

Phase I: Diagnostic-Feasibility Study of Homer Lake, Champaign County, Illinois

Shun Dar Lin and William C. Bogner

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Champaign County Forest Preserve District,
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Illinois State Water Survey
Watershed Science Section
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PART 1: DIAGNOSTIC STUDY OF HOMER LAKE

INTRODUCTION

The Champaign County Forest Preserve District (CCFPD) applied for and received a grant to conduct a diagnostic-feasibility study on Homer Lake commencing in April 1997.

The diagnostic study was designed to delineate the existing lake conditions, to examine the cases of degradation, if any, and to identify and quantify the sources of plant nutrients and any other pollutants flowing into the lake. On the basis of the findings of the diagnostic study, water quality goals were established for the lake. Alternative management techniques were then evaluated in relation to the established goals.

The project was funded (60 percent) by the Illinois Environmental Protection Agency (Illinois EPA) through the Illinois Clean Lakes Program under Conservation 2000 with cost sharing by the CCFPD. The Illinois EPA was responsible for grant administration and program management. The project was contracted by the CCFPD to the Watershed Science Section of the Illinois State Water Survey (ISWS) as a consultant.

Lake Identification and Location

Homer Lake is an 83.0-acre public lake within the Salt Fork River Forest Preserve (SFRFP) in Champaign County, Illinois (figure 1). The lake is located in the Second Principle Meridian, Township 19N, Range 14W, Section 31; it is 3 miles northwest of the town of Homer. The Homer Lake watershed (figure 2), including the lake surface area, is 9,280 acres. The two inflow tributaries are Conkey Branch and the west branch (unnamed).

Lake identification and other pertinent geographic and morphometric information regarding Homer Lake are listed in table 1. Homer Lake has a maximum depth of 19 feet, a mean depth of 7.4 feet, a shoreline length of 5.3 miles, and an average retention time of 0.097 years.

Acknowledgments

This investigation was jointly sponsored by the Champaign County Forest Preserve District and the Illinois EPA, as an Illinois Clean Lakes Program Phase I study.

Special thanks to Brian Taylor (site superintendent) and Roy Woodmansee of Salt Fork River Forest Preserve; Roger Kirkwood, Director of Natural Resources of CCFPD; and Jeff Reinhold, Projector Manager of CCFPD. They were very courteous and shared their information and knowledge about the lake and the watershed, which made data collection easier. Without their full cooperation, this task could not have been accomplished in a timely and orderly fashion. The authors owe a debt of gratitude to each of them. Roy Woodmansee and Illinois EPA personnel collected water samples.

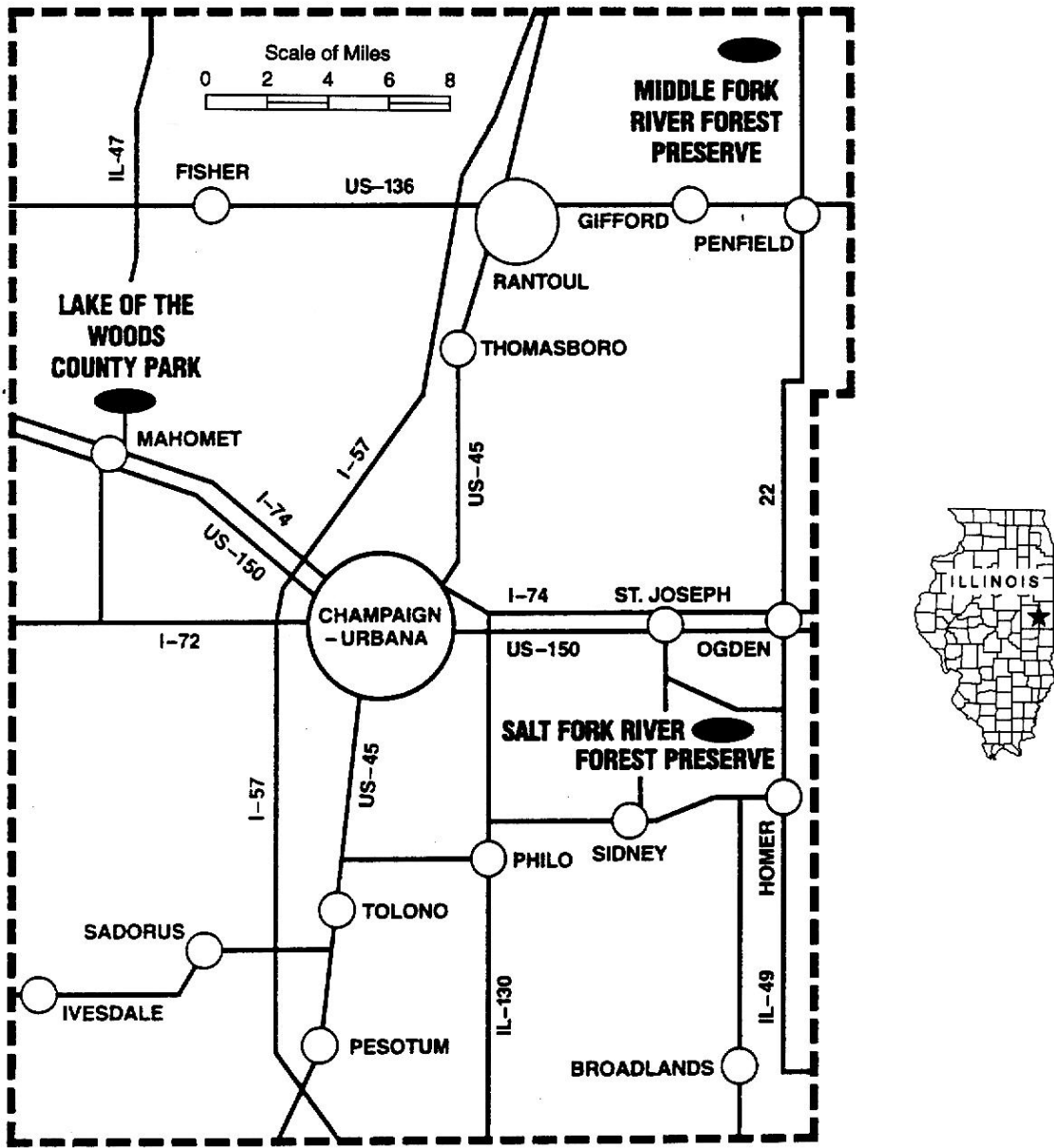


Figure 1. Location of study area, Salt Fork River Forest Preserve-Homer Lake
 (Source: Champaign County Forest Preserve District)

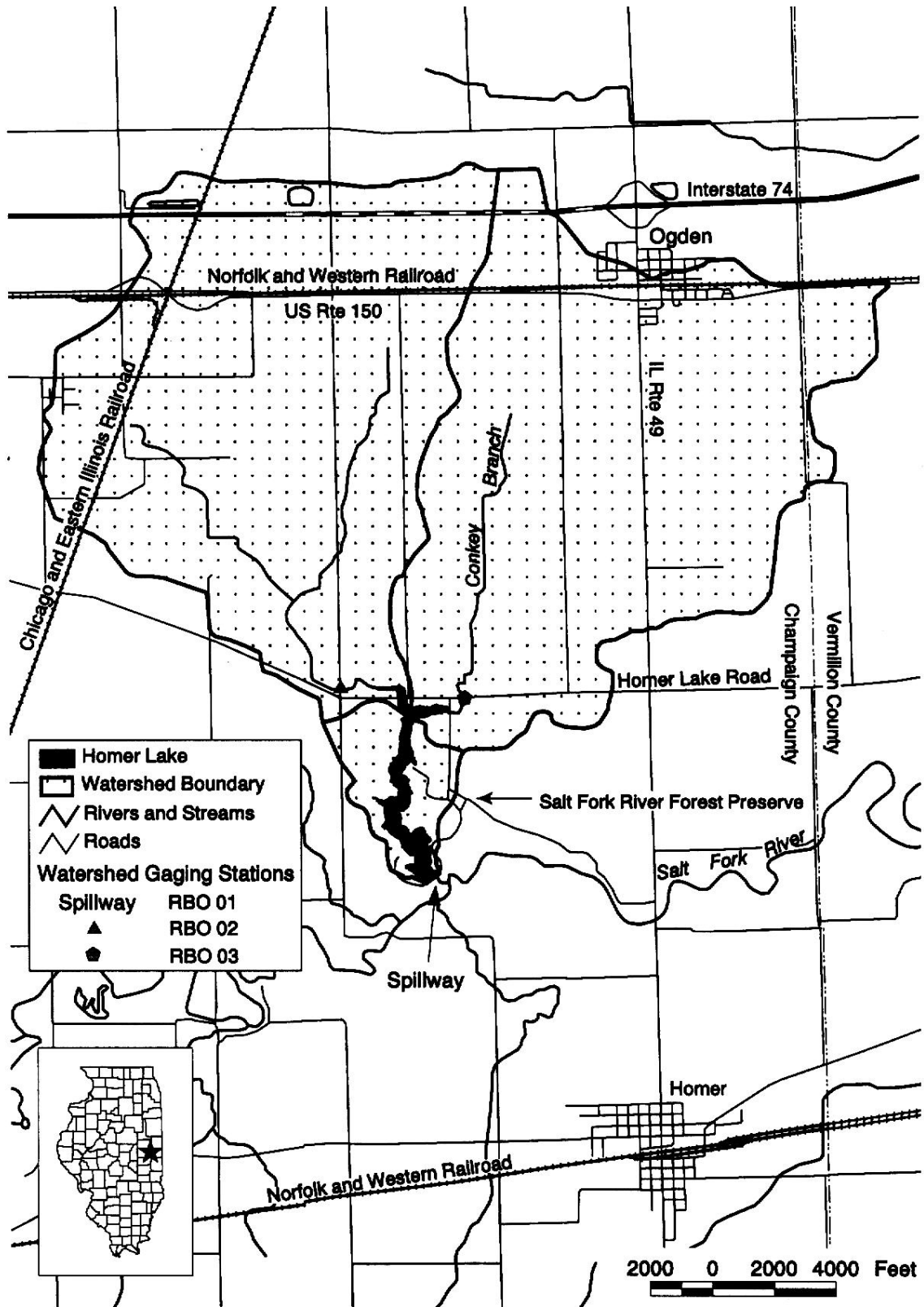


Figure 2. Homer Lake and its watershed

Table 1. Identification and Location of Homer Lake

Lake name	Homer Lake
IEPA lake code	RBO
State	Illinois
County	Champaign
Ownership	Champaign County Forest Preserve District
Nearest municipality	Homer
Latitude	40° 03' 45" N
Longitude	87° 59' 07" W
Location	Second Principle Meridian, Township 19 N, Range 14 W, Section 31
USEPA Region	5
USEPA major basin name	Upper Mississippi river Basin, code: 07
USEPA minor basin name	Illinois River Basin, code: 17
Major tributary	Conkey Branch
Out flowing stream	Salt Fork River
Surface area	83.0 acres
Watershed area	9,280 acres
Lake storage capacity	614 acre-feet
Maximum depth	19 feet
Mean depth	7.4 feet
Shoreline length	5.3 miles
Normal pool elevation	649.0 feet
Maximum pool elevation	652.5 feet
Average retention time	0.097 years
Water quality standards	General standards promulgated by the Illinois Pollution Control Board and applicable to water designated for aquatic life and whole body contact recreation: Title 35, Section C, chapter 1, Part 302, Subpart B.

Notes: IEPA - Illinois Environmental Protection Agency

USEPA - U.S. Environmental Protection Agency

The Illinois EPA Lake and Watershed Unit (Surface Water Section, Division of Water Pollution Control), under the direction of Gregg Good, was responsible for overall administration and coordination of this project. Amy Walkenbach was in charge of field operations. Teri Holland reviewed the final draft of the report. Jeff Mitzelfelt provided all data and information about publicly owned lakes within a 50 mile radius of Homer Lake. Chemical analyses were performed by the Illinois EPA staff.

Gary Lutterbie of the Illinois Department of Natural Resources provided fisheries information.

Leon Wendte of the U.S. Natural Resources Conservation Service provided information on watershed management of the Homer Lake watershed. The phytoplankton analysis was completed by Professor Lawrence O'Flaherty of Western Illinois University.

Kingsley Allan was responsible for the Geographic Information System (GIS) component of this project. John Beardsley assisted in preparing the appendices. Linda Hascall prepared the graphics. Mei-ling Lin and Linda Dexter prepared the draft and the final report. Eva Kingston and Agnes Dillon edited the final report. The efforts and assistance of all who worked on this project are gratefully acknowledged and appreciated.

The views expressed in this report are those of the authors and do not necessarily reflect the views of the Illinois State Water Survey.

STUDY AREA

Champaign County Forest Preserve District

In December 1947, a request to activate the CCFPD, which had been authorized by a 1935 referendum, was presented and approved by the Champaign County Board of Supervisors. The CCFPD now owns three recreation areas.

In 1948, the CCFPD purchased 260 acres of land around a small lake that was officially opened as Lake of the Woods County Park. The park has a 900-acre preserve. In 1974, the CCFPD began purchasing land in the northeast portion of the county for what would become the 1,530-acre Middle Fork River Forest Preserve in 1984 (CCFPD, 1994, 1998). The CCFPD also owns the SFRFP, an area of 798 acres (discussed in the next section). Each site offers diverse recreational, educational, and conservation experiences.

Salt Fork River Forest Preserve (Homer Lake)

In 1967, after the announcement by Congressman William Springer of Champaign that the U.S. Bureau of Outdoor Recreation released a \$78,000 federal grant for construction of Homer Lake, the Illinois Department of Conservation (now the Department of Natural Resources) developed the area into a state park. The 900-foot earth dam and concrete spillway were completed in 1969.

In the early 1970s, the state decided to concentrate efforts on its large parks and to turn as many of the smaller parks as possible over to local governments. After lengthy negotiation, a 20-year renewable lease to the CCFPD of Homer Lake State Park was formalized on March 25, 1971 (CCFPD, 1991).

The land transfer was of major concern to area conservationists. Homer Lake would be primarily a conservation area. The planting of trees and the use of the water and land were a tribute to the conservation interests of the CCFPD. In 1974, the area was officially named the Salt Fork River Forest Preserve, the second preserve in the CCFPD (CCFPD, 1998).

Disaster struck in 1974 when a tornado destroyed every building at Homer Lake. The next two years brought serious rebuilding efforts, with construction of many buildings in use today, such as the Trailside Visitor Center.

A number of improvements, including boat ramps and two new shelters, were completed at Homer Lake in the early 1980s. The 23-acre area that included the Riverview Retreat Center was donated to the Champaign County Design and Conservation Foundation (CCDCF) by the Champaign Asphalt Company, Champaign Builders Supply, and General Paving Company in 1983 (CCFPD, 1991). This area was given to the CCDCF to lease to the Forest Preserve District for a minimal fee. With the acquisition of 5-acre Flicker Woods, 30-acre Collins Memorial Woods, and a 3-acre homestead in the northeast corner (figure 3), the SFRFP (sometimes called Homer Lake) had grown to 865 acres (CCFPD, 1991).

In 1992, Governor Jim Edgar signed into law the bill that officially transferred ownership of the SFRFP to the CCFPD (CCFPD, 1998). The property had been leased for more than 20 years, but it was now owned by the citizens of Champaign County. The SFRFP is used as a nature preserve for recreational, educational, and scientific purposes.

The construction of the CCFPD's newest building, named the Outdoor Recreation Center, which included meeting facilities and the boat access on the north end of the preserve, was completed in 1998. Both have greatly enhanced the beauty and function of the Homer Lake area.

Climatologic Conditions of the Study Area

The following climatologic summary for Champaign, Illinois, is based on a period of record of more than 100 years (1888-1992). Champaign is located 16 miles west of the study site. This station was chosen to represent site conditions because it is the closest long-term meteorological site.

Champaign has a temperate continental climate dominated by maritime tropical air from the Gulf of Mexico from about May through October; maritime polar air from the Pacific Ocean in spring, fall, and winter; and short-duration incursions of continental polar air from Canada in winter. Mid-winter high temperatures are typically between 0 and 5°Celsius (°C); summer highs are usually in the 25°C range, with lows about 10°C lower. Spring and fall are a mix of winter-

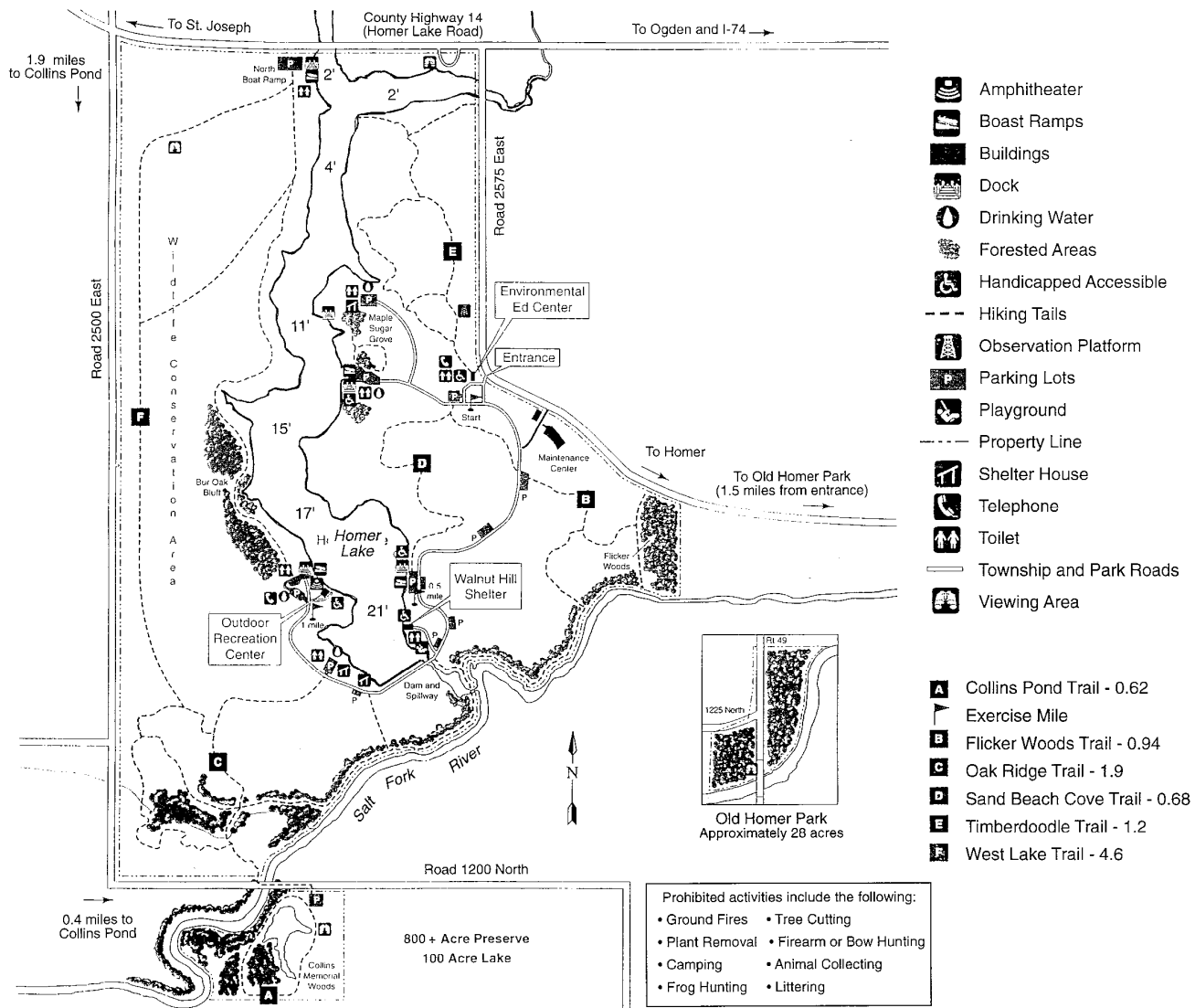


Figure 3. Facilities in the Salt Fork River Forest Preserve

and summer-like days, with rather large day-to-day temperature fluctuations common. The greatest day-to-day changes in temperature occur in late fall, winter, and early spring.

Winters are usually punctuated with two to eight cold, dry arctic outbreaks, in which daily lows drop into the -20°C range. These outbreaks generally persist for three to five days, and are often preceded by a winter storm that can reach severe proportions consisting of snowfalls of 6 inches (15 centimeters or cm) or more with strong winds or freezing precipitation.

Summers are humid with dew points between 15°C and 20°C and afternoon relative humidity in the 60 percent range. Usually about 25 days per year have temperatures greater than 30°C ; temperatures greater than 35°C are infrequent.

Average (1961-1990) precipitation for Champaign is just under 40 inches (100 cm), including about 29 inches (75 cm) of snow. There is considerable variability from year to year. About 118 days have measurable precipitation, of which about 40 days are associated with thunder and about 9 days have freezing precipitation. On average, precipitation is most frequent and greatest in magnitude during the warmer half of the year. Thunderstorms are common in the afternoon and evening, primarily during spring and summer. Some 25 tornadoes have been recorded in Champaign County since 1816.

Sixty percent of the mean annual precipitation falls from April–September. The frost-free growing season averages about 175 days, beginning about April 25 and ending about October 20.

The highest temperature of record is 40.5°C (July 14, 1954); the lowest temperature of record is -30°C (February 13, 1899). The wettest year of record is 1927, with 55.65 inches (141.3 cm); the driest year is 1894, with only 23.95 inches (60.8 cm). During the 104 complete years of record (1888-1992) there were:

- 3 years with more than 50 inches (125 cm) of precipitation
- 13 years with more than 45 inches (115 cm) of precipitation
- 42 years with less than 35 inches (90 cm) of precipitation, and
- 18 years with less than 30 inches (75 cm) of precipitation.

Geological and Soil Characteristics of the Drainage Basin

Drainage Area

The drainage area for Homer Lake is shown in figure 2. The watershed area is 9,280 acres (table 1). All the watershed land is privately owned, with the exception of the preserve property immediately adjacent to the lake.

Geology, Soils, and Topography

The soils of the Homer Lake watershed are predominantly Drummer-Flanagan, Drummer-Xenia, and Drummer-Elburn-Brenton Associations. These soils formed in glacial

outwash material. Slopes range from nearly level or depressional to gently sloping, and they are almost always poorly drained in their natural condition.

The Kansan, Illinoian, and Wisconsin glaciers covered all of Champaign County during the Pleistocene glacial epoch. The Wisconsin was the most recent stage of glaciation. This glacier deposited an average of more than 200 feet of glacial drift, to form the present topography. In most areas this glacial drift was covered by as much as 5 feet of windblown silt or loess.

Tile drains accomplish most agricultural drainage in the watershed. The potential for direct surface drainage is very limited due to the low field gradients.

Hydrologic Description of Homer Lake

Hydrologic System

The hydrologic system of Homer Lake is composed of the following major units:

- the lake pool,
- surface drainage from the two main tributaries and smaller tributaries to the lake,
- the local ground-water system,
- direct precipitation on the lake,
- evaporation from the lake surface,
- discharge over the spillway, and
- manipulated discharges (sluice gate operation and irrigation pumpage).

The manipulated discharges from the lake were the preplanned, September 10-September 18, 1997, release of water from the lake by CCFPD personnel. This release lowered lake levels by approximately 0.5 foot over nine days for a discharge volume of 40 acre-feet (ac-ft). This release was made to reduce lake levels for maintenance projects; it is made on an annual basis. The second manipulated release was the withdrawal of an unknown quantity of water from the lake for irrigation on the sod farm north of the lake.

Surface Inflow and Outflow Conditions

For any surface, runoff will be initiated only when precipitation volume has first wetted all surfaces and filled all depressions (puddles). After these initial losses have been exceeded, the precipitation rate must be greater than the infiltration rate for surface runoff to occur. For impervious surfaces (paved surfaces, building roofs), infiltration potential is very low, and runoff begins when initial losses have been met. For pervious surfaces (bare or vegetated soil and wooded areas), runoff occurs only for storm events that exceed infiltration capacity.

For the Homer Lake watershed area, much of the runoff from agricultural fields is affected by tile drainage. Most precipitation that falls in the watershed area seeps into the ground and is collected by the buried tiles. These tiles then serve as conduits to the creek channels. This process reduces the rate of runoff for the watershed and potential peak flows in the creeks.

As runoff enters the lake, the water level rises and the volume of water stored in the pool increases. When the water of the lake exceeds the top of the spillway, excess flow is passed downstream. The water storage below the spillway can be reduced only by ground-water seepage or evaporation, or by opening the sluice gate.

Lake levels follow a general trend of steady decline through the summer months, when evaporation rates exceed inflow rates; stabilize during the fall and winter as the weather cools; and, hopefully, rise in the spring in response to high precipitation and saturated soil conditions. During most years, the spring rise includes a surplus of water that is passed over the spillway.

The balance of inflows and outflows from the lake will be discussed in more detail later.

Ground-Water Conditions around Homer Lake

Glacial drift in the area of Homer Lake has an estimated thickness of 110 to 165 feet. The water-yielding potential of these formations depends on the occurrence of sand-and-gravel layers or lenses. Ground water for development of domestic water supplies in the area usually is obtained from small-diameter drilled wells tapping water-bearing sand-and-gravel deposits. In some instances, a large diameter, bored well is required. The underlying bedrock has little or no influence on the lake.

In general, ground-water levels adjacent to the lake probably conform to lake levels. Small, localized seepage may occur in the sides of the lake. However, the low transmissivity of the surface till deposits suggests limited ground-water inflow or outflow from the lake.

Public Access to the Lake Area

As show in figure 1, the SFRFP is accessible from I-74, US-150, IL-49, and IL-130. The main preserve entrance is at a county road perpendicular to IL-49 and IL-130. There is no public transportation to and from the lake. The lake is 15 miles southeast of Champaign-Urbana.

Figure 3 shows public access points, parking lots, and preserve facilities. A public road circles most of the lake, except on the west side of the wildlife conservation area (hiking trails are available in this area). There are two handicapped accesses for fishing.

The SFRFP provides free access to year-round recreational opportunities, of which the lake is the primary focus of activities. Homer Lake is the largest lake in Champaign County. The entire lake is publicly owned, and the entire lake shoreline is accessible, except the north tips of two arms. There are several picnic areas and five fishing piers from which people can fish for free. There also are four boat launch areas and three ramps for trailed boats (one is designed for sailboats and canoes). All watercraft owners are required to pay a lake-use fee before launching. The boat fee is \$13.50 per year for county residents and \$21.00 per year for nonresidents. There are four open-air pavilions, a newly constructed outdoor recreation center, and a visitor center/nature center located around Homer Lake. Additionally, there are ten picnic areas with picnic tables, grills, and toilets (table 2). The lake area also is used for hiking, bicycling, and environmental educational programs.

The CCFPD prohibits the use of outboard motors except to assist in launching or trailering boats under windy conditions.

Population Size and Economic Structure

Potential User Population

Several residences are north of the county road (north end of Homer Lake), and new residential development is continuing at the north end of the lake. The lake-user population is mainly out-of-town visitors.

The SFRFP lies between two large municipalities, Champaign-Urbana (15 miles) and Danville (25 miles). Champaign-Urbana has a population of 99,900, comprising 61 percent of Champaign County's total population. The population of Danville is 33,800, which comprises 38 percent of Vermilion County's total population.

It is difficult to know exactly where the visitors are from, the surrounding counties or even western Indiana. Seven counties are within a 50-mile (80 km) radius of Homer Lake. Table 3 presents pertinent population and economic information for Champaign, Coles, Douglas, Edgar, Ford, Piatt, and Vermilion Counties based on U.S. Department of Commerce 1990 data (U.S. Department of Commerce, 1992, 1993). The potential user population within a 50-mile radius (combined seven counties) is 374,000.

Economic Characteristics

Economic data for counties within 50 miles of Homer Lake are presented in table 3. The major sources of employment are manufacturing, retail trade, services, and agriculture. On the basis of counties, the per capita income ranges from \$12,828 for Vermilion County to about \$16,631 for Piatt County (table 3).

Historical Lake Uses and Conditions

Historical Lake Uses

Homer Lake was completed in 1969 within the SFRFP. The improvements of the lake and the preserve area in the past three decades were discussed previously. The SFRFP is one of the most popular recreational facilities in Champaign County and draws many visitors each year.

The lake area is used for fishing, boating (low power or electrical motors only), sailboating, hiking, picnicking, bicycling, camping, hunting, winter sports, environmental education activities (schools, YMCA, Boy and Girl Scouts), and waterfowl observations. The lake is not used as a public water supply source or for swimming.

Unfortunately, the preserve attendance has not been determined and recorded. However, the preserve estimates the annual attendance at 15,000 to 25,000 visitors.

Table 2. Parking and Facilities in the Salt Fork River Forest Preserve (Homer Lake)

<i>Location</i>	<i>Parking spaces</i>	<i>Wood tables</i>	<i>Metal tables</i>	<i>Trash cans</i>	<i>Grills</i>	<i>Benches</i>
North boat ramp	6			2		
Observation platform		2		1		1
Visitor center	21	4		4	1	4
Maintenance center		2		1		
North Peninsula	20	17		10	7	4
Maple Grove	34	14		6	4	6
Flicker Woods Trail	6	2		2		
Sand beach cove		2				
Sled Hill	6	1		1		
Sailboat launch	38	3		5	2	5
Sailboat, overflow	8					
Spillway						
Boat rental		1				2
Walnut Hill	8	7	25	15	11	7
Walnut Hill, overflow	6		12		1	2
Oakridge picnic area	22	15		6	3	3
Recreation center	42	13		8	4	6
Recreation center deck		4			1	8
Collins Woods			1	3	1	
Total	217	87	38	64	35	48

Note: Blank spaces – not applicable or none

Table 3. Population and Economic Data for Counties near Homer Lake

<i>County</i>	<i>Land area, square miles</i>	<i>Population (1996)</i>	<i>Wholesale trade, \$1,000</i>	<i>Manufacturing, 1992</i>				<i>Per capita income, \$</i>
				<i>Total number of establishments</i>	<i>Total number of employees</i>	<i>Total Value added \$1,000</i>	<i>Units annually</i>	
Champaign	997	162,900	2,033,468	73	11,000	1,333,600	940	14,388
Coles	508	52,500	370,765	56	5,600	609,900	429	13,580
Douglas	417	19,800	211,349	59	1,500	91,400	64	13,427
Edgar	624	19,700	135,159	28	1,000	51,700	36	13,319
Ford	486	13,900	387,588	21	1,000	70,000	49	13,997
Piatt	830	16,100	152,552	30	300	10,100	7	16,331
Vermilion	899	89,000	548,525	117	8,300	797,200	560	12,828

Source: Rand McNally Company, 1997.

Degradation of Homer Lake is a slow process, as is true of other Illinois lakes. Two primary sources for lake degradation have been noted as sedimentation and agricultural chemical runoff. The northern portion of the lake has sedimentation and macrophyte (in 1996, not 1997-1999) problems.

Homer Lake was designed for recreational uses, environmental education, and natural resources preservation. According to the IDNR fishery biologist (G. Lutterbie, personal communication, 1999), in May and June 1996 boat access (the northwest access) and bank fishing at the north end of the lake are nearly impossible at times if weeds are not treated with herbicide application.

According to the 1995 lake assessment survey by Lin and Raman (1997), lake problems included the high impairment by aquatic macrophyte and moderate impairment by siltation, taste and odor, and algal blooms.

The potential pollution sources were nonpoint runoffs, siltation, and rough fish. The major causes of impairment were siltation, nutrients, and organic enrichment/low dissolved oxygen (DO). The sources of impairment were agriculture and pasture.

Historical Lake Conditions and Management

The northern one-third of Homer Lake, the headwater portion, has become severely impaired as a result of years of sedimentation. Turbid water occurred from time to time around this area. The shallow water promoted macrophyte growth. The main cause of these problems is probably agricultural runoff.

During the winter of 1987-1988, the lake was drawdown 5 feet to facilitate work on the docks and remove some of the sediment from the upper part of the lake. No effect of the drawdown was observed in 1988, according to a Lake Periodic Report (February 7, 1989, prepared by District Fisheries Biologist Gary Lutterbie; see appendix G).

The CCFPD stocked 400 of 8-10 inch triploid grass carp into the lake on April 22, 1991. There has been no apparent reduction in the aquatic plants.

On June 17, 1996, 0.5 gallons of Aquathol K was applied (spot treatment) at the north end of the boat ramp area to treat curlyleaf pondweed and Eurasian water milfoil. There was no chemical treatment to the lake in 1996, 1997, and 1998.

The Illinois Department of Natural Resources (IDNR) has managed fish stocking. The fishing regulations for Homer Lake are as follows: two poles and lines fishing only; largemouth bass, 14 inches minimum length with a daily creel limit of six fish; northern pike, 24 inches minimum length with a daily creel limit of three fish; and channel catfish, daily creel limit of six fish.

Population Segments Adversely Affected by Lake Degradation

Fishermen and boats are affected by the gradual loss in lake surface area and depth due to sedimentation at the north east arm of the lake. During this study, the sampling boat could not go too far (10 to 20 feet) beyond station 3 (figure 4). The reduced depth in the northern portion of the lake has reduced the amount of favorable habitat for fish. Lake degradation also could adversely affect people who fish for recreation or to supplement their food supply. The lake becomes less attractive to boaters as the lake surface shrinks.

Lake degradation also could affect the environmental education program. It would not be as effective to show students a degraded lake. Lake degradation also could cause a decline in the preserve attendance due to reduced picnicking, hiking, bicycling, and camping values related to reduced aesthetics because of lake conditions. In addition, direct water contact activities such as boating and sailing could be affected by reduced water depths and water quality conditions. Reduced attendance could jeopardize revenues for operation and maintenance (O & M) of the preserve area.

Comparison to Other Lakes in the Region

Several major lakes are located in the vicinity of Homer Lake. Table 4 lists the Illinois public lakes that are within a 50-mile (80 km) radius of Homer Lake. Table 4 gives the names of these lakes and information about size, maximum depth, boat ramps, and lake uses. All of these lakes provide recreational opportunities, such as fishing, boating, etc. Only Lake Vermilion in Danville and the Georgetown Reservoir serve as public water supply sources.

Point Source Discharge

There is one point source of municipal discharges into the Homer Lake watershed. The village of Ogden (population 680), approximately 5.0 miles north of Homer Lake (figure 2), has a National Pollutant Discharge Elimination System permit (ILG-69145801-32). The allowable effluent water quality are: 25 milligrams per liter (mg/L) of monthly average carbonaceous biochemical oxygen demand (CBOD) and 37 mg/L of monthly average total suspended solids (TSS).

The Ogden wastewater treatment processes include one 6.2-acre nonaerated facultative lagoon, one 1.6-acre nonaerated facultative lagoon, and one 47,000 cubic feet rock filter. The effluent is exempted from disinfection. Its design average flow rate is 0.093 million gallons per day (mgd). The design maximum flow is 0.346 mgd. According to the monthly operational reports, from April 1997 through March 1998, the effluent monthly average CBOD ranged from 5 mg/L (November 1997) to 37 mg/L (February 1998), and the effluent monthly average TSS were between 13 (March 1998) and 49 mg/L (February 1998). Monthly average effluent CBOD in February 1998 exceeded the 25 mg/L limit. For TSS, July 1997, January 1998, and February 1998 exceeded the monthly average limit of 37 mg/L. Daily effluent flow of the plant ranged from zero to 0.448 mgd, with an average flow of 0.183 mgd. The concentrations of total nitrogen and phosphorus of the effluents were not determined.

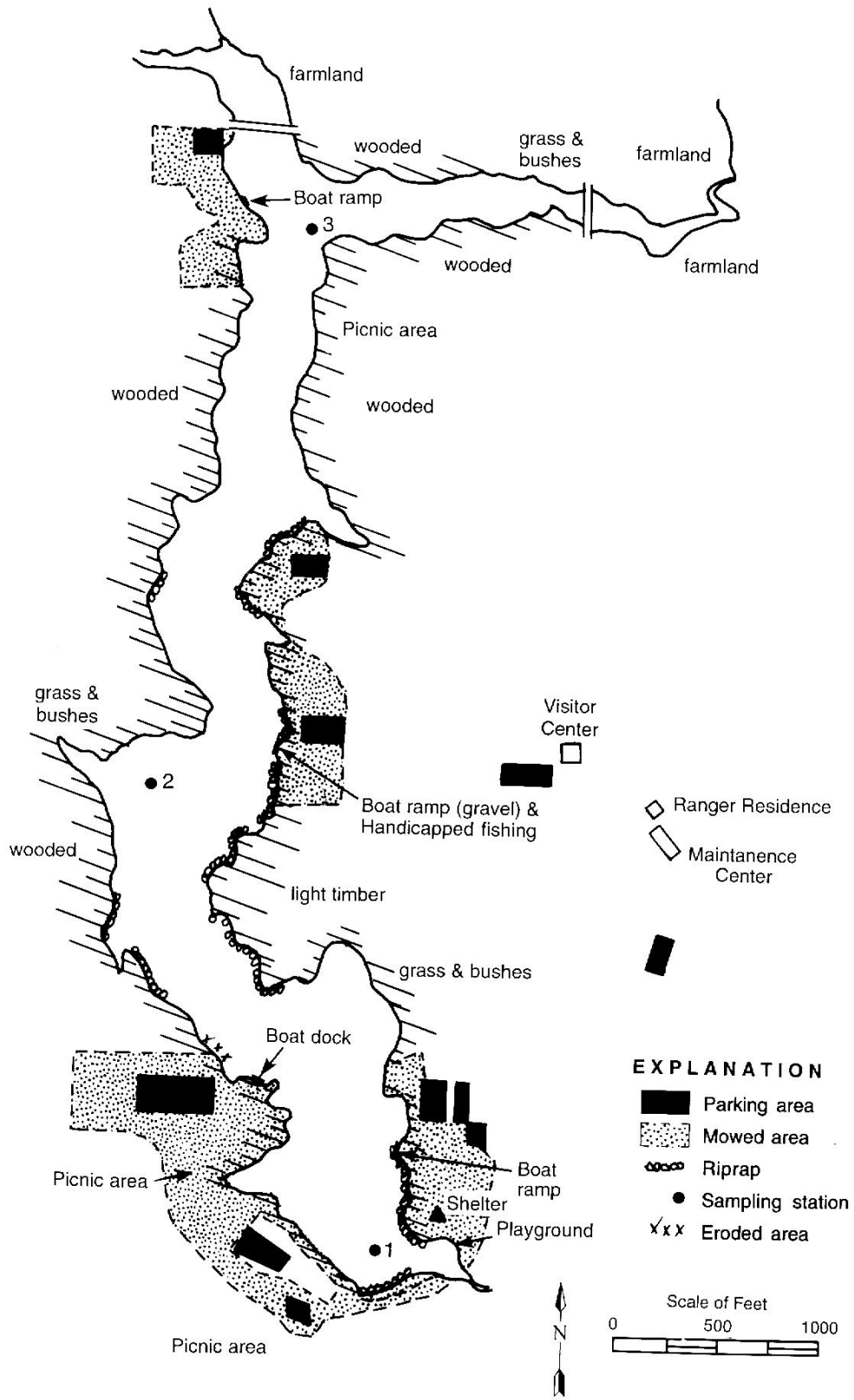


Figure 4. Shoreline and surrounding land types of Homer Lake and numbered sampling stations

Table 4. Illinois Public Lakes within a 50-Mile Radius of Homer Lake

<i>Lake name</i>	<i>County</i>	<i>Area, acres</i>	<i>Maximum depth, ft</i>	<i>Ramp</i>	<i>Lake use/ facilities*</i>
Iroquois	Iroquois	125.0	36.0		R,C,P,PK,F
Bayles	Iroquois	125.0	22.0		F
Dawson	McLean	150.0	28.0	1	P,PK,C,BR,F
Clinton	Dewitt	4895.0	40.0		S,R,P,F
Weldon Springs	Dewitt	29.4	28.0	1	S,R,P,PK,F
Mingo	Vermilion	170.0	41.0	1	F
Lake of the Woods	Champaign	23.2	28.0	1	F
Champaign Sportsmens Spring	Champaign	3.0	5.0		F
Crystal	Champaign	35.0	17.0		F
Kaufman	Champaign	38.5			R,P,PK,F
Vermilion	Champaign	10.0			PK,C,R,F
Vermilion	Vermilion	608.0	27.0	1	R,P,WS,F
Clear	Vermilion	7.0	53.0		R,C, P, PK,F
Long	Vermilion	56.6	39.0		R,P,F
Willow Creek	Vermilion	7.0	16.0		R,P,BR,F
Georgetown Reservoir	Vermilion	46.1	12.0	1	P,R,BR,WS,F
Walnut Point	Douglas	58.7	31.0	1	F
Oakland	Coles	23.4	9.0	1	R,P,F
Paris Twin east	Edgar	162.8	26.5	1	F
Paris Twin west	Edgar	56.7	8.5		B,P,F
Charleston Side Channel	Coles	346.0	20.0		F
Charleston	Coles	152.0	14.0	1	F
Mill Creek Pond	Clark	811.0	55.0		F
Ridge	Coles	15.0	24.9		F

Notes: *BR - boat rental, C - camping, P - picnicking, PK - park, R - recreation, S - swimming, WS - water supply, F - fishing. blank spaces - not applicable or not available.

