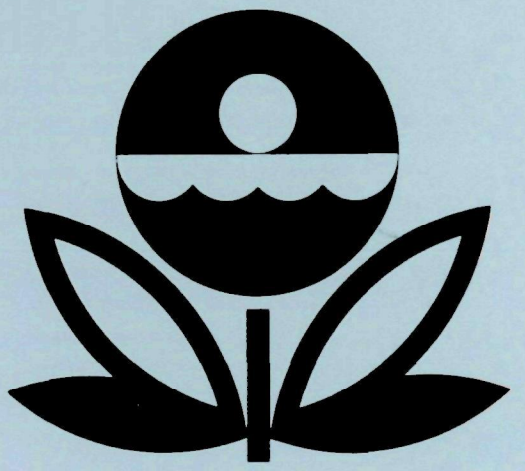
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

LAKE AMADOR

AMADOR COUNTY

CALIFORNIA

EPA REGION IX

WORKING PAPER No. 739

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPORT
ON
LAKE AMADOR
AMADOR COUNTY
CALIFORNIA
EPA REGION IX
WORKING PAPER No. 739

WITH THE COOPERATION OF THE
CALIFORNIA STATE WATER RESOURCES CONTROL BOARD
AND THE
CALIFORNIA NATIONAL GUARD
JUNE, 1978

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 concentration (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 California State Water Resources Control Board and the nine Regional Water Quality Control Boards for professional involvement, to the California National Guard for conducting the tributary sampling phase of the Survey, and to those California wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Division of Planning and Research of the State Water Resources Control Board provided invaluable lake documentation and counsel during the Survey, coordinated the reviews of the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

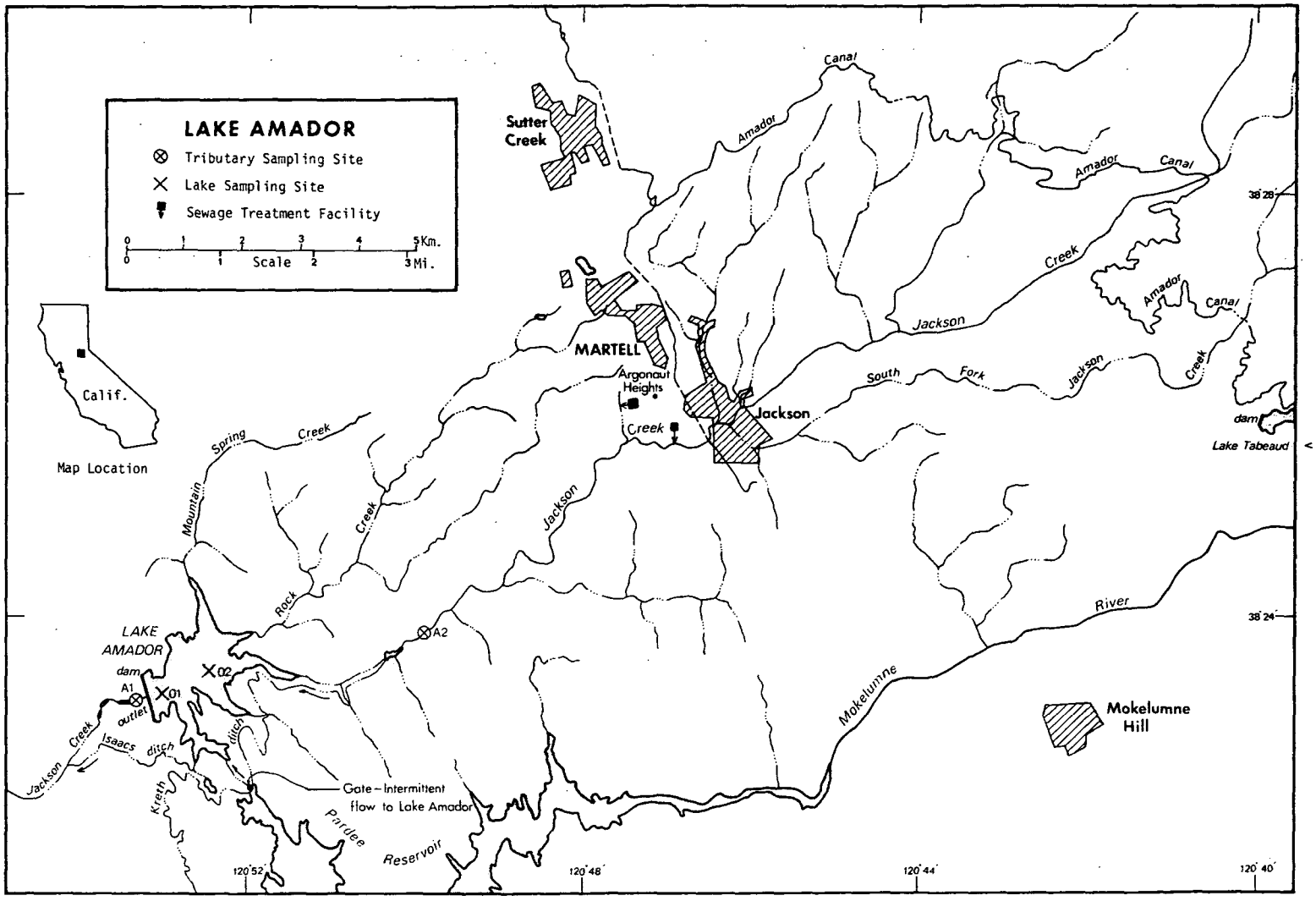
Major General Glen C. Ames, the Adjutant General of California, and Project Officer Second Lieutenant Terry L. Barrie, who directed the volunteer efforts of the California National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of California

