

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



REPORT
ON
RED ROCK RESERVOIR
MARION COUNTY
IOWA
EPA REGION VII
WORKING PAPER No. 503

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

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WITH THE COOPERATION OF THE
IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY
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SEPTEMBER, 1976

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F O R E W O R D

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

OBJECTIVES

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

ANALYTIC APPROACH

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

- a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.
- b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.
- c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

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

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

ACKNOWLEDGMENT

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

The staff of the Water Quality Division of the Department of Environmental Quality 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.

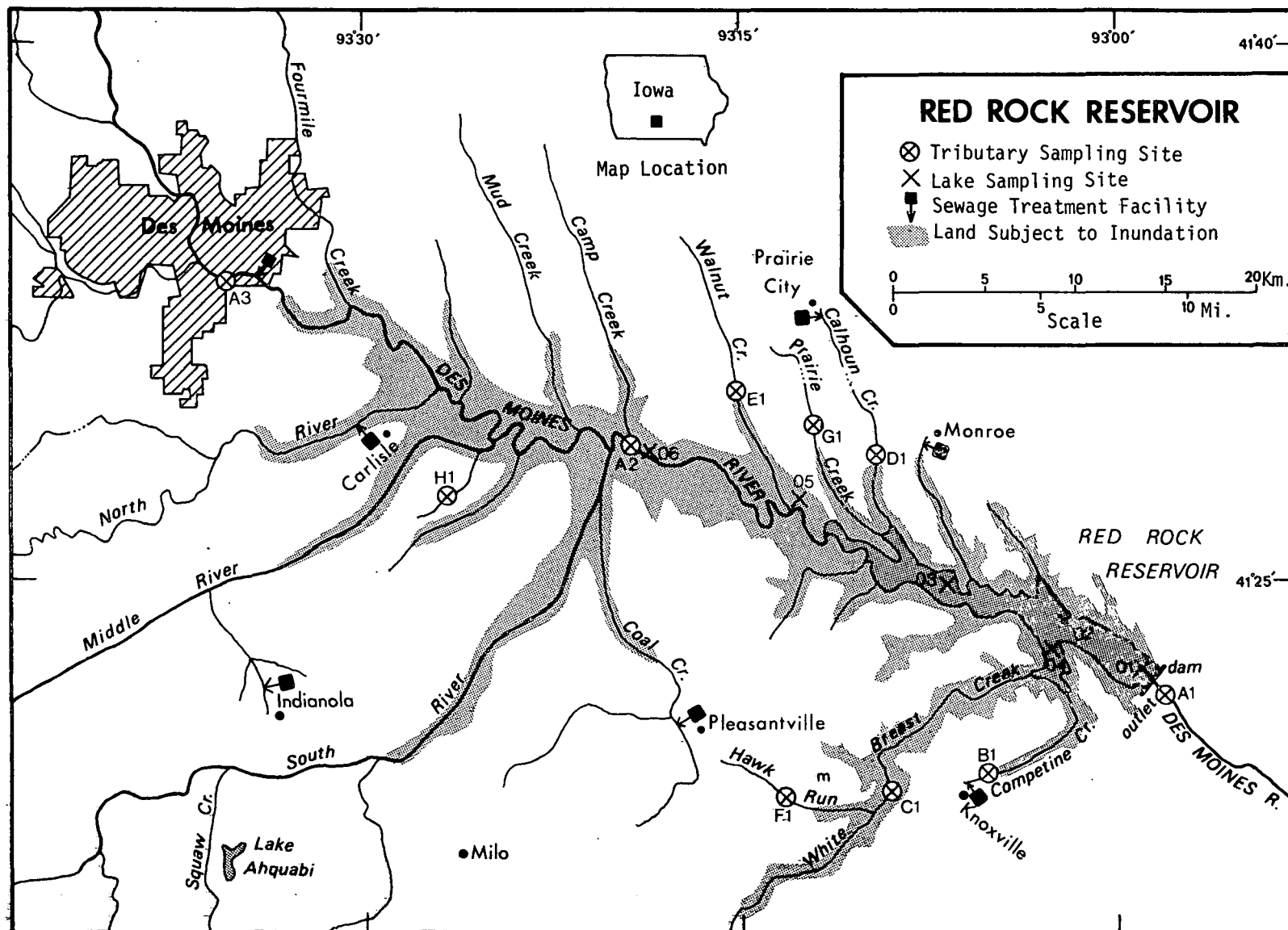
Major General Joseph G. May, the Adjutant General of Iowa, and Project Officer Colonel Cleadeth P. Woods, who directed the volunteer efforts of the Iowa National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

