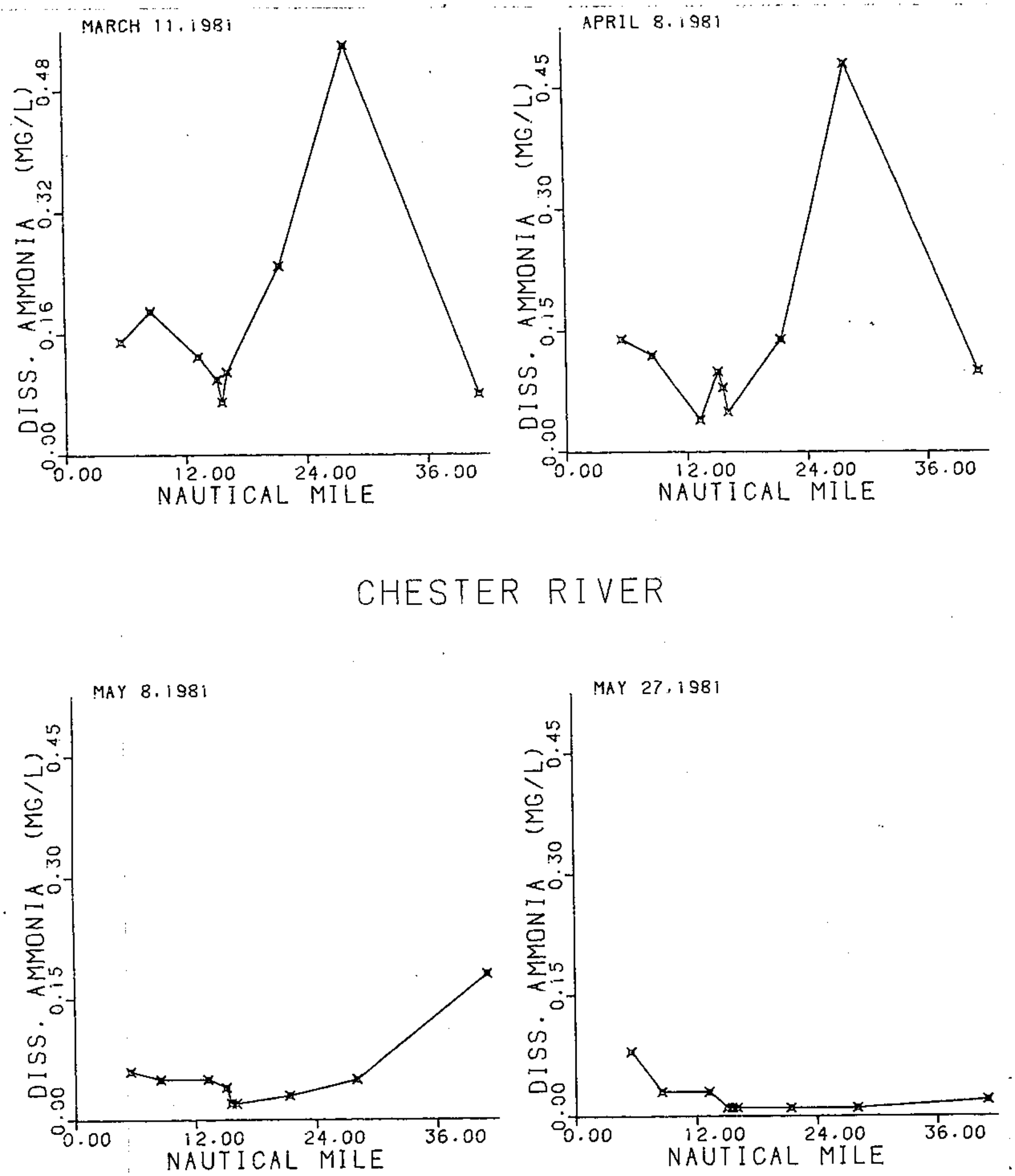


Figure 7-22 Longutudinal slack survey plots for Dissolved Ammonia, (amg/l).

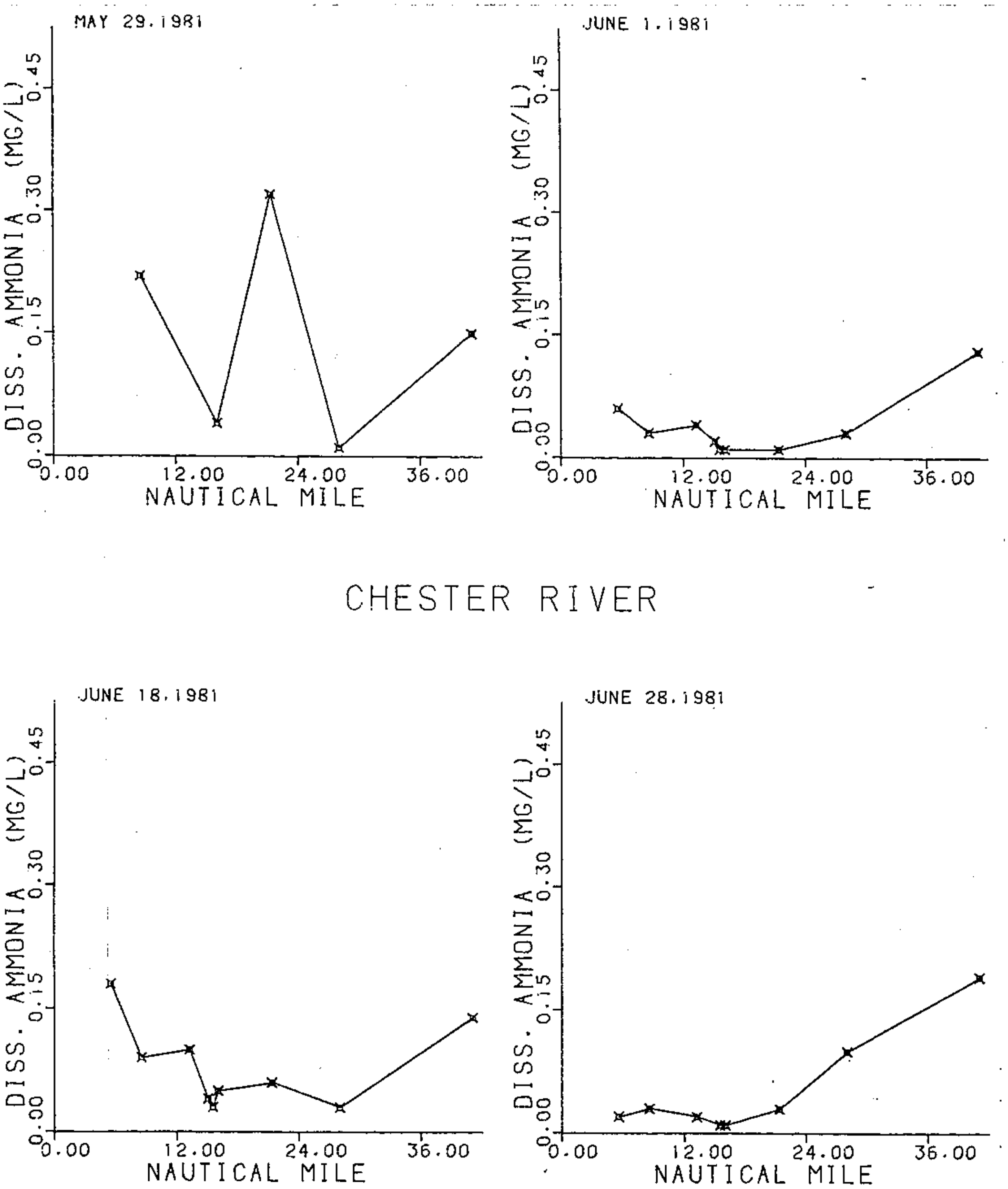


Figure 7-22 Longutudinal slack survey plots for Dissolved Ammonia, (mg/l).

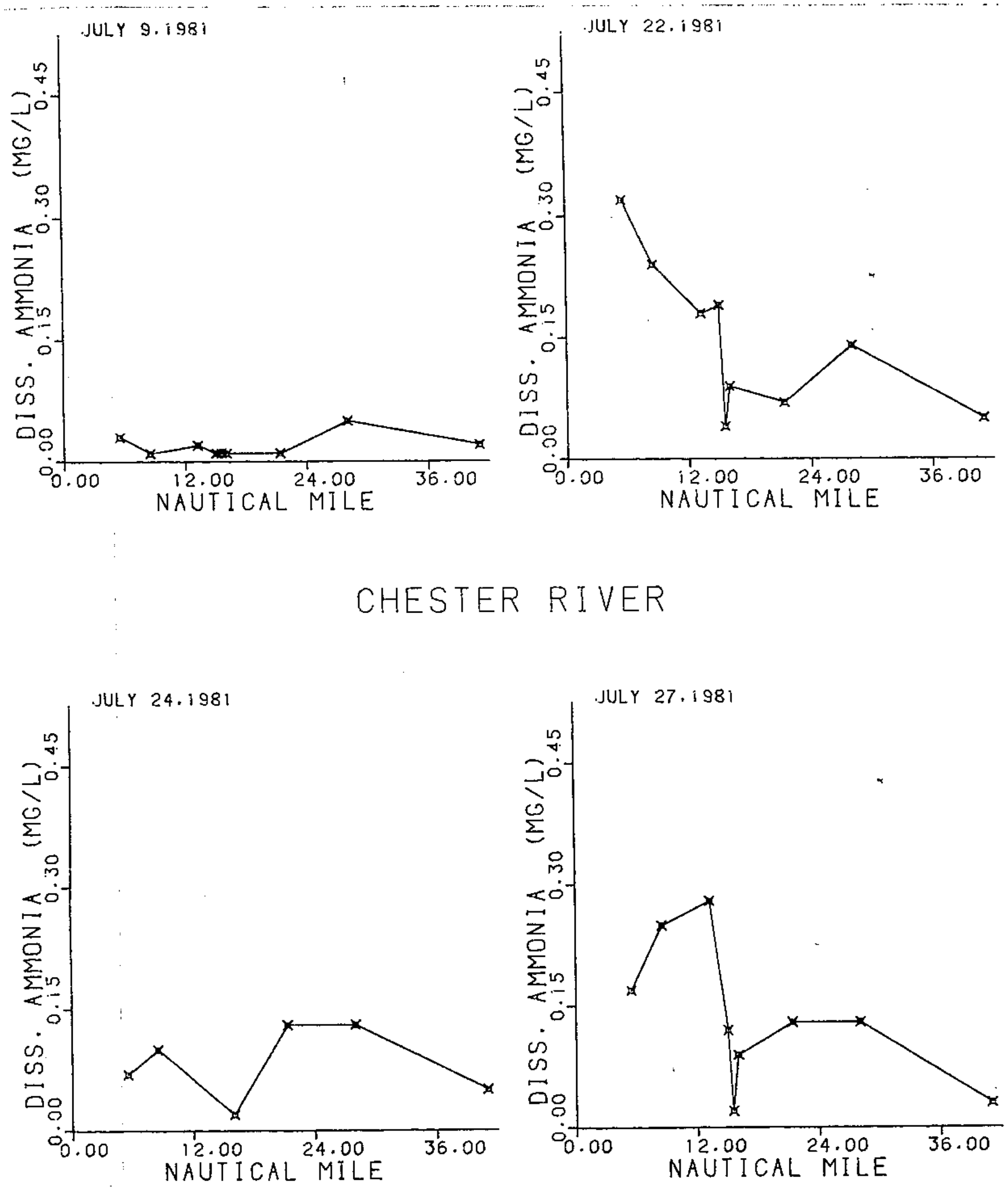
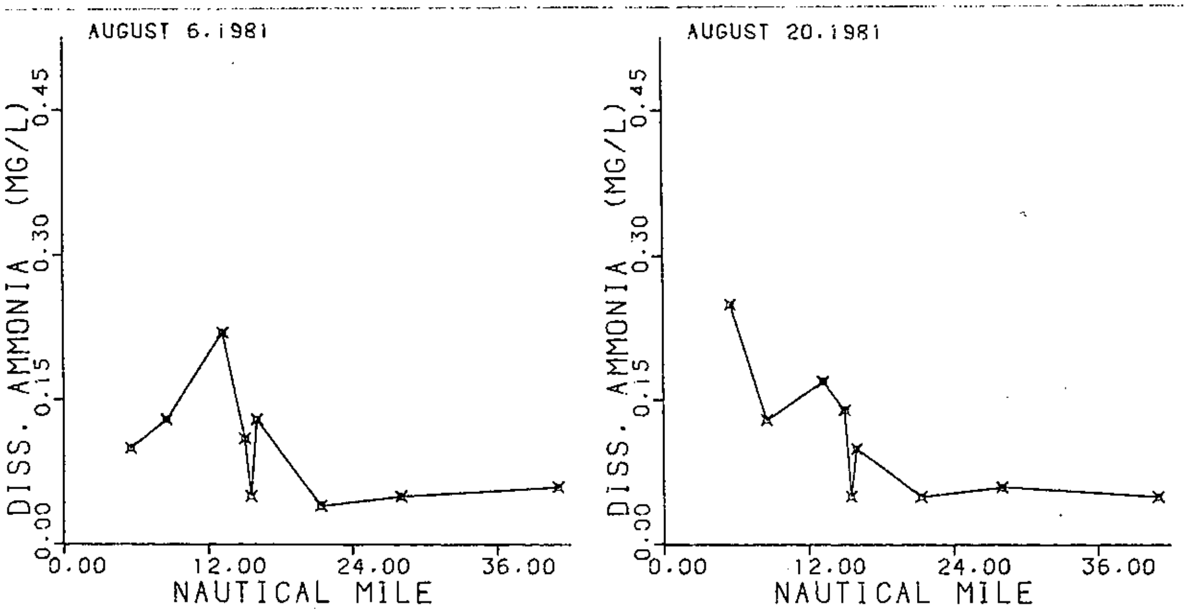


Figure 7-22 Longitudinal slack survey plots for Dissolved Ammonia, (mg/l).



CHESTER RIVER

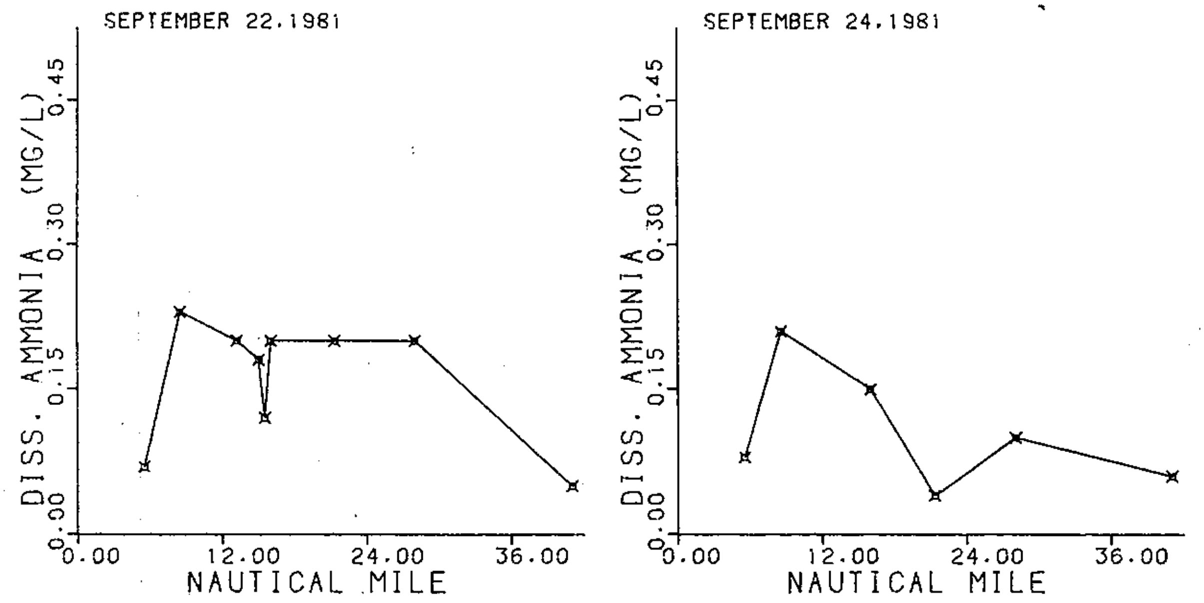


Figure 7-22Longitudinal slack survey plots for Dissolved Ammonia, (mg/l).

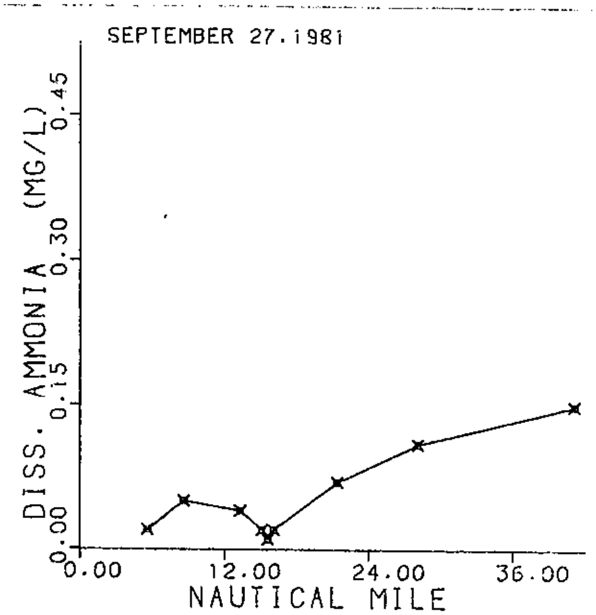


Figure 7-22 Longitudinal slack survey plots for Dissolved Ammonia, (mg/l).

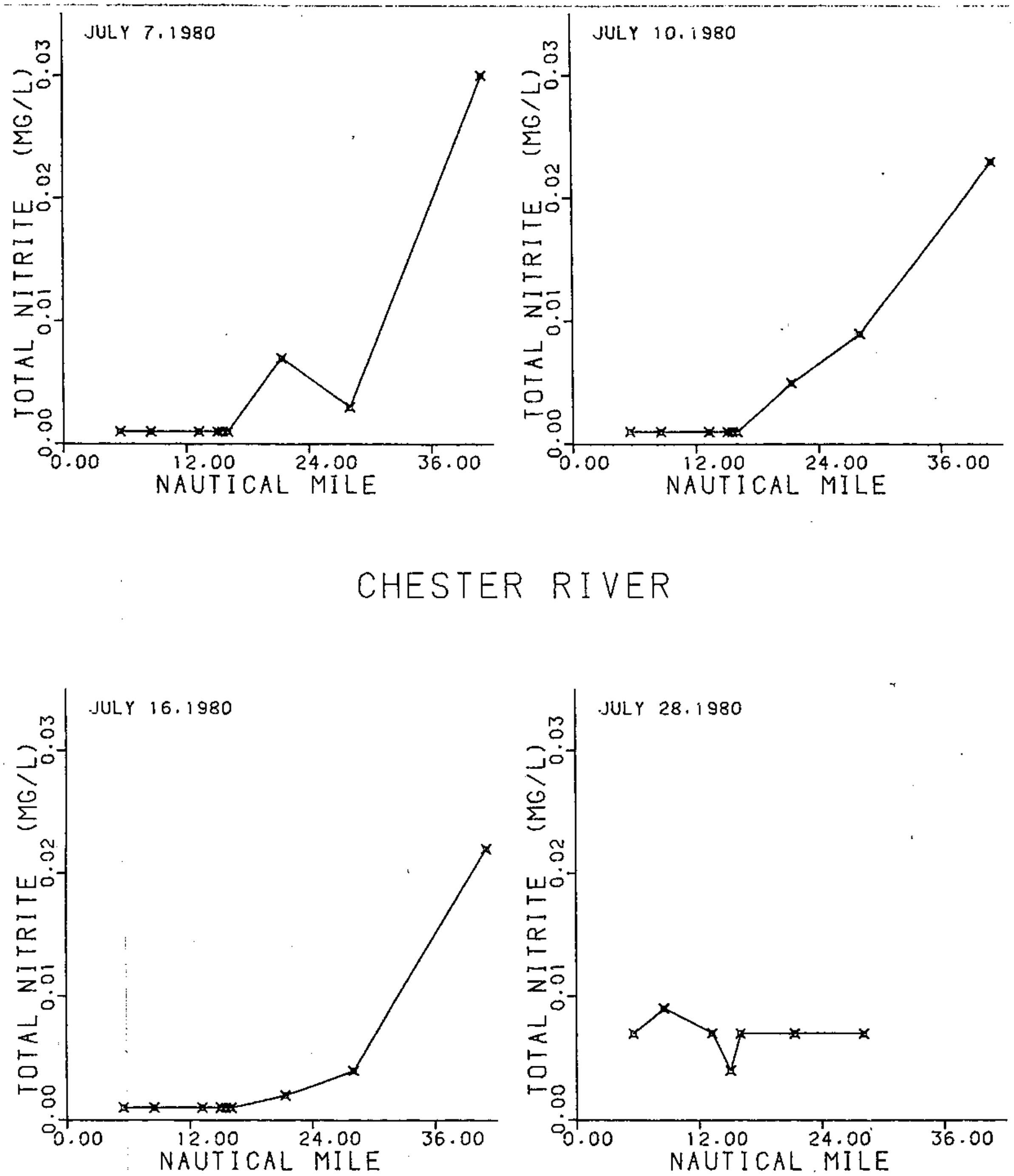


Figure 7-23 Longitudinal slack survey plots for Total Nitrite (mg/l).

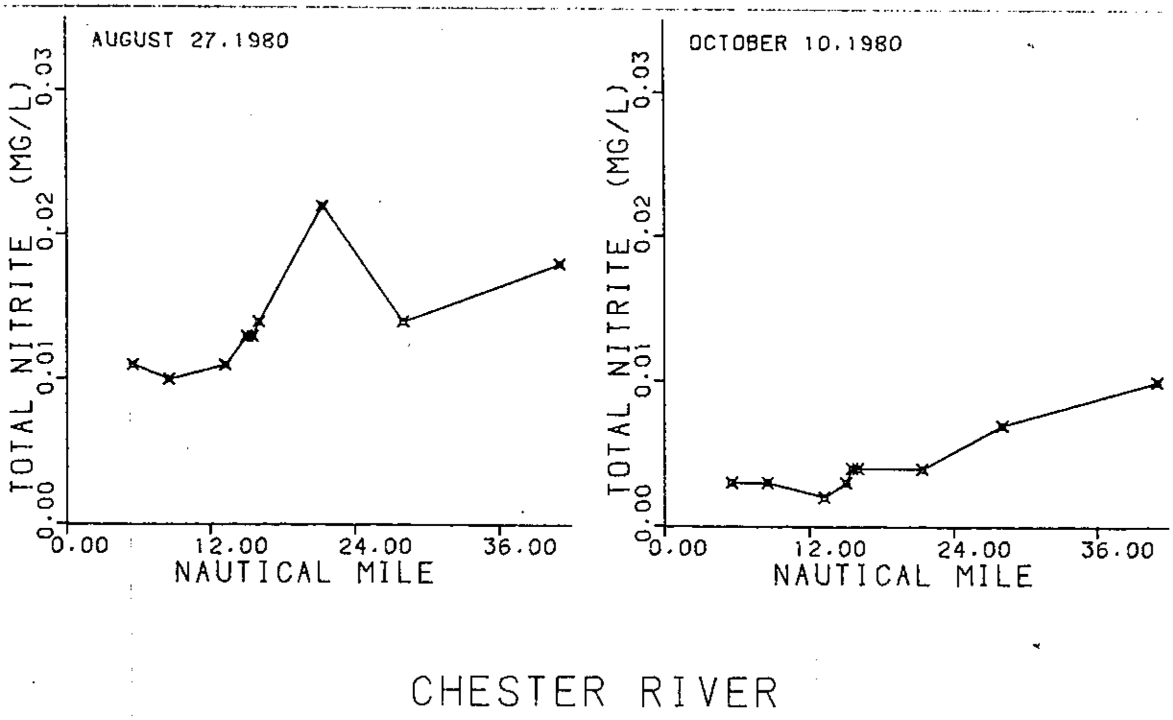


Figure 7-23 Longitudinal slack survey plots for Total Nitrite, (mg/l).

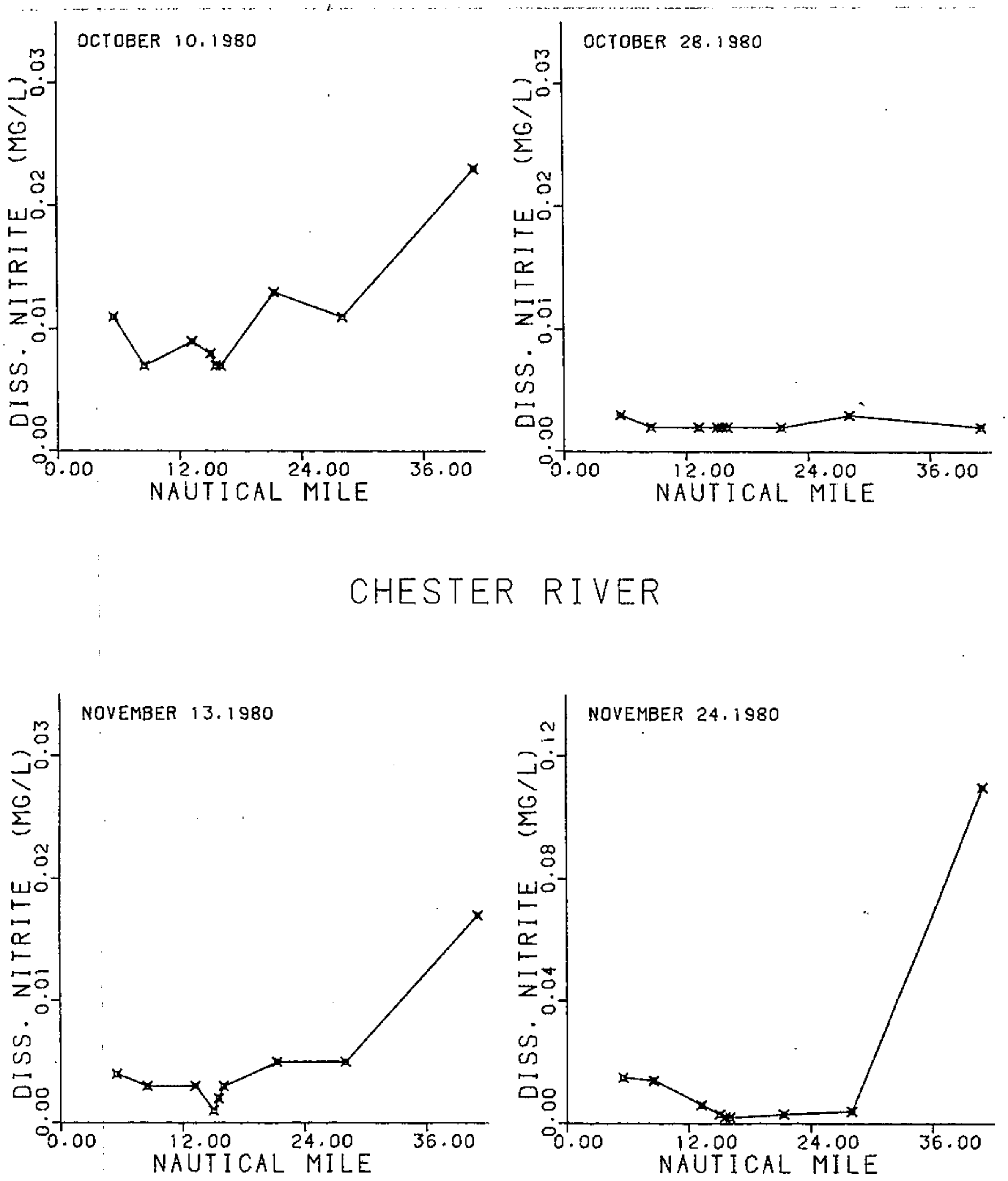


Figure 7-24 Longitudinal Slack survey plots for Dissolved Nitrite, (mg/l).

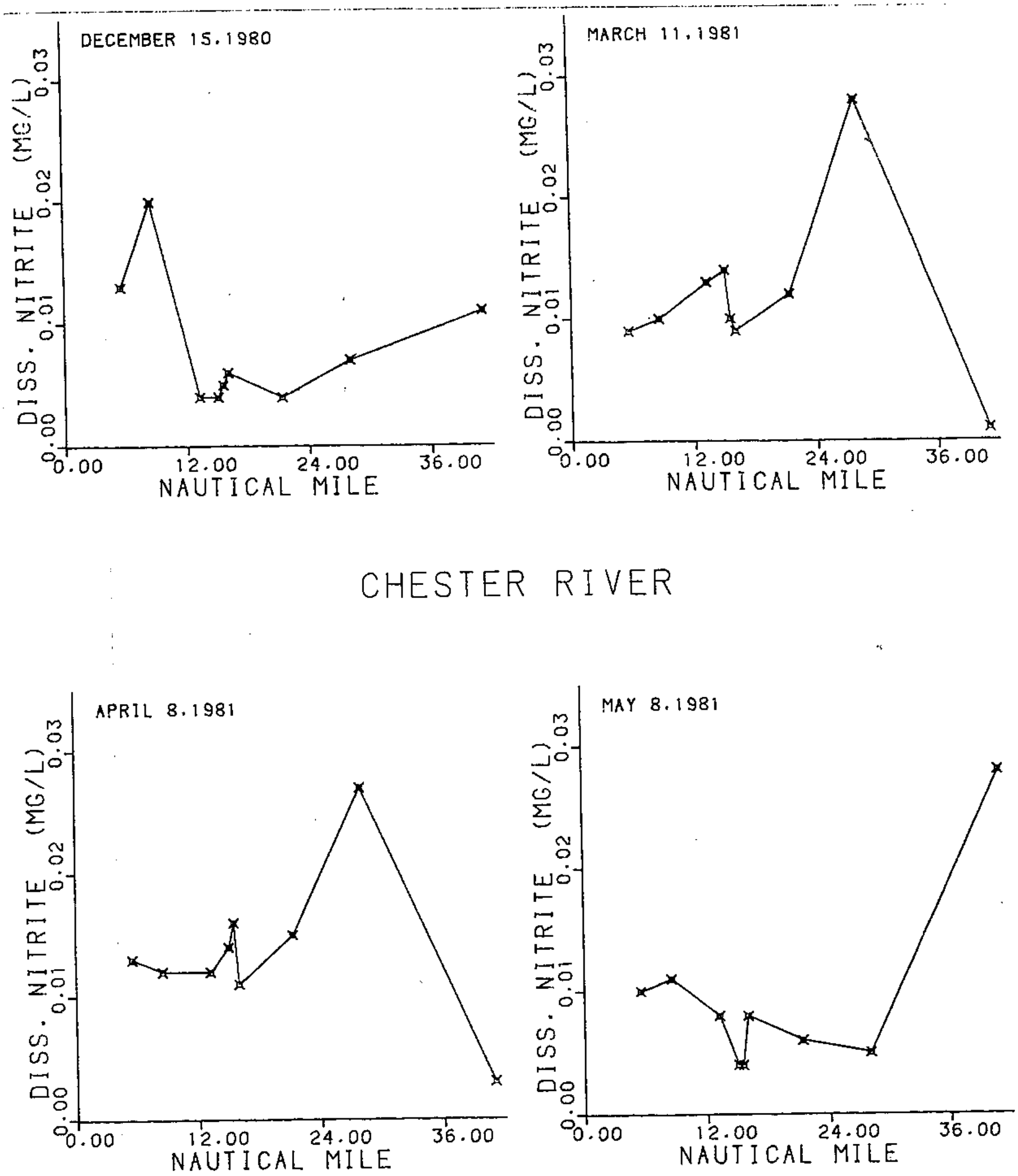


Figure 7-24 Longitudinal slack survey plots for Dissolved Nitrite, (mg/l).

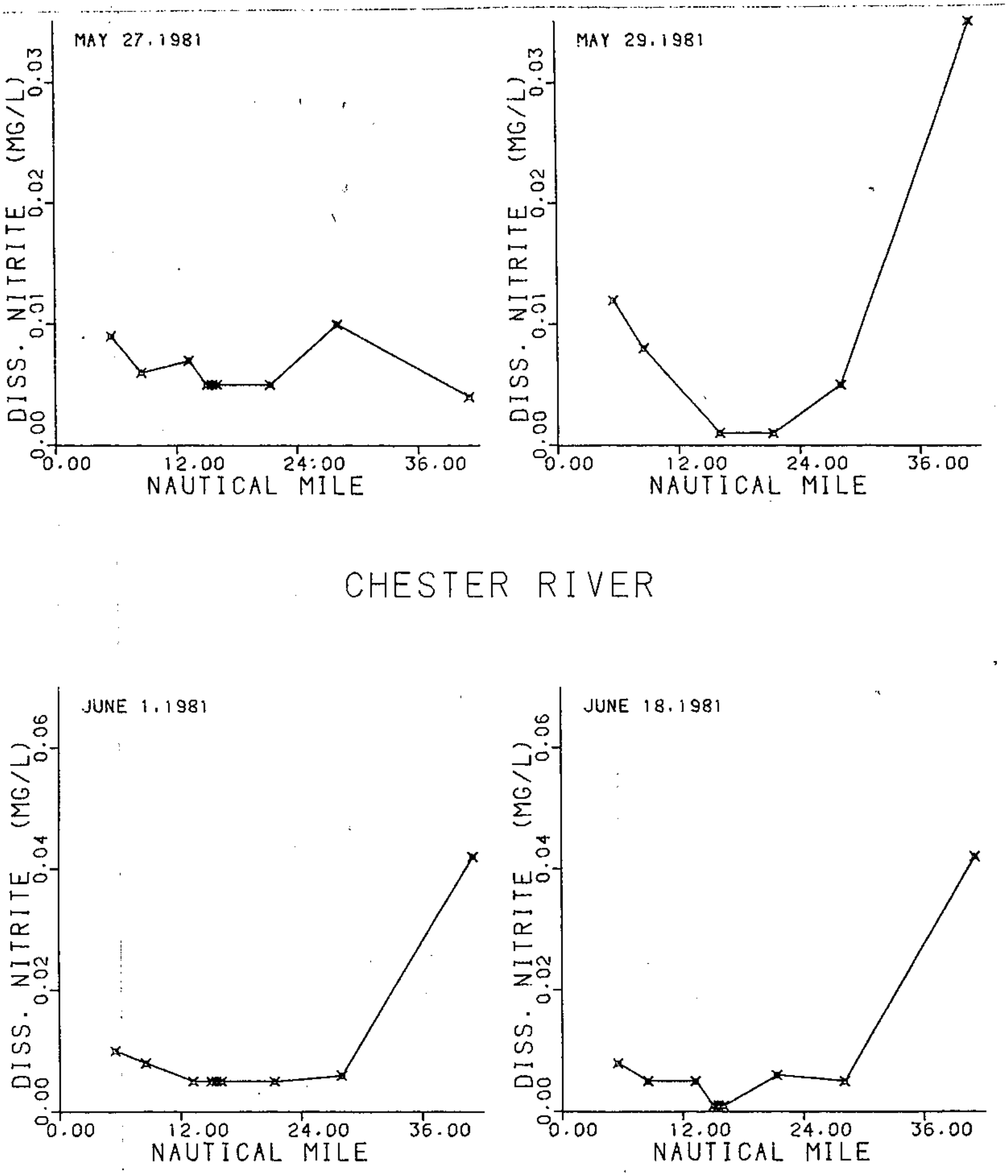
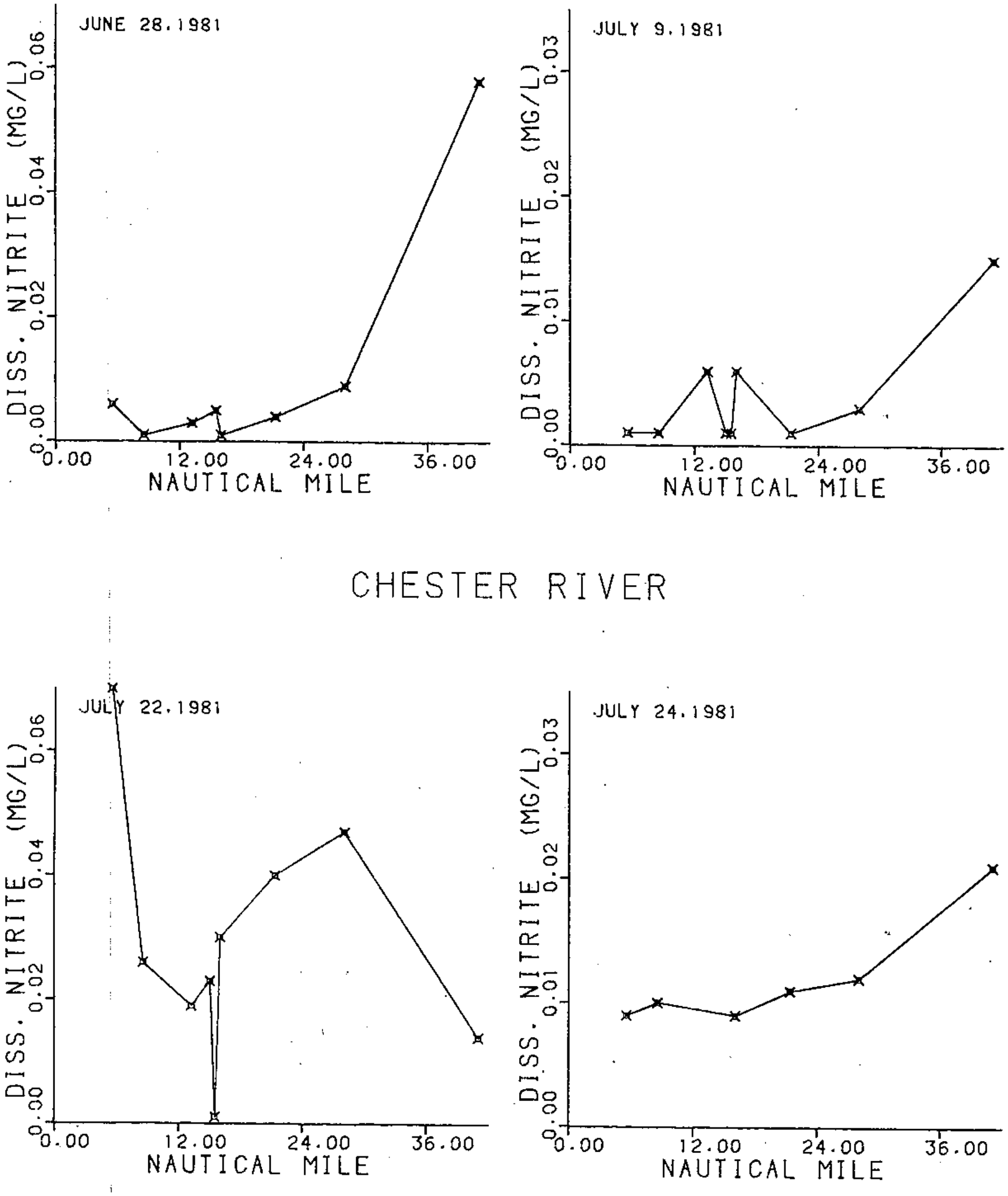


Figure 7-24 Longitudinal slack survey plots for Dissolved Nitrite, (mg/l).



CHESTER RIVER

Figure 7-24 Longitudinal slack survey plots for Dissolved Nitrite, (mg/l).

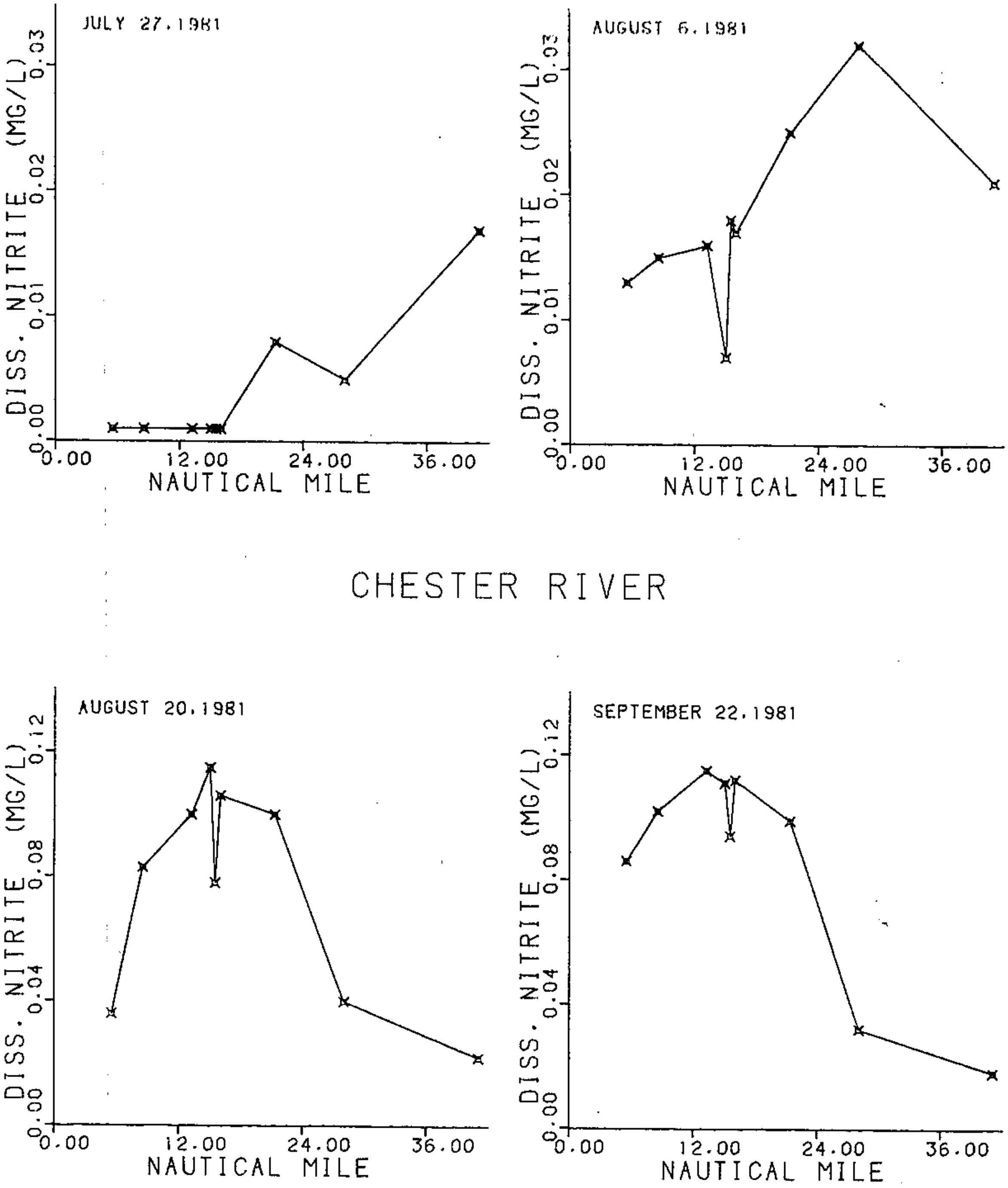
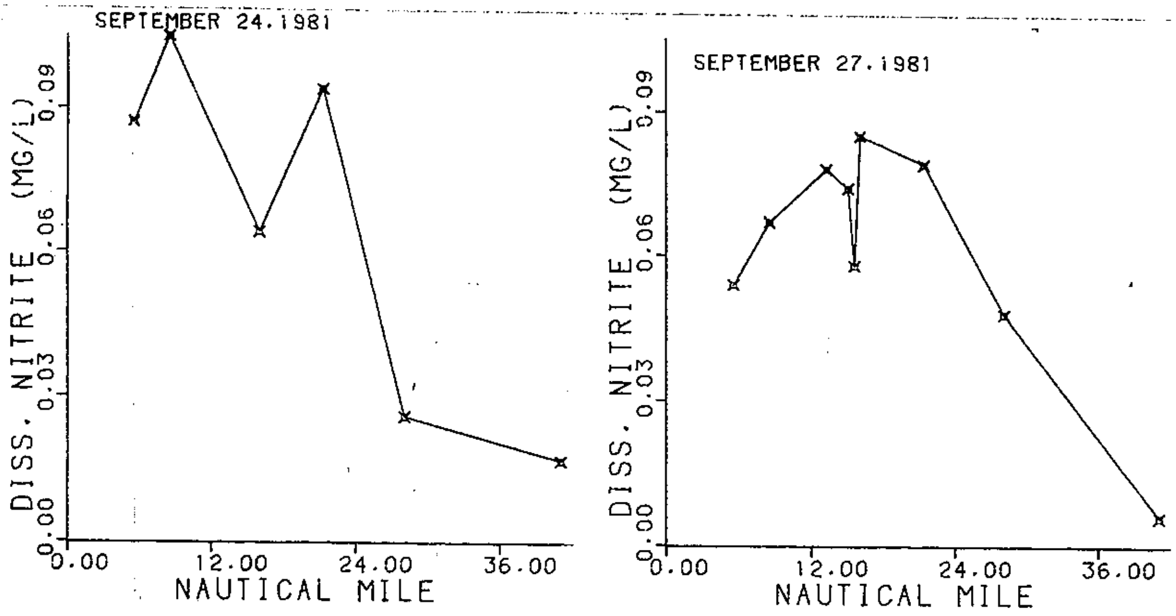


Figure 7-24 Longitudinal slack survey plots for Dissolved Nitrite, (mg/l).



CHESTER RIVER

Figure 7-24 Longitudinal slack survey plots for Dissolved Nitrite, (mg/l).

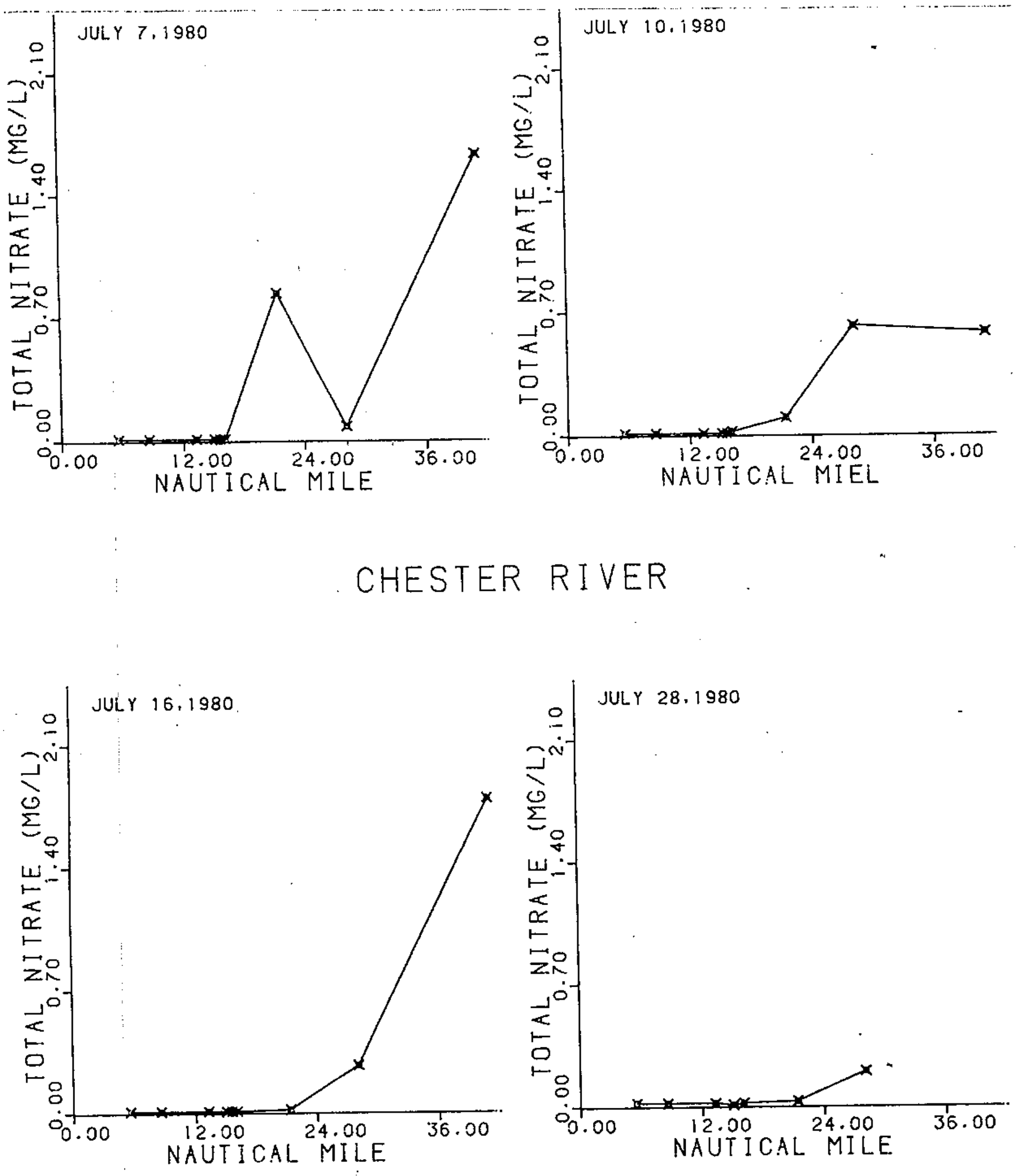
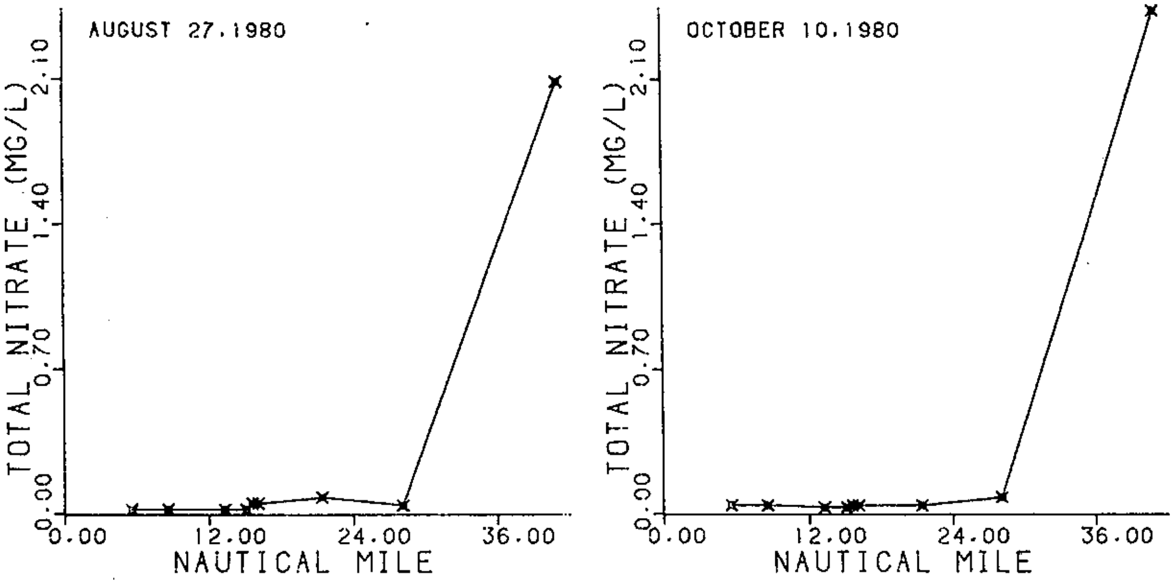


Figure 7-25 Longitudinal slack survey plots for Total Nitrite, (mg/l).



CHESTER RIVER

Figure 7-25 Longitudinal slack survey plots for Total Nitrate (mg/l).

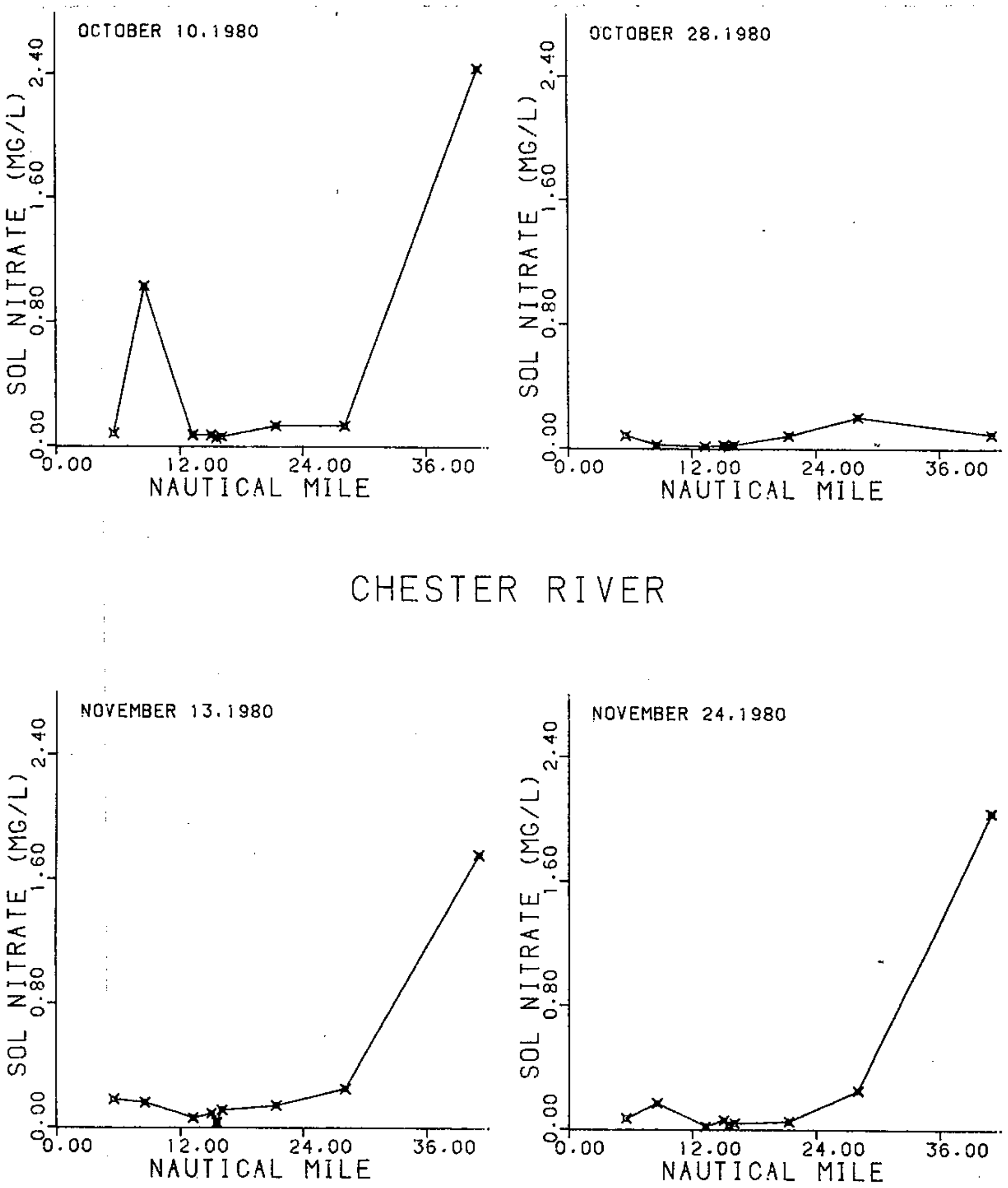


Figure 7-26 Longitudinal slack survey plots for Dissolved Nitrate (mg/l).

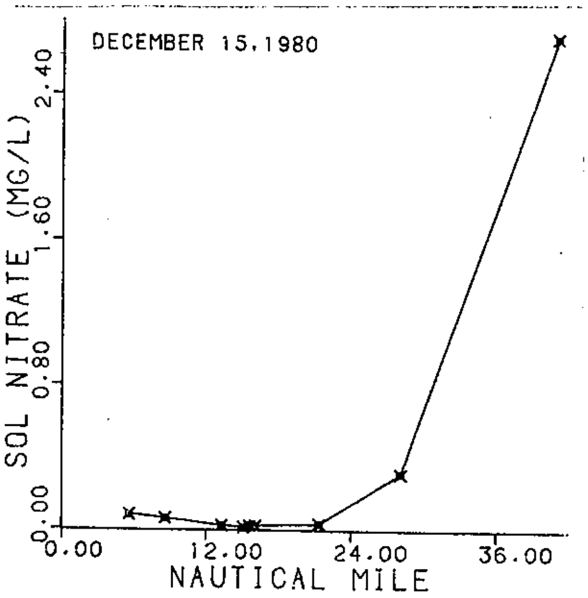


Figure 7-26 Longitudinal slack survey plots for Dissolved Nitrate, (mg/l).

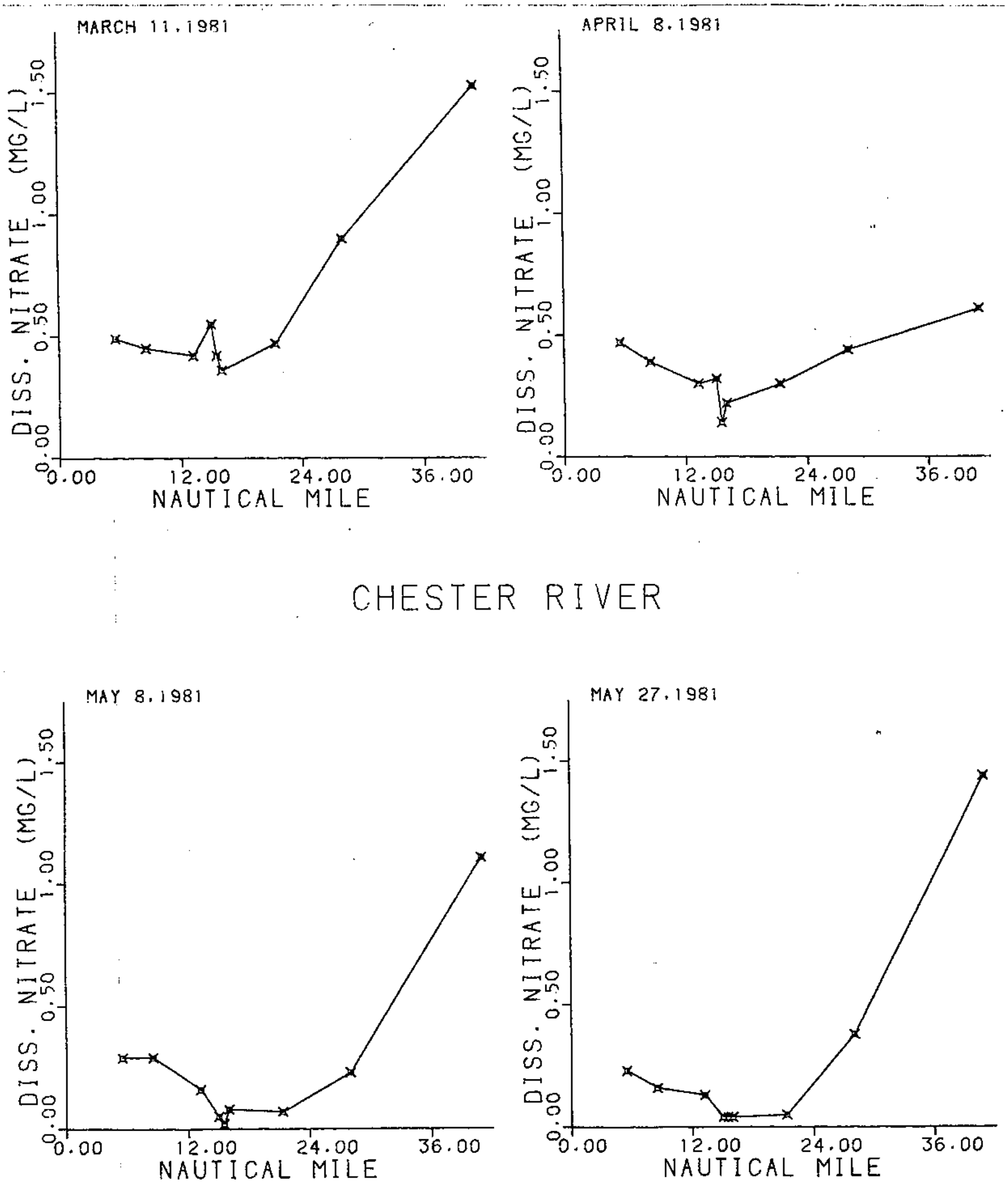


Figure 7-26 Longitudinal slack survey plots for Dissolved Nitrate, (mg/l).

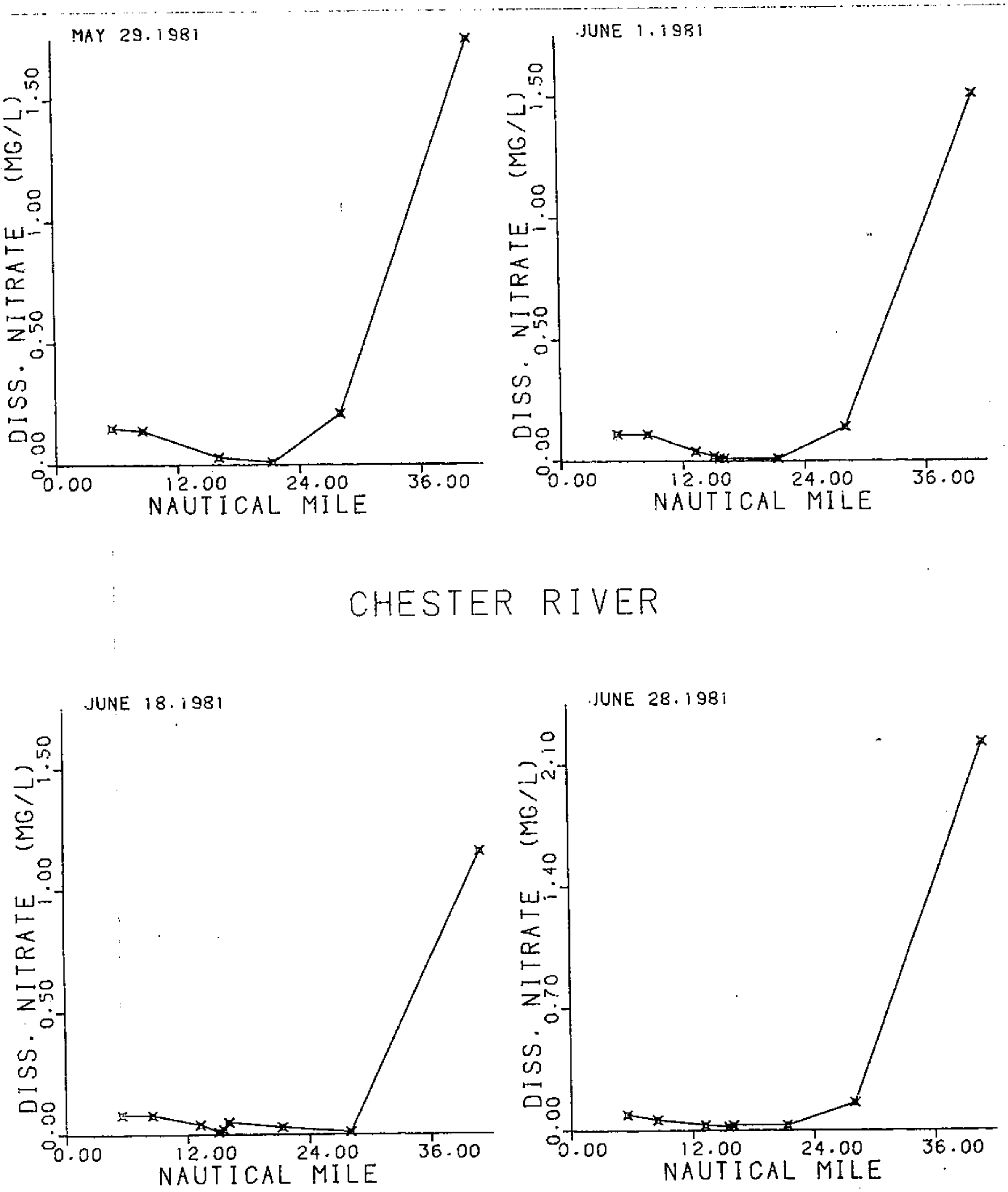


Figure 7-26 Longitudinal slack survey plots for Dissolved Nitrate, (mg/l).

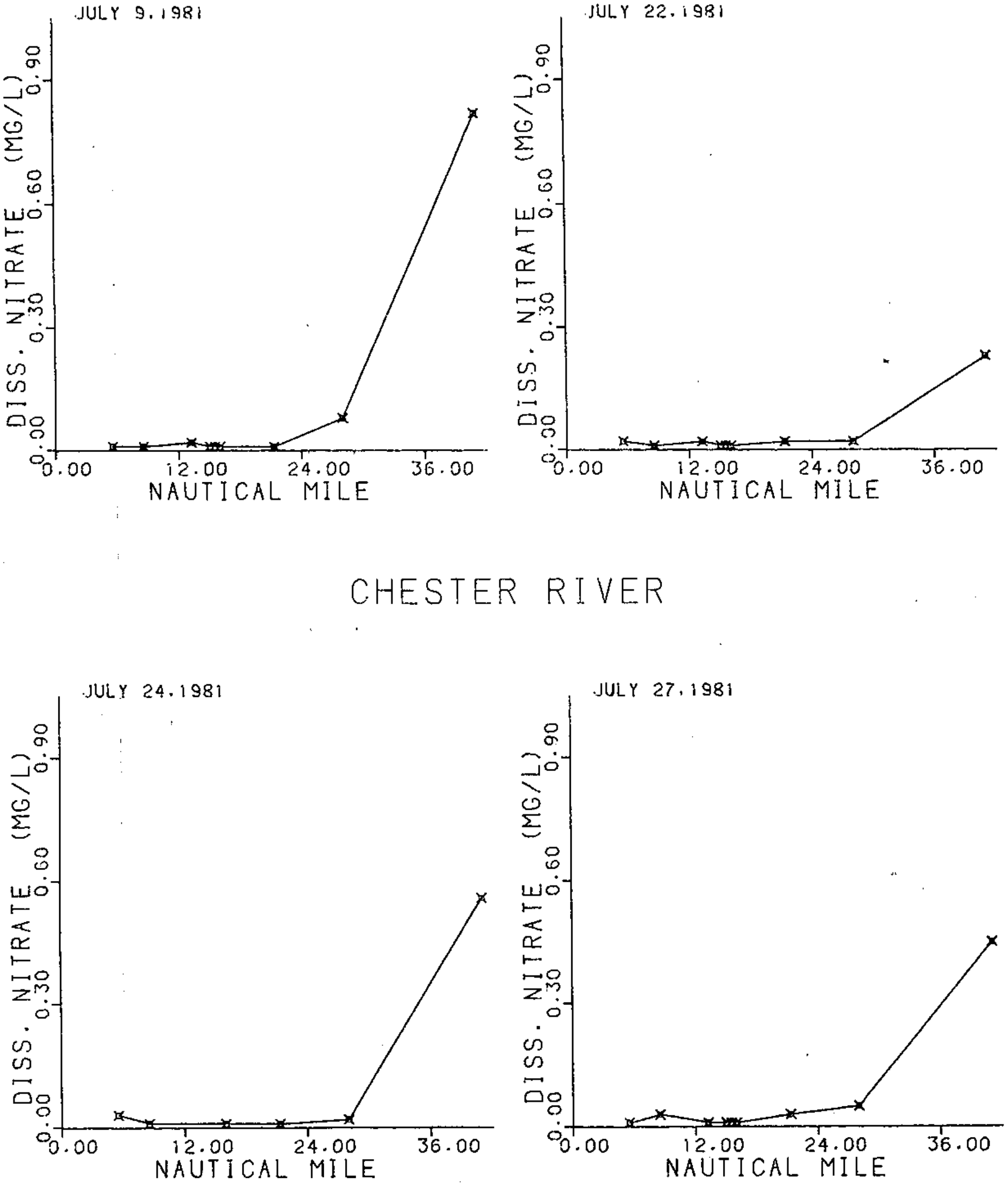


Figure 7-26 Longitudinal slack survey plots for Dissolved Nitrate, (mg/l).

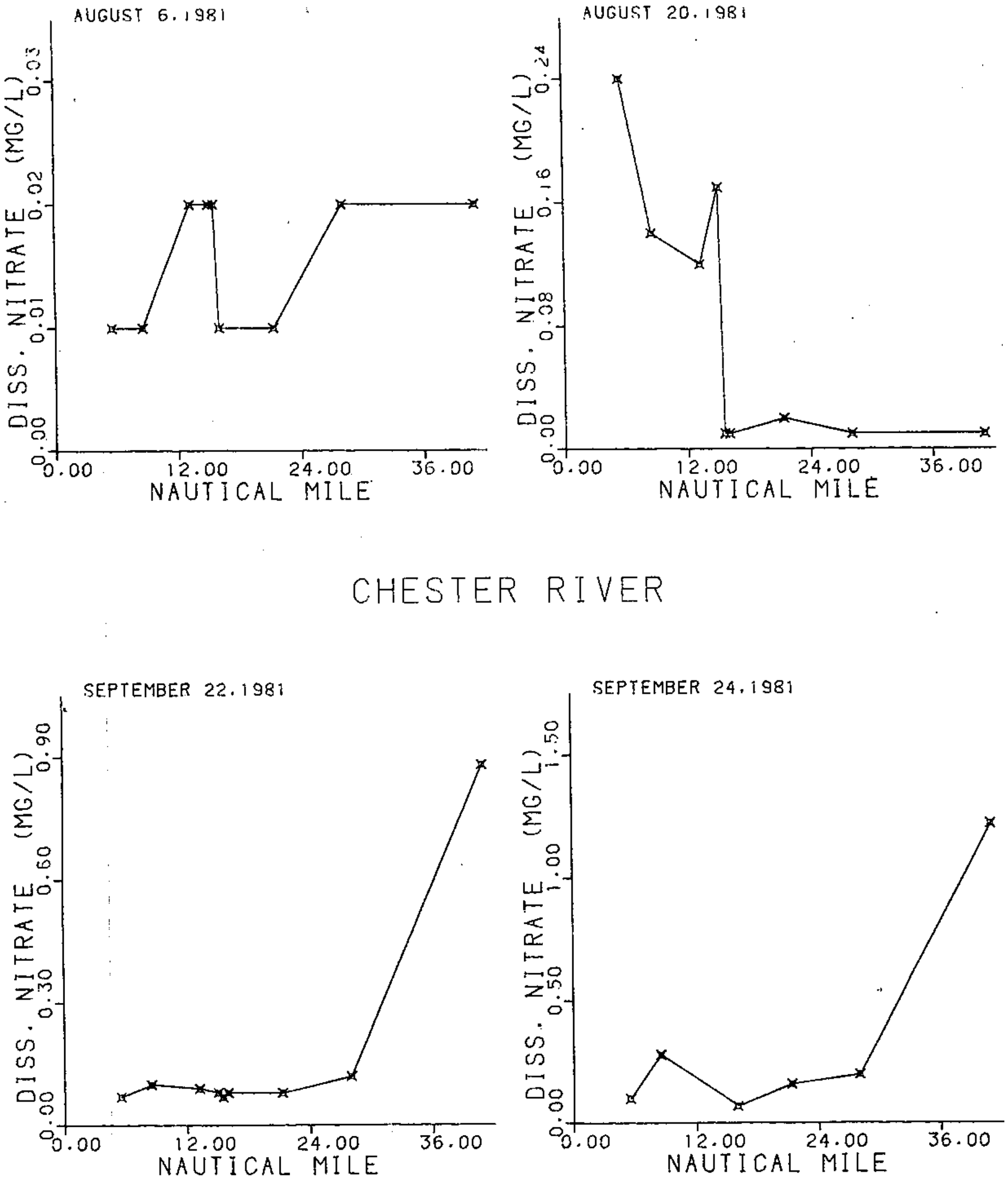


Figure 7-26 Longitudinal slack survey plots for Dissolved Nitrate, (mg/l).

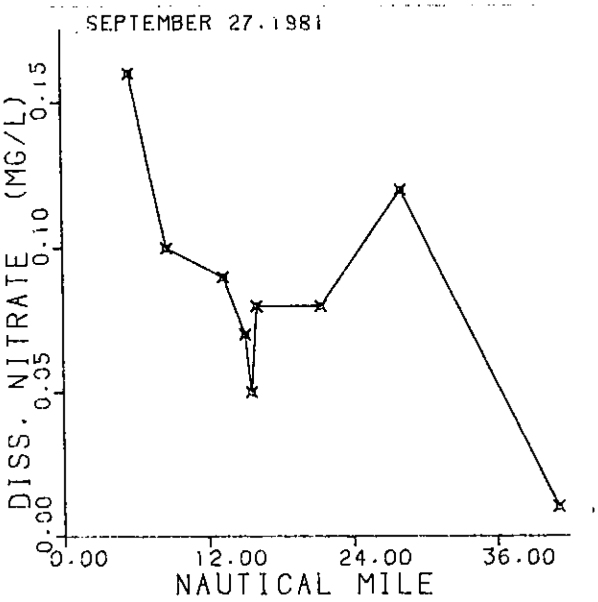


Figure 7-26 Longitudinal slack survey plots for Dissolved Nitrate, (mg/l).

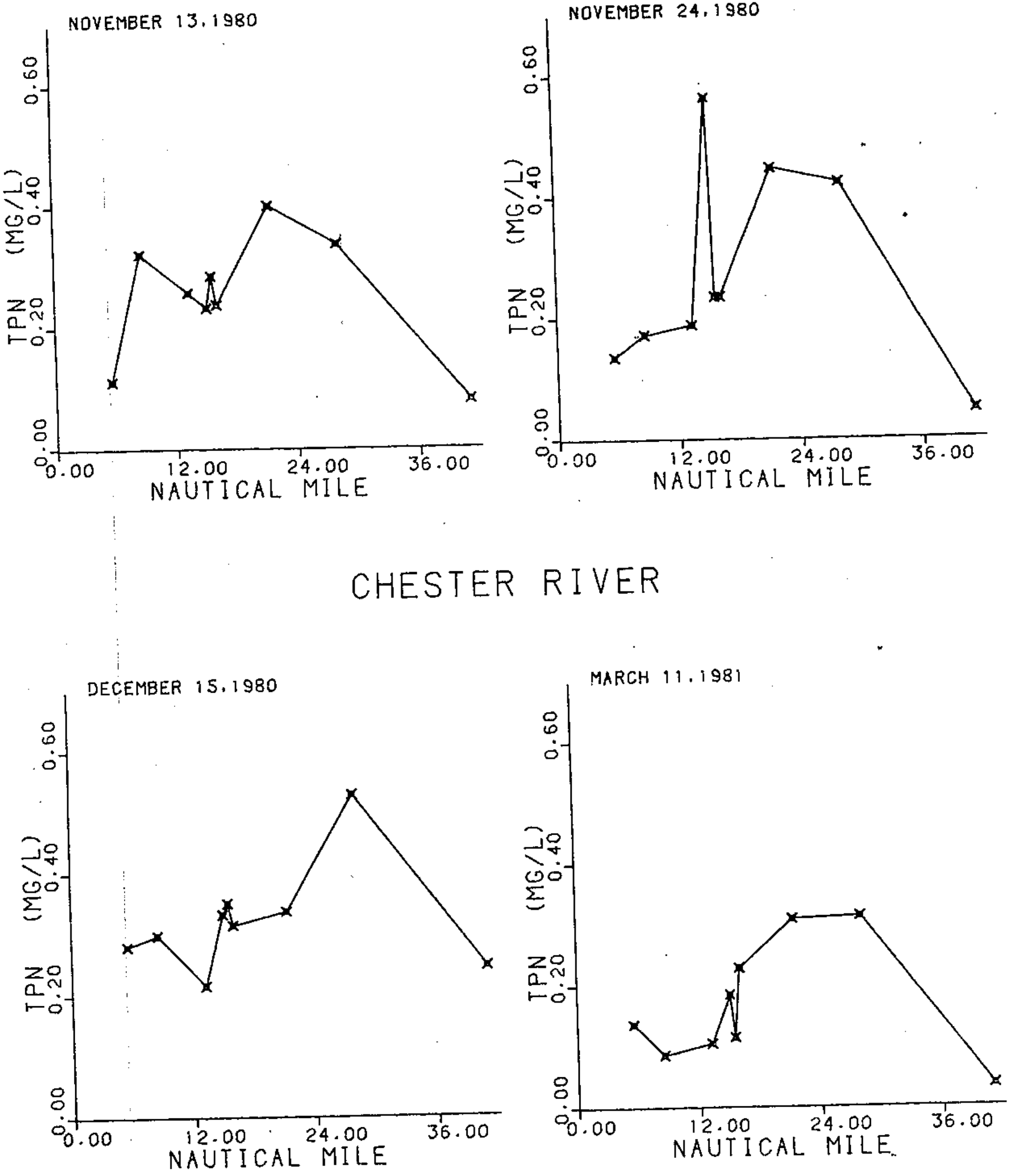


Figure 7-27 Longitudinal slack survey plots for Total Particulate Nitrogen, (mg/l).

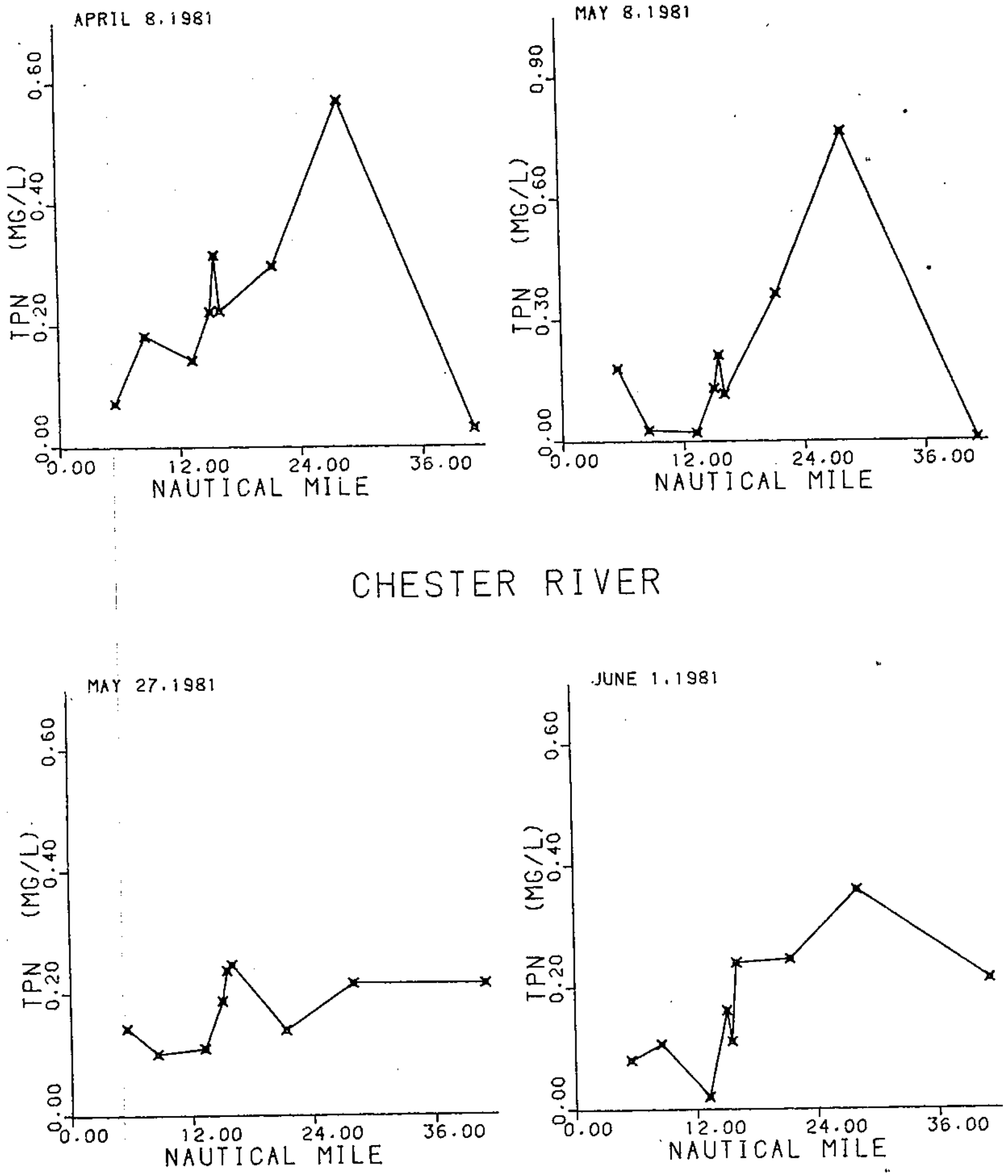


Figure 7-27 Longitudinal slack survey plots for Total Particulate Nitrogen, (mg/l).

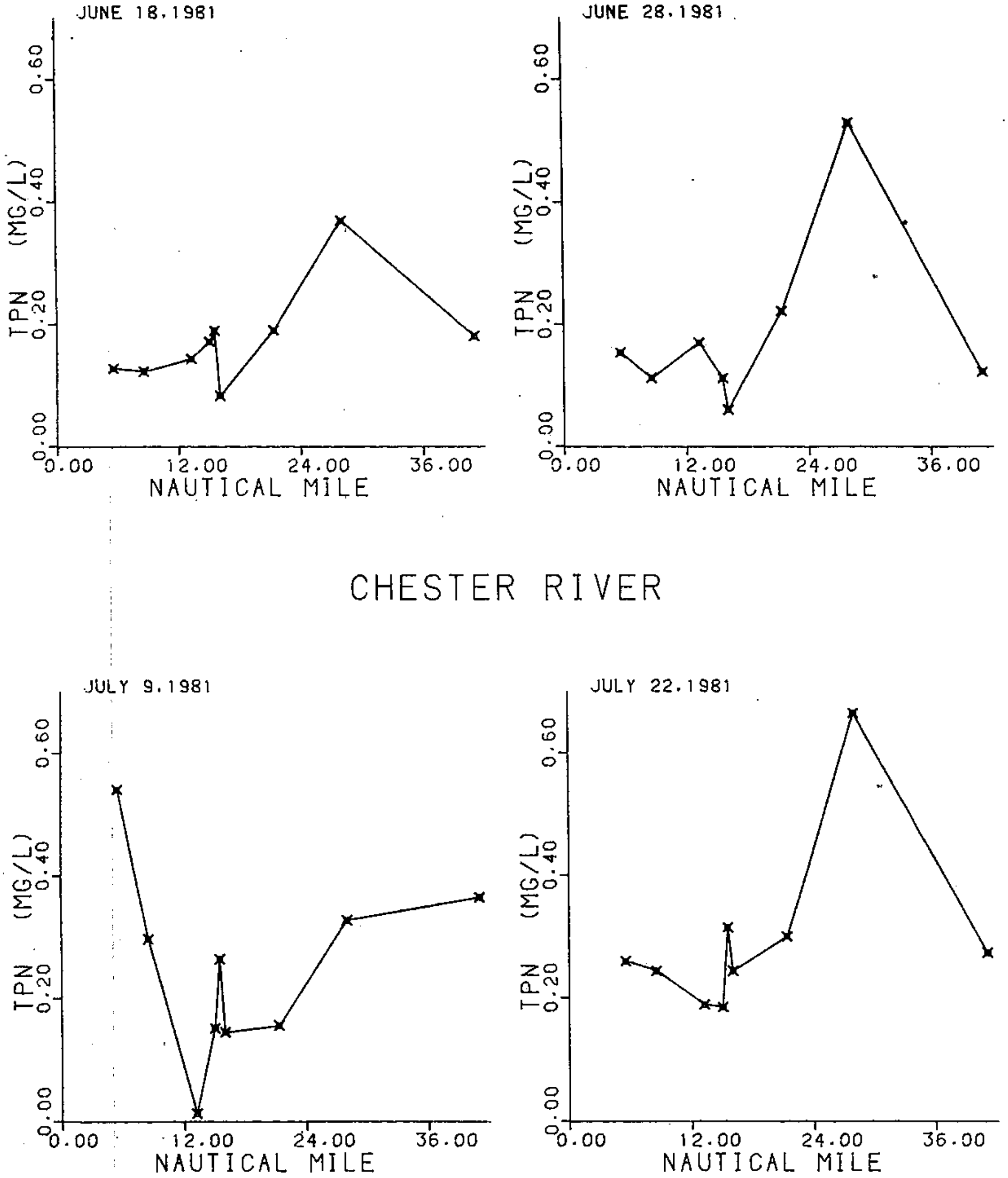


Figure 7-27 Longitudinal slack survey plots for Total Particulate Nitrogen, (mg/l).

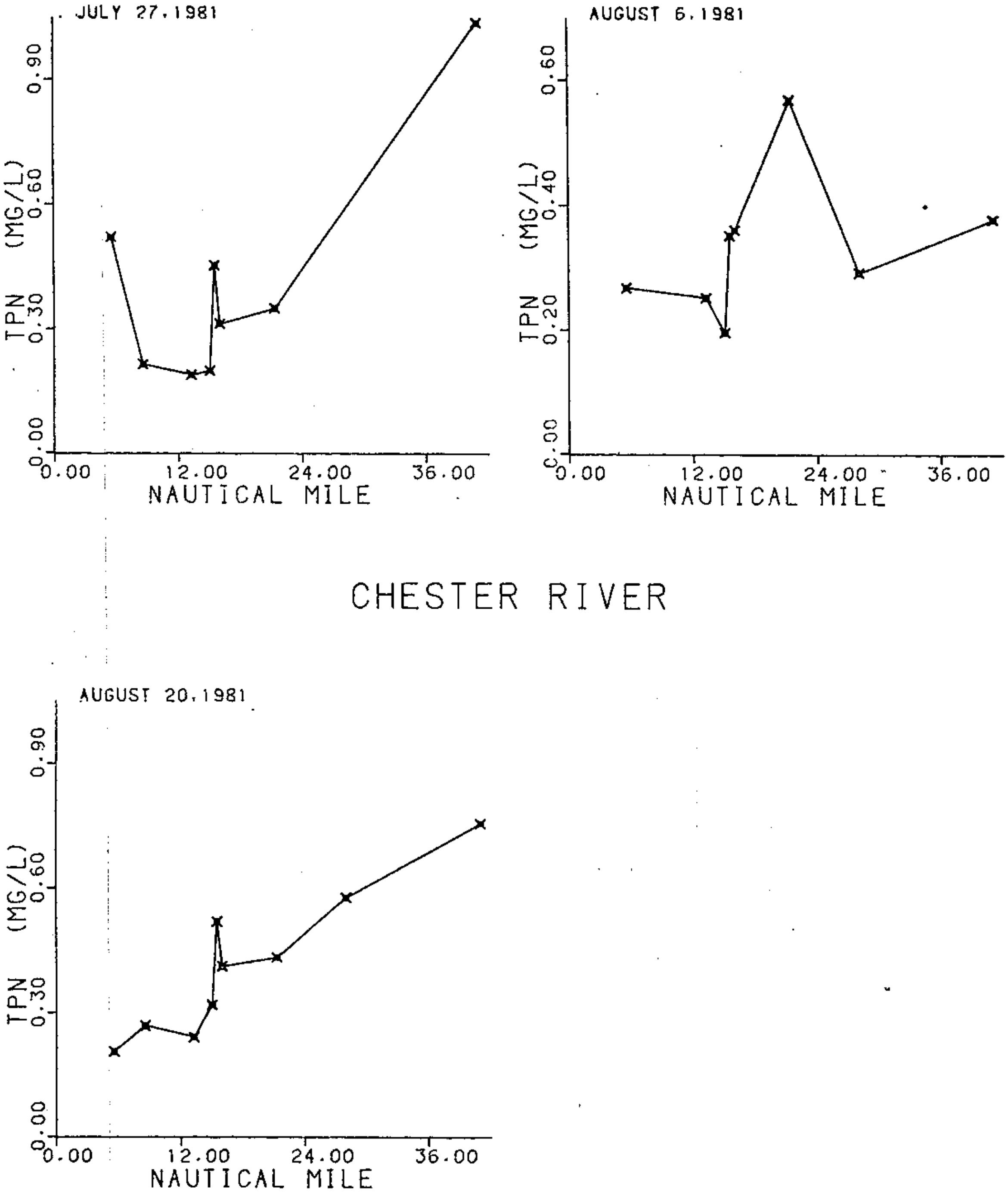
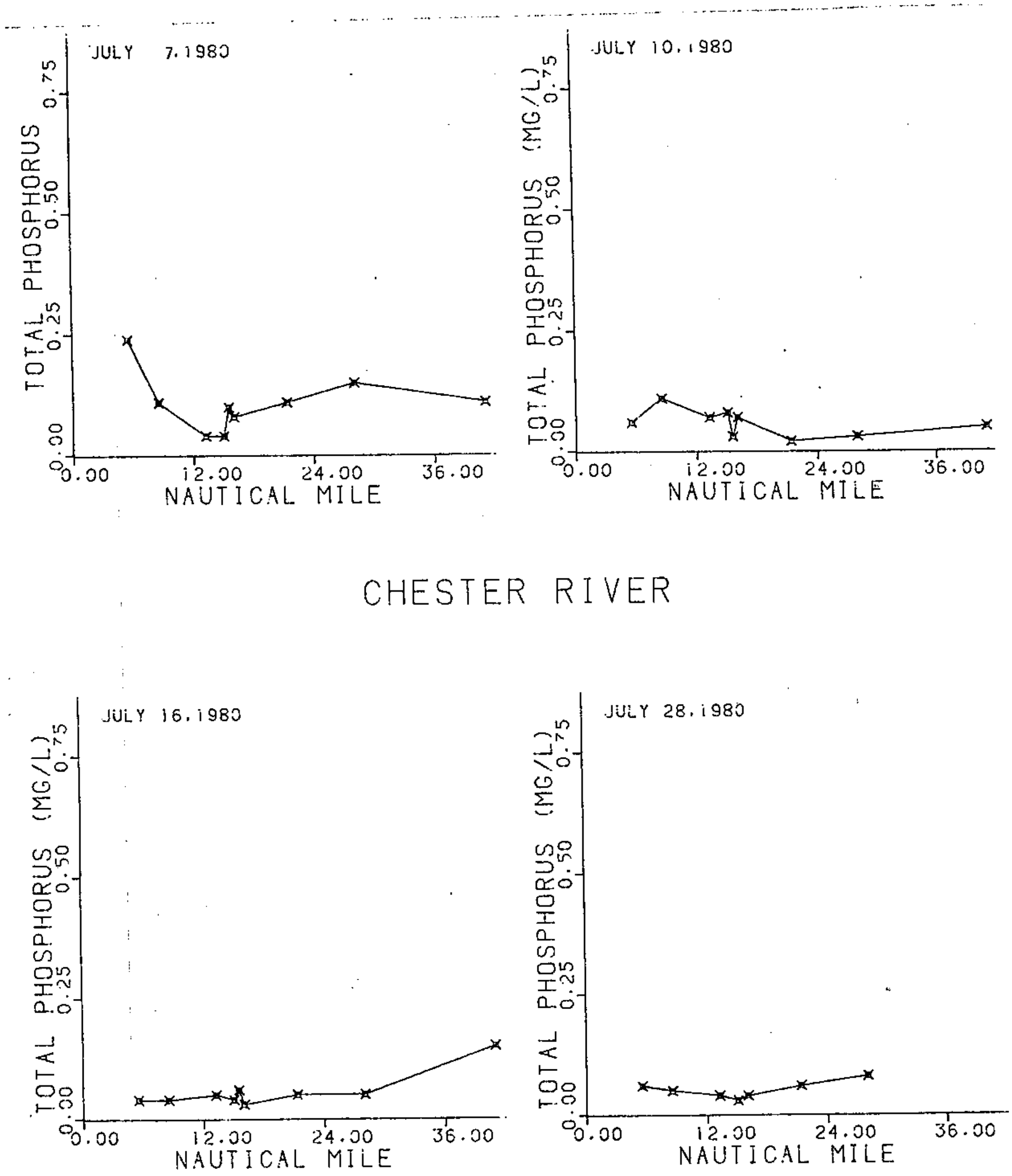


Figure 7-27Longitudinal slack survey plots for Total Particulate Nitrogen, (mg/l).



CHESTER RIVER

Figure 7-28 Longitudinal slack survey plots for Total Phosphorus, (mg/l).

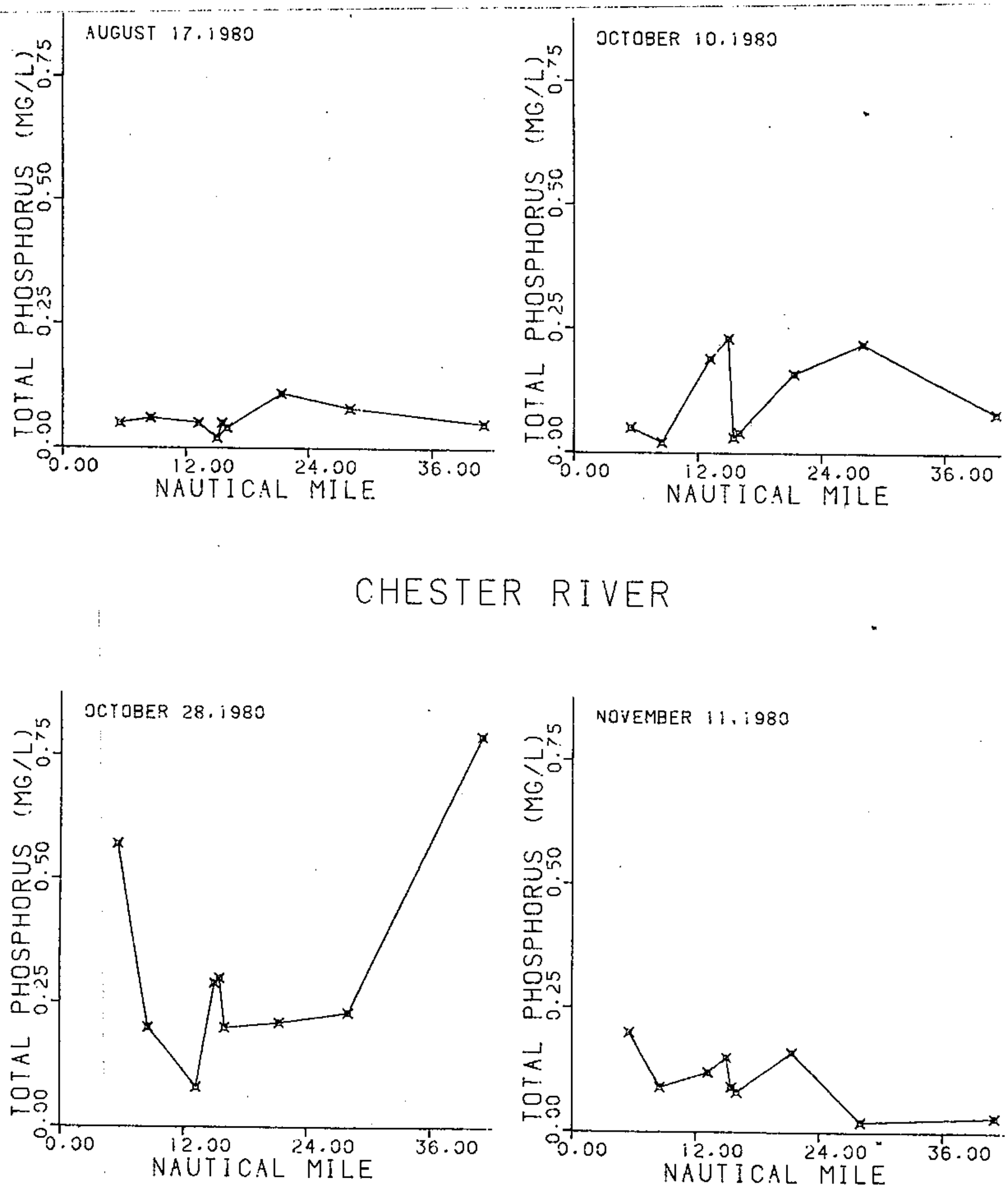
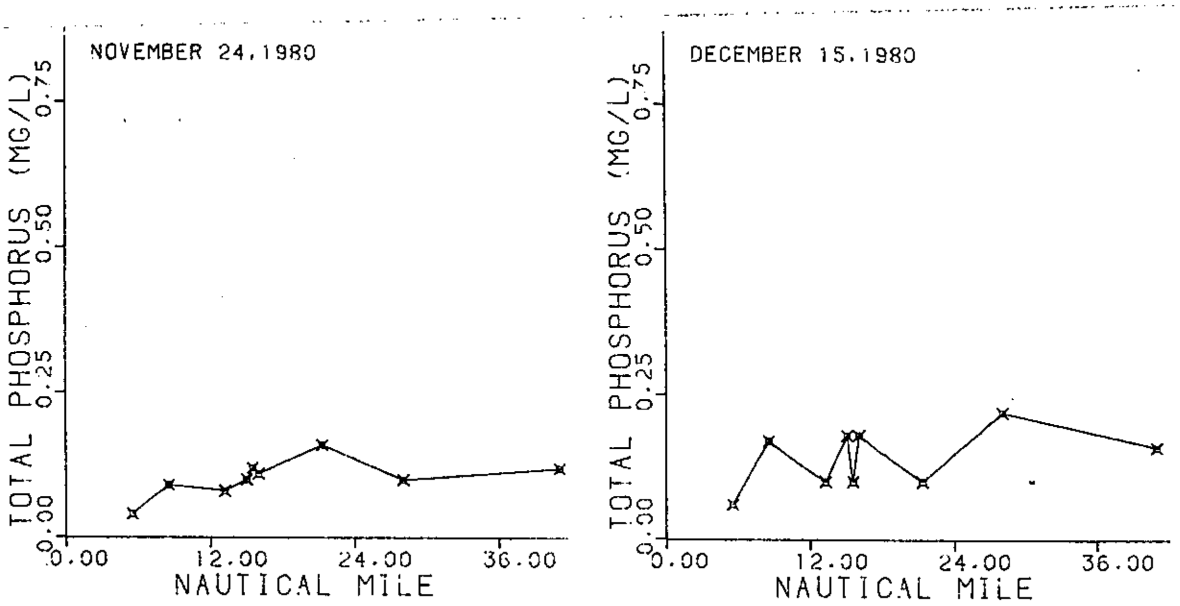
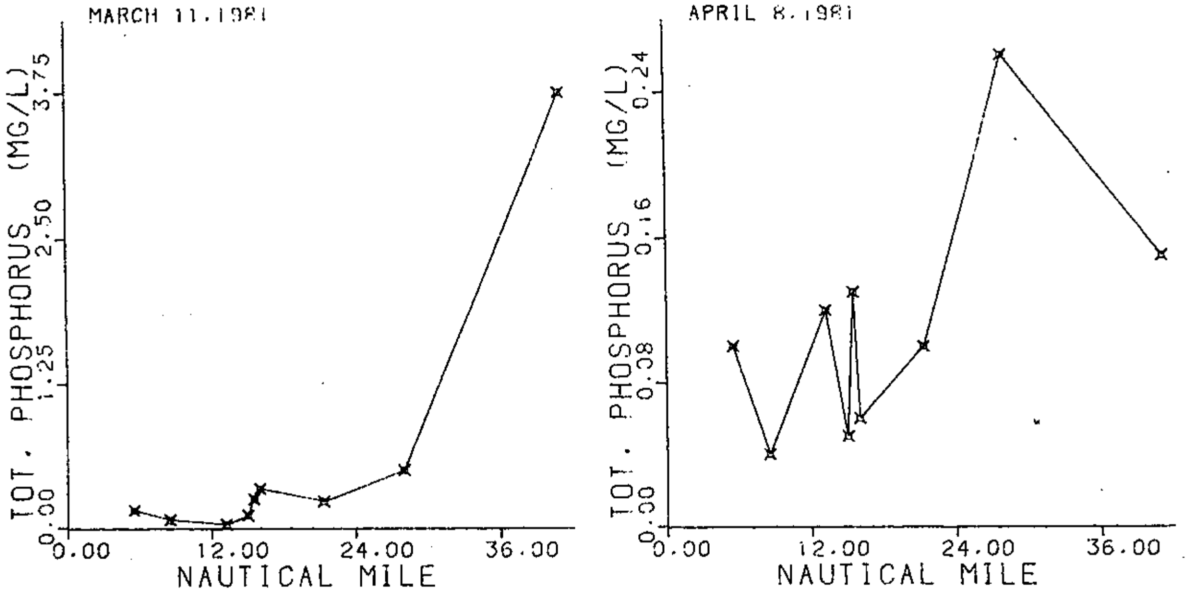


Figure 7-28 Longitudinal slack survey plots for Total Phosphorus, (mg/l).



CHESTER RIVER

Figure 7-28 Longitudinal slack survey plots for Total Phosphorus, (mg/l).



CHESTER RIVER

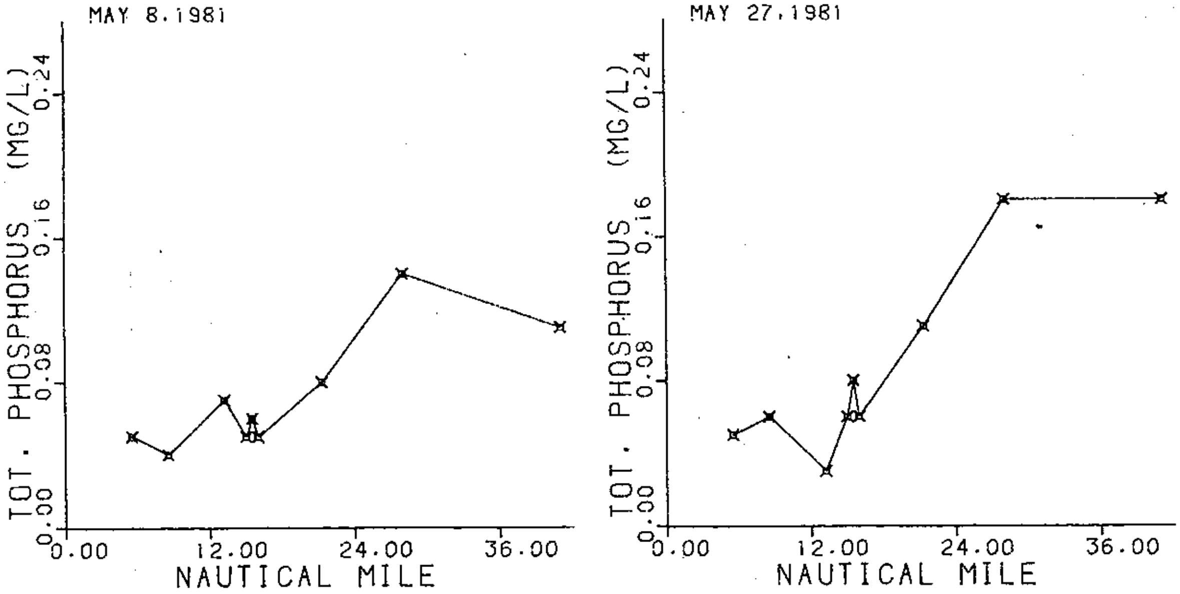


Figure 7-28 Longitudinal slack survey plots for Total Phosphorus, (mg/l).

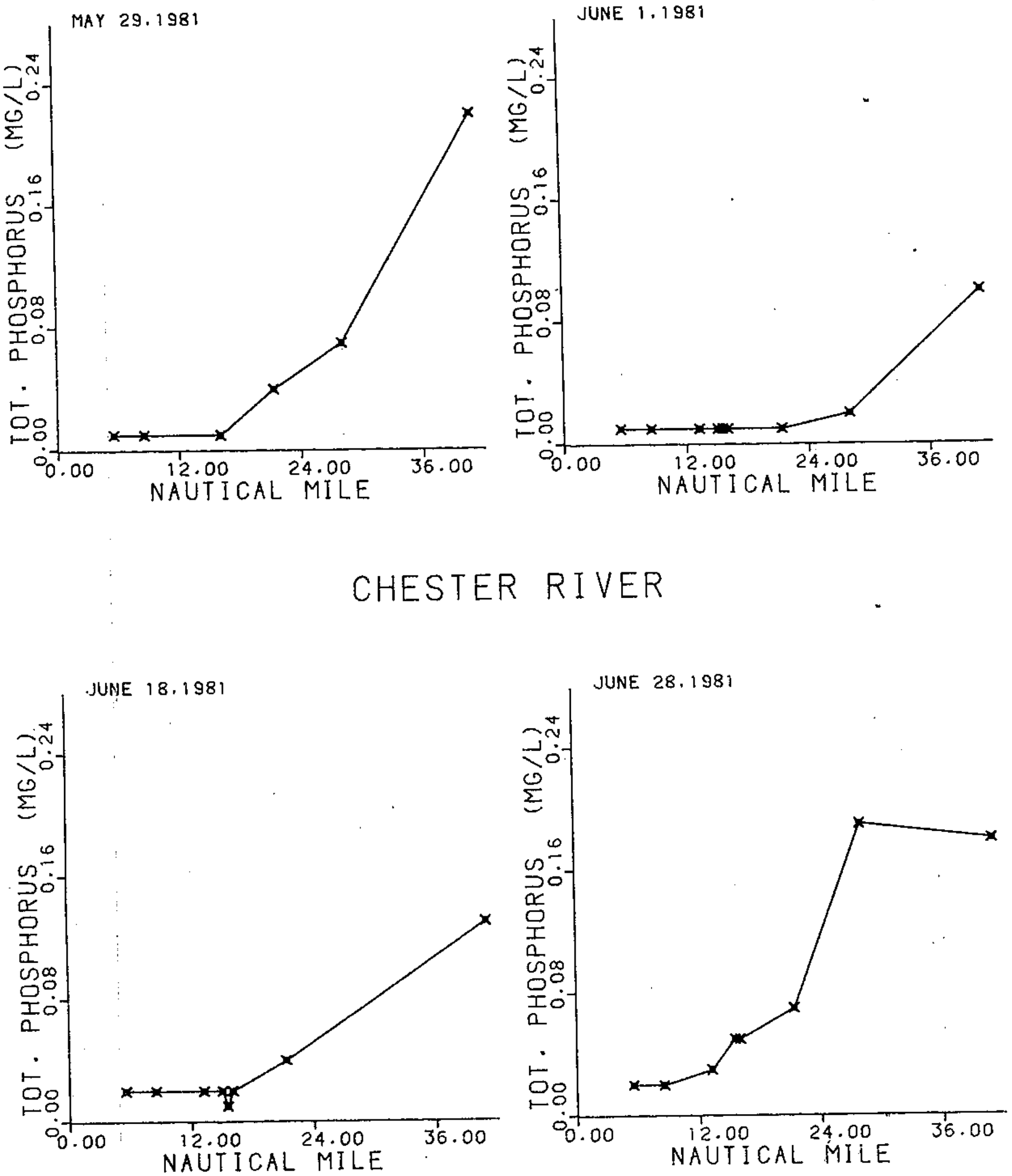


Figure 7-28 Longitudinal slack survey plots for Total Phosphorus, (mg/l).

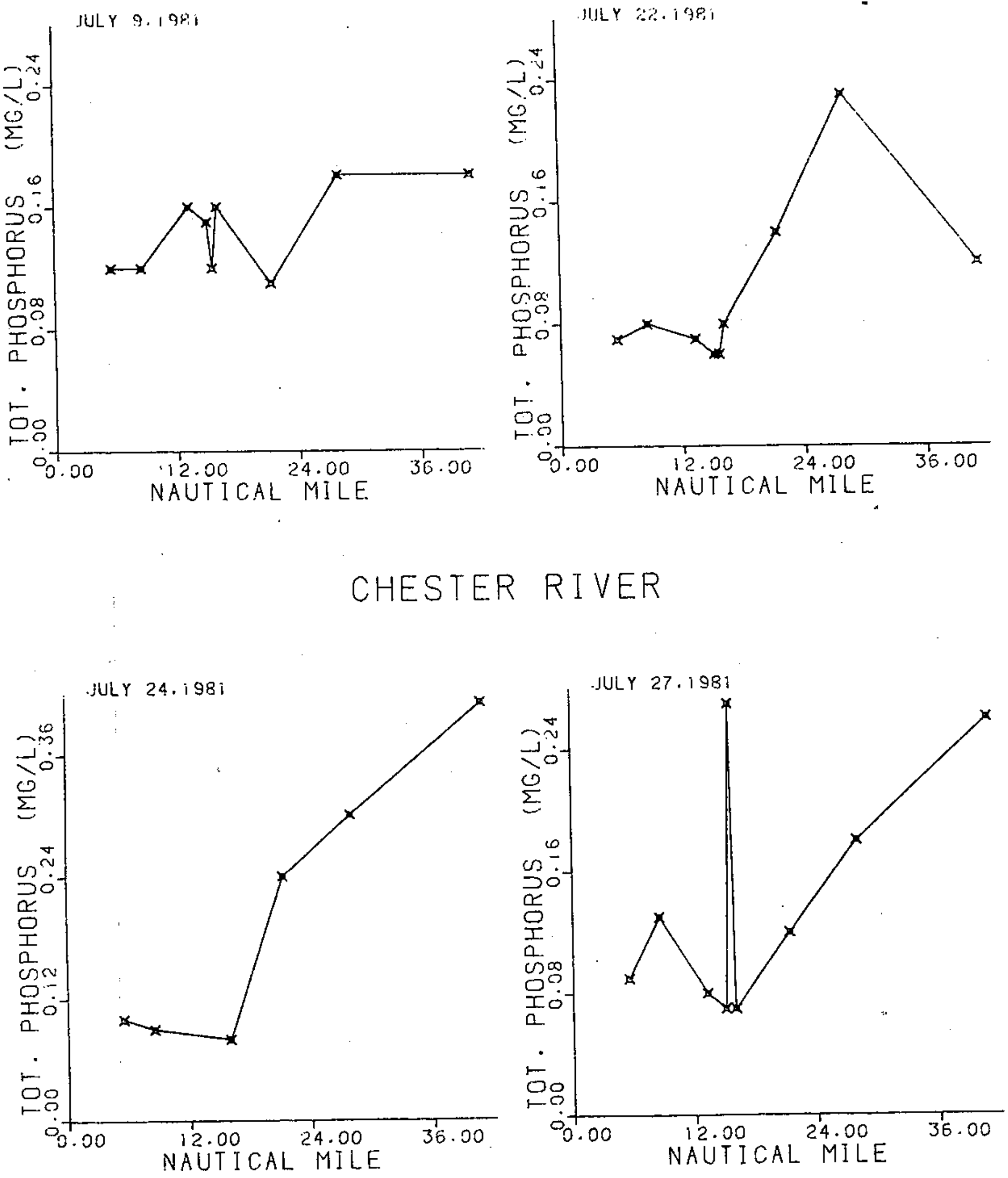


Figure 7-28 Longitudinal slack survey plots for Total Phosphorus, (mg/l).

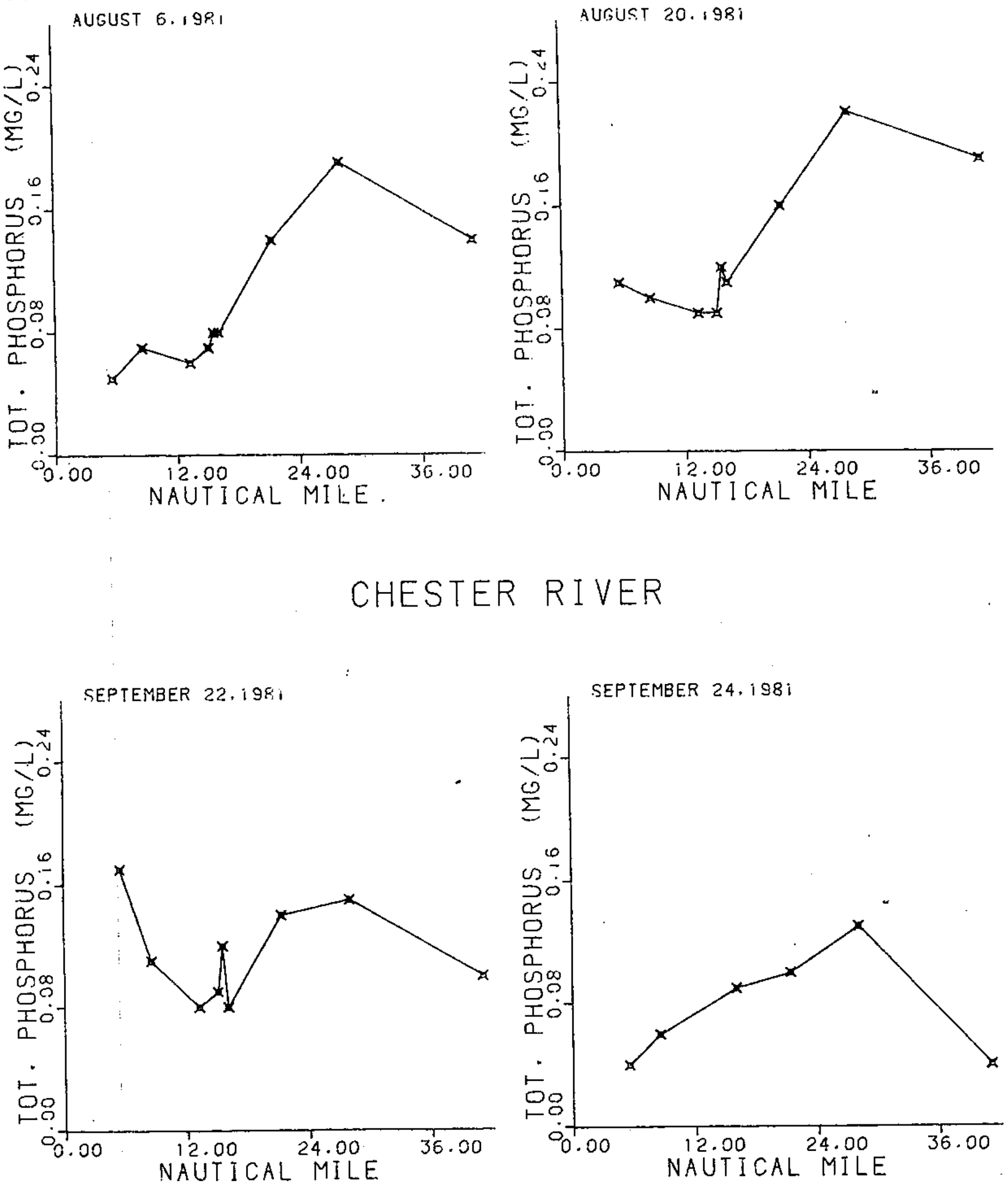


Figure 7-28 Longitudinal slack survey plots for Total Phosphorus, (mg/l).

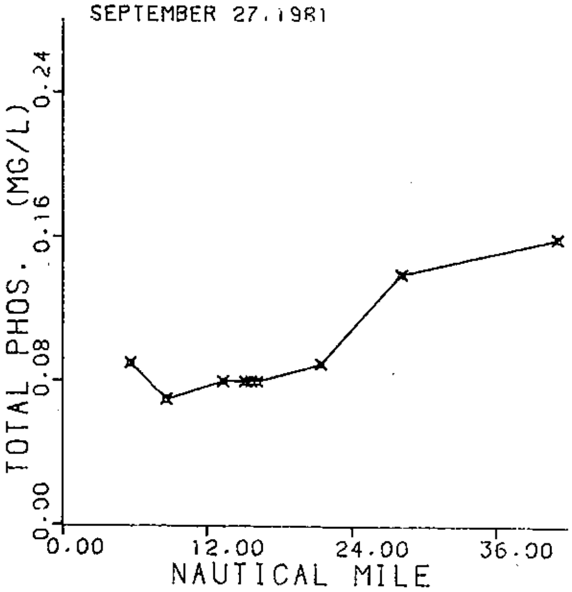


Figure 7-28 Longitudinal slack survey plots for Total Phosphorus, (mg/l).

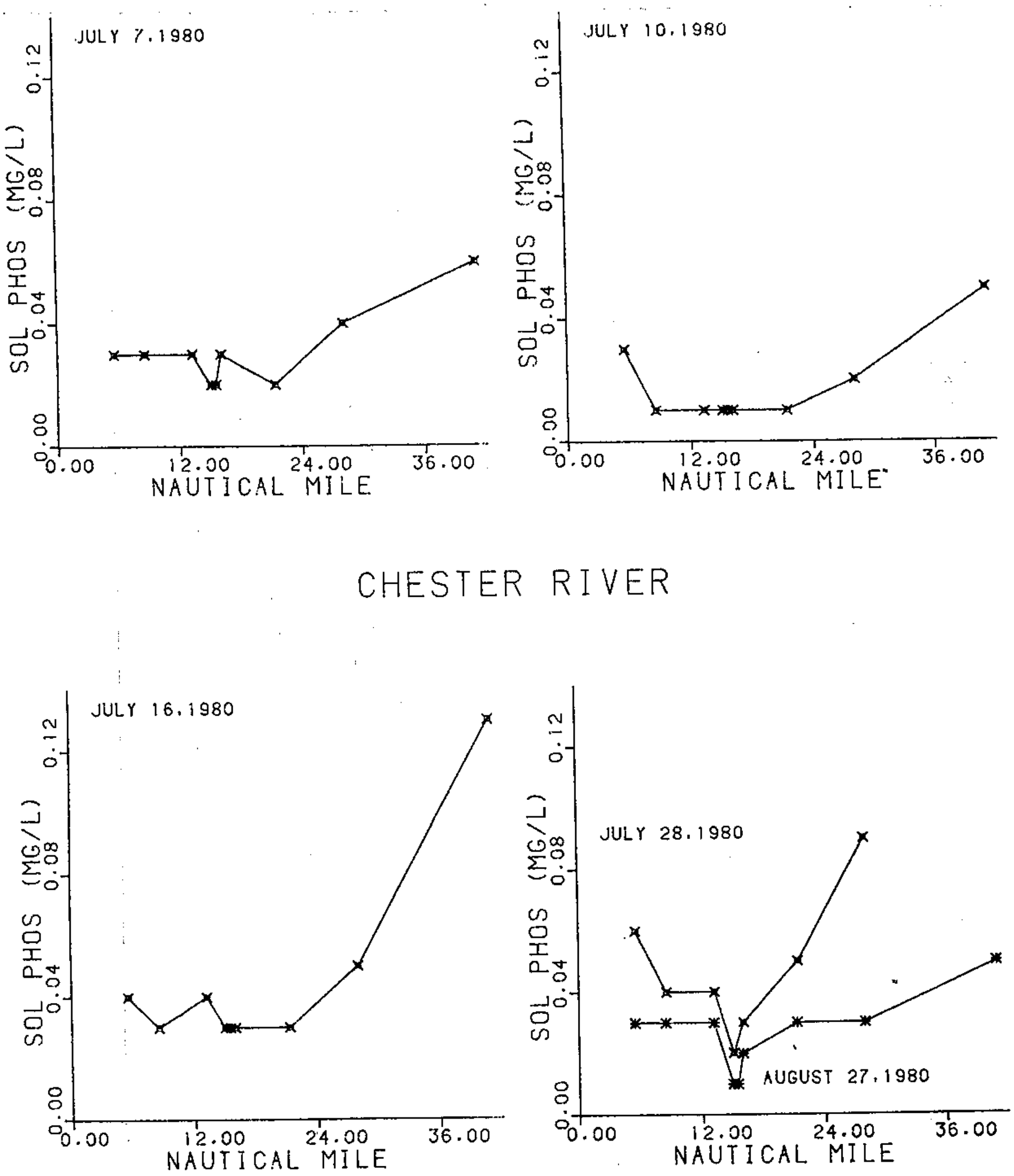


Figure 7-29 Longitudinal slack survey plots for Dissolved Phosphorus, (mg/l).

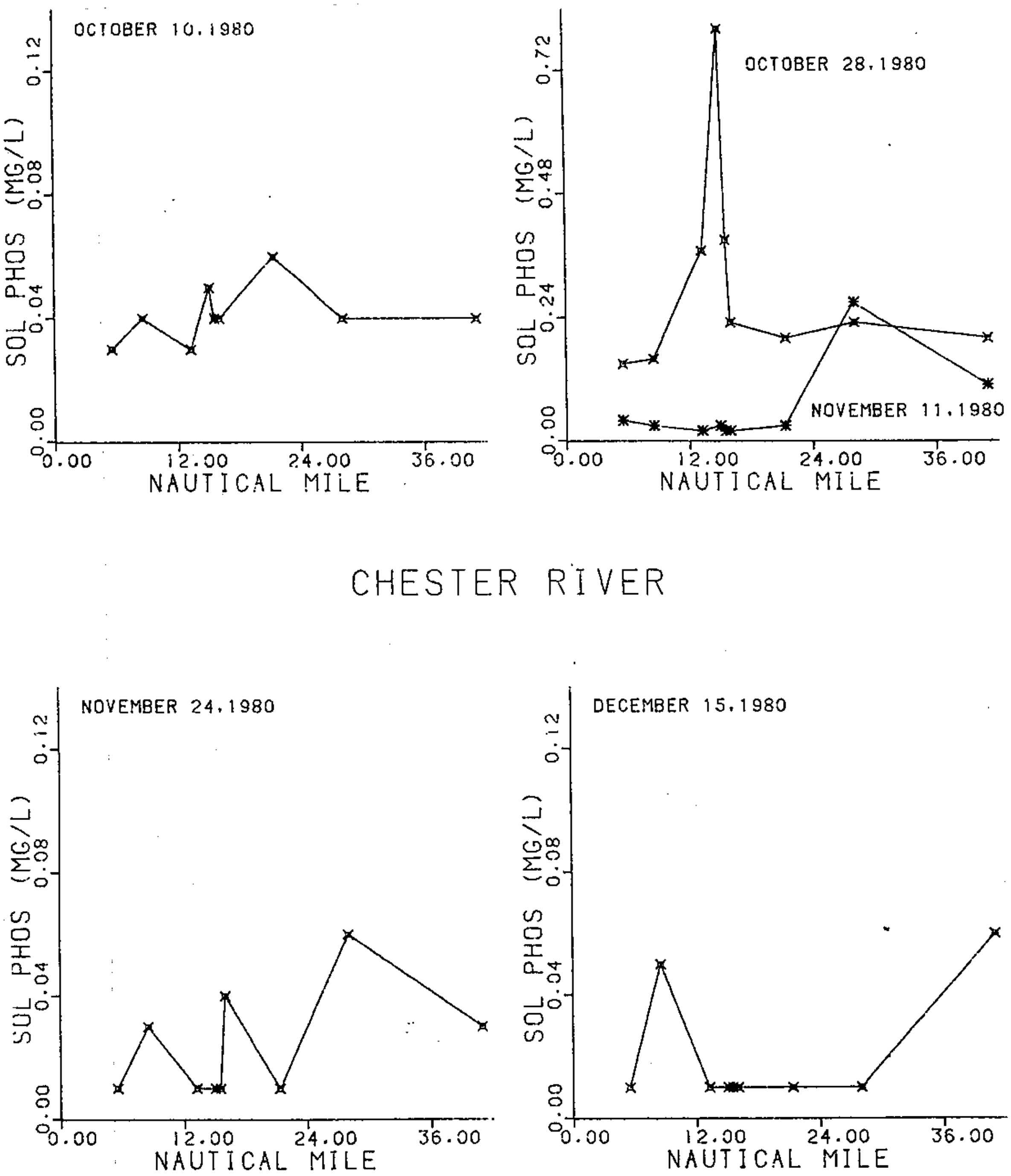

CHESTER RIVER

Figure 7-29 Longitudinal slack survey plots for Dissolved Phosphorus, (mg/l).

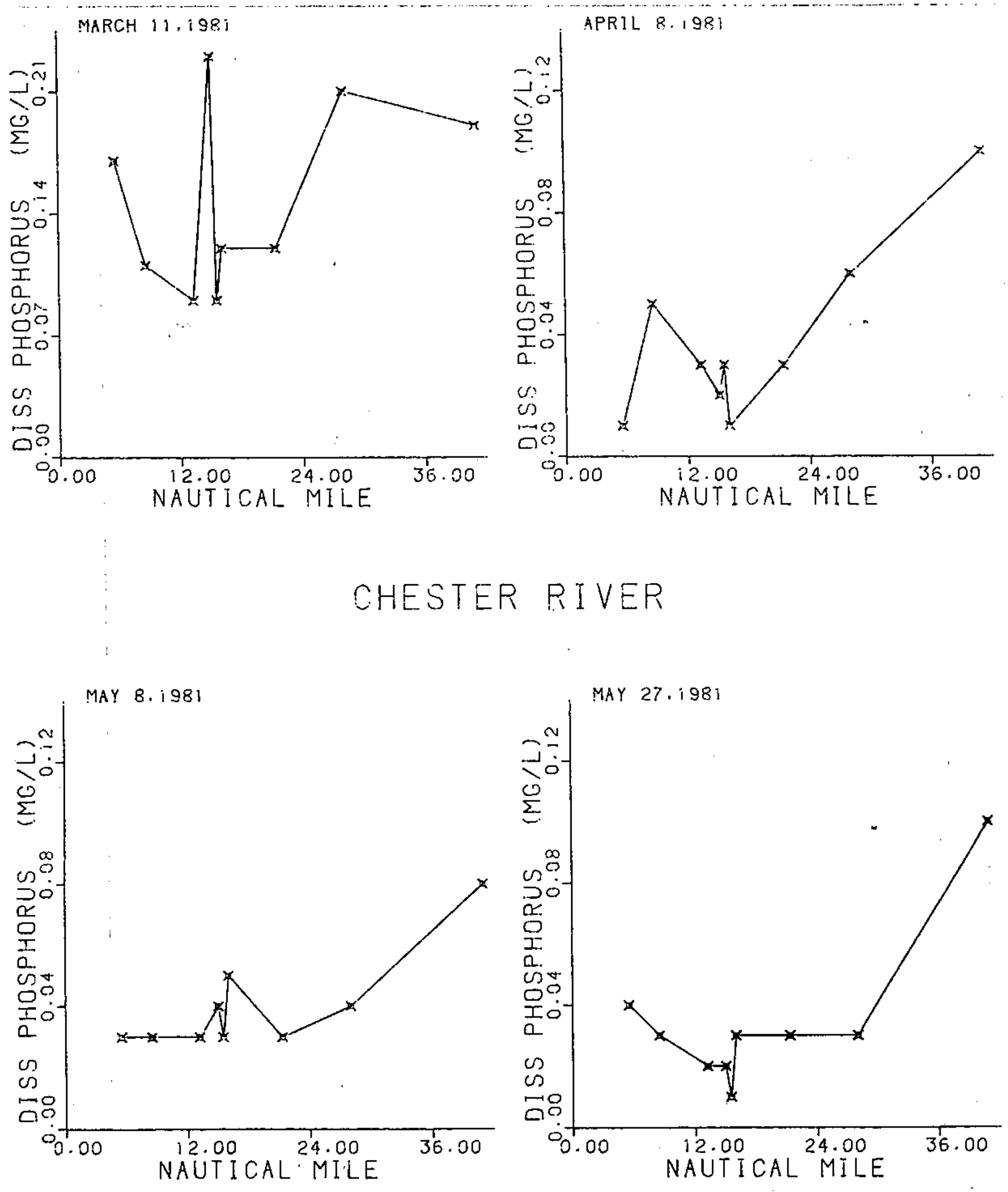


Figure 7-29 Longitudinal slack survey plots for Dissolved Phosphorus, (mg/l).

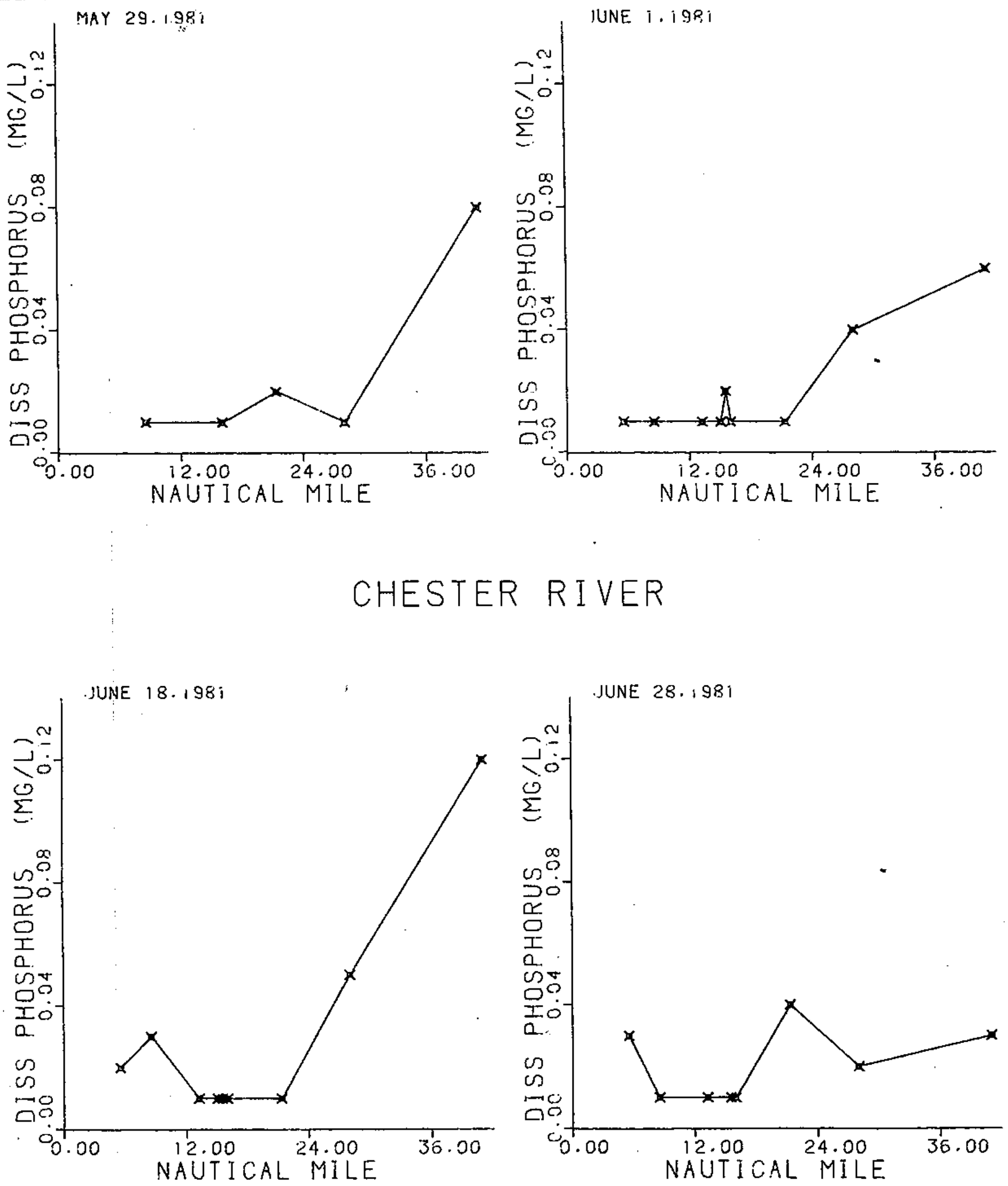


Figure 7-29 Longitudinal slack survey plots for Dissolved Phosphorus, (mg/l).

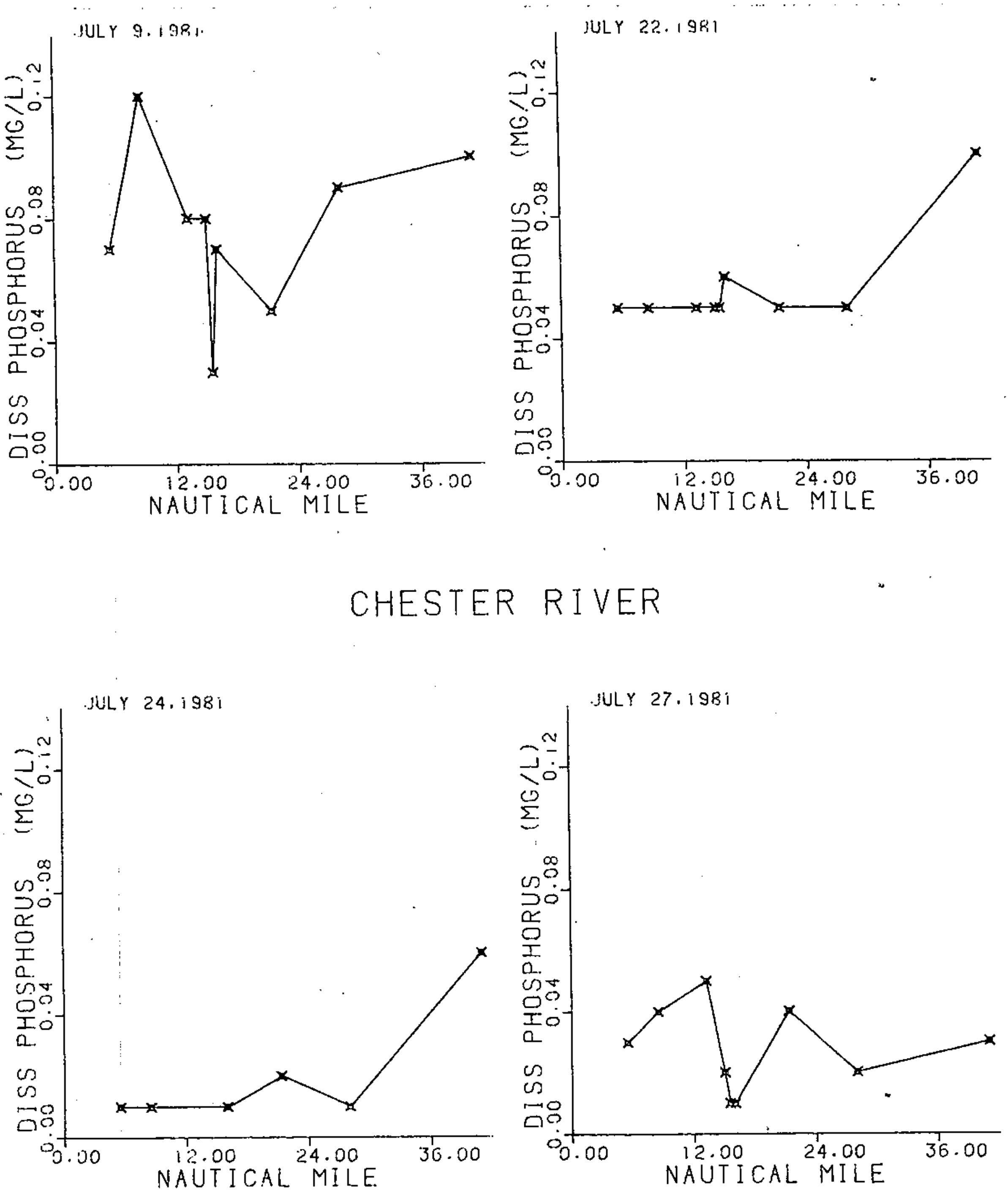


Figure 7-29 Longitudinal slack survey plots for Dissolved Phosphorus, (mg/l).

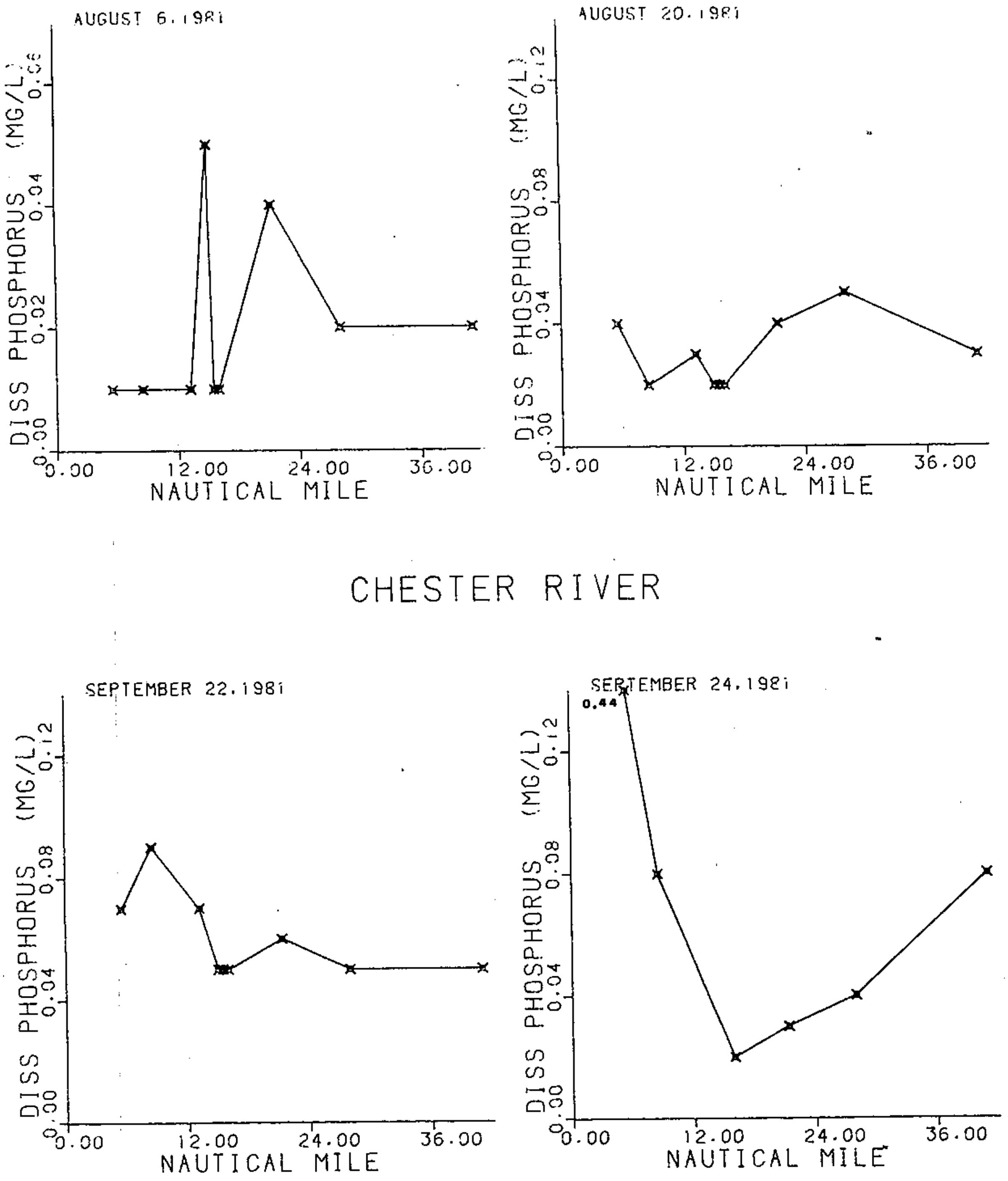


Figure 7-29 Longitudinal slack survey plots for Dissolved Phosphorus, (mg/l).

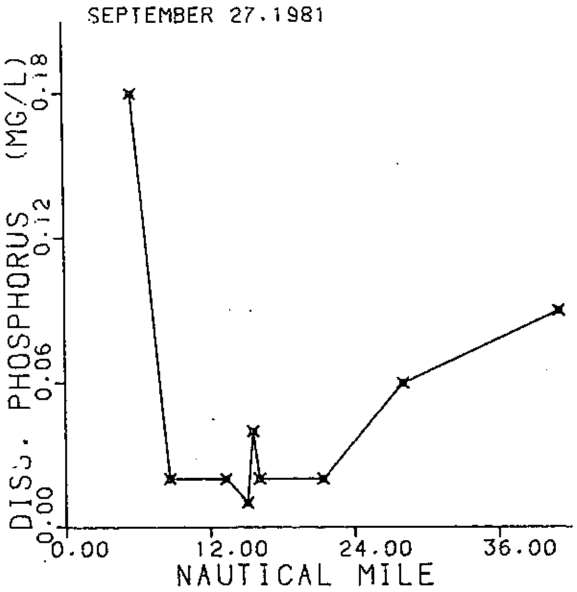


Figure 7-29 Longitudinal slack survey plots for Dissolved Phosphorus, (mg/l).

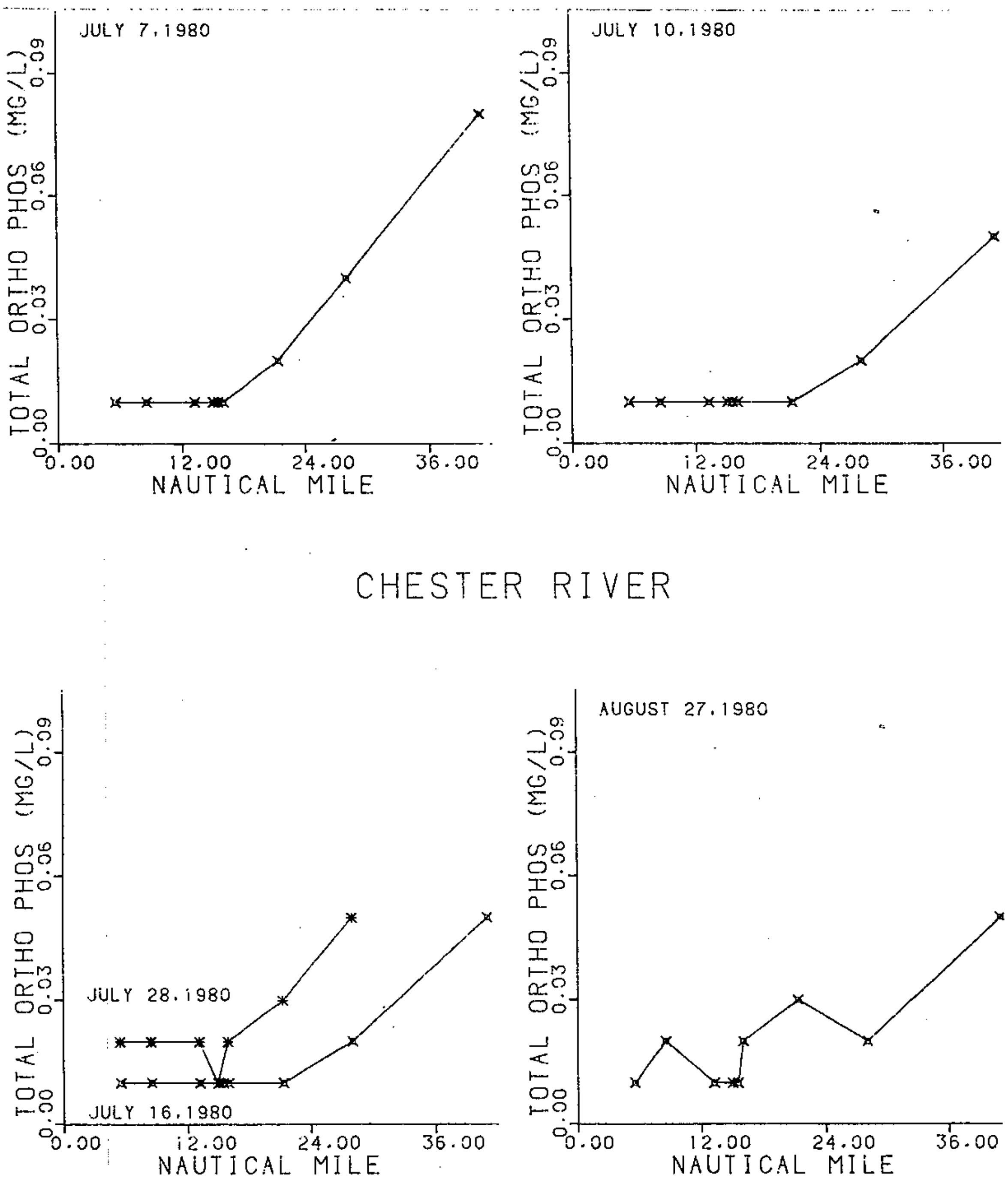
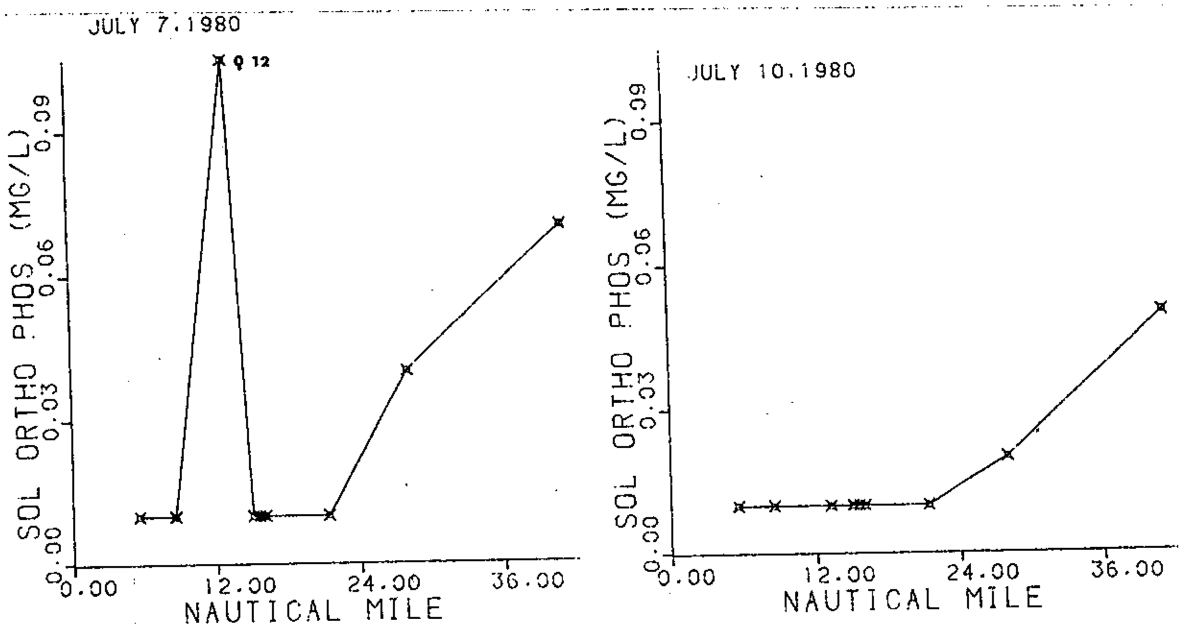


Figure 7-30 Longitudinal slack survey plots for total Ortho-phosphorus (mg/l).



CHESTER RIVER

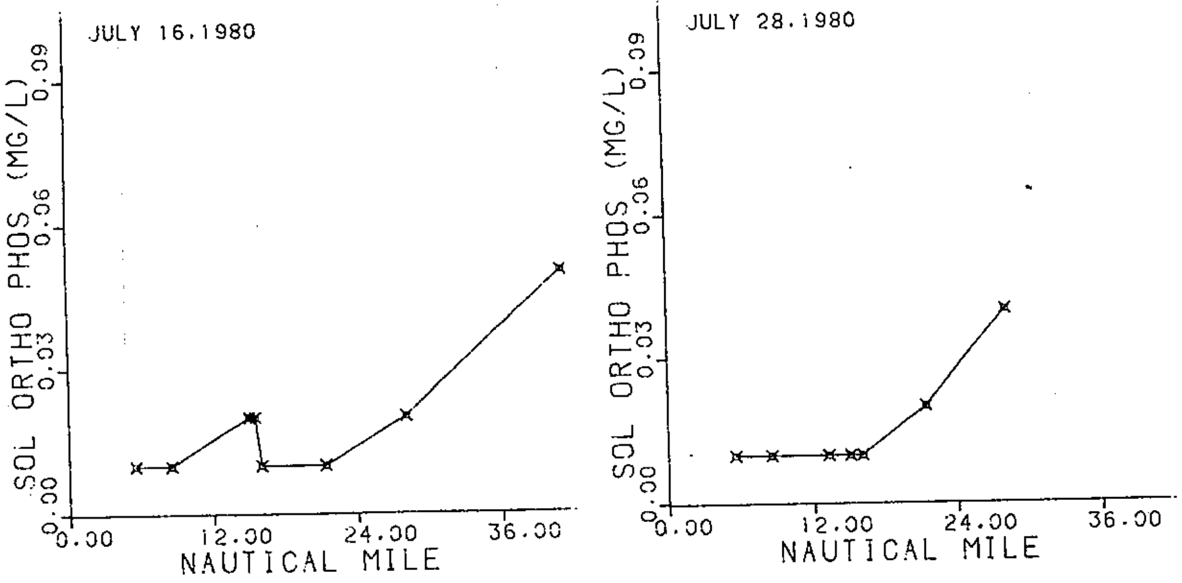


Figure 7-31 Longitudinal slack survey plots for Dissolved Ortho-phosphorus, (mg/l).

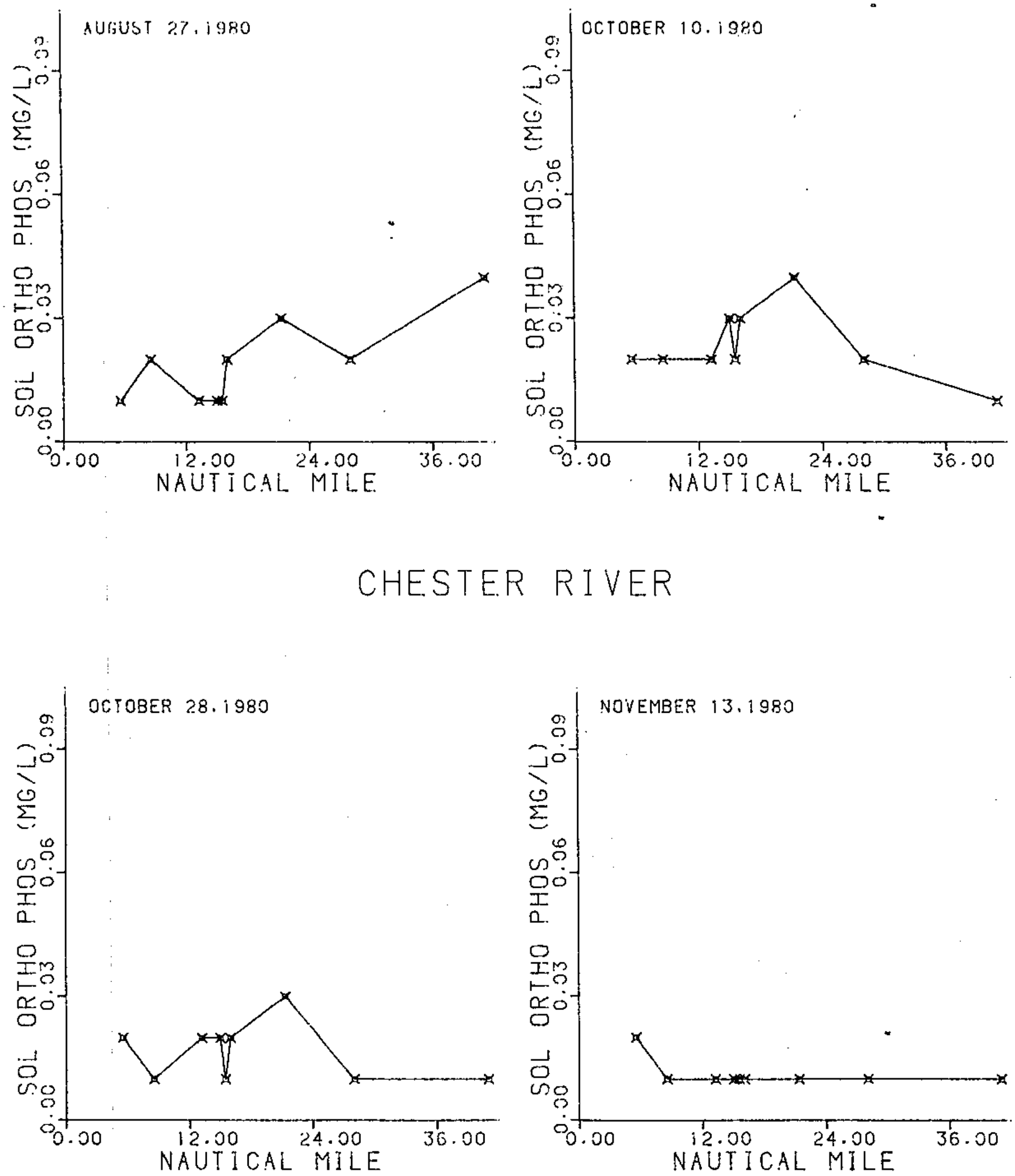
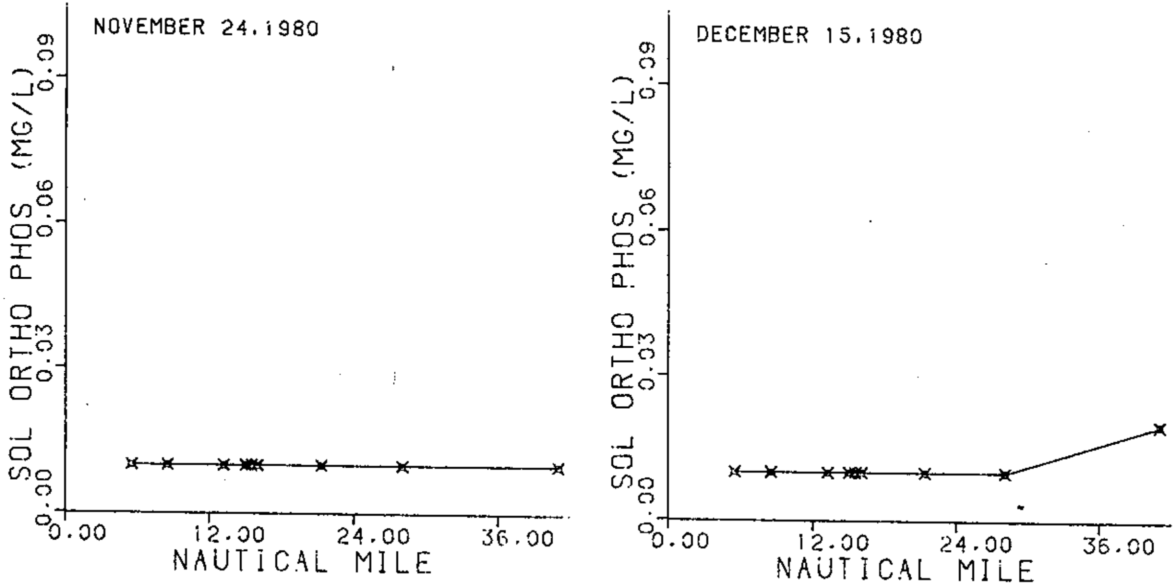
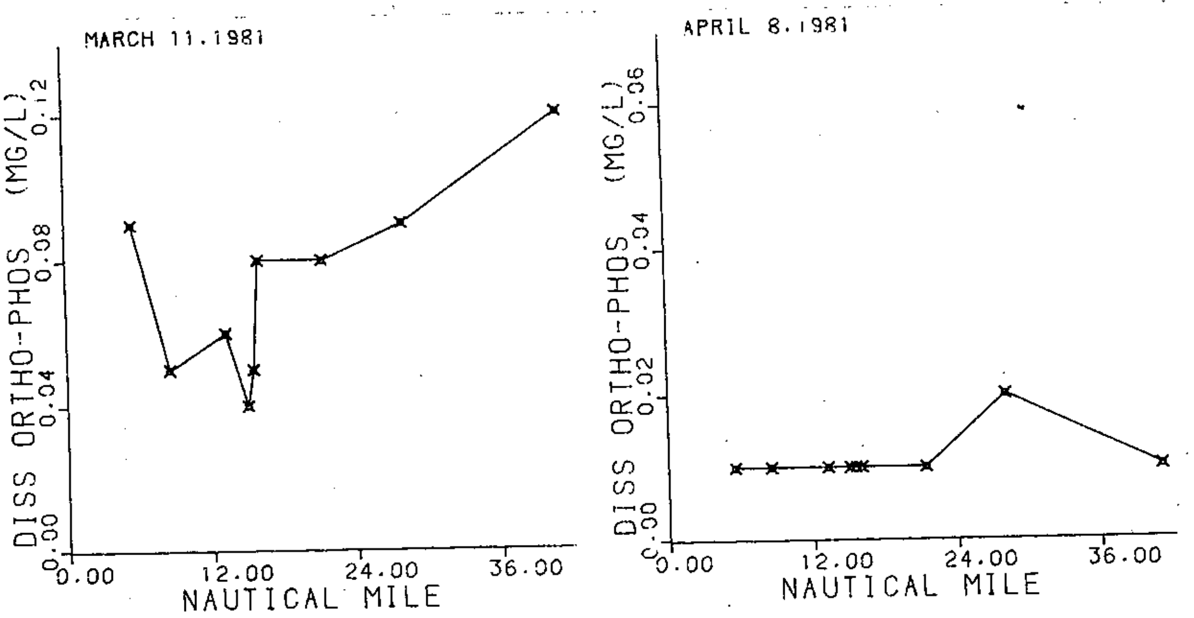


Figure 7-31 Longitudinal slack survey plots for Dissolved Ortho-phosphorus, (mg/l).



CHESTER RIVER

Figure 7-31 Longitudinal slack survey plots for dissolved Ortho-phosphorus, (mg/l).



CHESTER RIVER

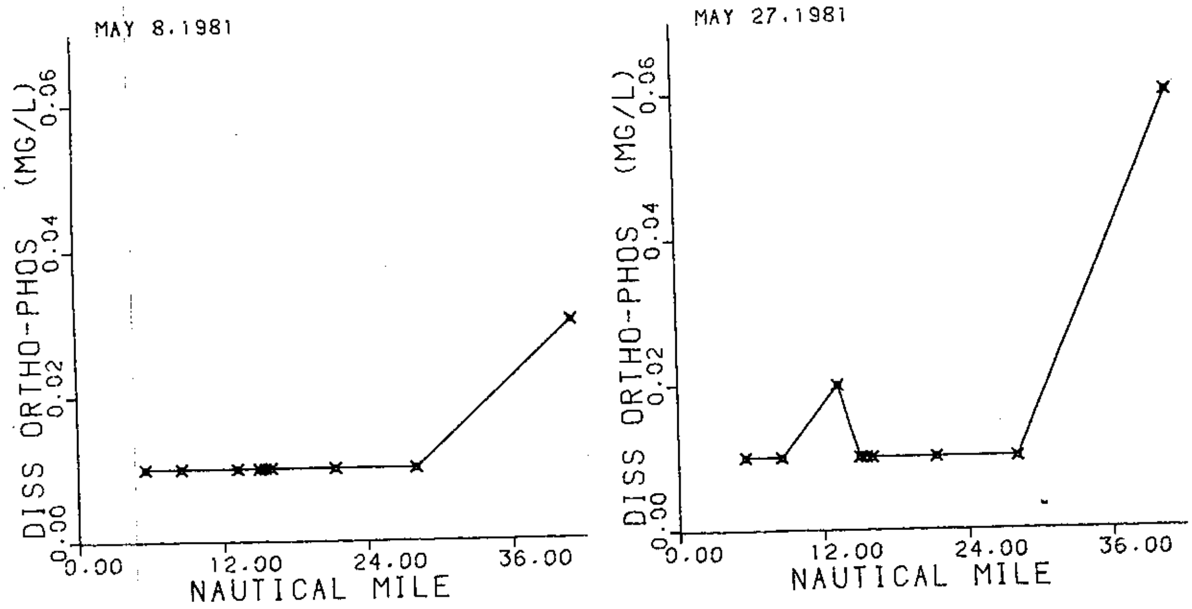


Figure 7-31 Longitudinal slack survey plots for Dissolved Ortho-Phosphorus, (mg/l).

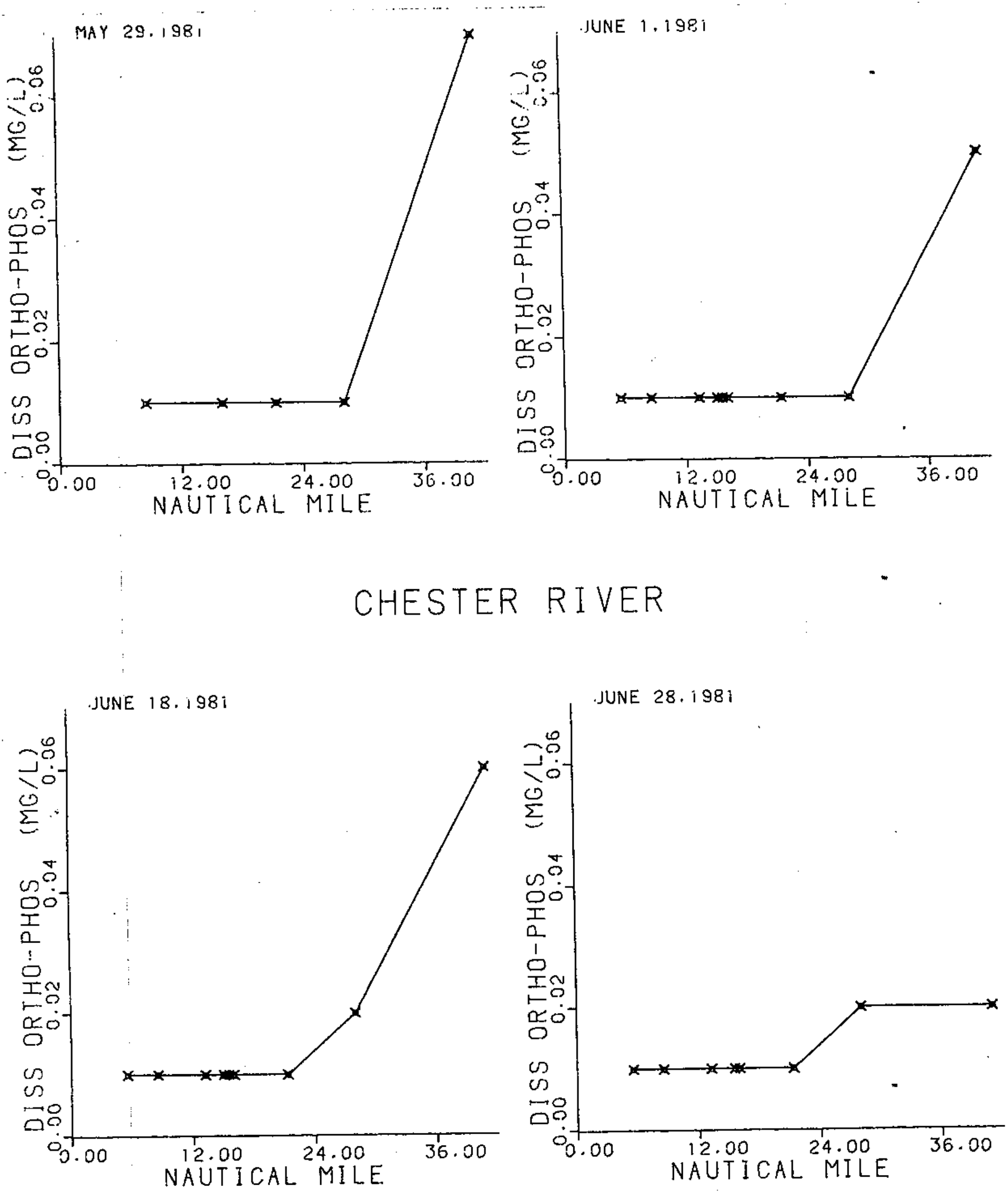


Figure 7-31 Longutidinal slack survey plots for Dissolved Ortho-Phosphorus, (mg/l).

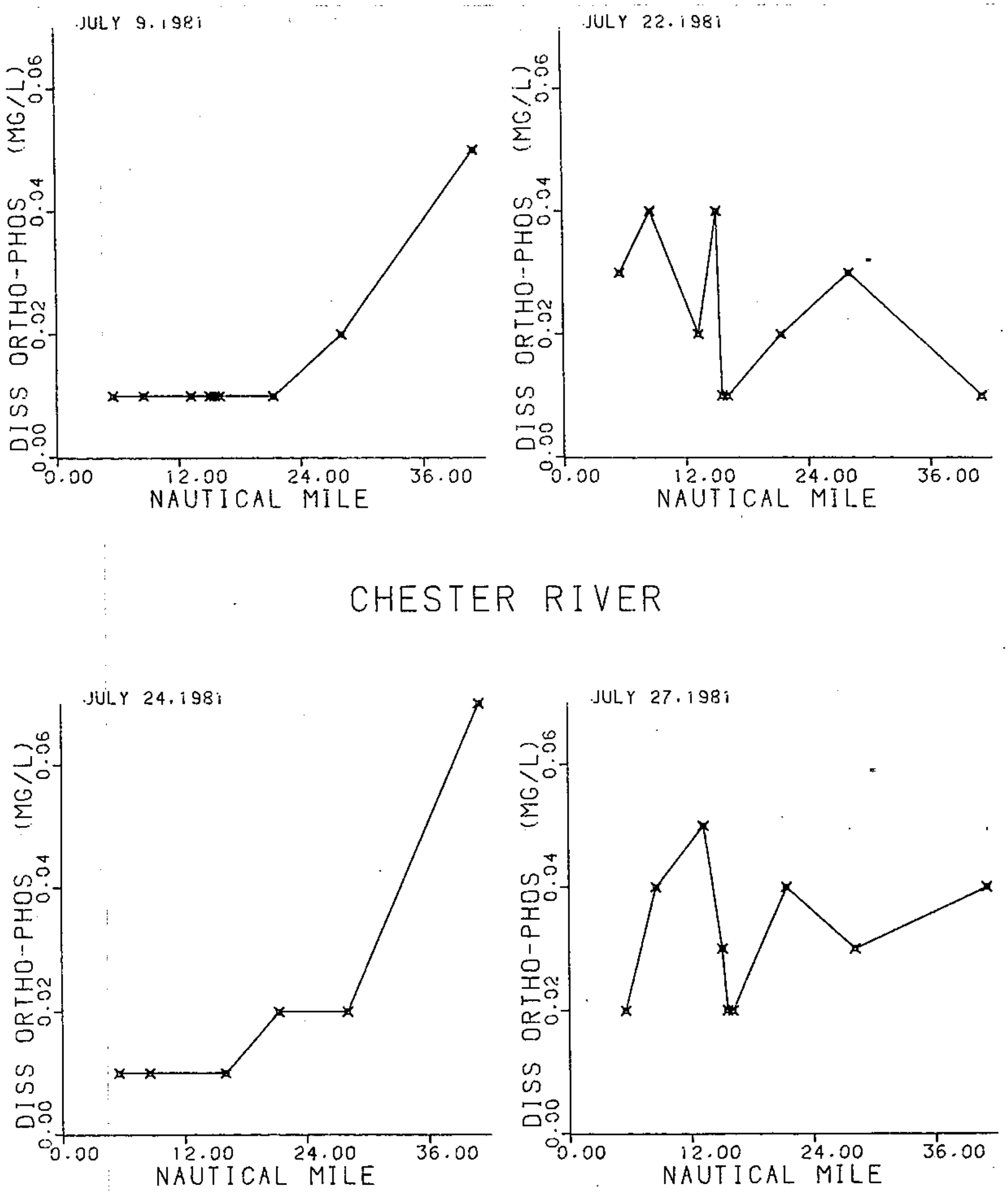


Figure 7-31 Longitudinal slack survey plots for Dissolved Ortho-Phosphorus, (mg/l).

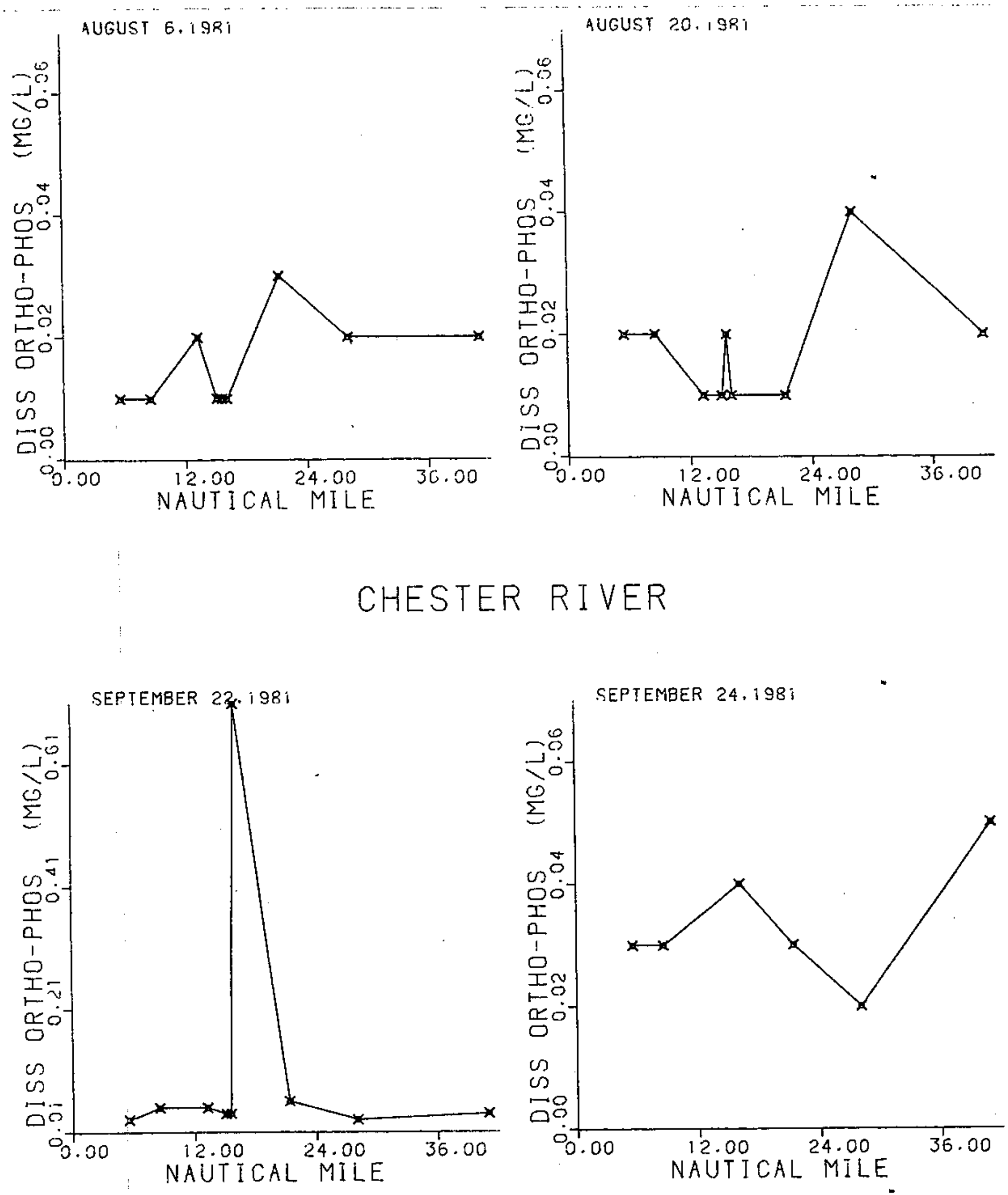


Figure 7-31 Longitudinal slack survey plots for Dissolved Ortho-Phosphorus, (mg/l).

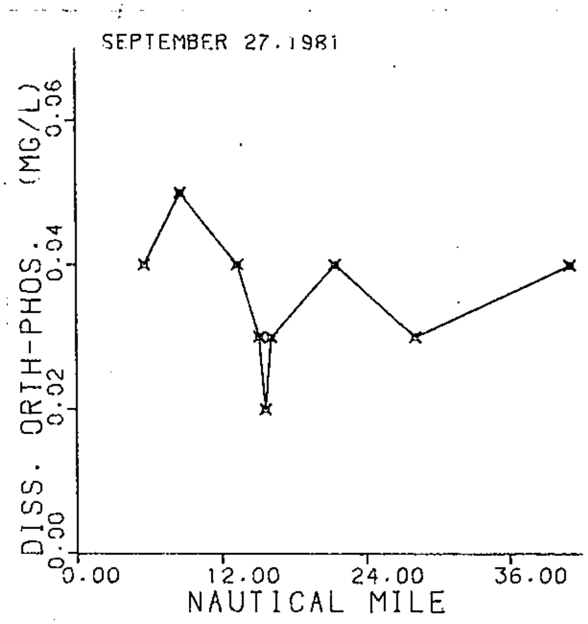


Figure 7-31 Longitudinal slack survey plots for Dissolved Ortho-phosphorus, (mg/l).

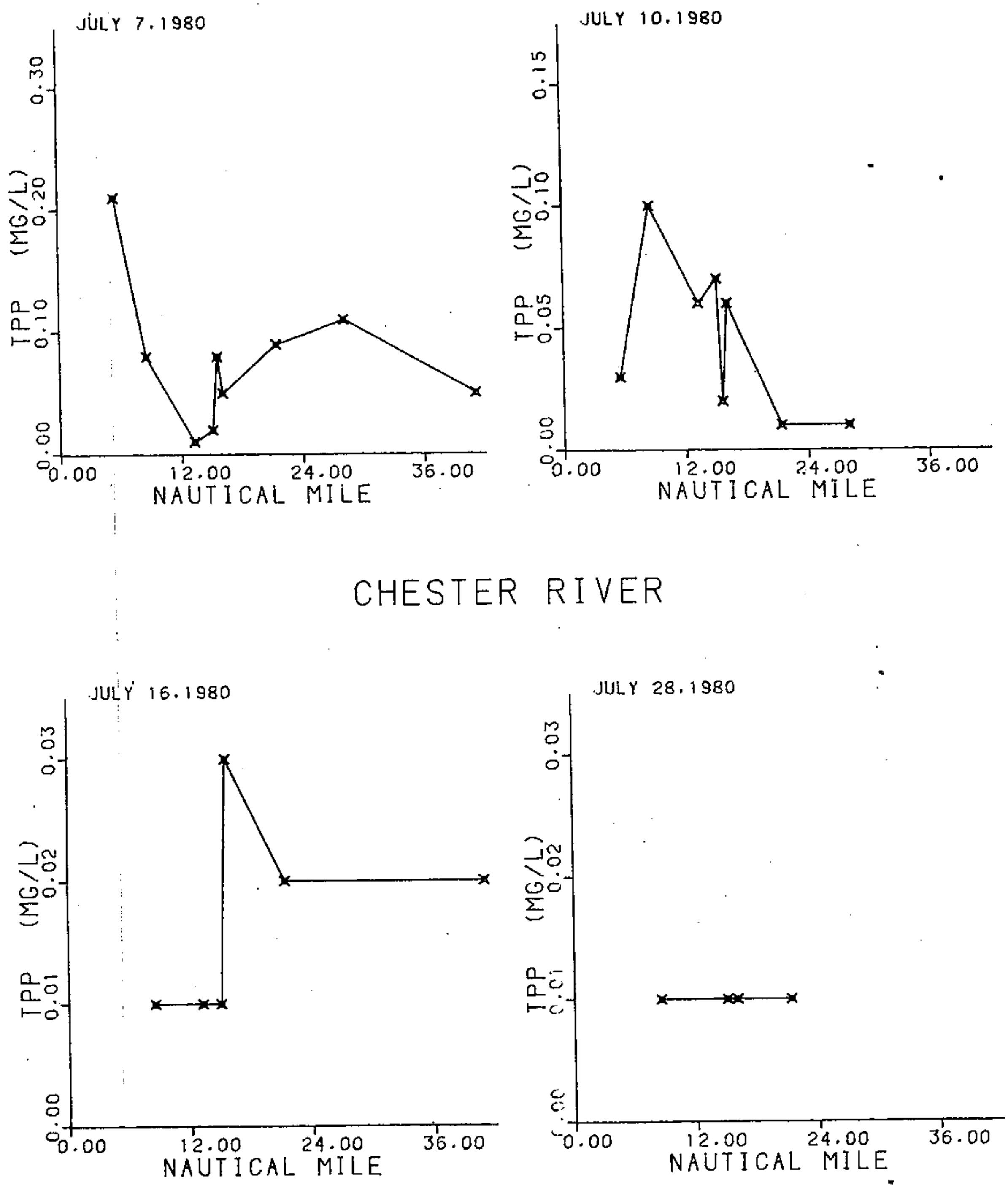

CHESTER RIVER

Figure 7-32 Longutidinal slack survey plots for Total Particulate Phosphorus, (mg/l).

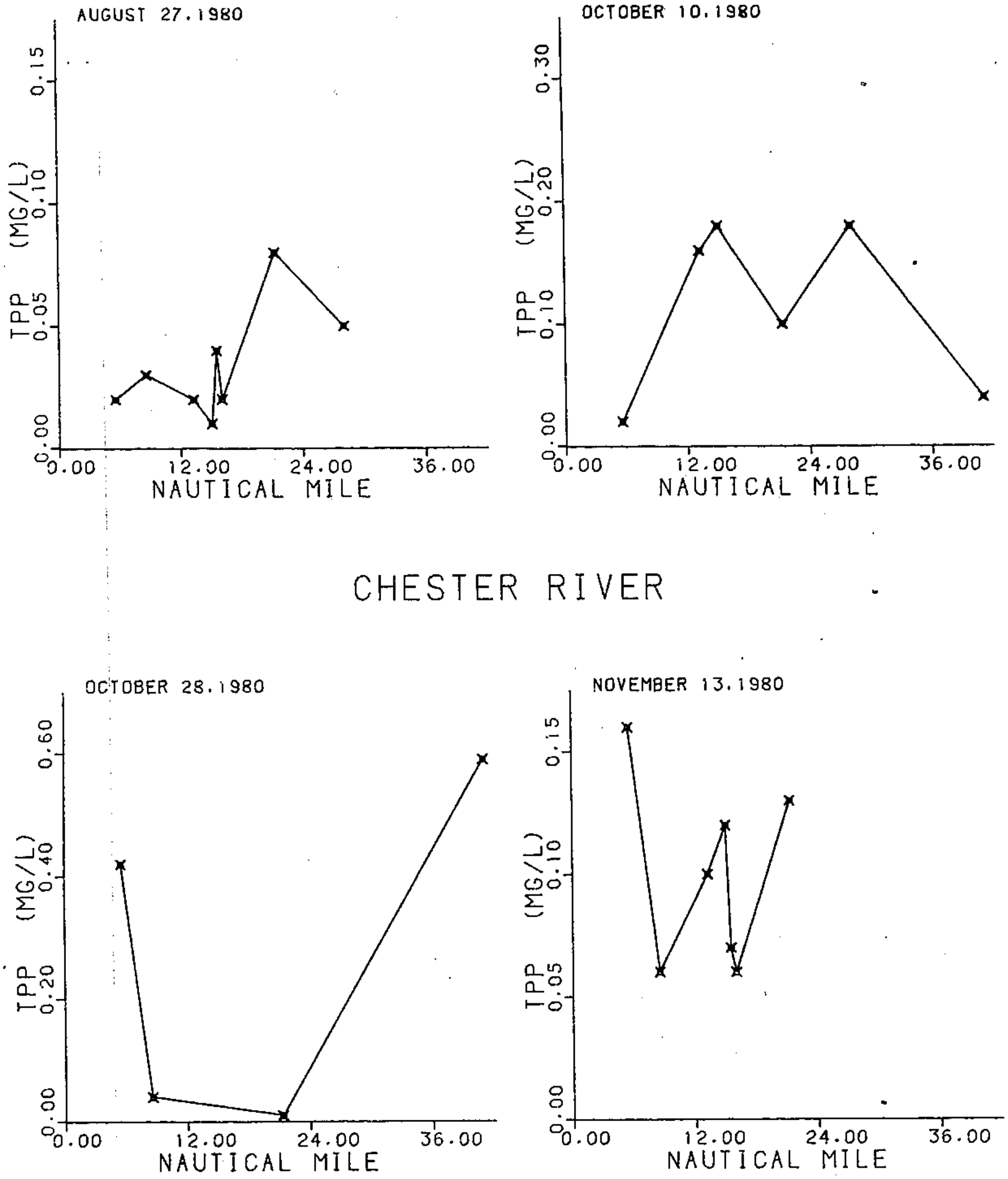


Figure 7-32 Longitudinal slack survey plots for Total Particulate Phosphorus, (mg/l).

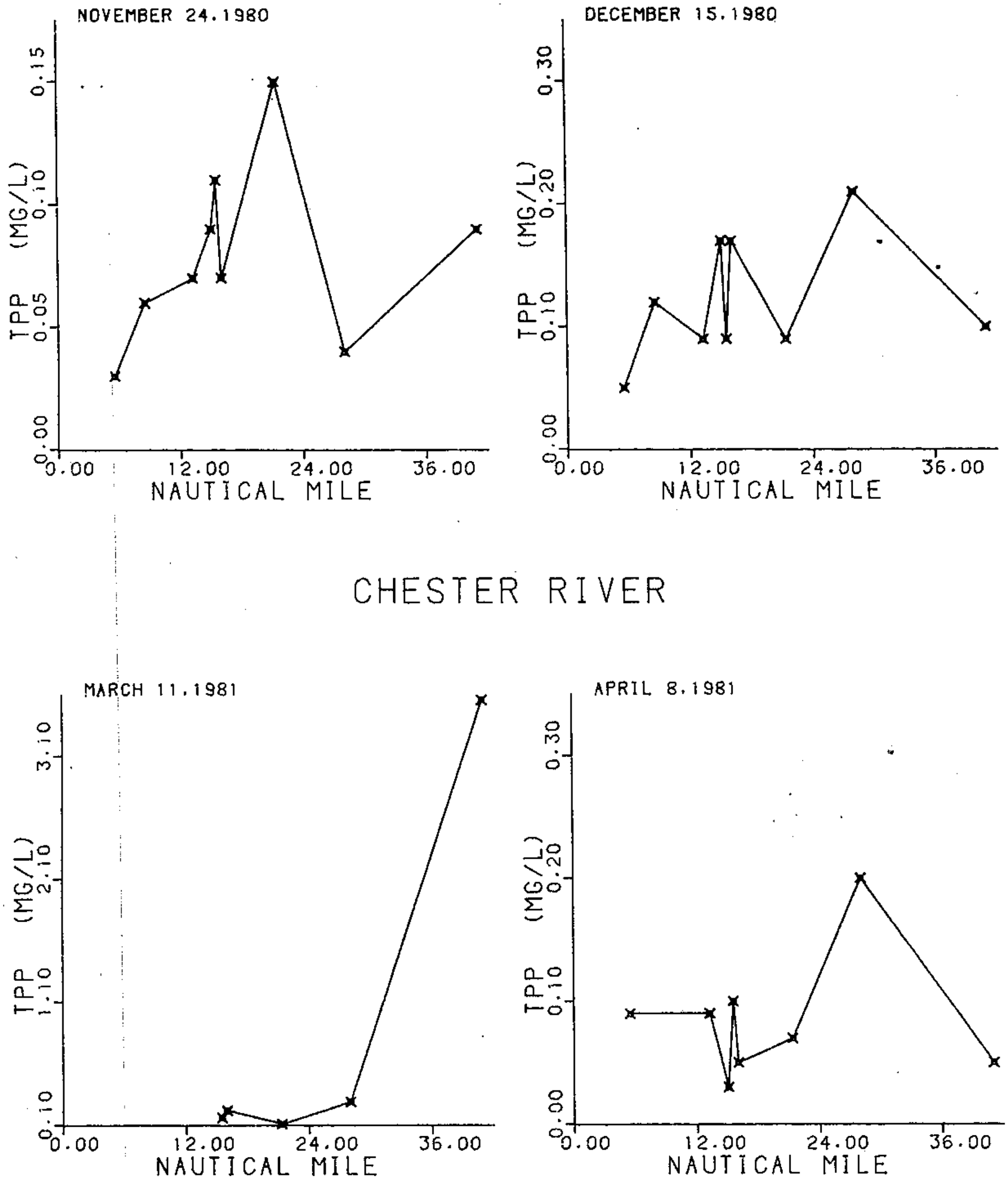


Figure 7-32 Longitudinal slack survey plots for Total Particulate Phosphorus, (mg/l).

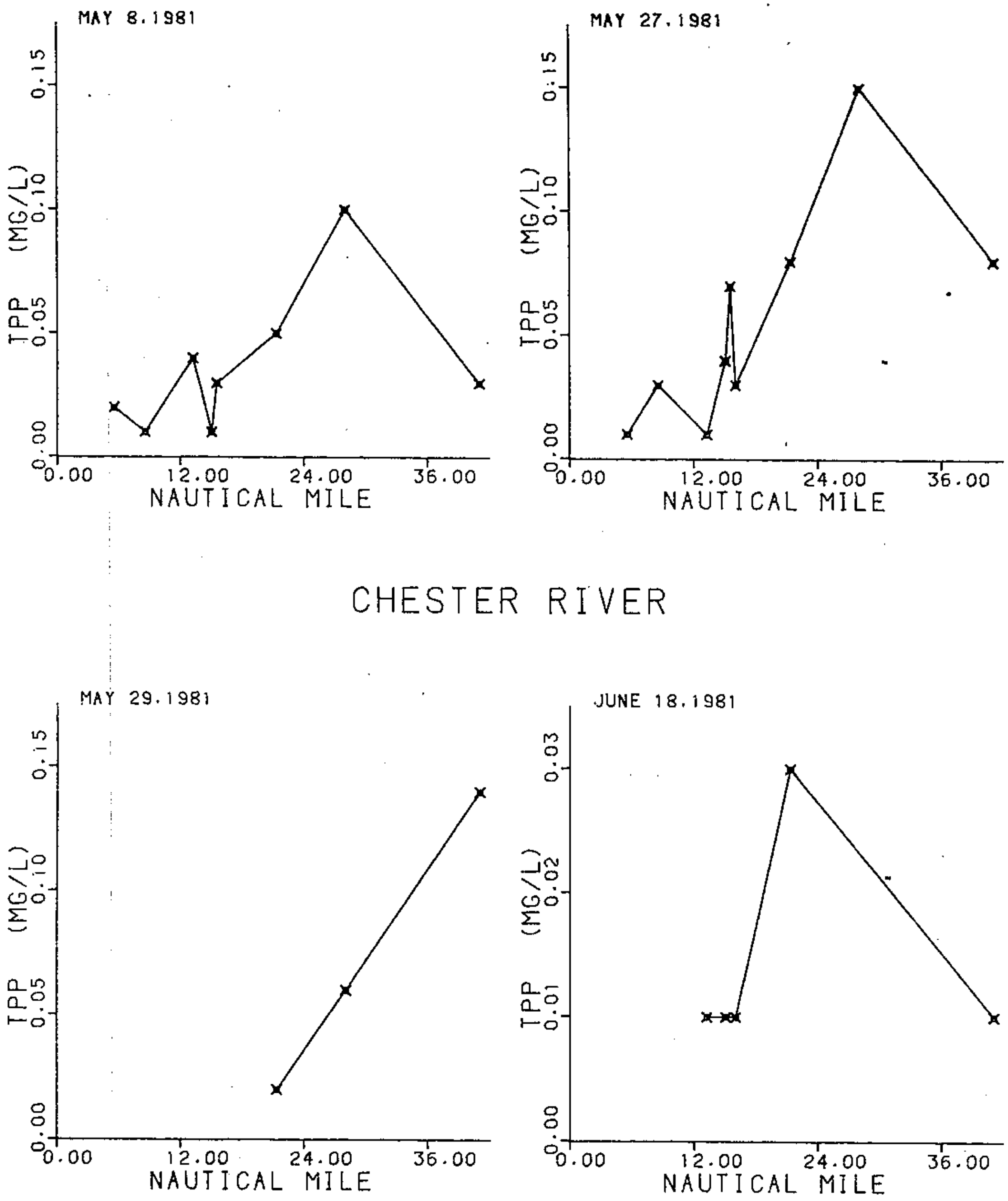


Figure 7-32 Longitudinal slack survey plots for Total Particulate Phosphorus, (mg/l).

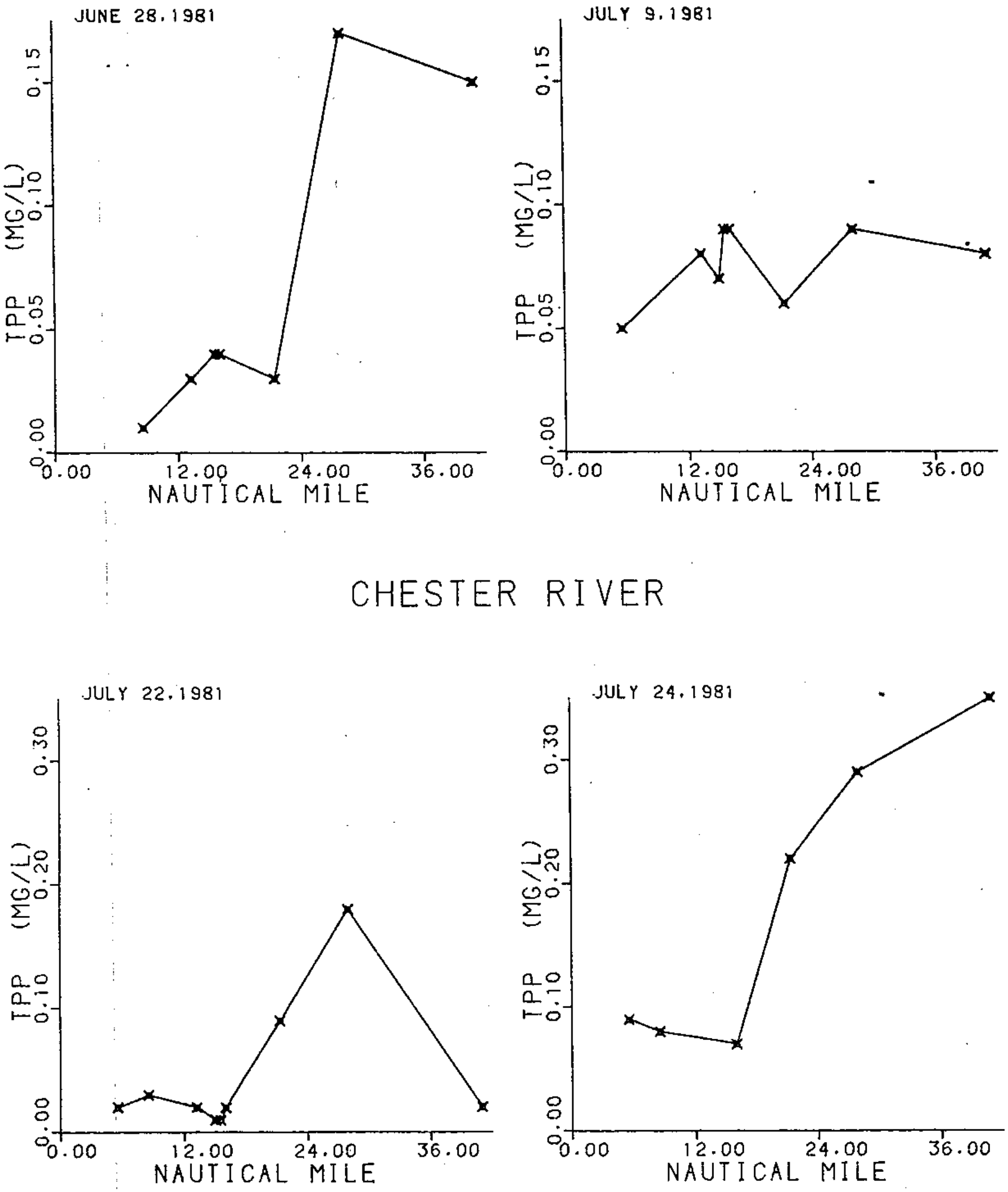


Figure 7-32 Longitudinal slack survey plots for Total Particulate Phosphorus, (mg/l).

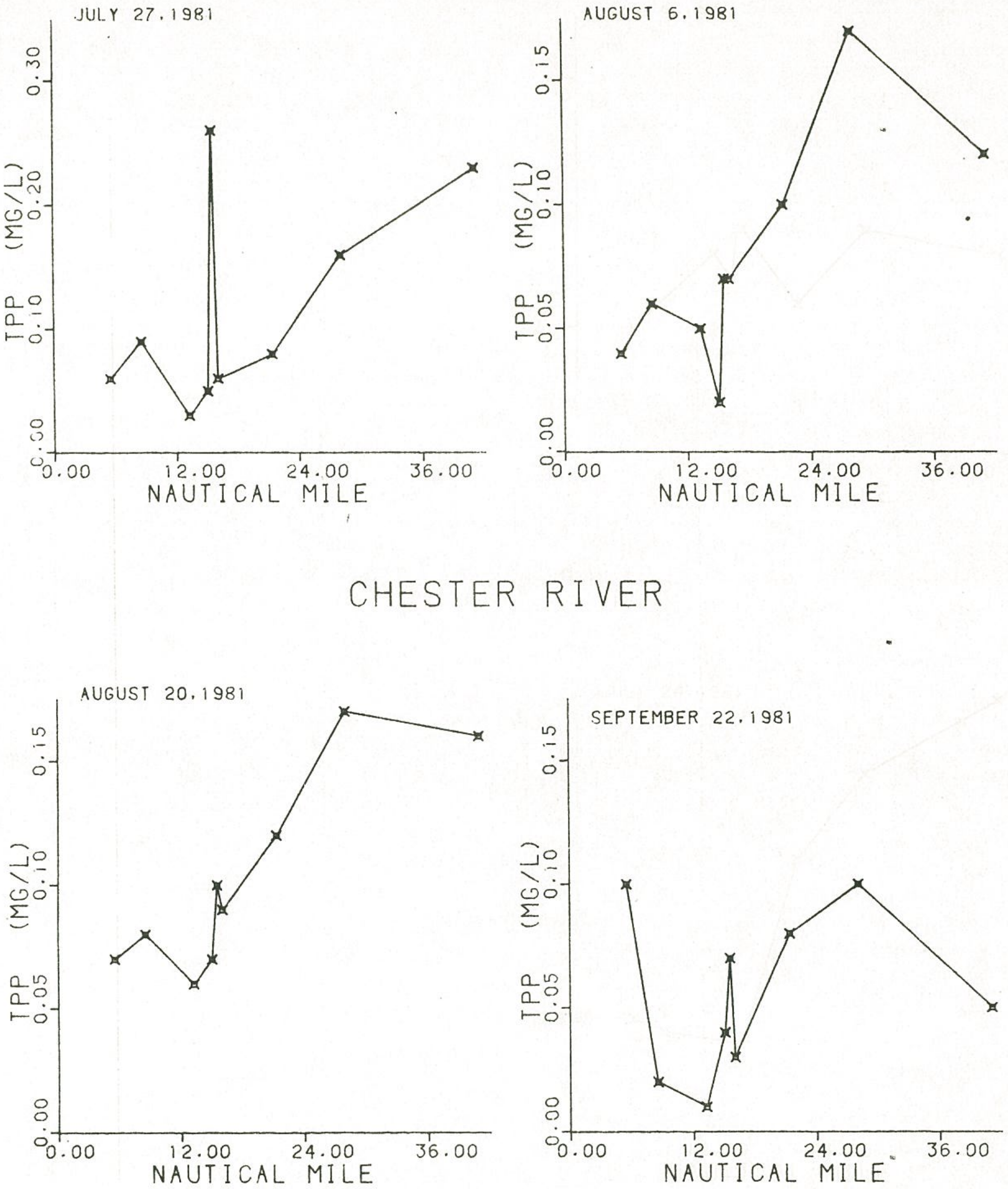
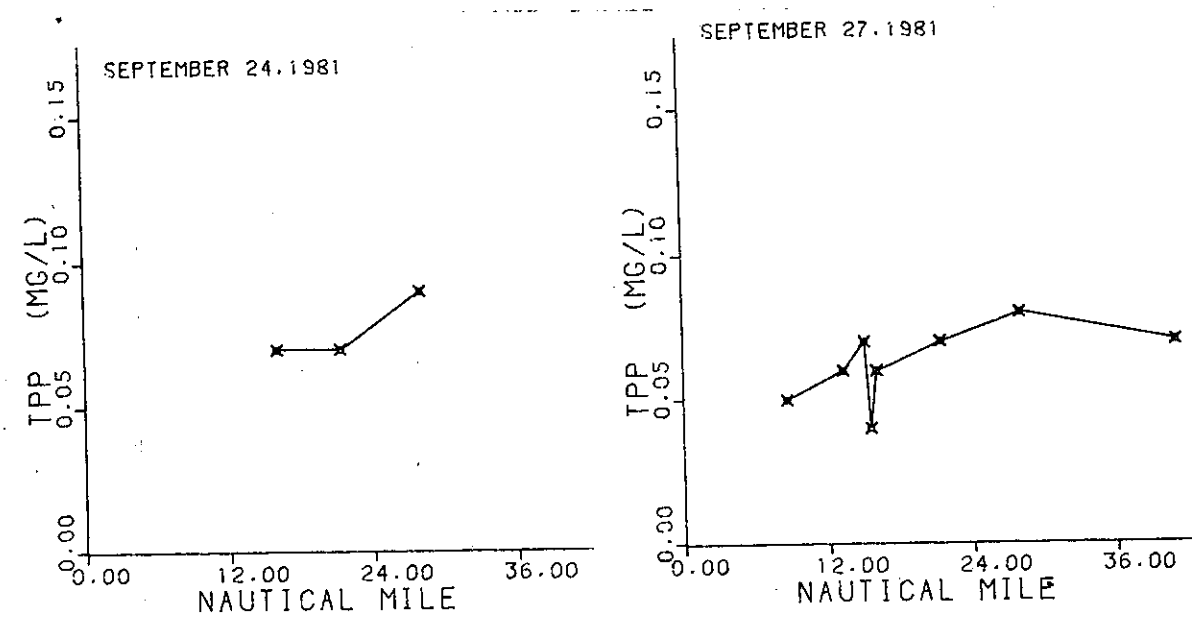


Figure 7-32 Longutudinal slack survey plots for Total Particulate Phosphorus, (mg/l).



CHESTER RIVER

Figure 7-32 Longitudinal slack survey plots for Total Particulate Phosphorus, (mg/l).

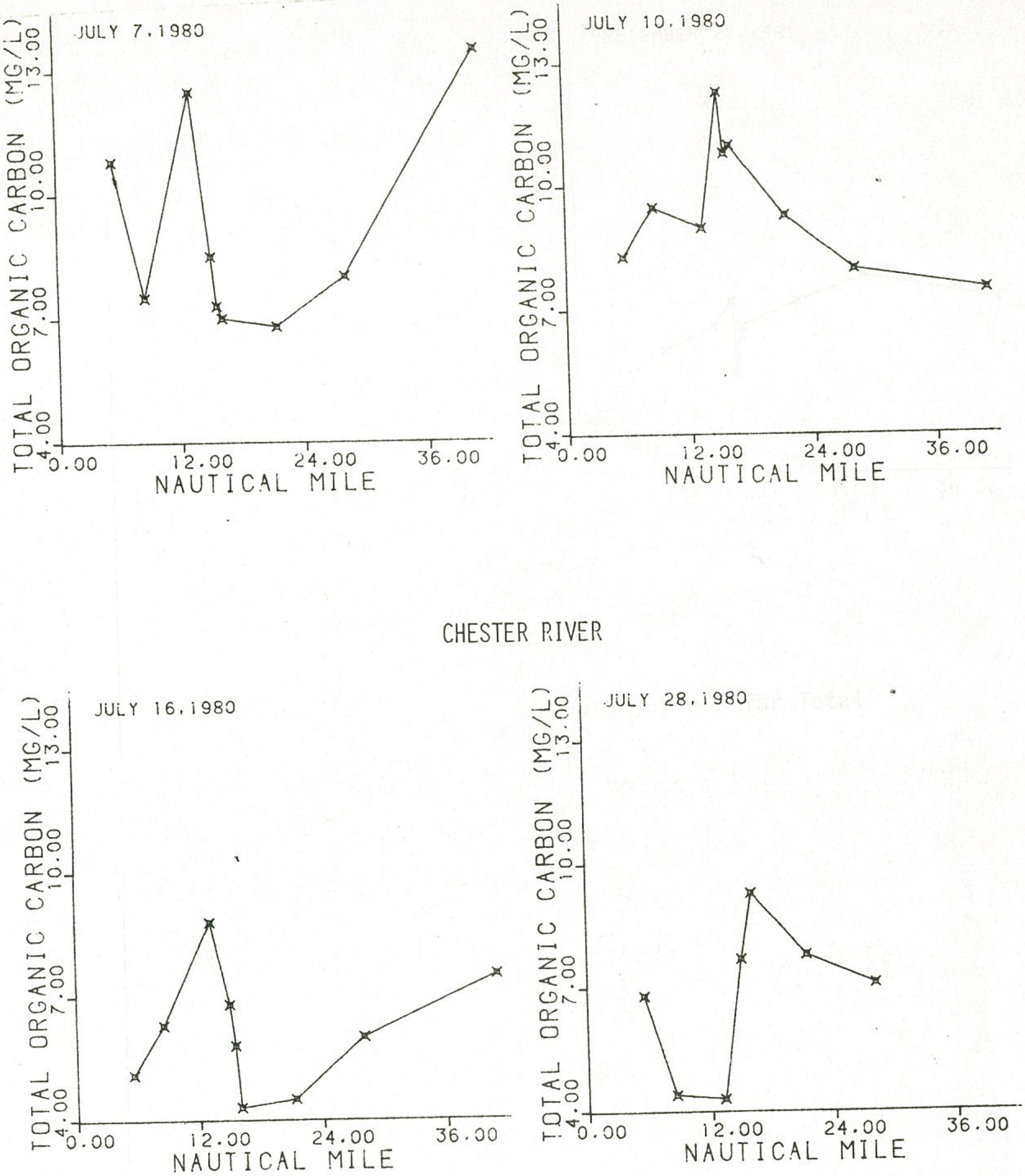


Figure 7-33 Longitudinal slack survey plots for Total Organic Carbon (mg/l).

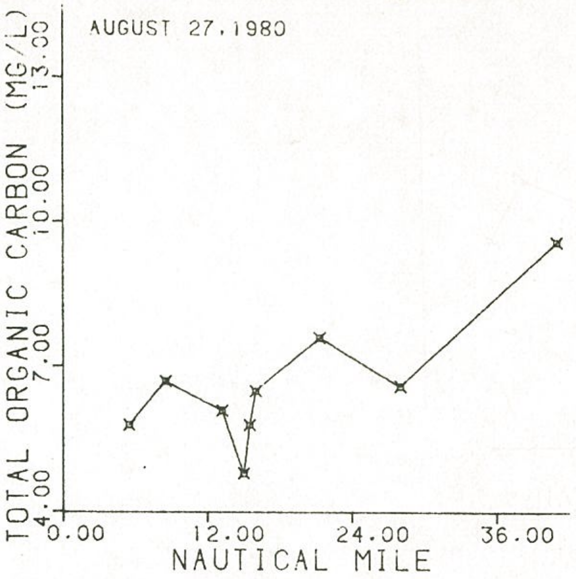
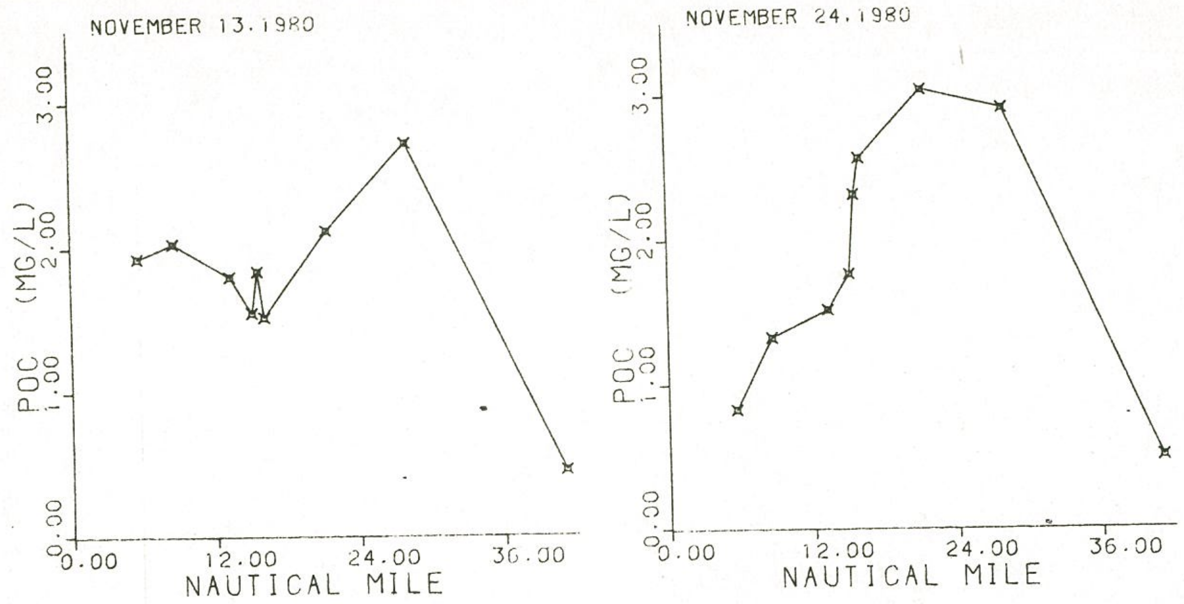


Figure 7-33 Longitudinal slack survey plots for Total Organic Carbon (mg/l).



CHESTER RIVER

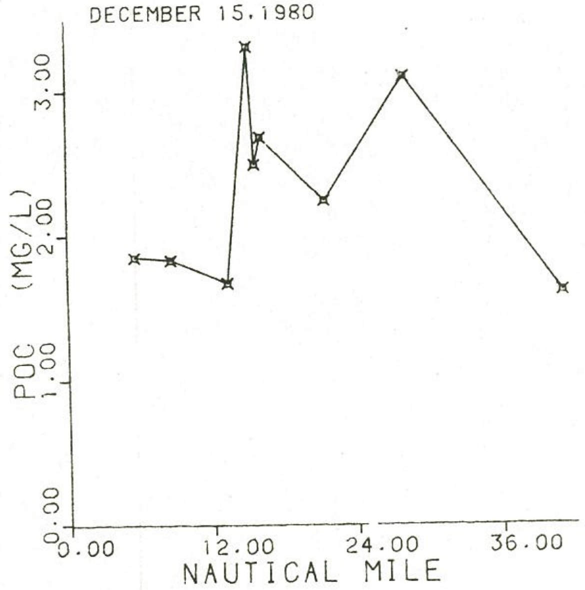


Figure 7-34 Longitudinal slack sruvey plots for Particulate Organic Carbon, (mg/l).

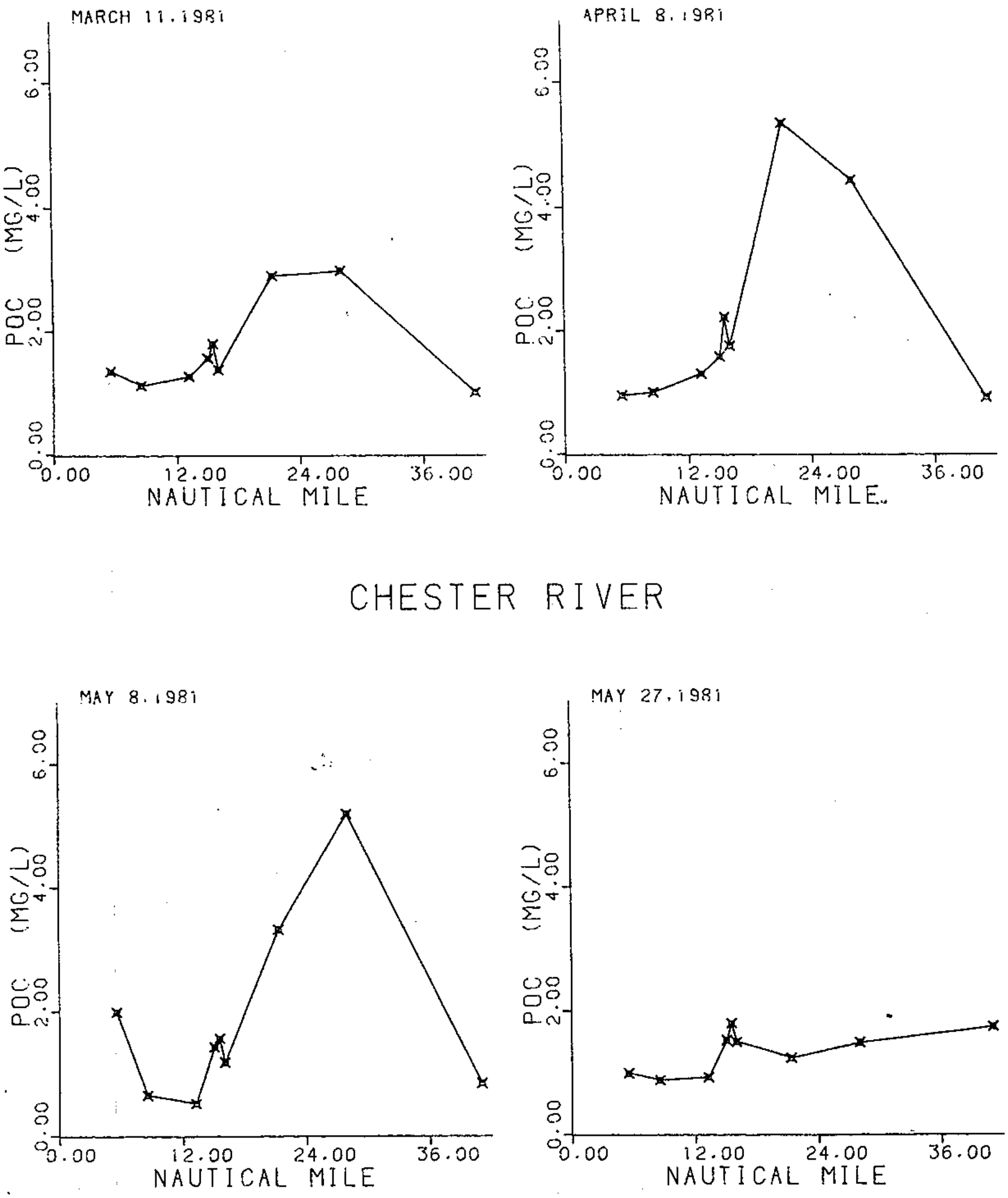


Figure 7-34 Longitudinal slack survey plots for Particulate Organic Carbon, (mg/l).

