U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

GRAND LAKE AND SHADOW MOUNTAIN LAKE

GRAND COUNTY

COLORADO

EPA REGION VIII

WORKING PAPER No. 770

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

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Report

on

Grand Lake and Shadow Mountain Lake

Grand County

Colorado

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Working Paper No. 770

With the cooperation of the

Colorado Department of Health

and the

Colorado National Guard

July, 1977

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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 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 & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Colorado Department of Health for professional involvement, to the Colorado National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples.

The staff of the Water Quality Control Division 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.

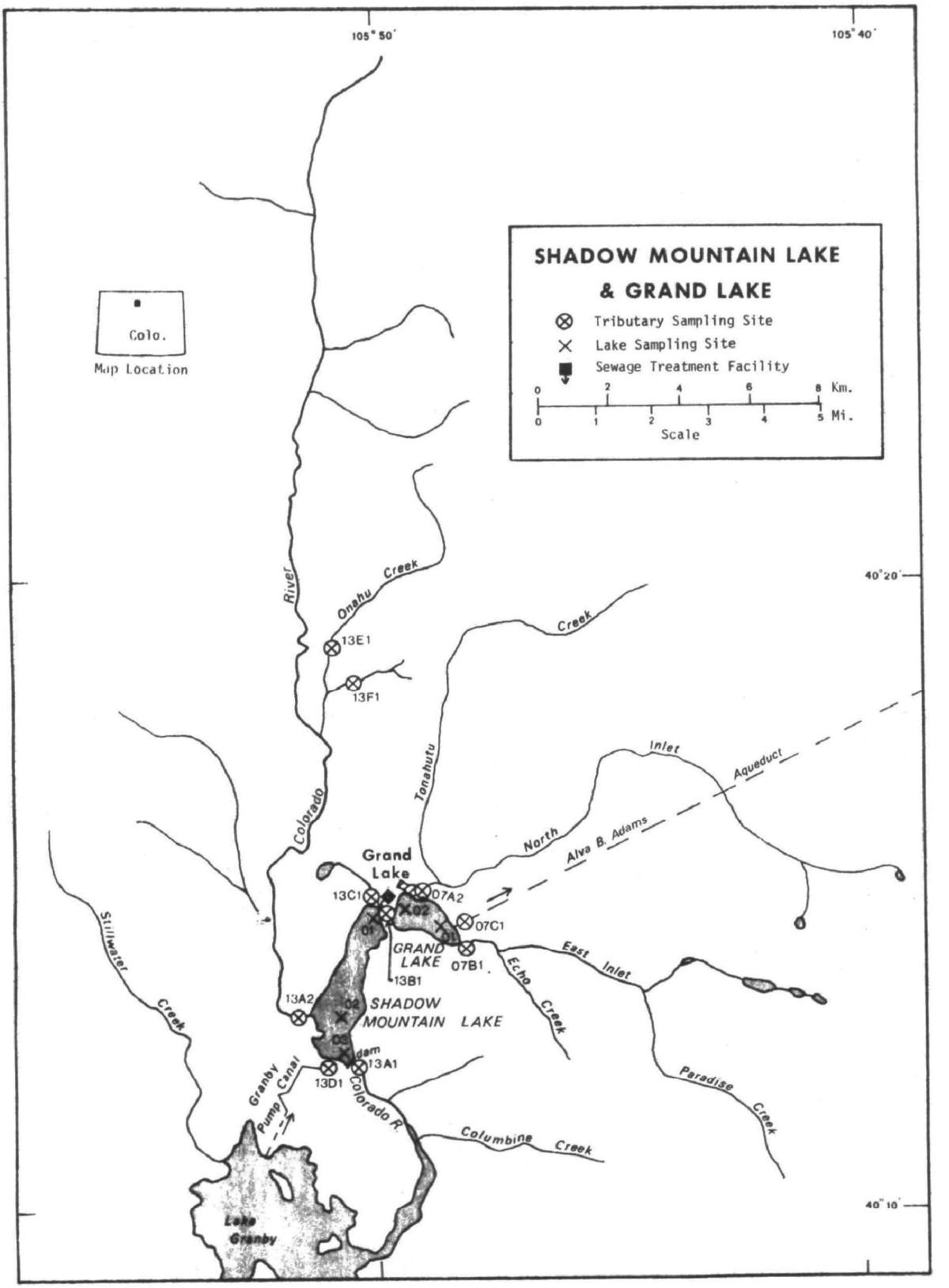
Lt. Colonel Paul A. Parsons, the Deputy Adjutant General of Colorado, and Project Officer Colonel Hershel C. Yeargan, who directed the volunteer efforts of the Colorado National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF COLORADO

NAME	COUNTY
Barker	Boulder
Barr	Adams
Blue Mesa	Boulder
Cherry Creek	Arapohoe
Cucharas	Huerfano
Dillon	Summit
Grand	Grand
Green Mountain	Summit
Holbrook	Otero
Meredith	Crowley
Milton	Weld
Navajo	Archuleta, CO; San Juan, Rio Arriba, NM
Shadow Mountain	Grand


105° 50'
105° 40'
40° 20'
40° 10'
SHADOW MOUNTAIN LAKE
& GRAND LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 2 4 6 8 Km.
0 1 2 3 4 5 Mi.
Scale
Colo.
Map Location
Colorado River
Onahu Creek
13E1
13F1
Tonahutu Creek
North Inlet
Alva B. Adams Aqueduct
Grand Lake
13C1
07A2
07C1
07B1
13B1
GRAND LAKE
SHADOW MOUNTAIN LAKE
13A2
13A1
13D1
dam
Stillwater Creek
Granby Pump Canal
Colorado R.
Echo Creek
East Inlet
Paradise Creek
Columbine Creek
Lake Granby

GRAND LAKE AND SHADOW MOUNTAIN LAKE

STORET NOS. 0807 and 0813

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Grand Lake and Shadow Mountain Lake are mesotrophic. Of the 13 Colorado lakes and reservoirs sampled in 1975, Grand Lake ranked third and Shadow Mountain Lake ranked fourth in overall trophic quality when compared using a combination of six water quality parameters*.