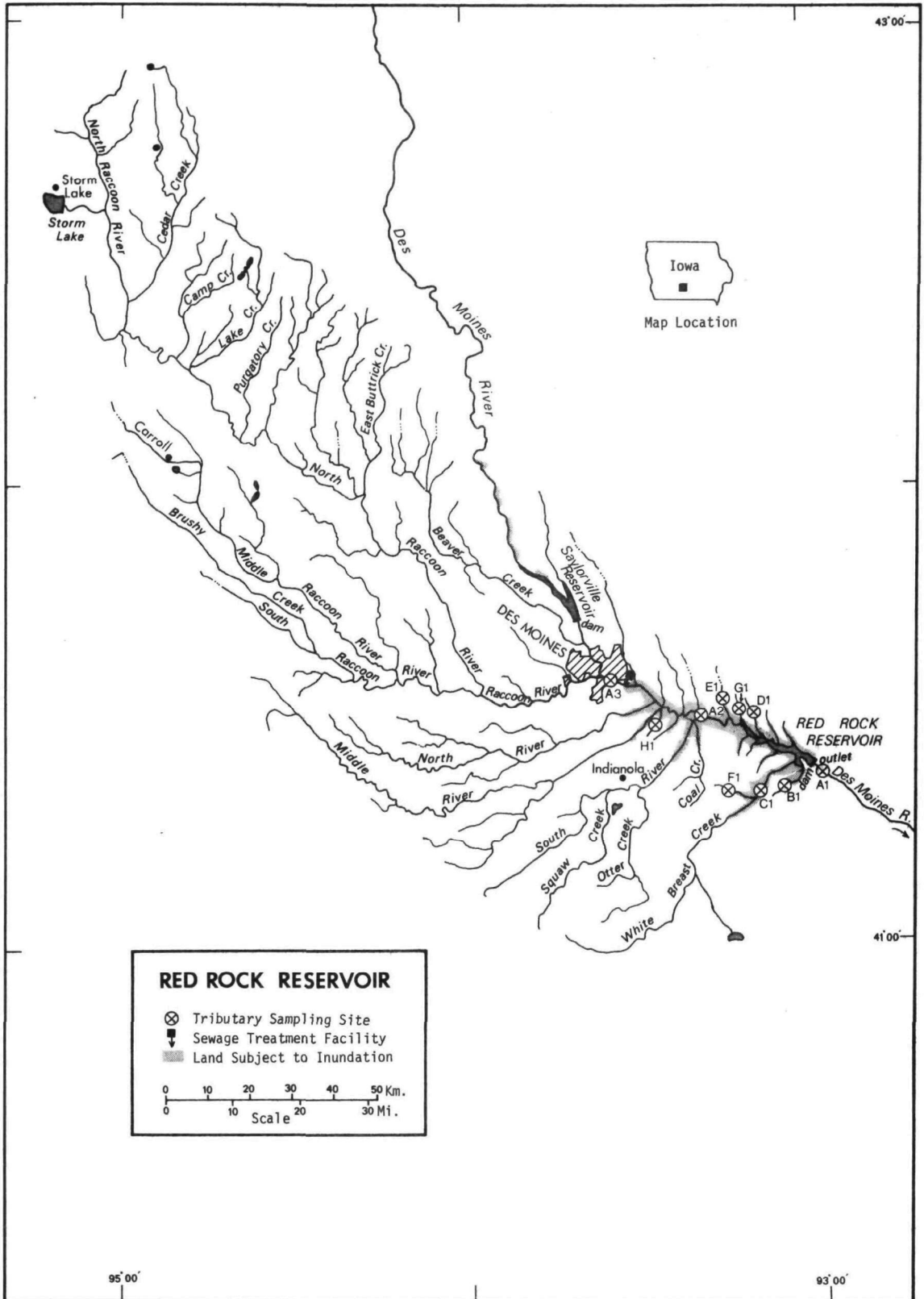
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IOWA

<u>LAKE NAME</u>	<u>COUNTY</u>
Ahquabi	Warren
Big Creek Reservoir	Polk
Black Hawk	Sac
Clear	Cerro Gordo
Darling	Washington
Lost Island	Clay, Palo Alto
MacBride	Johnson
Prairie Rose	Shelby
Rathbun Reservoir	Appanoose, Wayne
Red Rock Reservoir	Marion
Rock Creek	Jasper
Silver	Worth
Spirit	Dickinson
Viking	Montgomery
West Okoboji	Dickinson







RED ROCK RESERVOIR

STORET NO. 1910

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Red Rock Reservoir is eutrophic. It ranked thirteenth in overall trophic quality when the 15 Iowa lakes and reservoirs sampled in 1974 were compared using a combination of six parameters*. Twelve of the water bodies had less median total phosphorus, all of the others had less median dissolved phosphorus, 12 had less median inorganic nitrogen, five had less mean chlorophyll a, and nine had greater mean Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at stations 1, 3, and 5 in July.

B. Rate-Limiting Nutrient:

The algal assay results indicate the reservoir was phosphorus limited at the time the sample was collected (04/18/74). The reservoir data indicate phosphorus limitation in September also.

C. Nutrient Controllability:

1. Point sources--The phosphorus contribution of known point sources accounted for about 17% of the total load reaching Red Rock Reservoir during the sampling year. Almost all of the point-source load came from the Des Moines wastewater treatment plant (16.4% of the total).

* See Appendix A.

The present phosphorus loading of $68.95 \text{ g/m}^2/\text{yr}$ is more than 35 times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 14). However, Vollenweider's model probably is not applicable to water bodies with short hydraulic retention times, and the mean hydraulic retention time of Red Rock Reservoir is only 10 days. Nonetheless, the existing trophic condition of the reservoir is evidence of excessive nutrient loads.

On the basis of Survey data, the trophic condition of Red Rock Reservoir will very likely continue to deteriorate if the present loading is maintained. Therefore, all phosphorus inputs should be minimized to the greatest practicable extent to reduce the rate of eutrophication.

2. Non-point sources--Non-point sources accounted for about 83% of the total phosphorus load reaching the reservoir during the sampling year. The Des Moines River contributed over 78% of the total.

The phosphorus export rate of the Des Moines River was $65 \text{ kg/km}^2/\text{yr}$ (see page 13). This rate is within the range of other tributaries studied in this area of the state and appears to be typical of a heavily-cultivated watershed.

Fluctuations in the water level of the reservoir may add to the non-point contributions. In July, 1974, the Survey limnologists reported flooded farmland in the vicinity of Red Rock Reservoir. During the April and September visits, however, lake sampling sites 4, 5, and 6 were dry (see map, page v).

The upper portion of Red Rock Reservoir is a wildlife refuge, and ducks and geese utilize the area during spring and fall migrations (Harrison, 1976). However, only a few waterfowl counts were made during the Survey sampling year (Bishop, 1976), and an assessment of the nutrient contributions of migrating ducks and geese cannot be made.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS[†]

A. Lake Morphometry^{††}:

1. Surface area: 36.22 kilometers².
2. Mean depth: 3.0 meters.
3. Maximum depth: 10.7 meters.
4. Volume: 108.660×10^6 m³.
5. Mean hydraulic retention time: 10 days.

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

1. Tributaries -

<u>Name</u>	<u>Drainage area (km²)*</u>	<u>Mean flow (m³/sec)*</u>
Des Moines River	30,186.4	114.46
White Breast Creek	984.2	5.51
Calhoun Creek	58.8	0.33
Minor tributaries & immediate drainage -	<u>651.0</u>	<u>3.84</u>
Totals	31,880.4	124.14

2. Outlet -

Des Moines River	31,916.6**	121.04
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C. Precipitation***:

1. Year of sampling: 70.7 centimeters.
2. Mean annual: 82.7 centimeters.

[†] Table of metric conversions--Appendix B.

^{††} Mayhew, 1972.

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

** Includes area of reservoir.

*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Red Rock Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Samples for physical and chemical parameters were collected from a number of depths at two stations on the reservoir in April, five stations in July, and three stations in September (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the sampled stations for phytoplankton identification and enumeration; and during the April 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 sampled stations for chlorophyll a analysis. The maximum depths sampled were 18.9 meters at station 1, 6.4 meters at station 2, 13.7 meters at station 3, 9.8 meters at station 4, 13.1 meters at station 5, and 4.6 meters at station 6.