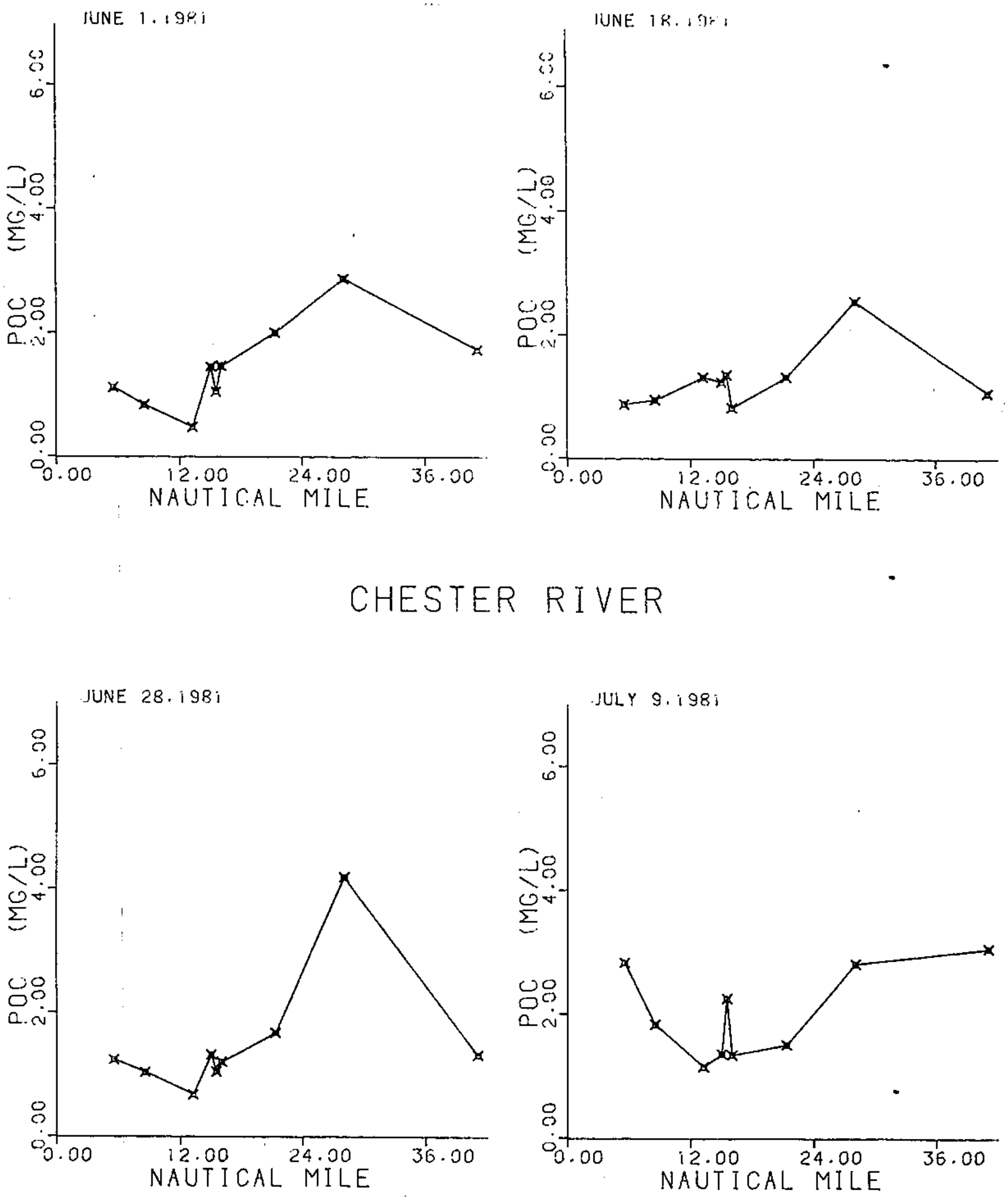


Figure 7-34 Longitudinal slack survey plots for Particulate Organic Carbon, (mg/l).

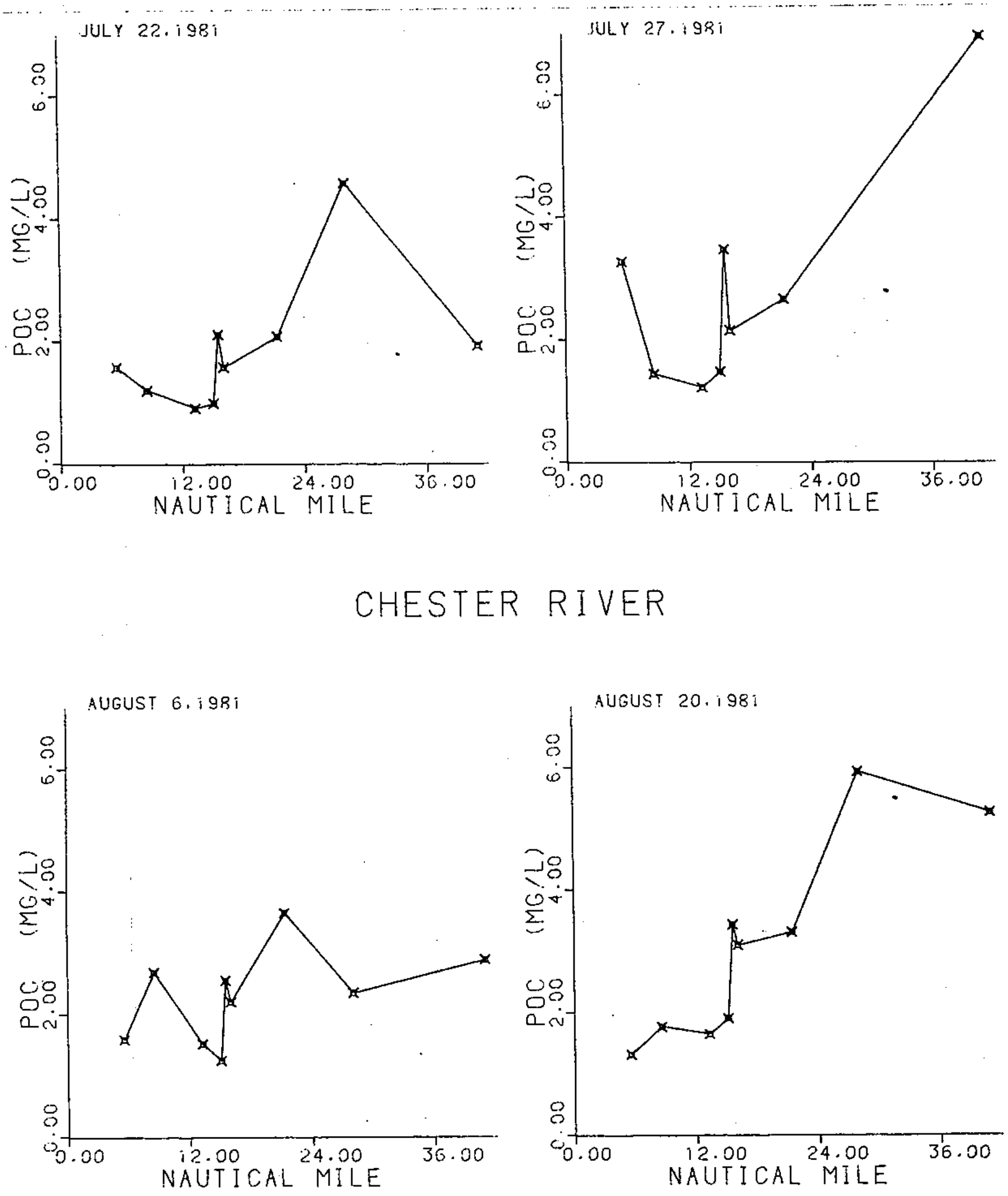
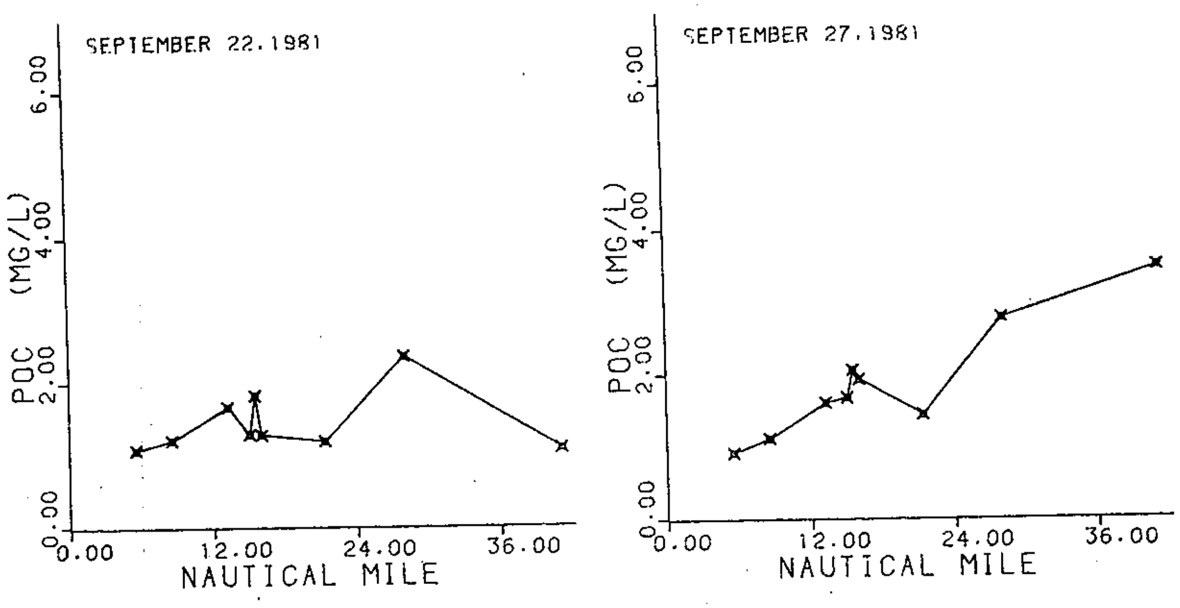


Figure 7-34 Longitudinal slack survey plots for Particulate Organic Carbon, (mg/l).



CHESTER RIVER

Figure 7-34 Longitudinal slack survey plots for Particulate Organic Carbon, (mg/l).

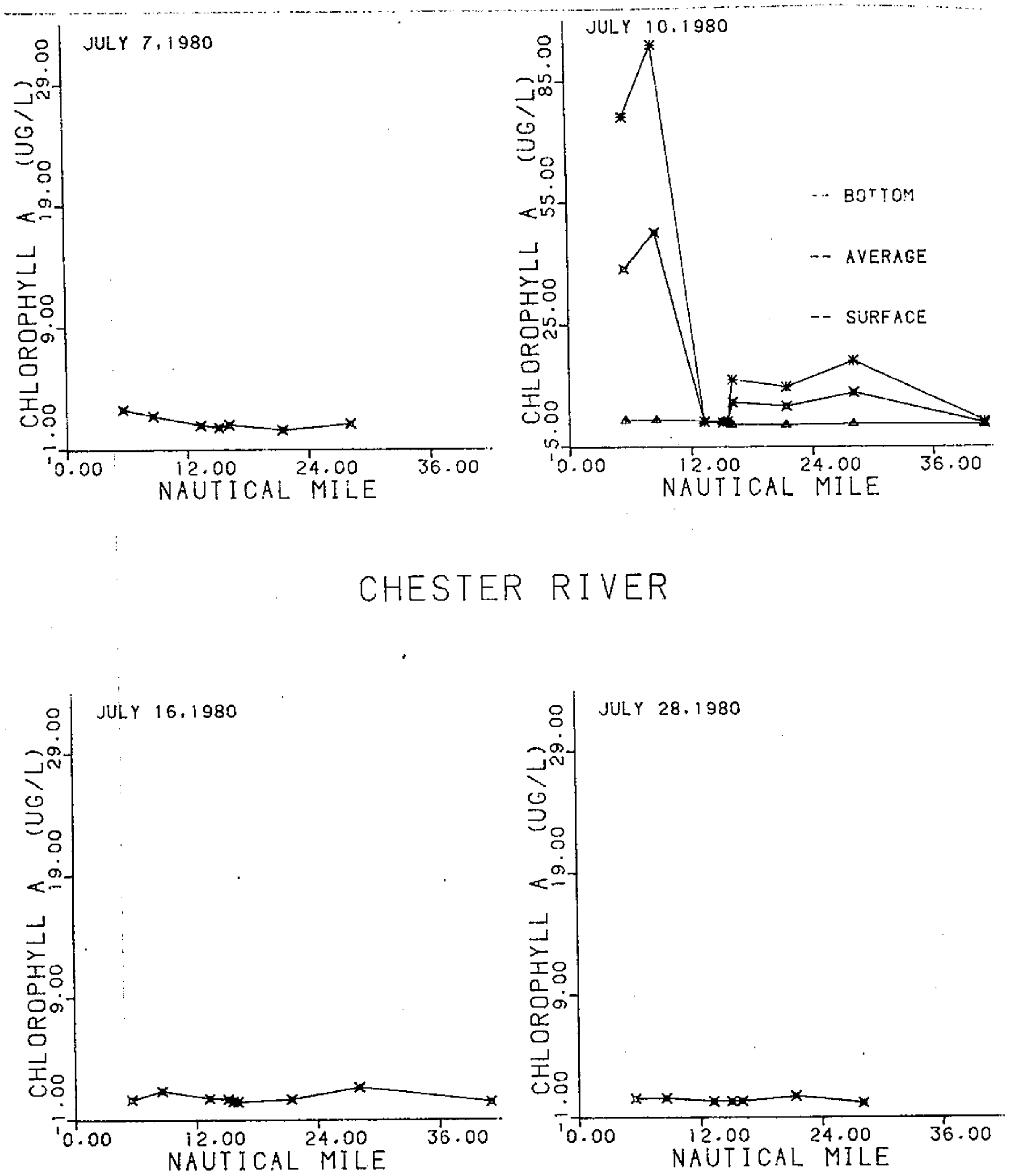


Figure 7-35 Longitudinal slack survey plots for Chlorophyll A (mg/l).

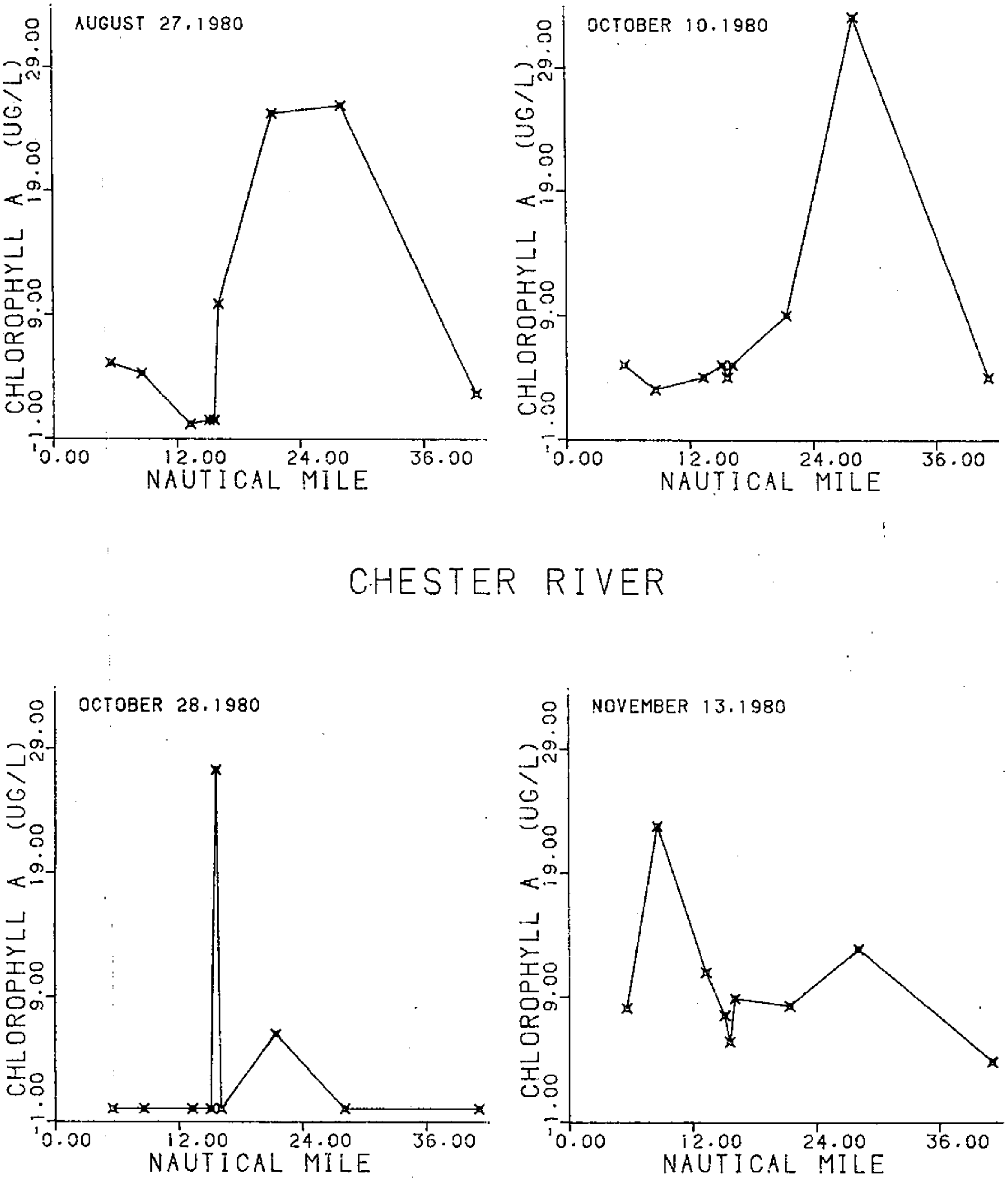
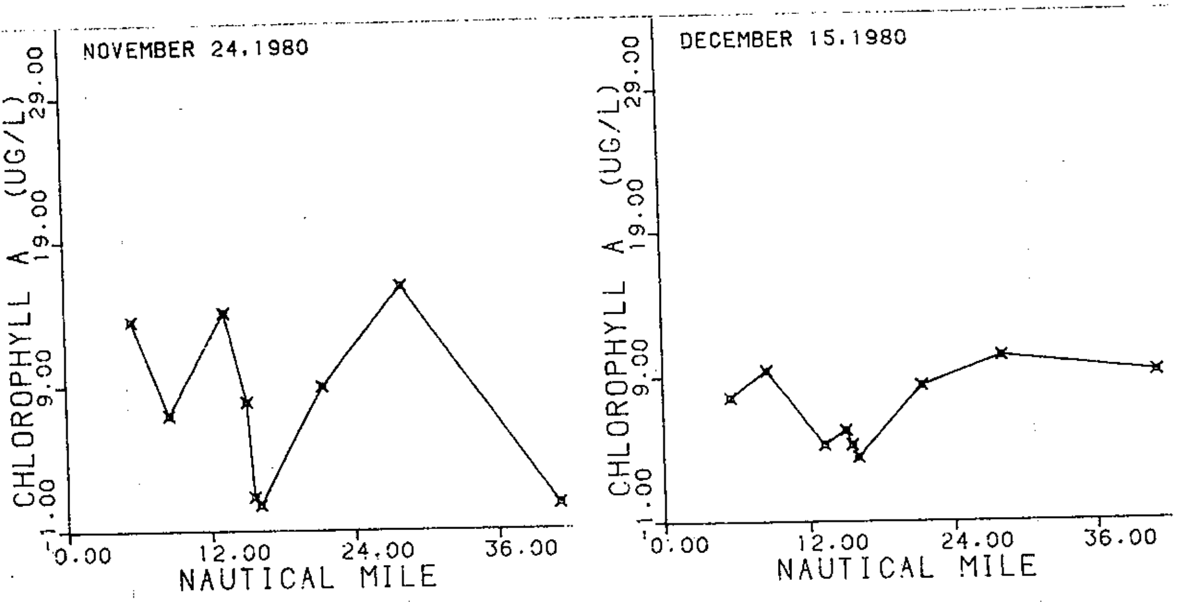


Figure 7-35 Longitudinal slack survey plots for Chlorophyll A (mg/l).



CHESTER RIVER

Figure 7-35 Longitudinal slack survey plots for Chlorophyll-A, (mg/l).

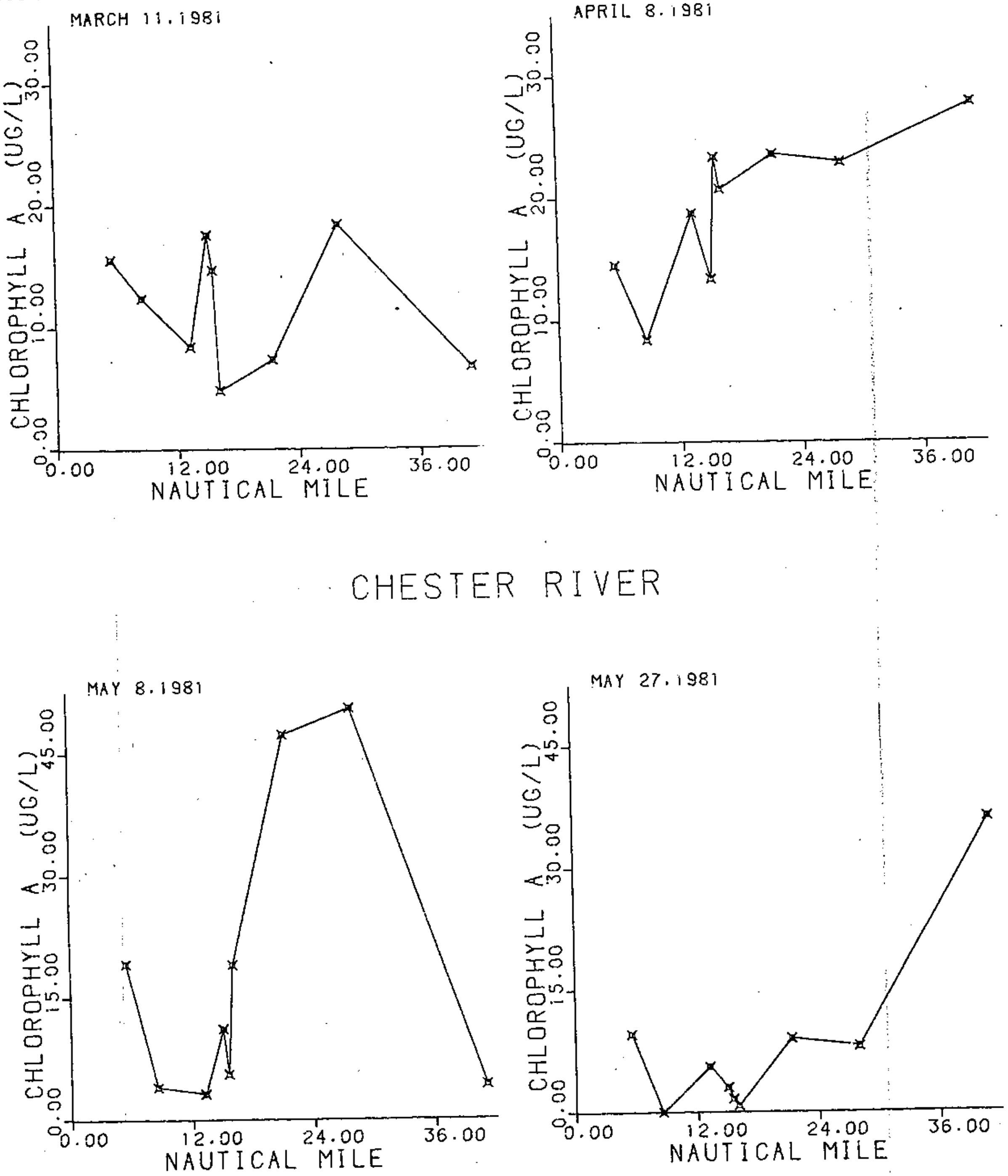


Figure 7-35 Longitudinal slack survey plots for Chlorophyll-A, (μg/l).

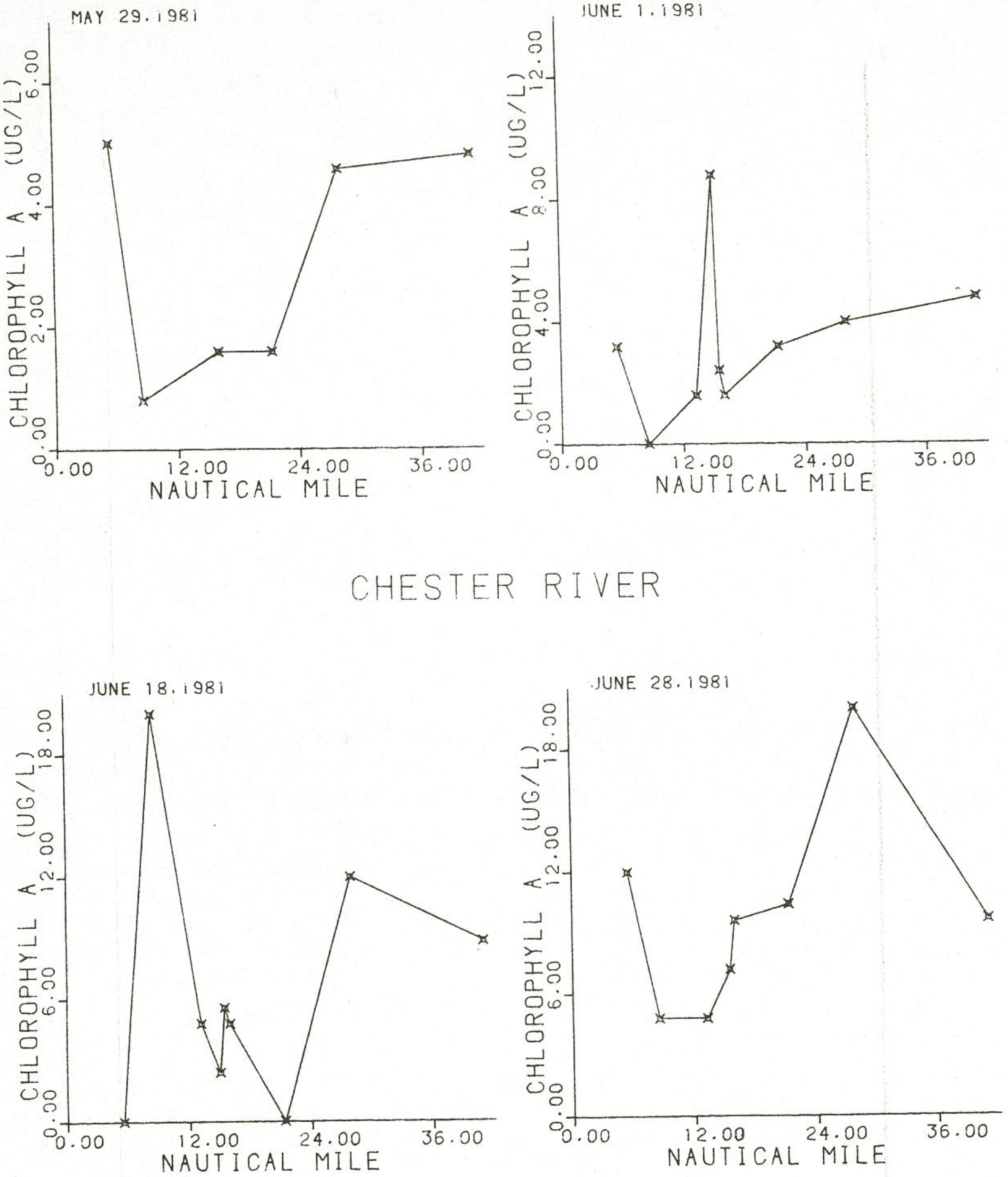


Figure 7-35 Longitudinal slack survey plots for Chlorophyll-A, (μg/l).

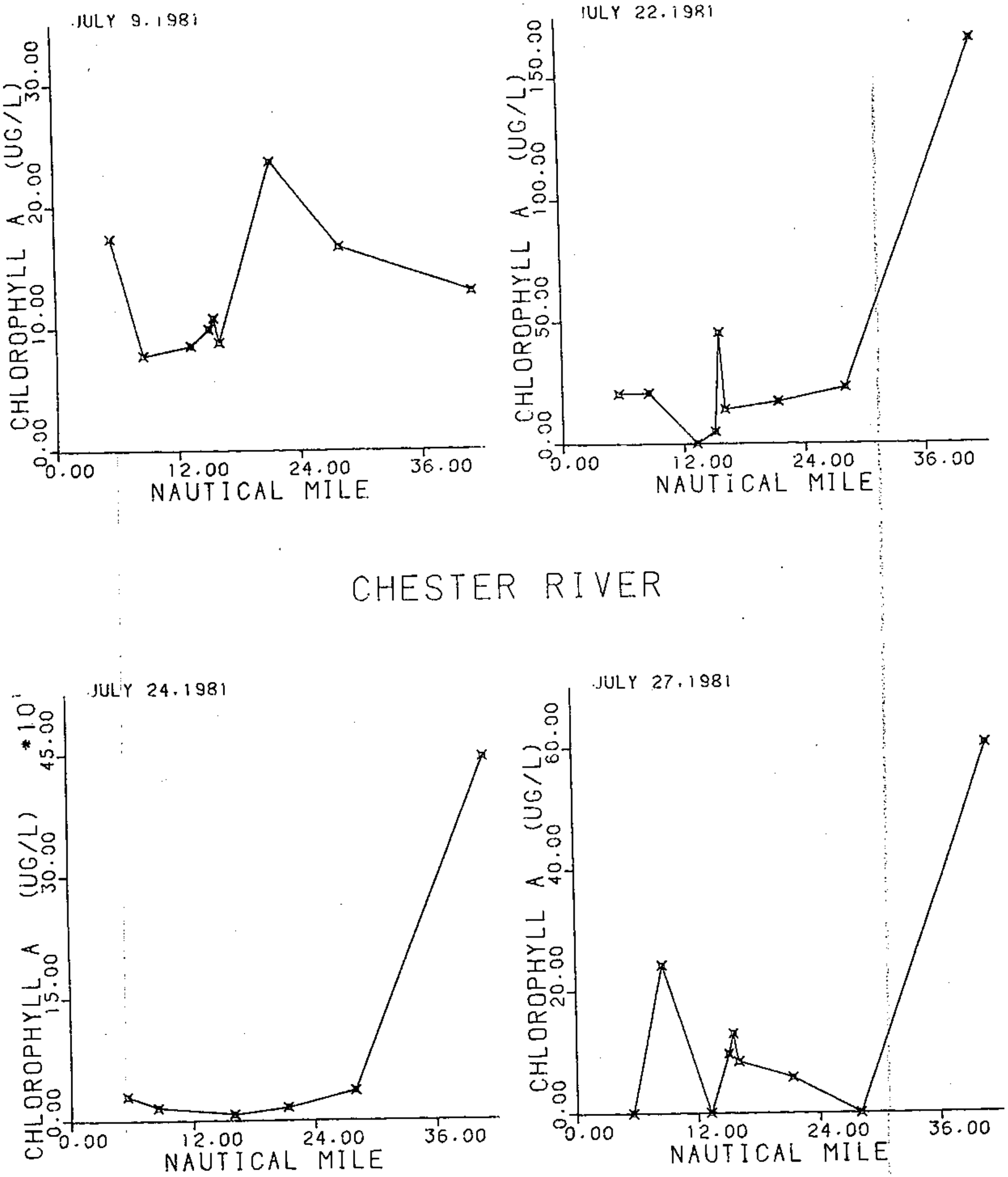


Figure 7-35 Longitudinal slack survey plots for Chlorophyll-A, (μg/l).

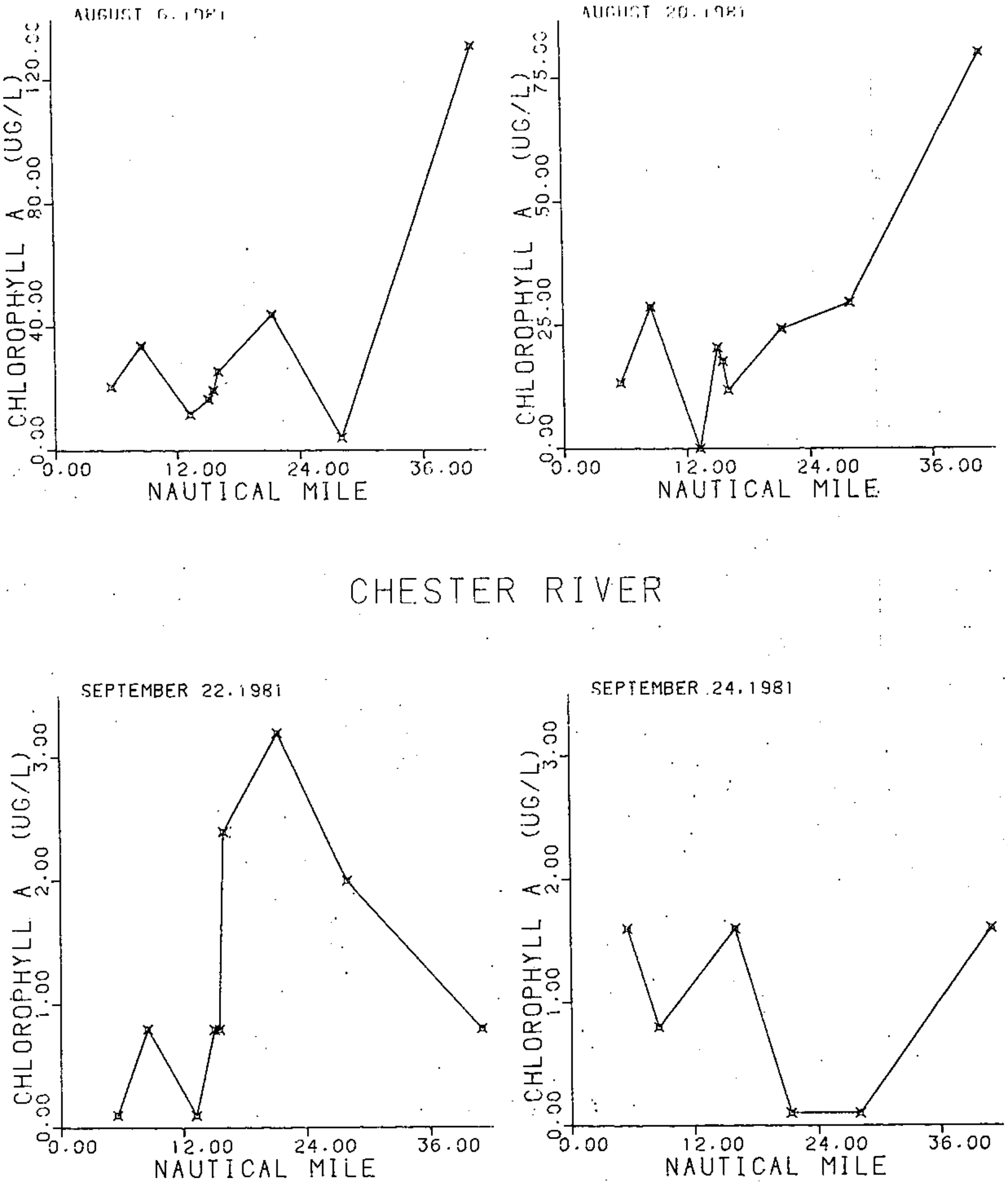


Figure 7-35 Longitudinal slack survey plots for Chlorophyll-A, (μg/l).

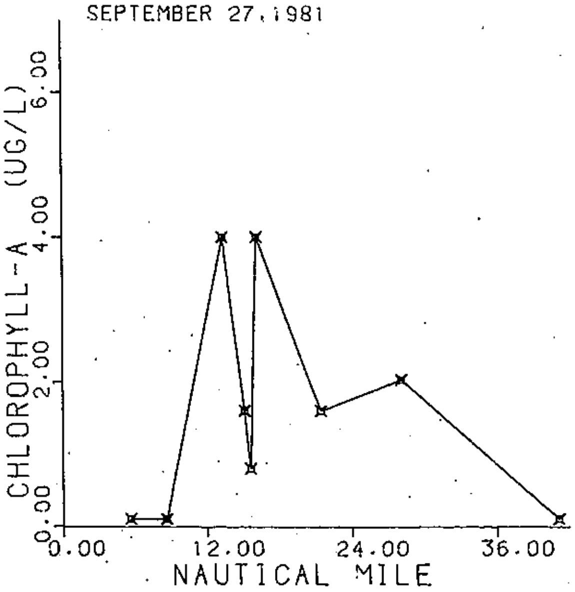


Figure 7-35 Longitudinal slack survey plots for Chlorophyll-A, (μg/l).

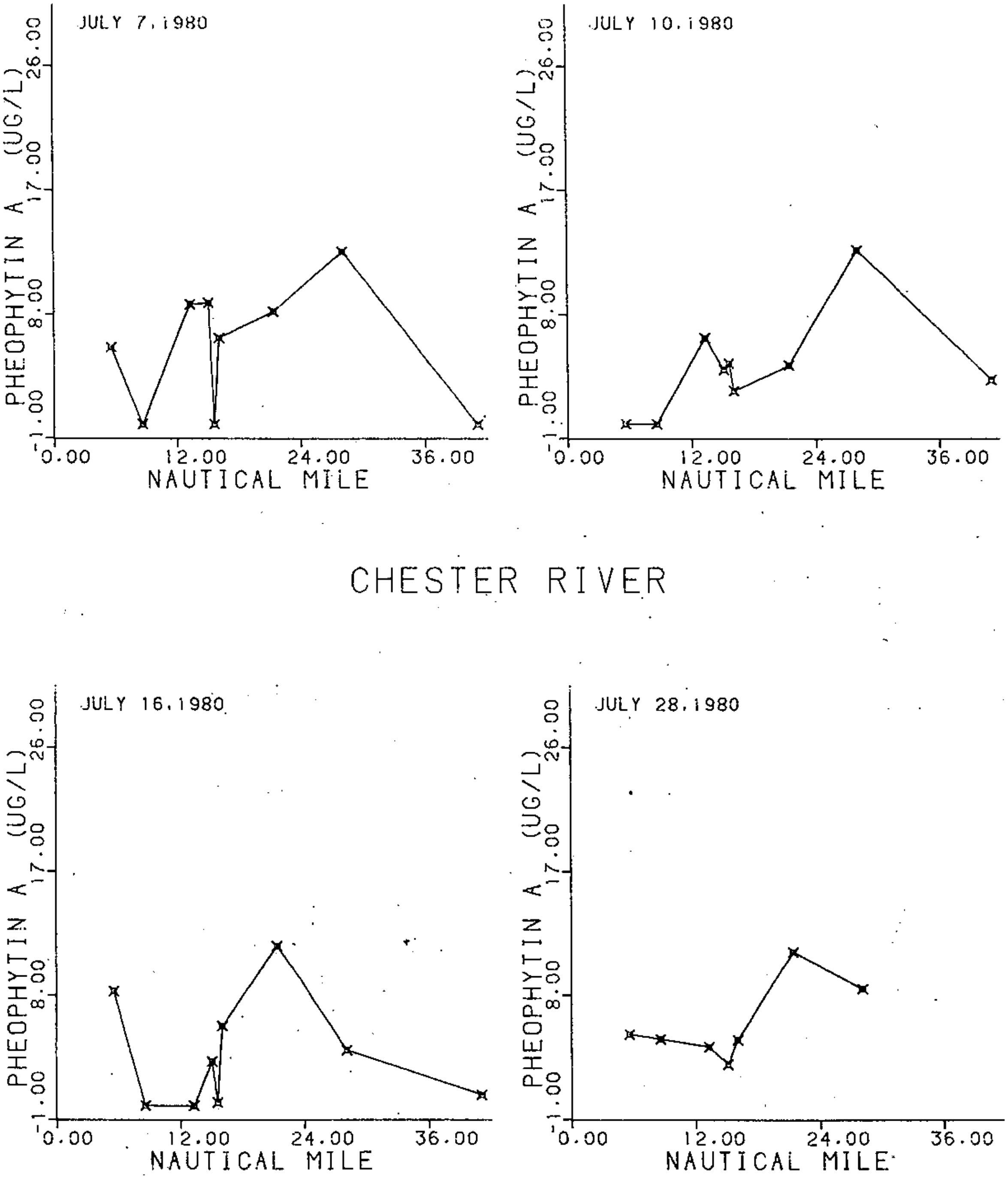


Figure 7-36 Longitudinal slack survey plots for Pheophytin A, (mg/l).

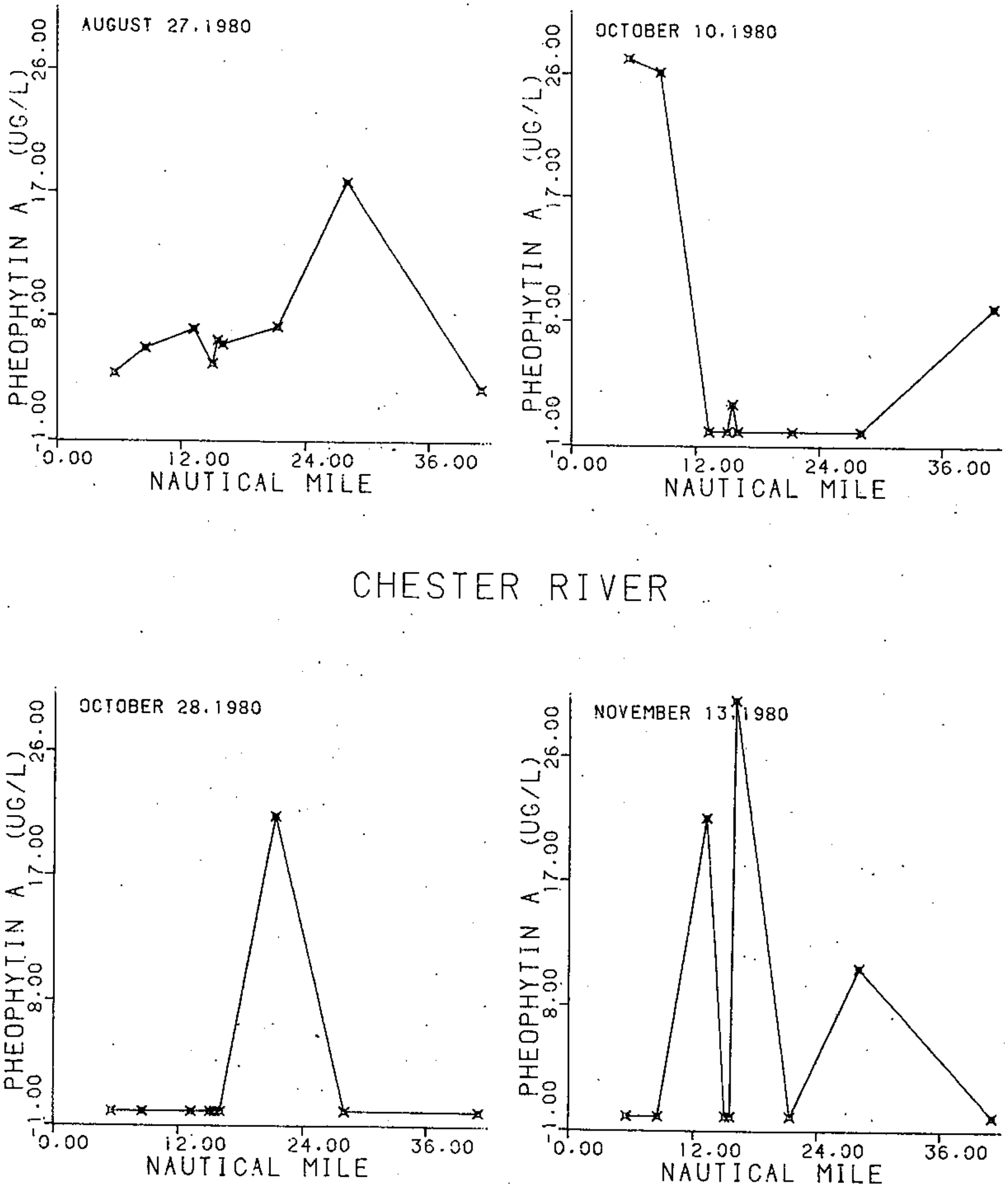
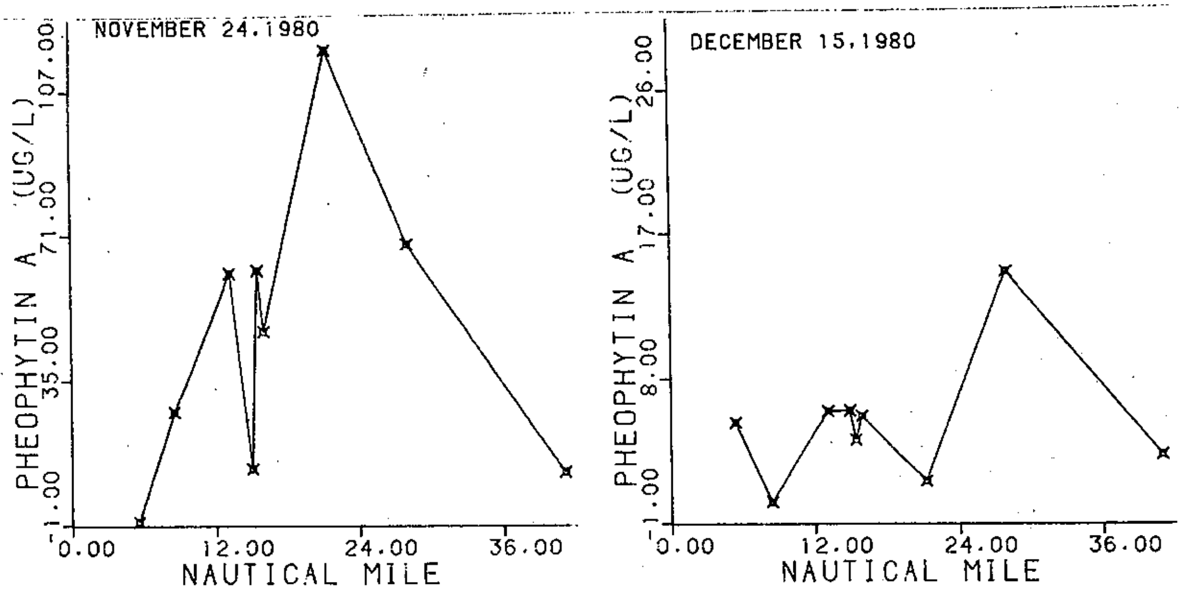


Figure 7-36 Longitudinal slack survey plots for Pheophytin A, (μg/l).



CHESTER RIVER

Figure 7-36 Longitudinal slack survey plots for Pheophytin A, (mg/l).

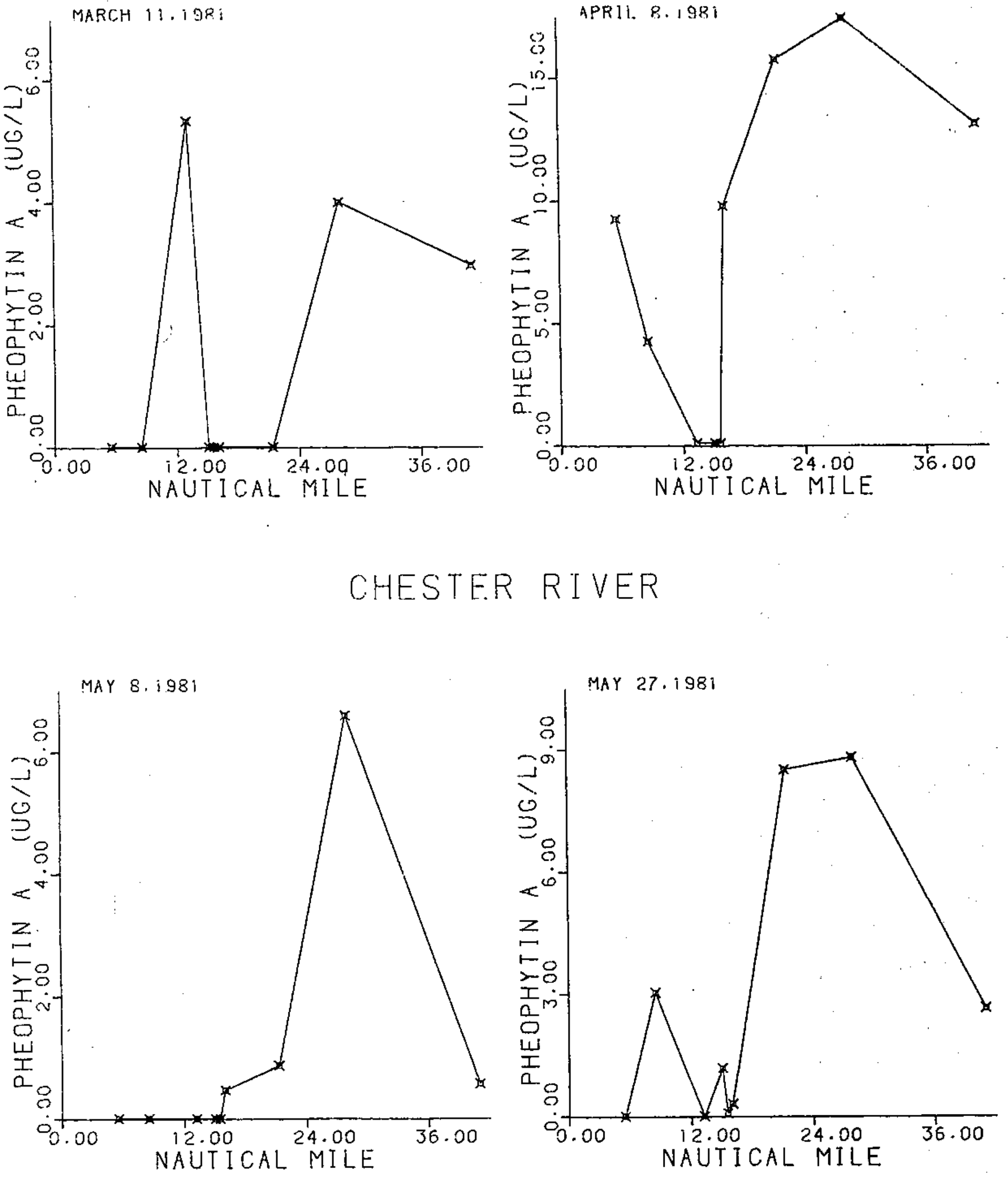


Figure 7-36 Longitudinal slack survey plots for Pheophytin-A, (μg/l).

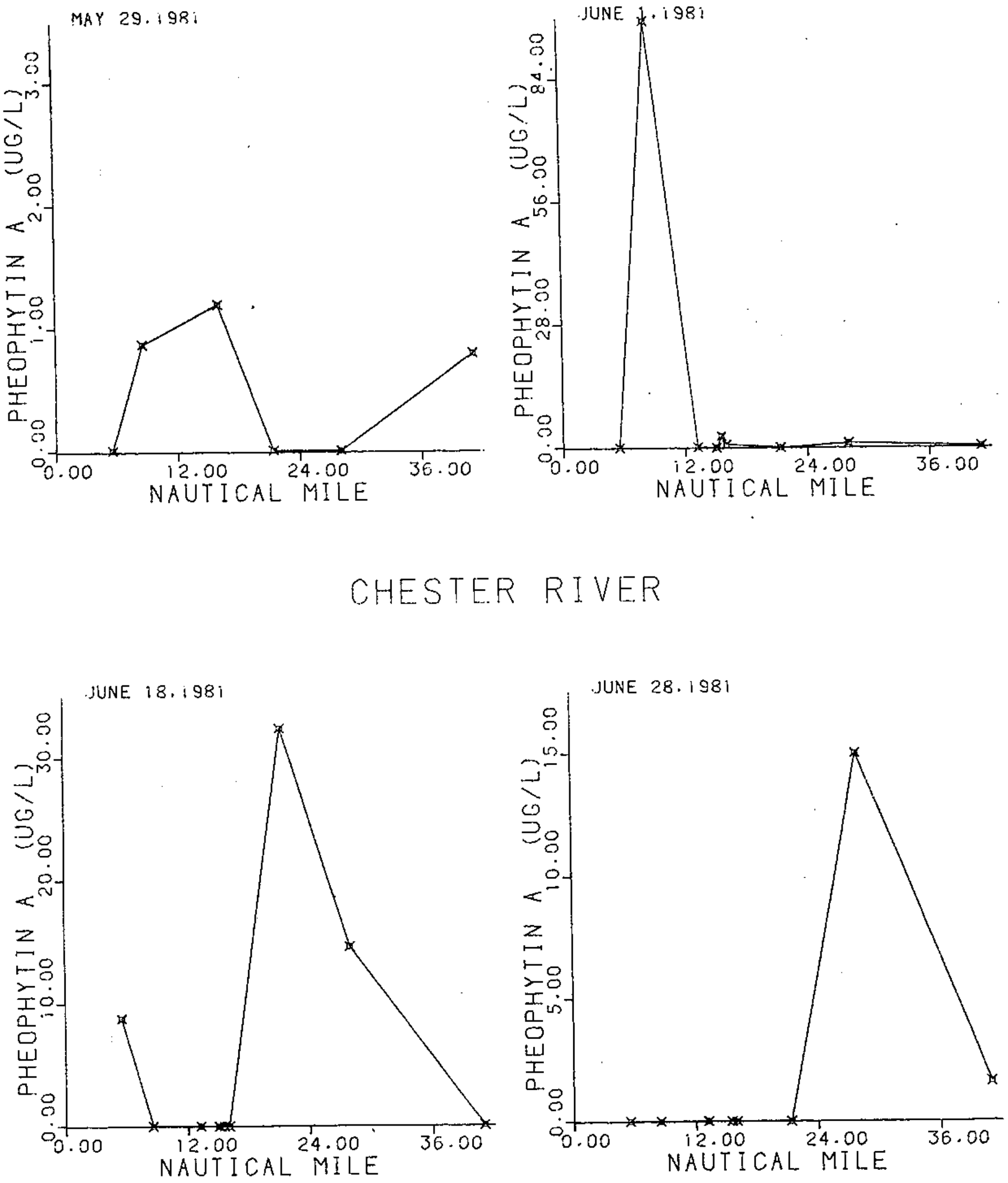


Figure 7-36 Longitudinal slack survey plots for Pheophytin-A, (μg/l).

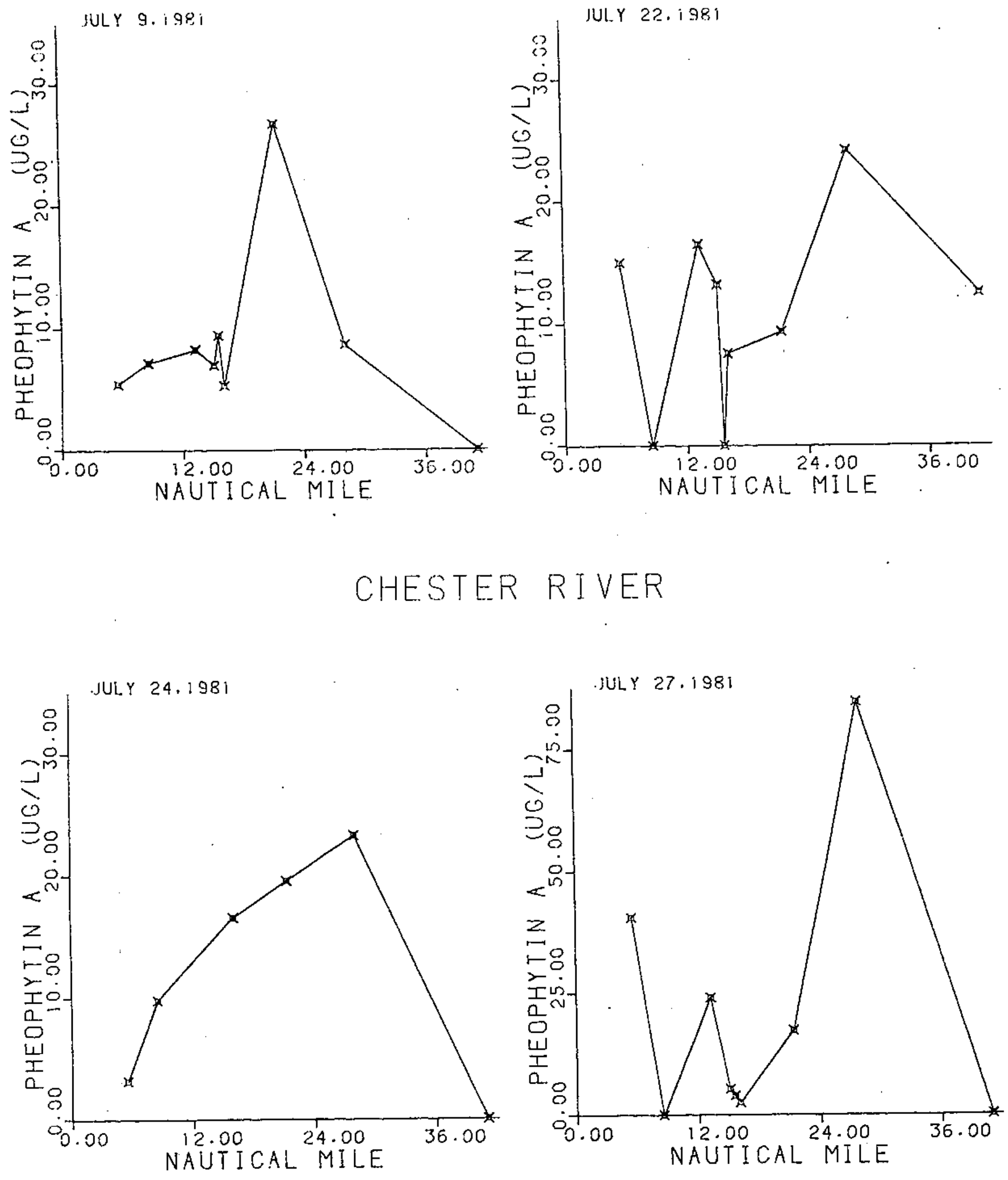


Figure 7-36 Longitudinal slack survey plots for Pheophytin-A, (μg/l).

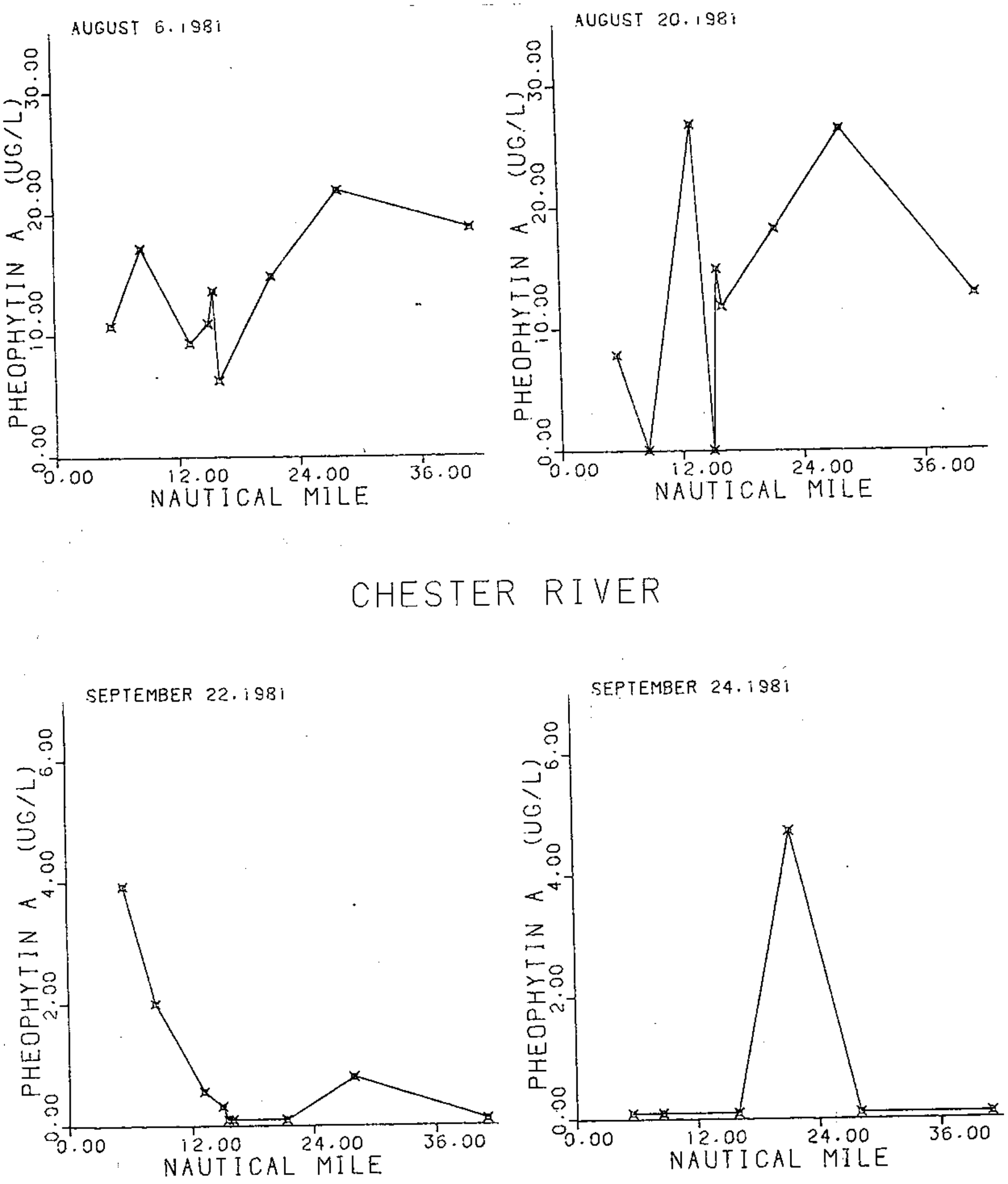


Figure 7-36 Longitudinal slack survey plots for Pheophytin-A, (μg/l).

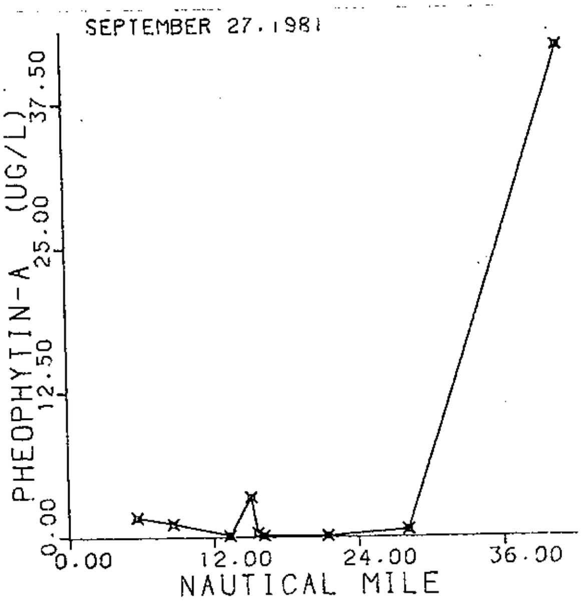


Figure 7-36 Longitudinal slack survey plots for Pheophytin-A, (mg/l).

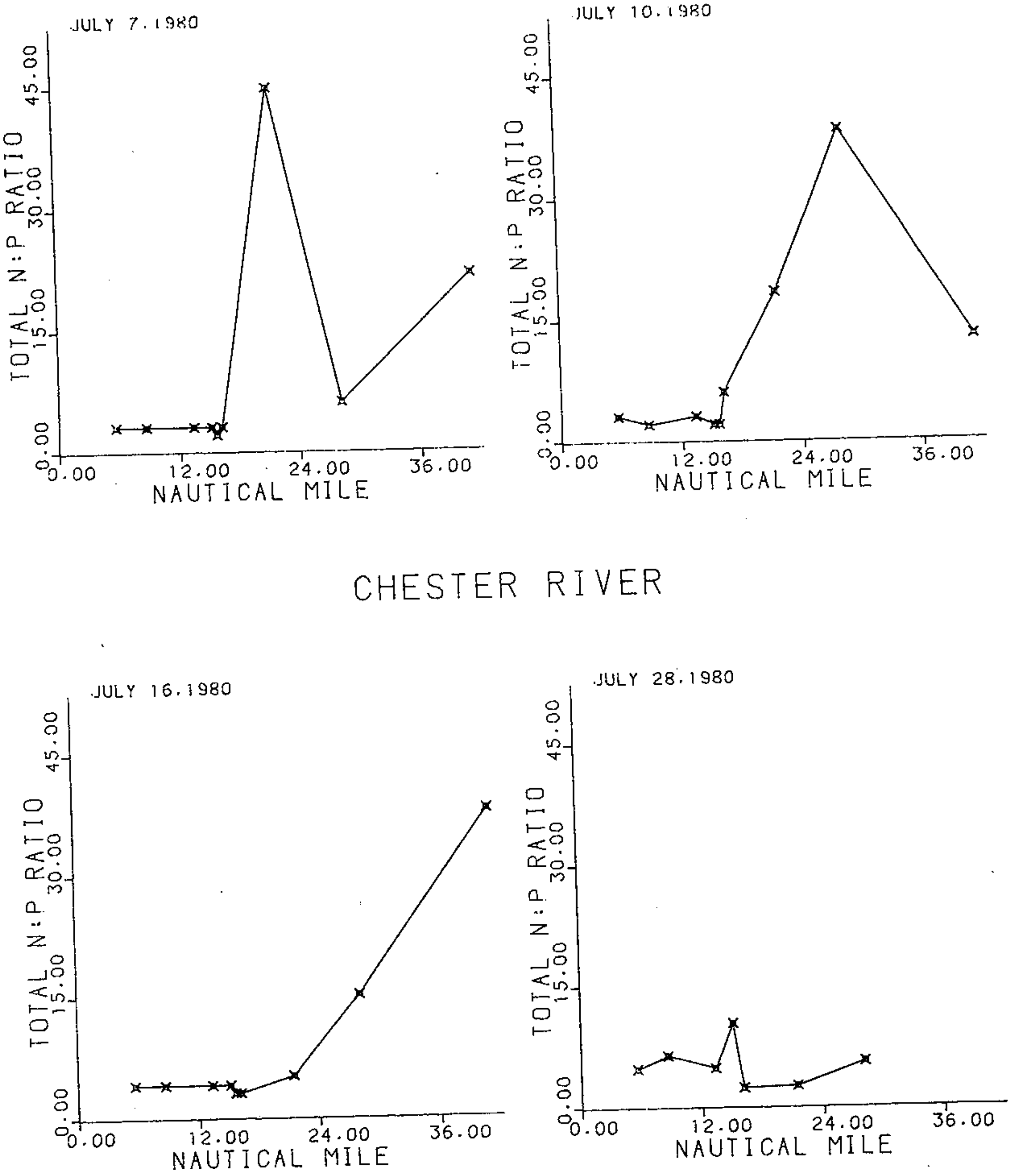


Figure 7-37 Longitudinal slack survey plots for Total Nitrogen: Phosphorus Ratio

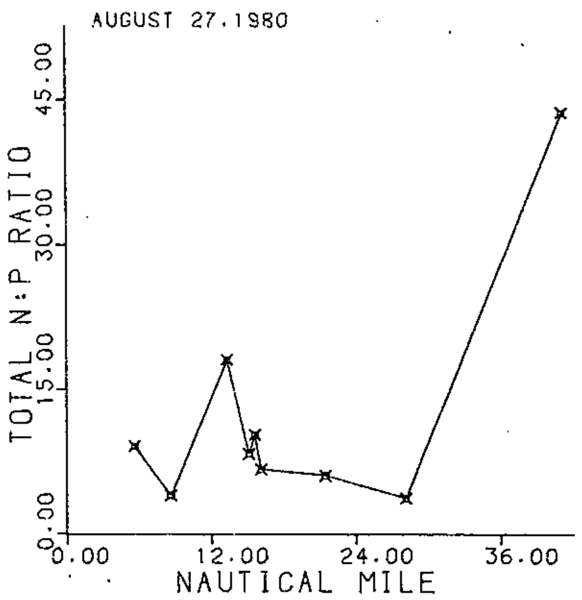


Figure 7-37 Longitudinal slack survey plots for Total Nitrogen: Phosphorus Ratio.

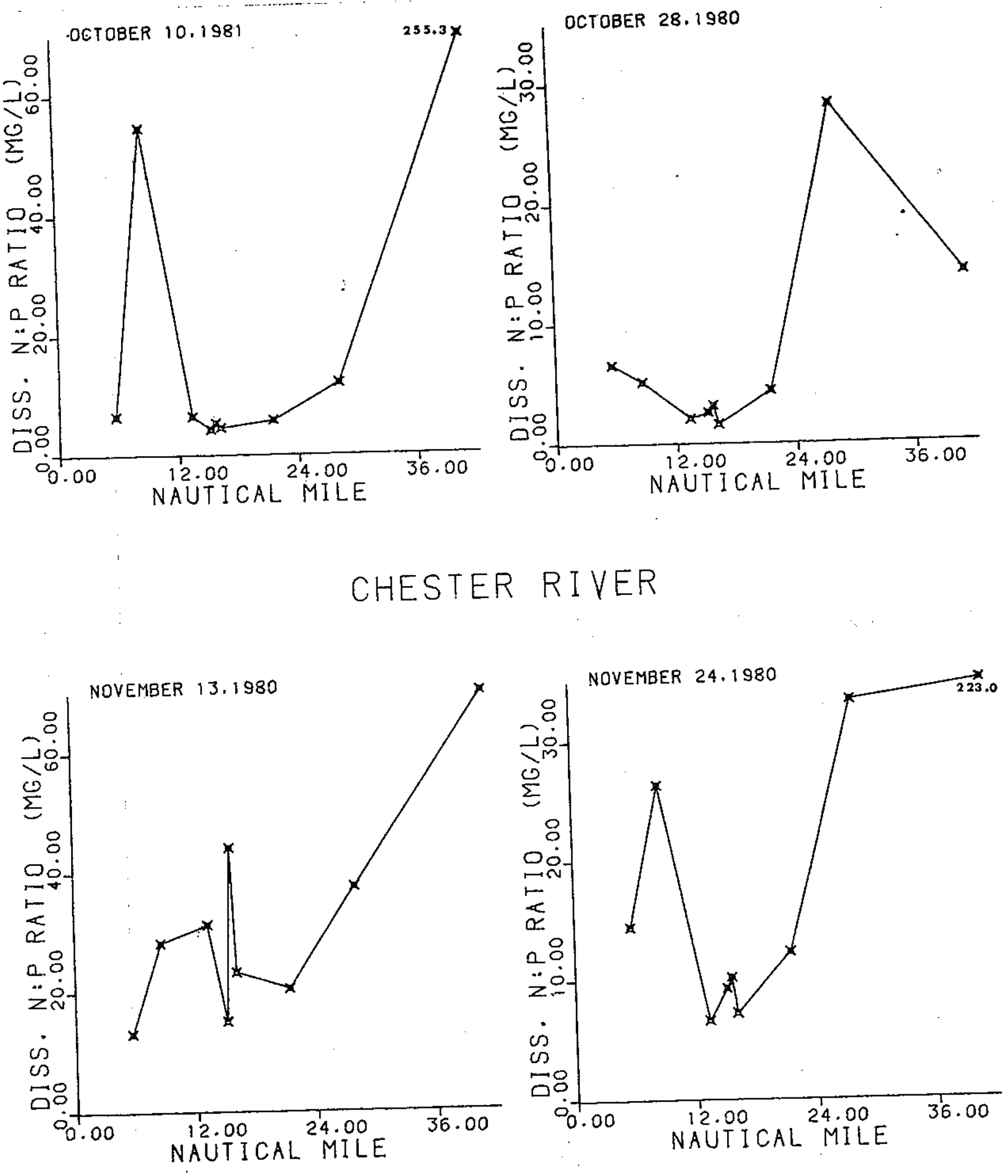


Figure 7-38 Longitudinal slack survey plots for Dissolved Nitrogen: Phosphorus Ratio.

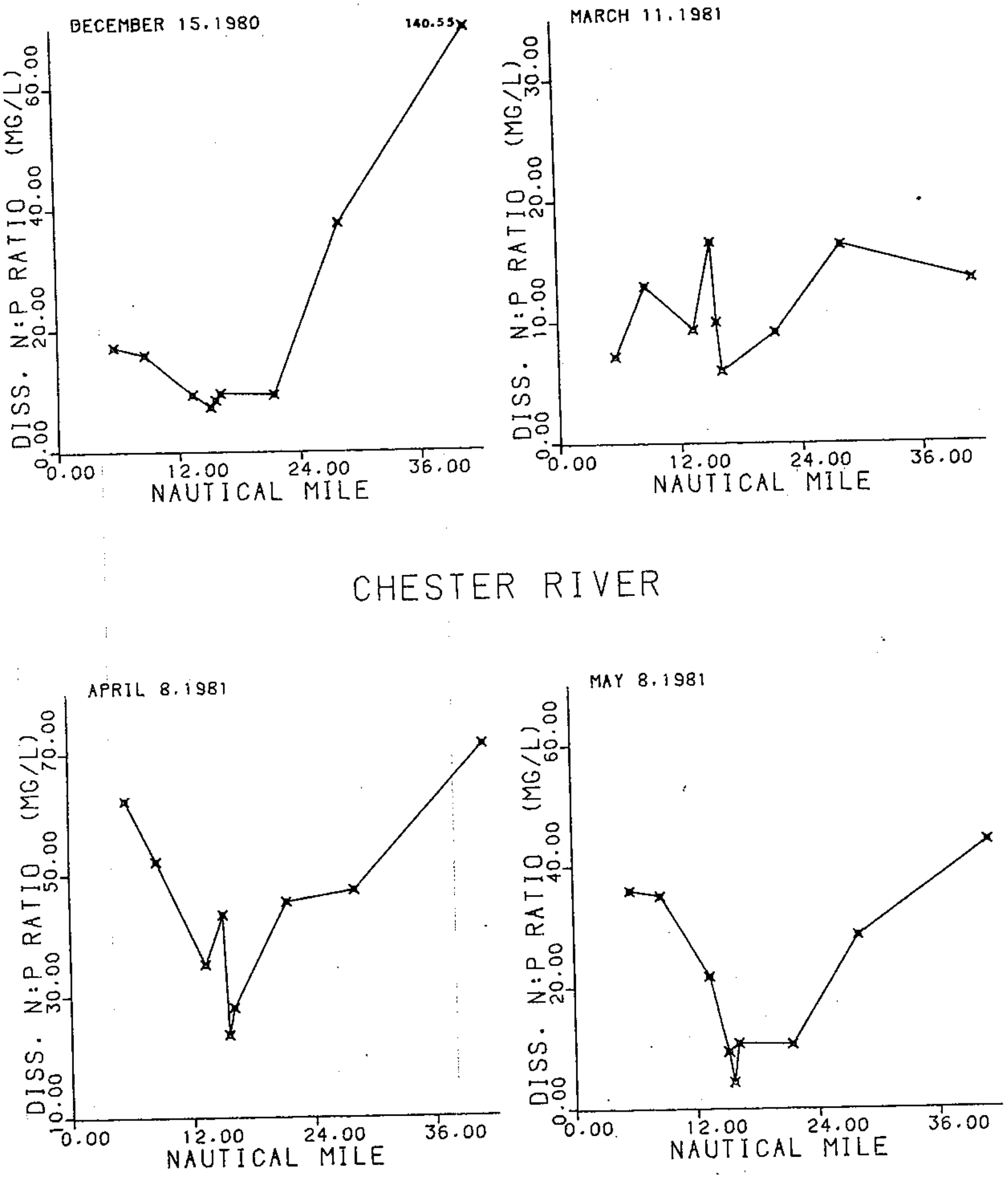


Figure 7-38 Longitudinal slack survey plots for Dissolved Nitrogen: Phosphorus Ratio.

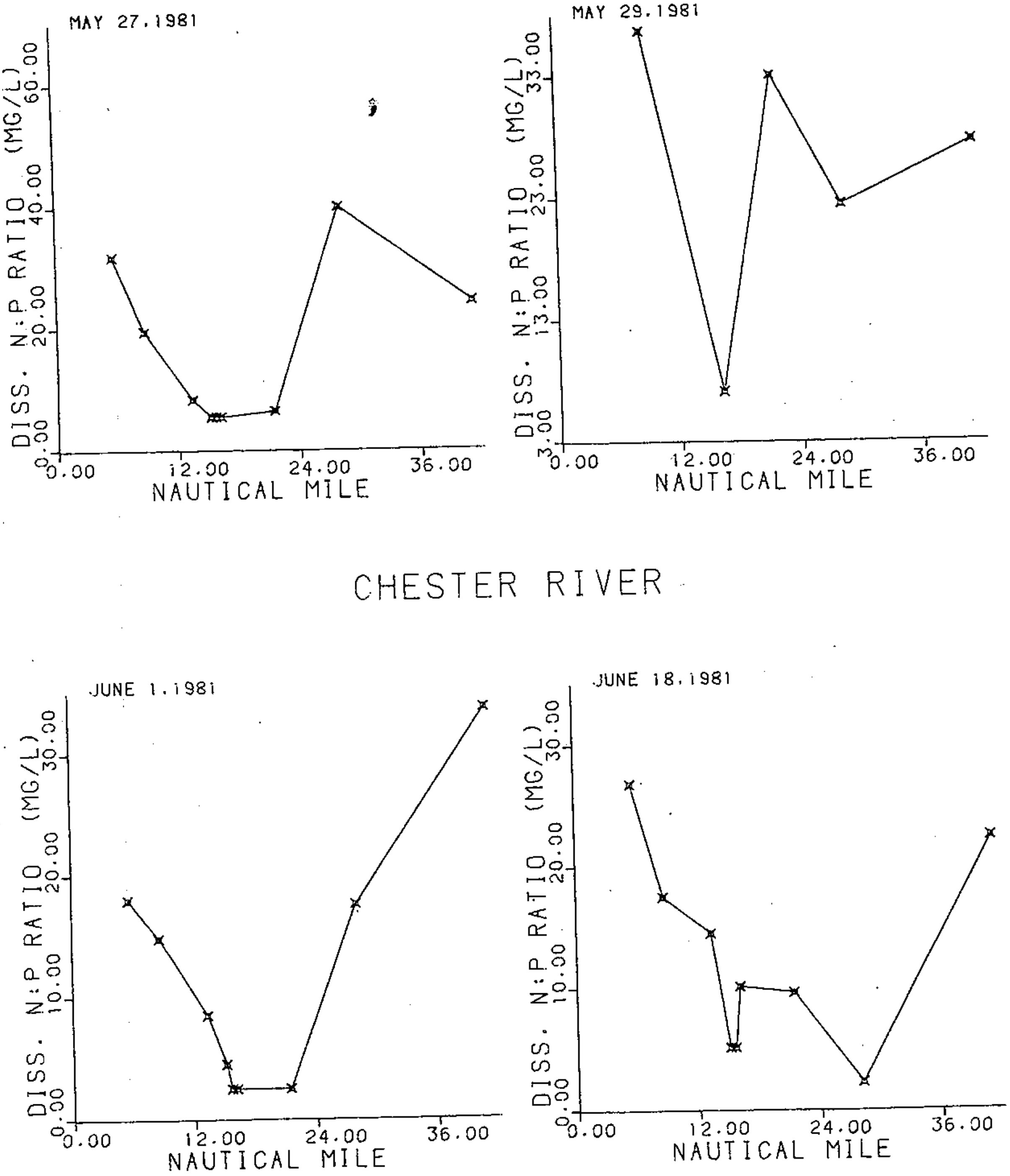


Figure 7-38 Longitudinal slack survey plots for Dissolved Nitrogen: Phosphorus Ratio.

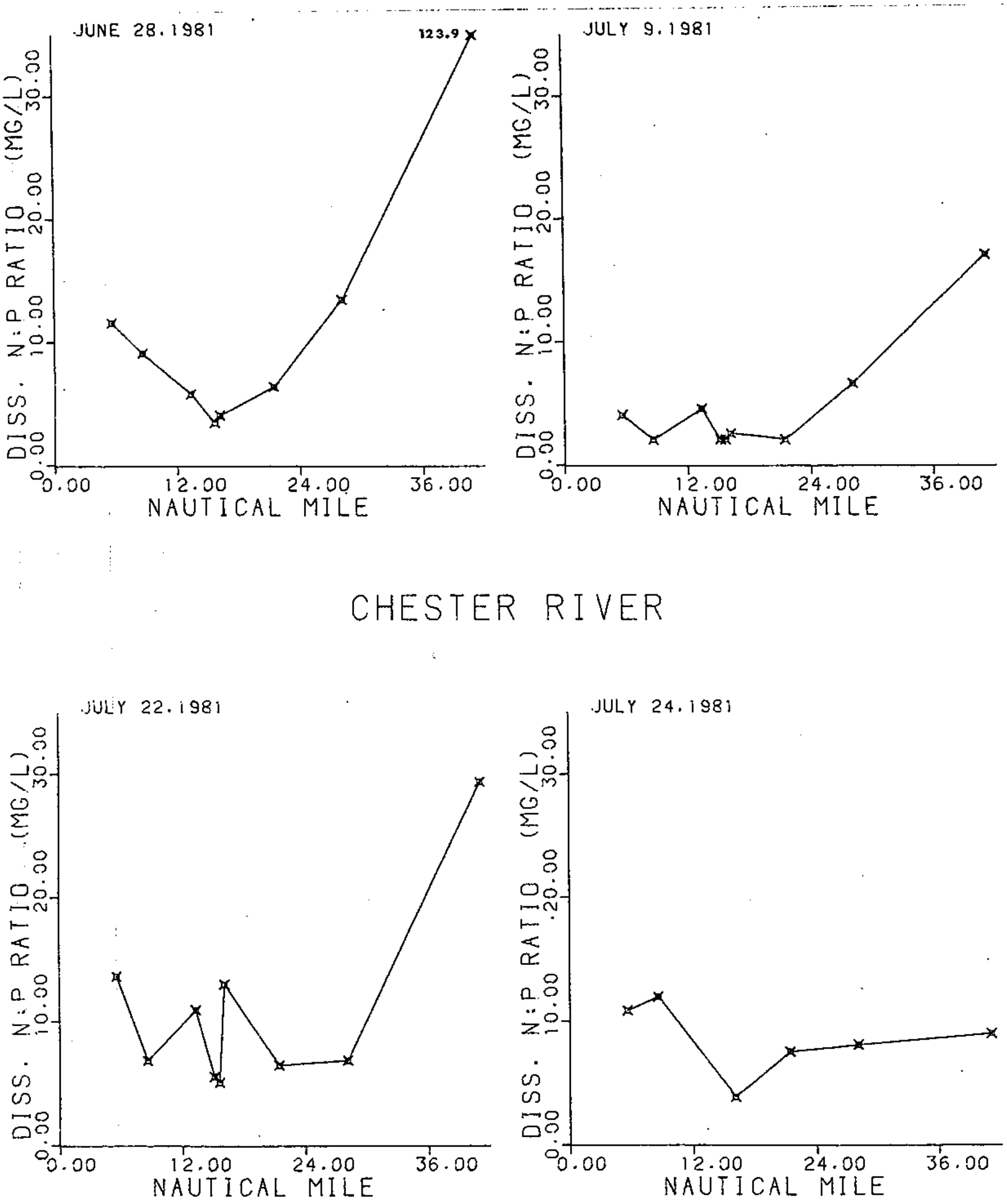


Figure 7-38 Longitudinal slack survey plots for Dissolved Nitrogen: Phosphorus Ratio.

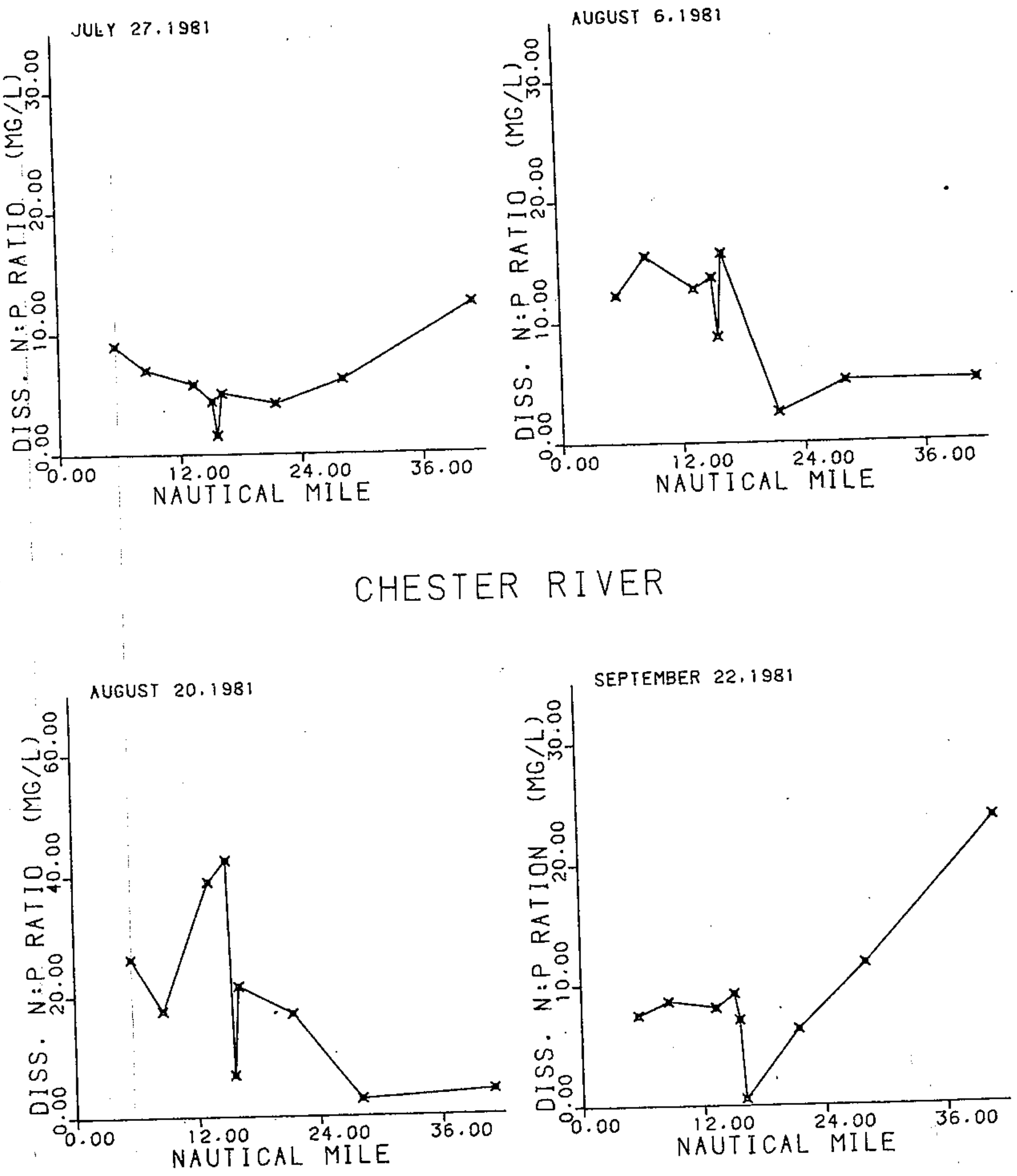
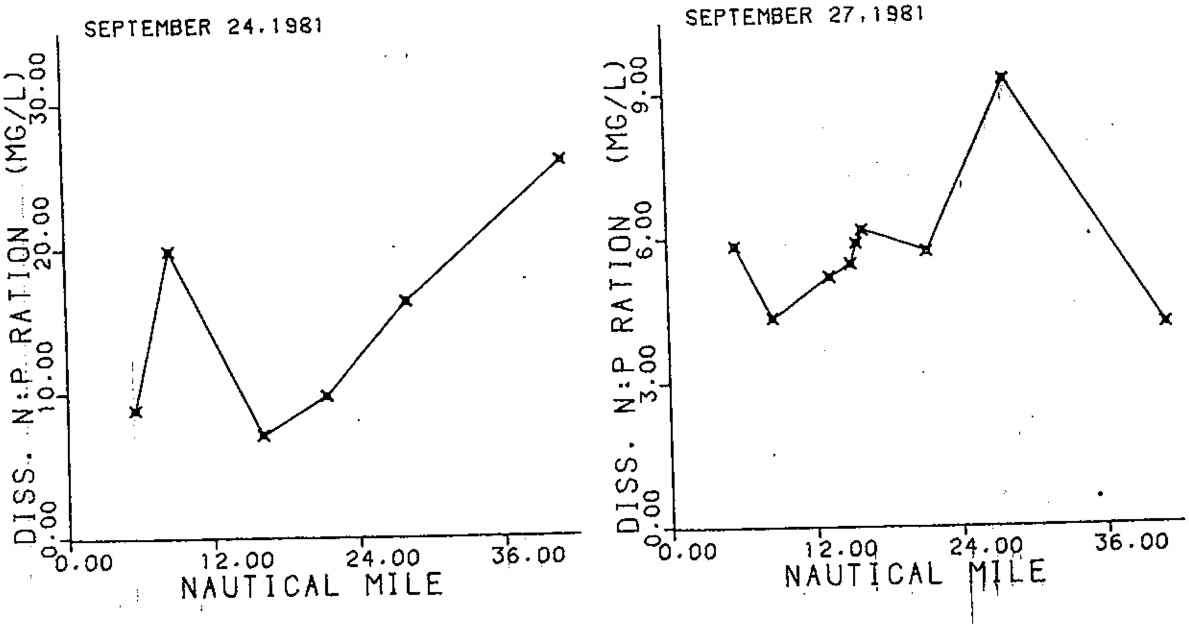


Figure 7-38 Longitudinal slack survey plots for Dissolved Nitrogen: Phosphorus Ratio.



CHESTER RIVER

Figure 7-38 Longitudinal slack survey plots for Dissolved Nitrogen: Phosphorus Ratio.

TABLE 7-1 SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		TEMPERTURE (DEGREES C)			
7/ 7/80	25	24.74	1.3853	.27707	5.5996
7/10/80	26	23.992	1.1771	.23085	4.9061
7/16/80	33	25.773	2.5528	.44439	9.9052
7/28/80	21	27.333	.45644	0.0996	1.6699
8/27/80	32	26.034	1.5737	.27819	6.0447
10/ 4/80	27	19.841	0.5472	.10531	2.758
10/10/80	27	17.867	1.1073	0.2131	6.1977
10/28/80	26	11.904	.72745	.14266	6.1111
11/13/80	26	7.4115	.39631	.07772	5.3472
11/24/80	26	6.3308	.56126	.11007	8.8656
12/15/80	26	3.7692	.49053	0.0962	13.014
3/11/81	27	4.7852	.93714	.18035	19.584
4/ 8/81	32	11.791	1.4097	.24921	11.956
5/ 8/81	27	15.233	1.7285	.33265	11.347
5/27/81	27	21.863	2.5253	.48599	11.55
6/ 1/81	27	21.593	1.3453	.25891	6.2306
6/18/81	27	24.733	1.4438	.27786	5.8375
6/28/81	27	25.415	1.1169	.21495	4.3947
7/ 9/81	27	27.2	2.2809	.43895	8.3855
7/22/81	27	26.756	1.2822	.24676	4.7924
7/27/81	28	26.586	2.1676	.40963	8.1531
8/ 6/81	27	26.096	.83504	0.1607	3.1998
8/20/81	27	23.781	.98841	.19022	4.1562
9/22/81	27	20.289	.63266	.12176	3.1182
9/27/81	26	18.596	.53102	.10414	2.8555
		TURBIDITY (FTU)			
7/ 7/80	14	10	7.3275	1.9584	73.275
7/10/80	9	8.3333	8.1394	2.7131	97.673
7/16/80	16	4.7875	2.4554	.61386	51.288
7/28/80	7	7.8571	4.5251	1.7103	57.592
8/27/80	9	7.4444	3.8766	1.2922	52.073
10/ 4/80					
10/10/80					
10/28/80					
11/13/80					
11/24/80					
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81	9	8.1111	9.9177	3.3059	122.27
6/28/81	9	12.222	13.962	4.6541	114.24
7/ 9/81	9	8.7778	9.2436	3.0812	105.31
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		SECCHI DISC (METERS)			
7/ 7/80	9	0.6388	0.2913	.09710	45.596
7/10/80	9	.18889	0.0928	.03093	49.127
7/16/80	10	0.59	.17288	.05467	29.302
7/28/80	7	0.6971	.22089	.08349	31.684
8/27/80	9	0.6567	0.2566	.08554	39.078
10/ 4/80					
10/10/80	9	1.0222	.33458	.11153	32.731
10/28/80	9	.92222	.23863	.07954	25.876
11/13/80	8	0.9125	.19594	.06928	21.473
11/24/80	9	.73333	.43875	.14625	59.829
12/15/80	9	.95556	.11304	.03768	11.83
3/11/81	9	1.1111	.47551	0.1585	42.796
4/ 8/81	8	0.825	.43997	.15555	53.329
5/ 8/81	8	0.7125	.48825	.17262	68.527
5/27/81	8	0.8875	.61514	.21748	69.311
6/ 1/81	6	1.2167	.78081	.31876	64.176
6/18/81	8	0.95	.45981	.16257	48.401
6/28/81	9	.73333	.47434	.15811	64.683
7/ 9/81	9	.72222	.31535	.10512	43.664
7/22/81	9	.76667	.44159	0.1472	57.598
7/27/81	10	0.58	.19322	0.0611	33.314
8/ 6/81	9	.61111	.28916	.09639	47.316
8/20/81	9	.55556	0.2555	.08517	45.989
9/22/81	9	.74444	.26977	.08992	36.238
9/27/81	7	0.7	.21602	.08165	30.861
		DISSOLVED OXYGEN (MG/L)			
7/ 7/80	25	5.816	1.7442	.34884	29.99
7/10/80	26	6.2923	1.7541	0.344	27.876
7/16/80	33	6.1758	1.2797	.22276	20.721
7/28/80	1	5.8			
8/27/80					
10/ 4/80	27	8.4556	1.4178	.27286	16.768
10/10/80	27	7.8	.67254	.12943	8.6223
10/28/80	26	9.5077	.27118	.05318	2.8522
11/13/80	26	10.612	.74851	.14679	7.0537
11/24/80	26	12.738	.83142	.16306	6.5269
12/15/80	26	11.069	.35187	.06901	3.1788
3/11/81	27	12.304	1.2148	.23379	9.8735
4/ 8/81	27	10.474	.52667	.10136	5.0283
5/ 8/81	27	8.3852	1.1857	.22819	14.141
5/27/81	27	9.1074	2.0834	.40096	22.876
6/ 1/81	27	6.1926	1.7133	.32972	27.667
6/18/81	27	5.3074	1.9867	.38234	37.432
6/28/81	27	6.9556	2.1753	.41863	31.274
7/ 9/81	27	6.7741	3.1116	.59883	45.934
7/22/81	27	5.8	2.5554	.49178	44.058
7/27/81	28	7.1214	3.7108	.70127	52.107
8/ 6/81	27	6.2778	.77427	.14901	12.333
8/20/81	26	6.4846	2.2497	.44121	34.694
9/22/81	27	7.1741	1.8076	.34787	25.196
9/27/81	26	8.2115	1.1039	0.2165	13.444

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE
STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		DISSOLVED OXYGEN SATURATION (PER CENT)			
7/ 7/80	24	72.346	22.439	4.5803	31.016
7/10/80	26	77.881	21.788	4.273	27.976
7/16/80	33	78.542	16.127	2.8074	20.533
7/28/80	1	76.2			
8/27/80					
10/ 4/80	27	97.926	14.637	2.8169	14.947
10/10/80	27	87.619	9.1621	1.7632	10.457
10/28/80	26	93.792	5.1769	1.0153	5.5196
11/13/80	26	93.915	4.095	0.8031	4.3604
11/24/80	26	110.34	6.9561	1.3642	6.3043
12/15/80	26	89.527	4.3032	.84392	4.8066
3/11/81	27	101.09	10.186	1.9602	10.076
4/ 8/81	27	102.32	5.3438	1.0284	5.2227
5/ 8/81	27	88.189	12.568	2.4186	14.251
5/27/81	27	109.77	26.246	5.0511	23.911
6/ 1/81	27	74.078	20.684	3.9806	27.922
6/18/81	27	67.13	25.455	4.8989	37.92
6/28/81	27	88.589	28.69	5.5214	32.386
7/ 9/81	27	89.115	41.481	7.9831	46.548
7/22/81	27	75.981	33.187	6.3868	43.677
7/27/81	28	92.946	48.453	9.1567	52.13
8/ 6/81	27	81.093	8.3385	1.6047	10.283
8/20/81	26	80.804	24.616	4.8277	30.464
9/22/81	27	85.307	21.145	4.0693	24.787
9/27/81	26	94.427	13.686	2.684	14.493
		BOD5 (MG/L)			
7/ 7/80	9	3.8889	1.5964	.53215	41.051
7/10/80	9	2.4444	1.0138	.33793	41.473
7/16/80	9	2.6111	.65085	.21695	24.926
7/28/80	7	1.7429	0.5127	.19378	29.417
8/27/80	9	2.2222	.66667	.22222	30
10/ 4/80					
10/10/80	9	2.8889	.78174	.26058	27.06
10/28/80	9	1.7778	.66667	.22222	37.5
11/13/80	9	2.1111	.78174	.26058	37.03
11/24/80	9	4.4444	.88192	.29397	19.843
12/15/80	9	2.3333	0.5	.16667	21.429
3/11/81	10	1.2	.42164	.13333	35.136
4/ 8/81	9	3.3333	.70711	0.2357	21.213
5/ 8/81	9	2.5556	.72648	.24216	28.428
5/27/81	9	3.3333	.70711	0.2357	21.213
6/ 1/81	9	1.7778	.97183	.32394	54.665
6/18/81					
6/28/81					
7/ 9/81	9	2.2222	.44096	.14699	19.843
7/22/81	9	2.4444	1.0138	.33793	41.473
7/27/81	9	4.8889	4.7551	1.585	97.264
8/ 6/81	9	3.5556	1.236	.41201	34.763
8/20/81	9	4.4444	3.2447	1.0816	73.005
9/22/81	9	1.6667	0.5	.16667	30
9/27/81	9	2.3333	1	.33333	42.857

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		BOD20	(MG/L)		
7/ 7/80	8	7.75	1.5119	.53452	19.508
7/10/80	9	4.5556	1.2105	0.4035	26.572
7/16/80	9	6.1667	1.4577	.48591	23.639
7/28/80	7	4.6429	.89974	.34007	19.379
8/27/80	9	3.7222	.97183	.32394	26.109
10/ 4/80					
10/10/80					
10/28/80					
11/13/80					
11/24/80					
12/15/80	9	4	1.2247	.40825	30.619
3/11/81	9	3.2222	.97183	.32394	30.16
4/ 8/81					
5/ 8/81					
5/27/81	6	6.1667	1.6021	.65405	25.98
6/ 1/81	6	3.8333	.98319	.40139	25.648
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81	9	4.4444	.52705	.17568	11.859
9/27/81	9	5	1.7321	.57735	34.641
		BOD30	(MG/L)		
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80	9	2.8889	.92796	.30932	32.122
10/10/80	9	4.2222	.66667	.22222	15.789
10/28/80	9	3.3333	1.5811	.52705	47.434
11/13/80	9	5.7778	1.3017	0.4339	22.53
11/24/80	9	6.6667	1	.33333	15
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE
STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
FIELD PH (STD. UNITS)					
7/ 7/80	9	7.5	.36401	.12134	4.8534
7/10/80	9	7.5222	.23863	.07954	3.1723
7/16/80	14	7.0143	.57091	.15258	8.1392
7/28/80	7	7.3	.14142	.05345	1.9373
8/27/80	9	7.4111	.56887	.18962	7.6759
10/ 4/80	27	7.4667	.20191	.03886	2.7042
10/10/80	21	7.6762	.16095	.03512	2.0967
10/28/80	26	7.7769	.10318	.02024	1.3267
11/13/80	26	7.6692	.65713	.12887	8.5684
11/24/80	23	6.6	.25226	0.0526	3.8222
12/15/80	26	7.8577	.17011	.03336	2.1649
3/11/81	27	8.037	.20782	0.04	2.5858
4/ 8/81	27	7.1556	.32972	.06346	4.6079
5/ 8/81	21	7.6333	.19579	.04272	2.5649
5/27/81	27	7.6222	.35009	.06738	4.593
6/ 1/81	24	6.9167	.35098	.07164	5.0744
6/18/81	27	6.9704	0.3462	.06663	4.9668
6/28/81	24	7.6833	.31439	.06417	4.0918
7/ 9/81	24	7.4583	.49512	.10107	6.6385
7/22/81	23	7.5043	.20333	0.0424	2.7095
7/27/81	25	7.58	.42817	.08563	5.6487
8/ 6/81	12	6.9083	.53165	.15347	7.6958
8/20/81	27	7.1	.55052	.10595	7.7539
9/22/81	24	7.5292	.31135	.06355	4.1352
9/27/81	23	7.6696	.41058	.08561	5.3534
SALINTY (PPT)					
7/ 7/80	26	6.8846	2.874	.56363	41.745
7/10/80	26	7.0315	3.0206	.59238	42.957
7/16/80	33	7.267	2.8957	.50408	39.848
7/28/80	21	7.9381	2.383	0.52	30.019
8/27/80	32	8.5187	3.1964	.56505	37.522
10/ 4/80					
10/10/80	27	10.343	4.2995	.82743	41.568
10/28/80	26	10.77	4.0221	0.7888	37.345
11/13/80	26	11.072	3.8375	.75261	34.661
11/24/80	26	11.645	3.8517	.75538	33.075
12/15/80	26	10.857	3.7561	.73664	34.597
3/11/81	27	9.4707	4.4256	.85171	46.73
4/ 8/81	32	9.8125	3.7666	.66584	38.385
5/ 8/81	27	9.0126	3.6849	.70916	40.886
5/27/81	27	8.4241	3.8539	.74168	45.748
6/ 1/81	27	8.2685	3.4434	.66269	41.645
6/18/81	27	8.5352	3.5667	.68642	41.789
6/28/81	27	7.7789	3.2122	.61819	41.294
7/ 9/81	27	8.3833	3.4632	0.6665	41.311
7/22/81	27	9.8022	4.0704	.78336	41.526
7/27/81	28	9.8375	4.0516	.76568	41.185
8/ 6/81	27	9.5607	3.9023	.75101	40.816
8/20/81	27	11.592	4.6933	.90323	40.488
9/22/81	27	12.367	4.3428	.83577	35.116
9/27/81	26	11.731	4.8977	.96051	41.749

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		TOTAL SOLIDS (MG/L)			
7/ 7/80	9	6483.3	3201.4	1067.1	49.378
7/10/80	9	7638	3642	1214	47.682
7/16/80	9	7337.3	3441.3	1147.1	46.901
7/28/80	7	7974.3	2534.2	957.83	31.78
8/27/80	9	9750.9	4487.8	1495.9	46.024
10/ 4/80					
10/10/80	1	56			
10/28/80	1	185			
11/13/80	1	113			
11/24/80	1	136			
12/15/80	1	134			
3/11/81	1	82			
4/ 8/81	1	40			
5/ 8/81	1	63			
5/27/81	1	156			
6/ 1/81	1	179			
6/18/81	1	449			
6/28/81	1	655			
7/ 9/81	1	177			
7/22/81					
7/27/81					
8/ 6/81	1	169			
8/20/81	1	185			
9/22/81					
9/27/81	1	307			
		SUSPENDED SOLIDS (MG/L)			
7/ 7/80	9	17.111	6.1328	2.0443	35.841
7/10/80	9	25.556	8.9598	2.9866	35.06
7/16/80	10	24.8	11.526	3.6448	46.475
7/28/80	7	26.857	3.8048	1.4381	14.167
8/27/80	9	40.556	9.8503	3.2834	24.288
10/ 4/80					
10/10/80	9	8.7778	8.258	2.7527	94.078
10/28/80	8	17.125	9.0149	3.1872	52.642
11/13/80	9	29.222	8.9551	2.985	30.645
11/24/80	8	30	9.3656	3.3112	31.219
12/15/80	9	37.889	11.57	3.8566	30.536
3/11/81	9	33.111	12.067	4.0223	36.444
4/ 8/81	9	38.778	8.136	2.712	20.981
5/ 8/81	9	41.222	17.21	5.7368	41.75
5/27/81	9	45.889	20.109	6.7029	43.82
6/ 1/81	9	34.556	13.52	4.5065	39.124
6/18/81	9	353.33	202.85	67.618	57.412
6/28/81	9	350	283.11	94.369	80.888
7/ 9/81	9	37.222	13.479	4.4931	36.213
7/22/81	9	48.889	23.614	7.8713	48.301
7/27/81	9	42.111	14.53	4.8432	34.503
8/ 6/81	9	42.111	14.53	4.8432	34.503
8/20/81	9	48.333	16.56	5.5202	34.263
9/22/81	9	37.667	8.9443	2.9814	23.746
9/27/81	9	35.778	14.087	4.6957	39.374

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
FILTERED AMMONIA (MG/L)					
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80	9	.06667	.02179	.00726	32.692
10/28/80	9	.03889	.02088	.00696	53.7
11/13/80	9	.14333	.11587	.03862	80.837
11/24/80	9	0.06	.02121	.00707	35.355
12/15/80	9	.06889	.00928	.00309	13.47
3/11/81	9	0.18	.14637	.04879	81.318
4/ 8/81	9	.13889	.13271	.04424	95.549
5/ 8/81	9	.05556	.04876	.01625	87.772
5/27/81	9	.02333	.02291	.00764	98.198
6/ 1/81	9	.03778	.03833	.01278	101.47
6/18/81	9	0.08	.05244	.01748	65.551
6/28/81	9	.04778	.06016	.02005	125.92
7/ 9/81	9	.01889	.01364	.00455	72.224
7/22/81	9	.14667	0.0946	.03153	64.503
7/27/81	9	.13556	.08805	.02935	64.955
8/ 6/81	9	.09889	.05754	.01918	58.189
8/20/81	9	.11111	.06882	.02294	61.937
9/22/81	9	.16111	0.0647	.02157	40.159
9/27/81	9	.05444	.04773	.01591	87.66
TOTAL AMMONIA (MG/L)					
7/ 7/80	9	.04556	.04953	.01651	108.71
7/10/80	9	.04111	.04343	.01448	105.64
7/16/80	10	0.034	.02011	.00636	59.149
7/28/80	7	.06571	0.0276	.01043	42.004
8/27/80	9	.06667	.03674	.01225	55.114
10/ 4/80					
10/10/80	9	0.02	0.01	.00333	50
10/28/80					
11/13/80					
11/24/80					
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		FILTERED NITRITE (MG/L)			
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80	9	.01067	0.0051	0.0017	47.803
10/28/80	9	.00222	441E-6	147E-6	19.843
11/13/80	9	.00478	.00476	.00159	99.709
11/24/80	9	.01767	.03498	.01166	198.01
12/15/80	9	.00822	.00547	.00182	66.553
3/11/81	9	.01178	.00714	.00238	60.602
4/ 8/81	9	.01367	.00624	.00208	45.695
5/ 8/81	9	.00933	.00743	.00248	79.64
5/27/81	9	.00622	.00205	683E-6	32.915
6/ 1/81	9	.01011	.01209	.00403	119.55
6/18/81	9	.00822	.01291	0.0043	157.03
6/28/81	9	0.01	0.0182	.00607	182
7/ 9/81	9	.00389	.00468	.00156	120.23
7/22/81	9	0.03	.02022	.00674	67.412
7/27/81	9	0.004	.00548	.00183	136.93
8/ 6/81	9	.01822	.00719	0.0024	39.457
8/20/81	9	.07556	.03434	.01145	45.456
9/22/81	9	.08544	.03565	.01188	41.725
9/27/81	9	0.061	0.0241	.00803	39.506
		TOTAL NITRITE (MG/L)			
7/ 7/80	9	.00511	.00955	.00318	186.75
7/10/80	9	.00478	.00738	.00246	154.44
7/16/80	10	0.0036	.00654	.00207	181.54
7/28/80	7	.00686	.00146	553E-6	21.348
8/27/80	9	0.014	.00381	.00127	27.199
10/ 4/80					
10/10/80	9	.00444	.00251	835E-6	56.375
10/28/80					
11/13/80					
11/24/80					
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		FILTERED NITRATE (MG/L)			
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80	9	.45111	.80925	.26975	179.39
10/28/80	9	.05889	.06234	.02078	105.86
11/13/80	9	.30889	.54814	.18271	177.46
11/24/80	9	.30333	.65563	.21854	216.14
12/15/80	9	.36333	.88872	.29624	244.6
3/11/81	9	.62111	.37538	.12513	60.437
4/ 8/81	9	.35444	.14072	.04691	39.702
5/ 8/81	9	.25556	.33638	.11213	131.63
5/27/81	9	.27889	0.4501	.15003	161.39
6/ 1/81	9	.21778	.48726	.16242	223.74
6/18/81	9	.16444	.37427	.12476	227.6
6/28/81	9	.29889	.72551	.24184	242.73
7/ 9/81	9	.10889	.26765	.08922	245.8
7/22/81	9	.03889	.07184	.02395	184.73
7/27/81	9	.06778	.14403	.04801	212.5
8/ 6/81	9	.01556	.00527	.00176	33.882
8/20/81	9	.08111	0.0881	.02937	108.61
9/22/81	9	.17444	.26505	.08835	151.94
9/27/81	9	.08444	.04216	.01405	49.931
		TOTAL NITRATE (MG/L)			
7/ 7/80	9	0.29	.57147	.19049	197.06
7/10/80	9	.15222	.25572	.08524	167.99
7/16/80	10	0.215	.55935	.17688	260.16
7/28/80	7	.04571	.06828	.02581	149.36
8/27/80	9	.26556	.68447	.22816	257.75
10/ 4/80					
10/10/80	9	.30889	0.7993	.26643	258.77
10/28/80					
11/13/80					
11/24/80					
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		FILTERED TOTAL KJELDAHL NITROGEN (MG/L)			
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80	9	.69333	.23249	0.0775	33.532
10/28/80	9	.74111	.27475	.09158	37.072
11/13/80	9	.59667	.12207	.04069	20.458
11/24/80	9	.49111	.08403	.02801	17.11
12/15/80	9	.52667	.11079	.03693	21.037
3/11/81	9	.59667	.18861	.06287	31.611
4/ 8/81	9	.48667	.20156	.06719	41.416
5/ 8/81	9	.89333	0.0911	.03037	10.198
5/27/81	9	.45111	.11516	.03839	25.527
6/ 1/81	9	.54667	0.235	.07833	42.988
6/18/81	9	.63889	.12811	0.0427	20.051
6/28/81	9	.73444	.19301	.06434	26.28
7/ 9/81	9	.83667	.13583	.04528	16.235
7/22/81	9	0.96	.14405	.04802	15.005
7/27/81	9	.86444	.15404	.05135	17.819
8/ 6/81	9	.69889	.07061	.02354	10.104
8/20/81	9	.52222	.11809	.03936	22.612
9/22/81	9	.72111	.27269	0.0909	37.816
9/27/81	9	.77222	.55061	.18354	71.302
		TOTAL KJELDAHL NITROGEN (MG/L)			
7/ 7/80	9	.07556	.03005	.01002	39.767
7/10/80	9	.13556	.27591	.09197	203.54
7/16/80	10	0.293	.19822	.06268	67.651
7/28/80	7	.46714	.08826	.03336	18.894
8/27/80	9	.05667	.01658	.00553	29.264
10/ 4/80					
10/10/80	9	0.6	.20469	.06823	34.116
10/28/80	9	.73333	.13592	.04531	18.535
11/13/80	9	.65222	.14025	.04675	21.503
11/24/80	9	.63667	.11045	.03682	17.349
12/15/80	9	.59889	.11911	0.0397	19.888
3/11/81	9	.59222	.23684	.07895	39.992
4/ 8/81	9	.95111	.32033	.10678	33.68
5/ 8/81	9	.96667	.09631	0.0321	9.9627
5/27/81	9	.78222	0.3112	.10373	39.784
6/ 1/81	9	0.66	0.3106	.10353	47.061
6/18/81	9	0.89	.24764	.08255	27.825
6/28/81	9	1.1467	0.3732	0.1244	32.546
7/ 9/81	9	1.1644	.20286	.06762	17.421
7/22/81	9	1.1789	.27647	.09216	23.452
7/27/81	9	1.1578	.49401	.16467	42.669
8/ 6/81	9	.86556	.14266	.04755	16.482
8/20/81	9	.92111	.29843	.09948	32.399
9/22/81	9	.69778	.18349	.06116	26.297
9/27/81	9	.75667	.15961	0.0532	21.094

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		TOTAL NITROGEN (MG/L)			
7/ 7/80	9	.29511	0.5806	.19353	196.74
7/10/80	9	0.157	.26208	.08736	166.93
7/16/80	10	0.2186	.56587	.17894	258.86
7/28/80	7	.05257	.06843	.02586	130.17
8/27/80	9	.27956	.68608	.22869	245.42
10/ 4/80					
10/10/80	9	.31333	.80141	.26714	255.77
10/28/80					
11/13/80	9	.56544	.49636	.16545	87.782
11/24/80	9	.59333	.62572	.20857	105.46
12/15/80	9	.69433	.87239	0.2908	125.64
3/11/81	9	.80111	.36225	.12075	45.218
4/ 8/81	9	.59689	.17896	.05965	29.983
5/ 8/81	9	.46722	.36063	.12021	77.186
5/27/81	9	.46267	.46487	.15496	100.48
6/ 1/81	9	.39889	.52648	.17549	131.99
6/18/81	9	.34844	.39391	0.1313	113.05
6/28/81	8	0.527	.78366	.27707	148.7
7/ 9/81	9	.36367	.34855	.11618	95.843
7/22/81	9	.36611	.16345	.05448	44.644
7/27/81	8	.48437	.43013	.15207	88.801
8/ 6/81	9	.37889	0.1124	.03747	29.666
8/20/81	9	0.572	.10053	.03351	17.576
9/22/81					
9/27/81					
		FILTERED TOTAL NITROGEN (MG/L)			
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80	9	.46178	.81327	.27109	176.12
10/28/80	9	.06111	.06266	.02089	102.54
11/13/80	9	.31367	.55281	.18427	176.24
11/24/80	9	0.321	0.6902	.23007	215.01
12/15/80	9	.37156	.88985	.29662	239.49
3/11/81	9	.63289	.37413	.12471	59.114
4/ 8/81	9	.36811	0.1392	0.0464	37.816
5/ 8/81	9	.26489	.34362	.11454	129.72
5/27/81	9	.28511	.44975	.14992	157.74
6/ 1/81	9	.22789	.49928	.16643	219.09
6/18/81	9	.17267	0.387	0.129	224.13
6/28/81	9	.30889	.74359	.24786	240.73
7/ 9/81	9	.11278	.27184	.09061	241.04
7/22/81	9	.06889	0.0695	.02317	100.89
7/27/81	9	.07178	.14906	.04969	207.67
8/ 6/81	9	.03378	.00931	0.0031	27.565
8/20/81	9	.15667	.09602	.03201	61.287
9/22/81	9	.25989	.24007	.08002	92.375
9/27/81	9	.14544	0.0558	0.0186	38.364

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
TOTAL PHOSPHORUS (MG/L)					
7/ 7/80	9	.10889	.06051	.02017	55.568
7/10/80	9	.05778	.02863	.00954	49.545
7/16/80	10	0.061	.03665	.01159	60.084
7/28/80	7	.05143	.01676	.00634	32.592
8/27/80	9	.05667	0.0255	0.0085	44.991
10/ 4/80					
10/10/80	9	.11333	.08602	.02867	75.903
10/28/80	9	.31889	.22116	.07372	69.353
11/13/80	9	.10444	0.0594	0.0198	56.868
11/24/80	9	.10222	0.0327	0.0109	31.991
12/15/80	9	.14111	.05255	.01752	37.238
3/11/81	9	.60333	1.1889	0.3963	197.05
4/ 8/81	9	.11222	.06685	.02228	59.573
5/ 8/81	9	.07222	.03308	.01103	45.806
5/27/81	9	0.09	.05545	.01848	61.614
6/ 1/81	9	.02111	.02977	.00992	141
6/18/81	8	0.035	.03928	.01389	112.23
6/28/81	9	.07222	.06629	0.0221	91.787
7/ 9/81	9	.14444	.02744	.00915	18.995
7/22/81	9	.10111	.05555	.01852	54.942
7/27/81	9	.14111	.07849	.02616	55.625
8/ 6/81	9	.09778	.04738	.01579	48.452
8/20/81	9	.13222	.04684	.01561	35.429
9/22/81	9	.11556	.03206	.01069	27.743
9/27/81	9	.09667	.03122	.01041	32.302
FILTERED PHOSPHORUS (MG/L)					
7/ 7/80	9	.03111	.01269	.00423	40.799
7/10/80	9	.01778	.01394	.00465	78.437
7/16/80	9	.04556	.03245	.01082	71.224
7/28/80	7	.04714	.02289	.00865	48.548
8/27/80	9	.02667	.01225	.00408	45.928
10/ 4/80					
10/10/80	9	.04111	.00928	.00309	22.572
10/28/80	9	.30333	.20457	.06819	67.442
11/13/80	9	.06333	.08246	.02749	130.2
11/24/80	9	.02333	.01803	.00601	77.262
12/15/80	9	0.02	0.02	.00667	100
3/11/81	9	.14778	0.0531	0.0177	35.931
4/ 8/81	9	.03778	.02863	.00954	75.775
5/ 8/81	9	0.04	.01658	.00553	41.458
5/27/81	9	.03444	.02603	.00868	75.583
6/ 1/81	9	0.02	.01803	.00601	90.139
6/18/81	9	0.03	0.0364	.01213	121.34
6/28/81	9	.01889	.01167	.00389	61.765
7/ 9/81	9	.07667	.02646	.00882	34.51
7/22/81	9	.05667	.01658	.00553	29.264
7/27/81	9	.02778	.01394	.00465	50.2
8/ 6/81	9	0.02	0.015	0.005	75
8/20/81	9	0.03	.01118	.00373	37.268
9/22/81	9	0.06	.01414	.00471	23.57
9/27/81	9	.05111	.05465	.01822	106.91

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		TOTAL PARTICULATE PHOSPHORUS (MG/L)			
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80					
10/28/80					
11/13/80					
11/24/80					
12/15/80	9	.12211	.05252	.01751	43.01
3/11/81	9	0.479	1.1604	.38681	242.26
4/ 8/81	9	.14456	.18238	.06079	126.17
5/ 8/81	8	.03637	.03148	.01113	86.536
5/27/81	9	.05656	.04693	.01564	82.987
6/ 1/81	9	.00711	.01581	.00527	222.4
6/18/81	9	.02189	0.0285	0.0095	130.19
6/28/81	9	.05789	.06114	.02038	105.62
7/ 9/81	9	.06633	.02666	.00889	40.198
7/22/81	9	0.051	.05772	.01924	113.18
7/27/81	9	.08567	0.0695	.02317	81.133
8/ 6/81	9	.07744	.04585	.01528	59.201
8/20/81	9	.10233	.03884	.01295	37.954
9/22/81	9	.05611	.03479	0.0116	62.002
9/27/81	9	0.06	.03563	.01188	59.389
		FILTERED ORTHOPHOSPHORUS (MG/L)			
7/ 7/80	9	.03222	.03898	.01299	120.97
7/10/80	9	.01556	.01333	.00444	85.714
7/16/80	10	0.017	.01337	.00423	78.676
7/28/80	7	.01571	.01134	.00429	72.157
8/27/80	9	.01889	.01054	.00351	55.805
10/ 4/80					
10/10/80	9	.02333	.00866	.00289	37.115
10/28/80	9	.01667	.00707	.00236	42.426
11/13/80	9	.01111	.00333	.00111	30
11/24/80	9	0.01	0	0	0
12/15/80	9	.01111	.00333	.00111	30
3/11/81	9	.07333	0.0255	0.0085	34.766
4/ 8/81	9	.01111	.00333	.00111	30
5/ 8/81	9	.01222	.00667	.00222	54.545
5/27/81	9	.01667	.01658	.00553	99.499
6/ 1/81	9	.01444	.01333	.00444	92.308
6/18/81	9	.01667	.01658	.00553	99.499
6/28/81	9	.01222	.00441	.00147	36.078
7/ 9/81	9	.01556	.01333	.00444	85.714
7/22/81	9	.02333	.01225	.00408	52.489
7/27/81	9	.03222	.01093	.00364	33.918
8/ 6/81	9	.01556	.00726	.00242	46.702
8/20/81	9	.01778	.00972	.00324	54.665
9/22/81	9	.11667	.22271	.07424	190.89
9/27/81	9	.03556	.00882	.00294	24.804

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
TOTAL ORGANIC CARBON (MG/L)					
7/ 7/80	9	9.1	2.5219	.84063	27.713
7/10/80	9	9.5222	1.5714	.52382	16.503
7/16/80	10	7.41	4.2938	1.3578	57.946
7/28/80	7	6.7714	1.8328	.69272	27.066
8/27/80	9	6.6111	1.3596	.45321	20.566
10/ 4/80					
10/10/80					
10/28/80					
11/13/80					
11/24/80					
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					
PARTICULATE ORGANIC CARBON (MG/L)					
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80					
10/28/80					
11/13/80	9	1.7734	.60977	.20326	34.383
11/24/80	9	1.8653	.90367	.30122	48.445
12/15/80	9	2.3089	.62649	.20883	27.134
3/11/81	9	1.7189	.73543	.24514	42.785
4/ 8/81	9	2.1742	1.6159	.53864	74.322
5/ 8/81	9	1.8644	1.5134	.50447	81.173
5/27/81	9	1.3452	.34681	0.1156	25.781
6/ 1/81	9	1.4492	.71026	.23675	49.01
6/18/81	9	1.2816	.52099	.17366	40.653
6/28/81	9	1.5267	1.0345	.34483	67.762
7/ 9/81	9	2.0278	.74047	.24682	36.516
7/22/81	9	1.8837	1.1042	.36808	58.621
7/27/81	8	2.8312	1.8708	.66141	66.075
8/ 6/81	9	2.3011	0.7596	0.2532	33.01
8/20/81	9	3.0756	1.6309	.54362	53.027
9/22/81	9	1.4433	.42924	.14308	29.74
9/27/81	9	1.8916	.80636	.26879	42.629

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		CHLOROPHYLL AC (UG/L)			
7/ 7/80	7	1.1771	.59581	0.2252	50.615
7/10/80	14	15.256	30.201	8.0715	197.95
7/16/80	9	.76333	.41842	.13947	54.815
7/28/80	7	.38286	.20467	.07736	53.459
8/27/80	15	9.7847	16.974	4.3828	173.48
10/ 4/80					
10/10/80	9	8.0211	9.5559	3.1853	119.13
10/28/80	9	3.7044	9.0535	3.0178	244.39
11/13/80	9	9.8722	5.5286	1.8429	56.002
11/24/80	9	7.7511	5.9117	1.9706	76.27
12/15/80	9	6.91	2.623	.87433	37.959
3/11/81	9	11.773	5.0831	1.6944	43.175
4/ 8/81	15	19.441	12.159	3.1393	62.539
5/ 8/81	15	20.562	20.656	5.3333	100.46
5/27/81	9	8.1967	11.063	3.6875	134.97
6/ 1/81	9	3.2989	2.5162	.83873	76.274
6/18/81	9	6.4978	6.3773	2.1258	98.145
6/28/81	9	9.2556	4.9123	1.6374	53.074
7/ 9/81	9	12.997	5.296	1.7653	40.749
7/22/81	9	34.751	50.863	16.954	146.36
7/27/81	9	13.561	19.299	6.433	142.31
8/ 6/81	9	34.182	38.162	12.721	111.64
8/20/81	9	25.212	22.629	7.5429	89.753
9/22/81	9	1.2222	1.0686	.35621	87.432
9/27/81	9	1.5922	1.5449	.51498	97.03
		PHAEOPHYTIN AC (UG/L)			
7/ 7/80	9	5.5689	4.5968	1.5323	82.543
7/10/80	14	4.3143	4.9977	1.3357	115.84
7/16/80	9	3.7622	4.1096	1.3699	109.23
7/28/80	7	5.9429	2.8347	1.0714	47.699
8/27/80	15	6.9733	4.8538	1.2532	69.605
10/ 4/80					
10/10/80	9	7.1411	11.413	3.8043	159.82
10/28/80	9	2.3756	7.0967	2.3656	298.74
11/13/80	9	6.9178	11.435	3.8116	165.3
11/24/80	9	45.599	36.821	12.274	80.749
12/15/80	9	5.2589	4.0682	1.3561	77.358
3/11/81	9	1.3756	2.1313	.71044	154.94
4/ 8/81	15	9.3267	12.89	3.3281	138.2
5/ 8/81	15	1.144	3.3698	.87009	294.57
5/27/81	9	2.74	3.5477	1.1826	129.48
6/ 1/81	9	11.354	32.32	10.773	284.64
6/18/81	9	6.2089	11.145	3.7151	179.51
6/28/81	9	1.8544	4.9575	1.6525	267.33
7/ 9/81	9	8.6756	7.3084	2.4361	84.241
7/22/81	9	10.94	7.7701	2.59	71.024
7/27/81	9	19.862	27.88	9.2933	140.37
8/ 6/81	9	13.773	4.9521	1.6507	35.954
8/20/81	9	13.269	9.821	3.2737	74.015
9/22/81	9	0.89	1.2948	0.4316	145.48
9/27/81	9	5.5378	13.866	4.622	250.39

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE
STATISTICS BY SURVEY DATE (ALL STATIONS)

TOTAL DISSOLVED SOLIDS (MG/L)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
7/ 7/80	9	6466.2	3196.3	1065.4	49.431
7/10/80	9	7612.4	3634.6	1211.5	47.746
7/16/80	9	7311	3441.6	1147.2	47.074
7/28/80	7	7947.4	2536.1	958.57	31.911
8/27/80	9	9710.3	4482.5	1494.2	46.162
10/ 4/80					
10/10/80	1	55			
10/28/80	1	163			
11/13/80	1	103			
11/24/80	1	124			
12/15/80	1	120			
3/11/81	1	70			
4/ 8/81	1	13			
5/ 8/81	1	38			
5/27/81	1	120			
6/ 1/81	1	150			
6/18/81	1	159			
6/28/81	1	175			
7/ 9/81	1	156			
7/22/81					
7/27/81					
8/ 6/81	1	150			
8/20/81	1	163			
9/22/81					
9/27/81	1	286			

ORTHOPHOSPHORUS (MG/L)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
7/ 7/80	9	.02222	.02386	.00795	107.38
7/10/80	9	.01556	.01333	.00444	85.714
7/16/80	9	.01556	.01333	.00444	85.714
7/28/80	7	.02429	.01272	.00481	52.394
8/27/80	9	0.02	.01323	.00441	66.144
10/ 4/80					
10/10/80					
10/28/80					
11/13/80					
11/24/80					
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		PARTICULATE PHOSPHORUS (MG/L)			
7/ 7/80	9	.07778	.05932	.01977	76.275
7/10/80	9	0.04	.03391	0.0113	84.779
7/16/80	9	.01111	.01054	.00351	94.868
7/28/80	6	.00667	.00516	.00211	77.46
8/27/80	9	0.03	.02398	.00799	79.93
10/ 4/80					
10/10/80	7	.09714	.07783	.02942	80.117
10/28/80	5	0.212	.27454	.12278	129.5
11/13/80	7	0.1	.03873	.01464	38.73
11/24/80	9	.07889	.03655	.01218	46.335
12/15/80	9	.12111	.05134	.01711	42.393
3/11/81	5	0.868	1.5064	.67367	173.55
4/ 8/81	8	0.085	.05237	.01852	61.614
5/ 8/81	9	.03222	.02991	.00997	92.816
5/27/81	9	.05556	.04475	.01492	80.554
6/ 1/81	7	.00571	.01512	.00571	264.58
6/18/81	7	0.01	0.01	.00378	100
6/28/81	8	.06125	.06244	.02207	101.94
7/ 9/81	9	.06778	.02906	.00969	42.874
7/22/81	9	.04444	.05637	.01879	126.84
7/27/81	9	.11333	.08337	.02779	73.559
8/ 6/81	9	.07778	.04577	.01526	58.841
8/20/81	9	.10222	.03993	.01331	39.062
9/22/81	9	.05556	.03358	.01119	60.448
9/27/81	8	0.0625	.01282	.00453	20.508
		FILTERED INORGANIC NITROGEN (MG/L)			
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80	9	.52844	.82164	.27388	155.48
10/28/80	9	0.1	0.0826	.02753	82.603
11/13/80	9	0.457	.52851	.17617	115.65
11/24/80	9	0.381	.69933	.23311	183.55
12/15/80	9	.44044	.89394	.29798	202.96
3/11/81	9	.81289	.42132	.14044	51.83
4/ 8/81	9	0.507	.22536	.07512	44.449
5/ 8/81	9	.32044	.39182	.13061	122.27
5/27/81	9	.30844	.45117	.15039	146.27
6/ 1/81	9	.26567	.53506	.17835	201.4
6/18/81	9	.25267	.41481	.13827	164.17
6/28/81	9	.35667	.79875	.26625	223.95
7/ 9/81	9	.13167	.27362	.09121	207.81
7/22/81	9	.21556	.10576	.03525	49.062
7/27/81	9	.20733	.13569	.04523	65.447
8/ 6/81	9	.13267	0.0544	.01813	41.008
8/20/81	9	.26778	.15894	.05298	59.354
9/22/81	9	0.421	0.2076	0.0692	49.31
9/27/81	9	.19989	.04722	.01574	23.621

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE STATISTICS BY SURVEY DATE (ALL STATIONS)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
		TOTAL INORGANIC NITROGEN	(MG/L)		
7/ 7/80	9	.34067	.60072	.20024	176.34
7/10/80	9	.19811	.29427	.09809	148.54
7/16/80	10	0.2526	.58548	.18514	231.78
7/28/80	7	.11829	.07439	.02812	62.888
8/27/80	9	.34622	.69192	.23064	199.85
10/ 4/80					
10/10/80	9	.33333	.80537	.26846	241.61
10/28/80					
11/13/80					
11/24/80					
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					
		TOTAL ORGANIC NITROGEN	(MG/L)		
7/ 7/80	7	.05143	.03625	0.0137	70.492
7/10/80	6	.16833	0.3392	.13848	201.5
7/16/80	10	0.259	.19547	.06181	75.473
7/28/80	7	.40143	.08668	.03276	21.594
8/27/80	5	0.016	.01517	.00678	94.786
10/ 4/80					
10/10/80	9	0.58	.20143	.06714	34.73
10/28/80					
11/13/80					
11/24/80					
12/15/80					
3/11/81					
4/ 8/81					
5/ 8/81					
5/27/81					
6/ 1/81					
6/18/81					
6/28/81					
7/ 9/81					
7/22/81					
7/27/81					
8/ 6/81					
8/20/81					
9/22/81					
9/27/81					

```
TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE
                  STATISTICS BY SURVEY DATE (ALL STATIONS)
-----------------------------------------------------------------------------
                                          STANDARD   STANDARD      COEFF
 DATE            N          MEAN         DEVIATION  MEAN ERROR   VARIATION
-----------------------------------------------------------------------------
                   DISSOLVED ORGANIC NITROGEN  (MG/L)

 7/ 7/80
 7/10/80
 7/16/80
 7/28/80
 8/27/80
10/ 4/80
10/10/80         9        .62667       0.2288     .07627       36.511
10/28/80         9        .70222       0.2846     .09487       40.528
11/13/80         9        .45333       0.1607     .05357       35.449
11/24/80         9        .43111       0.0871     .02903       20.203
12/15/80         9        .45778       .10745     .03582       23.471
 3/11/81         9        .41667       0.1456     .04853       34.945
 4/ 8/81         9        .34778       .18626     .06209       53.558
 5/ 8/81         9        .83778       0.1006     .03353       12.007
 5/27/81         9        .42778       .11443     .03814        26.75
 6/ 1/81         9        .50889       0.2049     0.0683       40.265
 6/18/81         9        .55889       .09867     .03289       17.655
 6/28/81         9        .68667       .13784     .04595       20.074
 7/ 9/81         9        .81778       .13691     .04564       16.742
 7/22/81         9        .81333       .10618     .03539       13.055
 7/27/81         9        .72889       .10671     .03557       14.639
 8/ 6/81         9           0.6       .08718     .02906        14.53
 8/20/81         9        .41111       .12303     .04101       29.926
 9/22/81         9          0.56       .28004     .09335       50.008
 9/27/81         9        .71778       .56118     .18706       78.183
                      PARTICULATE NITROGEN  (MG/L)

 7/ 7/80
 7/10/80
 7/16/80
 7/28/80
 8/27/80
10/ 4/80
10/10/80
10/28/80
11/13/80         9        .25178       .10344     .03448       41.085
11/24/80         9        .27233       .16873     .05624       61.956
12/15/80         9        .32278       .08877     .02959       27.502
 3/11/81         9        .16822       .09815     .03272       58.346
 4/ 8/81         9        .22878       0.1595     .05317       69.717
 5/ 8/81         9        .20233       .23948     .07983       118.36
 5/27/81         9        .17756       .05533     .01844       31.164
 6/ 1/81         9         0.171       .10379     0.0346       60.693
 6/18/81         9        .17578       0.0813     0.0271       46.254
 6/28/81         8        .18512       .14694     .05195       79.374
 7/ 9/81         9        .25089       .15474     .05158       61.675
 7/22/81         9        .29722       .14471     .04824       48.687
 7/27/81         8        0.4105       .28147     .09951       68.567
 8/ 6/81         9        .34511       0.1117     .03723       32.365
 8/20/81         9        .41533       .17951     .05984        43.22
 9/22/81
 9/27/81
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
```

TABLE 7-1 (CONT.) SLACK SURVEY DATA - UNIVARIATE
STATISTICS BY SURVEY DATE (ALL STATIONS)

FILTERED INORGANIC NITROGEN / ORTHOPHOSPHORUS (RATIO)

DATE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERROR	COEFF VARIATION
7/ 7/80					
7/10/80					
7/16/80					
7/28/80					
8/27/80					
10/ 4/80					
10/10/80	9	39.468	82.537	27.512	209.13
10/28/80	9	7.5833	8.6571	2.8857	114.16
11/13/80	9	44.233	53.631	17.877	121.25
11/24/80	9	38.1	69.933	23.311	183.55
12/15/80	9	28.428	43.089	14.363	151.57
3/11/81	9	11.23	3.7995	1.2665	33.834
4/ 8/81	9	45.439	15.366	5.1222	33.818
5/ 8/81	9	22.281	14.205	4.7349	63.751
5/27/81	9	16.361	13.185	4.3949	80.585
6/ 1/81	9	11.616	10.496	3.4988	90.366
6/18/81	9	12.591	8.363	2.7877	66.422
6/28/81	9	20.406	38.963	12.988	190.94
7/ 9/81	9	4.8278	4.8636	1.6212	100.74
7/22/81	9	10.888	7.6458	2.5486	70.223
7/27/81	9	6.1837	3.1226	1.0409	50.497
8/ 6/81	9	10.161	4.9438	1.6479	48.654
8/20/81	9	19.756	14.342	4.7806	72.596
9/22/81	9	9.2167	6.2097	2.0699	67.374
9/27/81	9	5.785	1.4787	.49292	25.562

TABLE 7-2 STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	0-3 PPT N	0-3 PPT MEAN	0-3 PPT STD	3.1-10 PPT N	3.1-10 PPT MEAN	3.1-10 PPT STD	GREATER 10 PPT N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	ALL DATA N	ALL DATA MEAN	ALL DATA STD
TEMPERTURE (DEGREES C)												
3	1	6		2	5.5	.4714	6	4.344	.6344	9	4.785	.8586
4	1	14.83		3	13	0	10	11.07	.8718	14	11.75	1.406
5	2	21.67	5.185	5	20.96	3.101	11	16.88	3.288	18	18.55	3.853
6	3	23.77	3.132	16	24.41	1.583	8	22.98	2	27	23.91	1.922
7	8	26.54	2.924	36	25.97	1.728	19	25.48	2.502	63	25.89	2.14
8	3	22.57	1.29	11	26.75	1.255	18	25.22	1.056	32	25.5	1.629
9	2	18.43	1.084	2	19.15	.5421	14	19.63	1.011	18	19.44	1.013
10	2	12.67	3.771	2	14.27	4.478	14	15.25	3.192	18	14.85	3.246
11	2	6.9	.1414	2	6.65	1.061	14	6.9	0.733	18	6.872	.6962
12	1	2.6		1	3.333		7	3.943	.3298	9	3.726	.5482
TURBIDITY (FTU)												
3												
4												
5												
6	2	16.5	13.44	10	9.8	12.33	5	3.6	1.517	17	8.765	10.67
7	6	16.33	11.2	33	7.079	5.713	5	4.4	2.302	44	8.036	7.157
8	1	10		4	9.25	4.573	4	5	2.16	9	7.444	3.877
9												
10												
11												
12												
SECCHI DISC (FEET)												
3	1	0.8		2	0.4	0	6	1.4	0.2	9	1.111	.4755
4	1	0.9		1	0.3		6	0.9	.4561	8	0.825	0.44
5	2	0.4	0	5	0.48	.2168	9	1.067	.5895	16	0.8	.5441
6	2	0.6	.4243	15	0.74	.4356	6	1.533	.5279	23	.9348	0.571
7	8	0.514	.4077	36	.5228	.2706	18	.7611	.2953	62	.5908	.3122
8	3	0.523	.2250	7	.4586	.2339	17	.6841	.2572	27	.6078	.2605
9	2	0.8	.2828	2	0.25	.0707	12	.7917	.1564	16	0.725	.2408
10	2	1.2	.4243	2	0.4	0	14	1.021	.1805	18	.9722	.2866
11	1	0.9		2	0.3	.4243	14	.8857	.2983	17	.8176	.3486
12	1	1.2		1	0.8		7	.9429	.0535	9	.9556	0.113

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	N	0-3 PPT MEAN	STD	N	3.1-10 PPT MEAN	STD	N	GREATER 10 PPT MEAN	STD	N	ALL DATA MEAN	STD
DISSOLVED OXYGEN (MG/L)												
3	1	11.8		2	11.62	.3064	6	12.62	.8392	9	12.3	.8217
4	1	10.53		1	10.67		7	10.44	.5526	9	10.47	0.485
5	2	8.2	.3771	5	9.68	.5684	11	8.421	.8421	18	8.746	.9281
6	3	7.056	.9021	16	6.317	.9271	8	5.483	.7717	27	6.152	.9835
7	8	7.802	3.367	30	6.139	1.026	19	6.086	1.245	57	6.355	1.676
8	2	9.45	2.616	3	6.644	.6619	13	5.788	.7861	18	6.338	1.509
9	2	8.467	1.226	2	6.317	.3064	14	7.799	1.099	18	7.708	1.149
10	2	8.533	1.226	2	8.45	1.485	14	8.698	.9736	18	8.652	.9753
11	2	11.95	1.061	2	12.35	1.909	14	11.55	1.328	18	11.69	1.306
12	1	11		1	11.3		7	11.04	.3526	9	11.07	0.318
DISSOLVED OXYGEN SATURATION (PER CENT)												
3	1	93.8		2	96.2	3.158	6	103.9	6.963	9	101.1	7.086
4	1	103.7		1	104.6		7	101.8	5.643	9	102.3	4.997
5	2	93.5	13.72	5	113.7	10.56	11	93.26	13.32	18	98.98	15.18
6	3	83.7	13.73	16	79.42	12.22	8	68.29	8.927	27	76.6	12.41
7	8	97.95	45.34	30	78.51	13.05	19	78.78	14.62	57	81.33	21.44
8	2	109.5	26.68	3	85.22	8.757	13	74.89	9.934	18	80.46	15.72
9	2	91.15	16.24	2	71.82	2.663	14	92.51	11.49	18	90.06	12.69
10	2	79.4	4.384	2	84.43	6.081	14	92.95	6.323	18	90.5	7.592
11	2	97.15	8.98	2	104.7	14.17	14	102.2	10.12	18	101.9	9.926
12	1	80.3		1	87.93		7	90.63	3.546	9	89.19	4.618
BOD5 (MG/L)												
3	1	1		2	1	0	6	1.25	.4183	9	1.167	.3536
4	1	3		1	3		7	3.429	.7868	9	3.333	.7071
5	2	3	1.414	5	3.6	.5477	11	2.636	.6742	18	2.944	.8024
6	1	3		5	2	1	3	1	0	9	1.778	.9718
7	8	4.125	5.303	35	2.82	1.21	18	2.611	1.243	61	2.93	2.186
8	3	6.333	6.11	7	3.143	1.069	17	3	0.866	27	3.407	2.171
9	2	2.5	2.121	2	2.5	.7071	14	1.857	0.663	18	2	.8402
10	2	3.5	.7071	2	2.5	.7071	14	2.143	.8644	18	2.333	.9075
11	2	3	2.828	2	3.5	3.536	14	3.286	1.069	18	3.278	1.447
12	1	3		1	3		7	2.143	0.378	9	2.333	0.5

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	N	0-3 PPT MEAN	0-3 PPT STD	N	3.1-10 PPT MEAN	3.1-10 PPT STD	N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	N	ALL DATA MEAN	ALL DATA STD
					BOD20 (MG/L)							
3	1	3		2	4.5	.7071	6	2.833	.7528	9	3.222	.9718
4												
5	1	9		3	6	1	2	5	0	6	6.167	1.602
6	1	5		3	4	1	2	3	0	6	3.833	.9832
7	4	4.875	1.436	28	5.911	1.871	1	6		33	5.788	1.807
8	1	3.5		4	4	1.155	4	3.5	1	9	3.722	.9718
9	2	6.5	3.536	2	5.5	.7071	14	4.357	.6333	18	4.722	1.274
10												
11												
12	1	4		1	4		7	4	1.414	9	4	1.225
					BOD30 (MG/L)							
3												
4												
5												
6												
7												
8												
9												
10	2	5.5	.7071	2	5	1.414	14	3.357	1.008	18	3.778	1.263
11	2	6	1.414	2	5.5	2.121	14	6.357	1.151	18	6.222	1.215
12												
					FIELD PH (STD. UNITS)							
3	1	7.7		2	7.9	0	6	8.139	0.039	9	8.037	.1662
4	1	6.8		1	7.3		7	7.186	.2974	9	7.156	.2925
5	2	7.117	.4478	4	7.692	.0739	10	7.703	.1365	16	7.627	.2557
6	3	6.922	.5316	14	7.419	0.435	8	6.862	.2699	25	7.181	.4717
7	6	7.394	0.426	36	7.307	.4964	18	7.511	.3029	60	7.377	.4433
8	3	6.633	.8737	6	7.2	.6197	13	7.318	.4328	22	7.192	.5706
9	2	7.017	.3536	2	7.267	.1886	12	7.76	.1711	16	7.605	.3358
10	1	7.6		2	7.75	0.165	13	7.736	.1377	16	7.729	.1349
11	2	7.6	1.697	1	8.1		14	7.06	.6393	17	7.184	.7744
12	1	8.2		1	8.033		7	7.8	.1139	9	7.87	.1759

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

		0-3 PPT			3.1-10 PPT			GREATER 10 PPT			ALL DATA	
MONTH	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD
					SALINTY (PPT)							
3	1	0.07		2	8	2.828	6	11.53	1.207	9	9.471	4.083
4	1	0.1		3	7.267	2.194	10	11.74	.7637	14	9.952	3.57
5	2	.0483	.0024	5	7.687	2.68	11	10.76	.4463	18	8.718	3.697
6	3	.0478	.0038	16	8.592	1.863	8	10.45	.2737	27	8.194	3.369
7	8	.9692	1.176	36	8.01	1.689	19	11.51	1.107	63	8.171	3.499
8	3	.4467	.4917	11	8.015	1.872	18	12.27	1.559	32	9.697	3.949
9	2	1.27	1.697	2	8.233	.1886	14	14.17	1.315	18	12.08	4.537
10	2	0.1	.0141	2	5.8	.4243	14	12.48	1.073	18	10.36	4.406
11	2	0.085	.0071	2	7.5	.9899	14	12.98	.7057	18	10.94	4.374
12	1	0.09		1	6.9		7	12.45	1.01	9	10.46	4.387
					TOTAL SOLIDS (MG/L)							
3	1	82								1	82	
4	1	40								1	40	
5	2	109.5	65.76							2	109.5	65.76
6	3	427.7	238.7							3	427.7	238.7
7	6	1569	2301	28	8196	2175	1	10228		35	7118	3348
8	3	158.3	33.31	4	9633	3695	4	12277	785.3	11	8010	5578
9	1	307								1	307	
10	2	120.5	91.22							2	120.5	91.22
11	2	124.5	16.26							2	124.5	16.26
12	1	134								1	134	
					SUSPENDED SOLIDS (MG/L)							
3	1	12		2	47	5.657	6	32	7.668	9	33.11	12.07
4	1	27		1	56		7	38	3.873	9	38.78	8.136
5	2	30.5	7.778	5	59.6	19.01	11	38.64	15.17	18	43.56	18.31
6	3	266.3	226.4	15	238.6	254.6	8	172.9	130.1	26	221.6	215.2
7	8	16.13	8.132	36	31.11	17.12	18	40.28	12.46	62	31.84	16.51
8	3	21	1.732	7	50.86	14.09	17	44.71	10.74	27	43.67	13.82
9	2	20	1.414	2	57.5	6.364	14	36.14	7.715	18	36.72	11.49
10	2	11.5	14.85	2	17.5	9.192	13	12.15	9.362	17	12.71	9.386
11	2	11	1.414	1	36		14	31.79	5.925	17	29.59	8.867
12	1	14		1	33		7	42	7.724	9	37.89	11.57

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

FILTERED AMMONIA (MG/L)

MONTH	N	0-3 PPT MEAN	0-3 PPT STD	N	3.1-10 PPT MEAN	3.1-10 PPT STD	N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	N	ALL DATA MEAN	ALL DATA STD
3	1	0.08		2	0.395	.2051	6	0.125	.0418	9	0.18	.1464
4	1	0.1		1	0.48		7	.0957	.0408	9	.1389	.1327
5	2	0.1	.1131	5	0.018	.0179	11	.0382	.0204	18	.0394	.0405
6	3	.1533	.0321	15	.0273	.0243	8	.0737	.0496	26	.0562	.0532
7	3	.0333	.0153	7	.0629	.0538	17	.1276	.1035	27	.1004	.0931
8	2	0.055	.0071	3	0.05	0.01	13	.1254	.0615	18	0.105	.0619
9	2	0.1	.0707	2	0.155	.0636	14	.1021	.0827	18	.1078	.0778
10	2	0.07	.0283	2	0.09	.0141	14	0.045	.0207	18	.0528	.0252
11	2	0.075	.0071	2	0.1	.0283	14	.1057	.1037	18	.1017	.0915
12	1	0.08		1	0.06		7	.0686	0.009	9	.0689	.0093

TOTAL AMMONIA (MG/L)

MONTH	N	0-3 PPT MEAN	0-3 PPT STD	N	3.1-10 PPT MEAN	3.1-10 PPT STD	N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	N	ALL DATA MEAN	ALL DATA STD
3												
4												
5												
6												
7	5	0.104	.0472	29	.0355	.0254	1	0.03		35	.0451	.0373
8	1	0.08		4	.0725	.0574	4	.0575	.0096	9	.0667	.0367
9												
10	1	0.03		1	0.04		7	.0157	.0053	9	0.02	0.01
11												
12												

FILTERED NITRITE (MG/L)

MONTH	N	0-3 PPT MEAN	0-3 PPT STD	N	3.1-10 PPT MEAN	3.1-10 PPT STD	N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	N	ALL DATA MEAN	ALL DATA STD
3	1	0.001		2	0.02	.0113	6	.0108	.0021	9	.0118	.0071
4	1	0.003		1	0.027		7	.0133	.0018	9	.0137	.0062
5	2	0.016	0.017	5	0.006	.0022	11	.0071	.0023	18	.0078	.0055
6	3	.0473	.0092	15	.0043	.0024	8	.0054	.0032	26	.0096	.0144
7	3	.0153	.0015	7	0.014	.0203	17	.0116	.0181	27	.0126	.0173
8	2	.0215	.0007	3	.0323	.0075	13	.0542	.0427	18	.0469	.0381
9	2	0.012	.0085	2	0.04	.0113	14	.0867	.0197	18	.0732	.0321
10	2	.0125	.0148	2	0.007	.0057	14	.0055	.0038	18	.0064	.0056
11	2	.0635	.0658	2	.0045	.0007	14	.0047	.0043	18	.0112	.0251
12	1	0.011		1	0.007		7	0.008	.0062	9	.0082	.0055

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	0-3 PPT N	0-3 PPT MEAN	0-3 PPT STD	3.1-10 PPT N	3.1-10 PPT MEAN	3.1-10 PPT STD	GREATER 10 PPT N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	ALL DATA N	ALL DATA MEAN	ALL DATA STD
					TOTAL NITRITE (MG/L)							
3												
4												
5												
6												
7	5	.0174	.0111	29	.0029	.0027	1	0.001		35	.0049	.0069
8	1	0.018		4	0.015	.0048	4	0.012	.0018	9	0.014	.0038
9												
10	1	0.01		1	0.007		7	.0033	.0008	9	.0044	.0025
11												
12												
					FILTERED NITRATE (MG/L)							
3	1	1.53		2	0.685	.3041	6	.4483	.0655	9	.6211	.3754
4	1	0.61		1	0.44		7	.3057	.1074	9	.3544	.1407
5	2	1.275	.2333	5	0.148	.1529	11	.1382	.0974	18	.2672	.3857
6	3	1.633	.5456	15	.0467	0.047	8	0.065	.0359	26	.2354	.5391
7	3	0.5	.2982	7	.0286	.0267	17	.0141	.0071	27	.0719	.1757
8	2	0.015	.0071	3	.0133	.0058	13	.0615	.0782	18	.0483	.0693
9	2	0.445	.6152	2	0.12	0	14	.0857	0.025	18	.1294	.1898
10	2	1.265	1.662	2	0.165	.0495	14	.1236	.2632	18	0.255	.5922
11	2	1.9	0.198	2	0.25	0	14	.0864	.0558	18	.3061	.5862
12	1	2.72		1	0.31		7	.0343	.0257	9	.3633	.8887
					TOTAL NITRATE (MG/L)							
3												
4												
5												
6												
7	5	0.94	.7366	29	0.06	.1614	1	0.01		35	.1843	.4282
8	1	2.09		4	.0475	0.025	4	.0275	0.015	9	.2656	.6845
9												
10	1	2.44		1	0.08		7	.0371	.0049	9	.3089	.7993
11												
12												

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY
MONTH AND SALINITY REGIMES

MONTH	N	0-3 PPT MEAN	0-3 PPT STD	N	3.1-10 PPT MEAN	3.1-10 PPT STD	N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	N	ALL DATA MEAN	ALL DATA STD
FILTERED TOTAL KJELDAHL NITROGEN (MG/L)												
3	1	0.79		2	0.85	.0141	6	0.48	0.086	9	.5967	.1886
4	1	0.86		1	0.69		7	.4043	0.127	9	.4867	.2016
5	2	0.825	.1768	5	0.524	.2166	11	.7118	.2569	18	.6722	.2488
6	3	.9867	0.155	15	.5993	.1808	8	.5712	0.111	26	.6354	.2015
7	3	.8167	.1721	7	.8729	.1764	17	.9053	.1394	27	0.887	.1492
8	2	0.735	.0495	3	.6567	.0289	13	.5808	.1411	18	.6106	0.131
9	2	0.82	.0566	2	0.71	.1556	14	.7414	.4796	18	.7467	.4223
10	2	0.49	.0283	2	0.67	.1414	14	.7564	.2626	18	.7172	.2481
11	2	0.42	.1131	2	0.6	.1556	14	.5536	.1076	18	.5439	.1153
12	1	0.54		1	0.35		7	0.55	.1025	9	.5267	.1108
TOTAL KJELDAHL NITROGEN (MG/L)												
3	1	0.55		2	0.905	.4172	6	0.495	.0641	9	.5922	.2368
4	1	0.97		1	1.52		7	.8671	.2731	9	.9511	.3203
5	2	0.93	.0566	5	0.844	.3516	11	.8782	.2221	18	.8744	.2428
6	3	1.283	.5082	15	.8893	.3448	8	.7075	.1902	26	.8788	.3556
7	8	.6687	.8533	36	.4417	.4769	18	1.02	.2305	62	.6389	.5429
8	3	.8567	0.775	7	.5129	.5646	17	.6135	.3288	27	.6144	.4425
9	2	0.88	.2828	2	0.97	.1556	14	.6707	.1161	18	.7272	.1696
10	2	0.495	.2192	2	0.95	.1556	14	.6507	.1435	18	.6667	0.182
11	2	0.41	.0424	2	0.675	.0919	14	.6736	.0969	18	.6444	.1227
12	1	0.63		1	0.89		7	.5529	.0464	9	.5989	.1191
TOTAL NITROGEN (MG/L)												
3	1	1.566		2	1.016	.3182	6	0.602	.0816	9	.8011	.3622
4	1	0.642		1	1.038		7	.5274	.0656	9	.5969	0.179
5	2	1.401	.3649	5	.4752	.3322	11	.2901	.1027	18	.4649	.4036
6	3	1.853	.5191	14	.2556	.1601	8	.1776	.0534	25	.4223	.5737
7	8	1.001	0.628	35	.1244	.2151	18	.2613	.1304	61	.2798	.4008
8	3	1.105	0.888	7	.2609	.2644	17	0.349	.2063	27	.4101	.4088
9												
10	1	2.45		1	0.087		7	.0404	.0054	9	.3133	.8014
11	2	2.026	.2411	2	.6345	.0601	14	.3648	.1258	18	.5794	.5481
12	1	2.976		1	0.845		7	.3469	.0494	9	.6943	.8724

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	N	0-3 PPT MEAN	0-3 PPT STD	N	3.1-10 PPT MEAN	3.1-10 PPT STD	N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	N	ALL DATA MEAN	ALL DATA STD
FILTERED TOTAL NITROGEN (MG/L)												
3	1	1.531		2	0.705	.3154	6	.4592	.0667	9	.6329	.3741
4	1	0.613		1	0.467		7	0.319	.1068	9	.3681	.1392
5	2	1.291	.2164	5	0.154	.1548	11	.1453	.0996	18	0.275	.3884
6	3	1.681	.5543	15	0.051	.0482	8	.0704	.0386	26	0.245	.5532
7	3	.5153	.2984	7	.0426	.0308	17	.0257	.0204	27	.0845	.1774
8	2	.0365	.0064	3	.0457	.0093	13	.1157	0.101	18	.0952	.0915
9	2	0.457	.6237	2	0.16	.0113	14	.1724	.0278	18	.2027	0.179
10	2	1.277	1.677	2	0.172	.0438	14	.1291	0.264	18	.2614	.5963
11	2	1.963	.2638	2	.2545	.0007	14	.0911	.0572	18	.3173	.6066
12	1	2.731		1	0.317		7	.0423	0.031	9	.3716	.8898
TOTAL PHOSPHORUS (MG/L)												
3	1	3.75		2	0.365	.1909	6	.1583	.1167	9	.6033	1.189
4	1	0.15		1	0.26		7	.0857	.0355	9	.1122	.0669
5	2	0.145	.0495	5	0.114	.0477	11	.0545	.0137	18	.0811	.0452
6	3	.1367	.0404	15	.0387	.0461	8	.0162	.0052	26	.0431	.0512
7	8	.1312	.0728	36	.0839	.0547	18	.1044	.0551	62	0.096	.0587
8	3	.1267	.0709	7	0.12	.0668	17	0.08	.0339	27	.0956	.0506
9	2	0.13	.0424	2	0.145	.0071	14	.0971	.0284	18	.1061	.0322
10	2	0.435	0.502	2	0.225	.0071	14	.1836	.1462	18	.2161	.1941
11	2	0.075	.0636	2	0.06	.0566	14	.1136	.0418	18	.1033	.0465
12	1	0.16		1	0.22		7	.1271	.0486	9	.1411	.0525
FILTERED PHOSPHORUS (MG/L)												
3	1	0.19		2	0.165	.0636	6	0.135	0.055	9	.1478	.0531
4	1	0.1		1	0.06		7	.0257	0.014	9	.0378	.0286
5	2	0.09	.0141	5	0.028	0.011	11	.0318	.0087	18	.0372	.0214
6	3	0.07	.0458	15	.0167	.0111	8	.0137	.0074	26	.0219	.0238
7	8	.0662	.0393	35	.0369	.0251	18	0.045	.0204	61	.0431	.0274
8	3	.0333	.0153	7	0.03	.0129	17	.0224	.0125	27	.0256	.0131
9	2	0.07	.0283	2	0.055	.0071	14	.0536	.0434	18	.0556	0.039
10	2	0.12	.1131	2	0.135	.1344	14	0.185	.2155	18	.1722	.1948
11	2	0.07	.0566	2	0.165	.1485	14	.0221	.0112	18	.0433	.0615
12	1	0.06		1	0.01		7	.0157	.0151	9	0.02	0.02

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	0-3 PPT N	0-3 PPT MEAN	0-3 PPT STD	3.1-10 PPT N	3.1-10 PPT MEAN	3.1-10 PPT STD	GREATER 10 PPT N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	ALL DATA N	ALL DATA MEAN	ALL DATA STD
TOTAL PARTICULATE PHOSPHORUS (MG/L)												
3	1	3.56		2	0.202	.1315	6	.0578	0.095	9	0.479	1.16
4	1	0.047		1	0.193		7	.1516	.2057	9	.1446	.1824
5	2	.0555	.0361	5	.0886	.0469	10	.0246	.0162	17	.0471	.0405
6	3	0.069	.0741	14	.0271	.0451	8	.0072	.0069	25	.0258	.0439
7	3	0.129	.0901	7	.0914	.0622	17	.0471	.0302	27	.0677	.0542
8	2	0.136	.0297	3	.1467	.0371	13	.0697	.0271	18	.0899	.0432
9	2	.0595	.0064	2	0.117	.0283	14	.0494	.0292	18	.0581	.0342
10												
11												
12	1	0.102		1	0.216		7	.1116	.0449	9	.1221	.0525
FILTERED ORTHOPHOSPHORUS (MG/L)												
3	1	0.12		2	0.085	.0071	6	.0617	.0194	9	.0733	.0255
4	1	0.01		1	0.02		7	0.01	0	9	.0111	.0033
5	2	0.045	.0212	5	0.01	0	11	.0109	0.003	18	.0144	.0125
6	3	.0433	.0208	15	.0107	.0026	8	0.01	0	26	.0142	.0124
7	8	.0412	.0189	36	.0167	.0193	18	.0233	.0137	62	.0218	.0193
8	3	.0267	.0115	7	.0229	.0111	17	.0135	.0049	27	.0174	0.009
9	2	0.04	0	2	0.03	0	14	.0879	.1794	18	.0761	.1585
10	2	0.01	0	2	0.015	.0071	14	.0221	0.008	18	0.02	.0084
11	2	0.01	0	2	0.01	0	14	.0107	.0027	18	.0106	.0024
12	1	0.02		1	0.01		7	0.01	0	9	.0111	.0033
TOTAL ORGANIC CARBON (MG/L)												
3												
4												
5												
6												
7	5	8.9	2.584	29	8.259	3.056	1	5.1		35	8.26	2.971
8	1	9.6		4	6.525	0.789	4	5.95	.8583	9	6.611	1.36
9												
10												
11												
12												

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	N	0-3 PPT MEAN	0-3 PPT STD	N	3.1-10 PPT MEAN	3.1-10 PPT STD	N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	N	ALL DATA MEAN	ALL DATA STD
PARTICULATE ORGANIC CARBON (MG/L)												
3	1	1.02		2	2.95	.0566	6	1.425	.2391	9	1.719	.7354
4	1	0.919		1	4.44		7	2.03	1.529	9	2.174	1.616
5	2	1.294	0.63	5	2.246	1.663	11	1.37	.7862	18	1.605	1.098
6	3	1.377	.3386	14	1.618	.9085	8	.9559	.2692	25	1.377	.7555
7	3	3.983	2.641	6	2.615	1.099	17	1.777	.7659	26	2.225	1.311
8	2	4.075	1.676	3	3.977	1.812	13	2.178	.7638	18	2.688	1.297
9	2	2.28	1.697	2	2.57	0.297	14	1.451	.3482	18	1.667	.6677
10												
11	2	0.473	.0311	2	2.815	.1344	14	1.869	.5465	18	1.819	.7493
12	1	1.61		1	3.1		7	2.296	.5809	9	2.309	.6265
CHLOROPHYLL AC (UG/L)												
3	1	6.68		2	12.87	7.814	6	12.25	4.814	9	11.77	5.083
4	1	27.75		3	25.43	13.63	10	15.98	7.488	14	18.85	9.476
5	2	20.12	22.57	5	13.99	20.74	11	11.62	13.41	18	13.22	15.64
6	3	7.75	2.577	15	6.624	5.053	8	4.607	6.493	26	6.133	5.276
7	7	34.5	62	34	5.963	14.2	18	11.48	11.2	59	11.03	25.12
8	3	71.31	64.66	11	19.04	20.61	18	14.18	10.75	32	21.21	27.26
9	2	0.45	0.495	2	2.015	.0212	14	1.457	1.414	18	1.407	1.303
10	2	2.01	2.828	2	16.55	23.4	14	4.886	7.032	18	5.863	9.299
11	2	2.285	2.213	2	14.35	2.044	14	8.952	5.466	18	8.812	5.659
12	1	9.22		1	10.4		7	6.081	2.335	9	6.91	2.623
PHAEOPHYTIN AC (UG/L)												
3	1	2.98		2	2.01	2.828	6	.8967	2.172	9	1.376	2.131
4	1	13.15		3	11.7	20.09	10	7.85	11.11	14	9.054	12.31
5	2	1.612	1.467	5	4.869	4.347	11	.5168	.9391	18	1.847	2.988
6	3	.6167	.8593	15	3.457	8.88	8	13.31	34.16	26	6.16	19.88
7	8	4.271	5.418	35	8.426	14.49	18	10.26	10.09	61	8.424	12.43
8	3	11.5	8.086	11	12.1	8.061	18	9.865	6.728	32	10.79	7.152
9	2	21.25	29.91	2	0.7	.1414	14	.9964	1.302	18	3.214	9.848
10	2	4.515	6.371	2	0.01	0	14	5.471	10.58	18	4.758	9.54
11	2	6.155	8.69	2	39.75	41.08	14	27.2	34.73	18	26.26	33.1
12	1	3.31		1	14.7		7	4.189	2.289	9	5.259	4.068

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	0-3 PPT N	0-3 PPT MEAN	0-3 PPT STD	3.1-10 PPT N	3.1-10 PPT MEAN	3.1-10 PPT STD	GREATER 10 PPT N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	ALL DATA N	ALL DATA MEAN	ALL DATA STD
TOTAL DISSOLVED SOLIDS (MG/L)												
3	1	70								1	70	
4	1	13								1	13	
5	2	79	57.98							2	79	57.98
6	3	161.3	12.66							3	161.3	12.66
7	6	1554	2294	28	8170	2176	1	10212		35	7094	3345
8	3	137.3	33.83	4	9590	3695	4	12234	790.8	11	7973	5569
9	1	286								1	286	
10	2	109	76.37							2	109	76.37
11	2	113.5	14.85							2	113.5	14.85
12	1	120								1	120	
ORTHOPHOSPHORUS (MG/L)												
3												
4												
5												
6												
7	5	1.061	.7265	29	.0984	.1696	1	0.041		35	.2344	.4508
8	1	2.188		4	0.135	0.055	4	0.097	.0251	9	.3462	.6919
9												
10	1	2.48		1	0.127		7	.0561	.0081	9	.3333	.8054
11												
12												
PARTICULATE PHOSPHORUS (MG/L)												
3	1	3.56		2	0.2	.1273	2	0.19	.0424	5	0.868	1.506
4	1	0.05		1	0.2		6	.0717	.0271	8	0.085	.0524
5	2	0.055	.0354	5	0.086	.0439	11	.0227	.0162	18	.0439	.0388
6	3	.0667	.0737	12	.0308	0.047	7	.0043	.0053	22	.0273	.0457
7	8	0.065	.0765	34	.0482	.0536	18	.0594	.0589	60	.0538	.0578
8	3	.0933	.0833	7	0.09	.0606	17	.0576	.0311	27	0.07	.0474
9	2	0.06	.0141	2	0.09	.0141	13	.0538	.0253	17	.0588	.0255
10	2	0.315	.3889	2	0.09	.1273	8	.1162	.1406	12	0.145	0.185
11	1	0.09		1	0.04		14	.0914	.0382	16	.0881	.0378
12	1	0.1		1	0.21		7	.1114	.0449	9	.1211	.0513

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

		0-3 PPT			3.1-10 PPT			GREATER 10 PPT			ALL DATA	
MONTH	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD
					FILTERED INORGANIC NITROGEN (MG/L)							
3	1	1.611		2	1.1	.5204	6	.5842	.0819	9	.8129	.4213
4	1	0.713		1	0.947		7	.4147	.1358	9	0.507	.2254
5	2	1.391	.1032	5	0.172	.1609	11	.1835	.1161	18	.3144	0.41
6	3	1.834	.5831	15	.0783	.0671	8	.1441	.0672	26	.3012	.5921
7	3	.5487	0.284	7	.1054	.0779	17	.1534	.1168	27	.1849	.1834
8	2	.0915	.0134	3	.0957	.0183	13	.2411	.1381	18	.2002	.1346
9	2	0.557	0.553	2	0.315	.0523	14	.2746	.1017	18	.3104	.1851
10	2	1.347	1.705	2	0.262	.0297	14	.1741	.2715	18	.3142	.6079
11	2	2.038	.2708	2	.3545	0.029	14	.1969	.1089	18	0.419	.6026
12	1	2.811		1	0.377		7	.1109	.0389	9	.4404	.8939
					TOTAL INORGANIC NITROGEN (MG/L)							
3												
4												
5												
6												
7	1	0.28		28	.2186	.2282	1	0.37		30	.2257	.2222
8				2	0.03	3E-9	3	.0067	.0115	5	0.016	.0152
9												
10	1	0.31		1	0.8		7	.5871	.1839	9	0.58	.2014
11												
12												
					TOTAL ORGANIC NITROGEN (MG/L)							
3												
4												
5												
6												
7	5	0.048	.0217	28	.0143	.0088	1	0.01		34	.0191	.0164
8	1	0.05		4	.0175	.0096	4	0.015	.0058	9	0.02	.0132
9												
10												
11												
12												

TABLE 7-2 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA BY MONTH AND SALINITY REGIMES

MONTH	0-3 PPT N	0-3 PPT MEAN	0-3 PPT STD	3.1-10 PPT N	3.1-10 PPT MEAN	3.1-10 PPT STD	GREATER 10 PPT N	GREATER 10 PPT MEAN	GREATER 10 PPT STD	ALL DATA N	ALL DATA MEAN	ALL DATA STD
DISSOLVED ORGANIC NITROGEN (MG/L)												
3	1	0.71		2	0.455	.1909	6	0.355	.0653	9	.4167	.1456
4	1	0.76		1	0.21		7	.3086	.1139	9	.3478	.1863
5	2	0.725	.0636	5	0.506	.1993	11	.6736	.2576	18	.6328	.2354
6	3	.8333	.1415	15	0.572	.1646	8	.4975	.0632	26	.5792	.1668
7	3	.7833	.1858	7	0.81	.1291	17	.7776	.1124	27	.7867	.1203
8	2	0.68	.0424	3	.6067	.0306	13	.4554	.1337	18	.5056	.1419
9	2	0.72	.1273	2	0.555	.0919	14	.6393	.4967	18	.6389	.4378
10	2	0.42	.0566	2	0.58	.1273	14	.7114	.2643	18	.6644	.2535
11	2	0.345	.1202	2	0.5	.1273	14	.4479	0.128	18	.4422	.1259
12	1	0.46		1	0.29		7	.4814	.1002	9	.4578	.1074
PARTICULATE NITROGEN (MG/L)												
3	1	0.035		2	0.311	.0028	6	.1428	.0542	9	.1682	.0982
4	1	0.029		1	0.571		7	.2084	.0852	9	.2288	.1595
5	2	0.11	.1485	5	.3212	.2516	11	.1448	.0946	18	.1899	.1691
6	3	0.172	.0462	14	.2041	.1193	8	.1072	.0465	25	.1693	.1025
7	3	0.559	0.419	6	.3808	.1863	17	.2503	.1188	26	0.316	.2026
8	2	0.567	.2673	3	.4797	.1626	13	.3285	.1005	18	.3802	.1495
9												
10												
11	2	0.063	.0226	2	0.38	.0608	14	.2736	.1247	18	.2621	.1362
12	1	0.245		1	0.528		7	.3046	.0457	9	.3228	.0888
TOTAL INORGANIC NITROGEN / ORTHOPHOSPHORUS (RATIO)												
3												
4												
5												
6												
7	5	23.46	14.61	28	6.266	8.485	1	4.1		34	8.731	11.11
8	1	43.76		4	9.542	6.325	4	7.025	2.25	9	12.23	12.58
9												
10												
11												
12												

TABLE 7-3 STATISTICAL SUMMARY OF SLACK SURVEY DATA FOR TOTAL PERIOD OF RECORD AND SALINITY REGIMES

VARIABLE	SALINITY REGIME	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
TEMPERTURE	0-3 PPT	25	19.76	7.944	1.589	40.2
	3.1-10 PPT	80	23.22	5.905	.6602	25.43
	> 10 PPT	121	17	7.839	.7127	46.12
	ALL DATA	226	19.51	7.749	.5155	39.72
TURBIDITY	0-3 PPT	9	15.67	10.27	3.424	65.56
	3.1-10 PPT	47	7.843	7.431	1.084	94.76
	> 10 PPT	14	4.286	1.939	.5181	45.23
	ALL DATA	70	8.137	7.76	.9275	95.37
SECCHI DISK	0-3 PPT	23	0.673	0.377	.0785	55.95
	3.1-10 PPT	73	0.539	0.314	.0367	58.21
	> 10 PPT	109	0.924	0.378	.0362	40.88
	ALL DATA	205	0.759	0.398	.0278	52.45
DIS OXYGEN	0-3 PPT	24	8.755	2.535	.5174	28.95
	3.1-10 PPT	64	7.078	2.009	.2511	28.38
	> 10 PPT	113	8.373	2.486	.2338	29.69
	ALL DATA	201	8.006	2.427	.1712	30.31
SATURT DO	0-3 PPT	24	93.91	27.74	5.662	29.54
	3.1-10 PPT	64	83.71	15.73	1.966	18.79
	> 10 PPT	113	88.86	14.93	1.405	16.81
	ALL DATA	201	87.82	17.37	1.225	19.78
BOD5	0-3 PPT	23	3.739	3.828	.7983	102.4
	3.1-10 PPT	62	2.802	1.218	.1546	43.46
	> 10 PPT	111	2.509	1.055	.1002	42.06
	ALL DATA	196	2.746	1.701	.1215	61.96
BOD20	0-3 PPT	11	5.182	2.148	.6476	41.45
	3.1-10 PPT	43	5.477	1.752	.2672	32
	> 10 PPT	36	3.944	1.094	.1823	27.74
	ALL DATA	90	4.828	1.724	.1817	35.71
BOD30	0-3 PPT	4	5.75	.9574	.4787	16.65
	3.1-10 PPT	4	5.25	1.5	0.75	28.57
	> 10 PPT	28	4.857	1.86	.3515	38.3
	ALL DATA	36	5	1.74	0.29	34.81
FIELD PH	0-3 PPT	22	7.218	.6758	.1441	9.362
	3.1-10 PPT	69	7.394	.4799	.0578	6.491
	> 10 PPT	108	7.486	.4643	.0447	6.201
	ALL DATA	199	7.424	.5011	.0355	6.75
SALINITY	0-3 PPT	25	.5001	.8706	.1741	174.1
	3.1-10 PPT	80	8.002	1.792	.2004	22.39
	> 10 PPT	121	12.15	1.454	.1322	11.97
	ALL DATA	226	9.393	3.987	.2652	42.45

TABLE 7-3 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA FOR TOTAL PERIOD OF RECORD AND SALINITY REGIMES

VARIABLE	SALINITY REGIME	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
TOT SOLIDS	0-3 PPT	22	565.6	1294	275.8	228.7
	3.1-10 PPT	32	8375	2382	421.1	28.44
	> 10 PPT	5	11867	1141	510.2	9.615
	ALL DATA	59	5759	4577	595.9	79.48
SUS SOLIDS	0-3 PPT	25	47.6	105.5	21.1	221.6
	3.1-10 PPT	72	79.47	140.8	16.59	177.2
	> 10 PPT	115	44.82	49.46	4.612	110.4
	ALL DATA	212	56.92	97.58	6.702	171.5
FIL AMMONIA	0-3 PPT	19	.0853	0.051	.0117	59.85
	3.1-10 PPT	40	.0777	.1144	.0181	147.2
	> 10 PPT	111	.0923	.0743	.0071	80.48
	ALL DATA	170	.0881	.0833	.0064	94.49
TOT AMMONIA	0-3 PPT	7	0.09	.0476	0.018	52.9
	3.1-10 PPT	34	0.04	.0315	.0054	78.82
	> 10 PPT	12	.0308	.0211	.0061	68.39
	ALL DATA	53	.0445	.0364	0.005	81.64
FIL NITRITE	0-3 PPT	19	.0239	.0257	.0059	107.6
	3.1-10 PPT	40	.0117	.0138	.0022	118
	> 10 PPT	111	.0234	.0333	.0032	142.6
	ALL DATA	170	.0207	.0294	.0023	142
TOT NITRITE	0-3 PPT	7	.0164	.0095	.0036	57.62
	3.1-10 PPT	34	.0045	.0049	.0008	109.9
	> 10 PPT	12	0.006	.0046	.0013	76.87
	ALL DATA	53	.0064	.0068	.0009	106.2
FIL NITRATE	0-3 PPT	19	1.108	.8691	.1994	78.41
	3.1-10 PPT	40	.1217	.1765	.0279	145
	> 10 PPT	111	.1107	.1492	.0142	134.7
	ALL DATA	170	.2248	.4483	.0344	199.4
TOT NITRATE	0-3 PPT	7	1.319	.8888	.3359	67.4
	3.1-10 PPT	34	.0591	.1489	.0255	251.9
	> 10 PPT	12	.0317	.0119	.0034	37.69
	ALL DATA	53	.2192	.5411	.0743	246.8
FIL TKN	0-3 PPT	19	.7463	0.207	.0475	27.74
	3.1-10 PPT	40	.6597	.1993	.0315	30.21
	> 10 PPT	111	.6632	0.267	.0253	40.26
	ALL DATA	170	.6717	.2467	.0189	36.73
TOT TKN	0-3 PPT	25	0.774	.5929	.1186	76.6
	3.1-10 PPT	73	.6364	.4761	.0557	74.81
	> 10 PPT	116	.7323	.2516	.0234	34.36
	ALL DATA	214	.7045	.3911	.0267	55.52

TABLE 7-3 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA FOR TOTAL PERIOD OF RECORD AND SALINITY REGIMES

VARIABLE	SALINITY REGIME	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
TOT NITROGEN	0-3 PPT	22	1.426	.7614	.1623	53.39
	3.1-10 PPT	68	.2559	.3029	.0367	118.4
	> 10 PPT	95	.3197	.1781	.0183	55.72
	ALL DATA	185	.4278	.5019	.0369	117.3
FIL NITROGEN	0-3 PPT	19	1.132	.8796	.2018	77.68
	3.1-10 PPT	40	.1334	.1792	.0283	134.3
	> 10 PPT	111	.1341	.1511	.0143	112.7
	ALL DATA	170	.2455	.4519	.0347	184.1
TOT PHOS	0-3 PPT	25	.2988	.7331	.1466	245.3
	3.1-10 PPT	73	0.097	.0832	.0097	85.76
	> 10 PPT	116	.1028	.0772	.0072	75.06
	ALL DATA	214	.1237	.2649	.0181	214.1
FIL PHOS	0-3 PPT	25	.0756	.0487	.0097	64.47
	3.1-10 PPT	72	.0417	.0476	.0056	114.2
	> 10 PPT	116	.0552	.0935	.0087	169.4
	ALL DATA	213	0.053	.0766	.0053	144.6
TOT PAR PHOS	0-3 PPT	15	.3203	0.898	.2319	280.3
	3.1-10 PPT	35	.0843	0.076	.0128	90.18
	> 10 PPT	82	.0596	.0759	.0084	127.2
	ALL DATA	132	.0958	.3128	.0272	326.6
FIL ORTHOP	0-3 PPT	25	0.036	.0255	.0051	70.82
	3.1-10 PPT	73	.0175	.0185	.0022	105.8
	> 10 PPT	116	.0263	0.066	.0061	250.9
	ALL DATA	214	.0244	.0507	.0035	207.5
TOT ORG CARBON	0-3 PPT	6	9.017	2.328	.9506	25.82
	3.1-10 PPT	33	8.048	2.925	.5092	36.35
	> 10 PPT	5	5.78	.8349	.3734	14.44
	ALL DATA	44	7.923	2.789	.4204	35.2
PAR CARBON	0-3 PPT	17	2.11	1.763	.4276	83.55
	3.1-10 PPT	36	2.381	1.271	.2119	53.4
	> 10 PPT	97	1.717	.7807	.0793	45.47
	ALL DATA	150	1.921	1.09	0.089	56.75
CHLOR AC	0-3 PPT	24	23.84	43.65	8.91	183.1
	3.1-10 PPT	77	9.867	14.8	1.687	150
	> 10 PPT	120	9.306	9.33	.8517	100.3
	ALL DATA	221	11.08	18.49	1.244	166.9
PHEOP AC	0-3 PPT	25	6.281	9.412	1.882	149.8
	3.1-10 PPT	78	8.192	13.69	1.55	167.1
	> 10 PPT	120	8.826	17.45	1.593	197.8
	ALL DATA	223	8.319	15.44	1.034	185.6

TABLE 7-3 (CONT.) STATISTICAL SUMMARY OF SLACK SURVEY DATA FOR TOTAL PERIOD OF RECORD AND SALINITY REGIMES

VARIABLE	SALINITY REGIME	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
DIS SOLIDS	0-3 PPT	22	514.2	1296	276.4	252.1
	3.1-10 PPT	32	8347	2381	421	28.53
	> 10 PPT	5	11830	1134	507.3	9.589
	ALL DATA	59	5722	4586	597.1	80.16
ORTHO PHOS	0-3 PPT	6	.0483	.0194	.0079	40.15
	3.1-10 PPT	32	.0147	.0088	.0016	59.87
	> 10 PPT	5	0.014	.0055	.0024	39.12
	ALL DATA	43	.0193	.0156	.0024	81.05
PAR PHOS	0-3 PPT	24	.2358	.7182	.1466	304.5
	3.1-10 PPT	67	.0639	.0663	.0081	103.8
	> 10 PPT	103	.0663	.0615	.0061	92.72
	ALL DATA	194	.0864	0.261	.0187	302
FIL INOR N	0-3 PPT	19	1.218	0.895	.2053	73.51
	3.1-10 PPT	40	.2112	.2813	.0445	133.2
	> 10 PPT	111	.2264	.1751	.0166	77.35
	ALL DATA	170	.3336	.4717	.0362	141.4
TOT INOR N	0-3 PPT	7	1.425	.8629	.3261	60.55
	3.1-10 PPT	34	.1036	.1576	0.027	152.1
	> 10 PPT	12	.0685	.0259	.0075	37.76
	ALL DATA	53	.2702	.5558	.0763	205.7
TOT ORGN N	0-3 PPT	2	0.295	.0212	0.015	7.191
	3.1-10 PPT	31	.2252	.2459	.0442	109.2
	> 10 PPT	11	.4091	.3021	.0911	73.84
	ALL DATA	44	.2743	.2643	.0398	96.33
DIS ORGN N	0-3 PPT	19	.6611	.1925	.0442	29.12
	3.1-10 PPT	40	0.582	.1884	.0298	32.37
	> 10 PPT	111	.5709	.2701	.0256	47.32
	ALL DATA	170	.5836	.2458	.0189	42.12
PAR NITROGEN	0-3 PPT	15	.2655	.2873	.0742	108.2
	3.1-10 PPT	34	.3138	.1799	.0308	57.32
	> 10 PPT	83	0.232	.1196	.0131	51.54
	ALL DATA	132	.2569	.1648	.0143	64.16
TOT IN N-ORHP(R)	0-3 PPT	6	26.84	15.48	6.319	57.66
	3.1-10 PPT	32	6.676	8.233	1.455	123.3
	> 10.PPT	5	6.44	2.347	1.05	36.44
	ALL DATA	43	9.462	11.37	1.734	120.1

TABLE 7-4 STATISTICAL SUMMARY OF SLACK SURVEY DATA BY STATION

VARIABLE	STATION ID	RIVER MILE	N	MEAN	STD DEVIATE	STD ERR MEAN	COEFF VARIA
TEMPERTURE	XHG1537	5.50	77	18.75	7.302	.8321	38.95
	XGG9572	8.50	77	19.1	7.448	.8487	38.99
	XHG3078	13.20	78	19.54	7.397	.8375	37.85
	XHG4893	15.00	77	19.75	7.593	.8653	38.44
	XHG6094	15.50	72	19.55	7.808	.9202	39.95
	XHH5301	16.00	77	19.72	7.693	.8767	39.01
	XHH8354	21.30	80	20.23	7.748	.8663	38.31
	XIH2463	28.00	74	20.09	8.159	.9485	40.62
	CYR0004	41.00	66	19.96	7.484	.9213	37.5
TURBIDITY	XHG1537	5.50	8	2.75	1.035	0.366	37.64
	XGG9572	8.50	10	4.2	2.486	0.786	59.18
	XHG3078	13.20	11	4	1.265	.3814	31.62
	XHG4893	15.00	8	4.7	.4536	.1604	9.65
	XHG6094	15.50	9	7.444	2.297	.7658	30.86
	XHH5301	16.00	10	6	1.826	.5774	30.43
	XHH8354	21.30	10	10.4	3.34	1.056	32.12
	XIH2463	28.00	9	24.33	12.51	4.17	51.41
	CYR0004	41.00	7	11.43	6.655	2.515	58.23
SECCHI DISC	XHG1537	5.50	20	1.019	.3153	.0705	30.93
	XGG9572	8.50	23	1.053	.4022	.0837	38.19
	XHG3078	13.20	24	1.008	.5102	.1041	50.59
	XHG4893	15.00	24	.7750	.2294	.0468	29.60
	XHG6094	15.50	23	.7387	.2730	.0569	36.96
	XHH5301	16.00	24	.7429	.3073	.0627	41.36
	XHH8354	21.30	23	.4952	.2360	.0492	47.66
	XIH2463	28.00	23	.2878	.1754	.0366	60.94
	CYR0004	41.00	21	.7286	.343	.0749	47.13
DIS OXYGEN	XHG1537	5.50	70	7.959	3.319	.3967	41.7
	XGG9572	8.50	69	7.99	2.441	.2938	30.55
	XHG3078	13.20	71	7.406	3.221	.3823	43.5
	XHG4893	15.00	71	7.824	2.824	.3352	36.1
	XHG6094	15.50	69	8.519	2.28	.2744	26.76
	XHH5301	16.00	68	8	2.432	.2949	30.4
	XHH8354	21.30	72	7.632	2.587	.3048	33.89
	XIH2463	28.00	66	7.809	2.681	0.33	34.33
	CYR0004	41.00	64	9.109	2.258	.2823	24.79
SATURT DO	XHG1537	5.50	70	87.89	33.81	4.041	38.47
	XGG9572	8.50	69	88.58	20.41	2.457	23.04
	XHG3078	13.20	71	81.49	29.73	3.529	36.49
	XHG4893	15.00	71	86.56	23.24	2.758	26.85
	XHG6094	15.50	69	94.97	15.41	1.855	16.22
	XHH5301	16.00	68	88.91	19.03	2.308	21.4
	XHH8354	21.30	72	84.83	21.93	2.584	25.85
	XIH2463	28.00	66	83.63	18.58	2.288	22.22
	CYR0004	41.00	63	99.1	26.79	3.376	27.03
BOD5	XHG1537	5.50	22	2.682	1.46	.3113	54.45
	XGG9572	8.50	23	2.5	1.055	0.22	42.21
	XHG3078	13.20	22	2.295	.9084	.1937	39.57
	XHG4893	15.00	22	2.477	1.006	.2144	40.6
	XHG6094	15.50	21	2.881	1.264	.2758	43.87
	XHH5301	16.00	22	2.5	1.058	.2255	42.31
	XHH8354	21.30	22	2.623	1.041	.2219	39.69
	XIH2463	28.00	22	2.909	1.109	.2364	38.11
	CYR0004	41.00	21	3.857	3.991	.8709	103.5

