EVALUATION OF WASTE

LOAD ALLOCATIONS

- PATUXENT RIVER BASIN -

February 14, 1974

Thomas H. Pheiffer

AIR & WATER PROGRAMS
ANNAPOLIS FIELD OFFICE

Environmental Protection Agency
Region III

600R74003

EVALUATION OF WASTE LOAD ALLOCATIONS

- PATUXENT RIVER BASIN -

February 14, 1974

Thomas H. Pheiffer

Library
U.S. Environmental Protection Agency
Region III
Central Regional Laboratory
839 Bestgate Road
Annapolis, Maryland 21401

AIR & WATER PROGRAMS
ANNAPOLIS FIELD OFFICE

Environmental Protection Agency
Region III

MDW 225

During the 1973 summer sampling season, the Annapolis Field Office collected water quality data in the Patuxent River Basin for the purpose of calibrating and validating math models for the Basin. Model application was completed in November, 1973. Utilizing the 1973 sampling data, the models have successfully predicted, in both the free-flowing Patuxent and the Little Patuxent Rivers, dissolved oxygen response to changes in volume and/or concentration of point sources of carbonaceous and nitrogenous BOD loadings under various stream flow conditions and temperatures. Documentation of the modelling verification procedure will be presented in a forthcoming Technical Report Number 58, "Application of Auto-Qual Modelling System to the Patuxent River Basin".

Mr. Charles Hall, Maryland Environmental Service (MES), is completing the final draft of the Section 303(e) Patuxent River Basin Plan. In the plan, the MES has recommended the adoption of a uniform policy on effluent standards for wastewater treatment discharges into the Patuxent River Basin. A copy of the uniform treatment policy is attached.

Mr. Thomas Pheiffer has made available to Mr. Hall the EPA math models for the Patuxent River Basin. The models were used to determine the adequacy of the recommended effluent levels and/or loadings for meeting water quality standards for the planning years

1980 and 2000. The 1980 and 2000 projected wastewater flows were tested utilizing the effluent restraints proposed by MES.

In assessing the load allocations of MES, the following criteria were used in making all the model runs. The 7 day - 10 year low flows -- obtained from U.S.G.S. records -- were 15.0 cfs for the free-flowing mainstem of the Patuxent River (specified release from Rocky Gorge Dam) and 11.8 cfs for the Little Patuxent River at Savage, Maryland. Incremental flows from minor tributaries were allowed for the Little Patuxent River. A constant stream temperature of 28°C was used. At 28°C dissolved oxygen saturation is 7.9 mg/l for background stream concentrations. Background stream levels of ultimate carbonaceous oxygen demand (CBOD) and ultimate nitrogenous oxygen demand (NBOD) were specified at 2.0 and 3.0 mg/l, respectively.

Model runs were made using the 1980 and 2000 projected wastewater flows for both a <u>with</u> and <u>without</u> regional treatment scheme. Figures 1-8 show the wastewater loadings, the effluent concentrations, and the resultant stream profiles of dissolved oxygen. Of the 3 mg/l total nitrogen, only 1 mg/l was assumed to be oxidizable. A dissolved oxygen concentration of 4 mg/l was assigned to all treatment plant effluents except for the Maryland City and Parkway plants where a 6.0 mg/l dissolved oxygen level was specified because of the low-flow stream conditions resulting from minimum releases from

Rocky Gorge Dam during the summer months.

Figures 1-8 clearly show that water quality standards will be met and maintained for the planning periods 1980 and 2000 with the implementation of the uniform effluent standards recommended by the State of Maryland. Maryland will opt for regional treatment because of cost effectiveness. The loadings from regional treatment are presented below.

S.T.P.	Year	Flow m^3/day	BOD_5 Kg/day	SS Kg/day	Tot. N Kg/day	Tot. P Kg/day
Little Pat. Reg. Plt.	1980	59,934	660.6	660.6	180.2	480.5
	2000	119,869	1,201.3	1,201.3	360.4	961.0
Maryland City (P.R.)	1980	10,274	103.0	103.0	30.9	82.4
	2000	15,901	159.4	159.4	47.8	127.5
Parkway (P.R.)	1980	24,218	242.7	242.7	72.8	194.2
	2000	55,042	551.6	551.6	165.5	441.3
Central Patuxent (P.R.)	1980	29,845	299.1	299.1	89.7	149.5
	2000	56,265	563.9	563.9	169.2	451.1

In order to buttress the need for high degrees of treatment for expanded wastewater flows in the Patuxent River Basin, an evaluation was made of the adequacy of existing treatment to meet water quality standards during the 7 day - 10 year low-flow condition. Figure 9 shows that with secondary treatment and no nitrogen removal water quality standards are violated in the mainstem of the Patuxent during the critical low-flow (15.0 cfs). The Parkway Wastewater Treatment Plant is currently being expanded to 7.5 mgd (10.2 cfs). When the enlarged Parkway Plant goes on line this spring, it will have nitrification and high BOD removal. Figure 10 shows that with an effluent concentration 8 mg/l BOD_5 and 2 mg/l of oxidizable nitrogen standards can be met in the mainstem of the Patuxent River.

For the Little Patuxent River, secondary treatment is not adequate to meet standards for current wastewater volumes during the critical low-flow (11.8 cfs). Even with high BOD removal (10 mg/l BOD_5 effluent) standards are contravened (Figure 11). High BOD removal at all plants together with nitrification at the Savage Wastewater Treatment Plant could result in standards compliance at the current wastewater volumes (Figure 12).

It is important to note that the above evaluation was based solely on current wastewater volumes. Although nitrification at the Parkway Plant appears adequate to meet standards in the mainstem of the

Patuxent, any expansion of other plants or the addition of a regional facility would necessitate nitrogen control for the expanded wastewater flows. For example, should the Maryland City Plant, located immediately upstream of the Parkway Plant, be expanded to 10.2 cfs in 1980 and 18.0 cfs in 2000, nitrogen control would have to be included at this facility.

There is one final note. It is fairly safe to assume that denitrification or control of the oxidizable nitrogen would protect dissolved oxygen standards in the free-flowing Patuxent River and the Little Patuxent River throughout the timeframe of the 303(e) Patuxent River Basin Plan. The governing factor for total nitrogen control (3 mg/l) is to maintain a biological balance in the estuary by limiting the amount of nitrate nitrogen discharged from point sources in the Basin.

State of Maryland

DEPARTMENT OF HEALTH AND MENTAL HYGIENE
Neil Solomon, M.D., Ph.D., Secretary

ENVIRONMENTAL HEALTH ADMINISTRATION
610 N. HOWARD STREET • BALTIMORE, MARYLAND 21201 • Area Code 301 • 383- 2949

POLICY ON EFFLUENT STANDARDS FOR WASTEWATER TREATMENT DISCHARGES INTO SURFACE WATERS IN THE PATUXENT RIVER BASIN

Effective June 15, 1973

All new treatment plants of any capacity and all existing plants which will be modified to increase capacity to 1.0 mgd or more that have not had a discharge approval from the Environmental Health Administration to the effective date of this policy, will immediately design to meet the following minimum effluent requirements:

BOD_5	Not to exceed 10 mg/l
Suspended Solids	Not to exceed 10 mg/l
pH	6.0 to 8.5
Dissolved Oxygen	
Above Baltimore-Washington Expressway	Not less than 6.0 mg/l
Below Baltimore-Washington Expressway	Not less than 4.0 mg/l
Phosphorus	Not to exceed 8 mg/l as P
Nitrogen ($TKN + NO_2 + NO_3$)	Not to exceed 3 mg/l as N

(Nitrogen removal on a seasonal basis as determined by assessment of Basin conditions)

All existing plants over 1.0 mgd including those that have a discharge approval from the Environmental Health Administration must produce effluent of the above quality by July 1, 1978.

