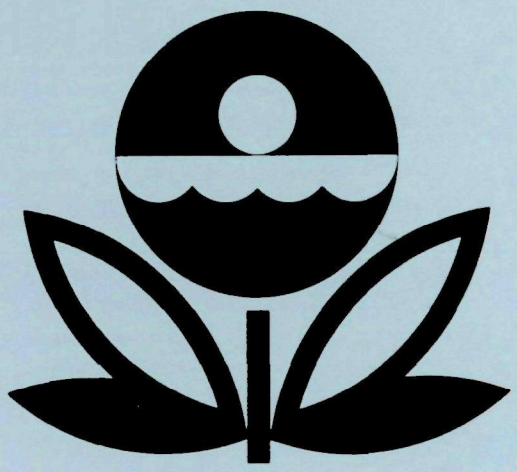
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

STEINAKER RESERVOIR

UINTAH COUNTY

UTAH

EPA REGION VIII

WORKING PAPER No. 859

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPORT

ON

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UINTAH COUNTY

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EPA REGION VIII

WORKING PAPER No. 859

WITH THE COOPERATION OF THE

UTAH STATE DIVISION OF HEALTH

AND THE

UTAH NATIONAL GUARD

DECEMBER, 1977

CONTENTS

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 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.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Utah Department of Social Services and the Utah Department of Natural Resources for professional involvement, to the Utah National Guard for conducting the tributary sampling phase of the Survey, and to those Utah wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staffs of the Bureau of Water Quality of the Division of Health and the Division of Wildlife Resources provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

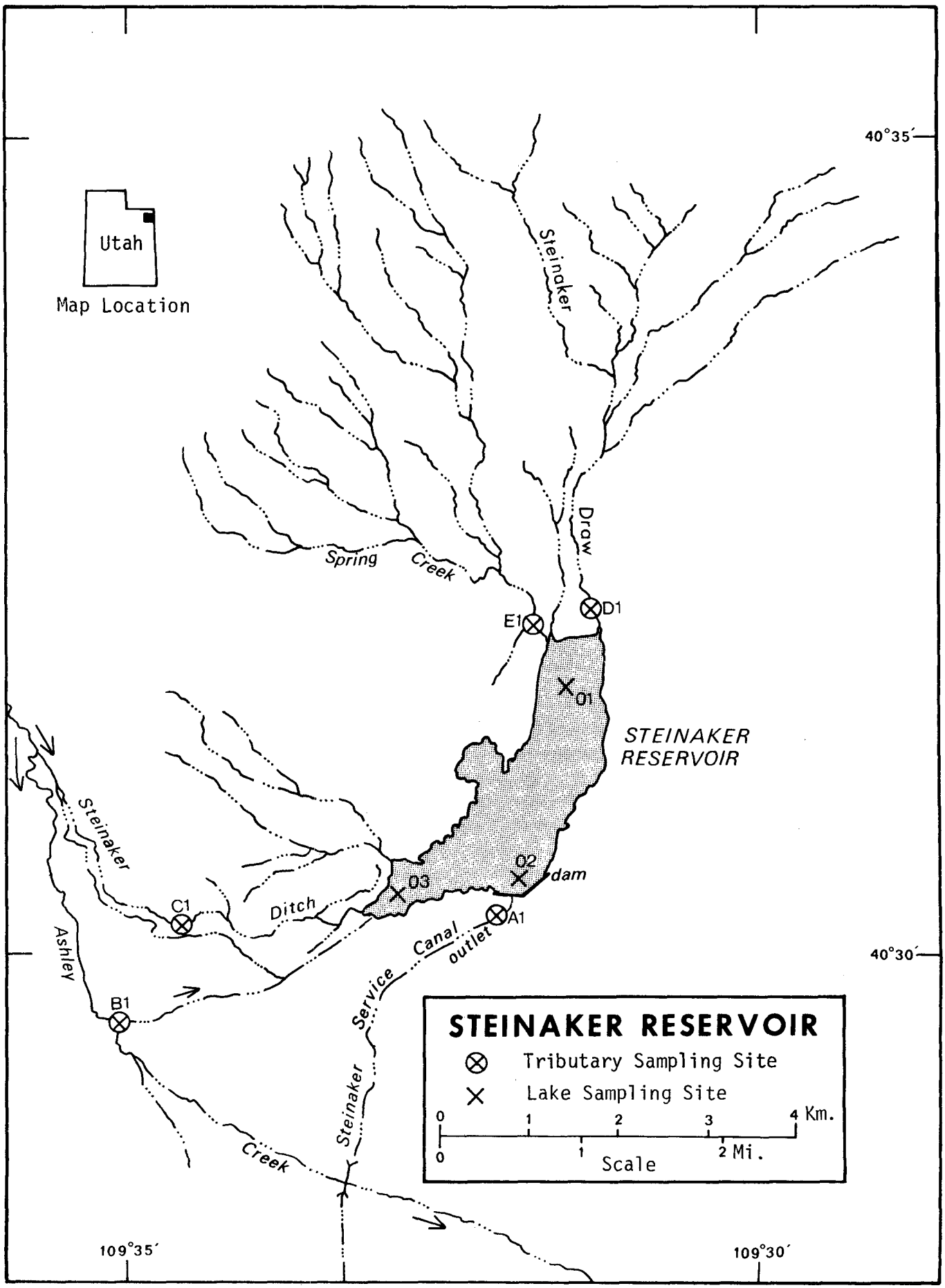
Major General Maurice L. Watts, the Adjutant General of Utah, and Project Officer Lt. Colonel T. Ray Kingston, who directed the volunteer efforts of the Utah National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF UTAH

