LAWTONKA RESERVOIR

PHASE I DIAGNOSTIC/FEASIBILITY STUDY

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LAWTONKA RESERVOIR

PHASE I DIAGNOSTIC/FEASIBILITY STUDY

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SECTION I

INTRODUCTION

This report was prepared in responses to Section 314(a) of the Clean Water Act (P.L. 95-217) of 1977 which, upon election to participate, requires each state to trophically classify, diagnose, and restore their publicly owned freshwater lakes. The initial step in this process, the classification study, culminated in the publication in December 1980, of the "Classification of Oklahoma Reservoirs Using LANDSAT Multispectral Scanner Data". This document, the diagnostic-feasibility study of Lawtonka Reservoir, constitutes one result of compliance with the second step of this process. An application for the participation of Lawtonka Reservoir in the third or restoration phase of the process will be submitted in the near future.

SECTION II

General Summary

This study was designed to identify the cause or causes of the persistent pollution problem occurring in Lawtonka Reservoir. Results from the analysis of field and laboratory data indicated there were three main sources of pollution entering the reservoir.

They are as follows:

1. Leakage of lagoon water into School House Slough which has the potential of being contaminated by pathogenic bacteria and viruses.

2. Utilization of the Lake Ellsworth water in Lawtonka Reservoir when water through the pipeline contains Total Phosphorus concentrations in excess of 0.05 milligrams per liter.

3. An unknown source of mercury at the Robinson's Landing area (north end) of Lawtonka Reservoir.

SECTION VII

CONCLUSIONS

Concerning Lawtonka Reservoir:

1) Lawtonka Reservoir is eutrophic and develops an anaerobic hypolimnion in the near dam area during the months of July, August and September.

2) Gross community photosynthesis and total community respiration data indicate the majority of net algal productivity occurs between 0.5 and 1.5 meter depths.

3) Phosphorus is the limiting macronutrient.

4) Lawtonka Reservoir is spatially and temporally heterogeneous with regard to the chlorophyll a content of its waters.

5) The vertical maxima in mean chlorophyll a biomass occurs between 1.5 and 2 meter depths.

6) The general trend in chlorophyll a distribution in Lawtonka Reservoir consists of an area of high chlorophyll a content at its northern end and an area of low chlorophyll content at its southern end.

7) In addition to the areas described in 6 above, there are locally persistent areas of unusually high and low chlorophyll a content, consisting of one major area of unusually high and two major areas of unusually low chlorophyll a content within Lawtonka Reservoir (Figures 10.4 and 10.17).

8) Water samples taken at the southern end of Lawtonka Reservoir did not exceed drinking water or fish and wildlife water quality standards for any heavy metals, however, two water samples taken near Robinson's Landing did exceed these standards for dissolved mercury.

9) The volume capacity of Lawtonka Reservoir to date is 56,574.31 acre-feet. If the original volume capacity estimate of 63,000 acre-feet was correct, the reservoir has lost 6,425.7 acre feet or 10% of its volume capacity to sediment in its 79 year history.

Concerning the Lawtonka Reservoir Watershed:

1) Water can pass from a small lagoon through a roadbed into School House Slough, a portion of Lawtonka Reservoir. Seepage occurs when the hydrologic head exceeds that of School House Slough.

2) The proportion of agricultural row crop activity in the Ellsworth Reservoir watershed is much greater than the amount of row crop activity in the Lawtonka Reservoir watershed.

3) Water which is pumped through a pipeline from Ellsworth Reservoir into Lawtonka Reservoir often contains Total Phosphorous concentrations in excess of those typical of Lawtonka Reservoir water.

4) Water temperature is significantly lower (0.05 significance level) and the conductivity significantly higher (0.02 significance level) in Jackson Creek than in Medicine Creek.

5) Water temperature, dissolved oxygen and pH are significantly lower in Canyon Creek than in Medicine Creek (0.05, 0.05, 0.02, respectively). Additionally, conductivity is significantly higher in Canyon Creek than in Medicine Creek at the 0.05 significance level.

6) Total Nitrogen concentration is nearly significantly higher (0.1 significance level) and the pH is significantly lower (0.01 significance level) in Jimmy Creek than in Medicine Creek.

7) The conductivity of water is significantly higher (0.05), the concentration of total nitrogen is nearly significantly higher (0.1) and the pH is significantly lower (0.05) at site 7 than water in Medicine Creek.

SECTION IV

RECOMMENDATIONS

1) Leakage of water through the road bed into School House Slough from the small pond to its east should be stopped. The potential exists for pathogenic contamination of Lawtonka Reservoir due to the proximity of an overloaded septic system upgrade from this small impoundment.

2) In addition to reservoir stage data, information concerning the concentration of Total Phosphorus in Ellsworth pipeline water should be utilized as an additional criterion for the initiation of pipeline pumping operations.

3) To the extent possible, pumping should be minimized when the concentration of Total Phosphorus in the pipeline water exceeds that in the reservoir.

4) Sampling should be undertaken to confirm and evaluate the persistence and magnitude of the mercury problem found at Robinson's Landing. Minimally, this evaluation should include fish flesh residue analysis from a composite of at least 10 channel catfish.

5) To the extent possible it would be advisable to:

- maintain naturally vegetated buffer zones on lands immediately adjacent to tributaries in the Lawtonka watershed.

- minimize the amount of agricultural row crop activity in the Lawtonka watershed to avoid a situation similar to that encountered in Lake Ellsworth.

- closely monitor the application and extent of herbicide, pesticide and fungicide usage in the Lawtonka watershed.

SECTION V

BACKGROUND INFORMATION (Tasks 1-8)

Lake Identification (Task 1):

Lawtonka Reservoir is located in southwest Oklahoma approximately six miles north of Lawton along Highway 58. This lake is located in Township 3N, Range 12WIM, Comanche County, Oklahoma, at 34°44'10" latitude and 98°30'15" longitude. Lawtonka Reservoir is publicly owned by the Lawton Water Authority. The Lawton Water Authority is a public trust created under the provisions of Title 60, O.S. 1961, Sections 176 to 180 on May 13, 1968. The major inflow and outflow is Medicine Creek, a fourth order stream (Water Quality Standards, 1982), which flows into Cache Creek below Lawtonka Dam (Figure 1.1).

The original dam impounding the reservoir was constucted in 1905 by the City of Lawton for municipal water supply. Lawtonka Reservoir is, therefore, the oldest reservoir in Oklahoma and has since been an important water source for Lawton and Fort Sill.

The reservoir level was increased in 1909, 1918, 1937, and 1953 by raising the dam and when full the present pool elevation is 406.9 meters. The reservoir contains 970.5 hectares, has 241 square kilometers of watershed, is 8 miles long from the dam to where water backs up on city property in Medicine Creek, and has 46.5 kilometers of shoreline. The average depth is 8 meters with a maximum depth of 21 meters by the dam.

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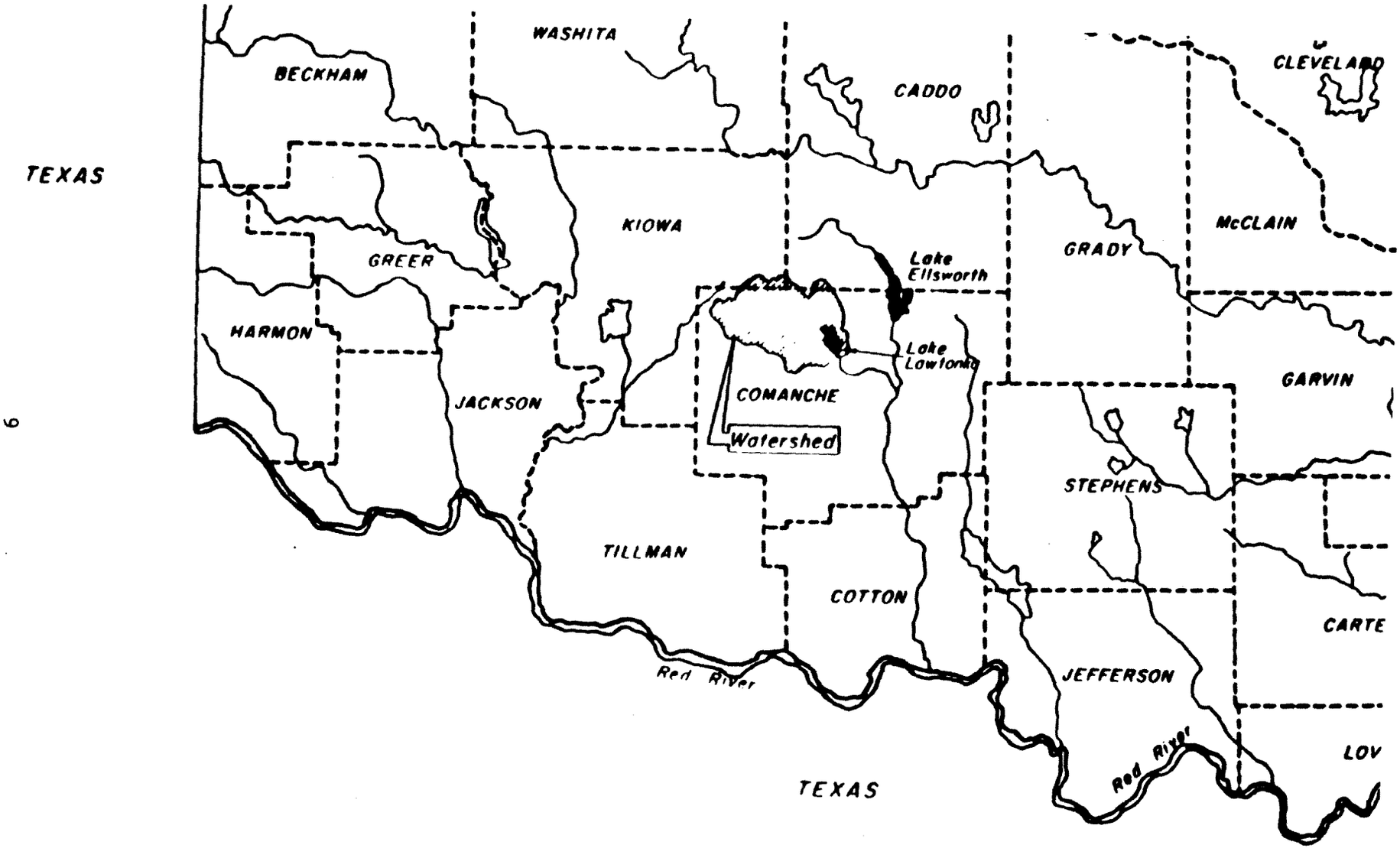


Figure 1.1 Lawtonka Reservoir watershed area

Lawtonka Reservoir is a multi-purpose lake which provides recreation (boating, water skiing, fishing, camping, and picnicking) and drinking water for the City of Lawton and several rural water districts. Applicable water quality standards are listed in Table 1.1.

Table 1.1. State Water Quality Standards applied to Lawtonka Reservoir.

PARAMETER	LIMIT
Physical:	
Color	75 color units
Odor	Non detectable by human senses
Temperature	Can be raised no more than 3° above original
Turbidity	25 NTU
Microbiological:	
Coliform organisms	200/100 ml (monthly geometric mean)
Inorganic Elements (mg/liter):	
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Copper	1.0
Fluoride (at 95°F)	1.6
Lead	0.05
Mercury	0.002
Nitrates (as N)	10
Oxygen	greater than 5.0
pH	6.5 to 8.5
Selenium	0.01
Silver	0.05
Zinc	5.0
Radioactive Elements (picocuries/liter):	
Radium - 226 and 228	5
Strontium - 90	8
Gross alpha particles (exluding radon and uranium)	15
Gross beta particles	50
Organic Chemicals (mg/liter):	
Cyanide	0.2
Detergents (total)	0.2
Methylene blue active substances	0.5
Oil and Grease	none visible
Phthalate esters	0.003
Polychlorinated Biphenyls	.0003
Pesticides (mg/liter):	
Aldrin/dieldrin	1.0
Endrin	1.0
Benzidine	1.0
Toxaphene	1.0
DDT	0.2
2, 4-D	0.1
2, 4, 5-T	.05

Drainage Basin Geology (Task 2):

LOCATION AND DESCRIPTION

The Lawtonka Reservoir Watershed consists of approximately 88.5 sections of land in North Central Comanche County, 3 sections in southeastern Kiowa County and 1 section in southwestern Caddo County of Oklahoma (Figure 2.1). The watershed acreage is nearly 59,000 acres. The watershed is primarily rangeland, judged to be in fair to good condition. Small areas are under cultivation; the main crop is wheat and/or small grains. Several residential and recreational developments exist near the reservoir.

Geology

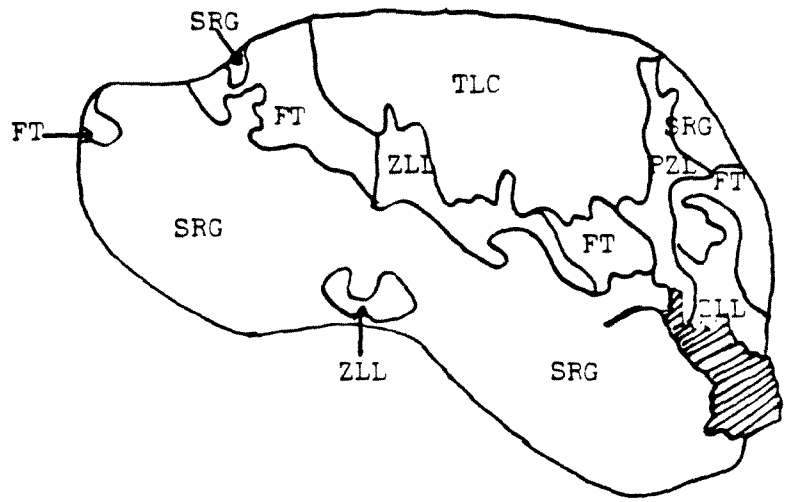
The basin consists of the following formations:

1. Cabbro: Approximately 25 percent of the basin is underlain by this basic, intrusive igneous rock of the late precambrian age.

2. Granite: Approximately 35 percent of the basin is underlain by this acid, intrusive igneous rock. It is also of the precambrian age.

3. Arbuckle group, upper part: Approximately 20 percent of the basin is underlain by limestones of this group; they belong to the Ordovician system.

Figure 2.1 Soil associations in the Lawtonka Reservoir watershed



FT	Foard-Tillman association
ZLL	Zaneis-Lawton-Lucien association
PZL	Port-Zavala-Lela association
SRG	Stony Rock land-Granite Cobbly land association
TLC	Tarrant-Limestone cobbly land association

4. Wichita formation: Approximately 15 percent of the basin is underlain by the Wichita shale (including some sandstone and conglomerate) and the Post Oak conglomerate. The former are the oldest Permean rocks in Comanche County. The latter is of more recent origin and rests on older sedimentary rocks and on igneous rocks.

5. Recent alluvium: Approximately 5 percent of the area is deeply capped with recent alluvium lying in the flood plains of the various tributaries that feed the reservoir (Quaternary deposits).

SOIL ASSOCIATIONS

Five soil associations (Figure 2.1) exist in the watershed according to the soil survey reports. They include:

Association	Abbreviation	Percent of Waterhed
Stony rock land-Granite cobbly land	(SRG)	51
Tarrant-Limestone cobbly land	(TLC)	25
Foard-Tillman	(FT)	12
Zaneis-Lawton-Lucien	(ZLL)	8
Port-Zavala-Lela	(PZL)	4

It should be noted that three-fourths (76%) of the watershed is covered by SRG and TLC associations. Soil within these associations fall within

Class VII land. Class VII land is suitable only for forestry, limited grazing, wildlife, and watershed purposes. Lands suitable for cultivation lie in two narrow strips. One extends north from the northwest end of the reservoir; the other strip extends west-northwest from the northwest tip of the reservoir. The former lies astride the stream course of Canyon Creek; the latter has no definitive stream association.

Soils of the FT association are on Class II and Class III land; the ZLL soil association has areas of Class III, IV, and VI land; the PZL soil association consists of Class II and III land. Land in Classes I through VI are suitable in varying degrees for cultivation.

Factors limiting use of most of the area soils involve the shallowness of the rooting zone, low moisture-holding capacity, rapid runoff, and permeability to water.

Stony Rock Land - Granite Cobbly Land Association (SRG):

The SRG association borders the entire western shore of the reservoir and extends west-northwest in a broad band. The association is 51 percent Stony rock land, 23 percent Granite cobbly land, 21 percent Rock land and 5 percent Granite outcrop. Stony rock land consists of small granite outcrops, very shallow soils (less than 25 cm deep) overlying gravel, and deep stony soils (greater than 90 cm deep); the terrain is hilly and steep (8 to 12% slope). Granite cobbly land consists of deep soils containing from 25 to 70 percent cobbles interspersed among loam and clay

loam soil material; the terrain is rolling to steep. Rock land is 90 percent Granite rock outcrops interspersed in shallow to deep stony soils; the terrain is gently sloping (1 to 3% slope) to moderately steep (5 to 8% slope). Granite outcrop is barren mountain peaks with more than 90% exposed bedrock.

Tarrant-Limestone Cobbly Land Association (TLC):

The TLC association occupies the northwest one-fourth of the watershed area encompassing land in all three counties. The association is 64 percent Tarrant-Rock outcrop and 35 percent Limestone cobbly land. Tarrant-Rock outcrop consists of 40 percent limestone outcrop. Tilted limestone strata protrude above the land surface to two feet in height. Tarrant soil lying between limestone strata is shallow to very shallow (7.62 to 30.48 cm) over bedrock; texture is silt loam. Limestone cobbly land consists of shallow to very shallow (7.62 to 50.8 cm) loam or clay loam soils extensively covered with limestone cobbles.

Foard-Tillman Association (FT):

The FT association soils lies in two areas west-northwest of the reservoir. The soils are deep clay loams with clay subsoils lying on nearly level to gently sloping terrain. Foard soils occupy broad flat upland areas. Surface soil ranges in depth from 15.24 to 40.64 cm. The subsoil is dense and compact; sodium ocupies significant proportions of the subsoil exchange complex. Tillman soils occupy gently slopes (1 to 3%) of the association and are similar to the Foard series.

Zaneis-Lawton-Lucien Association (ZLL):

The ZLL association occupies two small areas to the west and northwest of the reservoir. It consists of 41% Zaneis soils, 23% Lawton soils 21% of a Lucien complex and small areas of other soils. Zaneis soils are loamy upland soils with moderately fine textured subsoils; they lie on gentle slopes. Lawton soils are deep loamy soils that formed on granitic outwash from the Wichita Mountains; they occur on gentle to moderate slopes (1 to 5%). Lucien soils are shallow sandy loams forming on fine-grained sandstone; they occur on 5 to 12 percent slopes.

Port-Zavala-Lela Association (PZL):

The PZL association lies in a band north of the reservoir, along the course of and on the flood plain of Canyon Creek. Port dominates the complex (83%) with extremely small areas of Lela and Miller (1% each). The remaining area is Broken Alluvial land. Port soils are deep loams and clay loams with some evidence of stratification. Miller soils are clays with recent alluvial accumulations; Lela soils lie on the poorly drained alluvial sites; they are clays. All soils of the association are subject to flooding; erosion of cultivated areas occurs unless the soils are protected from overhead water. They lie on nearly level lands.

SOIL LOSSES

Soil loss was calculated using the Universal Soil Loss Equation, i.e.,

$$A = K\ R\ L\ S\ C\ P$$

where

A = soil lost from a plot of land in tons per acre per year

K = soil erodability factor (Table 2.1)

R = rainfall factor (assumed to be 200 for northern Comanche and southwest Caddo and southeast Kiowa Counties)

L = slope length assumed to be 122 meters

S = slope gradient (Table 2.1)

C = vegetative cover

P = not applicable to rangelands

Total soil loss from lands in the Lawtonka watershed were estimated to range from about 16,329,600 kilograms per year to 225,892,800 kilograms per year (Table 2.2). It must be recognized that broad generalizations concerning average slopes and slope length were made. However, the major factor influencing erosion is percent of the ground covered by vegetation. This factor is a variable from year to year. At the present, following several very favorable years, the cover is probably in the 95 perecent range. However, if several unfavorable (low rainfall) years are encountered and the privately held rangelands are overgrazed, the 80 percent cover value might be approached and erosion on the

Table 2.1. Acreage subject to erosion in the Lawtonka Reservoir watershed.

SOIL ID	SLOPE	K	HECTARES
Stony Rock	10%	0.32	6,210
Granite Cobbly	10%	0.32	2,800
Rock	10%	0.32	255
Tarrant	10%	0.28	1,528
Limestone Cobbly	10%	0.32	2,149
Foard	1%	0.49	1,433
Tillman	2%	0.37	1,433
Zaneis	2%	0.37	783
Lawton	3%	0.37	440
Lucien Complex	8%	0.32	401
Port	1%	0.35	793
Zavala, Lela, Broken Alluvial Land	1%	0.37	162
		TOTAL ERODABLE LAND	18,387

Table 2.2. Estimated annual soil losses assuming variable vegetative cover.

SOIL	+95% COVER (In Thousands of kg)	80% COVER (In Thousands of kg)	60% COVER (In Thousands of kg)
Stony Rock land	7,377	31,734	102,578
Granite Cobbly land	3,327	14,313	46,266
Rock land	303	1,305	4,218
Tarrant	1,576	6,815	22,056
Limestone Cobbly land	2,552	10,981	35,497
Foard	192	803	2,633
Tillman	225	963	3,082
Zaneis	122	527	1,685
Lawton	99	414	1,350
Lucien Complex	342	1,483	4,782
Port	71	320	1,049
Zavala, Lela Broken Alluvial	15	69	226
TOTAL	16,200	69,728	225,420

watershed might increase dramatically. These cyclical wet and dry patterns are characteristic of the weather experienced in the area. The equation does not account for man's non-agricultural activities in the area. Residental development on the watershed and particularly near the reservoir probably result in significant erosion activity.

Public Access and Transportation to the Lake (Task 3):

Lawtonka Reservoir is accessible along its east side via State Highway 58. The south side is accessible by a road maintained by the City of Lawton. The north side is accessible from County section line roads. The west side is inaccessible by vehicle and shares a boundary with the Wichita Mountains Wildlife Refuge.

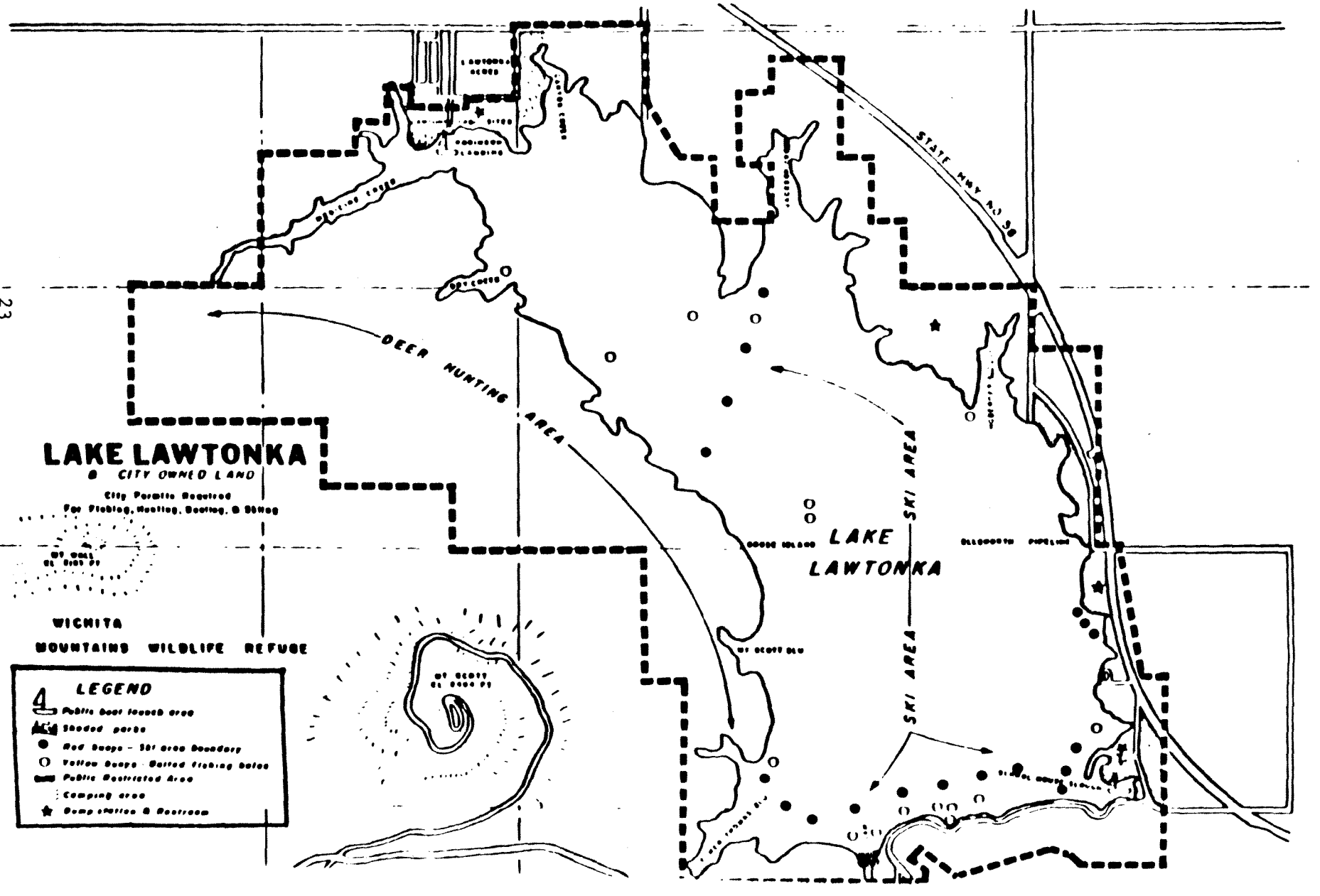
Lawtonka Reservoir was originally constructed on Medicine Creek as a municipal water source in 1905. While the primary purpose of the lake is to act as a source of potable water, the City does encourage limited types of recreation on the lake.

There are five areas at Lawtonka Reservoir where recreation is encouraged (Figure 3.1). At Robinson's Landing at the north end of the lake, a variety of recreational opportunities have been provided. The major items are as follows:

Private: a small commercial grocery store
boathouses

Public: 4 shelters
1 restroom
4 grills
1 softball backstop

Figure 3.1 Major public flows to Lawtonka Reservoir



At Canyon Creek Park are five swing sets and six grills. New campgrounds were constructed in 1977 and 1978 which consisted of 27 picnic shelters and two restrooms. The east campground (near Hoberger Slough) has 13 picnic shelters with potable drinking water in the area and a restroom with a dump station for camper trailers. The north campground has 13 shelters with potable drinking water in the area and a restroom. These camping areas have an excellent view of Mount Scott (Figure 3.1). The Ellsworth Pipeline camping area has 14 shelters. The shelters at the Hoberger Slough and Ellsworth Pipeline camping grounds are all new and have electricity with potable water and grills nearby. At the School House Slough are the following:

4 swing sets

5 shelters

8 grills

The roads linking State Highway 58 to these recreation areas are dirt or oil and chip. The City of Lawton does provide for police and safety at the lake by employing lake rangers.

Currently, there is no public transportation agency providing service to Lawtonka Reservoir. The private intrastate carrier (Oklahoma Transportation Corporation) also bypasses Lawtonka Reservoir. The Great Plains Improvement Foundation (GPIF), a community action agency, does provide transportation services from Medicine Park (a town at the base of the Lawtonka Reservoir Dam) to destinations within the County, primarily Lawton, with a 15 passenger van. This is, however, a social service

agency, not a recreational transportation vendor. This service is available only to GPIF clients, not the general public.

Permits are sold by the City of Lawton to the public for use of Lawtonka and other city-owned lakes. Revenues collected from permit sales are used for maintenance, clean-up, and improvements of the city-owned lake property to be used by the public for recreation. In addition, spaces are rented at School House Slough for boat storage.

During 1981 permits in 15 recreational areas brought $130,932 of revenue. Permits range from $1 for a daily hunt and fish permit to $23 for an annual boat and ski permit. The total number of permits sold was 35,748. Since several of these permits allow multiple use or multiple members of the family to use the permits, the exact number of recreation use trips to the lake cannot be determined.

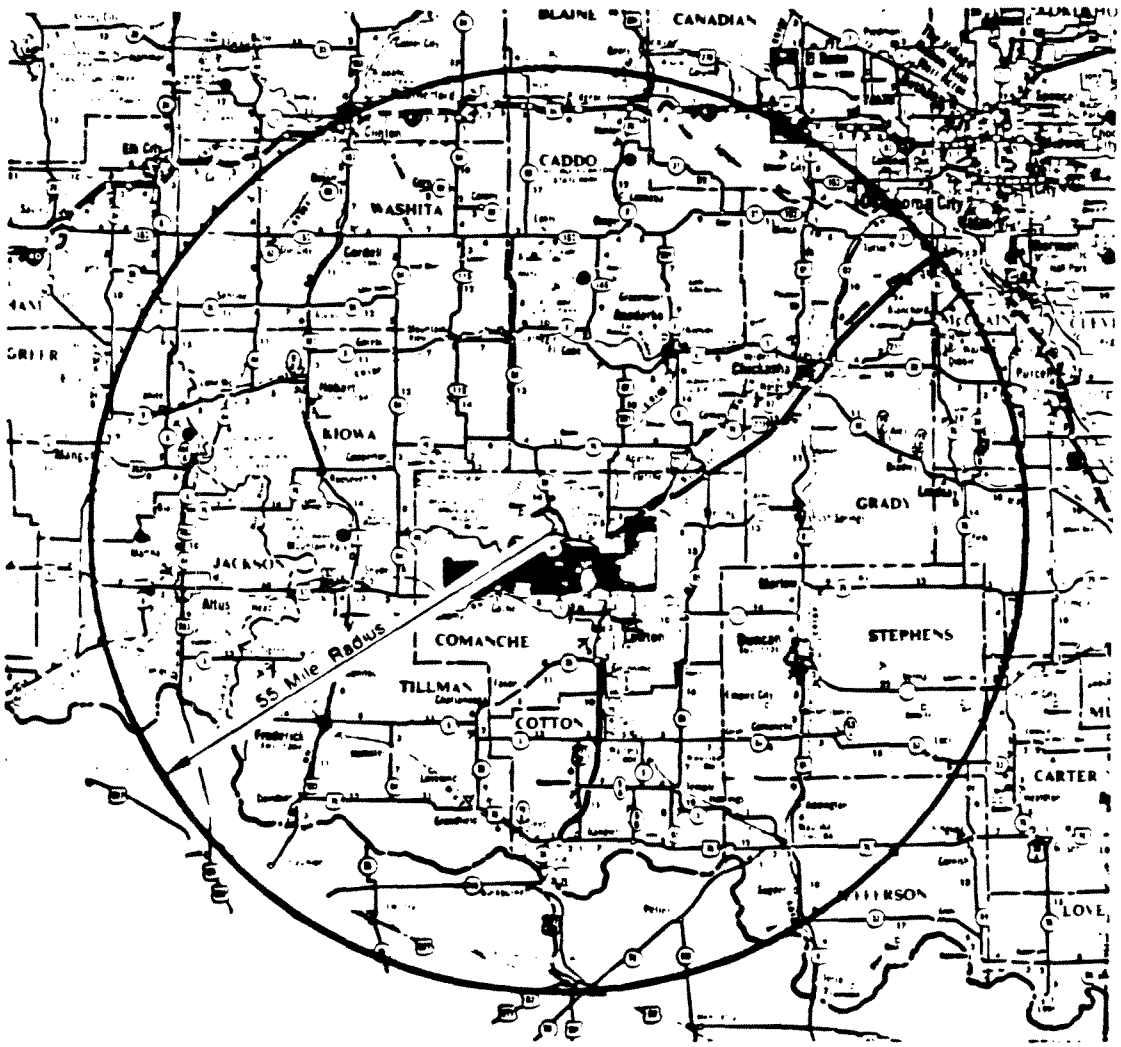
Adjacent Population (Task 4):

Lawtonka Reservoir is located in southwest Oklahoma and within 143 kilometers of six significantly large communities and three military bases. These include Lawton, Duncan, Chickasha, Anadarko, Altus, Wichita Falls, Fort Sill Army Military Reservation, and Altus Air Force Base in Oklahoma; and Shepard Air Force Base in Texas (map attached). The total 1980 population of the area contained within the 55 mile radius (Figure 4.1) was 419,000 (295,000 in Oklahoma and 124,000 in Texas). The previously listed cities and military bases account for 62 percent of the area's total population. Due to Interstate 44 linking Oklahoma City and Texas, which passes near Lawtonka, and the proximity of Wichita Mountains Wildlife Refuge, a large population will probably utilize the lake and the associated facilities.

The reported income from the area population is relatively low due to the large proportion of government sector employment. The average per capita income for the area in 1980 was $6,320 or 52 percent of the State of Oklahoma's $12,054.

It is recognized that different age groups use outdoor recreation differently (i.e., according to their interests, career and family life stages, abilities to drive or afford equipment). Therefore, the following age groups of the population estimated within 55 miles of Lawtonka Reservoir are given to guide the planners in addressing the types of recreation which most probably will have a large user group.

Figure 4.1 Area within 55 mile (88 kilometer) radius of Lawtonka Reservoir, Comanche County, Oklahoma



0 - 5 years	8.4%	35,196
5 -17 years	21.2%	88,828
18 - 64 years	58.3%	244,277
65+ years	12.1%	50,699
		419,000

Historical Lake Uses (Task 5):

The City of Lawton was settled in 1901 as the result of a Federal Government land sale in southwest Oklahoma Territory. Water was originally brought to town in water wagons from Cache Creek. In 1904, this system was improved with the construction of two reservoirs. These reservoirs served the city until 1905 when the summer drought caused the city to look for another water supply. The City Engineer, John D. Kennard, recommended a dam be built on Medicine Creek. This 5 meter dam was the first Lawtonka Dam. The dam, pipeline, and right-of-way cost the city $177,865 of which $60,000 were federal government funds from the lot sale.

This increased supply also proved insufficient and in 1909 the dam was raised 7 meters to an overall height of 15 meters. By 1917 because of the military buildup of Fort Sill during World War I, the water supply again proved to be insufficient. The City of Lawton passed a bond issue to raise the Lawtonka Dam 3 meters and add a 24 inch main to carry the increased water to Fort Sill. A graduated 16 inch and 14 inch main was built to Lawton. In 1919 the dam was 16 meters wide at the base, 5.5 meters through the central section, 3.0 meters wide at the top, 114 meters in length, and 30.5 meters high. The lake held more than 37 million cubic meters of water covering 570 hectares to an average depth of 5.5 meters.

By the middle 30's, the growth of Lawton caused water shortage to become a problem again. At the January 4, 1938 meeting of the Lawton City

Council, a resolution was passed authorizing the release of funds for WPA Project 65-65-761 to raise the height of Lawtonka 3 meters. Completion of this project brought the height of Lawtonka Dam to 21 meters.

Again in the 50's, the pressures of an expanding population required an improvement to Lawtonka. A $430,000 project was completed adding 3 meter gates to the top of Lawtonka. This was the final improvement which brought the height of the dam to 24.5 meters with the gates closed.

Lake Lawtonka today is a multi-use asset for southwest Oklahoma. It has been a municipal responsibility since its initial construction and, as a water supply, continues today as a major part of the public health services of the City of Lawton. To support this asset the city employs a work force to provide police and maintenance services to the lake.

Lake personnel consists of a Lake Supervisor, three Lake Rangers, one Laborer II, Part-time Clerk, Part-time Laborer I, and two CETA employees. The Lake Rangers' job consists of public safety, law enforcement and lake maintenance. The part-time clerk works in the office with the other personnel, doing lake maintenance which consists of cleaning restrooms, hauling trash, mowing grass, cleaning picnic and recreational areas, and general lake maintenance.

Lake recreation consists of fishing, boating, water skiing, hunting, sail boating, and hiking. Fees are charged for most of these activities to help compensate for the cost of law enforcement and lake maintenance.

In 1974 a fish stocking program was initiated to help increase revenue in fishing permits. Over 60 percent of the lake revenue comes from fishing permits. From 1974 to 1980, 250,000 catfish, 40,000 hybrid bass, and 1,600,000 walleye have been stocked in the lake.

There are two concessions on the lake. School House Slough is located on the southeast corner, and Robinson's Landing is located on the north end of the lake on Medicine Creek.

Since long before Statehood, the area along Medicine Creek and its tributaries (particularly the area lying south and east of the land mass uplift known as Mt. Scott) was considered to be one of the most beautiful recreational areas in the southwest. In 1908 Elmer Thomas (later United States Senator) and Hal Lloyd sold the Lawtonka Dam site and inundated land to the City of Lawton for $4,000. Thomas then opened up a resort at the base of the dam on July 4, 1908. The area became the favorite "watering place" of the State of Oklahoma. Senator Thomas sold the park in 1926. During his ownership he noted that the park "grossed between two and three million dollars from all park operations." Activities included boat rides to Sheridan Lodge and Cottages at the north end of the lake (now under water). During this period of time, many wealthy Oklahomans had their summer homes in the area and some came to live permanently.

The Senator formed the Medicine Park Corporation, provided for a platting of the area, built numerous buildings, both commercial and residential, and built his own home in the heart of the area. In general, this

activity was responsible for the original growth of the area into a rather self-contained community. There were two large hotels, a skating rink, many homes and rental units, and probably, for its time, the best and most picturesque swimming pool in this part of the United States. Along with this development came a post office, a church, grocery stores, general merchandise stores, curio shops, and, with time, filling stations, several cafes and restaurants and many other business and entertainment facilities to serve the public. Probably the most important development for the citizens of the community was the construction of a school house and later expansion. Senator Thomas contributed considerably of his own resources toward the building and development of the school.

All of this growth and development flowered during the early part of the twentieth century. One hotel burned but the area thrived, generally speaking, through the World War II period. Thereafter, primarily because of the lack of proper sanitary facilities, the area became somewhat blighted. The swimming pool was closed and the area began to deteriorate. People moved away; their properties, in many instances, were abandoned and fell into disrepair.

Effect of Degradation on the Lake User Population (Task 6):

Although water quality of Lawtonka Reservoir may have deteriorated during the past decade, recreational use of the lake has increased. Principle recreational activities include: fishing, hunting, boating, water skiing, camping, and picnicing. Swimming is not allowed in the lake.

Population figures for Comanche County show 108,144 people in 1970 and 112,456 persons in 1980, an increase of 4,312 for the 10 year period. During the period from 1972 to 1975, a very small increase in recreational use of Lake Lawtonka was noted. No improvements in recreational facilities at the lake were made during this time. The period, 1975 to 1979, was one of a large increase in recreational use of the lake. Factors accounting for this increase may have been the construction of 27 picnic shelters and two public restrooms. Also during this time the price of gasoline increased greatly. This increase in the cost of transportation may have caused some people to use recreational facilities close to home rather than travel to other sites. Without this increase of gasoline, The local population could have contributed a number of people toward the recreational use of Lawtonka Reservoir during this period. Lake usage leveled off in 1979 and has shown little increase (3 to 5%) since that time.

One activity which did not follow the general pattern of lake use was camping. Camping at Lawtonka Reservoir almost doubled in 1982 over 1981. This increase is attributed to an influx of oil field workers to the area during the "Oil Boom." These workers had difficulty finding

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accomodations in surrounding towns and often camped in recreational areas. Oil and gas exploration has decreased dramatically over the past several months and many workers have now moved to other areas.

No particular group of people were identified during this study as being more affected by changes in water quality of Lawtonka Reservoir than any other segment of the population.

Comparative Lake Use (Task 7):

LAKE LAWTONKA

Lawtonka's shoreline exhibits extreme contrasts in relation to human use. Inaccessibility of the western shore by foot or car has helped preserve the western shore and adjacent city property as habitat for a variety of wildlife species. By contrast, the eastern shoreline has been highly developed and highly impacted by a variety of recreational activities. Lawtonka's geographical location, close to the major population center of Lawton, encourages summer recreational use on a daily basis in all water sports except swimming. Swimming is prohibited in both of Lawton's municipal lakes. City lake permits are required for fishing, boating, trot lines, and boat houses. Records are kept of the numbers of permits sold on a yearly and daily basis. These records give some indication of use, however, several types of annual permits are valid for use on both Lake Lawtonka and Lake Ellsworth. One exception is water skiing which is permitted only on Lake Lawtonka. No records are available from the City of Lawton to verify the use of the lake by hours of use for the various recreational activities.

Fishing is the most frequent recreational activity on Lake Lawtonka, with catfish being the most sought after species. Interest in bass fishing has increased since the setting of a new state record for largemouth bass from Lake Lawtonka in the Spring of 1983. Fishing in Lake Lawtonka is not limited to the two previously mentioned species, crappie, walleye, and white bass are also popular species. Periodic stocking of catfish

and hybrid bass help maintain fish populations despite heavy fishing pressure.

Boating is the second most common form of recreational activity on Lawtonka Reservoir. Diversity of boating interests is evident by the varied craft powered by motor, sail and paddle which are present during favorable recreational conditions.

Camping is third among recreational uses on Lawtonka Reservoir. There are three camping areas subdivided into six separate camp grounds. A total of 27 shelters are provided by these facilities.

Picnicing is a popular activity at Lawtonka Reservoir. Peak activity occurs during the traditional outing times of Memorial Day, Independence Day and Labor Day.

Hunting is another major recreational activity present at Lawtonka Reservoir. City owned property on the west side of the lake provides hunters a selection of several game species. Deer, turkey, quail, dove, rabbit, squirrel and waterfowl are annually taken from the west and north shore of the lake. Hunter success ratio is relatively low. Game populations are adequate for the area, however, the large number of hunters using the area may explain the low success ratio.

LAKE ELMER THOMAS

Lake Elmer Thomas is unique in administration and also in recreational use. Although owned by the United States Government, the southern bank is used and regulated by the United States Army. The remainder of the lake is administered by the United States Fish and Wildlife Service as the property lies within the Wichita Mountains Wildlife Refuge.

The United States Army area, on the south bank, is supported by a marina with a concession operated by civil service and military personnel. The area has camp grounds, picnic areas, a boat ramp and a swimming beach. Hunting in designated areas is also a recreational activity on the Army portion of Lake Elmer Thomas.

Swimming is the main recreational attraction for the lake. This is due to a unique series of circumstances. These are: Adjacent Lawtonka Reservoir prohibits swimming. The City of Lawton's municipal swimming facilities consist of only one small pool. Lake Elmer Thomas is strategically located on a main entrance to the Wildlife Refuge.

Fishing is the second most common activity. Largemouth bass, crappie and sunfish are the most sought after species. Boating is the only other activity as picnicing and camping are prohibited on the Wildlife Refuge side of the lake.

LAKE ELLSWORTH

Lake Ellsworth was constructed as a municipal water supply for the City of Lawton. City lake permits are required for fishing, boating, camping, hunting, trot lines, boat houses and off-road vehicles. Permits for these activities are sold on both a daily and annual basis. Several categories of these permits allow use of both Lake Ellsworth and Lawtonka Reservoir, consequently, usage estimates by the number of permits sold is not valid. No records are presently maintained that quantify use of the lake in man hours for various recreational activities.

Fishing is the most popular activity. Largemouth bass is the most sought after species followed by channel catfish, crappie and walleye. Timber was left standing in much of the lake providing ideal fisheries habitat.

Boating is the second most common recreational activity on the lake. There are five boat ramps and two city owned concessions with marinas leased to private concessionaires. Boating on the lake is limited as the underwater timber discourages speed and sail boats. Water skiing is also prohibited.

Camping is popular around the lake due to the three camping units with a total of five campgrounds in these areas. Pavilions, electricity, water and sewage hook-ups are available at some locations.

Hunting is recognized as a major recreational activity around the lake. Numerous small tributaries, adjacent farm land and mixed standing timbers

in that headwaters area create ideal duck hunting habitat. Waterfowl hunting followed by quail, dove, rabbit and squirrel make up hunting activities.

A segment of city property on the south shore of the lake has been set aside for use of off-the-road recreational vehicles. This area has been received enthusiastically by users.

LAKE TOM STEED

Fishing is the most common recreational activity on the Lake Tom Steed. Walleye is the most sought after species followed by catfish, striper x white bass hybrids, crappie and largemouth bass. Both walleye and striper x white bass hybrids have been introduced to the area by the Oklahoma Department of Wildlife.

Water skiing is the second most popular recreational activity on the lake. There are two boat ramps on the lake and no marina is present. The State owns and leases a privately operated concession on the road leading to the lake.

Camping is the third most popular activity at the lake. There are four camping areas, 23 recreational vehicle hook-ups and five shelter pavilions for groups.

Hunting is recognized as a recreational activity at the lake. Limited areas for public hunting plus considerable pressure produce a marginal

quality of hunting at Tom Steed. Game that is hunted includes quail, deer, dove and waterfowl.

LAKE FORT COBB

Lake Fort Cobb offers considerable diversity in recreational activities. Fishing is the most common recreational activity. Largemouth bass is the most sought after species followed by crappie, white bass, channel catfish and walleye.

Water skiing is the second most common activity followed by boating, camping, golf and hunting. A nine hole golf course, complete with club house provides additional recreational opportunity for the lake users.

Fort Cobb Lake and adjacent public hunting areas afford quality hunting opportunities. Crow hunting at Fort Cobb Lake, reported to be the best in North America, attracts hunters from many states and some foreign countries. A section of Fort Cobb Lake is designated as a waterfowl refuge during the winter months. Quail, deer, rabbit, dove and squirrel are also hunted on public hunting areas adjacent to the lake.

LAKE WAURIKA

Fishing is the most popular recreational activity on Waurika Lake. Channel catfish is the most sought after species. Crappie, largemouth bass, striped x white bass hybrids and walleye are the next most popular species in order of listing.

Camping is the second most popular activity at the lake. There are eight parks located at the lake. Following camping, boating ranks third among recreational activities on Waurika Lake. The 203,000 acre feet of water affords ample space for all forms of boating activity.

Hunter participation at Waurika is greater than at many other area lakes. The most sought species are quail, rabbit, dove, squirrel and waterfowl.

LAKE JED JOHNSON

Jed Johnson Lake is located in the Wichita Mountains Wildlife Refuge. The Lake is restricted to fishing and boating by hand powered means only. Fishing is the main form of recreational activity. A limited amount of boating is present on the lake.

GRAMMA LAKE

Gramma Lake is located in the Wichita Mountains Wildlife Refuge. It is located in the restricted area of the refuge, consequently, no recreation uses are available for the lake other than hunting in the area during the annual elk hunt which is conducted each Fall.

LAKE ALTUS-LUGERT

Altus-Lugert Lake is bounded by low mountains of the Quartz Mountain chain. Fishing is the most popular recreational activity on the lake. Walleye, channel catfish, largemouth and white bass were cited as the

most sought after species. Boating is second in recreational time spent followed by camping, water skiing and golf.

The facilities of Quartz Mountain Lodge and State Park offer lodging, food, primative cabins, skating, golf and horseback riding in addition to the previously mentioned recreational activities.

LAKE BURTSCHI

Fishing is the main recreational activity on Lake Burtschi. Largemouth bass, channel catfish and sunfish make up most catches. Picnicing is the only other activity of significance, although hunting is allowed at the lake.

TAYLOR LAKE

Taylor Lake is a municipal water supply for the City of Marlow. The lake also offers fishing, boating and camping as recreational opportunities. Fishing for channel catfish, crappie, and largemouth bass is the main recreational activity. Camping is second in use. The lake has a campground, 34 leased cabin or trailer lots and 18 recreational vehicle hook-ups with water and electricity. Water skiing, swimming and hunting are prohibited.

OK

FREDRICK LAKE

Recreational activities at Fredrick Lake are fishing, water skiing, camping, picnicing, hunting and arrowhead collecting. Fishing for channel catfish, walleye, crappie and white bass is the most frequent recreational activity. Water skiing is the second most common activity. Boating activities are supported by two boat ramps. Camping is facilitated by ten campsites and a picnic area for day use. Hunting is limited to quail, dove and waterfowl. Waterfowl hunting produces the best success at the lake.

OK

CLEAR CREEK LAKE

Clear Creek Lake is a municipal water supply for the City of Duncan. The water from Clear Creek is used for industrial purposes. This allows more recreational activities than many other municipal water supplies. Consequently, recreational activities are fishing, water skiing, camping, swimming, hunting and picnicing. Swimming is allowed in designated areas which include an improved swimming beach. Hunting is restricted to quail and waterfowl.

OK

LAKE HUMPHRIES

Lake Humphries is a municipal water supply for the City of Duncan. Recreational activities are limited to fishing, camping and hunting for quail and waterfowl.

ok

LAKE FUQUA

Lake Fuqua is a municipal water supply for the City of Duncan. Recreational activities are limited to fishing, camping and hunting for quail and waterfowl.

Quanah Parker Lake

Known Point Sources of Pollution (Task 8):

INTRODUCTION

Potential industrial and municipal point source discharges occurring within the Lawtonka Reservoir watershed have been inventoried. Sources from two additional watershed areas have also been inventoried because of their possible contributions to Lawtonka's nutrient input.

Lawtonka Reservoir, located on Medicine Creek, a tributary of Cache Creek, is located in Sections 6, 7 and 18, Township 3N, Range 12WIM, Section 1, Township 3N, Range 13WIM, and Section 26, Township 4N, Range 13WIM, Comanche County, Oklahoma. The Wichita Mountains Wildlife Refuge borders the west side of Lawtonka Reservoir and covers the majority of its watershed area. The refuge is maintained by the U.S. Department of the Interior Fish and Wildlife Service and is restricted in discharges that may come from the refuge by Federal regulations. Lawtonka Reservoir is connected by pipeline to Lake Ellsworth, located approximately eight miles northeast of Lawtonka Reservoir. Water is pumped into the lake to maintain a sufficient pool for water supply. Lake Elmer Thomas overflows into Lawtonka Reservoir through two five-foot diameter pipes in its lower spillway to provide additional water (NDSP/OSDP, 1983).

Industrial Point Sources

Industrial inventory in the State of Oklahoma is based on state and federal permits. The Oklahoma Water Resources Board (OWRB) is

responsible for issuing state industrial waste disposal permits. National Pollutant Discharge Elimination System (NPDES) permits are issued by the U.S. Environmental Protection Agency, with OWRB performing Compliance Sampling Inspections (CSI) and Compliance Evaluation Inspections (CEI) on designated industries with NPDES permits. A computerized data base of information concerning existing permits, along with the Section 208 Areawide Waste Treatment Basin Management Plan (Oklahoma Department of Pollution Control, revised 1982) were used to determine industrial point source discharges that may be occurring within the tri-reservoir area. A review of the NPDES and State permits revealed that no industries are authorized to discharge into these three watersheds.

Municipal Point Sources

Sewage treatment facilities in the State of Oklahoma are regulated by the Oklahoma State Department of Health through construction permits, NPDES permits, Compliance Monitoring Inspection reports, facility plans and basic inventories. Along with these records, the Section 208 Waste Treatment Basin Management Plan (Ibid) were used to obtain information for this report.

The two sewage treatment facilities which exist in the Lake Ellsworth watershed are the Town of Apache, Caddo County, and the Town of Fletcher, Comanche County. No other treatment facilities are known to be in either the Lawtonka Reservoir or Lake Elmer Thomas watersheds. Information pertaining to each facility is provided.

Town of Apache Treatment Facility:

NPDES Number: OK0022721

Location: NE¼, NE¼, SW¼, Section 21, Township 5N, Range 11WIM, Caddo County.

Present Population (1981): 1,600

Designated Management Agency (DMA): City of Apache and/or Apache Power and Water Authority.

Current Treatment Process: Lagoon

Present Average Daily Flow (MGD): 0.14

Design Average Daily Flow (MGD): 0.18

Wasteload Allocation: Secondary treatment

Receiving Stream: East Cache Creek

Stream Class: Intermittent

7 Day 2 Year Low Flow (MGD): 0.0

The Apache sewage treatment facility originally consisted of a 2-cell lagoon system with an overflow basin. In 1981, the City of Lawton became aware that a complete bypass was occurring and that the plant was exceeding its design capacity. A construction grant, Step 1, was applied for in 1976 by the town of Apache but the Design and Construction Phase did not take place until around 1980. Oklahoma State Department of Health (OSDH) records show that actual construction on the facility began August 12, 1982. The construction grant will find a facility for land application to farmland as a treatment alternative to the present lagoon system.

Town of Fletcher Treatment Facility:

NPDES Number: OK0032395

Location: SW¼, SW¼, SW¼, Section 16, Township 4N, Range 10WIM, Comanche County.

Present Population (1981): 1,050

DMA: Town of Fletcher

Current Treatment Process: Total retention lagoon.

Prior to 1981, the Fletcher sewage treatment facility was a 4-cell lagoon system resulting in secondary treatment. The average daily flow was 0.10 MGD with a design average daily flow of 0.15 MGD which was discharged to a tributary to Tony Creek, an intermittent stream to Lake Ellsworth.

Problems surfaced when the fourth lagoon began filling with stormwater and sanitary sewage, causing the system to approach overflowing. In January of 1981, this facility was converted to a total retention lagoon system and is using the sewage lagoon effluent for irrigation as a land application treatment alternative.

No known industries discharge within these watersheds. Of the municipal point sources, two sewage treatment facilities are located in the Lake Ellsworth watershed. The recommended course of action for both sewage treatment facilities is outlined in the Section 208 Areawide Waste Treatment Basin Management Plan and involves completion of the Construction Grants Program. The Town of Apache has pursued this and

began construction in August 1983. The Town of Fletcher has eased the load on its facility by using land application.

At the present time the watersheds for Lake Ellsworth, Lawtonka Reservoir, and Lake Elmer Thomas appear to be free of point source discharge.

SECTION VI

LAND USE AND NONPOINT POLLUTANTS (TASK 9):

Land Use

The primary land uses in the Lawtonka Reservoir watershed consists of range/pasture, forest, and cropland which comprise an estimated 18,994; 3,088; and 602 acres, respectively (Table 9.1). Together these three types of land covers comprise 227 square kilometers or 93.4% of the total estimated watershed area of 243 square kilometers. Additionally, a significant portion of the Witchita Wildlife Refuge lies within the Lawtonka Reservoir watershed.

The source of these data were June 1979 LANDSAT images from which the various classes of land cover were delineated planimetrically. The extent of the Lawtonka Reservior watershed boundary was graphically determined from topographic maps (USGS, 7.5 min. Series) and superimposed upon LANDSAT images in order to define the area analyzed for land cover.

Recent aerial photography (since the acquisition of the LANDSAT images) has revealed that undeveloped land within the watershed has been replaced by agricultural operations and housing developments. Consequently, estimates of the areal extent of cropland may be considered conservative.

Table 9.1. Land usage in the Lawtonka Reservoir watershed.

Class of Land Cover	Number of Hectares	Percent
Recently Tilled Croplands	602	2.5
Range & Pastureland	18,994	80.4
Forest	3,089	13.1
Water	938	4.0
TOTAL	23,623	100

Nonpoint Source Pollutants

Some of the more important types of nonpoint source pollutants that were identified in the Lawtonka Reservoir watershed consisted of surface runoff, primarily from agricultural pursuits, such as crops and cattle operations. Farming activities are scattered throughout the watershed and are not as extensive as agricultural activities in the nearby Ellsworth Reservoir watershed (Table 9.2). The presence of cattle ranging in shaded, dry stream bed regions during the summer months were visually observed and probably contribute to nutrient loading following first flush.

The County of Comanche has no enforceable regulations established to prevent cattle from ranging in and about the tributaries of Lawtonka Reservoir. Wild and feral ungulates (e.g., bison, longhorn cattle, elk, pronghorn antelope; Task 11) of the Wichita Wildlife Refuge also contribute to the nutrient loading into the watershed although the extent of this contribution is not known.

A statistical analysis of longitudinal water chemistry data (Table 9.3) of the major tributaries of the Lawtonka Reservoir watershed revealed a number of significant and nearly significant differences in water quality. Some of these differences lend support to the supposition that natural and anthropogenic influences in water quality were differentially distributed in the watershed.

Table 9.2. Extent of recently tilled croplands in the Ellsworth Reservoir watershed.

Class of Land Cover	Number of Hectares	Percent of Total Watershed
Croplands	5,100	8.7

Because Medicine Creek is the major tributary defining the nature of the largest portion of the Lawtonka Reservoir watershed (46.2%), water quality data from certain other tributaries/watersheds were compared with it. Only five tributary sampling sites provided sufficient data to do an adequate statistical analysis (Wilcoxon nonparametric signed rank test, Table 9.3). These five tributaries were associated with subwatersheds that accounted for 73.5% of the total watershed.

Site 4 - Jackson Creek:

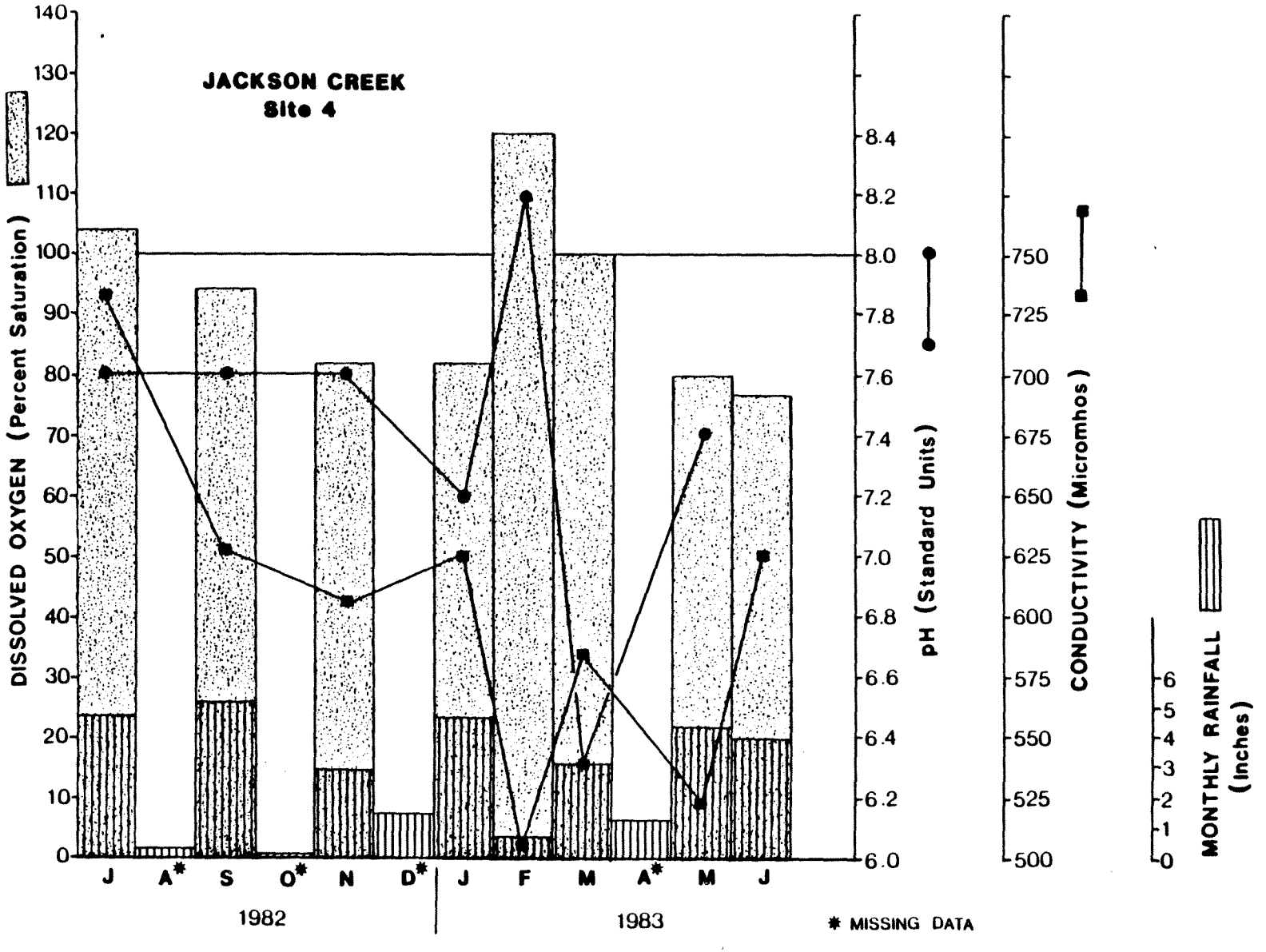
The water temperature of Jackson Creek was significantly lower than the water temperature in Medicine Creek ($p < .05$). This was probably due to the shaded nature of Jackson Creek.

The conductivity of Jackson Creek water was significantly higher than that of Medicine Creek ($p < .02$). This elevated conductivity was probably the result of groundwater contribution (rather than nutrient loading) as the annual loading yield for nutrients (which could also raise the conductivity) was not significantly different than that for Medicine Creek (Figure 9.1a and Table 9.4).

Site 5 - Canyon Creek:

Water temperature, dissolved oxygen and pH were significantly lower and conductivity was significantly higher in Canyon Creek compared to Medicine Creek ($p < .05$, $p < .02$, and $p < .05$, respectively). Based on this data and the data in Figure 9.1b, Canyon Creek flow is largely due

Figure 9.1a Temporal variability of pH, dissolved oxygen, conductivity and rainfall for sample site 4 (July 1982-June 1983)



and rainfall for sample site 5 (July 1982-June 1983)

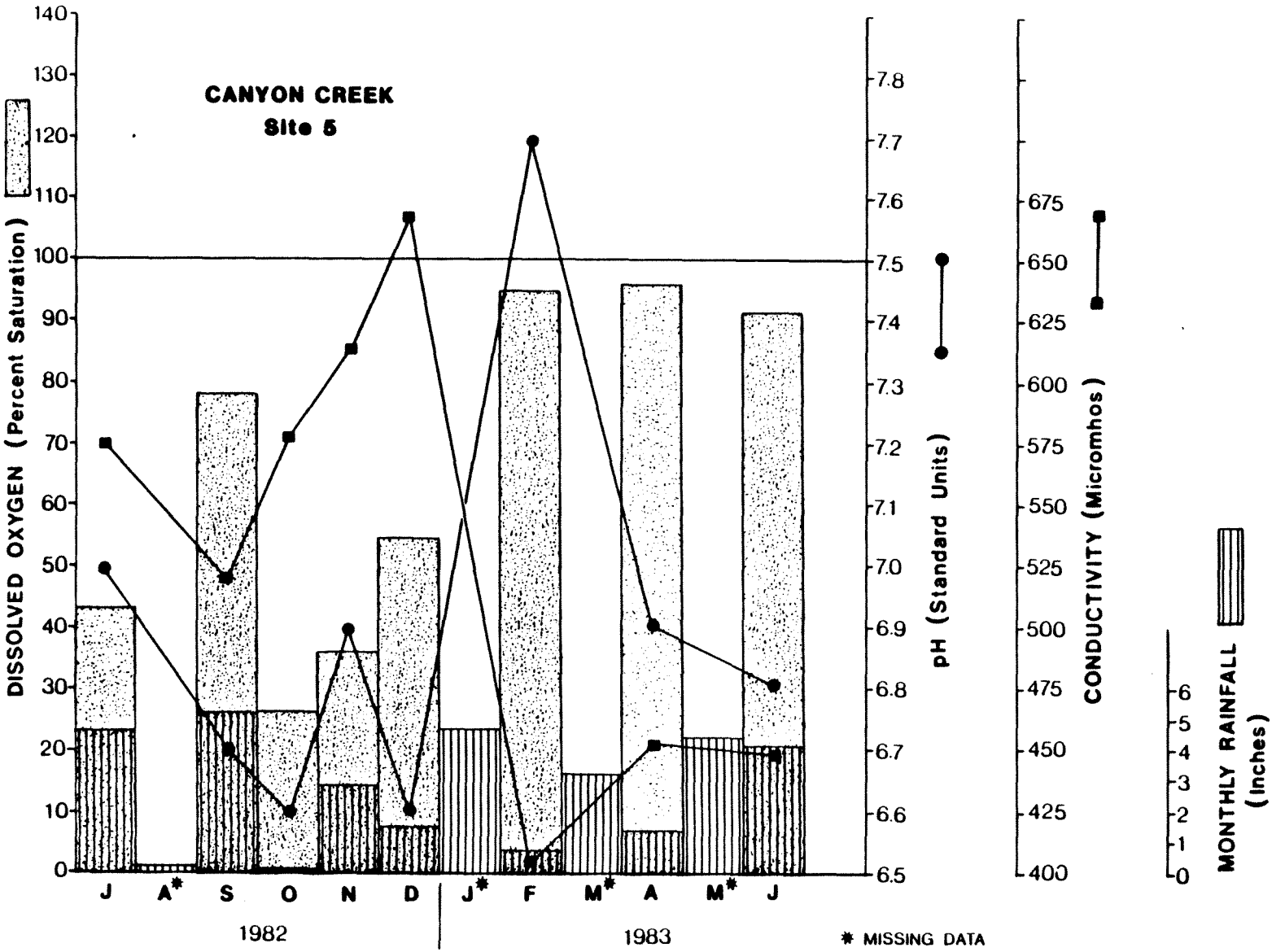


Table 9.3. Wilcoxon nonparametric signed rank test of differences between paired tributary sites.

PAIRED SITES	TEMPERATURE	DISSOLVED OXYGEN	pH	CONDUCTIVITY	TOTAL NITROGEN	TOTAL PHOSPHORUS
Jackson Creek vs Medicine Creek	Jackson lower 0.05*	N.S.	N.S.	Jackson higher 0.02*	I.D.	I.D. B.D.L.
Canyon Creek vs Medicine Creek	Canyon cooler 0.05*	Canyon lower 0.05*	Canyon lower 0.02*	Canyon higher 0.05*	I.D.	I.D. B.D.L.
Jimmy Creek vs Medicine Creek	N.S.	N.S.	Jimmy lower 0.01*	N.S.	Jimmy higher 0.10	I.D. B.D.L.
Site 7 vs Medicine Creek	N.S.	N.S.	Site 7 lower 0.05*	Site 7 higher 0.05*	Site 7 higher 0.10	I.D. B.D.L.

I.D. = insufficient data
B.D.L. = below detection limit
* = significantly different
N.S. = not significant

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Table 9.4. The annual loading yield for nutrients in the Lawtonka Reservoir subwatersheds.

Tributary/Subwatershed	% of Entire Watershed	Annual Loading Yield in kg per Hectare of Watershed	
		Total Phosphorus	Total Nitrates (Nitrate & Kjeldahl)
Jackson Creek - Site 4	3.7	0.20	0.67
Canyon Creek - Site 5	11.1	0.15	0.57
Jimmy Creek - Site 6	11.7	0.15	0.77
Site 7	0.8	1.98	1.53
Medicine Creek - Site 8	46.2	0.17	0.67

to groundwater and during the dry summer can be exclusively due to groundwater. Table 9.4 confirms that the loading yield from nutrients is the lowest for any tributary/watershed thereby supporting the groundwater contribution hypothesis.

Site 6 - Jimmy Creek:

Total Nitrogen concentrations were nearly significantly higher ($p < .1$) and the pH was significantly lower ($p < .01$) in Jimmy Creek when compared to water in Medicine Creek (Figure 9.1c). Additional data support the notion that tributary flow is a combination of surface runoff and groundwater (Tables 9.3 and 9.4).

Site 7:

This unnamed tributary is only fed by a small area of the Lawtonka Reservoir watershed (1.94 square kilometers). Although the concentration of Total Nitrogen in Site 7 water was only nearly significantly higher ($p < .1$) than the water from Medicine Creek, the annual Total Nitrogen loading yield for that area was appreciably higher than the yield in Medicine Creek water (Figure 9.1d and Table 9.4).

The annual Total Phosphorus yield also showed a slightly elevated value (the highest of any of the sites). These higher values in nutrient loading and concentration may have been due to the presence of ungulates (cattle and horses) which were free to range near the sampling site.

Figure 9.1c Temporal variability of pH, dissolved oxygen, conductivity and rainfall for sample site 6 (July 1982-June 1983)

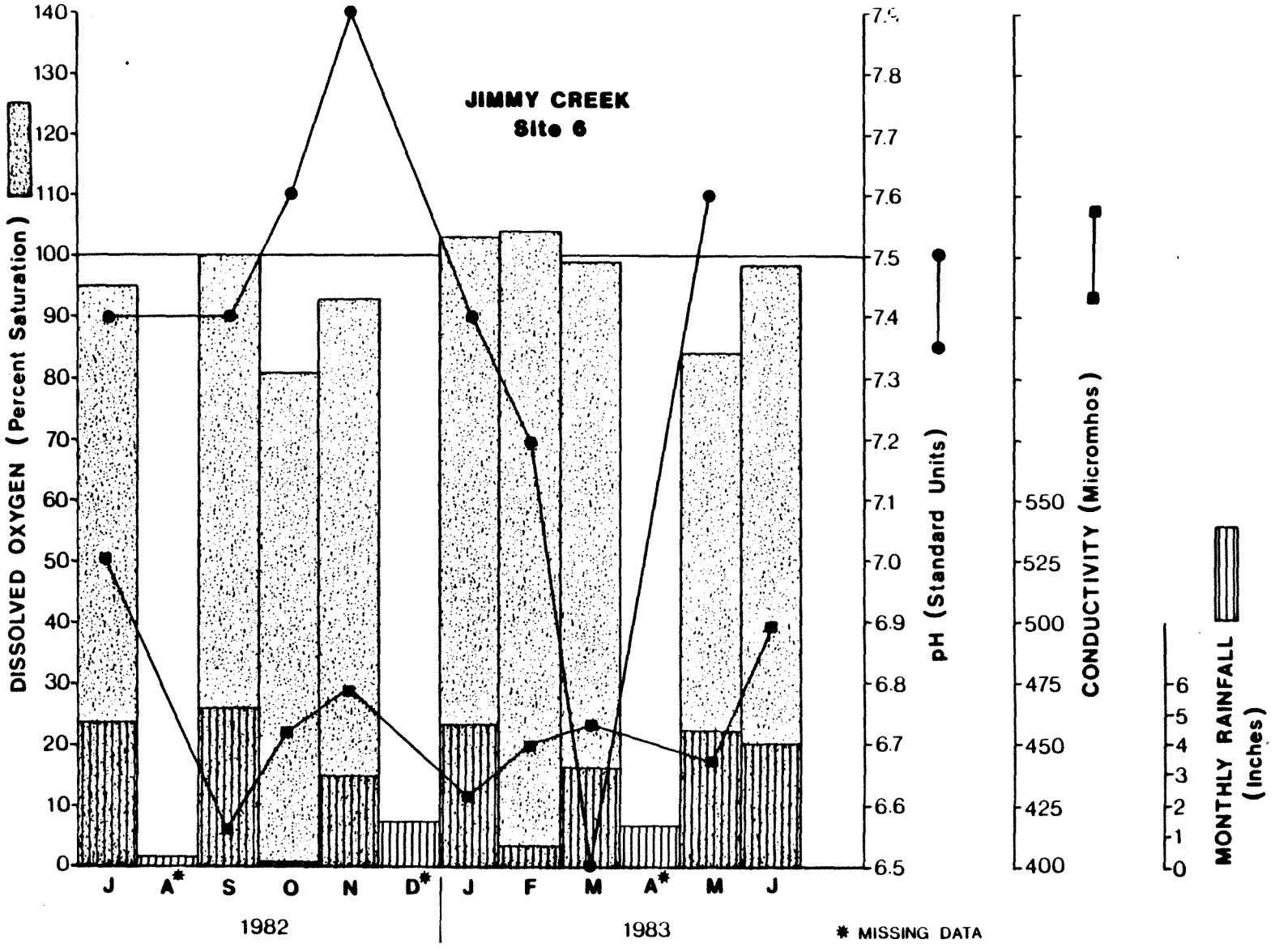
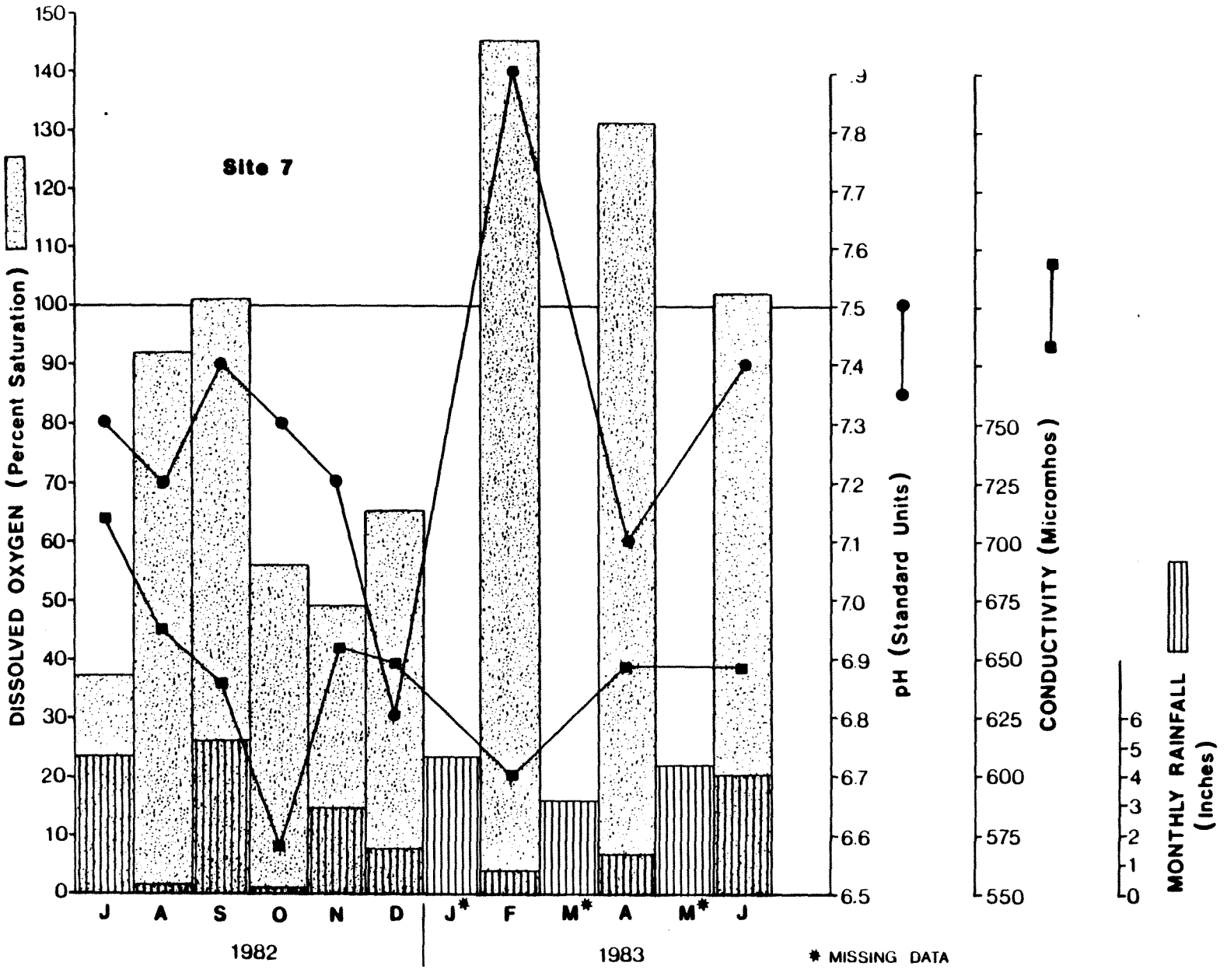


Figure 9.1d Temporal variability of pH, dissolved oxygen, conductivity and rainfall for sample site 7 (July 1982-June 1982)



Groundwater contribution to the flow at site 7 was implied from the data as conductivity of water was significantly higher ($p < .05$) and the pH was significantly lower ($p < .05$) than water of Medicine Creek (Table 9.3).

Site 8 - Medicine Creek:

Fed by the largest area of the Lawtonka Reservoir watershed, Medicine Creek had a lower mean Total Nitrogen concentration than the reservoir area near Robinson's Landing (sample site 1) but higher mean Total Nitrogen than the dam region of the reservoir (sample site 3). This may have been because Medicine Creek is composed largely of surface runoff while the reservoir area (near sample site 1) is supplied by the tributaries, some of which are composed exclusively of groundwater during portions of the year. Consequently, Medicine Creek is an appropriate baseline tributary for water quality comparisions (Figure 9.1e).

Ellsworth Reservoir Watershed and Pipeline

The intense utilization of the Ellsworth Reservoir watershed for agricultural activities has provided a significant nonpoint source of nutrient loading into Ellsworth Reservoir during stormwater runoff events. Since water from Ellsworth Reservoir is pumped into Lawtonka Reservoir when the lake level of the latter is below 1,340.5 feet MSL, nutrient analysis of Ellsworth Pipeline water is important in managing and mitigating impact of this nonpoint source of pollution. Figure 9.2

Figure 9.1e Temporal variability of pH, dissolved oxygen, conductivity and rainfall for sample site 8 (July 1982-June 1983)

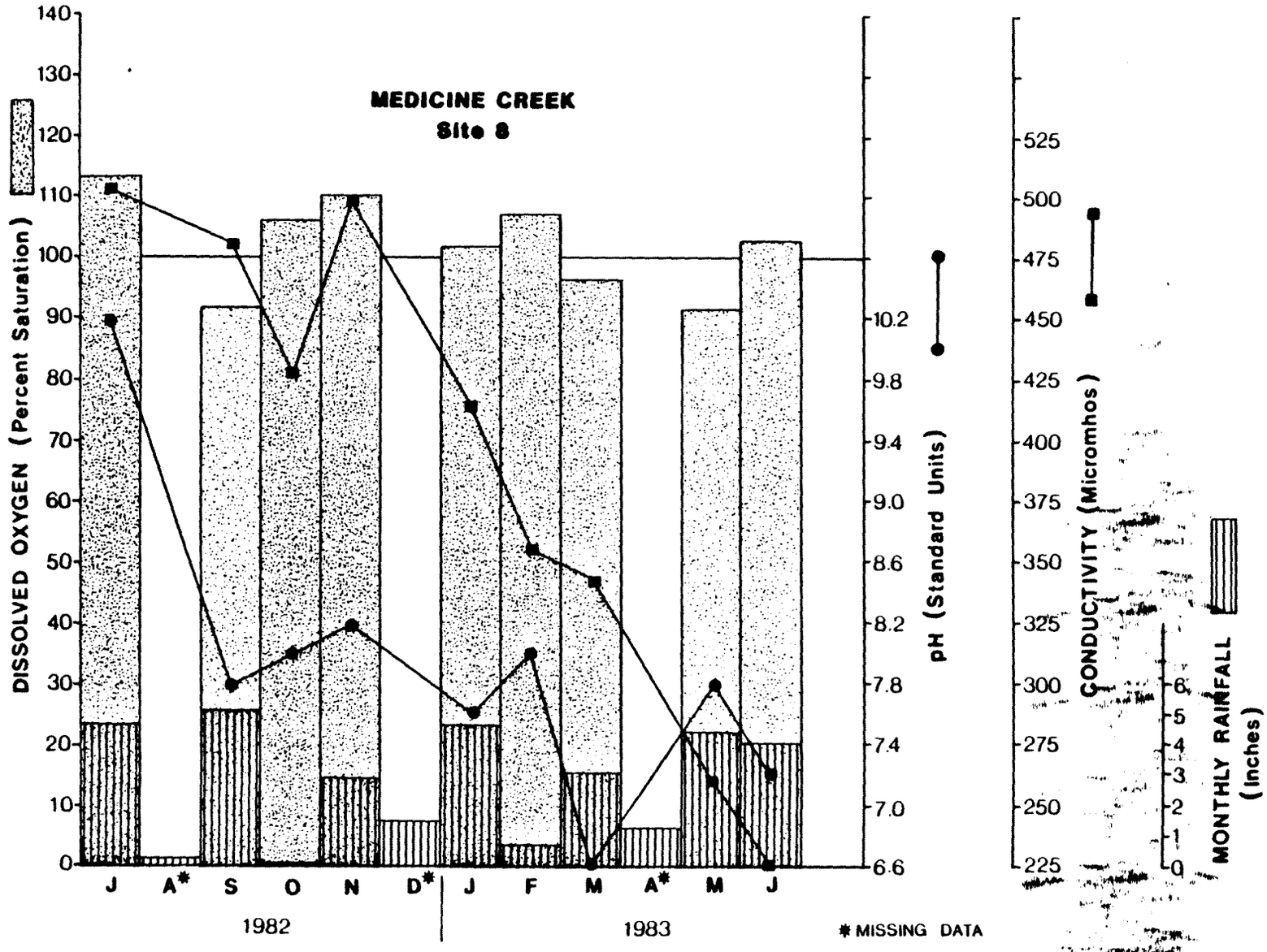
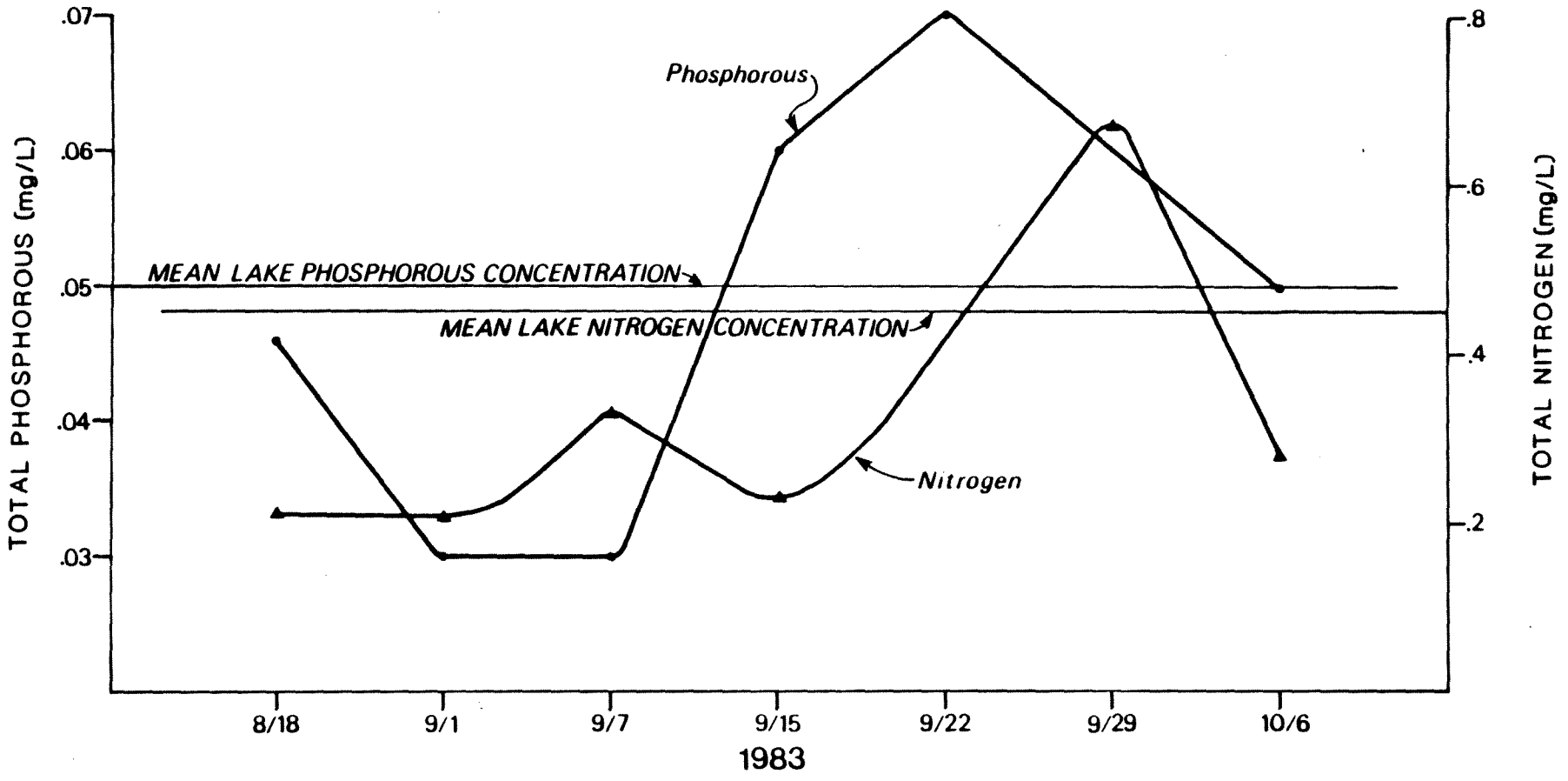


Figure 9.2 Temporal variability of nutrient concentration from Ellsworth Reservoir pipeline



illustrates the temporal distribution of nutrient concentration values of Ellsworth Pipeline water collected at the point of outflow. Intensive sampling of the Ellsworth Pipeline water from August through October, 1983 revealed a marked oscillation in Total Phosphorus concentration from Ellsworth Reservoir with values peaking at 0.07 mg/L on September 22, 1983. Total Nitrates (Nitrates and Kjeldahl Nitrogen) in the pipeline water similarly showed temporal fluctuations in concentrations ranging from 0.21 to 0.67 mg/L. For both Total Phosphorus and Total Nitrates (Nitrates and Kjeldahl), temporal fluctuations did occasionally exceed the mean lake nutrient concentration levels. When the concentration of the limiting nutrient (i.e., phosphorus) exceeds the reservoir mean concentration, stimulation of algae growth is inevitable.