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

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR RED ROCK LAKE
STORET CODE 1910

PARAMETER	1ST SAMPLING (4/18/74)				2ND SAMPLING (7/ 8/74)				3RD SAMPLING (9/24/74)			
	2 SITES				5 SITES				3 SITES			
	RANGE	MEAN	MEDIAN		RANGE	MEAN	MEDIAN		RANGE	MEAN	MEDIAN	
TEMP (C)	10.5 - 13.6	11.9	11.3		20.5 - 28.4	24.5	23.8		16.7 - 17.9	16.9	16.8	
DISS OXY (MG/L)	9.8 - 12.4	10.8	10.2		1.0 - 10.8	6.5	6.6		7.4 - 9.0	8.1	8.0	
CNDCTVY (MCROMO)	517. - 617.	565.	558.		434. - 792.	619.	594.		531. - 598.	542.	535.	
PH (STAND UNITS)	8.2 - 8.5	8.3	8.3		7.6 - 8.6	8.1	8.1		7.5 - 7.6	7.6	7.5	
TOT ALK (MG/L)	330. - 390.	358.	360.		***** -*****				210. - 254.	236.	238.	
TOT P (MG/L)	0.178 - 0.212	0.195	0.195		***** -*****				0.155 - 0.670	0.232	0.176	
ORTHO P (MG/L)	0.104 - 0.135	0.123	0.123		***** -*****				0.062 - 0.265	0.091	0.070	
NO2+N03 (MG/L)	8.050 - 9.750	8.962	8.980		***** -*****				1.360 - 1.840	1.630	1.600	
AMMONIA (MG/L)	0.030 - 0.080	0.057	0.060		***** -*****				0.040 - 0.340	0.082	0.050	
KJEL N (MG/L)	0.600 - 0.800	0.675	0.700		***** -*****				0.600 - 1.500	0.833	0.700	
INORG N (MG/L)	8.100 - 9.820	9.020	9.025		***** -*****				1.590 - 1.880	1.712	1.700	
TOTAL N (MG/L)	8.850 -10.450	9.637	9.630		***** -*****				2.120 - 2.860	2.463	2.470	
CHLRPYL A (UG/L)	11.2 - 25.4	18.3	18.3		1.7 - 19.9	7.7	3.8		13.3 - 41.2	24.0	17.5	
SECCHI (METERS)	0.5 - 0.6	0.5	0.5		0.3 - 1.5	1.0	0.9		0.2 - 0.3	0.3	0.3	

5

B. Biological characteristics:

1. Phytoplankton -

<u>Sampling Date</u>	<u>Dominant Genera</u>	<u>Algal Units per ml</u>
04/18/74	1. Centric diatoms	9,795
	2. <u>Stephanodiscus sp.</u>	1,245
	3. <u>Synedra sp.</u>	974
	4. <u>Cryptomonas sp.</u>	487
	5. <u>Ankistrodesmus sp.</u>	325
	Other genera	<u>648</u>
	Total	13,474
07/08/74	1. <u>Nitzschia sp.</u>	454
	2. <u>Oscillatoria sp.</u>	454
	3. <u>Actinastrum sp.</u>	363
	4. <u>Stephanodiscus sp.</u>	318
	5. <u>Coelosphaerium sp.</u>	273
	Other genera	<u>2,044</u>
	Total	3,906
09/24/74	1. <u>Cyclotella sp.</u>	3,213
	2. <u>Oscillatoria sp.</u>	771
	3. <u>Melosira sp.</u>	707
	4. Flagellates	321
	5. <u>Merismopedia sp.</u>	193
	Other genera	<u>1,028</u>
	Total	6,233

2. Chlorophyll a -

<u>Sampling Date</u>	<u>Station Number</u>	<u>Chlorophyll a ($\mu\text{g/l}$)</u>
04/18/74	1	25.4
	2	11.2
07/08/74	1	1.7
	3	3.8
	4	2.5
	5	10.8
	6	19.9
09/24/74	1	13.3
	2	17.5
	3	41.2

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

<u>Spike (mg/l)</u>	<u>Ortho P Conc. (mg/l)</u>	<u>Inorganic N Conc. (mg/l)</u>	<u>Maximum yield (mg/l-dry wt.)</u>
Control	0.060	7.935	2.8
0.050 P	0.110	7.935	20.4
0.050 P + 1.0 N	0.110	8.935	21.9
1.0 N	0.060	8.935	2.0

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Red Rock Reservoir was high at the time the sample was collected in April. The addition of phosphorus alone produced a significant increase in yield, but no such increase occurred when only nitrogen was added. This indicates limitation by phosphorus.

The reservoir data also indicate phosphorus limitation. The mean inorganic nitrogen to orthophosphorus ratios were 18 to 1 or greater in April and September.

IV. NUTRIENT LOADINGS (See Appendix E for data)

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

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Iowa 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 shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient concentrations at stations E-1, F-1, G-1, and H-1 and the mean annual ZZ flow.

The operator of the Des Moines wastewater treatment plant provided monthly effluent samples and corresponding flow data. The operators of the wastewater treatment plants of Carlisle, Des Moines Highland Hills, Indianola, Knoxville, Monroe, Pleasantville, and Prairie City did not participate; nutrient loads from these sources were estimated at 1.134 kg P and 3.401 kg N/capita/year, and flows were estimated at 0.3785 m³/capita/day.

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal -

<u>Name</u>	<u>Pop. Served</u>	<u>Treatment</u>	<u>Mean Flow (m³/d)</u>	<u>Receiving Water</u>
Carlisle	1,100	stab. pond	416.4	North River
Des Moines	300,000	tr. filter	145,084.2	Des Moines River
Des Moines	2,600	tr. filter	984.1	Middle Cr./
Highland Hills				Raccoon River
Indianola	6,500	tr. filter	2,460.2	Trib. of
				Middle River
Knoxville	4,000	tr. filter	1,514.0	Competine Cr.
Monroe -				
South Plant	350	stab. pond	132.5	Brush Cr./Red
				Rock Res.
Pleasantville	800	stab. pond	302.8	Coal Cr.
Prairie City	900	tr. filter	340.6	Calhoun Cr.