1. Grand Lake--Two of the waterbodies had less median total phosphorus, two had less and one had the same median dissolved orthophosphorus, none had less and six had the same median inorganic nitrogen, two had less mean chlorophyll a, and one had greater mean Secchi disc transparency. Some depression of dissolved oxygen with depth (to 4.8 mg/l at 67.1 meters) occurred at station 1 in August.

Survey limnologists did not observe nuisance aquatic growths during their visits.

In a previous report it is noted that Grand Lake acts as a sink for materials sedimenting out of natural inflows and pumped inflows from Shadow Mountain Lake; and, as a consequence, inflow-outflow conditions make the characteristics of the upper 5 to 10 meters of the lake quite similar to those of Shadow Mountain Lake (Nelson, 1971).

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* See Appendix A.

2. Shadow Mountain Lake--Four of the waterbodies had less median total phosphorus, two had less and one had the same median dissolved orthophosphorus, none had less and six had the same median inorganic nitrogen, four had less mean chlorophyll a, and five had greater mean Secchi disc transparency. No dissolved oxygen depression occurred during the sampling. Survey limnologists did not observe any nuisance conditions.

Shadow Mountain Lake, due to its hydrology and morphometry, has been regarded as a reversible flow-through system. At certain times in the year, it receives nutrients primarily from secondarily-enriched water pumped from Lake Granby; and aquatic plants are abundant at times (Nelson, op. cit.).

Although neither lake is presently considered to be eutrophic, it has been concluded that orthophosphorus concentrations are close to or exceed the minimum levels necessary to support algal blooms, and that the inflow from Shadow Mountain Lake may be primarily responsible for the enrichment of Grand Lake (Nelson, op. cit.).

B. Rate-Limiting Nutrient:

The algal assay results indicate that Grand Lake was phosphorus limited at the times the samples were collected (08/26/75 and 10/10/75). The lake data indicate phosphorus limitation at both sampling stations and times.

The results of the algal assays for Shadow Mountain Lake are not considered representative of conditions in the lake at the sampling times due to a significant change in nutrients in the

samples during shipment from the field to the laboratory. The lake data indicate phosphorus limitation at station 1 in August and at station 3 in August and October. Nitrogen limitation is indicated at all other sampling stations and times.

C. Nutrient Controllability:

1. Point sources--During the sampling year, point sources accounted for 9.2% of the total phosphorus load to Grand and Shadow Mountain lakes. The Grand Lake Sanitation District wastewater treatment plant contributed 8.8%, and septic tanks serving lakeshore dwellings contributed an estimated 0.4%. However, since much of the population around the lakes is seasonal, an additional investigation would have to be undertaken to determine the significance of such sources.

The present phosphorus loading of 1.38 g/m^2/year is just a little less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 16). In a previous report it is noted that even though the lakes are not presently considered eutrophic, system operations combined with continued sewage input could eventually result in a eutrophic system (Nelson, op. cit.). The Survey results appear to confirm this conclusion since the loading measured during the sampling year was a borderline eutrophic loading.

2. Non-point sources--Non-point sources accounted for 90.8% of the total phosphorus loading during the sampling year. The Granby Pump Canal contributed 48.7%, the Colorado River contributed 22.7%, the North Inlet contributed 12.1%, and Echo Creek contributed 4.8%. The ungaged minor tributaries and immediate drainage area contributed an estimated 1.3%.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Grand Lake:

   a. Surface area: 2.05 kilometers^2.

   b. Mean depth: 41.3 meters.

   c. Maximum depth: 81.0 meters.

   d. Volume: 84.640 x 10^6 m^3.

2. Shadow Mountain Lake:

   a. Surface area: 5.48 kilometers^2.

   b. Mean depth: 3.8 meters.

   c. Maximum depth: 11.0 meters.

   d. Volume: 20.600 x 10^6 m^3.

B. Mean hydraulic retention time of the system: 92 days.

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

1. Tributaries -

Name	Drainage area (km^2)*	Mean Flow (m^3/sec)*
North Inlet	118.9	1.990
Echo Creek	70.4	1.441
Colorado River	264.2	2.500
Granby Pump Canal	-	7.310
Minor tributaries & immediate drainage -	18.1	0.224
Totals	471.6	13.465

† Table of metric equivalents-Appendix B.
†† Anderson, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".

2. Outlet -

Alva B. Adams Aqueduct	-	8.990
Colorado River	479.1*	4.280
Total	479.1	13.270

D. Precipitation**:

1. Year of sampling: 52.1 centimeters.

2. Mean annual: 42.7 centimeters.

* Includes area of the lakes.
** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Grand and Shadow Mountain lakes were sampled two 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 six or more depths at two stations on Grand Lake and from two or more depths at three stations on Shadow Mountain Lake (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations on each lake for phytoplankton identification and enumeration; and during both visits, a single 18.9-liter depth-integrated sample was composited from each lake 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 in Grand Lake were 67.1 meters at station 1 and 36.9 meters at station 2. The maximum depths sampled in Shadow Mountain Lake were 1.8 meters at station 1, 3.7 meters at station 2, and 7.3 meters at station 3.

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

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR GRAND LAKE
STORET CODE 0807

PARAMETER	1ST SAMPLING (8/26/75) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (10/10/75) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/ 9/75) 0 SITES RANGE	MEAN	MEDIAN
TEMP (C)	1.2 - 12.5	6.7	5.2	4.3 - 10.7	8.0	9.5	****** -**********		
DISS OXY (MG/L)	4.8 - 7.8	7.0	7.4	6.0 - 8.0	7.1	7.6	****** -**********		
CNDCTVY (MCROMO)	1. - 12.	5.	6.	26. - 49.	35.	34.	****** -**********		
PH (STAND UNITS)	6.3 - 6.9	6.5	6.5	6.5 - 7.3	7.1	7.1	****** -**********		
TOT ALK (MG/L)	13. - 27.	20.	22.	13. - 22.	18.	19.	****** -**********		
TOT P (MG/L)	0.008 - 0.236	0.027	0.011	0.010 - 0.112	0.028	0.018	****** -**********		
ORTHO P (MG/L)	0.002 - 0.010	0.003	0.002	0.003 - 0.011	0.005	0.004	****** -**********		
NO2+NO3 (MG/L)	0.020 - 0.160	0.056	0.020	0.020 - 0.180	0.056	0.020	****** -**********		
AMMONIA (MG/L)	0.020 - 0.020	0.020	0.020	0.020 - 0.020	0.020	0.020	****** -**********		
KJEL N (MG/L)	0.200 - 0.300	0.207	0.200	0.200 - 0.400	0.229	0.200	****** -**********		
INORG N (MG/L)	0.040 - 0.180	0.076	0.040	0.040 - 0.200	0.076	0.040	****** -**********		
TOTAL N (MG/L)	0.220 - 0.390	0.263	0.220	0.220 - 0.420	0.284	0.260	****** -**********		
CHLRPYL A (UG/L)	5.4 - 5.5	5.4	5.4	4.0 - 4.7	4.3	4.3	****** -**********		
SECCHI (METERS)	2.4 - 2.6	2.5	2.5	4.3 - 4.3	4.3	4.3	****** -**********		

