WATER-QUALITY RECONNAISSANCE OF SELECTED WATER-SUPPLY LAKES IN EASTERN KANSAS

By Larry M. Pope, Joseph A. Arruda, and Annetta E. Vahsholtz

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Dallas L. Peck, Director

For additional information
write to:

District Chief
U.S. Geological Survey, WRD
1950 Constant Avenue - Campus West
Lawrence, Kansas 66046
[Telephone: (913) 864-4321]

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CONTENTS

ILLUSTRATIONS

TABLES

TABLES--Continued

CONVERSION FACTORS

Inch-pound units of measurements used in this report can be converted to the International System of Units (SI) using the following conversion factors:

Multiply inch-pound units	By	To obtain SI units
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
acre	0.4047	hectare (ha)
degree Fahrenheit (°F)	(1)	degree Celsius (°C)

[1] °C = 5/9 (°F - 32).

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ABSTRACT

Water-quality degradation of public water-supply lakes can produce taste, odor, turbidity, and trace-organic problems in drinking water. The U.S. Geological Survey, in cooperation with the Kansas Department of Health and Environment, is investigating the water-quality characteristics of public water-supply lakes in eastern Kansas. The initial phase of this investigation (spring-fall 1983) consisted of a water-quality reconnaissance of 19 public water-supply lakes. The purpose of this reconnaissance was to collect and statistically summarize water-quality data and describe relationships between water-quality constituents and lake and watershed physical characteristics.

The water-supply lakes had a large range in mean concentrations of total nitrite plus nitrate nitrogen (0.01 to 0.84 milligrams per liter), total ammonia nitrogen (0.01 to 0.38 milligrams per liter), total phosphorus (0.02 to 0.24 milligrams per liter), total organic carbon (3.5 to 9.1 milligrams per liter), and chlorophyll *a* (3.1 to 42 micrograms per liter); and in lake and watershed physical characteristics, such as age (1 to 57 years), surface area (13 to 1,240 acres), watershed area (92 to 41,090 acres), watershed-to-lake surface-area ratio (7 to 102), and average maximum depth (8 to 42 feet). Additionally, small concentrations of pesticides were detected in 8 of the 19 water-supply lakes. Atrazine and Alachlor were the most commonly detected pesticides.

Results of Spearman rank-order correlation analyses showed possible relationships between mean concentrations of total nitrite plus nitrate nitrogen, total ammonia nitrogen, total phosphorus, total organic carbon, and chlorophyll *a*; and certain lake and watershed physical characteristics. Multiple-regression analysis produced significant (0.05 level of significance) relations between mean concentrations of total nitrite plus nitrate nitrogen and percentage of watershed in protected cropland and age of lake (0.62 coefficient of determination); and between mean concentrations of total organic carbon and lake average maximum depth, lake-surface area, age of lake, and watershed-to-lake surface-area ratio (0.76 coefficient of determination).

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1 U.S. Geological Survey, Lawrence, Kansas.

2 Kansas Department of Health and Environment, Topeka, Kansas.

INTRODUCTION

Degradation of water quality in public water-supply lakes can increase treatment cost and reduce the quality of drinking water. Concentrations of organic substances, nutrients, iron, manganese, and algae can cause taste, odor, and turbidity problems, and pose a potential for increased concentrations of organohalides, especially trihalomethanes, that are formed as by-products of the interactions of disinfectants with natural organic substances during the drinking-water treatment process. The U.S. Geological Survey entered into a cooperative agreement with the Kansas Department of Health and Environment in 1983 to investigate the water quality of selected public water-supply lakes in eastern Kansas. The purpose of this continuing investigation is to examine the relationships between the severity and frequency of lake water-quality problems and lake and watershed physical characteristics, and to estimate nutrient contributions from the watershed.

The initial phase of this investigation, described in this report, consisted of a reconnaissance of 19 public water-supply lakes. Data collected in the reconnaissance phase included: specific conductance, pH, temperature, turbidity, secchi-disk transparency, dissolved oxygen, concentrations of nutrients, total organic carbon, pesticides, and chlorophyll *a*. Data also were collected to describe lake size and depth, and watershed size and land-use characteristics. The purpose of this report is to present and statistically summarize data collected during the reconnaissance, to present relationships between water-quality constituents and lake and watershed physical characteristics, to provide interpretations useful to lake and watershed managers, and to provide information useful in planning a more comprehensive investigation.

DESCRIPTION OF STUDY AREA AND SELECTED WATER-SUPPLY LAKES

The location of the study area and selected water-supply lakes are shown in figure 1. The study area is the eastern one-third of Kansas and contains the majority of the State's water-supply lakes. Map-index numbers, lake location descriptions, and principal cities that use water from the lakes are provided in table 1.

Seventeen public water-supply lakes initially were selected for this reconnaissance investigation. Selection was made to provide a range in lake and watershed physical characteristics, such as age, depth, surface area, and watershed size; and to minimize the occurrence and extent of watershed characteristics, such as urban areas, shoreline residential developments, and large feedlot operations. Two additional water-supply lakes were sampled during summer 1983, because of reported water-quality problems, and subsequently included in this reconnaissance.

All of the water-supply lakes serve multiple purposes such as public fishing, boating, water skiing, and waterfowl hunting, as well as drinking water for municipalities. Construction of some of the older lakes was accomplished with funds provided by the former U.S. Works Progress Adminis-

tration (WPA), while others are relatively new U.S. Soil Conservation Service projects constructed with funds provided by Public Law-566. One lake (Big Hill Lake) was constructed with Federal funds and is managed by the U.S. Army Corps of Engineers.

Physical characteristics of the water-supply lakes and watersheds are shown in table 2. Data for lake-surface area, watershed area, and watershed land-use classifications were provided by the U.S. Soil Conservation Service (Salina, Kansas, written commun., 1984). Six watershed land-use classifications were provided for this investigation: (1) protected cropland--cropland protected by soil-erosion control features, such as terraces and sedimentation ponds; (2) unprotected cropland--cropland lacking soil-erosion control features; (3) grazed grassland--grassland used for the pasturing of livestock; (4) ungrazed grassland--grassland mainly used for hay production; (5) forest land--land with trees as the predominate vegetative cover; and (6) other land use--includes urban areas, small industrial sites, animal feedlots, major roads and highways, ponds and small lakes, and recreational areas, such as golf courses,

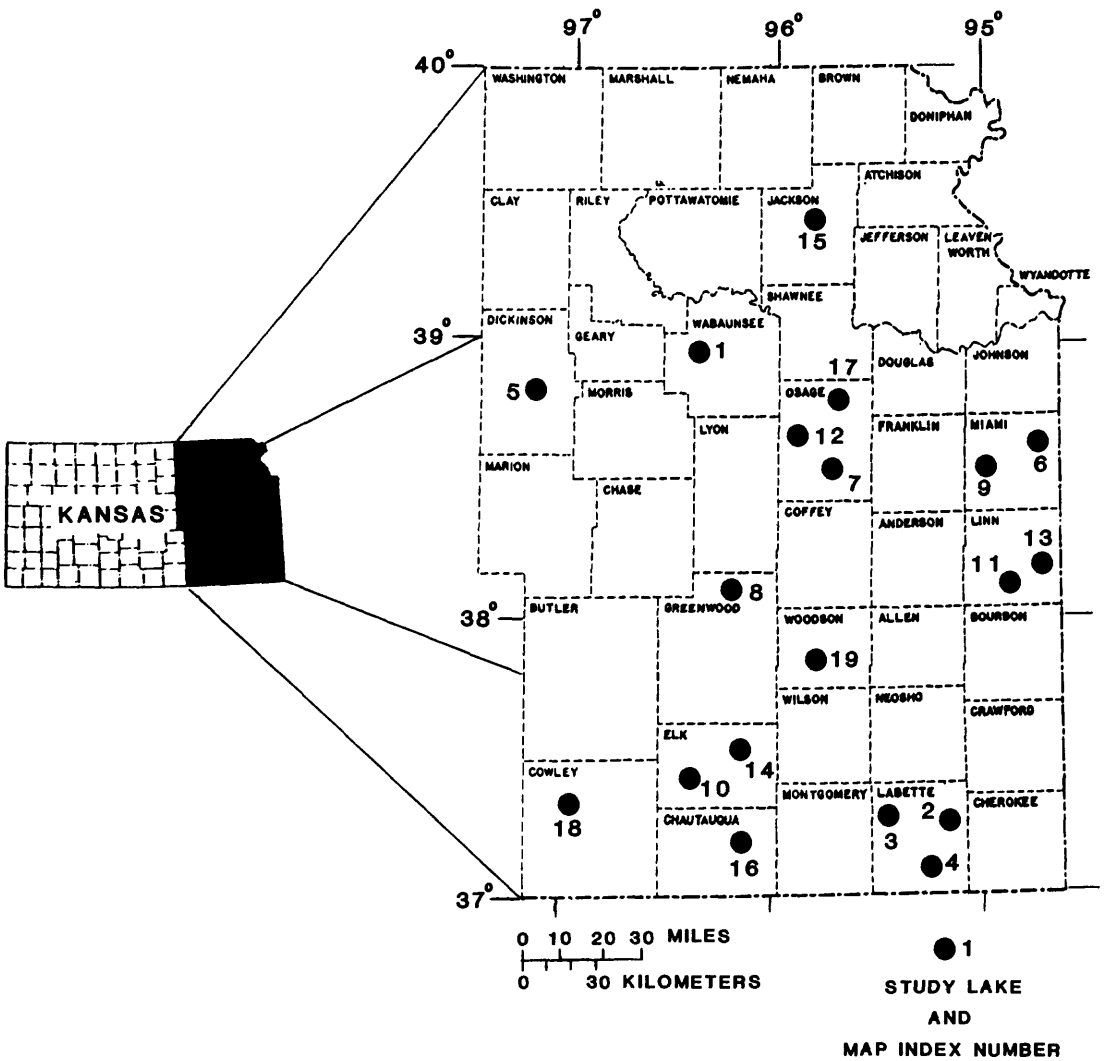

Figure 1.--Location of study area and selected water-supply lakes.

Table 1.-Map-index number, principal city using water, and location of selected water-supply lakes in eastern Kansas

Map-index number (fig. 1)	Water-supply lake	Principal city using water	Latitude (north)	Longitude (west)	Land-line description	County
1	Alma City Reservoir	Alma	38°58'39"	96°15'48"	NE1/4SE1/4 sec. 26, T. 12 S., R. 10 E.	Wabaunsee
2	Altamont West Lake	Altamont	37°08'31"	95°17'25"	NW1/4SE1/4 sec. 26, T. 33 S., R. 19 E.	Labette
3	Big Hill Lake	Cherryvale	37°16'14"	95°28'22"	SW1/4SE1/4 sec. 7, T. 32 S., R. 18 E.	Labette
4	Edna City Lake	Edna	37°02'08"	95°23'29"	SW1/4SW1/4 sec. 36, T. 34 S., R. 18 E.	Labette
5	Herington Reservoir	Herington	38°39'53"	97°00'16"	NE1/4NE1/4 sec. 17, T. 16 S., R. 4 E.	Dickinson
6	Louisburg Lake	Louisburg	38°36'27"	94°40'17"	SW1/4SW1/4 sec. 32, T. 16 S., R. 25 E.	Miami
7	Lyndon City Lake	Lyndon	38°35'13"	95°41'12"	SE1/4NW1/4 sec. 7, T. 17 S., R. 16 E.	Osage
8	Madison City Lake	Madison	38°06'31"	96°08'37"	SW1/4NE1/4 sec. 25, T. 22 S., R. 11 E.	Greenwood
9	Miola Lake	Paola	38°35'03"	94°50'33"	NW1/4SW1/4 sec. 11, T. 17 S., R. 23 E.	Miami
10	Moline Reservoir	Moline	37°23'22"	96°19'04"	SW1/4SE1/4 sec. 33, T. 30 S., R. 10 E.	Elk
11	Mound City Lake	Mound City	38°08'21"	94°53'30"	NE1/4NW1/4 sec. 16, T. 22 S., R. 23 E.	Linn
12	Osage City Reservoir	Osage City	38°40'10"	95°40'10"	SE1/4NW1/4 sec. 35, T. 16 S., R. 14 E.	Osage
13	Pleasanton East City Lake	Pleasanton	38°11'57"	94°41'21"	NE1/4NW1/4 sec. 29, T. 21 S., R. 25 E.	Linn
14	Polk Daniels Lake	Howard	37°27'41"	96°13'38"	SE1/4SW1/4 sec. 5, T. 30 S., R. 11 E.	Elk
15	Prairie Lake	Holton	39°29'17"	95°41'16"	SE1/4NE1/4 sec. 36, T. 6 S., R. 15 E.	Jackson
16	Sedan Lower City Lake	Sedan	37°09'01"	96°12'21"	SW1/4NE1/4 sec. 28, T. 33 S., R. 11 E.	Chautauqua
17	Strowbridge Reservoir	Carbondale	38°49'01"	95°38'26"	NE1/4SW1/4 sec. 21, T. 14 S., R. 16 E.	Osage
18	Timber Creek Lake	Winfield	37°21'03"	96°53'42"	NW1/4SW1/4 sec. 16, T. 31 S., R. 5 E.	Cowley
19	Yates Center Reservoir	Yates Center	37°51'59"	95°44'43"	SW1/4SE1/4 sec. 15, T. 25 S., R. 15 E.	Woodson

Table 2.--Physical characteristics of selected water-supply lakes and watersheds, 1983

[NA indicates data are not available from U.S. Soil Conservation Service]

Lake	Age (years)	Lake-surface area (acres)	Watershed area (acres)	Watershed-to-lake surface-area ratio	Average maximum depth (feet)	Watershed land use					
						Protected cropland (percent)	Unprotected cropland (percent)	Grazed grassland (percent)	Ungrazed grassland (percent)	Forest land (percent)	Other land use (percent)
Alma City Reservoir	13	28	1,440	51	26	0	0	95	0	5	0
Altamont West Lake	12	13	250	19	10	36	24	40	0	0	0
Big Hill Lake	1	1,240	23,460	19	39	20	25	47	0	8	0
Edna City Lake	30	14	92	7	21	6	0	94	0	0	0
Herington Reservoir	2	546	15,850	29	20	35	18	37	4	2	4
Louisburg Lake	29	15	400	27	21	6	17	46	18	5	8
Lyndon City Lake	17	77	885	11	26	1	19	60	12	0	8
Madison City Lake	14	115	2,500	22	28	5	3	84	7	0	1
Miola Lake	26	198	3,650	18	29	15	14	38	18	0	15
Moline Reservoir	1	185	4,740	26	18	7	4	81	5	0	3
Mound City Lake	4	150	3,650	24	18	15	18	45	4	13	5
Osage City Reservoir	29	50	2,990	60	8	12	23	44	15	2	4
Pleasanton East City Lake	18	79	1,260	16	26	20	19	21	21	0	19
Polk Daniels Lake	47	64	6,500	102	21	24	13	58	3	0	2
Prairie Lake	35	46	891	19	23	11	8	12	58	0	11
Sedan Lower City Lake	18	77	4,430	58	23	NA	NA	NA	NA	NA	NA
Strowbridge Reservoir	19	284	3,210	11	26	48	16	17	10	1	8
Timber Creek Lake	13	1,080	41,090	38	42	23	8	57	6	2	4
Yates Center Reservoir	57	125	2,500	20	16	17	4	69	7	0	3

parks, and camping areas. Accuracy of lake-surface area and watershed-area data was verified by planimetric procedures using U.S. Geological Survey 7 1/2-minute topographic maps. Average maximum depth is the average of the greatest depths recorded during sample-collection visits to the lakes.

