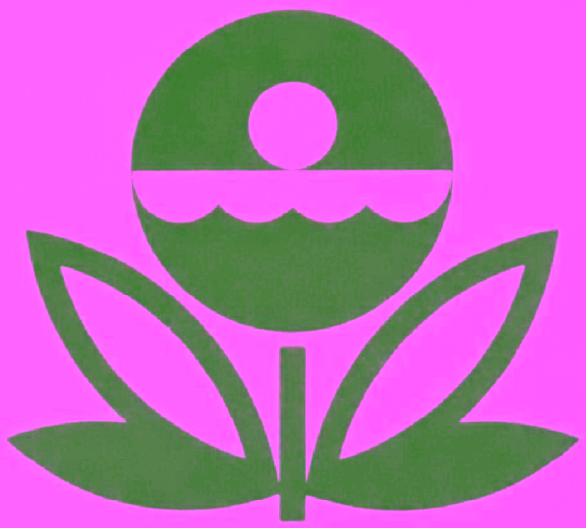
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

KEUKA LAKE

YATES AND STEUBEN COUNTIES

NEW YORK

EPA REGION II

WORKING PAPER NO. 160

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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WITH THE COOPERATION OF THE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

AND THE

NEW YORK NATIONAL GUARD

NOVEMBER, 1974

CONTENTS

F O R E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water 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 non-point 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 fresh water 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.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the New York Department of Environmental Conservation for professional involvement and to the New York National Guard for conducting the tributary sampling phase of the Survey.

Henry L. Diamond, Commissioner of the New York Department of Environmental Conservation, and Leo J. Hetling, Director, and Italo G. Carcich, Senior Sanitary Engineer, Environmental Quality Research, Department of Environmental Conservation, provided invaluable lake documentation and counsel during the Survey.

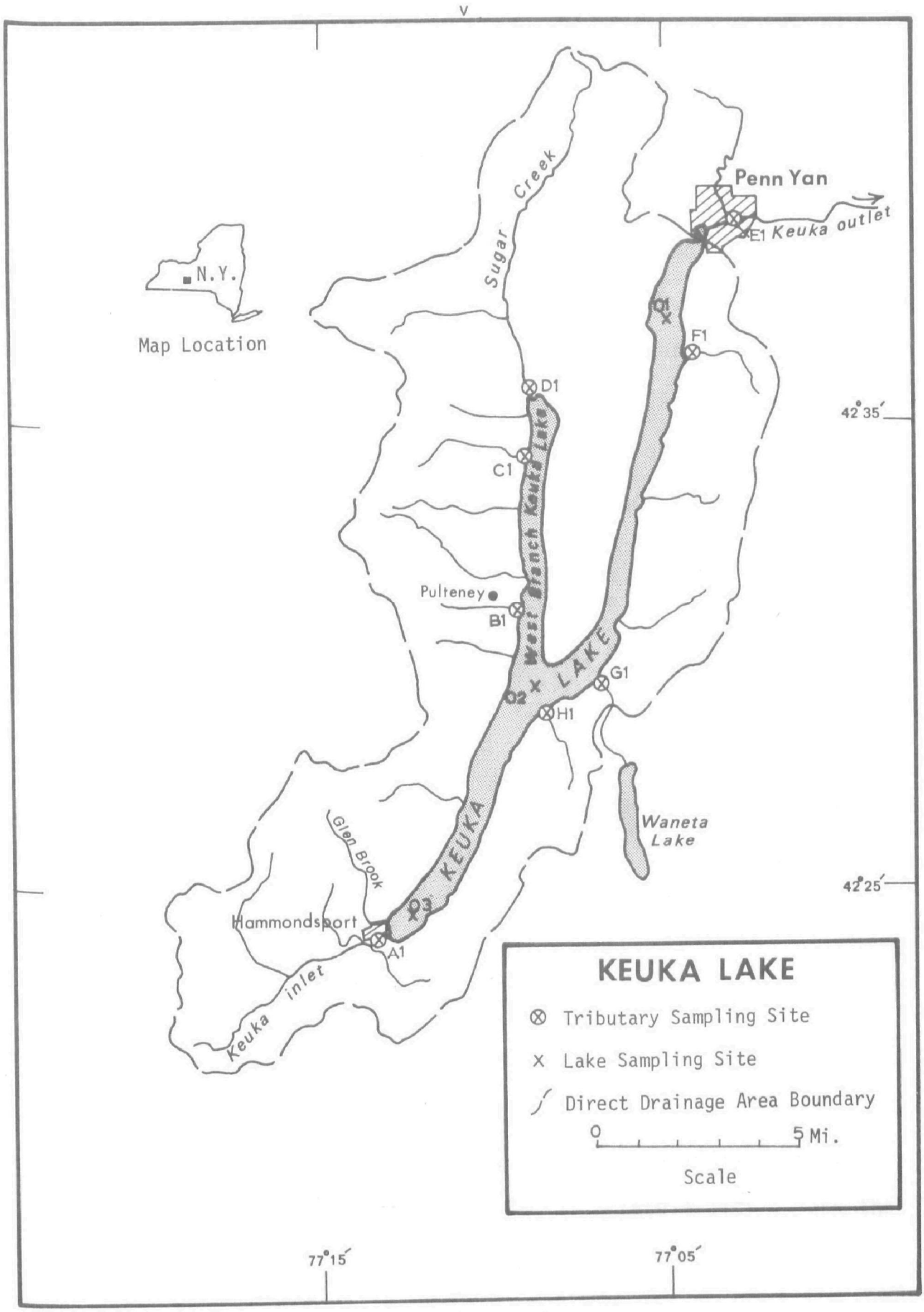
Major General John C. Baker, the Adjutant General of New York, and Project Officer Lieutenant Colonel Fred Peters, who directed the volunteer efforts of the New York National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NEW YORK

