LAKE ERIE WATER QUALITY MONITORING PROGRAM IN THE VICINITY OF THE DAVIS-BESSE NUCLEAR POWER STATION FOR 1980

Environmental Technical Specifications Sec. 3.1.1.a.1 Water Quality Analysis

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Prepared for

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Toledo, Ohio
Contract No. 28533

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COLUMBUS, OHIO

FEBRUARY 1981

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Procedures

Water quality methodology used for this study is contained in CLEAR Procedures Manual No. 8, Procedures for Aquatic Ecology Monitoring Program at the Davis-Besse Nuclear Power Station (Herdendorf, et al., 1979). Water quality samples were collected and related sensor measurements were made at three stations (Figure 1) during the ice-free period of 1980 (April through November). Because of the severe winter of 1978-1979, spring sampling was delayed, and the April samples were obtained on 30 April 1980. The 14 water quality parameters measured and the analytical methods employed for these determinations are listed in Table 1.

Field Measurements. Water quality measurements were made approximately every 30 days at Stations 1, 8 and 13 (Figure 1). Measurements of temperature, dissolved oxygen, conductivity, transparency and solar radiation were made in the field at the surface and approximately 50 cm above the bottom. Temperature and dissolved oxygen were measured with a YSI model 54A meter, conductivity with a Beckman RB3-3341 solubridge temperature-compensated meter, transparency with a 30-cm diameter Secchi disk and solar radiation with a Protomatic underwater photometer (Table 1).

Laboratory Determinations. Water samples were collected at the surface and approximately 50 cm above the bottom using a three-liter Kemmerer sampler and were placed in one-gallon collapsible polyethylene containers. These containers, supplied by TECO Chemistry Laboratory, were filled completely, labelled with station number, date and depth and delivered to the laboratory. Laboratory determinations of 10 water quality parameters (Table 1) were performed at TECO Chemistry Laboratory, normally within 1-10 days after sampling.

Results

The results of the monthly 1980 water quality determinations at Stations 1, 8 and 13 are presented in Tables 2-9. The monitoring stations have been selected to characterize Lake Erie water quality at several distinct areas within the vicinity of the Davis-Besse Nuclear Power Station (Figure 1). Station 1, at a point 500 feet offshore and 1,500 feet west of the discharge structure, is positioned to monitor nearshore water masses and serves as a control for the other two stations. Station 8 is 3,000 feet offshore and is positioned in the vicinity of the water intake crib. Station 13 is located 500 feet east of the discharge structure in the region of the discharge plume. All of the stations lie within Excepted Area "B" for Lake Erie water quality standards, established by the Ohio Environmental Protection Agency (1978, page 80).

Mean annual (April through November) values and ranges for the monthly water quality determinations for the 14 parameters are presented in Table 10. The results of the 1980 monitoring program indicate that none of the parameters examined exceeded Ohio EPA standards.

Analysis

Seasonal Variations. The quality of the water in the vicinity of the Davis-Besse Nuclear Power Station during the ice-free period of 1980 was typical for the south shore of western Lake Erie and showed normal seasonal trends. Average temperature rose 14°C from late April to late July and then dropped over 22°C by late November (Figure 2). Average dissolved oxygen concentrations fell from 10.8 ppm in late April to a low of 7.2 ppm in late August, then rose again to 13.8 ppm in late November. Hydrogen-ion concentrations remained fairly stable throughout the year, varying only 0.9 units (Figure 2).

Mild turbulence in spring and fall is reflected by the higher turbidity and suspended solids measurements for these periods (Figure 3). The decreased sediment load during summer months accounts for the higher transparency readings in July, August and September (Figure 3). A three-fold improvement in the water clarity was noted between late April and August, but a smaller decrease was observed from August to late November.

Major dissolved ions, including calcium, magnesium, sodium and chloride were not measured in 1980, but sulfate generally yielded the highest concentrations in the spring, the lowest concentrations in the summer and intermediate values in the fall (Figure 3). Similar patterns were exhibited by other parameters, including conductivity and total dissolved solids which are measures of dissolved ions (Figure 4). Alkalinity, which is largely a measure of bicarbonate ions, showed a pattern similar to the other ions with the highest concentration in October (Figure 4).

The biological nutrients, such as phosphorus, nitrate, and silica, also generally yielded high concentrations in the spring or early summer, their low concentrations in the late summer and high values in the fall (Figure 5). This cycle is attributed to utilization of these nutrients by photosynthesizing plankton. In November, when primary production was at a lower rate, nitrate concentration rose to over ten times the October level.

In July 1980 the dissolved oxygen (DO) concentration dropped to 6.6 ppm (Station 1), the lowest value recorded during the 1980 monitoring program. This represents a continuing improvement over the lowest concentration observed in 1977 (3.0 ppm) and is consistent with concentrations measured in earlier years:

Year	DO Range (ppm)	Year	DO Range (ppm)
1974	5.7-14.1	1978	5.7-12.5
1975	7.2-13.6	1979	6.6-12.7
1976	5.0-12.5	1980	6.6-14.2
1977	3.0-12.2	-	

The International Joint Commission recommends a minimum DO level of 6.0 ppm for Lake Erie water (Canada-United States Water Quality Agreement of 1978). However, Ohio EPA (1978) has established a minimum DO standard of 4.0 ppm for the nearshore waters of Lake Erie within the vicinity of Locust Point.

Station Variations. Stations 1, 8 and 13 are located approximately 500, 3,000 and 1,200 feet offshore respectively. In general no consistently significant differences in water quality were observed between the stations. In April and November when the concentrations of most parameters were the highest, a slight gradient was noted for most parameters from the closest inshore station (1) to the farthest offshore station (8). During the summer months these differences were not apparent. In November several of the dissolved and suspended materials parameters showed slightly higher concentrations at Station 13 (Table 9). This may have been related to the proximity of the power station discharge; a slight elevation (2°C) in water temperature was noted at Station 13 in relation to the other stations. Suspended solids, transparency and turbidity measurements indicate a general increase in water clarity from inshore to offshore, but differences were normally small.

Differences between the surface and bottom water quality were also slight because of the shallowness (0.8-4.0 meters) of this portion of Lake Erie and its well-mixed nature. Some depressions in the level of DO and small increases of suspended and dissolved materials were noted near the bottom. This may be due to the high oxygen demand of the sediments and the disturbance of these sediments by currents and wave action. As would be expected, the amount of solar radiation measured at the lake's bottom was significantly lower than the surface irradiance. The difference between surface and bottom readings at the three stations was found to be directly proportional to the water depth.

Water Quality Trends. The Ohio State University, Center for Lake Erie Area Research, initiated water quality studies at Locust Point in July 1972. Over the past nine years most parameters have shown typical seasonal trends with only small variations from year to year. Trends for eight water quality parameters from July 1972 through November 1979 are shown on Figures 6, 7 and 8. Temperature and DO show normal seasonal trends for each year with only minor variations from one year to the next over the entire period. Dissolved oxygen appears to have undergone more depletion in 1976 and 1977 than in previous years or in 1978-1980. Hydrogen-ion concentration (pH) and alkalinity have remained fairly stable over most of the period with a slight increase in 1980. Transparency, turbidity, phosphorus and conductivity have shown some radical variations in the early and mid-1970's which were probably due to storms and dredging activities that disturbed the bottom sediments. Conductivity values in early May 1979 were high, equaling those recorded during the storm period of 1972. Phosphorus concentrations were low during 1977-1979 compared to earlier years but showed a significant increase in 1980. In general, however, no significant deviations from the normal quality of the water in this part of western Lake Erie have been observed during the past nine years.