NAME	COUNTY
Bear	Rich, UT; Bear Lake, ID
Deer Creek	Wasatch
Echo	Summit
Fish	Sevier
Flaming Gorge	Daggett, UT; Sweetwater, WY
Huntington	Emery
Joes Valley	Emery
Lower Bowns	Garfield
Lynn	Box Elder
Minersville	Beaver
Moon	Duchesne
Navajo	Kane
Newcastle	Iron
Otter Creek	Piute
Panguich	Garfield
Pelican	Uintah
Pineview	Weber
Piute	Piute
Porcupine	Cache
Powell	Garfield, Kane, San Juan, UT; Coconino, AZ
Pruess	Millard
Sevier Bridge	Juab, Sanpete
Starvation	Duchesne
Steinaker	Uintah
Tropic	Garfield
Utah	Utah
Willard Bay	Box Elder


Utah
Map Location
40°35´
Steinaker
Draw
Spring
Creek
D1
E1
01
STEINAKER
RESERVOIR
Steinaker
02
dam
03
C1
Ditch
A1
Ashley
Canal
outlet
Service
40°30´
B1
Steinaker
Creek
STEINAKER RESERVOIR
Tributary Sampling Site
Lake Sampling Site
0 1 2 3 4 Km.
0 1 2 Mi.
Scale
109°35´
109°30´

STEINAKER RESERVOIR

STORET NO. 4922

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Steinaker Reservoir is mesotrophic. It ranked fifth in overall trophic quality when the 27 Utah lakes and reservoirs sampled in 1975 were compared using a combination of six parameters*. Two of the water bodies had less and two had the same median total phosphorus, eight had less and one had the same median dissolved orthophosphorus, none of the others had less but ten had the same median inorganic nitrogen, one had less mean chlorophyll a, and three had greater mean Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at sampling station 2 in September (2.4 mg/l at 15.2 meters).

B. Rate-Limiting Nutrient:

There was a significant change in nutrients in the algal assay samples from the time of collection to the beginning of the assays. Therefore, the results are not considered representative of conditions in the reservoir at the times the samples were taken.

The reservoir data indicate nitrogen limitation in May and September and phosphorus limitation in August.

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* See Appendix A.

C. Nutrient Controllability:

1. Point sources--No known point sources impacted Steinaker Reservoir during the sampling year.

The phosphorus loading of 0.11 g/m^2 measured during the sampling year is less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as an oligotrophic loading (see page 11). However, it is likely that too few tributary samples were taken to establish the actual loading. Note that only eight samples were collected from the Feeder Canal, four were taken from Steinaker Ditch, none were obtained from Steinaker Draw and Spring Creek, and only two outlet samples were collected (see Appendix E).

2. Non-point sources--The estimated phosphorus contributions of the four tributaries amounted to 82% of the total load. However, as noted above, sampling frequency was minimal, and a more intensive sampling effort is needed to determine the actual tributary loads.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 3.32 kilometers^2.
2. Mean depth: 14.0 meters.
3. Maximum depth: 39.6 meters.
4. Volume: 47.082 x 10^6 m^3.
5. Mean hydraulic retention time: 2 years (based on outflow).