LAKE NAME	COUNTY
Allegheny Reservoir	Cattaraugas, NY; McLean, Warren, PA
Black	St. Lawrence
Canadaigua	Ontario
Cannonsville	Delaware
Carry Falls	St. Lawrence
Cassadaga	Chautauqua
Cayuga	Seneca, Tompkins
Champlain	Clinton, Essex, NY; Addison, Chittenden, Franklin, VT
Chautauqua	Chautauqua
Conesus	Livingston
Cross	Cayuga, Onondaga
Goodyear	Otsego
Huntington	Sullivan
Keuka	Ontario
Long	Hamilton
Lower St. Regis	Franklin
Otter	Cayuga
Owasco	Cayuga
Raquette Pond	Franklin
Round	Saratoga
Sacandaga Res.	Fulton, Saratoga
Saratoga	Saratoga
Schroon	Essex, Warren
Seneca	Seneca, Schyler, Yates
Swan	Sullivan
Swinging Bridge Res.	Sullivan


Penn Yan
E1 Keuka outlet
Sugar Creek
N.Y.
Map Location
Q1
F1
D1
42°35′
C1
West Branch Keuka Lake
Pulteney
B1
LAKE
G1
Q2
H1
Waneta Lake
Glen Brook
KEUKA
Q3
42°25′
Hammondsport
A1
Keuka inlet
KEUKA LAKE
Tributary Sampling Site
Lake Sampling Site
Direct Drainage Area Boundary
0
5 Mi.
Scale
77°15′
77°05′

KEUKA LAKE

STORET NO. 3617

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Keuka Lake is mesotrophic. Of the 26 New York lakes sampled in the fall of 1972, when essentially all were well-mixed, only one had less mean total phosphorus, one had less mean dissolved phosphorus, and 14 had less mean inorganic nitrogen. For all New York data, seven had less mean chlorophyll a, and only three had greater Secchi disc transparency.

Survey limnologists noted that the water was very clear on all sampling occasions, and no algal blooms were observed.

B. Rate-Limiting Nutrient:

The response of the test alga, Selenastrum capricornutum, was atypical. However, the levels of nutrients observed in the lake at the time of sampling indicate a very low level of primary productivity.

The lake data indicate phosphorus limitation at all sampling times; i.e., N/P ratios were 51/1 or greater, and phosphorus limitation would be expected.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Keuka Lake received a total phosphorus load at a rate a little less than

that proposed by Vollenweider (in press) as "permissible"; i.e., an oligotrophic rate (see page 11). Of that load, point sources (septic tanks) are estimated to have contributed about 15%. It does not appear likely that control of the phosphorus from these sources would improve the trophic condition of Keuka Lake appreciably.

2. Non-point sources(see page 11)--The phosphorus exports of Keuka Lake tributaries were relatively low during the sampling year and compare favorably to the exports of other unimpacted streams studied elsewhere in New York (e.g., Canadaigua Lake*).

In all, the tributary phosphorus exports contributed about 33% of the total phosphorus load reaching Keuka Lake during the sampling year.

* Working Paper No. 149.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 11,713 acres.
2. Mean depth: 74 feet.
3. Maximum depth: 186 feet.
4. Volume: 866,762 acre/feet.
5. Mean hydraulic retention time: 7.8 years.

