U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

JOHNSON POND

WICOMICO COUNTY

MARYLAND

EPA REGION III

WORKING PAPER No. 356

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

and

NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA

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REPORT
ON
JOHNSON POND
WICOMICO COUNTY
MARYLAND
EPA REGION III
WORKING PAPER No. 356

WITH THE COOPERATION OF THE

MARYLAND DEPARTMENT OF NATURAL RESOURCES,

MARYLAND DEPARTMENT OF HEALTH AND MENTAL HYGIENE,

AND THE

MARYLAND NATIONAL GUARD

JUNE, 1975

REPORT ON JOHNSON POND

WICOMICO COUNTY, MARYLAND, EPA REGION III

by

National Eutrophication Survey

Water and Land Monitoring Branch
Monitoring Applications Laboratory
National Environmental Research Center
Las Vegas, Nevada

and

Eutrophication Survey Branch
Pacific Northwest Environmental Research Laboratory
National Environmental Research Center
Corvallis, Oregon

Working Paper No. 356

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

June 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin

planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Maryland Department of Natural Resources and the Maryland Department of Health and Mental Hygiene for professional involvement and to the Maryland National Guard for conducting the tributary sampling phase of the Survey.

Paul W. Slunt, Chief, Water Quality Services, James T. Allison, Natural Resources Manager, Water Quality Services, of the Maryland Department of Natural Resources, and Earl S. Quance, Chief, Division of Water and Sewerage, Maryland Department of Health and Mental Hygiene provided invaluable lake documentation and counsel during the course of the Survey.

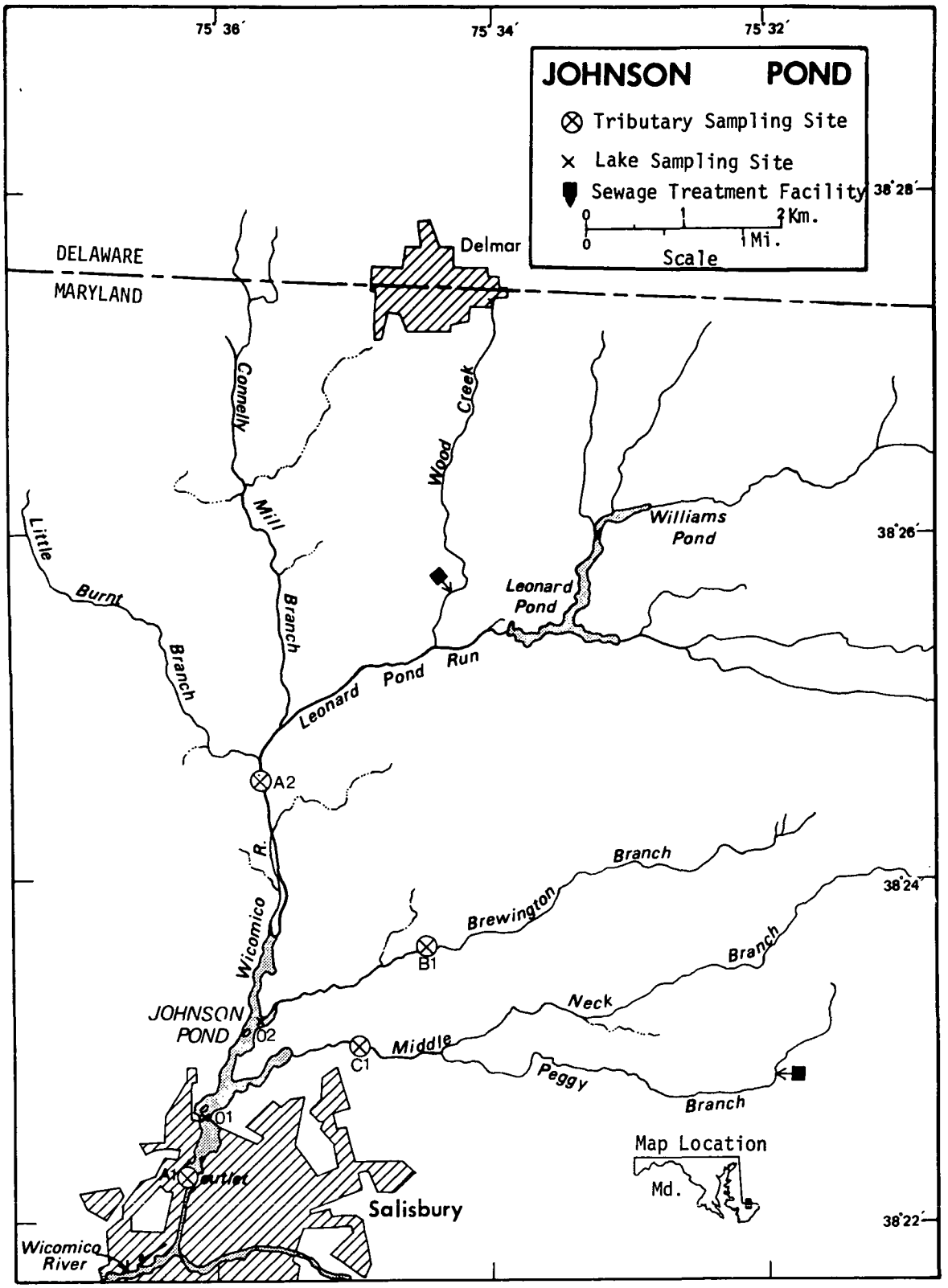
Major General Edwin Warfield III, the Adjutant General of Maryland, and Project Officer Colonel Bernard Feingold, who directed the volunteer efforts of the Maryland National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MARYLAND