Name	County
Amador	Amador
Boca	Nevada
Britton	Shasta
Casitas	Ventura
Crowley	Mono
Don Pedro	Tuolumne
Elsinore	Riverside
Fallen Leaf	El Dorado
Hennessey	Napa
Henshaw	San Diego
Iron Gate	Siskiyou
Lopez	San Luis Obispo
Mary	Mono
Mendocino	Mendocino
Nicasio	Marin
Lower Otay	San Diego
Pillsbury	Lake
Santa Margarita	San Luis Obispo
Shasta	Shasta
Shaver	Fresno
Silver	Mono
Tahoe	El Dorado, Placer, CA; Carson City, Douglas, Washoe, NV
Tulloch	Calaveras, Tuolumne
Lower Twin	Mono
Upper Twin	Mono


LAKE AMADOR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Scale
Km.
Mi.
Calif.
Map Location
Sutter Creek
Amador Canal
MARTELL
Argonaut Heights
Jackson
Creek
Jackson Creek
South Fork Jackson Creek
Amador Canal
dam
Lake Tabeaud
Spring Mountain Creek
Rock Creek
Jackson Creek
LAKE AMADOR
dam
A1
outlet
A2
X01
X02
Jackson Creek
Isaacs ditch
ditch
Gate – Intermittent flow to Lake Amador
Pardee Reservoir
Mokelumne River
Mokelumne Hill
38°28'
38°24'
120°52'
120°48'
120°44'
120°40'

LAKE AMADOR

STORET NO. 0601

I. CONCLUSIONS

A. Trophic Condition*:

Survey data indicate Lake Amador is eutrophic. It ranked twentieth in overall trophic quality when the 24 California lakes and reservoirs sampled in 1975 were compared using a combination of six parameters**. Fifteen of the waterbodies had less median total phosphorus, 17 had less median dissolved orthophosphorus, 22 had less median inorganic nitrogen, 21 had less mean chlorophyll a, and 13 had greater mean Secchi disc transparency. Marked depression of oxygen with depth occurred at both sampling stations in June and November.

Survey limnologists did not observe macrophytes or surface concentrations of algae at any of the sampling times. However, the chlorophyll a concentration at station 1 in November is indicative of a bloom condition.

B. Rate-Limiting Nutrient:

The results of the algal assay indicate the reservoir was phosphorus limited at the time the sample was taken (03/14/75). The reservoir data indicate phosphorus limitation in March and June and nitrogen limitation in November.

C. Nutrient Controllability:

1. Point sources--The contribution of known point sources amounted to 68.4% of the total phosphorus load to Lake Amador

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* Trophic assessment is based on levels of nutrients, dissolved oxygen, and chlorophyll a; phytoplankton kinds and numbers; and transparancy (Allum et al., 1977)

** See Appendix A.

during the sampling year. The City of Jackson added 67.6% of the total load, and Argonaut Heights added 0.8%.

The present phosphorus loading of 2.45 $g/m^2/yr$ is more than twice that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11). If 90% phosphorus removal is provided at Jackson, the reduced loading will be just equal to the eutrophic loading (0.96 $g/m^2/yr$). If a higher degree of removal can be achieved at the Jackson plant, the trophic condition of the reservoir should improve once a new phosphorus equilibrium is established.

2. Non-point sources--Non-point sources, including direct precipitation, added 31.6% of the total phosphorus load to the reservoir during the sampling year. Jackson Creek contributed 22.5% of the total, and the ungaged tributaries added an estimated 8.4%.

The phosphorus export rate of Jackson Creek was 8 $kg/km^2/yr$ (see page 10).

