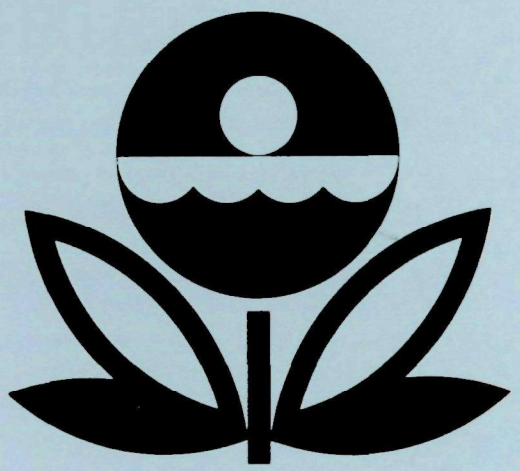
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

LAKE MCMILLAN

EDDY COUNTY

NEW MEXICO

EPA REGION VI

WORKING PAPER No. 823

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPORT
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WITH THE COOPERATION OF THE
NEW MEXICO ENVIRONMENTAL IMPROVEMENT AGENCY
AND THE
NEW MEXICO NATIONAL GUARD

JULY, 1977

REPORT ON LAKE MCMILLAN

EDDY COUNTY, NEW MEXICO

EPA REGION VI

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 823

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

July 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 nonpoint 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 the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

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

The staff of the Surveillance Section, Water Quality Division, New Mexico Environmental Improvement Agency 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.

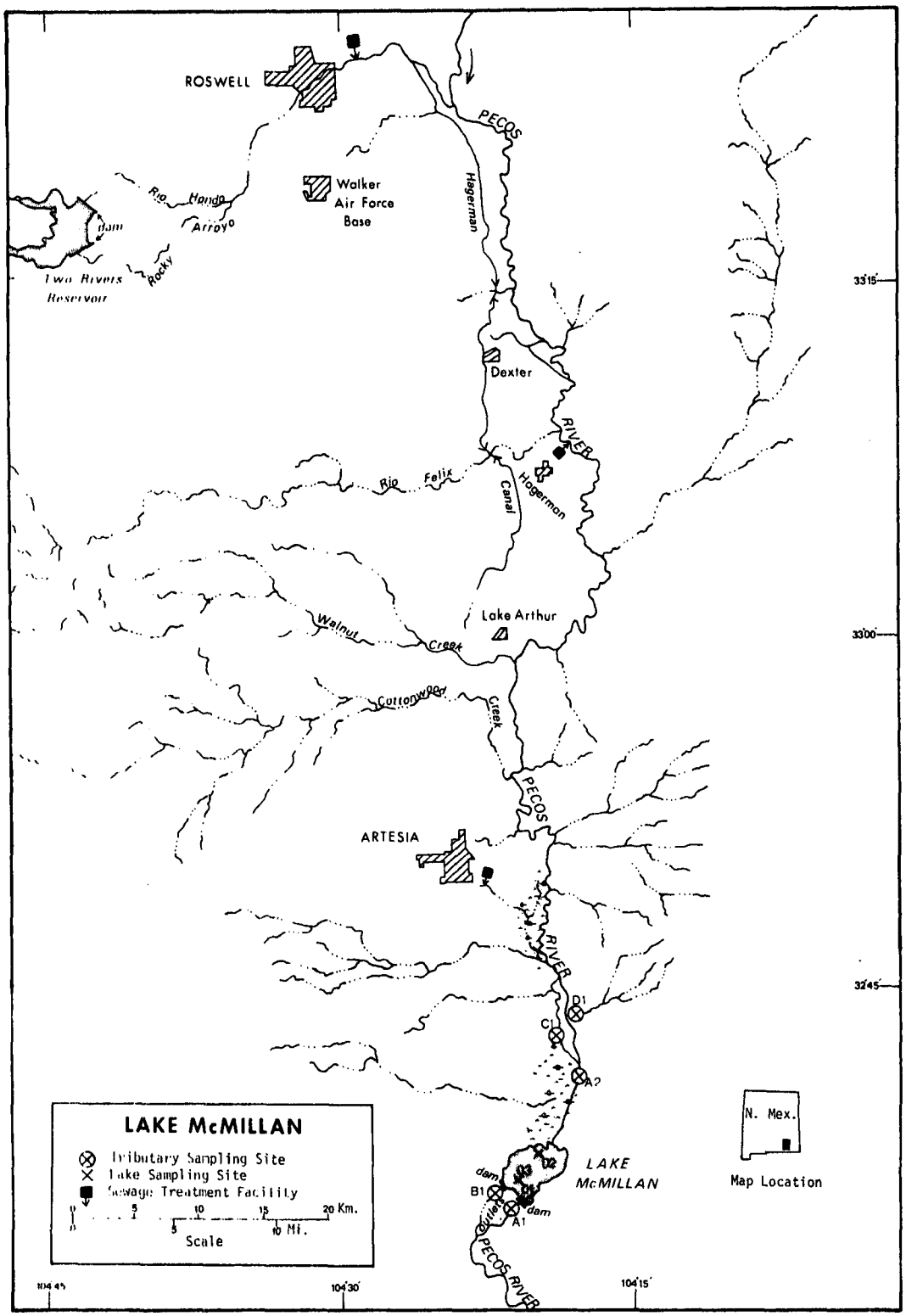
Brigadier General Franklin E. Miles, the Adjutant General of New Mexico, and Project Officer Colonel Marvin D. Bohannon, who directed the volunteer efforts of the New Mexico National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NEW MEXICO