School House Slough

Chlorophyll distribution:

Chlorophyll a data collected fluorometrically in School House Slough (SHS) from June 23 to October 5, 1983 were subjected to the SYMAP graphics program (Task 10 and Appendix A). Figure 9.3 exemplifies the spatial distribution of chlorophyll a along a longitudinal transect. Compared with the average chlorophyll a concentrations of the in-reservoir water, the SHS chlorophyll a concentrations were lower on 10 of 11 sampling occasions (Figure 9.4), however, the means were not significantly lower at the .05 level. These lower values may have been due to the toxic effects of oil and grease on algae. Oil and

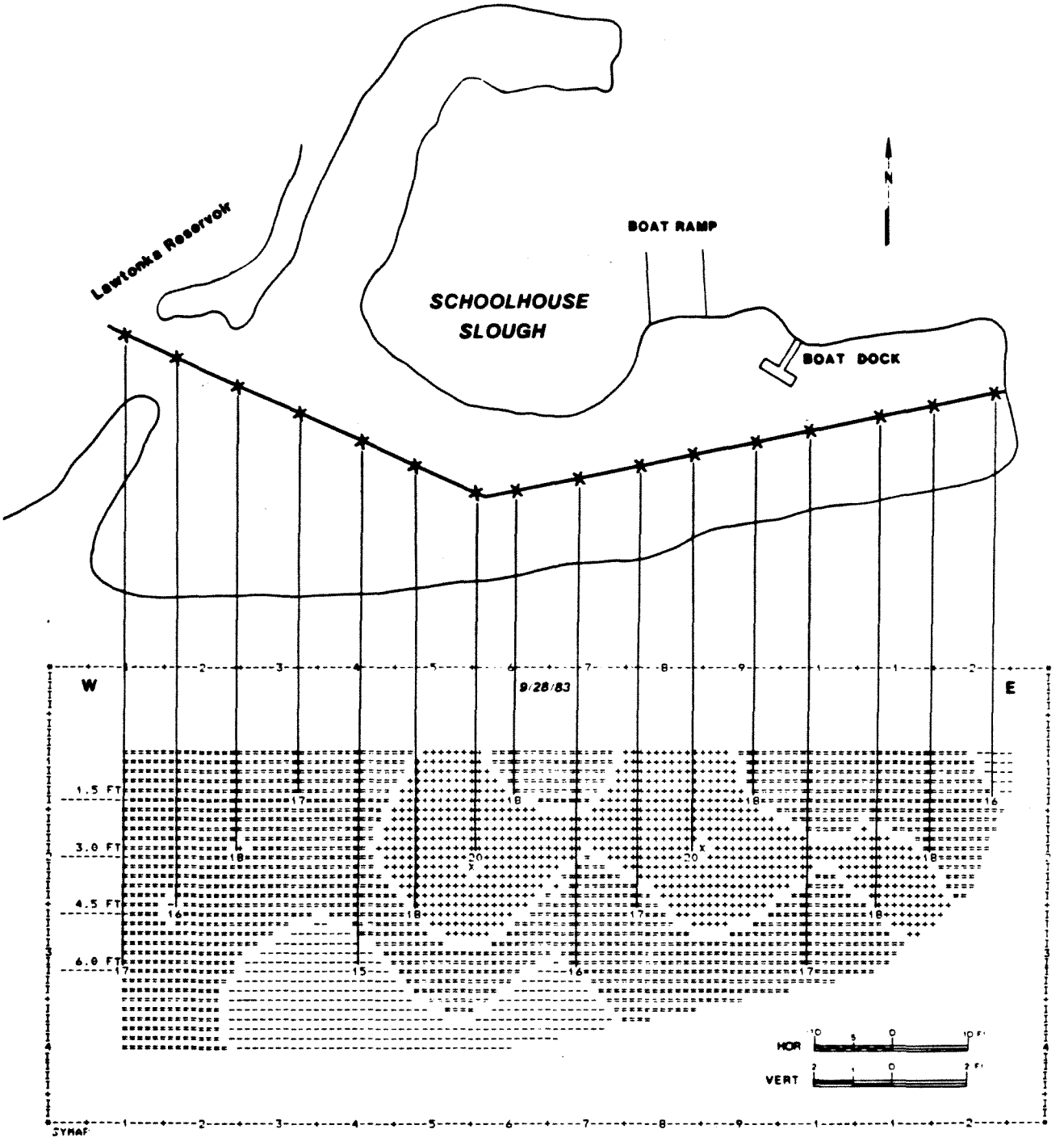


Figure 9.3 Spatial distribution of chlorophyll-a and location of sample sites in School House Slough

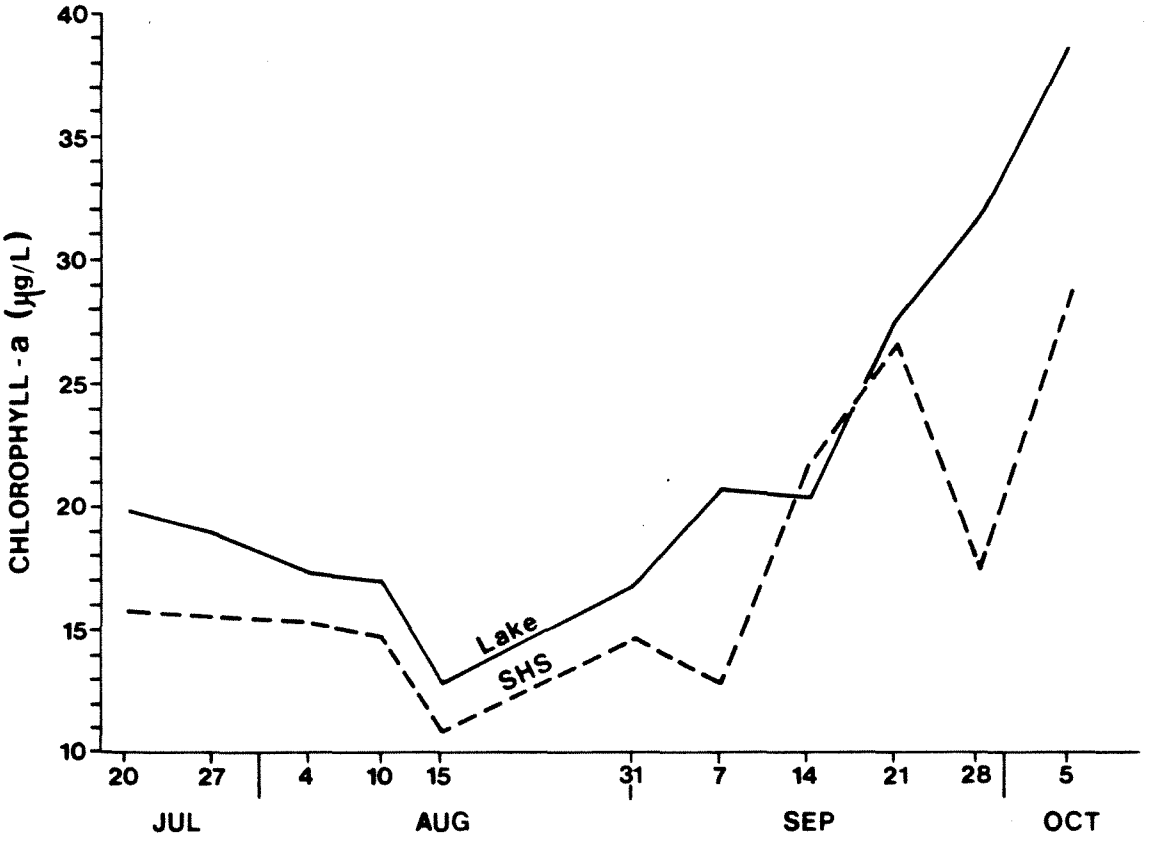


Figure 9.4 Temporal variability of mean chlorophyll-a values for Lawtonka Reservoir and School House Slough

grease increased in concentration during the summer months, presumably as a result of increased boating activity. In SHS during early June 1983, the oil and grease concentration was less than 1 mg/L while in early July the concentrations varied between 5.5 and 10 mg/L. In-reservoir oil and grease concentrations during the same period increased from less than 1 mg/L to a range of 2.3 to 3.5 mg/L.

Paradoxically, the overt presence of unsightly blue-green algae in SHS during the summer months was due to wind induced concentration and the algae's positive bouyancy. Patchy vertical distribution of algal populations was inferred by the heterogeneous patterns of chlorophyll a in SHS (Figure 9.3 and Appendix A). This patchiness persisted even when the overall chlorphyll a concentration dramatically increased by September 7, 1983 and continued until the termination of chlorophyll sampling.

Lagoon Seepage:

The close proximity of an overloaded septic system to Lawtonka Reservoir provides a potential route for nutrient and pathogenic contamination of the water body (Figure 9.5). In SHS, the lateral line network of the septic system lies in the same drainage area as an inadvertantly formed lagoon. Positive seepage contribution to SHS from the lagoon was documented (Task 10), and although the nutrient and bacteriological levels of the seepage water were within the range of in-reservoir levels, the leaky embankment is a chronic source of potential contamination.

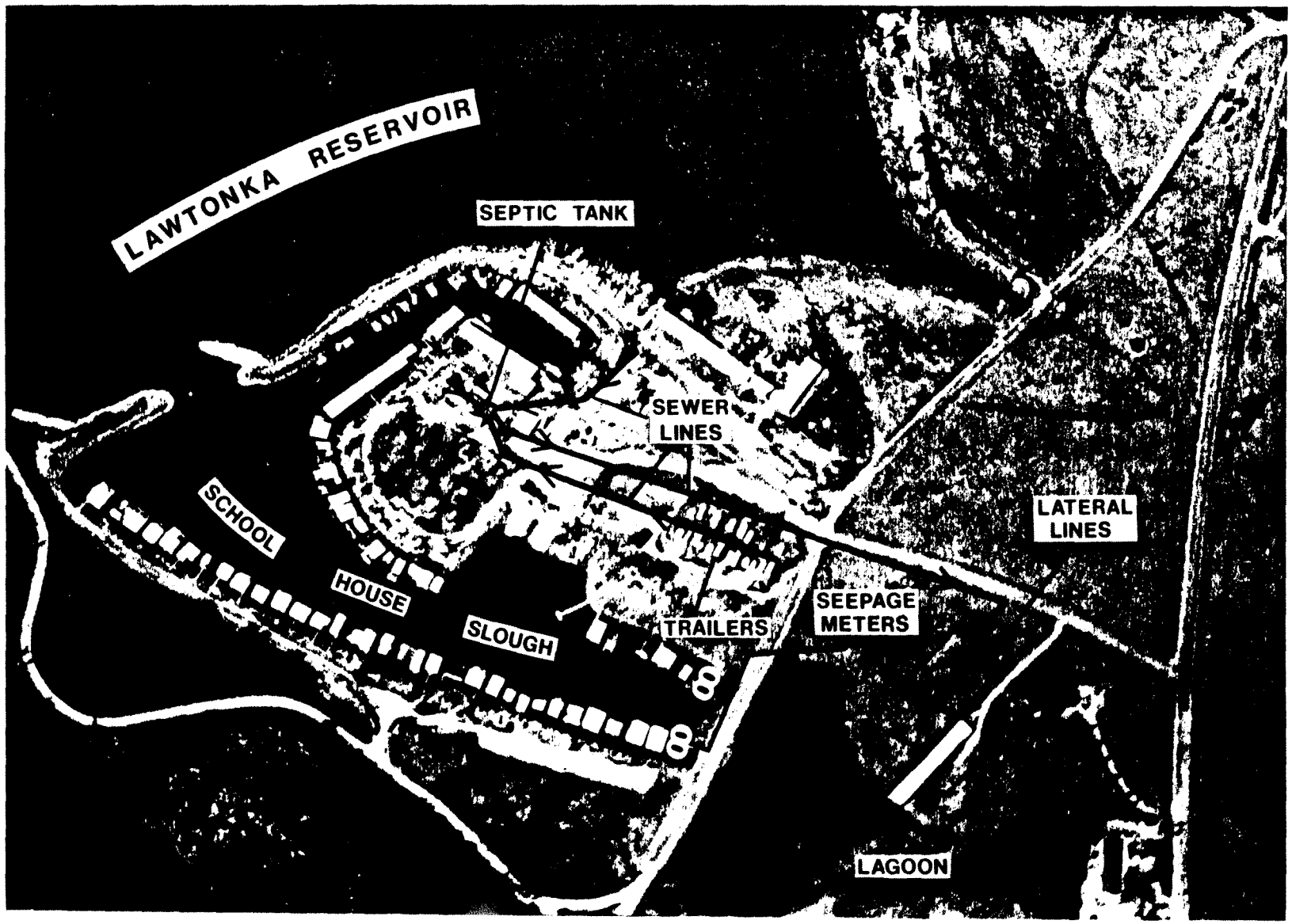


Figure 9.5 Location of septic system in the region of School House Slough

SECTION VII

LIMNOLOGICAL ANALYSIS (TASK 10):

The trophic state of Lawtonka Reservoir was determined using a serial chlorophyll mapping technique (Grimshaw and Shapiro, 1983; Grimshaw et al., in prep). These data (Figure 10.1a-d) indicate that a mean summer maximum in chlorophyll a content of 39 mg/m^3 occurred on October 5, 1983 at 1 meter depth. Calculations utilizing Carlson's chlorophyll a based trophic state index reveal that Lawtonka Reservoir has a TSI value of 67 indicating that it is a eutrophic reservoir. Figures 10.1a, b, c, and d illustrate the development of algal biomass which accumulated in Lawtonka Reservoir over the summer and fall seasons, while Figure 10.1e indicates the distribution of gross community photosynthesis and of total community respiration throughout the water column.

Morphometric Characteristics:

Lawtonka Reservoir is a crescent shaped (Figure 10.2) main channel reservoir 938 hectares in surface area. The reservoir, which has a volume capacity of approximately 6.98×10^7 m^3 was constructed on Medicine Creek and lies predominantly upon pre-Cambrian granite. The mean and maximum depth are 7.44 and 18.29 meters, respectively; and the reservoir exhibits a hydraulic residence time of 3.4 years based upon the hydrologic budget. The net contributing drainage basin area is 178.5 square kilometers and is large relative to the surface area of the reservoir.

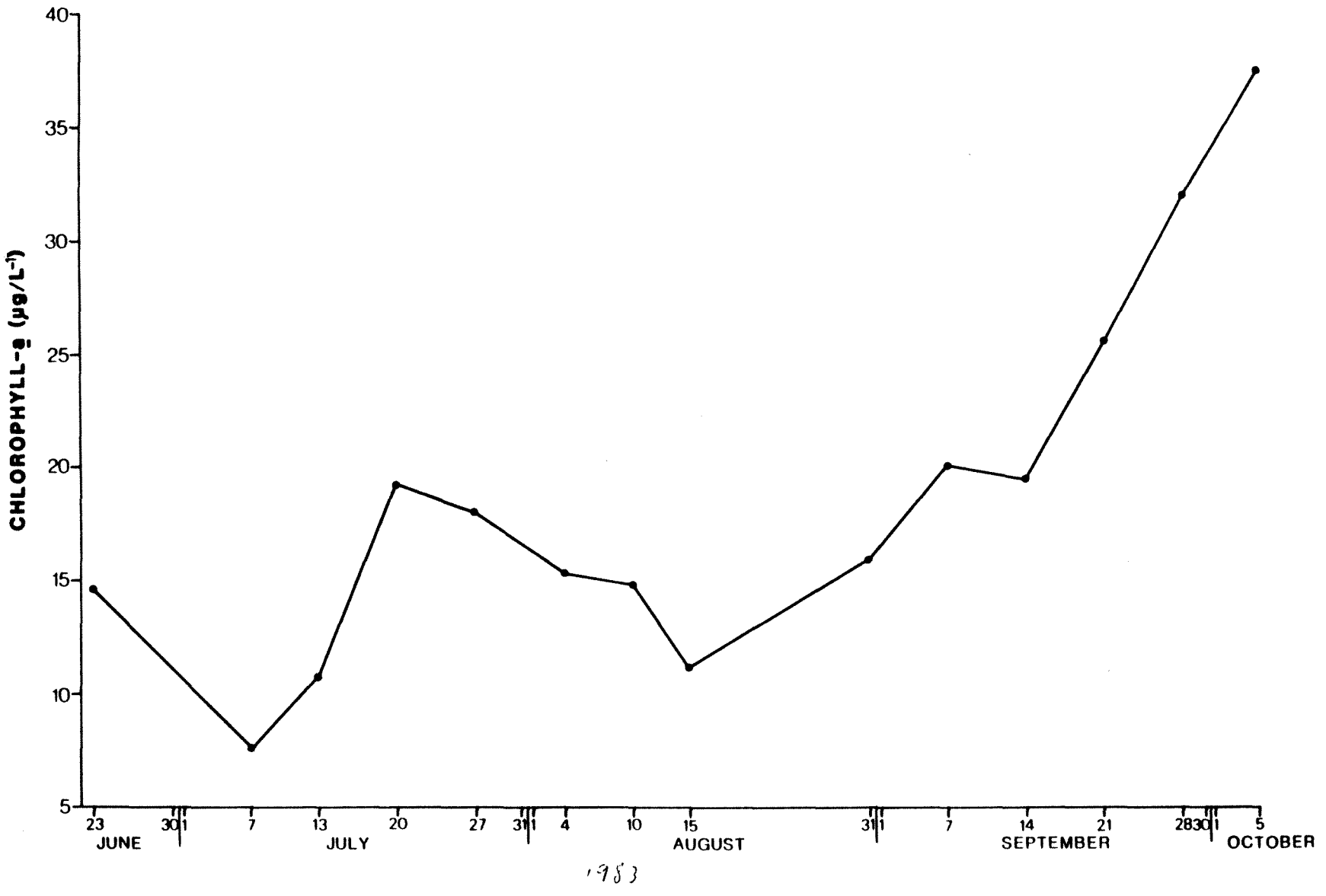


Figure 10.1a Temporal fluctuations in chlorophyll-a content of Lawtonka Reservoir at .5m depth

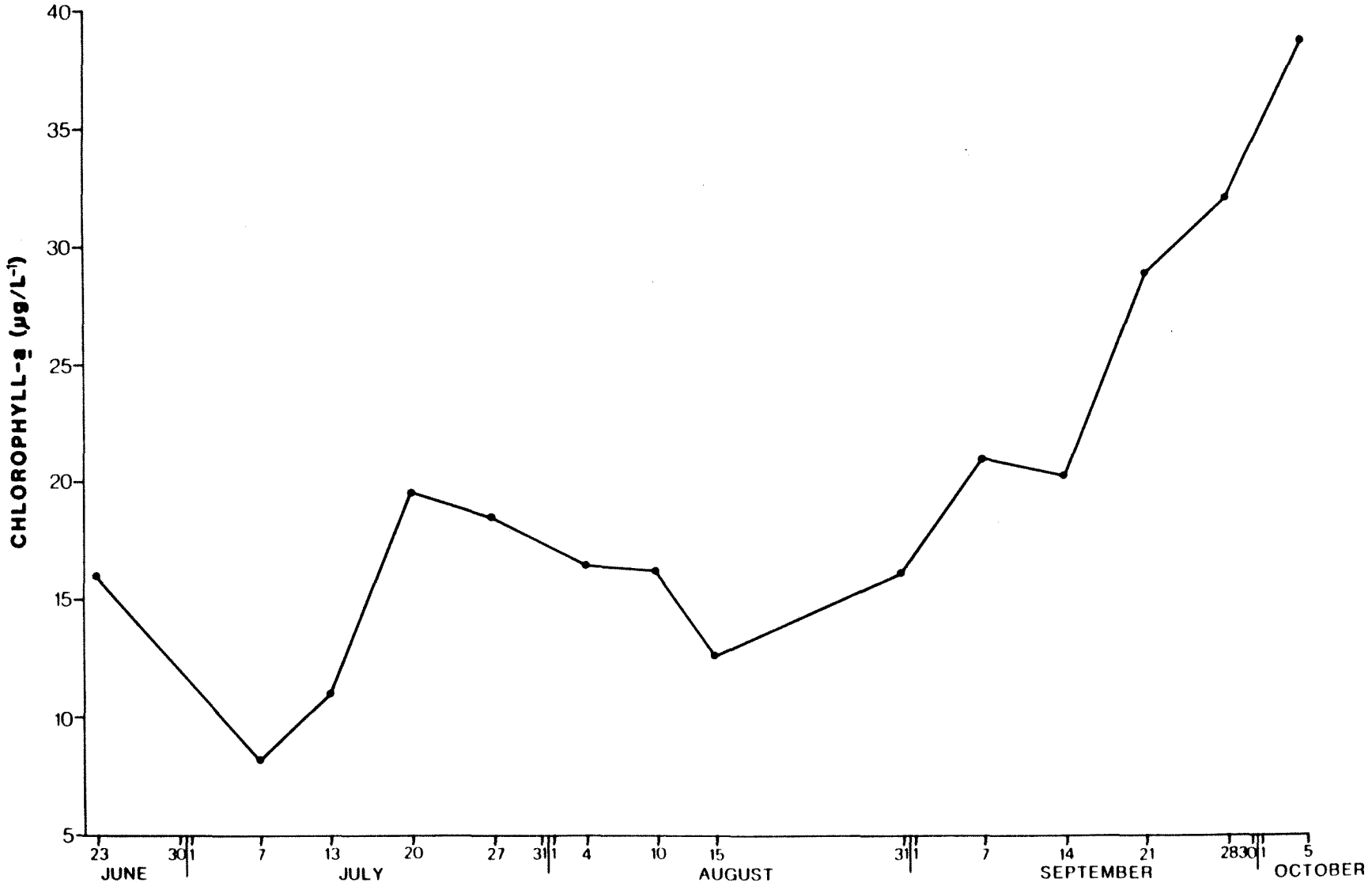


Figure 10.1b Temporal fluctuations in chlorophyll-a content of Lawtonka Reservoir at 1.0m depth

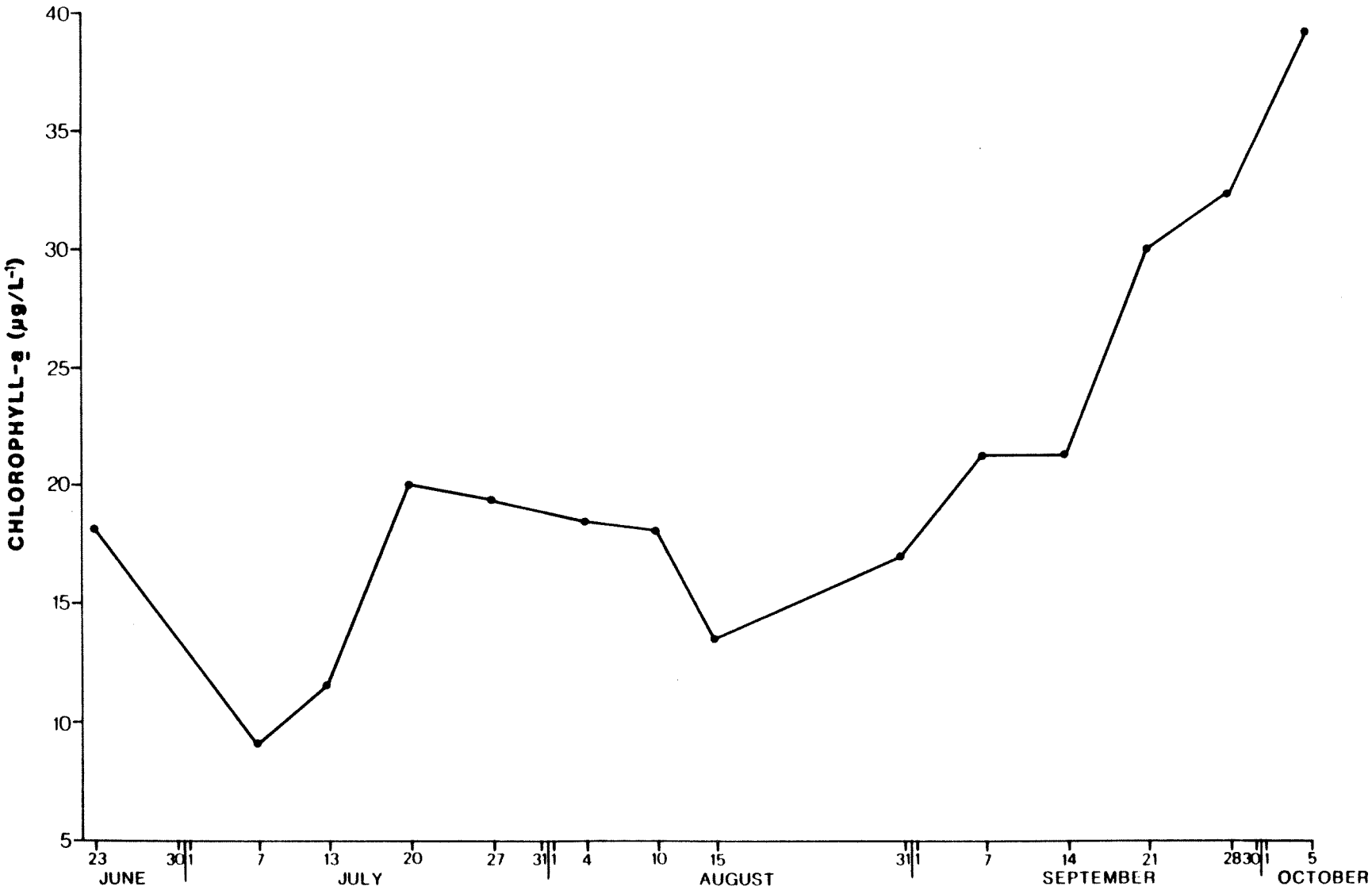


Figure 10.1c Temporal fluctuations in chlorophyll-a content of Lawtonka Reservoir at 1.5m depth

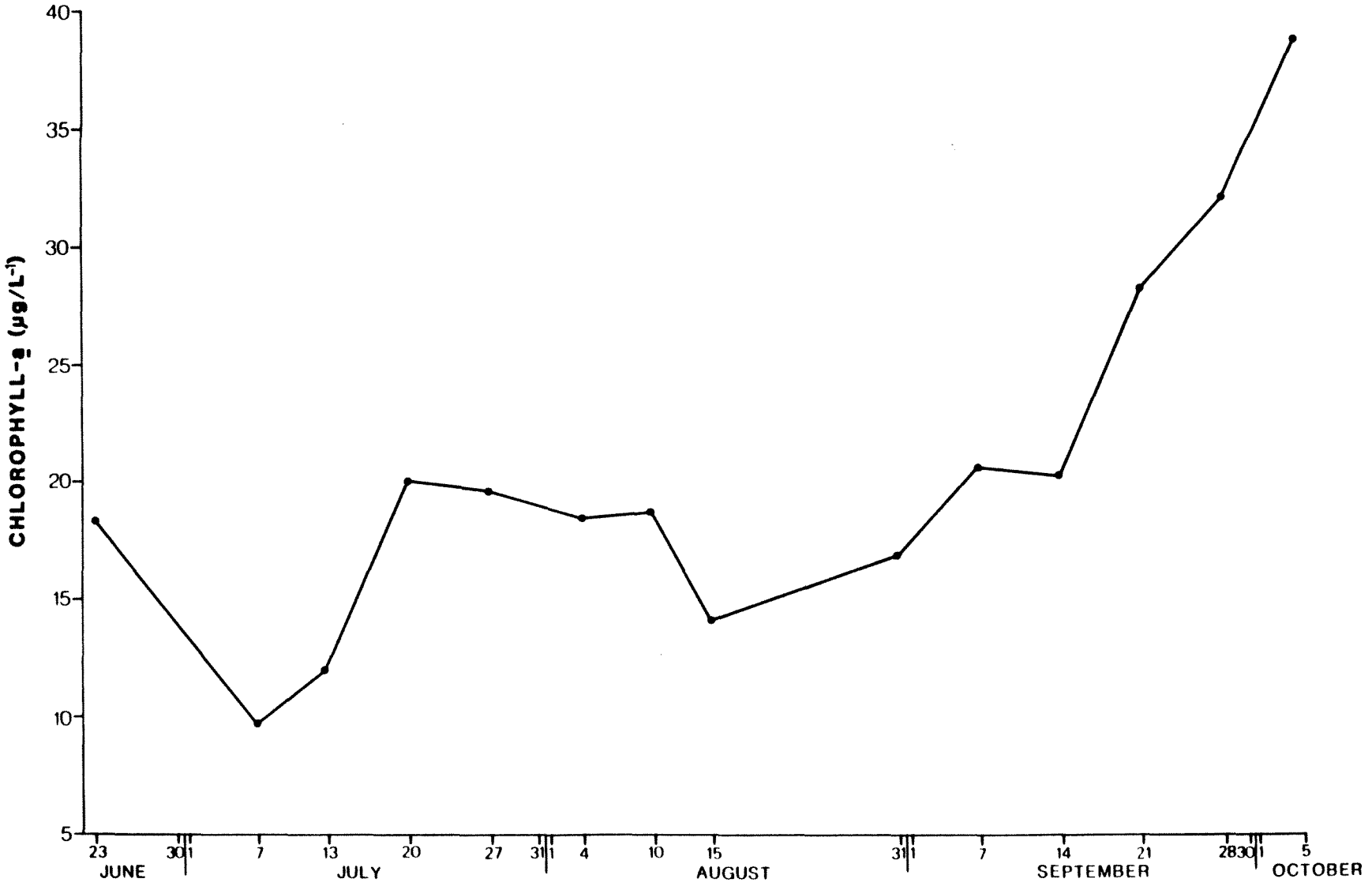


Figure 10.1d Temporal fluctuations in chlorophyll-a content of Lawtonka Reservoir at 2.0m depth

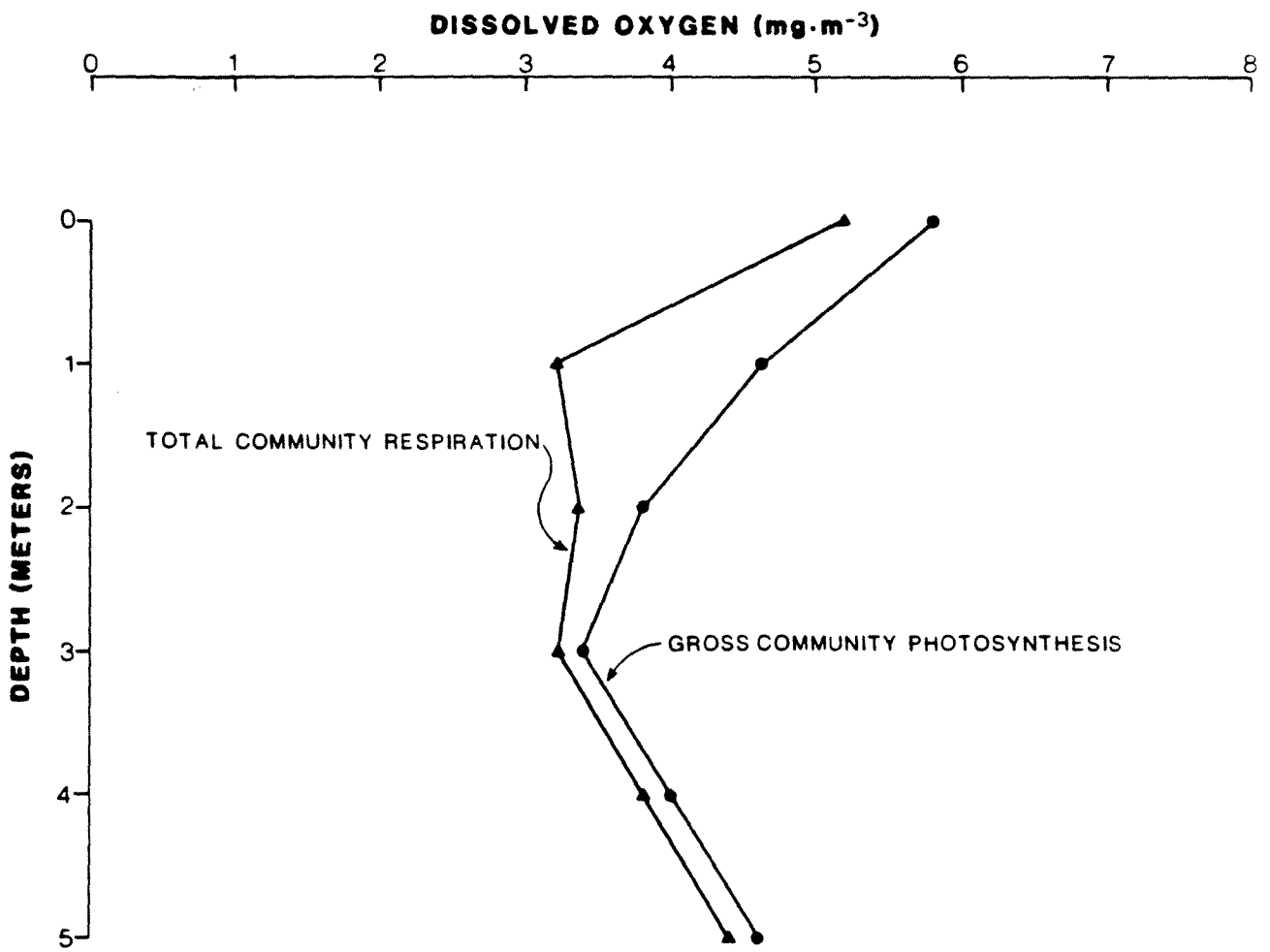


Figure 10.1e Vertical profile of gross community photosynthesis and total community resiration in Lawtonka Reservoir (Sept. 15-16,1983)

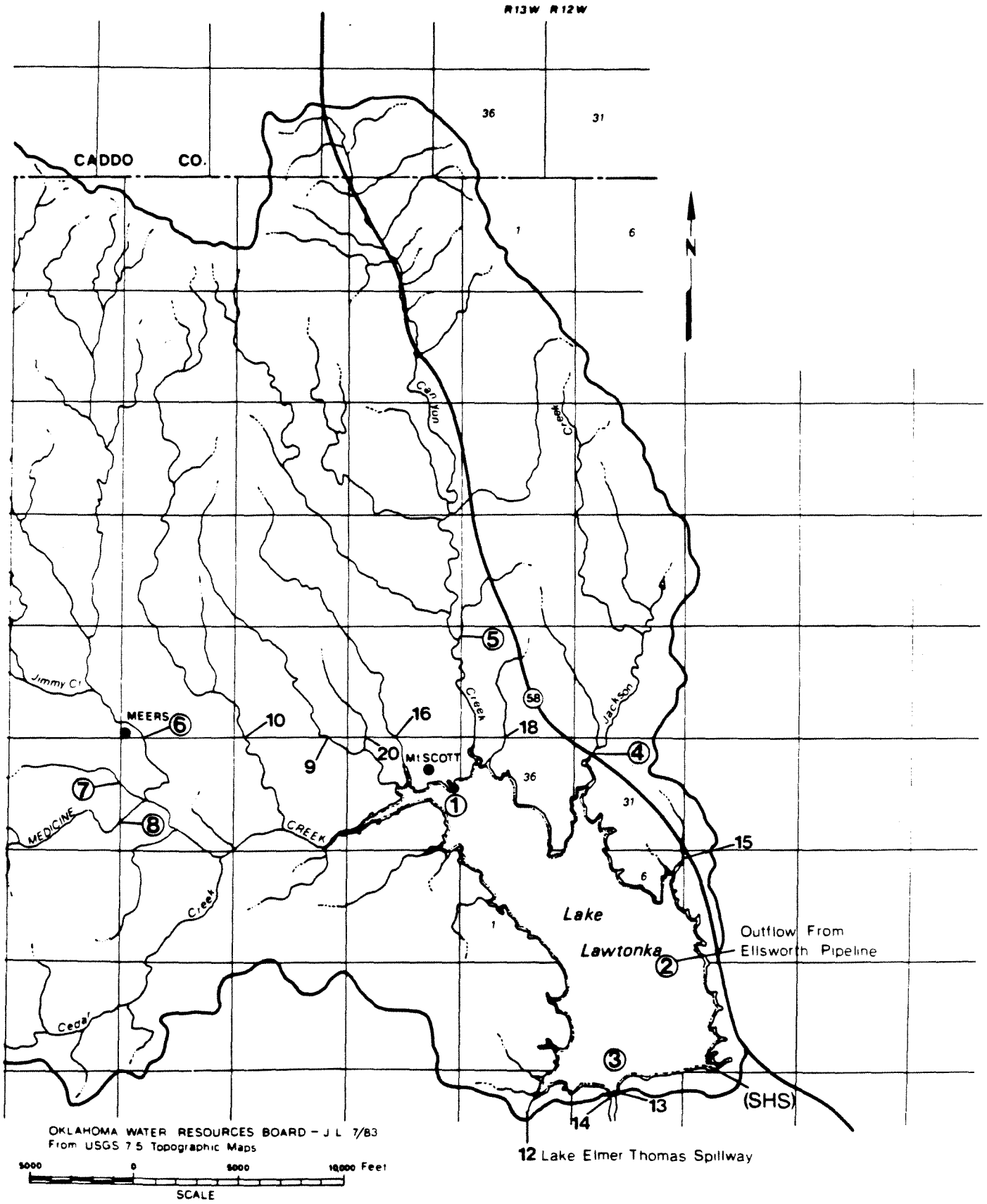


Figure 10.2 Morphometry and sampling locations on Lawtonka Reservoir

Physical, Chemical, and Biological Quality of Lawtonka Reservoir:

Physical:

Figure 10.2 indicates the location of sampling stations utilized in this study. Circled sample station numbers refer to primary sample sites. Analysis of temperature (Figures 10.3a-f) and other data obtained from these sites indicated the majority of Lawtonka Reservoir is largely polymictic, however, the deeper, southern end of the lake was seasonally stratified during the months of July, August and September 1983 (Figure 10.3e).

In addition to wind effects on thermal stratification, sustained southeasterly winds (Table 10.1) may have been responsible for the occurrence of regions of unusually high chlorophyll a content in the northwestern portion of the reservoir (Figure 10.4).

Figures 10.5a-c and 10.6a-c illustrate that the northern end of Lawtonka Reservoir was considerably more turbid than the southern end. Figure 10.6b (March 23, 1983) indicated that density currents probably underflowed the reservoir when the lake was filling with river water. The enhanced density of river water, due to its greater sediment load compared to the sediment load of reservoir water, explains the occurrence of these underflows within the reservoir. Figure 10.5a (July 29, 1982) illustrates a situation whereby turbid water overlaid cleaner water. This situation was probably due to groundwater seepage into the reservoir.

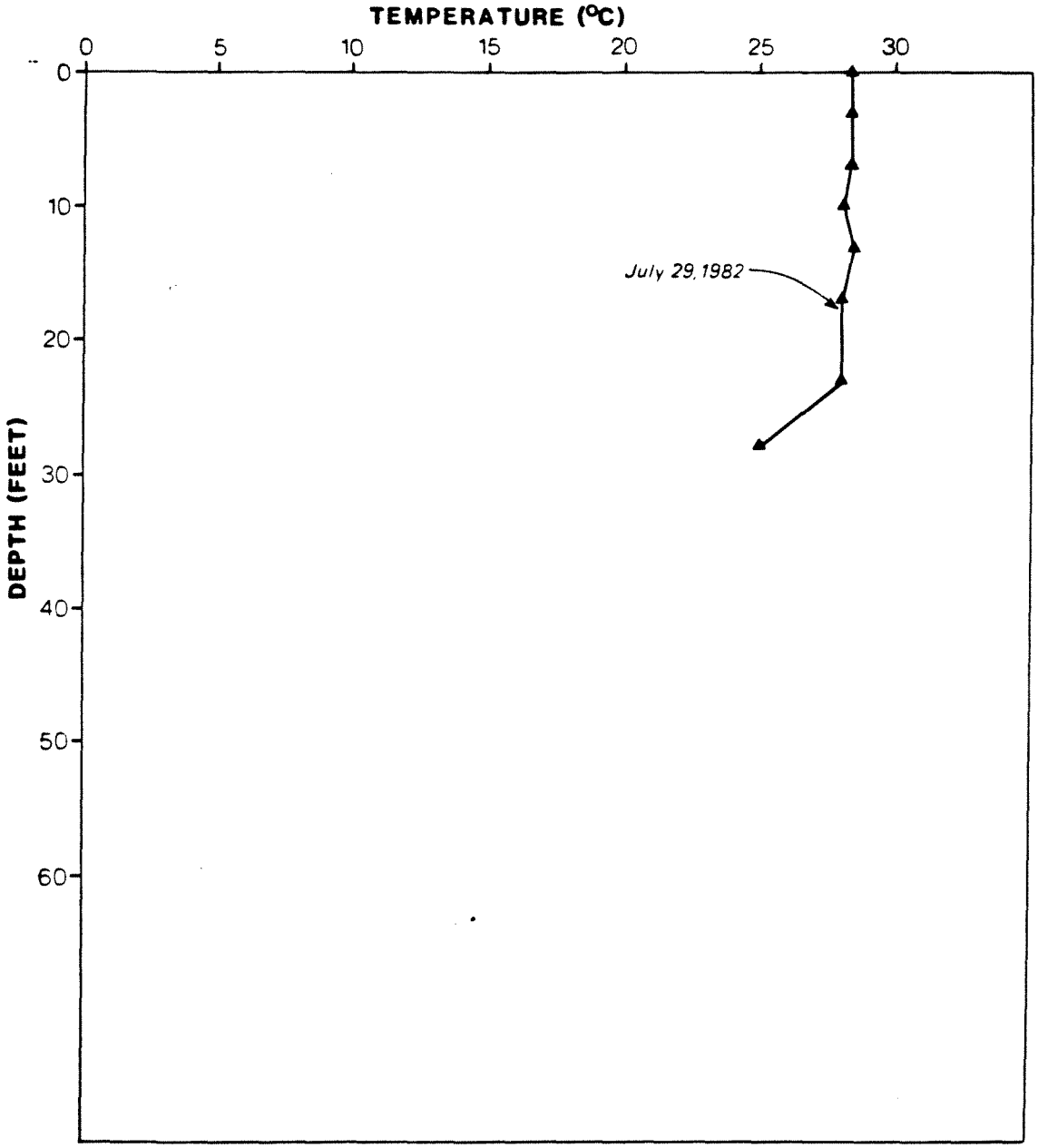


Figure 10.3a Vertical temperature profile taken at sample site 3 in Lawtonka Reservoir (July 29,1982)

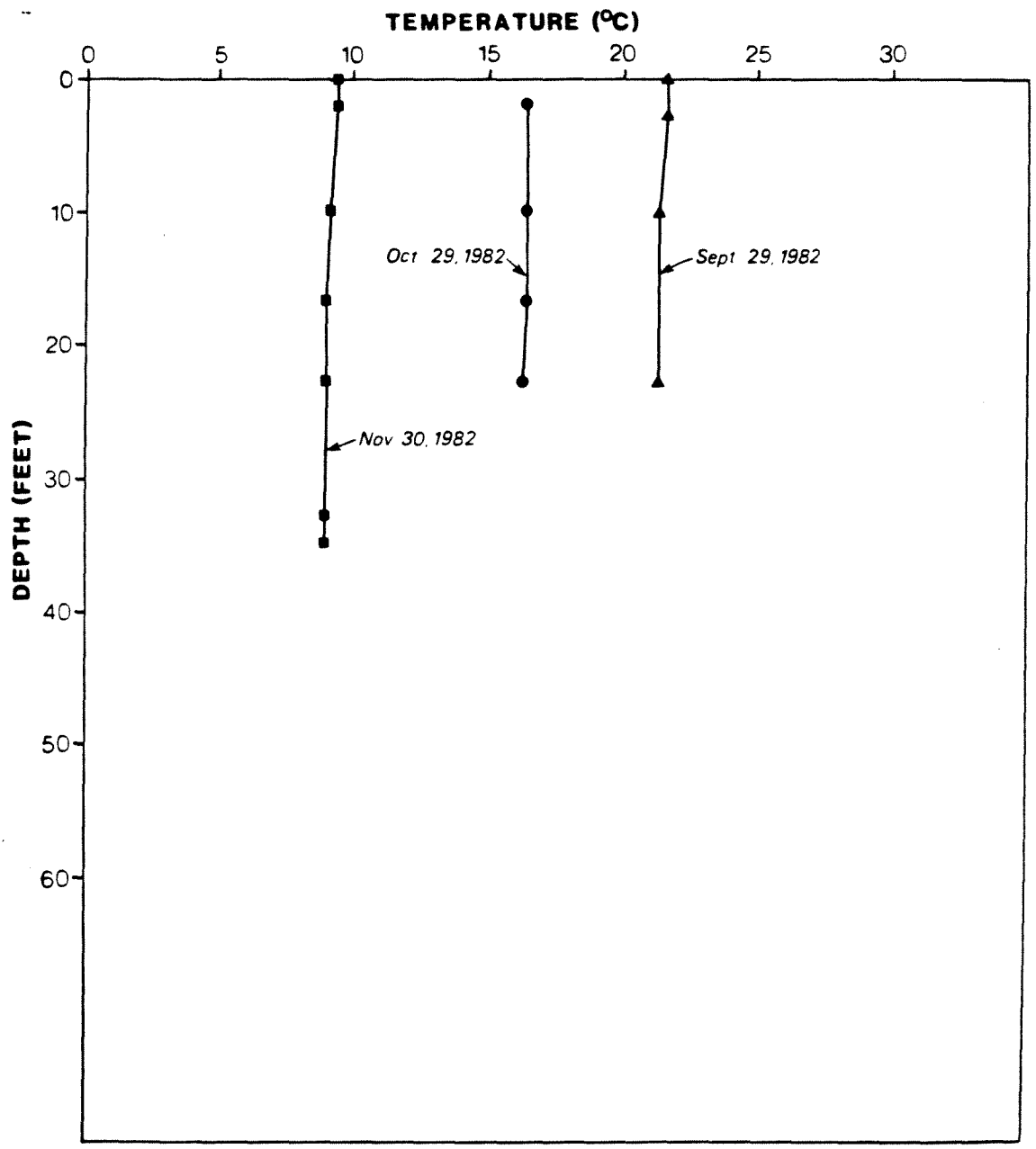


Figure 10.3b Vertical temperature profiles taken at sample site 3 in Lawtonka Reservoir (Sept.-Nov.1982)

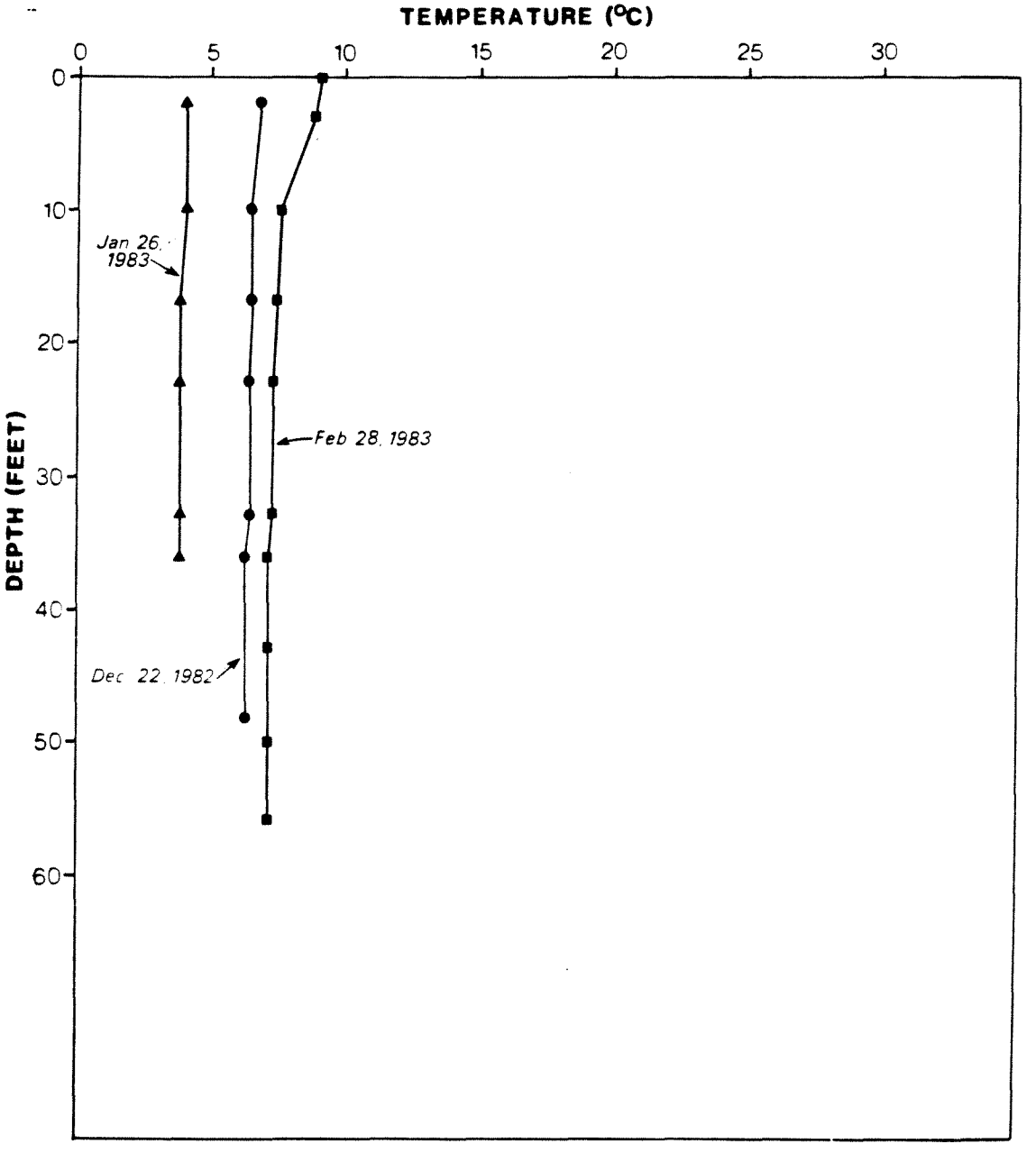


Figure 10.3c Vertical temperature profiles taken at sample site 3 in Lawtonka Reservoir (Dec.1982-Feb.1983)

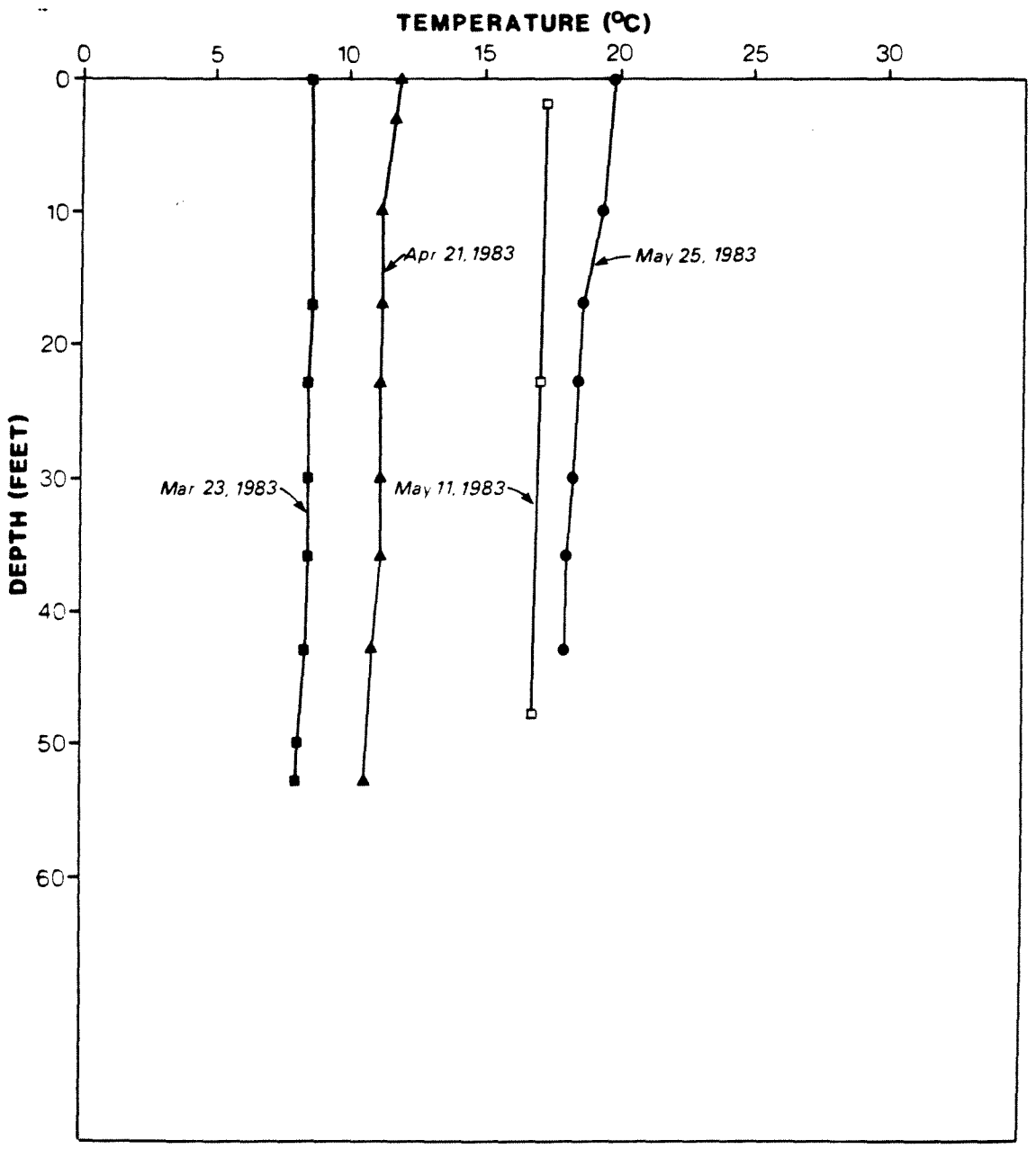


Figure 10.3d Vertical temperature profiles taken at sample site 3 in Lawtonka Reservoir (March-May 1983)

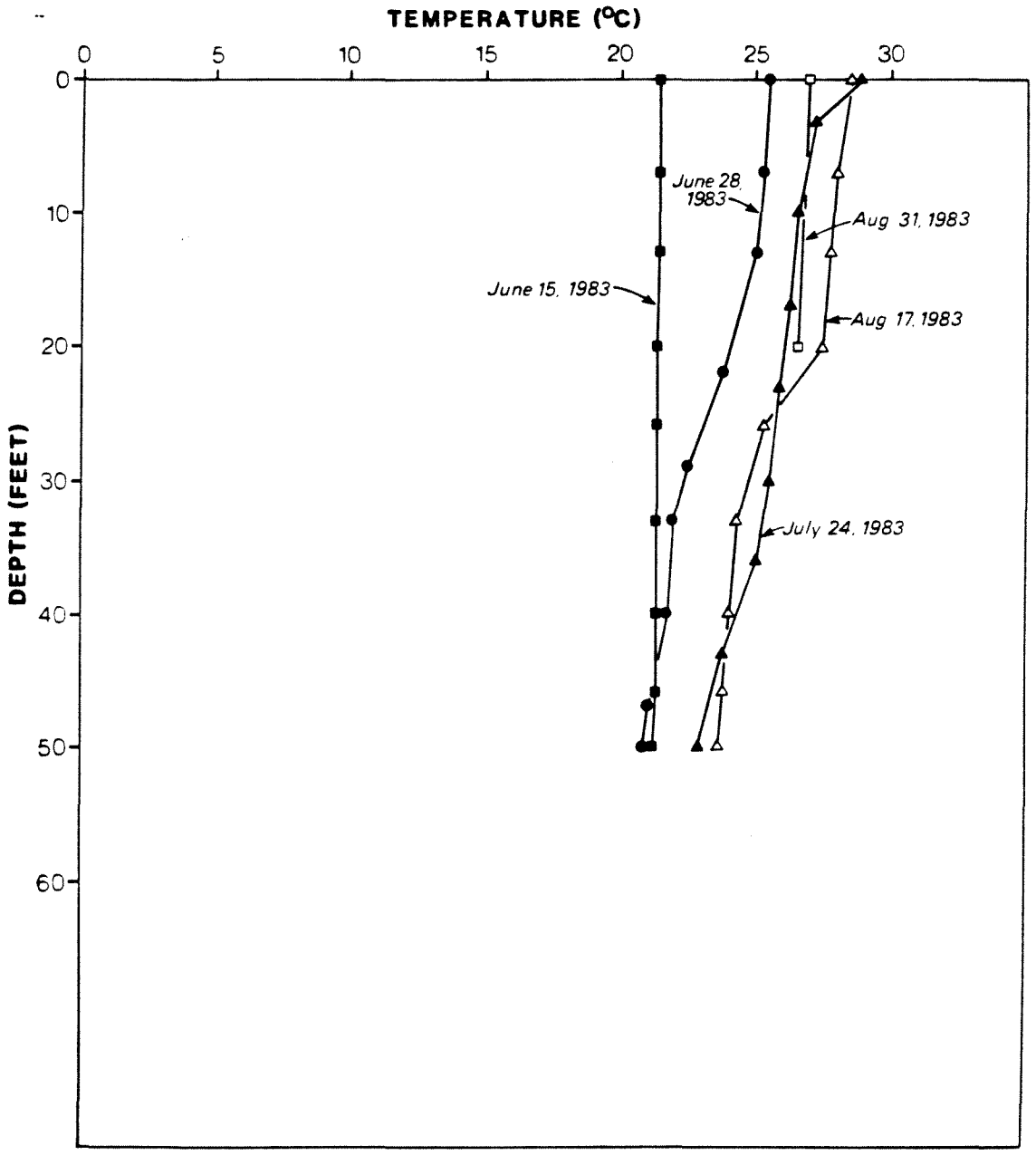


Figure 10.3e Vertical temperature profiles taken at sample site 3 in Lawtonka Reservoir (June-Aug.1983)

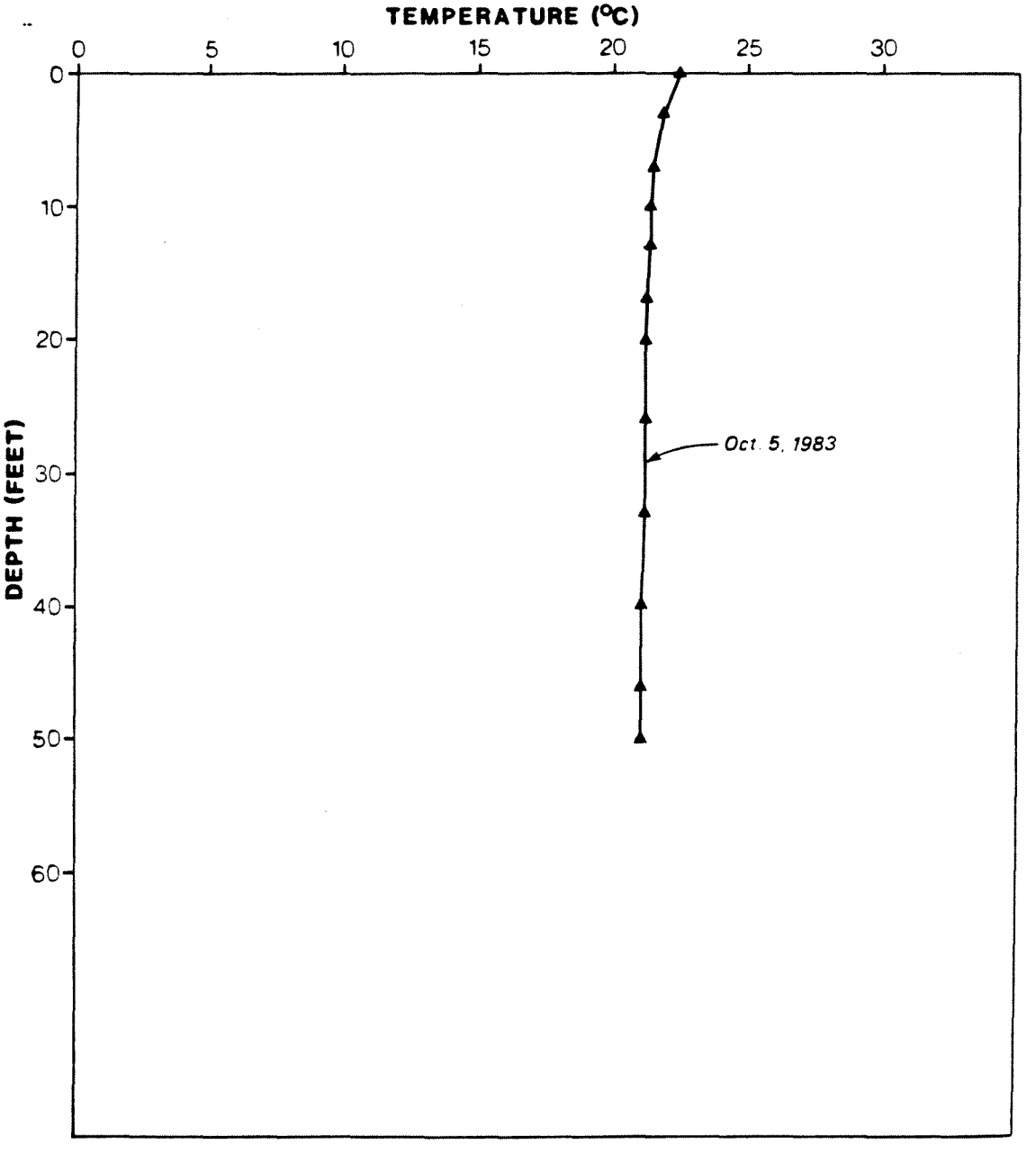


Figure 10.3f Vertical temperature profile taken at sample site 3 in Lawtonka Reservoir (Oct.5,1983)

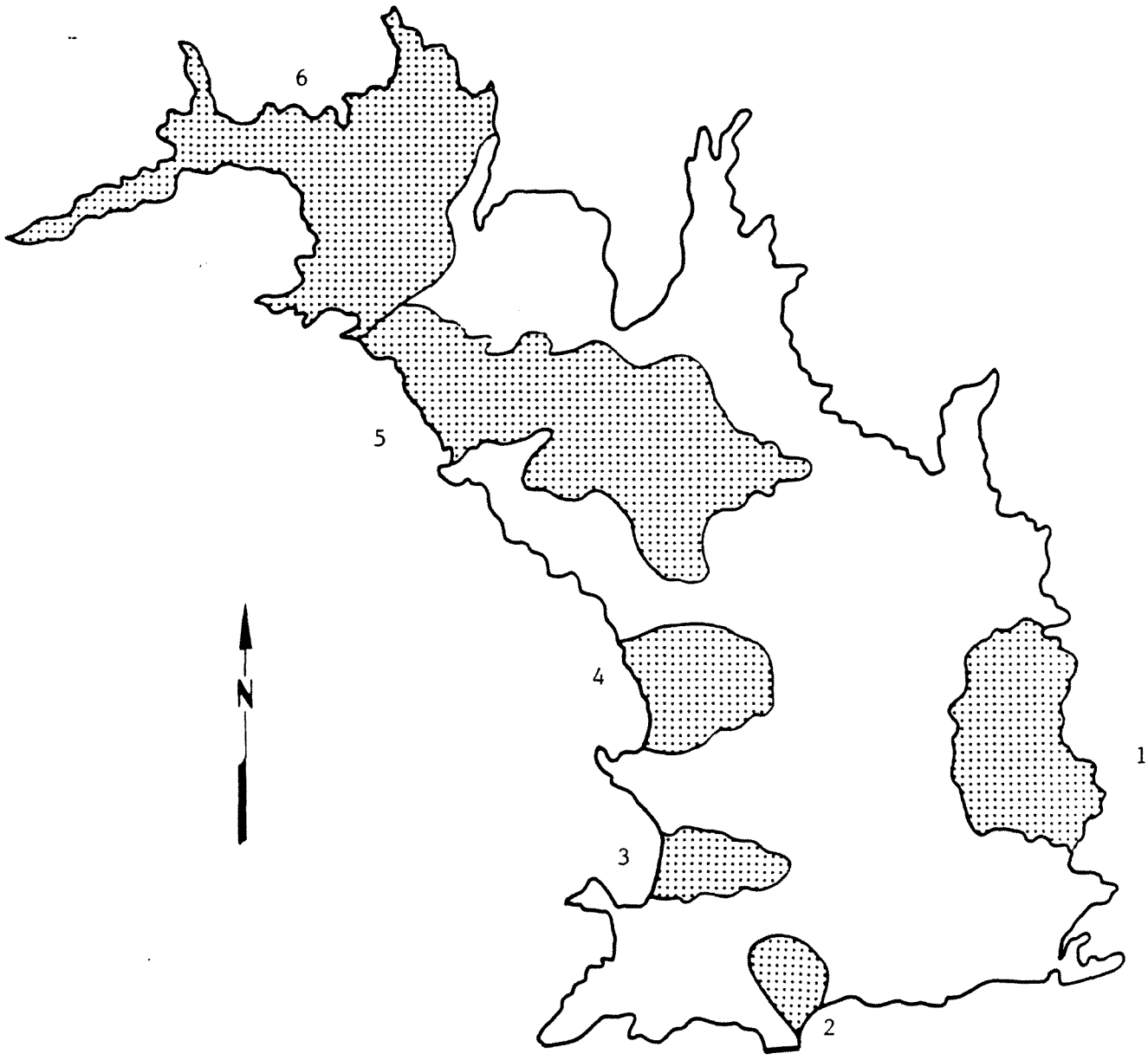


Figure 10.4 Regions of persistently high ($\bar{x}$ + 2SD) chlorophyll-a in Lawtonka Reservoir (June 23-Oct.5,1983)

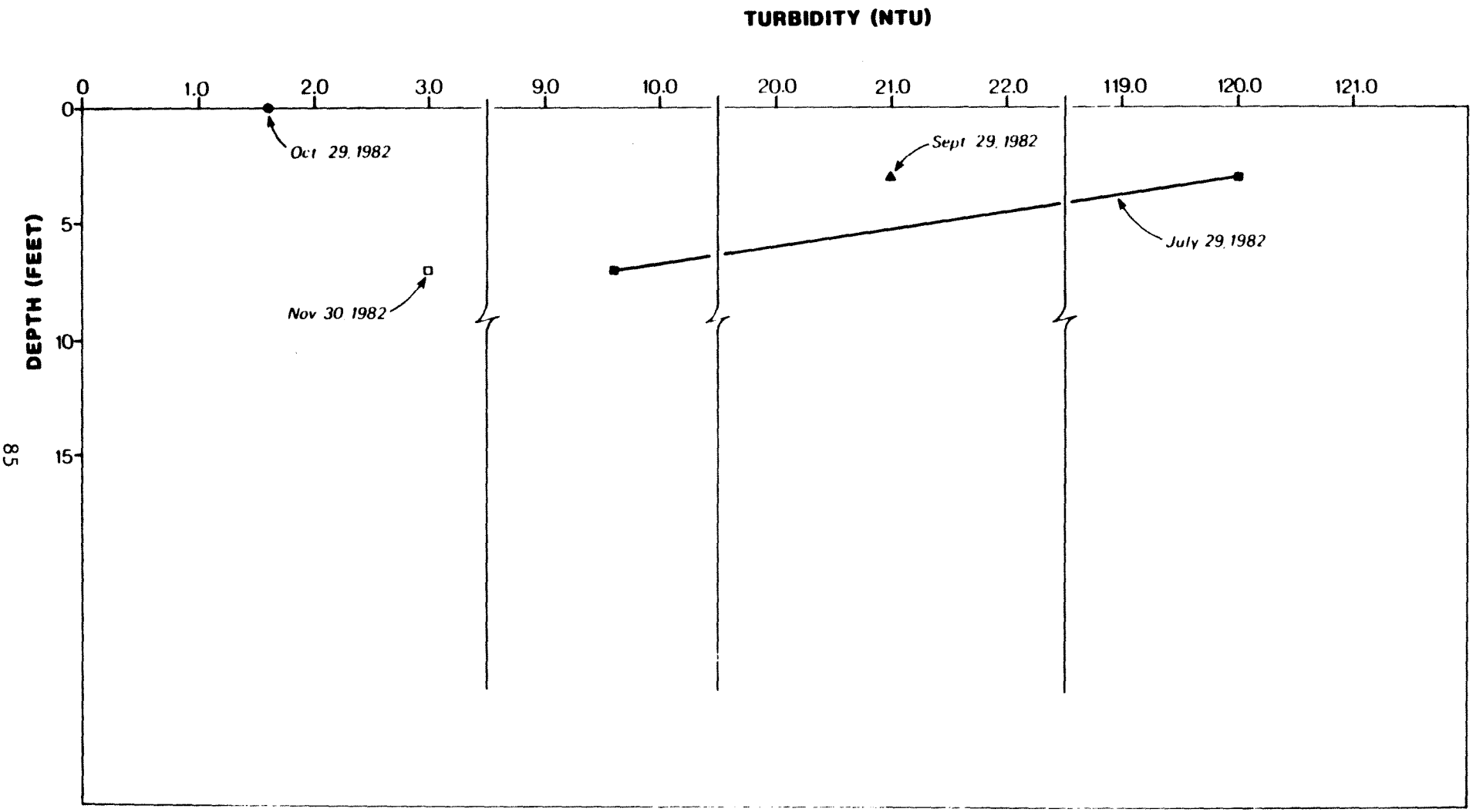


Figure 10.5a Temporal variation in nephelometric turbidity at sample site 1 in Lawtonka Reservoir (July-Nov. 1982)

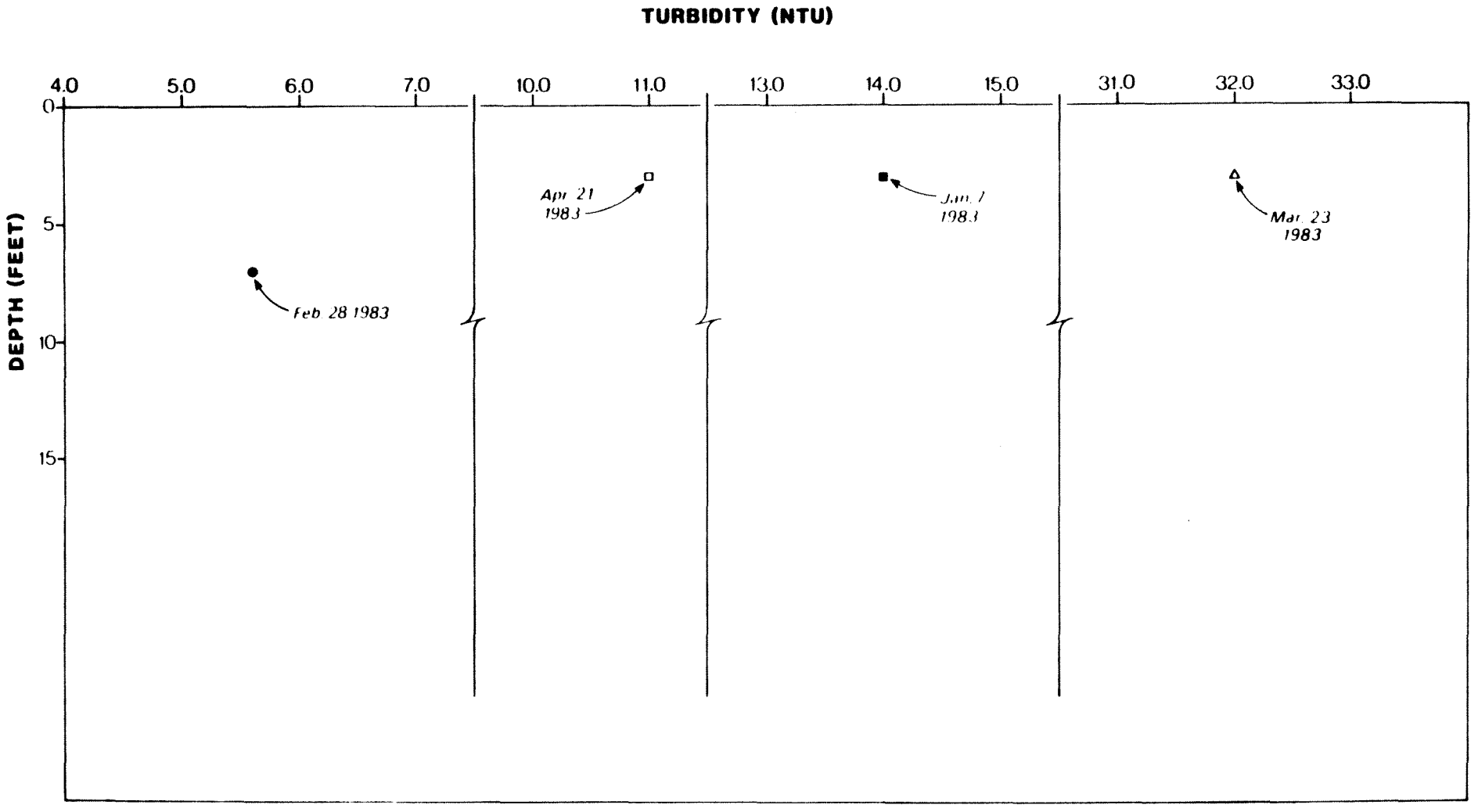


Figure 10.5b Temporal variation in nephelometric turbidity at sample site 1 in Lawtonka Reservoir

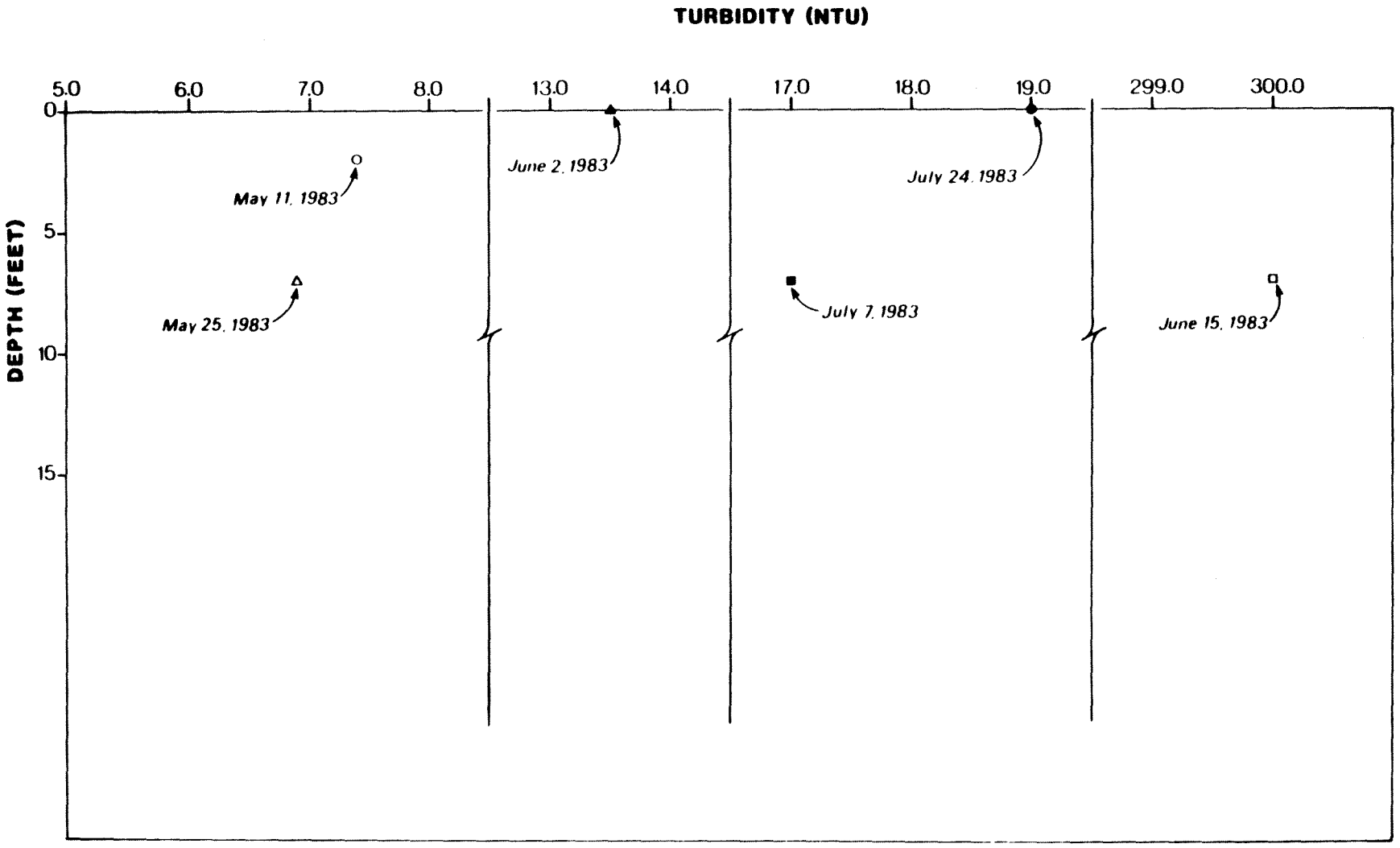


Figure 10.5c Temporal variation in nephelometric turbidity at sample site 1 in Lawtonka Reservoir (May-July 1983)

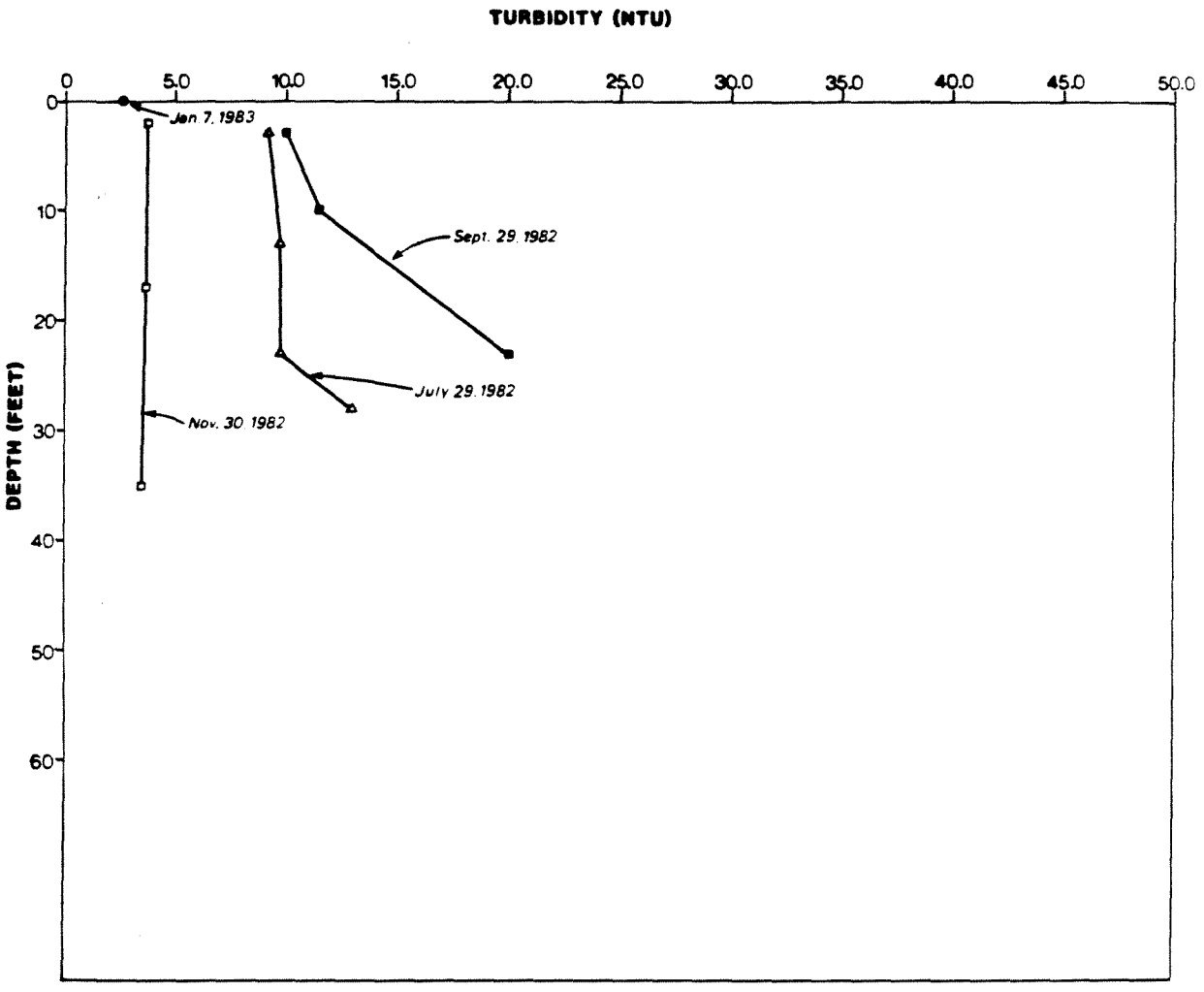


Figure 10.6a Temporal variation in nephelometric turbidity at sample site 3 in Lawtonka Reservoir (July 1982-Jan. 1983)

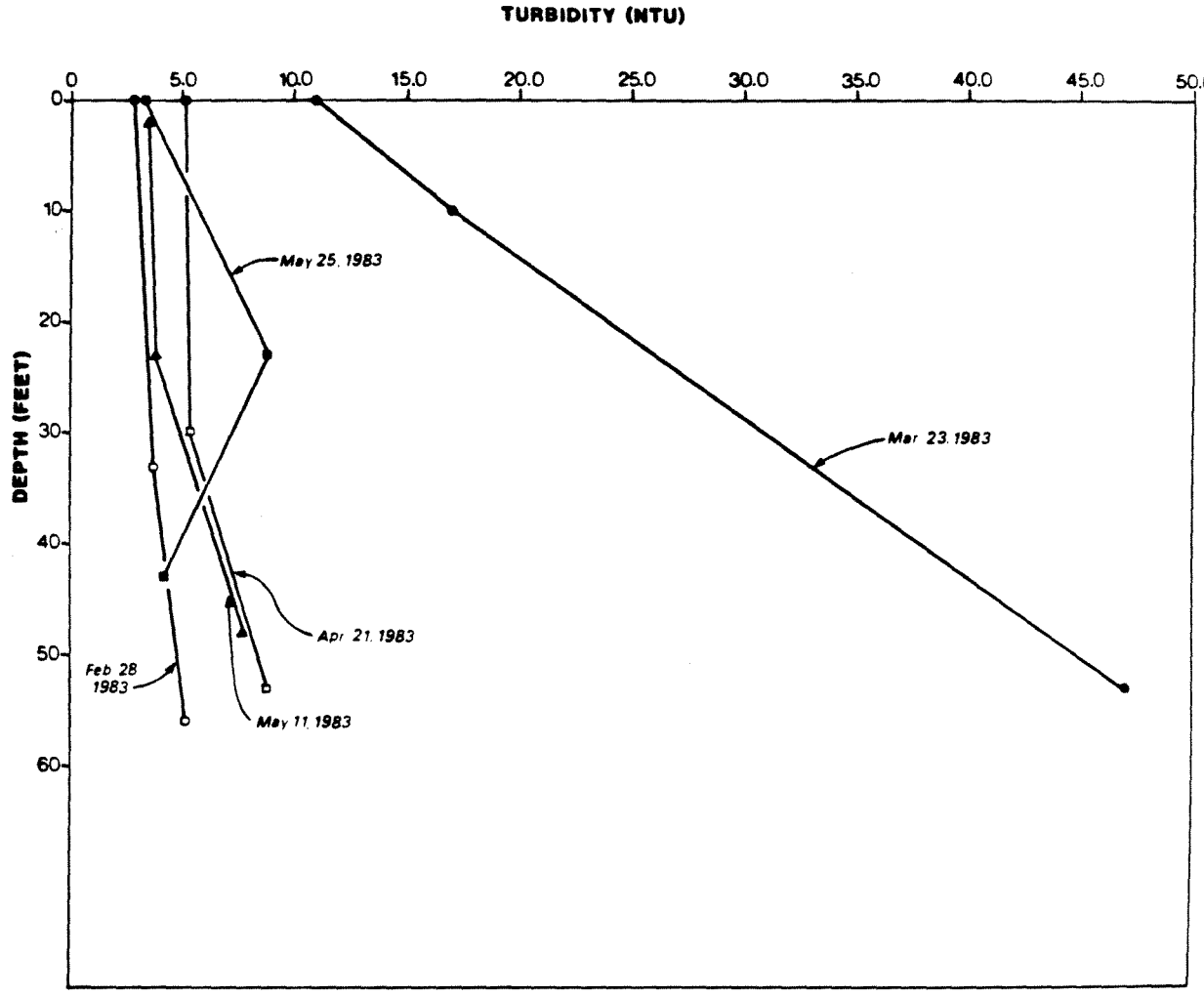


Figure 10.6b Temporal variation in nephelometric turbidity at sample site 3 in Lawtonka Reservoir (Feb.-May 25, 1983)

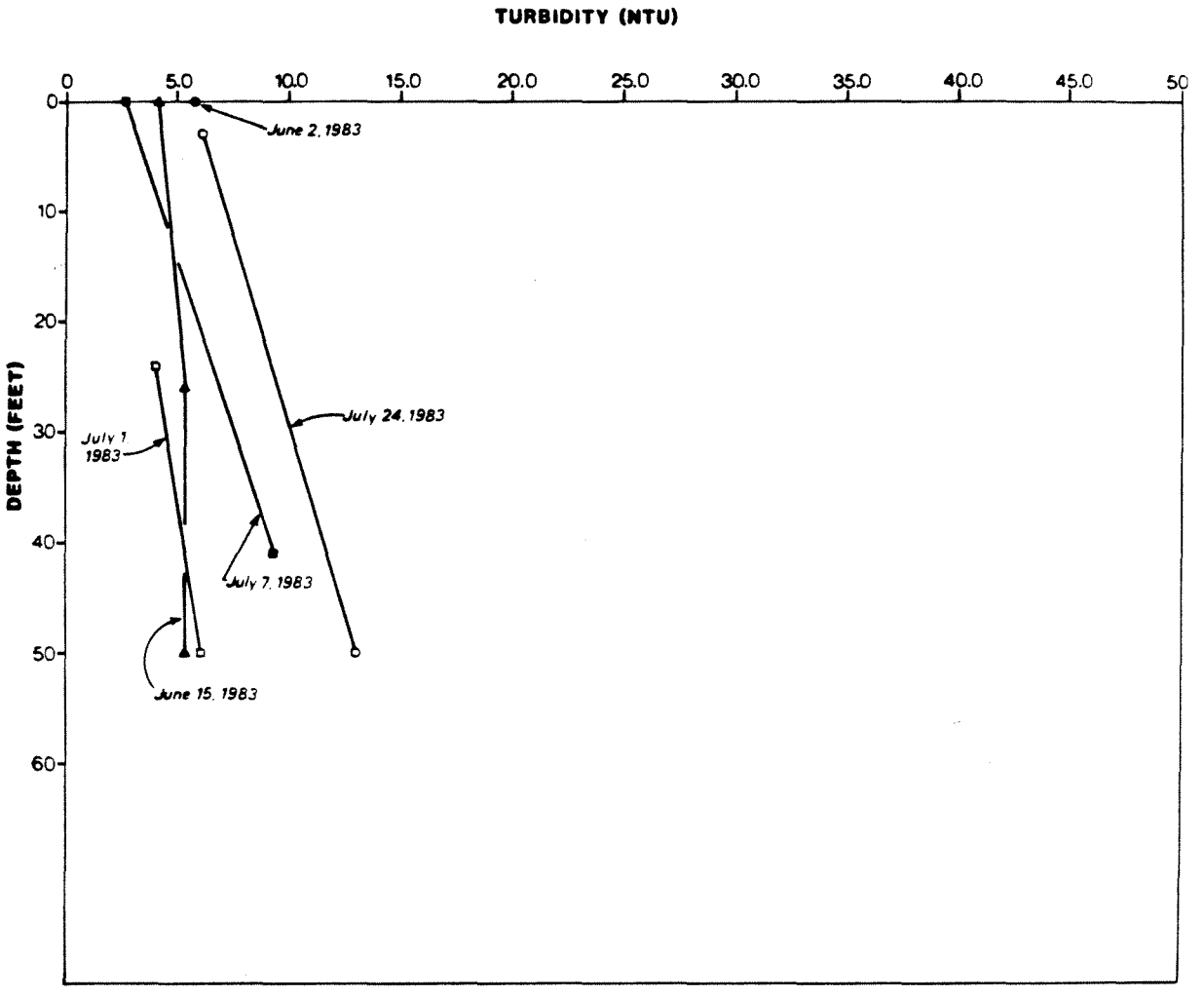


Figure 10.6c Temporal variation in nephelometric turbidity at sample site 3 in Lawtonka Reservoir (June-July, 1983)

Table 10.1. Percent of observation days for given month in which the mean wind direction was from a given direction.

