Contract Report 2005-10

Phase I: Diagnostic Study of Lake Vermilion, Vermilion County, Illinois

by

Shun Dar Lin and William Bogner

Prepared for
The Consumers Illinois Water Company and
Illinois Environmental Protection Agency

October 2005

Illinois State Water Survey
Center for Watershed Science
Champaign, Illinois

A Division of the Illinois Department of Natural Resources

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ABSTRACT

The Consumers Illinois Water Company applied for and received a grant to conduct a diagnostic-feasibility study on Lake Vermilion commencing in May 2000. Lake Vermilion is a 878-acre public lake that serves as the public water-supply source for the City of Danville and surrounding communities in Vermilion County, Illinois. The lake is located in the Second Principle Meridian, Township 20N, Range 11W, Section 31 one mile northwest of the City of Danville. Lake Vermilion has a maximum depth of 21.8 feet, a mean depth of 9.1 feet, a shoreline length of 14.3 miles, and an average retention time of 0.042 years. The Lake Vermilion watershed, including the lake surface area, is 190,720 acres or 298 square miles. The main inflow tributarary is the North Fork of the Vermilion River.

The diagnostic study was designed to delineate the existing lake conditions, to examine the causes of degradation, if any, and to identify and quantity 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 will be established for the lake and a restoration feasibility study will be conducted by Cochran & Wilken, Inc. of Springfield. Under the feasibility study, alternative management techniques will be evaluated in relation to the established management goals.

PART 1: DIAGNOSTIC STUDY OF LAKE VERMILION

INTRODUCTION

The Consumers Illinois Water Company (CIWC) applied for and received a grant to conduct a diagnostic-feasibility study on Lake Vermilion commencing in May 2000.

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

The materials presented in this report consist of a review of existing information on the history of the lake, population and economic conditions, the basic physical setting of the lake, ecological characteristics of the lake and watershed, and existing watershed management programs. A baseline or current monitoring program was initiated for a one-year period to collect data on the existing water quality and physical characteristics of the watershed and lake. These baseline data were compared to the available historical record for these conditions to provide an evaluation of the apparent trends in these conditions. The baseline data also were used to evaluate the trophic state of the lake and limitations that these conditions may place on effective use of the lake.

The project was funded (60 percent) by the Illinois Environmental Protection Agency (IEPA) through the Illinois Clean Lakes Program under Conservation 2000 with cost sharing by the CIWC. The IEPA was responsible for grant administration and program management. The diagnostic phase of this project was contracted by the CIWC to the Watershed Science Section of the Illinois State Water Survey (ISWS). The feasibility phase of the study will be conducted by Cochran & Wilken, Inc. (C&W), Springfield, Illinois, as consultants.

Lake Identification and Location

Lake Vermilion (Figure 1) is a 878-acre public access lake located in Vermilion County, one mile northwest of Danville, Illinois. The location of the dam is 40 9’ 24” north latitude and 87 39’8” west longitude in Section 31, T.20N., R.11W., second Principle Meridian, Vermilion County, Illinois. The dam impounds the North Fork of the Vermilion River, a tributary of the Vermilion River in the Wabash River basin. The watershed is a portion of Hydrologic Unit 05120109 as defined by the U.S. Geological Survey (USGS, 1974).

Lake identification and other pertinent geographic information regarding Lake Vermilion are listed in Table 1.

Acknowledgments

This investigation was jointly sponsored by the Consumers Illinois Water Company and the IEPA, as an Illinois Clean Lakes Program Phase I study.

