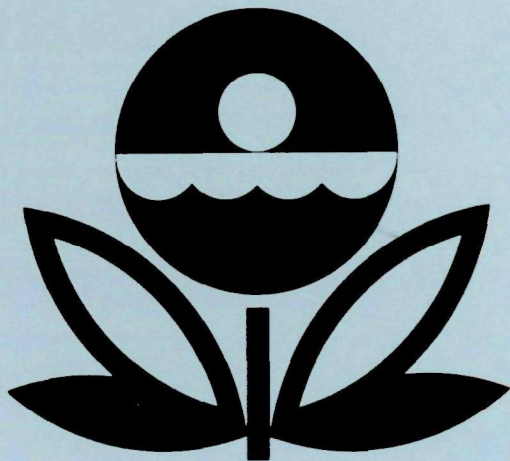


**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES**



REPORT
ON
MARY RONAN LAKE
LAKE COUNTY
MONTANA
EPA REGION VIII
WORKING PAPER No. 796

**CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON
and
ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA**

REPORT
ON
MARY RONAN LAKE
LAKE COUNTY
MONTANA
EPA REGION VIII
WORKING PAPER No. 796

WITH THE COOPERATION OF THE
MONTANA DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES
AND THE
MONTANA NATIONAL GUARD.
MAY, 1977

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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 nation-wide 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) express sincere appreciation to the Montana Department of Health and Environmental Sciences for professional involvement, to the Montana National Guard for conducting the tributary sampling phase of the Survey, and to those Montana wastewater treatment plant operators who voluntarily provided effluent samples.

The staff of the Water Quality Bureau 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 John J. Womack, the Adjutant General of Montana, and Project Officer Major William Yeager, who directed the volunteer efforts of the Montana National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF MONTANA

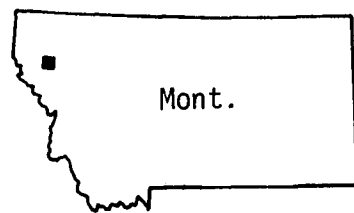
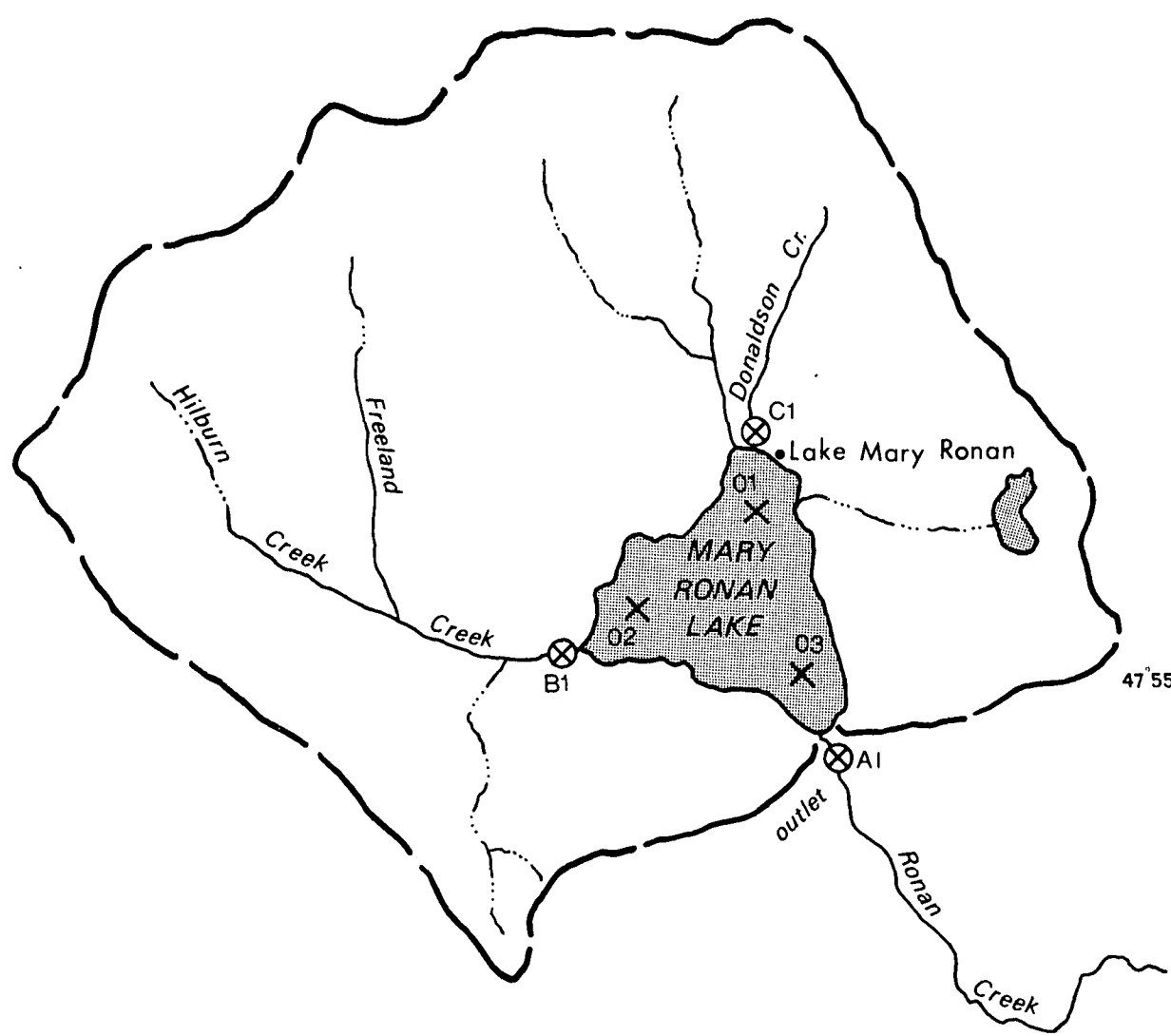
<u>LAKE NAME</u>	<u>COUNTY</u>
Canyon Ferry	Broadwater, Lewis and Clark
Clark Canyon	Beaverhead
Flathead	Flathead, Lake
Georgetown	Deer Lodge, Granite
Hebgen	Gallatin
Koocanusa	Lincoln, MT; British Columbia, Can.
Mary Ronan	Lake
McDonald	Flathead
Nelson	Phillips
Seeley	Missoula
Swan	Lake
Tally	Flathead
Tiber	Liberty, Toole
Tongue River	Big Horn
Whitefish	Flathead
Yellowtail	Carbon, Bighorn, MT; Bighorn, WY