Interim treatment plants of 1.0 mgd or less capacity shall be designed to produce the minimum effluent requirement for existing plants of less than 1.0 mgd.

All existing plants of less than 1.0 mgd will immediately design to produce the following minimum effluent requirements. This effluent quality must be met by units which are to be in operation on July 1, 1975:

BOD_5	Not to exceed 10 mg/l
Suspended Solids	Not to exceed 10 mg/l
pH	6.0 to 8.5
Dissolved Oxygen	
Above Baltimore-Washington Expressway	Not less than 6.0 mg/l
Below Baltimore-Washington Expressway	Not less than 4.0 mg/l

Addition of facilities to accomplish nutrient removal will be required if assessment of the treatment plant contribution to the algal problem determines it to be significant.

ESQ:fmz
9/6/73

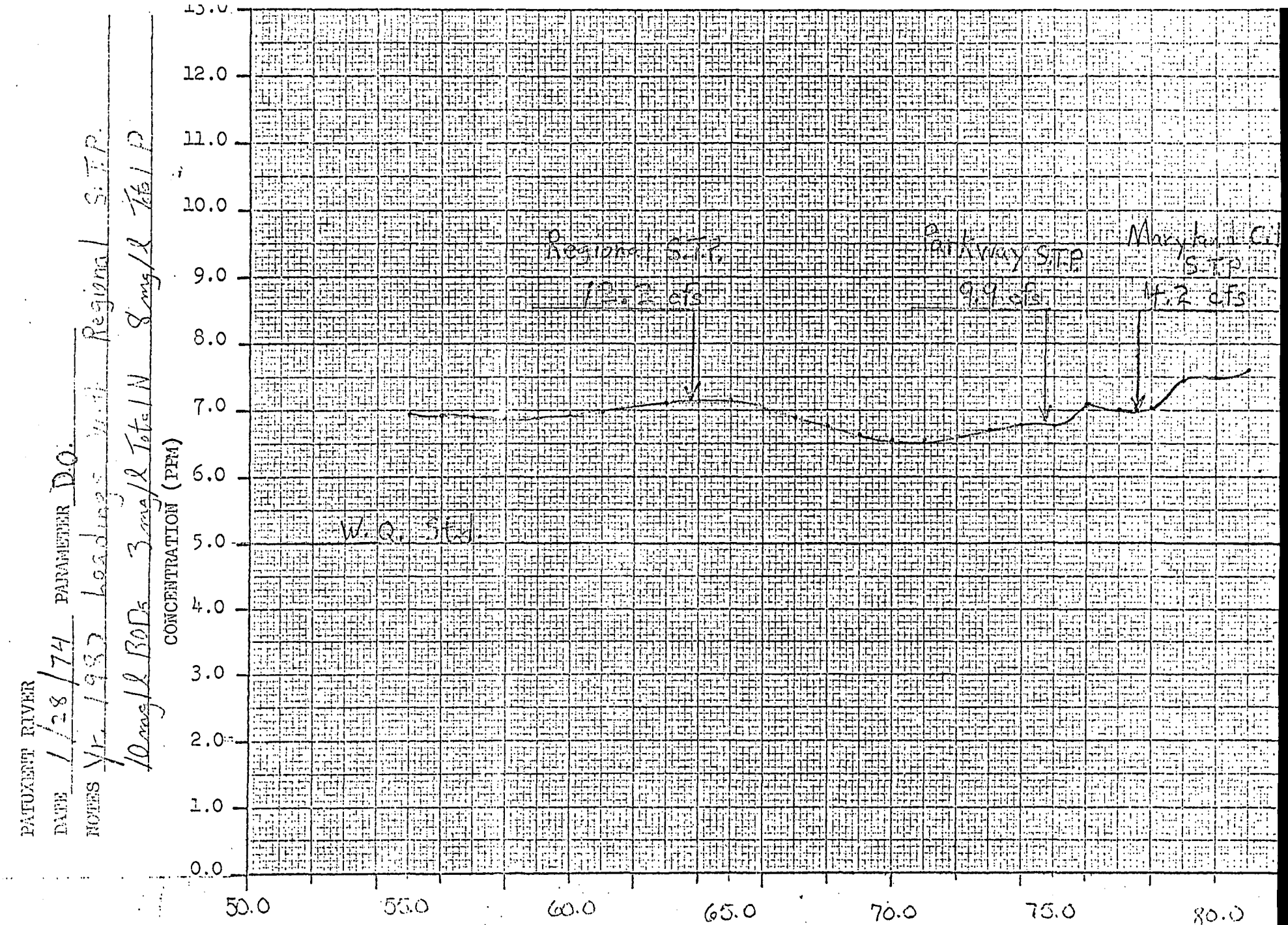
PATUXENT RIVER
DATE 1/28/74
PARAMETER D.O.
NOTES Yr. 1980 Loadings with Regional S.T.P.
10 mg/l BOD5 3 mg/l Total N 8 mg/l Total P
CONCENTRATION (PPM)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
Regional S.T.P.
10.2 cfs
Parkway S.T.P.
9.9 cfs
Maryland City S.T.P.
4.2 cfs
W.Q. 5.0