An examination of table 2 reveals that the water-supply lakes range in age from 1 to 57 years, in lake-surface area from 13 to 1,240 acres, in watershed area from 92 to 41,090 acres, in watershed-to-lake surface-area ratio from 7 to 102, and in average maximum depth from 8 to 42 feet. Grazed grassland comprises the largest watershed land use in 16 of the 19 water-supply lakes and is greater than 50 percent of the land use in 8 of the 19 lakes. Average land-use percentages are 17 percent for protected cropland, 13 percent for unprotected cropland, 52 percent for grazed grassland, 10 percent for ungrazed grassland, 2.1 percent for forest land, and 5.3 percent for other land uses.

SAMPLE COLLECTION AND ANALYSIS

All study lakes were sampled at least once during the reconnaissance. The 17 water-supply lakes initially selected for this reconnaissance investigation were sampled twice during 1983, once during late spring-early summer and again during late summer-early fall. Additional samples were collected from several of the study lakes during summer 1983 in immediate response to taste and odor complaints associated with the treated drinking water from these lakes.

Two to four data-collection sites were established in each water-supply lake. Site 1 was located offshore from the center point of the lake dam and corresponded to the greatest recorded depth in each lake. To define possible areal water-quality variations within the lakes, additional sampling sites were located in the major lake arms or coves or other representative locations. At each sampling site, a vertical profile of temperature and dissolved oxygen was defined. Surface samples for water-quality analysis were collected (within 1 foot of the surface) at each site. If the depth at a sampling site exceeded 8.0 feet, an additional sample was collected at a point approximately 1.5 feet above the lake bottom to document any stratification in lake-water quality. Samples for water-quality analysis were collected according to procedures presented in Skougstad and others (1979) and Greeson and others (1977). Water samples for pesticide analysis were collected at the surface of site 1. A survey of selected lake physical and botanical features during the late summer-early fall sample-collection period is presented in table 8 in the "Supplementary Information" section of this report.

Chemical analyses of water samples were made by the Division of Laboratories, Kansas Department of Health and Environment, Topeka, Kansas, for all water-quality constituents (except total organic carbon) and were made in accordance with methods described in "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association, 1975) or in "Methods for Chemical Analysis of Water and Waste" (U.S. Environmental Protection Agency, 1979). Analyses of water samples

for total organic carbon were made by the Central Laboratories, U.S. Geological Survey, Arvada, Colorado, in accordance with procedures presented in Wershaw and others (1983, p. 25).

WATER-QUALITY RECONNAISSANCE

Statistical Summary

Results of water-quality measurements and chemical analyses of water samples collected during this reconnaissance are presented in table 9 in the "Supplementary Information" section of this report. Mean values of selected water-quality physical and chemical characteristics were computed for each water-supply lake from the data presented in table 9. Mean values were computed by first averaging all surface-sample data values for each data-collection visit and then averaging the results of all data-collection visits.

In order to increase comparability between water-supply lakes and because sample-collection visits did not necessarily correspond with the development of thermal stratification, only surface-data values were used to compute mean values. Major trends in lake water quality, especially as influenced by lake and watershed physical characteristics, are adequately reflected by lake surface-water data values. These mean values and a statistical summary are shown in table 3.

The data presented in table 3 shows a large range in mean values of several water-quality measurements. Mean values of specific conductance ranged from 158 to 641 µS/cm (microsiemens per centimeter at 25 °C). With the exception of Herington Reservoir, Moline Reservoir, and Madison City Lake, all of the study lakes had mean values of specific conductance less than 310 µS/cm. Mean values of pH were not computed because pH is expressed in logarithmic units and represents the negative base-10 log of the hydrogen-ion activity in moles per liter. Areal and temporal variations in pH are shown in table 9 in the "Supplementary Information" section of this report. Mean values of turbidity (in Jackson turbidity units) ranged from 4.5 to 100; however, with the exception of the mean value of 100 at Altamont West Lake and the mean value of 90 at Yates Center Reservoir, all other mean values were 31 or less. Mean values of secchi-disk transparency ranged from 6 to 87 inches and generally were inversely related to mean values of turbidity.

Table 3 also shows a large range in mean concentrations for several of the chemical constituents. Mean concentrations of total nitrite plus nitrate nitrogen ranged from 0.01 to 0.84 mg/L (milligrams per liter) and appear to be normally distributed because the mean and median are equal. Mean concentrations of total ammonia nitrogen ranged from 0.01 to 0.38 mg/L. However, with the exception of the mean concentrations at Yates Center Reservoir (0.38 mg/L), Herington Reservoir (0.35 mg/L), and Prairie Lake (0.31 mg/L), mean concentrations of total ammonia nitrogen at all other study lakes were equal to or less than 0.13 mg/L. Those three relatively large mean concentrations are responsible for the significant

Table 3.--Mean values and statistical summary of selected water-quality characteristics for 19 water-supply lakes

[All data are for samples collected near the surface of the lakes]

Lake	Specific conductance (micro-siemens per centi-meter at 25 °Celcius)	Turbidity (Jackson turbidity units)	Trans-parency (secchi disk, inches)	Nitrite plus nitrate nitrogen, total (milligrams per liter)	Ammonia nitrogen, total (milli-grams per liter)	Phos-phorus, total (milli-grams per liter)	Organic carbon, total (milli-grams per liter)	Chloro-phyll a (micro-grams per liter)
Alma City Reservoir	283	4.5	87	0.05	0.10	0.05	3.5	3.7
Altamont West Lake	158	100	8	.32	.05	.02	7.1	3.1
Big Hill Lake	245	24	52	.27	.13	.03	6.9	6.0
Edna City Lake	196	6.2	66	.05	.05	.02	6.5	3.9
Herington Reservoir	641	9.5	44	.24	.35	.05	7.2	11
Louisburg Lake	254	9.1	49	.25	.03	.02	5.8	14
Lyndon City Lake	257	11	33	.12	.03	.04	4.1	5.0
Madison City Lake	370	5.7	41	.08	.04	.05	5.1	3.9
Miola Lake	262	16	21	.33	.02	.07	5.9	23
Moline Reservoir	428	14	26	.14	.13	.03	7.4	9.1
Mound City Lake	233	16	25	.01	.02	.07	6.4	42
Osage City Reservoir	280	19	26	.05	.13	.07	7.3	14
Pleasanton East City Lake	200	16	27	.16	.05	.07	6.4	13
Polk Daniels Lake	276	31	18	.25	.13	.04	6.4	7.7
Prairie Lake	253	8.9	34	.25	.31	.05	6.8	12
Sedan Lower City Lake	295	6.0	51	.84	.06	.05	5.5	3.9
Strowbridge Reservoir	233	22	20	.62	.01	.19	6.0	7.4
Timber Creek Lake	308	21	20	.27	.02	.05	4.9	12
Yates Center Reservoir	291	90	6	.53	.38	.24	9.1	9.8
Statistical Summary:								
Mean	288	23	34	.25	.11	.06	6.2	11
Median	262	16	27	.25	.05	.05	6.4	9.1
Minimum	158	4.5	6	.01	.01	.02	3.5	3.1
Maximum	641	100	87	.84	.38	.24	9.1	42
Standard deviation	105	26	20	.21	.11	.06	1.3	9.1

difference between the mean and median values of total ammonia nitrogen. Mean concentrations of total phosphorus ranged from 0.02 to 0.24 mg/L, but with the exception of the two largest mean concentrations, 0.24 mg/L (Yates Center Reservoir) and 0.19 mg/L (Strowbridge Reservoir), none of the water-supply lakes had mean concentrations exceeding 0.07 mg/L. Mean concentrations of total organic carbon ranged from 3.5 to 9.1 mg/L and appear to be normally distributed because of the similarity of the mean and median values. Mean concentrations of chlorophyll a (an index of algal biomass) ranged from 3.1 to 42 µg/L (micrograms per liter). Twelve of the 19 water-supply lakes had mean concentrations of chlorophyll a greater than 7.0 µg/L. According to Carlson (1977), these values indicate eutrophy, or high lake productivity.

Concentrations of selected pesticides were determined on lake-water samples collected during each data-collection visit. These selected pesticides and corresponding analytical detection limits are shown in table 4. Detectable concentrations of pesticides were observed in 8 of the 19 water-supply lakes (table 9 at the end of this report). Atrazine and Alachlor were the most commonly detected herbicides and ranged in concentrations from 1.4 to 4.0 µg/L and 0.28 to 0.63 µg/L, respectively.

According to Regehr and others (1984) both Atrazine and Alachlor are used as preplant and preemergent herbicides for the control of annual grasses and broadleaf weeds in corn, grain sorghum, and soybean fields. Atrazine also is used in the control of weeds in noncropland areas, such as along roadways and in ditches and around buildings, fences, and industrial areas. Atrazine is the longest lasting of these two herbicides. It can remain active in or on soils for 1 year or more when applied at recommended rates. Alachlor, however, is active for only 6 to 10 weeks.

There are currently (1984) no State or Federal water-quality criteria concerning concentrations of Atrazine or Alachlor in drinking-water supplies, and the concentrations observed during this investigation are smaller than concentrations that might produce chronic health problems in humans. However, with regard to Atrazine, the observed concentrations are similar to those that might have a temporary negative effect on the growth of plankton, followed by the development of an Atrazine resistant community (DeNoyelles and Kettle, 1980, 1983; DeNoyelles and others, 1982).

In addition to the occurrences of Atrazine and Alachlor, a single occurrence of the following pesticides was observed: Dual (0.54 µg/L at Strowbridge Reservoir), 2,4-D (0.5 µg/L at Herington Reservoir), DDE-o'p' and DDE-p'p' (each at 0.12 g/L at Pleasanton East City Lake), and 2,4,5-T (0.21 µg/L at Yates City Reservoir).

Correlation Analysis

Correlation analysis measures the degree of linear relationship between two variables and does not by itself imply causality. The correlation coefficient, an expression of the degree of linear relationship, has a range from -1.0 to 1.0. If all data points fall on a straight line and the relation-

Table 4.--Pesticide analytical detection limits

Pesticide[1]	Analytical detection limit, in micrograms per liter
Alachlor	0.25
Aldrin	.025
Atrazine	1.2
Chlordane	.25
Dacthal	.05
DDE-o'p'	.10
DDE-p'p'	.10
Dieldrin	.05
Dual	.25
Endrin	.10
Lindane	.025
Methoxychlor	.20
Propazine[2]	.10
Ramrod	.25
Sencor	.10
Simazine[2]	.10
Toxaphene	2.0
2,4-D (as the acid equivalent)	.40
2,4,5-TP Silvex (as the acid equivalent)	.20
2,4,5-T (as the acid equivalent)	.20

1 Pesticides are a general classification of chemicals used to control, among others, insects (insectides), weeds (herbicides), and fungii (fungicides).

2 Concentrations were not routinely determined.

ship is inverse or direct, the correlation coefficient will be -1.0 or 1.0, respectively. However, if the data points are randomly scattered, the correlation coefficient will be zero, and no linear relationship exists. The larger the magnitude of the correlation coefficient, the better the fit (Blalock, 1972, p. 376-377).

To identify the various relationships that may occur between selected lake physical and water-quality characteristics (table 5), Spearman rank-order correlation coefficients were computed (table 6). Values for those physical and water-quality characteristics have been shown previously in tables 2 and 3. Correlations at two levels of significance (0.05 and 0.10) are shown in table 6.

Knowledge of the relationships between lake and watershed physical characteristics presented in table 5 could be of value because these physical characteristics or characteristics related to them, such as mean depth, lake volume, and retention time, may affect the quality of lake water. Examination of the correlation results in table 6 leads to the following general observations: (1) the older lakes tend to have smaller watershed and lake-surface areas, (2) the larger the watershed the larger the lake-surface area, (3) the larger the lake-surface area the greater the maximum depth, and (4) the larger the watershed the greater the watershed-to-lake surface-area ratio.

In addition to the relationships between lake and watershed physical characteristics, knowledge of the relationships between the physical and water-quality characteristics of lakes will provide the ability to assess differences in lake-water quality due to differences in lake and watershed physical characteristics. Interpretation of the correlations in table 6 suggests several possible relationships.

Mean concentrations of total nitrite plus nitrate nitrogen were related directly to percentage of watershed in protected cropland (0.64 correlation coefficient) and inversely related to percentage of watershed in grazed grassland (-0.41 correlation coefficient). This may indicate that a significant part of the concentrations of nitrite plus nitrate nitrogen in public water-supply lakes originates from those areas of the watershed where crop production is intense and the application of commercially prepared fertilizers is common.

Mean concentrations of total ammonia nitrogen and total organic carbon were inversely related to lake average maximum depth (-0.44 and -0.68 correlation coefficients, respectively) and directly related to each other (0.65 correlation coefficient). Generally, therefore, the deeper the lake, the smaller the mean concentrations of total ammonia nitrogen and total organic carbon in water near the surface of the lake.

