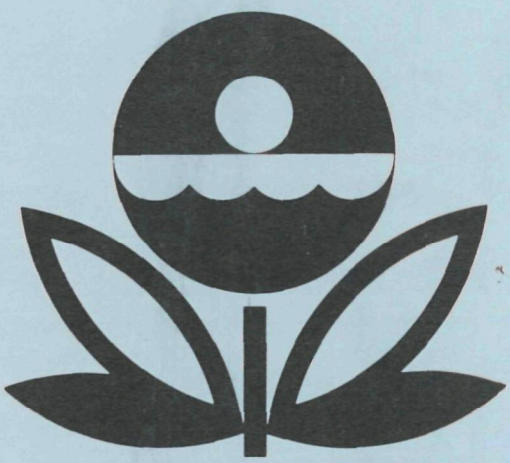
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES



REPORT
ON
CANYON RESERVOIR
COMAL COUNTY
TEXAS
EPA REGION VI
WORKING PAPER No. 639

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

☆G.P.O. 699-440

REPORT
ON
CANYON RESERVOIR
COMAL COUNTY
TEXAS

EPA REGION VI

WORKING PAPER No. 639

WITH THE COOPERATION OF THE

TEXAS WATER QUALITY BOARD

AND THE

TEXAS NATIONAL GUARD

MARCH, 1977

CONTENTS

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

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

Hugh C. Yantis, Jr., Executive Director of the Texas Water Quality Board, and John B. Latchford, Jr., Director, and the staff of the Field Operations 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.

Major General Thomas Bishop, the Adjutant General of Texas, and Project Officer Colonel William L. Seals, who directed the volunteer efforts of the Texas National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

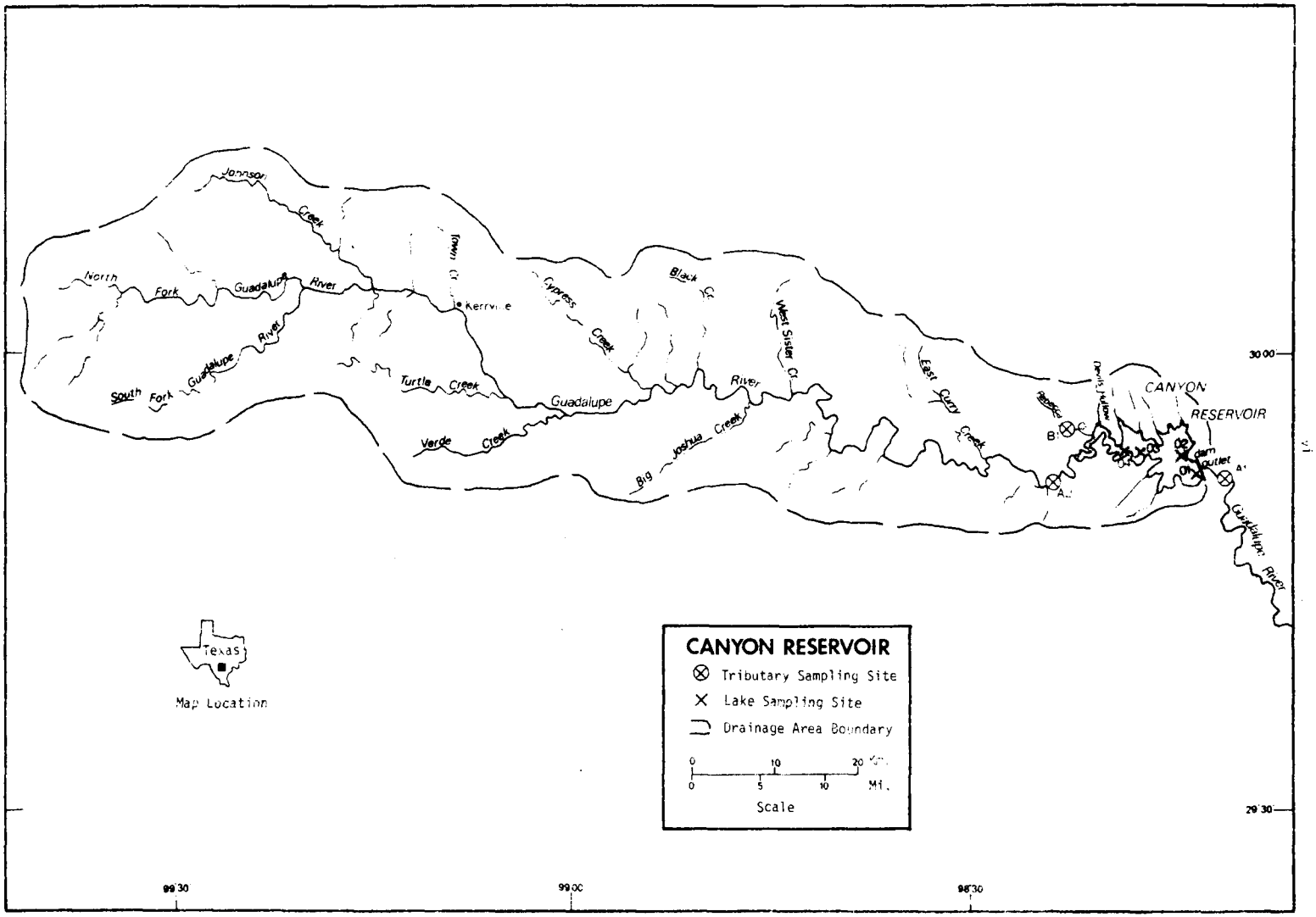
NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of Texas

NAME	COUNTY
Amistad	Val Verde
Bastrop	Bastrop
Belton	Bell, Coryell
Braunig	Bexar
Brownwood	Brown
Buchanan	Burnet, Llano
Caddo	Harrison, Marion, TX; Caddo Parish, LA
Calaveras	Bexar
Canyon	Comal
Colorado City	Mitchell
Corpus Christi	Jim Wells, Live Oak, San Patricio
Diversion	Archer, Baylor
Eagle Mountain	Tarrant, Wise
Fort Phantom Hill	Jones
Houston	Harris
Kemp	Baylor
Lake O'The Pines	Camp, Marion, Morris, Upshur
Lavon	Collin
Lewisville (Garza-Little Elm)	Denton
Livingston	Polk, San Jacinto, Trinity, Walker

