U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT
ON
SWANSON RESERVOIR
HITCHCOCK COUNTY
NEBRASKA
EPA REGION VII
WORKING PAPER No. 562

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

☆G.P.O. 699-440

REPORT
ON
SWANSON RESERVOIR
HITCHCOCK COUNTY
NEBRASKA
EPA REGION VII
WORKING PAPER No. 562

WITH THE COOPERATION OF THE
NEBRASKA DEPARTMENT OF ENVIRONMENTAL CONTROL
AND THE
NEBRASKA NATIONAL GUARD
AUGUST, 1976

CONTENTS

F O R E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to 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 freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

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

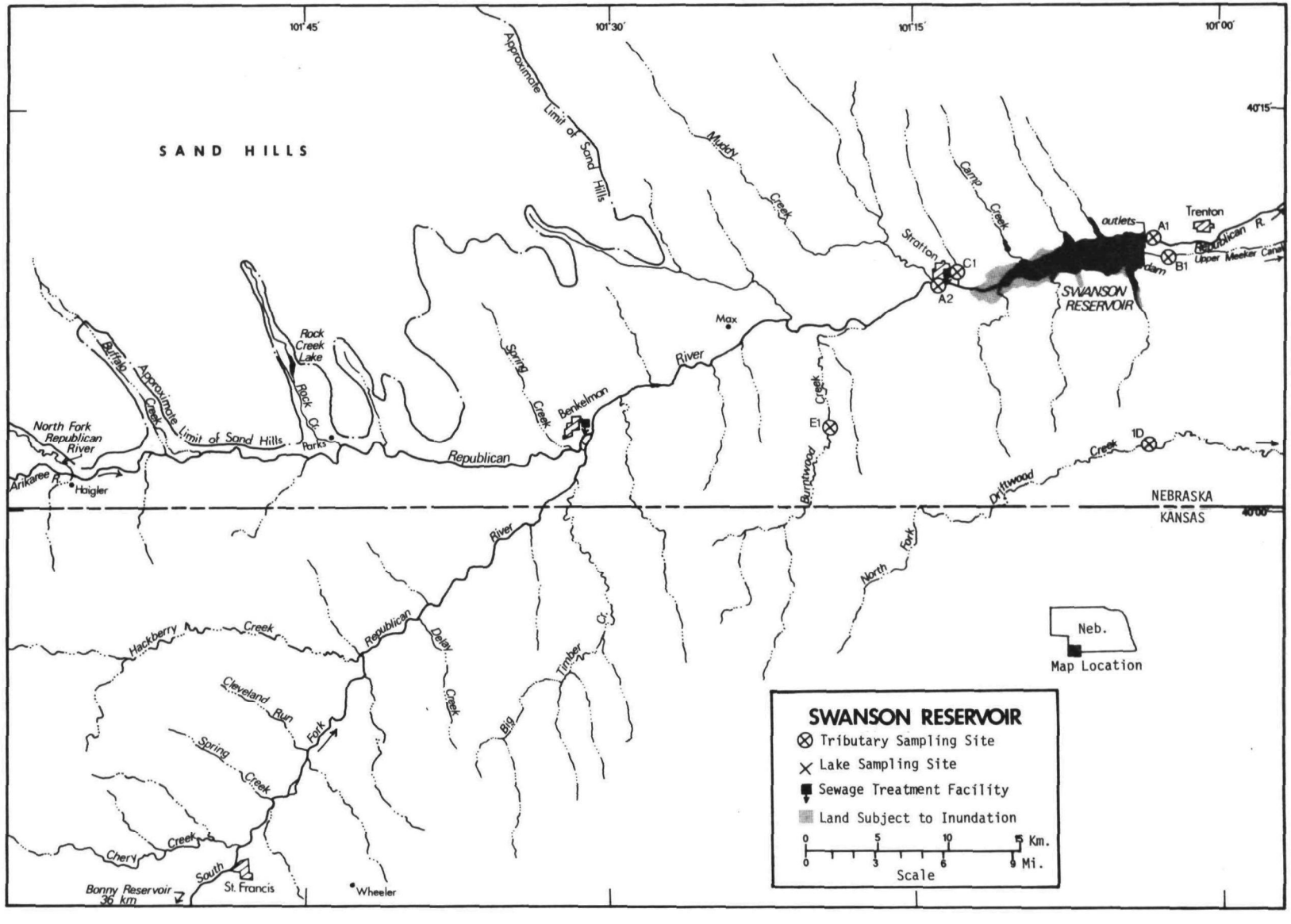
The staff of the Water Pollution Control Division, Department of Environmental Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General Francis L. Winner, the Adjutant General of Nebraska, and Project Officer Colonel Burl M. Johnson, who directed the volunteer efforts of the Nebraska National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STATE OF NEBRASKA