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 1.56 kilometers^2.
2. Mean depth: 17.4 meters.
3. Maximum depth: 58.8 meters.
4. Volume: 27.136 x 10^6 m^3.
5. Mean hydraulic retention time: 261 days (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)*
Jackson Creek	109.8	0.899
Minor tributaries & immediate drainage -	39.9	0.337
Totals	149.7	1.236

2. Outlets -

Unnamed Aqueduct	0.0	0.499
Jackson Creek	151.3	0.704
Totals	151.3**	1.203**

C. Precipitation***:

1. Year of sampling: 43.1 centimeters.
2. Mean annual: 44.6 centimeters.

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† Table of metric equivalents--Appendix B.
†† Dendy, 1974.
* For limits of accuracy, see Working Paper No. 175, "... Survey Methods, 1973-1976".
** Includes area of reservoir;lesser outflow due to evaporation.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Lake Amador 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 a number of depths at two stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first 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 44.2 meters at station 1 and 42.7 meters at station 2.

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

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR AMADOR RESERVOIR
STORET CODE 0601

	1ST SAMPLING (3/14/75)			2ND SAMPLING (6/26/75)			3RD SAMPLING (11/12/75)		
	2 SITES			2 SITES			2 SITES		
PARAMETER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
TEMP (C)	5.5 - 8.3	6.7	6.3	7.5 - 22.9	13.8	8.5	11.9 - 16.8	15.3	16.8
DISS OXY (MG/L)	6.8 - 11.8	8.8	7.8	1.6 - 9.4	4.7	3.4	0.4 - 9.2	5.5	7.6
CNDCTVY (MCROMO)	170. - 194.	183.	185.	130. - 210.	166.	155.	158. - 298.	183.	174.
PH (STAND UNITS)	6.9 - 8.7	7.8	7.5	7.2 - 9.4	8.0	7.6	7.1 - 7.7	7.5	7.6
TOT ALK (MG/L)	63. - 75.	70.	71.	75. - 90.	82.	80.	62. - 98.	71.	66.
TOT P (MG/L)	0.037 - 0.056	0.046	0.045	0.016 - 0.044	0.031	0.028	0.018 - 0.356	0.068	0.025
ORTHO P (MG/L)	0.012 - 0.049	0.031	0.034	0.006 - 0.027	0.015	0.009	0.005 - 0.092	0.026	0.013
NO2+NO3 (MG/L)	0.230 - 0.680	0.456	0.435	0.020 - 0.630	0.350	0.510	0.020 - 0.430	0.100	0.040
AMMONIA (MG/L)	0.020 - 0.030	0.021	0.020	0.020 - 0.040	0.024	0.020	0.020 - 0.720	0.096	0.020
KJEL N (MG/L)	0.200 - 0.600	0.312	0.200	0.200 - 0.600	0.257	0.200	0.200 - 1.000	0.277	0.200
INORG N (MG/L)	0.250 - 0.700	0.477	0.460	0.040 - 0.650	0.374	0.530	0.040 - 0.780	0.196	0.060
TOTAL N (MG/L)	0.610 - 0.920	0.768	0.780	0.230 - 0.830	0.607	0.710	0.220 - 1.060	0.377	0.240
CHLRPYL A (UG/L)	14.4 - 15.1	14.7	14.7	5.2 - 7.4	6.3	6.3	11.2 - 81.0	46.1	46.1
SECCHI (METERS)	0.9 - 0.9	0.9	0.9	2.1 - 2.7	2.4	2.4	3.7 - 3.7	3.7	3.7

B. Biological characteristics:

1. Phytoplankton

Sampling Date	Dominant Genera		Algal Units per ml
03/17/75	1.	Centric diatoms	68,733
	2.	Chroomonas (?) sp.	561
	3.	Asterionella sp.	421
	4.	Stephanodiscus sp.	224
	5.	Melosira sp.	112
		Other genera	112
		Total	70,163
06/26/75	1.	Fragilaria sp.	5,304
	2.	Scenedesmus sp.	3,700
	3.	Chroomonas (?) sp.	1,375
	4.	Cryptomonas sp.	360
	5.	Peridinium sp.	262
		Other genera	361
		Total	11,362
11/12/75	1.	Melosira sp.	1,064
	2.	Chroomonas (?) sp.	172
	3.	Glenodinium sp.	144
	4.	Cryptomonas sp.	144
	5.	Ceratium sp.	29
		Other genera	28
		Total	1,581

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
03/14/75	1	14.4
	2	15.1
06/26/75	1	7.4
	2	5.2
11/12/75	1	81.0
	2	11.2

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.)
Control	0.023	0.464	6.7
0.050 P	0.073	0.464	13.3
0.050 P + 1.0 N	0.073	1.464	28.4
1.0 N	0.023	1.464	6.4

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Lake Amador was high at the time the sample was collected (03/14/75). Also, a significant increase in yield with the addition of phosphorus alone indicates that the reservoir was limited by phosphorus at that time. Note that the addition of nitrogen alone resulted in a yield no greater than that of the control.