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

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Steinaker Feeder Canal	0.0	0.754
Steinaker Ditch	0.0	0.010
Steinaker Draw	17.1	0.013
Spring Creek	16.6	0.013
Minor tributaries & immediate drainage -	17.4	0.014
Totals	51.1	0.804

2. Outlet -

Steinaker Service Canal	54.4**	0.732

C. Precipitation***:

1. Year of sampling: 18.1 centimeters.
2. Mean annual: 18.9 centimeters.

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† Table of metric equivalents--Appendix B.
†† Sudweeks, 1975.
* For limits of accuracy, see Working Paper No. 175, "... Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Steinaker Reservoir was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at three stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, a single 18.9-liter depth-integrated sample was composited 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 12.2 meters at station 1, 27.7 meters at station 2, and 5.8 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR STEINAKER RESERVOIR
STORET CODE 4922

PARAMETER	1ST SAMPLING (5/13/75) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/ 7/75) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/22/75) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	7.3 - 11.4	9.5	10.0	8.0 - 22.9	18.4	21.0	12.8 - 19.7	18.0	18.7
DISS OXY (MG/L)	8.8 - 10.0	9.4	9.4	4.4 - 7.8	6.9	7.3	2.4 - 7.6	6.7	7.1
CNDCTVY (MCROMO)	230. - 254.	242.	245.	210. - 272.	255.	266.	189. - 221.	213.	215.
PH (STAND UNITS)	8.3 - 8.6	8.5	8.5	7.9 - 9.2	8.6	8.7	7.6 - 8.6	8.3	8.4
TOT ALK (MG/L)	114. - 118.	116.	116.	86. - 104.	90.	89.	99. - 113.	101.	100.
TOT P (MG/L)	0.010 - 0.017	0.013	0.012	0.010 - 0.031	0.015	0.011	0.008 - 0.033	0.012	0.009
ORTHO P (MG/L)	0.010 - 0.012	0.011	0.011	0.002 - 0.015	0.006	0.004	0.002 - 0.028	0.005	0.002
NO2+NO3 (MG/L)	0.020 - 0.020	0.020	0.020	0.020 - 0.140	0.039	0.020	0.020 - 0.190	0.038	0.020
AMMONIA (MG/L)	0.020 - 0.030	0.021	0.020	0.020 - 0.150	0.064	0.050	0.020 - 0.020	0.020	0.020
KJEL N (MG/L)	0.200 - 0.400	0.250	0.200	0.200 - 0.200	0.200	0.200	0.200 - 0.200	0.200	0.200
INORG N (MG/L)	0.040 - 0.050	0.041	0.040	0.040 - 0.290	0.103	0.070	0.040 - 0.210	0.058	0.040
TOTAL N (MG/L)	0.220 - 0.420	0.270	0.220	0.220 - 0.340	0.239	0.220	0.220 - 0.390	0.238	0.220
CHLRPYL A (UG/L)	1.6 - 1.9	1.7	1.7	1.8 - 2.3	2.1	2.2	1.6 - 1.8	1.7	1.7
SECCHI (METERS)	5.8 - 5.8	5.8	5.8	3.4 - 4.3	3.8	3.7	4.6 - 5.2	4.8	4.6

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/13/75	1. Chroomonas sp.	533
	2. Cryptomonas sp.	267
	3. Ankistrodesmus sp.	200
	4. Cyclotella sp.	33
	Total	1,033
08/07/75	1. Aphanocapsa sp.	253
	2. Chroomonas sp.	95
	3. Schroederia sp.	32
	Total	380
09/22/75	1. Aphanocapsa sp.	201
	2. Chroomonas sp.	134
	3. Asterionella sp.	34
	Total	369

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/13/75	1	1.6
	2	1.9
	3	1.7
08/07/75	1	1.8
	2	2.3
	3	2.2
09/22/75	1	1.7
	2	1.6
	3	1.8

C. Limiting Nutrient Study:

A significant change in nutrients occurred in the algal assay samples from the time of collection to the beginning of the assays. Therefore, the results are not considered representative of conditions in the reservoir at the times the samples were taken (05/13/75 and 09/22/75).

The reservoir data indicate nitrogen limitation in May and September and phosphorus limitation in August; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 4/1, 12/1, and 17/1, respectively.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Utah National Guard collected monthly near-surface grab samples when possible from each of the tributary sites indicated on the map (page v), except for the high runoff month of June when two samples were collected at two of the sites. Sampling was begun in November, 1974, and was completed in September, 1975.