FIGURE 1

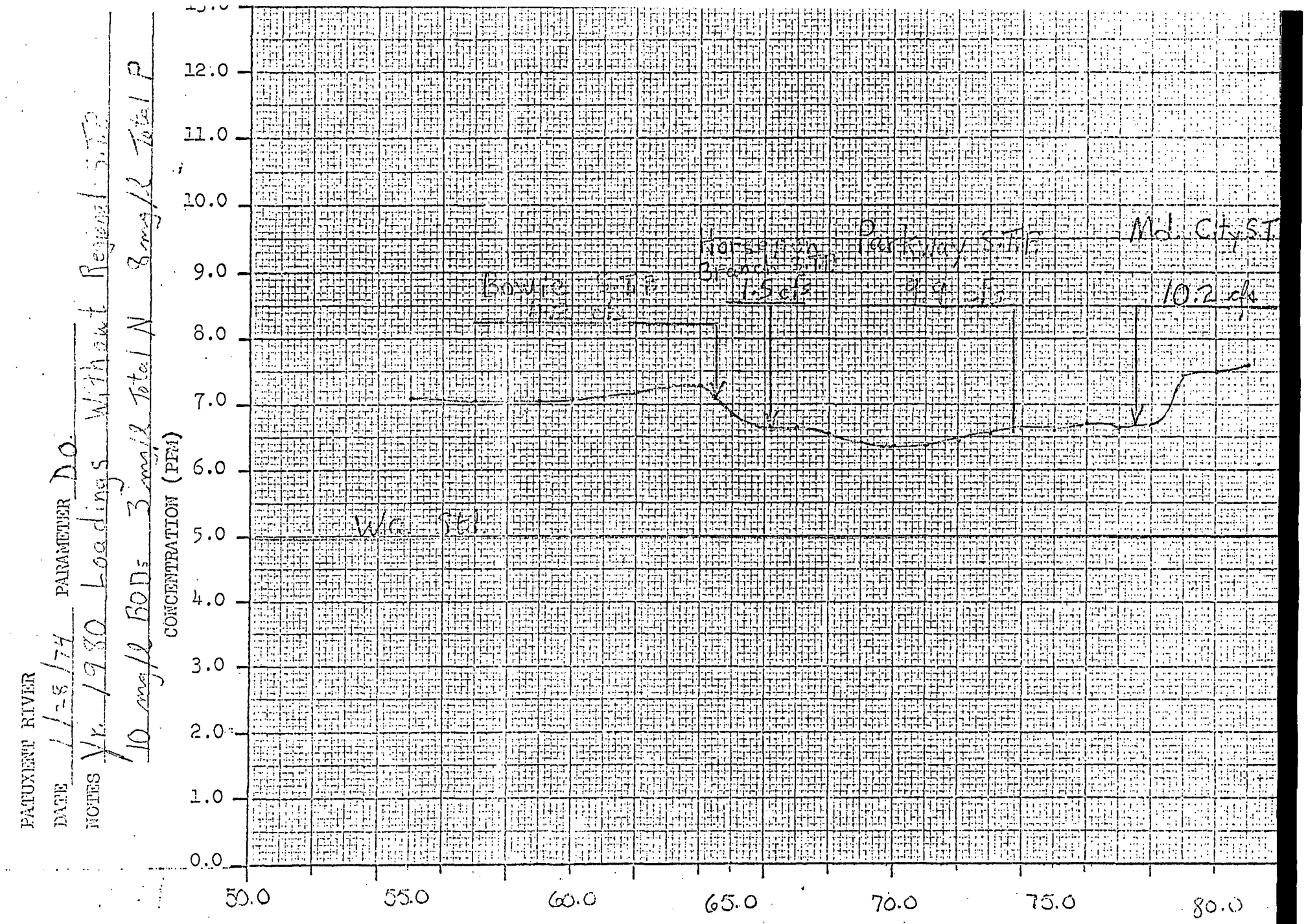
PATUXENT RIVER
DATE 1/28/74
PARAMETER D.O.
NOTES Yr. 1980 Loadings Without Regional STP
10 mg/l BOD5 3 mg/l Total N 3 mg/l Total P
CONCENTRATION (PPM)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
Md. City ST
10.2 cfs
1.5 cfs
Wic. std

FIGURE 2

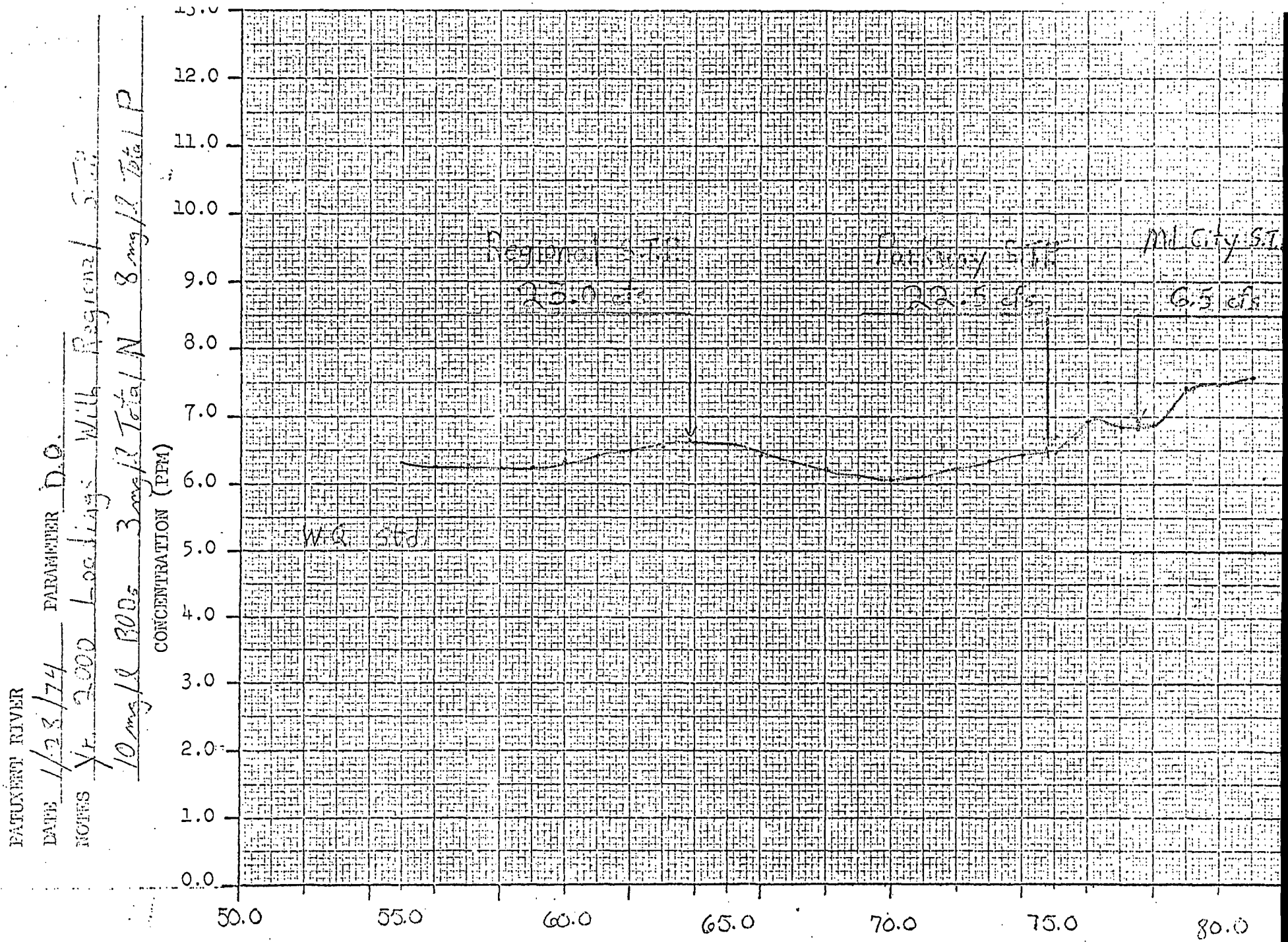
PATUXENT RIVER
DATE 1/23/74
PARAMETER D.O.
NOTES Yr. 2000 Loadings With Regional STP
10 mg/l BOD5 3 mg/l Total N 8 mg/l Total P
CONCENTRATION (PPM)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
W.Q. Std.
Ft. Meade STP
26.0 cfs
Patuxent STP
22.5 cfs
Md. City S.T.
6.3 cfs