RESERVOIR NAME	COUNTY
Branched Oak	Lancaster
Harlan County	Harlan
Harry D. Strunk	Frontier
Hugh Butler	Frontier, Red Willow
Johnson	Dawson, Gosper
McConaughy	Keith
Pawnee	Lancaster
Sherman	Sherman
Swanson	Hitchcock


101°45'
101°30'
101°15'
101°00'
40°15'
40°00'
SAND HILLS
Approximate Limit of Sand Hills
Muddy Creek
Camp Creek
Stratton
C1
A2
outlets
A1
B1
dam
Trenton
Republican R.
Upper Meeker Canal
SWANSON RESERVOIR
Max
Rock Creek Lake
Rock Ck.
Buffalo Creek
Approximate Limit of Sand Hills
Spring Creek
Benkelman
Republican River
Parks
North Fork Republican River
Arikaree R.
Haigler
E1
Bumtwood Creek
1D
Driftwood Creek
NEBRASKA
KANSAS
North Fork
Hackberry Creek
Republican River
Delay Creek
Big Timber Ck.
Cleveland Run
Fork
Spring Creek
Chery Creek
South
Bonny Reservoir
36 km
St. Francis
Wheeler
Neb.
Map Location
SWANSON RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Land Subject to Inundation
0 5 10 15 Km.
0 3 6 9 Mi.
Scale

SWANSON RESERVOIR

STORET NO. 3110

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Swanson Reservoir is eutrophic. It ranked fifth in overall trophic quality when the nine Nebraska reservoirs sampled in 1974 were compared using a combination of six parameters*. Five of the reservoirs had less and one had the same median total phosphorus, five had less median dissolved orthophosphorus, one had less and two had the same median inorganic nitrogen, three had less mean chlorophyll a, and four had greater mean Secchi disc transparency. Depression of dissolved oxygen with depth occurred at both sampling stations in late June.

Survey limnologists did not observe any macrophytes or surface concentrations of algae during sampling visits.

B. Rate-Limiting Nutrient:

Because of a significant loss of phosphorus in the samples between the time of collection and the beginning of the assays, the algal assay results are not considered to be representative of conditions in the reservoir at the time the sample was taken (04/15/74).

The reservoir data indicate nitrogen limitation at both sampling stations in April and September.

C. Nutrient Controllability:

1. Point sources--The phosphorus contribution of known point

* See Appendix A.

sources amounted to 9.0% of the total load reaching Swanson Reservoir during the sampling year. Nearly all this load came from the wastewater treatment plants at Benkelman and Stratton (4.2% and 4.8%, respectively). Septic tanks serving shoreline dwellings were estimated to have contributed less than 0.1%.

The present phosphorus loading of 0.87 $g/m^2/yr$ is about two times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 12); and, considering the relatively small phosphorus contribution of the point sources, it is not likely that point-source control would significantly improve the trophic condition of Swanson Reservoir.

2. Non-point sources--It is estimated that non-point sources contributed 91.0% of the total phosphorus load during the sampling year. The Republican River contributed 86.3%, and the ungaged tributaries were estimated to have contributed 2.7% of the total load.

The phosphorus export rate of the Republican River (2 kg $P/km^2/yr$) was considerably less than the export rate of a tributary of nearby Hugh Butler Reservoir* (13 $kg/km^2/yr$) and a tributary of Harry D. Strunk Reservoir** (27 $kg/km^2/yr$).