LAKE NAME	COUNTY
Alamogordo Reservoir (Sumner Lake)	De Baca, Guadalupe
Bluewater Lake	Valencia, McKinley
Conchas Reservoir	San Miguel
Eagle Nest Lake	Colfax
Elephant Butte Reservoir	Sierra
El Vado Reservoir	Rio Arriba
Lake McMillan	Eddy
Ute Reservoir	Quay


ROSWELL
PECOS
Hagerman
Walker
Air Force
Base
Rio Hondo
Arroyo
Dam
Two Rivers
Reservoir
Rocky
Dexter
RIVER
Rio Felix
Canal
Hagerman
Lake Arthur
Walnut Creek
Cottonwood Creek
PECOS
ARTESIA
RIVER
D1
C1
A2
D2
B2
B1
A1
dam
dam
Outlet
PECOS RIVER
LAKE
McMILLAN
N. Mex.
Map Location
LAKE McMILLAN
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 5 10 15 20 Km.
0 5 10 Mi.
Scale
33°15'
33°00'
32°45'
104°45'
104°30'
104°15'

REPORT ON LAKE MCMILLAN, NEW MEXICO

STORET NO. 3507

I. CONCLUSIONS

A. Trophic Condition:*

Survey data indicate Lake McMillan is eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses of each lake.

Chlorophyll a values in the lake ranged from 8.1 µg/l in the spring to 18.7 µg/l in the fall with a mean of 14.1 µg/l. Potential for primary productivity as measured by algal assay control yields was low in spring and high in the fall. Secchi disc visibility was low. Of the nine New Mexico lakes sampled (including Navajo Reservoir) in 1975, only one had higher median total phosphorus values (0.097 mg/l), six had higher median inorganic nitrogen levels (0.045 mg/l), and four had higher median orthophosphorus values (0.009 mg/l) than Lake McMillan.

Survey limnologists did not report any algal blooms or macrophyte problems during their visits to the lake. Other studies (New Mexico Environmental Improvement Agency, 1974) indicate that salinity and fluctuating water levels due to

*See Appendix E.

draw down for irrigation are the major water quality problems in Lake McMillan.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Lake McMillan was limited by available phosphorus during the sample collection times (05/01/75, 10/02/75). Lake data suggest primary limitation by phosphorus in the spring and nitrogen limitation in the summer and fall.

C. Nutrient Controllability:

1. Point sources -

The city of Artesia contributed an estimated 56.2% of the total phosphorus load to Lake McMillan during the sampling year. However, actual annual contributions to Lake McMillan from this source are probably somewhat less than the calculated values since a portion of the treatment plant discharge is diverted for irrigation (U.S. EPA, 1971). In addition, there are sewage treatment facilities upstream in the Pecos River at Hagerman and Roswell which are not included in the lake nutrient budget (Section IV B-C) due to their distance from the reservoir.