Lyndon B. Johnson	Burnet, Llano
Medina	Bandera, Medina
Meredith	Hutchinson, Moore, Potter
O. C. Fisher (San Angelo)	Tom Green
Palestine	Anderson, Cherokee, Henderson, Smith
Possum Kingdom	Palo Pinto, Stephens, Young
Sam Rayburn	Angelina, Jasper Nacogdoches, Sabine, San Augustine
Somerville	Burleson, Lee, Washington
E. V. Spence	Coke
Stamford	Haskell
Stillhouse Hollow	Bell
Tawakoni	Hunt, Rains, Van Zandt
Texoma	Cooke, Grayson TX; Bryan, Johnston, Love, Marshall, OK
Travis	Burnet, Travis
Trinidad	Henderson
Twin Buttes	Tom Green
White River	Crosby
Whitney	Bosque, Hill
Wright Patman (Texarkana)	Bowie, Cass


Johnson Creek
North Fork Guadalupe River
South Fork Guadalupe River
Kerrville
Cypress Creek
Black Cr.
West Sister Cr.
Turtle Creek
Guadalupe River
Verde Creek
Big Joshua Creek
East Curry Creek
Dry Comal Creek
CANYON RESERVOIR
Dam outlet
Guadalupe River
30°00
29°30
99°30
99°00
98°30
Texas
Map Location
CANYON RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 10 20 Km.
0 5 10 Mi.
Scale

CANYON RESERVOIR

STORET NO. 4809

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Canyon Reservoir is mesotrophic; i.e., moderately supplied with nutrients and productive. Whether nutrient enrichment is beneficial or deleterious depends on the actual or potential effect on the uses of the reservoir. In this regard, no nuisance conditions are known to personnel of the Texas Water Quality Board and there is little or no impairment of the designated beneficial uses of this water body.

Canyon Reservoir ranked first in overall trophic quality when 39 Texas reservoirs sampled in 1974 were compared using a combination of six parameters*. None of the other reservoirs had less but one had the same median total phosphorus, one had less median dissolved phosphorus, 35 had less median inorganic nitrogen, one had less mean chlorophyll a, and two had greater mean Secchi disc transparency.

Depression of hypolimnetic dissolved oxygen occurred at all stations in May and August, and depression with depth occurred at stations 1 and 2 in November.

B. Rate-Limiting Nutrient:

The algal assay results indicate that the primary productivity in Canyon Reservoir was phosphorus limited at the times the samples

* See Appendix A.

were collected (03/13/74 and 11/05/74). The reservoir data indicate phosphorus limitation at all sampling times.

C. Nutrient Controllability:

1. Point sources--During the sampling year, septic tanks serving shoreline dwellings were estimated to have contributed 0.4% of the total phosphorus load to Canyon Reservoir, but a shoreline survey would be needed to determine the significance of these sources. In addition, the Randolph Air Force Base Marina wastewater treatment facility discharges directly to the reservoir; however, no effluent quality data are available (Wyatt, 1976), and the phosphorus contribution of this source is not known.

The phosphorus loading of 0.15 g/m^2 measured during the sampling year is less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as an oligotrophic loading (see page 14); however, the actual loading was higher to some degree because of the Randolph AFB Marina contribution. The existing reservoir water quality should persist if phosphorus inputs are kept at or below the proposed oligotrophic loading.

2. Non-point sources--The phosphorus contributions of non-point sources accounted for 99.6% of the total phosphorus load during the sampling year. The Guadalupe River contributed 77.3%, and Rebecca Creek contributed 1.0% of the total. Ungaged drainage areas were estimated to have contributed 9.9% of the total load to Canyon Reservoir.

The phosphorus export rates of the Guadalupe River and Rebecca Creek were very low (see page 13) and compare very well with the export rates of unimpacted streams elsewhere in Texas.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 33.35 kilometers^2.
2. Mean depth: 14.0 meters.
3. Maximum depth: >39.0 meters.
4. Volume: 471.198 x 10^6 m^3.
5. Mean hydraulic retention time: 1 year (based on 1972-1976 mean outflow).

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

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Guadalupe River	3,405.8	7.560
Rebecca Creek	28.2	0.146
Minor tributaries & immediate drainage -	251.8	1.050
Totals	3,685.8	8.756

2. Outlet -

Guadalupe River	3,719.2**	7.910

C. Precipitation***:

1. Year of sampling: 85.6 centimeters.
2. Mean annual: 80.0 centimeters.

---

† Table of metric conversions--Appendix B.
†† At conservation pool level; Barrows, 1977.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Canyon Reservoir was sampled four times during 1974 by means of a pontoon-equippped Huey helicopter. Each time, samples for physical and chemical parameters were collected from four stations on the reservoir and from a number of depths at each station (see map, page vi). 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 March and November visits, single 18.9-liter depth-integrated samples were 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 39.0 meters at station 1, 30.2 meters at station 2, 22.6 meters at station 3, and 15.5 meters at station 4.

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

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR CANYON RESERVOIR
STORET CODE 4809

PARAMETER	1ST SAMPLING (3/13/74) 4 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (5/22/74) 4 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (8/15/74) 4 SITES RANGE	MEAN	MEDIAN
TEMP (C)	12.0 - 20.0	16.0	16.0	13.4 - 28.2	22.9	25.1	15.6 - 28.2	24.6	27.0
DISS OXY (MG/L)	5.0 - 9.6	8.0	8.1	1.0 - 8.0	4.8	5.4	0.2 - 7.6	4.6	6.4
CNDCTVY (MCROMO)	320. - 430.	367.	360.	342. - 512.	399.	395.	355. - 497.	399.	391.
PH (STAND UNITS)	7.8 - 8.3	8.2	8.2	7.1 - 8.3	7.7	7.7	7.2 - 8.5	8.0	8.0
TOT ALK (MG/L)	178. - 232.	198.	192.	155. - 203.	176.	174.	****** - **********		
TOT P (MG/L)	0.005 - 0.014	0.008	0.007	0.006 - 0.053	0.013	0.009	****** - **********		
ORTHO P (MG/L)	0.004 - 0.011	0.007	0.005	0.002 - 0.011	0.004	0.003	****** - **********		
NO2+NO3 (MG/L)	0.390 - 0.890	0.538	0.440	0.400 - 0.970	0.520	0.470	****** - **********		
AMMONIA (MG/L)	0.020 - 0.150	0.042	0.035	0.020 - 0.060	0.037	0.040	****** - **********		
KJEL N (MG/L)	0.200 - 0.500	0.250	0.200	0.200 - 0.800	0.257	0.200	****** - **********		
INORG N (MG/L)	0.410 - 1.020	0.581	0.465	0.430 - 1.030	0.557	0.500	****** - **********		
TOTAL N (MG/L)	0.590 - 1.220	0.788	0.725	0.600 - 1.280	0.777	0.720	****** - **********		
CHLRPYL A (UG/L)	0.8 - 1.2	1.0	1.0	3.5 - 7.9	5.7	5.7	1.0 - 3.0	1.9	1.8
SECCHI (METERS)	1.5 - 4.3	2.8	2.7	1.4 - 2.6	2.1	2.2	2.3 - 5.5	3.8	3.7