* Working Paper No. 557.
** Working Paper No. 556.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 20.13 kilometers^2.
2. Mean depth: 7.3 meters.
3. Maximum depth: 18.0 meters.
4. Volume: 146.949 x 10^6 m^3.
5. Mean hydraulic retention time: 1.4 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)*
Republican River	9,842.0	4.05
Minor tributaries & immediate drainage -	342.5	0.12
Totals	10,184.5	4.17

2. Outlets -

Republican River	10,204.6	2.02
Ungaged irrigation canal	0.0	1.40**
Total	10,204.6***	3.42

C. Precipitation****:

1. Year of sampling: 47.6 centimeters.
2. Mean annual: 52.8 centimeters.

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† Table of metric conversions--Appendix B.
†† Hartung, 1974; Adamovich, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Estimated flow; Alridge, 1976.
*** Includes area of reservoir.
**** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Swanson Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the reservoir and from a number of depths at each station (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 for phytoplankton identification and enumeration; and during the first visit, 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 10.7 meters at station 1 and 7.6 meters at station 2.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not preserved properly and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR SWANSON RESERVOIR
STORET CODE 3110

PARAMETER	1ST SAMPLING (4/15/74) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (6/28/74) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/27/74) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	7.9 - 8.2	8.1	8.0	19.2 - 23.9	21.8	21.5	15.5 - 16.8	16.2	16.5
DISS OXY (MG/L)	10.0 - 11.2	10.4	10.2	4.0 - 8.6	7.0	7.4	7.0 - 8.6	8.0	8.0
CNDCTVY (MCROMO)	366. - 370.	368.	367.	570. - 623.	597.	592.	307. - 469.	396.	437.
PH (STAND UNITS)	8.4 - 8.4	8.4	8.4	8.1 - 8.6	8.4	8.4	8.4 - 8.4	8.4	8.4
TOT ALK (MG/L)	185. - 194.	190.	190.	****** -**********			288. - 324.	302.	294.
TOT P (MG/L)	0.052 - 0.065	0.055	0.053	****** -**********			0.070 - 0.229	0.099	0.077
ORTHO P (MG/L)	0.006 - 0.021	0.011	0.009	****** -**********			0.016 - 0.049	0.022	0.018
NO2+NO3 (MG/L)	0.040 - 0.100	0.076	0.080	****** -**********			0.0 - 0.030	0.020	0.020
AMMONIA (MG/L)	0.040 - 0.080	0.064	0.070	****** -**********			0.030 - 0.080	0.041	0.040
KJEL N (MG/L)	0.500 - 1.400	0.786	0.700	****** -**********			0.500 - 2.200	0.814	0.600
INORG N (MG/L)	0.080 - 0.180	0.140	0.160	****** -**********			0.050 - 0.110	0.067	0.060
TOTAL N (MG/L)	0.540 - 1.480	0.861	0.770	****** -**********			0.520 - 2.230	0.873	0.620
CHLRPYL A (UG/L)	4.6 - 24.3	14.4	14.4	13.0 - 13.0	13.0	13.0	13.1 - 18.7	15.9	15.9
SECCHI (METERS)	0.5 - 0.5	0.5	0.5	1.5 - 1.9	1.7	1.7	0.4 - 0.4	0.4	0.4

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/15/74	1. *Asterionella sp.*	15,214
	2. *Cyclotella sp.*	709
	3. *Flagellates sp.*	125
	4. *Glenodinium sp.*	83
	Total	16,131
06/28/74	1. Flagellates	413
	2. *Schroederia sp.*	376
	3. *Cryptomonas sp.*	338
	4. *Fragilaria sp.*	338
	5. *Stephanodiscus sp.*	263
	Other genera	262
	Total	1,990
09/27/74	1. *Stephanodiscus sp.*	912
	2. *Cryptomonas sp.*	568
	3. *Oocystis sp.*	293
	4. *Microcystis sp.*	189
	5. *Closterium sp.*	155
	Other genera	636
	Total	2,753

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
04/15/74	1	4.6
	2	24.3
06/28/74	1	13.0
	2	13.0
09/27/74	1	13.1
	2	18.7

C. Limiting Nutrient Study:

Because of an 82% loss of total phosphorus in the sample between the time of collection and the beginning of the assay, the results of the algal assay are not considered representative of conditions in the reservoir at the time the sample was taken.