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

1. Tributaries -

Name	Drainage area*	Mean flow*
Keuka inlet	25.0 mi^2	14.9 cfs
Unnamed Creek (B-1)	1.5 mi^2	1.1 cfs
Unnamed Creek (C-1)	2.4 mi^2	1.8 cfs
Sugar Creek	36.2 mi^2	26.6 cfs
Unnamed Creek (F-1)	3.2 mi^2	2.4 cfs
Waneta Lake outlet	1.0 mi^2	0.8 cfs
Unnamed Creek (H-1)	1.7 mi^2	1.3 cfs
Minor tributaries & immediate drainage -	92.7 mi^2	103.8 cfs
Totals	163.7 mi^2	152.7 cfs

2. Outlet -

Keuka outlet	182.0 mi^2**	152.7 cfs

C. Precipitation:

1. Year of sampling***: 33.9 inches.
2. Mean annual: 31.8 inches.

† Greeson and Robison, 1970; mean depth by random-dot method.
* Drainage areas are accurate within ±5%, except for small basins (±10%); mean daily flows are accurate within ±5 to 25%; and normalized mean monthly flows are accurate within ±15%.
** Includes area of lake.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Keuka Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (15 feet to surface) sample was collected from the stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was collected for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 74 feet at station 1, 156 feet at station 2, and 100 feet at station 3.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/14/72)		
Temperature (Cent.)	6.1	11.5	13.8	14.4
Dissolved oxygen (mg/l)	7.6	8.6	8.6	9.2
Conductivity (µmhos)	240	244	243	255
pH (units)	7.3	7.7	7.9	8.0
Alkalinity (mg/l)	69	74	74	80
Total P (mg/l)	0.005	0.008	0.008	0.016
Dissolved P (mg/l)	0.004	0.004	0.004	0.005
NO_2 + NO_3 (mg/l)	0.214	0.267	0.240	0.350
Ammonia (mg/l)	0.030	0.040	0.040	0.050
		ALL VALUES		
Secchi disc (inches)	72	141	156	192

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
05/27/72	1. Dinobryon	550
	2. Fragilaria	521
	3. Asterionella	282
	4. Merismopedia	181
	5. Rhizosolenia	166
	Other genera	341
	Total	2,041
07/21/72	1. Dinobryon	2,296
	2. Asterionella	1,212
	3. Fragilaria	832
	4. Schroederia	778
	5. Cyclotella	271
	Other genera	452
	Total	5,841
10/14/72	1. Chroococcus	3,321
	2. Flagellates	906
	3. Kirchneriella	679
	4. Oscillatoria	679
	5. Polycystis	679
	Other genera	2,642
	Total	8,906

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/27/72	01	3.8
	02	4.9
	03	9.9
07/21/72	01	9.3
	02	6.6
	03	-
10/14/72	01	3.7
	02	3.4
	03	3.6

C. Limiting Nutrient Study:

The response of the test alga, Selenastrum capricornutum, was atypical, and the results are not reliable. However, the levels of nutrients observed in the lake at the time of sampling indicate a very low level of primary productivity (i.e., a dry weight of 0.4 mg/l would be expected).

The lake data at the time of sampling as well as the other occasions indicate phosphorus limitation; N/P ratios were 51/1 or greater, and phosphorus limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the New York 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 April and May when two samples were collected. Sampling was begun in November, 1972, and was completed in October, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the New York District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S) were estimated by using the means of the nutrient loads, in $lbs/mi^2/year$, at stations B-1, C-1, and G-1 and multiplying the means by the ZZ area in mi^2.

As far as is known, there are no waste treatment plants impacting Keuka Lake. The Village of Hammondsport is assumed to be served by septic tanks, and the loads attributed to that source were estimated* and included with septic tank loads.

* See Working Paper No. 1.

A. Waste Sources:

1. Known municipal treatment plants - None

2. Known industrial treatment plants - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Keuka inlet	1,600	14.7
Unnamed Creek (B-1)	90	0.8
Unnamed Creek (C-1)	60	0.6
Sugar Creek	1,620	14.9
Unnamed Creek (F-1)	120	1.1
Waneta Lake outlet	50	0.5
Unnamed Creek (H-1)	80	0.7
b. Minor tributaries & immediate drainage (non-point load) -	3,800	34.9
c. Known municipal - None		
d. Septic tanks* -	1,640	15.1
e. Known industrial - None	-	-
f. Direct precipitation** -	1,830	16.7
Total	10,890	100.0