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

<u>Source</u>	<u>kg P/ yr</u>	<u>% of total</u>
a. Tributaries (non-point load) -		
Des Moines River	1,957,190	78.4
White Breast Creek	77,035	3.1
Calhoun Creek	3,980	0.2
b. Minor tributaries & immediate drainage (non-point load) -	31,730	1.3
c. Known municipal STP's -		
Carlisle	1,245	0.1
Des Moines	408,740	16.4
Des Moines Highland Hills	2,950	0.1
Indianola	7,370	0.3
Knoxville	4,535	0.2
Monroe - South Plant	395	<0.1
Pleasantville	905	<0.1
Prairie City	1,020	<0.1
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	<u>635</u>	<u><0.1</u>
Total	2,497,730	100.0

2. Outputs -

Lake outlet - Des Moines River 978,530

3. Net annual P accumulation - 1,519,200 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

<u>Source</u>	<u>kg N/ yr</u>	<u>% of total</u>
a. Tributaries (non-point load) -		
Des Moines River	27,428,755	91.2
White Breast Creek	673,045	2.2
Calhoun Creek	91,735	0.3
b. Minor tributaries & immediate drainage (non-point load) -	668,705	2.2
c. Known municipal STP's -		
Carlisle	3,740	<0.1
Des Moines	1,104,540	3.7
Des Moines Highland Hills	8,845	<0.1
Indianola	22,105	0.1
Knoxville	13,605	<0.1
Monroe - South Plant	1,190	<0.1
Pleasantville	2,720	<0.1
Prairie City	3,060	<0.1
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation** -	<u>39,105</u>	<u>0.1</u>
Total	30,061,150	100.0

2. Outputs -

Lake outlet - Des Moines River 22,386,480

3. Net annual N accumulation - 7,667,825 kg.

* See Working Paper No. 175.

D. Non-point Nutrient Export by Subdrainage Area:

<u>Tributary</u>	<u>kg P/km²/yr</u>	<u>kg N/km²/yr</u>
Des Moines River	65	909
White Breast Creek	78	684
Calhoun Creek	68	1,560

E. Mean Nutrient Concentration in Ungaged Streams:

<u>Tributary</u>	<u>Mean Total P Conc. (mg/l)</u>	<u>Mean Total N Conc. (mg/l)</u>
Competine Creek*	4.244	9.648
Walnut Creek	0.300	7.383
Hawk Run	0.173	4.193
Prairie Creek	0.391	6.889
Butcher Creek	0.185	3.625

* Sampling site downstream from Knoxville STP.

F. 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.

	<u>Total Phosphorus</u>		<u>Total Nitrogen</u>	
	<u>Total</u>	<u>Accumulated</u>	<u>Total</u>	<u>Accumulated</u>
grams/m ² /yr	68.96	41.94	830.0	211.7

Vollenweider phosphorus loadings
(g/m²/yr) based on mean depth and mean
hydraulic retention time of Red Rock Reservoir:

"Dangerous" (eutrophic loading)	1.94
"Permissible" (oligotrophic loading)	0.97

V. LITERATURE REVIEWED

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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
1901	LAKE ACQUABI	0.062	0.335	469.333	8.600	8.200	0.009
1902	BIG CREEK RESERVOIR	0.046	6.465	438.500	16.867	14.800	0.011
1903	BLACK HAWK LAKE	0.185	0.130	488.167	49.740	15.000	0.020
1904	CLEAR LAKE	0.059	0.070	465.125	17.400	8.600	0.010
1905	LAKE DARLING	0.077	1.475	482.500	13.817	9.200	0.012
1906	LOST ISLAND LAKE	0.146	0.065	421.167	36.100	8.400	0.021
1907	LAKE MACBRIDE	0.061	2.035	458.444	17.067	15.000	0.010
1908	PRAIRIE ROSE LAKE	0.056	0.210	463.667	17.350	8.600	0.010
1909	RATHBUN RESERVOIR	0.071	1.170	475.889	12.039	14.000	0.008
1910	RED ROCK LAKE	0.180	1.880	473.400	14.730	14.000	0.104
1911	ROCK CREEK LAKE	0.065	1.400	480.500	18.367	8.400	0.007
1912	SILVER LAKE	0.193	0.565	482.667	95.300	10.000	0.034
1913	SPIRIT LAKE	0.041	0.090	422.667	12.622	9.000	0.007
1914	VIKING LAKE	0.075	0.130	459.000	26.033	14.200	0.017
1915	WEST LAKE OKOBOJI	0.046	0.060	380.444	7.722	15.000	0.017

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 NU
1901	LAKE ACQUABI	57 (8)	50 (7)	43 (6)	93 (13)	100 (14)	79 (11)	422
1902	BIG CREEK RESERVOIR	89 (12)	0 (0)	79 (11)	57 (8)	21 (3)	50 (7)	296
1903	BLACK HAWK LAKE	7 (1)	68 (9)	0 (0)	7 (1)	7 (0)	21 (3)	110
1904	CLEAR LAKE	71 (10)	86 (12)	50 (7)	36 (5)	75 (10)	64 (8)	382
1905	LAKE DARLING	29 (4)	21 (3)	14 (2)	71 (10)	57 (8)	43 (6)	235
1906	LOST ISLAND LAKE	21 (3)	93 (13)	93 (13)	14 (2)	89 (12)	14 (2)	324
1907	LAKE MACBRIDE	64 (9)	7 (1)	71 (10)	50 (7)	7 (0)	64 (8)	263
1908	PRAIRIE ROSE LAKE	79 (11)	57 (8)	57 (8)	43 (6)	75 (10)	64 (8)	375
1909	RATHBUN RESERVOIR	43 (6)	36 (5)	29 (4)	86 (12)	39 (5)	86 (12)	319
1910	RED ROCK LAKE	14 (2)	14 (2)	36 (5)	64 (9)	39 (5)	0 (0)	167
1911	ROCK CREEK LAKE	50 (7)	29 (4)	21 (3)	29 (4)	89 (12)	96 (13)	314
1912	SILVER LAKE	0 (0)	43 (6)	7 (1)	0 (0)	50 (7)	7 (1)	107
1913	SPIRIT LAKE	100 (14)	79 (11)	86 (12)	79 (11)	64 (9)	96 (13)	504
1914	VIKING LAKE	36 (5)	68 (9)	64 (9)	21 (3)	29 (4)	32 (4)	250
1915	WEST LAKE OKOBOJI	89 (12)	100 (14)	100 (14)	100 (14)	7 (0)	32 (4)	428

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1913	SPIRIT LAKE	504
2	1915	WEST LAKE OKOBOJI	428
3	1901	LAKE ACQUABI	422
4	1904	CLEAR LAKE	382
5	1908	PRAIRIE ROSE LAKE	375
6	1906	LOST ISLAND LAKE	324
7	1909	RATHBUN RESERVOIR	319
8	1911	ROCK CREEK LAKE	314
9	1902	BIG CREEK RESERVOIR	296
10	1907	LAKE MACBRIDE	263
11	1914	VIKING LAKE	250
12	1905	LAKE DARLING	235
13	1910	RED ROCK LAKE	167
14	1903	BLACK HAWK LAKE	110
15	1912	SILVER LAKE	107

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 IOWA

12/23/75

LAKE CODE 1910 RED ROCK RES.