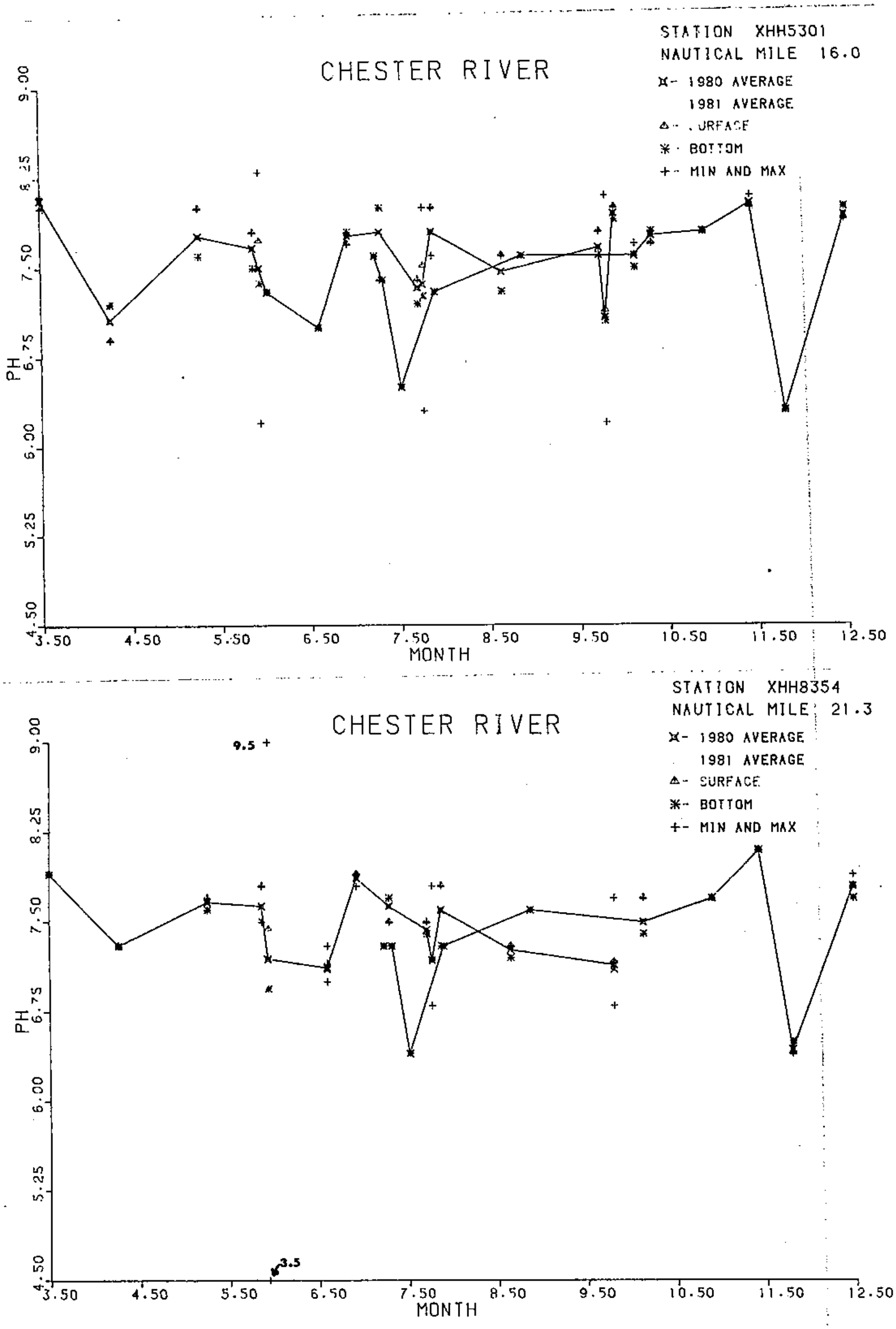


Figure 8-3 Temporal Plots of pH, 1980-1981

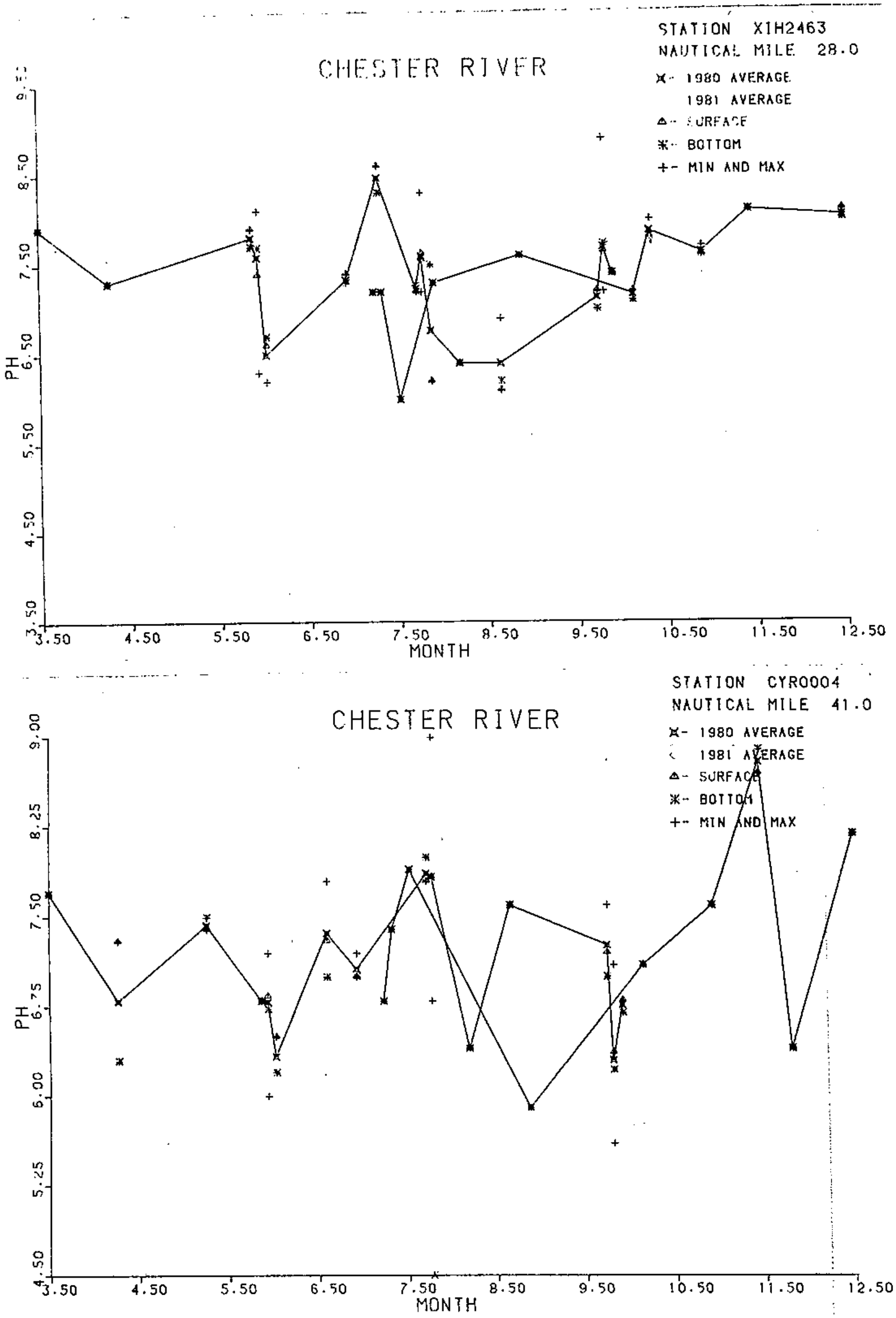


Figure 8-3 Temporal Plots of pH, 1980-1981

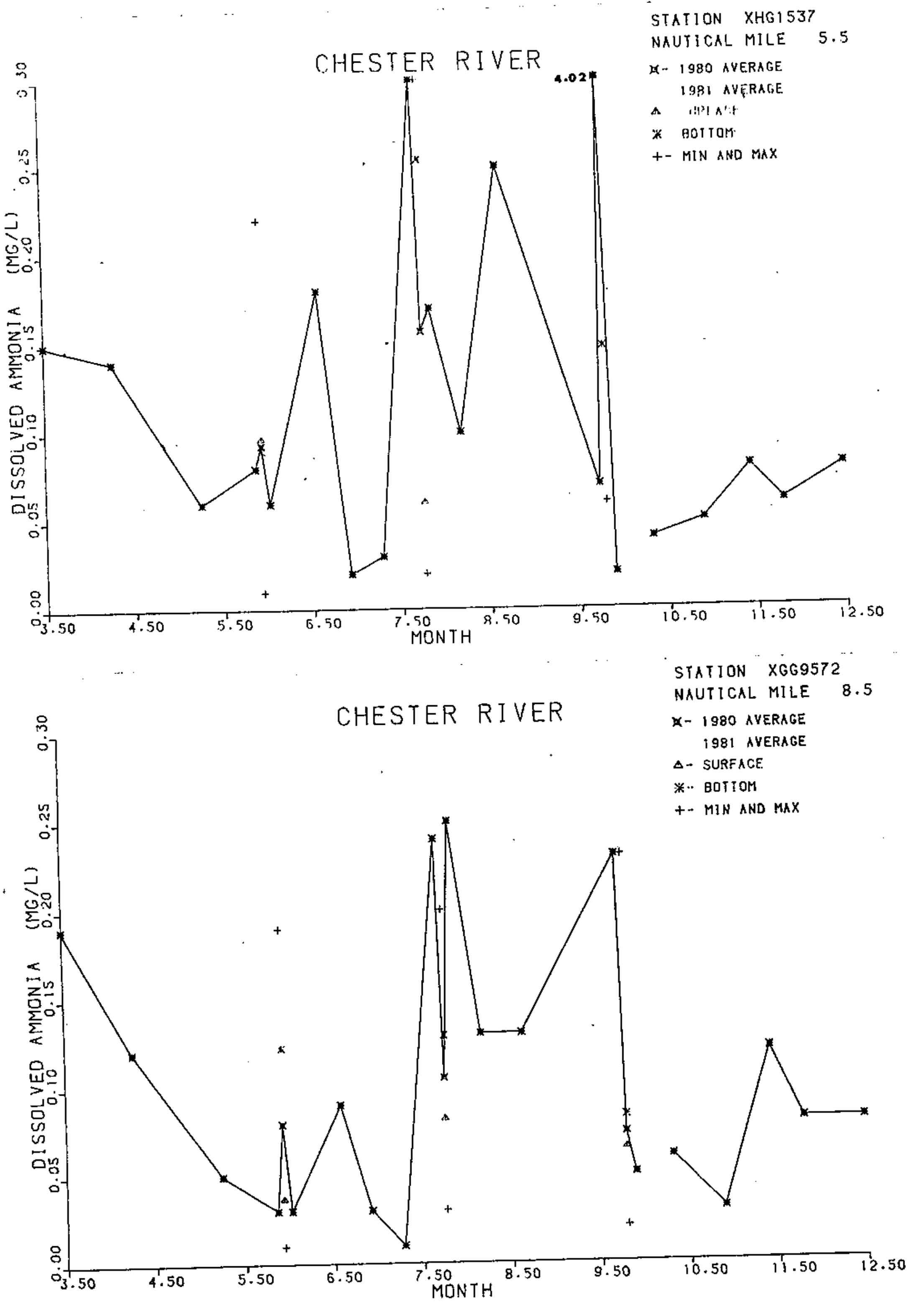


Figure 8-4 Temporal Plots of Dissolved Ammonia 1980-1981

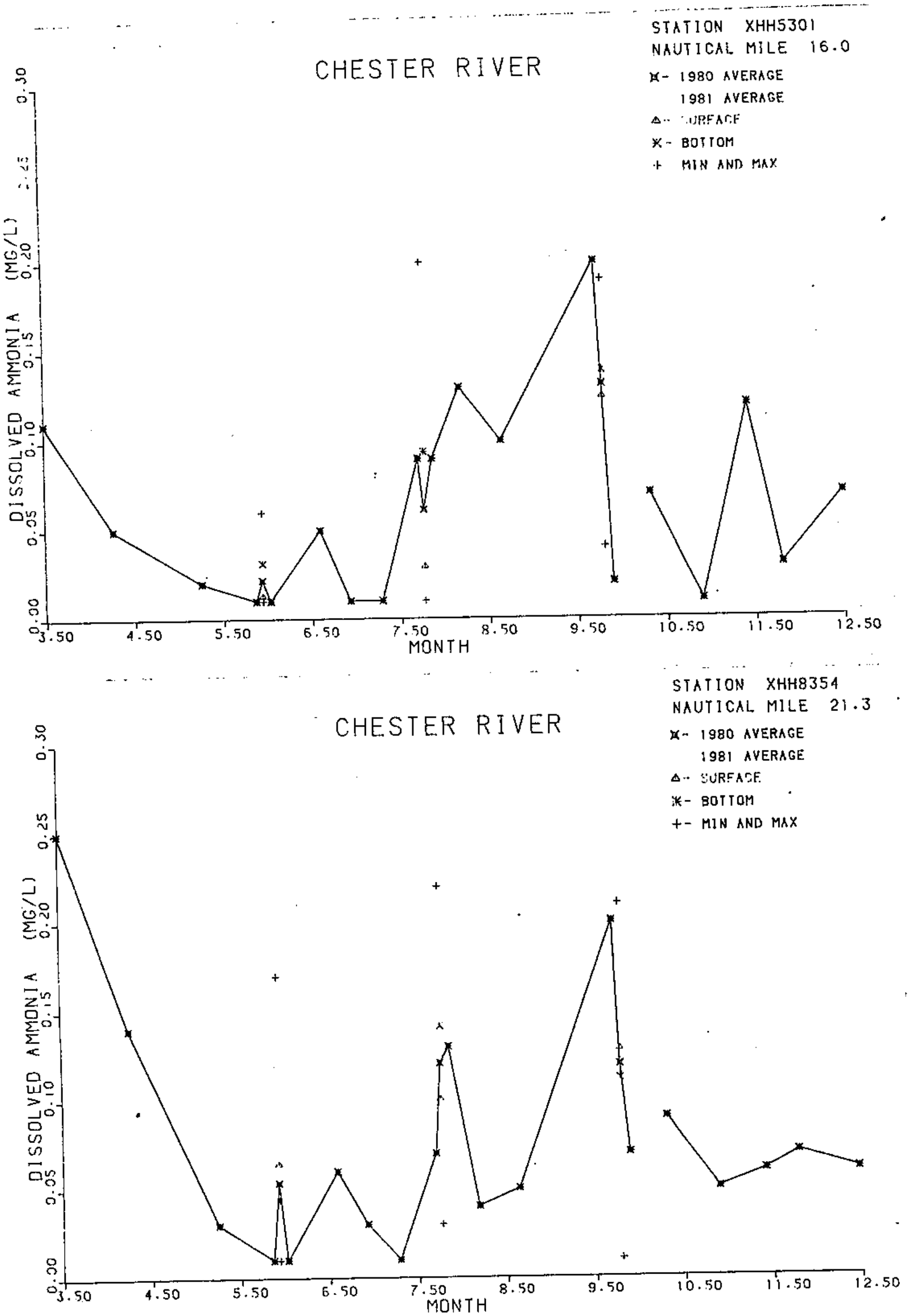


Figure 8-4 Temporal Plots of Dissolved Ammonia 1980-1981

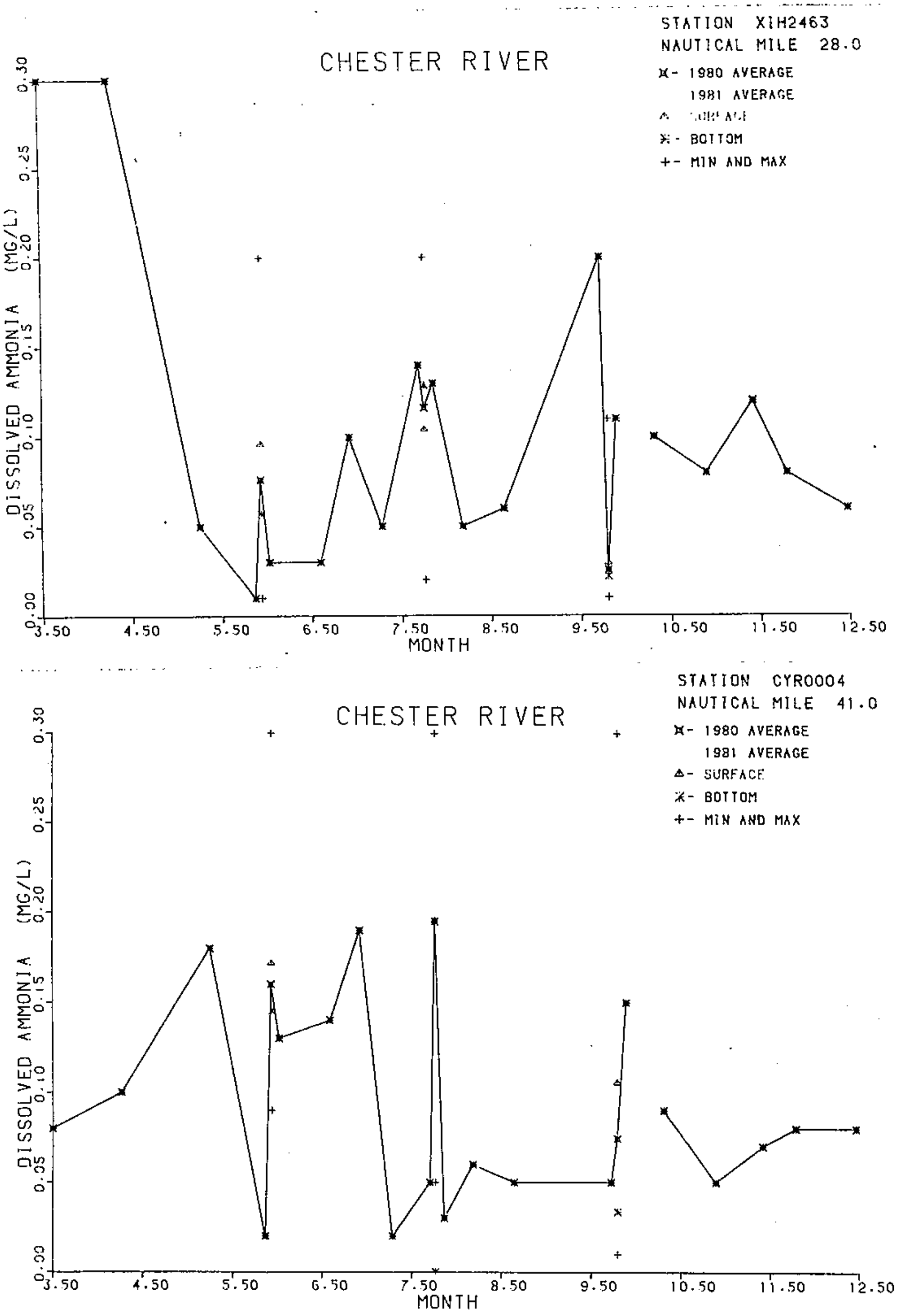


Figure 8-4 Temporal Plots of Dissolved Ammonia 1980-1981

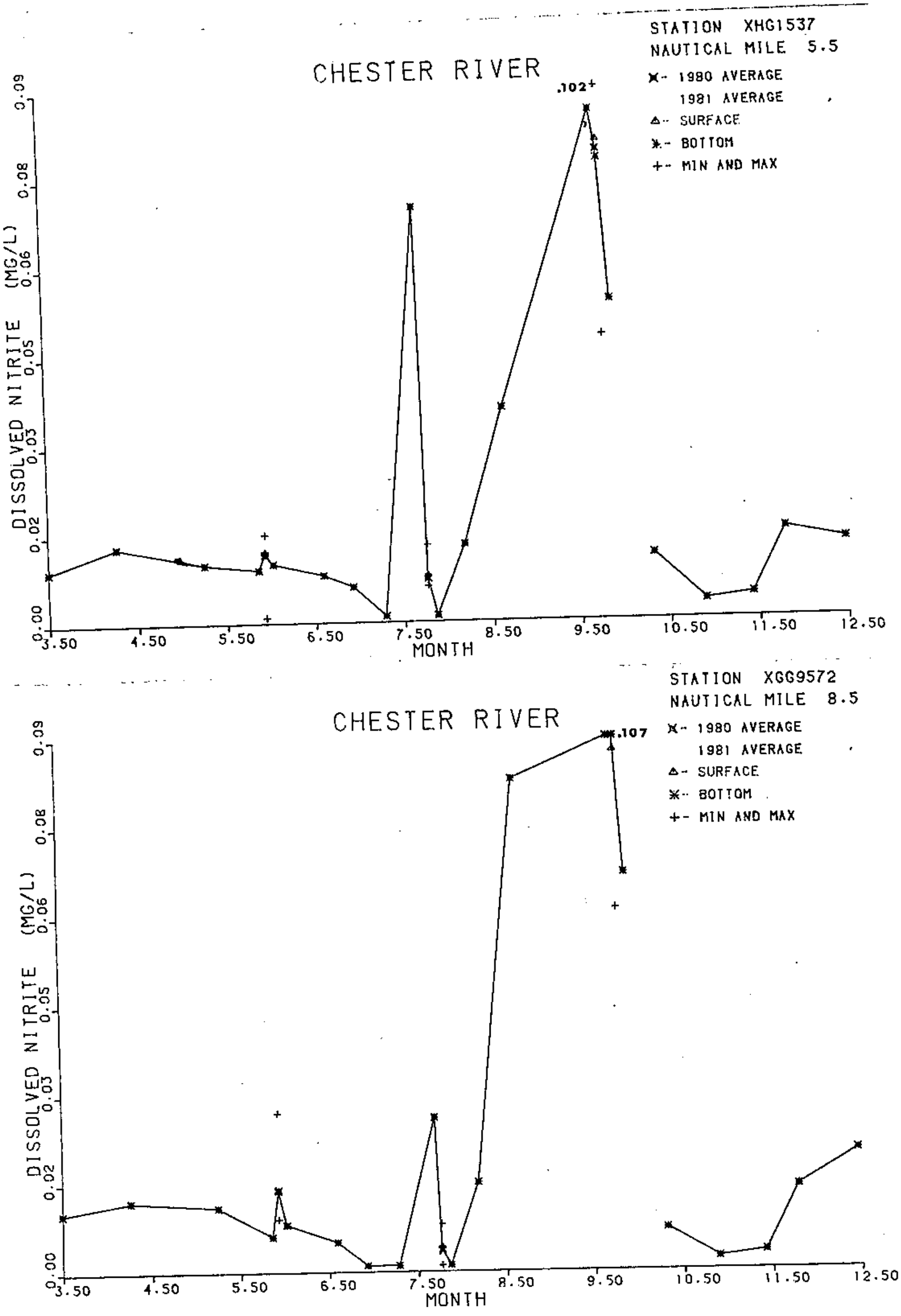


Figure 8-5 Temporal Plots of Dissolved Nitrite, 1980-1981

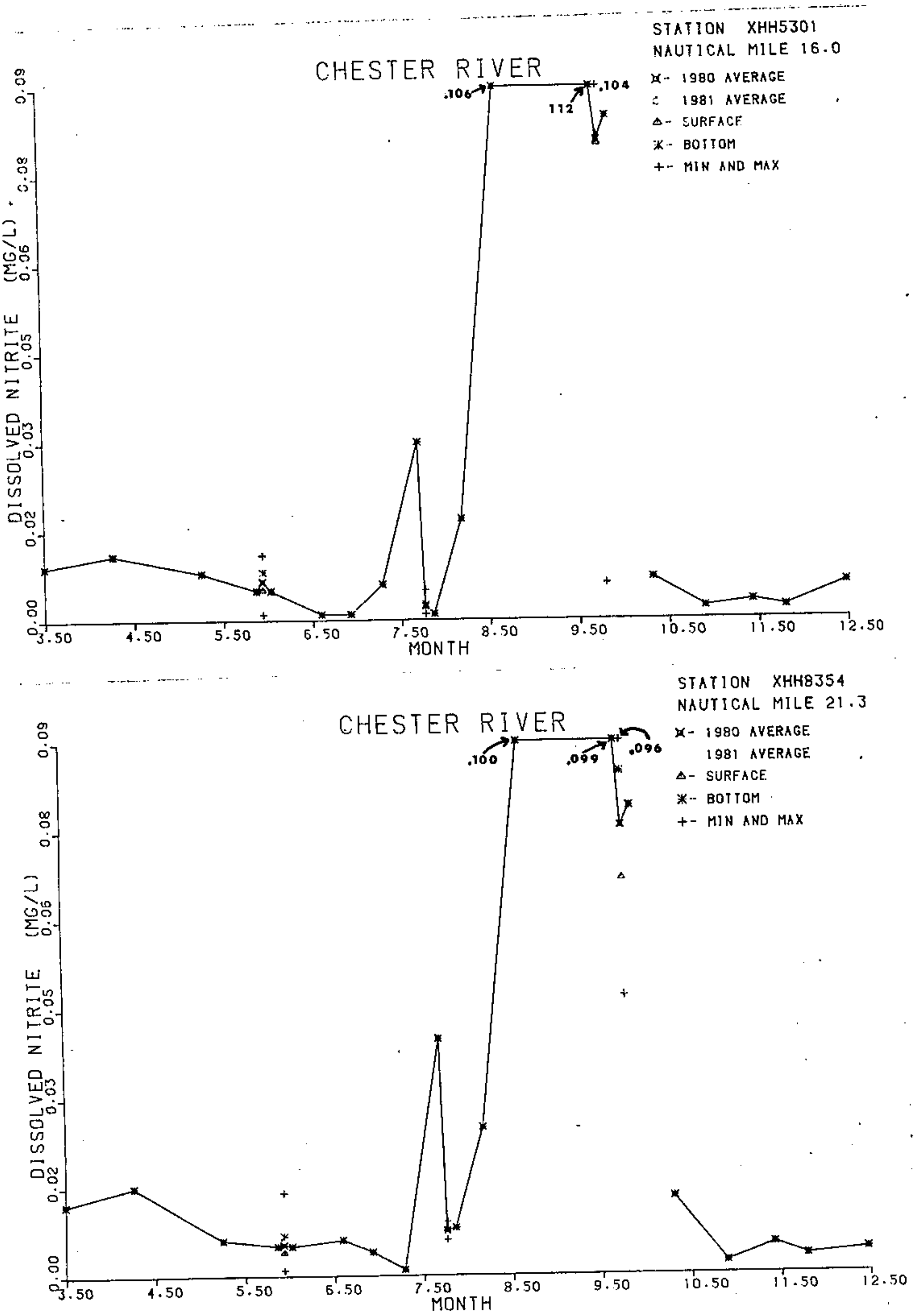


Figure 8-5 Temporal Plots of Dissolved Nitrite, 1980-1981

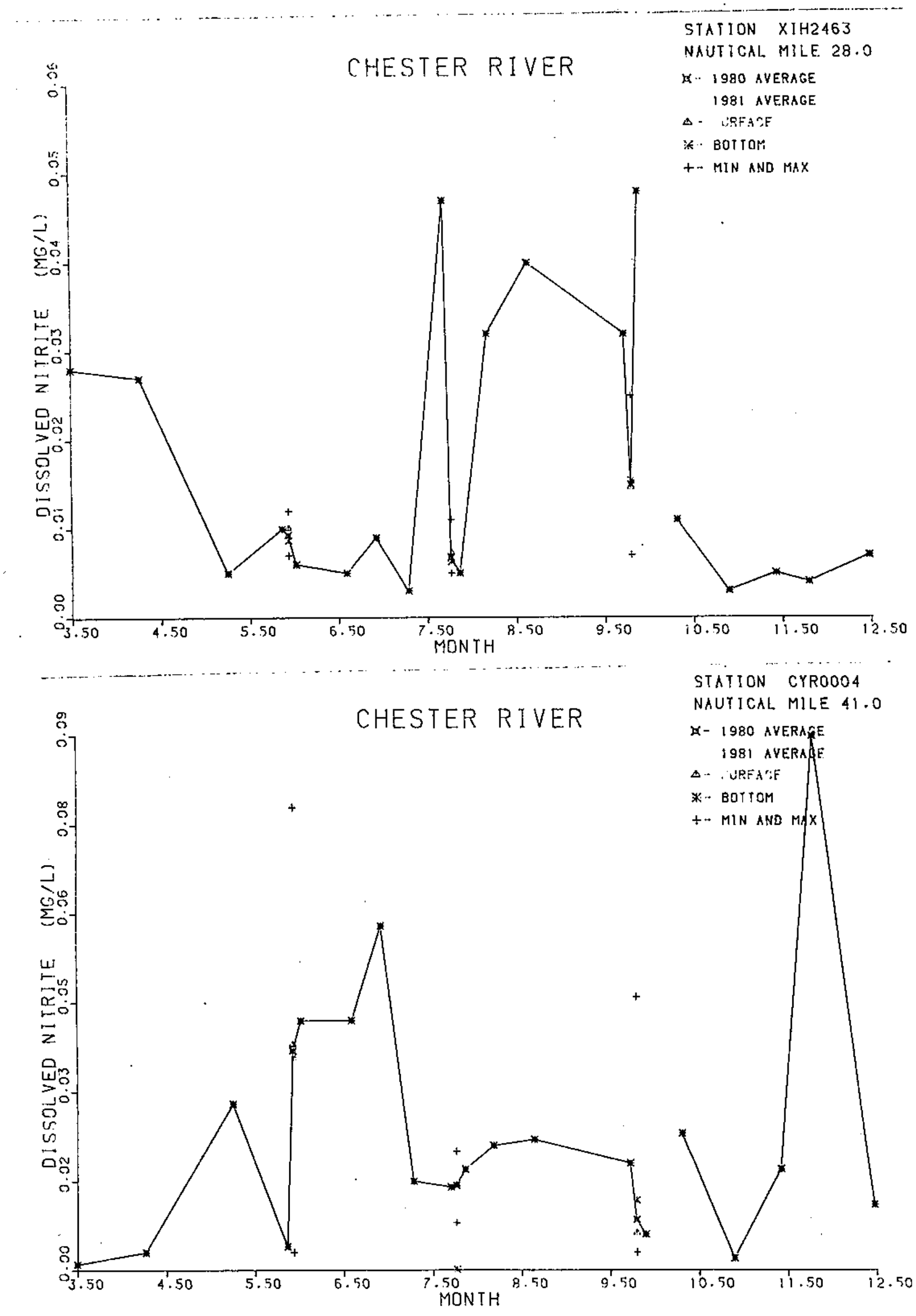


Figure 8-5 Temporal Plots of Dissolved Nitrite, 1980-1981

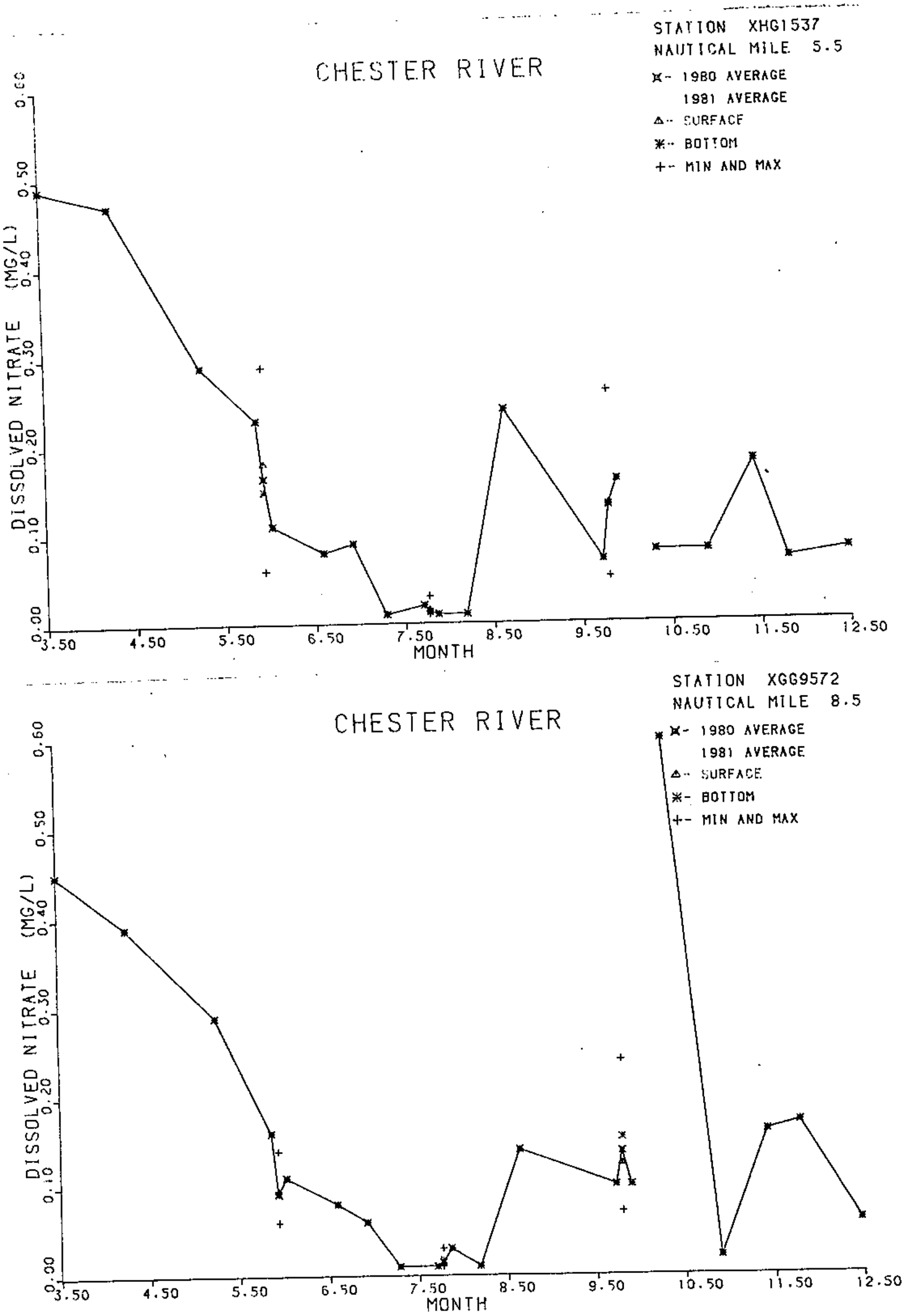


Figure 8-6 Temporal Plots of Dissolved Nitrate, 1980-1981

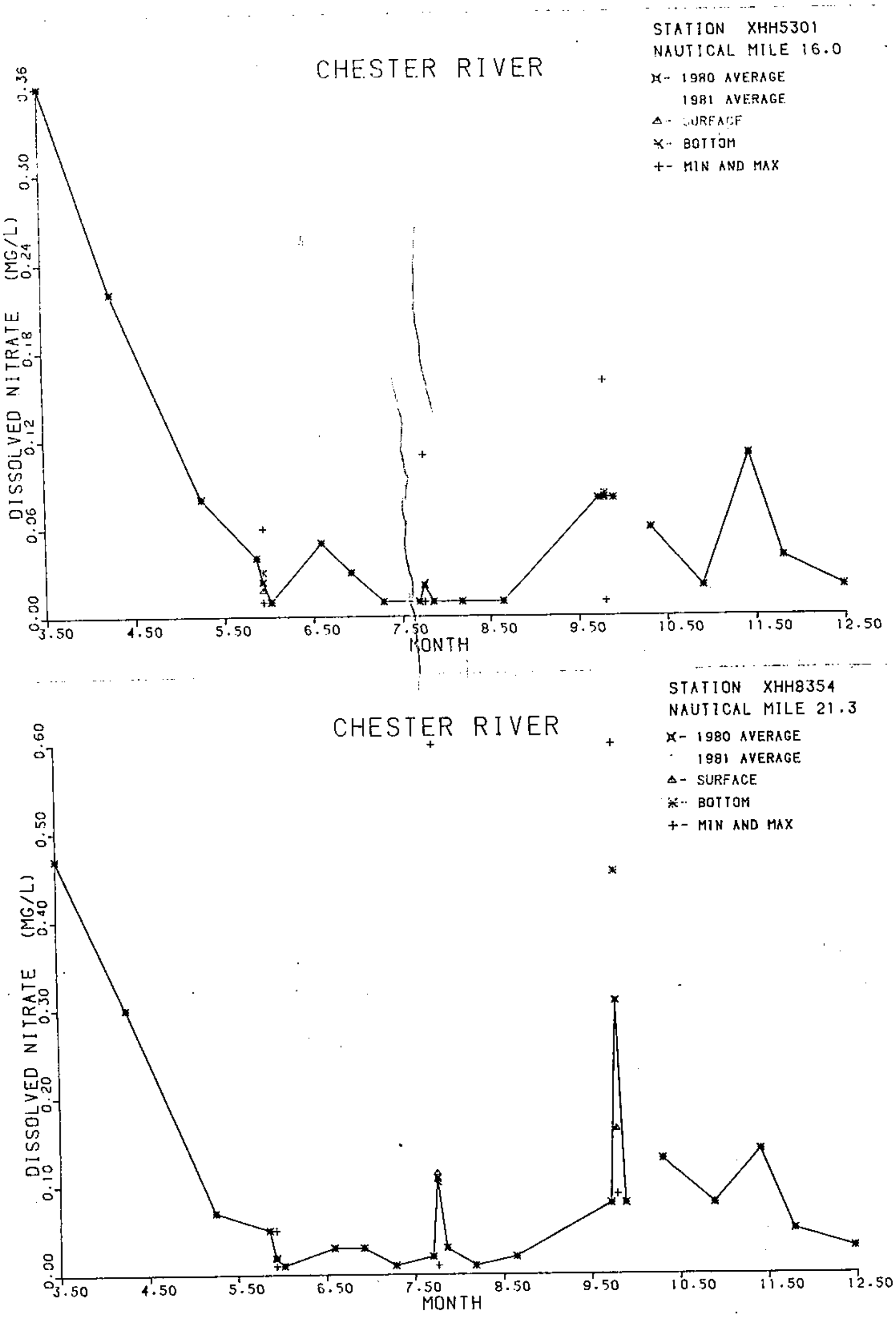


Figure 8-6 Temporal Plots of Dissolved Nitrate, 1980-1981

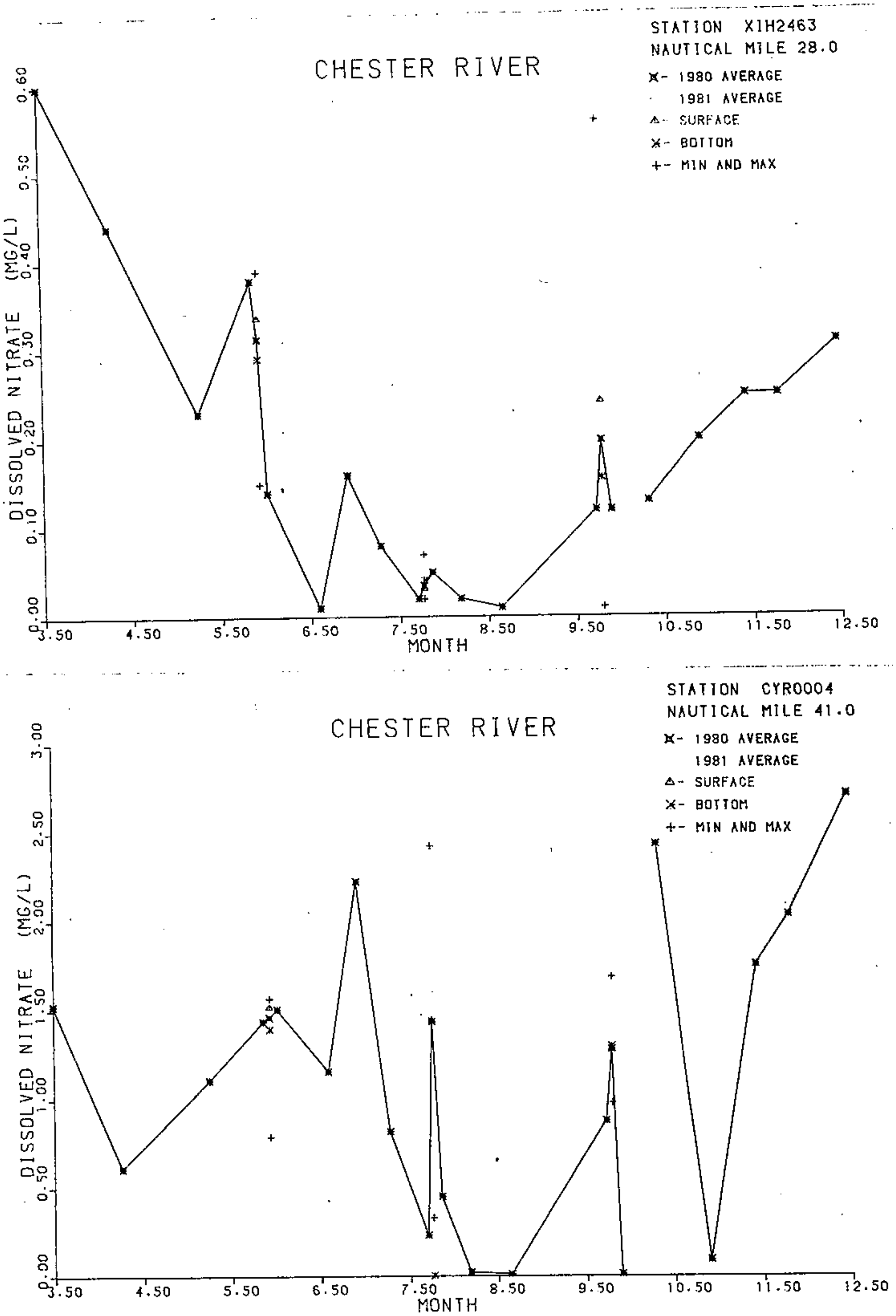


Figure 8-6 Temporal Plots of Dissolved Nitrate, 1980-1981

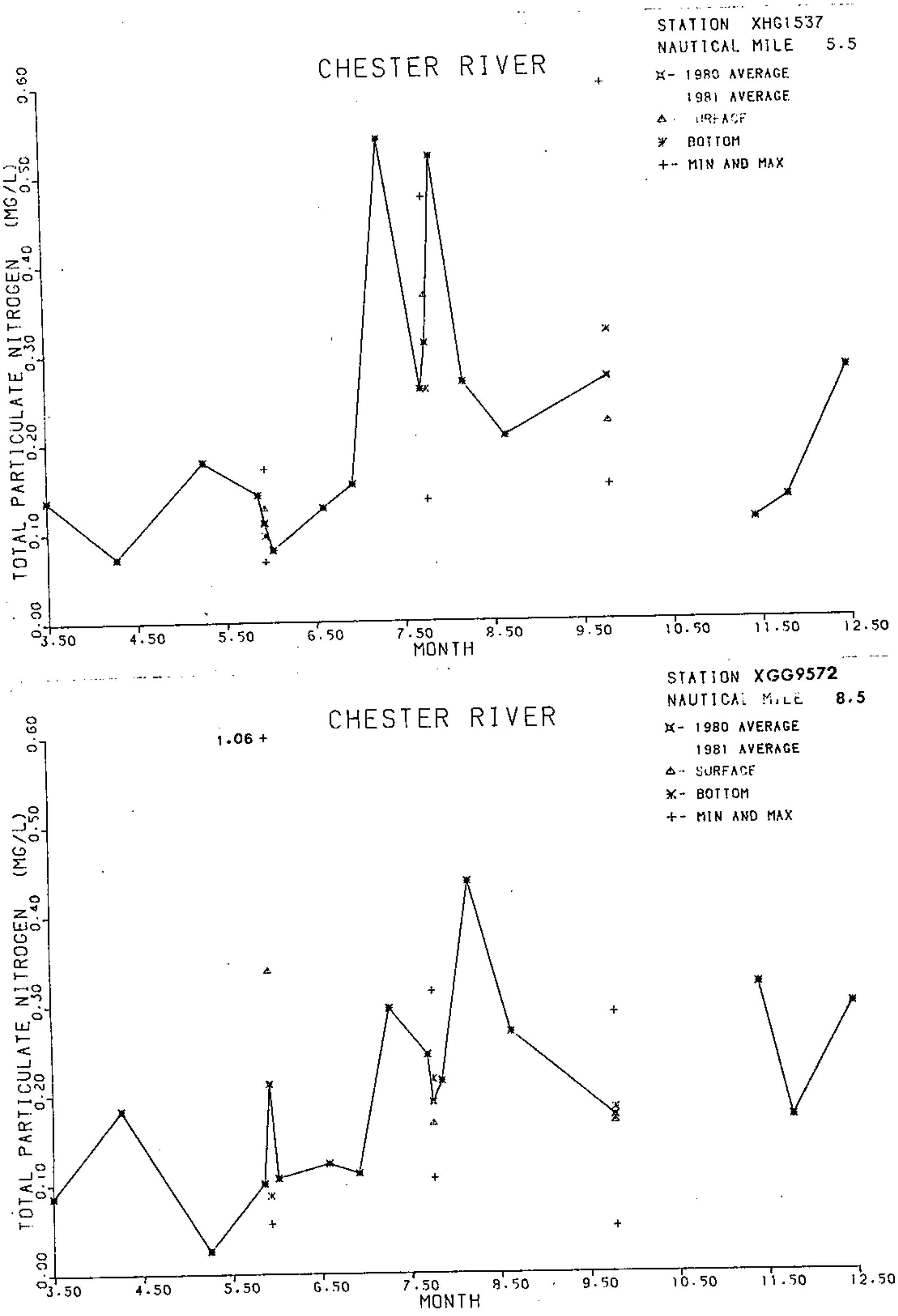


Figure 8-7 Temporal Plots of Total Particulate Nitrogen 1980-1981

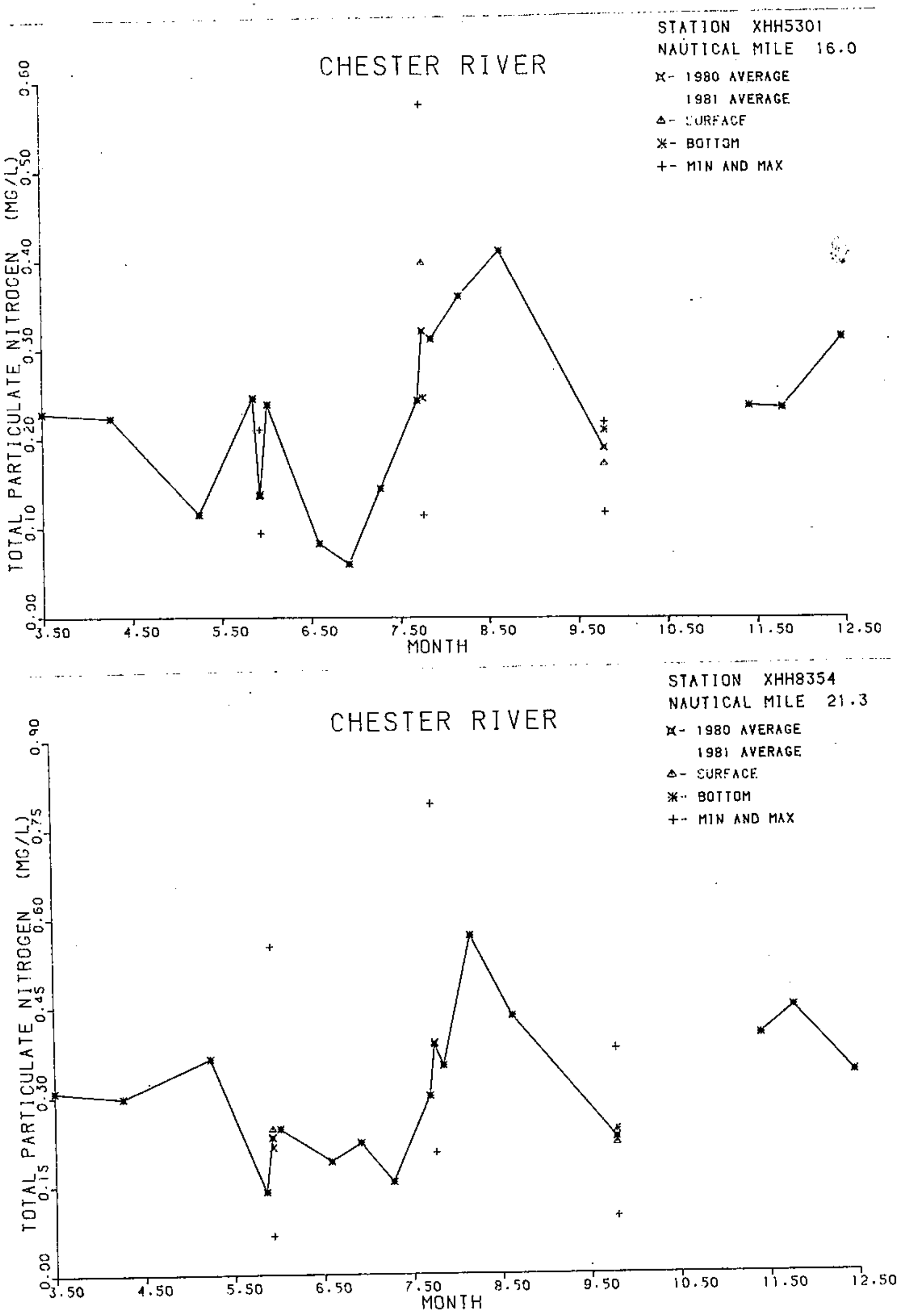


Figure 8-7 Temporal Plots of Total Particulate Nitrogen 1980-1981

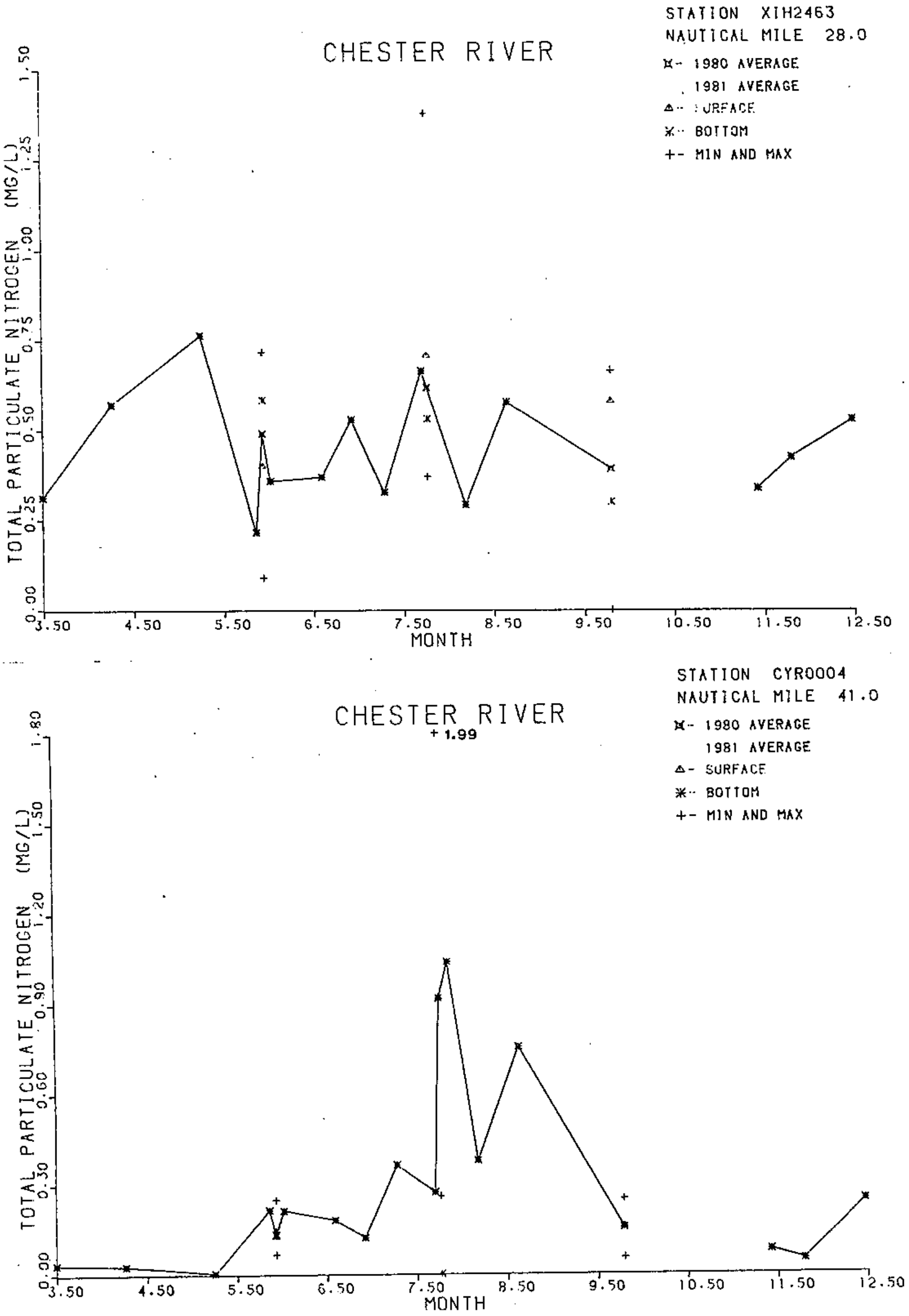


Figure 8-7 Temporal Plots of Total Particulate Nitrogen 1980-1981

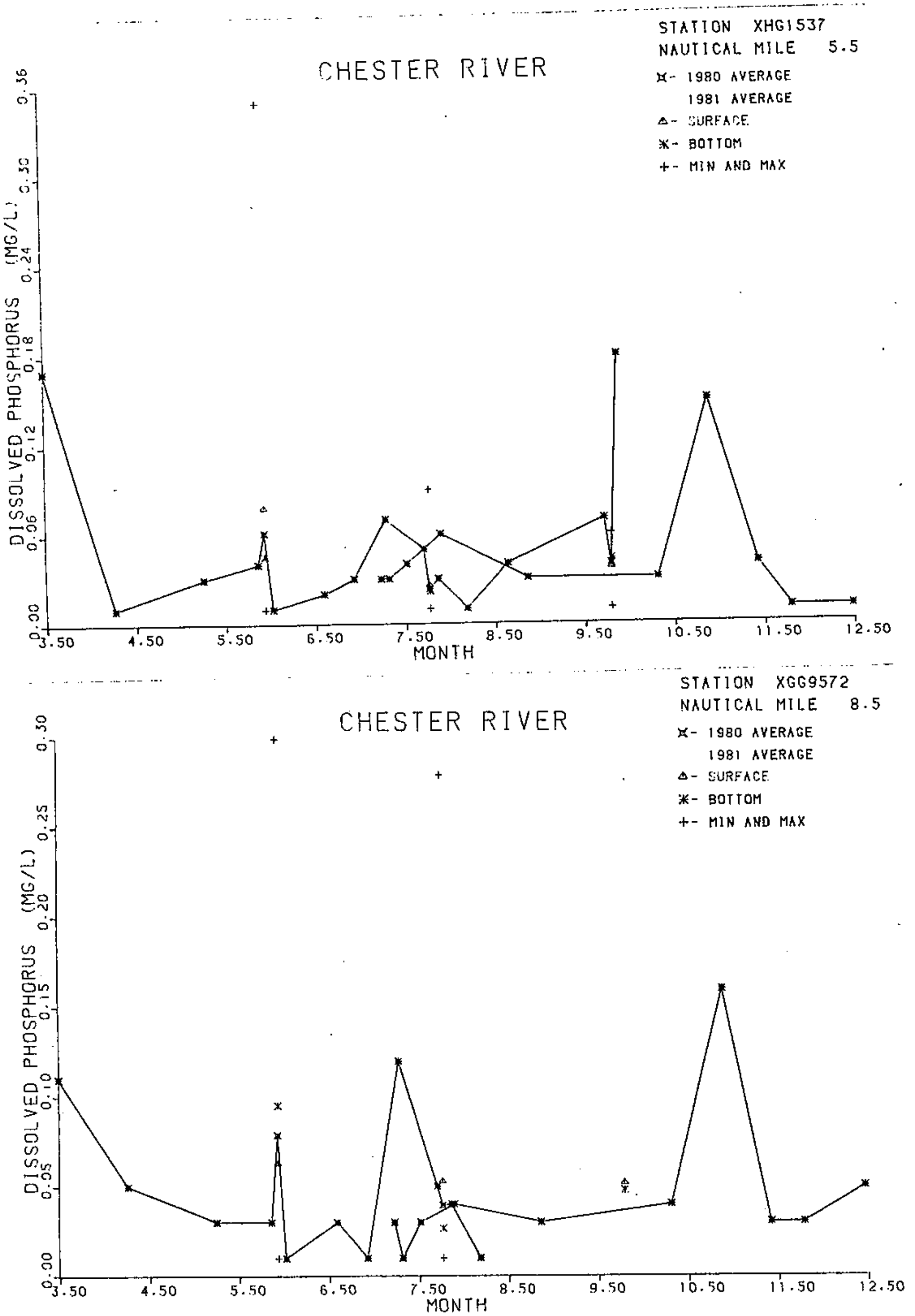
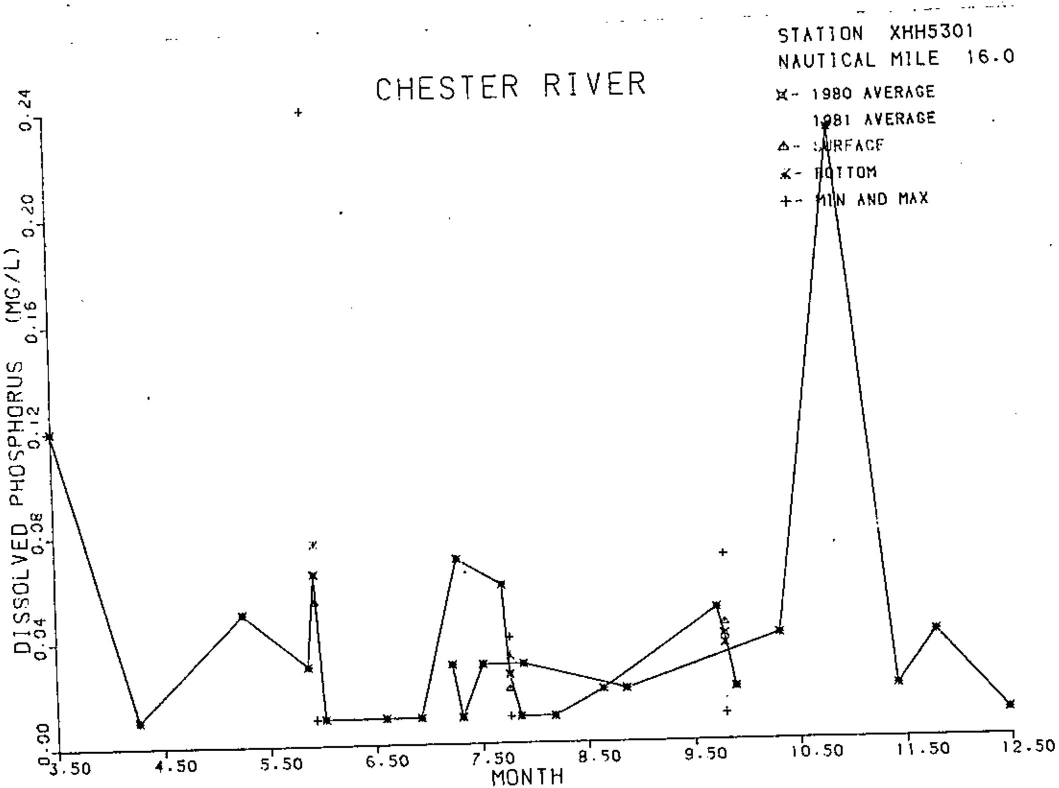


Figure 8-8 Temporal Plots of Dissolved Phosphorus 1980-1981



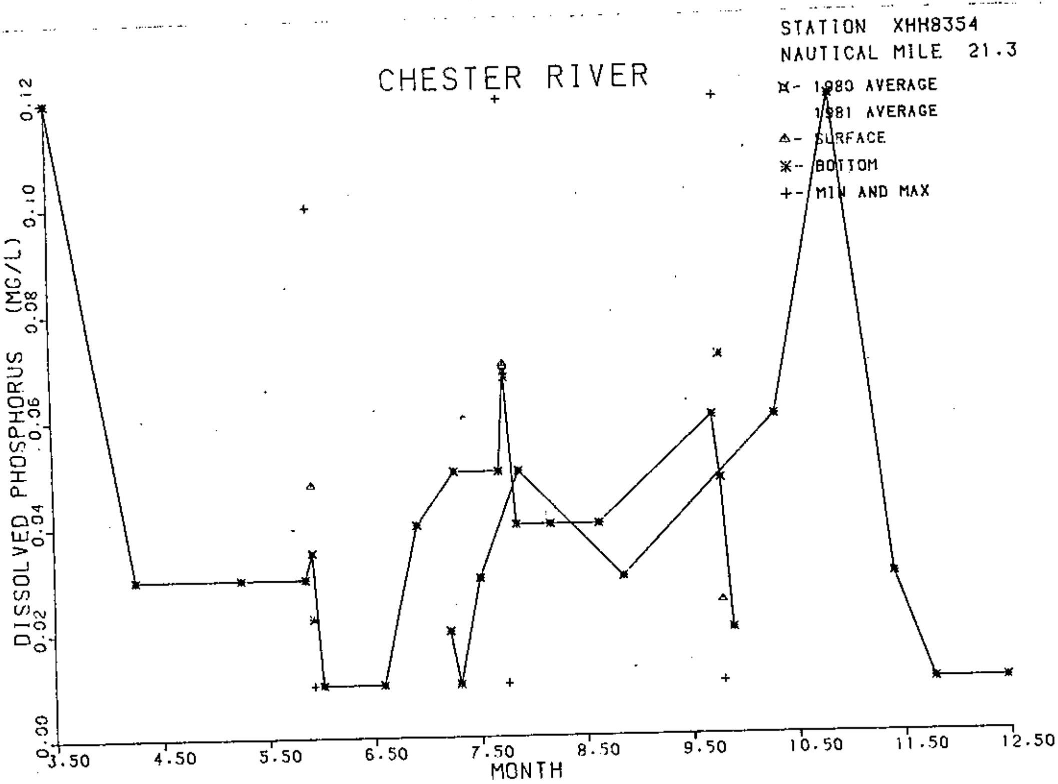


Figure 8-8 Temporal Plots of Dissolved Phosphorus 1980-1981

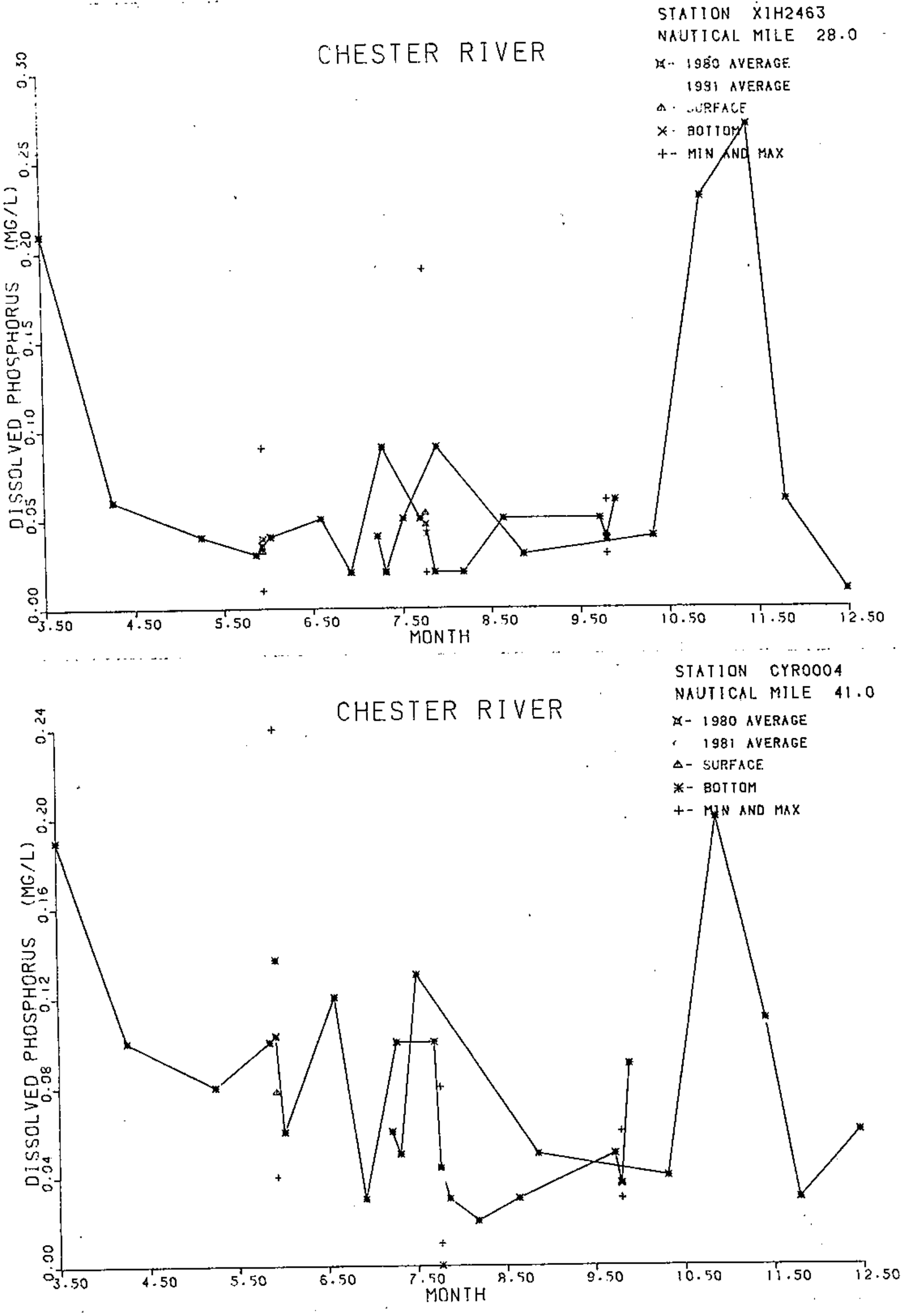


Figure 8-8 Temporal Plots of Dissolved Phosphorus 1980-1981

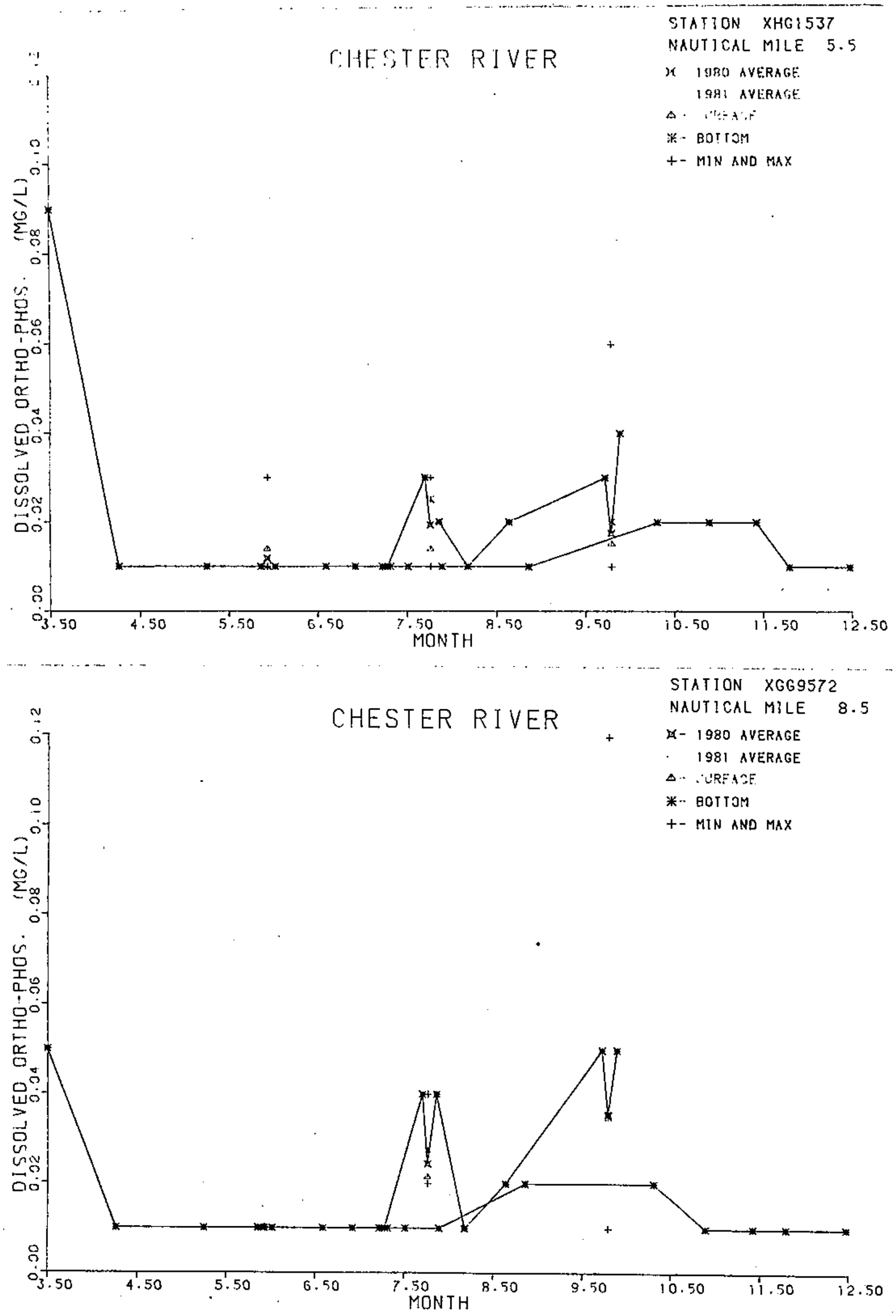


Figure 8-9 Temporal Plots of Dissolved Orthophosphorus, 1980-1981

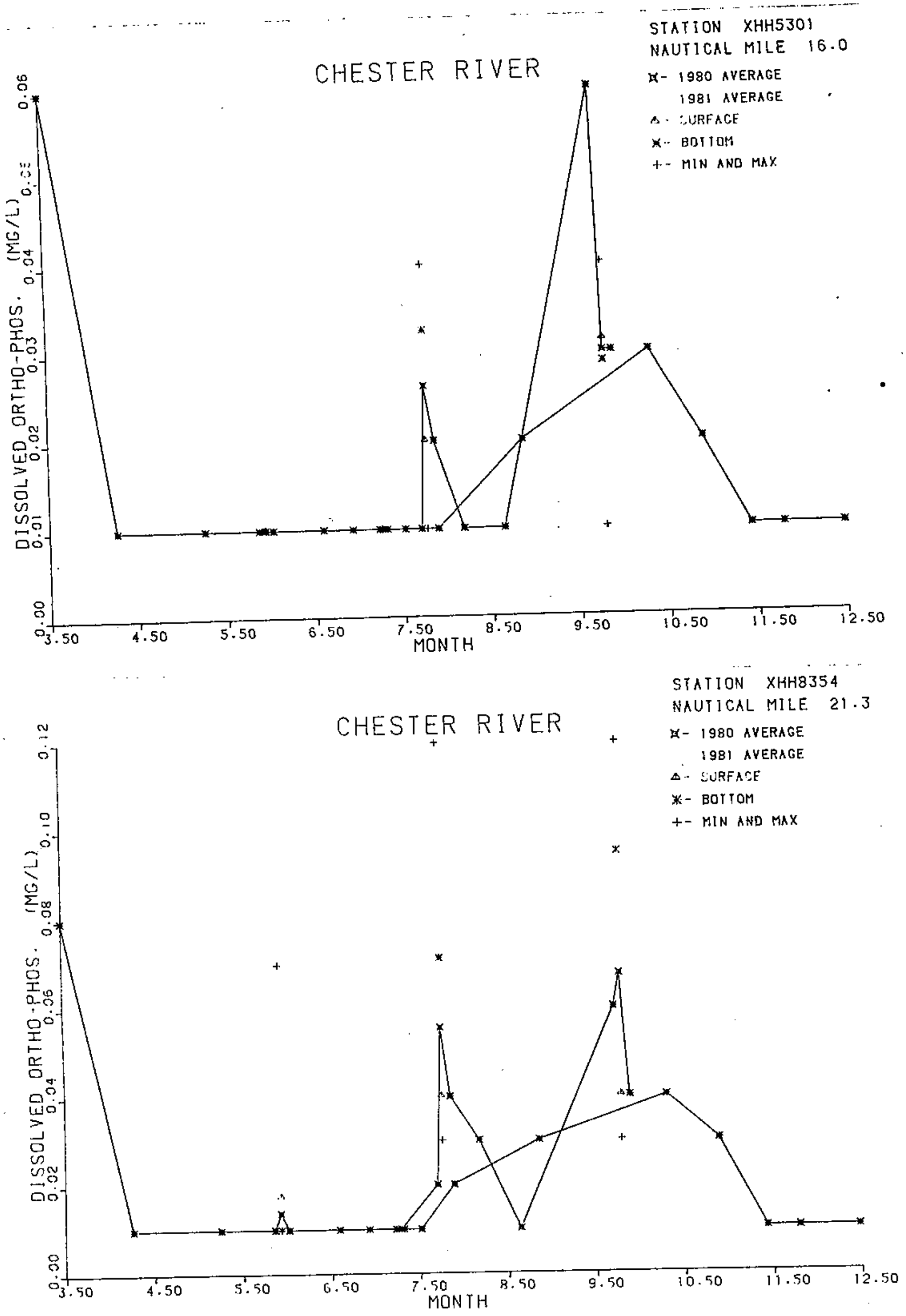


Figure 8-9 Temporal Plots of Dissolved Orthophosphorus, 1980-1981

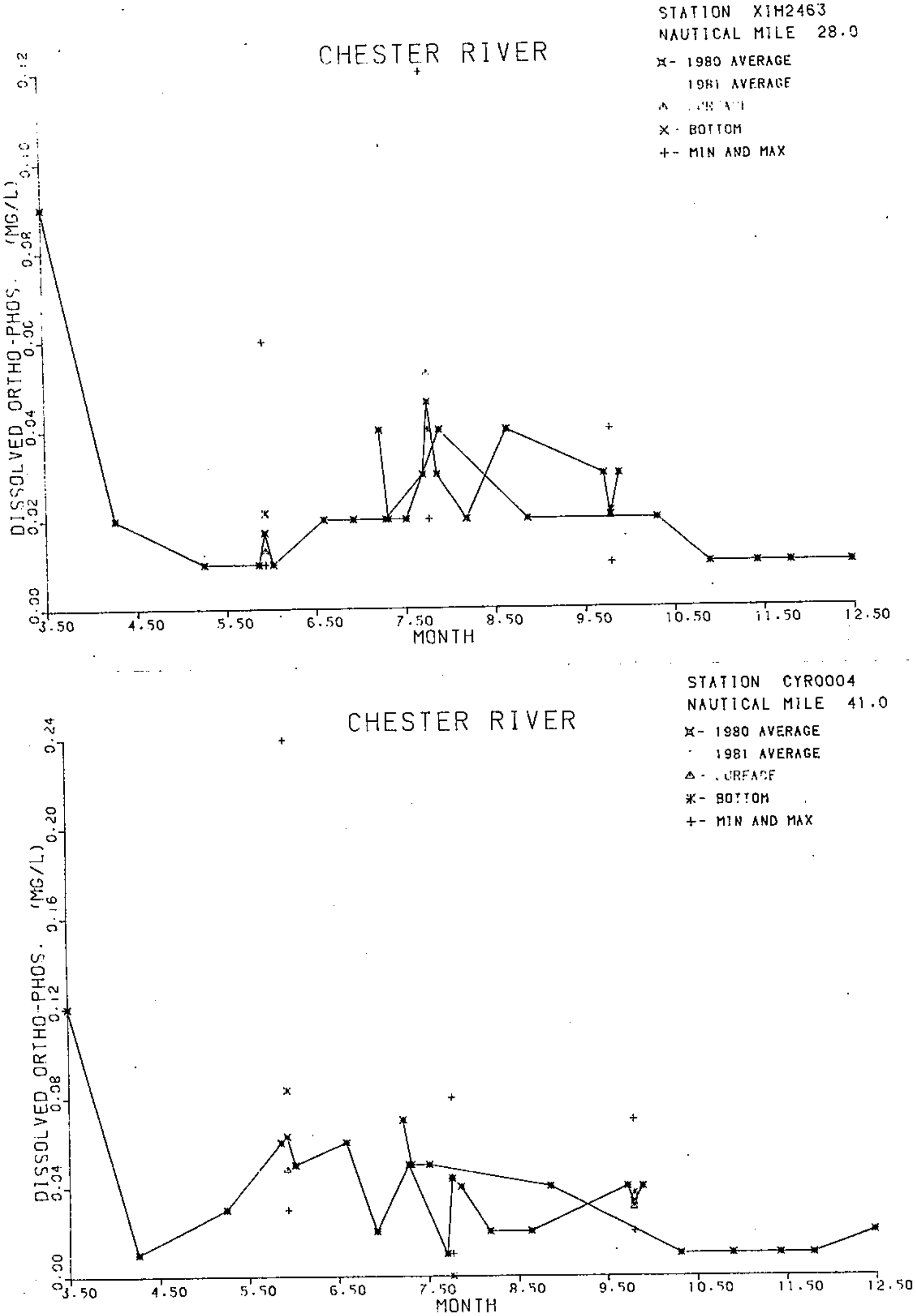


Figure 8-9 Temporal Plots of Dissolved Orthophosphorus, 1980-1981

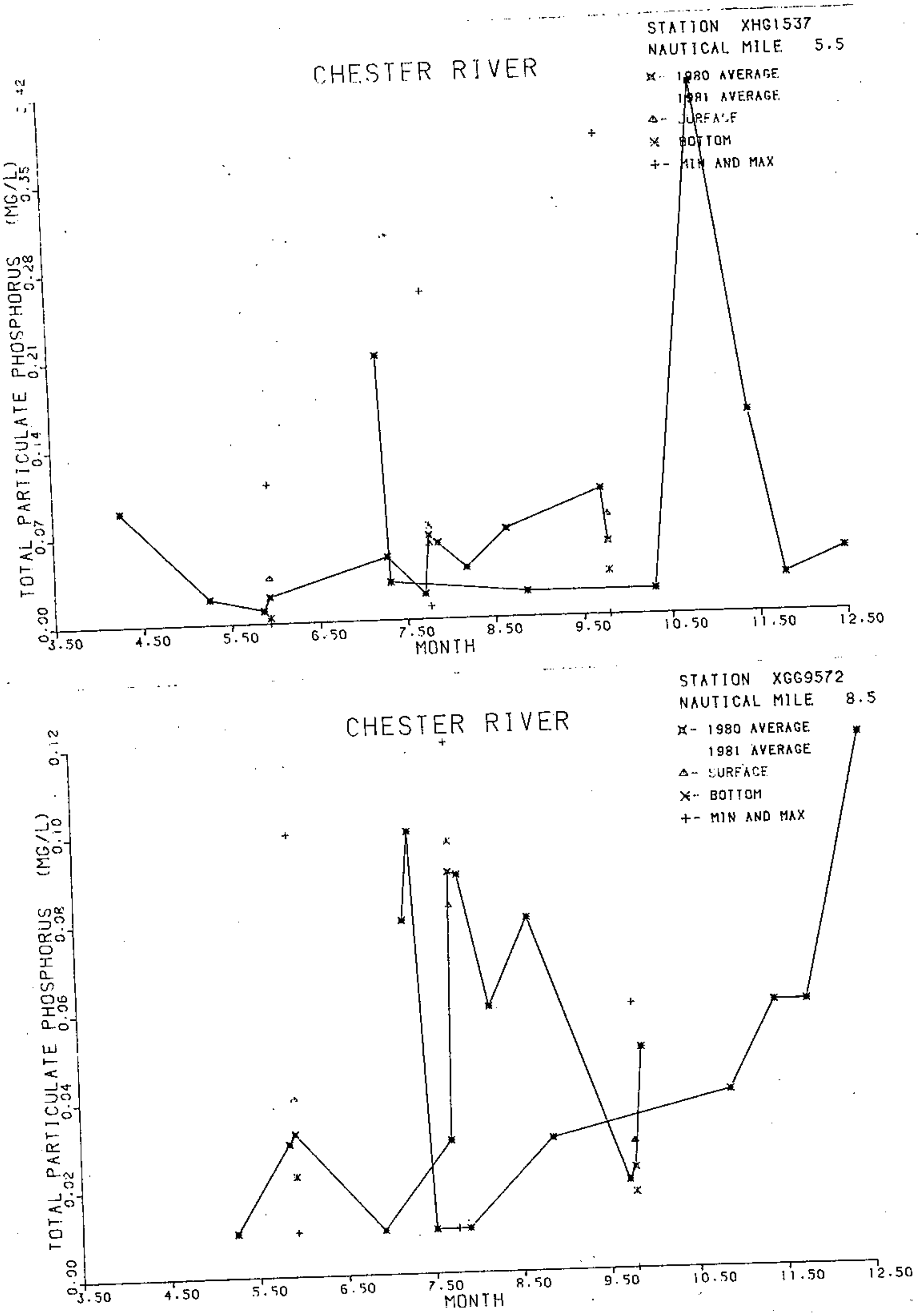


Figure 8-10 Temporal Plots of Total Particulate Phosphorus, 1980-1981

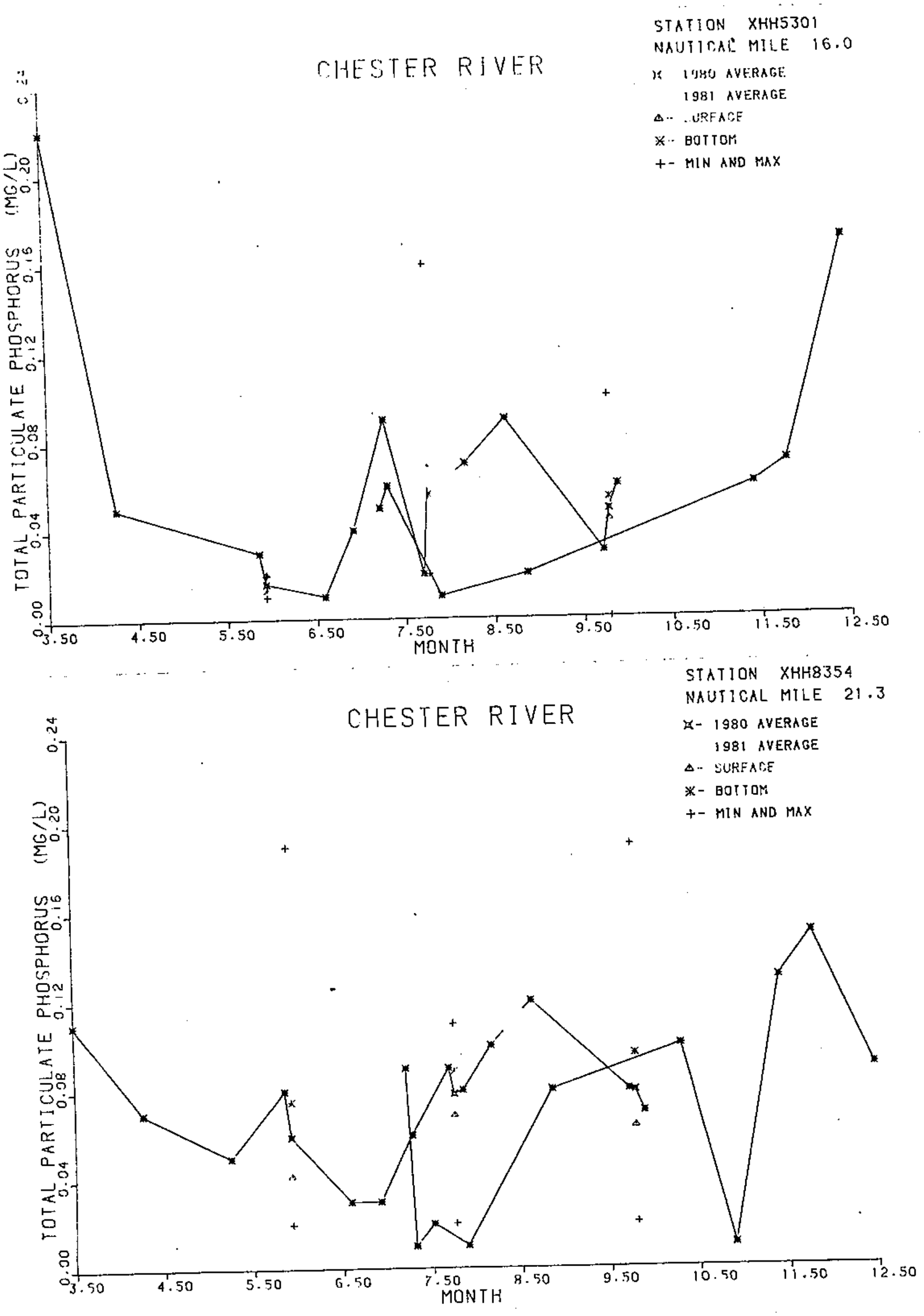
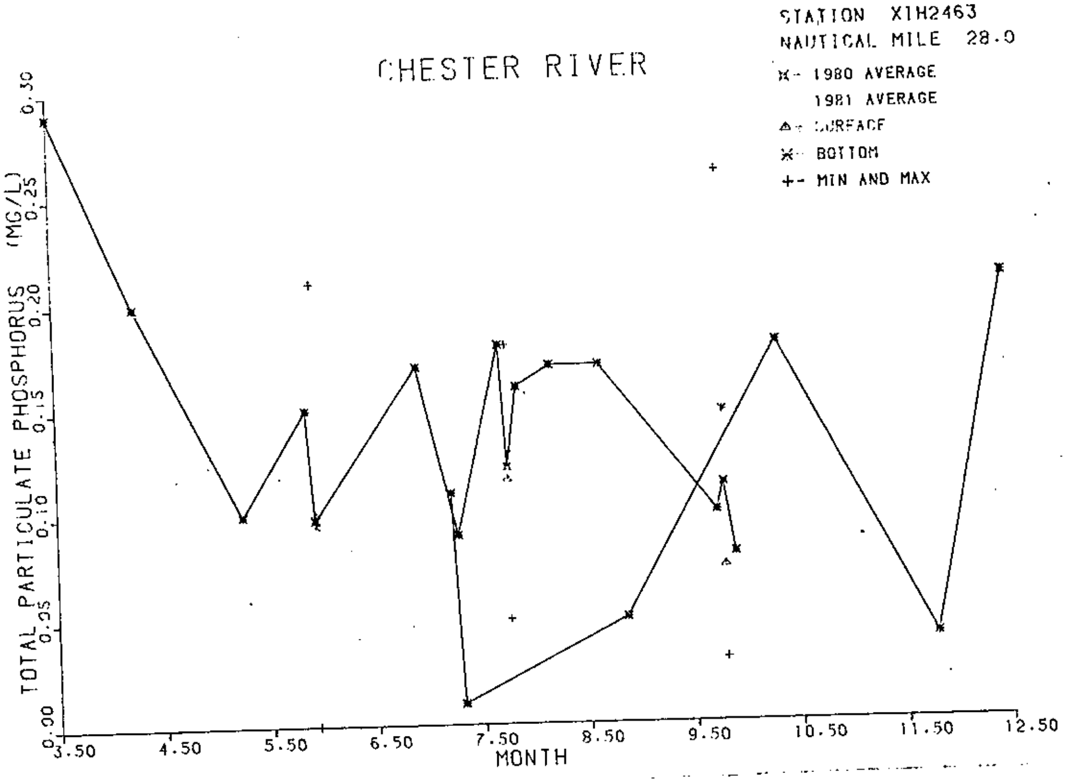


Figure 8-10 Temporal Plots of Total Particulate Phosphorus, 1980-1981



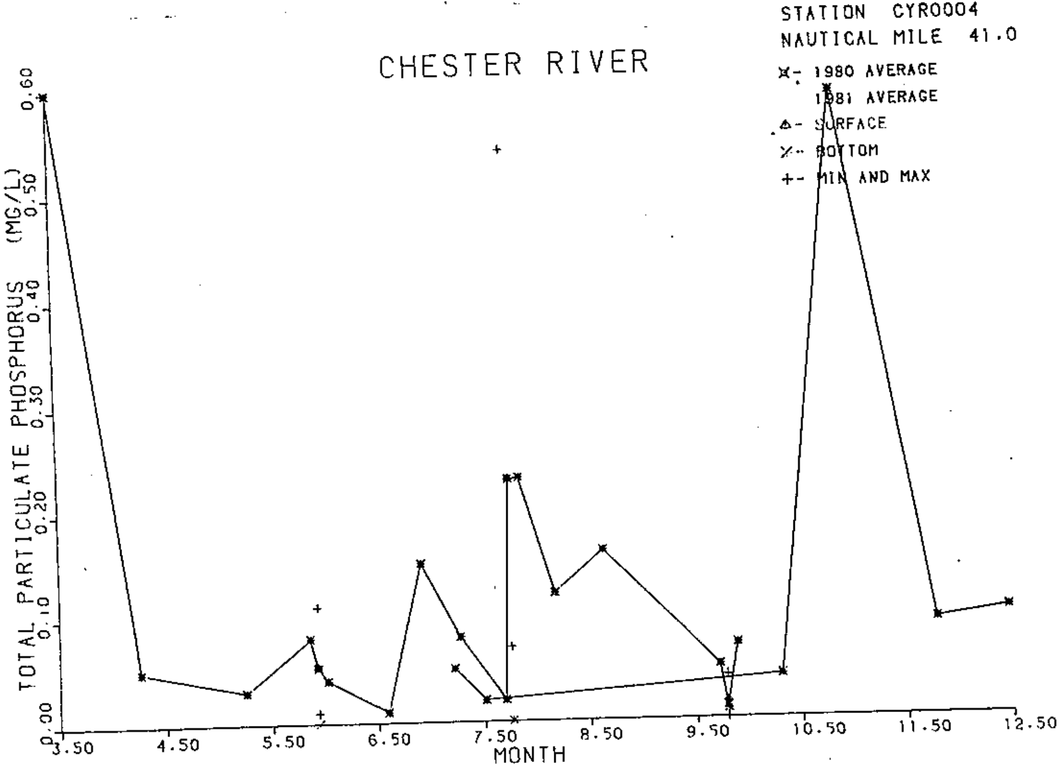


Figure 8-10 Temporal Plots of Total Particulate Phosphorus, 1980-1981

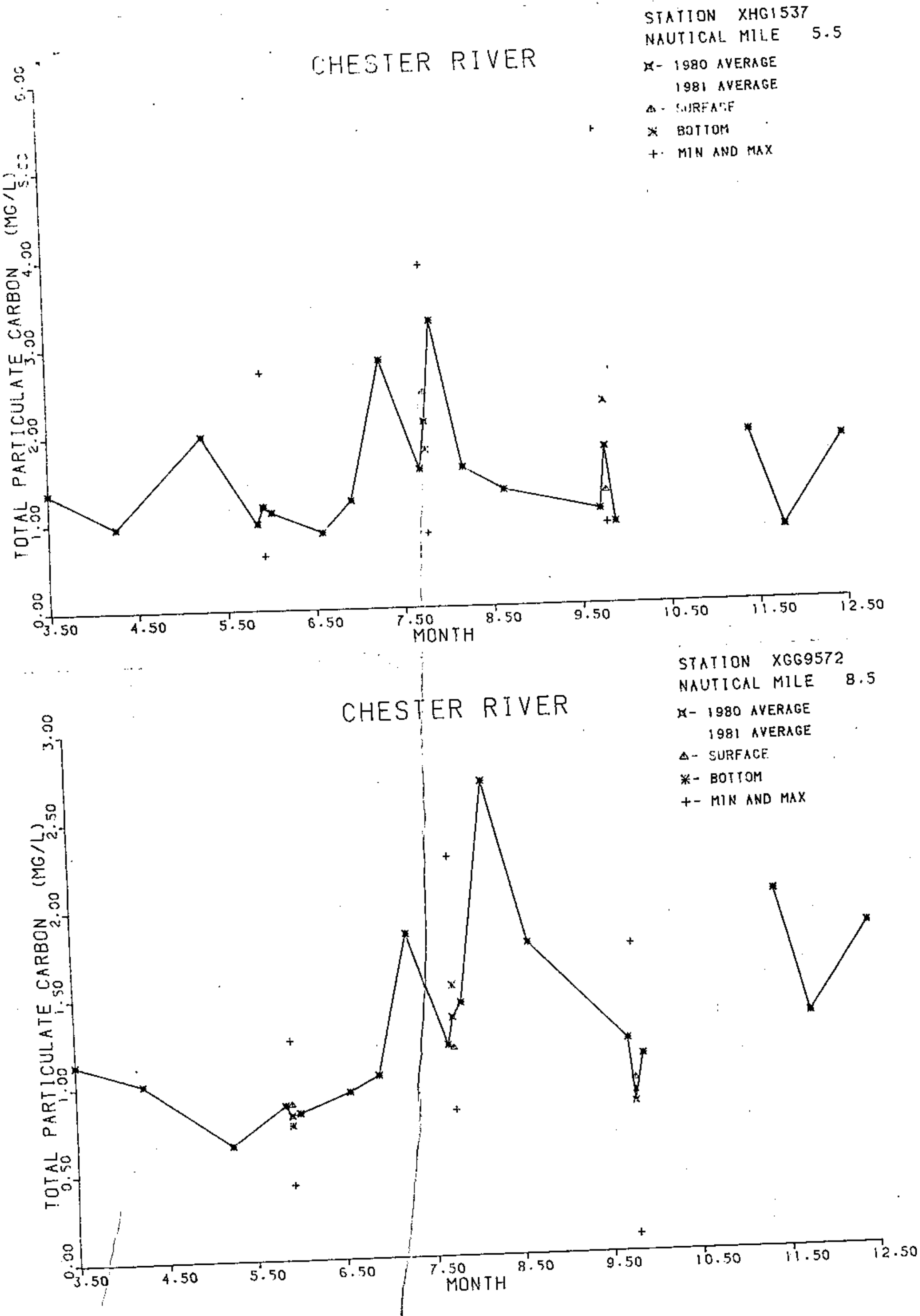


Figure 8-11 Temporal Plots of Total Particulate Carbon, 1980-1981

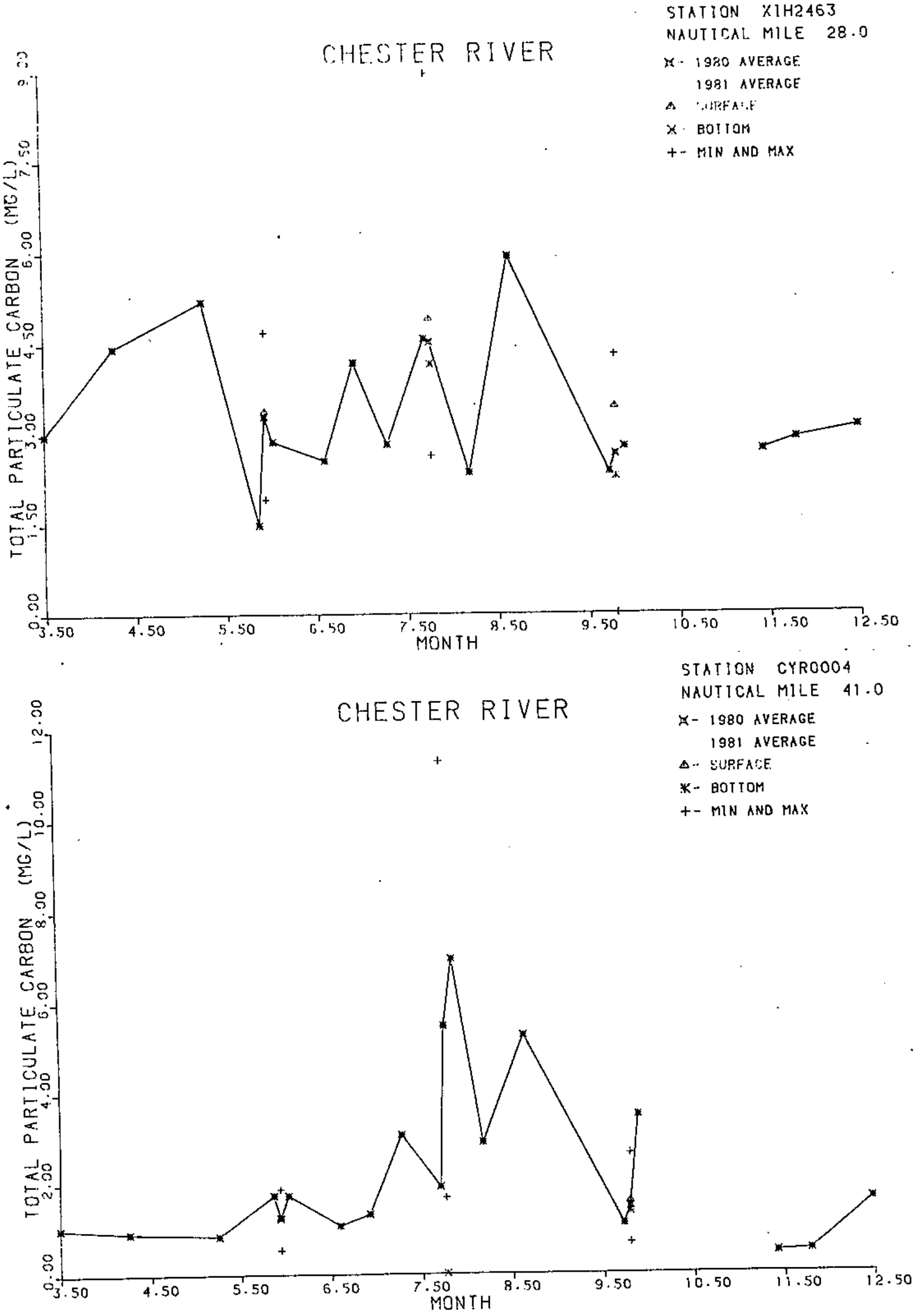


Figure 8-11 Temporal Plots of Total Particulate Carbon, 1980-1981

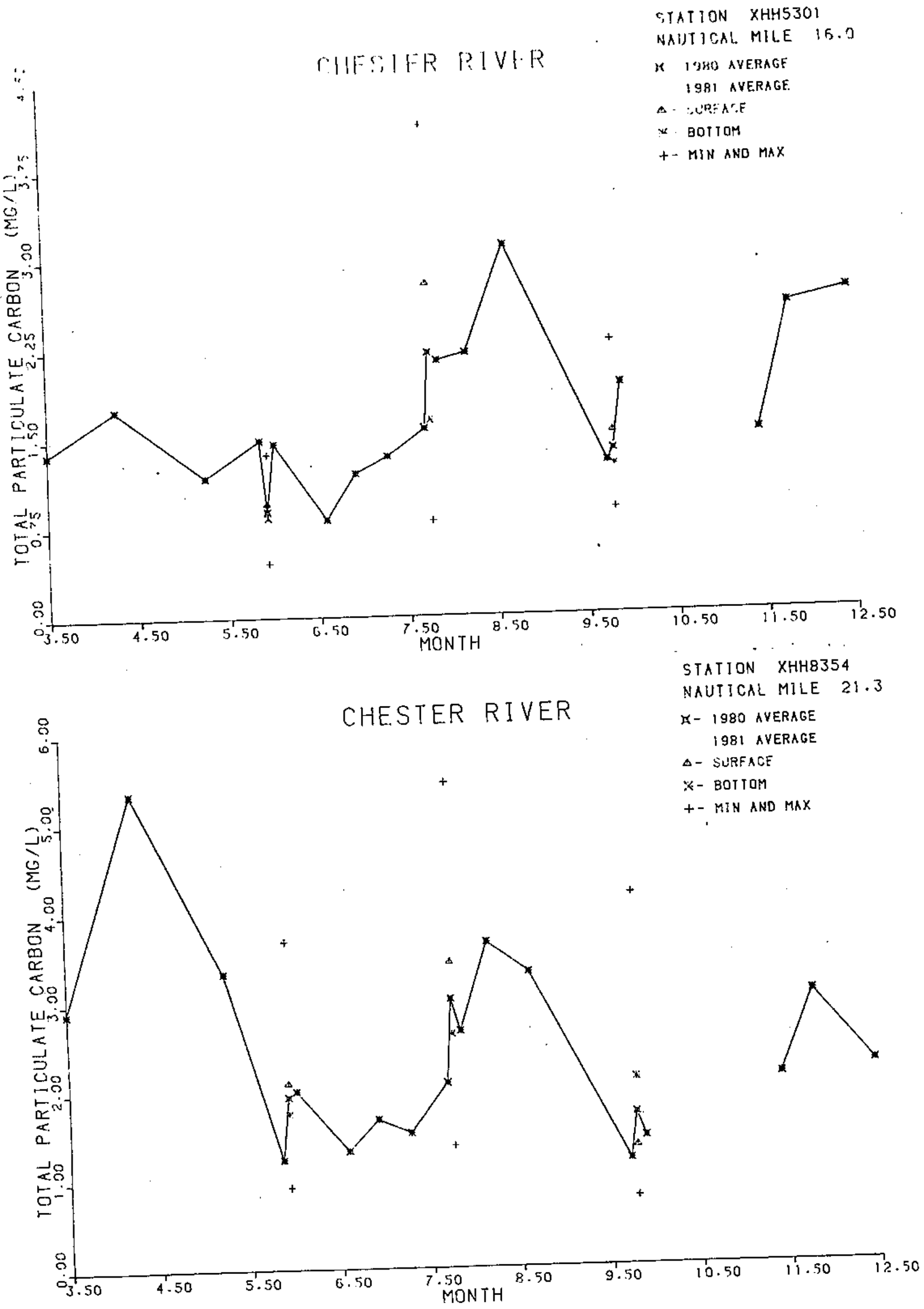


Figure 8-11 Temporal Plots of Total Particulate Carbon, 1980-1981

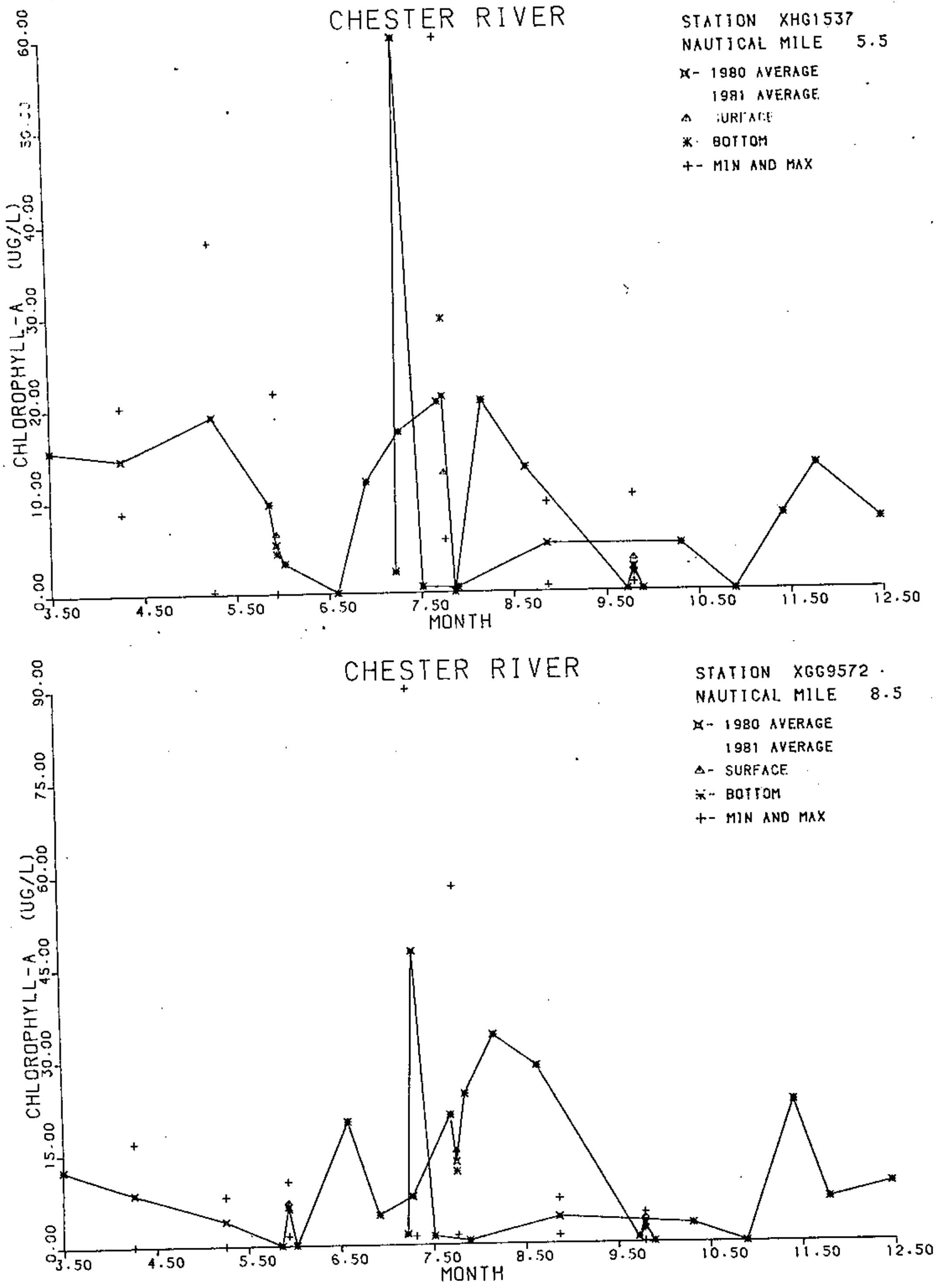


Figure 8-12 Temporal Plots of Chlorophyll-A, 1980-1981

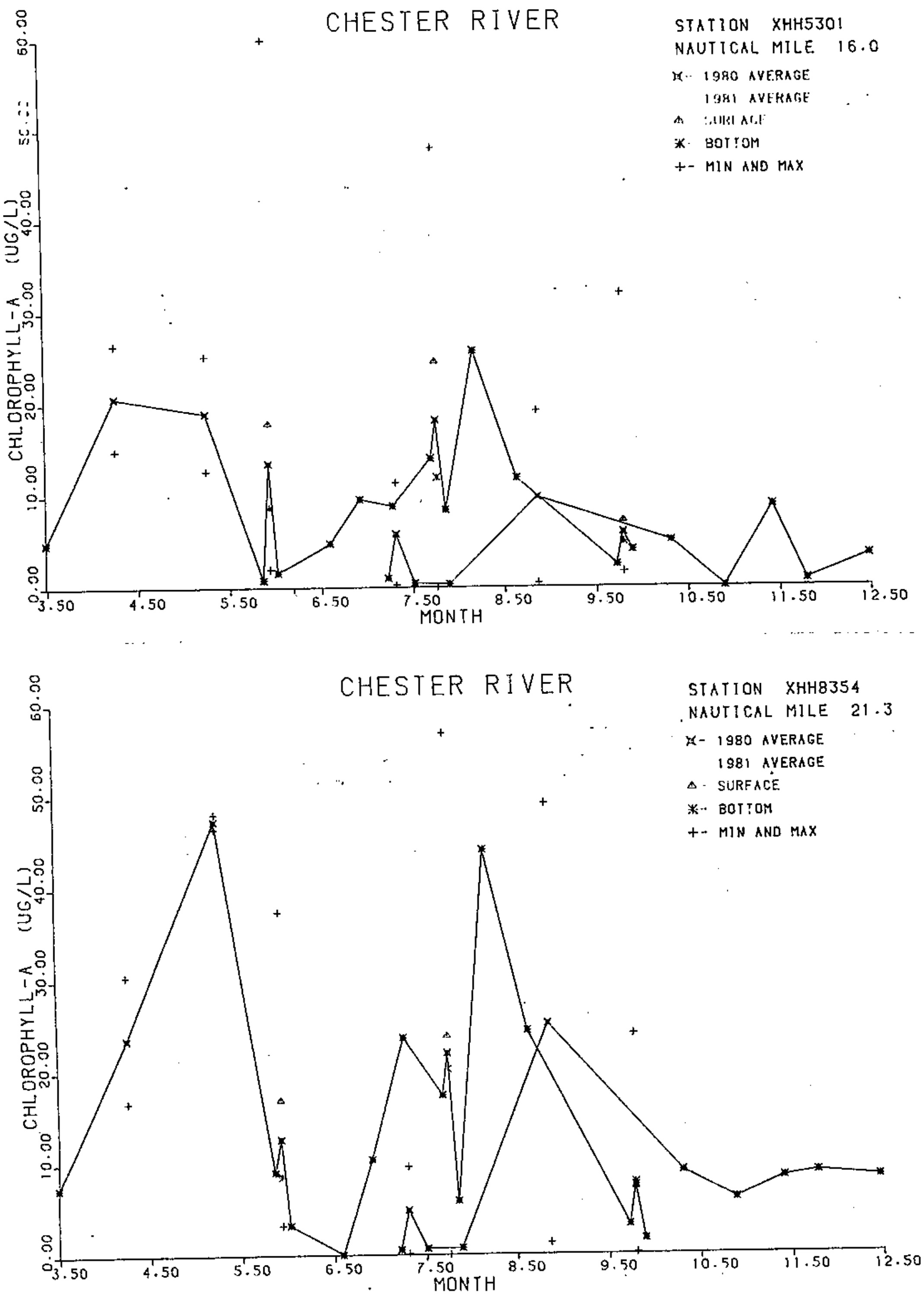


Figure 8-12 Temporal Plots of Chlorophyll-A, 1980-1981

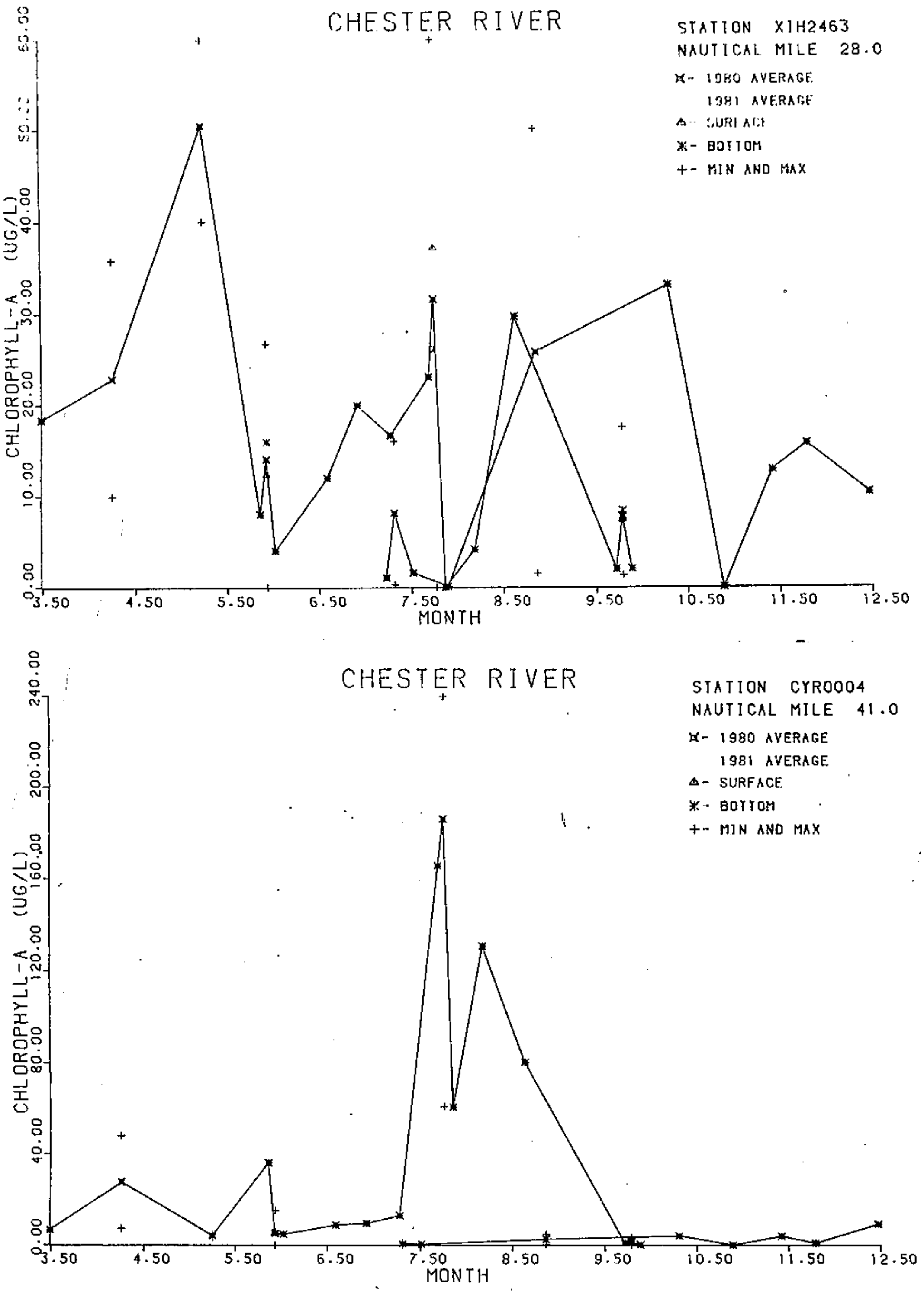


Figure 8-12 Temporal Plots of Chlorophyll-A, 1980-1981

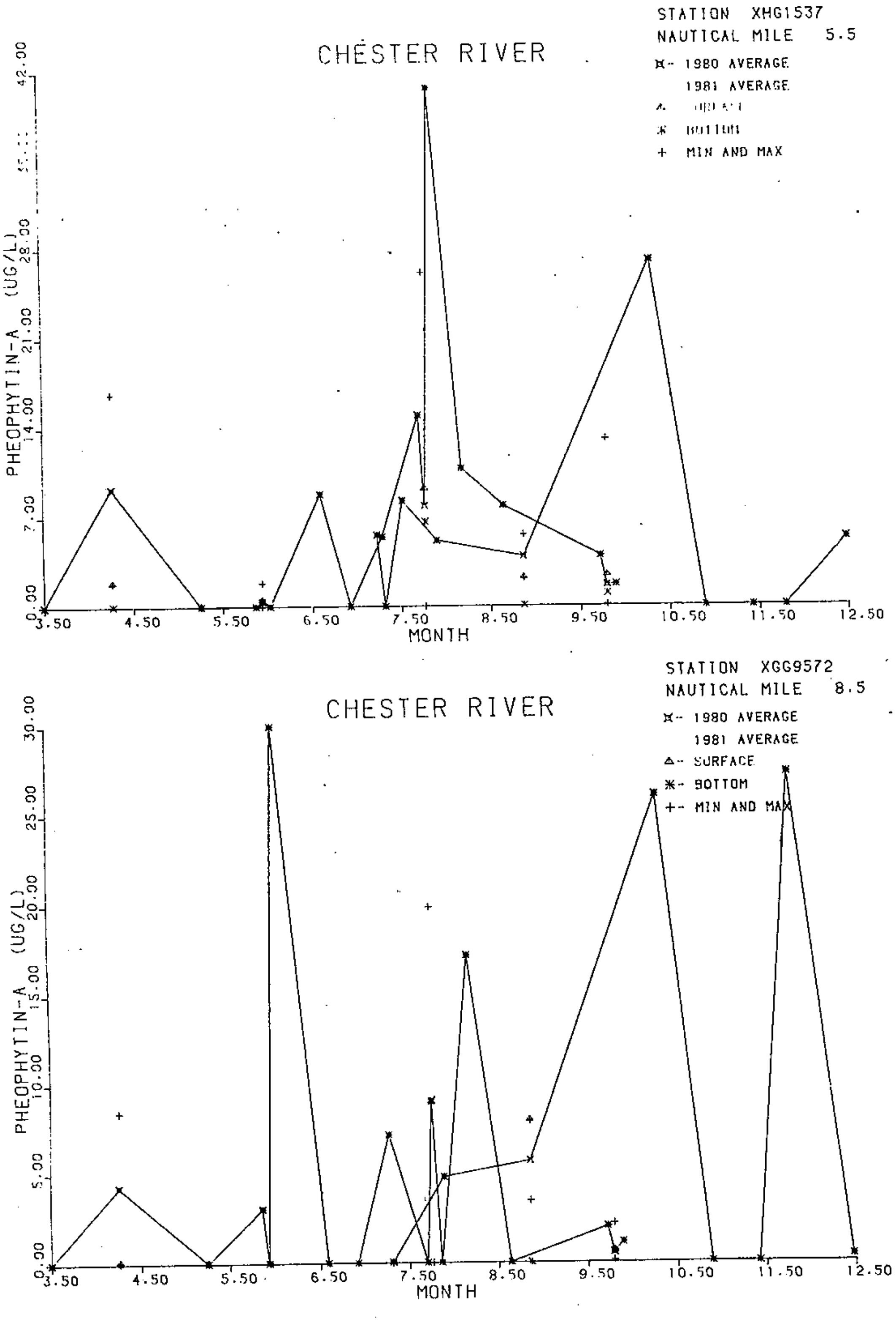


Figure 8-13 Temporal Plots of Pheophytin-A, 1980-1981

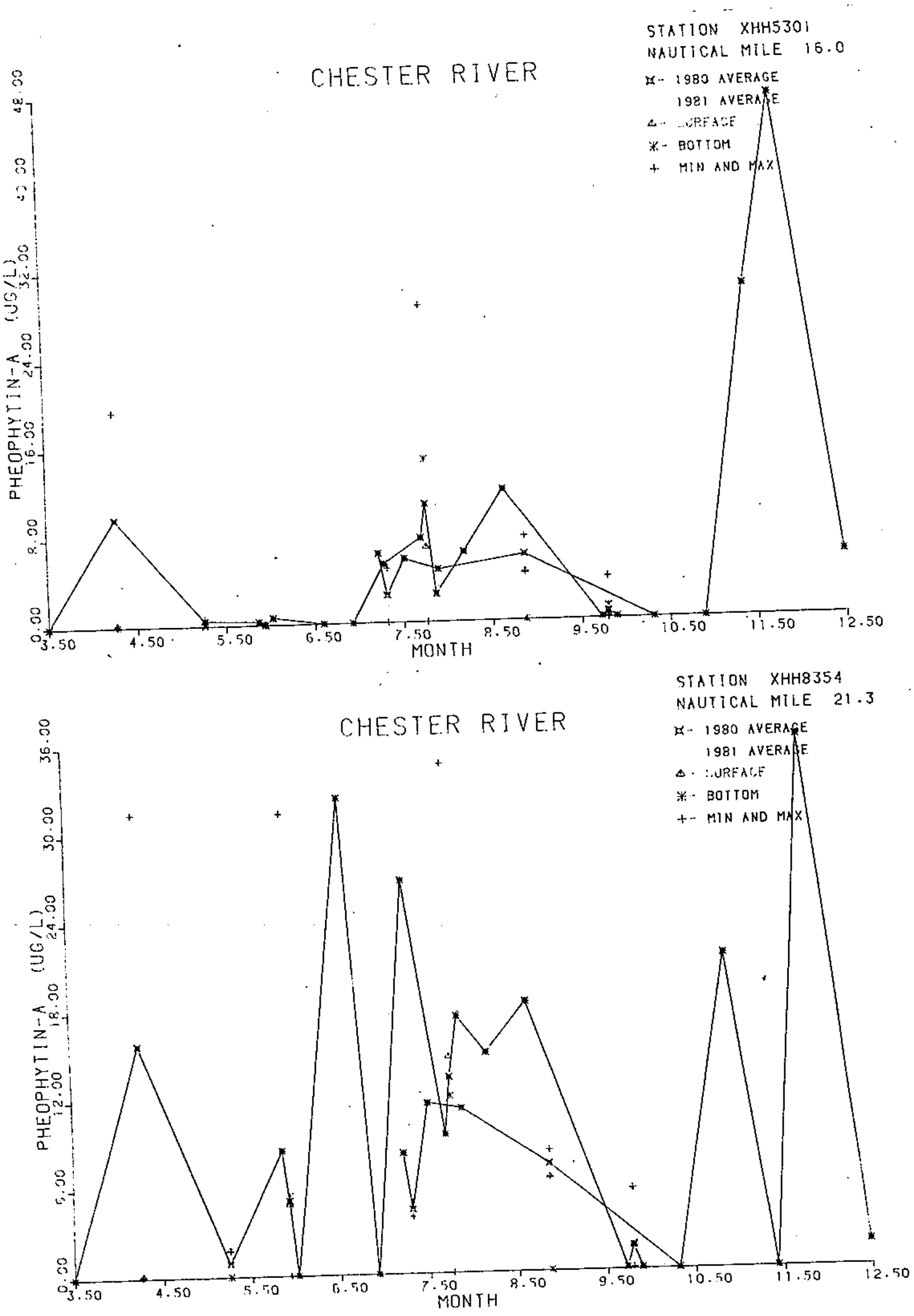


Figure 8-13 Temporal Plots of Pheophytin-A, 1980-1981

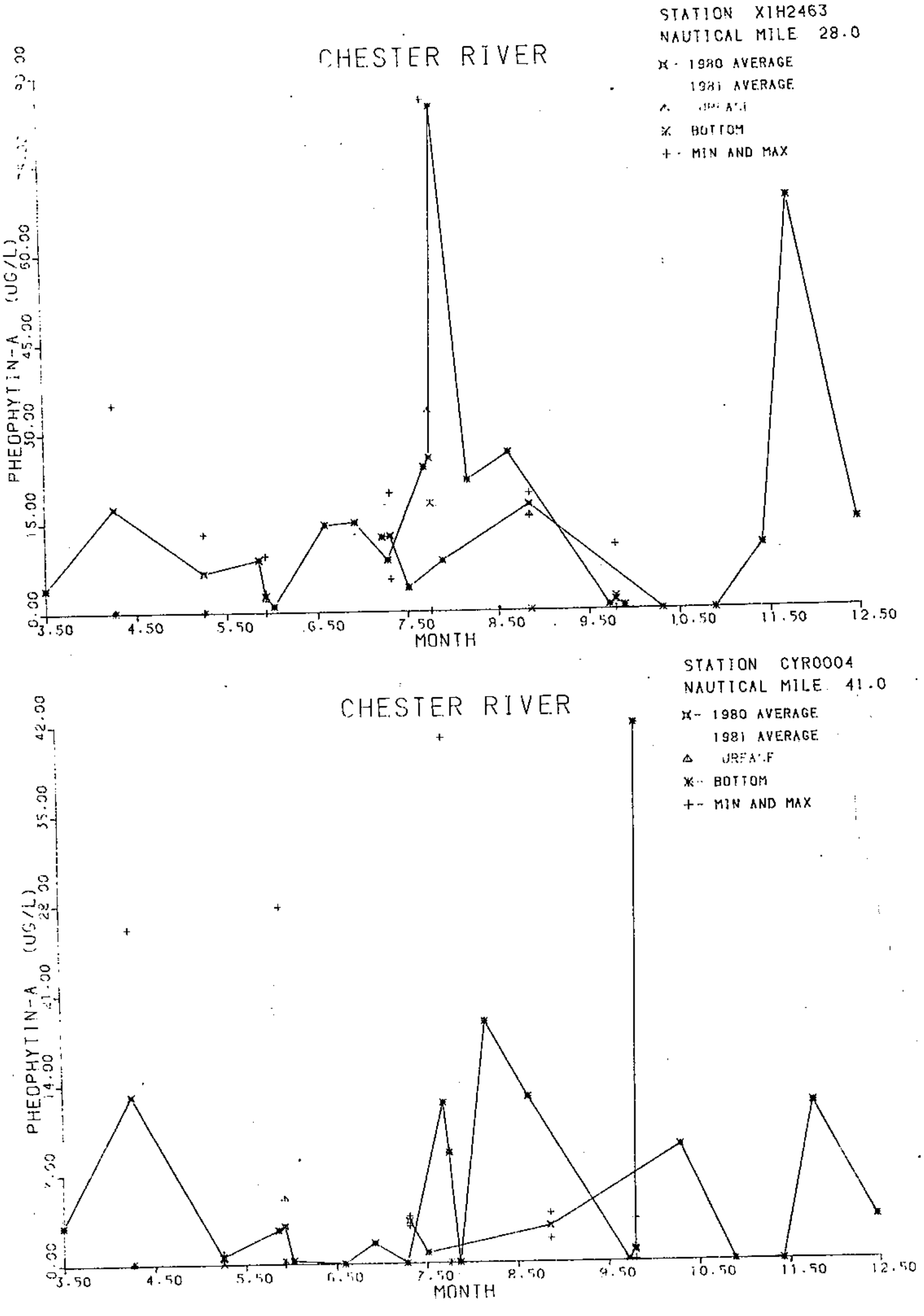


Figure 8-13 Temporal Plots of Pheophytin-A, 1980-1981

Table 8-1

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Temperature	80/07	N	14	87	4	105
		MEAN	25.74	25.52	21.50	25.40
		STD	1.85	1.87	3.11	2.05
	80/08	N	3	20	9	32
		MEAN	22.20	26.77	25.67	26.03
		STD	0.35	0.98	0.50	1.57
	80/10	N	73	7	41	121
		MEAN	19.47	13.94	15.32	17.75
		STD	1.88	3.30	3.11	3.25
	80/11	N	4	6	42	52
		MEAN	6.90	6.65	6.90	6.87
		STD	0.11	0.91	0.74	0.73
	80/12	N	2	4	20	26
		MEAN	2.60	3.50	3.94	3.77
		STD	0.00	0.36	0.33	0.49
	81/03	N	3	12	12	27
		MEAN	6.00	5.12	4.15	4.78
		STD	0.00	0.57	0.89	0.94
	81/04	N	3	7	22	32
		MEAN	14.83	12.57	11.13	11.79
		STD	0.29	1.13	0.76	1.41
	81/05	N	48	75	45	168
		MEAN	23.34	22.04	17.65	21.23
		STD	2.90	2.21	3.44	3.56
	81/06	N	9	60	12	81
		MEAN	23.77	24.28	22.21	23.91
		STD	2.76	1.71	2.72	2.12
	81/07	N	32	73	90	195
		MEAN	25.79	27.32	25.97	26.44
		STD	3.53	1.16	1.36	1.95
	81/08	N	6	9	39	54
		MEAN	22.75	26.01	25.03	24.94
		STD	1.40	1.44	1.15	1.48

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variable, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Temperature	81/09	N	34	41	92	167
		MEAN	17.39	18.58	18.84	18.48
		STD	1.16	0.57	1.08	1.14
Salinity	80/07	N	22	116	5	145
		MEAN	1.51	8.12	10.50	7.13
		STD	0.95	1.51	0.67	2.86
	80/08	N	4	26	11	41
		MEAN	1.00	8.36	11.32	8.43
		STD	0.00	1.72	1.09	3.16
	80/10	N	7	10	54	71
		MEAN	0.10	6.54	12.50	10.44
		STD	0.01	1.70	1.01	4.16
	80/11	N	6	8	56	70
		MEAN	0.08	7.30	12.88	11.15
		STD	0.005	1.08	0.88	3.94
	80/12	N	3	6	26	35
		MEAN	0.09	7.75	12.59	10.69
		STD	0.00	1.67	0.76	3.88
	80/03	N	4	19	13	36
		MEAN	0.07	8.81	12.38	9.13
		STD	0.00	1.60	2.81	4.17
	81/04	N	4	9	28	41
		MEAN	0.10	7.71	11.85	9.79
		STD	0.00	2.03	0.67	3.80
	81/05	N	11	106	54	171
		MEAN	0.06	7.85	11.11	8.38
		STD	0.02	2.45	1.02	3.32
	81/06	N	12	84	13	109
		MEAN	0.05	8.76	11.18	8.09
		STD	0.004	1.73	0.69	3.32
	81/07	N	53	102	117	272
		MEAN	0.46	7.37	11.63	7.86
		STD	0.86	1.86	1.18	4.36
	81/08	N	8	12	52	72
		MEAN	0.17	7.86	12.72	10.52
		STD	0.12	1.81	1.49	4.35

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Salinity	81/09	N	43	57	123	223
		MEAN	0.58	6.01	13.57	9.13
		STD	1.06	1.56	1.31	5.42
pH	80/07	N	5	32	1	39
		MEAN	7.30	7.30	7.00	7.29
		STD	0.40	0.48	--	0.45
	80/08	N	1	6	2	9
		MEAN	5.90	7.58	7.65	7.41
		STD	--	0.04	0.07	0.57
	80/10	N	43	7	38	88
		MEAN	6.85	7.74	7.74	7.30
		STD	0.92	0.14	0.14	0.79
	80/11	N	4	3	42	49
		MEAN	7.60	8.10	7.06	7.17
		STD	1.39	0.00	0.63	0.74
	80/12	N	2	4	20	26
		MEAN	8.20	7.97	7.80	7.86
		STD	0.00	0.13	0.13	0.17
	81/03	N	3	12	12	27
		MEAN	7.70	8.11	8.05	8.04
		STD	0.00	0.24	0.09	0.21
	81/04	N	3	5	19	27
		MEAN	6.80	7.34	7.16	7.16
		STD	0.50	0.09	0.31	0.33
	81/05	N	48	70	40	158
		MEAN	7.38	7.65	7.26	7.47
		STD	0.56	0.75	0.89	0.75
	81/06	N	9	54	12	75
		MEAN	6.92	7.25	7.04	7.18
		STD	0.51	0.48	0.36	0.48
	81/07	N	26	73	86	185
		MEAN	7.77	7.44	7.48	7.50
		STD	0.57	0.49	0.54	0.54

Table 8-1 (cont.)
Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
pH	81/08	N	6	6	27	39
		MEAN	7.00	6.40	7.19	7.04
		STD	0.66	0.28	0.47	0.54
	81/09	N	34	41	86	161
		MEAN	7.33	7.35	7.78	7.57
		STD	0.71	0.32	0.41	0.52
Dissolved oxygen	80/07	N	13	68	4	85
		MEAN	5.82	6.25	4.52	6.10
		STD	1.43	1.33	4.08	1.56
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	73	7	41	121
		MEAN	7.58	8.56	8.68	8.01
		STD	1.22	1.13	1.00	1.26
	80/11	N	4	6	42	52
		MEAN	11.95	12.35	11.55	11.67
		STD	0.87	1.55	1.33	1.33
	80/12	N	2	4	20	26
		MEAN	11.00	11.07	11.07	11.07
		STD	0.00	0.61	0.32	0.35
	81/03	N	3	12	12	27
		MEAN	11.80	12.32	12.42	12.30
		STD	0.17	1.14	1.45	1.21
	81/04	N	3	5	19	27
		MEAN	10.53	10.24	10.53	10.47
		STD	0.25	0.61	0.54	0.53
	81/05	N	46	73	45	164
		MEAN	7.95	8.83	6.53	7.95
		STD	1.67	2.08	2.87	2.41
	81/06	N	9	60	12	81
		MEAN	7.05	6.59	3.27	6.15
		STD	0.81	1.69	2.07	2.06

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/North	Statistics	0-3 ppt	3.1-10 ppt	>10 ppt	All Data
Dissolved Oxygen	81/07	N	32	73	90	195
		MEAN	8.93	6.64	6.18	6.80
		STD	2.56	1.89	2.76	2.61
	81/08	N	6	9	38	53
		MEAN	9.45	6.64	5.83	6.38
		STD	2.03	0.67	1.16	1.66
	81/09	N	34	40	92	166
		MEAN	8.59	8.83	8.43	8.56
		STD	0.86	1.23	1.31	1.22
Dissolved Oxygen Saturation	80/07	N	12	68	4	84
		MEAN	70.35	79.00	53.35	76.54
		STD	17.90	16.82	47.82	19.75
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	32	7	41	80
		MEAN	94.93	85.27	93.01	93.10
		STD	15.20	5.70	7.03	11.18
	80/11	N	4	6	42	52
		MEAN	97.15	104.75	102.23	102.13
		STD	7.36	11.68	10.06	10.03
	80/12	N	2	4	20	26
		MEAN	80.30	86.95	90.96	89.53
		STD	0.00	3.24	3.19	4.30
	81/03	N	3	12	12	27
		MEAN	97.80	101.49	102.50	101.08
		STD	1.39	9.08	12.07	10.18
	81/04	N	3	5	19	27
		MEAN	103.67	100.00	102.72	102.32
		STD	1.85	6.27	5.47	5.34
	81/05	N	46	72	44	162
		MEAN	93.81	106.72	74.38	94.27
		STD	20.82	26.62	30.99	29.45

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved Oxygen Saturation	81/06	N	9	60	12	81
		MEAN	83.70	6.59	40.72	76.60
		STD	12.33	1.69	26.91	26.42
	81/07	N	32	72	88	192
		MEAN	110.04	86.10	80.85	87.68
		STD	34.58	24.81	36.95	33.93
	81/08	N	6	9	38	53
		MEAN	109.47	85.22	75.44	80.95
		STD	20.84	8.92	14.66	18.06
	81/09	N	34	40	89	163
		MEAN	89.83	97.90	98.18	96.37
		STD	10.04	12.80	14.62	13.69
BOD_5	80/07	N	5	27	1	34
		MEAN	1.80	2.91	3.00	2.73
		STD	0.84	1.31	--	1.27
	80/08	N	1	6	2	9
		MEAN	1.00	2.33	2.50	2.22
		STD	--	0.52	0.71	0.67
	80/10	N	2	3	13	18
		MEAN	3.50	2.00	2.23	2.33
		STD	0.71	1.00	0.83	0.91
	80/11	N	2	2	14	18
		MEAN	3.00	3.50	3.29	3.28
		STD	2.83	3.53	1.07	1.45
	80/12	N	1	2	6	9
		MEAN	3.00	2.50	2.17	2.33
		STD	--	0.71	0.41	0.50
	80/03	N	1	7	2	10
		MEAN	1.00	1.29	1.00	1.20
		STD	--	0.49	0.00	0.42
	81/04	N	1	2	6	9
		MEAN	3.00	3.00	3.50	3.33
		STD	--	0.00	0.84	0.71

Table 8-1 (cont.)
Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
BOD_5	81/05	N	3	12	8	23
		MEAN	3.00	3.25	2.62	3.00
		STD	1.00	0.75	0.74	0.80
	81/06	N	1	8	--	9
		MEAN	3.00	1.62	--	1.78
		STD	--	0.92	--	0.97
	81/07	N	4	15	20	39
		MEAN	7.75	5.13	2.85	4.23
		STD	6.40	7.51	1.31	5.24
	81/08	N	2	3	13	18
		MEAN	9.00	4.00	3.23	4.00
		STD	5.66	1.00	0.83	2.42
	81/09	N	3	6	19	28
		MEAN	3.33	3.33	1.89	2.36
		STD	1.15	3.01	0.81	1.64
Suspended Solids	80/07	N	5	28	1	35
		MEAN	13.40	25.25	16.00	23.43
		STD	9.48	7.87	--	8.95
	80/08	N	1	6	2	9
		MEAN	22.00	44.83	37.00	40.55
		STD	--	7.70	0.00	9.85
	80/10	N	2	2	13	17
		MEAN	11.50	17.50	12.15	12.71
		STD	14.85	9.19	9.36	9.39
	80/11	N	2	1	14	17
		MEAN	11.00	36.00	31.79	29.59
		STD	1.41	--	5.92	8.87
	80/12	N	1	2	6	9
		MEAN	14.00	39.50	41.33	37.89
		STD	--	9.19	8.24	11.57
	81/03	N	1	7	1	9
		MEAN	12.00	37.14	26.00	33.11
		STD	--	9.62	--	12.07

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, At Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Suspended Solids	81/04	N	1	2	6	9
		MEAN	27.00	50.50	36.83	38.78
		STD	--	7.78	2.56	8.14
	81/05	N	28	31	9	68
		MEAN	93.71	41.32	34.78	62.03
		STD	184.38	20.59	10.52	120.92
	81/06	N	3	23	1	27
		MEAN	266.33	244.43	220.00	245.96
		STD	226.43	258.56	--	246.14
	81/07	N	21	29	27	77
		MEAN	56.67	61.03	39.85	52.41
		STD	85.88	26.27	13.03	48.40
	81/08	N	2	3	13	18
		MEAN	20.50	61.00	45.38	45.22
		STD	2.12	14.18	11.84	15.45
	81/09	N	20	16	31	67
		MEAN	40.95	49.81	29.45	37.75
		STD	39.73	19.27	11.60	25.90
Dissolved Organic Nitrogen	80/07	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	2	3	13	18
		MEAN	0.42	0.53	0.73	0.66
		STD	0.06	0.12	0.26	0.25
	80/11	N	2	2	14	18
		MEAN	0.34	0.50	0.45	0.44
		STD	0.12	0.13	0.13	0.13
	80/12	N	1	2	6	9
		MEAN	0.46	0.35	0.49	0.46
		STD	--	0.09	0.11	0.11

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved Organic Nitrogen	81/03	N	1	7	1	9
		MEAN	0.71	0.38	0.37	0.42
		STD	--	0.11	--	0.15
	81/04	N	1	2	6	9
		MEAN	0.76	0.24	0.31	0.35
		STD	--	0.05	0.12	0.19
	81/05	N	27	29	9	65
		MEAN	0.59	0.41	0.70	0.53
		STD	0.21	0.16	0.25	0.22
	81/06	N	3	23	1	27
		MEAN	0.83	0.55	0.55	0.58
		STD	0.14	0.15	--	0.17
	81/07	N	18	29	27	74
		MEAN	0.91	0.90	0.81	0.87
		STD	0.21	0.32	0.18	0.25
	81/08	N	2	3	13	18
		MEAN	0.68	0.61	0.45	0.50
		STD	0.04	0.03	0.13	0.14
	81/09	N	20	16	30	66
		MEAN	0.64	0.74	0.63	0.66
		STD	0.34	0.15	0.40	0.34
Dissolved Inorganic Nitrogen	80/07	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	2	3	13	18
		MEAN	1.35	0.22	0.18	0.31
		STD	1.70	0.08	0.28	0.61
	80/11	N	2	2	14	18
		MEAN	2.04	0.35	0.20	0.42
		STD	0.27	0.03	0.11	0.60

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, At Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved Inorganic Nitrogen	80/12	N	1	2	6	9
		MEAN	2.81	0.23	0.11	0.44
		STD	--	0.20	0.04	0.89
	80/03	N	1	7	1	9
		MEAN	1.61	0.74	0.50	0.81
		STD	--	0.33	--	0.42
	81/04	N	1	2	6	9
		MEAN	0.71	0.70	0.41	0.51
		STD	--	0.35	0.15	0.22
	81/05	N	28	29	9	66
		MEAN	1.36	0.21	0.16	0.69
		STD	1.35	0.16	0.12	1.05
	81/06	N	3	23	1	27
		MEAN	1.83	0.10	0.14	0.29
		STD	0.58	0.07	--	0.58
	81/07	N	19	29	27	75
		MEAN	0.84	0.11	0.14	0.30
		STD	0.75	0.07	0.10	0.49
	81/08	N	2	3	13	18
		MEAN	0.09	0.10	0.24	0.20
		STD	0.01	0.02	0.14	0.13
	81/09	N	20	16	31	67
		MEAN	1.17	0.36	0.30	0.57
		STD	0.95	0.18	0.11	0.65
Dissolved Ammonia	80/07	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	2	3	13	18
		MEAN	0.07	0.08	0.04	0.05
		STD	0.03	0.02	0.02	0.02

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, At Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved Nitrate	80/10	N	2	3	13	18
		MEAN	1.26	0.14	0.13	0.25
		STD	1.66	0.06	0.27	0.59
	80/11	N	2	2	14	18
		MEAN	1.90	0.25	0.09	0.31
		STD	0.20	0.00	0.06	0.59
	80/12	N	1	2	6	9
		MEAN	2.72	0.17	0.04	0.36
		STD	--	0.20	0.03	0.89
	81/03	N	1	7	1	9
		MEAN	1.53	0.52	0.42	0.62
		STD	--	0.18	--	0.37
	81/04	N	1	2	6	9
		MEAN	0.61	0.37	0.31	0.35
		STD	--	0.10	0.12	0.14
	81/05	N	28	30	9	67
		MEAN	1.11	0.10	0.12	0.52
		STD	1.31	0.10	0.11	0.98
	81/06	N	3	23	1	27
		MEAN	1.63	0.05	0.04	0.23
		STD	0.55	0.04	--	0.53
	81/07	N	20	29	27	76
		MEAN	0.69	0.02	0.013	0.20
		STD	0.68	0.03	0.006	0.46
	81/08	N	2	3	13	18
		MEAN	0.015	0.013	0.06	0.05
		STD	0.007	0.006	0.08	0.07
	81/09	N	20	16	31	67
		MEAN	1.02	0.23	0.09	0.40
		STD	0.97	0.20	0.04	0.67
Dissolved Nitrite	80/07	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--

Table 8 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, At Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved Ammonia	80/11	N	2	2	13	18
		MEAN	0.07	0.10	0.11	0.10
		STD	0.01	0.03	0.10	0.09
	80/12	N	1	2	6	9
		MEAN	0.08	0.06	0.07	0.07
		STD	--	0.00	0.01	0.009
	81/03	N	1	7	1	9
		MEAN	0.08	0.21	0.07	0.18
		STD	--	0.15	--	0.15
	81/04	N	1	2	6	9
		MEAN	0.10	0.31	0.09	0.14
		STD	--	0.24	0.04	0.13
	81/05	N	28	30	9	67
		MEAN	0.21	0.11	0.04	0.14
		STD	0.30	0.14	0.02	0.22
	81/06	N	3	23	1	27
		MEAN	0.15	0.04	0.10	0.05
		STD	0.03	0.04	--	0.05
	81/07	N	19	29	27	75
		MEAN	0.10	0.07	0.11	0.09
		STD	0.08	0.05	0.09	0.08
	81/08	N	2	3	13	18
		MEAN	0.05	0.05	0.12	0.10
		STD	0.007	0.01	0.06	0.06
	81/09	N	20	16	31	67
		MEAN	0.12	0.09	0.12	0.11
		STD	0.12	0.06	0.08	0.09
Dissolved Nitrate	80/07	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, At Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved Nitrite	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	2	3	13	18
		MEAN	0.012	0.005	0.006	0.006
		STD	0.015	0.005	0.004	0.006
	80/11	N	2	2	14	18
		MEAN	0.063	0.004	0.005	0.011
		STD	0.066	0.001	0.004	0.025
	80/12	N	1	2	6	9
		MEAN	0.011	0.005	0.009	0.008
		STD	--	0.002	0.006	0.005
	81/03	N	1	7	1	9
		MEAN	0.001	0.013	0.01	0.012
		STD	--	0.007	--	0.007
	81/04	N	1	2	6	9
		MEAN	0.003	0.021	0.013	0.014
		STD	--	0.008	0.002	0.006
	81/05	N	28	31	9	68
		MEAN	0.033	0.005	0.006	0.017
		STD	0.046	0.004	0.003	0.033
	81/06	N	3	23	1	27
		MEAN	0.047	0.005	0.005	0.009
		STD	0.009	0.003	--	0.014
	81/07	N	20	29	27	76
		MEAN	0.021	0.011	0.011	0.013
		STD	0.015	0.010	0.014	0.013
	81/08	N	2	3	13	18
		MEAN	0.021	0.032	0.054	0.047
		STD	0.001	0.007	0.043	0.038
	81/09	N	20	16	31	67
		MEAN	0.024	0.040	0.081	0.054
		STD	0.018	0.030	0.027	0.036

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Total Particulate Nitrogen	80/07	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/11	N	2	2	14	18
		MEAN	0.06	0.38	0.27	0.26
		STD	0.02	0.06	0.12	0.14
	80/12	N	1	2	6	9
		MEAN	0.24	0.43	0.30	0.32
		STD	--	0.13	0.05	0.09
	81/03	N	1	7	1	9
		MEAN	0.03	0.19	0.11	0.17
		STD	--	0.09	--	0.10
	81/04	N	1	2	6	9
		MEAN	0.03	0.43	0.19	0.23
		STD	--	0.19	0.08	0.16
	81/05	N	11	22	8	41
		MEAN	0.28	0.22	0.12	0.21
		STD	0.25	0.14	0.07	0.17
	81/06	N	3	23	1	27
		MEAN	0.17	0.18	0.14	0.17
		STD	0.05	0.11	--	0.11
	81/07	N	10	20	21	52
		MEAN	0.40	0.39	0.25	0.34
		STD	0.33	0.21	0.10	0.21
	81/08	N	2	3	13	18
		MEAN	0.57	0.48	0.33	0.38
		STD	0.27	0.16	0.10	0.15

Table 8-1 (cont.)
Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Total Particulate Nitrogen	81/09	N	7	7	10	24
		MEAN	0.25	0.37	0.26	0.29
		STD	0.24	0.30	0.13	0.22
Dissolved Phosphorus	80/07	N	5	27	1	34
		MEAN	0.06	0.03	0.04	0.03
		STD	0.04	0.01	--	0.02
	80/08	N	1	6	2	9
		MEAN	0.05	0.02	0.02	0.03
		STD	--	0.01	0.01	0.01
	80/10	N	2	3	13	18
		MEAN	0.12	0.16	0.18	0.17
		STD	0.11	0.10	0.22	0.19
	80/11	N	2	2	14	18
		MEAN	0.07	0.16	0.02	0.04
		STD	0.06	0.15	0.01	0.06
	80/12	N	1	2	6	9
		MEAN	0.06	0.01	0.02	0.02
		STD	--	0.00	0.02	0.02
	81/03	N	1	7	1	9
		MEAN	0.19	0.15	0.09	0.15
		STD	--	0.05	--	0.05
	81/04	N	1	2	6	9
		MEAN	0.10	0.04	0.02	0.04
		STD	--	0.02	0.01	0.03
	81/05	N	28	30	9	67
		MEAN	0.11	0.03	0.03	0.07
		STD	0.14	0.03	0.01	0.10
	81/06	N	3	23	1	27
		MEAN	0.07	0.02	0.01	0.02
		STD	0.05	0.01	--	0.02
	81/07	N	19	29	27	75
		MEAN	0.09	0.05	0.06	0.07
		STD	0.07	0.06	0.09	0.08

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981 at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved Phosphorus	81/08	N	2	3	13	18
		MEAN	0.02	0.04	0.02	0.02
		STD	0.01	0.01	0.01	0.01
	81/09	N	20	16	31	67
		MEAN	0.05	0.04	0.09	0.06
		STD	0.03	0.02	0.11	0.08
Dissolved Orthophosphorus	80/07	N	5	28	1	35
		MEAN	0.046	0.015	0.01	0.02
		STD	0.018	0.021	--	0.02
	80/08	N	1	6	2	9
		MEAN	0.04	0.017	0.015	0.02
		STD	--	0.008	0.007	0.01
	80/10	N	2	3	13	18
		MEAN	0.01	0.02	0.021	0.02
		STD	0.00	0.01	0.008	0.008
	80/11	N	2	2	14	18
		MEAN	0.01	0.01	0.011	0.01
		STD	0.00	0.00	0.003	0.002
	80/12	N	1	2	6	9
		MEAN	0.02	0.01	0.01	0.01
		STD	--	0.00	0.00	0.003
	80/03	N	1	7	1	9
		MEAN	0.12	0.07	0.05	0.07
		STD	--	0.02	--	0.02
	81/04	N	1	2	6	9
		MEAN	0.01	0.015	0.025	0.01
		STD	--	0.007	0.015	0.003
	81/05	N	28	30	9	67
		MEAN	0.12	0.01	0.011	0.06
		STD	0.18	0.00	0.003	0.13
	81/06	N	3	23	1	27
		MEAN	0.04	0.011	0.01	0.01
		STD	0.02	0.003	--	0.01

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved Orthophosphorus	81/07	N	19	29	27	75
		MEAN	0.06	0.05	0.03	0.04
		STD	0.06	0.06	0.06	0.05
	81/08	N	2	3	13	18
		MEAN	0.02	0.03	0.013	0.02
		STD	0.00	0.01	0.005	0.008
	81/09	N	20	16	31	67
		MEAN	0.04	0.031	0.06	0.04
		STD	0.02	0.009	0.12	0.08
Total Particulate Phosphorus	80/07	N	5	27	--	33
		MEAN	0.05	0.04	--	0.04
		STD	0.02	0.05	--	0.04
	80/08	N	--	6	2	9
		MEAN	--	0.04	0.02	0.03
		STD	--	0.02	0.01	0.02
	80/10	N	2	3	7	12
		MEAN	0.31	0.06	0.13	0.14
		STD	0.39	0.10	0.14	0.18
	80/11	N	1	1	14	16
		MEAN	0.09	0.04	0.09	0.09
		STD	--	--	0.04	0.04
	80/12	N	1	2	6	9
		MEAN	0.10	0.15	0.11	0.12
		STD	--	0.08	0.05	0.05
	81/03	N	1	3	1	5
		MEAN	3.56	0.21	0.16	0.87
		STD	--	0.09	--	1.51
	81/04	N	1	2	5	8
		MEAN	0.05	0.13	0.07	0.08
		STD	--	0.09	0.03	0.05
	81/05	N	21	21	9	51
		MEAN	0.12	0.04	0.02	0.07
		STD	0.12	0.04	0.02	0.09

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Total Particulate Phosphorus	81/06	N	3	18	1	22
		MEAN	0.07	0.02	0.01	0.03
		STD	0.07	0.04	--	0.05
	81/07	N	15	28	25	68
		MEAN	0.21	0.13	0.06	0.12
		STD	0.30	0.10	0.05	0.17
	81/08	N	2	3	13	18
		MEAN	0.14	0.15	0.07	0.09
		STD	0.03	0.04	0.03	0.04
	81/09	N	17	16	21	54
		MEAN	0.19	0.08	0.05	0.10
		STD	0.18	0.05	0.03	0.12
Particulate Organic Carbon	80/07	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/11	N	2	2	14	18
		MEAN	0.47	2.81	1.87	1.82
		STD	0.03	0.13	0.55	0.75
	80/12	N	1	2	6	9
		MEAN	1.61	2.67	2.30	2.31
		STD	--	0.61	0.64	0.63
	81/03	N	1	7	1	9
		MEAN	1.02	1.81	1.81	1.72
		STD	--	0.79	--	0.73
	81/04	N	1	2	6	9
		MEAN	0.92	4.89	1.48	2.17
		STD	--	0.64	0.48	1.62

Table 8-1 (cont.)
Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Particulate Organic Carbon	81/05	N	11	22	8	41
		MEAN	2.77	1.59	1.23	1.84
		STD	1.68	1.00	0.50	1.27
	81/06	N	3	23	1	27
		MEAN	1.38	1.43	1.32	1.42
		STD	0.34	0.82	--	0.76
	81/07	N	10	21	21	52
		MEAN	3.13	2.89	1.71	2.46
		STD	2.27	1.38	0.74	1.50
	81/08	N	2	3	13	18
		MEAN	4.07	3.98	2.18	2.69
		STD	1.68	1.81	0.76	1.30
	81/09	N	8	10	24	42
		MEAN	1.65	2.31	1.61	1.78
		STD	1.54	1.71	0.62	1.16
Pheophytin-A	80/07	N	7	30	1	39
		MEAN	6.46	4.13	8.29	4.77
		STD	7.21	3.39	--	4.31
	80/08	N	2	10	3	15
		MEAN	2.81	8.30	5.32	6.97
		STD	1.40	5.34	2.34	4.85
	80/10	N	2	3	13	18
		MEAN	4.51	7.11	4.25	4.76
		STD	6.37	12.29	9.93	9.54
	80/11	N	2	2	14	18
		MEAN	6.15	34.75	27.20	26.26
		STD	8.69	41.08	34.73	33.10
	80/12	N	1	2	6	9
		MEAN	3.31	8.18	4.61	5.26
		STD	--	9.22	2.19	4.07
	81/03	N	1	7	1	9
		MEAN	2.98	1.34	0.01	1.37
		STD	--	2.30	--	2.13

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Pheophytin-A	81/04	N	2	4	9	15
		MEAN	13.15	16.65	5.22	9.33
		STD	18.45	19.16	7.82	12.89
	81/05	N	28	32	12	72
		MEAN	3.01	1.65	0.29	1.95
		STD	4.59	3.08	0.47	3.62
	81/06	N	3	23	1	27
		MEAN	0.62	7.52	0.01	6.47
		STD	0.86	21.09	--	19.57
	81/07	N	21	29	27	77
		MEAN	27.70	21.18	9.84	18.98
		STD	27.57	27.50	8.39	23.56
	81/08	N	2	3	13	18
		MEAN	15.85	21.10	11.41	13.52
		STD	4.17	5.84	7.32	7.55
	81/09	N	19	16	29	64
		MEAN	4.95	6.49	0.57	3.35
		STD	10.10	7.85	0.98	7.15
Chlorophyll-A	80/07	N	6	29	1	37
		MEAN	3.19	7.29	0.62	6.25
		STD	6.31	21.82	--	19.50
	80/08	N	2	10	3	15
		MEAN	2.62	13.25	2.99	9.78
		STD	3.10	20.10	3.68	16.97
	80/10	N	2	3	13	18
		MEAN	2.01	13.04	4.80	5.86
		STD	2.83	17.63	7.31	9.30
	80/11	N	2	2	14	18
		MEAN	2.28	14.35	8.95	8.81
		STD	2.21	2.04	5.47	5.66
	80/12	N	1	2	6	9
		MEAN	9.22	9.37	5.70	6.91
		STD	--	1.45	2.31	2.62

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables, 1980-1981, at Salinity REgions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Chlorophyll-A	81/03	N	1	7	1	9
		MEAN	6.68	12.08	14.70	11.77
		STD	--	5.35	--	5.08
	81/04	N	2	4	9	15
		MEAN	27.74	23.25	15.90	19.44
		STD	28.78	11.95	7.94	12.16
	81/05	N	28	33	12	73
		MEAN	11.09	8.98	9.56	9.88
		STD	14.14	15.58	11.41	14.27
	81/06	N	3	23	1	27
		MEAN	7.75	6.23	4.81	6.25
		STD	2.58	5.67	--	5.29
	81/07	N	21	29	27	77
		MEAN	61.34	38.25	14.84	36.34
		STD	117.82	84.29	11.58	81.62
	81/08	N	2	3	13	18
		MEAN	105.65	25.98	18.87	29.70
		STD	35.85	20.34	8.67	30.78
	81/09	N	19	16	29	64
		MEAN	1.05	1.90	1.56	1.49
		STD	1.51	2.25	1.20	1.61
Dissolved N/P Ratio	80/07	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/08	N	--	--	--	--
		MEAN	--	--	--	--
		STD	--	--	--	--
	80/10	N	2	3	13	18
		MEAN	134.75	14.92	8.40	23.52
		STD	170.48	12.20	14.06	59.25
	80/11	N	2	2	14	18
		MEAN	203.85	35.45	18.74	41.17
		STD	27.08	2.90	10.83	60.54

Table 8-1 (cont.)

Statistical Summary of Chester River Monthly Water Quality Variables 1980-1981, at Salinity Regions of 0-3 ppt, 3.1-10 ppt and Greater than 10 ppt

Variable	Year/Month	Statistics	0-3 ppt	3.1-10 ppt	10 ppt	All Data
Dissolved N/P Ratio	80/12	N	1	2	6	9
		MEAN	140.55	23.55	11.37	28.43
		STD	--	20.01	4.19	43.09
	80/03	N	1	7	1	9
		MEAN	13.42	11.09	10.00	11.23
		STD	--	4.26	--	3.80
	81/04	N	1	2	6	9
		MEAN	71.30	46.42	40.80	45.44
		STD	--	1.31	14.75	15.37
	81/05	N	28	29	9	66
		MEAN	23.65	21.13	15.38	21.41
		STD	33.37	16.00	12.49	24.48
	81/06	N	3	23	1	27
		MEAN	59.97	9.00	14.50	14.87
		STD	55.65	6.45	--	23.21
	81/07	N	19	29	27	75
		MEAN	27.44	4.77	7.45	11.48
		STD	48.46	2.65	5.19	25.93
	81/08	N	2	3	13	18
		MEAN	4.57	3.45	19.21	14.96
		STD	0.67	1.43	10.81	11.52
	81/09	N	20	16	31	67
		MEAN	34.12	12.02	8.20	16.85
		STD	30.21	5.00	3.83	20.15

APPENDIX H

INTENSIVE 24-HOUR SURVEY FIGURES AND TABLES

SECTION 9

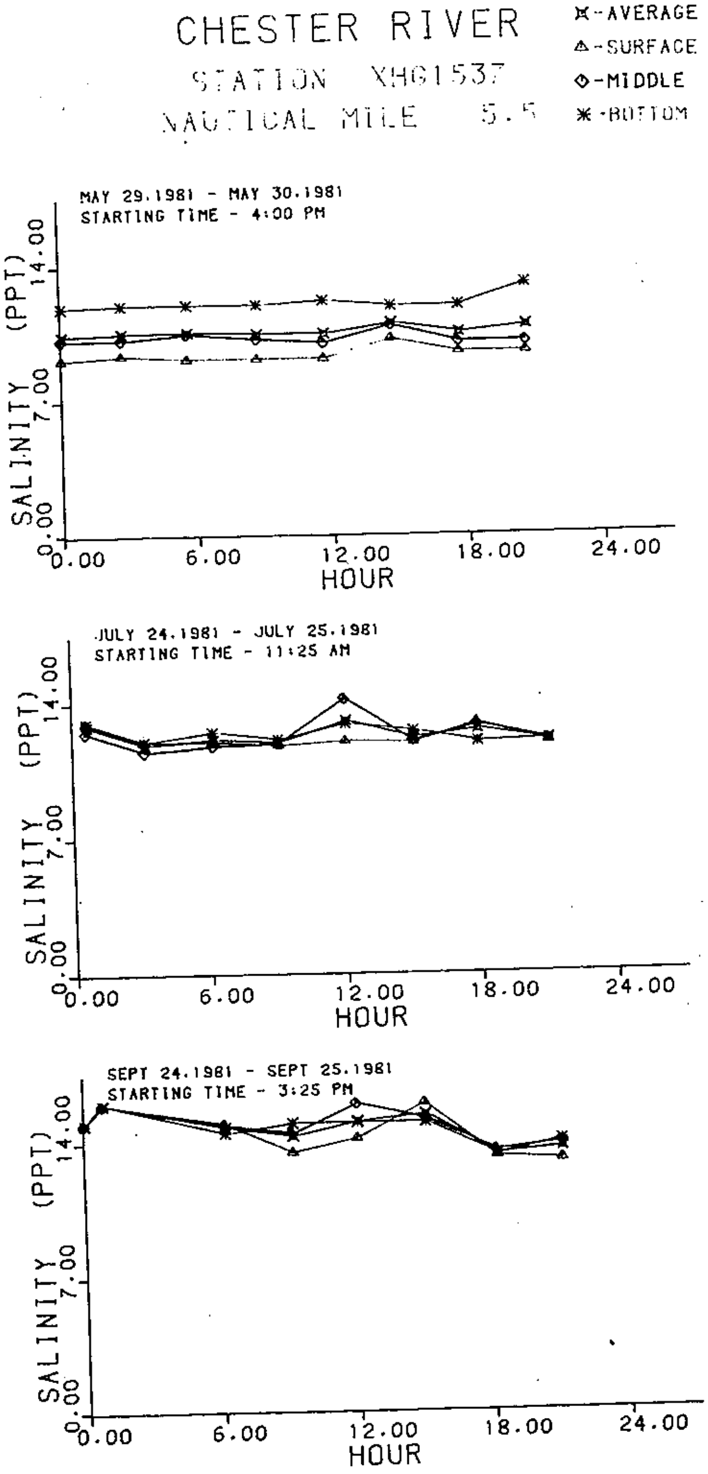


Figure 9-1 24 - Hour survey plots of Salinity, (ppt).

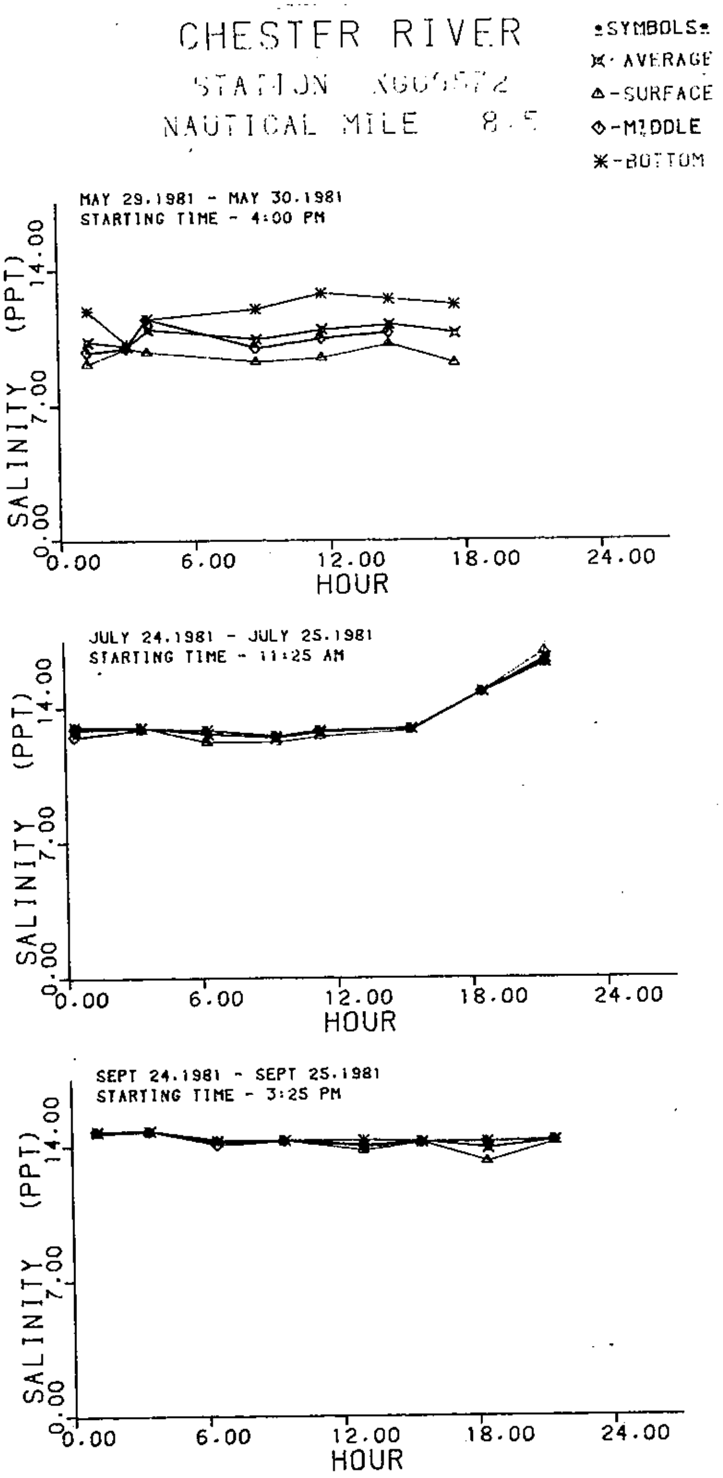


Figure 9-1 24 - Hour survey plots of Salinity, (ppt).

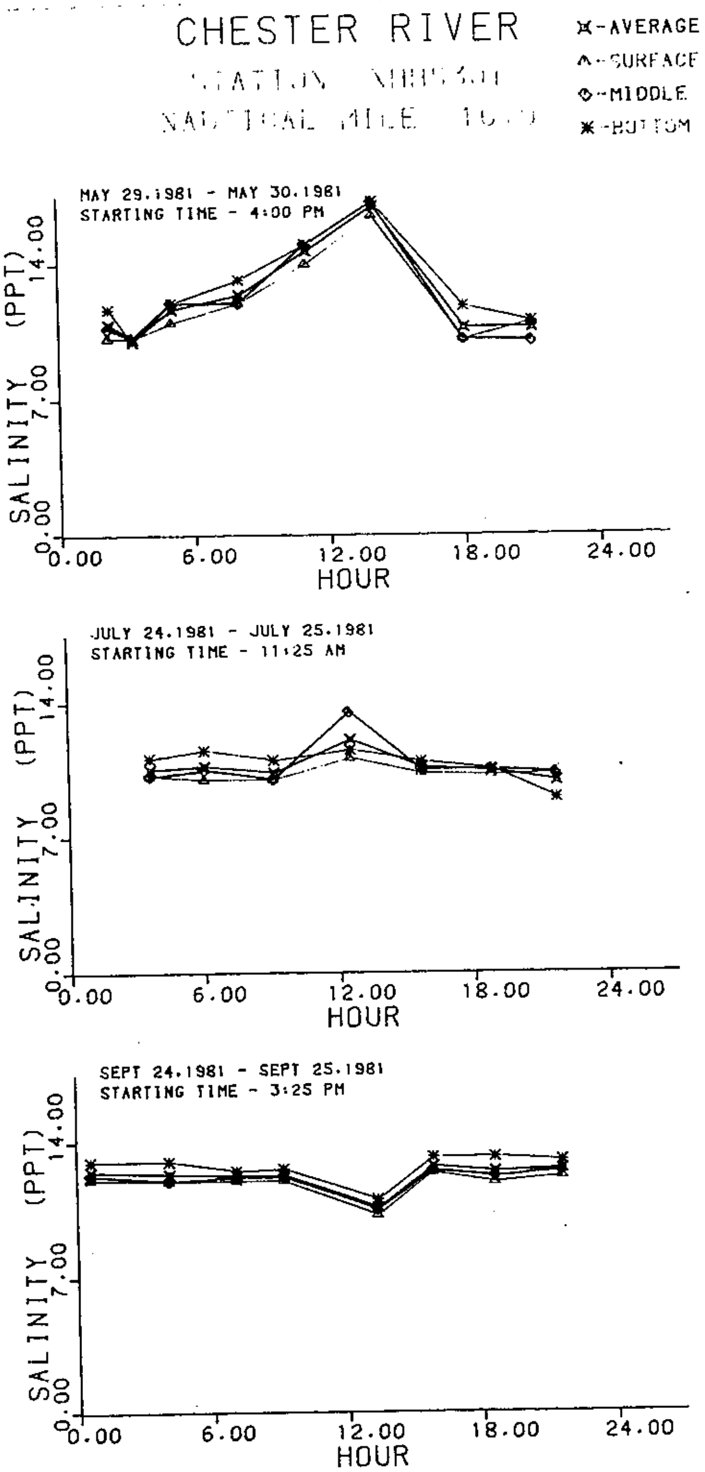


Figure 9-1 24 - Hour survey plots of Salinity, (ppt).

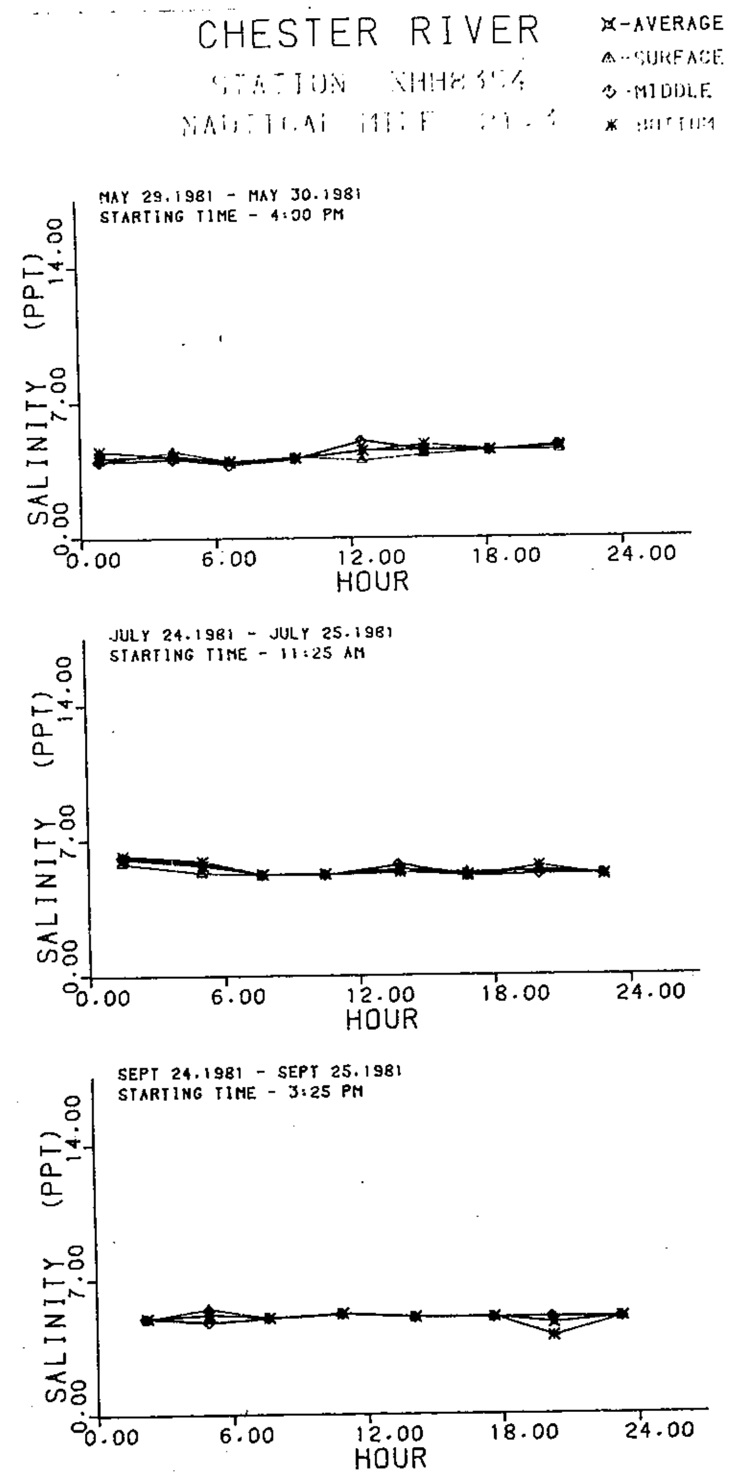


Figure 9-1 24 - Hour survey plots of Salinity, (ppt).

CHESTER RIVER

STATION XIH2463

NAUTICAL MILE 28.0

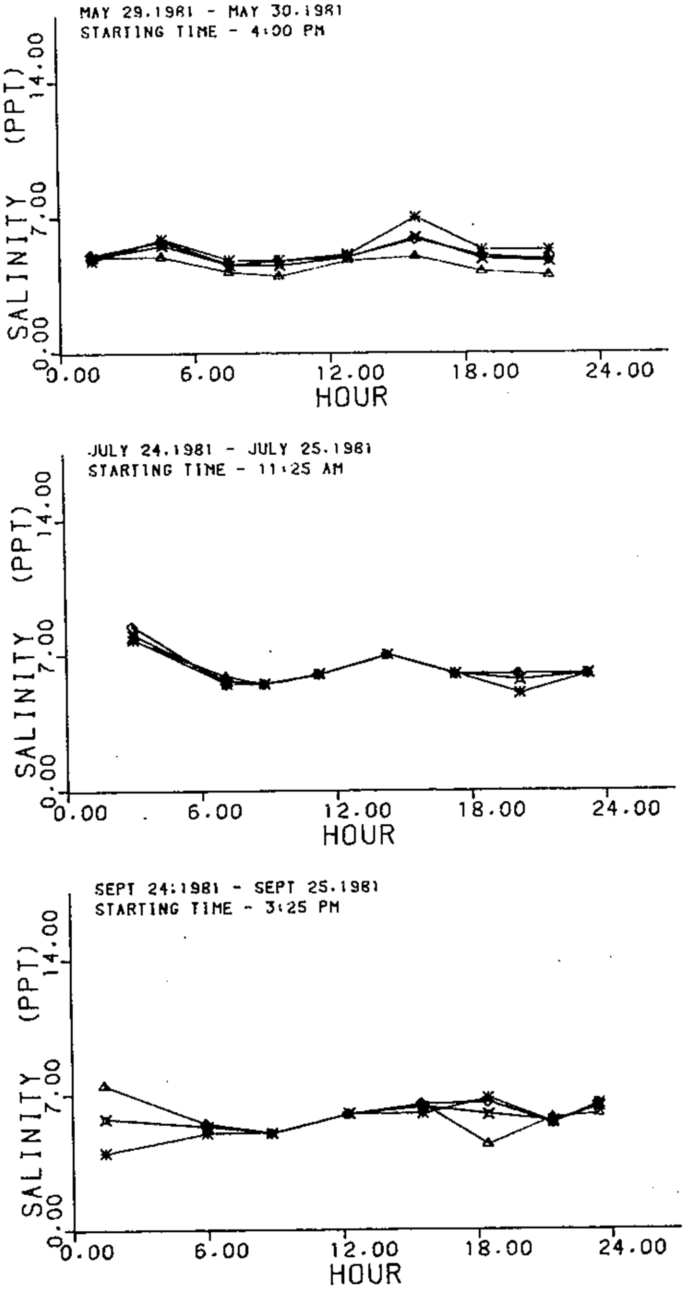


Figure 9-1 24 - Hour survey plots of Salinity, (ppt).

CHESTER RIVER
STATION CYR0004
NAUTICAL MILE 41.0

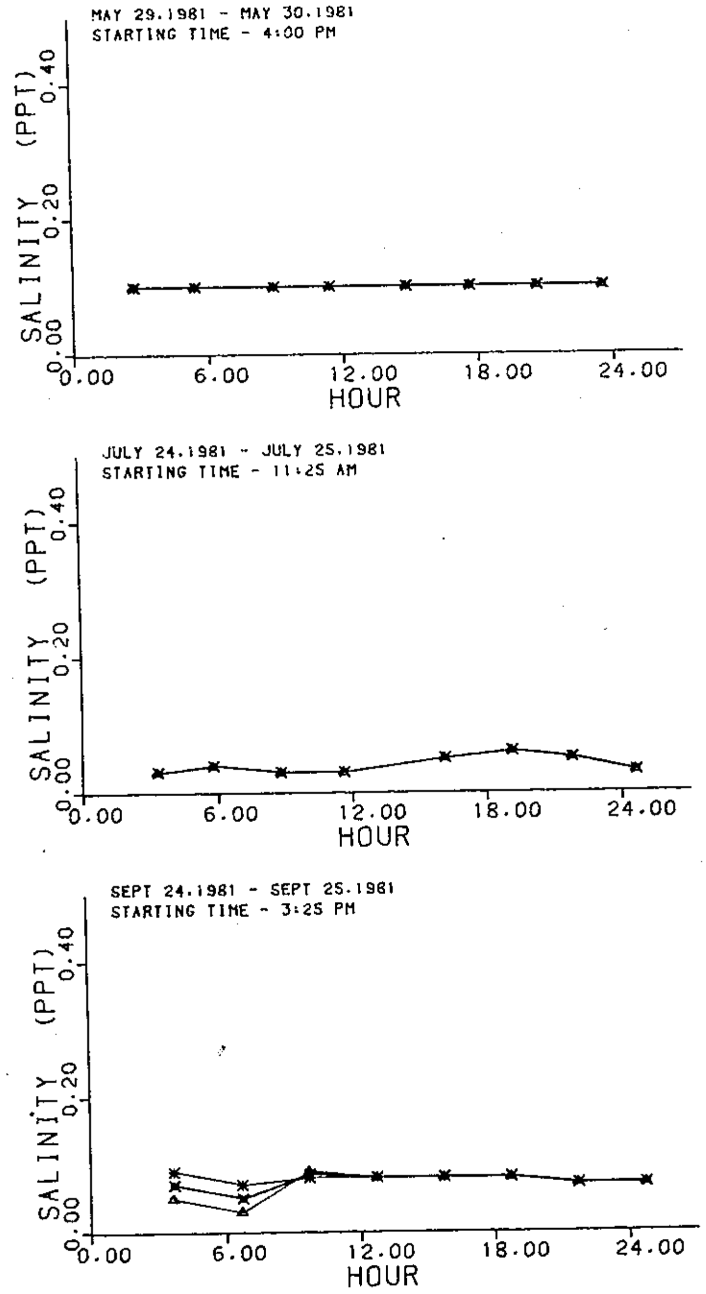


Figure 9-1 24 - Hour survey plots of Salinity, (ppt).

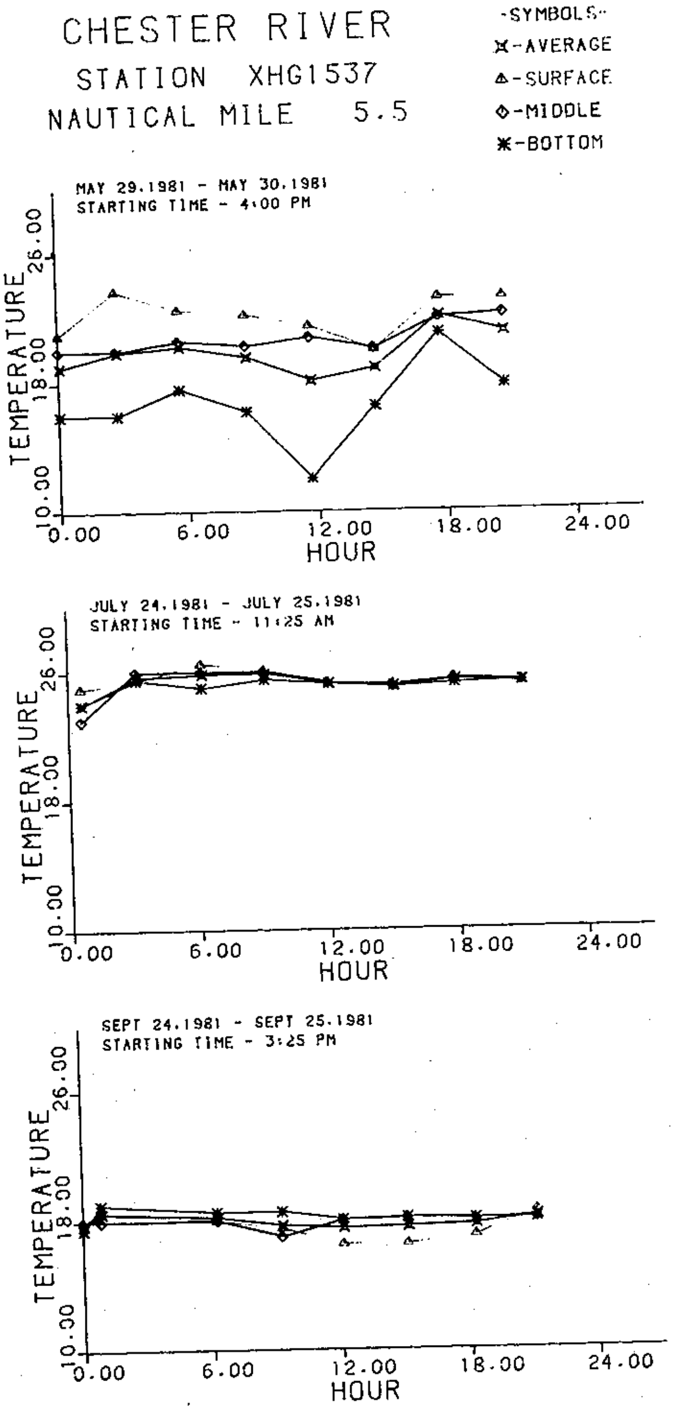


Figure 9-2 24 - Hour survey plots of Temperature, (°C).

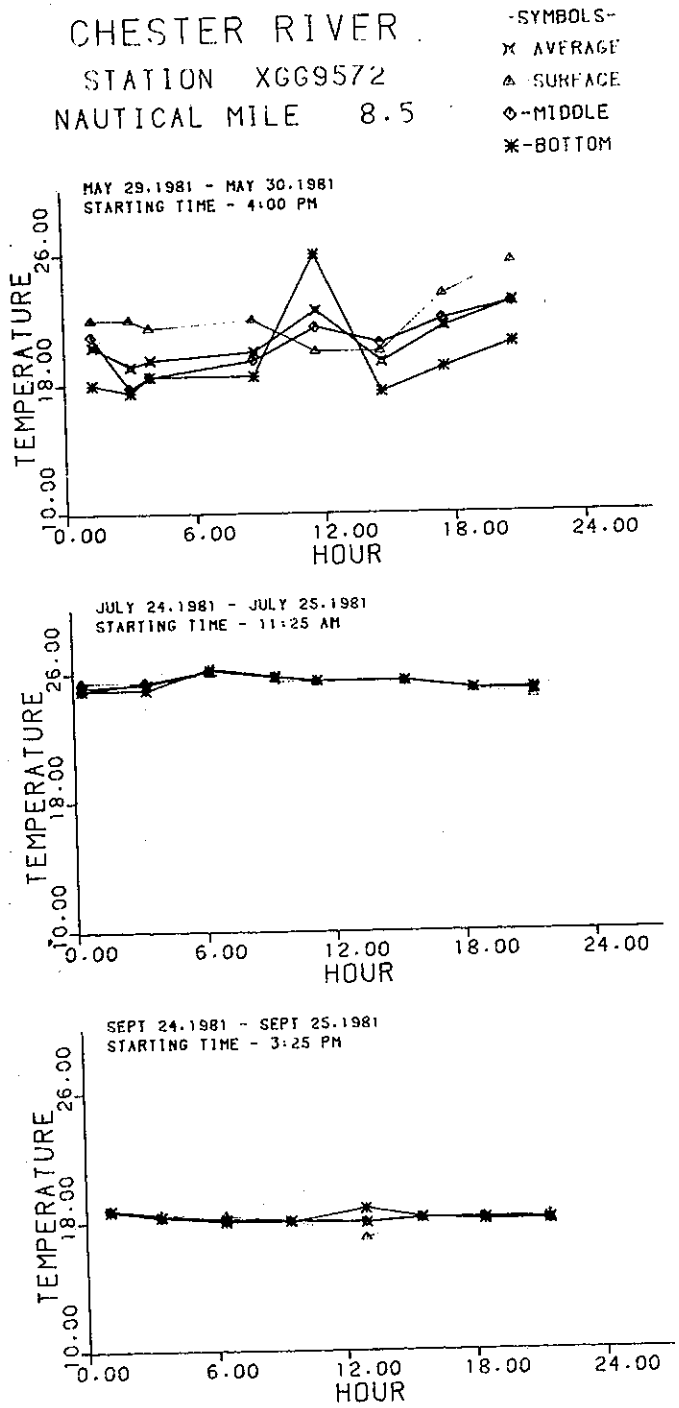


Figure 9-2 24 - Hour survey plots of Temperature, (°C).

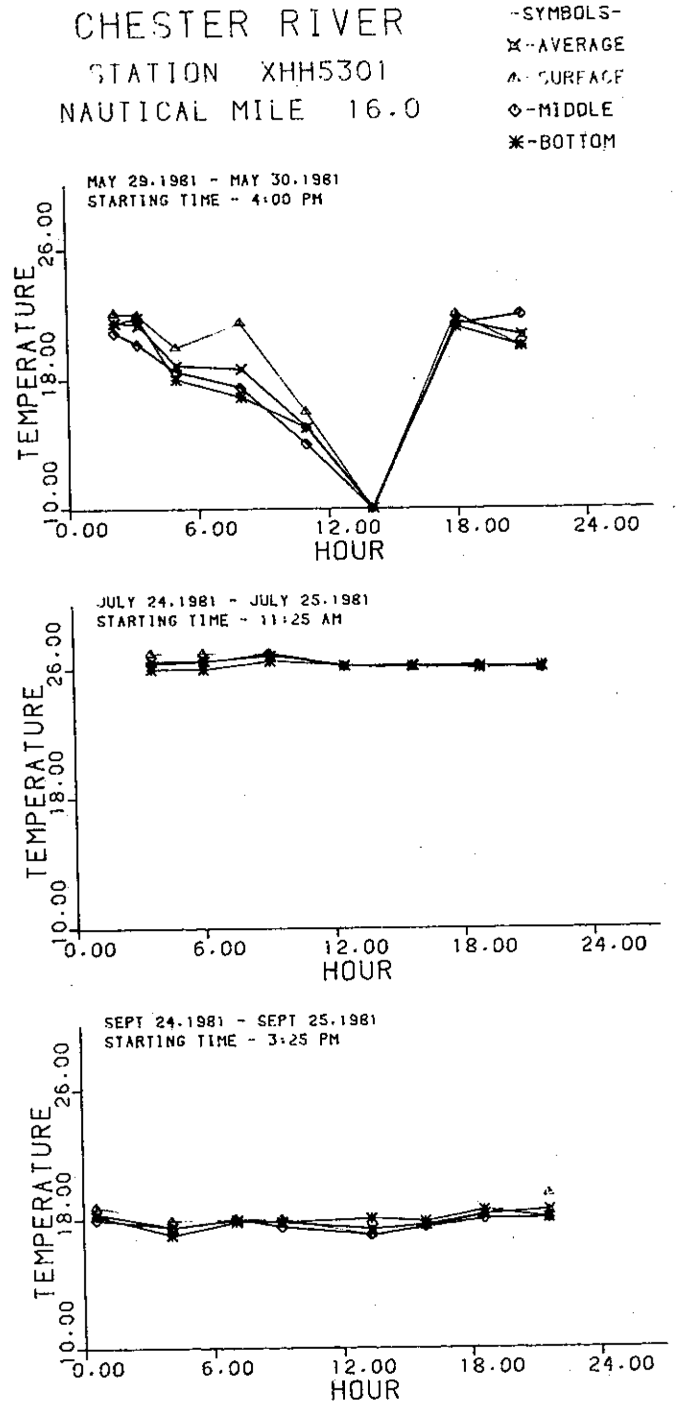


Figure 9-2 24 - Hour survey plots of Temperature, (°C).

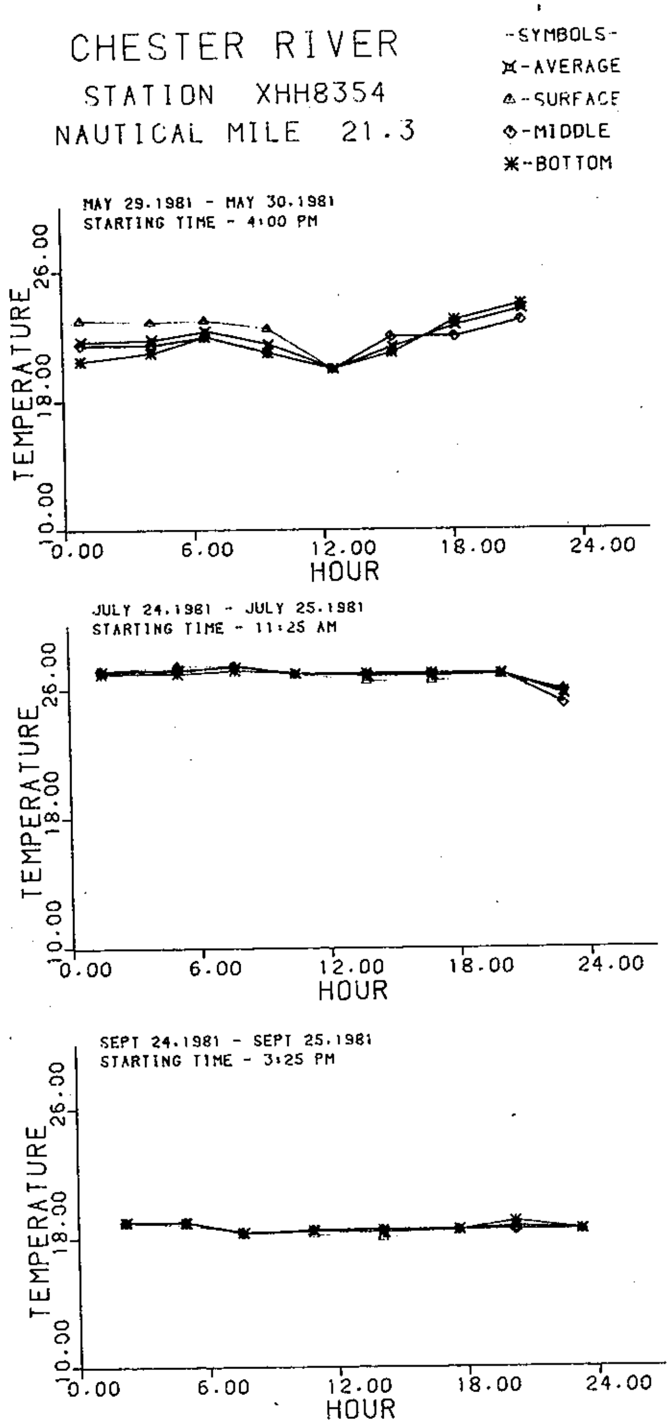


Figure 9-2 24 - Hour survey plots of Temperature, (^{o}C).

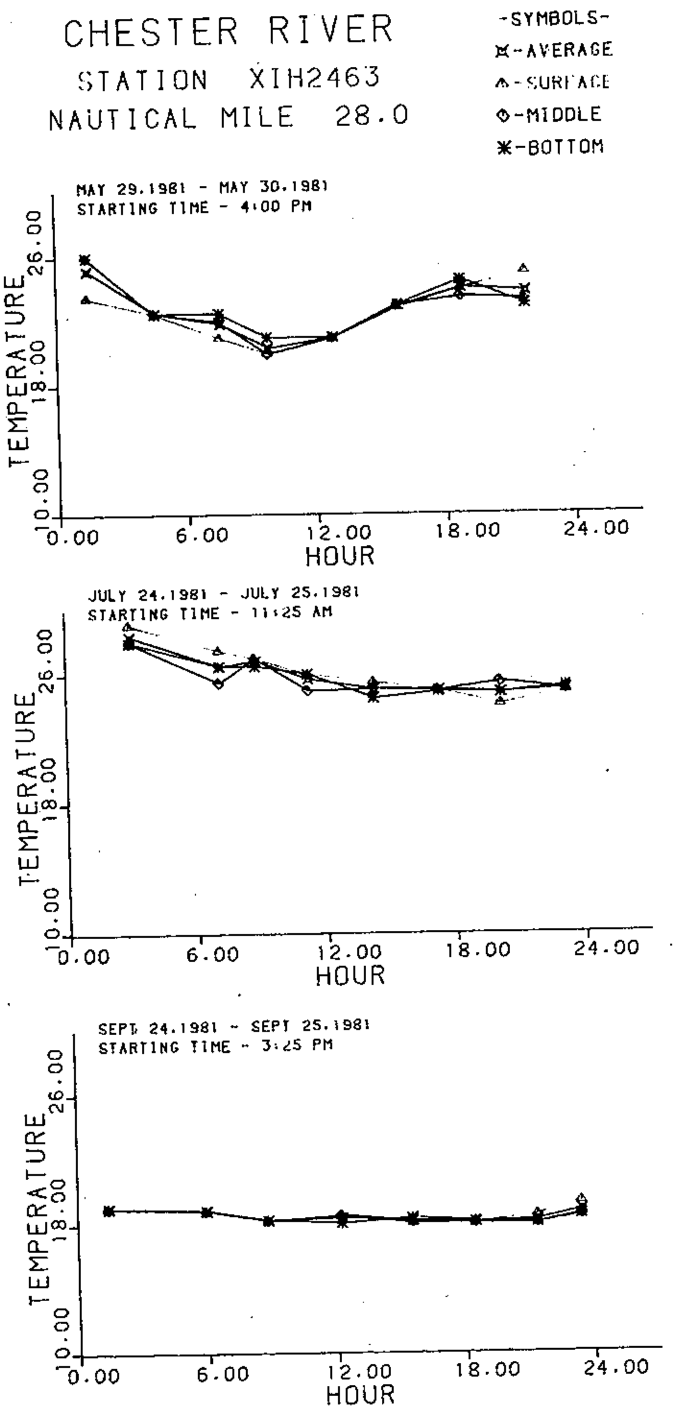


Figure 9-2 24 - Hour survey plots of Temperature, (°C).

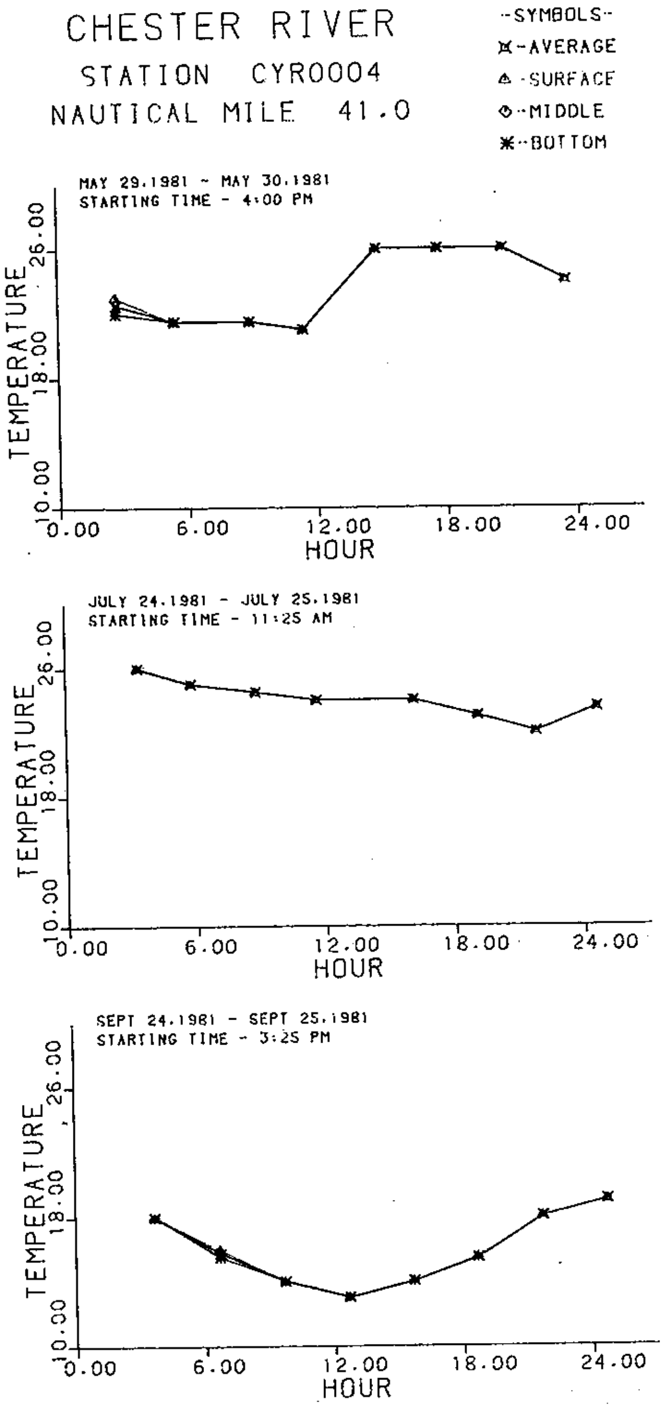


Figure 9-2 24 - Hour survey plots of Temperature, (C°).

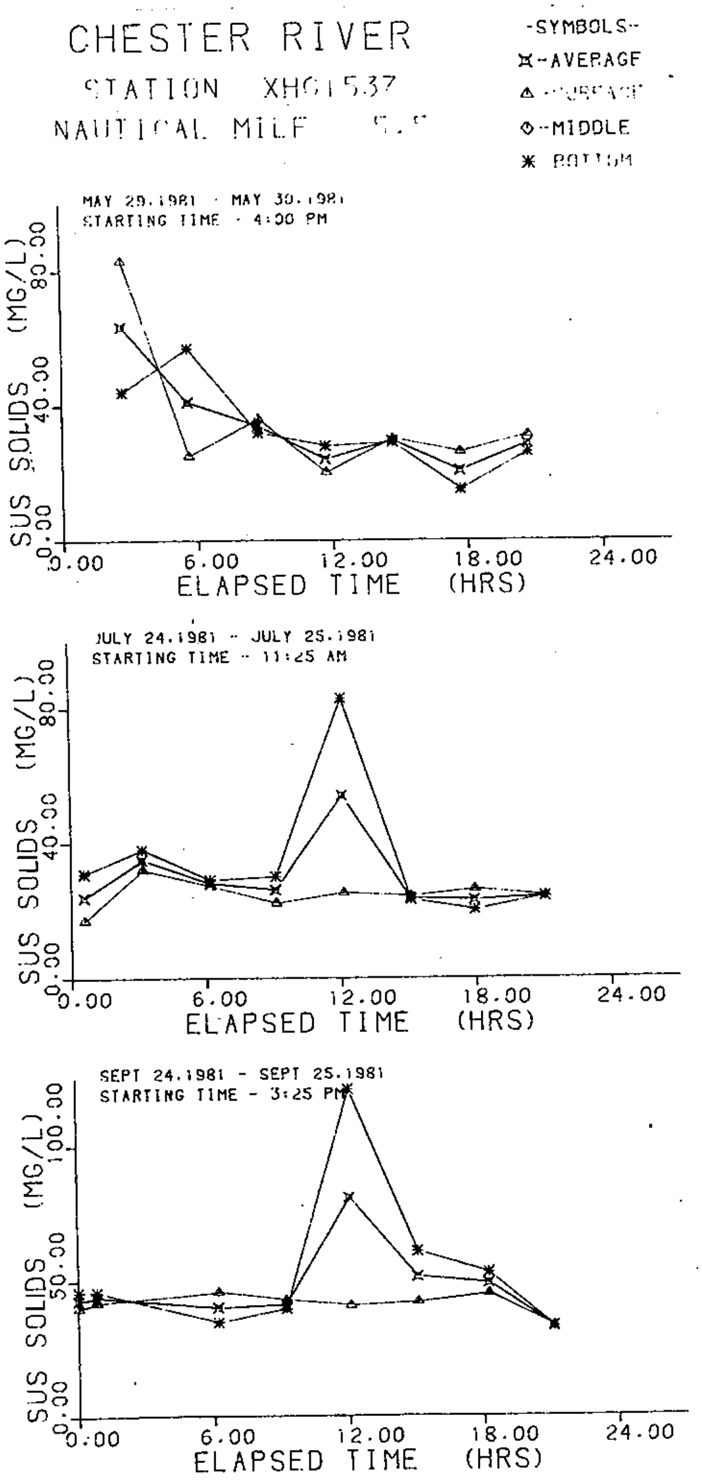


Figure 9-3 24-Hour survey plots of suspended solids or Total Non-filtered residue (mg/l).

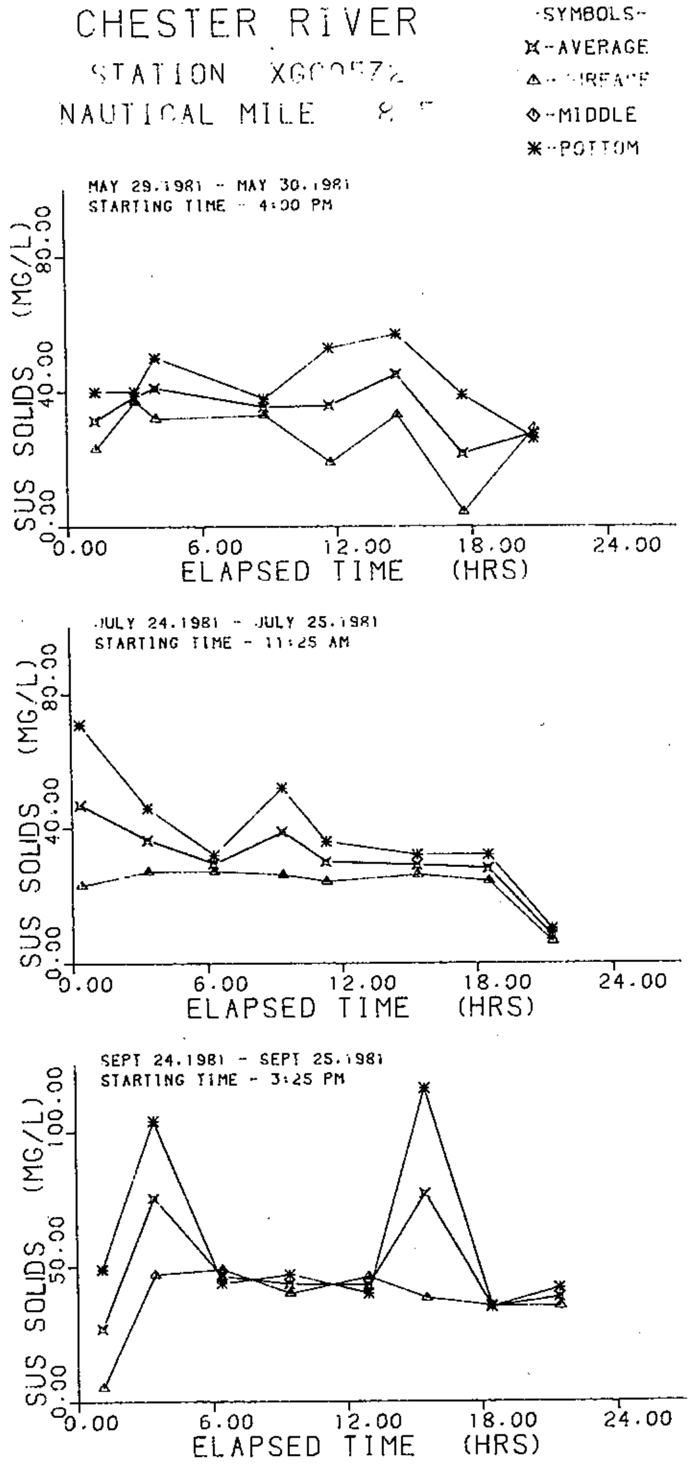


Figure 9-3 24-Hour survey plots of suspended solids or Total Non-filtered residue (mg/l).

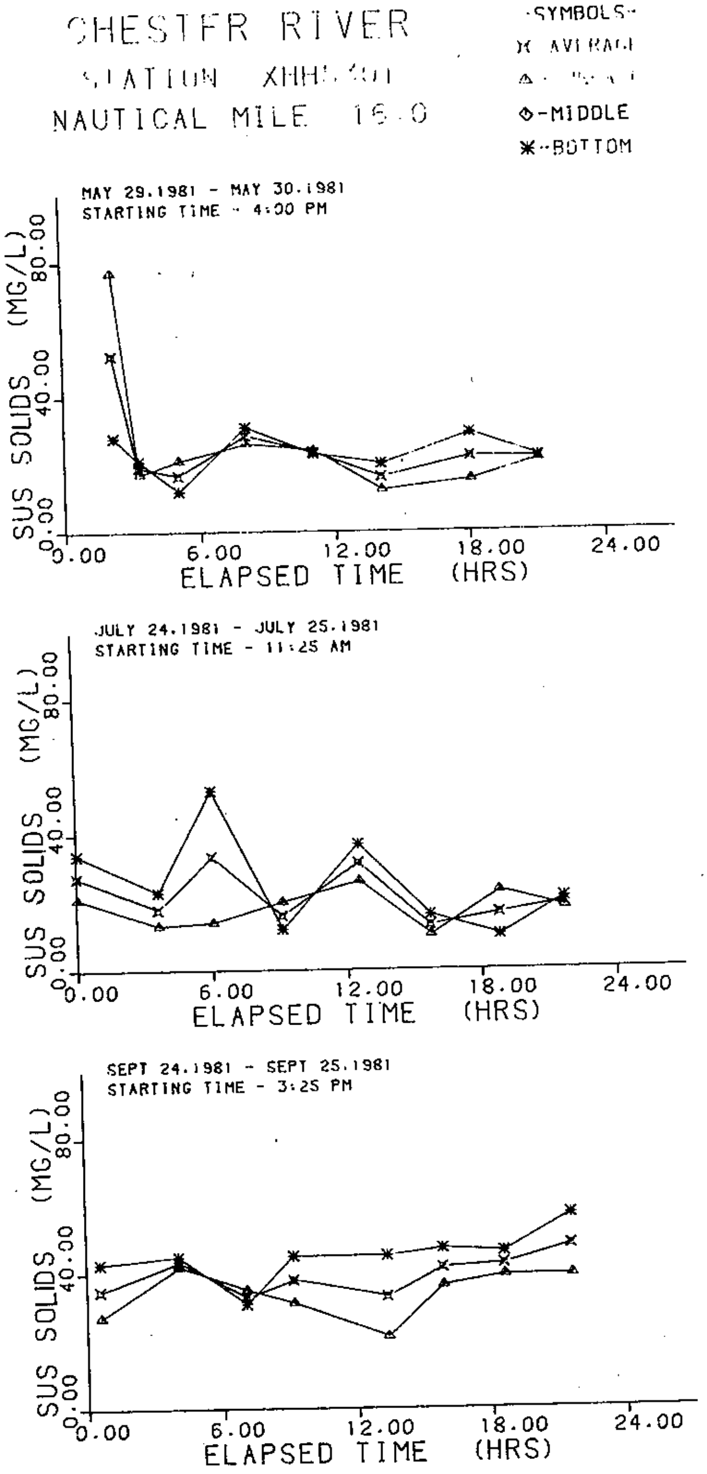


Figure 9-3 24-Hour survey plots of suspended solids or Total Non-filtered residue (mg/l).

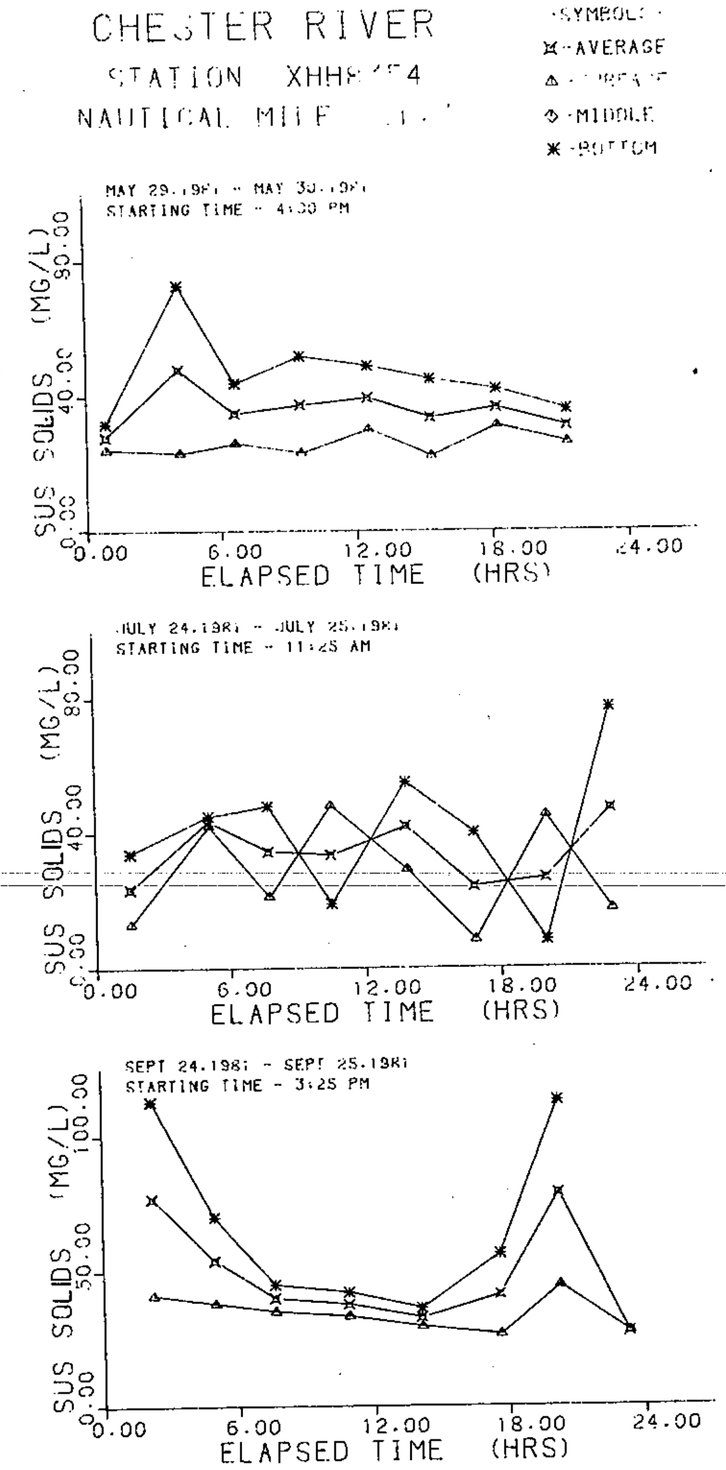


Figure 9- 3 24-Hour survey plots of suspended solids or Total Non-filtered residue (mg/l).

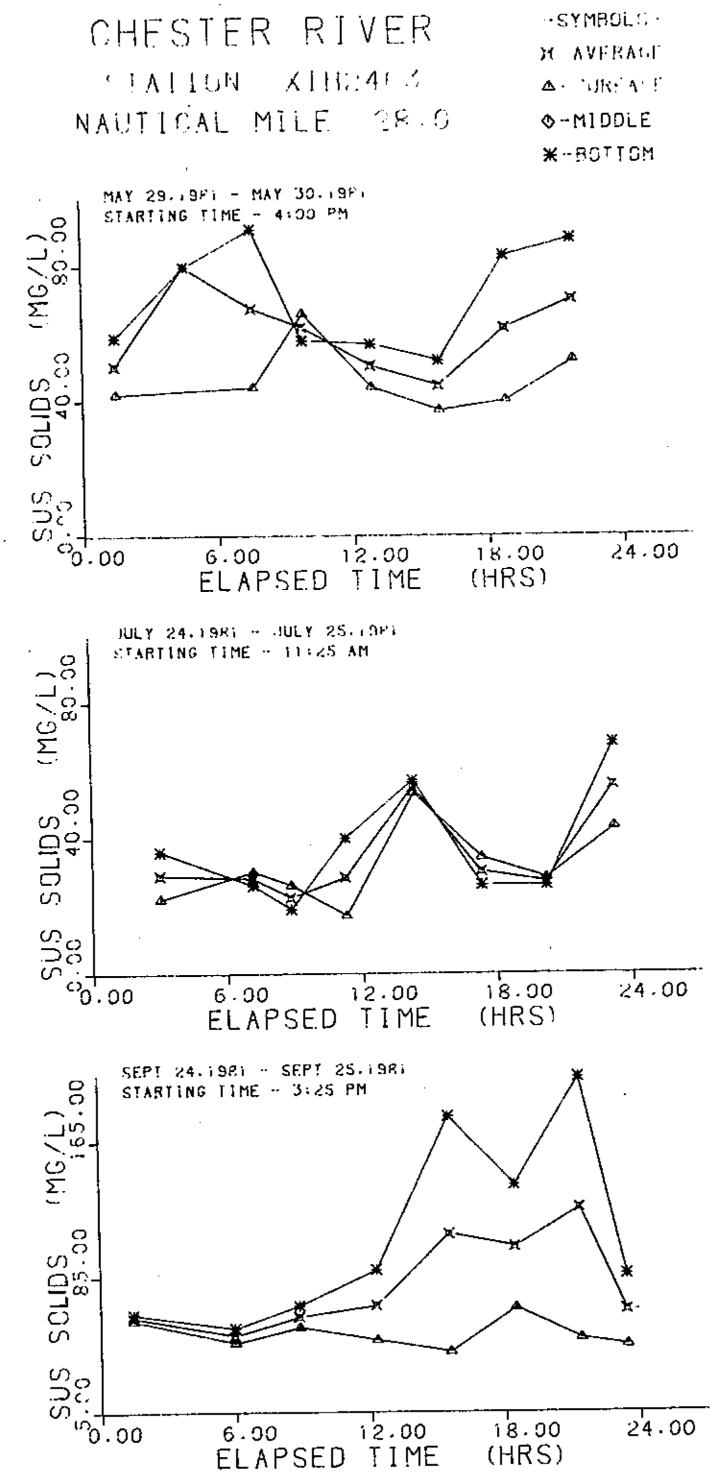


Figure 9-3 24-Hour survey plots of suspended solids or Total Non-filtered residue (mg/l).

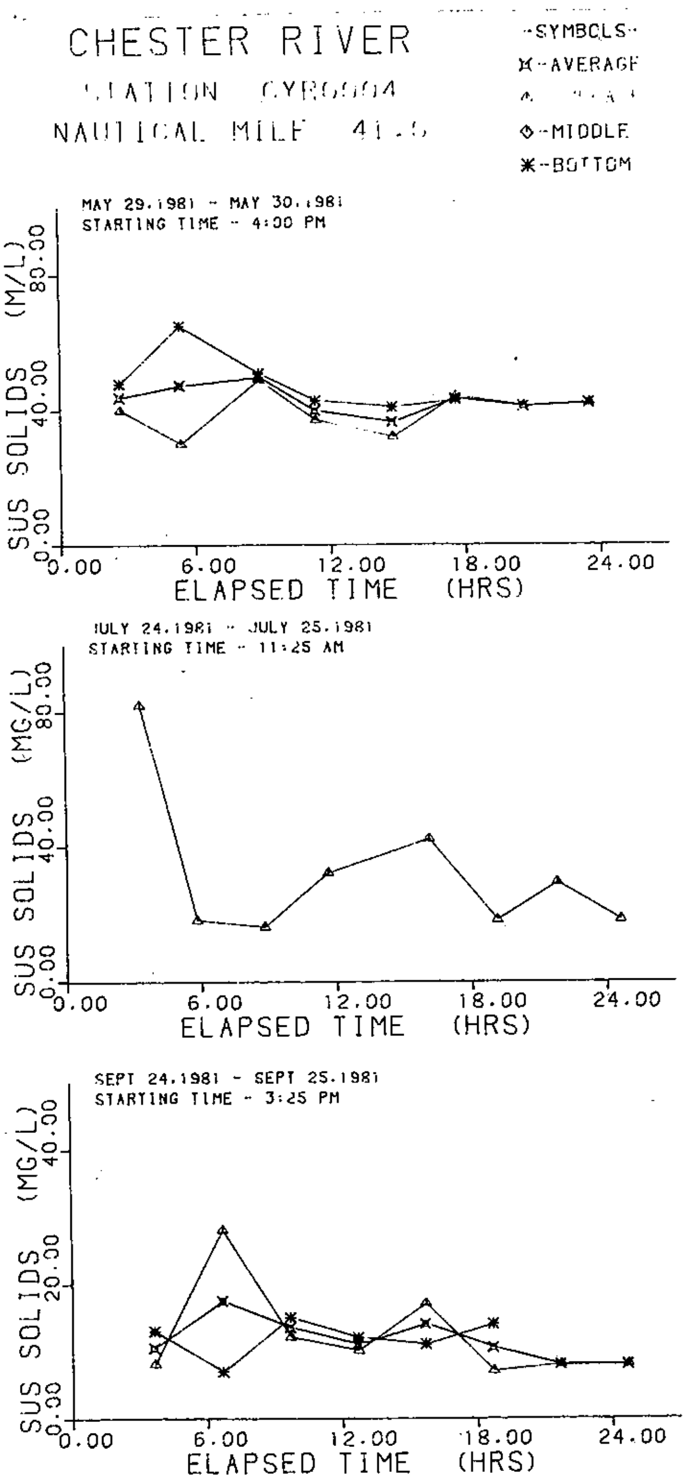


Figure 9-3 24-Hour survey plots of suspended solids or Total Non-filtered residue (mg/l).

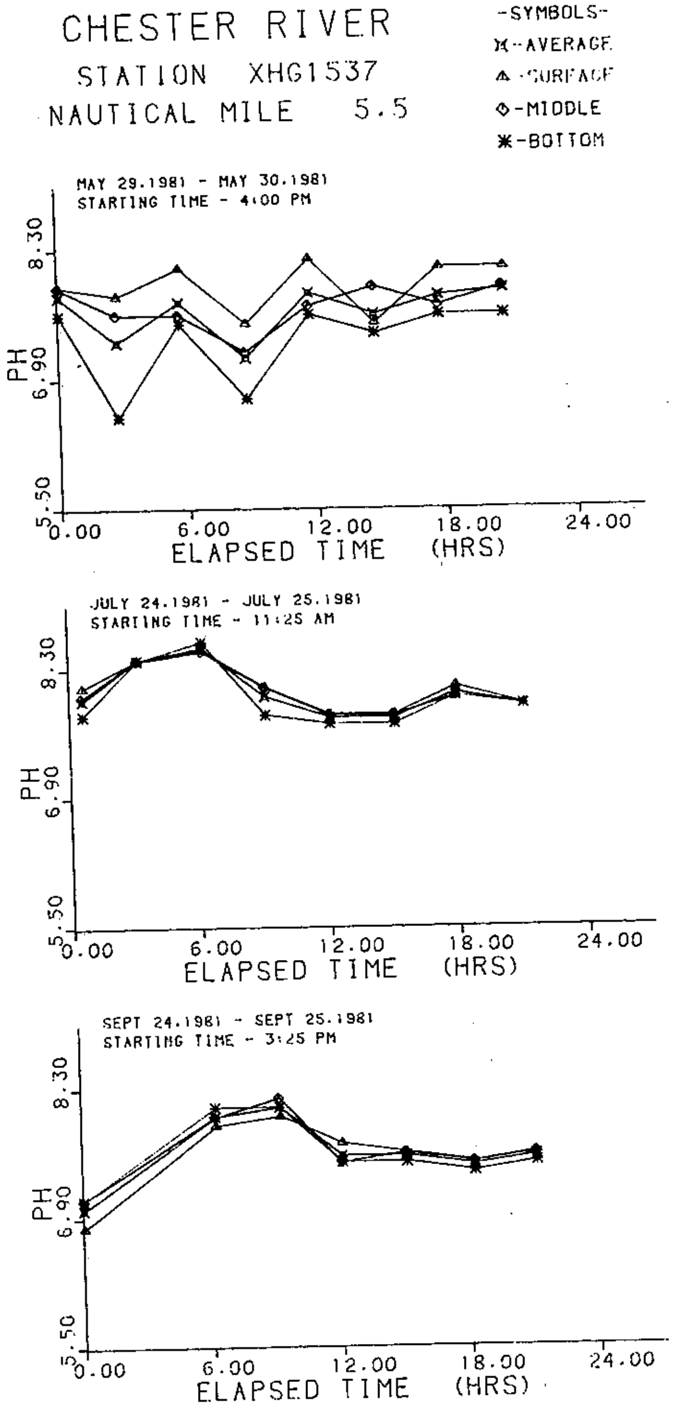


Figure 9-4 24 - Hour survey plots of pH.

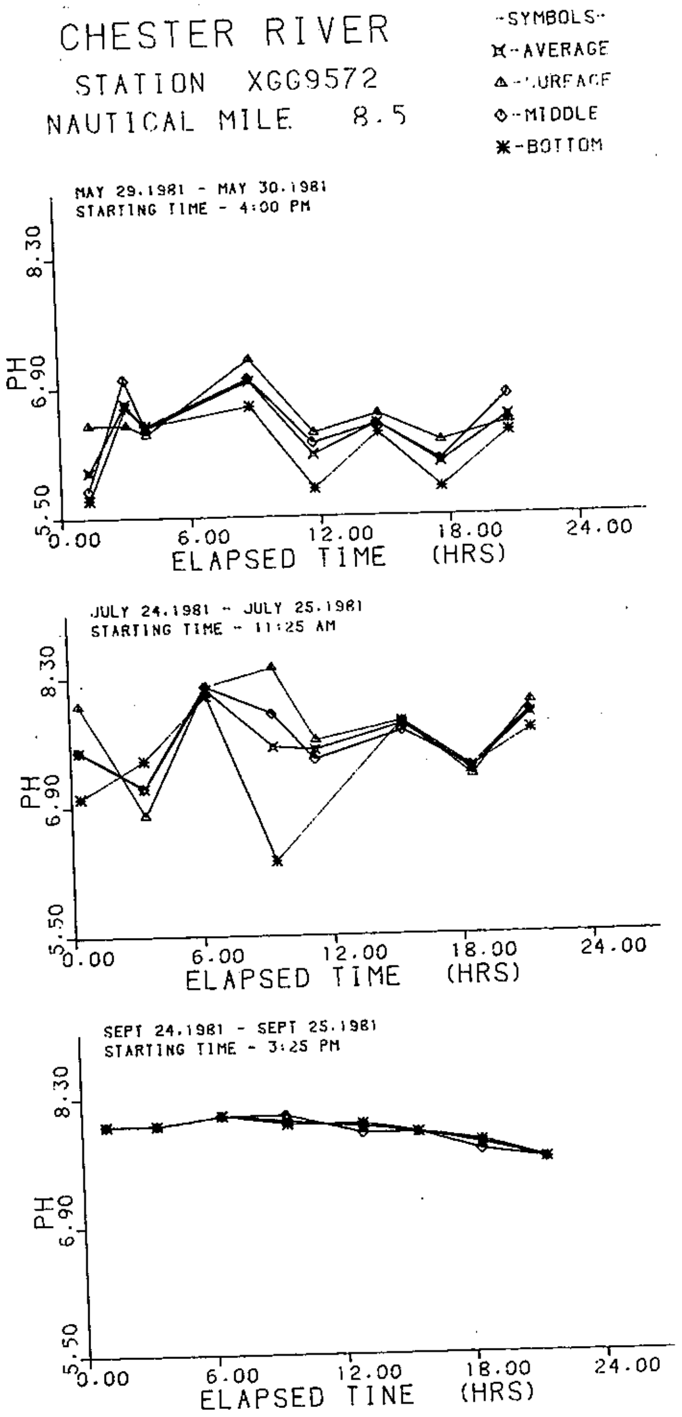


Figure 9-4 24 - Hour survey plots of pH.

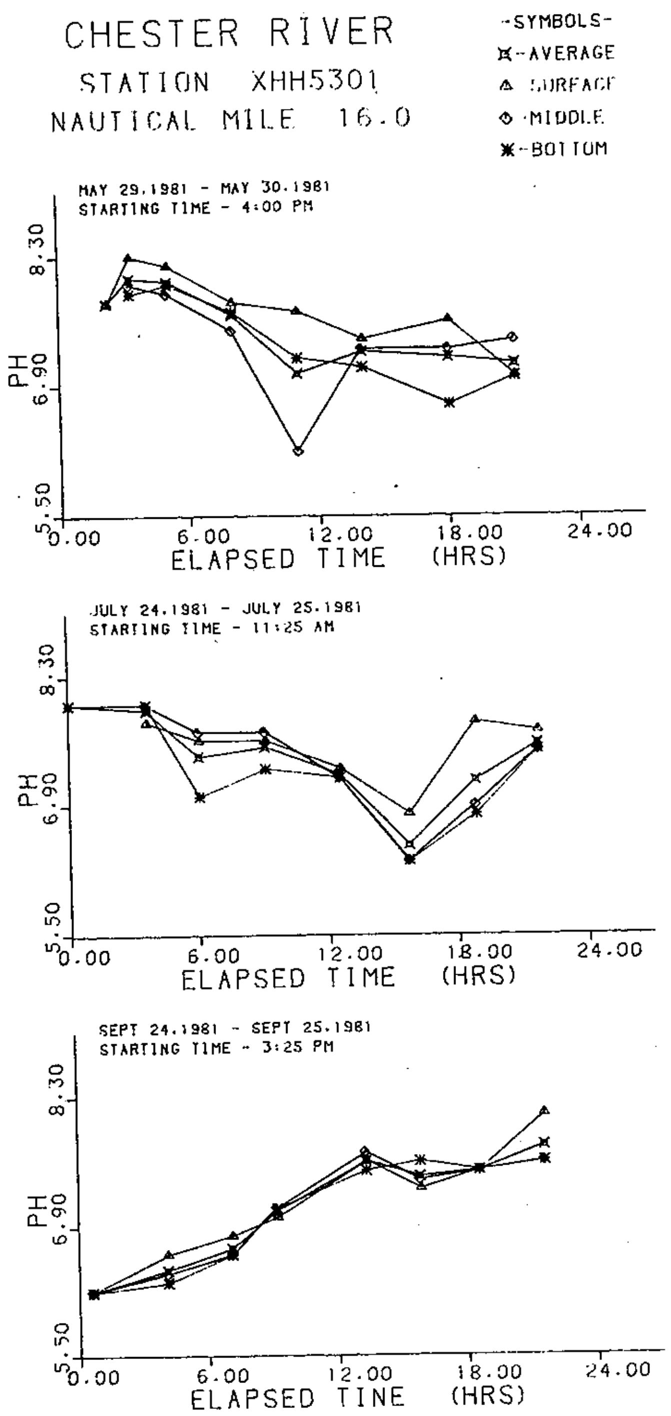


Figure 9- 4 24 - Hour survey plots of pH.

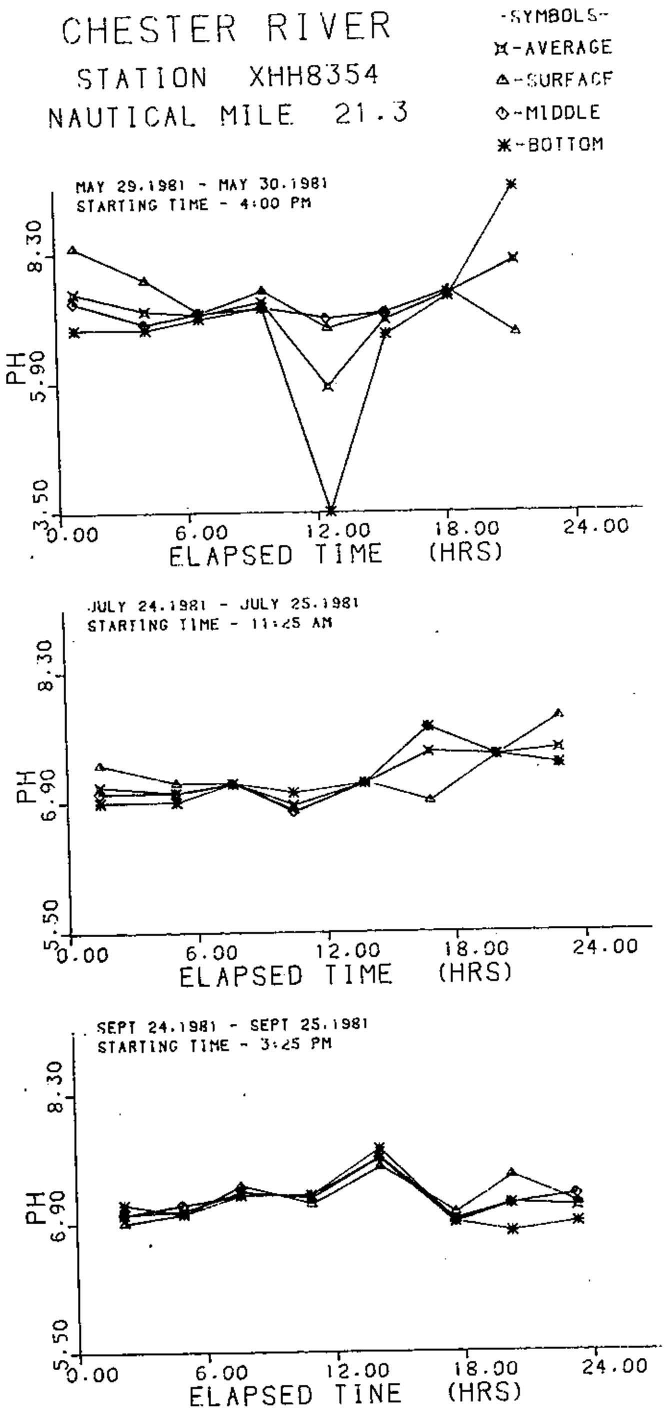


Figure 9-4 24 - Hour survey plots of pH.

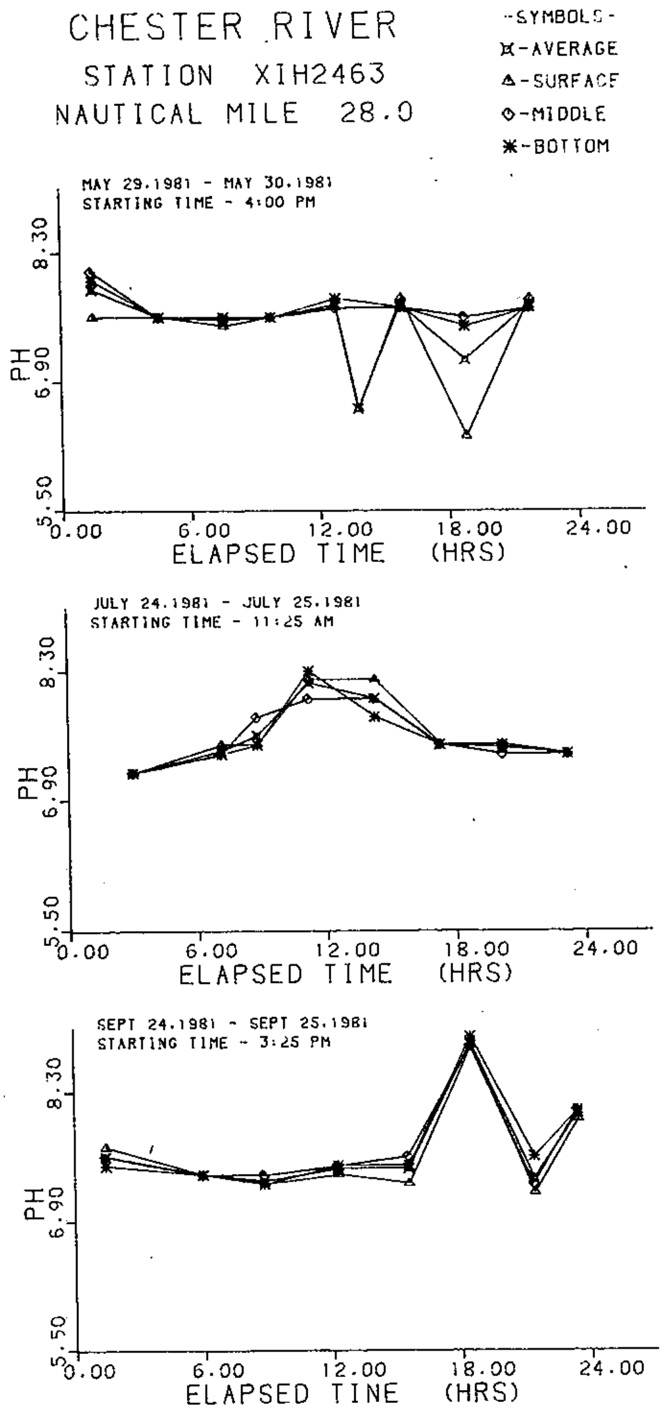


Figure 9-4 24 - Hour survey plots of pH.

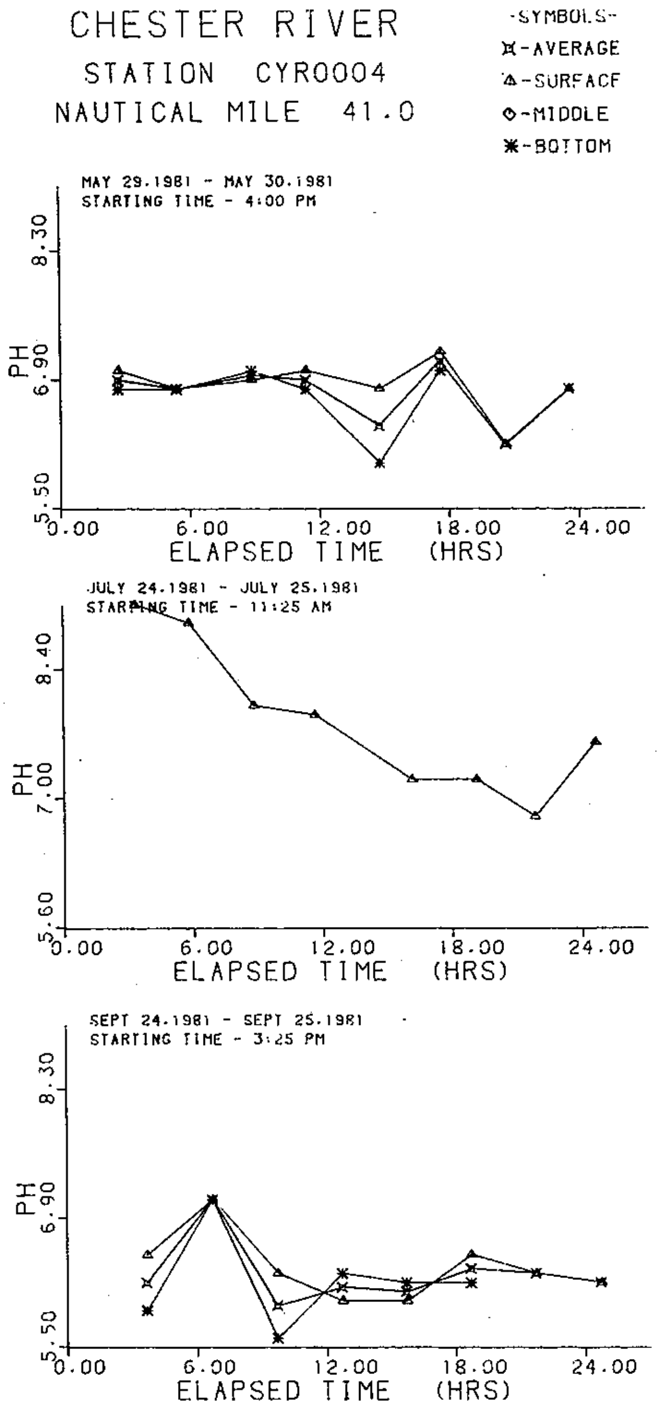


Figure 9-4 24 - Hour survey plots of pH.

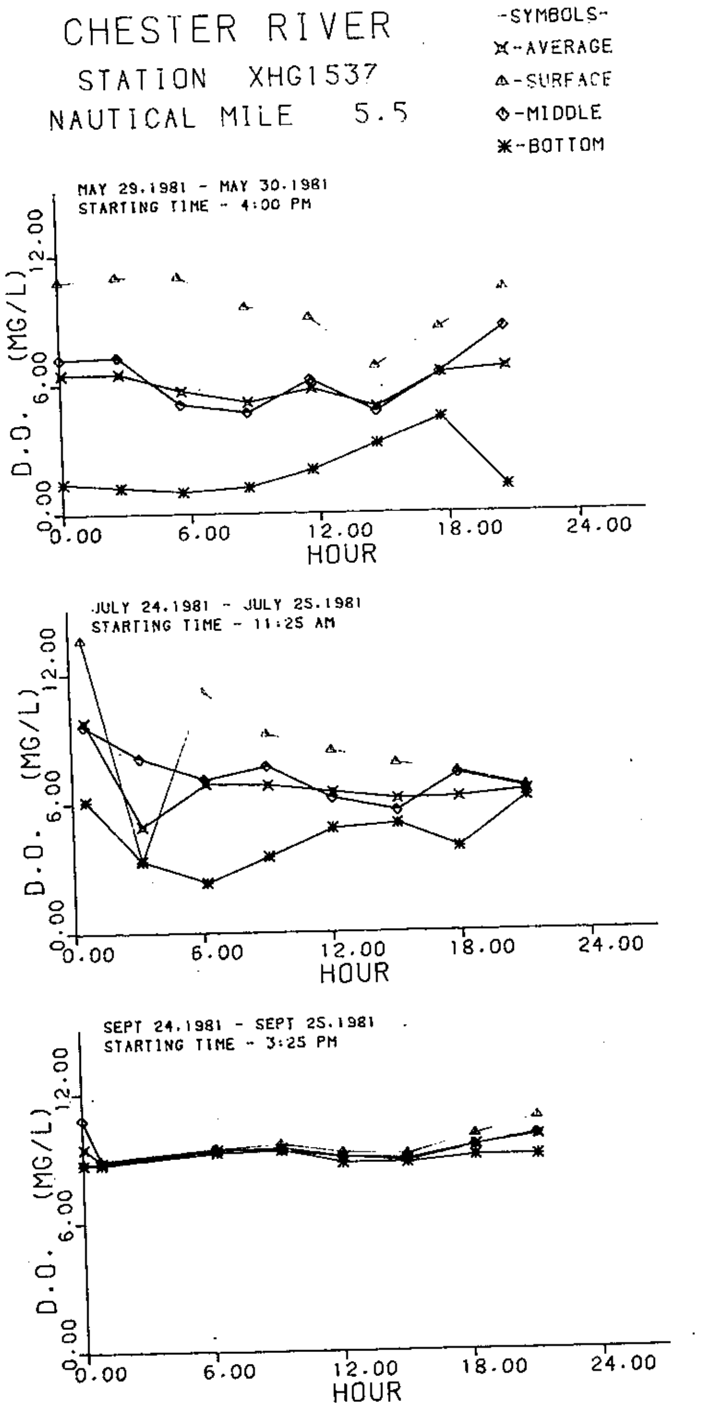


Figure 9-5 24 - Hour survey plots of Dissolved Oxygen, (mg/l).