LAKE NAME	COUNTY
Deep Creek Lake	Garrett
Liberty Reservoir	Carroll, Baltimore
Loch Raven Reservoir	Baltimore
Johnson Pond	Wicomico


JOHNSON POND
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 1 2 Km.
0 1 Mi.
Scale
75° 36'
75° 34'
75° 32'
38°28'
38°26'
38°24'
38°22'
DELAWARE
MARYLAND
Delmar
Connelly
Mill
Branch
Wood Creek
Little
Burnt
Branch
Leonard Pond Run
Leonard Pond
Williams Pond
A2
R.
Wicomico
Brewington
Branch
B1
Neck
Branch
JOHNSON POND
B2
C1
Middle
Peggy
Branch
B1
A1
outlet
Salisbury
Wicomico River
Map Location
Md.

JOHNSON POND

STORET NO. 2409

I. CONCLUSIONS

A. Trophic Condition*:

Johnson Pond is considered eutrophic based upon field observations and analysis of survey data. Rooted and floating aquatic vegetation was observed during the fall sampling with no visible algal blooms. The water clarity was low and presented a green turbid appearance. Phytoplankton genera identified were mostly pollution-tolerant forms. Chlorophyll a levels ranged from a low of 2.6 micrograms/liter in the spring, to a high level of 69.1 micrograms/liter in the summer. The algal assay control yield results indicate a high potential for primary productivity. The pond is characterized by high concentrations of inorganic nitrogen and dissolved phosphorus.

B. Rate-Limiting Nutrient:

Algal assay results indicate that Johnson Pond was limited by available phosphorus levels. Spikes with phosphorus, and nitrogen and phosphorus simultaneously result in increases in assay yield. Additions of nitrogen alone did not stimulate a growth response. The ratio of available nitrogen to dissolved phosphorus in sampled waters substantiates phosphorus limitation.

* See Appendix E

C. Nutrient Controllability:

1. Point sources -

The mean annual phosphorus load from point sources was estimated to be 29.1% of the total load reaching Johnson Pond. The city of Delmar wastewater treatment plant contributed 18.6% while Purdue Inc. contributed 10.5% of the total phosphorus load.