114°30'

114°25'

114°20'

48°00'

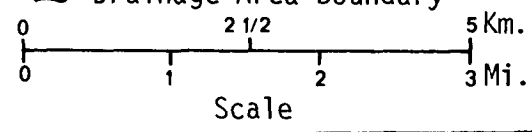


Mont.

Map Location

MARY RONAN LAKE

- ⊗ Tributary Sampling Site
- × Lake Sampling Site
- - - Drainage Area Boundary



47°50'

MARY RONAN LAKE

STORET NO. 3007

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Mary Ronan Lake is meso-eutrophic. It ranked seventh in overall trophic quality when the 15 Montana lakes and reservoirs sampled in 1975 were compared using a combination of six lake parameters*. Seven of the water bodies had less median total phosphorus, none had less and four had the same median inorganic nitrogen, six had less median dissolved orthophosphorus, ten had less mean chlorophyll a, and nine had greater mean Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at station 1 in September.

Survey limnologists reported the occurrence of macrophytes at station 1 and observed surface concentrations of algae in October.

B. Rate-Limiting Nutrient:

Due to significant nutrient changes in the algal assay samples during shipment from the field to the laboratory, the results are not considered representative of conditions in the lake at the times of sampling.

The lake data indicate nitrogen limitation all four sampling times.

* See Appendix A.

C. Nutrient Controllability:

1. Point sources--No known municipal or industrial wastewater treatment plants impacted the lake during the sampling year. Septic tanks serving lakeshore dwellings were estimated to have contributed 1.3% of the total phosphorus load, but a shoreline survey would be necessary to determine the actual significance of those sources.

The present phosphorus loading of $0.18 \text{ g/m}^2/\text{yr}$ is a little more than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 12).

2. Non-point sources--Non-point sources, including direct precipitation, accounted for 98.7% of the total phosphorus load to the lake during the sampling year. Freeland Creek contributed 29.9% of the total load; Donaldson Creek, 27.7%; and the ungaged tributaries added an estimated 31.3% of the total.