Mean concentrations of total phosphorus were related directly to lake-surface area (0.41 correlation coefficient), percentage of watershed in ungrazed grassland (0.44 correlation coefficient), and percentage of watershed in other land uses (0.47 correlation coefficient). Concentrations of phosphorus in natural waters are determined primarily by four factors: (1) Basin morphology as it relates to volume, dilution, and thermal stratifi-

cation or water movement, (2) chemical composition of the geological formations of the area, (3) drainage-area features in relation to introduction of organic matter, and (4) organic metabolism within the body of water (Reid and Wood, 1976, p. 236). Therefore, lake-surface area and percentages of watershed in ungrazed grassland and other land uses may be surrogates for characteristics of these four factors.

Table 5.--Selected physical and water-quality characteristics of water-supply lakes used in Spearman rank-order correlation analyses

Physical or water-quality characteristics	Variable name
1. Age, in years	AGE
2. Surface area, in acres	SA
3. Watershed area, in acres	WA
4. Watershed-to-lake surface-area ratio	WSRAT
5. Average maximum depth, in feet	MDEPTH
6. Percentage of watershed in protected cropland	PCROP
7. Percentage of watershed in unprotected cropland	UCROP
8. Percentage of watershed in grazed grassland	GGRASS
9. Percentage of watershed in ungrazed grassland	UGRASS
10. Percentage of watershed in forest land	FOREST
11. Percentage of watershed in other land use	OTHER
12. Mean specific conductance, in microsiemens per centimeter at 25 °Celsius	SPCON
13. Mean turbidity, in Jackson turbidity units	TURB
14. Mean secchi-disk transparency, in inches	TRANS
15. Mean total nitrite plus nitrate nitrogen, in milligrams per liter	NO2NO3
16. Mean total ammonia nitrogen, in milligrams per liter	NH4
17. Mean total phosphorus, in milligrams per liter	TOTP
18. Mean total organic carbon, in milligrams per liter	TOC
19. Mean chlorophyll *a*, in micrograms per liter	CHLA

Table 6.--Spearman rank-order correlation coefficients for selected physical and water-quality characteristics

	AGE	SA	WA	WSRAT	MDEPTH	PCROP	UCROP	GGRASS	UGRASS	FOREST	OTHER	SPCON	TURB	TRANS	NO2NO3	NH4	TOTP	TOC	CHLA
CHLA	0.18	0.30	0.23	0.11	-0.10	0.11	0.23	-0.50*	0.61*	0.26	0.72*	0.01	0.18	-0.28	-0.08	-0.12	0.44**	0.19	1.00
TOC	.03	.06	.08	-.02	-.68*	.36	.21	-.20	-.12	-.16	-.19	-.05	.46*	-.29	.05	-.08	.03	1.00	
TOTP	.23	.41**	.23	.00	.05	.23	-.03	-.35	.44**	.05	.47*	.14	.17	-.38	.14	-.02	1.00		
NH4	.11	-.11	.12	.34	-.44**	.02	-.06	.09	-.16	-.16	-.33	.34	.03	.14	-.02	1.00			
NO2NO3	.18	.28	.25	-.08	.20	.64*	.15	-.41**	.16	-.20	.17	.01	.43**	-.37	1.00				
TRANS	-.20	-.19	-.16	.01	.27	-.60*	-.14	.26	-.14	.33	-.17	.06	-.79*	1.00					
TURB	.04	.28	.27	-.07	-.21	.77*	.49*	-.28	-.12	-.04	-.06	-.27	1.00						
SPCON	-.18	.37	.55*	.62*	.04	-.18	-.39	.35	.03	.03	-.10	1.00							
OTHER	.25	.18	-.03	-.25	.16	.06	.24	-.67*	.88*	-.09	1.00								
FOREST	-.42**	.27	.36	.42**	.07	.04	.28	-.05	-.24	1.00									
UGRASS	.44*	.01	-.18	-.19	.13	-.14	.11	-.51*	1.00										
GGRASS	-.05	-.18	-.07	.21	.03	-.59*	-.58*	1.00											
UCROP	-.29	.13	.08	-.11	-.13	.44**	1.00												
PCROP	-.10	.41**	.45**	.01	-.09	1.00													
MDEPTH	-.15	.42**	.24	-.25	1.00														
WSRAT	-.06	-.04	.48*	1.00															
WA	-.39**	.80*	1.00																
SA	-.44**	1.00																	
AGE	1.00																		

* Significant at the 0.05 level of significance.

** Significant at the 0.10 level of significance.

Mean concentrations of chlorophyll a were related inversely to percentages of watershed in grazed grassland (-0.50 correlation coefficient) and directly to percentages of watershed in ungrazed grassland and other land uses (0.61 and 0.72 correlation coefficients, respectively).

The seemly contradictory relationships between chlorophyll a and percentages of the two grassland uses may be the result of the inverse relationship between the percentages of the watershed in grazed and ungrazed grassland (-0.51 correlation coefficient) and may not indicate two distinct relationships. Thus, the significant correlations of mean concentrations of chlorophyll a to percentages of watershed in grazed and ungrazed grassland uses may reflect the association of other water-quality or physical characteristics to the grassland uses or to chlorophyll a.

It was expected that mean concentrations of chlorophyll a might be related directly to percentages of cropland uses because of larger nutrient contributions from these areas, relative to grassland uses. Evidence for these larger nutrient contributions is seen in the direct relationship between mean concentrations of total nitrite plus nitrate nitrogen and percentage of watershed in protected cropland (0.64 correlation coefficient) and its inverse relationship with percentage of watershed in grazed grassland (-0.41 correlation coefficient). Although mean concentrations of chlorophyll a were related directly to percentages of watershed in protected and unprotected cropland (0.11 and 0.23 correlation coefficients, respectively), they were not significant at the 0.10 level of significance.

A possible explanation for a lack of significant relationships between mean concentrations of chlorophyll a and percentages of either cropland use may be evidenced from the direct relationship between mean concentrations of chlorophyll a and total phosphorus (0.44 correlation coefficient) and the lack of relationships between mean concentrations of total phosphorus and either cropland use. This may provide indirect evidence that, for this set of lakes, algal biomass (as measured by concentrations of chlorophyll a) is phosphorus limited, and the source of phosphorus may originate from several sources. Mean concentrations of chlorophyll a and total phosphorus both were related directly to percentages of watershed in other land use (0.72 and 0.47 correlation coefficients, respectively), which may be indicators of point sources of phosphorus. Runoff from animal-feedlot operations and urban or recreational areas could be a phosphorus contributor. Furthermore, it might be possible that, if the phosphorus from the watershed were of sufficient quantity, over time a significant internal source of phosphorus would be established within the lakes. This internal source may affect algal biomass to such a degree that it would mask any real difference in the effects of land use on mean concentrations of phosphorus or chlorophyll a.

Other factors can influence mean concentrations of total nitrite plus nitrate nitrogen, total ammonia nitrogen, total phosphorus, total organic carbon, and chlorophyll a. Although not available for this reconnaissance investigation, these other factors include lake volume, mean depth of lake, lake flushing time, seasonal variability, nutrient loading from sediments, chemical compositions of surrounding terrain and geologic formations, and extent of riparian woodland vegetation.

Multiple-Regression Analysis

Multiple-regression analysis was used to determine if mean concentrations of total nitrite plus nitrate nitrogen, total ammonia nitrogen, total phosphorus, total organic carbon, and chlorophyll a could be estimated from lake and watershed physical characteristics. Development of such relationships could help identify the relative quantitative importance of sources of degradation of lake-water quality. Application of such relationships through appropriate lake and watershed management practices could reduce degradation problems, minimize the time and cost involved in treating public drinking-water supplies, and increase drinking-water quality.

Methodology

The multiple-regression equation used in the analysis is of the form:

$$Y = a + b_1X_1 + b_2X_2 + \ldots b_nX_n \ , \qquad (1)$$

where Y is the mean constituent concentration estimated by the regression equation;

a is a constant determined by the regression analysis;

b_{1-n} are regression coefficients determined by the regression analysis; and

X_{1-n} are the lake and watershed physical characteristics used as independent variables.

Multiple-regression analysis also was used on logarithmic-transformed data; however, better results were obtained with the linear model presented in equation (1).

Lake and watershed physical characteristics used as independent variables in the regression analysis are listed in table 5, items 1-11. Values of these independent variables previously were shown in table 2. Mean concentrations of total nitrite plus nitrate nitrogen, total ammonia nitrogen, total phosphorus, total organic carbon, and chlorophyll a used as dependent variables, Y value in equation (1), previously were shown in table 3.

A stepwise procedure (Haan, 1977, p. 211) was used to develop the multiple-regression equations. The stepwise procedure develops a regression equation by first selecting the independent variable with the greatest simple correlation with the dependent variable (based on Pearson-product moment correlation coefficients). Additional independent variables then are selected for inclusion in the equation in the order of the amount of variation in the dependent variable that has not been explained by the previously entered independent variables. After each entry step, the equation and all independent variables are tested with an F-test for signi-

ficance at a predetermined level (0.05 level of significance in this investigation). Any independent variable not found to be significant is deleted from the equation. The selection/deletion process continues until no independent variable can be found that will be significant when entered in the equation. The stepwise procedure is considered to be an excellent method of developing a multiple-regression equation; however, care must be taken in evaluating the equation to insure that the independent variables are conceptually rational.

Results

Multiple-regression equations were developed to estimate mean concentrations of total nitrite plus nitrate nitrogen, total ammonia nitrogen, total phosphorus, total organic carbon, and chlorophyll a. However, only the equations for total nitrite plus nitrate nitrogen, total organic carbon, and chlorophyll a explained more than 50 percent of the variation in the dependent variable (that is, had coefficients of determination greater than 0.50). Furthermore, the independent variables in the equation for chlorophyll a (percentages of watershed in forest and other land use) were conceptually difficult to explain, at least in regard to the data presently available. The results of the multiple-regression analysis for total ammonia nitrogen, total phosphorus, and chlorophyll a, therefore, were not shown with the results for total nitrite plus nitrate nitrogen and total organic carbon, table 7.

The equation for estimating mean concentrations of total nitrite plus nitrate nitrogen shows a direct relationship with percentage of watershed in protected cropland, as previously observed in the Spearman rank-order correlation analysis, and with age. The relationship with percentage of watershed in protected cropland probably is due to the use of nitrate fertilizers. The relationship to lake age may be the result of a general lake evolutionary process characterized by nutrient enrichment.

The equation for estimating mean concentrations of total organic carbon shows inverse relationships with average maximum depth and watershed-to-lake surface-area ratio and direct relationships to lake-surface area and age. The relationship to average maximum depth and surface area, the two most significant independent variables, indicate large mean concentrations of total organic carbon in shallow and/or large lakes. The relationship to age may be similar to that discussed in regard to total nitrite plus nitrate nitrogen. Watershed-to-lake surface-area ratio is the least significant independent variable in the equation. In fact, it is barely significant at the 0.05 level of significance.

The ability to estimate mean concentrations of total organic carbon is important because of the possible relationship between organic carbon and the subsequent production of trihalomethanes during the chlorine-disinfection process of lake water used for public supply (Singer and others, 1981). However, this relationship may not be universally applicable because not all organic compounds can serve as precursors for trihalomethane formation and those that do will be found in different concentrations in

Table 7.--Multiple-regression equations for estimating mean concentrations of total nitrite plus nitrate nitrogen and total organic carbon, in milligrams per liter

[Both equations and all independent variables are significant at the 0.05 level. Independent variables are identified in table 4. Independent variables are listed in order of decreasing significance, as calculated by an F-test]

Multiple-regression equation	Number of samples	Coefficient of determination	Standard error of estimate (milligrams per liter)	Standard error of estimate (percent of mean)
Total nitrite plus nitrate nitrogen = -0.018 + 0.0091 (PCROP) + 0.0043 (AGE)	18	0.62	0.11	50
Total organic carbon = 9.03 - 0.1710 (MDEPTH) + 0.0036 (SA) + 0.0425 (AGE) - 0.0173 (WSRAT)	19	.76	.74	12

different areas (Symons and others, 1981; Glaze and others, 1981). Kansas has applied the Federal drinking-water-quality standard of 100 µg/L of trihalomethanes to all communities within the State, regardless of size. For small communities with small water-treatment operating budgets, it may be more cost effective to establish lake- and watershed-management practices that reduce the concentrations of total organic carbon than to implement changes in water-treatment procedures that minimize trihalomethane production.

It is emphasized that the relationships of total nitrite plus nitrate nitrogen and total organic carbon to lake and watershed physical characteristics were developed based on data collected during this reconnaissance investigation. The results of future intensive investigations that include seasonal changes in water quality and define additional lake and watershed physical characteristics may alter the findings presented in this report. However, it is felt that the relationships considered in this report could be of use in evaluating the possible causes of current water-quality problems.

SUMMARY

Water-quality reconnaissance data were collected from spring to fall 1983, at 19 public drinking-water-supply lakes in eastern Kansas. This data consisted of measurements of specific conductance, pH, temperature, turbidity, secchi-disk transparency, dissolved oxygen, and concentrations of nutrients, total organic carbon, pesticides, and chlorophyll a. Also, data were collected that described lake and watershed physical characteristics.

Mean values of specific conductance, pH, turbidity, and transparency and mean concentrations of total nitrite plus nitrate nitrogen, total ammonia nitrogen, total phosphorus, total organic carbon, and chlorophyll a were computed for each water-supply lake. A large range was observed for mean concentrations of total nitrite plus nitrate nitrogen (0.01 to 0.84 mg/L), total ammonia nitrogen (0.01 to 0.38 mg/L), total phosphorus (0.02 to 0.24 mg/L), total organic carbon (3.5 to 9.1 mg/L), and chlorophyll a (3.1 to 42 µg/L).

Small concentrations of pesticides were detected at 8 of the 19 water-supply lakes. The herbicides Atrazine and Alachlor were the most commonly detected. Concentrations of Atrazine ranged from 1.4 to 4.0 µg/L, while concentrations of Alachlor ranged from 0.28 to 0.63 µg/L. Additionally, concentrations of seven other pesticides were detected: Dual (0.54 µg/L at Strowbridge Reservoir), 2,4-D (0.51 µg/L at Herington Reservoir), DDE-o'p' and DDE-p'p' (each at 0.12 µg/L at Pleasanton East City Lake), and 2,4,5-T (0.21 µg/L at Yates Center Reservoir).