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR SHADOW MOUNTAIN LAKE
STORET CODE 0813

	1ST SAMPLING (8/26/75)			2ND SAMPLING (10/10/75)			3RD SAMPLING (**/**/**)		
	3 SITES			3 SITES			0 SITES		
PARAMETER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
TEMP (C)	7.9 - 12.2	10.3	11.5	8.1 - 10.0	8.9	8.9	****** -******		
DISS OXY (MG/L)	6.4 - 7.8	7.2	7.6	5.8 - 9.0	7.2	7.8	****** -******		
CNDCTVY (MCROMO)	23. - 26.	24.	24.	39. - 43.	41.	41.	****** -******		
PH (STAND UNITS)	6.6 - 7.3	6.9	6.8	7.0 - 7.6	7.3	7.3	****** -******		
TOT ALK (MG/L)	21. - 26.	24.	24.	27. - 31.	29.	29.	****** -******		
TOT P (MG/L)	0.016 - 0.075	0.025	0.019	0.020 - 0.028	0.022	0.021	****** -******		
ORTHO P (MG/L)	0.002 - 0.003	0.003	0.003	0.002 - 0.004	0.003	0.003	****** -******		
NO2+NO3 (MG/L)	0.020 - 0.070	0.038	0.020	0.020 - 0.080	0.046	0.020	****** -******		
AMMONIA (MG/L)	0.020 - 0.020	0.020	0.020	0.020 - 0.020	0.020	0.020	****** -******		
KJEL N (MG/L)	0.300 - 0.400	0.344	0.300	0.200 - 0.200	0.200	0.200	****** -******		
INORG N (MG/L)	0.040 - 0.090	0.058	0.040	0.040 - 0.100	0.066	0.040	****** -******		
TOTAL N (MG/L)	0.320 - 0.460	0.382	0.370	0.220 - 0.280	0.246	0.220	****** -******		
CHLRPYL A (UG/L)	3.9 - 8.1	6.2	6.5	4.3 - 6.0	5.2	5.4	****** -******		
SECCHI (METERS)	1.5 - 1.9	1.8	1.9	1.5 - 2.4	1.9	1.8	****** -******		

B. Biological characteristics:

1. Phytoplankton -

a. Grand Lake

Sampling Date	Dominant Genera	Algal Units per ml
08/26/75	1. *Asterionella sp.*	523
	2. *Anabaena sp.*	262
	3. *Cryptomonas sp.*	131
	4. *Melosira sp.*	87
	Total	1,003
10/10/75	1. *Spondylosium sp.*	339
	2. *Cryptomonas sp.*	136
	3. *Melosira sp.*	136
	4. *Asterionella sp.*	102
	5. *Anabaena sp.*	34
	Other genera	33
	Total	780

b. Shadow Mountain Lake

08/26/75	1. *Aphanizomenon sp.*	630
	2. *Phormidium sp.*	533
	3. *Microcystis sp.*	388
	4. *Chroomonas sp.*	291
	5. *Nitzschia sp.*	242
	Other genera	486
	Total	2,570
10/10/75	1. *Melosira sp.*	706
	2. *Asterionella sp.*	246
	3. *Cryptomonas sp.*	246
	4. *Chroomonas (?) sp.*	184
	5. Pennate diatoms	184
	Other genera	214
	Total	1,780

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (μg/l)
08/26/75	Grand 1	5.5
	Grand 2	5.4
	S. M. 1	8.1
	S. M. 2	6.5
	S. M. 3	3.9
10/10/75	Grand 1	4.7
	Grand 2	4.0
	S. M. 1	4.3
	S. M. 2	6.0
	S. M. 3	5.4

C. Grand Lake Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. August sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.004	0.075	0.2
0.050 P	0.054	0.075	4.7
0.050 P + 1.0 N	0.054	1.075	6.3
1.0 N	0.004	1.075	0.2

b. October sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.005	0.085	0.4
0.050 P	0.055	0.085	3.0
0.050 P + 1.0 N	0.055	1.085	7.9
1.0 N	0.005	1.085	0.3

2. Discussion -

The control yields of the assay alga, *Selenastrum capricornutum*, indicate that the potential primary productivity

of Grand Lake was moderate at the times the samples were collected. Also, the significant increases in yields with the addition of phosphorus alone indicate the lake was phosphorus limited at those times. Note that the addition of nitrogen alone resulted in yields no greater than those of the controls.

The lake data also indicate phosphorus limitation. The mean inorganic nitrogen/orthophosphorus ratios were 16/1 or greater at all sampling stations and times.

Due to significant changes in nutrients in the samples during shipment from the field to the laboratory, the assay results for Shadow Mountain Lake are not considered representative of conditions in the lake at the sampling times. The lake data indicate a combination of limiting nutrients. Following is a tabulation of the mean N/P ratios at the sampling stations and times with the indicated limiting nutrient in parentheses.

Station	08/25/75	10/10/75
1	16/1 (P)	11/1 (N)
2	13/1 (N-?)	13/1 (N-?)
3	27/1 (P)	29/1 (P)

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Colorado 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 June and July when two samples were collected. Sampling was begun in September, 1974, and was completed in August, 1975.

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

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads for the Alva B. Adams Aqueduct were calculated using the mean nutrient concentrations at Grand Lake sampling station 1 and the mean annual aqueduct flow.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in Unnamed Creek at station F-1 of Shadow Mountain Lake and the mean annual ZZ flow.