2. Outputs -

Lake outlet - Keuka outlet 5,170

3. Net annual P accumulation - 5,720 pounds

* Based on Hammondsport population of 1,066 (1970 Census) and 2,200 shoreline dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Keuka inlet	35,200	7.7
Unnamed Creek (B-1)	2,320	0.5
Unnamed Creek (C-1)	5,330	1.2
Sugar Creek	53,740	11.7
Unnamed Creek (F-1)	8,570	1.9
Waneta Lake outlet	1,410	0.3
Unnamed Creek (H-1)	5,060	1.1
b. Minor tributaries & immediate drainage (non-point load) -	171,400	37.5
c. Known municipal - None	-	-
d. Septic tanks* -	61,720	13.5
e. Known industrial - None	-	-
f. Direct precipitation** -	112,840	24.7
Total	457,890	100.0

2. Outputs -

Lake outlet - Keuka outlet	230,590

3. Net annual N accumulation - 227,000 pounds

* Based on Hammondsport population of 1,006 (1970 Census) and 2,200 shoreline dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
Keuka inlet	64	1,408
Unnamed Creek (B-1)	60	1,547
Unnamed Creek (C-1)	25	2,221
Sugar Creek	45	1,485
Unnamed Creek (F-1)	38	2,678
Waneta Lake outlet	50	1,410
Unnamed Creek (H-1)	47	2,976

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 Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	0.9	0.5	39.1	19.4
grams/m^2/yr	0.10	0.05	4.4	2.2

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Keuka Lake:

"Dangerous" (eutrophic rate)	0.34
"Permissible" (oligotrophic rate)	0.17

V. LITERATURE REVIEWED

Greeson, Phillip E., and F. Luman Robison, 1970. Characteristics of New York lakes. Part 1: Gazetteer of lakes, ponds, and reservoirs. Bull. 68, U.S. Dept. Int. and NY Dept. of Env. Cons.

Vollenweider, Richard A., (in press). Input-output models. Schweiz. A. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEW YORK 11/26/74

LAKE CODE 3617 KEUKA LAKE

TOTAL DRAINAGE AREA OF LAKE 182.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3617A1	25.00	14.00	18.00	45.00	42.00	18.00	9.20	3.20	2.10	1.80	4.80	8.00	13.00	14.90
3617B1	1.47	1.00	1.30	3.40	3.10	1.40	0.70	0.20	0.20	0.10	0.30	0.60	0.90	1.10
3617C1	2.44	1.70	2.20	5.50	5.10	2.20	1.10	0.40	0.30	0.20	0.60	0.90	1.50	1.80
3617D1	36.20	25.00	32.00	82.00	76.00	33.00	16.00	5.60	3.70	3.20	8.50	13.00	22.00	26.62
3617E1	182.00	180.25	180.25	270.37	220.30	170.23	150.21	98.13	68.09	63.09	82.11	130.18	220.30	152.70
3617F1	3.17	2.20	2.80	7.20	6.70	2.90	1.40	0.50	0.30	0.30	0.70	1.20	2.00	2.35
3617G1	1.01	0.70	0.90	2.30	2.10	0.90	0.50	0.20	0.10	0.10	0.20	0.40	0.60	0.75
3617H1	1.72	1.20	1.60	4.00	3.70	1.60	0.80	0.30	0.20	0.20	0.40	0.60	1.10	1.31
3617ZZ	110.99	96.00	130.00	320.00	290.00	130.00	64.00	22.00	14.00	12.00	33.00	52.00	86.00	103.87

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 182.00
SUM OF SUB-DRAINAGE AREAS = 182.00

TOTAL FLOW IN = 1835.90
TOTAL FLOW OUT = 1833.51

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3617A1	11	72	22.00	5	15.00				
	12	72	42.00	2	22.00				
	1	73	21.00	6	21.00				
	2	73	20.00	3	140.00				
	3	73	40.00	3	19.00				
	4	73	41.00	7	67.00	24	12.00		
	5	73	18.00	5	22.00	20	17.00		
	6	73	8.70	16	5.00				
	7	73	2.20	7	3.50				
	8	73	1.00	4	1.70				
	9	73	1.30	15	1.30				
	10	73	1.50	13	1.40				
3617B1	11	72	1.80	5	1.20				
	12	72	3.20	2	1.80				
	1	73	1.50	6	1.70				
	2	73	1.30	3	11.00				
	3	73	2.90	3	0.90				
	4	73	2.30	7	5.00	24	0.70		
	5	73	1.30	5	1.70	20	1.20		
	6	73	0.60	16	0.30				
	7	73	0.10	7	0.20				
	8	73	0.10	4	0.10				
	9	73	0.10	15	0.03				
	10	73	0.10	13	0.10				