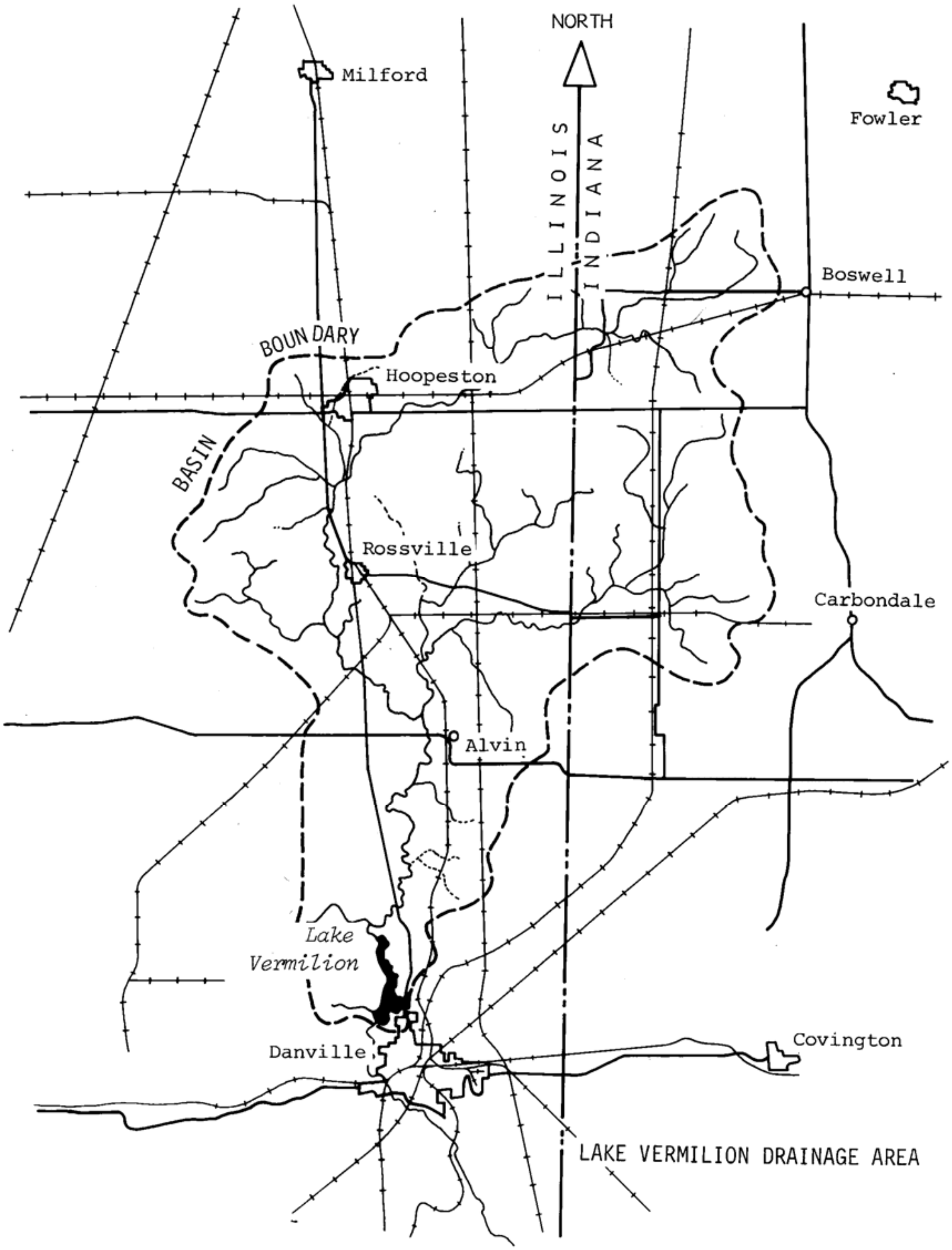


Figure 1. Location and watershed delineation for Lake Vermilion

Table 1. Lake Identification and Location

Lake name:	Lake Vermilion
IEPA/STORET lake code:	RBD
State:	Illinois
County:	Vermilion
Ownership:	Consumers Illinois Water Company
Nearest municipalities:	Danville, Champaign
Latitude:	40 09’ 24” N
Longitude:	87 39’ 08” E
USEPA region:	V
USEPA major basin name and code:	Ohio River Basin, 05
USEPA minor basin name and code	Wabash River Basin, 12
Major tributary:	North Fork Vermilion River
Outflowing stream:	North Fork Vermilion River
Receiving water body:	Wabash River and Ohio River via Vermilion River
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.
STORET - storage and retrieval.

Special thanks to David Cronk (Production Manager of the Danville Water Plant) of the CIWC. He was very courteous and shared his information and knowledge about the lake and the watershed, which made data collection easier. Without his full cooperation, this task could not have been accomplished in a timely and orderly fashion. The authors owe a debt of gratitude to Robert Bauer, David Cronk, and Donald Osborn, CIWC, and Phyllis Borland, IEPA, who collected water and sediment samples.

The IEPA Lakes Unit (Surface Water Section, Division of Water Pollution Control), under the direction of Amy Walkenbach was responsible for overall administration, project coordination and field operations. Teri Holland reviewed the final draft of the report. Steve Kolsto and Jeff Mitzelfelt provided all data and information about publicly owned lakes within a 50-mile radius of Lake Vermilion. Chemical analyses were performed by the IEPA staff. Paul Brewer and Joe Koronkoski, Champaign Regional Office of IEPA, provided discharge monitoring reports for three wastewater treatment plants in the watershed.