The loading rate of 20.81 $g/m^2/yr$ is over nine times higher than the proposed "dangerous" levels by Vollenweider (in press) and it is over 18.5 times higher than the "permissible" proposed rate. Total elimination of known point sources of phosphorus is not likely to result in a depression of loading values to below Vollenweider's "dangerous" levels.

2. Nonpoint sources -

Nonpoint sources contributed 70.9% of the phosphorus loading reaching Johnson Pond. Measured tributaries accounted for 66% of the total phosphorus load and the ungaged tributaries accounted for 4.9% of the load.

The calculations of loading based upon available nutrient concentrations and flow data indicate a net export of nitrogen from Johnson Pond, suggesting that the tributary sampling was perhaps inadequate to depict actual loading and export rate for that nutrient.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake surface area, mean and maximum depths were provided by the State of Maryland; tributary data were provided by the Maryland District Office of the U.S. Geological Survey (USGS) (outlet drainage area includes the lake surface area). Mean hydraulic retention time was obtained by dividing the lake volume by the mean flow of the outlet.

Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix D.

A. Lake Morphometry:

1. Surface area: 0.42 km^2.
2. Mean depth: 2.1 meters.
3. Maximum depth: 6.1 meters.
4. Volume: 0.884×10^6 m^3.
5. Mean hydraulic retention time: 5.4 days.

B. Tributary and Outlet (see Appendix A for flow data)

1. Tributaries -

Name	Drainage area(km^2)	Mean flow (m^3/sec)
A(2) Wicomico River	67.9	1.4
B(1) Brewington Branch	10.4	0.1
C(1) Middle Neck Branch	14.6	0.3
Minor tributaries & immediate drainage -	2.8	0.1
Totals	95.7	1.9

	Drainage area(km^2)	Mean flow (m^3/sec)
2. Outlet - A(1) Wicomico River	96.1	1.9

C. Precipitation:

1. Year of sampling: 115.7 centimeters.

2. Mean annual: 145.5 centimeters.

III. LAKE WATER QUALITY SUMMARY

Johnson Pond was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first visit, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 1.8 meters at Station 1, and the surface at Station 2. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix B and are summarized in III A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III B. Results of the limiting nutrient study are presented in III C.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR JOHNSON POND
STORET CODE 2409

PARAMETER	1ST SAMPLING (4/10/73) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/20/73) 1 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/28/73) 1 SITES RANGE	MEAN	MEDIAN
TEMP (C)	13.2 - 13.5	13.4	13.4	24.6 - 27.4	26.0	26.0	19.2 - 20.0	19.6	19.6
DISS OXY (MG/L)	8.3 - 8.9	8.6	8.6	11.5 - 16.0	13.8	13.8	7.8 - 8.2	8.0	8.0
CNDCTVY (MCROMO)	85. - 85.	85.	85.	94. - 110.	102.	102.	72. - 74.	73.	73.
PH (STAND UNITS)	8.4 - 8.5	8.4	8.4	9.0 - 9.9	9.4	9.4	6.9 - 7.4	7.1	7.1
TOT ALK (MG/L)	10. - 10.	10.	10.	12. - 15.	14.	14.	16. - 17.	17.	17.
TOT P (MG/L)	0.076 - 0.095	0.088	0.093	0.110 - 0.121	0.115	0.115	0.098 - 0.098	0.098	0.098
ORTHO P (MG/L)	0.040 - 0.041	0.040	0.040	0.011 - 0.024	0.017	0.017	0.033 - 0.053	0.043	0.043
NO2+NO3 (MG/L)	0.700 - 1.100	0.867	0.800	0.380 - 0.730	0.555	0.555	1.450 - 1.680	1.565	1.565
AMMONIA (MG/L)	0.100 - 0.150	0.127	0.130	0.050 - 0.060	0.055	0.055	0.080 - 0.100	0.090	0.090
KJEL N (MG/L)	0.600 - 0.800	0.700	0.700	0.900 - 1.900	1.400	1.400	0.500 - 1.300	0.900	0.900
INORG N (MG/L)	0.800 - 1.230	0.993	0.950	0.430 - 0.790	0.610	0.610	1.550 - 1.760	1.655	1.655
TOTAL N (MG/L)	1.400 - 1.700	1.567	1.600	1.630 - 2.280	1.955	1.955	2.180 - 2.750	2.465	2.465
CHLRPYL A (UG/L)	2.6 - 3.0	2.8	2.8	69.1 - 69.1	69.1	69.1	30.2 - 30.2	30.2	30.2
SECCHI (METERS)	0.8 - 0.8	0.8	0.8	0.9 - 0.9	0.9	0.9	1.8 - 1.8	1.8	1.8