LAKE CODE 3617 KEUKA LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3617C1	11	72	2.70	5	2.00				
	12	72	5.20	2	2.80				
	1	73	2.60	6	2.80				
	2	73	2.20	3	19.00				
	3	73	4.80	3	1.40				
	4	73	3.90	7	8.10	21	1.40		
	5	73	2.10	5	2.70	20	1.80		
	6	73	1.00	16	0.50				
	7	73	0.30	7	0.40				
	8	73	0.10	4	0.20				
	9	73	0.20	15	0.10				
	10	73	0.20	13	0.20				
3617D1	11	72	39.00	5	29.00				
	12	72	77.00	2	41.00				
	1	73	38.00	6	41.00				
	2	73	32.00	3	270.00				
	3	73	71.00	3	21.00				
	4	73	58.00	7	120.00	21	21.00		
	5	73	31.00	5	40.00	20	28.00		
	6	73	14.00	16	7.80				
	7	73	3.80	7	6.10				
	8	73	1.20	4	2.50				
	9	73	2.80	15	1.10				
	10	73	2.70	13	2.50				
3617E1	11	72	310.00	5	280.00				
	12	72	490.00	2	320.00				
	1	73	450.00	6	520.00				
	2	73	360.00	3	480.00				
	3	73	440.00	3	210.00				
	4	73	540.00	7	580.00	21	500.00		
	5	73	370.00	5	480.00	18	270.00		
	6	73	240.00	16	270.00				
	7	73	59.00	7	50.00				
	8	73	60.00	4	52.00				
	9	73	90.00	15	97.00				
	10	73	136.00	13	103.00				
3617F1	11	72	3.60	5	2.50				
	12	72	7.00	2	3.80				
	1	73	3.30	6	3.70				
	2	73	2.80	3	24.00				
	3	73	6.20	3	1.90				
	4	73	5.10	7	11.00	21	1.90		
	5	73	2.70	5	3.50	18	1.80		
	6	73	1.30	16	0.70				
	7	73	0.30	7	0.50				
	8	73	0.10	4	0.20				
	9	73	0.30	15	0.10				
	10	73	0.20	13	0.20				

LAKE CODE 3617 KEUKA LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3617G1	11	72	1.20	5	0.80				
	12	72	2.10	2	1.20				
	1	73	1.00	6	1.10				
	2	73	0.90	3	7.70				
	3	73	2.00	3	0.60				
	4	73	1.60	7	3.40	21	0.60		
	5	73	0.80	5	1.10	18	0.60		
	6	73	0.50	16	0.20				
	7	73	0.10	7	0.20				
	8	73	0.03	4	0.10				
	9	73	0.10	15	0.04				
	10	73	0.10	13	0.10				
3617H1	11	72	1.80	5	1.30				
	12	72	3.80	2	2.00				
	1	73	1.80	6	2.00				
	2	73	1.60	3	13.00				
	3	73	3.50	3	1.10				
	4	73	2.80	7	5.90	21	1.00		
	5	73	1.50	5	1.90	18	1.00		
	6	73	0.70	16	0.40				
	7	73	0.20	7	0.30				
	8	73	0.10	4	0.10				
	9	73	0.20	15	0.10				
	10	73	0.10	13	0.10				
3617ZZ	11	72	150.00						
	12	72	280.00						
	1	73	140.00						
	2	73	130.00						
	3	73	280.00						
	4	73	290.00						
	5	73	130.00						
	6	73	60.00						
	7	73	15.00						
	7	73	14.00						
	8	73	6.40						
	9	73	8.80						
	10	73	11.00						

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/11/26

361701
42 37 30.0 077 05 00.0
KEUKA LAKE
36 NEW YORK

11EPALES
3

2111202
0078 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	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/05/27	13	55 0000	13.7	12.4	186	240	8.20	79	0.220	0.030	0.010	0.002
	13	55 0010	12.4	12.8		240	8.20	80	0.220	0.020	0.004	0.002
	13	55 0050	6.9	12.8		240	7.90	79	0.250	0.050	0.005	0.003
72/07/21	15	20 0000			120	240	8.10	74	0.260	0.050	0.012	0.008
	15	20 0004	25.8	12.0		319	8.40	73	0.260	0.040	0.013	0.009
	15	20 0015	24.5	8.6		308	8.30	74	0.270	0.050	0.013	0.007
	15	20 0074	6.7	8.7		217	7.20	79	0.360	0.050	0.022	0.009
72/10/14	15	35 0000			192	250	8.00	74	0.210	0.040	0.008	0.005
	15	35 0004	14.4	9.0		245	8.00	76	0.210	0.050	0.008	0.005
	15	35 0015	14.4	9.0		245	8.00	74	0.210	0.040	0.009	0.005
	15	35 0025	14.4	9.2		240	8.00	77	0.220	0.050	0.008	0.005
	15	35 0036	14.4	9.2		240	8.00	80	0.210	0.050	0.011	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/05/27	13	55 0000	3.8J
72/07/21	15	20 0000	9.3J
72/10/14	15	35 0000	3.7J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/11/26