The present phosphorus loading of 1.05 g $P/m^2/yr$ is almost twice that proposed by Vollenweider as

"eutrophic" for a lake of such volume and hydraulic retention time. The New Mexico Environmental Improvement Agency (1974) reports that high nutrient levels in the reservoir can be attributed to surrounding land use practices, such as overgrazing, irrigational runoff and drainage from surrounding feedlots. Additional investigation to determine actual contributions from the known point sources upstream and a closer examination of land use practices are necessary before recommendations on nutrient controllability can be made.

2. Nonpoint sources -

The mean annual phosphorus load not attributable to point sources within 40 stream km (25 miles) of Lake McMillan was about 43.8% of the total reaching the lake. The Pecos River contributed 41.4% of the total load, and ungaged tributaries contributed an estimated 0.7%.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometry data were provided by Martin and Hanson (1966) and Tony Drypolcher (personal communication). Tributary flow data were provided by the New Mexico District Office of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 23.05 km^2.
2. Mean depth: 2.1 meters.
3. Maximum depth: 7.9 meters.
4. Volume: 48.637 x 10^6 m^3.
5. Mean hydraulic retention time: 81 days.

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

1. Tributaries -

Name	Drainage area (km^2)	Mean Flow (m^3/sec)
A-2 Pecos River (Kaiser Channel)	42,597.2	6.69
Minor tributaries and immediate drainage -	1,383.9	0.26
Total	43,981.1	6.95
2. Outlet - A-1 Pecos River	44,004.1	6.94

C. Precipitation:

1. Year of sampling: 26.3 cm.
2. Mean annual: 26.5 cm.

III. LAKE WATER QUALITY SUMMARY

Lake McMillan was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from one or more depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 3.0 meters at Station 01, the surface at Station 02, and 1.5 meters at Station 03. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