Several possible relationships between water-quality constituents and lake and watershed physical characteristics were suggested by analysis of Spearman rank-order correlations. Mean concentrations of total nitrite plus nitrate nitrogen were related directly to percentage of watershed in protected cropland (0.64 correlation coefficient). Mean concentrations of total ammonia nitrogen and total organic carbon were related inversely to lake average maximum depth (-0.44 and -0.68 correlation coefficients,

respectively). Mean concentrations of total phosphorus were related directly to lake-surface area (0.41 correlation coefficient), percentage of watershed in ungrazed grassland (0.44 correlation coefficient), and percentage of of watershed in other land uses (0.47 correlation coefficient). Mean concentrations of chlorophyll a were related to percentage of watershed in grazed grassland (-0.50 correlation coefficient), percentage of watershed in ungrazed grassland (0.61 correlation coefficient), and percentage of watershed in other land use (0.72 correlation coefficient), as well as total phosphorus (0.44 correlation coefficient).

Multiple-regression analysis produced significant relations (0.05 level of significance) for total nitrite plus nitrate nitrogen (0.62 coefficient of determination) and total organic carbon (0.76 coefficient of determination). Percentage of watershed in protected cropland and age of lake were the significant independent variables in estimating mean concentrations of total nitrite plus nitrate nitrogen. Lake average maximum depth, lake-surface area, age of lake, and watershed-to-lake surface-area ratio were the significant independent variables in estimating mean concentrations of total organic carbon.

REFERENCES CITED

American Public Health Association, 1975, Standard methods for the examination of water and wastewater (14th ed.): American Public Health Association, 1142 p.

Blalock, H. M., Jr., 1972, Social statistics: New York, McGraw-Hill Co., p. 376-377.

Carlson, R. E., 1977, A trophic state index for lakes: Limnology and Oceanography, v. 22, p. 361-369.

DeNoyelles, Frank, Jr., and Kettle, W. D., 1980, Herbicides in Kansas waters--Evaluations of the effects of agricultural runoff and aquatic weed control on aquatic food chains: Manhattan, Kansas, Kansas Water Resources Research Institute, Technical Communication Report A-092-KAN, 40 p.

1983, Site studies to determine the extent and potential impact of herbicide contamination in Kansas waters: Manhattan, Kansas, Kansas Water Resources Research Institute, Technical Communication Report A-104-KAN, 43 p.

DeNoyelles, Frank, Jr., Kettle, W. D., and Sinn, D. E., 1982, The response of plankton communities in experimental ponds to Atrazine, the most heavily used pesticide in the United States: Ecology, v. 63, p. 1285-1293.

Glaze, W. H., and others, 1981, Pilot scale evaluation of biological activated carbon in the removal of THM precursors: U.S. Environmental Protection Agency, 220 p.

Greeson, P. E., and others, 1977, Methods for collection and analysis of aquatic biological and microbiological samples: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A4, 332 p.

Haan, C. T., 1977, Statistical methods in hydrology: Ames, Iowa, Iowa State University Press, p. 211.

Regehr, D. L., and others, 1984, Chemical weed control for field crops and noncropland, 1984: Manhattan, Kansas, Agricultural Experiment Station Kansas State University, Report of Progress 446, 34 p.

Reid, G. K., and Wood, R. D., 1976, Ecology of inland waters and estuaries: New York, D. Van Nostrand Co., p. 236.

Singer, P. C., and others, 1981, Trihalomethane formation in North Carolina drinking waters: Journal of the American Waterworks Association, v. 73, no. 8, p. 392-401.

Skougstad, M.J., and others, 1979, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A1, 626 p.

Symons, J. M., and others, 1981, Treatment techniques for controlling trihalomethanes in drinking water: U.S. Environmental Protection Agency, EPA-600/2-81-156, 289 p.

U.S. Environmental Protection Agency, 1979, Methods for chemical analysis of water and waste: U.S. Environmental Protection Agency, EPA-600/4-79-020.

Wershaw, R. L., and others, 1983, Methods for the determination of organic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A3, p. 25.

SUPPLEMENTARY INFORMATION

Table 8.--Survey of selected lake physical and botanical features during late summer-early fall, 1983

[Date in parenthesis is date of survey]

Alma City Reservoir

(September 15, 1983)

The shoreline generally is rocky, with gradual slopes along the eastern shore and much steeper slopes along the western shore, and is vegetated by native grasses. Evidently cattle have grazed along the shoreline of the upstream end of the lake. No significant amount of standing timber was observed. Noticeable aquatic vegetation was limited to the upstream end of the lake and consisted mainly of the macroalgae, Chara, and small populations of sedge (family, Cyperaceae) and leafy pondweed (Potamogeton foliosus).

Altamont West Lake

(September 28, 1983)

The shoreline consists of packed soil, is vegetated by native grasses, and has a uniform gradual slope. No standing timber or significant populations of aquatic macrophytes were evident.

Big Hill Lake

(September 27, 1983)

The shoreline is rocky, steep, and heavily timbered. Standing timber is present in most of the upstream part of the reservoir. Numerous submerged brush piles are located throughout the reservoir. A variety of aquatic macrophytes were present in the one cove that was accessible by boat.

Edna City Lake

(September 28, 1983)

The shoreline is rocky and sandy except at the upstream end of the lake where the shoreline consists of deposited clay soil. Surrounding terrestrial vegetation predominately consists of native grasses. No standing timber is evident in the lake. Aquatic vascular plants included naiad (Najas guadalupensis) and coontail (Ceratophyllum demersum) and were present along the western shoreline and in the upstream end of the lake.

Table 8.--Survey of selected lake physical and botanical features during late summer-early fall, 1983--Continued

Herington Reservoir

(September 15, 1983)

The shoreline, generally, is a rocky soil vegetated by native grasses and herbaceous perennials. That part of the watershed adjacent to the reservoir is mostly pasture with a small amount of cropland. Significant amounts of standing timber are located in the upstream end of the reservoir. Aquatic macrophytes, most of which were located in the upstream end of the reservoir, consisted of smartweed (Polygonum coccineum), large duckweed (Spirodelia polyrhiza), and leafy pondweed (Potamogeton foliosus).

Louisburg Lake

(October 4, 1983)

The western shoreline consists of rock and soil, is gradually sloped, and is covered with grass and woody perennials. The eastern shoreline is more rocky and steeper than the western shoreline. No standing timber was evident in the lake; however, a small accumulation of algal-covered woody debris is present along parts of the shoreline. Dried vegetation was present along the exposed part of the western shoreline. No large populations of aquatic macrophytes were present.

Lyndon City Lake

(October 25, 1983)

The shoreline consists mostly of soil and mud. The lake is surrounded by pastureland, and cattle have grazed along the shoreline. No significant amount of standing timber is present in the lake; however, there are a few small dead trees in the southwestern cove of the lake. Small populations of leafy pondweed (Potamogeton foliosus) were growing along the southern and western shoreline.

Madison City Lake

(October 24, 1983)

Most of the southern shoreline is rocky soil, moderately steep, and sparsely timbered. The northern shoreline is mostly soil vegetated with native grasses and is gradually sloping. No standing timber or large populations of aquatic macrophytes were present.

Table 8.--Survey of selected lake physical and botanical features during late summer-early fall, 1983--Continued

Miola Lake

(October 4, 1983)

The shoreline consists of shallow soil underlain by sedimentary rock. The shoreline is steeper along the western side of the lake than along the eastern side. Some erosion along the western shoreline is evident. A sandy swimming beach is located in the west cove, and several rocky fishing berms are built along the western shoreline. No significant standing timber is evident in the lake. Water willows (Justicia americana) grow along much of the western and northern shoreline. No large populations of aquatic macrophytes were present.

Moline Reservoir

(September 29, 1983)

The gradually sloping shoreline is mostly soil and mud with a vegetative cover of native grasses. A few dead trees are present in the upstream end of the western arm of the reservoir. Submersed algal-covered brush is common in the shallow upstream areas of the reservoir. Thick mats of algae and dead brush are present along the southwestern shoreline. No large populations of aquatic macrophytes were evident.

Mound City Lake

(October 3, 1983)

The shoreline is mostly rock and soil and generally is heavily timbered. The slope of the shoreline varies from gradual along the eastern and downstream part of the western shore to steep at the upstream end of the western shore. Standing trees are present in the major inflow area of the lake. Submersed vegetation was present in shallow areas, and dead vegetation lined the exposed shorelines.

Osage City Reservoir

(Not surveyed)

Table 8.--Survey of selected lake physical and botanical features during late summer-early fall, 1983--Continued

Pleasanton East City Lake

(October 3, 1983)

The shoreline consists of a grass-covered, hard-packed sandy soil with gradual to moderately steep slopes. No standing timber is present in the lake. Aquatic macrophytes were scattered throughout the shallow areas and consisted mostly of members of the water-lily family (Nymphaeaceae) and leafy pondweed (Potamogeton foliosus). Cattails (Typha s.) were common in the shallow areas of coves.

Polk Daniels Lake

(September 29, 1983)

The shoreline is mostly rock with a thin covering of soil. Several rock fishing berms are present. No standing timber is evident. However, there is a large population of water willow (Justicia americana) growing along the shoreline in the upstream end and along the eastern shore of the lake. Additionally, a small population of the macroalgae, Chara, was present in the upstream end of the lake.

Prairie Lake

(October 25, 1983)

The shoreline is a hard-packed soil vegetated by cattails (Typha s.), water willows (Justicia americana), and smartweed (Polygonum coccineum). No standing timber is present in the lake; however, a few dead trees and branches are scattered in the upstream end. No large populations of macrophytes were present. Submersed rocks in the vicinity of the boat ramps supported a thick growth of algae.

Sedan Lower City Lake

(September 28, 1983)

Shorelines consist of rocky soils with slopes that vary from gradual to steep. Large rock ledges are evident along the eastern shore. A small, tree-covered island is located in the middle of the upstream end of the lake. No standing timber is present in the lake. Water willow (Justicia americana) and scattered small populations of aquatic macrophytes were common along the western shore and in the upstream end of the lake.

Table 8.--Survey of selected lake physical and botanical features during late summer-early fall, 1983--Continued

Strowbridge Reservoir

(October 26, 1983)

Most of the shoreline along the main body of the reservoir is rocky and lined with trees above the elevation of the flood pool. Shorelines along the major arms of the reservoir mostly consist of gradually sloping soils with only small amounts of woody vegetation. That part of the watershed adjacent to the reservoir contains plowed fields and a cattle-feedlot operation. There were no significant amounts of standing timber or populations of aquatic macrophytes. Submersed rocks had a thin growth of algae.

Timber Creek Lake

(September 14, 1983)

The shoreline generally is rocky and lined with trees. Shoreline slopes vary from gradual along the northern and eastern shores to moderately steep along the southern shore. Significant amounts of standing timber are present in four of the coves along the southern shore. Small populations of water willow (Justicia americana) and smartweed (Polygonum coccineum) occurred along the shoreline of the upstream end of the lake.

Yates Center Reservoir

(October 24, 1983)

The shoreline in the vicinity of the dam mostly consists of rock and rocky soil, while the shoreline in the upstream area of the lake consists of pastureland soil. Slope of the shoreline varies from gradual along the northern and western shore to steep along the southern shore in the vicinity of the dam. No significant amount of standing timber is present. Water willows (Justicia americana) are growing along 50 to 75 percent of the shoreline and are especially predominate in the major inflow area of the reservoir. A large population of water lily (family, Nymphaeaceae) was growing near the northeast corner of the dam. There were no obvious algal growth on submersed rocks or boat ramps and no dead vegetation along exposed shorelines.

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes

[Units of measurements used in this table are abbreviated as follows: degrees Celcius (°C); microsiemens per centimeter at 25 °C (µS/cm); colonies per 100 milliliters (colonies/100 ml); milligrams per liter (mg/L); micrograms per liter (µg/L)]

Alma City Reservoir

Date: May 4, 1983 — Weather conditions: Clear and calm — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		16.0	11.2	Surface		15.5	10.6	Specific conductance (µS/cm)	350	360	260
1.0	3.3	15.5	10.6	1.0	3.3	15.0	10.6	pH (pH units)	8.3	8.3	8.3
2.0	6.6	15.5	10.2	2.0	6.6	14.0	10.6	Turbidity (Jackson turbidity units)	5.5	6.0	5.5
3.0	9.8	15.0	10.1	3.0	9.8	14.0	10.8	Transparency, secchi disk (inches)	50.4	--	50.0
4.0	13.1	14.0	9.6	3.5	11.5	--	--	Fecal coliform bacteria (colonies/100 ml)	10	--	--
5.0	16.4	14.0	9.2					Fecal streptococci bacteria (colonies/100 ml)	10	--	--
6.0	19.7	13.5	8.5					Ammonia, total as N (mg/L)	.20	.20	.20
6.5	21.3	--	--					Nitrite plus nitrate, total as N (mg/L)	.10	.10	.10
								Phosphorus, total as P (mg/L)	.02	.02	.13
								Organic carbon, total (mg/L)	4.2	4.1	3.9
								Chlorophyll a (µg/L)	3.97	5.20	3.46
								Pesticides detected (µg/L): None			

Date: September 15, 1983 — Weather conditions: Clear and mild breeze — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		23.5	7.8	Surface		23.5	7.8	Specific conductance (µS/cm)	260	275	260
1.0	3.3	23.0	7.8	1.0	3.3	23.0	7.8	pH (pH units)	8.5	8.0	8.4
2.0	6.6	23.0	7.8	2.0	6.6	24.0	7.9	Turbidity (Jackson turbidity units)	3.0	4.0	4.0
3.0	9.8	23.0	7.8	2.5	8.2	24.0	8.0	Transparency, secchi disk (inches)	78.0	--	65.7
4.0	13.1	23.0	7.7					Fecal coliform bacteria (colonies/100 ml)	--	--	--
5.0	16.4	23.0	7.5					Fecal streptococci bacteria (colonies/100 ml)	--	--	--
6.0	19.7	23.0	7.2					Ammonia, total as N (mg/L)	.00	.00	.00
6.5	21.3	22.5	6.8					Nitrite plus nitrate, total as N (mg/L)	.00	.00	.00
7.0	23.0	21.0	3.2					Phosphorus, total as P (mg/L)	.01	.01	.00
7.5	24.6	16.5	0.7					Organic carbon, total (mg/L)	3.4	2.8	2.2
8.0	26.2	15.0	0.2					Chlorophyll a (µg/L)	3.17	22.8	4.01
9.0	29.5	13.0	0.2					Pesticides detected (µg/L): None			
9.5	31.2	12.5	0.2								