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR CANYON RESERVOIR
STORET CODE 4809

4TH SAMPLING (11/ 5/74)

PARAMETER	4 SITES RANGE	MEAN	MEDIAN
TEMP (C)	20.4 - 21.4	21.1	21.2
DISS OXY (MG/L)	0.6 - 8.0	6.5	7.0
CNDCTVY (MCROMO)	282. - 422.	346.	343.
PH (STAND UNITS)	7.2 - 8.0	7.8	7.9
TOT ALK (MG/L)	144. - 201.	167.	165.
TOT P (MG/L)	0.006 - 0.045	0.020	0.020
ORTHO P (MG/L)	0.005 - 0.015	0.009	0.009
NO2+NO3 (MG/L)	0.130 - 0.480	0.273	0.250
AMMONIA (MG/L)	0.020 - 0.460	0.053	0.030
KJEL N (MG/L)	0.200 - 0.400	0.264	0.200
INORG N (MG/L)	0.250 - 0.750	0.326	0.280
TOTAL N (MG/L)	0.430 - 0.780	0.537	0.530
CHLRPYL A (UG/L)	0.9 - 2.2	1.4	1.2
SECCHI (METERS)	1.2 - 4.6	3.0	3.2

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
03/13/74	1. Chroomonas sp.	217
	2. Synedra sp.	29
	3. Mallomonas sp.	14
	4. Nitzschia sp.	14
	Other genera	1
	Total	275
05/22/74	1. Chroomonas sp.	494
	2. Coelastrum sp.	198
	3. Cryptomonas sp.	99
	4. Cyclotella sp.	99
	5. Dinobryon sp.	49
	Other genera	148
	Total	1,087
08/15/74	1. Cryptomonas sp.	345
	2. Microcystis sp.	276
	3. Chroomonas sp.	242
	4. Tetraedron sp.	104
	5. Navicula sp.	69
	Other genera	310
	Total	1,346
11/05/74	1. Chroomonas sp.	686
	2. Cryptomonas sp.	172
	3. Dinobryon sp.	103
	4. Synedra sp.	103
	5. Chlamydomonas sp.	69
	Other genera	102
	Total	1,235

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
03/13/74	1	1.1
	2	0.8
	3	0.9
	4	1.2
05/22/74	1	4.4
	2	3.5
	3	7.9
	4	7.0
08/15/74	1	2.7
	2	1.0
	3	1.0
	4	3.0
11/05/74	1	2.2
	2	0.9
	3	1.1
	4	1.3

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. March sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	<0.005	0.610	0.1
0.050 P	<0.055	0.610	7.0
0.050 P + 1.0 N	<0.055	1.610	6.4
1.0 N	<0.005	1.610	0.1

b. November sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.004	0.267	0.1
0.050 P	0.054	0.267	6.6
0.050 P + 1.0 N	0.054	1.267	16.4
1.0 N	0.004	1.267	0.1

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Canyon Reservoir was low in March and November, 1974. Also, the significant increase in yields with the addition of orthophosphorus and the lack of change in yields when only nitrogen was added indicate phosphorus limitation.

The reservoir data also indicate phosphorus limitation; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 36/1 or greater at all sampling times, and phosphorus limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Texas National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the months of April and May 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 Texas District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

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, in $kg/km^2/year$, at station B-1 and multiplying by the ZZ area in km^2.

No known municipal or industrial waste sources impacted Canyon Reservoir during the sampling year; however, the treatment facility serving the Randolph Air Force Base Marina discharged an unknown amount of phosphorus directly to the reservoir.

---

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Guadalupe River	3,960	77.3
Rebecca Creek	50	1.0
b. Minor tributaries & immediate drainage (non-point load) -	505	9.9
c. Known municipal STP's - None	-	-
d. Septic tanks* -	20	0.4
e. Known industrial - None	-	-
f. Direct precipitation** -	585	11.4
Total	5,120	100.0

2. Outputs -

Lake outlet - Guadalupe River 3,105

3. Net annual P accumulation - 2,015 kg.

* Estimate based on 65 lakeshore dwellings and two parks; 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) -		
Guadalupe River	433,250	88.3
Rebecca Creek	2,090	0.4
b. Minor tributaries & immediate drainage (non-point load) -	18,635	3.8
c. Known municipal STP's - None	-	-
d. Septic tanks* -	835	0.2
e. Known industrial - None	-	-
f. Direct precipitation** -	36,005	7.3
Total	490,815	100.0

2. Outputs -

Lake outlet - Guadalupe River 174,140

3. Net annual N accumulation - 316,675 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Guadalupe River	1	127
Rebecca Creek	2	74

* Estimate based on 65 lakeshore dwellings and two parks; 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	0.15	0.06	14.7	9.5

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

"Dangerous" (eutrophic loading)	0.72
"Permissible" (oligotrophic loading)	0.36

V. LITERATURE REVIEWED

Barrows, David, 1977. Personal communication (reservoir morphometry and hydraulic retention time). Canyon Proj. Off., Fort Worth Dist., Corps of Engrs., New Braunfels, TX.

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.

Wyatt, Linda B., 1976. Personal communication (review of preliminary report) TX Water Qual. Bd., Austin.