LAKE MACMILLAN
STORET CODE 3507

PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(5/ 1/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(8/20/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(10/ 2/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)												
0.-1.5 M DEPTH	4	15.2- 16.8	15.7	0.0- 1.5	5	22.3- 25.7	23.9	0.0- 1.5	4	16.9- 18.5	18.1	0.0- 1.5
MAX DEPTH**	3	15.2- 16.8	16.2	0.0- 3.0	3	23.4- 25.7	23.9	0.0- 1.5	3	16.9- 18.5	17.8	0.0- 1.5
DISSOLVED OXYGEN (MG/L)												
0.-1.5 M DEPTH	4	8.2- 8.4	8.4	0.0- 1.5	5	4.9- 6.3	6.2	0.0- 1.5	4	8.3- 9.1	8.4	0.0- 1.5
MAX DEPTH**	3	8.4- 8.4	8.4	0.0- 3.0	3	4.9- 6.3	6.2	0.0- 1.5	3	8.3- 9.1	8.4	0.0- 1.5
CONDUCTIVITY (UMHOS)												
0.-1.5 M DEPTH	4	7193.-7243.	7220.	0.0- 1.5	5	3875.-4312.	3988.	0.0- 1.5	4	3581.-3875.	3745.	0.0- 1.5
MAX DEPTH**	3	7167.-7243.	7222.	0.0- 3.0	3	3875.-4312.	3988.	0.0- 1.5	3	3581.-3875.	3763.	0.0- 1.5
PH (STANDARD UNITS)												
0.-1.5 M DEPTH	4	8.3- 8.3	8.3	0.0- 1.5	5	7.9- 8.1	7.9	0.0- 1.5	4	7.7- 8.1	8.0	0.0- 1.5
MAX DEPTH**	3	8.3- 8.3	8.3	0.0- 3.0	3	7.9- 8.1	8.0	0.0- 1.5	3	7.9- 8.1	8.0	0.0- 1.5
TOTAL ALKALINITY (MG/L)												
0.-1.5 M DEPTH	4	119.- 126.	122.	0.0- 1.5	5	102.- 104.	103.	0.0- 1.5	4	78.- 87.	81.	0.0- 1.5
MAX DEPTH**	3	119.- 122.	121.	0.0- 3.0	3	102.- 104.	103.	0.0- 1.5	3	78.- 87.	79.	0.0- 1.5
TOTAL P (MG/L)												
0.-1.5 M DEPTH	4	0.044-0.254	0.050	0.0- 1.5	5	0.058-0.109	0.078	0.0- 1.5	4	0.117-0.217	0.134	0.0- 1.5
MAX DEPTH**	3	0.053-0.254	0.087	0.0- 3.0	3	0.070-0.109	0.108	0.0- 1.5	3	0.125-0.217	0.143	0.0- 1.5
DISSOLVED ORTHO P (MG/L)												
0.-1.5 M DEPTH	4	0.006-0.011	0.009	0.0- 1.5	5	0.006-0.009	0.007	0.0- 1.5	4	0.010-0.022	0.015	0.0- 1.5
MAX DEPTH**	3	0.009-0.011	0.009	0.0- 3.0	3	0.006-0.009	0.007	0.0- 1.5	3	0.010-0.021	0.010	0.0- 1.5
NO2+NO3 (MG/L)												
0.-1.5 M DEPTH	4	0.080-0.110	0.095	0.0- 1.5	5	0.020-0.020	0.020	0.0- 1.5	4	0.020-0.020	0.020	0.0- 1.5
MAX DEPTH**	3	0.080-0.110	0.090	0.0- 3.0	3	0.020-0.020	0.020	0.0- 1.5	3	0.020-0.020	0.020	0.0- 1.5
AMMONIA (MG/L)												
0.-1.5 M DEPTH	4	0.050-0.100	0.065	0.0- 1.5	5	0.020-0.030	0.020	0.0- 1.5	4	0.020-0.020	0.020	0.0- 1.5
MAX DEPTH**	3	0.050-0.080	0.060	0.0- 3.0	3	0.020-0.030	0.020	0.0- 1.5	3	0.020-0.020	0.020	0.0- 1.5
KJELDAHL N (MG/L)												
0.-1.5 M DEPTH	4	0.600-1.000	0.750	0.0- 1.5	5	0.300-0.400	0.400	0.0- 1.5	4	0.400-0.600	0.450	0.0- 1.5
MAX DEPTH**	3	0.600-1.000	0.700	0.0- 3.0	3	0.300-0.400	0.400	0.0- 1.5	3	0.400-0.600	0.500	0.0- 1.5
SECCHI DISC (METERS)												
	3	0.2- 0.5	0.3		3	0.3- 0.4	0.4		3	0.1- 0.1	0.1	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera		Algal Units per ml
05/01/75	1.	Achnanthes	2,733
	2.	Cyclotella	1,997
	3.	Chlorophytan lunate cell	1,682
	4.	Chroomonas ?	420
	5.	Oocystis	315
		Other genera	210
		Total	7,357
08/20/75	1.	Nitzschia	770
	2.	Oscillatoria	147
	3.	Euglena	147
	4.	Cryptomonas	37
	5.	Cyclotella	37
		Other genera	36
		Total	1,174
10/02/75	1.	Nitzschia	2,718
	2.	Oscillatoria	614
	3.	Anabaena	380
	4.	Euglena	146
	5.	Binuclearia	146
		Other genera	380
		Total	4,384

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
05/01/75	01	11.2
	02	8.1
	03	13.0
08/20/75	01	12.1
	02	10.7
	03	16.0
10/02/75	01	18.7
	02	18.7
	03	18.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
a. 05/01/75			
Control	<0.005	0.135	0.2
0.05 P	<0.055	0.135	5.0
0.05 P + 1.0 N	<0.055	1.135	14.7
1.00 N	<0.005	1.135	0.1
b. 10/02/75			
Control	0.020	0.155	3.2
0.05 P	0.070	0.155	7.8
0.05 P + 1.0 N	0.070	1.155	24.5
1.00 N	0.020	1.155	3.2

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential for primary production in Lake McMillan was low during the spring sampling (05/01/75) and high during the fall sampling (10/02/75). In both assays, a significant increase in growth over that of the control was produced by the addition of phosphorus alone and in combination with nitrogen, indicating phosphorus limitation. Spikes of only nitrogen did not stimulate growth beyond control yields.

The mean inorganic nitrogen to orthophosphorus ratios (N/P) in the lake data were approximately 17/1, 6/1, and 3/1 in the spring, summer and fall, respectively, suggesting primary limitation by phosphorus in the spring and by nitrogen in the summer and fall (a mean N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

IV. NUTRIENT LOADINGS
(See Appendix D for data)

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

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the New Mexico District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual concentrations in Unnamed Creek at Station D-1 and mean annual ZZ flow.

Nutrient loads for the city of Artesia wastewater treatment plant were estimated at 1.134 kg P and 3.401 kg N/capita/year.