Comparison of Pre-operational and Operational Periods. Data from 1974 through August 1977 (pre-operational period) when compared with data from September 1977 through 1980 (operational period) indicate that, in general, concentrations of dissolved and suspended substances were higher during the operational period, particularly the major ions, silica, conductivity, nitrate, phosphate, turbidity and suspended solids. Dissolved oxygen and transparency were lower after operation. The magnitude of those differences was not great and seemed to be caused by the general condition of the nearshore waters of western Lake Erie rather than the operation of the power station. The data gathered thus far from the operational period do not demonstrate degradation of Lake Erie water quality as a result of the operation of the power station.

REFERENCES CITED

American Public Health Association. 1975. Standard Methods for the Examination of Water and Wastewater. 14th ed. APHA, New York. 847 p.

American Society for Testing and Materials. 1973. Annual Book of ASTM Standards, Part 23, Water; Atmospheric Analysis. ASTM, Philadelphia. 1108 p.

Herdendorf, C. E., M. D. Barnes and J. M. Reutter. 1979. Procedures for Aquatic Ecology Monitoring Program at the Davis-Besse Nuclear Power Station. Ohio State University, Center for Lake Erie Area Research, CLEAR Procedures Manual No. 8. 34 p.

Ohio Environmental Protection Agency. 1978. Water Quality Standards. OEPA Administrative Code, Chapter 3745-1. 117 p.

Rich, P. R. and B. G. Wetzel. 1969. A Simple Sensitive Underwater Photometer. Limnology and Oceanography 14:611-613.

U.S. Environmental Protection Agency. 1974. Methods for Chemical Analysis of Water and Wastes. EPA Analytical Control Laboratory, Cincinnati, Ohio. 125 p.

Welch, P. S. 1948. Limnological Methods. McGraw-Hill Book Co., New York. 381 p.

TABLES

TABLE 1

ANALYTICAL METHODS FOR WATER QUALITY DETERMINATIONS

PARAMETER	UNITS	REFERENCES FOR ANALYTICAL METHODS
1. Temperature	°C	APHA (1975): Sec. 212
2. Dissolved Oxygen	ppm	APHA (1975): Sec. 422B
3. Conductivity	μmhos/cm (25°C)	ASTM (1975): D1125-64
4. Transparency	meters	Welch (1948): Secchi disk
5. Solar radiation	foot-candles	Rich and Wetzel (1969): Underwater Photometer
6. Nitrate (NO_3)	mg/l	ASTM (1973): D992-71
7. Sulfate (SO_4)	mg/l	ASTM (1973): D516-68C
8. Phosphorus (Total as P)	mg/l	APHA (1975): Sec. 425F
9. Silica (SiO_2)	mg/l	ASTM (1973): D859-68B
10. Alkalinity (Total as $CaCO_3$)	mg/l	APHA (1975): Sec. 403
11. Suspended Solids	mg/l	APHA (1975): Sec. 208D
12. Dissolved Solids	mg/l	USEPA (1974)
13. Turbidity	F.T.U.	APHA (1975): Sec. 214A
14. Hydrogen-ion conc. (pH)	pH units	ASTM (1973): D1293-65

TABLE 2

LAKE ERIE WATER QUALITY ANALYSES FOR APRIL 1980

Dates:
Field ____30 April____
Laboratory ____2 May____

PARAMETER	STATION NO. 1 SURFACE	STATION NO. 1 BOTTOM	STATION NO. 8 SURFACE	STATION NO. 8 BOTTOM	STATION NO. 13 SURFACE	STATION NO. 13 BOTTOM	RANGE	MEAN	STANDARD DEVIATION
Field Measurements:									
Temperature (°C)	12.0	12.0	12.0	11.5	12.0	12.0	11.5-12.0	11.9	0.20
Dissolved Oxygen (ppm)	10.8	10.7	10.9	11.0	10.8	10.8	10.7-11.0	10.8	0.10
Conductivity (µmhos/cm)	300	293	295	302	320	320	293-320	305	12
Transparency (m)	0.3		0.3		0.25		0.25-0.30	0.28	0.03
Depth (m)		2.5		4.0	3.0	3.0	2.5-4.0	3.2	0.8
Solar radiation (ft-candles)	2200	0.22	1100	<0.01	1400	0.05	<0.01-2200	783.4	930.4
Laboratory Determinations:									
Nitrate (mg/l)	13.0	16.1	13.0	16.6	11.6	15.0	11.6-16.6	14.2	2.0
Sulfate (mg/l)	39.0	39.0	38.0	37.0	36.0	35.0	35.0-39.0	37.3	1.6
Phosphorus (mg/l)	0.22	0.22	0.35	0.29	0.30	0.31	0.22-0.35	0.28	0.05
Silica (mg/l)	1.29	1.22	1.25	1.37	1.33	1.78	1.22-1.78	1.37	0.21
Total Alkalinity (mg/l)	85	85	88	87	87	89	85-89	87	2
Suspended Solids (mg/l)	33	34	37	40	41	110	33-110	49	30
Dissolved Solids (mg/l)	204	196	200	196	202	208	196-208	201	5
Turbidity (F.T.U.)	48	51	51	52	50	87	48-87	57	15
pH	7.8	8.0	7.8	7.7	7.9	7.7	7.7-7.9	7.8	0.1
Conductivity (µmhos/cm)	245	250	250	235	255	245	235-255	247	7

TABLE 3

LAKE ERIE WATER QUALITY ANALYSES FOR MAY 1980

Dates:

Field ___6 June___

Laboratory ___9 June___

PARAMETER	STATION NO. 1		STATION NO. 8		STATION NO. 13		RANGE	MEAN	STANDARD DEVIATION
	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM			
Field Measurements:									
Temperature (°C)	18.0	18.0	18.5	18.0	18.5	18.5	18.0-18.5	18.3	0.3
Dissolved Oxygen (ppm)	9.0	9.0	8.9	9.0	8.8	8.7	8.7-9.0	8.9	0.1
Conductivity (µmhos/cm)	345	345	350	365	380	382	345-382	361	17
Transparency (m)	0.53		0.55		0.50		0.50-0.55	0.53	0.03
Depth (m)		1.5		4.0		2.5	1.5-4.0	2.7	1.3
Solar radiation (ft-candles)	2500	1.50	2100	0.05	3500	0.20	0.05-3500	1350.3	1547.3
Laboratory Determinations:									
Nitrate (mg/l)	12.1	10.2	13.0	8.9	10.7	11.6	8.9-13.0	11.1	1.5
Sulfate (mg/l)	33.0	33.0	32.5	32.5	32.5	32.5	32.5-33.0	32.7	0.3
Phosphorus (mg/l)	0.09	0.09	0.14	0.09	0.04	0.03	0.03-0.14	0.08	0.04
Silica (mg/l)	0.24	0.21	0.29	0.36	0.28	0.21	0.21-0.36	0.27	0.06
Total Alkalinity (mg/l)	106	106	104	101	104	104	101-106	104	2
Suspended Solids (mg/l)	15	61	38	40	11	36	11-61	34	18
Dissolved Solids (mg/l)	212	218	218	204	210	212	204-218	212	5
Turbidity (F.T.U.)	56	51	47	49	42	39	39-56	47	6
pH	8.0	8.0	7.9	7.9	7.9	7.9	7.9-8.0	7.9	0.05
Conductivity (µmhos/cm)	320	320	315	320	315	315	315-320	318	3