361702
42 29 41.0 077 08 42.0
KEUKA LAKE
36 NEW YORK

11EPALES
3

2111202
0162 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	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/05/27	14	35 0000	16.2	12.0	192	230	8.30	79	0.220	0.030	0.008	0.004
	14	35 0010	12.4	12.6		228	8.30	80	0.240	0.030	0.008	0.004
	14	35 0050	6.3	12.2		238	7.80	79	0.260	0.080	0.007	0.004
72/07/21	15	45 0000			72	240	8.20	73	0.270	0.070	0.012	0.008
	15	45 0004	24.3	8.2		303	7.90	72	0.280	0.060	0.013	0.009
	15	45 0015	23.6	8.8		280	8.00	74	0.300	0.080	0.016	0.004
	15	45 0156	5.3	7.8		217	7.00	79	0.360	0.050	0.021	0.008
72/10/14	15	00 0000			156	243	7.90	73	0.240	0.040	0.008	0.004
	15	00 0004	14.1	9.2		243	7.90	71	0.240	0.040	0.008	0.004
	15	00 0015	14.0	8.8		243	7.90	76	0.230	0.040	0.008	0.005
	15	00 0030	14.0	9.2		240	7.90	75	0.230	0.040	0.008	0.005
	15	00 0045	13.8	8.6		243	7.85	73	0.240	0.040	0.007	0.005
	15	00 0060	12.1	8.6		243	7.60	77	0.270	0.040	0.007	0.004
	15	00 0090	7.5	8.0		243	7.40	74	0.320	0.040	0.011	0.005
	15	00 0121	6.4	7.6		255	7.30	77	0.350	0.040	0.016	0.004

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/05/27	14	35 0000	4.9J
72/07/21	15	45 0000	6.6J
72/10/14	15	00 0000	3.4J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/11/26

361703
42 24 37.0 077 12 42.0
KEUKA LAKE
36 NEW YORK

11EPALES
3

2111202
0104 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	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/05/27	15	15 0000	13.7	12.4	156	230	8.30	114	0.240	0.020	0.004	0.004
	15	15 0010	8.4	13.6		220	8.20	84	0.240	0.020	0.011	0.002
	15	15 0050	5.8	12.4		230	7.80	82	0.250	0.030	0.005	0.004
72/07/21	16	15 0000			84	240	8.20	72	0.290	0.090	0.013	0.010
	16	15 0004	22.7	9.0		295	8.00	74	0.300	0.070	0.014	0.009
	16	15 0015	20.1	9.2		276	7.50	77	0.370	0.040	0.011	0.005
	16	15 0066	7.4	7.6		208	7.10	77	0.320	0.040	0.008	0.005
	16	15 0100	6.1	9.6		206	7.40	78	0.310	0.040	0.010	0.006
72/10/14	14	35 0000			108	240	7.88	76	0.240	0.040	0.007	0.004
	14	35 0004	13.8	8.8		242	7.85	73	0.240	0.040	0.007	0.005
	14	35 0015	13.7	8.0		242	7.40	72	0.340	0.040	0.005	0.004
	14	35 0030	8.9	8.0		242	7.40	72	0.330	0.040	0.007	0.004
	14	35 0050	7.6	8.2		240	7.40	75	0.340	0.030	0.006	0.004
	14	35 0075	6.4	8.2		250	7.35	69	0.340	0.030	0.007	0.004
	14	35 0100	6.1	8.2		250	7.35	71	0.340	0.030	0.007	0.004

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/05/27	15	15 0000	9.9J
72/10/14	14	35 0000	3.6J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/11/26