The operator of the Grand Lake Sanitation District wastewater treatment plant provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal† -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Grand Lake SD	1,475††	act. sludge	1,356.9	Shadow Mtn. Lake

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
North Inlet	1,255	12.1
Echo Creek	500	4.8
Colorado River	2,365	22.7
Granby Pump Canal	5,070	48.7
b. Minor tributaries & immediate drainage (non-point load) -	135	1.3
c. Known municipal STP's -		
Grand Lake SD	920	8.8
d. Septic tanks* -	45	0.4
e. Known industrial - None	-	-
f. Direct precipitation** -	130	1.2
Total	10,420	100.0

2. Outputs -

Lake outlets -	Adams Aqueduct	3,685
	Colorado River	2,295
	Total	5,980

3. Net annual P accumulation - 4,440 kg.

† Treatment plant questionnaire.
†† Population equivalent based on 300 winter residents and a maximum of 5000 summer residents.
* Estimate based on 161 lakeshore dwellings; see Working Paper No. 175.
** 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) -		
North Inlet	42,235	10.5
Echo Creek	20,950	5.2
Colorado River	83,255	20.7
Granby Pump Canal	239,520	59.5
b. Minor tributaries & immediate drainage (non-point load) -	3,185	0.8
c. Known municipal STP's -		
Grand Lake SD	3,695	0.9
d. Septic tanks* -	1,715	0.4
e. Known industrial - None	-	-
f. Direct precipitation** -	8,130	2.0
Total	402,685	100.0

2. Outputs -

Lake outlets -	Adams Aqueduct	78,815
	Colorado River	120,665
	Total	199,480

3. Net annual N accumulation - 203,205 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
North Inlet	11	355
Echo Creek	7	298
Colorado River	9	315

* Estimate based on 161 lakeshore dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Little Columbine Creek	0.032	0.370
Onahu Creek	0.022	0.657
Unnamed Creek	0.019	0.451

F. 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	1.38	0.59	53.5	27.0

Vollenweider phosphorus loadings ($g/m^2/yr$) based on combined mean depth* and mean hydraulic retention time of Grand Lake and Shadow Mountain Lake:

"Dangerous" (eutrophic loading)	1.40
"Permissible" (oligotrophic loading)	0.70

* Mean depth of the lakes calculated by adding both volumes and both areas and dividing the combined volume by the combined area.

V. LITERATURE REVIEWED

Anderson, Dennis P., 1974. Personal communication (lake morphometry). CO Dept. of Health, Denver.

Nelson, Wesley C., 1971. Comparative limnology of Colorado--Big Thompson Project reservoirs and lakes. CO Dept. of Nat. Res., Fort Collins.

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
0801	BARKER RESERVOIR	0.023	0.045	419.000	5.333	9.400	0.006
0802	BARR LAKE	0.930	1.090	451.333	28.767	10.200	0.730
0803	BLUE MESA RESERVOIR	0.019	0.040	395.750	6.817	13.800	0.005
0804	CHERRY CREEK LAKE	0.054	0.040	469.333	23.322	10.000	0.007
0805	CUCHARAS RESERVOIR	0.263	0.040	490.000	27.400	14.800	0.015
0806	DILLON RESERVOIR	0.009	0.040	181.750	3.150	9.200	0.002
0807	GRAND LAKE	0.013	0.040	366.500	4.900	10.200	0.003
0808	GREEN MOUNTAIN RESERVOIR	0.010	0.040	391.167	5.833	9.100	0.002
0809	HOLBROOK LAKE	0.329	0.070	490.333	111.933	9.000	0.028
0810	LAKE MEREDITH	0.397	0.110	489.667	164.678	10.400	0.098
0811	MILTON RESERVOIR	0.846	2.280	429.333	5.900	9.200	0.808
0812	NAVAJO RESERVOIR	0.036	0.050	479.400	2.180	10.000	0.013
0813	SHADOW MOUNTAIN LAKE	0.020	0.040	427.000	5.700	9.200	0.003

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
0801	BARKER RESERVOIR	58 (7)	42 (5)	67 (8)	75 (9)	58 (7)	58 (7)	358
0802	BARR LAKE	0 (0)	8 (1)	42 (5)	17 (2)	29 (3)	8 (1)	104
0803	BLUE MESA RESERVOIR	75 (9)	87 (9)	75 (9)	42 (5)	8 (1)	67 (8)	354
0804	CHERRY CREEK LAKE	42 (5)	87 (9)	33 (4)	33 (4)	46 (5)	50 (6)	291
0805	CUCHARAS RESERVOIR	33 (4)	58 (6)	8 (1)	25 (3)	0 (0)	33 (4)	157
0806	DILLON RESERVOIR	100 (12)	58 (6)	100 (12)	92 (11)	75 (8)	96 (11)	521
0807	GRAND LAKE	83 (10)	87 (9)	92 (11)	83 (10)	29 (3)	79 (9)	453
0808	GREEN MOUNTAIN RESERVOIR	92 (11)	58 (6)	83 (10)	58 (7)	92 (11)	96 (11)	479
0809	HOLBROOK LAKE	25 (3)	25 (3)	0 (0)	8 (1)	100 (12)	25 (3)	183
0810	LAKE MEREDITH	17 (2)	17 (2)	17 (2)	0 (0)	17 (2)	17 (2)	85
0811	MILTON RESERVOIR	8 (1)	0 (0)	50 (6)	50 (6)	75 (8)	0 (0)	183
0812	NAVAJO RESERVOIR	50 (6)	33 (4)	25 (3)	100 (12)	46 (5)	42 (5)	296
0813	SHADOW MOUNTAIN LAKE	67 (8)	87 (9)	58 (7)	67 (8)	75 (8)	79 (9)	433

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	0806	DILLON RESERVOIR	521
2	0808	GREEN MOUNTAIN RESERVOIR	479
3	0807	GRAND LAKE	453
4	0813	SHADOW MOUNTAIN LAKE	433
5	0801	BARKER RESERVOIR	358
6	0803	BLUE MESA RESERVOIR	354
7	0812	NAVAJO RESERVOIR	296
8	0804	CHERRY CREEK LAKE	291
9	0811	MILTON RESERVOIR	183
10	0809	HOLBROOK LAKE	183
11	0805	CUCHARAS RESERVOIR	157
12	0802	BARR LAKE	104
13	0810	LAKE MEREDITH	85