The reservoir data indicate phosphorus limitation in March and June but nitrogen limitation in November. The mean inorganic nitrogen to orthophosphorus ratios were 15 to 1 in March, 25 to 1 in June, and 8 to 1 in November (phosphorus limitation is expected at N to P ratios of 14 to 1 or greater).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the California National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of March and May when two samples were collected. Sampling was begun in November, 1974, and was completed in September, 1975.

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

Except for the aqueduct, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Loads for the unnamed aqueduct were calculated using mean annual flows and mean annual concentrations in Jackson Creek at station A-1. Nutrient loads shown are those measured minus point-sources loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station A-2, in $kg/km^2/year$, and multiplying by the ZZ area in km^2.

The operators of the Jackson and Argonaut Heights wastewater treatment plants provided monthly effluent samples and corresponding flow data.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Jackson	2,000	act. sludge	1,842.9	Jackson Creek
Argonaut Heights	200	act. sludge	10.8	Jackson Creek

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Jackson Creek	860	22.5
b. Minor tributaries & immediate drainage (non-point load) -	320	8.4
c. Known municipal STP's -		
Jackson	2,580	67.6
Argonaut Heights	30	0.8
d. Septic tanks** - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation***	25	0.7
Total	3,815	100.0

2. Outputs -

Reservoir outlet -	Unnamed Aqueduct	820
	Jackson Creek	980
	Total	1,800

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

* Treatment plant questionnaires.
** Willy, 1976.
*** 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) -		
Jackson Creek	51,515	64.4
b. Minor tributaries & immediate drainage (non-point load) -	18,715	23.4
c. Known municipal STP's -		
Jackson	7,990	10.0
Argonaut Heights	75	0.1
d. Septic tanks* - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation** -	1,685	2.1
Total	79,980	100.0

2. Outputs -

Reservoir outlet -	Unnamed Aqueduct	25,275
	Jackson Creek	43,060
	Total	68,335

3. Net annual N accumulation - 11,645 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Jackson Creek	8	469

* Willy, 1976.
** 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	2.45	1.29	51.3	7.5

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake Amador:	
"Dangerous" (eutrophic loading)	0.96
"Permissible" (oligotrophic loading)	0.48

V. LITERATURE REVIEWED

Allum, M.O., R.E. Glessner, and J.H. Gakstatter, 1977. An evaluation of the National Eutrophication Survey data. Working Paper 900, Corvallis Env. Res. Lab., Corvallis, OR.

Dendy, William B., 1974. Personal communication (waterbody information and morphometry). CA Water Res. Contr. Bd., Sacramento.

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.

Willy, Henry, 1976. Personal communication (shoreline dwellings and campgrounds). Jackson Valley Irr. Distr., Ione.

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
0601	AMADOR RESERVOIR	0.040	0.390	408.667	22.383	14.600	0.020
0602	BOCA LAKE	0.012	0.040	372.833	1.700	6.800	0.003
0603	LAKE BRITTON	0.067	0.115	448.500	4.811	11.200	0.047
0604	CASITAS RESERVOIR	0.029	0.050	400.250	3.192	14.000	0.014
0605	CROWLEY LAKE	0.046	0.045	374.750	5.800	12.200	0.034
0606	DON PEDRO RESERVOIR	0.013	0.060	381.733	3.564	11.400	0.004
0607	LAKE ELSINORE	0.469	0.120	489.214	70.572	8.000	0.092
0608	FALLEN LEAF RESERVOIR	0.007	0.040	24.357	0.786	8.800	0.005
0609	LAKE HENNESSEY	0.027	0.060	416.000	4.525	15.000	0.012
0610	LAKE HENSHAW	0.138	0.070	461.000	26.783	9.800	0.073
0611	IRON GATE RESERVOIR	0.184	0.690	440.333	6.217	13.800	0.124
0614	LOPEZ LAKE	0.371	0.090	372.000	8.658	15.000	0.343
0615	LAKE MARY	0.010	0.040	296.000	2.550	10.600	0.002
0616	LAKE MENDOCINO	0.020	0.050	436.500	3.100	9.400	0.008
0617	NICASIO RESERVOIR	0.055	0.345	482.778	6.633	9.800	0.013
0618	LOWER OTAY RESERVOIR	0.058	0.180	447.250	15.933	15.000	0.013
0619	LAKE PILLSBURY	0.022	0.060	466.667	6.389	8.200	0.008
0620	SANTA MARGARITA LAKE	0.037	0.070	400.000	9.122	14.800	0.014
0621	SHASTA LAKE	0.021	0.060	381.542	4.087	9.000	0.015
0622	SHAVER	0.014	0.060	346.400	1.700	7.400	0.004
0623	SILVER LAKE	0.012	0.055	356.000	1.800	7.000	0.003
0624	TULLOCK RESERVOIR	0.025	0.060	433.000	13.878	7.400	0.009
0625	UPPER TWIN LAKES	0.015	0.040	300.200	3.340	7.400	0.004
0626	LOWER TWIN LAKES	0.014	0.040	248.000	2.900	11.400	0.003