RANGE OF DEGREES	DIRECTION	PERCENT OF OCCURANCE		
		JULY 1983	SEPT. 1983	OCT. 1983
337.5-22.5	North	0	0	0
22.5-67.5	Northeast	0	0	0
67.5-112.5	East	22.2	51.9	20.0
112.5-157.5	Southeast	66.6	33.3	33.3
157.5-202.5	South	11.1	3.7	13.3
202.5-247.5	Southwest	0	7.4	26.7
247.5-292.5	West	0	3.7	6.7
292.5-337.5	Northwest	0	0	0

Chemical:

Inspection of Lawtonka Reservoir's water chemistry data (Figures 10.7a-f, 10.8a-f, 10.9a-f, 10.10a and b, 10.11a and b and 10.12a and b) indicated that, with the exception of high conductivity values (Figure 10.9a-f), Lawtonka Reservoir's chemistry was typical of most Oklahoma reservoirs. Concentrations of parameters such as Total Phosphate, dissolved and suspended orthophosphate with the exception of one sample at sample site 3 at the 17 meter depth on July 24, 1983, never exceeded either the 50 microgram or the subsequently lowered 20 microgram detection limit (Figures 10.10a and b). Interestingly, suspended orthophosphate constituted the majority of the orthophosphate which exceeded detection limits. Nitrogen (Figure 10.11a and b, Appendices B and C) ranged from 0.31 to 2.26 mg/L and predominantly consisted of Kjeldahl nitrogen which comprised 32 to 95 percent of the nitrogen species, indicating seasonal trends.

Nonparametric pairwise analysis of the Total Nitrogen data (Figure 10.13a) indicated that there was no significant differences between the means from sample sites 1, 3, 4, 5, 6, 7, and 8. However, matched pair analysis indicated that sample sites 6 and 7 were nearly significantly higher than site 8. Further analysis of the Total Phosphorus data (Figure 10.13b) indicated that there were no significant differences between the means of sample sites 1, 3, 4, 5, 6, 7, and 8. However, sites 4 and 7 frequently exhibited Total Phosphorus in excess of detection limits.

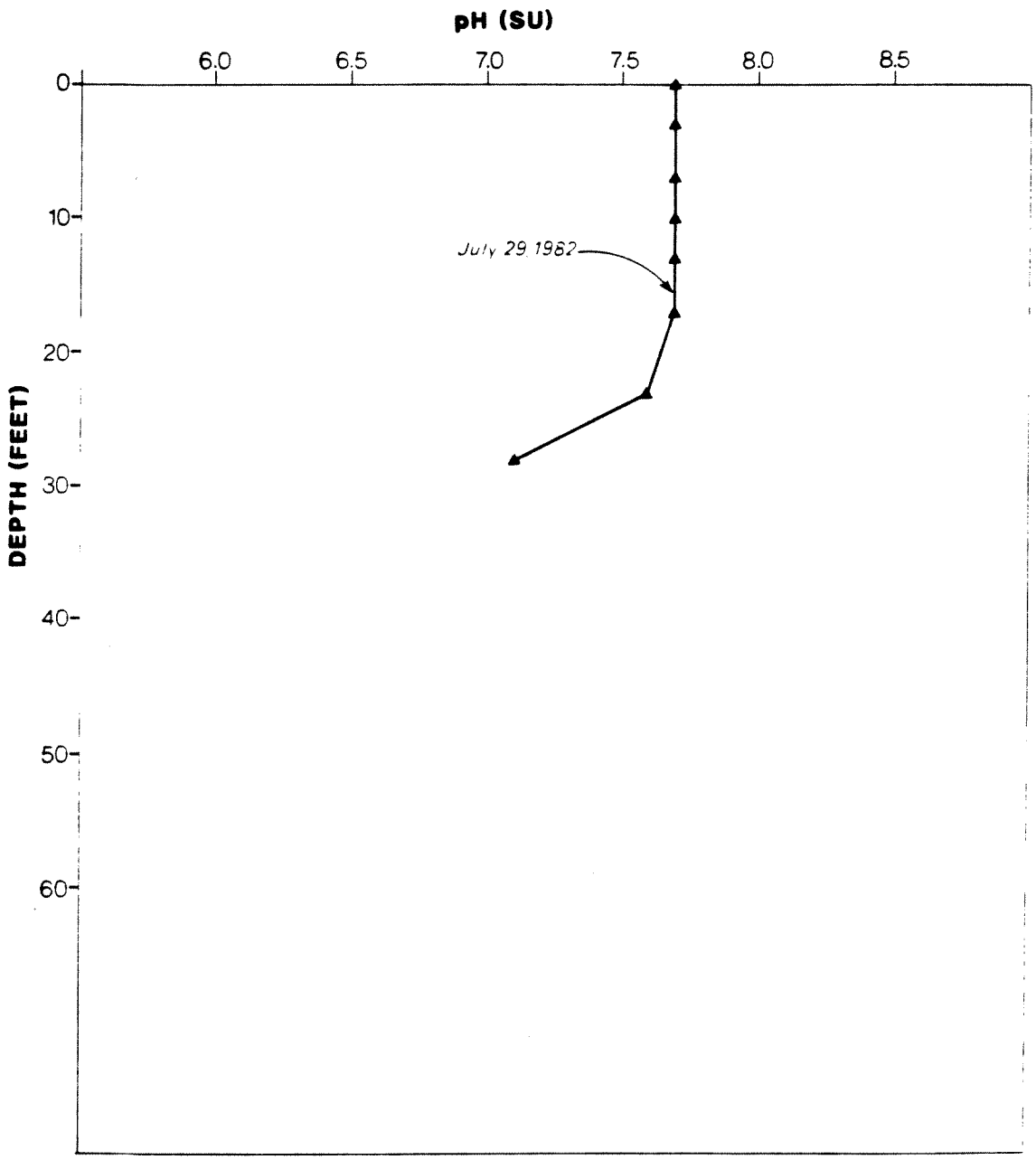


Figure 10.7a Vertical pH profile in Lawtonka Reservoir at sample site 3 (July 29,1983)

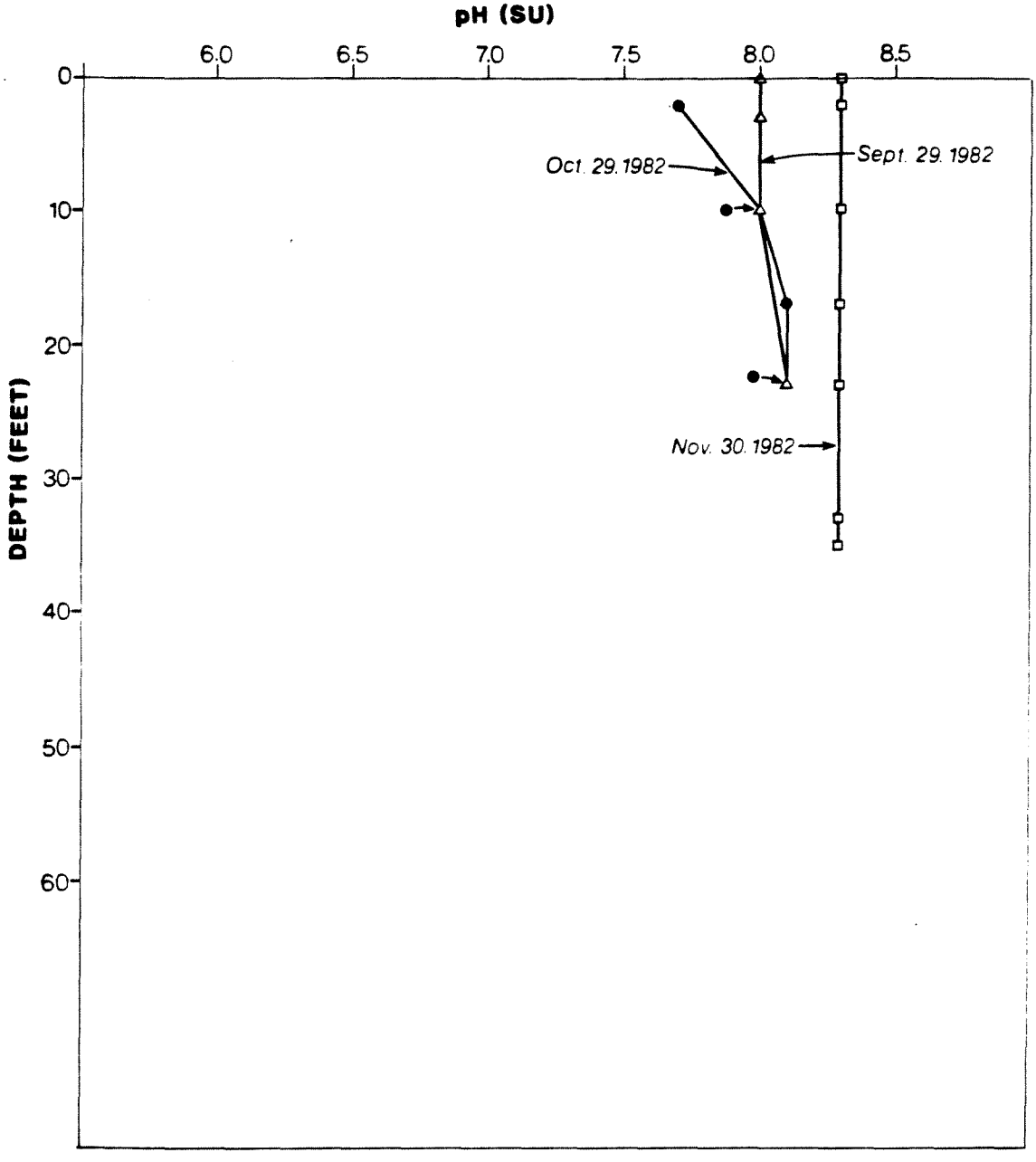


Figure 10.7b Vertical pH profile in Lawtonka Reservoir at sample site 3 (Sept.-Nov. 1982)

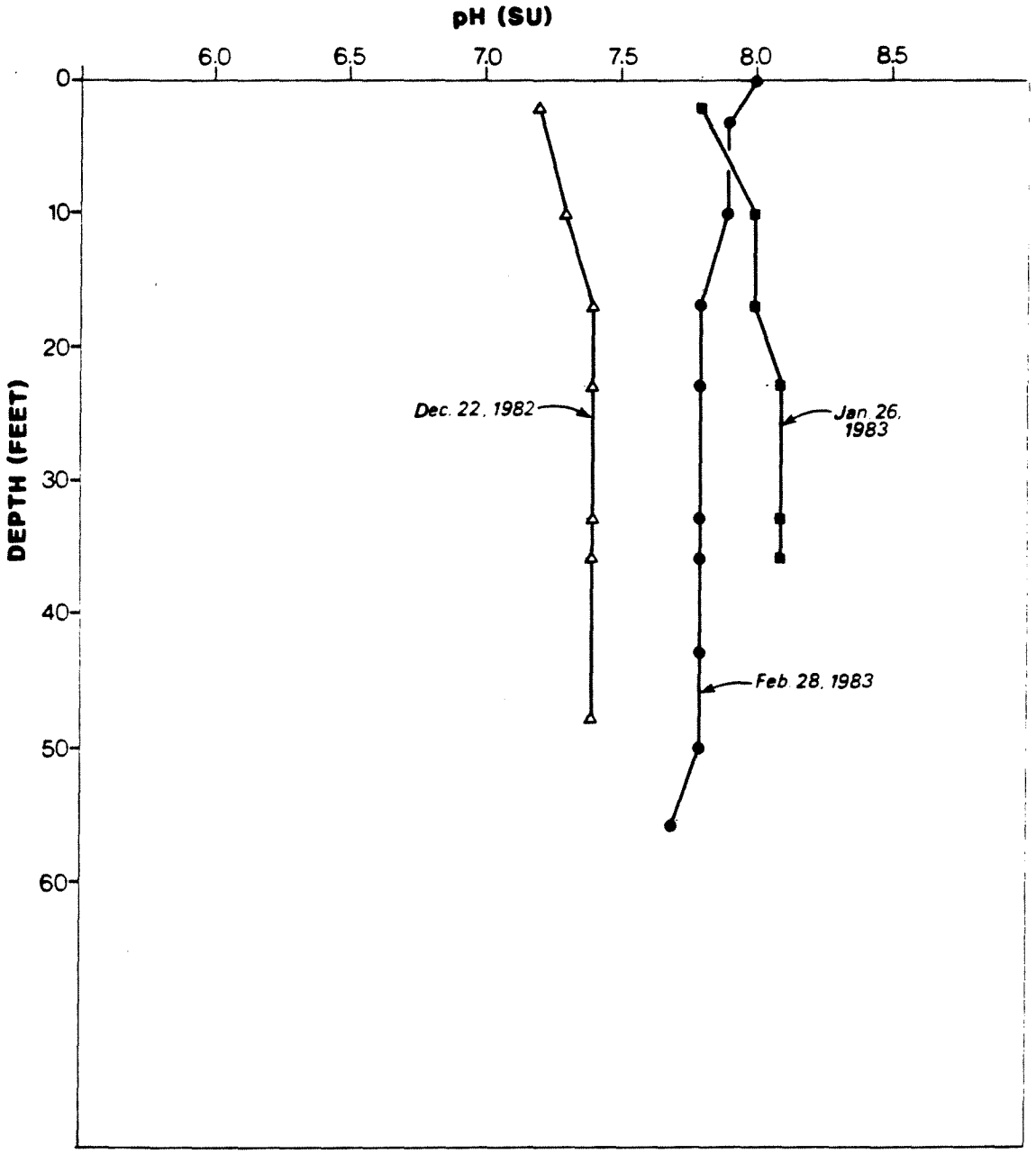


Figure 10.7c Vertical pH profile in Lawtonka Reservoir at sample site 3

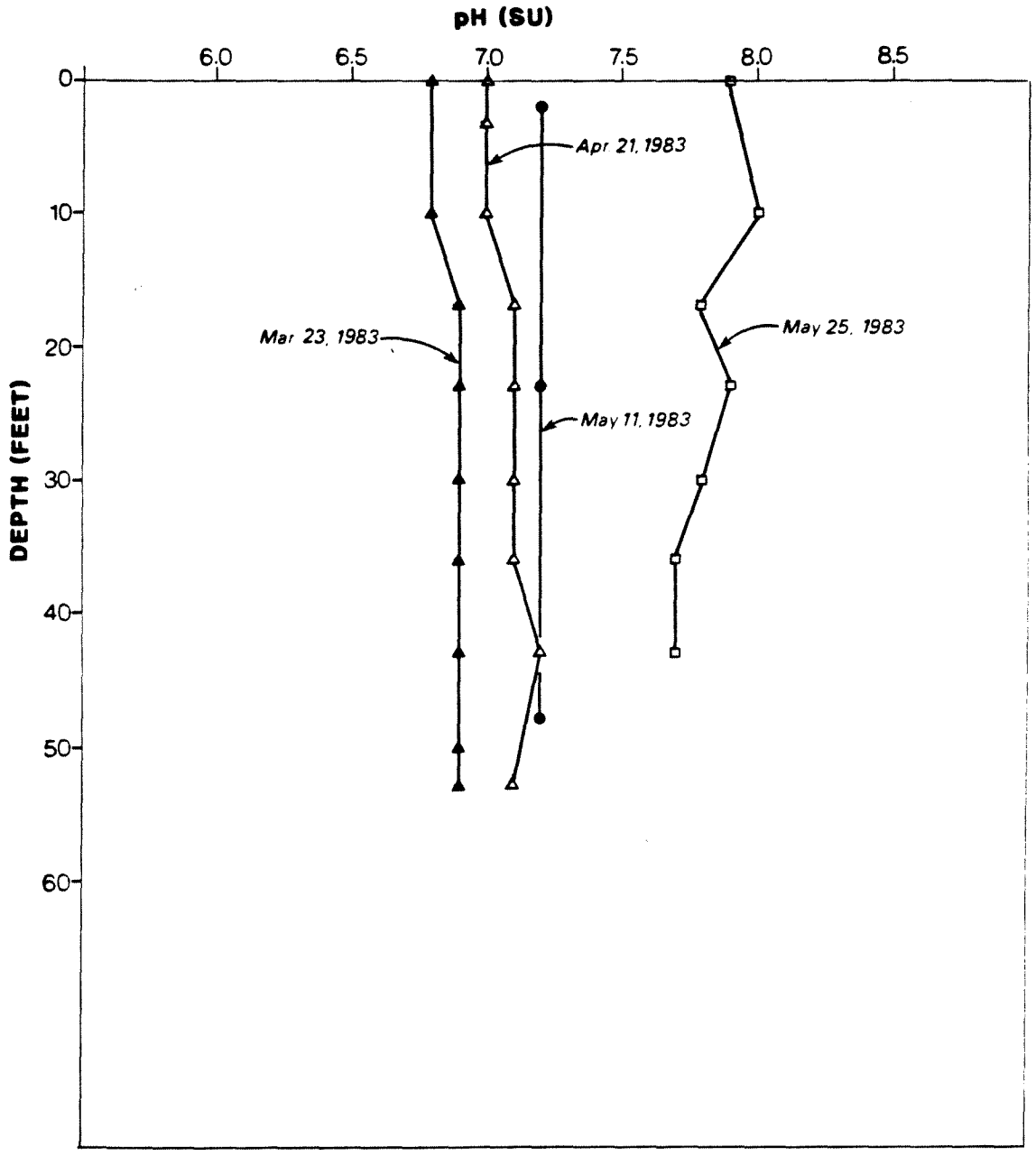


Figure 10.7d Vertical pH profile in Lawtonka Reservoir at sample site 3 (March-May 1983)

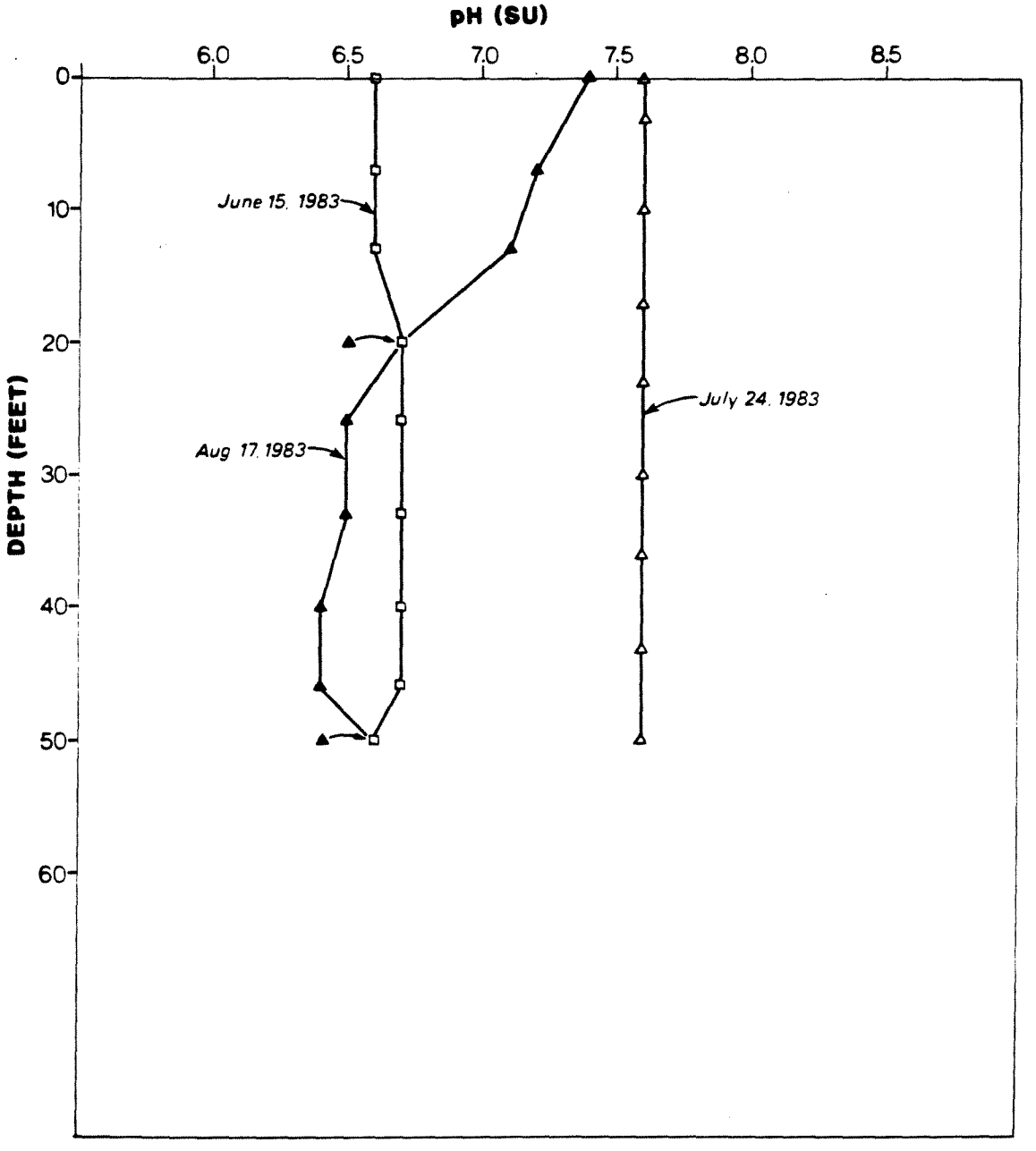


Figure 10.7e Vertical pH profile in Lawtonka Reservoir at sample site 3 (July-Aug. 1983)

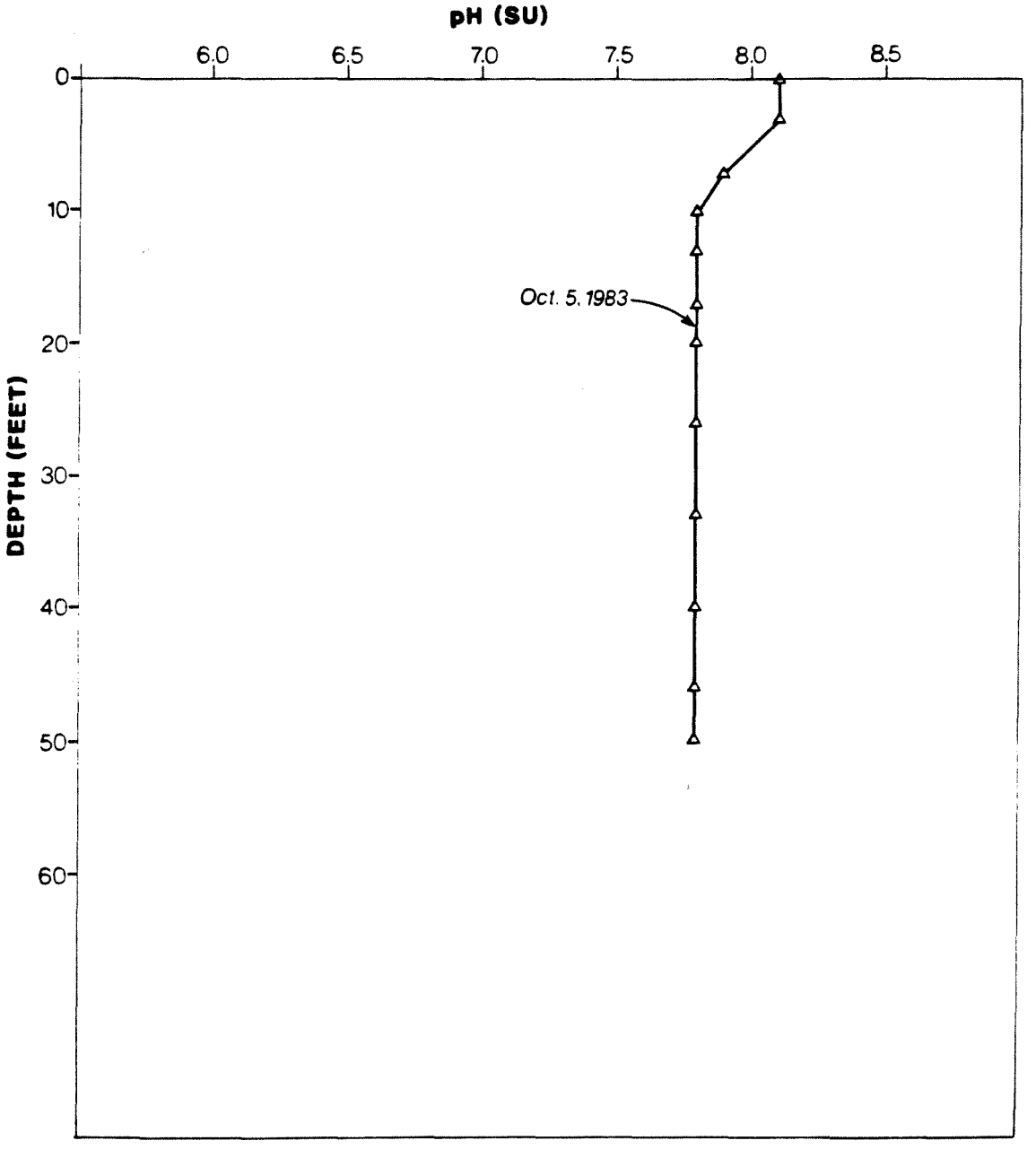


Figure 10.7f Vertical pH profile in Lawtonka Reservoir at sample site 3 (Oct. 5,1983)

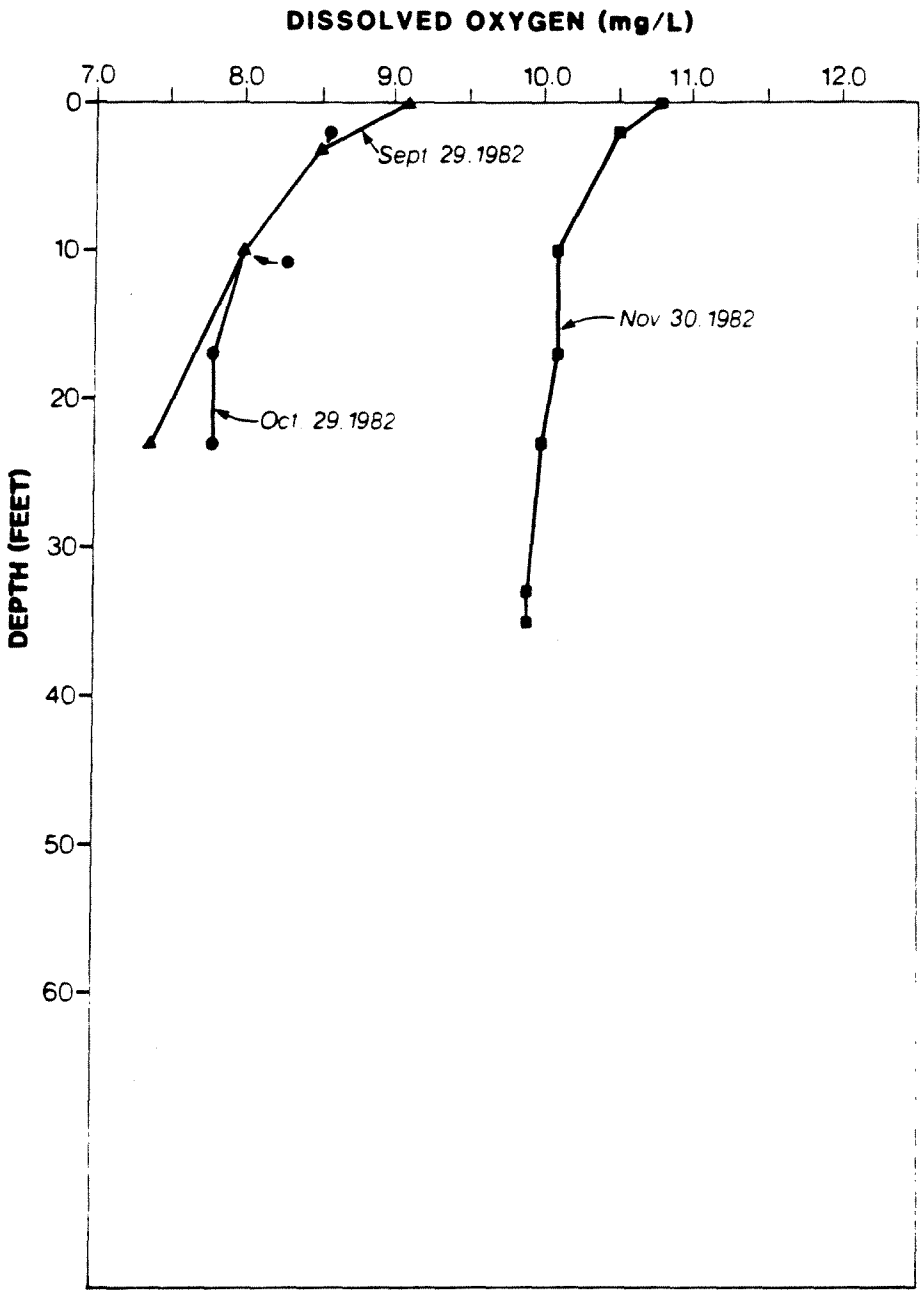


Figure 10.8b Vertical dissolved oxygen profile in Lawtonka Reservoir at sample site 3 (Sept.-Nov. 1982)

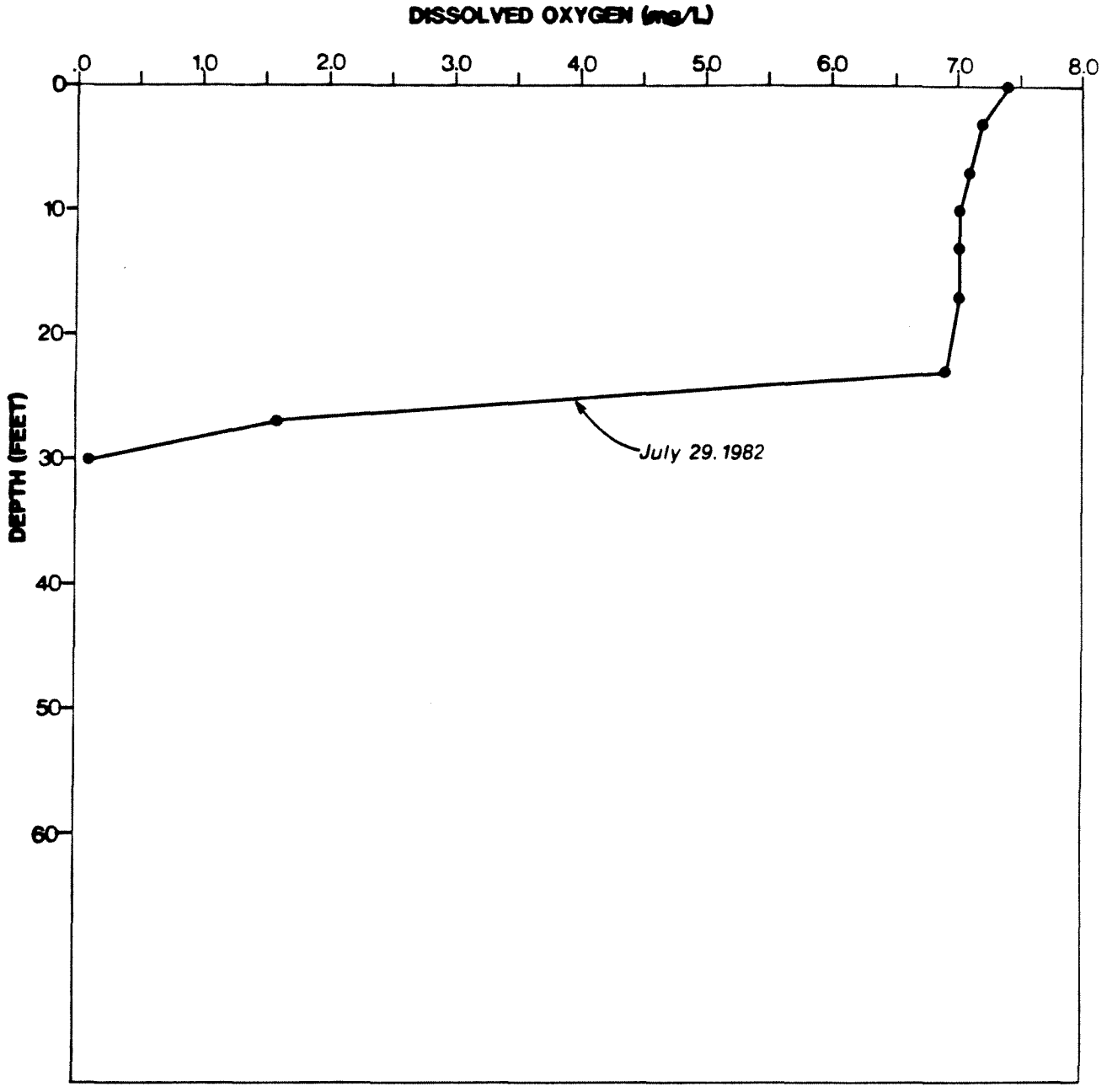


Figure 10.8a Vertical dissolved oxygen profile in Lawtonka Reservoir at sample site 3 (July 29,1982)

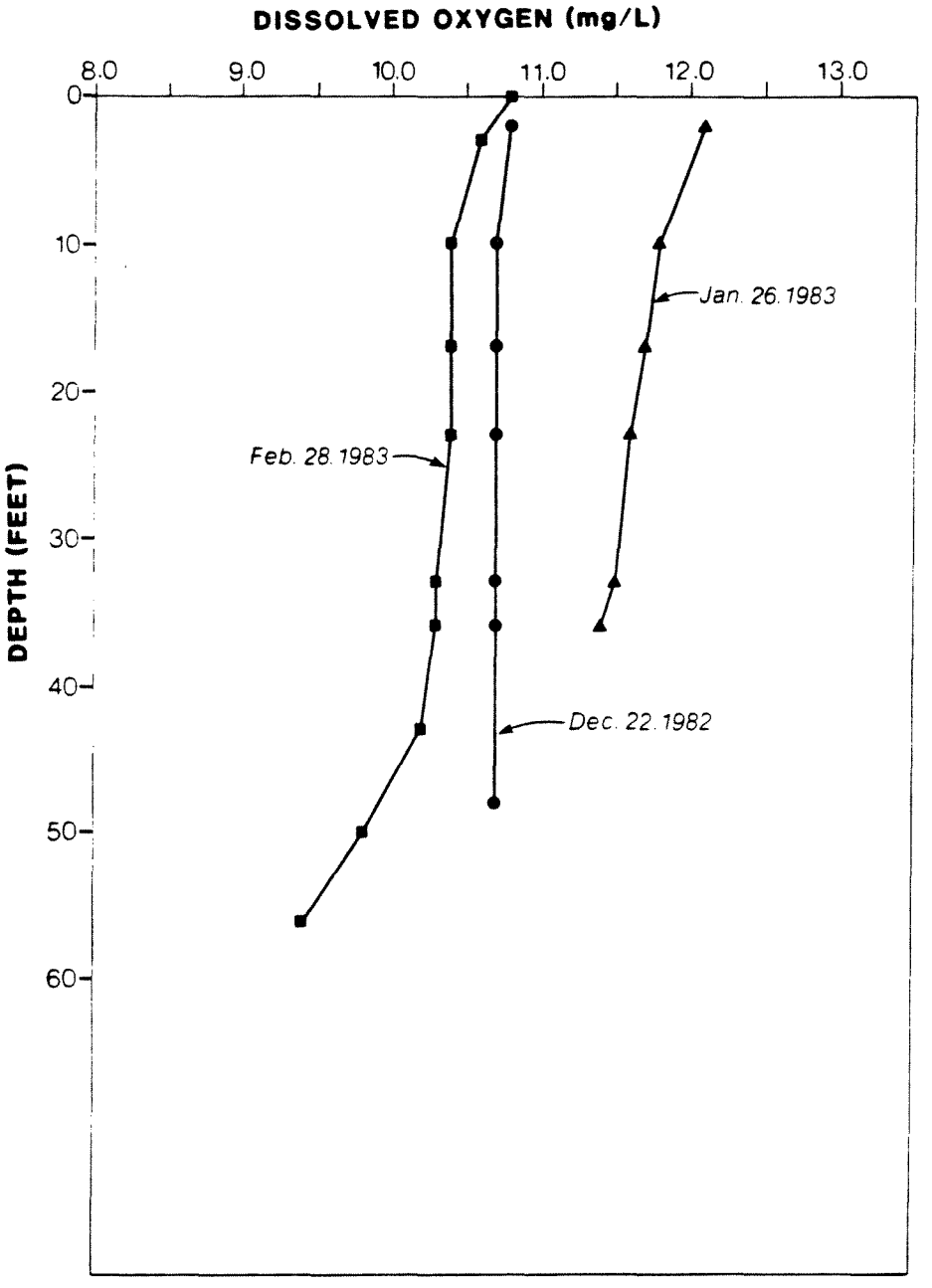


Figure 10.8c Vertical dissolved oxygen profile in Lawtonka Reservoir at sample site 3 (Dec. 1982-Feb. 1983)

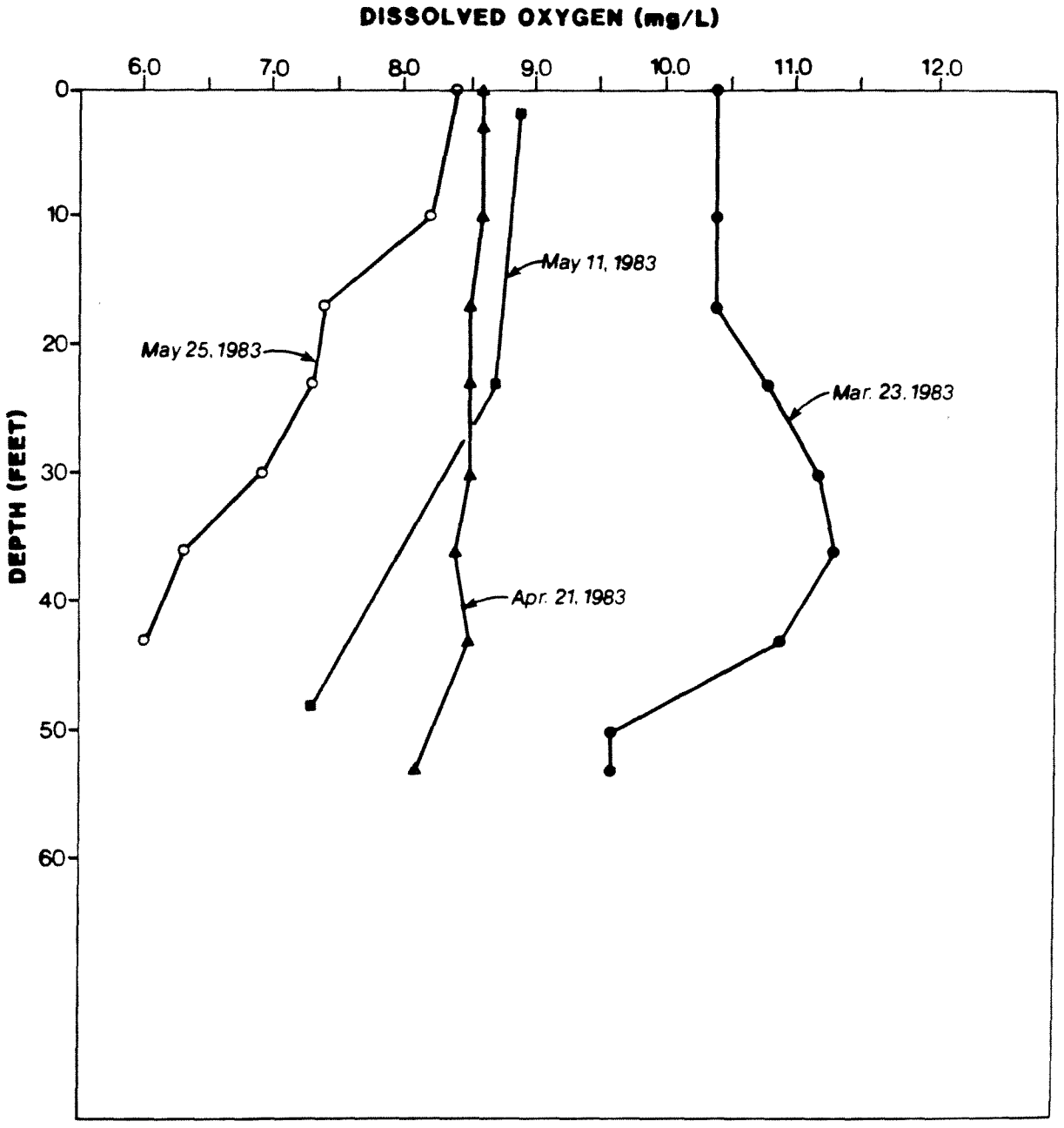


Figure 10.8d Vertical dissolved oxygen profile in Lawtonka Reservoir at sample site 3 (March-May 1983)

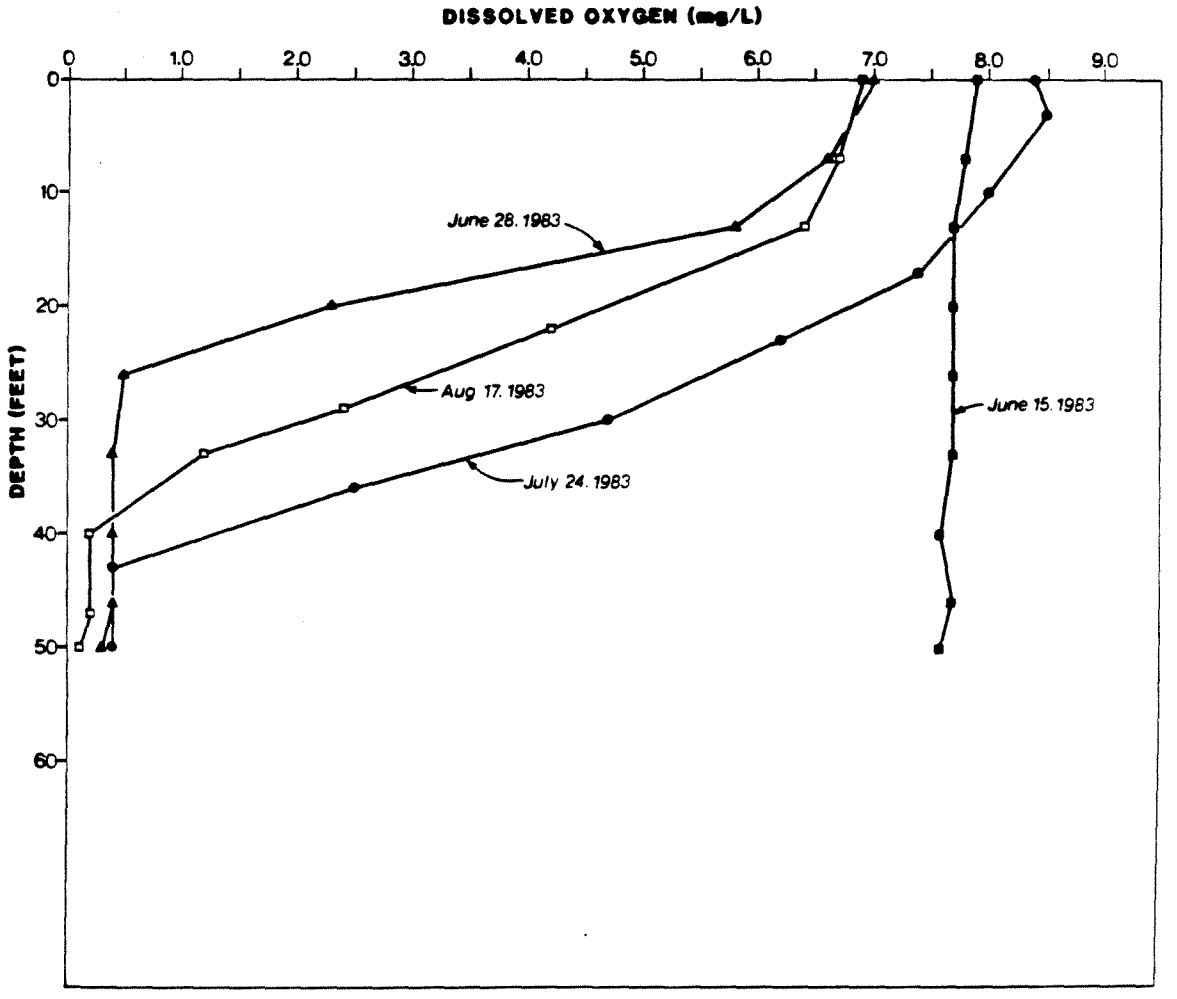


Figure 10.8e Vertical dissolved oxygen profile in Lawtonka Reservoir at sample site 3 (June-Aug. 1983)

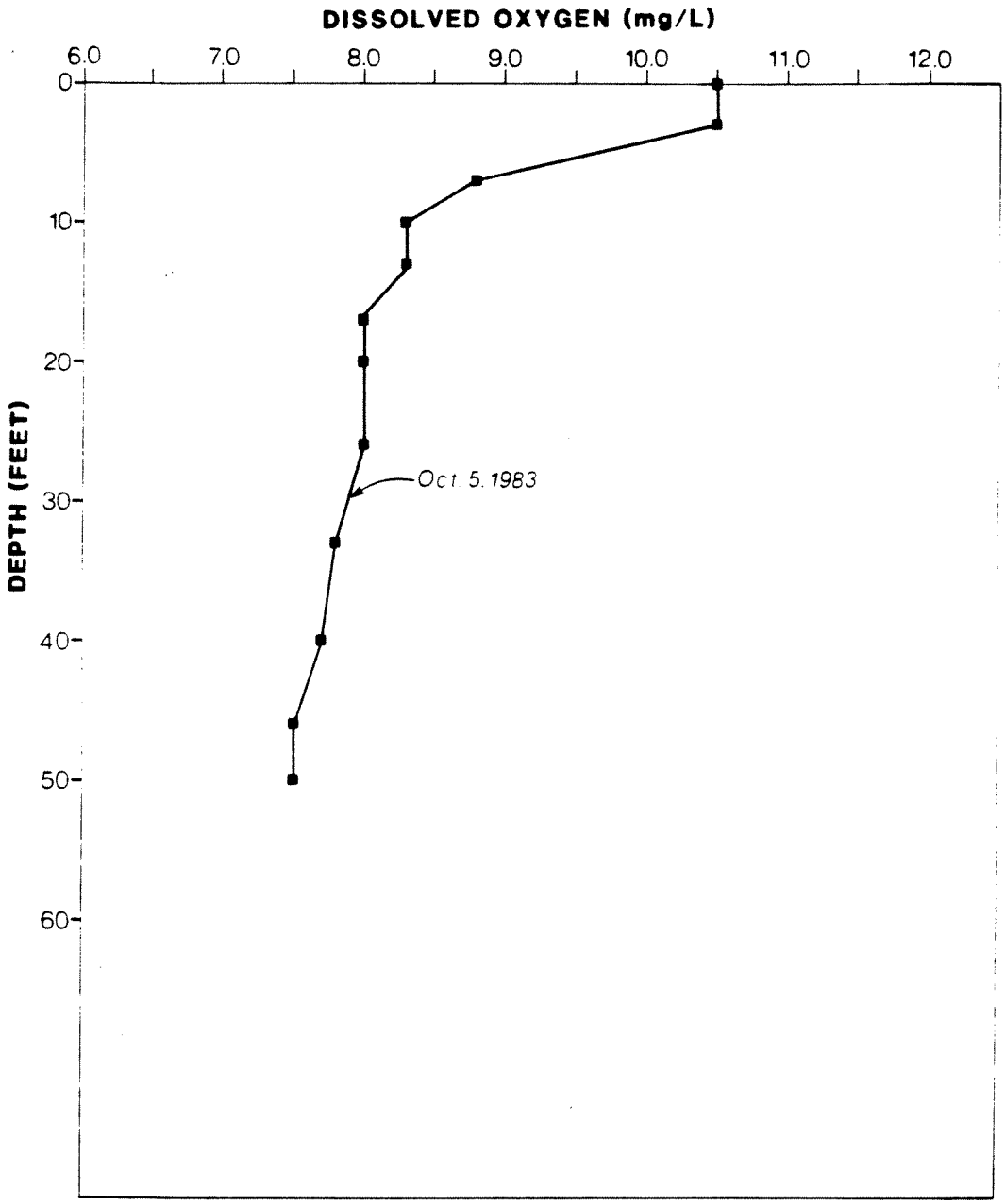


Figure 10.8f Vertical dissolved oxygen profile in Lawtonka Reservoir at sample site 3 (Oct. 5.1983)

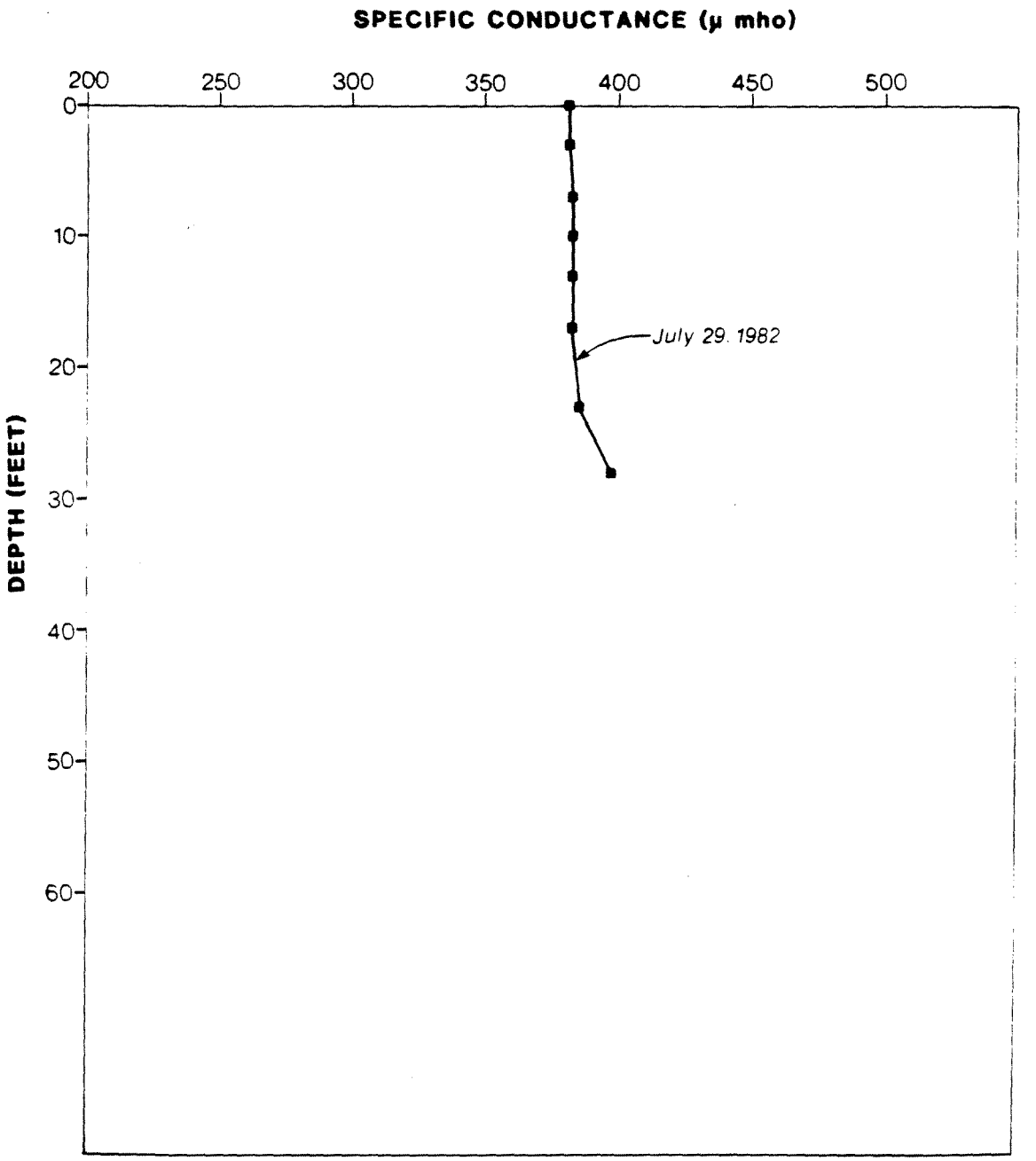


Figure 10.9a Vertical conductivity profile in Lawtonka Reservoir at sample site 3 (July 29,1982)

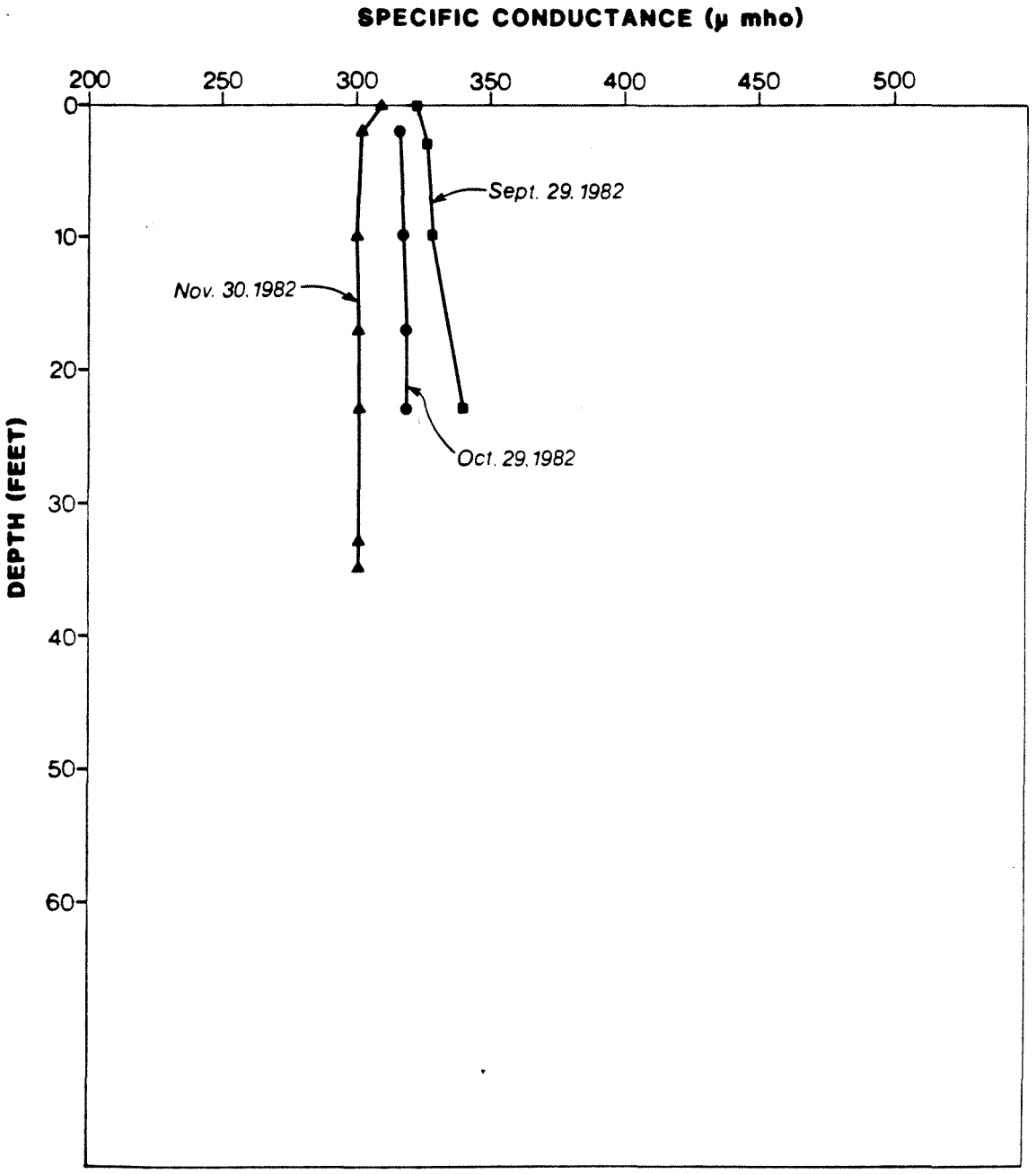


Figure 10.9b Vertical conductivity profile in Lawtonka Reservoir at sample site 3 (Sept.-Nov. 1982)

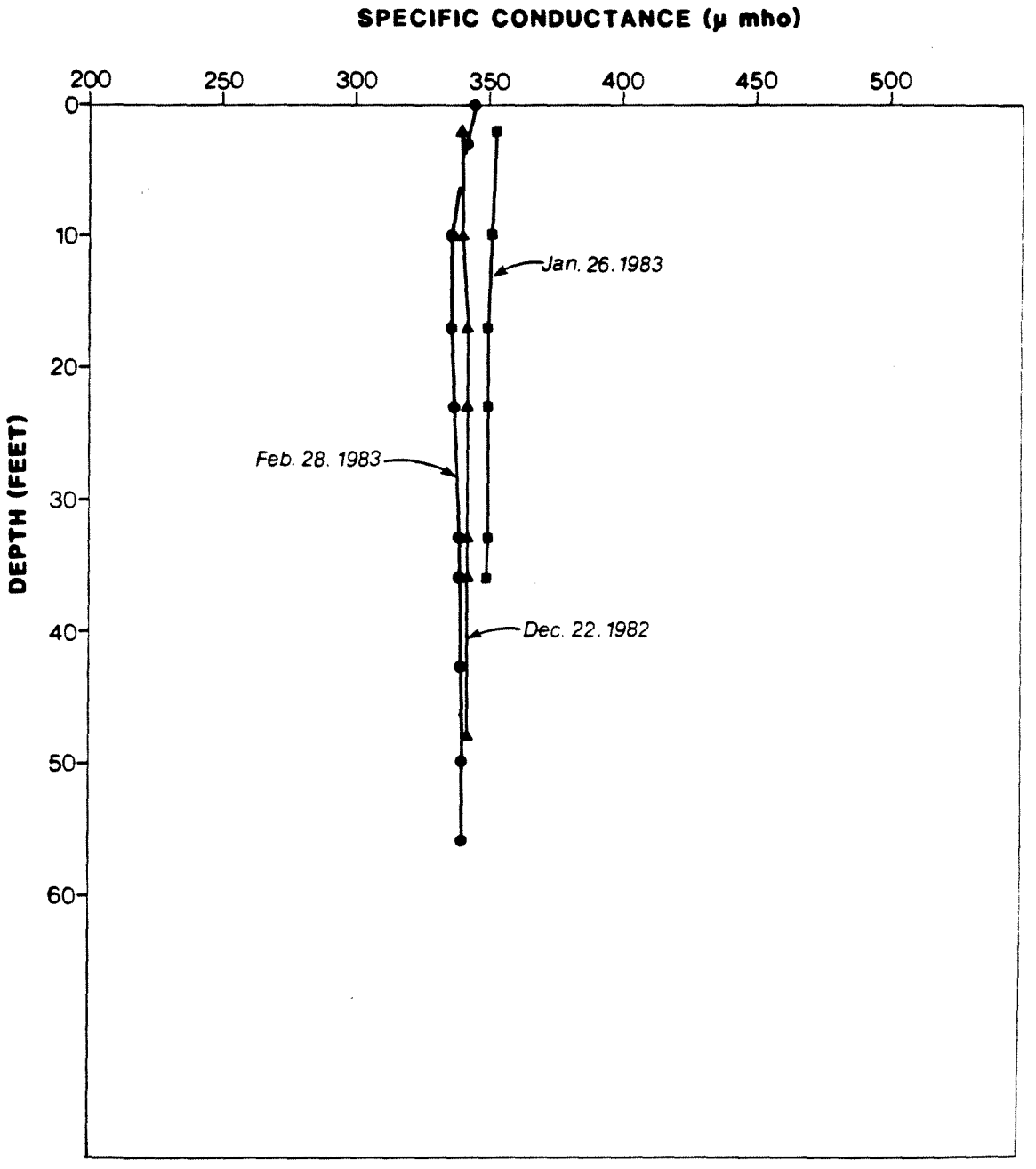


Figure 10.9c Vertical conductivity profile in Lawtonka Reservoir at sample site 3 (Dec. 1982-Feb. 1983)

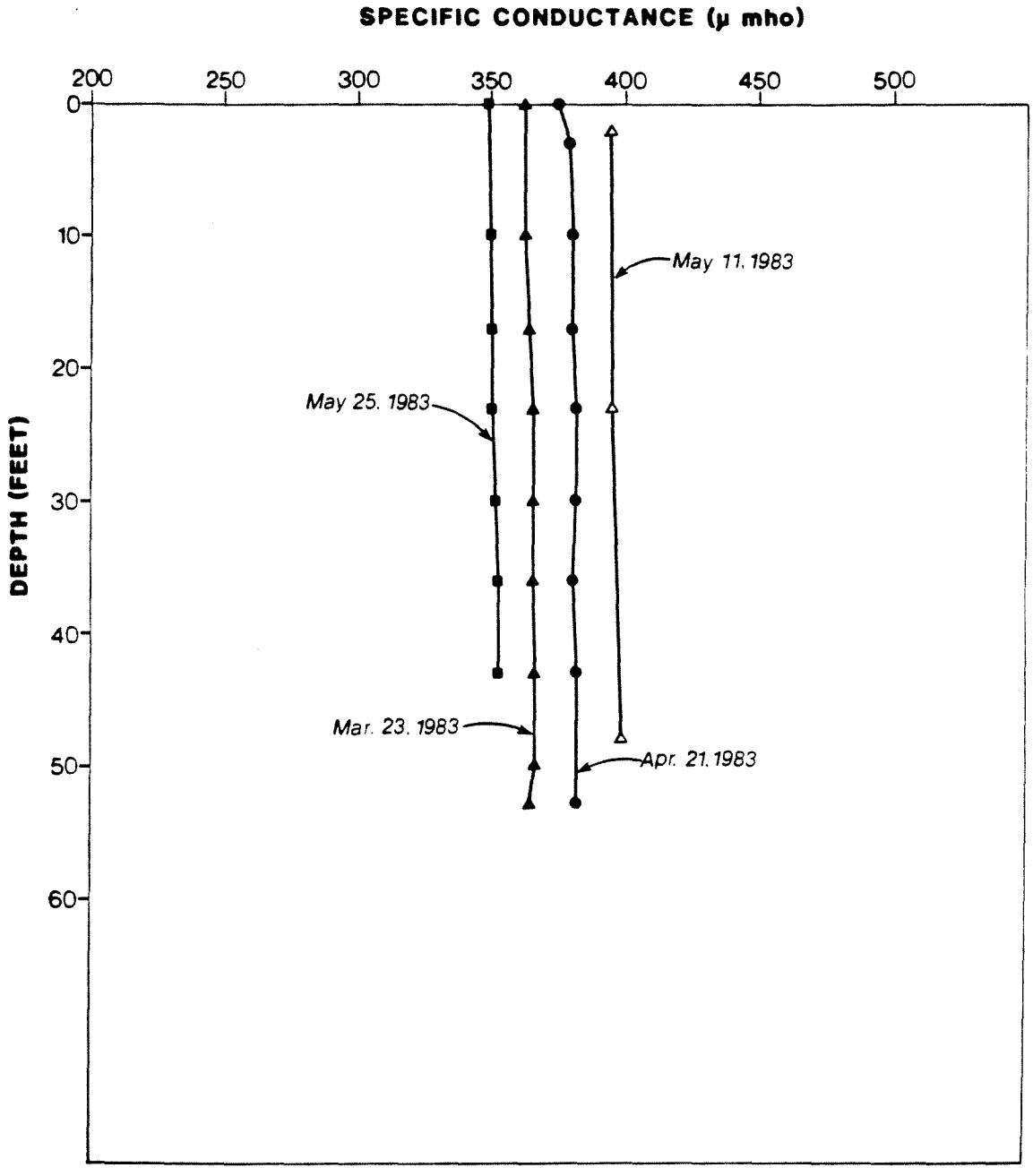


Figure 10.9d Vertical conductivity profile in Lawtonka Reservoir at sample site 3 (March-May 1983)

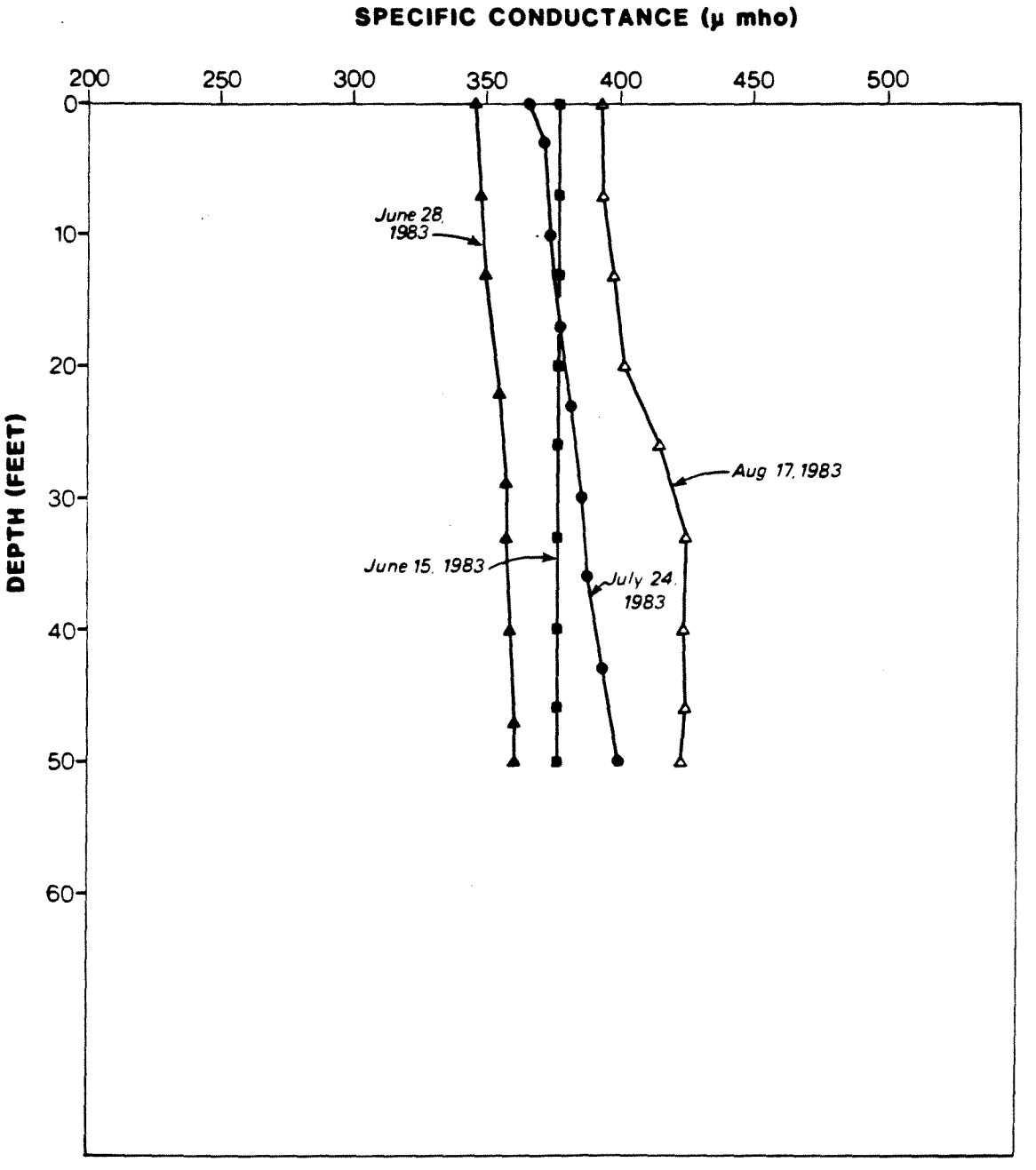


Figure 10.9e Vertical conductivity profile in Lawtonka Reservoir at sample site 3 (June-Aug. 1983)

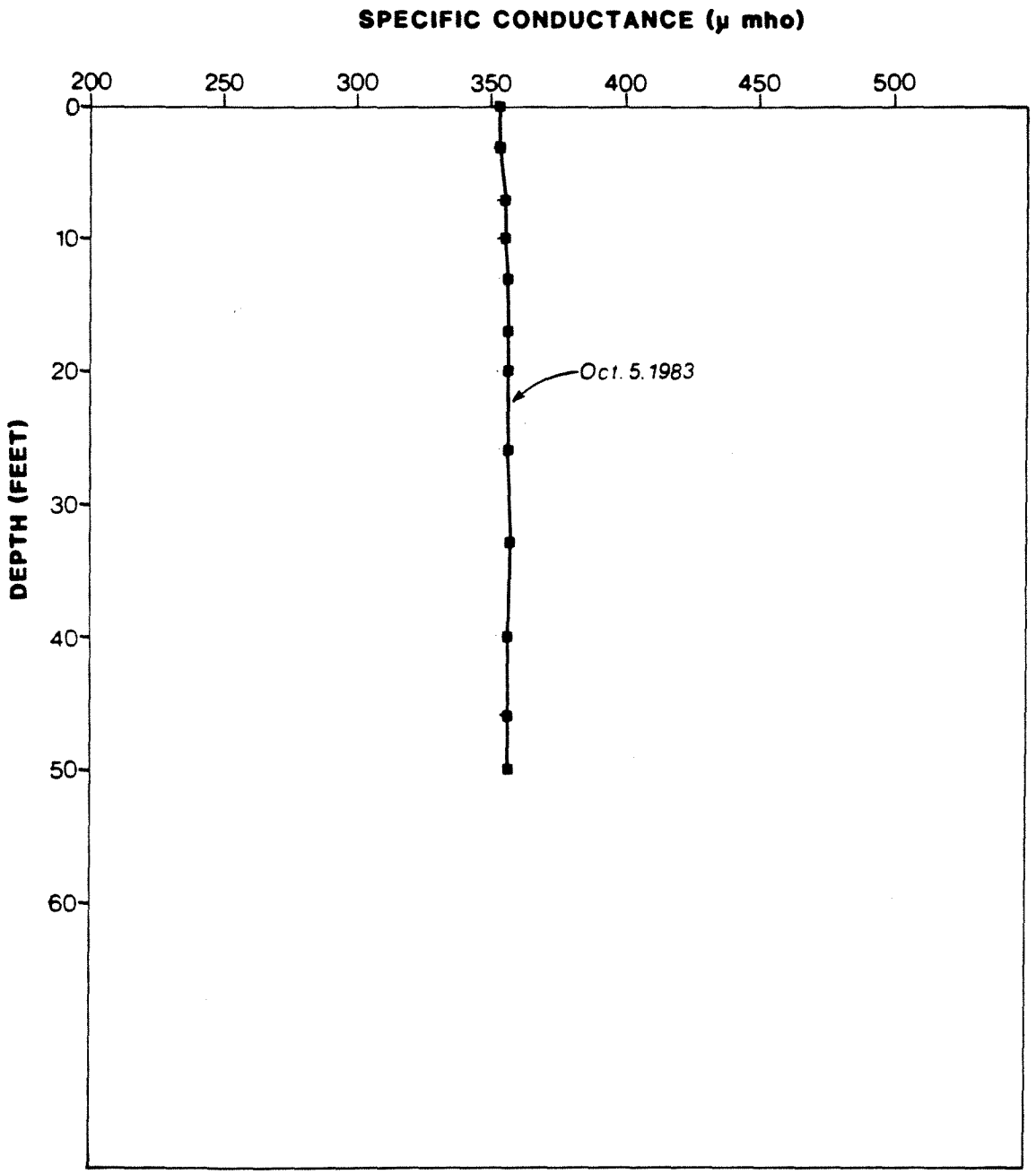


Figure 10.9f Vertical conductivity profile in Lawtonka Reservoir at sample site 3 (Oct. 5,1983)

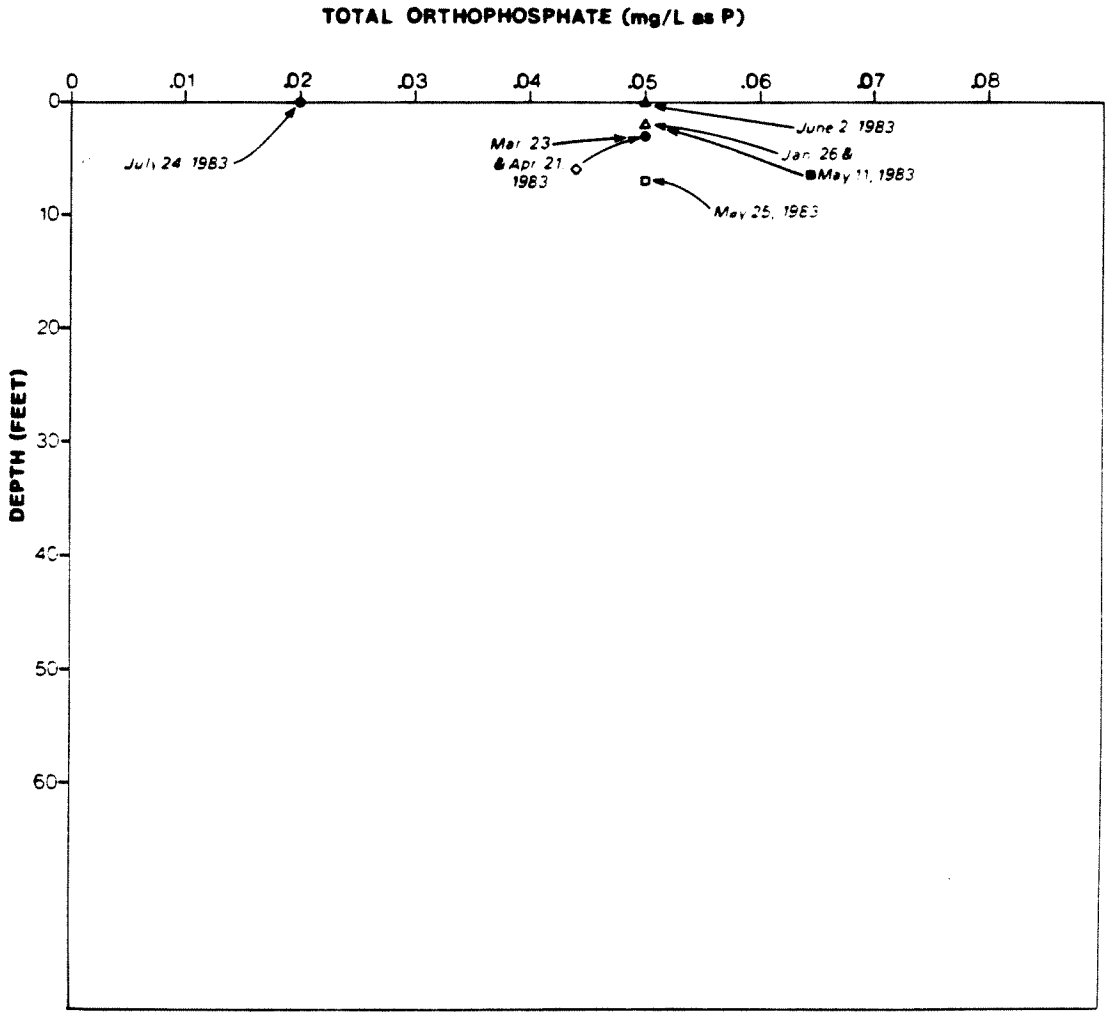


Figure 10.10a Vertical total orthophosphate profile in Lawtonka Reservoir at sample site 1 (Jan.-July 1983)

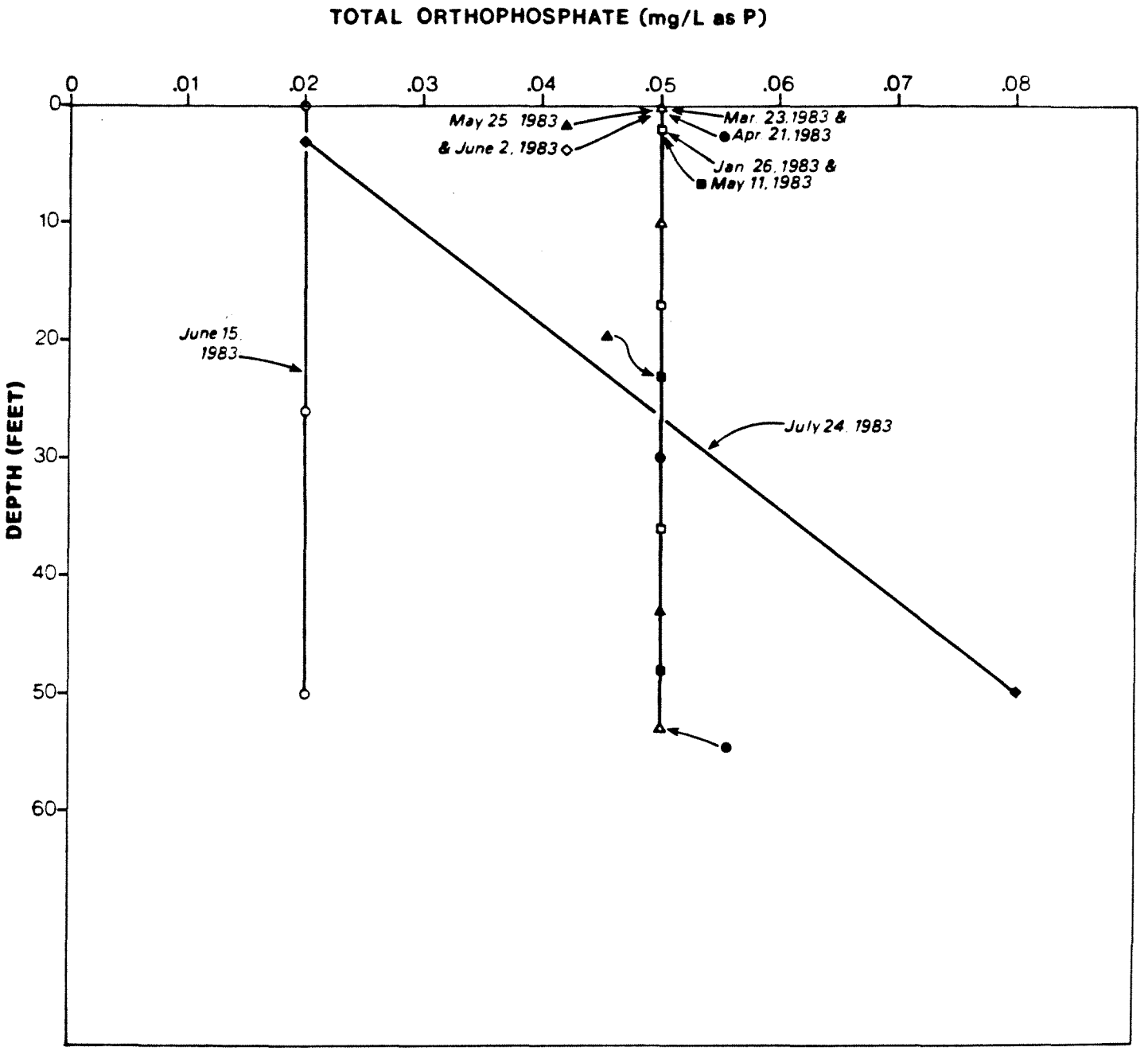


Figure 10.10b Vertical total orthophosphate profile in Lawtonka Reservoir at sample site 3 (Jan.-July 1983)

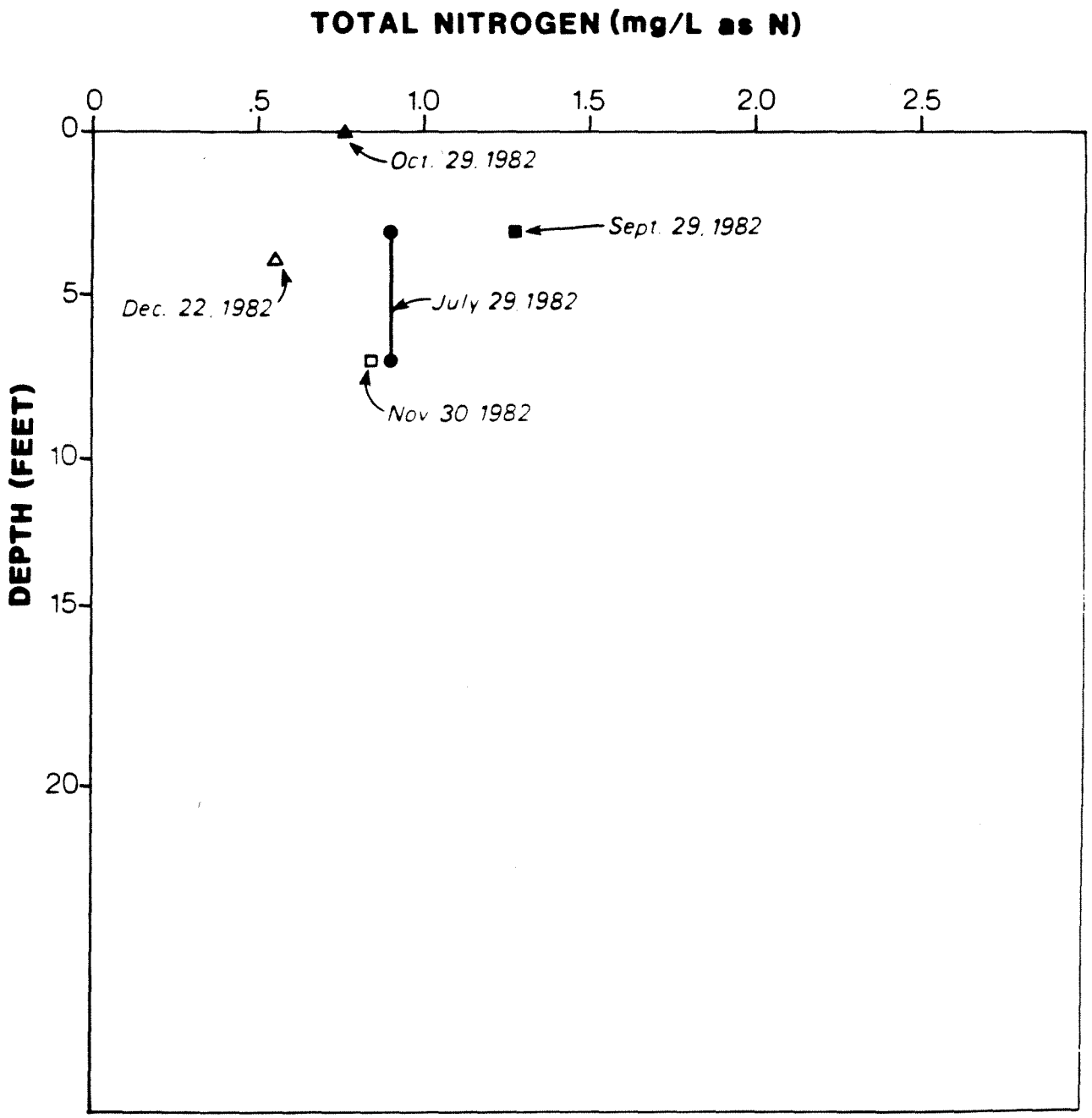


Figure 10.11a Vertical Total Nitrogen profile in Lawtonka Reservoir at sample site 1 (July-Dec. 1982)