3617A1 LS3617A1
42 24 30.0 077 13 30.0
KEUKA INLET
36 7.5 HAMMONDSPORT
I/KEUKA LAKE
ST HWY 54A BRDG IN HAMMONDSPORT
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
72/11/05	12 40		0.590	0.700	0.092	0.009	0.028
72/12/02	10 31		0.480	0.380	0.040	0.014	0.079
73/01/06	10 40		0.820	0.420	0.060	0.011	0.034
73/02/03	10 00		0.430	0.560	0.040	0.017	0.130
73/03/03	10 40		0.800	0.480	0.058	0.012	0.040
73/04/24	10 30		0.710	0.630	0.034	0.020	0.060
73/05/05	10 15		0.460	0.310	0.030	0.012	0.035
73/05/20	13 35		0.550	0.420	0.027	0.016	0.045
73/06/16	10 01		0.870	0.750	0.037	0.015	0.080
73/07/07	09 40		1.060	0.600	0.058	0.034	0.040
73/09/15	09 35		1.120	0.380	0.054	0.028	0.055
73/10/13	11 00		1.160	0.210	0.027	0.015	

STORET RETRIEVAL DATE 74/11/26

361781 LS361781
42 31 30.0 077 09 30.0
UNNAMED CREEK
36 7.5 PULTENEY
T/KEUKA LAKE
ST HWY 54A BRDG E OF PULTENEY
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
72/11/05			1.000	0.300	0.063	0.044	0.048
72/12/02	11 29		0.800	0.190	0.028	0.024	0.040
73/02/03	10 47		0.850	0.290	0.042	0.016	0.045
73/04/07	10 20		0.770	0.235	0.014	0.017	0.025
73/04/24	11 00		0.950	0.180	0.013	0.017	0.020
73/05/05	10 45		0.580	0.330	0.027	0.015	0.025
73/05/20	14 00		0.820	0.285	0.031	0.026	0.030
73/06/16	11 10		1.600	0.420	0.009	0.040	0.045
73/07/07	10 05		1.140		0.069	0.056	0.130
73/09/15	10 05		0.970	0.140	0.012	0.038	0.040
73/10/13	11 30		0.154	0.220	0.013	0.028	

STORET RETRIEVAL DATE 74/11/26

3617C1 LS3617C1
42 34 30.0 077 09 00.0
UNNAMED CREEK
36 7.5 PULTENEY
T/KEUKA LAKE
ST HWY 54A BRDG NEAR CHIDSEY POINT
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
72/11/05	11	40	0.260	0.600	0.088	0.007	0.009
72/12/02	12	03	0.830	1.150	0.014	0.005K	0.008
73/01/06	12	15	0.790	0.378	0.032	0.009	0.011
73/02/03	11	25	0.760	0.840	0.063	0.014	0.055
73/03/03	11	30	1.040	1.260	0.080	0.009	0.030
73/04/21			0.600	1.400	0.052	0.008	0.010
73/05/05	11	30	0.280	0.370	0.023	0.005K	0.010
73/05/20	14	15	0.399	0.250	0.018	0.008	0.010
73/06/16	12	05	1.400	0.480	0.005K	0.009	0.010
73/07/07	10	00	1.740	0.560	0.028	0.012	0.020
73/09/15	10	45	1.400	1.400	0.052	0.009	0.025
73/10/13			0.250	0.170	0.006	0.005K	0.005

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

3617D1 LS3617D1
42 36 00.0 077 09 00.0
SUGAR CREEK
36 7.5 PULTENEY
I/KEUKA LAKE
ST HWY 54A BRDG W OF BRANCHPORT
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
72/11/05	11 30		0.650	0.350	0.081	0.005K	0.014
72/12/02	12 37		1.260	0.140	0.016	0.005K	0.017
73/01/06	12 30		1.140	0.265	0.027	0.005K	0.015
73/02/03	12 49		1.140	0.480	0.084	0.014	0.110
73/03/03	11 50		1.040	0.297	0.029	0.005K	0.025
73/04/07	12 29		1.180	0.260	0.014	0.008	0.025
73/04/21	11 10		0.750	0.790	0.037	0.005K	0.020
73/05/05	13 00		0.600	0.360	0.039	0.005K	0.015
73/05/20	14 15		0.500	0.250	0.014	0.006	0.015
73/06/16	12 45		0.290	0.350	0.009	0.005K	0.015
73/07/07	11 15		0.210	0.420	0.046	0.012	0.030
73/09/15	11 30		0.069	0.630	0.048	0.024	0.120
73/10/13	13 30		0.010K	0.320	0.006	0.005K	0.005