Source: G. Good, Illinois EPA, personal communication, 1999.

The location of this discharge is 5 miles above the lake and would have minimal influence on the lake water quality. The discharges from this plant (0.183 mgd) are small in comparison to the average daily streamflow into the lake (10.7 mgd).

Land Use and Nonpoint Pollution Sources

Watershed Land Use

The primary land use in the watershed is row crop production (89.5 percent); an additional 2.2 percent of the watershed is in pasture or hay production. Forest, wetland, wildlife, and recreational areas make up 6.3 percent of the watershed. Residential and farmsteads are 2.0 percent. Residential development in the watershed has increased significantly during the study period.

There are 70 farms in the Homer Lake watershed, with an average farm size of 400 acres. There are no low income or minority farmers. The major type of farming is cash grain. Approximately 90 percent of farming is corn and soybean rotation.

Similar to other watersheds in Illinois, subsurface drainage systems are commonly used on cropland in the Homer Lake watershed. Subsurface drainage using clay tile or polyvinyl chloride pipes (so-called field tiles) can lower the water table enough to aerate the root zone and improve plant growth. Of the 8,300 acres of cropland in the watershed, approximately 2,300 acres have a whole-field subsurface drainage system. As is true with other watersheds in Illinois, field tile has been identified as a potential conduit for some nutrients and pesticides in water (L. Wendte, U.S. Natural Resources Conservation Service, personal communication, 1999).

Nonpoint Pollution Sources

The primary sources of nonpoint pollution are agricultural chemicals and fertilizers from tile drainage and eroded soils. There are no livestock operations in the watershed.

Watershed Soil Loss

An analysis was made of the estimated rainfall-based, cropland soil losses for the Homer Lake watershed. This analysis was made using the Universal Soil Loss Equation (USLE) developed by Wischmeier and Smith (1978). Specific adaptation of this method for Illinois soils is described in Walker and Pope (1980). The USLE accounts for a series of factors that are the most significant influences on the erosion of soil by precipitation.

The USLE is a calculation of in-field soil losses and does not account for deposition from the field to the stream or lake. Redeposition within the field or drainage system is accounted for by a sediment delivery ratio that defines the proportion of the upstream soil losses that actually pass through the stream. Because the Homer Lake watershed is predominantly field tile drained, there probably is a low sediment delivery ratio. Briefly, the USLE is:

$$A = RKSLC$$

where

A = the average annual soil loss rate in tons per acre per year,
R = a rainfall factor,
K = a soil erodibility factor,
S = a field slope factor,
L = a slope length factor,
C = a cropping factor.

The following values were used for each of these factors for Homer Lake:

- The rainfall factor (R) was set to 180, the value applicable for central Illinois.
- The soil erodibility factor (K) was determined from the Champaign County soil survey.
- The slope length factor (L) was set at 0.11 for general slope (S) of 0.5 percent and slope lengths of 200 feet.
- The cropping factor (C) was set at 0.49 for a corn and soybean rotation.

The average soil loss for each soil type was calculated and is presented in table 5. The watershed boundaries of the lake were determined from a 7.5 minute U.S. Geological Survey topographic map and digitized into a GIS coverage. This watershed coverage was then overlain on an existing soils delineation coverage for Champaign County. The soil loss summary in table 5 is for the 8,142 acres of the watershed that lies within Champaign County. Soil parameters used to calculate the soil losses in Champaign County were taken from the Soil Survey of Champaign County, Illinois (USDA-SCS, 1982).

Detailed soil survey information is not available for the Vermilion County portion of the watershed. The 1993- soil survey shows that the 208 acres of the watershed area in Vermilion County are approximately 40 percent Brenton (soil type 149), 40 percent Drummer (soil type 152), and 20 percent Catlin (soil type 171). Analyzing the Vermilion County soil data in the same manner as the Champaign County soil data, the annual soil loss for the Vermilion County portion of the watershed is 528 tons.

This analysis shows that the average annual soil loss in the watershed is 2.5 tons per acre per year. This results in a total soil loss of 20,744 tons of soil eroded per year in the watershed. Soil loss rates range from 1.8 to 3.3 tons per acre and tend to be highest from the less common soil types in the watershed. The annual soil losses from the predominant soil types in the watershed (soil type 152 Drummer silty clay loam and soil type 154 Flanagan silt loam) are 2.5 tons per acre. The large acreage of the Drummer (40.2 percent of the watershed) and Flanagan (23.4 percent) result in 63.3 percent of the watershed soil losses originating from these soils.

The results indicate very little variability in soil loss conditions in the watershed. Soil losses are also very low. These low values are a result of the low gradients (slopes) existing in the watershed. Maximum relief in the watershed is approximately 30 feet from the watershed

Table 5. Summary of Soil Losses in the Homer Lake Watershed Due to Precipitation Runoff

<i>Soil type</i>	<i>Areal coverage (acres)</i>	<i>Soil erodibility factor</i>	<i>Annual soil loss rate (tons/acre)</i>	<i>Total annual loss (tons)</i>	<i>Relative area (percent of area)</i>	<i>Relative soil loss (percent soil loss)</i>
27	19	0.37	3.3	61	0.2	0.3
56	251	0.32	2.8	707	3.1	3.5
67	56	0.28	2.5	139	0.7	0.7
102	217	0.28	2.5	537	2.7	2.7
125	256	0.28	2.5	631	3.1	3.1
131	56	0.24	2.1	118	0.7	0.6
134	11	0.37	3.3	36	0.1	0.2
148	40	0.32	2.8	112	0.5	0.6
149	142	0.28	2.5	350	1.7	1.7
150	119	0.20	1.8	210	1.5	1.0
152	3,272	0.28	2.5	8,079	40.2	40.0
153	468	0.28	2.5	1,156	5.7	5.7
154	1,905	0.28	2.5	4,705	23.4	23.3
171	260	0.32	2.8	733	3.2	3.6
198	309	0.28	2.5	764	3.8	3.8
199	122	0.32	2.8	344	1.5	1.7
206	3	0.37	3.3	9	0.0	0.0
219	41	0.32	2.8	116	0.5	0.6
221	6	0.32	2.8	18	0.1	0.1
223	53	0.32	2.8	149	0.6	0.7
233	46	0.37	3.3	149	0.6	0.7
234	78	0.32	2.8	221	1.0	1.1
236	29	0.37	3.3	95	0.4	0.5
243	31	0.37	3.3	100	0.4	0.5
291	23	0.37	3.3	76	0.3	0.4
322	19	0.37	3.3	62	0.2	0.3
330	93	0.28	2.5	230	1.1	1.1
402	48	0.28	2.5	119	0.6	0.6
481	44	0.28	2.5	110	0.5	0.5
570	28	0.37	3.3	81	0.3	0.4
802	2	0.00	0.0	0	0.0	0.0
999	96	0.00	0.0	0	1.2	0.0
Totals	8,140			20,200		
Averages		0.285	2.5			

Note: Blank spaces – not applicable

divide to the lake surface. For the overall 4-mile length of the watershed, this results in a slope factor of 0.14 percent.

Due to the predominance of tile drainage for this watershed, watershed nutrient loading and soil erosion cannot be correlated due to the effects of the tile drain system on the transport of nutrients. For tile drained fields, runoff concentrations for nitrate-nitrite will be elevated due to solution and transport through the soil column. Phosphorus is not readily transported through the soil; therefore, runoff concentrations tend to be much lower for watersheds in which tile drainage predominates (McIsaac et al., 1997)

Increasing residential lot development has been occurring in the watershed of the lake. For the short-term construction period, this development should be expected to increase both sediment and nutrient loading to the lake. As the residential lots become established, sediment loading can be expected to decline, but nutrient loading may remain high as a result of lawn maintenance fertilizer applications.

Past and Current Watershed Protection/Restoration Activities

The historical watershed management in Homer Lake watershed included 5 acres of grassed waterway, two ponds, 4,000 feet of field border strip, and 7,000 acres of conservation cropping system. The cropland tillage was: no-till, 18 percent of farmland; mulch till with 30 percent residue or more, 5 percent; mulch till with less than 30 percent residue, 72 percent; and moldboard plow, 5 percent (Lin and Raman, 1997).

There was no additional protection/restoration activity in the Homer Lake watershed during recent years.

BASELINE AND CURRENT LIMNOLOGICAL DATA

In order to evaluate the lake water quality, both historical and current limnological data were gathered. A sampling program was developed to collect data from the lake and its tributaries for 13 consecutive months, April 1997-April 1998. These data are referred to as the current baseline data. In situ monitoring and water and sediment sample collections were carried out. In addition, monitoring for macrophytes, a bathymetric survey, stage-level measurements, and flow determinations were carried out as required. The historical data were obtained from the Illinois EPA, other agencies, and publications.

Morphometric Data

The pertinent morphometric details of Homer Lake are presented with general lake information in table 1. Some data are again listed below:

<i>Item</i>	<i>English units</i>	<i>System International units</i>
Surface area	83.0 acres	33.6 hectares
Watershed area	9,280 acres	3,756 hectares
Maximum depth	19 feet	5.8 meters
Average depth	7.4 feet	2.3 meters
Shoreline length	5.3 miles	8.5 km
Storage capacity	614 ac-ft	757,000 cubic meters
Retention time	0.097 years	0.097 years

Materials and Methods

Field Measurements

In order to assess the current conditions of the lake, physical, chemical, and biological characteristics were monitored from April 21, 1997-April 15, 1998. The lake was monitored twice a month from May 1997-October 1997 and monthly from November 1997-April 1998. A total of 19 sampling visits were made.

During these sampling trips, lake water samples were collected at three sites (figure 4, stations 1, 2, and 3). In addition to the regular lake sampling, trips were made to the lake for collecting two tributaries (west and east) water samples during storm events (at the Illinois EPA's watershed gaging stations RBO 01 and RBO 02), from the spillway outflow (RBO 00, near lake station 1), and rain water.

Grab water samples were taken at 0.3 meter or m (1 foot) below the surface as surface sample and 0.6 m (2 feet) above the lake bottom for station 1 as near bottom samples. Only the surface samples were taken for stations 2 and 3 during the study period. Lake sediment samples also were collected twice at stations 1, 2, and 3 during this study period.

In situ observations for temperature, DO, and Secchi disc readings were made at the sampling sites on the lake. A DO meter (Yellow Springs Instrument model 58) with a 50-foot cable and probe was calibrated at the site using the saturated air chamber standardization procedure. Temperature and DO measurements were obtained in the water column at 0.3-m (1-foot) intervals from the surface.

Secchi disc visibility is a measure of a lake's water transparency, or its ability to allow sunlight penetration. Secchi disc transparencies were measured using an 8-inch diameter Secchi disc, which was lowered until it disappeared from view, and the depth was noted. The disc was

lowered further, then slowly raised until it reappeared. This depth also was noted, and the average of the two depths was recorded.

Water Chemistry

Grab samples for water chemistry analyses were collected near the surface (1 foot below), near the bottom (2 feet above the lake bottom if the water depth was greater than 10 feet), and at mid-depth for station 1 in two 500-milliliter (mL) plastic containers. Water samples for nutrient analyses were collected in 125-mL plastic bottles with and without filtration (0.45-micrometer or μm , membrane filter) that contained reagent-grade sulfuric acid as a preservative. These samples were kept on ice until transferred to the laboratory for analyses. Samples for metals were collected in 500-mL plastic bottles containing reagent-grade nitric acid as a preservative. Samples for organic analyses were collected in 1-gallon dark amber bottles filled to the brim without any headspace. The methods and procedures involved in the analytical determinations followed Illinois EPA methods.

Chlorophyll

Vertically integrated samples for chlorophyll and phytoplankton were collected using a weighted bottle sampler with a half-gallon plastic bottle. The sampler was lowered at a constant rate to a depth twice the Secchi depth, or to 0.6 m (2 feet) above the bottom of the lake, and raised at a constant rate to the surface. For chlorophyll analysis, a measured amount of sample was filtered through a Whatman GF/C (4.7-cm, glass microfiber filter) using a hand-operated vacuum pump. The chlorophyll filters then were folded into quadrants and wrapped in aluminum foil. The filtrate volume was measured using a graduated cylinder. Filters were kept frozen in the laboratory until analyzed. Chlorophyll concentrations were analyzed by the Illinois EPA.

Macrophytes

A macrophyte survey was conducted on August 21, 1997, by the Illinois EPA field staff. The entire perimeter of the lake was surveyed by moving a boat along the shoreline and macrophyte communities. Visible macrophyte areas were sketched onto the lake map with indication of the size and density of each macrophyte zone. Macrophytes were identified by common name as accurately as possible. If growth of an unidentified species was present, a specimen was collected to identify at the field office. The survey enabled the delineation of the areal extent and abundance of macrophytes in the lake.

While surveying the lake perimeter, the amount of each type of major shoreline development/land use also was noted. Land-use categories included, but were not limited to, woodland, pasture, residential, shrub/brush, golf course, picnic/camping, grass bordered crop, wetland, highway/dam, and industries.

Sediment

Surficial sediment samples were collected using an epoxy-coated Ekman dredge. Portions of each sample were placed in a 250-mL plastic bottle for metal and nutrient analyses and in a

specially prepared 200-mL glass bottle for trace organics analyses according to the Illinois EPA guidelines (1987).

Data Analyses

Statistical analyses were performed for means and standard deviation for each grouped data. Student's *t*-test was used to evaluate any significant difference between the mean concentrations of the historical data (1989 and 1995) and the current study data (1997-1998).

In-Lake Water Quality

The analytical results of historical samples and routine water samples (current study) from four sampling stations in Homer Lake, are listed in appendices A and B, respectively. Water quality data provided include turbidity, Secchi disc transparency, conductivity, pH, total and phenolphthalein alkalinity, total and volatile suspended solids, nitrogen (ammonia, nitrate-nitrite, and total Kjeldahl), and total and dissolved phosphorus. Sampling dates and site depths also are given.

For both the historical and current datasets, the water samples were collected either by Illinois EPA personnel or by a volunteer trained and approved by the Illinois EPA. All samples were collected using water sample collection protocols established by the IEPA. Sampling frequencies were either monthly or bi-weekly. All the chemical analyses were performed by the Illinois EPA's Analytical Laboratory with the same analytical procedures. On the basis of the sampling procedures, frequency of sampling, and analytical methods used, the use of Student's *t*-test to analyze the difference of means can provide meaningful results.

The observed data for each station are divided into two groups: historical and current study data. The mean values of historical and current water quality data for each station are summarized in table 6. The historical and current conditions of most parameters monitored were compared for stations 1S, 1B, 2S, and 3S. The results of statistical analyses with Student's *t*-tests are given in table 7. The upward arrows in the table indicate that the mean water quality parameter at a station during this study period was significantly (95 percent confidence level) higher than that during the past. The downward arrows indicate the reverse condition. The equal sign suggests that there is no significant difference between the two means of a water quality parameter.

Physical Characteristics

Temperature and Dissolved Oxygen. Lakes in the temperate zone generally undergo seasonal variations in temperature throughout the water column. These variations, with their accompanying phenomena, are perhaps the most influential controlling factors within the lakes.

The temperature of a deep lake in the temperate zone is about 4°C during early spring. As air temperatures rise, the upper layers of water warm up and are mixed with the lower layers by wind action. Spring turnover is a complete mixing of a lake when the water temperature is uniform from top to bottom. By late spring, differences in thermal resistance cause the mixing to

Table 6. Mean Values of Water Quality Characteristics for Current Study and Historical Data

<i>Characteristics</i>	<i>Station 1 surface</i>		<i>Station 1 bottom</i>		<i>Station 2 surface</i>		<i>Station 3 surface</i>	
	<i>Hist.</i>	<i>Current</i>	<i>Hist.</i>	<i>Current</i>	<i>Hist.</i>	<i>Current</i>	<i>Hist.</i>	<i>Current</i>
Turbidity, NTU	4.9	7.3	9.1	8.9	4.5	7.9	7.0	13.3
Secchi transparency, in	37	29			39	22	23	12
Conductivity, $\mu\text{mho/cm}$	528	514	492	497	498	518	531	532
Alkalinity, mg/L as CaCO_3								
Total	174	167	190	160	169	181	179	186
Phenolphthalein	6	6	0	5	5	6	0	8
Total suspended solids, mg/L	7	15	21	24	9	21	19	33
Volatile suspended solids, mg/L	4	6	9	8	4	8	6	9
Ammonia-nitrogen, mg/L	0.093	0.147	0.807	0.188	0.107	0.139	0.157	0.207
Total Kjeldahl nitrogen, mg/L	0.76	0.80	1.19	0.84	0.84	0.91	0.96	0.92
Nitrate/nitrite-nitrogen, mg/L	6.55	4.92	4.80	3.80	6.05	3.94	6.29	4.72
Total phosphorus, mg/L	0.044	0.061	0.105	0.066	0.049	0.087	0.078	0.107
Dissolved phosphorus, mg/L	0.016	0.034	0.085	0.028	0.030	0.030	0.024	0.014

Notes: Hist. – historical, NTU – nephelometric turbidity unit, mg/L – milligrams per liter, CaCO_3 – calcium carbonate, blank spaces – not applicable.

**Table 7. Analyses of Differences at a 95 Percent Confidence Level
in Means of the Current Study versus Historical Data**

<i>Parameter</i>	<i>Station 1</i>		<i>Station 2</i>	<i>Station 3</i>
	<i>Surface</i>	<i>Bottom</i>	<i>Surface</i>	<i>Surface</i>
Turbidity, NTU	=	=	=	=
Secchi transparency, inches	=	=	↓	↓
Conductivity, μmho/cm	=	=	=	=
Alkalinity, mg/L as CaCO ₃				
Total	=	=	=	=
Phenolphthalein	=	↑	=	↑
Suspended solids, mg/L				
Total	↑	=	↑	↑
Volatile	↑	=	↑	↑
Nitrogen, mg/L				
Ammonia	=	↓	=	=
Total Kjeldahl	=	↓	=	=
Nitrate/nitrite	=	=	=	=
Phosphorus, mg/L				
Total	=	=	=	=
Dissolved	=	=	=	=
Chlorophyll	=	=	↑	↑

Notes: ↑ - indicates the current mean is greater than historical mean
 ↓ - indicates the current mean is less than historical mean
 = - indicates no significant difference between the two means
 NTU - nephelometric turbidity unit
 μmho/cm - micromho per centimeter
 CaCO₃ - calcium carbonate
 Blank space - not applicable

cease, and the lake approaches the thermal stratification of the summer season. Almost as important as water temperature variations is the physical phenomenon of increasing density with decreasing temperature. These two interrelated forces are capable of creating strata of water of vastly different characteristics within the lake.

During thermal stratification, the upper layer (epilimnion) is isolated from the lower layer (hypolimnion) of water by a temperature gradient (thermocline). Temperatures in the epilimnion and hypolimnion are essentially uniform. The thermocline typically will have a sharp temperature drop per unit depth from the upper to the lower margin. When thermal stratification

is established, the lake enters the summer stagnation period, so named because the hypolimnion becomes stagnated.

With cooler air temperatures during the fall, the temperature of the epilimnion decreases and the density of the water increases. This decrease in temperature continues until the epilimnion is the same temperature as the upper margin of the thermocline. Successive cooling through the thermocline to the hypolimnion results in a uniform temperature throughout the water column. The lake then enters the fall circulation period (fall turnover) and is again subjected to a complete mixing by the wind.

Declining air temperatures and the formation of ice cover during the winter produce a slightly inverse thermal stratification. The water column is essentially uniform in temperature at about 3-4°C, but slightly colder temperatures of 0-2°C prevail just below the ice. With the advent of spring and gradually rising air temperatures, the ice begins to disappear and the temperature of the surface water rises. The lake again becomes uniform in temperature, and spring circulation occurs (spring turnover).

The most important phase of the thermal regime from the standpoint of eutrophication is the summer stagnation period. The hypolimnion, by virtue of its stagnation, traps sediment materials such as decaying plant and animal matter, thus decreasing the availability of nutrients during the critical growing season. In a eutrophic lake, the hypolimnion becomes anaerobic, or devoid of oxygen, because of the increased content of highly oxidizable material and because of its isolation from the atmosphere. In the absence of oxygen, the conditions for chemical reduction become favorable, and more nutrients are released from the bottom sediments to the overlying waters.

However, during the fall circulation period, the lake water becomes mixed, and the nutrient-rich hypolimnetic waters are redistributed. The nutrients that remain trapped during the stagnation period become available during the following growing season. Therefore, a continuous supply of plant nutrients from the drainage basin is not mandatory for sustained plant production. After an initial stimulus, the recycling of nutrients within a lake might be sufficient to sustain highly productive conditions for several years.

Impoundment of running water alters its physical, chemical, and biological characteristics. The literature is replete with detailed reports on the effects of impoundments on various water quality parameters (Kothandaraman and Evans, 1982, 1983a, b; Raman et al., 1996; Raman and Twait, 1994). The physical changes in the configuration of the water mass following impoundment reduce reaeration rates to a small fraction of those of free-flowing streams. When the depth of impoundment is considerable, thermal stratification acts as an effective barrier for the wind-induced mixing of the hypolimnetic zone. Oxygen transfer to the deep waters is essentially confined to the molecular diffusion transport mechanism.

During the period of summer stagnation and increasing water temperatures, the bacterial decomposition of the bottom organic sediments exerts a high rate of oxygen demand on the overlying waters. When the rate of oxygen demand exceeds oxygen replenishment by molecular

diffusion, anaerobic conditions begin to prevail in the zones adjacent to the lake bottom. Hypolimnetic zones of artificial impoundments also were found to be anaerobic within a year of their formation (Kothandaraman and Evans, 1983a, b).

The isothermal and isodissolved oxygen concentration plots for Homer Lake at station 1 is shown, respectively, in figures 5 and 6. Water depths at this station were greater than 10 feet when lakes typically exhibit the thermal stratification during summer months.

An examination of the isothermal and isodissolved oxygen profiles at station 1 (figures 5 and 6), which has a maximum depth of about 17 feet, indicates that the temperature and DO concentrations were nearly uniform from surface to bottom from September 1997 to March 1998. Then the lake exhibited very typical stratification phenomenon. Stratification began in late April to early May, intensified, and reached a peak in July and remained so through the middle of October. The fall turnover occurred by the middle of October. The maximum temperature difference at station 1 from surface to bottom was 11.1°C on June 23, 1997. However, less stratification occurred on August 21 and August 25, 1997. This was due to the 3-inch storm that occurred on August 17, 1997, and 1-inch storm on August 25, 1997.

Concomitant with the thermal stratification in the lake, DO levels began to decrease in the bottom waters in late May. The DO depletion in the deeper waters intensified during the summer months and became a mirror image of the thermal stratification phenomenon. Oxygen depletion reached a peak by late July and remained so through the end of September (except in late August). The oxygen condition in the deeper waters improved gradually during October. The lake became uniform in DO when the fall turnover occurred in mid October. There was no oxygen at depths below 8 feet from the surface during summer stratification.

Generally the observations made for station 1 are true for station 2, which has a maximum water depth of 10 feet (appendix C). Stratification at station 2 occurred from June 23, 1997-September 1997, except late August with storm events. Oxygen depletion during summer stratification occurred at depths below 8-9 feet from the surface. Maximum temperature gradient observed at station 2 was 6.2°C on June 23, 1997.

Station 3, which is relatively shallow (3-5 feet), exhibited minimal temperature gradient and very good oxygen conditions throughout the water column (appendix C). Percent DO saturation values were determined for the observed DO and temperature and are given in appendix C. Saturation DO values were computed using the formula (Committee on Sanitary Engineering Research, 1960):

$$DO = 14.652 - 0.410022T + 0.0079910T^2 - 0.000077774T^3$$

where

DO = the saturation dissolved oxygen, mg/L

T = water temperature, °C

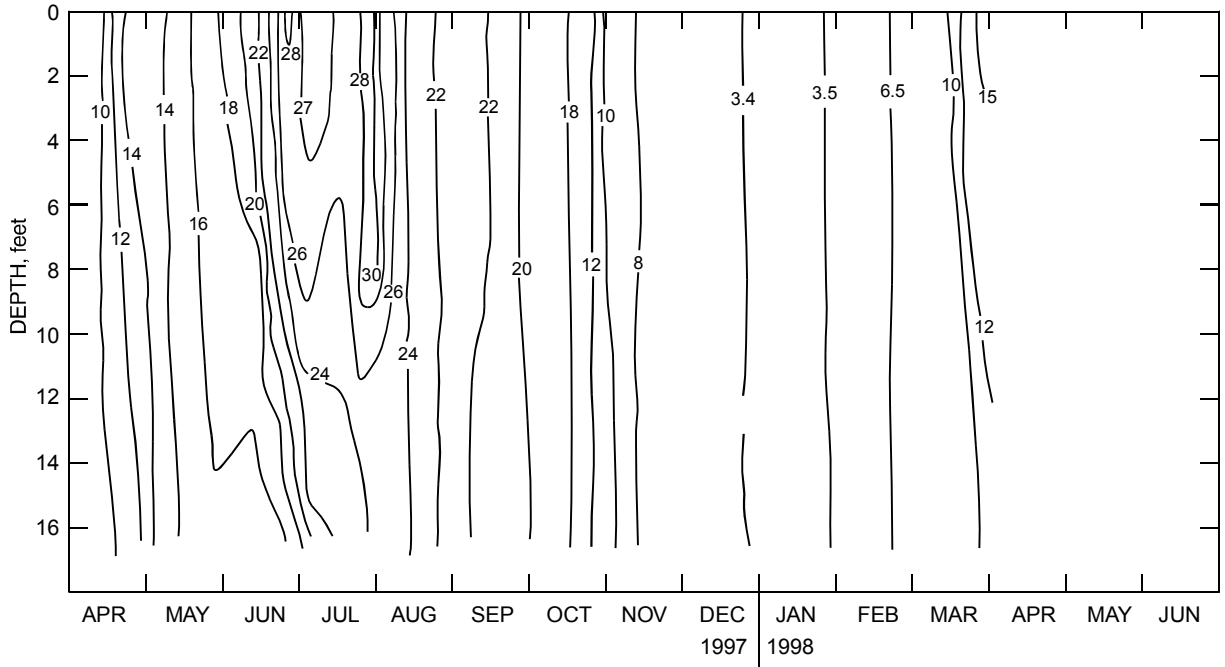


Figure 5. Isothermal plots for station 1

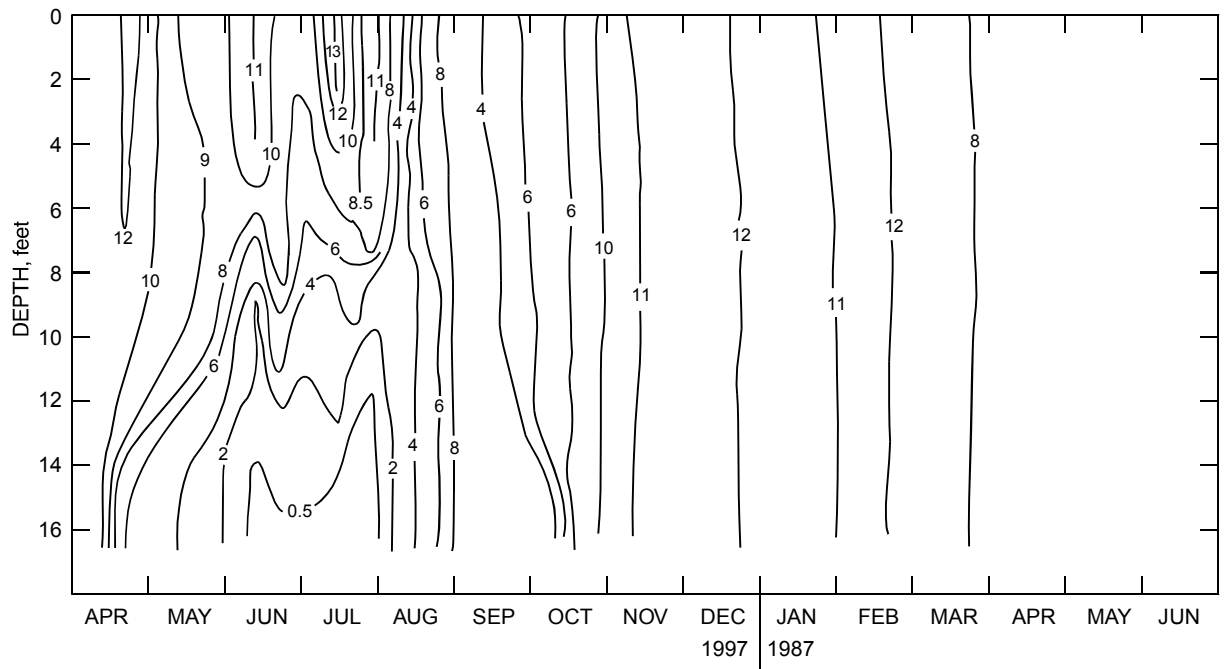


Figure 6. Isodissolved oxygen plots for station 1

The computed DO percent saturation values in Homer Lake at stations 1, 2, and 3 also are included in appendix C. The highest percent saturation values observed during the current study at stations 1, 2, and 3 were, respectively, 125, 125, and 130. These highest values occurred on July 14, 1997, July 28, 1997, and June 23, 1977 for stations 1, 2, and 3, respectively. The data presented in appendix C bring out the fact that oxygen was depleted in the lake at a depth of about 8-9 feet below the surface during summer months.

Turbidity. Turbidity is an expression of the property of water that causes light to be scattered and absorbed by a turbidimeter; it is expressed as nephelometric turbidity units (NTU). Turbidity in water is caused by colloidal and suspended matter, such as silt, clay, finely divided inorganic and organic materials, soluble colored organic compounds, plankton, and other microorganisms. Generally, turbidity in lake waters is influenced by sediment in runoff from a lake's watershed, shoreline erosion, algae in the water column, resuspension of lake bottom sediments by wind or wave action, by bottom-feeding fish, power boats, etc. Elevated turbidity values make the appearance of a lake less pleasing aesthetically.

During the current (1997-1998) study, the ranges of turbidity at stations 1S, 2S, 3S, and 1B were, respectively, 0.3-45, 1-69, 1-87, and 2-46 NTU. The maximum turbidity for all stations was observed on March 30, 1998. In 1998, 1-, 1-, 1-, and 2.5-inch storms occurred on March 9, 17, 20, and 28, respectively. The means and \pm standard deviations of turbidity at these stations were, respectively, 10.0 ± 10.6 , 11.2 ± 15.3 , 13.3 ± 19.2 , and 10.5 ± 10.7 NTU (appendices B1-B4). The mean turbidity at all stations was less than the 25 NTU limit.

High turbidity at station 3 occurred on March 30 and April 15, 1998, due to storms. High turbidity values also were found on August 25 and October 23, 1997, at all four stations, except on August 25, 1997, at station 1.

In the historical data in appendices A1-A4, the values of maximum turbidity are less meaningful because storm event samples most likely were not collected. Nevertheless, comparisons of historical and current turbidity data suggest that the current mean turbidity at stations 1S, 1B, 2S, and 3S were higher than the historical means, respectively, but not statistical difference at a 95 percent confidence level (table 7).

Secchi Disc Transparency. Secchi disc visibility is a measure of the lake's water transparency, which suggests the depth of light penetration into a body of water (its ability to allow sunlight penetration). Even though the Secchi disc transparency is not an actual quantitative indication of light transmission, it provides an index for comparing similar bodies of water or the same body of water at different times. Because changes in water color and turbidity in deep lakes are generally caused by aquatic flora and fauna, transparency is related to these entities. The euphotic zone or region of a lake in which enough sunlight penetrates to allow photosynthetic production of oxygen by algae and aquatic plants is taken as two to three times the Secchi disc depth (USEPA, 1980).

Suspended algae, microscopic aquatic animals, suspended matters (silt, clay, and organic matter), and water color are factors that interfere with light penetration into the water column and reduce Secchi disc transparency. Combined with other field observations, Secchi disc readings

may furnish information on suitable habitat for fish and other aquatic life, the lake's water quality and aesthetics, the state of the lake's nutrient enrichment, and problems and potential solutions for the lake's water quality and recreational use impairment.

During the study period, mean values observed for Secchi disc transparency at stations 1, 2, and 3 were 27, 26, and 14 inches, respectively (appendices B1-B3). The ranges were, respectively, 4-54, 4-66, and 4-28 inches. The lowest transparency was observed on March 30, 1998. Stations 1 and 2 have the best Secchi disc transparency, with the exception of this date.

The overall historical mean transparency for stations 1, 2, and 3 were, respectively, 37, 39, and 23 inches (appendices A1-A3). The mean transparency for the current study at stations 2 and 3 were significantly decreased from the historical values (table 7), but no difference was noted for station 1.

The Illinois EPA's Lake Assessment Criteria (IEPA, 1978) state that Secchi depths less than 18 inches indicate substantial lake-use impairment, and depths between 18 and 48 inches indicate moderate lake-use impairment. The Illinois Department of Public Health has adopted the minimum Secchi transparency for bathing beaches of 48 inches, which was set by the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers (1975). Nevertheless, a lake that does not meet the transparency criteria does not necessarily constitute a public health hazard, if it is not used for swimming. On the basis of these criteria, during this study station 3 was classified as substantial use-impairment; stations 1 and 2 were classified as moderate use-impairment.

Chemical Characteristics

pH. The pH value, or hydrogen ion concentration, is a measurement of the acidity in water. Values below 7.0 indicate acidic water, and values above 7.0 indicate basic (or alkaline) water. A pH of 7.0 is exactly neutral. The pH values are influenced by the concentration of carbonate in the water. One species of carbonate, carbonic acid, which forms as a result of dissolved carbon dioxide, usually controls pH to a great extent. Carbonic acid also is consumed by the photosynthetic activity of algae and other aquatic plants after the free carbon dioxide in water has been used up. A rise in pH can occur due to photosynthetic uptake of carbonic acid, causing water to become more basic. Decomposition and respiration of biota tend to reduce pH and increase bicarbonates.

In general, pH values above 8.0 in surface waters are considered to be produced by a photosynthetic rate that demands more carbon dioxide than the quantities furnished by respiration and decomposition (Mackenthun, 1969). Although rainwater in Illinois is acidic (pH about 4.4), most of the lakes can offset this acidic input by an abundance of natural buffering compounds in the lake water and the watershed. Most Illinois lakes have a pH between 6.5 and 9.0. The Illinois Pollution Control Board or IPCB (IEPA, 1999) general-use water quality standard for pH also ranges from 6.5-9.0, except for natural causes.

During the current study, the ranges of pH values at the lake surface waters were 7.9-8.4, 7.8-8.5, and 7.8-8.7 at stations 1, 2, and 3, respectively (appendices B1-B3). No sample exceeded

pH 9.0. When pH values in a water approach 8.0 and above, an increase in photosynthetic activity frequently occurs.

The pH values at the lake bottom water at station 1 were between 7.2 and 8.4 (appendix B4). Homer Lake pH values met the state standard of 6.5 to 9.0 for general use water quality.

In appendices A1-A4, the pH values at the three surface water sites ranged from 7.8-9.0 and from 6.9-8.2 in the bottom waters at station 1. Comparison of historical and current pH data indicates that the current pH values at station 1S, 2S, 3S, and 1B are similar to the historical values.

Alkalinity. The alkalinity of a water is its capacity to accept protons, and it is generally imparted by bicarbonate, carbonate, and hydroxide components. The species makeup of alkalinity is a function of pH and mineral composition. The carbonate equilibrium, in which carbonate and bicarbonate ions and carbonic acid are in equilibrium, is the chemical system present in natural waters.

Alkalinity is a measure of a water's acid-neutralizing capacity. It is expressed in terms of an equivalent amount of calcium carbonate (CaCO_3). Total alkalinity is defined as the amount of acid required to bring water to a pH of 4.5, and phenolphthalein alkalinity is measured by the amount of acid needed to bring water to a pH of 8.3 (APHA et al., 1998).

Lakes with low alkalinity are, or have the potential to be, susceptible to acid rain damage. However, Midwest lakes usually have a high alkalinity and thus are well buffered from the impacts of acid rain. Natural waters generally have a total alkalinity between 20 and 200 mg/L (APHA et al., 1992).

Total Alkalinity. During this study, the range of total alkalinity for lake water at stations 1S, 2S, 3S, and 1B were 134-254, 146-255, 140-274, and 134-180 mg/L as CaCO_3 , respectively; their means were, respectively, 167, 181, 186, and 160 mg/L as CaCO_3 (appendices B1-B4). Total alkalinity at stations 2S and 3S are similar. Total alkalinity for surface and near bottom waters were similar at site 1.

Historical data on total alkalinity at stations 1S, 2S, 3S, and 1B ranged from 130-282, 110-241, 140-258, and 130-274 mg/L as CaCO_3 ; means were 184, 169, 179, and 190 mg/L as CaCO_3 , respectively. Total alkalinity (historical data) for surface waters at stations 1-3 also were similar (appendix A).