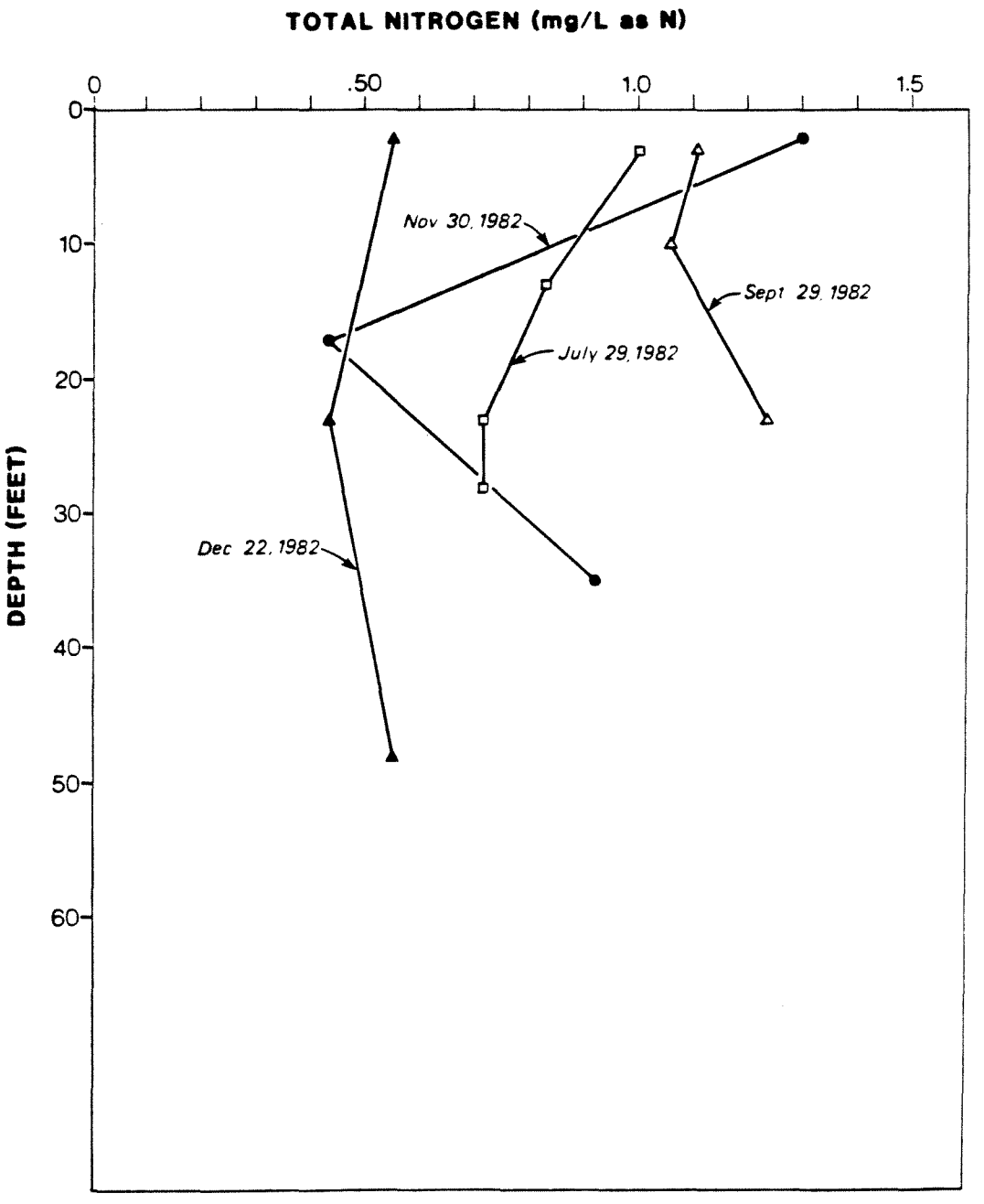


Figure 10.11b Vertical Total Nitrogen profile in Lawtonka Reservoir at sample site 3 (July-Dec. 1982)

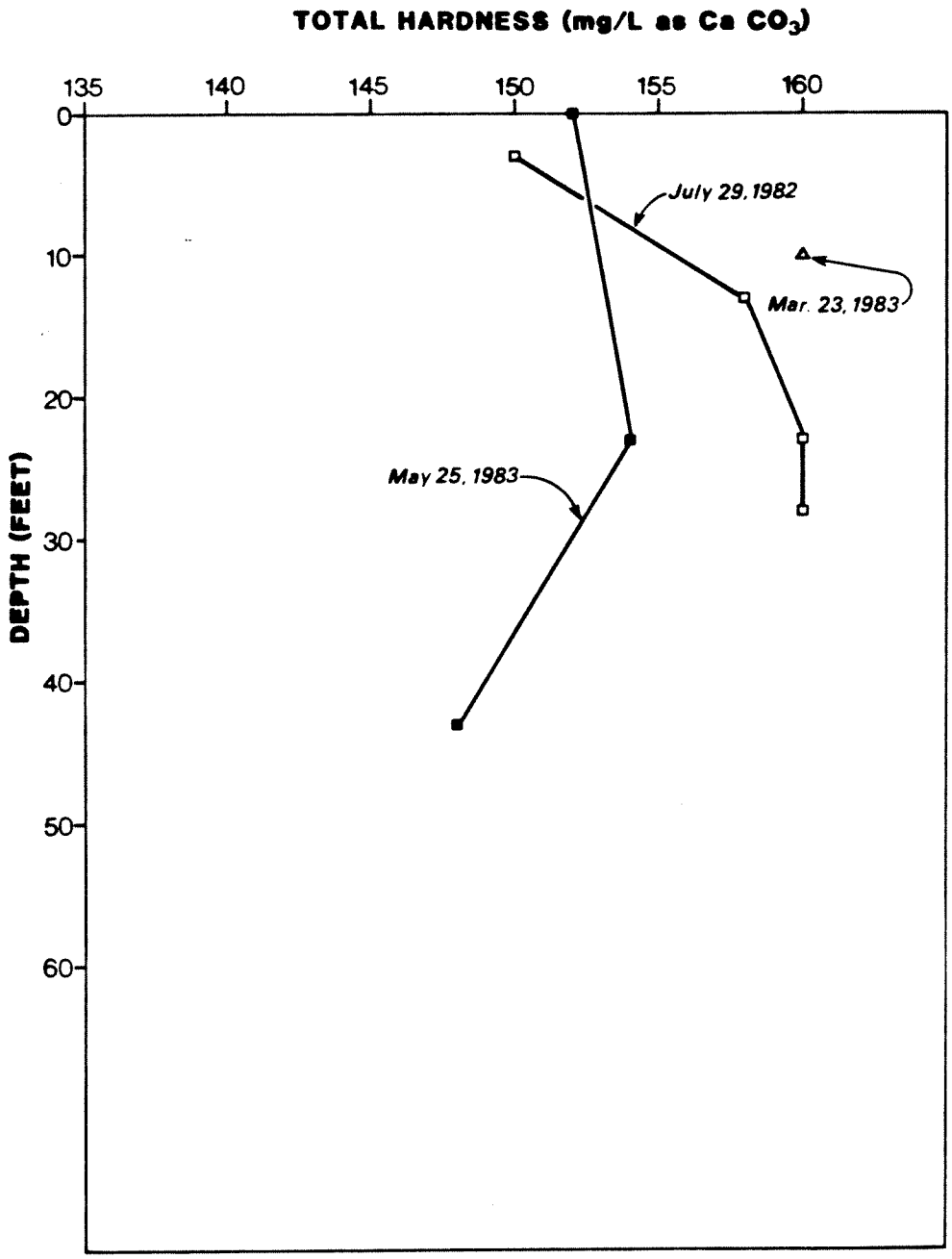


Figure 10.12a Vertical total hardness profile in Lawtonka Reservoir at sample site 3 (March-July 1982)

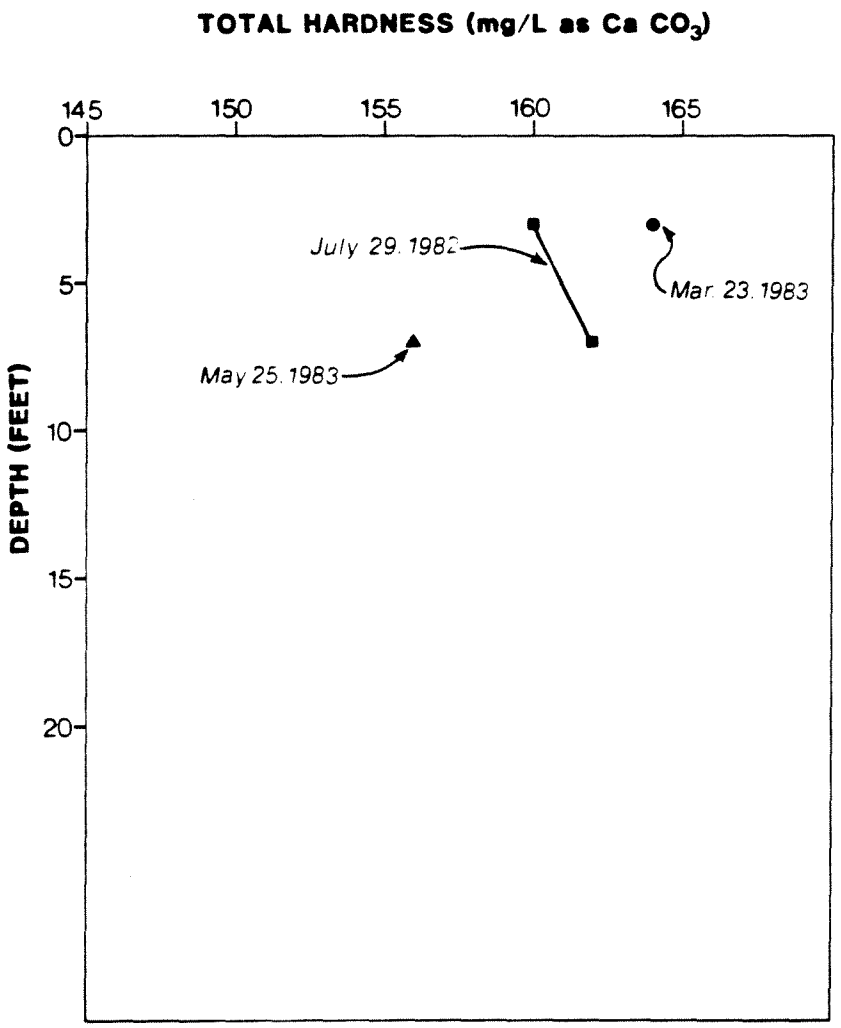


Figure 10.12b Vertical total hardness profile in Lawtonka Reservoir at sample site 1 (July 1982-May 1983)

	1	3	4	5	6	7	8
1		2	6.5	5	5	2	4.5
3			4.5	3	3	4	2.5
4				1.5	1.5	8.5	2
5					0	7	0.5
6						7	0.5
7							6.5
8							

Critical Value
-at .05 = 15

Figure 10.13a Nonparametric pairwise analysis of Total Nitrogen for sample sites 1,3,4,5,6,7, and 8

1	3	4	5	6	7	8	
	6	2	4	5	4.5	3	1
		4	2	1	1.5	3	3
			2	3	2.5	1	4
				1	0.5	1	5
					0.5	2	6
						1.5	7
							8

Critical Value
-at .05 = 15

Figure 10.13b Nonparametric pairwise analysis of Total Phosphorus for sample sites 1,3,4,5,6,7, and 8

Total Alkalinity in the reservoir (Appendix A) ranged from 116 to 158 mg/L while in the tributaries it ranged from 124 to 290. Phenolphthalein alkalinity ranged from 0 to 14 mg/L as $CaCO_4$, indicating the reservoir was a well buffered system and the predominant ionic species was the bicarbonate ion (Figures 10.14a and b).

Biological:

Biological quality of Lawtonka Reservoir was evaluated based upon the analysis of chlorophyll standing crop (Figures 10.15a, b, and c). A nonparametric statistical analysis was performed upon the spectrophotometrically analyzed chlorophyll a data collected at sample sites 1 and 3 with the sampling frequency specified in the Federal Register (Vol. 45, No. 25). No significant differences were found to exist between the various sample sites with regard to their chlorophyll a content.

The conclusion that there were no significant differences in chlorophyll a distribution within Lawtonka Reservoir seemed, based upon our experience with the reservoir, to be largely due to the imposed sampling frequency. Consequently, a method (Grimshaw and Shapiro, 1983) utilizing flow-through fluorometry was developed to intensively analyze the spatial and temporal distribution of chlorophyll a. One harbor (School House Slough) and ten in-reservoir transects were run on each sampling occasion (Figure 10.16). During a given transect run (always east to west), reservoir water from four depths (.5, 1.0, 1.5 and 2.0 meters) was sequentially pumped through a Turner model 10 fluorometer (1980). Data

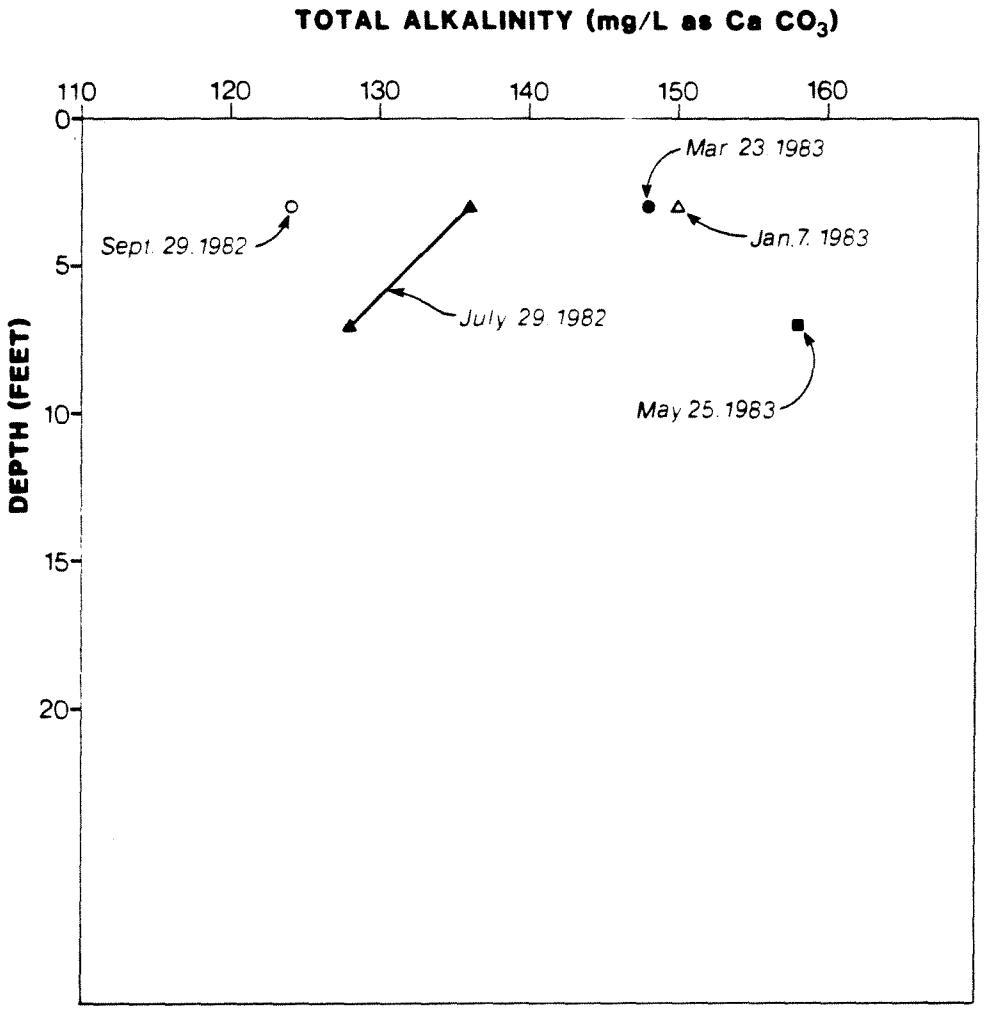


Figure 10.14a Vertical total alkalinity profile in Lawtonka Reservoir at sample site 1 (July 1982-May 1983)

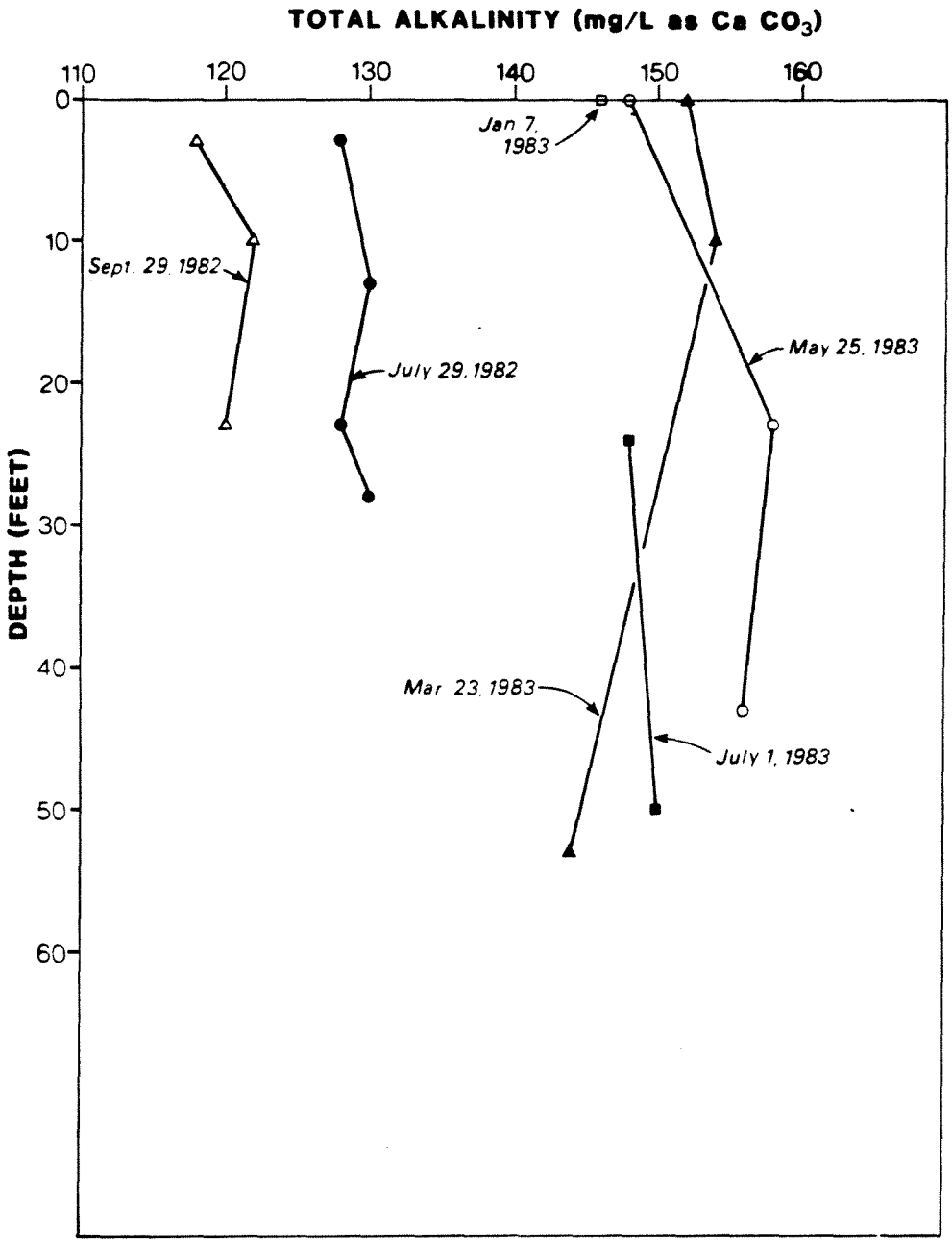


Figure 10.14b Vertical total alkalinity profile in Lawtonka Reservoir at sample site 3 (July 1982-July 1983)

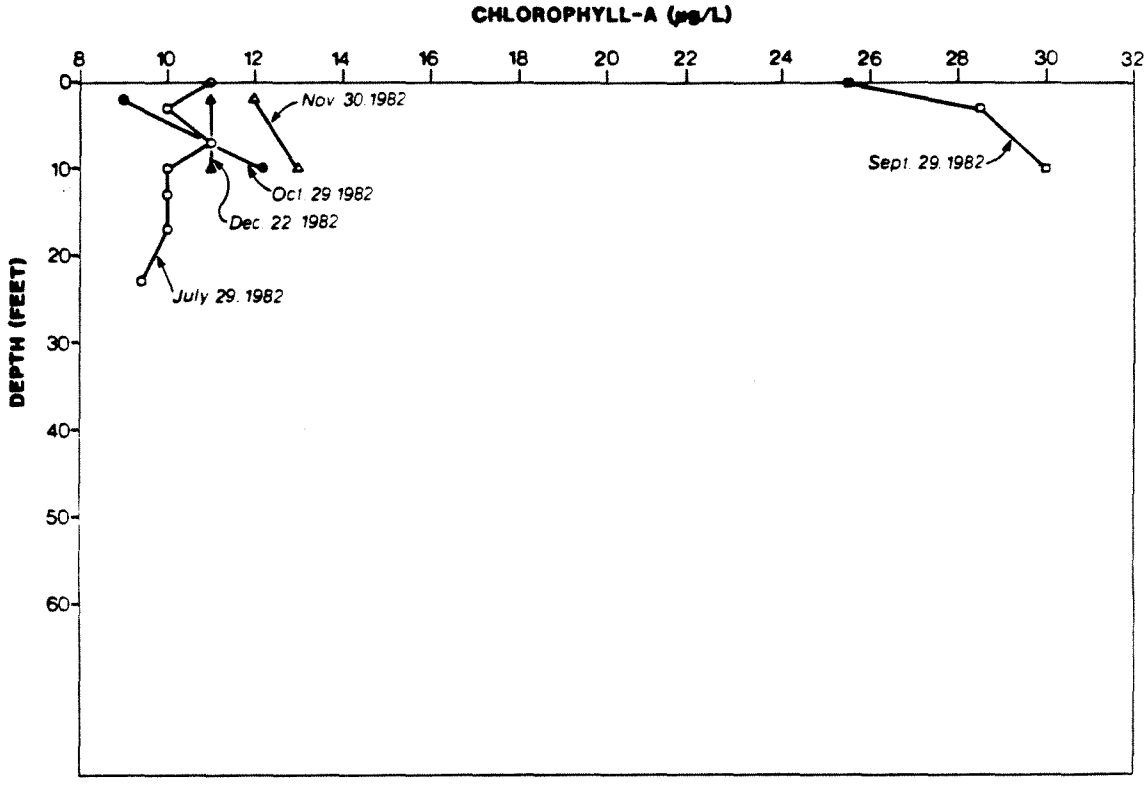


Figure 10.15a Vertical chlorophyll-a profile in Lawtonka Reservoir at sample site 3 (July-Dec. 1982)

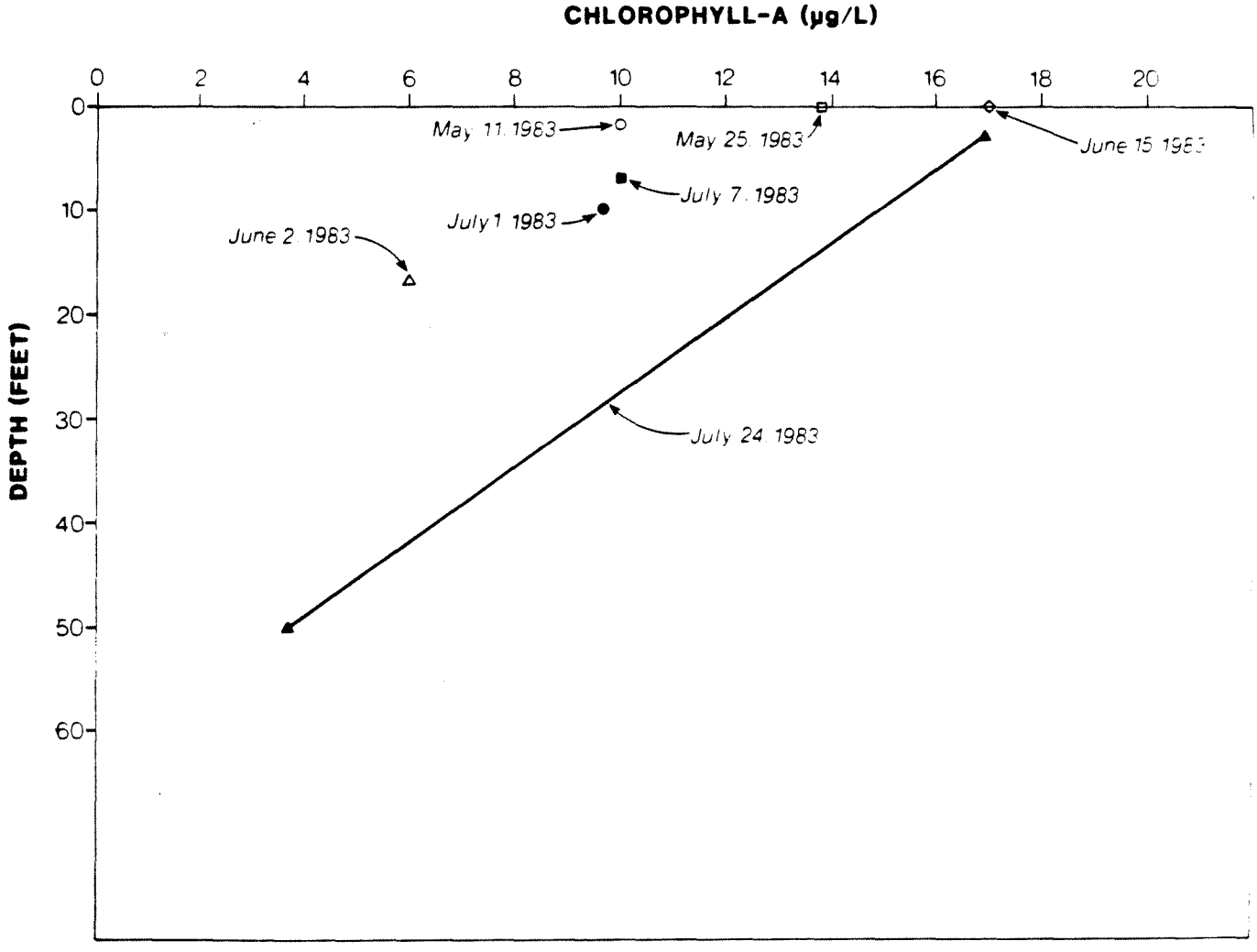


Figure 10.15b Vertical chlorophyll-a profile in Lawtonka Reservoir at sample site 3 (May-July 1983)

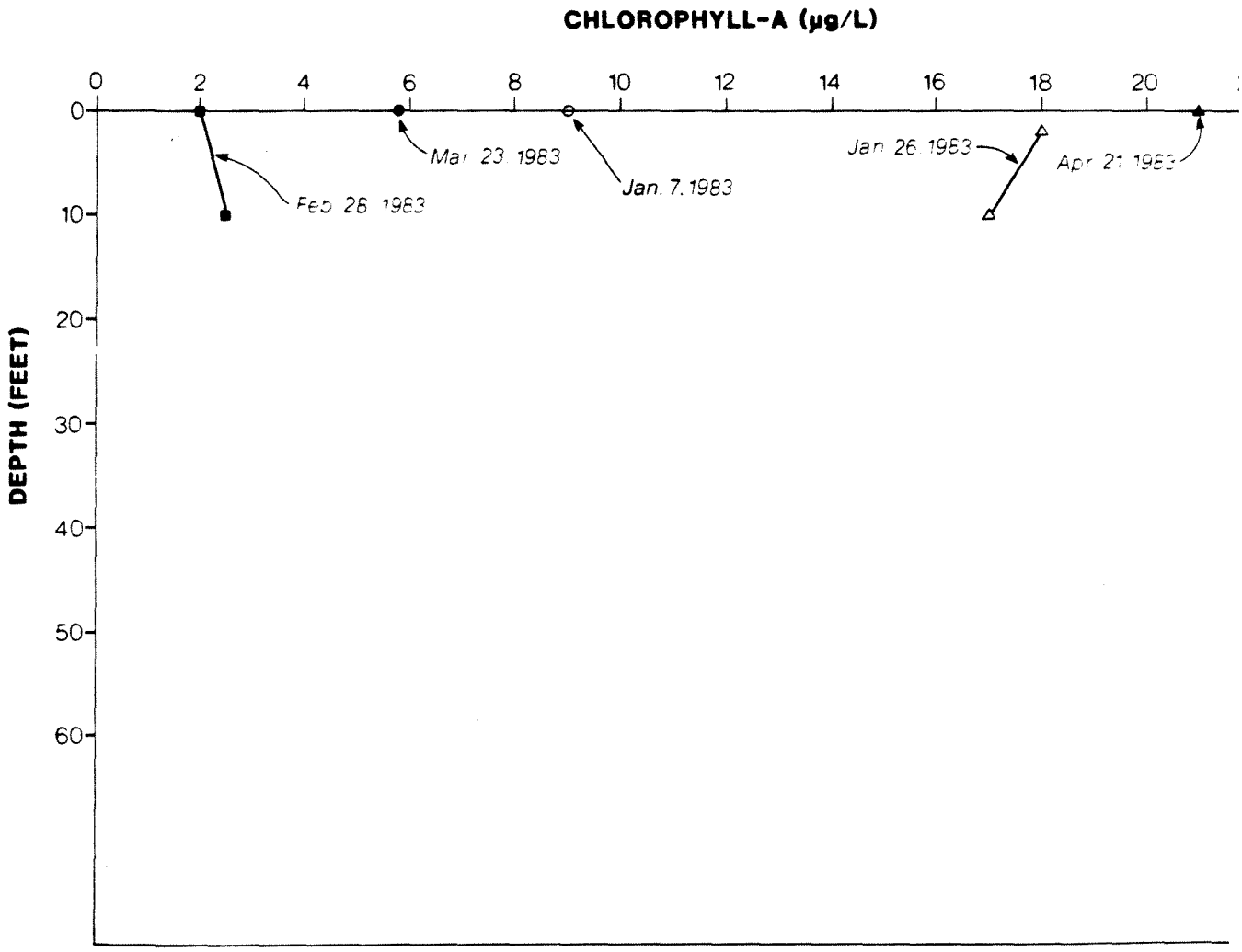


Figure 10.15c Vertical chlorophyll-a profile in Lawtonka Reservoir at sample site 1 (Jan.-April 1983)

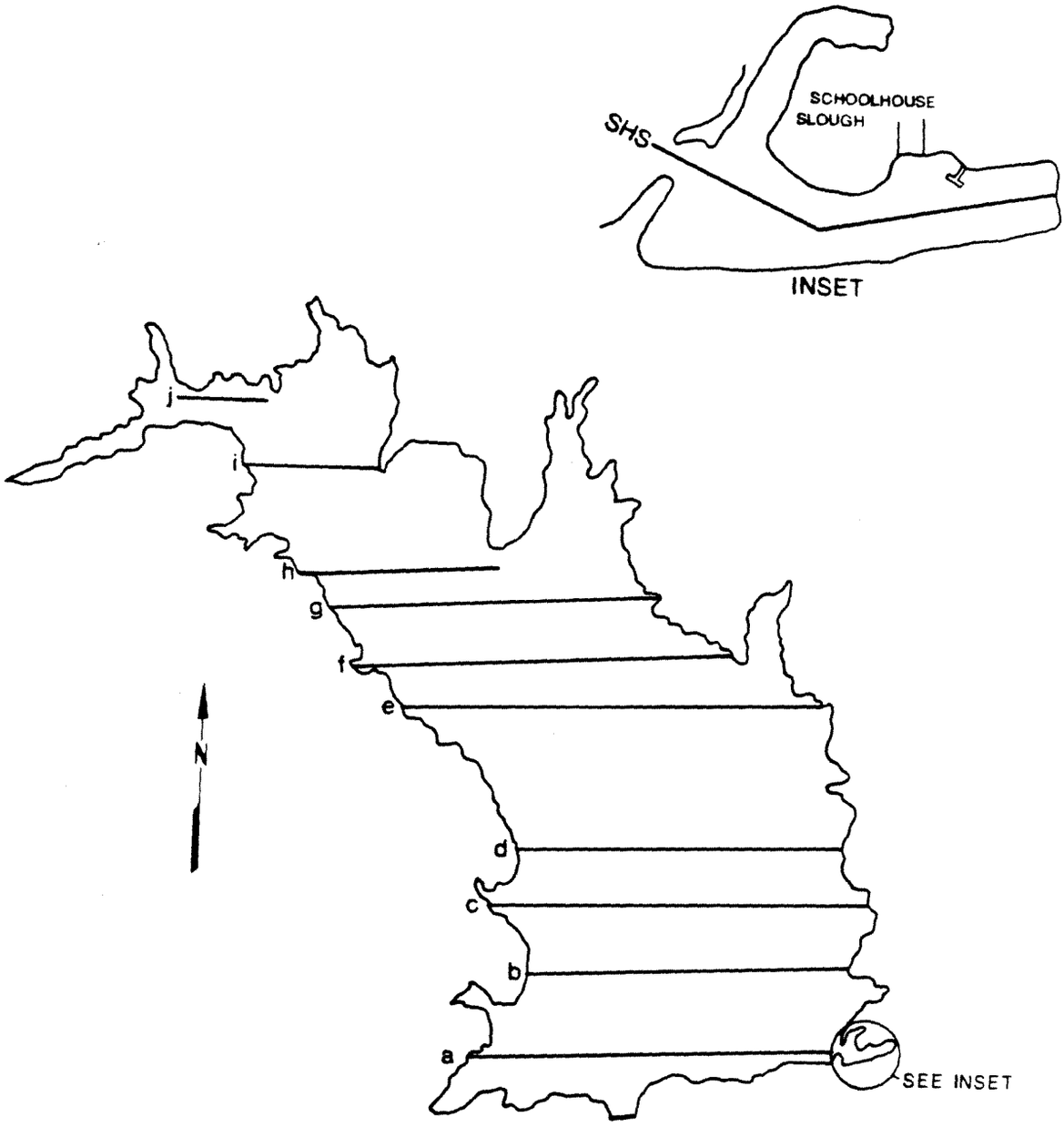


Figure 10.16 Transect locations for Chlorophyll-a fluorometric sampling in Lawtonka Reservoir

Table 10.2. Method for the calculation of relative persistence and magnitude of high chlorophyll a exceedence areas.

AREA	HIGH CHLOROPHYLL a AREAS	RELATIVE PERSISTENCE AND MAGNITUDE OF EXCEEDENCE AREAS
1	(0.067)(25) + (0.077)(25) + (0.08)(50) =	7.6
2	(0.007)(25) + (0.031)(25) + (0.08)(50) =	4.95
3	(0.014)(25) + (0.062)(25) + (0.08)(50) =	5.9
4	(0.031)(25) + (0.077)(25) + (0.08)(50) =	6.7
5	(0.135)(25) + (0.323)(25) + (0.36)(50) =	29.45
6	(0.745)(25) + (0.431)(25) + (0.32)(50) =	45.4

Table 10.3. Method for the calculation of relative persistence and magnitude of low chlorophyll a exceedence areas.

AREA	LOW CHLOROPHYLL a AREAS	RELATIVE PERSISTENCE AND MAGNITUDE OF EXCEEDENCE AREAS
1	(0.362)(25) + (0.316)(25) + (0.333)(50) =	33.6
2	(0.116)(25) + (0.211)(25) + (0.111)(50) =	13.7
3	(0.442)(25) + (0.263)(25) + (0.222)(50) =	28.7
4	(0.080)(25) + (0.421)(25) + (0.333)(50) =	29.2

collected was corrected to yield absolute chlorophyll a values. These values were subjected to the SYMAP graphic program (Laboratory for Computer Graphics and Spatial Analysis, Harvard University, 1975) which generated chlorophyll a isopleth maps of raw statistically modified data (e.g., averaged over depths). These statistical and graphical analyses were performed on 14 occasions from June 23 to October 5 during the summer of 1983 (Figure 10.1a-d and Appendices D and E). These data indicated there were two major areas of the reservoir (an area in the north and an area in the northwest) which persistently contained unusually high amounts of chlorophyll a (areas 5 and 6 in Figure 10.4 and Table 10.2).

The area of high chlorophyll a content in the northern end of the reservoir (area 6) was due to nutrients from tributaries entering the reservoir, while the area of high chlorophyll a content in the northwestern corner of the reservoir (area 5) may have been due to: 1) wind shear transport of nutrient laden water from the Ellsworth Pipeline or, 2) wind accumulation of endogenously generated algae.

These data also indicate that there were three major areas of persistently low chlorophyll a (areas 1, 3, and 4 in Figure 10.17, Table 10.3). One area immediately north of the Ellsworth Reservoir pipeline (area 1) had a shape (as indicated by the SYMAP mapping program) suggesting that low chlorophyll a waters from the pipeline were swept northwestward by prevailing winds. However, because the same pattern existed in the region prior to the onset of filling, the actual causal mechanism for the pattern is presently unknown. A second major region of

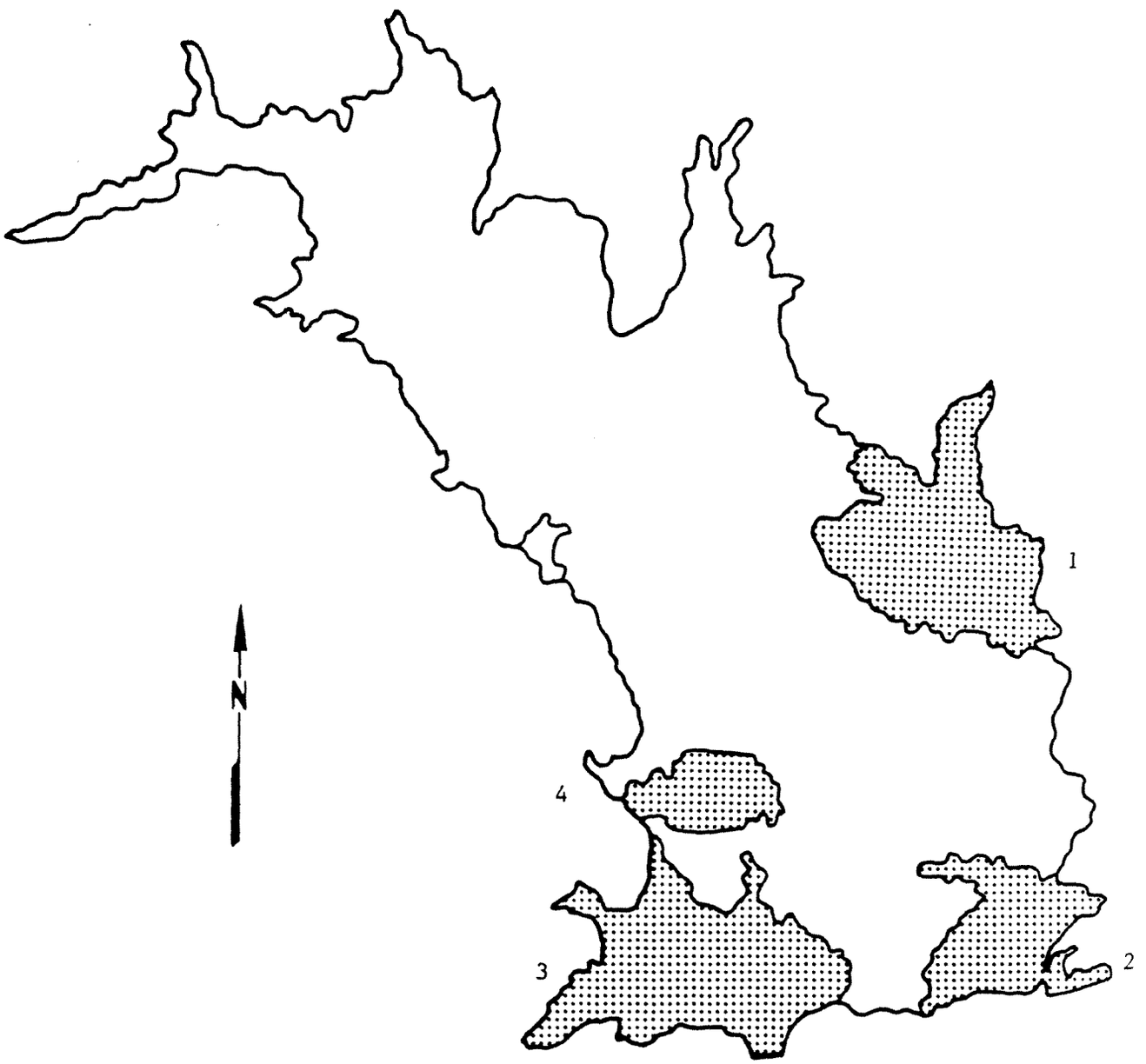


Figure 10.17 Regions of persistently low ($\bar{x}$-2SD) chlorophyll-a in Lawtonka Reservoir (June 23-Oct. 5,1983)

significantly low chlorophyll a (area 3) persisted to the north and west of the dam. Thermal stratification in the wind protected region of the reservoir probably contributed significantly to the phenomenon. The last major area of persistently low chlorophyll a (area 4) occurred north of the last region mentioned. Further work will be necessary to determine the cause or causes of these low chlorophyll a regions.

Bathymetric Mapping:

A bathymetric map of Lawtonka Reservoir was drawn (Figure 10.18) based upon 66 sonar transects located at approximately 250 feet intervals, collected in 1983, during the course of this study. Planimetry of this map enabled the calculation of the volume capacity of the reservoir in 1983 to be made. The present volume capacity of Lawtonka Reservoir was determined to be 56,574 acre-feet.

Assessment of Phosphorus and Nitrogen Inflows
and Outflows / Hydrologic Budget:

Hydrologic budgets (Table 10.4a and b) were prepared for Lawtonka Reservoir. The accuracy of the initial budget (Table 10.4a) was 96.4% utilizing an emperically derived runoff coefficient of 15%. Insights into nitrogen and phosphorus inflows and outflows to and from Lawtonka Reservoir were gained from the observation that the reservoir loses approximately 3,184 kilograms of total nitrates per year and gains 2,433 kilograms of Total Phosphorus per year (Table 10.5).

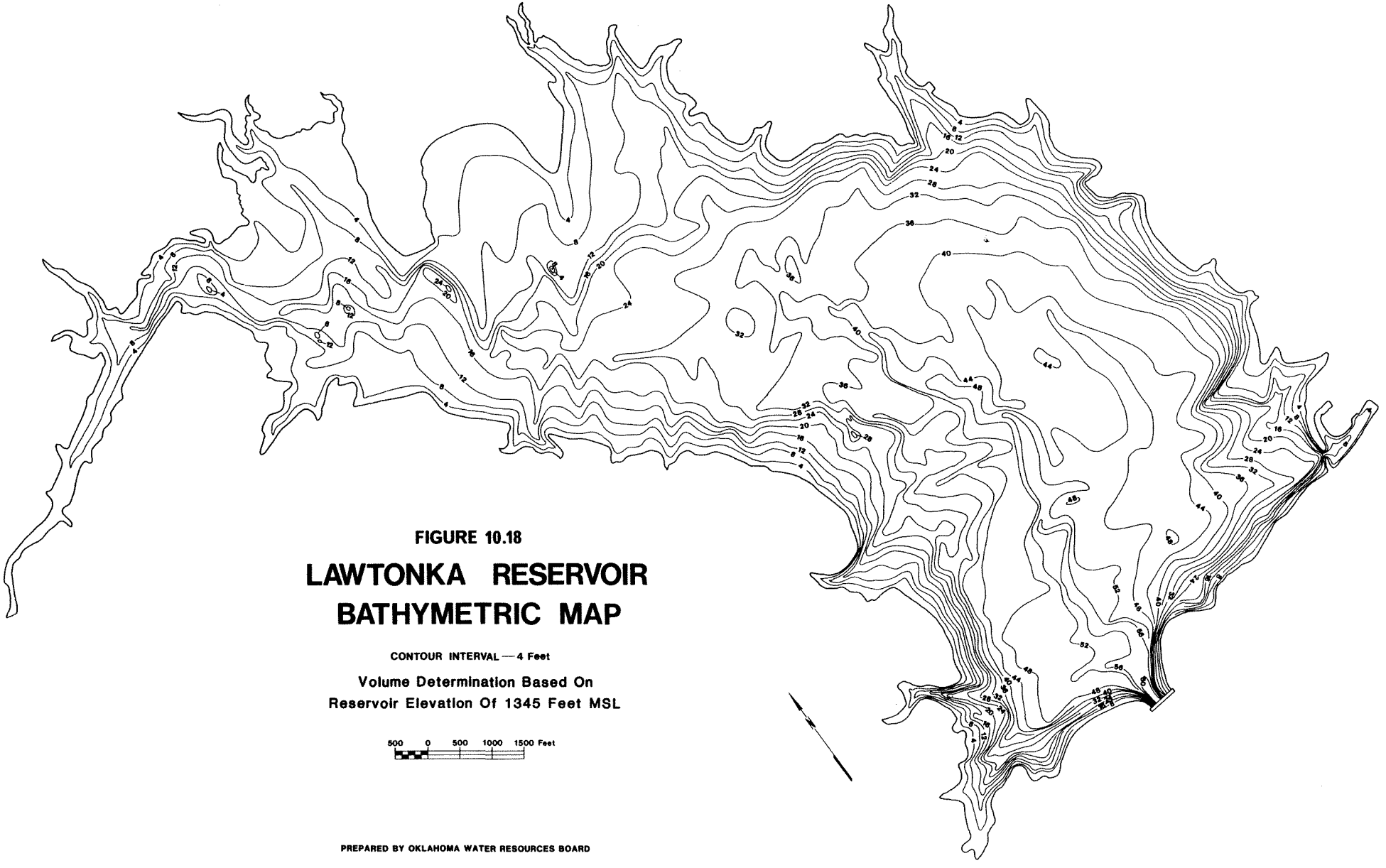


FIGURE 10.18

LAWTONKA RESERVOIR BATHYMETRIC MAP

CONTOUR INTERVAL — 4 Feet

Volume Determination Based On Reservoir Elevation Of 1345 Feet MSL

500 0 500 1000 1500 Feet

PREPARED BY OKLAHOMA WATER RESOURCES BOARD

Table 10.4a. Hydrologic budget of Lawtonka Reservoir.

DATE	LAKE VOL. (stage)	INPUTS			OUTPUTS		NET
		ELLSWORTH	PRECIP. L	RUNOFF	DISCHARGE	EVAP. L	
Sept. 82	56041.97	0	1282.75	4716.00	2159.43	1022.60	2816.72
Oct. 82	55539.68	0	27.42	100.80	2004.75	729.10	-2605.63
Nov. 82	55539.68	0	436.72	1605.60	1765.77	454.70	-178.14
Dec. 82	55539.68	0	276.13	1015.20	1728.72	345.00	-782.39
Jan. 83	55539.68	525.81	838.20	3081.60	1822.60	295.70	2327.30
Feb. 83	55775.80	0	148.84	547.20	1692.07	412.20	-1408.23
Mar. 83	55775.80	0	491.56	1807.20	1859.09	710.10	-270.43
Apr. 83	55775.80	0	356.43	1310.40	1753.79	950.90	-1037.86
May 83	55775.80	0	1327.80	4881.60	1914.88	1150.20	3144.31
June 83	56041.97	0	558.14	2052.00	1898.61	1378.70	-667.16
July 83	55775.80	300.46	78.34	288.00	2491.46	1476.00	-3300.67
Aug. 83	55303.55	2328.57	150.80	554.40	2756.79	1341.80	-1064.83
TOTALS	6.68E+05	3154.83	5973.12	21960.00	23847.96	10267.00	-3027.00

Key: Lake Vol. (stage) - Lake Volume as determined from stage
Ellsworth - Volume from Ellsworth pipeline
Precip. L - Precipitation on lake
Runoff - Water entering lake following precipitation
Discharge - Water discharged from lake to treatment plant
Evap L. Evaporation from surface of lake
Net - Inputs minus Outputs

Annual volumetric deficit = -2288.58

Percent error in budget = -4.05

Table 10.4b. Balanced hydrologic budget with 17% runoff coefficient.

DATE	LAKE VOL. (stage)	INPUTS ELLSWORTH	INPUTS PRECIP. L	INPUTS RUNOFF	OUTPUTS DISCHARGE	OUTPUTS EVAP. L	NET
Sept. 82	56041.97	0	1282.75	5207.48	2159.43	1022.60	3308.21
Oct. 82	55539.68	0	27.42	111.30	2004.75	729.10	-2595.13
Nov. 82	55539.68	0	436.72	1772.93	1765.77	454.70	-10.81
Dec. 82	55539.68	0	276.13	1121.00	1728.72	345.00	-676.59
Jan. 83	55539.68	525.81	838.20	3402.75	1822.60	295.70	2648.46
Feb. 83	55775.80	0	148.84	604.23	1692.07	412.20	-1351.20
Mar. 83	55775.80	0	491.56	1995.54	1859.09	710.10	-82.09
Apr. 83	55775.80	0	356.43	1446.96	1753.79	950.90	-901.29
May 83	55775.80	0	1327.80	5390.34	1914.88	1150.20	3653.05
June 83	56041.97	0	558.14	2265.85	1898.61	1378.70	-453.31
July 83	55775.80	300.46	78.34	318.01	2491.46	1476.00	-3270.65
Aug. 83	55303.55	2328.56	150.80	612.18	2756.79	1341.80	-1007.05
TOTALS	6.68E+05	3154.83	5973.12	24248.58	23847.96	10267.00	-738.42

Key: Lake Vol. (stage) - Lake Volume as determined from stage
Ellsworth - Volume from Ellsworth pipeline
Precip. L - Precipitation on lake
Runoff - Water entering lake following precipitation
Discharge - Water discharged from lake to treatment plant
Evap L. Evaporation from surface of lake
Net - Inputs minus Outputs

Annual volumetric deficit = 0.00

Percent error in budget = 0.00

Table 10.5. Total annual nutrient loadings to Lawtonka Reservoir.

INPUTS	Phosphorus kg/yr	Total Nitrates (Nitrates and Kjeldahl) kg/yr
Ellsworth	155.72	1712.95
Runoff	1610.75	6682.38
Rainfall	2137.54	515.96
SUM	3904.01	8911.28
OUTPUTS		
Discharge	1471.42	12095.07

Seepage into School House Slough:

Construction of a raised roadway across the east end of School House Slough (SHS) effectively prevented drainage of rainwater runoff from flowing into the slough. Thus, standing water in this lagoon area has accumulated following rain events (Figure 9.5). Because the lagoon area was near the lateral line network of the SHS septic system and because the roadway was built over a porous substrate, seepage meters (Grimshaw and Shapiro, 1983) were installed to investigate the possiblity of lagoon water intrusion into the reservoir. Briefly, water filtering through the porous substrate (presumably from the lagoon) entered the funnel portion of the meter and collected in a plastic bag via an interconnecting plastic tube. Seepage rates were empirically determined by directly measuring the amount of water collected during a given period of time.

Seepage rates ranged from 2.5 ml/hr to 260 ml/hr at SHS. Following the significant rain event of October 18, 1983, seepage rates declined precipitously from 201 ml/hr to 78 ml/hr. Change in head pressure between the lagoon and SHS was probably responsible for the reduction in seepage rate. Additionally, as the reservoir level declined in early fall 1983, water was observed seeping from the shallow embankment at eight locations well above the water line. This visually indicated that the porosity of the lower embankment substrate was heterogeneous. Consequently, calculation of overall seepage rates into SHS could not be accurately estimated.

Qualitative analysis of the seepage water indicated that there was no immediate bacteriological or nutrient loading problem. The bacterial (fecal coliform) count of seepage water was less than 2 colonies per 100 ml. Nutrient data indicated that Total Nitrogen levels ranged from 0.25 to 0.92 mg/L, while the nitrogen values fall within the range of values for the in-reservoir nitrogen concentrations. Phosphorus concentrations in seepage and lagoon water was lower than in-reservoir phosphorus values suggesting that phosphorus in lagoon water was being utilized by the abundant marsh vegetation within the lagoon prior to transport to SHS. Significantly, however, this system potentially provides a direct route for pathogenic contamination of Lawtonka Reservoir.

Temperature and Dissolved Oxygen Profiles:

Temperature (Figures 10.3a-f) and dissolved oxygen (Figures 10.8a-f) data were collected at the sampling stations described above (Figure 10.2). Representative thermal data is presented in Figure 10.3 a-f. These and other data indicate that the deep area near the dam in Lawtonka Reservoir thermally stratified in early summer and remained stratified throughout the summer, whereas the shallow portion of the reservoir was regularly destabilized due to wind action.

Lawtonka Reservoir thermally stratified in the deeper area near the dam and its hypolimnion became anaerobic in the summer months (Figures 10.8a and e). An anaerobic hypolimnion is typical in a eutrophic reservoir and presumably is due to decomposition of autotrophic organic matter.

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Nutrients and Alkalinity:

Nutrients and alkalinity data are presented in (Figures 10.10a and b, 10.11a and b, 10.14a and b, and Appendix C) and are discussed under the sections dealing with the N to P ratio and with the chemical quality of the lake. Additional nutrient data is included in Appendix B.

Chlorophyll a for the Upper Mixing Zone:

The chlorophyll a isopleth maps (Appendix E) illustrate the spatial and temporal aspects of chlorophyll a distribution in Lawtonka Reservoir. Results of this analysis are discussed under the sections entitled "Biological Lake Quality" and "Trophic Condition."

Total Nitrogen to Total Phosphorus Ratios:

Lawtonka Reservoir is typically a very clear water reservoir (Figure 10.5a-c). Consequently, primary production in the reservoir is generally not light limited (Grimshaw, et al., 1980).

Algal bloom events occurred in Lawtonka Reservoir in July and September through October 1983. The ratio of Total Nitrogen to Total Phosphorus during these events should indicate the growth limiting nutrient (Wetzel, 1975). Since this ratio varied between 15 to 96 to 1, it seems clear that phosphorus was and is the major limiting nutrient within Lawtonka Reservoir.

Extent of Algal Blooms:

Data (Figures 10.1a-d and 10.15a-c, Appendices D and E) obtained from sample sites and transects (Figure 10.2 and 10.16) beginning July 29, 1982, and continuing through October 5, 1983, indicate the occurrence of at least six algal bloom events during this time period. The first occurred September 29, 1982 and the second occurred January 26, 1983. The third and fourth, fifth, and sixth events occurred April 21, June 15, July 24, September 7, and October 5, 1983, respectively. The highest chlorophyll a values recorded during this study occurred during the sixth bloom. The mean value for the reservoir during this bloom event was 39 micrograms per liter with a sample size of approximatley 50. Carlson's trophic state index for the reservoir, based upon these data, is 67, once again indicating that the reservoir is eutrophic.

Algal Biomass, Genera, Cell Density, and Cell Volume Determination:

Samples of water were collected during an algal bloom on April 21, 1983 and analyzed to genera for predominant algal forms (Table 10.6). The sample taken at sample site 1 (Figure 10.2) had five genera of algae that constituted the bulk of the algae observed in the sample. Five major genera of algae were also identified in the sample taken at sample site 3, however, one of these major genera was a blue green algal form. Appendix F lists the genera of predominant algal forms identified in Lawtonka Reservoir water taken during fluorometric analysis of chlorophyll a.

Table 10.6. Algal composition of water collected on April 21, 1983 in Lawtonka Reservoir.

Site 1 - 0.5 Meters

	Units/ml	volume in um^3/ml
unidentified flagellates	760	
Chlorophyta		
Chlorococcales		
Pediastrum tetras	74*	
Quadrigula lacustris	74*	
Chrysophyta		
Chrysomonadales		
Mallomonas caudata	172	$3.6x10^6$
Ochromonas sp.	565	$2.8x10^5$
Cryptophyta		
Cryptomonadales		
Cryptomonas erosa	147	$1.8x10^6$
Euglenophyta		
Euglenales		
Euglena acus	74*	
Trachelomonas sp.	74*	
Cyanophyta		
Chroococcales		
Chroococcus minimus	74*	
Bacillariophyta		
Centrales		
Cyclotella atomus	950	$4.8x10^4$
Melosira granulata	74	$3.4x10^6$
Pennales		
Gomphonema sp.	74*	
Nitzschia acicularis	74*	
Nitzschia palea	74*	

* = Less than indicated value.

Table 10.6. Cont.

Site 3 - 0.5 Meters

	Units/ml	volume in um^3/ml
Chlorophyta		
Chlorococcales		
Coelastrum microporum	37*	
Oocystis pusilla	37*	
Schroederia setigera	37	$2.9x10^3$
Chrysophyta		
Chrysomonadales		
Ochromonas sp.	150	$7.4x10^4$
Cryptophyta		
Cryptomonadales	37*	
Cryptomonas erosa	160	$1.9x10^6$
Euglenophyta		
Euglenales		
Trachelomonas spp.	37*	
Cyanophyta		
Nostocales		
Anabaena sp.	37	
Aphanizomenon flos-aquae	1900	$2.3x10^7$
Bacillariophyta		
Centrales		
Cyclotella spp.	37*	
Melosira granulata	37	$1.7x10^6$
Pennales		
Asterionella formosa	37*	
Fragilaria crotonensis	37*	
Nitzschia acicularis	37*	
Nitzschia palea	37*	

* = Less than indicated value.

Table 10.6. Cont.

Site 3 - Mid Depths

	Units/ml	volume in um^3/ml
Chlorophyta		
Chlorococcales		
Crucigenia tetras	37*	
Oocystis pusilla	37*	
Pediastrum simplex	37*	
Quadrigula lacustris	37*	
Schroederia setigera	37*	
Chrysophyta		
Chrysomonadales		
Dinobryon sp.	37*	
Mallomonas caudata	37*	
Ochromonas sp.	150	$7.4x10^4$
Cryptophyta		
Cryptomonadales		
Cryptomonas erosa	170	$2.1x10^6$
Cyanophyta		
Nostocales		
Aphanizomenon flos-aquae	760	$9.3x10^6$
Bacillariophyta		
Centrales		
Melosira granulata	61	
Melosira italica	37*	
Pennales		
Asterionella formosa	37*	
Nitzschia palea	37*	

* = Less than indicated value.

Table 10.6. Cont.

Site 3 - Bottom

	Units/ml	volume in um^3/ml
Chlorophyta		
Chlorococcales		
Oocystis pusilla	61	$4.0x10^4$
Tetrasporales		
Sphaerocystis schroeteri	37*	
Chrysophyta		
Chrysomonadales		
Dinobryon sp.	37*	
Ochromonas sp.	86	$4.2x10^4$
Cryptophyta		
Cryptomonadales		
Cryptomonas erosa	86	$1.0x10^6$
Cyanophyta		
Chroococcales		
Coelosphaerium dubium	37*	
Nostocales		
Aphanizomenon flos-aquae	250	$3.1x10^6$
Bacillariophyta		
Centrales		
Cyclotella spp.	49	
Melosira granulata	170	$7.8x10^6$
Melosira italica	37*	
Stephanodiscus sp.	37*	
Pennales		
Asterionella formosa	37*	

* = Less than indicated value.

Table 10.6. Cont.

Site 13 - Raw Water in Water Treatment Plant

	Units/ml	volume in um^3/ml
Chlorophyta		
Chlorococcales		
Pediastrum simplex	37*	
Quadrigula lacustris	37*	
Chrysophyta		
Chrysomonadales		
Ochromonas sp.	98	$4.8x10^4$
Cryptophyta		
Cryptomonadales		
Cryptomonas erosa	98	$1.2x10^6$
Euglenophyta		
Euglenales		
Trachelomonas sp.	37*	
Pyrrhophyta		
Peridiniales		
Ceratium hirundinella	37*	
Cyanophyta		
Nostocales		
Aphanizomenon flos-aquae	1200**	$1.5x10^7$
Bacillariophyta		
Centrales		
Melosira ganulata	61	$2.8x10^6$
Pennales		
Asterionella formosa	37	$1.6x10^6$

* = Less than indicated value.

** = Aphanizomenon counts represent individual filaments instead of colonies.

Methods for relating algal species composition to relative degrees of pollution have been reported (Palmer, 1969; EPA, 1973; Patrick and Reimer, 1966). Two of these methods (EPA, 1973; Patrick and Reimer, 1966) rely on diatom analysis exclusively for this determination, while Palmer utilizes the identification of both diatoms and nondiatom algae in a determination of relative pollution. Utilizing Palmer's Index (Table 10.7) and algal data obtained on April 21, 1981 sample sites 1, 3 and 13 total 134, 87 and 104 index points, respectively.

Based on these data, it is logical to infer that Lawtonka Reservoir's eutrophic condition has been caused by nutrient loading which has stimulated the production of algae, many genera of which have been linked with pollution problems.

Dissolved and Settleable Solids / Secchi Disk / Sediments:

Analysis of dissolved solids data (Figure 10.19a-b) over the annual cycle indicated that the peak value occurred July 7, 1983 at sample site 7 and July 1, 1983 at sample site 3. The determination of dissolved solids provides an estimator of a reservoir's trophic condition since it quantifies the amount of dissolved material in the water column. Generally, dissolved solids were highest during the summer months due to evaporative concentration and lowest during the cool months of the year.

Settleable solids content was essentially homogeneous throughout the reservoir and indicated no long range transport of larger diameter (i.e., rapidly settleable) sediment in the reservoir. Turbidity analysis

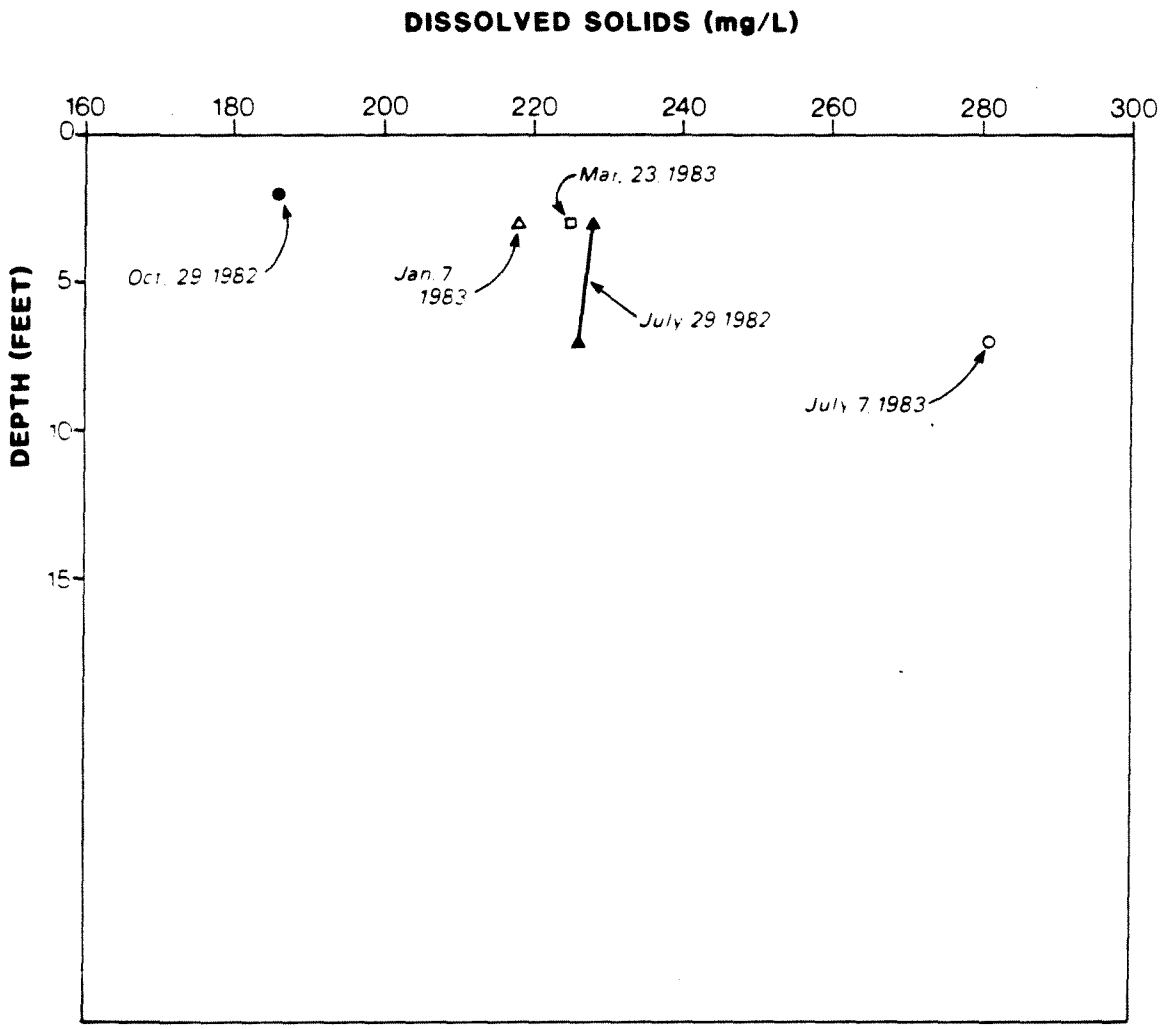

Figure 10.19a Vertical dissolved solids profile in Lawtonka Reservoir at sample site 1 (July 1982-July 1983)

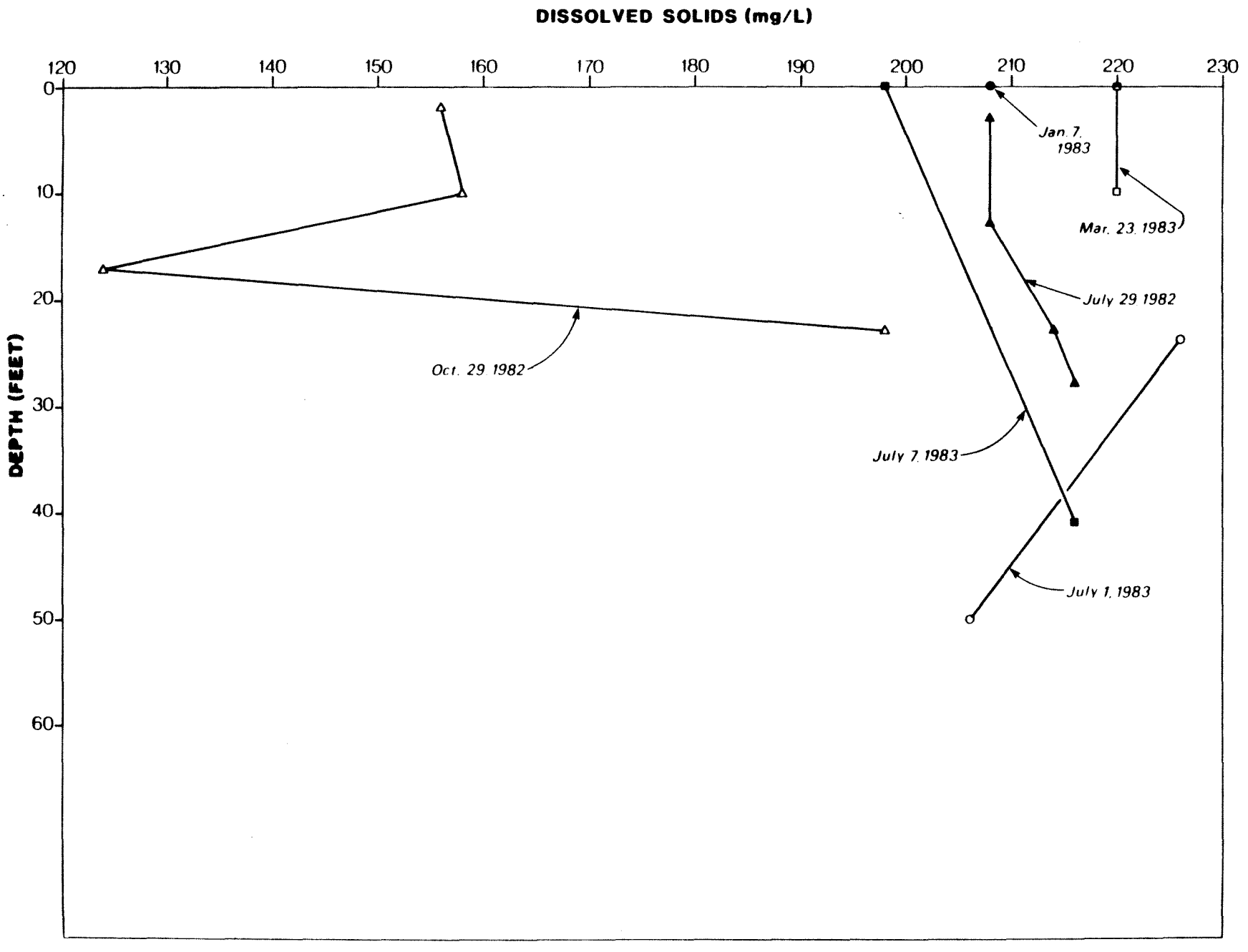

Figure 10.19b Vertical dissolved solids profile in Lawtonka Reservoir at sample site 3

Table 10.7. Pollution-tolerant genera of algae. List of 60 most tolerant genera, in orders of decreasing emphasis by 165 authorities (Palmer, 1969).

No.	GENUS	GROUP*	NO. AUTHORS	TOTAL POINTS
1	Euglena	F	97	172
2	Oscillatoria	B	93	161
3	Chlamydomonas	F	68	115
4	Scendesmus	G	70	112
5	Chlorella	G	60	103
6	Nitzxchia	D	58	98
7	Navicula	D	61	92
8	Stigeoclanium	G	50	69
9	Synedra	D	44	58
10	Ankistrodesinus	G	36	57
11	Phacus	F	39	57
12	Phornidium	B	37	52
13	Melosira	D	37	51
14	Gomphonema	D	35	47
15	Cyclotella	D	35	47
16	Closterium	G	34	45
17	Micractinium	G	27	44
18	Pandorina	F	32	42
19	Anarystis	B	28	39
20	Lepocinclis	F	25	38
21	Spirogyra	G	26	37
22	Anaberna	B	27	36
23	Cryptomonas	F	27	36
24	Pdeiastrum	G	28	35
25	Arthrospira	B	18	34
26	Trachelomonas	F	26	34
27	Carieria	F	21	33
28	Chlorogonium	F	23	33
29	Fragilaria	D	24	33
30	Ulothrix	G	25	33
31	Surirella	D	27	33
32	Stephanodiscus	D	22	32
33	Eudorina	F	23	30
34	Lyngbya	B	17	28
35	Oocystis	G	20	28
36	Agmenellum	B	19	27
37	Spirulina	B	17	25
38	Pyrobotrys	E	16	24
39	Cymbella	D	19	24

*Groups: B, blue-green; D, diatom; F, flagellate; G, green.

Table 10.7. Continued.

No.	GENUS	GROUP*	NO. AUTHORS	TOTAL POINTS
40	Actinastrum	G	20	24
41	Coelastrum	G	21	24
42	Cladophara	G	22	24
43	Hantzschia	D	18	23
44	Diatoma	D	19	22
45	Spondylomorum	F	16	21
46	Golenkinia	G	14	19
47	Achnanthes	D	16	21
48	Synura	F	14	18
49	Pinnularin	D	15	18
50	Chiorococcum	G	15	17
51	Asterionella	D	14	17
52	Cocconcis	D	14	17
53	Cosmamus	G	14	17
54	Gonium	F	15	17
55	Tribonema	G	16	16
56	Siaurouris	D	14	16
57	Selenasirum	G	13	14
58	Dietyosphaerium	G	11	14
59	Cymatopieura	D	13	14
60	Crueigreia	G	13	14

*Groups: B, blue-green; D, diatom; F, flagellate; G, green.

consistently indicated the more turbid nature of site 1 as compared to 3. Presumably, this was due largely to wind induced wave action which resulted in resuspension of bottom sediment (Figures 10.5a-c and 10.6a-c). The secchi disk data followed the same pattern as the turbidity data. Bottom sediments were analyzed for their Iron, Manganese, Cadmium and Chromium content and exhibited 0.08, 1.91, 0.01, and 0.05 mg/Kg, respectively.

Areal Extent of Vascular Plants:

A small area of aquatic macrophytes was found to exist in the northeastern portion of Lawtonka Reservoir. It was 5.41 acre hectares in area and was dominated by Nelumbo lutea. Elsewhere in the reservoir, isolated stands of Polygonum coccinium, Potamogeton americonus, Dianthera ovata and Myriophyllum spicatum occurred.

Bacterial Analysis:

Analysis of fecal coliform bacteriological data from sampling stations in Lawtonka Reservoir indicated a trend of decreasing colony counts as one progressed from sample site 1 (maximum of 1,700 colonies per 100 ml) to site 3 (200 colonies per 100 ml). These data indicated that aeration, photolytic actions, and thermal changes occurring within the reservoir were acting to reduce the number of fecal coliform bacteria in the water. They also indicated that bacteria levels were highest in Lawtonka Reservoir in the month of May 1983 (Appendix B).

Fish Flesh Analysis:

An analysis of channel catfish (Ictalurus punctatus) was performed for PCBs, Chlordane, DDT, Aldrin, Toxaphene and Heptachlor. Results of these analyses have been published by the Oklahoma State Department of Health (1981). The report concluded that "Lawtonka Reservoir does not appear to be a problem with bioaccumulation of toxic organics in fish tissue." Moreover in their executive summary they concluded, "Two reservoirs, Greenleaf and Lawtonka, did not show any detectable levels of the chemicals (i.e., Toxic chemicals) even in the parts per billion range."

Toxic Heavy Metals:

With the exception of total reactive mercury, none of the toxic heavy metals analyzed exceeded drinking water or fish and wildlife water quality criteria. The detection limit for the total mercury analytical method utilized was 0.5 ug/L. No mercury was found in water samples taken at the south end of the reservoir near the dam. However, two water samples, taken at sample site 1 both exceeded water quality standards. These samples both contained 3.7 ug/L of total mercury and as can be seen are far in excess of detection limits (Figure 10.20). It will be necessary to: (1) repeat the water sampling to reconfirm the presence of mercury; (2) determine the source tributary of the mercury contamination if its presence is confirmed; (3) to determine if the mercury is anthropogenic or natural in origin; and (4) to evaluate the occurrence and extent of biomagnification of the mercury through the analysis of fish flesh residue.

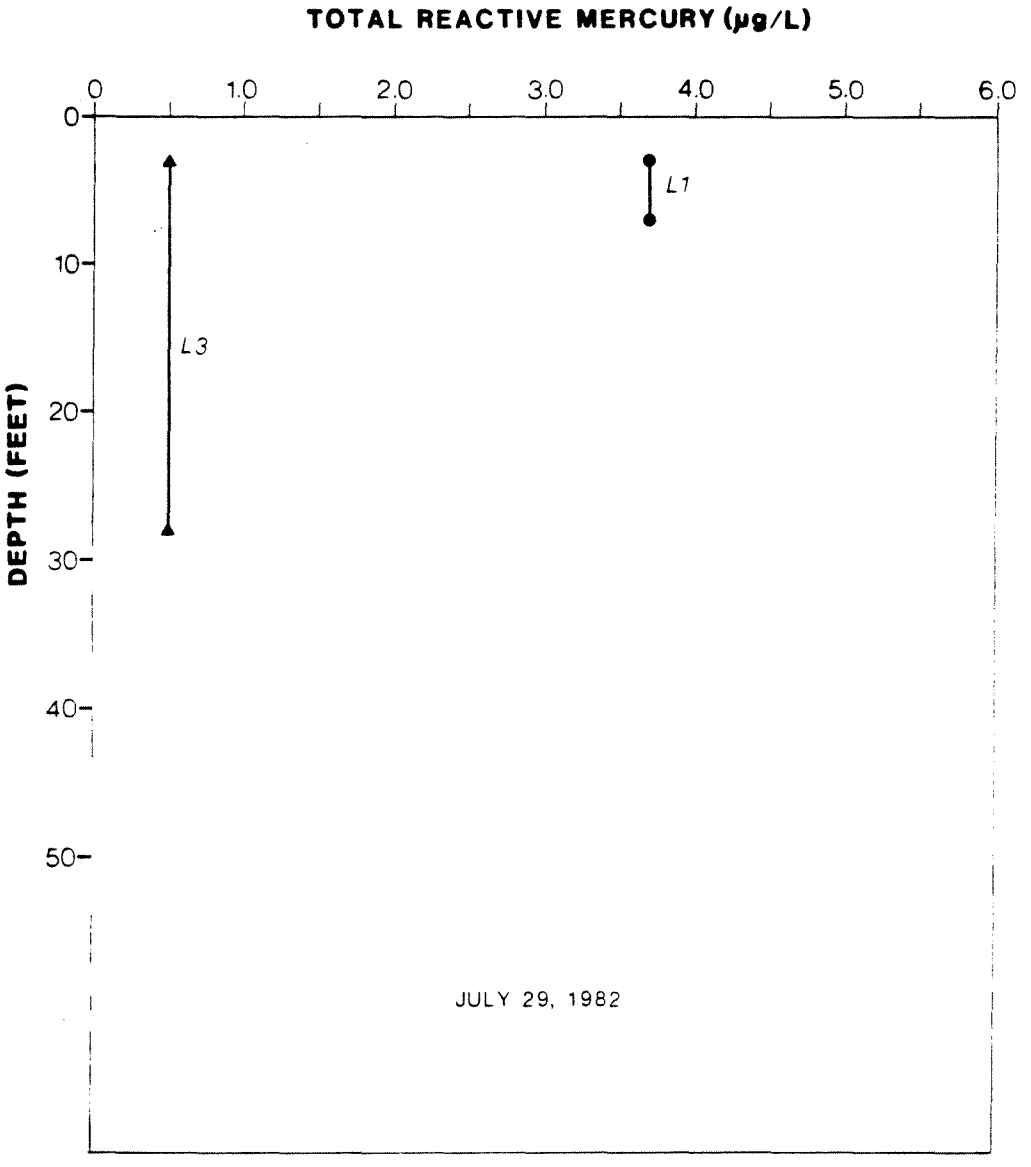

Figure 10.20 Vertical total reactive mercury profile in Lawtonka Reservoir

SECTION VIII

Biological Resources (Task 11):

Lawtonka Reservoir is located in the area of southwest Oklahoma which includes the Wichita Mountain Range. This range consists mainly of granite; its huge weathered boulders are uniquely characteristic of the area. Besides the ancient rock-crowned mountains, the principal habitat types include extensive inter-montane meadows of restored native grasslands, post oak - blackjack forests, small but important areas of narrow, tree-covered stream bottoms and good condition rangeland. Collectively with the lake, this makes for a variable habitat in a relatively concentrated area.

Common grasses in the area include prairie cord grass (*Spartina pectinata*), blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloe dactyloides*), and Suiter fescue (*Festuca elatior*).

Trees that occupy the habitat include eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*), pecan (*Carya illinoiensis*), bur oak (*Quercus macrocarpa*), sugar hackberry (*Celtis laevigata*), and American elm (*Ulmus americana*). A few of the species that are directly dependent on the reservoir are the common cattail (*Typha latifolia*), Kansas horsetail (*Equisetum kansanum*), and Butler quillwort (*Isoetes butleri*).

Terrestrial vertebrate species found in association with the habitat ranges from the common oppossum (Didelphis virginiana) to the rare black-tailed prairie dog (Cynomys ludovicianus) and buffalo (Bison bison) which are both protected in the Wichita Mountain Wildlife Refuge. Other species found in the refuge are Texas Longhorn Cattle (Bos taurus), pronghorn (Antilocapra americana), elk (Cervus canadensis), and whitetailed deer (Odocoileus virginianus). The watershed area will also accommodate such species as the desert shrew (Notiosorex crawfordi), western big-eared bat (Corynorhinus refinesquii), desert cottontail (Sylvilagus audubonii), red wolf (Canis niger) and bobcat (Lynx rufus).

Migratory bird species that utilize the reservoir directly include Canadian geese (Branta canadensis), mallard (Anas platyrhynchos), blue-winged teal (Anas discors), bufflehead (Bucephala albeola), and common merganser (Mergus merganser). Resident bird species that occupy the habitat around the reservoir include the bobwhite (Colinus virginianus), turkey (Meleagris gallopavo), and roadrunner (Geococcyx californianus). Birds that use Lawtonka Reservoir directly for food, water and habitat include the great blue heron (Ardea herodias), great egret (Casmerodius albus), osprey (Pandion haliaetus), Baird's sandpiper (Calidris bairdii), and silt sandpiper (Micropalama himantopus).

There is a great variety of reptiles and amphibians in the Lawtonka Reservoir watershed. For example, the broad-banded copperhead (Agkistrodon controtrix laticinctus) can be found atop the granite boulders and the smooth softshell (Trionyx muticus) inhabits the reservoir itself. Other common species include the red-spotted toad

(Bufo punctatus), bullfrog (Rana catesbeiana), southern prairie lizard (Sceloporus undulatos consobrinus), and bullsnake (Pituophis melanoleucus sayi).

Lawtonka Reservoir also provides direct habitat for large populations of aquatic vertebrates. Chief among these are the fishes which predominantly consist of channel catfish (Ictalurus punctatus), flathead catfish (Pylodictis olivaris), bluegill (Lepomis macrochirus), gizzard shad (Dorosoma cepedianium), white bass (Morone chrysops), black crappie (Pomoxis nigromaculatus), and largemouth bass (Micropterus salmoides).

An extensive listing of flora and fauna of the Lawtonka Reservoir area is presented in Appendix G.

SECTION IX

RESTORATION ALTERNATIVES AND RECOMMENDATIONS (TASK 12):

The occurrence of algal blooms in Lawtonka Reservoir, has been documented. Restoration alternatives were evaluated and discussed with the Lawtonka Reservoir Committee throughout the course of the public participation program. These alternatives were grouped into symptomatic and causative approaches and were evaluated with regard to their cost and applicability to Lawtonka Reservoir.

Symptomatic Approaches:

Dilution

The addition of dilution water to Lawtonka Reservoir could reduce the concentration of nutrients in the reservoir but obviously would not reduce nutrient loading. Consequently, this restoration method is viewed as a symptomatic treatment and not as one which would solve the reservoir's problems.

Stormwater runoff and low flows are presently utilized to fill the reservoir. The only additional source of water to Lawtonka Reservoir would be water presently stored in Ellsworth Reservoir. The Total Phosphorus concentration of Ellsworth water, however, is frequently higher than that found in Lawtonka Reservoir. Consequently, the addition of Ellsworth water would increase the Total Phosphorus concentration in

Lawtonka Reservoir instead of reducing it. Dilution, therefore, is not a feasible restoration alternative for Lawtonka Reservoir.

Nutrient Inactivation

Nutrient inactivation by application of aluminum sulfate (alum) is also viewed as a symptomatic approach to lake restoration. In addition to its symptomatic nature, the method has the disadvantage in that it can only be applied after an environmental impact has occurred.

Application rates taken from the literature range from 0.4 to 22.6 mg/L. Utilizing the upper treatment level, a single application to Lawtonka Reservoir would cost $694,787 for aluminum sulfate and an additional $500 in personnel and application hardware, resulting in a total cost of approximately $695,287 per application.

6.97×10^{10} liters/lake volume x 22.6 mg/L =
1.58×10^{12} mg or 1.58×10^{6} kg X 0.4405286 dollars/kg = $694,787

Macrophyte Harvesting

Macrophyte harvesting is not a feasible restoration option for Lawtonka Reservoir since the areal extent of reservoir bottom covered by macrophytes is less than one percent of the reservoir's surface area (Task 10).