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 COLORADO 11/08/76

LAKE CODE 0807 GRAND

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 197.6

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
0807A1	197.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0807A2	118.9	0.14	0.11	0.14	0.71	5.10	10.19	4.39	1.27	0.71	0.57	0.34	0.17	1.99
0807B1	70.4	0.085	0.071	0.085	0.425	3.398	7.646	3.540	0.850	0.425	0.425	0.198	0.113	1.441
0807C1	0.0	11.19	11.47	11.04	8.21	7.08	3.26	8.07	9.63	8.21	9.34	9.34	11.04	8.99
0807ZZ	8.3	0.011	0.008	0.011	0.045	0.170	0.283	0.113	0.071	0.051	0.040	0.023	0.011	0.070

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 197.6 TOTAL FLOW IN = 149.83
SUM OF SUB-DRAINAGE AREAS = 197.6 TOTAL FLOW OUT = 0.0

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0807A2	9	74	0.368	28	0.311				
	10	74	0.368	19	0.368				
	11	74	0.283	16	0.283				
	12	74	0.142	14	0.142				
	2	75	0.099	23	0.099				
	3	75	0.099	29	0.113				
	4	75	0.212	19	0.142				
	5	75	2.832	19	4.531				
	6	75	8.495	15	7.929	28	11.610		
	7	75	7.929	12	8.495	26	3.964		
	8	75	1.699	23	1.274				
0807B1	9	74	0.283	28	0.227				
	10	74	0.255	19	0.283				
	11	74	0.184	16	0.170				
	12	74	0.099	14	0.085				
	2	75	0.071	23	0.057				
	3	75	0.071	29	0.071				
	4	75	0.127	19	0.085				
	5	75	1.841	19	3.681				
	6	75	6.230	15	6.796	28	8.778		
	7	75	6.513	12	6.796	26	3.115		
	8	75	1.274	23	0.991				
0807ZZ	9	74	0.028						
	10	74	0.025						
	11	74	0.020						
	12	74	0.014						
	2	75	0.008						
	3	75	0.008						
	4	75	0.020						
	5	75	0.102						
	6	75	0.283						
	7	75	0.227						
	8	75	0.088						

TRIBUTARY FLOW INFORMATION FOR COLORADO 09/24/76

LAKE CODE 0813 SHADOW MOUNTAIN

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 479.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
0813A1	479.1	0.71	0.71	0.71	0.96	10.34	27.18	5.95	1.42	1.33	0.71	0.71	0.71	4.28
0813A2	264.2	0.51	0.43	0.51	1.84	7.50	11.04	2.97	1.42	1.13	1.13	0.85	0.57	2.50
0813B1	197.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0813D1	0.0	11.04	11.33	10.48	5.95	1.90	0.15	4.67	8.21	6.94	7.22	9.20	10.76	7.31
0813ZZ	18.1	0.025	0.020	0.025	0.099	0.368	0.623	0.249	0.156	0.110	0.088	0.051	0.025	0.154

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 479.1 TOTAL FLOW IN = 119.64
SUM OF SUB-DRAINAGE AREAS = 479.9 TOTAL FLOW OUT = 51.42

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0813A1	9	74	1.416	28	1.416				
	10	74	0.708	19	0.708				
	11	74	0.708	16	0.708				
	12	74	0.708	14	0.708				
	1	75	0.708	19	0.708				
	2	75	0.708	23	0.708				
	3	75	0.708	29	0.708				
	5	75	6.088	5	0.708	19	24.919		
	6	75	22.937	11	20.388	28	23.220		
	7	75	13.309	12	12.459	26	2.549		
	8	75	1.416	23	1.416				
0813A2	9	74	1.133	28	0.934				
	10	74	0.708	19	0.708				
	11	74	0.623	16	0.623				
	12	74	0.425	14	0.396				
	1	75	0.425	18	0.425				
	2	75	0.425	23	0.425				
	3	75	0.425	29	0.425				
	5	75	4.814	5	2.152	19	8.920		
	6	75	8.495	15	9.005	28	8.240		
	7	75	3.964	23	0.736	26	0.396		
	8	75	1.133	23	1.161				
0813D1	9	74	12.743	28	12.176				
	10	74	12.176	19	11.044				
	11	74	8.778	16	8.920				
	12	74	11.610	14	13.309				
	1	75	13.309	18	11.893				
	2	75	12.459	23	11.327				
	3	75	10.760	29	9.466				
	4	75	7.362	19	11.751				
	5	75	5.663	19	0.0				
	6	75	9.911	15	0.0	28	0.0		
	7	75	0.708	23	0.0	26	0.0		
	8	75	10.194	23	10.477				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/12

080701
40 14 23.0 105 48 18.0 3
GRAND LAKE
08049 COLORADO

11EPALES 760109 2111202
0999 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
75/08/26	10 00	0000	11.8	7.6	96	10	6.90	23	0.020K	0.200	0.020K	0.003
	10 00	0005	12.0	7.6		5	6.80	24	0.020K	0.200	0.020K	0.002
	10 00	0018	10.9	7.4		1K	6.65	23	0.020K	0.200K	0.020K	0.002
	10 00	0050	5.4	7.6		1K	6.40	22	0.020K	0.200K	0.020K	0.003
	10 00	0090	2.8	7.0		2	6.30	27	0.020K	0.200K	0.060	0.002
	10 00	0130	1.5			9	6.40	22	0.020K	0.200K	0.110	0.010
	10 00	0170	1.2	5.6		10	6.50	24	0.020K	0.200K	0.120	0.007
	10 00	0220	1.5	4.8		12	6.45	23	0.020K	0.200K	0.160	0.003
75/10/10	13 40	0000	10.7	8.0	168	28	7.30	19	0.020K	0.400	0.020K	0.011
	13 40	0005	10.2	8.0		33	7.30	19	0.020K	0.200K	0.020K	0.004
	13 40	0016	10.1	7.8		35	7.20	18	0.020	0.200	0.020K	0.003
	13 40	0045	9.8	7.6		31	7.15	13	0.020K	0.200K	0.020K	0.003
	13 40	0090	6.3	6.8		26	7.10	13	0.020K	0.200K	0.020K	0.003
	13 40	0135	4.6	6.0		32	6.85	22	0.020K	0.200K	0.120	0.004
	13 40	0180	4.3	6.0		34	6.50	19	0.020K	0.200	0.120	0.004
	13 40	0220	4.3			34	6.80	22	0.020K	0.200K	0.180	0.009