As shown in table 7, the lake water total alkalinity in the current study was not significantly different from the past.

Phenolphthalein Alkalinity. Phenolphthalein alkalinity in lake waters generally was found only during warm weather periods (with high pH periods) in low concentrations. The highest phenolphthalein alkalinity observed was 20 mg/L as CaCO_3 at station 3S on October 23, 1997 (appendix B3).

Historical data show zero phenolphthalein alkalinity at stations 3S and 1B (appendices A3 and A4). The current phenolphthalein alkalinity concentrations were increased only at these two stations compared to the historical data (table 7).

Conductivity. Specific conductance provides a measure of a water's capacity to convey electric current and is used as an estimate of the dissolved mineral quality of water. This property is related to the total concentration of ionized substances in water and the temperature at which the measurement is made. Specific conductance is affected by factors such as the nature of dissolved substances, their relative concentrations, and the ionic strength of the water sample. The geochemistry of the soils in the drainage basin is the major factor determining the chemical constituents in the waters. The higher the conductivity reading, the higher the concentration of dissolved minerals in the lake water. Practical applications of conductivity measurements include determination of the purity of distilled or deionized water, quick determination of the variations in dissolved mineral concentrations in water samples, and estimation of dissolved ionic matter in water samples.

Conductivity in Homer Lake during the current study ranged from 248 micromhos per centimeter ($\mu\text{mho/cm}$) at station 1B on August 21, 1997, to 650 $\mu\text{mho/cm}$ at station 3S on April 15, 1998 (appendices B1-B4). The mean conductivity values for lake waters at stations 1S, 2S, 3S, and 1B were, respectively, 514, 518, 532, and 497 $\mu\text{mho/cm}$. These values are higher than typical of Illinois lake waters (Lin et al., 1996, 1999). The Illinois General Use Water Quality Standards for total dissolved solids is 1,000 mg/L (IEPA, 1999), which is approximately equivalent to a conductivity of 1,700 $\mu\text{mho/cm}$. The observed conductivity values did not exceed this criterion.

For historical data, the lowest conductivity was 249 $\mu\text{mho/cm}$ at station 1B on June 5, 1989. The highest conductivity observed was 725 $\mu\text{mho/cm}$ at station 1S on April 25, 1995 (appendices A1-A4). The mean conductivity values for the historical data at stations 1S, 2S, 3S, and 1B were 528, 498, 531, and 492 $\mu\text{mho/cm}$, respectively.

Comparing the current and historical data of conductivity for stations 1S, 2S, 3S, and 1B, no significant change with time could be discerned (table 7).

Total Suspended Solids. Total suspended solids (TSS) are the portion of total solids retained by a filter $\leq 2.0 \mu\text{m}$ nominal pore size. Total solids is the term applied to the material residue left in the vessel after evaporation of a sample and its subsequent drying in an oven at 103-105°C. Total solids include TSS and total dissolved solids, the portion that passes through the filter (APHA et al., 1998).

Total suspended solids represent the amount of all inorganic and organic materials suspended in the water column. Typical inorganic components originate from the weathering and erosion of rocks and soils in a lake's watershed and from resuspension of lake sediments. Organic components are derived from a variety of biological origins, but in a lacustrine environment they mainly are composed of algae and resuspended plant and animal material from the lake bottom.

Generally, the higher the TSS concentration, the lower the Secchi disc reading. A high TSS concentration results in decreased water transparency, which can reduce photosynthetic activities beyond a certain depth in the lake and subsequently decrease the amount of oxygen produced by algae, possibly creating anoxic conditions. Anaerobic water may limit fish habitats and potentially cause taste and odor problems by releasing noxious substances such as hydrogen sulfide, ammonia, iron, and manganese from the lake bottom sediments. A high concentration of TSS also may cause aesthetic problems in the lake.

The amount of suspended solids found in impounded waters is smaller compared with the amount found in streams because solids tend to settle to the bottom in lakes. However, in shallow lakes, this aspect is greatly modified by wind and wave actions and by the type and intensity of uses to which these lakes are subjected.

As shown in appendices B1-B4, the highest TSS concentration (122 mg/L) occurred during this study at station 1S on March 30, 1998, because of storm events during March 1998. The mean TSS at stations 1S, 2S, 3S, and 1B were 21, 21, 33, and 26 mg/L, respectively. As expected, higher TSS values were found in the surface waters at station 3.

Referring to appendices A1-A4 for the historical data, the mean TSS values at stations 1S, 2S, 3S, and 1B were, respectively, 7, 9, 19, and 21 mg/L. The overall range of historical TSS values was between 1 and 46 mg/L. In comparison, the current TSS values for the surface water were higher than historical values for all three surface stations. There were no significant differences in TSS values for the bottom waters at site 1 (table 7).

On the basis of the Illinois Lake Assessment Criteria (IEPA, 1978), water with TSS > 25 mg/L is classified as having a high lake-use impairment; TSS between 15 and 25 mg/L indicates moderate-use impairment; TSS < 15 mg/L is considered to have minimal impairment. In this study, the number of samples that exceeded TSS levels of 25 mg/L were 0, 26, 68, and 12 percent of samples at stations 1S, 2S, 3S, and 1B, respectively. At the same stations, the percent of samples having TSS values between 15 and 25 mg/L were 50, 32, 21, and 53, respectively. On the basis of TSS, waters at all stations might be considered as at least moderately impaired.

Volatile Suspended Solids. Volatile suspended solids (VSS) are the portion of TSS lost to ignition at $500 \pm 50^\circ\text{C}$. The VSS represent the organic portion of TSS, such as phytoplankton, zooplankton, other biological organisms, and other suspended organic detritus. Resuspended sediments and other plant and animal matter resuspended from the lake bottom by bottom-feeding fish, wind action, or human activities can be major contributors of VSS and TSS.

The VSS levels in the surface and bottom samples at all four stations ranged from 1 (station 2S on June 23, 1997) to 22 mg/L (at station 1S on August 25, 1997, and March 30, 1998) during the current study. Mean VSS were 7, 8, 9, and 8 mg/L at station 1S, 2S, 3S, and 1B, respectively (appendices B1-B4).

Appendices A1-A4 reveal that the historical mean VSS at stations 1S, 2S, 3S, and 1B were, respectively, 4, 4, 6, and 9 mg/L. Comparing the historical and current data, the VSS increased at stations 1S, 2S, and 3S; but there were no differences in VSS at station 1B (table 7).

Nitrogen. Nitrogen is generally found in surface waters in the form of ammonia (NH_3), nitrite (NO_2), nitrate (NO_3), and organic nitrogen. Organic nitrogen is determined by subtracting NH_3 nitrogen from the total Kjeldahl nitrogen (TKN) measurements. Organic nitrogen content can indicate the relative abundance of organic matter (algae and other vegetative matter) in water, but it has not been shown to be directly used as a growth nutrient by planktonic algae (Vollenweider, 1968). Total nitrogen is the sum of nitrite, nitrate, and TKN. Nitrogen is an essential nutrient for plant and animal growth, but it can cause algal blooms in surface waters and create public health problems at high concentrations. The IPCB has stipulated (IEPA, 1999) that nitrate not exceed 10 mg/L nitrate-nitrogen or 1 mg/L nitrite-nitrogen for public water-supply and food-processing waters.

Nitrates are the end product of the aerobic stabilization of organic nitrogen, and as such they occur in polluted waters that have undergone self-purification or aerobic treatment processes. Nitrates also occur in percolating ground waters. Ammonia-nitrogen, a constituent of the complex nitrogen cycle, results from the decomposition of nitrogenous organic matter. It also can result from municipal and industrial waste discharges to streams and lakes.

The concerns about nitrogen as a contaminant in water bodies are twofold. First, because of adverse physiological effects on infants and because the traditional water treatment processes have no effect on the removal of nitrate, concentrations of nitrate plus nitrite as nitrogen are limited to 10 mg/L in public water supplies. Second, a concentration in excess of 0.3 mg/L is considered sufficient to stimulate nuisance algal blooms (Sawyer, 1952). The IEPA (1999) stipulates that ammonia-nitrogen and nitrate plus nitrite as nitrogen should not exceed 1.5 and 10.0 mg/L, respectively.

Nitrogen is one of the principal elemental constituents of amino acids, peptides, proteins, urea, and other organic matter. Various forms of nitrogen (for example, dissolved organic nitrogen and inorganic nitrogen such as ammonium, nitrate, nitrite, and elemental nitrogen) cannot be used to the same extent by different groups of aquatic plants and algae.

Vollenweider (1968) reports that, in laboratory tests, the two inorganic forms of ammonia and nitrate are, as a general rule, used by planktonic algae to roughly the same extent. However, Wang et al. (1973) reported that, during periods of maximum algal growth under laboratory conditions, ammonium-nitrogen was the source of nitrogen preferred by plankton. With higher initial concentrations of ammonium salts, yields were noted to be lower than with equivalent concentrations of nitrates (Vollenweider, 1968). This was attributed to the toxic effects of ammonium salts. The use of nitrogenous organic compounds has been noted by several investigators, according to Hutchinson (1957). However, Vollenweider (1968) cautions that the direct use of organic nitrogen by plankton has not been established definitely, citing that not 1 of 12 amino acids tested with green algae and diatoms was a source of nitrogen when bacteria-free cultures were used. But the amino acids were completely used up after a few days when the cultures were inoculated with a mixture of bacteria isolated from water. Vollenweider (1968) has stated that, in view of the fact there are always bacterial fauna active in nature, the question of the use of organic nitrogen sources is of more interest to physiology than to ecology.

Ammonia-Nitrogen. As shown in appendices B1-B4, during this study the minimum ammonia-nitrogen (NH₃-N) concentration was 0.01 mg/L for the three routine surface water sampling stations. The maximum NH₃-N levels observed for stations 1S, 2S, 3S, and 1B were 0.38, 0.29, 1.10, and 0.47 mg/L, respectively. At the same stations, the mean ammonia concentrations were, respectively, 0.16, 0.14, 0.21, and 0.19 mg/L.

The Illinois General Use Water Quality Standards (IEPA, 1999) of NH₃-N vary according to water temperature and pH values, with the allowable concentration of NH₃-N decreasing as temperature and pH rise. High water temperatures and pH increase the toxicity of NH₃-N for fish and other aquatic organisms. The allowable concentration of NH₃-N for the lake waters varied from 1.5-13.0 mg/L, depending on the observed temperature and pH values. The observed data in Homer Lake showed that the NH₃-N values are well within the upper limit of the standards.

For historical data, the mean NH₃-N concentrations for stations 1S, 2S, 3S, and 1B were 0.09, 0.11, 0.16, and 0.81 mg/L, respectively (appendices A1-A4). Based on the statistical comparison, NH₃-N values for surface waters in the current study were no different from the historical means. In contrast, mean NH₃-N value for bottom waters (station 1B) in the current study were less than the historical means (table 7).

Total Kjeldahl Nitrogen. During this study, TKN values in Homer Lake ranged from 0.41 mg/L at station 1B on July 28, 1997, to 1.80 mg/L at station 3S on March 30, 1998 (appendices B1-B4). Results in appendices B1-B4 show that mean TKN levels at stations 1S, 2S, 3S, and 1B were 0.88, 0.91, 0.92, and 0.91 mg/L, respectively.

For historical data, TKN ranged from 0.10 mg/L at station 1S on April 25, 1995, to 2.80 mg/L at station 1B on August 30, 1995 (appendices A1-A4). Mean TKN concentrations for stations 1S, 2S, 3S, and 1B were, respectively, 0.76, 0.84, 0.96, and 1.19 mg/L (appendices A1-A4). Mean TKN at station 1B in this study was significantly less than the historical mean. At stations 1S, 2S, and 3S, mean TKN in the current study was comparable to the historical mean (table 7).

An examination of the data for NH₃-N, nitrate/nitrite-nitrogen (NO₃/NO₂-N), and TKN reveals that total nitrogen in the water column was predominantly of inorganic origin (mainly NO₃/NO₂-N). Organic nitrogen constituted approximately 70-80 percent of the total Kjeldahl nitrogen determined for the three surface water samples.

Nitrate/Nitrite-Nitrogen. An examination of observed data during this study in appendices B1-B4 suggests that many samples, especially those collected in cool months, have low NO₃/NO₂-N levels (at the detectable limit) of 0.01 mg/L. The highest value observed was 13.20 mg/L at station 3S on April 15, 1998. During the spring, high NO₃/NO₂ values also were found at all four stations. Mean NO₃/NO₂-N values for stations 1S, 2S, 3S, and 1B were 4.42, 3.94, 4.72, and 4.12 mg/L, respectively.

As can be seen in appendices A1-A4, NO₃/NO₂-N was not detected in August 30, 1995, samples at all four stations. A maximum NO₃/NO₂ concentration of 16.7 mg/L was found at

station 3S on June 5, 1989. On this date, the maximum NO₃/NO₂-N concentration ever recorded also occurred at other stations (13.0, 14.0, and 11.0 mg/L at stations 1S, 2S, and 1B, respectively).

Comparison of the current and historical mean NO₃/NO₂-N data suggests that there were no significant differences at all stations (table 7).

Phosphorus. The term total phosphorus (TP) represents all forms of phosphorus in water, both in particulate and dissolved forms, including three chemical types: reactive, acid-hydrolyzed, and organic. Dissolved phosphorus (DP) is the soluble form of TP (filterable through a 0.45- μ m filter).

Phosphorus as phosphate may occur in surface water or ground water as a result of leaching from minerals or ores, natural processes of degradation, or agricultural drainage. Phosphorus is an essential nutrient for plant and animal growth and, as is true of nitrogen, it passes through cycles of decomposition and photosynthesis.

Because phosphorus is essential to the plant growth process, it has become the focus of attention in the entire eutrophication issue. With phosphorus being singled out as probably the most limiting nutrient and the one most easily controlled by removal techniques, various facets of phosphorus chemistry and biology have been extensively studied in the natural environment. Any condition that approaches or exceeds the limits of tolerance is said to be a limiting condition or a limiting factor.

In any ecosystem, the two aspects of interest for phosphorus dynamics are phosphorus concentration and phosphorus flux (concentration times flow rate) as functions of time and distance. The concentration alone indicates the possible limitation that this nutrient can place on vegetative growth in the water. Phosphorus flux is a measure of the phosphorus transport rate at any point in flowing water.

Unlike nitrate-nitrogen, phosphorus applied to the land as a fertilizer is held tightly to the soil. Most of the phosphorus carried into streams and lakes from runoff over cropland will be in the particulate form adsorbed to soil particles. However, the major portion of phosphate-phosphorus emitted from municipal sewer systems is in a dissolved form. This is also true of phosphorus generated from anaerobic degradation of organic matter in the lake bottom. Consequently, the form of phosphorus, namely particulate or dissolved, is indicative of its source, to a certain extent. Other sources of DP in the lake water may include the decomposition of aquatic plants and animals. Dissolved phosphorus is readily available for algae and macrophyte growth. However, the DP concentration can vary widely over short periods of time as plants take up and release this nutrient. Therefore, TP in lake water is the more commonly used indicator of a lake's nutrient status.

From his experience with Wisconsin lakes, Sawyer (1952) concluded that aquatic blooms are likely to develop in lakes during summer months when concentrations of inorganic nitrogen and inorganic phosphorus exceed 0.3 and 0.01 mg/L, respectively. These critical levels for

nitrogen and phosphorus concentrations have been accepted and widely quoted in scientific literature.

To prevent biological nuisance, the Illinois Pollution Control Board (IEPA, 1999, Title 35, page 10) stipulates, “Phosphorus as P shall not exceed a concentration of 0.05 mg/L in any reservoir or lake with a surface area of 20 acres (8.1 ha) or more or in any stream at the point where it enters any reservoir or lake.”

Total Phosphorus. During this study period, the ranges of TP values observed were 0.017-0.304, 0.016-0.349, 0.031-0.334, and 0.020-0.496 mg/L for stations 1S, 2S, 3S, and 1B, respectively (appendices B1-B4). The maximum TP values for all four stations were found on March 30, 1998. This was caused by storm events in March 1998. At these same stations, the mean TP concentrations were 0.075, 0.087, 0.107, and 0.087 mg/L, respectively (appendices B1-B4).

In this study, the number (percent) of samples collected from stations 1S, 2S, 3S, and 1B exceeding the 0.05 mg/L TP standard were 11 (58 percent), 11 (58 percent), 15 (79 percent), and 13 (68 percent), respectively. High TP concentrations were observed in stations 2 and 3.

Appendices A1-A4 show that the range of historical TP concentrations in Homer Lake were between 0.006 and 0.314 mg/L. The mean TP values for stations 1S, 2S, 3S, and 1B were, respectively, 0.044, 0.049, 0.079, and 0.105 mg/L.

Statistical analyses suggest that the current TP values for all four stations were not significantly different from the historical results, although all surface samples had higher TP values (table 7).

Dissolved Phosphorus. Dissolved phosphorus usually followed the same pattern as TP. During the study period, DP concentrations in Homer Lake ranged from 0.005 mg/L at stations 1S, 2S, and 1B on June 23, 1997, to 0.130 mg/L at station 2S on April 15, 1998. On this latter date, DP contributed 76 percent of TP. Mean DP values for stations 1S, 2S, 3S, and 1B were, 0.014, 0.030, 0.014, and 0.026 mg/L, respectively (appendices B1-B4).

For the historical data in appendices A1-A4, DP concentrations in lake water samples were 0.001-0.248 mg/L. The highest DP concentration observed was 0.248 mg/L at station 1B on August 30, 1995. Mean DP concentrations for stations 1S, 2S, 3S, and 1B were, respectively, 0.016, 0.018, 0.024, and 0.055 mg/L.

Comparisons of the current DP results and the historical results indicate no significant difference (table 7).

Chlorophyll. All green plants contain chlorophyll *a*, which constitutes approximately 1 to 2 percent of the dry weight of planktonic algae (APHA et al., 1998). Other pigments that occur in phytoplankton include chlorophyll *b* and *c*, xanthophylls, phycobilius, and carotenes. The important chlorophyll degradation products in water are the chlorophyllides, pheophorbides, and pheophytines. The concentration of photosynthetic pigments is used extensively to estimate

phytoplanktonic biomass. The presence or absence of the various photosynthetic pigments is used, among other features, to identify the major algal groups present in the water.

Chlorophyll *a* is a primary photosynthetic pigment in all oxygen-evolving photosynthetic organisms. Extraction and quantification of chlorophyll *a* can be used to estimate biomass or the standing crop of planktonic algae present in a body of water. Other algae pigments, particularly chlorophyll *b* and *c*, can give information on the type of algae present. Blue-green algae (Cyanophyta) contains only chlorophyll *a*, but both the green algae (Chlorophyta) and the euglenoids (Euglenophyta) contain chlorophyll *a* and *c*. Chlorophyll *a* and *c* also are present in the diatoms, yellow-green and yellow-brown (Chrysophyta), as well as dinoflagellates (Pyrrophyta). These accessory pigments can be used to identify the types of algae present in a lake. Pheophytin *a* results from the breakdown of chlorophyll *a*, and a large amount indicates a stressed algal population or a recent algal die-off. Because direct microscopic examination of water samples was used to identify and enumerate the type and concentrations of algae present in the water samples, the indirect method of making such assessments was not used in this investigation.

The observed, mean, and range of values for chlorophyll *a* and other pigments are given in appendices D and E for historical survey and the current study, respectively. The mean concentrations of chlorophyll *a* (corrected) in the lake (stations 1-3) during the current study and in the same three stations during the historical survey were, respectively, 33.32, 49.27, 41.56, 31.45, 27.80, and 26.60 µg/L. Mean chlorophyll values for stations 2 and 3 in the current study were significantly higher compared to the historical values. However, at station 1, chlorophyll *a* values were not significantly increased with time (table 7).

Chlorophyll *a* concentration at each station has a peak in summer and reaches its annual maximum in August or September (appendices D and E). During this study, the maximum values of chlorophyll *a* (corrected) for stations 1, 2, and 3 were 109.47 (September 15, 1997), 240.30 (August 25, 1997), and 149.28 µg/L (August 21, 1997), respectively. Historical maximum values of chlorophyll *a* (corrected) for stations 1, 2, and 3 were 92.50 (June 5, 1989), 62.87 (August 30, 1995), and 64.32 µg/L (August 30, 1995), respectively. During these monitoring periods, chlorophyll *a* showed the highest levels ever recorded due to more nutrients being available.

An examination of the data in appendices D and E suggests that chlorophyll *b* and *c* and pheophytin *a* in Homer Lake were found to be generally low. They were, respectively, about 8-22, 4-21, and 3-12 percent of chlorophyll *a* concentration.

Summary of Lake Water Quality

Comparisons of data collected during previous years and the current study and concentrations of TSS and VSS showed significant increases at all three surface stations. Lake water transparencies (Secchi depths) at stations 2 and 3 were significantly decreased. Mean TP concentrations in surface samples at all three stations were higher, although not significantly different. Chlorophyll *a* values at stations 2 and 3 were increased significantly. Water quality in the lake is considered deteriorating.

The ratio of total elemental nitrogen to total elemental phosphorus is commonly used to determine the limiting nutrient for algal growth in a lake. In these analyses, the ratio of nitrogen to phosphorus in algal cell tissue of 15 to 1 is compared to the ratio of available aquatic nutrients. A ratio significantly greater than 15 to 1 implies that phosphorus is the limiting nutrient. A ratio significantly less than 15 to 1 implies that nitrogen is the limiting nutrient.

For the 19 lake sampling dates for Homer Lake for this study, the 11 sampling dates for the months of January through July (April 1997 to July 1997 and January 1998 to April 1998) showed distinct evidence for phosphorus being the limiting nutrient. For these months, site averaged N:P ratios for the four lake sampling points ranged from 33 to 481. For the 8 sampling dates in August through December (August 1997 to December 1997), the site averaged N:P ratios all fall within the 10 to 20 range indicating balanced nutrient levels.

Sample results for the samples collected at site 3 (the most upstream, shallow site) showed a stronger tendency for a lower N:P ratio than the deeper sites. Analyses for several dates had N:P ratios of 10 or less, indicating that, for these dates, nitrogen might be the limiting nutrient.

Biological Characteristics

Macrophytes. Macrophytes are commonly called aquatic plants (or weeds). The macrophytes consist principally of aquatic vascular flowering plants, including aquatic mosses, liverworts, ferns, and larger macroalgae (APHA et al., 1992). Macrophytes may include submerged, emerged, and floating plants and filamentous algae. In most lakes and ponds, aquatic vegetation is found that may beneficially and/or adversely impact the natural ecosystem. Reasonable amounts of aquatic vegetation improve water clarity by preventing shoreline erosion, stabilizing sediment, storing nutrients, and providing habitats and hiding places for many small fish (fingerlings, bluegill, sunfish, etc.). Aquatic plants also provide food, shade, and oxygen for aquatic organisms; block water movement (wind wave); and use nutrients in the water, reducing the excessive growth of phytoplankton.

However, excessive growth of aquatic vegetation generally interferes with recreational activities (fishing, boating, skiing, etc.); adversely affects aquatic life (overpopulation of small fish and benthic invertebrates); causes fish kills; produces taste and odor in water due to decomposition of dense weed beds; blocks water movement and retards heat transfer, creating vertical temperature gradients; and destroys aesthetic value to the extent of decreasing the economic values of properties surrounding a lake. Under these circumstances, aquatic plants often are referred to as weeds.

In the 1995 survey by Lin and Raman (1997), seven species of macrophytes were found in Homer Lake. Curlyleaf pondweed (*Potamogeton crispus*), coontail (*Ceratophyllum demersum*), duckweed (*Lemna* spp.), Eurasian water milfoil (*Myriophyllum spicatum*), horned pondweed (*Zanzechellia palustris*), bulrush (*Scirpus* spp.), and cattail (*Typha* spp.) covered a 10-50 foot width of the littoral zone almost all around the lake (figure 7). In addition, there is a dense growth of curlyleaf pondweed and coontail in the northeast arm of the lake.

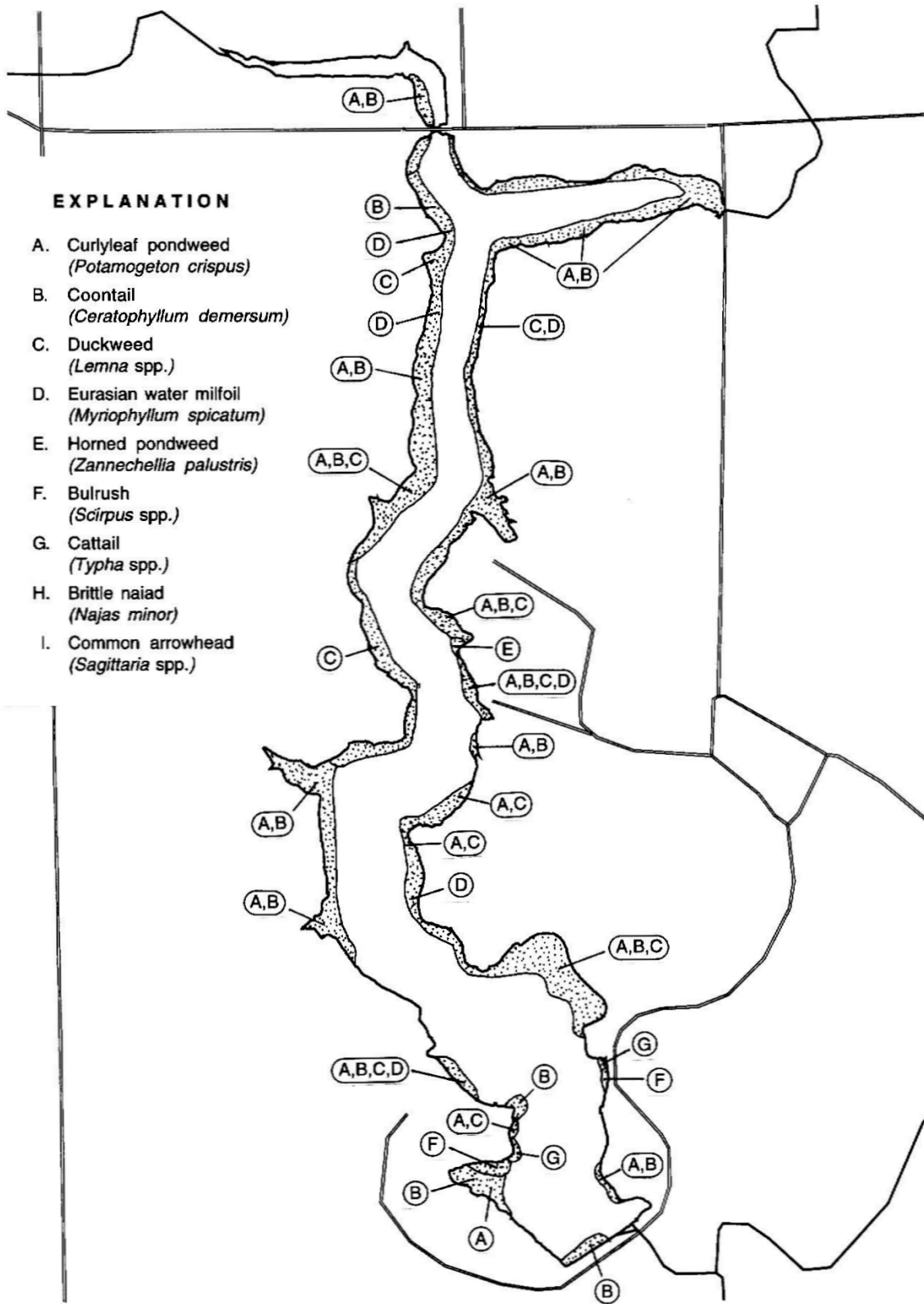


Figure 7. Macrophytes in Homer Lake, June 14, 1995

During the current study, the macrophyte survey was conducted on August 21, 1997, by the Illinois EPA. The 1997 survey results are plotted in figure 8. Seven species of macrophytes were observed: curlyleaf pondweed, coontail, smaller duckweed, brittle naiad (*Najas minor*), common arrowhead (*Sagittaria* spp.), bulrush, and cattail. Eurasian water milfoil and horned pondweed were not found in the 1997 study

Duckweed, arrowhead, and cattail were the dominant species found in shallow areas along most of the shoreline. The densities of macrophytes observed were sparse to moderate, which provide benefits to shoreline, aquatic habitat, fish, and waterfowl. Pondweed can serve as a primary food source for waterfowl and provides shelter and spawning places for fish. Eurasian water milfoil is a non-native aquatic plant that has become a widespread problem throughout North America: it was not found in Homer Lake during this study period. The aquatic macrophyte growth in Homer Lake was not of a nuisance proportion.

Phytoplankton (Algae). Phytoplankton samples were collected by the Illinois EPA. Phytoplankton analyses were completed by Dr. Lawrence M. O'Flaherty of Western Illinois University to identify and quantify the species present in the water column. Historical phytoplankton analyses were conducted on samples collected from site (station) 1 in 1989 on April 24, June 5, July 5, August 7, and October 10. During the 1997 sampling period, samples were collected at all three sites on April 21, June 21, July 23, August 21, and October 23.

Samples collected in both years were analyzed using the Sedgewick-Rafter counting cell (sweep method). Numerical results of the analyses provide a measurement of each species of phytoplankton as well as a total for each of the following categories: greens (Chlorophytes), blue-green (Cyanophytes), diatoms (Bacillariophytes), flagellates (Chrysophytes, Euglenophytes, etc.), others, and total algae.

Phytoplankton was measured using two types of units: phytoplankton density (units per milliliter) and phytoplankton biovolume (cubic micrometers per milliliter). Density is a measure of the individual units of phytoplankton per unit volume of water. The phytoplankton data and report prepared by Dr. L. O'Flaherty was obtained from the Illinois EPA and is given in appendix F (O'Flaherty, 1998).

The highest density of phytoplankton for 1989 (34,940,588/mL) was obtained at site 1 on August 7. In 1997, the greatest density was at site 3 on August 21 (17,425/mL) (figure 9). The largest number of algae for site 2 was seen on August 21 (14,747/mL). The density on that date at site 1 (10,267/mL) was close to the highest density for that site seen on October 23 (10,892/mL). The pattern of total phytoplankton distribution for the three sites sampled in 1997 was similar across the sites (figure 9). The numbers and biovolumes observed in 1997 were less than those in 1989, which probably was caused by higher concentrations of total and nonvolatile suspended solids as well as lower water transparency during the study period than in the past.

Phytoplankton analyses for the 1997 sampling period showed that the blue-green (Cyanophytes) and green (Chlorophytes) algae were dominant at all three sites. The blue-green species have a peak density of 7,545 cells/mL with a biovolume of 3,847,200 cubic micrometers/mL at site 1.

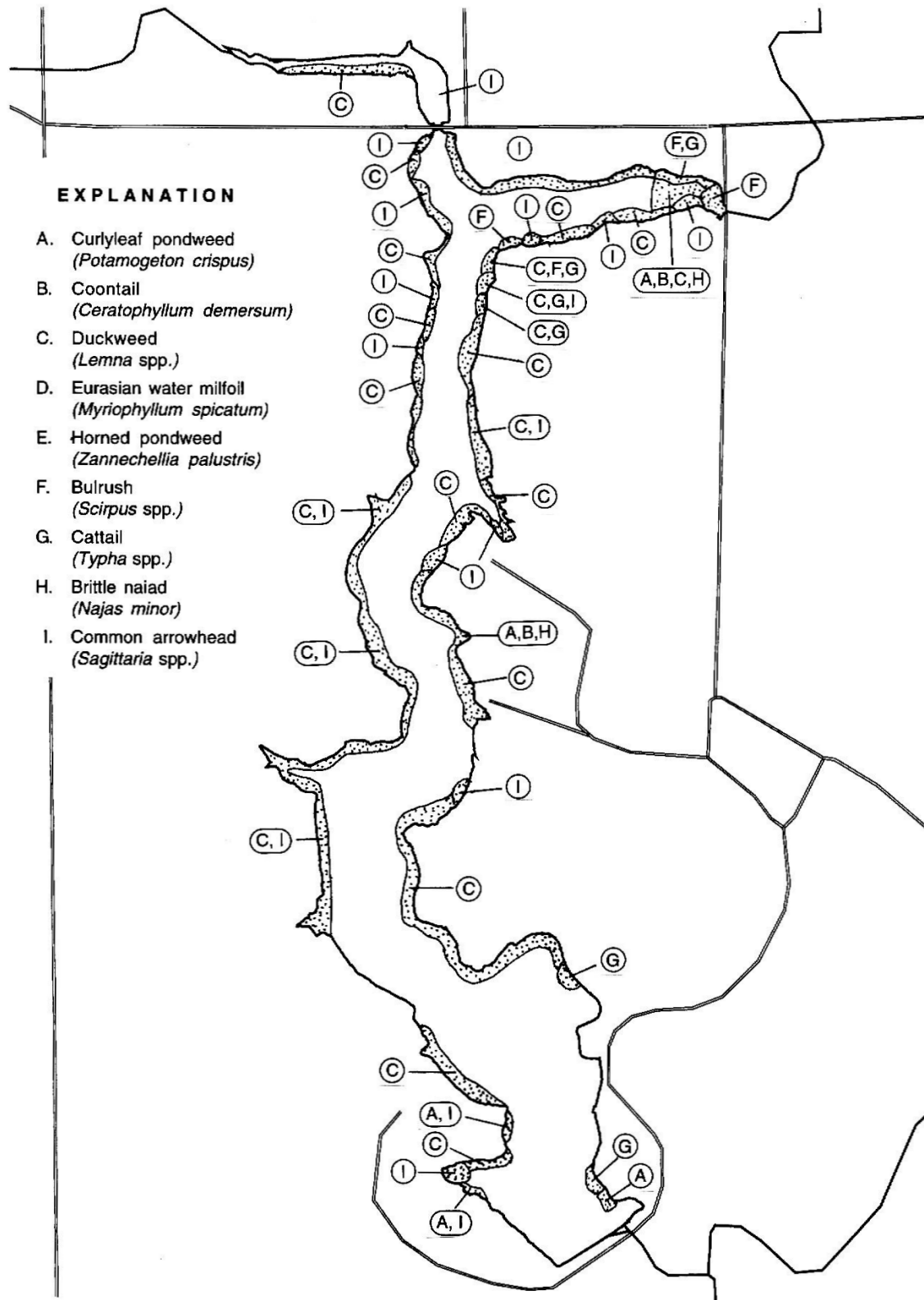


Figure 8. Macrophytes in Homer Lake, August 21, 1997

Lake Homer Phytoplankton Totals-1989, 1997

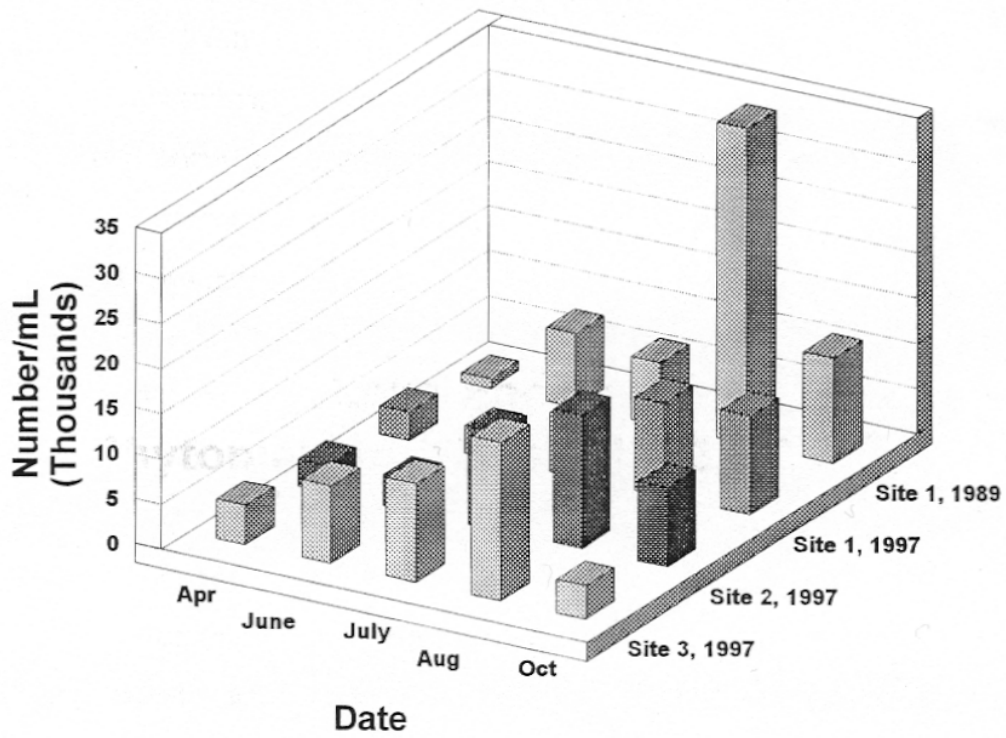


Figure 9. Total phytoplankton densities for Homer Lake, 1989 and 1997
(Source: O'Flaherty, 1998)

The detailed discussion of algal density, algal diversity, summary of numbers, and biovolume of organisms as well as taxa observed for Homer Lake at the three sites is in appendix F (O'Flaherty, 1998).

Water Quality of Surface Inflow and Outflow

Tributary inflow and spillway outflow water quality also was monitored. East tributary samples were collected from the bridge on Homer Lake Road (County Highway 14), and west tributary samples were taken from a bridge on County Road 2500E (250 feet north of Homer Lake Road). Some samples were taken during storm events (May 3, June 6, July 9, July 23, August 17, September 2, and September 3, 1997 and January 8, 1998). The results of these samplings are presented in tables 8, 9, and 10. The statistical summary for the parameters monitored also are included in these tables. It can be noticed from tables 8 and 9 that during or after storm events total and volatile suspended solids, ammonia, total Kjeldahl nitrogen, and TP in storm waters, generally increased from those for normal tributary flows. Concentrations of nitrate/nitrite in the tributary waters were high during spring (April-June 1997) and decreased in summer. As expected, the water quality data for the outflow (table 10) were in a similar range as station 1S (appendix B1).

Trophic State

Eutrophication is a normal process that affects every body of water from its time of formation. As a lake ages, the degree of enrichment from nutrient materials increases. In general, the lake traps a portion of the nutrients originating in the surrounding drainage basin. Precipitation, dry fallout, ground-water inflow, septic tank effluents, waterfowl, etc. are the other contributing sources.

A wide variety of indices of lake trophic conditions have been proposed. These indices have been based on Secchi disc transparency; nutrient concentrations; hypolimnetic oxygen depletion; and biological parameters, including chlorophyll *a*, species abundance, and diversity.