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
4801	AMISTAD LAKE	0.013	0.500	371.474	2.042	14.900	0.009
4802	BASTROP LAKE	0.022	0.090	419.917	12.392	15.000	0.007
4803	BELTON RESERVOIR	0.016	0.185	378.312	8.025	15.000	0.007
4804	BRAUNIG LAKE	0.134	0.150	461.625	22.762	14.800	0.062
4805	BROWNWOOD LAKE	0.027	0.100	470.375	4.887	14.400	0.007
4806	LAKE BUCHANAN	0.036	0.250	437.625	8.606	15.000	0.012
4807	CADDO LAKE	0.055	0.070	463.333	14.808	11.400	0.013
4808	CALAVERAS LAKE	0.038	0.060	461.667	22.500	13.000	0.007
4809	CANYON RESERVOIR	0.010	0.450	384.812	2.500	14.800	0.006
4810	LAKE COLORADO CITY	0.042	0.090	473.625	12.675	10.200	0.012
4811	CORPUS CRISTI LAKE	0.113	0.130	475.187	19.756	14.000	0.050
4812	DIVERSION LAKE	0.025	0.080	470.111	15.867	9.000	0.009
4813	EAGLE MOUNTAIN LAKE	0.024	0.070	469.625	5.662	11.000	0.008
4814	FT PHANTOM HILL LAKE	0.060	0.105	474.909	6.317	9.800	0.022
4815	GARZA LITTLE ELM RESERVO	0.045	0.380	475.782	14.156	14.600	0.018
4816	KEMP LAKE	0.023	0.110	455.000	10.217	10.400	0.007
4817	HOUSTON LAKE	0.097	0.260	486.187	16.650	12.400	0.036
4818	LAKE OF THE PINES	0.031	0.090	440.000	12.919	15.000	0.011
4819	LAVON RESERVOIR	0.063	0.180	485.333	5.400	8.800	0.018
4820	LIVINGSTON LAKE	0.196	0.555	465.469	16.112	15.000	0.128
4821	LYNDON B JOHNSON LAKE	0.042	0.420	456.500	8.100	14.900	0.013
4822	MEDINA LAKE	0.010	0.600	403.562	12.944	15.000	0.004
4823	LAKE MEREDITH	0.021	0.070	439.312	3.037	14.900	0.009
4824	PALESTINE LAKE	0.031	0.180	442.625	10.619	14.800	0.010
4825	POSSUM KINGDOM RESERVOIR	0.023	0.070	419.045	9.495	15.000	0.009
4826	SAN ANGELO RESERVOIR	0.098	0.140	481.000	24.675	10.200	0.011
4827	SAM RAYBURN RESERVOIR	0.029	0.150	439.458	6.267	15.000	0.009
4828	E V SPENCE RESERVOIR	0.036	0.080	462.583	11.775	15.000	0.008

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
4829	SOMERVILLE LAKE	0.053	0.115	473.833	24.491	13.000	0.013
4830	STAMFORD LAKE	0.073	0.060	482.714	18.457	10.600	0.012
4831	STILLHOUSE HOLLOW RESERV	0.018	0.160	406.250	3.917	15.000	0.010
4832	TAWAKONI LAKE	0.046	0.100	466.417	18.246	13.200	0.013
4833	TEXARKANA LAKE	0.106	0.120	478.500	19.119	12.400	0.030
4834	TEXOMA LAKE	0.042	0.160	451.321	12.493	15.000	0.018
4835	TRAVIS LAKE	0.018	0.250	389.913	5.595	15.000	0.007
4836	TRINIDAD	0.389	0.110	479.500	24.300	10.000	0.240
4837	TWIN BUTTES RESERVOIR	0.029	0.250	454.917	8.708	14.800	0.009
4838	WHITE RIVER RESERVOIR	0.020	0.110	434.500	4.333	15.000	0.009
4839	WHITNEY LAKE	0.028	0.120	430.500	6.912	15.000	0.008

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
4801	AMISTAD LAKE	95 (36)	5 (2)	100 (38)	100 (38)	39 (14)	63 (21)	402
4802	BASTROP LAKE	79 (30)	76 (28)	82 (31)	47 (18)	17 (0)	92 (34)	393
4803	BELTON RESERVOIR	92 (35)	26 (10)	97 (37)	68 (26)	17 (0)	84 (31)	384
4804	BRAUNIG LAKE	5 (2)	42 (16)	50 (19)	8 (3)	49 (17)	5 (2)	159
4805	BROWNWOOD LAKE	66 (25)	70 (26)	29 (11)	87 (33)	58 (22)	84 (31)	394
4806	LAKE BUCHANAN	47 (18)	21 (7)	74 (28)	63 (24)	17 (0)	39 (14)	261
4807	CADDO LAKE	26 (10)	91 (33)	42 (16)	32 (12)	76 (29)	30 (10)	297
4808	CALAVERAS LAKE	45 (17)	100 (38)	47 (18)	11 (4)	67 (25)	92 (34)	362
4809	CANYON RESERVOIR	99 (37)	8 (3)	95 (36)	97 (37)	49 (17)	97 (37)	445
4810	LAKE COLORADO CITY	39 (14)	76 (28)	26 (10)	42 (16)	88 (33)	39 (14)	310
4811	CORPUS CRISTI LAKE	8 (3)	47 (18)	18 (7)	13 (5)	61 (23)	8 (3)	155
4812	DIVERSION LAKE	68 (26)	83 (31)	32 (12)	29 (11)	97 (37)	63 (21)	372
4813	EAGLE MOUNTAIN LAKE	71 (27)	91 (33)	34 (13)	79 (30)	79 (30)	76 (28)	430
4814	FT PHANTOM HILL LAKE	24 (9)	66 (25)	21 (8)	74 (28)	95 (36)	16 (6)	296
4815	GARZA LITTLE ELM RESERVO	34 (13)	13 (5)	16 (6)	34 (13)	55 (21)	21 (7)	173
4816	KEMP LAKE	76 (29)	61 (22)	55 (21)	55 (21)	84 (32)	92 (34)	423
4817	HOUSTON LAKE	16 (6)	16 (6)	0 (0)	24 (9)	72 (27)	11 (4)	139
4818	LAKE OF THE PINES	54 (20)	76 (28)	66 (25)	39 (15)	17 (0)	46 (17)	298
4819	LAVON RESERVOIR	21 (8)	29 (11)	3 (1)	84 (32)	100 (38)	21 (7)	258
4820	LIVINGSTON LAKE	3 (1)	3 (1)	39 (15)	26 (10)	17 (0)	3 (1)	91
4821	LYNDON B JOHNSON LAKE	39 (14)	11 (4)	53 (20)	66 (25)	39 (14)	30 (10)	238
4822	MEDINA LAKE	99 (37)	0 (0)	89 (34)	37 (14)	17 (0)	100 (38)	342
4823	LAKE MEREDITH	82 (31)	91 (33)	71 (27)	95 (36)	39 (14)	63 (21)	441
4824	PALESTINE LAKE	54 (20)	32 (12)	63 (24)	53 (20)	49 (17)	51 (19)	302
4825	POSSUM KINGDOM RESERVOIR	74 (28)	91 (33)	84 (32)	58 (22)	17 (0)	63 (21)	387
4826	SAN ANGELO RESERVOIR	13 (5)	45 (17)	8 (3)	0 (0)	88 (33)	46 (17)	200
4827	SAM RAYBURN RESERVOIR	59 (22)	39 (15)	68 (26)	76 (29)	17 (0)	63 (21)	322
4828	E V SPENCE RESERVOIR	50 (19)	83 (31)	45 (17)	50 (19)	17 (0)	76 (28)	321