Aeration/Mixing

Hypolimnetic aeration was not considered as a feasible restoration alternative for Lawtonka Reservoir since the thermal profile data from Task 10 indicates that only small portions of this reservoir stratify locally 3 months of the year.

Dredging Lawtonka Reservoir

Stormwater entering the Lawtonka Reservation carries a high sediment load. While the data illustrates the significant loss of reservoir volume capacity (10 percent) since the time of the reservoir's construction, the symptomatic approach of dredging the reservoir proper was not recommended by the committee. In-reservoir dredging would be costly, would reduce the aesthetic quality of this heavily used reservoir, and would need to be repeated in the future as sedimentation would continue to decrease the reservoir's volume capacity.

Causative Treatment:

Biomanipulation

Biomanipulation was considered to be too poorly documented to be proposed as a restoration method. Theoretically, however, it might be quite effective since the primary energy pathway in the reservoir appears to be the following food chain:

$$\text{Diatoms + Green Algae} - \frac{\text{Daphnia}}{\text{Cyclops}} - \text{Shad} - \begin{array}{l}\text{Skipjack Herring}\\ \text{Channel Catfish}\\ \text{Largemouth Bass}\end{array}$$

Experimental manipulation of the shad population, either by increased predation or by selective removal of components of the population (which presently avoid predation due to their size), could decrease the reservoir's algal standing crop.

Watershed Management

Total Watershed Management:

The size of Lawtonka Reservoir's watershed and the reservoir's on-channel design all tend to support watershed management as the most effective method to reduce nutrient loading of the reservoir.

Ellsworth Water Transfer Management:

Since phosphorus was found to be the limiting macronutrient in Lawtonka Reservoir it would be of value to monitor its concentration in the Lake Ellsworth water and to minimize and/or avoid use of the transfer pipeline when phosphorus concentration from Lake Ellsworth is above 0.05 milligrams per liter.

Lawtonka Watershed Agricultural Activity Management:

To the extent possible it would be wise to:

(a) minimize row crop cultivation

(b) discourage any supplemental feeding cattle operations

(c) subsidize farmers for the maintenance of land-tributary interface buffer strips

(d) prohibit feedlot operations

(e) carefully monitor the use and magnitude of application of herbicides, pesticides and fungicides.

Restoration Plan Proposed for Overholser Reservoir:

Action 1: Monitor Ellsworth Pipeline Phosphorus Concentrations

Ellsworth pipeline water should only be used for quantity augumentation when its Total Phosphorus concentration is below 0.05 mg/L.

Action 2: Monitor and Minimize the amount and nature of agricultural activity in the Lawtonka watershed.

Thought should be given to acquiring land in this area for a park or conservation area, as well as provide subsidies to farmers in the watershed to reduce agricultural activities.

Action 3: Limnological Studies

Studies should be conducted to:

(1) Evaluate the extent of the mercury problem in Lawtonka Reservoir.

SECTION X

Restoration Benefits (Task 13):

The following is a discussion of the restoration benefits that are expected to result if the proposed recommendations are implemented.

Restoration Benefits from Action 1:

The inclusion of a water quality criterion, in addition to the water quantity criterion of Lawtonka Reservoir stage elevation, as a corequisite to the initiation of pumping from the Ellsworth pipeline will reduce algal growth stimulation. Such algal stimulation has occurred, historically, due to the introduction of water containing Total Phosphorus in excess of 0.05 milligrams per liter to a reservoir where the algal growth limiting macronutrient is phosphorus.

Reducing algal growth in Lawtonka Reservoir will lower water treatment costs as well as reduce the amount of dissolved organic carbon (DOC) in the water column. Such a reduction of DOC should help in the ameoloration of inadvertent trihalomethane production during the chlorination process in the water treatment plant.

Restoration Benefits from Action 2:

(Watershed Management)

Overall reduction in phosphorus and nitrogen entering the reservoir as a result of (1) buffer zone placement; (2) minimizing phosphorus intense agricultural activities; and (3) prohibiting the establishment of feedlot operations within the watershed will help decrease the production of algal growth that presently occurs in the north end of the reservoir.

To the extent that this nutrient loading influences algal growth in the south end of the reservoir (as evidenced by the chlorophyll maps), watershed management of the limiting nutrient should help decrease the production of algae near the intake structure to the water treatment plant. Lowering the concentration of algae and nutrients in the source water to the plant should help to reduce water treatment costs.

If algal bloom problems in the reservoir can be eliminated by actions 1 and 2, both economic and esthetic benefits will be realized. Unsightly algal blooms presently deter some of the public from utilizing the reservoir facilities during the peak summer months. Increased attendance and revenues could be generated if the algal problems were mitigated.

By educating users of mercury containing fungicides as to alternative methods of application, the obvious ecological benefits of reducing mercuric loading into the reservoir will be realized. Continued investigation of this potential problem will help to determine whether increased mercury levels in the north end of Lawtonka Reservoir are (1) episodic or continuous, and (2) are concentrated in the biota.

Restoration Benefits from Action 3:

A field study to evalute the existance of a mercury problem at the Robinson's landing end of Lawtonka Reservoir will eliminate the possibilty of the occurrence of any "tainted fish" scares. Additionally, if the existence of a mercury problem is confirmed, such information will minimize the possibility of toxic exposure.

SECTION XI

PHASE II MONITORING PROGRAM & MILESTONE WORK SCHEDULE (TASKS 14 & 15):

A program has been developed in order to monitor Lawtonka Reservoir water quality during implementation of the Phase II Restoration project. Parameters which were indicated to be significant in the Phase I Diagnostic Monitoring program will be included for analytical study.

The major problem in Lawtonka Reservoir appears to be increased algal bloom development during the summer months. Chlorophyll data suggests the pipeline coming from Lake Ellsworth to Lawtonka Reservoir is stimulating algal bloom development in Lawtonka Reservoir. A monitoring program is suggested that will compare pipeline water to Lawtonka Reservoir water over a summer season. Statistical analysis can then be done in order to determine the actual impact of the pipeline on Lawtonka Reservoir.

A proposed monitoring program along with a milestone work schedule for project completion under Phase II is provided (Tables 14/15.1 and 14/15.2).

Table 14/15.1. Phase II monitoring program.

DATE	PARAMETERS	MONITORING FREQUENCY
Grant Award Date (GAD) plus one month	Chlorophyll a Total Phophorus	As specified in Federal Register Vol. 24, No. 25
GAD plus two months	Chlorophyll a Total Phophorus	As specified in Federal Register Vol. 24, No. 25
GAD plus three months (Phase II work begins)	Chlorophyll a Total Phosphorus	As specified in Federal Register Vol. 24, No. 25
GAD plus 4 .... 15 months	Chlorophyll a Total Phosphorus	As specified in Federal Register Vol. 24, No. 25

Table 14/15.2. Lawtonka Reservoir Phase II milestone schedule.

DATE	ACTIVITY
Grant Award Date (GAD) plus one month or adjust to two months before onset of work	Phase II monitoring program
GAD plus two months	Pre-project monitoring continues
GAD plus three months	Project work begins
GAD plus 4....15 months	Concurrent and past project monitoring

SECTION XII

NON-FEDERAL FUNDING (TASK 16):

Fifty percent of Phase II Clean Lakes funding is the responsibility of State and local sources, with the remaining 50 percent matched by EPA. The Lawton Water Department and other Lawton City agencies were contacted in an attempt to locate potential sources of non-federal matching funds and we are awaiting their response.

SECTION XIII

PROJECT RELATION TO OTHER POLLUTION CONTROL PROGRAMS (TASK 17):

The following agencies were contracted concerning other pollution control programs that have occured or are ongoing in the Lawtonka Reservoir watershed:

The Oklahoma Department of Pollution Control (DPC);
Oklahoma State Department of Health (OSDH);
Association of South Central Oklahoma Governments (ASCOG);
Oklahoma Conservation Commission (OCC);
Oklahoma State Department of Agriculture (OSDA);
Soil Conservation Service (SCS); and
Agricultural Stabilization and Conservation Service (ASCS).

Information pertaining to the 208 areawide wastewater management program, through DPC on point sources, has been outlined in Task 8. The city's of Apache and Fletcher sewage treatment plants operate within the Lake Ellsworth watershed. Both have been recommended for upgrading under the 201 Construction Grants Program.

Under the 201 Construction Grants Program administered by OSDH, the city of Apache sewage treatment plant is now being upgraded to total retention lagoons. Fletchers sewage treatment plant was converted to total retention after 1981.

A Toxics Monitoring Survey of Oklahoma Reservoirs, released in 1982 was performed by OSDH, Environmental Health Services, State Environmental Laboratory Service. The program began as a supplemental appropriation from the Legislature, made at Governor Nigh's request. The purpose of the study was to measure and evaluate the level of toxic organic compounds in fish tissue. Fish samples collected and analyzed showed no FDA action level violations and OSDH warning and concern levels were not exceeded. The report stated that Lawtonka Reservoir did not appear to have a problem with toxic organic residue in fish.

One program administered by ASCOG involves land fill operations. A seven town trust fund is set up in the Lawtonka Reservoir area to help upgrade these landfills to OSDH standards. They are also involved in assisting the city of Apache, through planning and grants, in upgradng its sewage treatment plant. No water treatment plants are known to be undergoing upgrading through ASCOG at this time.

The 208 selection and prioritization of Target Watersheds for Nonpoint Source Implementation, conducted by the OCC, has selected watersheds for nonpoint source implementation activities by evaluating runoff data collected from 1980 to 1984. One site in basin 3 in Comanche county, was included in the nonpoint source watershed ranking. This area is below the Lawtonka Reservoir watershed.

Two programs now offered through SCS are the Great Plains Conservation Program and the Agriculture Conservation Program (ACP). The first

program is set up between the farmer (producer) and USDA with applications taken through the Conservation District office. This program allows the farmer to apply conservation measures to his property over an extended period of time, from 3 to 10 years. The ACP involves annual applications and provides government supported cost - share arrangements with up to 50 - 65% funding. Ongoing individual projects in Comanche county include grass planting, terracing and pond construction.

At the present time, ASCS is taking flood damage applications. Due to the severe flooding that took place in October 1983, many homes and farms are in need of financial assistance.

SECTION XIV

PLAN OF OPERATION AND MAINTENANCE (TASK 18):

A plan of operation and maintenance has been developed for the pollution control measures recommended for the Phase II Restoration Project.

Considerable leakage into Lawtonka Reservoir has been documented coming from a pond which fills with septic overflow located across the road from School House Slough on the east side of the lake. Due to the possibility of fecal coliform and other contamination to the lake in that area, it is recommended that this pond be drained and lined with plastic to OWRB specifications. Depending on the life of the material, minimal maintenance is forseen.

SECTION XV

PERMIT REQUIREMENTS (TASK 19):

No dredging is associated with the proposed Phase II project for Lawtonka Reservoir, and therefore, no permits pertaining to Section 404 of the Clean Water Act are required.

SECTION XVI

PUBLIC PARTICIPATION (TASK 20):

The projected public participation program for the Lawtonka Reservoir Phase II project is included in Table 20.1. Appendix H contains a complete record of the Phase I public participation activities to date for Lawtonka Reservoir. Because of timing problems, the final public meeting will be held on March 29, 1984 in Lawton, Oklahoma.

Table 20.1. Lawtonka Reservoir Phase II Public Participation Milestone Schedule.

DATE	ACTIVITY
Grant Award Date (GAD)	Revise mailing list
GAD plus two months	Press release for public meeting
GAD plus three months	Public meeting to begin project
GAD plus five months and every two months thereafter until restoration projects end.	Committee meeting for update

A public meeting will be held at the beginning of the two year monitoring program which is required for any Phase II project. Also, press releases will be sent out before each major restoration technique is implemented.

SECTION XVII

Environmental Evaluation (Task 21):

(1) Will the proposed project result in the displacement of any people?

No.

(2) Will the proposed project deface existing residents or residential areas? What mitigative actions such as landscaping, screening, or buffer zones have been considered? Are they included?

No.

(3) Will the proposed project be likely to lead to a change in established land use patterns, such as an increased development pressure near the reservoir? To what extent and how will this change be controlled, through land use planning, zoning, or through other methods?

Yes. One of our recommendations is to change land use.

(4) How does this project conform to area wide waste treatment management plans, if any, developed under section 208 of the Act?

No conflicts with Statewide 208 Programs have been identified.

(5) Will the proposed project adversely affect a significant amount of prime agricultural land or agricultural operations on such land?

There will be minimal adverse affects on agricultural operations or land, since we are only recommending to minimize any increase in agricultural development.

(6) Will the proposed project result in significant adverse effect on park land, other public land, or lands of recognized scenic value?

No, on the contrary, park land will be enhanced by the improved nature of the lake.

(7) Has the state historical society or state historical preservation officer been contacted by the grantee? Has he responded, and if so, what was the nature of the response? Will the proposed project result in a significant adverse affect on lands or structures of historical, architectural, archeological or cultural value?

No, since there will be no construction activities in the watershed.

(8) Will the proposed project lead to a significant long range increase in energy demand?

No. There will be no long range increase in energy demands.

(9) Will the proposed project result in significant and long range adverse changes in ambient air quality or noise level? Short term?

No. There will be no adverse effects in ambient air quality.

(10) If the proposed project involves the use of in-reservoir, chemical treatment, what long and short term adverse effects can be expected from the treatment? How will the grantee mitigate these effects?

No. The project doesn't involve the use of in-reservoir chemical treatment.

(11) Does the proposal contain all the information that EPA requires in order to determine whether the project complies with Executive Order 11988? Is the proposed project located in a flood plain? If so, will the project involve construction of structures in the flood plain? What steps will be taken to reduce the possible effects of flood damage to the project?

The project of necessity is located in a flood plain, however, there will be no structures constructed.

SECTION XVII

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SECTION XIX

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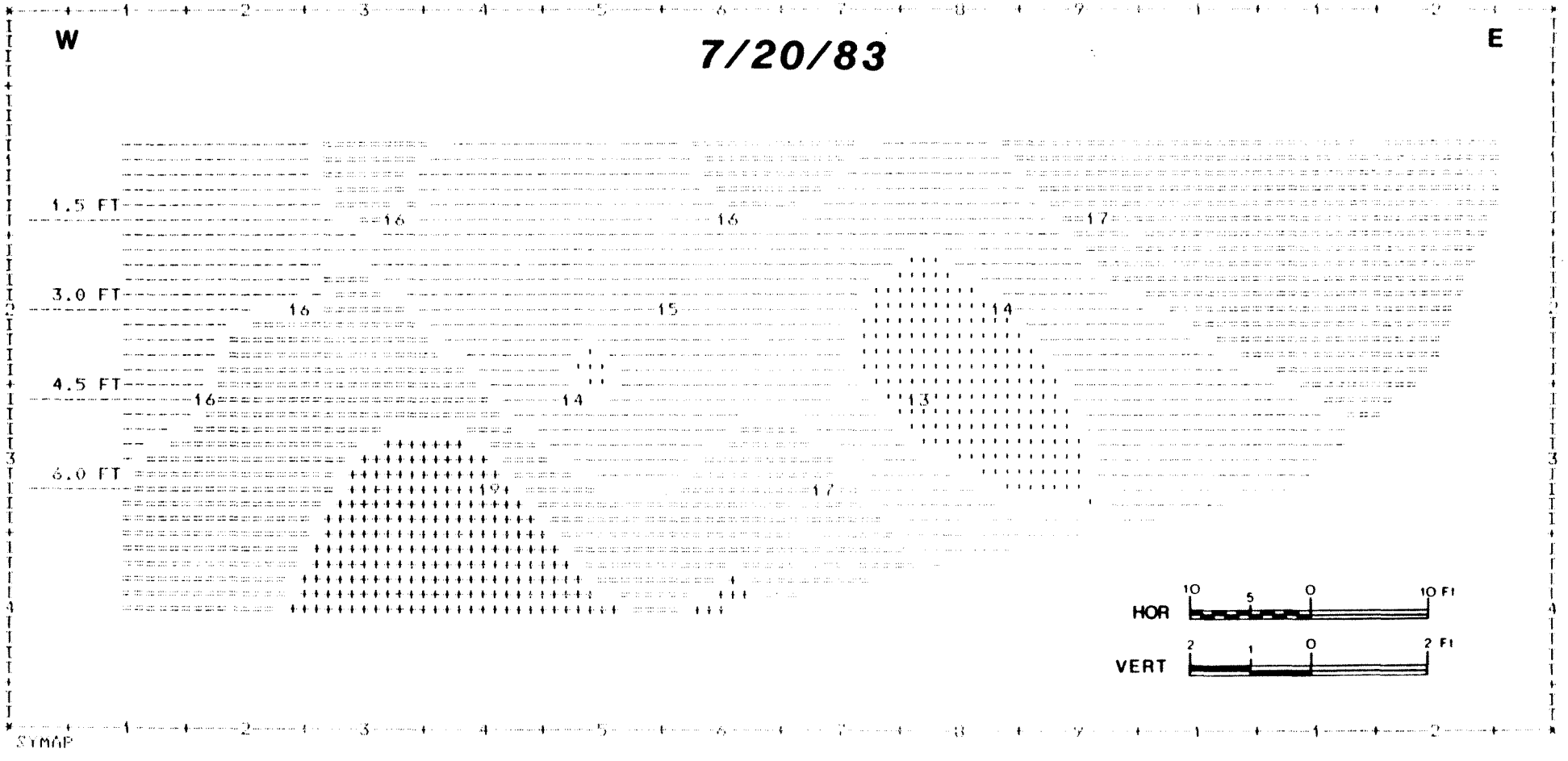
APPENDIX H: PUBLIC PARTICIPATION MEETING SUMMARIES

APPENDIX A

SYMAPS BASED UPON CHLOROPHYLL *a* DATA FOR SCHOOL HOUSE SLOUGH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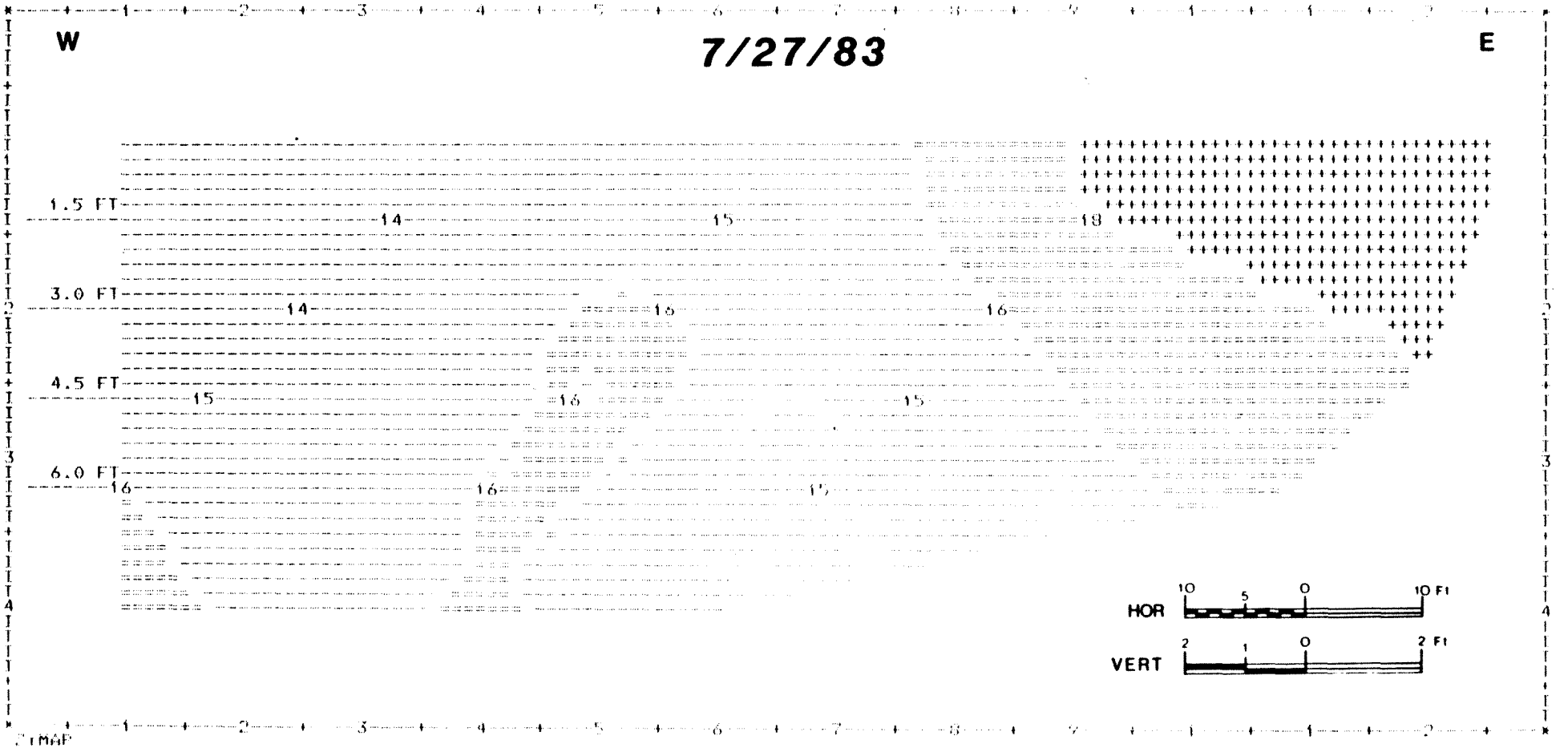
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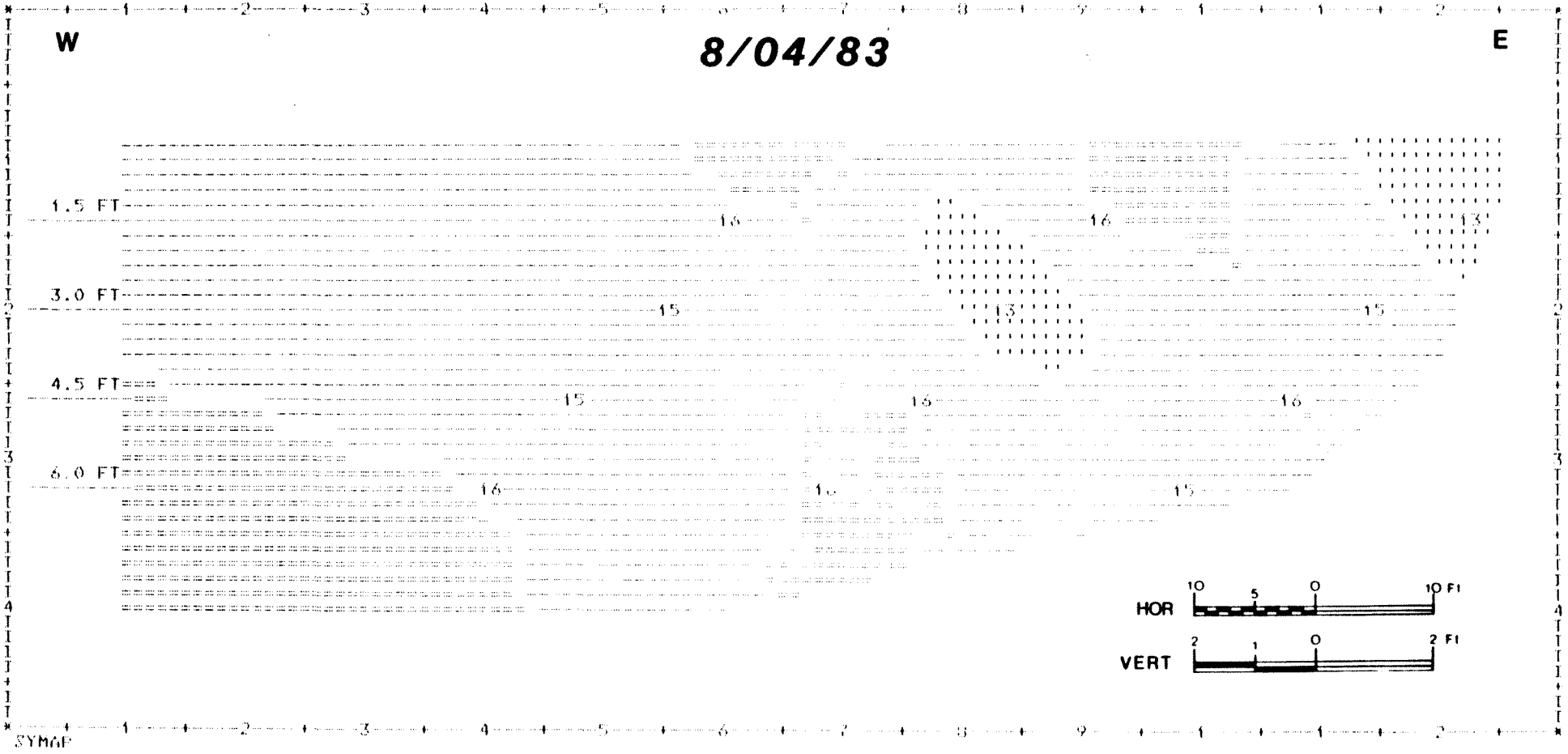
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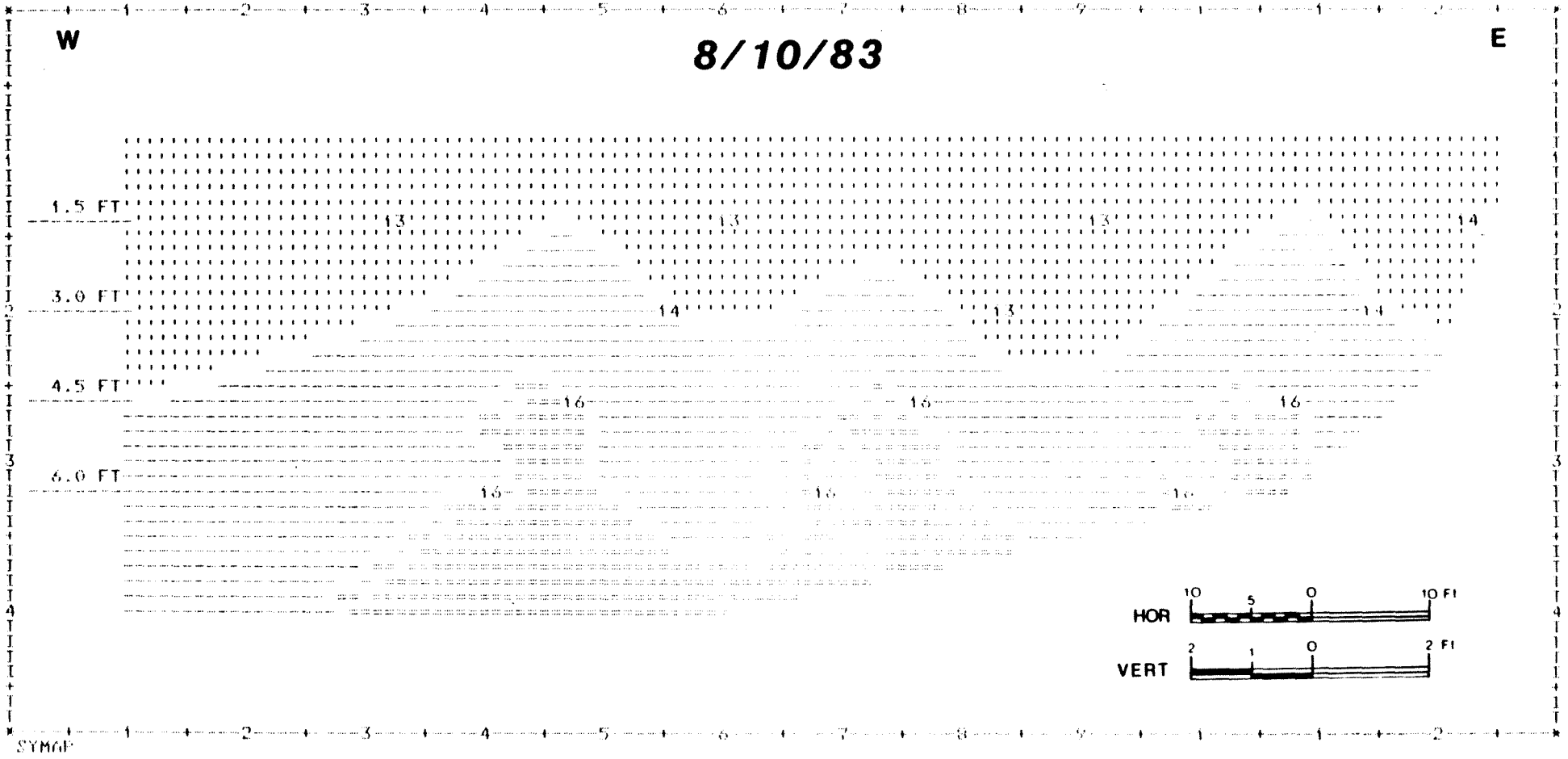
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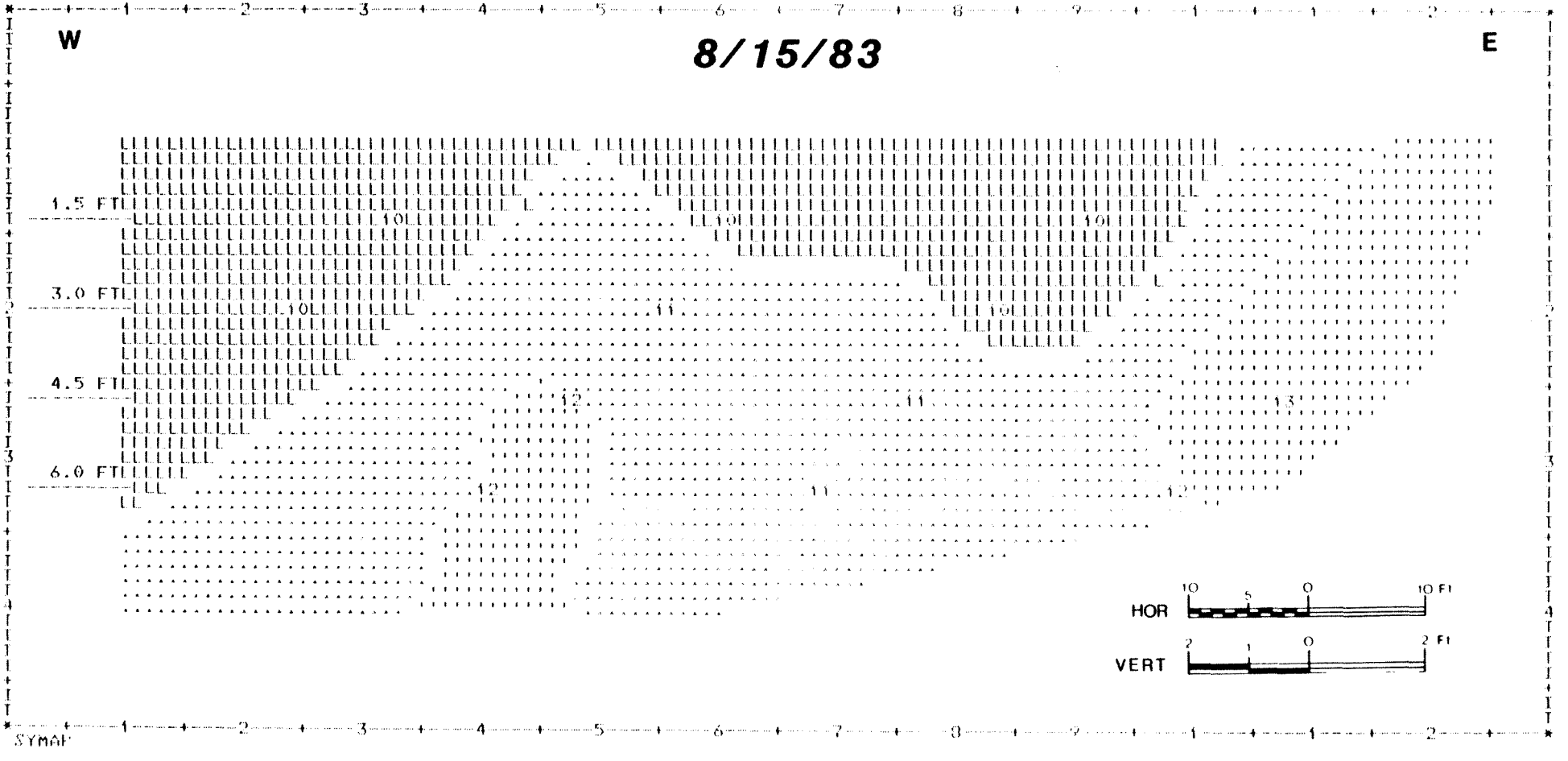
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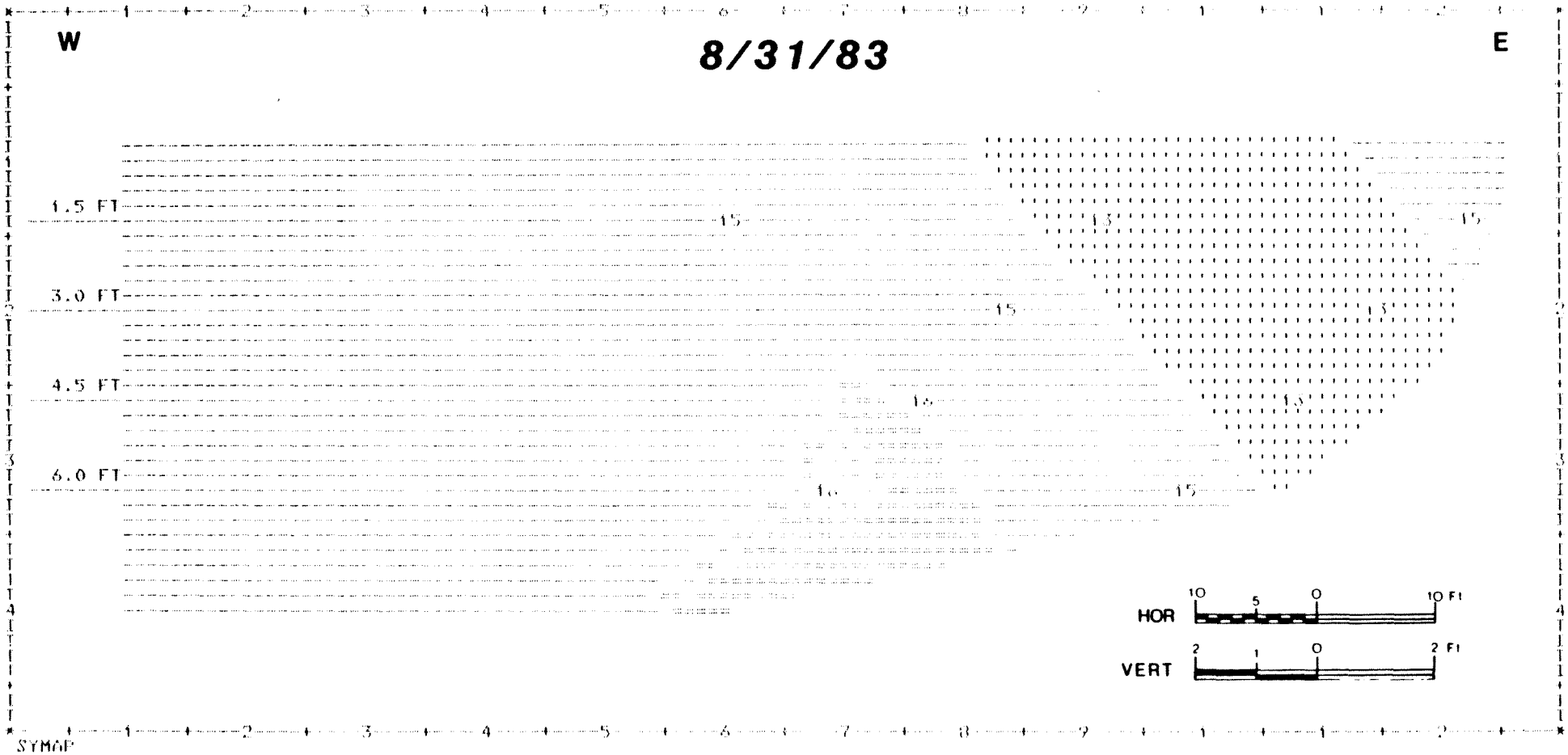
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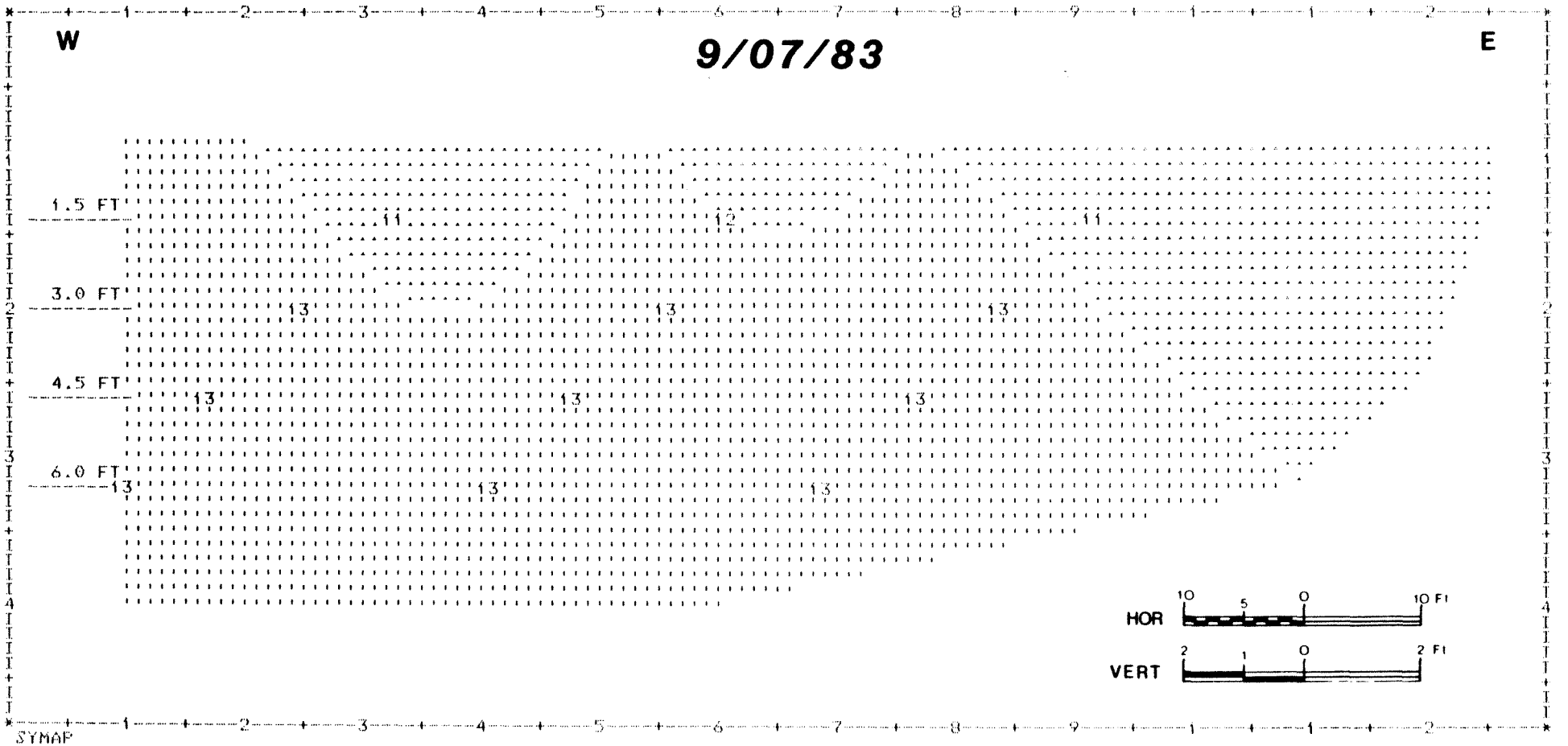
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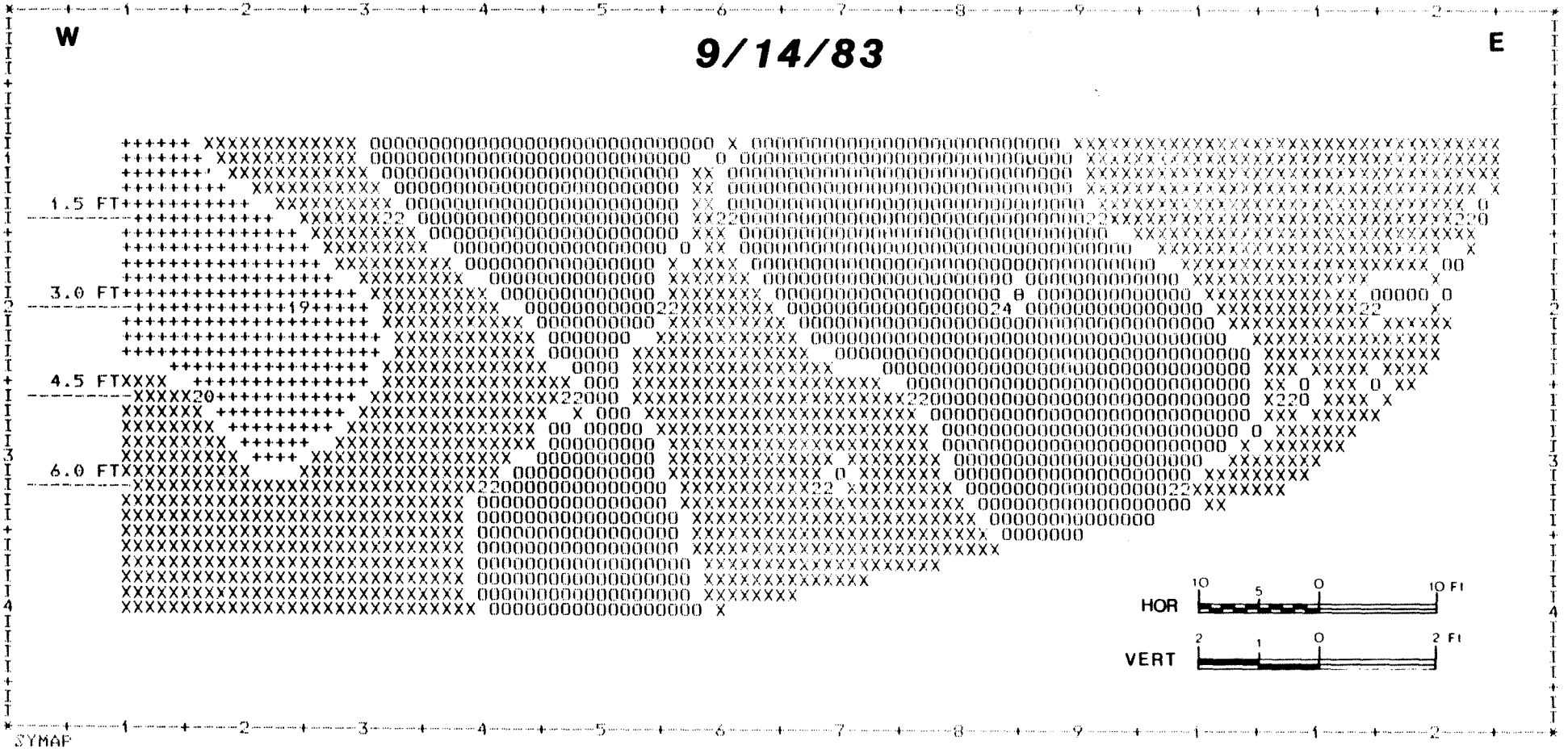

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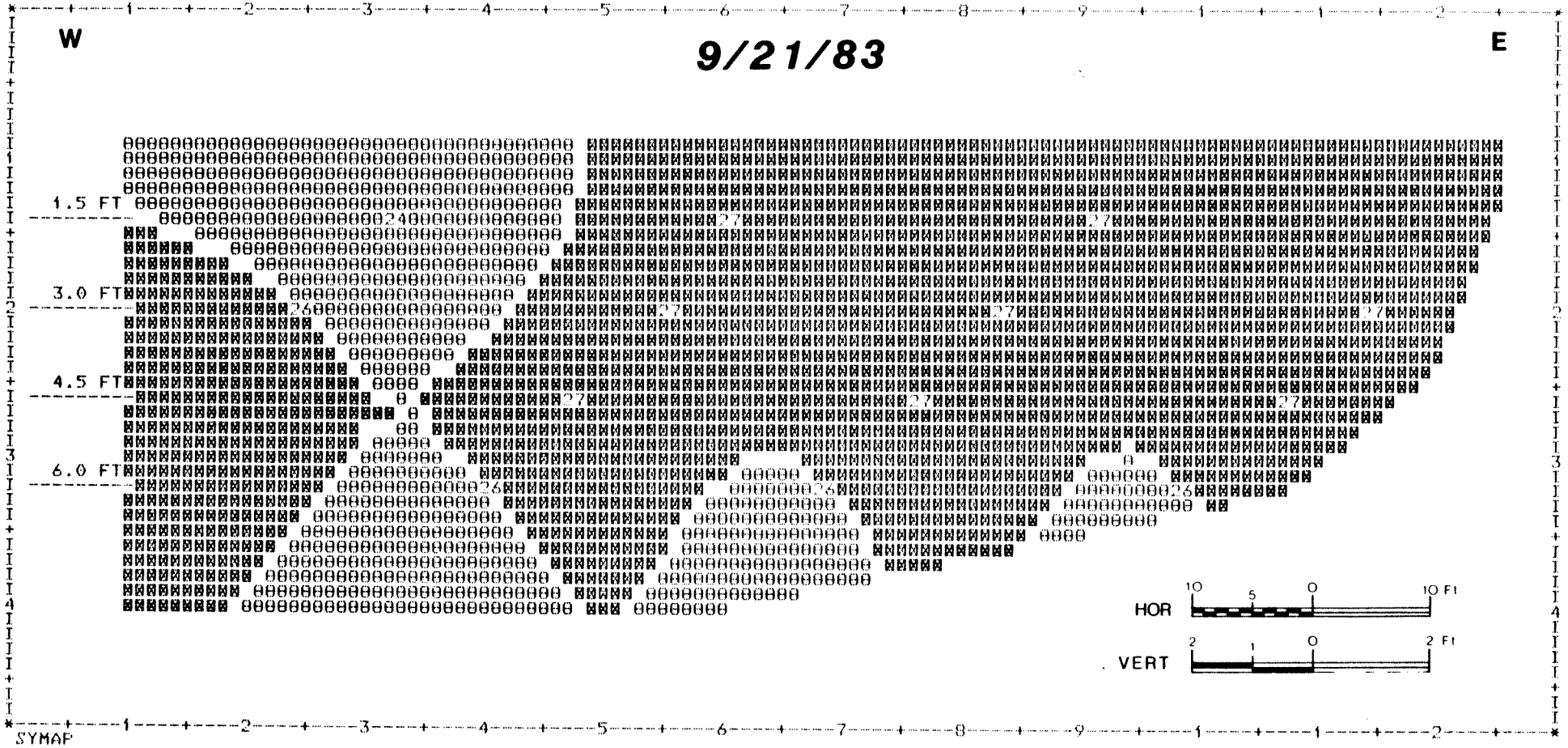

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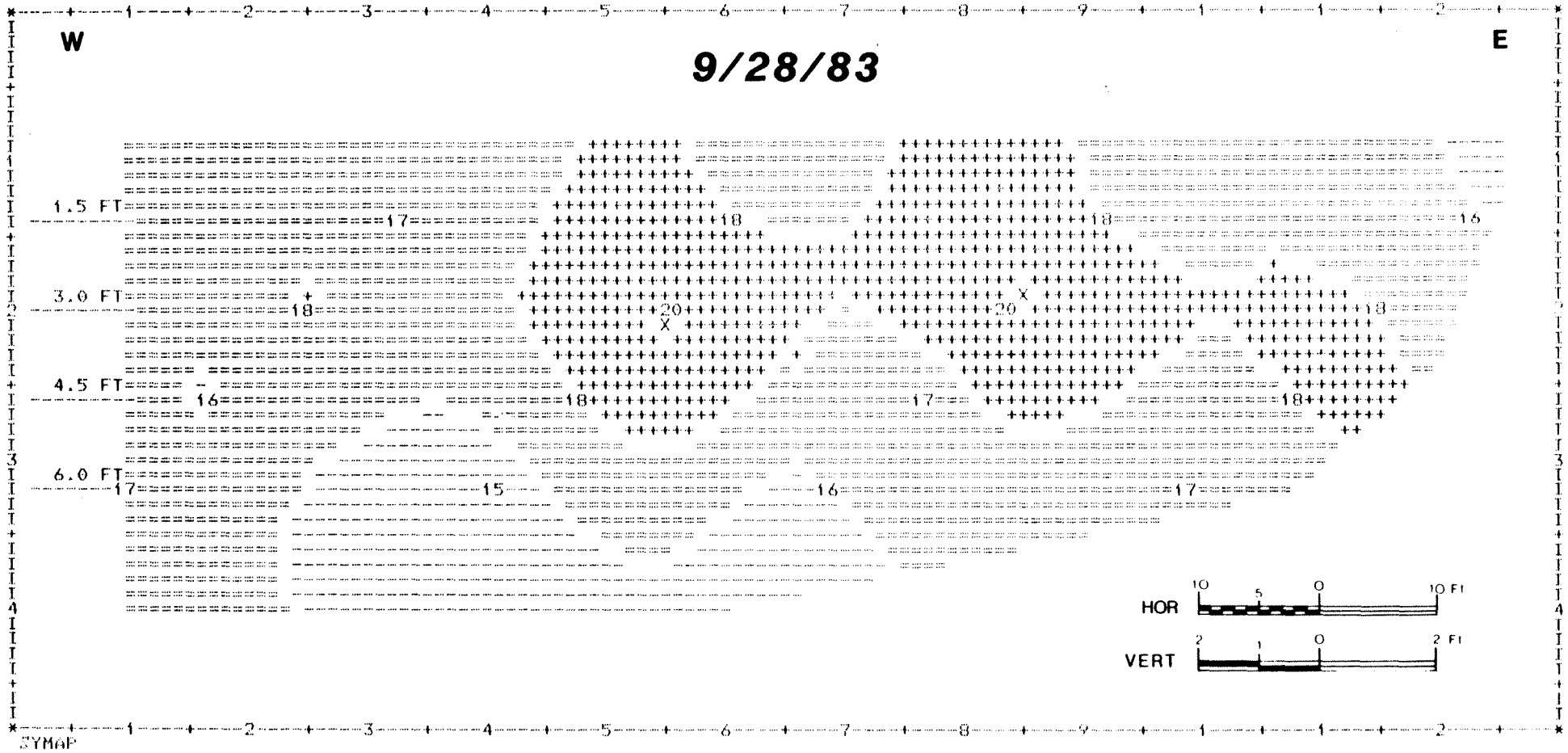
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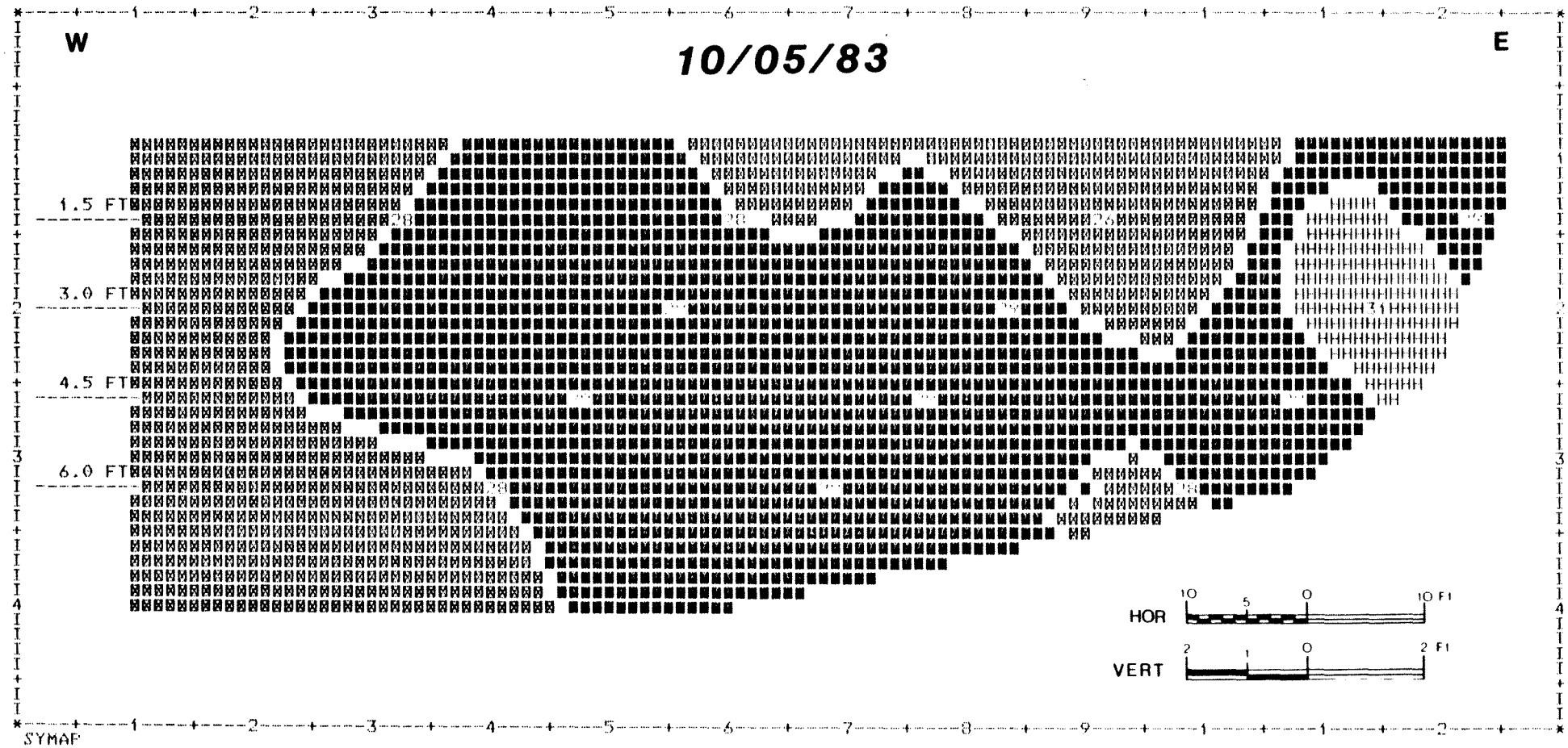
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APPENDIX B

WATER CHEMISTRY DATA FOR

LAWTONKA RESERVOIR

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SS
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SCHOOL HOUSE SLOUGH SE CORNER OF LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008
0018 FEET DEPTH CLASS 00 CSN-RSP 0714123-0395402

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/09/29		0017	0.05K	1.34K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/10/29		0000		0.71K	15.70	0.50K		0.050K			0.100K	0.500K
		0010	0.05K				0.050K	0.050K				
82/11/30		0000	0.05K	0.80K			0.050K			0.010K	0.100K	0.110
		0002			13.00	0.60						
		0010	0.05K	1.02K			0.050K	0.050K	0.050K	0.010K	0.100K	0.200
82/12/22		0000					0.050			0.010K	0.100K	0.110
83/01/26		0002			10.00	1.00						
		0007	0.05K	0.93K			0.050K		0.050K		0.130	0.100K
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83/04/21		0000			17.00	0.50						
		0010		0.77K			0.050K		0.050K	0.010K	0.100K	0.100K
83/05/11		0002		0.11	19.00	1.40	0.050K		0.050K	0.010K	0.100K	0.100K
83/05/25		0000			6.00	0.60						
		0007		0.31K			0.050K		0.050K	0.010K	0.100K	0.100K
83/06/02		0000		0.31K			0.050K		0.050	0.010K	0.100K	0.100K
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83/06/15		0000			13.60	1.10						
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STORET RETRIEVAL DATE 84/02/14

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SCHOOL HOUSE SLOUGH SE CORNER OF LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008
0018 FEET DEPTH CLASS 00 CSN-RSP 0714123-0395402

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
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		0010							182			
82/11/30		0000	0.580									
		0010	0.710				1.6					
82/12/22		0000	0.450									
83/01/26		0007	0.700									
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83/04/21		0010	0.560				6.2					
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83/06/15		0010	0.100K									
		0017	0.390									

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SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008
0018 FEET DEPTH CLASS 00 CSN-RSP 0714123-0395402

/TYPA/AMBNT/LAKE

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		0010							21.4	7.6	314	7.80
		0017							21.2	6.1	315	7.60
82/10/29		0000							16.1	8.4	318	8.00
		0010							16.2	8.0	322	8.10
		0017							16.1	7.0	323	8.00
82/11/30		0000							9.3	9.9	315	8.20
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		0017							8.6	8.9	314	8.30
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83/05/11		0002							17.0	9.0	394	7.20
		0013							16.9	8.4	396	7.20
83/05/25		0000							22.0	8.1	347	7.90
		0003							21.4	8.1	346	7.90
		0007							20.6	8.2	346	7.90
		0010							19.3	8.1	346	7.90
83/06/15		0000							21.9	7.8	377	6.70
		0010							21.3	7.0	379	6.70
		0017							19.7	0.8	384	6.30
83/06/28		0000							27.6	7.3	377	
		0003							27.2	7.2	375	
		0007							26.2	7.0	372	
		0010							25.2	6.6	372	

DATE FROM TO	TIME OF DAY	DEPTH FEET	70507 PHOS-T ORTHO MG/L P	31614 FEC COLI MPN TUBECODE	00550 OIL-GRSE TOT-SXLT MG/L	31507 TOT COLI MPN COMP /100ML	31671 FECSTREP PCKFAGAR /100ML	00680 T ORG C C MG/L
82/09/29		0017		4			64	
82/10/29		0000		3K		4	3	4.6
83/01/26		0007	0.050K					
83/04/21		0010	0.050K					
83/05/11		0002	0.050K					
83/05/25		0007		200		1300		
83/06/02		0000	0.050K	20	1.0K	170		
83/06/15		0010	0.020K					
		0017	0.058					
83/07/07		0003		33				

STORET RETRIEVAL DATE 84/02/14

L1
34 46 30.0 098 31 54.0 4
ROBINSON'S LANDING COVE NW CORNER OF LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 210KWRBQ 831008
0009 FEET DEPTH CLASS 00 CSN-RSP 0714106-0395385

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/07/29		0000			10.00	0.80						
		0003	0.05K	0.89K	17.00	2.30	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0007	0.05K	0.89K	9.80	1.60	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/09/29		0003	0.05K	1.28K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/10/29		0000		0.77K							0.100K	0.500K
		0002	0.05K		15.40	0.50K	0.050K	0.050	0.050K	0.010K		
82/11/30		0002			15.00	0.50K						
		0007	0.05K	0.85K			0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
82/12/22		0000			9.30	0.50K						
		0004	0.05K	0.55K			0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
83/01/07		0000			18.00	3.00						
		0003		0.41K			0.060	0.020K	0.020K	0.010	0.100K	0.200K
83/01/26		0002	0.05K	0.77K	10.00	0.50K	0.050K		0.050K	0.010K	0.100K	0.100K
83/02/28		0000			3.40	1.30						
		0007		0.31K			0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
83/03/23		0003		0.60K	4.30	1.30	0.050K		0.050K	0.010K	0.100K	0.100K
83/04/21		0000			21.00	1.00						
		0003		0.77K			0.077		0.050K	0.010K	0.100K	0.100K
83/05/11		0002		0.31K	15.00	2.70	0.050K		0.050K	0.010K	0.100K	0.100K
83/05/25		0000			10.20	0.50K						
		0007		0.31K			0.050K		0.050K	0.010K	0.100K	0.100K
83/06/02		0000		0.35K			0.050K		0.050K	0.010	0.100K	0.140
		0002			7.20	1.60						
83/06/15		0000			2.20	5.90						
		0007					0.284		0.035		0.380	0.100K
83/07/07		0000			14.00	1.90						
		0007		2.26K			0.020K	0.020K	0.020K	0.010K	0.100K	0.590
83/07/24		0000		0.32K	23.00	4.10	0.020K		0.020K	0.010K	0.100K	0.100K

STORET RETRIEVAL DATE 84/02/14

L1
34 46 30.0 098 31 54.0 4
ROBINSON'S LANDING COVE NW CORNER OF LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 21OKWRBQ 831008
0009 FEET DEPTH CLASS 00 CSN-RSP 0714106-0395385

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/07/29		0000									0.08	1.91
		0003	0.280	160	136	2	120.0	2.2	228	0.10K		
		0007	0.280	162	128	0	9.6	1.9	226	0.10K		
82/09/29		0003	0.670		124	12	21.0			0.10K		
82/10/29		0000	0.170				1.6					
		0002							186			
82/11/30		0007	0.640				3.0					
82/12/22		0004	0.340									
83/01/07		0003	0.100K		150		14.0		218			
83/01/26		0002	0.560									
83/02/28		0007	0.100K				5.6					
83/03/23		0003	0.390	164	148		32.0		225			
83/04/21		0003	0.560				11.0					
83/05/11		0002					7.4					
83/05/25		0007	0.100K	156	158		6.9	5.0K				
83/06/02		0000	0.100K				13.5	5.0K				
83/06/15		0007	1.510				300.0					
83/07/07		0007	2.150				17.0		281			
83/07/24		0000	0.110				19.0					

STORET RETRIEVAL DATE 84/02/14

L1
34 46 30.0 098 31 54.0 4
ROBINSON'S LANDING COVE NW CORNER OF LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 21OKWRBQ 831008
0009 FEET DEPTH CLASS 00 CSN-RSP 0714106-0395385

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
83/06/28		0004							27.7	7.5	376	
		0010							27.4	6.8	376	
83/07/24		0000							30.8	6.7	382	7.20
		0003							27.9	5.3	381	7.30
		0007							27.7	4.8	378	7.00
83/08/17		0000							31.5	6.9	357	7.70
		0003							31.2	6.7	378	7.60
		0007							30.6	5.9	380	7.40

STORET RETRIEVAL DATE 84/02/14

L1
34 46 30.0 098 31 54.0 4
ROBINSON'S LANDING COVE NW CORNER OF LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008
0009 FEET DEPTH CLASS 00 CSN-RSP 0714106-0395385

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/05/11		0000							18.5	8.3	412	7.20
82/07/29		0000							29.6		402	
		0003	16	100K	12	428	60K	4				
		0007		100K	10	980	60K	4				
82/09/29		0000							21.9	8.4	322	8.00
		0003							21.9	8.2	322	8.00
		0007							21.9	8.1	322	8.00
82/10/29		0000							16.4	8.3	325	8.00
		0002							16.4	8.2	326	8.10
		0007							16.4	8.2	327	8.10
82/11/30		0002							8.4	11.6	313	8.40
		0007							8.3	11.0	314	8.40
		0010							8.0	10.8	315	8.40
82/12/22		0000							7.3	11.4	367	7.20
		0004							7.2	11.1	370	7.20
		0007							6.9	10.9	386	7.20
83/01/26		0002							3.5	12.4	350	7.90
		0007							3.5	12.0	352	8.00
83/02/28		0000							13.5	9.9	361	7.60
		0003							12.2	9.8	359	7.50
		0007							10.5	9.5	355	7.60
		0010							9.0	9.6	343	7.60
83/03/23		0000							7.2	10.8	366	6.80
		0003							7.2	10.7	368	6.90
		0010							7.3	10.7	368	7.00
83/04/21		0000							13.9	7.6	389	7.00
		0003							13.6	7.5	390	7.00
		0007							13.2	7.2	394	7.00
83/05/11		0002							18.5	8.2	413	7.20
83/05/25		0000							23.7	7.6	351	7.70
		0007							23.3	7.3	351	7.80
83/06/15		0000							20.5	7.2	201	6.30
		0007							19.6	7.0	197	6.30
		0013							19.3	7.4	215	6.40
83/06/28		0000							27.8	7.8	373	
		0003							27.7	7.7	375	

L2
34 45 06.0 098 29 30.0 4
100 YDS. DIRECTLY W OF PIPELINE INFLOW
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 210KWRBQ 831008
0021 FEET DEPTH CLASS 00 CSN-RSP 0714114-0395393

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/07/29		0003	0.170	152	128	6	12.0	2.6	214	0.10K		
		0013	0.390	156	128	6	8.6	1.8	208	0.10K		
		0023	0.340	160	128	0	9.2	1.7	204	0.10K		
		0033	0.280	158	130	0	28.0	2.0	214	0.10K		
82/09/29		0003	0.730		116	10	11.0			0.10K		
82/10/29		0000	0.170									
		0010							162			
82/12/22		0000	0.340									
		0017	0.450									

STORET RETRIEVAL DATE 84/02/14

L2
34 45 06.0 098 29 30.0 4
100 YDS. DIRECTLY W OF PIPELINE INFLOW
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 210KWRBQ 831008
0021 FEET DEPTH CLASS 00 CSN-RSP 0714114-0395393

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/10/29		0000							16.0	8.5	312	7.80
		0002							16.1	8.3	314	8.00
		0010							16.1	8.1	316	8.10
		0017							16.1	8.0	316	8.10
		0023							16.1	7.9	317	8.20
82/12/22		0000							6.5	10.9	350	7.30
		0007							6.4	10.8	352	7.30
		0013							6.4	10.8	356	7.40
		0017							6.5	10.9	366	7.40
83/01/26		0000							3.9	12.1	348	7.80
		0003							3.9	11.9	348	7.90
		0007							3.9	11.9	348	8.00
83/07/24		0000							30.7	7.6	371	8.30
		0003							29.0	8.2	368	8.40
		0007							26.9	7.6	376	8.50
		0010							26.5	7.5	375	8.30
83/10/05		0000							22.7	9.4	353	7.70
		0003							22.5	9.3	353	7.70
		0007							22.3	9.2	354	7.80
		0010							22.1	9.1	354	7.80
		0013							22.0	9.0	355	7.90
		0017							21.9	8.9	355	7.90
		0020							21.9	8.9	355	7.90
		0023							21.7	8.7	356	7.90

STORET RETRIEVAL DATE 84/02/14

L1
34 46 30.0 098 31 54.0 4
ROBINSON'S LANDING COVE NW CORNER OF LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 210KWRBQ 831008
0009 FEET DEPTH CLASS 00 CSN-RSP 0714106-0395385

DATE FROM TO	TIME OF DAY	DEPTH FEET	70507 PHOS-T ORTHO MG/L P	31614 FEC COLI MPN TUBECODE	00550 OIL-GRSE TOT-SXLT MG/L	31507 TOT COLI MPN COMP /100ML	31671 FECSTREP PCKFAGAR /100ML	00680 T ORG C C MG/L
82/09/29		0000			2.0K			
		0003		30			8	
		0007		20			8	
82/10/29		0000		3K		3	3	
		0002						6.1
83/01/26		0002	0.050K					
83/03/23		0003	0.050K					
83/04/21		0003	0.050K					
83/05/11		0002	0.050K					
83/05/25		0007	0.050K	1700		4600		
83/06/02		0000	0.050K	20	1.0K	230		
83/07/07		0007		0				
83/07/24		0000	0.020K	0				

STORET RETRIEVAL DATE 84/02/14

L2
34 45 06.0 098 29 30.0 4
100 YDS. DIRECTLY W OF PIPELINE INFLOW
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 210KWRBQ 831008
0021 FEET DEPTH CLASS 00 CSN-RSP 0714114-0395393

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/07/29		0000			17.00	0.70						
		0003	0.05K	0.78K	18.00	0.50K	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0007			14.00	1.30						
		0010			17.00	0.50K						
		0013	0.05K	1.00K	12.00	0.50K	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0017			11.00	0.70						
		0023	0.05K	0.95K	4.30	1.70	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0033	0.05K	0.89K	3.00	3.60	0.050K	0.050K	0.050K	0.010	0.100	0.500K
82/09/29		0003	0.05K	1.43K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/10/29		0000		0.77K							0.100K	0.500K
		0002			10.60	0.50K						
		0010	0.05K				0.050K			0.010K		
82/12/22		0000		0.55K	10.00	0.50K	0.050K			0.010K	0.100K	0.100K
		0017		0.65K			0.050K				0.100K	0.100K

DATE FROM TO	TIME OF DAY	DEPTH FEET	70507 PHOS-T ORTHO MG/L P	31614 FEC COLI MPN TUBECODE	00550 OIL-GRSE TOT-SXLT MG/L	31507 TOT COLI MPN COMP /100ML	31671 FECSTREP PCKFAGAR /100ML	00680 T ORG C C MG/L
82/09/29		0000			2.0K			
		0003		2K			64	
		0007		2			2	
82/10/29		0000		3K		14	3	
		0002						5.9

STORET RETRIEVAL DATE 84/02/14

L3
34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 21OKWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/07/29		0000	0.1	0.1K	0.05	0.4K		3	28.4	7.4	382	7.70
		0003	14	100K	14	1492	60K	0.5K	28.4	7.2	382	7.70
		0007							28.4	7.1	384	7.70
		0010							28.3	7.0	384	7.70
		0013							28.4	7.0	384	7.70
		0017							28.3	7.0	384	7.70
		0023							28.3	6.9	385	7.60
		0028	16	100K	10	854	60K	0.5K	25.0	0.1	398	7.10
82/09/29		0000							21.6	9.1	323	8.00
		0003							21.6	8.5	327	8.00
		0010							21.3	8.0	329	8.00
		0023							21.3	7.4	341	8.10
82/10/29		0002							16.3	8.6	317	7.70
		0010							16.3	8.0	318	8.00
		0017							16.3	7.8	319	8.10
		0023							16.2	7.8	319	8.10
82/11/30		0000							9.4	10.8	310	8.30
		0002							9.4	10.5	302	8.30
		0010							9.2	10.1	300	8.30
		0017							9.1	10.1	301	8.30
		0023							9.1	10.0	301	8.30
		0033							9.0	19.9	301	8.30
		0035							9.0	9.9	301	8.30
82/12/22		0002							6.8	10.8	340	7.20
		0010							6.5	10.7	340	7.30
		0017							6.5	10.7	342	7.40
		0023							6.4	10.7	342	7.40
		0033							6.4	10.7	342	7.40
		0036							6.3	10.7	342	7.40
		0048							6.3	10.7	342	7.40
83/01/26		0002							4.0	12.1	353	7.80
		0010							4.0	11.8	352	8.00
		0017							3.9	11.7	351	8.00
		0023							3.9	11.6	351	8.10
		0033							3.9	11.5	351	8.10
		0036							3.9	11.4	350	8.10

L3
34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
83/02/28		0000							9.1	10.8	345	8.00
		0003							8.8	10.6	341	7.90
		0010							7.6	10.4	336	7.90
		0017							7.5	10.4	336	7.80
		0023							7.4	10.4	337	7.80
		0033							7.3	10.3	339	7.80
		0036							7.2	10.3	340	7.80
		0043							7.2	10.2	340	7.80
		0050							7.2	9.8	341	7.80
		0056							7.2	9.4	341	7.70
83/03/23		0000							8.6	10.4	363	6.80
		0010							8.6	10.4	363	6.80
		0017							8.6	10.4	364	6.90
		0023							8.5	10.8	366	6.90
		0030							8.5	11.2	366	6.90
		0036							8.5	11.3	366	6.90
		0043							8.4	10.9	367	6.90
		0050							8.2	9.6	367	6.90
		0053							8.1	9.6	365	6.90
83/04/21		0000							11.8	8.6	376	7.00
		0003							11.7	8.6	380	7.00
		0010							11.4	8.6	381	7.00
		0017							11.4	8.5	381	7.10
		0023							11.3	8.5	382	7.10
		0030							11.2	8.5	382	7.10
		0036							11.2	8.4	381	7.10
		0043							11.0	8.5	382	7.20
		0053							10.6	8.1	382	7.10
83/05/11		0002							17.3	8.9	395	7.20
		0023							17.2	8.7	396	7.20
		0048							16.8	7.3	399	7.20
83/05/25		0000							19.8	8.4	349	7.90
		0010							19.5	8.2	350	8.00
		0017							18.7	7.4	351	7.80
		0023							18.6	7.3	351	7.90
		0030							18.4	6.9	352	7.80

34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 21OKWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
83/05/25		0036							18.2	6.3	353	7.70
		0043							18.1	6.0	535	7.70
83/06/15		0000							21.5	7.9	377	6.60
		0007							21.5	7.8	377	6.60
		0013							21.5	7.7	377	6.60
		0020							21.4	7.7	377	6.70
		0026							21.4	7.7	377	6.70
		0033							21.4	7.7	377	6.70
		0040							21.4	7.6	377	6.70
		0046							21.4	7.7	377	6.70
		0050							21.3	7.6	377	6.60
83/06/28		0000							25.5	6.9	346	
		0007							25.4	6.7	348	
		0013							25.1	6.4	350	
		0022							23.8	4.2	355	
		0029							22.5	2.4	358	
		0033							22.0	1.2	358	
		0040							21.5	0.2	359	
		0047							21.2	0.2	361	
		0050							21.2	0.1	361	
83/07/24		0000							28.9	8.4	366	7.60
		0003							27.3	8.5	372	7.60
		0010							26.7	8.0	374	7.60
		0017							26.3	7.4	377	7.60
		0023							26.0	6.2	382	7.60
		0030							25.5	4.7	386	7.60
		0036							25.1	2.5	388	7.60
		0043							23.8	0.4	394	7.60
		0050							22.8	0.4	400	7.60
83/08/17		0000							28.7	7.0	393	7.40
		0007							28.1	6.6	394	7.20
		0013							27.9	5.8	398	7.10
		0020							27.6	2.3	402	6.70
		0026							25.4	0.5	416	6.50
		0033							24.4	0.4	426	6.50
		0040							24.1	0.4	425	6.40

L3
34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 21OKWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
83/08/17		0046							23.8	0.4	426	6.40
		0050							23.7	0.3	424	6.60
83/08/31		0000							27.0			
		0020							26.6			
83/10/05		0000							22.5	10.5	353	8.10
		0003							21.8	10.5	353	8.10
		0007							21.5	8.8	356	7.90
		0010							21.4	8.3	356	7.80
		0013							21.4	8.3	357	7.80
		0017							21.3	8.0	357	7.80
		0020							21.3	8.0	357	7.80
		0026							21.3	8.0	357	7.80
		0033							21.3	7.8	358	7.80
		0040							21.2	7.7	357	7.80
		0046							21.2	7.5	357	7.80
		0050							21.2	7.5	357	7.80

L3
34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/07/29		0000			11.00	0.50K						
		0003	0.05K	1.00K	10.00	0.50K	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0007			11.00	0.50K						
		0010			10.00	1.10						
		0013	0.05K	0.83K	10.00	0.50K	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0017			10.00	0.50K						
		0023	0.05K	0.72K	9.40	0.80	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0028	0.05K	0.72K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/09/29		0000			25.50	1.30						
		0003	0.05K	1.11K	28.50	1.10K	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0010	0.05K	1.06K	30.00	1.00	0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
		0023	0.05K	1.23K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/10/29		0002	0.05K		9.00	1.00	0.050K	0.050K	0.050K	0.010K		
		0010	0.05K		12.20	0.50K	0.050K	0.050K	0.050K	0.010K		
		0017	0.05K				0.050K	0.050K	0.050K	0.010K		
		0023	0.05K				0.050K	0.050K	0.050K	0.010K		
82/11/30		0002	0.05K	1.30K	12.00	0.50K	0.050K	0.050K	0.050K	0.010K	0.100K	0.420
		0010			13.00	0.50K						
		0017	0.05K	0.43K			0.050K	0.050K	0.050K	0.010K	0.100K	0.210
		0035	0.05K	0.92K			0.050K	0.050K	0.050K	0.010K	0.100K	0.170
82/12/22		0002	0.05K	0.55K	11.00	0.50K	0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
		0010			11.00	0.50K						
		0023	0.05K	0.43K			0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
		0048	0.05K	0.55K			0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
83/01/07		0000		0.41K	9.00	1.60	0.020	0.020K	0.020K	0.010K	0.100K	0.200K
83/01/26		0002	0.05K	1.04K	18.00	0.50K	0.050K		0.050K		0.100K	0.100K
		0010			17.00	0.50K						
		0017	0.05K	1.05K			0.050K		0.050K	0.010K	0.100K	0.100K
		0036	0.05K	1.11K			0.050K		0.050K	0.010K	0.100K	0.100K
83/02/28		0000		0.31K	2.00	0.70	0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
		0010			2.50	0.70						
		0033		0.38K			0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
		0056		0.39K			0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
83/03/23		0000		0.43K	5.80	0.50K	0.050K		0.050K	0.010K	0.100K	0.100K
		0010		0.43K			0.050K		0.050K	0.010K	0.100K	0.100K
		0053		0.38K			0.050K		0.050K	0.010K	0.100K	0.100K

L3
34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 210KWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
83/04/21		0000		0.73K	21.00	0.50K	0.050K		0.050K	0.010K	0.100K	0.100K
		0030		0.71K			0.050K		0.050K	0.010K	0.100K	0.100K
		0053		0.31K			0.059		0.050K	0.010K	0.100K	0.100K
83/05/11		0002		0.31K	10.00	2.00	0.050K		0.050K	0.010K	0.100K	0.100K
		0023		0.31K			0.050K		0.050K	0.010K	0.100K	0.100K
		0048		0.31K			0.085K		0.050K	0.010K	0.100K	0.100K
83/05/25		0000		0.31K	13.80	0.60	0.050K		0.050K	0.010K	0.100K	0.100K
		0023		0.31K			0.050K		0.050K	0.010K	0.100K	0.100K
		0043		0.32K			0.050K		0.050K	0.010K	0.100K	0.100K
83/06/02		0000		0.31K			0.050K		0.050K	0.010K	0.100K	0.140
		0017			6.00	1.10						
83/06/15		0000			17.10	1.30	0.020		0.020K		0.100K	0.100K
		0026					0.022		0.020K		0.100K	0.100K
		0050					0.020		0.020K		0.100K	0.100K
83/07/01		0010			9.70	1.40						
		0024		0.59K			0.020	0.020K	0.020K	0.010	0.100K	0.200K
		0050		0.10K			0.030	0.020K	0.020K	0.010	0.100K	0.240
83/07/07		0000		1.92K			0.020K	0.020K	0.020K	0.010K	0.100K	0.530
		0007			10.00	0.20						
		0041		1.68K			0.020K	0.020K	0.020K	0.010K	0.120	0.500
83/07/24		0003		0.38K	17.00	3.20	0.070		0.020K	0.010K	0.100K	0.100K
		0050		1.29K	3.70	3.50	0.080		0.080	0.010K	0.100K	0.280

STORET RETRIEVAL DATE 84/02/14

L3
34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 210KWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
83/06/02		0000	0.100K				5.9	5.0K				
83/06/15		0000	0.100K				4.1					
		0026	0.100K				5.4					
		0050	0.170				5.3					
83/07/01		0024	0.280		148		4.0		226			
		0050	0.100K		150		6.0		206			
83/07/07		0000	1.810				2.6		198			
		0041	1.550				9.4		216			
83/07/24		0003	0.170				6.2					
		0050	1.180				13.0					

34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/LAKE 210KWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/07/29		0003	0.390	150	128	8	9.2	1.9	208	0.10K		
		0013	0.220	158	130	4	9.7	1.7	208	0.10K		
		0023	0.110	160	128	6	9.7	1.8	214	0.10K		
		0028	0.110	160	130	0	13.0	1.8	216	0.10K		
82/09/29		0003	0.500		118	14	10.0			0.10K		
		0010	0.450		122	12	11.5			0.10K		
		0023	0.620		120	12	20.0			0.10K		
82/10/29		0002							156			
		0010							158			
		0017							124			
		0023							198			
82/11/30		0002	0.770				4.7					
		0017	0.110K				4.6					
		0035	0.640				3.5					
82/12/22		0002	0.340									
		0023	0.220									
		0048	0.340									
83/01/07		0000	0.100K		146		2.6		208			
83/01/26		0002	0.840									
		0017	0.840									
		0036	0.900									
83/02/28		0000	0.100K				2.9					
		0033	0.170				3.7					
		0056	0.180				5.1					
83/03/23		0000	0.220		152		11.0		220			
		0010	0.220	160	154		17.0		220			
		0053	0.170		144		47.0					
83/04/21		0000	0.620				5.1					
		0030	0.500				5.4					
		0053	0.100K				8.8					
83/05/11		0002					3.5					
		0023					3.8					
		0048					7.8					
83/05/25		0000	0.100K	152	148		3.3	5.0K				
		0023	0.100K	154	158		8.9	5.0K				
		0043	0.110K	148	156		4.3	5.0K				

STORET RETRIEVAL DATE 84/02/14

L3
34 44 18.0 098 30 12.0 4
APROX. 75 YDS. DIRECTLY N OF DAM
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008
0045 FEET DEPTH CLASS 00 CSN-RSP 0714116-0395395

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	70507 PHOS-T ORTHO MG/L P	31614 FEC COLI MPN TUBECODE	00550 OIL-GRSE TOT-SXLT MG/L	31507 TOT COLI MPN COMP /100ML	31671 FECSTREP PCKFAGAR /100ML	T	00680 ORG C C MG/L
82/09/29		0000			2.0K				
		0003		4			2		
		0023		2			4		
82/10/29		0002							4.9
83/01/26		0002	0.050K						
		0017	0.050K						
		0036	0.050K						
83/03/23		0000	0.050K						
		0010	0.050K						
		0053	0.050K						
83/04/21		0000	0.050K						
		0030	0.050K						
		0053	0.050K						
83/05/11		0002	0.050K						
		0023	0.050K						
		0048	0.050K						
83/05/25		0000	0.050K	200K		200K			
		0023	0.050K						
		0043	0.050K						
83/06/02		0000	0.050K	20K	1.0K	20			
83/06/15		0000	0.020K						
		0026	0.020K						
		0050	0.020K						
83/07/07		0000		0					
		0041		13					
83/07/24		0003	0.020K						
		0050	0.080	9					

34 46 48.0 098 30 24.0 4
JACKSON CREEK NEAR LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714117-0395396

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/07/29		0000	0.05K	0.71K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/08/19		0000		0.72K			0.050K			0.010K	0.100K	0.500K
82/09/29		0000		1.23K			0.087	0.081	0.074	0.010K	0.100K	0.500K
82/11/30		0000		0.53K			0.050K			0.010K	0.100K	0.100K
83/01/26		0000		0.42K			0.050K				0.100K	0.100K
83/03/23		0000		0.31K			0.050K			0.010K	0.100K	0.100K
83/05/25		0000		0.55K			0.146				0.350	0.100K
83/07/01		0000		0.40K			0.062				0.100K	0.200K

STORET RETRIEVAL DATE 84/02/14

L4
34 46 48.0 098 30 24.0 4
JACKSON CREEK NEAR LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714117-0395396

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/07/29		0000	0.100K	296	274	0	2.7	1.9	434	0.10K		
82/08/19		0000	0.110K	332	244	0	1.6		410	0.10K		
82/09/29		0000	0.620		284	16				0.10K		
82/11/30		0000	0.320									
83/01/26		0000	0.220									
83/03/23		0000	0.100K	266					420			
83/05/25		0000	0.100K									
83/07/01		0000	0.100K									

STORET RETRIEVAL DATE 84/02/14

L4
34 46 48.0 098 30 24.0 4
JACKSON CREEK NEAR LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714117-0395396

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/07/29		0000							25.5	8.4	732	7.60
82/09/29		0000							22.0	8.0	628	7.60
82/11/30		0000							12.3	8.5	604	7.60
83/01/26		0000							3.8	10.5	625	7.20
83/02/28		0000							9.9	13.2	506	8.20
83/03/23		0000							7.4	11.7	584	6.30
83/05/25		0000							21.4	6.9	522	7.40
83/06/28		0000							20.7	6.7	624	

PROPERTY OF
OKLAHOMA WATER RESOURCES BOARD

STORET . RIEVAL DATE 84/02/14

L5
34 47 48.0 098 31 48.0 4
APROX. 1 MILE N OF MOUNT SCOTT TOWN
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714118-0395397

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/07/29		0000	0.05K	0.71K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/09/29		0000		1.49K						0.010K	0.360	0.500K
82/10/29		0000	0.05K	0.70K			0.050K				0.100K	0.500K
82/11/30		0000		0.40K			0.050K			0.010K	0.100K	0.100K
82/12/22		0000		0.32K			0.050K			0.010K	0.100K	0.100K
83/02/28		0000		0.31K			0.050K			0.010K	0.100K	0.100K
83/04/21		0000		0.31K			0.050K			0.010K	0.100K	0.100K
83/06/15		0000					0.046				0.100K	0.100K

STORET RETRIEVAL DATE 84/02/14

L5
34 47 48.0 098 31 48.0 4
APROX. 1 MILE N OF MOUNT SCOTT TOWN
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714118-0395397

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/07/29		0000	0.100K	294	254	0	2.1	1.7	360	0.10K		
82/09/29		0000	0.620		242	0	0.1K			0.50K		
82/10/29		0000	0.100K				0.5					
82/11/30		0000	0.190									
82/12/22		0000	0.110K									
83/02/28		0000	0.100K									
83/04/21		0000	0.100K									
83/06/15		0000	0.100K									