The USEPA (1980) suggests the use of four parameters as trophic indicators: Secchi disc transparency, chlorophyll *a*, surface water TP, and total organic carbon. In addition, the lake trophic state index (TSI) developed by Carlson (1977) on the basis of Secchi disc transparency, chlorophyll *a*, and surface water TP can be used to calculate a lake's trophic state. The TSI can be calculated from Secchi disc transparency (SD) in meters, chlorophyll *a* (CHL) in micrograms per liter ($\mu\text{g/L}$), and TP in micrograms per liter as follows:

$$\text{on the basis of SD,} \quad \text{TSI} = 60 - 14.4 \ln (\text{SD}) \quad (1)$$

$$\text{on the basis of CHL,} \quad \text{TSI} = 9.81 \ln (\text{CHL}) + 30.6 \quad (2)$$

$$\text{on the basis of TP,} \quad \text{TSI} = 14.42 \ln (\text{TP}) + 4.15 \quad (3)$$

The TSI is based on the amount of algal biomass in surface water, using a scale of 0 to 100. Each increment of ten in the TSI represents a theoretical doubling of biomass in the lake.

Table 8. Water Quality Characteristics for East Tributary of Homer Lake, 1997-1998

<i>Sample date</i>	<i>Turbidity, NTU</i>	<i>Conductivity, μmho/cm</i>	<i>pH</i>	<i>Total suspended solids, mg/L</i>	<i>Volatile suspended solids, mg/L</i>	<i>Ammonia-nitrogen, mg/L</i>	<i>Total Kjehldahl nitrogen, mg/L</i>	<i>Nitrite/nitrate nitrogen, mg/L</i>	<i>Total phosphorus, mg/L</i>	<i>Dissolved phosphorus, mg/L</i>	<i>Depth, feet</i>
04/21/97	4.8	615	8.2	23	4	0.08	0.51	10.10	0.016	0.007	0.6
05/03/97	10.0			28	4	0.15	0.69	12.40	0.057		2
05/05/97	13.0			3	1	0.11	0.24	12.90	0.009		2
05/28/97	5.1			1	1	0.07	0.26	12.30	0.01		2
06/06/97	4.2			61	5	0.19	0.66	12.00	0.067		2
06/07/97	3.9			67	9	0.17	0.50	16.40	0.076		2
06/23/97	7.0	674		16	2	0.11	0.48	12.70	0.046	0.026	1
06/30/97	16.0			61	9	0.12	0.55	11.00	0.084		1
07/09/97	0.7			45	14	0.16	0.66	6.50	0.041		2
07/22/97	13.0			7	2	0.10	0.55	0.01	0.039		2
07/23/97	2.0	656	7.4	30	15	0.12	0.73	0.11	0.039	0.015	1
07/28/97	3.5			8	4	0.06	0.28	0.01	0.367		2
08/17/97	7.5			8	4	0.18	1.40	0.05	0.349		2
08/17/97	5.2			7	4	0.16	0.97	0.01	0.256		2
08/21/97	3.7	540	7.9	9	3	0.15	0.72	0.06	0.089	0.052	1
09/02/97	6.7			17	5	0.31	0.96	0.10	0.29		2
09/03/97	6.9			43	10	0.22	1.30	0.09	0.173		2
09/03/97	7.2			10	5	0.32	0.79	0.04	0.327		2
01/08/98	55.0			270	68	0.19	1.30	8.30	0.225		2
Count	19	4	3	19	19	19	19	19	19	4	19
Maximum	55.0	674	8.2	270	68	0.32	1.40	16.40	0.367	0.052	2.0
Minimum	0.7	540	7.4	1	1	0.06	0.24	0.01	0.009	0.007	0.6
Average	9.2	621		38	9	0.16	0.71	6.06	0.135	0.025	1.7
S.D.	11.8	60		60	15	0.07	0.34	6.16	0.125	0.020	0.5

Notes: NTU - nephelometric turbidity units, μ mho/cm - micromho per centimeter, blank spaces - no data or not applicable, S.D. - standard deviation, mg/L - milligrams per liter

Table 9. Water Quality Characteristics for West Tributary of Homer Lake, 1997-1998

<i>Sample date</i>	<i>Turbidity, NTU</i>	<i>Conductivity, µmho/cm</i>	<i>pH</i>	<i>Total suspended solids, mg/L</i>	<i>Volatile suspended solids, mg/L</i>	<i>Ammonia-nitrogen, mg/L</i>	<i>Total Kjehldahl nitrogen, mg/L</i>	<i>Nitrite/nitrate nitrogen, mg/L</i>	<i>Total phosphorus, mg/L</i>	<i>Dissolved phosphorus, mg/L</i>	<i>Depth, feet</i>
04/21/97	6.6	607	8.1	13	5	0.05	0.65	8.50	0.02	0.013	0.9
05/03/97	12.0			69	9	0.16	0.98	14.00	0.092		2
05/05/97	10.0			10	2	0.14	0.28	12.30	0.026		2
05/28/97	2.9			4	1	0.06	0.31	11.90	0.015		2
06/06/97	3.7			20	3	0.10	0.38	13.10	0.034		2
06/07/97	7.1			21	4	0.11	0.27	13.60	0.03		2
06/23/97	6.7	683	7.9	18	4	0.10	0.65	11.10	0.025	0.011	1
06/30/97	7.2			7	3	0.09	0.10	9.80	0.011		1
07/09/97	0.7			40	14	0.21	0.63	5.20	0.030		2
07/22/97	12.0			18	7	0.15	0.98	4.50	0.067		2
07/23/97	1.9	741	7.5	10	2	0.07	0.84	0.06	0.171	0.143	1
07/28/97	9.1			13	6	0.15	0.64	0.14	0.085		2
08/17/97	6.6			30	6	0.15	1.00	0.49	0.282		2
08/17/97	4.2			20	10	0.31	1.80	1.30	0.463		2
08/21/97	2.0	670	7.9	6	3	0.21	0.76	0.01	0.311	0.246	1
08/25/97	5.5			6	3	0.34	0.53	0.18	0.158		2
08/25/97	33.0			2	1	0.35	0.92	0.17	0.166		2
09/02/97	13.0			170	26	0.24	1.80	0.13	0.249		2
09/15/97	9.2			6	3	0.17	0.52	0.11	0.213		2
09/28/97	8.2			27	5	0.19	1.40	0.01	0.121		1
01/08/98	5.0			278	38	0.23	2.10	9.00	0.328		2
Count	21	4	4	21	21	21	21	21	21	4	21
Maximum	33.0	741	8.1	278	38	0.35	2.10	14.00	0.463	0.246	2.0
Minimum	0.7	607	7.5	2	1	0.05	0.10	0.01	0.011	0.011	0.9
Average	7.9	675		38	7	0.17	0.84	5.50	0.138	0.103	1.7
S.D.	6.7	55		66	9	0.09	0.54	5.60	0.128	0.113	0.5

Notes: NTU - nephelometric turbidity units, µmho/cm - micromho per centimeter, blank spaces - no data or not applicable, S.D. - standard deviation, mg/L - milligrams per liter

Table 10. Water Quality Characteristics for Spillway (Outflow) of Homer Lake, 1997-1998

<i>Sample date</i>	<i>Turbidity, NTU</i>	<i>Conductivity, μmho/cm</i>	<i>pH</i>	<i>Total suspended solids, mg/L</i>	<i>Volatile suspended solids, mg/L</i>	<i>Ammonia-nitrogen, mg/L</i>	<i>Total Kjehldahl nitrogen, mg/L</i>	<i>Nitrite/nitrate nitrogen, mg/L</i>	<i>Total phosphorus, mg/L</i>	<i>Dissolved phosphorus, mg/L</i>	<i>Depth, feet</i>
05/03/97	12.0			17	6	0.15	0.68	7.30	0.055		2
06/06/97	4.9			12	5	0.06	0.83	7.90	0.035		2
06/07/97	2.8			14	5	0.08	0.68	8.40	0.037		2
07/09/97	0.8			11	7	0.11	0.69	6.90	0.025		2
07/22/97	14.0			20	12	0.05	0.52	0.02	0.041		2
08/17/97	7.9			16	7	0.18	1.00	0.79	0.093		2
08/17/97	5.8			13	8	0.22	0.83	0.75	0.068		2
08/25/97	12.0			17	9	0.20	1.10	0.45	0.104		2
09/02/97	10.0			18	9	0.22	0.88	0.06	0.082		2
09/03/97	8.1			27	9	0.27	1.40	0.07	0.116		2
09/15/97	9.6			36	7	0.17	0.86	0.11	0.134		2
09/28/97	11.0			45	17	0.17	1.40	0.01	0.261		1
01/08/98	4.7			23	7	0.17	1.10	0.01	0.053		2
Count	13			13	13	13	13	13	13		13
Maximum	14.0			45	17	0.27	1.40	8.40	0.261		2.0
Minimum	0.8			11	5	0.05	0.52	0.01	0.025		1.0
Average	8.0			21	8	0.16	0.92	2.52	0.085		1.9
S.D.	4.0			10	3	0.07	0.27	3.57	0.063		0.3

Notes: NTU - nephelometric turbidity units, μ mho/cm - micromho per centimeter, blank spaces - no data or not applicable, S.D. - standard deviation, mg/L - milligrams per liter

Hudson et al. (1992) discussed the advantages and disadvantages of using the TSI. Water coloration or suspended solids other than algae often diminish the accuracy of Carlson's index. Applying TSI classification to lakes that are dominated by rooted aquatic plants may indicate less eutrophication than actually exists.

The values of TSI for Homer Lake were calculated for each station using equations 1-3, based on Secchi disc transparency, TP, and chlorophyll *a* concentrations of both the historical and the current study data. The TSI results, range and average of TSI values, and trophic state are listed in table 11. Categorizing the trophic state of each station or of the lake was accomplished using mean TSI values and the information provided in table 12.

Lakes are generally classified by limnologists into one of four trophic states: oligotrophic, mesotrophic, eutrophic, or hypereutrophic. Oligotrophic lakes are known for their clean and cold waters and lack of aquatic weeds or algae due to low nutrient levels. There are few oligotrophic lakes in the Midwest. At the other extreme, eutrophic lakes are high in nutrient levels and are likely to be very productive in terms of weed growth and algal blooms. Eutrophic lakes can support large fish populations, but the fish tend to be rougher species that can better tolerate depleted levels of DO. Mesotrophic lakes are in an intermediate stage between oligotrophic and eutrophic. The majority of Midwestern lakes are eutrophic. A hypereutrophic lake is one that has undergone extreme eutrophication to the point of having developed undesirable aesthetic qualities (e.g., odors, algal mats, and fish kills) and water-use limitations (e.g., extremely dense growth of vegetation). The natural aging process causes all lakes to progress to the eutrophic condition over time, but this eutrophication process can be accelerated by certain land uses in the contributing watershed (e.g., agricultural activities, application of lawn fertilizers, and erosion from construction sites). Given enough time, a lake will grow shallower and eventually will fill in with trapped sediments and decayed organic matter, such that it becomes a shallow marsh or emergent wetland.

The mean TSI values shown in table 11 suggest that values calculated using the three parameters fall within a narrow range for each station and for each study period. The overall average TSI values for stations 1, 2, and 3 using the average of mean SD-TSI, TP-TSI, and CHL-TSI, during the current study, were 63.4, 67.8, and 71.1, respectively. During the period 1989-1995, the overall average TSI values for stations 1, 2, and 3 were, respectively, 61.3, 61.1, and 65.9. These values indicate that the lake waters could be classified as eutrophic, except for the portion at station 3 during 1997-1998 that falls in the hypereutrophic category (table 11). The trophic state has worsened only in the upper end (station 3) of Homer Lake, from a eutrophic to a hypereutrophic condition. Lake transparency decreased at station 3, and suspended solids, TP, and chlorophyll *a* values increased significantly during the current investigation compared to the historical data. These factors contribute to the change in the trophic state of the shallow portion of the lake.

When considering the results of the TSI calculations, one should keep in mind the assumptions on which the Carlson formulae are based: Secchi disc transparency is a function of phytoplankton biomass, phosphorus is the factor limiting algal growth, and TP concentration is directly correlated with algal biomass. These assumptions will not necessarily hold when suspended solids other than algal biomass are a major source of turbidity, short retention times

Table 11. Statistical Summary of Trophic State Index (TSI) and Trophic State of Homer Lake

<i>TSI/ Trophic state</i>	<i>Station 1</i>		<i>Station 2</i>		<i>Station 3</i>	
	<i>1989- 1995</i>	<i>1997- 1998</i>	<i>1989- 1995</i>	<i>1997- 1998</i>	<i>1989- 1995</i>	<i>1997- 1998</i>
SD-TSI						
Minimum	47.2	55.4	47.2	52.6	63.9	64.9
Maximum	68.4	73.0	69.1	92.9	71.3	92.9
Mean	60.9	65.0	60.0	66.2	67.8	74.7
Trophic state	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Hypertrophic
TP-TSI						
Minimum	34.1	45.0	30.0	44.1	44.1	53.7
Maximum	79.1	73.7	71.9	88.6	82.8	87.9
Mean	58.6	60.3	60.1	68.5	67.1	71.5
Trophic state	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Hypertrophic
CHL-TSI						
Minimum	41.3	30.6	39.0	30.6	30.6	40.2
Maximum	75.0	76.7	71.2	84.4	71.4	79.7
Mean	64.4	65.0	63.2	68.8	62.8	67.2
Trophic state	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Eutrophic
Overall						
Mean	61.3	63.4	61.1	67.8	65.9	71.1
Trophic state	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Hypertrophic

Notes: CHL - chlorophyll *a*
SD - Secchi disc transparency
TP - total phosphorus
TSI - trophic state index

Table 12. Quantitative Definitions of Lake Trophic States

<i>Trophic state</i>	<i>Secchi disc transparency</i> (in.) (m)		<i>Chlorophyll a</i> (µg/L)	<i>Total phosphorus, lake surface</i> (µg/L)	<i>Trophic State Index</i>
Oligotrophic	>157	>4.0	<2.6	<12	<40
Mesotrophic	79-157	2.0-4.0	2.6-7.2	12-24	40-50
Eutrophic	20-79	0.5-2.0	7.2-55.5	24-96	50-70
Hypereutrophic	<20	<0.5	>55.5	>96	>70

prohibit a large algal standing crop from developing, or grazing by zooplankton affects algal populations.

Use-Support Analysis

Definition

An analysis of use support for Homer Lake was conducted using a methodology developed by the Illinois EPA (1998). The degree of support identified for each designated use indicates the ability of the lake to: support a variety of high-quality recreational activities, such as boating, sport fishing, swimming, and aesthetic enjoyment; support healthy aquatic life and sport fish populations; and provide adequate, long-term quality and quantity of water for public or industrial water supply (if applicable). Determination of a lake's use support is based upon the state's water quality standards as described in the State of Illinois Administrative Code (IEPA, 1999). Each of four established use designation categories (including General Use, Public and Food Processing Water Supply, Lake Michigan, and Secondary Contact and Indigenous Aquatic Life) has a specific set of water quality standards.

For the lake uses assessed in this report, the General Use standards—primarily the 0.05 mg/L TP standard—were used. The TP standard was established for the protection of aquatic life as well as primary contact (e.g., swimming) and secondary contact (e.g., boating) recreation, agriculture, and industrial uses. In addition, lake-use support is based in part on the amount of sediment, macrophytes, and algae in the lake and how these might impair designated lake uses. The following is a summary of the various classifications of use impairment:

- Full = full support of designated uses, with minimal impairment.
- Full/threatened = full support of designated uses, with indications of declining water quality or evidence of existing use impairment.
- Partial = partial support of designated uses, with slight-to-moderate-impairment.
- Nonsupport = no support of designated uses, with severe impairment.

Lakes that fully support designated uses still may exhibit some impairment, or have slight-to-moderate amounts of sediment, macrophytes, or algae in a portion of the lake (e.g., headwaters or shoreline); however, most of the lake acreage shows minimal impairment of the aquatic community and uses. If a lake is rated as not fully supporting designated uses, it does not

necessarily mean that the lake cannot be used for those purposes or that a health hazard exists. Rather, it indicates impairment in the ability of significant portions of the lake waters to support either a variety of quality recreational experiences or a balanced sport fishery. Because most lakes are multiple-use bodies of water, a lake can fully support one designated use (e.g., aquatic life) but exhibit impairment of another (e.g., swimming).

Lakes that partially support designated uses have a designated use that is slightly-to-moderately impaired in a portion of the lake (e.g., swimming impaired by excessive aquatic macrophytes or algae, or boating impaired by sediment accumulation). So-called nonsupport lakes have a designated use that is severely impaired in a substantial portion of the lake (e.g., a large portion of the lake has so much sediment that boat ramps are virtually inaccessible, boating is nearly impossible, and fisheries are degraded. But nonsupport does not necessarily mean that a lake cannot support any uses, that it is a public health hazard, or that use of the lake is prohibited.

Lake-use support and level of attainment were determined for aquatic life, recreation, swimming, and overall lake use, using methodologies described by the Illinois EPA (1998).

The primary criterion in the aquatic-life-use assessment is an Aquatic Life Use Impairment Index (ALI); in the recreation use assessment, the primary criterion is a Recreation Use Impairment Index (RUI). Both indices combine ratings for TSI (Carlson, 1977) and degree of use impairment from sediment and aquatic macrophytes; each index is specifically designed for the assessed use. The ALI and RUI relate directly to the TP standard of 0.05 mg/L. If a lake water sample has a TP concentration at or below the standard, the lake is given a “full support” designation. The ALI rating reflects the degree of attainment of the “fishable goal” of the Clean Water Act; the RUI rating reflects the degree to which pleasure boating, canoeing, and aesthetic enjoyment may be obtained at a lake.

The assessment of swimming use for primary-contact recreation was based on available data using two criteria: Secchi disc transparency depth data and Carlson's TSI. The swimming use rating reflects the degree of attainment of the “swimmable goal” of the Clean Water Act. A rating of “nonsupport” for swimming does not mean the lake cannot be used or that health hazards exist. It indicates that swimming may be less desirable than at those lakes assessed as fully or partially supporting swimming.

In addition to assessing individual aquatic life, recreation, and swimming uses, the overall use support of the lake was assessed. The overall use-support methodology aggregates the use support attained for each of the lake uses assessed. Values assigned to each use-support attainment category were summed and averaged, then used to assign an overall lake-use attainment value for the lake.

Use-Support Analysis for Homer Lake

Support of designated uses in Homer Lake was determined based on Illinois' use-support assessment criteria. Table 13 presents basic information and assessed use-support information for

stations 1 and 2. The use-support analysis results for both stations 1 and 2 are similar. For overall use, water at stations 1, 2, and 3 of Homer Lake during 1997-1998 can be classified as full/threatened partial, and partial, respectively. However, recreation use at station 3 is classified as nonsupport.

Sediment Characteristics

Lake sediments can be potential pollution sources (for pollutants such as phosphorus and metals) affecting lake water quality. Metal and/or organic chemical toxicities can directly affect the presence of aquatic animals and plants on the lake bottom. Lake sediments, if and when dredged, should be carefully managed to prevent surface water and ground-water contamination.

Sediment monitoring is becoming increasingly important as a tool for detecting pollution loadings in lakes and streams because (Indiana Department of Environmental Management, 1992):

- Many potential toxicants are easier to assess in sediments as they accumulate at levels far greater than those normally found in the water column.
- Sediments are less mobile than water and can be used more reliably to infer sources of pollutants.
- Nutrients, heavy metals, and many organic compounds can become tightly bound to the fine particulate silts and clays of the sediment deposits where they remain until they are released to the overlying water and made available to the biological community through physical, chemical, or bioturbation processes.
- Remedial pollution mitigation projects may include the removal of contaminated sediments as a necessary step.

Sediment Quality Standards

No regulatory agencies promulgate sediment quality standards, but sediment quality in Illinois generally is assessed by using data by Kelly and Hite (1981), who collected 273 individual sediment samples from 63 lakes across Illinois during the summer of 1979. On the basis of each parameter measured, they defined “elevated levels” as concentrations of one to two standard deviations greater than the mean value, and “highly elevated levels” as concentrations greater than two standard deviations from the mean. The Illinois EPA (J. Mitzelfelt, personal communication, 1996) revised classification of lake sediments as shown in table 14. In this classification, lake sediment data are considered to be elevated based on a statistical comparison of levels found in a 20-year record and not on toxicity data. Therefore, elevated or highly elevated levels of parameters do not necessarily indicate a human health risk.

Nutrients and Metals

Available historical and current chemical data on sediments in Homer Lake are given in tables 15 and 16. An examination of data in table 15 showed that only total Kjeldahl nitrogen concentration at stations 1 and 3 during the current study period increased from that of historical

Table 13. Use-Support Assessment for Homer Lake, 1997-1998

<i>Use</i>	<i>Station 1</i>		<i>Station 2</i>		<i>Station 3</i>	
	<i>Value</i>	<i>ALI points</i>	<i>Value</i>	<i>ALI points</i>	<i>Value</i>	<i>ALI points</i>
Aquatic life use						
Mean trophic state index	63.4	50	67.8	50	71.1	50
Macrophyte impairment	<5%	10	<5%	10	<15%	5
Mean nonvolatile suspended solids	14 mg/L	5	13 mg/L	5	24 mg/L	15
Total points:		65		65		70
Criteria points:		<75		<75		<75
Use support:		Full		Full		Full
	<i>Value</i>	<i>RUI points</i>	<i>Value</i>	<i>RUI points</i>	<i>Value</i>	<i>RUI points</i>
Recreation use						
Mean trophic state index	63.4	63	67.8	68	71.1	71
Macrophyte impairment	<5%	0	<5%	0	<15%	5
Mean nonvolatile suspended solids	14 mg/L	10	13 mg/L	10	24 mg/L	15
Total points:		73		78		91
Criteria points:		60<RUI<90		60<RUI<90		90<RUI
Use support:		Partial		Partial		Nonsupport
	<i>Value</i>	<i>Degree of use support</i>	<i>Value</i>	<i>Degree of use support</i>	<i>Value</i>	<i>Degree of use support</i>
Swimming use						
Secchi depth < 24 in.	25%	Partial	58%	Partial	95%	Partial
Fecal coliform > 200/100 mL	Not determined		Not determined		Not determined	
Mean trophic state index	63.4	Partial	67.8	Partial	71.7	Partial
Use support:		Partial		Partial		Partial
Overall use	3.7		3.3		2.6	
Use support:		Full/Threatened		Partial		Partial

Notes: ALI - aquatic life use impairment index
RUI - recreation use impairment index

Table 14. Classification of Lake Sediments (revised 1996)

<i>Parameters</i>	<i>Detection limit*</i>	<i>Low</i>	<i>Normal</i>	<i>Elevated</i>	<i>Highly elevated</i>
Phosphorus	0.1	<394	394-<1115	1115-<2179	≥2179
Total Kjeldahl-N	1.0	<1300	1300-<5357	5357-<11,700	≥11,700
Arsenic	0.5	<4.1	4.1-<14	14-<95.5	≥95.5
Barium	1.0	<94	94-<271	271-<397	≥397
Cadmium	0.1	n/a	<5	5-<14	≥14
Chromium	10	<13	13-<27	27-<49	≥49
Copper	1.0	<16.7	16.7-<100	100-<590	≥590
Iron	10	<16,000	16,000-<37,000	37,000-<56,000	≥56,000
Lead	0.1	<14	14-<59	59-<339	≥339
Manganese	10	<500	500-<1700	1700-<5500	≥5500
Mercury	0.1	n/a	<0.15	0.15-<0.701	≥0.701
Nickel	1.0	<14.3	14.3-<31	31-43	≥43
Potassium	1.0	<410	410-<2100	2100-<2797	≥2797
Silver	0.1	n/a	<0.1	0.1-<1	≥1
Zinc	10	<59	59-<145	145-<1100	≥1100
PCB	10	n/a	<10	10-<89	≥89
Aldrin	1	n/a	<1	1-<1.2	≥1.2
Dieldrin	1	n/a	<3.4	3.4-<15	≥15
DDT	10	n/a	<10	10-180	≥180
Chlordane	5	n/a	<5	5-12	≥12
Endrin	1	n/a	<1	n/a	≥1
Methoxychlor	5	n/a	<5	n/a	≥5
Alph-BHC	1	n/a	<1	n/a	≥1
Gamma-BHC	1	n/a	<1	n/a	≥1
HCB	1	n/a	<1	n/a	≥1
Heptachlor	1	n/a	<1	n/a	≥1
Heptachlor epoxide	1	n/a	<1	1-<1.6	≥1.6

Notes: * Amounts of metals and inorganics expressed as mg/kg; organics expressed as µg/kg
 BHC - benzene hexachloride
 DDT - dichloro-diphenyl-trichloro-ethane
 HCB - hexachlorobenzene
 n/a - data not available
 PCB - polychlorinated biphenyls

Source: J. Mitzelfelt, Illinois EPA, personal communication, 1996

Table 15. Characteristics of Sediments in Homer Lake

<i>Parameters</i>	<i>Station 1</i>			<i>Station 3</i>		
	<i>4/24/89</i>	<i>7/19/95</i>	<i>7/23/97</i>	<i>4/24/89</i>	<i>7/19/95</i>	<i>7/23/97</i>
Residue, %						
By weight	30.8	31.1	34.4	33.6	34.6	34.1
By volatile	11.5	11.1	11.1	8.5	8.2	8.4
Phosphorus	296	640	645	590	669	589
TKN	3,412	1,544	7,400	386	1,812	6,500
Arsenic	6.0	5.6	5.4	5.0	4.0	3.7
Barium	208	174	170	129	128	130
Cadmium	0.1 k	1.0k	1.0 k	0.1 k	1.0 k	1.0 k
Chromium	22.6	17.0	21.0	11.9	14.0	15.0
Copper	42.1	24.0	28.0	33.3	20.0	24.0
Iron	31,800	19,000	24,000	19,200	16,000	17,000
Lead	7.2	16	20	4.8	14	14
Manganese	780	655	590	596	479	440
Mercury	0.03	0.1 k	0.1 k	0.1 k	0.1 k	0.1 k
Nickel	22.4	20.0	21.0	13.3	17.0	16.0
Potassium	1,966	1,700	1,900	1,076	1,300	1,400
Silver	0.1 k	1 k	1 k	1 k	1 k	1 k
Zinc	96.9	79.0	86.0	57.9	65.0	65.0

Notes: Units are mg/kg, unless specified otherwise.

A k indicates that values were below the detection level.

TKN – total Kjeldahl nitrogen.

Table 16. Organochlorine Compounds Tested for Sediments in Homer Lake

<i>Organic compounds,</i> <i>µg/kg</i>	<i>Station 1</i>				<i>Station 2</i>	<i>Station 3</i>			
	<i>4/24/89</i>	<i>7/19/95</i>	<i>7/23/97</i>	<i>8/26/97</i>	<i>8/26/97</i>	<i>4/24/89</i>	<i>7/19/95</i>	<i>7/23/97</i>	<i>8/26/97</i>
Total PCB	10 k	10 k	10 k	10 k	10 k	10 k	10 k	10 k	10 k
Aldrin	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1 k
Dieldrin	1.6	3.4	1.8	5 k	5 k	1 k	1 k	1 k	1 k
Total DDT	10 k	10 k	10 k			10 k	10 k	10 k	
O'P'-DDE	1 k					1 k			
P'P'-DDE	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1.1
O'P'-DDD	1 k					1 k			
P'P'-DDD	1 k	1 k	1 k			1 k	1.1	1 k	1.1
O'P'-DDT	1 k					1 k			
P'P'-DDT	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1 k
Chlordane									
Total	5 k	5 k	5 k			5 k	5 k	5 k	
<i>Cis</i> isomer	2 k	2 k	2 k	10 k	10 k	2 k	2 k	2 k	2 k
<i>Trans</i> isomer	2 k	2 k	2 k	10 k	10 k	2 k	2 k	2 k	2 k
Endrin	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1 k
Methoxychlor	5 k	5 k	5 k	25 k	25 k	5 k	5 k	5 k	5 k
Alpha-BHC	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1 k
Gamma-BHC	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1 k
(Lindane)									
Hexachlorobenzene	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1 k
Hectachlor	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1 k
Heptachlor epoxide	1 k	1 k	1 k	5 k	5 k	1 k	1 k	1 k	1 k

Notes: k indicates that values are below the detection level
 BHC - benzene hexachloride
 Blank spaces - no data
Cis isomer - the isomer with like groups close together

values. Other parameters and heavy metals monitored at stations 1 and 3 were comparable for both historical and current data.

Cadmium, mercury, and silver concentrations in Homer Lake sediments were not detected. During the current study, TP and TKN concentrations as well as other parameters between stations 1 and 3 were comparable (table 15). On the basis of the classification given in table 14, TKN levels at stations 1 and 3 were considered elevated, and TP at stations 1 and 3 were considered normal for Illinois lakes. Classifications of arsenic and manganese at station 3 are considered low level. Other metals (barium, chromium, copper, iron, lead, nickel, potassium, and zinc) in Homer Lake sediments were classified as normal.

Organic Compounds

Chlorinated hydrocarbon compounds consist of a group of pesticides that are no longer in use but are persistent in the environment. These compounds, such as chlordane, dieldrin, and dichloro-diphenyl-trichloro-ethane (DDT) present a somewhat unique problem in aquatic systems because of their potential for bioaccumulation in fish from the food web. Organochlorine compounds are relatively insoluble in water but highly soluble in lipids, in which they are retained and accumulate. Minute and often undetectable concentrations of these compounds in water and sediment ultimately may pose a threat to aquatic life, then possibly to human health.

Table 16 presents the historical and current observed concentrations of tested organochlorine compounds. An examination of table 16 indicates that almost all parameters assessed were below detection levels. Dieldrin was the only compound detected, but it was in low concentration.

No parameter analyzed was found to be elevated or highly elevated. Data of sediment quality indicate that the lake sediment is nonhazardous and would not require disposal in a special hazardous facility if the sediment were to be dredged.

Shoreline Erosion Survey

Shoreline erosion may impair lake usage by adding turbidity and sediment, decreasing the storage capacity of the lake, and/or damaging valuable lakeshore property. Loss of lake shoreline also may threaten important shoreline features (e.g., boat dock, dam, road, public use facilities) and reduce the aesthetic appeal of the lake.

An evaluation of shoreline erosion conditions for Homer Lake was made on July 23, 1997. For this evaluation, a visual inspection was made of all lake shoreline. For the 5.3-mile shoreline, most areas showed no apparent erosion (less than 1 foot high). Almost all of the eroded shoreline (4,200 feet) had been protected by riprap with concrete blocks (figure 4). One exception was an area approximately 350 feet north of the boat ramp near the outdoor recreation center, 120 feet long and 8-10 feet high, that was classified with severe erosion (x marked on figure 4). Some locations in this area have steep elevations.

Lake Sedimentation Survey

The September 1998 survey is the only known survey of Homer Lake. Cross sections were laid out at 14 lines across the lake (figure 10). Survey transect lines were distributed longitudinally along the lake axis to define loss of depth within the pool area. The end points of these transect lines were documented by determining their location using a differentially corrected global positioning system. Table 17 gives the coordinates for each transect endpoint.

These transect lines then were surveyed using standard Water Survey lake sedimentation survey methods. Horizontal distances along transect lines were measured by stretching a marked polyethylene cable between the end points. Water depths were measured at regular intervals using a 2-inch diameter aluminum sounding pole with an 8-inch diameter sliding sounding shoe. The sounding shoe increases the sensitivity of measurements for the soft sediment surface.

The sounding pole also is used to measure the thickness of the accumulated sediments on the lake bottom. The pole is manually driven through the sediment layer to the more solid original bottom. The difference between the water depth measurement and the water level measurement on the pole at the original bottom is the depth of sediment accumulation.

In addition to the sounding pole survey, lake depths also were surveyed using a Trimble Global Positioning System receiver and an Odom Hydrographic Systems DF3200 dual frequency depth sounder. Additional depth data were collected in contouring runs that approximately followed lines of constant depth in loops around the lake.

The cross-sectional areas and widths of these transects were analyzed using the U.S. Department of Agriculture, Natural Resource and Conservation Service standard range survey calculation (USDA-SCS, 1968). The results of this analysis are presented in table 18.

The northern portion of the lake (segments 10 to 15) had higher sedimentation rates, which are in the range of 1.0-2.2 percent per year. With the exception of the northern basin of the lake, annual sedimentation rates are less than 1.0 percent per year, corresponding to half-life values of more 50 years (postconstruction). Most of the lake has at least a 50-year life expectancy.

The summary of sedimentation volumes and rates for Homer Lake are given in table 19. Homer Lake has lost 111.3 ac-ft of volume to sedimentation; with an average annual rate of 3.7 ac-ft per year. This corresponds to a loss of 16.4 percent of the original lake capacity and at an annual rate of 0.55 percent per year. On an annual basis, this amounts to an average contribution of 19.4 cubic feet, or 0.29 tons, of soil from every watershed acre.

Data collected during the field survey were processed and plotted using the Water Survey's GIS. Depth contours for the lake (figure 11) were developed from the survey depth files. The contours initially were generated by a computer. These contours were modified manually to remove excessively detailed or ambiguous contours. Surface areas for these contours were used for the depth-volume analyses in table 20 and the stage-volume-area plot in figure 12.

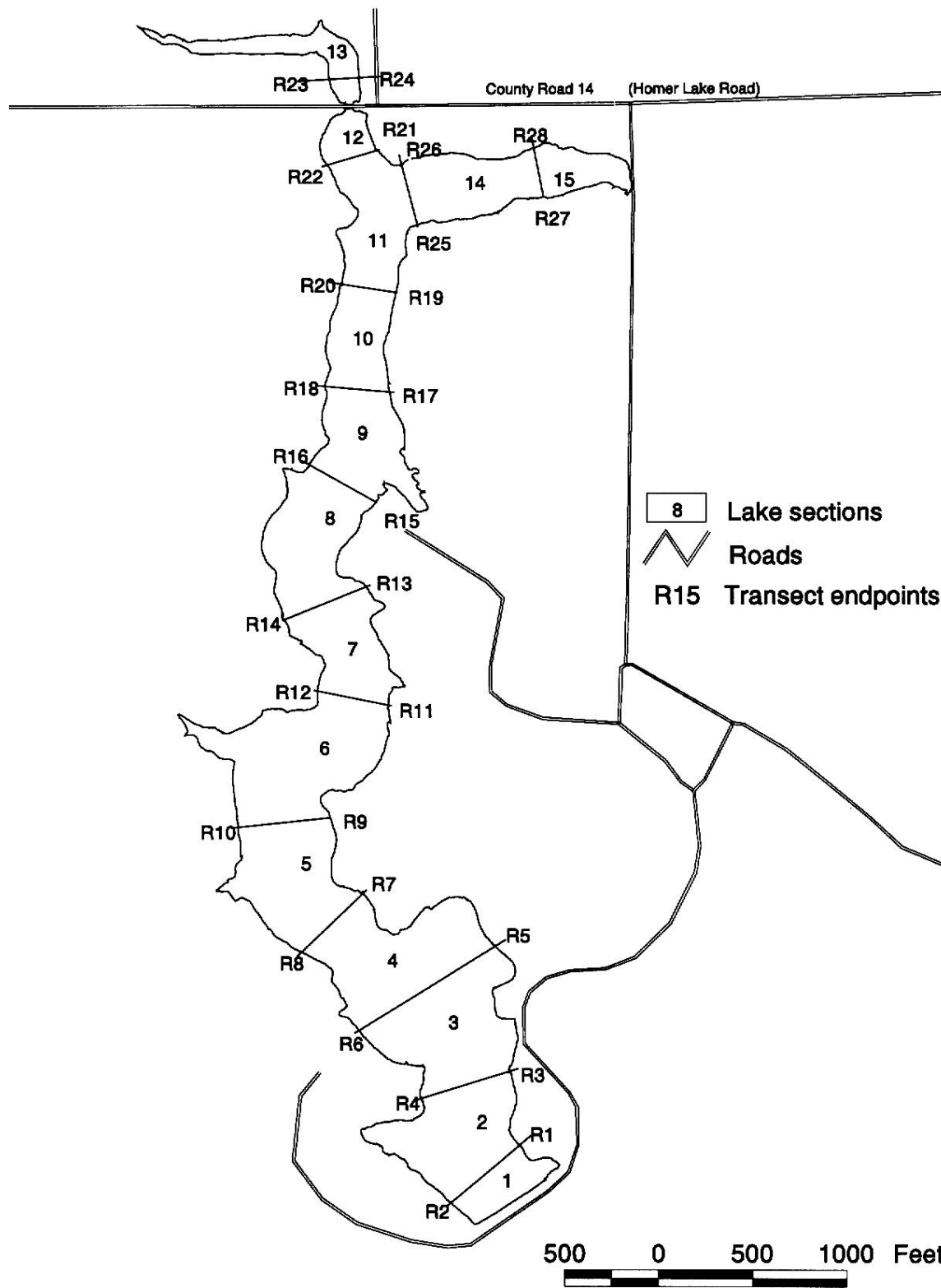


Figure 10. Survey plan for Homer Lake, 1998

**Table 17. Universal Transverse Mercator Coordinates
for Lake Sedimentation Range Ends**

<i>End point</i>	<i>Coordinates in Universal Transverse Mercator Projection (feet)</i>	
	<i>East</i>	<i>North</i>
R1	1,364,543	14,549,974
R2	1,365,008	14,550,340
R3	1,364,395	14,550,544
R4	1,364,947	14,550,694
R5	1,364,073	14,550,910
R6	1,364,896	14,551,393
R7	1,363,778	14,551,344
R8	1,364,163	14,551,680
R9	1,363,449	14,552,033
R10	1,363,980	14,552,075
R11	1,363,912	14,552,770
R12	1,364,326	14,552,675
R13	1,363,756	14,553,150
R14	1,364,233	14,553,329
R15	1,363,886	14,554,010
R16	1,364,262	14,553,784
R17	1,363,985	14,554,413
R18	1,364,394	14,554,365
R19	1,364,067	14,554,967
R20	1,364,412	14,554,905
R21	1,364,043	14,555,593
R22	1,364,355	14,555,677
R23	1,364,220	14,556,063
R24	1,364,062	14,556,060
R25	1,364,460	14,555,646
R26	1,364,541	14,555,281
R27	1,365,174	14,555,714
R28	1,365,222	14,555,410

Table 18. Homer Lake Sedimentation Survey, 1998

<i>Segment number</i>	<i>1968 water volume (acre-feet)</i>	<i>1998 water volume (acre-feet)</i>	<i>1998 sediment volume (acre-feet)</i>	<i>1968 to 1998 volume loss (percent)</i>	<i>1968 to 1998 volume loss rate (percent per year)</i>	<i>1998 average sediment thickness (feet)</i>	<i>1998 sediment weight (tons)</i>
1	35.7	32.5	3.2	8.9	0.30	1.4	2,102
2	93.7	85.8	7.9	8.4	0.28	1.1	5,200
3	111.9	100.5	11.3	10.1	0.34	1.3	7,454
4	99.9	86.5	13.4	13.4	0.45	1.5	7,130
5	67.3	58.6	8.8	13.0	0.43	1.2	4,652
6	83.9	72.6	11.3	13.5	0.45	1.1	6,888
7	39.7	33.2	6.4	16.2	0.54	1.3	3,930
8	44.2	35.2	9.0	20.3	0.68	1.3	6,466
9	29.7	21.5	8.2	27.6	0.92	1.5	5,909
10	18.5	12.9	5.6	30.4	1.01	1.5	4,310
11	18.2	11.4	6.8	37.2	1.24	1.3	4,698
12	8.0	3.7	4.2	53.4	1.78	2.3	2,877
13	6.0	2.5	3.5	58.6	1.95	1.4	2,363
14	19.6	10.3	9.3	47.4	1.58	1.9	7,076
15	3.6	1.3	2.3	64.8	2.16	1.0	2,057
Totals	679.8	568.5	111.3			1.3	73,113
Percent of totals				16.4	0.55		

Note: Blank spaces – not applicable

Table 19. Lake Capacity and Rate of Loss Analysis

<i>Year</i>	Lake Capacity Loss		
	<i>Capacity, (acre-feet)</i>	<i>Period capacity Loss, (acre-feet)</i>	<i>Period capacity annual Loss rate, (acre-feet)</i>
1968	679.8		
1998	568.5	111.3	3.7

Computed Sediment Delivery Rates from the Watershed

<i>Period Ending in</i>	<i>Annually (acre-feet)</i>	<i>Per square</i>		
		<i>mile (acre-feet)</i>	<i>Per acre (cubic feet)</i>	<i>Per acre (tons)</i>
1998	3.7	0.28	19.4	0.29

Capacity Loss Rates Relative to the Original Lake Capacity

<i>Period Ending in</i>	<i>Percent Per period</i>	<i>Period annual percent loss</i>
1988	16.4	0.55

Notes: Lake surface area is 83 acres for 1998.
Total watershed area is 13 square miles.