FIGURE 3

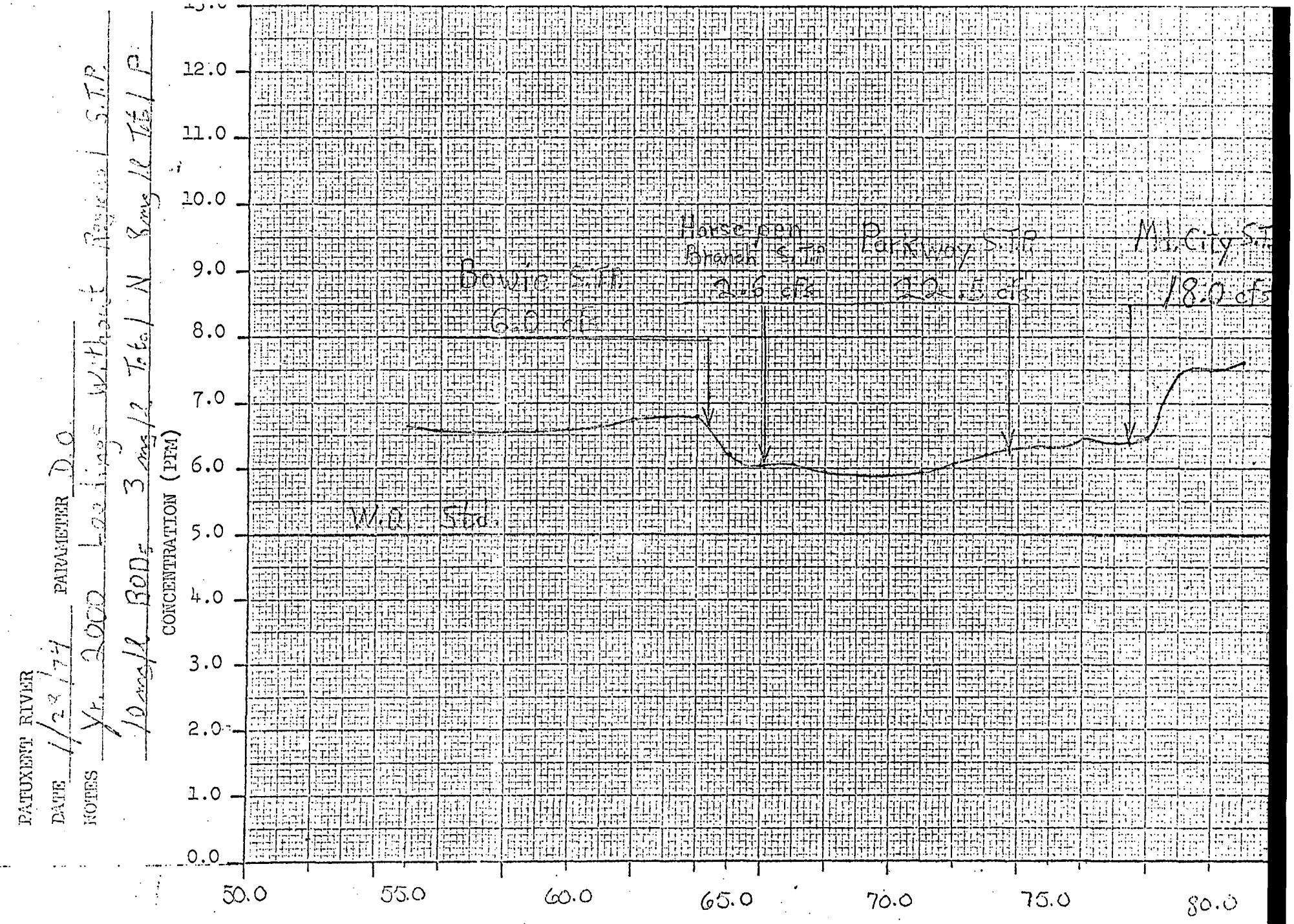
PATUXENT RIVER
DATE 1/28/74
PARAMETER D.O.
NOTES Yr. 2000 Loadings Without Bowie S.T.P.
10 mg/l BOD5 3 mg/l Total N 8 mg/l Total P
CONCENTRATION (PPM)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
W.Q. Std.
Bowie S.T.P.
6.0 cfs
Horse Pen Branch S.T.P.
2.6 cfs
Parkway S.T.P.
12.0 cfs
Mt. City S.T.P.
18.0 cfs

FIGURE 4

LITTLE PATUXENT RIVER - FREE FLOWING SECTION

DATE 1/28/74 PARAMETER(S) DO

NOTES Yr. 1980 conditions With Reduced Total N.

Dose R Rate 3 mg/l Total P 4 mg/l DO Effluent

8 mg/l Total P 4 mg/l DO Effluent

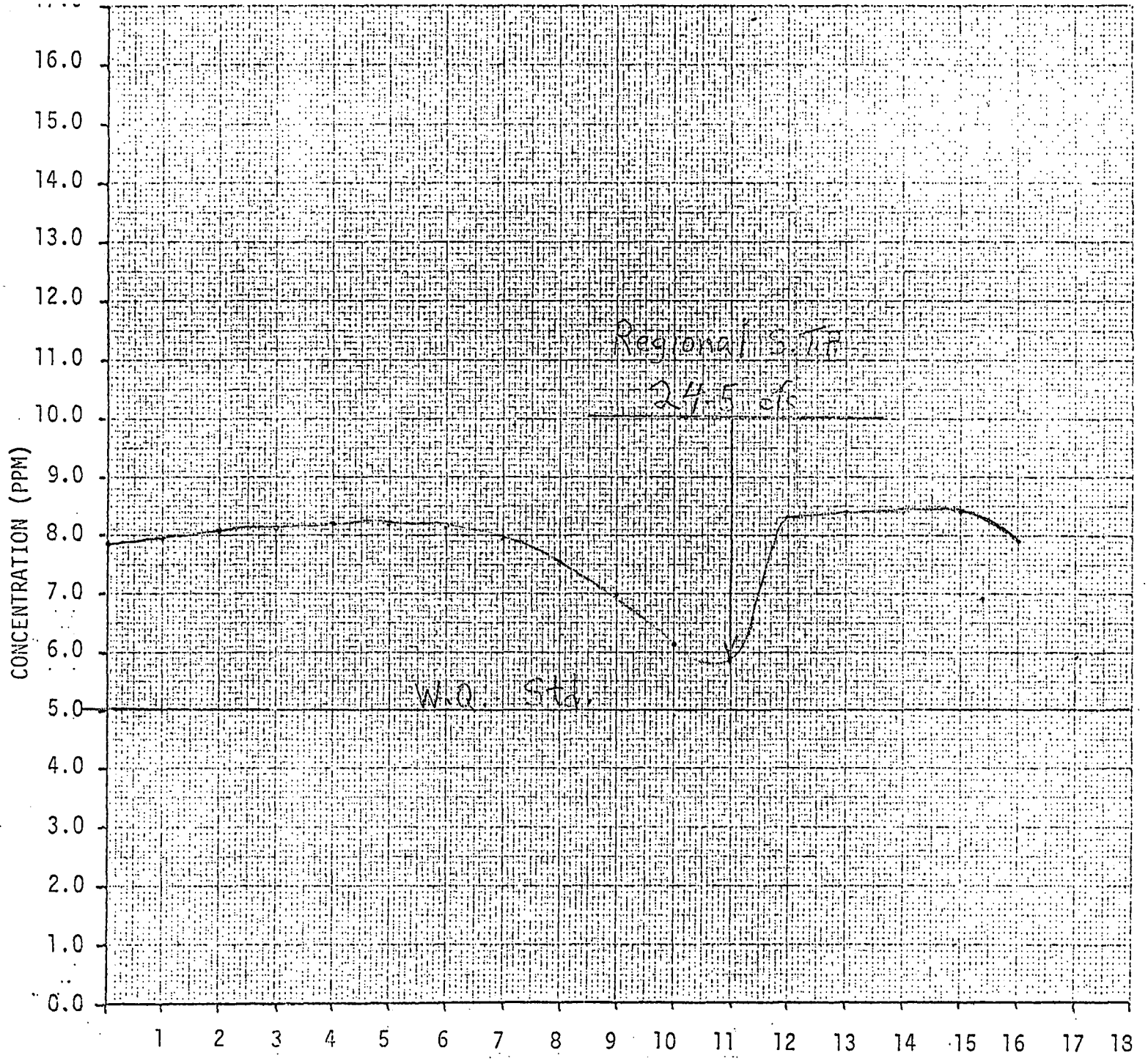

FIGURE 5

LITTLE PATUXENT RIVER - FREE FLOWING SECTION

DATE 11/28/77 PARAMETER(S) D.O.