STORET RETRIEVAL DATE 84/02/14

L5
34 47 48.0 098 31 48.0 4
APROX. 1 MILE N OF MOUNT SCOTT TOWN
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714118-0395397

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/07/29		0000							21.4	3.7	575	7.00
82/08/19		0000							22.8		715	6.40
82/09/29		0000							21.0	6.8	520	6.70
82/10/29		0000							13.6	2.7	578	6.60
82/11/30		0000							12.2	3.7	612	6.90
82/12/22		0000							9.7	6.0	668	6.60
83/02/28		0000							11.5	10.0	405	7.70

L6
34 47 00.0 098 34 36.0 4
APROX. .2 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 21OKWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714119-0395398

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/07/29		0000	0.05K	0.71K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/08/19		0000		0.95K			0.050K			0.010K	0.100K	0.500K
82/09/29		0000		1.49K						0.010K	0.360	0.500K
82/10/29		0000	0.05K	0.71K			0.050K				0.100K	0.500K
82/11/30		0000		0.40K			0.050K			0.010K	0.100	0.100K
83/01/26		0000					0.050K				0.590	0.100K
83/03/23		0000		0.46K			0.050K			0.010K	0.250	0.100K
83/05/25		0000		0.54K			0.050K				0.340	0.100K
83/07/01		0000		0.43K			0.020K				0.130	0.200K

STORET RETRIEVAL DATE 84/02/14

L6
34 47 00.0 098 34 36.0 4
APROX. .2 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 21OKWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714119-0395398

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/07/29		0000	0.100K	240	210	0	2.7	2.0	288	0.10K		
82/08/19		0000	0.340	204	168	0	3.7		244	0.10		
82/09/29		0000	0.620		184	10	0.1K			0.50K		
82/10/29		0000	0.110				0.7					
82/11/30		0000	0.450									
83/01/26		0000	0.220									
83/03/23		0000	0.100K	246					290			
83/05/25		0000	0.100K									
83/07/01		0000	0.100K									

L7
34 46 36.0 098 34 48.0 4
APROX. .4 MILES S OF MEERS ON HWY 115
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714120-0395399

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/07/29		0000	0.100K	270	290	0	22.0	2.3	428	0.10K		
82/08/19		0000	0.500	242	234	0	5.4		388	0.10K		
82/09/29		0000			288	12	0.1K			0.11		
82/10/29		0000	0.110				2.3					
82/11/30		0000	0.580									
82/12/22		0000	0.170									
83/02/28		0000	0.100K									
83/04/21		0000	1.900									

STORET RETRIEVAL DATE 84/02/14

L7
34 46 36.0 098 34 48.0 4
APROX. .4 MILES S OF MEERS ON HWY 115
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714120-0395399

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/07/29		0000							25.0	3.0	709	7.30
82/08/19		0000							26.1	7.2	663	7.20
82/09/29		0000							23.3	8.4	640	7.40
82/10/29		0000							11.0	6.0	570	7.30
82/11/30		0000							14.7	4.8	655	7.20
82/12/22		0000							7.9	7.5	648	6.80
83/02/28		0000							17.4	13.6	600	7.90
83/04/21		0000							14.3	13.0	647	7.10
83/06/15		0000							23.7	8.5	644	7.40

34 47 00.0 098 34 36.0 4
APROX. .2 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714119-0395398

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/07/29		0000							26.1	7.6	524	7.40
82/08/19		0000							26.4		470	7.00
82/09/29		0000							22.8	8.5	414	7.40
82/10/29		0000							11.0	9.0	456	7.60
82/11/30		0000							12.9	9.5	473	7.90
83/01/26		0000							7.4	12.0	428	7.40
83/02/28		0000							13.2	10.6	451	7.20
83/03/23		0000							7.6	11.5	458	6.50
83/05/25		0000							22.1	7.2	443	7.60
83/06/28		0000							22.0	8.4	497	

STORET RETRIEVAL DATE 84/02/14

L7
34 46 36.0 098 34 48.0 4
APROX. .4 MILES S OF MEERS ON HWY 115
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714120-0395399

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/07/29		0000	0.05K	0.71K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/08/19		0000		1.83K			0.125			0.010	0.820	0.500K
82/09/29		0000		3.21						0.010K	1.860	0.500K
82/10/29		0000	0.05K	0.98K			0.050K				0.370	0.500K
82/11/30		0000		1.03			0.070			0.010		0.440
82/12/22		0000		0.82K			0.090			0.010K	0.540	0.100K
83/02/28		0000		1.10K			0.072K			0.010K	0.890	10.000K
83/04/21		0000		2.75K			0.068			0.010K	0.740	0.100K
83/06/15		0000					0.157				0.730	0.100K

STORET TRIEVAL DATE 84/02/14

L8
34 46 18.0 098 34 48.0 4
MEDICINE CREEK AT HWY 115
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0002 FEET DEPTH CLASS 00 CSN-RSP 0714121-0395400

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/07/29		0000	0.05K	0.71K			0.050K	0.050K	0.050K	0.010K	0.100K	0.500K
82/08/19		0000		0.83K			0.050K			0.010K	0.100K	0.500K
82/09/29		0000		1.28K						0.010K	0.100K	0.500K
82/10/29		0000	0.05K	0.70K			0.050K				0.100K	0.500K
82/11/30		0000		0.53			0.050K			0.010K	0.100K	0.100K
83/01/26		0000		0.48			0.050K				0.100K	0.100K
83/03/23		0000		0.31K			0.050K			0.010K	0.100K	0.100K
83/04/21		0000		0.43K			0.066			0.010K	0.100K	0.100K
83/05/25		0000		0.30K			0.050K				0.100K	0.100K
83/06/15		0000					0.117				0.100K	0.100K
83/07/01		0000		0.40K			0.023				0.100K	0.200K
83/08/19		0000		0.83K			0.050K			0.010K	0.100K	0.500

STORET RETRIEVAL DATE 84/02/14

L8
34 46 18.0 098 34 48.0 4
MEDICINE CREEK AT HWY 115
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0002 FEET DEPTH CLASS 00 CSN-RSP 0714121-0395400

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/07/29		0000	0.100K	202	170	8	1.8	1.7	288	0.10K		
82/08/19		0000	0.220	172	124	4	2.7		252	0.10K		
82/09/29		0000	0.670		180	12	0.1K			0.05K		
82/10/29		0000	0.100K				0.9					
82/11/30		0000	0.320									
83/01/26		0000	0.280									
83/03/23		0000	0.100K	144					210			
83/04/21		0000	0.220									
83/05/25		0000	0.100K									
83/06/15		0000	0.100K									
83/07/01		0000	0.100K									
83/08/19		0000	0.220	172	124	4	2.7		252	0.10K		

34 46 18.0 098 34 48.0 4
MEDICINE CREEK AT HWY 115
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0002 FEET DEPTH CLASS 00 CSN-RSP 0714121-0395400

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/07/29		0000							29.4	8.6	504	10.20
82/08/19		0000							29.2		445	7.60
82/09/29		0000							24.5	7.5	479	7.80
82/10/29		0000							13.6	10.7	427	8.00
82/11/30		0000							12.4	11.4	501	8.20
83/01/26		0000							4.3	12.8	415	7.60
83/02/28		0000							14.5	10.6	356	8.00
83/03/23		0000							6.5	11.5	343	6.60
83/05/25		0000							26.2	7.3	259	7.80
83/06/15		0000							24.6	8.1	226	7.20
83/06/28		0000							26.0	8.5	491	

STORET RETRIEVAL DATE 84/02/14

L9
34 47 00.0 098 32 54.0 4
APROX. 1.8 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714122-0395401

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L
83/02/28		0000		0.73K			0.050K			0.010K	0.520	10.000K
83/04/21		0000		0.93K			0.066			0.010	0.370	0.100K
83/06/15		0000					0.128				0.400	0.100K

STORET RETRIEVAL DATE 84/02/14

L9
34 47 00.0 098 32 54.0 4
APROX. 1.8 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714122-0395401

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH- LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
83/02/28		0000	0.100									
83/04/21		0000	0.450									
83/06/15		0000	0.100K									

L9
34 47 00.0 098 32 54.0 4
APROX. 1.8 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714122-0395401

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
83/02/28		0000							15.0	12.8	575	7.80
83/04/21		0000							13.7	12.0	617	7.10
83/06/15		0000							23.1	8.5	642	7.30

STORET RETRIEVAL DATE 84/02/14

L10
34 47 00.0 098 33 36.0 4
APROX. 1.1 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714107-0395386

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/11/30		0000		0.92K			0.050K			0.010K	0.100K	0.100K
83/01/26		0000		0.42K			0.050K				0.100K	0.100K
83/03/23		0000		1.05K			0.050K			0.070	0.780	0.100K
83/05/25		0000		0.85K			0.050K				0.650	0.100K
83/07/01		0000		0.84K			0.062				0.540	0.200K

STORET RETRIEVAL DATE 84/02/14

L10
34 47 00.0 098 33 36.0 4
APROX. 1.1 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714107-0395386

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/11/30		0000	0.710									
83/01/26		0000	0.220									
83/03/23		0000	0.100K	316						420		
83/05/25		0000	0.100K									
83/07/01		0000	0.100K									

34 47 00.0 098 33 36.0 4
APROX. 1.1 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714107-0395386

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/11/30		0000							13.3	3.7	720	7.20
83/01/26		0000							5.0	11.8	686	6.90
83/02/28		0000							14.6	12.7	620	7.70
83/03/23		0000							6.7	11.7	634	6.30
83/05/25		0000							21.0	7.4	689	7.30
83/06/28		0000							20.7	7.4	675	

STORET RETRIEVAL DATE 84/02/14

L12
34 44 00.0 098 31 00.0 4
CANAL LEADING FROM ELMER THOMAS LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/CANAL/TYPA/AMBNT 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714108-0395387

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L
82/09/29		0000		1.28K						0.010K	0.100K	0.500K
83/02/28		0000		0.31K			0.050K			0.010K	0.100K	0.100K
83/03/23		0000		0.78K			0.050K			0.010K	0.170	0.100K
83/05/25		0000		0.30K			0.050K				0.100K	0.100K

STORET RETRIEVAL DATE 84/02/14

L12
34 44 00.0 098 31 00.0 4
CANAL LEADING FROM ELMER THOMAS LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/CANAL/TYPA/AMBNT 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714108-0395387

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH- LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/09/29		0000	0.670		60	2	0.1K			0.05K		
83/02/28		0000	0.100									
83/03/23		0000	0.500K	66							82	
83/05/25		0000	0.100									

STORET RETRIEVAL DATE 84/02/14

L12
34 44 00.0 098 31 00.0 4
CANAL LEADING FROM ELMER THOMAS LAKE
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008

/CANAL/TYPA/AMBNT

0001 FEET DEPTH CLASS 00 CSN-RSP 0714108-0395387

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/09/29		0000							22.5	7.5	162	7.90
83/02/28		0000							12.0	10.5	156	8.00
83/03/23		0000							6.6	12.3	171	6.40
83/05/25		0000							20.7	7.8	129	7.80

STORET RETRIEVAL DATE 84/02/14

L13
34 44 06.0 098 30 06.0 4
MEDICINE CREEK OUTFLOW FROM LAWTONKA
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008

/TYPA/AMBNT/STREAM

0002 FEET DEPTH CLASS 00 CSN-RSP 0714109-0395388

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
83/03/23		0000		0.71K			0.075			0.010K	0.100K	0.100K
83/04/21		0000		0.66K			0.050K			0.010K	0.100K	0.100K

STORET RETRIEVAL DATE 84/02/14

L13
34 44 06.0 098 30 06.0 4
MEDICINE CREEK OUTFLOW FROM LAWTONKA
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWER MISS 101500
UPPER RED RIVER ABOVE DENISON
210KWRBQ 831008

/TYPA/AMBNT/STREAM

0002 FEET DEPTH CLASS 00 CSN-RSP 0714109-0395388

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
83/03/23		0000	0.500	164					220			
83/04/21		0000	0.450									

L14
34 44 00.0 098 30 06.0 4
RAW WATER FAUCET FROM WATER TREATMENT PLANT
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/MUN/NTRTMT/INTAKE/PIPE/SUPPLY 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714110-0395389

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/09/29		0000		1.56						0.010K	0.100K	0.500K
82/10/29		0000	0.50K	0.70K			0.050				0.100K	0.500K
82/11/30		0000		1.04K			0.050K			0.010K	0.100K	0.220
83/01/26		0000		0.98K			0.050K				0.100K	0.100K
83/05/25		0000		0.30K			0.053				0.100K	0.100K
83/07/01		0000		0.40K			0.025				0.100K	0.200K

STORET RETRIEVAL DATE 84/02/14

L14
34 44 00.0 098 30 06.0 4
RAW WATER FAUCET FROM WATER TREATMENT PLANT
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/MUN/NTRTMT/INTAKE/PIPE/SUPPLY 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714110-0395389

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/09/29		0000	0.950		122	8	0.1K			0.05K		
82/10/29		0000	0.100K				2.4					
82/11/30		0000	0.710									
83/01/26		0000	0.780									
83/05/25		0000	0.100K									
83/07/01		0000	0.100K									

STORET RETRIEVAL DATE 84/02/14

L15
34 46 06.0 098 29 30.0 4
STREAM RUNNING INTO HORSESHOE SLOUGH ON HWY 58
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714111-0395390

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/11/30		0000		0.53K			0.050K			0.010K	0.100K	0.100K
83/02/28		0000		0.32K			0.050K	0.050K	0.050K	0.010K	0.100K	0.100K
83/03/23		0000		0.51K			0.050K		0.050K	0.010K	0.300	0.100K
83/04/21		0000		0.71K			0.050K			0.010K	0.100K	0.100K

STORET TRIEVAL DATE 84/02/14

L15
34 46 06.0 098 29 30.0 4
STREAM RUNNING INTO HORSESHOE SLOUGH ON HWY 58
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714111-0395390

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/11/30		0000	0.320									
83/02/28		0000	0.110									
83/03/23		0000	0.100K	316						475		
83/04/21		0000	0.500									

STORET RETRIEVAL DATE 84/02/14

L15
34 46 06.0 098 29 30.0 4
STREAM RUNNING INTO HORSESHOE SLOUGH ON HWY 58
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714111-0395390

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/11/30		0000							11.7	5.3	662	7.40
83/02/28		0000							8.3	6.3	674	7.80
83/03/23		0000							8.4	10.0	689	5.90
83/04/21		0000							10.5	5.5	735	7.00

STORET RETRIEVAL DATE 84/02/14

L15
34 46 06.0 098 29 30.0 4
STREAM RUNNING INTO HORSESHOE SLOUGH ON HWY 58
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714111-0395390

DATE FROM TO	TIME OF DAY	DEPTH FEET	70507 PHOS-T ORTHO MG/L P	31614 FEC COLI MPN TUBECODE	00550 OIL-GRSE TOT-SXLT MG/L	31507 TOT COLI MPN COMP /100ML	31671 FECSTREP PCKFAGAR /100ML	00680 T ORG C C MG/L
83/03/23		0000	0.050K					

STORET RETRIEVAL DATE 84/02/14

L16
34 47 00.0 098 32 12.0 4
APROX. 2.5 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714112-0395391

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
82/11/30		0000		0.65K			0.050K			0.010	0.150	0.100K

34 47 00.0 098 32 12.0 4
APROX. 2.5 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714112-0395391

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
82/11/30		0000	0.390									
83/01/26		0000	0.340									
83/05/25		0000	0.220									

STORET RETRIEVAL DATE 84/02/14

L16
34 47 00.0 098 32 12.0 4
APROX. 2.5 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714112-0395391

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
82/11/30		0000							13.8	4.9	643	7.20
83/01/26		0000							5.1	11.7	650	6.80
83/02/28		0000							11.9	9.7	689	7.60
83/05/25		0000							27.1	8.9	618	7.50

STORET RETRIEVAL DATE 84/02/14

L18
34 47 00.0 098 31 18.0 4
.8 MI W OF JACKSON CREEK/HWY 58 INTERSECTION
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714113-0395392

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
83/02/28		0000		0.52K			0.059			0.010K	0.100K	0.100K
83/05/25		0000		0.70K			0.071				0.100K	0.100K

STORET RETRIEVAL DATE 84/02/14

L18
34 47 00.0 098 31 18.0 4
.8 MI W OF JACKSON CREEK/HWY 58 INTERSECTION
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714113-0395392

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
83/02/28		0000	0.310									
83/05/25		0000	0.500									

STORET RIEVAL DATE 84/02/14

L18
34 47 00.0 098 31 18.0 4
.8 MI W OF JACKSON CREEK/HWY 58 INTERSECTION
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714113-0395392

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
83/02/28		0000							13.7	10.3	869	7.80
83/05/25		0000							28.6	6.8	697	7.80

STORET RETRIEVAL DATE 84/02/14

L20
34 47 00.0 098 32 30.0 4
APROX. 2.1 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714115-0395394

DATE FROM TO	TIME OF DAY	DEPTH FEET	00650 T PO4 PO4 MG/L	00600 TOTAL N N MG/L	32211 CHLRPHYL A UG/L CORRECTD	32218 PHEOPHTN A UG/L	00665 PHOS-TOT MG/L P	00671 PHOS-DIS ORTHO MG/L P	00674 PHOS-SUS ORTHO MG/L P	00615 NO2-N TOTAL MG/L	00620 NO3-N TOTAL MG/L	00610 NH3+NH4-N TOTAL MG/L
83/05/25		0000		0.55K			0.050K				0.350	0.100K
83/07/01		0000		0.83K			0.164				0.180	0.200K

STORET RETRIEVAL DATE 84/02/14

L20
34 47 00.0 098 32 30.0 4
APROX. 2.1 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714115-0395394

DATE FROM TO	TIME OF DAY	DEPTH FEET	00625 TOT KJEL N MG/L	00900 TOT HARD CACO3 MG/L	00410 T ALK CACO3 MG/L	00415 PHEN-PH-LFIN ALK MG/L	82079 TURBIDTY LAB NTU	00311 DISS BOD 5 DAY MG/L	70301 DISS SOL SUM MG/L	70348 SOLIDS SETTLE ML/L	01170 FE MUD DRY WGT MG/KG-FE	01053 MN MUD DRY WGT MG/KG-MN
83/05/25		0000	0.100K									
83/07/01		0000	0.450									

STORET RETRIEVAL DATE 84/02/14

L20
34 47 00.0 098 32 30.0 4
APROX. 2.1 MILES E OF MEERS
40031 OKLAHOMA COMANCHE
SOUTHCENTRAL-LOWERMISS 101500
UPPER RED RIVER ABOVE DENISON
/TYPA/AMBNT/STREAM 210KWRBQ 831008
0001 FEET DEPTH CLASS 00 CSN-RSP 0714115-0395394

DATE FROM TO	TIME OF DAY	DEPTH FEET	01119 COPPER TOT.REC. UG/L	01114 LEAD(PB) TOT.REC. UG/L	01094 ZINC(ZN) TOT.REC. UG/L	01104 ALUMINUM TOT.REC. UG/L	01074 NICKEL TOT.REC. UG/L	71901 MERCURY TOT.REC. UG/L	00010 WATER TEMP CENT	00299 DO PROBE MG/L	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU
83/02/28		0000							16.2	10.7	615	7.40
83/05/25		0000							23.3	7.2	691	7.60
83/06/28		0000							22.6	4.5	596	

Jim Brunso

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring And Analysis Division

921 N. E. 23rd Street

Oklahoma City, Oklahoma 73105

O.W.R.B. Lawtonka Lake

Site/Lab No.	Date Received	TOC(mg/L)	Oil & Grease (mg/L)
Surface 1 M/1225	May 25, 1983	5.2	1*
Surface 3 M/1282	May 25, 1983	4.9	1*
Surface SS/1234	May 25, 1983	4.5	1*
Surface 1 M/1289	June 2, 1983	2.6	1*
Surface 3 M/1291	June 2, 1983	4.4	1*
Surface SS/1293	June 2, 1983	2.8	1*
Surface 1 M/4	July 1, 1983	8.6	3.5
Surface 3 M/7	July 1, 1983	6.5	2.4
Surface SS/13	July 1, 1983	7.7	10.0
Surface 1 M/108	July 7, 1983	5.8	2.3
Surface 3 M/110	July 7, 1983	7.2	3.3
Surface SS/114	July 7, 1983	6.7	5.5

* = less than indicated value.

RECEIVED
OCT 31 1983
Oklahoma Water Resources Board

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis

Zooplankton Data Summary

Project: Lawtonka Lake **Date Received: 7-29-82**

	Station / Depth (Individuals per liter)	
	1/2 m	3/8.5 m
Crustacea		
Copepoda		
Diaptomidae	17.2	30.0
Cyclopidae	5.2	19.6
Cladocera		
Daphnidae	6.1	30.0
Bosminidae	3.7	43.9
Sididae	4.4	1.2

Preliminary Data

SUBJECT TO REVISION

300 wp

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring and Analysis Division

Project: Lawtonka Lake **Date Received: 7-29-82**

Total Concentration of Chlorinated Hydrocarbon
Pesticides and PCB's (ug/g) in Sediment

Parameter (ug/g)	**Site No.**	
	1	**3**
A & B		
BHC	0.003*	0.003*
Lindane	0.003*	0.015
Heptachlor	0.002*	0.002*
Aldrin	0.004*	0.004*
p,p D D E	0.007*	0.007*
Dieldrin	0.007*	0.007*
p,p D D T	0.016*	0.016*
Endrin	0.020*	0.020*
Methoxychlor	0.070*	0.070*
Chlordane	0.14*	0.14*
Arochlor 1242	0.14*	0.14*
Arochlor 1254	0.20*	0.20*
p,p D D D	0.014*	0.014*

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Project: Lawtonka Lake **Date Received: 7-29-82**

Concentration of Herbicides (ug/g) in Sediment

	Site No.	
	1	**3**
2,4 - D	0.025*	0.025*
2,4,5 - T	0.005*	0.005*
Silvex	0.016*	0.016*

Parameter (ug/l)	**1 Surface**	**2 Surface**
Total Carbon	39.89	35.52
Inorganic Carbon	40.38	33.62
T O C	0	1.90

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OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring & Analysis Division

Zooplankton Data Summary

Project: O.W.R.B. Lawtonka Lake **Date Received: May 25, 1983**

Lab No. 1227 **Station No. 3 at 12 Meters**

	Organisms/liter
Crusteacea	
Copepada	
Diaptomidae	11.4
Cyclopidae	5.2
nauplii	41.3
Cladocera	
Daphnidae	21.5
Bosminidae	10.7

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: Lawtonka Lake **Date Recieved: 8-18-83**

Parameter (mg/L)	Site No./Depth/Lab No.					
	1-1 M. 1406	3-1 M. 1407	3-M.D. 1408	3-Bottom 1409	Elseworth Pipeline 1410	14-M.D. 1411
Total Phosphorous	0.052	0.020*	0.021	0.152	0.030	0.046
Nitrite (as N)	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*
Nitrate (as N)	0.10*	0.10*	0.10*	0.10*	0.10*	0.10*
Ammonia N (as N)	0.10*	0.10*	0.10*	0.10*	0.10*	0.10*
Kjeldahl N (as N)	0.10*	0.10*	0.10*	0.10*	0.10*	0.10*
Total Nitrogen	0.21*	0.21*	0.21*	0.21*	0.21*	0.21*
Chlorophyll a (ug/L)	18.7	13.2	3.1	4.3	10.3	11.1
Pheophytin a (ug/L)	4.0	1.1	3.4	3.4	3.0	2.2

* = Less than indicated value.

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: Lawtonka Lake **Date Received: September 1, 1983**

Parameter (mg/L)	**Transect/Lab No.**						
	A	**B**	**C**	**H**	**G**	**J**	**Elsworth Pipeline**
	1719	**1720**	**1721**	**1722**	**1723**	**1724**	**1725**
Nitrite (as N)	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*
Nitrate (as N)	0.10*	0.10*	0.10*	0.10*	0.10*	0.10*	0.10*
Kjeldahl N (as N)	0.10*	0.10*	0.10*	0.10*	0.11	0.45	0.10*
Total Nitrogen	0.21*	0.21*	0.21*	0.21*	0.22*	0.56*	0.21*
Total Phosphorous	0.02	0.02	0.02	0.05	0.04	0.06	0.03

* = less than indicated value.

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring & Analysis Division

Project: Lawtonka Lake **Date Received: September 15, 1983**

Parameter	Transect/Lab No.						
	B	C	D	G	H	J	Ellsworth Pipeline
	2126	2127	2128	2129	2130	2131	2132
Nitrite (as N)	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*
Nitrate (as N)	0.10*	0.10*	0.10*	0.10*	0.10*	0.10*	0.12
Kjeldahl N (as N)	0.10*	0.10*	0.10*	0.10*	0.10*	0.10*	0.10*
Total Nitrogen	0.21*	0.21*	0.21*	0.21*	0.21*	0.21*	0.23*
Total Phosphorous	0.03	0.03	0.02	0.03	0.03	0.05	0.06
Chlorophyll a							7.9
Pheophytin a							3.7

* = less than indicated value.

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: Lawtonka Lake **Date Received: September 7, 1983**

Parameter	Site/Lab No.					
	Lake Site 1918	Lagoon 1919	Ellsworth Pipeline 1920	S. Slough 1921	Lagoon 1922	Seepage Meter 1923
Nitrite (as N)	0.01*	0.01*	0.01			
Nitrate (as N)	0.10*	0.10*	0.10*			
Kjeldahl N (as N)	0.10*	1.29	0.22			
Total Nitrogen	0.21*	2.40*	0.33*			
Total Phosphorous	0.03	0.02	0.03			
Fecal Coliforms				2	7	2*
Chlorophyll a			4.3			
Pheophytin a			1.7			

* = less than indicated value.

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring And Analysis Division

Project: O.W.R.B. Lawtonka Lake **Date Received: September 15, 1983**

Parameter (mg/L)	Transect/Lab No.			
	B 2126	C 2127	D 2128	G 2129
Nitrite (as N)	0.01*	0.01*	0.01*	0.01*
Nitrate (as N)	0.10*	0.10*	0.10*	0.10*
Kjeldahl N (as N)	0.10*	0.10*	0.10*	0.10*
Total Nitrogen	0.21*	0.21*	0.21*	0.21*
Total Phosphorous	0.03	0.03	0.02	0.03

	H 2130	J 2131	Elsworth Pipeline 1232
Nitrite (as N)	0.01*	0.01*	0.01*
Nitrate (as N)	0.10*	0.10*	0.12
Kjeldahl N (as N)	0.10*	0.10*	0.10*
Total Nitrogen	0.21*	0.21*	0.21*
Total Phosphorous	0.03	0.05	0.06

* = less than indicated value.

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring And Analysis Division

Project: O.W.R.B. Lawtonka Lake **Date Received: September 22, 1983**

Parameters (mg/L)	**Transect/Lab No.**			
	A 2268	**B** 2269	**C** 2270	**D** 2271
Nitrite (as N)	0.01*	0.01*	0.01*	0.01*
Nitrate (as N)	0.10*	0.10*	0.10*	0.10*
Kjeldahl N (as N)	L.A.	L.A.	L.A.	L.A.
Total Phosphorous	0.07	0.05	0.06	0.06

	E 2272	**F** 2273	**G** 2274	**Ellsworth Pipeline** 2275
Alkalinity Total				140
Alkalinity P				6
Nitrite (as N)	0.01*	0.01*	0.01*	0.01*
Nitrate (as N)	0.10*	0.10*	0.10*	0.10*
Kjeldahl N (as N)	L.A.	L.A.	L.A.	L.A.
Total Phosphorous	0.05	0.06	0.06	0.07
Chlorophyll a				11.9
Pheophytin a				3.7

* = less than indicated value.

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring And Analysis Division

O.W.R.B. Lawtonka Lake **Date Received: September 27, 1983**

	N	S	SMI
	2378	2379	2422
Nitrite (as N)	0.01*	0.01*	0.01*
Nitrate (as N)	0.81	0.20	0.14
Kjeldahl N (as N)	0.10*	0.10*	0.10*
Total Nitrogen	0.92*	0.31*	0.25*
Total Phosphorous	0.02*	0.03	0.03

* = less than indicated value.

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring And Analysis Division

Project: O.W.R.B. Lawtonka Lake **Date Received: September 29, 1983**

	Ellsworth Pipeline 2451	Transect E 2452
Nitrite (as N)	0.01*	0.01*
Nitrate (as N)	0.10*	0.10*
Kjeldahl N (as N)	0.36	0.56
Total Nitrogen	0.47*	0.67*
Total Phosphorous	0.06	0.04
Chlorophyll a	L.A.	38.4
Pheophytin a	L.A.	1.1

* = less than indicated value.

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring And Analysis Division

Project: O.W.R.B. Lawtonka Lake **Date Received: October 6, 1983**

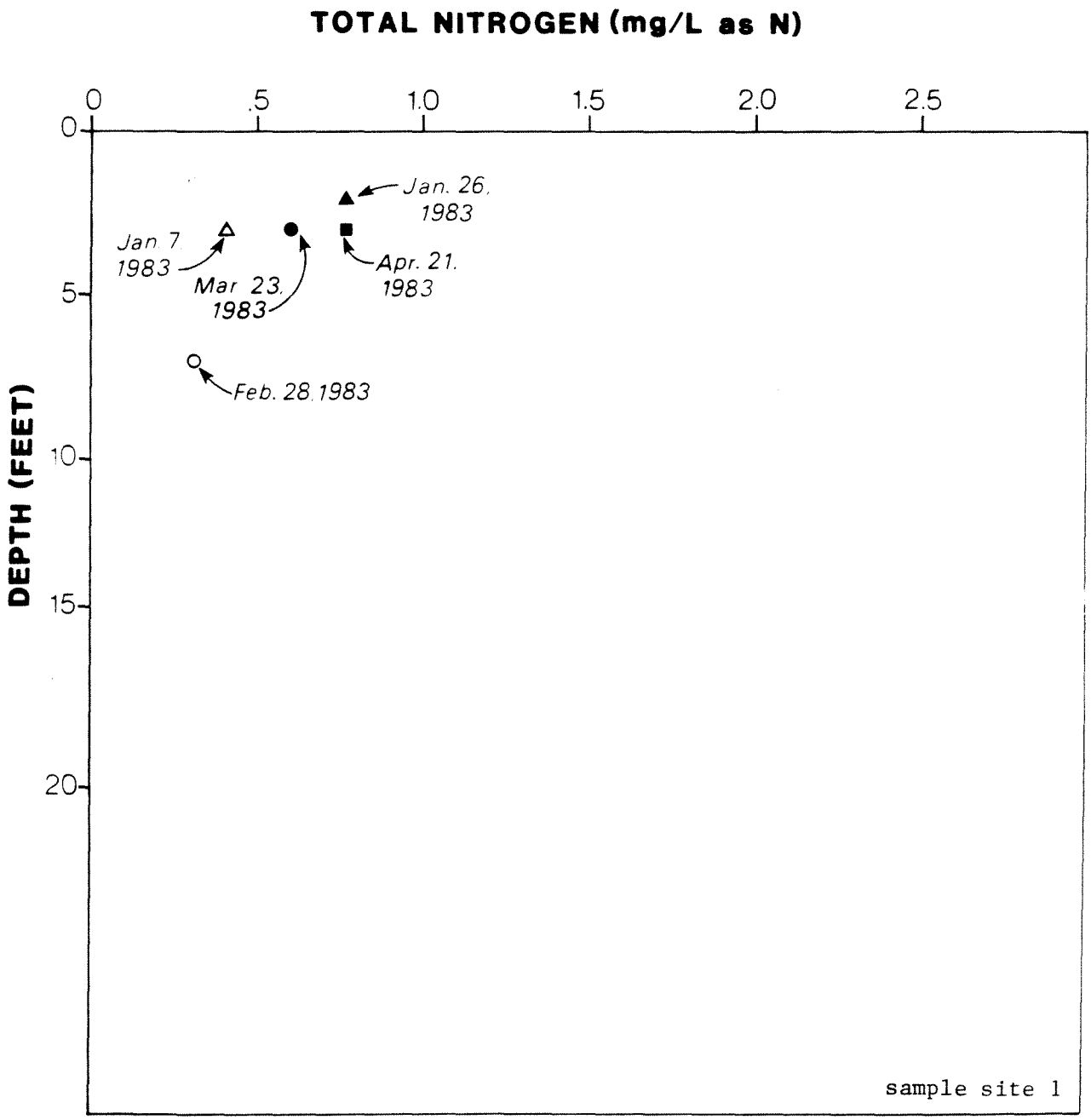
	Transect B 2701	Transect F 2702	Transect I 2703
Nitrite (as N)	0.01*	0.01	0.02
Nitrate (as N)	0.10*	0.10*	0.10*
Kjeldahl N (as N)	0.10*	0.62	0.78
Total Nitrogen	0.21	0.73	0.90*
Total Phosphorous	0.05	0.05	0.05
Chlorophyll a			37.3
Pheophytin a			2.3

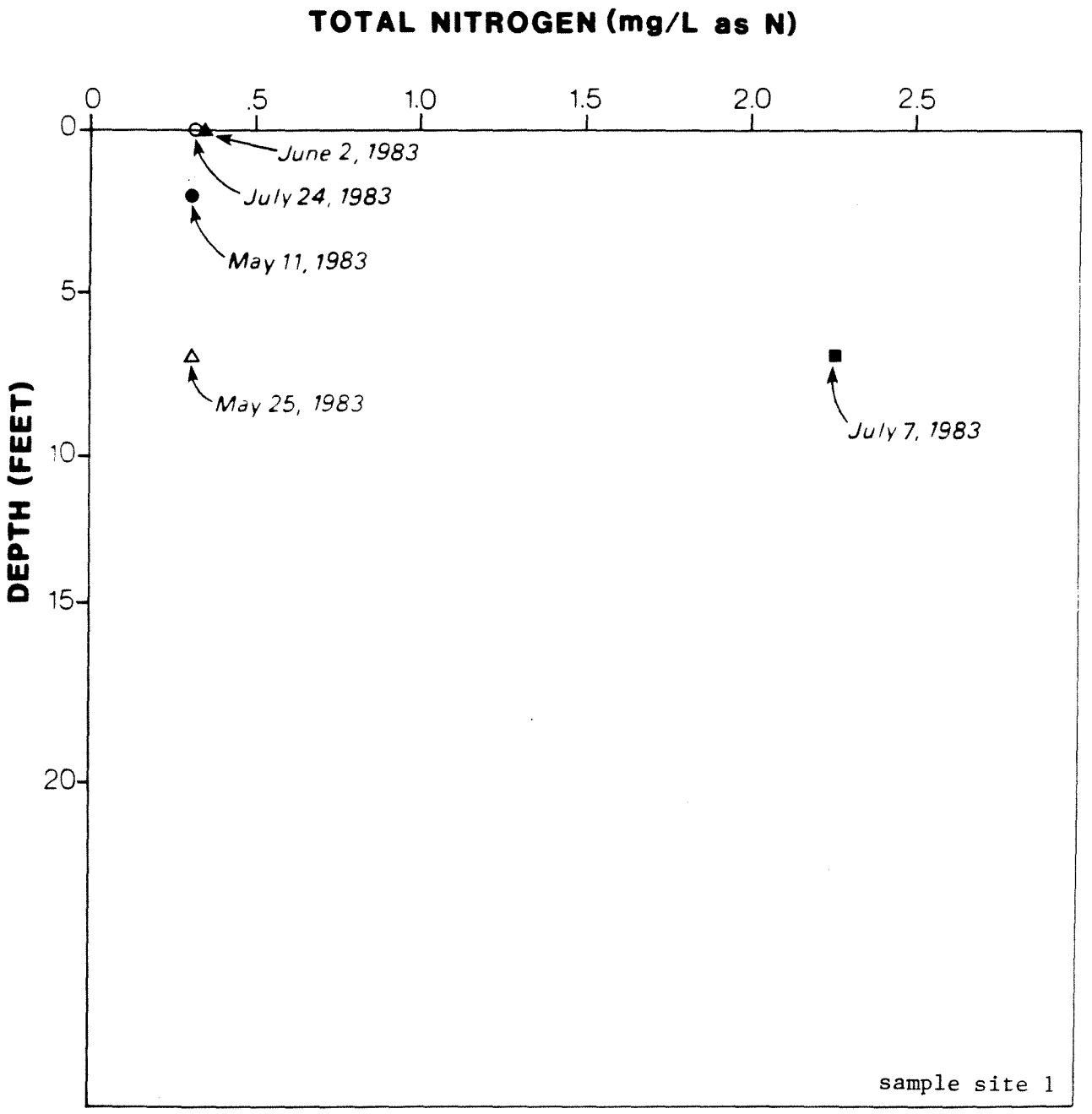
	Medicine Creek 2704	Ellsworth Pipeline 2705
Nitrite (as N)	0.02	0.01*
Nitrate (as N)	0.10*	0.10*
Kjeldahl N (as N)	0.67	0.17
Total Nitrogen	0.79*	0.28*
Total Phosphorous	0.07	0.05
Chlorophyll a	37.0	5.7
Pheophytin a	2.4	1.3

* = less than indicated value.

APPENDIX C

FIGURES FOR TOTAL KJELDAHL, AMMONIA, AND NITROGEN


TOTAL NITROGEN (mg/L as N)
0
.5
1.0
1.5
2.0
2.5
DEPTH (FEET)
0
5
10
15
20
Jan. 26, 1983
Jan. 7, 1983
Mar. 23, 1983
Apr. 21, 1983
Feb. 28, 1983
sample site 1


TOTAL NITROGEN (mg/L as N)
0
.5
1.0
1.5
2.0
2.5
DEPTH (FEET)
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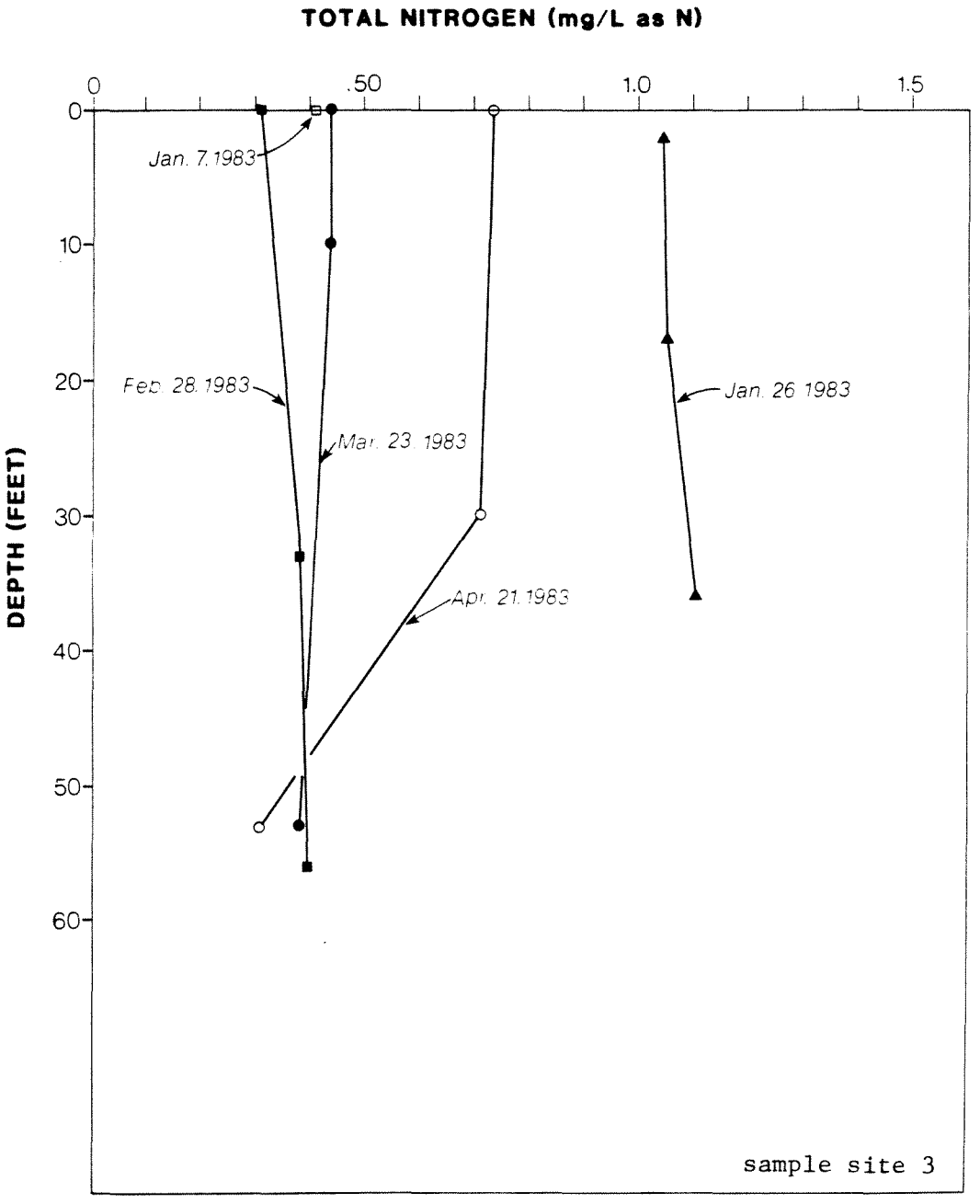
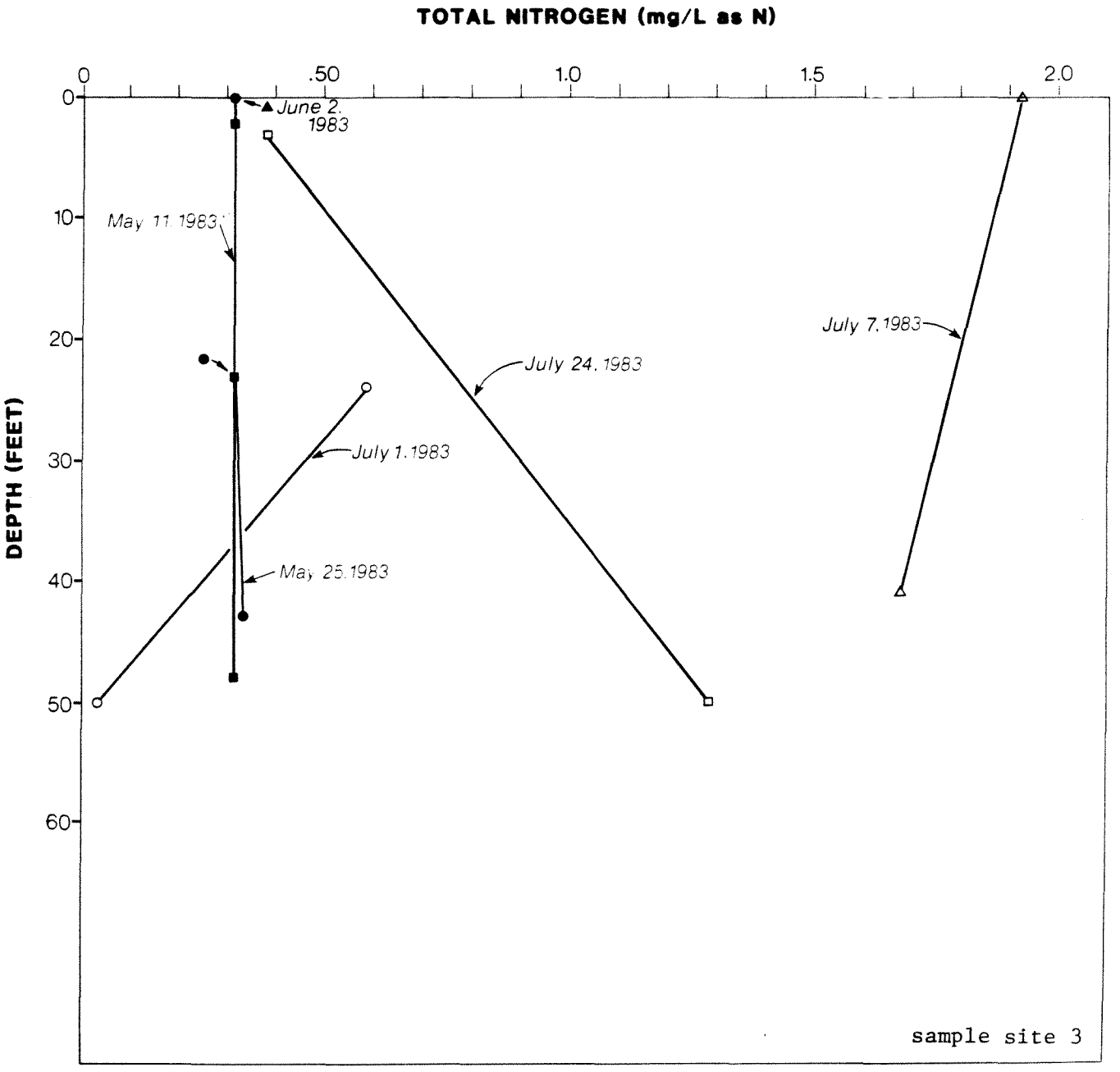
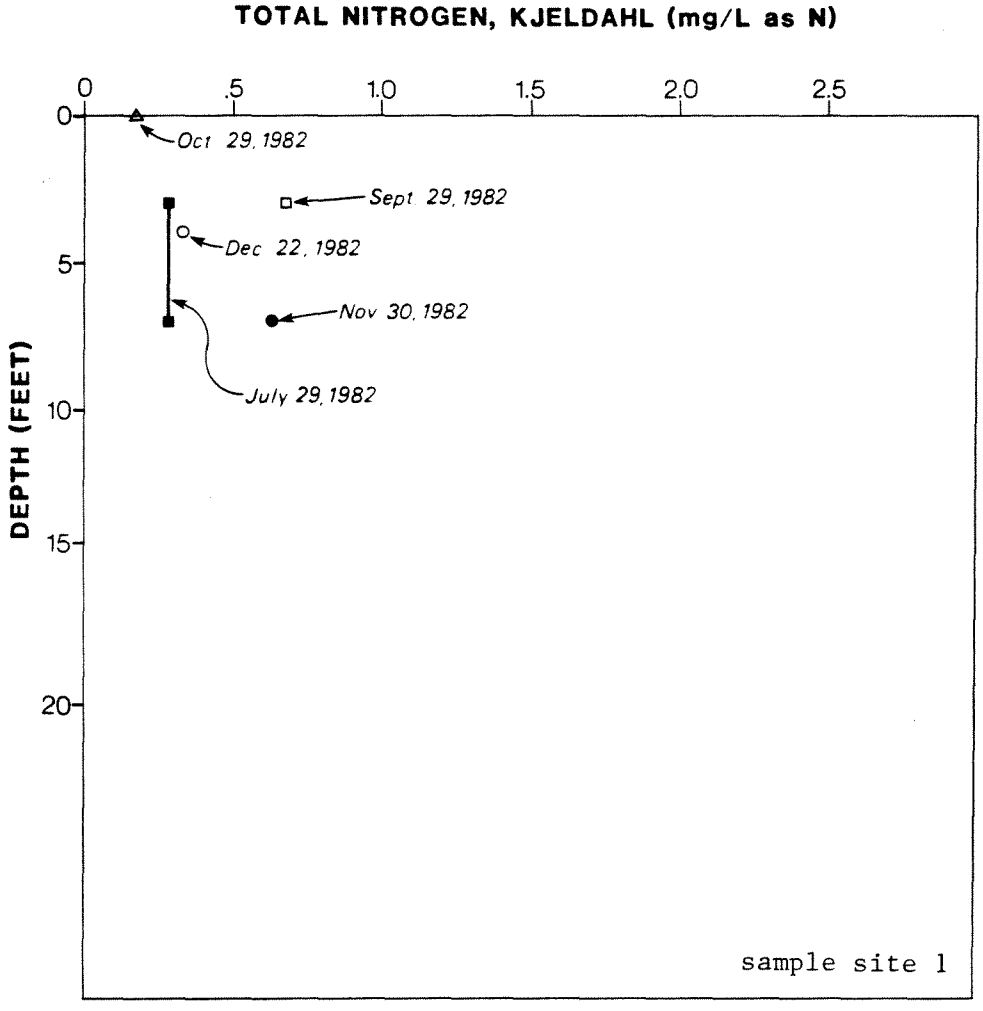
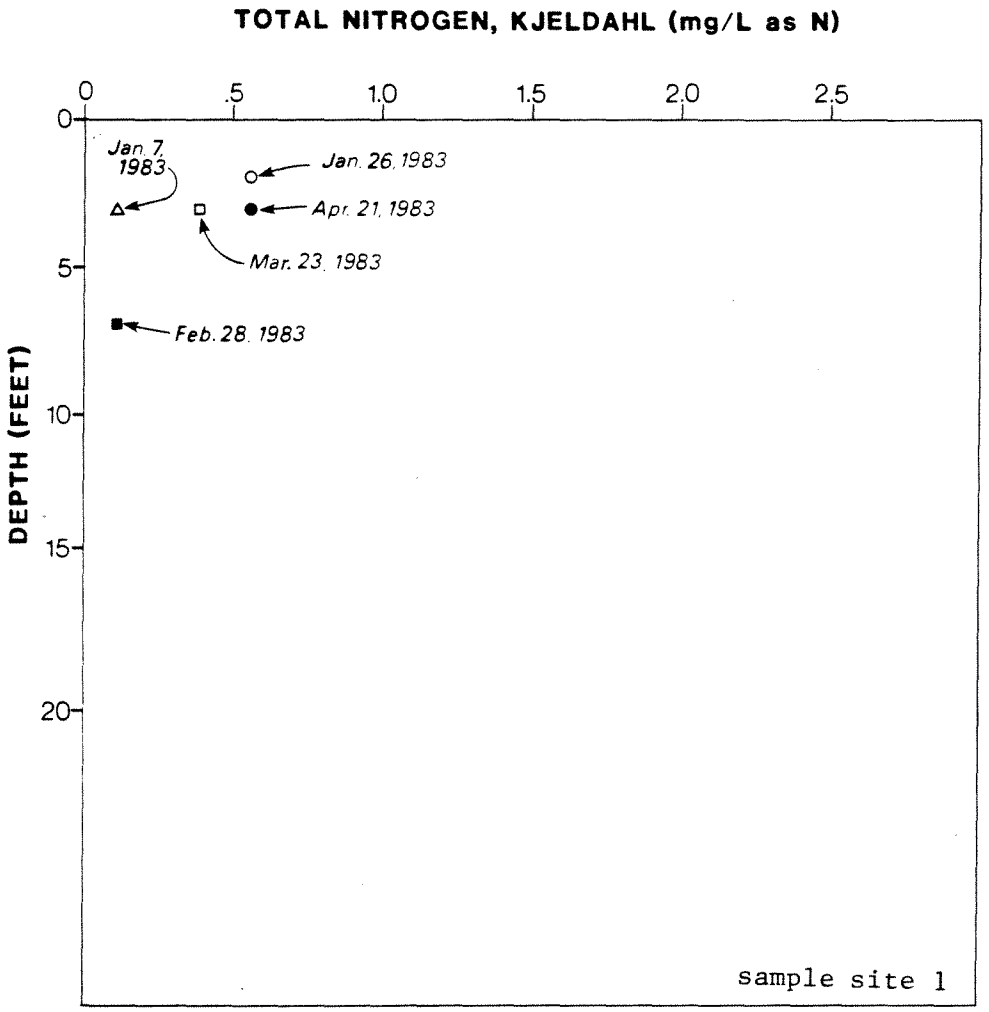
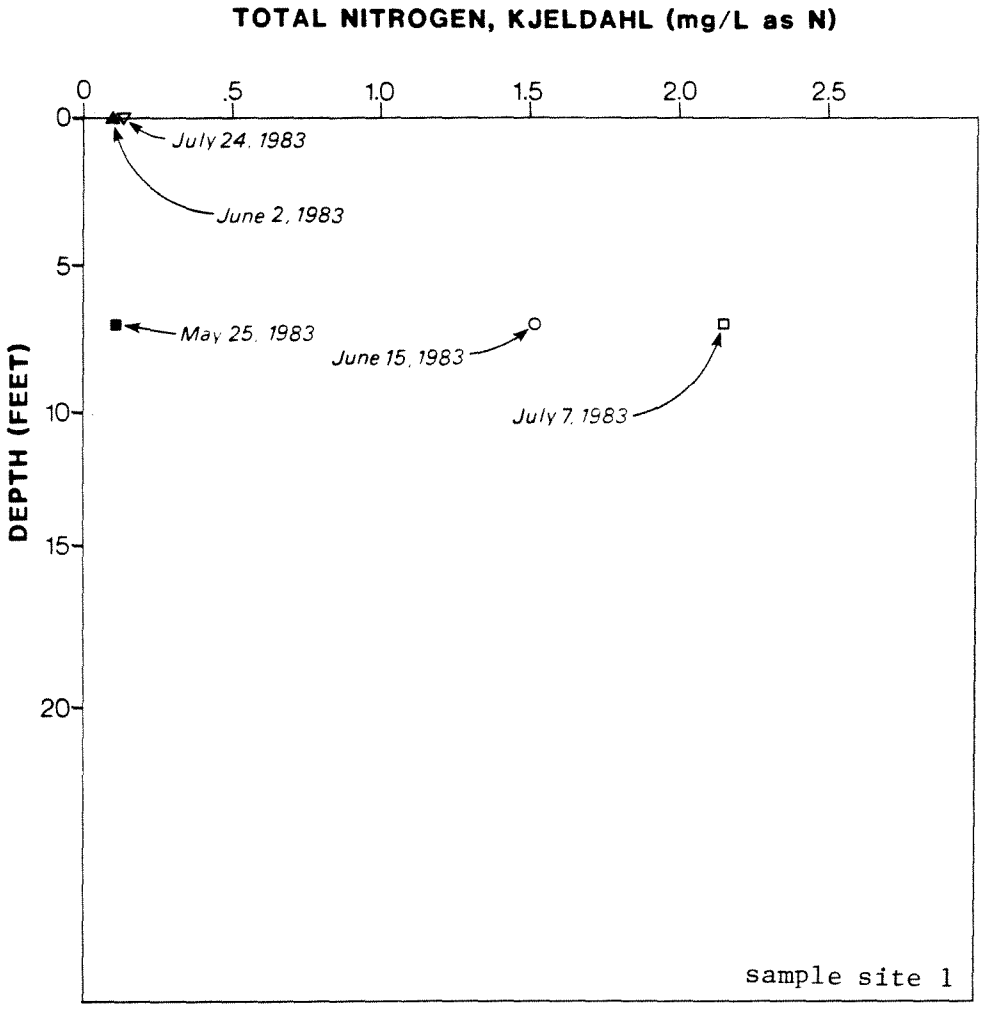
5
10
15
20
June 2, 1983
July 24, 1983
May 11, 1983
May 25, 1983
July 7, 1983
sample site 1

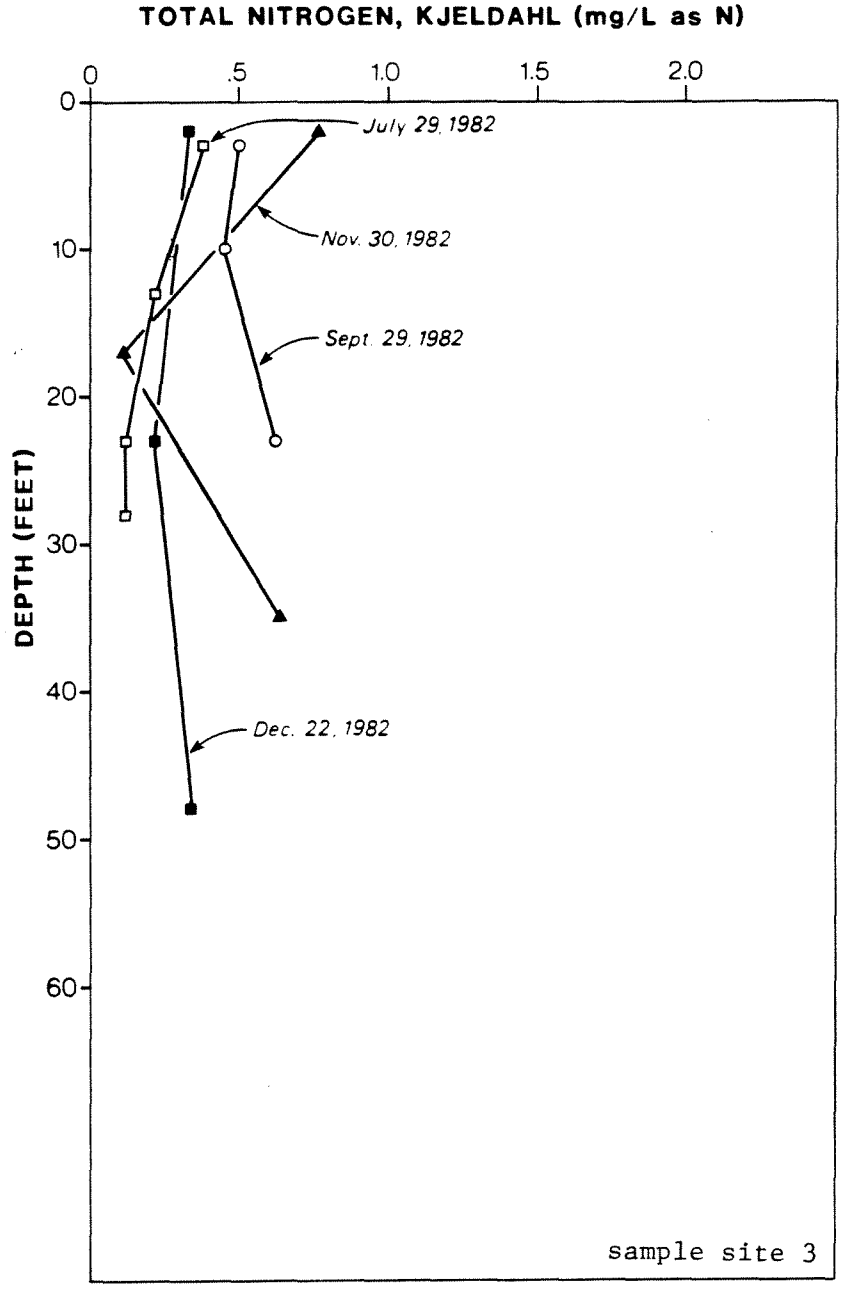

TOTAL NITROGEN (mg/L as N)
0
.50
1.0
1.5
DEPTH (FEET)
0
10
20
30
40
50
60
Jan. 7, 1983
Feb. 28, 1983
Mar. 23, 1983
Apr. 21, 1983
Jan. 26, 1983
sample site 3

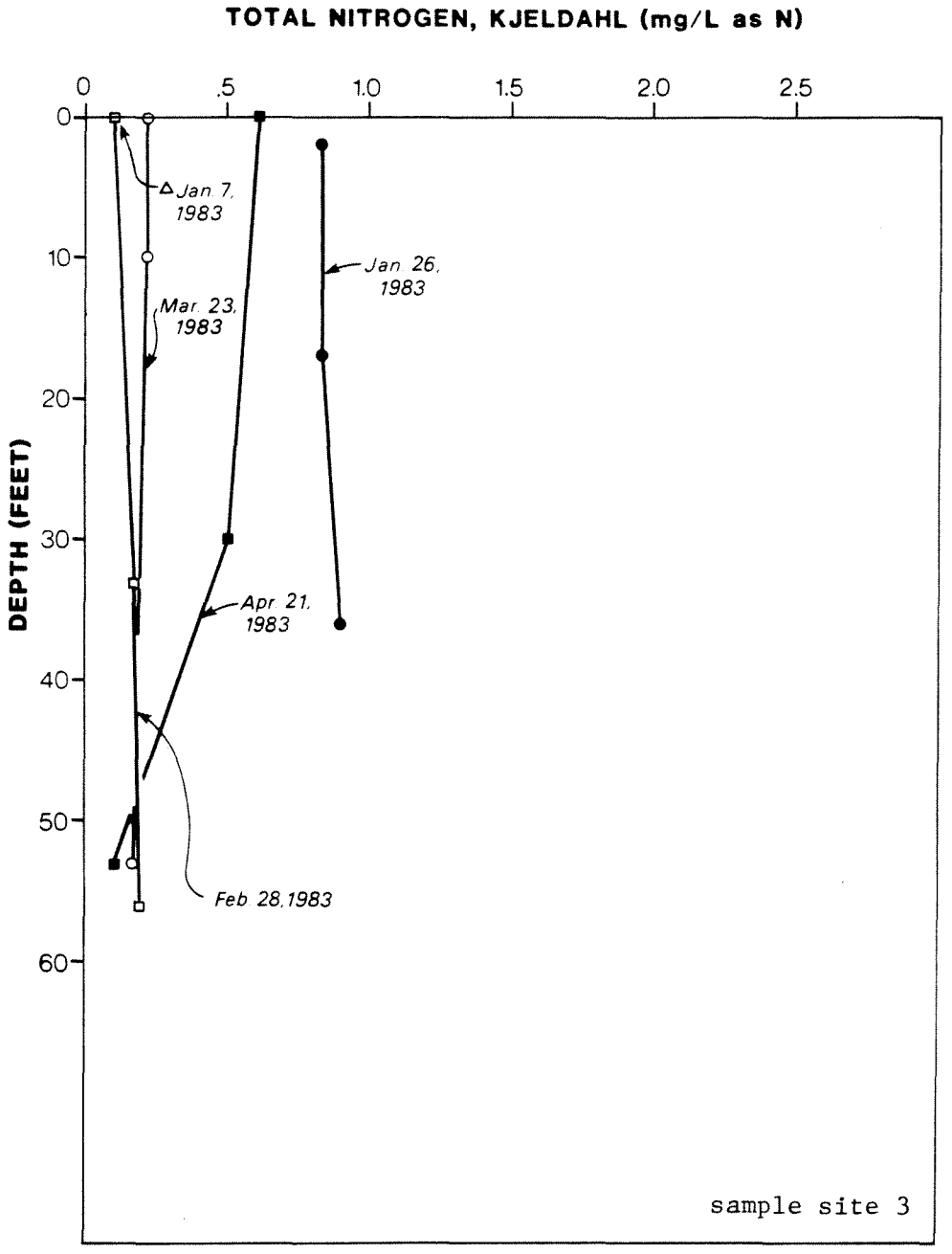

TOTAL NITROGEN (mg/L as N)
0
.50
1.0
1.5
2.0
DEPTH (FEET)
0
10
20
30
40
50
60
June 2, 1983
May 11 1983
July 7, 1983
July 24, 1983
July 1, 1983
May 25, 1983
sample site 3

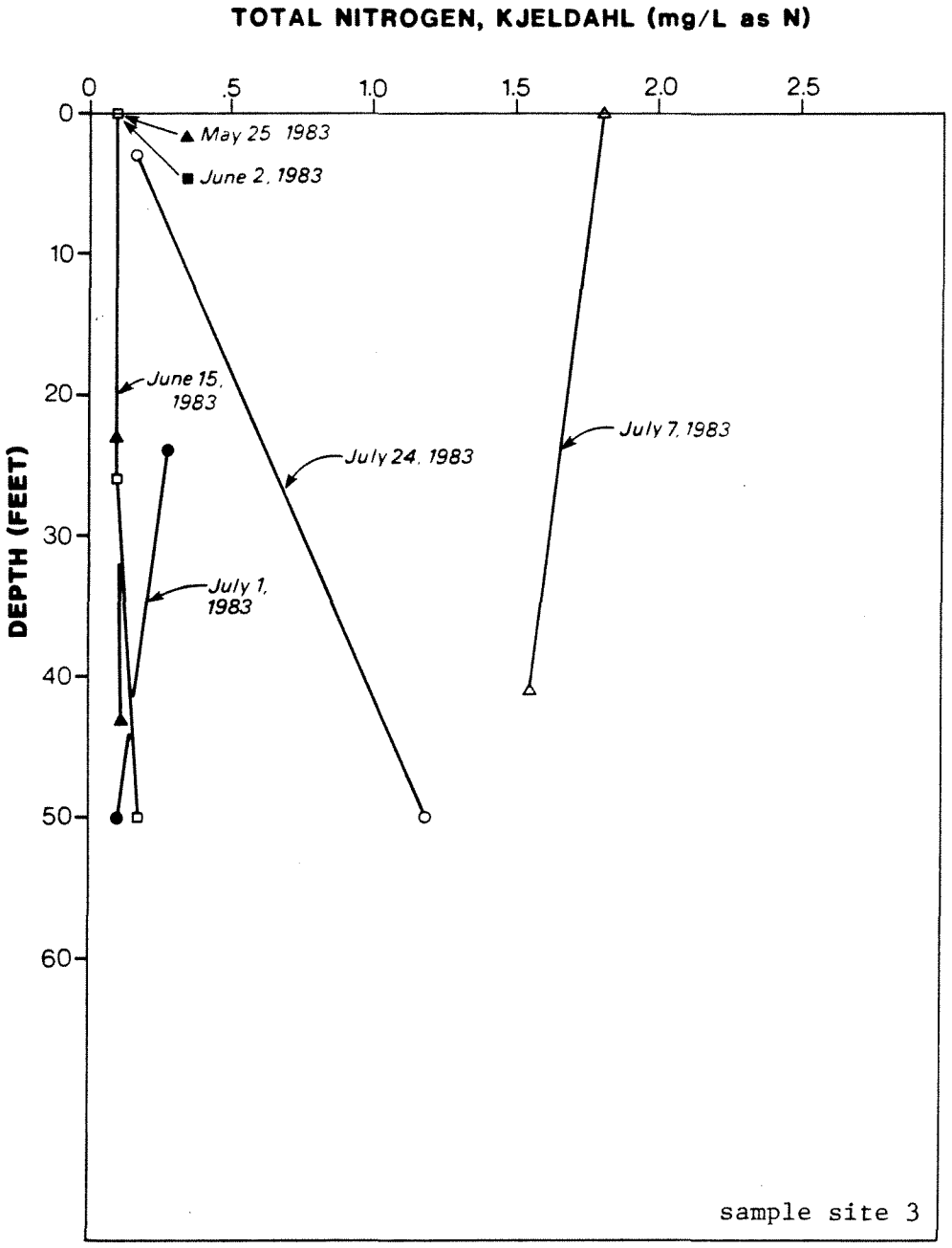

TOTAL NITROGEN, KJELDAHL (mg/L as N)
0
.5
1.0
1.5
2.0
2.5
DEPTH (FEET)
0
5
10
15
20
Oct 29, 1982
Sept 29, 1982
Dec 22, 1982
Nov 30, 1982
July 29, 1982
sample site 1

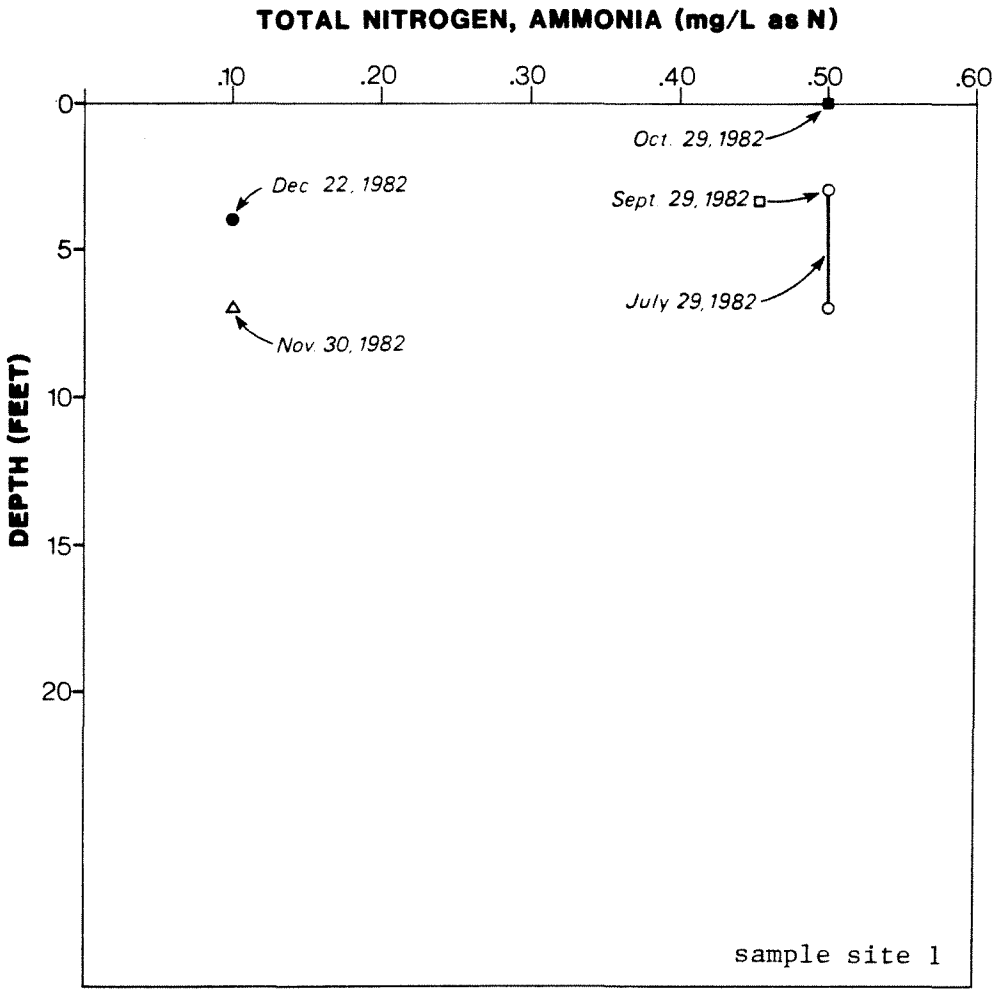

TOTAL NITROGEN, KJELDAHL (mg/L as N)
0
.5
1.0
1.5
2.0
2.5
DEPTH (FEET)
0
5
10
15
20
Jan. 7, 1983
Jan. 26, 1983
Apr. 21, 1983
Mar. 23, 1983
Feb. 28, 1983
sample site 1

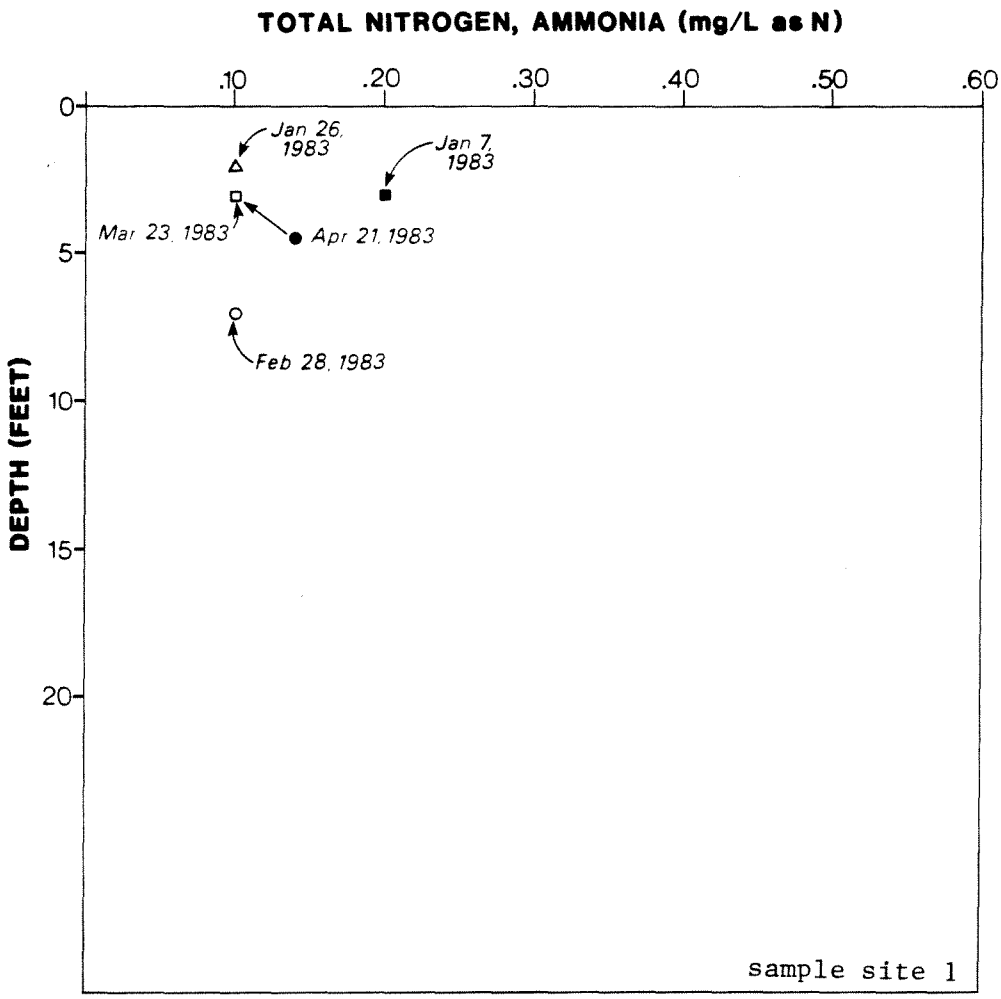

TOTAL NITROGEN, KJELDAHL (mg/L as N)
0
.5
1.0
1.5
2.0
2.5
DEPTH (FEET)
0
5
10
15
20
July 24, 1983
June 2, 1983
May 25, 1983
June 15, 1983
July 7, 1983
sample site 1

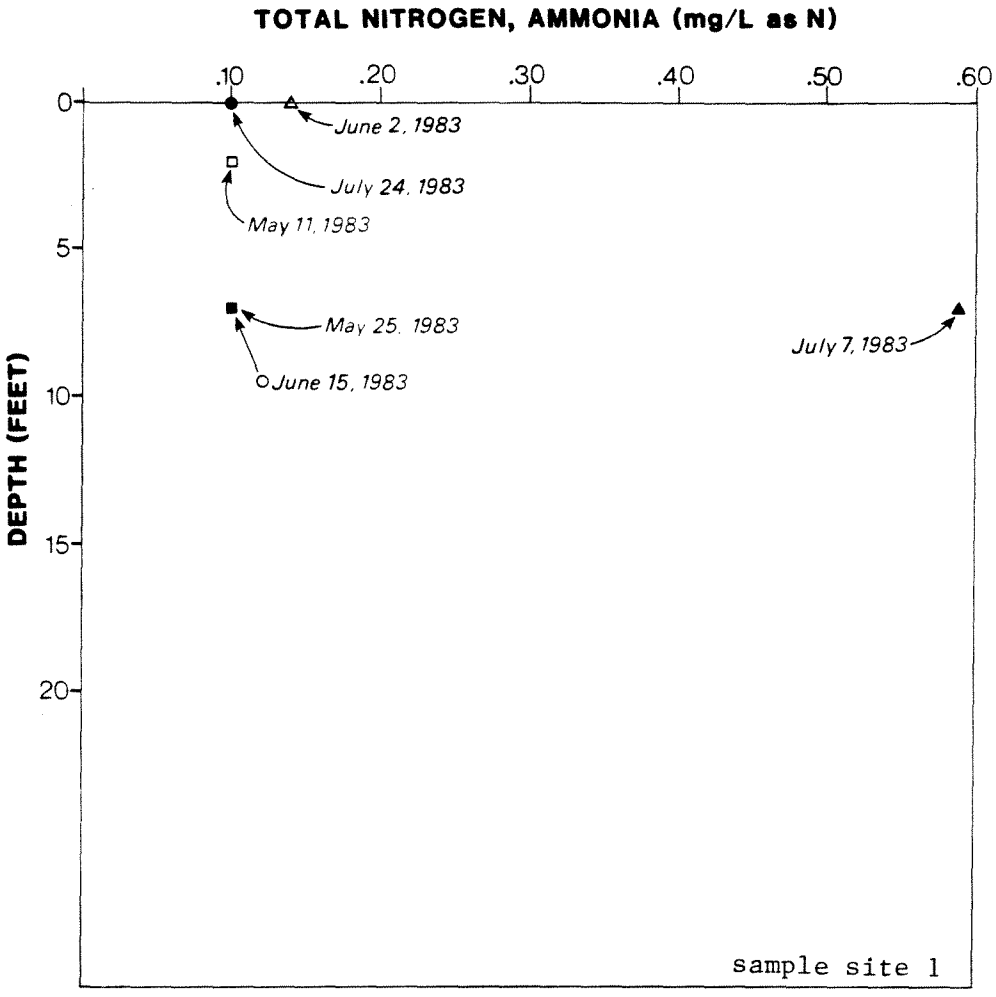

TOTAL NITROGEN, KJELDAHL (mg/L as N)
0
.5
1.0
1.5
2.0
DEPTH (FEET)
0
10
20
30
40
50
60
July 29, 1982
Nov. 30, 1982
Sept. 29, 1982
Dec. 22, 1982
sample site 3

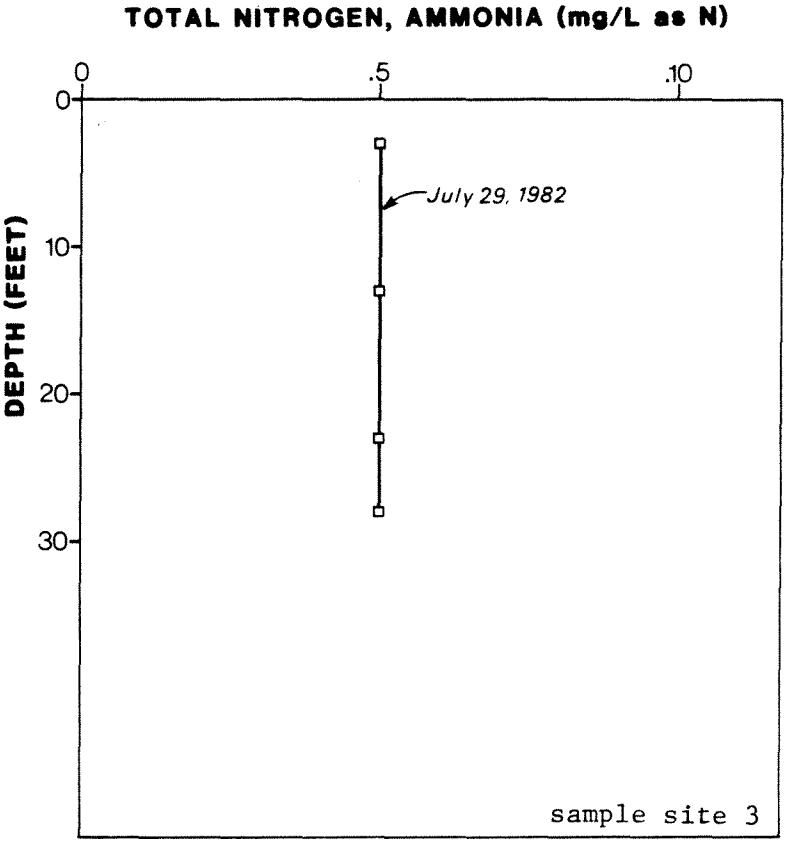

TOTAL NITROGEN, KJELDAHL (mg/L as N)
0
.5
1.0
1.5
2.0
2.5
DEPTH (FEET)
0
10
20
30
40
50
60
Jan 7, 1983
Jan 26, 1983
Mar. 23, 1983
Apr. 21, 1983
Feb 28, 1983
sample site 3

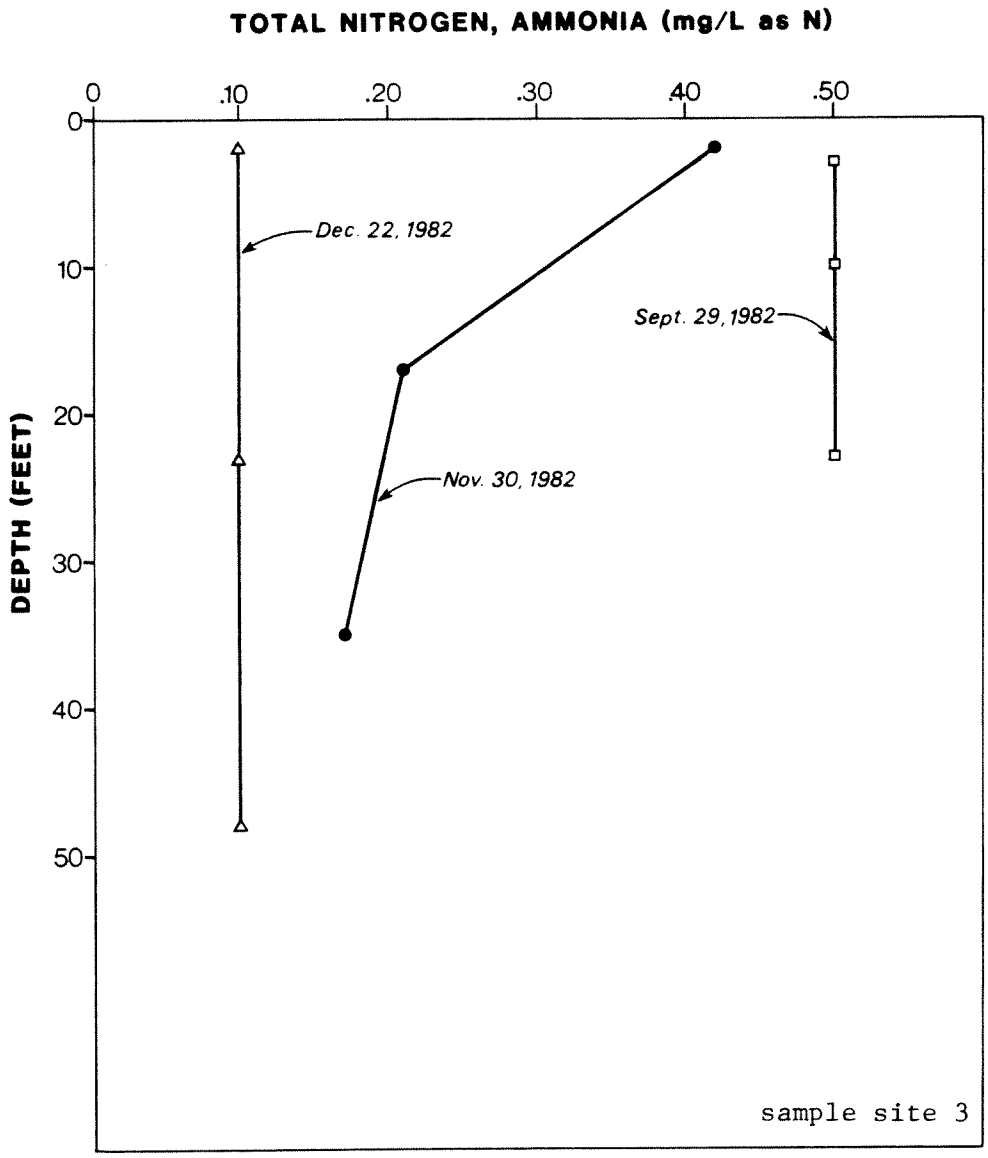

TOTAL NITROGEN, KJELDAHL (mg/L as N)
0
.5
1.0
1.5
2.0
2.5
DEPTH (FEET)
0
10
20
30
40
50
60
May 25 1983
June 2, 1983
June 15, 1983
July 24, 1983
July 7, 1983
July 1, 1983
sample site 3


TOTAL NITROGEN, AMMONIA (mg/L as N)
.10
.20
.30
.40
.50
.60
0
5
10
15
20
DEPTH (FEET)
Oct. 29, 1982
Dec. 22, 1982
Sept. 29, 1982
July 29, 1982
Nov. 30, 1982
sample site 1


TOTAL NITROGEN, AMMONIA (mg/L as N)
.10
.20
.30
.40
.50
.60
0
5
10
15
20
DEPTH (FEET)
Jan 26, 1983
Jan 7, 1983
Mar 23, 1983
Apr 21, 1983
Feb 28, 1983
sample site 1

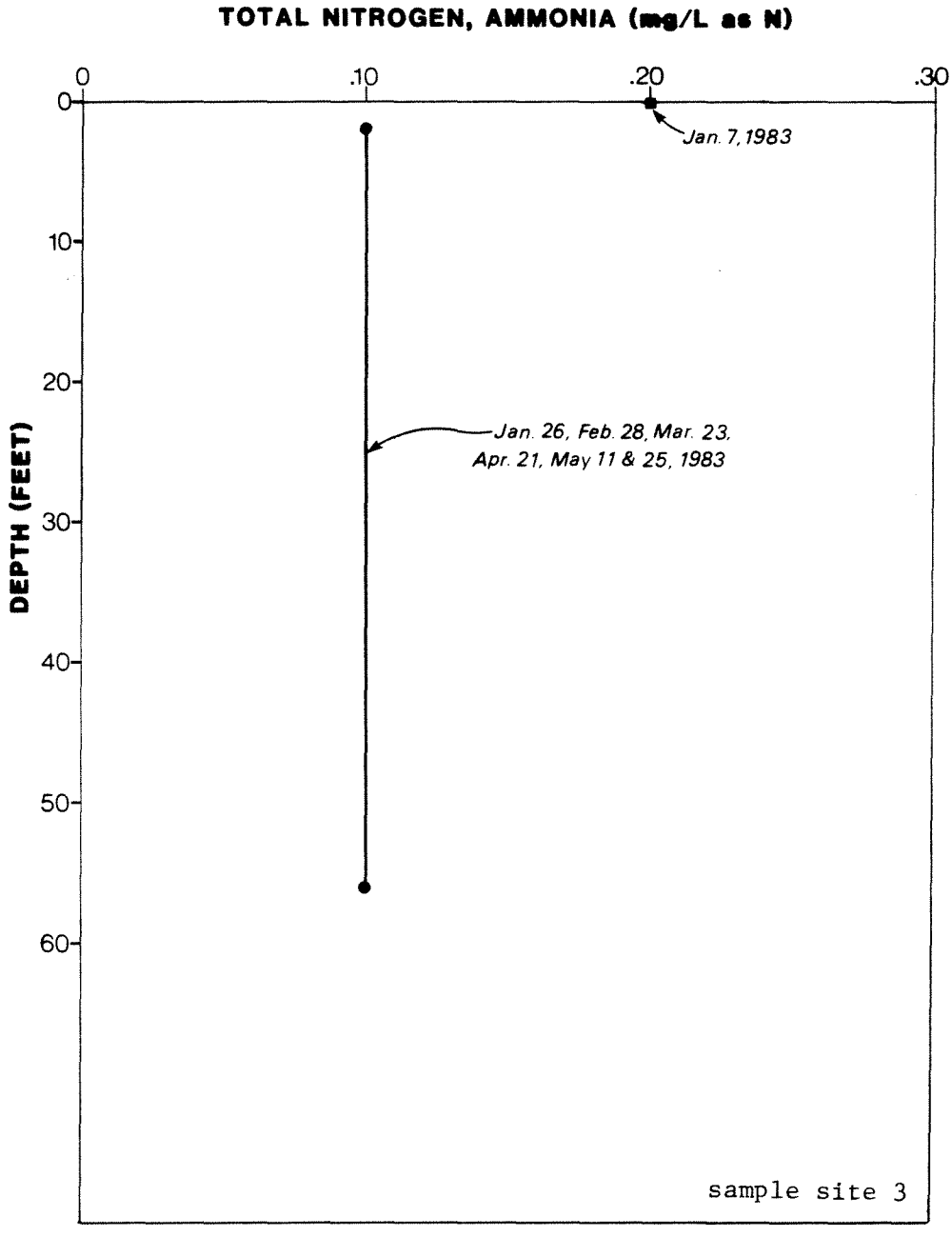

TOTAL NITROGEN, AMMONIA (mg/L as N)
.10
.20
.30
.40
.50
.60
0
5
10
15
20
DEPTH (FEET)
June 2, 1983
July 24, 1983
May 11, 1983
May 25, 1983
June 15, 1983
July 7, 1983
sample site 1


TOTAL NITROGEN, AMMONIA (mg/L as N)
0
.5
.10
0
10
20
30
DEPTH (FEET)
July 29, 1982
sample site 3


TOTAL NITROGEN, AMMONIA (mg/L as N)
0
.10
.20
.30
.40
.50
DEPTH (FEET)
0
10
20
30
40
50
Dec. 22, 1982
Sept. 29, 1982
Nov. 30, 1982
sample site 3

APPENDIX D

SUMMARY STATISTICS OF FLUOROMETRICALLY DERIVED CHLOROPHYLL *a* DATA FOR LAWTONKA RESERVOIR


TOTAL NITROGEN, AMMONIA (mg/L as N)
0
.10
.20
.30
0
10
20
30
40
50
60
DEPTH (FEET)
Jan. 7, 1983
Jan. 26, Feb. 28, Mar. 23,
Apr. 21, May 11 & 25, 1983
sample site 3

DATE	DEPTH	MEAN	STANDARD DEVIATIONS	SAMPLE SIZE	RANGE	TWO STANDARD DEVIATIONS ABOVE MEAN	TWO STANDARD DEVIATIONS BELOW MEAN
6/23/83	1	14.687	1.805	45	9.9-18.0	18.297	11.077
	2	16.156	1.632	45	11.0-19.0	19.420	12.892
	3	18.024	1.683	42	13.0-21.0	21.390	14.658
	4	18.375	2.870	40	10.0-23.0	24.115	12.635
7/7/83	1	7.506	1.494	49	4.0-12.0	10.494	4.518
	2	8.171	1.521	45	6.1-13.0	11.213	5.129
	3	8.98	1.671	45	5.7-12.0	12.322	5.638
	4	9.561	1.878	44	6.1-14.0	13.317	5.805
7/13/83	1	10.711	2.510	54	7.2-19.0	15.731	5.691
	2	11.080	2.606	51	7.2-18.0	16.292	5.868
	3	11.419	2.516	47	7.2-17.0	16.451	6.387
	4	11.877	2.592	47	7.2-17.0	17.061	6.693
7/20/83	1	19.354	1.714	65	14.0-23.0	22.782	15.926
	2	19.609	1.635	69	15.0-23.0	22.879	16.339
	3	19.925	1.847	67	16.0-26.0	23.619	16.231
	4	20.048	1.914	63	16.0-25.0	23.876	16.220
PIPELINE FROM LAKE ELLSWORTH TURNED ON							
7/27/83	1	18.066	1.854	61	15.0-23.0	21.774	14.358
	2	18.676	2.138	68	14.0-27.0	22.952	14.400
	3	19.394	2.510	66	13.0-27.0	24.414	14.374
	4	19.661	2.433	59	14.0-28.0	24.527	14.795
8/4/83	1	15.328	2.674	58	10.0-21.0	20.676	9.980
	2	16.554	2.840	65	10.0-23.0	22.234	10.874
	3	18.453	2.761	64	13.0-25.0	23.975	12.931
	4	18.456	2.528	57	14.0-24.0	23.512	13.400
8/10/83	1	14.943	2.367	53	11.0-21.0	19.677	10.209
	2	16.377	2.613	61	12.0-22.0	21.603	11.151
	3	18.085	2.745	59	13.0-24.0	23.575	12.595
	4	18.695	2.757	59	13.0-26.0	24.209	13.181
8/15/83	1	11.116	2.303	58	8.4-24.0	15.722	6.510
	2	12.555	3.408	62	9.6-31.0	19.371	5.739
	3	13.412	2.3951	66	8.6-21.0	18.202	8.622
	4	14.000	1.636	59	11.0-18.0	17.272	10.728

DATE	DEPTH	MEAN	STANDARD DEVIATIONS	SAMPLE SIZE	RANGE	TWO STANDARD DEVIATIONS ABOVE MEAN	TWO STANDAR DEVIATION BELOW MEA
8/31/83	1	15.978	2.906	45	7.4-20.0	21.790	10.166
	2	16.250	3.066	48	7.4-21.0	22.382	10.118
	3	16.892	3.104	51	7.4-21.0	23.100	10.684
	4	16.760	3.352	48	6.9-21.0	23.464	10.056
9/7/83	1	20.056	4.112	54	16.0-41.0	28.280	11.832
	2	20.929	3.600	56	16.0-36.0	28.129	13.729
	3	21.200	3.216	55	17.0-36.0	27.632	14.768
	4	20.698	2.632	53	17.0-30.0	25.962	15.434
9/14/83	1	19.417	2.637	48	15.0-29.0	24.691	14.143
	2	20.347	2.528	49	17.0-29.0	25.403	15.291
	3	21.208	2.777	53	17.0-29.0	26.762	15.654
	4	20.327	2.600	52	14.0-28.0	25.527	15.127
9/21/83	1	25.491	3.653	53	20.0-37.0	32.797	18.185
	2	28.965	4.209	57	24.0-38.0	37.383	20.547
	3	29.879	4.511	58	24.0-40.0	38.901	20.857
	4	28.250	3.795	56	22.0-37.0	35.840	20.660
9/28/83	1	31.930	4.977	57	20.0-41.0	41.884	21.976
	2	32.081	5.332	62	18.0-41.0	42.745	21.417
	3	32.085	5.289	59	18.0-41.0	42.663	21.507
	4	32.052	5.513	58	18.0-41.0	43.078	21.026
10/5/83	1	37.464	3.887	56	32.0-50.0	45.238	29.690
	2	39.306	3.476	62	35.0-50.0	46.258	32.354
	3	39.290	3.319	62	33.0-50.0	45.928	32.652
	4	38.780	3.571	59	33.0-50.0	54.922	31.640

APPENDIX E

SYMAPS BASED UPON RAW AND MODIFIED CHLOROPHYLL *a* DATA

(For a complete set of maps, contact the OWRB)

Key for Symap symbols

CONCENTRATIONS ARE IN UG/L.