The phosphorus export rates of Freeland and Donaldson creeks were 11 and $54 \text{ kg/km}^2/\text{yr}$, respectively (see page 11). The cause of the much higher rate of Donaldson Creek is not known, but it may have resulted from insufficient sampling.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS[†]A. Morphometry^{††}:

1. Surface area: 6.15 kilometers².
2. Mean depth: 8.5 meters.
3. Maximum depth: 14.3 meters.
4. Volume: 52.275×10^6 m³.
5. Mean hydraulic retention time: 17.4 years (based on outflow).

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

1. Tributaries -

<u>Name</u>	<u>Drainage area (km²)*</u>	<u>Mean flow (m³/sec)*</u>
Freeland Creek	31.8	0.060
Donaldson Creek	5.7	0.046
Minor tributaries & immediate drainage -	<u>33.1</u>	<u>0.004</u>
Totals	70.6	0.110

2. Outlet -

Ronan Creek	76.8**	0.095
-------------	--------	-------

C. Precipitation***:

1. Year of sampling: 51.4 centimeters.
2. Mean annual: 59.0 centimeters.

† Table of metric conversions--Appendix B.

†† Surface area determined by planimetry; mean depth from Horpestad (1975).

* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".

** Includes area of lake.

*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Mary Ronan Lake was sampled four 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 three stations on the lake in June, July, and September (two stations in October) and from a number of depths at each station (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, third 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 11.0 meters at station 1, 11.6 meters at station 2, and 7.6 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 MARY RONAN LAKE
STORET CODE 3007

1ST SAMPLING (6/ 2/75)

2ND SAMPLING (7/28/75)

3RD SAMPLING (9/ 5/75)

3 SITES

3 SITES

3 SITES

PARAMETER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
TEMP (C)	6.8 - 13.3	10.4	10.4	8.8 - 20.4	17.2	19.8	13.3 - 17.1	16.1	16.3
DISS OXY (MG/L)	5.6 - 10.4	9.3	10.0	2.0 - 9.6	7.1	7.9	0.8 - 9.0	7.6	8.7
CNDCTVY (MCROMO)	86. - 111.	95.	94.	90. - 125.	111.	113.	103. - 123.	108.	107.
PH (STAND UNITS)	7.5 - 8.4	8.1	8.1	7.5 - 8.8	8.5	8.8	7.8 - 8.8	8.5	8.7
TOT ALK (MG/L)	56. - 84.	74.	82.	59. - 67.	62.	61.	64. - 69.	67.	67.
TOT P (MG/L)	0.018 - 0.029	0.023	0.022	0.006 - 0.021	0.014	0.012	0.015 - 0.090	0.030	0.019
ORTHO P (MG/L)	0.005 - 0.018	0.012	0.013	0.003 - 0.013	0.005	0.004	0.002 - 0.014	0.004	0.003
NO2+NO3 (MG/L)	0.020 - 0.020	0.020	0.020	0.020 - 0.020	0.020	0.020	0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.020 - 0.040	0.024	0.020	0.020 - 0.050	0.028	0.030	0.020 - 0.020	0.020	0.020
KJEL N (MG/L)	0.400 - 0.600	0.523	0.500	0.300 - 0.700	0.582	0.600	0.300 - 0.900	0.425	0.350
INORG N (MG/L)	0.040 - 0.060	0.044	0.040	0.040 - 0.070	0.048	0.050	0.040 - 0.040	0.040	0.040
TOTAL N (MG/L)	0.420 - 0.620	0.543	0.520	0.320 - 0.720	0.602	0.620	0.320 - 0.920	0.445	0.370
CHLRPYL A (UG/L)	5.0 - 5.7	5.4	5.5	3.2 - 4.7	3.7	3.2	0.9 - 1.1	1.0	1.0
SECCHI (METERS)	3.4 - 3.4	3.4	3.4	3.8 - 6.5	5.5	6.1	1.5 - 2.3	1.8	1.5

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR MARY RONAN LAKE
STORET CODE 3007

4TH SAMPLING (10/22/75)