A. Waste Sources:

1. Known municipal -

Name	Pop.* Served	Treatment*	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Artesia	12,000	Trickling Filter	4.542**	Irrigation and Pecos River

2. Known industrial - None

*U.S. EPA, 1971.
**Estimated at 0.3785 m^3/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Pecos River (Kaiser Channel)	10,040	41.4
b. Minor tributaries and immediate drainage (nonpoint load) -	180	0.7
c. Known municipal STP's -		
Artesia	13,610	56.2
d. Septic tanks - None known		
e. Known industrial - None		
f. Direct precipitation* -	405	1.7
Total	24,235	100.0%

2. Outputs - A-1 Pecos River 16,860

3. Net annual P accumulation - 7,375

*Estimated (See NES Working Paper No. 175).

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Pecos River (Kaiser Channel)	356,695	75.7
b. Minor tributaries and immediate drainage (nonpoint load) -	48,540	10.3
c. Known municipal STP's -		
Artesia	40,810	8.7
d. Septic tanks - None known		
e. Known industrial - None		
f. Direct precipitation* -	24,885	5.3
Total	470,930	100.0%

2. Outputs - A-1 Pecos River 641,260

3. Net annual N export** - 170,330

*Estimated (See NES Working Paper No. 175).
**Export probably due to unknown sources and/or sampling error.

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Pecos River (Kaiser Channel)	<1	8

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P (mg/l)	Mean Total N (mg/l)
B-1 Overflow Outlet	0.043	1.605
C-1 Pecos River (West Channel)	0.230	1.910
D-1 Unnamed Creek	0.022	5.920

Phosphorus levels in the Pecos River (West Channel), C-1, and nitrogen levels in Unnamed Creek, D-1, appear greatly inflated when compared to the other tributaries to Lake McMillan.

F. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" 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 "eutrophic" and "oligotrophic".

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading ($g/m^2/yr$)
Estimated loading for Lake McMillan	1.05
Vollenweider's "eutrophic" loading	0.62
Vollenweider's "oligotrophic" loading	0.31

V. LITERATURE REVIEWED

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VI. APPENDICES

APPENDIX A

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 B

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEW MEXICO 12/16/76

LAKE CODE 3507 LAKE MCMILLAN

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 44004.1

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEA
3507A1	44004.1	3.54	1.70	1.61	3.96	11.04	8.50	16.14	16.99	11.61	5.95	0.91	0.74	6.9
3507A2	42597.2	3.43	1.64	1.56	3.85	10.70	8.24	15.66	16.48	11.24	5.78	0.62	0.51	6.6
3507D1	60.1	0.0	0.002	0.002	0.006	0.011	0.001	0.057	0.034	0.023	0.011	0.001	0.0	0.01
3507ZZ	1346.8	0.108	0.051	0.048	0.122	0.340	0.261	0.481	0.510	0.368	0.181	0.278	0.227	0.24

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 44004.1
SUM OF SUB-DRAINAGE AREAS = 44004.1
TOTAL FLOW IN = 82.83
TOTAL FLOW OUT = 82.69

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3507A1	12	74	0.224						
	1	75	0.229						
	2	75	0.031						
	3	75	0.249						
	4	75	5.550	13	3.285				
	5	75	2.209						
	6	75	3.398	7	3.087				
	7	75	1.869	26	1.982				
	8	75	4.248	25	6.371				
	9	75	2.492	22	0.878				
	10	75	1.954	23	0.017				
	11	75	0.006	11	0.008				
3507A2	12	74	2.605	7	2.860				
	1	75	2.124	11	2.095				
	2	75	2.095	1	1.642				
	3	75	1.359	2	2.209				
	4	75	0.991	1	0.934				
	5	75	0.453						
	6	75	14.442						
	7	75	8.495	26	7.334				
	8	75	0.481	25	0.102				
	9	75	0.280	22	0.283				
	10	75	0.396	23	0.425				
	11	75	0.934	12	0.991				