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
4829	SOMERVILLE LAKE	29 (11)	55 (21)	24 (9)	3 (1)	67 (25)	30 (10)	208
4830	STAMFORD LAKE	18 (7)	97 (37)	5 (2)	18 (7)	82 (31)	39 (14)	259
4831	STILLHOUSE HOLLOW RESERV	88 (33)	37 (14)	87 (33)	92 (35)	17 (0)	51 (19)	372
4832	TAWAKONI LAKE	32 (12)	70 (26)	37 (14)	21 (8)	63 (24)	30 (10)	253
4833	TEXARKANA LAKE	11 (4)	51 (19)	13 (5)	16 (6)	72 (27)	13 (5)	176
4834	TEXOMA LAKE	39 (14)	34 (13)	61 (23)	45 (17)	17 (0)	21 (7)	217
4835	TRAVIS LAKE	88 (33)	21 (7)	92 (35)	82 (31)	17 (0)	84 (31)	384
4836	TRINIDAD	0 (0)	61 (22)	11 (4)	5 (2)	92 (35)	0 (0)	169
4837	TWIN BUTTES RESERVOIR	59 (22)	21 (7)	58 (22)	61 (23)	49 (17)	63 (21)	311
4838	WHITE RIVER RESERVOIR	84 (32)	61 (22)	76 (29)	89 (34)	17 (0)	63 (21)	390
4839	WHITNEY LAKE	63 (24)	51 (19)	79 (30)	71 (27)	17 (0)	76 (28)	357

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	4809	CANYON RESERVOIR	445
2	4823	LAKE MEREDITH	441
3	4813	EAGLE MOUNTAIN LAKE	430
4	4816	KEMP LAKE	423
5	4801	AMISTAD LAKE	402
6	4805	BROWNWOOD LAKE	394
7	4802	BASTROP LAKE	393
8	4838	WHITE RIVER RESERVOIR	390
9	4825	POSSUM KINGDOM RESERVOIR	387
10	4835	TRAVIS LAKE	384
11	4803	BELTON RESERVOIR	384
12	4831	STILLHOUSE HOLLOW RESERV	372
13	4812	DIVERSION LAKE	372
14	4808	CALAVERAS LAKE	362
15	4839	WHITNEY LAKE	357
16	4822	MEDINA LAKE	342
17	4827	SAM RAYBURN RESERVOIR	322
18	4828	E V SPENCE RESERVOIR	321
19	4837	TWIN BUTTES RESERVOIR	311
20	4810	LAKE COLORADO CITY	310
21	4824	PALESTINE LAKE	302
22	4818	LAKE OF THE PINES	298
23	4807	CADDO LAKE	297
24	4814	FT PHANTOM HILL LAKE	296
25	4806	LAKE BUCHANAN	261
26	4830	STAMFORD LAKE	259
27	4819	LAVON RESERVOIR	258
28	4832	TAWAKONI LAKE	253

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	4821	LYNDON B JOHNSON LAKE	238
30	4834	TEXOMA LAKE	217
31	4829	SOMERVILLE LAKE	208
32	4826	SAN ANGELO RESERVOIR	200
33	4833	TEXARKANA LAKE	176
34	4815	GARZA LITTLE ELM RESERVO	173
35	4836	TRINIDAD	169
36	4804	BRAUNIG LAKE	159
37	4811	CORPUS CRISTI LAKE	155
38	4817	HOUSTON LAKE	139
39	4820	LIVINGSTON LAKE	91

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 TEXAS 03/15/76

LAKE CODE 4809 CANYON

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 3719.2

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
4809A1	3719.2	5.97	6.82	7.87	8.33	9.74	9.29	10.51	8.52	7.16	7.79	7.48	5.38	7.91
4809A2	3405.8	6.60	7.67	7.59	8.83	12.91	9.71	7.22	4.16	8.61	5.97	5.78	5.80	7.56
4809B1	28.2	0.198	0.190	0.119	0.170	0.283	0.198	0.108	0.037	0.082	0.136	0.099	0.136	0.146
4809Z2	284.9	1.27	1.27	0.91	1.22	1.95	1.42	0.85	0.37	0.76	0.93	0.74	0.93	1.05

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 3719.2
SUM OF SUB-DRAINAGE AREAS = 3719.0
TOTAL FLOW IN = 105.25
TOTAL FLOW OUT = 94.86

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4809A1	9	74	19.539	8	22.370				
	10	74	10.477	8	10.279				
	11	74	28.034	8	47.289				
	12	74	13.451	9	18.463				
	1	75	19.737	8	23.984				
	2	75	54.368	7	19.142				
	3	75	21.181	7	20.756				
	4	75	16.650	3	16.537	21	16.622		
	5	75	26.221	8	20.445	23	20.756		
	6	75	61.448	9	48.139				
	7	75	24.551	8	90.331				
	8	75	19.142	8	19.171				
4809A2	9	74	17.840	8	13.734				
	10	74	9.203	8	8.750				
	11	74	26.618	8	29.733				
	12	74	14.300	9	13.309				
	1	75	16.339	8	17.273				
	2	75	52.952	7	65.978				
	3	75	19.397	7	22.597				
	4	75	15.291	3	13.451	21	11.100		
	5	75	53.519	8	18.548	23	43.042		
	6	75	35.396	9	31.432				
	7	75	20.445	8	22.144				
	8	75	19.142	8	19.171				