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/08/26	10 00	0000	0.016	5.5	
	10 00	0005	0.013		
	10 00	0018	0.013		
	10 00	0050	0.009		
	10 00	0090	0.009		
	10 00	0130	0.012		
	10 00	0170	0.011		
	10 00	0220	0.009		
75/10/10	13 40	0000	0.023	4.7	
	13 40	0005	0.020		
	13 40	0016	0.016		
	13 40	0045	0.019		
	13 40	0090	0.010		
	13 40	0135	0.010		
	13 40	0180	0.011		
	13 40	0220	0.012		

K* VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/03/12

080702
40 14 41.0 105 49 07.0 3
GRAND LAKE
08049 COLORADO

11EPALES 760109 2111202
0125 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
75/08/26	10 55	0000	12.5	7.8	102	7	6.75	16	0.020K	0.200	0.020	0.002
	10 55	0005	11.9	7.6		4	6.60	14	0.020K	0.200	0.020K	0.002
	10 55	0018	11.7	7.4		1	6.50	13	0.020K	0.200	0.020K	0.002K
	10 55	0050	5.1	7.8		1K	6.40	13	0.020K	0.200K	0.020	0.002K
	10 55	0090	2.9	6.8		6	6.30	21	0.020K	0.200K	0.080	0.002K
	10 55	0121	2.5	5.8		7	6.35	18	0.020K	0.300	0.090	0.002
75/10/10	14 20	0000	10.5	7.8	168	37	7.10	22	0.020K	0.200	0.020K	0.004
	14 20	0005	10.4	7.8		34	7.25	20	0.020K	0.300	0.020K	0.003
	14 20	0016	10.1	7.8		37	7.20	18	0.020K	0.200K	0.020K	0.007
	14 20	0040	9.3	7.2		37	7.15	16	0.020K	0.200K	0.020K	0.004
	14 20	0080	6.4	6.0		36	7.00	16	0.020K	0.300	0.080	0.003
	14 20	0120	5.3	6.0		49	6.90	18	0.020K	0.200	0.100	0.004

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/08/26	10 55	0000	0.012	5.4	
	10 55	0005	0.013		
	10 55	0018	0.011		
	10 55	0050	0.008		
	10 55	0090	0.008		
	10 55	0121	0.236		
75/10/10	14 20	0000	0.018	4.0	
	14 20	0005	0.017		
	14 20	0016	0.023		
	14 20	0040	0.039		
	14 20	0080	0.063		
	14 20	0120	0.112		

K* VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

081301
40 14 41.0 105 49 56.0 3
SHADOW MOUNTAIN LAKE
08049 COLORADO

11EPALES 760109 2111202
0009 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
75/08/26	11 30	0000	12.2	7.6	60	23	6.65	22	0.020K	0.300	0.020K	0.002
	11 30	0006	12.0	7.8		24	6.80	23	0.020K	0.400	0.020K	0.003
75/10/10	14 55	0000	10.0	8.6	60	42	7.30	29	0.020K	0.200K	0.020K	0.004
	14 55	0005	10.0	9.0		42	7.60	31	0.020K	0.200K	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
75/08/26	11 30	0000	0.075	8.1	
	11 30	0006	0.022		
75/10/10	14 55	0000	0.028	4.3	
	14 55	0005	0.020		

K* VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

081302
40 12 52.0 105 51 00.0 3
SHADOW MOUNTAIN LAKE
08049 COLORADO

11EPALES 760109 2111202
0012 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
75/08/26	12 00	0000	12.1	7.6	75	26	7.25	26	0.020K	0.300	0.020K	0.003
	12 00	0005	11.7	7.6		25	7.00	25	0.020K	0.400	0.020K	0.002
	12 00	0009	11.5	7.6		24	6.80	26	0.020K	0.400	0.020K	0.003
75/10/10	15 10	0000	9.0	8.0	96	40	7.50	27	0.020K	0.200K	0.020K	0.003
	15 10	0005	8.7	7.8		43	7.40	28	0.020K	0.200K	0.020K	0.002
	15 10	0012	8.9	8.0		41	7.40	29	0.020K	0.200K	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
75/08/26	12 00	0000	0.019	6.5	
	12 00	0005	0.017		
	12 00	0009	0.026		
75/10/10	15 10	0000	0.022	6.0	
	15 10	0005	0.021		
	15 10	0012	0.023		

K* VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

081303
40 12 28.0 105 50 31.0 3
SHADOW MOUNTAIN LAKE
08049 COLORADO

11EPALES 760109 2111202
0024 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
75/08/26	12 20	0000	9.2	7.2	75	26	7.20	26	0.020K	0.300	0.050	0.002
	12 20	0005	8.0	6.6		24	6.60	21	0.020K	0.300	0.060	0.003
	12 20	0015	8.1	6.6		23	6.80	21	0.020K	0.400	0.060	0.003
	12 20	0021	7.9	6.4		23	6.70	24	0.020K	0.300	0.070	0.003
75/10/10	15 25	0000	8.9	6.0	72	39	7.20	30	0.020K	0.200K	0.070	0.002
	15 25	0005	8.4	5.8		40	7.10	28	0.020K	0.200K	0.080	0.003
	15 25	0015	8.1	6.0		41	7.05	27	0.020K	0.200K	0.080	0.002
	15 25	0024	8.1	6.0		40	7.05	29	0.020K	0.200K	0.080	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
75/08/26	12 20	0000	0.016	3.9	
	12 20	0005	0.017		
	12 20	0015	0.019		
	12 20	0021	0.018		
75/10/10	15 25	0000	0.020	5.4	
	15 25	0005	0.020		
	15 25	0015	0.020		
	15 25	0024	0.022		