TABLE 4

LAKE ERIE WATER QUALITY ANALYSES FOR JUNE 1980

PARAMETER	STATION NO. 1 SURFACE	STATION NO. 1 BOTTOM	STATION NO. 8 SURFACE	STATION NO. 8 BOTTOM	STATION NO. 13 SURFACE	STATION NO. 13 BOTTOM	RANGE	MEAN	STANDARD DEVIATION
Field Measurements:									
Temperature (°C)	21.5	21.0	21.0	21.0	21.5	21.0	21.0-21.5	21.2	0.3
Dissolved Oxygen (ppm)	8.0	8.2	8.1	8.2	8.0	8.0	8.0-8.2	8.1	0.1
Conductivity (µmhos/cm)	400	400	320	335	320	320	320-400	349	40
Transparency (m)	0.3		0.3		0.3		---	0.3	0.0
Depth (m)		1.0		3.8		2.4	1.0-3.8	2.4	1.4
Solar radiation (ft-candles)	1000	3.00	2500	<0.01	2400	0.02	<0.01-2500	983.8	1200.2
Laboratory Determinations:									
Nitrate (mg/l)	11.6	13.0	12.1	14.0	11.6	12.5	11.6-14.0	12.5	0.9
Sulfate (mg/l)	24.0	24.0	20.5	21.0	16.0	16.5	16.0-24.0	20.3	3.5
Phosphorus (mg/l)	0.13	0.19	0.09	0.11	0.11	0.10	0.09-0.19	0.12	0.04
Silica (mg/l)	0.93	0.93	0.80	0.83	0.77	1.18	0.77-1.18	0.91	0.15
Total Alkalinity (mg/l)	105	105	105	105	105	105	---	105	0
Suspended Solids (mg/l)	121	164	42	61	66	31	31-164	81	51
Dissolved Solids (mg/l)	198	212	208	206	204	202	198-212	205	5
Turbidity (F.T.U.)	77	80	46	53	55	47	46-80	60	15
pH	7.9	8.2	8.1	8.0	8.1	7.8	7.8-8.2	8.0	0.2
Conductivity (µmhos/cm)	340	340	340	340	340	350	340-350	342	4

TABLE 5

LAKE ERIE WATER QUALITY ANALYSES FOR JULY 1980

PARAMETER	STATION NO. 1		STATION NO. 8		STATION NO. 13		RANGE	MEAN	STANDARD DEVIATION
	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM			
Field Measurements:									
Temperature (°C)	26.5	25.0	25.5	25.0	28.0	26.0	25.0-28.0	26.0	1.1
Dissolved Oxygen (ppm)	8.3	7.0	8.3	6.6	8.6	7.9	6.6-8.6	7.8	0.8
Conductivity (µmhos/cm)	345	350	265	270	265	270	265-350	242	106
Transparency (m)	0.78		0.87		0.77		0.77-0.87	0.81	0.06
Depth (m)		1.5		4.0		2.5	1.5-4.0	2.7	1.3
Solar radiation (ft-candles)	2000	130	3900	15	5000	120	15-5000	1861	2166
Laboratory Determinations:									
Nitrate (mg/l)	4.5	4.5	4.8	4.8	5.4	4.2	4.2-5.4	4.7	0.4
Sulfate (mg/l)	27.5	27.5	25.0	22.5	25.0	25.0	22.5-27.5	25.4	1.9
Phosphorus (mg/l)	0.04	0.04	0.04	0.04	0.05	0.02	0.02-0.05	0.04	0.01
Silica (mg/l)	0.05	0.05	0.09	0.09	0.07	0.06	0.05-0.09	0.07	0.02
Total Alkalinity (mg/l)	96	96	95	94	93	93	93-96	95	1
Suspended Solids (mg/l)	12	22	8	10	11	9	8-22	12	5
Dissolved Solids (mg/l)	176	170	158	158	164	162	158-176	165	7
Turbidity (F.T.U.)	18	18	8	13	11	13	8-18	14	4
pH	8.4	8.4	8.5	8.4	8.6	8.6	8.4-8.6	8.5	0.1
Conductivity (µmhos/cm)	305	305	300	300	320	300	300-320	305	8

TABLE 6

LAKE ERIE WATER QUALITY ANALYSES FOR AUGUST 1980

Dates:
Field   30 August
Laboratory   10 September

PARAMETER	STATION NO. 1		STATION NO. 8		STATION NO. 13		RANGE	MEAN	STANDARD DEVIATION
	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM			
Field Measurements:									
Temperature (°C)	25.5	26.0	24.0	24.5	25.0	25.0	24.0-26.0	25	1
Dissolved Oxygen (ppm)	7.5	7.5	7.0	7.2	7.0	7.0	7.0-7.5	7.2	0.2
Conductivity (µmhos/cm)	272	274	275	281	293	293	272-293	281	10
Transparency (m)	0.80		0.81		0.81		0.80-0.81	0.81	0.01
Depth (m)		2.0		3.5		2.0	2.0-3.5	2.5	0.9
Solar radiation (ft-candles)	800	20	1100	9	400	62	9-1100	399	461
Laboratory Determinations:									
Nitrate (mg/l)	2.4	1.5	1.5	1.2	1.5	2.1	1.2-2.1	1.7	0.5
Sulfate (mg/l)	21.5	21.5	21.0	21.0	18.5	18.5	18.5-21.5	20.3	1.4
Phosphorus (mg/l)	0.01	0.01	0.01	0.01	0.01	0.02	0.01-0.02	0.01	0.004
Silica (mg/l)	1.18	0.33	0.25	0.31	0.33	0.28	0.25-1.18	0.45	0.36
Total Alkalinity (mg/l)	84	85	83	85	83	83	83-85	84	1
Suspended Solids (mg/l)	17	17	8	14	18	19	8-19	16	4
Dissolved Solids (mg/l)	150	146	142	146	142	144	142-150	145	3
Turbidity (F.T.U.)	24	16	9	14	18	16	9-24	16	5
pH	8.2	8.4	8.4	8.4	8.4	7.9	7.9-8.4	8.3	0.2
Conductivity (µmhos/cm)	290	265	295	265	260	265	260-295	273	15