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
0601	AMADOR RESERVOIR	35 (8)	4 (1)	43 (10)	9 (2)	17 (4)	26 (6)	134
0602	BOCA LAKE	89 (20)	98 (22)	70 (16)	91 (21)	100 (23)	91 (20)	539
0603	LAKE BRITTON	17 (4)	22 (5)	17 (4)	48 (11)	43 (10)	17 (4)	164
0604	CASITAS RESERVOIR	43 (10)	74 (17)	48 (11)	70 (16)	22 (5)	37 (8)	294
0605	CROWLEY LAKE	30 (7)	78 (18)	65 (15)	43 (10)	30 (7)	22 (5)	268
0606	DON PEDRO RESERVOIR	83 (19)	54 (11)	57 (13)	61 (14)	37 (8)	78 (17)	370
0607	LAKE ELSINORE	0 (0)	17 (4)	0 (0)	0 (0)	78 (18)	9 (2)	104
0608	FALLEN LEAF RESERVOIR	100 (23)	87 (19)	100 (23)	100 (23)	70 (16)	70 (16)	527
0609	LAKE HENNESSEY	48 (11)	54 (11)	39 (9)	52 (12)	4 (0)	52 (12)	249
0610	LAKE HENSHAW	13 (3)	33 (7)	13 (3)	4 (1)	54 (12)	13 (3)	130
0611	IRON GATE RESERVOIR	9 (2)	0 (0)	26 (6)	39 (9)	26 (6)	4 (1)	104
0614	LOPEZ LAKE	4 (1)	26 (6)	74 (17)	26 (6)	4 (0)	0 (0)	134
0615	LAKE MARY	96 (22)	87 (19)	91 (21)	83 (19)	48 (11)	100 (23)	505
0616	LAKE MENDOCINO	65 (15)	70 (16)	30 (7)	74 (17)	61 (14)	63 (14)	363
0617	NICASIO RESERVOIR	26 (6)	9 (2)	4 (1)	30 (7)	54 (12)	46 (10)	169
0618	LOWER OTAY RESERVOIR	22 (5)	13 (3)	22 (5)	13 (3)	4 (0)	46 (10)	120
0619	LAKE PILLSBURY	57 (13)	41 (9)	9 (2)	35 (8)	74 (17)	63 (14)	279
0620	SANTA MARGARITA LAKE	39 (9)	33 (7)	52 (12)	22 (5)	13 (3)	37 (8)	196
0621	SHASTA LAKE	61 (14)	54 (11)	61 (14)	57 (13)	65 (15)	30 (7)	328
0622	SHAVER	78 (18)	41 (9)	83 (19)	96 (22)	87 (19)	78 (17)	463
0623	SILVER LAKE	89 (20)	65 (15)	78 (18)	87 (20)	96 (22)	91 (20)	506
0624	TULLOCK RESERVOIR	52 (12)	54 (11)	35 (8)	17 (4)	87 (19)	57 (13)	302
0625	UPPER TWIN LAKES	70 (16)	98 (22)	87 (20)	65 (15)	87 (19)	78 (17)	485
0626	LOWER TWIN LAKES	74 (17)	87 (19)	96 (22)	78 (18)	37 (8)	91 (20)	463

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	0602	BOCA LAKE	539
2	0608	FALLEN LEAF RESERVOIR	527
3	0623	SILVER LAKE	506
4	0615	LAKE MARY	505
5	0625	UPPER TWIN LAKES	485
6	0626	LOWER TWIN LAKES	463
7	0622	SHAVER	463
8	0606	DON PEDRO RESERVOIR	370
9	0616	LAKE MENDOCINO	363
10	0621	SHASTA LAKE	328
11	0624	TULLOCK RESERVOIR	302
12	0604	CASITAS RESERVOIR	294
13	0619	LAKE PILLSBURY	279
14	0605	CROWLEY LAKE	268
15	0609	LAKE HENNESSEY	249
16	0620	SANTA MARGARITA LAKE	196
17	0617	NICASIO RESERVOIR	169
18	0603	LAKE BRITTON	164
19	0614	LOPEZ LAKE	134
20	0601	AMADOR RESERVOIR	134
21	0610	LAKE HENSHAW	130
22	0618	LOWER OTAY RESERVOIR	120
23	0607	LAKE ELSINORE	104
24	0611	IRON GATE RESERVOIR	104