K* VALUE KNOWN TO BE LESS
THAN INDICATED

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/08/12

0807A1
40 14 45.0 105 49 42.0 4
SHADOW MTN LAKE INLET
08 7.5 SHADOW MTN.
O/GRAND LAKE 091091
OVERFLOW AT GRAND LAKE 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
74/11/16	11 05		0.008	0.400	0.015	0.005	0.010
75/01/18	11 05		0.096	0.600	0.024	0.008K	0.010K
75/02/23	10 40		0.120	0.200	0.064	0.008K	0.010K
75/05/19	14 00		0.040		0.020	0.005K	0.030
75/06/15	13 55		0.040	0.300	0.015	0.015	0.020
75/06/28	14 05		0.030	0.300	0.020	0.005	0.020
75/07/12	15 10		0.025	0.250	0.020	0.005K	0.010K
75/07/26	11 15		0.005	0.250	0.032	0.015	0.040
75/08/23	13 50		0.005	0.300	0.005	0.005K	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

0807A2
40 15 05.0 105 48 50.0 4
NORTH INLET
08 7.5 GRAND LAKE
T/GRAND LAKE 110392
SEC RD BRDG JUST E OF CITY OF GRAND LAKE
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
74/09/28	15 25		0.016	0.500	0.015	0.005K	0.010
74/11/16	11 15		0.048	0.400	0.010	0.005K	0.010K
74/12/14			0.754	1.400	0.128	0.056	0.080
75/05/19	15 00		0.060	0.450	0.015	0.005	0.020
75/06/15	13 30		0.020	1.050	0.040	0.005	0.010
75/06/28	14 15		0.025	0.350	0.010	0.020	0.020
75/07/12	15 25		0.015		0.020	0.005K	0.010
75/07/26	11 25		0.010	0.100	0.010	0.005K	0.010
75/08/23	14 10		0.005	0.200	0.005K	0.005K	0.010K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

0807B1
40 14 10.0 105 48 08.0 4
ECHO CREEK
08 7.5 SHADOW MTN
T/GRAND LAKE 091091
BNK 100 FT S END SEC RD .4 MI S W PORTAL
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
74/09/28	15	50	0.020	0.600	0.020	0.005K	0.005K
74/11/16	11	45	0.080	0.500	0.015	0.005K	0.010K
75/05/19	16	00	0.060	0.850	0.020	0.005K	0.020
75/06/15	14	00	0.025	0.350	0.020	0.005K	0.010K
75/06/28	14	23	0.025	0.350	0.025	0.020	0.020
75/07/12	15	45	0.020		0.015	0.005K	0.010
75/07/26	11	50	0.005	0.050K	0.005	0.005K	0.005K
75/08/23	14	30	0.010	0.300	0.010	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0813A1
40 12 25.0 105 50 27.0 4
COLORADO RIVER
08 7.5 SHADOW MTN
O/SHADOW MOUNTAIN LAKE 091091
BELO DAM 200 FT E OF SEC 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
74/09/28	11 55		0.056	0.400	0.005	0.005K	0.010
74/11/16	09 45		0.040	0.500	0.005	0.005K	0.010K
74/12/14	12 00		2.160	1.000	0.152	0.032	0.040
75/01/19	10 00		0.104	0.500	0.016	0.008K	0.010K
75/02/23	09 30		0.112	0.100	0.024	0.008K	0.010
75/03/29	10 00		0.120	0.600	0.020	0.010	0.015
75/05/19	11 00		0.040	2.400	0.052	0.020	0.040
75/06/11	10 30		0.002	0.800	0.035	0.015	
75/06/28	13 00		0.005	0.550	0.025	0.005	0.010K
75/07/12	14 25		0.010	0.200	0.010	0.005K	0.010
75/07/26	10 15		0.010	0.150	0.005	0.005K	0.010K
75/08/23	13 00		0.070	0.800	0.010	0.005K	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0813A2
40 13 10.0 105 51 28.0 4
COLORADO RIVER
08 7.5 SHADOW MTN
T/SHADOW MOUNTAIN LAKE 091091
RT 34 BRDG 2.7 MI SW OF CTY OF GRAND LK
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
74/09/28	12 45		0.012	0.500	0.020	0.005	0.005
74/11/16	10 10		0.016	1.000	0.035	0.015	0.015
74/12/14	13 30		3.990	1.900	0.144	0.064	0.080
75/01/18	10 20		0.048	0.600	0.024	0.008	0.010K
75/02/23	10 35		0.048	1.500	0.024	0.008K	0.010K
75/03/29	10 20		0.045	1.000	0.015	0.005	0.010K
75/05/05	13 40		0.040	0.750	0.020	0.010	0.020
75/05/19	12 00		0.050	1.100	0.030		0.060
75/06/15	11 15		0.005	0.500	0.015	0.005	0.050
75/06/28	13 20		0.005	0.250	0.020	0.005K	0.060
75/07/23	14 45		0.005	0.200	0.022	0.005K	0.030
75/07/26	10 30		0.010	0.050	0.005K	0.010	0.030
75/08/23	13 25		0.005	0.100	0.005K	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

081361
40 14 45.0 105 49 42.0 4
OUTLET OF GRAND LAKE
08 7.5 SHADOW MTN
T/SHADOW MOUNTAIN LAKE 091091
OVERFLOW AT DAM .25 MI E HILLTOP RNGER ST
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
74/09/28	15 00		0.016	0.400	0.005	0.005K	0.020
74/11/16	11 00		0.008	0.500	0.020	0.005K	0.020
74/12/14			0.375	0.500	0.016	0.016	0.030
75/01/18	11 00		0.104	0.400	0.020	0.008K	0.010
75/02/23	10 00		0.112	0.400	0.032	0.008K	0.010K
75/05/19	14 10		0.010	1.650	0.005K	0.005	0.020
75/06/15	13 50		0.040	0.750	0.020	0.010	0.020
75/06/28	13 55		0.030	0.750	0.035	0.005K	0.040
75/07/23	15 10		0.025	0.250	0.020	0.005K	0.020
75/07/26	11 10		0.010	0.200	0.035	0.010	0.040
75/08/23	13 45		0.010	0.350	0.005K	0.005K	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0813C1
40 15 07.0 105 50 00.0 4
LITTLE COLUMBINE CREEK
08 7.5 GRAND LAKE
T/SHADOW MOUNTAIN LAKE 110392
ST RT 278 BRDG 300 FT E OF I34 JCT
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
74/09/28	13 50		0.012	0.300	0.005	0.010	0.025
74/11/16	10 40		0.032	0.500	0.015	0.015	0.015
75/03/29	11 15		0.060	0.250	0.015	0.015	0.020
75/05/19	12 45		0.015	0.800	0.035	0.010	0.050
75/06/15	13 10		0.005	0.400	0.015	0.020	0.040
75/06/28	13 40		0.025	0.300	0.030	0.020	0.050
75/07/23	14 55		0.010	0.250	0.045	0.020	0.030
75/07/26	11 00		0.015	0.150	0.005	0.015	0.030
75/08/23	13 30		0.005	0.200	0.005K	0.010	0.030