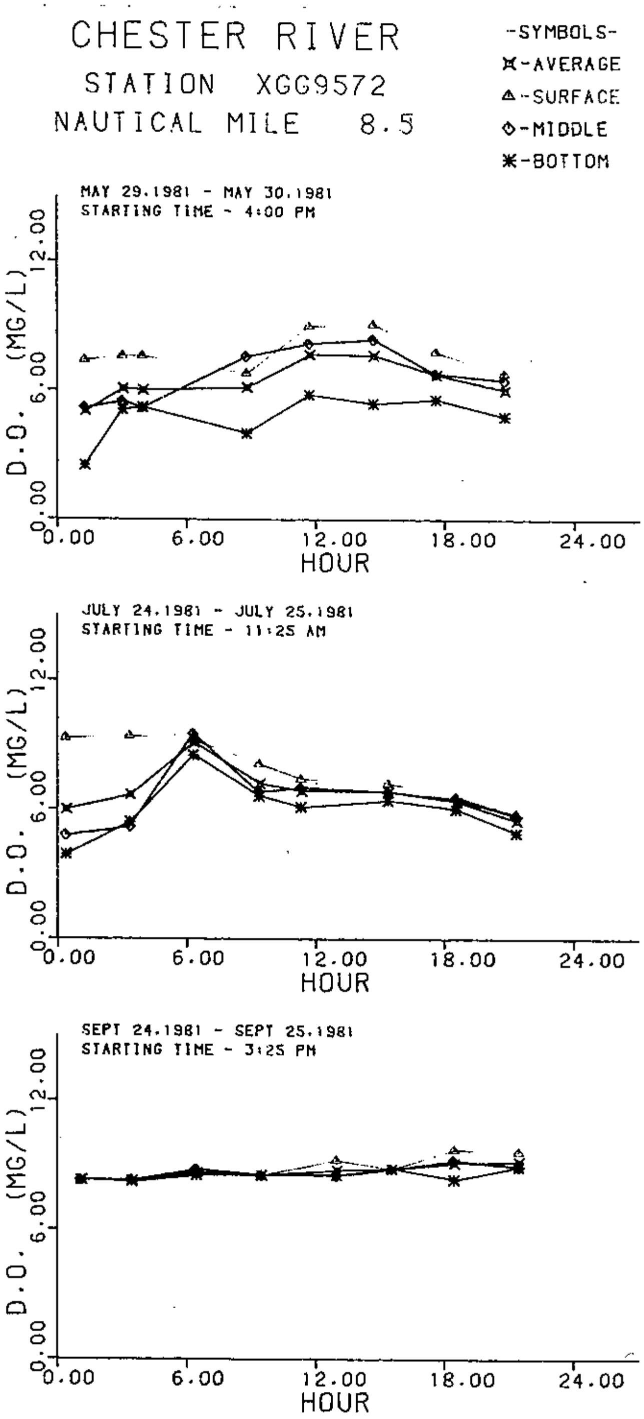


Figure 9-5 24 - Hour survey plots of Dissolved Oxygen, (mg/1).

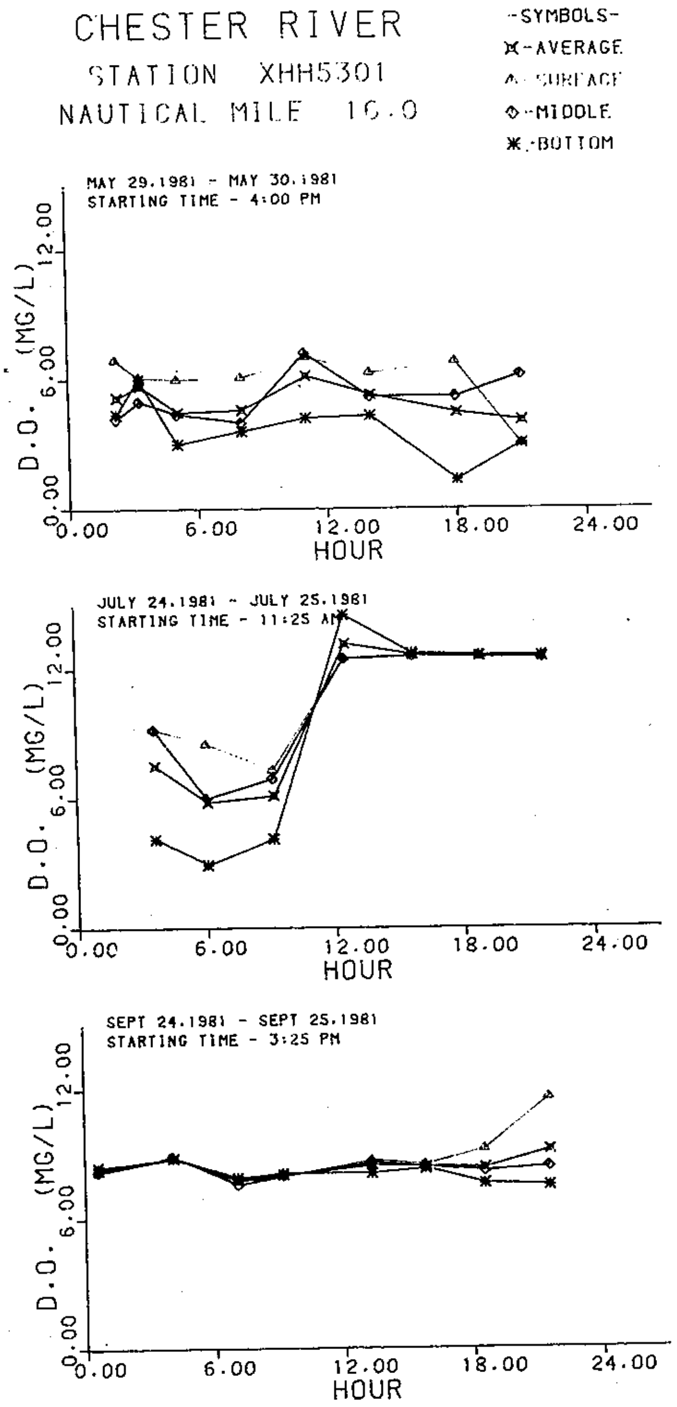


Figure 9-5 24 - Hour survey plots of Dissolved Oxygen, (mg/l).

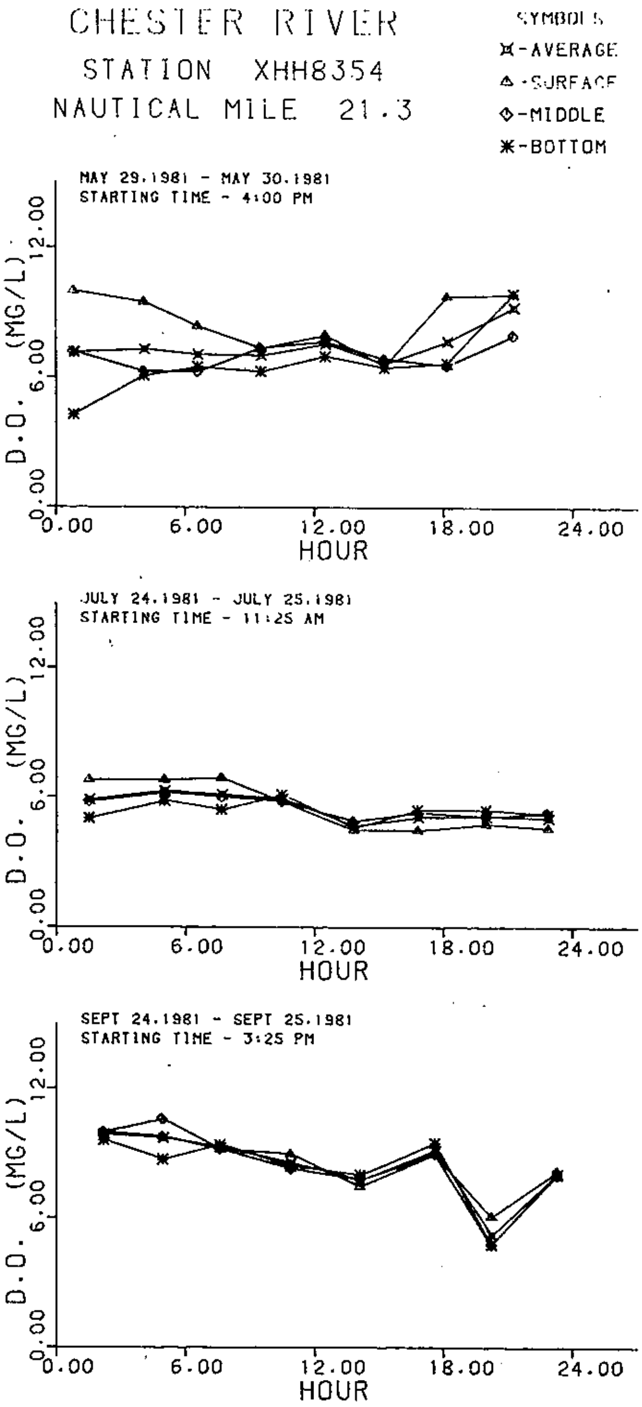


Figure 9-5 24 - Hour survey plots of Dissolved Oxygen, (mg/l).

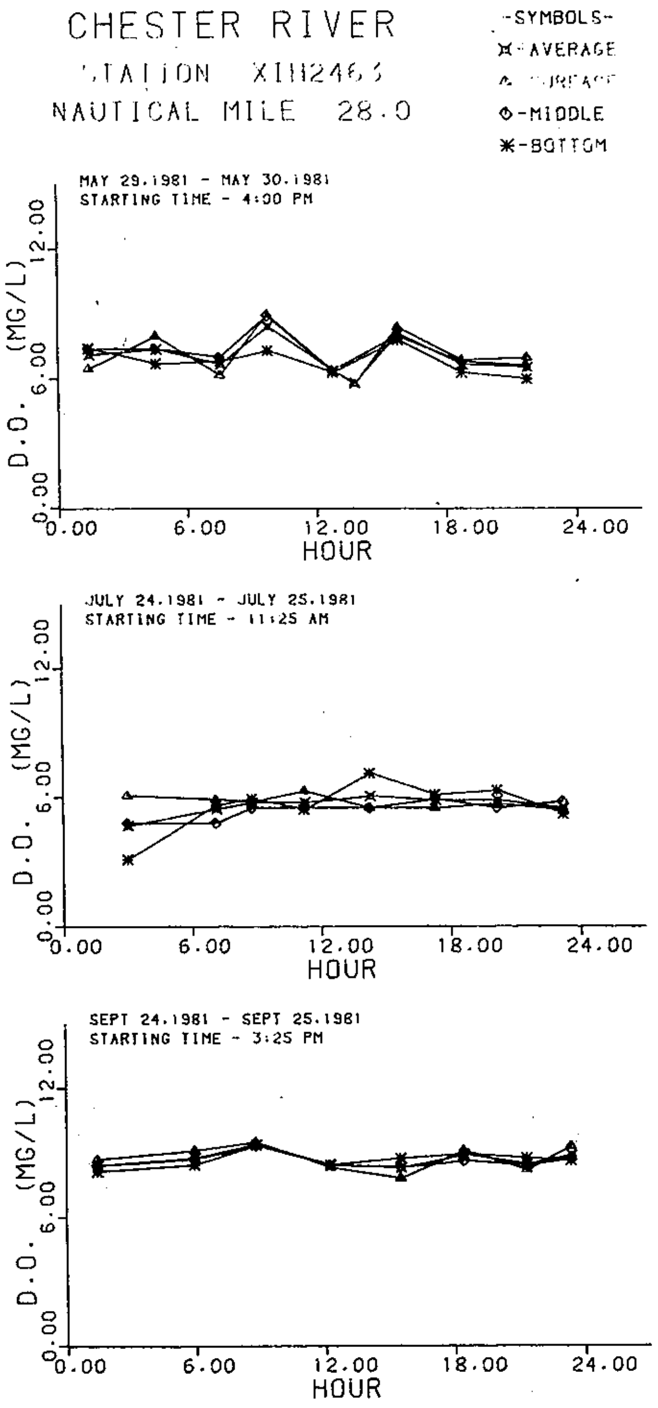


Figure 9-5 24 - Hour survey plots of Dissolved Oxygen, (mg/l).

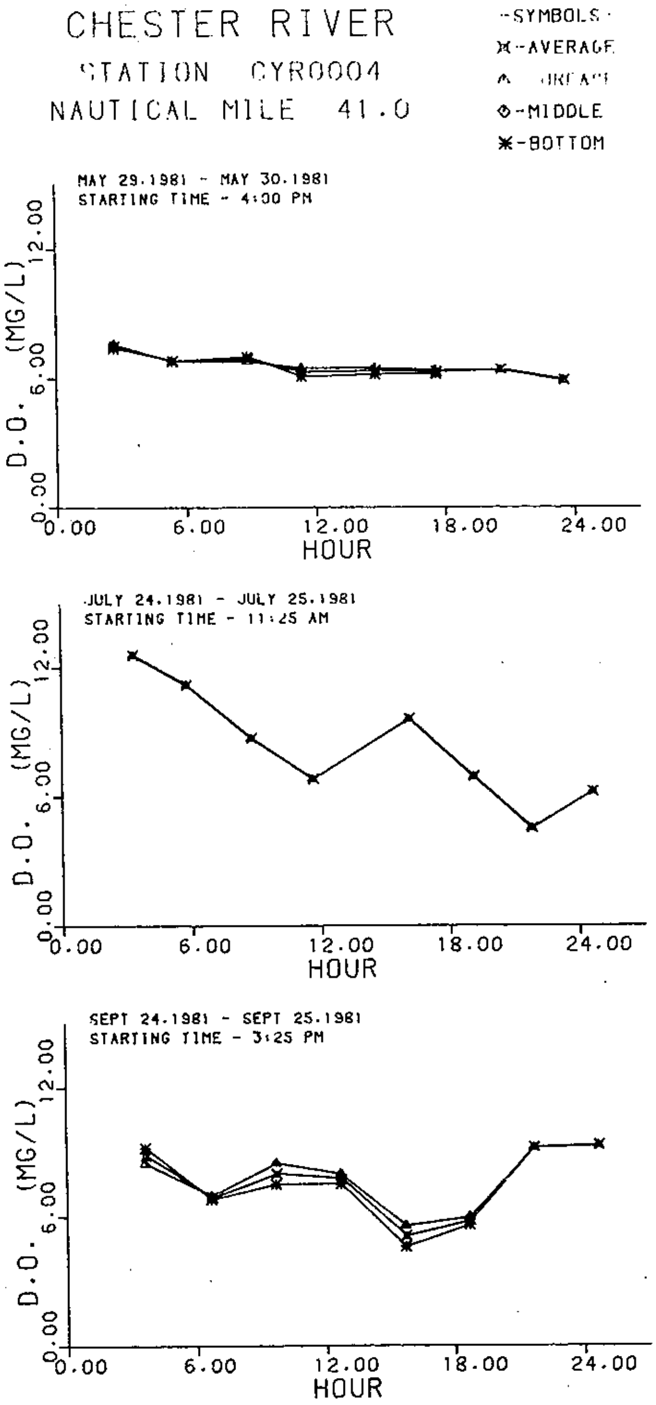


Figure 9-5 24 - Hour survey plots of Dissolved Oxygen, (mg/l).

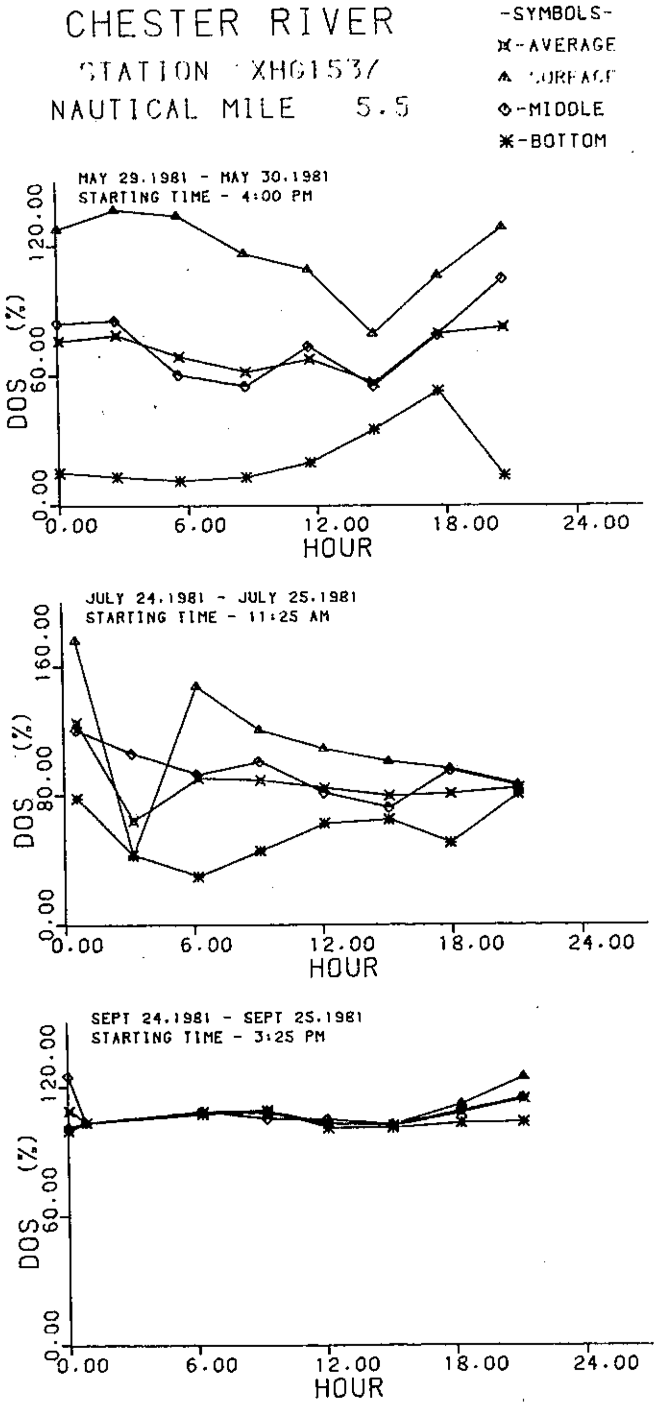


Figure 9-6 24 - Hour survey plots of Dissolved Oxygen Saturation, (mg/l).

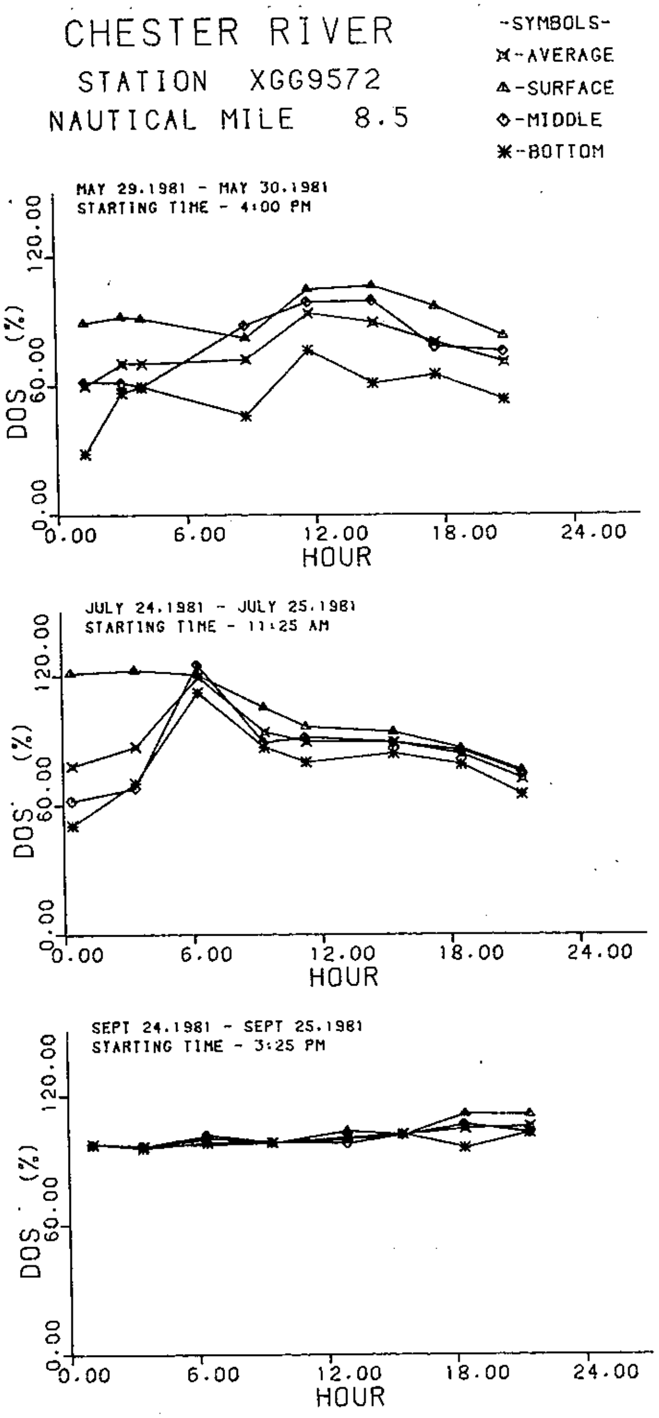


Figure 9-6 24 - Hour survey plots of Dissolved Oxygen Saturation, (mg/l).

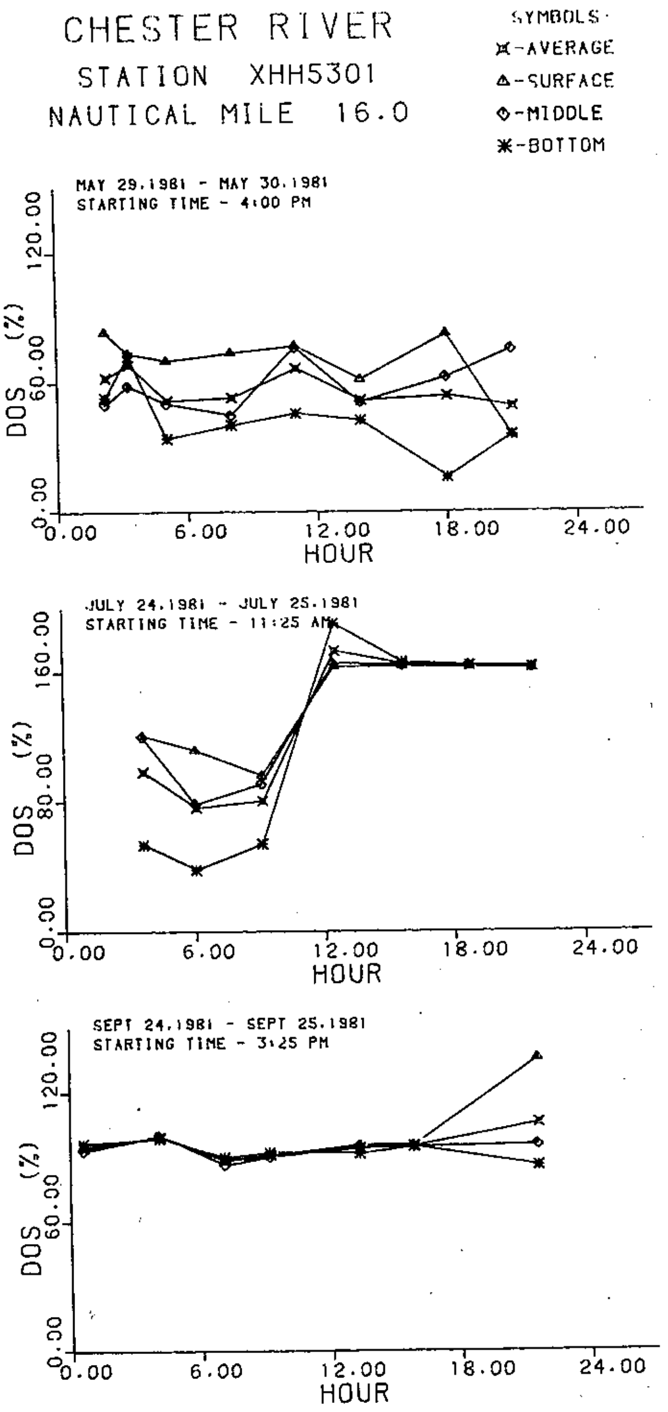


Figure 9-6 24 - Hour survey plots of Dissolved Oxygen Saturation, (mg/l).

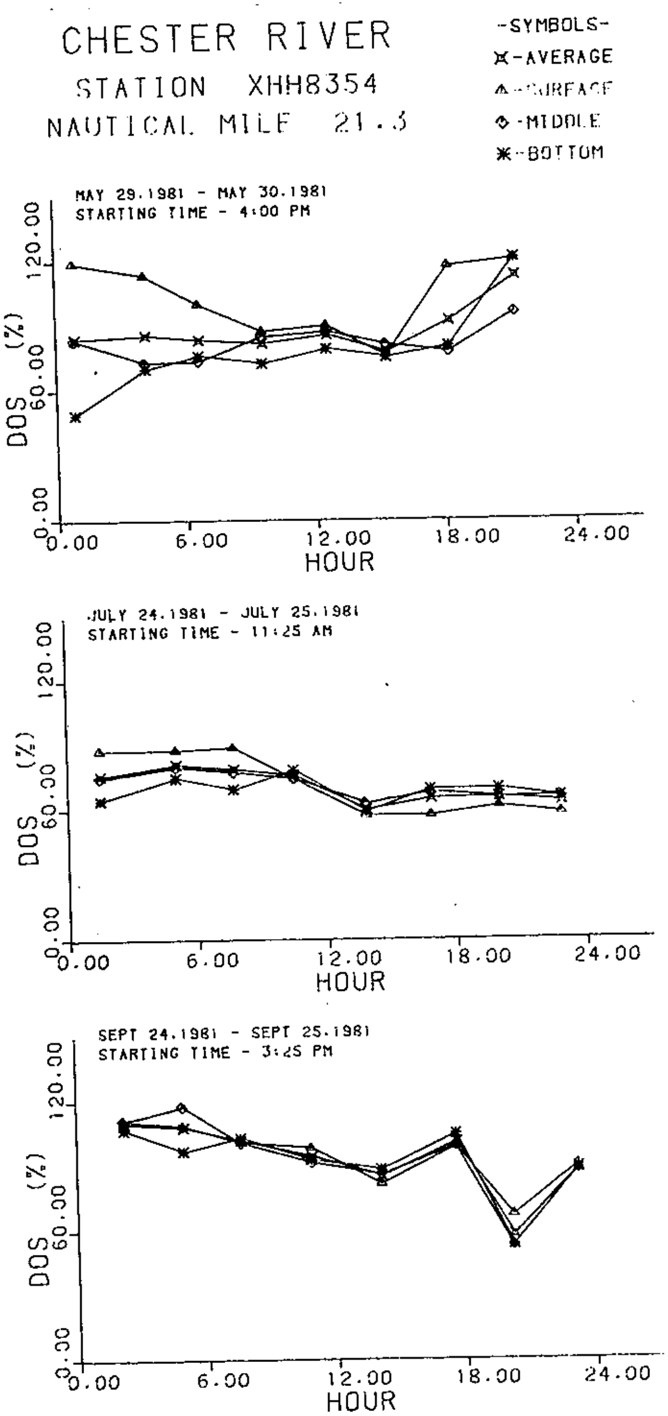


Figure 9-6 24 - Hour survey plots of Dissolved Oxygen Saturation, (mg/l).

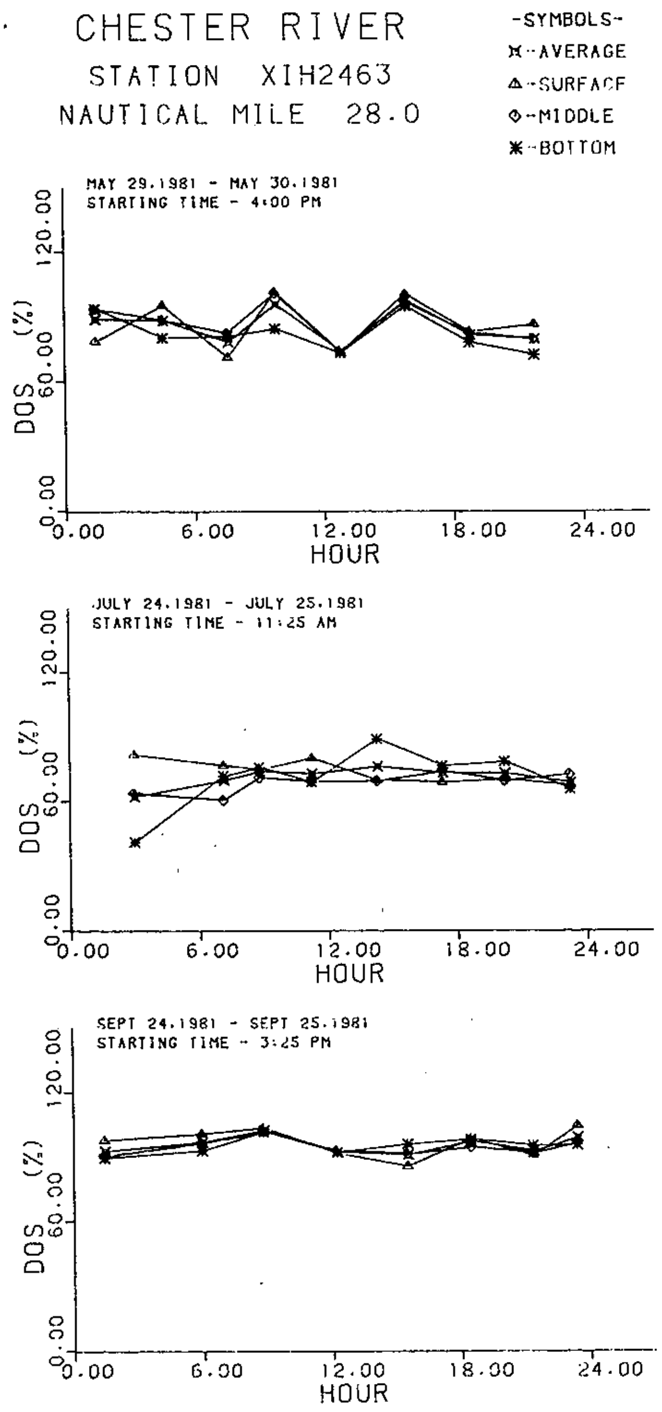


Figure 9-6 24 - Hour survey plots of Dissolved Oxygen Saturation, (mg/l).

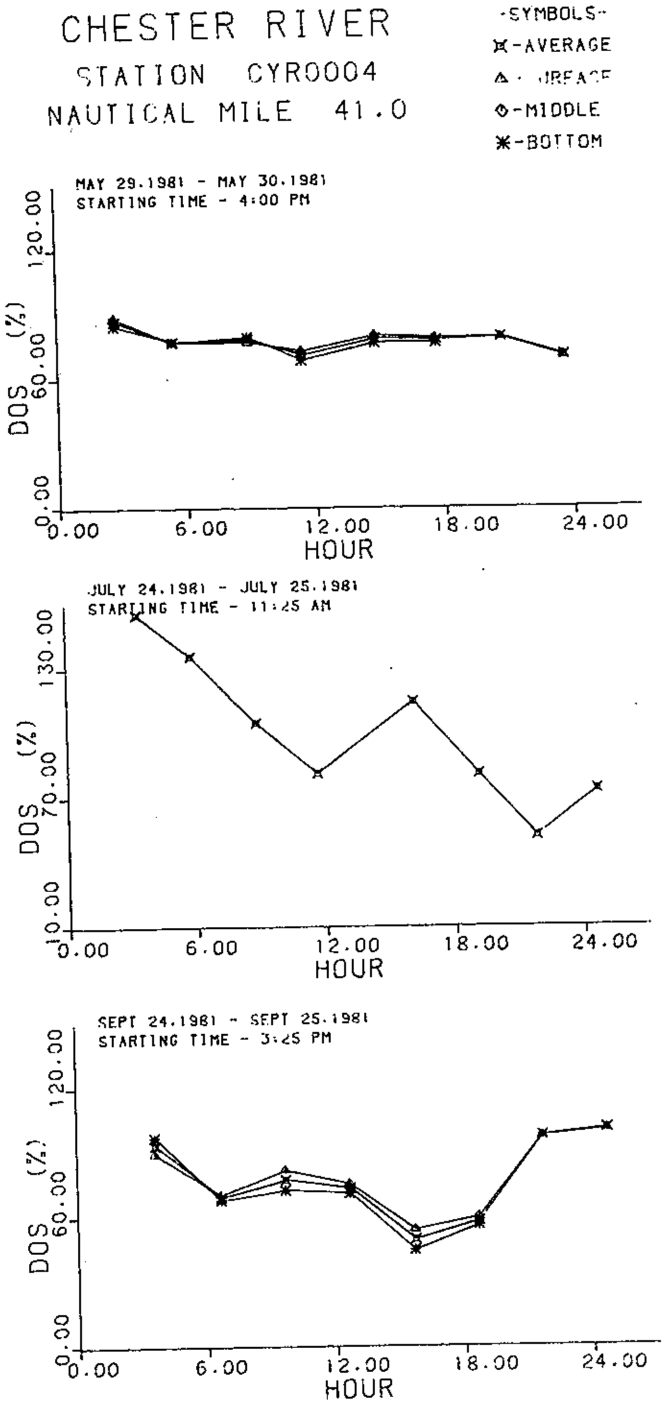


Figure 9-6 24 - Hour survey plots of Dissolved Oxygen Saturation, (mg/l).

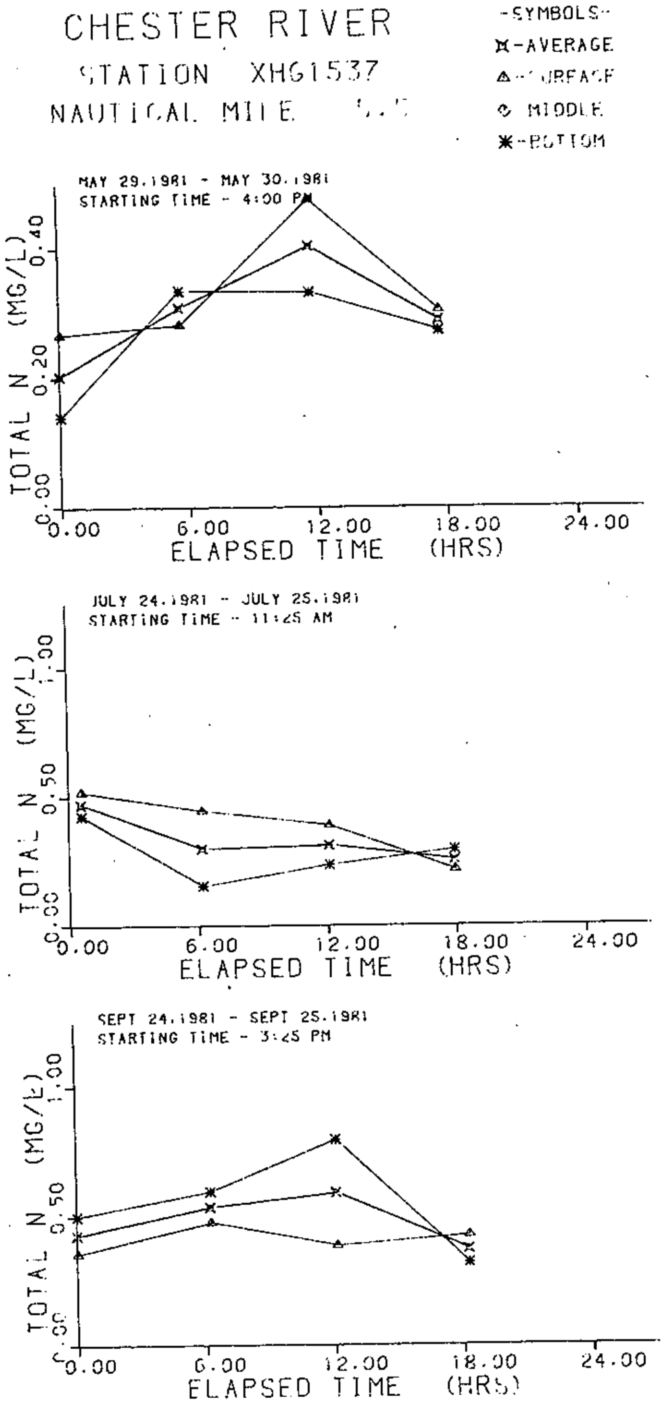


Figure 9-7 24 - Hour survey plots of Total Nitrogen (mg/l).

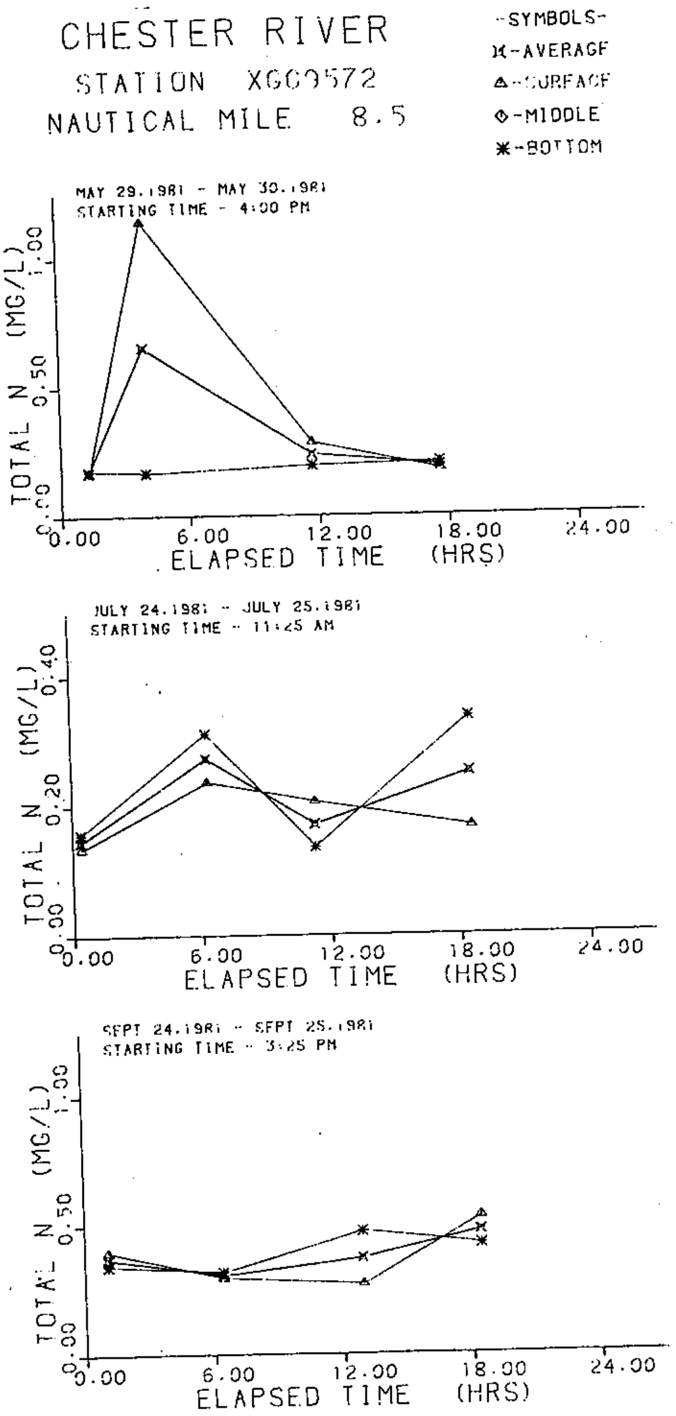


Figure 9-7 24 - Hour survey plots of Total Nitrogen (mg/l).

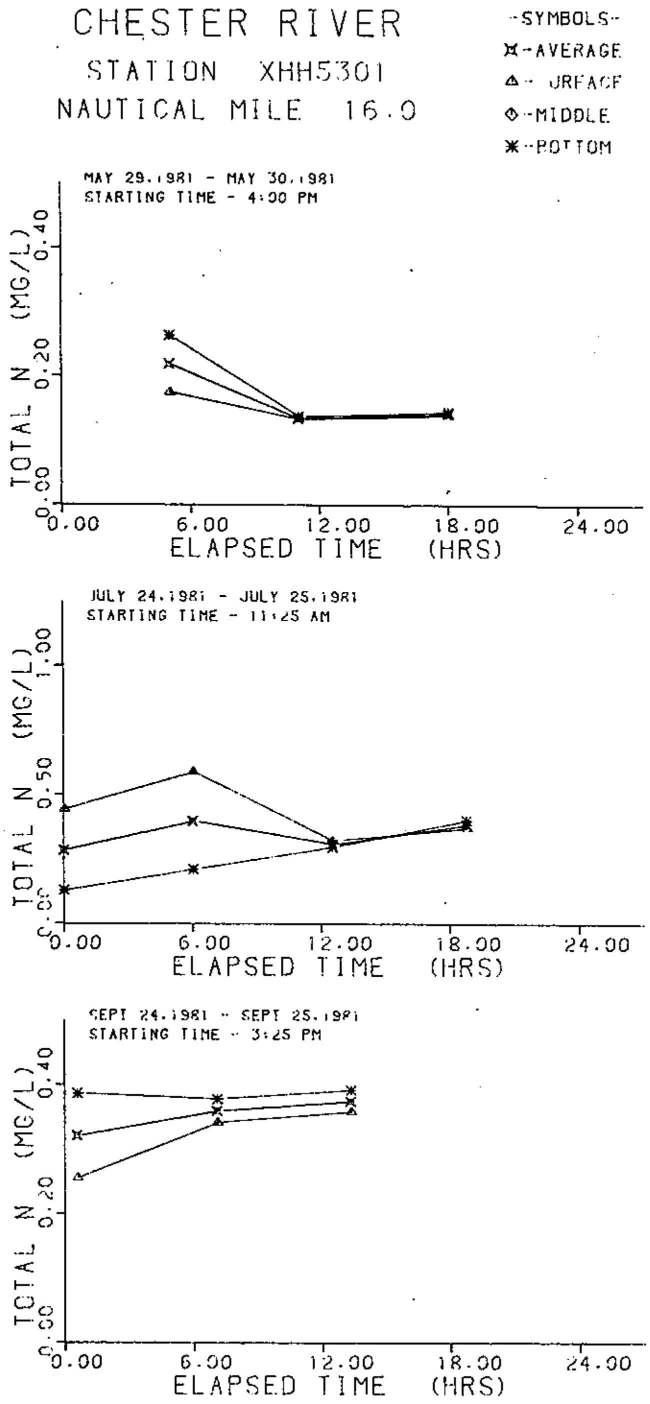


Figure 9-7 24 - Hour survey plots of Total Nitrogen (mg/l).

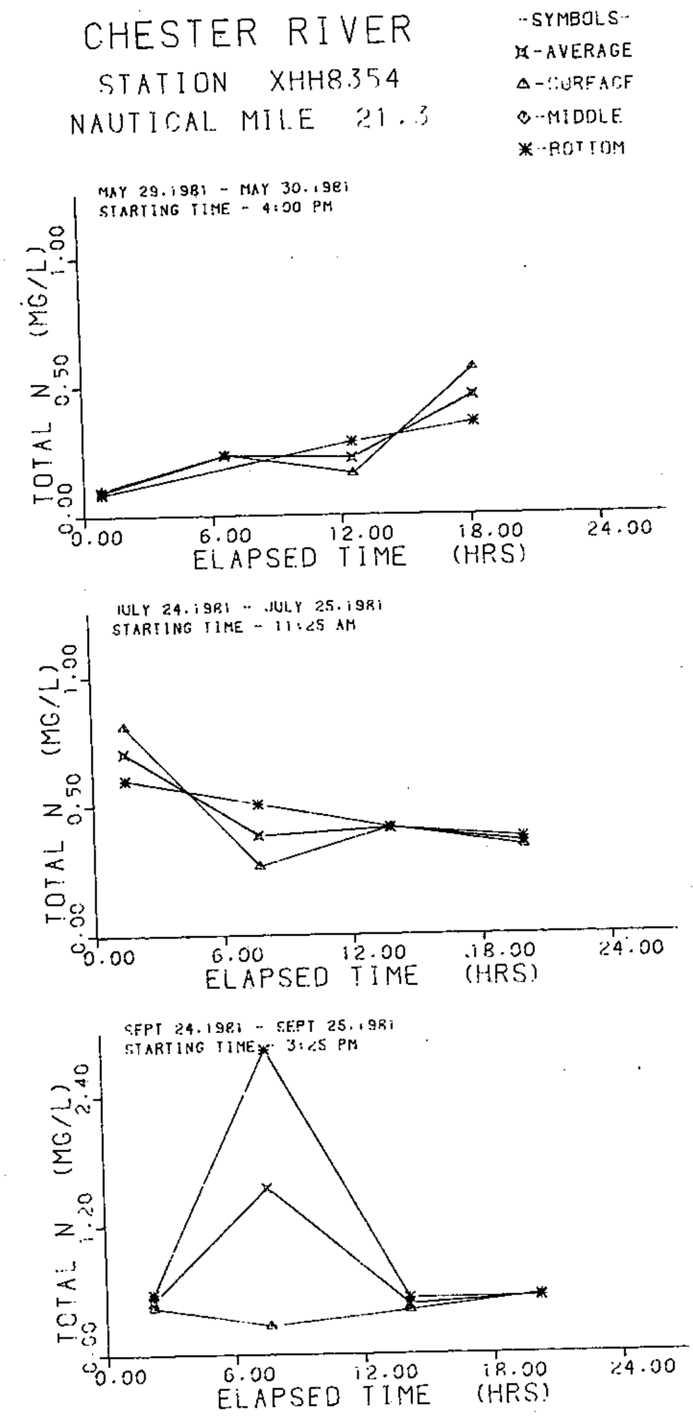


Figure 9-7 24 - Hour survey plots of Total Nitrogen (mg/l).

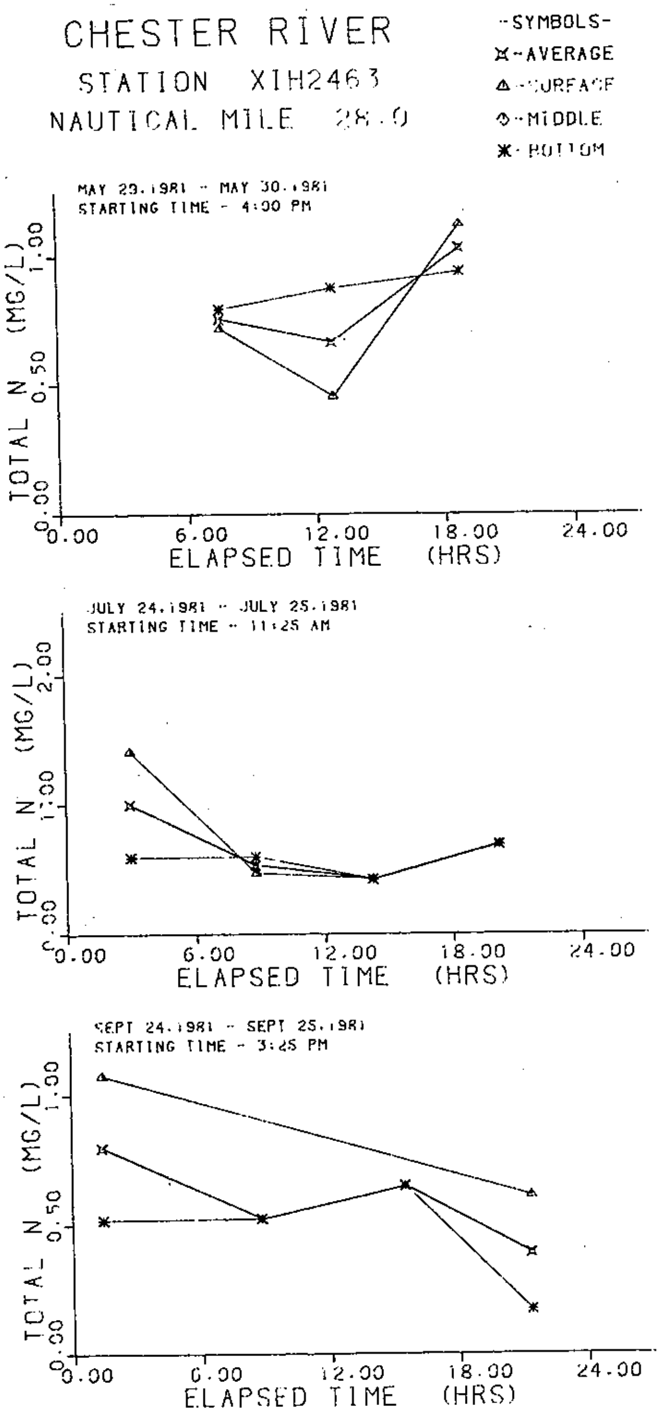


Figure 9-7 24 - Hour survey plots of Total Nitrogen (mg/l).

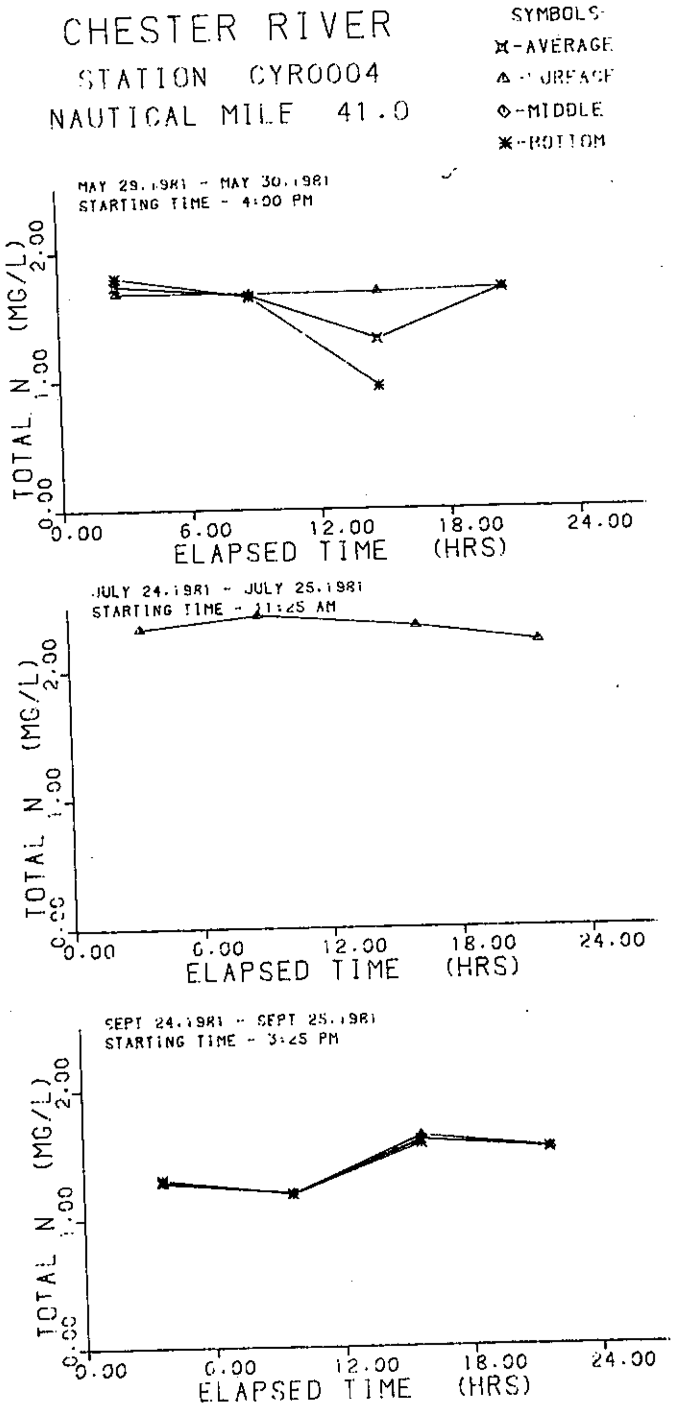


Figure 9-7 24 - Hour survey plots of Total Nitrogen (mg/l).

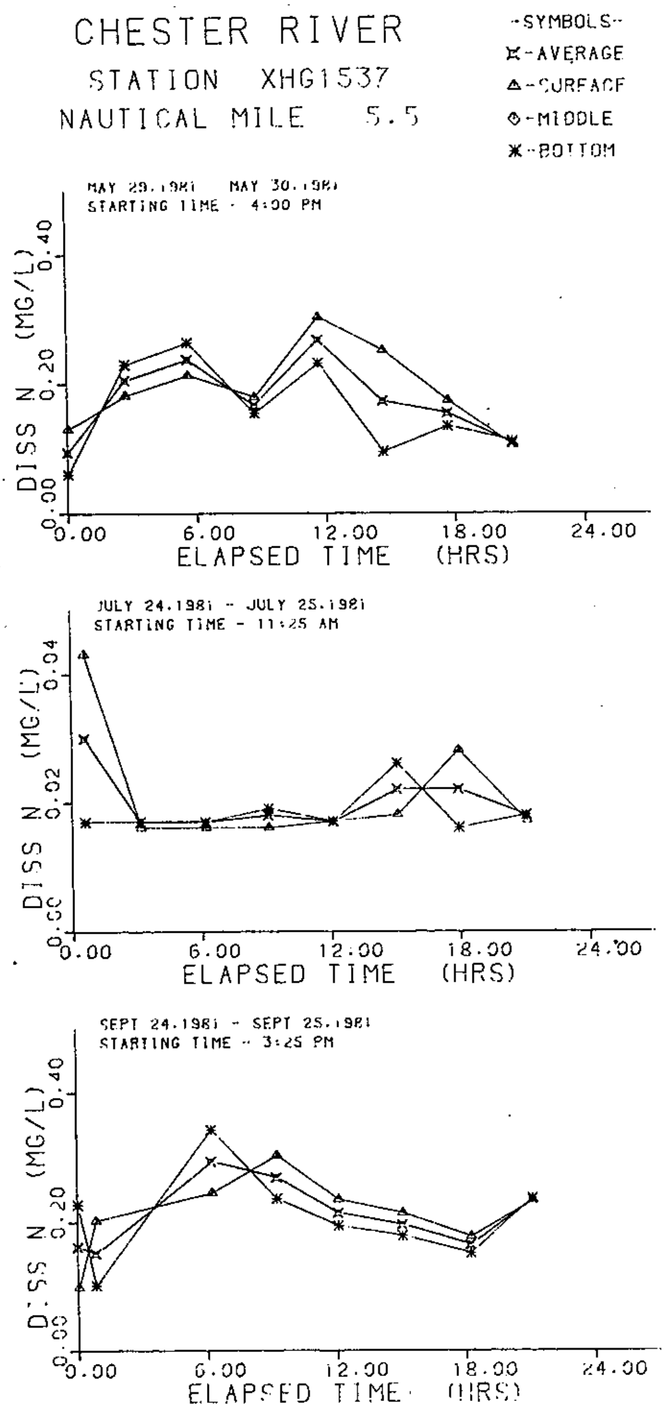


Figure 9-8 24 - Hour Survey plots of Total Dissolved Nitrogen, (mg/l).

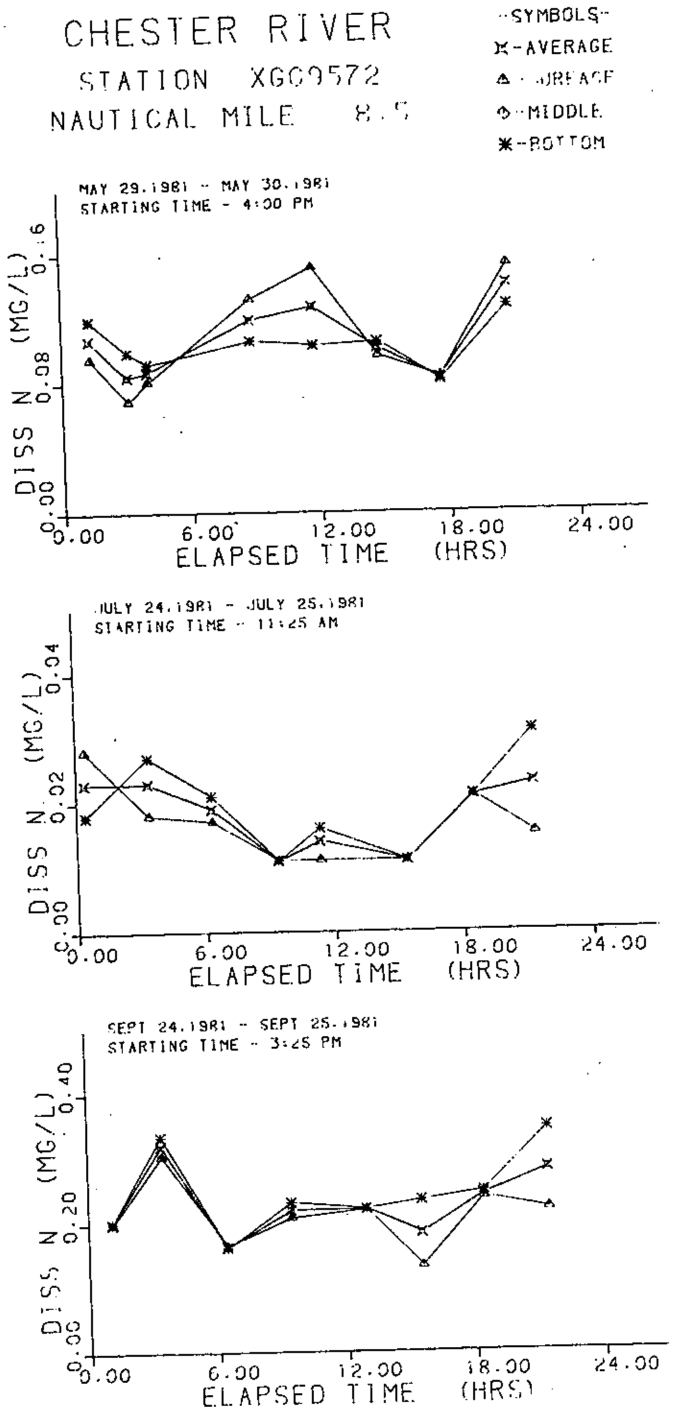


Figure 9- 8 24 - Hour survey plots of Total Dissolved Nitrogen, (mg/l).

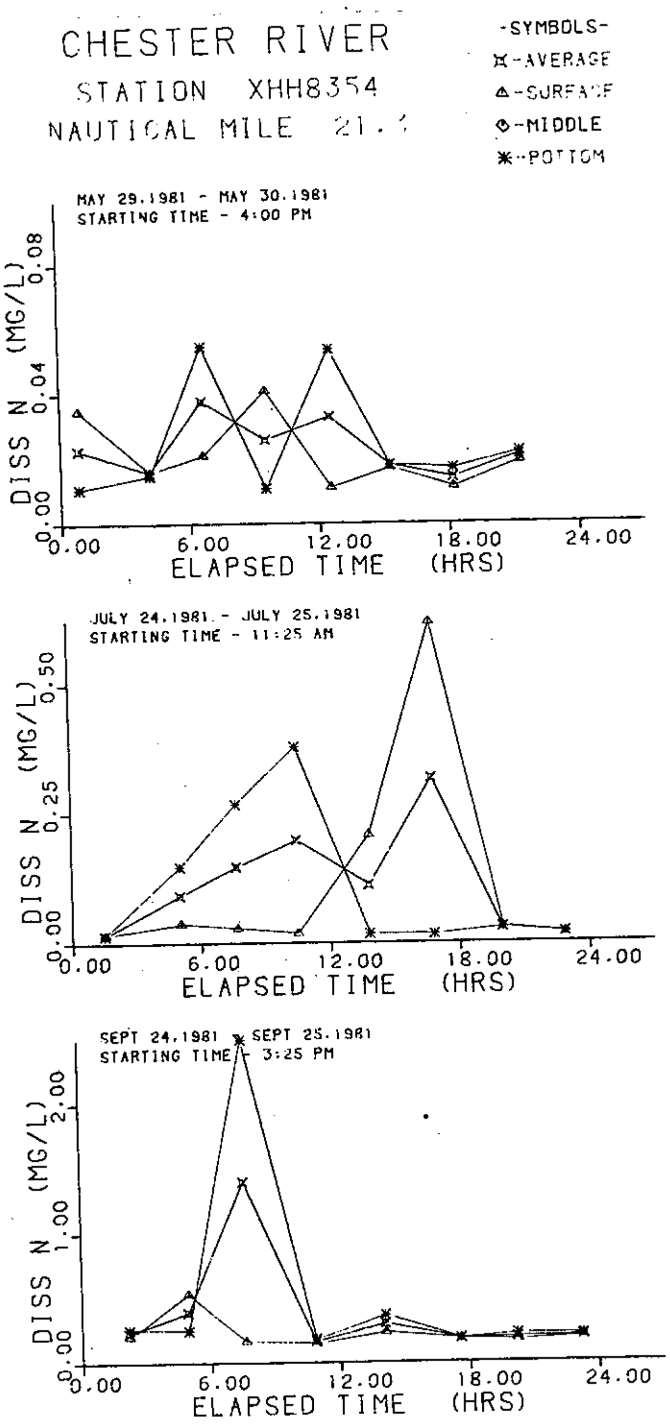


Figure 9- 8 24 - Hour Survey Plots of Total Dissolved Nitrogen, (mg/l).

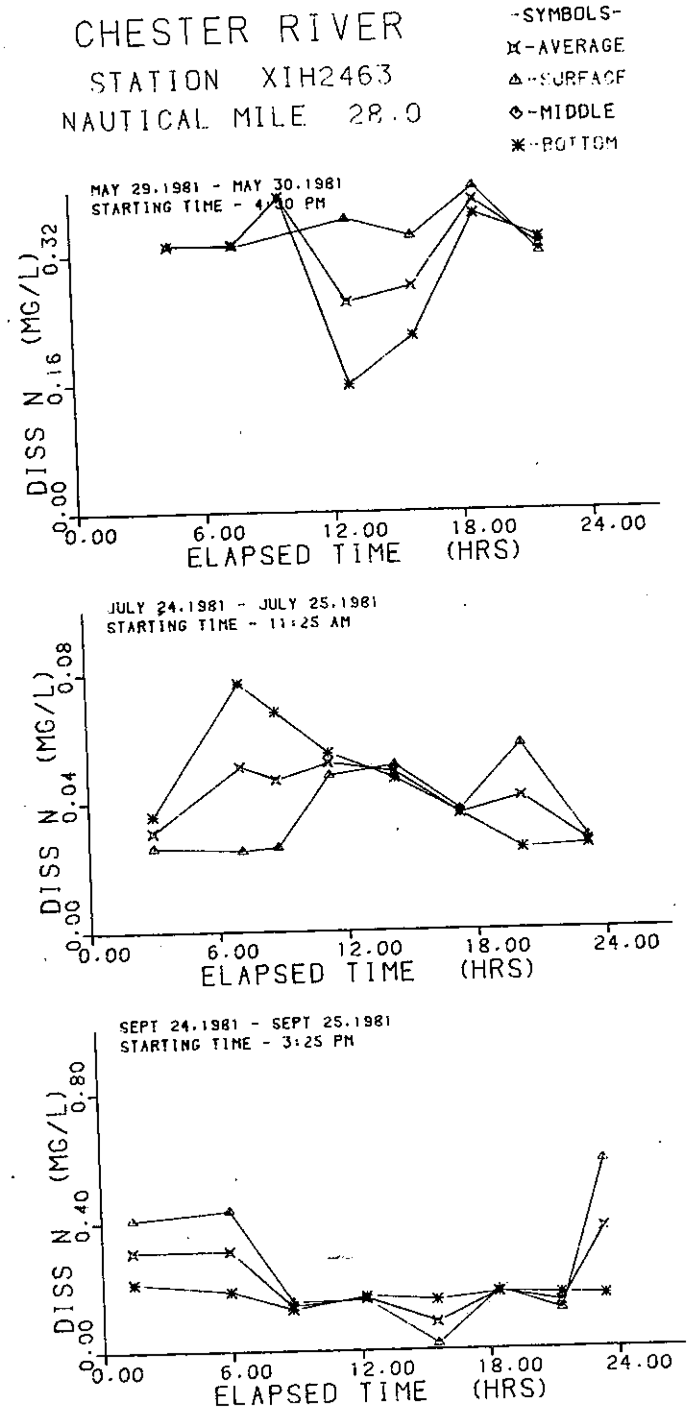


Figure 9- 8 24 - Hour Survey plots of Total Dissolved Nitrogen, (mg/l).

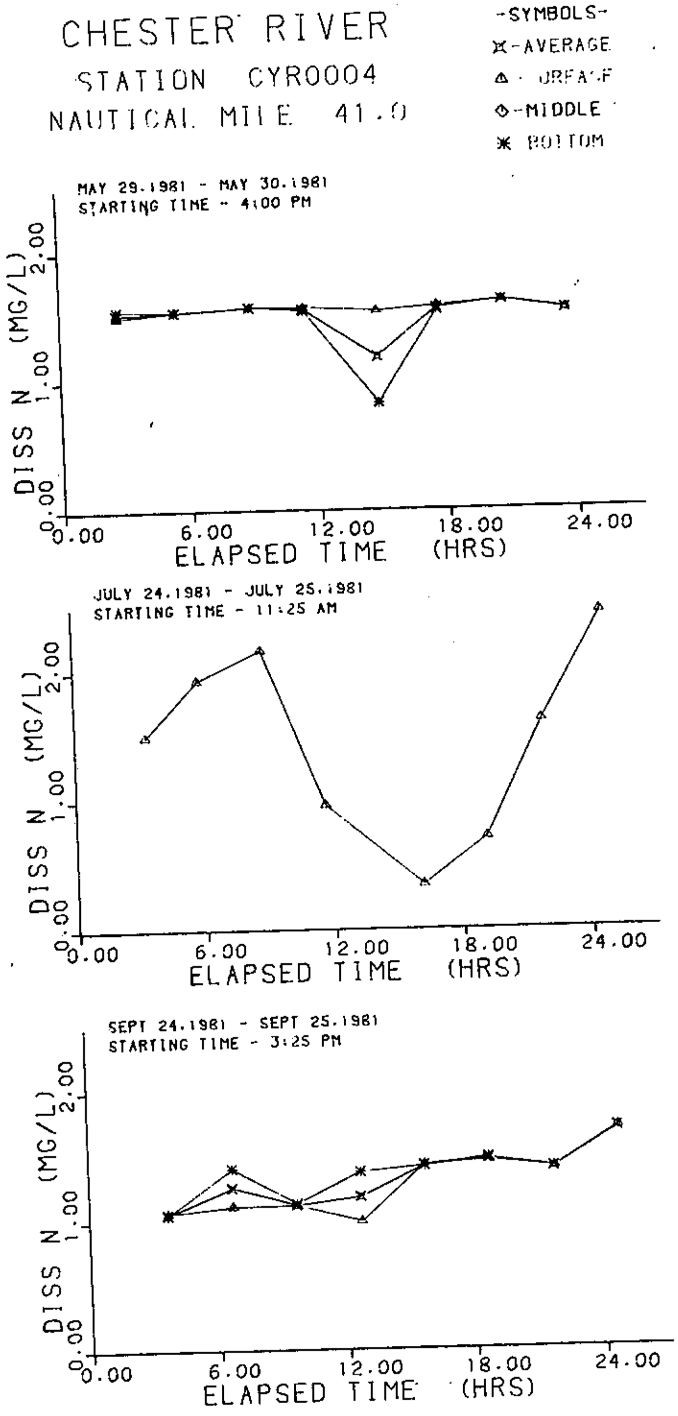


Figure 9-8 24 - Hour Survey plots of Total Dissolved Nitrogen, (mg/l).

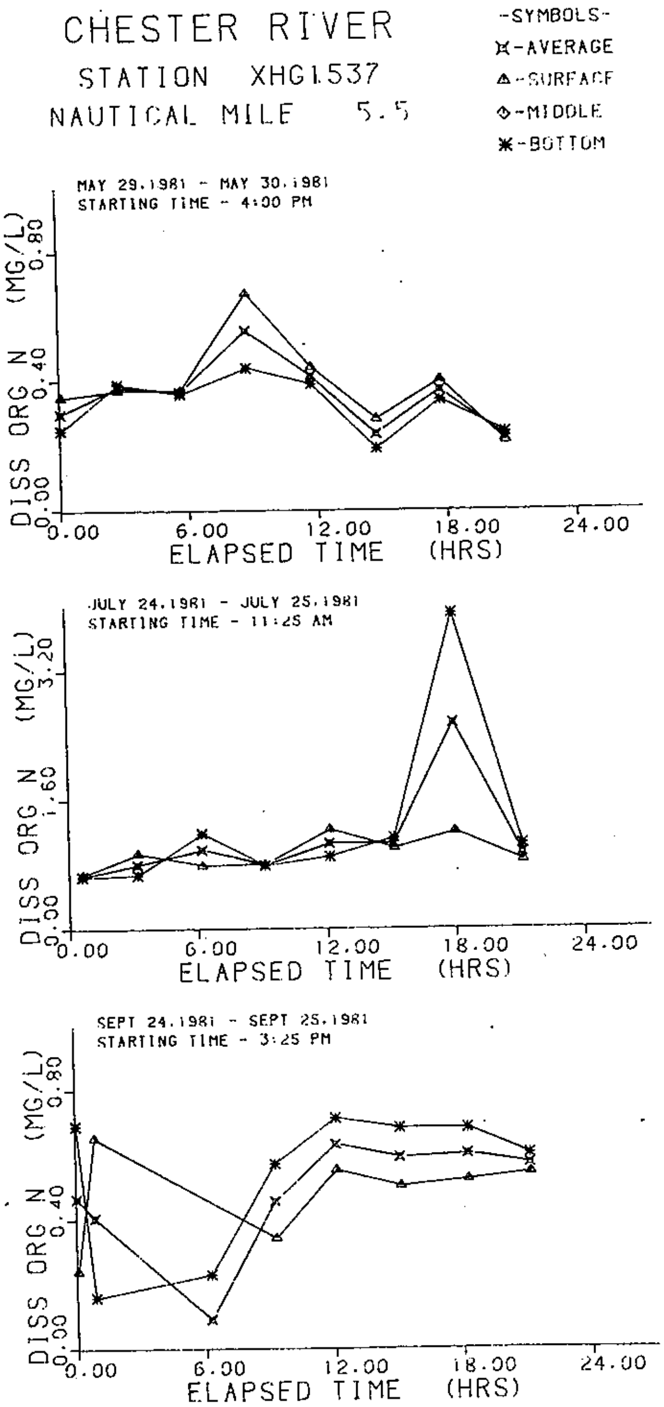


Figure 9-9 24 - Hour survey plots of Dissolved Organic Nitrogen, (mg/l).

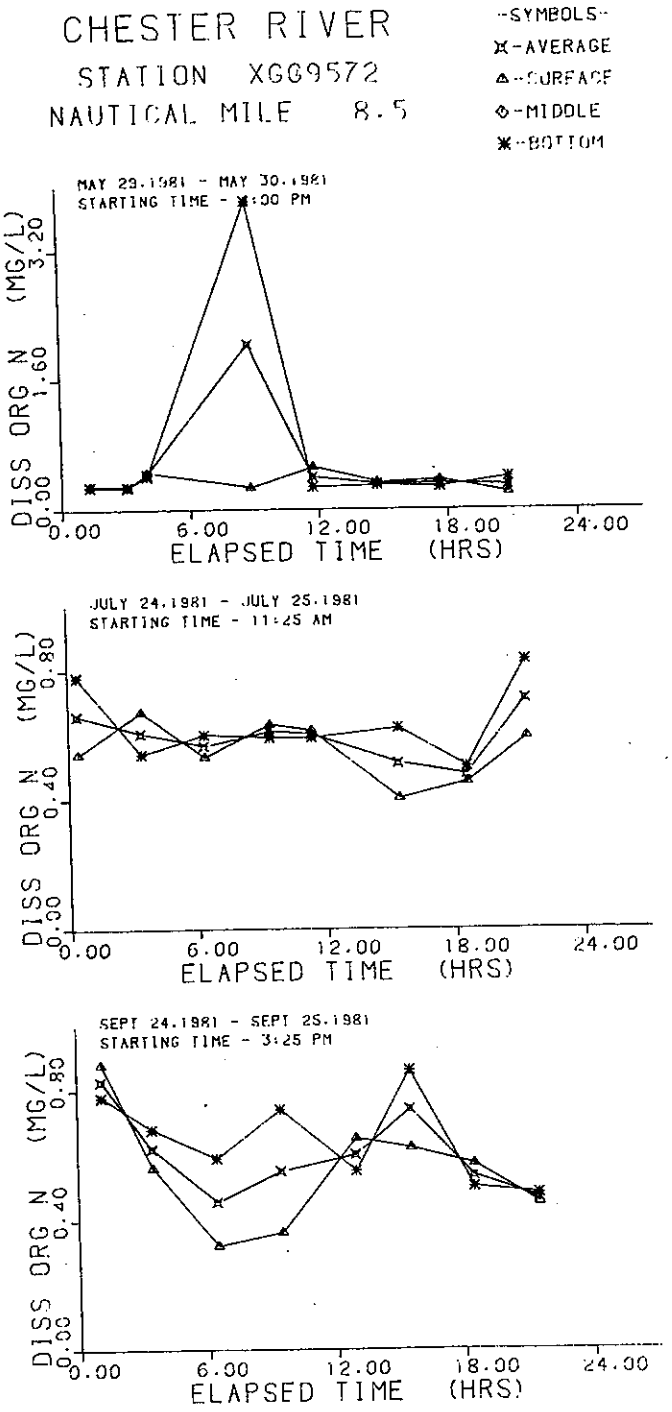


Figure 9-9 24 - Hour survey plots of Dissolved Organic Nitrogen, (mg/l).

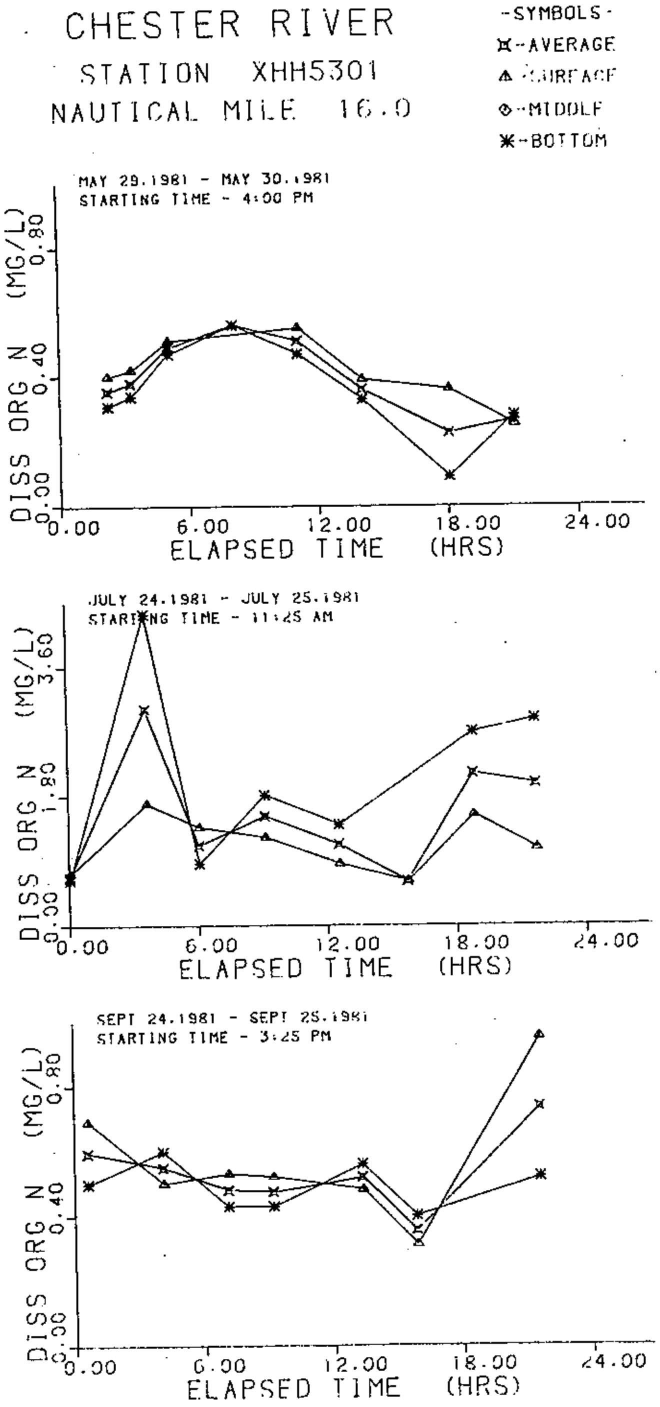


Figure 9- 9 24 - Hour survey plots of Dissolved Organic Nitrogen, (mg/l).

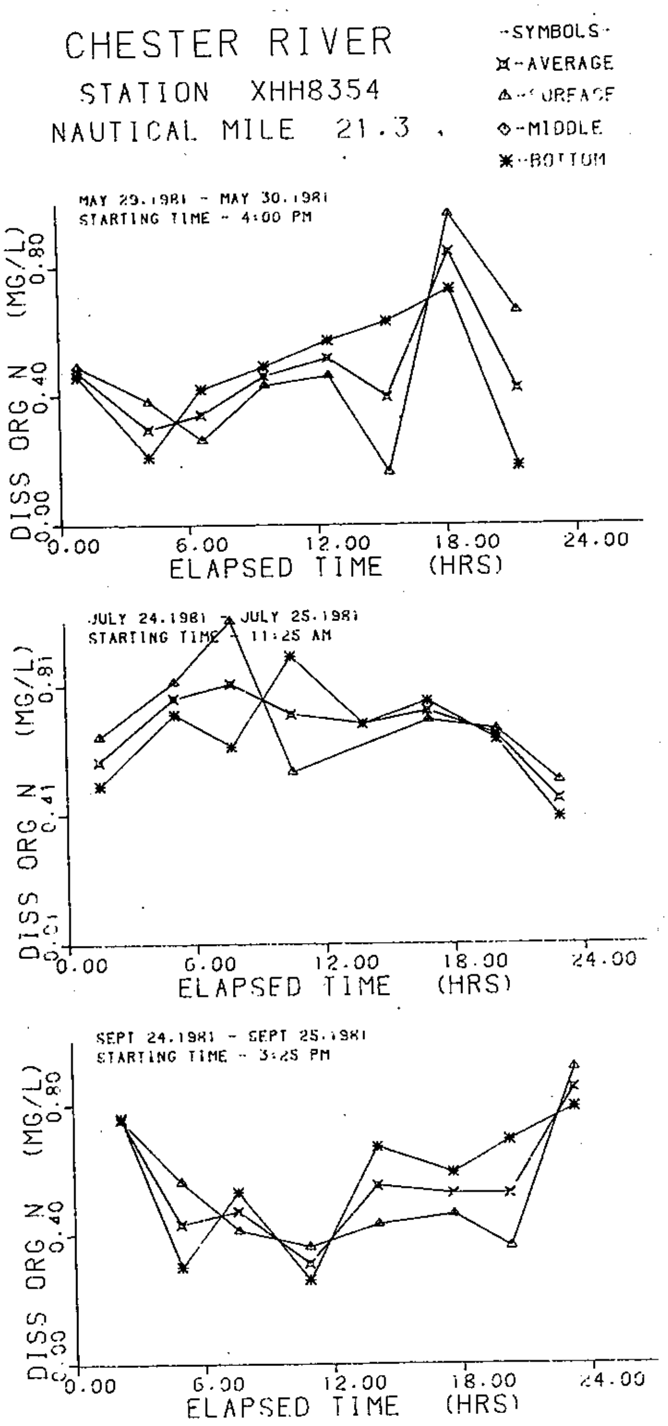


Figure 9- 9 24 - Hour survey plots of Dissolved Organic Nitrogen, (mg/l).

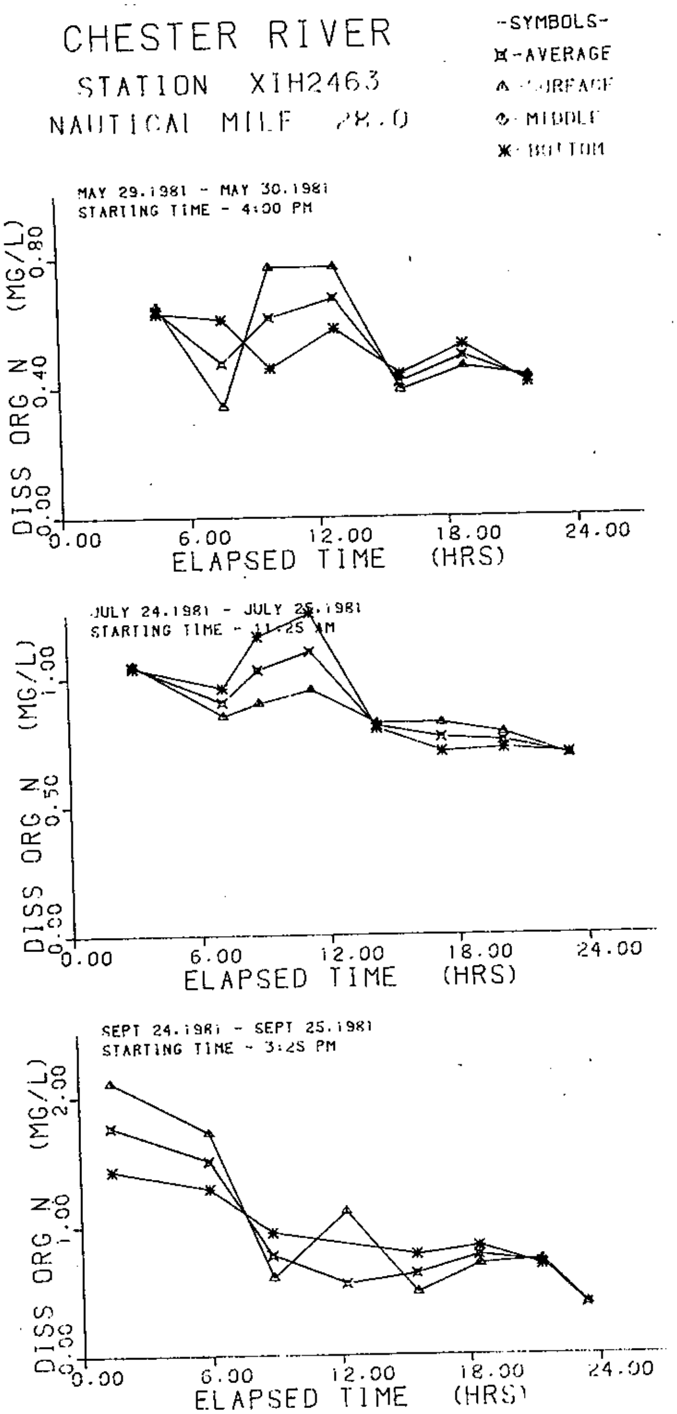


Figure 9-9 24 - Hour survey plots of Dissolved Organic Nitrogen, (mg/l).

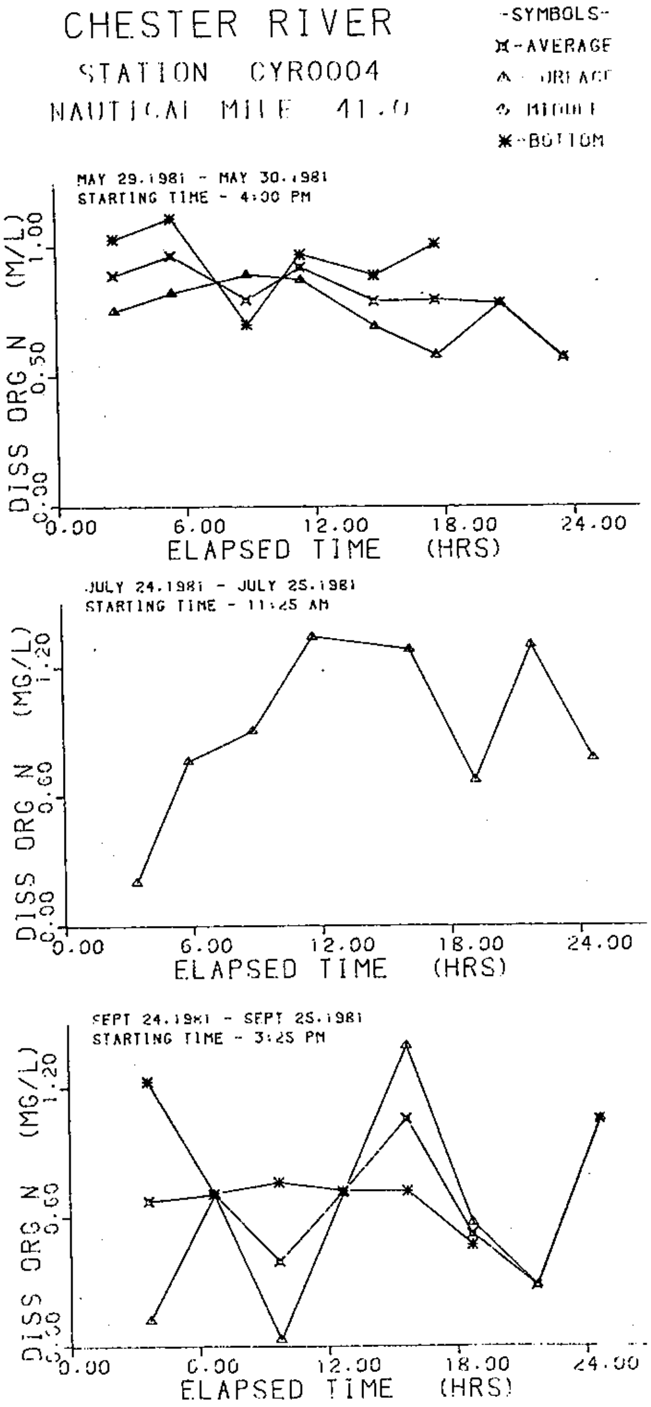


Figure 9-9 24 - Hour survey plots of Dissolved Organic Nitrogen, (mg/l).

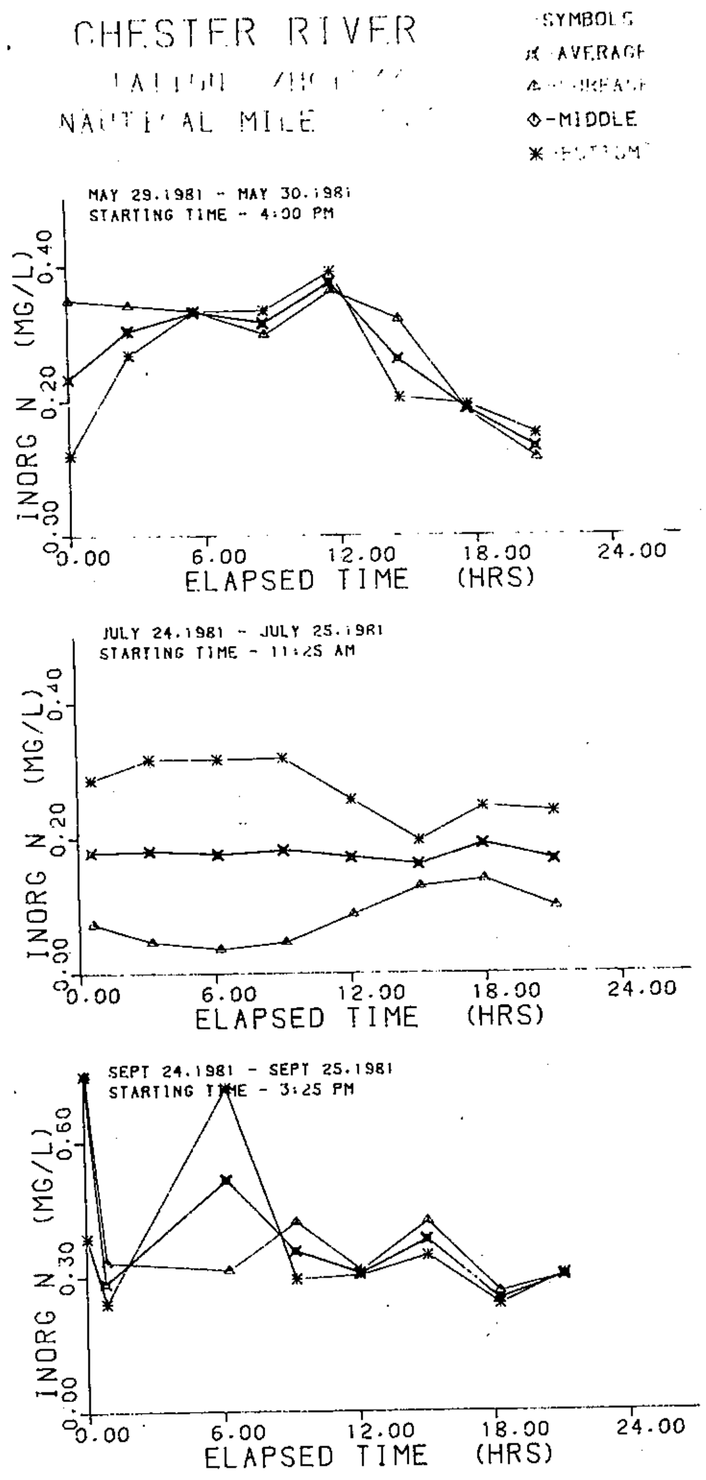


Figure 9-10 24-Hour survey plots of Dissolved inorganic Nitrogen (mg/l).

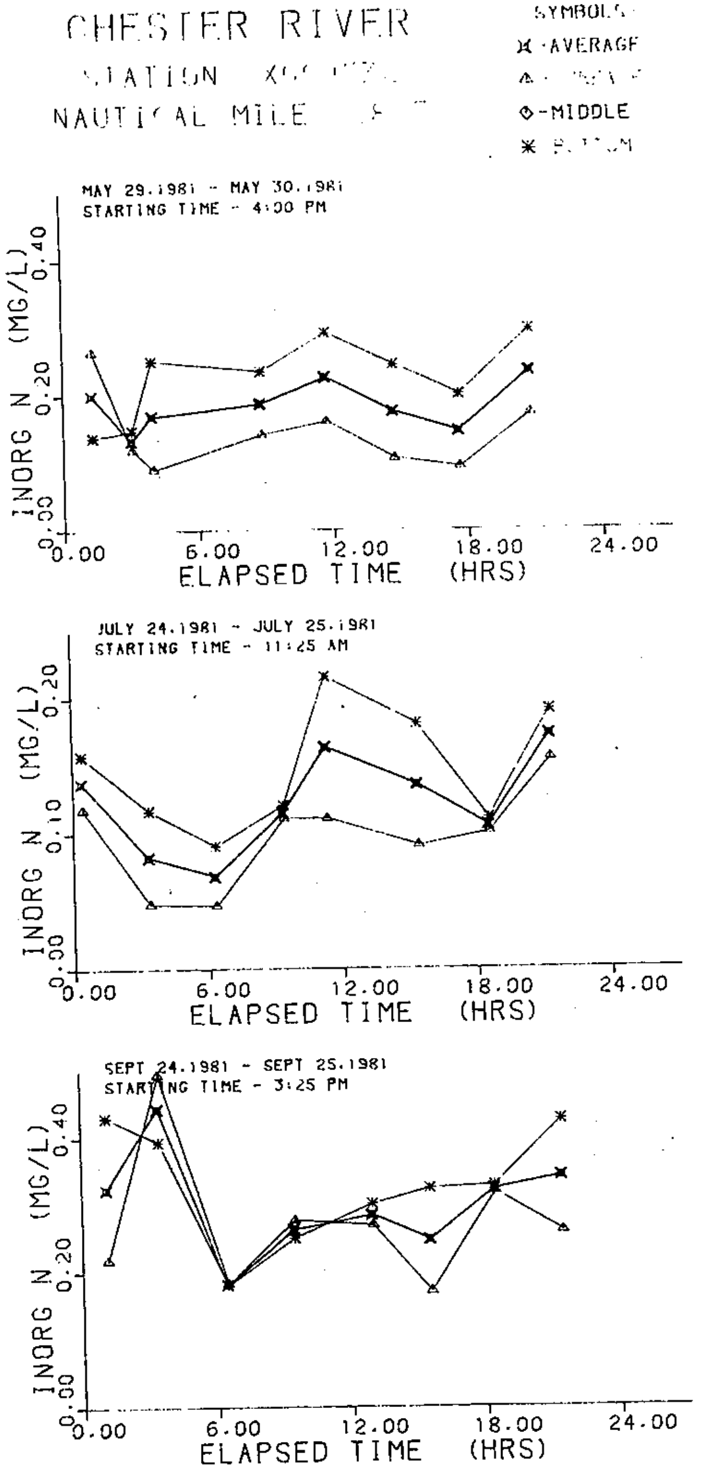


Figure 9-10 24-Hour survey plots of Dissolved inorganic Nitrogen (mg/l).

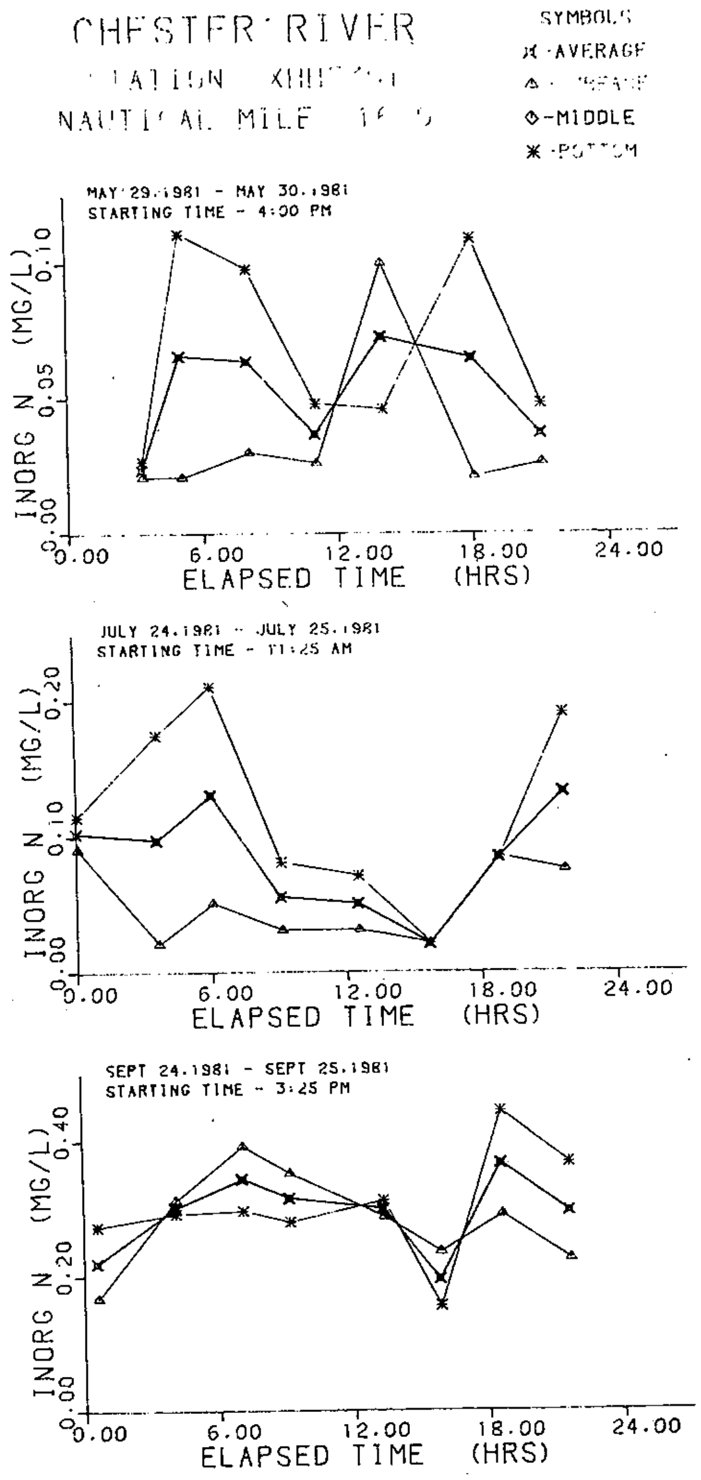


Figure 9-10 24-Hour survey plots of Dissolved Inorganic Nitrogen (mg/l).

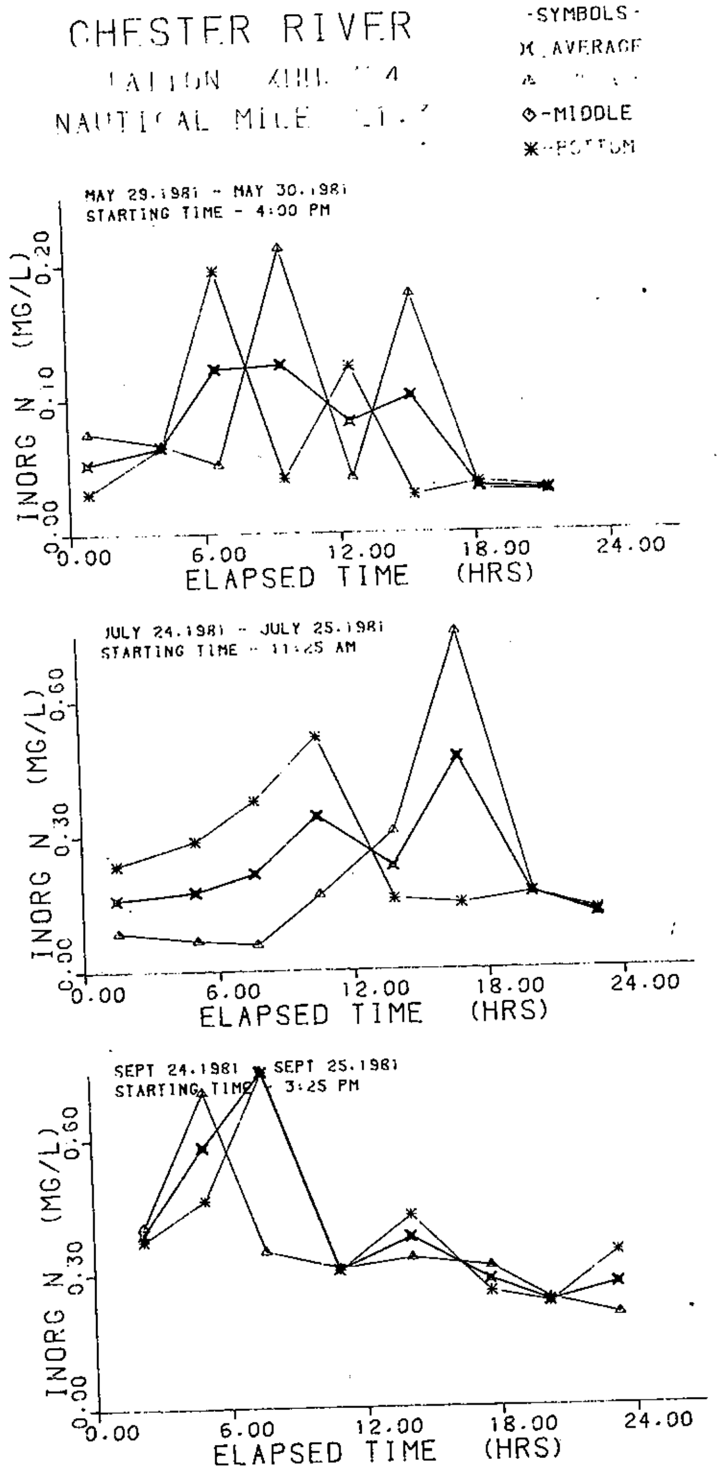


Figure 9-10 24-Hour survey plots of Dissolved inorganic Nitrogen (mg/l).

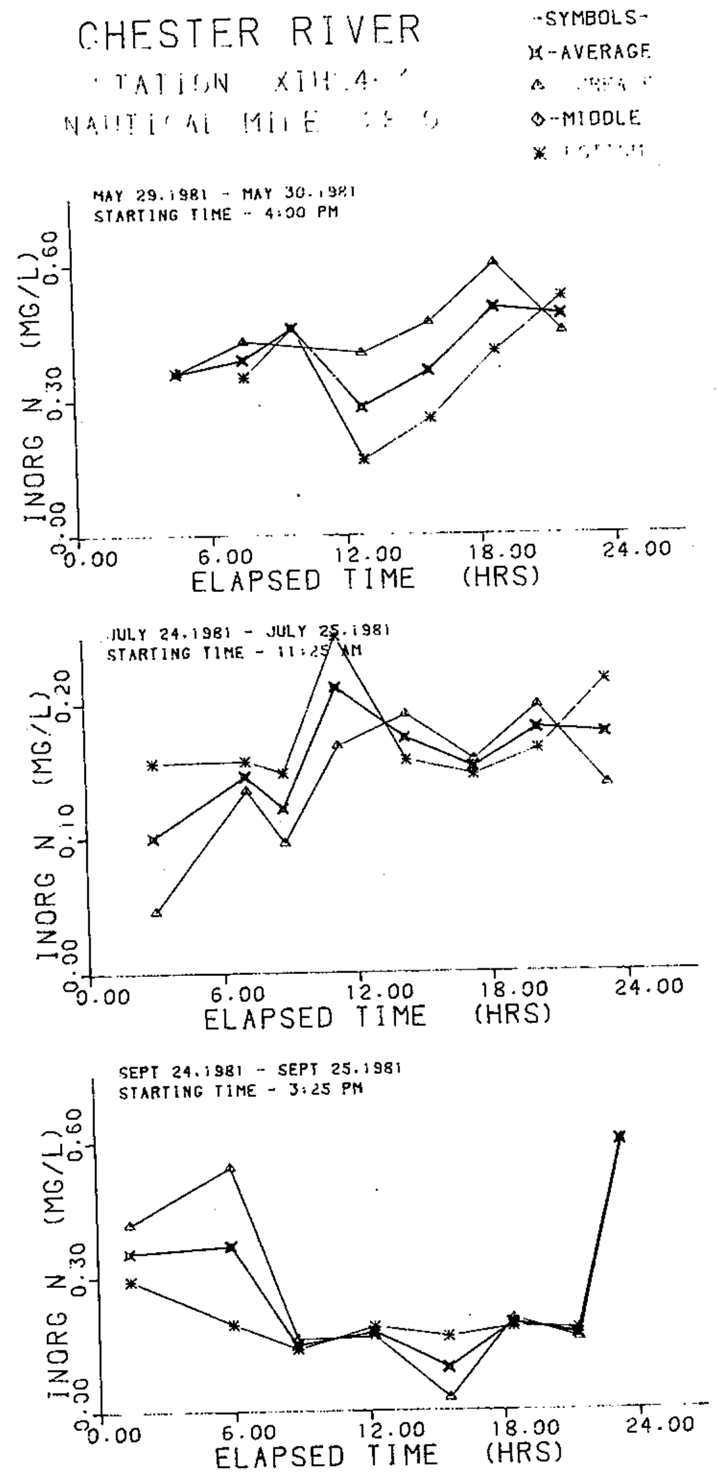


Figure 9-10 24-Hour survey plots of Dissolved inorganic Nitrogen (mg/l).

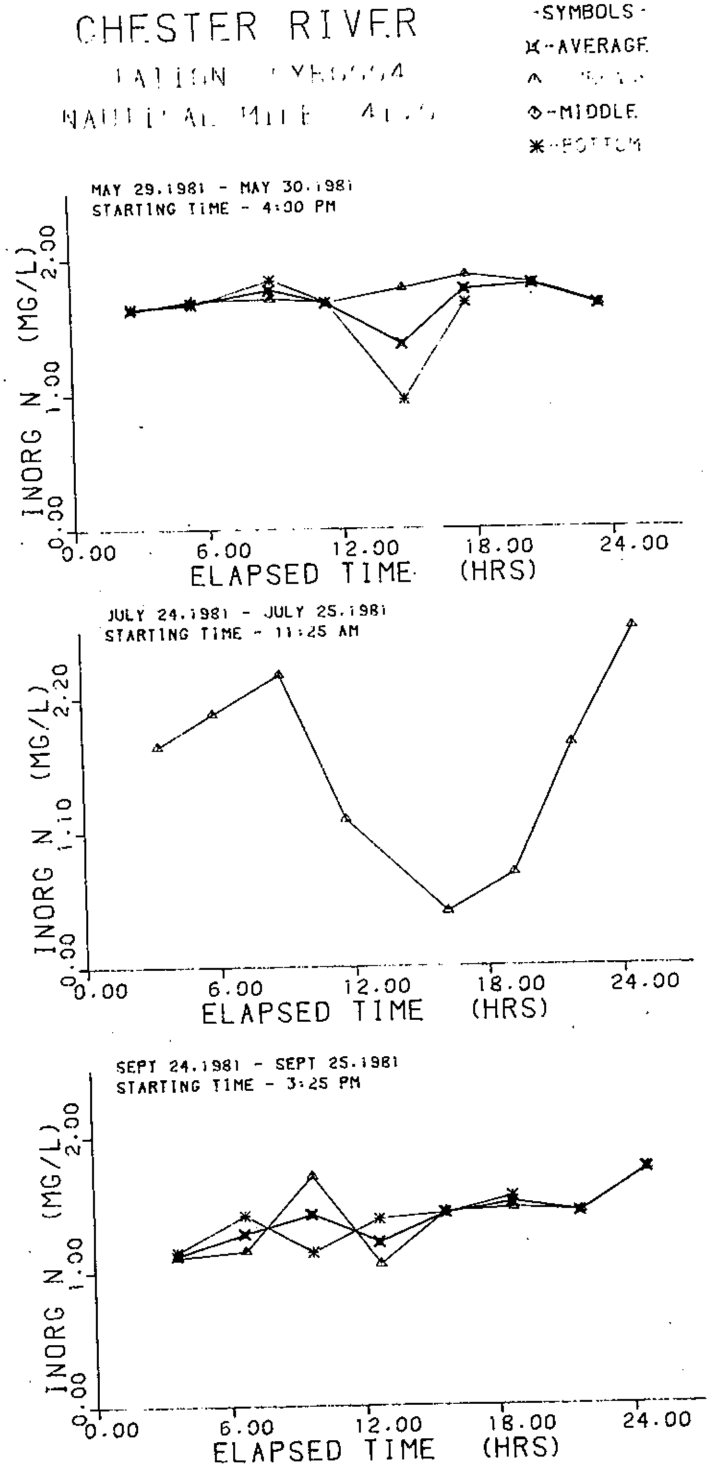


Figure 9-10 24-Hour survey plots of Dissolved inorganic Nitrogen (mg/l).

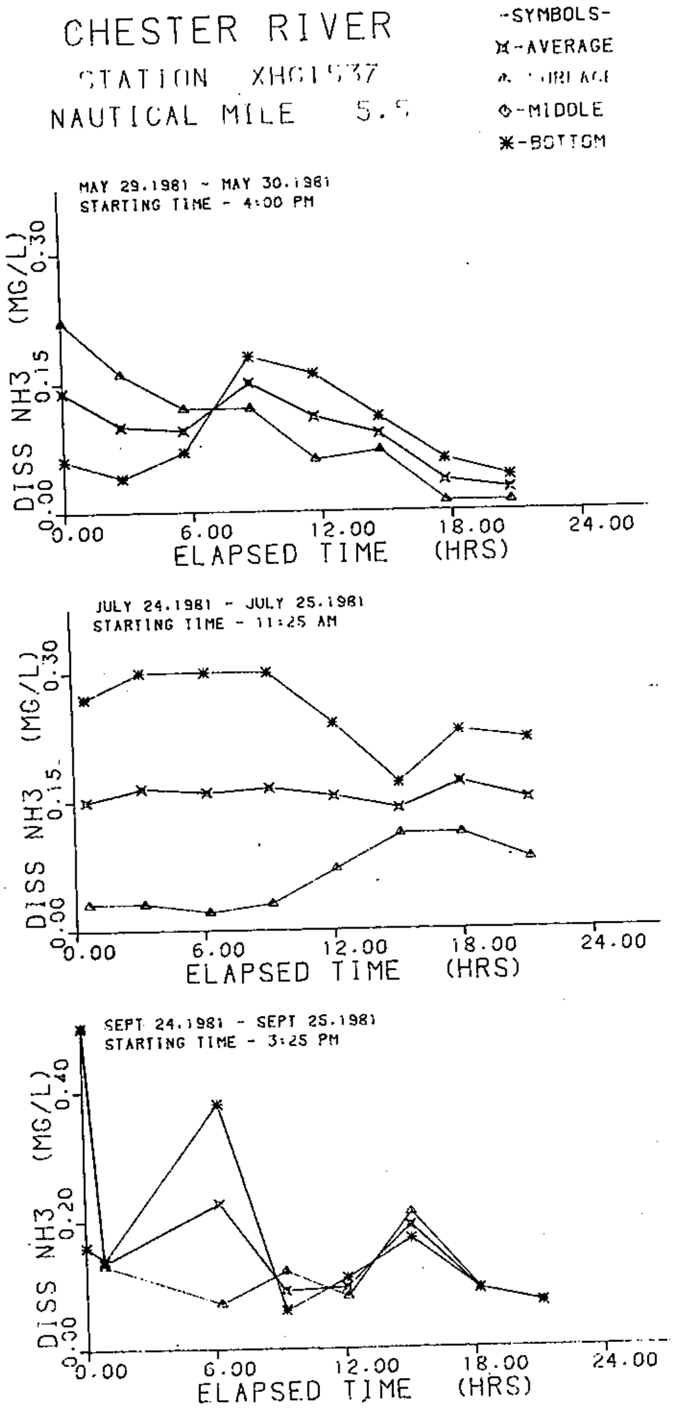


Figure 9-11 24 - Hour survey plots of Dissolved Ammonia, (mg/l).

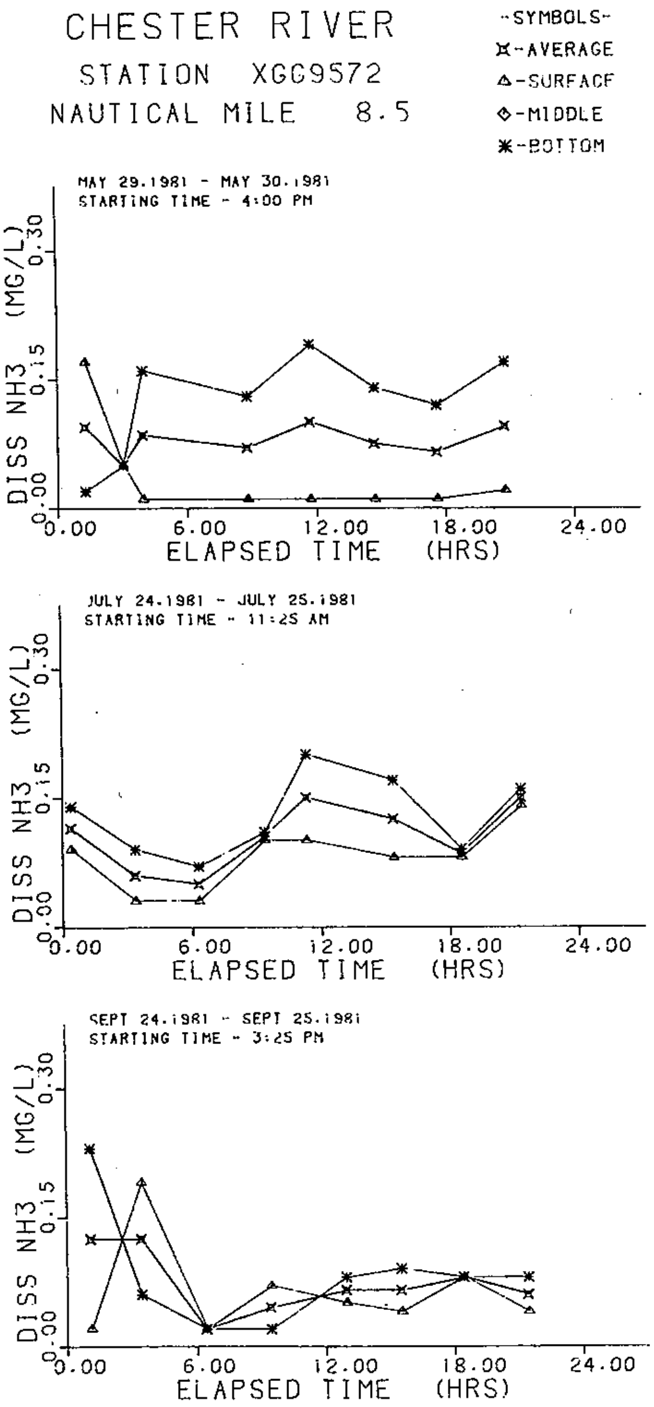


Figure 9-11 24 - Hour survey plots of Dissolved Ammonia, (mg/l).

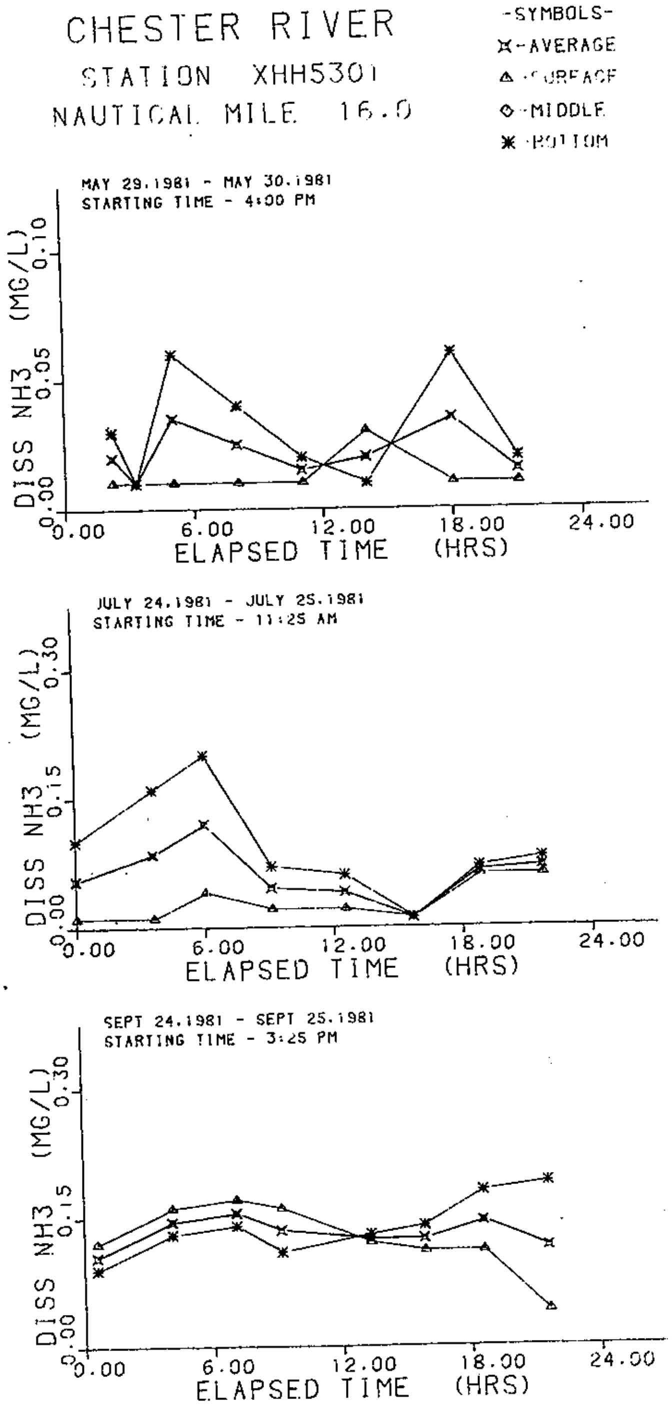
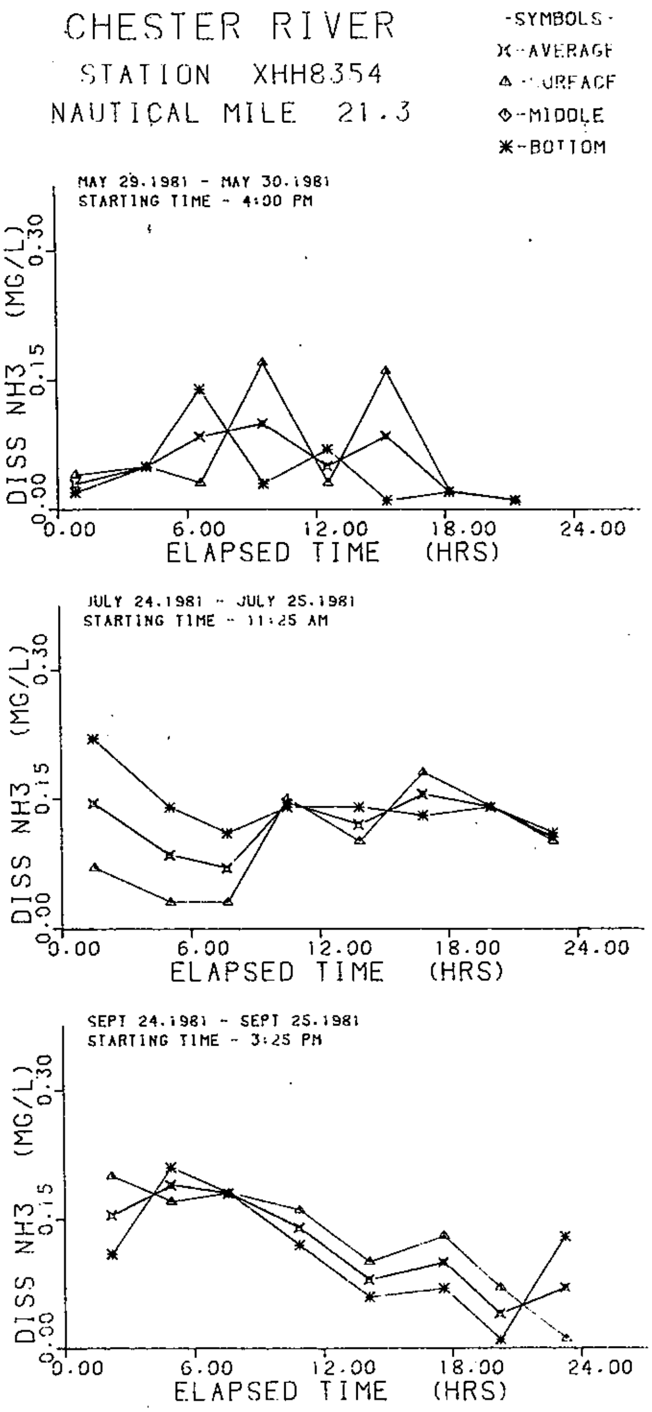


Figure 9-11 24 - Hour survey plots of Dissolved Ammonia, (mg/l).



CHESTER RIVER
STATION XHH8354
NAUTICAL MILE 21.3

Figure 9-11 24 - Hour survey plots of Dissolved Ammonia, (mg/l).

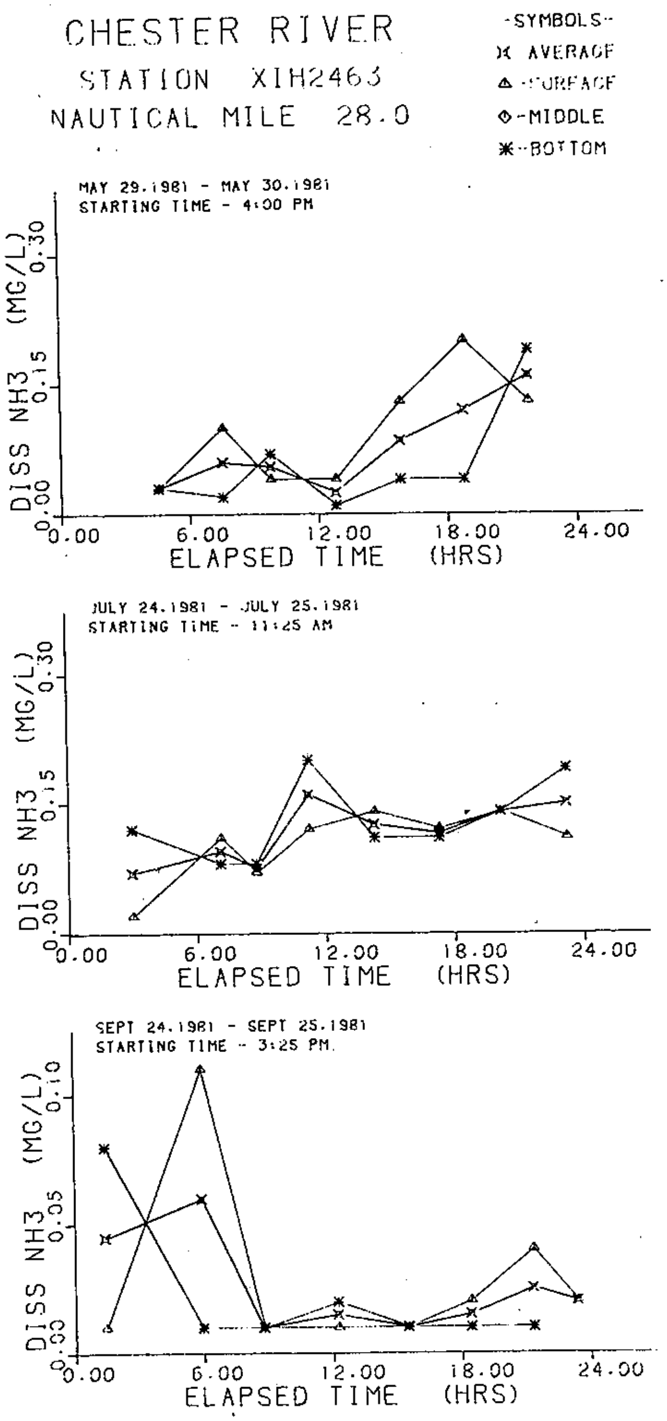


Figure 9-11 24 - Hour survey plots of Dissolved Ammonia, (mg/l).

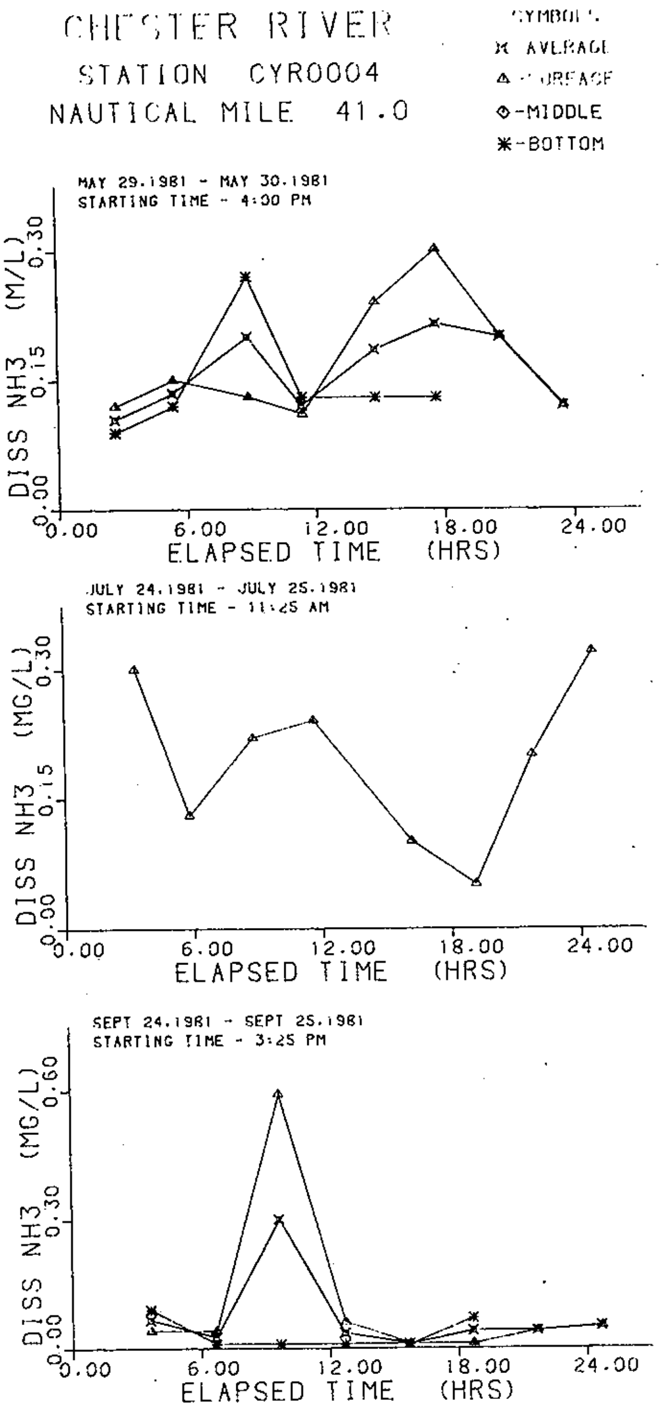


Figure 9-11 24 - Hour survey plots of Dissolved Ammonia, (mg/l).

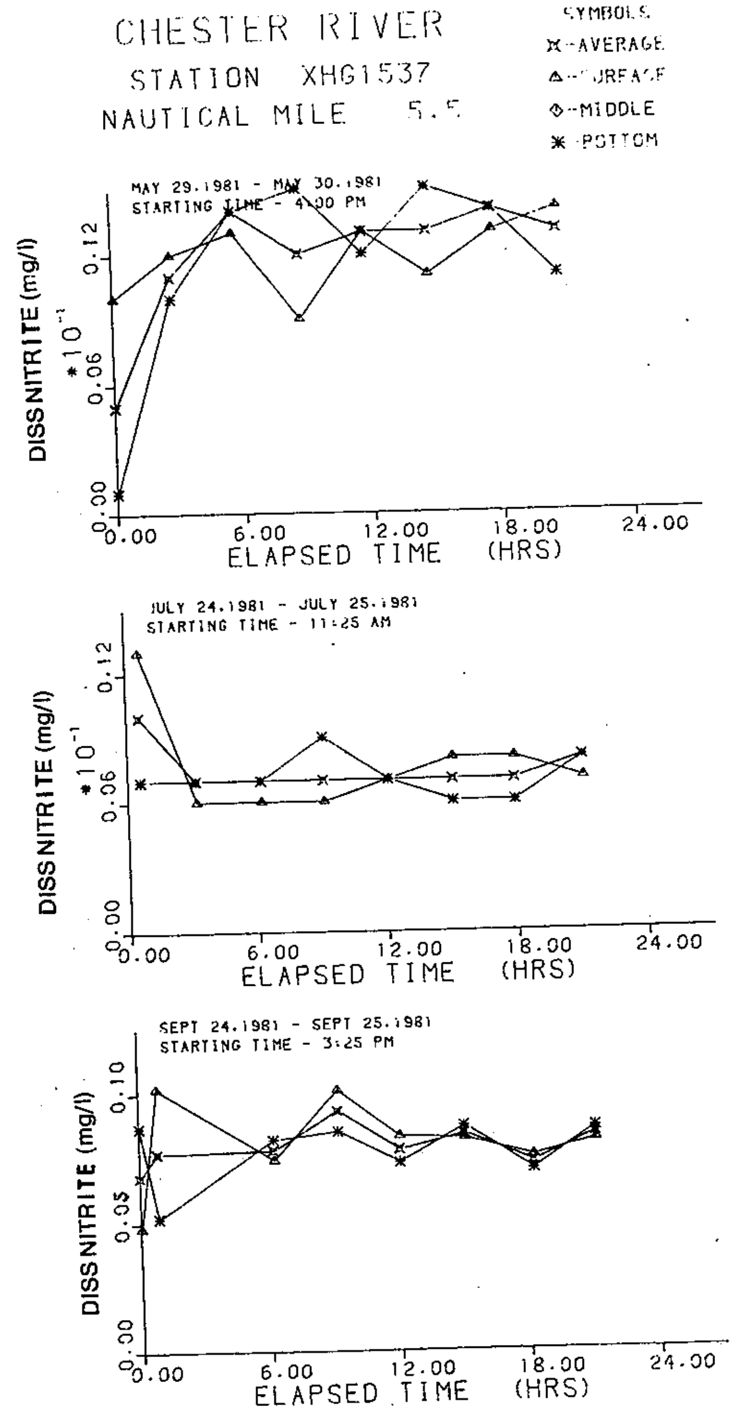


Figure 9-12 24-Hour survey plots of Dissolved Nitrite, (mg/l).

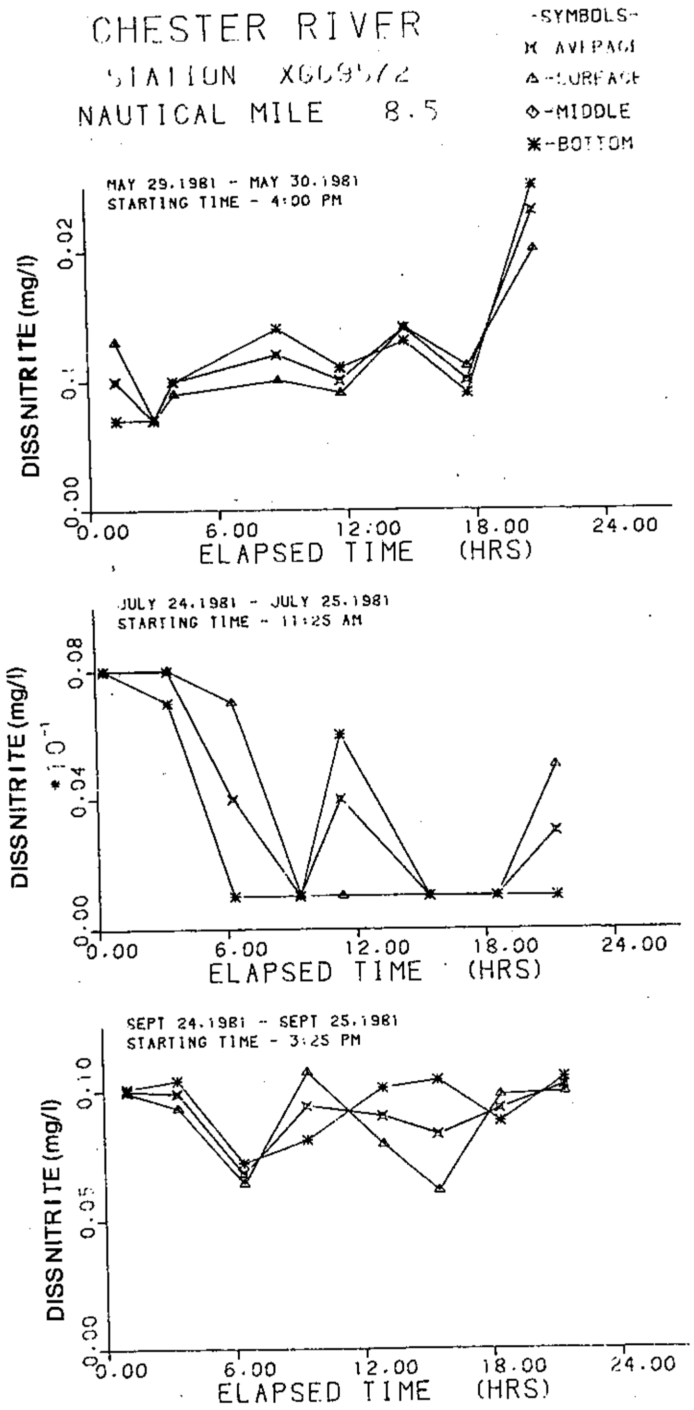


Figure 9-12 24-Hour survey plots of Dissolved Nitrite, (mg/l).

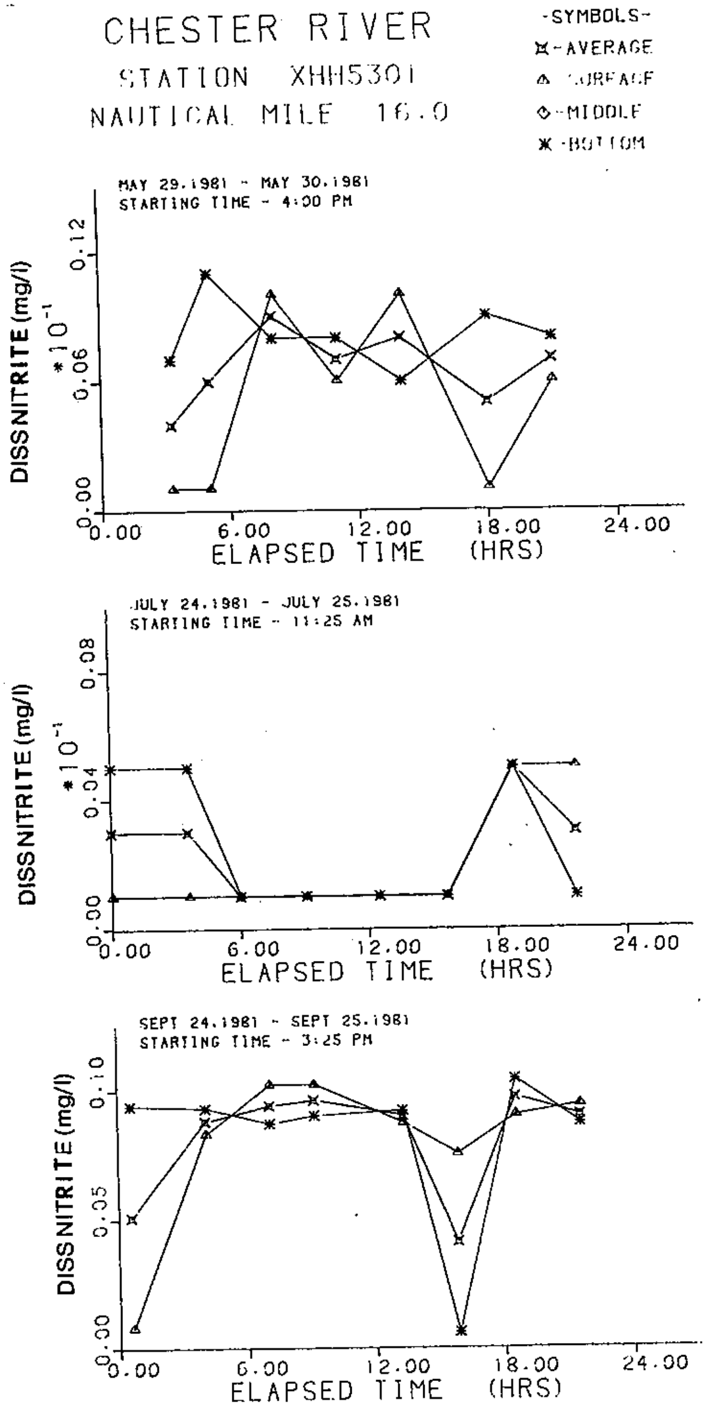


Figure 9-12 24-Hour survey plots of Dissolved Nitrite, (mg/l).

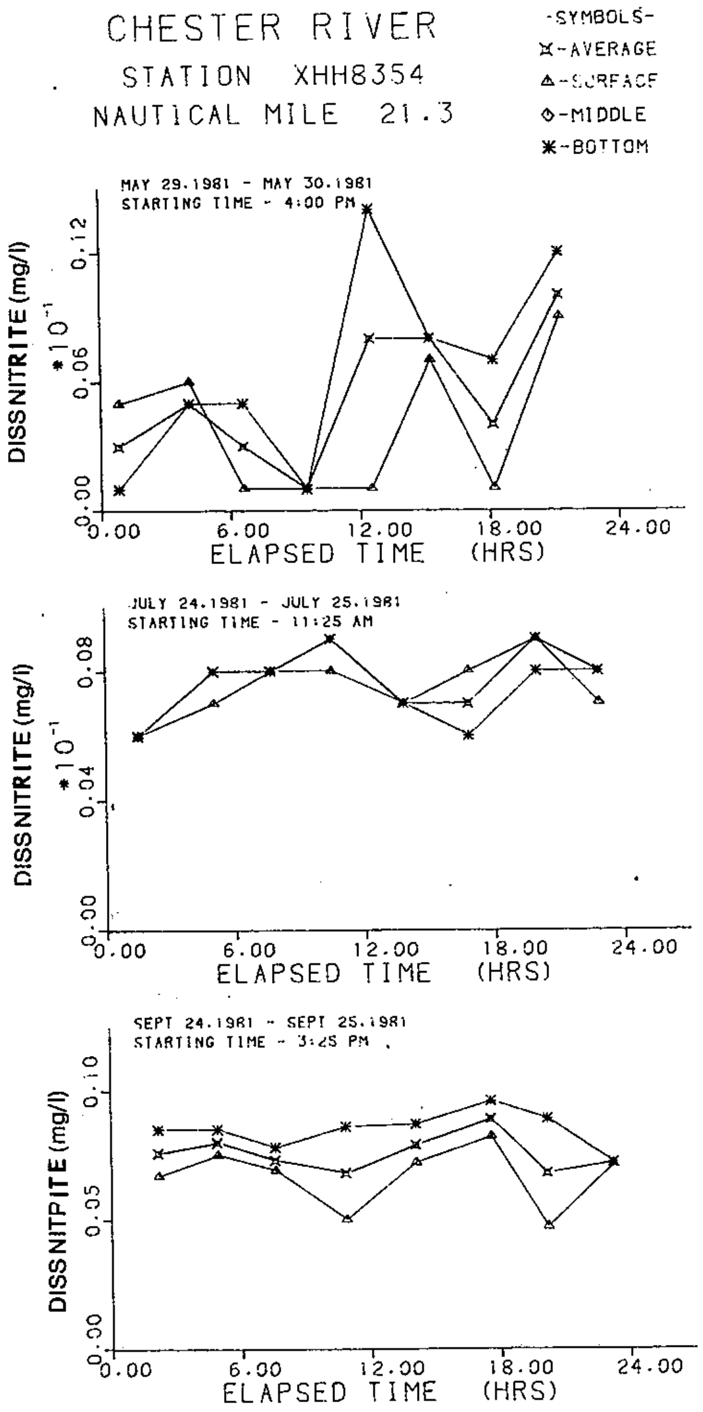


Figure 9-12 24-Hour survey plots of Dissolved Nitrite, (mg/l).

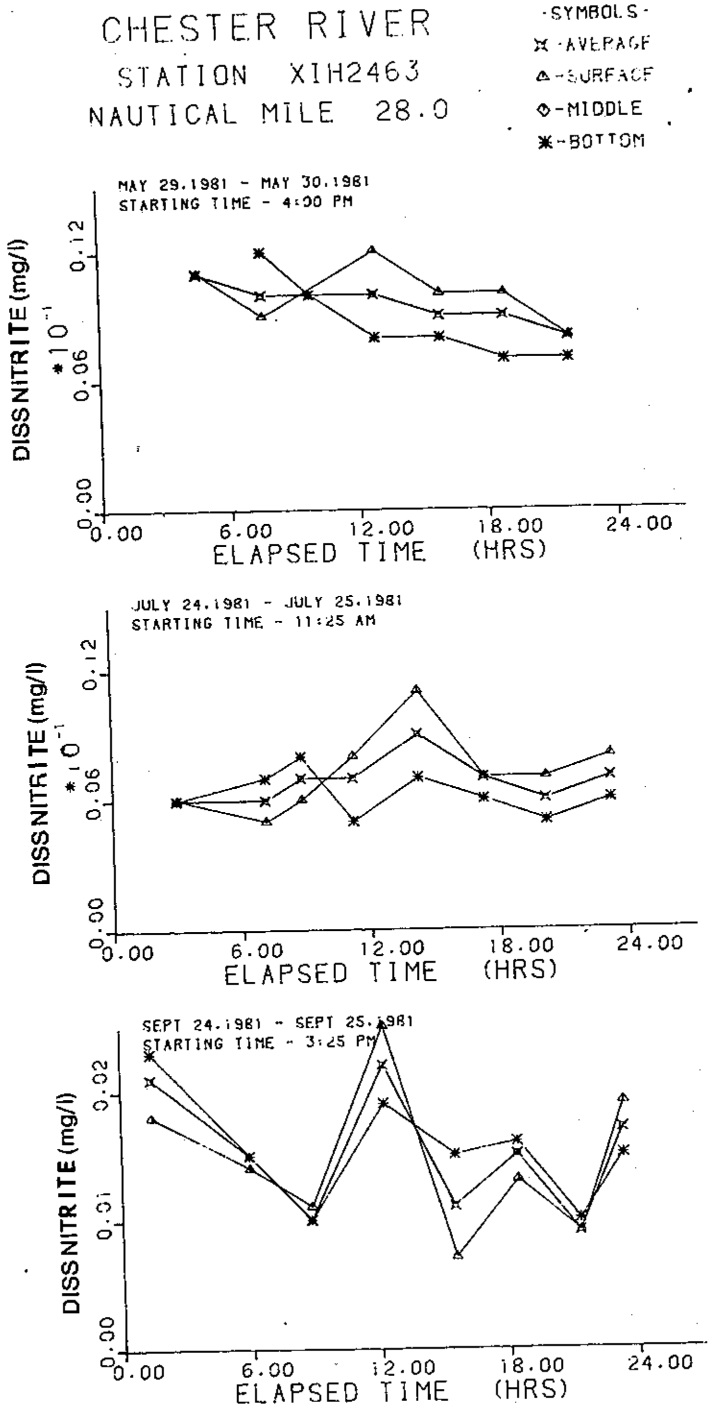


Figure 9-12 24-Hour survey plots of Dissolved Nitrite, (mg/l).

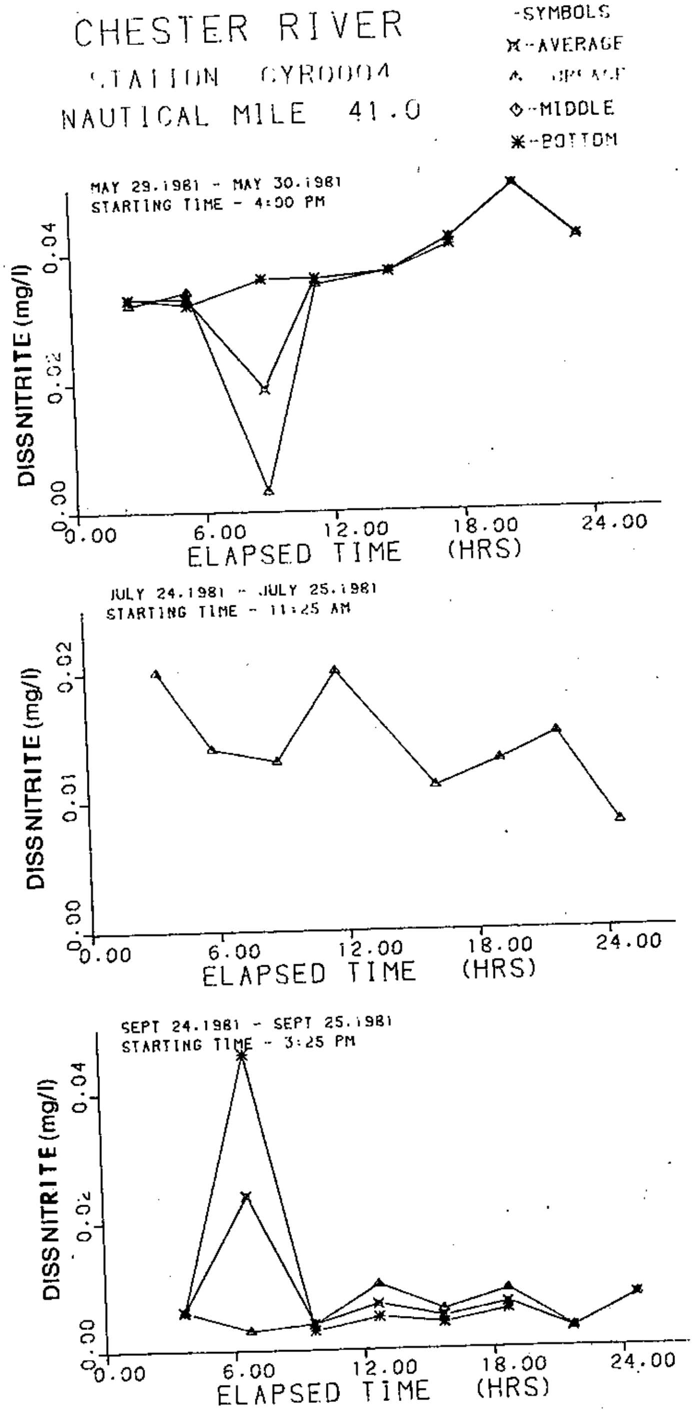


Figure 9-12 24-Hour survey plots of Dissolved Nitrite, (mg/1).

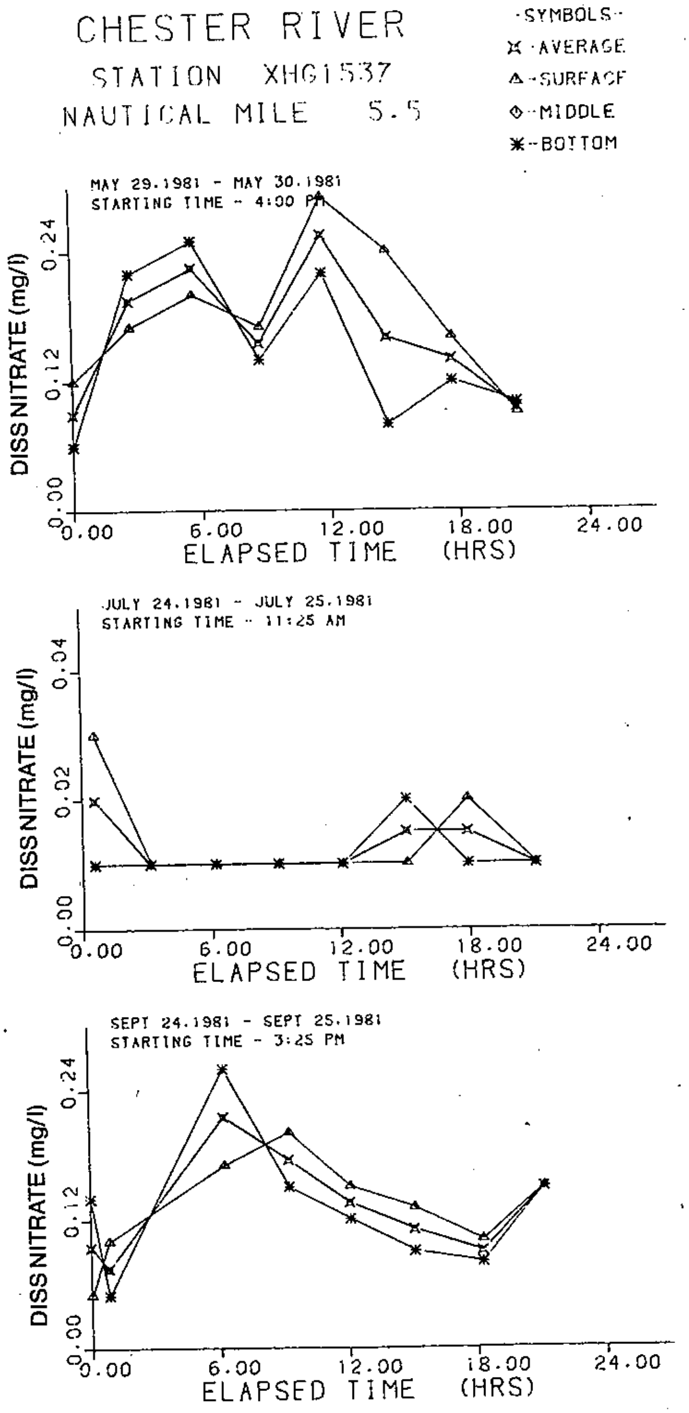


Figure 9-13 24-Hour survey plots of Dissolved Nitrate, (mg/l).

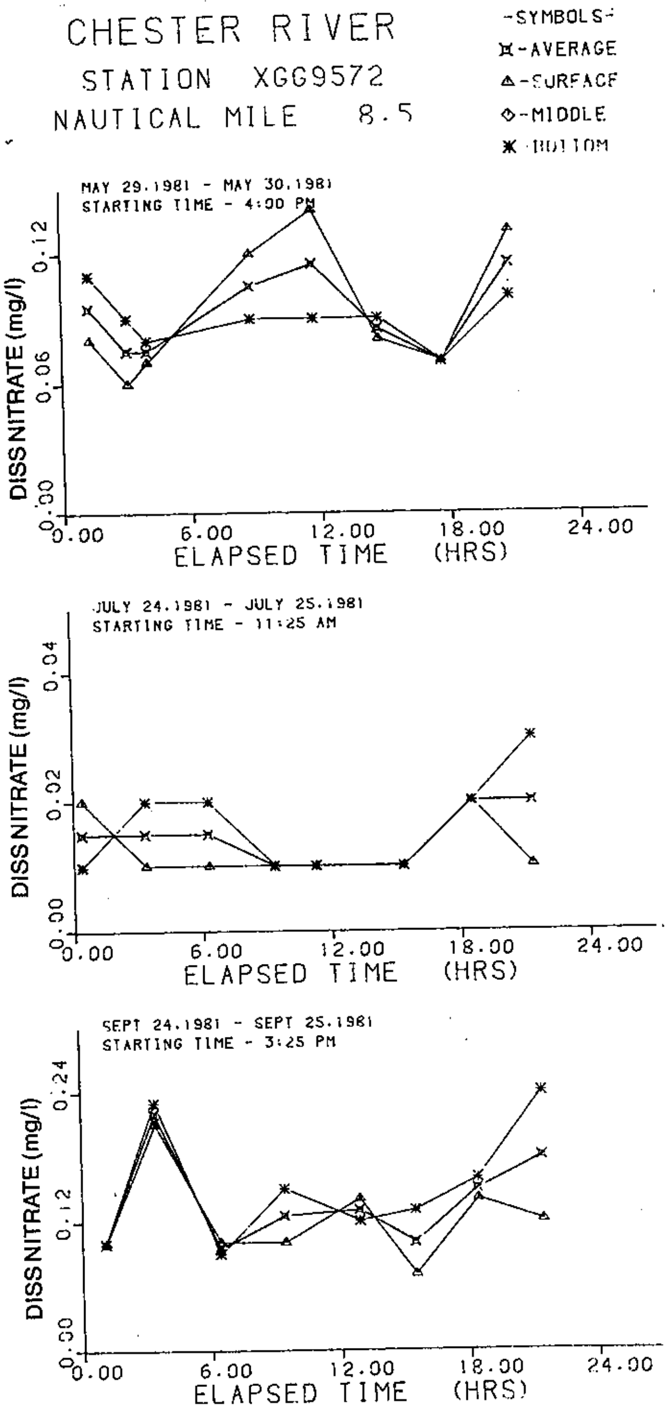


Figure 9-13 24-Hour survey plots of Dissolved Nitrate, (mg/l).

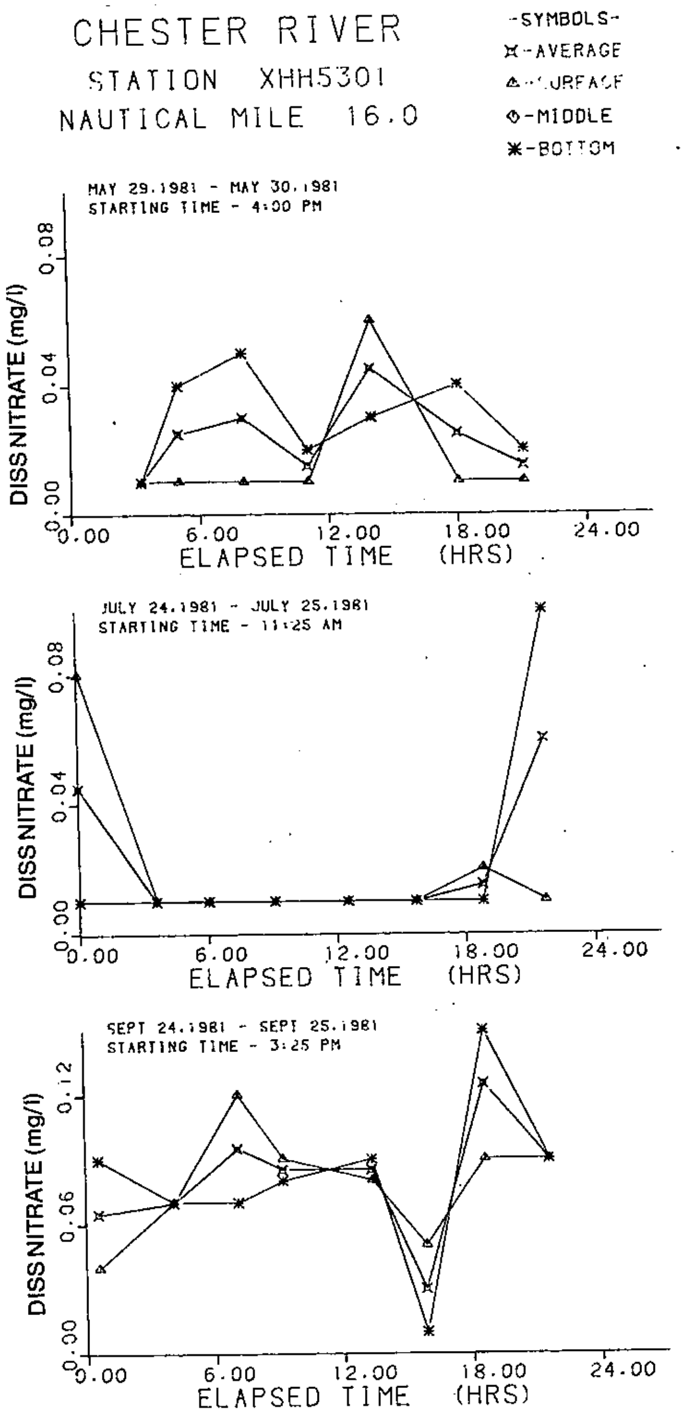


Figure 9-13 24-Hour survey plots of Dissolved Nitrate, (mg/l).

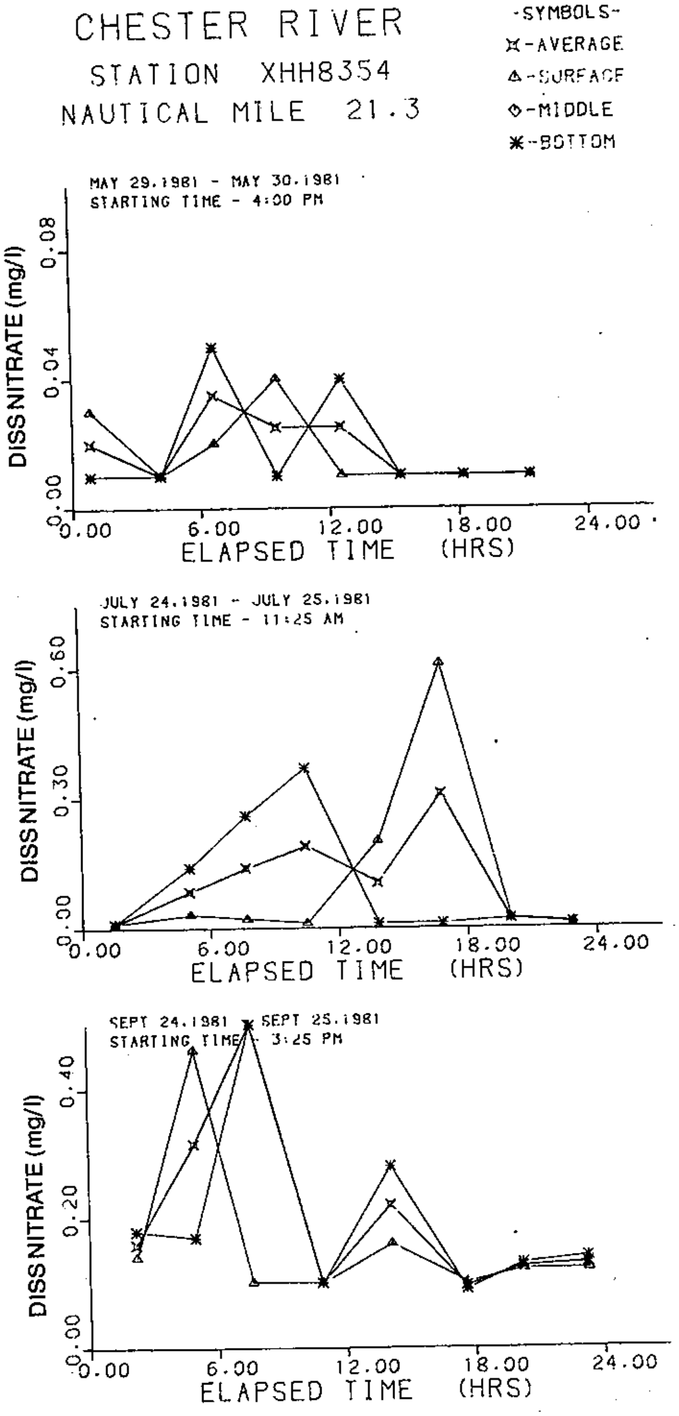


Figure 9-13 24-Hour survey plots of Dissolved Nitrate, (mg/l).

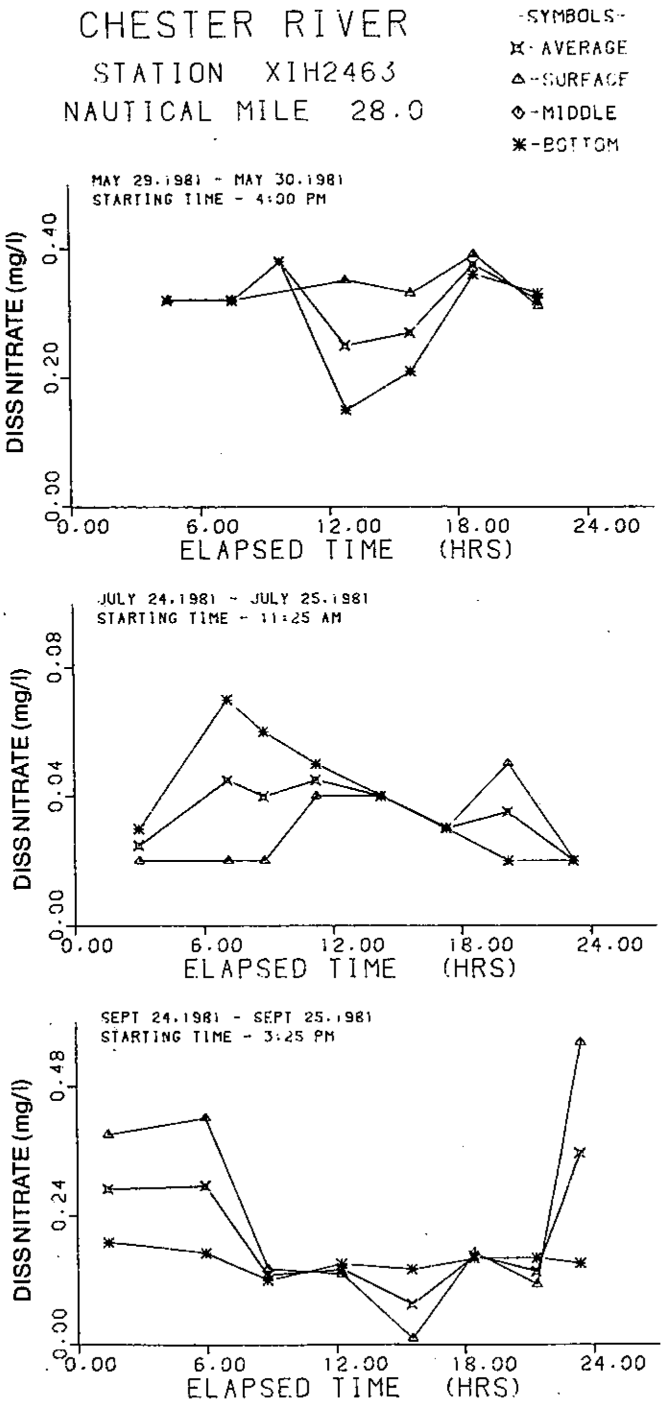


Figure 9-13 24-Hour survey plots of Dissolved Nitrate, (mg/l).

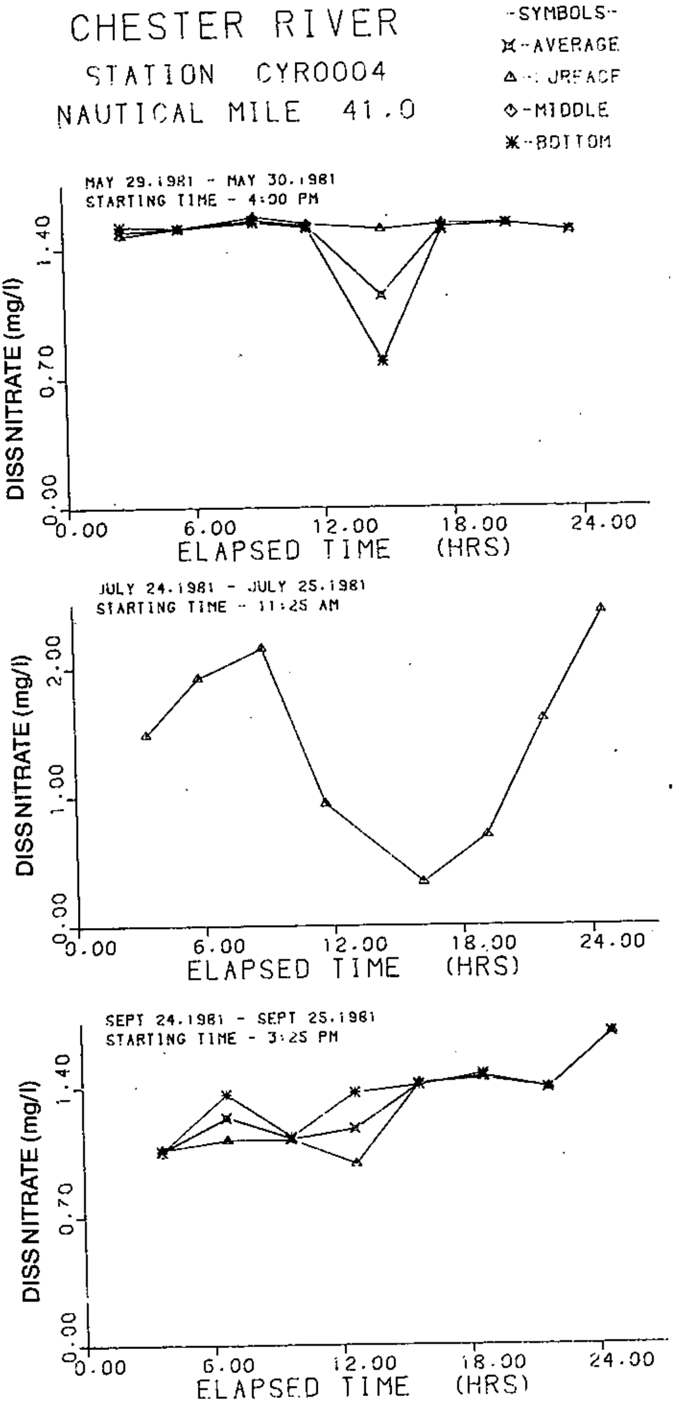


Figure 9-13 24-Hour survey plots of Dissolved Nitrate, (mg/l).

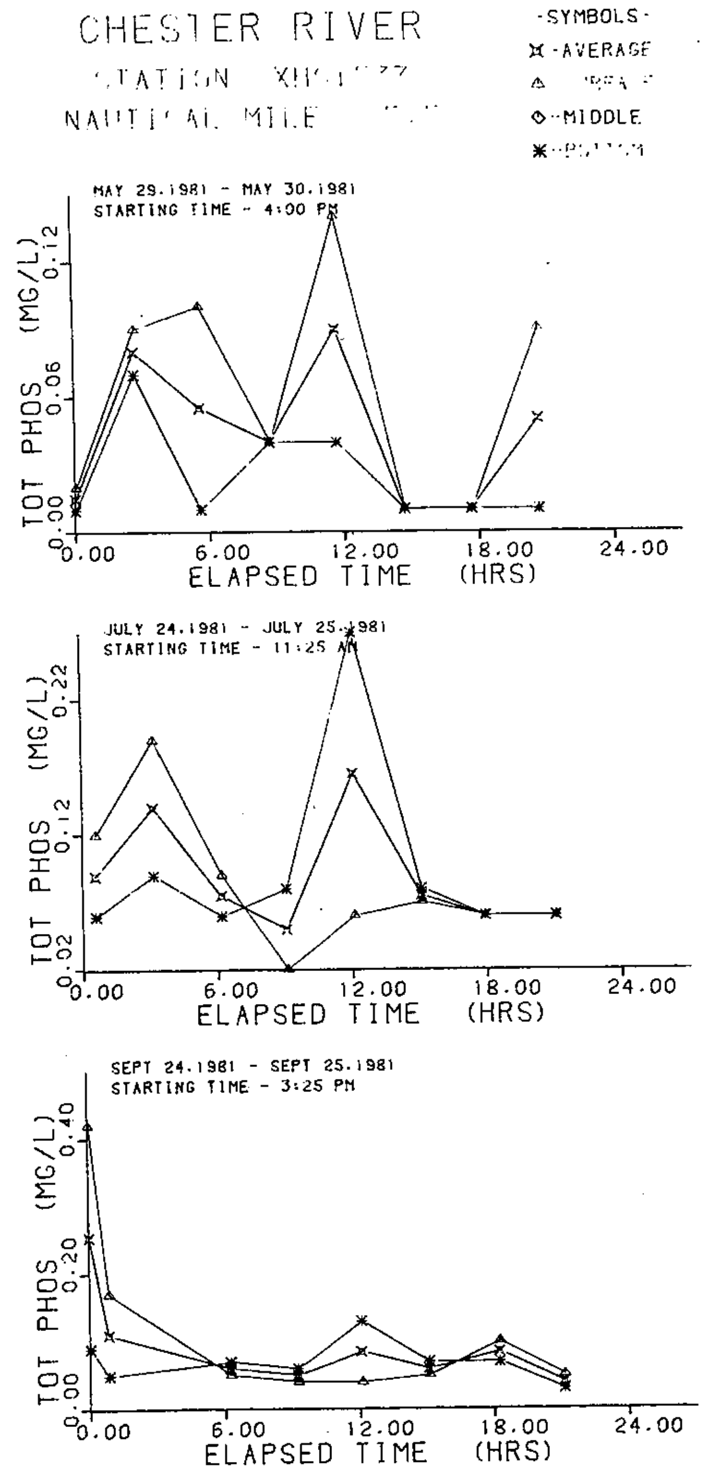


Figure 9-14 24-Hour survey plots of Total Phosphorus, (mg/l).

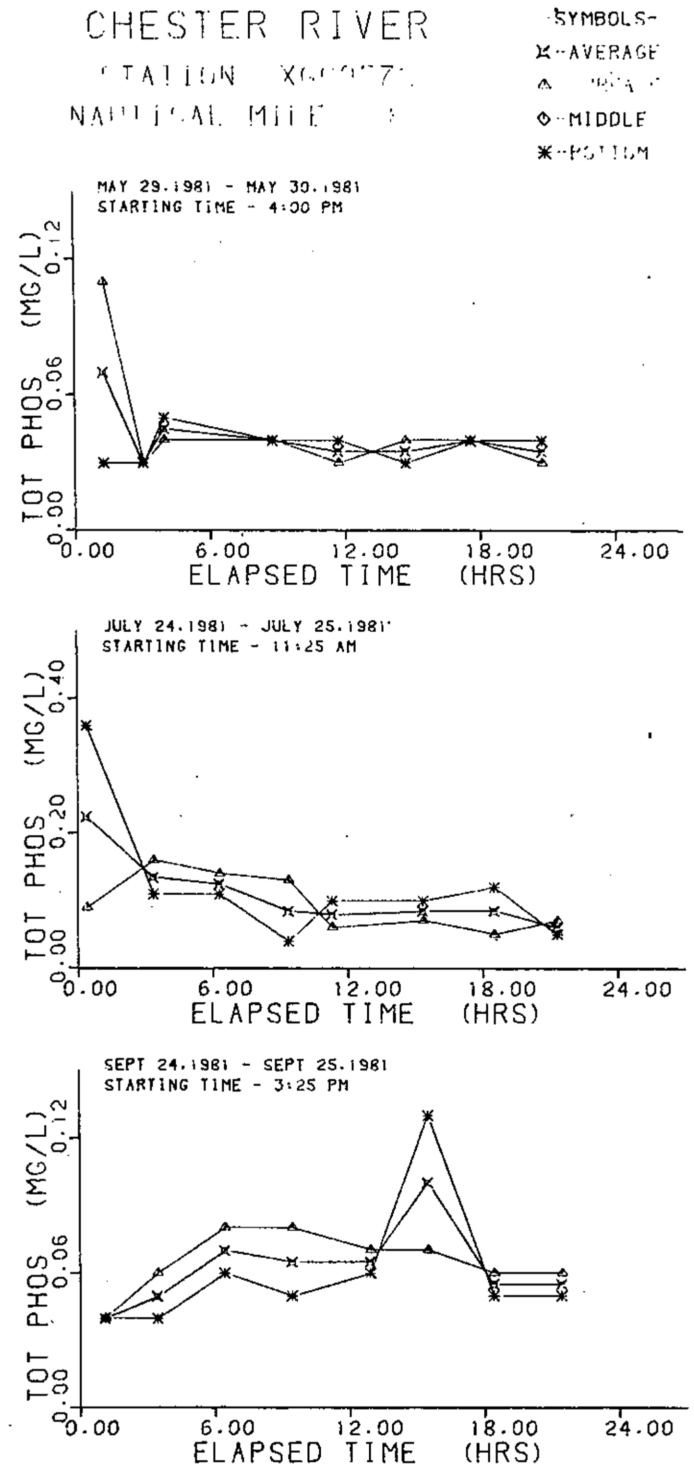


Figure 9-14 24-Hour survey plots of Total Phosphorus, (mg/l).

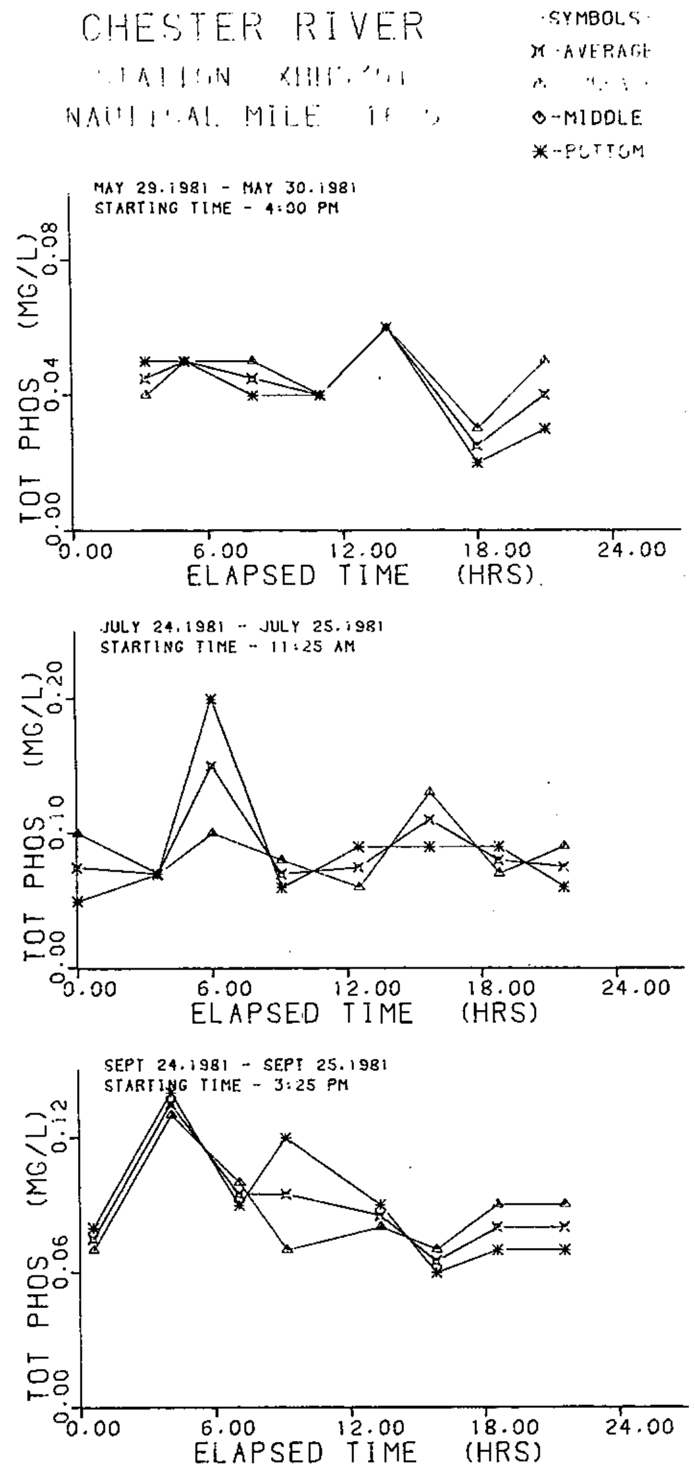


Figure 9-14 24-Hour survey plots of Total Phosphorus, (mg/l).

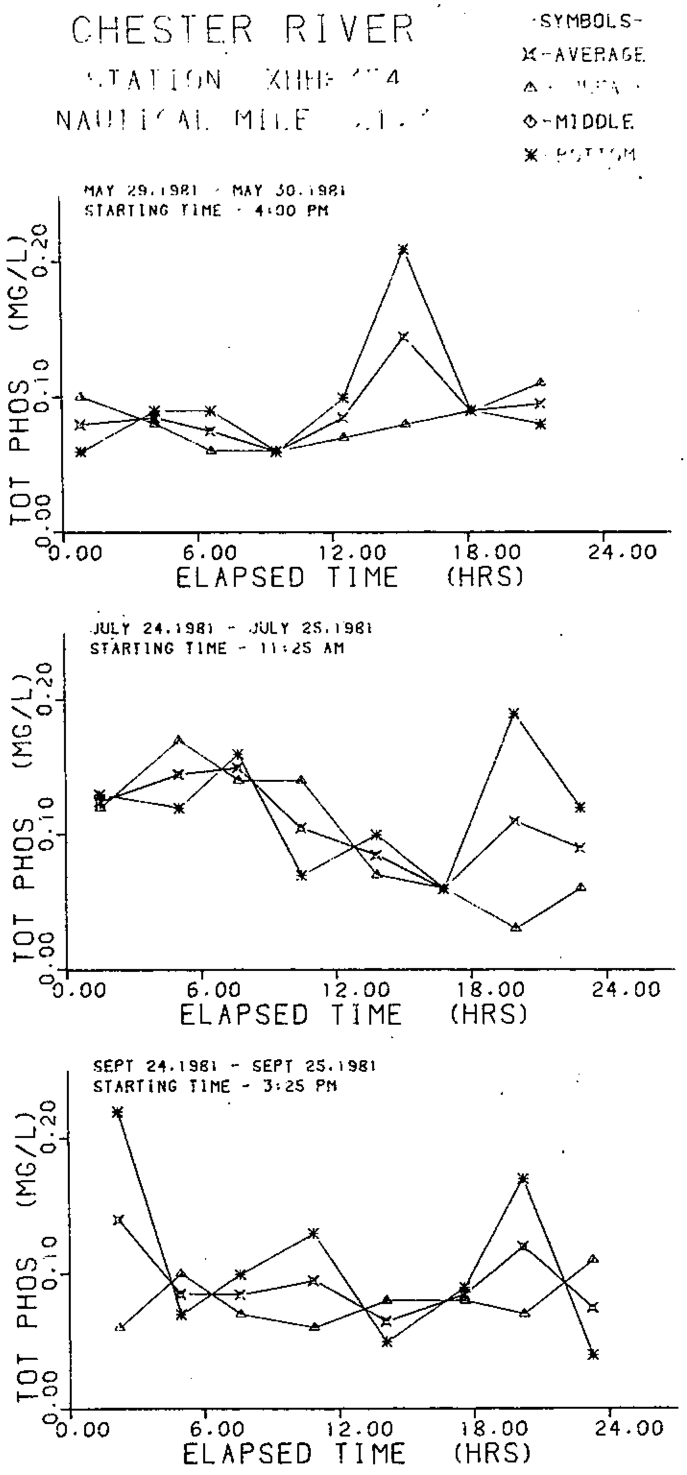


Figure 9-14 24-Hour survey plots of Total Phosphorus, (mg/l).

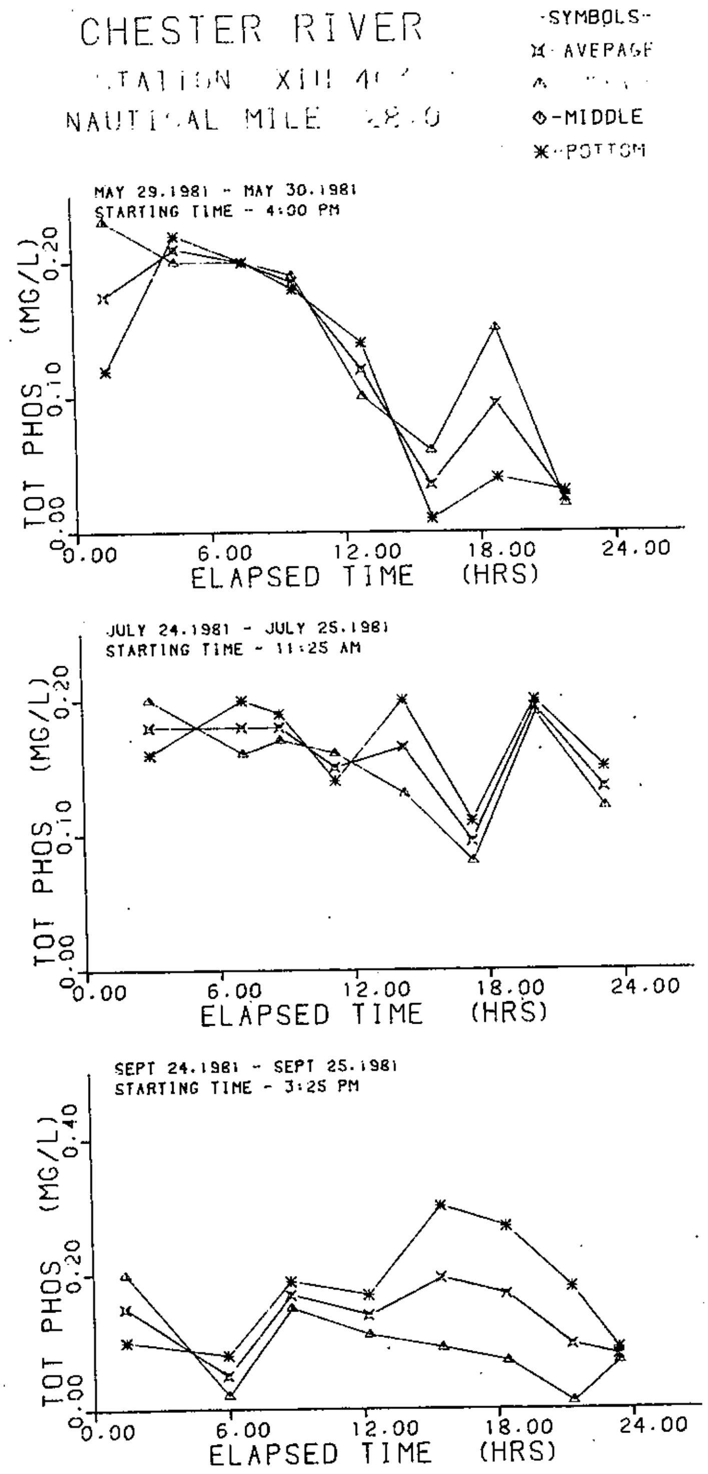


Figure 9-14 24-Hour survey plots of Total Phosphorus, (mg/l).

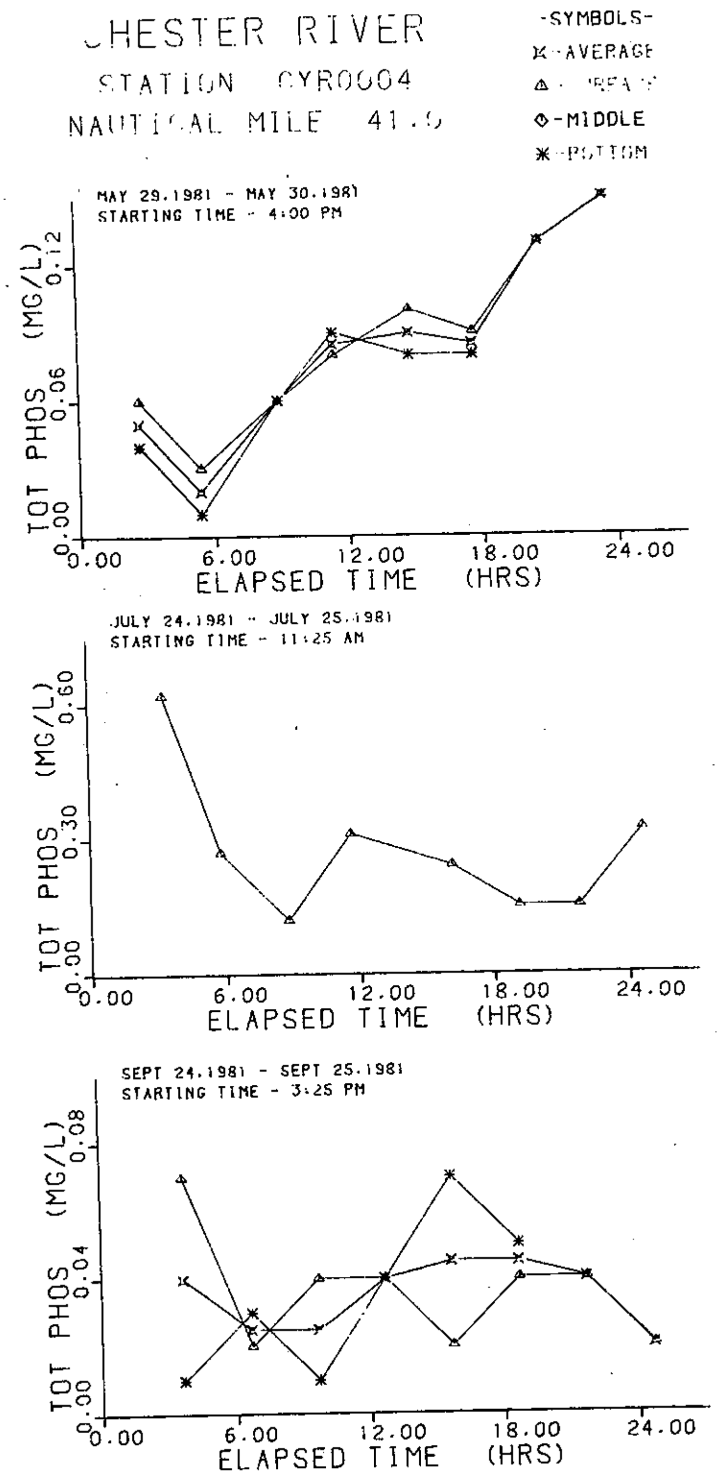


Figure 9-14 24-Hour survey plots of Total Phosphorus, (mg/l).

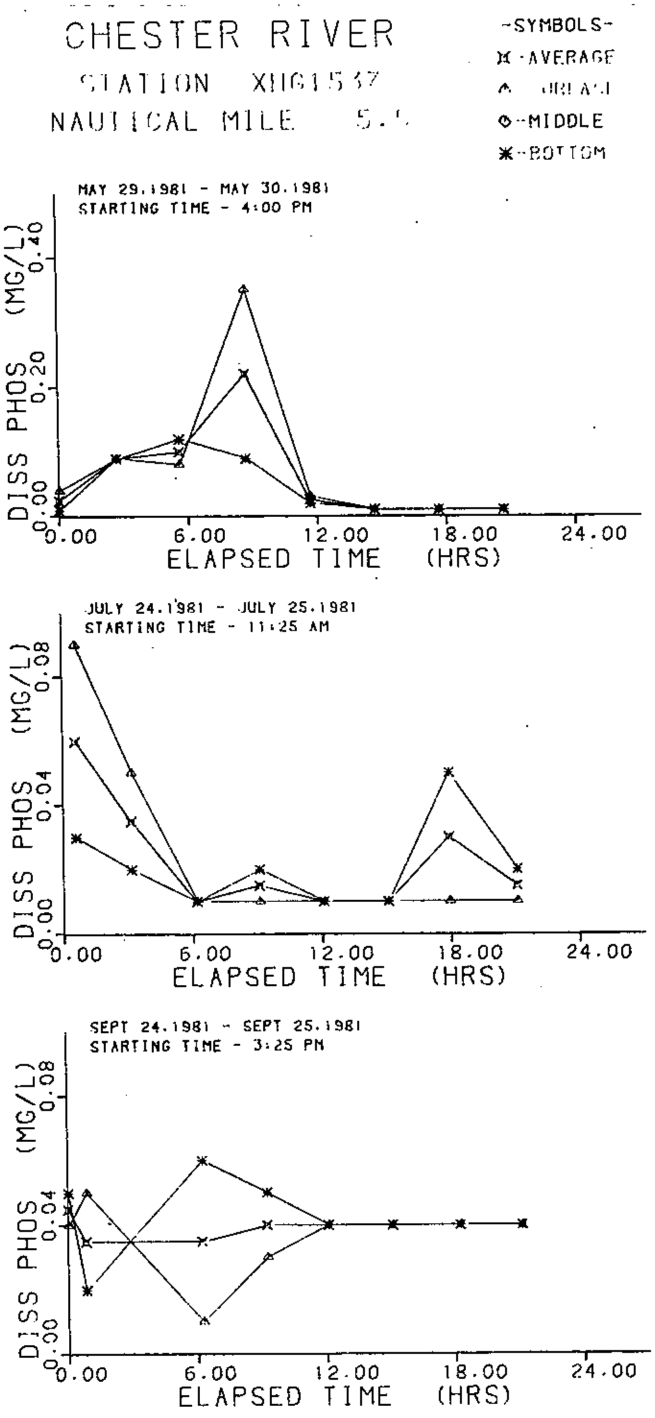


Figure 9-15 24 - Hour survey plots of Dissolved Phosphorus.

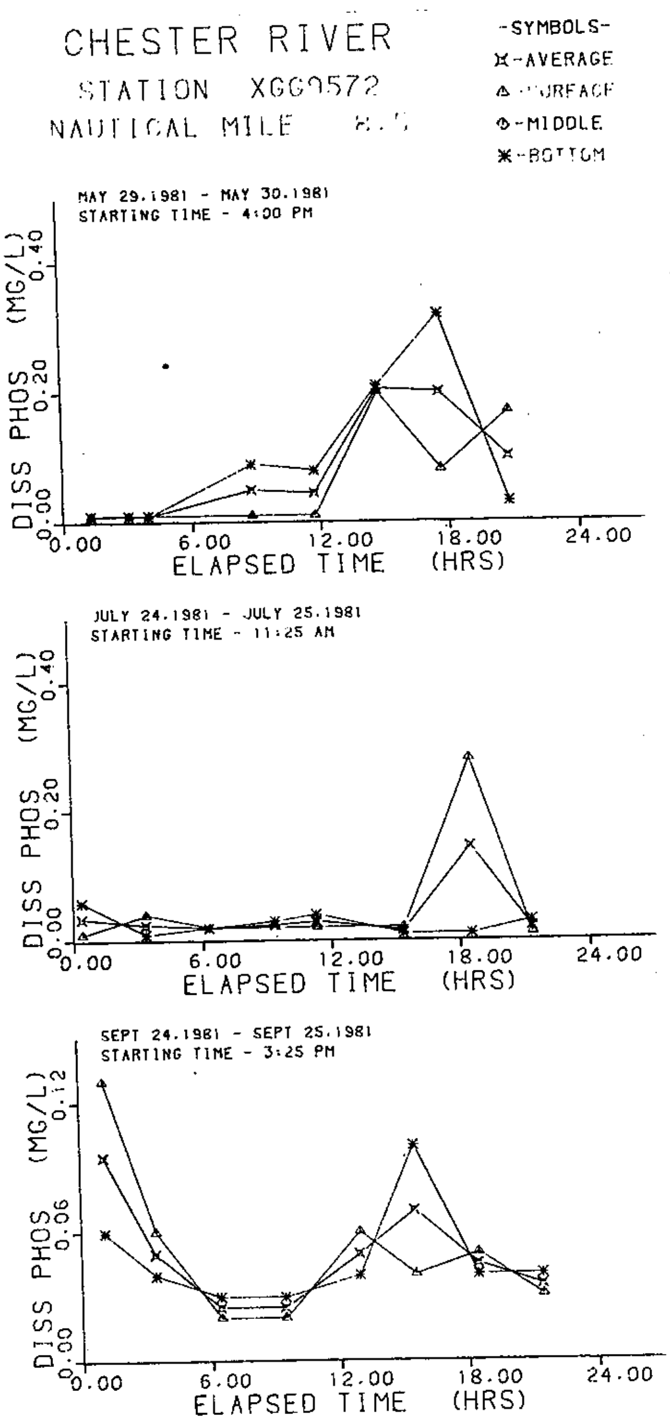


Figure 9-15 24 - Hour survey plots of Dissolved Phosphorus.

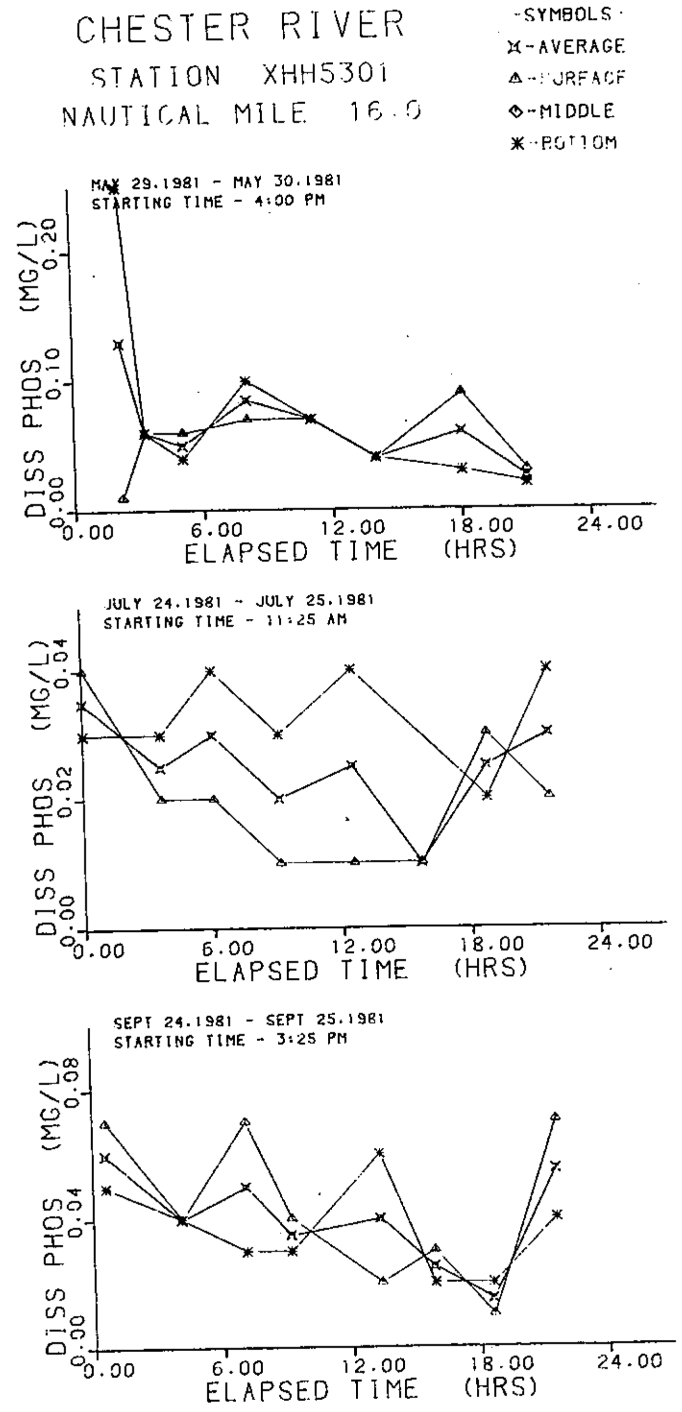


Figure 9-15 24 - Hour survey plots of Dissolved Phosphorus.

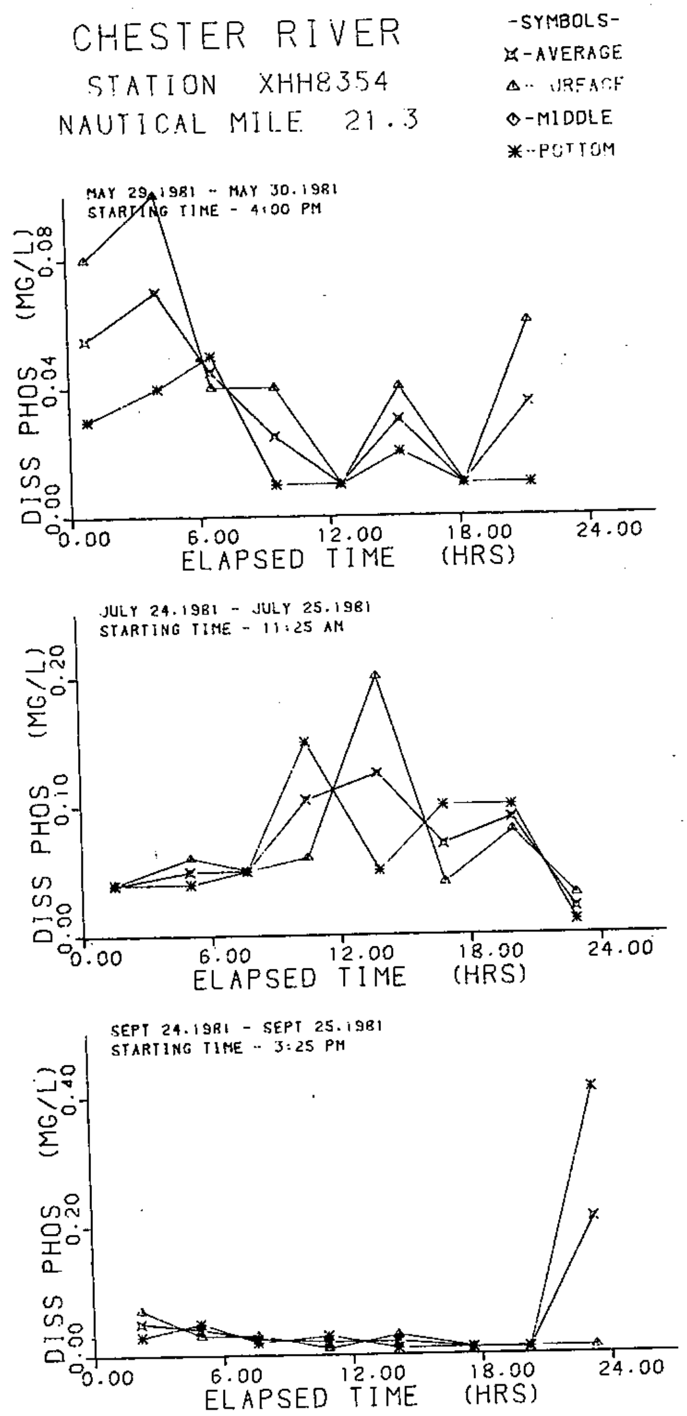


Figure 9-15 24 - Hour survey plots of Dissolved Phosphorus.

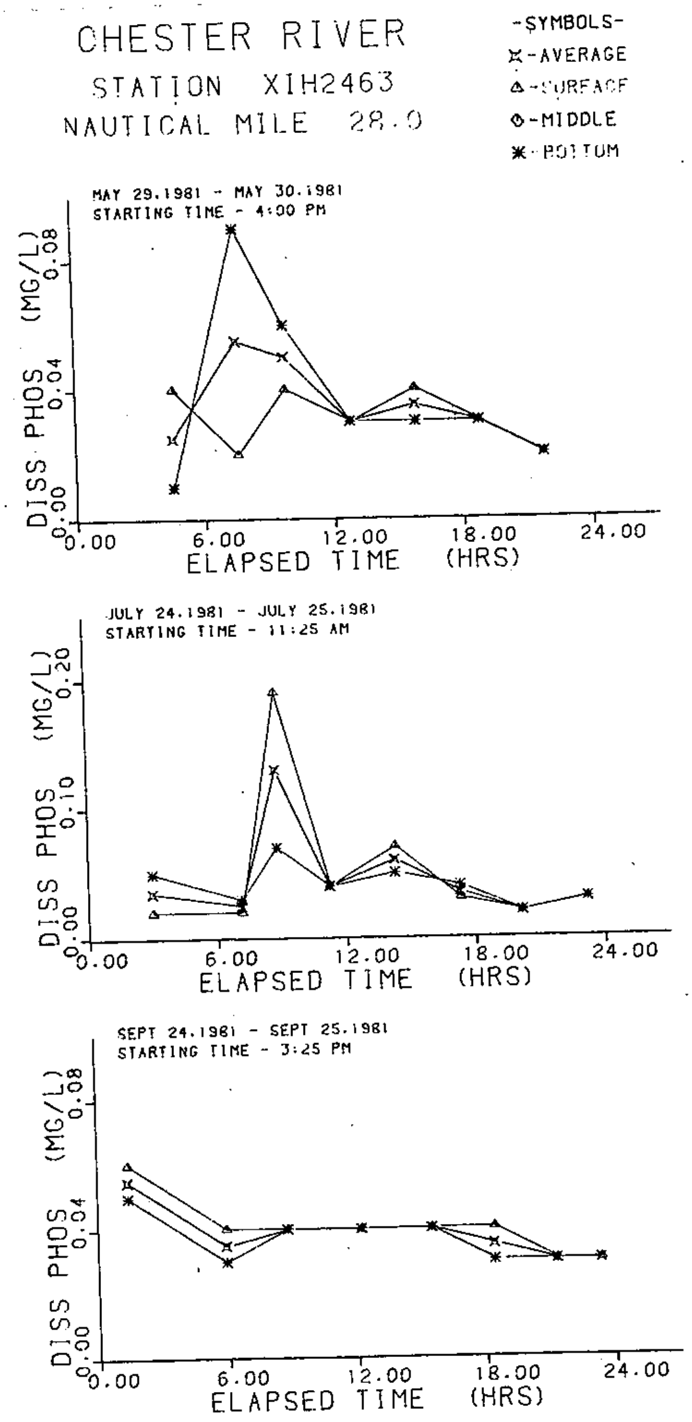


Figure 9-15 24 - Hour survey plots of Dissolved Phosphorus.

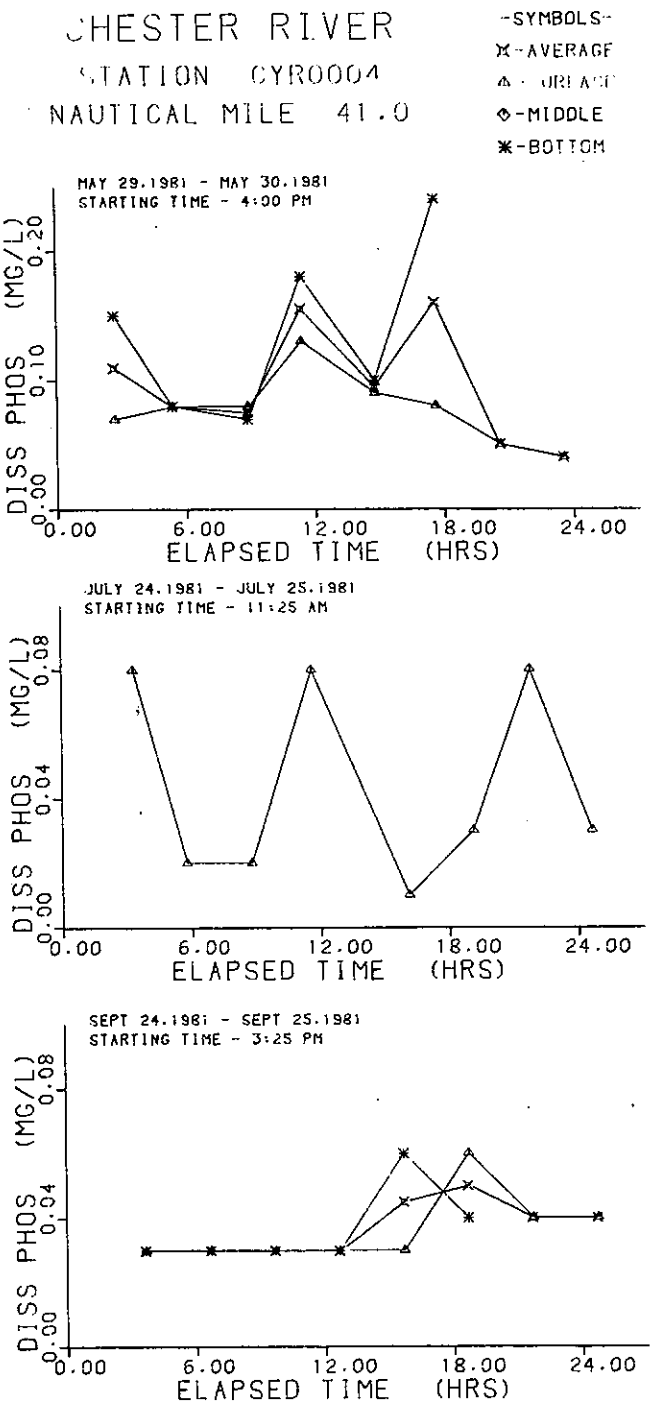


Figure 9-15 24 - Hour survey plots of Dissolved Phosphorus.

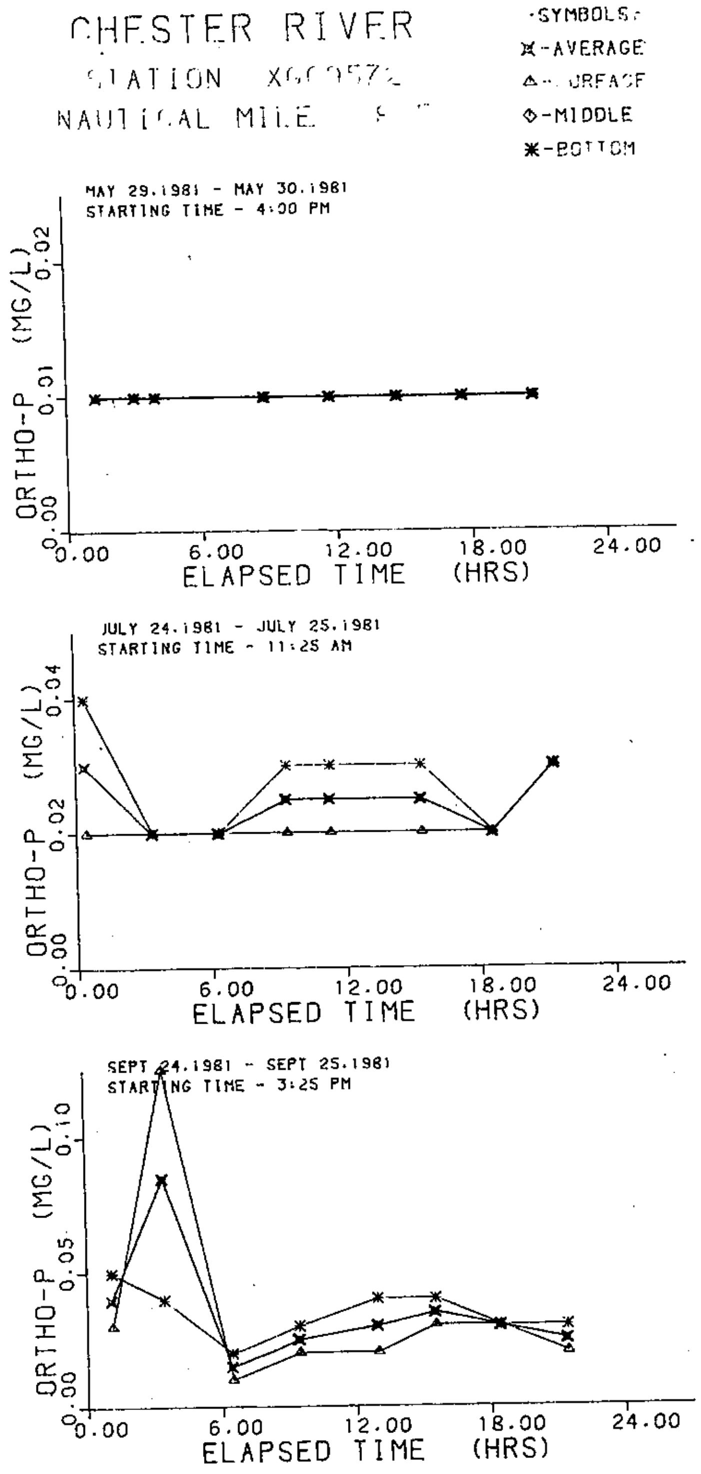


Figure 9-16 24-Hour survey plots of Dissolved Ortho-phosphorus, (mg/l).

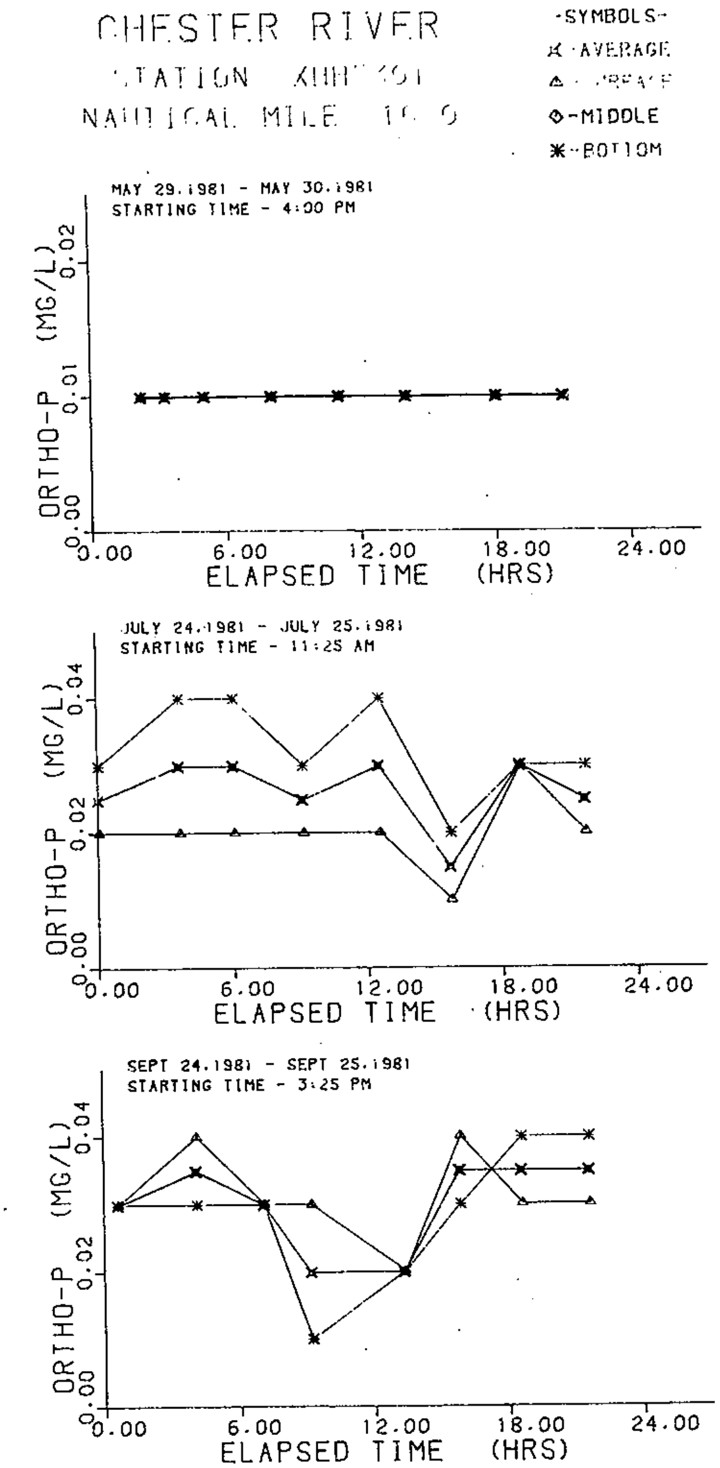


Figure 9-16 24-Hour survey plots of Dissolved Ortho-phosphorus, (mg/l).