TABLE 7

LAKE ERIE WATER QUALITY ANALYSES FOR SEPTEMBER 1980

Dates:
Field   27 September
Laboratory   2 October

PARAMETER	STATION NO. 1 SURFACE	STATION NO. 1 BOTTOM	STATION NO. 8 SURFACE	STATION NO. 8 BOTTOM	STATION NO. 13 SURFACE	STATION NO. 13 BOTTOM	RANGE	MEAN	STANDARD DEVIATION
Field Measurements:									
Temperature (°C)	15.5	15.0	16.2	16.0	16.0	15.0	15.0-16.2	15.6	0.5
Dissolved Oxygen (ppm)	9.5	10.8	9.2	9.2	10.0	9.3	9.2-10.8	9.7	0.6
Conductivity (μmhos/cm)	260	260	260	260	245	255	245-260	257	6
Transparency (m)	0.50		0.65		0.55		0.50-0.65	0.57	0.08
Depth (m)		1.3		3.5		2.3	1.3-3.5	2.4	1.1
Solar radiation (ft-candles)	3500	8.5	510	0.13	4000	8.5	0.13-4000	1338	1885
Laboratory Determinations:									
Nitrate (mg/l)	1.2	0.6	1.2	1.2	1.2	1.2	0.6-1.2	1.1	0.2
Sulfate (mg/l)	48.0	25.0	26.0	23.0	29.5	30.0	23.0-48.0	30.2	9.1
Phosphorus (mg/l)	0.04	0.02	0.01	0.01	0.02	0.08	0.01-0.08	0.03	0.03
Silica (mg/l)	1.01	0.14	0.08	0.05	0.04	0.06	0.04-1.01	0.23	0.38
Total Alkalinity (mg/l)	91	91	87	89	91	90	87-91	90	2
Suspended Solids (mg/l)	56	56	26	23	38	197	23-197	66	66
Dissolved Solids (mg/l)	188	176	176	162	170	170	162-188	174	9
Turbidity (F.T.U.)	45	47	27	25	37	70	25-70	42	16
pH	8.4	8.3	8.4	8.3	8.2	8.0	8.0-8.4	8.3	0.2
Conductivity (μmhos/cm)	285	295	285	280	280	300	280-300	288	8

TABLE 8

LAKE ERIE WATER QUALITY ANALYSES FOR OCTOBER 1980

Dates:
Field ___30 October___
Laboratory ___7 November___

PARAMETER	STATION NO. 1 SURFACE	STATION NO. 1 BOTTOM	STATION NO. 8 SURFACE	STATION NO. 8 BOTTOM	STATION NO. 13 SURFACE	STATION NO. 13 BOTTOM	RANGE	MEAN	STANDARD DEVIATION
Field Measurements:									
Temperature (°C)	6.0	6.0	7.0	7.0	7.0	7.0	6.0-7.0	6.7	0.5
Dissolved Oxygen (ppm)	12.0	11.4	11.1	10.9	12.5	12.4	10.9-12.5	11.7	0.7
Conductivity (µmhos/cm)	300	300	280	300	370	375	280-375	321	41
Transparency (m)	0.33		0.53		0.53		0.33-0.53	0.46	0.12
Depth (m)		1.2		3.5		2.5	1.2-3.5	2.4	1.2
Solar radiation (ft-candles)	1900	19	1200	7	1400	45	7-1900	762	840
Laboratory Determinations:									
Nitrate (mg/l)	1.9	0.6	1.2	0.6	1.2	1.9	0.6-1.9	1.2	0.6
Sulfate (mg/l)	32.5	32.5	28.5	28.0	31.0	29.5	28.0-32.5	30.3	2.0
Phosphorus (mg/l)	0.02	0.01	0.02	0.04	0.04	0.02	0.01-0.04	0.03	0.01
Silica (mg/l)	0.07	0.04	0.02	0.02	0.02	0.02	0.02-0.07	0.03	0.02
Total Alkalinity (mg/l)	133	130	130	131	132	132	130-133	131	1
Suspended Solids (mg/l)	23	27	19	22	45	36	19-45	29	10
Dissolved Solids (mg/l)	202	186	206	184	188	186	184-206	192	9
Turbidity (F.T.U.)	21	20	18	18	27	23	18-27	21	3
pH	7.9	7.8	7.9	7.9	7.8	7.8	7.8-7.9	7.85	0.1
Conductivity (µmhos/cm)	327	316	325	322	325	325	316-327	323	4

TABLE 9

LAKE ERIE WATER QUALITY ANALYSES FOR NOVEMBER 1980

Dates:
Field ___ 30 November ___
Laboratory ___ 4 December ___

PARAMETER	STATION NO. 1		STATION NO. 8		STATION NO. 13		RANGE	MEAN	STANDARD DEVIATION
	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM			
Field Measurements:									
Temperature (°C)	1.0	1.0	1.0	1.0	3.0	3.0	1.0-3.0	1.7	1.0
Dissolved Oxygen (ppm)	13.8	13.8	13.9	14.0	14.2	13.2	13.2-14.2	13.8	0.3
Conductivity (µmhos/cm)	350	310	280	280	310	310	280-350	307	26
Transparency (m)	0.5		0.6		0.5		0.5-0.6	0.53	0.06
Depth (m)		0.8		3.5		3.0	0.8-3.5	2.4	1.4
Solar radiation (ft-candles)	290	98	800	1	500	0.53	0.53-800	282	319
Laboratory Determinations:									
Nitrate (mg/l)	15.6	16.6	16.1	15.3	17.1	16.6	15.3-17.1	16.2	0.7
Sulfate (mg/l)	28.0	27.0	28.0	25.5	29.5	30.0	25.5-30.0	28	1.6
Phosphorus (mg/l)	0.04	0.07	0.04	0.02	0.06	0.18	0.02-0.18	0.07	0.06
Silica (mg/l)	0.08	0.08	0.10	0.08	0.13	0.11	0.08-0.13	0.10	0.02
Total Alkalinity (mg/l)	92	95	99	94	98	99	92-99	96	3
Suspended Solids (mg/l)	25	30	13	14	16	19	13-30	20	7
Dissolved Solids (mg/l)	160	176	176	162	176	174	160-176	171	8
Turbidity (F.T.U.)	26	26	19	17	19	19	17-26	21	4
pH	7.7	7.8	7.8	7.8	8.0	8.0	7.7-8.0	7.9	0.1
Conductivity (µmhos/cm)	310	310	290	300	320	320	290-320	308	12