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera		Algal Units per ml
04/10/73	1.	Flagellates	403
	2.	Fragilaria	77
	3.	Melosira	76
	4.	Synedra	38
	5.	Scenedesmus	19
		Other genera	114
		Total	727
07/20/73	1.	Flagellates	683
	2.	Microcystis	518
	3.	Phormidium	448
	4.	Oscillatoria	424
	5.	Ankistrodesmus	377
		Other genera	2,257
		Total	4,707
09/28/73	1.	Flagellates	2,168
	2.	Cryptomonas	1,174
	3.	Melosira	569
	4.	Microcystis	178
	5.	Phormidium	178
		Other genera	286
		Total	4,553

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (micrograms/liter)
04/10/73	1	3.0
	2	2.6
07/20/73	1	69.1
09/28/73	1	30.2

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.044	0.97	10.7
0.05 P	0.094	0.97	20.3
0.05 P + 1.0 N	0.094	1.97	40.0
1.00 N	0.044	1.97	9.5

2. Discussion -

The results of the algal assay with Selenastrum capricorntum indicate that Johnson Pond was growth limited by phosphorus at the time of sample analysis. Simultaneous addition of nitrogen and phosphorus spikes produced a substantial increase in yield over the addition of phosphorus alone. No growth response accompanied spikes of nitrogen alone.

The ratio of inorganic nitrogen to dissolved phosphorus in the field samples was about 33:1 indicating the lake was phosphorus limited at the time of assay sample collection.

The high control yield of the test alga indicates high potential primary productivity.

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Maryland National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and March when two samples were collected. Sampling was begun in May 1973, and was completed in May 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Maryland District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of the USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual concentrations in Brewington Branch at Station B(1) and mean annual ZZ flow.

The operator of the Delmar and Purdue Inc. (Salisbury) wastewater treatment plants provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

Name	Population Served	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Delmar	2,500*	Trickling filter	0.950**	Wood Creek, Leonard Pond Run

2. Known industrial -

Name	Product	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Purdue Inc. (Salisbury)***	Soybean plant, Feed mill, Chicken hatchery	Stabilization pond	3.312	Peggy Brook

*Provided by the State of Maryland.
**Estimated based upon 0.38 m^3/capita/day.
***Consists of an old plant and a new plant. New plant also serves a population of 150 employees.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) Wicomico River	5,205	59.6
B(1) Brewington Branch	355	4.1
C(1) Middle Neck Branch	200	2.3
b. Minor tributaries & immediate drainage (nonpoint load) -	425	4.9
c. Known municipal STP's - Delmar	1,630	18.6
d. Septic tanks* -	5	<0.1
e. Known industrial -		
Purdue Inc. (Salisbury)	915	10.5
f. Direct precipitation** -	5	<0.1
Total	8,740	100.0

2. Outputs - A(1) Wicomico River 7,385

3. Net annual P accumulation - 1,355 kg.

*Estimate based upon 22 lakeside residences.
**Estimated (see NES Working Paper No. 175).