The reservoir data indicate that nitrogen was limiting primary productivity during the spring and fall sampling visits. The mean inorganic nitrogen/orthophosphorus ratio was 13/1 in April and 3/1 in September, and nitrogen limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Nebraska National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in August, 1974, and was completed in July, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Nebraska 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 shown are those measured minus point-source loads, if any. Nutrient loads for the Republican River outlet and Upper Meeker Canal were calculated using the mean concentrations measured at stations A-1 and B-1 and multiplying by the combined mean outflow.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in the Republican River at station A-2 and the mean ZZ flow.

The operators of the Benkelman and Stratton wastewater treatment plants 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
Benkelman	1,349	stab. pond	515.8	Republican River
Stratton	481	tr. filter	200.7	Republican River

2. Known industrial - None

* Treatment plant questionnaires.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Republican River	15,105	86.3
b. Minor tributaries & immediate drainage (non-point load) -	470	2.7
c. Known municipal STP's -		
Benkelman	730	4.2
Stratton	830	4.8
d. Septic tanks* -	10	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	350	2.0
Total	17,495	100.0

2. Outputs -

Lake outlet -	Republican River	} 5,930
	Ungaged irrigation canal	

3. Net annual P accumulation - 11,565 kg.

* Estimate based on 20 shoreline dwellings and one campground; 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) -		
Republican River	242,700	87.8
b. Minor tributaries & immediate drainage (non-point load) -	7,255	2.6
c. Known municipal STP's -		
Benkelman	2,140	0.8
Stratton	2,400	0.9
d. Septic tanks* -	285	0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	21,730	7.8
Total	276,510	100.0

2. Outputs -

Lake outlet - Republican River Ungaged irrigation canal	}	138,805

3. Net annual N accumulation - 137,705 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Republican River	2	25

* Estimate based on 20 shoreline dwellings and one campground; 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	0.87	0.57	13.7	6.8

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Swanson Reservoir:	
"Dangerous" (eutrophic loading)	0.44
"Permissible" (oligotrophic loading)	0.22

V. LITERATURE REVIEWED

Adamovich, Ted, 1975. Personal communication (reservoir morphometry). NE Dept. of Env. Contr., Lincoln.

Alridge, Ray, 1976. Personal communication (evaporation loss and irrigation withdrawal from Swanson Reservoir). Bureau of Reclamation, McCook.

Hartung, Ray, 1974. Personal communication (reservoir morphometry). NE Dept. of Env. Contr., Lincoln.

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
3101	BRANCHED OAK	0.044	0.070	456.444	17.033	9.400	0.013
3102	HARLAN COUNTY RESERVOIR	0.112	0.365	476.111	27.822	12.200	0.061
3103	HARRY D. STRUNK (MEDICIN	0.064	0.460	470.500	14.367	14.200	0.009
3104	HUGH BUTLER (RED WILLOW)	0.061	0.090	468.875	16.612	14.400	0.014
3105	JOHNSON RESERVOIR	0.075	0.340	477.667	26.133	8.600	0.009
3106	LAKE MCCONAUGHY	0.027	0.585	409.555	8.644	11.400	0.004
3107	PAWNEE LAKE	0.060	0.175	453.000	15.367	8.800	0.020
3108	SHERMAN COUNTY RESERVOIR	0.067	0.090	451.167	6.717	11.800	0.050
3110	SWANSON RESERVOIR	0.067	0.090	466.333	14.450	11.000	0.016