LAKE CODE 4809 CANYON

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
480981	9	74	0.150	8	0.108				
	10	74	0.142	8	0.071				
	11	74	0.136	8	0.150				
	12	74	0.127	9	2.662				
	1	75	0.144	8	0.161				
	2	75	0.538	7	0.708				
	3	75	0.127	7	0.136				
	4	75	0.085	3	0.082	21	0.051		
	5	75	0.510	8	0.340	23	2.039		
	6	75	0.235	9	0.249				
	7	75	0.235	8	0.252				
	8	75	0.040	8	0.082				
4809ZZ	9	74	1.529						
	10	74	1.076						
	11	74	1.784						
	12	74	1.246						
	1	75	1.444						
	2	75	5.550						
	3	75	1.274						
	4	75	0.850						
	5	75	4.984						
	6	75	2.350						
	7	75	0.963						
	8	75	0.396						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/02/11

480901
29 52 05.0 098 11 58.0
CANYON RESERVOIR
48091 TEXAS

11EPALES
3

2111202
0127 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
74/03/13	09 30	0000	17.1		168	350	8.35	186	0.020	0.200	0.400	0.005
	09 30	0006	17.0	9.0		350	8.35	186	0.020	0.200	0.390	0.010
	09 30	0020	16.5	9.6		350	8.30	187	0.020	0.200	0.390	0.005
	09 30	0045	14.5	9.2		335	8.25	188	0.030	0.200	0.390	0.004
	09 30	0070	12.7	9.0		320	8.25	189	0.020	0.200	0.390	0.005
	09 30	0095	12.5	8.8		320	8.20	189	0.020	0.200	0.390	0.006
	09 30	0123	12.0	7.0		325	8.00	194	0.020	0.200	0.450	0.005
74/05/22	15 40	0000	26.7		102	416	8.10	163	0.050	0.500	0.430	0.004
	15 40	0005	26.3	8.0		406	8.05	155	0.030	0.200K	0.420	0.003
	15 40	0022	25.1	6.2		395	7.70	180	0.020	0.200K	0.470	0.003
	15 40	0055	17.9	5.4		366	7.55	185	0.020	0.200K	0.450	0.002K
	15 40	0090	14.3	3.2		346	7.50	187	0.030	0.200K	0.440	0.002
	15 40	0128	13.4	3.2		342	7.50	189	0.030	0.200K	0.440	0.002
74/08/15	09 30	0000	27.4	7.2	216	383	8.40					
	09 30	0005	27.1	7.6		382	8.30					
	09 30	0015	27.0	7.6		381	8.30					
	09 30	0030	26.8	7.6		380	8.40					
	09 30	0043	25.1	1.4		391	7.60					
	09 30	0060	19.5	1.4		371	7.80					
	09 30	0080	16.9	2.0		359	7.80					
	09 30	0100	15.6	0.6		355	7.80					
74/11/05	09 20	0000	21.3	6.8	180	346	7.85	168	0.020K	0.300	0.250	0.009
	09 20	0005	21.3	6.6		345	7.85	169	0.020K	0.200	0.240	0.006
	09 20	0020	21.3	7.4		345	7.84	167	0.020K	0.200	0.250	0.006
	09 20	0040	21.3	6.8		346	7.83	168	0.020K	0.200K	0.240	0.006
	09 20	0060	21.3	6.4		345	7.80	167	0.020K	0.200K	0.240	0.005
	09 20	0080	21.3	8.0		345	7.75	168	0.040	0.200K	0.240	0.005
	09 20	0101	20.4	0.6		386	7.22	201	0.150	0.300	0.130	0.005

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/11

480901
29 52 05.0 098 11 58.0
CANYON RESERVOIR
48091 TEXAS

11EPALES 2111202
3 0127 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/03/13	09	30 0000	0.008	1.1	
	09	30 0006	0.007		
	09	30 0020	0.006		
	09	30 0045	0.006		
	09	30 0070	0.005		
	09	30 0095	0.006		
	09	30 0123	0.008		
74/05/22	15	40 0000	0.009	4.4	
	15	40 0005	0.008		
	15	40 0022	0.007		
	15	40 0055	0.006		
	15	40 0090	0.008		
	15	40 0128	0.007		
74/08/15	09	30 0000		2.7	
	09	30 0008			50.0
	09	30 0043			1.0
74/11/05	09	20 0000	0.011	2.2	
	09	20 0001			50.0
	09	20 0005	0.006		
	09	20 0020	0.008		
	09	20 0029			1.0
	09	20 0040	0.007		
	09	20 0060	0.006		
	09	20 0080	0.006		
	09	20 0101	0.009		

STORET RETRIEVAL DATE 76/02/11

480902
29 52 54.0 098 13 37.0
CANYON RESERVOIR
48091 TEXAS

11EPALES 2111202
3 0100 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
74/03/13	10 30	0000	18.4		106	365	8.35	190	0.040	0.500	0.420	0.010
	10 30	0006	18.4	9.0		365	8.30	189	0.030	0.200	0.410	0.005
	10 30	0015	17.4	9.0		355	8.30	189	0.030	0.200	0.410	0.005
	10 30	0035	15.3	9.4		340	8.25	190	0.020	0.200K	0.390	0.011
	10 30	0058	12.9	8.2		320	8.20	193	0.030	0.200	0.390	0.010
	10 30	0075	12.7	7.8		320	8.15	187	0.030	0.200	0.400	0.006
	10 30	0094	12.4	7.0		325	8.00	190	0.020	0.200	0.430	0.011
74/05/22	16 10	0000	27.2		95	416	8.20	162	0.040	0.400	0.400	0.003
	16 10	0005	26.0	8.0		401	8.15	163	0.030	0.200K	0.420	0.003
	16 10	0020	25.1	7.2		395	8.00	165	0.040	0.200K	0.460	0.002
	16 10	0030	23.8	5.4		389	7.75	180	0.020	0.200K	0.460	0.002K
	16 10	0055	18.6	2.6		369	7.55	187	0.040	0.200K	0.420	0.002
	16 10	0088	14.8	1.6		350	7.60	188	0.030	0.200K	0.400	0.002
74/08/15	10 15	0000	27.9	7.2	144	385	8.50					
	10 15	0010	27.7	7.2		385	8.40					
	10 15	0035	27.4	6.8		383	8.40					
	10 15	0043	25.1	2.0		391	7.60					
	10 15	0055	19.9	0.2		373	7.70					
	10 15	0080	17.2	2.6		365	7.50					
74/11/05	10 05	0000	21.4	7.4	180	343	7.97	165	0.020	0.400	0.230	0.013
	10 05	0005	21.4	7.4		342	7.98	163	0.020K	0.200	0.240	0.014
	10 05	0020	21.4	7.0		341	7.98	162	0.020K	0.300	0.230	0.012
	10 05	0040	21.3	7.8		340	7.98	161	0.020K	0.300	0.230	0.011
	10 05	0060	21.3	7.4		341	7.96	159	0.020K	0.400	0.230	0.014
	10 05	0085	20.9	4.0		405	7.59	182	0.020K	0.400	0.380	0.012
	10 05	0099	20.6	2.0		422	7.47	201	0.020K	0.300	0.480	0.013