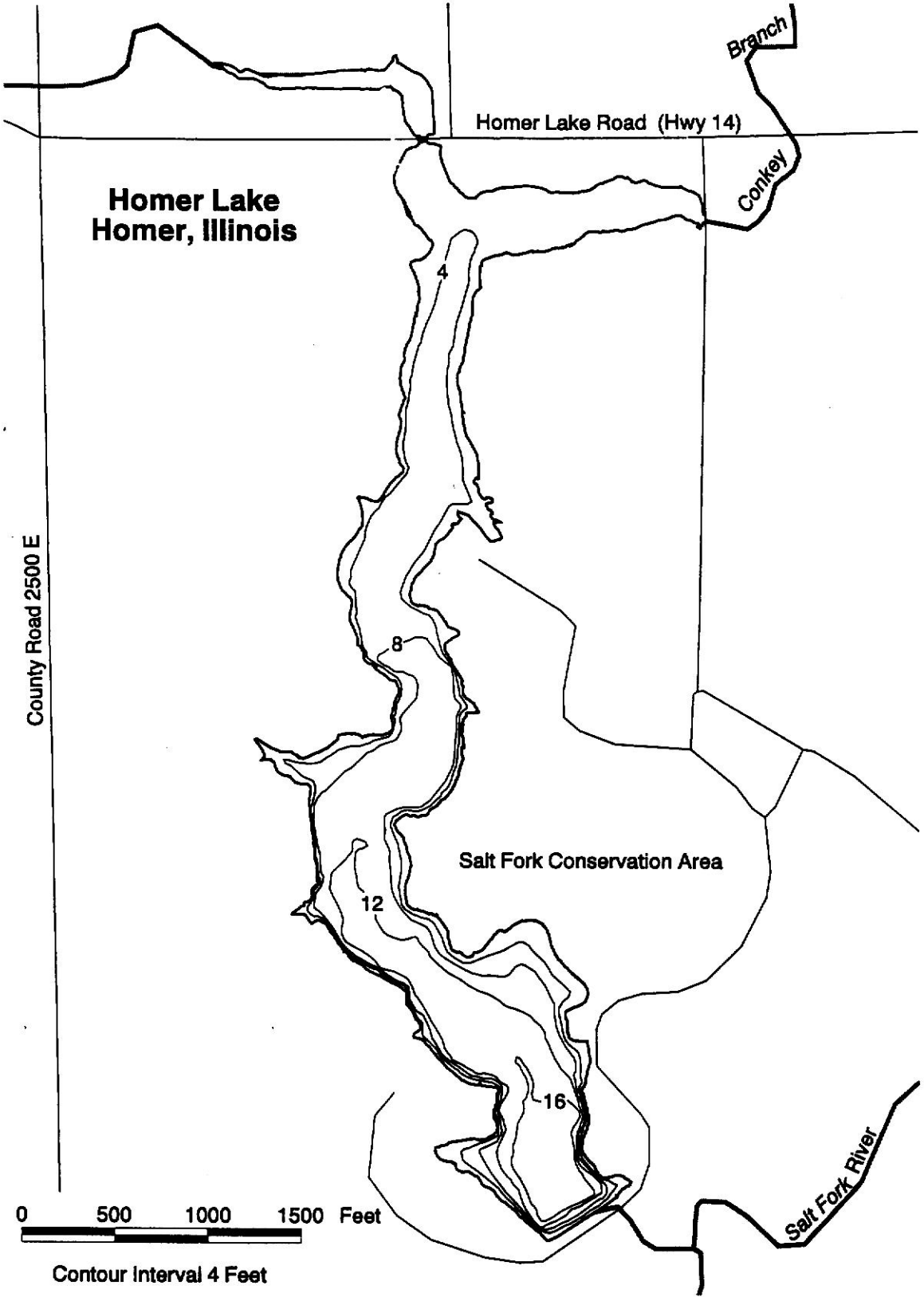


Figure 11. Homer Lake water depth contours

**Table 20. Stage versus Volume and Area
for Selected Elevations at Homer Lake, 1998**

<i>Depth below spillway crest (feet)</i>	<i>Surface area (acres)</i>	<i>Volume (acre-feet)</i>
0	83.0	614
4	56.7	336
8	35.5	153
12	18.3	48
16	4.7	5
18.9	0.0	0

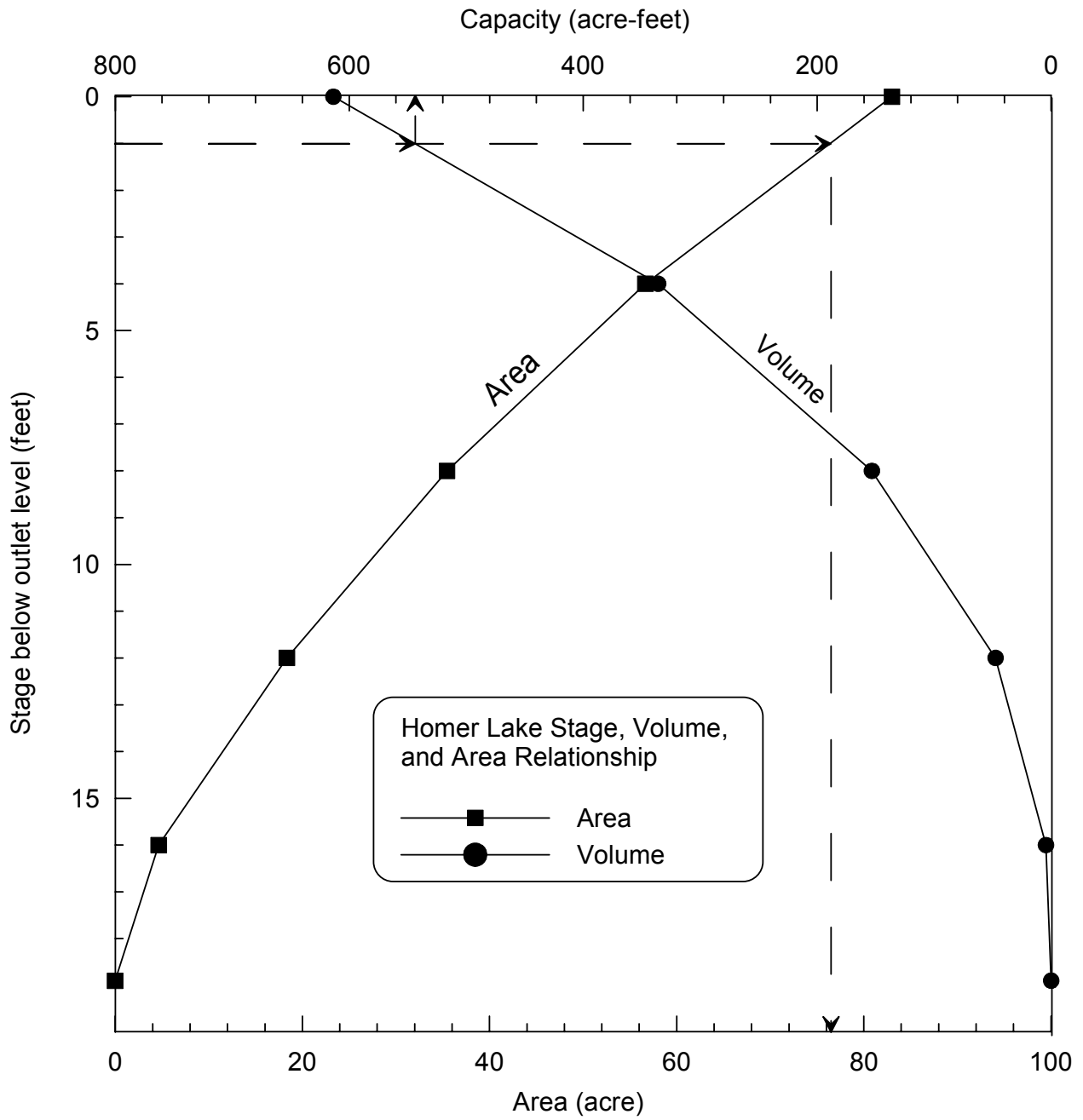


Figure 12. Stage, volume, and area relationships for Homer Lake

In figure 11, each line inside the lake boundary defines a continuous line of the marked depth when the lake level is exactly even with the crest of the spillway. Inside the boundary of the line, all depths are equal to or greater than the marked depth. Minor inconsistencies of this figure with actual depth measurements in the lake can be attributed to the scale of the limits of the survey coverage and some simplifications made for the analysis.

The lines plotted in figure 12 represent a graphical summary of the relationship of lake surface area and volume-to-water level drawdown in the lake. For a given lowering of the lake water level below the spillway level:

- enter the left axis of the plot at the drawdown in feet,
- draw a horizontal line to the lines marked for “Area” and “Volume”,
- determine the area of the lake at that water level by following a vertical line down to the bottom axis and read the area in acres, or
- determine volume of the lake at that water level by following a vertical line up to the top axis and read the lake volume in acre-feet.

An example of these readings would be to enter the left scale at a level of 1.0 foot below the spillway level; the approximate values of surface area and volume are 76 acres and 540 ac-ft, respectively.

The total mass of the accumulated sediment was determined on the basis of eight samples of the sediments. These samples were collected by removing a known volume of the sediments from a core of the lake sediments, oven drying the samples, and determining the unit weight of the sample by dividing the dried weight by the sampled volume. These unit weights then were applied to the calculated volume of the lake sediments to determine the total mass of the accumulated sediments.

The total mass of sediment accumulated in Homer Lake in 1998 was 73,100 tons. This represents an average annual accumulation of 2,440 tons of sediment and an average of 0.29 tons per year from each acre of the watershed. Adjusting this accumulated tonnage for the estimated 8 percent of the incoming sediments discharged at the spillway during the monitoring year, an average of 0.32 tons of sediment enters the lake for every watershed acre. When compared to the estimated watershed soil losses of 2.51 tons per acre presented in an earlier section (Watershed Soil Loss) indicates that only 13 percent of the calculated soil erosion from the watershed actually reaches the lake.

Sediment input to the lake for the one-year monitoring period was 0.46 tons per acre of watershed, which was 45 percent greater than the average input of 0.32 tons determined above.

Hydrologic Flux

The hydrologic balance for Homer Lake, or any other lake system, takes the general form:

$$\text{storage change} = \text{inflows} - \text{outflows}$$

In general, inflows to the lake include direct precipitation, watershed runoff, ground-water inflow, and pumped input. Outflows include surface evaporation, discharge at the lake outlet, ground-water outflow, and withdrawals. For Homer Lake, pumped inputs and ground-water interaction are not significant factors; pumped inputs because there are no existing pumped inputs to Homer Lake; and ground-water interaction because the fine-grained soils that form the valley walls will support little or no seepage from the surrounding soils. However, all other factors must be considered in developing an effective hydrologic budget for the lake.

Data necessary for evaluating various parameters to analyze the hydrologic fluxes for the lake were collected for a one-year period (April 1997-March 1998) during the diagnostic phase of the project. Table 21 presents monthly results of this monitoring. This analysis reflects the result of a one-year monitoring period and should not be construed to represent a long-term hydrologic or nutrient loading budget.

Several elements of this analysis were evaluated on the basis of data collected during the monitoring period, including:

- Reservoir storage change on the basis of direct monitoring of the lake level during the study. Lake level data were collected by an automatic water level recorder from April 3, 1997-March 31, 1998. Data were collected at 15-minute intervals and recorded at 6-hour intervals or less.
- Spillway discharge also was analyzed on the basis of the lake level records. The general spillway rating equation $3.4 \cdot 100 \cdot H^{1.5}$ was used. Where 3.4 is the weir coefficient for the spillway, 100 feet is the spillway length, and H is the height of water over the spillway.
- Direct precipitation was determined on the basis of the precipitation record collected for the study by SFRFP personnel.

Evaporation was estimated using average monthly values for Urbana as determined by Roberts and Stall (1967).

On the basis of these available, directly measured parameters, the following elements of the flux balance were determined. Based on the water level record frequency:

- Changes in basin storage were estimated by multiplying the periodic change in lake stage from the water level record by the lake surface area to determine net inflow or outflow volume in acre-feet.
- Spillway discharge was calculated when the water level exceeded the spillway elevation.

These values were initially determined for time periods of less than a day and were then combined into daily values that could be analyzed on a daily basis with:

**Table 21. Summary of Hydrologic Fluxes for Homer Lake,
April 1997-March 1998**

<i>Date</i>	<i>Storage change (acre-feet)</i>	<i>Direct precipitation (inches)</i>	<i>Direct (acre-feet)</i>	<i>Calculated inflow (acre-feet)</i>	<i>Monthly evaporation (inches)</i>	<i>(acre-feet)</i>	<i>Spillway discharge (acre-feet)</i>
1997							
April	-3.0	1.40	9.4	2,111	2.59	17.4	2,106
May	9.3	4.03	27.1	1,980	4.00	26.9	1,971
June	-9.5	1.97	13.3	2,118	4.85	32.7	2,108
July	-22.8	2.50	16.8	524	5.50	37.0	526
August	7.3	4.55	30.6	9	4.71	31.7	0
September	-52.4	3.20	21.5	-11	3.31	22.3	1
October	-24.6	1.20	8.1	-19	2.01	13.5	0
November	4.4	2.00	13.5	-5	0.66	4.4	0
December	25.9	1.50	10.1	18	0.33	2.2	0
1998							
January	59.0	1.90	12.8	745	0.31	2.1	696
February	5.7	1.75	11.8	925	0.61	4.1	927
March	17.8	7.40	49.8	3,638	1.39	9.4	3,661
April 1997 to March 1998 totals	17.0	33.40	225	12,033	30.27	204	11,997

Notes: Other outflows included releases through the sluice gate in September 1997 estimated at 40 acre-feet.

Irrigation withdrawal for sod farm – not estimated.

- The volume of direct precipitation input to the lake based on the daily precipitation data from the project record. The precipitation depth was multiplied by the lake surface area to determine inflow volume.
- Monthly evaporation rates were reduced to daily values by calculating an average daily value for each month. Daily lake surface evaporation volume was determined for the study period by multiplying the daily average evaporation depth by the lake surface area.
- Surface water inflow was not determined from direct measurements; instead it was determined by calculation of the determinate factors listed. The summation of daily inflow and outflow values generally left a calculated remainder that was allotted to surface water runoff.

A summation of these analyses was made on a monthly basis and is presented in table 21. This record has been adjusted for the estimated 40 ac-ft of water released through the sluice gate from September 10-18, 1997. The record has not been adjusted for the irrigation pumpage for the sod operation.

Table 22 summarizes the hydrologic budget for the one-year monitoring period. During this period, 1.8 percent of the inflow volume to the lake was direct precipitation on the lake surface and 98.2 percent was watershed runoff. Outflow volume was 1.7 percent evaporation, 97.9 percent spillway overflow, and 0.3 percent sluice gate releases. A 0.1 percent increase in storage was observed.

Sediment and Nutrient Fluxes

The sediment and nutrient fluxes for the lake were analyzed using daily values from the hydrologic analysis and the sediment and nutrient analyses from the one-year monitoring program. The laboratory results from the water samples collected during the field monitoring were compared to flow conditions. Analysis for each sampling site was made on the basis of an annual average for the stable, in-lake conditions. Linear regression analysis for the more volatile stream inflow sites was not successful. No direct relationship between discharge and sediment concentration was found, so all of the stream flow analyses were made using annual average values.

The only exception to this methodology was the calculation of total nitrogen fluxes. With nitrogen, a distinct division of the observed concentrations could be discerned between cool weather and warm weather conditions. Cool weather nitrogen levels were, generally, a factor of 10 higher than warm weather nitrogen concentrations. The following list presents the methods used for calculation of the major nutrient inflows and outflows:

**Table 22. Annual Summary of the Hydrologic Fluxes for Homer Lake,
April 1997- March 1998**

<i>Source</i>	<i>Inflow volume (acre-feet)</i>	<i>Outflow volume (acre-feet)</i>	<i>Inflow (percent)</i>	<i>Outflow (percent)</i>
Storage change	17		0.1	
Direct precipitation	225		1.8	
Surface inflow	12,033		98.2	
Spillway discharge		11,997		97.9
Evaporation		204		1.7
Sluice gate release		40		0.3
Totals	12,258	12,241		

Note: Blank spaces – not applicable

Watershed inflow concentrations annual average:

Sediment		
West tributary		234 mg/L
East tributary		235 mg/L
Total nitrogen		
West tributary		11.6 mg/L (1.9 mg/L warm season)
East tributary		12.2 mg/L (1.1 mg/L warm season)
TP		
West tributary		0.06 mg/L
East tributary		0.06 mg/L
Spillway discharge concentrations by annual average:		
Sediment		19.3 mg/L
Total nitrogen		8.5 mg/L (1.5 mg/L warm season)
TP		0.04 mg/L
Precipitation chemistry concentrations by annual average:		
Total nitrogen		13.9 mg/L
TP		1.6 mg/L

For these water-based sites, concentration is in milligrams per liter. These concentrations were weighted by the daily discharges at each site to determine nutrient loading by source. The results of this analysis are summarized in table 23.

Annualized bank erosion sediment and nutrient inputs to the lake could not be calculated for this study. The shoreline of Homer Lake is well protected and without erosion problems. Only a 120-foot section of the shoreline, 0.4 percent of the total shoreline length, shows any significant erosion. This section and the rest of the shoreline have been stable for more than a decade (R. Woodmasee, personal communication, 1999).

For the one-year monitoring period, the sediment input from the watershed of 3,850 tons represented an annual yield of 0.46 tons per acre from the watershed. This input of sediment was only slightly offset by the discharge of 316 tons of sediment at the spillway.

Total nitrogen load from the watershed was 187 tons, with an additional 2.1 tons of nitrogen from direct precipitation. This was offset by 133 tons of nitrogen discharged at the spillway.

Total phosphorus input to the lake was 1.26 tons, of which 1.02 tons originated from watershed runoff and 0.24 tons came from precipitation. Spillway phosphorus removal from the lake was 0.62 tons.

One-hundred percent of sediment input to the lake and 98.8 and 79.3 percent, respectively, of the nitrogen and phosphorus input to the lake originates in the watershed. Just over 8 percent of the sediment input, 70.1 percent of the nitrogen input, and 48.4 percent of the phosphorus input to the lake leaves the lake in flow over the spillway.

**Table 23. Annual Summary of Sediment and Nutrient Fluxes for Homer Lake,
April 1997-March 1998**

<i>Water flows</i>	<u><i>Sediment load</i></u>		<u><i>Total nitrogen</i></u>		<u><i>Total phosphorus</i></u>	
	<i>(tons)</i>	<i>(percent of total)</i>	<i>(tons)</i>	<i>(percent of total)</i>	<i>(tons)</i>	<i>(percent of total)</i>
Annual sediment and nutrient inflows						
Watershed surface drainage yield	(3,850)	100	(187)	98.8	(1.02)	79.3
West tributary	1,920	49.8	91.5	48.3	0.50	39.0
East tributary	1,930	50.2	95.7	50.5	0.52	40.3
Direct precipitation on the lake			2.1	1.1	0.24	19.0
Total	3,850		189		1.26	
Outflow at spillway	316	8.2	133	70.1	0.62	48.4
Internal regeneration of phosphorus					0.02	1.7

Note: Numbers in parentheses represent subtotals and are not included in the total.

Internal regeneration of phosphorus in the lake from deposited sediments was calculated by estimating the TP weight in the lake when phosphorus concentrations were at their peak at mid-summer and subtracting TP weight in the lake at the end of the spring season. This analysis indicated that TP in the lake increased by 0.022 tons.

For comparison purposes only, during this time period, the nutrient flux analysis determined that the net external phosphorus influx to the lake (inflow minus outflow) was 0.64 ton. Thus, the internal regeneration of phosphorus represented 3.4 percent of the net phosphorus loading to the lake.

Also for comparison, the USEPA recommends (USEPA, 1980) that internal regeneration of phosphorus can be estimated on the basis of a maximum range of values of 5 grams/meter²/year (g/m²/year) under aerobic conditions and 20 g/m²/year under anaerobic conditions. Using these values, 2.26 tons of phosphorus would have been regenerated from the sediments of Homer Lake during the monitoring year.

BIOLOGICAL RESOURCES AND ECOLOGICAL RELATIONSHIPS

Local Fauna

Fish

The IDNR has conducted several fish population surveys at Homer Lake during the past decade: August 7, 1985; August 12, 1986; June 13, 1988; June 11, 1991; and June 21, 1994. The lake was surveyed for 1.5 hours with an electrofishing boat on all occasions. The upper end of the lake was surveyed for 45 minutes and the dam end of the lake was surveyed for another 45 minutes. The number of fish shocked at Homer Lake were: 254, 381, 372, 165, and 405 for the 1985, 1986, 1987, 1991, and 1994 surveys, respectively. The number of species shocked were, respectively, 8, 11, 9, 10, and 12. The species of fish shocked in the 1994 survey were largemouth bass, bluegill, redear sunfish, green sunfish, hybrid sunfish, white crappie, black crappie, channel catfish, carp, golden shiner, and black bullhead grass pickerel. A general summary of the fish survey, fish stocking, fishery management practices, and recommendations for Homer Lake were documented in lake periodic reports by the IDNR. Some selected (available) lake periodic reports are in appendix G.

Eight-inch channel catfish were stocked by the IDNR on August 30, 1989 (2,020); August 13, 1990 (4,000); and July 30, 1991 (4,000). Eight-inch northern pike were stocked on July 24, 1989 (830), and August 1, 1990 (648). The CCFPD stocked 400, 8-inch triploid grass carp on April 22, 1991. There has been an apparent reduction in the aquatic vegetation as a result (G. Lutterbie, IDNR, personal communication, 1998). No fish stocking was done after 1994. It was planned to stock and conduct a creel survey in the summer of 1999 (G. Lutterbie, IDNR, personal communication, 1999).

The most recent (1997) fisheries report indicates that largemouth bass are in fair condition. However, the bass population was out of proportion relative to other species. Crappie

population was dominated by white crappie. Gizzard shad were noted for the first time in 10 years.

There is no indication in the 1997 fisheries biologist's report specifically concerning rough fish or their impact on water clarity. Also, there is no indication in this report to indicate that water quality has had any impact on the quality of the fisheries resource at Homer Lake.

During the winter of 1987-1988, the lake was drawn down 5 feet because of the work on the docks and to remove some of the sediment from the upper part of the lake. No effect on fish populations was observed in 1988. No fish kill occurrences have been recorded at Homer Lake (G. Lutterbie, IDNR, personal communication, 1999).

No herbicide application was conducted in 1995. In 1996, algae, duckweed, and Eurasian water milfoil filled in the upper end of the lake. On June 17, 1996, 0.5 gallons of Aquathol was applied near the boat lane to maintain an open area from the north boat ramp to the main lake. No lake management procedures were conducted in 1997 and 1998.

The fishing regulations at Homer Lake are: largemouth bass, 14-inch minimum length limit with a daily creel limit of 6; northern pike, 24-inch minimum length limit with a daily creel limit of 3; and channel catfish, daily creel limit of 6. Fishing in Homer Lake is considered good to excellent (G. Lutterbie, IDNR, personal communication, 1999).

Fish Flesh Analyses

The primary concern in fish flesh analyses is the possibility of the bioaccumulation of toxic substances such as mercury, organochlorine, and other organochemicals in fish, which may prove detrimental to higher forms in the food chain including humans, the ultimate consumers. In taking a preventive approach, the U.S. Food and Drug Administration (FDA) has adopted cancer-risk assessment guidelines as well as guidelines for other health effects (U.S. Food and Drug Administration, 1998). To protect the public from long-term health effects, states have used the FDA guidelines to establish threshold concentrations for organics and metals in fish tissues above which an advisory will be issued that the fish should not be consumed. The federal action levels are:

<i>Contaminants</i>	<i>Federal action levels (parts per million)</i>
Heptachlor epoxide	0.3
PCBs	2.0
Chlordane	0.3
Total DDT	5.0
Dieldrin	0.3
Mercury	1.0

Fish flesh samples for analysis (carp fillets without skin) were collected by the IDNR on June 12, 1997, and analyzed by the Illinois EPA. The results of fish flesh analyses are given in

table 24. Most of the organochlorine tests were below detection levels. Heptachlor epoxide, PCBs, chlordane, total DDT, and dieldrin concentrations were lower than the action levels.

Birds

The resident birds observed in the Homer Lake area are: American kestrel, ring-necked pheasant, mourning dove, rock dove, screech owl, great horned owl, barred owl, red-bellied woodpecker, downy woodpecker, hairy woodpecker, pileated woodpecker, horned lark, blue jay, American crow, Carolina chickadee, Carolina wren, European starling, yellow warbler, and chestnut-sided warbler. One hundred species of breeding birds are recorded by the Champaign County Audubon (CCA). A total of 225 species, which includes full-time residents, locally breeding species, uncertain locally breeding species, migratory birds, and winter-season species, can be observed in the Homer Lake area (Beth Chato, CCA, personal communication, 1999).

The endangered and threatened birds in Champaign County are: cooper's hawk (*Accipiter cooperii*), upland sandpiper (*Bartramia longicauda*), northern harrier (*Circus cyaneus*), loggerhead shrike (*Lanius ludovicianus*), and pied-billed grebe (*Podilymbus podiceps*).

The lake has a population of approximately 40 resident (non-migratory) Canada geese. Other geese and ducks utilize Homer Lake on a seasonal basis under natural migratory conditions. This population has not been a problem on the 100-acre lake (Brian Taylor, personal communication, June 19, 2000).

Mammals

Forty-four species of mammals are found in Champaign County (CCFPD, 1994). They include: bat, beaver, coyote, deer, fox, mink, mole, mouse, muskrat, opossum, raccoon, vole, shrew, skunk, squirrel, weasel, and woodchuck.

Reptiles and Amphibians

Thirty-seven species of reptiles and amphibians were found in Champaign County (CCFPD, 1994). The major groups include: frog (family of ranidae), treefrog (family of hylidae), lizard, salamander, snake, toad, turtle, and mud puppy.

Mussels

The endangered and threatened mussel species include: wavy-rayed lampmussel (*Lampsilis fasciola*), creek heelsplitter (*Lasmigona compressa*), salamander mussel (*Simpsonaias ambigua*), poundhorn (*Unio merus tetralasmus*), and rayed bean (*Villosa fabalis*) (Herkert, 1992).

Table 24. Results of Fish Flesh Analyses from Homer Lake

<i>Organics*</i>	<i>Concentration</i>
Aldrin	0.01 k
Total chlordane	0.03
Total DDT and analogs	0.03
Dieldrin	0.04
Endrin	0.01 k
Total PCBs	0.01 k
Heptachlor	0.01 k
Heptachlor epoxide	0.01
Toxaphene	1.00 k
Methoxychlor	0.05 k
Hexachlorobenzene	0.01 k
Alpha-BHC	0.01 k
Gamma-BHC	0.01 k
Mirex	0.01 k
Lipid content, percent	7.80

Notes: *Unit - $\mu\text{g/g}$, unless specified
k - less than detectable level
BHC - benzene hexachloride
DDT - dichloro-diphenyl-trichloro-ethane
PCBs - polychlorinated biphenyls

Local Flora

Plants

This discussion of the vegetation in the Homer Lake area is adopted from the CCFPD Master Plan (CCFPD, 1994). The dominant plant species in the Homer Lake watershed are grain and forage plants. Corn and soybeans are the primary crops produced in the watershed. Wheat and, to a lesser extent, grain sorghum also are produced in the watershed.

Endangered and threatened plants of Champaign County include Sangamon phlox (*Phlox pilosa*), white lady's slipper (*Cypripedium candidum*), ear-leaved foxglove (*Tomanthera auriculata*), heart-leaved plantain (*Plantago cordata*), prairie white fringed orchid (*Plantanthera leucophaea*), and prairie dandelion (*Microseris cuspidata*) (Herkert, 1992).

Forests/Woodlands

Vegetation in the county includes forest/woodland, prairie, and marsh. Forest/woodland plant communities include: floodplain, mesic upland, dry upland, and prairie groves. Forests once bordered the rivers, with occasional groves on moraines and other prominent glacial landforms. The largest forested areas were those on the Salt Fork and Middle Fork Rivers at the eastern edge of the county. Forests also were found along the Sangamon and Kaskaskia Rivers. At Mahomet, and for at least 6 miles to the north, the belt of timber along the Sangamon River was about 3 miles wide. North and east of Urbana, the timberland along the Saline Branch was known as "the Big Woods." It extended from what is now Main Street in Urbana, to north of the present town of Leverett, and east as far as Mayview. Isolated prairie groves were once found in the northeastern and southeastern parts of Champaign County. All that remains today are narrow belts of timber along the streams and isolated woodlots throughout the county (CCFPD, 1994).

Floodplain forests in Champaign County are of the silver-American elm-ash type. White oak, black oak, shagbark hickory, shingle oak, and burr oak dominate dry upland forests. Commonly found in mesic upland forests are basswood, sugar maple, slippery elm, American elm, hackberry, red oak, white ash, black walnuts, and butternut hickory. Prairie groves are influenced by recurrent fires and were dominated by either burr oak or American elm and hackberry. Ninety species of forest trees native to Champaign County and several other Illinois species commonly found are listed in the Master Plan (CCFPD, 1994).

Flicker Woods next to Homer Lake has the highest quality upland oak-hickory woodland at the SFRFP. This area is bordered on the east by pasture, on the south by the Salt Fork River, on the north by County Road 1400 North (Homer Lake Road), and on the west by encroaching exotics and successional growth. The understory is predicated on a luxurious growth of herbaceous materials—mostly native wildflowers. A lane crosses the area from north to south. The land includes a cabin; a small pond nearby has been drained.

Twin Oaks Hill, a relatively small acreage, contains surprisingly high quality trees. Spring woodland wildflowers abound, and there is a trail nearby.

The Collins Memorial Woods is a high-quality, mature oak-hickory area. Row-crop agriculture is ongoing on property to the south. Collins Pond is on the north, to the east is successional growth, and the Salt Fork River is to the west. The relative isolation of this woods and the associated Collins Pond will dramatically change when the new county bridge goes in across the river. Historically known as the Sugar Maple Grove, this 5-acre tract of hard or sugar maples has been used for maple sugaring and, in recent times, as an integral part of the CCFPD's educational program. A dense stand of sugar maple seedlings has developed to the east of the older trees.

Prairies

Prairie plant communities include the wet, mesic, dry, and sand varieties. These prairies contain several hundred species of grasses and forbs. Prairie once covered 90 percent of Champaign County.

Vegetation found in the wet prairie sites included cord grass, sedges, and bluejoint grass. These areas supported such species as ironweed, boneset, swamp milkweed, and water hemlock. Mesic prairie sites were dominated by big bluestem, Indian grass, prairie dropseed, switch grass, little bluestem, and many characteristic prairie plants such as leadplant, compass plant, prairie dock, and rattlesnake master.

Dry prairie sites contained little bluestem and sideoats grama as well as forbs such as scurf-pea, pale beard-tongue, false boneset, cylindrical blazing star, and fringed puccoon. Dominating sand prairie sites were little bluestem, fall switch-grass and sand dropseed, and forbs such as goat's rue and spotted monarda. June grass, porcupine grass, western ragweed, prickly-pear cactus, poppy mallow, hairy grama, western sunflower, silky aster, and flax-leaved aster were also common.

Windsong Prairie is a prairie restoration northwest of the Visitor Center that was started in the 1970s. The remnants of 2- x 4-inch lumber that formed the original framed area for the initial seeding still can be seen. Management by SFRFP staff in the form of prairie burns as well as seeding/transplanting for increases in diversity has made this one of the CCFPD's more successful restoration efforts. Comprised of approximately 4 acres, this site has a platform overlooking the prairie. The prairie also is accessible via a concrete sidewalk. Windsong Prairie is used extensively in the CCFPD's school programs.

Relic prairie plants are the only indication of the schoolyard prairie at the northwest corner of the SFRFP site. Farming operations in the past and recent stripping and removal of topsoil have obliterated what must have been an outstanding example of the grand prairie.

Marshes

Marshes contain bulrushes, sedges, bur reeds, cattails, and common reed. Many species of aquatic and semiaquatic plants such as arrowhead, cattail, duckweed, water plantain, pondweed, pickerel-weed, beggar-ticks, and water crowfoot were found there as well.

PART 2: FEASIBILITY STUDY OF HOMER LAKE

INTRODUCTION

On the basis of the information obtained and the conclusions derived from the diagnostic portion of this lake restoration and protection study (see Part 1), a feasibility study was undertaken to investigate potential alternatives for restoring the environmental quality and enhancing the recreational and aesthetic value of Homer Lake. The purposes were to identify and evaluate possible alternative techniques for restoring and/or protecting the lake water quality to maximize public benefits; to provide sufficient technical, environmental, socioeconomic, and financial information to enable decision makers to select the most cost-effective techniques; and to develop a technical program for using the techniques selected.

Alternative methods to address various problems at Homer Lake have been identified and evaluated. The proposed restoration plan is presented for consideration as a Phase II project under the Clean Lakes Program. The anticipated benefits, cost estimates, and time schedule of the proposed lake restoration program also are presented.

EXISTING LAKE QUALITY PROBLEMS

On the basis of the detailed and systematic study of the lake ecology, which covered a period of more than 12 months, an assessment of the physical, chemical, and biological characteristics of the lake water and sediment was made. Additionally, factors affecting the lake's aesthetic and ecological qualities were assessed, and the causes of its use degradation were determined. The lake's hydraulic, sediment, and nutrient budgets were estimated using the data collected for precipitation, lake-level fluctuations, and the water quality characteristics of ephemeral runoffs into the lake after storm events.

No obnoxious algae were observed in the lake at any time during the study period. Aquatic vegetation (macrophytes) can be found in shallow areas along almost the entire length of the lake. The growth of macrophytes was not extensive in density. The macrophyte beds did not impair recreational fishing but was beneficial for fisheries.

Most of the shoreline of Homer Lake is well protected and lake shoreline erosion is not a problem. Only a small section of the shoreline (120 feet long, 0.4 percent) has been severely eroded. The shoreline has been stable for more than a decade (R. Woodmansee, SFRFP, personal communication, 1999).

The chemical quality characteristics of parameters for which standards have been set in Illinois were generally within the stipulated limits, except TP. Ammonia-nitrogen was well within the upper limit of the standards.

For overall lake-use support, waters at stations 1, 2, and 3 of Homer Lake during 1976-1998 were classified as full/threatened, partial, and partial, respectively. The trophic states for stations 1, 2, and 3 were, respectively, eutrophic, eutrophic, and hypereutrophic.

Based on the results of the diagnostic study, the problems at Homer Lake have been identified as:

- watershed runoff-sediment and nutrients,
- siltation in the north end of the lake,
- high nutrient concentrations,
- turbid water,
- summer stratification—low DO levels in bottom water.

Watershed Runoff

The soil, nutrients, and pesticides that have been washed from the watershed into the lake for years have impacted all uses of the lake. Watershed erosion and silt deposition have been a problem at Homer Lake for a long time. Total erosion in the watershed has reduced the lake's surface by approximately 16.4 percent since its construction in 1968 (table 18). During the period April 1997–March 1998, the sediment, nitrogen, and phosphorus loads to the lake from the watershed were, respectively, 3,850, 187, and 1.02 tons annually (table 23). These values represent 100, 99.8, and 79.3 percent, respectively, of the total input of sediment, nitrogen, and phosphorus from the watershed. The annual mean concentrations of sediment, total nitrogen and TP were 234, 11.9, and 0.06 mg/L, respectively. The values of TP and inorganic nitrogen were elevated in the lake.

During a storm event (March 30, 1998), high turbidity; low Secchi disc transparency (4 inches), and high TSS and TP occurred at all stations.

Siltation in the North End of the Lake

The lake sedimentation survey conducted in November 1998 revealed that approximately 111.3 ac-ft (179,600 cubic yards) of accumulated sediment were deposited in the lake. This represents a total capacity of volume loss of 16.4 percent from the original 1969 capacity. In the upper end of the lake from segment 11 through 15, the volume loss ranged from 37.2 to 64.8 percent of the original 1969 capacity (table 18). The average annual sedimentation rate in Homer Lake is 0.55 percent. In these segments, approximately 26.1 ac-ft (42,100 cubic yards) of sediment have accumulated and have contributed to shallow water conditions ranging from 1.0 to 6.0 feet in depth. An estimated 3,850 tons of sediment is added to the lake annually from the watershed (table 23). Boaters on Homer Lake report difficulty in reaching the upper (north) end of the lake because of sedimentation.

The north end of the lake acts as a silt basin, trapping most of the soil particles and agricultural chemicals before they are transported to the south end of the lake, especially during and after storm events (tables 8 and 9). The upper (north end, station 3) area of the lake has higher levels of turbidity, TSS, total nitrogen, and TP, with lower DO concentration and Secchi

disc transparency. These conditions can result in less aquatic vegetation and adversely impact the aesthetic enjoyment of the lake. The trophic state condition at station 3 has deteriorated to a hypereutrophic condition.

Siltation reduces the storage volume of the lake, the habitat available for fish, and the growth of aquatic vegetation. The accumulated sediments, which are nutrient rich and high in organic content, create a loosely compacted substrate over the lake bottom. This loose bottom sediment is easily resuspended by bottom-feeding fish, storm flows, and high wind velocity; and it can contribute to elevated suspended solids and decreased water transparencies.