TRIBUTARY FLOW INFORMATION FOR NEW MEXICO 12/16/76

LAKE CODE 3507 LAKE MCMILLAN

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
350701	12	74	0.0	7	0.0				
	1	75	0.0	11	0.0				
	2	75	0.003	1	0.002				
	3	75	0.002	2	0.003				
	4	75	0.000	1	0.000				
	5	75	0.001						
	6	75	0.002						
	7	75	0.031	26	0.027				
	8	75	0.001	25	0.000				
	9	75	0.001	22	0.0				
	10	75	0.001	22	0.0				
	11	75	0.002	12	0.0				
3507ZZ	12	74	1.161						
	1	75	0.068						
	2	75	0.065						
	3	75	0.042						
	4	75	0.031						
	5	75	0.014						
	6	75	0.453						
	7	75	0.261						
	8	75	0.015						
	9	75	0.009						
	10	75	0.012						
	11	75	0.028						

APPENDIX C

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

350701
32 35 51.0 104 20 47.0 3
LAKE MACMILLAN
35015 NEW MEXICO

/TYPA/AMBNT/LAKE

11EPALES 760109 04001002
0015 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/01	11	25 0000	15.2	8.4	20	7218	8.30	126	0.100	0.900	0.110	0.009
	11	25 0005	15.3	8.2		7193	8.30	123	0.070	0.600	0.100	0.006
	11	25 0010	15.2	8.4		7167	8.30	122	0.080	0.700	0.110	0.009
75/08/20	10	10 0000	23.9	6.3	15	4007	7.90	103	0.020K	0.400	0.020K	0.007
	10	10 0004	23.9	6.2		3988	8.10	103	0.020	0.400	0.020K	0.006
75/10/02	10	15 0000	18.5	8.4	3	3727	7.70	83	0.020K	0.400	0.020K	0.022
	10	15 0005	18.5	8.3		3763	8.00	79	0.020K	0.500	0.020K	0.021

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/01	11	25 0000	0.044	11.2	
	11	25 0005	0.048		
	11	25 0010	0.087		
75/08/20	10	10 0000	0.058	12.1	
	10	10 0004	0.070		
75/10/02	10	15 0000	0.117	18.7	
	10	15 0005	0.125		

K VALUE KNOWN TO BE LESS
THAN INDICATED

NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

350702
32 37 45.0 104 19 44.0 3
LAKE MACMILLAN
35015 NEW MEXICO

/TYPA/AMBNT/LAKE

11EPALES 760109 04001002
0003 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/01	13 25	0000	16.2	8.4	12	7222	8.30	121	0.060	0.600	0.090	0.009
75/08/20	10 45	0000	25.7	6.3	12	4312	8.00	102	0.020	0.300	0.020K	0.007
75/10/02	10 00	0000	17.8	8.4	3	3875	7.95	87	0.020K	0.400	0.020K	0.010

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/01	13 25	0000	0.053	8.1	
75/08/20	10 45	0000	0.109	10.7	
75/10/02	10 00	0000	0.143	18.7	

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

350703
32 36 58.0 104 21 23.0 3
LAKE MACMILLAN
35015 NEW MEXICO

/TYPA/AMBNT/LAKE

11EPALES 760109 04001002
0003 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/01	13 50	0000	16.8	8.4	9	7243	8.30	119	0.050	1.000	0.080	0.011
75/08/20	10 25	0000	22.3	5.1	15	3900	7.90	104	0.030	0.400	0.020K	0.006
	10 25	0005	23.4	4.9		3875	7.90	104	0.030	0.400	0.020K	0.009
75/10/02	10 25	0000	16.9	9.1	3	3581	8.10	78	0.020K	0.600	0.020K	0.010

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/01	13 50	0000	0.254	13.0	
75/08/20	10 25	0000	0.078	16.0	
	10 25	0005	0.108		
75/10/02	10 25	0000	0.217	18.7	

K VALUE KNOWN TO BE LESS
THAN INDICATED

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3507A1
32 35 42.0 104 20 49.0 4
PECOS RIVER
35 7.5 LK MCMILAN S
O/LAKE MCMILLAN 120891
BNK 100 FT SW DRT RD 4 M WNW FANNING RAN
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/04/13	11	45	0.115	2.900	0.030	0.005K	0.010
75/06/07	15	45	0.010	1.050	0.090	0.020	0.120
75/07/26	11	35	0.005	1.700	0.040	0.005K	0.080
75/08/25	08	40	0.005	1.400		0.010	0.050
75/09/22	16	00	0.015	1.400	0.055	0.020	0.120
75/10/23	13	00	0.015	2.200	0.070	0.020	0.140
75/11/11	12	00	0.010	0.100K	0.045	0.015	0.070