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

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads for unsampled Steinaker Draw, Spring Creek, and "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in Steinaker Feeder Canal and Steinaker Ditch at stations B-1 and C-1 and the mean annual ZZ flow.

No known wastewater treatment plants impacted Steinaker Reservoir during the year of sampling.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Steinaker Feeder Canal	285	78.1
Steinaker Ditch	5	1.4
Steinaker Draw	5	1.4
Spring Creek	5	1.4
b. Minor tributaries & immediate drainage (non-point load) -	5	1.4
c. Known municipal STP's - None	-	-
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	60	16.3
Total	365	100.0

2. Outputs -

Reservoir outlet - Steinaker Service Canal	460

3. Net annual P loss - 95 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Steinaker Feeder Canal	13,910	76.3
Steinaker Ditch	110	0.6
Steinaker Draw	205	1.1
Spring Creek	205	1.1
b. Minor tributaries & immediate drainage (non-point load) -	220	1.2
c. Known municipal STP's - None	-	-
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	3,585	19.7
Total	18,235	100.0

2. Outputs -

Reservoir outlet - Steinaker Service Canal	18,165

3. Net annual N accumulation - 70 kg.

D. Mean Nutrient Concentrations in Sampled Streams:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Feeder Canal (B-1)	0.012	0.585
Steinaker Ditch (C-1)	0.020	0.343
Service Canal (outlet)	0.020	0.787

* See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.11	loss*	5.5	< 0.1*

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Steinaker Reservoir:

"Dangerous" (eutrophic loading)	0.48
"Permissible" (oligotrophic loading)	0.24

* The apparent loss of phosphorus and the minimal retention of nitrogen probably are due to insufficient tributary and outlet sampling (see page 2).

V. LITERATURE REVIEWED

Sudweeks, Calvin K., 1975. Personal communication (reservoir morphometry). UT Bur. of Env. Health, Salt Lake City.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

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
0408	LAKE POWELL	0.010	0.410	339.830	3.081	13.800	0.007
4901	BEAR LAKE	0.011	0.040	253.167	0.945	9.200	0.003
4902	LOWER BOWN'S RESERVOIR	0.031	0.040	336.000	5.567	9.400	0.006
4903	DEER CREEK RESERVOIR	0.038	0.215	430.333	9.078	14.800	0.006
4904	ECHO RESERVOIR	0.047	0.170	450.333	6.967	14.000	0.012
4905	LYNN RESERVOIR	0.121	0.200	417.667	39.600	10.400	0.052
4906	FISH LAKE	0.023	0.040	152.000	12.483	10.400	0.004
4907	HUNTINGTON NORTH RESERVO	0.013	0.040	392.000	1.900	7.800	0.005
4908	JOE'S VALLEY RESERVOIR	0.012	0.045	400.000	2.483	11.200	0.003
4909	MINERSVILLE RESERVOIR	0.192	0.060	445.000	33.583	8.600	0.107
4910	MOON LAKE	0.008	0.040	381.000	2.700	9.600	0.002
4911	NAVAJO LAKE	0.016	0.040	368.000	2.000	6.000	0.003
4912	NEWCASTLE RESERVOIR	0.051	0.040	428.667	12.467	13.600	0.009
4913	OTTER CREEK RESERVOIR	0.067	0.040	453.667	11.767	10.600	0.033
4914	PANGUITCH LAKE	0.071	0.040	426.500	45.950	14.200	0.010
4915	PELICAN LAKE	0.044	0.090	438.500	6.350	8.400	0.004
4916	PINEVIEW RESERVOIR	0.028	0.300	435.083	5.692	14.600	0.006
4917	PIUTE RESERVOIR	0.047	0.150	482.625	25.329	11.600	0.007
4918	PORCUPINE RESERVOIR	0.025	0.110	440.000	7.860	12.400	0.011
4919	PRUESS RESERVOIR (GARRIS	0.057	0.140	491.000	4.533	8.800	0.008
4920	SEVIER BRIDGE RESERVOIR	0.026	0.355	449.778	18.222	12.400	0.008
4921	STARVATION RESERVOIR	0.016	0.040	394.583	5.675	13.200	0.004
4922	STEINAKER RESERVOIR	0.011	0.040	316.750	1.844	12.600	0.005
4923	TROPIC RESERVOIR	0.021	0.050	425.000	7.200	8.400	0.006
4924	UTAH LAKE	0.132	0.320	490.583	72.012	11.400	0.012
4925	WILLARD BAY RESERVOIR	0.044	0.060	457.182	7.567	11.000	0.009
5605	FLAMING GORGE RESERVOIR	0.011	0.690	285.636	2.500	10.400	0.003