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Altamont West Lake

Date: April 26, 1983 — Weather conditions: Windy and warm — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		15.5	9.5	Surface		15.0	9.6	Specific conductance (µS/cm)	140	130	135
1.0	3.3	15.5	9.3	1.0	3.3	15.0	9.4	pH (pH units)	7.9	7.8	7.8
2.0	6.6	15.5	9.3	2.0	6.6	15.0	9.4	Turbidity (Jackson turbidity units)	110	110	135
3.0	9.8	15.0	9.2	2.5	8.2	--	--	Transparency, secchi disk (inches)	7.9	--	7.9
4.0	13.1	14.0	8.9	3.5				Fecal coliform bacteria (colonies/100 ml)	--	--	--
4.5	16.4	--	--					Fecal streptococci bacteria (colonies/100 ml)	--	--	--
								Ammonia, total as N (mg/L)	.10	.10	.10
								Nitrite plus nitrate, total as N (mg/L)	.60	.60	.60
								Phosphorus, total as P (mg/L)	.14	.06	.05
								Organic carbon, total (mg/L)	9.6	9.6	9.0
								Chlorophyll a (µg/L)	2.33	4.09	1.42
								Pesticides detected (µg/L): None			

Date: September 28, 1983 — Weather conditions: Clear and warm (19 °C) — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		21.0	8.3	Surface		21.0	8.6	Specific conductance (µS/cm)	180		175
0.5	1.6	21.0	8.0	0.8	2.6	21.0	7.7	pH (pH units)	8.1		7.8
1.0	3.3	19.0	7.9					Turbidity (Jackson turbidity units)	86.0		86
1.5	4.9	18.0	7.8					Transparency, secchi disk (inches)	7.9		--
								Fecal coliform bacteria (colonies/100 ml)	--		--
								Fecal streptococci bacteria (colonies/100 ml)	--		--
								Ammonia, total as N (mg/L)	.00		.00
								Nitrite plus nitrate, total as N (mg/L)	.00		.08
								Phosphorus, total as P (mg/L)	.06		.01
								Organic carbon, total (mg/L)	6.9		6.6
								Chlorophyll a (µg/L)	4.49		4.17
								Pesticides detected (µg/L): None			

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Big Hill Lake

Date: April 26, 1983

Weather conditions: Windy and cool

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		11.5	10.2	Surface		11.5	10.2	Surface		14.0	10.2
1.0	3.3	11.0	10.2	1.0	3.3	11.0	10.2	1.0	3.3	13.0	9.9
2.0	6.6	11.0	9.8	2.0	6.6	11.0	10.1	2.0	6.6	12.5	9.4
3.0	9.8	11.0	10.0	3.0	9.8	11.0	10.0	3.0	9.8	12.5	9.2
4.0	13.1	11.0	9.6	4.0	13.1	11.0	9.9	4.0	13.1	12.0	9.2
5.0	16.4	11.0	9.5	5.0	16.4	11.0	9.8	5.0	16.4	12.0	8.8
6.0	19.7	11.0	9.3	6.0	19.7	11.0	9.6	6.0	19.7	12.0	8.4
7.0	23.0	10.5	9.2	7.0	23.0	11.0	9.6	7.0	23.0	11.5	7.6
8.0	26.2	10.5	9.1	8.0	26.2	11.0	9.6	8.0	26.2	10.5	6.6
9.0	29.5	10.5	9.2	9.0	29.5	10.5	7.4	9.0	29.5	9.5	5.1
10.0	32.8	10.5	9.0	9.5	31.2	--	--	9.5	31.2	9.0	4.2
11.0	36.1	10.5	8.2					10.0	32.8	--	--
11.5	37.7	--	--								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface	Site 3 Bottom
Specific conductance (µS/cm)	260	260	260	265	250	220
pH (pH units)	7.8	7.9	7.9	7.9	7.9	7.7
Turbidity (Jackson turbidity units)	11	11	13	13	23	27
Transparency, secchi disk (inches)	40.2	--	35.0	--	20.1	--
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--	--
Ammonia, total as N (mg/L)	.30	.20	.20	.30	.10	.20
Nitrite plus nitrate, total as N (mg/L)	.50	.50	.50	.50	.60	.60
Phosphorus, total as P (mg/L)	.04	.01	.02	.03	.07	.06
Organic carbon, total (mg/L)	7.8	7.3	7.5	7.0	7.8	6.0
Chlorophyll a (µg/L)	2.62	3.11	2.91	2.50	10.9	1.38
Pesticides detected (µg/L): None						

Date: September 27, 1983

Weather conditions: Calm and warm

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)	Site 4 Depth (Meters)	Site 4 Depth (Feet)	Site 4 Temperature (°C)	Site 4 Dissolved oxygen (mg/L)
Surface		21.0	6.3	Surface		21.5	7.6	Surface		23.0	7.1	Surface		23.0	7.1
1.0	3.3	20.5	6.4	1.0	3.3	21.5	7.4	1.0	3.3	22.0	6.9	1.0	3.3	23.0	6.9
2.0	6.6	20.0	5.8	2.0	6.6	21.0	7.2	2.0	6.6	21.5	6.6	1.5	4.9	22.5	6.8
3.0	9.8	20.0	5.8	3.0	9.8	21.0	6.9	3.0	9.8	21.0	5.6	2.0	6.6	21.0	4.9
4.0	13.1	20.0	5.8	3.5	11.5	21.0	6.5	4.0	13.1	20.5	4.6	3.0	9.8	20.5	3.3
5.0	16.4	20.0	5.8	4.0	13.1	20.5	5.0	5.0	16.4	20.0	4.5	4.0	13.1	20.5	2.8
6.0	19.7	19.5	5.7	5.0	16.4	20.0	4.8	6.0	19.7	20.0	4.4	5.0	16.4	20.0	1.2
7.0	23.0	19.5	5.6	6.0	19.7	20.0	5.2	7.0	23.0	19.5	4.4	6.0	19.7	19.5	0.3
7.5	24.6	19.5	4.0	7.0	23.0	20.0	5.5	7.5	24.6	19.5	3.8				
8.0	26.2	19.0	3.0	8.0	26.2	19.5	4.8	8.0	26.2	19.0	0.7				
8.5	27.9	18.5	0.5	8.5	27.9	19.0	3.8	8.5	27.9	--	--				
9.0	29.5	16.0	0.2	9.0	29.5	18.0	0.5								
10.0	32.8	13.5	0.1	10.0	32.8	14.0	0.2								
11.0	36.1	13.0	0.1												
12.0	39.4	12.5	0.1												
12.5	41.0	12.5	0.1												

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface	Site 3 Bottom	Site 4 Surface	Site 4 Bottom
Specific conductance (µS/cm)	230	270	230	275	240	235	230	280
pH (pH units)	7.5	7.4	7.6	7.3	7.6	7.5	7.5	7.4
Turbidity (Jackson turbidity units)	3.1	10	3.2	19	3.2	7.0	3.4	6.1
Transparency, secchi disk (inches)	78.7	--	65.0	--	63.0	--	63.0	--
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--	--	--	--
Ammonia, total as N (mg/L)	.05	.74	.01	.77	.08	.09	.08	.21
Nitrite plus nitrate, total as N (mg/L)	.01	.04	.02	.00	.00	.01	.01	.00
Phosphorus, total as P (mg/L)	.03	.10	.01	.10	.00	.00	.00	.00
Organic carbon, total (mg/L)	6.1	8.2	6.5	8.4	4.8	6.3	6.5	7.0
Chlorophyll a, (µg/L)	6.13	3.60	9.53	5.83	5.04	5.26	5.33	3.15
Pesticides detected (µg/L): None								

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Edna City Lake

Date: April 26, 1983 — Weather conditions: Windy and warm — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		15.0	9.8	Surface		15.5	9.8
1.0	3.3	15.0	9.8	1.0	3.3	15.5	9.6
2.0	6.6	15.0	9.6	2.0	6.6	15.0	9.6
3.0	9.8	14.0	9.6	3.0	9.8	15.0	9.6
4.0	13.1	14.0	9.2	4.0	13.1	13.5	9.4
5.0	16.4	13.0	9.2	4.5	14.8	--	--
6.0	19.7	12.5	8.6				
7.0	23.0	12.0	7.2				
8.0	26.2	12.0	7.1				
8.5	27.9	--	--				

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom
Specific conductance (µS/cm)	210	205	205	205
pH (pH units)	7.9	7.9	8.0	8.0
Turbidity (Jackson turbidity units)	9.0	10	9.0	9.0
Transparency, secchi disk (inches)	42.1	--	40.2	--
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--
Ammonia, total as N (mg/L)	.10	.10	.10	.00
Nitrite plus nitrate, total as N (mg/L)	.10	.10	.10	.10
Phosphorus, total as P (mg/L)	.02	.01	.01	.02
Organic carbon, total (mg/L)	6.0	6.2	6.3	6.5
Chlorophyll *a* (µg/L)	3.10	1.36	3.27	2.38
Pesticides detected (µg/L): None				

Date: September 28, 1983 — Weather conditions: Clear, calm, and warm (24 °C) — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		21.0	8.4	Surface		21.5	8.4
1.0	3.3	20.0	8.0	1.0	3.3	21.0	8.4
2.0	6.6	19.0	8.0	1.5	4.9	21.0	8.4
3.0	9.8	18.5	7.4	2.0	6.6	20.0	6.9
4.0	13.1	18.0	7.1	2.5	8.2	19.0	7.3
4.5	14.8	18.0	6.7	3.0	9.8	18.5	7.6
5.0	16.4	18.0	6.0	3.3	10.8	18.5	6.0

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom
Specific conductance (µS/cm)	180	175	190	190
pH (pH units)	7.9	7.8	7.9	8.0
Turbidity (Jackson turbidity units)	3.3	4.4	3.4	4.0
Transparency, secchi disk (inches)	89.8	--	90.6	--
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--
Ammonia, total as N (mg/L)	.00	.00	.00	.00
Nitrite plus nitrate, total as N (mg/L)	.00	.00	.00	1.2
Phosphorus, total as P (mg/L)	.02	.01	.00	.00
Organic carbon, total (mg/L)	7.4	--	5.7	6.0
Chlorophyll *a* (µg/L)	3.78	6.73	5.37	5.61
Pesticides detected (µg/L): Several detected but actual concentrations were questionable.				

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Herington Reservoir

Date: May 4, 1983

Weather conditions: Clear and calm

Remarks: None

Site 1

Depth (Meters)	Depth (Feet)	Temperature (°C)	Dissolved oxygen (mg/L)
Surface		14.0	10.6
1.0	3.3	14.0	10.6
2.0	6.6	13.5	10.2
3.0	9.8	13.5	9.8
4.0	13.1	13.5	9.6
5.0	16.4	13.5	9.2
6.0	19.7	13.5	8.8
6.5	21.3	--	--

Site 2

Depth (Meters)	Depth (Feet)	Temperature (°C)	Dissolved oxygen (mg/L)
Surface		15.0	13.2
1.0	3.3	15.0	13.2
2.0	6.6	14.5	12.6
2.5	8.2	14.0	11.4
3.0	9.8	--	--

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Specific conductance (µS/cm)	550	600	575
pH (pH units)	8.2	8.3	8.5
Turbidity (Jackson turbidity units)	5.3	7.5	7.8
Transparency, secchi disk (inches)	73.6	--	65.0
Fecal coliform bacteria (colonies/100 ml)	10	--	--
Fecal streptococci bacteria (colonies/100 ml)	10	--	--
Ammonia, total as N (mg/L)	.30	.20	.40
Nitrite plus nitrate, total as N (mg/L)	.50	.50	.20
Phosphorus, total as P (mg/L)	.06	.04	.06
Organic carbon, total (mg/L)	7.1	6.8	7.3
Chlorophyll a (µg/L)	4.91	4.21	36.3
Pesticides detected (µg/L): 2,4-D (0.51)			

Date: September 15, 1983

Weather conditions: Cloudy and windy

Remarks: None

Site 1

Depth (Meters)	Depth (Feet)	Temperature (°C)	Dissolved oxygen (mg/L)
Surface		22.5	7.1
1.0	3.3	22.5	7.0
2.0	6.6	22.5	6.9
3.0	9.8	22.5	6.8
4.0	13.1	22.0	6.8
5.0	16.4	22.0	6.3
5.5	18.0	22.0	6.0

Site 2

Depth (Meters)	Depth (Feet)	Temperature (°C)	Dissolved oxygen (mg/L)
Surface		22.0	7.2
1.0	3.3	22.0	6.8
2.0	6.6	22.0	6.4
3.0	9.8	22.0	6.2
4.0	13.1	22.0	6.0

Site 3

Depth (Meters)	Depth (Feet)	Temperature (°C)	Dissolved oxygen (mg/L)
Surface		21.5	7.1
1.0	3.3	21.5	7.0
1.5	4.9	21.5	6.5

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	715	710	715	720	730
pH (pH units)	8.2	8.2	8.2	8.2	8.3
Turbidity (Jackson turbidity units)	10	10	12	12	15
Transparency, secchi disk (inches)	22.8	--	16.9	--	15.7
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.39	.44	.39	.38	.28
Nitrite plus nitrate, total as N (mg/L)	.20	.11	.09	.11	.12
Phosphorus, total as P (mg/L)	.02	.02	.04	.04	.04
Organic carbon, total (mg/L)	6.0	5.1	7.4	4.9	8.1
Chlorophyll a, (µg/L)	24.7	7.37	11.7	11.7	13.7
Pesticides detected (µg/L): None					