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

081301
40 12 25.0 105 50 58.0 4
GRANBY PUMP CANAL
08 7.5 SHADOW MTN
T/SHADOW MOUNTAIN LAKE 091091
SEC RD BRDG 1 MI SE RT 34 JCT
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
74/09/28	12 30		0.104	0.400	0.010	0.005K	0.015
74/11/16	10 00		0.064	0.500	0.020	0.005K	0.010
74/12/14	12 30		0.600	1.800	0.176	0.048	0.060
75/01/18	10 10		0.104	0.800	0.016	0.008K	0.010K
75/02/23	09 45		0.104	0.200	0.008	0.008K	0.010K
75/03/29	10 15		0.115	1.200	0.025	0.005	0.010
75/04/19	11 30		0.135	1.550	0.030	0.010	0.015
75/05/19	11 15		0.015	1.750	0.030	0.010	0.030
75/06/15	10 50		0.005	1.050	0.015	0.005	0.010
75/06/28	13 05		0.015	0.800	0.050	0.010	0.040
75/07/23	14 35		0.005	0.350	0.040	0.005K	0.040
75/07/26	10 20		0.005	0.350	0.005K	0.005K	0.020
75/08/23	13 10		0.055	1.430	0.015	0.005K	0.010K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0813E1
40 19 05.0 105 50 42.0 4
ONAHU CREEK
08 7.5 GRAND LAKE
T/SHADOW MOUNTAIN LAKE 110392
TRAIL RDG RD XING 4.5 M FRM ROCKY MTN PK
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
74/09/28	14 30		0.016	0.400	0.010	0.005	0.015
74/11/16	10 29		0.048	0.500	0.015	0.005	0.010K
75/05/19	12 45		0.300	2.800	0.175		0.040
75/06/15	12 20		0.005	0.300	0.020	0.010	0.030
75/06/28	13 35		0.015	0.550	0.030	0.005	0.020
75/07/23	16 45		0.005	0.150	0.030	0.010	0.030
75/07/26	10 48		0.010	0.100	0.005K	0.005	0.010
75/08/23	15 00		0.005	0.050K	0.005K	0.005K	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/0[illegible]/24

0813F1
40 18 25.0 105 50 27.0 4
UNNAMED CREEK
0.8 7.5 GRAND LAKE
T/SHADOW MOUNTAIN LAKE 110392
TRAIL RDG RD XING NEAR GREEN MTN RANCH
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
74/09/28	14 15		0.00[illegible]	0.300	0.010	0.005K	0.005
75/05/19	13 00		0.200	1.250	0.025	0.036	0.050
75/06/15	11 45		0.00[illegible]	0.450	0.020	0.005	0.020
75/06/28	13 10		0.01[illegible]	0.300	0.025	0.005K	0.020
75/07/23	16 40		0.01[illegible]	0.300	0.075	0.005K	0.020
75/07/26	10 40		0.01[illegible]	0.150	0.005K	0.005	0.010K
75/08/23	14 50		0.01[illegible]	0.150	0.005K	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

081321 AS081321 P002000
40 14 55.0 105 49 45.0 4
GRAND LAKE
08 7.5 SHADOW MT.
U/SHADOW MOUNTAIN LAKE 091091
SHADOW MOUNTAIN LAKE
11EPALES 2141204
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	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/02/14	11 00								
CP(T)-			0.160	1.200	0.410	0.340	0.460	0.500	0.500
75/02/14	16 00								
75/03/17	11 00								
CP(T)-			0.160	1.000K	0.350	0.230	0.540	0.500	0.500
75/03/17	16 00								
75/04/11	11 00								
CP(T)-			0.640	1.400	0.190	0.230	0.420	0.500	0.500
75/04/11	16 00								
75/05/02	11 00								
CP(T)-			0.300	2.300	0.590	0.170	0.460	0.500	0.500
75/05/02	16 00								
75/05/28	11 00								
CP(T)-			0.300	4.900	2.800	0.480	1.300	0.500	0.500
75/05/28	16 00								
75/06/17	10 00								
CP(T)-			0.150	10.500	5.250	1.150	2.900	0.250	0.250
75/06/17	15 00								
75/07/09	11 00								
CP(T)-			0.050	17.500	6.400	1.750	4.000	0.300	0.300
75/07/09	15 00								
75/07/28	10 00								
CP(T)-			0.025	16.500	10.000	3.600	4.900	0.360	0.300
75/07/28	14 00								
75/08/19	10 00								
CP(T)-			0.075	24.500	8.150	3.100	5.325	0.250	0.280
75/08/19	14 00								
75/09/08	11 00								
CP(T)-			0.025	14.250	7.100	2.100	3.250	0.200	0.250
75/09/08	15 00								
75/10/01	10 00								
CP(T)-			3.800	11.000	3.400	2.700	3.300	0.100	0.130
75/10/01	15 00								
75/10/21	11 00								
CP(T)-			2.200	4.600	0.059	0.740	1.400	0.288	0.250

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

081321 AS081321 P002000
40 14 55.0 105 49 45.0 4
GRAND LAKE
08 7.5 SHADOW MT.
D/SHADOW MOUNTAIN LAKE 091091
SHADOW MOUNTAIN LAKE
11EPALES 2141204
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	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/11/11	11	00	0.125	5.000	0.900	0.460	1.500	0.342	0.400

K VALUE KNOWN TO BE
LESS THAN INDICATED