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	4901	BEAR LAKE	540
2	4911	NAVAJO LAKE	506
3	4910	MOON LAKE	506
4	4907	HUNTINGTON NORTH RESERVO	468
5	4922	STEINAKER RESERVOIR	448
6	4908	JOE'S VALLEY RESERVOIR	428
7	5605	FLAMING GORGE RESERVOIR	415
8	4902	LOWER BOWN'S RESERVOIR	406
9	4906	FISH LAKE	391
10	4921	STARVATION RESERVOIR	389
11	4923	TROPIC RESERVOIR	363
12	4915	PELICAN LAKE	343
13	0408	LAKE POWELL	311
14	4919	PRUESS RESERVOIR (GARRIS	241
15	4912	NEWCASTLE RESERVOIR	229
16	4916	PINEVIEW RESERVOIR	223
17	4918	PORCUPINE RESERVOIR	217
18	4925	WILLARD BAY RESERVOIR	216
19	4913	OTTER CREEK RESERVOIR	210
20	4903	DEER CREEK RESERVOIR	196
21	4920	SEVIER BRIDGE RESERVOIR	174
22	4909	MINERSVILLE RESERVOIR	168
23	4917	PIUTE RESERVOIR	165
24	4905	LYNN RESERVOIR	163
25	4914	PANQUITCH LAKE	162
26	4904	ECHO RESERVOIR	152
27	4924	UTAH LAKE	75

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
0408	LAKE POWELL	96 (25)	4 (1)	81 (21)	73 (19)	15 (4)	42 (11)	311
4901	BEAR LAKE	90 (23)	87 (19)	96 (25)	100 (26)	77 (20)	90 (23)	540
4902	LOWER BOWN'S RESERVOIR	46 (12)	87 (19)	85 (22)	65 (17)	73 (19)	50 (13)	406
4903	DEER CREEK RESERVOIR	42 (11)	19 (5)	42 (11)	35 (9)	0 (0)	58 (14)	196
4904	ECHO RESERVOIR	31 (8)	27 (7)	19 (5)	50 (13)	12 (3)	13 (3)	152
4905	LYNN RESERVOIR	8 (2)	23 (6)	58 (15)	8 (2)	62 (15)	4 (1)	163
4906	FISH LAKE	62 (16)	65 (16)	100 (26)	23 (6)	62 (15)	79 (20)	391
4907	HUNTINGTON NORTH RESERVO	77 (20)	65 (16)	69 (18)	92 (24)	96 (25)	69 (18)	468
4908	JOE'S VALLEY RESERVOIR	81 (21)	58 (15)	62 (16)	85 (22)	46 (12)	96 (25)	428
4909	MINERSVILLE RESERVOIR	0 (0)	44 (11)	27 (7)	12 (3)	85 (22)	0 (0)	168
4910	MOON LAKE	100 (26)	87 (19)	73 (19)	77 (20)	69 (18)	100 (26)	506
4911	NAVAJO LAKE	69 (18)	87 (19)	77 (20)	88 (23)	100 (26)	85 (22)	506
4912	NEWCASTLE RESERVOIR	23 (6)	87 (19)	46 (12)	27 (7)	19 (5)	27 (7)	229
4913	OTTER CREEK RESERVOIR	15 (4)	87 (19)	15 (4)	31 (8)	54 (14)	8 (2)	210
4914	PANGUITCH LAKE	12 (3)	65 (16)	50 (13)	4 (1)	8 (2)	23 (6)	162
4915	PELICAN LAKE	37 (9)	54 (14)	35 (9)	54 (14)	90 (23)	73 (19)	343
4916	PINEVIEW RESERVOIR	50 (13)	15 (4)	38 (10)	58 (15)	4 (1)	58 (14)	223
4917	PIUTE RESERVOIR	27 (7)	31 (8)	8 (2)	15 (4)	38 (10)	46 (12)	165
4918	PORCUPINE RESERVOIR	58 (15)	38 (10)	31 (8)	38 (10)	33 (8)	19 (5)	217
4919	PRUESS RESERVOIR (GARRIS	19 (5)	35 (9)	0 (0)	69 (18)	81 (21)	37 (9)	241
4920	SEVIER BRIDGE RESERVOIR	54 (14)	8 (2)	23 (6)	19 (5)	33 (8)	37 (9)	174
4921	STARVATION RESERVOIR	73 (19)	87 (19)	65 (17)	62 (16)	23 (6)	79 (20)	389
4922	STEINAKER RESERVOIR	85 (22)	87 (19)	88 (23)	96 (25)	27 (7)	65 (17)	448
4923	TROPIC RESERVOIR	65 (17)	50 (13)	54 (14)	46 (12)	90 (23)	58 (14)	363
4924	UTAH LAKE	4 (1)	12 (3)	4 (1)	0 (0)	42 (11)	13 (3)	75
4925	WILLARD BAY RESERVOIR	37 (9)	44 (11)	12 (3)	42 (11)	50 (13)	31 (8)	216
5605	FLAMING GORGE RESERVOIR	90 (23)	0 (0)	92 (24)	81 (21)	62 (15)	90 (23)	415