TABLE 10

MEAN VALUES AND RANGES FOR WATER QUALITY PARAMETERS TESTED IN 1980

| PARAMETER | APRIL-NOVEMBER 1980 | | UNITS |
	MEAN	RANGE	
1. Temperature	15.8	1.0-28.0	°C
2. Dissolved Oxygen	9.8	6.6-14.2	ppm
3. Conductivity (field)	309	245-400	μmhos/cm
4. Transparency	0.54	0.25-0.87	m
5. Solar Radiation	970	<0.01-5000	ft-candles
6. Nitrate	7.8	.06-17.1	mg/l
7. Sulfate	28.0	16.0-48.0	mg/l
8. Phosphorus	0.16	0.01-0.35	mg/l
9. Silica	0.47	0.02-1.78	mg/l
10. Total Alkalinity	99	83-133	mg/l
11. Suspended Solids	38	8-197	mg/l
12. Dissolved Solids	183	142-218	mg/l
13. Turbidity	35	8-87	F.T.U.
14. Hydrogen-ions	8.1	7.7-8.6	pH
15. Conductivity (lab)	300	235-350	μmhos/cm
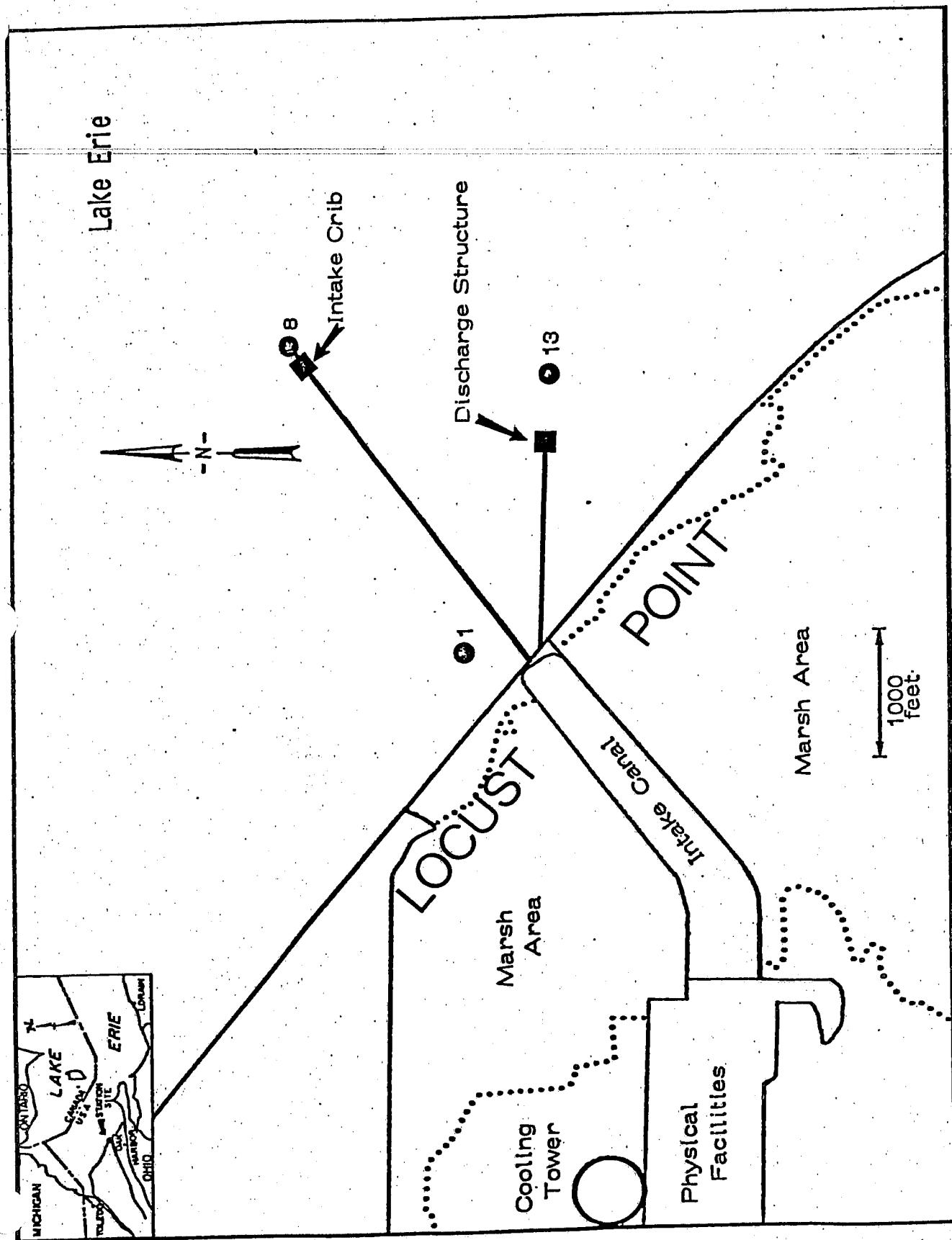
FIGURES