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Louisburg Lake

Date: April 21, 1983 — Weather conditions: Cloudy, calm, and cool — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		11.0	12.4	Surface		10.5	12.7	Specific conductance (µS/cm)	260	260	270
1.0	3.3	11.0	12.2	1.0	3.3	10.5	12.7	pH (pH units)	8.3	8.0	8.4
2.0	6.6	10.5	12.3	2.0	6.6	10.5	12.7	Turbidity (Jackson turbidity units)	9.5	11	9.8
3.0	9.8	10.0	12.0	2.5	8.2	--	--	Transparency, secchi disk (inches)	35.8	--	33.9
4.0	13.1	9.5	11.2					Fecal coliform bacteria (colonies/100 ml)	5	--	--
5.0	16.4	9.0	9.6					Fecal streptococci bacteria (colonies/100 ml)	200	--	--
6.0	19.7	9.0	8.1					Ammonia, total as N (mg/L)	.00	.00	.00
7.0	23.0	8.5	6.2					Nitrite plus nitrate, total as N (mg/L)	.50	.50	.50
7.5	24.6	--	--					Phosphorus, total as P (mg/L)	.17	.02	.02
								Organic carbon, total (mg/L)	5.9	5.6	6.9
								Chlorophyll a (µg/L)	8.46	8.53	8.65
								Pesticides detected (µg/L): None			

Date: October 4, 1983 — Weather conditions: Not available — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		20.0	8.4	Surface		20.0	7.8	Specific conductance (µS/cm)	245	245	240
1.0	3.3	20.0	8.4	1.0	3.3	20.0	7.7	pH (pH units)	8.2	7.7	8.1
2.0	6.6	20.0	8.4					Turbidity (Jackson turbidity units)	8.4	12	8.8
3.0	9.8	20.0	8.5					Transparency, secchi disk (inches)	29.9	--	24.8
3.5	11.5	20.0	7.8					Fecal coliform bacteria (colonies/100 ml)	--	--	--
3.8	12.5	18.5	1.6					Fecal streptococci bacteria (colonies/100 ml)	--	--	--
4.0	13.1	17.5	0.8					Ammonia, total as N (mg/L)	.06	.61	.04
5.0	16.4	17.0	0.2					Nitrite plus nitrate, total as N (mg/L)	.01	.00	.00
								Phosphorus, total as P (mg/L)	.03	.06	.04
								Organic carbon, total (mg/L)	5.3	8.2	5.1
								Chlorophyll a (µg/L)	13.3	10.2	25.4
								Pesticides detected (µg/L): None			

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Lyndon City Lake

Date: April 20, 1983 — Weather conditions: Clear, windy, and cool — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom
Surface		11.0	11.0	Surface		10.0	10.7	Specific conductance (µS/cm)	220	240	250	250
1.0	3.3	10.5	10.8	1.0	3.3	10.0	10.7	pH (pH units)	8.5	8.3	8.3	8.3
2.0	6.6	10.0	10.6	2.0	6.6	10.0	10.2	Turbidity (Jackson turbidity units)	22	20	18	18
3.0	9.8	10.0	10.5	3.0	9.8	10.0	10.3	Transparency, secchi disk (inches)	20.9	--	22.0	--
4.0	13.1	10.0	10.3	4.0	13.1	9.0	9.9	Fecal coliform bacteria (colonies/100 ml)	10	--	--	--
5.0	16.4	10.0	10.3	4.5	14.8	--	--	Fecal streptococci bacteria (colonies/100 ml)	10	--	--	--
6.0	19.7	10.0	10.2					Ammonia, total as N (mg/L)	.10	.10	.10	.10
7.0	23.0	10.0	10.2					Nitrite plus nitrate, total as N (mg/L)	.30	.20	.20	.20
7.5	24.6	10.0	9.8					Phosphorus, total as P (mg/L)	.12	.09	.03	.11
8.0	26.2	--	--					Organic carbon, total (mg/L)	5.1	4.2	5.3	5.1
								Chlorophyll a (µg/L)	5.04	5.29	5.39	5.29
								Pesticides detected (µg/L): None				

Date: August 17, 1983 — Weather conditions: Clear, calm, and hot — Remarks: Taste and odor complaint

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		28.0	7.4	Surface		28.0	7.5	Specific conductance (µS/cm)	295	370	255
1.0	3.3	28.0	7.3	1.0	3.3	27.5	7.3	pH (pH units)	8.4	7.8	8.3
2.0	6.6	27.5	7.2	1.5	4.9	27.5	7.3	Turbidity (Jackson turbidity units)	5.4	5.5	7.0
3.0	9.8	27.5	7.2	2.0	6.6	27.5	7.4	Transparency, secchi disk (inches)	42.1	--	31.9
4.0	13.1	27.5	7.0	2.5	8.2	27.5	6.0	Fecal coliform bacteria (colonies/100 ml)	--	--	--
4.5	14.8	27.5	6.8					Fecal streptococci bacteria (colonies/100 ml)	--	--	--
5.0	16.4	27.5	0.7					Ammonia, total as N (mg/L)	.00	.42	.00
5.5	18.0	24.0	0.3					Nitrite plus nitrate, total as N (mg/L)	.03	.00	.02
6.0	19.7	23.0	0.2					Phosphorus, total as P (mg/L)	.03	.16	.01
7.0	23.0	20.0	0.4					Organic carbon, total (mg/L)	3.6	3.5	3.5
7.5	24.6	18.0	0.2					Chlorophyll a (µg/L)	28.6	1.11	4.26
								Pesticides detected (µg/L): Alachlor (0.63)			

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Lyndon City Lake--Continued

Date: October 25, 1983 Weather conditions: Clear, breeze, and cool (11 °C) Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		13.0	9.5	Surface		13.0	9.8
1.0	3.3	13.0	9.5	1.0	3.3	13.0	9.8
2.0	6.6	13.0	9.4	2.0	6.6	13.0	9.8
3.0	9.8	13.0	9.4	2.5	8.2	13.0	9.9
4.0	13.1	13.0	9.2				
5.0	16.4	13.0	9.2				
6.0	19.7	13.0	9.2				
7.0	23.0	13.0	9.0				
7.5	24.6	13.0	8.2				

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Specific conductance (µS/cm)	260	260	260
pH (pH units)	8.0	8.2	8.3
Turbidity (Jackson turbidity units)	7.0	8.0	7.0
Transparency, secchi disk (inches)	43.3	--	38.2
Fecal coliform bacteria (colonies/100 ml)	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--
Ammonia, total as N (mg/L)	.00	.00	.00
Nitrite plus nitrate, total as N (mg/L)	.07	.05	.07
Phosphorus, total as P (mg/L)	.04	.02	.01
Organic carbon, total (mg/L)	3.7	3.8	3.3
Chlorophyll a (µg/L)	6.41	4.72	5.73
Pesticides detected (µg/L): Alachlor (0.28)			

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Madison City Lake

Date: July 12, 1983 — Weather conditions: Clear, breeze, and hot — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		31.0	7.5	Surface		31.0	7.7
1.0	3.3	30.5	7.4	1.0	3.3	30.5	7.2
2.0	6.6	28.0	6.8	1.5	4.9	30.0	7.2
2.5	8.2	27.0	6.3	2.0	6.6	29.5	5.8
3.0	9.8	27.0	5.7				
3.5	11.5	26.5	5.1				
4.0	13.1	26.0	3.4				
4.5	14.8	26.0	2.4				
5.0	16.4	25.0	1.0				
5.5	18.0	24.5	0.4				
6.0	19.7	22.5	0.3				
7.0	23.0	20.0	0.3				
8.0	26.2	17.5	0.3				
9.0	29.5	17.0	0.3				

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Specific conductance (µS/cm)	370	370	380
pH (pH units)	8.2	8.2	8.2
Turbidity (Jackson turbidity units)	5.0	7.5	7.5
Transparency, secchi disk (inches)	45.3	--	32.7
Fecal coliform bacteria (colonies/100 ml)	5	--	--
Fecal streptococci bacteria (colonies/100 ml)	35	--	--
Ammonia, total as N (mg/L)	.00	.34	.00
Nitrite plus nitrate, total as N (mg/L)	.01	.02	.07
Phosphorus, total as P (mg/L)	.04	.07	.03
Organic carbon, total (mg/L)	5.2	5.3	5.5
Chlorophyll a (µg/L)	3.74	1.81	4.30
Pesticides detected (µg/L): None			

Date: October 24, 1983 — Weather conditions: Clear, calm, and cool (15 °C) — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		15.0	9.1	Surface		15.0	9.8
1.0	3.3	14.5	9.0	1.0	3.3	15.0	9.8
2.0	6.6	13.5	9.0	2.0	6.6	13.5	9.4
3.0	9.8	13.5	9.0				
4.0	13.1	13.5	8.9				
5.0	16.4	13.0	8.8				
6.0	19.7	13.0	8.7				
7.0	23.0	13.0	8.6				
8.0	26.2	13.0	8.5				

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Specific conductance (µS/cm)	380	365	350
pH (pH units)	8.2	8.3	8.3
Turbidity (Jackson turbidity units)	4.6	6.2	5.6
Transparency, secchi disk (inches)	48.4	--	36.2
Fecal coliform bacteria (colonies/100 ml)	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--
Ammonia, total as N (mg/L)	.12	.06	.05
Nitrite plus nitrate, total as N (mg/L)	.11	.11	.11
Phosphorus, total as P (mg/L)	.10	.05	.02
Organic carbon, total (mg/L)	4.6	5.1	4.9
Chlorophyll a (µg/L)	2.64	2.39	4.81
Pesticides detected (µg/L): None			

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Miola Lake

Date: April 26, 1983

Weather conditions: Windy and warm

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		12.0	11.4	Surface		12.0	11.5	Surface		13.0	11.2
1.0	3.3	12.0	11.2	1.0	3.3	12.0	11.5	0.5	1.6	13.0	11.2
2.0	6.6	12.0	11.0	2.0	6.6	12.0	11.5	1.0	3.3	--	--
3.0	9.8	12.0	10.9	3.0	9.8	12.0	11.5				
4.0	13.1	11.5	10.8	3.5	11.5	--	--				
5.0	16.4	11.5	10.6								
6.0	19.7	11.5	10.6								
7.0	23.0	11.5	10.4								
8.0	26.3	11.0	9.6								
9.0	29.5	10.5	9.0								
9.5	31.2	--	--								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	240	270	260	270	280
pH (pH units)	8.4	8.4	8.5	8.6	8.5
Turbidity (Jackson turbidity units)	15	16	15	16	26
Transparency, secchi disk (inches)	24.8	--	23.6	--	15.7
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.10	.00	.00	.10	.00
Nitrite plus nitrate, total as N (mg/L)	.60	.50	.50	.50	.50
Phosphorus, total as P (mg/L)	.16	.03	.07	.05	.05
Organic carbon, total (mg/L)	5.6	6.0	5.5	5.7	7.2
Chlorophyll a (µg/L)	28.8	21.0	29.9	28.4	20.3
Pesticides detected (µg/L): None					

Date: October 4, 1983

Weather conditions: Cloudy, breeze, and cool (16 °C)

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		20.0	7.8	Surface		20.0	7.7	Surface		20.0	7.8
1.0	3.3	20.0	7.7	1.0	3.3	20.0	7.7	1.0	3.3	20.0	7.6
2.0	6.6	20.0	7.7	2.0	6.6	20.0	7.7	1.3	4.3	20.0	6.5
3.0	9.8	20.0	7.7	3.0	9.8	20.0	7.5				
4.0	13.1	20.0	7.8	3.5	11.5	20.0	6.6				
5.0	16.4	20.0	7.8	4.0	13.1	20.0	6.6				
6.0	19.7	20.0	7.8	4.3	14.1	20.0	6.4				
6.5	21.3	19.5	5.7								
7.0	23.0	19.0	2.8								
8.0	26.2	19.0	1.7								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	250	260	260	280	280
pH (pH units)	7.8	7.7	8.0	8.0	8.0
Turbidity (Jackson turbidity units)	8.1	25	8.3	11	22
Transparency, secchi disk (inches)	26.8	--	24.4	--	11.0
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.00	.03	.00	.00	.00
Nitrite plus nitrate, total as N (mg/L)	.13	.23	.12	.12	.10
Phosphorus, total as P (mg/L)	.05	.04	.04	.04	.04
Organic carbon, total (mg/L)	7.7	5.2	4.6	4.8	4.8
Chlorophyll a, (µg/L)	19.5	19.2	12.7	13.0	29.5
Pesticides detected (µg/L): None					

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Moline Reservoir

Date: July 12, 1983

Weather conditions: Clear, calm, and hot (36 °C) Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		29.0	6.7	Surface		29.5	6.0	Surface		29.5	6.5
1.0	3.3	28.0	6.2	1.0	3.3	29.0	5.8	1.0	3.3	29.5	6.4
2.0	6.6	27.5	5.8	1.5	4.9	27.0	2.9	1.5	4.9	29.0	6.2
2.5	8.2	27.0	4.4	2.0	6.6	26.5	0.5	2.0	6.6	29.0	6.0
3.0	9.8	27.0	3.8								
3.5	11.5	26.0	3.0								
4.0	13.1	26.0	2.4								
4.5	14.8	25.5	1.0								
5.0	16.4	25.0	0.5								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 3 Surface
Specific conductance (µS/cm)	430	430	400	410
pH (pH units)	7.2	7.4	7.6	7.5
Turbidity (Jackson turbidity units)	16	18	17	14
Transparency, secchi disk (inches)	23.6	--	20.9	24.8
Fecal coliform bacteria (colonies/100 ml)	5	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	150	--	--	--
Ammonia, total as N (mg/L)	.21	.40	.27	.21
Nitrite plus nitrate, total as N (mg/L)	.23	.21	.23	.23
Phosphorus, total as P (mg/L)	.08	.05	.04	.04
Organic carbon, total (mg/L)	7.4	6.8	6.6	7.1
Chlorophyll a (µg/L)	--	3.43	5.68	3.92
Pesticides detected (µg/L): None				