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3507A2
32 39 02.0 104 18 43.0 4
KAISER CHANNEL
35 7.5 LK MCMILAN N
T/LAKE MCMILLAN 120891
BNK W END DRT RD 5.5 MI WSW WILLIAMS RAN
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
74/12/07	10 45		0.736	1.100	0.120	0.010	0.100
75/01/11	12 02		0.497	1.250			0.107
75/02/01	12 40		0.160	2.200	0.056	0.095	0.195
75/03/02	09 50		0.035	1.250	0.105	0.080	0.160
75/04/01	11 45		0.005	2.300	0.065	0.045	0.150
75/07/26	10 50		0.230		0.650	0.005K	
75/08/25	10 15		0.540		0.120	0.015	
75/09/22	10 00		0.015	1.600	0.060	0.030	0.100
75/10/23	14 50		0.690	0.900	0.005K	0.005K	
75/11/12	11 00		0.010	0.700	0.050	0.030	0.050

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

350781
32 36 20.0 104 21 50.0 4
OVERFLOW OUTLET
35 7.5 LK MCMILAN S
T/LAKE MCMILLAN 120891
BNK 500 FT N OF DRT RD 1 MI NW OF DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/12/07	09 40		0.064	1.800	0.105	0.005	0.010
75/01/11	13 15		0.172	1.220	0.128	0.012	0.020
75/02/01	13 30		0.168	1.500	0.088	0.020	0.032
75/03/02	09 15		0.175	1.750	0.105	0.020	0.020
75/07/26	11 45		0.015	1.650	0.040	0.010	0.040
75/08/25	08 55		0.015	1.150	0.035	0.010	0.050
75/10/23	14 00		0.005	1.800	0.025	0.010	0.050
75/11/11	12 20		0.005	1.350	0.040	0.020	0.120

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3507C1
32 39 12.0 104 19 55.0 4
WEST CHANNEL
35 7.5 LK MCMILAN N
T/LAKE MCMILLAN 120891
BNK E END DRT RD 3.4 MI NE OF LAKEWOOD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/11/12	10	00	0.010	1.900	0.055	0.075	0.230

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

350701
32 43 45.0 104 18 12.0 4
UNNAMED CREEK
35 7.5 LK MCMILAN N
T/LAKE MCMILLAN 120891
RD XING .4 MI UPSTRM FRM CON WITH PECOS
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
74/12/07	12 05		8.200	0.600	0.040	0.008	0.010K
75/01/11	11 00		8.130	0.460	0.040	0.015	0.040
75/02/01	11 45		7.920	0.800	0.024	0.010	0.020
75/03/02	10 50		7.500	0.600	0.040	0.005K	0.010
75/04/01	13 00		6.000	1.690	0.055	0.005K	0.012
75/07/26	09 45		2.400	1.150	0.070	0.005K	0.020
75/08/25	12 50		2.750	0.600	0.070	0.005	0.020
75/09/22	10 00		2.500	0.700	0.065	0.010	0.040
75/10/22	15 00		2.500	1.600	0.115	0.015	0.015
75/11/12	09 00		2.200	0.900	0.178	0.005	0.020

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 77/02/14
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3507A1 TF3507AA P0420000
33 24 45.0 104 24 50.0 4
ROSWELL
35 7.5 ROSWELL N
T/LAKE MCMILLAN 120291
RIO RONDO TO PECOS RIVER
11EPALES 00001004
0000 FEET DEPTH CLASS 00