APPENDIX B

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 C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR UTAH 10/18/76

LAKE CODE 4922 STEINAKER RES.

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 54.4

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
4922A1	54.4	0.0	0.0	0.0	0.227	0.906	0.708	2.832	2.435	1.246	0.340	0.0	0.0	0.732
4922B1	0.0	0.736	0.680	0.708	0.198	2.265	2.237	0.113	0.057	0.0	0.113	1.076	0.878	0.754
4922C1	0.0	0.0	0.0	0.0	0.0	0.0	0.057	0.057	0.006	0.0	0.0	0.0	0.0	0.010
4922D1	17.1	0.0	0.0	0.0	0.0	0.0	0.085	0.071	0.0	0.0	0.0	0.0	0.0	0.013
4922E1	16.6	0.0	0.0	0.0	0.0	0.0	0.085	0.071	0.003	0.0	0.0	0.0	0.0	0.013
4922ZZ	20.7	0.0	0.0	0.0	0.0	0.0	0.099	0.071	0.0	0.0	0.0	0.0	0.0	0.014

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 54.4
SUM OF SUB-DRAINAGE AREAS = 54.4
TOTAL FLOW IN = 9.66
TOTAL FLOW OUT = 8.69

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4922A1	11	74	0.0	9	0.0				
	12	74	0.0	15	0.0				
	1	75	0.0	12	0.0				
	2	75	0.0	8	0.0				
	3	75	0.0	8	0.0				
	4	75	0.008	6	0.0				
	5	75	0.008	5	0.0	18	0.0		
	6	75	0.170	7	0.0	22	0.396		
	7	75	0.623	14	0.0				
	8	75	2.747	16	2.549				
	9	75	2.010						
	10	75	0.340						
4922B1	11	74	0.708	10	0.736				
	12	74	0.566	15	0.623				
	1	75	0.595	12	0.538				
	2	75	0.566	8	0.595				
	3	75	0.623	8	0.651				
	4	75	0.368	6	0.623				
	5	75	1.104	2	0.227	18	0.850		
	6	75	5.663	7	9.911	22	0.566		
	7	75	0.142	14	0.170				
	8	75	0.0	16	0.0				
	9	75	0.0						
	10	75	0.0						

TRIBUTARY FLOW INFORMATION FOR UTAH 10/18/76

LAKE CODE 4922 STEINAKER RES.

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4922C1	11	74	0.0	9	0.0				
	12	74	0.0	12	0.0				
	1	75	0.0	12	0.0				
	2	75	0.0	8	0.0				
	3	75	0.0	8	0.0				
	4	75	0.0	6	0.0				
	5	75	0.0	5	0.0	18	0.0		
	6	75	0.057	7	0.006	22	0.057		
	7	75	0.057	14	0.085				
	8	75	0.028	16	0.028				
	9	75	0.0						
	10	75	0.0						
4922D1	11	74	0.0	9	0.0				
	12	74	0.0	15	0.0				
	1	75	0.0	12	0.0				
	2	75	0.0	8	0.0				
	3	75	0.0	8	0.0				
	4	75	0.0	6	0.0				
	5	75	0.0	5	0.0	18	0.0		
	6	75	0.040	7	0.0	22	0.0		
	7	75	0.011	14	0.0				
	8	75	0.0	16	0.0				
	9	75	0.0						
	10	75	0.0						
4922E1	11	74	0.0	9	0.0				
	12	74	0.0	15	0.0				
	1	75	0.0	12	0.0				
	2	75	0.0	8	0.0				
	3	75	0.0	8	0.0				
	4	75	0.0	6	0.0				
	5	75	0.0	5	0.0	18	0.0		
	6	75	0.040	7	0.0	22	0.0		
	7	75	0.011	14	0.0				
	8	75	0.0	16	0.0				
	9	75	0.0						
	10	75	0.0						
4922ZZ	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0						
	4	75	0.0						
	5	75	0.0						
	6	75	0.042						
	7	75	0.014						
	8	75	0.0						
	9	75	0.0						
	10	75	0.0						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/12