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 31916.6

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS)												MEAN
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1910A1	31916.6	44.17	80.70	207.28	238.43	192.27	249.47	127.14	73.91	79.85	60.31	60.60	39.08	121.04
1910A2	30186.4	41.91	76.17	195.95	225.40	181.79	235.88	120.06	69.94	75.61	57.20	57.48	36.81	114.46
1910A3	25586.6	26.90	51.17	167.78	243.35	190.35	251.06	133.66	70.25	61.28	49.58	40.27	26.33	109.37
1910C1	984.2	2.23	8.38	13.88	9.03	9.74	8.86	3.71	1.80	3.71	0.97	3.09	1.05	5.51
1910D1	58.8	0.13	0.50	0.83	0.54	0.58	0.53	0.22	0.11	0.22	0.06	0.18	0.06	0.33
1910ZZ	686.3	1.55	5.83	9.68	6.31	6.80	6.17	2.59	1.25	2.59	0.67	2.15	0.74	3.84

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 31916.6
SUM OF SUB-DRAINAGE AREAS = 57502.4

TOTAL FLOW IN = 2802.95
TOTAL FLOW OUT = 1453.22

NOTE *** USE A3 FOR INLET, A2 IS SUPPLEMENTAL FLOW DATA FOR DES MOINES RIVER.

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1910A1	8	74	119.78	17	99.11				
	9	74	23.39	14	25.15				
	10	74	15.49	5	15.01				
	11	74	48.14	3	70.79				
	12	74	35.96	14	36.25				
	1	75	35.11	11	28.32				
	2	75	32.00	8	27.18				
	3	75	158.01	8	40.21				
	4	75	436.08	13	450.24	20	370.95		
	5	75	311.49	3	142.43	20	515.37		
	6	75	455.90	1	467.23	15	492.71	28	487.05
	7	75	219.17	18	274.39				
1910A2	8	74	45.31	18	50.97				
	9	74	21.52	14	31.15				
	10	74	17.56	5	14.44				
	11	74	30.02	2	54.09				
	12	74	18.69	14	21.80	15	26.05		
	1	75	16.14	11	9.91	18	17.84		
	2	75	18.12	8	17.27	22	16.14		
	3	75	187.74	8	19.26	16	19.54		
	4	75	433.25	7	276.94	13	478.55	20	430.42
	5	75	311.49	3	142.43	20	515.37		
	6	75	455.90	1	467.23	15	492.71	20	487.05
	7	75	219.17	18	274.39				

TRIBUTARY FLOW INFORMATION FOR IOWA

12/23/75

LAKE CODE 1910 RED ROCK RES.

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1910A3	8	74	37.66	17	43.04				
	9	74	18.15	14	25.80				
	10	74	14.78	5	12.29				
	11	74	25.34	2	45.87				
	12	74	15.94	15	21.97				
	1	75	13.65	18	15.01				
	2	75	15.38	22	13.59				
	3	75	159.14	16	16.54				
	4	75	368.12	7	234.75	20	365.29		
	5	75	368.12	3	880.65	17	288.83		
	6	75	421.92	8	237.86	21	555.01		
	7	75	110.15	18	73.91				
1910C1	8	74	0.40	18	0.59				
	9	74	0.16	14	0.34				
	10	74	1.64	5	0.19				
	11	74	0.59	2	7.31				
	12	74	2.21	8	7.25	14	2.66		
	1	75	3.45	11	22.03				
	2	75	2.83	8	0.62				
	3	75	15.74						
	4	75	9.63	13	6.43	20	8.78		
	5	75	4.87	3	3.85	20	1.10		
	6	75	13.51	15	3.45	28	52.67		
	7	75	1.42	13	0.37				
1910D1	8	74	0.06	18	0.06				
	9	74	0.02	14	0.05				
	10	74	0.06	5	0.01				
	11	74	0.10	2	0.23				
	12	74	0.13	14	0.12				
	1	75	0.07	11	0.19				
	2	75	0.21	8	0.04				
	3	75	0.82	8	0.11				
	4	75	0.62	13	0.31	20	0.59		
	5	75	0.20	4	0.19	17	0.11	31	0.65
	6	75	0.45	13	0.25	28	0.45		
	7	75	0.06	18	0.02				
1910Z2	8	74	0.31						
	9	74	0.12						
	10	74	1.13						
	11	74	0.45						
	12	74	1.53						
	1	75	2.32						
	2	75	2.01						
	3	75	10.90						
	4	75	6.74						
	5	75	3.34						
	6	75	9.17						
	7	75	0.96						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

191001
41 22 09.0 092 58 31.0
RED ROCK LAKE
19125 IOWA

11EPALES
3

2111202
0033 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 CAC03 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/18	15 30	0000	13.6		24	555	8.55	330	0.050	0.800	8.050	0.104
	15 30	0005	13.6	12.4		555	8.50	370	0.040	0.600	9.250	0.115
	15 30	0015	12.6	12.4		542	8.40	340	0.030	0.700	8.170	0.116
	15 30	0028	11.1	10.4		517	8.30	350	0.050	0.700	8.710	0.118
74/07/08	11 00	0000	24.2	6.4	60	579	8.10					
	11 00	0005	23.7	7.0		573	8.10					
	11 00	0015	23.2	6.0		540	8.10					
	11 00	0030	23.0	5.2		571	8.00					
	11 00	0045	22.4	4.2		566	7.90					
	11 00	0062	20.5	2.8		550	7.80					
74/09/24	15 20	0000	16.8	8.0	12	536	7.53	254	0.040	0.600	1.840	0.075
	15 20	0005	16.8	8.0		536	7.53	238	0.050	0.900	1.570	0.069
	15 20	0015	16.8	7.4		531	7.52	228	0.040	0.900	1.600	0.065
	15 20	0032	16.7	7.4		535	7.50	234	0.060	1.000	1.660	0.064

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/18	15 30	0000	0.190	25.4	
	15 30	0005	0.178		
	15 30	0015	0.180		
	15 30	0028	0.178		
74/07/08	11 00	0000		1.7	
	11 00	0002			50.0
	11 00	0015			1.0
74/09/24	15 20	0000	0.176	13.3	
	15 20	0001			1.0
	15 20	0005	0.175		
	15 20	0015	0.179		
	15 20	0032	0.208		