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) Wicomico River	113,055	78.1
B(1) Brewington Branch	4,415	3.0
C(1) Middle Neck Branch	13,965	9.6
b. Minor tributaries & immediate drainage (nonpoint load) -	5,635	3.9
c. Known municipal STP's - Delmar	4,340	3.0
d. Septic tanks * -	10	<0.1
e. Known industrial -		
Purdue Inc. (Salisbury)	3,105	2.1
f. Direct precipitation** -	455	0.3
Total	144,980	100.0

2. Outputs - A(1) Wicomico River 161,405

3. Net annual N export*** - 16,425 kg.

*Estimate based upon 22 lakeside residences.
**Estimated (see NES Working Paper No. 175).
***Calculated export probably due to unknown sources and/or sampling error.

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
A(2) Wicomico River	77	1,665
B(1) Brewington Branch	34	425
C(1) Middle Neck Branch	14	956

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Yearly Phosphorus Loading Rate (grams/m^2/year)
Estimated loading rate for Johnson Pond	20.81
Vollenweider's "dangerous" or eutrophic rate	2.24
Vollenweider's "permissible" or oligotrophic rate	1.12

V. LITERATURE REVIEWED

U.S. Environmental Protection Agency. 1975. "National Eutrophication Survey Methods 1974-1976." Working Paper No. 175. NERC, Las Vegas, Nevada and PNERL, Corvallis, Oregon.

Vollenweider, Richard A. (in press). "Input-Output Models." Schweiz Z. Hydrol.

VI. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2409 JOHNSON POND

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 96.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2409A1	96.1	2.29	2.63	3.17	2.49	1.78	1.53	1.22	1.70	1.19	1.36	1.56	1.78	1.89
2409A2	67.9	1.67	1.87	2.10	1.78	1.42	1.16	0.96	1.33	0.93	1.02	1.19	1.42	1.48
2409B1	10.4	0.13	0.20	0.24	0.16	0.07	0.03	0.01	0.05	-0.01	0.02	0.04	0.07	0.09
2409C1	14.6	0.30	0.32	0.35	0.31	0.27	0.24	0.20	0.25	0.20	0.21	0.24	0.27	0.26
2409ZZ	3.2	0.19	0.24	0.49	0.23	0.03	0.10	0.04	0.06	0.05	0.11	0.09	0.03	0.14

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 96.1
SUM OF SUB-DRAINAGE AREAS = 96.1
TOTAL FLOW IN = 22.71
TOTAL FLOW OUT = 22.71

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2409A1	5	73	1.93	12	1.87				
	6	73	1.39	9	1.22				
	7	73	1.19	15	1.08				
	8	73	2.49	11	1.10				
	9	73	1.61	8	1.44				
	10	73	1.33	13	1.33				
	11	73	1.19	10	1.39				
	12	73	2.32	9	2.41				
	1	74	2.92	15	1.93				
	2	74	2.18	10	1.87	24	2.18		
	3	74	2.07	10	1.64	24	2.27		
	4	74	2.63	14	2.75				
2409A2	5	73	1.50	12	1.44				
	6	73	1.05	9	0.91				
	7	73	0.88	15	0.79				
	8	73	1.78	11	0.79				
	9	73	1.25	8	1.10				
	10	73	1.02	13	1.02				
	11	73	0.88	10	1.05				
	12	73	1.67	9	1.73				
	1	74	1.98	15	1.50				
	2	74	1.61	10	1.47	24	1.61		
	3	74	1.56	10	1.30	24	1.64		
	4	74	1.87	14	1.90				