Date: September 29, 1983

Weather conditions: Hazey, breeze, and cool (18.5 °C) Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		20.0	9.2	Surface		20.0	8.5	Surface		20.5	8.0
1.0	3.3	20.0	9.1	1.0	3.3	20.0	8.3	1.0	3.3	20.5	8.1
2.0	6.6	20.0	8.6	2.0	6.6	20.0	8.1	1.8	5.9	20.0	8.0
3.0	9.8	19.5	8.3								
4.0	13.1	18.5	6.8								
4.5	14.8	18.0	6.2								
5.0	16.4	18.0	5.3								
6.0	19.7	18.0	2.6								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 3 Surface
Specific conductance (µS/cm)	435	450	445	445
pH (pH units)	8.1	8.0	8.1	8.1
Turbidity (Jackson turbidity units)	12	18	13	13
Transparency, secchi disk (inches)	30.7	--	28.7	24.8
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--
Ammonia, total as N (mg/L)	.00	.10	.00	.01
Nitrite plus nitrate, total as N (mg/L)	.13	.02	.00	.00
Phosphorus, total as P (mg/L)	.00	.00	.00	.00
Organic carbon, total (mg/L)	7.6	8.7	7.4	8.1
Chlorophyll a, (µg/L)	13.1	13.8	13.7	15.6
Pesticides detected (µg/L): None				

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Mound City Lake

Date: August 25, 1983

Weather conditions: Clear, windy, and hot

Remarks: Taste and odor complaint

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)
Surface		29.5	9.5
0.5	1.6	29.5	9.4
1.0	3.3	29.5	9.1
1.5	4.9	29.5	8.9
2.0	6.6	29.5	9.0
2.5	8.2	29.0	9.1
3.0	9.8	29.0	8.4
3.5	11.5	28.0	2.1
4.0	13.1	28.0	0.9
4.5	14.8	27.5	0.2
5.0	16.4	26.0	0.2
5.5	18.0	24.5	0.1

Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		30.0	9.0
1.0	3.3	29.0	8.4
2.0	6.6	28.5	6.2
2.5	8.2	28.0	4.4
3.0	9.8	28.0	3.4
3.5	11.5	28.0	3.2
4.0	13.1	27.0	1.3
5.0	16.4	26.5	0.2
6.0	19.7	20.0	0.2
6.5	21.3	19.0	0.2

Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		30.0	9.3
0.5	1.6	30.0	8.9
1.0	3.3	29.0	6.0

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	247	272	246	263	246
pH (pH units)	8.3	7.3	8.3	7.3	8.3
Turbidity (Jackson turbidity units)	10	9.6	16	9.3	9.8
Transparency, secchi disk (inches)	31.5	--	31.5	--	31.5
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.04	.35	.00	.21	.02
Nitrite plus nitrate, total as N (mg/L)	.00	.00	.05	.00	.00
Phosphorus, total as P (mg/L)	.11	.09	.05	.07	.04
Organic carbon, total (mg/L)	5.8	6.2	6.5	5.3	6.5
Chlorophyll a (µg/L)	40.8	21.7	43.9	25.5	38.9
Pesticides detected (µg/L): None					

Date: October 3, 1983

Weather conditions: Partly cloudy, windy, and warm (24 °C)

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)
Surface		21.0	7.7
1.0	3.3	21.0	7.5
2.0	6.6	20.5	7.6
3.0	9.8	20.5	7.5
4.0	13.1	20.5	7.5
4.5	14.8	20.5	7.5

Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		21.0	7.5
1.0	3.3	21.0	7.0
2.0	6.6	20.5	6.8
3.0	9.8	20.5	6.7
4.0	13.1	20.5	6.5
4.3	14.1	20.5	6.3

Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		21.0	7.5
1.0	3.3	20.5	6.3

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	200	210	220	240	240
pH (pH units)	7.7	7.8	7.8	7.8	7.8
Turbidity (Jackson turbidity units)	22	22	18	19	17
Transparency, secchi disk (inches)	16.5	--	19.7	--	20.9
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.02	.00	.01	.01	.00
Nitrite plus nitrate, total as N (mg/L)	.00	.00	.00	.00	.00
Phosphorus, total as P (mg/L)	.08	.08	.04	.10	.07
Organic carbon, total (mg/L)	6.8	6.4	6.9	6.6	5.8
Chlorophyll a, (µg/L)	24.6	51.4	54.6	51.4	51.6
Pesticides detected (µg/L): None					

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Osage City Reservoir

Date: September 13, 1983

Weather conditions: Clear, calm, and cool (18.5 °C) Remarks: Taste and odor complaint

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		18.0	4.4	Surface		17.0	5.3	Surface		14.0	6.8
0.5	1.6	17.5	4.1	0.5	1.6	17.0	5.1	0.5	1.6	13.5	6.4
1.0	3.3	17.5	4.0	1.0	3.3	17.0	5.1				
1.5	4.9	17.5	4.0	1.5	4.9	16.5	5.2				
2.0	6.6	17.5	3.9	2.0	6.6	16.5	2.0				
2.5	8.2	17.5	0.1								

Measurement or constituent	Site 1 Surface	Site 2 Surface	Site 3 Surface
Specific conductance (µS/cm)	275	275	290
pH (pH units)	7.2	7.7	7.9
Turbidity (Jackson turbidity units)	23	13	20
Transparency, secchi disk (inches)	22.0	35.0	20.9
Fecal coliform bacteria (colonies/100 ml)	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--
Ammonia, total as N (mg/L)	.18	.11	.10
Nitrite plus nitrate, total as N (mg/L)	.08	.05	.02
Phosphorus, total as P (mg/L)	.09	.06	.05
Organic carbon, total (mg/L)	7.3	--	--
Chlorophyll a (µg/L)	9.98	10.8	21.3
Pesticides detected (µg/L): Alachlor (0.43) Atrazine (4.0)			

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Pleasanton East City Lake

Date: April 21, 1983

Weather conditions: Rainy and windy

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)
Surface		11.0	11.0
1.0	3.3	11.0	11.0
2.0	6.6	11.0	10.9
3.0	9.8	11.0	10.6
4.0	13.1	11.0	10.8
5.0	16.4	11.0	10.8
6.0	19.7	10.0	9.7
7.0	23.0	9.5	9.5
8.0	26.2	--	--

Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		11.0	11.0
1.0	3.3	11.0	10.6
2.0	6.6	10.5	9.6
3.0	9.8	10.0	9.3
3.5	11.5	--	--

Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		11.0	--
1.0	3.3	10.5	--
1.5	4.9	10.5	--
2.0	6.6	--	--

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	190	200	200	200	200
pH (pH units)	8.2	8.1	7.8	7.7	8.0
Turbidity (Jackson turbidity units)	23	24	22	23	23
Transparency, secchi disk (inches)	20.9	--	18.9	--	20.9
Fecal coliform bacteria (colonies/100 ml)	5	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	80	--	--	--	--
Ammonia, total as N (mg/L)	.10	.00	.00	.10	.10
Nitrite plus nitrate, total as N (mg/L)	.30	.30	.30	.30	.30
Phosphorus, total as P (mg/L)	.09	.20	.06	.19	.06
Organic carbon, total (mg/L)	7.4	7.6	7.4	8.3	7.3
Chlorophyll a (µg/L)	20.3	7.02	13.9	7.25	16.5
Pesticides detected (µg/L): DDE-o'p' (0.12) DDE-p'p' (0.12)					

Date: October 3, 1983

Weather conditions: Partly cloudy, windy, and warm (24 °C)

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)
Surface		21.0	7.9
1.0	3.3	21.0	7.8
2.0	6.6	21.0	8.0
3.0	9.8	21.0	7.9
4.0	13.1	21.0	7.8
5.0	16.4	21.0	7.8
6.0	19.7	21.0	7.6
7.0	23.0	20.5	7.5
7.5	24.6	20.5	5.0

Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		21.5	8.4
1.0	3.3	21.5	8.4
2.0	6.6	21.0	8.4
3.0	9.8	21.0	8.3

Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		22.0	8.9
0.8	2.6	22.0	8.7

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	210	205	200	200	200
pH (pH units)	7.6	7.6	7.7	7.8	7.7
Turbidity (Jackson turbidity units)	7.0	12	12	13	8.0
Transparency, secchi disk (inches)	34.6	--	31.5	--	--
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.00	.04	.00	.00	.01
Nitrite plus nitrate, total as N (mg/L)	.02	.02	.01	.02	.05
Phosphorus, total as P (mg/L)	.11	.03	.04	.07	.08
Organic carbon, total (mg/L)	6.2	5.3	5.0	7.2	5.3
Chlorophyll a, (µg/L)	10.3	8.80	9.13	9.93	8.81
Pesticides detected (µg/L): None					

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Polk Daniels Lake

Date: April 27, 1983 — Weather conditions: Rainy, windy, and cold — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		15.0	9.7	Surface		16.0	8.2
1.0	3.3	15.0	9.6	1.0	3.3	16.0	8.0
2.0	6.6	15.0	9.4	1.5	4.9	16.0	8.0
3.0	9.8	15.0	9.4	2.0	6.6	--	--
4.0	13.1	15.0	9.4				
5.0	16.4	15.0	9.4				
6.0	19.7	15.0	7.6				
6.5	21.3	--	--				

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Specific conductance (µS/cm)	240	240	240
pH (pH units)	8.0	8.0	8.0
Turbidity (Jackson turbidity units)	42	58	58
Transparency, secchi disk (inches)	13.0	--	9.8
Fecal coliform bacteria (colonies/100 ml)	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--
Ammonia, total as N (mg/L)	.30	.30	.20
Nitrite plus nitrate, total as N (mg/L)	.50	.50	.50
Phosphorus, total as P (mg/L)	.05	.09	.08
Organic carbon, total (mg/L)	7.3	8.7	6.8
Chlorophyll a (µg/L)	6.72	3.67	4.41
Pesticides detected (µg/L): None			

Date: September 29, 1983 — Weather conditions: Clear, breeze, and warm (22 °C) — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		21.5	8.3	Surface		22.5	7.4
1.0	3.3	21.0	7.9				
2.0	6.6	20.5	7.0				
2.5	8.2	20.0	6.8				
3.0	9.8	19.5	5.8				
4.0	13.1	19.0	5.2				
5.0	16.4	18.5	4.5				
6.0	19.7	18.5	3.4				
6.5	21.3	18.5	3.7				

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Specific conductance (µS/cm)	315	320	310
pH (pH units)	8.1	7.8	8.0
Turbidity (Jackson turbidity units)	7.0	9.0	17
Transparency, secchi disk (inches)	29.5	--	17.3
Fecal coliform bacteria (colonies/100 ml)	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--
Ammonia, total as N (mg/L)	.00	.00	.00
Nitrite plus nitrate, total as N (mg/L)	.00	.10	.00
Phosphorus, total as P (mg/L)	.00	.00	.02
Organic carbon, total (mg/L)	5.3	5.2	6.1
Chlorophyll a (µg/L)	10.2	8.49	9.50
Pesticides detected (µg/L): None			

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Prairie Lake

Date: May 11, 1983 — Weather conditions: Not available — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		17.5	8.6	Surface		18.0	8.6	Specific conductance (µS/cm)	255	275	275
1.0	3.3	17.0	8.6	1.0	3.3	18.0	8.2	pH (pH units)	7.8	7.8	7.8
2.0	6.6	17.0	8.0	1.5	4.9	--	--	Turbidity (Jackson turbidity units)	6.4	7.0	8.2
3.0	9.8	17.0	8.0					Transparency, secchi disk (inches)	43.3	--	39.4
4.0	13.1	16.5	7.6					Fecal coliform bacteria (colonies/100 ml)	10	--	--
5.0	16.4	16.0	7.0					Fecal streptococci bacteria (colonies/100 ml)	740	--	--
6.0	19.7	15.5	5.6					Ammonia, total as N (mg/L)	.10	.10	.10
7.0	23.0	15.0	4.4					Nitrite plus nitrate, total as N (mg/L)	.30	.30	.40
7.5	24.6	--	--					Phosphorus, total as P (mg/L)	.05	.07	.04
								Organic carbon, total (mg/L)	--	--	--
								Chlorophyll a (µg/L)	3.97	4.68	6.53
								Pesticides detected (µg/L): None			

Date: October 25, 1983 — Weather conditions: Clear, calm, and cool (8 °C) — Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface
Surface		12.0	9.2	Surface		11.5	9.1	Specific conductance (µS/cm)	230	240	250
1.0	3.3	12.0	9.1	1.0	3.3	11.5	9.2	pH (pH units)	8.0	8.0	8.0
2.0	6.6	12.0	8.9	1.3	4.3	11.0	9.0	Turbidity (Jackson turbidity units)	9.0	10	12
3.0	9.8	12.0	9.0					Transparency, secchi disk (inches)	26.8	--	--
4.0	13.1	12.0	9.0					Fecal coliform bacteria (colonies/100 ml)	--	--	--
5.0	16.4	12.0	9.0					Fecal streptococci bacteria (colonies/100 ml)	--	--	--
6.0	19.7	12.0	9.0					Ammonia, total as N (mg/L)	.57	.52	.47
6.3	20.7	12.0	8.5					Nitrite plus nitrate, total as N (mg/L)	.16	.16	.15
								Phosphorus, total as P (mg/L)	.05	.07	.05
								Organic carbon, total (mg/L)	6.5	7.6	7.1
								Chlorophyll a (µg/L)	21.4	19.7	16.5
								Pesticides detected (µg/L): Atrazine (3.2)			

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Sedan Lower City Lake

Date: July 12, 1983

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		29.0	7.3	Surface		30.0	6.7	Surface		30.0	6.8
1.0	3.3	29.0	7.2	1.0	3.3	29.0	7.0	0.5	1.6	29.5	6.6
2.0	6.6	29.0	7.2	2.0	6.6	29.0	6.6	1.0	3.3	29.5	6.8
2.5	8.2	28.0	5.4	2.5	8.2	28.5	4.8	1.5	4.9	29.0	6.2
3.0	9.8	28.0	5.4	3.0	9.8	28.0	4.5	2.0	6.6	29.0	6.1
3.5	11.5	24.0	1.2	3.5	11.5	27.0	0.7				
4.0	13.1	24.0	1.2	4.0	13.1	26.0	0.6				
4.5	14.8	19.0	0.3								
5.0	16.4	19.5	0.3								
6.0	19.7	17.0	0.2								
7.0	23.0	17.0	0.3								