High Nutrient Concentrations

The estimated nonpoint sources nutrient loading rates from the watershed are 187 tons of total nitrogen and 1.02 tons of TP per year (table 23). The nutrients in the sediment from fertilizer used for farming redissolved in the lake water and affected water quality and lake biota.

The observed data during this study indicate that nutrients are high in Homer Lake. The mean concentration for TP did not fall below the 0.030 mg/L level shown to contribute to algal growth (Vollenweider, 1968). The mean TP concentrations for stations 1S, 2S, 3S, and 1B were, respectively, 0.075, 0.087, 0.107, and 0.087 mg/L (appendices B1-B4). The TP levels for lake waters exceeded the 0.05 mg/L Illinois standard for 58, 58, 79, and 68 percent of the time at stations 1S, 2S, 3S, and 1B, respectively. The mean TP concentrations were 0.135 and 0.138 mg/L respectively, for the east and west tributaries (tables 8 and 9). The TP concentration is part of the reason Homer Lake is classified as a eutrophic to hypereutrophic lake.

The mean concentration of NO_3/NO_2 ranged from 3.94 to 4.72 mg/L for the four stations monitored during this study. The mean ammonia values for the four stations were between 0.14 and 0.21 mg/L. According to Sawyer (1952), inorganic nitrogen exceeding 0.30 mg/L was considered sufficient to stimulate algal growth. The nutrient budget identified the tributaries as the major contributor of TP to the lake. The IPCB (IEPA, 1999) stipulates that nitrite plus nitrate as nitrogen should not exceed 10.0 mg/L. Nitrate/nitrite concentrations in the lake waters were generally higher in February through May. Many samples exceeded this limit, especially at station 3 (appendices B1-B4).

Turbid Water

Turbid water is caused primarily by the presence of suspended solids from watershed runoff, both living and dead animal/plant matter, and resuspended bottom sediments. It causes lower water clarity. During this study period, Secchi transparency ranged from 4 inches (March 30, 1998, at stations 1-3) to 66 inches (January 26, 1998, at station 2). Mean Secchi transparencies were 27, 26, and 26 inches for stations 1, 2, and 3, respectively. During the lake's primary recreation-use period (April-September), Secchi disk transparencies were generally less than 48 inches. Water transparencies typically ranged from 12- 36 inches. The lake water is classified as moderate-use impairment.

Watershed runoff and bottom sediment resuspension have contributed to the turbidity of Homer Lake's water. On March 30, 1998, the entire lake water was turbid with a brown, murky appearance (TSS = 70 to 122 mg/L, and Secchi transparency = 4 inches at all three surface stations) due to four storm events. The aesthetic aspects of the lake were reduced after storm events. Bottom sediments disturbed by wind, waves, and the feeding activity of common carp and catfish also contribute to a reduction in water clarity. Fine-grained particles can remain suspended in the water column for extended periods of time, and resuspended sediments can release nutrients into the water column. Sediment resuspension and turbidity resulting from wind and wave action in shallow, nearshore areas is evident and reduces the aesthetic enjoyment of Homer Lake.

Dissolved Oxygen Levels

The DO values in the lake surface water at all three sampling stations generally were good throughout the current study period. The lake exhibits typical thermal stratification phenomenon from spring through summer, as do other Midwestern lakes. During the summer (June-September) peak stratification period, the lake was anoxic at depths below 8-9 feet from the surface at stations 1 and 2. This condition is typical for Illinois lakes. DO depletion in the hypolimnion (deeper) water is detrimental to the fishery and results in the regeneration of phosphorus and nitrogen compounds from the lake sediment.

OBJECTIVES OF THE HOMER LAKE MANAGEMENT PLAN

The goal of the lake restoration plan for Homer Lake is to address the current problems identified previously and to protect, preserve, and enhance existing lake water quality and the beneficial uses of the lake. Beneficial uses include: cultural uses such as public water supply; fishing, boating, and other recreational uses; and environmental uses such as water quality and habitat for fish and other wildlife.

The desirable water quality goals developed for the this lake management plan based on water quality guidelines of the Illinois EPA (IEPA, 1978, 1999) are:

- DO of at least 5 mg/L throughout the entire lake during the critical summer months,
- Secchi disc transparency of not less than 4 feet during summer months,
- TP of less than 0.05 mg/L at the time of the lake spring turnover,
- average annual suspended solids and turbidity values of less than 25 units,
- nutrient loading reduced to the maximum practicable extent,
- soil erosion in the watershed reduced to the maximum practicable extent.

The objectives for the proposed lake management program are:

- reduce the amount of sedimentation in the lake through watershed land treatment,
- reduce the inflow of nutrients into the lake through watershed land treatment,
- reduce the turbidity of the water in the lake,
- restore the depth and volume of the lake, which has been reduced by sedimentation,
- maintain the DO level in the lake above 5.0 mg/L.

POLLUTION CONTROL AND RESTORATION SCHEMES

There are several alternative approaches or solutions for each of the lake management plan objectives. Taking no action is also an alternative. The following pollution control and restoration measures have been identified for Homer Lake:

- reduce the amount of pollutants being delivered to the lake,
- perform shallow lake dredging,
- reduce nutrients concentrations in the lake,
- increase DO levels,
- reduce lake turbidity,
- conduct Phase II monitoring and prepare a final report.

Reduction of Pollutants Delivered to the Lake

To reduce the pollutants (sediment and nutrients) being delivered to the lake, best management practices (BMP) and land treatment should be carried out in the watershed. The following BMP can be applied in the Homer Lake watershed: conservation tillage, contour farming, contour stripcropping, terraces, crop rotation, grassed waterways or filter strips, and runoff detention ponds.

Conservation Tillage

Conservation tillage is a farming practice that leaves stems or stalks and roots intact in the field after harvest. The purpose of this practice is to reduce water runoff and soil loss compared to conventional tillage in which the topsoil is turned over and mixed by a plow. The capital cost is high if new equipment is to be purchased. Conservation tillage reduces the number of times the top soil is mixed; for no-till, the topsoil is left essentially undisturbed.

Contour Farming

Under contour farming practices, the field is plowed across the slope of the land. Contour farming is an effective erosion-control measure on farmland with 2-8 percent slopes. It is less effective on steeper slopes. There is no up-front capital cost for this practice. Operational costs might be slightly higher than straight row-crop procedures

Contour Stripcropping

Contour stripcropping is similar to contour farming, for which the farmer plows across the slope of the land. The difference is that strips of close-growing crops or meadow grasses are planted between strips of row crops, such as corn or soybeans. Contour stripcropping can be used more effectively on 8-15 percent slopes. Contour stripcropping is good to excellent for runoff control. Implementation (capital) costs average \$24 per acre and \$3 to \$5 per acre per year for operation and maintenance.

Terraces

Terraces are used when conservation tillage, contour farming, or contour stripcropping do not achieve sufficient soil protection. Terraces are used in long slopes and slopes up to 12 percent. They are step platforms that reduce the slope by breaking it into lesser or near horizontal slopes. Terraces are fair for runoff protection and are more effective in reducing soil erosion than runoff volume. They have high initial costs, an average of \$73 per acre. Maintenance costs are \$16 per acre annually (USEPA, 1990).

Crop Rotation

Crop rotation is planned planting of crops, such as grass or legumes that are alternated with corn in two- to four-year rotations. Surface runoff control is good when field sequences of crops are planted in some area of farmland. For example, plow-based crops are followed by pasture in grasses or legumes. Capital cost may be high if the farm economy declines. Operational costs will be less of a problem in combination with a livestock operation that can use pasture and silage. Costs for operation and maintenance are moderate, but there is an increased labor requirement. Cost may be offset by lower nitrogen applications to the land when corn is planted after legumes, and there may be a reduction in pesticide application.

Grassed Waterways

Grassed waterways are broad and shallow drainage channels (natural or constructed) that are planted with erosion-resistant grasses. In some cases grassed waterways are combined with filter strips, which are strips of land between or on the edges of fields that are permanently planted with grasses.

The capital cost of grassed waterways is moderate, approximately \$22 per acre. Average maintenance costs range from \$1 to \$14 per acre per year (USEPA, 1990). The effectiveness of soil loss control by this practice is good, with 60 to 80 percent reduction.

Retention Basins

Runoff retention (siltation) basins settle and filter out pollutants (mainly sediments and some nutrients) or hold water until treated. The retention basin itself provides no treatment. Retention facilities may include natural ponds, artificial basins, underground tunnels, and other holding structures.

Retention basins have fair-to-excellent effectiveness for sediment removal and runoff control, with 60 to 80 percent reduction in sediment load. The capital cost depends on the types and sizes of the basins and range from \$100 to \$1,000 per acre; the operation and maintenance costs range from \$10 to \$125, depending on the site.

There is no silt retention basin above the entrance of both tributaries of Homer Lake. Private properties are at both arms above (north) Homer Lake Road.

Construction of an in-lake sedimentation basin in the upper end of the lake also is an alternative method to reduce lake sedimentation by catching or retaining runoff water long enough to allow suspended solids to settle out before reaching the main body of the lake. An effective in-lake sedimentation basin would impound runoff water behind an earth- and rock-filled dam temporarily. The impounded water would be released gradually through a slotted drop-inlet structure with an overflow structure and an appropriate debris screen to prevent clogging. The cost of constructing this type of large structure would be high. Therefore, this alternative (in-lake sediment basin) is not considered an efficient option for reducing sediment delivery to Homer Lake.

Proposed Alternatives

Each farming practice or land-treatment method given here would provide erosion control, reduce farmland soil losses, and reduce input of sediments, nutrients, and agricultural chemicals to the lake. Regional soil specialists should be contacted for watershed management measures. The following recommendations can be adopted for agricultural fields:

- conservation tillage practices such as no-till planting, discontinuation of plowing up and down the land slope, and/or leaving high amounts of crop residue on the land surface;
- cropping practices, such as crop rotation or conversion to entire cover crops (such as hay);
- testing of soil nutrient levels to ensure that only the minimum amount of fertilizer nutrients are applied.

Watershed management for soil stabilization should continue and be encouraged. Securing funding and detailed planning should be the responsibility of the landowners, the Champaign County Soil and Water Conservation District (CCSWCD), and the CCFPD. The land-treatment measures may include sediment and erosion control structures, grass waterways, terraces, waterway diversion, streambank stabilization, and other BMP.

According to CCSWCD conservationist, Leon Wendte (personal communication, 1999), only two acres (2.5 percent) of filter strips have been constructed in the Homer Lake watershed of a total of 81 acres required. The number of filter strips installed in the Homer Lake watershed is too low in comparison to the rest of Champaign County (20 percent constructed). In Wendte's opinion, vegetative filter strips (66 feet wide) along each bank of the tributary creeks is the most effective method of reducing soil erosion and nutrient runoff from cropland. Increased participation in the Conservation Reserve Program (CRP) is urgently needed.

The CRP, implemented by the Commodity Credit Corporation (CCC), will pay up to 50 percent of the cost of establishing a permanent cover. The cost to the landowner is a one-time 50 percent cost share. In addition, in the Homer Lake watershed (mostly Drummer soil types), the CRP will pay \$185 per acre per year to the landowner for up to 15 years after installation. Real estate tax also will be reduced to one-sixth of the cropland tax. The CRP is a good program. Unfortunately, the CRP is short of personnel (funding) to contact farmers. Continuous signup by farmers is encouraged.

If the goal is set at 75 percent CRP participation by watershed landowners, 60 acres of filter strips will be installed along both banks of the two tributaries. The filter strips would be an average of 66 feet wide (the CRP requires 30-100 feet depending on the land slope). The cost of installation of the filter strips is \$150 per acre (ranging from \$90 to \$150 per acre) or \$9,000. The Illinois Clean Lakes Program would provide 50 percent of the non-Federal cost share (25 percent of the total) of the cost of establishing a permanent cover, the landowner would pay the remaining portion of the non-Federal cost share (also 25 percent of the total), and the CCC would pay the other 50 percent of the cost. A contractor would be needed to implement the project at an estimated charge of \$4,000. The contractor's tasks would include sending out letters, making follow-up phone calls, conducting interviews, and making site visits. There are approximately 40 farmers. The total, non-Federal cost for enhancing sign-up for the CRP is \$8,500.

A properly installed and maintained filter strip is capable of filtering or trapping 85, 85, and 20 percent of TSS, TP, and total nitrogen, respectively (Leon Wendte, personal communication, 1999). If 60 acres of filter strips were installed, the sediment load would be reduced by an estimated 2,450 ($3850 \times 0.75 \times 0.85$) tons per year; TP would be reduced by 0.65 ton per year; and the total nitrogen load would be decreased by 28 tons per year. These reductions represent 63.7, 63.7, and 15.0 percent of reduction for the respective loads.

Shallow Lake Dredging for Sediment Removal

Sediment removal in freshwater lakes usually is undertaken to increase lake water volume, improve sport fishery habitats, enhance overwintering fish survival, remove nutrient-rich sediments and/or hazardous materials, reduce the abundance of rooted aquatic plants, reduce the sediment's oxygen demand on the overlying water, reduce the potential for sediment resuspension, and control algae.

The advantages of sediment-removal techniques include the ability to selectively deepen parts of a lake basin, increase the lake volume, recover organically rich sediment for soil enrichment, and improve limnetic water quality. Disadvantages include high cost, possible phosphorus release from sediment, increased phytoplankton productivity, noise, lake drawdown, temporary reduction in benthic fish food organisms, and the potential for release of toxic materials to the overlying water and environmental degradation at the dredged material disposal site (Peterson, 1981). In addition, the nutrient content of the sediments may remain high at a considerable depth, thus making it impossible to reach a low nutrient level in sediment. Although satisfactory disposal of the spoils may be very expensive, high quality dredge material can be used for beneficial purposes and may offset the initial high cost of dredging. In nearly all cases, permits from the U.S. Army Corps of Engineers are required (USEPA, 1990).

Peterson's (1981) report on the restoration of Wisconsin Spring Ponds through dredging is one of the most thoroughly documented studies concerning the ecological effects of dredging small lakes. The purpose of the dredging was to deepen the ponds to improve fish production. Incidental to the deepening was the control of aquatic macrophytes. Even though there was a temporary decrease in the benthic organisms soon after dredging, four to five years after lake restoration the average density and biomass of fishable-size fish were substantially greater than

during the predredging period. During the dredging process, there may be an increase in turbidity in the immediate surrounding area and a possible decrease in the ambient DO concentrations. However these problems are short lived and many of them can be minimized with proper planning.

Peterson (1981) also reports on the successful restoration of Lilly Lake (southeastern Wisconsin) by dredging. The main problems in this lake were severe shoaling (a sandbar that makes the water shallow), abundant aquatic plant growth, and winter fish kills. In addition to dredging the entire basin, 10 percent of the 97-acre lake was dredged to a depth of approximately 6.0 m (20 feet). Dredging was completed in September 1979. As of 1981, water quality had remained good, macrophytes had virtually been eliminated, and local sponsors generally were pleased with the outcome.

Springfield, Illinois, successfully used hydraulic dredging for Lake Springfield to meet multiple objectives: deepen the shallow end of the lake to increase sediment retention capacity, control emergent aquatic vegetation, and enhance aesthetic and recreational opportunities. This project is considered the largest inland lake dredging project completed in the early 1990s in Illinois (Cochran & Wilken, Inc., Springfield, Illinois, personal communication, 1994).

Sediment removal can be accomplished by either hydraulic dredging or exposing lake sediments for removal by conventional earth-moving equipment. Pierce (1970) describes various types of hydraulic dredging equipment and provides guidance on the engineering aspects of dredge selection. Peterson (1981) describes various grab, bucket, and clam-shell dredges; hydraulic cutterhead dredges; and specialized dredges to minimize secondary water quality impacts. Sediment removal using earth-moving equipment after lake-level drawdown was successfully used in Crystal Lake, Urbana, Illinois, during 1990-1991.

The major alternations for lake sediment removal are lake water level drawdown and excavation, mechanical dredging, and hydraulic dredging. The advantages and disadvantages of these methods have been discussed by Berrini (1992).

Drawdown and Excavation

Several methods of mechanical dredging or excavation currently are available. The lake can be dredged at normal pool with a dragline, or the water level can be lowered enough to allow low ground pressure excavation equipment into the dry lakebed. There are several advantages to dry lakebed excavation compared to hydraulic or dragline dredging, e.g., the elimination of excessive turbidity or resuspended solids and a smaller quantity of material to remove due to consolidation and compaction. However, many disadvantages and problems would be encountered. Although initial water level drawdown could be accomplished quickly with high capacity pumps, the length of time required for the sediment to dewater and consolidate enough to support excavation equipment would be a year or more.

In order to effectively reduce sediment volume in the upper ends of Homer Lake, water levels would have to be lowered approximately 7-8 feet for the entire period of drawdown. It is

impractical to use drawdown for sediment removal in Homer Lake due to a loss of almost one-half of the lake water volume for an extended period.

Other Mechanical Dredging

Another method of mechanical dredging would be accomplished with a dragline while the lake water level is at normal pool. This is accomplished by extending excavating equipment from shore, or by mounting the equipment on a barge. This method is more practical for smaller lakes or when a large quantity of rocks or debris is anticipated. Removal of accumulated lake sediment is inefficient and can leave a high percentage of material behind. Disposal of the sediment also is very inefficient and labor intensive as the material must be handled several times. After the sediment is removed from the lake, it must be placed on a barge or truck and transported to the retention site. This repeated handling generally is not cost effective and can result in sediment losses during transfer. Equipment access for the removal and placement of dredged sediment also would have a negative impact on the lake shoreline. Therefore, mechanical dredging would not be considered a feasible restoration method.

Hydraulic Dredging

Hydraulic dredging involves a centrifugal pump mounted on a pontoon or hull that uses suction to pull the loose sediment off the bottom and pump it through a polyethylene pipeline to a sediment retention area. Generally, a cutter head is added to the intake of the suction line in order to loosen the accumulated or native sediment for easy transport and discharge. A slurry of sediment and water, generally between 10 and 30 percent solids, can be pumped a distances of 5,000 feet, or as much as 10,000 feet with the use of a booster pump (Berrini, 1992). The efficiently pumped sediment slurry must reach a suitably constructed earthen dike-walled containment area with adequate storage capacity. The sediment containment or retention area must be properly designed to allow sufficient retention time for the sediment particles to settle throughout the project and allow the clear decant or effluent water to flow through the outlet structure back to the lake.

One advantage of hydraulic dredging is the efficiency of sediment handling. The removal, transport, and deposition are performed in one operation, which minimizes expenses and potential sediment losses during transport. Another advantage is that the lake does not have to be drained, and most areas can remain open for public use. Most hydraulic dredges are considered portable and are easily moved from one site to another. They are extremely versatile and capable of covering large areas of the lake by maneuvering with their spud anchorage system and moving the discharge pipeline when necessary.

Proposed Alternatives

Hydraulic dredging is the proposed alternative for removing accumulated sediment from the upper arms of Homer Lake because of its efficiency and versatility. Hydraulic dredging has the capability of removing large quantities of sediment with the lake at its normal water level without dewatering the lake. Bottom sediment will be loosened and pumped as a slurry to a retention basin (pond) where the sediment will settle as the slurry travels through the basin. The

north end of the wildlife conservation area (south of Highway 14, figure 3) would provide a suitable surface area to construct a sediment retention basin. The retention site is upland within the preserve boundaries, at which no filling of wetlands or floodplain will occur. The sediment left in the retention basin would need to be hauled away or reclaimed later. When the water reaches the outlet structure, it must meet the Illinois EPA's effluent standard for TSS. The clarified water will return to the lake by gravity flow through designed drain ditches.

An estimated 25,500 cubic yards (15.8 ac-ft x 1613 cubic yards/ac-ft) of sediment would be removed from the upper ends of the lake (south of Homer Lake Road) at segments 12 (4.2 ac-ft), 14 (9.3 ac-ft), and 15 (2.3 ac-ft), (see figure 10). This quantity is based on removing all accumulated sediment within these areas down to the hard original bottom. The sediment volume removed represents 14.2 percent of the total. Note that segment 13 is not the property of CCFPD.

The cost for removing 25,500 cubic yards of sediment by hydraulic dredging is estimated as follows. The construction of an earthen sediment retention basin will require a 3.0-acre site with an average embankment height of 9 feet. An estimated cost for the retention basin is \$15,000. The removal of 25,500 cubic yards of sediment by hydraulic dredging is estimated to cost \$3.60 per cubic yard, a total of \$91,800. Project engineering design and administration will be approximately \$15,000. The cost of regrading and reclaiming the sediment retention site after dredging is complete is an estimated \$16,000. The total cost of hydraulic dredging 25,500 cubic yards, therefore, is estimated to be \$137,800.

Reduction of Nutrient Concentrations in the Lake

Measures that can be effective in reducing nutrient concentrations in the lake are under the following two categories.

Limiting nutrient influx:

- point source nutrient removal and diversion,
- control of nonpoint sources of nutrients,
- prevention of shoreline erosion.

In-lake treatment and control measures:

- dilution and dispersion,
- nutrient inactivation/precipitation,
- sediment exposure and desiccation,
- lake bottom sealing,
- dredging,
- selective discharge,
- artificial circulation.

A long-term solution to improving water quality of the lake in the north basin involves preventing as much pollutant (sediments, nitrogen, phosphorus, etc.) entry as possible. One alternative is a short-term solution that involves sediment removal and nutrient inactivation. Another effective alternative is a combination of pollutant reduction and removal.

Removing nutrient-rich sediment from the lake bottom is a complement to nutrient reduction, and dredging is an effective method for removing nutrient-rich sediment from the lake.

Limiting Nutrient Influx

Point Source Nutrient Removal and Diversion. Nutrient removal and diversion have been widely practiced as lake restoration schemes in the United States. Advanced wastewater treatment for nutrient removal, removal of both nitrogen and phosphorus, and diversion of treated effluents are practiced in many areas.

There is one small point source wastewater effluent discharge (Village of Ogden, population of 680) within the Homer Lake watershed. Its effluent quality is regulated by the Illinois EPA.

The prelake methods involve some low-check dams upstream of the lake, diversion of sediment-laden water, and use of sedimentation pools (silt basin). Diversion is routing the inflow source to other places during storm events. The diversion of sediment-laden water by a 3- to 4-foot diameter pipe, laid along the length of the lake from the bridge downstream of Homer Lake Road to a point below the dam, not only will be very costly but also will require costly operation and control. Due to the morphometric and hydrologic features of the lake, it would be technically unfeasible and expensive to undertake a diversion or flow routing system for the control of nutrients.

A sediment basin can be constructed in the eastern part of the lake just downstream from the bridge. But it would not solve the current siltation problem and may cause flooding.

Nonpoint Source Control. Nonpoint sources of pollution, which are incidental to land uses throughout the drainage area of the lake, are a significant cause of lake degradation. Drainage basin alterations are the long-term solutions that involve preventing as much nutrient entry as possible from external nonpoint sources. Because cropland erosion and watershed runoff are the major sources of nutrients entering the lake, there must be a concentrated effort toward reducing fertilizer use, increasing effective utilization, and preventing runoff. Nutrients must be maintained on the fields through continued and increased conservation practices that reduce runoff.

Sediment from the cultivated and fertilized farmland has been found to be the most important source of nitrogen and phosphorus inputs to the lake. Nitrogen and phosphorus contributions to the lake from the watershed are, respectively, 187 and 1.02 tons per year (98.8 and 79.3 percent of the total). Phosphorus has a high affinity for becoming adsorbed on to soil particles; such eroded soil is the principal transport mechanism of agricultural phosphorus in the watershed.

Nutrient control strategies appropriate for the agricultural fields are discussed in the section, Reduction of Pollutants Delivered to the Lake. An educational program to promote

conservation tillage, crop rotation, minimizing use of fertilizer, grassed buffer zone, etc. should be undertaken.

Prevention of Shoreline Erosion. Shoreline erosion control techniques can be categorized into two groups: nonstructural (vegetative) and structural methods. Nonstructural methods include cypress plantings, willow planting, hydroseeding, tree-cutting with grass seeding, and lower water levels. Structural methods include riprap, gabions, biologs (palm tree leaves), seawalls, bulkheads, and a combination of these methods. Some of these methods are discussed in detail in other reports (U.S. Army Corps of Engineers, 1981; City of Charleston, 1992; Hoag et al., 1993; Lin et al., 1999).

Shoreline erosion is not a problem in Homer Lake. It did not contribute to lake sedimentation.

In-Lake Treatment and Control Measures

Dilution and Dispersion. The technique for dilution and dispersion (flushing) is accomplished by the replacement of nutrient-rich waters with nutrient-poor waters (usually ground water) and is the washout of phytoplankton. Successful flushing requires that the water exchange rate must approach algal growth rate, i.e., complete water replacement every 2 or 3 weeks (USEPA, 1980). Nutrient dilution has been attempted by two procedures: pumping water out of the lake and permitting increased inflow of nutrient-poor ground water; and routing additional quantities of inflow of nutrient-poor surface waters into the lake. Domestic public water supply, artesian wells, and nearby rivers are among the possible water sources.

A new well can be drilled and sufficient ground water can be routed to the lake after aeration and removal of iron. The effectiveness of this technique depends on the difference between nutrient concentrations in the inflow and lake waters and the proportion of water used for dilution. Admission of ground water will reduce nutrient levels, with a subsequent reduction in chlorophyll *a* and biomass. It also will improve Secchi disc transparency and the aesthetic quality of the lake waters. Admission of ground water also will reduce lake water temperatures and may allow the development of a year-round trout fishery as well as enhance conditions for swimming.

Flushing reduces algal biomass by increasing the loss rate of cells. However, dilution and flushing are not considered acceptable alternatives for Homer Lake due to the lack of suitable ground-water resources. Discharge of nutrient-rich, anoxic hypolimnetic water would not be a feasible solution because anoxic conditions normally occur during the summer thermal stratification period when water conservation is critical due to lack of precipitation and excessive water loss from evaporation. The benefits of flushing are similar to those for dilution.

Nutrient Inactivation/Precipitation. The purposes of nutrient inactivation/precipitation are: to change the form of the nutrient to make it unavailable to aquatic plants, to remove the nutrient from the photic zone, and to prevent the release or recycling of potentially available nutrients within the lake. In-lake nutrient inactivation techniques have been directed primary toward phosphorus.

Phosphorus precipitation removes phosphorus from the water column by adding a compound that binds with phosphorus, precipitates as a floc particle, then settles to the lake bottom. Phosphorus inactivation, however, is a technique to achieve long-term control of phosphorus release from sediments by adding as much alum (aluminum sulfate) to the lake as possible within the limits dictated by environmental safety.

Aluminum, iron, and calcium have salts that can combine with (or adsorb) inorganic phosphorus or remove phosphorus-containing particulate matter from the water column as part of a floc. Alum is often used because it retains its phosphorus-adsorbing ability over a relative wide range of environmental conditions. When alum is added to the water, pin-point, colloidal aggregates of aluminum hydroxide are formed. These aggregates rapidly grow into visible, brownish floc, a precipitate carrying adsorbed phosphorus that settles to the sediment surface. The water will be very clear within a few hours to a few days. If enough alum is added, a layer of 1 to 2 inches of aluminum hydroxide will cover the sediment and significantly retard the release of phosphorus into the water column as an “internal load.”

The addition of aluminum salts to lakes has the potential of negative impacts. As alum is added to the lake water, alkalinity and pH decline. The pH must be maintained between 6 and 8 during application. Soft water lakes must be buffered. Another potential negative effect of phosphorus inactivation is the sharp increase in water transparency, which may allow an existing weed infestation to spread into deeper water.

Phosphorus inactivation has been highly effective and long-lasting in thermally stratified natural lakes, especially when an adequate alum dose has been applied to the sediment and sufficient diversion of nutrient inputs has occurred. Successful treatments have been made to large, deep (flush very slowly) lakes as well as to the more common small farm ponds. There has been no experience in using this procedure in impoundments, in which it is difficult to divert nutrients. Therefore, phosphorus inactivation could be very brief. In addition, high flow may wash the floc out or quickly cover it with another layer of nutrient-rich silt.

Homer Lake has significant allochthonous inputs and flushes many times a year. Therefore, phosphorus precipitation is not considered a feasible alternative because the predominant phosphorus loading to the lake is from the watershed.

Sediment Exposure and Desiccation. Water level manipulation has been used as a mechanism for enhancing water quality of certain lakes and reservoirs. The exposure of lake bottom mud to the atmosphere reduces sediment oxygen demand and increases the oxidation state of the mud surface. This procedure can retard the movement of nutrients from the sediments to the overlying water when flooded once again. Sediment exposure also can curb sediment nutrient release by physically stabilizing the upper flocculated zone of the sediments. Lake drawdown has been used as a control measure for rooted aquatic vegetation and as a mechanism for lake deepening through sediment consolidation. In addition, this technique has been used to manage fish; to provide access to docks, dam, and shoreline stabilization structures for needed repairs; to permit dredging using conventional earth-moving equipment; and to facilitate the application of sediment covers.

The negative impacts following drawdown include possible fish kills, establishment of resistant macrophytes, algal blooms, changes in littoral fauna, failure to refill, unavailability of open water or access to open water for recreation, and decline in attractiveness of waterfowl.

Lake drawdown for sediment consolidation is not likely to increase the lake capacity to any significant degree, and it will interfere with fishing and other recreational activities. Drawdown is not considered a viable technique for Homer Lake. It will be difficult to convince the public to forego their recreational opportunities for any length of time because of lake drawdown, particularly when the end results may be doubtful.

Lake Bottom Sealing. Sediment covering to control sediment nutrient release and macrophyte population has been used as an in-lake treatment technique. Covering of bottom sediment with sheeting material (plastic, rubber, etc.) or particulate material (clay, sand, fly ash, etc.) can exchange nutrients from the sediments to the overlaying waters either by forming a physical barrier or by increasing the capacity of surface sediments to hold nutrients.

The drawback encountered when bottom sealing with sheeting is the blooming of the sheeting in the underlying sediments. Sand and other particulate materials of large size tend to sink below the flocculent sediments. Seed germination and regrowth of macrophytes occur on polyethylene (usually 1 millimeter thick, 7 feet wide, and 100 feet long) sheeting after significant sedimentation (two or three years) had taken place. It is very expensive to correct the problem. Unless the lake is drawn down, sheeting has to be placed directly over vegetative growth by scuba divers and anchored with metal T-bars.

In view of the disadvantages of bottom sealing, especially the need for skilled labor for removal and repositioning of the sheets for years after installation, bottom sealing with sheets to control nutrient release is not economically justifiable at Homer Lake.

Dredging. Sediment removal in freshwater lakes will remove nutrient-rich sediment for nutrient control. Sediment removal techniques reduce the potential for sediment resuspension and consequent nutrient regeneration caused by wind/wave action and bottom-feeding fish, thereby increasing water clarity. Dredging as an alternative for Homer Lake is discussed in the section, Shallow Lake Dredging for Sediment Removal.

Selective Discharge. Selective discharge of anaerobic bottom waters has been used as an in-lake management tool to improve DO concentration in the hypolimnetic zones. This technique permits the release of anaerobic, nutrient-rich water from the hypolimnion of the lake. The surface water discharge is often blocked off. The release of cooler water from the lake bottom generally results in elevated temperatures at that location. As a consequence, the rate of chemical reaction can be greatly accelerated in bottom water, thereby causing an increased demand of the oxygen resources. The degree of improvement in hypolimnetic water quality conditions depends on the lake volume and the outflows (Dunst et. al., 1974).

The release of anaerobic, nutrient-rich water has been reported to have caused problems in the downstream channel. An oxygen sag can develop downstream due to high oxygen

demand. Also, gases (such as hydrogen sulfide, methane, and ammonia) can be released from the discharging water and cause odor problems. The release of these gases is the major criticism of the selective technique.

If the selective discharges are matched to the inflow to the lake (i.e., 9, -11, and -19 ac-ft for August, September, and October 1997, respectively, see table 21), so the discharge rate will not cause any change in water quantity of the lake, no discharge could be made during most summer months. Homer Lake has 153 ac-ft of volume that is in an anaerobic condition (table 20). A permit is required by the Illinois EPA for this selective discharge. Because the water withdrawal rate cannot be maintained at adequate levels and because of adverse environmental impacts, selective discharge is not considered a feasible alternative to control nutrients in Homer Lake.

Artificial Circulation. When DO levels fall close to zero, more phosphorus is released from the sediments under the prevailing anaerobic conditions in the lower layers of the hypolimnion. One ameliorative technique is to pump hypolimnetic water to the surface and allow it to mix with warm epilimnetic water, or force the epilimnetic water to the hypolimnion. Another technique is to supply air under pressure to perforated pipes laid in the hypolimnion. Both methods have been used in various lakes with remarkable success.

Artificial circulation, also referred to as destratification, is a process by which the lake waters are oxygenated and circulated. The primary improvements in water quality that may be attained as a result of artificial circulation are reduced nutrient loading, increased oxygen levels, and chemical oxidation of substances in the entire water column.

The advantages of artificial circulation in a lake are (Kothandaraman and Evans, 1983a):

- With increased oxygen levels in the hypolimnion, there is a reduction in the anaerobic release of nutrients from the bottom sediments.
- Oxidation of reduced organic and inorganic materials occurs in the water. (This is particularly advantageous when the lakes serve as a raw water source because taste, odor, and color problems caused by iron, manganese, and/or hydrogen sulfide are eliminated or at least minimized.)
- The range of benthic populations is extended to the profundal region that was once anaerobic. (An increase in the number of fish and a shift to more favorable species can result from the greater availability of food organisms.)
- Favorable changes in algal populations occur with a decrease in undesirable blue-green species. (This is a result of the lowering of water temperature and the distribution of the algae between the euphotic and aphotic zones; however, there is no reduction in the productivity of the lake.)
- Evaporation rates are reduced in summer with the reduction in surface water temperatures.
- Artificial destratification often results in increased water clarity.
- Winter fish kills may be prevented by maintaining sufficient oxygen levels in the water under the ice.

The disadvantages of artificial destratification include (Kothandaraman and Evans, 1983a):

- An increased heat budget in the lake.
- Aeration may temporarily increase water turbidity due to the resuspension of bottom sediments.
- In most investigations, artificial destratification resulted in a reduction in blue-green algae, but in other instances there was no observable effect on blue-green algae.
- The artificial destratification may induce foaming.
- The oxygen demand of resuspended anaerobic mud may result in a decrease in oxygen concentrations, at least temporarily, that may kill fish.
- Aeration may cause supersaturation of nitrogen gas, raising the potential danger of gas bubble disease to fish.

Several types of destratification systems are available. The most commonly used is the mechanical type, typically consisting of a floating platform with a submerged motor-driven propeller or with a floating pump drawing bottom anoxic water to the surface. Another type of aeration system uses a compressed air system, such as that used in Charleston Side Channel Reservoir (City of Charleston, 1992) and Canton Lake (Crawford, Murphy & Tilly, 1995).

The compressor air aeration system consists of a heavy duty, oil-free, continuous rated air compressor of suitable horsepower (230/460 volts, 60 Hertz, 3-phases), with silencer, pressure gage, relief valves, control valves, and other appurtenances. The compressor should be capable of delivering 50 standard cubic feet per minute filtered, oil-free air at 15 pounds per square inch. The compressor system should be housed in a weatherproof shelter with adequate ventilation and noise dampening features.

The air diffusion system should be designed on the basis of the lake bottom configuration to maximize the destratification and circulation in the lake. In view of the enormous benefits achievable by this in-lake treatment technique, artificial aeration/destratification, is not only an economically and technically feasible management tool, but it also is an indispensable tool for lakes in Illinois with maximum depths greater than 12-15 feet.

Proposed Alternatives

Three alternatives can be taken to reduce high nutrient levels in the lake. The first action is continued and increased application of soil conservation practices in the watershed that would reduce and minimize sediment and nutrient delivery to the lake. The chosen actions are discussed in the section, Reduction of Pollutants Delivered to the Lake.

Another alternative that can be taken to reduce nutrient levels is dredging, which was discussed in the section, Shallow Lake Dredging for Sediment Removal. Removing the nutrient-rich sediments from the bottom of the upper arms of the lake will remove a large amount of the available nutrients that promote algae growth. By removing this accumulated sediment, the upper arms of the lake will once again be deeper and more capable of trapping incoming sediments and nutrients.

To control nutrient release and increasing DO levels in the lake water, a destratifier using a 2- to 3-horsepower electric unit operating a variable speed hydraulic motor with a 72-inch, six-blade, fixed-pitch propeller and mechanical gear reduction box should be installed near station 1. Based on the Water Survey's experience, the cost of a destratification system for Homer Lake, including complete installation and testing, will be \$10,000, and the monthly power cost for the system will be about \$60 to \$70.

Increasing Dissolved Oxygen Levels

Three techniques are available to increase DO levels in the lake: artificial circulation, selective discharge, and hypolimnetic aeration. Artificial circulation injects air from a diffuser located on the lake bottom to destratify the lake. Selective discharge of anaerobic bottom waters has been used as an in-lake management tool to improve the DO concentration in the hypolimnetic zones. The surface water discharge is often blocked off. Hypolimnetic aeration is different from artificial circulation in both objective and operation. Hypolimnetic aeration most commonly uses an airlift device to bring cold hypolimnetic water (the deep, stagnant water layer) up to the surface of deep lakes. The water is aerated by contact with the atmosphere, and some dissolved gases such as carbon dioxide and methane escape. The water is then returned to the hypolimnion. The intention is not to destratify the lake.

A common use of hypolimnetic aeration is to maintain a cold water fishery in a lake in which the hypolimnion is normally anoxic. Another use of this procedure is to eliminate color, taste, and odor in a water supply source withdrawn from a hypolimnion. Introducing oxygen to the water, which will precipitate iron and manganese from the water, does this. The procedure also could be used to improve the quality of water from a hypolimnetic discharge. Hypolimnetic aeration can control phosphorus release from lake sediments by promoting its combination with iron.

Hypolimnetic aerators need a large hypolimnion to work properly. Homer Lake does not have a large hypolimnion; therefore, this procedure is not considered feasible.

The choice for increasing DO levels in Homer Lake is the installation of a destratifier near station 1. The equipment for this system and its cost are described in the section, "Proposed Alternatives" under the section, "Reduction of Nutrient Concentrations in the Lake."

Reducing Lake Turbidity

The alternative techniques for reducing lake turbidity include watershed management (erosion control practices), reduction of sediment input, lake deepening or dredging, admission of unpolluted waters (dilution or flushing), aeration, and lake level drawdown. All these alternatives have been discussed in the sections, Reduction of Pollutants Delivered to the Lake and Reduction of Nutrient Concentrations in the Lake).

The proposed alternatives for reducing turbid water in the lake are exactly the same as those stated for reducing nutrient concentrations in the lake.

BENEFITS EXPECTED FROM THE RESTORATION PROJECT

When implemented, the proposed lake restoration program will impart a wide range of water quality and aesthetic improvements to Homer Lake. Benefits expected will contribute directly and indirectly to accomplishing the restoration objectives presented in the section, Pollution Control and Restoration Schemes.