NOTES: 1980 Loadings Without Regional S.T.P.

10 mg/l BOD5 3 mg/l Total N

8 mg/l Total P 4 mg/l DO Effluent

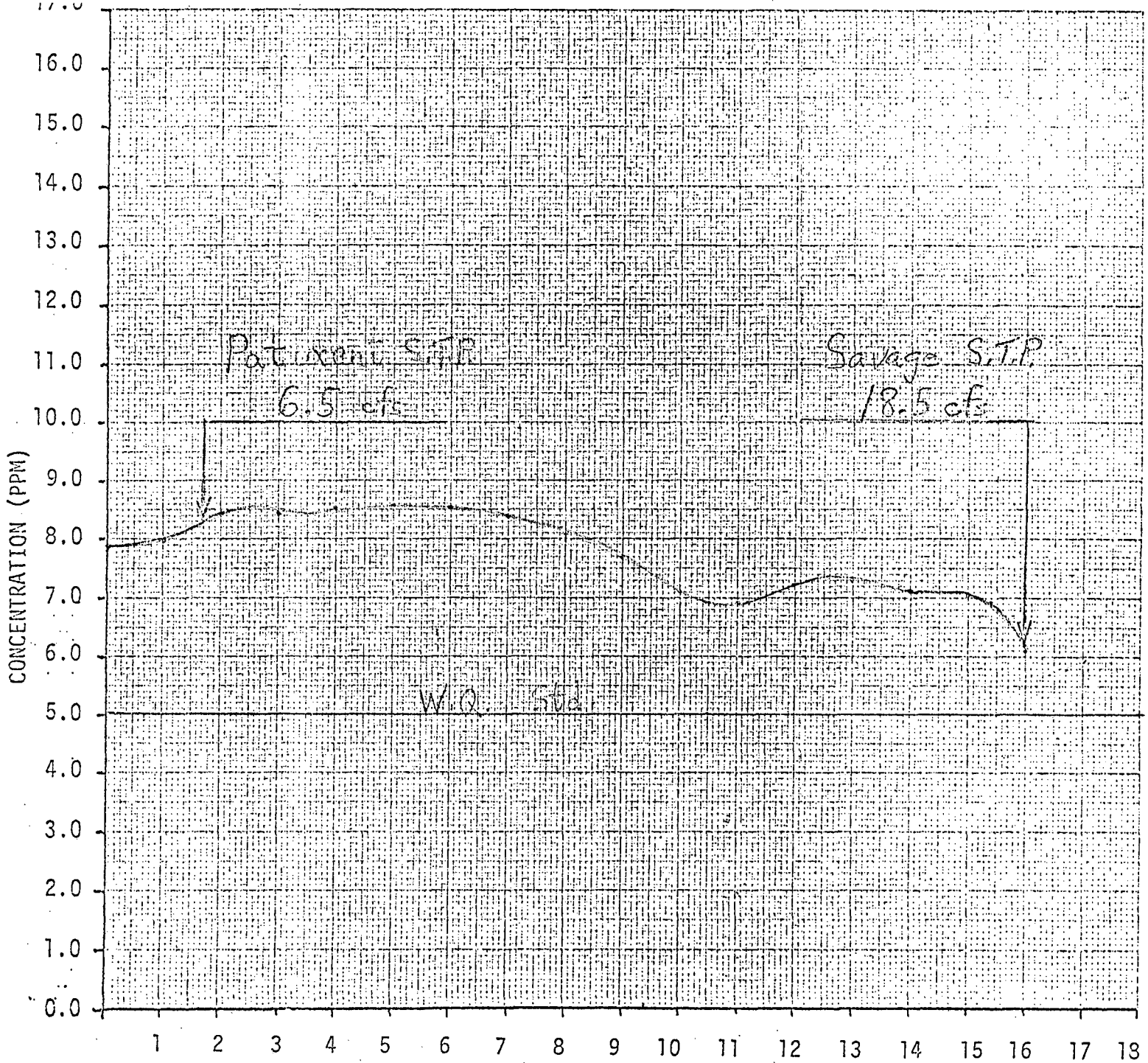

FIGURE 6

LITTLE PATUXENT RIVER - FREE FLOWING SECTION

DATE 1/28/74 PARAMETER(S) D.O.

NOTES Yr. 2000 Loadings With Regional [illegible]