PARAMETER	RANGE	2 SITES	
		MEAN	MEDIAN
TEMP (C)	10.9 - 11.0	11.0	11.0
DISS OXY (MG/L)	7.2 - 7.9	7.5	7.5
CNDCTVY (MCROMO)	102. - 114.	105.	103.
PH (STAND UNITS)	7.3 - 7.6	7.4	7.4
TOT ALK (MG/L)	69. - 71.	70.	70.
TOT P (MG/L)	0.038 - 0.079	0.054	0.054
ORTHO P (MG/L)	0.006 - 0.012	0.008	0.008
NO2+NO3 (MG/L)	0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.080 - 0.090	0.082	0.080
KJEL N (MG/L)	0.400 - 1.000	0.587	0.550
INORG N (MG/L)	0.100 - 0.110	0.102	0.100
TOTAL N (MG/L)	0.420 - 1.020	0.607	0.570
CHLRPYL A (UG/L)	4.9 - 16.2	10.5	10.5
SECCHI (METERS)	2.1 - 2.1	2.1	2.1

B. Biological Characteristics:

1. Phytoplankton -

<u>Sampling Date</u>	<u>Dominant Genera</u>	<u>Algal Units per ml</u>
06/02/75	1. <u>Dinobryon sp.</u>	2,787
	2. <u>Cryptomonas sp.</u>	190
	3. <u>Microcystis sp.</u>	127
	4. <u>Aphanizomenon sp.</u>	95
	5. <u>Fragilaria sp.</u>	95
	Other genera	<u>126</u>
	Total	3,420
07/28/75	1. <u>Aphanizomenon sp.</u>	245
	2. <u>Crucigenia sp.</u>	163
	3. <u>Cryptomonas sp.</u>	163
	4. <u>Chroomonas sp.</u>	163
	5. <u>Anabaena sp.</u>	82
	Other genera	<u>124</u>
	Total	940
09/05/75	1. <u>Chroomonas sp.</u>	373
	2. <u>Aphanothece sp.</u>	217
	3. <u>Anabaena sp.</u>	155
	4. <u>Cryptomonas sp.</u>	155
	5. <u>Aphanizomenon sp.</u>	93
	Other genera	<u>32</u>
	Total	1,025
10/22/75	1. <u>Aphanizomenon sp.</u>	851
	2. <u>Cryptomonas sp.</u>	675
	3. <u>Microcystis sp.</u>	294
	4. <u>Chroomonas sp.</u>	264
	5. <u>Fragilaria sp.</u>	175
	Other genera	<u>441</u>
	Total	2,700

2. Chlorophyll a -

<u>Sampling Date</u>	<u>Station Number</u>	<u>Chlorophyll a (ug/l)</u>
06/02/75	1	5.0
	2	5.5
	3	5.7
07/28/75	1	3.2
	2	4.7
	3	3.2
09/05/75	1	1.1
	2	0.9
	3	1.0
10/22/75	1	4.9
	2	-
	3	16.2

C. Limiting Nutrient Study:

Due to significant changes in nutrients in the algal assay samples during shipment from the field to the laboratory, the results are not considered representative of conditions in the lake at the time of sampling.

The lake data indicate nitrogen limitation at all sampling times. The mean inorganic nitrogen to orthophosphorus ratios were 4 to 1 in June, 10 to 1 in July and September, and 13 to 1 in October; and nitrogen limitation would be expected.

IV. NUTRIENT LOADINGS (See Appendix E for data)

For the determination of nutrient loadings, the Montana 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 month of June when two samples were collected. Sampling was begun in October, 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 Montana 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 loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station B-1, in kg/km²/year, and multiplying by the ZZ area in km².

No known wastewater treatment plants impacted Mary Ronan Lake during the sampling year.

A. Waste Sources:

1. Known municipal - None
2. Known industrial - None

* See Working Paper No. 175.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

<u>Source</u>	<u>kg P/ yr</u>	<u>% of total</u>
a. Tributaries (non-point load) -		
Freeland Creek	335	29.9
Donaldson Creek	310	27.7
b. Minor tributaries & immediate drainage (non-point load) -	350	31.3
c. Known municipal STP's - None	-	-
d. Septic tanks* -	15	1.3
e. Known industrial - None	-	-
f. Direct precipitation** -	<u>110</u>	<u>9.8</u>
Total	1,120	100.0

2. Outputs -

Lake outlet - Ronan Creek 490

3. Net annual P accumulation - 630 kg.

* Estimate based on 50 lakeshore dwellings; see Working Paper No. 175.

** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

<u>Source</u>	<u>kg N/ yr</u>	<u>% of total</u>
a. Tributaries (non-point load) -		
Freeland Creek	2,665	15.3
Donaldson Creek	4,760	27.4
b. Minor tributaries & immediate drainage (non-point load) -	2,775	16.0
c. Known municipal STP's - None	-	-
d. Septic tanks* -	535	3.1
e. Known industrial - None	-	-
f. Direct precipitation** -	<u>6,640</u>	<u>38.2</u>
Total	17,375	100.0

2. Outputs -

Lake outlet - Ronan Creek 8,520

3. Net annual N accumulation - 8,855 kg.

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

<u>Tributary</u>	<u>kg P/km²/yr</u>	<u>kg N/km²/yr</u>
Freeland Creek	11	84
Donaldson Creek	54	835

* Estimate based on 50 lakeshore dwellings; see Working Paper No. 175.

** 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	0.18	0.10	2.8	1.4

Vollenweider phosphorus loadings
(g/m²/yr) based on mean depth and mean
hydraulic retention time of Mary Ronan Lake:

"Dangerous" (eutrophic loading)	0.14
"Permissible" (oligotrophic loading)	0.07

V. LITERATURE REVIEWED

Horpestad, Abe, 1975. Personal communication (lake morphometry).
MT Dept. of Health & Env. Sci., Helena.

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
3001	CANYON FERRY RESERVOIR	0.047	0.170	442.800	5.816	14.400	0.029
3002	CLARK CANYON RESERVOIR	0.049	0.160	398.750	2.375	12.000	0.027
3003	FLATHEAD LAKE	0.008	0.050	267.833	1.273	9.000	0.004
3004	GEORGETOWN RESERVOIR	0.022	0.040	367.333	6.983	10.200	0.011
3005	HEBGEN RESERVOIR	0.022	0.040	367.700	4.083	13.800	0.020
3006	KOOCANUSA RESERVOIR	0.045	0.100	337.643	2.669	10.400	0.044
3007	MARY RONAN LAKE	0.020	0.040	371.091	4.673	14.200	0.006
3008	MC DONALD LAKE	0.006	0.180	190.667	0.467	6.400	0.002
3009	NELSON RESERVOIR	0.029	0.075	456.750	7.233	11.400	0.007
3010	SEELEY LAKE	0.015	0.040	362.857	2.171	13.200	0.010
3011	SWAN LAKE	0.010	0.050	282.750	3.289	9.600	0.004
3012	TALLY LAKE	0.011	0.050	339.167	2.083	9.200	0.004
3013	TIBER RESERVOIR	0.018	0.180	448.555	2.806	9.600	0.004
3014	TONGUE RIVER RESERVOIR	0.051	0.050	474.111	16.878	13.600	0.008
3016	WHITEFISH LAKE (LOWER)	0.008	0.040	290.000	1.400	7.000	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
3001	CANYON FERRY RESERVOIR	14 (2)	14 (2)	21 (3)	21 (3)	0 (0)	7 (1)	77
3002	CLARK CANYON RESERVOIR	7 (1)	21 (3)	29 (4)	64 (9)	36 (5)	14 (2)	171
3003	FLATHEAD LAKE	89 (12)	61 (8)	93 (13)	93 (13)	86 (12)	75 (9)	497
3004	GEORGETOWN RESERVOIR	39 (5)	79 (10)	50 (7)	14 (2)	57 (8)	29 (4)	268
3005	HEBGEN RESERVOIR	39 (5)	79 (10)	43 (6)	36 (5)	14 (2)	21 (3)	232
3006	KOOCANUSA RESERVOIR	21 (3)	29 (4)	71 (10)	57 (8)	50 (7)	0 (0)	228
3007	MARY RONAN LAKE	50 (7)	96 (13)	36 (5)	29 (4)	7 (1)	57 (8)	275
3008	MC DONALD LAKE	100 (14)	4 (0)	100 (14)	100 (14)	100 (14)	100 (14)	504
3009	NELSON RESERVOIR	29 (4)	36 (5)	7 (1)	7 (1)	43 (6)	50 (7)	172
3010	SEELEY LAKE	64 (9)	96 (13)	57 (8)	71 (10)	29 (4)	36 (5)	353
3011	SWAN LAKE	79 (11)	46 (6)	86 (12)	43 (6)	68 (9)	75 (9)	397
3012	TALLY LAKE	71 (10)	61 (8)	64 (9)	79 (11)	79 (11)	75 (9)	429
3013	TIBER RESERVOIR	57 (8)	4 (0)	14 (2)	50 (7)	68 (9)	75 (9)	268
3014	TONGUE RIVER RESERVOIR	0 (0)	46 (6)	0 (0)	0 (0)	21 (3)	43 (6)	110
3016	WHITEFISH LAKE (LOWER)	89 (12)	79 (10)	79 (11)	86 (12)	93 (13)	93 (13)	519