FIGURE 1. Sampling Stations at the Davis-Besse Nuclear Power Station.
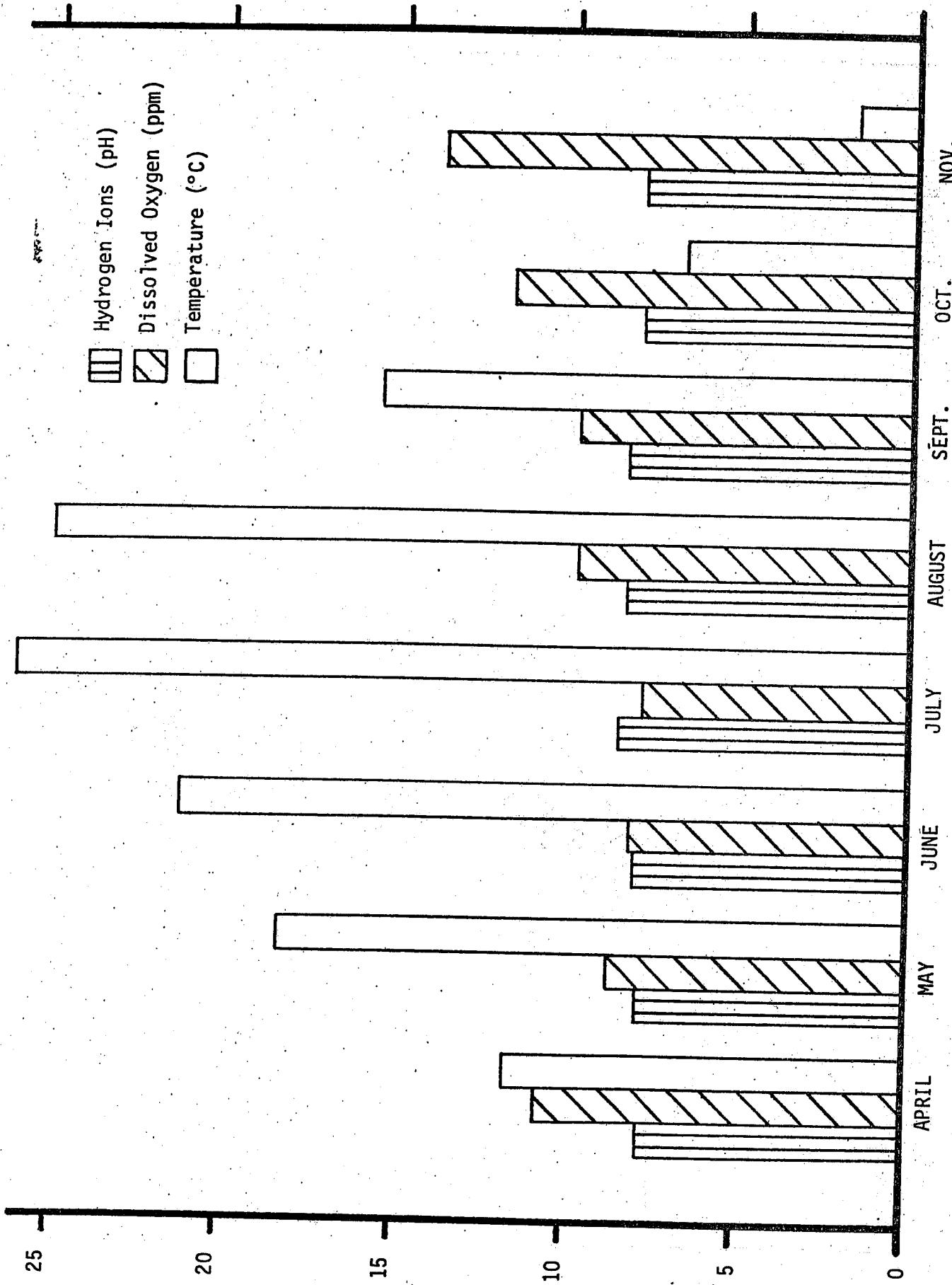
FIGURE 2. Mean Monthly Hydrogen-ion, Temperature and Dissolved Oxygen Measurements for Lake Erie at Locust Point for 1980.
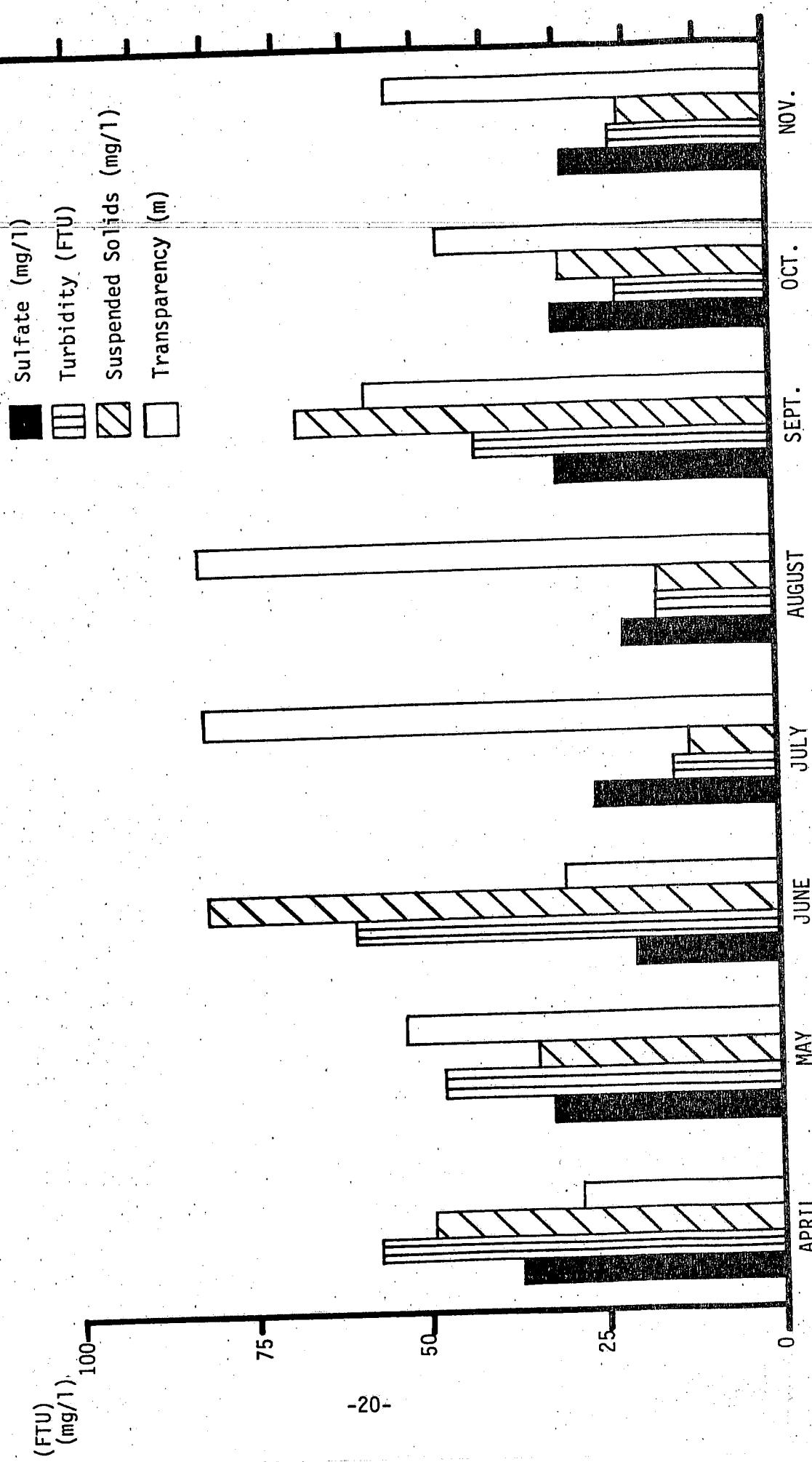
FIGURE 3. Mean Monthly Turbidity, Suspended Solids, Transparency and Sulfate Measurements for Lake Erie at Locust Point During 1980.