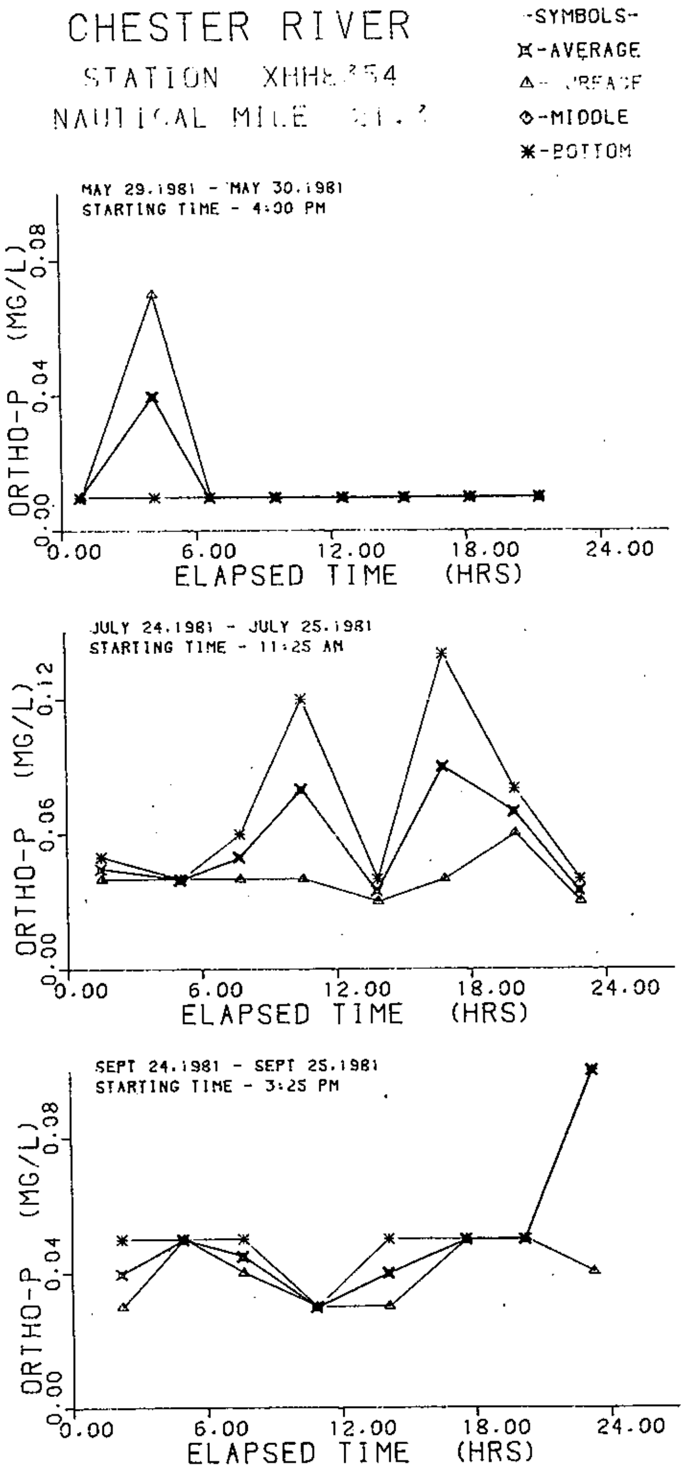


Figure 9-1624-Hour survey plots of Dissolved Ortho-phosphorus, (mg/l).

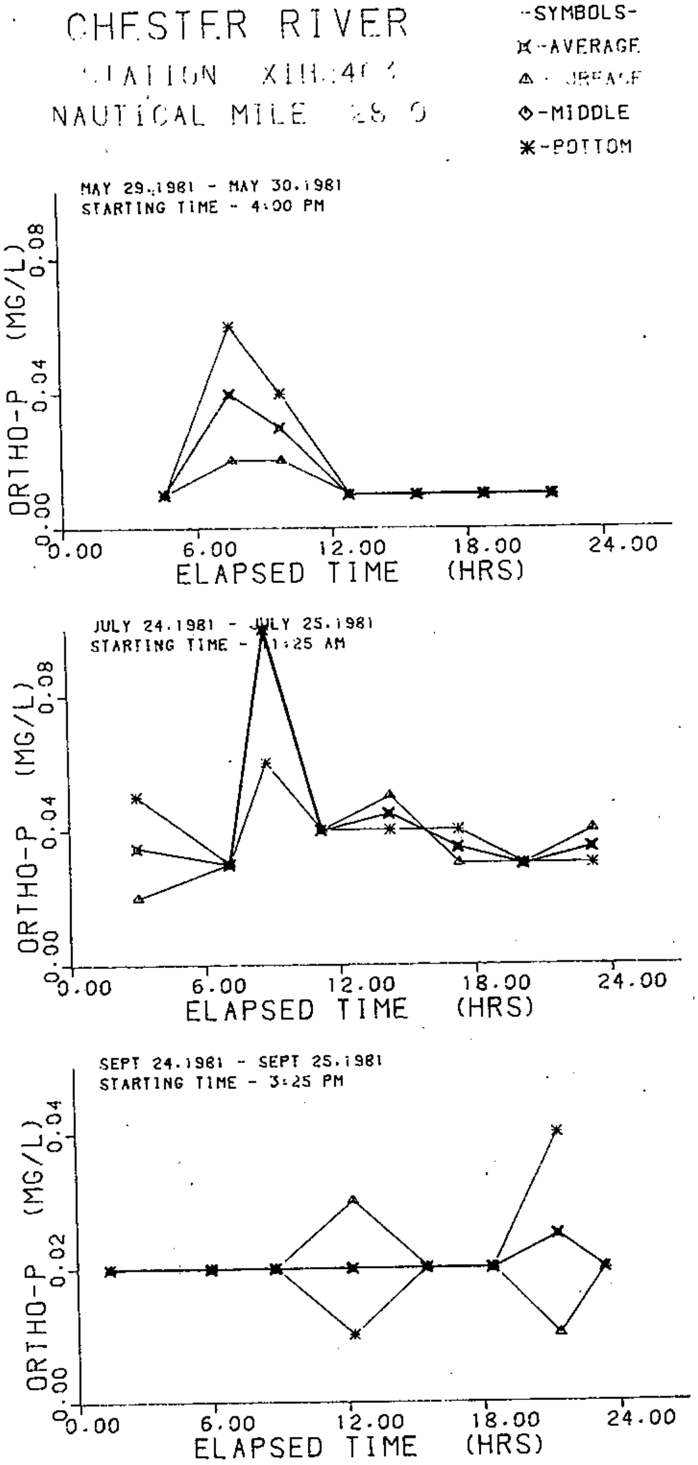


Figure 9-16 24-Hour survey plots of Dissolved Ortho-phosphorus, (mg/l).

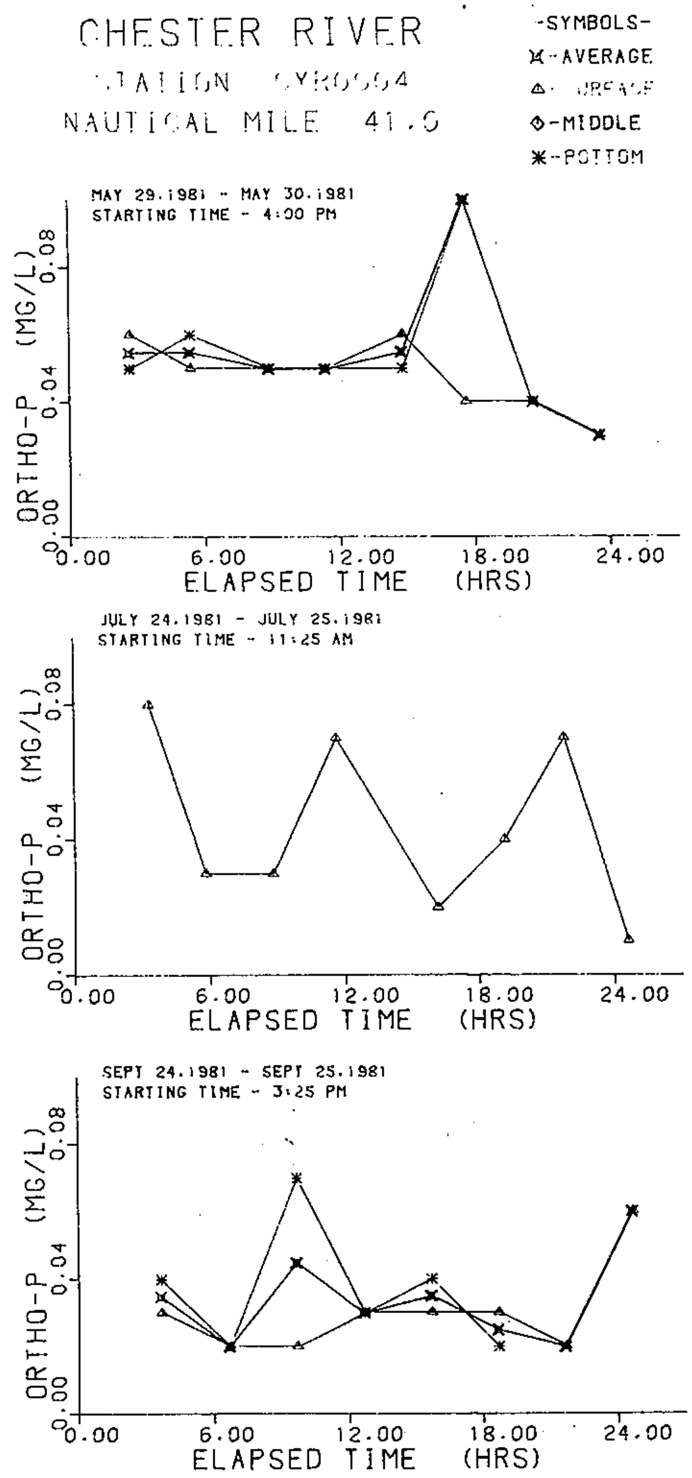


Figure 9-16 24-Hour survey plots of Dissolved Ortho-phosphorus, (mg/l).

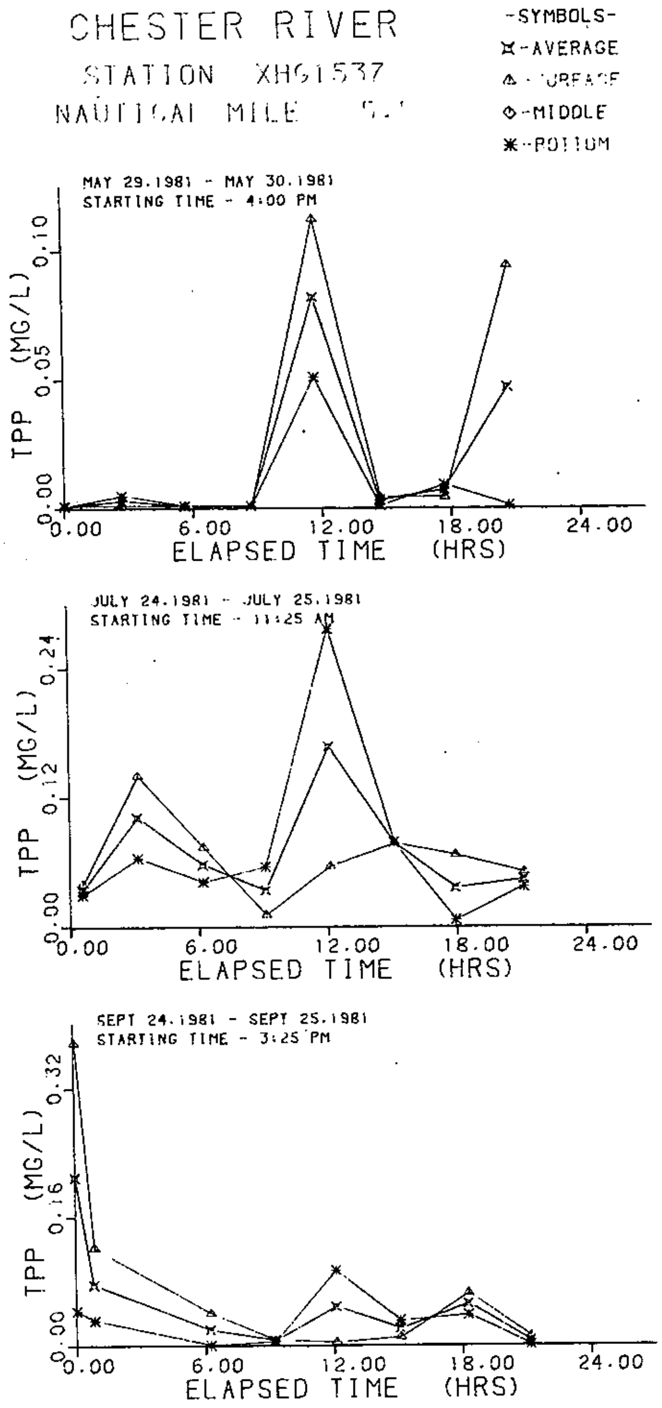


Figure 9-17 24 - Hour survey plots of Total Particulate Phosphorus (mg/l).

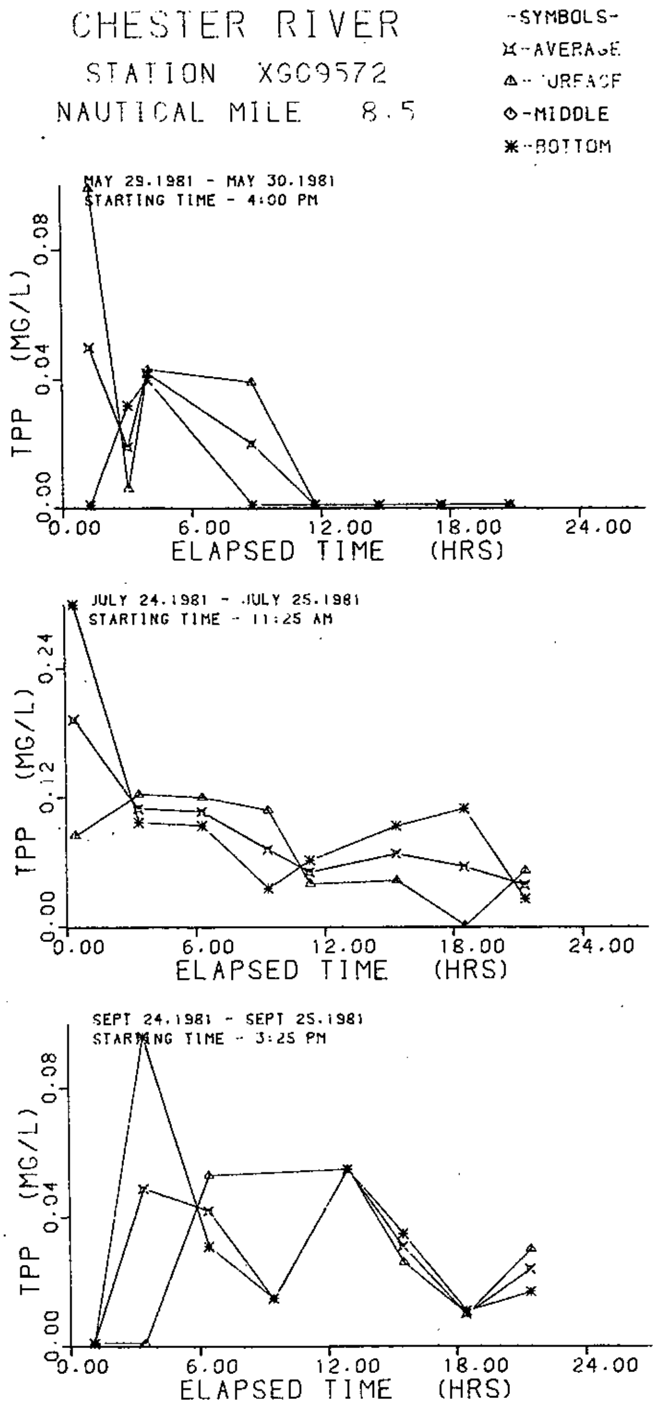


Figure 9-17 24 - Hour survey plots of Total Particulate Phosphorus (mg/l).

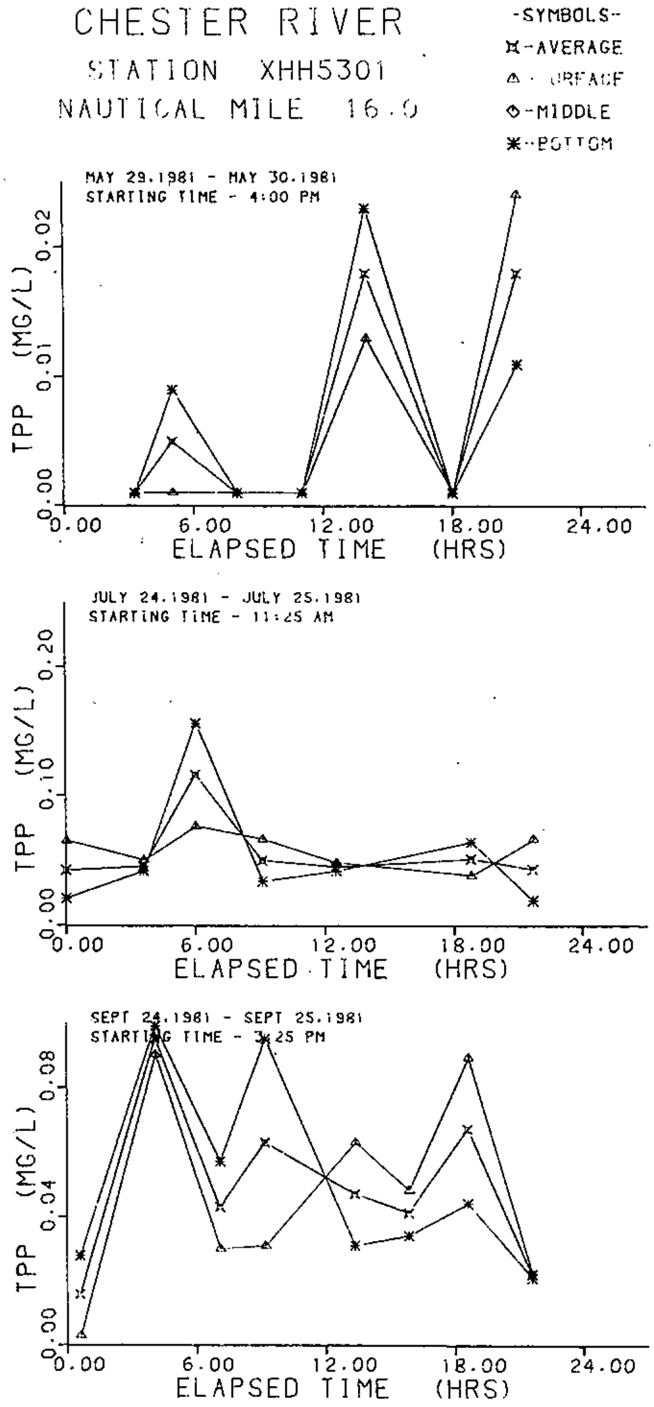


Figure 9-17 24 - Hour survey plots of Total Particulate Phosphorus (mg/l).

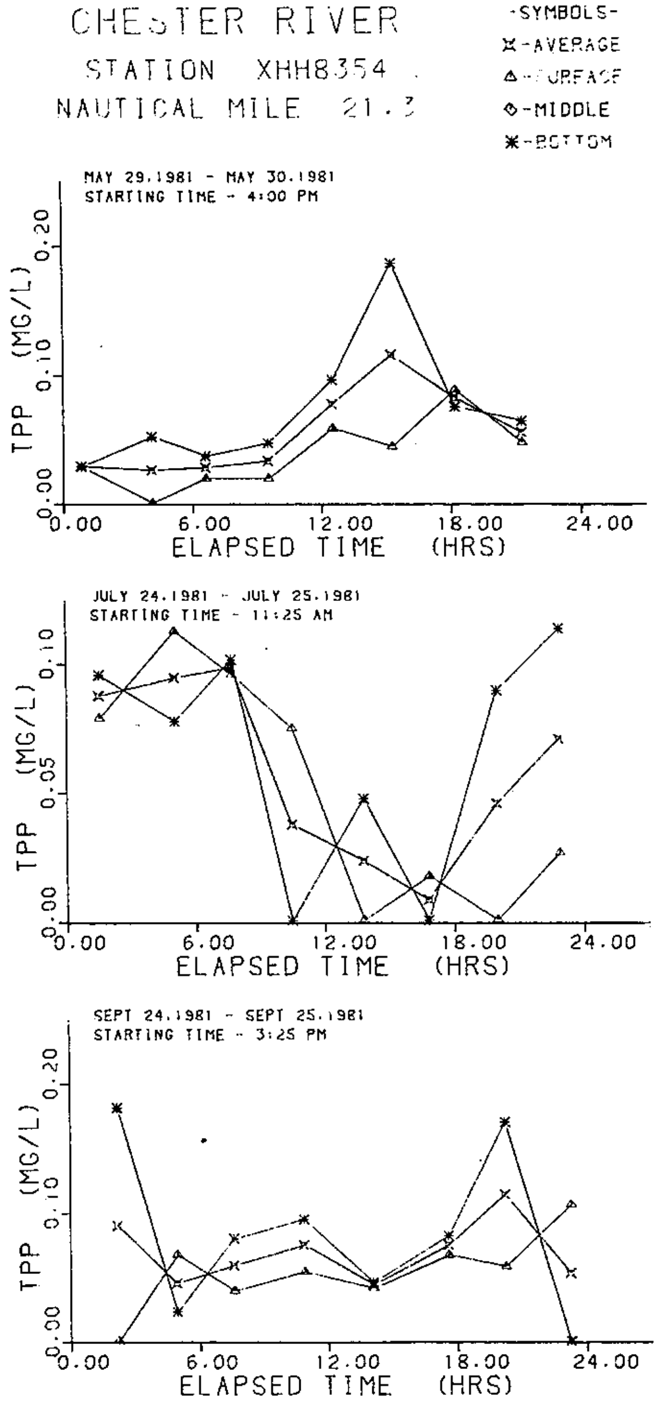


Figure 9-17 24 - Hour survey plots of Total Particulate Phosphorus (mg/l).

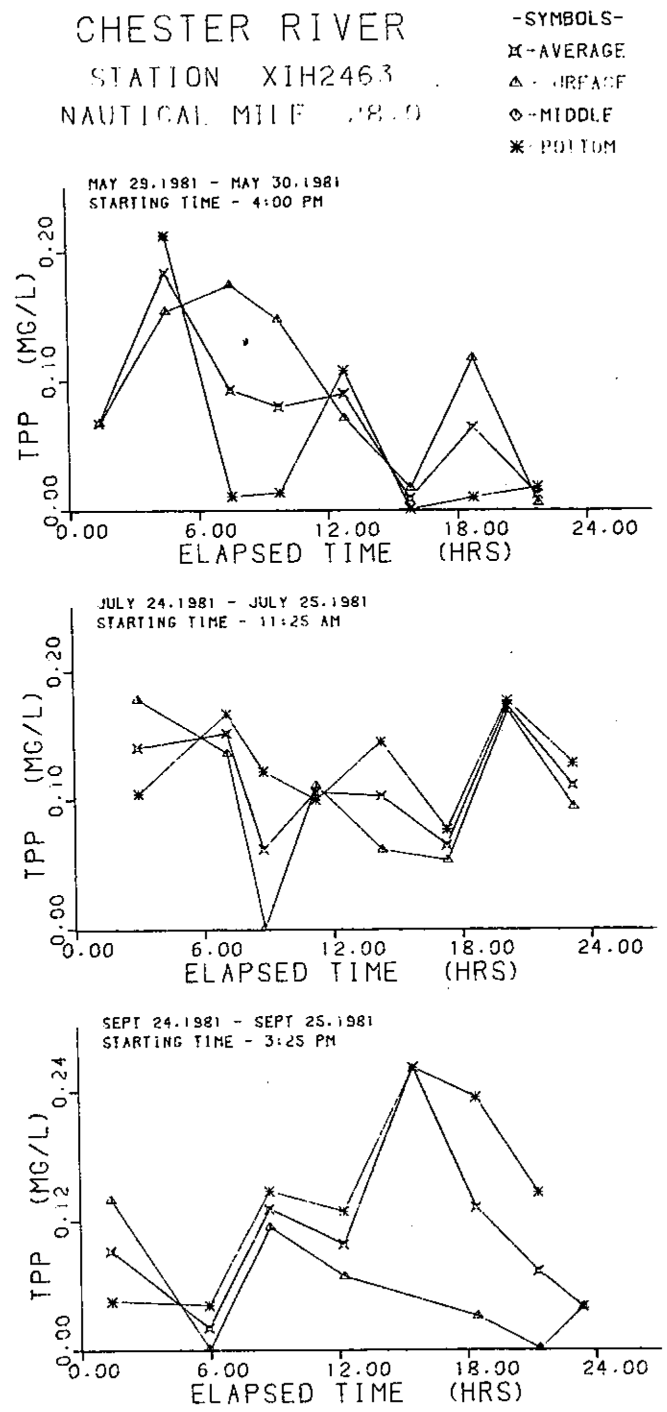


Figure 9-17 24 - Hour survey plots of Total Particulate Phosphorus (mg/l).

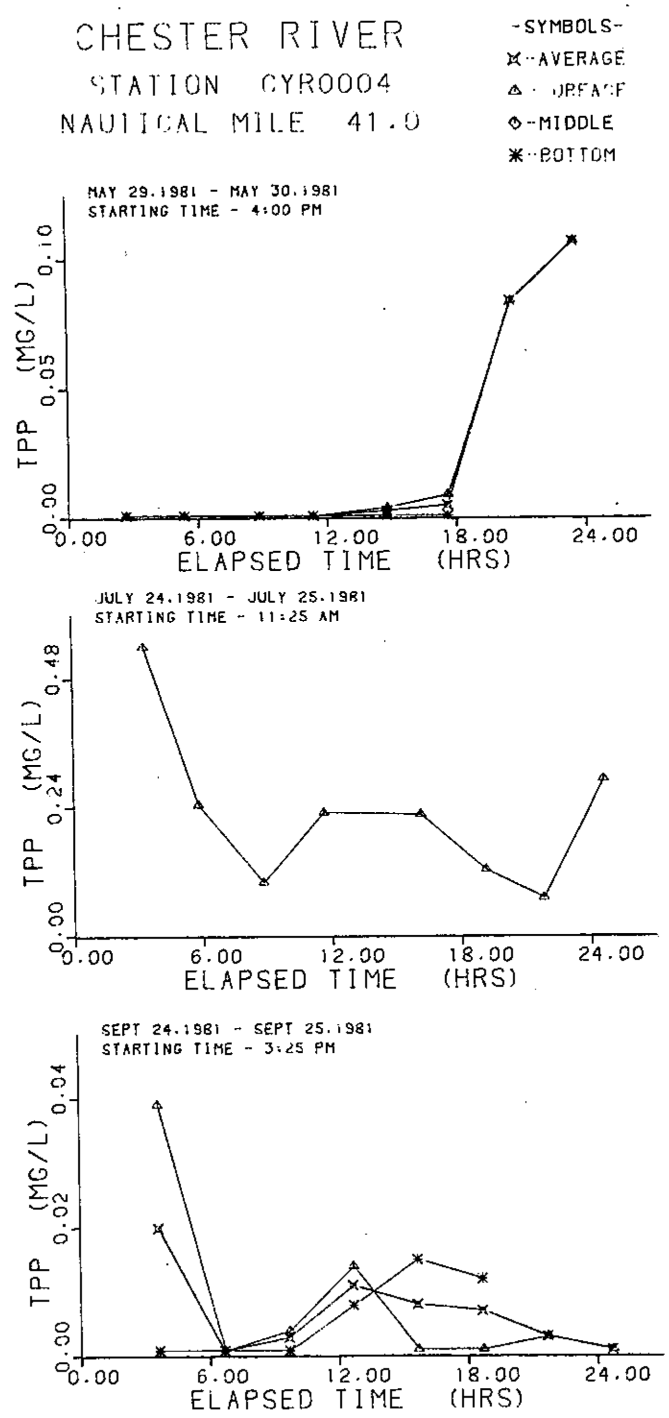


Figure 9-17 24 - Hour survey plots of Total Particulate Phosphorus (mg/l).

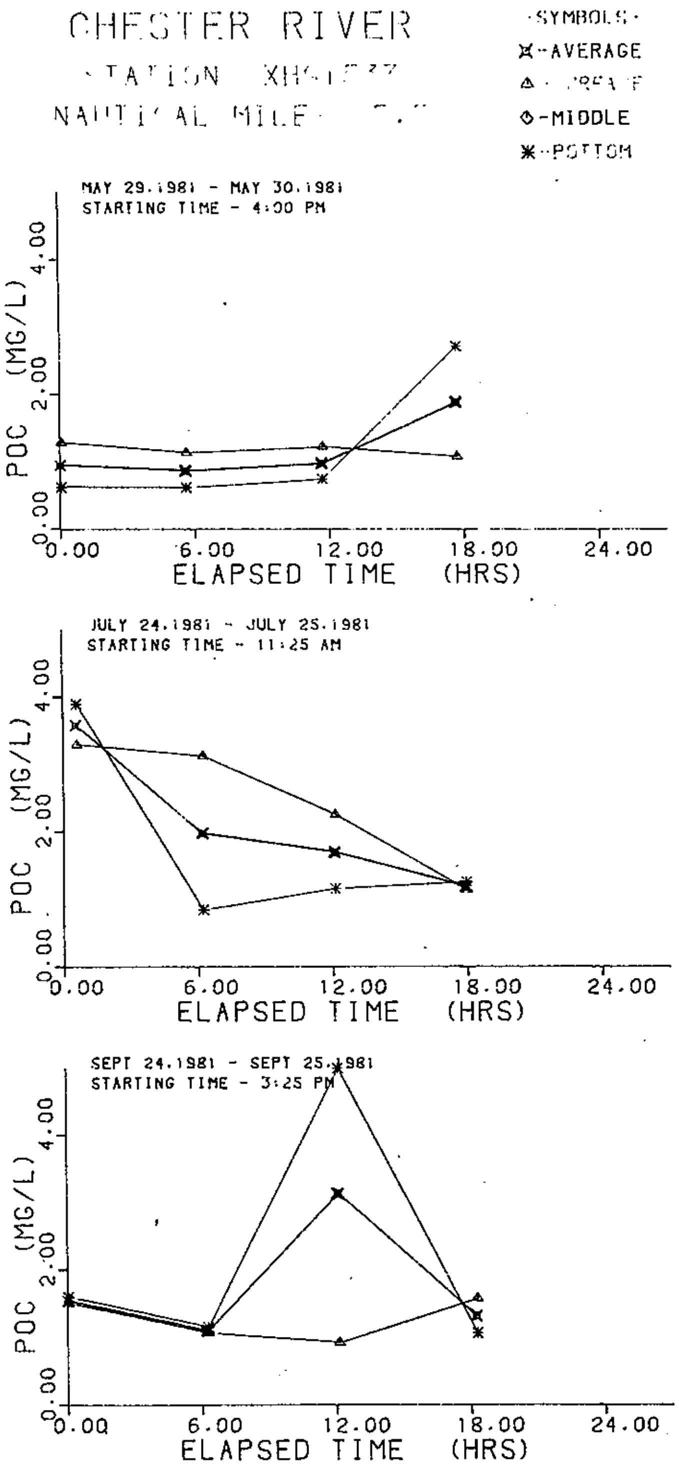


Figure 9-18 24-Hour survey plots of Particulate Organic Carbon, (mg/l).

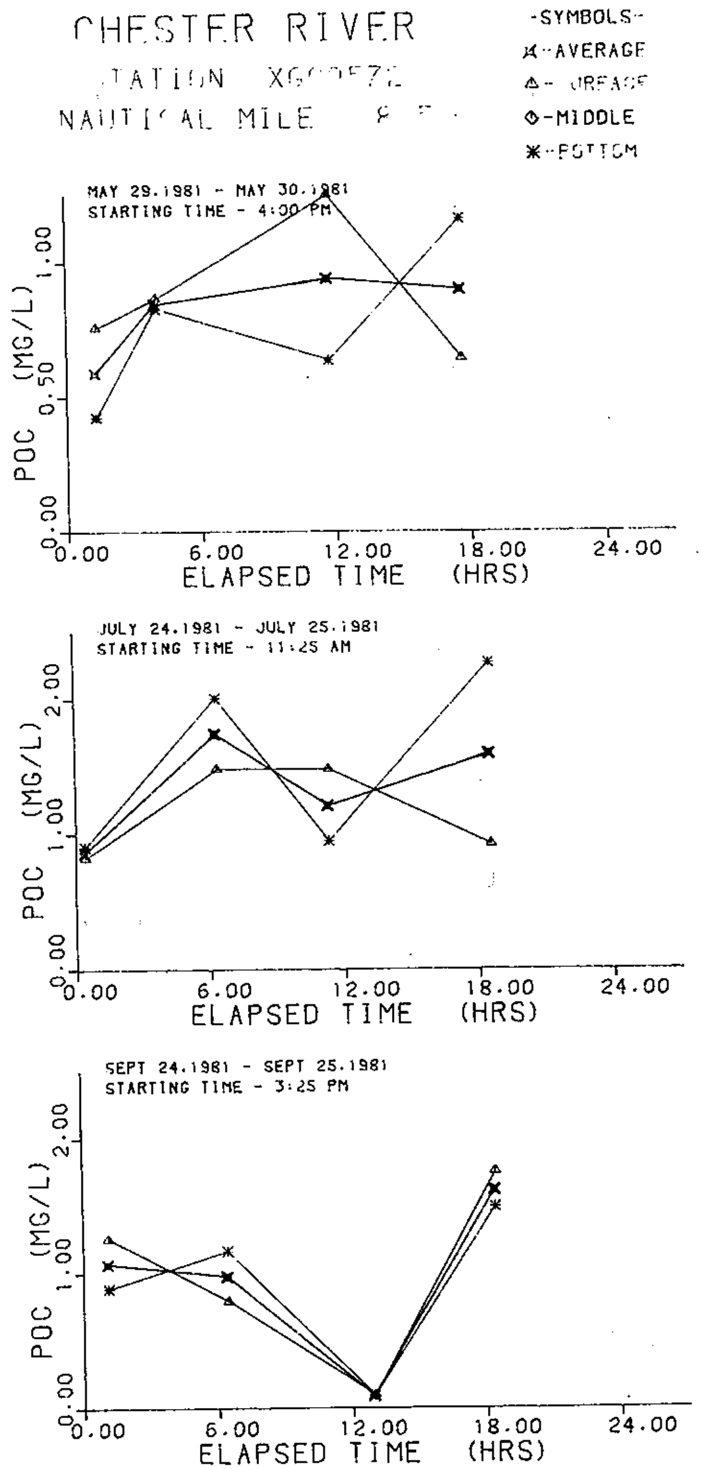


Figure 9-18 24-Hour survey plots of Particulate Organic Carbon, (mg/l).

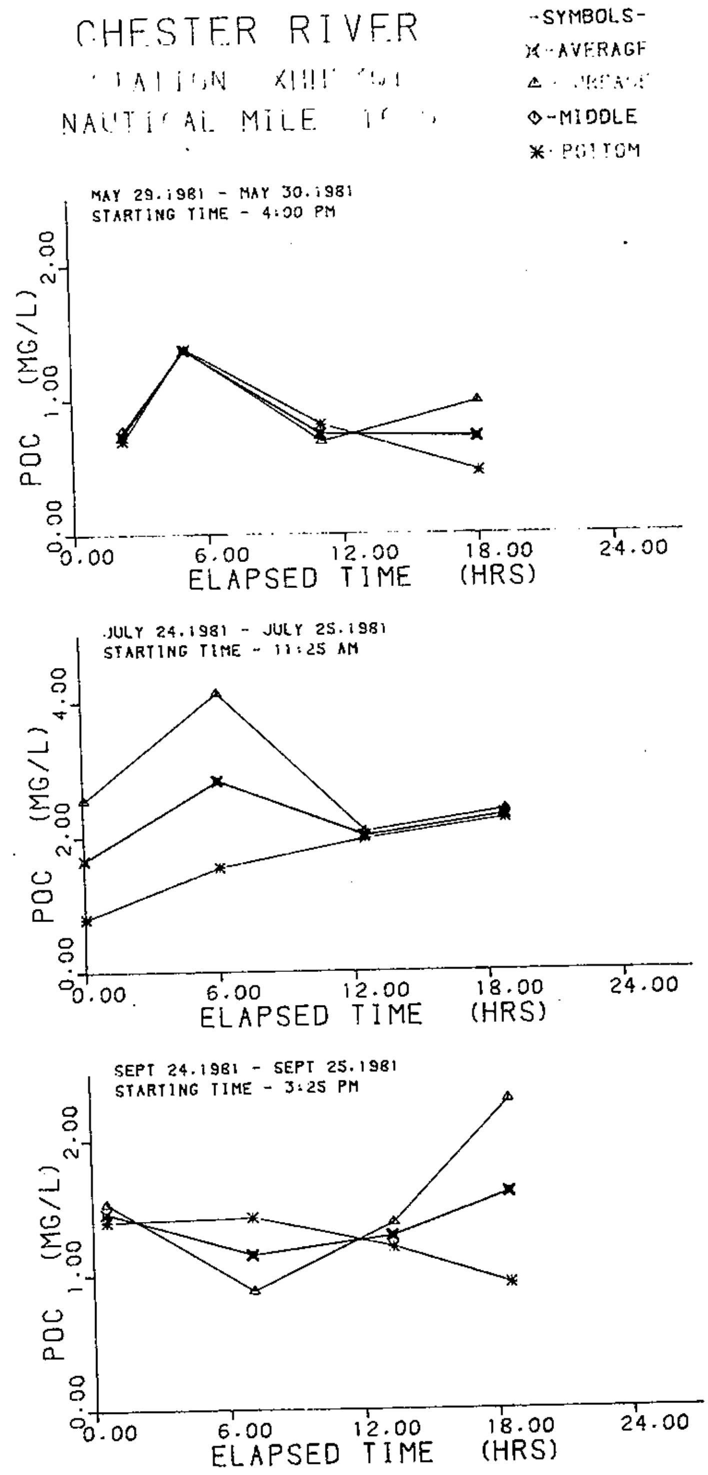


Figure 9-18 24-Hour survey plots of Particulate Organic Carbon, (mg/l).

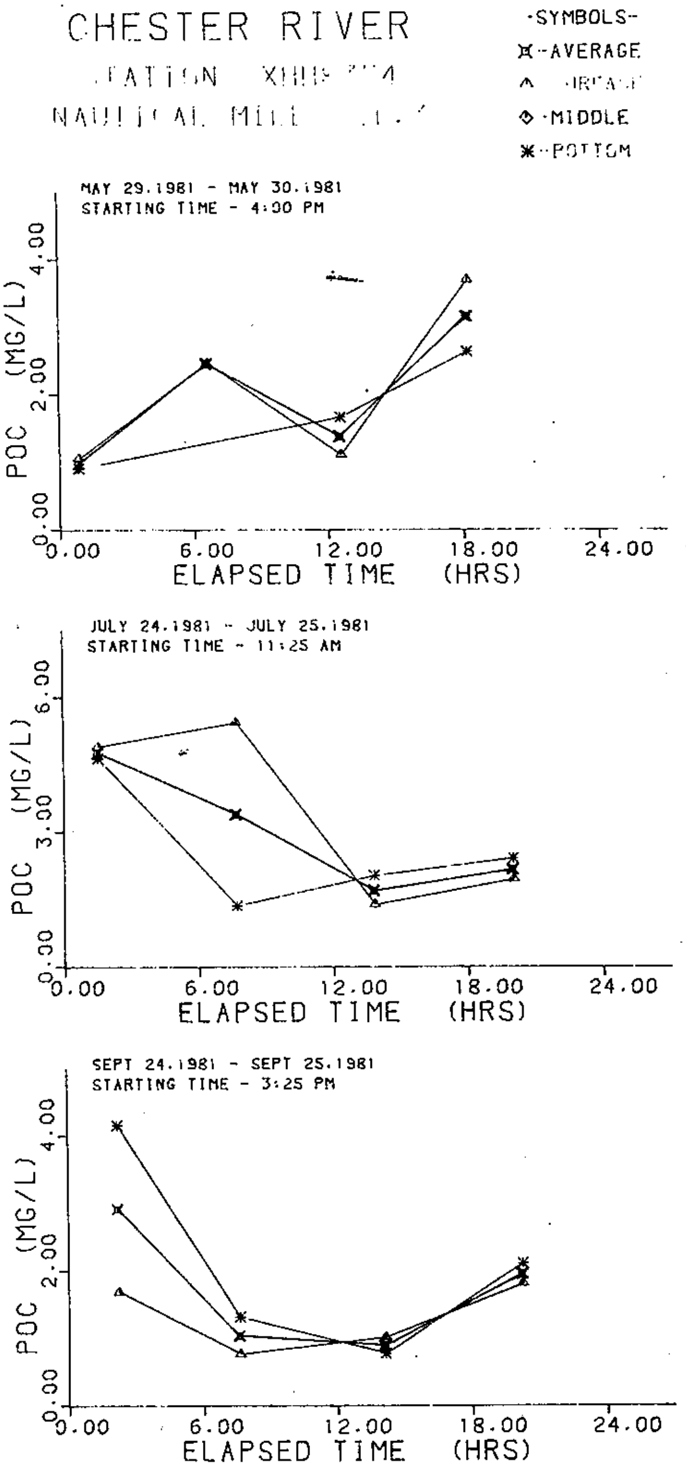


Figure 9-18 24-Hour survey plots of Particulate Organic Carbon, (mg/l).

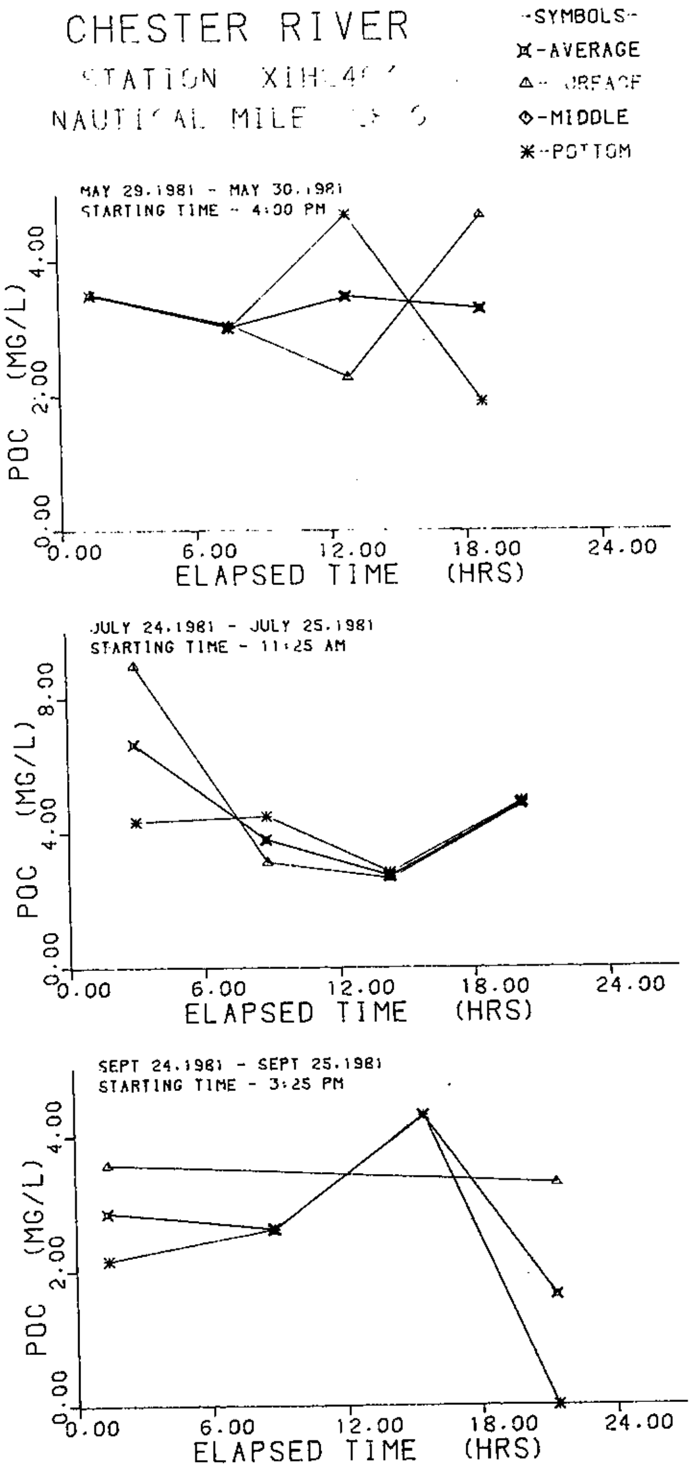


Figure 9-18 24-Hour survey plots of Particulate Organic Carbon, (mg/l).

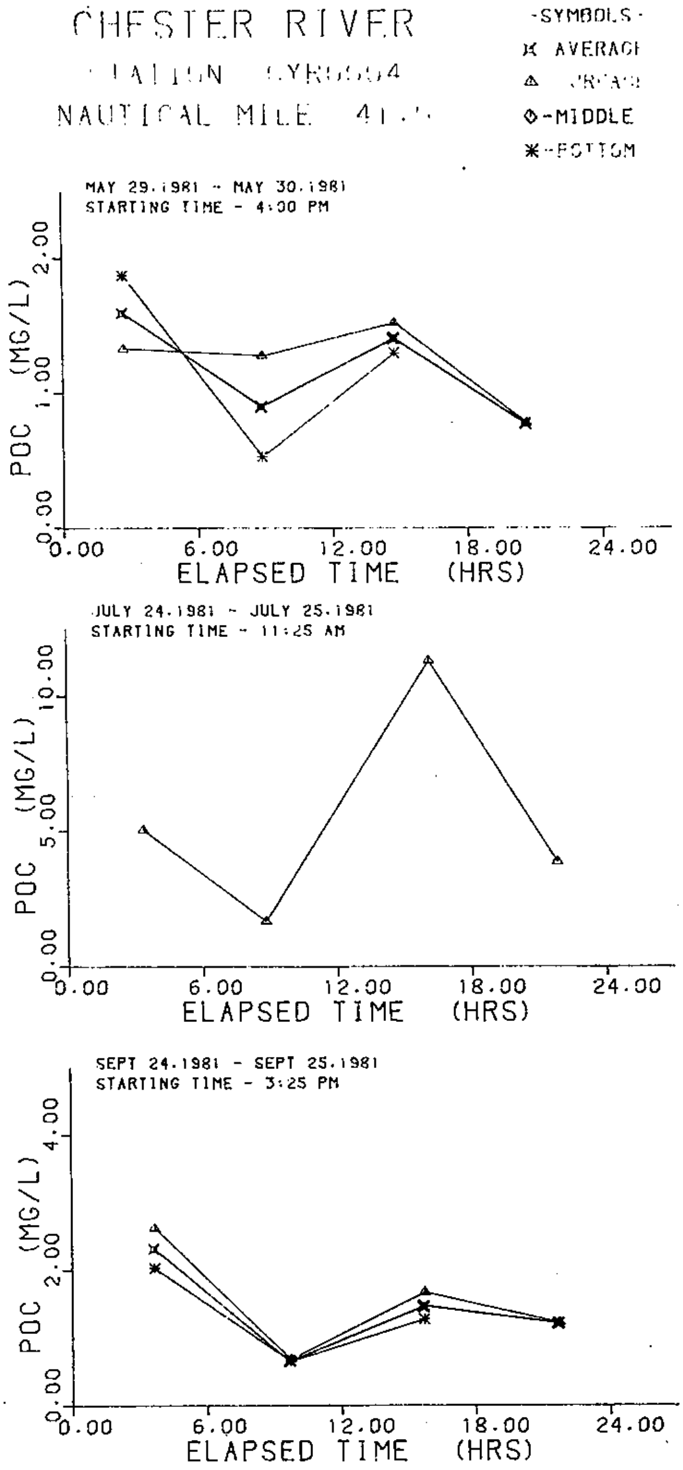


Figure 9-18 24-Hour survey plots of Particulate Organic Carbon, (mg/l).

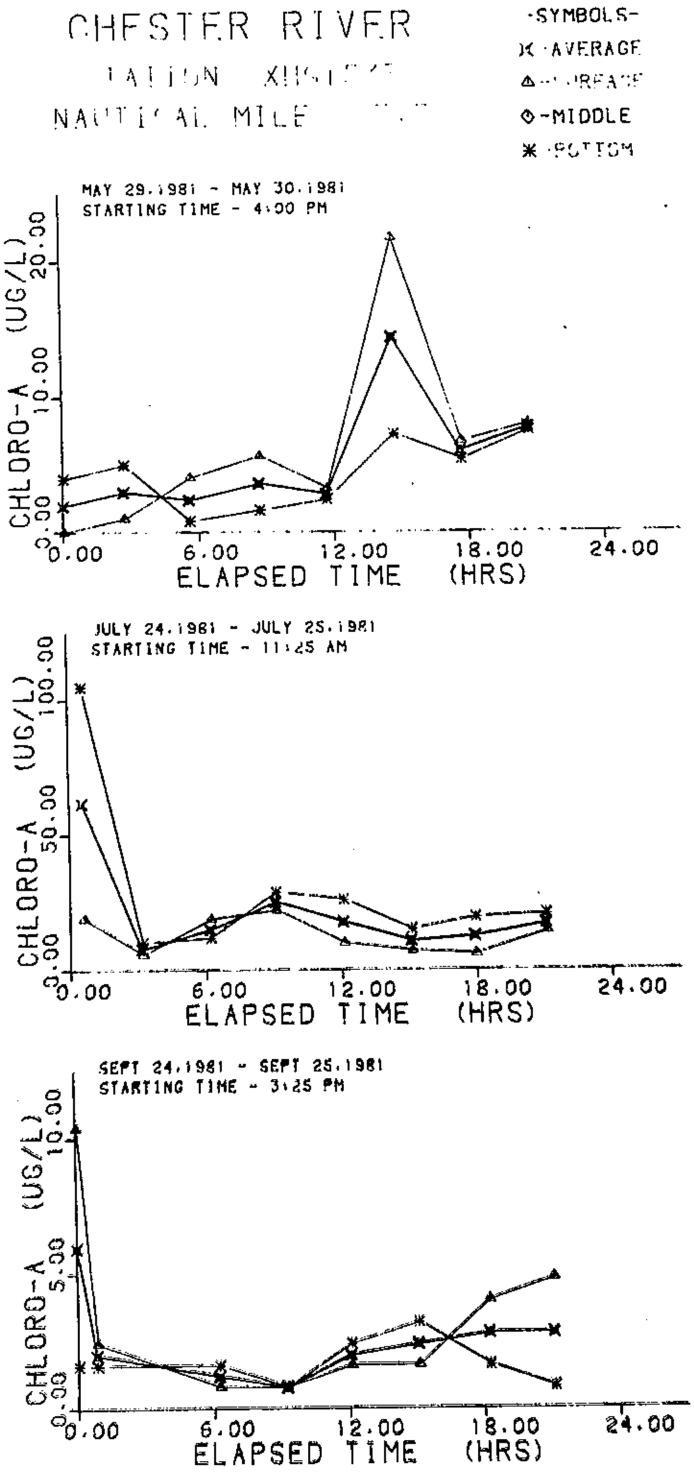


Figure 9-19 24-Hour survey plots of Chlorophyll-A (corrected), (mg/l).

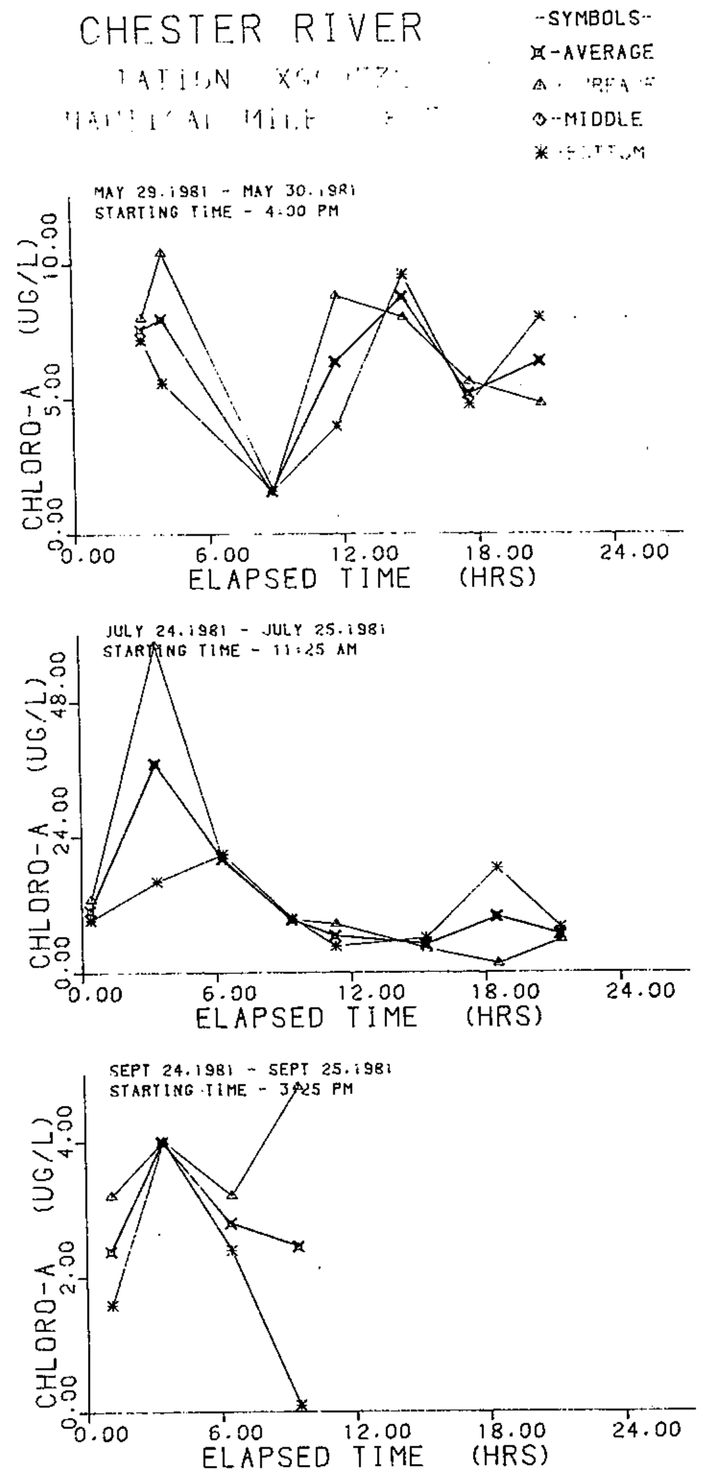


Figure 9-19 24-Hour survey plots of Chlorophyll-A (corrected), (mg/l).

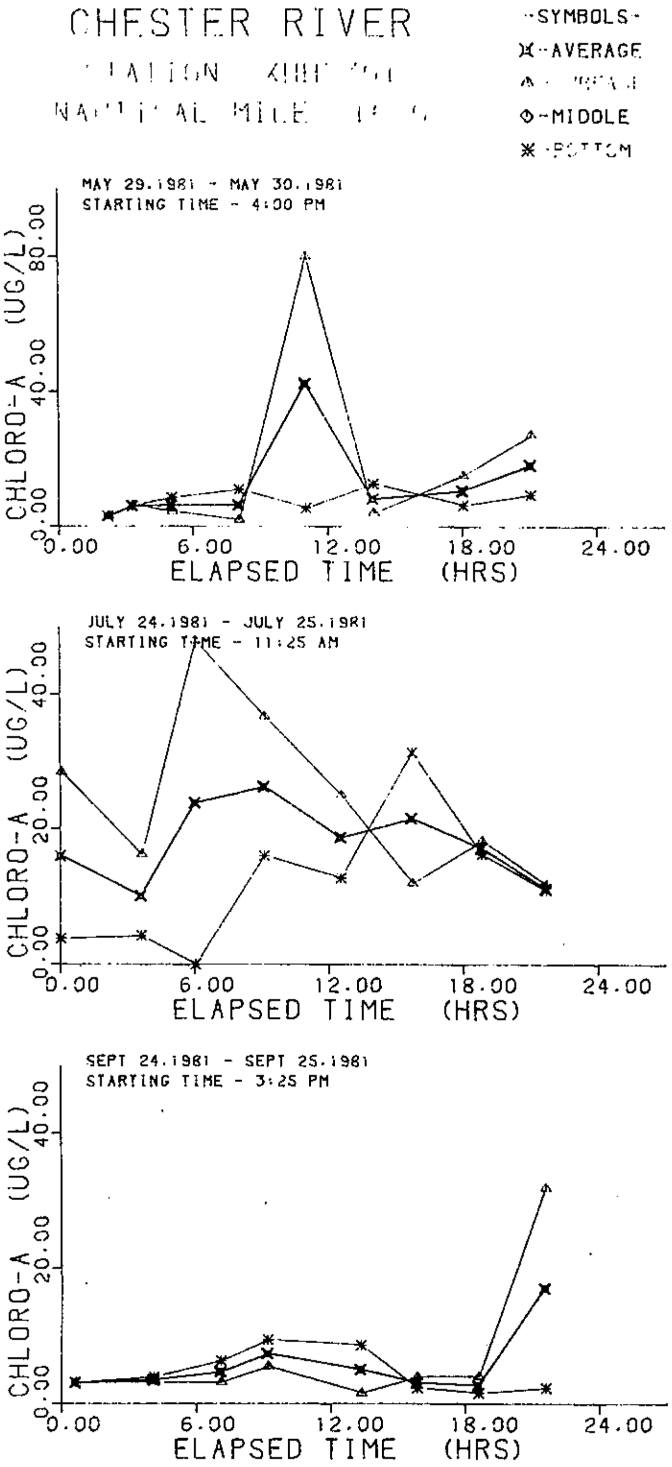


Figure 9-19 24-Hour survey plots of Chlorophyll-A (corrected), (mg/l).

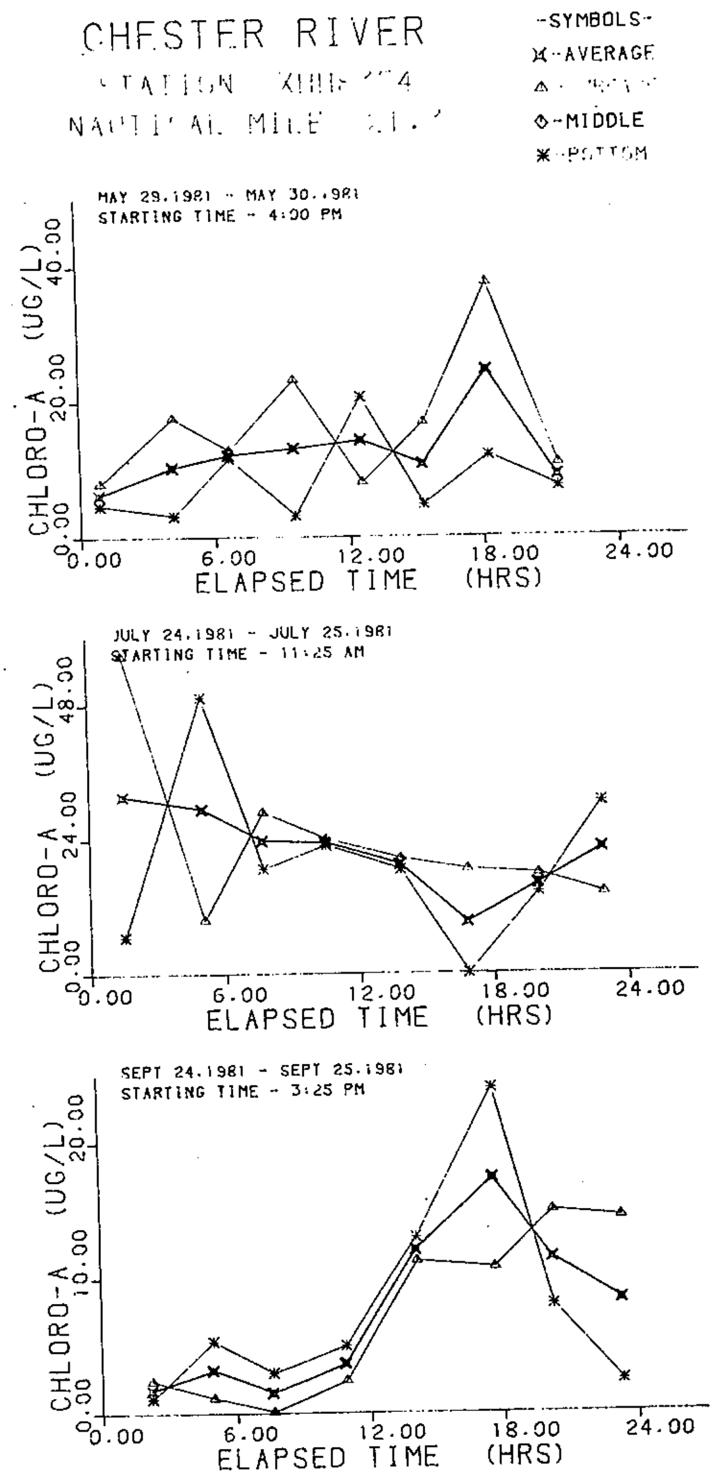


Figure 9-19 24-Hour survey plots of Chlorophyll-A (corrected), (mg/l).

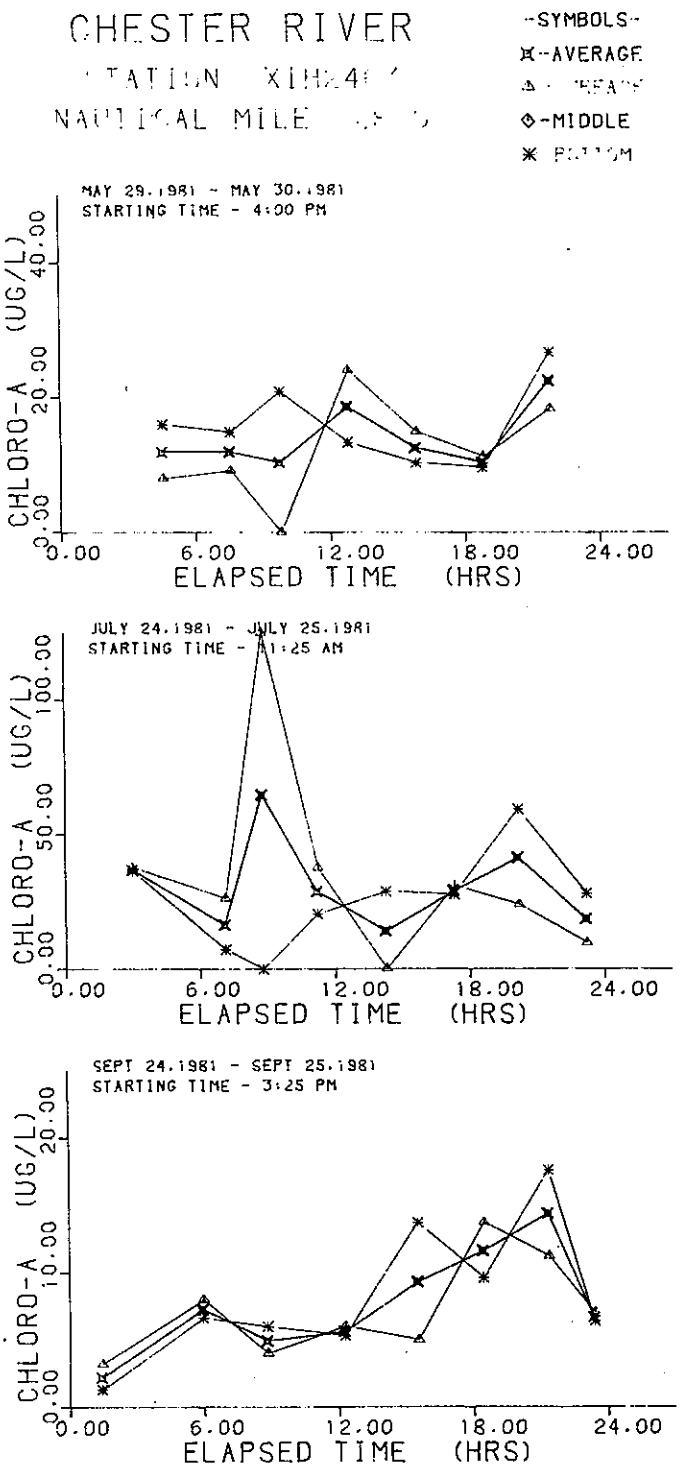


Figure 9-19 24-Hour survey plots of Chlorophyll-A (corrected), (mg/l).

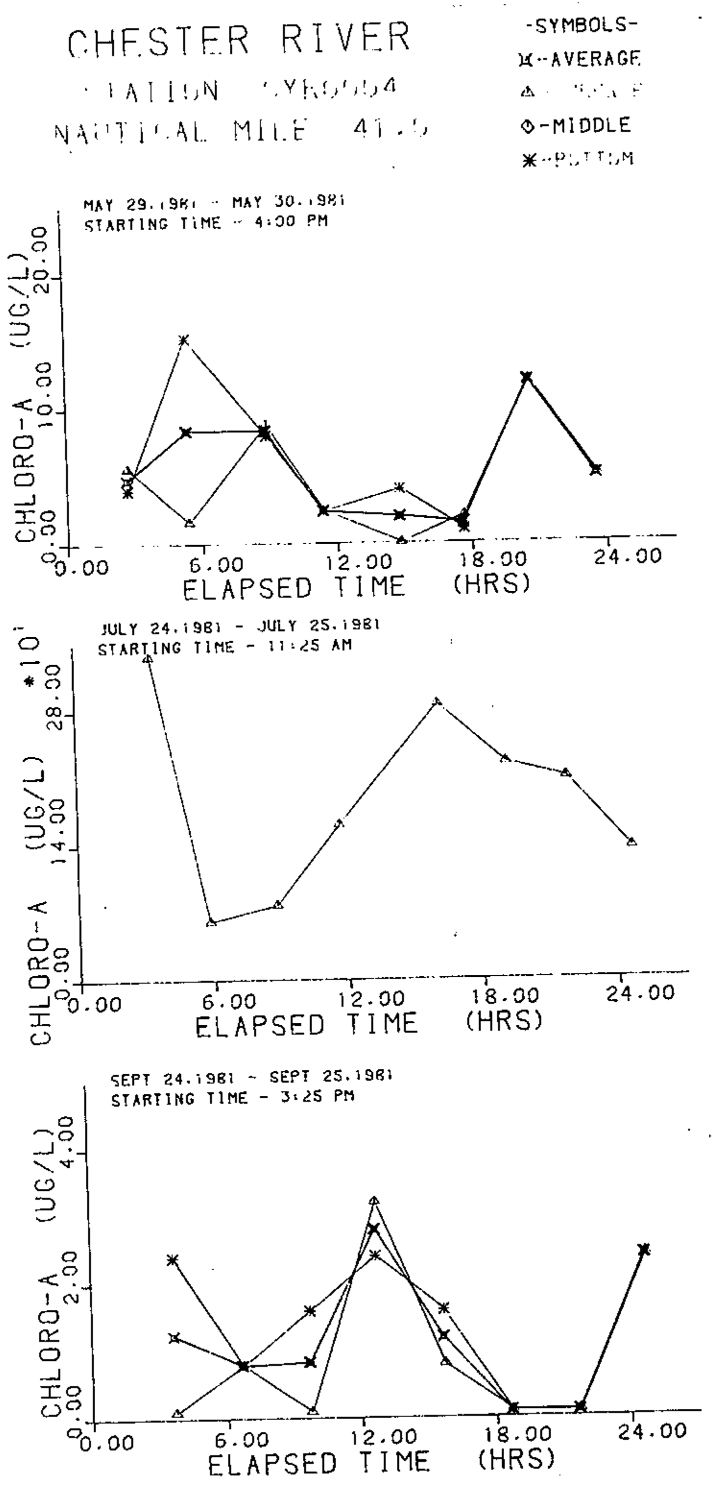


Figure 9-19 24-Hour survey plots of Chlorophyll-A (corrected), (mg/l).

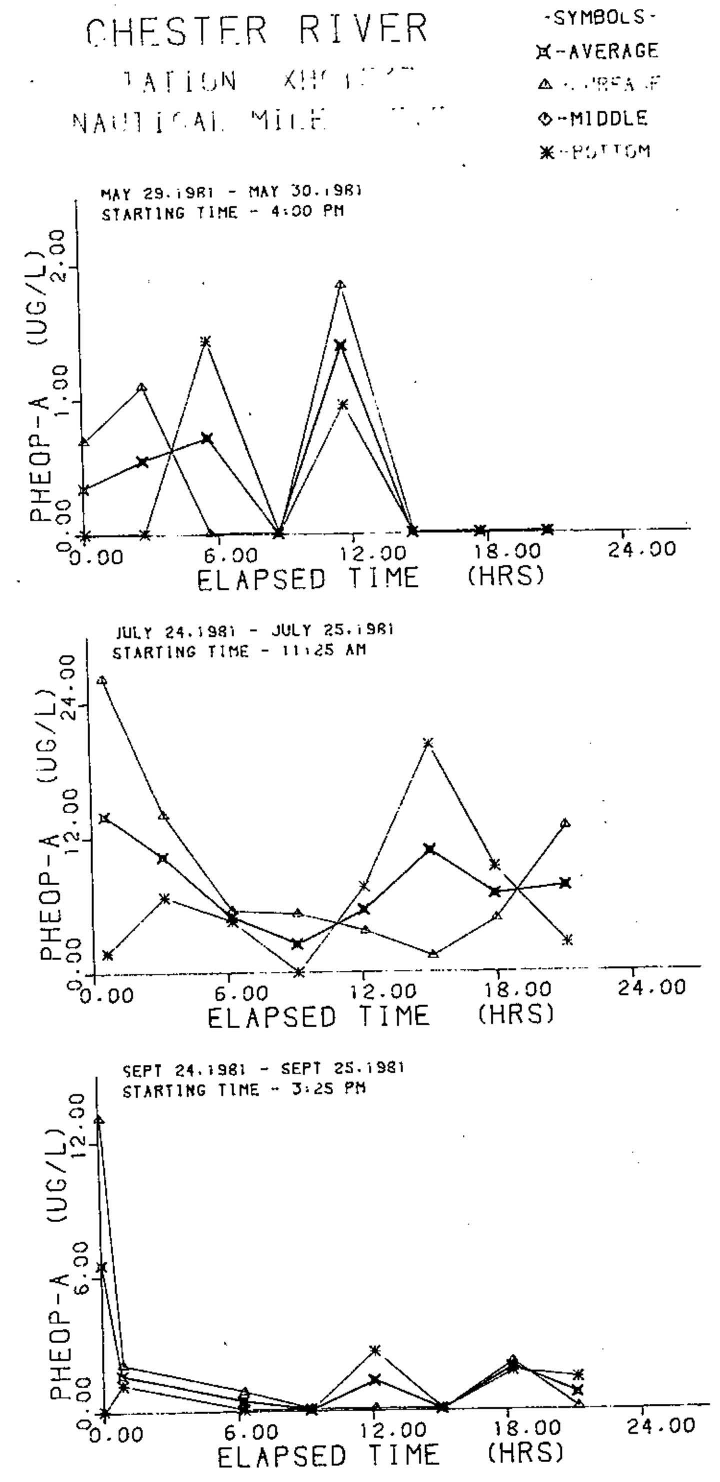


Figure 9-20 24-Hour survey plots of Pheophytin-A, (μg/l).

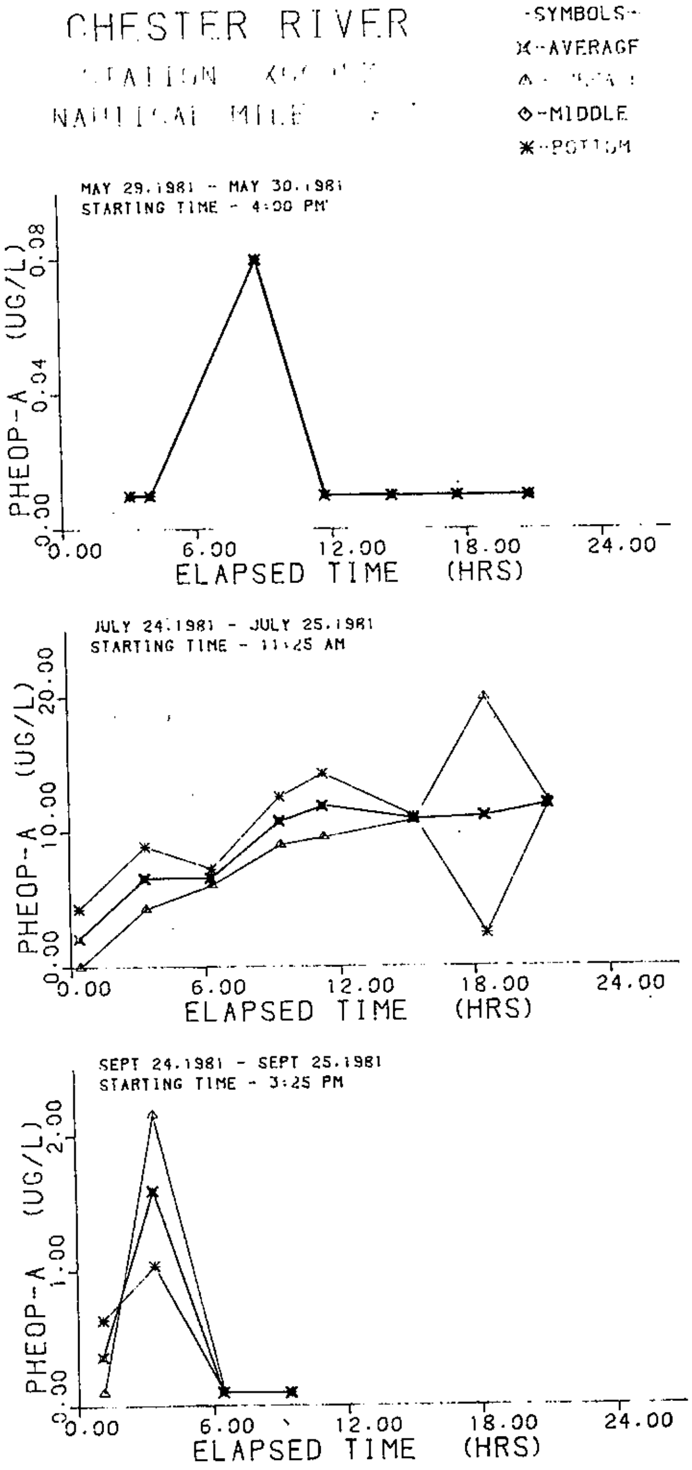


Figure 9-20 24-Hour survey plots of Pheophytin-A, (μg/l).

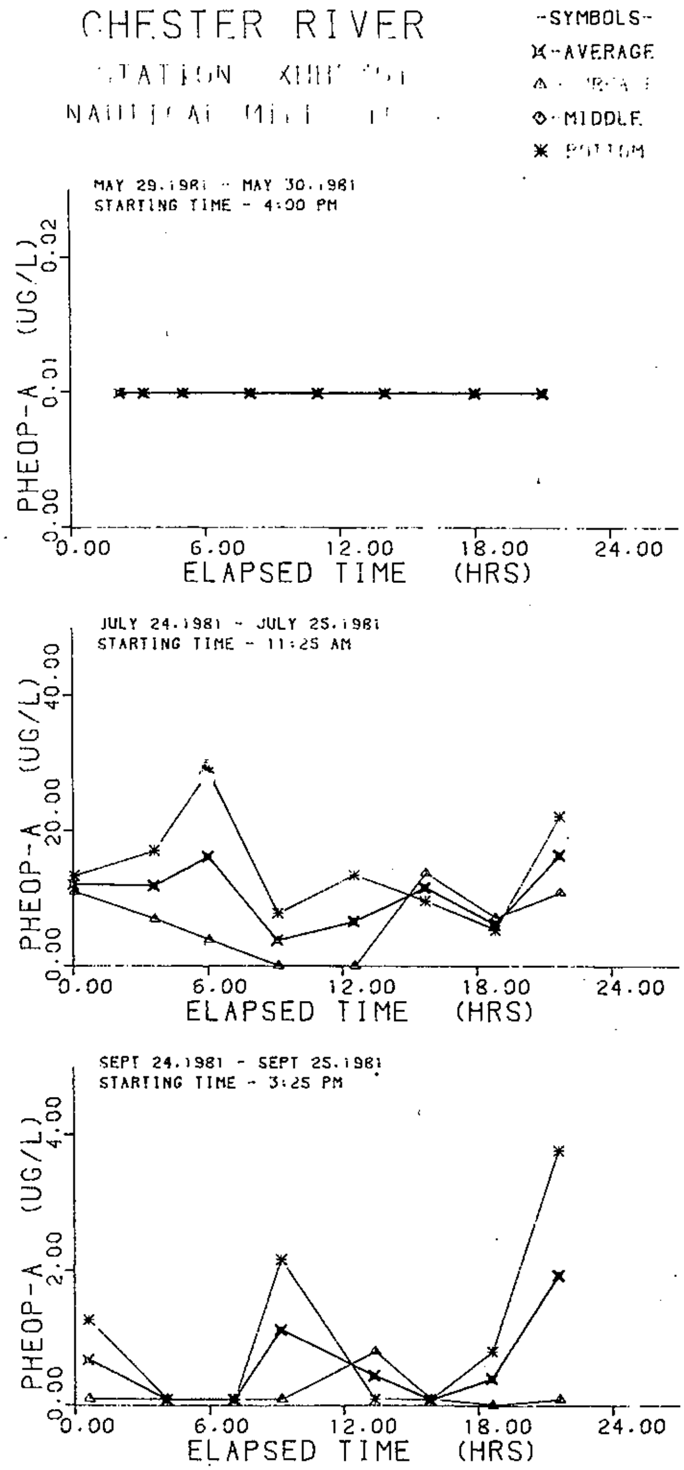


Figure 9-20 24-Hour survey plots of Pheophytin-A, (µg/l).

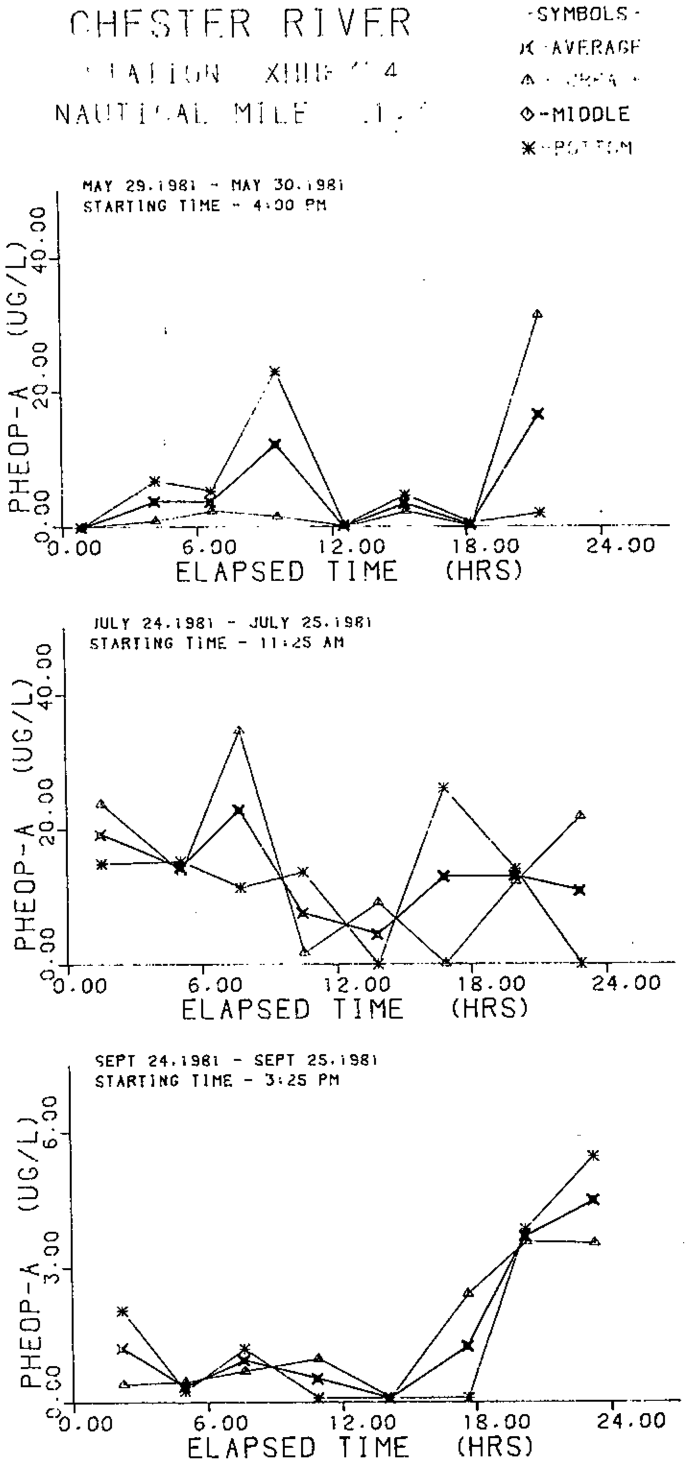


Figure 9-20 24-Hour survey plots of Pheophytin-A, (µg/l).

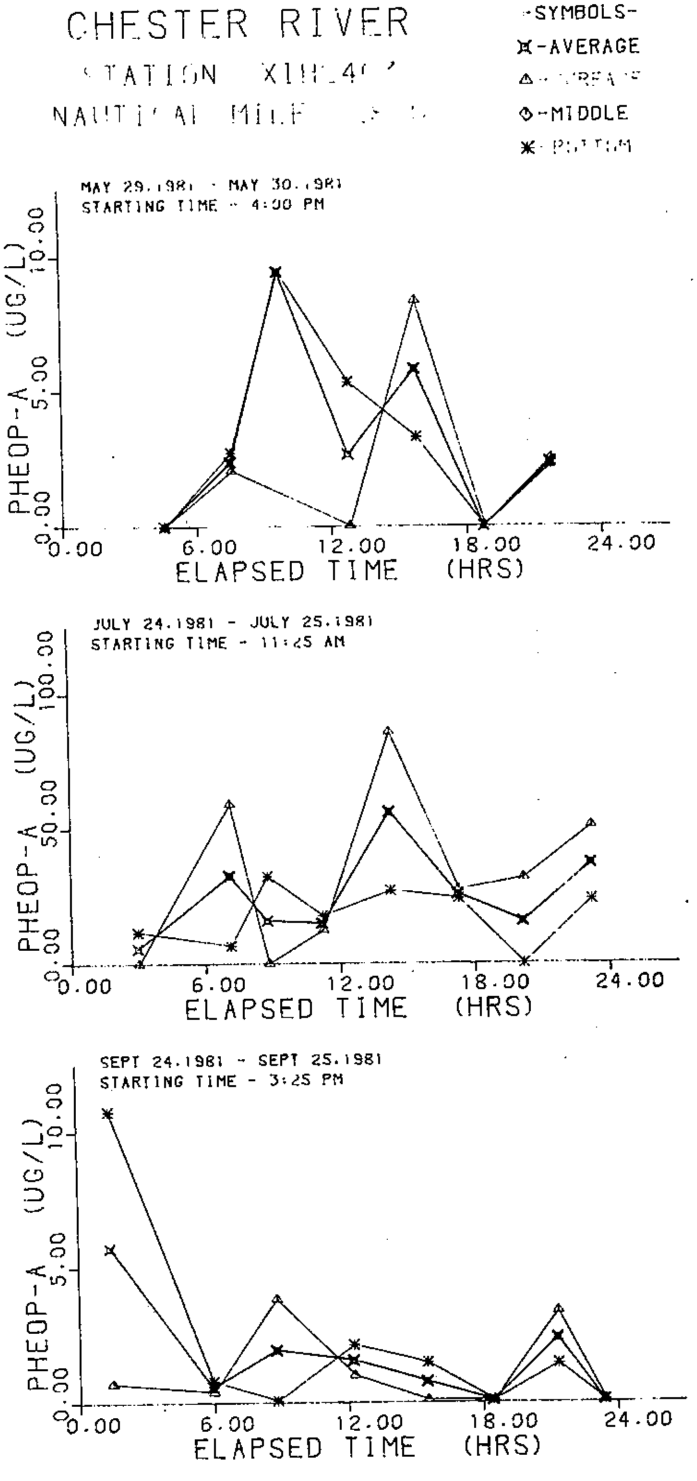


Figure 9-20 24-Hour survey plots of Pheophytin-A, (µg/l).

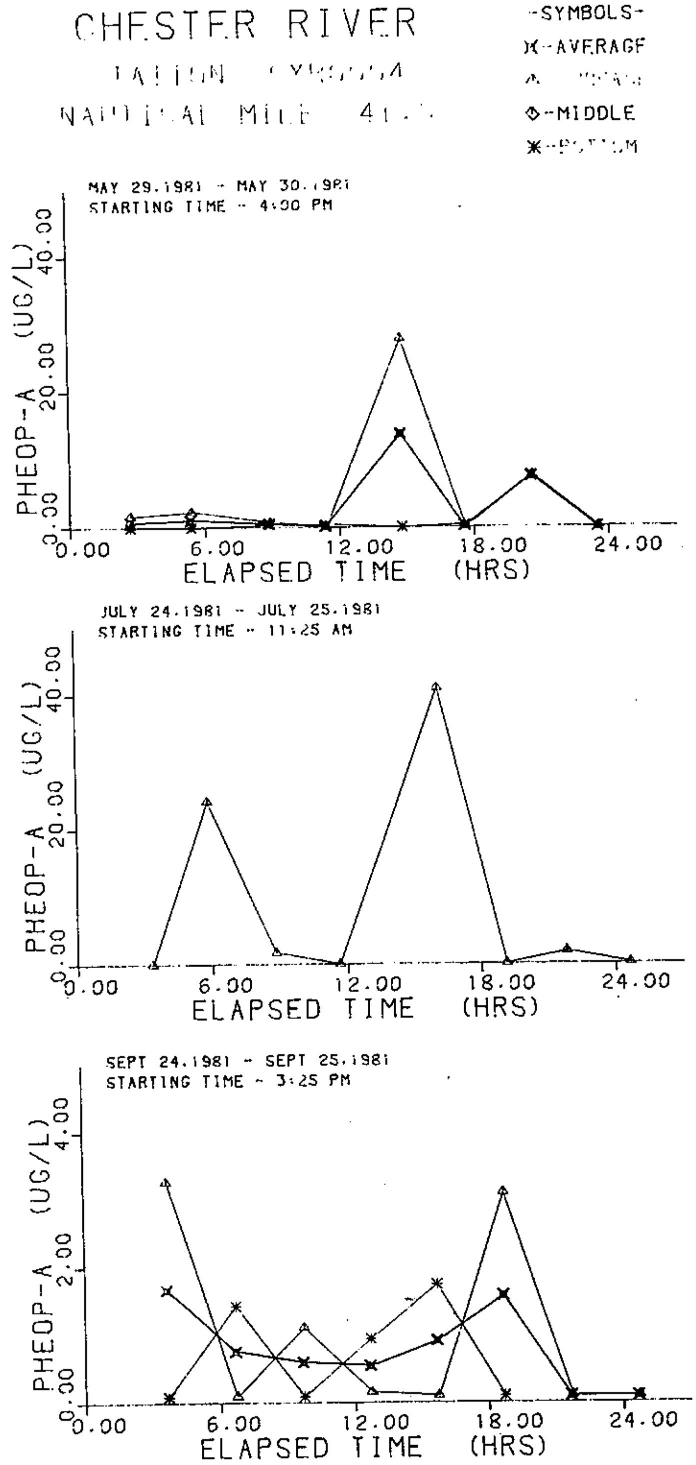


Figure 9-20 24-Hour survey plots of Pheophytin-A, (µg/1).

CHESTER RIVER
STATION XGG9572
NAUTICAL MILE 8.5

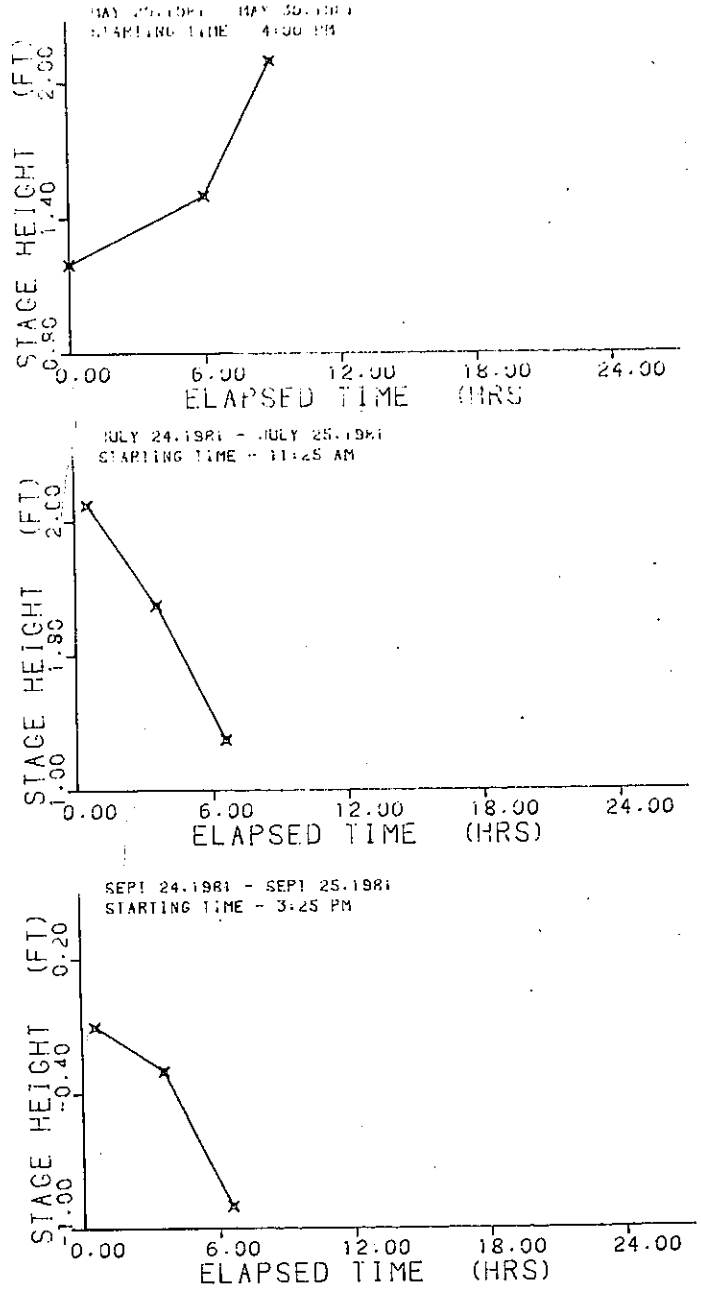


Figure 9-21 24-Hour Survey Plots for Stage Height (feet).

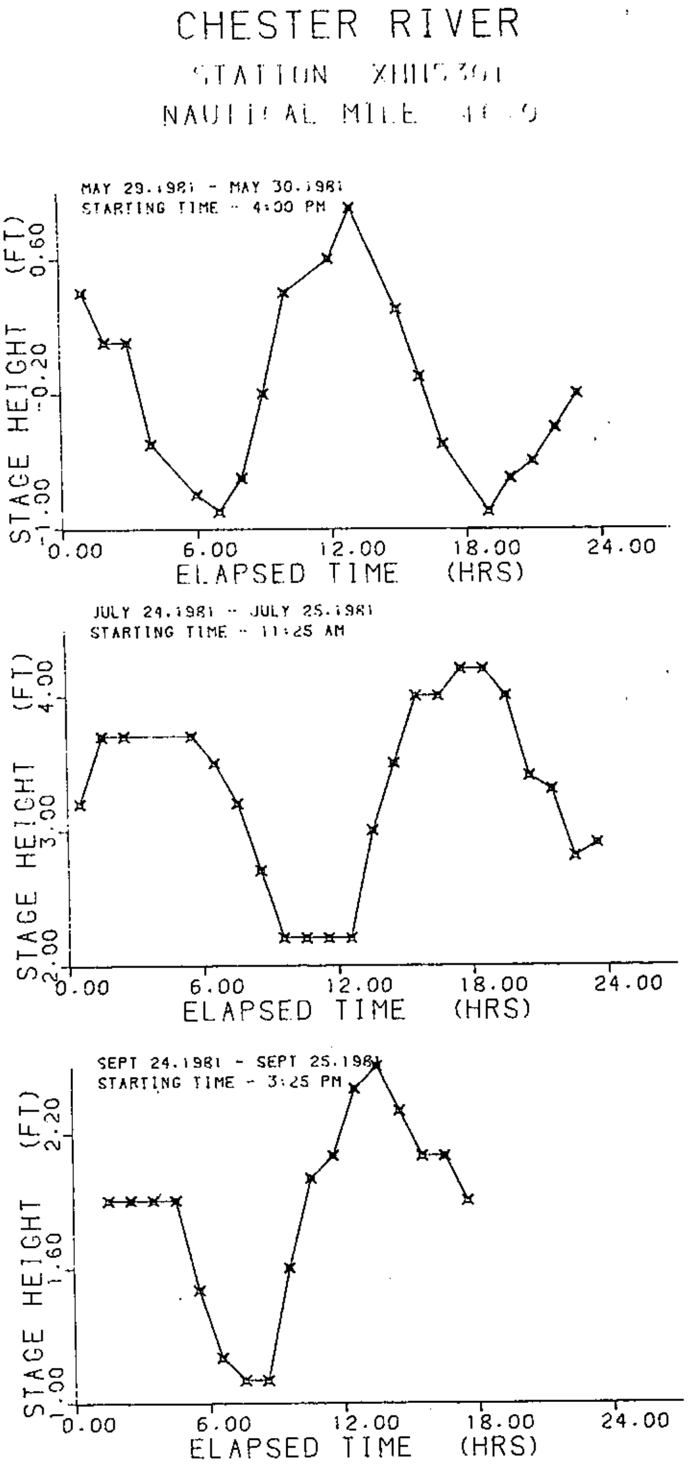


Figure 9-21 24-Hour Survey Plots for Stage Height (feet).

CHESTER RIVER
STATION XHH8354
NAUTICAL MILE [illegible]

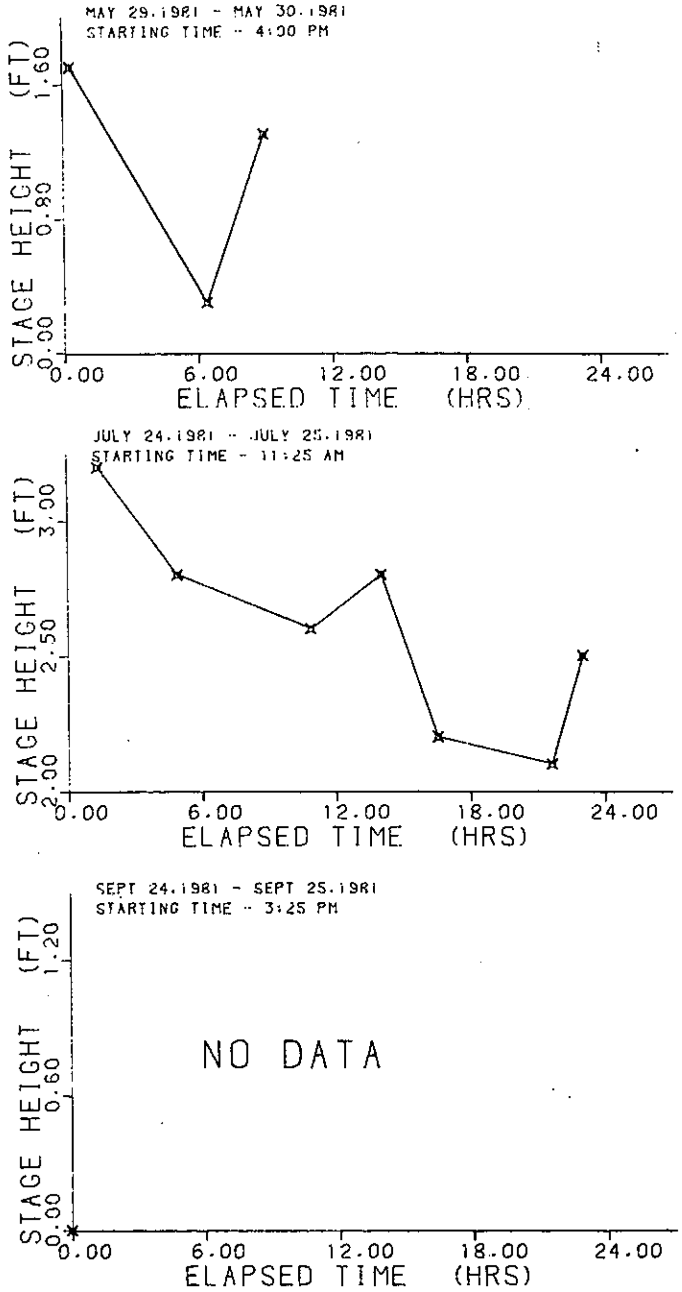


Figure 9-21 24 Hour Survey Plots for State Height (feet).

CHESTER RIVER
STATION XIIE4[illegible]
NAUTICAL MILE [illegible]

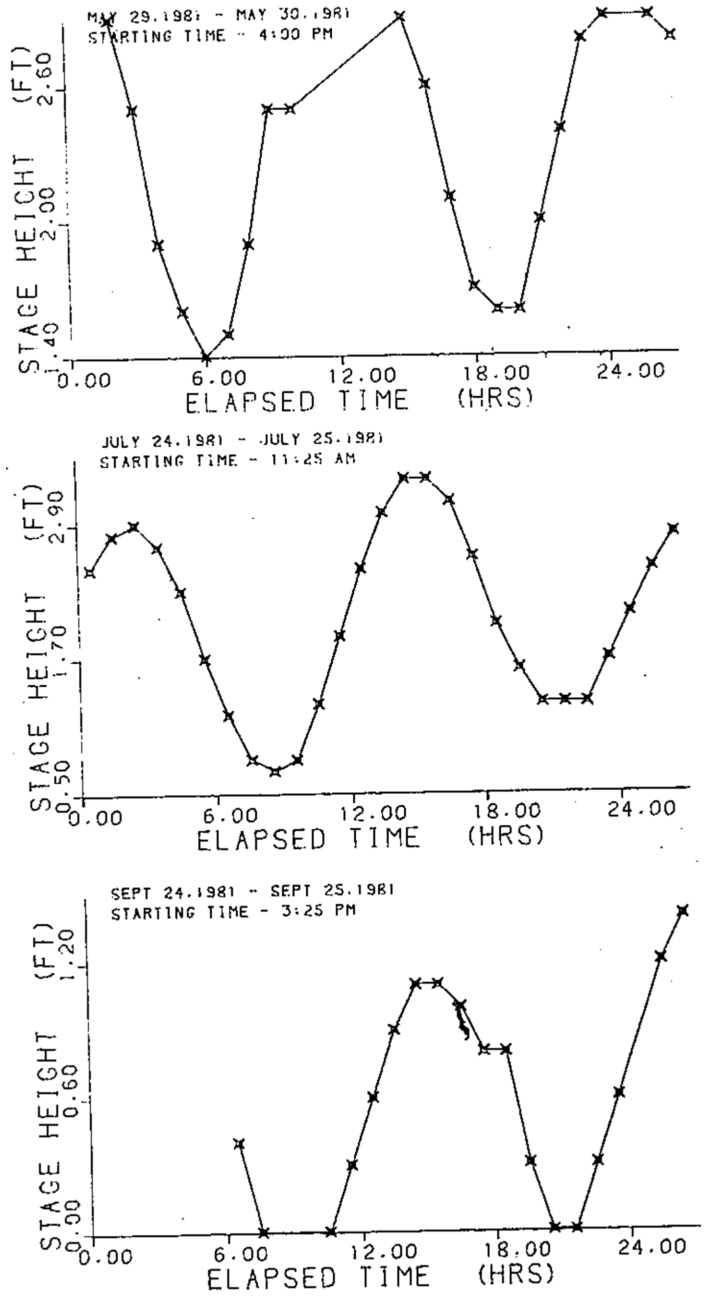


Figure 9-21 24-Hour Survey Plots for Stage Height (feet).

TABLE 9-1 TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
			TEMPERTURE (DEGREES C)				
5/29/81	XHG1537	5.50	24	19.85	2.8908	.59007	14.563
7/24/81			24	25.292	0.6959	.14205	2.7515
9/24/81			24	17.883	.61479	.12549	3.4378
ALL DATA			72	21.008	3.5976	.42398	17.125
5/29/81	XGG9572	8.50	24	20.658	2.3631	.48237	11.439
7/24/81			24	25.4	.43339	.08846	1.7062
9/24/81			24	18.217	.37261	.07606	2.0454
ALL DATA			72	21.425	3.3067	.38969	15.434
5/29/81	XHH5301	16.00	24	18.437	4.005	.81751	21.722
7/24/81			23	24.739	5.2936	1.1038	21.398
9/24/81			24	17.896	0.5552	.11333	3.1024
ALL DATA			71	20.296	4.881	.57927	24.049
5/29/81	XHH8354	21.30	24	21.871	1.2052	.24602	5.5107
7/24/81			24	26.875	.55658	.11361	2.071
9/24/81			24	18.583	.28387	.05794	1.5275
ALL DATA			72	22.443	3.519	.41471	15.679
5/29/81	XIH2463	28.00	24	22.692	1.6629	.33943	7.3281
7/24/81			24	25.9	1.286	.26251	4.9654
9/24/81			24	18.429	.39943	.08153	2.1674
ALL DATA			72	22.34	3.3135	0.3905	14.832
5/29/81	CYR0004	41.00	14	23.357	2.1876	.58467	9.366
7/24/81			8	24	1.2247	.43301	5.1031
9/24/81			14	15.529	2.0143	.53836	12.972
ALL DATA			36	20.456	4.4197	.73662	21.606
			TURBIDITY (FTU)				
5/29/81	XHG1537	5.50	16	2.2	2.9392	.73479	133.6
7/24/81			16	3.375	2.0936	.52341	62.034
9/24/81							
ALL DATA			32	2.7875	2.5802	.45611	92.562
5/29/81	XGG9572	8.50	16	1.4125	1.7914	.44785	126.83
7/24/81			16	5.5	5.5618	1.3904	101.12
9/24/81							
ALL DATA			32	3.4562	4.5642	.80685	132.06
5/29/81	XHH5301	16.00	16	3.9375	3.6963	.92407	93.874
7/24/81			16	8	1.9322	.48305	24.152
9/24/81							
ALL DATA			32	5.9688	3.5604	.62939	59.651
5/29/81	XHH8354	21.30	14	15.714	9.8717	2.6383	62.82
7/24/81			16	22.188	10.98	2.745	49.488
9/24/81							
ALL DATA			30	19.167	10.809	1.9734	56.395
5/29/81	XIH2463	28.00	16	28.188	6.4106	1.6027	22.743
7/24/81			16	33.813	9.9211	2.4803	29.342
9/24/81							
ALL DATA			32	31	8.6993	1.5378	28.062
5/29/81	CYR0004	41.00	14	13.5	1.9115	.51087	14.159
7/24/81			8	9.5	2.5635	.90633	26.984
9/24/81							
ALL DATA			22	12.045	2.8864	.61538	23.962

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SECCHI DISC (METERS)

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
5/29/81	XHG1537	5.50	4	1.2	.21602	.10801	18.002
7/24/81			5	1	.12247	.05477	12.247
9/24/81			4	1.65	.23805	.11902	14.427
ALL DATA			13	1.2615	.33301	.09236	26.397
5/29/81	XGG9572	8.50	5	0.94	.35071	.15684	37.31
7/24/81			4	0.9	.08165	.04082	9.0722
9/24/81							
ALL DATA			9	.92222	.25386	.08462	27.527
5/29/81	XHH5301	16.00	5	1.08	.26833	0.12	24.845
7/24/81			5	0.56	.08944	0.04	15.972
9/24/81			4	0.875	0.15	0.075	17.143
ALL DATA			14	.83571	.28718	.07675	34.363
5/29/81	XHH8354	21.30					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XIH2463	28.00					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	CYR0004	41.00					
7/24/81							
9/24/81							
ALL DATA							

DISSOLVED OXYGEN (MG/L)

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
5/29/81	XHG1537	5.50	24	5.9667	3.4791	.71017	58.309
7/24/81			24	6.7042	2.6353	.53793	39.308
9/24/81			24	9.2792	.60071	.12262	6.4737
ALL DATA			72	7.3167	2.8866	.34019	39.452
5/29/81	XGG9572	8.50	24	6.4125	1.634	.33353	25.481
7/24/81			24	6.7958	1.5521	.31683	22.839
9/24/81			24	8.6792	0.4107	.08383	4.7321
ALL DATA			72	7.2958	1.6417	.19347	22.501
5/29/81	XHH5301	16.00	24	4.975	1.5386	.31406	30.926
7/24/81			21	10.043	3.5285	.76999	35.135
9/24/81			24	8.4083	.80537	0.1644	9.5783
ALL DATA			69	7.7116	3.029	.36465	39.279
5/29/81	XHH8354	21.30	24	7.4708	1.4728	.30063	19.714
7/24/81			24	5.5	.71869	0.1467	13.067
9/24/81			24	8.4542	1.487	.30354	17.589
ALL DATA			72	7.1417	1.7653	.20804	24.718
5/29/81	XIH2463	28.00	25	7.092	.86454	.17291	12.19
7/24/81			24	5.5917	.71985	.14694	12.874
9/24/81			24	8.6625	.43018	.08781	4.966
ALL DATA			73	7.1151	1.4303	0.1674	20.102
5/29/81	CYR0004	41.00	14	6.6143	.48652	.13003	7.3556
7/24/81			8	8.3125	2.7205	.96185	32.728
9/24/81			14	7.3786	1.5111	.40385	20.479
ALL DATA			36	7.2889	1.6855	.28092	23.125

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
				DISSOLVED OXYGEN SATURATION (PER CENT)			
5/29/81	XHG1537	5.50	24	71.346	43.169	8.8118	60.506
7/24/81			24	86.987	34.258	6.9929	39.383
9/24/81			24	106.92	6.7171	1.3711	6.2821
ALL DATA			72	88.419	34.835	4.1054	39.398
5/29/81	XGG9572	8.50	24	75.658	20.373	4.1586	26.927
7/24/81			24	88.867	20.448	4.1739	23.01
9/24/81			24	100.47	4.3554	.88904	4.3351
ALL DATA			72	88.331	19.499	2.298	22.075
5/29/81	XHH5301	16.00	24	57.033	18.244	3.7241	31.989
7/24/81			21	131.13	45.868	10.009	34.978
9/24/81			21	95.543	10.097	2.2033	10.568
ALL DATA			66	92.864	41.785	5.1434	44.996
5/29/81	XHH8354	21.30	24	87.85	18.815	3.8406	21.417
7/24/81			24	70.633	9.5805	1.9556	13.564
9/24/81			24	93.267	16.602	3.389	17.801
ALL DATA			72	83.917	18.114	2.1348	21.586
5/29/81	XIH2463	28.00	24	85.287	9.7255	1.9852	11.403
7/24/81			24	70.921	8.8455	1.8056	12.472
9/24/81			24	95.512	4.8394	.98783	5.0667
ALL DATA			72	83.907	12.913	1.5218	15.39
5/29/81	CYR0004	41.00	14	77.671	5.1981	1.3893	6.6925
7/24/81			8	99.487	34.541	12.212	34.719
9/24/81			14	74.129	17.425	4.6571	23.507
ALL DATA			36	81.142	21.514	3.5857	26.514
			BOD5	(MG/L)			
5/29/81	XHG1537	5.50					
7/24/81			2	5	5.6569	4	113.14
9/24/81			2	1.5	.70711	0.5	47.14
ALL DATA			4	3.25	3.8622	1.9311	118.84
5/29/81	XGG9572	8.50					
7/24/81			2	4	1.4142	1	35.355
9/24/81			2	1	0	0	0
ALL DATA			4	2.5	1.9149	.95743	76.594
5/29/81	XHH5301	16.00	4	2.75	0.5	0.25	18.182
7/24/81			2	3	2.8284	2	94.281
9/24/81			2	1.5	.70711	0.5	47.14
ALL DATA			8	2.5	1.3093	.46291	52.372
5/29/81	XHH8354	21.30					
7/24/81			2	3.5	3.5355	2.5	101.02
9/24/81			2	2.5	.70711	0.5	28.284
ALL DATA			4	3	2.1602	1.0801	72.008
5/29/81	XIH2463	28.00					
7/24/81			2	8.5	6.364	4.5	74.87
9/24/81			2	2.5	.70711	0.5	28.284
ALL DATA			4	5.5	5.0662	2.5331	92.113
5/29/81	CYR0004	41.00					
7/24/81			1	38			
9/24/81			2	2	0	0	0
ALL DATA			3	14	20.785	12	148.46

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
			BOD20	(MG/L)			
5/29/81	XHG1537	5.50					
7/24/81			2	10.5	7.7782	5.5	74.078
9/24/81			2	4.5	.70711	0.5	15.713
ALL DATA			4	7.5	5.6862	2.8431	75.817
5/29/81	XGG9572	8.50					
7/24/81							
9/24/81			2	4	0	0	0
ALL DATA			2	4	0	0	0
5/29/81	XHH5301	16.00					
7/24/81			2	7	4.2426	3	60.609
9/24/81			2	5.5	.70711	0.5	12.856
ALL DATA			4	6.25	2.63	1.315	42.079
5/29/81	XHH8354	21.30					
7/24/81							
9/24/81			2	6	1.4142	1	23.57
ALL DATA			2	6	1.4142	1	23.57
5/29/81	XIH2463	28.00					
7/24/81							
9/24/81			2	7.5	.70711	0.5	9.4281
ALL DATA			2	7.5	.70711	0.5	9.4281
5/29/81	CYR0004	41.00					
7/24/81			1	96			
9/24/81			2	5.5	.70711	0.5	12.856
ALL DATA			3	35.667	52.253	30.168	146.5
			FIELD PH	(STD. UNITS)			
5/29/81	XHG1537	5.50	24	7.6333	.40397	.08246	5.2921
7/24/81			23	8.0522	.28263	.05893	3.51
9/24/81			21	7.6095	.35483	.07743	4.663
ALL DATA			68	7.7676	0.4024	0.0488	5.1804
5/29/81	XGG9572	8.50	24	6.4333	.38749	0.0791	6.0231
7/24/81			23	7.5913	.50354	0.105	6.6332
9/24/81			24	7.9208	.15874	0.0324	2.0041
ALL DATA			71	7.3113	0.7448	.08839	10.187
5/29/81	XHH5301	16.00	22	7.5	.50709	.10811	6.7612
7/24/81			22	7.3636	.50667	.10802	6.8806
9/24/81			24	7.0833	.57231	.11682	8.0796
ALL DATA			68	7.3088	.55199	.06694	7.5524
5/29/81	XHH8354	21.30	22	7.1909	1.0212	.21771	14.201
7/24/81			24	7.1792	.27816	.05678	3.8745
9/24/81			24	7.1417	.22826	.04659	3.1961
ALL DATA			70	7.17	.60081	.07181	8.3795
5/29/81	XIH2463	28.00	25	7.584	.37045	.07409	4.8846
7/24/81			24	7.5958	.32367	.06607	4.2612
9/24/81			24	7.6917	0.5021	.10249	6.5278
ALL DATA			73	7.6233	0.4026	.04712	5.2812
5/29/81	CYR0004	41.00	14	6.7929	.31977	.08546	4.7074
7/24/81			8	7.8375	0.8193	.28967	10.454
9/24/81			14	6.3	.41324	.11044	6.5594
ALL DATA			36	6.8333	.76195	.12699	11.151

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
				SALINTY (PPT)			
5/29/81	XHG1537	5.50	24	10.596	1.194	.24372	11.269
7/24/81			24	12.296	.59453	.12136	4.8352
9/24/81			24	14.696	.95119	.19416	6.4725
ALL DATA			72	12.529	1.9334	.22786	15.431
5/29/81	XGG9572	8.50	20	10.645	1.1651	.26051	10.945
7/24/81			24	13.454	1.3875	.28322	10.313
9/24/81			24	14.308	.36465	.07443	2.5485
ALL DATA			68	12.929	1.8517	.22456	14.322
5/29/81	XHH5301	16.00	24	12.254	2.3404	.47773	19.099
7/24/81			21	10.624	.87173	.19023	8.2054
9/24/81			24	12.196	.75151	0.1534	6.162
ALL DATA			69	11.738	1.6789	.20211	14.303
5/29/81	XHH8354	21.30	24	4.3375	.31425	.06415	7.2448
7/24/81			24	5.4042	.33032	.06743	6.1123
9/24/81			24	5.0042	.25105	.05125	5.0168
ALL DATA			72	4.9153	.53297	.06281	10.843
5/29/81	XIH2463	28.00	24	5.0083	.66393	.13552	13.256
7/24/81			24	6.2292	.85286	.17409	13.691
9/24/81			23	5.787	.82037	.17106	14.176
ALL DATA			71	5.6732	.92581	.10987	16.319
5/29/81	CYR0004	41.00	14	0.1	0	0	0
7/24/81			8	0.04	.01195	.00423	29.881
9/24/81			14	.07357	.01598	.00427	21.726
ALL DATA			36	.07639	.02554	.00426	33.434
				TOTAL SOLIDS (MG/L)			
5/29/81	XHG1537	5.50					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XGG9572	8.50					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XHH5301	16.00					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XHH8354	21.30					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XIH2463	28.00					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	CYR0004	41.00	13	277.23	78.936	21.893	28.473
7/24/81			7	126	44.166	16.693	35.053
9/24/81			11	176.82	129.4	39.016	73.183
ALL DATA			31	207.45	111.65	20.053	53.821

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
				SUSPENDED SOLIDS (MG/L)			
5/29/81	XHG1537	5.50	14	34.429	17.293	4.6216	50.227
7/24/81			16	29.688	15.094	3.7735	50.843
9/24/81			16	47.938	20.715	5.1789	43.213
ALL DATA			46	37.478	19.203	2.8313	51.237
5/29/81	XGG9572	8.50	16	34.563	13.176	3.2939	38.121
7/24/81			16	30.875	15.5	3.875	50.202
9/24/81			16	48.25	26.335	6.5838	54.58
ALL DATA			48	37.896	20.26	2.9243	53.463
5/29/81	XHH5301	16.00	16	24.938	14.955	3.7388	59.971
7/24/81			16	21.938	11.369	2.8423	51.826
9/24/81			16	39.313	8.9048	2.2262	22.651
ALL DATA			48	28.729	14.024	2.0242	48.814
5/29/81	XHH8354	21.30	16	36.125	13.976	3.4939	38.687
7/24/81			16	34.313	19.189	4.7973	55.925
9/24/81			15	49.867	28.005	7.2308	56.159
ALL DATA			47	39.894	21.695	3.1645	54.382
5/29/81	XIH2463	28.00	15	59.533	18.154	4.6872	30.493
7/24/81			16	34.438	14.445	3.6113	41.946
9/24/81			16	80.5	49.805	12.451	61.87
ALL DATA			47	58.128	36.704	5.3538	63.143
5/29/81	CYR0004	41.00	14	43.286	8.5613	2.2881	19.779
7/24/81			8	31.875	22.21	7.8523	69.677
9/24/81			14	12.143	5.5311	1.4783	45.55
ALL DATA			36	28.639	18.284	3.0473	63.842
				FILTERED AMMONIA (MG/L)			
5/29/81	XHG1537	5.50	16	.09312	.06226	.01556	66.856
7/24/81			16	.15687	.10818	.02705	68.959
9/24/81			16	.37312	0.9757	.24392	261.49
ALL DATA			48	.20771	.56874	.08209	273.81
5/29/81	XGG9572	8.50	16	.07937	.07113	.01778	89.614
7/24/81			16	0.105	.04705	.01176	44.806
9/24/81			16	.07312	.05941	.01485	81.245
ALL DATA			48	.08583	.06035	.00871	70.308
5/29/81	XHH5301	16.00	16	.02187	.01759	0.0044	80.434
7/24/81			16	.06125	0.055	.01375	89.796
9/24/81			16	.13125	.03722	0.0093	28.355
ALL DATA			48	.07146	.05996	.00866	83.915
5/29/81	XHH8354	21.30	16	.05375	0.0539	.01347	100.28
7/24/81			16	.12062	.04919	0.0123	40.779
9/24/81			16	.11937	.06287	.01572	52.668
ALL DATA			48	.09792	.06291	.00908	64.245
5/29/81	XIH2463	28.00	14	.07643	.06308	.01686	82.529
7/24/81			16	.11625	.04349	.01087	37.414
9/24/81			15	.02533	.02997	.00774	118.3
ALL DATA			45	.07356	0.0597	0.0089	81.166
5/29/81	CYR0004	41.00	14	0.16	0.0654	.01748	40.874
7/24/81			8	0.195	.09532	0.0337	48.882
9/24/81			14	.07429	.15073	.04028	202.9
ALL DATA			36	.13444	.11996	.01999	89.229

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
				FILTERED NITRITE (MG/L)			
5/29/81	XHG1537	5.50	16	.01169	.00338	845E-6	28.926
7/24/81			16	.00737	.00175	437E-6	23.68
9/24/81			16	.07925	0.0144	0.0036	18.172
ALL DATA			48	.03277	.03431	.00495	104.69
5/29/81	XGG9572	8.50	16	.01381	.00486	.00122	35.193
7/24/81			16	.00362	.00316	790E-6	87.163
9/24/81			16	0.091	.01509	.00377	16.578
ALL DATA			48	.03615	.04047	.00584	111.95
5/29/81	XHH5301	16.00	14	.00657	.00339	906E-6	51.592
7/24/81			16	.00225	.00191	479E-6	85.105
9/24/81			16	.08087	.02975	.00744	36.788
ALL DATA			46	.03091	.04079	.00601	131.94
5/29/81	XHH8354	21.30	16	.00525	.00416	.00104	79.149
7/24/81			16	0.0075	966E-6	242E-6	12.881
9/24/81			16	.07569	.01341	.00335	17.711
ALL DATA			48	.02948	.03398	0.0049	115.25
5/29/81	XIH2463	28.00	12	.00933	.00178	512E-6	19.021
7/24/81			16	.00675	.00153	382E-6	22.63
9/24/81			16	.01494	.00501	.00125	33.559
ALL DATA			44	.01043	.00483	728E-6	46.293
5/29/81	CYR0004	41.00	14	0.037	.01515	.00405	40.947
7/24/81			8	.01425	.00413	.00146	28.995
9/24/81			14	0.0085	.01102	.00294	129.6
ALL DATA			36	.02086	.01758	.00293	84.269
				FILTERED NITRATE (MG/L)			
5/29/81	XHG1537	5.50	16	.16437	.06762	.01691	41.14
7/24/81			16	0.0125	.00577	.00144	46.188
9/24/81			16	.13062	.05409	.01352	41.412
ALL DATA			48	0.1025	.08206	.01184	80.06
5/29/81	XGG9572	8.50	16	.09187	.02287	.00572	24.89
7/24/81			16	.01437	.00629	.00157	43.767
9/24/81			16	0.1375	0.0504	0.0126	36.653
ALL DATA			48	.08125	.06023	.00869	74.135
5/29/81	XHH5301	16.00	14	.02357	.01737	.00464	73.683
7/24/81			16	.02125	.02941	.00735	138.4
9/24/81			16	.08062	.03296	.00824	40.879
ALL DATA			46	.04261	.03907	.00576	91.692
5/29/81	XHH8354	21.30	16	.01812	.01377	.00344	75.966
7/24/81			16	.10875	.17316	.04329	159.23
9/24/81			16	.30875	.60482	.15121	195.89
ALL DATA			48	.14521	.37608	.05428	258.99
5/29/81	XIH2463	28.00	12	.31417	.06868	.01983	21.862
7/24/81			16	0.035	.01592	.00398	45.476
9/24/81			16	.19812	.13829	.03457	69.797
ALL DATA			44	.17045	.14437	.02176	84.695
5/29/81	CYR0004	41.00	14	1.4643	.19555	.05226	13.355
7/24/81			8	1.4412	.73517	.25992	51.009
9/24/81			14	1.285	.20832	.05568	16.211
ALL DATA			36	1.3894	.38162	0.0636	27.466

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
FILTERED TOTAL KJELDAHL NITROGEN (MG/L)							
5/29/81	XHG1537	5.50	16	.44875	.14564	.03641	32.455
7/24/81			16	1.26	.79764	.19941	63.305
9/24/81			16	.84875	.93471	.23368	110.13
ALL DATA			48	0.8525	.77504	.11187	90.914
5/29/81	XGG9572	8.50	16	.61812	0.8893	.22233	143.87
7/24/81			16	.69687	0.1342	.03355	19.257
9/24/81			16	0.6725	.18109	.04527	26.928
ALL DATA			48	0.6625	.51935	.07496	78.392
5/29/81	XHH5301	16.00	16	.40187	0.1185	.02963	29.487
7/24/81			15	1.6413	1.0468	.27029	63.779
9/24/81			16	.64812	.13212	.03303	20.385
ALL DATA			47	.88128	.79436	.11587	90.138
5/29/81	XHH8354	21.30	16	.52187	.20064	.05016	38.446
7/24/81			15	.79733	0.1432	.03697	17.96
9/24/81			16	.67125	.17802	.04451	26.521
ALL DATA			47	.66064	.20623	.03008	31.217
5/29/81	XIH2463	28.00	14	0.61	.10926	0.0292	17.912
7/24/81			16	1.0037	.16796	.04199	16.734
9/24/81			15	.94667	.55261	.14268	58.375
ALL DATA			45	.86222	.37452	.05583	43.437
5/29/81	CYR0004	41.00	14	.99286	.13356	.03569	13.452
7/24/81			8	1.0975	0.3813	.13481	34.743
9/24/81			14	0.75	.33916	.09064	45.222
ALL DATA			36	.92167	.31514	.05252	34.192
TOTAL KJELDAHL NITROGEN (MG/L)							
5/29/81	XHG1537	5.50	16	0.4475	.12551	.03138	28.047
7/24/81			16	1.4306	.24965	.06241	17.451
9/24/81			15	.82267	.23187	.05987	28.185
ALL DATA			47	.90191	.46144	.06731	51.162
5/29/81	XGG9572	8.50	16	0.37	.09409	.02352	25.43
7/24/81			16	1.4281	.40936	.10234	28.664
9/24/81			16	0.785	.15858	.03964	20.201
ALL DATA			48	.86104	0.5078	.07329	58.975
5/29/81	XHH5301	16.00	14	.36714	.11472	.03066	31.246
7/24/81			16	1.5181	.66728	.16682	43.954
9/24/81			16	0.91	.27476	.06869	30.193
ALL DATA			46	0.9563	.63116	.09306	66
5/29/81	XHH8354	21.30	16	0.565	.17675	.04419	31.283
7/24/81			16	1.3037	.70336	.17584	53.949
9/24/81			16	.82812	.20695	.05174	24.991
ALL DATA			48	.89896	.52629	.07596	58.545
5/29/81	XIH2463	28.00	16	.79875	.23146	.05786	28.977
7/24/81			16	1.3287	.39461	.09865	29.698
9/24/81			16	1.0962	.52205	.13051	47.621
ALL DATA			48	1.0746	.44925	.06484	41.807
5/29/81	CYR0004	41.00	14	.81786	.13016	.03479	15.915
7/24/81			8	2.2837	1.6277	.57547	71.272
9/24/81			14	1.1436	0.6708	.17928	58.659
ALL DATA			36	1.2703	1.0131	.16885	79.754

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

TOTAL NITROGEN (MG/L)

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
5/29/81	XHG1537	5.50	8	.30037	.09313	.03293	31.005
7/24/81			8	0.333	0.1289	.04557	38.709
9/24/81			8	.47987	.15383	.05439	32.055
ALL DATA			24	.37108	0.1458	.02976	39.291
5/29/81	XGG9572	8.50	8	.31312	.33663	.11902	107.51
7/24/81			8	.21012	.07817	.02764	37.202
9/24/81			8	0.3815	.09058	.03202	23.742
ALL DATA			24	.30158	.20981	.04283	69.571
5/29/81	XHH5301	16.00	6	.16467	.05045	0.0206	30.639
7/24/81			8	.34437	0.141	.04985	40.942
9/24/81			6	0.351	.05074	.02072	14.457
ALL DATA			20	.29245	.12667	.02832	43.314
5/29/81	XHH8354	21.30	7	.25414	.16784	.06344	66.041
7/24/81			8	0.463	.17254	0.061	37.266
9/24/81			8	.76125	.84293	.29802	110.73
ALL DATA			23	.50317	.53644	.11186	106.61
5/29/81	XIH2463	28.00	6	.81567	.22442	.09162	27.514
7/24/81			8	0.66	.32052	.11332	48.564
9/24/81			6	.59083	.29092	.11877	49.24
ALL DATA			20	.68595	.28606	.06397	41.703
5/29/81	CYR0004	41.00	7	1.5876	0.287	.10848	18.078
7/24/81			4	2.321	.08851	.04426	3.8136
9/24/81			7	1.3823	.18594	.07028	13.451
ALL DATA			18	1.6707	.42339	.09979	25.342

FILTERED TOTAL NITROGEN (MG/L)

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
5/29/81	XHG1537	5.50	16	.17606	.06855	.01714	38.936
7/24/81			16	.01987	0.0071	.00177	35.714
9/24/81			16	.20987	.06319	0.0158	30.11
ALL DATA			48	.13527	.09892	.01428	73.126
5/29/81	XGG9572	8.50	16	.10569	.02456	.00614	23.24
7/24/81			16	0.018	.00651	.00163	36.175
9/24/81			16	0.2285	.05841	0.0146	25.562
ALL DATA			48	0.1174	.09438	.01362	80.392
5/29/81	XHH5301	16.00	14	.03014	.01956	.00523	64.891
7/24/81			16	0.0235	.02905	.00726	123.62
9/24/81			14	.15286	.05602	.01497	36.65
ALL DATA			44	.06677	.07004	.01056	104.89
5/29/81	XHH8354	21.30	16	.02337	.01474	.00368	63.047
7/24/81			16	.11625	.17353	.04338	149.27
9/24/81			16	.38444	.60582	.15145	157.59
ALL DATA			48	.17469	.38826	.05604	222.26
5/29/81	XIH2463	28.00	12	0.3235	.06929	0.02	21.419
7/24/81			16	.04175	.01648	.00412	39.479
9/24/81			16	.21306	.14016	.03504	65.784
ALL DATA			44	.18089	.14643	.02207	80.949
5/29/81	CYR0004	41.00	14	1.5013	.19568	0.0523	13.034
7/24/81			8	1.4555	.73417	.25957	50.441
9/24/81			14	1.2935	.20998	.05612	16.234
ALL DATA			36	1.4103	.38423	.06404	27.245

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
FILTERED PHOSPHORUS (MG/L)							
5/29/81	XHG1537	5.50	16	.06125	.08609	.02152	140.56
7/24/81			16	.02312	.02243	.00561	96.976
9/24/81			16	.03937	.01181	.00295	30.005
ALL DATA			48	.04125	0.0531	.00766	128.73
5/29/81	XGG9572	8.50	16	.07875	.09619	.02405	122.14
7/24/81			16	.03937	.06567	.01642	166.79
9/24/81			16	.04937	.02909	.00727	58.917
ALL DATA			48	.05583	.06989	.01009	125.17
5/29/81	XHH5301	16.00	16	0.065	.05514	.01378	84.825
7/24/81			15	0.026	.01121	.00289	43.124
9/24/81			16	0.04	.01932	.00483	48.305
ALL DATA			47	.04404	.03763	.00549	85.437
5/29/81	XHH8354	21.30	16	0.035	.02733	.00683	78.072
7/24/81			16	.06875	.04856	.01214	70.637
9/24/81			16	.04812	.09799	0.0245	203.62
ALL DATA			48	.05062	.06521	.00941	128.82
5/29/81	XIH2463	28.00	14	0.035	0.0199	.00532	56.867
7/24/81			16	.04687	.04143	.01036	88.379
9/24/81			15	.03867	.00834	.00215	21.564
ALL DATA			45	.04044	.02738	.00408	67.704
5/29/81	CYR0004	41.00	14	.10286	.05469	.01462	53.173
7/24/81			8	.04375	.03068	.01085	70.119
9/24/81			14	.03643	.01082	.00289	29.697
ALL DATA			36	.06389	.04842	.00807	75.787
FILTERED ORTHOPHOSPHORUS (MG/L)							
5/29/81	XHG1537	5.50	16	.01187	.00544	.00136	45.803
7/24/81			16	.01937	.00854	.00213	44.073
9/24/81			16	0.0175	.01291	.00323	73.771
ALL DATA			48	.01625	.00981	.00142	60.382
5/29/81	XGG9572	8.50	16	0.01	0	0	0
7/24/81			16	.02437	.00629	.00157	25.811
9/24/81			16	.03562	.02707	.00677	75.993
ALL DATA			48	.02333	.01894	.00273	81.187
5/29/81	XHH5301	16.00	16	0.01	72E-11	18E-11	716E-8
7/24/81			16	.02625	.00885	.00221	33.717
9/24/81			16	0.03	.00816	.00204	27.217
ALL DATA			48	.02208	0.0111	0.0016	50.268
5/29/81	XHH8354	21.30	16	.01375	0.015	.00375	109.09
7/24/81			16	.05562	.03183	.00796	57.216
9/24/81			16	0.0675	.09706	.02426	143.79
ALL DATA			48	.04562	0.0628	.00906	137.65
5/29/81	XIH2463	28.00	14	.01714	0.0149	.00398	86.91
7/24/81			16	.04625	.03704	.00926	80.078
9/24/81			15	.02067	.00704	.00182	34.052
ALL DATA			45	.02867	.02693	.00402	93.957
5/29/81	CYR0004	41.00	14	.06286	.05165	.01381	82.177
7/24/81			8	.04375	.02615	.00925	59.776
9/24/81			14	.03286	.01541	.00412	46.89
ALL DATA			36	.04694	0.0374	.00623	79.675

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
PARTICULATE ORGANIC CARBON (MG/L)							
5/29/81	XHG1537	5.50	8	1.185	0.6738	.23822	56.861
7/24/81			8	2.1197	1.184	.41862	55.857
9/24/81			8	1.7862	1.4717	.52033	82.392
ALL DATA			24	1.697	1.1748	.23981	69.228
5/29/81	XGG9572	8.50	8	.82212	.27418	.09694	33.35
7/24/81			8	1.3565	0.5507	0.1947	40.597
9/24/81			9	.84922	.63339	.21113	74.585
ALL DATA			25	1.0029	.55275	.11055	55.116
5/29/81	XHH5301	16.00	8	0.8975	.32822	.11604	36.57
7/24/81			8	2.2141	.95062	.33609	42.934
9/24/81			8	1.38	0.4372	.15457	31.681
ALL DATA			24	1.4972	.82136	.16766	54.86
5/29/81	XHH8354	21.30	7	1.9423	1.0294	.38909	53.001
7/24/81			8	3.02	1.6858	0.596	55.82
9/24/81			8	1.7109	1.1093	.39221	64.841
ALL DATA			23	2.2367	1.3914	.29013	62.21
5/29/81	XIH2463	28.00	7	3.3029	1.0774	.40722	32.621
7/24/81			8	4.5225	2.0132	.71179	44.516
9/24/81			6	2.6585	1.5013	0.6129	56.471
ALL DATA			21	3.5834	1.7226	0.3759	48.071
5/29/81	CYR0004	41.00	7	1.2319	.44941	.16986	36.482
7/24/81			4	5.475	4.1277	2.0638	75.391
9/24/81			7	1.4553	0.7161	.27066	49.207
ALL DATA			18	2.2617	2.5284	.59595	111.79
CHLOROPHYLL AC (UG/L)							
5/29/81	XHG1537	5.50	16	5.26	5.0563	1.2641	96.128
7/24/81			16	21.191	23.417	5.8543	110.5
9/24/81			16	2.5012	2.4077	.60193	96.26
ALL DATA			48	9.6508	15.947	2.3018	165.24
5/29/81	XGG9572	8.50	14	6.2993	2.758	.73711	43.783
7/24/81			16	13.336	13.279	3.3197	99.569
9/24/81			8	2.9162	1.5152	.53569	51.956
ALL DATA			38	8.55	9.658	1.5667	112.96
5/29/81	XHH5301	16.00	15	13.583	19.466	5.0261	143.31
7/24/81			16	18.246	12.808	3.2021	70.199
9/24/81			16	5.9544	7.3262	1.8315	123.04
ALL DATA			47	12.573	14.597	2.1292	116.1
5/29/81	XHH8354	21.30	16	12.661	8.9851	2.2463	70.969
7/24/81			16	21.979	14.431	3.6077	65.658
9/24/81			16	7.4462	6.7023	1.6756	90.009
ALL DATA			48	14.029	11.978	1.7288	85.381
5/29/81	XIH2463	28.00	14	14.107	6.9631	1.861	49.359
7/24/81			16	31.579	30.409	7.6022	96.293
9/24/81			16	7.8025	4.3347	1.0837	55.556
ALL DATA			46	17.992	20.875	3.0778	116.02
5/29/81	CYR0004	41.00	14	5.1571	4.4268	1.1831	85.837
7/24/81			8	186.5	96.634	34.165	51.815
9/24/81			14	1.1786	1.08	.28865	91.637
ALL DATA			36	43.908	88.621	14.77	201.83

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
				PHAEOPHYTIN AC (UG/L)			
5/29/81	XHG1537	5.50	16	.38437	.61741	.15435	160.63
7/24/81			16	7.8812	7.1852	1.7963	91.168
9/24/81			16	1.6275	3.1901	.79753	196.01
ALL DATA			48	3.2977	5.5531	.80152	168.39
5/29/81	XGG9572	8.50	14	0.02	.02542	.00679	127.1
7/24/81			16	9.0469	4.9375	1.2344	54.577
9/24/81			8	0.5425	.74185	.26228	136.75
ALL DATA			38	3.9308	5.4383	.88222	138.35
5/29/81	XHH5301	16.00	15	0.01	74E-11	19E-11	739E-8
7/24/81			16	10.718	7.579	1.8948	70.712
9/24/81			16	.61375	1.0286	.25715	167.59
ALL DATA			47	3.8609	6.6283	.96684	171.68
5/29/81	XHH8354	21.30	16	5.0887	9.039	2.2597	177.63
7/24/81			16	13.279	9.9867	2.4967	75.205
9/24/81			16	1.575	1.6934	.42335	107.52
ALL DATA			48	6.6477	9.1312	1.318	137.36
5/29/81	XIH2463	28.00	13	2.78	3.1868	.88385	114.63
7/24/81			16	25.712	23.432	5.858	91.131
9/24/81			16	1.6625	2.7053	.67633	162.73
ALL DATA			45	10.536	17.961	2.6775	170.47
5/29/81	CYR0004	41.00	14	2.9621	7.4481	1.9906	251.44
7/24/81			8	8.5925	15.502	5.4807	180.41
9/24/81			14	.89429	1.1305	.30214	126.42
ALL DATA			36	3.4092	8.8256	1.4709	258.88
				TOTAL DISSOLVED SOLIDS (MG/L)			
5/29/81	XHG1537	5.50					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XGG9572	8.50					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XHH5301	16.00					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XHH8354	21.30					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	XIH2463	28.00					
7/24/81							
9/24/81							
ALL DATA							
5/29/81	CYR0004	41.00	13	234	77.173	21.404	32.98
7/24/81			7	101.29	41.971	15.864	41.438
9/24/81			11	165.64	128.12	38.631	77.352
ALL DATA			31	179.77	104.84	18.83	58.317

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
			PARTICULATE PHOSPHORUS (MG/L)				
5/29/81	XHG1537	5.50	11	.02091	.03807	.01148	182.06
7/24/81			16	.06625	.05999	0.015	90.545
9/24/81			15	0.058	.09503	.02454	163.85
ALL DATA			42	.05143	.07145	.01103	138.93
5/29/81	XGG9572	8.50	9	.03222	.02682	.00894	83.242
7/24/81			15	.09067	.06766	.01747	74.627
9/24/81			14	.02286	.01899	.00507	83.06
ALL DATA			38	.05184	.05511	.00894	106.3
5/29/81	XHH5301	16.00	5	0.016	.00548	.00245	34.233
7/24/81			15	0.062	.03726	.00962	60.102
9/24/81			16	.04875	.02872	.00718	58.919
ALL DATA			36	.04972	.03376	.00563	67.903
5/29/81	XHH8354	21.30	15	.05933	.04267	.01102	71.92
7/24/81			12	.07833	0.0301	.00869	38.427
9/24/81			14	.07929	.04682	.01251	59.047
ALL DATA			41	.07171	0.0411	.00642	57.321
5/29/81	XIH2463	28.00	13	.09769	.07014	.01945	71.794
7/24/81			15	0.122	.04296	.01109	35.215
9/24/81			13	.11308	.07499	0.0208	66.315
ALL DATA			41	.11146	.06255	.00977	56.119
5/29/81	CYR0004	41.00	4	0.0525	.05058	.02529	96.343
7/24/81			8	.22875	.14865	.05256	64.986
9/24/81			8	.01125	.01246	.00441	110.79
ALL DATA			20	0.1065	.13903	.03109	130.54
			FILTERED INORGANIC NITROGEN (MG/L)				
5/29/81	XHG1537	5.50	16	.26919	.09277	.02319	34.465
7/24/81			16	.17675	0.1065	.02663	60.257
9/24/81			16	0.583	.94948	.23737	162.86
ALL DATA			48	.34298	.57005	.08228	166.21
5/29/81	XGG9572	8.50	16	.18506	.07093	.01773	38.325
7/24/81			16	0.123	.04713	.01178	38.316
9/24/81			16	.30162	.09545	.02386	31.646
ALL DATA			48	.20323	.10403	.01502	51.187
5/29/81	XHH5301	16.00	14	.05229	.03569	.00954	68.263
7/24/81			16	.08475	.06096	.01524	71.925
9/24/81			16	.29275	.07547	.01887	25.779
ALL DATA			46	.14722	0.1234	.01819	83.819
5/29/81	XHH8354	21.30	16	.07712	.06334	.01584	82.132
7/24/81			16	.23687	0.1933	.04833	81.605
9/24/81			16	.50381	.62589	.15647	124.23
ALL DATA			48	0.2726	.41215	.05949	151.19
5/29/81	XIH2463	28.00	12	.40683	.11484	.03315	28.229
7/24/81			16	0.158	.04698	.01174	29.731
9/24/81			15	0.2416	.15759	.04069	65.228
ALL DATA			43	0.2566	.15084	0.023	58.784
5/29/81	CYR0004	41.00	14	1.6613	.21745	.05812	13.09
7/24/81			8	1.6505	.79747	.28195	48.317
9/24/81			14	1.3678	.21974	.05873	16.066
ALL DATA			36	1.5447	.42802	.07134	27.708

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

DISSOLVED ORGANIC NITROGEN (MG/L)

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
5/29/81	XHG1537	5.50	16	.35562	0.1146	.02865	32.225
7/24/81			16	1.1031	.77261	.19315	70.039
9/24/81			16	.47562	.22533	.05633	47.375
ALL DATA			48	.64479	.56624	.08173	87.817
5/29/81	XGG9572	8.50	16	.53875	.87353	.21838	162.14
7/24/81			16	.59187	.10815	.02704	18.272
9/24/81			16	.59937	.16234	.04058	27.084
ALL DATA			48	.57667	.50637	.07309	87.81
5/29/81	XHH5301	16.00	16	0.38	0.1205	.03012	31.71
7/24/81			15	1.5767	1.0239	.26437	64.941
9/24/81			16	.51687	.14536	.03634	28.123
ALL DATA			47	.80851	.78521	.11454	97.119
5/29/81	XHH8354	21.30	16	.46812	.21361	0.0534	45.631
7/24/81			15	.67533	.15824	.04086	23.432
9/24/81			16	.55187	.19464	.04866	35.268
ALL DATA			47	.56277	.20529	.02994	36.478
5/29/81	XIH2463	28.00	14	.53357	.13765	.03679	25.798
7/24/81			16	0.8875	.16894	.04223	19.035
9/24/81			15	.92133	.53963	.13933	58.57
ALL DATA			45	.78867	.37181	.05543	47.144
5/29/81	CYR0004	41.00	14	.83286	.16518	.04415	19.833
7/24/81			8	0.9025	.39231	0.1387	43.469
9/24/81			14	.67571	.38304	.10237	56.686
ALL DATA			36	.78722	.32289	.05381	41.016

PARTICULATE NITROGEN (MG/L)

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
5/29/81	XHG1537	5.50	8	.11162	0.038	.01343	34.042
7/24/81			8	.31162	.12543	.04435	40.251
9/24/81			8	.27212	.13934	.04927	51.205
ALL DATA			24	.23179	.13763	.02809	59.377
5/29/81	XGG9572	8.50	8	0.2125	.34339	.12141	161.6
7/24/81			8	0.191	.07843	.02773	41.061
9/24/81			8	0.175	.07439	0.0263	42.507
ALL DATA			24	.19283	.19923	.04067	103.31
5/29/81	XHH5301	16.00	6	0.137	.04334	.01769	31.632
7/24/81			8	.32187	.13635	.04821	42.36
9/24/81			6	0.191	.03707	.01513	19.41
ALL DATA			20	.22715	.12026	.02689	52.942
5/29/81	XHH8354	21.30	7	.23129	.17067	.06451	73.79
7/24/81			8	.38687	.20323	.07185	52.532
9/24/81			8	0.2295	.09383	.03317	40.882
ALL DATA			23	.28478	.17233	.03593	60.514
5/29/81	XIH2463	28.00	6	0.491	.23692	.09672	48.253
7/24/81			8	0.618	.32689	.11557	52.894
9/24/81			6	.39167	.22599	.09226	57.7
ALL DATA			20	0.512	.27753	.06206	54.205
5/29/81	CYR0004	41.00	7	.13386	.06128	.02316	45.78
7/24/81			4	.91875	.75078	.37539	81.718
9/24/81			7	.15343	.07046	.02663	45.921
ALL DATA			18	.31589	.46106	.10867	145.96

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
				CHLOROPHYLL AC/ PARTICULATE PHOSPHORUS (RATIO)			
5/29/81	XHG1537	5.50	4	112.61	70.474	35.237	62.584
7/24/81			16	685.1	987.33	246.83	144.11
9/24/81			14	98.229	119.51	31.94	121.66
ALL DATA			34	376.1	732.56	125.63	194.78
5/29/81	XGG9572	8.50	7	363.7	240.14	90.765	66.027
7/24/81			15	225.78	238.33	61.536	105.56
9/24/81			4	54.625	35.405	17.703	64.815
ALL DATA			26	236.58	235.99	46.281	99.75
5/29/81	XHH5301	16.00	5	809.8	428.36	191.57	52.897
7/24/81			15	334.41	195.84	50.567	58.565
9/24/81			15	195.49	394.67	101.9	201.89
ALL DATA			35	342.78	378.41	63.964	110.39
5/29/81	XHH8354	21.30	15	302.27	295.31	76.248	97.695
7/24/81			12	374.21	263.01	75.924	70.283
9/24/81			14	133.69	118.22	31.595	88.427
ALL DATA			41	265.76	253.42	39.577	95.354
5/29/81	XIH2463	28.00	12	452.07	761.18	219.73	168.38
7/24/81			15	221.17	163.68	42.261	74.007
9/24/81			13	102.22	116.43	32.293	113.9
ALL DATA			40	251.78	444.26	70.244	176.45
5/29/81	CYR0004	41.00	4	99.23	91.836	45.918	92.549
7/24/81			8	1114.8	910.23	321.82	81.65
9/24/81			6	123.75	137.06	55.953	110.75
ALL DATA			18	558.77	781.11	184.11	139.79
				CHLOROPHYLL AC/ PARTICULATE NITROGEN (RATIO)			
5/29/81	XHG1537	5.50	8	31.768	21.325	7.5395	67.126
7/24/81			8	84.54	76.453	27.03	90.434
9/24/81			8	12.073	12.252	4.3318	101.49
ALL DATA			24	42.794	54.22	11.068	126.7
5/29/81	XGG9572	8.50	6	49.169	23.595	9.6326	47.987
7/24/81			8	63.052	34.055	12.04	54.011
9/24/81			4	16.762	5.5546	2.7773	33.137
ALL DATA			18	48.138	31.359	7.3914	65.145
5/29/81	XHH5301	16.00	6	166.55	259.05	105.76	155.54
7/24/81			8	52.097	28.58	10.104	54.858
9/24/81			6	23.022	12.183	4.9736	52.919
ALL DATA			20	77.711	147.35	32.95	189.62
5/29/81	XHH8354	21.30	7	70.759	27.795	10.506	39.282
7/24/81			8	66.565	34.716	12.274	52.153
9/24/81			8	30.925	30.868	10.913	99.816
ALL DATA			23	55.445	35.151	7.3294	63.397
5/29/81	XIH2463	28.00	6	61.903	99.386	40.574	160.55
7/24/81			8	74.247	95.445	33.745	128.55
9/24/81			6	2945.8	7179	2930.8	243.7
ALL DATA			20	932.02	3924.1	877.45	421.03
5/29/81	CYR0004	41.00	7	60.371	52.225	19.739	86.506
7/24/81			4	300.19	113.48	56.741	37.804
9/24/81			7	8.0147	10.374	3.921	129.44
ALL DATA			18	93.303	129.56	30.538	138.86

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
FILTERED INORGANIC NITROGEN / ORTHOPHOSPHORUS (RATIO)							
5/29/81	XHG1537	5.50	16	24.559	10.08	2.5201	41.044
7/24/81			16	9.4406	4.6146	1.1536	48.88
9/24/81			16	35.856	46.157	11.539	128.73
ALL DATA			48	23.285	28.961	4.1802	124.38
5/29/81	XGG9572	8.50	16	18.506	7.0926	1.7731	38.325
7/24/81			16	5.0031	1.3284	0.3321	26.552
9/24/81			16	10.169	3.684	0.921	36.228
ALL DATA			48	11.226	7.2495	1.0464	64.577
5/29/81	XHH5301	16.00	14	5.2286	3.5692	.95391	68.263
7/24/81			16	3.0089	1.5605	.39013	51.864
9/24/81			16	10.841	5.4696	1.3674	50.452
ALL DATA			46	6.4087	5.0983	0.7517	79.553
5/29/81	XHH8354	21.30	16	7.3589	6.5547	1.6387	89.072
7/24/81			16	4.9492	4.6531	1.1633	94.017
9/24/81			16	10.999	12.545	3.1362	114.05
ALL DATA			48	7.7692	8.7843	1.2679	113.06
5/29/81	XIH2463	28.00	12	33.576	17.097	4.9354	50.919
7/24/81			16	4.2546	1.7418	.43546	40.94
9/24/81			15	12.757	8.3498	2.1559	65.454
ALL DATA			43	15.403	15.655	2.3874	101.64
5/29/81	CYR0004	41.00	14	33.019	11.732	3.1354	35.53
7/24/81			8	66.292	88.04	31.127	132.81
9/24/81			14	49.06	20.723	5.5385	42.24
ALL DATA			36	46.651	43.882	7.3137	94.065
PARTICULATE CARBON / PARTICULATE NITROGEN (RATIO)							
5/29/81	XHG1537	5.50	8	10.75	4.7447	1.6775	44.137
7/24/81			8	6.5192	1.4871	.52577	22.811
9/24/81			8	6.1048	1.3417	.47436	21.978
ALL DATA			24	7.7913	3.5594	.72656	45.684
5/29/81	XGG9572	8.50	8	7.8904	3.2676	1.1553	41.413
7/24/81			8	7.1469	.59459	.21022	8.3195
9/24/81			9	5.135	2.5891	.86304	50.421
ALL DATA			25	6.6605	2.6282	.52565	39.46
5/29/81	XHH5301	16.00	8	6.949	1.1236	.39726	16.169
7/24/81			8	6.9238	0.5379	.19018	7.7689
9/24/81			8	6.9659	.67648	.23917	9.7113
ALL DATA			24	6.9462	.78224	.15967	11.261
5/29/81	XHH8354	21.30	7	9.9631	3.5453	1.34	35.584
7/24/81			8	8.5489	5.9183	2.0924	69.228
9/24/81			8	7.3247	2.8478	1.0068	38.879
ALL DATA			23	8.5535	4.2819	.89283	50.06
5/29/81	XIH2463	28.00	7	8.9833	7.1788	2.7133	79.912
7/24/81			8	7.4672	.59796	.21141	8.0079
9/24/81			6	5.9208	2.6409	1.0781	44.603
ALL DATA			21	7.5307	4.3413	.94735	57.647
5/29/81	CYR0004	41.00	7	9.5229	2.2133	.83656	23.242
7/24/81			4	6.175	.35851	.17926	5.8058
9/24/81			7	9.6847	1.9562	.73936	20.198
ALL DATA			18	8.8418	2.2933	.54053	25.937

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
				CHLOROPHYLL AC/ PARTICULATE CARBON (RATIO)			
5/29/81	XHG1537	5.50	8	3.1308	2.2141	0.7828	70.721
7/24/81			8	12.504	8.6614	3.0623	69.268
9/24/81			8	2.0284	2.0657	.73035	101.84
ALL DATA			24	5.8878	6.9767	1.4241	118.49
5/29/81	XGG9572	8.50	6	7.4949	2.6521	1.0827	35.385
7/24/81			8	8.7741	4.6108	1.6301	52.549
9/24/81			4	2.5989	.99393	.49696	38.244
ALL DATA			18	6.9755	4.1378	.97529	59.319
5/29/81	XHH5301	16.00	7	23.794	41.17	15.561	173.02
7/24/81			8	7.6296	4.0644	1.437	53.272
9/24/81			8	3.0575	2.0462	.72342	66.923
ALL DATA			23	10.959	23.41	4.8812	213.61
5/29/81	XHH8354	21.30	7	7.4394	2.8786	1.088	38.694
7/24/81			8	8.8776	4.4934	1.5887	50.615
9/24/81			8	5.461	5.9478	2.1029	108.91
ALL DATA			23	7.2515	4.6988	.97977	64.798
5/29/81	XIH2463	28.00	6	4.8022	3.0486	1.2446	63.483
7/24/81			8	10.192	13.457	4.7578	132.04
9/24/81			6	2935.1	7184.3	2933	244.78
ALL DATA			20	886.04	3934.1	879.68	444.01
5/29/81	CYR0004	41.00	7	6.6849	6.199	2.343	92.731
7/24/81			4	48.136	17.328	8.6642	35.999
9/24/81			7	.79933	.87653	0.3313	109.66
ALL DATA			18	13.607	20.848	4.9138	153.21
				CURRENT SPEED (FEET/SEC)			
5/29/81	XHG1537	5.50	24	.07621	.06266	.01279	82.217
7/24/81			24	.15433	.07585	.01548	49.149
9/24/81							
ALL DATA			48	.11527	.07934	.01145	68.831
5/29/81	XGG9572	8.50	21	0.4149	.22956	.05009	55.328
7/24/81			24	.21279	.10285	.02099	48.334
9/24/81			24	.20525	.10337	0.0211	50.363
ALL DATA			69	.27168	.17835	.02147	65.646
5/29/81	XHH5301	16.00	20	.20335	.11262	.02518	55.381
7/24/81			15	.63547	1.1862	.30626	186.66
9/24/81			18	.16867	.09368	.02208	55.539
ALL DATA			53	.31387	.65432	.08988	208.47
5/29/81	XHH8354	21.30	18	.16239	.13767	.03245	84.779
7/24/81			24	.35875	.25055	.05114	69.84
9/24/81			21	.19971	0.105	.02291	52.577
ALL DATA			63	.24963	.19926	0.0251	79.82
5/29/81	XIH2463	28.00	15	.17567	.16306	0.0421	92.822
7/24/81			24	.21654	.15736	.03212	72.671
9/24/81			24	.39583	.20114	.04106	50.814
ALL DATA			63	.27511	0.1989	.02506	72.297
5/29/81	CYR0004	41.00					
7/24/81							
9/24/81							
ALL DATA							

TABLE 9-1 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY - STATION UNIVARIATE STATISTICS

SURVEY DATE	STATION ID	RIVER MILE	N	MEAN	STANDARD DEVIATION	STANDARD MEAN ERR	COEFF VARIA
				CURRENT DIRECTION (DEGREES)			
5/29/81	XHG1537	5.50	24	203.25	125.7	25.658	61.844
7/24/81			24	196.38	112.94	23.053	57.511
9/24/81							
ALL DATA			48	199.81	118.26	17.07	59.186
5/29/81	XGG9572	8.50	21	180.71	88.164	19.239	48.786
7/24/81			24	153.25	69.954	14.279	45.647
9/24/81			24	73.833	28.961	5.9117	39.225
ALL DATA			69	133.99	79.419	9.5609	59.274
5/29/81	XHH5301	16.00	20	154	92.48	20.679	60.052
7/24/81			24	213.33	93.357	19.056	43.761
9/24/81			21	141.05	79.445	17.336	56.325
ALL DATA			65	171.72	93.273	11.569	54.316
5/29/81	XHH8354	21.30	18	198.17	101.3	23.877	51.119
7/24/81			24	109.38	110.78	22.613	101.29
9/24/81			21	110.29	107.11	23.374	97.123
ALL DATA			63	135.05	112.64	14.191	83.405
5/29/81	XIH2463	28.00	15	147.6	99.111	25.59	67.148
7/24/81			24	129.83	82.18	16.775	63.296
9/24/81			24	184.71	101.34	20.687	54.867
ALL DATA			63	154.97	95.57	12.041	61.671
5/29/81	CYR0004	41.00					
7/24/81							
9/24/81							
ALL DATA							

TABLE 9-2 TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

TEMPERTURE (DEGREES C)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8	8	8	8	8	8	8	8	8
		MEAN	22.162	20.75	16.637	25.525	25.262	25.087	17.563	17.887	18.2
		STD	1.2592	.88156	2.5025	.51755	0.9913	0.4794	.82104	.36031	.45356
		STDERR	.44519	.31168	.88478	.18298	.35048	.16949	.29028	.12739	.16036
		CV	5.6816	4.2485	15.042	2.0276	3.924	1.9109	4.675	2.0143	2.4921
XGG9572	8.50	N	8	8	8	8	8	8	8	8	8
		MEAN	22.063	20.475	19.438	25.375	25.437	25.387	18.187	18.212	18.25
		STD	1.8015	1.7742	2.8213	0.4432	.43074	.48236	.52763	.25877	0.3295
		STDERR	.63694	.62728	.99749	0.1567	.15229	.17054	.18654	.09149	0.1165
		CV	8.1656	8.6653	14.515	1.7466	1.6933	1.9	2.901	1.4208	1.8055
XHH5301	16.00	N	8	8	8	8	8	7	8	8	8
		MEAN	19.2	18.062	18.05	24.2	24.037	26.157	18.112	17.688	17.887
		STD	4.2349	4.1624	4.0553	6.4807	6.5679	.18127	.76427	.37201	.43239
		STDERR	1.4973	1.4716	1.4338	2.2913	2.3221	.06851	.27021	.13153	.15287
		CV	22.057	23.044	22.467	26.78	27.323	.69298	4.2196	2.1032	2.4173
XHH8354	21.30	N	8	8	8	8	8	8	8	8	8
		MEAN	22.425	21.625	21.563	26.875	26.875	26.875	18.487	18.6	18.662
		STD	1.2881	.87627	1.3479	.52847	.73824	.43997	.31368	.25635	.28754
		STDERR	.45542	.30981	.47657	.18684	.26101	.15555	0.1109	.09063	.10166
		CV	5.7442	4.0521	6.2514	1.9664	2.747	1.6371	1.6967	1.3782	1.5407
XIH2463	28.00	N	8	8	8	8	8	8	8	8	8
		MEAN	22.475	22.662	22.938	26.137	25.762	25.8	18.537	18.387	18.362
		STD	1.7044	1.7999	1.6784	1.6379	1.125	1.1784	.47188	.37583	.37393
		STDERR	0.6026	.63638	0.5934	.57908	.39773	.41662	.16684	.13288	0.1322
		CV	7.5836	7.9424	7.3172	6.2664	4.3667	4.5674	2.5456	2.044	2.0364
CYR0004	41.00	N	8		6	8			8		6
		MEAN	23.625		23	24			15.938		14.983
		STD	2.1835		2.3452	1.2247			2.211		1.7555
		STDERR	0.772		.95743	.43301			0.7817		.71667
		CV	9.2425		10.197	5.1031			13.873		11.716

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

TURBIDITY (FTU)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	MIDDLE	BOTTOM	SURVEY 7/24/81 SURFACE	MIDDLE	BOTTOM	SURVEY 9/24/81 SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8			
		MEAN	1.3875		3.0125	3.125		3.625			
		STD	.71801		4.0604	1.4577		2.6693			
		STDERR	.25385		1.4356	.51539		.94373			
		CV	51.748		134.79	46.648		73.635			
XGG9572	8.50	N	8		8	8		8			
		MEAN	0.675		2.15	3.25		7.75			
		STD	.69642		2.269	1.0351		7.3241			
		STDERR	.24622		.80223	.36596		2.5895			
		CV	103.17		105.54	31.849		94.505			
XHH5301	16.00	N	8		8	8		8			
		MEAN	3.5		4.375	7		9			
		STD	1.6036		5.1252	.75593		2.2678			
		STDERR	.56695		1.812	.26726		.80178			
		CV	45.816		117.15	10.799		25.198			
XHH8354	21.30	N	7		7	8		8			
		MEAN	10.714		20.714	13.625		30.75			
		STD	2.2147		12.162	2.7223		9.13			
		STDERR	.83707		4.5967	.96247		3.2279			
		CV	20.67		58.711	19.98		29.691			
XIH2463	28.00	N	8		8	8		8			
		MEAN	25.25		31.125	25.125		42.5			
		STD	6.5192		5.0832	3.3991		5.1824			
		STDERR	2.3049		1.7972	1.2017		1.8323			
		CV	25.819		16.332	13.529		12.194			
CYR0004	41.00	N	8		6	8					
		MEAN	13.75		13.167	9.5					
		STD	1.488		2.4833	2.5635					
		STDERR	0.5261		1.0138	.90633					
		CV	10.822		18.86	26.984					

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH
STATION BY DEPTH RANGE FOR EACH SURVEY

SECCHI DISC (METERS)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	MIDDLE	BOTTOM	SURVEY 7/24/81 SURFACE	MIDDLE	BOTTOM	SURVEY 9/24/81 SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	4			5			4		
		MEAN	1.2			1			1.65		
		STD	.21602			.12247			.23805		
		STDERR	.10801			.05477			.11902		
		CV	18.002			12.247			14.427		
XGG9572	8.50	N				5			4		
		MEAN				0.94			0.9		
		STD				.35071			.08165		
		STDERR				.15684			.04082		
		CV				37.31			9.0722		
XHH5301	16.00	N	5			5			4		
		MEAN	1.08			0.56			0.875		
		STD	.26833			.08944			0.15		
		STDERR	0.12			0.04			0.075		
		CV	24.845			15.972			17.143		
XHH8354	21.30	N									
		MEAN									
		STD									
		STDERR									
		CV									
XIH2463	28.00	N									
		MEAN									
		STD									
		STDERR									
		CV									
CYR0004	41.00	N									
		MEAN									
		STD									
		STDERR									
		CV									

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

DISSOLVED OXYGEN (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8	8	8	8	8	8	8	8	8
		MEAN	9.6625	6.2875	1.95	8.45	7.275	4.3875	9.4625	9.4625	8.9125
		STD	1.4667	1.3994	1.2224	3.065	1.2372	1.3799	.67387	.66319	.24749
		STDERR	.51856	.49477	.43219	1.0836	.43742	.48787	.23825	.23447	0.0875
		CV	15.179	22.257	62.688	36.272	17.006	31.451	7.1215	7.0086	2.7769
XGG9572	8.50	N	8	8	8	8	8	8	8	8	8
		MEAN	7.7625	6.675	4.8	7.875	6.5375	5.975	8.875	8.6625	8.5
		STD	.87495	1.3058	1.081	1.3509	1.4461	1.3499	.55997	.31595	.24495
		STDERR	.30934	.46165	.38219	.47762	.51128	.47725	.19798	0.1117	0.0866
		CV	11.271	19.562	22.521	17.155	22.12	22.592	6.3096	3.6473	2.8818
XHH5301	16.00	N	8	8	8	7	7	7	8	8	8
		MEAN	6.025	5.175	3.725	10.729	10.329	9.0714	8.85	8.2875	8.0875
		STD	1.2848	1.0767	1.3698	2.3085	2.9301	5.0835	1.2	.39074	.42573
		STDERR	.45425	.38067	.48431	.87252	1.1075	1.9214	.42426	.13815	.15052
		CV	21.325	20.806	36.774	21.517	28.369	56.039	13.559	4.7148	5.2641
XHH8354	21.30	N	8	8	8	8	8	8	8	8	8
		MEAN	8.7	7.05	6.6625	5.5875	5.55	5.3625	8.6	8.4625	8.3
		STD	1.2906	.63471	1.5436	1.1128	.46291	.45962	1.2928	1.7671	1.5556
		STDERR	.45631	0.2244	.54574	.39345	.16366	0.1625	.45709	.62477	0.55
		CV	14.835	9.003	23.168	19.916	8.3407	8.571	15.033	20.882	18.743
XIH2463	28.00	N	9	8	8	8	8	8	8	8	8
		MEAN	7.1333	7.3125	6.825	5.775	5.4125	5.5875	8.75	8.6	8.6375
		STD	1.0897	.82017	.62735	0.3151	.40861	1.1667	0.6	.32071	.36228
		STDERR	.36324	.28997	0.2218	0.1114	.14447	0.4125	.21213	.11339	.12809
		CV	15.277	11.216	9.192	5.4562	7.5494	20.881	6.8571	3.7292	4.1943
CYR0004	41.00	N	8		6	8			8		6
		MEAN	6.6125		6.6167	8.3125			7.7625		6.8667
		STD	.48825		.53072	2.7205			1.4111		1.612
		STDERR	.17262		.21667	.96185			.49891		.65811
		CV	7.3838		8.021	32.728			18.179		23.476

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

DISSOLVED OXYGEN SATURATION (PER CENT)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8	8	8	8	8	8	8	8	8
		MEAN	117.44	74.787	21.812	110.01	94.225	56.725	108.2	109.17	103.4
		STD	19.017	17.255	14.772	40.06	15.05	17.677	7.6982	7.5602	3.16
		STDERR	6.7234	6.1005	5.2226	14.163	5.3209	6.2499	2.7217	2.6729	1.1172
		CV	16.193	23.072	67.721	36.414	15.972	31.163	7.1148	6.9248	3.0561
XGG9572	8.50	N	8	8	8	8	8	8	8	8	8
		MEAN	93.312	77.9	55.762	102.87	85.55	78.175	102.57	100.29	98.537
		STD	9.012	16.394	14.122	17.641	19.267	17.997	5.8884	3.3622	2.6419
		STDERR	3.1862	5.7963	4.9929	6.2372	6.812	6.363	2.0819	1.1887	.93406
		CV	9.6578	21.045	25.325	17.148	22.522	23.022	5.7406	3.3525	2.6811
XHH5301	16.00	N	8	8	8	7	7	7	7	7	7
		MEAN	69.95	58.737	42.412	140.13	135.04	118.23	100.29	93.657	92.686
		STD	15.657	11.903	16.388	29.455	38.178	66.191	16.2	4.3378	4.3164
		STDERR	5.5357	4.2084	5.7939	11.133	14.43	25.018	6.1231	1.6395	1.6315
		CV	22.383	20.265	38.639	21.02	28.271	55.986	16.154	4.6315	4.657
XHH8354	21.30	N	8	8	8	8	8	8	8	8	8
		MEAN	103.25	82.287	78.012	71.775	71.262	68.862	94.75	93.4	91.65
		STD	17.067	7.5564	19.944	14.837	6.3241	5.9938	14.636	19.769	17.179
		STDERR	6.0342	2.6716	7.0513	5.2457	2.2359	2.1191	5.1747	6.9895	6.0737
		CV	16.53	9.1829	25.565	20.672	8.8744	8.704	15.447	21.166	18.744
XIH2463	28.00	N	8	8	8	8	8	8	8	8	8
		MEAN	86.45	87.3	82.112	73.625	68.562	70.575	96.862	94.55	95.125
		STD	11.699	9.2079	8.452	5.405	4.496	13.885	6.7747	3.6925	3.7557
		STDERR	4.1362	3.2555	2.9882	1.9109	1.5896	4.9092	2.3952	1.3055	1.3278
		CV	13.532	10.547	10.293	7.3412	6.5575	19.675	6.9942	3.9053	3.9481
CYR0004	41.00	N	8		6	8			8		6
		MEAN	78.05		77.167	99.487			78.675		68.067
		STD	5.4613		5.288	34.541			16.803		17.805
		STDERR	1.9309		2.1588	12.212			5.9408		7.2688
		CV	6.9972		6.8527	34.719			21.358		26.158

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

DISSOLVED OXYGEN SATURATION (PER CENT)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8	8	8	8	8	8	8	8	8
		MEAN	117.44	74.787	21.812	110.01	94.225	56.725	108.2	109.17	103.4
		STD	19.017	17.255	14.772	40.06	15.05	17.677	7.6982	7.5602	3.16
		STDERR	6.7234	6.1005	5.2226	14.163	5.3209	6.2499	2.7217	2.6729	1.1172
		CV	16.193	23.072	67.721	36.414	15.972	31.163	7.1148	6.9248	3.0561
XGG9572	8.50	N	8	8	8	8	8	8	8	8	8
		MEAN	93.312	77.9	55.762	102.87	85.55	78.175	102.57	100.29	98.537
		STD	9.012	16.394	14.122	17.641	19.267	17.997	5.8884	3.3622	2.6419
		STDERR	3.1862	5.7963	4.9929	6.2372	6.812	6.363	2.0819	1.1887	.93406
		CV	9.6578	21.045	25.325	17.148	22.522	23.022	5.7406	3.3525	2.6811
XHH5301	16.00	N	8	8	8	7	7	7	7	7	7
		MEAN	69.95	58.737	42.412	140.13	135.04	118.23	100.29	93.657	92.686
		STD	15.657	11.903	16.388	29.455	38.178	66.191	16.2	4.3378	4.3164
		STDERR	5.5357	4.2084	5.7939	11.133	14.43	25.018	6.1231	1.6395	1.6315
		CV	22.383	20.265	38.639	21.02	28.271	55.986	16.154	4.6315	4.657
XHH8354	21.30	N	8	8	8	8	8	8	8	8	8
		MEAN	103.25	82.287	78.012	71.775	71.262	68.862	94.75	93.4	91.65
		STD	17.067	7.5564	19.944	14.837	6.3241	5.9938	14.636	19.769	17.179
		STDERR	6.0342	2.6716	7.0513	5.2457	2.2359	2.1191	5.1747	6.9895	6.0737
		CV	16.53	9.1829	25.565	20.672	8.8744	8.704	15.447	21.166	18.744
XIH2463	28.00	N	8	8	8	8	8	8	8	8	8
		MEAN	86.45	87.3	82.112	73.625	68.562	70.575	96.862	94.55	95.125
		STD	11.699	9.2079	8.452	5.405	4.496	13.885	6.7747	3.6925	3.7557
		STDERR	4.1362	3.2555	2.9882	1.9109	1.5896	4.9092	2.3952	1.3055	1.3278
		CV	13.532	10.547	10.293	7.3412	6.5575	19.675	6.9942	3.9053	3.9481
CYR0004	41.00	N	8		6	8			8		6
		MEAN	78.05		77.167	99.487			78.675		68.067
		STD	5.4613		5.288	34.541			16.803		17.805
		STDERR	1.9309		2.1588	12.212			5.9408		7.2688
		CV	6.9972		6.8527	34.719			21.358		26.158

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

DISSOLVED OXYGEN SATURATION (PER CENT)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8	8	8	8	8	8	8	8	8
		MEAN	117.44	74.787	21.812	110.01	94.225	56.725	108.2	109.17	103.4
		STD	19.017	17.255	14.772	40.06	15.05	17.677	7.6982	7.5602	3.16
		STDERR	6.7234	6.1005	5.2226	14.163	5.3209	6.2499	2.7217	2.6729	1.1172
		CV	16.193	23.072	67.721	36.414	15.972	31.163	7.1148	6.9248	3.0561
XGG9572	8.50	N	8	8	8	8	8	8	8	8	8
		MEAN	93.312	77.9	55.762	102.87	85.55	78.175	102.57	100.29	98.537
		STD	9.012	16.394	14.122	17.641	19.267	17.997	5.8884	3.3622	2.6419
		STDERR	3.1862	5.7963	4.9929	6.2372	6.812	6.363	2.0819	1.1887	.93406
		CV	9.6578	21.045	25.325	17.148	22.522	23.022	5.7406	3.3525	2.6811
XHH5301	16.00	N	8	8	8	7	7	7	7	7	7
		MEAN	69.95	58.737	42.412	140.13	135.04	118.23	100.29	93.657	92.686
		STD	15.657	11.903	16.388	29.455	38.178	66.191	16.2	4.3378	4.3164
		STDERR	5.5357	4.2084	5.7939	11.133	14.43	25.018	6.1231	1.6395	1.6315
		CV	22.383	20.265	38.639	21.02	28.271	55.986	16.154	4.6315	4.657
XHH8354	21.30	N	8	8	8	8	8	8	8	8	8
		MEAN	103.25	82.287	78.012	71.775	71.262	68.862	94.75	93.4	91.65
		STD	17.067	7.5564	19.944	14.837	6.3241	5.9938	14.636	19.769	17.179
		STDERR	6.0342	2.6716	7.0513	5.2457	2.2359	2.1191	5.1747	6.9895	6.0737
		CV	16.53	9.1829	25.565	20.672	8.8744	8.704	15.447	21.166	18.744
XIH2463	28.00	N	8	8	8	8	8	8	8	8	8
		MEAN	86.45	87.3	82.112	73.625	68.562	70.575	96.862	94.55	95.125
		STD	11.699	9.2079	8.452	5.405	4.496	13.885	6.7747	3.6925	3.7557
		STDERR	4.1362	3.2555	2.9882	1.9109	1.5896	4.9092	2.3952	1.3055	1.3278
		CV	13.532	10.547	10.293	7.3412	6.5575	19.675	6.9942	3.9053	3.9481
CYR0004	41.00	N	8		6	8			8		6
		MEAN	78.05		77.167	99.487			78.675		68.067
		STD	5.4613		5.288	34.541			16.803		17.805
		STDERR	1.9309		2.1588	12.212			5.9408		7.2688
		CV	6.9972		6.8527	34.719			21.358		26.158

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

BOD5 (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	MIDDLE	BOTTOM	SURVEY 7/24/81 SURFACE	MIDDLE	BOTTOM	SURVEY 9/24/81 SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N				1		1	1		1
		MEAN				9		1	2		1
		STD									
		STDERR									
		CV									
XGG9572	8.50	N				1		1	1		1
		MEAN				5		3	1		1
		STD									
		STDERR									
		CV									
XHH5301	16.00	N	2		2	1		1	1		1
		MEAN	3		2.5	5		1	2		1
		STD	0		.70711						
		STDERR	0		0.5						
		CV	0		28.284						
XHH8354	21.30	N				1		1	1		1
		MEAN				6		1	2		3
		STD									
		STDERR									
		CV									
XIH2463	28.00	N				1		1	1		1
		MEAN				13		4	3		2
		STD									
		STDERR									
		CV									
CYR0004	41.00	N				1			1		1
		MEAN				38			2		2
		STD									
		STDERR									
		CV									

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

BOD20 (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N				1		1	1		1
		MEAN				16		5	5		4
		STD									
		STDERR									
		CV									
XGG9572	8.50	N							1		1
		MEAN							4		4
		STD									
		STDERR									
		CV									
XHH5301	16.00	N				1		1	1		1
		MEAN				10		4	6		5
		STD									
		STDERR									
		CV									
XHH8354	21.30	N							1		1
		MEAN							5		7
		STD									
		STDERR									
		CV									
XIH2463	28.00	N							1		1
		MEAN							8		7
		STD									
		STDERR									
		CV									
CYR0004	41.00	N				1			1		1
		MEAN				96			5		6
		STD									
		STDERR									
		CV									

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FIELD PH (STD. UNITS)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8	8	8	8	7	8	7	7	7
		MEAN	7.9	7.6875	7.3125	8.0875	8.0857	7.9875	7.5857	7.6429	7.6
		STD	.27775	.23566	.44861	.25877	.27343	.33568	.38914	.35989	.36968
		STDERR	0.0982	.08332	.15861	.09149	.10335	.11868	.14708	.13603	.13973
		CV	3.5158	3.0655	6.1348	3.1997	3.3816	4.2025	5.1299	4.7089	4.8643
XGG9572	8.50	N	8	8	8	8	8	7	8	8	8
		MEAN	6.55	6.5	6.25	7.75	7.625	7.3714	7.925	7.9125	7.925
		STD	.27775	.42762	.41748	.53184	.36547	.59362	.15811	.18077	.15811
		STDERR	0.0982	.15119	0.1476	.18804	.12921	.22437	0.0559	.06391	0.0559
		CV	4.2404	6.5787	6.6796	6.8625	4.7931	8.0529	1.9951	2.2846	1.9951
XHH5301	16.00	N	8	7	7	7	7	8	8	8	8
		MEAN	7.725	7.3714	7.3714	7.5143	7.3286	7.2625	7.1375	7.0625	7.05
		STD	.41662	.58797	0.4957	0.3579	.57941	.58049	0.6093	.58539	.59761
		STDERR	0.1473	.22223	.18736	.13528	0.219	.20523	.21542	.20697	.21129
		CV	5.3931	7.9764	6.7246	4.763	7.9062	7.9929	8.5366	8.2887	8.4768
XHH8354	21.30	N	8	6	8	8	8	8	8	8	8
		MEAN	7.4375	7.2	6.9375	7.1875	7.175	7.175	7.1625	7.1625	7.1
		STD	.52355	.14142	1.6422	.31368	.28158	.27646	.21339	.20659	.28284
		STDERR	0.1851	.05773	.58062	0.1109	.09955	.09774	.07545	.07304	0.1
		CV	7.0394	1.9642	23.672	4.3642	3.9244	3.8531	2.9793	2.8843	3.9837
XIH2463	28.00	N	9	8	8	8	8	8	8	8	8
		MEAN	7.3889	7.7	7.6875	7.625	7.5875	7.575	7.6375	7.7125	7.725
		STD	.54645	.16903	.15526	.36936	.30443	0.337	.53702	.50267	.53117
		STDERR	.18215	.05976	.05489	.13059	.10763	.11915	.18987	.17772	0.1878
		CV	7.3956	2.1952	2.0197	4.8441	4.0123	4.4489	7.0314	6.5176	6.876
CYR0004	41.00	N	8		6	8			8		6
		MEAN	6.8375		6.7333	7.8375			6.3625		6.2167
		STD	.29246		.37238	0.8193			.35431		.50365
		STDERR	0.1034		.15202	.28967			.12527		.20562
		CV	4.2774		5.5304	10.454			5.5687		8.1017

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

SALINTY (PPT)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8	8	8	8	8	8	8	8	8
		MEAN	9.425	10.25	12.112	12.187	12.337	12.362	14.487	14.875	14.725
		STD	.34122	.31168	.37201	.47641	.85513	.42741	1.1969	.89722	0.8049
		STDERR	.12064	.11019	.13153	.16844	.30233	.15111	.42318	.31721	.28457
		CV	3.6203	3.0408	3.0713	3.909	6.9312	3.4573	8.2619	6.0317	5.4662
XGG9572	8.50	N	7	6	7	8	8	8	8	8	8
		MEAN	9.6	10.433	11.871	13.425	13.437	13.5	14.187	14.337	14.4
		STD	.40415	.64083	.84797	1.629	1.3731	1.3352	.50551	.30208	.25071
		STDERR	.15275	.26162	0.3205	.57593	.48548	.47208	.17872	0.1068	.08864
		CV	4.2098	6.1422	7.1429	12.134	10.219	9.8906	3.563	2.1069	1.7411
XHH5301	16.00	N	8	8	8	7	7	7	8	8	8
		MEAN	11.875	12.15	12.737	10.3	10.786	10.786	11.85	12.05	12.687
		STD	2.2745	2.6295	2.3378	.37417	1.2116	.86106	.68452	.64807	.72789
		STDERR	.80417	.92967	.82655	.14142	.45796	.32545	.24202	.22913	.25735
		CV	19.154	21.642	18.354	3.6327	11.234	7.9834	5.7766	5.3782	5.7371
XHH8354	21.30	N	8	8	8	8	8	8	8	8	8
		MEAN	4.25	4.3437	4.4187	5.325	5.4375	5.45	5.0875	5	4.925
		STD	.23299	.41009	.29269	.19821	.37393	.41057	.18077	0.1069	.38452
		STDERR	.08238	.14499	.10348	.07008	0.1322	.14516	.06391	0.0378	.13595
		CV	5.4822	9.4408	6.6239	3.7222	6.8768	7.5335	3.5533	2.1381	7.8076
XIH2463	28.00	N	8	8	8	8	8	8	8	7	8
		MEAN	4.525	5.125	5.375	6.275	6.3125	6.1	5.8375	5.9429	5.6
		STD	.46522	.47434	.75546	.74594	.99777	.89921	.93646	.62412	.91495
		STDERR	.16448	.16771	.26709	.26373	.35276	.31792	.33109	.23589	.32349
		CV	10.281	9.2554	14.055	11.888	15.806	14.741	16.042	10.502	16.338
CYR0004	41.00	N	8		6	8			8		6
		MEAN	0.1		0.1	0.04			.06875		0.08
		STD	0		0	.01195			.01959		.00632
		STDERR	0		0	.00423			.00693		.00258
		CV	0		0	29.881			28.5		7.9057

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

TOTAL SOLIDS (MG/L)

			SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
STATION	RIVER MILE	STAT	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N									
		MEAN									
		STD									
		STDERR									
		CV									
XGG9572	8.50	N									
		MEAN									
		STD									
		STDERR									
		CV									
XHH5301	16.00	N									
		MEAN									
		STD									
		STDERR									
		CV									
XHH8354	21.30	N									
		MEAN									
		STD									
		STDERR									
		CV									
XIH2463	28.00	N									
		MEAN									
		STD									
		STDERR									
		CV									
CYR0004	41.00	N	7		6	7			6		5
		MEAN	274.29		280.67	126			126.83		236.8
		STD	39.229		114.37	44.166			35.233		179.07
		STDERR	14.827		46.692	16.693			14.384		80.081
		CV	14.302		40.75	35.053			27.779		75.62

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

SUSPENDED SOLIDS (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	7		7	8		8	8		8
		MEAN	35.857		33	24.625		34.75	41.5		54.375
		STD	21.396		13.614	4.2741		20.282	3.9641		28.445
		STDERR	8.0871		5.1455	1.5111		7.1707	1.4015		10.057
		CV	59.671		41.254	17.357		58.365	9.5521		52.313
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	26.25		42.875	22.875		38.875	36.875		59.625
		STD	10.727		9.949	6.9783		17.884	13.974		31.546
		STDERR	3.7926		3.5175	2.4672		6.323	4.9405		11.153
		CV	40.865		23.205	30.506		46.004	37.895		52.907
XHH5301	16.00	N	8		8	8		8	8		8
		MEAN	26.625		23.25	18.125		25.75	33.75		44.875
		STD	20.873		6.0886	5.4363		14.636	7.0255		7.0597
		STDERR	7.3798		2.1527	1.922		5.1746	2.4839		2.496
		CV	78.398		26.188	29.993		56.839	20.816		15.732
XHH8354	21.30	N	8		8	8		8	8		7
		MEAN	25.625		46.625	27.875		40.75	34.125		67.857
		STD	3.3354		12.466	15.496		21.312	6.5995		32.728
		STDERR	1.1792		4.4075	5.4787		7.535	2.3333		12.37
		CV	13.016		26.738	55.591		52.3	19.339		48.231
XIH2463	28.00	N	7		8	8		8	8		8
		MEAN	46.429		71	31.625		37.25	50.625		110.38
		STD	9.7955		15.964	11.624		17.144	8.651		56.573
		STDERR	3.7024		5.6442	4.1098		6.0614	3.0586		20.002
		CV	21.098		22.485	36.757		46.025	17.088		51.256
CYR0004	41.00	N	8		6	8			8		6
		MEAN	39.375		48.5	31.875			12.25		12
		STD	6.2321		8.8938	22.21			7.1464		2.8284
		STDERR	2.2034		3.6309	7.8523			2.5266		1.1547
		CV	15.828		18.338	69.677			58.338		23.57

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED AMMONIA (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	.09625		0.09	0.06		.25375	.59875		0.1475
		STD	.07308		.05425	.03742		.04719	1.3832		.10223
		STDERR	.02584		.01918	.01323		.01668	.48902		.03614
		CV	75.93		60.276	62.361		18.597	231.01		69.305
XGB9572	8.50	N	8		8	8		8	8		8
		MEAN	.03625		0.1225	.08125		.12875	.06375		0.0825
		STD	.05579		.05898	.03682		.04581	.05528		.06563
		STDERR	.01972		.02085	.01302		.01619	.01954		0.0232
		CV	153.9		48.146	45.311		35.578	86.706		79.55
XHH5301	16.00	N	8		8	8		8	8		8
		MEAN	0.0125		.03125	.02875		.09375	.12375		.13875
		STD	.00707		.02031	.02167		.05999	.04173		.03314
		STDERR	0.0025		.00718	.00766		.02121	.01475		.01172
		CV	56.569		64.992	75.378		63.984	33.718		23.884
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	.06375		.04375	0.1		.14125	0.1275		.11125
		STD	.06368		.04406	.05503		.03441	.06409		0.0649
		STDERR	.02251		.01558	.01946		.01217	.02266		.02295
		CV	99.893		100.7	55.032		24.36	50.264		58.34
XIH2463	28.00	N	7		7	8		8	8		7
		MEAN	.09571		.05714	.10375		.12875	.02875		.02143
		STD	.06294		.06157	.04033		.04549	.03441		0.0261
		STDERR	.02379		.02327	.01426		.01608	.01217		.00986
		CV	65.762		107.74	38.876		35.335	119.68		121.78
CYR0004	41.00	N	8		6	8			8		6
		MEAN	.17125		0.145	0.195			0.105		.03333
		STD	.06896		.06317	.09532			.19676		0.0367
		STDERR	.02438		.02579	0.0337			.06956		.01498
		CV	40.268		43.563	48.882			187.39		110.09

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED NITRITE (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	.01187		0.0115	.00762		.00712	.08075		.07775
		STD	.00173		.00463	.00233		991E-6	.01699		.01228
		STDERR	611E-6		.00164	822E-6		350E-6	.00601		.00434
		CV	14.542		40.253	30.506		13.909	21.034		15.794
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	.01362		0.014	0.004		.00325	0.0875		0.0945
		STD	.00407		.00583	.00334		.00315	.01737		.01257
		STDERR	.00144		.00206	.00118		.00111	.00614		.00444
		CV	29.861		41.65	83.452		96.953	19.851		13.301
XHH5301	16.00	N	7		7	8		8	8		8
		MEAN	0.005		.00814	0.002		0.0025	.08012		.08162
		STD	.00408		.00157	.00185		.00207	.03054		.03103
		STDERR	.00154		595E-6	655E-6		732E-6	0.0108		.01097
		CV	81.65		19.325	92.582		82.808	38.121		38.009
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	.00387		.00662	0.0075		0.0075	.06662		.08475
		STD	.00327		.00469	926E-6		.00107	.01208		.00717
		STDERR	.00116		.00166	327E-6		378E-6	.00427		.00253
		CV	84.401		70.77	12.344		14.254	18.135		8.4559
XIH2463	28.00	N	6		6	8		8	8		8
		MEAN	0.01		.00867	.00725		.00625	0.0145		.01537
		STD	.00141		.00197	.00183		.00104	0.0059		.00431
		STDERR	577E-6		803E-6	648E-6		366E-6	.00209		.00152
		CV	14.142		22.689	25.272		16.562	40.717		28.016
CYR0004	41.00	N	8		6	8			8		6
		MEAN	.03787		.03583	.01425			.00612		.01167
		STD	.02042		.00319	.00413			0.0027		.01686
		STDERR	.00722		0.0013	.00146			953E-6		.00688
		CV	53.915		8.8982	28.995			44.015		144.52

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED NITRATE (MG/L)

			SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
STATION	RIVER MILE	STAT	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	0.18		.14875	.01375		.01125	.13125		0.13
		STD	0.0637		0.072	.00744		.00354	.04704		0.0637
		STDERR	.02252		.02546	.00263		.00125	.01663		.02252
		CV	35.387		48.403	54.111		31.427	35.838		48.997
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	.09375		0.09	0.0125		.01625	0.1225		0.1525
		STD	.03114		.01195	.00463		.00744	.04234		0.056
		STDERR	.01101		.00423	.00164		.00263	.01497		0.0198
		CV	33.215		13.28	37.033		45.786	34.565		36.72
XHH5301	16.00	N	7		7	8		8	8		8
		MEAN	.01714		0.03	0.02		0.0225	.07875		0.0825
		STD	0.0189		.01414	.02449		.03536	.02532		.04097
		STDERR	.00714		.00535	.00866		0.0125	.00895		.01449
		CV	110.24		47.14	122.47		157.13	32.152		49.661
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	0.0175		.01875	.11375		.10375	0.1625		0.455
		STD	.01165		.01642	.21064		.14081	.12209		.84858
		STDERR	.00412		.00581	.07447		.04978	.04317		.30002
		CV	66.569		87.578	185.18		135.72	75.135		186.5
XIH2463	28.00	N	6		6	8		8	8		8
		MEAN	.33667		.29167	0.03		0.04	.24125		0.155
		STD	.02944		.09109	.01195		.01852	.19052		0.0207
		STDERR	.01202		.03719	.00423		.00655	.06736		.00732
		CV	8.7443		31.23	39.841		46.291	78.972		13.356
CYR0004	41.00	N	8		6	8			8		6
		MEAN	1.5162		1.395	1.4412			1.275		1.2983
		STD	.03068		0.2967	.73517			.24536		.16786
		STDERR	.01085		.12113	.25992			.08675		.06853
		CV	2.0232		21.269	51.009			19.244		12.929

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED TOTAL KJELDAHL NITROGEN (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	0.4825		0.415	.98625		1.5337	1.01		0.6875
		STD	.16757		.12154	.22399		1.0686	1.3338		.18398
		STDERR	.05924		.04297	.07919		0.3778	.47156		.06505
		CV	34.729		29.286	22.711		69.672	132.06		26.761
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	0.365		.87125	.63375		0.76	0.615		0.73
		STD	0.1065		1.2397	.09899		.14031	.18338		.17055
		STDERR	.03765		.43831	0.035		.04961	.06483		0.0603
		CV	29.179		142.29	15.619		18.461	29.818		23.362
XHH5301	16.00	N	8		8	8		7	8		8
		MEAN	.41625		0.3875	1.1587		2.1929	.67375		0.6225
		STD	.09365		0.1444	0.3969		1.3068	0.1732		.07686
		STDERR	.03311		.05105	.14032		.49394	.06124		.02717
		CV	22.498		37.263	34.252		59.595	25.707		12.347
XHH8354	21.30	N	8		8	7		8	8		8
		MEAN	.53875		0.505	0.8		0.795	0.6575		0.685
		STD	.22029		.19258	.14213		0.1539	.19114		.17591
		STDERR	.07788		.06809	.05372		.05441	.06758		.06219
		CV	40.889		38.134	17.766		19.359	29.071		25.68
XIH2463	28.00	N	7		7	8		8	8		7
		MEAN	0.64		0.58	.96125		1.0462	1.0087		.87571
		STD	.14177		.06055	0.0861		.22116	.63793		.47619
		STDERR	.05359		.02289	.03044		.07819	.22554		.17998
		CV	22.152		10.44	8.9566		21.139	63.24		54.378
CYR0004	41.00	N	8		6	8			8		6
		MEAN	0.915		1.0967	1.0975			.71125		.80167
		STD	.10461		0.0918	0.3813			.39862		.26649
		STDERR	.03698		.03748	.13481			.14093		.10879
		CV	11.433		8.3705	34.743			56.045		33.242

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

TOTAL KJELDAHL NITROGEN (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8	7		8
		MEAN	0.455		0.44	1.4075		1.4537	.85286		.79625
		STD	.14233		.11563	.20576		0.3	.25617		.22264
		STDERR	.05032		.04088	.07275		.10606	.09682		.07872
		CV	31.281		26.281	14.619		20.636	30.037		27.961
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	.32875		.41125	1.36		1.4962	.72875		.84125
		STD	.07972		.09342	.24142		0.5387	.11445		.18318
		STDERR	.02819		.03303	.08536		.19046	.04046		.06476
		CV	24.25		22.715	17.752		36.003	15.705		21.775
XHH5301	16.00	N	7		7	8		8	8		8
		MEAN	.40857		.32571	1.6825		1.3537	.95875		.86125
		STD	.10931		.11208	.91771		.22399	.15348		0.3644
		STDERR	.04131		.04236	.32446		.07919	.05426		.12883
		CV	26.753		34.41	54.544		16.546	16.008		42.31
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	0.5275		0.6025	1.4362		1.1712	0.7725		.88375
		STD	.13221		.21506	.98211		.23546	0.1444		0.2527
		STDERR	.04674		.07603	.34723		.08325	.05105		.08934
		CV	25.063		35.694	68.38		20.103	18.692		28.594
XIH2463	28.00	N	8		8	8		8	8		8
		MEAN	.80625		.79125	1.3675		1.29	.93875		1.2537
		STD	.27764		.19387	.46906		.33201	.44322		0.5752
		STDERR	.09816		.06854	.16584		.11738	0.1567		.20336
		CV	34.436		24.501	34.301		25.737	47.213		45.878
CYR0004	41.00	N	8		6	8			8		6
		MEAN	.84375		.78333	2.2837			1.0975		1.205
		STD	.12783		.13663	1.6277			.47219		.92188
		STDERR	0.0452		.05578	.57547			.16694		.37636
		CV	15.15		17.442	71.272			43.024		76.505

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

PARTICULATE ORGANIC CARBON (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	4		4	4		4	4		4
		MEAN	1.185		1.185	2.4475		1.792	1.27		2.3025
		STD	.09327		1.025	.98942		1.4162	.32465		2.0586
		STDERR	.04664		0.5125	.49471		.70812	.16233		1.0293
		CV	7.8712		86.499	40.426		79.032	25.563		89.407
XGG9572	8.50	N	4		4	4		4	4	1	4
		MEAN	.88025		0.764	1.1777		1.5352	.97525	0.094	0.912
		STD	.26335		.31152	.35107		.70652	.70467		.59724
		STDERR	.13168		.15576	.17553		.35326	.35234		.29862
		CV	29.918		40.775	29.808		46.02	72.256		65.487
XHH5301	16.00	N	4		4	4		4	4		4
		MEAN	0.954		0.841	2.7825		1.6457	1.521		1.239
		STD	.30347		.38827	.92005		.63294	.58226		0.2323
		STDERR	.15173		.19414	.46002		.31647	.29113		.11615
		CV	31.81		46.168	33.066		38.459	38.282		18.749
XHH8354	21.30	N	4		3	4		4	4		4
		MEAN	2.0875		1.7487	3.42		2.62	1.324		2.0977
		STD	1.2498		.85906	2.0455		1.4212	.51113		1.487
		STDERR	.62488		.49598	1.0228		.71062	.25556		0.7435
		CV	59.869		49.127	59.811		54.246	38.605		70.885
XIH2463	28.00	N	4		3	4		4	2		4
		MEAN	3.375		3.2067	4.89		4.155	3.43		2.2727
		STD	1.0036		1.3954	2.873		.91813	.19799		1.7743
		STDERR	.50182		.80565	1.4365		.45907	0.14		.88716
		CV	29.738		43.517	58.753		22.097	5.7723		78.069
CYR0004	41.00	N	4		3	4			4		3
		MEAN	1.2272		1.238	5.475			1.5517		1.3267
		STD	.31621		.67514	4.1277			0.8235		.69118
		STDERR	.15811		.38979	2.0638			.41175		.39905
		CV	25.766		54.535	75.391			53.069		52.099

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

CHLOROPHYLL AC (UG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	6.28		4.24	12.795		29.587	3.3025		1.7
		STD	6.7948		2.4977	6.6203		31.146	3.2135		.79282
		STDERR	2.4023		.88306	2.3406		11.012	1.1361		.28031
		CV	108.2		58.908	51.741		105.27	97.304		46.637
XGG9572	8.50	N	7		7	8		8	4		4
		MEAN	6.7571		5.8414	14.984		11.689	3.805		2.0275
		STD	2.9599		2.689	18.301		6.06	.77117		1.6296
		STDERR	1.1187		1.0164	6.4703		2.1425	.38558		.81481
		CV	43.804		46.034	122.14		51.845	20.267		80.376
XHH5301	16.00	N	8		7	8		8	8		8
		MEAN	17.849		8.7071	24.537		11.954	7.1037		4.805
		STD	26.589		2.7161	12.784		9.8809	10.122		3.088
		STDERR	9.4005		1.0266	4.5197		3.4934	3.5787		1.0918
		CV	148.97		31.194	52.099		82.66	142.49		64.267
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	16.84		8.4812	23.76		20.197	7.155		7.7375
		STD	9.8189		6.0547	14.563		15.063	6.2402		7.5582
		STDERR	3.4715		2.1406	5.1488		5.3257	2.2062		2.6722
		CV	58.307		71.389	61.292		74.581	87.214		97.683
XIH2463	28.00	N	7		7	8		8	8		8
		MEAN	12.243		15.971	37.05		26.109	7.2687		8.3362
		STD	7.7643		6.0544	39.802		18.135	3.6113		5.1547
		STDERR	2.9346		2.2883	14.072		6.4118	1.2768		1.8225
		CV	63.419		37.908	107.43		69.46	49.683		61.835
CYR0004	41.00	N	8		6	8			8		6
		MEAN	4.6875		5.7833	186.5			0.95		1.4833
		STD	4.0659		5.1945	96.634			1.2012		.90425
		STDERR	1.4375		2.1206	34.165			.42468		.36916
		CV	86.739		89.818	51.815			126.44		60.961

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

PHAEOPHYTIN AC (UG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	.46125		0.3075	9.1675		6.595	2.3275		0.9275
		STD	0.6953		0.5656	8.1752		6.3256	4.4413		0.9809
		STDERR	.24583		.19997	2.8904		2.2364	1.5702		0.3468
		CV	150.74		183.94	89.176		95.915	190.82		105.76
XGG9572	8.50	N	7		7	8		8	4		4
		MEAN	0.02		0.02	8.9862		9.1075	0.615		0.47
		STD	.02646		.02646	5.905		4.1669	1.03		.45738
		STDERR	0.01		0.01	2.0877		1.4732	0.515		.22869
		CV	132.29		132.29	65.712		45.752	167.48		97.316
XHH5301	16.00	N	8		7	8		8	8		8
		MEAN	0.01		0.01	6.7062		14.73	.17625		1.0512
		STD	75E-11		81E-11	5.1319		7.7436	.25399		1.3286
		STDERR	26E-11		30E-11	1.8144		2.7378	0.0898		.46972
		CV	747E-8		807E-8	76.524		52.57	144.11		126.38
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	4.79		5.3875	14.606		11.952	1.5112		1.6387
		STD	10.799		7.6329	11.674		8.5679	1.428		2.0239
		STDERR	3.8179		2.6986	4.1274		3.0292	.50489		.71557
		CV	225.44		141.68	79.925		71.683	94.494		123.5
XIH2463	28.00	N	6		7	8		8	8		8
		MEAN	2.1617		3.31	33.44		17.985	1.2037		2.1212
		STD	3.2387		3.2954	30.299		11.048	1.5226		3.5894
		STDERR	1.3222		1.2456	10.712		3.9061	.53832		1.269
		CV	149.83		99.56	90.606		61.43	126.49		169.21
CYR0004	41.00	N	8		6	8			8		6
		MEAN	5.03		0.205	8.5925			1.0075		.74333
		STD	9.5702		.21361	15.502			1.3922		.74934
		STDERR	3.3836		.08721	5.4807			.49222		.30592
		CV	190.26		104.2	180.41			138.19		100.81

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

TOTAL DISSOLVED SOLIDS (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N									
		MEAN									
		STD									
		STDERR									
		CV									
XGG9572	8.50	N									
		MEAN									
		STD									
		STDERR									
		CV									
XHH5301	16.00	N									
		MEAN									
		STD									
		STDERR									
		CV									
XHH8354	21.30	N									
		MEAN									
		STD									
		STDERR									
		CV									
XIH2463	28.00	N									
		MEAN									
		STD									
		STDERR									
		CV									
CYR0004	41.00	N	7		6	7			6		5
		MEAN	235.57		232.17	101.29			117.17		223.8
		STD	39.862		111.26	41.971			34.868		178.23
		STDERR	15.066		45.423	15.864			14.235		79.708
		CV	16.921		47.924	41.438			29.759		79.639

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

PARTICULATE PHOSPHORUS (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	6		5	8		8	8		7
		MEAN	0.035		0.004	.05875		.07375	.07875		.03429
		STD	.04806		.00894	.03871		0.078	0.128		.02699
		STDERR	.01962		0.004	.01368		.02758	.04525		0.0102
		CV	137.32		223.61	65.884		105.76	162.54		78.727
XGG9572	8.50	N	5		4	7		8	7		7
		MEAN	0.04		0.0225	.08286		0.0975	.02857		.01714
		STD	.03391		.01258	.03402		.08972	0.0241		.01113
		STDERR	.01517		.00629	.01286		.03172	.00911		.00421
		CV	84.779		55.925	41.055		92.022	84.36		64.907
XHH5301	16.00	N	2		3	8		7	8		8
		MEAN	0.02		.01333	0.0675		.05571	.04375		.05375
		STD	0		.00577	.02493		.04928	.03068		.02774
		STDERR	0		.00333	.00881		.01863	.01085		.00981
		CV	0		43.301	36.931		88.452	70.119		51.614
XHH8354	21.30	N	7		8	6		6	7		7
		MEAN	.04143		0.075	.06833		.08833	.06286		.09571
		STD	0.0234		.05071	.03545		.02229	.01976		.06106
		STDERR	.00884		.01793	.01447		0.0091	.00747		.02308
		CV	56.486		67.612	51.877		25.229	31.437		63.796
XIH2463	28.00	N	7		6	7		8	6		7
		MEAN	0.1		0.095	.11571		0.1275	.07333		.14714
		STD	.07095		.07583	.05127		.03694	0.0432		0.0822
		STDERR	.02682		.03096	.01938		.01306	.01764		.03107
		CV	70.946		79.82	44.307		28.97	58.916		55.865
CYR0004	41.00	N	4			8			4		4
		MEAN	0.0525			.22875			0.015		0.0075
		STD	.05058			.14865			.01732		0.005
		STDERR	.02529			.05256			.00866		0.0025
		CV	96.343			64.986			115.47		66.667

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

TOTAL NITROGEN (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	4		4	4		4	4		4
		MEAN	.33125		0.2695	.38975		.27625	0.4085		.55125
		STD	.09703		0.091	.13025		.11496	.05145		.19743
		STDERR	.04852		0.0455	.06512		.05748	.02572		.09872
		CV	29.292		33.766	33.418		41.615	12.595		35.816
XBG9572	8.50	N	4		4	4		4	4		4
		MEAN	0.4405		.18575	.18525		0.235	.37225		.39075
		STD	.46994		0.0174	.04458		.10306	.11725		.07188
		STDERR	.23497		0.0087	.02229		.05153	.05863		.03594
		CV	106.68		9.3699	24.066		43.854	31.498		18.395
XHH5301	16.00	N	3		3	4		4	3		3
		MEAN	0.148		.18133	0.4295		.25925	.31733		.38467
		STD	.02272		.07081	.11635		0.1163	.05465		.00709
		STDERR	.01311		.04088	.05818		.05815	.03155		0.0041
		CV	15.348		39.051	27.09		44.859	17.221		1.8444
XHH8354	21.30	N	4		3	4		4	4		4
		MEAN	0.2635		.24167	.45475		.47125	.41125		1.1112
		STD	0.2074		.13993	.24248		.10239	.11523		1.148
		STDERR	0.1037		.08079	.12124		.05119	.05762		.57401
		CV	78.709		57.902	53.322		21.727	28.02		103.31
XIH2463	28.00	N	3		3	4		4	2		4
		MEAN	.76233		0.869	.74575		.57425	0.8415		0.4655
		STD	.33491		.07219	.45542		.11269	0.3288		0.2054
		STDERR	.19336		.04168	.22771		.05634	0.2325		0.1027
		CV	43.933		8.3069	61.069		19.623	39.074		44.125
CYR0004	41.00	N	4		3	4			4		3
		MEAN	1.68		1.4643	2.321			1.4037		1.3537
		STD	.01369		.45494	.08851			.20501		.19627
		STDERR	.00684		.26266	.04426			.10251		.11332
		CV	0.8147		31.068	3.8136			14.605		14.499

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED TOTAL NITROGEN (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	MIDDLE	BOTTOM	SURVEY 7/24/81 SURFACE	MIDDLE	BOTTOM	SURVEY 9/24/81 SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	.19187		.16025	.02137		.01837	0.212		.20775
		STD	.06376		.07371	.00962		0.0032	.05881		.07133
		STDERR	.02254		.02606	0.0034		.00113	.02079		.02522
		CV	33.232		45.994	45.008		17.439	27.742		34.334
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	.10737		0.104	0.0165		0.0195	0.21		0.247
		STD	.03283		.01443	.00595		.00709	.05082		.06281
		STDERR	.01161		0.0051	0.0021		.00251	.01797		.02221
		CV	30.578		13.877	36.074		36.365	24.202		25.429
XHH5301	16.00	N	7		7	8		8	7		7
		MEAN	.02214		.03814	0.022		0.025	.15586		.14986
		STD	.02138		.01492	.02433		.03481	.05656		.05984
		STDERR	.00808		.00564	0.0086		.01231	.02138		.02262
		CV	96.559		39.105	110.6		139.22	36.286		39.929
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	.02137		.02537	.12125		.11125	.22912		.53975
		STD	.01095		.01834	.21079		.14156	.12619		.84581
		STDERR	.00387		.00648	.07453		.05005	.04461		.29904
		CV	51.245		72.266	173.85		127.24	55.075		156.7
XIH2463	28.00	N	6		6	8		8	8		8
		MEAN	.34667		.30033	.03725		.04625	.25575		.17037
		STD	.03001		.09151	0.013		.01915	0.1933		.02378
		STDERR	.01225		.03736	0.0046		.00677	.06834		.00841
		CV	8.6571		30.469	34.907		41.409	75.583		13.96
CYR0004	41.00	N	8		6	8			8		6
		MEAN	1.5541		1.4308	1.4555			1.2811		1.31
		STD	.03229		0.2961	.73417			.24574		.17185
		STDERR	.01142		.12088	.25957			.08688		.07016
		CV	2.0777		20.694	50.441			19.181		13.118

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED PHOSPHORUS (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	0.0775		0.045	0.025		.02125	.03625		0.0425
		STD	.11449		0.0466	.02976		.01356	.01188		.01165
		STDERR	.04048		.01648	.01052		.00479	0.0042		.00412
		CV	147.72		103.55	119.04		63.821	32.765		27.411
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	0.0625		0.095	0.0525		.02625	.05125		0.0475
		STD	.07978		.11339	.09239		.01768	.03563		.02315
		STDERR	.02821		.04009	.03266		.00625	0.0126		.00818
		CV	127.64		119.36	175.98		67.344	69.526		48.727
XHH5301	16.00	N	8		8	8		7	8		8
		MEAN	.05375		.07625	0.02		.03286	.04375		.03625
		STD	0.0256		.07463	.01069		.00756	.02387		.01408
		STDERR	.00905		.02639	.00378		.00286	.00844		.00498
		CV	47.628		97.875	53.452		23.007	54.554		38.838
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	0.0475		0.0225	0.07		0.0675	0.025		.07125
		STD	.03151		.01581	.05477		.04528	0.0207		.13757
		STDERR	.01114		.00559	.01936		.01601	.00732		.04864
		CV	66.336		70.273	78.246		67.077	82.808		193.09
XIH2463	28.00	N	7		7	8		8	8		7
		MEAN	.03143		.03857	0.0525		.04125	0.04		.03714
		STD	0.009		.02734	0.058		.01553	.00926		.00756
		STDERR	0.0034		.01033	.02051		.00549	.00327		.00286
		CV	28.628		70.888	110.48		37.64	23.146		20.352
CYR0004	41.00	N	8		6	8			8		6
		MEAN	0.0775		.13667	.04375			.03625		.03667
		STD	.02712		.06593	.03068			.01061		.01211
		STDERR	.00959		.02692	.01085			.00375		.00494
		CV	34.999		48.241	70.119			29.26		33.029

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED ORTHOPHOSPHORUS (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	MIDDLE	BOTTOM	SURVEY 7/24/81 SURFACE	MIDDLE	BOTTOM	SURVEY 9/24/81 SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	.01375		0.01	.01375		0.025	0.015		0.02
		STD	.00744		0	.00518		.00756	.00756		0.0169
		STDERR	.00263		0	.00183		.00267	.00267		.00598
		CV	54.111		0	37.64		30.237	50.395		84.515
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	0.01		0.01	.02125		0.0275	.03625		0.035
		STD	0		0	.00354		.00707	.03852		.00926
		STDERR	0		0	.00125		0.0025	.01362		.00327
		CV	0		0	16.638		25.713	106.27		26.452
XHH5301	16.00	N	8		8	8		8	8		8
		MEAN	0.01		0.01	0.02		0.0325	.03125		.02875
		STD	75E-11		75E-11	.00535		.00707	.00641		.00991
		STDERR	26E-11		26E-11	.00189		0.0025	.00227		0.0035
		CV	747E-8		747E-8	26.726		21.757	20.508		34.471
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	0.0175		0.01	0.04		.07125	0.04		0.095
		STD	.02121		0	.00926		.03907	.00926		.13554
		STDERR	0.0075		0	.00327		.01381	.00327		.04792
		CV	121.22		0	23.146		54.841	23.146		142.67
XIH2463	28.00	N	7		7	8		8	8		7
		MEAN	.01286		.02143	0.0525		0.04	0.02		.02143
		STD	.00488		.02035	0.0523		.01069	.00535		0.009
		STDERR	.00184		.00769	.01849		.00378	.00189		0.0034
		CV	37.952		94.985	99.627		26.726	26.726		41.988
CYR0004	41.00	N	8		6	8			8		6
		MEAN	0.0475		.08333	.04375			0.03		.03667
		STD	.01035		.07685	.02615			.01309		.01862
		STDERR	.00366		.03138	.00925			.00463		0.0076
		CV	21.792		92.226	59.776			43.644		50.779

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

PARTICULATE NITROGEN (MG/L)

			SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
STATION	RIVER MILE	STAT	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	4		4	4		4	4		4
		MEAN	0.1265		.09675	.36375		0.2595	0.221		.32325
		STD	.04319		.03024	.12743		.11501	.04802		.18981
		STDERR	.02159		.01512	.06371		0.0575	.02401		.09491
		CV	34.139		31.252	35.032		44.319	21.729		58.72
XGG9572	8.50	N	4		4	4		4	4		4
		MEAN	0.338		0.087	0.166		0.216	.16725		.18275
		STD	.48197		.02911	.05044		0.1007	.10129		.04991
		STDERR	.24099		.01455	.02522		.05035	.05065		.02495
		CV	142.59		33.459	30.388		46.621	60.564		27.31
XHH5301	16.00	N	3		3	4		4	3		3
		MEAN	.13533		.13867	0.3975		.24625	.17167		.21033
		STD	.02458		.06389	.12095		.11618	.04725		.00907
		STDERR	.01419		.03689	.06048		.05809	.02728		.00524
		CV	18.165		46.077	30.428		47.178	27.523		4.314
XHH8354	21.30	N	4		3	4		4	4		4
		MEAN	0.244		.21433	.38475		0.389	0.2175		0.2415
		STD	.21437		.13303	.27418		.14556	.11951		.07664
		STDERR	.10718		0.0768	.13709		.07278	.05976		.03832
		CV	87.855		62.066	71.261		37.42	54.949		31.733
XIH2463	28.00	N	3		3	4		4	2		4
		MEAN	.39867		.58333	.70575		.53025	0.578		0.2985
		STD	.31366		.12795	.46287		.12063	.12445		.21269
		STDERR	.18109		.07387	.23143		.06031	0.088		.10635
		CV	78.678		21.934	65.585		22.749	21.531		71.253
CYR0004	41.00	N	4		3	4			4		3
		MEAN	0.125		.14567	.91875			0.154		.15267
		STD	.03843		.09319	.75078			0.0604		.09704
		STDERR	.01921		0.0538	.37539			0.0302		.05603
		CV	30.742		63.975	81.718			39.224		63.565