10 mg/l BOD5 3 mg/l Total N

8 mg/l Total P 4 mg/l DO Effluent

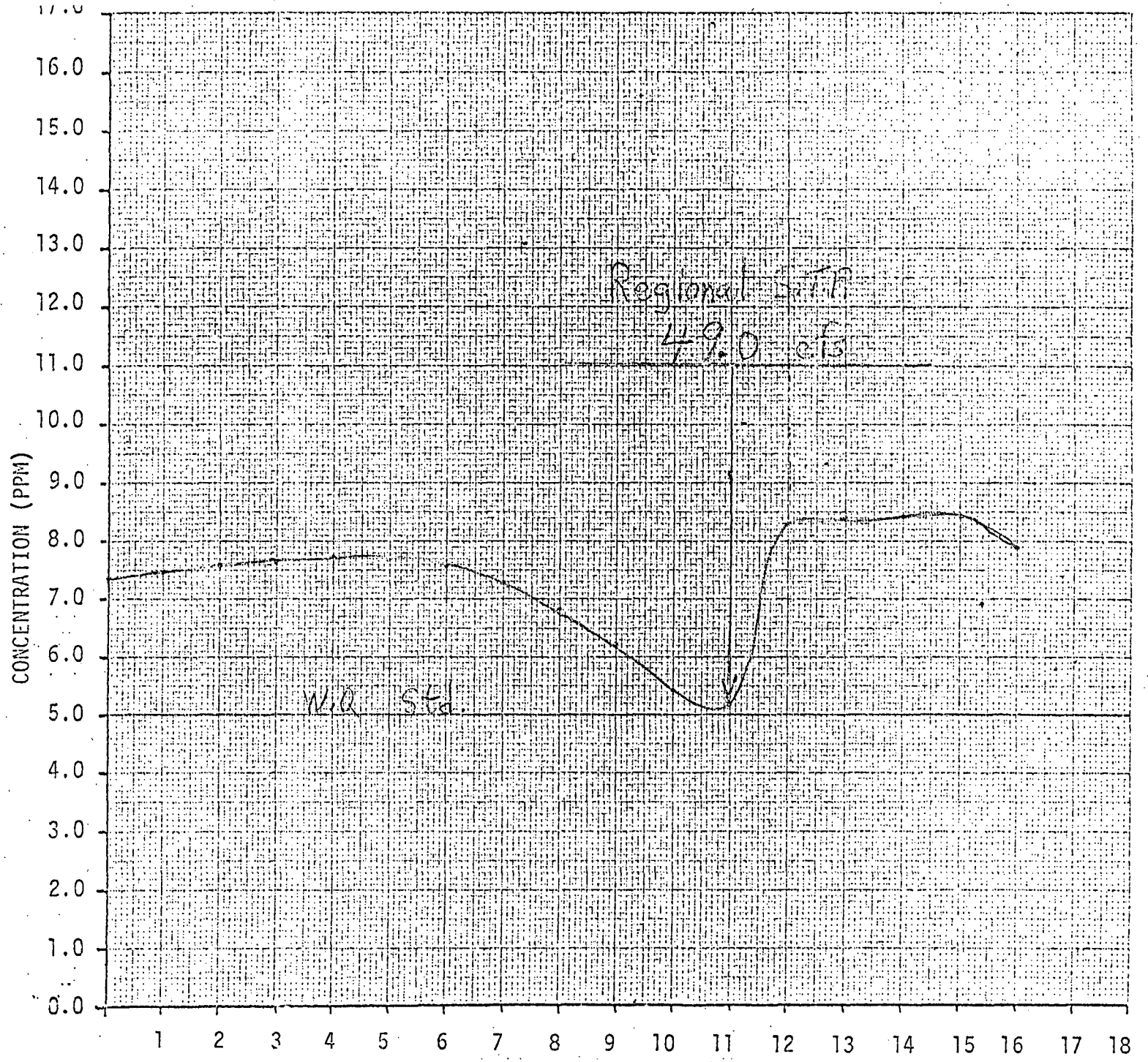

FIGURE 7

LITTLE PATUXENT RIVER - FREE FLOWING SECTION

DATE 1/28/74 PARAMETER(S) D.O.