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
3101	BRANCHED OAK	88 (7)	100 (8)	63 (5)	25 (2)	75 (6)	63 (5)	414
3102	HARLAN COUNTY RESERVOIR	0 (0)	25 (2)	13 (1)	0 (0)	25 (2)	0 (0)	63
3103	HARRY D. STRUNK (MEDICIN	50 (4)	13 (1)	25 (2)	75 (6)	13 (1)	81 (6)	257
3104	HUGH BUTLER (RED WILLOW)	63 (5)	75 (5)	38 (3)	38 (3)	0 (0)	50 (4)	264
3105	JOHNSON RESERVOIR	13 (1)	38 (3)	0 (0)	13 (1)	100 (8)	81 (6)	245
3106	LAKE MCCONAUGHY	100 (8)	0 (0)	100 (8)	88 (7)	50 (4)	100 (8)	438
3107	PAWNEE LAKE	75 (6)	50 (4)	75 (6)	50 (4)	88 (7)	25 (2)	363
3108	SHERMAN COUNTY RESERVOIR	38 (3)	75 (5)	88 (7)	100 (8)	38 (3)	13 (1)	352
3110	SWANSON RESERVOIR	25 (2)	75 (5)	50 (4)	63 (5)	63 (5)	38 (3)	314

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3106	LAKE MCCONAUGHY	438
2	3101	BRANCHED OAK	414
3	3107	PAWNEE LAKE	363
4	3108	SHERMAN COUNTY RESERVOIR	352
5	3110	SWANSON RESERVOIR	314
6	3104	HUGH BUTLER (RED WILLOW)	264
7	3103	HARRY D. STRUNK (MEDICIN	257
8	3105	JOHNSON RESERVOIR	245
9	3102	HARLAN COUNTY RESERVOIR	63

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 NEBRASKA 12/23/75

LAKE CODE 3110 SWANSON RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 10204.6

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3110A1	10204.6	0.82	1.13	1.53	2.55	3.62	3.26	4.08	4.19	1.22	0.59	0.51	0.62	2.02
3110A2	9842.0	3.11	4.47	6.14	5.44	6.48	5.41	4.13	2.83	2.63	1.93	3.20	2.89	4.05
3110ZZ	362.6	0.02	0.05	0.11	0.03	0.14	0.25	0.29	0.24	0.19	0.10	0.02	0.02	0.12

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 10204.6
SUM OF SUB-DRAINAGE AREAS = 10204.6
TOTAL FLOW IN = 50.13
TOTAL FLOW OUT = 24.13

NOTE *** TOTAL & ZZ DR. AREAS DIRECTLY CONTRIBUTING. 8620 SQ. MI. TOTAL AREA.

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3110A1	8	74	5.15	24	8.41				
	9	74	0.43	7	0.51				
	10	74	0.06	5	0.10				
	11	74	0.03	16	0.03				
	12	74	0.03	7	0.03				
	1	75	0.03	5	0.03				
	2	75	0.03	9	0.03				
	3	75	0.03	23	0.03				
	4	75	0.03	12	0.03				
	5	75	0.03	4	0.03				
	6	75	0.05	7	0.04				
	7	75	3.79						
3110A2	8	74	0.0	24	0.0				
	9	74	0.0	7	0.0				
	10	74	0.30	5	0.0				
	11	74	2.41	16	2.80				
	12	74	1.86	7	1.70				
	1	75	2.92	5	2.32				
	2	75	3.40	9	3.11				
	3	75	4.36	22	4.25				
	4	75	4.64	12	4.45				
	5	75	3.54	4	2.58				
	6	75	14.33	7	8.86				
	7	75	2.43						

TRIBUTARY FLOW INFORMATION FOR NEBRASKA 12/23/75

LAKE CODE 3110 SWANSON RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3110ZZ	8	74	0.25	24	0.24				
	9	74	0.11	7	0.10				
	10	74	0.07	5	0.08				
	11	74	0.07	16	0.07				
	12	74	0.08	7	0.07				
	1	75	0.07	5	0.08				
	2	75	0.07	9	0.07				
	3	75	0.07	22	0.05				
	4	75	0.07	12	0.07				
	5	75	0.07	4	0.05				
	6	75	0.38	7	0.08				
	7	75	0.16						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