Weather conditions: Clear, calm, and hot (33 °C) Remarks: None

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	280	290	280	280	290
pH (pH units)	7.9	8.4	8.3	8.2	8.2
Turbidity (Jackson turbidity units)	3.0	18	4.0	10	3.0
Transparency, secchi disk (inches)	88.6	--	42.5	--	57.1
Fecal coliform bacteria (colonies/100 ml)	10	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	1,400	--	--	--	--
Ammonia, total as N (mg/L)	.03	.55	.04	.03	.00
Nitrite plus nitrate, total as N (mg/L)	.01	.00	.02	.01	.00
Phosphorus, total as P (mg/L)	.01	.08	.02	.02	.01
Organic carbon, total (mg/L)	4.9	7.3	5.3	5.4	5.1
Chlorophyll a (µg/L)	1.89	10.2	3.27	4.68	2.14
Pesticides detected (µg/L): None					

Date: September 28, 1983

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		22.0	8.2	Surface		23.0	8.7	Surface		23.5	8.9
1.0	3.3	21.0	7.5	1.0	3.3	23.0	8.7	1.0	3.3	23.0	8.7
2.0	6.6	20.5	7.2	2.0	6.6	23.0	8.3	1.5	4.9	23.0	8.4
3.0	9.8	20.0	6.9	3.0	9.8	22.0	7.9				
4.0	13.1	19.5	6.2	3.5	11.5	21.5	7.4				
5.0	16.4	19.5	6.3								
6.0	19.7	19.5	5.1								
6.5	21.3	19.0	3.7								
7.0	23.0	19.0	1.4								

Weather conditions: Clear, breeze, and warm (25 °C) Remarks: None

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	300	315	310	290	310
pH (pH units)	7.9	7.5	8.0	7.9	8.1
Turbidity (Jackson turbidity units)	8.3	41	7.9	10	9.5
Transparency, secchi disk (inches)	43.3	--	38.6	--	36.6
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.12	.45	.09	.07	.10
Nitrite plus nitrate, total as N (mg/L)	.01	.01	.01	.01	.03
Phosphorus, total as P (mg/L)	.00	.00	.00	.00	.26
Organic carbon, total (mg/L)	6.2	5.3	--	5.6	5.6
Chlorophyll a, (µg/L)	6.69	2.30	4.19	5.88	5.16
Pesticides detected (µg/L): None					

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Strowbridge Reservoir

Date: April 20, 1983

Weather conditions: Partly cloudy, windy, and cool Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		10.5	11.1	Surface		9.8	10.6	Surface		10.0	10.5
1.0	3.3	10.0	10.7	1.0	3.3	9.5	10.4	1.0	3.3	10.0	10.5
2.0	6.6	10.0	10.7	2.0	6.6	9.5	10.4	2.0	6.6	9.5	10.0
3.0	9.8	10.0	10.6	3.0	9.8	9.0	10.4	3.0	9.8	9.0	10.0
4.0	13.1	10.0	10.4	3.5	11.5	9.0	10.0	4.0	13.1	9.0	9.5
5.0	16.4	9.5	10.2	4.0	13.1	--	--	4.5	14.8	--	--
6.0	19.7	9.5	10.2								
7.0	23.0	9.5	10.2								
8.0	26.2	9.5	10.0								
8.5	27.9	--	--								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface	Site 3 Bottom
Specific conductance (µS/cm)	200	200	200	210	210	200
pH (pH units)	8.0	8.1	7.9	8.0	7.9	7.8
Turbidity (Jackson turbidity units)	35	34	37	37	33	35
Transparency, secchi disk (inches)	15.0	--	13.0	--	13.0	--
Fecal coliform bacteria (colonies/100 ml)	20	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	80	--	--	--	--	--
Ammonia, total as N (mg/L)	.01	.01	.01	.01	.01	.01
Nitrite plus nitrate, total as N (mg/L)	.80	.80	.80	.80	.80	.70
Phosphorus, total as P (mg/L)	.29	.32	.26	.13	.30	.29
Organic carbon, total (mg/L)	6.7	6.7	7.1	6.7	7.4	6.9
Chlorophyll a (µg/L)	13.5	11.7	8.34	9.18	10.8	8.08
Pesticides detected (µg/L): None						

Date: October 26, 1983

Weather conditions: Clear, calm, and cool (17.0 °C) Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		15.0	9.8	Surface		14.0	9.6	Surface		15.0	9.6
1.0	3.3	13.0	9.9	1.0	3.3	13.0	9.5	1.0	3.3	13.0	9.9
2.0	6.6	12.5	9.8	2.0	6.6	13.0	9.6	2.0	6.6	12.5	9.8
3.0	9.8	12.5	9.8	3.0	9.8	12.5	9.7	3.0	9.8	12.0	9.9
4.0	13.1	12.5	9.8	4.0	13.1	12.0	9.8	4.0	13.1	12.0	9.0
5.0	16.4	12.5	9.8								
6.0	19.7	12.5	9.7								
7.0	23.0	12.5	9.6								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface	Site 3 Bottom
Specific conductance (µS/cm)	270	270	250	260	270	270
pH (pH units)	8.1	7.8	8.0	8.0	8.0	7.9
Turbidity (Jackson turbidity units)	10	11	10	12	8.0	8.0
Transparency, secchi disk (inches)	26.8	--	24.0	--	28.0	--
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--	--
Ammonia, total as N (mg/L)	.00	.00	.00	.00	.00	.00
Nitrite plus nitrate, total as N (mg/L)	.47	.42	.43	.42	.44	.49
Phosphorus, total as P (mg/L)	.04	.18	.12	.01	.10	.04
Organic carbon, total (mg/L)	4.9	4.9	5.0	4.9	4.7	4.8
Chlorophyll a, (µg/L)	2.67	3.17	4.34	2.22	4.38	4.96
Pesticides detected (µg/L): Atrazine (2.5), Dual (0.54)						

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Timber Creek Lake

Date: April 27, 1983

Weather conditions: Cloudy, windy, and cool

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)
Surface		12.5	10.6
1.0	3.3	12.5	10.5
2.0	6.6	12.5	10.4
3.0	9.8	12.5	10.4
4.0	13.1	12.5	10.2
5.0	16.4	12.5	10.2
6.0	19.7	12.0	10.2
7.0	23.0	12.0	10.1
8.0	26.2	12.0	10.0
9.0	29.5	12.0	10.0
10.0	32.8	12.0	10.0
11.0	36.1	12.0	9.8
11.5	37.7	--	--

Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		13.0	10.4
1.0	3.3	13.0	10.3
2.0	6.6	13.0	10.2
3.0	9.8	13.0	10.2
4.0	13.1	13.0	10.2
5.0	16.4	13.0	10.2
6.0	19.7	12.0	10.2
6.5	21.3	--	--

Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		15.0	9.2
1.0	3.3	15.0	9.2
1.5	4.9	--	--

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	300	300	310	300	350
pH (pH units)	8.4	8.3	8.3	8.3	8.2
Turbidity (Jackson turbidity units)	22	23	23	26	41
Transparency, secchi disk (inches)	20.1	--	18.9	--	9.8
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.10	.10	.10	.10	.10
Nitrite plus nitrate, total as N (mg/L)	.50	.40	.40	.40	.50
Phosphorus, total as P (mg/L)	.14	.04	.01	.04	.06
Organic carbon, total (mg/L)	4.9	5.2	5.3	5.6	7.0
Chlorophyll a (µg/L)	6.68	12.7	7.91	8.81	12.7
Pesticides detected (µg/L): None					

Date: September 14, 1983

Weather conditions: Clear and windy

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)
Surface		24.5	7.3
1.0	3.3	24.5	7.3
2.0	6.6	24.5	7.3
3.0	9.8	24.0	7.2
4.0	13.1	24.0	7.2
5.0	16.4	24.0	7.1
6.0	19.7	24.0	6.6
7.0	23.0	24.0	6.6
8.0	26.2	24.0	6.6
9.0	29.5	24.0	6.5
10.0	32.8	24.0	6.5
11.0	36.1	24.0	6.5
12.0	37.7	24.0	6.5

Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)
Surface		24.0	6.9
1.0	3.3	24.0	6.7
2.0	6.6	24.0	6.8
3.0	9.8	24.0	6.8
4.0	13.1	24.0	6.7
5.0	16.4	24.0	6.6
6.0	19.7	24.0	6.3
7.0	23.0	23.5	5.9
8.0	26.2	23.5	5.5

Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		23.5	8.2
1.0	3.3	23.5	8.1
1.3	4.3	23.5	7.1

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 2 Bottom	Site 3 Surface
Specific conductance (µS/cm)	275	290	310	310	300
pH (pH units)	7.9	8.0	8.0	8.0	8.1
Turbidity (Jackson turbidity units)	7.5	7.0	9.0	18	24
Transparency, secchi disk (inches)	35.4	--	24.4	--	13.0
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--	--
Ammonia, total as N (mg/L)	.00	.06	.00	.04	.09
Nitrite plus nitrate, total as N (mg/L)	.07	.00	.07	.07	.04
Phosphorus, total as P (mg/L)	.02	.03	.01	.01	.02
Organic carbon, total (mg/L)	3.5	3.7	3.8	4.3	5.0
Chlorophyll a, (µg/L)	12.5	11.9	10.8	7.11	19.6
Pesticides detected (µg/L): None					

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Yates Center Reservoir

Date: April 20, 1983

Weather conditions: Clear, windy, and cool

Remarks: None

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		10.5	9.6	Surface		10.0	10.6	Surface		10.0	10.4
1.0	3.3	9.5	9.6	1.0	3.3	10.0	10.2	1.0	3.3	10.0	10.3
2.0	6.6	9.5	9.6	1.5	4.9	10.0	10.0	2.0	6.6	10.0	10.2
3.0	9.8	9.5	9.4	2.0	6.6	--	--	2.5	8.2	--	--
4.0	13.1	9.5	9.3								
5.0	16.4	9.5	9.2								
5.5	18.0	--	--								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 3 Surface
Specific conductance (µS/cm)	210	200	230	200
pH (pH units)	8.5	8.3	8.3	8.3
Turbidity (Jackson turbidity units)	70	69	72	72
Transparency, secchi disk (inches)	7.9	--	9.8	7.9
Fecal coliform bacteria (colonies/100 ml)	20	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	600	--	--	--
Ammonia, total as N (mg/L)	.20	.00	.00	.00
Nitrite plus nitrate, total as N (mg/L)	.60	.60	.50	.60
Phosphorus, total as P (mg/L)	.40	.18	.22	.26
Organic carbon, total (mg/L)	10	9.7	8.5	9.6
Chlorophyll a (µg/L)	12.1	11.0	19.8	15.3
Pesticides detected (µg/L): No sample taken				

Date: August 9, 1983

Weather conditions: Clear, calm, and hot

Remarks: Taste and odor complaint

Site 1 Depth (Meters)	Site 1 Depth (Feet)	Site 1 Temperature (°C)	Site 1 Dissolved oxygen (mg/L)	Site 2 Depth (Meters)	Site 2 Depth (Feet)	Site 2 Temperature (°C)	Site 2 Dissolved oxygen (mg/L)	Site 3 Depth (Meters)	Site 3 Depth (Feet)	Site 3 Temperature (°C)	Site 3 Dissolved oxygen (mg/L)
Surface		32.5	6.3	Surface		32.0	6.5	Surface		32.0	6.0
0.5	1.6	29.0	5.9	0.5	1.6	28.5	6.2	0.5	1.6	28.0	5.3
1.0	3.3	28.5	5.8	1.0	3.3	27.5	5.0	1.0	3.3	28.0	4.7
1.5	4.9	28.0	5.3	1.5	4.9	27.0	4.0	1.5	4.9	27.5	3.9
2.0	6.6	28.0	5.3					2.0	6.6	27.0	3.5
2.5	8.2	28.0	5.2					2.5	8.2	27.0	1.0
3.0	9.8	27.5	3.4								
3.5	11.5	27.5	3.1								
4.0	13.1	27.0	0.9								
4.5	14.8	26.0	0.3								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 3 Surface
Specific conductance (µS/cm)	320	330	325	335
pH (pH units)	7.3	7.1	7.3	7.1
Turbidity (Jackson turbidity units)	110	116	108	104
Transparency, secchi disk (inches)	3.9	--	4.3	3.9
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--
Ammonia, total as N (mg/L)	.03	.04	.01	.08
Nitrite plus nitrate, total as N (mg/L)	.49	.35	.58	.31
Phosphorus, total as P (mg/L)	.15	.15	.32	.18
Organic carbon, total (mg/L)	9.0	9.1	9.3	9.5
Chlorophyll a, (µg/L)	6.71	2.56	11.6	11.2
Pesticides detected (µg/L): Atrazine (2.4), 2,4,5-T (0.21)				

Table 9.--Results of water-quality measurements and chemical analyses of water samples for selected water-supply lakes--Continued

Yates Center Reservoir--Continued

Date: October 24, 1983

Weather conditions: Clear, calm, and cool (15.5 °C) Remarks: None

Site 1				Site 2				Site 3			
Depth (Meters)	Depth (Feet)	Temperature (°C)	Dissolved oxygen (mg/L)	Depth (Meters)	Depth (Feet)	Temperature (°C)	Dissolved oxygen (mg/L)	Depth (Meters)	Depth (Feet)	Temperature (°C)	Dissolved oxygen (mg/L)
Surface		13.0	9.2	Surface		13.0	9.2	Surface		13.0	9.4
1.0	3.3	12.5	9.2	0.8	2.6	12.0	9.3	1.0	3.3	12.5	9.3
2.0	6.6	12.0	9.2					1.9	6.2	12.0	9.2
3.0	9.8	12.0	9.2								
4.0	13.1	12.0	9.2								
4.8	15.7	12.0	9.0								

Measurement or constituent	Site 1 Surface	Site 1 Bottom	Site 2 Surface	Site 3 Surface
Specific conductance (µS/cm)	340	340	340	330
pH (pH units)	7.8	7.6	7.7	7.6
Turbidity (Jackson turbidity units)	100	93	92	89
Transparency, secchi disk (inches)	4.7	--	3.9	--
Fecal coliform bacteria (colonies/100 ml)	--	--	--	--
Fecal streptococci bacteria (colonies/100 ml)	--	--	--	--
Ammonia, total as N (mg/L)	.00	.02	.00	.02
Nitrite plus nitrate, total as N (mg/L)	.51	.52	.52	.66
Phosphorus, total as P (mg/L)	.20	.18	.18	.22
Organic carbon, total (mg/L)	8.3	8.5	8.5	8.7
Chlorophyll a (µg/L)	5.61	3.89	3.46	4.81
Pesticides detected (µg/L): Atrazine (1.4)				