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/02/11

480902
29 52 54.0 098 13 37.0
CANYON RESERVOIR
48091 TEXAS

11EPALES 2111202
3 0100 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/03/13	10 30	0000	0.013	0.8	
	10 30	0006	0.006		
	10 30	0015	0.006		
	10 30	0035	0.006		
	10 30	0058	0.010		
	10 30	0075	0.006		
	10 30	0094	0.011		
74/05/22	16 10	0000	0.008	3.5	
	16 10	0005	0.006		
	16 10	0020	0.007		
	16 10	0030	0.006		
	16 10	0055	0.007		
	16 10	0088	0.053		
74/08/15	10 15	0000		1.0	
	10 15	0005			50.0
	10 15	0043			1.0
74/11/05	10 05	0000	0.029	0.9	
	10 05	0001			50.0
	10 05	0005	0.023		
	10 05	0020	0.031		
	10 05	0023			1.0
	10 05	0040	0.023		
	10 05	0060	0.034		
	10 05	0085	0.023		
	10 05	0099	0.027		

STORET RETRIEVAL DATE 76/02/11

480903
29 53 31.0 098 16 49.0
CANYON RESERVOIR
48091 TEXAS

11EPALES 2111202
3 0072 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
74/03/13	11 20	0000	19.6		108	400	8.30	201	0.050	0.400	0.600	0.011
	11 20	0006	19.7	8.4		400	8.30	201	0.050	0.300	0.600	0.011
	11 20	0020	18.0	8.2		395	8.20	203	0.040	0.200K	0.600	0.005
	11 20	0035	15.4	8.0		365	8.00	199	0.040	0.300	0.540	0.010
	11 20	0050	13.8	7.2		365	8.00	224	0.060	0.300	0.660	0.011
	11 20	0068	13.2	7.2		355	8.00	216	0.050	0.300	0.620	0.006
74/05/23	09 55	0000	27.7		75	424	8.30	168	0.040	0.800	0.480	0.007
	09 55	0005	27.2	7.4		420	8.10	169	0.050	0.200K	0.490	0.005
	09 55	0015	26.4	6.4		418	7.60	169	0.050	0.200K	0.520	0.005
	09 55	0040	20.5	4.4		369	7.30	170	0.040	0.200K	0.550	0.003
	09 55	0071	15.9	2.6		383	7.40	164	0.030	0.200K	0.640	0.011
74/08/15	10 45	0000	28.2	7.2	144	399	8.40					
	10 45	0015	28.2	7.4		398	8.30					
	10 45	0028	27.2	7.0		420	8.00					
	10 45	0040	26.6	2.6		422	7.80					
	10 45	0055	20.2	0.4		482	7.20					
	10 45	0074	17.8	0.8		417	7.40					
74/11/05	10 50	0000	21.2	7.6	72	343	7.99	163	0.040	0.300	0.260	0.006
	10 50	0005	21.2	7.4		343	8.00	163	0.030	0.300	0.250	0.005
	10 50	0015	21.2	7.6		343	8.00	163	0.030	0.300	0.250	0.006
	10 50	0030	21.2	7.2		342	7.99	162	0.030	0.200K	0.250	0.011
	10 50	0050	21.0	7.0		332	7.90	159	0.040	0.200K	0.250	0.011
	10 50	0061	20.4	5.4		282	7.50	144	0.060	0.200K	0.320	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/02/11

480903
29 53 31.0 098 16 49.0
CANYON RESERVOIR
48091 TEXAS

11EPALES 2111202
3 0072 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/03/13	11	20 0000	0.009	0.9	
	11	20 0006	0.009		
	11	20 0020	0.007		
	11	20 0035	0.007		
	11	20 0050	0.007		
	11	20 0068	0.014		
74/05/23	09	55 0000	0.018	7.9	
	09	55 0005	0.008		
	09	55 0015	0.020		
	09	55 0040	0.016		
	09	55 0071	0.021		
74/08/15	10	45 0000		1.0	
	10	45 0005			50.0
	10	45 0028			1.0
74/11/05	10	50 0000	0.019	1.1	
	10	50 0001			50.0
	10	50 0005	0.015		
	10	50 0013			1.0
	10	50 0015	0.015		
	10	50 0030	0.016		
	10	50 0050	0.016		
	10	50 0061	0.045		