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	BELOW	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00
MAXIMUM	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00	32.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

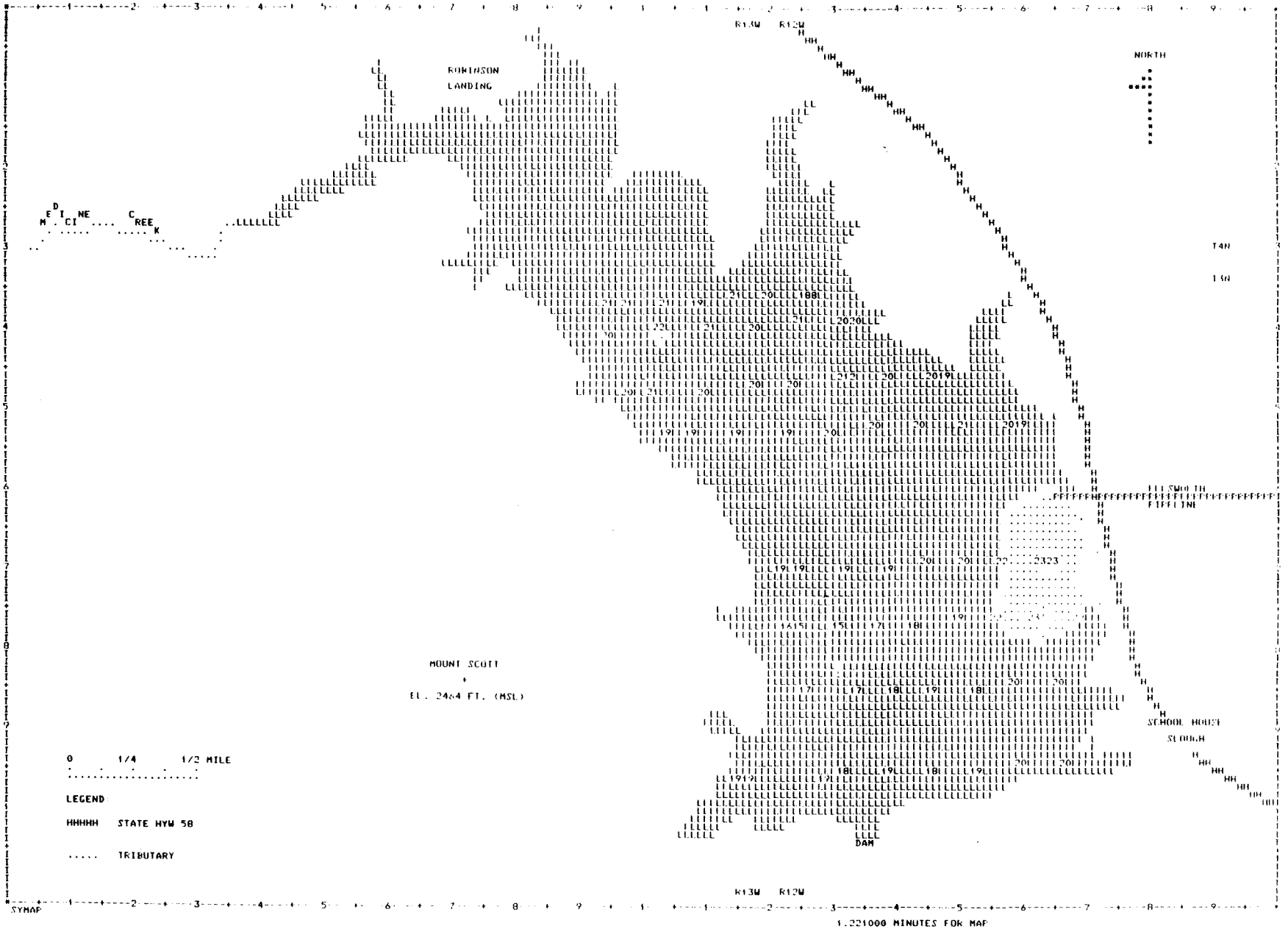
10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	L	1	2	3	4	5	6	7	8	9	10
SYMBOLS	LLLLLLLLL	.....	.....	-----	=====	+++++++++	XXXXXXXXX	000000000	000000000	NNNNNNNNN	■■■■■■■■■
	LLLLLLLLL	.....	.....	-----	=====	+++++++++	XXXXXXXXX	000000000	000000000	NNNNNNNNN	■■■■■■■■■
	LLLLLLLLL	....1....	....2....	----3----	====4====	++++5++++	XXXXX6XXXX	00007 0000	00003 0000	NNNN9NNNN	■■■■×■■■■
	LLLLLLLLL	.....	.....	-----	=====	+++++++++	XXXXXXXXX	000000000	000000000	NNNNNNNNN	■■■■■■■■■
	LLLLLLLLL	.....	.....	-----	=====	+++++++++	XXXXXXXXX	000000000	000000000	NNNNNNNNN	■■■■■■■■■

Chlorophyll-a concentrations

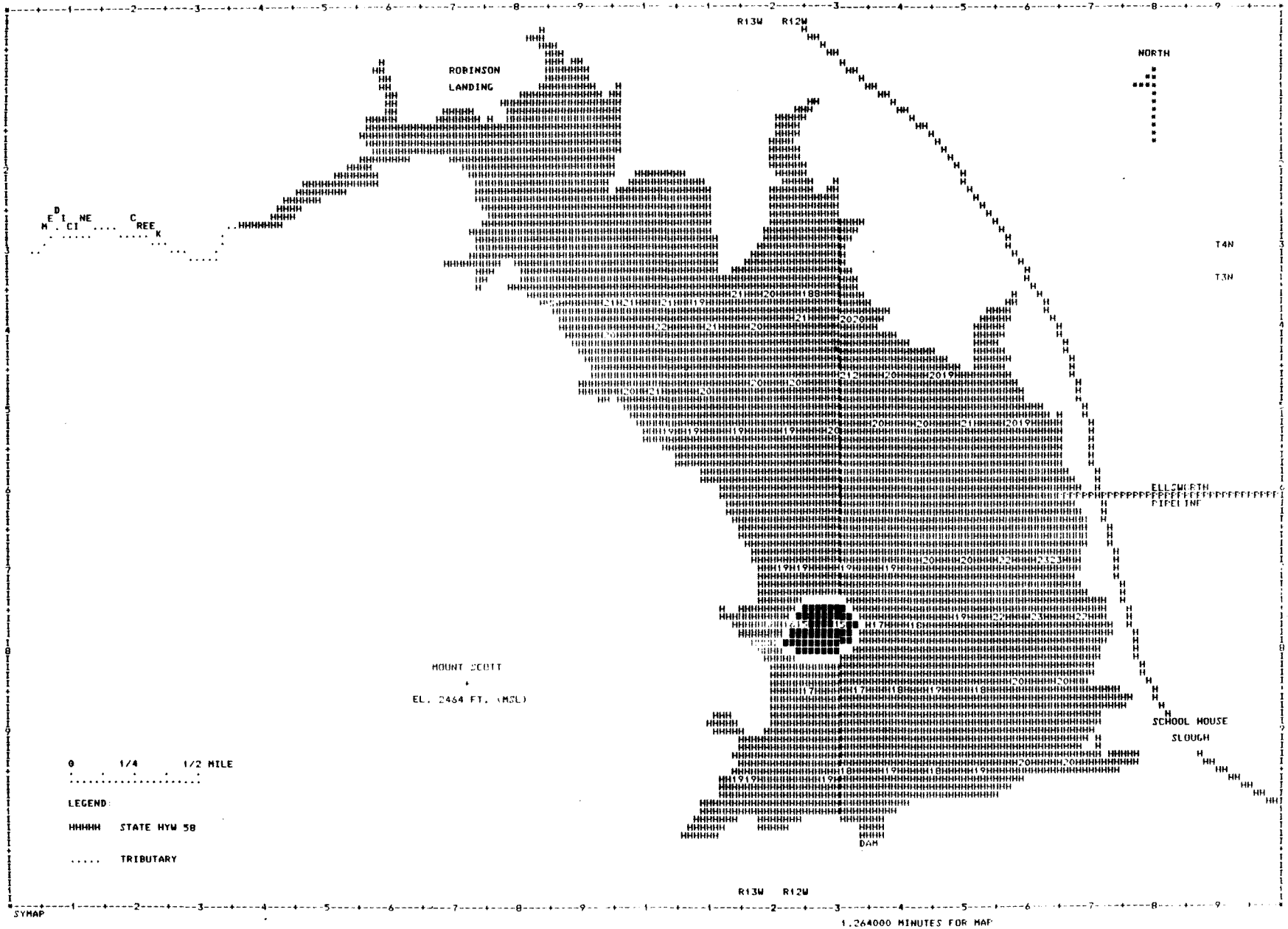
High critical values on July 20,1983



FLUOROMETRY DATA FOR LAKE LAWTONKA.
SAMPLES WERE TAKEN ON 7/20/83
AT DEPTH 2. CONCENTRATIONS ARE IN UG/L.

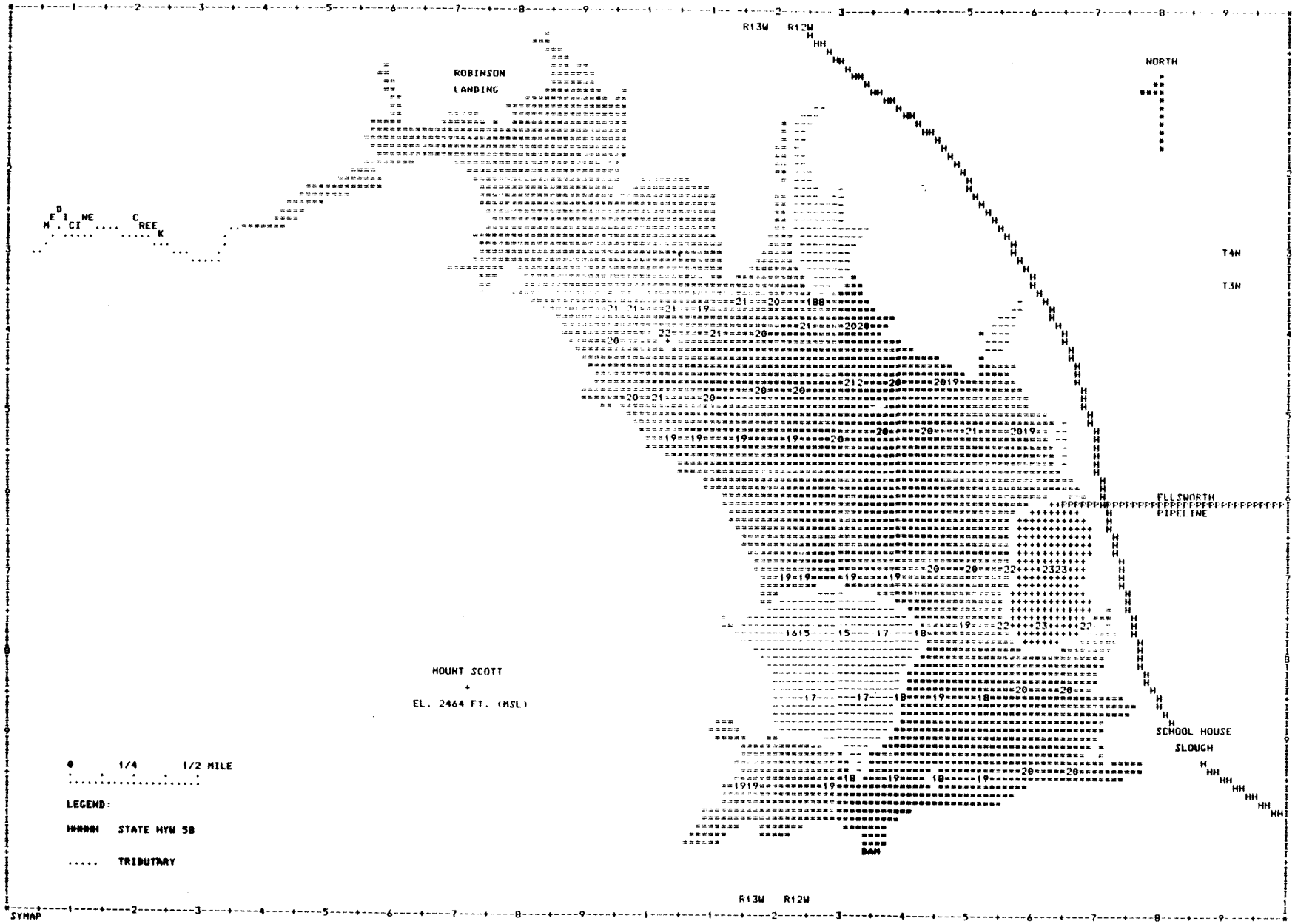
Chlorophyll-a concentrations

Low critical values on July 20,1983



FLUOROMETRY DATA FOR LAKE LAWTONKA.

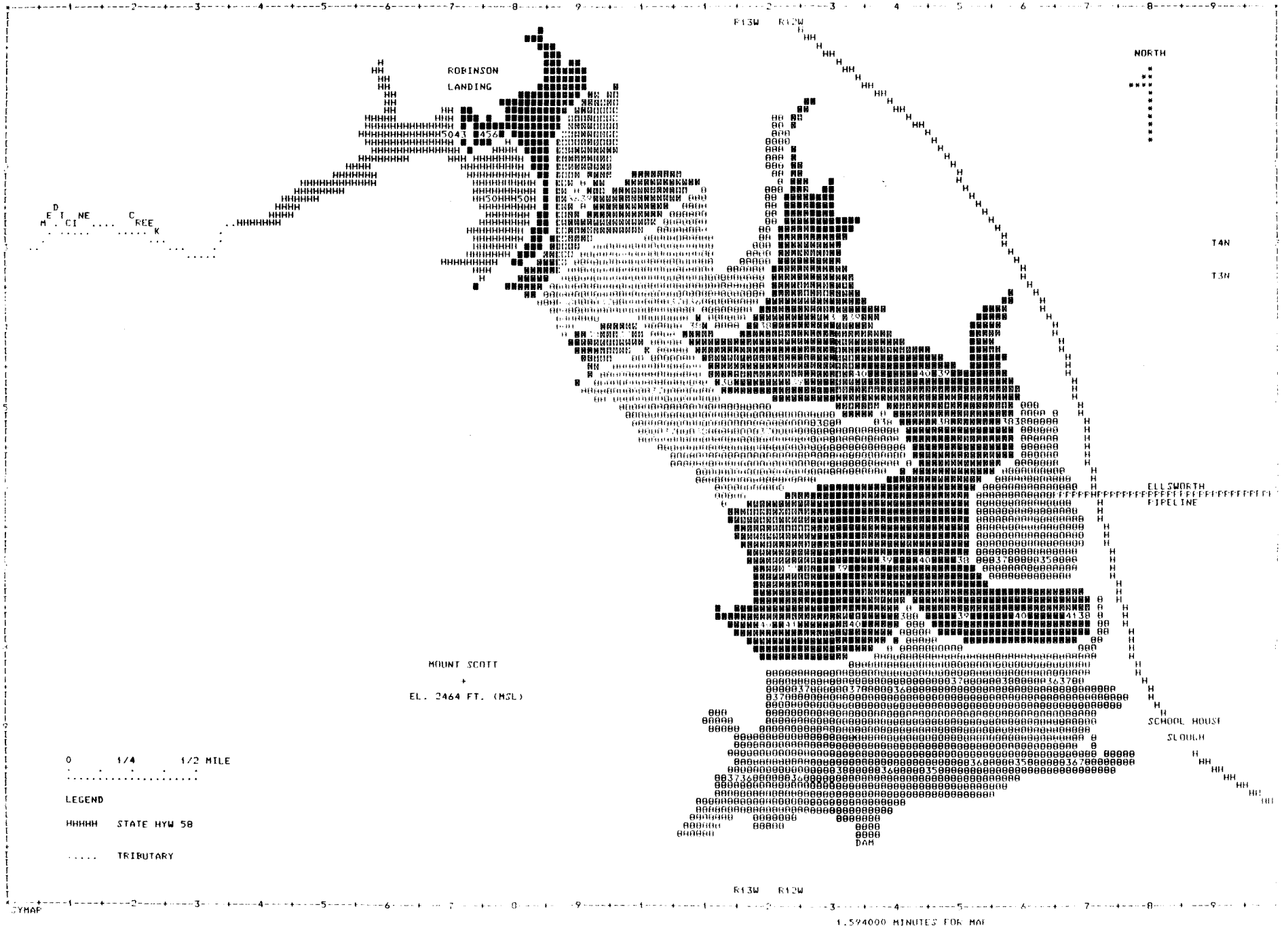
Normally displayed chlorophyll-a concentrations on July 20,1983



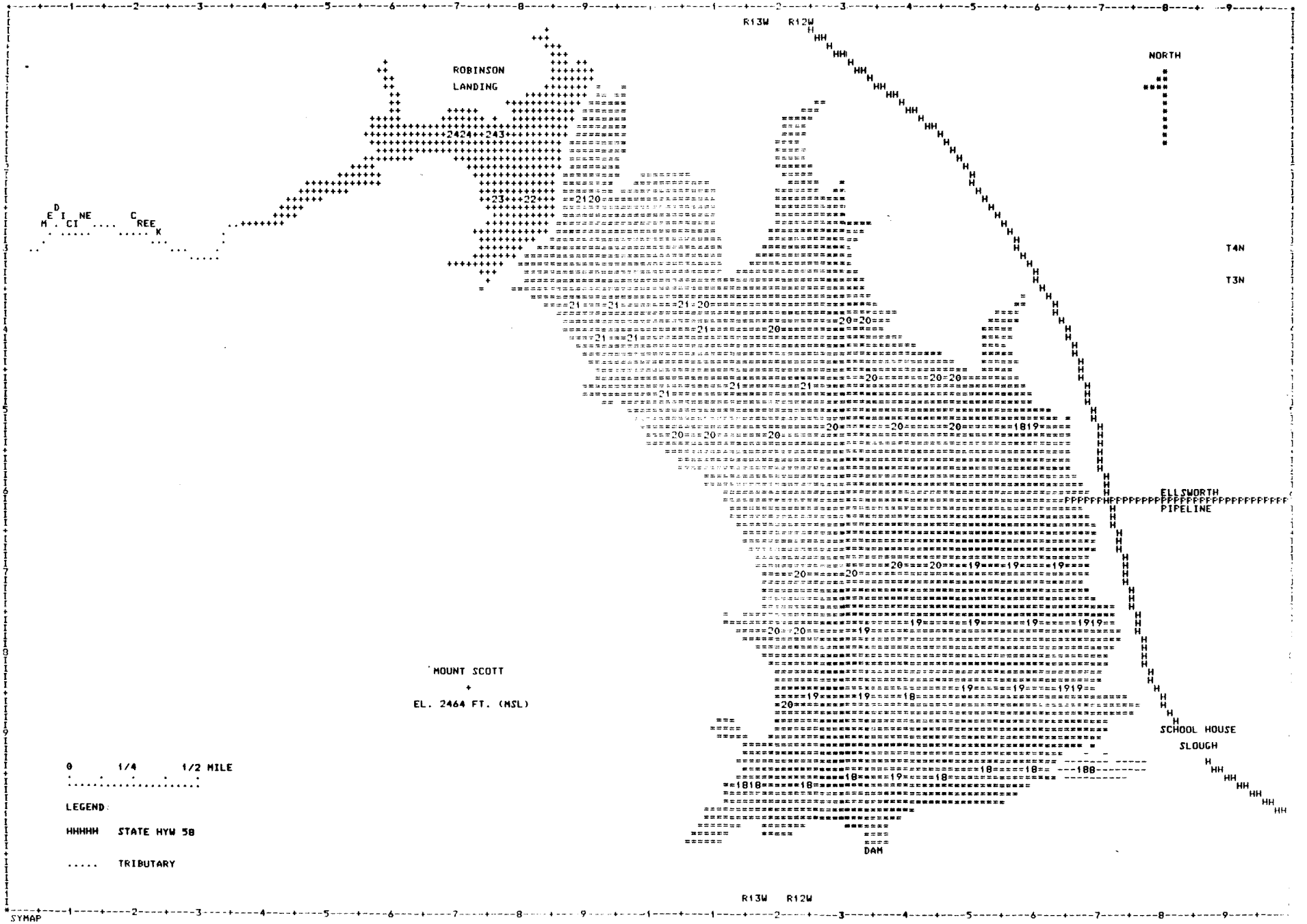
1.233999 MINUTES FOR MAP

FLUOROMETRY DATA FOR LAKE LAWTONKA.
SAMPLES WERE TAKEN ON 7/20/83
AT DEPTH 2. CONCENTRATIONS ARE IN UG/L.

Chlorophyll-a concentrations fc all depths on Oct. 5,1983



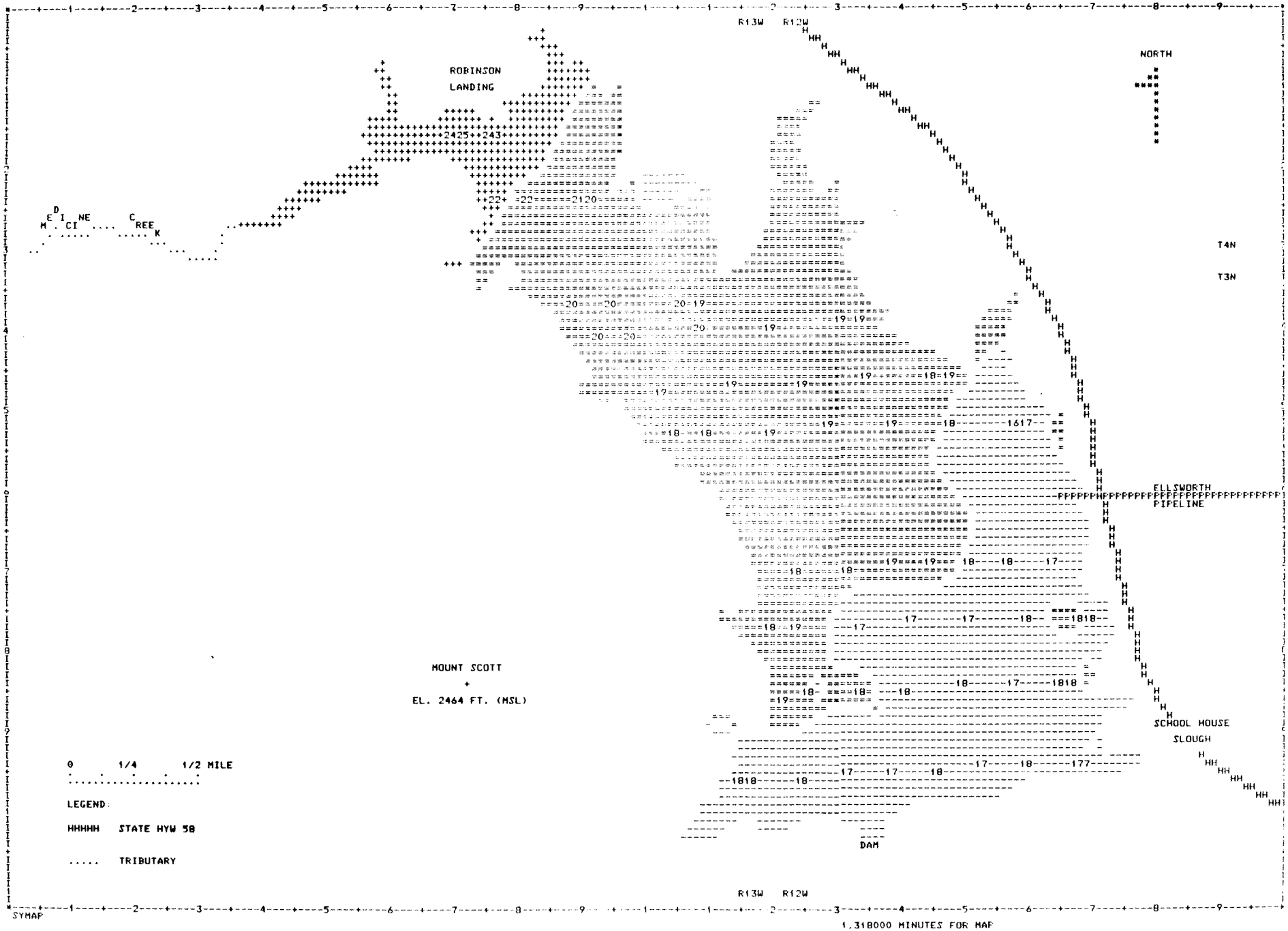
FLUOROMETRY DATA AVERAGED FOR ALL DEPTHS FOR LAKE LAWTONKA.
SAMPLES WERE TAKEN ON 10 OCT 83. PIPELINE SWITCHED ON



1.299999 MINUTES FOR MAP

FLUOROMETRY DATA AVERAGED AT EACH POINT AT ALL DEPTHS FOR ALL DAYS
FOR LAKE LAWTONKA.
PIPELINE SWITCHED ON 7/26/83. CONCENTRATIONS IN UG/L.

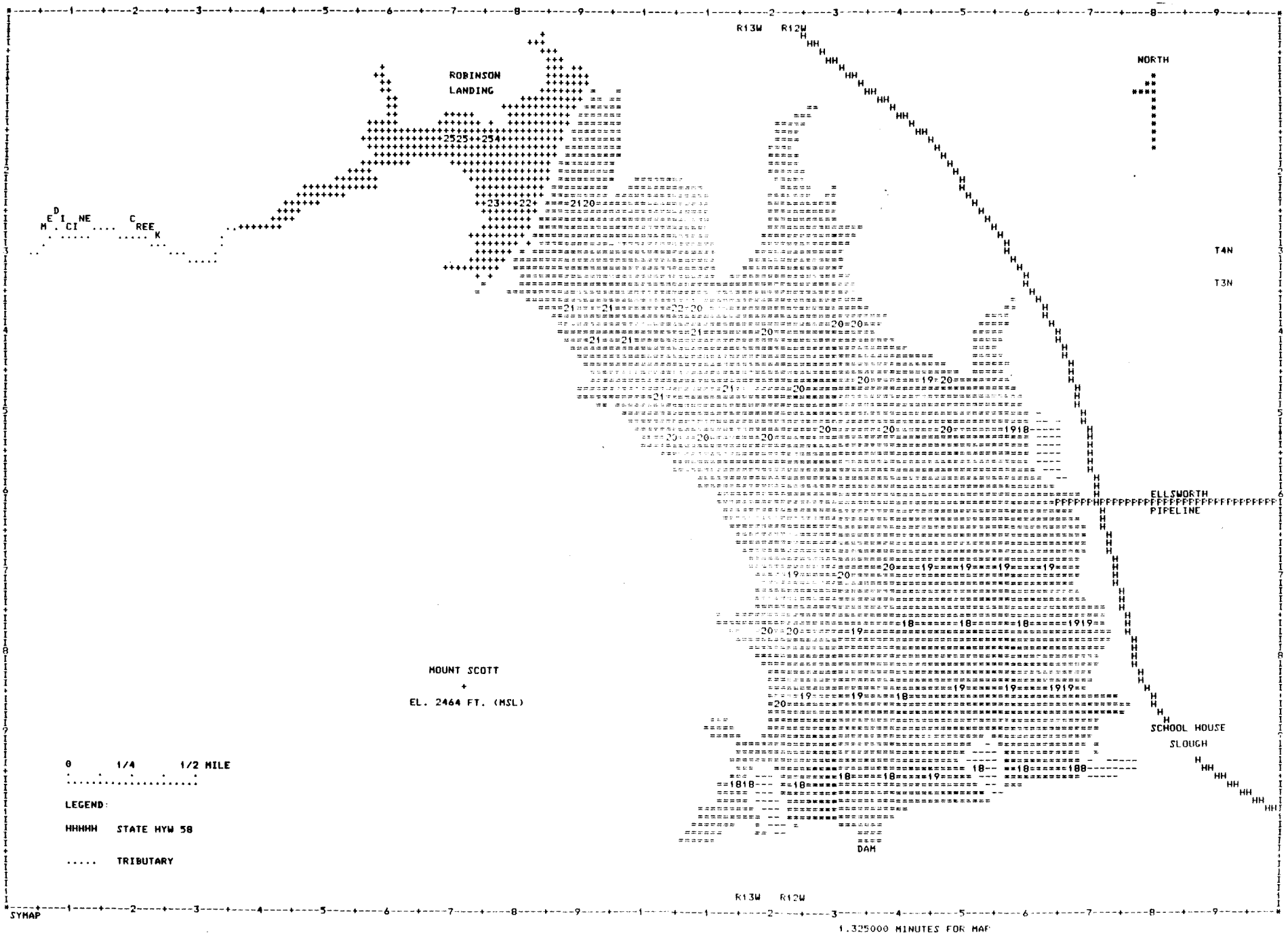
Chlorophyll-a concentrations av ged for all days at depth 1



1.318000 MINUTES FOR MAP

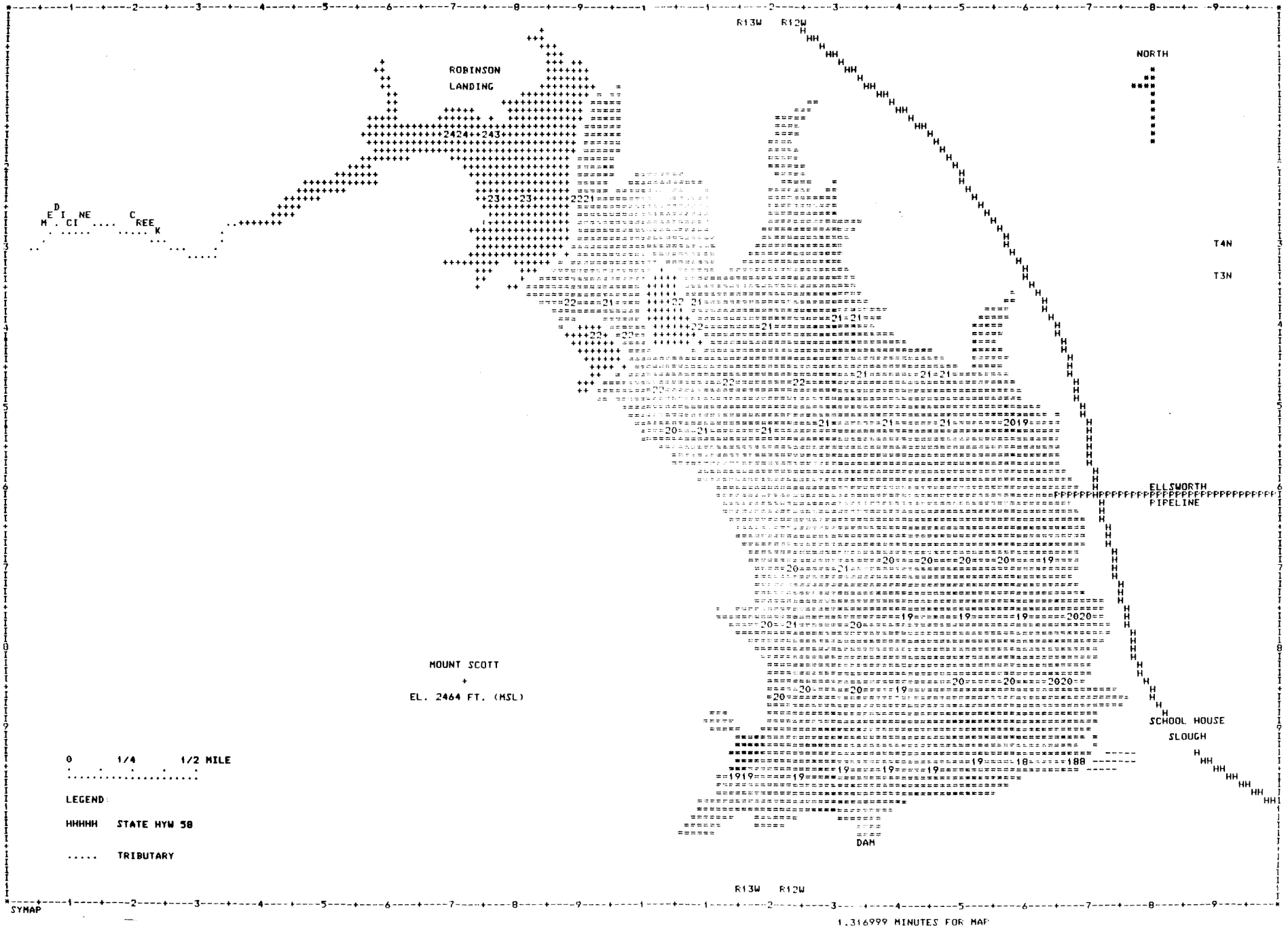
FLUOROMETRY DATA AVERAGED FOR ALL ~~DEPTHS~~ Days FOR LAKE LAWTONKA.
COMPOSITE OVERLAYS OF DEPTH 1. PIPELINE SWITCHED ON
7/26/83. CONCENTRATIONS IN UG/L.

Chlorophyll-a concentrations averaged for all days at depth 2



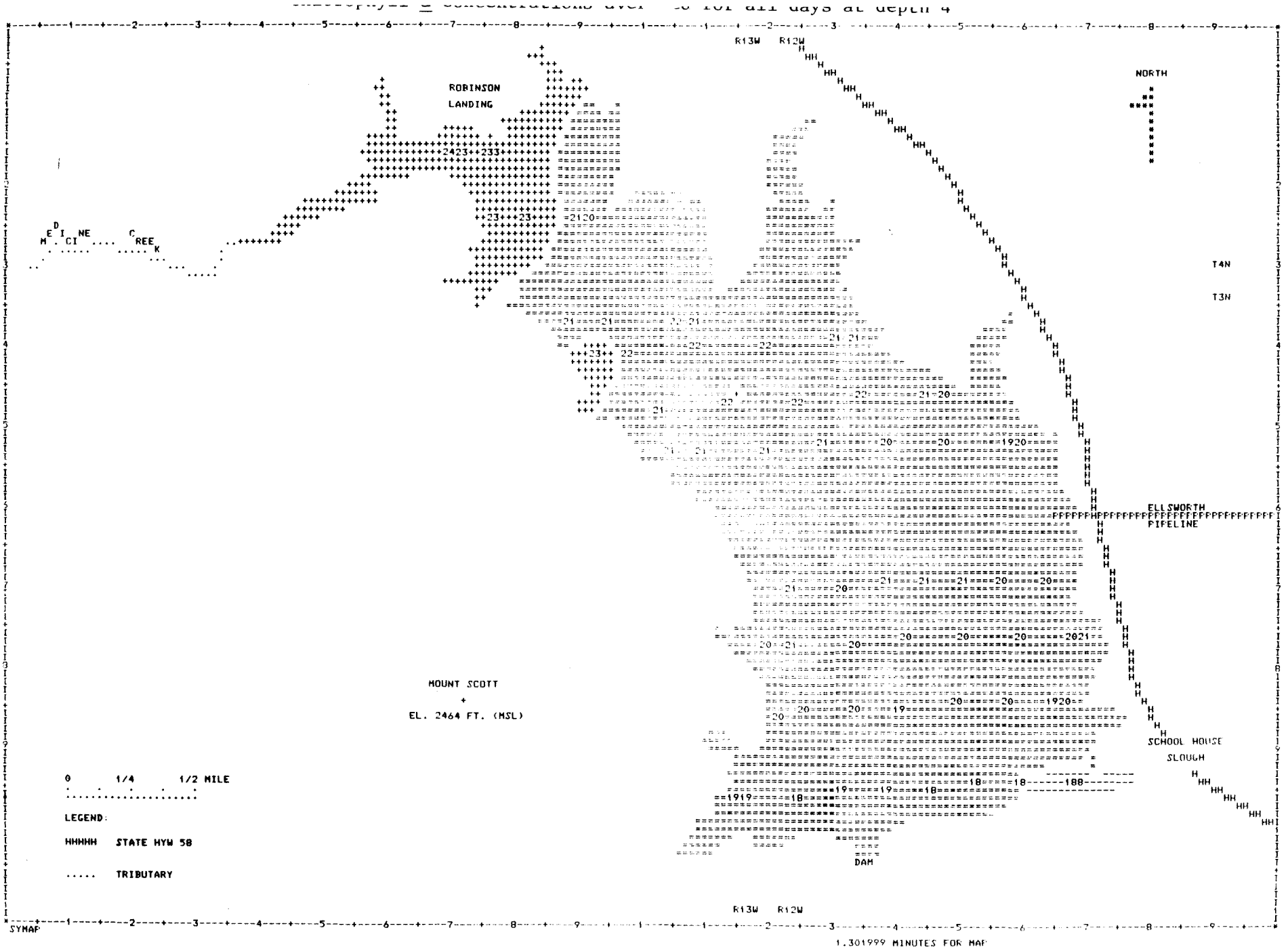
FLUOROMETRY DATA AVERAGED FOR ALL ~~DEPTHS~~ DAYS FOR LAKE LAWTONKA.
COMPOSITE OVERLAYS OF DEPTH 2. PIPELINE SWITCHED ON
7/26/83. CONCENTRATIONS IN UG/L.

Chororphyll-a concentrations aver ed for all days at depth 3



1.316999 MINUTES FOR MAP

FLUOROMETRY DATA AVERAGED FOR ALL ~~DEPTHS~~ Days FOR LAKE LAWTONKA.
COMPOSITE OVERLAYS OF DEPTH 3. PIPELINE SWITCHED ON
7/26/83. CONCENTRATIONS IN UG/L.



1.301999 MINUTES FOR MAP

FLUOROMETRY DATA AVERAGED FOR ALL ~~DEPTHS~~ DAYS FOR LAKE LAWTONKA.
COMPOSITE OVERLAYS OF DEPTH 4. PIPELINE SWITCHED ON
7/28/83. CONCENTRATIONS IN UG/L.

APPENDIX F

PHYTOPLANKTON DATA COLLECTED

FOR LAWTONKA RESERVOIR

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring and Analysis Division

Phytoplankton Data Summary

Project: Lake Lawtonka **Date Received: 7-28-82**

Classification: Site 1 at 1 Meter

	Units/ml	um3/ml
unidentified flagellate	725	1.0×10^5
Chlorophyta		
Chlorococcales		
Ankistrodesmus braunii	48	8.7×10^3
Ankistrodesmus falcatus	120	3×10^5
Golenkinia radiata	97	3.7×10^4
Kirchneriella subsolitoria	72	1.8×10^4
Micractinium pusillum	220	1×10^5
Oocystis pusilla	120	6.4×10^4
Pediastrum duplex	24	7.5×10^4
Tetraedron quadratum	24	2.1×10^4
Treubaria triappendiculata	24	5.2×10^3
Tetrasporales		
Gloeocystis gigas	24	7.5×10^3
Volvocales		
Phacotus lenticularis	220	1.6×10^5
Pyrrhophyta		
Peridiniales		
Peridinium inconspicuum	24	2.1×10^4
Euylenophyta		
Euglenales		
Euglena acus	24	5.1×10^4
Euglena proxima	24	1.7×10^4
Lepocinclis acuta	97	9.9×10^4
Trachelomonas abrubta	24	4.0×10^4
Trachelomonas gibberosa	48	7.5×10^4
Trachelomonas girardiana	24	3×10^4

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	Units/ml	um3/ml
Trachelomonas volvocina	97	5.2×10^4
Trachelomonas sp.	48	1.5×10^4
Cyanophyta		
Chroococcales		
Coelosphaerium pallidum	290	1.4×10^5
Chroococcus minimus	1600	5.3×10^5
Merismopedia glauca	24	1.4×10^4
Merismopedia tenuissima	700	1.6×10^5
Bacillariophyta		
Centrales		
Cyclotella meneghiniana	38	2.9×10^4
Cyclotella stelligera	27	1.2×10^4
Melosira ambigua	32	1.2×10^5
Melosira italica	110	4.3×10^4
Stephanodiscus dubius	5	3.3×10^3
Stephanodiscus tenuis	170	2.4×10^4
unidentified centric diatoms	27	2.9×10^3
Pennales		
Achnanthes sp.	5	7.7×10^1
Diploneis puella	16	4.1×10^3
Eunotia pectinalis	5	5.5×10^2
Fragilaria crotonensis	5	2.6×10^3
Gomphonema sp.	5	1.1×10^3
Navicula salinarum	5	3.1×10^3
Navicula secreta	91	1.7×10^4
Navicula spp.	32	2.3×10^3
Nitzschia acicularis	11	4.6×10^3
Nitzschia elliptica	11	4.1×10^3
Nitzschia filiformis	11	8.7×10^3
Nitzschia gracilis	11	3.5×10^3
Nitzschia palea	32	4.6×10^3
Nitzschia sinuata v. tabellaria	5	3.1×10^3
Synedra sp.	11	6.4×10^2
unidentified pennate diatoms	16	9.0×102

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OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring and Analysis Division

Phytoplankton Data Summary

Project: Lake Lawtonka

Date Received: 7-28-82

Site 3 at 1 Meter

	Units/ml	um3/ml
unidentified flagellates	130	4.0×10^4
Chlorophyta		
Chlorococcales		
Crucigenia sp.	11	1.2×10^4
Dictyosphaerium pulchellum	22	5.4×10^4
Oocystis pusilla	54	4.6×10^4
Tetrasporales		
Elakatothrix gelatinosa	11	4.2×10^3
Gloeocystis vesiculosa		5.4×10^4
Sphaerocystis schroeteri	11	1.7×10^4
Volvocales		
Phacotus lenticularis	315	2.4×10^5
Zygnematales		
Cosmarium sp.	11	4.2×10^3
Staurastrum sp.	11	1.4×10^4
Pyrrhophyta		
Peridiniales		
Ceratium hirundinella	11	1.3×10^5
Euglenophyta		
Euglenales		
Trachelomonas robusta	11	1.2×10^4
Cyanophyta		
Chroococcales		
Chroococcus minimus	664	2.1×10^5
Coelosphaerium pallidum	773	2.9×10^5
Microcystis aeruginosa	120	7.5×10^5
Synechococcus sp.	500	5.7×10^4

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O.W.R.B. Lawtonka Lake

Site: 1 - 0.5 Meters

Date Received: May 24, 1983

	Units'ml
Hormogonales	
Anabaena	3
Aphanizomenon	3
Oscillatoria	3
EUGLENOPHYTA	
Euglenales	
Euglena	22
Lepocinclis	8
Phacus	3
Trachelomonas	46
PYRROPHYTA	
Cryptomonadales	
Cryptomonas (?)	3
Peridiniales	
Glenodinium	3
Peridinium	3
BACILLARIOPHYTA	
Fragilariales	
Diatoma	3
Synedra	8
Achnanthales	
Achnanthales	3
Naviculales	
Cymbella	8
Navicula	27
Nitzschiales	
Nitzschia	14
Eupodiscales	
Cyclotella	11
Melosira	57

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Site 1 - 0.5 Meters

Date Received: May 24, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	3
Chlorella	79
Gloeocystis	11
Oocystis	73
Pediastrum	3
Quadrigula	3
Scenedesmus	57
Schroederia	16
Sphaerocystis	11
Oedogoniales	
Oedogonium (oogonia)	3
Volvocales	
Chlamydomonas	5
Phacotus	120
Zygnematales	
Closterium	2
CHRYSOPHYTA	
Chrysomonadales	
Dinobryon	3
Mallomonas	43
CYANOPHYTA	
Chroococcales	
Dactylococcopsis	41
Gomphosphaeria	3

O.W.R.B. Lawtonka Lake

Site 3 - 0.5 Meters

Date Received: May 24, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Coelosphaerium	2
Hormogonales	
Anabaena	2
EUGLENOPHYTA	
Euglenales	
Lepocinclis	2
PYRROPHYTA	
Cryptomonadales	
Cryptomonas (?)	24
Peridinales	
Ceratium	2
Gymnodinium	2
BACILLARIOPHYTA	
Fragilariales	
Asterionella	1
Synedra	2
Achnanthales	
Achnanthes	1
Naviculales	
Cymbella	1
Diploneis	1
Nitzschiales	
Nitzschia	1
Eupodiscales	
Melosira	6

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Site 3 - 0.5 Meters

Date Received: May 24, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Chlorella	6
Dictyosphaerium	3
Oocystis	53
Quadrigula	2
Scenedesmus	2
Schroederia	18
Sphaerocystis	8
Volvocales	
Pandorina	2
Phacotus	31
Zygnematales	
Closterium	3
Cosmarium	2
Mougeotia	3
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	140
CYANOPHYTA	
Chroococcales	
Coelosphaerium	2
Hormogonales	
Anabaena	2

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Schoolhouse Slough - 0.5 Meters

Date Received: May 24, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Chlorella	8
Gloeocystis	3
Oocystis	45
Pediastrum	2
Quadrigula	2
Scenedesmus	3
Schroederia	28
Sphaerocystis	9
Trochiscia	1
Volvocales	
Chlamydomonas	8
Phacotus	5
Zygnematales	
Closterium	2
Cosmarium	2
Mougeotia	2
Staurastrum	5
Oedogoniales	
Oedogonium (spore)	2

O.W.R.B. LAWTONKA LAKE

Schoolhouse Slough - 0,.5 Meters

Date Received: May 24, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Chroococcus	3
Dacytylococcopsis	2
Merismopedia	2
Coelosphaerium	2
Hormogonales	
Anabaena	3
Oscillatoria	2
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	62
EUGLENOPHYTA	
Euglenales	
Euglena	3
Trachelomonas	3
PYRROPHYTA	
Cryptomonadales	
Cryptomonas (?)	8
Peridinales	
Ceratium	2
BACILLARIOPHYTA	
Fragilariales	
Asterionella	2
Achnanthales	
Cocconeis	2

O.W.R.B. LAWTONKA LAKE

Site: Schoolhouse Slough - 0.5 Meters

Date Received: May 24, 1983

	Units/ml
Naviculales	
Anomoeneis	2
Navicula	3
Gomphonema	2
Nitzschiales	
Nitzschia	9
Eupodiscales	
Cyclotella	16
Melosira	11
Stephanodiscus	2

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Schoolhouse Slough - 2 Meters

Date Received: June 30, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Chlorella	9
Coelastrum	9
Crucigenia	5
Dictyosphaerium	9
Gloeocystis	5
Oocystis	24
Pediastrum	2
Scenedesmus	2
Schroederia	20
Volvocales	
Phacotus	160
CYANOPHYTA	
Chroococcales	
Coelosphaerium	5
Chroococcus	2
Dactylococcopsis	3
Gomphosphaeria	6
Microcystis	3
Hormogonales	
Anabaena	60
Aphanizomenon	9

O.W.R.B. Lawtonka Lake

Site: Schoolhouse Slough - 2 Meters

Date Received: June 30, 1983

	Units/ml
EUGLENOPHYTA	
Euglenales	
Euglena	2
Trachelomonas	3
CHRYSOPHYTA	
Chrysomonadales	
Dinobryon	3
Mallomonas	6
PYRROPHYTA	
Cryptomonadales	
Cryptomonas	5
BACILLARIOPHYTA	
Fragilariales	
Synedra	2
Achnanthales	
Achnanthes	2
Naviculales	
Amphora	2
Cymbella	2
Navicula	6
Neidium	2
Stauroneis	2
Nitzschiales	
Nitzschia	5
Eupodiscales	
Cyclotella	9
Melosira	6

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Site 1 at 1.75 Meters

Date Received: July 6, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Actinastrum	6
Ankistrodesmus	30
Chlorella	36
Crucigenia	30
Coelastrum	24
Dictyosphaerium	12
Dimorphococcus	6
Gloeocystis	54
Kirchneriella	6
Micractinium	6
Oocystis	60
Scenedesmus	60
Shroederia	42
Sphaerocystis	12
Volvocales	
Chlamydomonas	6
Phacotus	540
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	6
CYANOPHYTA	
Chroococcales	
Anacystis	24
Aphanocapsa	6
Chroococcus	12
Dactylococcopsis	210
Microcystis	6

O.W.R.B. Lawtonka Lake

Site 1

Date Received: July 6, 1983

	Units/ml
Hormogonales	
Anabaena	6
Aphanizomenon	6
EUGLENOPHYTA	
Euglenales	
Euglena	24
Lepocinclis	24
Phacus	24
Trachelomonas	66
BACILLARIOPHYTA	
Fragilariales	
Diatoma	6
Synedra	6
Achnanthales	
Cocconeis	12
Naviculales	
Navicula	48
Gomphonema	6
Nitzschiales	
Nitzschia	18
Eupodiscales	
Cyclotella	84
Melosira	90
Stephanodiscus	6
unidentified	96

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake
Site 3 - 2 Meters
Date Received: July 6, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	21
Chlorella	13
Coelastrum	2
Dictyosphaerium	21
Crucigenia	6
Gloeocystis	29
Kirchneriella	2
Oocystis	63
Pediastrum	10
Quadrigula	2
Scenedesmus	4
Schroederia	8
Sphaerocystis	6
Volvocales	
Chlamydomonas	17
Phacotus	200
Zygnematales	
Closterium	2
Cosmarium	2
CHRYSOPHYTA	
Chrysomonadales	
Dinobryon	4
Mallomonas	50

PROPERTY OF
OKLAHOMA WATER RESOURCES BOARD

O.W.R.B. Lawtonka Lake

Site: 3 - 2 Meters

Date Received: July 6, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Chroococcus	8
Dactylococcopsis	8
Gomphosphaeria	23
Microcystis	6
Hormogonales	
Anabaena	19
Aphanizomenon	25
EUGLENOPHYTA	
Euglenales	
Trachelomonas	8
PYRROPHYTA	
Cryptomonadales	
Cryptomonas (?)	38
BACILLARIOPHYTA	
Nitzschiales	
Nitzschia	6
Eupodiscales	
Melosira	12

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Schoolhouse Slough - 1 Meter

Date Received: July 6, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	15
Chlorella	12
Crucigenia	19
Coelastrum	16
Dictyosphaerium	3
Gloeocystis	4
Kirchneriella	1
Oocystis	55
Pediastrum	6
Quadrigula	4
Scenedesmus	3
Schroederia	7
Selenastrum	4
Sphaerocystis	6
Westella	3
Volvocales	
Chlamydomonas	7
Phacotus	110
Zygnematales	
Closterium	1
Nephrocytium	1
Phymatodocis (?)	1
Staurastrum	1
CHRYSOPHYTA	
Chrysomonadales	
Dinobryon	25
Mallomonas	13

O.W.R.B. Lawtonka Lake

Site: Schoolhouse Slough - 1 Meter

Date Received: July 6, 1983

	Units/ml
Heterococcales	
Centritractus	1
CYANOPHYTA	
Chroococcales	
Anacystis	9
Chroococcus	1
Dactylococcopsis	18
Gomphosphaeria	6
Microcystis	1
Hormogonales	
Anabaena	21
Aphanizomenon	12
EUGLENOPHYTA	
Euglenales	
Euglena	1
Trachelomonas	3
Lepocinclis	4
PYRROPHYTA	
Peridinales	
Ceratium	1
BACILLARIOPHYTA	
Fragilariales	
Fragilaria	1
Naviculales	
Gomphonema	1
Navicula	6
Nitzschiales	
Nitzschia	6
Eupodiscales	
Cyclotella	3
Melosira	15

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Site 1

Date Received: July 24, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	8
Actinastrum	3
Chlorella	3
Coelastrum	67
Crucigenia	24
Gloeocystis	11
Dictyosphaerium	19
Oocystis	120
Pediastrum	24
Micractinium	3
Scenedesmus	19
Schroederia	5
Tetraedron	3
Volvocales	
Chlamydomonas	35
Phacotus	540
Zygnematales	
Closterium	5
Cosmarium	5
Staurastrum	5
CHRYSOPHYTA	
Chrysomonadales	
Dinobryon	3

O.W.R.B. Lawtonka Lake

Site 1

Date Received: July 24, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Coelosphaerium	13
Gomphosphaeria	100
Microcystis	110
Dactylococcopsis	27
Chroococcus	32
Hormogonales	
Arthrospira	11
Anabaena	200
Aphanizomenon	180
Oscillatoria	5
EUGLENOPHYTA	
Euglena	
Euglena	21
Lepocinclis	5
Trachelomonas	24
BACILLARIOPHYTA	
Fragilariales	
Fragilaria	3
Synedra	3
Asterionella	3
Achnanthales	
Achnanthes	5
Naviculales	
Caloneis	3
Cymbella	3
Gomphonema	21
Navicula	37

O.W.R.B. Lawtonka Lake

Site 1

Date Received: July 24, 1983

	Units/ml
Nitzschiales	
Nitzschia	11
Eupodiscales	
Melosira	99
Cyclotella	150

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Site 3 - 1 Meter

Date Received: July 24, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	6
Coelastrum	140
Crucigenia	12
Dictyosphaerium	3
Elakatothrix	3
Gloeocystis	59
Oocystis	89
Pediastrum	21
Schroederia	3
Sphaerocystis	6
Volvocales	
Chlamydomonas	3
Phacotus	220
Zygnematales	
Closterium	3
Staurastrum	3
CYANOPHYTA	
Chroococcales	
Coelosphaerium	3
Chroococcus	9
Dactylococcopsis	6
Gomphosphaeria	30
Microcystis	9

O.W.R.B. Lawtonka Lake

Site 3 - 1 Meter

Date Received: July 24, 1983

	Units/ml
Hormogonales	
Anabaena	27
Aphanizomenon	79
EUGLENOPHYTA	
Euglenales	
Trachelomonas	3
PYRROPHYTA	
Peridinales	
Ceratium	6
BACILLARIOPHYTA	
Naviculales	
Navicula	3
Eupodiscales	
Melosira	74

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. LAWTONKA LAKE

Site 3 - 15 Meters

Date Received: July 24, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Coelastrum	44
Crucigenia	5
Dictyosphaerium	3
Gloeocystis	11
Oocystis	30
Pediastrum	5
Scenedesmus	8
Schroederia	3
Tetraedron	3
Volvocales	
Chlamydomonas	3
Phacotus	38
Zygnematales	
Closterium	3
CYANOPHYTA	
Chroococcales	
Chroococcus	11
Gomphosphaeria	27
Merismopedia	27

Project: Lawtonka Lake

Site 3 - 15 Meters

Date Received: July 24, 1983

	Units/ml
Hormogonales	
Anabaena	3
Aphanizomenon	5
Oscillatoria	22
BACILLARIOPHYTA	
Nitzschiales	
Nitzschia	5
Eupodiscales	
Melosira	5

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Transect A - Depth 1

Date Received: August 10, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Crucigenia	39
Dictyosphaerium	72
Elakatothrix	7
Gloeocystis	110
Kirchneriella	13
Oocystis	130
Pediastrum	14
Scenedesmus	14
Trochiscia	7
Volvocales	
Chlamydomonas	7
Carteria	26
Phacotus	310
Zygnematales	
Closterium	7
Euastrum	7
Staurastrum	7
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	7

Project: O.W.R.B. Lawtonka Lake

Transect A - Depth 1

Date Received: August 10, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	7
Chroococcus	110
Dactylococcopsis	7
Gomphosphaeria	230
Microcystis	33
Hormogonales	
Anabaena	547
Aphanizomenon	420
EUGLENOPHYTA	
Euglenales	
Trachelomonas	7
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	33
Melosira	79

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Transect A - Depth 4

Date Received: August 10, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	8
Botryococcus	4
Coelastrum	4
Crucigenia	20
Dictyosphaerium	48
Elakatothrix	4
Gloeocystis	110
Lagerheimia	4
Nephrocytium	4
Oocystis	125
Pediastrum	8
Scenedesmus	48
Schroederia	4
Selenastrum	4
Sphaerocystis	8
Volvocales	
Carteria	16
Chlamydomonas	32
Phacotus	310
Zygnematales	
Closterium	8
Cosmarium	12
Staurastrum	12

Project: O.W.R.B. Lawtonka Lake

Transect A - Depth 4

Date Received: August 10, 1983

	Units/ml
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	8
CYANOPHYTA	
Chroococcales	
Chroococcus	64
Gomphosphaeria	210
Dactylococcopsis	4
Microcystis	16
Hormogonales	
Anabaena	340
Aphanizomenon	420
EUGLENOPHYTA	
Euglenales	
Euglena	4
Trachelomonas	16
PYRROPHYTA	
Peridinales	
Ceratium	24
BACILLARIOPHYTA	
Fragilariales	
Fragilaria	4
Synedra	4
Nitzschiales	
Nitzschia	4
Eupodiscales	
Cyclotella	32
Melosira	84

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Medicine Creek **Date Received: August 10, 1983**

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Actinastrum	17
Ankistrodesmus	17
Coelastrum	17
Crucigenia	17
Gloeocystis	70
Golenkinia	160
Dictyosphaerium	35
Kirchneriella	17
Oocystis	170
Pediastrum	17
Scenedesmus	100
Schroederia	17
Selenastrum	52
Tetraedron	87
Treubaria	69
Westella	17
Volvocales	
Chlamydomonas	17
Phacotus	350
Zygnematales	
Cosmarium	17

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	520
Chroococcus	260
Dactylococcopsis	240
Gomphosphaeria	52
Merismopedia	140
Microcystis	35
Hormogonales	
Anabaena	52
Aphanizomenon	17
Oscillatoria	52
EUGLENOPHYTA	
Euglenales	
Euglena	69
Lepocinclis	17
Phacus	17
Trachelomonas	69
PYRROPHYTA	
Peridinales	
Gymnodinium	35
Ceratium	17
Peridinium	17
BACILLARIOPHYTA	
Fragilariales	
Diatoma	17
Synedra	17

	Units/ml
Achnanthales	
Achnanthes	35
Cocconeis	17
Naviculales	
Caloneis	17
Cymbella	35
Gomphonema	17
Neidium	17
Navicula	100
Nitzschiales	
Nitzschia	480
Eupodiscales	
Cyclotella	290
Melosira	140
Stephanodiscus	52

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Medicine Creek

Date Received: August 10, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	180
Chlorella	380
Crucigenia	56
Dictyosphaerium	14
Gloecystis	420
Golenkinia	680
Franceia	42
Micractinium	42
Oocystis	180
Pediastrum	14
Scenedesmus	270
Schroederia	56
Selenastrum	370
Tetraedron	84
Treubaria	56
Trochiscia	14
Westella	84
Volvocales	
Carteria	99
Chlamydomonas	660
Phacotus	270
Zygnematales	
Staurastrum	14

	Units/ml
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	28
Dinobryon	28
CYANOPHYTA	
Chroococcales	
Anacystis	440
Aphanocapsa	28
Chroococcus	240
Coelosphaerium	14
Dactylococcopsis	140
Gomphosphaeria	28
Marssoniella	28
Merismopedia	480
Microcystis	130
Hormogonales	
Anabaena	84
Aphanizomenon	56
Oscillatoria	140
EUGLENOPHYTA	
Euglenales	
Euglena	140
Lepocinclis	84
Phacus	42
Trachelomonas	180

	Units/ml
PYRROPHYTA	
Cryptomonadales	
Cryptomonas	28
Peridinales	
Gymnodinium	14
Peridinium	14
BACILLARIOPHYTA	
Fragilariales	
Synedra	28
Achnanthales	
Achnanthes	42
Cocconeis	14
Naviculales	
Amphora	14
Cymbella	14
Gomphonema	14
Navicula	70
Nitzschiales	
Nitzschia	420
Eupodiscales	
Cyclotella	550
Melosira	110
Stephanodiscus	14

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect B **Date Received: August 24, 1983**

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	22
Elakatothrix	22
Gloeocystis	55
Lagerheimia	11
Nephrocytium	11
Oocystis	65
Pediastrum	11
Scenedesmus	11
Schroederia	11
Sphaerocystis	22
Volvocales	
Phacotus	185
Carteria	33
Zygnematales	
Cosmarium	33
Closterium	22
Staurastrum	11
unidentified	33
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	22

Project: O.W.R.B. Lawtonka Lake

Transect B

Date Received: August 24, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	55
Chroococcus	160
Dactylococcopsis	11
Gomphosphaeria	160
Merismopedia	22
Microcystis	44
Hormogonales	
Anabaena	270
Aphanizomenon	750
Oscillatoria	11
EUGLENOPHYTA	
Euglenales	
Trachelomonas	11
PYRROPHYTA	
Peridinales	
Ceratium	22
BACILLARIOPHYTA	
Fragilariales	
Synedra	11
Nitzschiales	
Nitzschia	11
Eupodiscales	
Cyclotella	33
Melosira	240
Stephanodiscus	22

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect C **Date Received: August 24, 1983**

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	33
Botryococcus	22
Crucigenia	22
Dictyosphaerium	11
Elakatothrix	11
Gloeocystis	98
Golenkinia	11
Oocystis	150
Pediastrum	11
Scenedesmus	11
Schroederia	33
Sphaerocystis	11
Tetraedron	11
Volvocales	
Carteria	33
Phacotus	160
Zygnematales	
Cosmarium	44
Staurastrum	22
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	33

Project: O.W.R.B. Lawtonka Lake

Transect C

Date Received: August 24, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	22
Coelosphaerium	11
Chroococcus	65
Dactylococcopsis	11
Gomphosphaeria	120
Merismopedia	11
Microcystis	76
Hormogonales	
Anabaena	450
Aphanizomenon	760
Lyngbya	11
Oscillatoria	11
PYRROPHYTA	
Peridinales	
Ceratium	11
BACILLARIOPHYTA	
Nitzschiales	
Nitzschia	87
Eupodiscales	
Cyclotella	44
Melosira	210

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect H **Date Received: August 24, 1983**

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	44
Crucigenia	11
Dictyosphaerium	33
Oocystis	240
Pediastrum	33
Scenedesmus	55
Schroederia	11
Tetrasporales	
Elakatothrix	22
Gloeocystis	250
Volvocales	
Carteria	44
Chlamdomonas	11
Phacotus	350
Zygnematales	
Closterium	22
Cosmarium	22
Staurastrum	44
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	22

O.W.R.B. Lawtonka Lake

Transect H

Date Received: August 24, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	33
Chroococcus	44
Dactylococcopsis	55
Gomphosphaeria	160
Merismopedia	22
Microcystis	65
Hormogonales	
Anabaena	310
Aphanizomenon	770
Oscillatoria	33
BACILLARIOPHYTA	
Fragilariales	
Synedra	11
Naviculales	
Navicula	11
Nitzschiales	
Nitzschia	130
Eupodiscales	
Cyclotella	33
Melosira	230
Stephanodiscus	11

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect I **Date Received: August 24, 1983**

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	33
Botryococcus	22
Crucigenia	55
Elakatothrix	11
Gloeocystis	350
Nephrocytium	11
Lagerheimia	11
Oocystis	190
Pediastrum	33
Scenedesmus	130
Schroederia	22
Tetraedron	11
Volvocales	
Carteria	65
Chlamydomonas	11
Phacotus	280
Zygnematales	
Closterium	11

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	110
Dactylococcopsis	65
Chroococcus	65
Coelosphaerium	11
Gomphosphaeria	190
Microcystis	55
Merismopedia	22
Hormogonales	
Anabaena	400
Aphanizomenon	490
Oscillatoria	11
EUGLENOPHYTA	
Euglenales	
Lepocinclis	11
Phacus	11
BACILLARIOPHYTA	
Achnanthales	
Cocconeis	11
Naviculales	
Navicula	22
Nitzschiales	
Nitzschia	44
Eupodiscales	
Cyclotella	55
Melosira	280
Stephanodiscus	44

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect J **Date Received: August 24, 1983**

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	50
Chlorella	200
Crucigenia	50
Dictyosphaerium	17
Golenkinia	33
Lagerheimia	33
Oocystis	360
Pediastrum	33
Scenedesmus	360
Schroederia	66
Tetraedron	17
Treubaria	17
Trochiscia	17
Tetrasporales	
Elakatothrix	17
Gloeocystis	180
Volvocales	
Carteria	100
Chlamydomonas	66
Phacotus	560
Zygnematales	
Closterium	17
Cosmarium	83
Staurastrum	17

O.W.R.B. Lawtonka Lake

Transect J

Date Received: August 24, 1983

	Units/ml
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	17
CYANOPHYTA	
Chroococcales	
Anacystis	150
Chroococcus	150
Coelosphaerium	33
Dactylococcopsis	100
Gomphosphaeria	50
Merismopedia	50
Microcystis	150
Hormogonales	
Aphanizomenon	150
Anabaena	550
Lyngbya	33
EUGLENOPHYTA	
Euglenales	
Euglena	180
Lepocinclis	50
Trachelomonas	230
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	50
Melosira	230
Naviculales	
Navicula	50
Nitzschiales	
Nitzschia	200

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Transect A

Date Received: August 31, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	44
Coelastrum	22
Nephrocytium	22
Oocystis	150
Pediastrum	44
Scenedesmus	65
Tetrasporales	
Gloeocystis	110
Volvocales	
Carteria	22
Phacotus	460
Zygnematales	
Closteium	22
Staurastrum	22
CYANOPHYTA	
Chroococcales	
Anacystis	87
Dactylococcopsis	65
Chroococcus	110
Gomphosphaeria	330
Merismopedia	22
Microcystis	130

O.W.R.B. Lawtonka Lake

Transect A

Date Received: August 31, 1983

	Units/ml
Hormogonales	
Anabaena	1100
Aphanizomenon	1100
Lyngbya	22
PYRRHOPHYTA	
Peridiniales	
Ceratium	22
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	44
Melosira	280
Stephanodiscus	22
Fragilariales	
Fragilaria	44
Naviculales	
Navicula	22
Nitzschiales	
Nitzschia	87

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Transect B

Date Received: August 31, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	22
Coelastrum	22
Crucigenia	22
Dictyosphaerium	22
Nephrocytium	22
Oocystis	130
Scenedesmus	44
Westella	22
Tetrasporales	
Elakatothrix	22
Gloeocystis	65
Volvocales	
Carteria	44
Phacotus	310
Zygnematales	
Closterium	22
Mougeotia	22
CYANOPHYTA	
Chroococcales	
Chroococcus	22
Gomphosphaeria	260
Merismopedia	44
Microcystis	200

O.W.R.B. Lawtonka Lake

Transect B

Date Received: August 31, 1983

	Units/ml
Hormogonales	
Anabaena	1200
Aphanizomenon	920
Oscillatoria	22
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	200
Melosira	350
Nitzschiales	
Nitzschia	87

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Transect C

Date Received: August 31, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	44
Crucigenia	22
Dictyosphaerium	22
Oocystis	110
Pediastrum	22
Scenedesmus	44
Tetrasporales	
Gloeocystis	130
Volvocales	
Carteria	110
Phacotus	480
Zygnematales	
Closterium	44
EUGLENOPHYTA	
Euglenales	
Trachelomonas	44
CYANOPHYTA	
Chroococcales	
Anacystis	44
Chroococcus	65
Gomphosphaeria	460
Merismopedia	22
Microcystis	150
Hormogonales	
Anabaena	1600
Aphanizomenon	960

O.W.R.B. Lawtonka Lake

Transect C

Date Received: August 31, 1983

	Units/ml
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	170
Melosira	480
Stephanodiscus	22
Naviculales	
Navicula	22
Nitzschiales	
Nitzschia	65

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake
Transect G
Date Received: August 31, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	22
Oocystis	110
Pediastrum	22
Scenedesmus	130
Schroederia	22
Tetrasporales	
Gloeocystis	22
Volvocales	
Carteria	65
Chlamydomonas	44
Phacotus	570
CYANOPHYTA	
Chroococcales	
Anacystis	87
Chroococcus	130
Coelosphaerium	65
Dactylococcopsis	22
Gomphosphaeria	240
Microcystis	87
Hormogonales	
Anabaena	1400
Aphanizomenon	720

	Units/ml
EUGLENOPHYTA	
Euglenales	
Trachelomonas	65
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	65
Melosira	520
Nitzschiales	
Nitzschia	22

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake
Transect H
Date Received: August 31, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	16
Coelastrum	16
Crucigenia	31
Nephrocytium	16
Oocystis	63
Pediastrum	16
Scenedesmus	16
Tetrasporales	
Gloeocystis	94
Volvocales	
Carteria	63
Phacotus	450
Zygnematales	
Staurastrum	16
CYANOPHYTA	
Chroococcales	
Anacystis	31
Chroococcus	140
Coelosphaerium	16
Gomphosphaeria	94
Merismopedia	31
Microcystis	78

	Units/ml
Homogonales	
Anabaena	690
Aphanizomenon	1100
EUGLENOPHYTA	
Euglenales	
Phacus	16
Trachelomonas	31
PYRRHOPHYTA	
Peridiniales	
Ceratium	16
Peridinium	16
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	94
Melosira	310
Naviculales	
Navicula	16
Nitzschiales	
Nitzschia	47

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Transect J

Date Received: August 31, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	44
Lagerheimia	11
Oocystis	22
Scenedesmus	44
Sphaerocystis	11
Treubaria	11
Tetrasporales	
Gloeocystis	65
Volvocales	
Carteria	65
Chlamydomonas	22
Phacotus	480
CYANOPHYTA	
Chroococcales	
Chroococcus	22
Dactylococcopsis	55
Gomphosphaeria	76
Merismopedia	11
Microcystis	87

	Units/ml
Hormogonales	
Anabaena	250
Aphanizomenon	310
Lyngbya	11
Oscillatoria	11
EUGLENOPHYTA	
Euglenales	
Euglena	110
Trachelomonas	160
PYRRHOPHYTA	
Peridinales	
Peridinium	22
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	230
Melosira	240
Stephanodiscus	44
Naviculales	
Amphora	11
Nitzschiales	
Nitzschia	110

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake
Ellsworth Pipeline Outflow
Date Received: August 31, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	44
Coelastrum	11
Golenkinia	33
Oocystis	11
Polyedriopsis	11
Scenedesmus	11
Schroederia	22
Tetraedron	11
Treubaria	11
Tetrasporales	
Gloeocystis	22
Volvocales	
Carteria	290
Phacotus	210
Zygnematales	
Cosmarium	11
CYANOPHYTA	
Chroococcales	
Anacystis	11
Chroococcales	11
Dactylococcopsis	76
Gomphosphaeria	33
Merismopedia	33
Microcystis	11

	Units/ml
Hormogonales	
Anabaena	65
Aphanizomenon	55
Lyngbya	11
Oscillatoria	33
EUGLENOPHYTA	
Euglenales	
Euglena	11
Trachelomonas	44
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	190
Melosira	87
Stephanodiscus	11
Fragilariales	
Synedra	11
Naviculales	
Navicula	22
Nitzschiales	
Nitzschia	210

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Transect A

Date Received: September 7, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	61
Crucigenia	37
Dictyosphaerium	12
Lagerheimia	12
Oocystis	200
Scenedesmus	12
Schroederia	25
Sphaerocystis	12
Tetrasporales	
Elakatothrix	25
Gloeocystis	86
Volvocales	
Carteria	49
Phacotus	250
Zygnematales	
Cosmarium	12
Mougeotia	12
CHRYSOPHYTA	
unidentified flagellate	12

O.W.R.B. Lawtonka Lake

Transect A

Date Received: September 7, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Chroococcus	74
Gomphosphaeria	230
Merismopedia	49
Microcystis	74
Hormogoriales	
Anabaena	680
Aphanizomenon	440
Oscillatoria	86
EUGLENOPHYTA	
Euglenales	
Trachelomonas	12
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	98
Melosira	450
Fragilariales	
Synedra	61
Naviculales	
Navicula	74
Nitzschiales	
Nitzschia	250

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring & Analysis Division

O.W.R.B. Lawtonka Lake
Transect J
Date Received: September 7, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	83
Crucigenia	41
Oocystis	100
Pediastrum	21
Quadrigula	21
Scenedesmus	21
Tetrasporales	
Elakatothrix	21
Gloeocystis	100
Volvocales	
Carteria	250
Chlamydomonas	21
Phacotus	720
Zygnematales	
Staurastrum	21
CYANOPHYTA	
Chroococcales	
Chroococcus	41
Gomphosphaeria	310
Microcystis	83

O.W.R.B. Lawtonka Lake

Transect J

Date Received: September 7, 1983

	Units/ml
Hormogonales	
Anabaena	1100
Aphanizomenon	520
EUGLENOPHYTA	
Euglenales	
Euglena	83
Lepocinclis	21
Trachelomonas	62
PYRRHOPHYTA	
Peridiniales	
Gymnodinium	41
Peridinium	21
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	100
Melosira	620
Fragilariales	
Synedra	21
Nitzschiales	
Nitzschia	100

O.W.R.B. Lawtonka Lake

Ellsworth Pipeline Outflow

Date Received: September 7, 1983

	Units/ml
EUGLENOPHYTA	
Euglenales	
Euglena	33
Trachelomonas	22
BACILLARIOPHYTA	
Eupodiscales	
Coscinodiscus	11
Cyclotella	160
Melosira	76
Stephanodiscus	55
Fragilariales	
Synedra	22
Nitzschiales	
Nitzschia	55

O.W.R.B. Lawtonka Lake

Ellsworth Pipeline Outflow

Date Received: September 7, 1983

	Units/ml
EUGLENOPHYTA	
Euglenales	
Euglena	33
Trachelomonas	22
BACILLARIOPHYTA	
Eupodiscales	
Coscinodiscus	11
Cyclotella	160
Melosira	76
Stephanodiscus	55
Fragilariales	
Synedra	22
Nitzschiales	
Nitzschia	55

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

O.W.R.B. Lawtonka Lake

Transect B

Date Received: September 14, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	44
Botryococcus	11
Oocystis	110
Pediastrum	22
Scenedesmus	22
Selenastrum	22
Sphaerocystis	22
Tetrasporales	
Elakatothrix	22
Gloeocystis	11
Volvocales	
Carteria	55
Phacotus	55
Zygnematales	
Closterium	11
Cosmarium	11
CHRYSOPHYTA	
unidentified flagellate	11
CYANOPHYTA	
Chroococcales	
Chroococcus	22
Gomphosphaeria	110
Merismopedia	11
Microcystis	33

O.W.R.B. Lawtonka Lake

Transect B

Date Received: September 14, 1983

	Units/ml
Hormogonales	
Anabaena	440
Aphanizomenon	650
Lyngbya	11
Oscillatoria	11
EUGLENOPHYTA	
Euglenales	
Euglena	11
Trachelomonas	11
BACILLARIOPHYTA	
Achnanthales	
Cocconeis	11
Eupodiscales	
Cyclotella	110
Melosira	590
Stephanodiscus	22
Fragilariales	
Fragilaria	22
Nitzschiales	
Nitzschia	11

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect C

Date Received: September 14, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	76
Coelastrum	22
Crucigenia	11
Micractinium	11
Oocystis	190
Pediastrum	11
Scenedesmus	33
Schroederia	11
Sphaerocystis	11
Treubaria	11
Tetrasporales	
Gloeocystis	55
Volvocales	
Carteria	22
Phacotus	120
Zygnematales	
Closterium	22
Staurastrum	11
CYANOPHYTA	
Chroococcales	
Chroococcus	33
Gomphosphaeria	150
Merismopedia	11
Microcystis	33

	Units/ml
Hormogonales	
Anabaena	980
Aphanizomenon	760
Oscillatoria	55
EUGLENOPHYTA	
Euglenales	
Trachelomonas	22
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	130
Melosira	510
Stephanodiscus	120
Naviculales	
Navicula	11
Nitzschiales	
Nitzschia	22

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect D

Date Received: September 14, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	22
Coelastrum	11
Crucigenia	55
Dictyosphaerium	33
Micractinium	11
Oocystis	44
Pediastrum	33
Scenedesmus	11
Schroederia	11
Sphaerocystis	33
Tetrasporales	
Elakatothrix	11
Gloeocystis	22
Volvocales	
Phacotus	150
Zygnematales	
Closterium	11
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	33
CYANOPHYTA	
Chroococcales	
Chroococcus	44
Coelosphaerium	33
Gomphosphaeria	110
Microcystis	22

Project: O.W.R.B. Lawtonka Lake

Transect D

Date Received: September 14, 1983

	Units/ml
Hormogonales	
Anabaena	850
Aphanizomenon	710
Oscillatoria	55
EUGLENOPOHYTA	
Euglenales	
Trachelomonas	11
PYRRHOPHYTA	
Peridiniales	
Ceratium	11
BACILLARIOPHYTA	
Achnanthales	
Cocconeis	11
Eupodiscales	
Cyclotella	160
Melosira	580
Stephanodiscus	55
Fragilariales	
Fragilaria	11
Synedra	11
Naviculales	
Amphora	11
Navicula	44
Nitzschiales	
Nitzschia	22

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect G

Date Received: September 14, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	22
Coelastrum	11
Crucigenia	11
Nephrocytium	11
Oocystis	76
Pediastrum	11
Scenedesmus	55
Schroederia	11
Sphaerocystis	33
Tetrasporales	
Elakatothrix	33
Gloeocystis	120
Volvocales	
Carteria	130
Dysmorphococcus	22
Phacotus	65
Zygnematales	
Closterium	22
Cosmarium	11
Euastrum	11
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	33
Ochromonas?	290