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

3617E1 LS3617F1
42 39 30.0 077 03 00.0
KEUKA OUTLET
36 7.5 PENN YAN
0/KEUKA LAKE
ST HWY 14A BRDG IN PENN YAN
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
72/11/05	11 10		0.250	0.250	0.050	0.005K	0.009
72/12/02	14 00		0.336	0.820	0.039	0.005K	0.010
73/01/06	13 30		0.340	0.335	0.013	0.005K	0.010
73/02/03	13 00		0.580	0.295	0.016	0.008	0.045
73/03/03	12 30		0.610	0.270	0.023	0.005K	0.010
73/04/07	13 00		0.430	0.370	0.011	0.005K	0.015
73/04/21	12 30		0.357	0.265	0.012	0.005K	0.015
73/05/05	13 30		0.357	0.370	0.012	0.005K	0.010
73/05/18	13 00		0.399	0.220	0.005K	0.005K	0.010
73/06/16	13 25		0.270	1.270	0.027	0.005K	0.010
73/07/07	13 20		0.138	0.330	0.032	0.009	0.020
73/08/04	13 00		0.058	0.440	0.014	0.011	0.015
73/09/15	13 00		0.100	0.350	0.024	0.006	0.045
73/10/13	13 00		0.052	0.560	0.015	0.005K	0.005K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

3617F1 LS3617F1
42 36 30.0 077 04 30.0
UNNAMED CREEK
36 7.5 KEUKA PARK
T/KEUKA LAKE
ST HWY 54 BRDG
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
72/11/05	09	40	0.647	0.550	0.070	0.010	0.026
72/12/02	11	45	1.500	0.290	0.012	0.005K	0.016
73/01/06	11	30	1.760	0.295	0.009	0.009	0.017
73/02/03	11	15	1.600	0.530	0.050	0.019	0.060
73/03/03	11	00	1.400	0.280	0.033	0.012	0.025
73/04/07	10	15	1.640	1.540	0.048	0.012	0.025
73/04/21	10	20	1.260	0.230	0.005K	0.009	0.015
73/05/05	11	15	1.020	0.580	0.021	0.005K	0.040
73/05/18	11	30	0.690	0.320	0.005K	0.007	0.010
73/06/16	11	00	1.760	0.900	0.015	0.022	0.030
73/07/07	11	30	1.840	1.540	0.048	0.020	0.025
73/08/04	11	15	1.800	0.460	0.044	0.033	0.040
73/09/15	10	15	1.160	0.200	0.020	0.021	0.025
73/10/13	11	00	0.260	1.100	0.115	0.013	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

361761 LS361761
42 29 30.0 077 07 00.0
UNNAMED OUTLET OF WANETA LAKE
36 7.5 WAYNE
T/KEUKA LAKE
ST HWY 54 BRDG
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
72/11/05	09	20	0.207	0.550	0.205	0.007	0.035
72/12/02	10	45	0.240	0.620	0.023	0.005K	0.022
73/01/06	10	45	0.350	0.452	0.021	0.006	0.030
73/02/03	10	40	0.270	0.420	0.029	0.008	0.040
73/03/03	10	15	0.310	1.100	0.069	0.005K	0.030
73/04/07	09	45	0.210	1.700	0.048	0.006	0.040
73/04/21	09	30	0.320	0.400	0.037	0.007	0.020
73/05/05	10	40	0.069	0.580	0.026	0.005K	0.045
73/05/18	11	15	0.200	0.340	0.007	0.010	0.030
73/06/16	10	30	0.044	2.400	0.052	0.005	0.045
73/07/07	10	40	0.079	0.680	0.080	0.012	0.060
73/08/04	10	30	0.080	0.740	0.046	0.016	0.050
73/09/15	09	45	0.075	0.800	0.032	0.007	0.045
73/10/13	10	30	0.032	0.710	0.027	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

3617H1 LS3617H1
42 29 00.0 077 08 30.0
UNNAMED CREEK
36 7.5 HAMMONDSPORT
T/KEUKA LAKE
ST HWY 54 BRDG
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
72/11/05	09 05		0.620	1.250	0.110	0.019	0.023
72/12/02	10 30		1.220	0.520	0.009	0.011	0.023
73/01/06	10 35		1.340	0.165	0.009	0.013	0.017
73/02/03	10 20		0.840	0.660	0.065	0.019	0.080
73/03/03	10 00		1.100	2.800	0.170	0.038	0.080
73/04/21	09 00		1.400	0.290	0.009	0.009	0.020
73/05/05	10 20		0.570	0.380	0.013	0.011	0.020
73/05/18	11 00		0.740	0.210	0.005K	0.015	0.015
73/06/16	10 00		2.000	0.580	0.027	0.024	0.025
73/08/04	10 00		2.900	0.980	0.028	0.038	0.070
73/09/15	09 15		2.000	0.690	0.028	0.018	0.025
73/10/13	10 00		0.830	0.440	0.020	0.006	0.006

K VALUE KNOWN TO BE
LESS THAN INDICATED