STORET RETRIEVAL DATE 75/12/23

191002
41 24 08.0 093 00 53.0
RED ROCK LAKE
19125 IOWA

11EPALES
3

2111202
0024 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 CAC03 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/18	15 50	0000	11.4		18	560	8.20	380	0.070	0.600	9.640	0.131
	15 50	0005	11.2	9.8		561	8.20	330	0.080	0.600	8.640	0.135
	15 50	0015	11.0	10.0		617	8.20	370	0.070	0.700	9.750	0.134
	15 50	0021	10.5	10.0		612	8.30	390	0.070	0.700	9.490	0.128
74/09/24	14 55	0000	16.8	8.0	12	534	7.60	224	0.050	0.700	1.600	0.080
	14 55	0005	16.8	8.4		535	7.58	210	0.070	0.600	1.520	0.072
	14 55	0015	16.7	8.2		535	7.61	240	0.040	0.600	1.700	0.070
	14 55	0020	16.7	8.2		535	7.58	254	0.050	0.700	1.820	0.062

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/18	15 50	0000	0.201	11.2	
	15 50	0005	0.211		
	15 50	0015	0.212		
	15 50	0021	0.210		
74/09/24	14 55	0000	0.176	17.5	
	14 55	0001			1.0
	14 55	0005	0.155		
	14 55	0015	0.167		
	14 55	0020	0.180		

STORET RETRIEVAL DATE 75/12/23

191003
41 24 49.0 093 06 04.0
RED ROCK LAKE
19125 IOWA

11EPALES
3

2111202
0000 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 CAC03 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/08	14 05	0000	25.4	9.3	48	606	8.20					
	14 05	0005	24.8	7.8		613	8.10					
	14 05	0015	24.3	7.0		631	8.10					
	14 05	0030	23.6	6.6		653	8.00					
	14 05	0045	21.1	2.2		580	7.60					
74/09/24	14 35	0000	17.9	9.0	8	598	7.53	238	0.340	1.500	1.360	0.265

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/08	14 05	0000		3.8	
74/09/24	14 35	0000	0.670	41.2	
	14 35	0001			1.0

STORET RETRIEVAL DATE 75/12/23

191004
41 22 43.0 093 03 10.0
RED ROCK LAKE
19125 IOWA

11EPALES
3

2111202
0000 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 CAC03 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/08	14 30	0000	28.1	10.4	36	434	8.40					
	14 30	0005	27.3	8.6		525	8.40					
	14 30	0015	23.5	6.0		580	8.00					
	14 30	0025	23.4	6.6		576	8.00					
	14 30	0032	21.6	5.4		455	7.80					

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/08	14 30	0000		2.5	
	14 30	0006			1.0

STORET RETRIEVAL DATE 75/12/23

191005
41 28 03.0 093 12 46.0
RED ROCK LAKE
19 IOWA

11EPALES
3

2111202
0047 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 CAC03 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/08	13 30	0000	28.4	10.8	36	722	8.60					
	13 30	0005	28.3	10.2		721	8.60					
	13 30	0015	26.2	8.0		696	8.00					
	13 30	0020	23.8	3.8		708	7.80					
	13 30	0030	23.3	3.6		658	7.80					
	13 30	0043	21.7	1.0		594	7.60					

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/08	13 30	0000		10.8	
	13 30	0007			1.0

STORET RETRIEVAL DATE 75/12/23

191006
41 29 20.0 093 20 12.0
RED ROCK LAKE
19 IOWA

11EPALES
3

2111202
0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CAC03 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&N03 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/08	13 00	0000	26.2	9.4	12	792	8.40					
	13 00	0005	27.6	7.8		788	8.30					
	13 00	0015	26.5	6.2		760	8.20					

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/08	13 00	0000		19.9	
	13 00	0002			1.0

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/01/27

1910A1
 41 31 40.0 092 58 00.0
 DES MOINES RIVER
 19007 15 PELLA IA
 O/RED ROCK RESERVOIR
 LGHT DTY RD BRDG .75 MI DWNST RM OF DAM
 11EPALES 2111204
 4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&N03 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	09 53		2.700	1.300	0.080	0.065	0.130
74/09/14	10 50		1.440	1.400	0.040	0.070	0.165
74/10/05	10 45		1.520	0.925	0.065	0.090	0.187
74/11/03	09 15		1.520	0.900	0.065	0.110	0.200
74/12/14	11 20		1.560	1.600	0.055	0.153	0.330
75/01/11	11 00		2.500	1.400	0.144	0.250	0.340
75/02/08	13 45		1.150	1.400	0.528	0.336	0.340
75/03/08	09 35		2.400	2.200	0.763	0.430	0.520
75/04/13	12 50		6.000	1.300	0.300	0.115	0.180
75/04/20	15 25		7.600	1.200	0.185	0.150	0.240
75/05/04	13 50		7.100	1.200	0.350	0.035	0.160
75/05/20	15 15		7.800	1.750	0.050	0.105	0.250
75/05/31	14 30		6.900	2.300	0.145	0.095	0.180
75/06/28	11 20		7.800	1.200	0.060	0.105	0.180
75/07/13	08 30		7.800	1.700	0.185	0.145	0.260
75/07/18	07 45		7.200	1.000	0.095	0.135	0.220

STORET RETRIEVAL DATE 76/01/27

1910A2
 41 20 13.0 093 29 17.0
 DES MOINES RIVER
 19 7.5 PLEASANTVILE
 T/RED ROCK RESERVOIR
 MED DTY RD BRDG 7 MI NNW OF PLEASANTVILE
 11EPALES 2111204
 4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	14	24	0.990	2.400	0.140	0.190	0.610
74/09/14	15	20	1.200	2.300	0.315	0.380	0.680
74/10/05	14	30	0.910	2.300	0.330	0.290	0.550
74/11/02	14	20	1.040	2.900	0.280	0.185	1.030
74/12/14	14	30	2.640	2.000	0.460	0.500	0.750
75/01/11	13	00	1.560	4.400	0.368	0.070	0.230
75/02/08	13	25	2.630	1.400	0.600	0.480	0.500
75/03/08	10	20	3.000	1.700	0.730	0.480	0.580
75/04/13	12	40	7.500	2.400	0.210	0.190	0.720
75/04/20	15	25	8.000	1.850	0.080	0.190	0.560
75/05/03	13	25	6.500	3.750	0.050	0.165	1.600
75/05/20	16	50	8.600	1.700	0.035	0.160	0.420
75/06/01	08	35	10.500	2.350	0.065	0.175	0.500
75/06/15	16	05	12.000	2.600	0.044	0.155	0.760
75/07/13	12	45	5.600	2.200	0.125	0.125	0.380