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3016	WHITEFISH LAKE (LOWER)	519
2	3008	MC DONALD LAKE	504
3	3003	FLATHEAD LAKE	497
4	3012	TALLY LAKE	429
5	3011	SWAN LAKE	397
6	3010	SEELEY LAKE	353
7	3007	MARY RONAN LAKE	275
8	3013	TIBER RESERVOIR	268
9	3004	GEORGETOWN RESERVOIR	268
10	3005	HEBGEN RESERVOIR	232
11	3006	KOOCANUSA RESERVOIR	228
12	3009	NELSON RESERVOIR	172
13	3002	CLARK CANYON RESERVOIR	171
14	3014	TONGUE RIVER RESERVOIR	110
15	3001	CANYON FERRY RESERVOIR	77

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 MONTANA

08/16/76

LAKE CODE 0007 MARY RONAN LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 39.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS)												MEAN
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
3007A1	76.8	0.0	0.0	0.006	0.057	0.170	0.340	0.283	0.255	0.008	0.006	0.006	0.0	0.095
3007B1	31.8	0.0	0.0	0.003	0.014	0.425	0.142	0.085	0.028	0.008	0.003	0.003	0.003	0.060
3007C1	5.7	0.0	0.0	0.0	0.023	0.340	0.085	0.042	0.028	0.014	0.006	0.006	0.0	0.046
3007ZZ	39.3	0.0	0.0	0.0	0.0	0.0	0.028	0.014	0.0	0.0	0.0	0.0	0.0	0.004

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 39.1
SUM OF SUB-DRAINAGE AREAS = 76.8

TOTAL FLOW IN = 1.30
TOTAL FLOW OUT = 1.13

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3007A1	10	74	0.006	5	0.006				
	11	74	0.003	2	0.006				
	12	74	0.0	7	0.003				
	1	75	0.0						
	2	75	0.0						
	3	75	0.003						
	4	75	0.028						
	5	75	0.156						
	6	75	0.283	5	0.425	10	0.425		
	7	75	0.269	12	0.283				
	8	75	0.241	20	0.283				
	9	75	0.008	6	0.003				
3007B1	10	74	0.003	5	0.003				
	11	74	0.003	2	0.003				
	12	74	0.003	7	0.014				
	1	75	0.0						
	2	75	0.0						
	3	75	0.003						
	4	75	0.014						
	5	75	0.340						
	6	75	0.085	5	0.113	10	0.085		
	7	75	0.057	12	0.057				
	8	75	0.028	20	0.028				
	9	75	0.006	5	0.003				

TRIBUTARY FLOW INFORMATION FOR MONTANA

08/16/75

LAKE CODE 3007 MARY RONAN LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3007C1	10	74	0.006	5	0.006				
	11	74	0.003	2	0.006				
	12	74	0.0	7	0.142				
	1	75	0.0	4	0.0				
	2	75	0.0	1	0.0				
	3	75	0.0						
	4	75	0.014	6	0.0				
	5	75	0.255						
	6	75	0.057	5	0.028	10	0.028		
	7	75	0.037						
	8	75	0.028	20	0.028				
	9	75	0.014	6	0.014				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/05