STORET RETRIEVAL DATE 76/02/11

480904
29 53 19.0 098 17 54.0
CANYON RESERVOIR
48091 TEXAS

11EPALES 2111202
3 0054 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
74/03/13	12 00	0000	20.0		60	425	8.20	178	0.060	0.500	0.720	0.005
	12 00	0006	20.0	8.0		425	8.20	200	0.050	0.300	0.700	0.004
	12 00	0015	19.9	8.0		420	8.00	210	0.060	0.200	0.770	0.005
	12 00	0028	16.6	7.0		410	8.00	208	0.060	0.200	0.780	0.005
	12 00	0038	15.6	6.4		430	7.90	216	0.080	0.200	0.890	0.004
	12 00	0050	14.7	5.0		420	7.80	232	0.150	0.200	0.870	0.006
74/05/23	10 15	0000	28.2		55	436	8.00	174	0.050	0.400	0.580	0.005
	10 15	0005	27.7	7.4		432	7.90	174	0.020	0.200K	0.530	0.003
	10 15	0015	26.5	6.2		430	7.80	178	0.050	0.200	0.580	0.008
	10 15	0025	25.8	4.2		512	7.40	203	0.060	0.200	0.970	0.004
	10 15	0035	21.6	1.0		390	7.10	189	0.040	0.200K	0.710	0.006
	10 15	0051	19.0	1.0		382	7.10	188	0.050	0.200K	0.700	0.005
74/08/15	11 20	0000	28.1	6.8	90	412	8.30					
	11 20	0005	28.1	7.0		413	8.30					
	11 20	0020	27.8	6.4		413	8.20					
	11 20	0030	27.3	5.0		424	7.85					
	11 20	0043	25.5	1.8		497	7.60					
74/11/05	11 20	0000	20.8	6.8	48	343	7.99	163	0.460	0.400	0.290	0.009
	11 20	0005	20.8	7.2		343	8.01	166	0.040	0.200	0.280	0.013
	11 20	0015	20.8	7.0		344	7.99	165	0.050	0.200K	0.280	0.011
	11 20	0025	20.8	6.6		338	7.90	165	0.050	0.200K	0.360	0.009
	11 20	0039	20.5	6.0		314	7.69	164	0.060	0.200K	0.430	0.009

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/02/11

480904
29 53 19.0 098 17 54.0
CANYON RESERVOIR
48091 TEXAS

11EPALES 2111202
3 0054 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/03/13	12 00	0000	0.009	1.2	
	12 00	0006	0.010		
	12 00	0015	0.010		
	12 00	0028	0.010		
	12 00	0038	0.007		
	12 00	0050	0.014		
74/05/23	10 15	0000	0.013	7.0	
	10 15	0005	0.013		
	10 15	0015	0.016		
	10 15	0025	0.017		
	10 15	0035	0.015		
	10 15	0051	0.021		
74/08/15	11 20	0000		3.0	
	11 20	0002			50.0
	11 20	0020			1.0
74/11/05	11 20	0000	0.022	1.3	
	11 20	0005	0.022		
	11 20	0015	0.020		
	11 20	0025	0.025		
	11 20	0039	0.040		

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/03/10

48809A1
29 51 50.0 098 09 50.0 4
GUADALUPE RIVER
48029 7.5 SATTLER
O/CANYON RESERVOIR
BRDG ON CO HWY 306 .25 M NW OF HWY 2673
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
74/09/08	11	00	0.128	0.600	0.020	0.005K	0.010
74/10/08	09	45	0.144	0.600	0.190	0.005K	0.010K
74/11/08	10	45	0.208	0.400	0.065	0.005	0.010K
74/12/09	10	00	0.288	0.700	0.032	0.016	0.016
75/01/08	08	50	0.416	0.400	0.016	0.005K	0.010K
75/02/07	08	50	0.368	0.200	0.016	0.008K	0.010K
75/03/07	11	00	0.350	0.500	0.025	0.005K	0.010
75/04/03	09	30	0.430	0.550	0.010	0.005K	0.020
75/04/21	13	55	0.450	0.250	0.015	0.005K	0.020
75/05/08	09	35	0.470	0.175	0.020	0.005K	0.010K
75/05/23	09	15	0.490	0.250	0.010	0.005K	0.010K
75/06/09	09	30	0.450	0.250	0.012	0.005	0.010
75/07/08	09	00	0.590	0.150	0.010	0.005K	0.010
75/08/08	09	15	0.315	0.200	0.030	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/03/10

4809A2
29 51 37.0 098 28 00.0 4
GUADALUPE RIVER
48 7.5 ANHALT
T/CANYON RESERVOIR
BRDG ON CO HWY 311 2 MI SE OF JCT US 281
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
74/09/08	08	55	1.000	1.000	0.005K	0.005	0.020
74/10/08	09	15	0.930	0.400	0.030	0.010	0.010
74/11/08	09	05	0.880	0.700	0.010	0.005	0.020
74/12/09	09	15	1.010	1.200	0.032	0.008	0.010
75/01/08	10	15	0.960	0.600	0.008	0.005K	0.010
75/02/07	10	30	0.800	0.300	0.016	0.008K	0.010K
75/03/07	09	50	1.400	0.400	0.010	0.005K	0.010
75/04/03	10	50	1.050K	0.350	0.025	0.005K	0.010K
75/04/21	15	05	1.200	0.400	0.055	0.005K	0.020
75/05/08	10	55	0.930	0.650	0.035	0.010	0.020
75/05/23	10	45	0.870	0.350	0.010	0.015	0.040
75/06/09	11	15	1.050	0.200	0.005K	0.005K	0.010
75/07/08	10	30	1.050	0.250	0.005K	0.005K	0.025
75/08/08	10	35	0.950	0.350	0.005	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/03/10

480981
29 55 00.0 098 21 55.0 4
REBBECA CREEK
48 7.5 FISCHER
T/CANYON RESERVOIR
BRDG ON SEC RD OFF US 281 4 M NE SPR BRH
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
74/09/08	09	35	0.208	0.900	0.015	0.005K	0.010
74/10/08	09	45	0.128	0.100	0.020	0.005K	0.010K
74/11/08	09	30	0.152	0.400	0.005	0.005K	0.010K
74/12/09	09	35	0.136	0.200	0.016	0.008K	0.010K
75/01/08	09	40	0.152	0.400	0.008	0.005K	0.010K
75/02/07	10	05	0.240	0.200	0.008K	0.008K	0.010K
75/03/07	10	15	0.180	0.700	0.025	0.005K	0.010K
75/04/03	10	20	0.105	0.400	0.115	0.005K	0.020
75/04/21	14	35	0.090	0.300	0.015	0.005K	0.010K
75/05/08	10	25	0.140	0.450	0.060	0.005K	0.010K
75/05/23	10	05	0.100	0.250	0.020	0.005K	0.010K
75/06/09	10	50	0.130	0.100	0.005K	0.005K	0.010K
75/07/08	10	00	0.010	0.100	0.010	0.005K	0.010K
75/08/08	10	10	0.090	0.100	0.005K	0.005K	0.010K

K VALUE KNOWN TO BE
LESS THAN INDICATED