STORET RETRIEVAL DATE 76/01/27

1910A3
41 34 35.0 093 35 49.0
DES MOINES RIVER
19 7.5 DS MOINES SE
T/RED ROCK RESERVOIR
HWY 65/69 BRDG UPSTRM OF DES MOINES STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	11 30		0.670	3.000	0.270	0.045	0.240
74/09/14	12 05		0.432	1.800	0.100	0.035	0.180
74/10/05	11 00		0.144	1.800	0.015	0.045	0.220
74/11/02	11 50		1.280	2.500	0.105	0.135	0.520
74/12/15	11 20		1.970	1.300	0.140	0.100	0.210
75/02/22	10 30		2.240	1.500	0.552	0.256	0.350
75/03/16	10 15		2.880	1.100	0.410	0.250	0.280
75/04/13	11 00		6.600	2.400	0.310	0.180	0.630
75/04/20	10 00		8.500	1.480	0.063	0.175	0.400
75/05/03	11 35		9.100	2.100	0.065	0.180	0.600
75/06/08	13 30		11.000	2.800	0.115	0.140	0.660
75/06/21	13 05		11.000	1.780	0.070	0.170	0.530

STORET RETRIEVAL DATE 76/01/27

191081
 41 20 08.0 093 03 45.0
 COMPETINE CREEK
 19 7.5 KNOXVILLE IA
 T/RED ROCK RESERVOIR
 100 FT DNSTRM LTDTY RD BRDG ENE KNOXVILL
 11EPALES 2111204
 4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	09	20	2.700	5.200	2.900	4.900	6.000
74/09/14	10	00	3.840	6.700	4.100	3.400	5.400
74/10/05	10	00	1.760	9.500	6.800	6.200	9.800
74/11/03	09	00	3.600	4.800	2.880	2.600	3.700
74/12/14	10	45	2.600	9.200	2.900	2.300	3.900
75/01/11	10	35	2.760	4.400	2.360	1.700	2.800
75/02/22	13	15	1.760	13.500	9.100	3.300	6.000
75/03/08	09	00	1.570	7.700	3.500	1.350	2.100
75/04/13	12	15	2.600	2.800	1.300	0.940	1.250
75/04/20	13	45	2.600	2.900	1.250	1.300	1.500
75/05/03	16	25	2.300	4.400	2.100	2.300	2.600
75/05/20	15	35	2.880	11.970	6.100	2.000	
75/05/31	15	00	6.900	2.300	0.790	0.840	1.050
75/06/13	08	40	4.000	3.450	1.760	2.300	2.600
75/06/28	11	45	2.700	3.450	1.500	2.880	3.600
75/07/13	08	00	4.500	9.750	5.900	3.200	8.100
75/07/18	08	15	3.525	9.400	6.000	6.400	7.500

STORET RETRIEVAL DATE 76/01/27

1910C1
 41 19 20.0 093 09 00.0
 WHITE BREST CREEK
 19 7.5 KNOXVILLE SW
 T/RED ROCK RESERVOIR
 1A HWY 60/92 BRDG 3.0 MI W OF KNOXVILLE
 11EPALES 2111204
 4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	13 21		0.860	2.300	0.360	0.045	0.045
74/09/14	14 15		0.510	1.800	0.290	0.045	0.350
74/10/05	13 00		0.016	2.100	0.055	0.050	0.230
74/11/02	13 10		1.760	3.600	0.340	0.085	0.825
75/01/11	14 00		1.840	5.700	0.320	0.070	
75/03/08	10 00		1.150	1.950	0.775	0.100	0.290
75/04/13	12 05		1.650	1.350	0.260	0.060	0.370
75/04/20	14 45		1.100	1.400	0.170	0.075	0.420
75/05/03	12 45		0.900	1.700	0.110	0.050	0.420
75/05/20	16 15		0.040	1.700	0.030	0.037	0.380
75/06/15	15 20		3.850	2.800	0.120	0.070	0.800
75/06/28	12 00		0.005	2.600	0.055	0.060	0.340
75/07/13	12 00		0.075	1.850	0.135	0.075	0.520

STORET RETRIEVAL DATE 76/01/27

191001
 41 28 47.0 093 09 42.0
 CALHOUN CREEK
 19 7.5 KNOXVILLE NW
 T/RED ROCK RESERVOIR
 2NDRY RD BRDG 9.1 MI SE OF PRAIRIE CITY
 11EPALES 2111204
 4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	10	44	6.900	1.200	0.095	0.155	0.330
74/09/14	12	20	3.680	4.000	0.760	0.550	0.880
74/10/05	11	30	0.820	2.000	0.130	0.060	0.260
74/11/02	10	00	3.360	2.800	1.200	0.860	0.900
74/12/14	13	15	3.600	0.600	0.560	0.510	0.780
75/01/11	13	05	2.880	4.600	1.300	0.180	0.750
75/04/13	13	20	6.900	0.850	0.185	0.090	0.270
75/04/20	13	50	6.300	1.050	0.080	0.090	0.220
75/05/04	15	20	6.900	1.050	0.220	0.040	0.260
75/05/17	19	15	7.200	1.500	0.050	0.080	0.350
75/05/31	12	25	6.800	2.400	0.300	0.270	0.660
75/06/15	10	45	7.200	1.450	0.145	0.230	0.520
75/06/28	10	30	9.500	2.350	0.185	0.135	0.600
75/07/13	09	10	8.800	0.950	0.080	0.170	0.340
75/07/18	10	25	8.000	1.300	0.100	0.160	0.350

STORET RETRIEVAL DATE 76/01/27

1910E1
 41 30 05.0 093 15 01.0
 WALNUT CREEK
 19 MARION CO HWY MP
 T/RED ROCK RESERVOIR
 2NDRY RD BRDG 7.0 MI SSW OF PRAIRIE CITY
 11EPALES 2111204
 4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	11 30		5.100	1.600	0.080	0.050	0.410
74/09/14	12 10		4.300	5.000	0.575	0.085	0.945
74/10/06	09 15		0.256	1.400	0.110	0.045	0.190
74/11/02	10 15		8.380	2.100	0.255	0.190	0.500
74/12/14	13 40		4.000	0.500	0.115	0.010	0.015
75/01/11	13 30		3.200	4.000	0.800	0.160	0.660
75/04/13	13 50		6.300	0.650	0.160	0.035	0.130
75/04/20	11 30		6.300	0.850	0.050	0.030	0.090
75/05/04	14 50		7.000	0.750	0.470	0.055	0.130
75/05/17	18 50		7.100	1.100	0.020	0.005	0.170
75/05/31	12 00		6.600	1.650	0.140	0.065	0.250
75/06/13	11 10		6.600	1.250	0.050	0.070	0.280
75/07/13	09 35		7.800	1.280	0.080	0.060	0.195
75/07/18	10 45		7.000	1.300	0.055	0.065	0.230