300701
47 56 15.0 114 23 45.0 3
MARY RONAN LAKE
30047 MONTANA

130291

11EPALES 2111202
0040 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 CONDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CAC03 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS URTHO MG/L P
75/06/02	14 00	0000	13.3	10.0	132	100	8.10	83	0.020	0.500	0.020K	0.013
	14 00	0005	13.2	10.4		98	8.05	82	0.020	0.500	0.020K	0.013
	14 00	0015	10.7	10.4		93	8.10	82	0.020	0.600	0.020K	0.006
	14 00	0025	10.1	10.4		90	8.05	84	0.020	0.500	0.020K	0.005
	14 00	0036	7.0	7.0		111	8.20	83	0.020K	0.600	0.020K	0.012
75/07/28	11 40	0000	20.4	8.2	254	112	8.80	61	0.030	0.600	0.020K	0.005
	11 40	0005	20.2	9.0		119	8.80	62	0.030	0.700	0.020K	0.004
	11 40	0029	10.0			90	7.70	63	0.030	0.300	0.020K	0.004
75/09/05	12 50	0000	17.1	8.8	90	109	8.60	68	0.020K	0.300	0.020K	0.004
	12 50	0005	16.6	8.8		107	8.70	68	0.020K	0.300	0.020K	0.004
	12 50	0025	15.8	7.4		105	8.30	64	0.020K	0.400	0.020K	0.003
	12 50	0031	13.3	0.8		123	7.80	68	0.020	0.900	0.020K	0.014
75/10/22	16 00	0000	11.0	7.8	84	113	7.30	70	0.080	0.400	0.020K	0.008
	16 00	0005	11.0	7.4		103	7.35	71	0.080	0.400	0.020K	0.009
	16 00	0015	11.0	7.3		103	7.40	71	0.080	0.400	0.020K	0.008
	16 00	0032	10.9	7.2		114	7.40	69	0.090	0.800	0.020K	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/06/02	14 00	0000	0.019	5.0	
	14 00	0005	0.023		
	14 00	0015	0.022		
	14 00	0025	0.021		
	14 00	0036	0.029		
75/07/28	11 40	0000	0.012	3.2	
	11 40	0005	0.011		
	11 40	0029	0.018		
75/09/05	12 50	0000	0.022	1.1	
	12 50	0005	0.017		
	12 50	0025	0.044		
	12 50	0031	0.090		
75/10/22	16 00	0000	0.038	4.9	
	16 00	0005	0.042		
	16 00	0015	0.039		
	16 00	0032	0.058		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/08/05

300702
47 55 23.0 114 24 52.0 3
MARY KONAN LAKE
30047 MONTANA

130291

11EPALES 2111202
0042 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 CONDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CAC03 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
75/06/02	14 30	0000	13.2	9.8	132	100	8.20	84	0.020	0.400	0.020K	0.007
	14 30	0005	12.8	10.0		98	8.30	83	0.030	0.600	0.020K	0.014
	14 30	0018	9.8	5.6		91	7.50	84	0.020	0.500	0.020K	0.012
	14 30	0038	6.8	9.4		86	8.40	56	0.030	0.500	0.020	0.018J
75/07/28	11 20	0000	20.2	7.8	240	119	8.80	61	0.020	0.600	0.020K	0.003
	11 20	0005	20.0	2.0		113	8.80	61	0.030	0.600	0.020K	0.004
	11 20	0020	14.3	7.8		103	8.50	59	0.020	0.600	0.020K	0.005
	11 20	0034	8.8	2.0		92	7.50	63	0.050	0.700	0.020K	0.013K
75/09/05	13 15	0000	16.9	8.8	60	109	8.60	65	0.020K	0.400	0.020K	0.003
	13 15	0005	17.0	9.0		109	8.75	66	0.020K	0.400	0.020K	0.003
	13 15	0018	16.7	8.8		107	8.70	65	0.020K	0.400	0.020K	0.002
	13 15	0030	15.2	5.2		105	8.15	69	0.020	0.300	0.020K	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/06/02	14 30	0000	0.018	5.5	
	14 30	0005	0.020		
	14 30	0018	0.029		
	14 30	0038	0.018		
75/07/28	11 20	0000	0.012	4.7	
	11 20	0005	0.021		
	11 20	0020	0.019		
	11 20	0034	0.006		
75/09/05	13 15	0000	0.020	0.9	
	13 15	0005	0.018		
	13 15	0018	0.017		
	13 15	0030	0.029		