311001
40 10 16.0 101 03 57.0
SWANSON RESERVOIR
31087 NEBRASKA

11EPALES 2111202
3 0040 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/15	15 40	0000	8.0		18	369	8.45	194	0.080	1.400	0.080	0.021
	15 40	0005	8.0	10.2		367	8.45	191	0.070	1.000	0.090	0.013
	15 40	0015	8.0	10.4		366	8.40	190	0.080	0.900	0.100	0.011
	15 40	0035	7.9	11.2		367	8.40	190	0.080	0.500	0.100	0.009
74/06/28	14 00	0000	23.7	7.7	75	623	8.40					
	14 00	0005	22.0	7.4		601	8.40					
	14 00	0016	21.2	6.6		589	8.40					
	14 00	0025	20.7	7.8		589	8.10					
	14 00	0035	19.2	4.0		570	8.30					
74/09/27	10 15	0000	16.5	8.2	17	469	8.45	290	0.080	2.200	0.030	0.049
	10 15	0005	16.8	8.0		323	8.45	294	0.030	0.600	0.020K	0.019
	10 15	0015	16.6	8.6		437	8.41	314	0.030	0.600	0.000K	0.017
	10 15	0022	16.6	7.0		469	8.41	316	0.040	0.600	0.020K	0.018

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/15	15 40	0000	0.065	4.6	
	15 40	0005	0.053		
	15 40	0015	0.052		
	15 40	0035	0.052		
74/06/28	14 00	0000		13.0	
	14 00	0002			50.0
	14 00	0016			1.0
74/09/27	10 15	0000	0.089	13.1	
	10 15	0003			1.0
	10 15	0005	0.070		
	10 15	0015	0.072		
	10 15	0022	0.229		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/12/23

311002
40 09 35.0 101 07 16.0
SWANSON RESERVOIR
31087 NEBRASKA

11EPALES 2111202
3 0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/15	16 15	0000	8.2		18	370	8.40	189	0.060	0.700	0.070	0.009
	16 15	0005	8.2	10.0		370	8.40	188	0.040	0.500	0.050	0.006
	16 15	0015	8.1	10.0		367	8.40	185	0.040	0.500	0.040	0.007
74/06/28	14 30	0000	23.9	8.6	60	623	8.60					
	14 30	0005	22.9	8.2		603	8.60					
	14 30	0015	21.5	6.8		592	8.30					
	14 30	0025	21.0	5.8		585	8.20					
74/09/27	10 45	0000	15.5	8.0	14	307	8.41	288	0.040	0.600	0.020	0.016
	10 45	0005	15.5	8.0		457	8.43	324	0.040	0.600	0.030	0.019
	10 45	0011	15.5	8.0		309	8.45	288	0.030	0.500	0.020	0.018

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/15	16 15	0000	0.056	24.3	
	16 15	0005	0.053		
	16 15	0015	0.053		
74/06/28	14 30	0000		13.0	
	14 30	0005			1.0
	14 30	0006			50.0
74/09/27	10 45	0000	0.079	18.7	
	10 45	0002			1.0
	10 45	0005	0.077		
	10 45	0011	0.076		

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/01/27

3110A1
40 10 14.0 101 03 25.0
REPUBLICAN RIVER
31057 7.5 TRENTON
O/SWANSON RESERVOIR
BANK SAMP OFF RD .3 MI E OF TRENTON DAM
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	09	35	0.008	0.600	0.010	0.015	0.070
74/09/07	10	10	0.410	0.600	0.050	0.015	0.105
74/10/05	09	35	0.352	0.900	0.025	0.005	0.040
74/11/16	10	15	0.464	0.900	0.050	0.005	0.040
74/12/07	09	35	0.448	1.000	0.024	0.008	0.040
75/01/05	09	35	0.600	1.400	0.024	0.010	0.030
75/02/09	09	35	0.637	0.700	0.016	0.008	0.030
75/03/22	14	45	0.556	0.900	0.025	0.006	0.050
75/04/12	12	00	0.630	1.200	0.110	0.010	0.050
75/05/04	09	35	0.580	0.750	0.025	0.010	0.040
75/06/07	10	10	0.440	1.100	0.050	0.010	0.050