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

DISSOLVED ORGANIC NITROGEN (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	.38625		0.325	.92625		1.28	.41125		0.54
		STD	.13511		.08799	.19719		1.0811	.22668		.21896
		STDERR	.04777		.03111	.06972		.38222	.08014		.07741
		CV	34.981		27.075	21.289		84.46	55.12		40.548
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	.32875		.74875	0.5525		.63125	.55125		0.6475
		STD	.10575		1.2342	.09177		.11445	0.1786		.13885
		STDERR	.03739		.43634	.03245		.04046	.06314		.04909
		CV	32.169		164.83	16.61		18.13	32.399		21.444
XHH5301	16.00	N	8		8	8		7	8		8
		MEAN	.40375		.35625	1.13		2.0871	0.55		.48375
		STD	0.0938		.14501	.38848		1.3039	.19376		0.0723
		STDERR	.03316		.05127	.13735		.49282	0.0685		.02556
		CV	23.232		40.703	34.378		62.472	35.229		14.945
XHH8354	21.30	N	8		8	7		8	8		8
		MEAN	0.475		.46125	0.7		.65375	0.53		.57375
		STD	.24681		.19172	.17108		.15445	.20029		.19992
		STDERR	.08726		.06778	.06466		.05461	.07081		.07068
		CV	51.96		41.565	24.439		23.626	37.79		34.845
XIH2463	28.00	N	7		7	8		8	8		7
		MEAN	.54429		.52286	0.8575		0.9175	0.98		.85429
		STD	.18201		.08751	.10977		.21691	0.6239		.46421
		STDERR	.06879		.03307	.03881		.07669	.22058		.17546
		CV	33.441		16.736	12.801		23.641	63.664		54.339
CYR0004	41.00	N	8		6	8			8		6
		MEAN	.74375		.95167	0.9025			.60625		.76833
		STD	.12212		.14289	.39231			.46399		.24911
		STDERR	.04317		.05833	0.1387			.16404		0.1017
		CV	16.419		15.014	43.469			76.534		32.422

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED INORGANIC NITROGEN (MG/L)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	.28812		.25025	.08137		.27212	.81075		.35525
		STD	.09018		.09743	.03834		.04522	1.3375		.15606
		STDERR	.03188		.03445	.01355		.01599	.47288		.05517
		CV	31.297		38.933	47.111		16.619	164.97		43.929
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	.14362		0.2265	.09775		.14825	.27375		0.3295
		STD	.05756		.05951	.03615		.04467	.10134		.08648
		STDERR	.02035		.02104	.01278		.01579	.03583		.03057
		CV	40.08		26.273	36.978		30.133	37.019		26.244
XHH5301	16.00	N	7		7	8		8	8		8
		MEAN	0.035		.06957	.05075		.11875	.28262		.30287
		STD	.02887		.03507	.02911		.06688	.07232		.08209
		STDERR	.01091		.01325	.01029		.02364	.02557		.02902
		CV	82.479		50.403	57.358		56.317	25.59		27.104
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	.08512		.06912	.22125		0.2525	.35662		0.651
		STD	.06964		.06002	.24645		.13701	.15458		.87523
		STDERR	.02462		.02122	.08713		.04844	.05465		.30944
		CV	81.805		86.832	111.39		54.263	43.345		134.44
XIH2463	28.00	N	6		6	8		8	8		7
		MEAN	.45167		0.362	0.141		0.175	0.2845		.19257
		STD	.08192		.13222	.05031		.03921	.20781		.04801
		STDERR	.03344		.05398	.01779		.01386	.07347		.01815
		CV	18.137		36.524	35.679		22.404	73.045		24.931
CYR0004	41.00	N	8		6	8			8		6
		MEAN	1.7254		1.5758	1.6505			1.3861		1.3433
		STD	.08543		.31208	.79747			.26398		.16351
		STDERR	0.0302		.12741	.28195			.09333		.06675
		CV	4.9512		19.804	48.317			19.044		12.172

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

PARTICULATE CARBON / PARTICULATE NITROGEN (RATIO)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	4		4	4		4	4		4
		MEAN	10.427		11.073	6.618		6.4204	5.7587		6.4509
		STD	4.3311		5.7872	.59654		2.1859	.74963		1.8218
		STDERR	2.1656		2.8936	.29827		1.093	.37481		.91089
		CV	41.537		52.266	9.014		34.046	13.017		28.241
XGG9572	8.50	N	4		4	4		4	4	1	4
		MEAN	7.0677		8.7131	7.1416		7.1523	5.0894	1.8431	6.0036
		STD	4.4682		1.7731	.69735		.58184	2.1701		2.9234
		STDERR	2.2341		.88657	.34868		.29092	1.085		1.4617
		CV	63.221		20.35	9.7647		8.1351	42.639		48.694
XHH5301	16.00	N	4		4	4		4	4		4
		MEAN	7.3824		6.5156	6.9629		6.8847	7.1769		6.7549
		STD	1.0457		1.1625	.20388		0.7934	.42071		.87869
		STDERR	.52287		.58126	.10194		0.3967	.21035		.43935
		CV	14.165		17.842	2.9281		11.524	5.862		13.008
XHH8354	21.30	N	4		3	4		4	4		4
		MEAN	10.566		9.1599	10.594		6.5034	6.568		8.0815
		STD	4.348		2.7669	8.308		1.2441	1.4394		3.9146
		STDERR	2.174		1.5975	4.154		.62207	0.7197		1.9573
		CV	41.153		30.207	78.418		19.131	21.915		48.439
XIH2463	28.00	N	4		3	4		4	2		4
		MEAN	11.616		5.4729	7.0894		7.8449	6.0373		5.8625
		STD	8.9038		1.8277	.47618		.47651	.95737		3.3622
		STDERR	4.4519		1.0552	.23809		.23825	.67696		1.6811
		CV	76.65		33.396	6.7168		6.0741	15.858		57.351
CYR0004	41.00	N	4		3	4			4		3
		MEAN	10.106		8.7455	6.175			9.7849		9.5511
		STD	2.5584		1.8144	.35851			2.0135		2.3133
		STDERR	1.2792		1.0476	.17926			1.0068		1.3356
		CV	25.315		20.747	5.8058			20.578		24.221

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

FILTERED INORGANIC NITROGEN / ORTHOPHOSPHORUS (RATIO)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8		8	8		8	8		8
		MEAN	24.094		25.025	7.1687		11.712	49.933		21.779
		STD	11.06		9.7429	4.7199		3.3993	63.653		7.7842
		STDERR	3.9102		3.4447	1.6687		1.2018	22.505		2.7521
		CV	45.903		38.933	65.84		29.022	127.48		35.742
XGG9572	8.50	N	8		8	8		8	8		8
		MEAN	14.363		22.65	4.5646		5.4417	10.755		9.5827
		STD	5.7565		5.9508	1.4098		1.1637	4.8712		2.1374
		STDERR	2.0352		2.1039	.49845		.41143	1.7222		.75569
		CV	40.08		26.273	30.887		21.385	45.291		22.305
XHH5301	16.00	N	7		7	8		8	8		8
		MEAN	3.5		6.9571	2.4917		3.526	9.4479		12.234
		STD	2.8868		3.5066	1.192		1.7849	3.3064		6.9813
		STDERR	1.0911		1.3254	.42143		.63107	1.169		2.4683
		CV	82.479		50.403	47.838		50.622	34.997		57.063
XHH8354	21.30	N	8		8	8		8	8		8
		MEAN	7.8054		6.9125	5.7969		4.1016	9.2246		12.774
		STD	7.4555		6.0022	6.3719		2.0379	3.6674		17.792
		STDERR	2.6359		2.1221	2.2528		.72051	1.2966		6.2906
		CV	95.518		86.832	109.92		49.686	39.757		139.28
XIH2463	28.00	N	6		6	8		8	8		7
		MEAN	41.592		25.561	3.8254		4.6837	14.875		10.336
		STD	12.776		18.045	1.8283		1.6547	10.394		4.8804
		STDERR	5.216		7.3668	.64639		.58501	3.6748		1.8446
		CV	30.719		70.595	47.792		35.328	69.875		47.219
CYR0004	41.00	N	8		6	8			8		6
		MEAN	38.145		26.184	66.292			51.5		45.808
		STD	9.7371		11.27	88.04			19.226		24.017
		STDERR	3.4426		4.6008	31.127			6.7976		9.8049
		CV	25.527		43.041	132.81			37.333		52.431

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

CHLOROPHYLL AC/ PARTICULATE NITROGEN (RATIO)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	4		4	4		4	4		4
		MEAN	32.273		31.264	35.498		133.58	17.721		6.4248
		STD	27.689		17.138	7.9989		84.622	16.126		2.2684
		STDERR	13.845		8.5691	3.9995		42.311	8.0632		1.1342
		CV	85.797		54.818	22.533		63.348	91.002		35.308
XGG9572	8.50	N	3		3	4		4	2		2
		MEAN	46.218		52.121	66.592		59.512	20.336		13.189
		STD	31.699		18.995	49.514		14.866	5.7868		2.8292
		STDERR	18.302		10.967	24.757		7.4332	4.0919		2.0005
		CV	68.587		36.444	74.355		24.981	28.452		21.45
XHH5301	16.00	N	3		3	4		4	3		3
		MEAN	279.55		53.55	74.027		30.167	17		29.044
		STD	359.57		13.112	14.016		20.663	9.4435		13.156
		STDERR	207.6		7.5703	7.0081		10.331	5.4522		7.5956
		CV	128.63		24.486	18.934		68.495	55.552		45.297
XHH8354	21.30	N	4		3	4		4	4		4
		MEAN	76.23		63.464	87.874		45.257	29.24		32.609
		STD	30.636		27.753	28.782		27.801	29.372		36.783
		STDERR	15.318		16.023	14.391		13.9	14.686		18.392
		CV	40.188		43.731	32.754		61.429	100.45		112.8
XIH2463	28.00	N	3		3	4		4	2		4
		MEAN	101.24		22.57	90.23		58.263	13.831		4411.8
		STD	141.36		8.4127	137.75		40.004	12.765		8792.1
		STDERR	81.613		4.8571	68.874		20.002	9.0262		4396.1
		CV	139.63		37.274	152.66		68.661	92.292		199.28
CYR0004	41.00	N	4		3	4			4		3
		MEAN	63.784		55.821	300.19			1.6349		16.521
		STD	58.644		54.49	113.48			1.6243		11.356
		STDERR	29.322		31.46	56.741			.81213		6.5564
		CV	91.942		97.616	37.804			99.351		68.736

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

CHLOROPHYLL AC/ PARTICULATE PHOSPHORUS (RATIO)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	3		1	8		8	7		7
		MEAN	109.98		120.5	478.96		891.24	122.17		74.286
		STD	86.072			722.68		1212.2	165.78		46.096
		STDERR	49.694			255.51		428.59	62.658		17.423
		CV	78.264			150.88		136.02	135.69		62.053
XGG9572	8.50	N	4		3	7		8	2		2
		MEAN	310.67		434.42	183.66		262.63	66.75		42.5
		STD	175.8		336.93	141.41		305.18	18.974		53.033
		STDERR	87.898		194.53	53.446		107.9	13.417		37.5
		CV	56.586		77.559	76.993		116.2	28.426		124.78
XHH5301	16.00	N	2		3	8		7	7		8
		MEAN	781.75		828.5	393.28		267.12	300.9		103.26
		STD	822.01		166.81	178.79		205.66	575.49		82.61
		STDERR	581.25		96.31	63.213		77.732	217.51		29.207
		CV	105.15		20.134	45.462		76.992	191.26		80.006
XHH8354	21.30	N	7		8	6		6	7		7
		MEAN	491.67		136.55	469.24		279.19	119.43		147.95
		STD	339.68		90.843	304.19		194.88	98.899		141.51
		STDERR	128.39		32.118	124.18		79.559	37.38		53.484
		CV	69.087		66.528	64.826		69.802	82.812		95.644
XIH2463	28.00	N	6		6	7		8	6		7
		MEAN	213.81		690.32	225.66		217.23	146.21		64.516
		STD	287.05		1027.6	198.75		140.3	161.4		42.565
		STDERR	117.19		419.53	75.122		49.602	65.891		16.088
		CV	134.25		148.86	88.075		64.584	110.39		65.976
CYR0004	41.00	N	4			8			3		3
		MEAN	99.23			1114.8			110.83		136.67
		STD	91.836			910.23			181.18		116.76
		STDERR	45.918			321.82			104.61		67.412
		CV	92.549			81.65			163.47		85.435

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

CHLOROPHYLL AC/ PARTICULATE CARBON (RATIO)

STATION	RIVER MILE	STAT	SURVEY 5/29/81			SURVEY 7/24/81			SURVEY 9/24/81		
			SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	4		4	4		4	4		4
		MEAN	3.0801		3.1814	5.3166		19.692	2.978		1.0788
		STD	2.5491		2.2212	.74927		6.06	2.7072		.47268
		STDERR	1.2745		1.1106	.37464		3.03	1.3536		.23634
		CV	82.761		69.817	14.093		30.774	90.904		43.814
XGG9572	8.50	N	3		3	4		4	2		2
		MEAN	9.2617		5.7282	9.0751		8.4732	3.2774		1.9205
		STD	2.5087		1.3879	6.5253		2.6044	1.0432		.18496
		STDERR	1.4484		.80129	3.2627		1.3022	.73769		.13079
		CV	27.087		24.229	71.904		30.737	31.832		9.6309
XHH5301	16.00	N	4		3	4		4	4		4
		MEAN	34.867		9.0314	10.631		4.6277	2.1555		3.9594
		STD	54.745		4.1679	1.9988		3.2435	1.0495		2.5491
		STDERR	27.372		2.4063	0.9994		1.6217	.52475		1.2746
		CV	157.01		46.149	18.801		70.088	48.69		64.381
XHH8354	21.30	N	4		3	4		4	4		4
		MEAN	7.4978		7.3615	10.178		7.5774	5.1795		5.7424
		STD	2.0335		4.3175	3.9979		5.1595	5.2383		7.409
		STDERR	1.0168		2.4927	1.999		2.5797	2.6191		3.7045
		CV	27.122		58.65	39.281		68.091	101.14		129.02
XIH2463	28.00	N	3		3	4		4	2		4
		MEAN	5.3357		4.2686	12.715		7.6688	2.1503		4401.5
		STD	4.5681		1.2302	19.424		5.3168	1.7734		8799
		STDERR	2.6374		.71024	9.7122		2.6584	1.2539		4399.5
		CV	85.613		28.819	152.77		69.33	82.47		199.91
CYR0004	41.00	N	4		3	4			4		3
		MEAN	6.6395		6.7454	48.136			.18615		1.6169
		STD	6.5172		7.1807	17.328			.20019		.70014
		STDERR	3.2586		4.1458	8.6642			0.1001		.40423
		CV	98.157		106.45	35.999			107.54		43.301

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

CURRENT SPEED (FEET/SEC)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	SURVEY 5/29/81 MIDDLE	SURVEY 5/29/81 BOTTOM	SURVEY 7/24/81 SURFACE	SURVEY 7/24/81 MIDDLE	SURVEY 7/24/81 BOTTOM	SURVEY 9/24/81 SURFACE	SURVEY 9/24/81 MIDDLE	SURVEY 9/24/81 BOTTOM
XHG1537	5.50	N	8	8	8	8	8	8			
		MEAN	.07362	.07362	.08137	.17087	.15562	0.1365			
		STD	0.086	.04668	.05725	.09225	.07204	.06728			
		STDERR	.03041	.01651	.02024	.03261	.02547	.02379			
		CV	116.81	63.408	70.355	53.986	46.29	49.292			
XGG9572	8.50	N	7	7	7	8	8	8	8	8	8
		MEAN	0.372	.49643	.37629	.22037	0.2205	0.1975	.20537	.20137	0.209
		STD	.15396	.21497	.30676	.11474	.09603	0.1094	.10534	.09048	.12567
		STDERR	.05819	.08125	.11594	.04057	.03395	.03868	.03724	.03199	.04443
		CV	41.388	43.304	81.522	52.068	43.549	55.394	51.292	44.933	60.127
XHH5301	16.00	N	7	7	6	5	5	5	6	6	6
		MEAN	.24357	.23514	.11933	0.6638	0.6152	0.6274	.17717	.17717	.15167
		STD	.11095	.12745	.04219	1.2823	1.2918	1.2687	.09326	.10105	.10201
		STDERR	.04194	.04817	.01722	.57346	.57773	.56739	.03807	.04125	.04165
		CV	45.551	54.202	35.353	193.17	209.99	202.22	52.642	57.036	67.261
XHH8354	21.30	N	6	6	6	8	8	8	7	7	7
		MEAN	.17567	0.171	0.1405	.35375	.34212	.38037	.26071	.16929	.16914
		STD	.12348	.14906	.16155	.30466	.22597	0.248	0.1126	.09932	.08774
		STDERR	.05041	.06085	.06595	.10771	.07989	.08768	.04256	.03754	.03316
		CV	70.294	87.17	114.98	86.123	66.048	65.2	43.188	58.668	51.876
XIH2463	28.00	N	5	5	5	8	8	8	8	8	8
		MEAN	0.217	0.1612	0.1488	0.2545	.24325	.15187	0.434	0.392	0.3615
		STD	0.2203	.16607	.11682	.18446	.17407	.09899	.25184	.19394	.16989
		STDERR	.09852	.07427	.05224	.06522	.06154	0.035	.08904	.06857	.06007
		CV	101.52	103.02	78.506	72.478	71.559	65.179	58.028	49.474	46.996
CYR0004	41.00	N									
		MEAN									
		STD									
		STDERR									
		CV									

TABLE 9-2 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY DATA FOR EACH STATION BY DEPTH RANGE FOR EACH SURVEY

CURRENT DIRECTION (DEGREES)

STATION	RIVER MILE	STAT	SURVEY 5/29/81 SURFACE	MIDDLE	BOTTOM	SURVEY 7/24/81 SURFACE	MIDDLE	BOTTOM	SURVEY 9/24/81 SURFACE	MIDDLE	BOTTOM
XHG1537	5.50	N	8	8	8	8	8	8			
		MEAN	250	149.63	210.13	179.38	193.5	216.25			
		STD	97.885	128.68	141.2	144.26	104.65	96.723			
		STDERR	34.607	45.494	49.921	51.003	37	34.197			
		CV	39.154	86	67.197	80.422	54.084	44.727			
XGG9572	8.50	N	7	7	7	8	8	8	8	8	8
		MEAN	180.71	181.43	180	159.5	152.75	147.5	48.75	90.625	82.125
		STD	104.71	82.879	89.859	88.806	62.773	64.569	13.025	28.59	25.475
		STDERR	39.578	31.325	33.964	31.398	22.194	22.829	4.6049	10.108	9.0068
		CV	57.944	45.681	49.922	55.678	41.096	43.776	26.717	31.548	31.02
XHH5301	16.00	N	7	7	6	8	8	8	7	7	7
		MEAN	167	162.57	128.83	223.13	194.63	222.25	130	137	156.14
		STD	102.5	95.628	88.432	98.939	93.087	97.889	81.392	74.726	91.665
		STDERR	38.74	36.144	36.102	34.98	32.911	34.609	30.763	28.244	34.646
		CV	61.376	58.822	68.64	44.343	47.829	44.044	62.609	54.545	58.706
XHH8354	21.30	N	6	6	6	8	8	8	7	7	7
		MEAN	227.33	202.17	165	148.38	70.875	108.88	131.43	140	59.429
		STD	86.901	108.78	114.66	135.81	73.219	114.39	121.23	116.77	73.093
		STDERR	35.477	44.408	46.81	48.017	25.887	40.443	45.822	44.134	27.627
		CV	38.226	53.805	69.491	91.533	103.31	105.07	92.243	83.405	122.99
XIH2463	28.00	N	5	5	5	8	8	8	8	8	8
		MEAN	127.8	131.6	183.4	136.5	129	124	180.63	188.75	184.75
		STD	80.148	89.246	132.59	90.968	82.873	83.406	114.06	99.13	104.27
		STDERR	35.843	39.912	59.296	32.162	29.3	29.488	40.327	35.048	36.864
		CV	62.714	67.816	72.295	66.643	64.243	67.263	63.149	52.519	56.438
CYR0004	41.00	N									
		MEAN									
		STD									
		STDERR									
		CV									

Table 9-3
Correlation of Mean Intensive Survey Data Vs Salinity

Dependent Variable	Survey Date	R^2	N
Temp	All	0.133	50
	May	0.163	25
	July	0.225	50
	September	0.287	46
DO	All	0.072	50
	May	0.058	25
	July	0.156	50
	September	0.092	46
FLDPH	All	0.111	50
	May	0.035	25
	July	0.234	50
	September	0.197	46
SUSSOL	All	0.115	50
	May	0.165	25
	July	0.012	50
	September	0.093	46
CHLORAC	All	0.037	50
	May	0.500	25
	July	0.015	50
	September	0.022	43
DISSOL	All	0.132	18
	May		
	July	0.136	16
	September	0.208	13
TPN	All	0.007	27
	May	0.521	15
	July	0.003	26
	September	0.020	22
PAROCAR	All	0.258	27
	May	0.561	15
	July	0.018	26
	September	0.014	22
RPCPN	All	0.214	27
	May	0.014	15
	July	0.105	26
	September	0.068	22

Table 9-3 (continued)
Correlation of Mean Intensive Survey Data Vs Salinity

Dependent Variable	Survey Date	R^2	N
PNPC	All	0.054	27
	May	0.004	15
	July	0.091	26
	September	0.003	22
RCHLOPC	All	0.018	27
	May	0.292	15
	July	0.006	26
	September	0.002	20
TKN	All	0.061	50
	May	0.039	25
	July	0.047	49
	September	0.041	46
TPHOS	All	0.269	50
	May	0.060	25
	July	0.082	49
	September	0.198	46
TOTN	All	0.410	26
	May	0.447	13
	July	0.295	25
	September	0.262	21
PARN	All	0.003	26
	May	0.525	13
	July	0.003	25
	September	0.012	21
RCHLOPN	All	0.012	26
	May	0.405	13
	July	0.008	25
	September	0.001	19
FTOTN	All	0.388	49
	May	0.135	23
	July	0.358	48
	September	0.325	45
PHEOP	All	0.048	50
	May	0.009	24
	July	0.158	50
	September	0.048	43

Table 9-3 (continued)
Correlation of Mean Intensive Survey Data Vs Salinity

Dependent Variable	Survey Date	R^2	N
SEECHI	All	0.517	20
	May	0.133	15
	July	0.320	18
	September	0.091	16
DOSAT	All	0.009	49
	May	0.027	24
	July	0.047	49
	September	0.416	45
BOD (5)	All	0.080	13
	May	0.030	5
	July	0.008	42
	September	0.128	9
BOD (20)	All	0.141	16
	May		
	July	0.013	15
	September	0.253	9
TOTSOL	All	0.129	18
	May		
	July	0.136	16
	September	0.209	13
FORGN	All	0.000	49
	May	0.545	22
	July	0.003	47
	September	0.000	45
FAMMON	All	0.165	50
	May	0.353	24
	July	0.059	48
	September	0.005	46
FTKN	All	0.068	50
	May	0.0002	24
	July	0.183	48
	September	0.001	46
TFPHOS	All	0.035	50
	May	0.033	24
	July	0.027	48
	September	0.119	46

Table 9-3 (continued)
Correlation of Mean Intensive Survey Data Vs Salinity

Dependent Variable	Survey Date	R^2	N
FORTHOP	All	0.270	50
	May	0.289	24
	July	0.065	48
	September	0.009	46
FINORGN	All	0.420	50
	May	0.374	23
	July	0.357	48
	September	0.320	46
DISORGN	All	0.005	50
	May	0.519	24
	July	0.001	48
	September	0.001	46
RFINORH	All	0.224	50
	May	0.045	23
	July	0.084	48
	September	0.281	46
CURSPD	All	0.844	5
	May	0.701	4
	July	0.340	55
	September	0.471	5
CURDIR	All	0.142	5
	May	0.946	4
	July	0.0004	5
	September	0.001	5
FNO (2)	All	0.017	50
	May	0.235	25
	July	0.282	49
	September	0.375	46
FNO (3)	All	0.385	50
	May	0.090	24
	July	0.352	49
	September	0.348	46
PARPHOS	All	0.357	48
	May	0.158	15
	July	0.123	41
	September	0.254	34

Table 9-3 (continued)

Correlation of Mean Intensive Survey Data Vs Salinity

Dependent Variable	Survey Date	R^2	N
RCHLOPP	All	0.001	48
	May	0.347	8
	July	0.014	41
	September	0.066	32

TABLE 9-4 TWENTY-FOUR INTENSIVE SURVEY STATISTICS BY SALINITY REGIMES AND BY DEPTH (SURFACE, BOTTOM)

VARIABLE	STATISTIC	SURFACE 0-3 PPT	 3.1-10 PPT	 >10 PPT	BOTTOM 0-3 PPT	 3.1-10 PPT	 >10 PPT
TEMPERTURE	N	24	63	55	12	50	68
	MEAN	21.188	22.568	21.147	18.992	22.432	20.384
	STD	4.219	3.1708	3.9623	4.6291	3.3884	4.022
	STDERR	.86121	.39948	.53428	1.3363	0.4792	.48774
	CV	19.913	14.05	18.737	24.374	15.105	19.731
TURBIDITY	N	16	46	31	6	33	44
	MEAN	11.625	13.398	3.7129	13.167	30.03	4.9614
	STD	2.9861	10.303	1.9292	2.4833	12.401	5.0092
	STDERR	.74652	1.5191	0.3465	1.0138	2.1587	.75517
	CV	25.687	76.901	51.959	18.86	41.294	100.96
SECCHI DISK	N		5	30			
	MEAN		1.08	1.0133			
	STD		.32711	.35305			
	STDERR		.14629	.06446			
	CV		30.288	34.84			
DIS OXYGEN	N	24	63	55	12	50	68
	MEAN	7.5625	7.781	8.5727	6.7417	6.992	6.0412
	STD	1.8587	1.7074	2.0882	1.1516	1.7739	2.9766
	STDERR	0.3794	.21511	.28157	.33245	.25087	.36096
	CV	24.577	21.943	24.359	17.083	25.371	49.272
SATURT DO	N	24	63	54	12	50	67
	MEAN	85.404	92.671	103.89	72.617	82.526	72.269
	STD	23.7	18.953	28.153	13.394	19.358	36.939
	STDERR	4.8376	2.3879	3.8311	3.8664	2.7376	4.5128
	CV	27.75	20.452	27.099	18.444	23.456	51.113
BOD5	N	2	4	7	1	5	6
	MEAN	20	6	3.5714	2	2.4	1.6667
	STD	25.456	4.9666	2.6992		1.1402	1.0328
	STDERR	18	2.4833	1.0202		0.5099	.42164
	CV	127.28	82.776	75.578		47.507	61.968
BOD20	N	2	2	4	1	2	4
	MEAN	50.5	6.5	7.75	6	7	4.5
	STD	64.347	2.1213	5.5603		0	.57735
	STDERR	45.5	1.5	2.7801		0	.28868
	CV	127.42	32.636	71.745		0	12.83

TABLE 9-4 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY STATISTICS BY SALINITY REGIMES AND BY DEPTH (SURFACE, BOTTOM)

		SURFACE			BOTTOM		
VARIABLE	STATISTIC	0-3 PPT	3.1-10 PPT	>10 PPT	0-3 PPT	3.1-10 PPT	>10 PPT
FIELD PH	N	24	63	54	12	50	65
	MEAN	7.0125	7.4048	7.6593	6.475	7.38	7.3369
	STD	.81417	.52068	.50935	.50114	.75241	.66157
	STDERR	.16619	0.0656	.06931	.14467	.10641	.08206
	CV	11.61	7.0317	6.6502	7.7395	10.195	9.017
SALINITY	N	24	63	55	12	50	68
	MEAN	.06958	6.2317	12.665	0.09	5.479	12.938
	STD	.02805	1.9885	1.781	.01128	1.1598	1.4496
	STDERR	.00573	.25053	.24015	.00326	.16402	.17578
	CV	40.311	31.909	14.062	12.535	21.168	11.204
TOT SOLIDS	N	20			11		
	MEAN	178.15			260.73		
	STD	81.653			141.04		
	STDERR	18.258			42.524		
	CV	45.834			54.094		
SUS SOLIDS	N	24	61	55	12	49	67
	MEAN	27.833	34.213	29.873	30.25	60.51	40.657
	STD	17.719	14.672	12.564	20.073	38.244	21.36
	STDERR	3.6169	1.8786	1.6941	5.7946	5.4635	2.6095
	CV	63.662	42.884	42.058	66.358	63.203	52.536
FIL AMMONIA	N	24	62	55	12	48	68
	MEAN	.15708	.08194	.14109	.08917	.08417	.12279
	STD	.13232	.06342	.53522	.07633	.06388	.08074
	STDERR	.02701	.00805	.07217	.02204	.00922	.00979
	CV	84.235	77.405	379.35	85.606	75.892	65.752
FIL NITRITE	N	24	61	54	12	48	67
	MEAN	.01942	.01664	.03991	.02375	.02133	.03515
	STD	.01799	.02048	0.0414	.01712	0.0291	.03942
	STDERR	.00367	.00262	.00563	.00494	0.0042	.00482
	CV	92.641	123.08	103.75	72.087	136.4	112.15
FIL NITRATE	N	24	61	54	12	48	67
	MEAN	1.4108	.13607	.06241	1.3467	.16771	.07776
	STD	.44012	0.1472	.06173	.23531	.36759	.06891
	STDERR	.08984	.01885	0.0084	.06793	.05306	.00842
	CV	31.196	108.18	98.921	17.473	219.19	88.611

TABLE 9-4 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY STATISTICS BY SALINITY REGIMES AND BY DEPTH (SURFACE, BOTTOM)

		SURFACE			BOTTOM		
VARIABLE	STATISTIC	0-3 PPT	3.1-10 PPT	>10 PPT	0-3 PPT	3.1-10 PPT	>10 PPT
FIL TKN	N	24	61	55	12	48	67
	MEAN	.90792	.72033	.75018	.94917	.78625	.87776
	STD	.34916	.34576	.57204	.24463	.43391	0.8299
	STDERR	.07127	.04427	.07713	.07062	.06263	.10139
	CV	38.457	48.001	76.254	25.773	55.187	94.547
TOT TKN	N	24	63	53	12	50	67
	MEAN	1.4083	0.88	1.0168	.99417	0.9958	.89582
	STD	1.1359	.57046	.56229	.66579	.40791	.50666
	STDERR	.23186	.07187	.07724	0.1922	.05769	0.0619
	CV	80.653	64.825	55.3	66.97	40.963	56.558
TOT NITROGEN	N	12	30	24	6	22	33
	MEAN	1.8016	.50483	.31283	1.409	.62823	.31027
	STD	.41795	.32538	0.1211	.31917	.53323	.14566
	STDERR	.12065	.05941	.02472	0.1303	.11369	.02536
	CV	23.199	64.454	38.712	22.652	84.879	46.946
FIL NITROGEN	N	24	61	53	12	48	66
	MEAN	1.4302	0.1527	.10085	1.3704	.18904	.11062
	STD	.44276	.15234	.09719	.23928	.37816	.09618
	STDERR	.09038	.01951	.01335	.06908	.05458	.01184
	CV	30.957	99.763	96.37	17.461	200.04	86.945
FIL PHOS	N	24	62	55	12	48	67
	MEAN	0.0525	.04629	.04364	.08667	.04687	.04761
	STD	.02967	.05338	.04688	.06906	.06008	.05363
	STDERR	.00606	.00678	.00632	.01994	.00867	.00655
	CV	56.518	115.33	107.43	79.688	128.16	112.64
FIL ORTHOP	N	24	62	55	12	48	68
	MEAN	.04042	.02661	.02073	0.06	.04312	.02221
	STD	.01876	.02482	0.0173	.05862	.06318	.01244
	STDERR	.00383	.00315	.00233	.01692	.00912	.00151
	CV	46.42	93.276	83.489	97.701	146.51	56.023
PAR CARBON	N	12	31	26	6	22	35
	MEAN	2.7513	2.5689	1.4551	1.2823	2.7022	1.3732
	STD	2.9874	1.8551	.74743	.61301	1.4507	1.0069
	STDERR	.86238	.33318	.14658	.25026	0.3093	0.1702
	CV	108.58	72.212	51.367	47.804	53.687	73.325

TABLE 9-4 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY STATISTICS BY SALINITY REGIMES AND BY DEPTH (SURFACE, BOTTOM)

		SURFACE			BOTTOM		
VARIABLE	STATISTIC	0-3 PPT	3.1-10 PPT	>10 PPT	0-3 PPT	3.1-10 PPT	>10 PPT
CHLOR AC	N	24	61	51	12	49	62
	MEAN	64.046	15.902	11.302	3.6333	14.204	9.5574
	STD	103.31	19.279	14.225	4.2047	12.366	14.267
	STDERR	21.089	2.4684	1.992	1.2138	1.7665	1.8119
	CV	161.31	121.24	125.87	115.72	87.055	149.28
PHEOP AC	N	24	60	51	12	49	62
	MEAN	4.8767	7.7508	4.051	.47417	7.3073	3.681
	STD	10.565	16.255	5.9807	.59583	9.0525	5.8612
	STDERR	2.1566	2.0985	.83746	0.172	1.2932	.74437
	CV	216.64	209.72	147.63	125.66	123.88	159.23
DIS SOLIDS	N	20			11		
	MEAN	153.05			228.36		
	STD	72.668			137.53		
	STDERR	16.249			41.468		
	CV	47.48			60.226		
PAR PHOS	N	16	52	46	4	43	54
	MEAN	.13125	.07019	.05652	0.0075	.10326	.04907
	STD	.14564	0.048	.06115	0.005	.06082	.05684
	STDERR	.03641	.00666	.00902	0.0025	.00927	.00774
	CV	110.97	68.382	108.18	66.667	58.899	115.83
FIL INOR N	N	24	61	54	12	47	67
	MEAN	1.5873	.23533	.24583	1.4596	.27487	.23709
	STD	.48896	.17647	.55211	.26677	.39963	.12072
	STDERR	.09981	.02259	.07513	.07701	.05829	.01475
	CV	30.804	74.987	224.59	18.277	145.39	50.916
DIS ORGN N	N	24	61	55	12	48	67
	MEAN	.75083	.63869	.60909	0.86	.70208	.75328
	STD	.36358	.35389	.31162	0.216	.42716	.81281
	STDERR	.07422	.04531	.04202	.06235	.06166	0.0993
	CV	48.424	55.409	51.161	25.116	60.842	107.9
PAR NITROGEN	N	12	30	24	6	22	33
	MEAN	.39925	.36647	.21858	.14917	.37409	.19933
	STD	.54999	.31864	.10569	.08518	.18622	.11505
	STDERR	.15877	.05817	.02157	.03477	0.0397	.02003
	CV	137.76	86.948	48.354	57.103	49.778	57.716

TABLE 9-4 (CONT.) TWENTY-FOUR HOUR INTENSIVE SURVEY STATISTICS BY SALINITY REGIMES AND BY DEPTH (SURFACE, BOTTOM)

		SURFACE			BOTTOM		
VARIABLE	STATISTIC	0-3 PPT	3.1-10 PPT	>10 PPT	0-3 PPT	3.1-10 PPT	>10 PPT
CHLOR-P PHOS(R)	N	15	48	38	3	43	44
	MEAN	643.19	281.87	298.01	136.67	248.36	338.67
	STD	832.54	261.59	461.26	116.76	421.94	604.01
	STDERR	214.96	37.757	74.826	67.412	64.345	91.057
	CV	129.44	92.804	154.78	85.435	169.89	178.35
CHLOR-PAR N (R)	N	12	29	22	6	22	30
	MEAN	121.87	62.646	70.167	36.171	838.64	48.028
	STD	149.99	69.231	142.82	41.262	3743.8	48.534
	STDERR	43.299	12.856	30.45	16.845	798.19	8.861
	CV	123.08	110.51	203.55	114.08	446.42	101.05
FIL IN N-ORHP(R)	N	24	61	54	12	47	67
	MEAN	51.979	13.666	13.582	35.996	9.8417	13.458
	STD	51.364	13.309	28.246	20.614	11.84	9.07
	STDERR	10.485	1.704	3.8438	5.9508	1.7271	1.1081
	CV	98.817	97.387	207.96	57.269	120.31	67.393
PAR C-PAR N (R)	N	12	31	26	6	22	35
	MEAN	8.6886	8.8696	6.5494	9.1483	7.1395	7.3397
	STD	2.528	5.0155	1.2508	1.9111	2.5954	2.7171
	STDERR	.72977	.90082	0.2453	.78019	.55335	.45927
	CV	29.096	56.547	19.097	20.89	36.353	37.019
CHLOR-P CAR (R)	N	12	29	24	6	22	31
	MEAN	18.321	7.3902	10.162	4.1812	805.68	6.6895
	STD	24.206	7.7597	23.082	5.3583	3751.1	6.3448
	STDERR	6.9878	1.4409	4.7116	2.1875	799.73	1.1396
	CV	132.13	105	227.14	128.15	465.58	94.848
CUR SPEED	N		50	9		39	19
	MEAN		.27798	.22389		.22546	0.191
	STD		.22307	.12084		.17176	.22766
	STDERR		.03155	.04028		0.0275	.05223
	CV		80.246	53.972		76.18	119.19
CUR DIRECTION	N		50	9		39	19
	MEAN		170.08	199.11		130.1	186.26
	STD		107.4	110.62		100.42	113.43
	STDERR		15.188	36.873		16.079	26.023
	CV		63.145	55.557		77.182	60.899

Table 9-5

Chester River 1981 24 Hour Intensive Survey Data Statistical Summary By Depth

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Standard Mean Error	C.V.	Depth
TEMP	131	21.04	3.98	10.00	28.0	.35	18.92	B
	146	21.71	3.86	8.20	29.10	.32	17.79	T
	120	21.45	3.82	7.80	28.0	.35	17.82	M
TURB	85	15.27	14.70	.10	50.0	1.60	96.22	B
	95	9.73	8.58	.10	37.00	.88	88.18	T
	--	--	--	--	--	--	--	M
SECCHI	0	--	--	--	--	--	--	B
	36	1.01	.35	.40	2.00	.06	34.41	T
	--	--	--	--	--	--	--	M
DO_2	131	6.46	2.47	1.00	14.50	.22	38.22	B
	145	8.00	1.94	3.00	13.60	.16	24.29	T
	119	7.38	1.85	4.00	12.60	.17	25.00	M
DOSAT	130	76.10	29.74	11.30	189.90	2.61	39.08	B
	143	95.29	24.69	35.30	176.30	2.06	25.91	T
	118	88.0	22.41	45.00	165.30	2.06	25.46	M
BOD5	13	1.92	1.04	1.0	4.0	.29	53.96	B
	14	6.71	9.58	1.0	38.0	2.56	142.67	T
	--	--	--	--	--	--	--	M
BOD20	8	5.25	1.28	4.0	7.0	.45	24.41	B
	9	17.22	29.78	4.0	96.00	9.93	172.90	T
	--	--	--	--	--	--	--	M

Table 9-5(continued)
Chester River 1981 24 Hour Intensive Survey Data Statistical Summary By Depth

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Standard Mean Error	C.V.	Depth
BOD30	--	--	--	--	--	--	--	B
	--	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M
FLOPH	129	7.27	.73	3.5	9.50	.06	10.05	B
	144	7.42	.62	6.0	9.10	.05	8.36	T
	114	7.45	.52	5.80	8.80	.05	7.03	M
SALIN	130	8.88	4.69	.07	17.20	.41	52.74	B
	143	7.71	4.84	.03	16.90	.40	62.74	T
	116	9.53	3.81	3.80	17.20	.35	39.96	M
TOTSOL	11	260.73	141.04	128.00	548.00	42.52	54.09	B
	20	178.15	81.65	57.00	306.00	18.26	45.83	T
	--	--	--	--	--	--	--	M
SUSSOL	130	47.02	30.55	7.00	203.00	2.68	64.97	B
	142	31.32	14.51	4.00	83.00	1.22	46.33	T
	--	--	--	--	--	--	--	M
TPN	64	.25	.17	.001	.72	.02	67.77	B
	70	.32	.32	.05	1.99	.04	99.78	T
	1	.05	--	.05	.05	--	--	M
FAMMON	130	.11	.08	.01	.38	.01	71.82	B
	143	.12	.34	.01	4.02	.03	291.02	T
	--	--	--	--	--	--	--	M
AMMON	--	--	--	--	--	--	--	B
	--	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M

Table 9-5(continued)

Chester River 1981 24 Hour Intensive Survey Data Statistical Summary By Depth

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Standard Mean Error	C.V.	Depth
TPHOS	131	.09	.06	.01	.36	.01	71.46	B
	143	.10	.08	.01	.62	.01	80.74	T
	--	--	--	--	--	--	--	M
TFPHOS	129	.05	.06	.01	.41	.01	114.28	B
	143	.05	.05	.01	.35	.004	102.18	T
	--	--	--	--	--	--	--	M
FORTHOP	130	.03	.04	.01	.43	.003	133.94	B
	143	.03	.02	.01	.18	.002	82.96	T
	--	--	--	--	--	--	--	M
TOC	0	--	--	--	--	--	--	B
	0	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M
PAROCAR	64	1.81	1.31	.001	5.37	.16	72.04	B
	70	2.19	1.86	.09	11.30	.22	84.91	T
	1	.09	--	.09	.09	--	--	M
CHLORAC	125	10.75	13.10	.01	105.00	1.17	121.85	B
	138	22.58	48.98	.01	337.00	4.17	216.89	T
	--	--	--	--	--	--	--	M
DISSOL	11	228.36	137.53	115.00	534.00	41.47	60.23	B
	20	153.05	72.67	47.00	266.00	16.25	47.48	T
	--	--	--	--	--	--	--	M
ORTHOP	0	--	--	--	--	--	--	B
	0	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M

Table 9-5 (continued)
Chester River 1981 24 Hour Intensive Survey Data Statistical Summary By Depth

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Standard Mean Error	C.V.	Depth
FNITRITE	129	.03	.03	.001	.11	.003	120.21	B
	141	.03	.03	.001	.11	.003	122.26	T
	--	--	--	--	--	--	--	M
NITRITE	--	--	--	--	--	--	--	B
	--	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M
FNITRATE	129	.23	.43	.01	2.55	.04	189.32	B
	141	.32	.54	.01	2.43	.05	165.30	T
	--	--	--	--	--	--	--	M
NITRATE	--	--	--	--	--	--	--	B
	--	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M
FTKN	129	.85	.66	.02	4.5	.06	77.71	B
	142	.76	.45	.02	4.26	.04	59.23	T
	--	--	--	--	--	--	--	M
TKN	131	.94	.49	.05	3.02	.04	51.52	B
	142	1.02	.71	.08	6.07	.06	70.09	T
	--	--	--	--	--	--	--	M
TOTN	62	.53	.47	.09	2.83	.06	90.21	B
	67	.67	.61	.10	2.42	.07	91.53	T
	--	--	--	--	--	--	--	M
FTOTN	128	.26	.44	.01	2.63	.04	170.70	B
	140	.35	.54	.01	2.44	.05	152.92	T
	--	--	--	--	--	--	--	M

Table 9-5(continued)
Chester River 1981 24 Hour Intensive Survey Data Statistical Summary By Depth

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Standard Mean Error	C.V.	Depth
PARPHOS	128	.04	.09	-.37	.30	.01	218.87	B
	142	.05	.09	-.31	.54	.01	191.77	T
	--	--	--	--	--	--	--	M
TFINORGN	128	.37	.44	.02	2.81	.04	121.56	B
	141	.47	.65	.02	4.12	.06	139.64	T
	--	--	--	--	--	--	--	M
TINORGN	0	--	--	--	--	--	--	B
	0	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M
TORGN	--	--	--	--	--	--	--	B
	0	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M
DISORGN	129	.74	.64	0.00	4.34	.06	86.97	B
	142	.64	.34	-.05	2.11	.03	52.92	T
	--	--	--	--	--	--	--	M
PARN	62	.26	.17	.001	.717	.02	65.22	B
	67	.32	.32	.05	1.99	.04	101.40	T
	--	--	--	--	--	--	--	M
RCHLORPP	117	191.25	503.73	-802.00	3500.00	46.57	263.39	B
	129	158.41	805.10	-6499.99	2985.71	70.89	508.25	T
	--	--	--	--	--	--	--	M
RCHLORPN	59	341.38	2285.99	.02	17600.00	297.61	669.63	B
	64	76.59	115.55	.03	691.29	14.44	150.88	T
	--	--	--	--	--	--	--	M

Table 9-5(continued)

Chester River 1981 24 Hour Intensive Survey Data Statistical Summary By Depth

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Standard Mean Error	C.V.	Depth
RFINORHP	128	14.29	13.61	.80	77.30	1.20	95.22	B
	141	20.12	31.97	.53	275.80	2.69	158.91	T
	--	--	--	--	--	--	--	M
RTINORHP	0	--	--	--	--	--	--	B
	0	--	--	--	--	--	--	T
	--	--	--	--	--	--	--	M
RPCPN	64	7.43	2.61	1.00	19.71	.33	35.17	B
	70	7.95	3.71	.82	24.95	.44	46.63	T
	1	1.84	--	1.84	1.84	--	--	M
RPNPC	64	.16	.12	.05	1.00	.02	76.78	B
	70	.16	.14	.04	1.22	.02	90.22	T
	1	.54	--	.54	.54	--	--	M
RCHLOPC	60	299.37	2271.36	.002	17600.00	293.23	758.72	B
	66	10.44	18.15	.003	116.56	2.23	173.77	T
	--	--	--	--	--	--	--	M
CURSPD	98	.23	.32	.01	2.90	.03	141.22	B
	99	.27	.33	.03	2.96	.03	122.85	T
	99	.25	.32	.03	2.93	.03	126.27	M
CURDIR	102	155.06	102.96	5.00	355.00	10.19	66.40	B
	103	163.85	108.00	5.00	360.00	10.64	65.91	T
	103	151.22	93.73	7.00	360.00	9.24	61.98	M
PHEOP	125	4.84	7.37	.01	32.50	.66	152.23	B
	137	5.84	12.25	.01	85.80	1.05	209.87	T
	--	--	--	--	--	--	--	M

Table 9-6
Table Regression of Intensive Survey Data Versus Dissolved Oxygen

Dependent Variable	Survey Date	N	R^2
TEMP	All	50	.001
	May	49	.196
	July	50	.093
	September	49	.104
SALIN	All	50	.072
	May	25	.058
	July	50	.156
	September	46	.092
FLOPH	All	50	.110
	May	49	.155
	July	50	.126
	September	49	.008
SUSSOL	All	50	.057
	May	49	.008
	July	50	.001
	September	49	.050
FAMMON	All	50	.005
	May	48	.027
	July	48	.055
	September	49	.146
FORTHOP	All	50	.342
	May	48	.001
	July	48	.008
	September	49	.051
CHLORAC	All	50	.028
	May	48	.023
	July	50	.185
	September	46	.022
PHEOP	All	50	.001
	May	47	.019
	July	50	.000
	September	46	.042
FINORGN	All	50	.004
	May	47	.005
	July	48	.031
	September	49	.136

Table 9-6 (continued)
Table Regression of Intensive Survey Data Versus Dissolved Oxygen

Dependent Variable	Survey Date	N	R^2
DISORGN	All	50	.021
	May	48	.015
	July	48	.008
	September	49	.077
PAROCAR	All	27	.190
	May	22	.115
	July	26	.079
	September	24	.251
RPCPN	All	27	.007
	May	22	.020
	July	26	.004
	September	24	.160
RPNPC	All	27	.001
	May	22	.033
	July	26	.009
	September	24	.005
RCHLOPC	All	27	.001
	May	22	.020
	July	26	.003
	September	22	.031
CURSPD	All	5	.592
	May	5	.279
	July	5	.008
	September	5	.008
CURDIR	All	5	.082
	May	5	.575
	July	5	.408
	September	5	.540
FNO_2	All	50	.018
	May	49	.006
	July	49	.107
	September	49	.000
FNO3	All	50	.007
	May	48	.001
	July	49	.046
	September	49	.098

Table 9-6 (continued)
Table Regression of Intensive Survey Data Versus Dissolved Oxygen

Dependent Variable	Survey Date	N	R^2
FTKN	All	50	.009
	May	48	.001
	July	48	.001
	September	49	.029
TKN	All	50	.024
	May	48	.004
	July	49	.000
	September	49	.087
TPHOS	All	50	.069
	May	48	.017
	July	49	.028
	September	49	.131
TFPHOS	All	50	.022
	May	48	.016
	July	48	.004
	September	49	.013
FTOTN	All	49	.005
	May	47	.002
	July	48	.049
	September	48	.106
BOD(5)	All	13	.145
	May	5	.019
	July	12	.004
	September	10	.140
BOD(20)	All	16	.143
	May		
	July	15	.005
	September	10	.292
TOTSOL	All	18	.001
	May	15	.062
	July	16	.021
	September	14	.168
DISSOL	All	18	.001
	May	15	.064
	July	16	.022
	September	14	.019

Table 9-6 (continued)
Table Regression of Intensive Survey Data Versus Dissolved Oxygen

Dependent Variable	Survey Date	N	R^2
TPN	All	27	.173
	May	22	.159
	July	26	.057
	September	24	.316
RFINORH	All	50	.002
	May	47	.016
	July	48	.022
	September	49	.106
SEECHI	All	20	.148
	May	15	.001
	July	18	.136
	September	18	.611
DOSAT	All	49	.839
	May	48	.975
	July	49	.925
	September	48	.830
FORGN	All	49	.002
	May	46	.006
	July	47	.009
	September	48	.071
TOTN	All	26	.051
	May	20	.001
	July	25	.234
	September	23	.007
PARN	All	26	.155
	May	20	.138
	July	25	.058
	September	23	.305
RCHLOPN	All	26	.001
	May	20	.003
	July	25	.008
	September	21	.047
PARPHOS	All	48	.075
	May	32	.005
	July	41	.088
	September	37	.169

Table 9-6 (continued)
Table Regression of Intensive Survey Data Versus Dissolved Oxygen

Dependent Variable	Survey Date	N	R^2
RCHLOPP	All	48	.002
	May	23	.000
	July	41	.221
	September	35	.004

APPENDIX I

FIGURES AND TABLES OF DISSOLVED OXYGEN CHARACTERISTICS

SECTION 10

Table 10-1
Chester River Dissolved Oxygen For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949	6.3550	1.8318	60	-.448
1950	7.9935	2.6776	46	-.645
1951	8.9000	.67528	11	-.702
1957	6.2860	1.3136	57	-.562
1958	6.4200	2.3472	45	-.687
1959	8.4600	2.4170	120	-.093
1960	8.4000	2.1860	121	-.388
1961	8.4333	3.8187	6	.278
1962	6.1750	1.6701	4	-.999
1967	10.194	1.6510	16	.148
1968	7.6850	2.0674	20	.372
1969	7.9100	2.3524	20	.560
1970	6.7815	1.1529	27	.342
1971	7.8774	2.4340	115	.484
1972	4.6000	1.3206	6	-.998
1973	11.212	1.1115	8	.724
1974	9.0696	2.1744	56	.121
1975	8.5768	2.6934	69	-.425
1976	7.4939	1.6619	409	-.162
1977	8.3219	2.6453	96	-.408
1978	7.8317	2.3915	101	-.207
1979	8.5645	1.9061	31	.119
1980	7.2859	2.1466	617	.325
1981	7.2455	2.0597	1518	.041

*From regression of DO vs Salinity.

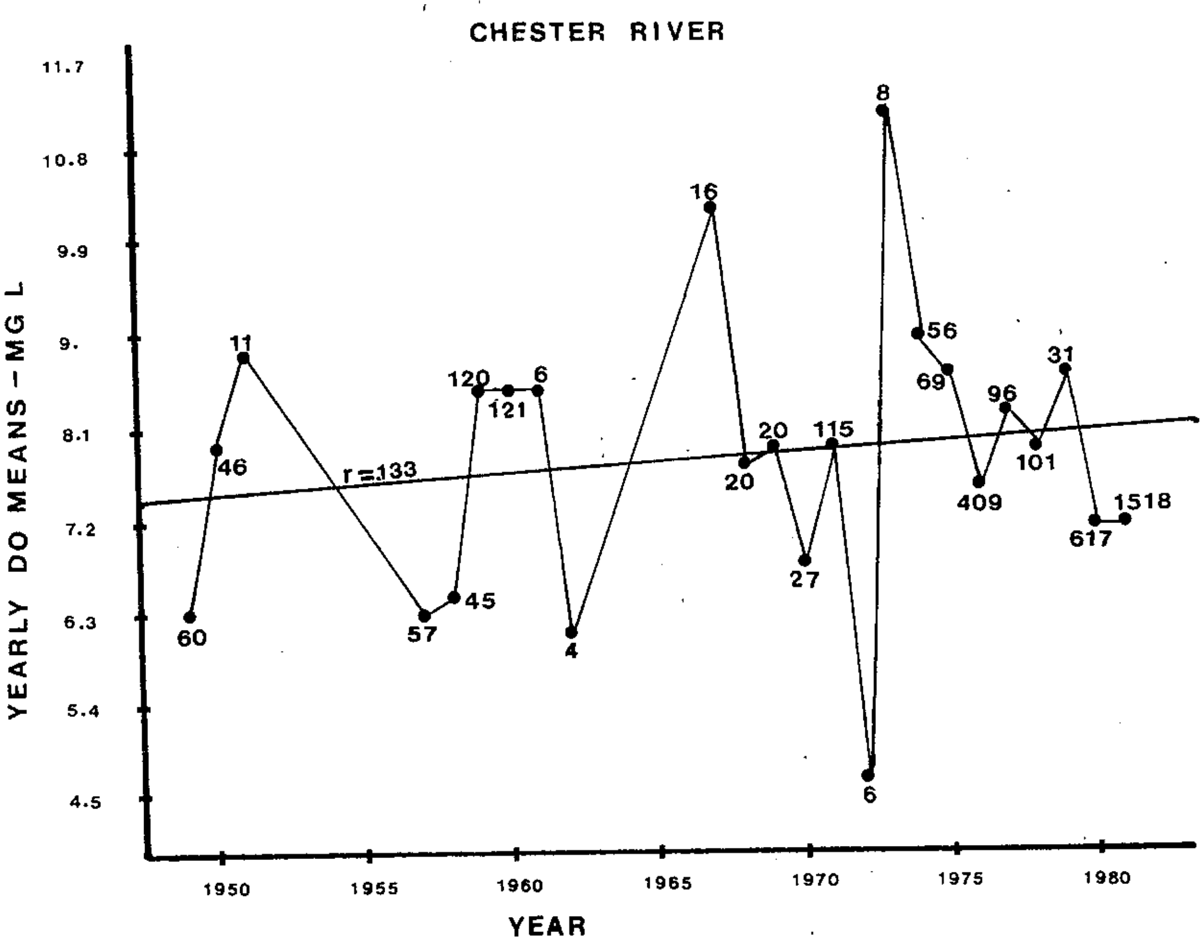


Figure 10-1 Yearly Mean Dissolved Oxygen vs Year (1949-1981)

Table 10-2
Chester River Dissolved Oxygen Upper River (.2-10.0 ppt) Salinity For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949	7.4100	.48871	20	-.394
1950	9.2400	1.6466	30	-.479
1951	9.3750	.25000	4	-.842
1957	6.9310	.83371	29	-.607
1958	7.1462	1.1934	39	-.274
1959	8.7339	2.1253	62	.078
1960	8.8585	1.9081	82	-.402
1961	8.4333	3.8187	6	.278
1967	10.194	1.6510	16	.148
1968	7.6850	2.0674	20	.372
1969	7.9100	2.3524	20	.560
1970	6.7815	1.1529	27	.342
1971	6.8712	1.4962	73	-.067
1973	10.425	.63443	4	-.206
1974	8.7739	2.1675	46	-.093
1975	8.1984	2.8360	49	-.456
1976	7.5506	1.7312	324	-.224
1977	9.0095	2.2748	74	-.187
1978	7.9036	2.4019	84	-.215
1979	8.5645	1.9061	31	.119
1980	6.7098	1.5073	501	-.226
1981	7.2108	1.6468	1030	.080

*From regression of DO vs Salinity.

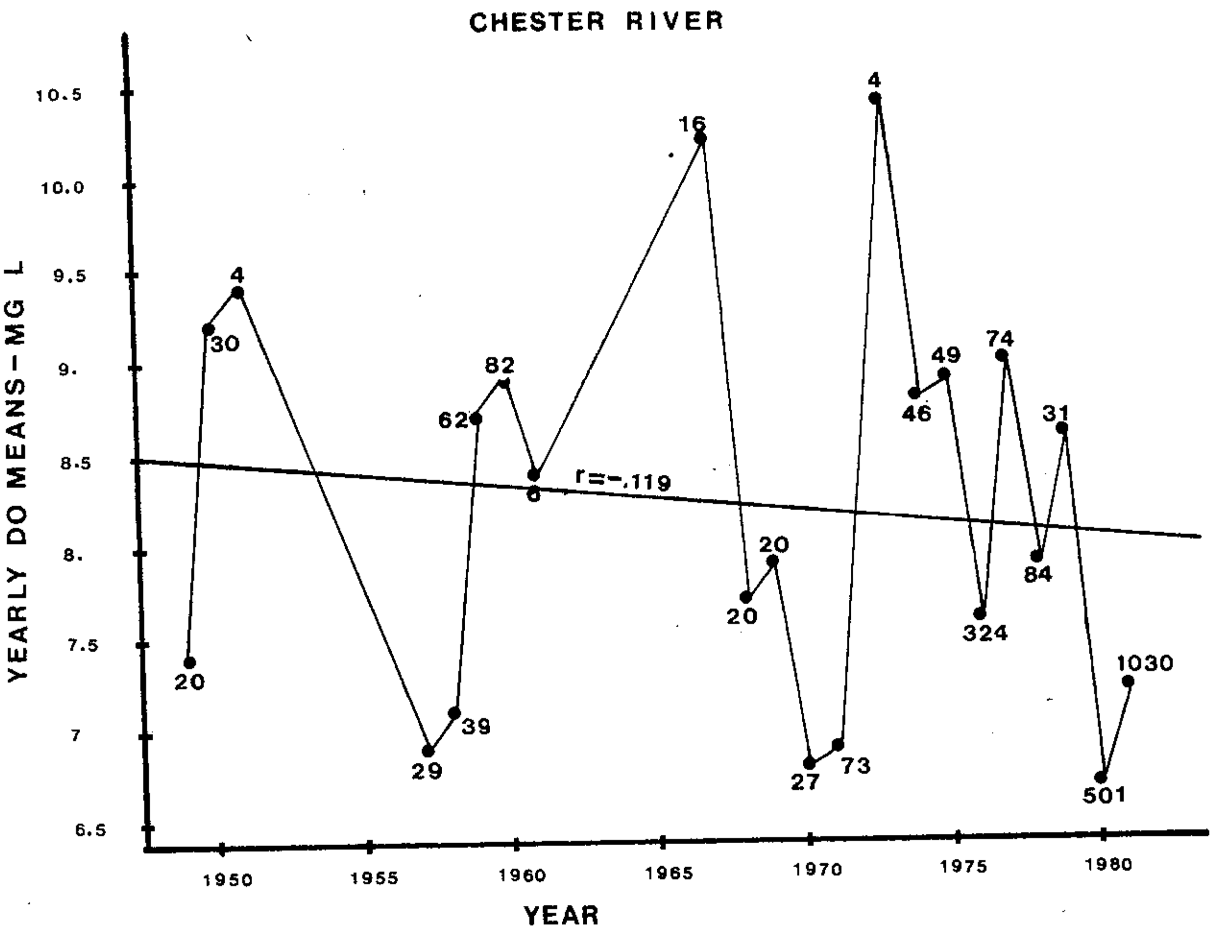


Figure 10-2 Yearly Mean Dissolved Oxygen Versus Year (1949-1981), Salinity Zone - 0.2 to 10.0 ppt

Table 10-3
Chester River Dissolved Oxygen Lower River (10.01-20.0 ppt) Salinity For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949	5.8275	2.0257	40	-.197
1950	5.6563	2.7078	16	.020
1951	8.6286	.70170	7	-.573
1957	5.6179	1.3958	28	-.091
1958	1.7000	2.6100	6	-.748
1959	8.1672	2.6821	58	-.136
1960	7.4359	2.4335	39	.175
1962	6.1750	1.6701	4	-.999
1971	9.6262	2.7580	42	-.485
1972	4.6000	1.3206	6	-.998
1973	12.000	.90921	4	-.938
1974	10.430	1.7030	10	-.147
1975	7.7400	2.1463	20	-.417
1976	7.2776	1.3529	85	.033
1977	6.0091	2.5294	22	.208
1978	7.4765	2.3784	17	-.492
1980	9.7741	2.5040	116	.472
1981	7.3186	2.7344	488	-.015

*From regression of DO vs Salinity.

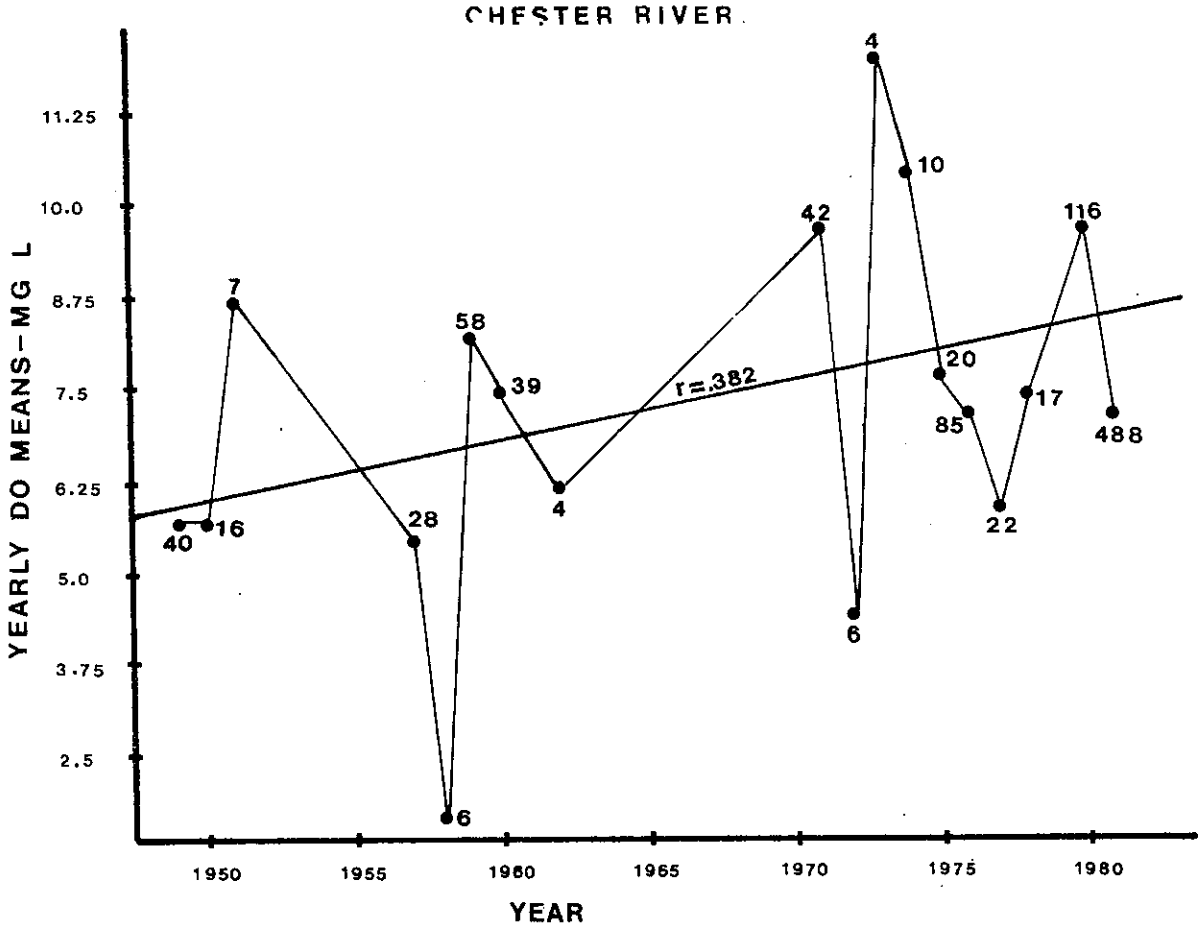


Figure 10-3 Yearly Mean Dissolved Oxygen Versus Year (1949-1981), Salinity Zone - 10.01 to 20.0 ppt

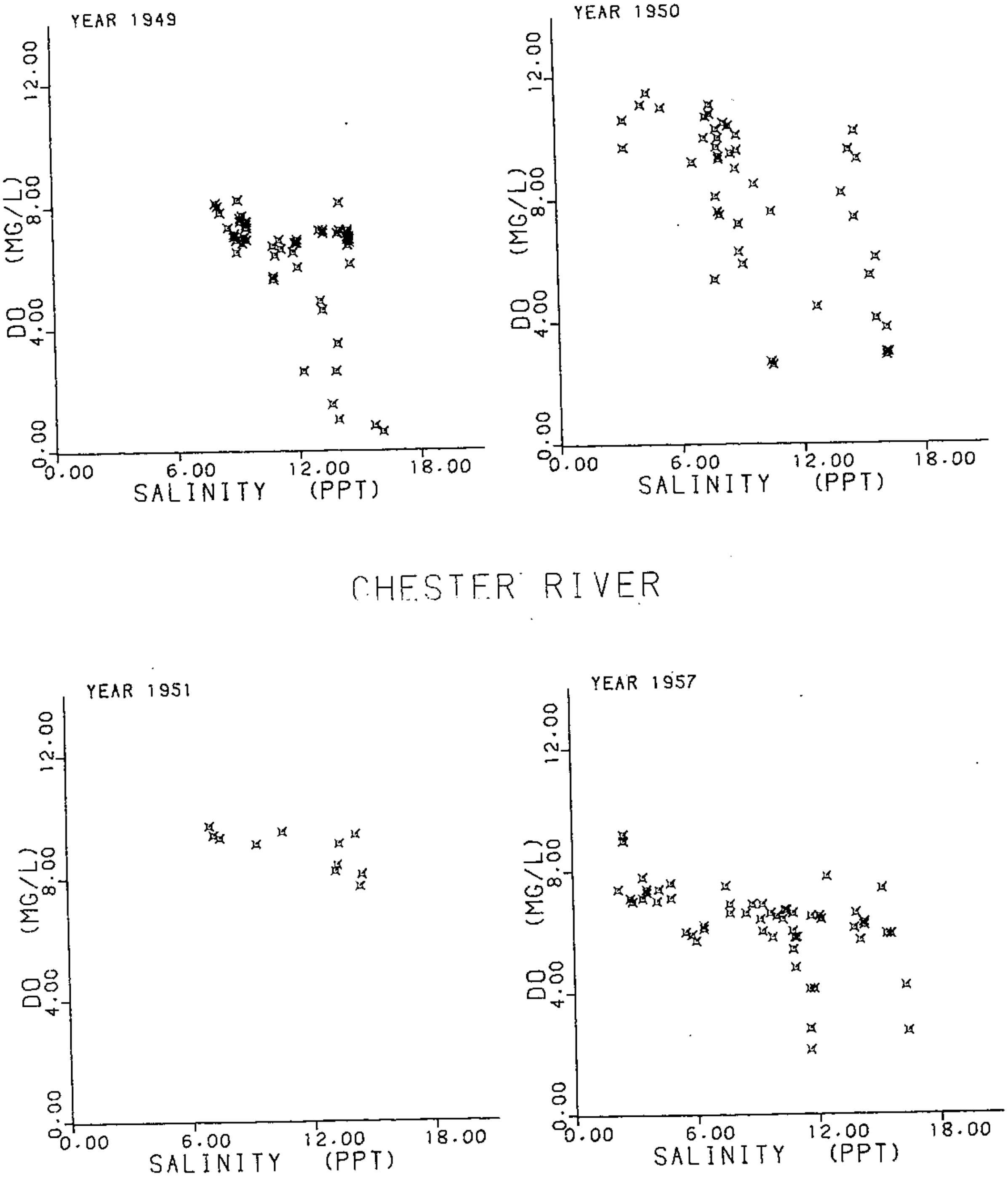


Figure 10-4 Chester River plots of historical dissolved oxygen versus salinity (grouped by years).

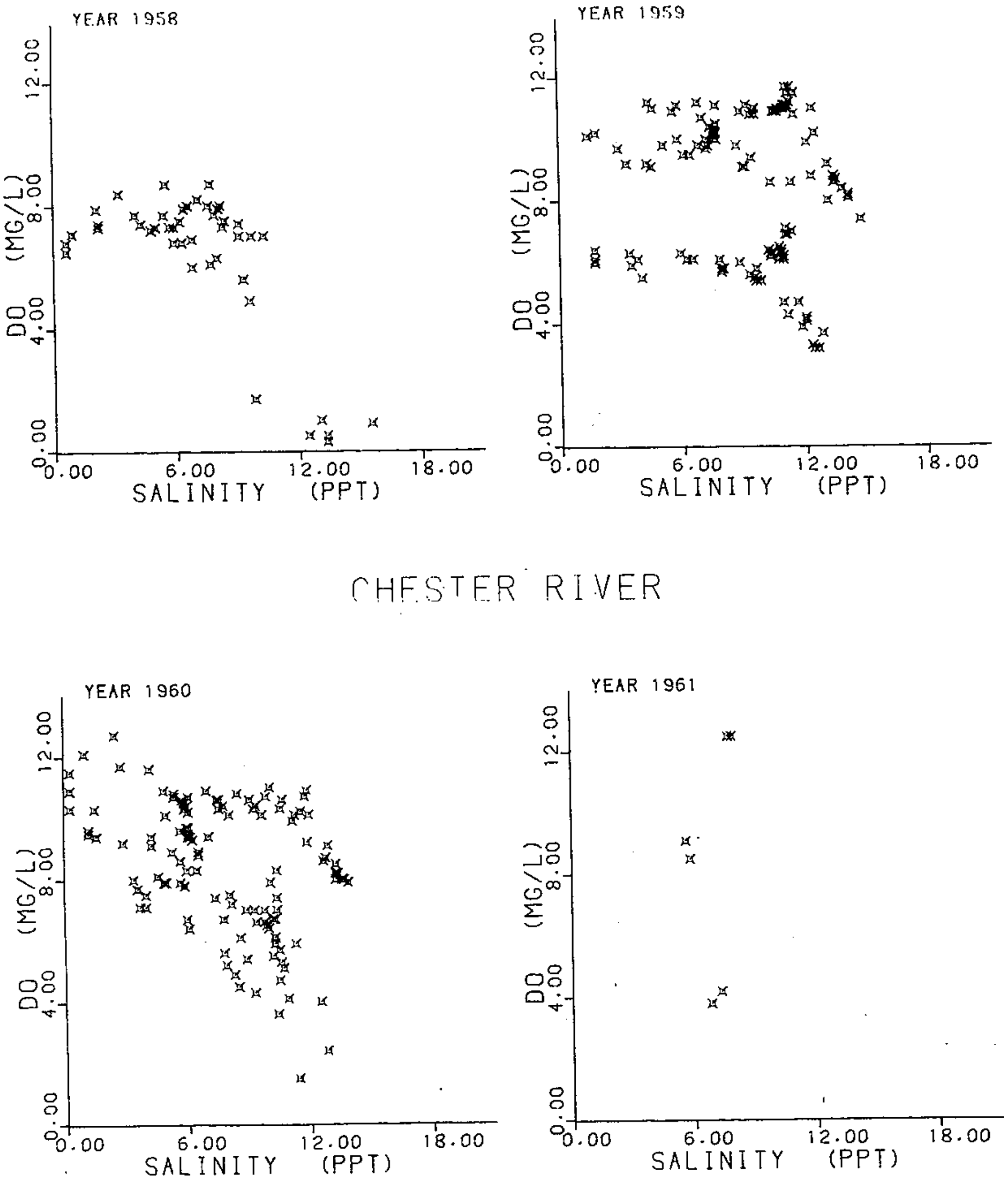


Figure 10-4 Chester River plots of historical dissolved oxygen versus salinity (grouped by years).

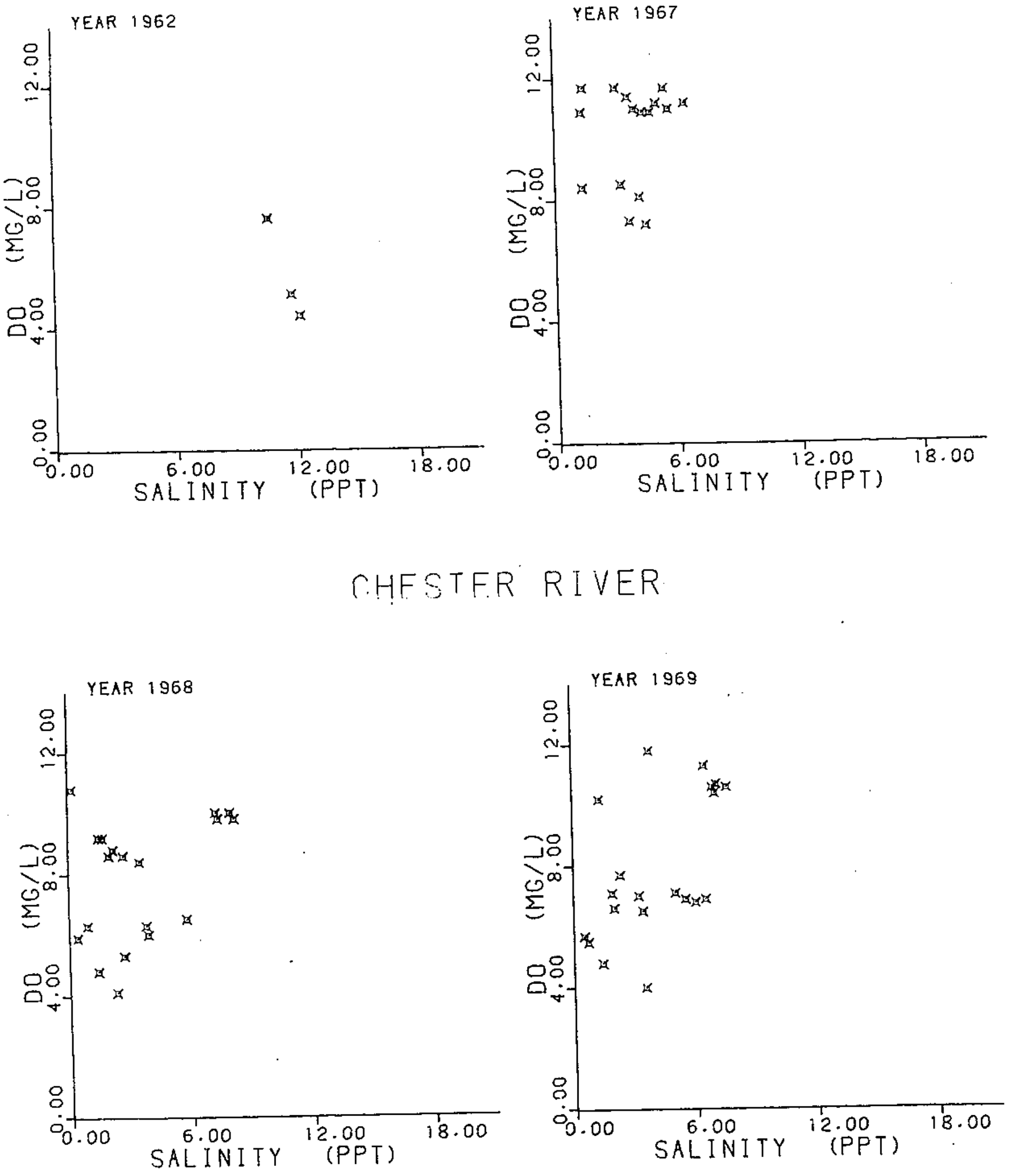
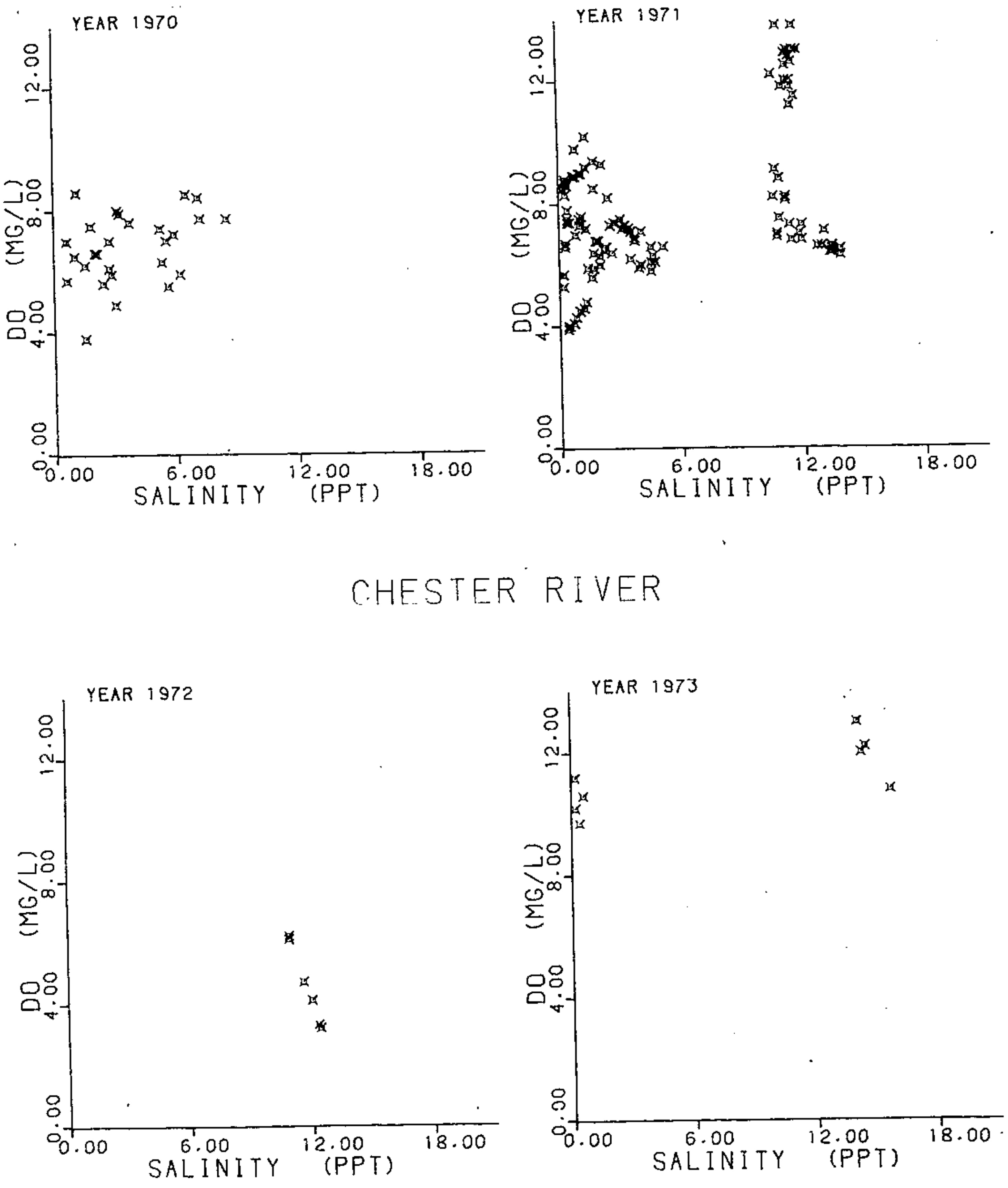


Figure 10-4 Chester River plots of historical dissolved oxygen versus salinity (grouped by years).



CHESTER RIVER

Figure 10-4 Chester River plots of historical dissolved oxygen versus salinity (grouped by years).

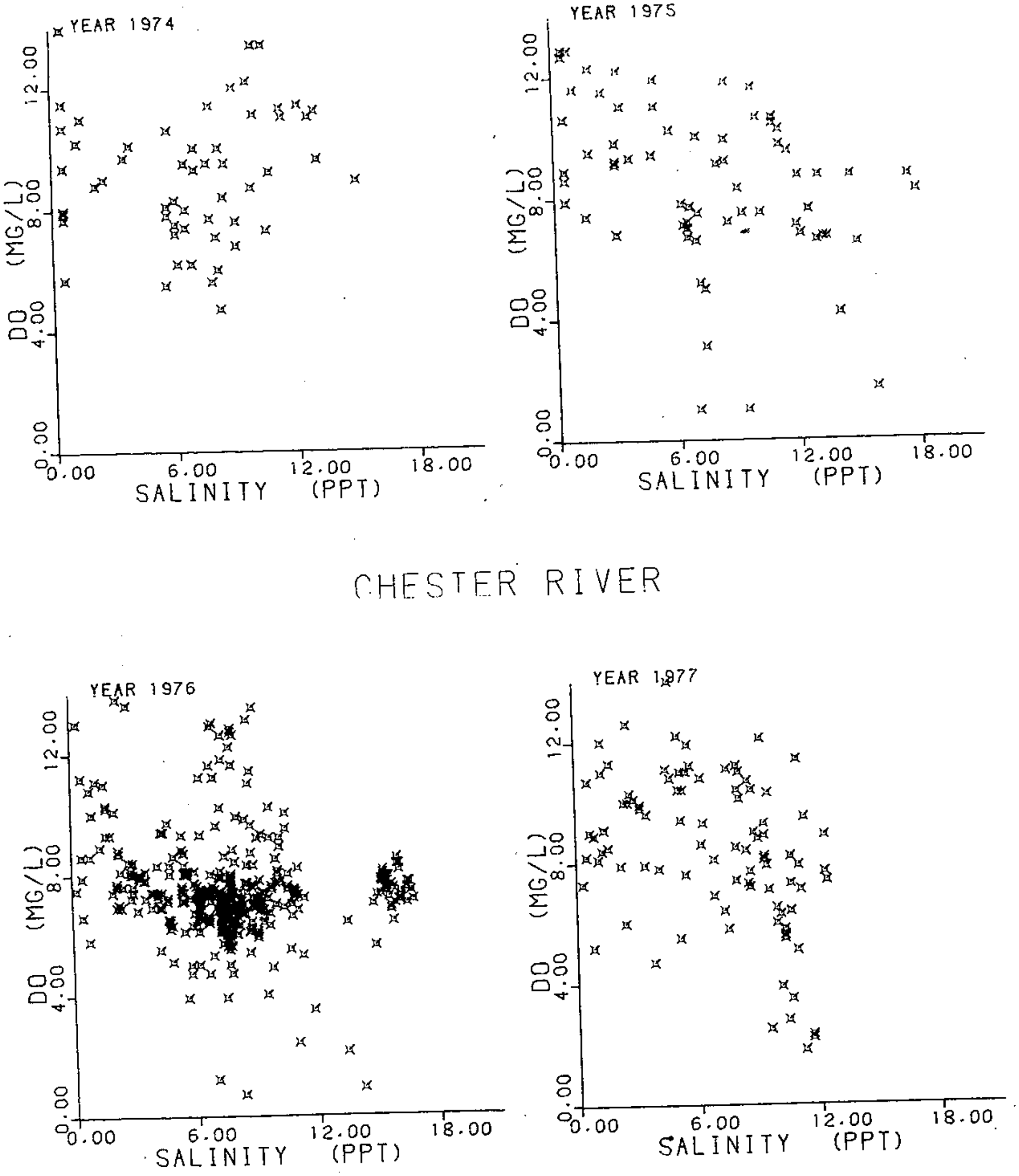


Figure 10-4 Chester River plots of historical dissolved oxygen versus salinity (grouped by years).

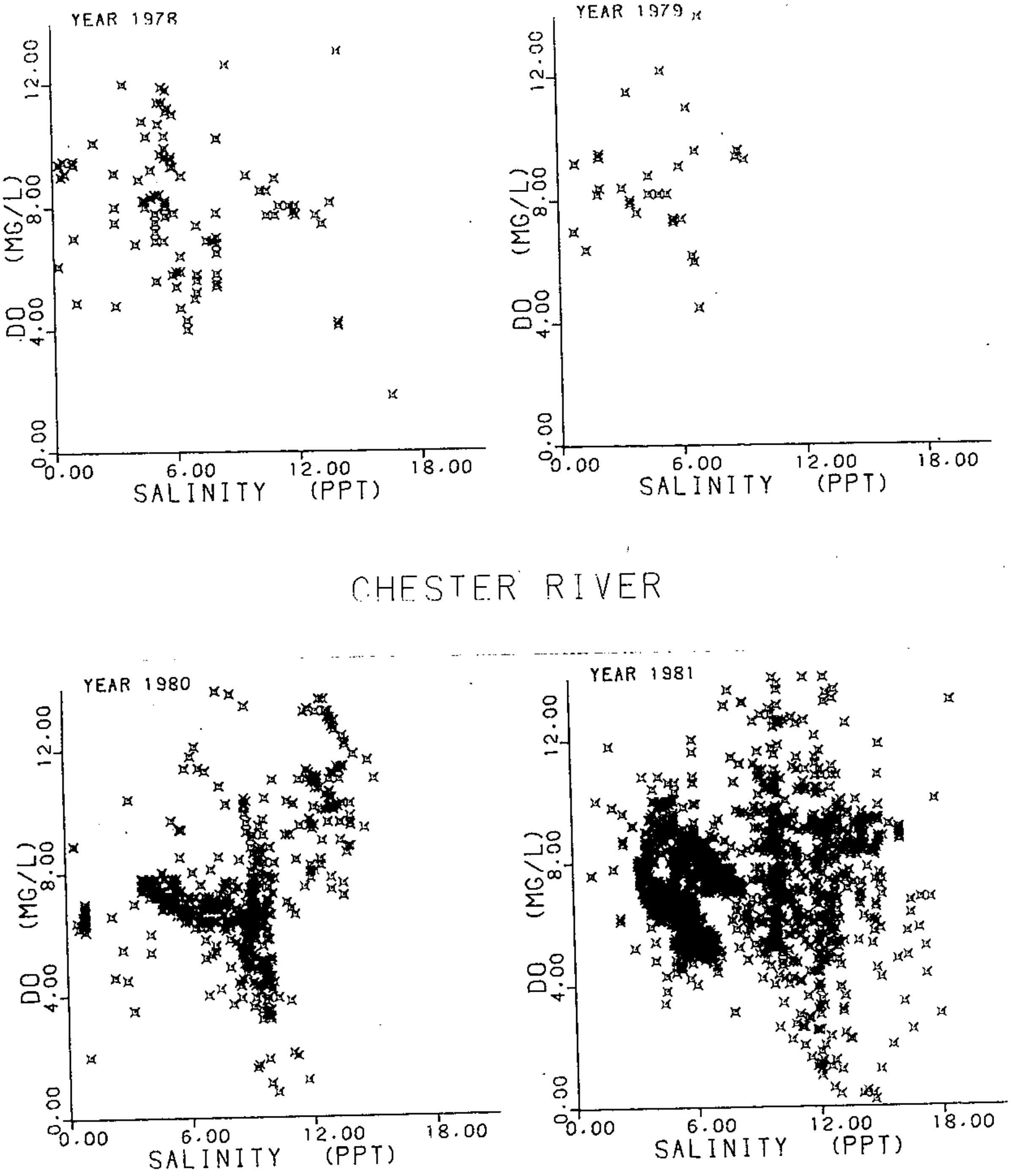


Figure 10-4 Chester River plots of historical dissolved oxygen versus salinity (grouped by years).

Table 10-4
Chester River Dissolved Oxygen For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation* Coefficient
49-59	7.4021	2.3801	339	-.330
60-69	8.3781	2.2815	187	-.192
70-79	7.8719	2.1771	918	-.087
80-81	7.2571	2.0848	2135	.120

Table 10-5
Chester River Dissolved Oxygen Upper River (.2 to 10.01 ppt) Salinity For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation* Coefficient
49-59	8.0658	1.7914	184	-.049
60-69	8.6944	2.1586	144	-.027
70-79	7.8785	2.0862	712	-.130
80-81	7.0468	1.6386	1531	-.056

Table 10-6
Chester River Dissolved Oxygen Lower River (10.01-20.0 ppt) Salinity For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation* Coefficient
49-59	6.6142	2.7328	155	-.280
60-69	7.3186	2.3863	43	.146
70-79	7.8490	2.4710	206	-.118
80-81	7.7902	2.8586	604	.050

*From regression of DO vs Salinity

Table 10-7
Dissolved Oxygen In Chester Estuary At Various Depth Ranges

Depth Range (ft.)	Mean	Standard Deviation	N	Correlation* Coefficient
0-5	7.8051	1.8257	2017	.144
6-10	7.7341	1.9418	317	.023
11-20	7.5047	2.1894	612	.075
21-40	6.4322	2.8144	556	-.066
41+	5.6195	2.7079	77	-.295

*From regression of DO vs Salinity

Table 10-8
Dissolved Oxygen In Upper Chester Estuary (Salinity=.2 - 10.0 ppt) At Various Depth Ranges

Depth Range (ft.)	Mean	Standard Deviation	N	Correlation* Coefficient
0-5	7.6141	1.7252	1662	-.036
6-10	7.6118	1.9409	229	-.079
11-20	7.2613	2.0115	375	-.138
21-40	6.6268	2.2752	272	-.169
41+	6.3970	1.9751	33	-.156

Table 10-9
Dissolved Oxygen In Lower Chester Estuary (Salinity=10.01-20.0 ppt) At Various Depth Ranges

Depth Range (ft.)	Mean	Standard Deviation	N	Correlation* Coefficient
0-5	8.6992	2.0107	355	-.085
6-10	8.0523	1.9188	88	-.106
11-20	7.8899	2.3989	237	.094
21-40	6.2458	3.2413	284	.105
41+	5.0364	3.0407	44	-.174

*From regression of DO vs Salinity

Table 10-10
Chester River Dissolved Oxygen By Months

Month	Average DOD	Standard Deviation	N	Correlation* Coefficient
January	9.5643	1.4789	14	-.824
February	12.467	.58595	3	-.979
March	11.814	1.1466	83	.193
April	9.4889	1.5118	190	.136
May	7.3795	2.0251	562	-.277
June	6.3361	2.1041	155	-.221
July	6.2444	1.8875	953	-.052
August	6.2503	2.0161	171	-.537
September	7.7038	1.3063	787	-.019
October	7.4277	1.1127	423	.063
November	10.143	2.0548	173	-.081
December	11.277	1.2001	65	-.414

* From regression of DO vs Salinity

Table 10-11
Chester River Dissolved Oxygen Lower River (Salinity = 10.01-20.0 ppt) By Months

Month	Average DOD	Standard Deviation	N	Correlation* Coefficient
January	8.6286	.70170	7	-.573
February	-	-	-	-
March	12.067	1.2858	39	-.215
April	9.7034	1.3460	29	.009
May	5.6232	2.5878	95	-.430
June	3.4437	2.0906	16	-.716
July	6.2644	2.8046	222	-.217
August	5.0891	2.1055	64	-.538
September	7.9190	1.7385	226	.106
October	7.6940	1.2250	166	-.238
November	10.145	2.2320	113	-.473
December	10.668	1.0505	31	-.321

* From regression of Do vs Salinity

Table 10-12
Chester River Dissolved Oxygen Upper River
(Salinity = .2-10.0 ppt) By Months

Month	Average DOD	Standard Deviation	N	Correlation Coefficient
January	10.500	1.4844	7	-.682
February	12.467	.58595	3	-.979
March	11.591	.96805	44	.255
April	9.4503	1.5404	161	.140
May	7.7368	1.6821	467	.110
June	6.6691	1.8395	139	-.013
July	6.2383	1.5049	731	-.053
August	6.9449	1.6072	107	-.288
September	7.6171	1.0745	561	-.423
October	7.2556	.99893	257	-.328
November	10.138	1.6889	60	.279
December	11.832	1.0599	34	.117

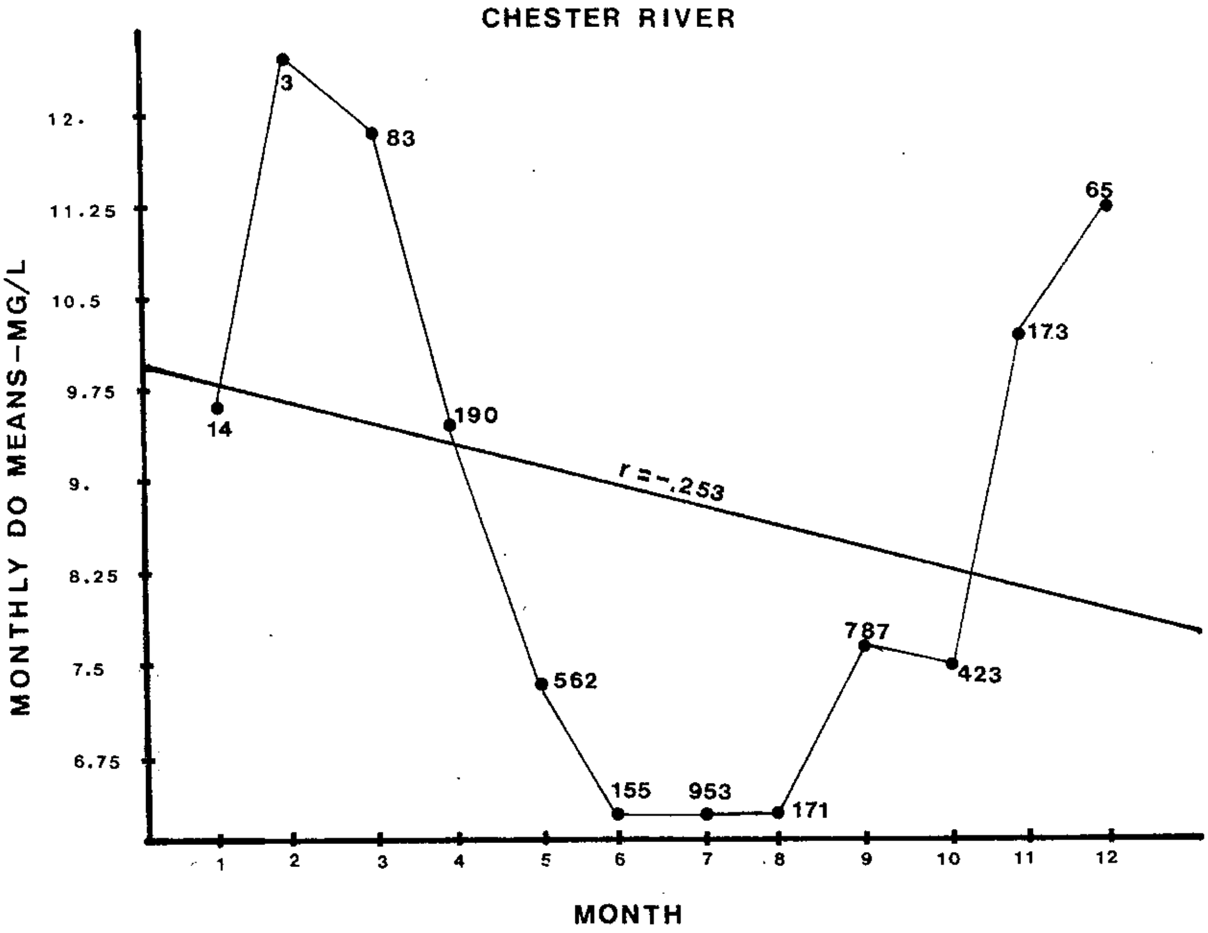


Figure 10-5 Chester Estuary Mean Monthly D.O. (1949-1981)

Table 10-13
Chester River Dissolved Oxygen By Time of Day

Time (Hours)	Mean	Standard Deviation	N	Correlation* Coefficient
0-2	6.6955	1.0815	44	-.443
2-4	7.2528	1.7195	106	.217
4-6	6.4652	1.1427	112	.346
6-8	7,0587	2.1915	283	.177
8-10	7.5515	2.2638	542	-.070
10-12	7.5976	2.3791	755	-.006
12-14	7.8138	2.3918	552	-.008
14-16	7.6195	2.2191	379	-.148
16-18	7.4227	2.0560	300	-.071
18-20	7.8041	1.6260	148	-.266
20-22	7.1242	1.5748	124	-.219
22-24	7.2233	1.5298	116	-.110

*From regression of DO vs Salinity

Table 10-14
Chester River Dissolved Oxygen Upper River (.2 to 10.0 ppt) Salinity By Time of Day

Time (Hours)	Mean	Standard Deviation	N	Correlation* Coefficient
0-2	6.6955	1.0815	44	-.443
2-4	7.1682	1.3772	88	.504
4-6	6.2596	.97796	94	.043
6-8	6.7335	1.6383	197	.004
8-10	7.4117	1.7582	333	-.295
10-12	7.6141	2.1847	461	.033
12-14	7.7820	2.1264	416	-.038
14-16	7.7579	1.9221	278	-.171
16-18	7.4964	1.9601	224	-.149
18-20	7.8594	1.4343	123	-.483
20-22	7.2075	1.3353	106	-.434
22-24	7.1436	1.1158	101	-.506

*From regression of DO vs Salinity

Table 10-15
Chester River Dissolved Oxygen Lower River (10.01 to 20.0 ppt) Salinity By Time of Day

Time (Hours)	Mean	Standard Deviation	N	Correlation* Coefficient
0-2				
2-4	7.6667	2.8875	18	-.351
4-6	7.5389	1.3561	18	-.151
6-8	7.8035	2.9897	86	-.018
8-10	7.7742	2.8835	209	-.191
10-12	7.5718	2.6591	294	-.070
12-14	7.9110	3.0720	136	-.046
14-16	7.2386	2.8601	101	.039
16-18	7.2053	2.3163	76	.308
18-20	7.5320	2.3755	25	.287
20-22	6.6333	2.5754	18	.656
22-24	7.7600	3.1586	15	-.391

*From regression of DO vs Salinity

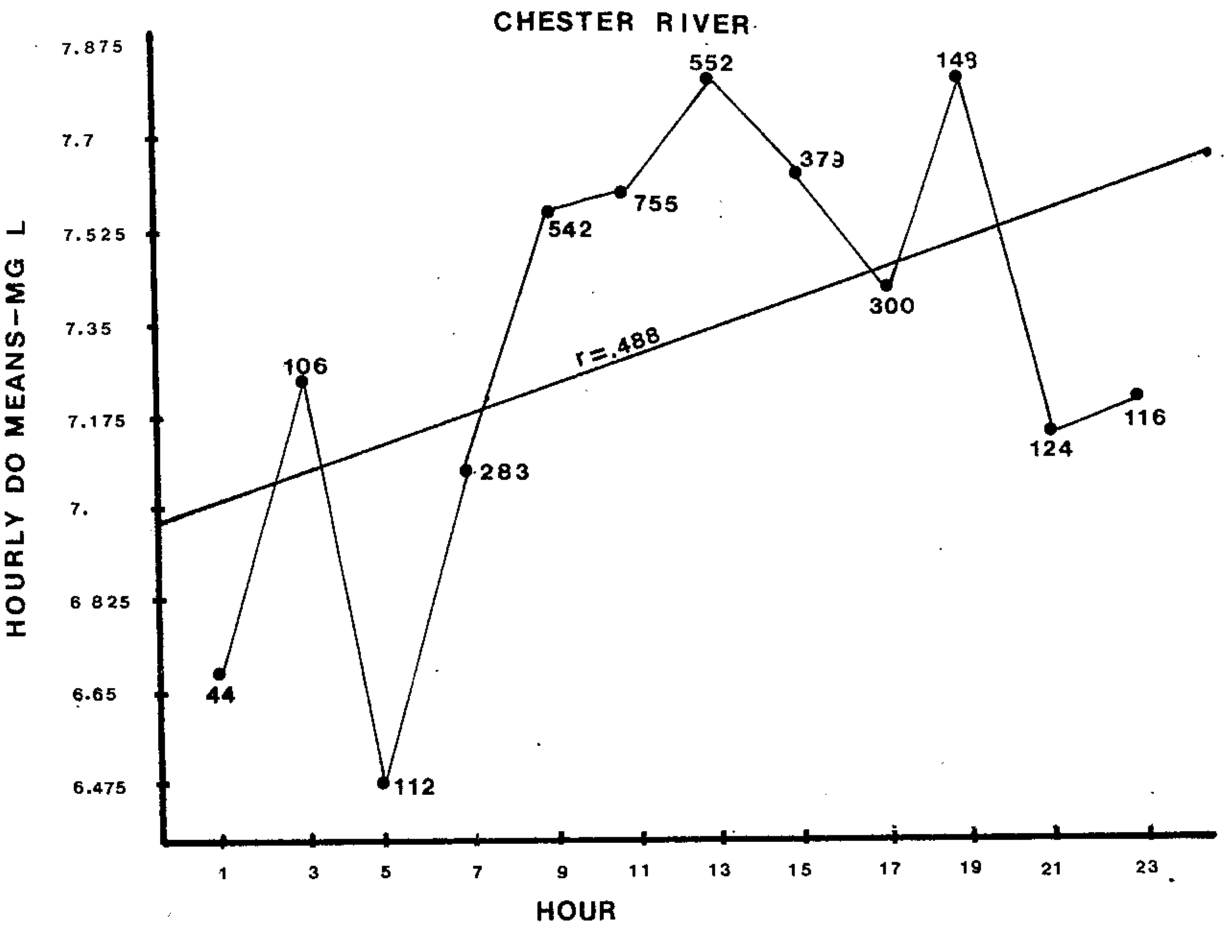


Figure 10-6 Mean DO Versus Time of Day (All data)

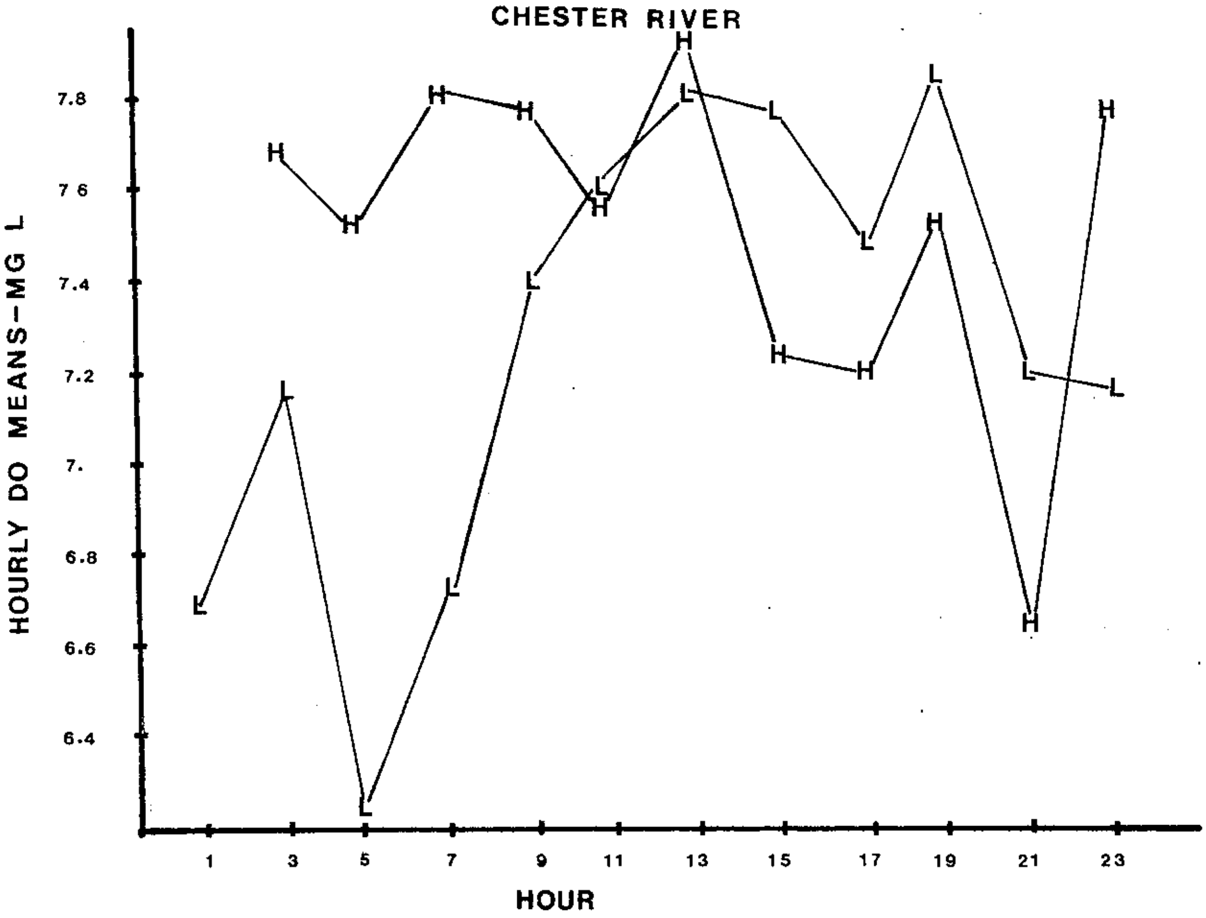


Figure 10-7 Chester River DO versus Time of Day in the Upper and Lower Salinity Zones.

Table 10-16
Chester River Winter* Dissolved Oxygen for Years 1951-80

Years	Mean	Standard Deviation	N	Correlation** Coefficient
1951	8.9000	.67528	11	-.702
1959	10.333	.98150	3	-1.00
1967	11.033	.13663	6	.619
1974	11.700	1.4799	3	1.00
1975	10.637	1.5487	16	-.914
1976	12.771	.68773	14	-.496
1980	11.104	.38674	25	.131

* (December, January, February)

** From regression of DO vs Salinity

Table 10-17
Chester River Spring* Dissolved Oxygen For Years 1950-1981

Years	Mean	Standard Deviation	N	Correlation** Coefficient
1950	9.7542	1.4380	24	-.710
1958	7.4000	.61473	20	.079
1959	9.8054	.80793	37	-.589
1960	9.2286	1.3156	42	-.568
1967	11.480	.34929	5	.469
1968	9.2000	.82946	6	-.957
1970	7.0429	.50943	7	.522
1971	10.288	2.3871	40	.902
1974	9.5500	1.8536	24	.586
1975	8.4476	3.6799	21	-.795
1976	8.0763	1.3708	38	-.155
1977	9.9025	1.8339	40	.145
1978	9.0957	2.3793	47	-.147
1979	8.9286	1.1954	7	-.357
1980	11.200	1.2728	2	-1.00
1981	7.5643	2.3095	473	.046

* March, April, and May

**From regression of DO vs Salinity

Table 10-18
Chester River Summer* Dissolved Oxygen For Years 1949-1981

Years	Mean	Standard Deviation	N	Correlation** Coefficient
1949	6.0700	2.1575	40	-.883
1950	6.0500	1.9716	10	-.829
1957	6.2939	1.4879	33	-.751
1958	5.6360	2.8915	25	-.851
1959	5.7000	1.1071	46	-.333
1961	6.4000	2.7869	4	-.951
1962	6.1750	1.6701	4	-.999
1968	5.3857	.76251	7	.321
1969	6.2833	.87958	6	.591
1970	5.6167	.95795	6	.361
1971	6.2863	1.1465	51	.287
1972	4.6000	1.3206	6	-.998
1974	7.3286	1.7955	14	-.262
1975	7.2500	2.0248	16	-.501
1976	6.5875	2.1855	40	-.329
1977	6.8400	2.6364	45	-.569
1978	6.3947	1.2901	38	-.237
1979	7.8000	1.3730	20	.046
1980	6.0743	1.7659	268	-.120
1981	6.2722	2.0099	600	-.006

* June, July, and August

** From regression of DO vs Salinity

Table 10-19
Chester River Fall* Dissolved Oxygen For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949	6.9250	.59283	20	.175
1950	6.0917	2.7718	12	-.901
1957	6.2750	1.0588	24	-.482
1959	10.565	1.0459	34	-.727
1960	7.9595	2.4239	79	-.219
1967	7.9000	.61237	5	-.619
1968	8.6857	1.6577	7	.798
1969	8.6071	2.4587	14	.394
1970	7.1500	1.1733	14	.100
1971	7.2417	.84180	24	-.290
1973	11.357	1.1163	7	.678
1974	9.4000	2.1441	15	-.151
1975	8.0125	1.2500	16	-,731
1976	7.3054	1.1500	317	-.152
1977	8.2900	1.2801	10	.146
1978	7.1667	2.1219	15	-.628
1979	11.600	2.3580	3	.616
1980	7.9736	1.8170	322	.667
1981	8.2189	1.0184	445	.117

*From regression of DO vs Salinity

Table 10-20
Chester River Winter* Dissolved Oxygen Upper River
(salinity = .2 - 10.0) For Years 1951-80

Years	Mean	Standard Deviation	N	Correlation** Coefficient
1951	9.3750	.25000	4	-.842
1967	11.033	.13663	6	.619
1974	11.700	1.4799	3	1.00
1975	11.875	.87790	8	-.696
1976	12.771	.68773	14	-.496
1980	11.075	.60759	4	-.935

* December, January, and February

** From regression of DO vs Salinity

Table 10-21
Chester River Spring* Dissolved Oxygen Upper River (salinity = .2 - 10.0) For Years 1958-1981

Years	Mean	Standard Deviation	N	Correlation ** Coefficient
1950	10.091	.78127	22	-.513
1958	7.4211	.62413	19	.140
1959	10.000	.57933	33	-.114
1960	9.2286	1.3156	42	-.568
1967	11.480	.34929	5	.469
1968	9.2000	.82946	6	-.957
1970	7.0429	.50943	7	.522
1971	8.2857	1.3414	21	.358
1974	9.0944	1.9077	18	.463
1975	9.0263	3.3408	19	-.722
1976	8.0763	1.3708	38	-.155
1977	9.9128	1.8567	39	.169
1978	9.2163	2.4543	43	-.047
1979	8.9286	1.1954	7	-.357
1980	11.200	1.2728	2	-1.00
1981	7.7169	1.7689	349	.407

* March, April, and May

** From regression of DO vs Salinity

Table 10-22
Chester River Summer* Dissolved Oxygen Upper River (salinity = .2 - 10.0) For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation Coefficient
1949	7.4100	.48871	20	-.394
1950	6.9000	.93197	8	-.246
1957	7.0273	.86530	22	-.618
1958	6.8850	1.5270	20	-.510
1959	5.8905	.29817	21	-.628
1961	6.4000	2.7869	4	-.951
1968	5.3857	.76251	7	.321
1969	6.2833	.87958	6	.591
1970	5.6167	.95795	6	.361
1971	6.2863	1.1465	51	.287
1974	7.3308	1.8688	13	-.277
1975	7.2500	2.0248	16	-.501
1976	6.5875	2.1855	40	-.329
1977	7.8500	2.3491	30	-.378
1978	6.3947	1.2901	38	-.237
1979	7.8000	1.3730	20	.046
1980	6.1484	1.6796	258	-.081
1981	6.1965	1.4189	397	.041

* June, July, and August

** From regression of DO vs Salinity

Table 10-23
Chester River Fall* Dissolved Oxygen Upper River (salinity = .2 - 10.0) For Years 1957-81

Years	Mean	Standard Deviation	N	Correlation** Coefficient
1957	6.6286	.69454	7	-.863
1959	11.000	.16733	6	-.759
1960	8.4700	2.3323	40	-.249
1967	7.9000	.61237	5	-.619
1968	8.6857	1.6577	7	.798
1969	8.6071	2.4587	14	.394
1970	7.1500	1.1733	14	.100
1973	10.500	.75498	3	-.397
1974	9.1250	2.0706	12	-.685
1975	9.0833	.82563	6	-.399
1976	7.3155	1.0692	232	-.364
1977	8.2150	.79320	4	.508
1978	8.2000	1.3000	3	-1.00
1979	11.600	2.3580	3	.616
1980	7.2093	1.0254	237	-.030
1981	8.0067	.89517	284	-.603

* September, October, and November

** From regression of DO vs Salinity

Table 10-24
Chester River Winter* Dissolved Oxygen Lower River (salinity = 10.01 - 20.0 ppt) For Years 1951-81

Years	Mean	Standard Deviation	N	Correlation** Coefficient
1951	8.6286	.70170	7	-.573
1975	9.4000	.93197	8	-.875
1981	11.110	.35200	21	.765

* December, January, and February

** From regression of DO vs Salinity

Table 10-25
Chester River Spring* Dissolved Oxygen Lower River (salinity = 10.01 - 20.0 ppt) For Years 1950-81

Years	Mean	Deviation	N	Correlation** Coefficient
1950	6.0500	2.1920	2	-1.00
1959	8.2000	.63246	4	-.910
1971	12.500	.71024	19	.029
1974	10.917	.66458	6	-.507
1975	2.9500	1.7678	2	-1.00
1978	7.8000	.14142	4	.292
1981	7.1347	3.3708	124	-.111

* March, April, and May

** From regresssion of DO vs Salinity

Table 10-26
Chester River Summer* Dissolved Oxygen Lower River (salinity = 10.01 - 20.0 ppt) For Years 1950-81

Years	Mean	Standard Deviation	N	Correlation** Coefficient
1949	4.7300	2.3528	20	-.866
1950	2.6500	.07071	2	-1.00
1957	4.8273	1.4008	11	-.841
1958	.64000	.29665	5	.422
1959	5.5400	1.4717	25	-.829
1962	6.1750	1.6701	4	-.999
1972	4.6000	1.3206	6	-.998
1977	4.8200	1.9637	15	-.575
1980	4.1600	2.7782	10	-.626
1981	6.4202	2.8283	203	-.295

* June, July, and August

** From regression of DO vs Salinity

Table 10-27
Chester River Fall* Dissolved Oxygen Lower River (salinity = 10.01 - 20.0 ppt) For Years 1949-81

Years	Mean	Standard Deviation	N	Correlation** Coefficient
1949	6.9250	.59283	20	.175
1950	6.0917	2.7718	12	-.901
1957	6.1294	1.1634	17	-.595
1959	10.471	1.1317	28	-.908
1960	7.4359	2.4335	39	.175
1971	7.2522	.85911	23	-.763
1973	12.000	.90921	4	-.938
1974	10.500	2.5159	3	-.583
1975	7.3700	1.0012	10	-.537
1976	7.2776	1.3529	85	.033
1977	8.4000	1.5925	6	-.315
1978	6.9083	2.2492	12	-.857
1980	10.105	1.8491	85	.227
1981	8.5932	1.1135	161	-.278

* September, October, and November

** From regression of DO vs Salinity

Table 10-28

Chester River Dissolved Oxygen Deficit For Years 1949-1981

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949	1.4307	1.7653	59	.576
1950	1.7628	1.8862	46	.431
1951	3.6182	.49319	11	.099
1957	1.4361	1.2562	57	.498
1958	2.2724	2.1406	45	.655
1959	1.2248	1.1631	119	.188
1960	.84818	1.4139	121	.498
1961	.87500	2.4055	6	.332
1962	1.6200	1.6758	4	.999
1967	1.2138	.66614	16	.414
1968	1.7240	1.4561	20	-.301
1969	1.7265	1.2383	20	-.457
1970	2.5181	1.3678	26	-.371
1971	1.3194	1.4447	114	-.438
1972	3.1417	1.3152	6	.998
1973	-.21375	1.9769	8	-.502
1974	.39982	1.5145	56	-.115
1975	1.3924	1.8178	68	.309
1976	1.1787	1.1866	408	.102
1977	.89242	2.2315	95	.230
1978	.99571	1.4998	98	.336
1979	.72452	2.0788	31	-.240
1980	1.4875	1.4392	617	-.262
1981	1.0759	1.8416	1517	-.023

*From regression of DOD vs Salinity.

Table 10-29
Chester River Dissolved Oxygen Deficits Lower River (10.01-20.0 ppt) Salinity For Years 1949-1981

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949	2.0736	1.8134	39	.269
1950	3.1106	2.5421	16	-.020
1951	3.6043	.62663	7	.367
1957	2.0271	1.3478	28	.060
1958	6.4617	1.2964	6	.686
1959	1.3921	1.4404	57	.441
1960	1.4677	1.5258	39	.192
1962	1.6200	1.6758	4	.999
1971	.49537	1.0021	41	.534
1973	-1.1900	1.0091	4	.938
1974	- .17500	1.3078	10	.227
1975	1.7110	1.5957	20	.417
1976	1.2595	1.2409	84	-.106
1977	2.1657	2.1752	21	-.154
1978	1.8759	2.0255	17	.395
1980	.56922	1.5728	116	-.488
1981	1.0423	2.5456	487	.037

*From regression of DOD vs Salinity.

Table 10-30

Chester River Dissolved Oxygen Deficits Upper River (.2-10.0 ppt) Salinity For Years 1949-1981

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949	.09750	.46859	20	.309
1950	1.0440	.80088	30	-.186
1951	3.6425	.15564	4	.393
1957	.86552	.84739	29	.452
1958	1.6279	1.3738	39	.231
1959	1.0710	.81374	62	-.056
1960	.55354	1.2637	82	.536
1961	.87500	2.4055	6	.332
1967	1.2138	.66614	16	.414
1968	1.7240	1.4561	20	-.301
1969	1.7265	1.2383	20	-.457
1970	2.5181	1.3678	26	-.371
1971	1.7822	1.4539	73	-.266
1973	.76250	2.3578	4	.452
1974	.52478	1.5401	46	-.018
1975	1.2596	1.9026	48	.353
1976	1.1577	1.1732	324	.184
1977	.53108	2.1253	74	.064
1978	.81099	1.3068	81	.172
1979	.72452	2.0788	31	-.240
1980	1.7002	1.3198	501	-.020
1981	1.0919	1.3911	1030	-.073

*From regression of DOD vs Salinity

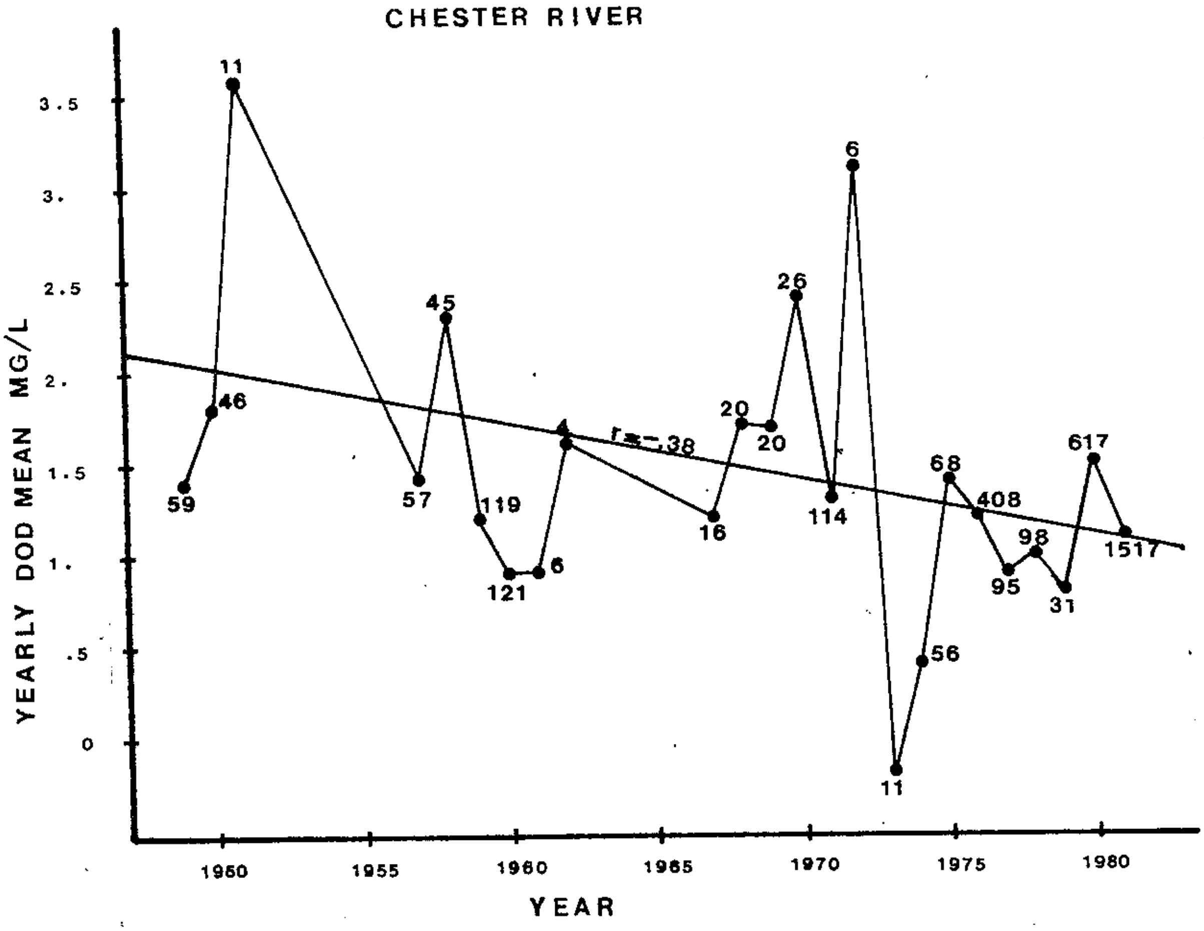


Figure 10-8 Chester River Yearly Mean DOD vs Year (all estuarine data)

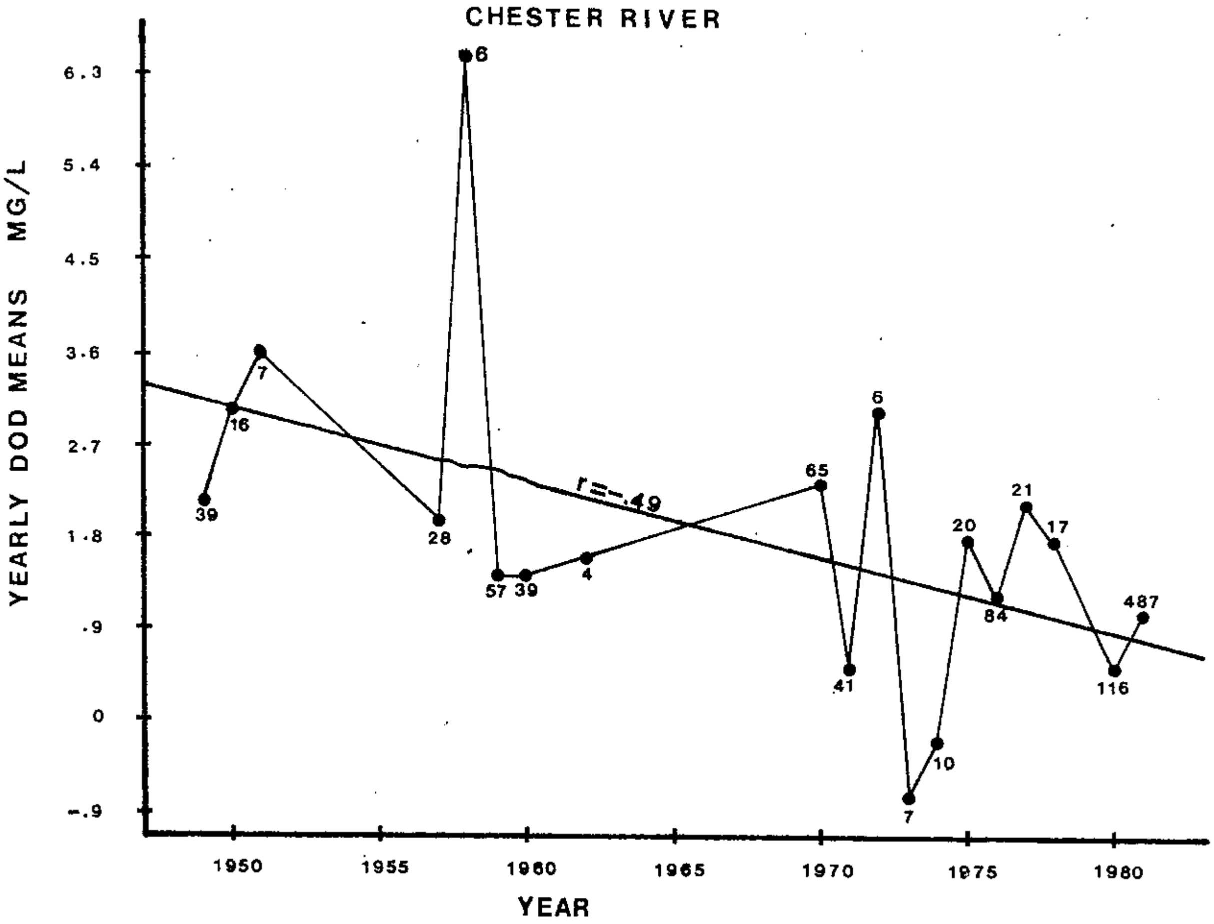


Figure 10-9 Chester River Yearly Mean DOD vs Year (Lower River)

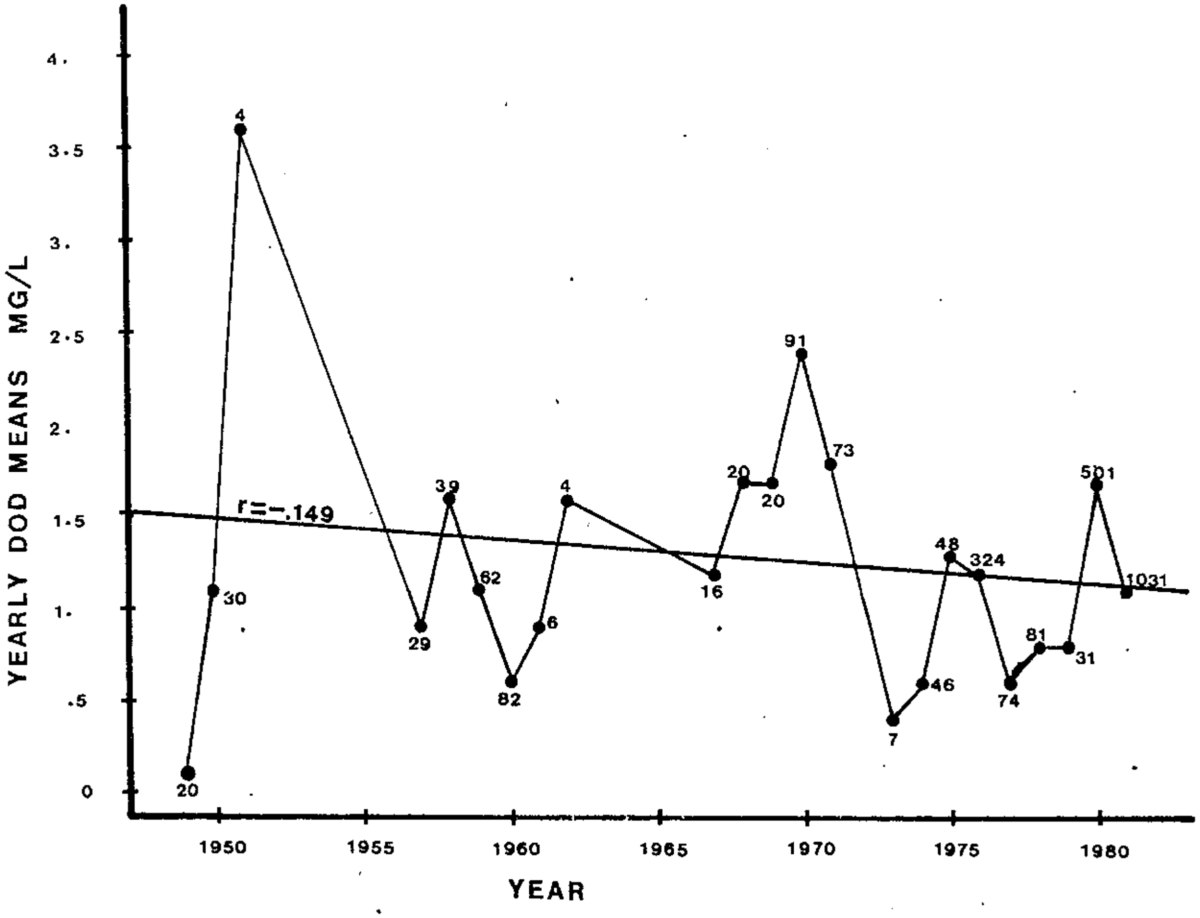


Figure 10-10 Chester River Yearly Mean DOD vs Year (Upper River)

Table 10-31
Chester River Dissolved Oxygen Deficits For Years 1949-1981

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949-59	1.5833	1.6181	337	.347
1960-69	1.0844	1.4259	187	.157
1970-79	1.1382	1.5542	910	.030
1980-81	1.1949	1.7445	2134	-.080

*From regression of DOD vs Salinity

Table 10-32

Chester River Dissolved Oxygen Deficits Upper River (.2-10.0) Salinity For Years 1949-1981

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949-59	1.1023	1.0804	184	.006
1960-69	.96576	1.3802	144	.045
1970-79	1.1114	1.5391	707	.002
1980-81	1.2909	1.3972	1531	-.020

*From regression of DOD vs Salinity

Table 10-33
Chester River Dissolved Oxygen Deficits Lower River (10.01-20.0) Salinity For Years 1949-1981

Years	Mean	Standard Deviation	N	Correlation* Coefficient
1949-59	2.1618	1.9405	153	.313
1960-69	1.4819	1.5195	43	.229
1970-79	1.2317	1.6062	203	.037
1980-81	.95128	2.3956	603	-.011

*From regression of DOD vs Salinity

Table 10-34
Dissolved Oxygen Deficits In Chester Estuary At Various Depth Ranges

Depth Range (ft)	Average DO	Standard Deviation	Correlation* Coefficient	N
0-5	.89014	1.3994	-.236	2013
6-10	.83984	1.2201	-.16	315
11-20	1.2016	1.512	-.137	610
21-40	2.3462	2.1901	.089	554
41 +	3.0661	2.0719	.440	76

*From regression of DOD vs Salinity

Table 10-35
Dissolved Oxygen Deficits In Upper Chester Estuary (Salinity=.2-10.0 ppt) At Various Depth Ranges

Depth Range (ft.)	Average DOD	Standard Deviation	Correlation* Coefficient	N
0-5	1.0449	1.3405	-.114	1660
6-10	.9521	1.2709	-.093	227
11-20	1.3801	1.3255	.009	374
21-40	2.0839	1.7048	.079	272
41 +	2.1333	1.5459	.126	33

*From regression of DOD vs Salinity

Table 10-36
Dissolved Oxygen Deficits In Lower Chester Estuary (Salinity=10.01-20.0 ppt)

Depth Range (ft.)	Average DOD	Standard Deviation	Correlation* Coefficient	N
0-5	.1623	1.4421	.079	353
6-10	.5502	1.0291	.009	88
11-20	.9188	1.7335	-.113	236
21-40	2.5991	2.5505	-.083	282
41 +	3.7819	2.1533	.285	43

*From regression of DOD vs Salinity

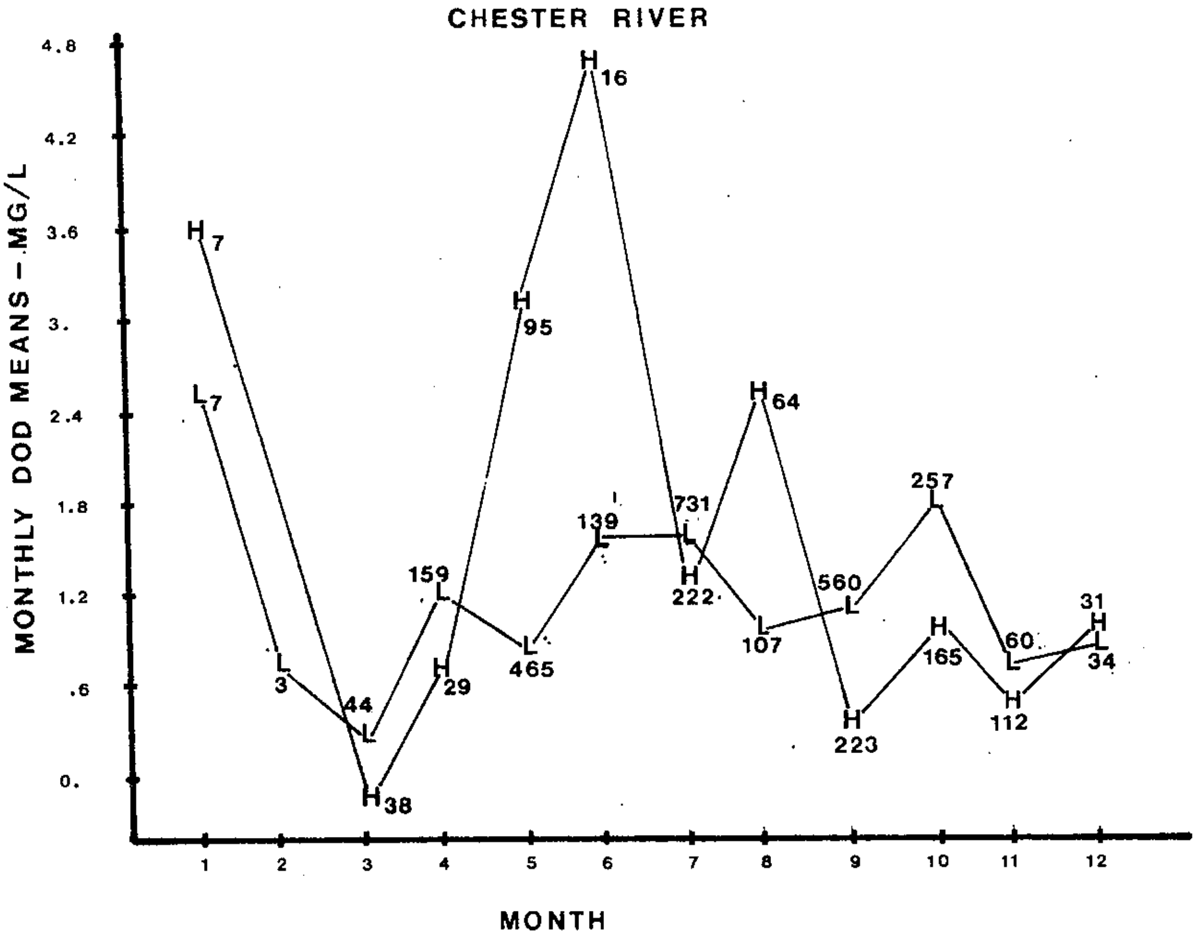


Figure 10-11 Chester River DOD Monthly Mean In The Upper and Lower Estuary (Period of Record)

Table 10-37
Chester River Dissolved Oxygen Deficits By Months

Months	Average DOD	Standard Deviation	N	Correlation* Coefficient
January	3.0700	1.1966	14	.650
February	.69333	.45092	3	-.097
March	.02659	1.0375	82	-.285
April	1.0887	1.5013	188	-.114
May	1.1998	1.9973	560	.302
June	1.8503	2.2197	155	.122
July	1.4760	1.9147	953	.004
August	1.5205	1.9505	171	.476
September	.84902	1.1733	783	-.114
October	1.4807	.86488	422	-.341
November	.55448	1.5151	172	-.085
December	.92231	.75517	65	-.093

* From regression of DOD vs Salinity

Table 10-38
Chester River Dissolved Oxygen Deficits Lower River (salinity = 10.01-20.0 ppt) By Months

Months	Average DOD	Standard Deviation	N	Correlation* Coefficient
January	3.6043	.62663	7	.367
February	--	--	-	--
March	- .17947	1.1402	38	.231
April	.73241	1.7411	29	.025
May	3.1664	2.5876	95	.514
June	4.7156	2.2483	16	.737
July	1.3627	2.8481	222	.208
August	2.5375	2.0357	64	.533
September	.41085	1.4940	223	-.089
October	1.0075	.89916	165	.060
November	.43723	1.5738	112	.386
December	.98290	.68824	31	-.137

Table 10-39
Chester River Dissolved Oxyten Deficits Upper River (salinity = .2-10.0 ppt) By Months

Months	Average DOD	Standard Deviation	N	Correlation* Coefficient
January	2.5357	1.4296	7	.564
February	.69333	.45092	3	-.097
March	.20455	.91597	44	-.537
April	1.1537	1.4501	159	-.069
May	.79804	1.5798	465	-.167
June	1.5205	1.9716	139	-.103
July	1.5104	1.5233	731	-.006
August	.91224	1.6249	107	.200
September	1.0235	.96550	560	.343
October	1.7846	.68932	257	.274
November	.77333	1.3851	60	-.455
December	.86706	.81779	34	-.335

* From regression of DOD vs Salinity

Table 10-40

Chester River Dissolved Oxygen Deficits By Time Of Day

Hours	Average DOD	Standard Deviation	N	Correlation* Coefficient
0-2	1.6891	.65835	44	.309
2-4	1.0477	1.9049	106	-.272
4-6	1.8259	.89708	112	-.571
6-8	1.5162	1.6912	283	-.166
8-10	1.2651	1.5272	540	.039
10-12	1.3981	1.5709	751	-.061
12-14	1.0893	1.8314	550	.062
14-16	1.0624	1.7918	379	.078
16-18	.86903	2.0367	299	.070
18-20	.68284	1.6146	148	.302
20-22	1.1785	1.4046	124	.166
22-24	1.2871	1.4926	116	-.155

* From regression of DO vs Salinity

Table 10-41
Chester River Dissolved Oxygen Deficits Upper River (Salinity = .2 to 10.0 ppt) By Time of Day

Hours	Average DOD	Standard Deviation	N	Correlation* Coefficient
0-2	1.6891	.65835	44	.309
2-4	1.1558	1.4861	88	-.674
4-6	2.0482	.67609	94	-.287
6-8	1.7877	1.0455	197	-.050
8-10	1.2837	1.1382	333	.019
10-12	1.4306	1.4023	459	-.133
12-14	1.0384	1.6448	415	.008
14-16	.94953	1.4373	278	-.005
16-18	.76018	1.9075	224	.087
18-20	.60220	1.4179	123	.500
20-22	1.1175	1.0650	106	.394
22-24	1.4423	.83865	101	.140

* From regression of DO vs Salinity

Table 10-42
Chester River Dissolved Oxygen Deficits Lower River (Salinity = 10.01 to 20.0 ppt) By Time of Day

Hours	Average DOD	Standard Deviation	N	Correlation* Coefficient
0-2	-	-	-	-
2-4	.51944	3.2791	18	.428
4-6	.66500	1.0266	18	.018
6-8	.89430	2.5311	86	.165
8-10	1.2353	2.0033	207	.227
10-12	1.3469	1.8058	292	.067
12-14	1.2458	2.3129	135	.146
14-16	1.3731	2.5060	101	.000
16-18	1.1941	2.3659	75	-.285
18-20	1.0796	2.3558	25	-.276
20-22	1.5378	2.6663	18	-.561
22-24	.24200	3.4542	15	.331

* From regression of DOD vs Salinity

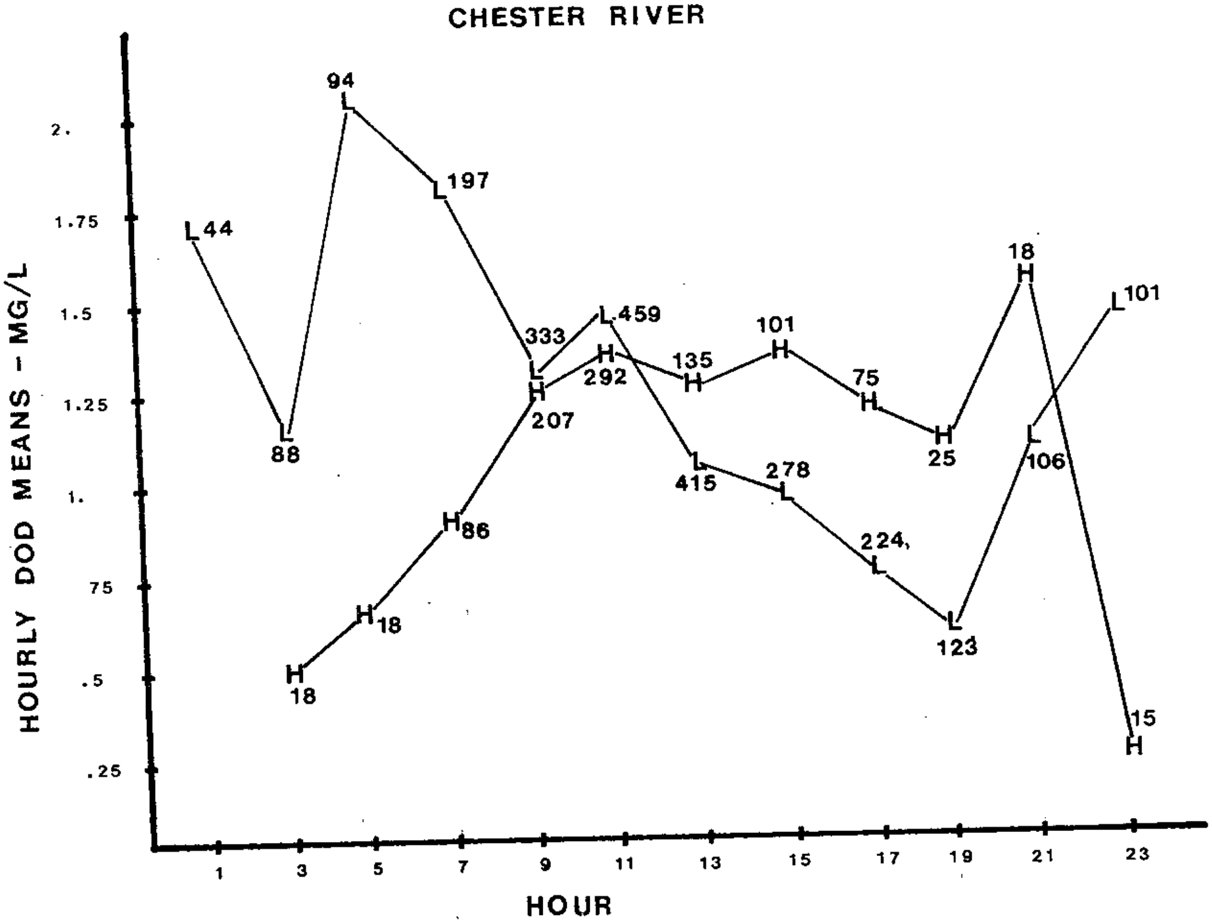


Figure 10-12 Chester River Upper and Lower River Mean DOD by Hours (Period of Record)

Table 10-43
Chester River Winter* Dissolved Oxygen Deficits For Years 1951-80

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1951	3.6182	.49319	11	.099
1954	.89667	.42724	3	1.00
1967	1.6133	.20810	6	-.834
1974	.43333	1.8392	3	-.998
1975	1.1456	.47329	16	.498
1976	.40286	.49720	14	.014
1980	1.0552	.54276	25	-.652

Table 10-44
Chester River Winter* Lower Estuary (Salinity= 10.01-20.00 ppt) Dissolved Oxygen Deficits For Years 1951-1980

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1951	3.6043	.62663	7	.367
1975	1.3500	.40922	8	.555
1980	.94667	.50473	21	-.910

Table 10-45
Chester River Winter* Upper Estuary (Salinity= .2 to 10.0 ppt) Dissolved Oxygen Deficits for Years 1951-80

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1951	3.6425	.15564	4	.393
1967	1.6133	.20810	6	-.834
1974	.43333	1.8392	3	-.998
1975	.94125	.46591	8	.090
1976	.40286	.49720	14	.014
1980	1.6250	.37811	4	.822

Table 10-46
Chester River Spring* Dissolved Oxygen Deficits for Years 1950-81

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1950	1.2946	1.1155	24	.299
1958	2.4280	.78107	20	.404
1959	.84973	.86020	37	.621
1960	.41643	1.4794	42	.652
1961	-.15000	.01414	2	1.00
1967	1.4580	.46864	5	.508
1968	.76667	.93545	6	.944
1970	3.5071	.49792	7	-.547
1971	.56000	1.3710	39	-.740
1974	.65875	1.2668	24	-.354
1975	2.1150	2.5913	20	.673
1976	1.1663	.88637	38	.034
1977	.86600	1.9306	40	-.093
1978	.41364	1.3466	44	.444
1979	2.6257	1.6540	7	.244
1980	-1.7950	2.0294	2	1.00
1981	1.1039	2.0433	473	.164

* March, April, and May

** From regression of DOD vs Salinity

Table 10-47

Chester River Spring* Upper Estuary (salinity= .2 to 10.0 ppt)
Dissolved Oxygen Deficits for Years 1950-81

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1950	1.0841	.74764	22	-.237
1958	2.3516	.72157	19	.303
1959	.62091	.54750	33	.084
1960	.41643	1.4794	42	.652
1961	- .15000	.01414	2	1.00
1967	1.4580	.46864	5	.508
1968	.76667	.93545	6	.944
1970	3.5071	.49792	7	-.547
1971	1.4581	1.2501	21	-.482
1974	.78722	1.3842	18	-.374
1975	1.6994	2.3401	18	.521
1976	1.1663	.88637	38	.034
1977	.83077	1.9428	39	-.145
1978	.11550	.99760	40	-.088
1979	2.6257	1.6540	7	.244
1980	-1.7950	2.0294	2	1.00
1981	.71453	1.5620	349	-.347

* March, April, and May

** From regression of DOD vs Salinity

Table 10-48
Chester River Spring* Lower Estuary (Salinity= 10.0-20.0 ppt) Dissolved Oxygen Deficits For Years 1950-81

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1950	3.6100	2.2769	2	1.00
1959	2.7375	.59528	4	.893
1971	-.48778	.45214	18	.405
1974	.27333	.79399	6	.661
1975	5.8550	1.8455	2	1.00
1978	3.3950	.13528	4	.263
1981	2.1999	2.7344	124	.263

Table 10-49
Chester River Summer* Dissolved Oxygen Deficits for Years 1949-1981

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1949	1.4963	2.1149	40	.896
1950	1.8170	2.0532	10	.808
1957	1.3645	1.4429	33	.714
1958	2.1480	2.8074	25	.846
1959	2.1254	1.0847	46	.219
1961	1.3875	2.9314	4	.953
1962	1.6200	1.6758	4	.999
1968	2.5800	.82714	7	-.376
1969	1.8583	1.0498	6	-.621
1970	2.4217	1.1437	6	-.374
1971	1.9106	1.5351	51	-.358
1972	3.1417	1.3152	6	.998
1974	.65000	1.7933	14	.127
1975	1.1481	2.0578	16	.370
1976	1.4838	2.2120	40	.291
1977	1.0344	2.6742	45	.498
1978	1.5537	1.2355	38	.144
1979	.50300	1.4212	20	-.101
1980	1.7081	1.7954	268	.064
1981	1.4110	2.0527	600	-.008

* June, July, and August

** From regression of DOD vs Salinity

Table 10-50
Chester River Summer* Upper Estuary (Salinity .2 to 10.0 ppt)
Dissolved Oxygen Deficits for Years 1949-81

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1949	.09750	.46859	20	.309
1950	.93375	.98051	8	.155
1957	.66091	.81324	22	.533
1958	.94050	1.5034	20	.499
1959	2.0281	.24549	21	.129
1961	1.3875	2.9314	4	.953
1968	2.5800	.82714	7	-.376
1969	1.8583	1.0498	6	-.621
1970	2.4217	1.1437	6	-.374
1971	1.9106	1.5351	51	-.358
1974	.67000	1.8649	13	.150
1975	1.1481	2.0578	16	.370
1976	1.4838	2.2120	40	.291
1977	.15933	2.4726	30	.327
1978	1.5537	1.2355	38	.144
1979	.50300	1.4212	20	-.101
1980	1.6232	1.7107	258	.014
1981	1.5160	1.4365	397	-.029

* June, July, and August

** From regression of DOD vs Salinity

Table 10-51
Chester River Summer* Lower Estuary (Salinity= 10.01-20.0 ppt) Dissolved Oxygen Deficits For Years 1949-81

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1949	2.8950	2.2005	20	.858
1950	5.3500	.07071	2	1.00
1957	2.7718	1.4161	11	.839
1958	6.9780	.31823	5	-.532
1959	2.2072	1.4360	25	.827
1962	1.6200	1.6758	4	.999
1972	3.1417	1.3152	6	.998
1977	2.7847	2.2109	15	.518
1980	3.8980	2.5549	10	.630
1981	1.2057	2.8957	203	.287

Table 10-52
Chester River Fall* Dissolved Oxygen Deficits for Years 1949-81

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1949	1.2089	.54016	19	-.255
1950	2.6542	2.6751	12	.893
1957	1.5346	.96355	24	.283
1959	.41970	.69519	33	.578
1960	1.0777	1.3310	79	.381
1967	.49000	.64919	5	.615
1968	1.6886	1.8783	7	-.848
1969	1.6700	1.3438	14	-.499
1970	2.0300	1.5477	13	-.210
1971	1.2971	.52135	24	-.011
1973	-.51714	1.9236	7	-.403
1974	-.25467	1.5060	15	-.091
1975	.98000	.88835	16	.480
1976	1.1759	1.0356	316	.108
1977	.29556	.70050	9	-.117
1978	1.4627	1.8322	15	.565
1979	-1.9767	3.6108	3	-.790
1980	1.3580	1.0581	322	-.678
1981	.59336	1.0363	444	-.340

* September, October, and November

** From regression of DOD vs Salinity

Table 10-53

Chester River Fall* Upper Estuary (Salinity= .2 to 10.0 ppt) Dissolved Oxygen Deficits for Years 1957-81

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1957	1.5086	.63273	7	.817
1959	.33667	.12925	6	.092
1960	.69750	.98709	40	.369
1967	.49000	.64919	5	.615
1968	1.6886	1.8783	7	-.848
1969	1.6700	1.3438	14	-.499
1970	2.0300	1.5477	13	-.210
1973	.38000	2.7315	3	.771
1974	-.00333	1.3744	12	.394
1975	.66167	1.0363	6	.554
1976	1.1456	.95167	232	.224
1977	.29750	.57604	4	-.108
1978	.67667	.69637	3	.976
1979	-1.9767	3.6108	3	-.790
1980	1.8147	.60088	237	.082
1981	.96268	.83878	284	.534

* September, October, and December

** From regression of DOD vs Salinity

Table 10-54
Chester River Fall* Lower Estuary (Salinity= 10.01-20.0 ppt) Dissolved Oxygen Deficits For Years 1949-81

Years	Average DOD	Standard Deviation	N	Correlation** Coefficient
1949	1.2089	.54016	19	-.255
1950	2.6542	2.6751	12	.893
1957	1.5453	1.0882	17	.530
1959	.43815	.76789	27	.833
1960	1.4677	1.5258	39	.192
1970	1.2648	.50792	23	.601
1973	-1.1900	1.0091	4	.938
1974	-1.2600	1.8953	3	.217
1975	1.1710	.78137	10	.308
1976	1.2595	1.2409	84	-.106
1977	.29400	.85588	5	-.687
1978	1.6592	1.9935	12	.817
1980	.08435	1.0168	85	-.283
1981	-.06219	1.1135	160	.172

* September, October, and November

** From regression of DOD vs Salinity

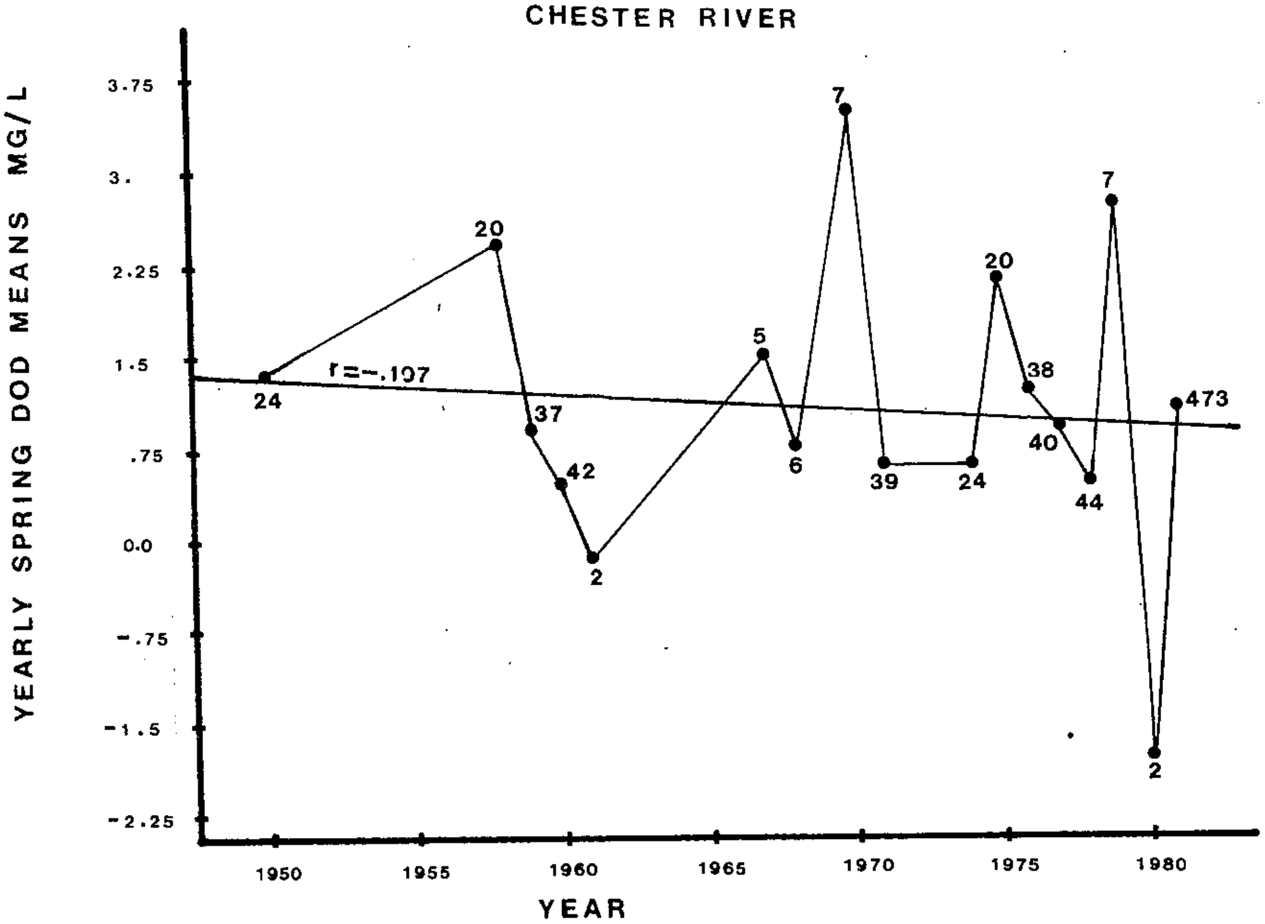


Figure 10-13 Spring yearly mean DOD (all data)

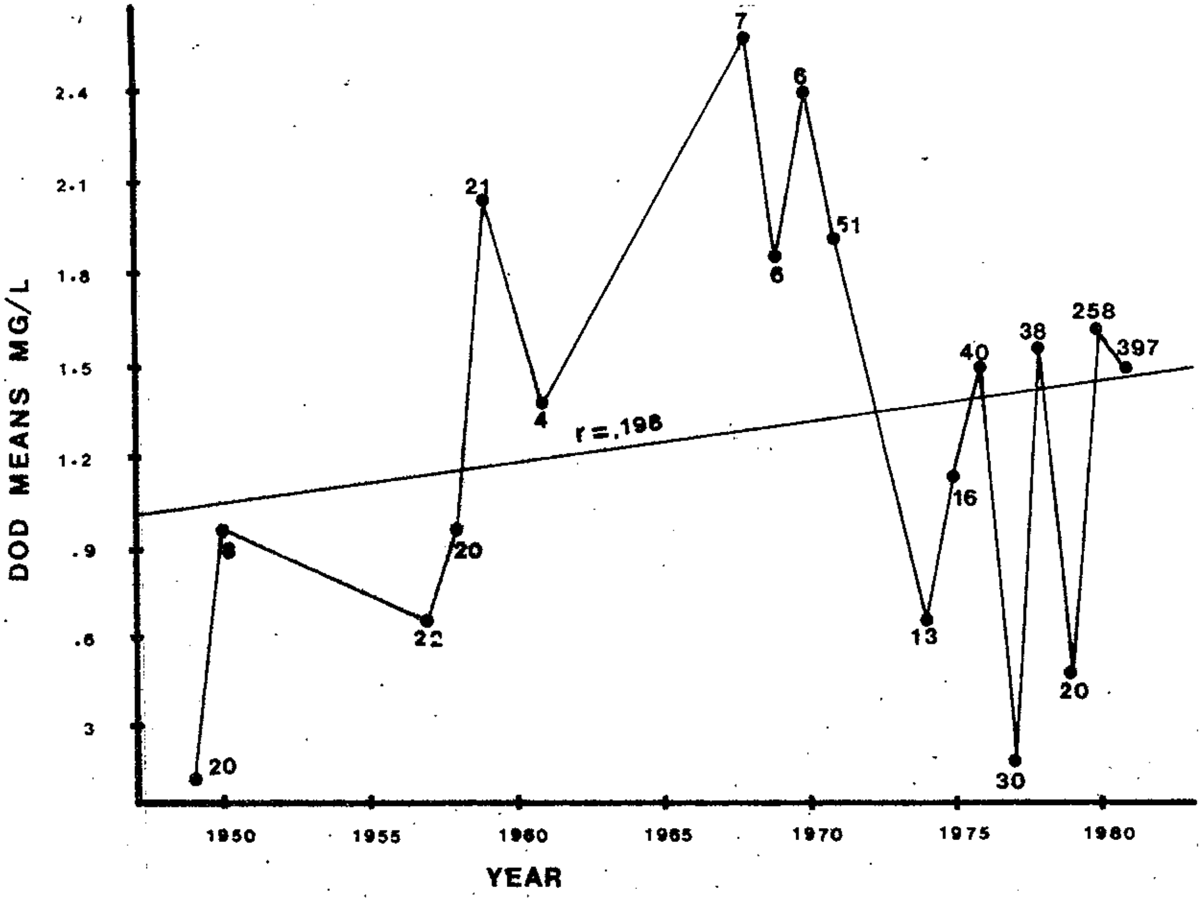


Figure 10-14 Summer Yearly Mean DOD (Low Salinity Zone)

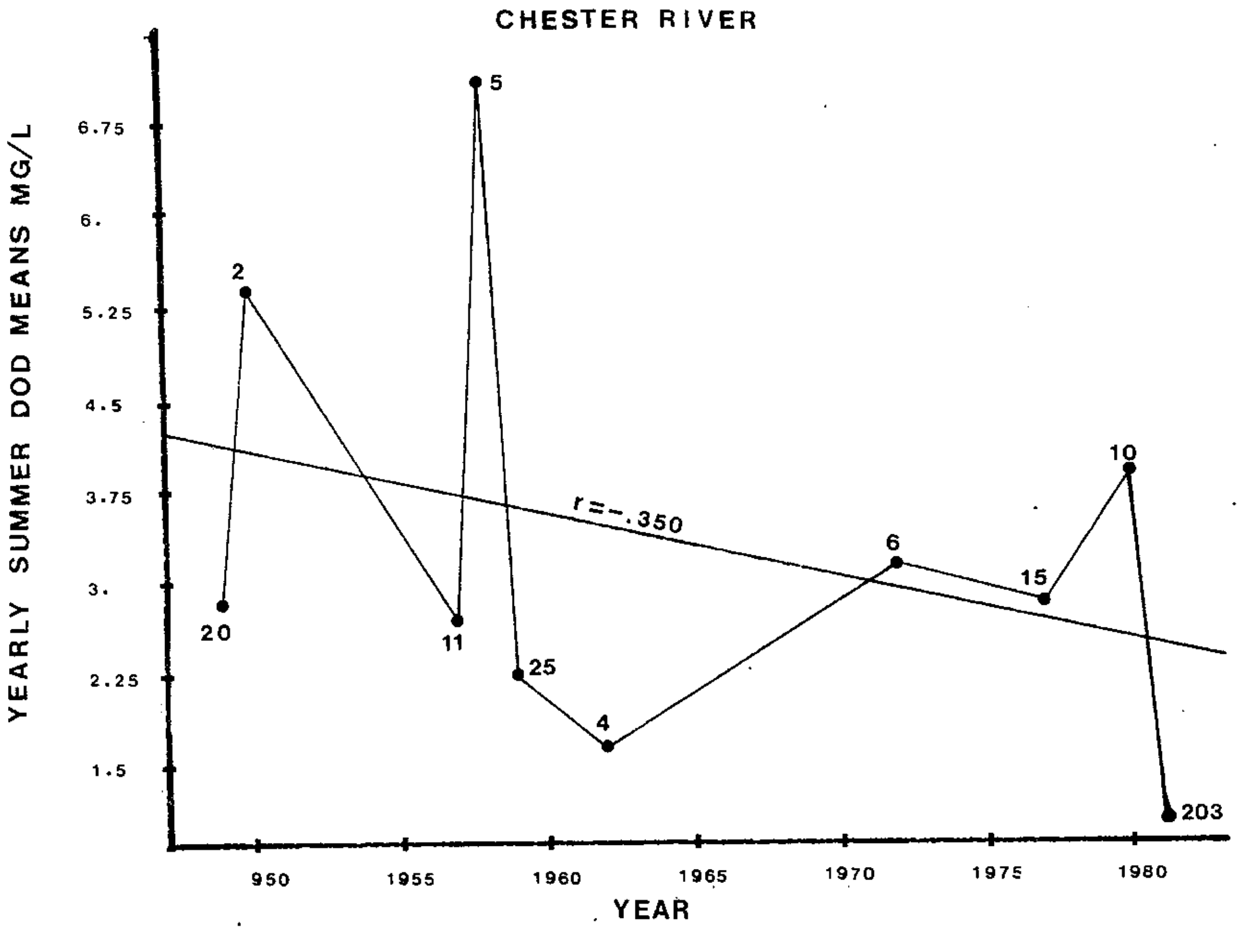


Figure 10-15 Summer yearly mean DOD (High Salinity Zone)

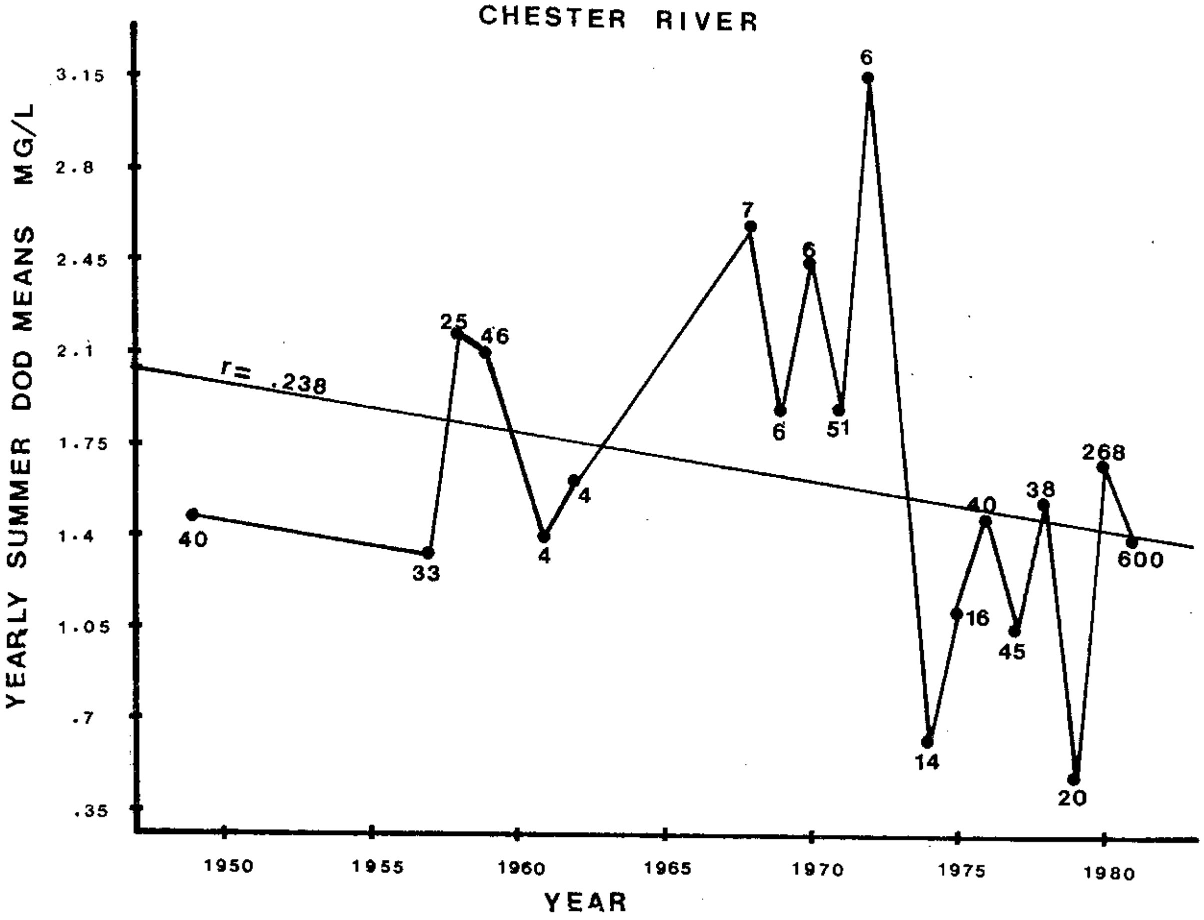


Figure 10-16 Summer yearly mean DOD (all data)

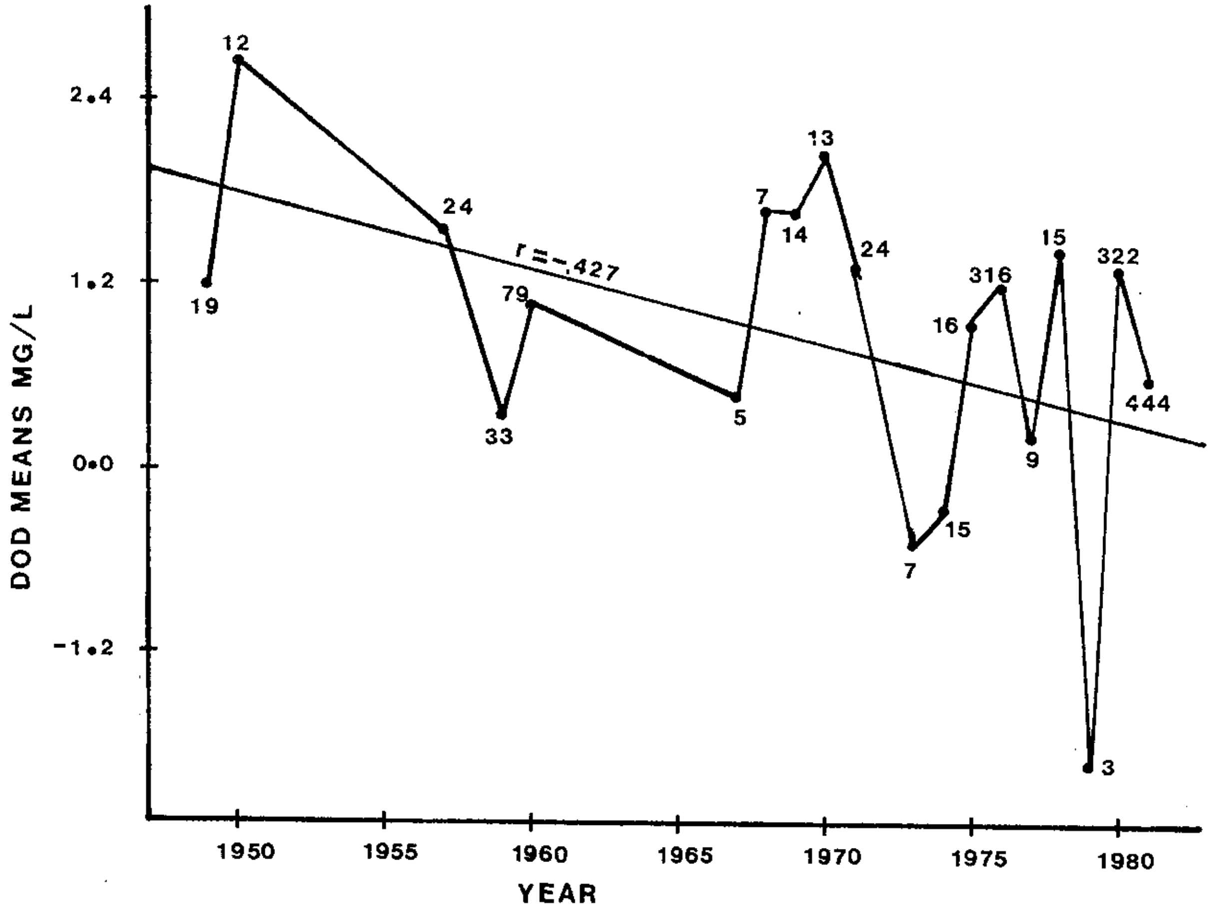


Figure 10-17 Fall Yearly Mean DOD(all data)

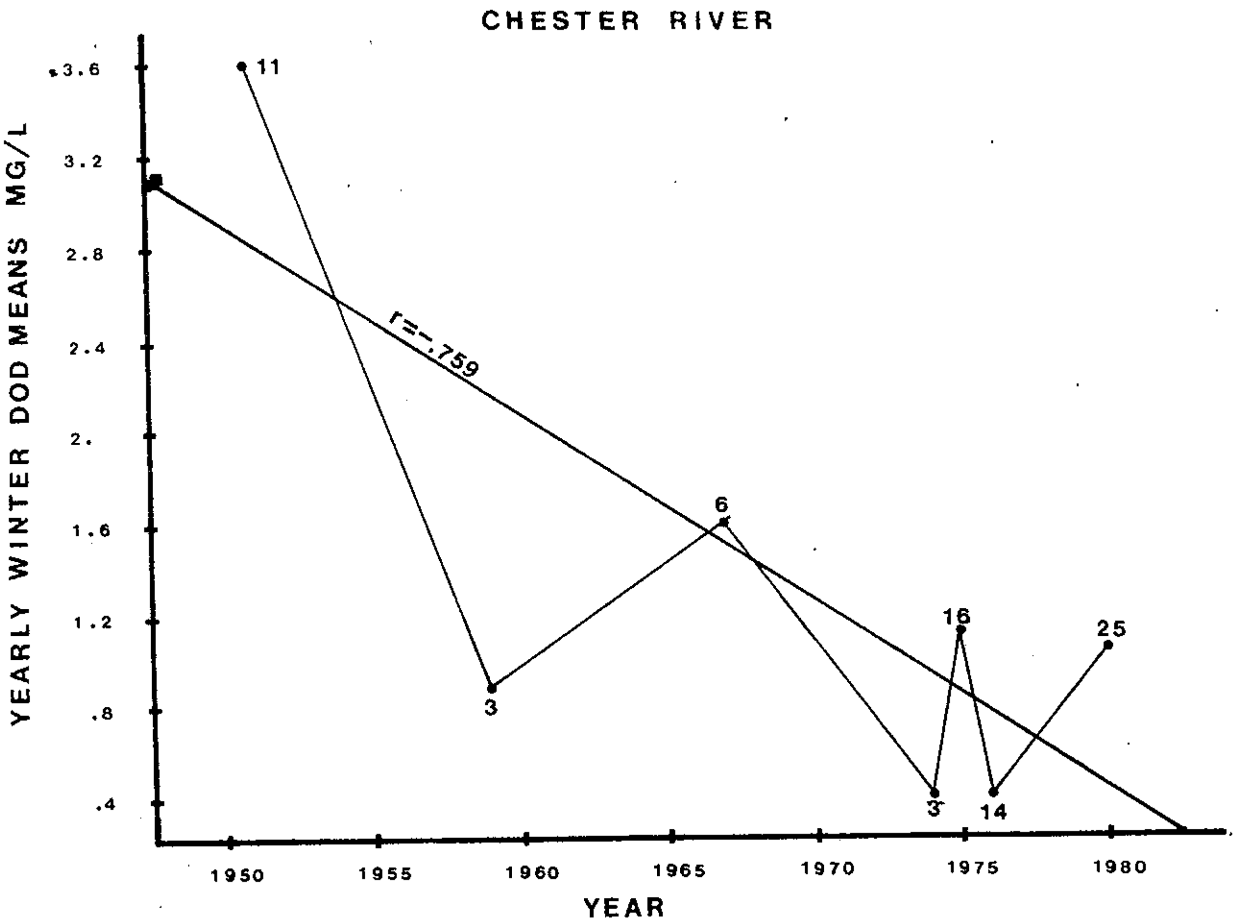


Figure 10-18 Winter yearly mean DOD (all data)

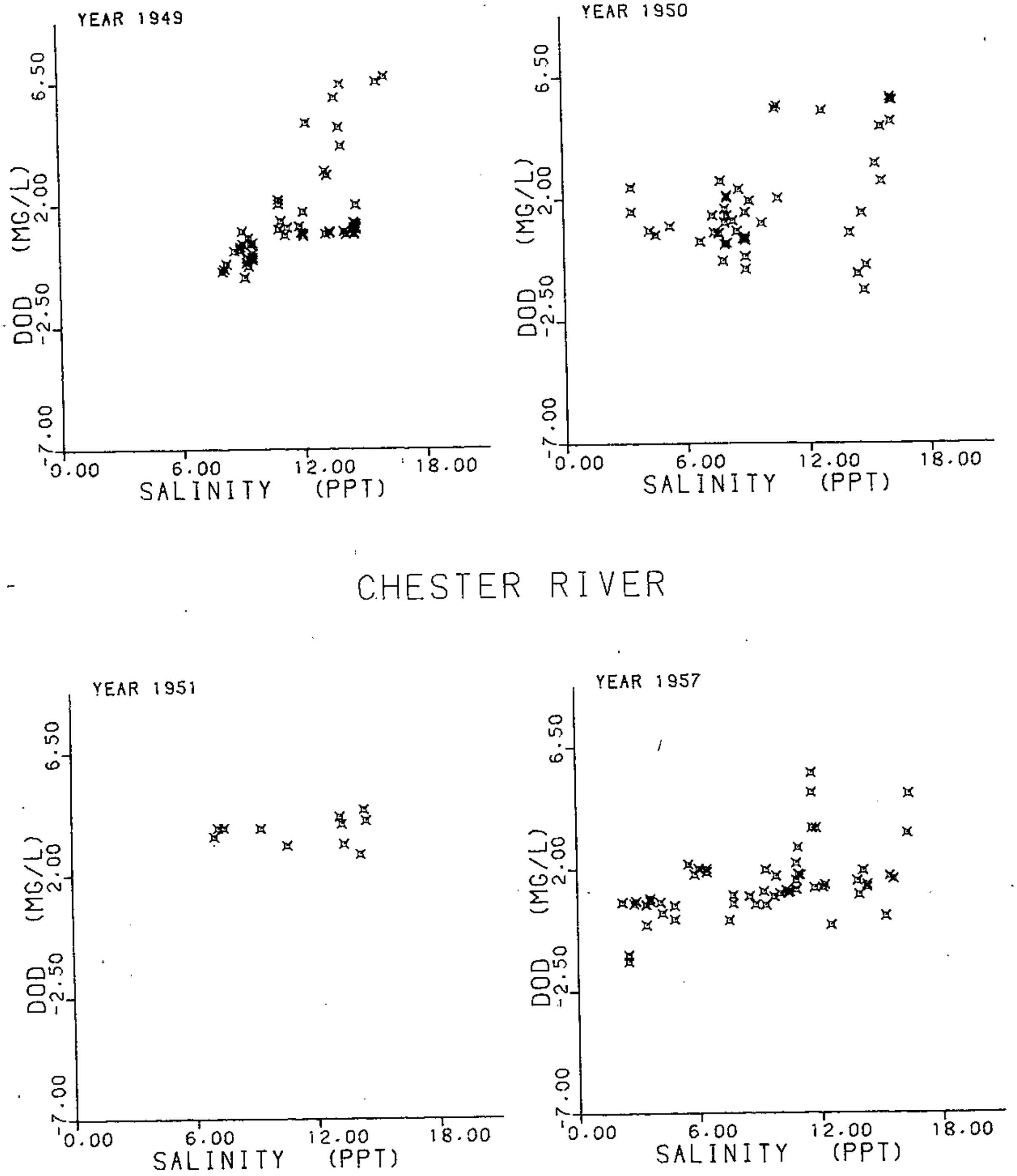


Figure 10-19 Chester River plots of historical dissolved oxygen deficits versus salinity, (grouped by years).

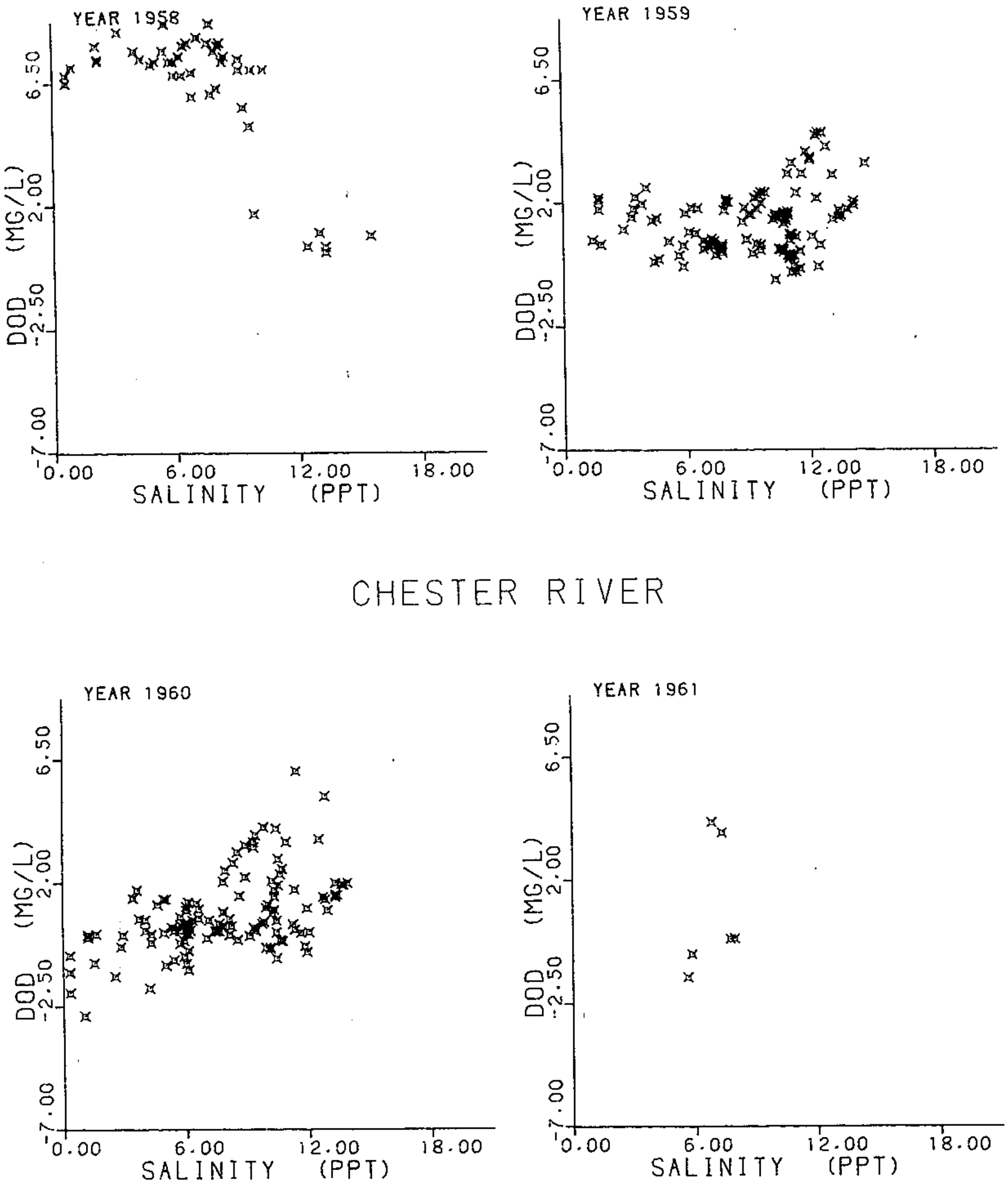


Figure 10-19 Chester River plots of historical dissolved oxygen deficits versus salinity, (grouped by years).

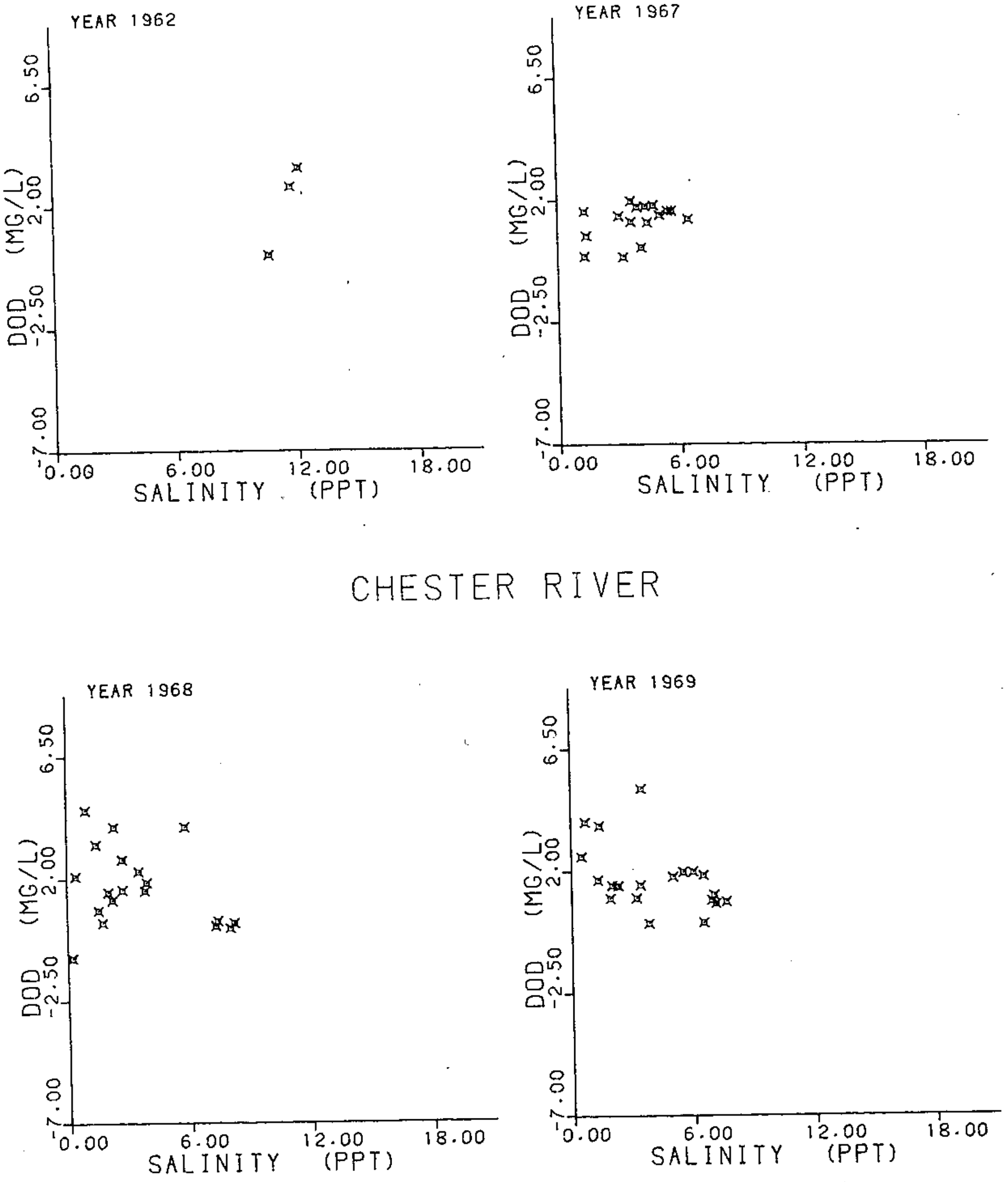


Figure 10-19 Chester River plots of historical dissolved oxygen deficits versus salinity, (grouped by years).

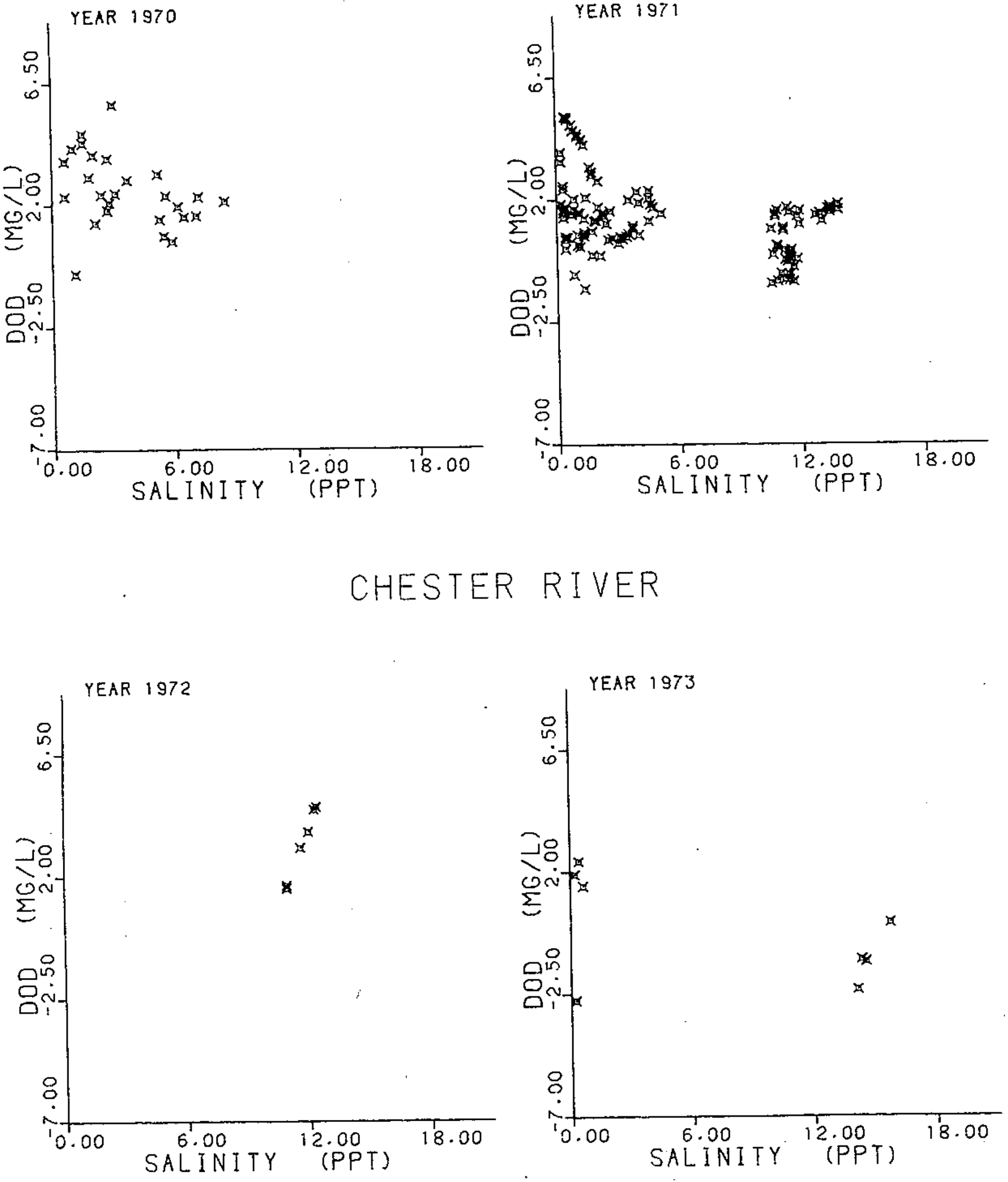


Figure 10-19 Chester River plots of historical dissolved oxygen deficits versus salinity, (grouped by years).

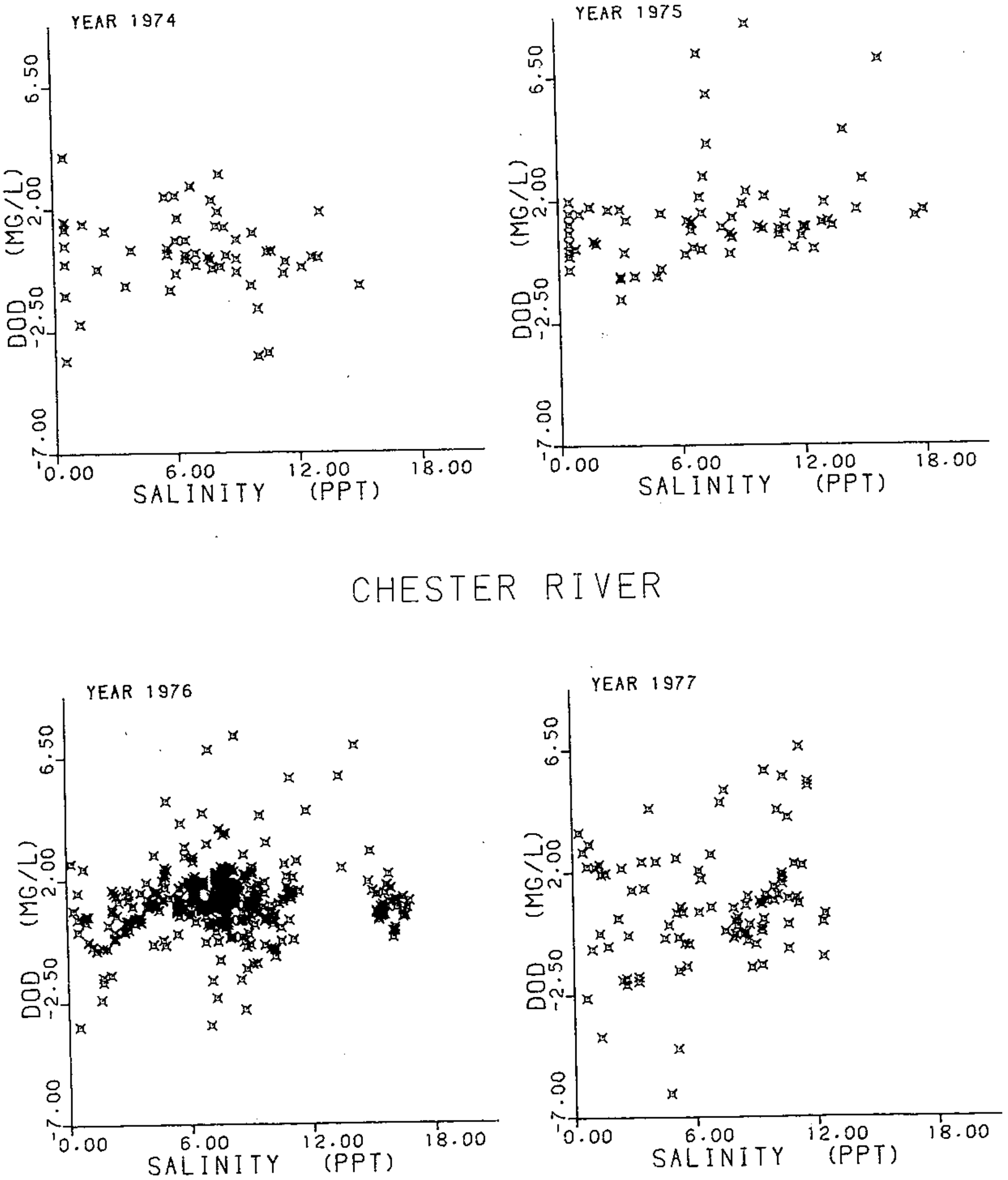

CHESTER RIVER

Figure 10-19 Chester River plots of historical dissolved oxygen deficits versus salinity, (grouped by years).

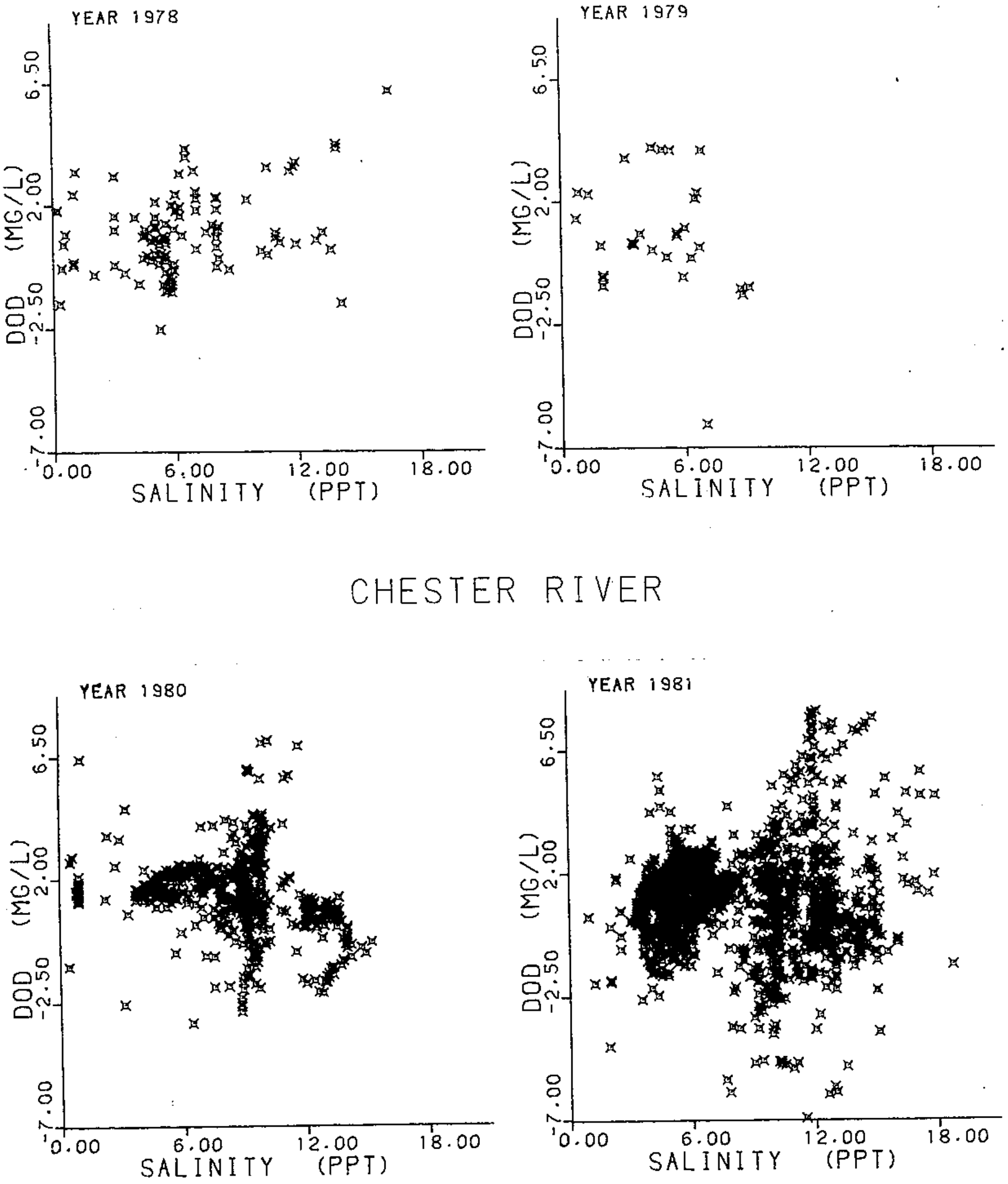


Figure 10-19 Chester River plots of historical dissolved oxygen deficits versus salinity, (grouped by years).

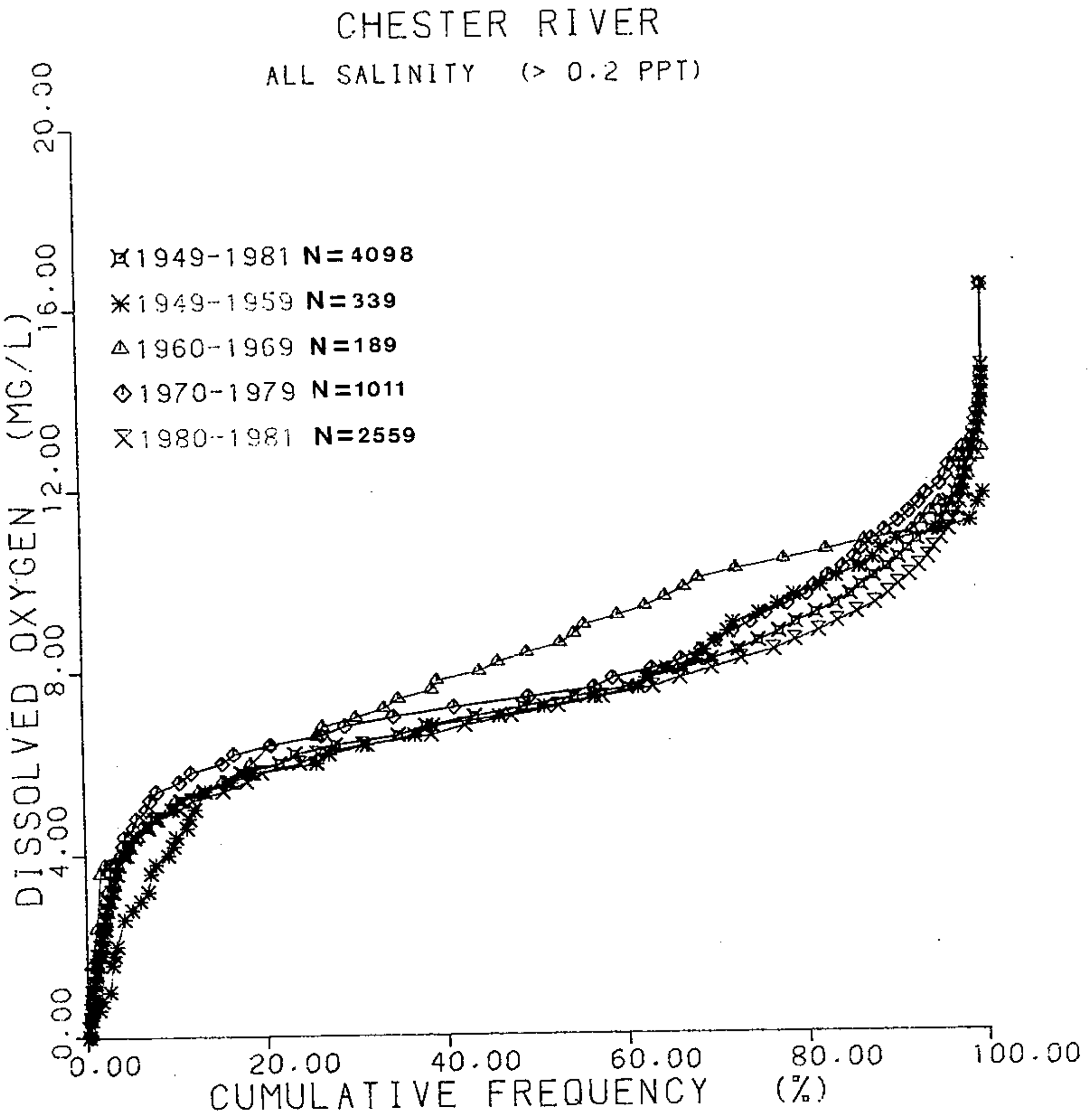


Figure 10-20 Cumulative Frequency Distribution of Dissolved Oxygen at all salinity ranges with the historical data grouped by years.

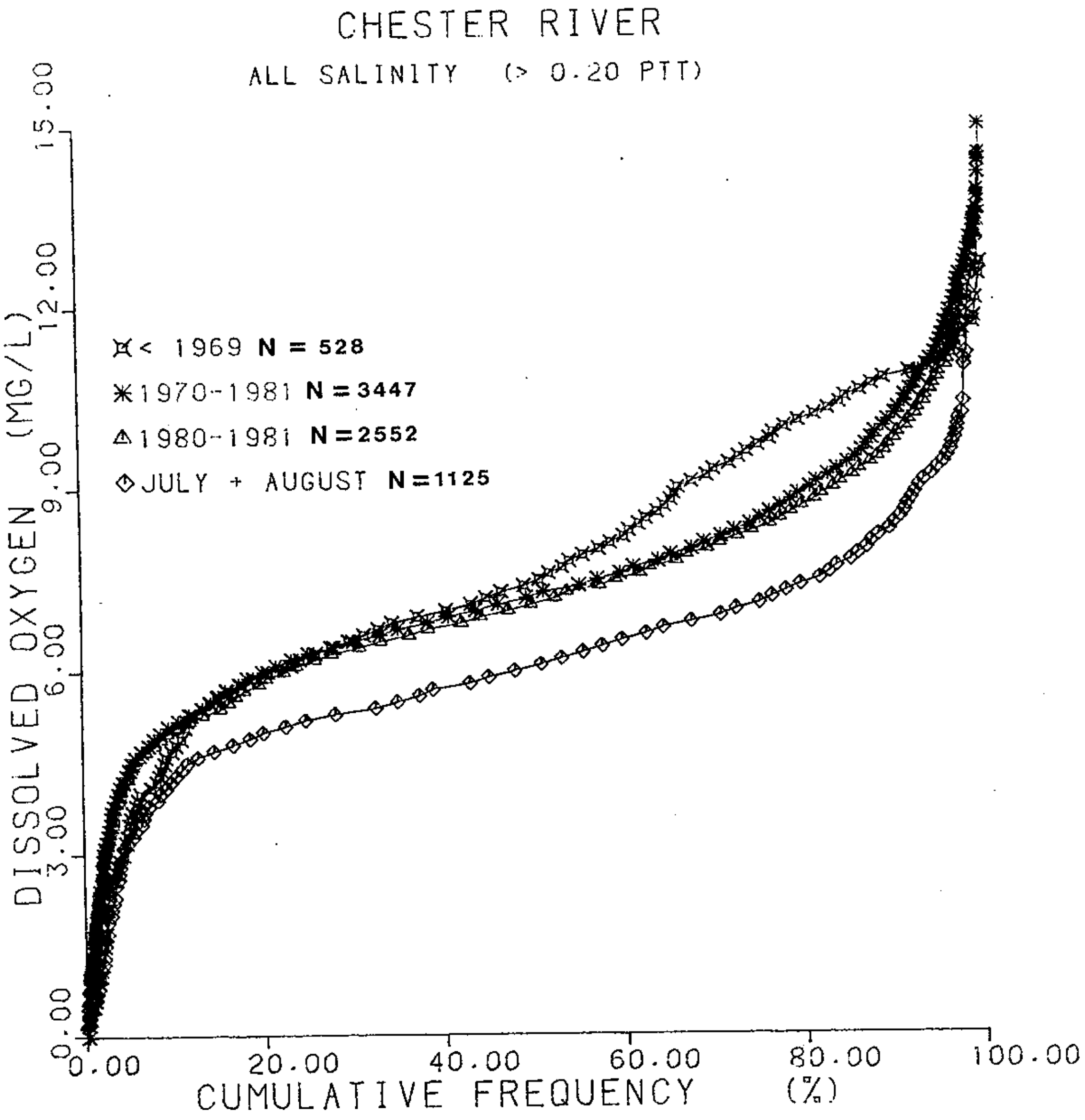


Figure 10-21 Cumulative Frequency Distribution of Dissolved Oxygen at all salinity ranges for various years and all data for months of July and August.

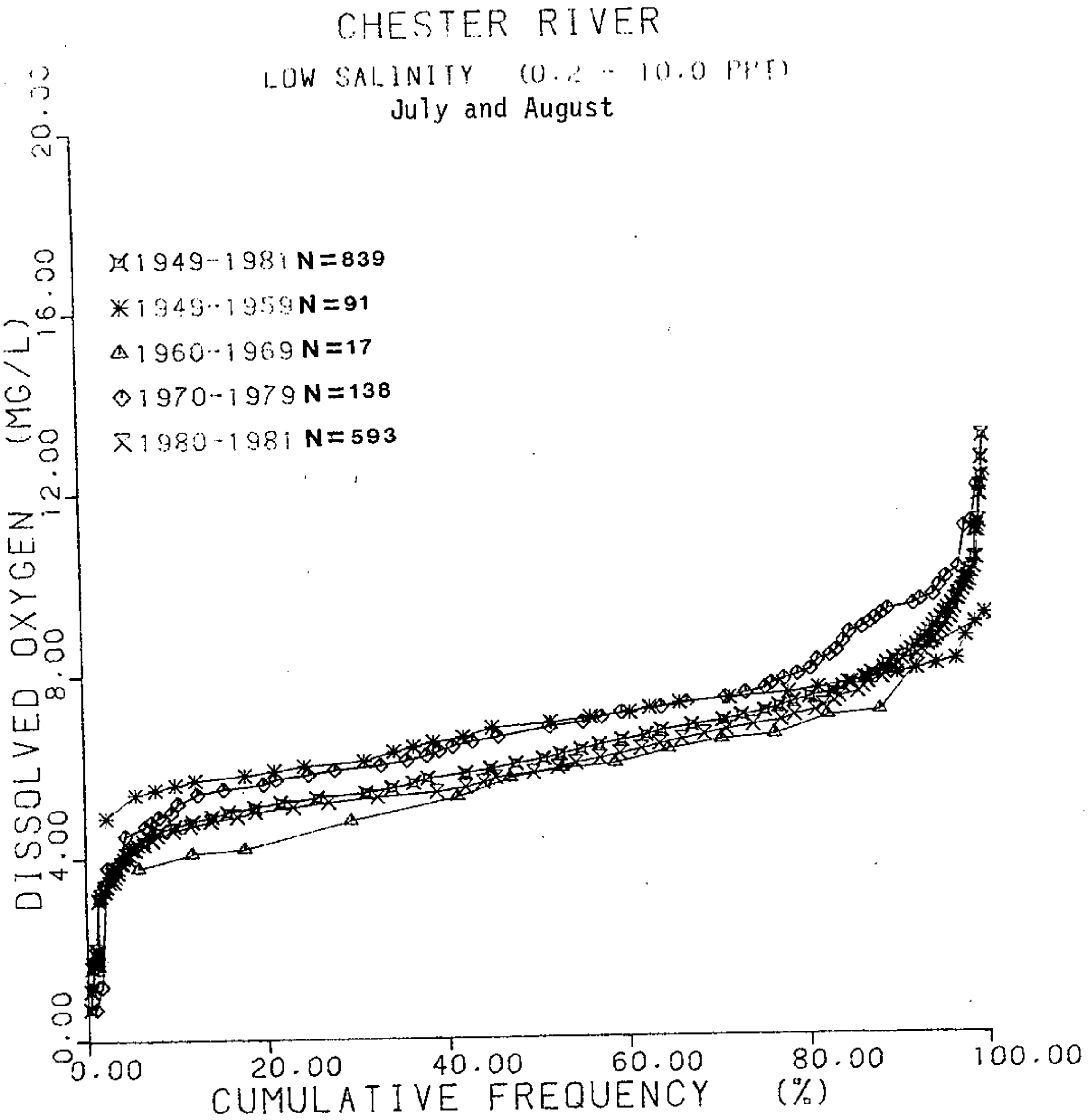


Figure 10-22 CFD of DO in the Upper Estuary for the month of July and August, by years.

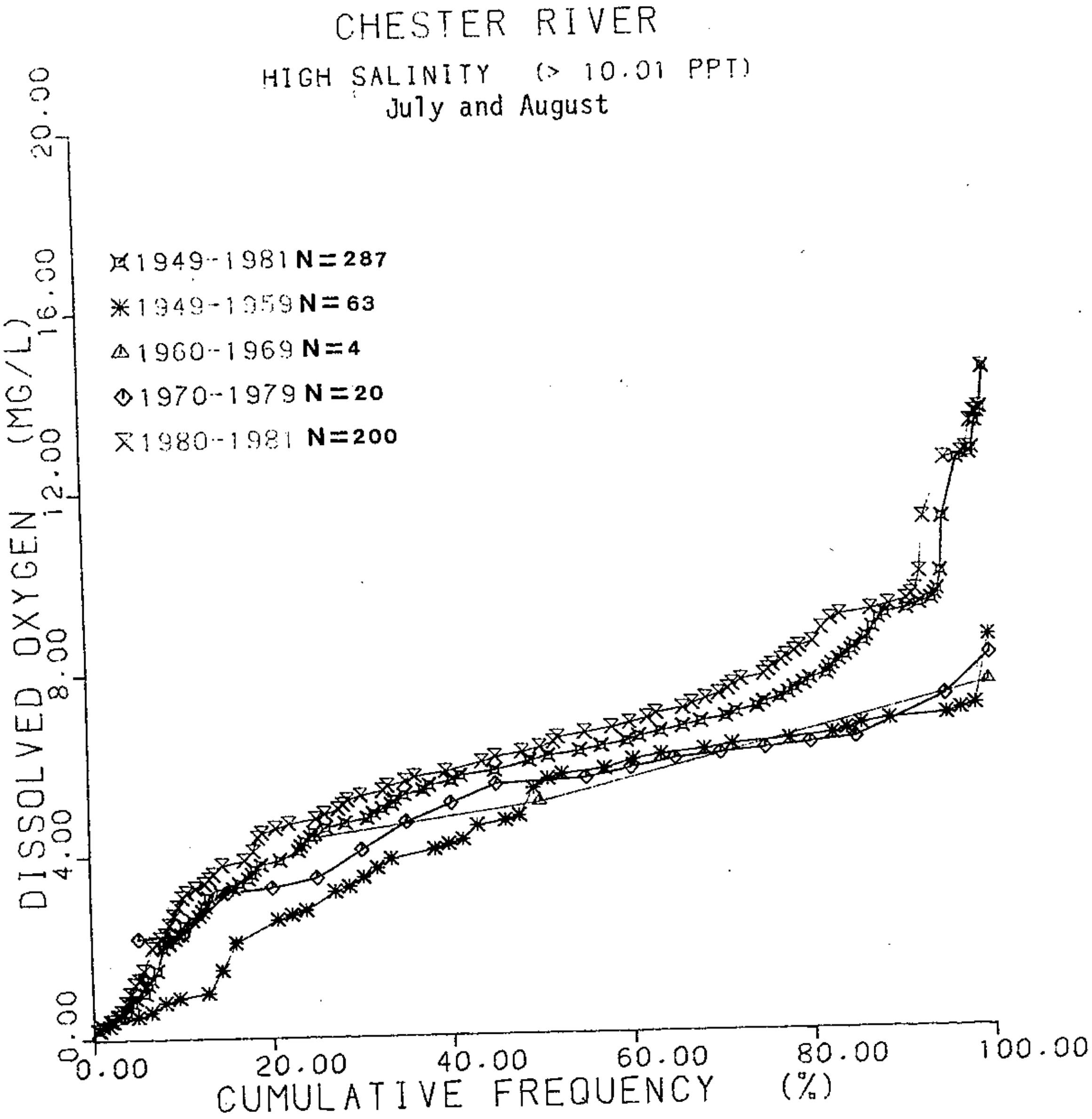


Figure 10-23 CFD of DO for the Lower Estuary for the months of July and August with the historical data grouped by years.