K* VALUE KNOWN TO BE LESS
THAN INDICATED

J* VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 76/08/05

300703
47 55 03.0 114 23 20.0 3
MARY RONAN LAKE
30047 MONTANA

130291

11EPALES 2111202
0026 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 CONDUCTIVY FIELD MICROMHO	00400 PH SU	00410 T ALK CAC03 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
75/06/02	14 50	0000	12.0	10.2	132	98	8.40	63	0.040	0.500	0.020	0.018
	14 50	0005	10.4	10.0		94	8.30	61	0.030	0.500	0.020K	0.013
	14 50	0015	7.9	9.4		88	7.75	59	0.020K	0.500	0.020K	0.012
	14 50	0022	7.4	8.2		86	7.60	58	0.020K	0.600	0.020K	0.013
75/07/28	11 00	0000	19.8	7.8	150	125	8.70	67	0.020	0.600	0.020	0.005
	11 00	0005	19.8	8.0		123	8.80	67	0.020	0.600	0.020K	0.004
	11 00	0015	19.5	8.4		115	8.80	59	0.030	0.500	0.020	0.004
	11 00	0020	15.7	9.6		105	8.70	59	0.030	0.600	0.020K	0.004
75/09/05	13 30	0000	16.5	8.8	60	107	8.70	68	0.020K	0.300	0.020K	0.003
	13 30	0005	16.2	8.6			8.75	68	0.020K	0.300	0.020K	0.002K
	13 30	0018	15.8	8.6		105	8.75	66	0.020K	0.300	0.020K	0.004
	13 30	0025	15.8	8.2		103	8.70	65	0.020K	0.800	0.020K	0.004
75/10/22	15 15	0000	11.0	7.6	84	102	7.50	69	0.080	0.600	0.020K	0.012
	15 15	0005	11.0	7.6		103	7.60	69	0.080	0.600	0.020K	0.009
	15 15	0015	11.0	7.9		102	7.55	70	0.080	0.500	0.020K	0.007
	15 15	0022	10.9	7.4		102	7.50	71	0.090	1.000	0.020K	0.006

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/06/02	14 50	0000	0.029	5.7	
	14 50	0005	0.023		
	14 50	0015	0.020		
	14 50	0022	0.024		
75/07/28	11 00	0000	0.011	3.2	
	11 00	0005	0.012		
	11 00	0015	0.013		
	11 00	0020	0.019		
75/09/05	13 30	0000	0.016	1.0	
	13 30	0005	0.015		
	13 30	0018	0.017		
	13 30	0025	0.052		
75/10/22	15 15	0000	0.079	16.2	
	15 15	0005	0.063		
	15 15	0015	0.050		
	15 15	0022	0.067		

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/08/05

3007A1
47 54 18.0 114 22 50.0 4
RONAN CREEK
30 7.5 MRY RONAN LK
O/MARY RONAN LAKE 130291
UNMPRVD RD XING 3.5 MI WNW OF PROCTOR
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
74/10/02	10 25		0.016	1.600	0.135	0.005	0.030
74/10/05	12 05		0.016	0.700	0.010	0.005K	0.020
74/12/07	12 45		0.008	0.600	0.015	0.005K	0.010
75/06/05	12 00		0.010	0.800	0.020	0.015	0.050
75/06/10	18 45		0.005	1.050	0.025	0.005	0.050
75/07/12	14 30		0.005	0.700	0.055	0.010	0.070
75/08/20	11 00		0.005	0.850	0.040	0.022	0.060
75/09/06	11 30		0.005	0.550	0.025	0.005K	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

300781
47 55 10.0 114 25 25.0 4
FREELAND CREEK
30 7.5 MRY RONAN LK
T/MARY RONAN LAKE 130291
UNMPRVD RD XING 6 MI WNW OF PROCTOR
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
74/10/02	10 45		0.008	0.400	0.040	0.005K	0.010K
74/10/05	12 30		0.012	0.300	0.010	0.005K	0.010
74/12/07	13 00		0.008	0.200	0.015	0.010	0.020
75/06/05	14 15		0.005	0.600	0.030	0.025	0.050
75/06/10	10 45		0.005	0.300	0.010	0.020	0.050
75/07/12			0.015	0.250	0.025	0.015	0.040
75/08/20	11 00		0.005	0.500	0.025	0.030	0.110
75/09/05	12 00		0.010	0.400	0.025	0.010	0.050

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

3007C1
47 56 36.0 114 23 55.0 4
DONALDSON CREEK
30 7.5 MRY RONAN LK
T/MARY RONAN LAKE 130291
UNMPRVD RD XING .2 M W VLG OF LK MRY RON
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
74/10/02	09 45		0.008	0.700	0.020	0.005	0.010K
74/10/05	11 05		0.012	0.150	0.007	0.005	0.020
74/12/07	12 15		0.008	0.400	0.015	0.005K	0.010K
75/06/05	18 00		0.005	0.750	0.010	0.010	0.030
75/06/10	09 45		0.010	0.550	0.015	0.005	0.040
75/07/12	14 30		0.010	0.900	0.035	0.010	0.050
75/08/20	11 00		0.005	0.350	0.030	0.025	0.030
75/09/06	14 30		0.005	0.150	0.030	0.005K	0.010K

K VALUE KNOWN TO BE
LESS THAN INDICATED