STORET RETRIEVAL DATE 76/01/27

3110A2
40 08 55.0 101 13 58.0
REPUBLICAN RIVER
31 7.5 STRATTON
T/SWANSON RESERVOIR
SEC RD BRDG .5 MI S OF STRATTON
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/16	14 45		0.768	0.700	0.025	0.020	0.070
74/12/07	14 40		0.890	0.600	0.100	0.035	0.060
75/01/05	14 45		0.990	1.300	0.048	0.045	0.060
75/02/09	14 55		1.245	0.900	0.032	0.048	0.070
75/03/23	10 15		0.436	0.850	0.024	0.031	0.110
75/04/12	12 30		0.575	1.500	0.020	0.040	0.150
75/05/04	14 40		0.125	0.600	0.015	0.015	0.050
75/06/07	14 40		0.260	3.600	0.050	0.085	0.420

STORET RETRIEVAL DATE 76/01/27

311081
40 09 05.0 101 02 27.0
UPPER MEEKER CANAL
31 7.5 TRENTON
0/SWANSON RESERVOIR
NE HWY 25 BRDG 3 MI SW OF TRENTON
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/24	09	15	0.028	0.600	0.020	0.017	0.055
74/09/07	09	55	0.132	0.800	0.050	0.020	0.120

STORET RETRIEVAL DATE 76/01/27

3110AA PD3110AA P001400
40 02 30.0 101 31 15.0
BENKELMAN
31057 7.5 BENKELMAN NE
T/SWANSON RESERVOIR
REPUBLICAN RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/09/17	11 00		0.080	11.500	0.034	0.990	2.500	0.250	0.250
74/10/17	11 00		0.080	9.800	0.350	2.000	3.000		
74/11/15	11 30		0.160	12.000	0.060	4.200	4.900		
74/12/17	10 00		0.400	14.000	0.120	4.900	5.800		
75/01/17	13 30		0.080	20.000	4.400	5.700	7.800		
75/02/18	13 30		0.080	22.000	11.000	5.200	7.900	0.150	0.150
75/03/17	08 30		0.080	9.900	8.200	5.200	7.200	0.150	
75/04/17	08 00		0.050	23.000	5.400	3.800	8.700	0.100	0.100
75/05/19	13 30		0.250	12.500	0.700	2.800	3.100		
75/06/17	16 00		0.050	2.700	0.050K	1.100	1.400	0.100	
75/07/17	12 00		0.050	2.250	0.025K	0.680	0.920	0.120	
75/09/17	15 00		0.075	8.200	0.100	0.610	1.275	0.110	0.120
75/10/17	15 00		0.110	8.400	0.050	0.525	0.940	0.120	0.100

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/01/27

3110AB TF3110AB P000481
40 08 45.0 101 14 00.0
STRATTON
31 7.5 STRATTON NE
T/SWANSON RESERVOIR
REPUBLICAN RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/09/30	10 30		6.600	30.000	10.000	7.000	14.000	0.078	0.068
74/10/31	17 00		9.300	18.000	2.600	6.200	11.000L	0.085	0.085
74/12/24	10 00		7.680	26.000	8.400	6.300	7.900	0.040	0.055
75/01/28	14 30		8.200	29.000	7.900	7.100	9.100	0.058	0.068
75/02/25	13 15		0.080	30.000	0.170	1.280	14.000	0.035	0.042
75/03/27	15 00		4.900	24.000	4.900	8.200	8.500	0.050	0.050
75/04/29	11 30		7.900	31.000	1.450	5.900	17.300	0.040	0.040
75/05/27	11 00		4.700	35.000	11.500	5.400	7.100	0.033	0.035
75/06/24	13 00		3.670	18.000	0.370	3.800	12.500	0.030	0.035

L ACTUAL VALUE IS KNOWN TO BE
GREATER THAN VALUE GIVEN