STORET RETRIEVAL DATE 76/01/27

1910F1
 41 18 53.0 093 12 49.0
 HAWK RUN
 19 7.5 KNOXVILLE SW
 T/RED ROCK RESERVOIR
 SEC RD BRDG 1.2 M S JCT WITH HWYS 60/92
 11EPALES 2111204
 4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&N03 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	13 42		0.637	1.150	0.110	0.065	0.175
74/09/14	14 30		1.480	2.600	0.240	0.108	0.475
74/10/05	13 30		0.352	2.400	0.470	0.050	0.250
74/11/02	13 20		2.520	1.000	0.085	0.130	0.220
74/12/14	13 30		2.320	0.500	0.050	0.035	0.080
75/01/11	12 40		3.360	1.500	0.272	0.135	0.375
75/04/13	12 15		5.500	0.650	0.045	0.035	0.080
75/04/20	14 55		4.200	0.550	0.025	0.030	0.070
75/05/04	13 00		4.100	0.850	0.125	0.070	0.080
75/05/20	10 25		3.600	1.300	0.110	0.065	0.160
75/06/01	20 40		3.200	1.250	0.040	0.035	0.120
75/06/15	15 30		5.600	0.650	0.030	0.050	0.100
75/06/28	14 20		4.400	1.250	0.050	0.070	0.140
75/07/13	12 15		0.880	0.900	0.045	0.015	0.100

STORET RETRIEVAL DATE 76/01/27

1910G1
41 28 48.0 093 11 43.0
PRAIRE CREEK
19 7.5 KNOXVILLE NW
T/RED ROCK RESERVOIR
COUNTY TRUNK S6G BRIDGE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	10	57	5.100	1.000	0.105	0.060	0.140
74/09/14	12	24	1.200	2.600	0.510	0.085	0.480
74/10/05	13	05	0.144	1.400	0.160	0.030	0.230
74/11/03	10	05	1.600	8.540	2.200	0.220	2.600
74/12/14	13	15	1.360	1.300	0.290	0.035	0.220
75/04/13	13	35	6.600	0.850	0.110	0.050	0.120
75/04/20	14	10	6.000	0.700	0.040	0.045	0.080
75/05/04	15	05	6.500	0.650	0.175	0.040	0.050
75/05/17	19	05	6.300	1.250	0.135	0.030	0.120
75/05/31	12	15	4.900	2.300	0.630	0.180	0.380
75/06/13	11	00	5.600	1.150	0.120	0.095	0.190
75/06/28	10	15	9.100	2.200	0.090	0.080	0.580
75/07/13	09	20	8.400	1.850	0.095	0.055	0.130
75/07/18	10	35	7.000	0.850	0.040	0.060	0.150

STORET RETRIEVAL DATE 76/01/27

1910H1
 41 27 20.0 093 26 35.0
 BUTCHER CREEK
 19 7.5 HARTFORD
 T/RED ROCK RESERVOIR
 SEC RD XING 2 MI NW OF PALMYRA
 11EPALES 2111204
 4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/18	15 00		1.260	1.200	0.095	0.050	0.185
74/09/14	16 00		1.320	3.700	0.185	0.075	0.460
74/10/05	14 15		0.008	0.800	0.030	0.050	0.145
74/11/02	14 45		1.680	1.500	0.170	0.200	0.252
74/12/14	15 00		1.440	0.700	0.180	0.020	0.040
75/01/11	13 20		2.240	2.200	0.384	0.110	0.400
75/04/13	13 05		3.600	0.675	0.100	0.025	0.080
75/04/20	15 40		2.630	0.550	0.035	0.025	0.060
75/05/03	13 14		3.200	0.950	0.060	0.035	0.050
75/05/20	17 20		2.200	1.450	0.115	0.050	0.210
75/06/01	20 00		2.200	1.750	0.050	0.055	0.270
75/06/15	16 30		4.000	1.050	0.035	0.056	0.170
75/06/28	14 55		3.900	1.150	0.050	0.055	0.190
75/07/13	13 00		2.800	0.600	0.025	0.035	0.080

STORET RETRIEVAL DATE 76/01/27

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1910AA          TF1910AA          P300000*
41 48 40.0 091 30 15.0
DES MOINES
19007  7.5 DES MOINE SE
T/RED ROCK RESERVOIR
DES MOINES RIVER
11EPALES
4          2141204
          0000 FEET  DEPTH

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DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/09/29	00	00							
CP(T)-			8.700	15.000	6.300	7.400	9.400	27.700	38.500
74/09/29	24	00							
74/10/30	00	00							
CP(T)-			8.500	17.000	5.800	7.100	7.750	32.600	30.300
74/10/30	24	00							
74/11/26	00	00							
CP(T)-			11.200	18.000	6.000	7.800	10.000	35.900	35.000
74/11/26	24	00							
74/12/29	00	00							
CP(T)-			11.600	7.200	0.084	8.300	10.000	30.300	34.000
74/12/29	24	00							
75/01/29	00	00							
CP(T)-			10.100	16.000	2.640	6.000	8.200	35.100	35.400
75/01/29	24	00							
75/02/28	00	00							
CP(T)-			6.900	18.500	4.000	6.900	8.000	39.600	40.100
75/02/28	24	00							
75/04/03			7.100	1.900	0.220	4.480	5.600	43.500	38.900
75/04/27	00	00							
CP(T)-			9.800	7.100	0.480	4.400	6.300	39.900	43.200
75/04/27	24	00							
75/05/28	00	00							
CP(T)-			11.000	13.000	0.140	6.000	7.000	42.400	44.600
75/05/28	24	00							
75/07/27	00	00							
CP(T)-			11.000	5.800	0.470	6.800	7.700	36.900	39.800
75/07/27	24	00							
75/08/25	00	00							
CP(T)-			9.300	8.200	1.050	6.000	6.600	42.900	41.800
75/08/25	24	00							