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2409 JOHNSON POND

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2409B1	5	73	0.08	12	0.08				
	6	73	0.02	9	0.01				
	7	73	0.01	15	0.01				
	8	73	0.16	11	0.01				
	9	73	0.04	8	0.03				
	10	73	0.02	13	0.02				
	11	73	0.01	10	0.02				
	12	73	0.14	9	0.15				
	1	74	0.22	15	0.08				
	2	74	0.12	10	0.08	24	0.12		
	3	74	0.10	10	0.05	24	0.13		
	4	74	0.20	14	0.20				
2409C1	5	73	0.28	12	0.27				
	6	73	0.21	9	0.20				
	7	73	0.19	15	0.18				
	8	73	0.31	11	0.18				
	9	73	0.24	8	0.22				
	10	73	0.21	13	0.21				
	11	73	0.19	10	0.22				
	12	73	0.31	9	0.31				
	1	74	0.34	15	0.28				
	2	74	0.28	10	0.27	24	0.28		
	3	74	0.28	10	0.25	24	0.31		
	4	74	0.31	14	0.31				
2409ZZ	5	73	0.06	12	0.08				
	6	73	0.10	9	0.10				
	7	73	0.11	15	0.10				
	8	73	0.24	11	0.12				
	9	73	0.08	8	0.09				
	10	73	0.08	13	0.08				
	11	73	0.11	10	0.10				
	12	73	0.20	9	0.22				
	1	74	0.37	15	0.06				
	2	74	0.16	10	0.05	24	0.16		
	3	74	0.12	10	0.04	24	0.18		
	4	74	0.25	14	0.34				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/09/16

240901
38 22 38.0 075 36 05.0
JOHNSON POND
24045 MARYLAND

11EPALES 2111202
3 0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/10	15 00	0000	13.4		30	85	8.40	10	0.150	0.800	0.800	0.040
	15 00	0006	13.2	8.9		85	8.40	10	0.130	0.600	1.100	0.040
73/07/20	15 25	0000	27.4	16.0	35	110	9.90	12	0.050	1.900	0.380	0.011
	15 25	0005	24.6	11.5		94	9.00	15	0.060	0.900	0.730	0.024
73/09/28	14 20	0000	20.0	8.2	72	74	7.40	17	0.100	1.300	1.450	0.033
	14 20	0006	19.2	7.8		72	6.90	16	0.080	0.500	1.680	0.053

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/10	15 00	0000	0.095	3.0
	15 00	0006	0.093	
73/07/20	15 25	0000	0.121	69.1
	15 25	0005	0.110	
73/09/28	14 20	0000	0.098	30.2
	14 20	0006	0.098	

STORET RETRIEVAL DATE 75/09/16

240902
38 23 12.0 075 35 45.0
JOHNSON POND
24045 MARYLAND

11EPALES
3

2111202
0005 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/10	15 20	0000	13.5	8.3	30	85	8.50	10K	0.100	0.700	0.700	0.041

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/10	15 20	0000	0.076	2.6

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX C

TRIBUTARY and WASTEWATER

TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/09/16

2409A1
38 22 18.0 075 36 12.0
WILCOMICO RIVER
24005 7.5 SALISBURY
O/JOHNSON POND
BRDG BTWN JOHNSON PD AND N PRONG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	11 30		1.400	1.050	0.025	0.046	0.115
73/06/09	09 05		1.040	0.980	0.011	0.050	0.100
73/07/15	13 55		0.340	3.500	1.300	0.635	1.350
73/08/11	11 00		1.000		1.000	0.550	1.250
73/09/08	14 30		0.510	1.100	0.015		0.110
73/10/13	10 00		1.420	1.300	0.050	0.058	0.200
73/11/10			1.420	1.150	0.163	0.063	0.110
73/12/09	14 10		1.600	0.400	0.032	0.072	0.120
74/01/15	13 40		1.500	0.700	0.108	0.048	0.090
74/02/10	13 21		2.100	3.200	0.140	0.070	0.820
74/02/24	11 00		1.850	1.600	0.110	0.060	0.170
74/03/10	13 30		1.520	0.600	0.010	0.030	0.085
74/03/24	13 00		1.500	0.900	0.025	0.030	0.140
74/04/14	12 50		1.360	0.900	0.030	0.050	0.070
74/05/18	14 00		0.970	1.200	0.155	0.032	0.110