NOTES Yr. 3000 Loading Without Proposed STP

10 mg/l BOD5 3 mg/l Total N

3 mg/l Total P 4 mg/l DO EFFLUENT

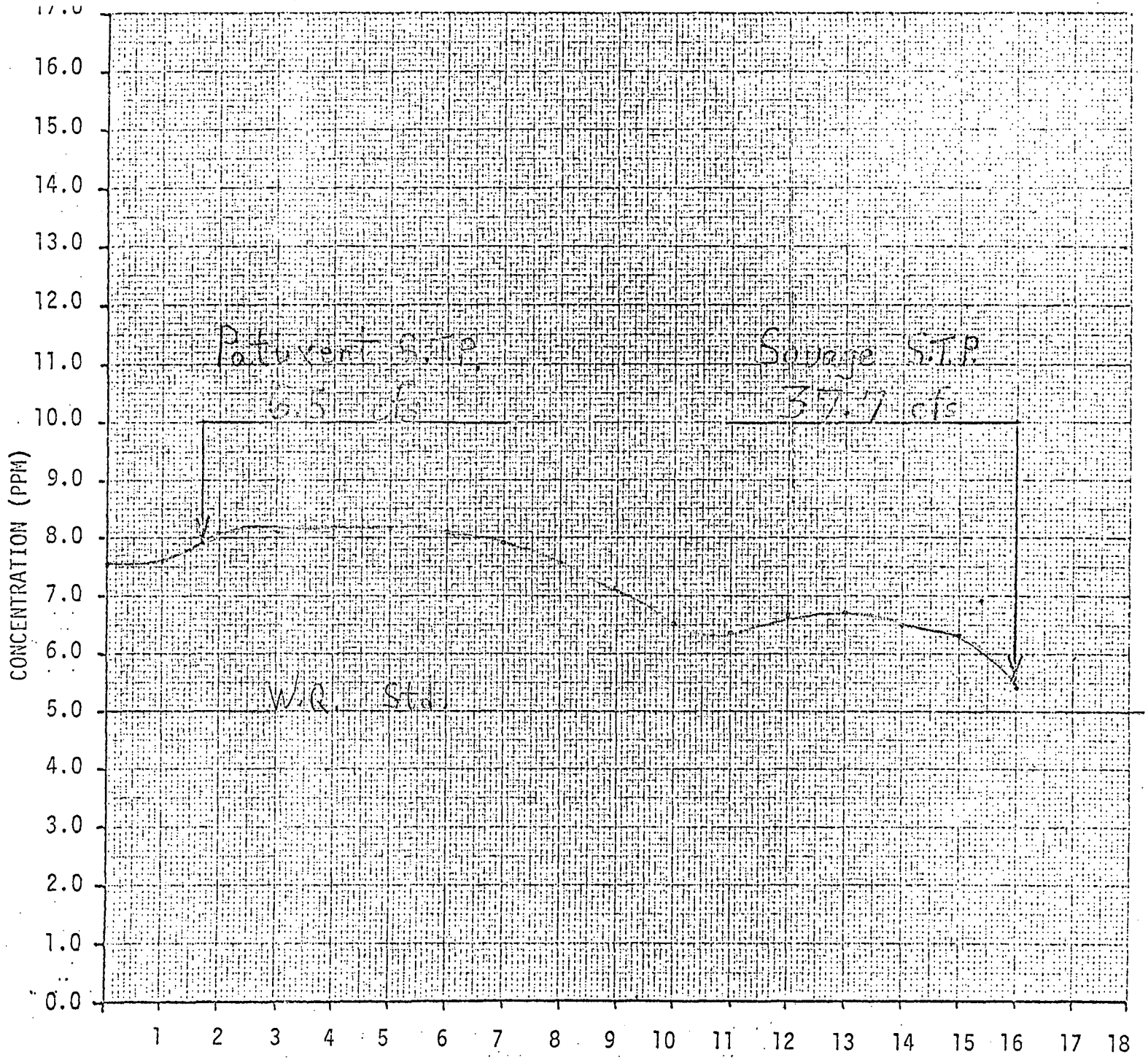

FIGURE 2

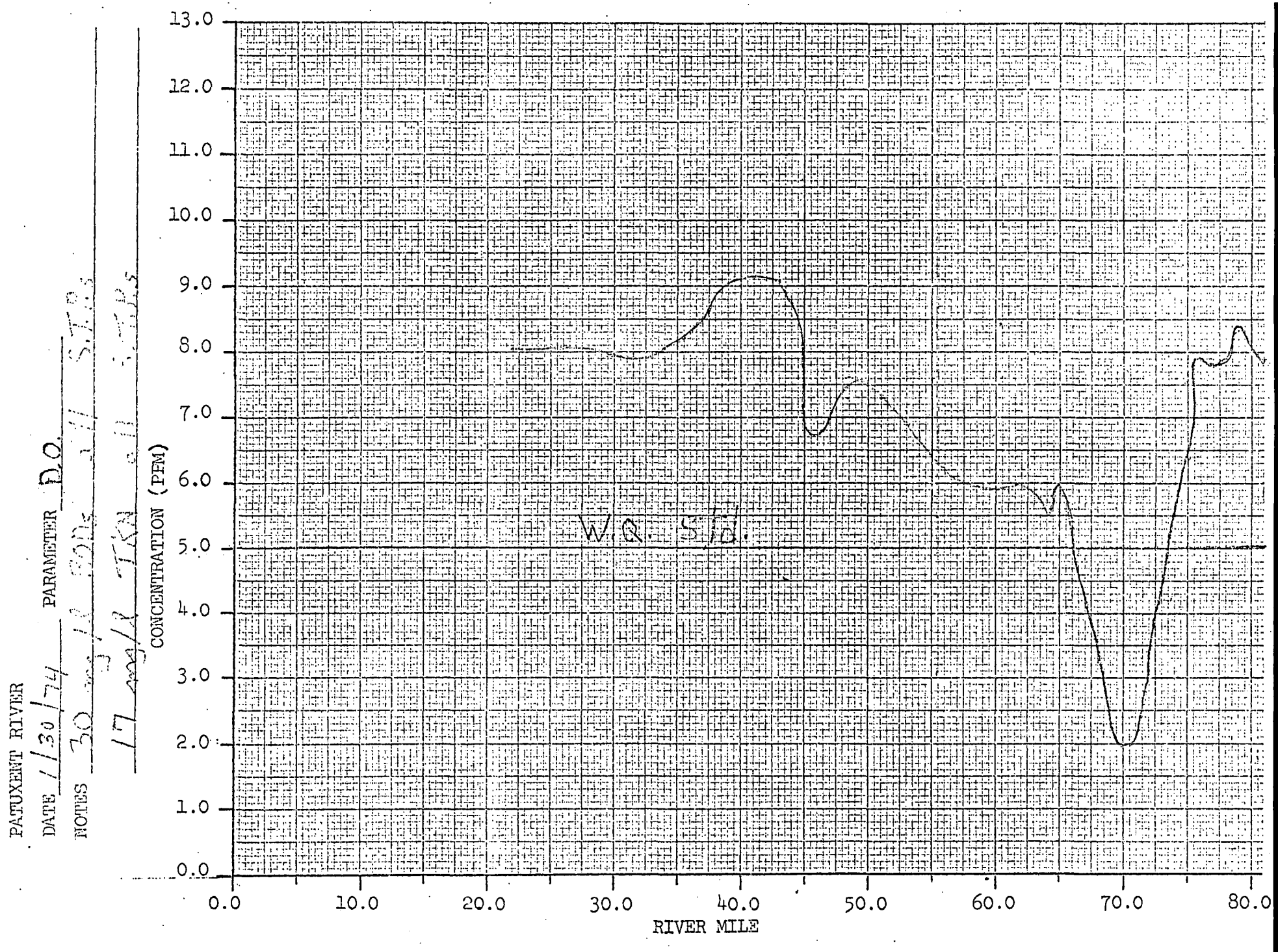
PATUXENT RIVER
DATE 1/30/74
PARAMETER D.O.
NOTES 30 mg/l BOD5 17 mg/l TKN
CONCENTRATION (PPM)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
W.Q. Std.
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
RIVER MILE

FIGURE 9

PATUXENT RIVER

DATE 11/30/74 PARAMETER D.O.

NOTES 30 mg/l CO_2 at all STPs except Parkway (No nitrogen removal) Parkway STP is 8 mg/l BOD_5 2 mg/l TKN

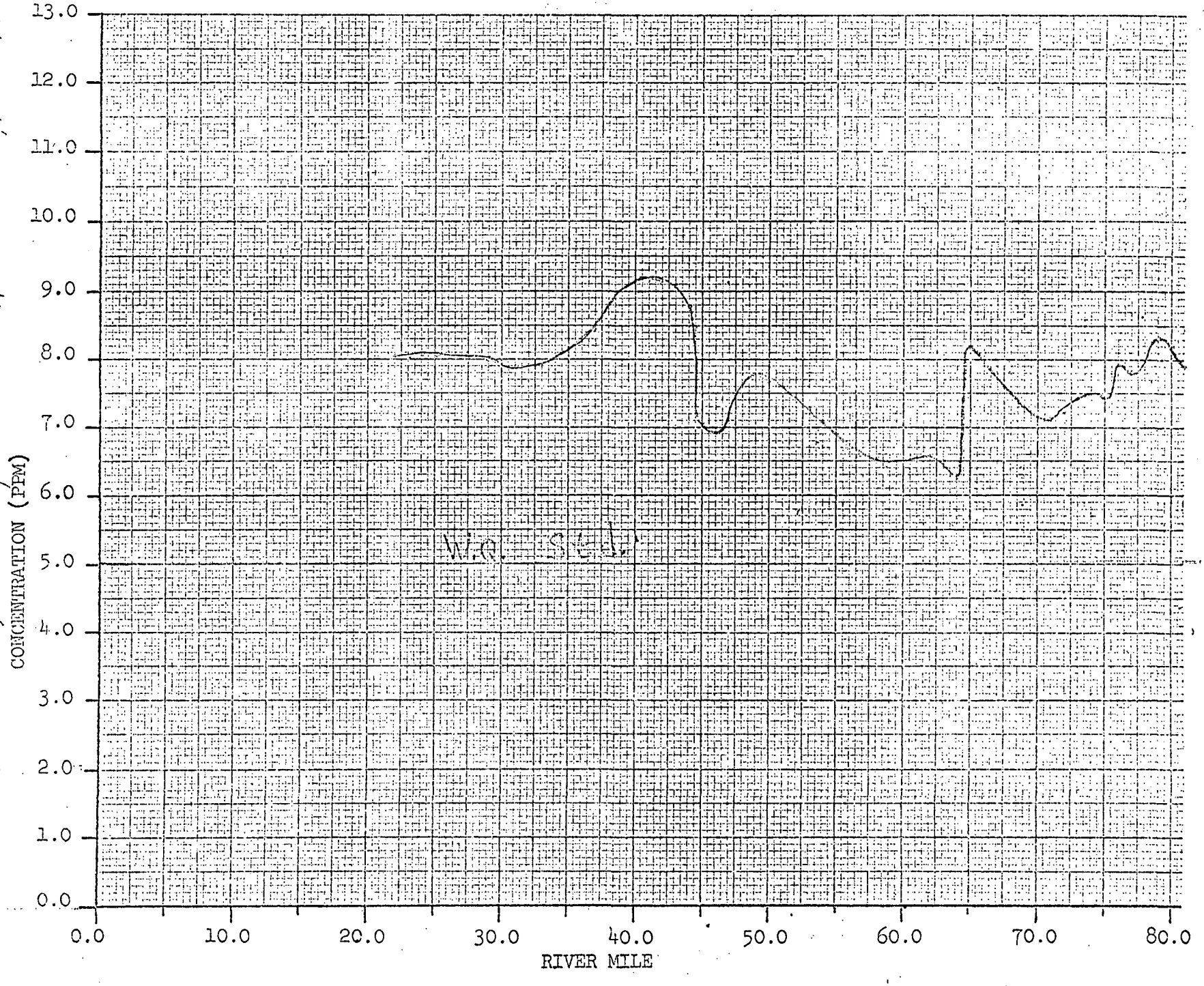

FIGURE 10

LITTLE PATUXENT RIVER - FREE FLOWING SECTION

DATE 1/30/74 PARAMETER(S) D.O.