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 CALIFORNIA 09/24/76

LAKE CODE 0601 AMADOR LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 151.3

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
0601A1	151.3	0.566	2.803	2.860	1.727	0.623	0.003	0.003	0.003	0.003	0.003	0.014	0.014	0.704
0601A2	109.8	2.945	2.322	2.067	1.218	0.453	0.207	0.088	0.014	0.008	0.042	0.311	1.189	0.899
0601ZZ	41.4	1.104	0.878	0.765	0.453	0.167	0.076	0.034	0.006	0.003	0.017	0.119	0.453	0.337

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 151.3
SUM OF SUB-DRAINAGE AREAS = 151.3
TOTAL FLOW IN = 14.94
TOTAL FLOW OUT = 8.62

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0601A1	11	74	0.003	17	0.003				
	12	74	0.003	8	0.003				
	1	75	0.003	12	0.003				
	2	75	5.635	15	6.541				
	3	75	6.513	1	4.049	15	7.617	29	5.295
	4	75	3.228	13	3.568				
	5	75	0.708	6	1.699	26	0.003		
	6	75	0.003						
	7	75	0.003	20	0.003				
	8	75	0.003	25	0.003				
	9	75	0.003	21	0.003				
	10	75	0.003						
0601A2	11	74	0.187	17	0.119				
	12	74	0.283	8	0.275				
	1	75	0.510	12	0.566				
	2	75	2.209	15	2.350				
	3	75	3.851	1	0.595	15	2.180	29	3.002
	4	75	1.784	13	1.954				
	5	75	0.680	6	0.934	26	0.481		
	6	75	0.263						
	7	75	0.091	20	0.079				
	8	75	0.034	25	0.034				
	9	75	0.014	21	0.011				
	10	75	0.011						
0601ZZ	11	74	0.071						
	12	74	0.110						
	1	75	0.195						
	2	75	0.821						
	3	75	1.444						
	4	75	0.680						
	5	75	0.255						
	6	75	0.099						
	7	75	0.034						
	8	75	0.014						
	9	75	0.006						
	10	75	0.003						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/09/24

060101
38 18 10.0 120 53 12.0 3
AMADOR RESERVOIR
06005 CALIFORNIA

141091

11EPALES 2111202
0165 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
75/03/14	09 45	0000	7.6	11.8	34	173	8.70	69	0.020	0.600	0.230	0.013
	09 45	0005	8.0	11.8		171	8.60	70	0.020	0.500	0.240	0.012
	09 45	0015	7.5	10.2		177	7.90	70	0.030	0.400	0.360	0.022
	09 45	0025	6.5	8.4		181	7.70	69	0.030	0.200	0.440	0.032
	09 45	0060	5.8	7.6		189	7.55	72	0.020K	0.200	0.410	0.035
	09 45	0090	5.8	7.6		192	7.50	72	0.020	0.200K	0.430	0.038
	09 45	0120	5.6	6.8		191	7.45	71	0.020K	0.200	0.540	0.043
	09 45	0145	5.5	6.8		194	7.40	70	0.020K	0.200	0.600	0.041
75/06/26	15 30	0000	21.9	9.4	84	205	9.30	88	0.040	0.600	0.040	0.006
	15 30	0005	21.6	9.2		200	9.40	88	0.030	0.300	0.020K	0.010
	15 30	0015	21.1	2.8		200	7.70	86	0.030	0.300	0.030	0.008
	15 30	0040	8.4	3.4		135	7.45	79	0.020	0.200	0.500	0.007
	15 30	0080	7.6	3.2		135	7.30	80	0.020	0.200	0.590	0.027
	15 30	0110	7.5	3.0		130	7.25	78	0.020K	0.200K	0.620	0.026
	15 30	0130	7.5	2.0		170	7.20	79	0.020	0.200K	0.620	0.020
75/11/12	08 45	0000	16.8	9.2	144	169	7.50	62	0.020K	0.200K	0.020K	0.005
	08 45	0005	16.8	8.2		175	7.60	62	0.020K	0.200K	0.040	0.005
	08 45	0018	16.8	8.2		173	7.65	65	0.020K	0.200K	0.020K	0.009
	08 45	0035	16.8	7.6		172	7.60	65	0.020K	0.200	0.020K	0.013
	08 45	0055	15.8	4.0		174	7.35	77	0.040	0.200	0.090	0.049
	08 45	0090	12.1	0.4		158	7.20	70	0.060	0.200	0.360	0.059
	08 45	0145	11.9	0.6		298	7.15	84	0.220	0.400	0.160	0.092