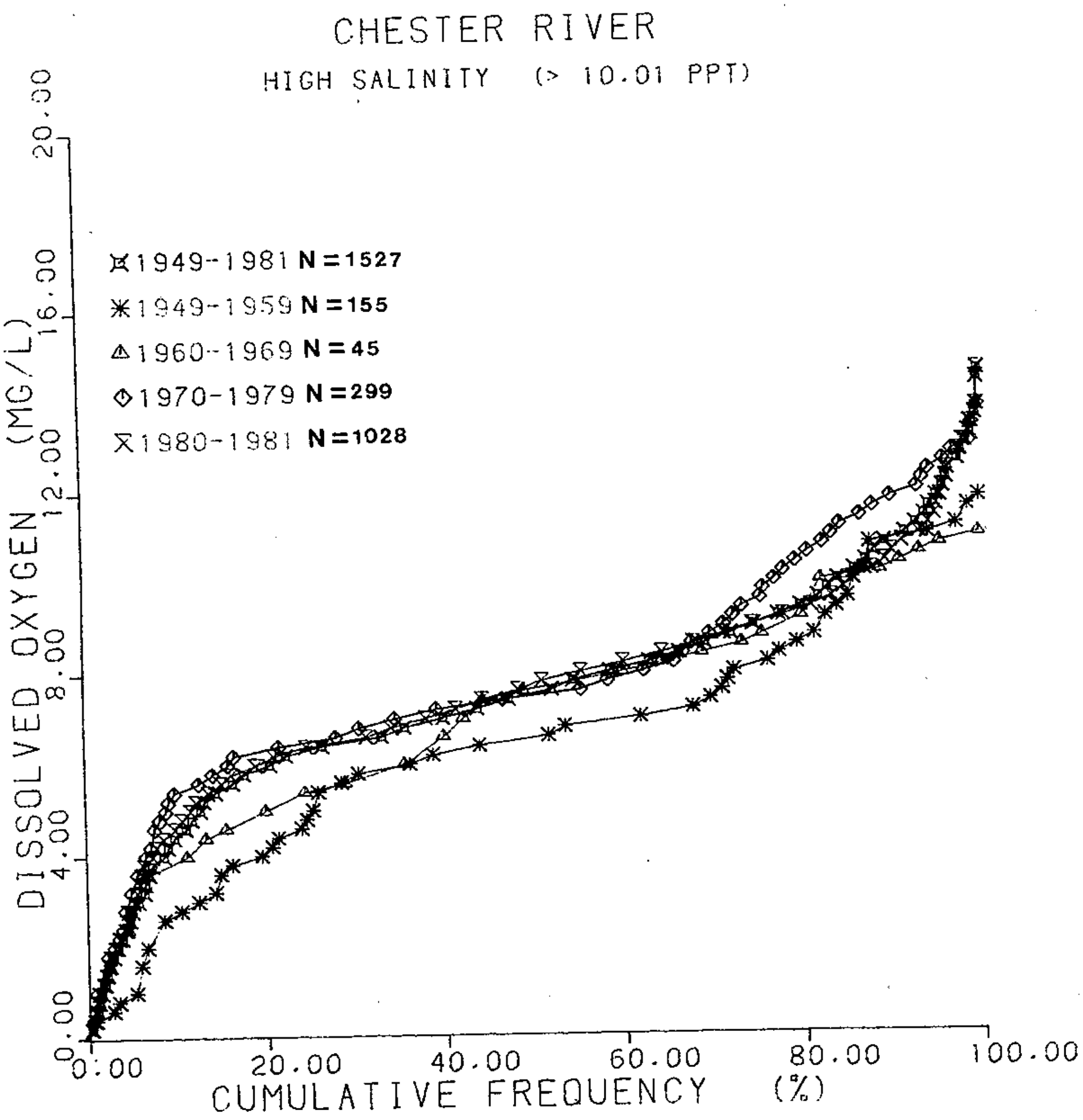


Figure 10-24 CFD of Historical DO for the Lower Estuary, grouped by years.

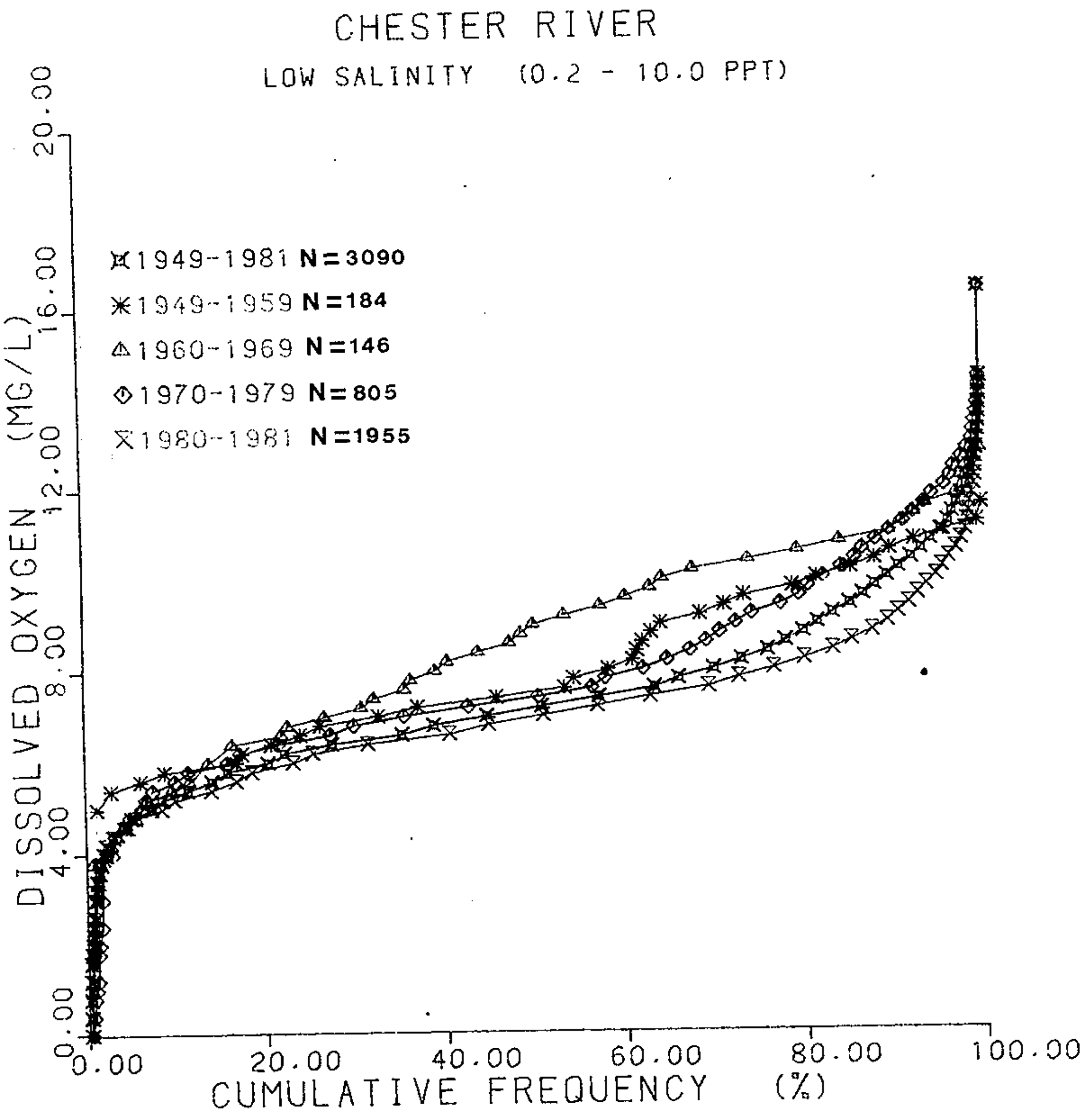


Figure 10-25 CFD of historical DO for the Upper Estuary, grouped by years.

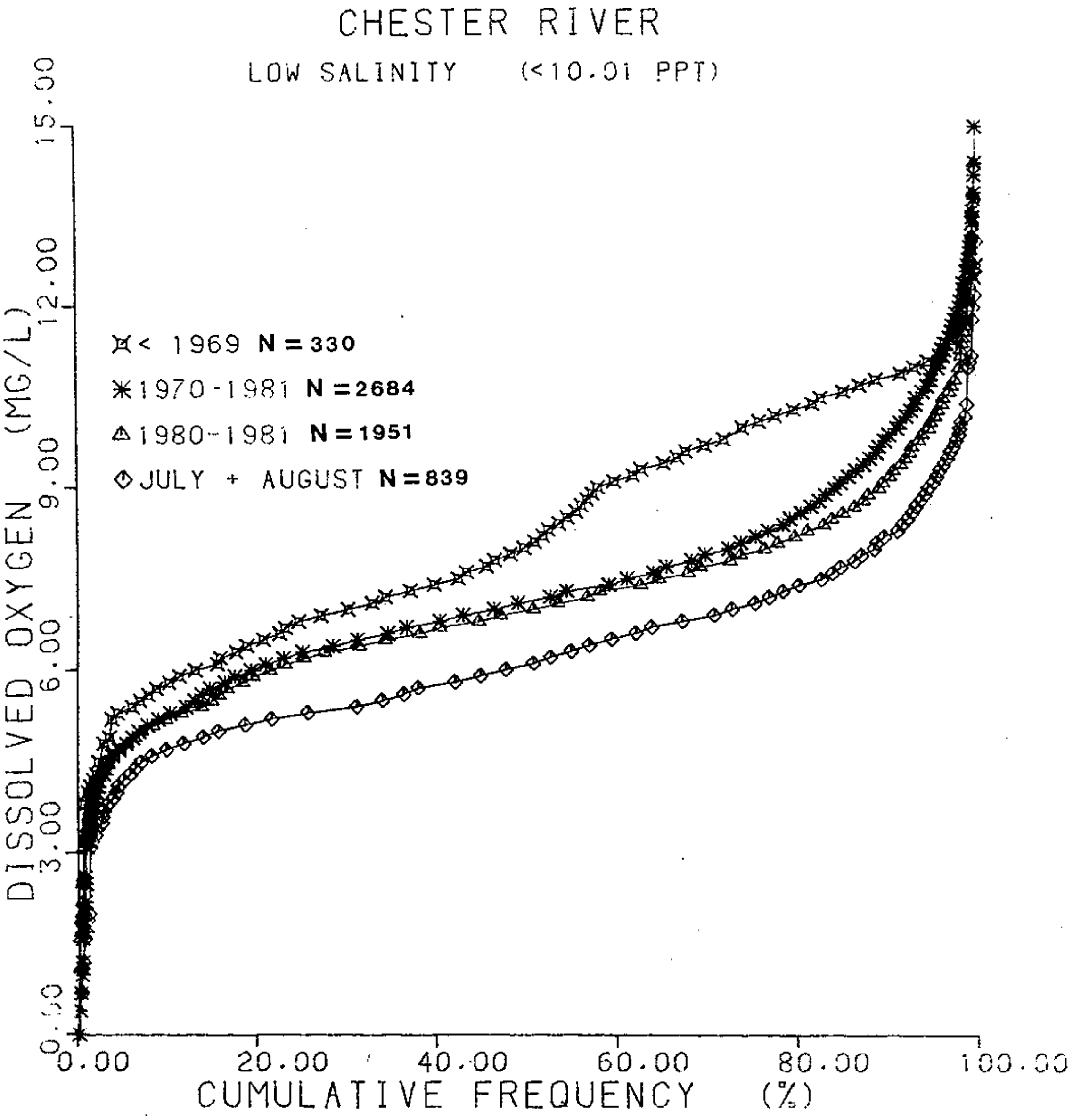


Figure 10-26 CFD of DO in the Upper Estuary grouped by years and all data for the months of July and August.

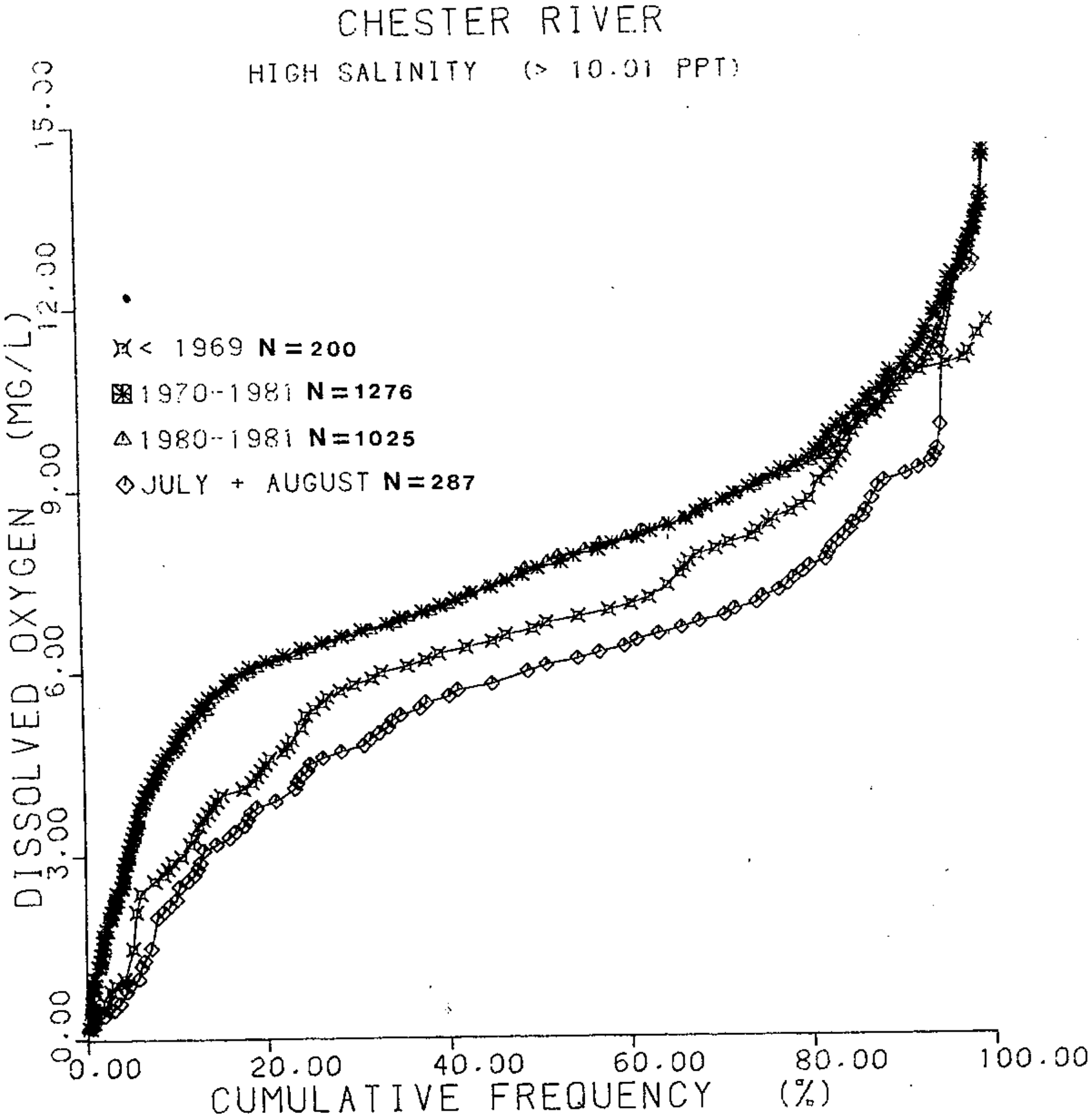


Figure 10-27 CFD of DO in the Lower Estuary grouped by years and all data for the month of July and August.

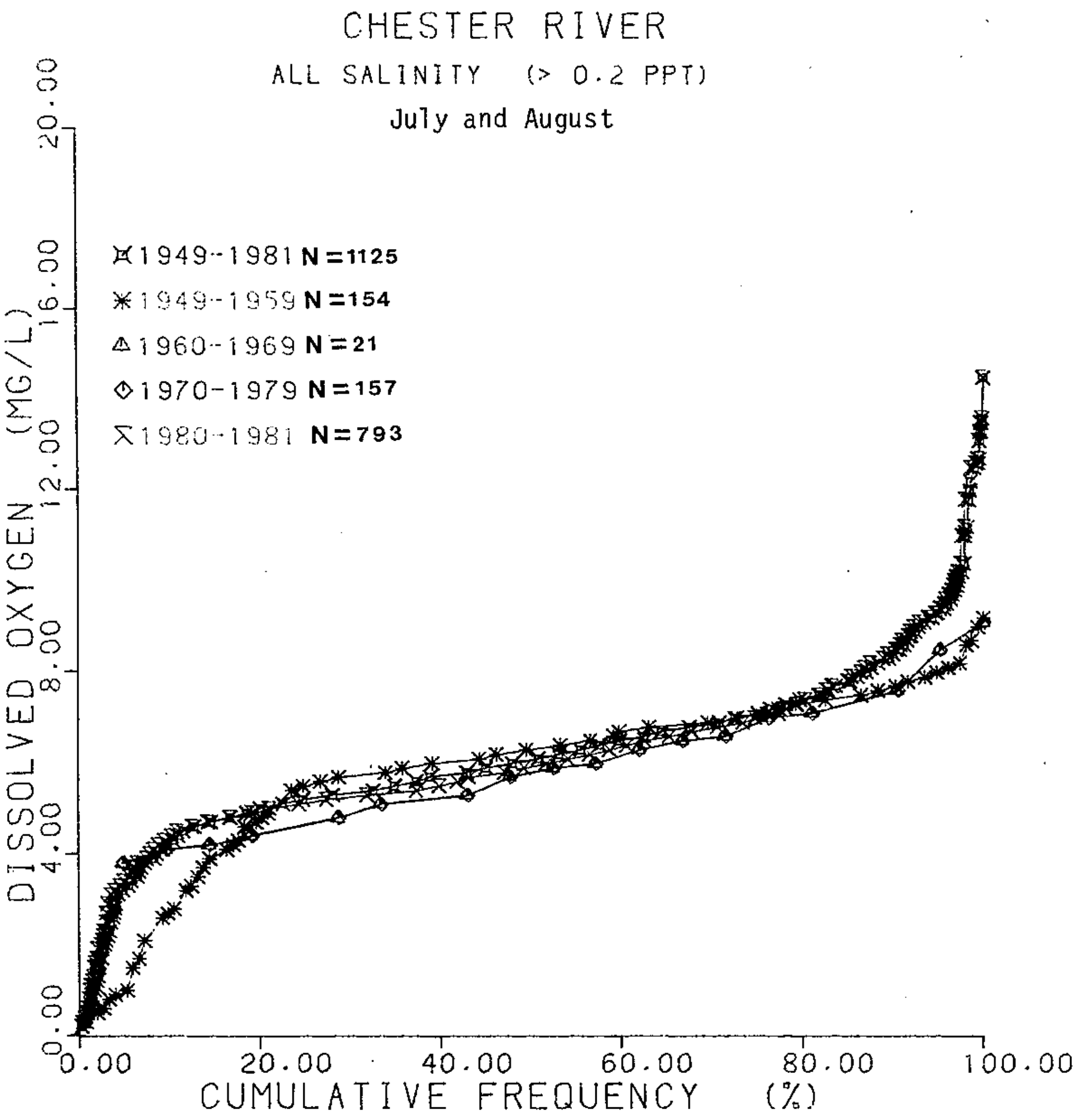


Figure 10-28 CFD of DO for the month July and August at all salinity ranges, grouped by years.

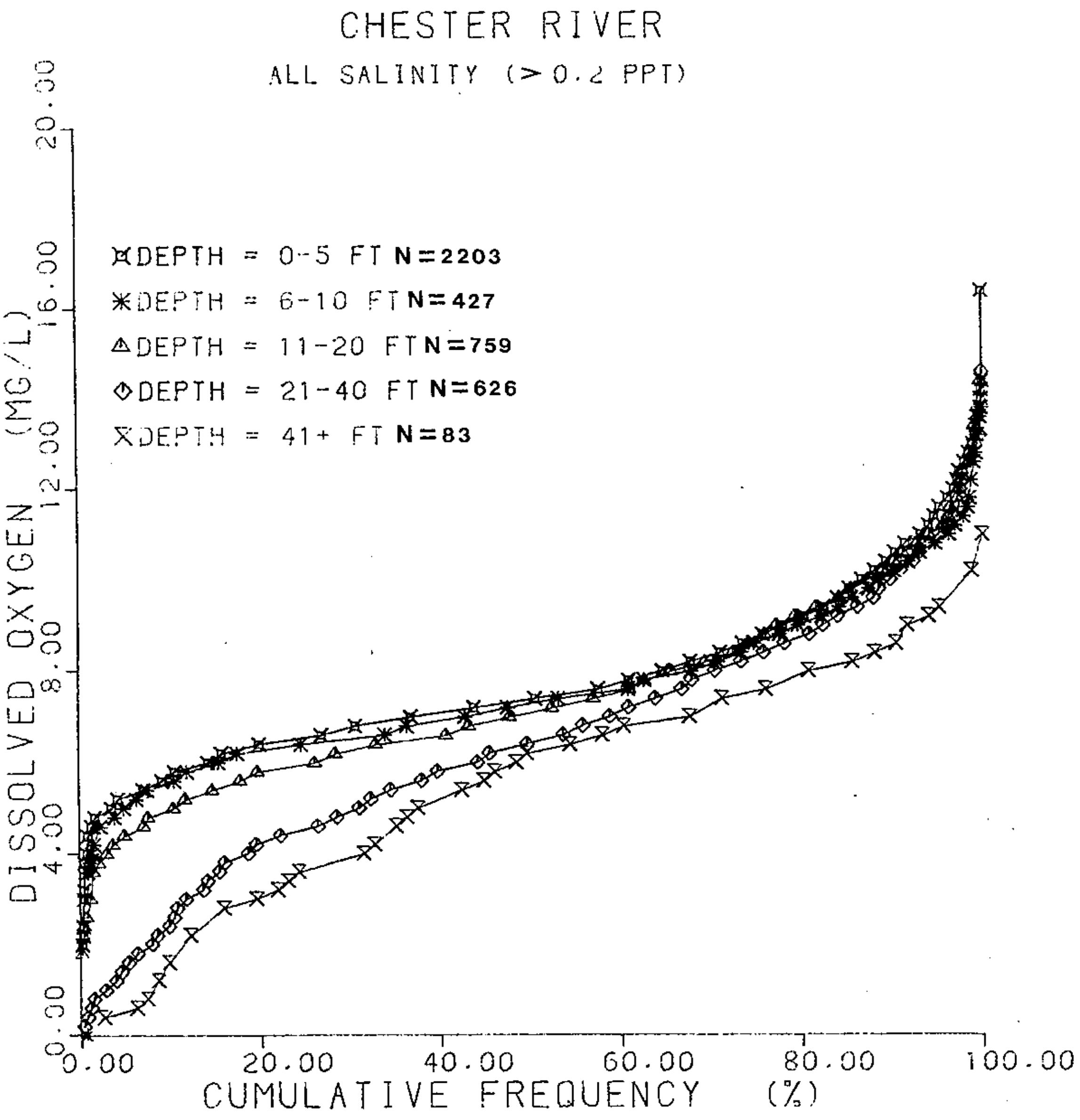


Figure 10-29 CFD of DO for various depths at all salinity ranges.

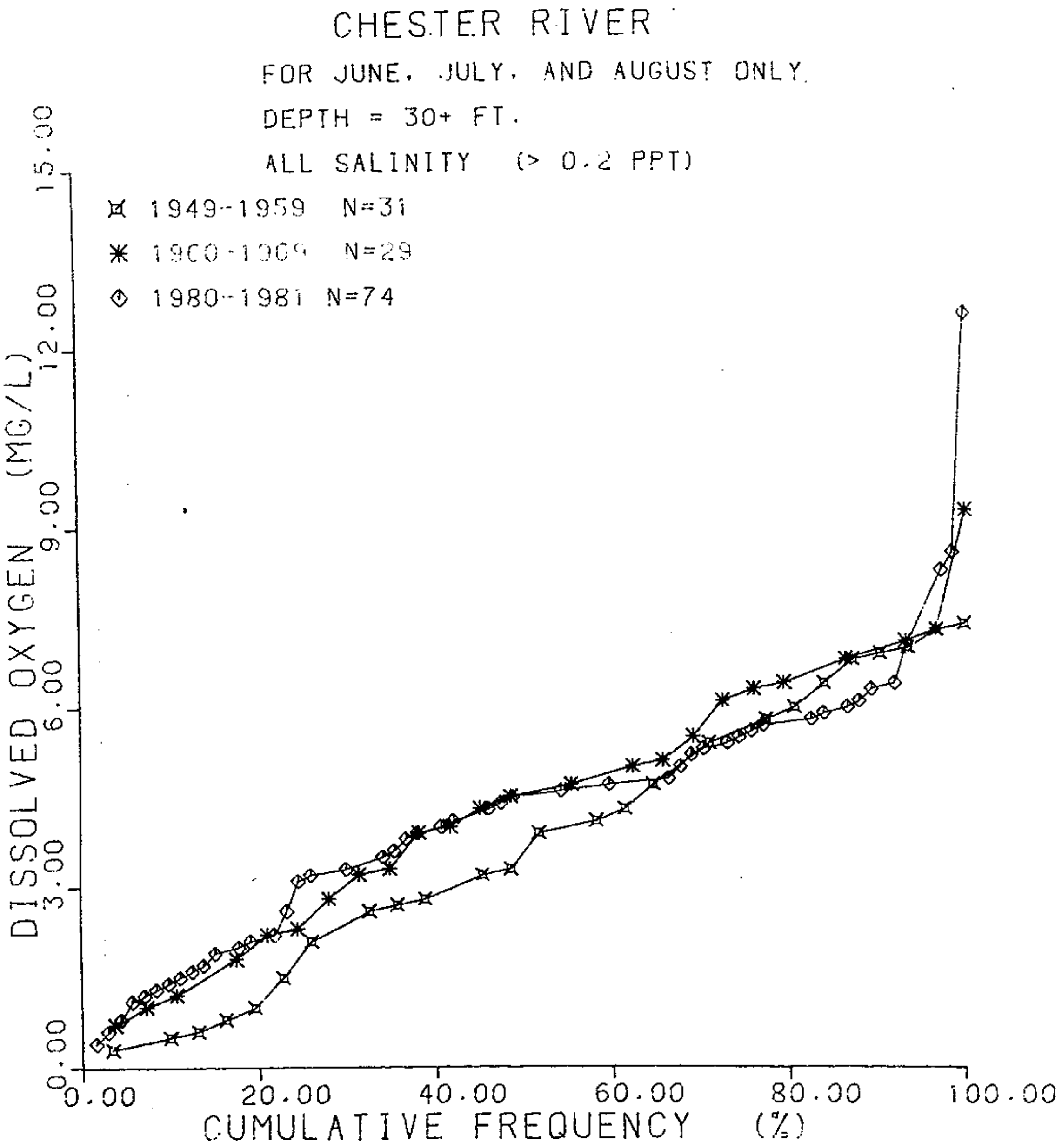


Figure 10-30 CFD of DO for all data collected in the months of June, July and August at a depth greater than thirty feet (grouped by years).

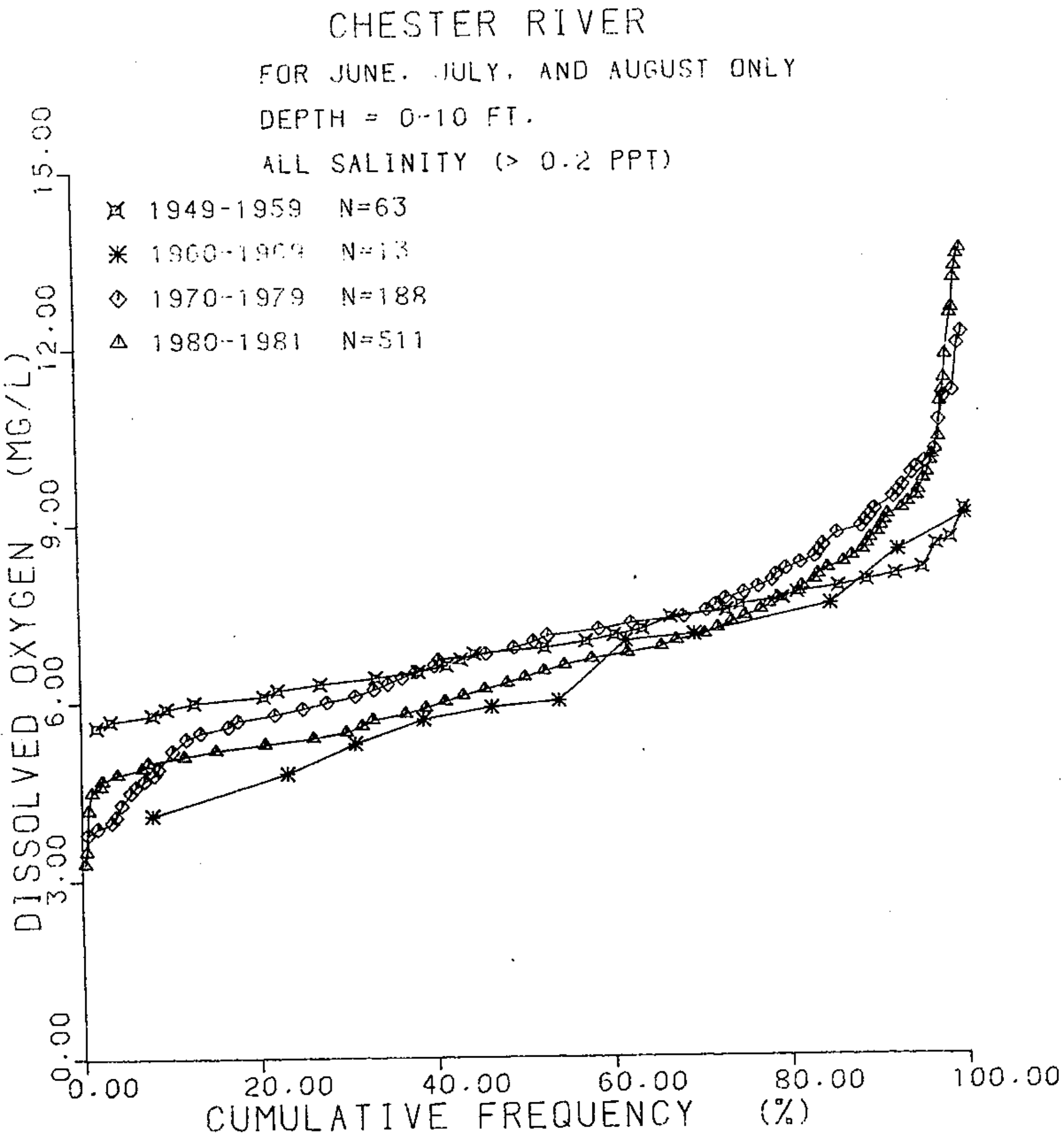


Figure 10-31 CFD of DO for all data collected in the months of June, July and August at a depth between 0-10 feet (grouped by years).

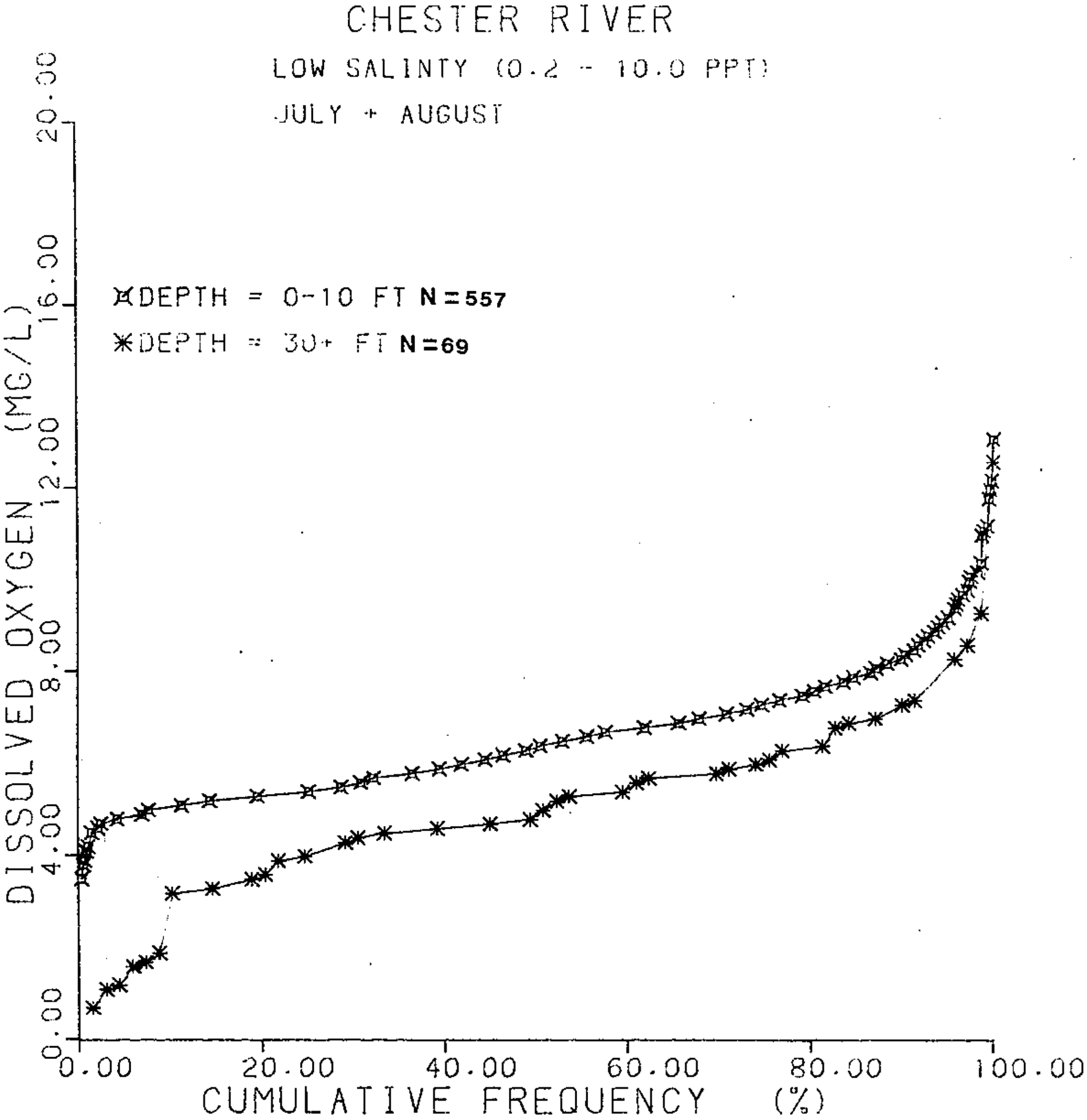


Figure 10-32 CFD of DO for the months July and August in the Upper Estuary and grouped by depth.

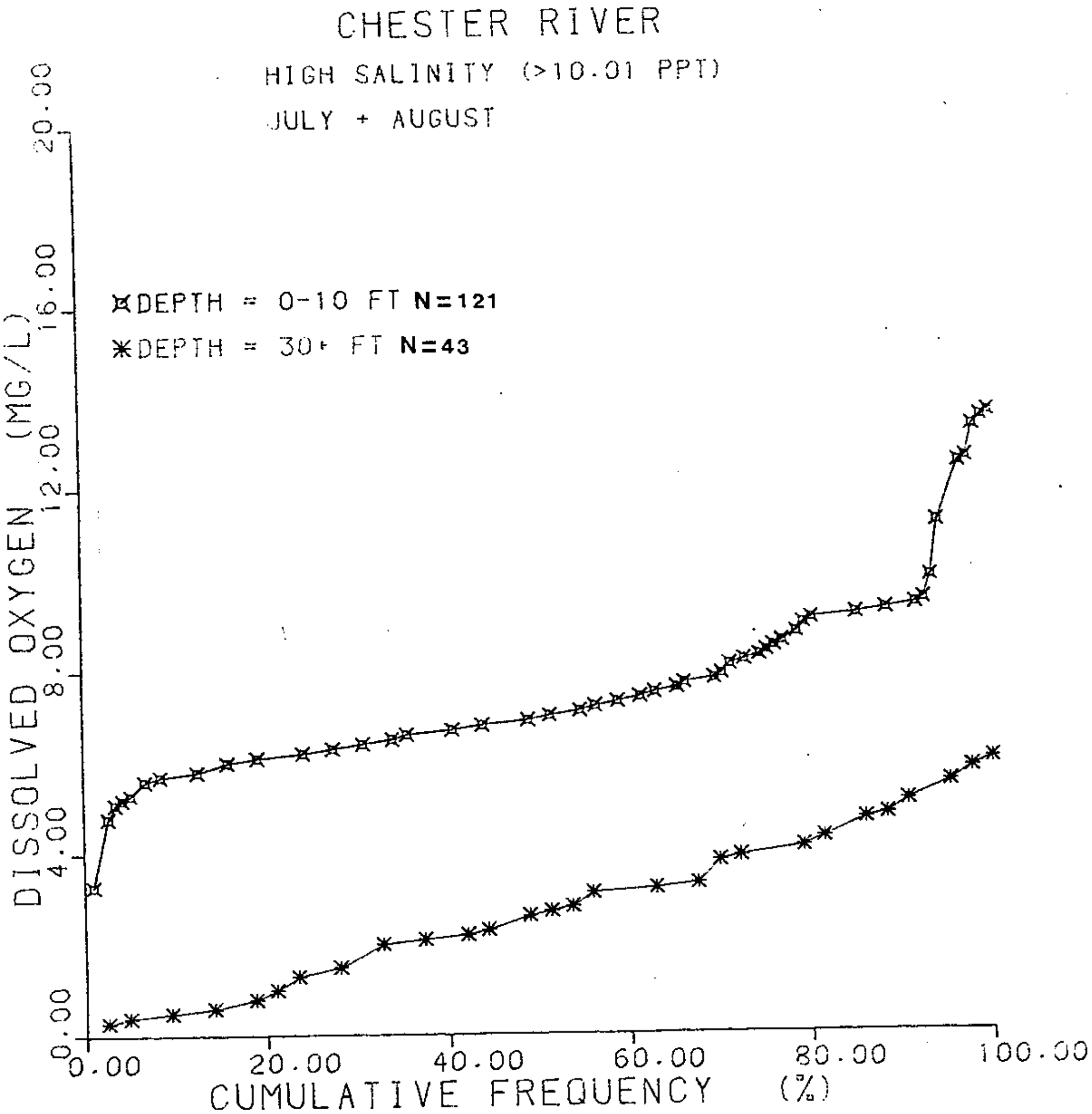


Figure 10-33 CFD of DO for the months of July and August in the lower estuary and grouped by dpeth.

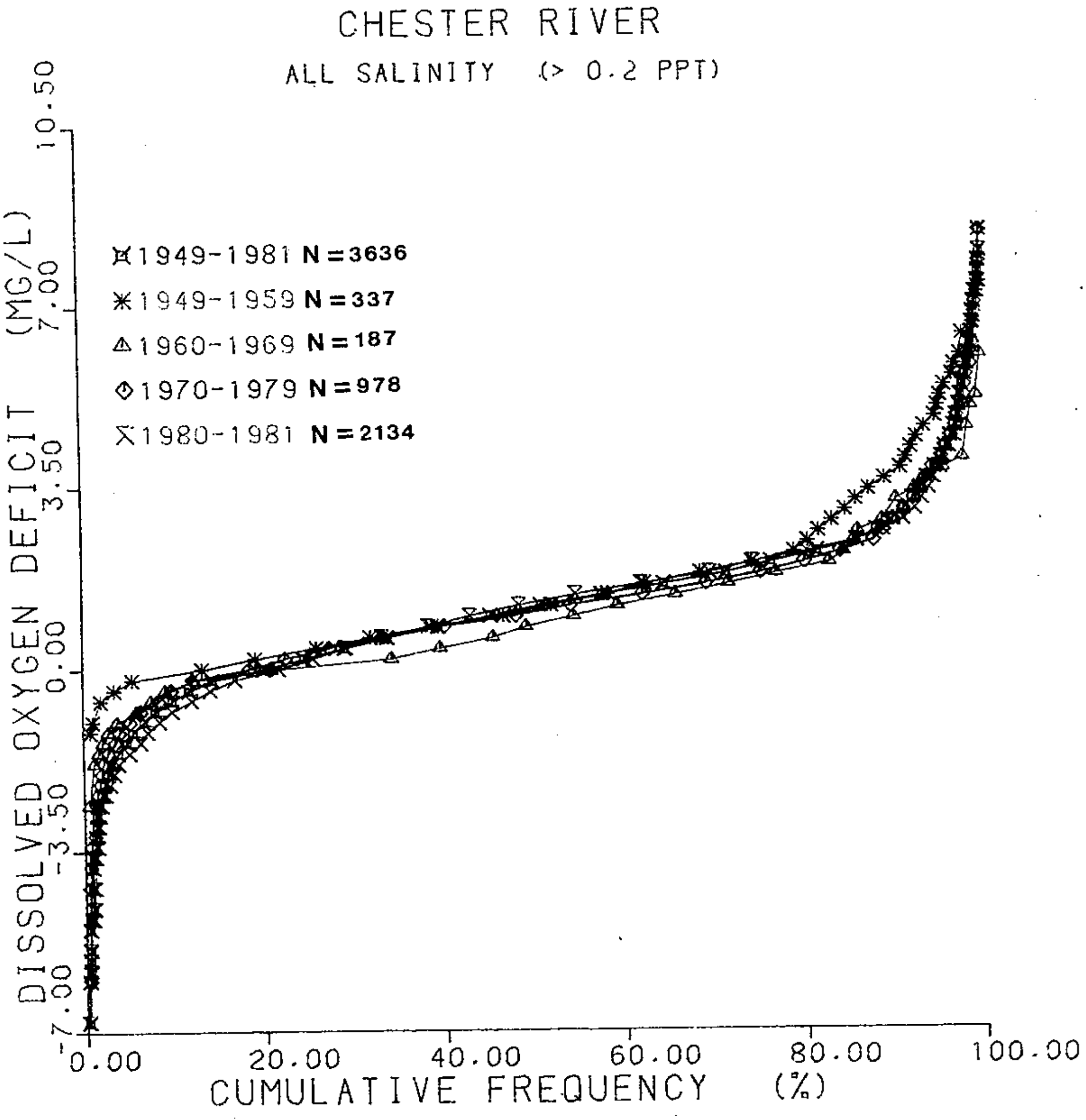


Figure 10-34 CFD of DOD for all salinity ranges with the historical data grouped by years.

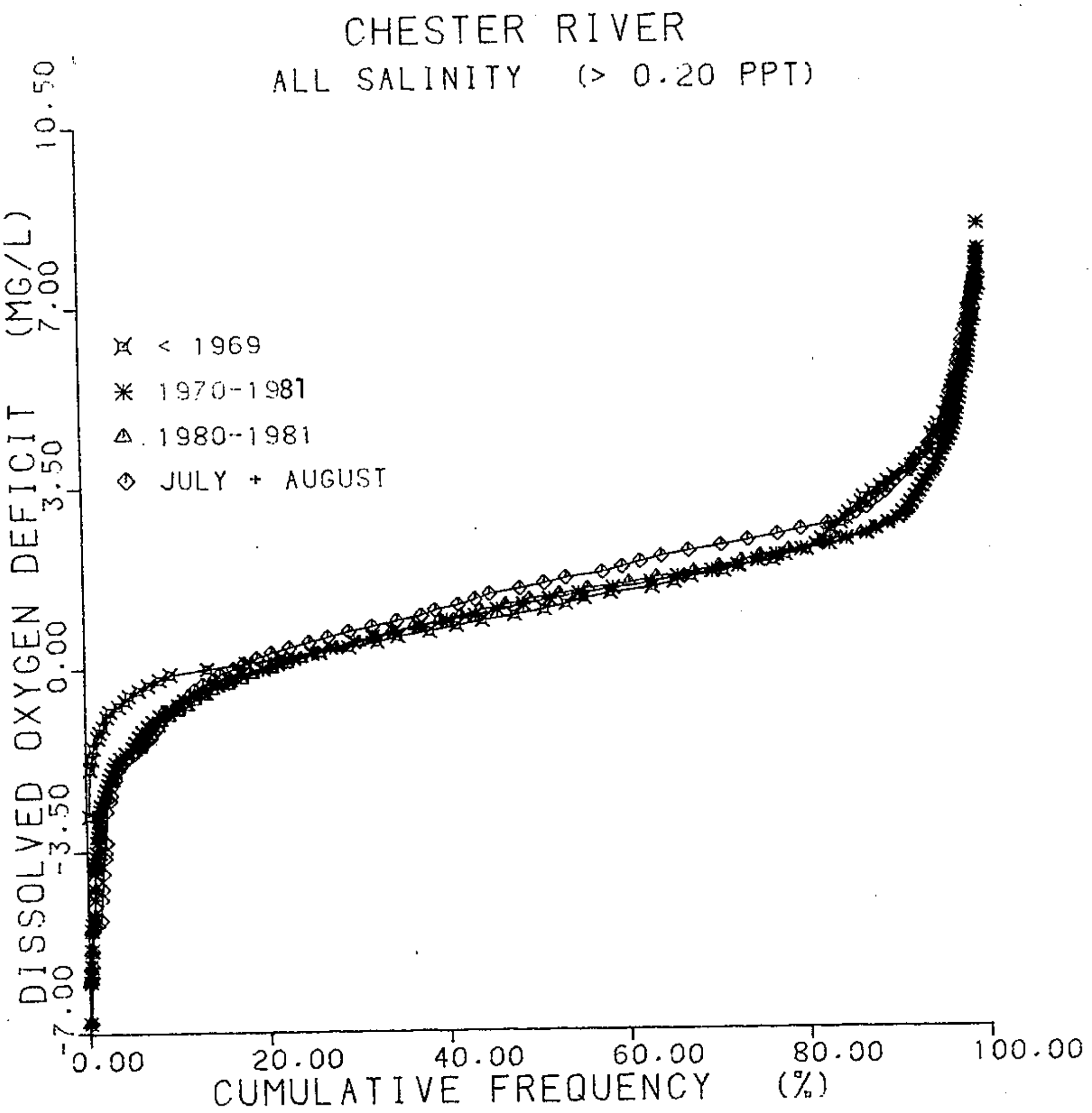


Figure 10-35 CFD of DOD for all salinity ranges for various years and all data for the months of July and August.

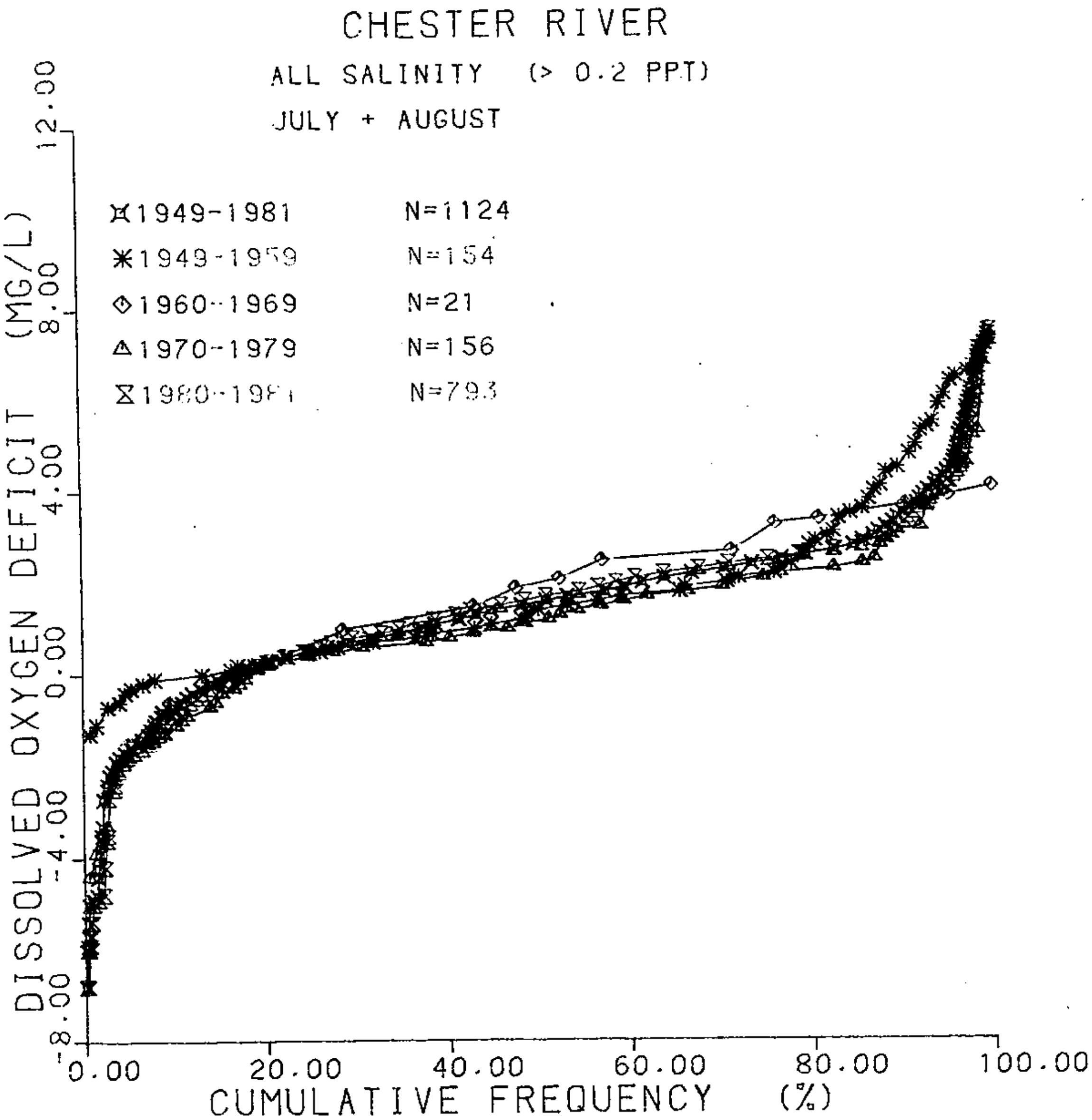


Figure 10-36 CFD of DOD in the month July and August for all salinity ranges for various years.

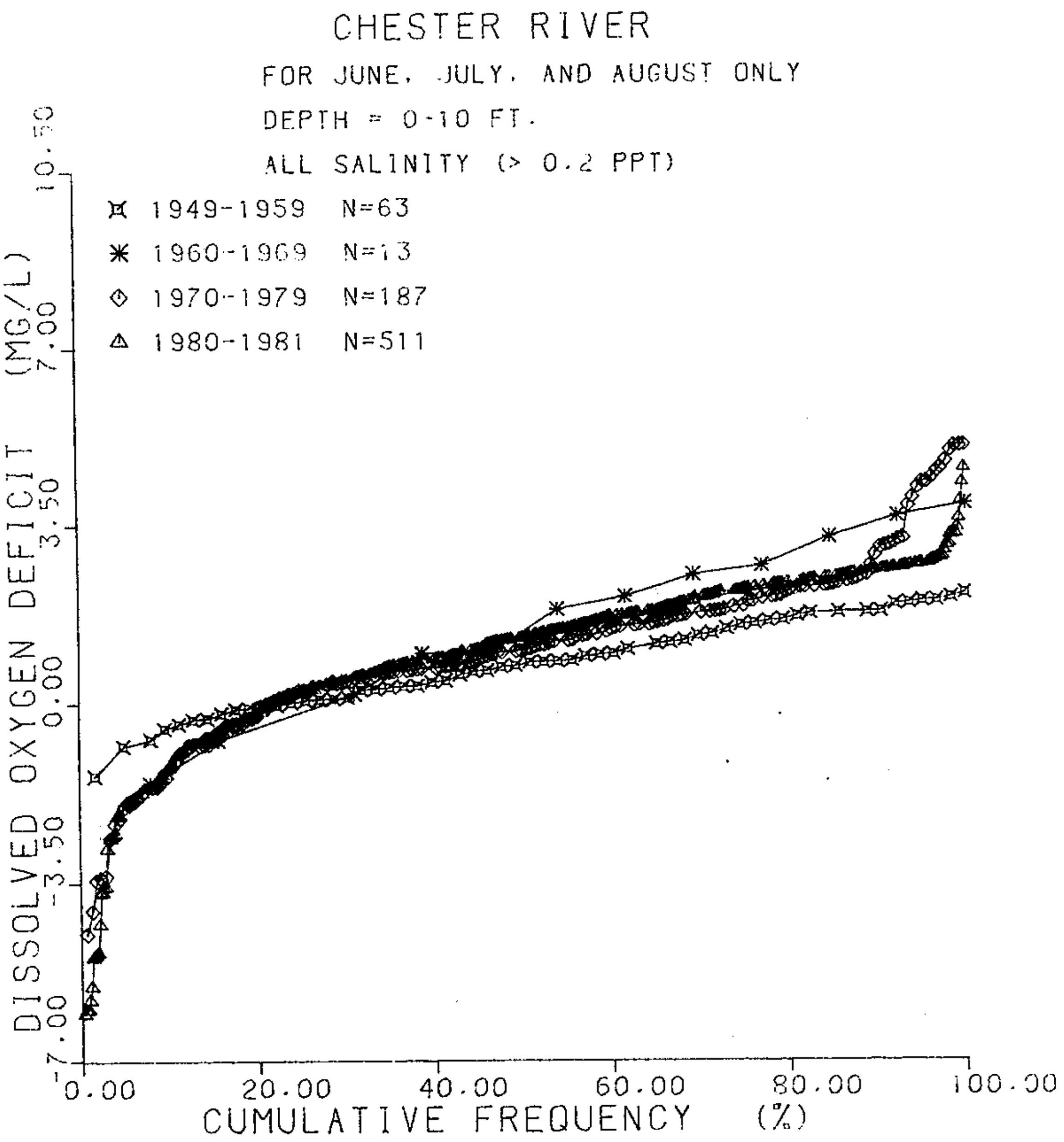


Figure 10-37 CFD of DOD for all data collected in the months June, July and August at a depth between 0-10 feet (grouped by years).

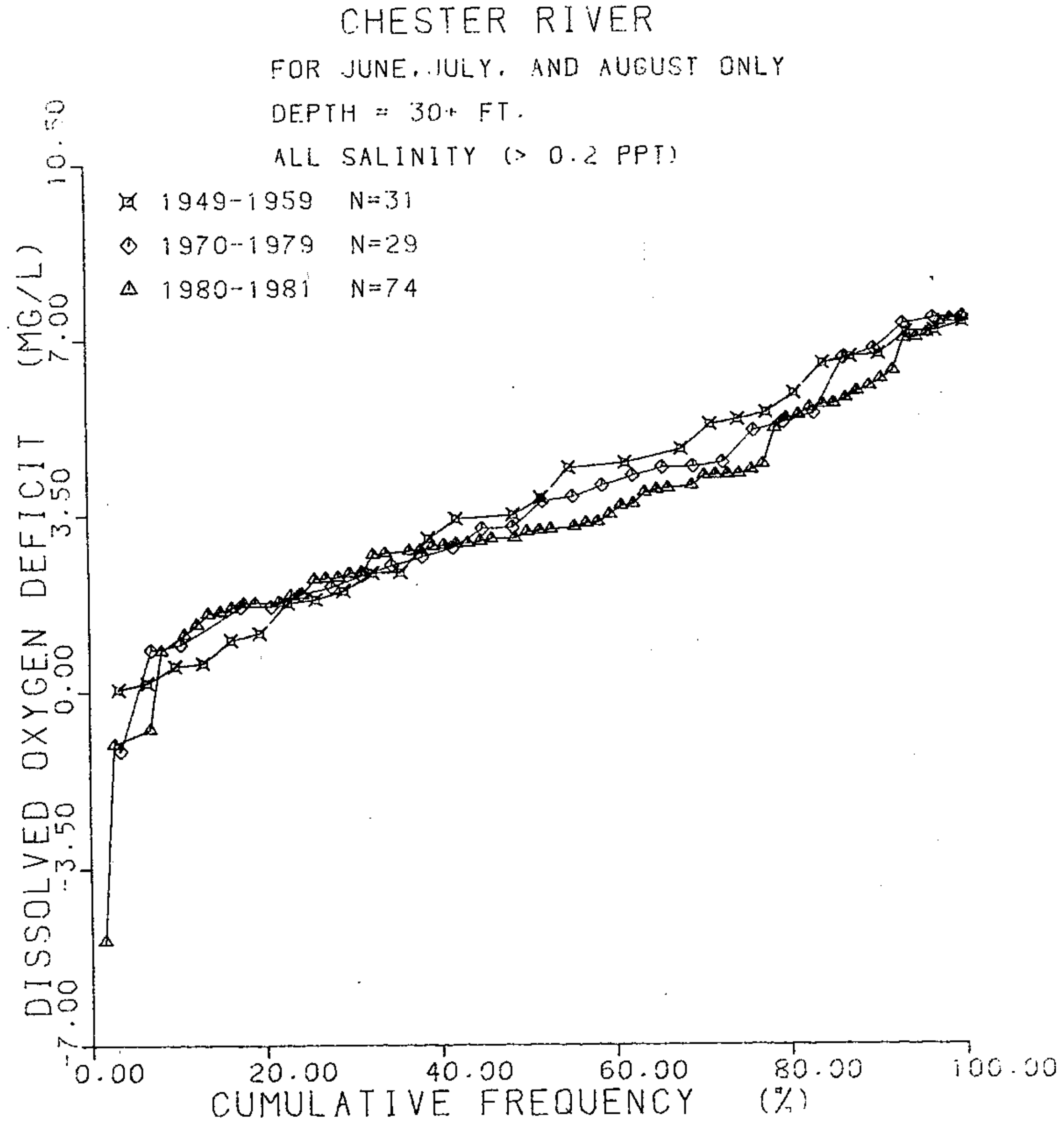


Figure 10-38 CFD of DOD for all data collected in June, July and August at a depth greater than thirty feet (grouped by years).

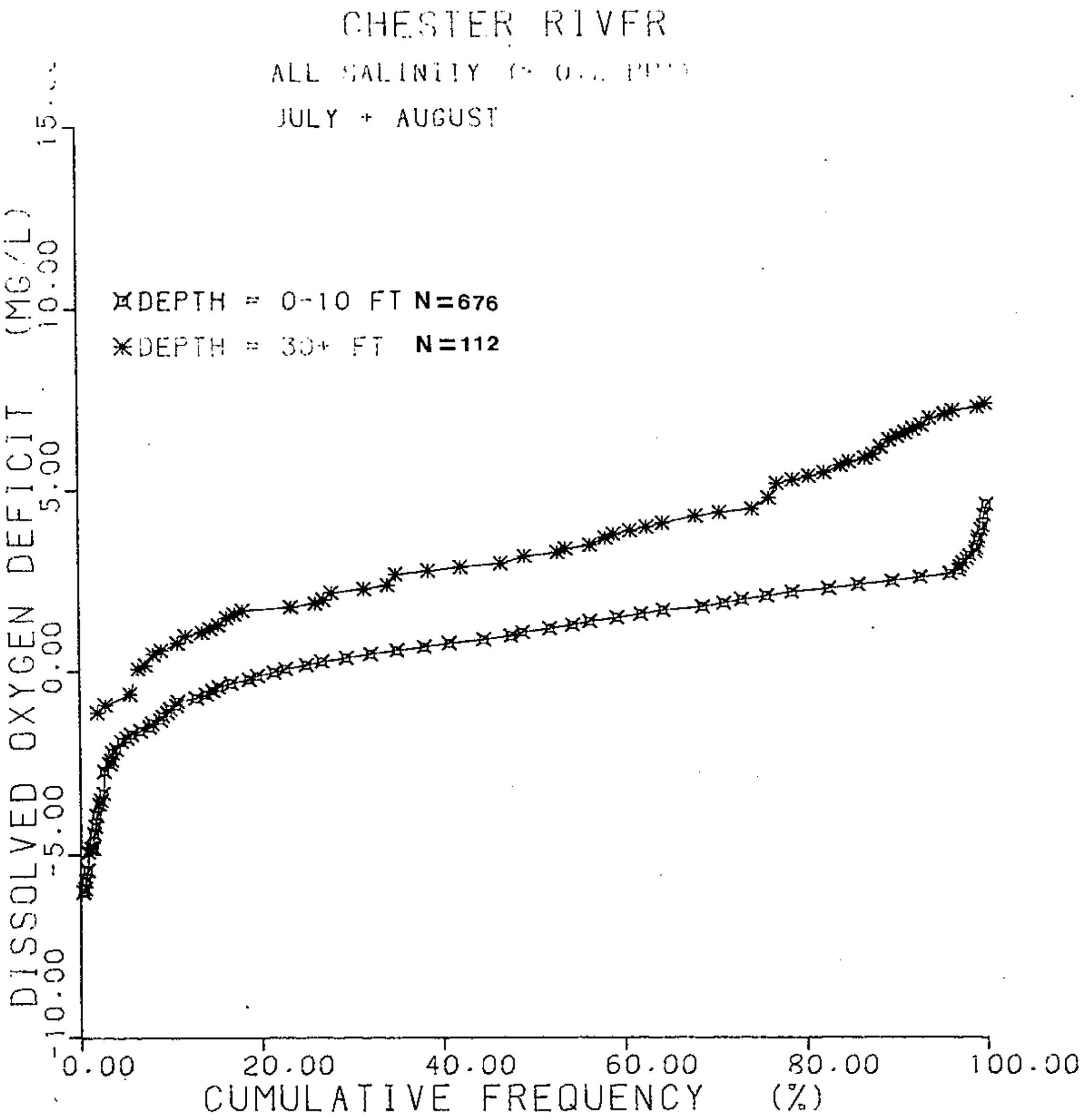


Figure 10-39 CFD of DOD for the Chester Estuary for the months of July and August, grouped by depth.

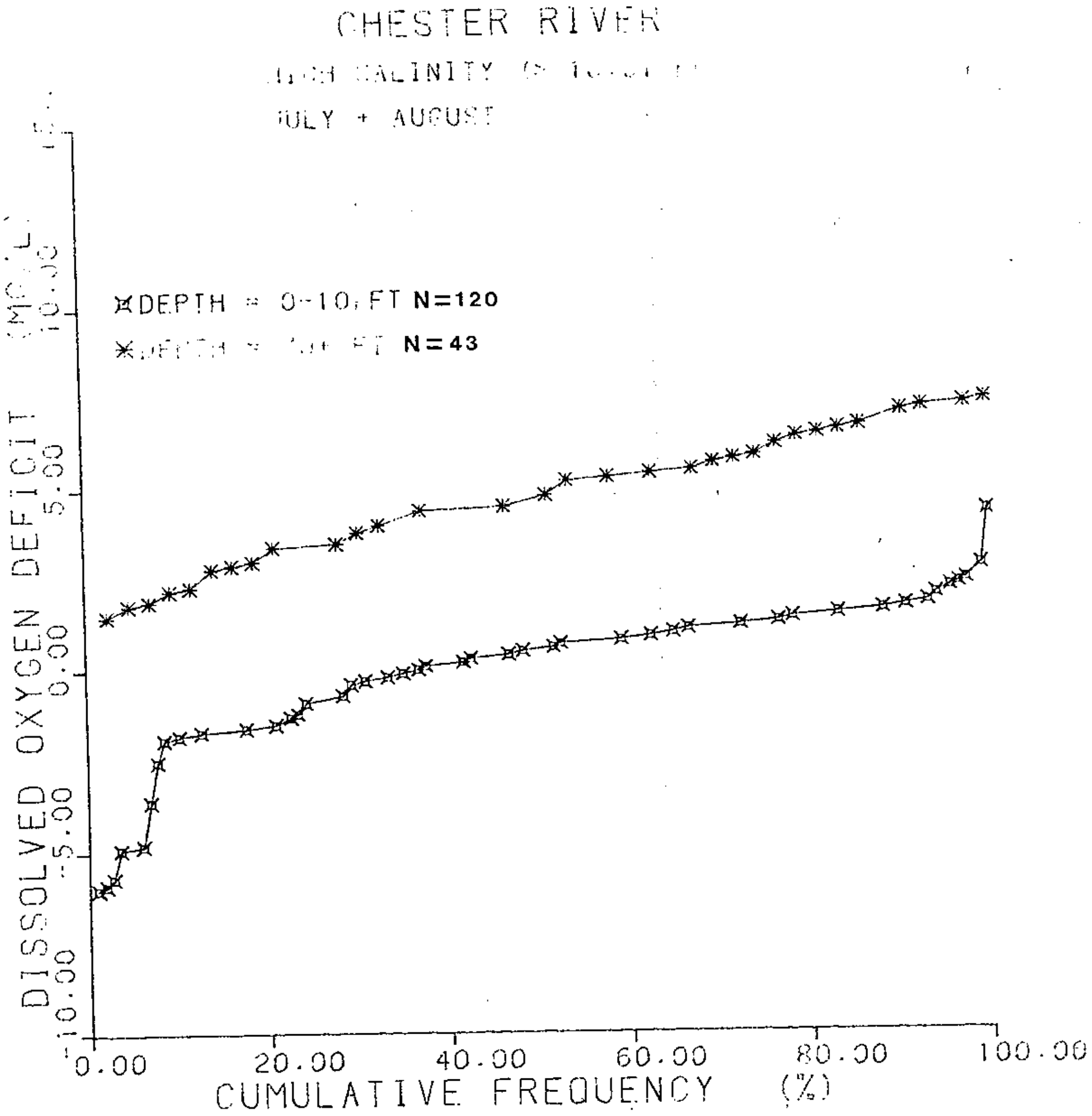


Figure 10-40 CFD of DOD for the Lower Estuary for the month of July and August, grouped by depth.

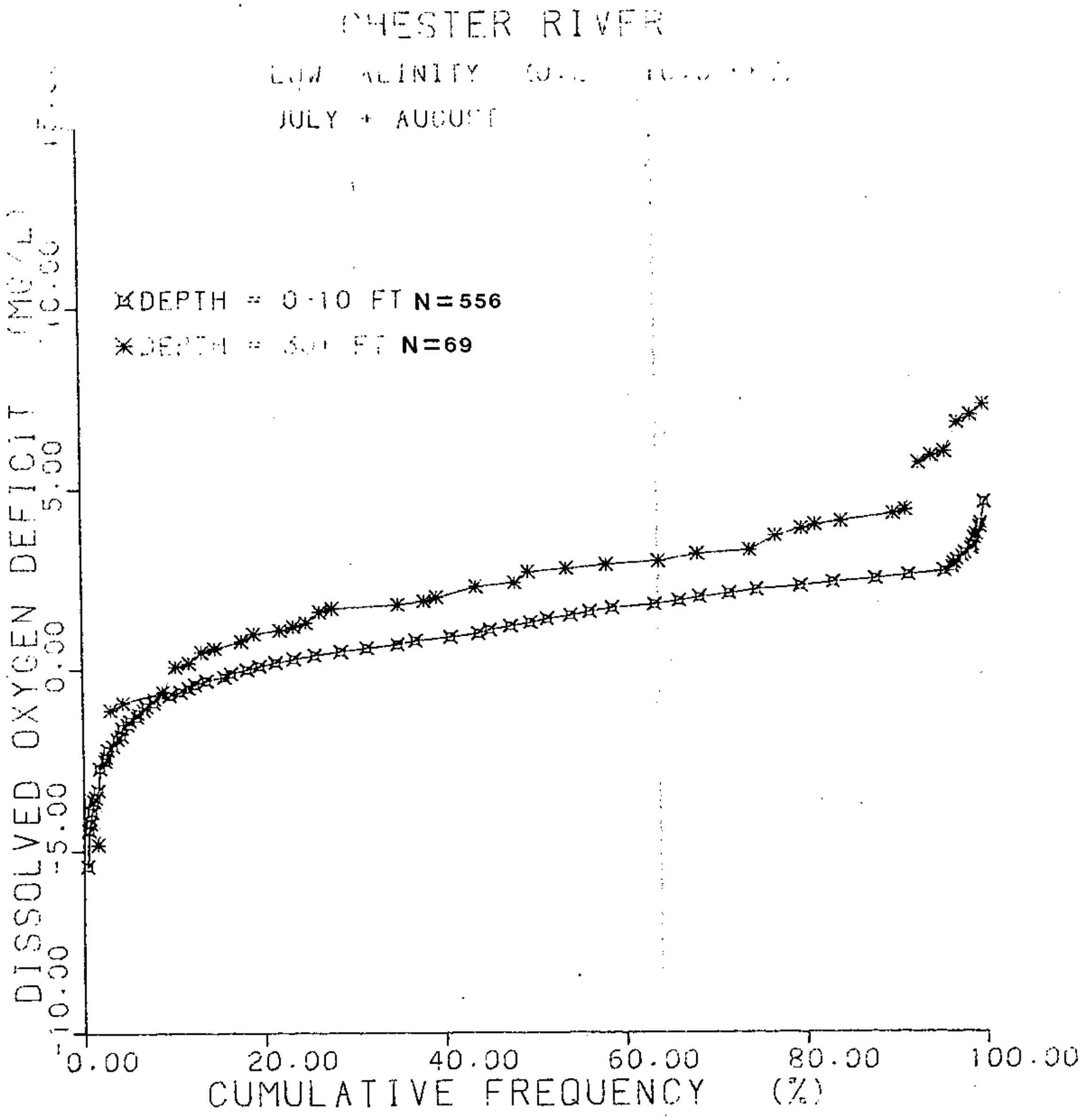


Figure 10-41 CFD of DOD in the Upper Estuary for the month of July and August; grouped by depth.

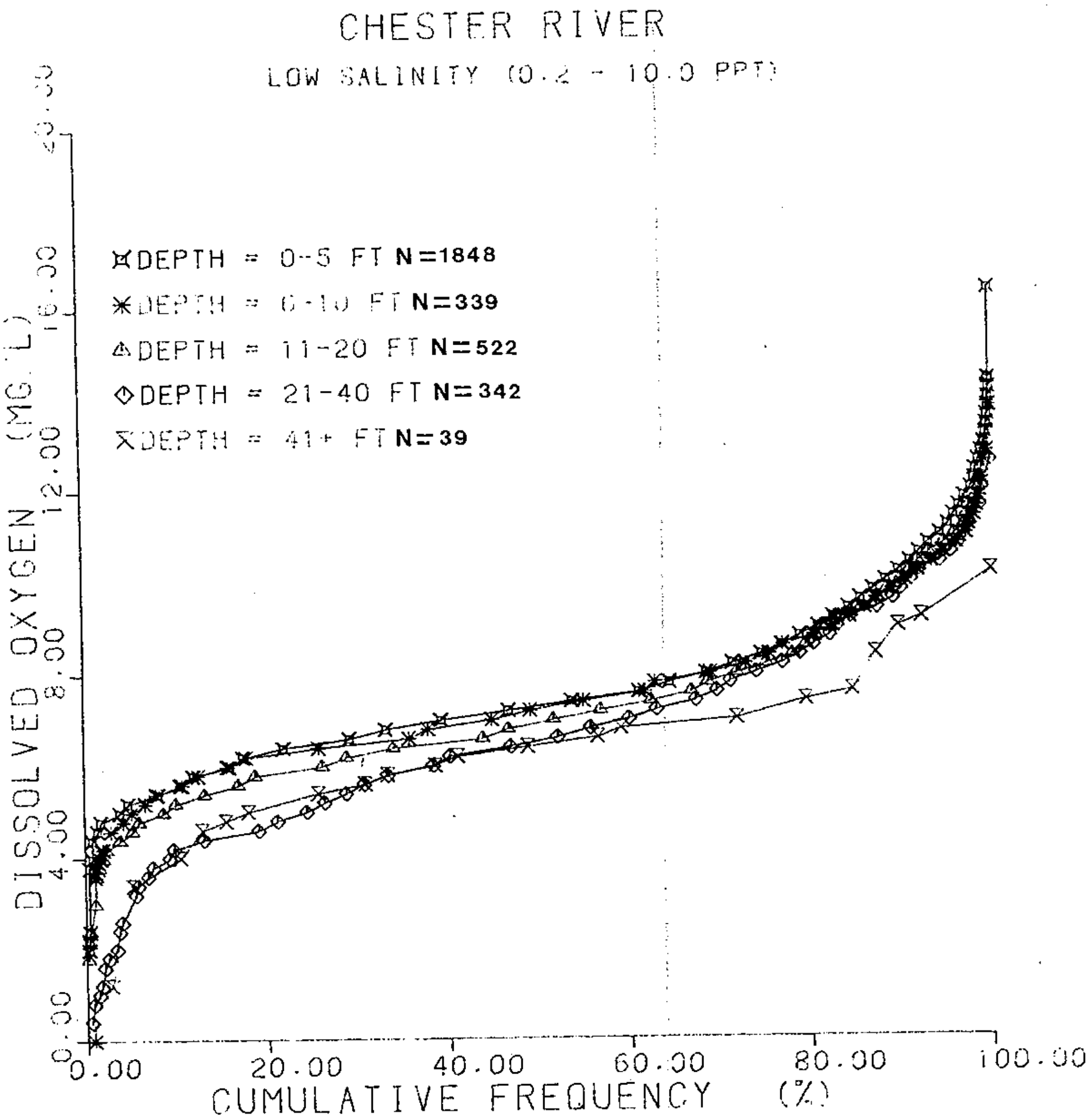


Figure 10-42 CFD of DO in the Upper Estuary and grouped by depth.

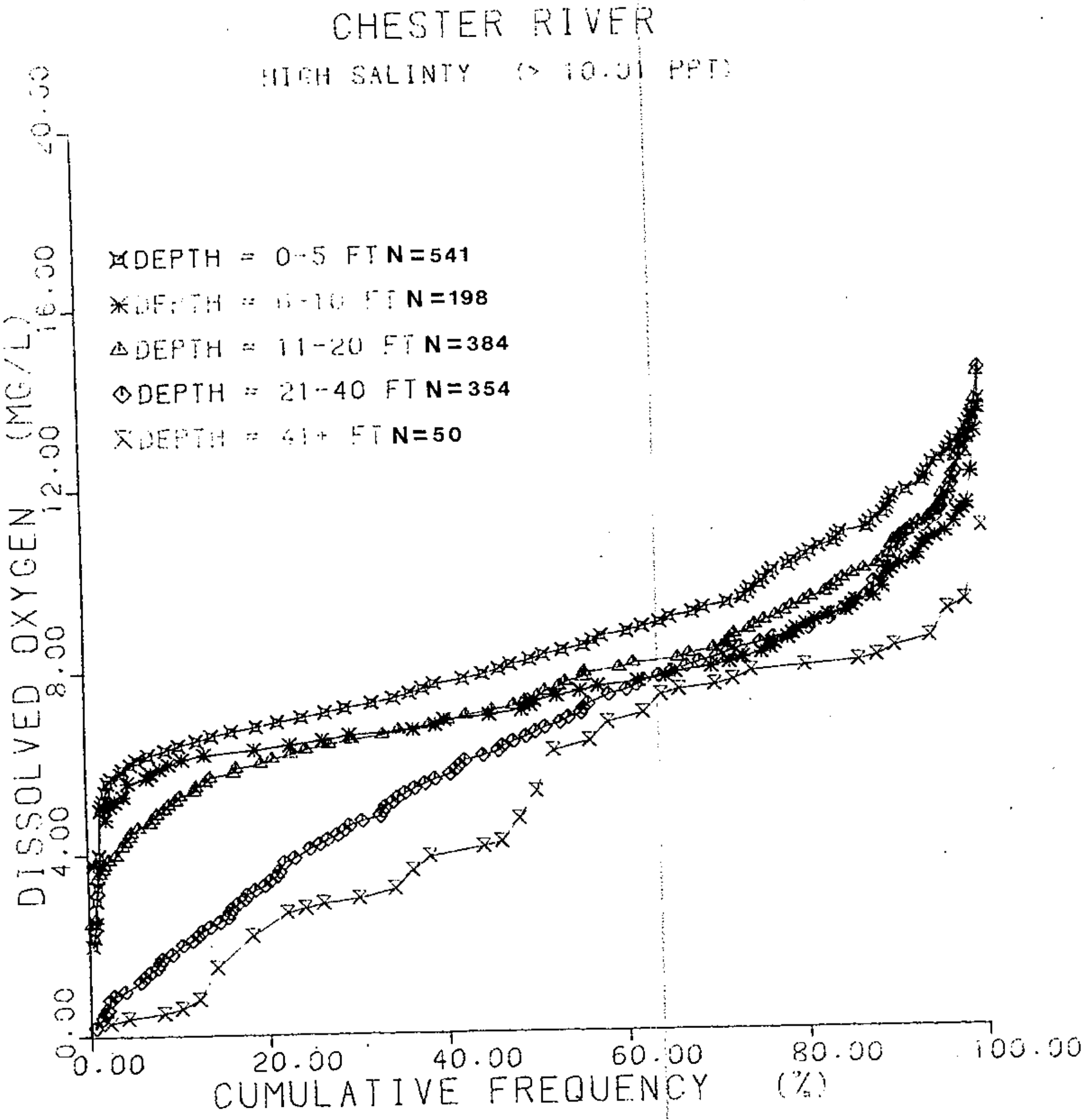


Figure 10-43 CFD of DO in the Lower Estuary and grouped by depth.

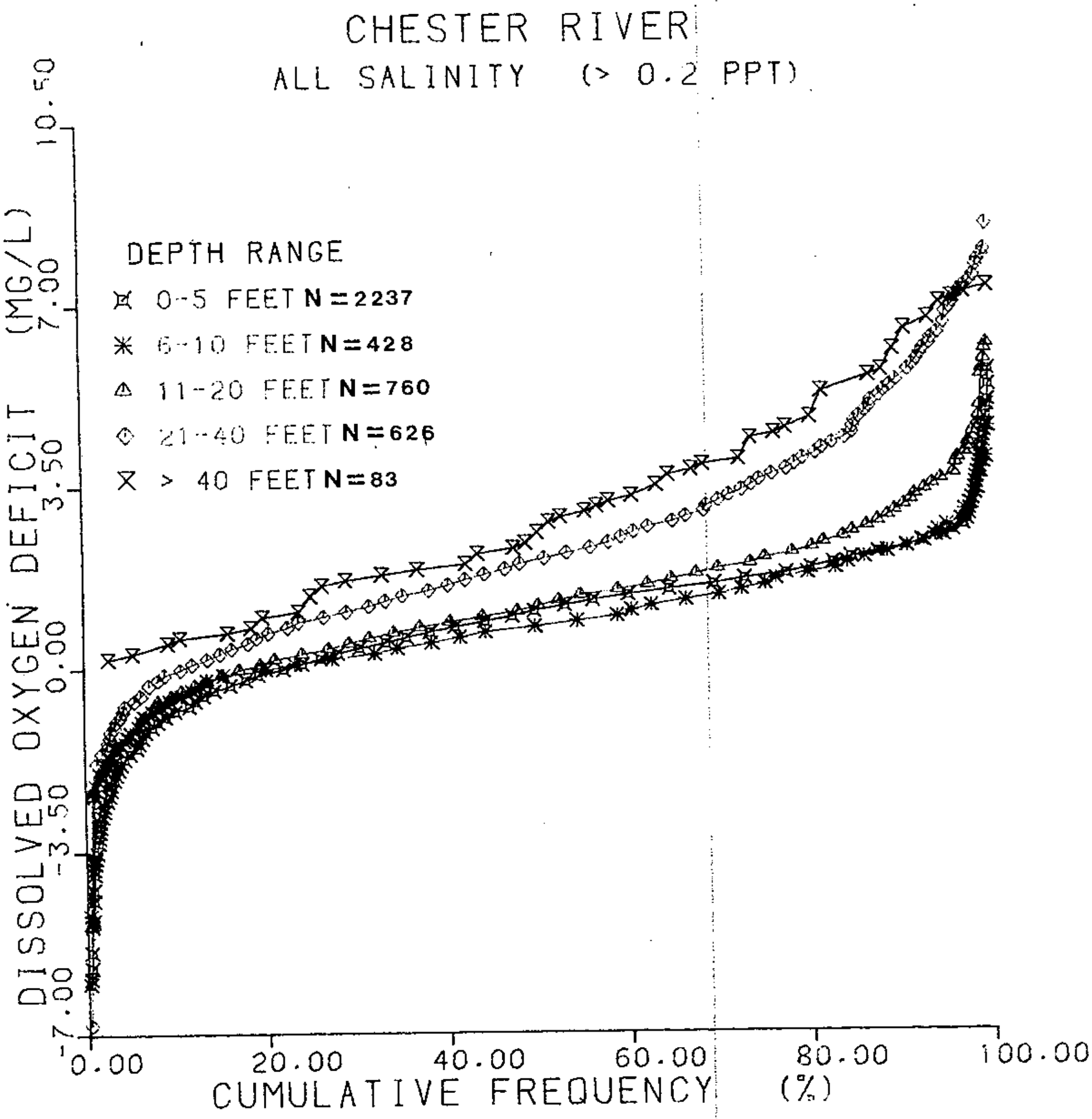


Figure 10-44 CFD of DOD in the Chester Estuary and grouped by depth.

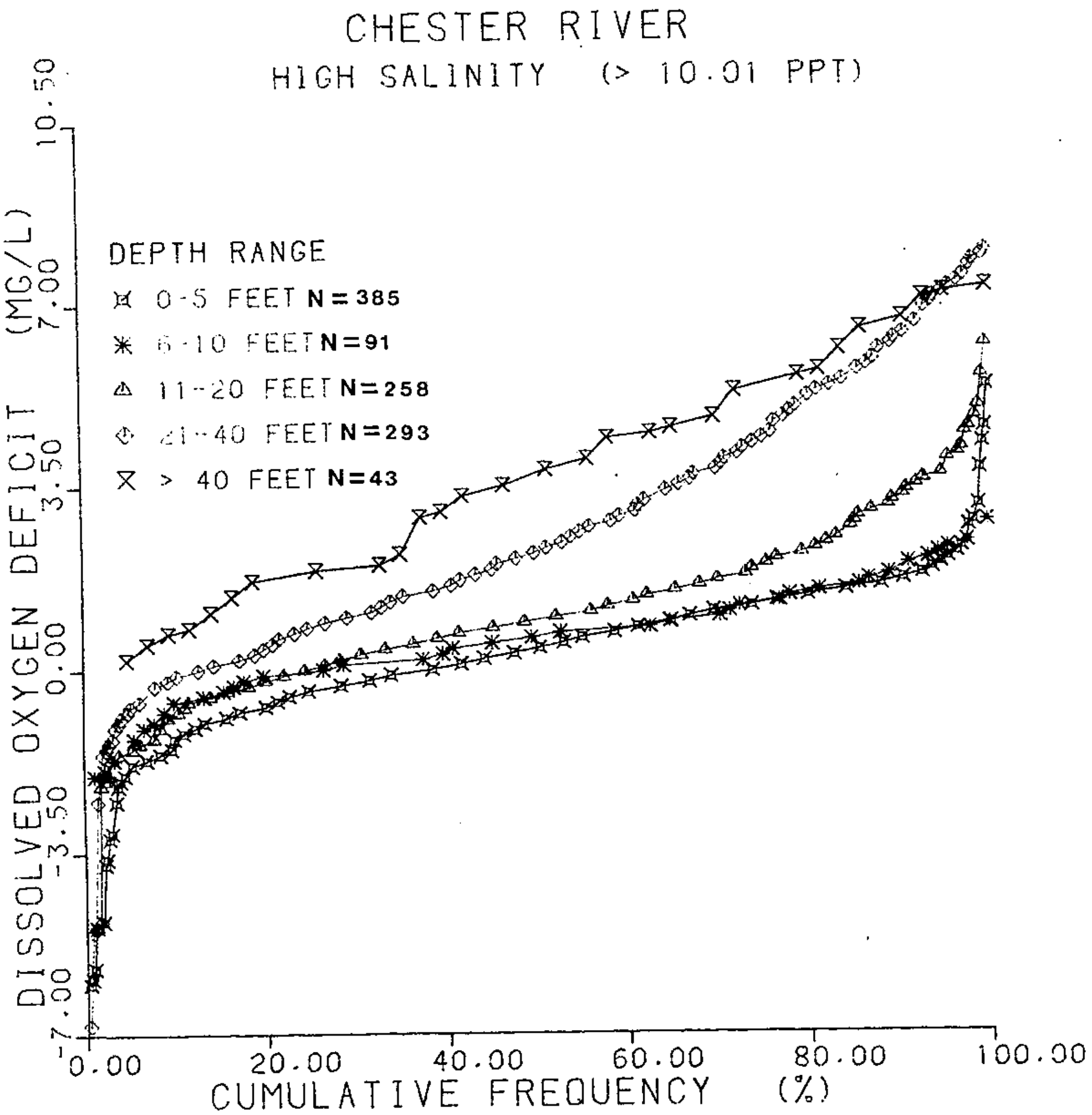


Figure 10-45 CFD of DOD in the Lower Estuary and grouped by depth.

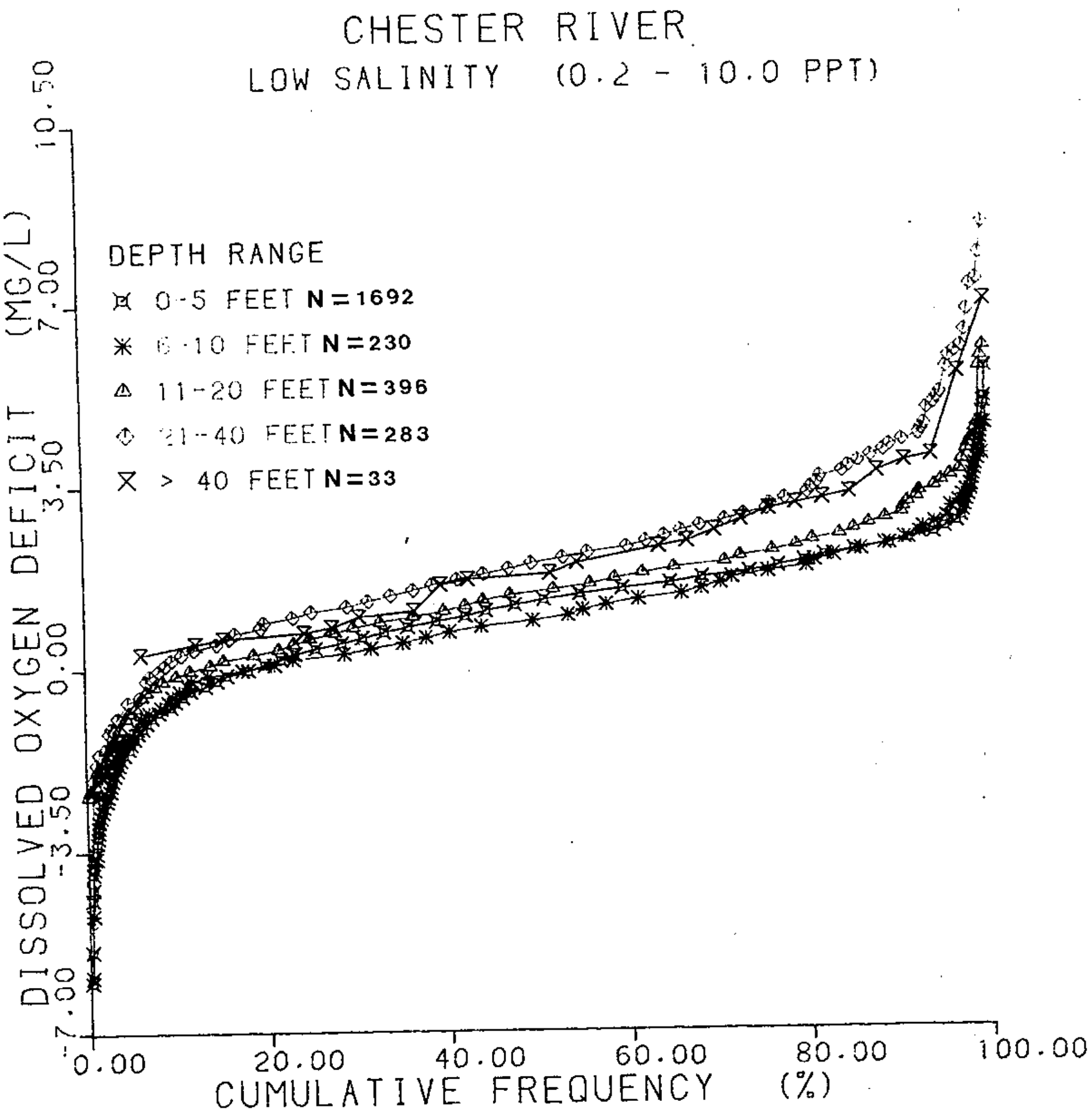


Figure 10-46 CFD of DOD in the Upper Estuary and grouped by depth.

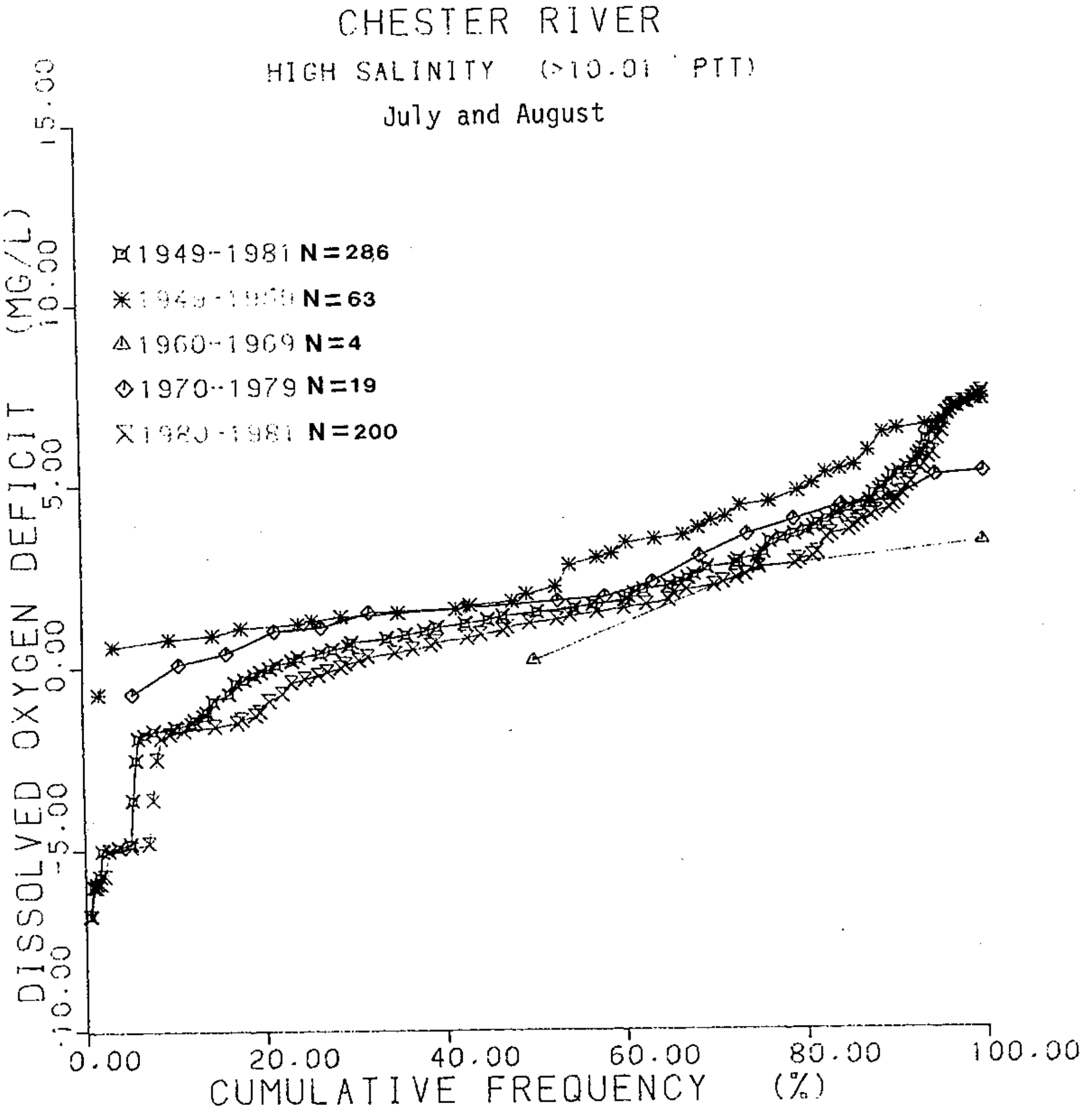


Figure 10-47 CFD of DOD in the Lower Estuary for the months of July and August and grouped by various years.

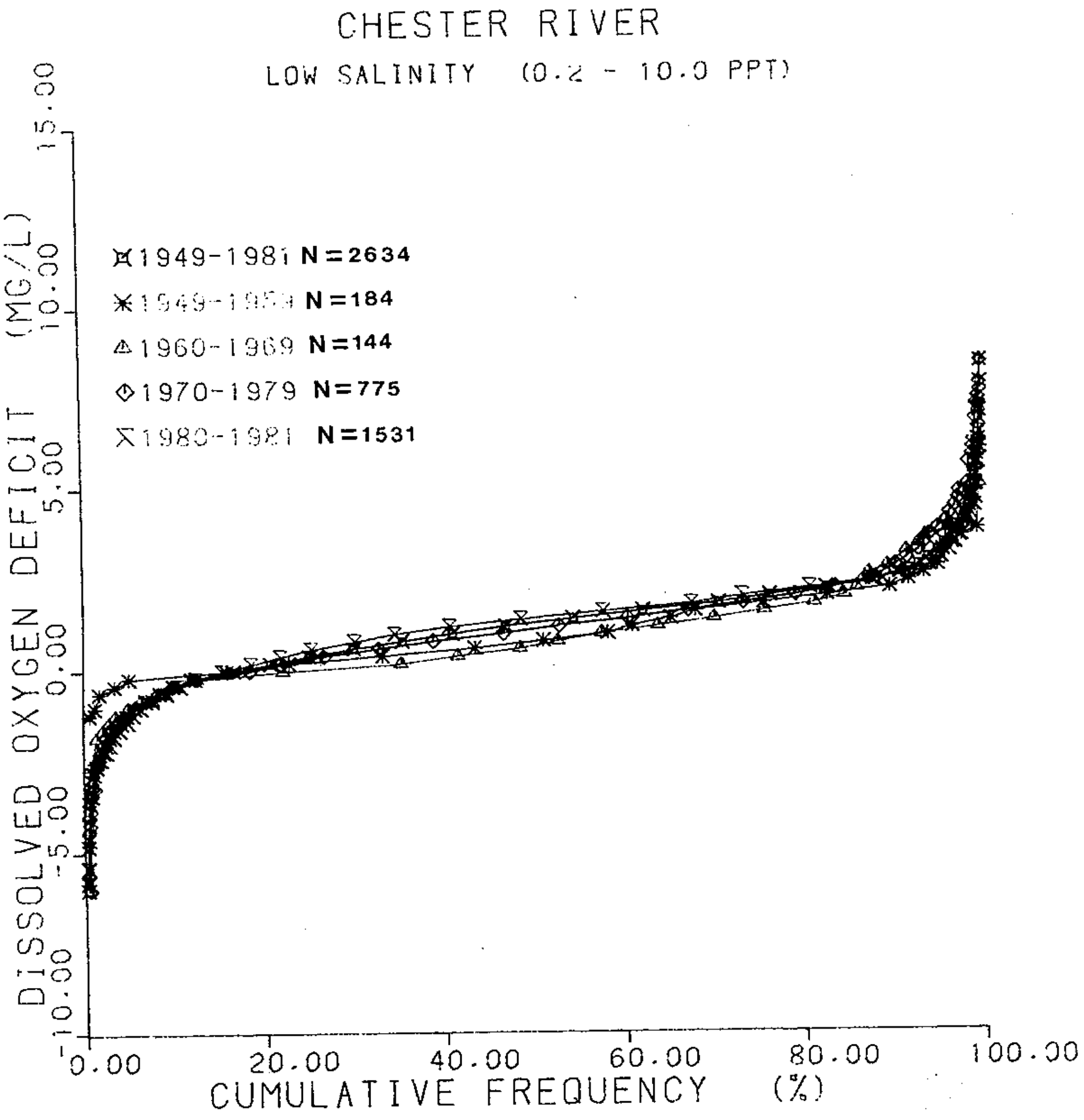


Figure 10-48 CFD of DOD in the Upper Estuary and grouped by various years.

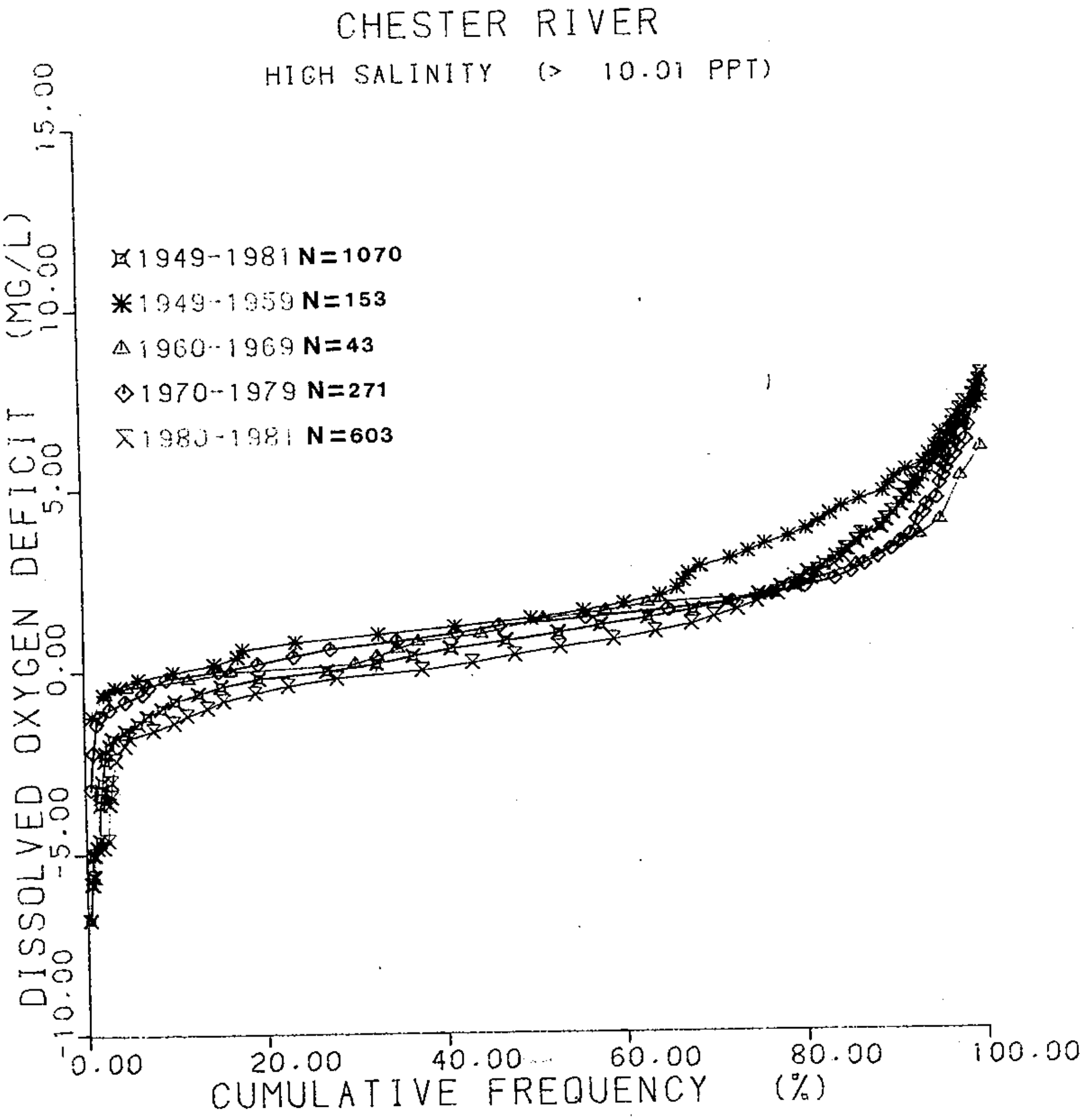


Figure 10-49 CFD of DOD in the Lower Estuary and grouped by various years.

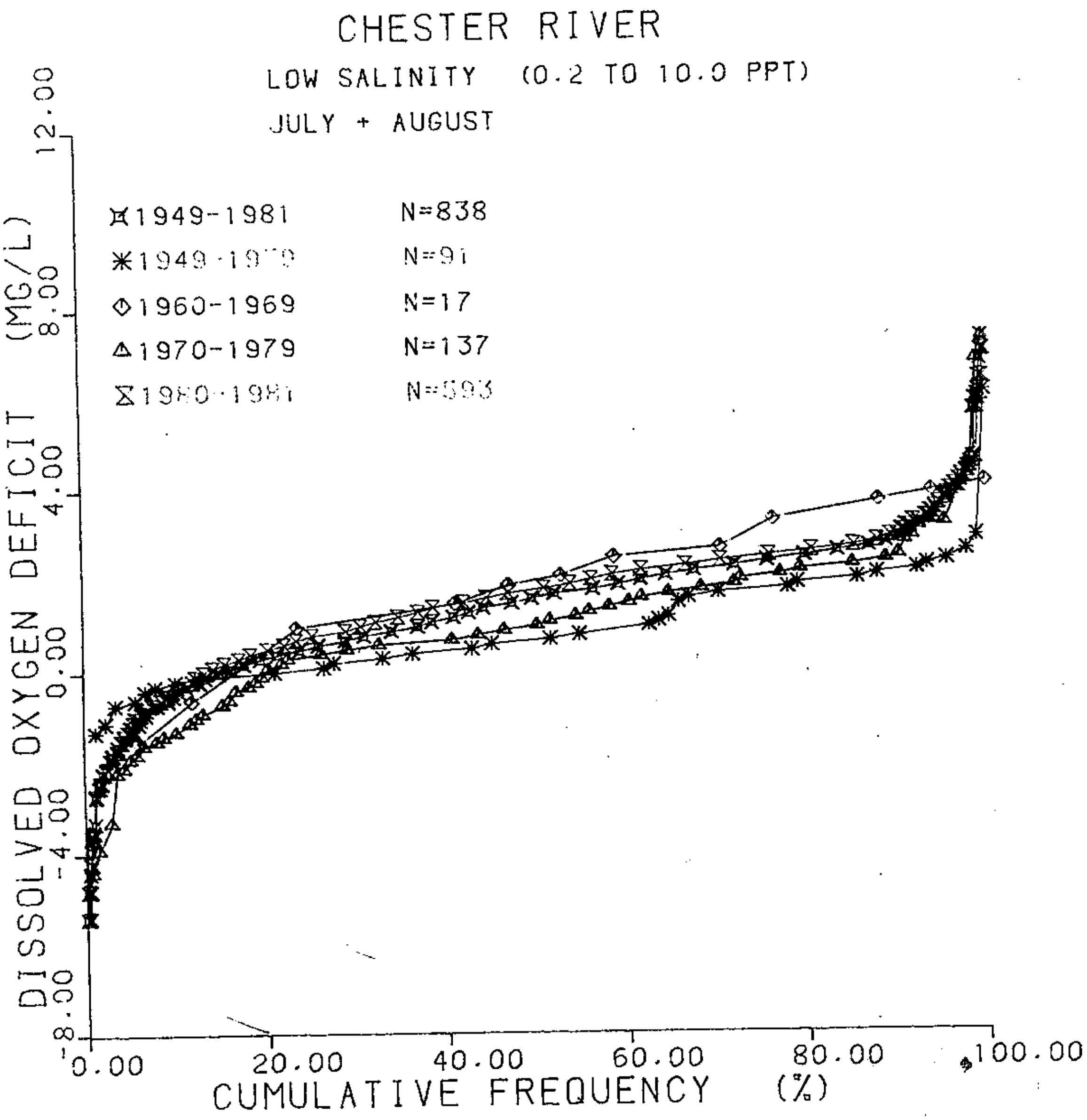


Figure 10-50 CFD of DOD in the Upper Estuary for the month of July and August and grouped by various years.

APPENDIX J

FIGURES AND TABLES FOR RESULTS AND DISCUSSION

SECTION 11

Table 11-1
Selected Multiple Linear Regressions of CZ-Juvenile Index Based Upon Climatic Variables

Species (Dependent Variable)	Best Subset Regression Equation	R^2
CZ Menhaden	$= .641655\ (x_1) + .00272761\ (x_2) + 1.08294\ (x_3) + .357723\ (x_4) - 15.0173$	.516
CZ Bluefish	$= .0020935\ (x_2) + .962127\ (x_3) - 10.4897$	.863
CZ Alewife	$= -.442726\ (x_1) - .694467\ (x_4) + .593300$	.480
CZ Spot	$= .730081\ (x_1) + .00244472\ (x_2) + 1.29388\ (x_3) - 13.3628$	.873
CZ Roe	$= -.739476\ (x_3) + .429116\ (x_4) + 2.10470$	.610
CZ Striped Bass	$= -.720485\ (x_1) - .00226123\ (x_2) - .482545\ (x_3) - .426848\ (x_4) + 11.8036$	.778
CZ White Perch	$= -.00239546\ (x_2) - .525178\ (x_3) + 12.6535$	.616

(x_1) = CZ - snowfall, (x_2) = CZ - degree days, (x_3) = CZ - precipitation

(x_4) = CZ - air temperature

Table 11-2
Selected Multiple Linear Regressions Based Upon Climatic, Chemical and Average Ocean and Estuarine Spawner Variables for CZ-Index

Species (Dependent Variable)	Best Subset Regression Equation	R^2
CZ-Menhaden	$= 0.843659\ (x_{10}) - 0.357469\ (x_6) - 0.0560967$	0.994
CZ-Bluefish	$= 1.57001\ (x_{10}) + 1.21076\ (x_7) + 1.39607\ (x_2) + 0.597502\ (x_3) - 0.755858\ (x_8) + 3.09671\ (x_9) - 0.611284\ (x_5) + 0.956085\ (x_6) - 5.42314$	0.999
CZ-Alewife	$= -2.76375\ (x_9) + 0.842848\ (x_5) - 0.102381$	0.816
CZ-Spot	$= 1.05580\ (x_{10}) + 0.185300\ (x_1) - 0.830778\ (x_2) - 0.403285\ (x_3) - 1.54827\ (x_9) - 0.551701\ (x_6) + 0.03977$	0.997
CZ-Roe Shad	$= -3.44874\ (x_{10}) - 2.22680\ (x_7) + 0.319863\ (x_1) - 2.63016\ (x_3) + 3.10128\ (x_4) - 1.70019\ (x_8) + 11.5834\ (x_9) - 1.79528\ (x_5) - 9.02185\ (x_6) + 9.60461$	0.999
CZ-Striped Bass	$= 1.39284\ (x_7) + 0.126132\ (x_4) - 0.862107\ (x_5) - 3.04124$	0.927

(x_1) = CZ - snowfall; (x_2) = CZ - degree days; (x_3) = CZ - precipitation;

(x_4) = CZ - air temperature; (x_5) = CZ - Chester River water temperature;

(x_6) = CZ - Patuxent River ph; (x_7) = CZ - average anadromous index;

(x_8) = CZ - Chester River NO_3; (x_9) = CZ - Patuxent River NO_3;

(x_{10}) = CZ - average ocean spawners index

Table 11-3
Selected Estuarine And Other Spawner Index Regression Equations Developed From Multiple Linear Regressions

Index	Selected Regression Equation	r^2
Estuarine Spawners		
CZA1	$= 0.222734\ (X_1) - 0.727594$	0.183
CZA2	$= -0.564213\ (X_2) + 1.27075$	0.505
CZA2	$= .153255\ (X_1) + .442485\ (X_2) - .686231\ (X_7) - .090488\ (X_6) + .110061\ (X_8) + 1.15432$	0.979
Ocean Spawners		
CZO1	$= 0.876\ (X_1) + 0.634\ (X_2) + 1.082\ (X_3) - 2.17006$	0.842
CZO2	$= 0.618917\ (X_1) + 0.530626\ (X_2) + 1.01933\ (X_3) - 1.5655$	0.842
CZO2	$= 0.344871\ (X_1) - 0.23179\ (X_4) + 0.685246\ (X_2) - 1.24692\ (X_5) - 0.123416\ (X_6) + 1.44229$	0.991

X_1 - CZ - snowfall; X_2 - CZ - precipitation; X_3 - CZ - air temperature X_4 - degree days; X_5 - CZA2 (average estuarine spawner index); X_6 - Chester River NO_3; X_7 - CZO2 (average ocean spawner index); X_8 - water temperature

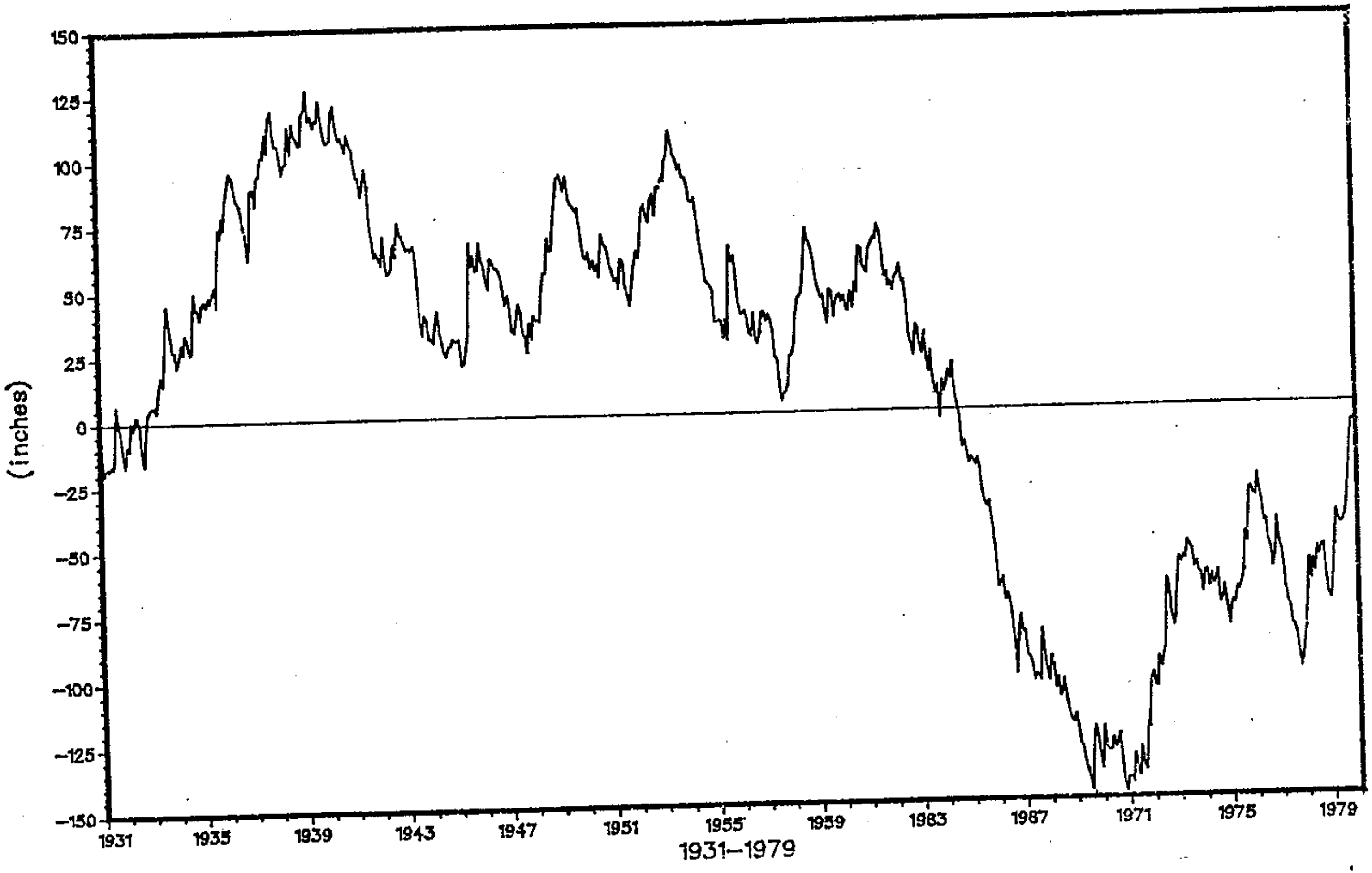


Figure 11-2 Cumulative departures from the mean for Maryland Precipitation data (developed by National Weather Service). Continued downward trend during the 1960's is indicative of the continued below normal rainfall.

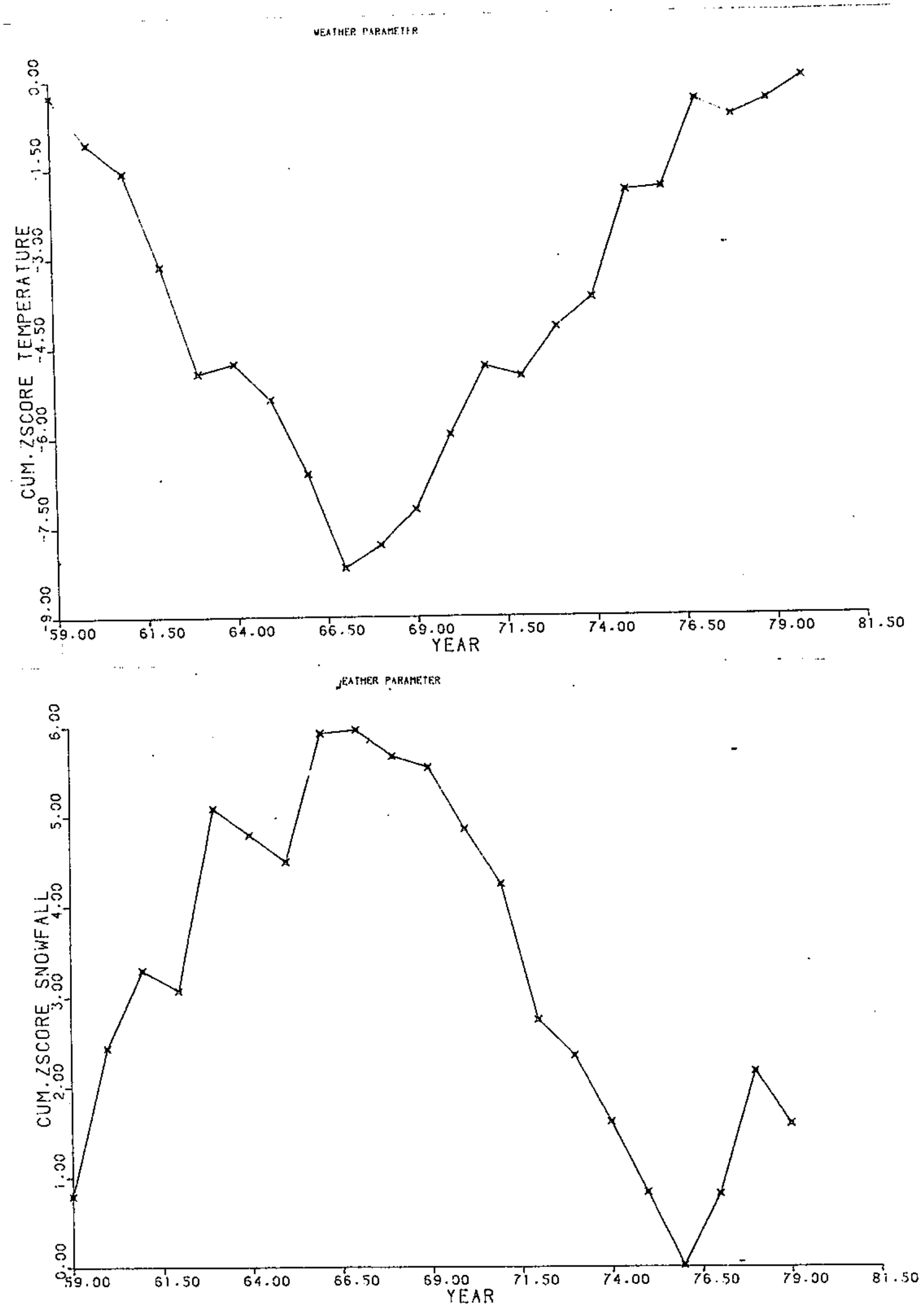


Figure 11-3 and 11-4 Standardized cumulative (z) time series for annual mean on temperature and snowfall from NWS data, Baltimore Washington International Airport

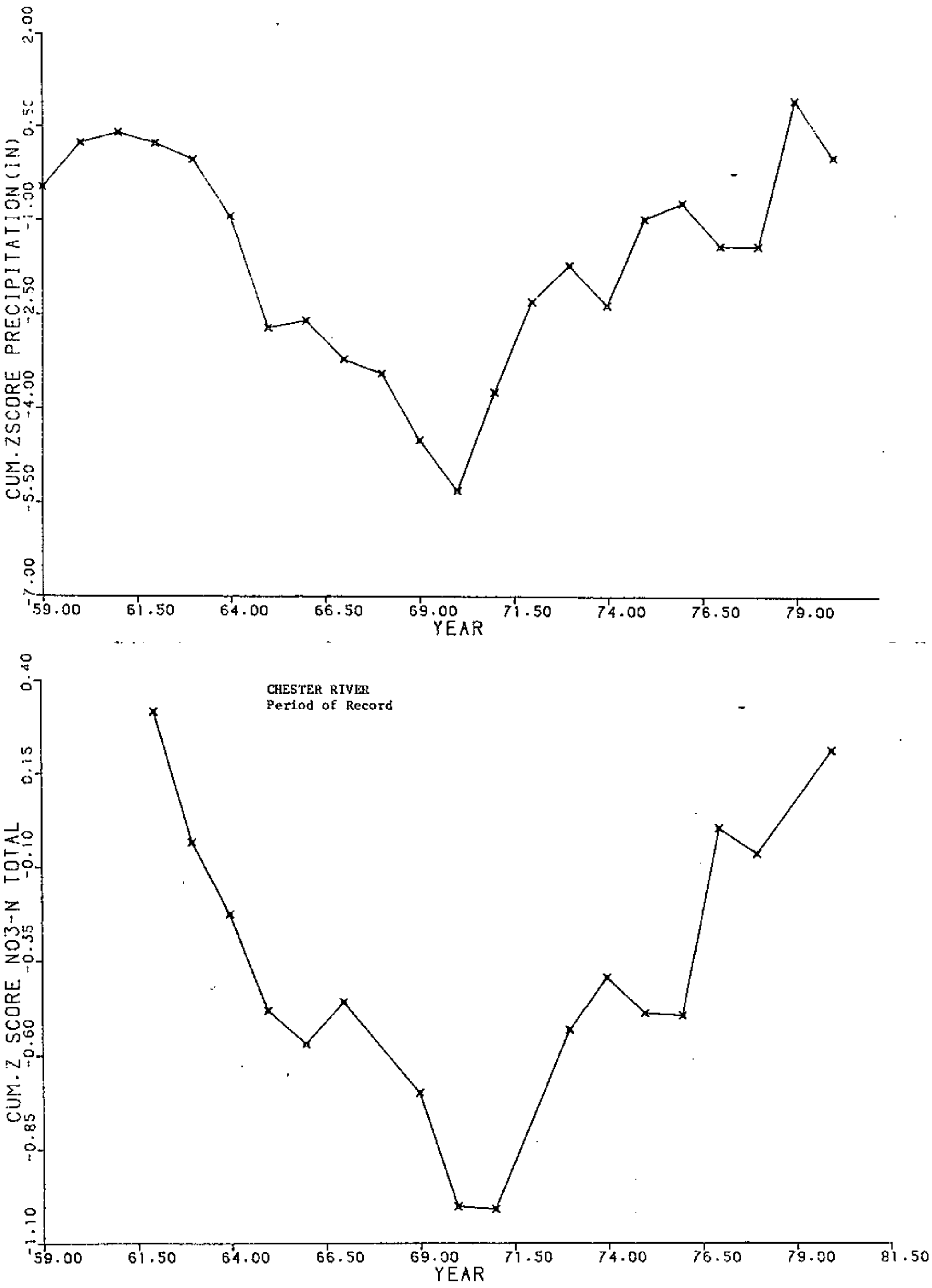


Figure 11-5 and 11-6 Cumulative Standardized (z) time series for annual mean precipitation and mean annual nitrate from NWS data, Baltimore Washington International Airport.

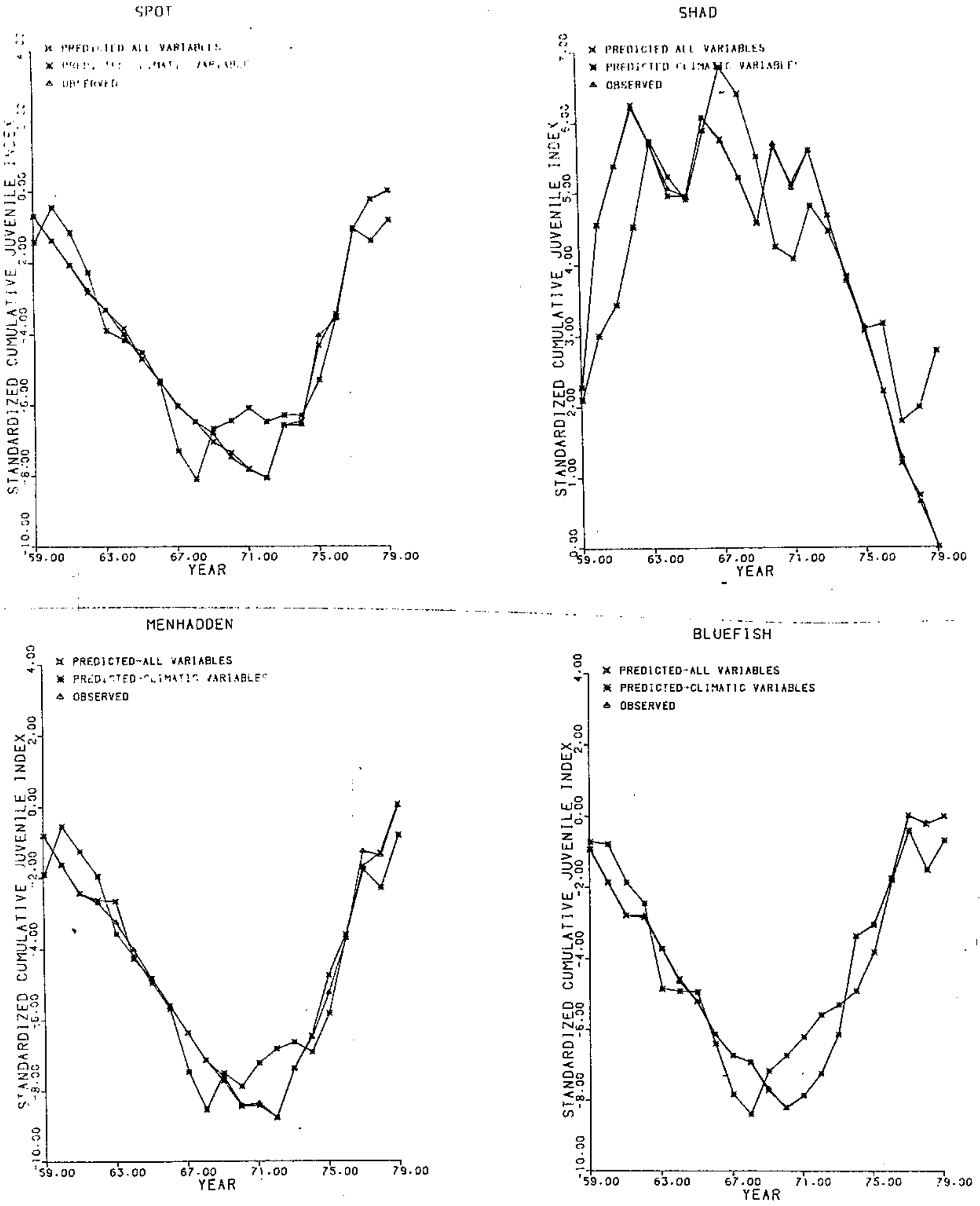


Figure 11-7 thru 11-10 Observed and Predicted standardized cumulative juvenile index. Predicted values are from multiple linear regression functions using (a) climatic variables or (b) climatic, water quality and the average index variable for ocean or estuarine species shown in figure 11-8 (c).

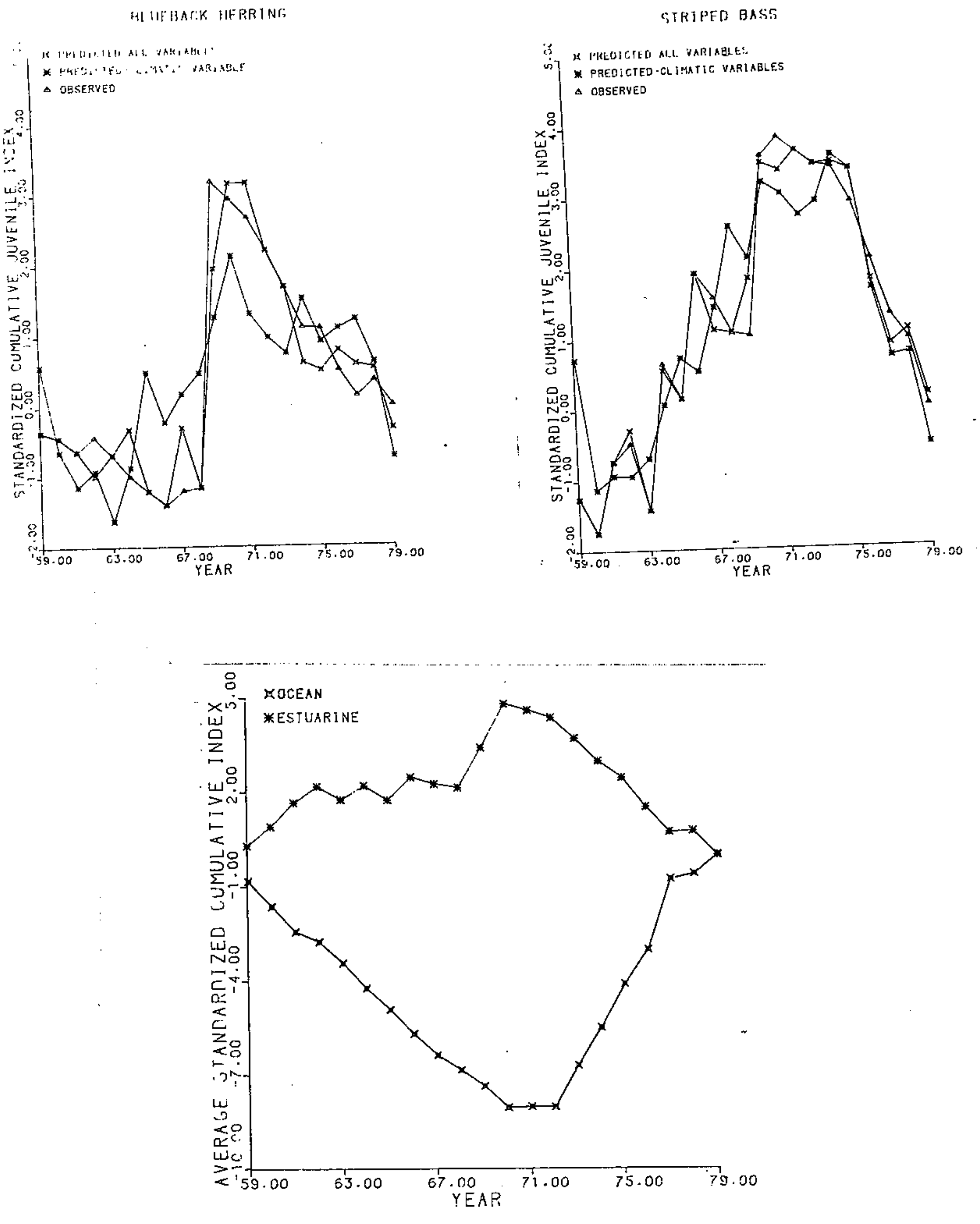


Fig. 11-11 thru 11-13 Observed and Predicted standardized cumulative juvenile index. Predicted values are from multiple linear regression functions using (a) climatic variables or (b) climatic, water quality and the average index variable for ocean or estuarine species as shown above.

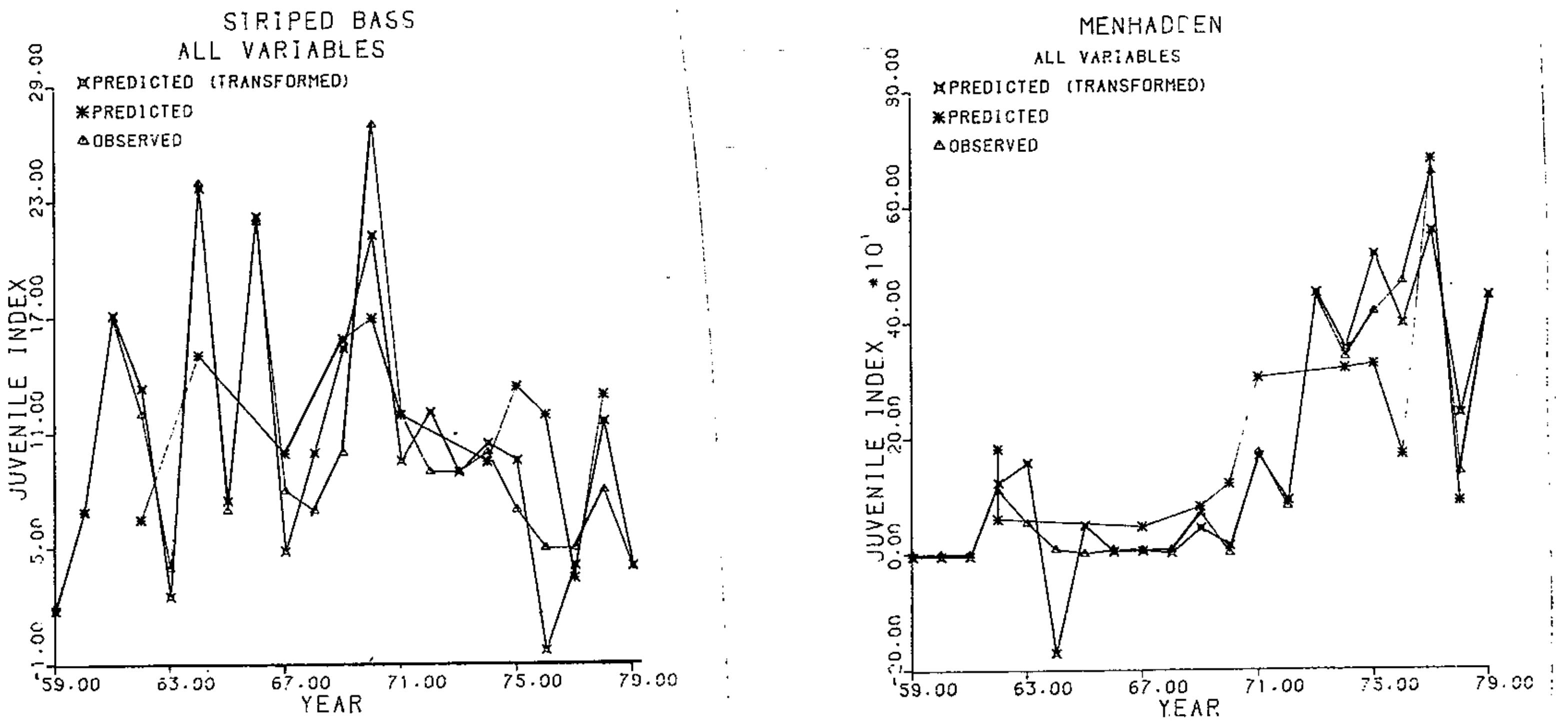


Fig. 11-14 and 11-15 Observed juvenile index, predicted (transformal) index using multiple linear regression functions developed from transformed variable series and predicted juvenile index from multiple linear regression of the actual independent time series.

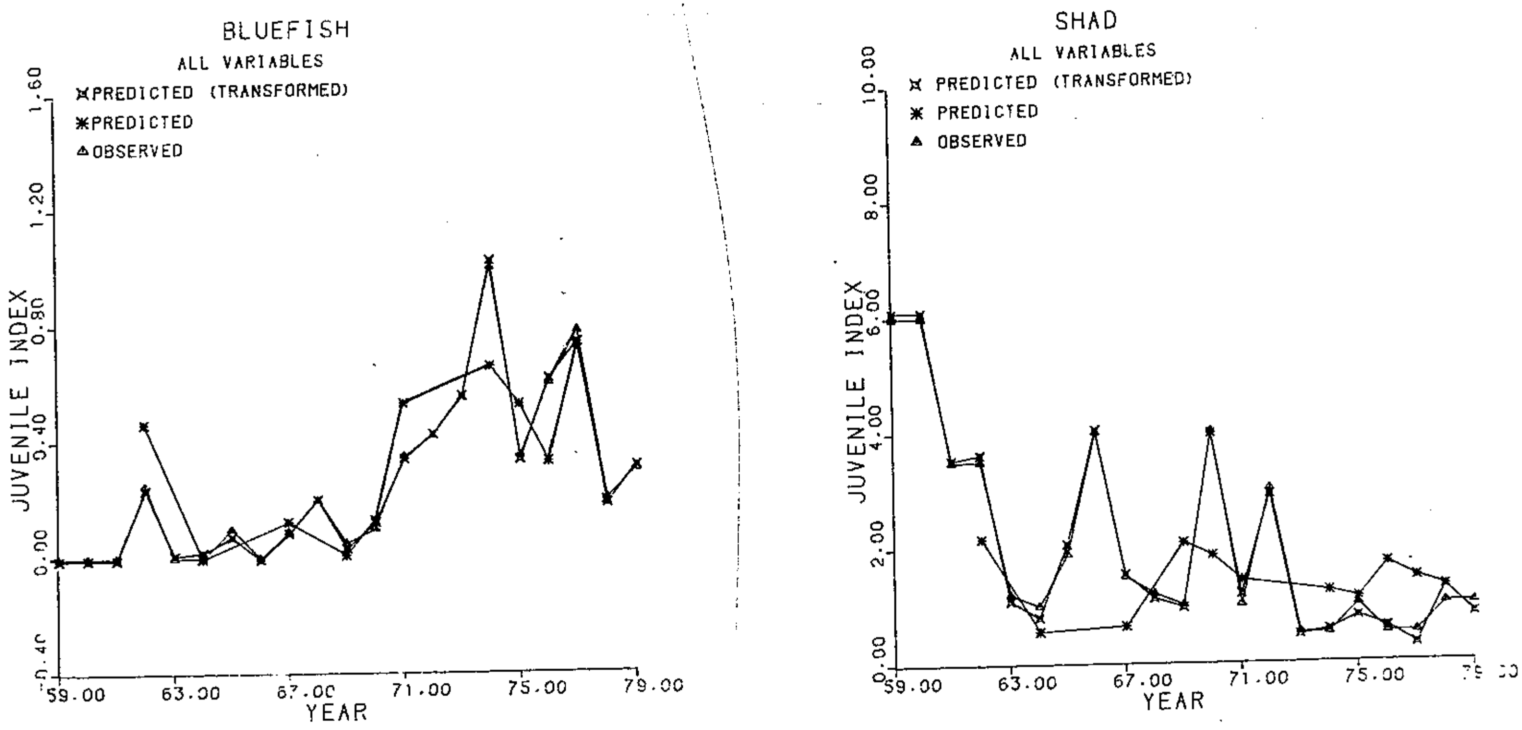


Fig. 11-16 and 11-17 Observed juvenile index, predicted (transformal) index using multiple linear regression functions developed from transformed variable series and predicted juvenile index from multiple linear regression of the actual independent time series.

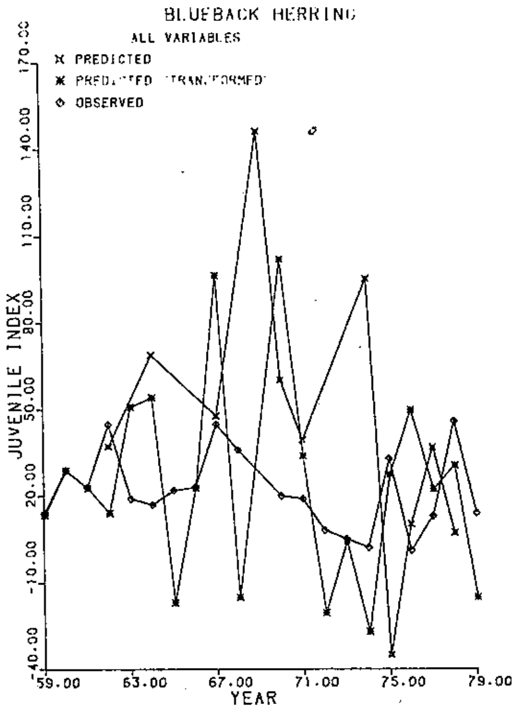


Fig. 11-18 Observed juvenile index, predicted (transformal) index using multiple linear regression functions developed from transformed variable series and predicted juvenile index from multiple linear regression of the actual independent time series.

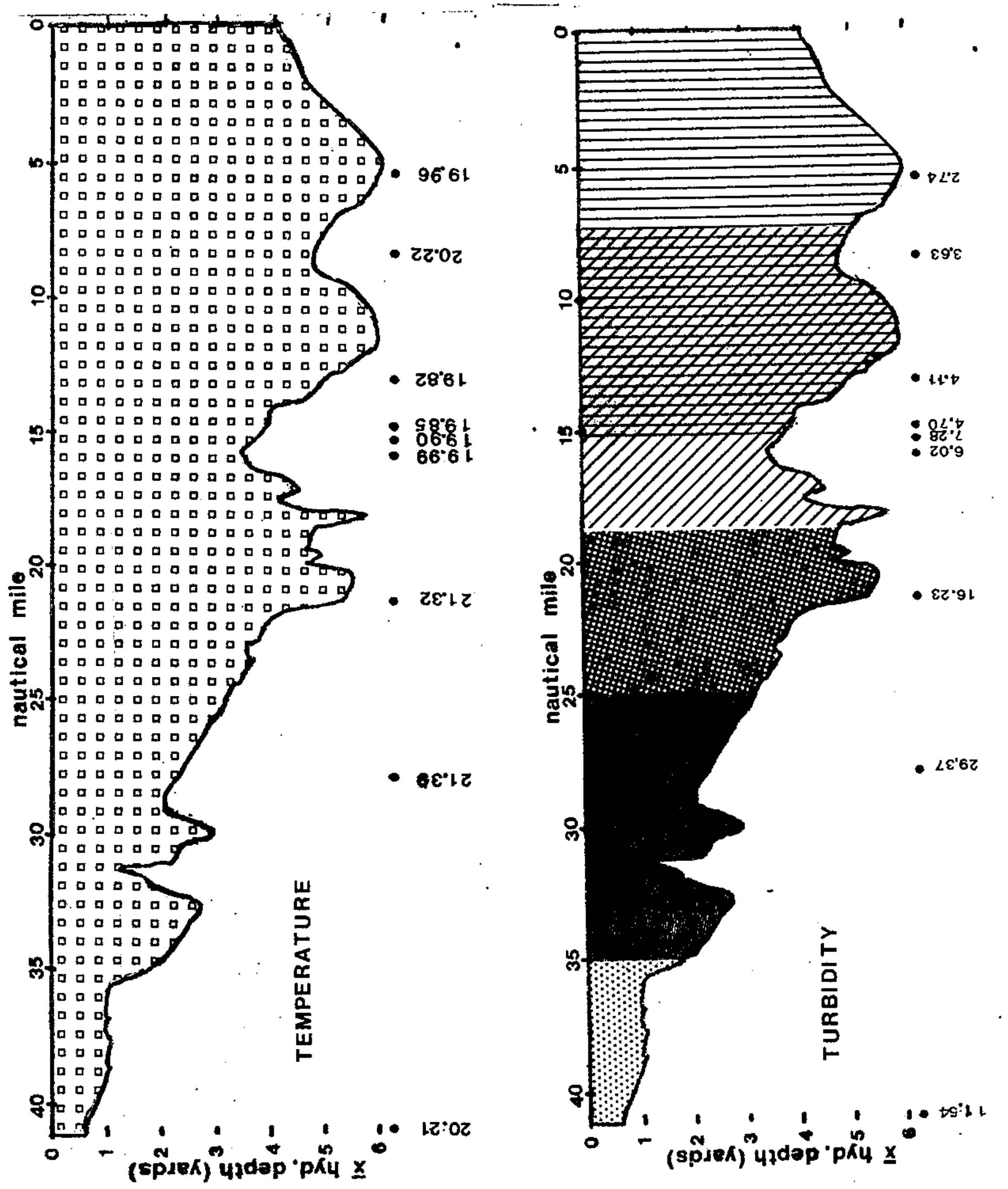


Figure 11-20 Chester River longitudinal characterization of 1980-1981 data for Temperature (^{0}C) and Turbidity (FTU).

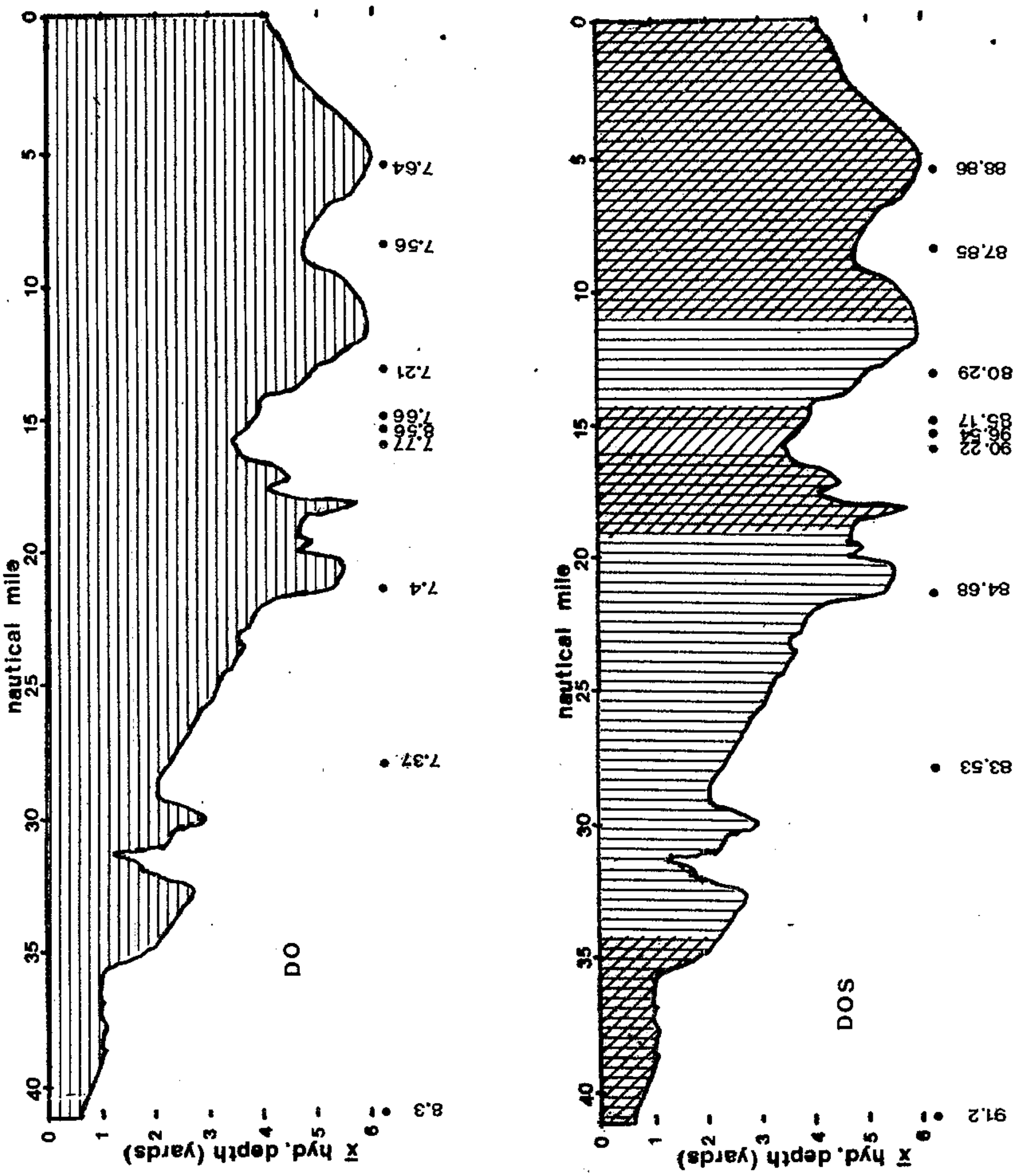


Figure 11-21 Chester River longitudinal characterization of 1980-1981 data for Dissolved Oxygen (mg/l) and Dissolved Oxygen Saturation (mg/l).

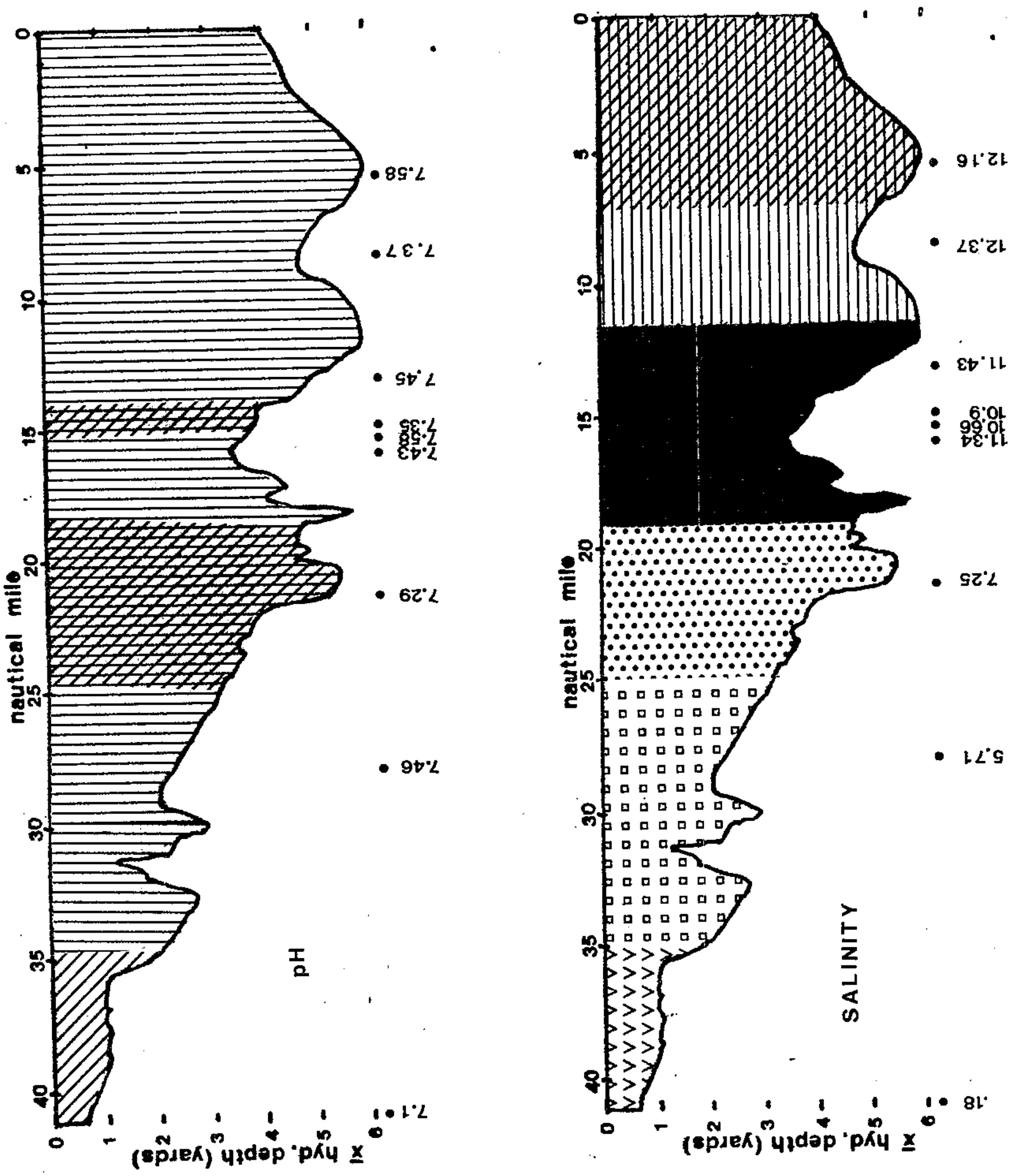


Figure 11-22Chester River longitudinal characterization of 1980-1981 data for pH and Salinity (ppt).

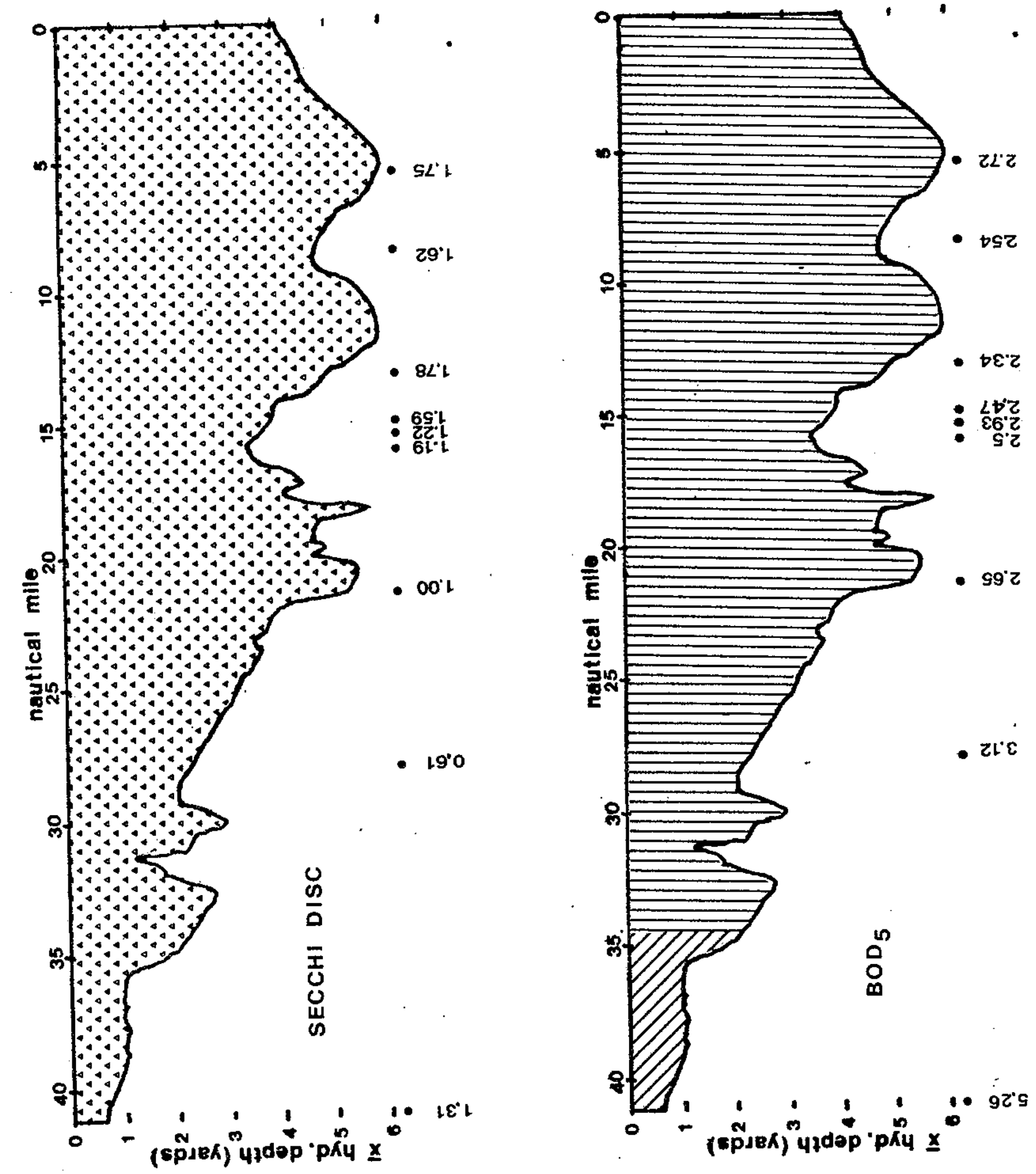


Figure 11-23 Chester River longitudinal characterization of 1980-1981 data for Secchi Disc (meters) and BOD_5 (mg/l).

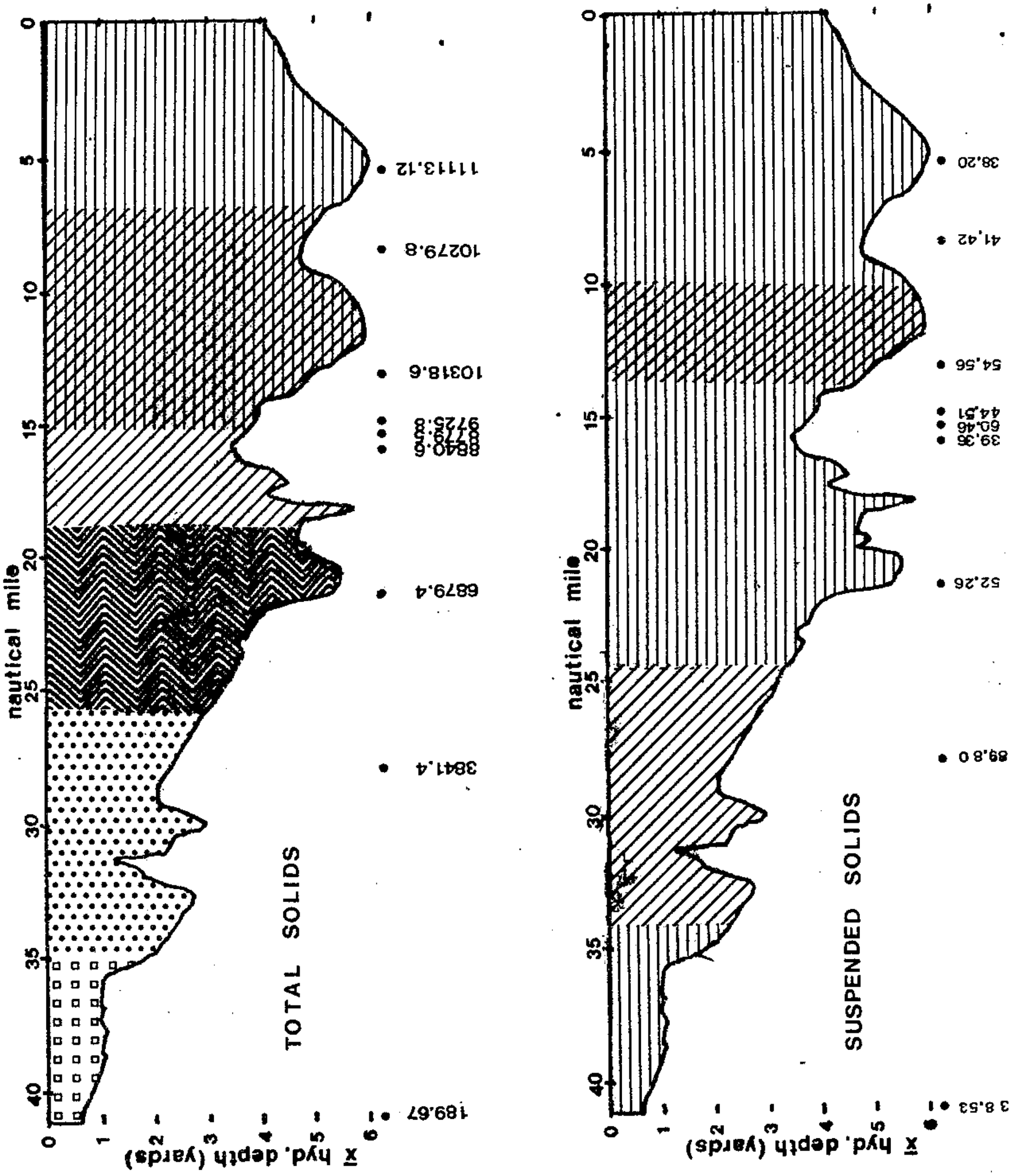


Figure11-24 Chester River longitudinal characterization of 1980-1981 data for Total Solids (mg/l) and suspended solids (mg/l).

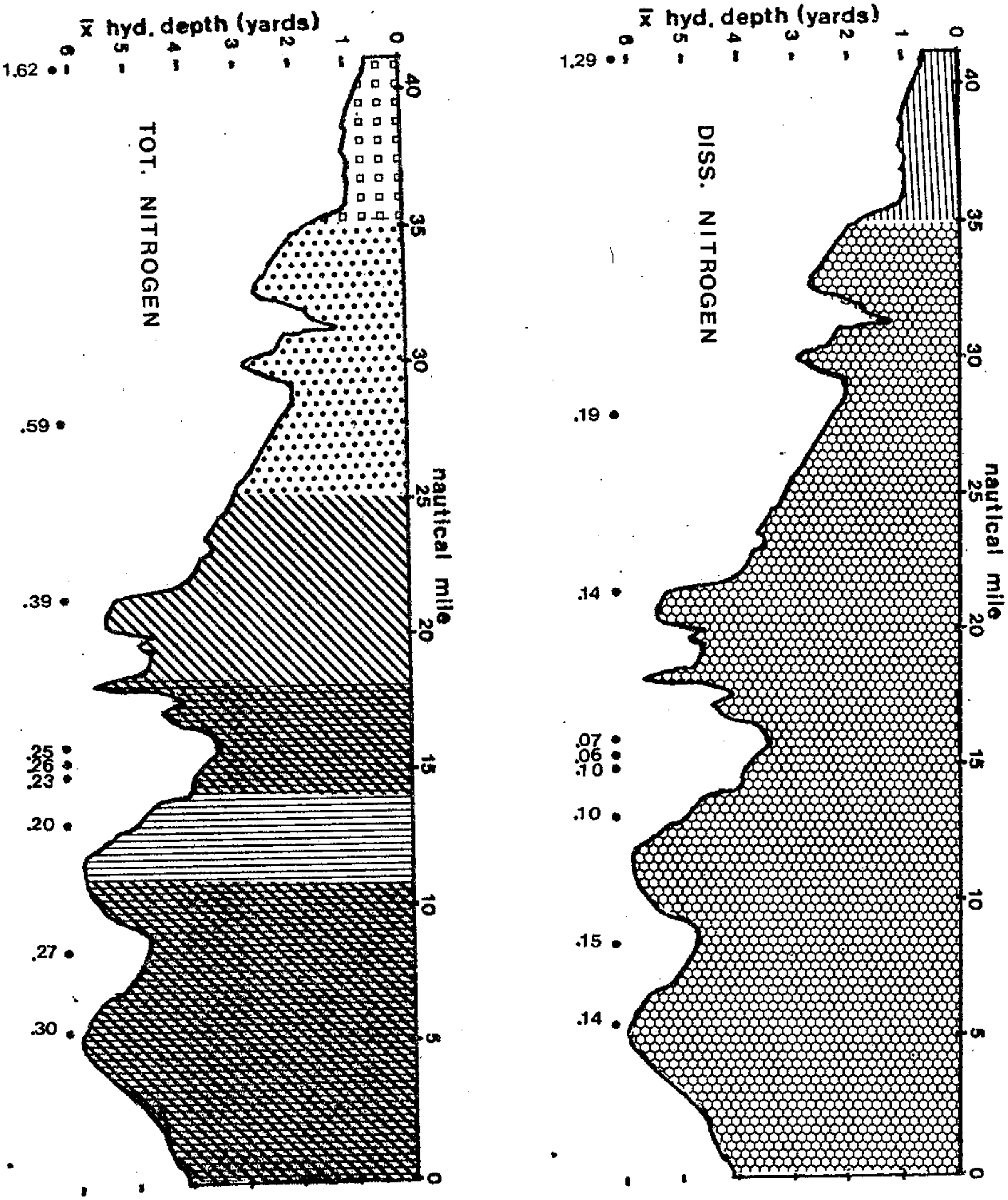


Figure 11-25 Chester River longitudinal characterization of 1980-1981 data for Total Nitrogen (mg/l) and Dissolved Nitrogen (mg/l).

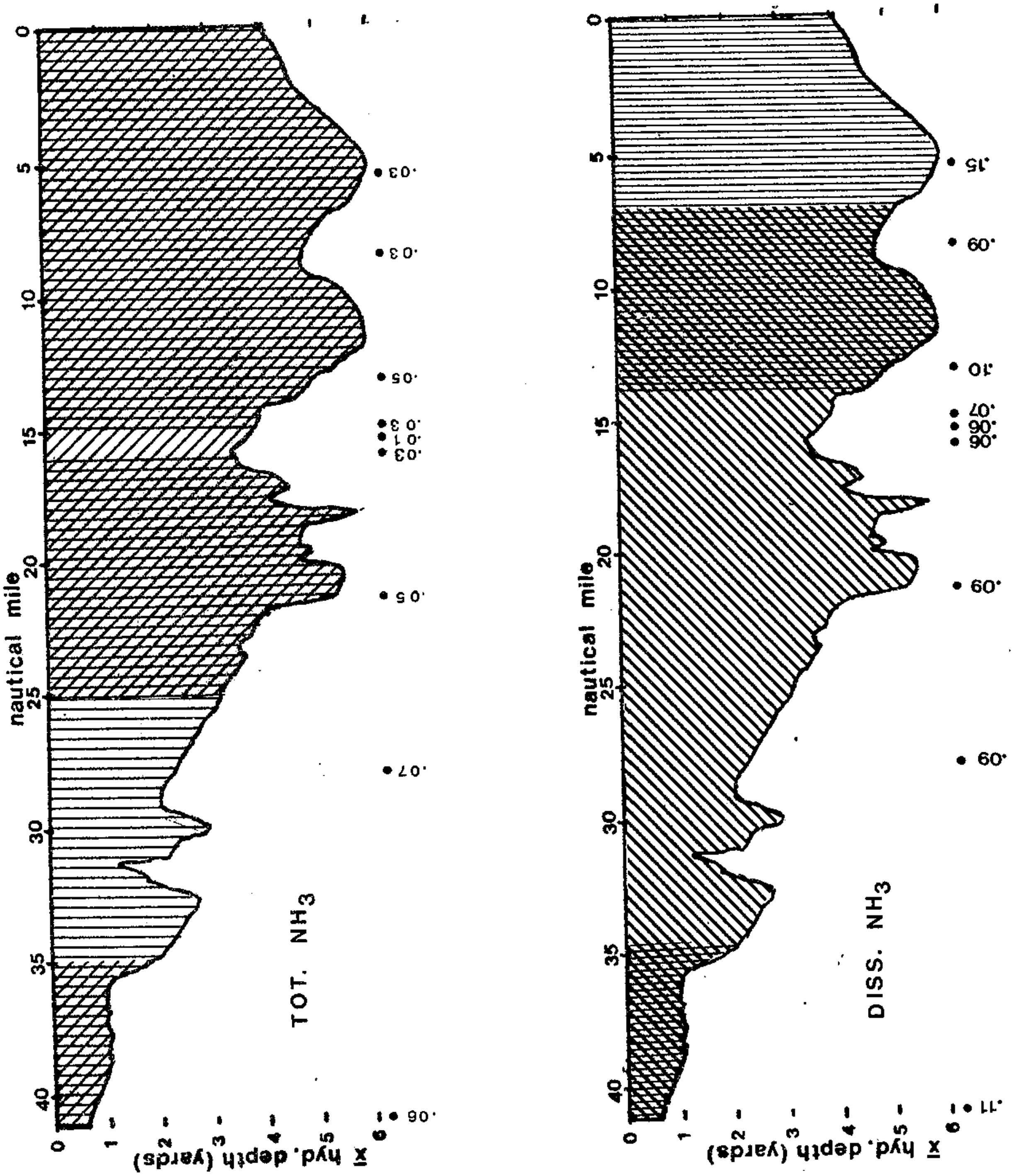


Figure 11-26 Chester River longitudinal characterization of 1980-1981 data for Total Ammonia (mg/l) and Dissolved Ammonia (mg/l).

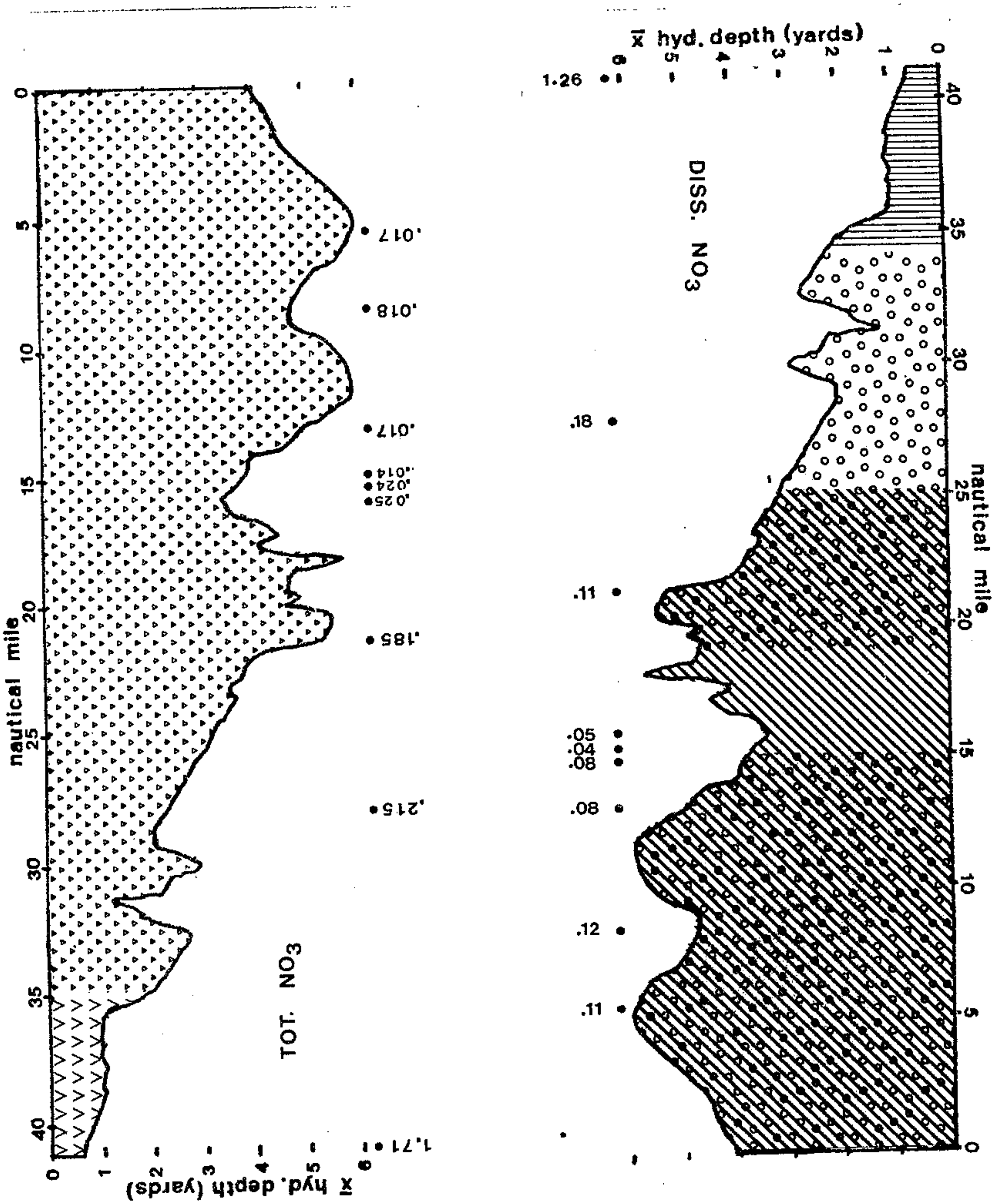


Figure 11-27 Chester River longitudinal characterization at 1980-1981 data for Total Nitrate (mg/l) and Dissolved Nitrate (mg/l).

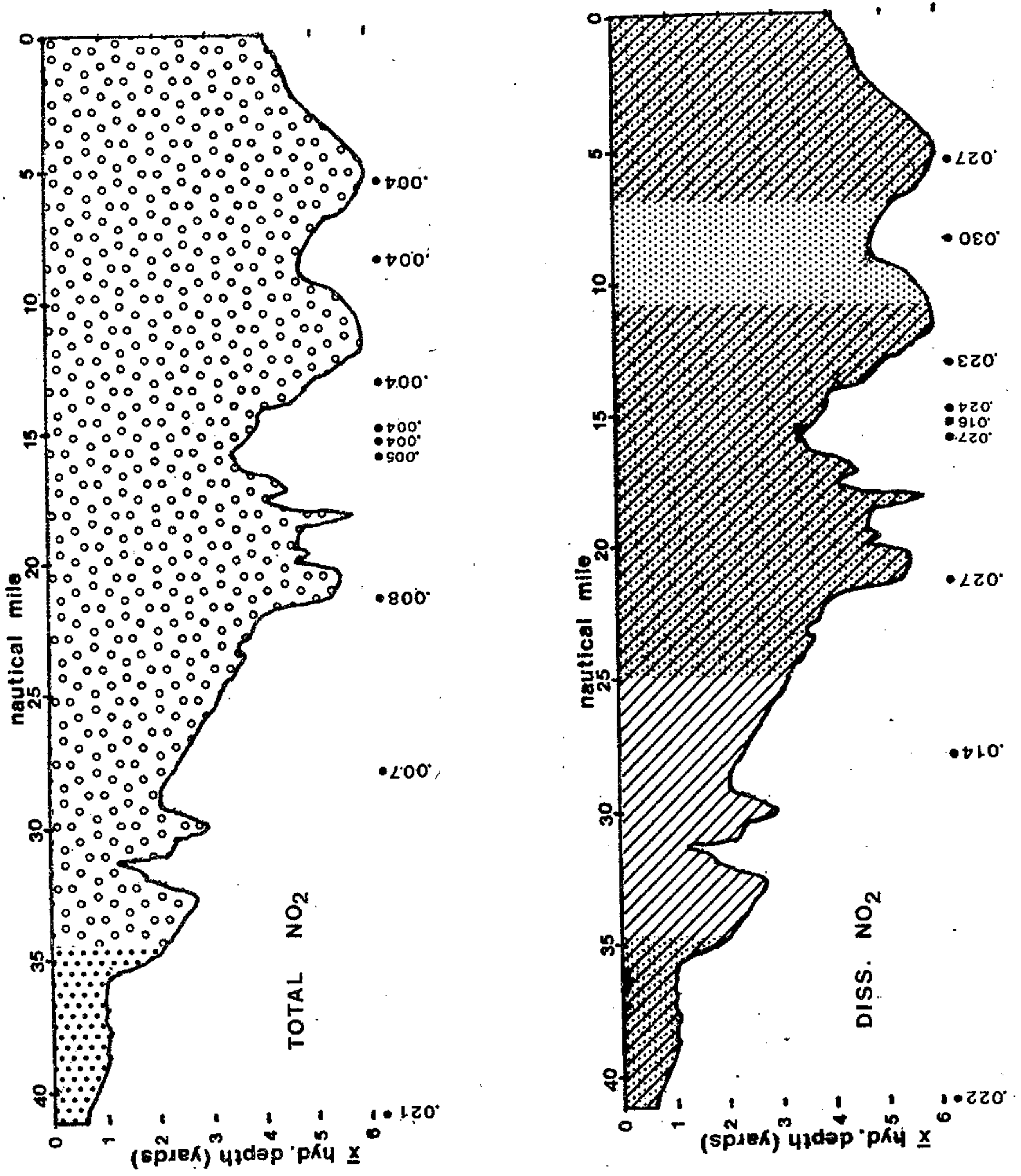


Figure 11-28 Chester River longitudinal characterization of 1980-1981 data for Total Nitrite (mg/l) and Dissolved Nitrite (mg/l).

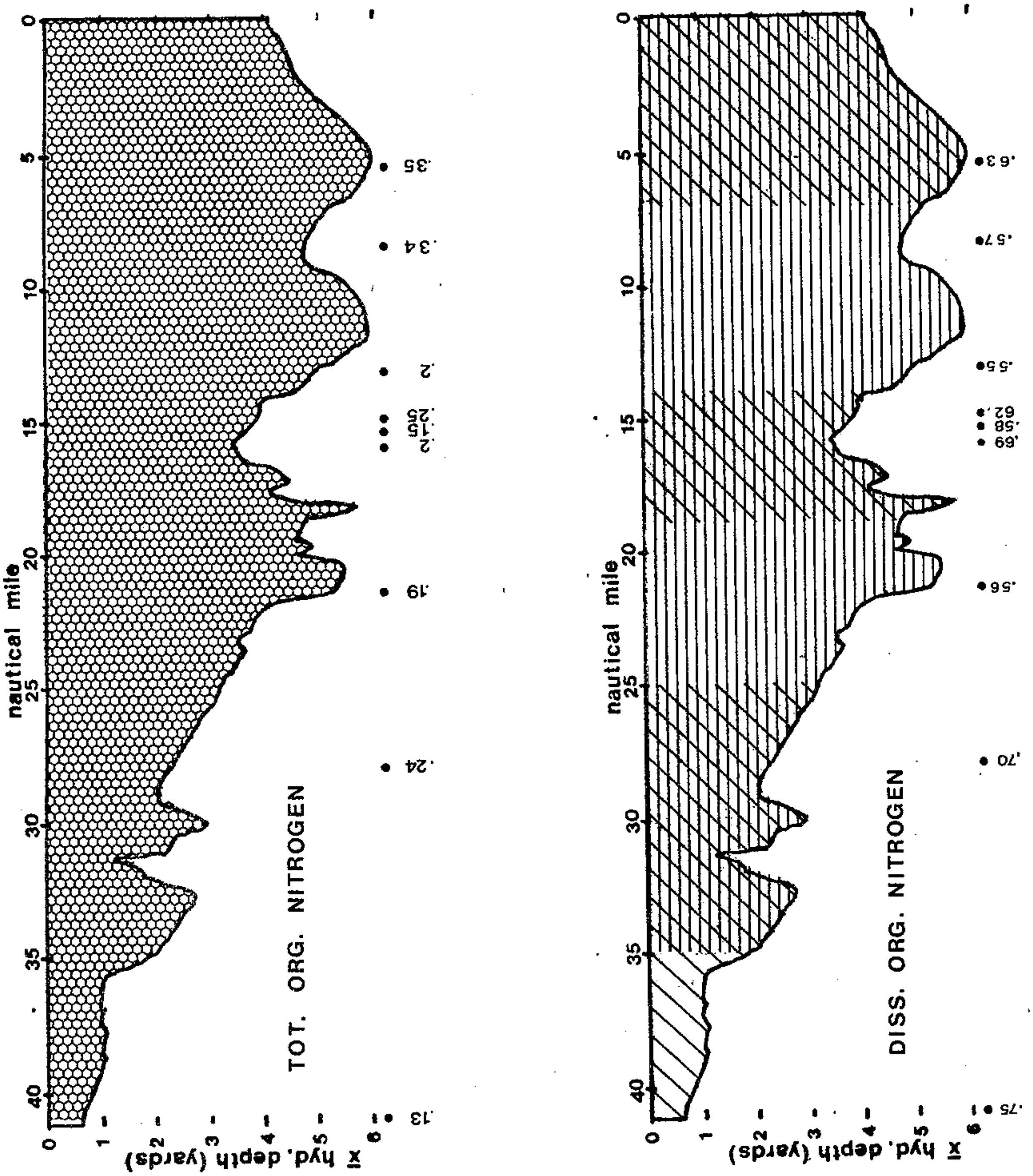


Figure 11-29 Chester River longitudinal characterization of 1980-1981 data for Total Organic Nitrogen (mg/l) and Dissolved Organic Nitrogen (mg/l).

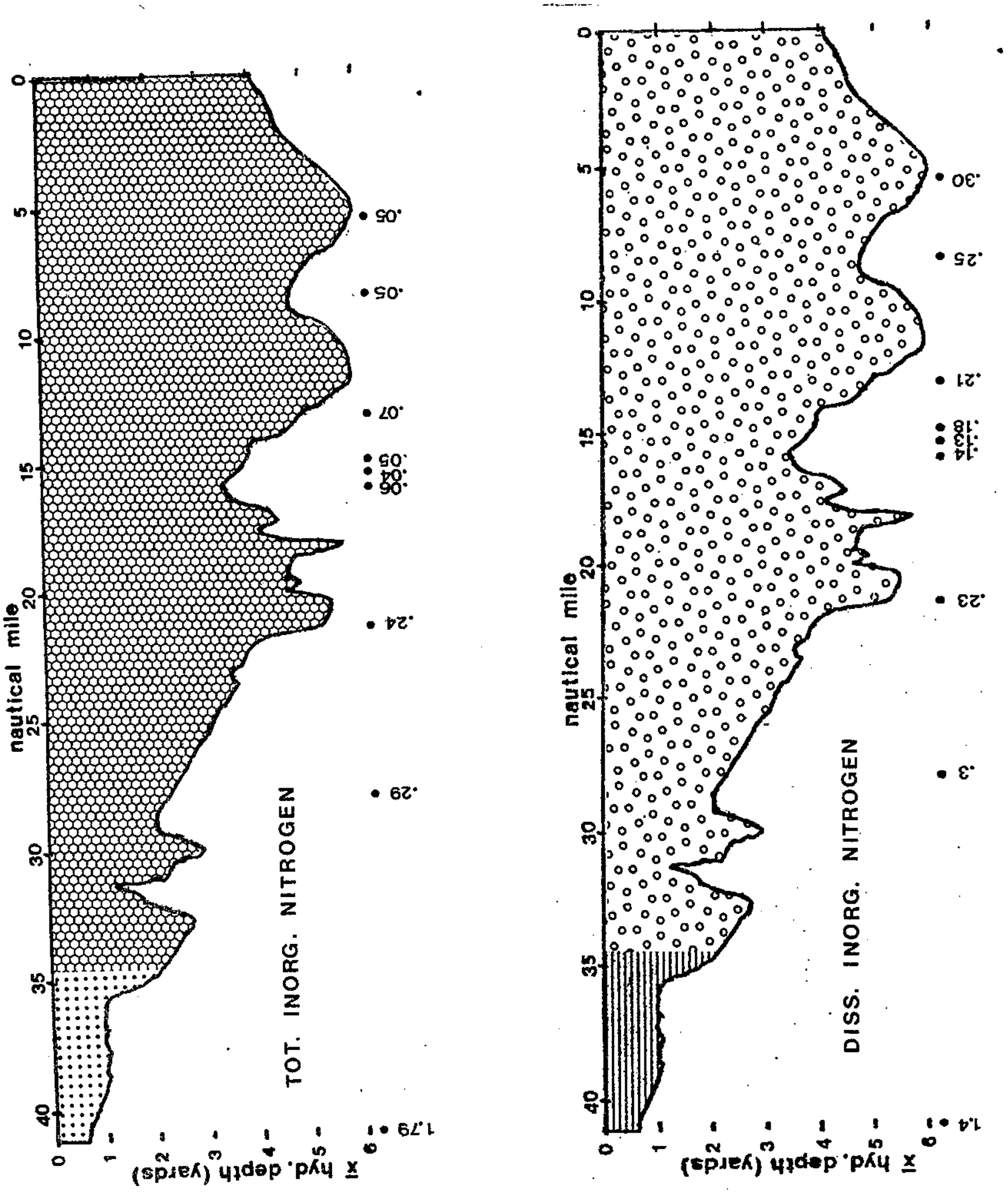


Figure 11-30 Chester River longitudinal characterization of 1980-1981 data for Total Inorganic Nitrogen (mg/l) and Dissolved Inorganic Nitrogen (mg/l).

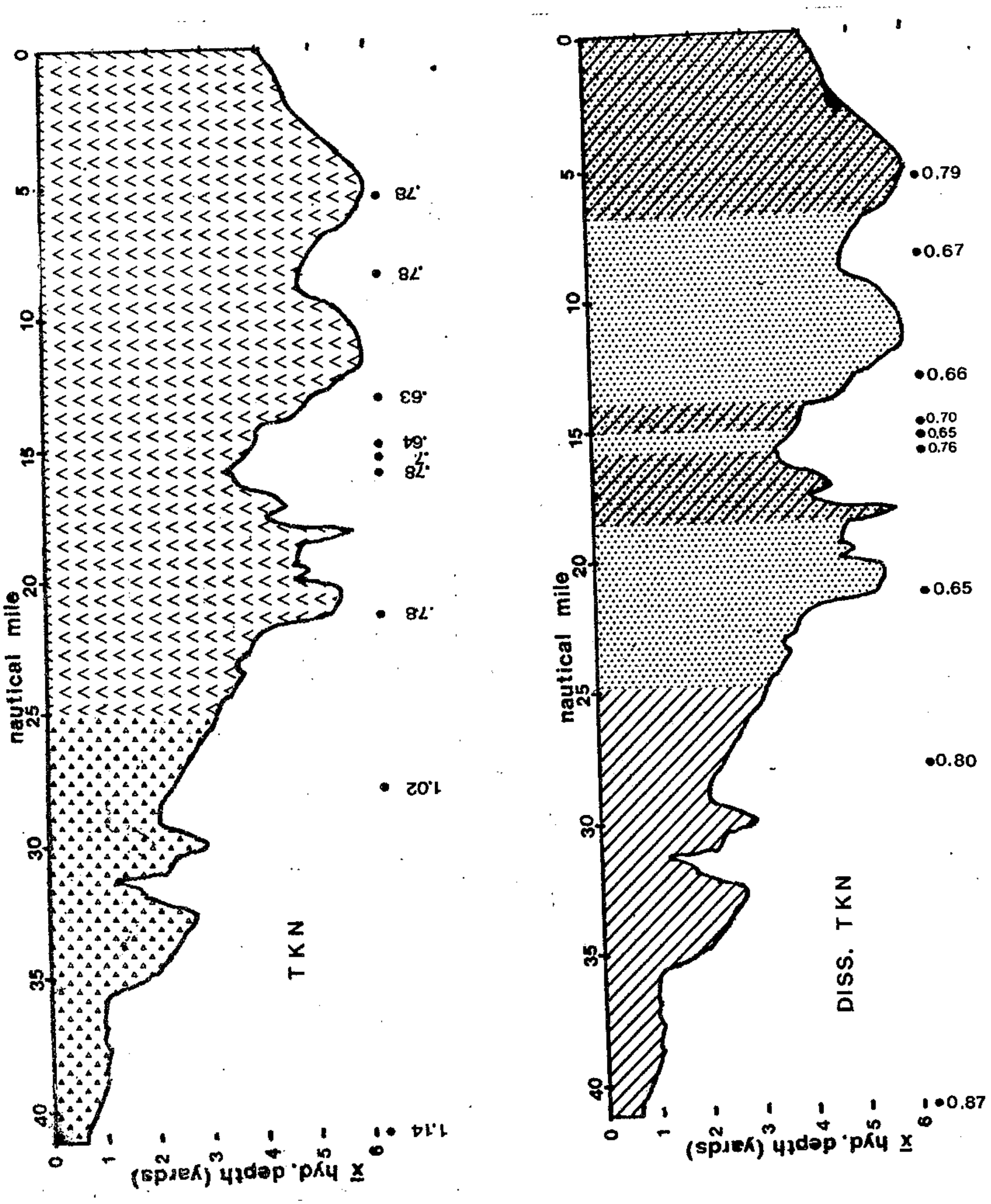


Figure 11-31 Chester River longitudinal characterization of 1980-1981 data for Total Khejdahl Nitrogen (mg/l) and Total Dissolved Khejdahl Nitrogen (mg/l).

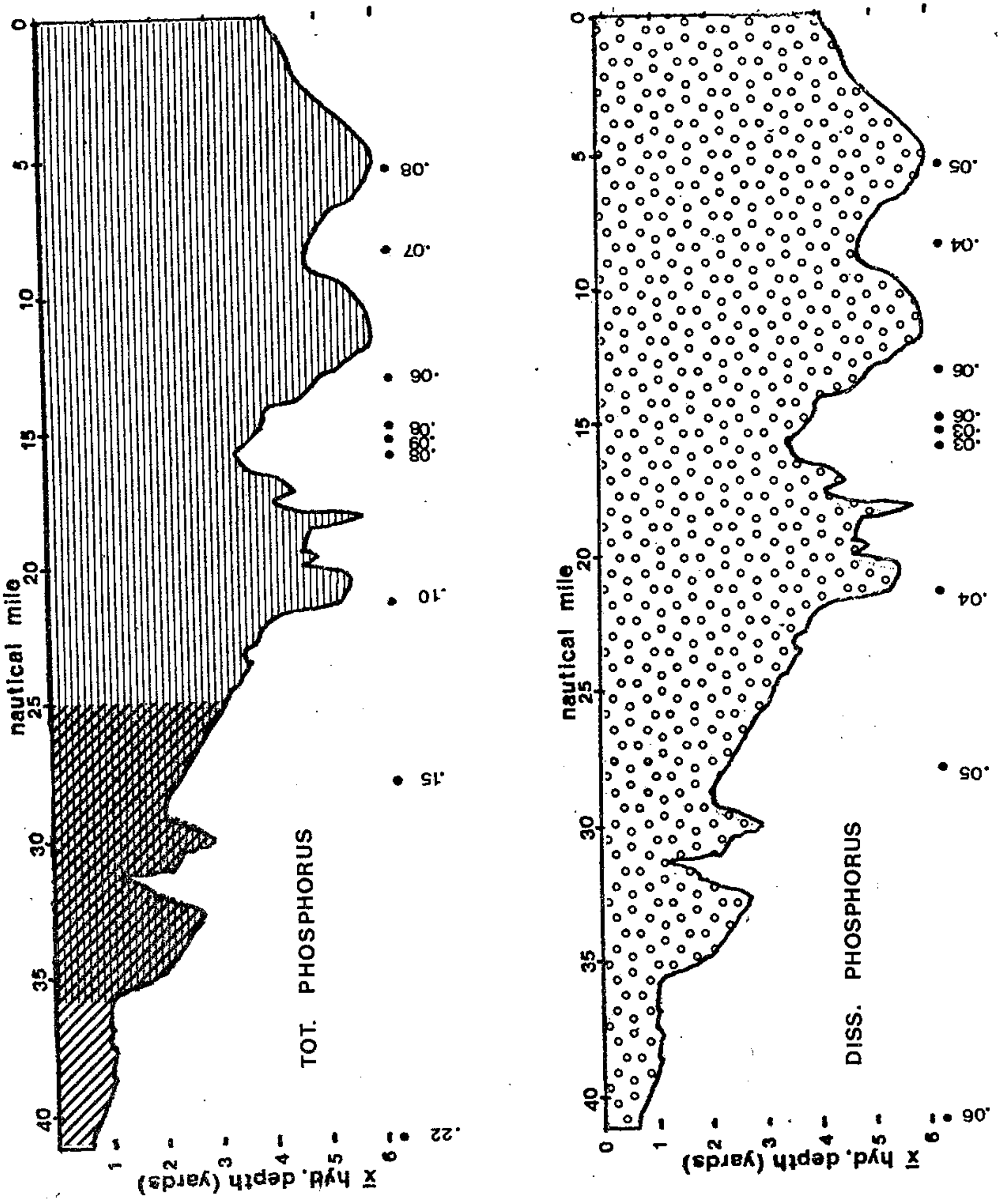


Figure 11-32 Chester River longitudinal characterization of 1980-1981 data for Total Phosphorus (mg/l) and Dissolved Phosphorus (mg/l).

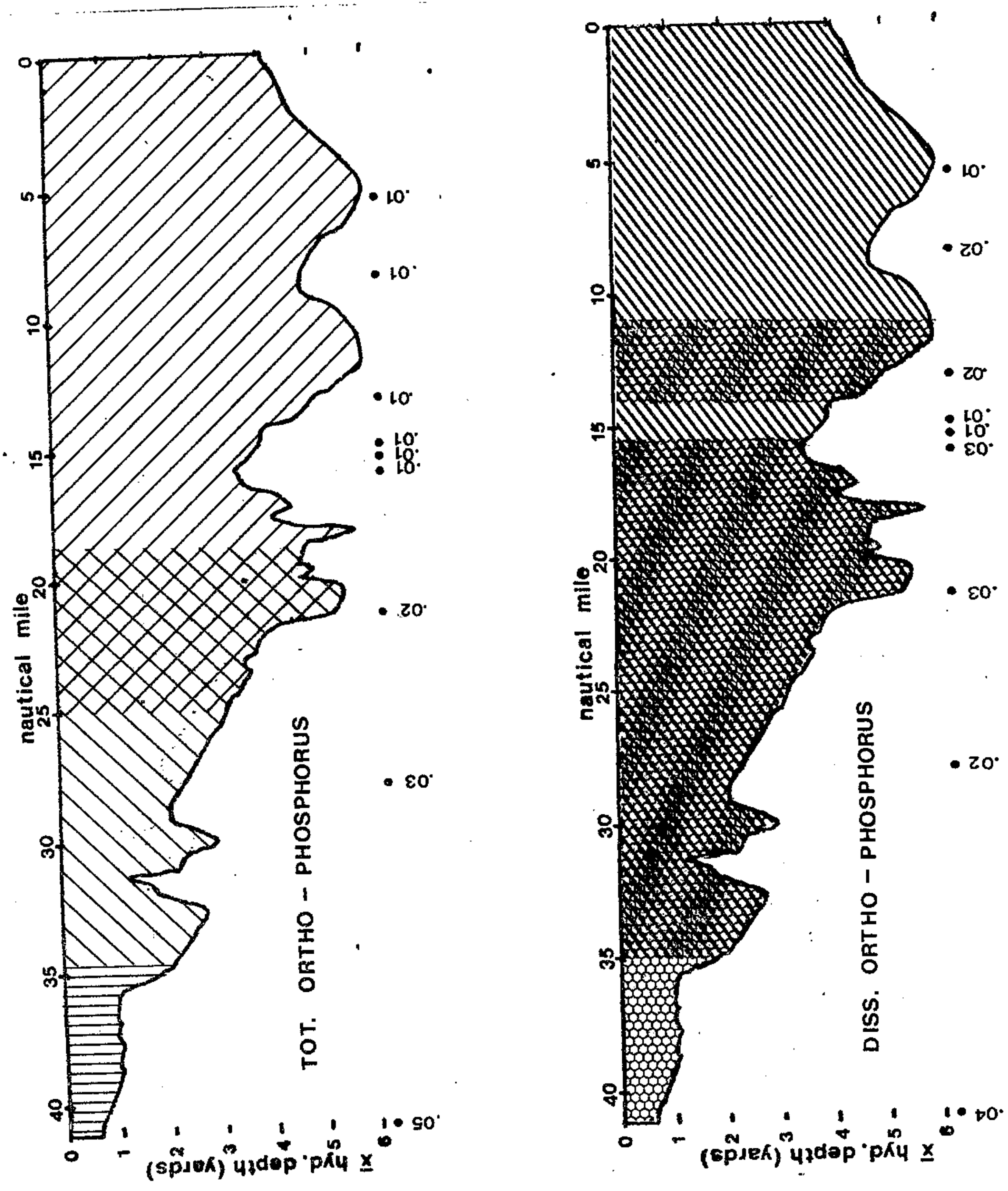


Figure 11-33 Chester River longitudinal characterization of 1980-1981 data for Total Ortho-phosphorus (mg/l) and Dissolved Ortho-phosphorus (mg/l).

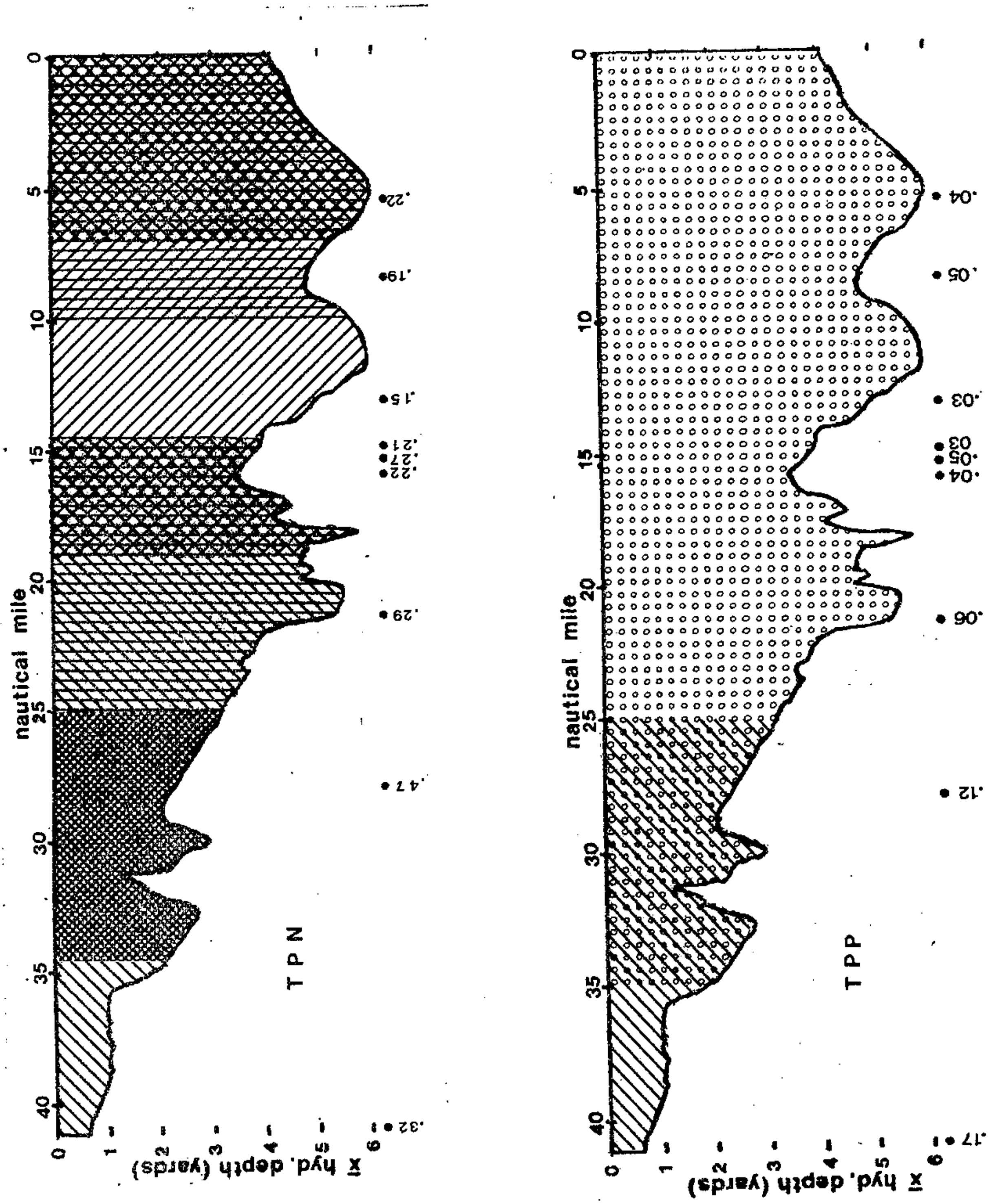


Figure 11-34 Chester River longitudinal characterization of 1980-1981 data for Total Particulate Nitrogen (mg/l) and Total Particulate Phosphorus (mg/l).

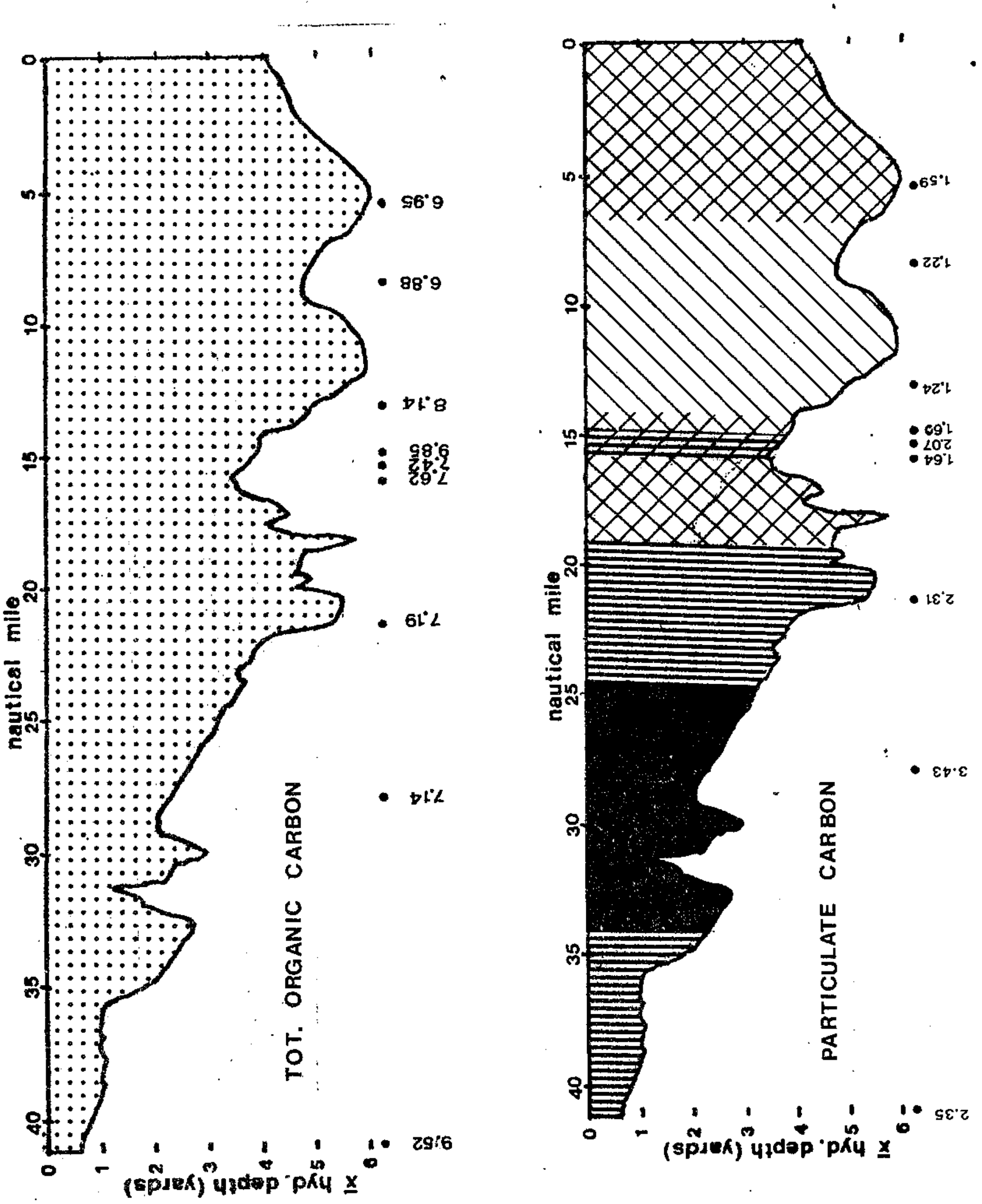


Figure 11-35 Chester River longitudinal characterization of 1980-1981 data for Total Organic Carbon (mg/l) and Particulate Organic Carbon (mg/l).

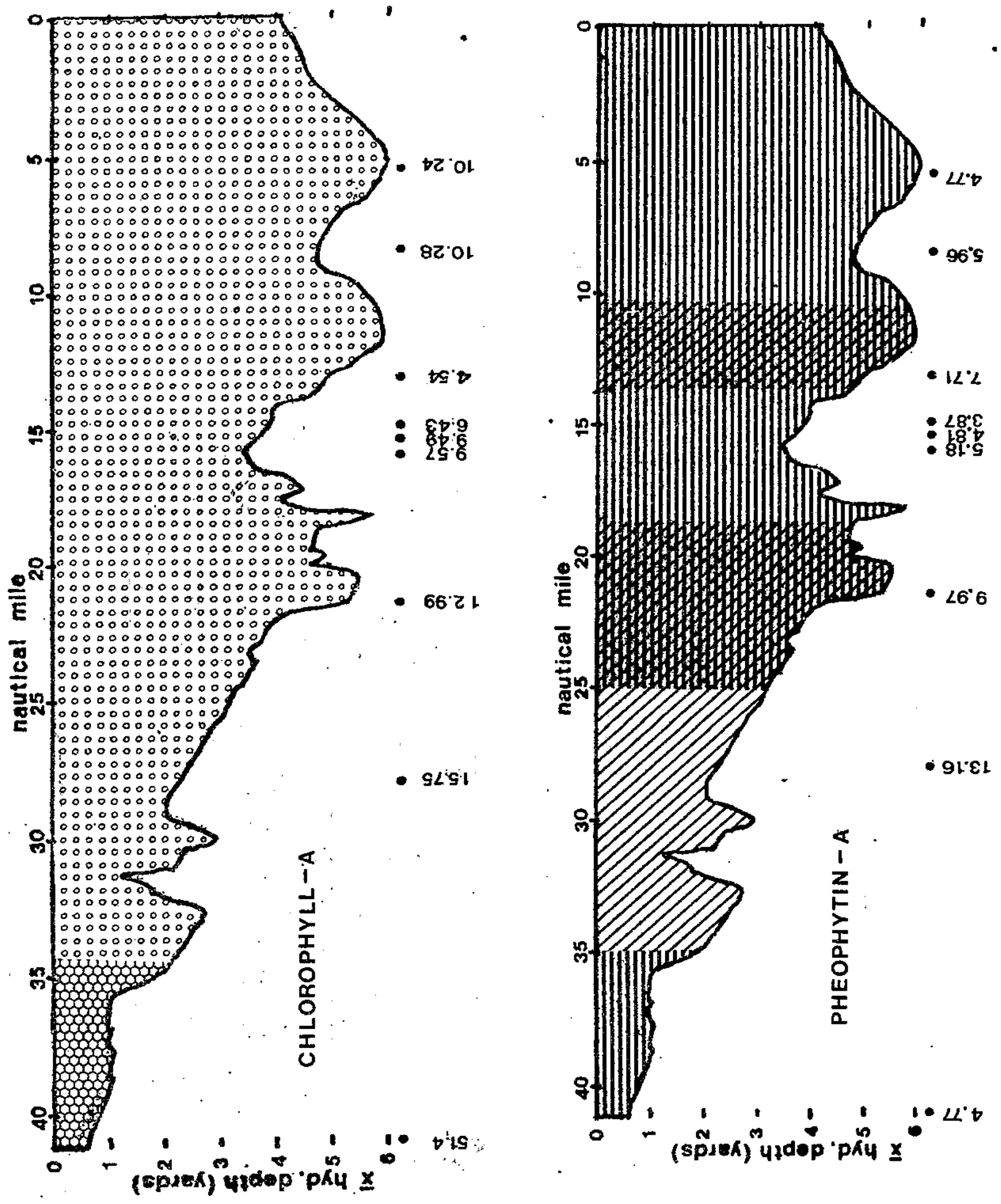


Figure 11-36 Chester River longitudinal characterization of 1980-1981 data for Chlorophyll-A corrected (μg/l) and Pheophytin-A (μg/l).

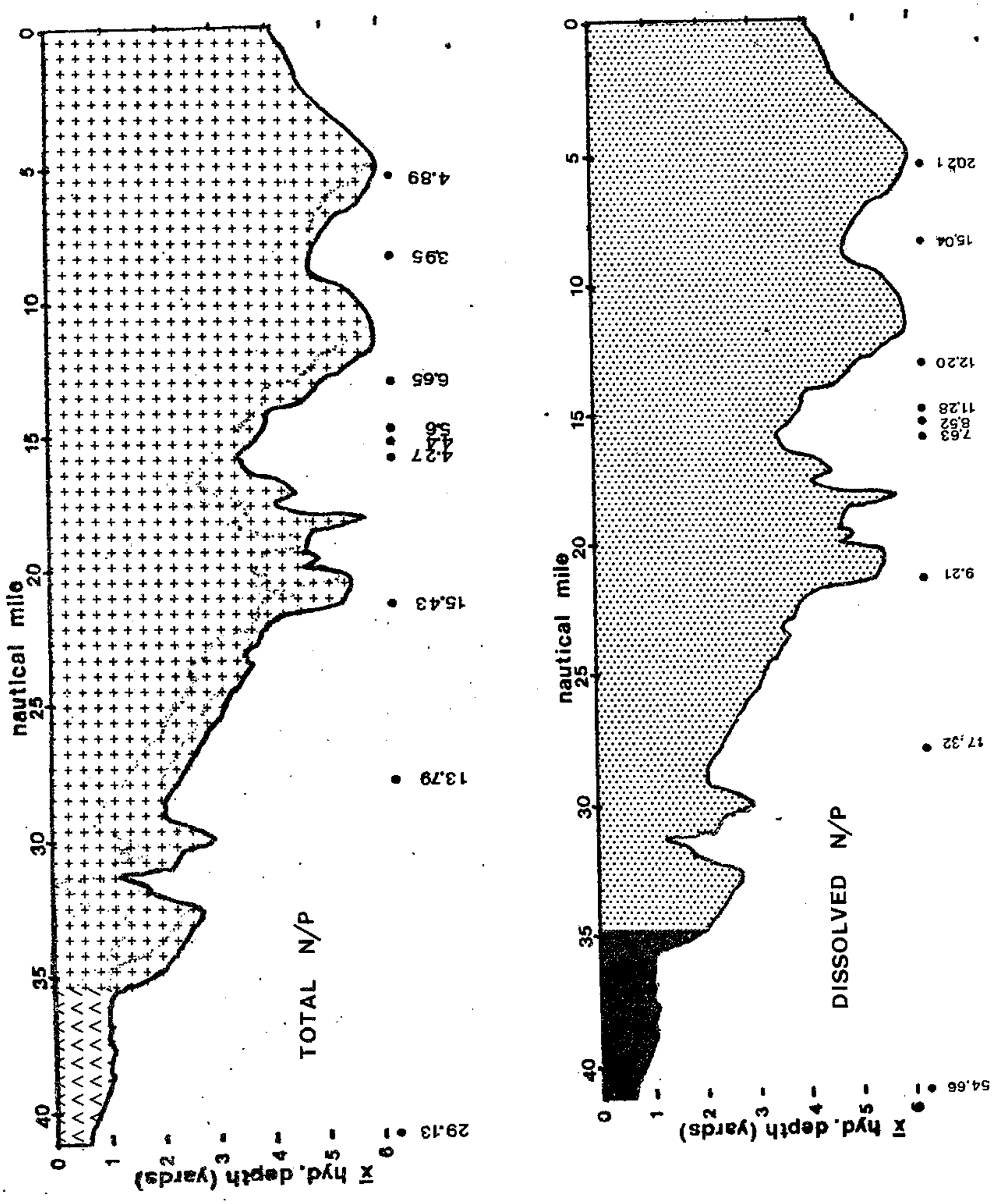


Figure 11-37 Chester River longitudinal characterization of 1980-1981 data for Total N:P Ratio and Dissolved N:P Ratio.

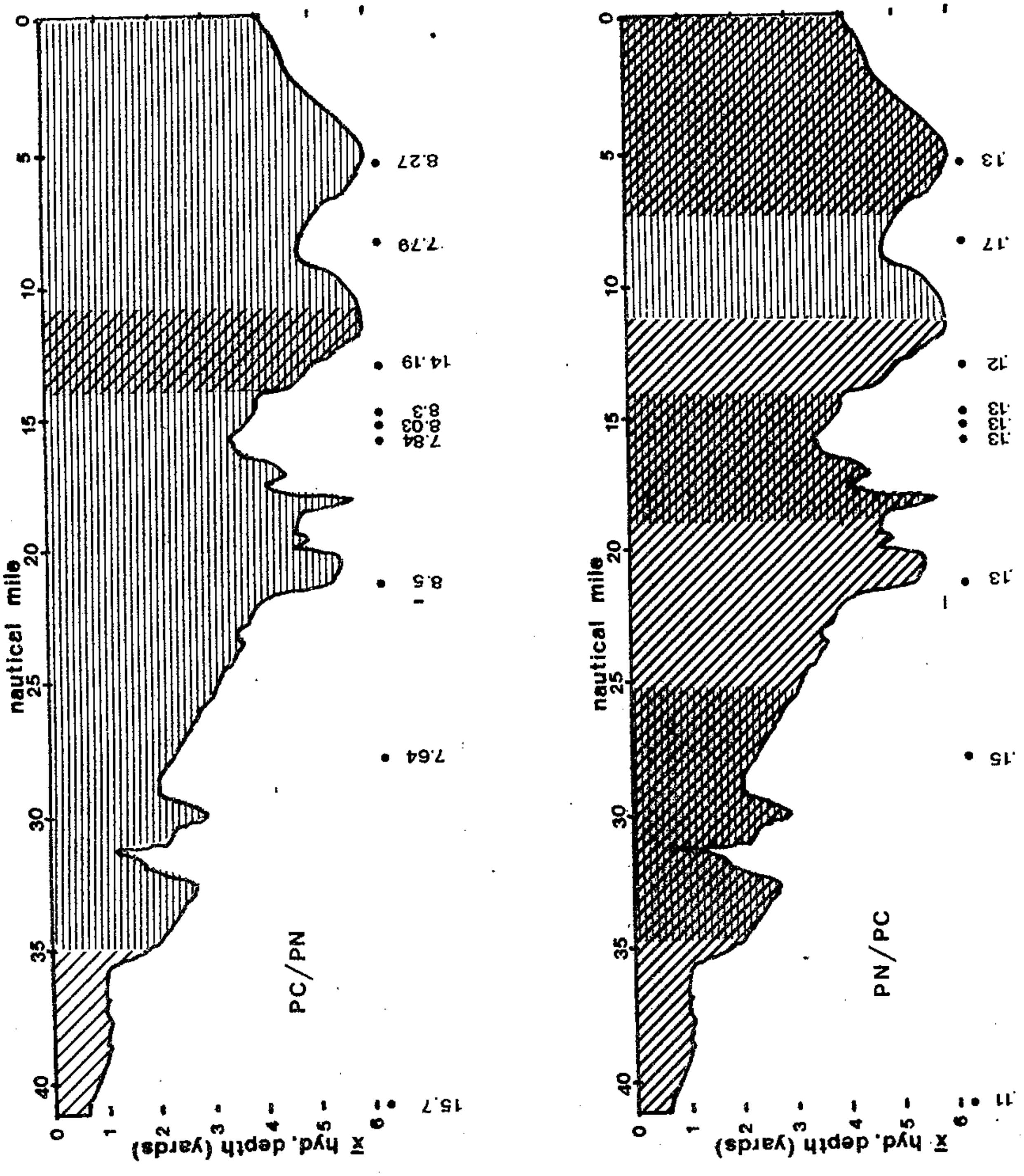


Figure 11-39 Chester River longitudinal characterization of 1980-1981 data for the Ratio of Particulate Carbon to Particulate nItrogen and Particulate Nitrogen to Particulate Carbon.