492201
40 31 38.0 109 31 33.0 3
STEINAKER RESERVOIR
49047 UTAH

110691

11EPALES 2111202
0044 FEET DEPTH CLASS 00

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
75/05/13	14 20	0000	10.4	9.0	228	245	8.60	118	0.030	0.300	0.020K	0.012
	14 20	0005	10.3	9.2		247	8.55	118	0.020	0.200K	0.020K	0.012
	14 20	0020	9.3	9.7		245	8.50	116	0.020K	0.200K	0.020K	0.011
	14 20	0040	7.7	9.6		235	8.50	118	0.020	0.200K	0.020K	0.010
75/08/07	11 40	0000	22.9	7.6	144	270	8.70	88	0.020	0.200	0.020K	0.003
	11 40	0005		7.6			8.75	87	0.140	0.200K	0.020K	0.006
	11 40	0016	22.2	7.1		267	8.70	89	0.030	0.200K	0.020K	0.004
75/09/22	16 10	0000	19.4	7.1	180	221	8.60	102	0.020K	0.200	0.020K	0.002K
	16 10	0005	18.9	6.8		216	8.40	99	0.020K	0.200	0.020K	0.002K
	16 10	0020	18.7	7.0		215	8.40	100	0.020K	0.200	0.020K	0.002K
	16 10	0034	18.5	7.0		213	8.40	99	0.020K	0.200K	0.020K	0.002K

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/13	14 20	0000	0.017	1.6	
	14 20	0005	0.012		
	14 20	0020	0.012		
	14 20	0040	0.014		
75/08/07	11 40	0000	0.012	1.8	
	11 40	0005	0.021		
	11 40	0016	0.010		
75/09/22	16 10	0000	0.010	1.7	
	16 10	0005	0.011		
	16 10	0020	0.008		
	16 10	0034	0.008		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

492202
40 30 27.0 109 31 52.0 3
STEINAKER RESERVOIR
49047 UTAH

110691

11EPALES 2111202
0075 FEET DEPTH CLASS 00

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
75/05/13	14 45	0000	10.2	9.2	228	240	8.50	116	0.020	0.300	0.020K	0.011
	14 45	0005	10.0	9.6		245	8.50	114	0.020	0.300	0.020K	0.011
	14 45	0023	8.9	9.8		238	8.50	114	0.020K	0.200	0.020K	0.010
	14 45	0048	7.4	8.8		230	8.35	115	0.020	0.200K	0.020K	0.011
	14 45	0071	7.3	8.8		230	8.40	115	0.020	0.200K	0.020K	0.011
75/08/07	11 15	0000	21.5	7.8	168	272	8.70	86	0.050	0.200	0.020K	0.002
	11 15	0005	22.0	7.2		259	8.70	86	0.050	0.200	0.020K	0.002
	11 15	0015	21.4	6.6		256	8.65	86	0.050	0.200	0.020K	0.004
	11 15	0030	12.1	4.4		210	8.00	91	0.060	0.200	0.060	0.006
	11 15	0050	10.0	4.8		219	7.90	94	0.050	0.200	0.090	0.014
	11 15	0091	8.0	7.4		244	8.20	104	0.150	0.200	0.140	0.015
75/09/23	16 25	0000	18.9	7.1	180	221	8.40	99	0.020K	0.200	0.020K	0.002K
	16 25	0005	18.7	7.2		212	8.40	99	0.020K	0.200K	0.020K	0.002K
	16 25	0020	18.6	7.0		209	8.30	99	0.020K	0.200	0.020K	0.002
	16 25	0050	14.6	2.4		189	7.80	104	0.020K	0.200K	0.070	0.008
	16 25	0086	12.8			207	7.60	113	0.020K	0.200K	0.190	0.028