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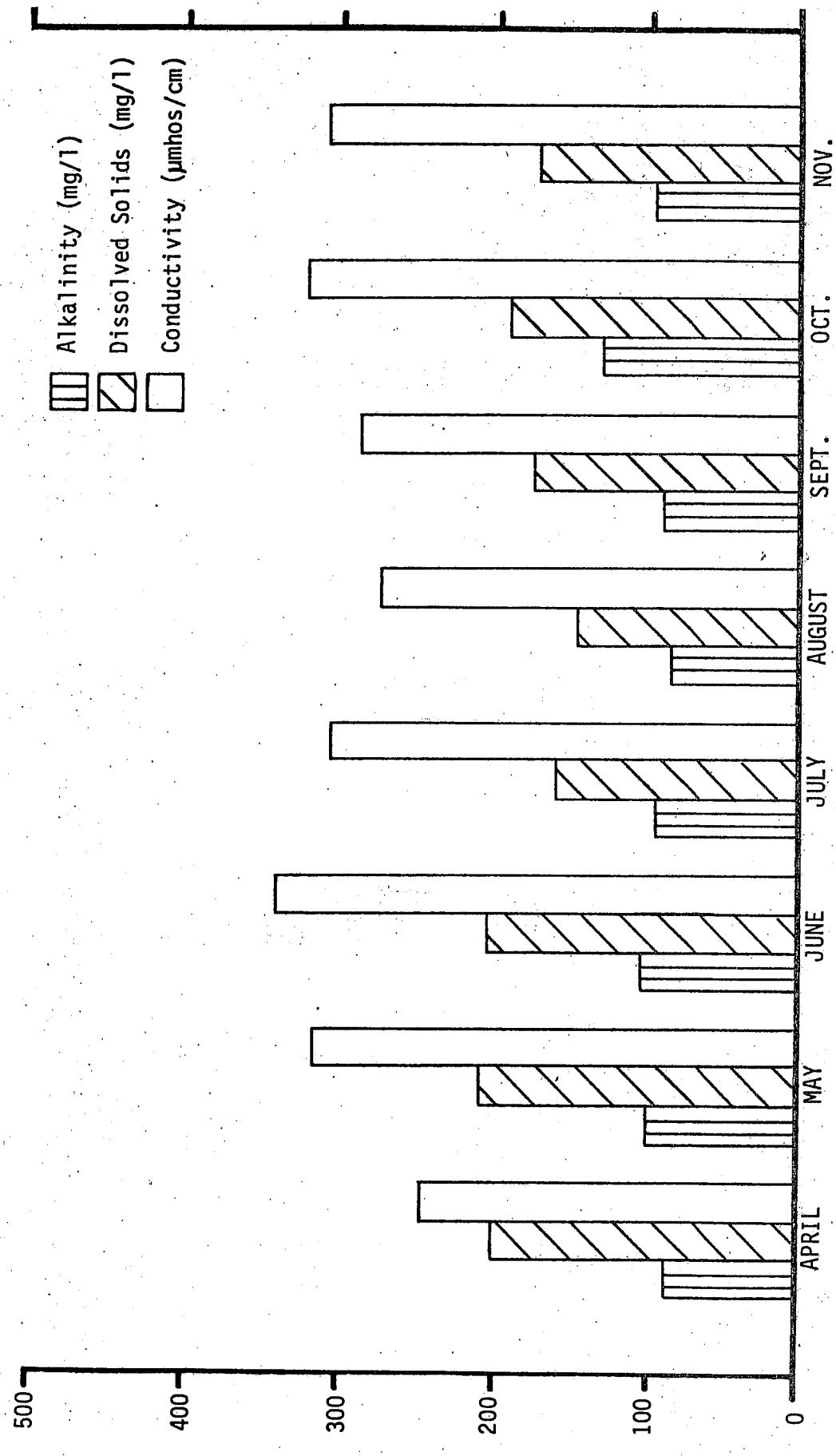
FIGURE 4. Mean Monthly Alkalinity, Dissolved Solids and Conductivity Measurements for Lake Erie at Locust Point During 1980.
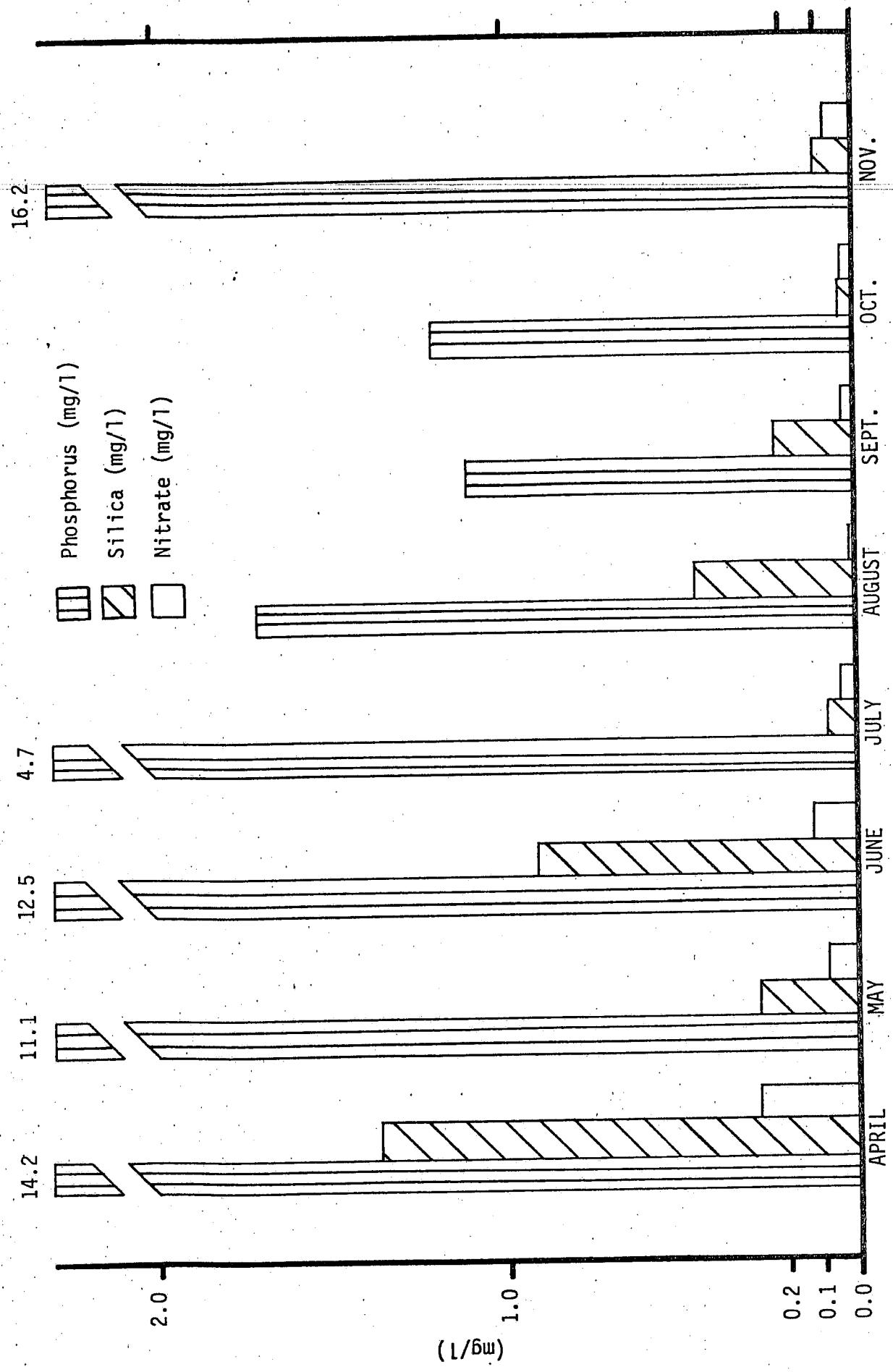
FIGURE 5. Mean Monthly Nitrate, Phosphorus, and Silica Concentrations in Lake Erie at Locust Point During 1980.
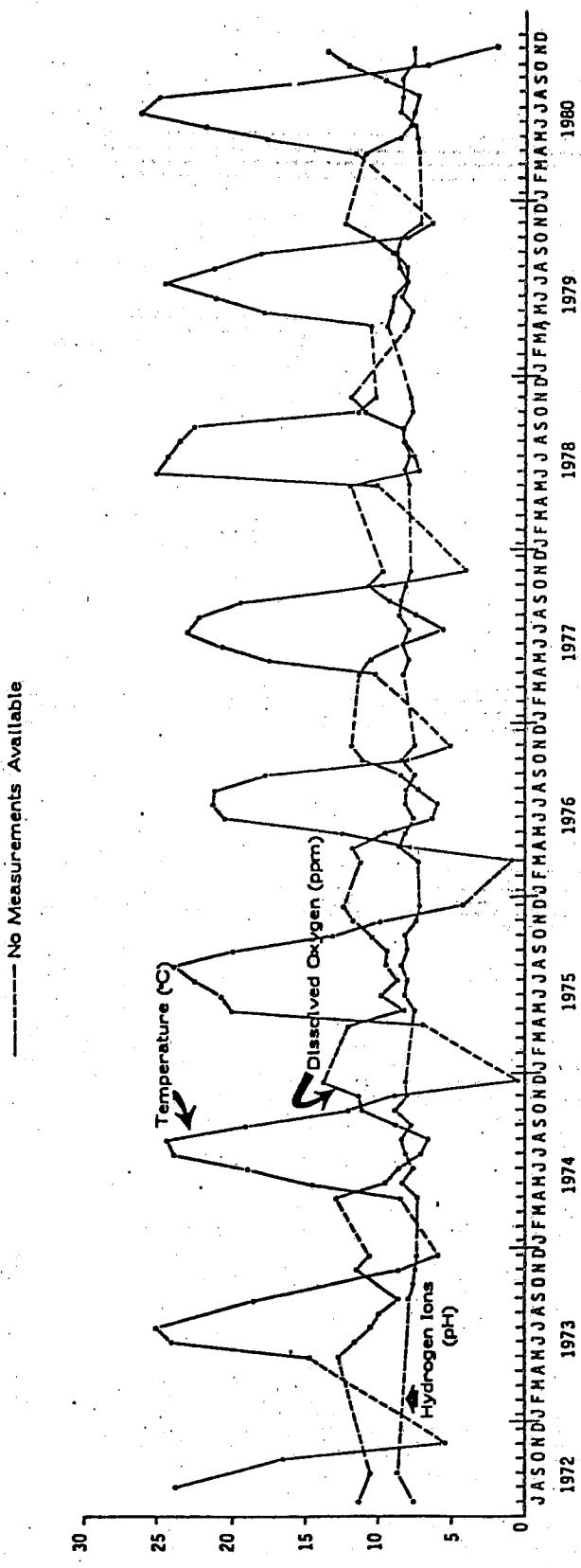
FIGURE 6. Trends in Mean Monthly Temperature, Dissolved Oxygen, and Hydrogen-ion Measurements for Lake Erie at Locust Point for the Period 1972-1980.