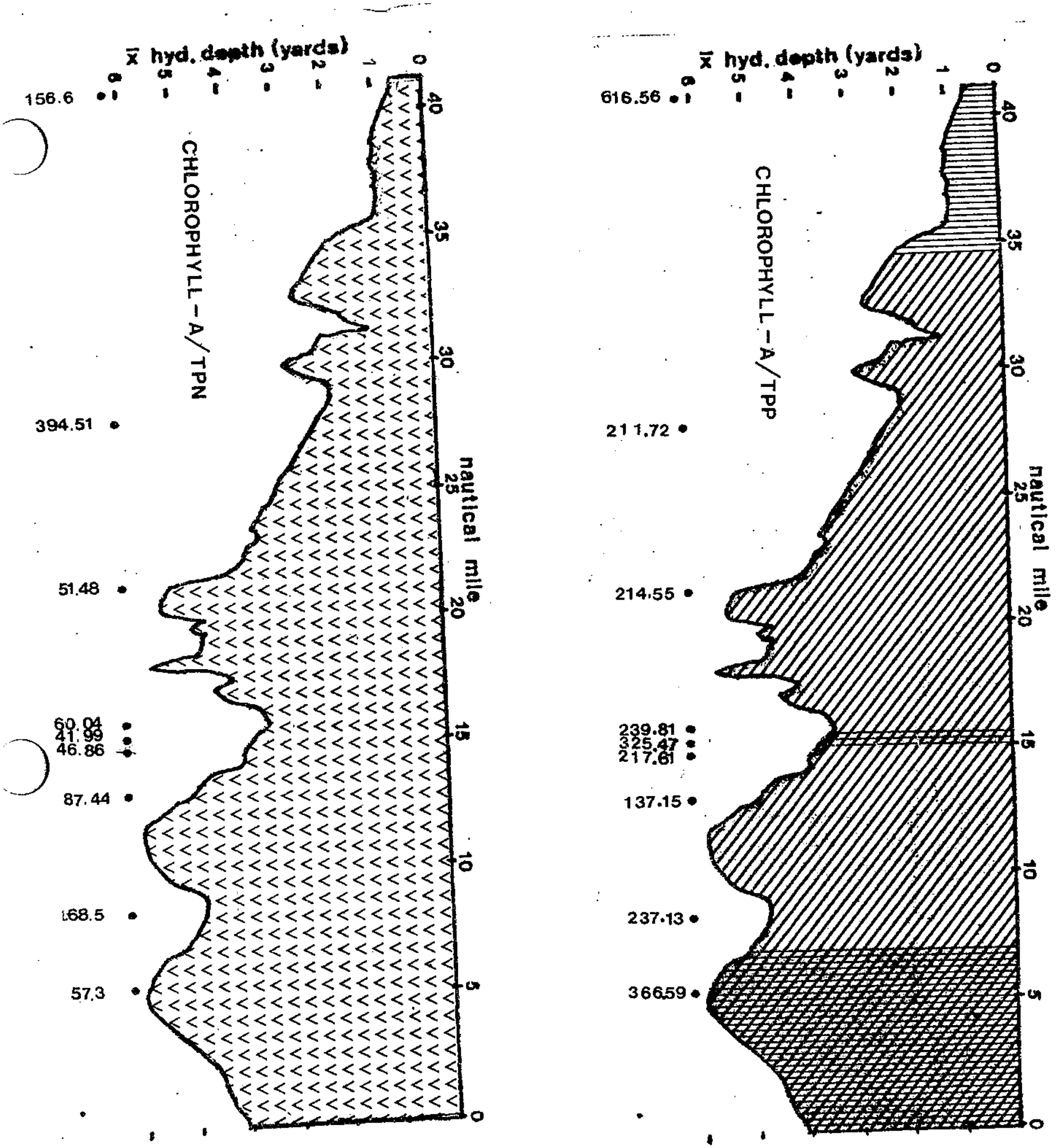


Figure 11-38Chester River longitudinal characterization of 1980-1981 data for the Ratio of Chlorophyll-A to Particulate Nitrogen and Chlorophyll-A to Particulate Phosphorus.

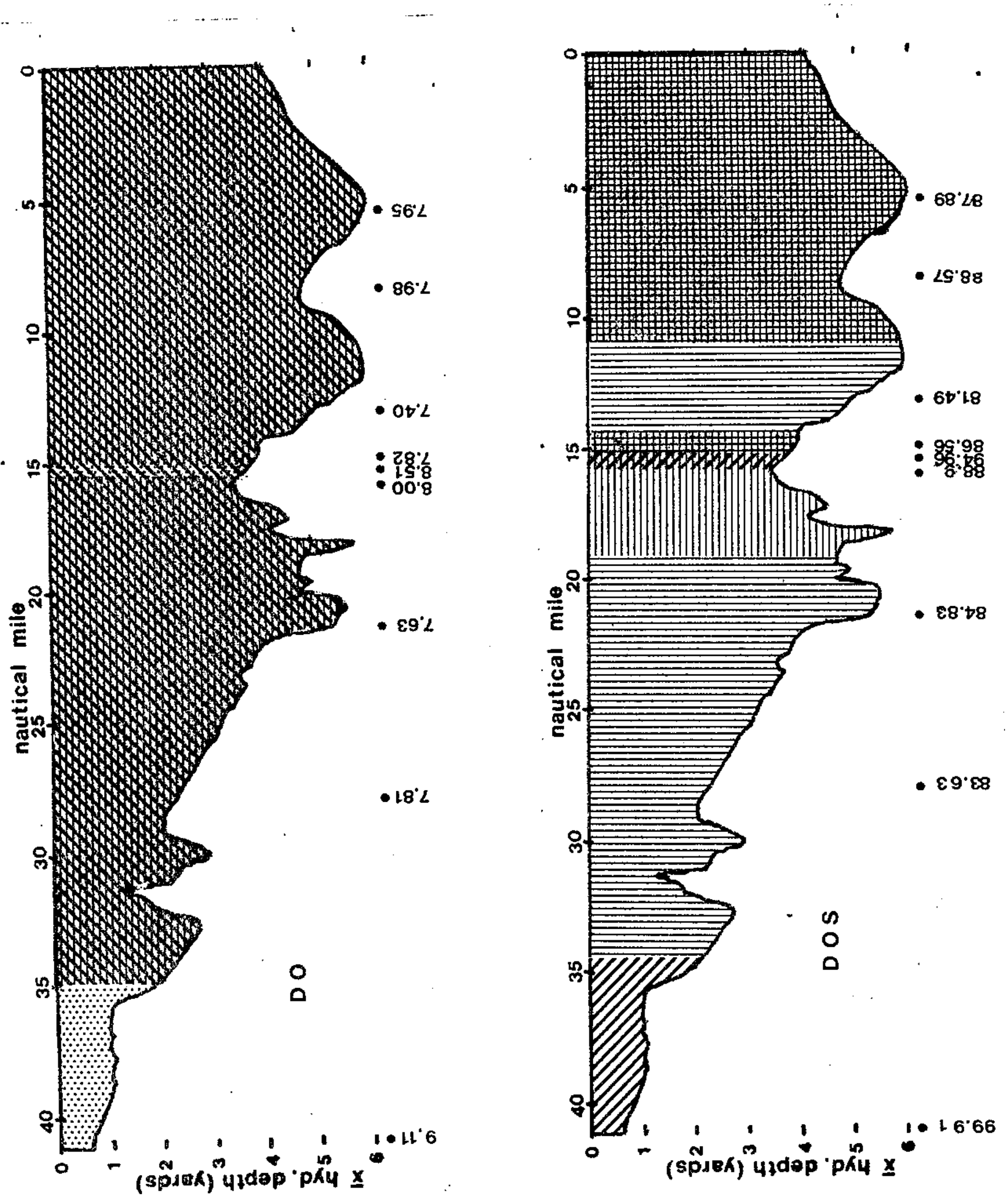


Figure 11-40Chester River longitudinal characterization of 1980-1981 slack data for Dissolved Oxygen (mg/l) and Dissolved Oxygen Saturation (mg/l).

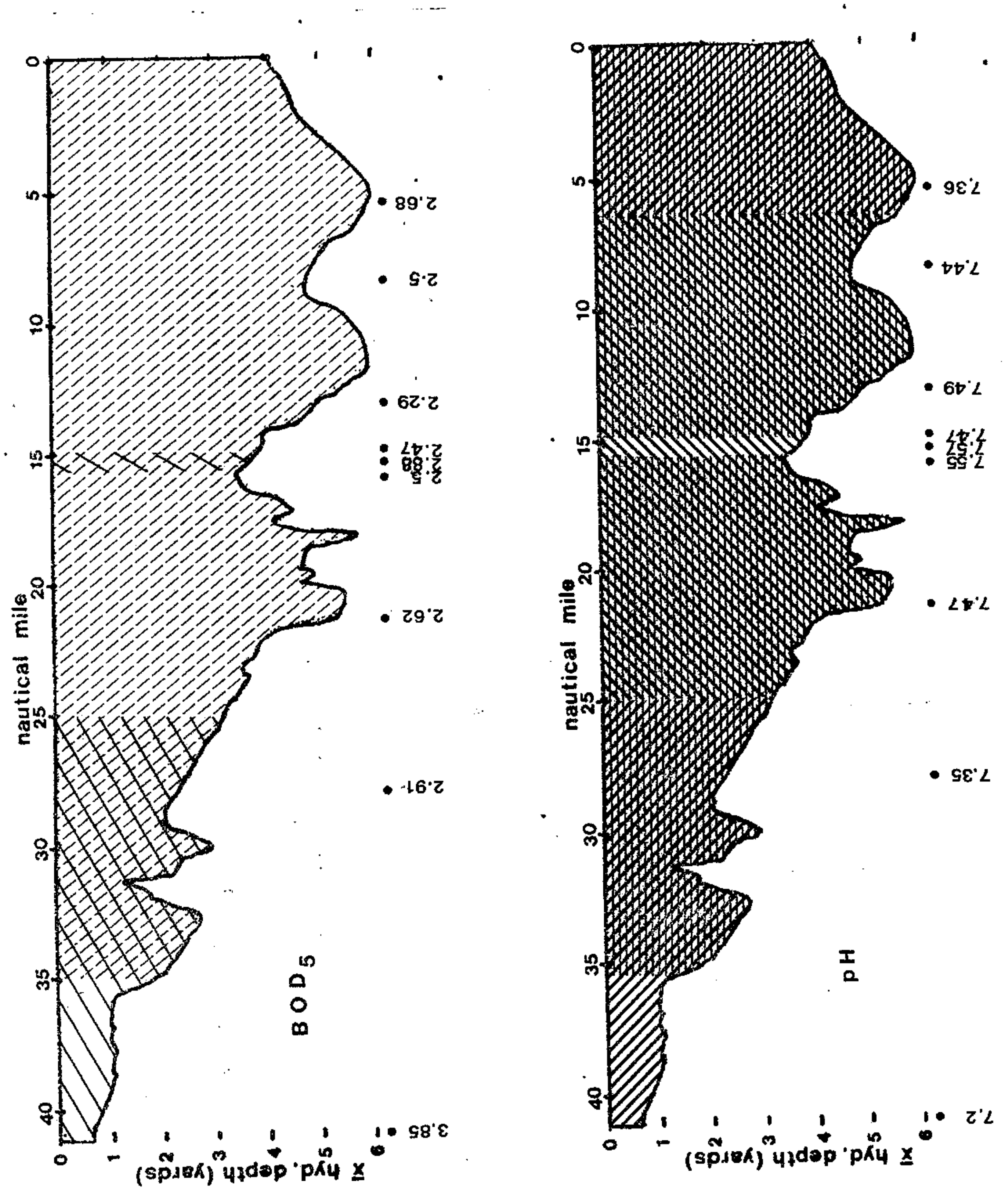


Figure 11-41 Chester River longitudinal characterization of 1980-1981 slack data for Biochemical Oxygen Demand (mg/l) and pH.

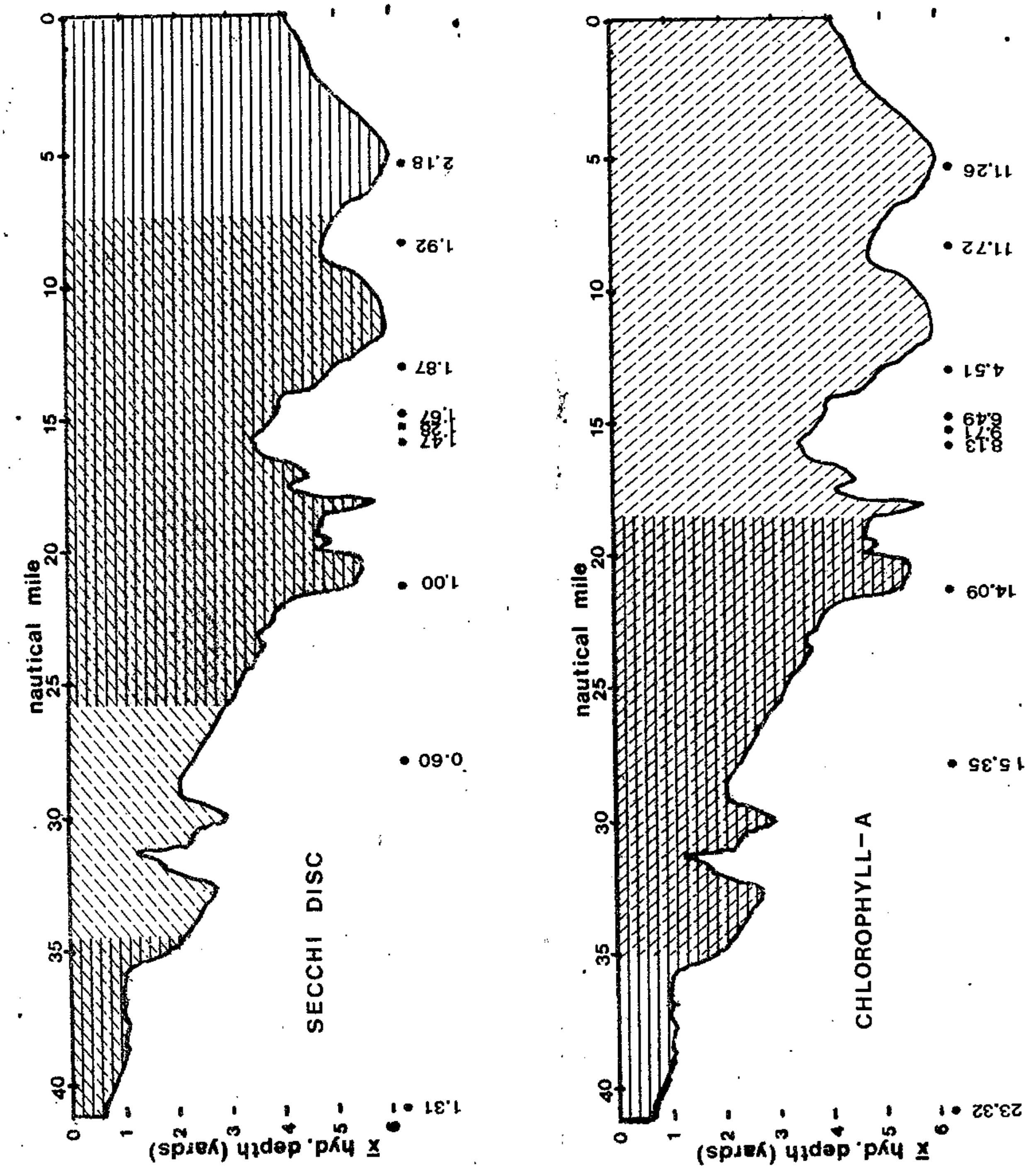
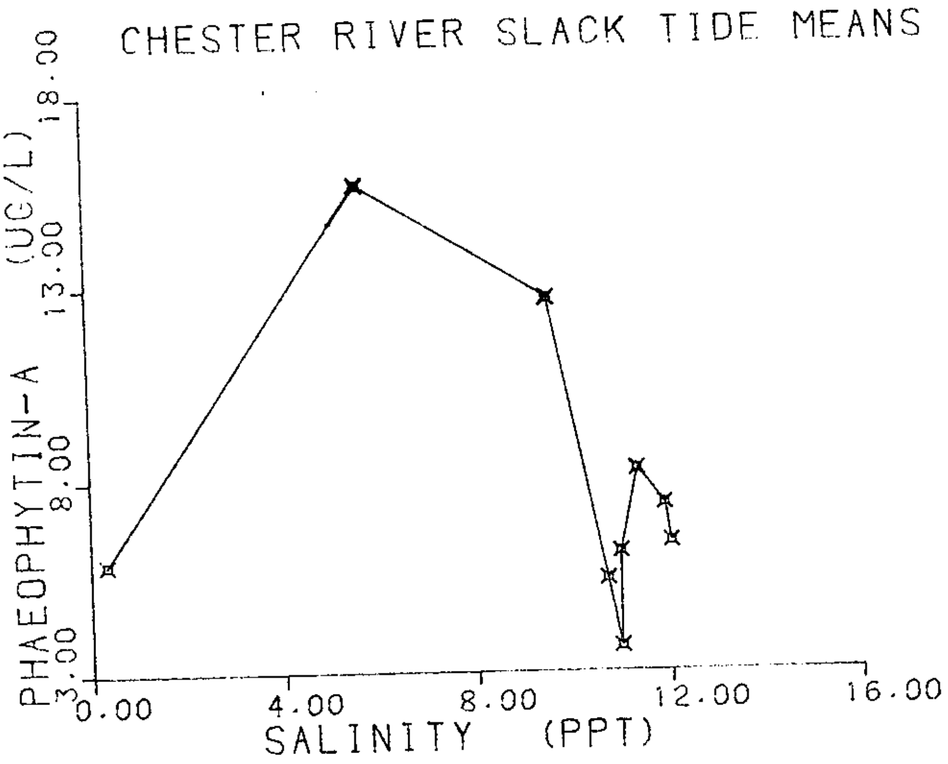


Figure 11-42 Chester River longitudinal characterization of 1980-1981 slack data for Secchi Disc (meters) and Chlorophyll-a corrected (μg/l).



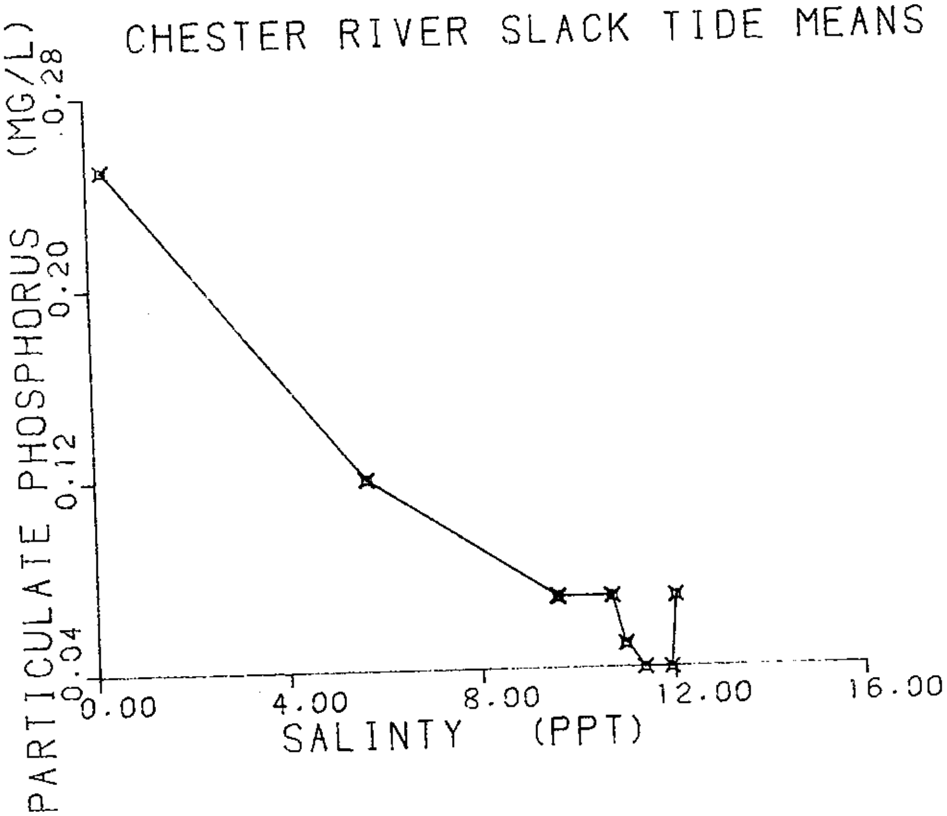
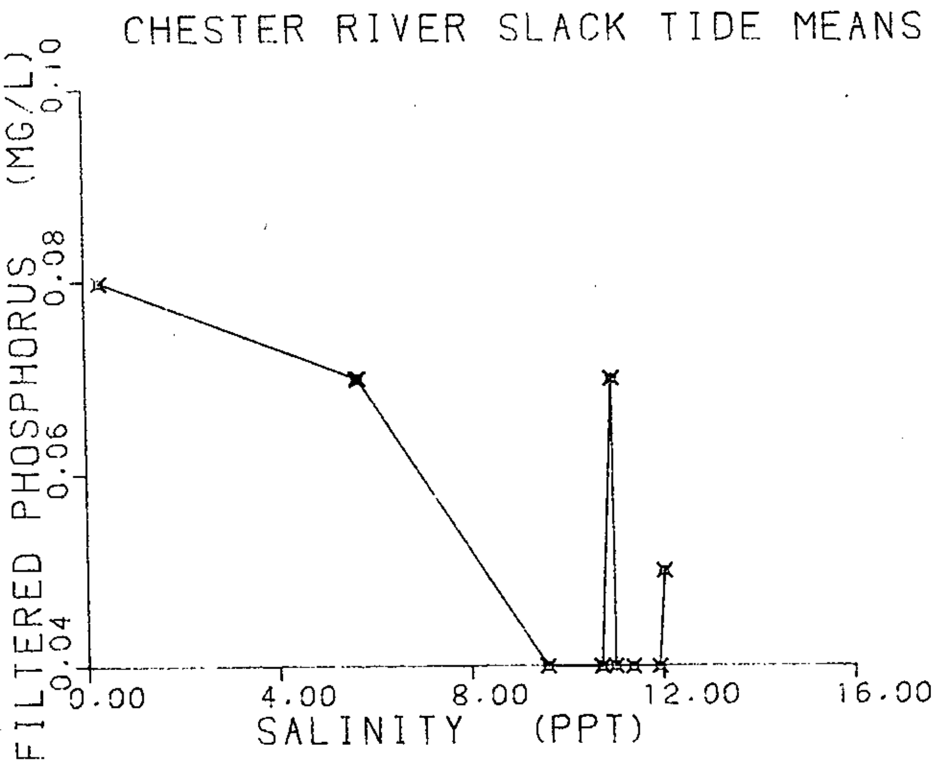


Figure11-43 Relationship between mean pheophytin-A and mean total particulate phosphorus to mean salinity.



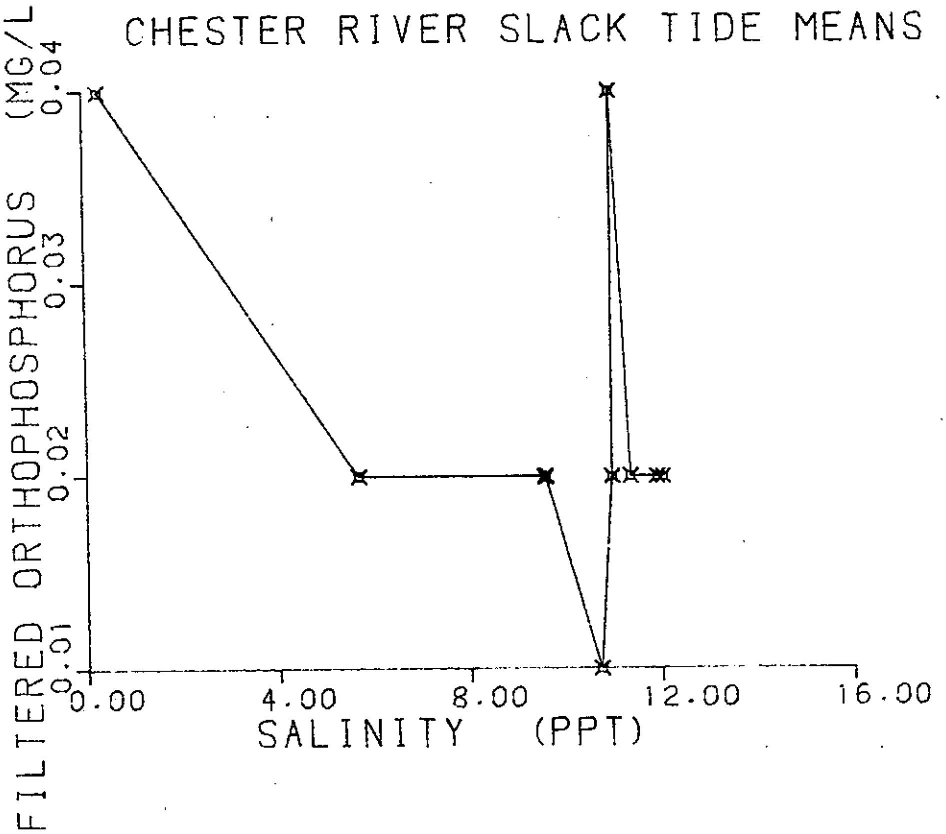


Figure 11-44 Relationship between mean dissolved phosphorous and mean dissolved ortho-phosphorus to mean salinity.

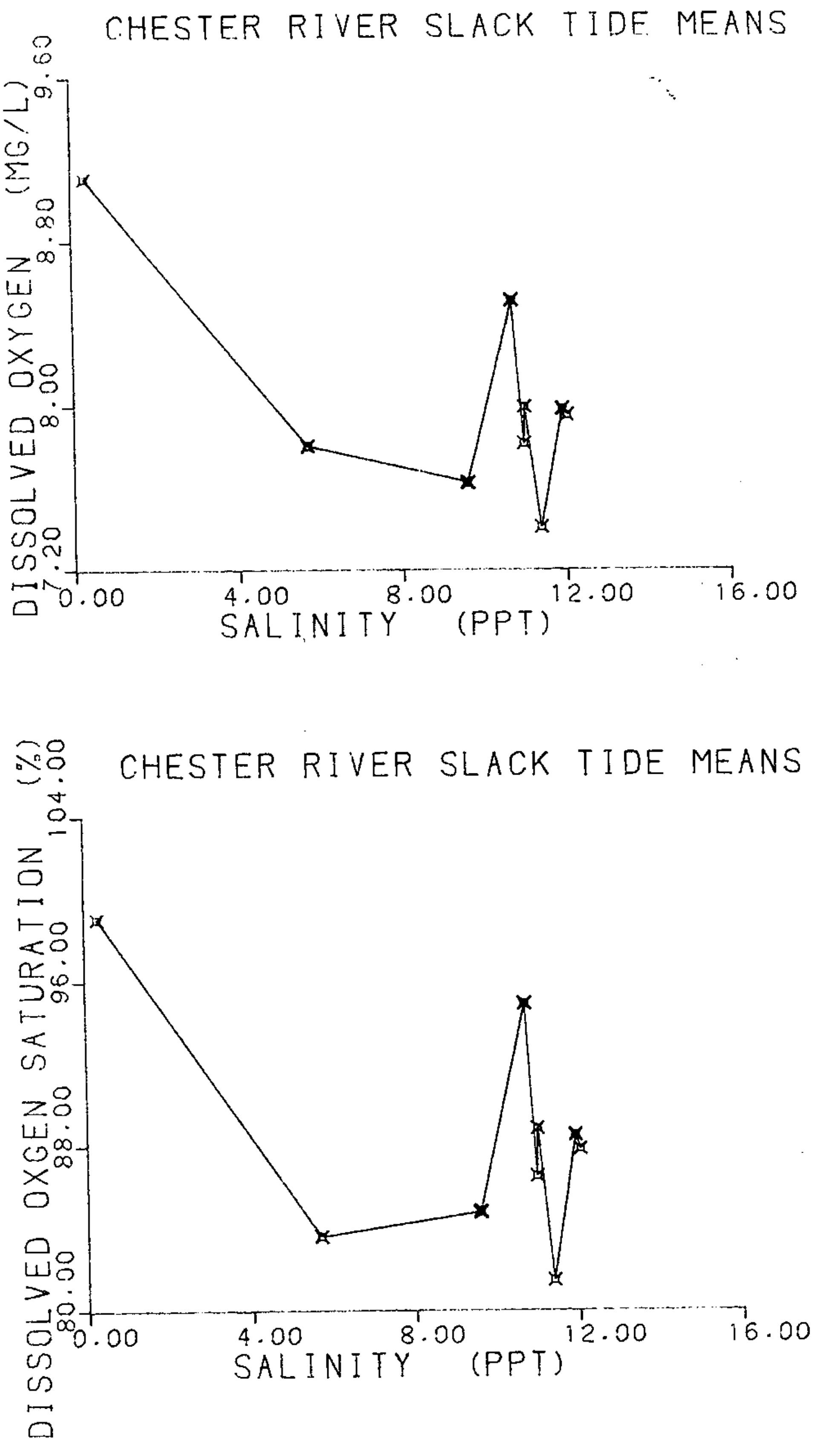
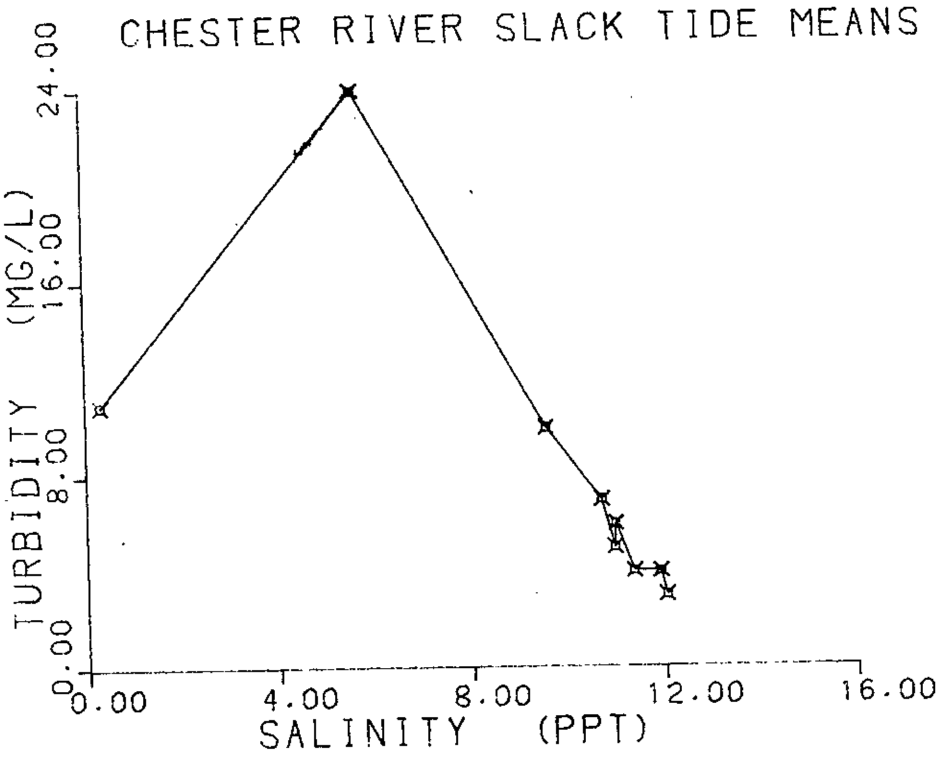


Figure 11-45 Relationship between mean dissolved oxygen and mean dissolved oxygen saturation to mean salinity.



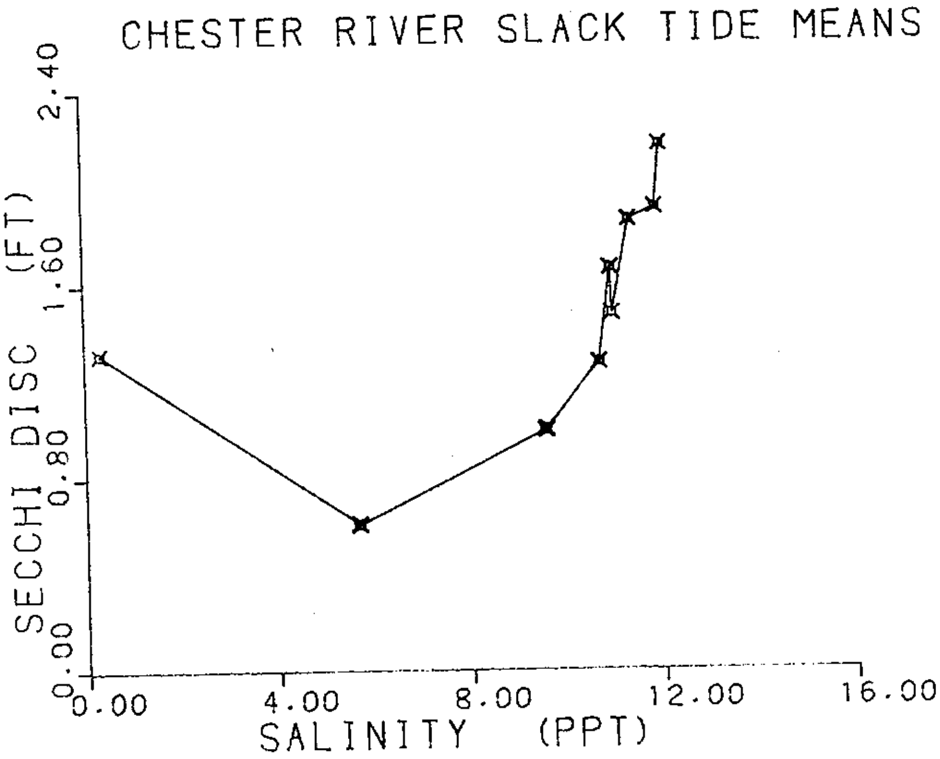


Figure 11-46 Relationship between mean turbidity and mean secchi disc to mean salinity.

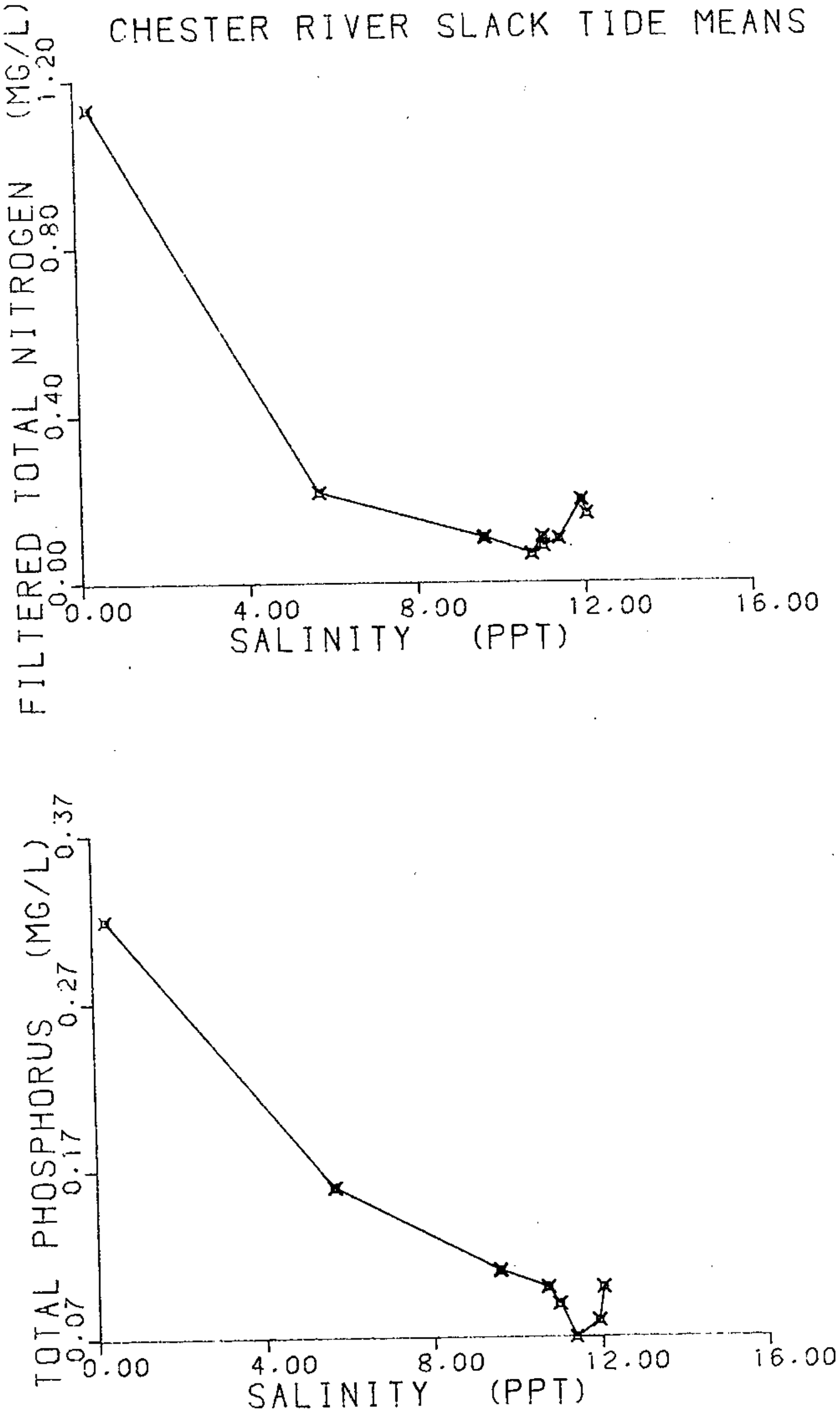
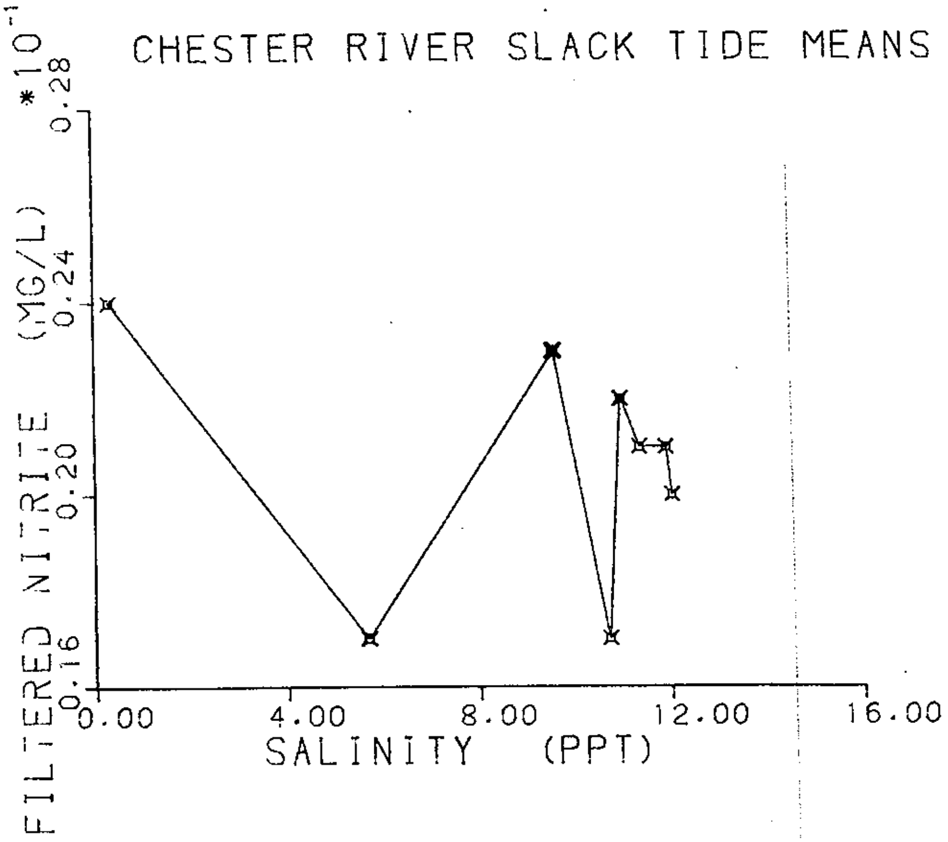


Figure 11-47 Relationship between mean dissolved nitrogen and mean total phosphorus to mean salinity.



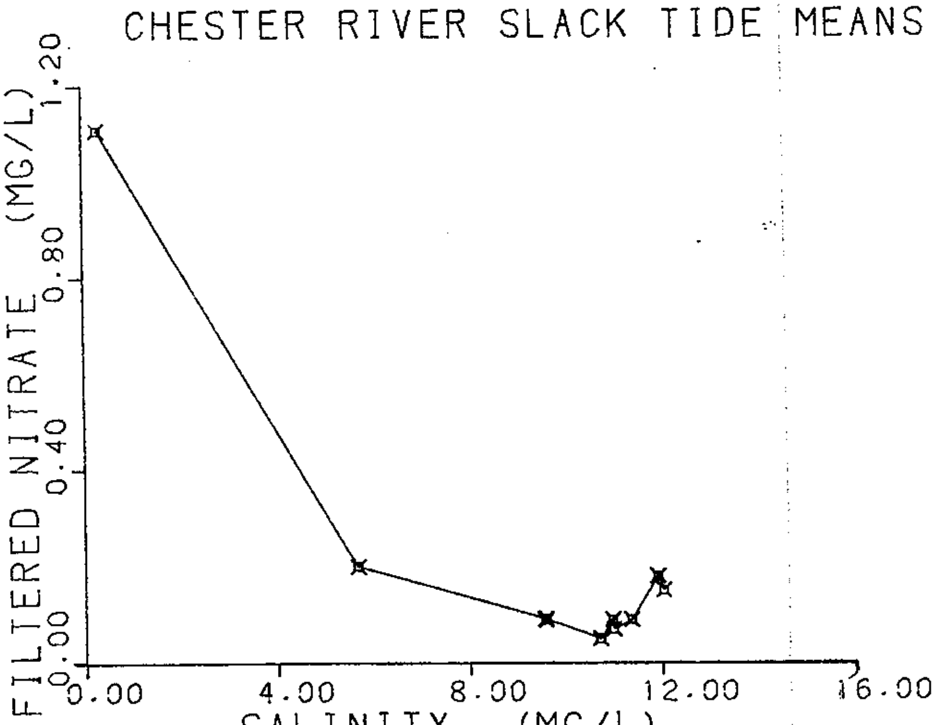


Figure 11-48 Relationship between mean dissolved nitrite and mean dissolved nitrate to mean salinity.

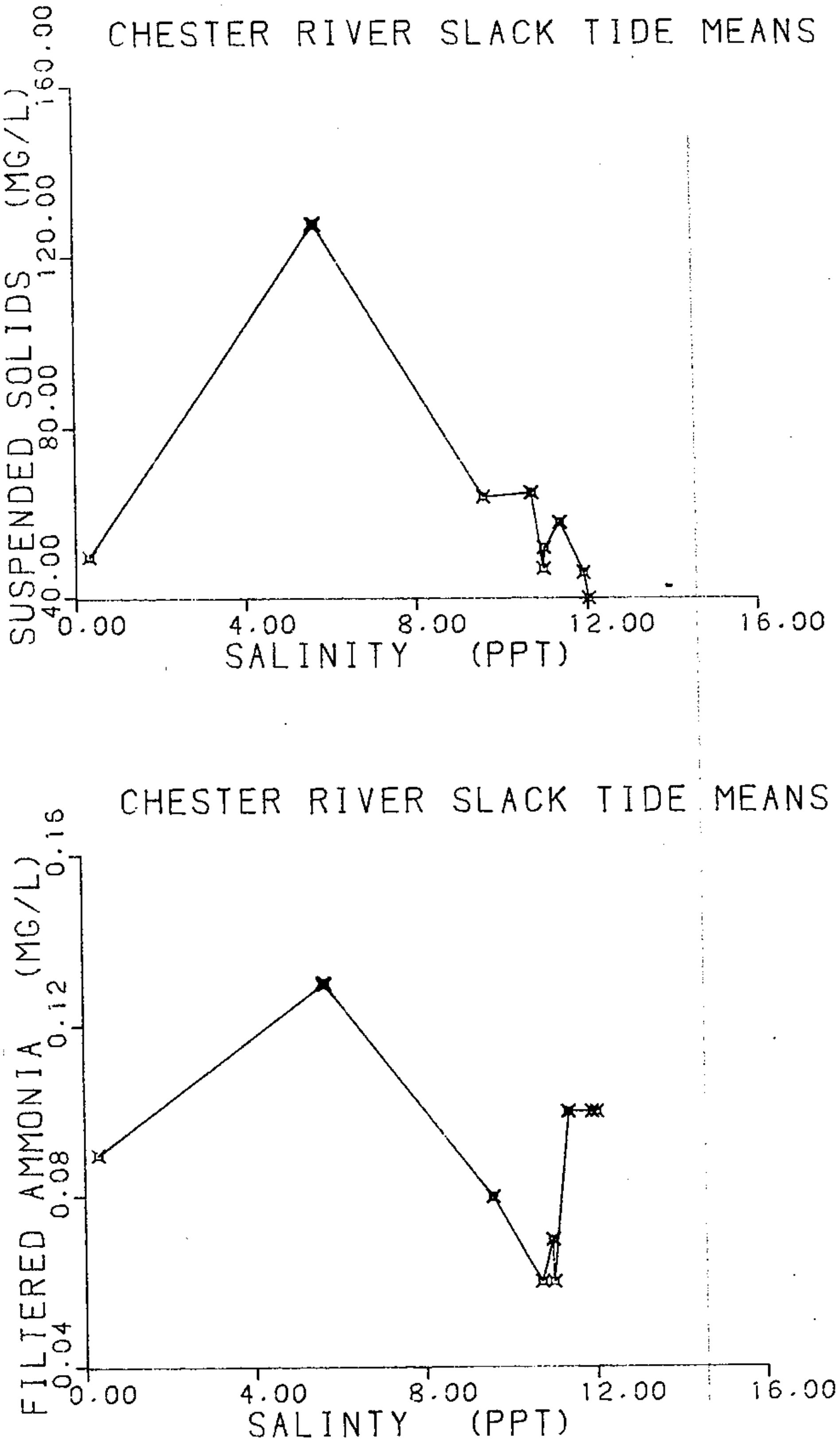


Figure 11-49 Relationship between mean suspended solids and mean dissolved ammonia to mean salinity.

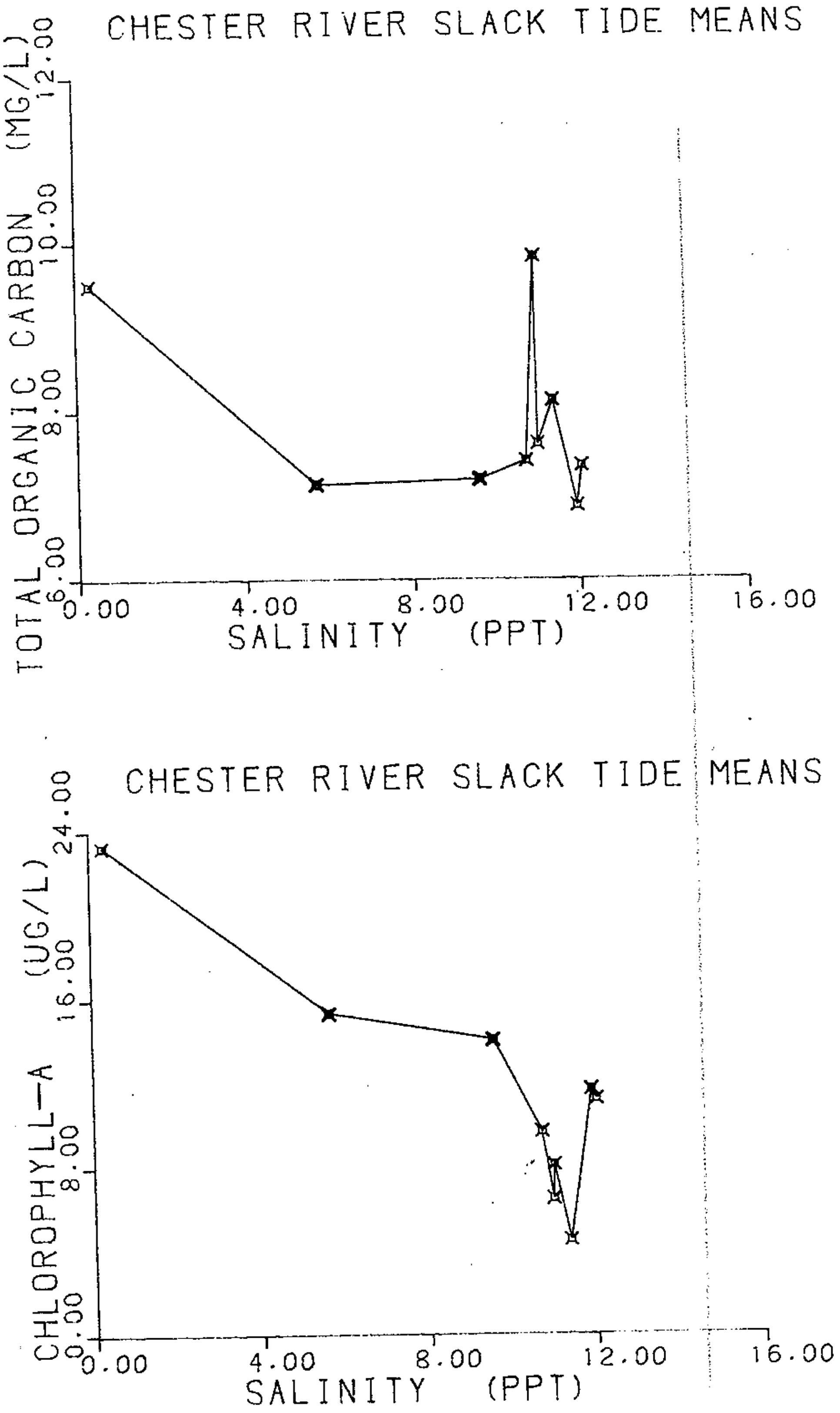


Figure 11-50 Relationship between mean total organic carbon and mean chlorophyll-A (corrected) to mean salinity.

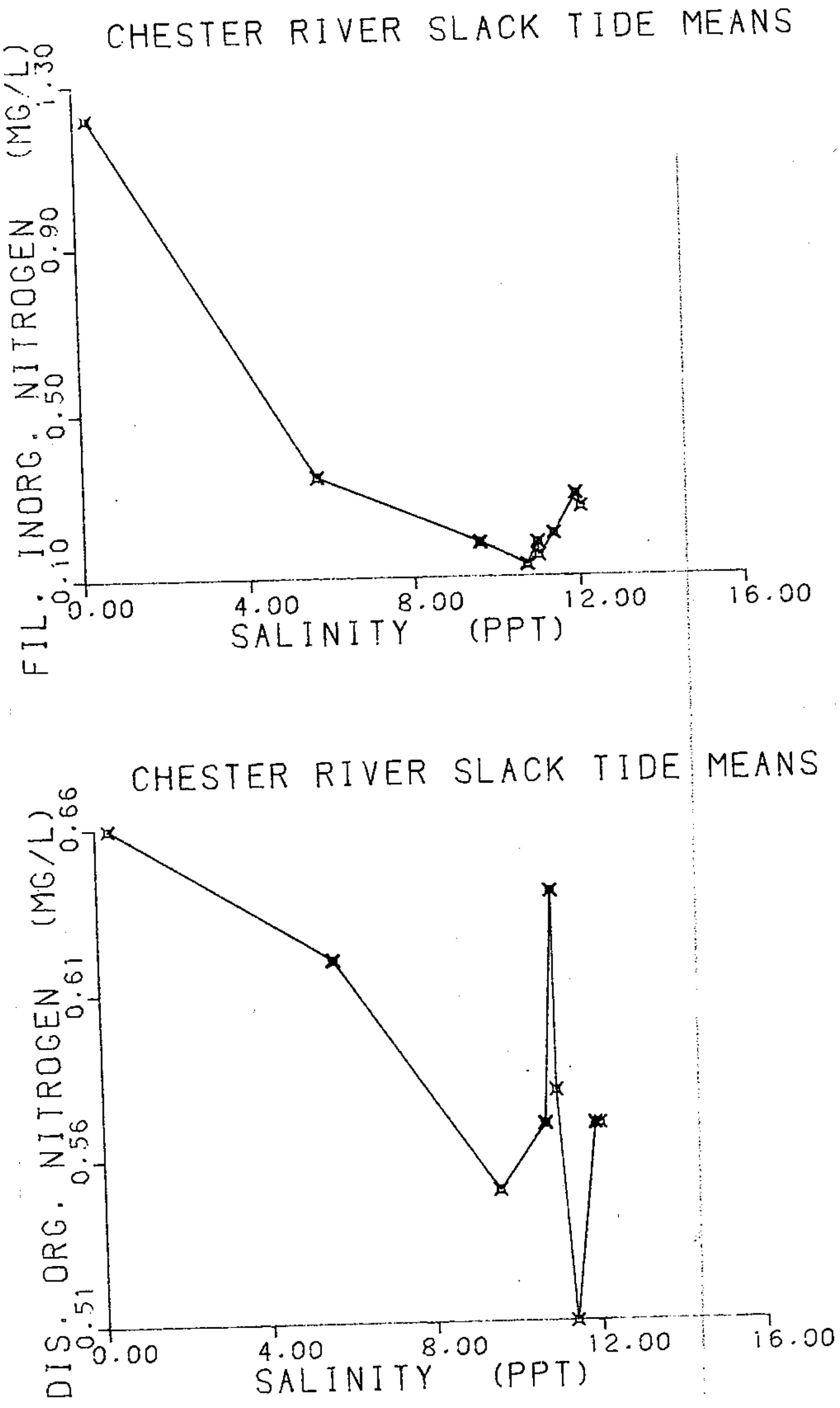
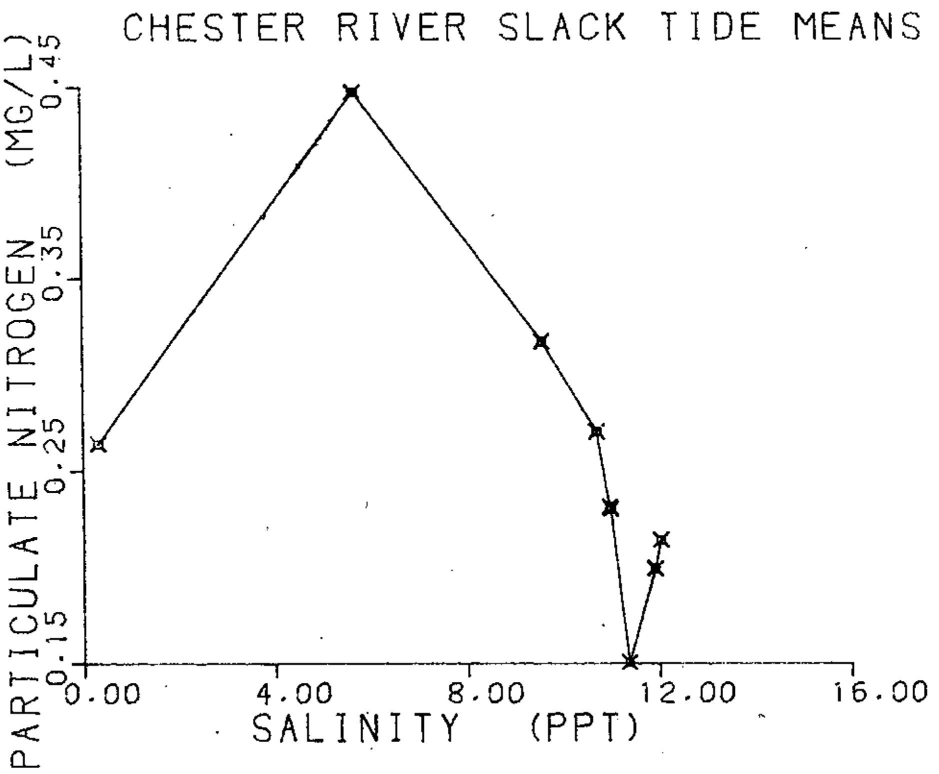


Figure 11-51 Relationship between mean dissolved inorganic nitrogen and mean dissolved organic nitrogen to mean salinity.



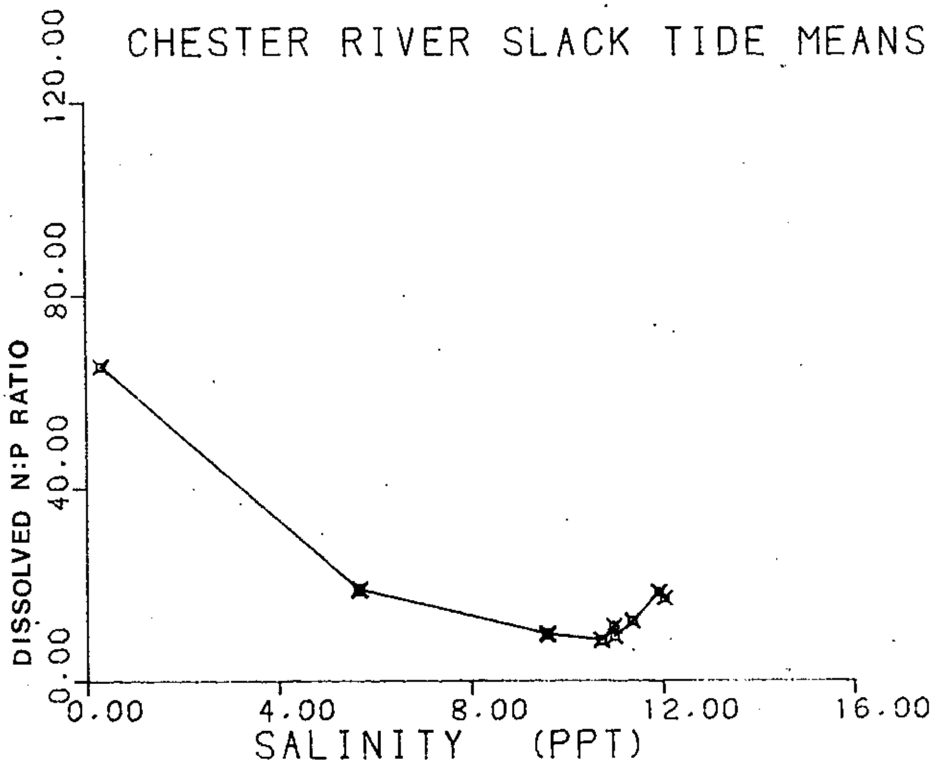


Figure 11-52 Relationship between mean total particulate nitrogen and mean dissolved N/P ratio to mean salinity.

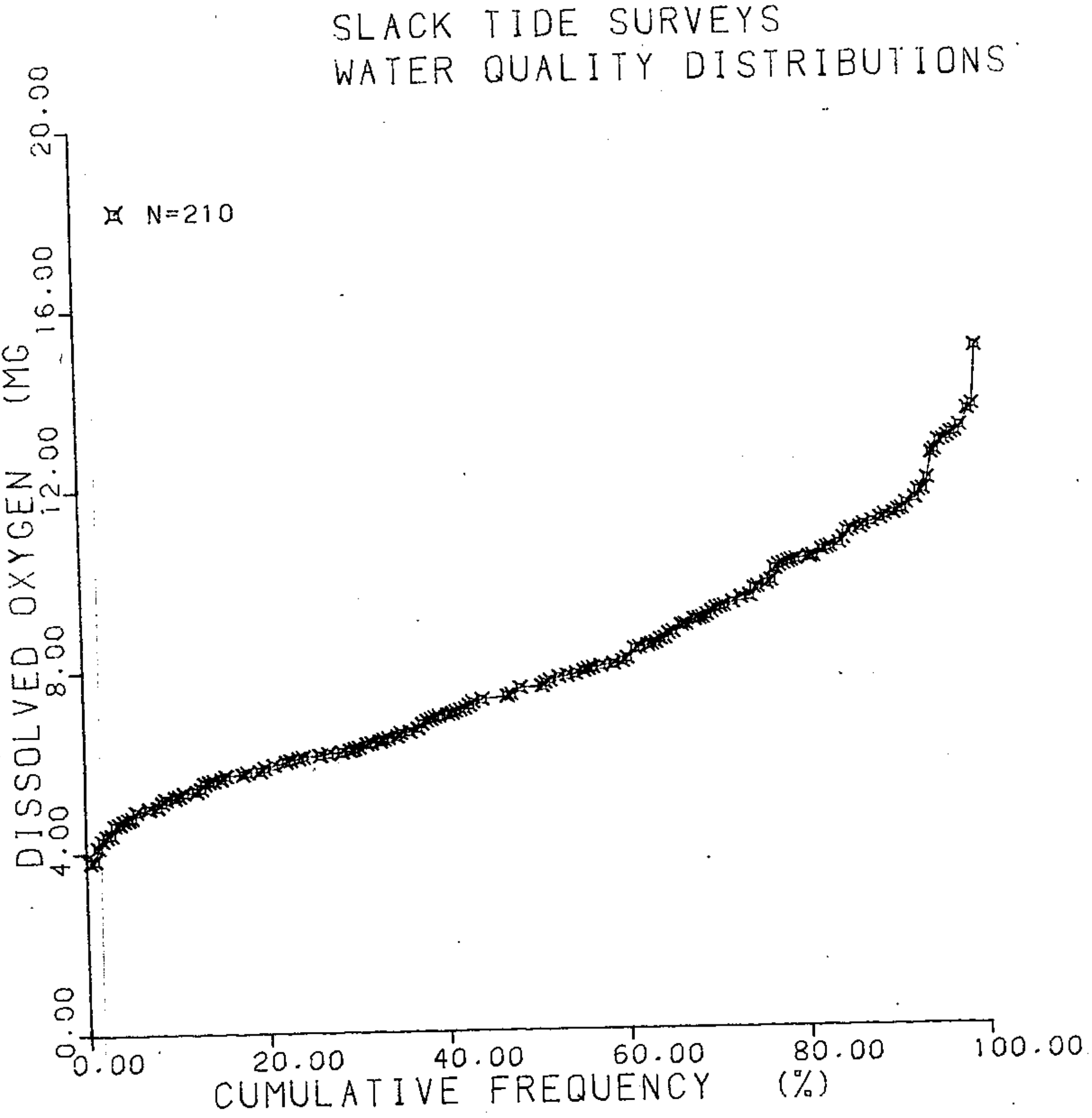


Figure 11-53 Chester River slack tide water quality survey. Dissolved Oxygen (mg/l) cumulative frequency distribution.

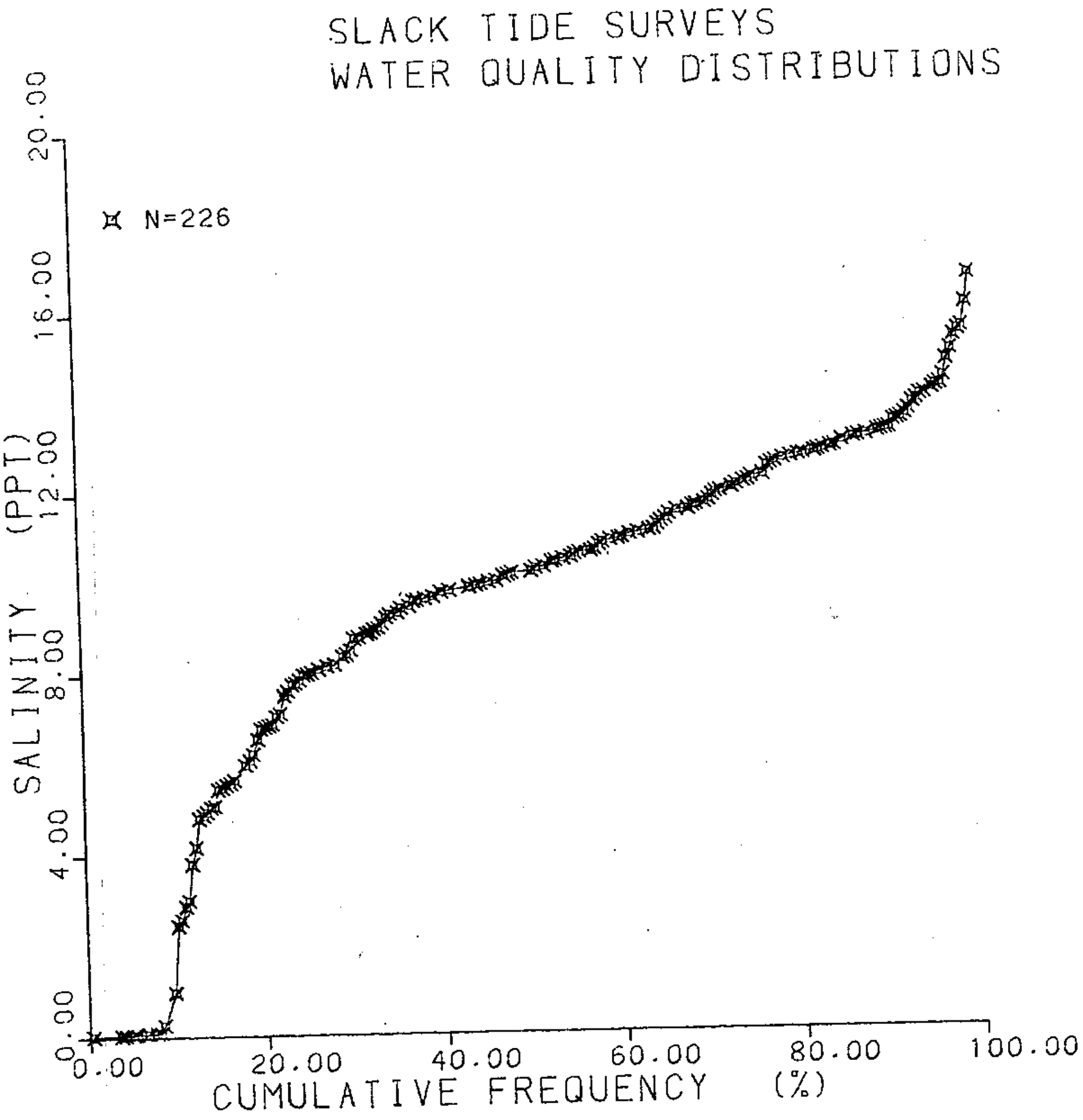


Figure 11-54 Chester River slack tide water quality survey. Salinity (PPT) cumulative frequency distribution.

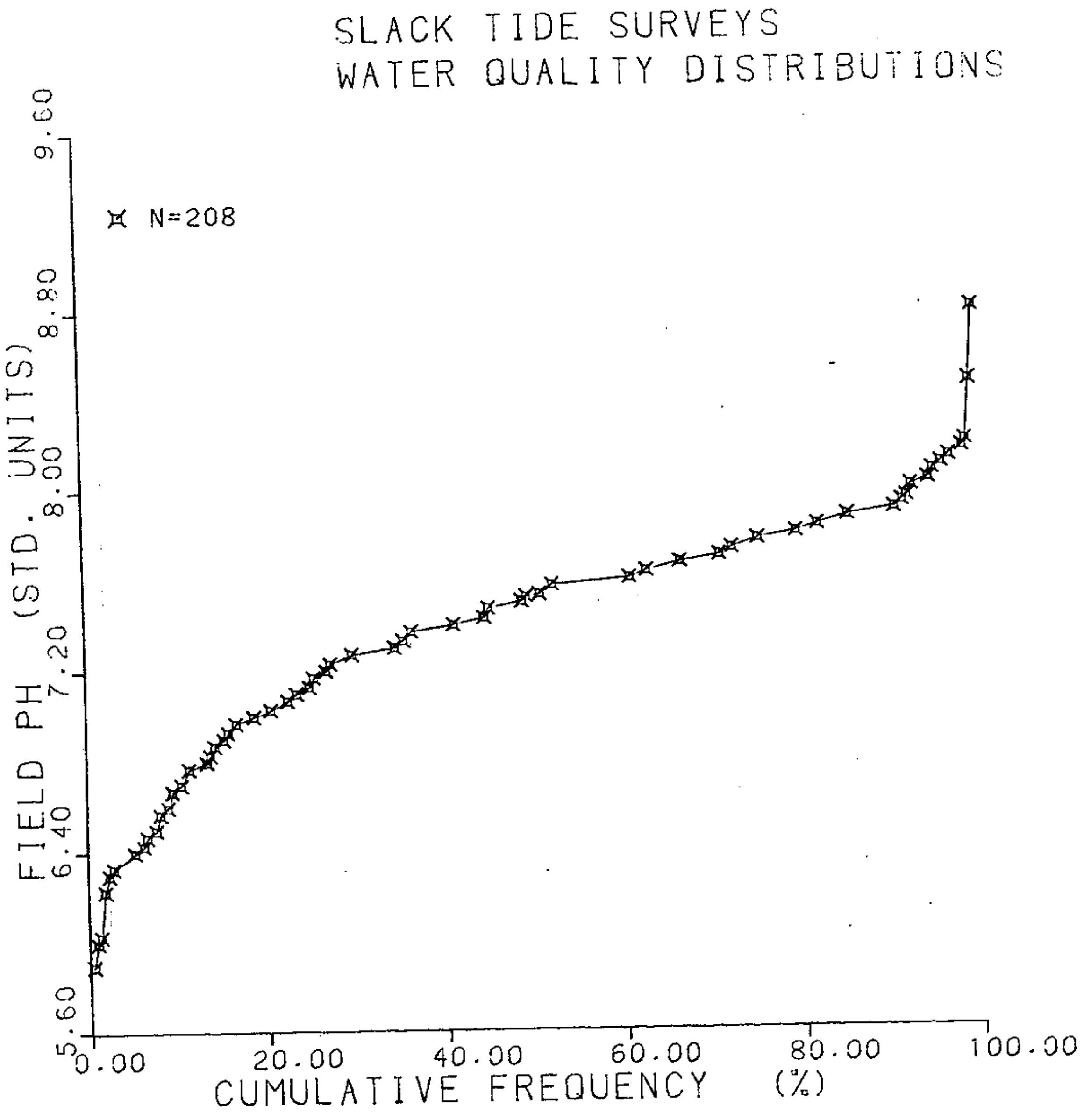


Figure 11-55 Chester River slack tide water quality survey. Field PH (standard units) cumulative frequency distribution.

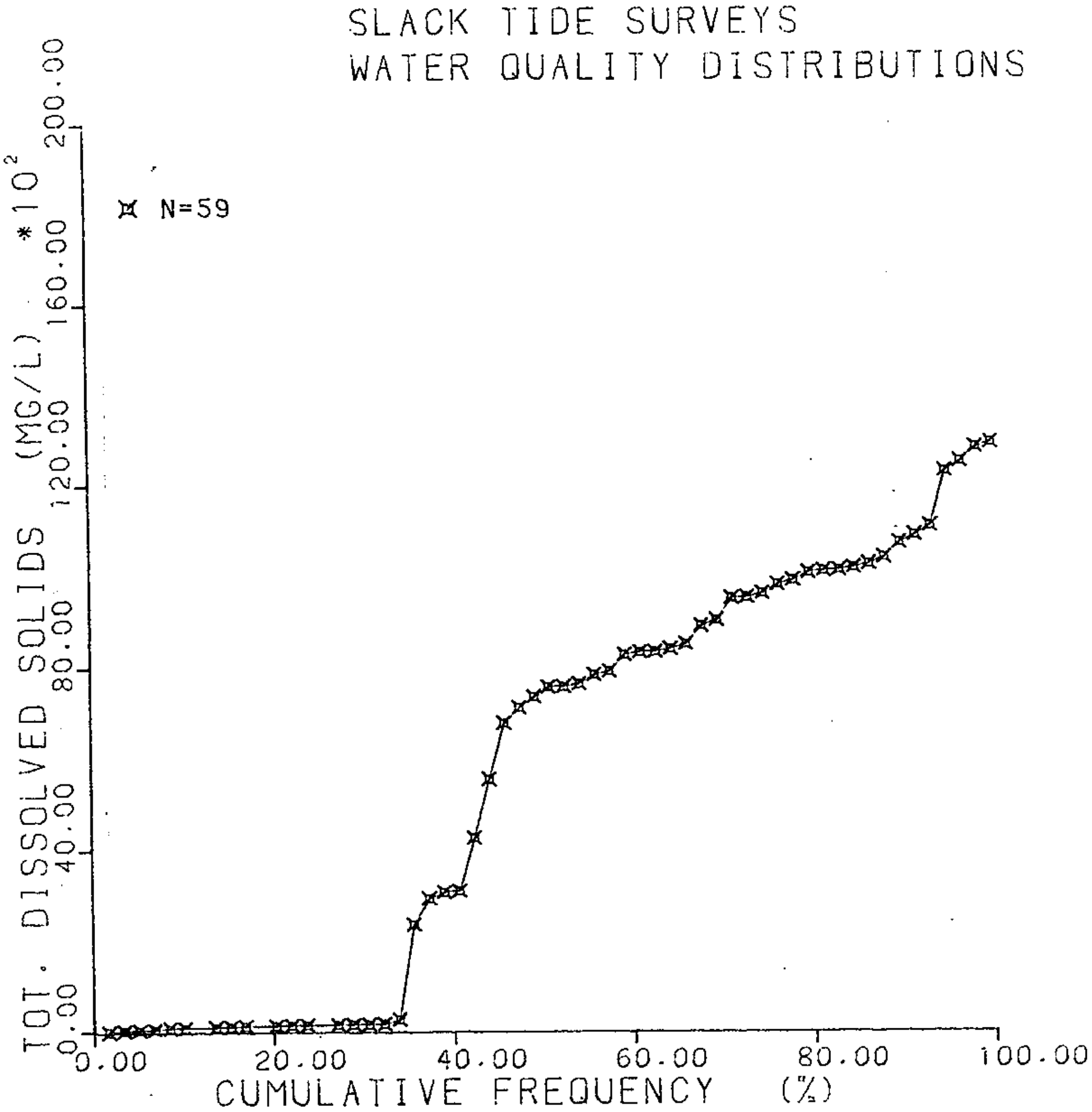


Figure 11-56 Chester River slack tide water quality survey. Total dissolved solids (mg/l) cumulative frequency distribution.

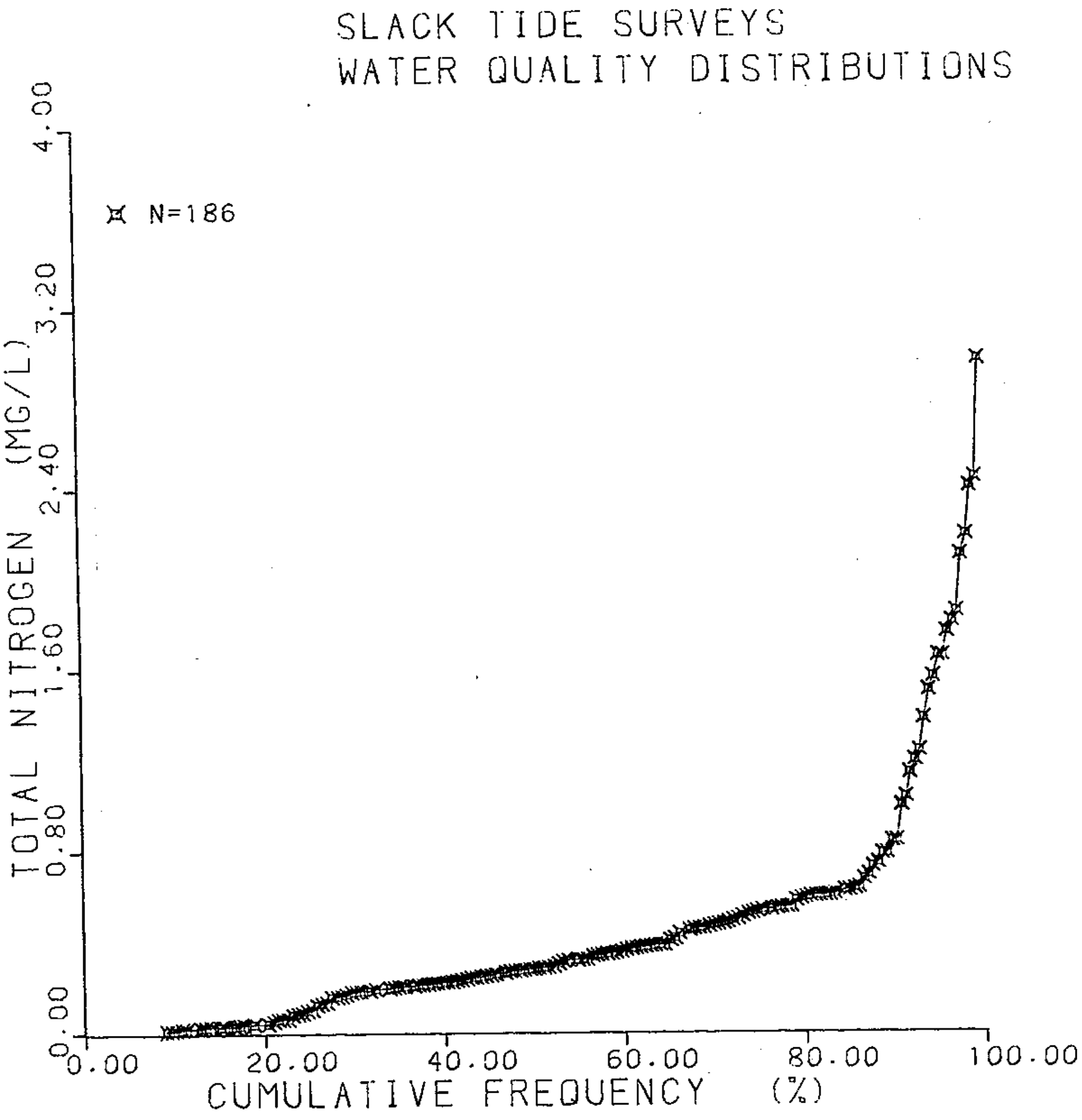


Figure 11-57 Chester River slack tide water quality survey. Total Nitrogen (mg/l) cumulative frequency distribution.

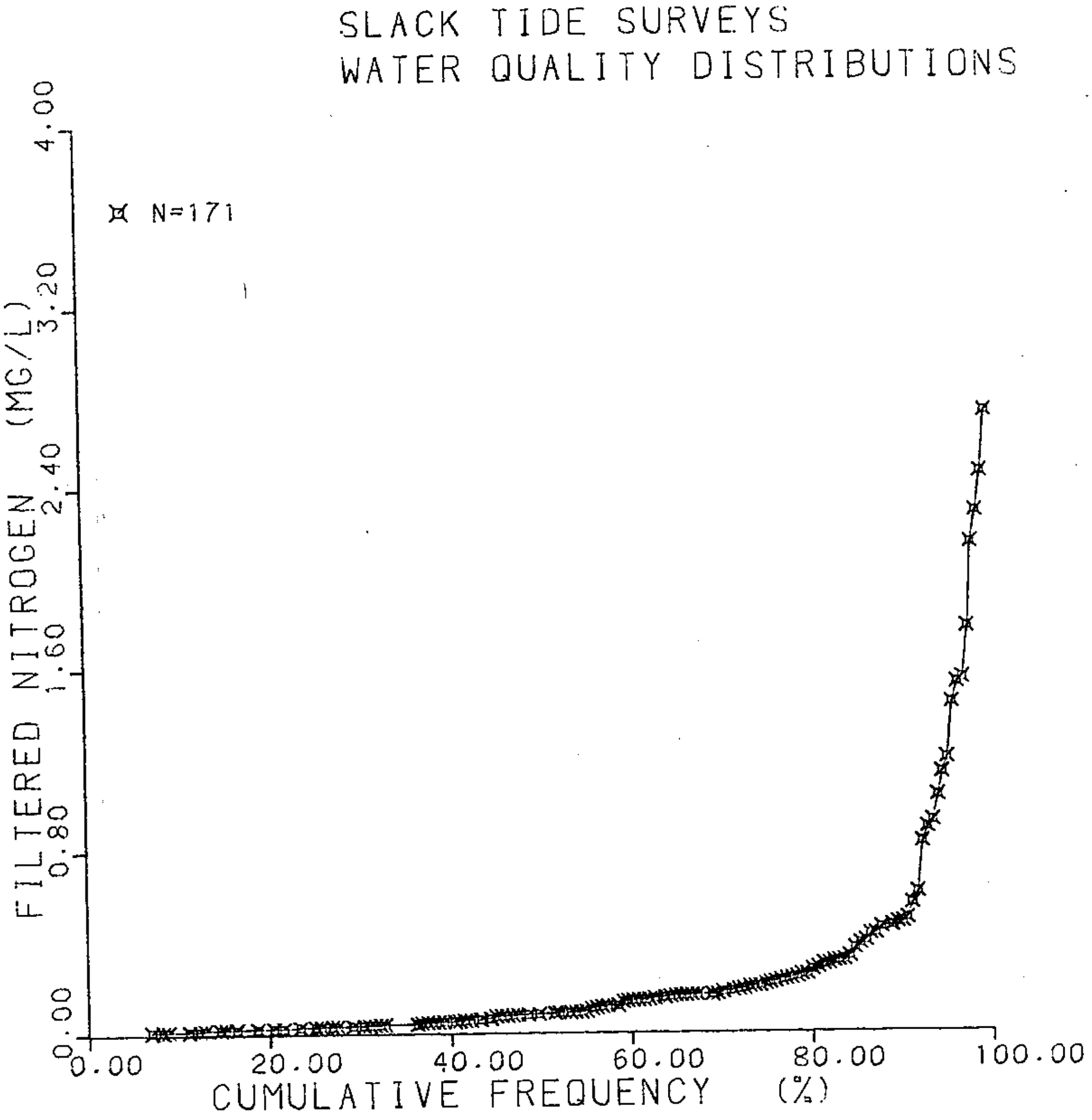


Figure 11-58 Chester River slack tide water quality survey. Filtered Nitrogen (mg/l) cumulative frequency distribution.

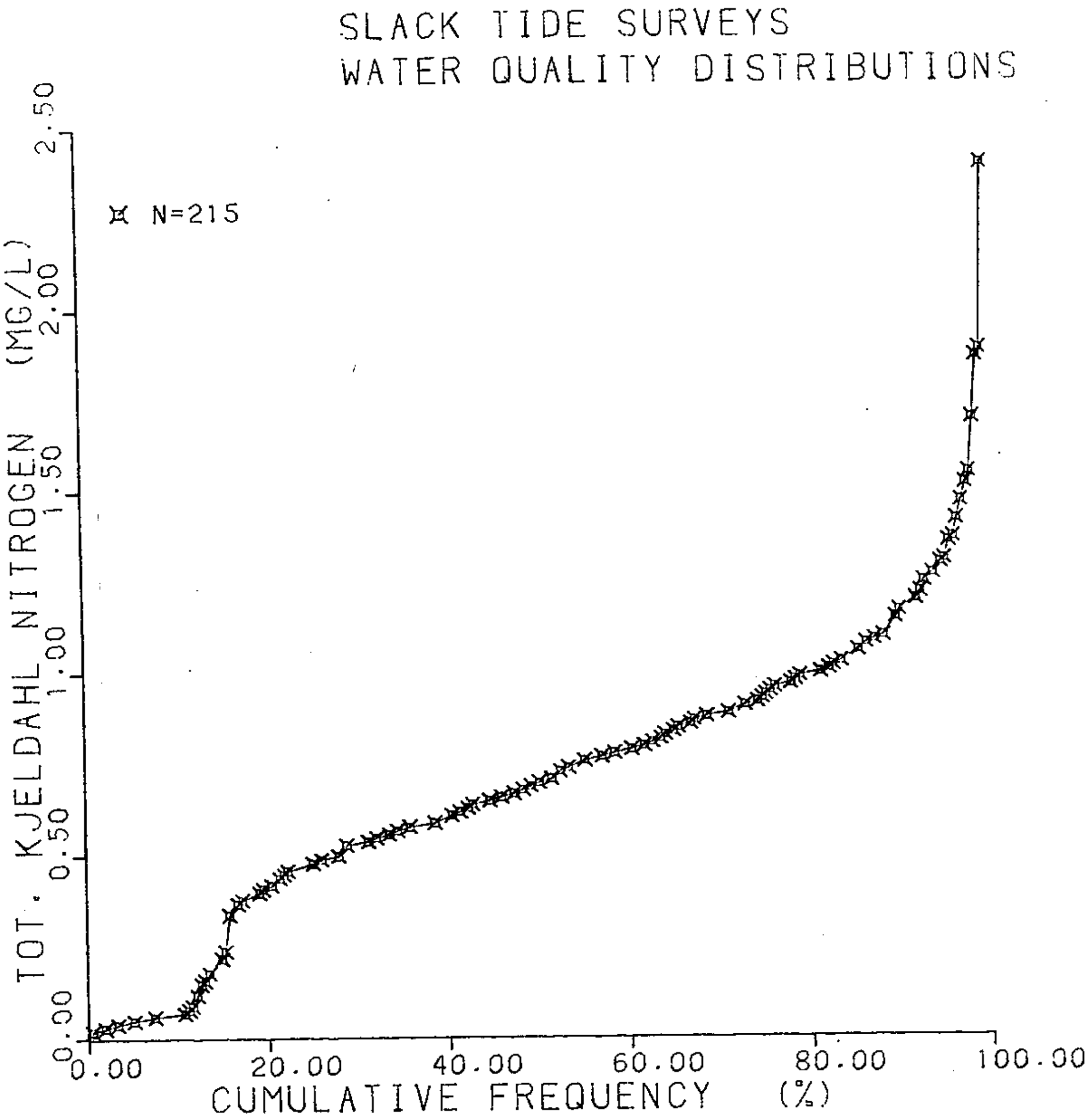


Figure 11-59 Chester River slack tide water quality survey. Total Kjeldahl Nitrogen (mg/l) cumulative frequency distribution.

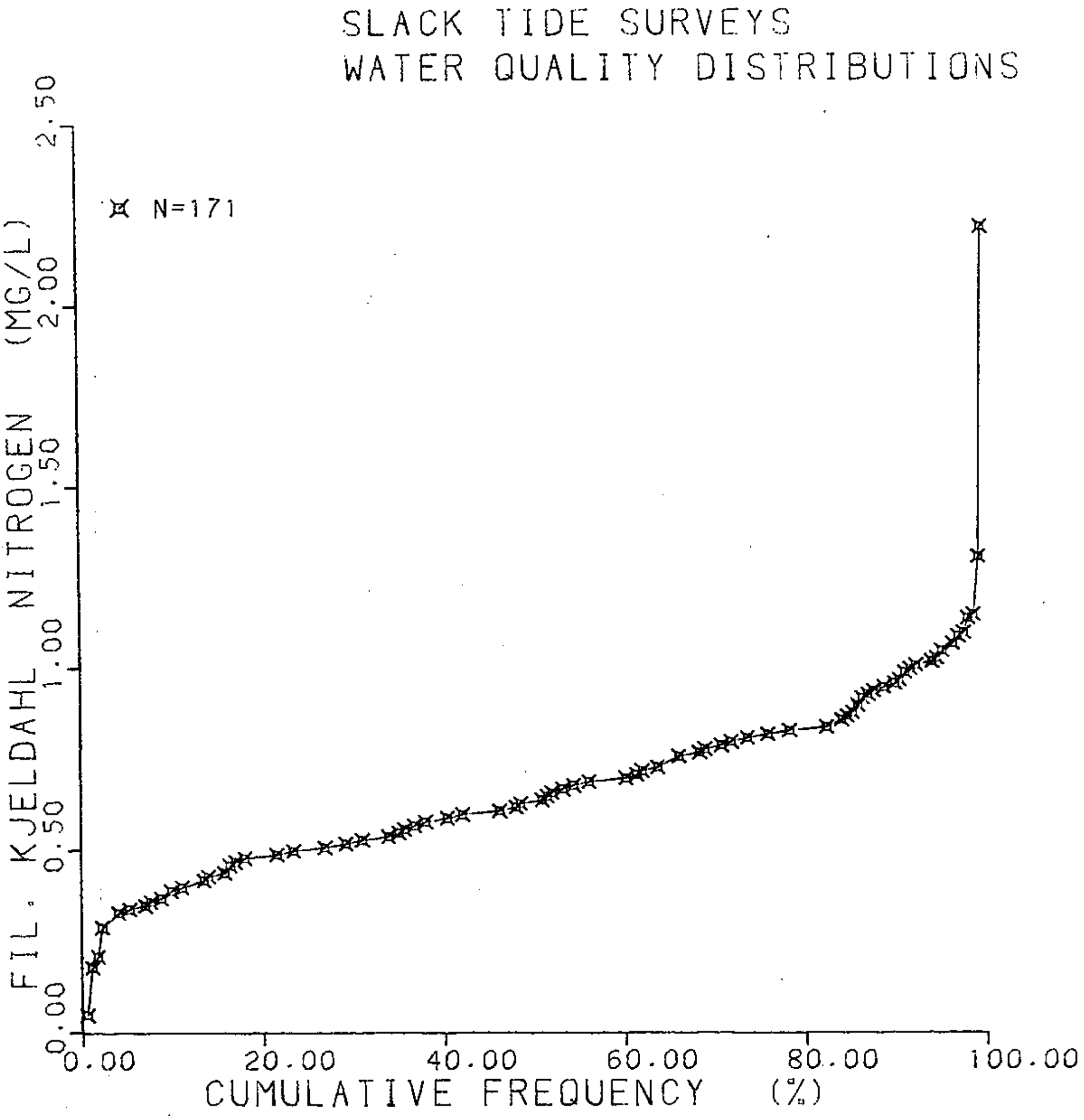


Figure 11-60 Chester River slack tide water quality survey. Filtered Kjeldahl Nitrogen (mg/l) cumulative frequency distribution.

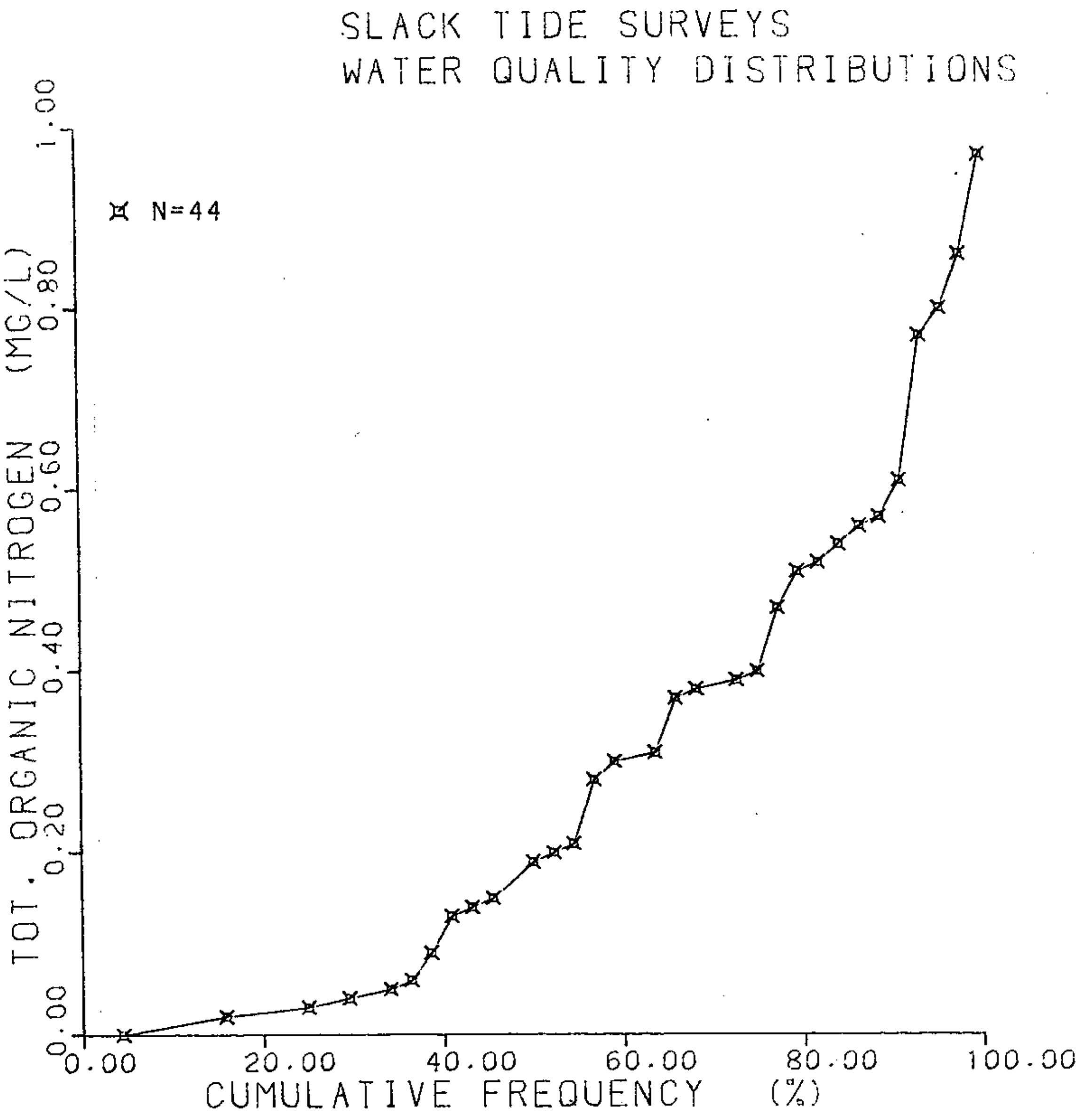


Figure11-61 Chester River slack tide water quality survey. Total organic nitrogen (mg/l) cumulative frequency distribution.

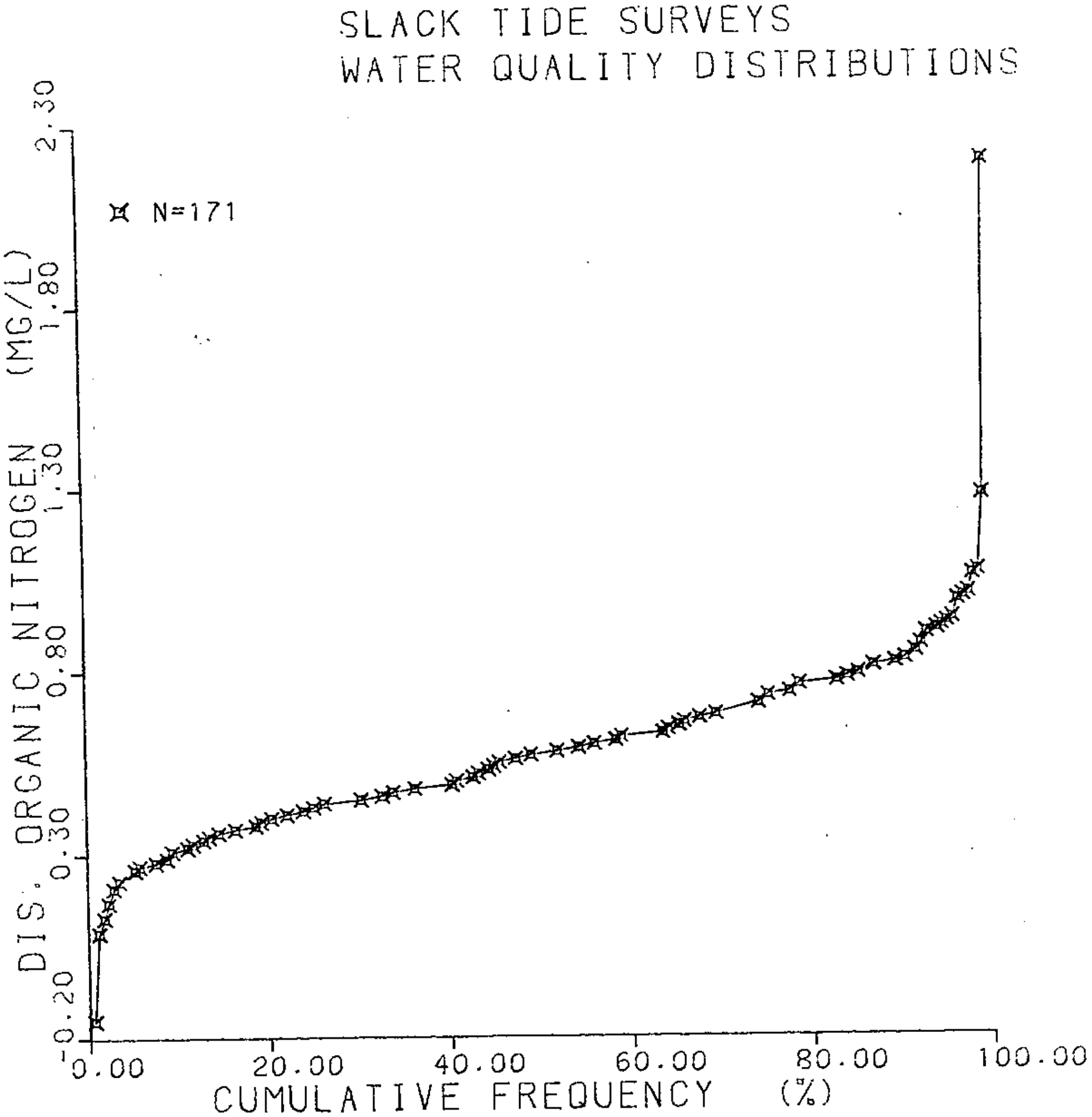


Figure 11-62Chester River slack tide water quality survey. Dissolved Organic Nitrogen (mg/l) cumulative frequency distribution.

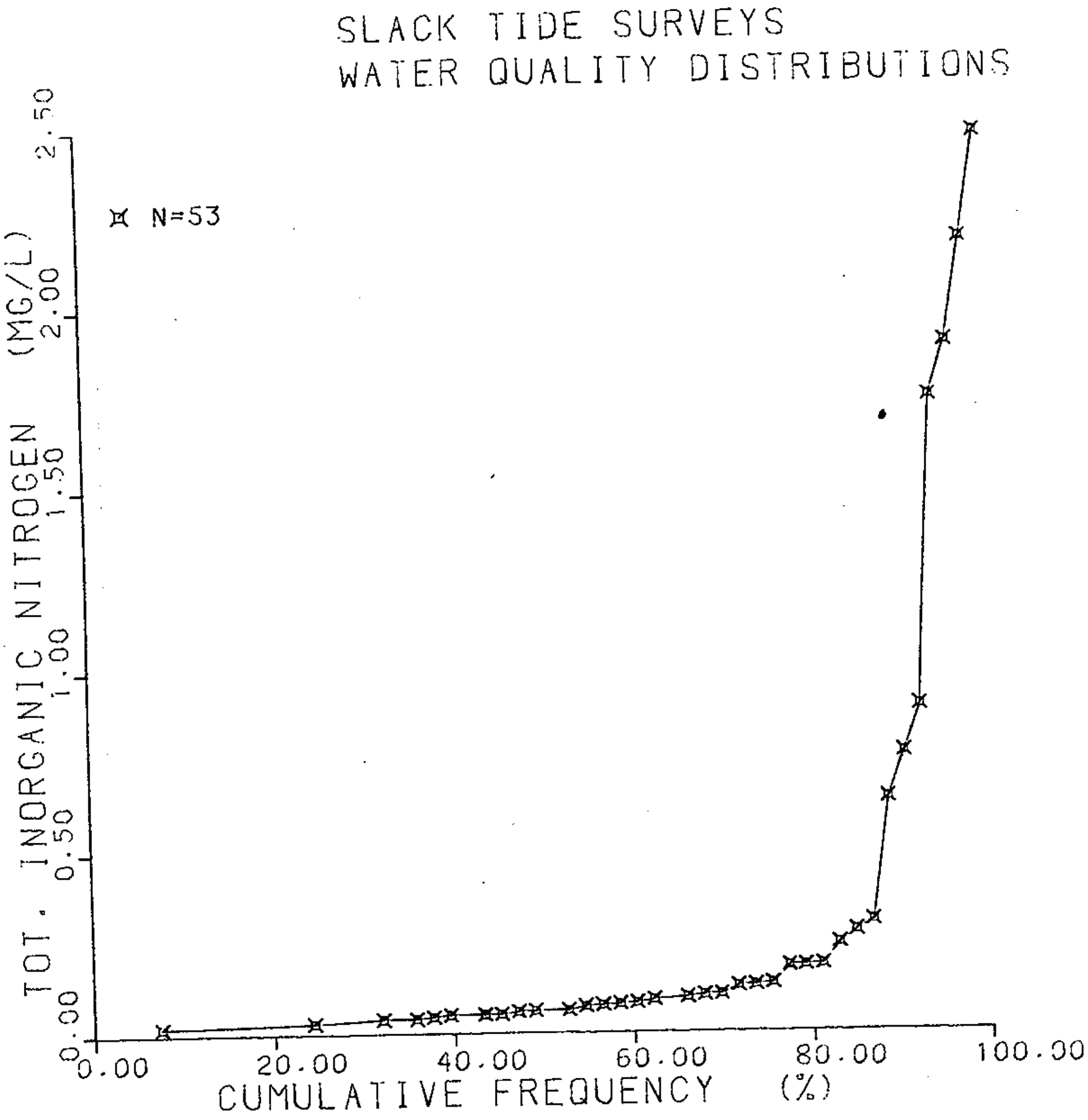


Figure 11-63 Chester River slack tide water quality survey. Total inorganic nitrogen (mg/l) cumulative frequency distribution.

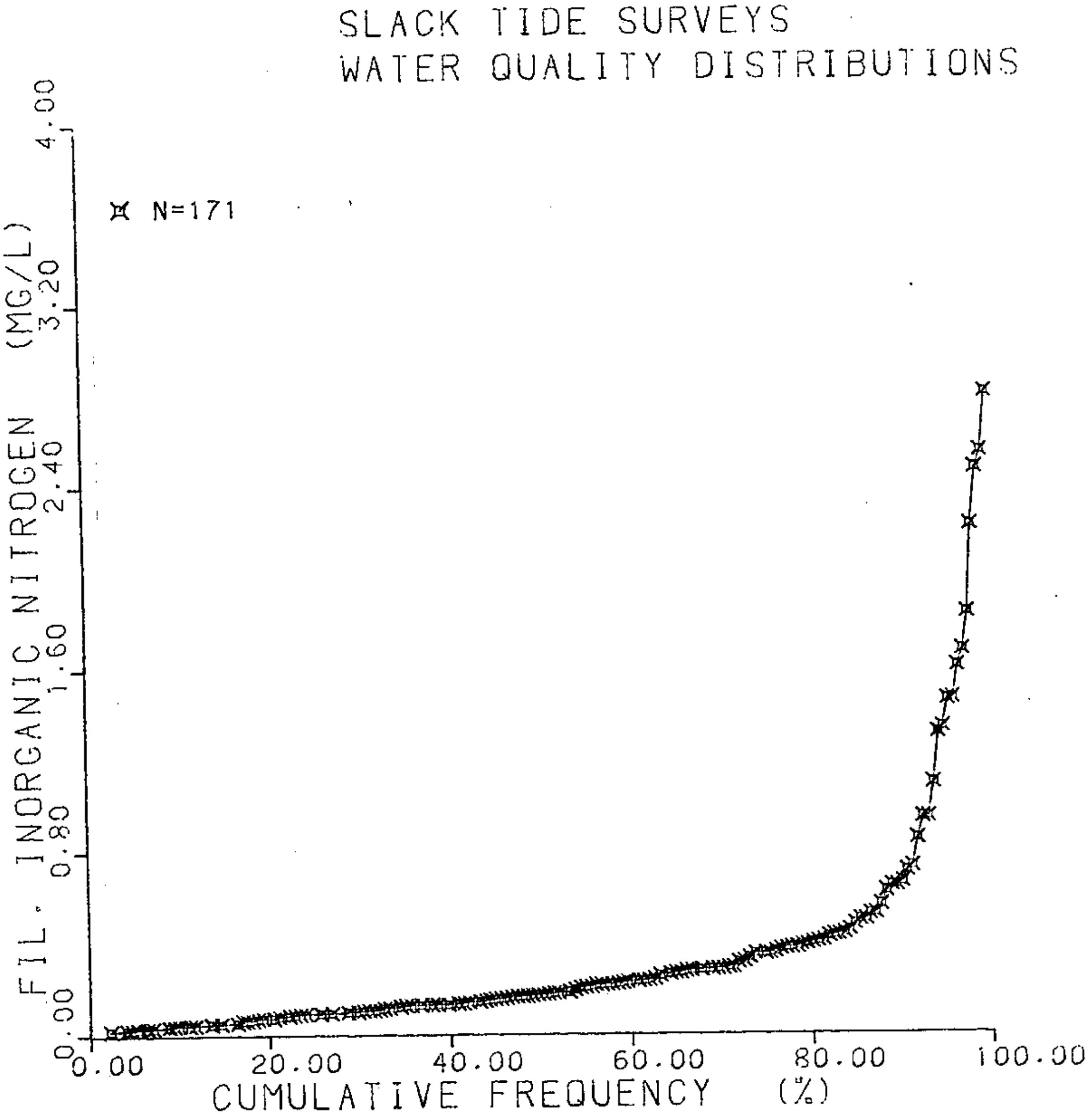


Figure11-64 Chester River slack tide water quality survey. Filtered inorganic nitrogen (mg/l) cumulative frequency distribution.

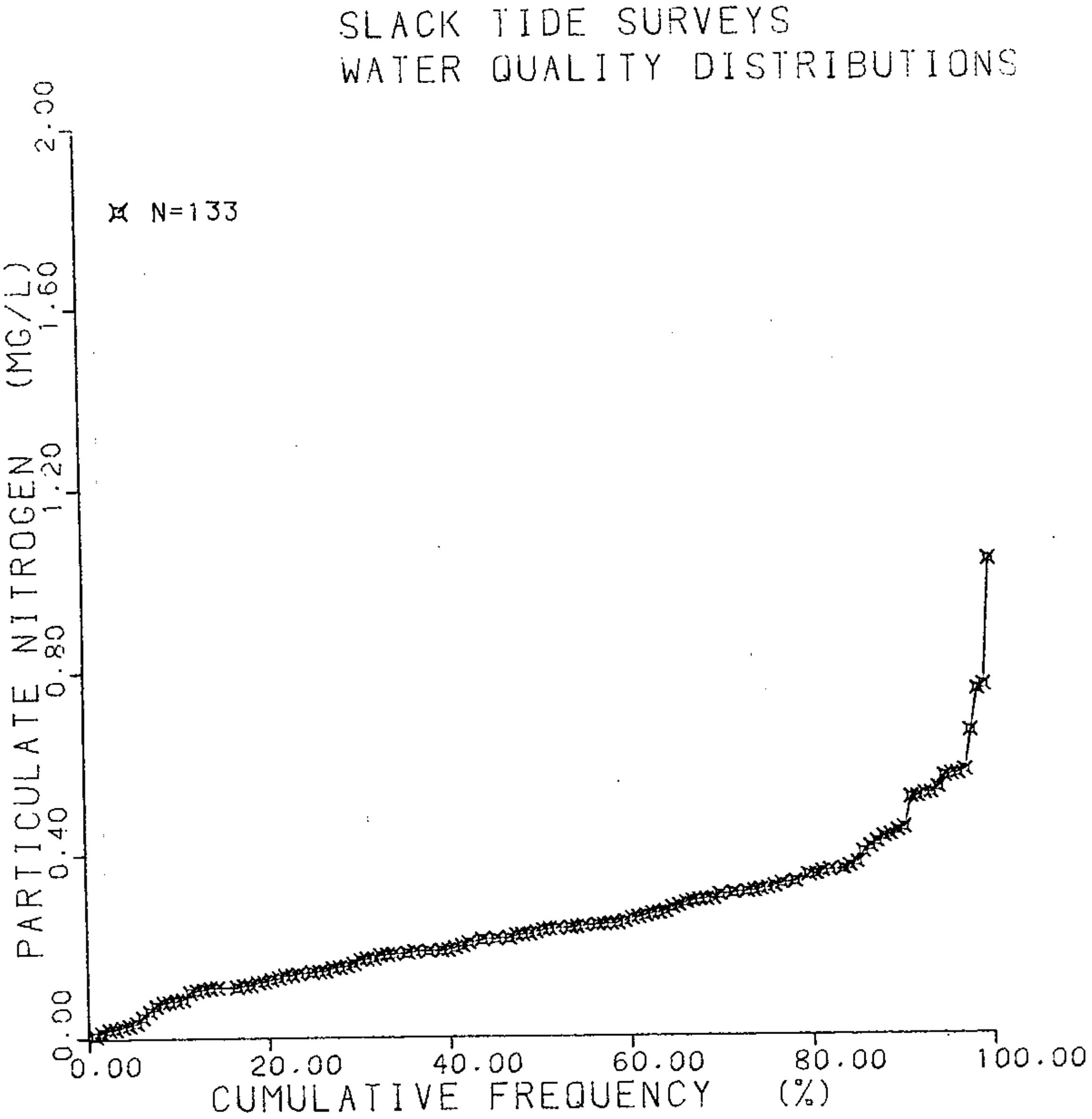


Figure 11-65 Chester River slack tide water quality survey. Particulate nitrogen (mg/l) cumulative frequency distribution.

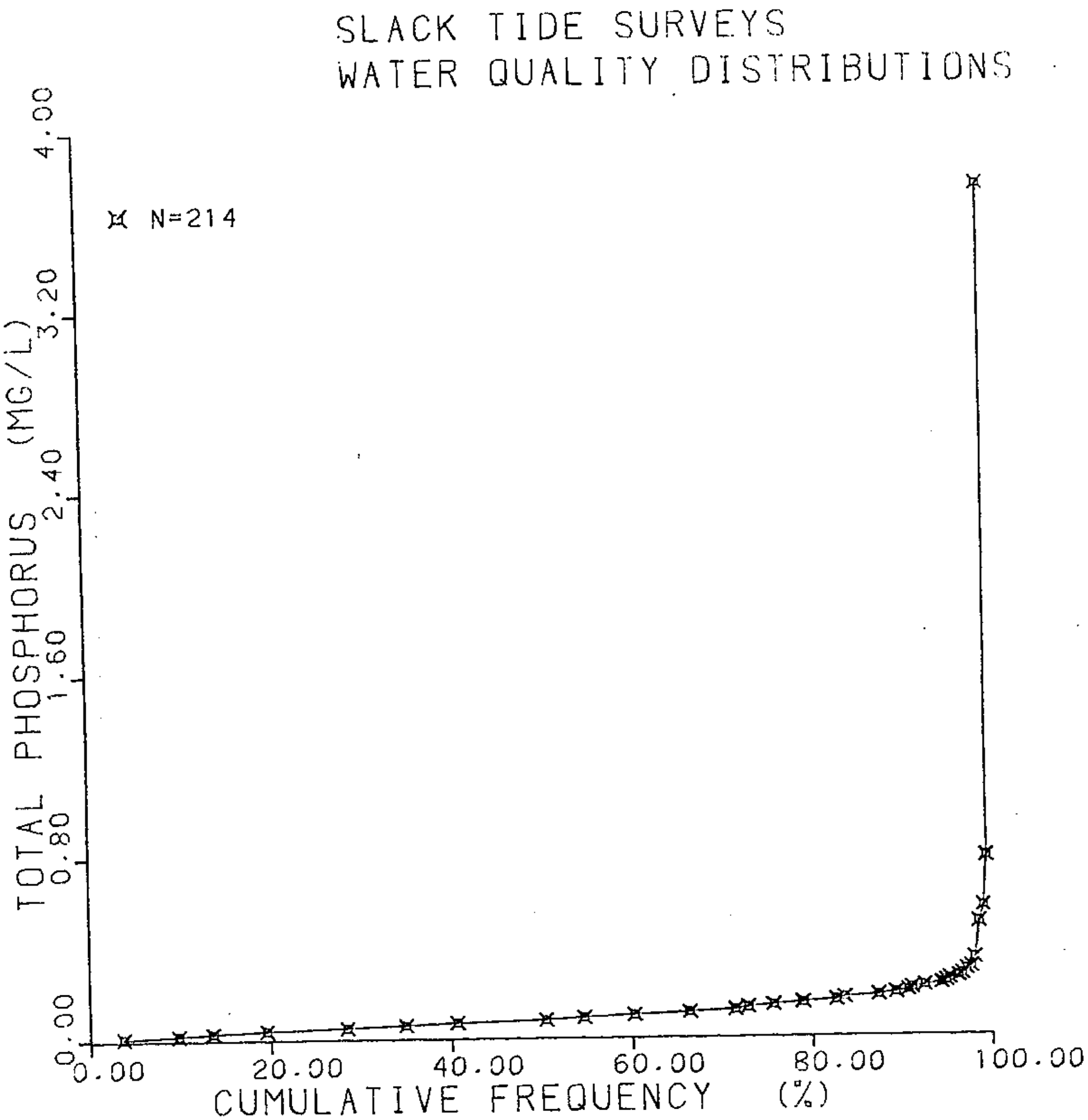


Figure 11-66 Chester River slack tide water quality survey. Total Phosphorus (mg/l) cumulative frequency distribution.

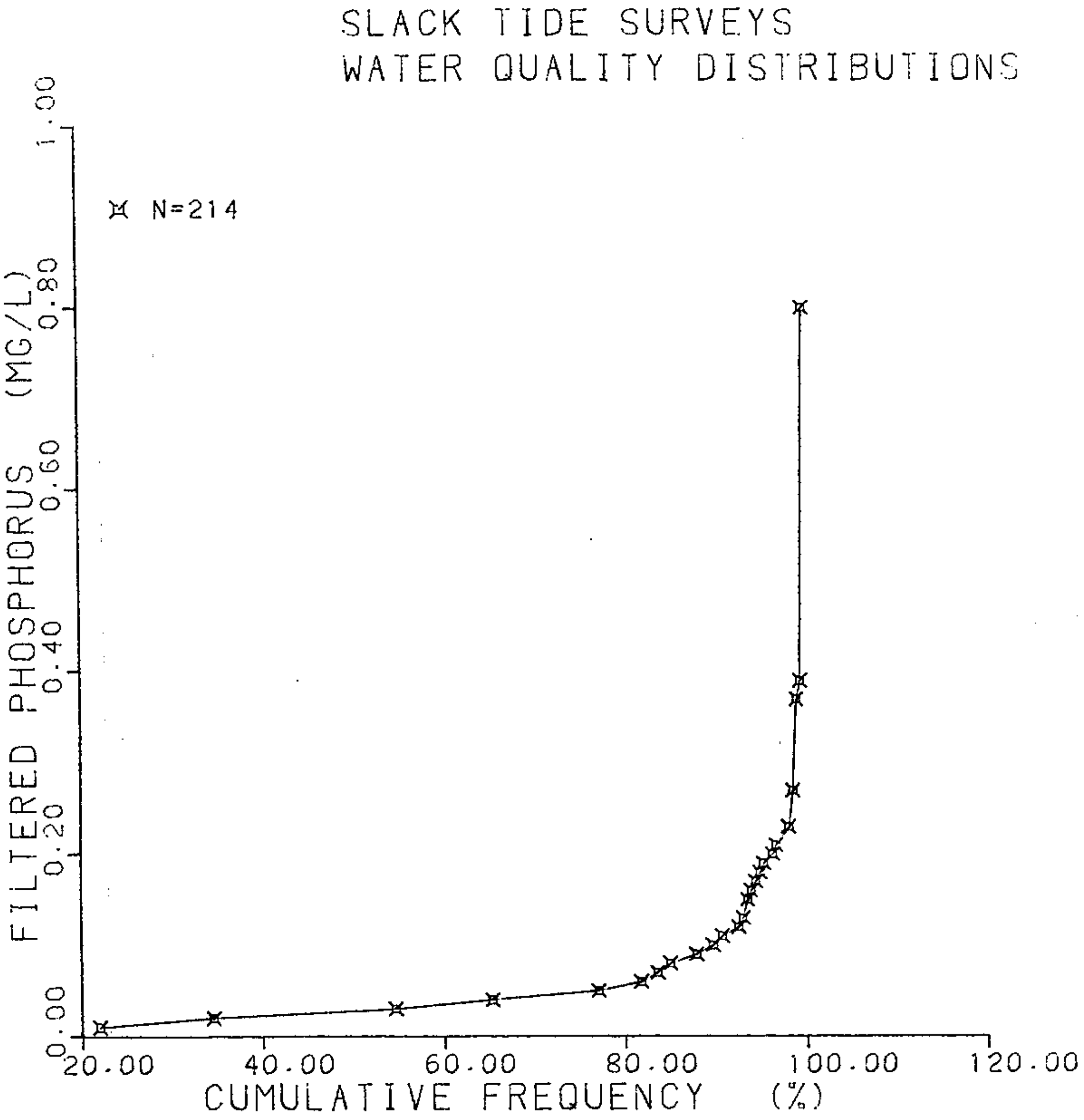


Figure 11-67 Chester River slack tide water quality survey. Filtered Phosphorus (mg/l) cumulative frequency distribution.

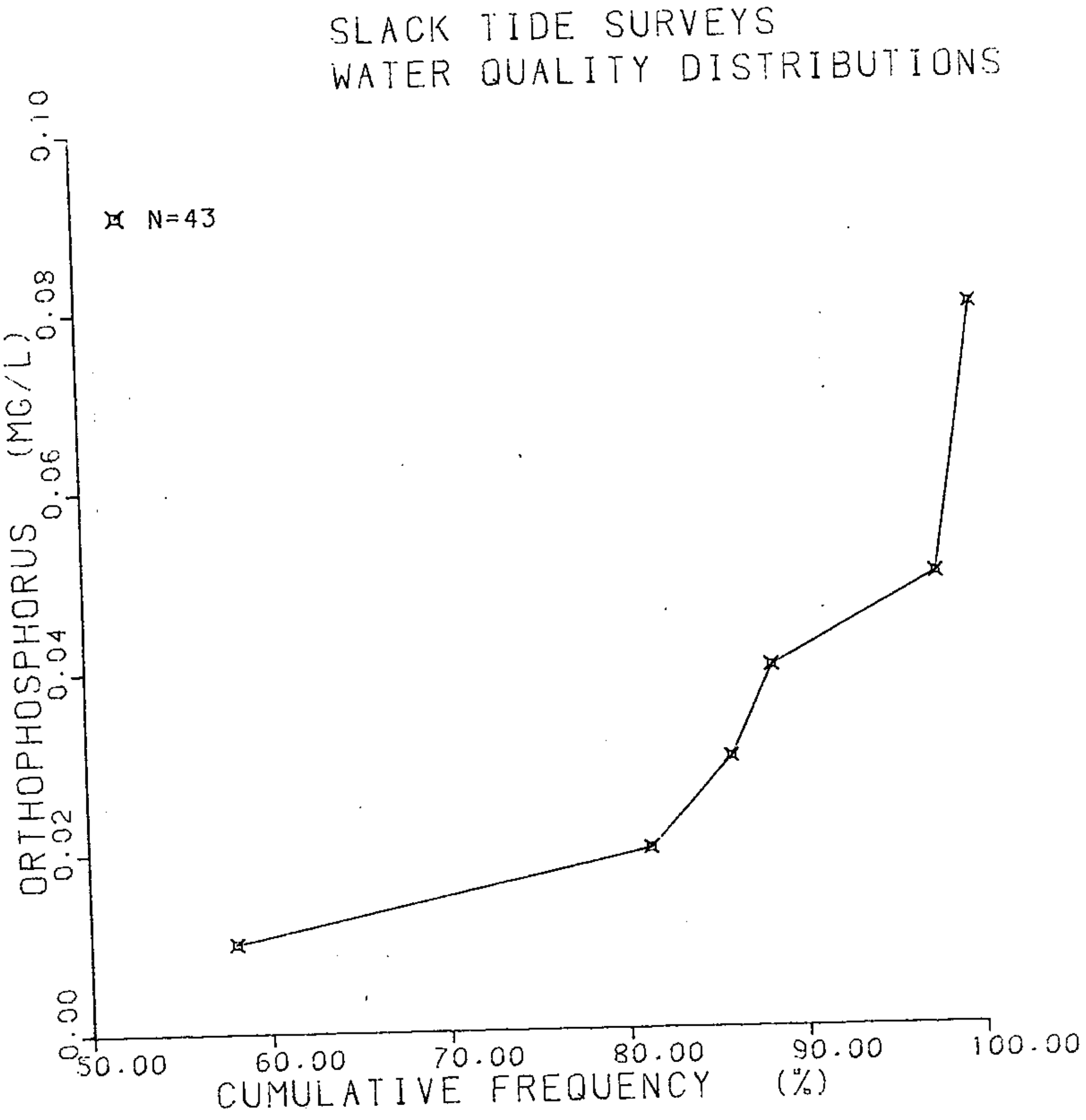


Figure 11-68 Chester River slack tide water quality survey. Orthophosphorous (mg/l) cumulative frequency distribution.

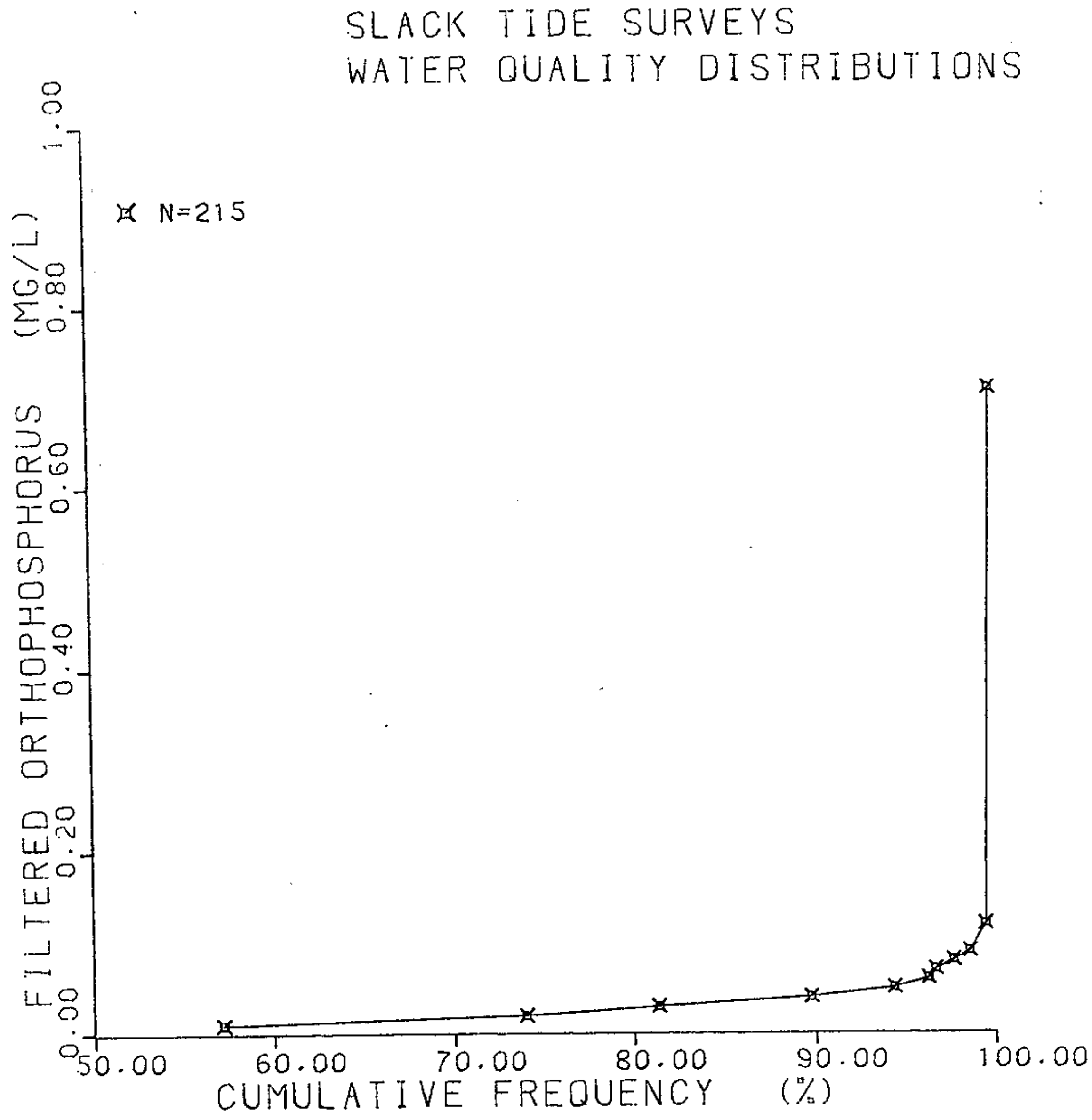
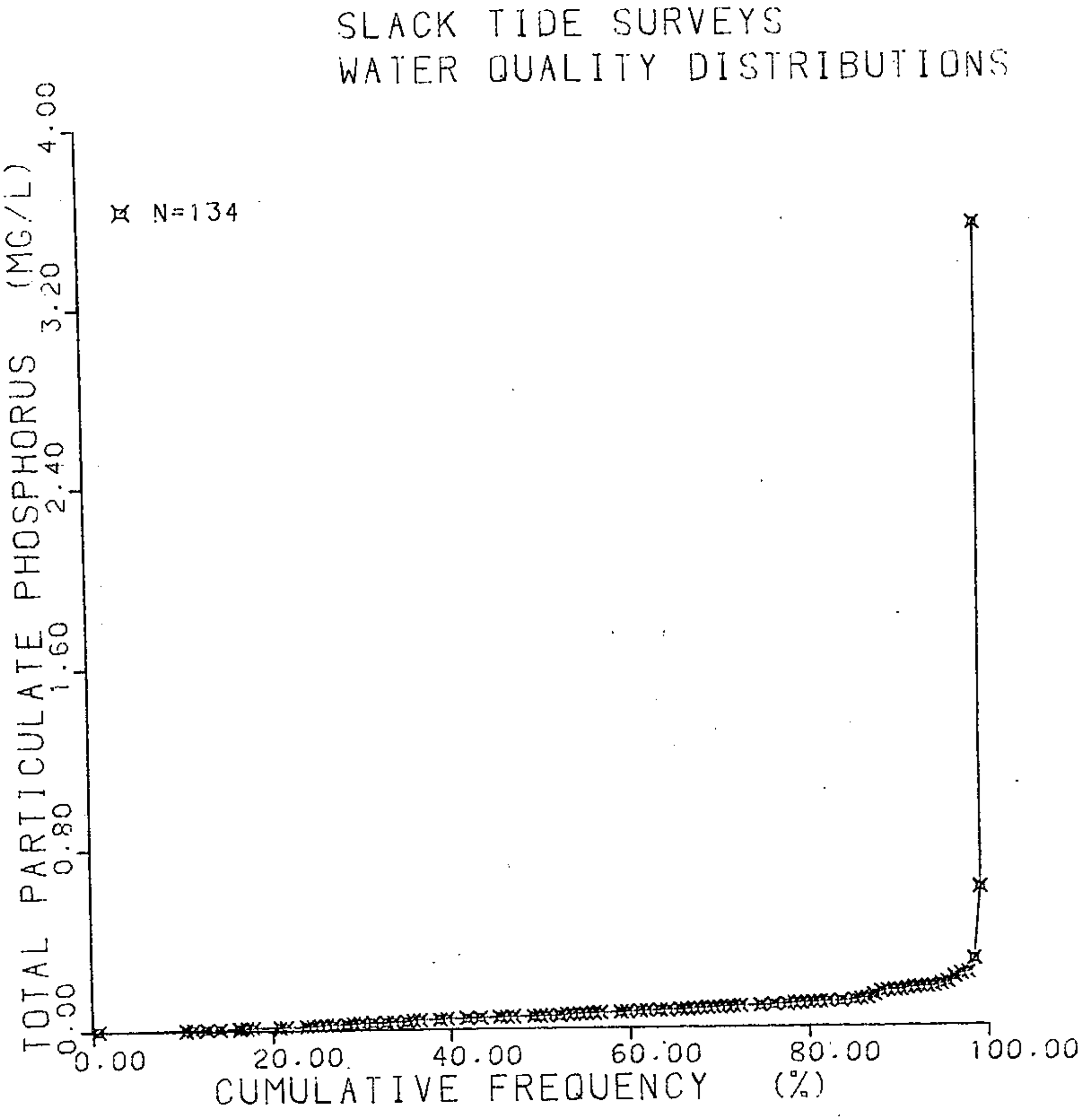


Figure 11-69 Chester River slack tide water quality survey. Filtered Orthophosphorus (mg/l) cumulative frequency distribution.



Figurell-70 Chester River slack tide water quality survey. Total Particulate Phosphorus (mg/l) cumulative frequency distribution.

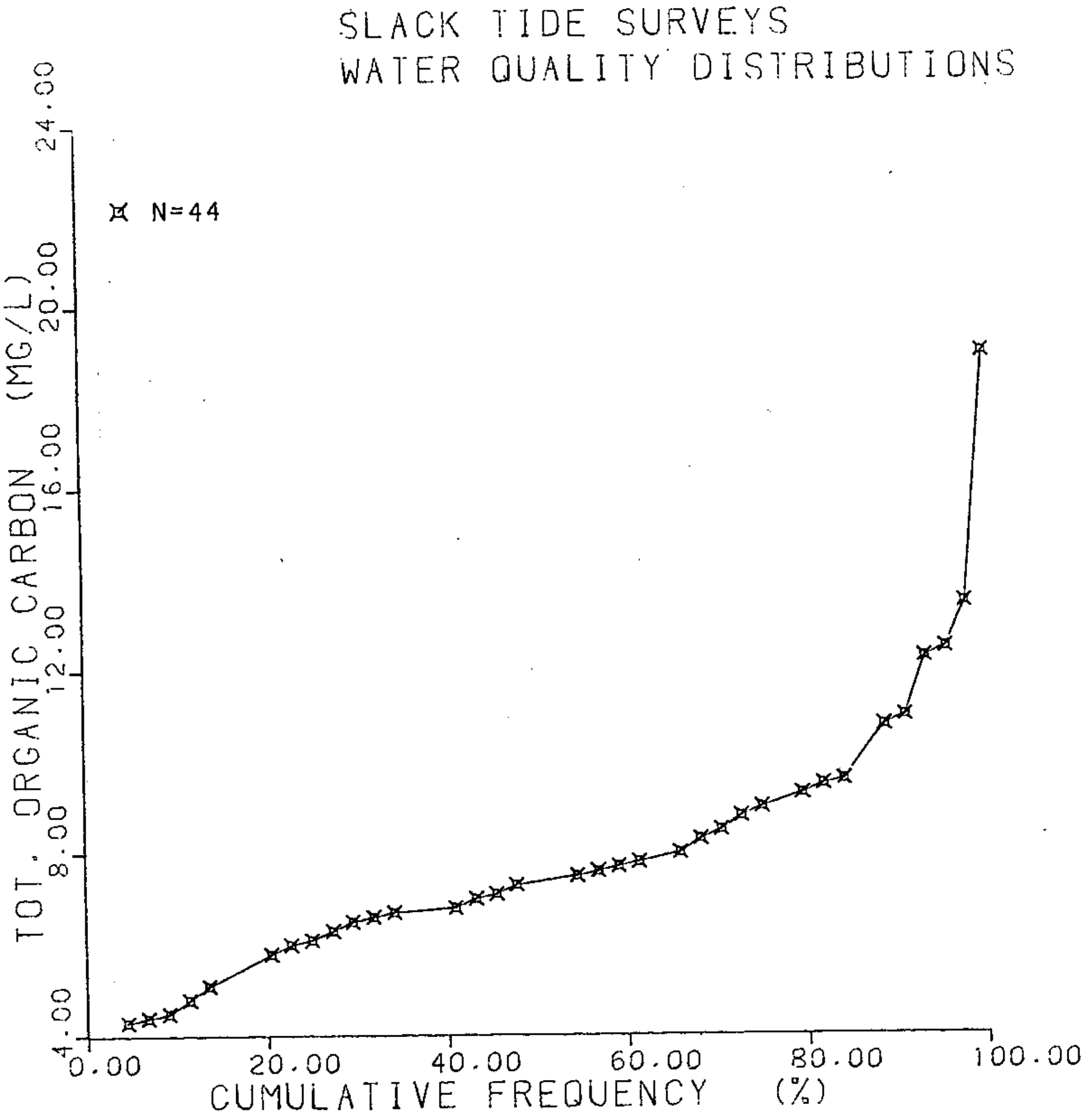


Figure 11-71 Chester River slack tide water quality survey. Total Organic Carbon (mg/l) cumulative frequency distribution.

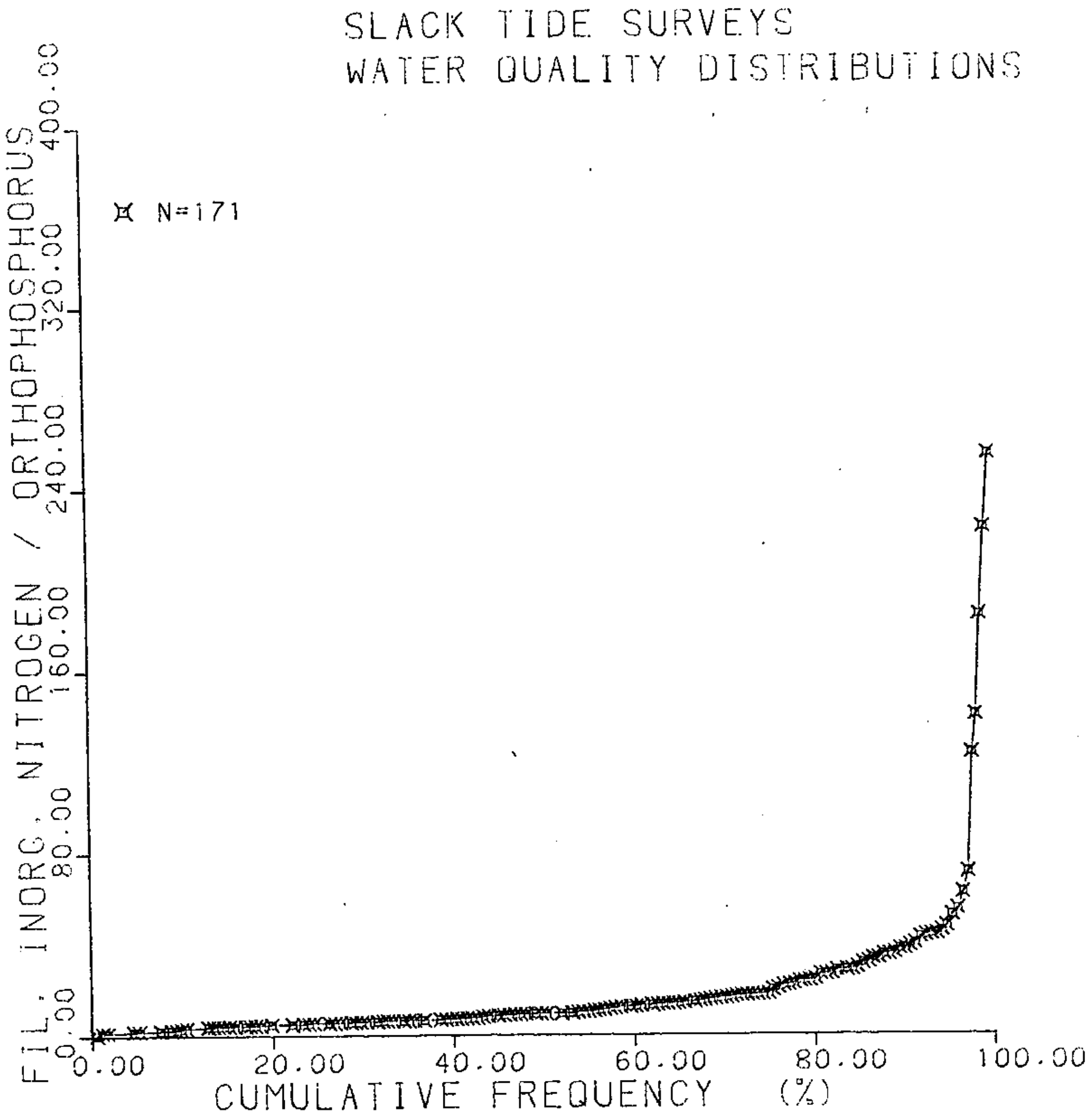


Figure 11-72 Chester River slack tide water quality survey. Filtered inorganic nitrogen/orthophosphorous cumulative frequency distribution.

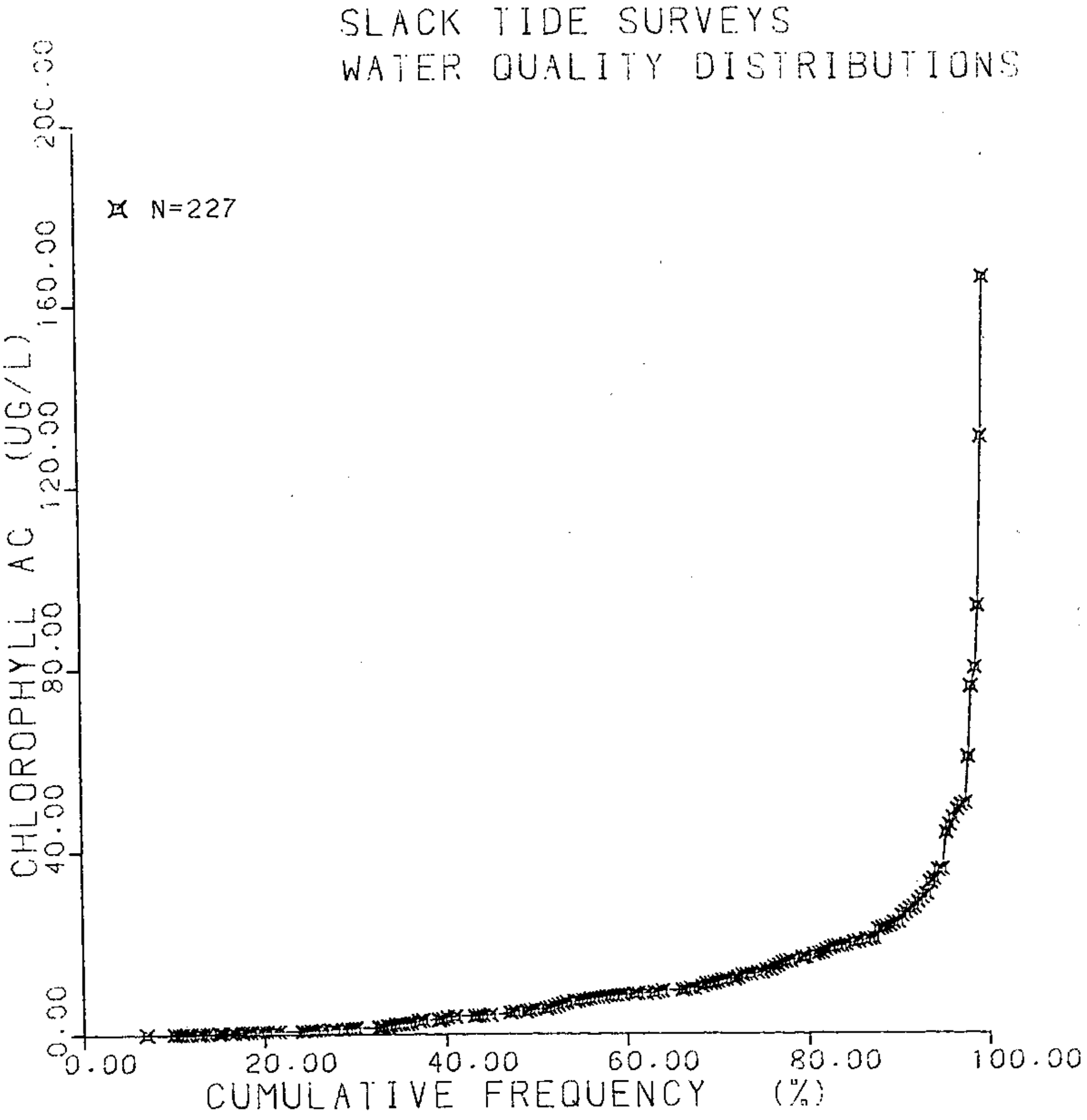


Figure 11-73 Chester River slack tide water quality survey. Chlorophyll AC (μg/l) cumulative frequency distribution.

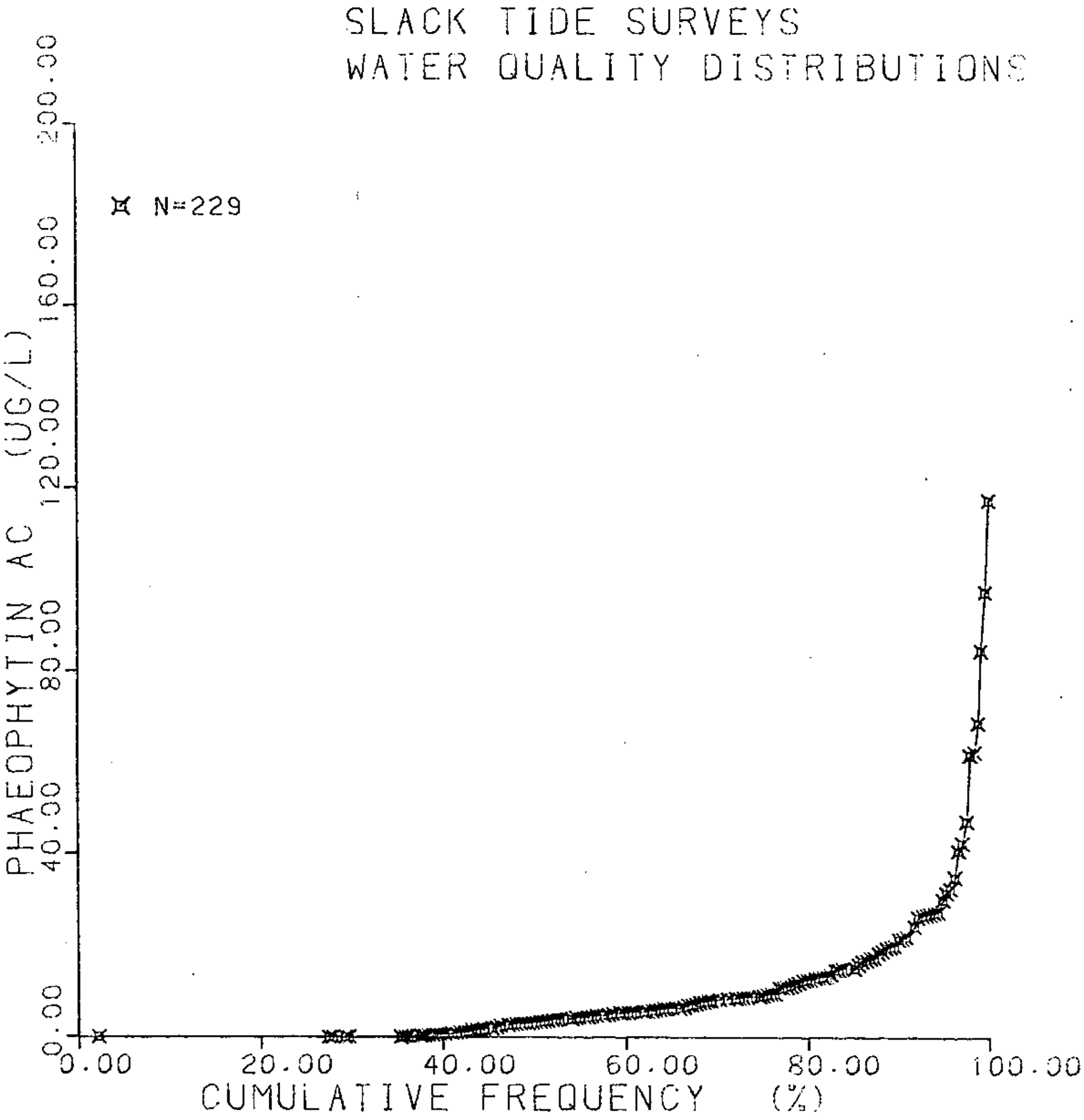


Figure 11-74 Chester River slack tide water quality survey. Phaeophytin AC (μg/l) cumulative frequency distribution.

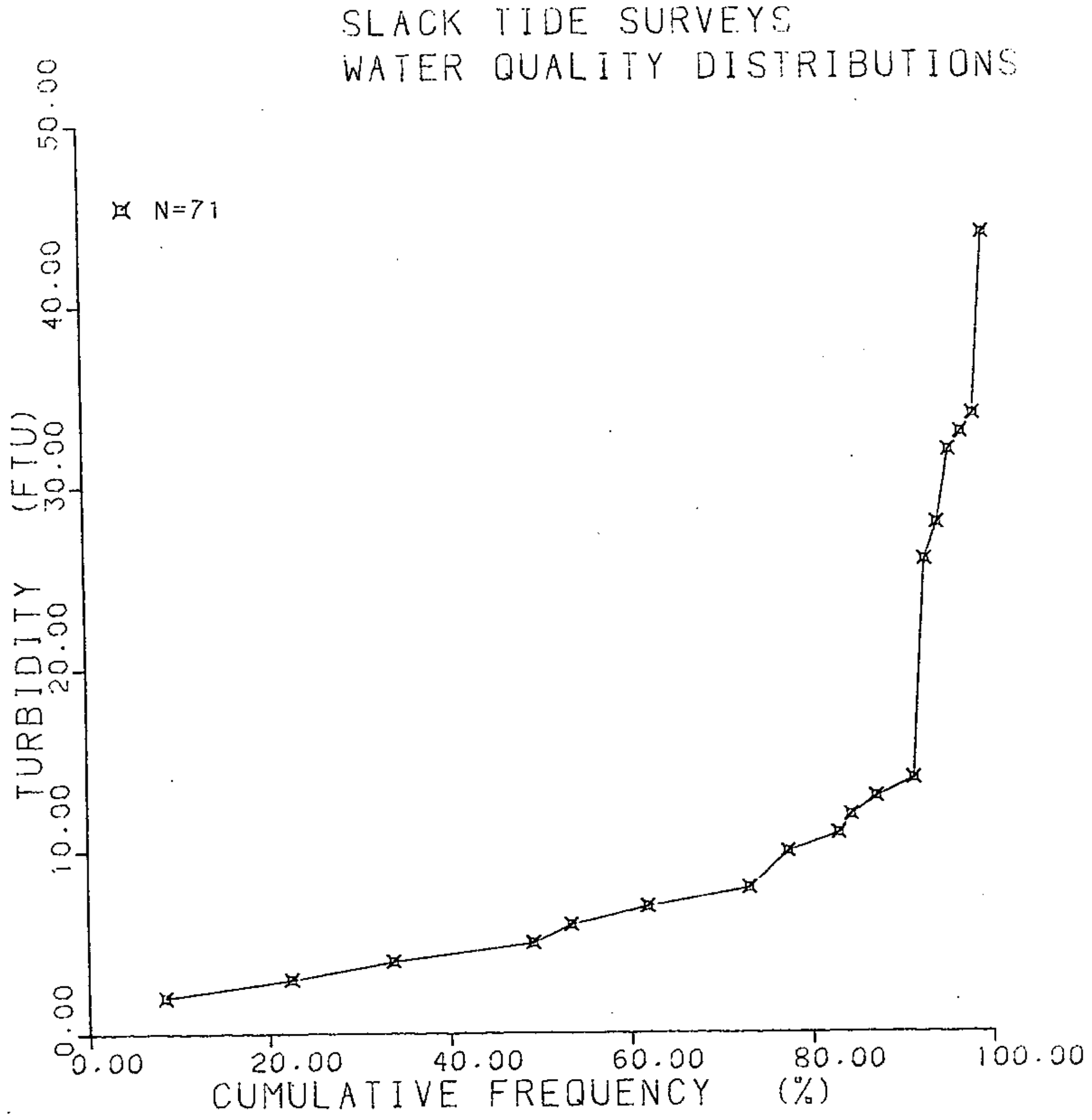


Figure 11-75Chester River slack tide water quality survey. Turbidity (FTU) cumulative frequency distribution.

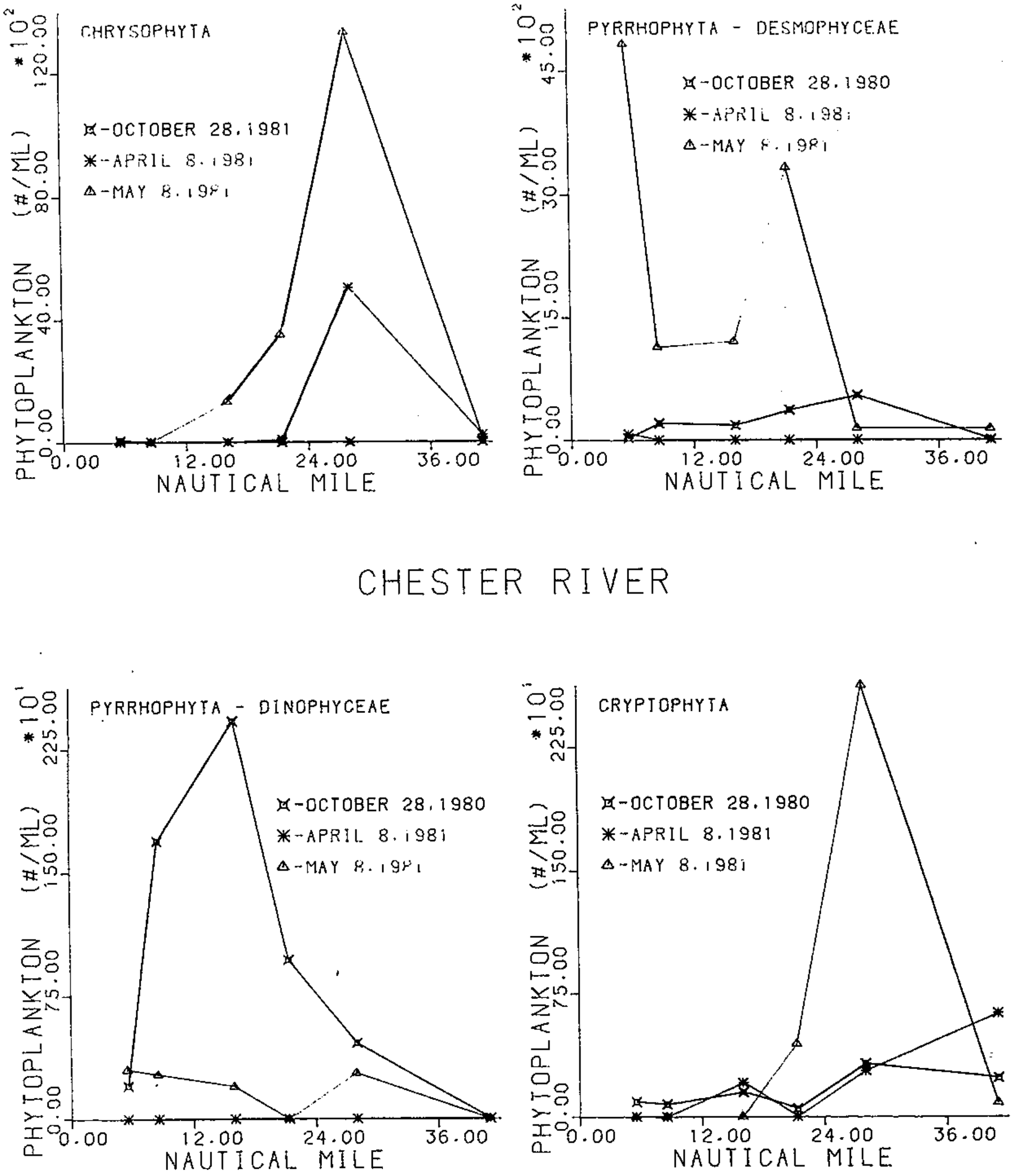


Figure 11-76 Longitudinal survey of the dominant classes of phytoplankton (cell/ml) observed during 1980-81.

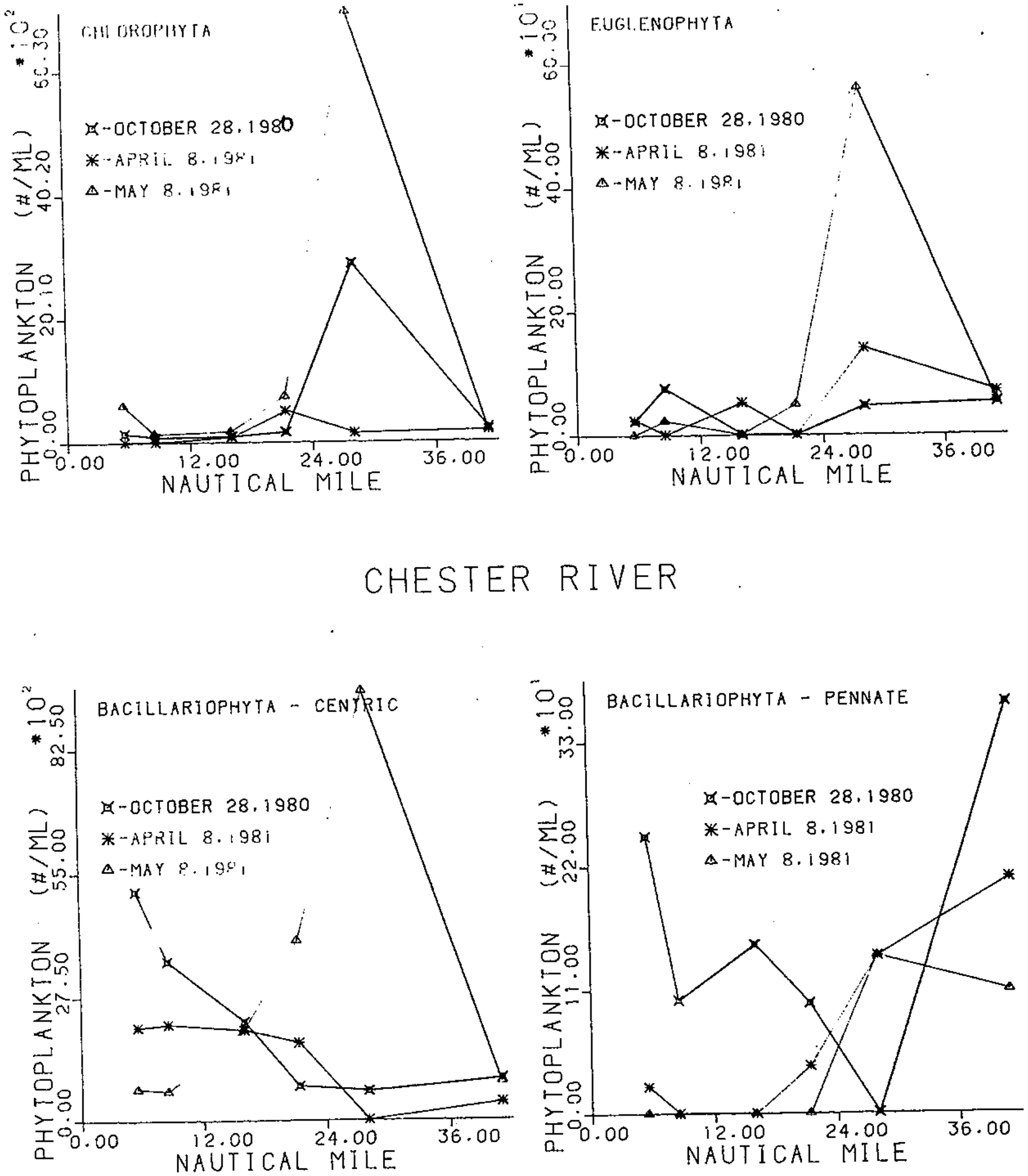


Figure 11-76 Longitudinal survey of the dominant classes of phytoplankton (cell/ml) observed during 1980-81.

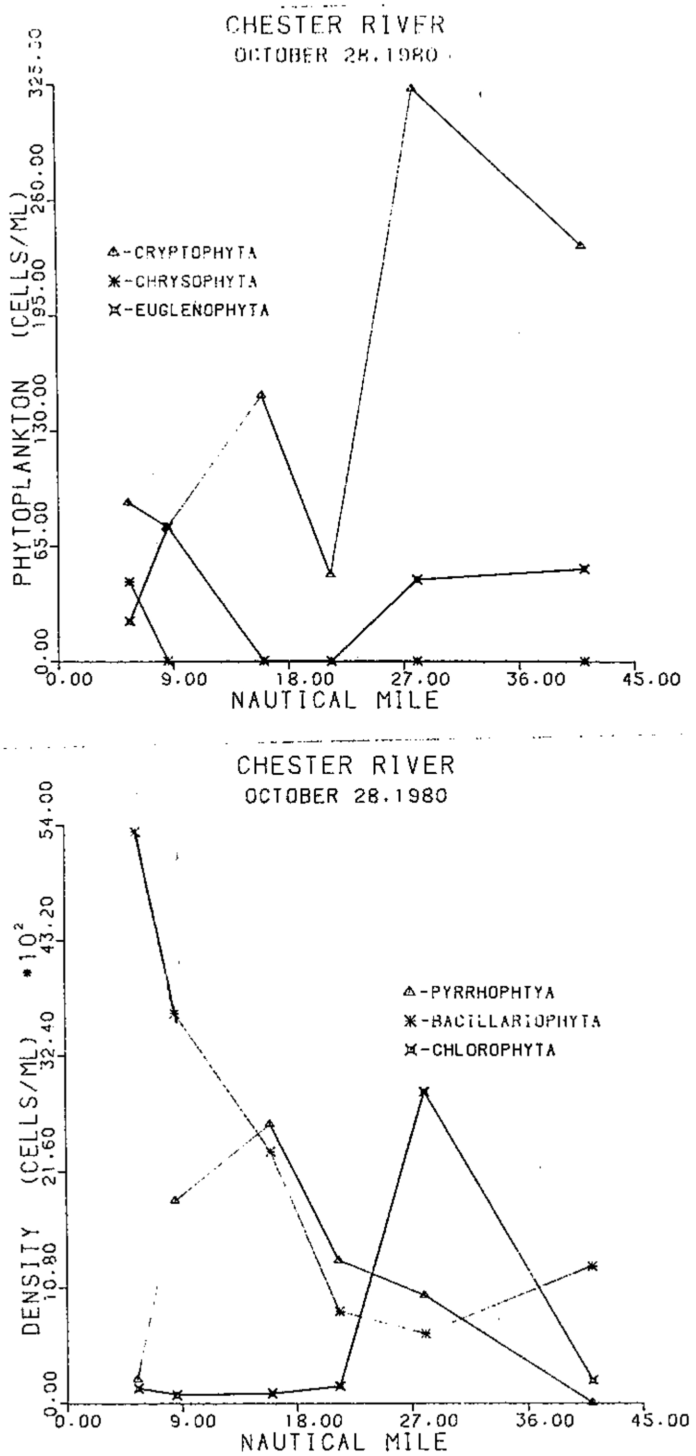


Figure 11-77 Estimated cells of phytoplankton during the October 28, 1980 longitudinal phytoplankton survey.

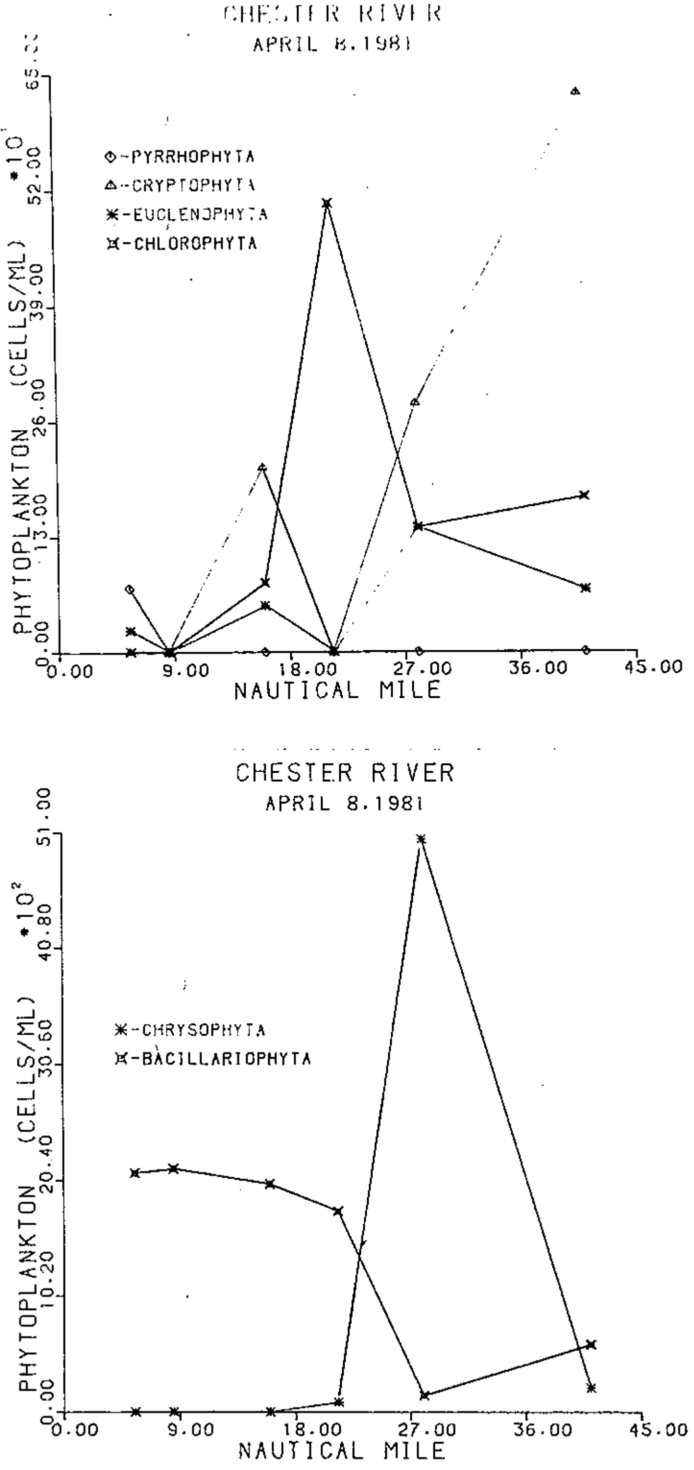


Figure 11-78 Estimated cells of phytoplankton during the May 8, 1981 longitudinal phytoplankton survey.

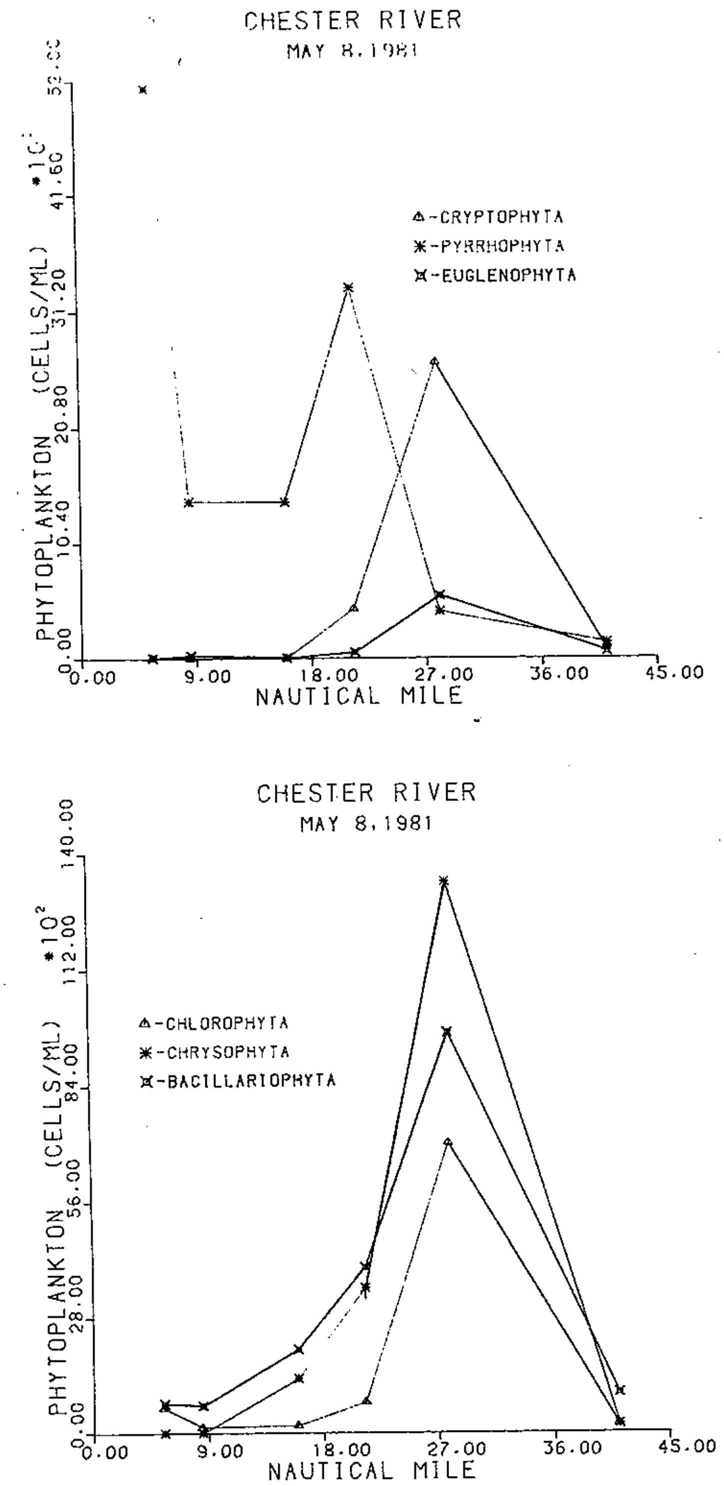


Figure 11-79 Estimated cells of phytoplankton during the April 8, 1981 longitudinal phytoplankton survey.

Table 11-4
Phytoplankton Organisms
Collected from Surface Waters of the Chester River 1980-1981

Class	Species
Cyanophyta	Agmenellum sp.
	Anacystis sp.
	Merismopedia sp.
	Calothrix sp.
	Anabaena sp.
	Spirulina sp.
	Synechococcus sp.
	Coelosphaerium sp.
	Chroococcus turgidus
	Chroococcus minor
	Oscillatoria subbrevis
	Oscillatoria sp.
	Synechocystis
	Dactylococcopsis
Lhlosophyta	Ankistrodesmus falcatus
	Scenedesmus dimorphus
	Scenedesmus armatus
	Scenedesmus incrassatulus
	Scenedusmus sp.
	Chlamydomonas sp.
	Pyramimonas sp.
	Nannochloris sp.
	Pediastrum sp.
	Oligochaetophora sp.
	Ulothrix sp.
	Closteriopsis longissima
	Gleocystis sp.
	Sphaerocystis sp.
	Arthrodesmus sp.
	Staurastrum sp.
	Eudorina sp.
	Cerasterias sp.
	Mougeoutia sp.
	Spirogyra sp.
Chrysophyta	Ochromonas sp.
Bacillariophyta	Centrales
	Cyclotella sp.
	Thalassiosira spl
	Skeletonema costatum
	Chaetoceros danicus
	Chaetoceros sp.
	Stephanodiscus tenuis
	Steophnodiscus sp.
	Melosira sp.

Table 11-4 (continued)
Phytoplankton Organisms
Collected from Surface Waters of the Chester River 1980-1981

Class	Species
	Pennales
	Fragilaria sp.
	Nitzschia closterium
	Nitzschia sigmoidea
	Nitzschia sp.
	Diatoma elongatum
	Diatoma sp.
	Pinnularia sp.
	Cymbella sp.
	Epithemia sp.
	Navicula sp.
	Pleurosigma sp.
	Gomphonema sp.
	Meridion sp.
	Synedra sp.
	Denticula sp.
	Diploneis sp.
	Amphiprora sp.
	Leptocylindrus
Pyrrophyta	Prorocentrum minimum
	Katodinium rotundatum
	Polykrikos sp.
	Amphidinium sp.
	Gyrodinium estuariale
	Gyrodinium sp.
	Gymnodinium aurantium
	Gymnodinium verruculosm
	Gymnodinium rotundatum
	Gymnodinium splendens
	Gymnodinium sp.
	Glenodinium sp.
	Heterocapsa or Glenodinium
	Peridinium pentagonum
	Peridinium sp.
Englenophyta	Eutreptia
	Phacus
	Euglena
Cryptophyta	Chroomonas

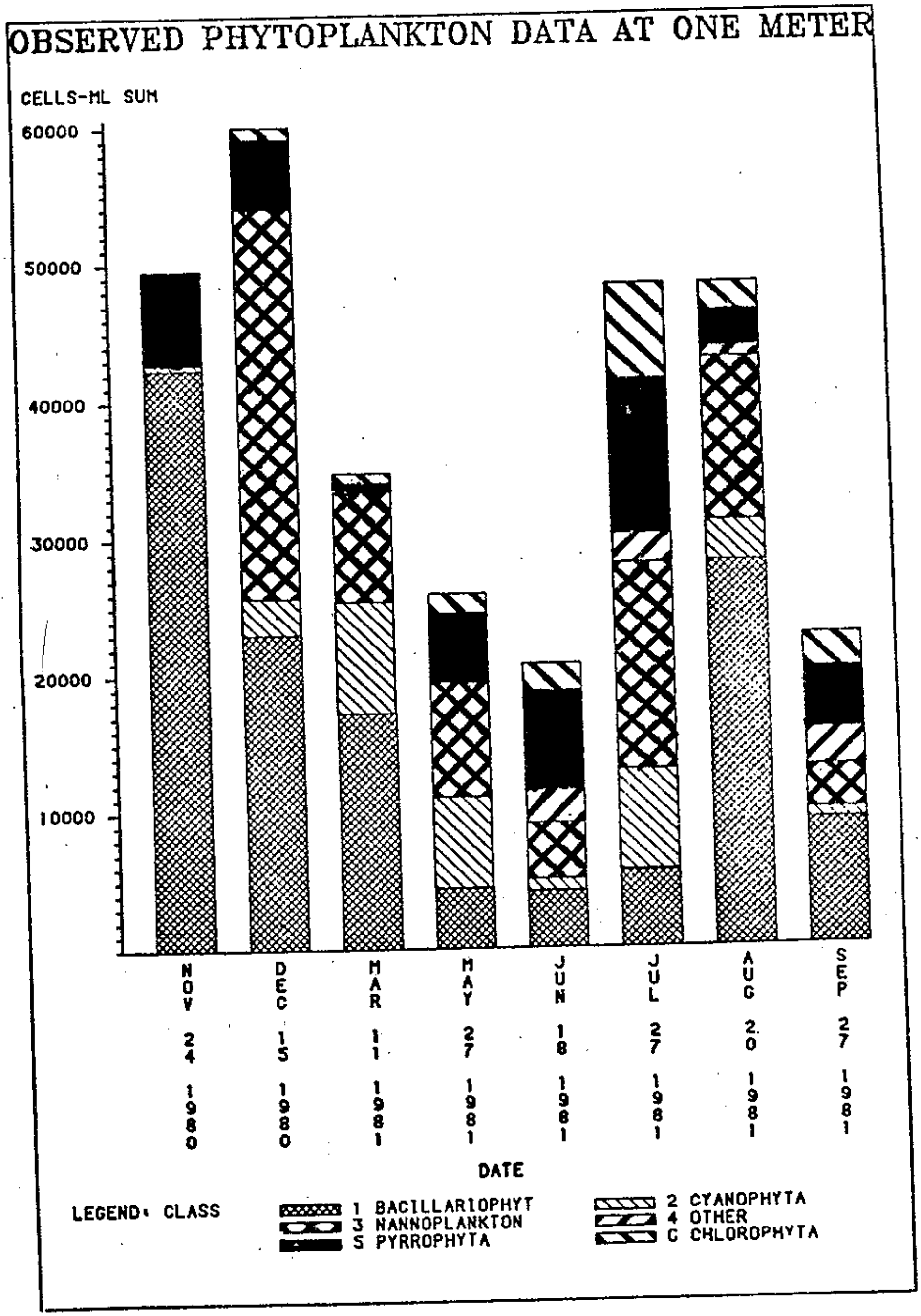


Figure 11-80 Chester River-Phytoplankton cells, November 1980-September 1981.

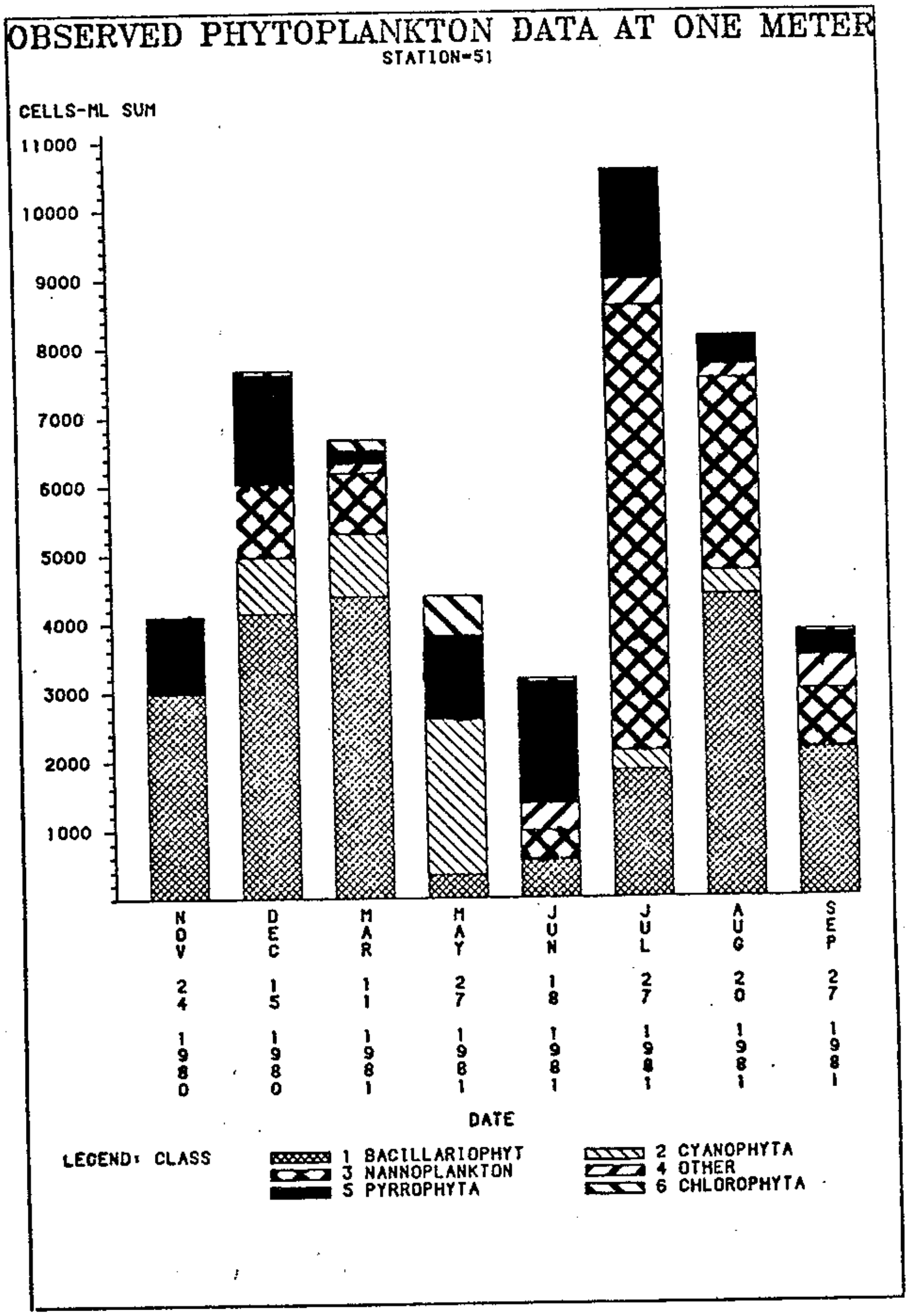


Figure 11-81 Chester River phytoplankton class dominance, November 1980-September 1981, at station 51.

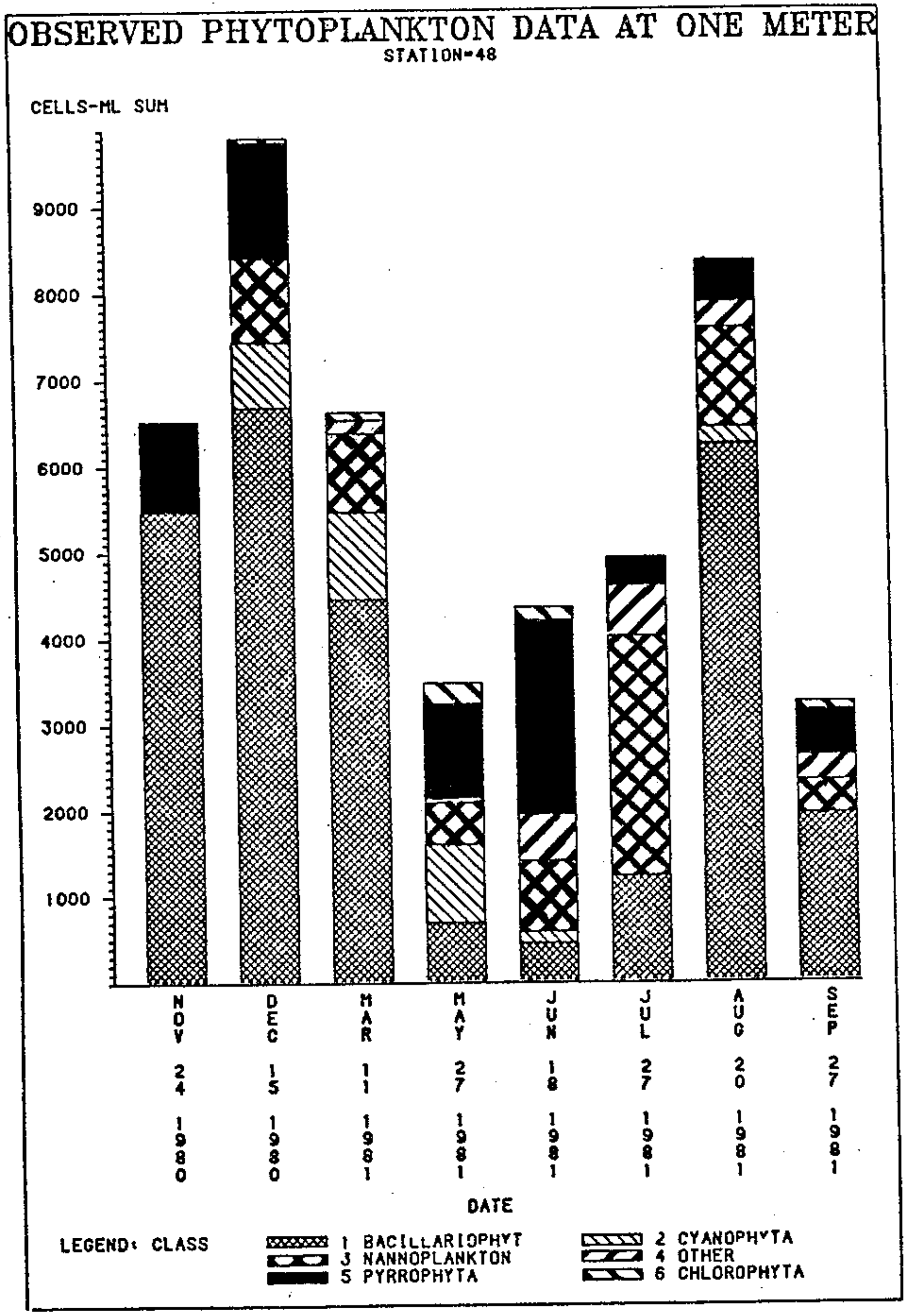


Figure 11-82 Chester River phytoplankton class dominance, November 1980-September 1981 at station 48.

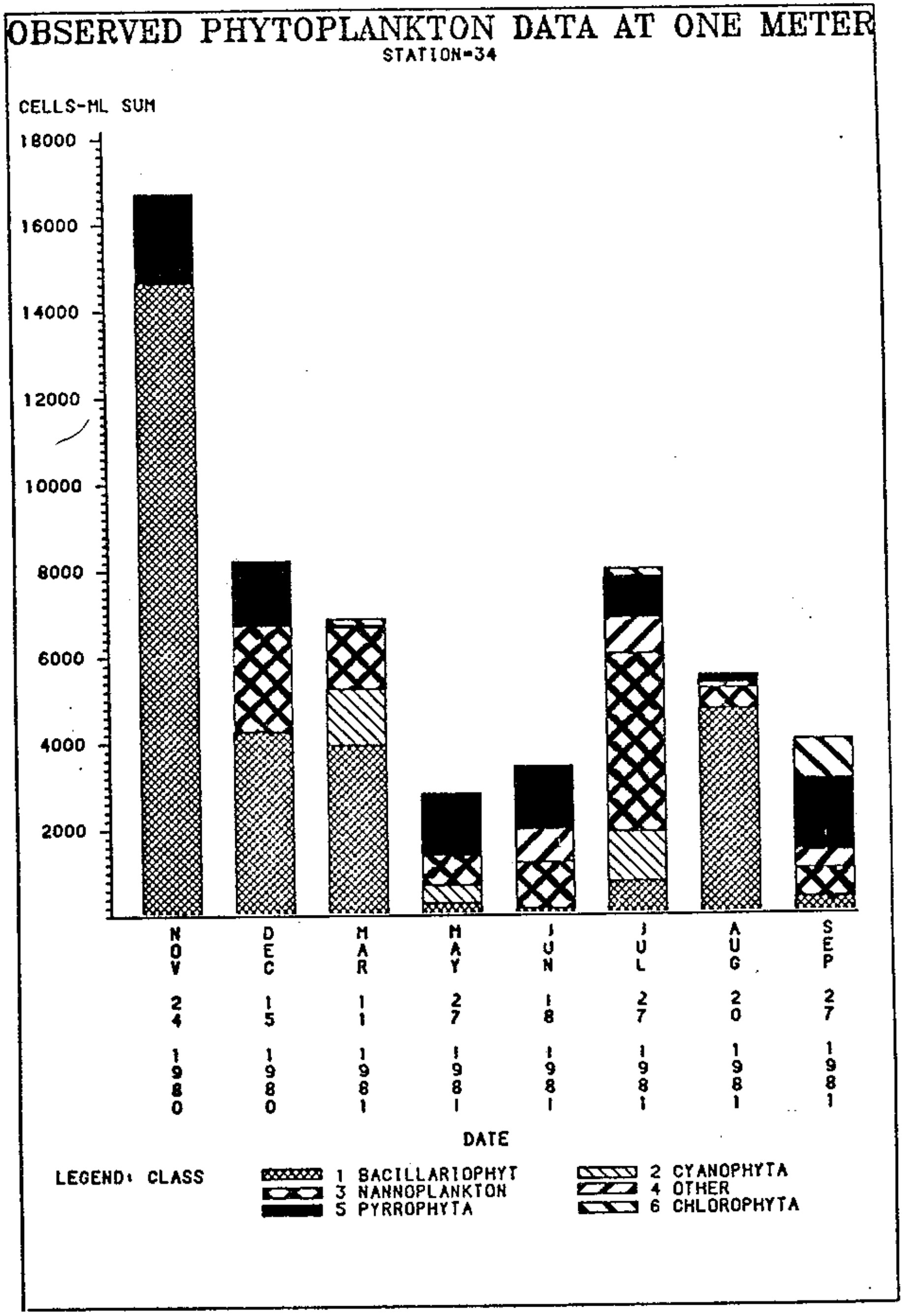


Figure 11-83 Chester River phytoplankton class dominance, November 1980 - September 1981, at station 34.

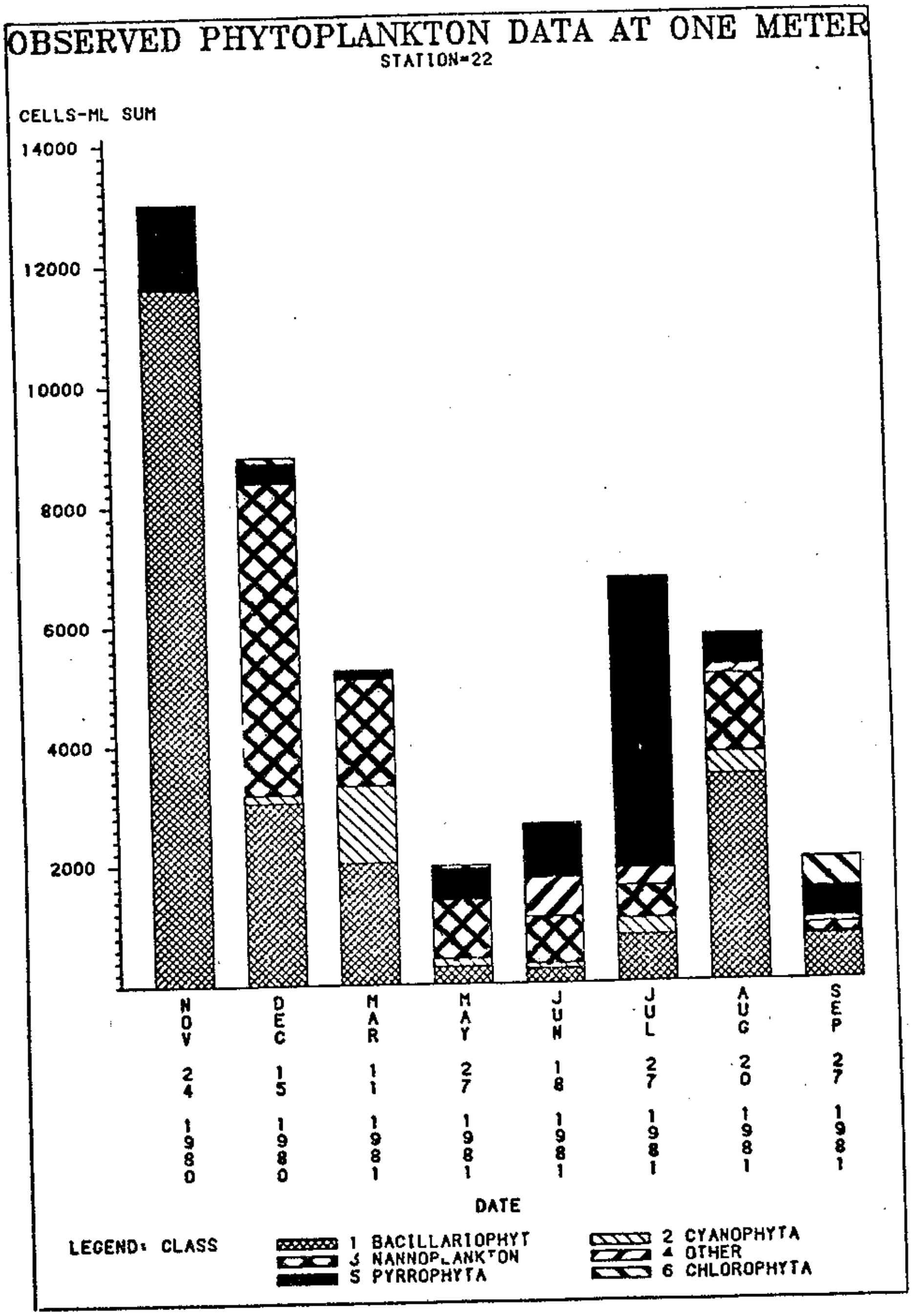


Figure 11-84 Chester River phytoplankton class dominance, November 1980-September 1981 at Station 22.

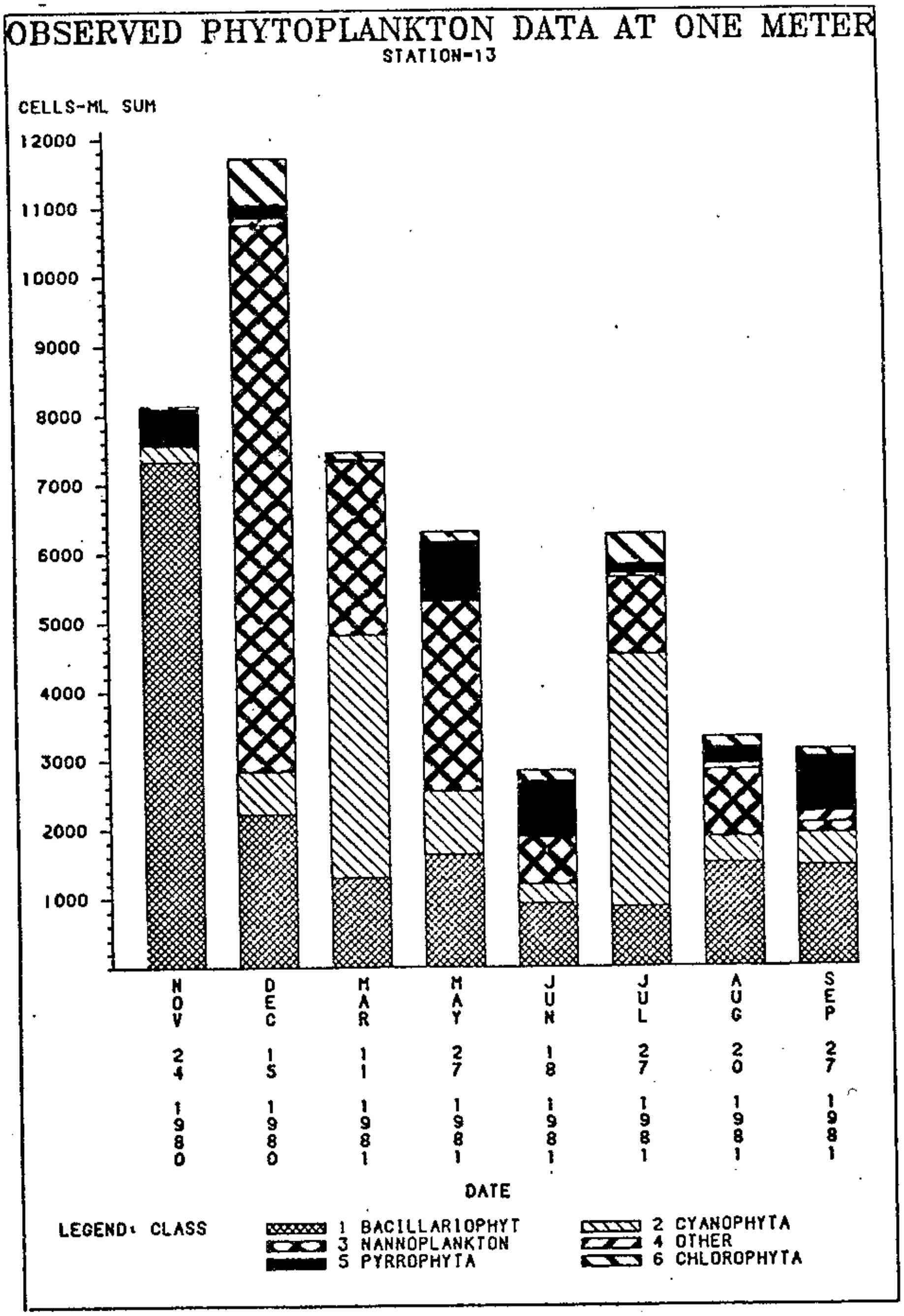


Figure 11-85 Chester River phytoplankton class dominance, November 1980-September 1981 at station 13.

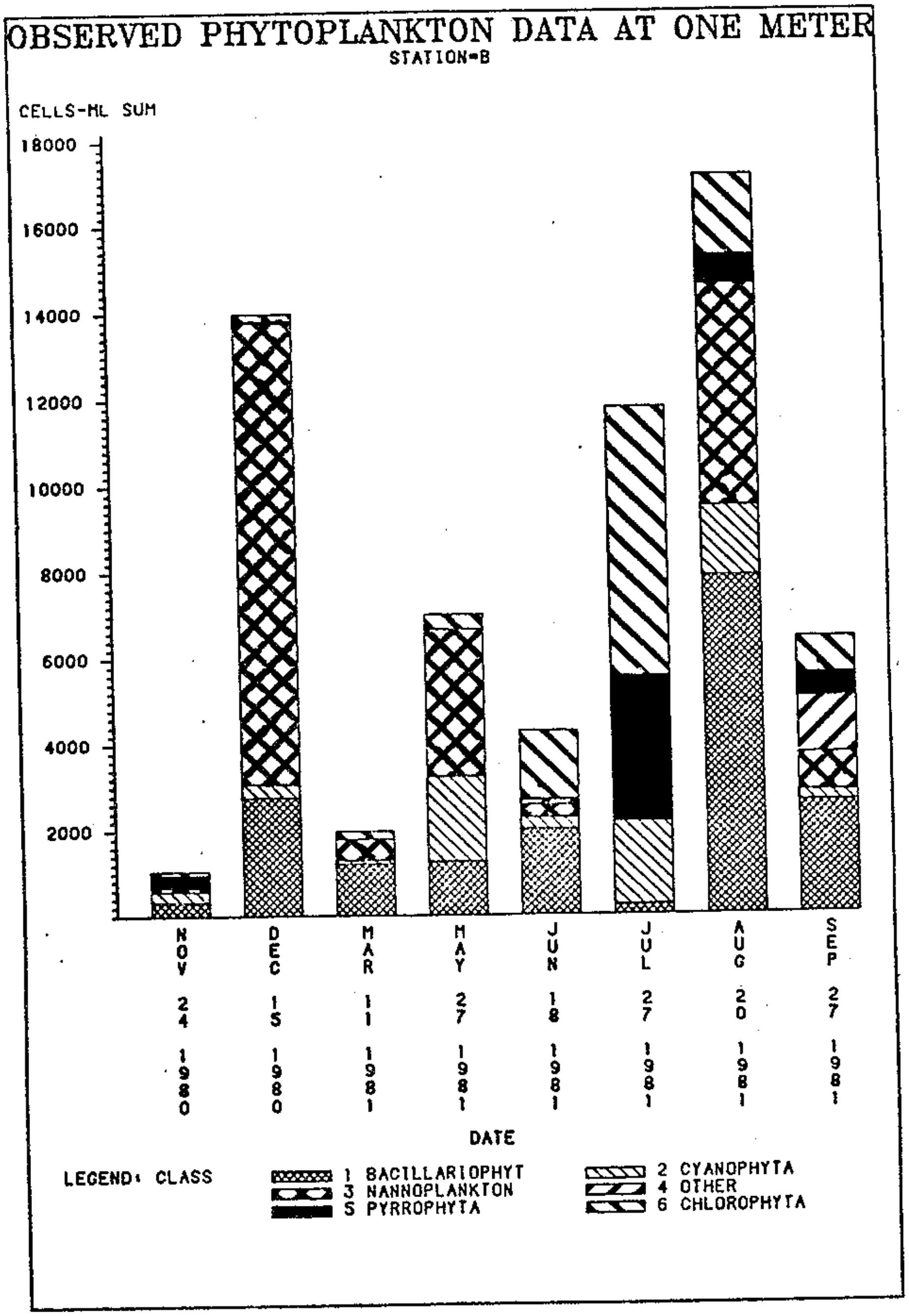


Figure 11-86 Chester River phytoplankton class dominance, November 1980-September 1981, at Station B.

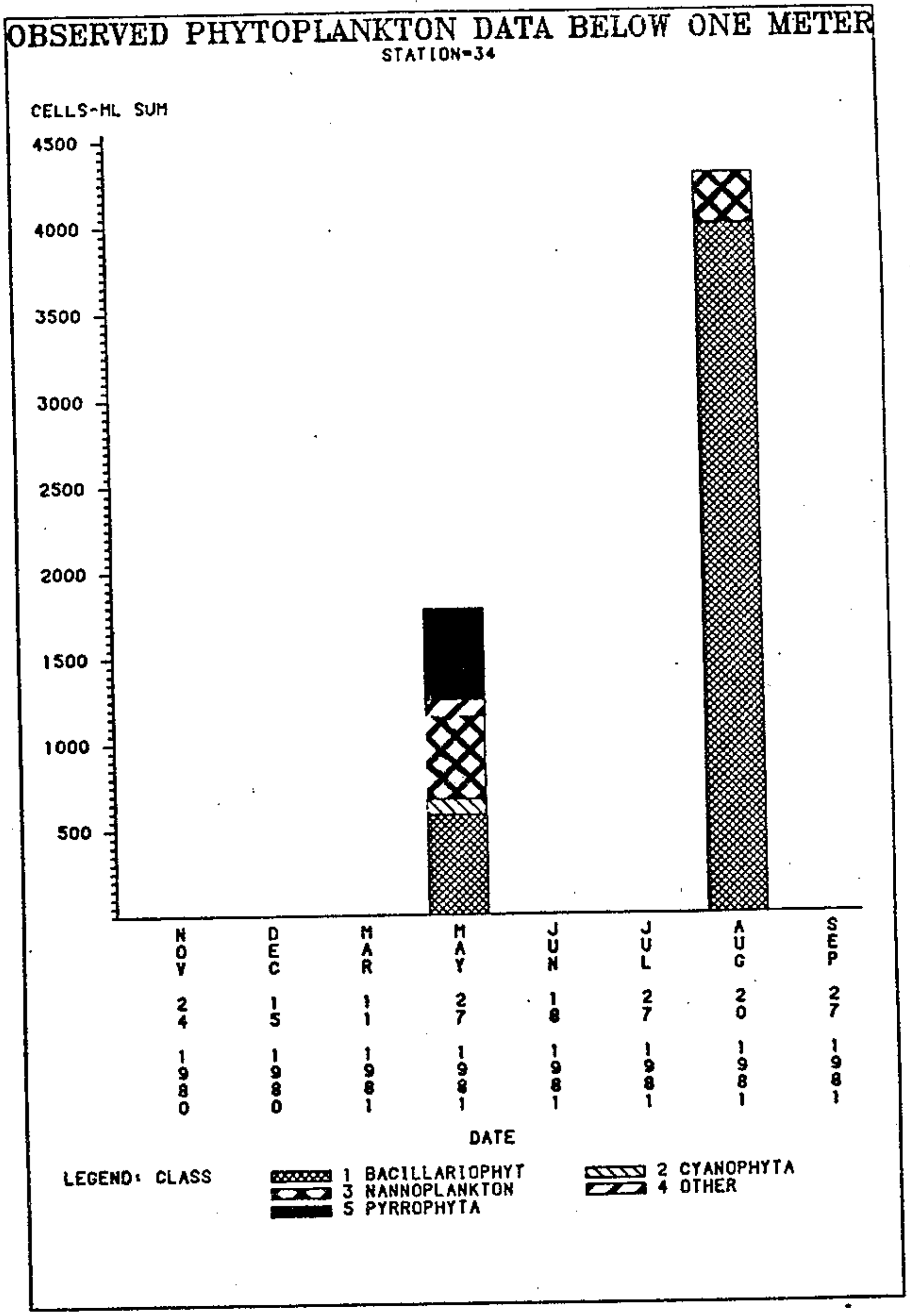


Figure 11-87 Chester River phytoplankton class dominance, May 1981 and August, 1981 at (8 meter depth) station 34.

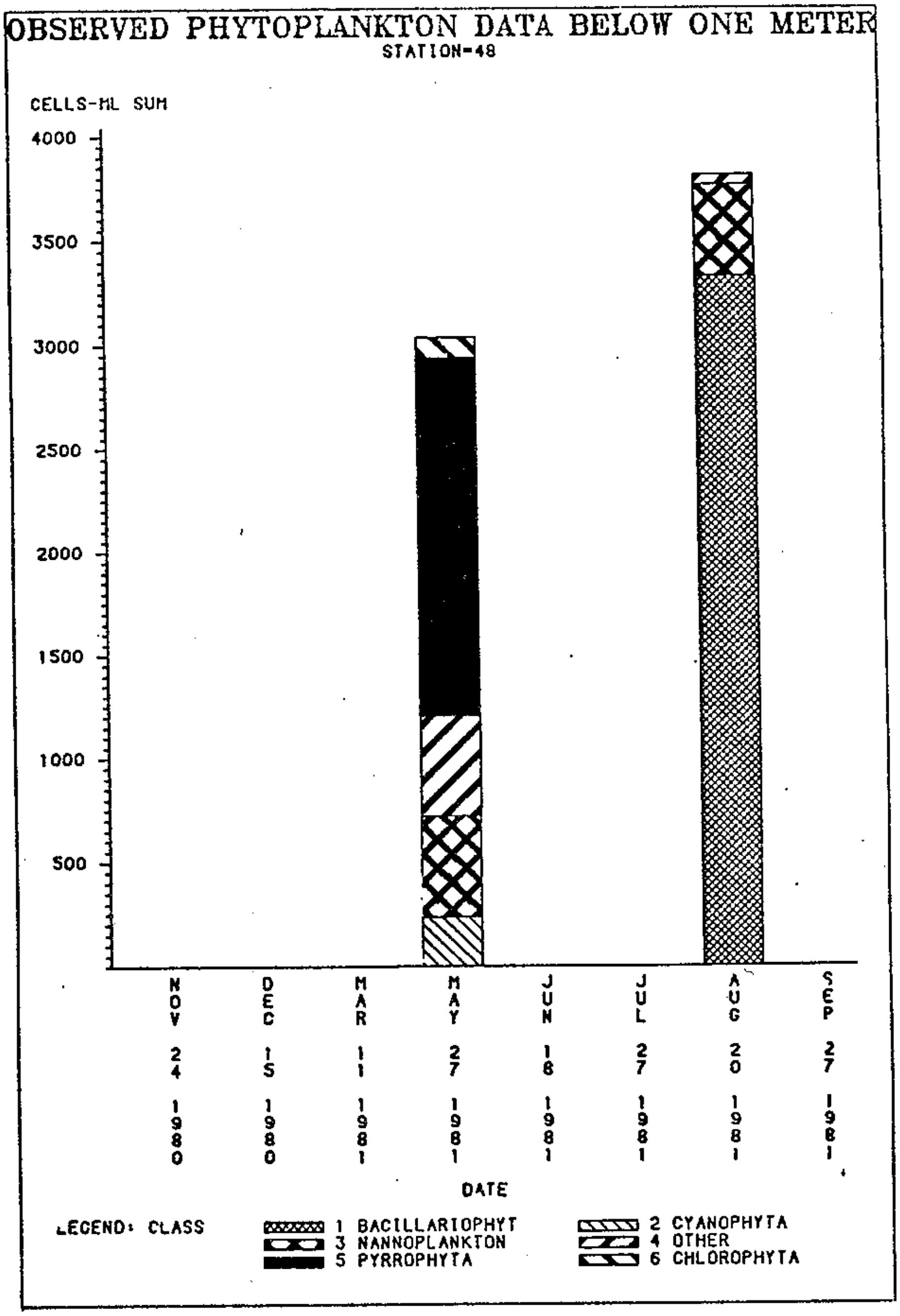


Figure 11-88 Chester River phytoplankton class dominance, May 1981 and August, 1981 at (8 meters depth) station 48.

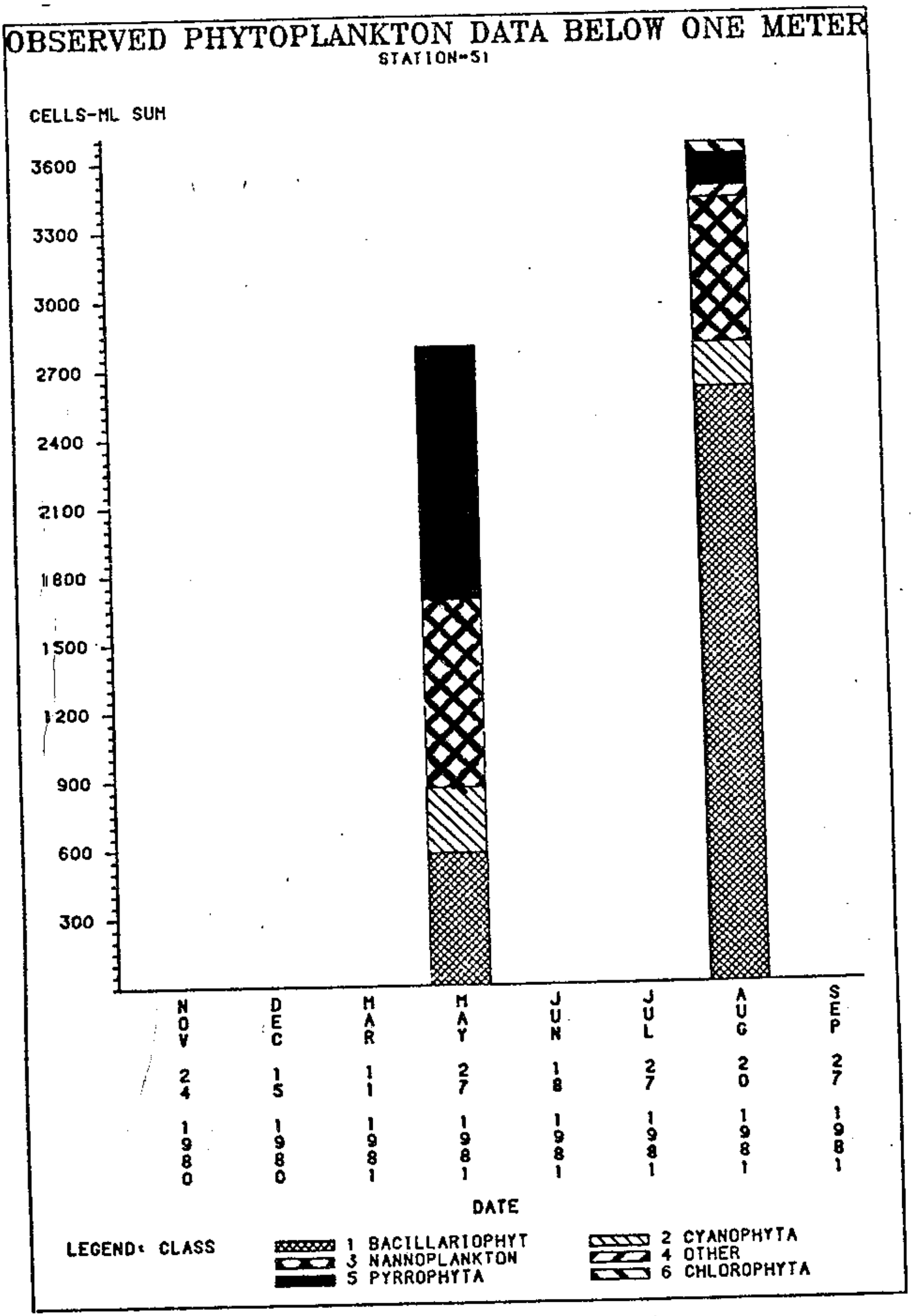


Figure 11-89 Chester River phytoplankton class dominance, May 1981 and August 1981, at (9 meters depth) station 51.

Table 11-5
Dominant Individuals For Each Sampling Period

	Survey Date							
Station	11/24/80	12/15/80	3/11/81	5/27/81	6/18/81	7/27/81	8/20/81	9/27/8
51	Skeletonema costatum 1881 cells/ml	S. costatum 3086 cells/ml	Melosira sp. 3858 cells/ml	Synechocystis sp. 2170 cells/ml	Grodinium estuariale 1013 cells/ml	Thalassiosira sp. 772 cells/ml	Melosira sp. 3424 cells/ml	Melosira s 482 cells/m
48	S. costatum 3472 cells/ml	S. costatum 5257 cells/ml	Melosira sp. 4196 cells/ml	Synechocystis sp. 916 cells/ml	Prorocentrum minimum 627 cells/ml	Melosira sp. 772 cells/ml	Melosira sp. 4774 cells/ml	Unident fil sp. 434 cells/m
34	S. costatum 12,731 cells/ml	S. costatum 3183 cells/ml	Melosira sp. 2701 cells/ml	Gyrodinium estuariale 1109 cells/ml	Chroomonas sp. 627 cells	Chroococcus minor 820 cells/ml	Melosira sp. 3906 cells/ml	Colonial g sp. 916 cells/m
22	S. costatum 9742 cells/ml	S. costatum 1688 cells/ml	Melosira sp. 1399 cells/ml Synechocystis sp. 1302 cells/ml	Ghynodinium sp. 241 cells/ml	Chroomonas sp. 482 cells/ml	Amphidinium sp. 1350 cells/ml	Melosira sp. 2701 cells/ml	Colonial g sp. 434 cells/m
13	S. costatum 5835 cells/ml	Melosira sp. 1109 cells/ml	Synechocystis sp. 3376 cells/ml	Thalassiosira sp. 820 cells/ml	Gymnodium nelsoni 579 cells/ml	Oscillatoria sp. 2749 cells/ml	Melosira sp. 627 cella/ml.	Melosira s 579 cells/m
B	Perdinium sp. 289 cells/ml	Melosira sp. 1399 cells/ml	Fragilaria sp. 434 cells/ml	Synechocystis sp. 1977 cells/ml	Melosira sp. 1109 cells/ml	Chlamydomonas sp. 5616 cells/ml	Cyclotella sp. 3328 cells/ml. Thalassiosira sp. 3086 cells/ml	Melosira s 772 cells/m Chroomonas 723 cells/m