The extent of benefits is obtained from the CRP practices in the watershed, shallow lake dredging, and destratification. The following benefits are likely to result from implementation of the proposed protection/restoration methods for Homer Lake:

- Soil conservation practices and watershed treatment will reduce the amount of sediment and nutrient inputs to the lake, thus improving overall water quality and prolonging the benefits of the dredging program.
- An estimated 75 percent filter strip installation along the two tributaries will reduce the sediment load by 63.7 percent. This would reduce the average annual sediment load from 3,850 to 1,400 tons per year. The TP load will decrease to 0.65 tons per year from 1.02 tons per year (63.7 percent reduction). Total nitrogen load to the lake will be reduced from 187 tons per year to 159 tons per year (15 percent reduction).
- Dredging will remove approximately 15.8 ac-ft (24,500 cubic yards) of accumulated sediment from the shallow, upper ends of the lake. It will expand recreational opportunities. Sediment will once again settle out in the upper reaches of the lake, resulting in less suspended solids and turbidity in the main body of the lake.
- The area and lifespan of recreational usable water depth will be increased.
- Recreational access resulting from sediment removal in the upper arms of the lake will be improved.
- The removal of oxygen-consuming, nutrient-rich sediment and detritus also may improve and expand aquatic habitat for fish and the macroinvertebrates upon which they feed.
- The release of materials (e.g., ammonia, phosphorus, iron, manganese, hydrogen sulfide, and methane) from the lake bottom sediments under reducing conditions will be decreased by more than 90 percent.
- Lake water transparency will be increased, except during storm events.
- Dissolved oxygen concentrations in the hypolimnetic waters will be increased from 0.0 mg/L to at least 5.0 mg/L during summer months.
- The fish habitat will be increased from 75 (461 acres/614 acres) percent to 100 percent of the lake volume during summer months. Winter fish kills will be avoided.
- Fishing opportunities in the lake will be enhanced near the aeration system.

PHASE II LAKE MONITORING SCHEDULE AND BUDGET

Monitoring Program

In order to evaluate the response of Homer Lake to Phase II restoration activities, a monitoring program (one year) will be implemented to document the changes in the lake's water quality when the restoration project is complete. The proposed monitoring program is essentially the same as that conducted under the Phase I study. Samples will be collected by the SFRFP staff and analyzed by the Illinois EPA. The Phase II final report will be provided to the Illinois EPA. The following monitoring schedule will be used in evaluating the effectiveness of the Phase I management technique adopted for the lake.

The lake water will be monitored for DO, temperature, and Secchi disc readings at stations 1, 2, and 3. Observations for DO and temperature will be made at 2-foot intervals from the surface. Water samples for the monitoring program and other necessary field data will be collected by the SFRFP staff.

Water samples for chemical analyses will be taken at station 1 from two different points: 1 foot below the water surface and 2 feet above the bottom. Analyses will be made for pH, phenolphthalein and total alkalinity, conductivity, TSS, total and dissolved solids, VSS, turbidity, TP, DP, nitrate plus nitrite-nitrogen, ammonia-nitrogen, and TKN.

Integrated water samples (integrated to a depth of twice the Secchi disc depth) will be collected at each deep station for determining chlorophyll *a*, *b*, and *c*, and pheophytin.

Physical and chemical water quality characteristics will be monitored at biweekly intervals from May through September and at monthly intervals from October through April.

Implementation Schedule

The proposed implementation schedule is dependent on grant availability for the on-going programs in watershed soil erosion management and nonpoint pollution source control. The proposed implementation schedule shown in table 25 is based on the assumption that the Illinois Clean Lakes Program grant award be in the month of April (the due date for Phase II application is August 31). The projected schedule for the Phase II implementation project has not been assigned specific target dates. The completed Phase I report will serve as information backup for the Phase II application.

Budget

The estimated costs for the Phase II restoration and protection program are summarized in table 26. The estimated cost for filter strips is \$5,125. The total estimated cost for sediment removal from the lake is \$137,800 (\$15,000 + \$15,000 + \$91,800 + \$16,000). A destratification system, Phase II sample collections, and Phase II final report are \$10,000, \$5,000, and \$25,000, respectively. The estimated total cost for the Phase II study is \$182,050.

Table 25. Proposed Implementation Schedule

Activity	Year 1				Year 2				Year 3				Year 4										
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Conservation Reserve Program																							
Sign-up	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Filter strip installation		X	X	X	X					X	X	X	X	X	X								
Sediment Removal																							
Design and permitting	X	X																					
Advertise and bidding		X	X																				
Construct retention basin			X	X																			
Hydraulic dredging			X	X	X																		
Site reclamation									X	X	X												
Installation of an aerator								X	X	X													
Post restoration water quality monitoring												X	X	X	X	X	X	X	X	X	X	X	X
Quarterly report		X		X		X		X		X		X		X		X		X		X		X	
Final report																				X	X	X	X

Note: Blank spaces – not applicable

Table 26. Proposed Budget for Phase II Lake Restoration

<i>Activity</i>	<i>Estimated budget, \$</i>				<i>Total \$</i>
	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	
Watershed protection					
CRP sign-up	4,000				4,000
Filter strip installation	1,125	1,125			2,250
Sediment removal					
Design and administration	15,000				15,000
Construct retention basin	15,000				15,000
Hydraulic dredging	91,800				91,800
Site reclamation		16,000			16,000
Installation of a destratifier		10,000			10,000
Post restoration water					
quality sampling			5,000		5,000
Final report				25,000	25,000
Total	126,925	27,125	5,000	25,000	182,050

Notes: Blank spaces – not applicable
 CRP – Conservation Reserve Program

Matching Funds

If the Phase II study is granted, a total of \$91,025 will be available from the Illinois EPA over a four-year period. The CCFPD has to match \$91,025, for a total fund of \$182,050.

Coordination with Other Pollution-Control Programs

The Homer Lake restoration program will be consistent with other pollution-control efforts. The Phase I study has been coordinated with other federal, state, and county agencies and will continue to be coordinated with these agencies through Phase II.

The primary objective of reducing pollutant (sediment, nutrients, etc.) inflow to Homer Lake is consistent with the CCSWCD and the U.S. Natural Resources Conservation Service (NRCS) efforts to reduce agricultural soil erosion and thereby lengthen or perpetuate the useful life of agricultural lands. The efforts of the CCFPD under the proposed implementation program should continue to be coordinated with the watershed land treatment programs of the NRCS.

The stormwater runoff water quality from large construction sites is now regulated by the Illinois EPA through the National Pollutant Discharge Elimination System permit process. This program is consistent with the lake restoration program because it protects the lake from large, new erosion sources when development occurs within the watershed.

The restoration program is consistent with the IDNR initiatives to restore healthy fish populations to Illinois lakes. The IDNR has been actively involved in fisheries management at Homer Lake, including activities such as monitoring, surveying fish populations, fish stocking, and controlling algae and aquatic vegetation growth.

The staff of the SFRFP has been monitoring Homer Lake as part of the Illinois EPA Volunteer Lake Monitoring Program. Also, staff from the Illinois EPA have monitored Homer Lake as part of the EPA Ambient Lake Monitoring Program. The Phase II restoration project is consistent with the EPA Illinois' Nonpoint Source Management Program.

Public Participation

Public notification was accomplished through the installation of signs at the entrance of the SFRFP indicating that the Illinois EPA and the CCFPD were cooperating in conducting the Phase I Diagnostic Study of Homer Lake.

Other information was disseminated to the public through a newspaper article (appendix H) concerning monitoring activities at the lake.

A public hearing was held on January 27, 2000, at the Outdoor Recreation Center in the SFRFP to present the findings of the study and answer any pertinent questions. Approximately 10 persons attended the public hearing, including interested citizens as well as staff of the CCFPD. The finding of the study concerning the condition of Homer Lake and alternative solutions developed for lake maintenance and remediation were presented. The Phase II project benefits, implementation schedule, and cost estimates also were discussed. Questions regarding water quality, potential sediment disposal sites, hydrology, and aeration and destratification systems were discussed. All questions were positive and informational.

Operation and Maintenance Plan

If awarded a Phase II Illinois Clean Lakes Program grant, the CCFPD, as the owner of the Homer Lake, will be responsible for the O & M of all proposed alternatives such as watershed treatment practices, dredging, sediment detention sites, sign posting, and the aeration/destratification system. The CCFPD will be responsible for all costs of O & M of the aeration system. The maintenance requirements will be written into the annual schedule of work prepared by the CCFPD and assigned to various employees as scheduled.

The sediment retention site will be inspected annually as per Illinois Department of Transportation (IDOT) dam safety requirements, and will be reclaimed as wildlife habitat approximately one or two years after the hydraulic dredging is completed. Watershed land treatment practices will be coordinated by the CCFPD, CCSWCD, and the local NRCS of the U.S. Department of Agriculture. The NRCS will inspect treated areas annually to ensure continued effectiveness and participation in the CRP.

Required Permits

The removal of sediment would require a Section 404 dredge-and-fill permit from the U.S. Army Corps of Engineers; a Section 401 Water Quality Certification from the Illinois EPA for discharging the clarified effluent water back to the lake; and a construction and operating permit, also from the Illinois EPA. A dam construction and an operating permit from IDOT also will be required for the sediment basin. Both items can be considered under a single permit. In addition, approval must be granted from the Illinois Historic Preservation Agency prior to constructing the sediment retention site to ensure that no significant archaeological resources are present. Coordination and consultation with IDOT, the Illinois EPA, and the U.S. Fish and Wildlife Service also may be necessary. The permit application process will be initiated immediately upon approval of either the Phase I report or the implementation of Phase II restoration activities.

EVALUATION OF ENVIRONMENTAL IMPACTS

This section covers some of the environmental impacts of the proposed Phase II restoration project. The Illinois Clean Lakes Program requires that the following questions be addressed.

Will the project displace people?

The project will not displace people or places of business because all project-related activities occur in the lake area.

Will the project deface residential areas?

The project will have no adverse visual impacts on residential areas near the lake. Dredging will be completed within the preserve boundaries. No watershed CRP practices will impact residential areas.

Will the project entail changes in land-use patterns or increases in development pressure?

No land-use pattern will be affected. There will be no increase in development pressure. Demand for further residential development at the north end of the lake may intensify, but it is not due to overall improvement as a result of the restoration project.

Will the project impact prime agricultural land or activities?

No agricultural land is affected by the project. Soil conservation measures applied in the watershed will help maintain soil fertility and erosion control on agricultural lands.

Will the project adversely affect park, public, or scenic land?

Almost all of the land around Homer Lake shoreline is publicly owned by the CCFPD. Lake restoration will provide long-term enhancement of the environmental, aesthetic, and recreational values in the general area.

Will there be adverse impacts to land or structures of historical, architectural, archaeological, or cultural resources?

In order to acquire a permit to construct a dewatering basin for the dredged sediment, an archeological survey should be done to ensure that no cultural resources are present

Will the project entail long-range increases in energy demand?

After the major components of the restoration scheme are implemented, there will be no activity requiring excessive energy use in the O & M of the lake system.

Are changes in ambient air quality or noise levels expected?

No significant long-term impact on air quality and noise levels is anticipated as a result of implementing the restoration project. Elevated noise levels are expected during work at the construction (dredging) site only.

Will there be any adverse effects due to chemical treatment?

No chemical treatment is included in the restoration project.

Does the management plan comply with Executive Order (E.O.) 11988 on floodplain management?

The restoration of Homer Lake does not involve any activities in floodplains and consequently does not infringe on E.O. 11988.

If the project involves physically modifying the lakeshore, its bed, or its watershed, will the project cause any short-term or long-term adverse impacts?

Dredging of Homer Lake is a part of the proposed restoration. No long-term adverse impacts will result from project activities. There may be short-term impacts such as higher localized turbidity, restricted access in certain areas during construction, and minimal landscape disturbance from heavy equipment.

Will there be any adverse effects on fish and wildlife, wetlands, or other wildlife habitat?

No significant adverse effects on fish and wildlife, wetlands, or other wildlife habitats will occur as a result of this project.

Will the project adversely impact threatened or endangered species?

No threatened or endangered plants or wildlife species will be affected by this project.

Have all the feasible alternatives been considered?

All the relevant and applicable management options were considered and discussed, and appropriate suggestions and recommendations have been made.

Are other mitigative measures required?

The pros and cons of various alternatives have been considered, and the need for other mitigative measures should not arise.

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Appendix A. Historical Water Quality Characteristics in Homer Lake

Appendix A1. Historical Water Quality Characteristics in Homer Lake, Station 1 Surface

Sample date	Sample depth (feet)	Turbidity (NTU)	Secchi	Conduc- tivity (μ mho/cm)	pH	Total	Phenolph- thalein	Total	Volatile	Ammonia- nitrogen (mg/L)	Total	Nitrate/ Nitrite- nitrogen (mg/L)	Total	Dissolved	Total depth (feet)
			transpa- rency (in.)			alkalinity (mg/L as CaCO ₃)	alkalinity (mg/L as CaCO ₃)	suspen- ded (mg/L)	suspen- ded (mg/L)		Kjeldahl nitrogen (mg/L)	phos- phorus (mg/L)	phos- phorus (mg/L)		
04/24/89	1	1.0	96	554	8.0	130	0	1	1	0.10	0.90	12.00	0.008	0.001	19.0
06/05/89	1	4.0	28	497	8.4	160	10	8	7	0.10	2.00	13.00	0.181	0.093	17.0
07/05/89	1	3.0	36	535	8.2	140	0	6	5	0.15	0.80	11.00	0.023	0.008	18.5
08/07/89	1	5.0	24	441	8.2	130	0	10	6	0.17	1.10	4.40	0.027	0.008	17.0
10/10/89	1	10.0	22	483	8.4	200	0	9	3	0.28	0.60	1.00	0.077	0.040	17.0
04/25/95	1	7.0		710	8.5	282	12	3	1	0.05	0.19	9.70	0.008	0.002	17.0
04/25/95	1	7.0	27	617	8.5	241	16	11	5	0.03	0.57	6.20	0.026	0.004	16.0
04/25/95	1	7.0	24	725	8.3	258	0	4	1	0.02	0.10	8.90	0.011	0.003	15.0
06/14/95	1	2.0	67	547	8.4	196	2	5	2	0.01	0.67	8.80	0.026	0.009	16.0
07/19/95	1	5.0	34	449	8.7	158	12	7	1	0.01	0.29	3.50	0.029	0.008	16.0
08/30/95	1	5.0	25	369	9.0	139	16	10	6	0.06	1.10	0.00	0.047	0.006	16.0
10/06/95	1	3.0	24	406	8.4	170	4	8	4	0.14	0.76	0.10	0.060	0.011	15.0
Count		12	11	12	12	12	12	12	12	12	12	12	12	12	12.0
Maximum		10.0	96	725	9.0	282	16	11	7	0.28	2.00	13.00	0.181	0.093	19.0
Minimum		1.0	22	369	8.0	130	0	1	1	0.01	0.10	0.00	0.008	0.001	1.0
Average		4.9	37	528		184	6	7	4	0.09	0.76	6.55	0.044	0.016	16.6
S.D.		2.5	23	112		52	7	3	2	0.08	0.51	4.68	0.048	0.026	1.2

Notes: NTU-nephelometric turbidity unit, μ mho/cm – micromhos per centimeter, mg/L – milligrams per liter, CaCO₃ – calcium carbonate, Blank spaces – no data, S.D. – standard deviation

Appendix A2. Historical Water Quality Characteristics in Homer Lake, Station 2 Surface

Sample date	Sample depth (feet)	Turbidity (NTU)	Secchi	Conduc-	pH	Total	Phenolph-	Total	Volatile	Ammonia-nitrogen (mg/L)	Total	Nitrate/Nitrite-nitrogen (mg/L)	Total	Dissolved	Total depth (feet)
			transpa- rency (in.)	tivity (µmho/cm)		alkalinity (mg/L as CaCO ₃)	thalein alkalinity (mg/L as CaCO ₃)	suspen- ded solids (mg/L)	suspen- ded solids (mg/L)		Kjeldahl nitrogen (mg/L)	phos- phorus (mg/L)	phos- phorus (mg/L)		
04/24/89	1	1.0	96	527	8.4	110	1	1	1	0.10	0.50	12.00	0.006	0.001	10.0
06/05/89	1	6.0	34	546	8.2	180	0	8	4	0.10	1.30	14.00	0.110	0.071	9.5
07/05/89	1	1.0	32	538	8.0	150	0	6	4	0.21	0.60	11.00	0.029	0.018	12.5
08/07/89	1	5.0	24	450	8.4	140	10	18	8	0.24	1.00	4.10	0.046	0.001	9.5
10/10/89	1	7.0	32	482	8.4	200	0	11	5	0.12	1.00	1.00	0.075	0.037	9.0
04/25/95	1	7.0	29	627	8.5	241	12	11	6	0.01	0.50	6.40	0.023	0.005	12.0
06/14/95	1	2.0	67	556	8.3	200	0	3	1	0.06	0.77	8.80	0.025	0.003	12.0
07/19/95	1	5.0	32	465	8.6	158	8	8	2	0.01	0.40	3.10	0.035	0.002	11.0
08/30/95	1	8.0	26	380	9.0	143	16	6	4	0.06	1.40	0.00	0.061	0.026	11.0
10/06/95	1	3.0	21	406	8.3	166	0	16	7	0.16	0.90	0.10	0.075	0.014	11.0
Count		10	10	10	10	10	10	10	10	10	10	10	10	10	10
Maximum		8.0	96	627	9.0	241	16	18	8	0.24	1.40	14.00	0.110	0.071	12.5
Minimum		1.0	21	380	8.0	110	0	1	1	0.01	0.40	0.00	0.006	0.001	9.0
Average		4.5	39	498		169	5	9	4	0.11	0.84	6.05	0.049	0.018	10.8
S.D.		2.5	22	71		36	6	5	2	0.07	0.33	4.91	0.030	0.021	1.1

Notes: NTU-nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, CaCO₃ – calcium carbonate, Blank spaces – no data, S.D. – standard deviation

Appendix A3. Historical Water Quality Characteristics in Homer Lake, Station 3 Surface

Sample date	Sample depth (feet)	Turbidity (NTU)	Secchi	Conduc- tivity (μ mho/cm)	pH	Total	Phenolph-	Total	Volatile	Ammonia- nitrogen (mg/L)	Total	Nitrate/ Nitrite- nitrogen (mg/L)	Total	Dissolved	Total depth (feet)
			transpa- rency (in.)			alkalinity (mg/L as CaCO ₃)	thalein alkalinity (mg/L as CaCO ₃)	suspen- ded solids (mg/L)	suspen- ded solids (mg/L)		Kjeldahl nitrogen (mg/L)	phos- phorus (mg/L)	phos- phorus (mg/L)		
04/24/89	1	4.0	30	608	7.9	140	0	6	2	0.10	0.90	14.00	0.016	0.001	6.5
06/05/89	1	18.0	18	580	7.8	170	0	21	9	0.10	1.40	16.70	0.233	0.130	6.0
07/05/89	1	1.0	24	554	7.8	150	0	11	5	0.48	1.40	9.80	0.063	0.005	6.0
08/07/89	1	5.0	24	442	8.3	140	0	14	7	0.19	1.40	2.70	0.075	0.007	6.5
10/10/89	1	9.0	24	501	8.5	200	0	14	6	0.10	0.80	0.80	0.077	0.042	6.0
04/25/95	1	7.0	24	694	8.3	258	0	16	3	0.08	0.56	8.50	0.019	0.004	6.0
06/14/95	1		21	647	8.2	245	0			0.09	0.69	9.50	0.035	0.002	5.0
07/19/95	1	5.0	22	470	8.1	174	0	20	7	0.05	0.46	0.80	0.068	0.021	5.0
08/30/95	1	11.0	18	403	8.3	147	0	24	7	0.09	1.20	0.00	0.128	0.012	5.0
10/06/95	1	3.0	24	414	8.0	168	0	46	5	0.29	0.79	0.10	0.071	0.019	5.0
Count		9	10	10	10	10	10	9	9	10	10	10	10	10	10
Maximum		18.0	30	694	8.5	258	0	46	9	0.48	1.40	16.70	0.233	0.130	6.5
Minimum		1.0	18	403	7.8	140	0	6	2	0.05	0.46	0.00	0.016	0.001	5.0
Average		7.0	23	531		179	0	19	6	0.16	0.96	6.29	0.079	0.024	5.7
S.D.		4.8	3	96		40	0	11	2	0.13	0.34	5.89	0.060	0.037	0.6

Notes: NTU-nephelometric turbidity unit, μ mho/cm – micromhos per centimeter, mg/L – milligrams per liter, CaCO₃ – calcium carbonate, Blank spaces – no data, S.D. – standard deviation

Appendix A4. Historical Water Quality Characteristics in Homer Lake, Station 1 Bottom

Sample date	Sample depth (feet)	Turbidity (NTU)	Secchi	Conduc- tivity (μ mho/cm)	pH	Total	Phenolph-	Total	Volatile	Ammonia- nitrogen (mg/L)	Total	Nitrate/ Nitrite- nitrogen (mg/L)	Total	Dissolved	Total depth (feet)
			transpa- rency (in.)			alkalinity (mg/L as CaCO ₃)	thalein alkalinity (mg/L as CaCO ₃)	suspen- ded solids (mg/L)	suspen- ded solids (mg/L)		Kjeldahl nitrogen (mg/L)	phos- phorus (mg/L)	phos- phorus (mg/L)		
04/24/89	17	3.0		583	7.6	140	0	4	2	0.10	0.50	11.00	0.008	0.006	19.0
06/05/89	15	32.0		249	7.3	130	0	17	6	0.19	1.00	11.00	0.177	0.124	17.0
07/05/89	17	10.0		495	7.2	175	0	46	15	0.91	1.20	6.40	0.078	0.023	18.5
08/07/89	15	7.0		547	6.9	160	0	20	9	1.40	1.80	4.00	0.061	0.005	17.0
10/10/89	15	7.0		485	7.9	200	0	11	4	0.26	0.70	1.00	0.080	0.036	17.0
04/25/95	14	7.0		673	8.2	274	0	13	4	0.05	0.72	7.90	0.024	0.002	16.0
06/14/95	14			470	8.0	184	0			0.52	1.20	5.60	0.150	0.083	16.0
07/19/95	14	5.0		486	7.6	213	0	36	24	0.84	1.10	1.10	0.083	0.011	16.0
08/30/95	14	8.0		525	7.8	254	0	31	8	3.50	2.80	0.00	0.314	0.248	16.0
10/06/95	13	3.0		407	8.1	166		14	5	0.30	0.86	0.00	0.073	0.011	15.0
Count		9		10	10	10	9	9	9	10	10	10	10	10	10
Maximum		32.0		673	8.2	274	0	46	24	3.50	2.80	11.00	0.314	0.248	19.0
Minimum		3.0		249	6.9	130	0	4	2	0.05	0.50	0.00	0.008	0.002	15.0
Average		9.1		492		190	0	21	9	0.81	1.19	4.80	0.105	0.055	16.8
S.D.		8.4		106		44	0	13	7	0.99	0.64	4.06	0.085	0.075	1.2

Notes: NTU-nephelometric turbidity unit, μ mho/cm – micromhos per centimeter, mg/L – milligrams per liter, CaCO₃ – calcium carbonate, Blank spaces – no data, S.D. – standard deviation

Appendix B. Current Water Quality Characteristics in Homer Lake

Appendix B1. Current Water Quality Characteristics in Homer Lake, Station 1 Surface

Sample date	Sample depth (feet)	Turbidity (NTU)	Secchi	Conductivity ($\mu\text{mho/cm}$)	pH	Total	Phenolph-	Total	Volatile	Ammonia-nitrogen (mg/L)	Total	Nitrate/Nitrite-nitrogen (mg/L)	Total	Dissolved	Total depth (feet)
			transparency (in.)			alkalinity (mg/L as CaCO_3)	thalein alkalinity (mg/L as CaCO_3)	suspended solids (mg/L)	suspended solids (mg/L)		Kjeldahl nitrogen (mg/L)	phosphorus (mg/L)	phosphorus (mg/L)		
04/21/97	1	5.0	32	555	8.1	150	10	14	5	0.07	0.64	8.40	0.020	0.007	16.0
05/05/97	1	12.0	23					15	5	0.17	0.72	7.30	0.042		17.0
05/28/97	1		24					16	6	0.08	0.75	7.30	0.041		16.0
06/23/97	1		52	605	7.9	170	0	2	2	0.10	0.72	9.70	0.017	0.005	17.0
06/30/97	1	8.0	37					7	3	0.17	0.56	8.60	0.023		16.0
07/23/97	1	4.0	28	480	8.1	142	8	14	5	0.12	1.00	4.30	0.057	0.006	15.0
07/28/97	1	3.0	32					13	8	0.13	0.46	3.30	0.029		15.0
08/21/97	1	7.0	18	428	8.1	134	8	18	7	0.22	1.10	0.60	0.104	0.013	15.0
08/25/97	1	19.0	18					38	22	0.38	1.50	0.46	0.120		15.0
09/15/97	1	7.0	22					19	9	0.15	1.20	0.01	0.124		15.0
09/28/97	1	6.0	16					16	9	0.14	1.10	4.30	0.103		15.0
10/23/97	1	20.0	18	425	8.4	154	12	24	7	0.09	0.86	0.00	0.113	0.020	16.0
10/27/97	1		16					22	9	0.01	1.00	0.01	0.072		13.0
11/10/97	1	6.0	24					14	7	0.15	0.66	0.00	0.047		15.0
12/23/97	1	3.0	42					12	6	0.14	0.83	0.00	0.050		15.0
01/26/98	1	2.0	54					4	2	0.18	0.98	3.20	0.051		17.0
02/24/98	1	0.3	36					9	2	0.19	0.57	4.30	0.040		17.0
03/30/98	1	45.0	4					122	22	0.23	1.70	9.60	0.304		17.0
04/15/98	1	12.0	24	588	8.1	254	0	22	6	0.34	0.46	12.60	0.060	0.034	17.0
Count		16	19	6	6	6	6	19	19	19	19	19	19	6	19
Maximum		45.0	54	605	8.4	254	12	122	22	0.38	1.70	12.60	0.304	0.034	17.0
Minimum		0.3	4	425	7.9	134	0	2	2	0.01	0.46	0.00	0.017	0.005	13.0
Average		10.0	27	514		167	6	21	7	0.16	0.88	4.42	0.075	0.014	15.7
S.D.		10.6	12	73		40	5	25	5	0.09	0.33	3.99	0.064	0.010	1.1

Notes: NTU-nephelometric turbidity unit, $\mu\text{mho/cm}$ – micromhos per centimeter, mg/L – milligrams per liter, CaCO_3 – calcium carbonate, Blank spaces – no data, S.D. – standard deviation

Appendix B2. Current Water Quality Characteristics in Homer Lake, Station 2 Surface

Sample date	Sample depth (feet)	Turbidity (NTU)	Secchi	Conductivity ($\mu\text{mho/cm}$)	pH	Total	Phenolph-	Total	Volatile	Ammonia-nitrogen (mg/L)	Total	Nitrate/Nitrite-nitrogen (mg/L)	Total	Dissolved	Total depth (feet)
			transparency (in.)			alkalinity (mg/L as CaCO_3)	thalein alkalinity (mg/L as CaCO_3)	suspended solids (mg/L)	suspended solids (mg/L)		Kjeldahl nitrogen (mg/L)	phosphorus (mg/L)	phosphorus (mg/L)		
04/21/97	1	5.0	28	562	8.2	190	10	5	2	0.05	0.45	11.30	0.016	0.006	10.0
05/05/97	1	11.0	20					24	5	0.13	0.78	7.40	0.049		10.0
05/28/97	1	5.0	20					25	7	0.16	0.83	7.00	0.047		11.0
06/23/97	1	7.0	50	611	7.9	180	0	3	1	0.11	0.46	9.70	0.017	0.005	10.0
06/30/97	1	7.0	28					11	6	0.05	0.50	8.40	0.035		11.0
07/23/97	1	2.0	20	482	7.8	146	0	26	8	0.23	0.92	3.70	0.084	0.010	9.0
07/28/97	1	1.0	26					20	13	0.09	0.52	2.80	0.039		10.0
08/21/97	1	6.0	18	424	8.3	152	10	24	7	0.27	1.00	0.60	0.104	0.012	10.0
08/25/97	1	16.0	16					34	18	0.29	1.50	0.40	0.238		11.0
09/15/97	1	7.0	20					12	9	0.13	0.90	0.10	0.055		11.0
09/28/97	1	6.0	16					19	10	0.12	0.84	0.00	0.092		11.0
10/23/97	1	16.0	20	425	8.5	160	18	21	7	0.09	1.00	0.00	0.081	0.017	8.0
10/27/97	1	8.0	16					34	12	0.01	0.94	0.00	0.068		9.0
11/10/97	1	6.0	22					14	5	0.28	0.89	0.00	0.070		11.0
12/23/97	1	4.0	36					12	8	0.14	0.79	0.00	0.061		11.0
01/26/98	1	2.0	66					4	2	0.01	0.87	3.10	0.037		9.0
02/24/98	1	2.0	36					8	2	0.23	0.77	4.70	0.035		11.0
03/30/98	1	69.0	4					70	16	0.15	1.60	9.20	0.349		12.0
04/15/98	1	32.0	24	606	8.1	255	0	26	7	0.10	1.70	6.40	0.171	0.130	10.0
Count		19	19	6	6	6	6	19	19	19	19	19	19	6	19
Maximum		69.0	66	611	8.5	255	18	70	18	0.29	1.70	11.30	0.349	0.130	12.0
Minimum		1.0	4	424	7.8	146	0	3	1	0.01	0.45	0.00	0.016	0.005	8.0
Average		11.2	26	518		181	6	21	8	0.14	0.91	3.94	0.087	0.030	10.3
S.D.		15.3	13	79		37	7	15	5	0.08	0.35	3.85	0.081	0.045	1.0

Notes: NTU-nephelometric turbidity unit, $\mu\text{mho/cm}$ – micromhos per centimeter, mg/L – milligrams per liter, CaCO_3 – calcium carbonate, Blank spaces – no data, S.D. – standard deviation

Appendix B3. Current Water Quality Characteristics in Homer Lake, Station 3 Surface

Sample date	Sample depth (feet)	Turbidity (NTU)	Secchi	Conductivity (µmho/cm)	pH	Total alkalinity (mg/L as CaCO ₃)	Phenolph-	Total	Volatile	Ammonia-nitrogen (mg/L)	Total Kjeldahl nitrogen (mg/L)	Nitrate/Nitrite-nitrogen (mg/L)	Total phosphorus (mg/L)	Dissolved	Total depth (feet)
			transpa- rency (in.)				thalein alkalinity (mg/L as CaCO ₃)	suspen- ded solids (mg/L)	suspen- ded solids (mg/L)					phos- phorus (mg/L)	
04/21/97	1	6.0	12	611	7.8	180	0	4	2	0.22	0.71	9.10	0.050	0.010	
05/05/97	1	12.0	16					37	8	0.18	0.68	11.70	0.054		3.0
05/28/97	1	3.0	12					47	7	0.13	0.77	8.80	0.073		6.0
06/23/97	1	6.0	20	626	7.8	200	0	15	6	0.19	0.70	9.80	0.047	0.007	5.0
06/30/97	1	7.0	16					33	10	0.08	0.77	8.20	0.093		4.0
07/23/97	1	1.0	14	463	8.2	148	14	19	6	0.10	0.58	2.20	0.107	0.014	5.0
07/28/97	1	2.0	13					35	13	0.13	0.69	1.50	0.137		2.0
08/21/97	1	17.0	12	414	8.6	140	12	33	10	0.11	1.40	0.10	0.188	0.019	5.0
08/25/97	1	26.0	11					36	14	0.35	1.30	0.10	0.092		3.0
09/15/97	1	9.0	12					38	11	0.14	1.10	0.10	0.178		5.0
09/28/97	1	5.0	14					35	13	0.11	0.91	0.00	0.171		5.0
10/23/97	1	18.0	16	430	8.7	174	20	27	9	0.07	1.00	0.00	0.095	0.017	5.0
10/27/97	1	8.0	14					29	10	0.01	0.93	0.00	0.083		3.0
11/10/97	1	6.0	14					20	8	1.10	0.94	0.00	0.079		5.0
12/23/97	1	3.0	16					36	10	0.23	0.85	0.00	0.100		5.0
01/26/98	1	2.0	28					7	4	0.30	1.20	3.70	0.049		5.0
02/24/98	1	3.0	14					23	2	0.22	0.74	10.30	0.031		4.0
03/30/98	1	87.0	4					88	16	0.10	1.80	10.90	0.334		5.0
04/15/98	1	31.0	12	650	8.0	274	0	68	10	0.16	0.49	13.20	0.070	0.016	5.0
Count		19	19	6	6	6	6	19	19	19	19	19	19	6	19
Maximum		87.0	28	650	8.7	274	20	88	16	1.10	1.80	13.20	0.334	0.019	6.0
Minimum		1.0	4	414	7.8	140	0	4	2	0.01	0.49	0.00	0.031	0.007	2.0
Average		13.3	14	532		186	8	33	9	0.21	0.92	4.72	0.107	0.014	4.4
S.D.		19.2	4	98		44	8	19	4	0.23	0.31	4.90	0.069	0.004	1.0

Notes: NTU-nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, CaCO₃ – calcium carbonate, Blank spaces – no data, S.D. – standard deviation

Appendix B4. Current Water Quality Characteristics in Homer Lake, Station 1 Bottom

Sample date	Sample depth (feet)	Turbidity (NTU)	Secchi	Conductivity ($\mu\text{mho/cm}$)	pH	Total	Phenolph-	Total	Volatile	Ammonia-nitrogen (mg/L)	Total	Nitrate/Nitrite-nitrogen (mg/L)	Total	Dissolved	Total depth (feet)
			transparency (in.)			alkalinity (mg/L as CaCO_3)	thalein alkalinity (mg/L as CaCO_3)	suspended solids (mg/L)	suspended solids (mg/L)		Kjeldahl nitrogen (mg/L)	phosphorus (mg/L)	phosphorus (mg/L)		
04/21/97	14	7.0		560	7.9	180	10	13	4	0.06	0.72	8.40	0.024	0.008	16.0
05/05/97	15	10.0						22	6	0.16	0.92	8.00	0.048		17.0
05/28/97	14	4.0						70	20	0.07	0.77	6.90	0.050		16.0
06/23/97	15	6.0		604	7.4	180	0	11	3	0.12	0.60	8.80	0.020	0.005	17.0
06/30/97	14	7.0						19	6	0.18	0.72	8.10	0.038		16.0
07/23/97	13	2.0		553	7.2	144	0	17	3	0.21	0.96	4.30	0.052	0.089	15.0
07/28/97	13	2.0						22	11	0.22	0.41	3.30	0.066		15.0
08/21/97	13	12.0		248	8.2	134	10	19	7	0.22	1.20	0.60	0.097	0.011	15.0
08/25/97	13	25.0						72	16	0.41	1.00	0.40	0.090		15.0
09/15/97	13	9.0						14	9	0.17	0.93	0.10	0.111		15.0
09/28/97	13	5.0						23	10	0.10	0.82	0.00	0.113		15.0
10/23/97	14	19.0		425	8.4	164	12	25	8	0.47	0.92	0.00	0.087	0.019	16.0
10/27/97	11	9.0						25	10	0.08	1.10	0.00	0.089		13.0
11/10/97	13	6.0						13	7	0.13	0.73	0.00	0.082		15.0
12/23/97	13	3.0						14	6	0.16	1.00	0.00	0.055		15.0
01/26/98	15	2.0						4	3	0.19	1.10	3.20	0.048		17.0
02/24/98	15	1.7						11	3	0.24	0.68	4.40	0.035		17.0
03/30/98	15	46.0						80	16	0.20	2.30	9.30	0.496		17.0
04/15/98	15	23.0		592	7.9	156	0	22	5	0.25	0.45	12.50	0.056	0.025	17.0
Count		19		6	6	6	6	19	19	19	19	19	19	6	19
Maximum		46.0		604	8.4	180	12	80	20	0.47	2.30	12.50	0.496	0.089	17.0
Minimum		1.7		248	7.2	134	0	4	3	0.06	0.41	0.00	0.020	0.005	13.0
Average		10.5		497		160	5	26	8	0.19	0.91	4.12	0.087	0.026	15.7
S.D.		10.7		126		17	5	21	5	0.10	0.39	4.01	0.100	0.029	1.1

Notes: NTU-nephelometric turbidity unit, $\mu\text{mho/cm}$ – micromhos per centimeter, mg/L – milligrams per liter, CaCO_3 – calcium carbonate, Blank spaces – no data, S.D. – standard deviation

**Appendix C. Temperature and Dissolved Oxygen Data
for Homer Lake**

Appendix C. Temperature and Dissolved Oxygen Data

Date	Station 1				Station 2				Station 3			
	Depth, feet	Temp., °C	DO, mg/L	% sat.	Depth, feet	Temp., °C	DO, mg/L	% sat.	Depth, feet	Temp., °C	DO, mg/L	% sat.
04/24/89	0	14.5	11.5	110.6	0	15.7	11.3		0	17.2	13.1	135.1
04/24/89	1	14.5	11.5	110.6	1	15.7	11.4	114.0	1	16.9	12.4	127.8
04/24/89	3	14.4	11.5	110.6	3	15.6	11.6	116.0	3	14.8	11.7	114.7
04/24/89	5	14.4	11.5	110.6	5	15.6	11.7	117.0	5	14.0	11.0	105.8
04/24/89	7	13.5	12.3	116.0	7	15.5	12.0	117.6	7	13.3	11.0	103.8
04/24/89	9	12.6	12.6	118.9	9	15.0	12.3	120.6				
04/24/89	11	12.1	12.2	113.0	10	14.6	13.2	129.4				
04/24/89	13	11.6	11.7	108.3								
04/24/89	15	11.2	9.7	87.4								
04/24/89	17	9.8	7.5	66.4								
04/24/89	19	9.5	5.6	48.3								
06/05/89	0	22.3	15.1	171.6	0	22.8	12.7	146.0	0	21.0	12.4	137.8
06/05/89	1	22.4	15.1	171.6	1	22.8	12.9	148.3	1	20.3	11.8	128.3
06/05/89	3	22.2	14.2	161.4	3	22.5	12.9	146.6	3	17.2	6.5	67.0
06/05/89	5	21.5	6.5	72.2	5	20.0	7.0	76.1	5	15.8	7.3	73.0
06/05/89	7	18.4	3.2	33.7	7	18.4	3.0	31.6	6	15.5	6.2	60.8
06/05/89	9	17.5	2.9	29.9	9	16.9	3.4	35.1				
06/05/89	11	16.6	3.1	32.0	10	16.9	3.2	33.0				
06/05/89	13	15.5	2.4	23.5								
06/05/89	15	14.7	1.8	17.6								
06/05/89	17	14.4	1.4	13.5								
07/05/89	0	27.1	7.1	87.7	0	27.5	8.0	98.8	0	27.5	7.0	86.4
07/05/89	1	27.1	7.1	87.7	1	27.5	8.0	98.8	1	27.5	7.0	86.4
07/05/89	3	26.4	7.6	92.7	3	26.0	7.9	96.3	3	24.5	6.3	74.1
07/05/89	5	25.8	8.0	97.6	5	25.5	7.5	89.3	5	23.8	4.9	57.6
07/05/89	7	24.5	6.0	70.6	7	24.7	7.0	83.3	6	23.6	4.0	47.1
07/05/89	9	23.5	4.4	50.6	9	23.9	3.4	40.0				
07/05/89	11	20.0	2.4	26.1	11	21.3	2.4	26.7				
07/05/89	13	17.0	2.2	22.7	12	19.4	2.4	25.5				
07/05/89	15	15.2	2.5	24.5								
07/05/89	16	14.8	2.4	23.5								
07/05/89	17	14.7	2.3	22.5								
07/05/89	18	14.6	2.3	22.5								
08/07/89	0	26.5	9.5	115.9	0	26.6	8.2	101.2	0	25.2	8.7	103.6
08/07/89	1	26.5	8.9	108.5	1	26.6	7.9	97.5	1	25.2	8.5	101.2
08/07/89	3	26.5	8.8	107.3	3	26.5	7.6	92.7	3	25.0	8.1	96.4
08/07/89	5	26.4	8.9	108.5	5	26.2	6.6	80.5	5	24.6	6.2	73.8
08/07/89	7	26.4	8.7	106.1	7	25.9	6.4	78.0	7	24.4	5.7	67.1
08/07/89	9	26.4	8.5	103.7	9	25.7	5.4	65.9				
08/07/89	11	25.9	6.1	74.4	10	25.7	5.0	61.0				