STORET RETRIEVAL DATE 75/09/16

2409A2
38 24 32.0 075 35 30.0
WILCOMICO RIVER
24 7.5 DELMAR
I/JOHNSON POND
NAYLOR MILL RD BRDG BLOW NAYLORS POND
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	10 35		1.950	0.500	0.090	0.088	0.140
73/06/09	08 40		2.300	0.500	0.075	0.150	0.190
73/07/15	13 25		2.200	0.350	0.040	0.176	0.200
73/08/11	10 30		2.300	0.390	0.036	0.210	0.240
73/09/08	14 05		1.660	0.710	0.085	0.077	0.135
73/10/13	10 15		2.200	0.630	0.110	0.138	0.175
73/11/10			4.200	2.300	0.294		
73/12/09	14 40		1.850	0.700	0.148	0.136	0.220
74/01/15	11 10		1.760	0.500	0.108	0.044	0.065
74/02/10	14 00		2.270	0.700	0.185	0.065	0.120
74/02/24	12 00		1.960	0.600	0.090	0.060	0.100
74/03/10	12 45		2.200	1.200	0.220	0.110	0.250
74/03/24	14 10		1.680	0.600	0.120	0.052	0.092
74/04/14	12 10		1.700	0.600	0.065	0.055	0.075
74/05/18	13 20		2.000	0.500	0.080	0.130	0.170

STORET RETRIEVAL DATE 75/09/16

2409B1
38 23 35.0 075 34 30.0
BREWINGTON BRANCH
24 7.5 DELMAR
T/JOHNSON POND
US HWY 13 BRDG N OF JCT WITH ZION RD
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	11 00		0.500	1.150	0.340	0.058	0.150
73/06/09	08 50		0.300	1.350	0.470	0.075	0.185
73/07/15	13 35		0.440	4.800	0.940	0.176	0.310
73/08/11	10 38		0.085	1.680	0.440	0.092	0.300
73/09/08	14 50		0.410	1.320	0.230	0.044	0.130
73/10/13	11 05		0.350	0.730	0.147	0.040	0.100
73/11/10			0.140	0.650	0.147	0.023	0.075
73/12/09	14 20		0.264	0.700	0.076	0.060	0.200
74/01/15	13 30		0.490	0.400	0.036	0.020	0.035
74/02/10	13 40		0.860	0.800	0.115	0.025	0.105
74/02/24	11 20		0.516	0.500	0.030	0.015	0.050
74/03/10	13 10		0.470	0.700	0.095	0.025	0.055
74/03/24	13 30		0.216	0.800	0.035	0.025	0.075
74/04/14	12 40		0.232	1.000	0.052	0.017	0.035
74/05/18	13 00		1.520	4.200	0.165	0.105	0.600

STORET RETRIEVAL DATE 75/09/16

2409C1
38 23 00.0 075 35 00.0
MIDDLE NECK BRANCH
24 7.5 DELMAR
T/JOHNSON POND
US HWY 13 BRDG .5MI S OF JCT WTH ZION RD
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	11 10		1.600	0.820	0.230	0.160	0.240
73/06/09	08 55		1.060	0.890	0.110	0.130	0.190
73/07/15	13 40		0.780	0.840	0.079	0.085	0.130
73/08/11	10 46		0.700	0.460	0.132	0.105	0.148
73/09/08	14 10		1.540	0.355	0.050	0.066	0.110
73/10/13	10 35		1.610	0.750	0.027	0.054	0.085
73/11/10			1.500	0.650	0.095	0.063	0.110
73/12/09	14 30		1.340	0.300	0.036	0.128	0.175
74/01/15	11 20		1.800	0.400	0.100	0.088	0.115
74/02/10	14 00		2.400	0.200	0.025	0.055	0.080
74/02/24	11 40		1.700	0.600	0.030	0.105	0.150
74/03/10	13 20		1.760	0.400	0.030	0.075	0.105
74/03/24	13 45		1.600	0.500	0.040	0.095	0.145
74/04/14	13 00		1.600	0.600	0.060	0.100	0.100
74/05/18	13 00		0.172	4.600	1.100	0.220	0.530