Project: O.W.R.B. Lawtonka Lake

Transect G

Date Received: 9-14-83

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	11
Coelosphaerium	55
Chroococcus	33
Gomphosphaeria	190
Merismopedia	33
Microcystis	44
Hormogonales	
Anabaena	590
Aphanizomenon	740
Oscillatoria	65
EUGLENOPHYTA	
Euglenales	
Trachelomonas	22
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	130
Melosira	580
Stephanodiscus	22
Fragilariales	
Synedra	11
Naviculales	
Gomphonema	11
Navicula	11
Nitzschiales	
Nitzschia	44

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect H

Date Received: September 14, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	100
Chlorella	35
Coelastrum	17
Crucigenia	17
Dictyosphaerium	17
Micractinium	17
Nephrocytium	17
Oocystis	120
Pediastrum	17
Scenedesmus	17
Schroederia	140
Sphaerocysits	69
Trochiscia	17
Tetrasporales	
Elakatothrix	17
Gloeocystis	17
Volvocales	
Carteria	170
Dysmorphococcus	100
Phacotus	310
Zygnematales	
Closterium	17

Project: O.W.R.B. Lawtonka Lake

Transect H

Date Received: September 14, 1983

	Units/ml
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	240
CYANOPHYTA	
Chroococcales	
Anacystis	17
Chroococcus	35
Coelosphaerium	35
Gomphosphaeria	350
Microcystis	87
Hormogonales	
Anabaena	360
Aphanizomenon	760
Oscillatoria	52
EUGLENOPHYTA	
Euglenales	
Trachelomonas	69
BACILLARIOPHYTA	
Achnanthiales	
Cocconeis	17
Eupodiscales	
Cyclotella	210
Melosira	620
Stephanodiscus	69
Naviculales	
Navicula	17
Nitzschiales	
Nitzschia	52
Rhizosoleniales	
Rhizosolenia	17

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect J

Date Received: September 14, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	65
Crucigenia	33
Dictyosphaerium	33
Oocystis	65
Scenedesmus	33
Schroederia	22
Sphaerocystis	33
Tetrasporales	
Gloeocystis	200
Volvocales	
Carteria	160
Chlamydomonas	11
Phacotus	98
Zygnematales	
Closterium	11
Cosmarium	11
Euastrum	11
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	140

Project; O.W.R.B. Lawtonka Lake

Transect J

Date Received: September 14, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	11
Aphanocapsa	44
Chroococcus	65
Coelosphaerium	11
Dactylococcopsis	33
Gomphosphaeria	120
Microcystis	22
Hormogonales	
Anabaena	770
Aphanizomenon	580
Lyngbya	22
Oscillatoria	22
EUGLENOPHYTA	
Euglenales	
Euglena	22
Trachelomonas	76
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	140
Melosira	290
Stephanodiscus	33
Nitzschiales	
Nitzschia	22

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT
LABORATORY HEALTH SERVICES
Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect A
Date Received: September 21, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Coelastrum	49
Oocystis	98
Pediastrum	33
Scenedesmus	49
Sphaerocystis	16
Westella	33
Tetrasporales	
Elakatothrix	49
Gloeocystis	65
Volvocales	
Carteria	16
Phacotus	200
Zygnematales	
Closterium	49
Cosmarium	16
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	65
CYANOPHYTA	
Chroococcales	
Aphanocapsa	16
Coelosphaerium	16
Dactylococcopsis	49

	Units/ml
Gomphosphaeria	150
Merismopedia	16
Microcystis	33
Hormogonales	
Anabaena	880
Aphanizomenon	1300
Oscillatoria	16
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	110
Melosira	730
Stephanodiscus	130

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect B

Date Received: September 21, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	55
Botryococcus	18
Crucigenia	36
Dictyosphaerium	18
Oocystis	150
Schroederia	18
Sphaerocystis	36
Westella	73
Tetrasporales	
Elakatothrix	36
Gloeocystis	36
Volvocales	
Carteria	36
Phacotus	250
Zygnematales	
Closterium	18
Staurastrum	18
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	36

Project: O.W.R.B. Lawtonka Lake

Transect B

September 21, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Chroococcus	91
Gomphosphaeria	160
Microcystis	18
Hormogonales	
Anabaena	870
Aphanizomenon	1000
Lyngbya	18
Oscillatoria	18
EUGLENOPHYTA	
Euglenales	
Trachelomonas	18
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	330
Melosira	820
Stephanodiscus	18
Nitzschiales	
Nitzschia	55

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project; O.W.R.B. Lawtonka Lake - Transect C

Date Received: September 21, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	58
Botryococcus	29
Crucigenia	15
Nephrocytium	15
Oocystis	100
Pediastrum	29
Scenedesmus	15
Sphaerocystis	73
Tetrasporales	
Gloeocystis	29
Volvocales	
Carteria	58
Phacotus	250
Zygnematales	
Closterium	29
Cosmarium	15
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	130

Project: O.W.R.B. Lawtonka Lake

Transect C

September 21, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Aphanocapsa	29
Chroococcus	100
Coelosphaerium	15
Gomphosphaeria	87
Hormogonales	
Anabaena	1400
Aphanizomenon	570
Lyngbya	15
Oscillatoria	29
EUGLENOPHYTA	
Euglenales	
Trachelomonas	58
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	330
Melosira	570
Stephanodiscus	15
Naviculales	
Navicula	29

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect D

Date Received: September 21, 1983

	Units/ml
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	55
Botryococcus	11
Coelastrum	11
Errerella	11
Nephrocytium	22
Oocystis	120
Pediastrum	22
Scenedesmus	22
Schroederia	22
Sphaerocystis	22
Tetrasporales	
Elakatothrix	22
Gloeocystis	76
Volvocales	
Carteria	98
Phacotus	280
Zygnematales	
Closterium	33
Cosmarium	11
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	65

PROPERTY OF
OKLAHOMA WATER RESOURCES BOARD

Project: O.W.R.B. Lawtonka Lake

Transect D

Date Received: September 21, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Chroococcus	65
Coelosphaerium	11
Gomphosphaeria	210
Microcystis	11
Hormogonales	
Anabaena	800
Aphanizomenon	810
Oscillatoria	55
EUGLENOPHYTA	
Euglenales	
Euglena	11
Phacus	11
Trachelomonas	11
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	190
Melosira	760
Stephanodiscus	65
Fragilariales	
Synedra	22
Naviculales	
Navicula	22
Nitzschiales	
Nitzschia	33

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect E

Date Received: September 21, 1983

	Units/ml
unidentified flagellates	33
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	55
Coelastrum	22
Crucigenia	44
Dictyosphaerium	33
Oocystis	55
Scenedesmus	11
Sphaerocystis	98
Treubaria	11
Tetrasporales	
Gloeocystis	11
Volvocales	
Carteria	55
Phacotus	220
Zygnematales	
Closterium	22
Cosmarium	11
Staurastrum	11
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	33
Ochromonas?	150

Project: O.W.R.B. Lawtonka Lake

Transect E

Date Received: September 21, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	11
Chroococcus	87
Coelosphaerium	11
Dactylococcopsis	11
Gomphosphaeria	130
Microcystis	22
Hormogonales	
Anabaena	1100
Aphanizomenon	860
Lyngbya	76
Oscillatoria	11
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	230
Melosira	620
Naviculales	
Navicula	11

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect F

Date Received: September 21, 1983

	Units/ml
unidentified	15
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	58
Crucigenia	44
Dictyosphaerium	29
Oocytis	160
Scenedesmus	15
Schroederia	15
Westella	15
Tetrasporales	
Gloeocystis	29
Volvocales	
Carteria	170
Chlamydomonas	44
Phacotus	380
Zgynematales	
Closterium	15
Cosmarium	58
Staurastrum	15
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas	73

Project: O.W.R.B. Lawtonka Lake

Transect F

Date Received: September 21, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Anacystis	44
Chroococcus	87
Coelosphaerium	15
Dactylococcopsis	29
Gomphosphaeria	150
Hormogonales	
Anabaena	1200
Aphanizomenon	860
Lyngbya	44
EUGLENOPHYTA	
Euglenales	
Phacus	15
Trachelomonas	15
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	510
Melosira	330
Stephanodiscus	15
Nitzschiales	
Nitzschia	29

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect G

Date Received: September 21, 1983

	Units/ml
unidentified flagellates	95
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	16
Chlorella	16
Coelastrum	32
Crucigenia	16
Dictyosphaerium	32
Golenkinia	16
Oocystis	79
Pediastrum	32
Scenedesmus	32
Schroederia	32
Sphaerocystis	32
Westella	16
Tetrasporales	
Gloeocystis	63
Volvocales	
Carteria	190
Phacotus	350
Zygnematales	
Cosmarium	16
Starurastrum	16

Project: O.W.R.B. Lawtonka Lake

Transect G

Date Received: September 21, 1983

	Units/ml
CHRYSOPHYTA	
Chrysomonadales	
Mallomonas	16
Ochromonas?	95
CYANOPHYTA	
Chroococcales	
Anacystis	32
Chroococcus	32
Coelosphaerium	32
Gomphosphaeria	220
Microcystis	32
Hormogonales	
Anabaena	870
Aphanizomenon	1100
Lyngbya	32
Oscillatoria	32
EUGLENOPHYTA	
Euglenales	
Euglena	16
Trachelomonas	47
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	220
Melosira	590
Stephanodiscus	32
Nitzschiales	
Nitzschia	47

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Ellsworth Pipeline Outflow

Date Received: September 21, 1983

	Units/ml
unidentified flagellates	110
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	110
Coelastrum	44
Crucigenia	44
Dictyosphaerium	22
Errerella	22
Gloeoactinium	44
Oocystis	110
Scenedesmus	44
Tetraedron	22
Tetrasporales	
Gloeocystis	22
Volvocales	
Carteria	44
Phacotus	240
Zygnematales	
Closterium	22
Cosmarium	22
CYANOPHYTA	
Chroococcales	
Gomphosphaeria	44
Microcystis	44

	Units/ml
Hormogonales	
Aphanizomenon	44
EUGLENOPHYTA	
Euglenales	
Trachelomonas	22
BACILLARIOPHYTA	
Achnanthales	
Achnanthes	22
Eupodiscales	
Cyclotella	680
Melosira	330
Stephanodiscus	1500
Nitzschiales	
Nitzschia	44

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect B

Date Received: October 5, 1983

	Units/ml
unidentified flagellates	260
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	65
Coelastrum	33
Crucigenia	22
Dictyosphaerium	44
Dimorphococcus	33
Oocystis	130
Pediastrum	22
Scenedesmus	11
Sphaerocystis	11
Volvocales	
Carteria	11
Dysmorphococcus	98
Phacotus	33
Zygnematales	
Cosmarium	11
CYANOPHYTA	
Chroococcales	
Chroococcus	11
Gomphosphaeria	87
Microcystis	44

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake - Transect I

Date Received: October 5, 1983

	Units/ml
unidentified flagellates	58
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	100
Coelastrum	44
Crucigenia	44
Dictyosphaerium	29
Dimorphococcus	15
Oocystis	120
Pediastrum	15
Scenedesmus	29
Schroederia	15
Sphaerocystis	15
Westella	29
Tetrasporales	
Gloeocystis	58
Volvocales	
Carteria	29
Dysmorphococcus	230
Phacotus	58
Zygnematales	
Closterium	15
Cosmarium	29

Project: O.W.R.B. Lawtonka Lake

Transect I

Date Received: October 5, 1983

	Units/ml
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	29
CYANOPHYTA	
Chroococcales	
Chroococcus	58
Coelosphaerium	15
Gomphosphaeria	150
Microcystis	44
Hormogonales	
Anabaena	1500
Aphanizomenon	73
EUGLENOPHYTA	
Euglenales	
Trachelomonas	58
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	550
Melosira	350
Stephanodiscus	150
Naviculales	
Navicula	15

OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT

LABORATORY HEALTH SERVICES

Environmental Monitoring & Analysis Division

Project: O.W.R.B. Lawtonka Lake

Medicine Creek

Date Received: October 5, 1983

	Units/ml
unidentified flagellates	280
CHLOROPHYTA	
Chlorococcales	
Ankistrodesmus	260
Crucigenia	65
Dictyosphaerium	22
Dimorphococcus	44
Oocystis	280
Pediastrum	22
Scenedesmus	280
Schroederia	44
Sphaerocystis	44
Westella	87
Volvocales	
Carteria	22
Chlamydomonas	22
Dysmorphococcus	65
Phacotus	44
CHRYSOPHYTA	
Chrysomonadales	
Ochromonas?	22

Project: O.W.R.B. Lawtonka Lake

Medicine Creek

Date Received: October 5, 1983

	Units/ml
CYANOPHYTA	
Chroococcales	
Chroococcus	44
Coelosphaerium	44
Dactylococcopsis	370
Gomphosphaeria	130
Merismopedia	350
Hormogonales	
Anabaena	830
Aphanizomenon	87
Lyngbya	44
Oscillatoria	65
EUGLENOPHYTA	
Euglenales	
Euglena	22
Trachelomonas	65
BACILLARIOPHYTA	
Eupodiscales	
Cyclotella	480
Melosira	280
Stephanodiscus	130
Naviculales	
Cymbella	22
Navicula	22
Nitzschiales	
Nitzschia	65

APPENDIX G

LIST OF FLORA AND FAUNA OF THE LAWTONKA RESERVOIR WATERSHED

LIST OF VASCULAR PLANTS

The following is a popular list of the vascular plants of the Wichita Mountains Wildlife Refuge and Lawtonka Reservoir area. It has been compiled by Paul Beck of the University of Tulsa for the Wildlife Refuge. The botanical nomenclature follows that of Stemen and Myers (1937).

EQUISETACEAE	
Equisetum kansanum	Kansas horsetail
SELAGINELLACEAE	
Selaginella peruviana	Sheldon selaginella
Selaginella rupestris	Rock selaginella
ISOETACEAE	
Isoetes butleri	Butler quillwort
Isoetes melanopoda	Blackfoot quillwort
POLYPODIACEAE	
Cheilanthes eatoni	Eaton lipfern
Cheilanthes lanosa	Hairy lipfern
Dryopteris marginalis	Leather woodfern
Pellaea atropurpurea	Purple cliffbrake
Pellaea wrightiana	Wright cliffbrake
Woodsia obtusa	Common woodsia
MARSILEACEAE	
Marsilea mucronata	Pepperwort
PINACEAE	
Juniperus virginiana	Eastern red cedar
Pinus taeda	Loblolly pine (Probably in refuge as result of landscaping.)
TYPHACEAE	
Typha angustifolia	Narrowleaf cattail
Typha latifolia	Common cattail
ZOSTERACEAE	
Potamogeton amplifolius	Largeleaf pondweed
Potamogeton diversifolius	Waterthread pondweed
Potamogeton nodosus	Longleaf pondweed
Potamogeton pusillus var. pusillus	Baby pondweed
NAJADACEAE	
Najas quadalupensis	Southern naiad
ALISMACEAE	
Echinodorus cordifolius	Erect burhead
Sagittaria calycina	Longlobe arrowhead
Sagittaria latifolia	Common arrowhead
GRAMINEAE	
Agropyron smithii	Western wheatgrass
Agrostis elliottiana	Elliott bentgrass
Agrostis hyemalis	Winter bentgrass
Alopecurus carolinianus	Carolina foxtail

Andropogon barbinodis	Cane bluestem
Andropogon gerardi	Big bluestem
Andropogon saccharoides	Silver bluestem
Andropogon scoparius	Little bluestem
Aristida dichotoma var. curtissii	Curtis threeawn
Aristida dichotoma var. dichotoma	Churchmouse threeawn
Aristida longespica	Slimspike threeawn
Aristida longiseta	Red threeawn
Aristida oligantha	Oldfield threeawn
Aristida purpurea	Purple threeawn
Aristida wrightii	Wright threeawn
Bouteloua curtipendula	Sideoats grama
Bouteloua gracilis	Blue grama
Bouteloua hirsuta	Hairy grama
Bouteloua rigidiseta	Texas grama
Bromus arvensis*	Field bromegrass
Bromus catharticus	Rescuegrass
Bromus japonicus	Japanese brome
Bromus purgans	Canada brome
Buchloe dactyloides	Buffalograss
Cenchrus pauciflorus	Mat sandbur
Chloris verticillata	Tumble windmillgrass
Chloris virgata	Showy chloris
Cynodon dactylon	Bermudagrass
Dactylis glomerata	Orchardgrass
Digitaria sanguinalis	Hairy crabgrass
Diplachne fascicularis	Bearded sprangleqrass
Echinochloa crusgalli	Barnyardgrass
Eleusine indica	Goosegrass
Elymus canadensis	Canada wildrye
Elymus virginicus	Virginia wildrye
Eragrostis capillaris	Lacegrass
Eragrostis curtipedicellata	Gummy lovegrass
Eragrostis hypnoides	Teal lovegrass
Eragrostis intermedia	Plains lovegrass
Eragrostis megastachya	Stinkgrass
Eragrostis oxylepis var. beyrichii	Wichita lovegrass
Eragrostis oxylepis var. oxylepis	Red lovegrass
Eragrostis pectinacea	Carolina lovegrass
Eragrostis reptans	Creeping lovegrass
Eragrostis sessilispica	Tumble lovegrass
Eragrostis spectabilis var. sparsibirsuta	Purple lovegrass
Eragrostis trichodes	Sand lovegrass
Eriochloa contracta	Prairie cutgrass
Festuca elatior	Suiter fescue
Festuca octoflora	Sixweeks fescue
Festuca versuta	Texas fescue

Hordeum pusillum	Little barley
Leersia oryzoides	Rice cutgrass
Leptochloa dubia	Green sprangletop
Leptoloma cognatum	Fall witchgrass
Limnodea arkansana	Ozarkgrass
Manisuris cylindrica	Carolina jointtail
Melica nitens	Threeflower melic
Muhlenbergia capillaris	Hairawn muhly
Muhlenbergia frondosa	Wirestem muhly
Muhlenbergia racemosa	Green muhly
Panicum agrostoides	Redtop panicum
Panicum anceps	Beaked panicum
Panicum capillare	Common witchgrass
Panicum depauperatum	Poor panic grass
Panicum dichotomiflorum	Fall panicum
Panicum lanuginosum	Wooly panicum
Panicum linearifolium	Slimleaf panicum
Panicum malacophyllum	Shortleaf panicum
Panicum obtusum	Vine-mesquite
Panicum oligosanthes var. scribnerianum	Scribner panicum
Panicum perlongum	Elongate panic grass
Panicum philadelphicum	Philadelphia witchgrass
Panicum virgatum	Switchgrass
Paspalum ciliatifolium	Fringeleaf paspalum
Paspalum pubiflorum var. glabrum	Smoothseed paspalum
Paspalum pubiflorum var. publiflorum	Hairyseed paspalum
Phalaris caroliniana	Carolina canarygrass
Poa annua	Annual bluegrass
Poa arachnifera	Texas bluegrass
Poa compressa	Canada bluegrass
Schedonnardus paniculatus	Tumblegrass
Setaria geniculata	Knotroot bristlegrass
Setaria viridis	Green bristlegrass
Sorghastrum nutans	Indiangrass
Sorghum halepense	Johnsongrass
Spartina pectinata var. suttiei	Prairie cordgrass
Sphenopholis obtusata	Prairie wedgescale
Sporobolus airoides	Alkali sacaton
Sporobolus asper	Tall dropseed
Sporobolus cryptandrus	Sand dropseed
Sporobolus pyramidatus	Whorled dropseed
Sporobolus vaginiflorus var. neglectus	Puffsheath dropseed
Sporobolus vaginiflorus var. vaginiflorus	Poverty dropseed
Trichachne californica	Arizona cottontop
Tridens albescens	White tridens

Tridens flavus	Purpletop
Tridens muticus var. elongatus	Rough tridens
Tridens muticus var. muticus	Slim tridens
Tridens pilosus	Hairy tridens
Tridens strictus	Longspike tridens
Tripsacum dactyloides	Eastern gamagrass
Uniola latifolia	Broadleaf uniola

CYPERACEAE

Bulbostylis capillaris	Hairsedge
Carex amphibola	Narrowleaf sedge
Carex annectens	Yellowfruit sedge
Carex austrina	Southern sedge
Carex blanda	Woodland sedge
Carex emoryi	Emory sedge
Carex festucacea	Fescue sedge
Carex frankii	Franks sedge
Carex gravida var. lunelliana	Lunell sedge
Carex joori	Hummock sedge
Carex microrhyncha	Littlesnout sedge
Carex praegracilis	Slender sedge
Carex vulpinoidea	Fox sedge
Cyperus acuminatus	Taperleaf flatsedge
Cyperus aristatus	Bearded flatsedge
Cyperus erythrorhizos	Redroot flatsedge
Cyperus esculentus	Chufa
Cyperus filiculmis	Slender flatsedge
Cyperus odoratus	Fragrant flatsedge
Cyperus ovularis	Globe flatsedge
Cyperus schweinitzii	Schweinitz flatsedge
Cyperus setigerus	Bristled spike sedge
Cyperus strigosus	False nut-grass
Cyperus virens	Green flatsedge
Eleocharis compressa	Flatstem spikesedge
Eleocharis engelmanii	Engelmann spikesedge
Eleocharis macrostachya	Long spiked spikesedge
Eleocharis montividiensis	Sand spikesedge
Eleocharis obtusa	Blunt spikesedge
Eleocharis parvulva	Dwarf spikesedge
Eleocharis quadrangulata	Squarestem spikesedge
Eleocharis tenuis var. verrucosa	Slender spikesedge
Fimbristylis spadicea	Plains fimbry
Fimbristylis vahlii	Vahl fimbry
Fuirena simplex	Western umbrella sedge
Hemicarpha micrantha	Common hemicarpha
Scirpus acutus	Hardstem bulrush
Scirpus americanus	American bulrush
Scirpus atrovirens	Green bulrush

Scirpus lineatus	Rusty bulrush
Scirpus paludosis	Alkali bulrush
Scirpus validus	Softstem bulrush
Scleria pauciflora	Fewflower nutrush

ARACEAE

Arisaema dracontium	Dragonroot jack-in-the-pulpit

LEMNACEAE

Lemna minor	Common duckweed

COMMELINACEAE

Commelina erecta var. angustifolia	Narrowleaf dayflower
Commelina virginica	Virginia dayflower
Tradescantia bracteata*	Bracted spiderwort
Tradescantia hirsutiflora	Hairyflower spiderwort
Tradescantia occidentalis	Prairie spiderwort
Tradescantia ohiensis var. ohiensis	Smoothstalk spiderwort
Tradescantia tharpii	Tharp spiderwort
Tradescantia virginiana*	Virginia spiderwort

PONTEDERIACEAE

Heteranthera limosa	Blue mudplantain

JUNCACEAE

Juncus acuminatus	Knotleaf rush
Juncus balticus	Baltic rush
Juncus covillii*	Coville's rush
Juncus interior	Inland rush
Juncus marginatus	Grassleaf rush
Juncus tenuis var. tenuis	Poverty rush
Juncus tenuis var. dudleyi	Dudley rush
Juncus torreyi	Torrey rush

LILIACEAE

Allium canadense var. canadense	Canada garlic
Allium drummondii	Drummond onion
Allium stellatum	Prairie onion
Androstephium coeruleum	Blue funnellily
Camassia scilloides	Atlantic camas
Erythronium americanum	Common fawnlily
Nothoscordum bivalve	Yellow falsegarlic
Smilax bona-nox	Saw greenbrier
Smilax herbacea	Carrionflower
Smilax rotundifolia	Common greenbrier
Smilax tamnoides	Bristly greenbrier
Yucca glauca	Small soapweed

AMARYLLIDACEAE

Agave lata	Agave
Cooperia drummondii	Eveningstart Rainlily

IRIDACEAE

Nemastylis geminiflora	Prairie iris
Sisyrichium angustifolium	Common blueeye-grass

ORCHIDACEAE

Spiranthes cernua	Nodding ladiestresses

SALICACEAE

Populus deltoides	Eastern cottonwood
Salix amygdaloides	Peachleaf willow
Salix caroliniana	Ward's willow
Salix interiot	Sandbar willow
Salix nigra	Black willow

JUGLANDACEAE

Carya cordiformis	Bitternut hickory
Carya illinoiensis	Pecan
Juglans nigra	Black walnut
Juglans rupestris	Little walnut

FAGACEAE

Quercus macrocarpa	Bur oak
Quercus marilandica	Blackjack oak
Quercus mohriana	Mohrs oak
Quercus muhlenbergii	Chinquapin oak
Quercus rubus var. borealis	Red oak
Quercus shumardii var. shumardii	Shumard oak
Quercus shumardii var. schneckii	Schneck's red oak
Quercus stellata	Post oak
Quercus velutina	Black oak
Quercus virginiana	Live oak

ULMACEAE

Celtis laevigata	Sugar hackberry
Celtis occidentalis	Common hackberry
Celtis reticulata	Netleaf hackberry
Ulmus americana	American elm
Ulmus rubra	Slippery elm

MORACEAE

Maclura pomifera	Osage orange
Morus rubra	Red mulberry

URTICACEAE

Boehmeria cylindrica	Smallspike falsenettle
Parietaria pensylvanica	Pennsylvania pellitory

SANTALACEAE

Comandra pallida	Western comandra

POLYGONACEAE

Eriogonum annum	Annual wild-buckwheat
Eriogonum longifolium	Longleaf wild-buckwheat
Polygonum aviculare	Prostrate knotweed
Polygonum bicorne	Longstyle smartweed
Polygonum coccinium	Bigroot smartweed
Polygonum convolvulus	Dullseed cornbind
Polygonum hydropiper	Marshpepper smartweed
Polygonum hydropiperoides var. hydropiperoides	Swamp smartweed
Polygonum hydropiperoides var. opelousanum	Opelousas swamp smartweed
Polygonum lapathifolium	Curltop smartweed
Polygonum pensylvanicum	Pennsylvania smartweed
Polygonum punctatum	Dotted smartweed
Polygonum ramosissimum	Bushy knotweed
Polygonum scandens	Hedge cornbind
Polygonum tenue	Pleatleaf knotweed
Rumex altissimus	Pale dock
Rumex crispus	Curly dock

CHENOPODIACEAE

Chenopodium album	Lambs quarters
Chenopodium hybridum var. gigantospermum	Bigseed goosefoot
Chenopodium leptophyllum	Slimleaf goosefoot
Chenopodium standleyanum	Standley goosefoot
Monolepis nuttalliana	Nuttall monolepis
Salsola kali var. tenuifolia	Russian thistle

AMANRANTHACEAE

Alternanthera repens	Mat chaff-flower
Amaranthus graecizans	Tumbleweed
Amaranthus hybridus	Slim amaranth
Amaranthus retroflexus	Redroot amaranth
Amaranthus tamarascinus	Common waterhemp
Brayulinea densa	?
Froelichia floridana	Florida snakecotton
Froelichia gracilis	Slender snakecotton
Gossypianthus lanuginosus	Woolly cottonflower
Gossypianthus tenuifolius	Lanceleaf cottonflower

NYCTAGINACEAE	
Mirabilis albida	Pale umbrella-wort
Mirabilis linearis	Narrowleaf umbrella-wort
Mirabilis nyctaginea	Heartleaf umbrella-wort
PHYTOLACCACEAE	
Phytolacca americana	Common pokeberry
AIZOACEAE	
Mollugo verticillata	Green carpetweed
PORTULACACEAE	
Claytonia virginica	Virginia springbeauty
Portulaca oleracea	Common purslane
Portulaca parvula	Shaggy purslane
Portulaca umbraticola	Wingpod purslane
Talinum calcinum	Rockpink
Talinum parviflorum	Prairie fameflower
Talinum rugospermum*	Roughseed fameflower
CARYOPHYLLACEAE	
Arenaria patula	Pitchers sandwort
Arenaria stricta var. texana	Texas sandwort
Cerastium brachypodum	Shortstalk chickweed
Sagina decumbens	Trailing pearlwort
Silene antirrhina	Sleepy catchfly
ILLECEBRACEAE	
Paronychia jamesii	James nailwort
Paronychia virginica	Virginia nailwort
RANUNCULACEAE	
Anemone caroliniana	Carolina anemone
Anemone decapetala	Tenpetal anemone
Clematis pitcheri	Pitcher clematic
Delphinium virescens	Plains larkspur
MENISPERMACEAE	
Cocculus carolinus	Carolina snailseed
PAPAVERACEAE	
Argemone polyanthemos	Pricklepoppy
FUMARIACEAE	
Corydalis aurea var. occidentalis	Goldon corydalis
CAPPARIDACEAE	
Cleomella angustifolia	Narrowleaf rhombopod
Cleoma serrulata	Bee spiderflower
Polanisia dodecandra	Roughseed clammywort

CRUCIFERAE

Arabis missouriensis	Green rockcress
Capsella bursa-pastoris	Common shepherdspurse
Descurainia pinnata	Pinnate tansymustard
Dithyrea wislizenii	Wislizenus spectaclepod
Drana brachycarpa	Shortpod draba
Draba cuneifolia	Wedgeleaf draba
Draba reptans	Carolina draba
Erysimum capitatum	Plains erysimum
Lepidium oblongum	Veiny pepperwort
Lepidium virginianum	Virginia pepperwort
Lesquerella auriculata	Earleaf bladderpod
Lesquerella gordonii	Gordon bladderpod
Lesquerella gracilis	Lax bladderpod
Lesquerella ovalifolia var. alba	Roundleaf bladderpod
Nasturtium officinale	Watercress
Rorippa islandica	Bog marshcress
Rorippa sessiliflora	Stalkless yellowcress
Sibara virginica	Virginia rockcress

CRASSULACEAE

Sedum nuttallianum	Yellow stonecrop
Sedum pulchellum	Texas stonecrop

SAXIFRAGACEAE

Ribes odoratum	Clove current

ROSACEAE

Agrimonia parviflora	Manyflower grovebur
Crataegus crus-galli	Cockspur hawthorn
Crataegus reverchoni	Reverchon hawthorn
Geum canadense	White avens
Geum virginiana*	Bristly avens
Potentilla argutat	Cinquefoil
Prunus americana	American plum
Prunus angustifolia	Chickasaw plum
Prunus gracilis	Oklahoma plum
Prunus mexicana	Mexican plum
Prunus virginiana	Common chokecherry
Rubus aboriginum	Northern dewberry
Rubus idaeaus	Red raspberry
Rubus louisianus	Louisiana blackberry
Rubus occidentalis	Blackcap raspberry

LEGUMINOSAE

Acacia angustissima	Prairie acacia
Amorpha canescens	Leadplant
Amorpha fruticosa	Indigobush amorpha
Amorpha microphylla*	Small leaf amorpha
Apios americana	Potatobean

Astragalus crassicarpus var. crassicarpus	Groundplum milkvetch
Astragalus lindheimerlana	Lindheimer milkvetch
Astragalus plattensis	Platte milkvetch
Baptisia australis var. minor	Blue wildindigo
Baptisia leucophaea	Plains wildindigo
Cassia fasiciulata	Showy partridgepea
Cassia marilandica	Wild senna
Cercis canadensis	Eastern redbud
Clitoria mariana	Atlantic pigeonwings
Crotalaria sagittalis	Arrow crotalaria
Dalea aurea	Silktop aurea
Dalea candida	White prairieclover
Dalea laxiflora	Bigtop dalea
Dalea multiflora	Roundhead prairieclover
Dalea purpurea	Purple prairieclover
Dalea tenuifolia	Slimleaf prairieclover
Desmanthus illinoensis	Illinois bundleflower
Desmodium ciliare	Littleleaf tickclover
Desmodium glutinosum	Sticky tickclover
Desmodium nudiflorum	Barestem tickclover
Desmodium paniculatum	Panicled tickclover
Desmodium sessilifolium	Sessile tickclover
Galactia volubilis	Downy milkpea
Gleditsia triacanthos	Common honeylocust
Glycyrrhiza lepidota	American licorice
Gymnocladus dioica	Kentucky coffeebean
Hoffmanseggia densiflora	Indian rushpea
Indigofera miniata var. leptosepala	Coast indigo
Krameria secundiflora	Trailing ratany
Lespedeza capitata	Roundhead lespedeza
Lespedeza intermedia	Intermediate lespedeza
Lespedeza procumbens	Trailing lespedeza
Lespedeza virginica	Slender lespedeza
Lotus americana	Deervetch
Melilotus alba	White sweetclover
Neptunea lutea	Yellow neptunea
Prosopis juliflora	Common mesquite
Psoralea cuspidata	Tallbread scrufpea
Psoralea esculenta	Indian breadroot
Psoralea linearifolia	Slimleaf scrufpea
Psoralea tenuiflora	Wild-alfalfa
Robinia pseudo-acacia	Black locust
Schrankia uncinata	Catclaw sensitivebrier
Strophostyles helvola	Trailing wildbean
Strophostyles leiosperma	Slickseed wildbean
Stylosanthes riparia	Endbeak pencilflower
Trifolium reflexum	Buffalo clover
Vicia ludoviciana	Louisiana vetch
Vicia minutiflora	Smallflower vetch
Vicia sparsifolia	Stiffleaf vetch

LINACEAE	
Linum multicaule	Tufted flax
Linum rigidum	Stiffstem flax
Linum sulcatum	Grooved flax
OXALIDACEAE	
Oxalis stricta	Common oxalis
Oxalis violacea	Violet woodsorrel
GERANIACEAE	
Geranium carolinianum	Carolina geranium
ZYGOPHYLLACEAE	
Tribulus terrestris	Puncturevine
RUTACEAE	
Ptelea trifoliata	Common hoptree
SIMAROUBACEAE	
Ailanthus altissima	Tree-of-heaven
POLYGALACEAE	
Polygala alba	White milkwort
Polygala verticillata	Whorled milkwort
EUPHORBIACEAE	
Acalypha gracilens	Slender copperleaf
Acalypha ostryaefolia	Hophornbeam copperleaf
Croton capitatus	Woolly croton
Croton glandulosus	Tropic croton
Croton lindheimerianus	Threeseed croton
Croton monanthogynus	Oneseed croton
Croton texensis	Texas croton
Euphorbia chamaesyche	Prostrate euphorbia
Euphorbia commutata	Tinted euphorbia
Euphorbia corollata	Floweringspurge
Euphorbia dentata	Toothed euphorbia
Euphorbia glyptosperma	Ridgeseed euphorbia
Euphorbia hexagona	Sixangle euphorbia
Euphorbia maculata	Spotted euphorbia
Euphorbia marginata	Snow-on-the-mountain
Euphorbia missurica	Missouri euphorbia
Euphorbia obtusata	Roughpod euphorbia
Euphorbia spathulata	Warty euphorbia
Euphorbia supina	Milk-purslane
Phyllanthus caroliniensis	Carolina leafflower
Phyllanthus polygonoides	Knotweed leafflower
Stillingia sylvatica	Queens delight
Tragia ramosa	Branching noseburn
CALLITRICHACEAE	
Callitriche heterophylla	Larger waterstar wort

ANACARDIACEAE

Rhus aromatica var. serotina	Skunkbush
Rhus copallina	Flameleaf sumac
Rhus glabra	Smooth sumac
Rhus toxicodendron	Poison ivy

CELASTRACEAE

Celastrus scandens	American bittersweet

ACERACEAE

Acer saccharum	Sugar maple

HIPPOCASTANACEAE

Aesculus glabra	Ohio buckeye

SAPINDACEAE

Sapindus drummondii	Western soapberry

RHAMNACEAE

Ceanothus herbaceous var. pubescens	Fuzzy ceanothus

VITACEAE

Ampelopsis cordata	Heartleaf ampelopsis
Cissus incisa	Ivy treebine
Parthenocissus quinquefolia	Virginia creeper
Vitis cinerea	Sweet grape
Vitis palmata	Cat grape
Vitis rotundifolia	Muscadine grape
Vitis rupestris	Sand grape
Vitis vulpina	Riverbank grape

MALVACEAE

Callirhoe involucrata	Low poppymallow
Callirhoe leiocarpa	Tall poppymallow
Sphaeralcea coccinea	Scarlet globemallow

GUTTIFERAE

Hypericum drummondii	Drummond's St. Johnswort
Hypericum mutilum	Dwarf St. Johnswort

CISTACEAE

Lechea tenuifolia	Narrowleaf pinweed

VIOLACEAE

Hybanthus verticillatus	Whorled nodviolet
Viola kitaibelliana var. rafinesquii	Johnny jump-up
Viola missouriensis	Missouri violet
Viola papilionacea	Butterfly violet

LOASACEAE

Mentzelia oligosperma	Chickthief
Mentzelia stricta	Sandlily

CACTACEAE

Echinocereus baileyi	Wichita echinocereus
Echinocereus reichenbachii	Lace echinocereus
Opuntia compressa	Common pricklypear

LYTHRACEAE

Ammannia auriculata	Earleaf ammannia
Ammannia coccinea	Purple ammannia
Lythrum alatum	Winged lythrum

ONAGRACEAE

Gaura biennis var. pitcheri	Pitcher gaura
Gaura coccinea var. coccinea	Scarlet gaura
Gaura parviflora	Smallflower gaura
Gaura sinuata	Wavyleaf gaura
Gaura suffulta	Roadside gaura
Gaura tripetala var. triangulata	Threepetal gaura
Jussiaea decurrens	Wingleaf water primrose
Jussiaea repens var. glabrescens	Smooth water primrose
Ludwigia alternifolia	Bushy seedbox
Ludwigia palustris	Marsh seedbox
Oenothera biennis	Common evening primrose
Oenothera heterophylla	Varileaf evening primrose
Oenothera jamesii	Trumpet evening primrose
Oenothera laciniata var. grandiflora	Largeflowered cutleaf evening primrose
Oenothera laciniata var. laciniata	Cutleaf evening primrose
Oenothera linifolia	Threadleaf sundrops
Oenothera missouriensis var. incana	Gray sundrops
Oenothera missouriensis var. missouriensis	Ozark sundrops
Oenothera serrulata	Halfshrub sundrops
Oenothera speciosa	Showy sundrops
Oenothera triloba	Stemless evening primrose
Stenosiphon linifolius	False gaura

HALORAGACEAE

Myriophyllum pinnatum	Green parrotfeather

UMBELLIFERAE

Ammoselinum butleri	Butler sandparsley
Ammoselinum popei	Plains sandparsley
Chaerophyllum tainturieri var. dasycarpum	Hairyfruit chervil
Cicuta maculata	Spotted waterhemlock
Daucus carota*	Wild carrot
Daucus pusillus	Southwestern carrot
Eryngium leavenworthii	Leavenworth eryngium
Limnosciadum pinnatum	Arkansas dogshade
Lomatium daucifolium	Carrotleaf lomatium
Polytaenia nuttallii	Prairie parsley
Ptilimnium nuttallii	Nuttall mockbishop
Sanicula canadensis	Canada sanicle
Spermolepsis divaricata	Forked scaleseed
Spermolepsis echinata	Bristly scaleseed

CORNACEAE

Cornus drummondii	Roughleaf dogwood
Cornus florida*	Flowering dogwood

PRIMULACEAE

Androsace occidentalis	Western rockjasmine
Dodecatheon meadia	Common shootingstar
Samolus parviflorus	Thinleaf brookweed

SAPOTACEAE

Bumelia lanuginosa	Woollybucket bumelia

EVENACEAE

Diospyros virginiana	Common persimmon

OLEACEAE

Fraxinus americana	White ash
Fraxinus pennsylvanica var. pennsylvanica	Red ash
Fraxinus pennsylvanica var. subintegerrima	Green ash

GENTIANACEAE

Sabatia angularis	Squarestem rosegentian
Sabatia campestris	Prairie rosegentian

APOCYNACEAE

Amsonia ciliata var. texana	Texas slimpod
Amsonia tabernaemontana	Willow slimpod
Apocynum cannabinum	Hemp dogbane

ASCLEPIADACEAE

Asclepias asperula var. decumbens	Trailing milkweed
Asclepias latifolia	Broadleaf milkweed

Asclepias pumila	Plains milkweed
Asclepias stenophylla	Slimleaf milkweed
Asclepias sullivantii	Sullivant milkweed
Asclepias tuberosa	Butterfly weed
Asclepias verticillata	Whorled milkweed
Asclepias viridiflora	Green acerates
Asclepias viridis	Green antelope horn

CONVOLVULACEAE

Convolvulus incanus	Gray bindweed
Cuscuta coryli	Hazel dodder
Cuscuta gronovii	Gronovius dodder
Cuscuta indecora	Showy dodder
Evolvulus nuttallianus	Silver evolvulus
Ipomoea longifolia	Narrowleaf morningglory

POLEMONIACEAE

Gilia rubra	Texasplume
Phlox pilosa	Downy phlox

HYDROPHYLLACEAE

Nama hispidum	Rough nama
Phacelia congesta	Spike phacelia
Phacelia hirsuta	Hairy phacelia

BORAGINACEAE

Lithospermum arvense	Corn gromwell
Lithospermum incisum	Narrowleaf gromwell
Myosotis macrosperma	Southern forget-me-not
Myosotis verna	Forget-me-not
Onosmodium occidentale	Marbleseed

VERBENACEAE

Lippia cuneifolia	Wedgeleaf fogfruit
Lippia incisa	Sawtooth fogfruit
Verbena ambrosifolia	Ragweed verbena
Verbena bipinnatifida	Dakota verbena
Verbena bracteata	Bigbract verbena
Verbena canadensis	Rose verbena
Verbena pumila	Pink verbena
Verbena stricta	Woolly verbena
Verbena urticifolia	White verbena

LABIATAE

Hedeoma drummondii	Drummond hedeoma
Hedeoma hispida	Rough hedeoma
Lycopus americanus	American bugleweed
Monarda citriodora	Lemon beebalm
Monarda clinopodioides	Basil beebalm
Monarda fistulosa	Shrubby beebalm
Monarda pectinata	Plains beebalm
Monarda punctata	Spotted beebalm
Nepeta cataria	Catnip

Salvia azurea var. grandiflora	Azure sage
Salvia reflexa	Lanceleaf sage
Scutellaria drummondii	Drummond skullcap
Scutellaria resionosa	Resindot skullcap
Scutellaria wrightii	Wright skullcap
Teucrium canadense	American germander
Teucrium laciniatum	Cutleaf germander
Trichostema brachiatum	Fluxweed

SOLANACEAE

Physalis lobata	Purple groundcherry
Physalis virginiana var. sonorae	Virginia groundcherry
Physalis viscosa var. cinerascens	Beach groundcherry
Physalis viscosa var. mollis	Field groundcherry
Solanum carolinense	Carolina horsenettle
Solanum citrullifolium**	Watermelon leaved solanum
Solanum eleagnifolium	Silverleaf nightshade
Solanum rostratum	Buffalobur
Solanum torreyi	Torrey horsenettle

SCROPHULARIACEAE

Bacopa rotundifolia	Disc waterhyssop
Castilleja citrina	Citron paintbrush
Castilleja sessiliflora	Downy paintbrush
Collinsia violacea	Violet collinsia
Conobea multifida	Narrowlobe conobea
Gratiola virginiana	Virginia hedgehyssop
Linaria canadensis var. texana	Oldfield toadflax
Lindernia anagallidea	Clasping false-pimpernel
Lindernia dubia	Yellowseed false-pimpernel
Penstemon albidus	White penstemon
Penstemon cobaea	Cobaea Penstemon
Penstemon oklahomensis	Oklahoma penstemon
Penstemon tubaeflorus	Tube penstemon
Scrophularia lanceolata	Narrowleaf figwort
Veronica arvensis	Common speedwell
Veronica peregrina	Purslane speedwell

MARTYNIACEAE

Proboscidea louisianaca	Common devilsclaw

LENTIBULARIACEAE

Utricularia biflora	Bladderwort
Utricularia vulgaris	Bladderwort

ACANTHACEAE

Justicia americana	Justica
Ruellia humilis	Low ruellia
Ruellia pedunculata	Stalked ruellia

PHRYMACEAE

Phryma leptostachya	Lopseed

PLANTAGINACEAE

Plantago aristata	Bottlebrush plantain
Plantago elongata	Elongate plantain
Plantago purshii var. purshii	Slender plantain
Plantago purshii var. spinulosa	Bristlebract plantain
Plantago rhodosperma	Redseed plantain
Plantago virginica	Paleseed plantain
Plantago wrightii	Wright plantain

RUBIACEAE

Cephalanthus occidentalis	Common buttonbush
Diodia teres var. setifera	Rough buttonweed
Galium aparine	Catchweed bedstraw
Galium pilosum	Hairy bedstraw
Galium texense	Texas bedstraw
Galium triflorum	Fragrant bedstraw
Galium virgatum	Southwest bedstraw
Hedyotis crassifolia	Tiny bluet
Hedyotis nigricans	Narrowleaf bluet
Hedyotis purpurea var. longifolia	Purple bluets

CAPRIFOLIACEAE

Symphoricarpos orbiculatus	Coralberry
Viburnum prunifolium var. ferrugineum	Rusty blackhaw

VALERIANACEAE

Valerianella radiata	Beaked cornsalad
Valerianella stenocarpa var. parviflora	Narrowcell cornsalad

CUCURBITACEAE

Cucurbita foetidissima	Buffalogourd
Cyclanthera dissecta	Cutleaf cyclanthera
Ibervillea lindheimeri	Lindheimer globeberry
Melothria pendula	Drooping melonette

CAMPANULACEAE

Lobelia appendiculata	Earflower lobelia
Lobelia cardinalis	Cardinal flower
Lobelia spicata	Palespike lobelia
Specularia biflora	Small venus-lookingglass
Specularia leptocarpa	Slimpod venus-lookingglass
Specularia perfoliata	Clasping venus-lookingglass

COMPOSITAE

Achillea lanulosa	Western yarrow
Achillea millefolium	Common yarrow
Agoseris cuspidata	Wavyleaf agoseris
Aphanostephus ramosissimus	Plains dozedaisy
Aphanostephus pilosus	Hairy dozedaisy
Aphanostephus skirrhobasis	Arkansas dozedaisy
Ambrosia artemisiifolia	Common ragweed
Ambrosia psilostachya	Western ragweed
Ambrosia trifida	Giant ragweed
Antennaria plantaginifolia	Plantainleaf pussytoes
Artimisia carruthii	Carruth sagewort
Artimisia filifolia	Figleaf sagewort
Artimisia glauca	False terragon sagewort
Artimisia ludoviciana var. ludoviciana	Louisiana sagewort
Artimisia ludoviciana var. mexicana	American sagewort
Artimisia serrata*	Sawtooth sagewort
Aster commutatus*	Cluster aster
Aster ericoides	Heath aster
Aster fendleri	Fendler aster
Aster oblongifolius	Aromatic aster
Aster patens	Skydrop aster
Aster subulatus	Awl shaped aster
Baccharis salicina	Willow groundsel-tree
Berlandiera texana	Texas greeneyes
Bidens cernua	Nodding beggarticks
Bidens frondosa	Devils beggarticks
Centaurea americana	Basket flower
Chaetopappa asteroides	Common leastdaisy
Chrysopsis pilosa	Soft goldaster
Chrysopsis villosa var. canescens	Hairy goldaster
Chrysopsis villosa var. stenophylla	Narrowleaf goldaster
Chrysopsis villosa var. villosa	Hairy goldaster
Cirsium ochrocentrum	Yellowspine thistle
Cirsium undulatum	Wavyleaf thistle
Conyza canadensis	Horseweed fleabane
Conyza ramosissima	Conyza
Coreopsis grandiflora var. longipes	Biglower coreopsis
Coreopsis lanceolata var. villosa	Lanceleaf coreopsis
Coreopsis tinctoria	Plains coreopsis
Dyssodia tagetloides	Marigold dogweed
Echinacea angustifolia	Blacksamson
Eclipta alba	Yerba de tajo
Engelmannia pinnatifida	Engelmann daisy
Erigeron bellidiastrum	Western fleabane

Erigeron divergens	Spreading fleabane
Erigeron strigosus	Prairie fleabane
Eupatorium serotinum	Late eupatorium
Evax multicaulis	Manystem evax
Evax prolifera	Bighead evax
Gaillardia pulchella	Rosering gaillardia
Gaillardia suavis	Sweet gaillardia
Gnaphalium chilense	Cottonbatting cudweed
Gnaphalium purpureum	Purple cudweed
Gnaphalium wrightii	Wright cudweed
Grindelia squarrosa var. nuda	Rayless gumweed
Grindelia squarrosa var. squarrosa	Curlycup gumweed
Gutierrizia dracunculoides	Common broomweed
Gutierrizia sarothrae*	Broom snakeweed
Haplopappus ciliatus	Wax goldonweed
Haplopappus spinulosis	Cutleaf goldonweed
Helenium amarum var. amarum	Bitter sneezeweed
Helenium amarum var. badium	Basin sneezeweed
Helenium autumnale	Common sneezeweed
Helenium flexuosum	Flexuous sneezeweed
Helenium microcephalum	Smallhead sneezeweed
Helianthus annus	Common sunflower
Helianthus hirsutus	Hairy sunflower
Helianthus laetiflorus	Stiff sunflower
Helianthus maximiliani	Maximilian sunflower
Helianthus petiolaris	Prairie sunflower
Hieracium longipilum	Longbeard hawkseed
Hymenopappus scabiosaeus	Flattop woollywhite
Hymenopappus tenuifolius	Chalkhill woollywhite
Hymenoxys linearifolia	Fineleaf actinea
Hymenoxys scaposa var. linearis	Plains actinea
Iva ciliata	Seacoast sumpweed
Krigia dandelion	Tuber dwarf-dandelion
Krigia oppositifolia	Weedy dwarf-dandelion
Kuhnia eupatorioides var. corymbulosa	Plains kuhnia
Lactuca canadensis	Canada lettuce
Lactuca pulchella*	Chicory lettuce
Lactuca scariola	Prickly lettuce
Liatris aspera	Rough gayfeather
Liatris punctata	Dotted gayfeather
Liatris scariosa*	Tall gayfeather
Palafoxia texana	Texas palafoxia
Pluchea camphorata	Camphor pluchea
Pyrrhopappus carolinianus	Carolina false-dandelion
Pyrrhopappus scaposus	Tuber false-dandelion
Ratibida columnifera	Upright prairie-coneflower

Rudbeckia hirta	Black-eyed susan
Senecio plattensis	Prairie groundsel
Senecio riddellii	Riddell groundsel
Silphium asteriscus	Sand rosinweed
Silphium laciniatum	Compassplant
Solidago bootii*	Boot goldonrod
Solidago gigantea var. leiophylla	November goldonrod
Solidago missouriensis var. fasciculata	Missouri goldonrod
Solidago mollis	Ashy goldonrod
Solidago petiolaris	Downy goldonrod
Solidago radula	Rough goldonrod
Taraxacum officinale	Common dandelion
Thelesperma ambiguum	Colorado greenthread
Thelesperma filifolium	Plains greenthread
Thelesperma megapotamicum	Rayless greenthread
Townsendia excapa	Stemless Townsendia
Verbesina virginica	White crownbeard
Vernonia baldwinii	Baldwin ironweed
Vernonia missurica	Missouri ironweed
Xanthisma texanum var. drummondii	Texas sleepydaisy
Xanthium strumarium	Cocklebur

LIST OF MAMMALS

The following list representing 50 species of mammals from the Lawtonka Reservoir area was prepared by the Wichita Wildlife Refuge personnel. The order in which the species and scientific names are listed follows USDI (1964).

LIST OF MAMMALS

ORDER MARSUPIALIA

Virginia oppossum	Didelphis virginiana

ORDER INSECTIVORA

short-tailed shrew	Blarina brevicauda
least shrew	Cryptotis parva
desert shrew	Notiosorex crawford:
eastern mole	Scalopus aquaticus

ORDER CHIROPTERA

eastern pipistrelle	Pipistrellus subflavus
western pipistrel	Pipistrellus hesperus
small-footed myotis	Myotis subulatus
western big-eared bat	Corynorhinus refinesquii
mexican freetail bat	Tadarida mexicana
red bat	Lasiurus borealis
hoary bat	Lasiurus cinereus
cave myotis	Myotis velifer

ORDER EDENTATA

nine-banded armadillo	Dasypus novemcinctus

ORDER LAGOMORPHA

black-tailed jackrabbit	Lepus californicus
eastern cottontail	Sylvilagus floridaans
desert cottontail	Sylvilagus audubonii

ORDER RODENTIA

eastern fox squirrel	Sciurus niger
black-tailed prairie dog	Cynomys ludovicianus
thirteen-lined ground squirrel	Spermophilus tridecemlineatus
southern flying squirrel	Glaucomys volans
spotted ground squirrel	Citellus spilosoma
hispid pocket mouse	Perognathus hispidus
beaver	Castor canadensis
plains harvest mouse	Reithrodontomys montanus
fulvous harvest mouse	Reithrodontomys fulvescens
deer mouse	Peromyscus maniculatus
white-footed mouse	Peromyscus leucopus
hispid cotton rat	Sigmodon hispidus
eastern woodrat	Neotoma floridana
brush mouse	Peromyscus boylii
pine vole	Pitymys pinetorum
Norway rat	Rattus norvegicus
house mouse	mus musculus
nutria	Myocastor coypus

LIST OF MAMMALS (cont.)

ORDER CARNIVORA

coyote	*Canis latrans*
red wolf	*Canis niger*
red fox	*Vulpes fulva*
gray fox	*Urocyon cinereoargenteus*
raccoon	*Procyon lotor*
mink	*Mustela vison*
badger	*Taxidea taxus*
striped skink	*Mephitis mephitis*
eastern spotted skunk	*Spilogale putorius*
bobcat	*Lynx rufus*

ORDER ARTIODACTYLA

whitetail deer	*Odocoileus virginianus*
bison	*Bison bison*
Elk	*Cervus canadensis*
Pronghorn	*Antilocapra americana*
Texas longhorn cattle	*Bos taurus*

LIST OF BIRDS

The following list contains 183 species of birds known to exist in the Lawtonka Reservoir area. This listing does not include species that are recorded as rare or accidental. It should be noted that no distictions are made between winter and summer residents, breeding species, and migrant species. Nomenclature and taxonomic order are based on Tyler (1979).

LIST OF BIRDS

ORDER GAVIIFORMES

common loon	*Gavia immer*

ORDER PODICIPEDIFORMES

horned grebe	*Podiceps auritus*
eared grebe	*Podiceps nigricollis*
western grebe	*Aechmophorus accidentalis*
pied-billed grebe	*Podilymbus podiceps*

ORDER PELECANIFORMES

white pelican	*Pelecanus erythrorhynchos*
double-crested cormorant	*Phalacrocorax auritus*

ORDER CICONIIFORMES

great blue heron	*Ardea herodias*
green heron	*Butorides virescens*
little blue heron	*Florida caerulea*
cattle egret	*Bubulcus ibis*
great egret	*Casmerodius albus*
snowy egret	*Egretta thula*
black-crowned night heron	*Nycticorax nycticorax*
yellow-crowned night heron	*Nyctanassa violacea*
least bittern	*Ixobrychus exilis*
American bittern	*Botaurus lentiginosus*
white-faced ibis	*Plegadis chihi*

ORDER ANSERIFORMES

Canada goose	*Branta canadensis*
white-fronted goose	*Anser albifrons*
snow goose	*Chen caerulescens*
mallard	*Anas platyrhynchos*
gadwall	*Anas strepera*
pintail	*Anas acuta*
green-winged teal	*Anas crecca*
blue-winged teal	*Anas discors*
American wigeon	*Anas americana*
wood duck	*Aix sponsa*
redhead	*Aythya americana*
ring-necked duck	*Aythya collaris*
canvasback	*Anthya valisineria*
lesser scaup	*Anthya affinis*
common goldeneye	*Bucephala clangula*
bufflehead	*Bucephala albeola*
ruddy duck	*Oxyura jamaicensis*
hooded merganser	*Lophodytes cucullatus*
common merganser	*Mergus merganser*

ORDER FALCONIFORMES

turkey vulture	*Cathartes aura*
Mississippi kite	*Ictinia mississippiensis*
red-tailed hawk	*Accipiter cooperii*
	Buteo jamaicensis
Swainson's hawk	*Buteo swainsoni*
rough-legged hawk	*Buteo lagopus*
golden eagle	*Aquila chrysaetos*
bald eagle	*Haliaeetus leucocephalus*
marsh hawk	*Circus cyaneus*
osprey	*Pandion haliaetus*

ORDER GALLIFORMES

bobwhite	*Colinus virginianus*
turkey	*Meleagris gallopavo*

ORDER GRUIFORMES

sandhill crane	*Grus canadensis*

ORDER RALLIFORMES

king rail	*Rallus elegans*
American coot	*Fulica americana*

ORDER CHARADRIFORMES

killdeer	*Charadrius vociferus*
common snipe	*Capella gallinago*
upland sandpiper	*Bartramia longicauda*
spotted sandpiper	*Actitis macularia*
solitary sandpiper	*Tringa solitaris*
greater yellow legs	*Tringa melanoleuca*
lesser yellow legs	*Tringa flavipes*
willet	*Catoptrophorus semipalmatus*
pectoral sandpiper	*Calidris melanotos*
Baird's sandpiper	*Calidris bairdii*
least sandpiper	*Calidris minutilla*
western sandpiper	*Calidris mauri*
long-billed dowitcher	*Limnodromus scolopaceus*
stilt sandpiper	*Micropalama himantopus*
American avocet	*Recurvirostra americana*
Wilson's phalarope	*Steganopus tricolor*
herring gull	*Larus argentatus*
ring-billed gull	*Larus delawarensis*
Franklin's gull	*Larus pipixcan*
Forster's tern	*Sterna forsteri*
black tern	*Chlidonian niger*

ORDER COLUMBIFORMES

rock dove	*Columba livia*
mourning dove	*Zenaida macroura*

ORDER CUCLIFORMES

yellow-billed cuckoo	*Coccyzus americanus*
roadrunner	*Geococcyx californianus*

ORDER STRIGIFORMES

barn owl	*Tyto alba*
screech owl	*Otus asio*
great horned owl	*Bubo virginianus*
burrowing owl	*Speotyto cunicularia*
barred owl	*Strix varia*

ORDER CAPRIMULGIFORMES

chuck-will's-widow	*Caprimulgus carolinensis*
common nighthawk	*Chordeiles minor*

ORDER APODIFORMES

chimney swift	*Chaetura pelagica*
ruby-throated hummingbird	*Archilochus colubris*

ORDER CORACIIFORMES

belted kingfisher	*Megaceryle alcyon*

ORDER PICIFORMES

common flicker	*Colaptes auratus*
red-bellied woodpecker	*Centurus carolinus*
red-headed woodpecker	*Melanerpes erythrocephalus*
yellow-bellied sapsucker	*Sphyrapicus varius*
hairy woodpecker	*Dendrocopos villosus*
downy woodpecker	*Dendrocopos pubescens*
ladder-backed woodpecker	*Dendrocopos scalaris*

ORDER PASSERIFORMES

eastern kingbird	*Tryannus tryannus*
western kingbird	*Tryannus verticalis*
scissor-tailed flycatcher	*Muscivora forficata*
great crested flycatcher	*Myiarchus crinitus*
eastern phoebe	*Sayornis phoebe*
eastern wood pewee	*Contropus virens*
horned lark	*Eremophila alpestris*
barn swallow	*Hirundo rustica*
cliff swallow	*Petrochelidon pyrrhonota*
purple martin	*Prongne subis*
blue jay	*Cyanocitta cristata*
common crow	*Corvus brachyrhyrchos*
white-necked raven	*Corvus cryptoleucus*
Carolina chickadee	*Parus carolinensis*
tufted titmouse	*Parus bicolor*

ORDER PASSERIFORMES (cont.)

white-breasted nuthatch	Sitta carolinensis
brown creeper	Certhia familaris
Bewick's wren	Thryomanes bewickii
Carolina wren	Thryothorus ludovicianus
rock wren	Salpinctes obsoletus
canyon wren	Catherpes mexicanus
mockingbird	Mimus polyglottis
brown thrasher	Toxostoma rufum
robin	Turdus migratoruis
hermit thrush	Catharus guttatus
eastern bluebird	Sialia sialis
mountain bluebird	Sialia currucoides
Townsend's solitaire	Myadestes townsendi
blue-gray gnatcatcher	Polioptila caerulea
golden-crowned kinglet	Regulus satrapa
ruby-crowned kinglet	Regulus calendula
water pipit	Anthus spinoletta
cedar waxwing	Bombycilla cedroroum
loggerhead shrike	Lanius ludovicianus
starling	Sturnus vulgaris
red-eyed vireo	Vireo olivaceus
black-and-white warbler	Mniotilta varia
orange-crowned warbler	Vermivora celata
Nashville warbler	Vermivora ruficapilla
yellow warbler	Dendroica petechia
yellow-rumped warbler	Dendroica coronata
oven bird	Seiurus aurocapillus
northern waterthrush	Seiurus noveboracensis
common yellowthroat	Geothylpis trichas
yellow-breasted chat	Icteria virens
Wilson's warbler	Wilsonia pusilla
American redstart	Setophaga ruticilla
English sparrow	Passer domesticus
eastern meadow lark	Sturnella magna
western meadow lark	Sturnella neglecta
yellow-headed blackbird	Xanthocephalus xanthocephalus
red-winged blackbird	Agelaius phoeniceus
orchard oriole	Icterus spurius
northern oriole	Icterus galbula
rusty blackbird	Euphagus carolinus
Brewer's blackbird	Euphagus cyanocephalus
great-tailed grackle	Cassidix mexicanus
common grackle	Quiscalus quiscula
brown-headed cowbird	Molathrusater
summer tanager	Piranga rubra
cardinal	Cardinalis cardinalis
blue grosbeak	Guiraca caerulea
indigo bunting	Passerina cyanea
painted bunting	Passerina ciris
dickcissel	Spiza americana
purple finch	Carpodacus purpureus
pine siskin	Carduelis pinus

ORDER PASSERIFORMES (cont.)

American goldfinch	*Carduelis tristis*
lesser goldfinch	*Carduelis psaltria*
rufous-sided towhee	*Pipilo erythrophthalmus*
Savannah sparrow	*Passerculus sandwichensis*
grasshopper sparrow	*Ammodramus savannarum*
LeConte's sparrow	*Ammospiza leconteii*
vesper sparrow	*Pooecetes gramineus*
lark sparrow	*Chondestes grammacus*
Rufous-crowned sparrow	*Aimophila ruficeps*
slate-colored junco	*Junco hyemalis*
Oregon Junco	*Junco oreganus*
tree sparrow	*Spizella arborea*
chipping sparrow	*Spizella passerina*
field sparrow	*Spizella pusilla*
Harris's sparrow	*Zonotrichia querula*
white-crowned sparrow	*Zonotrichia leucophrys*
white-throated sparrow	*Zonotrichia albicollis*
Lincoln's sparrow	*Melospiza lincolnii*
song sparrow	*Melospiza melodia*
Lapland longspur	*Calcarius lapponicus*
chestnut-collared longspur	*Calcarius ornatus*

LIST OF AMPHIBIANS AND REPTILES

This listing is of the known amphibians and reptiles in the Lawtonka Reservoir area. It was obtained from records kept by the Wichita Mountains Wildlife Refuge.

LIST OF AMPHIBIANS AND REPTILES

ORDER CAUDATA

barred tiger salamander	*Ambystoma tigrinum mavortium*

ORDER SALIENTIA

couch's spadefoot	*Scaphiopus couchi*
plains spadefoot	*Scaphiopus bombifrons*
Rocky mountain toad	*Bufo woodhousei woodhousei*
great plains toad	*Bufo cognatus*
Texas toad	*Bufo compactilis speciosus*
red-spotted toad	*Bufo punctatus*
eastern green toad	*Bufo debelis debelis*
Blanchard's cricket frog	*Acris gryllus blanchardi*
spotted chorus frog	*Pseudacris clarki*
Strecker's chorus frog	*Pseudacris streckeri streckeri*
great plains narrow-mouthed toad	*Gastrophyryne olivacea olivacea*
bullfrog	*Rana catesbeiana*
Rio Grande leopard frog	*Rana pipiens berlandieri*

ORDER CHELONIA

common snapping turtle	*Chelydra serpentina serpentina*
yellow mud turtle	*Kinosternon flavescens flavescens*
ornate box turtle	*Terrapena ornata ornata*
quachita map turtle	*Graptemys pseudogeographica ouachitensis*
red-eared turtle	*Pseudemys scripta elegans*
smooth softshell	*Trionyx muticus*
Texas softshell	*Trionyx ferox emoryi*

ORDER SAURIA

eastern collared lizard	*Crotaphytus collaris collaris*
eastern earless lizard	*Holbrookia maculata perspicua*
southern prairie lizard	*Sceloporus undulatos consobrinus*
Texas horned lizard	*Phrynosoma cornutum*
western slender glass lizard	*Ophsaurus attenuatus attenuatus*
eastern spotted whiptail	*Cnemidophorus sacki gularis*
six-lined racerunner	*Cnemidophorus sexlineatus*
ground skink	*Lygosoma laterale*
five-lined skink	*Eumeces fasciatus*
great plains skink	*Eumeces obsoletus*
southern prairie skink	*Eumeces septentrionalis obtusirostris*

ORDER SERPENTES

plains blind snake	*Leptotyphlops dulcis dulcis*
New Mexico blind snake	*Leptotyphlops dulcis dissectus*
Graham's water snake	*Natrix grahami*
blotched water snake	*Natrix erythrogaster transversa*
diamond-backed water snake	*Natrix rhombifera rhombifera*
Texas brown snake	*Storeria dekayi texana*

eastern checkered garter snake	Thamnophis marcianus marcianus
western checkered garter snake	Thamnophis marcianus nigrolateris
western ribbon snake	Thamnophis sauritus proximus
central lined snake	Tropidoclonion lineatum annectens
eastern hognose snake	Heterodon platyrhinos platyrhinos
plains hognose snake	Heterodon nasicus nasicus
prairie ringneck snake	Diadophis punctatus arnyi
eastern yellow-bellied racer	Coluber constrictor flaviventris
eastern coachwhip	Masticophis flagellum flagellum
western coachwhip	Masticophis flagellum testaceus
rough green snake	Opheodrys aestivus
great plains rat snake	Elaphe guttata emoryi
black rat snake	Elaphe obsoleta obsoleta
Kansas glossy snake	Arizona elegans blanchardi
bullsnake	Pituophis melanoleucus sayi
speckled kingsnake	Lampropeltis getulus holbrooki
prairie kingsnake	Lampropeltis calligaster calligaster
western milk snake	Lampropeltis doliata gentilis
Texas long-nosed snake	Rhinocheilus lecontei tessallatus
great plains ground snake	Sonora episcopa episcopa
Texas night snake	Hypsiglena torquata texana
slender flat-headed snake	Tantilla gracilis gracilis
Texas black-headed snake	Tantilla nigriceps fumiceps
broad-banded copperhead	Agkistrodon controtrix laticinctus
western massasauga	Sistrurus catenatus tergeminus
western diamondback rattlesnake	Crotalus atrox
prairie rattlesnake	Crotalus viridis viridis

LIST OF MAMMALS

The following list representing 50 species of mammals from the Lawtonka Reservoir area was prepared by the Wichita Wildlife Refuge personnel. The order in which the species and scientific names are listed follows USDI (1964).

ORDER MARSUPIALIA

Virginia oppossum	*Didelphis virginiana*

ORDER INSECTIVORA

short-tailed shrew	*Blarina brevicauda*
least shrew	*Cryptotis parva*
desert shrew	*Notiosorex crawford:*
eastern mole	*Scalopus aquaticus*

ORDER CHIROPTERA

eastern pipistrelle	*Pipistrellus subflavus*
western pipistrel	*Pipistrellus hesperus*
small-footed myotis	*Myotis subulatus*
western big-eared bat	*Corynorhinus refinesquii*
mexican freetail bat	*Tadarida mexicana*
red bat	*Lasiurus borealis*
hoary bat	*Lasiurus cinereus*
cave myotis	*Myotis velifer*

ORDER EDENTATA

nine-banded armadillo	*Dasypus novemcinctus*

ORDER LAGOMORPHA

black-tailed jackrabbit	*Lepus californicus*
eastern cottontail	*Sylvilagus floridaans*
desert cottontail	*Sylvilagus audubonii*

ORDER RODENTIA

eastern fox squirrel	*Sciurus niger*
black-tailed prairie dog	*Cynomys ludovicianus*
thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
southern flying squirrel	*Glaucomys volans*
spotted ground squirrel	*Citellus spilosoma*
hispid pocket mouse	*Perognathus hispidus*
beaver	*Castor canadensis*
plains harvest mouse	*Reithrodontomys montanus*
fulvous harvest mouse	*Reithrodontomys fulvescens*
deer mouse	*Peromyscus maniculatus*
white-footed mouse	*Peromyscus leucopus*
hispid cotton rat	*Sigmodon hispidus*
eastern woodrat	*Neotoma floridana*

LIST OF MAMMALS (Cont.)

ORDER RODENTIA (Cont.)

brush mouse	*Peromyscus boylii*
pine vole	*Pitymys pinetorum*
Norway rat	*Rattus norvegicus*
house mouse	*Mus musculus*
nutria	*Myocastor coypus*

ORDER CARNIVORA

coyote	*Canis latrans*
red wolf	*Canis niger*
red fox	*Vulpes fulva*
gray fox	*Urocyon cinereoargenteus*
raccoon	*Procyon lotor*
mink	*Mustela vison*
badger	*Taxidea taxus*
striped skink	*Mephitis mephitis*
eastern spotted skunk	*Spilogale putorius*
bobcat	*Lynx rufus*

ORDER ARTIODACTYLA

whitetail deer	*Odocoileus virginianus*
bison	*Bison bison*
Elk	*Cervus canadensis*
Pronghorn	*Antilocapra americana*
Texas longhorn cattle	*Bos taurus*

LIST OF BIRDS

The following list contains 183 species of birds known to exist in the Lawtonka Reservoir area. This listing does not include species that are recorded as rare or accidental. It should be noted that no distictions are made between winter and summer residents, breeding species, and migrant species. Nomenclature and taxonomic order are based on Tyler (1979).

ORDER GAVIIFORMES

common loon	*Gavia immer*

ORDER PODICIPEDIFORMES

horned grebe	*Podiceps auritus*
eared grebe	*Podiceps nigricollis*
western grebe	*Aechmophorus accidentalis*
pied-billed grebe	*Podilymbus podiceps*

ORDER PELECANIFORMES

white pelican	*Pelecanus erythrorhynchos*
double-crested cormorant	*Phalacrocorax auritus*

ORDER CICONIIFORMES

great blue heron	*Ardea herodias*
green heron	*Butorides virescens*
little blue heron	*Florida caerulea*
cattle egret	*Bubulcus ibis*
great egret	*Casmerodius albus*
snowy egret	*Egretta thula*
black-crowned night heron	*Nycticorax nycticorax*
yellow-crowned night heron	*Nyctanassa violacea*
least bittern	*Ixobrychus exilis*
American bittern	*Botaurus lentiginosus*
white-faced ibis	*Plegadis chihi*

ORDER ANSERIFORMES

Canada goose	*Branta canadensis*
white-fronted goose	*Anser albifrons*
snow goose	*Chen caerulescens*
mallard	*Anas platyrhynchos*
gadwall	*Anas strepera*
pintail	*Anas acuta*
green-winged teal	*Anas crecca*
blue-winged teal	*Anas discors*
American wigeon	*Anas americana*
wood duck	*Aix sponsa*
redhead	*Aythya americana*
ring-necked duck	*Aythya collaris*
canvasback	*Anthya valisineria*

LIST OF BIRDS (Cont.)

ORDER ANSERIFORMES (Cont.)

lesser scaup	Aythya ~~Anthya~~ affinis
common goldeneye	Bucephala clangula
bufflehead	Bucephala albeola
ruddy duck	Oxyura jamaicensis
hooded merganser	Lophodytes cucullatus
common merganser	Mergus merganser

ORDER FALCONIFORMES

turkey vulture	Cathartes aura
Mississippi kite	Ictinia mississippiensis
red-tailed hawk	Accipiter cooperii
	Buteo jamaicensis
Swainson's hawk	Buteo swainsoni
rough-legged hawk	Buteo lagopus
golden eagle	Aquila chrysaetos
bald eagle	Haliaeetus leucocephalus
marsh hawk	Circus cyaneus
osprey	Pandion haliaetus

ORDER GALLIFORMES

bobwhite	Colinus virginianus
turkey	Meleagris gallopavo

ORDER GRUIFORMES

sandhill crane	Grus canadensis

ORDER RALLIFORMES

king rail	Rallus elegans
American coot	Fulica americana

ORDER CHARADRIFORMES

killdeer	Charadrius vociferus
common snipe	Capella gallinago
upland sandpiper	Bartramia longicauda
spotted sandpiper	Actitis macularia
solitary sandpiper	Tringa solitaris
greater yellow legs	Tringa melanoleuca
lesser yellow legs	Tringa flavipes
willet	Catoptrophorus semipalmatus
pectoral sandpiper	Calidris melanotos
Baird's sandpiper	Calidris bairdii
least sandpiper	Calidris minutilla
western sandpiper	Calidris mauri
long-billed dowitcher	Limnodromus scolopaceus
stilt sandpiper	Micropalama himantopus

LIST OF BIRDS (Cont.)

ORDER CHARADRIFORMES (Cont.)

American avocet	Recurvirostra americana
Wilson's phalarope	Steganopus tricolor
herring gull	Larus argentatus
ring-billed gull	Larus delawarensis
Franklin's gull	Larus pipixcan
Forster's tern	Sterna forsteri
black tern	Chlidonian niger

ORDER COLUMBIFORMES

rock dove	Columba livia
mourning dove	Zenaida macroura

ORDER CUCLIFORMES

yellow-billed cuckoo	Coccyzus americanus
roadrunner	Geococcyx californianus

ORDER STRIGIFORMES

barn owl	Tyto alba
screech owl	Otus asio
great horned owl	Bubo virginianus
burrowing owl	Speotyto cunicularia
barred owl	Strix varia

ORDER CAPRIMULGIFORMES

chuck-will's-widow	Caprimulgus carolinensis
common nighthawk	Chordeiles minor

ORDER APODIFORMES

chimney swift	Chaetura pelagica
ruby-throated hummingbird	Archilochus colubris

ORDER CORACIIFORMES

belted kingfisher	Megaceryle alcyon

ORDER PICIFORMES

common flicker	Colaptes auratus
red-bellied woodpecker	Centurus carolinus
red-headed woodpecker	Melanerpes erythrocephalus
yellow-bellied sapsucker	Sphyrapicus varius
hairy woodpecker	Dendrocopos villosus
downy woodpecker	Dendrocopos pubescens
ladder-backed woodpecker	Dendrocopos scalaris

LIST OF BIRDS (Cont.)

ORDER PASSERIFORMES

eastern kingbird	*Tryannus tryannus*
western kingbird	*Tryannus verticalis*
scissor-tailed flycatcher	*Muscivora forficata*
great crested flycatcher	*Myiarchus crinitus*
eastern phoebe	*Sayornis phoebe*
eastern wood pewee	*Contropus virens*
horned lark	*Eremophila alpestris*
barn swallow	*Hirundo rustica*
cliff swallow	*Petrochelidon pyrrhonota*
purple martin	*Prongne subis*
blue jay	*Cyanocitta cristata*
common crow	*Corvus brachyrhyrchos*
white-necked raven	*Corvus cryptoleucus*
Carolina chickadee	*Parus carolinensis*
tufted titmouse	*Parus bicolor*
white-breasted nuthatch	*Sitta carolinensis*
brown creeper	*Certhia familaris*
Bewick's wren	*Thryomanes bewickii*
Carolina wren	*Thryothorus ludovicianus*
rock wren	*Salpinctes obsoletus*
canyon wren	*Catherpes mexicanus*
mockingbird	*Mimus polyglottis*
brown thrasher	*Toxostoma rufum*
robin	*Turdus migratoruis*
hermit thrush	*Catharus guttatus*
eastern bluebird	*Sialia sialis*
mountain bluebird	*Sialia currucoides*
Townsend's solitaire	*Myadestes townsendi*
blue-gray gnatcatcher	*Polioptila caerulea*
golden-crowned kinglet	*Regulus satrapa*
ruby-crowned kinglet	*Regulus calendula*
water pipit	*Anthus spinoletta*
cedar waxwing	*Bombycilla cedroroum*
loggerhead shrike	*Lanius ludovicianus*
starling	*Sturnus vulgaris*
red-eyed vireo	*Vireo olivaceus*
black-and-white warbler	*Mniotilta varia*
orange-crowned warbler	*Vermivora celata*
Nashville warbler	*Vermivora ruficapilla*
yellow warbler	*Dendroica petechia*
yellow-rumped warbler	*Dendroica coronata*
oven bird	*Seiurus aurocapillus*
northern waterthrush	*Seiurus noveboracensis*
common yellowthroat	*Geothylpis trichas*
yellow-breasted chat	*Icteria virens*
Wilson's warbler	*Wilsonia pusilla*
American redstart	*Setophaga ruticilla*
English sparrow	*Passer domesticus*
eastern meadow lark	*Sturnella magna*
western meadow lark	*Sturnella neglecta*

LIST OF BIRDS (Cont.)

ORDER PASSERIFORMES (Cont.)

yellow-headed blackbird	*Xanthocephalus xanthocephalus*
red-winged blackbird	*Agelaius phoeniceus*
orchard oriole	*Icterus spurius*
northern oriole	*Icterus galbula*
rusty blackbird	*Euphagus carolinus*
Brewer's blackbird	*Euphagus cyanocephalus*
great-tailed grackle	*Cassidix mexicanus*
common grackle	*Quiscalus quiscula*
brown-headed cowbird	*Molathrusater*
summer tanager	*Piranga rubra*
cardinal	*Cardinalis cardinalis*
blue grosbeak	*Guiraca caerulea*
indigo bunting	*Passerina cyanea*
painted bunting	*Passerina ciris*
dickcissel	*Spiza americana*
purple finch	*Carpodacus purpureus*
pine siskin	*Carduelis pinus*
American goldfinch	*Carduelis tristis*
lesser goldfinch	*Carduelis psaltria*
rufous-sided towhee	*Pipilo erythrophthalmus*
Savannah sparrow	*Passerculus sandwichensis*
grasshopper sparrow	*Ammodramus savannarum*
LeConte's sparrow	*Ammospiza leconteii*
vesper sparrow	*Pooecetes gramineus*
lark sparrow	*Chondestes grammacus*
Rufous-crowned sparrow	*Aimophila ruficeps*
slate-colored junco	*Junco hyemalis*
Oregon Junco	*Junco oreganus*
tree sparrow	*Spizella arborea*
chipping sparrow	*Spizella passerina*
field sparrow	*Spizella pusilla*
Harris's sparrow	*Zonotrichia querula*
white-crowned sparrow	*Zonotrichia leucophrys*
white-throated sparrow	*Zonotrichia albicollis*
Lincoln's sparrow	*Melospiza lincolnii*
song sparrow	*Melospiza melodia*
Lapland longspur	*Calcarius lapponicus*
chestnut-collared longspur	*Calcarius ornatus*

LIST OF AMPHIBIANS AND REPTILES

This listing is of the known amphibians and reptiles in the Lawtonka Reservoir area. It was obtained from records maintained by the Wichita Mountains Wildlife Refuge.

ORDER CAUDATA

barred tiger salamander	*Ambystoma tigrinum mavortium*

ORDER SALIENTIA

couch's spadefoot	*Scaphiopus couchi*
plains spadefoot	*Scaphiopus bombifrons*
Rocky mountain toad	*Bufo woodhousei woodhousei*
great plains toad	*Bufo cognatus*
Texas toad	*Bufo compactilis speciosus*
red-spotted toad	*Bufo punctatus*
eastern green toad	*Bufo debelis debelis*
Blanchard's cricket frog	*Acris gryllus blanchardi* crepitans
spotted chorus frog	*Pseudacris clarki*
Strecker's chorus frog	*Pseudacris streckeri streckeri*
great plains narrow-mouthed toad	*Gastrophyryne olivacea olivacea*
bullfrog	*Rana catesbeiana*
Rio Grande leopard frog	*Rana pipiens berlandieri*

ORDER CHELONIA

common snapping turtle	*Chelydra serpentina serpentina*
yellow mud turtle	*Kinosternon flavescens flavescens*
ornate box turtle	*Terrapena ornata ornata*
quachita map turtle	*Graptemys pseudogeographica ouachitensis*
red-eared turtle	Trachemys *Pseudemys scripta elegans*
smooth softshell	*Trionyx muticus*
Texas softshell	*Trionyx ferox emoryi*

ORDER SAURIA

eastern collared lizard	*Crotaphytus collaris collaris*
eastern earless lizard	*Holbrookia maculata perspicua*
southern prairie lizard	*Sceloporus undulatos consobrinus*
Texas horned lizard	*Phrynosoma cornutum*
western slender glass lizard	*Ophsaurus attenuatus attenuatus*
eastern spotted whiptail	*Cnemidophorus sacki gularis*
six-lined racerunner	*Cnemidophorus sexlineatus*
ground skink	Scincella *Lygosoma laterale*
five-lined skink	*Eumeces fasciatus*
great plains skink	*Eumeces obsoletus*
southern prairie skink	*Eumeces septentrionalis obtusirostris*

ORDER SERPENTES

plains blind snake	*Leptotyphlops dulcis dulcis*
New Mexico blind snake	*Leptotyphlops dulcis dissectus*

LIST OF AMPHIBIANS AND REPTILES (Cont.)

ORDER SERPENTES (Cont.)

Graham's water snake	Regina ~~Natrix~~ grahami
blotched water snake	Nerodia ~~Natrix~~ erythrogaster transversa
diamond-backed water snake	Nerodia ~~Natrix~~ rhombifera rhombifera
Texas brown snake	Storeria dekayi texana
eastern checkered garter snake	Thamnophis marcianus marcianus
western checkered garter snake	Thamnophis marcianus nigrolateris?
western ribbon snake	Thamnophis sauritus proximus proximus
central lined snake	Tropidoclonion lineatum annectens
eastern hognose snake	Heterodon platyrhinos platyrhinos
plains hognose snake	Heterodon nasicus nasicus
prairie ringneck snake	Diadophis punctatus arnyi
eastern yellow-bellied racer	Coluber constrictor flaviventris
eastern coachwhip	Masticophis flagellum flagellum
western coachwhip	Masticophis flagellum testaceus
rough green snake	Opheodrys aestivus
great plains rat snake	Elaphe guttata emoryi
black rat snake	Elaphe obsoleta obsoleta
Kansas glossy snake	Arizona elegans ~~blanchardi~~ elegans
bullsnake	Pituophis melanoleucus sayi
speckled kingsnake	Lampropeltis getulus holbrooki
prairie kingsnake	Lampropeltis calligaster calligaster
western milk snake	Lampropeltis doliata gentilis?
Texas long-nosed snake	Rhinocheilus lecontei tessallatus
great plains ground snake	Sonora episcopa episcopa?
Texas night snake	Hypsiglena torquata ~~texana~~ jani
slender flat-headed snake	Tantilla gracilis gracilis
Texas black-headed snake	Tantilla nigriceps fumiceps
broad-banded copperhead	Agkistrodon controtrix laticinctus
western massasauga	Sistrurus catenatus tergeminus
western diamondback rattlesnake	Crotalus atrox
prairie rattlesnake	Crotalus viridis viridis

LIST OF FISHES

The following list represents 37 species of fish found in Lawtonka Reservoir. It was compiled in cooperation with the Wichita Mountains Wildlife Refuge.

ORDER LEPISOSTEIFORMES

longnose gar	*Lepisosteus osseus*

ORDER CLUPEIFORMES

gizzard shad	*Dorosoma cepedianum*
skipjack herring	*Alosa chrysochloris*

ORDER CYPRINIFORMES

carp	*Cyprinus carpio*
golden shiner	*Notemigonus crysoleucas*
red shiner	*Notropis lutrensis*
bigeye shiner	*Notropis boops*
sand shiner	*Notropis stramineus*
plains minnow	*Hybognathus placitus*
fathead minnow	*Pimephales promelas*
stoneroller	*Campostoma anomalum*
smallmouth buffalo	*Ictiobus bubalus*
river carpsucker	*Carpiodes carpio*
black redhorse	*Moxostoma duquesnei*
golden redhorse	*Moxostoma erythrurum*
channel catfish	*Ictalurus punctatus*
black bullhead	*Ictalurus melas*
yellow bullhead	*Ictalurus natalis*
flathead catfish	*Pylodictus olivaris*

ORDER CYPRINODONTIFORMES

plains killfish	*Fundulus* ~~*kansae*~~ *zebrinus*
Red River pupfish	*Cyprinodon rubrofluviatilis*
gambusia	*Gambusia affinis*

ORDER MUGILIFORMES

brook silversides	*Labidesthes sicculus*

ORDER PERCIFORMES

white bass	*Morone chrysops*
spotted bass	*Micropterus punctulatus*
largemouth bass	*Micropterus salmoides*
warmouth	*Chaenobryttus gulosus*
green sunfish	*Lepomis cyanellus*
redear sunfish	*Lepomis microlophus*
longear sunfish	*Lepomis megalotis*
orangespotted sunfish	*Lepomis humilis*

LIST OF FISHES (Cont.)

ORDER PERCIFORMES (Cont.)

bluegill	*Lepomis macrochirus*
black crappie	*Pomoxis nigromaculatus*
white crappie	*Pomoxis annularis*
log perch	*Percina caprodes*
orangethroat darter	*Etheostoma spectabile*
freshwater drum	*Aplodinotus grunniens*