Appendix C. (Continued)

<i>Date</i>	<i>Station 1</i>				<i>Station 2</i>				<i>Station 3</i>			
	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>
08/07/89	13	20.7	0.6	6.7								
08/07/89	15	18.8	0.6	6.4								
08/07/89	17	17.2	0.6	6.2								
10/10/89	0	14.2	9.2	88.5	0	14.1	9.9	95.2	0	12.8	10.6	100.0
10/10/89	1	14.3	9.2	88.5	1	14.1	9.9	95.2	1	12.8	10.6	100.0
10/10/89	3	14.2	9.2	88.5	3	14.1	9.9	95.2	3	12.8	10.5	99.1
10/10/89	5	14.1	9.2	88.5	5	14.0	9.8	94.2	5	12.7	10.4	98.1
10/10/89	7	14.1	9.2	88.5	7	13.9	9.8	94.2	6	12.4	10.1	93.5
10/10/89	9	14.1	9.2	88.5	9	13.9	9.8	94.2				
10/10/89	11	14.1	9.3	89.4								
10/10/89	13	14.1	9.3	89.4								
10/10/89	15	14.0	9.1	87.5								
10/10/89	17	14.0	8.8	84.6								
04/25/95	0	12.7	8.4	79.2	0	13.0	8.8	83.0	0	12.4	10.2	94.4
04/25/95	1	12.7	8.5	80.2	1	12.8	9.0	84.9	1	12.5	10.3	95.4
04/25/95	2	12.7	8.5	80.2	2	12.8	9.0	84.9	2	12.4	10.3	95.4
04/25/95	3	12.7	8.5	80.2	3	12.7	9.0	84.9	3	11.3	9.2	82.9
04/25/95	4	12.6	8.5	80.2	4	12.4	9.1	84.3	4	10.8	8.3	74.8
04/25/95	5	12.6	8.5	80.2	5	12.2	9.1	84.3	5	10.6	7.8	70.3
04/25/95	6	12.6	8.5	80.2	6	12.0	8.9	82.4	6	10.5	7.8	69.0
04/25/95	7	12.6	8.5	80.2	7	11.9	8.3	76.9				
04/25/95	8	12.6	8.5	80.2	8	11.6	8.3	76.9				
04/25/95	9	12.6	8.5	80.2	9	11.4	8.3	74.8				
04/25/95	10	12.2	7.7	71.3	10	11.3	8.3	74.8				
04/25/95	11	11.5	6.8	61.3	11	10.6	9.4	84.7				
04/25/95	12	10.9	7.6	68.5	12	10.2	9.7	85.8				
04/25/95	13	10.8	8.2	73.9								
04/25/95	14	10.7	8.3	74.8								
04/25/95	15	10.6	8.4	75.7								
04/25/95	16	10.6	8.4	75.7								
06/14/95	0	23.1	10.7	123.0	0	23.0	10.7	123.0	0	23.2	11.6	133.3
06/14/95	7	22.5	11.1	126.1	1	22.8	10.8	124.1	1	23.0	11.9	136.8
06/14/95	2	22.8	10.9	125.3	2	22.8	10.8	124.1	2	21.5	12.8	142.2
06/14/95	3	22.6	11.1	127.6	3	22.7	10.8	124.1	3	20.8	10.7	118.9
06/14/95	4	22.6	11.1	127.6	4	21.9	10.7	121.6	4	19.9	8.3	90.2
06/14/95	5	22.5	11.2	127.3	5	21.4	10.7	118.9	5	19.4	7.6	80.9
06/14/95	6	22.5	11.2	127.3	6	20.9	10.8	120.0				
06/14/95	1	23.0	10.9	125.3	7	20.1	10.3	112.0				
06/14/95	8	19.0	12.3	130.9	8	18.9	9.9	105.3				
06/14/95	9	16.0	9.1	91.0	9	16.7	6.4	66.0				

Appendix C. (Continued)

<i>Date</i>	<i>Station 1</i>				<i>Station 2</i>				<i>Station 3</i>			
	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>
06/14/95	10	14.3	5.8	55.8	10	15.4	3.0	29.4				
06/14/95	11	13.3	1.9	17.9	11	14.5	0.6	5.8				
06/14/95	12	13.0	1.0	9.4	12	14.0	0.6	5.8				
06/14/95	13	12.6	0.8	7.5								
06/14/95	14	12.4	0.5	4.6								
06/14/95	15	12.0	0.4	3.7								
06/14/95	16	11.9	0.4	3.7								
07/19/95	0	27.7	9.7	122.8	0	27.8	9.3	117.7	0	27.0	5.2	64.2
07/19/95	1	27.8	10.1	127.8	1	27.8	9.3	117.7	1	26.9	5.2	64.2
07/19/95	2	27.8	10.2	129.1	2	27.8	9.4	119.0	2	26.7	5.3	65.4
07/19/95	3	27.8	10.3	130.4	3	27.8	9.5	120.3	3	26.5	5.3	64.6
07/19/95	4	27.8	10.3	130.4	4	27.7	9.2	116.5	4	26.3	4.7	57.3
07/19/95	5	27.7	9.7	122.8	5	27.6	9.0	113.9	5	25.8	4.8	58.5
07/19/95	6	27.7	10.8	136.7	6	27.6	8.9	112.7				
07/19/95	7	27.7	9.3	117.7	7	27.6	8.8	111.4				
07/19/95	8	27.7	9.5	120.3	8	27.6	8.7	110.1				
07/19/95	9	27.4	7.5	92.6	9	26.8	3.6	44.4				
07/19/95	10	26.3	3.7	45.1	10	25.5	0.8	9.5				
07/19/95	11	24.0	2.3	27.1	11	23.1	0.4	4.6				
07/19/95	12	21.9	1.0	11.4								
07/19/95	13	18.5	0.2	2.1								
07/19/95	14	16.4	0.2	2.0								
07/19/95	15	15.1	0.2	2.0								
07/19/95	16	14.3	0.2	1.9								
08/30/95	0	28.4	10.2	129.1	0	28.5	9.2	116.5	0	28.5	3.9	49.4
08/30/95	1	28.4	10.1	127.8	1	28.6	10.2	130.8	1	28.5	4.4	55.7
08/30/95	2	28.4	10.1	127.8	2	28.5	9.0	113.9	2	28.5	4.0	50.6
08/30/95	3	28.4	10.1	127.8	3	28.5	9.8	124.1	3	28.0	2.1	26.6
08/30/95	4	28.3	8.3	105.1	4	28.4	8.8	111.4	4	27.8	0.8	10.1
08/30/95	5	28.1	7.3	92.4	5	28.3	6.8	86.1	5	27.7	0.6	7.6
08/30/95	6	27.7	5.1	64.6	6	28.0	4.7	59.5				
08/30/95	7	27.6	3.6	45.6	7	27.8	2.4	30.4				
08/30/95	8	27.2	2.9	35.8	8	27.5	1.9	23.5				
08/30/95	9	26.3	2.0	24.4	9	26.6	0.8	9.9				
08/30/95	10	25.5	0.2	2.4	10	25.3	0.8	9.5				
08/30/95	11	24.2	0.2	2.4								
08/30/95	12	21.8	0.2	2.3								
08/30/95	13	20.5	0.2	2.2								
08/30/95	14	19.2	0.1	1.1								
08/30/95	15	17.7	0.1	1.1								

Appendix C. (Continued)

<i>Date</i>	<i>Station 1</i>				<i>Station 2</i>				<i>Station 3</i>			
	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>
08/30/95	16	16.7	0.1	1.0								
10/06/95	0	18.2	7.7	81.1	0	18.4	6.4	67.4	0	17.4	4.9	50.5
10/06/95	2	18.3	7.7	81.1	2	18.4	6.5	68.4	1	17.5	5.1	52.6
10/06/95	4	18.3	7.7	81.1	4	18.4	6.3	66.3	2	17.5	5.1	52.6
10/06/95	6	18.3	7.9	83.2	6	18.4	6.3	66.3	3	17.5	5.1	52.6
10/06/95	8	18.2	7.4	77.9	8	18.4	6.1	64.2	4	17.4	4.7	48.5
10/06/95	10	18.1	6.8	71.6	10	18.4	4.4	46.3	5	17.3	4.0	41.2
10/06/95	12	18.0	6.2	65.3								
10/06/95	14	17.8	3.9	41.1								
10/06/95	15	17.3	2.3	23.7								
04/14/97	0	9.8	11.0	97.3	0	9.8	11.0	97.3	0	8.3	11.5	96.6
04/14/97	1	9.8	10.9	96.5	1	9.5	11.0	94.8	1	8.2	11.6	97.5
04/14/97	3	9.5	11.0	94.8	3	9.2	11.0	94.8	3	7.3	11.4	93.4
04/14/97	5	9.3	10.9	94.0	5	9.0	11.2	96.6				
04/14/97	7	9.3	10.7	92.2	7	8.9	10.6	91.4				
04/14/97	9	9.3	10.7	92.2								
04/14/97	11	9.3	10.8	93.1								
04/14/97	13	9.3	10.3	88.8								
04/21/97	0	14.5	12.5	120.2	0	14.8	12.2	119.6	0	15.9	10.0	100.0
04/21/97	1	14.5	12.4	119.2	1	14.8	12.1	118.6	1	15.9	10.0	100.0
04/21/97	3	14.3	12.5	120.2	3	14.6	12.1	118.6	3	15.7	9.9	99.0
04/21/97	5	13.9	12.4	119.2	5	14.5	12.0	115.4				
04/21/97	7	13.6	12.2	117.3	7	14.2	11.9	114.4				
04/21/97	9	12.1	11.0	101.9	9	13.0	11.3	106.6				
04/21/97	11	11.3	10.1	91.0	10	12.1	10.2	94.4				
04/21/97	13	10.9	8.3	74.8								
04/21/97	14	10.9	7.7	69.4								
04/21/97	15	10.8	7.0	63.1								
04/21/97	16	10.7	5.8	52.3								
05/05/97	0	13.5	9.1	85.8	0	13.9	9.0	9.0	0	11.8	10.1	93.5
05/05/97	1	13.5	9.1	85.8	1	13.9	9.0	9.0	1	11.8	10.1	93.5
05/05/97	3	13.6	9.2	88.5	3	13.9	9.0	9.0	3	11.6	10.2	94.4
05/05/97	5	13.6	9.2	88.5	5	13.8	9.0	9.0	5	11.7	10.2	94.4
05/05/97	7	13.3	8.8	83.0	7	13.7	9.0	9.0				
05/05/97	9	13.4	8.7	82.1	9	13.8	9.0	9.0				
05/05/97	11	13.3	8.8	83.0								
05/05/97	13	13.1	8.7	82.1								
05/05/97	15	12.8	8.8	83.0								

Appendix C. (Continued)

<i>Date</i>	<i>Station 1</i>				<i>Station 2</i>				<i>Station 3</i>			
	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>
05/28/97	0	17.2	9.3	95.9	0	17.4	9.7	100.0	0	15.7	9.3	93.0
05/28/97	1	17.2	9.5	97.9	1	17.5	9.2	94.8	1	15.6	8.7	87.0
05/28/97	3	17.2	9.3	95.9	3	17.5	9.1	93.8	3	14.9	8.4	82.4
05/28/97	5	17.2	9.0	92.8	5	17.5	9.2	94.8				
05/28/97	7	17.2	8.6	88.7	7	17.4	9.1	93.8				
05/28/97	9	17.1	8.4	86.6	9	16.9	8.5	87.6				
05/28/97	11	16.9	7.4	76.3								
05/28/97	13	16.3	4.8	48.0								
05/28/97	14	16.0	2.8	28.0								
06/11/97	0	20.9	11.2	124.4	0	17.4	9.7	100.0	0	22.3	10.6	120.5
06/11/97	1	20.8	11.0	122.2	1	17.5	9.2	94.8	1	22.2	10.2	115.9
06/11/97	3	20.3	11.5	125.0	3	17.5	9.1	93.8	3	18.9	7.4	78.7
06/11/97	5	19.9	10.7	116.3	5	17.5	9.2	94.8	5	19.2	8.6	91.5
06/11/97	7	17.8	5.8	61.1	7	17.4	9.1	93.8				
06/11/97	9	16.6	2.0	20.6	9	16.9	8.5	87.6				
06/11/97	11	16.1	2.3	23.0								
06/11/97	13	15.9	1.3	13.0								
06/11/97	14	15.8	0.5	5.0								
06/23/97	0	27.5	9.6	118.5	0	28.2	9.9	125.3	0	28.9	10.1	129.5
06/23/97	1	27.4	9.6	118.5	1	28.0	9.7	122.8	1	28.7	10.1	129.5
06/23/97	3	26.7	9.5	117.3	3	27.2	9.5	117.3	3	27.3	8.7	107.4
06/23/97	5	26.6	9.4	116.1	5	26.6	9.1	112.3	4	27.1	8.1	100.0
06/23/97	7	25.3	8.9	106.0	7	25.4	7.7	91.7				
06/23/97	9	23.1	7.9	90.8	9	23.3	4.7	54.0				
06/23/97	11	20.4	4.4	47.8	10	22.0	2.4	27.3				
06/23/97	13	18.1	1.3	13.7								
06/23/97	15	16.9	0.7	7.2								
06/23/97	17	16.1	0.5	5.0								
06/30/97	0	27.2	8.1	100.0	0	27.8	8.2	103.8	0	27.4	8.8	108.6
06/30/97	1	27.2	7.6	93.8	1	27.9	7.9	100.0	1	27.5	8.5	104.9
06/30/97	3	27.0	7.8	96.3	3	27.8	8.1	102.5	3	27.2	8.2	101.2
06/30/97	5	27.0	7.3	90.1	5	27.6	8.0	101.3				
06/30/97	7	26.7	6.0	74.1	7	25.5	7.5	89.3				
06/30/97	9	25.9	4.2	51.2	9	26.6	3.9	48.1				
06/30/97	11	24.6	2.8	33.3								
06/30/97	13	22.5	1.0	11.4								
06/30/97	14	22.5	1.0	11.4								

Appendix C. (Continued)

<i>Date</i>	<i>Station 1</i>				<i>Station 2</i>				<i>Station 3</i>			
	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>
07/14/97	0	27.5	13.4	165.4	0	28.2	11.5	145.6	0	29.2	9.2	117.9
07/14/97	1	27.6	13.1	165.8	1	28.2	11.5	145.6	1	29.2	9.1	116.7
07/14/97	3	27.3	12.8	158.0	3	28.1	11.8	149.4	3	29.1	8.9	114.1
07/14/97	5	26.4	11.9	145.1	5	27.7	11.1	140.5				
07/14/97	7	25.5	7.6	90.5	7	26.1	7.7	93.9				
07/14/97	9	24.8	2.5	29.8	9	25.4	3.9	46.4				
07/14/97	11	24.4	0.8	9.4								
07/14/97	13	23.7	0.2	2.4								
07/23/97	0	28.1	8.5	107.6	0	27.9	6.3	79.7	0	27.0	7.8	96.3
07/23/97	1	28.1	8.4	106.3	1	27.9	6.3	79.7	1	27.0	7.7	95.1
07/23/97	3	28.1	8.3	105.1	3	27.9	6.1	77.2	2	27.0	7.2	88.9
07/23/97	5	28.1	8.3	105.1	5	27.9	5.9	74.7				
07/23/97	7	28.1	7.9	100.0	7	27.9	5.8	73.4				
07/23/97	9	28.1	7.8	98.7	9	27.8	4.4	55.7				
07/23/97	11	27.7	1.1	13.9								
07/23/97	13	25.1	0.4	4.8								
07/23/97	15	23.8	0.4	4.7								
07/28/97	0	30.2	11.4	150.0	0	30.4	12.0	157.9	0	31.0	8.2	109.3
07/28/97	1	30.2	11.6	152.6	1	30.5	11.7	153.9	1	31.0	7.9	105.3
07/28/97	3	30.2	11.7	153.9	3	30.2	11.3	148.7	3	30.7	7.5	100.0
07/28/97	5	30.2	10.6	139.5	5	29.7	7.7	101.3				
07/28/97	7	30.2	11.1	146.1	7	28.5	1.6	20.3				
07/28/97	9	28.2	3.5	44.3	9	27.8	0.2	2.5				
07/28/97	11	24.4	0.9	10.6								
07/28/97	13	25.2	0.2	2.4								
08/11/97	0	24.2	3.4	40.0	0	24.6	7.6	90.5	0	24.4	8.2	96.5
08/11/97	1	24.3	3.4	40.0	1	24.6	7.3	86.9	1	24.3	8.0	94.1
08/11/97	3	24.3	3.1	36.5	3	25.5	7.1	84.5	3	23.8	6.2	72.9
08/11/97	5	24.3	3.0	35.3	5	24.5	6.7	78.8				
08/11/97	7	24.3	3.0	35.3	7	24.4	5.6	65.9				
08/11/97	9	24.3	2.9	34.1								
08/11/97	11	24.3	2.9	34.1								
08/11/97	13	24.3	2.8	32.9								
08/21/97	0	23.2	6.4	73.6	0	23.0	7.2	82.8	0	21.5	9.5	105.6
08/21/97	1	23.3	6.2	71.3	1	23.1	7.0	80.5	1	21.4	9.4	104.4
08/21/97	3	23.3	6.1	70.1	3	23.0	6.8	78.2				
08/21/97	5	23.3	6.1	70.1	5	23.0	6.7	77.0				
08/21/97	7	23.2	6.0	69.0	7	23.0	6.5	74.7				
08/21/97	9	23.2	6.0	69.0	9	22.9	6.5	74.7				
08/21/97	11	23.2	6.0	69.0								

Appendix C. (Continued)

<i>Date</i>	<i>Station 1</i>				<i>Station 2</i>				<i>Station 3</i>			
	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>
08/21/97	13	23.2	6.0	69.0								
08/21/97	15	23.2	6.0	69.0								
08/25/97	0	22.9	8.4	96.6	0	23.3	9.1	104.6	0	23.6	9.5	111.8
08/25/97	1	22.9	8.9	102.3	1	23.3	9.2	105.7	1	23.7	10.1	118.8
08/25/97	3	22.5	7.3	83.0	3	22.9	10.3	118.4	3	22.0	7.0	79.5
08/25/97	5	22.4	6.3	71.6	5	22.7	9.7	111.5				
08/25/97	7	22.4	6.2	70.5	7	22.5	7.8	88.6				
08/25/97	9	22.3	6.0	68.2	9	22.4	7.4	84.1				
08/25/97	11	22.3	6.1	69.3								
08/25/97	13	22.3	6.0	68.2								
09/15/97	0	22.1	5.3	60.2	0	22.7	8.9	102.3	0	23.1	7.4	85.1
09/15/97	1	22.1	5.1	58.0	1	22.8	8.6	98.9	1	23.1	6.5	74.7
09/15/97	3	22.1	4.8	54.5	3	22.7	8.1	93.1	3	22.8	6.0	69.0
09/15/97	5	22.1	4.0	45.5	5	22.6	7.4	85.1				
09/15/97	7	21.9	2.3	26.1	7	22.3	4.8	54.5				
09/15/97	9	21.8	0.9	10.2	9	20.0	1.4	15.2				
09/15/97	11	21.6	0.2	2.3								
09/15/97	13	21.5	0.2	2.2								
09/28/97	0	20.4	6.1	66.3	0	21.1	9.8	108.9	0	20.9	9.4	104.4
09/28/97	1	20.4	6.0	65.2	1	20.8	9.2	102.2	1	20.9	9.1	101.1
09/28/97	3	20.4	5.7	62.0	3	20.5	8.4	91.3	3	20.1	8.8	95.7
09/28/97	5	20.3	5.6	60.9	5	20.5	7.9	85.9				
09/28/97	7	20.1	4.9	53.3	7	20.4	6.8	73.9				
09/28/97	9	20.1	4.7	51.1	9	20.1	4.3	46.7				
09/28/97	11	20.1	4.7	51.1								
09/28/97	13	20.0	4.0	43.5								
10/14/97	0	18.3	5.9	62.1	0	18.2	6.7	70.5	0	15.4	9.8	96.1
10/14/97	1	18.3	5.6	58.9	1	18.2	6.5	68.4	1	15.3	9.9	97.1
10/14/97	3	18.3	5.7	60.0	3	17.8	5.7	60.0	3	15.3	9.9	97.1
10/14/97	5	18.2	5.8	61.1	5	17.7	5.5	57.9				
10/14/97	7	18.2	5.6	58.9	7	17.4	5.6	57.7				
10/14/97	9	18.1	5.5	57.9	9	17.4	5.6	57.7				
10/14/97	11	18.0	4.9	51.6								
10/14/97	13	18.0	4.2	44.2								
10/23/97	0	12.9	9.3	87.7	0	12.3	10.1	93.5	0	10.1	11.7	103.5
10/23/97	1	12.9	9.2	86.8	1	12.2	10.0	92.6	1	10.0	11.4	100.9
10/23/97	3	12.9	9.2	86.8	3	12.3	9.9	91.7	3	10.0	11.2	99.1
10/23/97	5	12.9	9.2	86.8	5	12.2	9.9	91.7				
10/23/97	7	12.9	9.2	86.8	7	11.9	9.9	91.7				
10/23/97	9	12.9	9.4	88.7	8	11.8	9.8	90.7				

Appendix C. (Continued)

<i>Date</i>	<i>Station 1</i>				<i>Station 2</i>				<i>Station 3</i>			
	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>
10/23/97	11	12.8	9.6	90.6								
10/23/97	13	12.8	9.7	91.5								
10/23/97	14	12.8	9.6	90.6								
10/23/97	15	12.8	9.4	88.7								
10/23/97	16	12.8	9.3	87.7								
10/27/97	0	10.4	9.3	82.3	0	9.8	9.6	85.0	0	7.2	11.1	91.0
10/27/97	1	10.3	9.2	81.4	1	9.8	9.5	84.1	1	7.2	11.1	91.0
10/27/97	3	10.3	9.0	79.6	3	9.8	9.5	84.1	3	7.2	11.0	90.2
10/27/97	5	10.3	8.9	78.8	5	9.8	9.4	83.2				
10/27/97	7	10.3	9.0	79.6	7	9.8	9.4	83.2				
10/27/97	9	10.3	8.9	78.8								
10/27/97	11	10.3	8.8	77.9								
11/10/97	0	7.9	11.6	97.5	0	7.7	11.5	96.6	0	6.8	12.2	100.0
11/10/97	1	7.9	11.1	93.3	1	7.7	11.4	95.8	1	6.8	11.9	97.5
11/10/97	3	7.9	11.3	95.0	3	7.7	11.4	95.8	3	6.8	11.7	95.9
11/10/97	5	7.9	10.7	89.9	5	7.7	11.3	95.0				
11/10/97	7	7.9	10.8	90.8	7	7.6	11.4	95.8				
11/10/97	9	7.9	10.6	89.1	9	7.6	10.5	88.2				
11/10/97	11	7.9	10.6	89.1								
11/10/97	13	7.9	11.0	92.4								
12/23/97	0	3.4	12.7	94.1	0	3.5	12.5	92.6	0	2.7	12.7	94.1
12/23/97	1	3.4	12.4	91.9	1	3.5	12.2	90.4	1	2.7	12.5	92.6
12/23/97	3	3.4	12.4	91.9	3	3.5	12.2	90.4	3	2.7	12.5	92.6
12/23/97	5	3.4	12.1	89.6	5	3.5	12.2	90.4				
12/23/97	7	3.4	12.2	90.4	7	3.5	12.2	90.4				
12/23/97	9	3.4	12.1	89.6	9	3.5	11.9	88.1				
12/23/97	11	3.4	12.0	88.9								
12/23/97	13	3.4	12.0	88.9								
01/26/98	0	3.4	11.4	84.4	0	3.4	12.4	91.9	0	3.9	14.9	113.7
01/26/98	1	3.4	10.4	77.0	1	3.3	11.0	81.5	1	3.9	13.2	100.8
01/26/98	3	3.3	10.4	77.0	3	3.5	11.2	83.0	3	4.2	12.6	96.2
01/26/98	5	3.3	10.4	77.0	5	3.5	11.2	83.0				
01/26/98	7	3.3	10.6	78.5	7	3.5	11.5	85.2				
01/26/98	9	3.3	10.6	78.5								
01/26/98	11	3.4	10.6	78.5								
01/26/98	13	3.4	10.6	78.5								
01/26/98	15	3.5	10.5	77.8								
02/24/98	0	6.4	12.2	97.6	0	6.5	11.7	93.6	0	8.1	12.7	106.7
02/24/98	1	6.4	12.1	96.8	1	6.5	11.7	93.6	1	8.1	12.7	106.7

Appendix C. (Concluded)

<i>Date</i>	<i>Station 1</i>				<i>Station 2</i>				<i>Station 3</i>			
	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>	<i>Depth,</i> <i>feet</i>	<i>Temp.,</i> <i>°C</i>	<i>DO,</i> <i>mg/L</i>	<i>% sat.</i>
02/24/98	3	6.4	12.0	96.0	3	6.4	11.7	93.6	3	8.1	12.7	106.7
02/24/98	5	6.4	12.0	96.0	5	6.4	11.7	93.6				
02/24/98	7	6.4	12.0	96.0	7	6.4	11.7	93.6				
02/24/98	9	6.4	11.9	95.2	9	6.3	11.8	94.4				
02/24/98	11	6.4	12.0	96.0								
02/24/98	13	6.4	12.0	96.0								
02/24/98	15	6.4	11.9	95.2								
03/30/98	0	15.2	7.8	76.5	0	15.7	7.9	79.0	0	12.4	8.1	75.0
03/30/98	1	15.1	7.9	77.5	1	15.7	7.9	79.0	1	13.0	8.1	76.4
03/30/98	3	14.6	7.8	76.5	3	15.7	7.8	78.0	3	12.0	8.1	75.0
03/30/98	5	14.3	7.7	74.0	5	15.6	7.8	78.0				
03/30/98	7	13.7	7.8	75.0	7	15.5	7.7	75.5				
03/30/98	9	12.6	7.6	71.7	9	15.5	7.6	74.5				
03/30/98	11	11.6	7.3	67.6								
03/30/98	13	10.9	7.2	64.9								
03/30/98	15	10.7	7.0	63.1								
06/03/98	0	22.4	10.7	121.6	0	22.3	10.7	121.6	0	20.2	9.3	101.1
06/03/98	1	22.4	10.5	119.3	1	22.3	10.5	119.3	1	20.1	9.1	98.9
06/03/98	3	22.3	10.4	118.2	3	22.2	10.0	113.6				
06/03/98	5	22.0	9.3	105.7	5	22.0	9.5	108.0				
06/03/98	7	21.6	8.3	94.3	7	21.4	7.7	85.6				
06/03/98	9	20.3	5.5	59.8	8	20.7	6.3	70.0				
06/03/98	11	16.6	1.9	19.6								
06/03/98	13	15.2	1.6	15.7								

Notes: Temp. – temperature, °C – degree Celcius, DO – dissolved oxygen, % sat. – percent saturation, blank spaces – no data.

Appendix D. Historical Chlorophyll Concentrations in Homer Lake

Appendix D1. Historical Chlorophyll Concentrations in Homer Lake, Station 1

<i>Sample date</i>	<i>Chlorophyll a</i>				
	<i>Chlorophyll a</i> ($\mu\text{g/L}$)	<i>corrected</i> ($\mu\text{g/L}$)	<i>Chlorophyll b</i> ($\mu\text{g/L}$)	<i>Chlorophyll c</i> ($\mu\text{g/L}$)	<i>Pheophytin a</i> ($\mu\text{g/L}$)
04/24/89	2.72	2.97	0.89	0.00	0.00
06/05/89	90.93	92.50	3.17	9.34	0.00
07/05/89	53.00	11.24	3.58	0.41	1.87
08/07/89	33.37	30.71	3.28	3.41	2.94
10/10/89	27.59	28.61	1.45	0.75	0.00
04/25/95	25.24	22.10	11.16	21.70	5.62
06/14/95	14.86	12.59	8.26	12.56	4.23
07/19/95	20.20	19.83	4.18	1.37	0.00
08/30/95	61.11	64.08	1.41	1.20	0.00
10/06/95	38.52	37.47	3.54	3.72	0.00
05/17/96	2.13	4.01	1.80	0.98	0.00
06/26/96	6.80	6.23	0.77	0.00	0.62
07/31/96	25.09	24.03	4.86	1.13	0.89
08/26/96	55.96	56.07	6.21	3.33	0.00
09/30/96	59.28	53.40	7.47	4.14	7.34
10/29/96	39.06	37.38	3.59	2.66	0.93
Count	16	16	16	16	16
Maximum	90.93	92.5	11.16	21.7	7.34
Minimum	2.13	2.97	0.77	0.00	0.00
Average	34.74	31.45	4.10	4.17	1.53
S.D.	23.70	23.98	2.82	5.62	2.24

Notes: S.D. – standard deviation, $\mu\text{g/L}$ – micrograms per liter.

Appendix D2. Historical Chlorophyll Concentrations in Homer Lake, Station 2

<i>Sample date</i>	<i>Chlorophyll a</i>		<i>Chlorophyll b</i>	<i>Chlorophyll c</i>	<i>Pheophytin a</i>
	<i>Chlorophyll a</i> ($\mu\text{g/L}$)	<i>corrected</i> ($\mu\text{g/L}$)			
04/24/89	1.49	2.35	0.15	0.00	0.00
06/05/89	42.37	43.13	1.76	5.75	0.00
07/05/89	18.58	18.79	5.54	0.67	0.00
08/07/89	29.44	26.70	4.21	2.08	3.41
10/10/89	29.09	29.37	2.26	1.64	0.00
04/25/95	27.61	24.48	14.08	25.93	5.90
06/14/95	10.00	7.71	6.89	10.35	4.33
07/19/95	29.48	28.48	1.99	2.40	0.18
08/30/95	60.89	62.87	2.18	3.32	0.00
10/06/95	37.26	34.12	4.88	6.52	3.78
Count	10	10	10	10	10
Maximum	60.89	62.87	14.08	25.93	5.9
Minimum	1.49	2.35	0.15	0.00	0.00
Average	28.62	27.80	4.39	5.87	1.76
S.D.	15.78	16.29	3.77	7.32	2.20

Notes: S.D. – standard deviation, $\mu\text{g/L}$ – micrograms per liter.

Appendix D3. Historical Chlorophyll Concentrations in Homer Lake, Station 3

<i>Sample date</i>	<i>Chlorophyll a</i>		<i>Chlorophyll b</i> (µg/L)	<i>Chlorophyll c</i> (µg/L)	<i>Pheophytin a</i> (µg/L)
	<i>Chlorophyll a</i> (µg/L)	<i>corrected</i> (µg/L)			
04/24/89	2.74	0.00	1.55	0.00	4.67
06/05/89	54.18	54.56	4.17	5.70	0.00
07/05/89	23.31	21.14	5.98	0.09	3.00
08/07/89	46.85	43.56	7.14	3.40	3.65
10/10/89	23.01	22.48	2.77	0.00	0.00
04/25/95	6.52	5.34	6.86	10.72	2.67
06/14/95	20.78	18.69	12.44	18.55	4.21
07/19/95	14.73	14.83	2.80	1.55	0.00
08/30/95	71.72	64.32	10.21	8.53	9.59
10/06/95	24.57	21.11	4.25	3.67	4.97
Count	10	10	10	10	10
Maximum	71.72	64.32	12.44	18.55	9.59
Minimum	2.74	0.00	1.55	0.00	0.00
Average	28.84	26.60	5.82	5.22	3.28
S.D.	20.81	19.82	3.28	5.65	2.80

Notes: S.D. – standard deviation, µg/L – micrograms per liter.

Appendix E. Current Chlorophyll Concentrations in Homer Lake

Appendix E1. Current Chlorophyll Concentrations in Homer Lake, Station 1

<i>Sample date</i>	<i>Chlorophyll a</i>		<i>Chlorophyll b</i>	<i>Chlorophyll c</i>	<i>Pheophytin a</i>
	<i>Chlorophyll a</i> ($\mu\text{g/L}$)	<i>corrected</i> ($\mu\text{g/L}$)			
04/14/97	25.39	24.03	3.14	3.65	1.20
04/21/97	17.19	17.44	0.59	0.07	0.00
05/05/97	23.85	22.70	1.20	1.36	0.67
05/28/97	27.61	28.03	4.30	1.33	0.00
06/23/97	6.13	6.43	0.05	0.00	0.00
06/30/97	20.38	16.91	2.05	0.00	5.00
07/23/97	46.81	46.18	4.23	3.83	0.00
07/28/97	44.54	40.94	3.85	3.17	3.92
08/21/97	85.79	74.76	6.98	2.60	14.38
09/15/97	119.59	109.47	7.96	14.16	11.08
09/28/97	57.71	56.07	4.60	10.44	0.00
10/27/97	44.32	42.72	2.46	0.00	0.27
11/10/97	53.15	49.40	5.47	4.51	3.87
12/23/97	33.48	34.04	1.77	3.37	0.00
01/26/98	13.84	13.35	1.62	0.85	0.20
02/24/98	11.32	9.79	1.14	0.00	2.05
03/30/98	2.39	0.00	0.00	0.00	12.82
04/15/98	10.18	7.48	0.00	0.00	3.74
Count	18	18	18	18	18
Maximum	119.59	109.47	7.96	14.16	14.38
Minimum	2.39	0.00	0.00	0.00	0.00
Average	35.76	33.32	2.86	2.74	3.29
S.D.	29.07	26.67	2.32	3.76	4.56

Notes: S.D. – standard deviation, $\mu\text{g/L}$ – micrograms per liter.

Appendix E2. Current Chlorophyll Concentrations in Homer Lake, Station 2

<i>Sample date</i>	<i>Chlorophyll a</i>		<i>Chlorophyll b</i>	<i>Chlorophyll c</i>	<i>Pheophytin a</i>
	<i>Chlorophyll a</i> ($\mu\text{g/L}$)	<i>corrected</i> ($\mu\text{g/L}$)			
04/14/97	29.37	26.70	2.95	5.98	3.20
04/21/97	14.22	16.29	1.02	1.46	0.00
05/05/97	19.94	21.36	0.08	1.86	0.00
05/28/97	36.10	33.38	5.08	1.85	3.07
06/23/97	13.81	15.09	1.10	0.00	0.00
06/30/97	20.38	14.69	2.05	0.00	8.68
07/23/97	49.49	46.96	5.83	2.29	2.03
07/28/97	133.39	136.17	14.18	13.27	0.00
08/21/97	76.81	70.31	5.02	1.09	6.94
08/25/97	229.39	240.30	13.49	4.21	0.00
09/15/97	63.86	64.08	7.27	3.94	0.00
09/28/97	79.28	82.77	6.10	10.06	0.00
10/27/97	49.76	53.40	5.26	3.32	0.00
11/10/97	52.21	53.40	3.12	3.37	0.00
12/23/97	25.06	24.92	0.22	2.14	0.00
01/26/98	15.24	13.35	1.93	0.88	2.54
02/24/98	13.19	13.35	1.54	0.00	0.00
03/30/98	2.73	0.00	0.00	0.00	3.74
04/15/98	10.46	9.61	0.57	0.00	0.89
Count	19	19	19	19	19
Maximum	229.39	240.3	14.18	13.27	8.68
Minimum	2.73	0.00	0.00	0.00	0.00
Average	49.19	49.27	4.04	2.93	1.64
S.D.	52.75	55.27	4.02	3.45	2.49

Notes: S.D. – standard deviation, $\mu\text{g/L}$ – micrograms per liter.

Appendix E3. Current Chlorophyll Concentrations in Homer Lake, Station 3

<i>Sample date</i>	<i>Chlorophyll a</i>		<i>Chlorophyll b</i> (µg/L)	<i>Chlorophyll c</i> (µg/L)	<i>Pheophytin a</i> (µg/L)
	<i>Chlorophyll a</i> (µg/L)	<i>corrected</i> (µg/L)			
04/14/97	5.01	2.67	1.23	2.63	3.87
04/21/97	16.35	16.14	1.33	0.00	0.00
05/05/97	8.41	6.68	1.84	0.15	2.67
05/28/97	21.41	21.36	3.61	0.00	0.00
06/23/97	31.63	33.59	5.18	0.00	0.00
06/30/97	15.46	12.46	1.86	0.00	4.36
07/23/97	65.49	68.09	8.69	1.71	0.00
07/28/97	81.22	82.77	12.39	0.00	0.00
08/21/97	157.41	149.28	16.16	3.60	6.19
08/25/97	123.91	133.50	0.00	0.00	0.00
09/15/97	71.16	77.43	8.60	4.64	0.00
09/28/97	59.06	58.74	2.22	8.58	0.00
10/27/97	41.61	42.72	6.69	7.70	0.00
12/23/97	25.11	24.03	0.00	4.03	0.27
01/26/98	5.10	2.67	0.50	0.00	3.87
02/24/98	5.77	5.34	0.00	0.00	0.27
03/30/98	3.03	5.34	0.00	0.00	0.00
04/15/98	8.28	5.34	0.00	0.00	4.38
Count	18	18	18	18	18
Maximum	157.41	149.28	16.16	8.58	6.19
Minimum	3.03	2.67	0.00	0.00	0.00
Average	41.41	41.56	3.91	1.84	1.44
S.D.	42.99	43.77	4.65	2.72	2.06

Notes: S.D. – standard deviation, µg/L – micrograms per liter.

Appendix F. Phytoplankton Report for Homer Lake

Appendix G. Lake Periodic Reports
(Source: Illinois Department of Natural Resources)

Appendix H. An Article Regarding Monitoring in Homer Lake