/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00631 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
74/12/03	08 00								
CP(T)-			0.240	19.000	11.000	7.100	8.600	4.000	4.300
74/12/04	08 00								
75/01/07	00 00								
CP(T)-			0.150	32.000	16.000	7.700	9.900	4.500	4.300
75/01/07	24 00								
75/02/02	00 00								
CP(T)-			0.150	33.000	14.000	8.000	10.500	3.800	4.200
75/02/02	24 00								
75/03/04	00 00								
CP(T)-			0.080	32.000	16.000	8.000	13.800	4.400	4.300
75/03/04	24 00								
75/04/01	00 00								
CP(T)-			0.116	29.000	13.600	4.500	5.150	4.500	4.200
75/04/01	24 00								
75/05/04	00 00								
CP(T)-			0.100	31.000	13.500	7.100	10.500	3.800	4.500
75/05/04	24 00								
75/06/03	00 00								
CP(T)-			0.050	35.000	17.000	3.900	5.200	4.900	4.500
75/06/03	24 00								
75/07/08	00 00								
CP(T)-			0.200	30.000	10.500	2.900	7.950	4.800	4.500
75/07/08	24 00								
75/08/03	00 00								
CP(T)-			0.675	28.000	14.500	6.400	7.400	4.100	4.800
75/08/03	24 00								
75/09/02	00 00								
CP(T)-			0.200	25.000	11.500	6.400	7.100	5.000	5.100
75/09/02	24 00								
75/09/27	00 00								
CP(T)-								5.000	5.100
75/09/27	24 00								
75/10/01	00 00								
CP(T)-			0.425	35.000	19.500	5.010	8.300	4.000	4.300
75/10/01	24 00								

STREET RETRIEVAL DATE 77/03/19
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3507AA TF3507AA 0042000
33 24 45.0 104 28 50.0 4
ROSWELL
35 7.5 ROSWELL N
T/LAKE MCMILLAN 120891
RIO HONDO TO PECOS RIVER
11EPALES 00001004
0000 FEET DEPTH CLASS 00

/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2+NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/11/04	00	00							
CP(T)-			1.300	4.600	12.000	7.400	8.800	4.000	4.800
75/11/04	24	00							
75/12/02	00	00							
CP(T)-			0.300	32.000	21.000	7.800	8.400	4.300	3.700
75/12/02	24	00							

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1975

STATE OF NEW MEXICO

Mean or median values for six of the key parameters evaluated in establishing the trophic conditions of New Mexico lakes sampled are presented to allow direct comparison of the ranking, by parameter, of each lake relative to the others. Median total phosphorus, median inorganic nitrogen and median dissolved orthophosphorus levels are expressed in mg/l. Chlorophyll a values are expressed in µg/l. To maintain consistent rank order with the preceding parameters, the mean Secchi disc depth, in inches, is subtracted from 500. Similarly, minimum dissolved oxygen values are subtracted from 15 to create table entries.

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
0812	NAVAJO RESERVOIR	0.025	0.130	420.928	2.164	11.200	0.009
3501	ALAMOGORDO	0.025	0.050	469.667	5.867	10.600	0.003
3502	BLUE WATER LAKE	0.036	0.140	480.125	3.867	11.400	0.012
3503	CONCHAS RESERVOIR	0.020	0.040	451.833	3.275	14.400	0.004
3504	EAGLE NEST LAKE	0.181	0.070	455.750	13.357	14.400	0.132
3505	ELEPHANT BUTTE RESERVOIR	0.083	0.110	475.750	6.758	14.200	0.052
3506	EL VADO RESERVOIR	0.034	0.140	466.444	2.189	12.600	0.014
3507	LAKE MACMILLAN	0.097	0.045	489.778	14.133	10.100	0.009
3509	UTE RESERVOIR	0.021	0.040	448.750	3.242	13.800	0.004

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
0812	NAVAJO RESERVOIR	63 (5)	25 (2)	100 (8)	100 (8)	75 (6)	56 (4)
3501	ALAMOGORDO	75 (6)	63 (5)	38 (3)	38 (3)	88 (7)	100 (8)
3502	BLUE WATER LAKE	38 (3)	6 (0)	13 (1)	50 (4)	63 (5)	38 (3)
3503	CONCHAS RESERVOIR	100 (8)	94 (7)	75 (6)	63 (5)	6 (0)	81 (6)
3504	EAGLE NEST LAKE	0 (0)	50 (4)	63 (5)	13 (1)	6 (0)	0 (0)
3505	ELEPHANT BUTTE RESERVOIR	25 (2)	38 (3)	25 (2)	25 (2)	25 (2)	13 (1)
3506	EL VADO RESERVOIR	50 (4)	6 (0)	50 (4)	88 (7)	50 (4)	25 (2)
3507	LAKE MACMILLAN	13 (1)	75 (6)	0 (0)	0 (0)	100 (8)	56 (4)
3509	UTE RESERVOIR	88 (7)	94 (7)	88 (7)	75 (6)	38 (3)	81 (6)