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

060101
38 18 10.0 120 53 12.0 3
AMADOR RESERVOIR
06005 CALIFORNIA
141091

11EPALES 2111202
0165 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/14	09	45 0000	0.044	14.4	
	09	45 0005	0.046		
	09	45 0015	0.044		
	09	45 0025	0.040		
	09	45 0060	0.037		
	09	45 0090	0.045		
	09	45 0120	0.045		
	09	45 0145	0.047		
75/06/26	15	30 0000	0.026	7.4	
	15	30 0005	0.026		
	15	30 0015	0.029		
	15	30 0040	0.016		
	15	30 0080	0.039		
	15	30 0110	0.037		
	15	30 0130	0.042		
75/11/12	08	45 0000	0.018	81.0	
	08	45 0005	0.020		
	08	45 0018	0.025		
	08	45 0035	0.025		
	08	45 0055	0.068		
	08	45 0090	0.075		
	08	45 0145	0.124		

STORET RETRIEVAL DATE 76/09/24

060102
38 18 28.0 120 52 28.0 3
AMADOR RESERVOIR
06005 CALIFORNIA
141091

11EPALES 2111202
0145 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
75/03/14	10 35	0000	8.3	11.6	34	174	8.40	63	0.020K	0.600	0.320	0.017
	10 35	0005	8.3	11.6		171	8.50	64	0.020K	0.500	0.300	0.019
	10 35	0015	8.1	10.6		170	8.20	67	0.020	0.400	0.320	0.018
	10 35	0040	6.4	8.0		180	6.95	71	0.020K	0.200	0.480	0.034
	10 35	0065	6.1	7.0		189	7.50	73	0.020K	0.200	0.600	0.042
	10 35	0100	6.0	7.0		191	7.45	75	0.020	0.200	0.670	0.049
	10 35	0120	5.9	7.0		191	7.40	75	0.020K	0.200K	0.670	0.046
	10 35	0140	5.9	6.8		191	7.40	74	0.020K	0.200K	0.680	0.042
75/06/26	16 05	0000	22.9	9.2	108	210	9.40	90	0.020	0.300	0.050	0.007
	16 05	0005	22.7	8.0		210	9.00	88	0.020K	0.300	0.020K	0.006
	16 05	0015	20.7	6.0		190	7.90	86	0.020	0.200	0.030	0.008
	16 05	0040	8.6	3.6		135	7.60	79	0.020	0.200K	0.520	0.009
	16 05	0070	7.7	3.4		135	7.40	77	0.020	0.200K	0.620	0.027
	16 05	0100	7.6	1.6		135	7.30	75	0.020K	0.200K	0.630	0.027
	16 05	0124	7.5	1.6		140	7.80	80	0.030	0.200K	0.610	0.023
75/11/12	09 30	0000	16.8	8.6	144	175	7.60	68	0.020K	0.200	0.020K	0.013
	09 30	0005	16.8	8.2		176	7.70	66	0.020K	0.200K	0.020K	0.009
	09 30	0023	16.8	8.4		174	7.70	64	0.020K	0.200K	0.020K	0.009
	09 30	0055	16.4	6.2		181	7.60	66	0.030	0.200K	0.040	0.022
	09 30	0090	12.8	0.8		166	7.25	76	0.040	0.200K	0.430	0.040
	09 30	0128	11.9	0.6		191	7.15	98	0.720	1.000	0.060	0.019

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

060102
38 18 28.0 120 52 28.0 3
AMADOR RESERVOIR
06005 CALIFORNIA
141091

11EPALES 2111202
0145 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/14	10	35 0000	0.056	15.1	
	10	35 0005	0.051		
	10	35 0015	0.042		
	10	35 0040	0.041		
	10	35 0065	0.046		
	10	35 0100	0.052		
	10	35 0120	0.052		
	10	35 0140	0.051		
75/06/26	16	05 0000	0.023	5.2	
	16	05 0005	0.025		
	16	05 0015	0.028		
	16	05 0040	0.022		
	16	05 0070	0.037		
	16	05 0100	0.044		
	16	05 0124	0.038		
75/11/12	09	30 0000	0.025	11.2	
	09	30 0005	0.020		
	09	30 0023	0.025		
	09	30 0055	0.039		
	09	30 0090	0.067		
	09	30 0128	0.356		