NOTES 10 mg/l BOD5 all STPs

No nitrogen removal

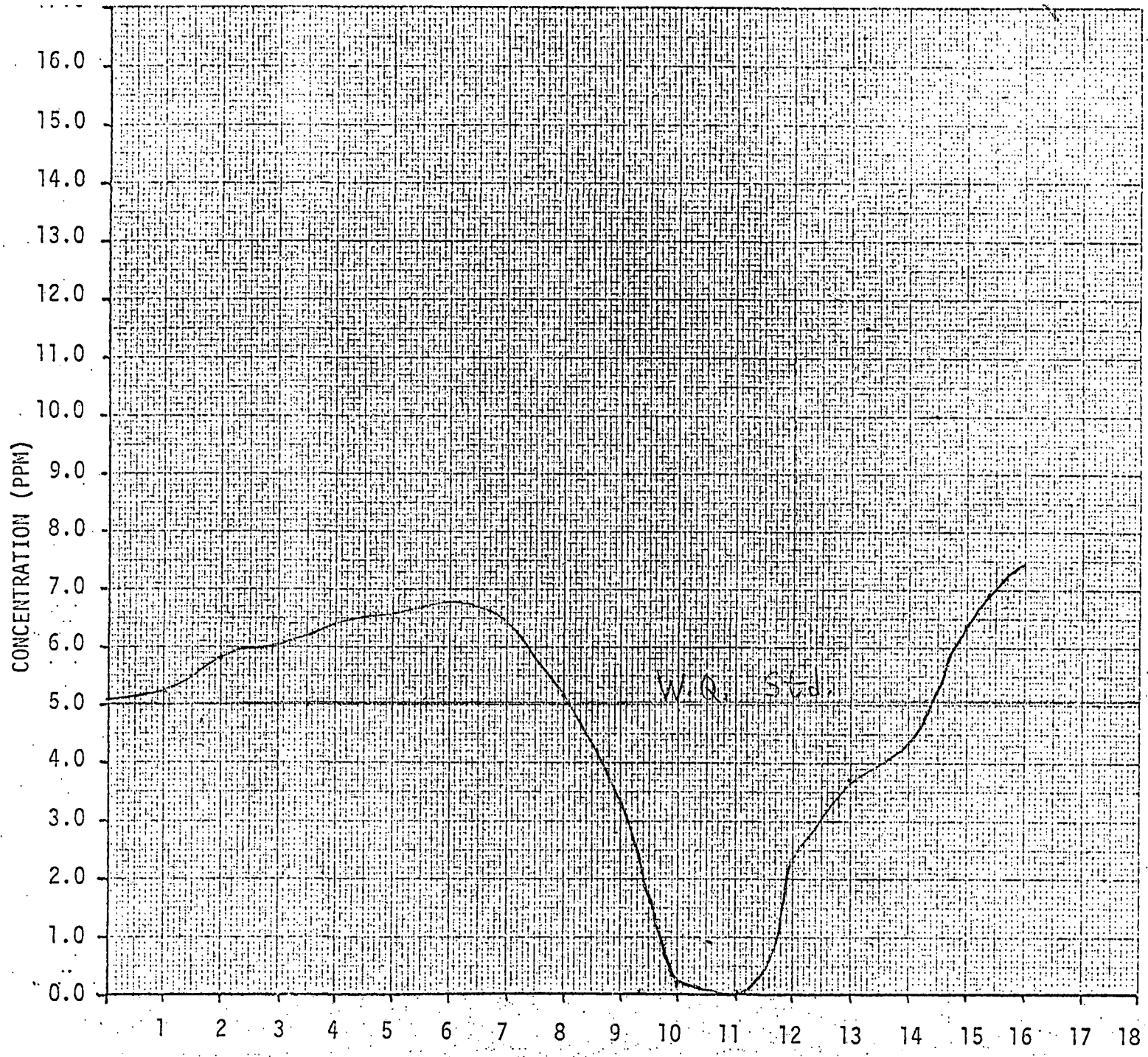

FIGURE 11

LITTLE PATUXENT RIVER - FREE FLOWING SECTION

DATE 1/30/74 PARAMETER(S) D.O.

NOTES 10 mg/l BOD5 all S.T.P.s

17 mg/l TKN Ft. Meade #1 + #2, Patuxent S.T.P.

2 mg/l TKN Savage S.T.P.

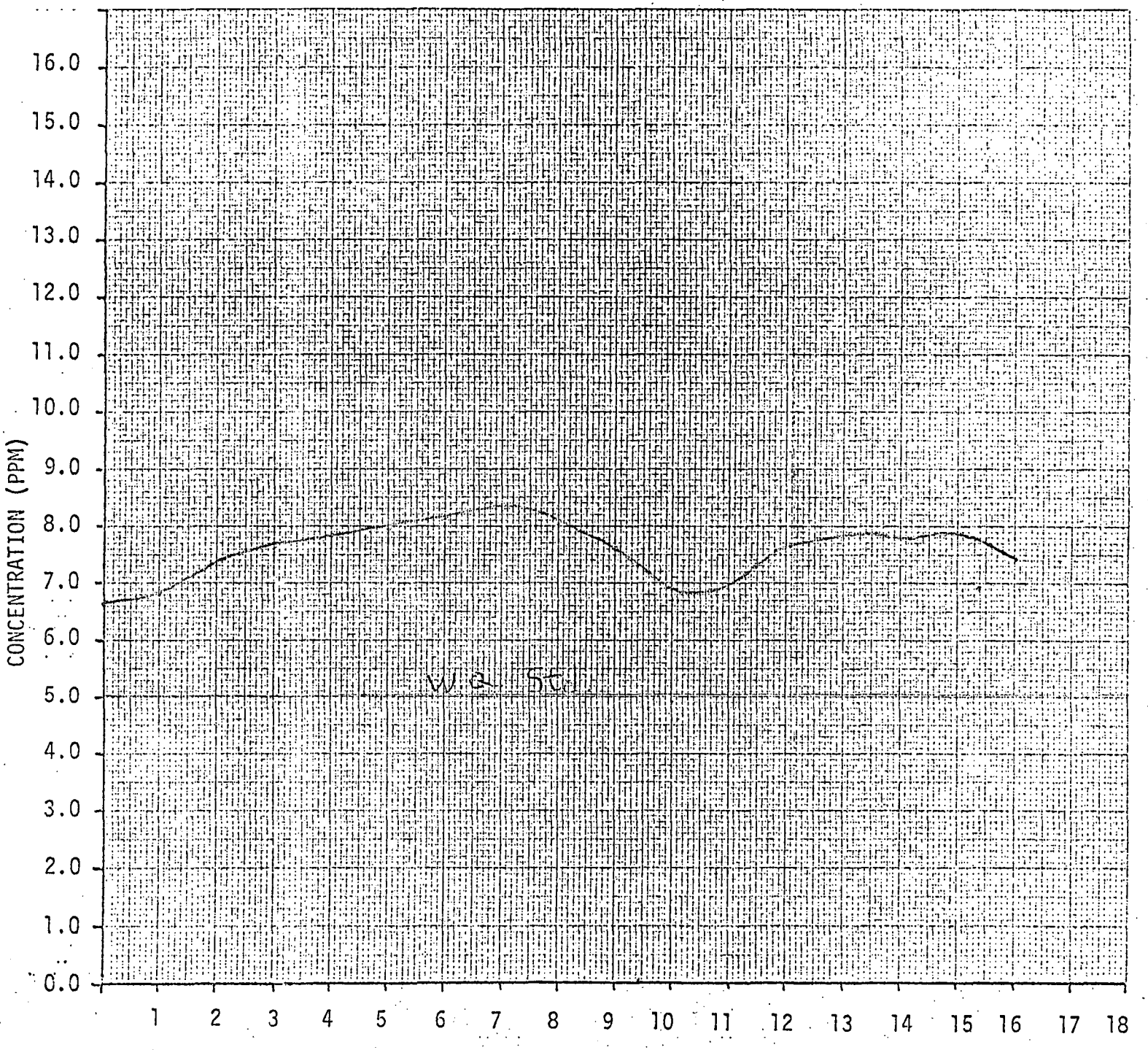

FIGURE 12