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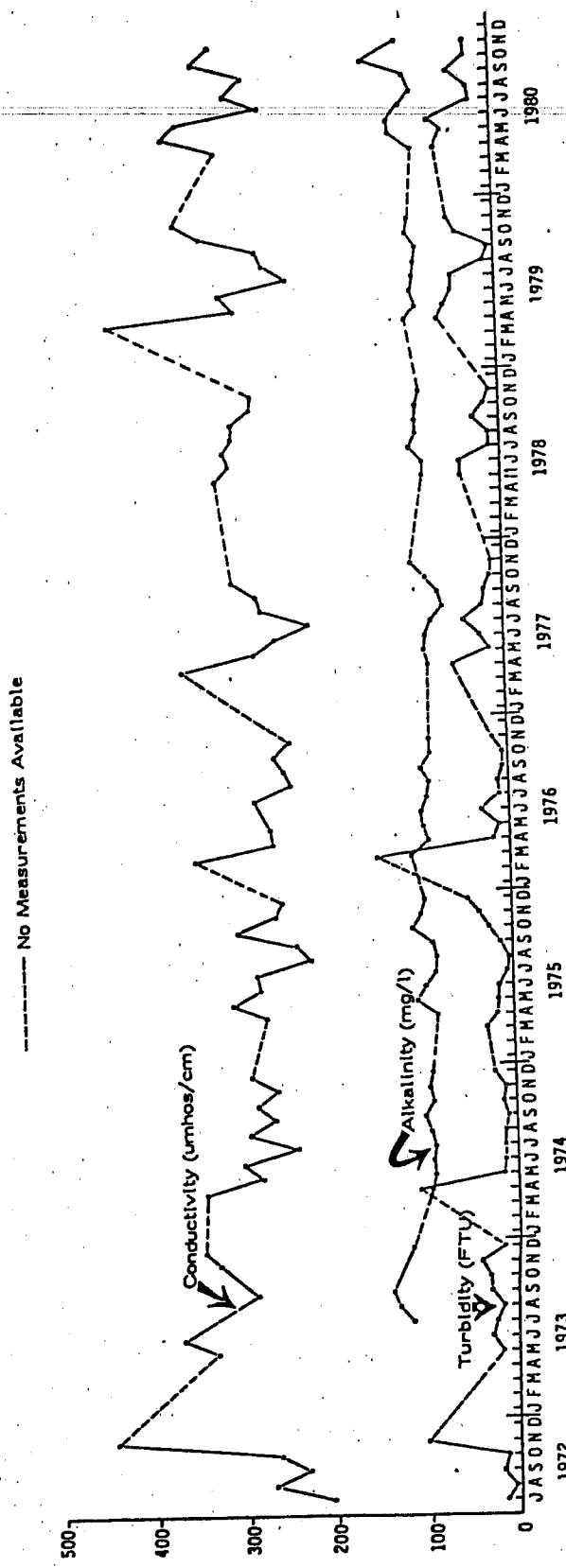
FIGURE 7. Trends in Mean Monthly Conductivity, Alkalinity and Turbidity Measurements for Lake Erie at Locust Point for the Period 1972-1980.
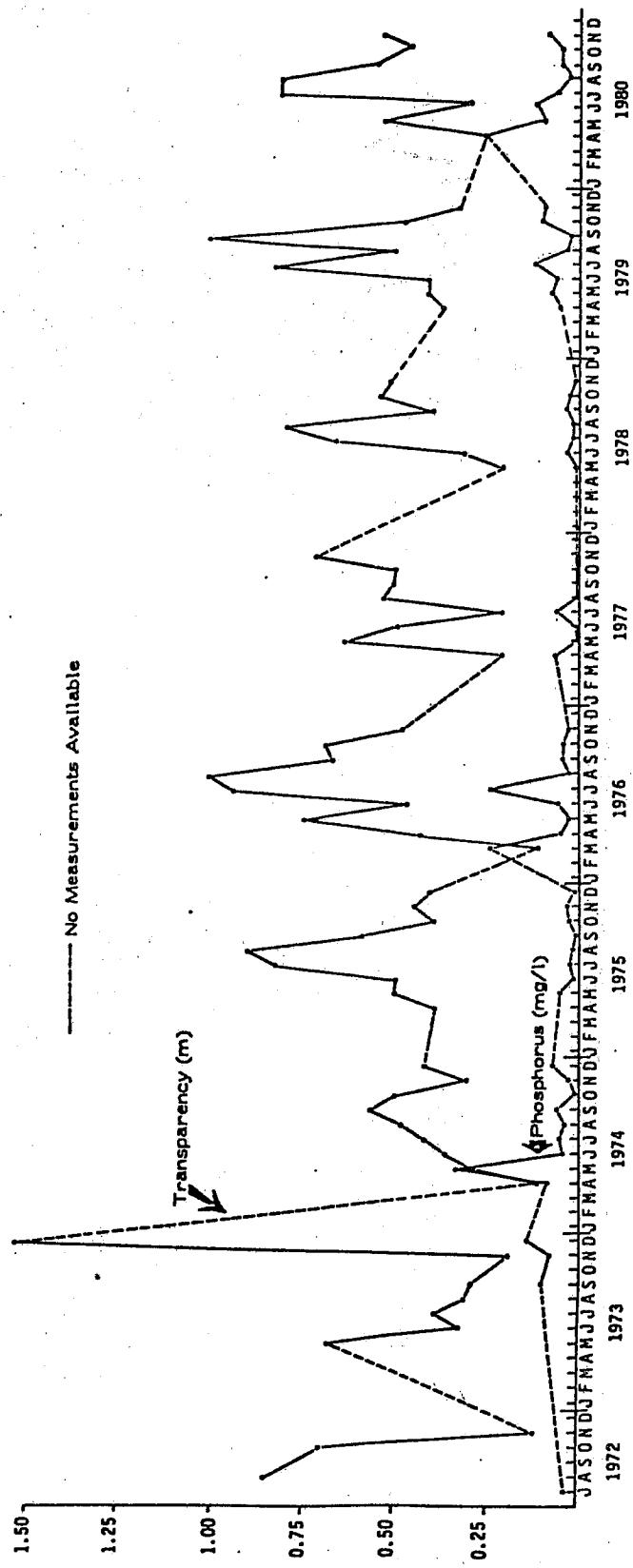
FIGURE 8. Trends in Mean Monthly Transparency and Phosphorus Measurements for Lake Erie at Locust Point for the Period 1972-1980.