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/13	14 45	0000	0.011	1.9	
	14 45	0005	0.016		
	14 45	0023	0.012		
	14 45	0048	0.016		
	14 45	0071	0.012		
75/08/07	11 15	0000	0.010	2.3	
	11 15	0005	0.010		
	11 15	0015	0.010		
	11 15	0030	0.031		
	11 15	0050	0.015		
	11 15	0091	0.022		
75/09/23	16 25	0000	0.008	1.6	
	16 25	0005	0.009		
	16 25	0020	0.010		
	16 25	0050	0.017		
	16 25	0086	0.033		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

492203
40 30 22.0 109 32 48.0 3
STEINAKER RESERVOIR
49047 UTAH

110691

11EPALES 2111202
0016 FEET DEPTH CLASS 00

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
75/05/13	15 10	0000	11.4	9.2		254	8.50	117	0.020	0.400	0.020K	0.011
	15 10	0005	10.9	9.6		249	8.50	114	0.020K	0.200K	0.020K	0.011
	15 10	0012	10.0	10.0		247	8.55	116	0.020	0.300	0.020K	0.011
75/08/07	10 50	0000	21.0	7.2	132	270	9.20	91	0.040	0.200	0.020K	0.004
	10 50	0005	20.7	7.6		270	8.70	89	0.040	0.200K	0.020K	0.004
	10 50	0014	20.8	7.5		266	8.70	87	0.090	0.200	0.020K	0.005
75/09/23	16 50	0000	19.7	7.2	206	221	8.40	101	0.020K	0.200	0.020K	0.002
	16 50	0005	18.9	7.2		216	8.40	99	0.020K	0.200	0.020K	0.002K
	16 50	0019	18.6	7.6		214	8.40	100	0.020K	0.200	0.020K	0.003

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/13	15 10	0000	0.011	1.7	
	15 10	0005	0.010		
	15 10	0012	0.014		
75/08/07	10 50	0000	0.014	2.2	
	10 50	0005	0.010		
	10 50	0014	0.010		
75/09/23	16 50	0000	0.009	1.8	
	16 50	0005	0.009		
	16 50	0019	0.012		

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/08/12

4922A1
40 30 18.0 109 32 00.0 4
STEINAKER SERVICE CANAL
49 7.5 STEINAKER RS
O/STEINAKER RESERVOIR 110691
BNK .1 MI SW OF DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

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
75/06/22	09 00		0.040	0.350	0.040	0.005K	0.020
75/09/20	13 30		0.085	1.100	0.130	0.010	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

492281
40 29 34.0 109 35 04.0 4
STEINAKER FEEDER CANAL
49 7.5 VERNAL
T/STEINAKER RESERVOIR 110691
PARSHALL FLUME .4 MI W OF TAYLOR MT RD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

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
74/11/10	15 55		0.368	0.300	0.020	0.005K	0.010K
74/12/15	14 00		0.096	0.800	0.020	0.005K	0.010K
75/01/12	09 45		0.168	0.500	0.015	0.005K	0.010
75/02/05	12 10		0.112	0.400	0.016	0.008K	0.010K
75/03/08	14 00		0.125	0.200	0.011	0.005	0.010K
75/04/06	07 30		0.080	0.600	0.017	0.005K	0.010K
75/05/02	17 50		0.015	0.350	0.070	0.005K	0.010K
75/06/07	14 00		0.050	0.750	0.025	0.010	
75/06/22	07 30		0.050	0.300	0.015	0.010	0.030

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

4922C1
40 30 08.0 109 34 37.0 4
STEINAKER DITCH
49 7.5 STEINAKER RS
T/STEINAKER RESERVOIR 110691
SEC RD BRDG .5 MI S OF ASHLEY SUBSTATION
11EPALES 2111204
0000 FEET DEPTH CLASS 00

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
75/06/07	14 20		0.045	0.600	0.020	0.020	
75/06/22	07 45		0.035	0.250	0.015	0.010	0.030
75/07/14	09 00		0.020	0.350	0.005K	0.030	0.030
75/08/16	19 00		0.010	0.100	0.015	0.005	0.010K
75/09/20	13 30		0.005	0.300	0.015	0.005K	0.010K

K VALUE KNOWN TO BE
LESS THAN INDICATED