STORET RETRIEVAL DATE 75/09/16

240930 PD240930 P000000*
38 22 55.0 075 32 02.0
PERDUE INC. (SALISBURY)
24045 WICOMICO COUNTY
T/JOHNSONS POND
PEGGY BROOK
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/01	12 30		0.880	0.750	0.315	0.220	0.350	0.875	0.875
73/08/02	13 30		1.400	2.100	0.217	0.197	0.480	0.875	0.875
73/09/02	13 30		1.900	0.120		0.100	0.212	0.875	0.875
73/10/04	10 30		1.680	1.400	0.078	0.270	0.510	0.875	0.875
73/11/02	14 00		0.780	0.900	0.390	0.210	0.570	0.875	0.875
74/01/10	16 30		2.240	0.620	0.380	0.450	0.910	0.875	0.875
74/02/01	09 30		0.880	1.400	0.520	0.500	0.800	0.875	0.875
74/03/07	10 00		1.520	1.500	0.245	1.125	1.150	0.875	0.875
74/08/23			0.040	1.500	0.050K	0.050	1.700	0.875	0.875
74/09/18			3.000	1.025	0.068	0.075	2.700	0.875	0.875
74/10/20			4.000	1.000K	0.050K	0.130			
74/11/22			3.680	3.200	0.360	0.720	0.800		
74/12/12			0.720	4.650	0.480	4.000	4.550		
74/12/31			0.560	6.000	0.640	4.500	5.100		

.K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

240931 TF240931 P002500
38 25 22.0 075 34 15.0
DELMAR
24 WICOMICO COUNTY
T/JOHNSONS POND
WOOD CREEK/LEONARD POND RUN
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/06	12 00		0.940	15.000	9.900	4.140	5.250	0.350	0.350
73/07/09	10 00		1.380	12.000	6.200	4.500	5.200	0.300	0.300
73/08/06	12 00							0.350	0.350
73/09/04	09 00		1.480	4.570				0.350	0.350
73/10/04	09 00		1.050	9.000	6.900	3.700	4.600	0.300	0.325
73/11/05	10 00		1.050	22.000	11.800	8.900	11.500	0.300	0.350
73/12/03	09 00		3.100	19.500	19.000	7.100	8.250	0.350	0.325
74/01/04	09 00		2.900	3.700	1.520	0.750	1.300	0.300	0.300
74/02/04	10 00		1.840	4.200	2.600	1.120	1.550	0.350	0.350
74/03/04	09 00		2.000	6.400	3.150	1.600	2.300	0.350	0.350
74/04/02	09 00		1.120	7.500	2.700	1.750	3.000	0.350	0.350
74/05/02	08 00		1.600	10.000	5.000	2.500	3.400	0.350	0.350
74/06/04	11 00		0.880	17.000	7.800	4.100	5.400	0.350	0.350

APPENDIX D

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX E

PARAMETRIC RANKINGS OF LAKES

SAMPLED BY NES IN 1973

STATE OF MARYLAND

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	2402	DEEP CREEK LAKE	550
2	2403	LIBERTY RESERVOIR	268
3	2408	LOCH RAVEN RESERVOIR	215
4	2409	JOHNSON POND	167

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
2402	DEEP CREEK LAKE	0.011	0.450	382.167	6.150	14.800	0.005
2403	LIBERTY RESERVOIR	0.018	1.760	401.833	6.325	14.900	0.006
2408	LOCH RAVEN RESERVOIR	0.023	1.440	429.555	7.133	14.800	0.007
2409	JOHNSON POND	0.098	0.950	458.250	26.225	7.200	0.040

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P	INDEX NO
2402	DEEP CREEK LAKE	100 (3)	100 (3)	100 (3)	100 (3)	50 (1)	100 (3)	550
2403	LIBERTY RESERVOIR	67 (2)	0 (0)	67 (2)	67 (2)	0 (0)	67 (2)	268
2408	LOCH RAVEN RESERVOIR	33 (1)	33 (1)	33 (1)	33 (1)	50 (1)	33 (1)	215
2409	JOHNSON POND	0 (0)	67 (2)	0 (0)	0 (0)	100 (3)	0 (0)	167