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/09/24

0601A1
38 18 15.0 120 53 15.0 4
JACKSON CREEK
06 15 SUTTER CREEK
O/AMADOR LAKE 141091
BNK FRM DAM OUTLET
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/17	09	30	0.240	0.800	0.145	0.040	0.060
74/12/08	11	20	0.280	1.800	0.115	0.040	0.060
75/01/12	14	05	0.672	0.800	0.130	0.025	0.090
75/02/15	11	45	1.100	0.300	0.016	0.064	0.069
75/03/01	14	30	0.590	1.400	0.032	0.040	0.050
75/03/15	15	20	0.760	0.100K	0.009	0.030	0.040
75/03/29	15	30	0.800	1.600	0.022	0.024	0.030
75/04/13	15	00	0.570	2.100	0.040	0.015	0.030
75/05/06	17	00	0.480	1.450	0.020		0.030
75/05/26	15	30	0.600	0.450	0.015	0.030	0.040
75/07/20	17	50	0.540	0.450	0.035	0.030	0.060
75/08/25	12	20	0.490	1.300	0.067	0.035	0.060
75/09/21	16	30	0.400	0.800	0.080	0.035	0.060

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0601A2
38 18 50.0 120 49 55.0 4
JACKSON CREEK
06 15 SUTTER CREEK
T/AMADOR LAKE 141091
STONEY CRK RD BRDG 5 MI SW OF JACKSON
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/17	11 20		0.690	0.800	0.120	0.300	0.330
74/12/08	12 20		0.768	1.900	0.055	0.230	0.250
75/01/12	14 50		1.000	3.100	0.055	0.085	0.140
75/02/15	12 55		1.250	1.200	0.032	0.032	0.070
75/03/01	15 00		0.880	0.300	0.032	0.152	0.180
75/03/15	16 10		0.612	0.800	0.024	0.042	0.080
75/03/29	16 00		0.590	0.700	0.031	0.046	0.070
75/04/13	15 30		0.345	1.200	0.030	0.080	0.100
75/05/06	17 48		0.240	1.100	0.015		0.150
75/05/26	15 15		0.810	0.350	0.025	0.315	0.330
75/07/20	18 30		1.400	0.700	0.030	0.860	0.880
75/08/25	12 25		0.740	1.350	0.045	0.675	0.720
75/09/21	16 50		1.200	1.200	0.034	0.615	0.615

STORET RETRIEVAL DATE 76/09/24

0601AA AS0601AA P002000
38 20 45.0 120 47 00.0 4
JACKSON
06005 15 SUTTER CREEK
T/LAKE AMADOR 141091
JACKSON CREEK
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/06/18	09	30	6.500	1.600	0.330	3.600	3.800	0.460	0.500
75/07/03			9.400	2.300	0.475	4.200	4.200	0.470	0.470
75/07/17	10	40	8.600	1.500	0.475	4.000	4.000	0.570	0.480
75/08/01	09	30	8.100	2.700	1.000	3.400	5.400	0.450	0.480
75/08/19	09	00	7.700	1.900	0.090	3.000	3.400	0.600	0.500
75/09/05	10	30	10.500	2.700	0.550	4.700	4.900	0.440	0.470
75/09/12	09	00	10.000	1.900	0.425	3.700	3.800	0.420	0.390
75/09/30	09	00	6.900	4.350	0.280	2.800	3.300	0.340	0.440
75/10/09	08	30	6.600	3.400	0.360	4.100	4.200	0.490	0.490
75/10/28	10	30	0.900	14.000	1.100	1.650	3.500	1.060	0.434
75/11/10	09	30	0.650	11.000	0.620	2.000	2.500	0.558	0.562
75/11/24	09	00	0.650	10.000	0.200	2.500	3.200	0.536	0.593
75/12/08	12	00	0.075	17.000	3.200	2.630	4.400	0.540	0.520

STORET RETRIEVAL DATE 76/09/24

0601XA AS0601XA P000200
38 21 45.0 120 47 20.0 4
ARONAUT HEIGHTS
06005 15 SUTTER CREEK
T/LAKE AMADOR 141091
N. FORK JACKSON CREEK
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/03/04	18	00	13.600	1.700	0.440	1.900	2.000	0.002	0.002
75/04/16	12	00	10.500	1.400	0.410	0.330	0.420	0.003	0.003
75/05/15	12	00	13.000		0.690	0.900		0.003	0.003
75/05/31	12	00	14.000	6.400	1.150	2.300		0.003	0.003
75/07/01	14	00	14.700	2.300	0.390	4.700	4.700	0.003	0.003
75/08/05	18	00	13.800	8.400	0.325	7.900	8.800	0.003	0.003
75/09/04	12	00	15.000	6.300	0.460	10.000	11.000	0.003	0.003
75/11/24	16	30	18.000	6.100	2.400		13.500	0.003	0.003