Thomas Benjamin (District Conservationist), Paul Sermersheim (Conservation Technician) of the U.S. Natural Resources Conservation Service (Vermilion County) provided information on watershed management of the Lake Vermilion watershed. Dr. Gary C. Lin, Bradley University, performed the Mann-Whitney rank sum tests to evaluate any difference between the historical and current data. Dr. Edward Mehnert, Illinois State Geological Survey, prepared the geological and groundwater hydrology descriptions of the Lake Vermilion watershed. Michel Garthaus (District Fisheries Manager), Illinois Department of Natural Resources (Gibson City) provided fisheries and other biological resources information. Steve Havera and Jeff Levengood, Illinois Natural History Survey, provided waterfowl information.

A shoreline erosion survey and macrophytes survey were conducted by IEPA personnel. Peter Berrini, C&W, assisted in a review of the maps produced for these surveys. The analysis of phytoplankton was performed under the direction of Professor Lawrence O'Flaherty, Western Illinois University, Macomb.

Gen-Ming Zheng assisted in data entry. Long Duong and John Beardsley assisted in preparing the illustrations. Kevin Rennels assisted with the sample collection at the North Fork tributary site and the spillway. Linda Hascall prepared the graphics. Mei-ling Lin assisted in typing the report. Eva Kingston 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 author and do not necessarily reflect the views of the sponsors or of the Illinois State Water Survey.

STUDY AREA

Lake Vermilion

The first public water-supply system for Danville was placed in service by the Danville Water Company in 1883. This system was constructed under a franchise granted by the Danville City Council. The source of water for this system was the available flow from the North Fork of the Vermilion River. The original waterworks are described in ISWS file notes as “a single brick building, divided into a boiler and an engine room.” There are no indications of any water purification facilities.

With this initial supply system, the water taken directly from the river was unreliable in terms of quantity and quality. Water supply was limited during periods of low streamflow, and at other times water quality was affected by high turbidity. By 1902, several improvements to the system had been made: in-stream storage was increased by a small channel dam, a small excavated settling pond was added, turbidity was reduced with the installation of a rapid sand filtration plant, and the pumping capacity was increased. In 1912, the treatment plant was expanded to include a laboratory and hypochlorite treatment of the water.

Efforts to augment the surface water supply with a groundwater system periodically have been initiated since at least 1913 when six wells were bored to a depth of 90 ft. According to ISWS file reports, “these wells flowed and furnished a very large yield.” However, the high iron content and mineralization of the well water made it less desirable than the surface water supply.

The earliest impounding dam, the old dam located north of the Jaycee’s boat ramp, was constructed in 1914 to augment flow to the pre-existing channel dam adjacent to the treatment plant. The present dam and spillway were constructed in 1925, with an initial storage capacity of 8,514 acre-ft (ac-ft) or 2,784 million gallons. The initial construction and filling of the new reservoir submerged the 1914 dam structure to just below the surface of the new water level. The gates of the 1925 spillway structure were modified in 1991 to accommodate an increase in the operating pool elevation.

A water shortage in 1976 prompted a search for additional sources of raw water. This search effort led to an ISWS report *Water Supply Alternatives for the City of Danville* (Singh, 1978). Options considered in this study were raising the lake level, lake dredging, water transfers from the Vermilion or Wabash Rivers, and groundwater development either locally, in the Wabash River valley, or regionally, in northern Vermilion County.

Additional water shortages in 1988 and 1989 revived interest in the storage alternative presented in the 1978 study. In October 1991, an increase in the operating spillway level for Lake Vermilion was approved. The pool level was increased from 576 ft (ft) National Geodetic Vertical Datum (NGVD) to 582.2 ft NGVD, using extensions that had been added to the original spillway gates. The available storage in the reservoir was increased by approximately 4,600 ac-ft or 1,500 million gallons.

Several exploratory wells have been drilled both locally and in northern Vermilion County. At least one well near the lake was drilled, logged, and tested. In northern Vermilion County, several exploratory wells were drilled, but there have been no reported efforts to develop or run pumping tests on these wells.

The 878-acre impoundment is a public water-supply lake owned by the CIWC. Currently, it has a maximum depth of 21.8 ft, a mean depth of 9.1 ft, a shoreline length of 14.3 miles, and an average hydraulic retention time of 0.042 years (15 days). From the upper end of the lake to the dam, Lake Vermilion is approximately 3.5 miles long.

The current water storage capacity is 7,971 ac-ft at the normal pool elevation (Bogner and Hessler, 1999). Average annual lake evaporation rates are 10.5 inches per year at Urbana, Illinois (Roberts and Stall, 1967).

The Danville Water Company began operating in 1883, but it became the Inter-State Water Company in 1913. It was purchased by Consumers Water Company in 1986 and became the CIWC in 1995. Philadelphia Suburban Water Corporation purchased Consumers Water Company in 1999, and it is a wholly owned subsidiary of Philadelphia Suburban Water Corporation.

Watershed

The North Fork of the Vermilion River (Lake Vermilion) watershed consists of the approximately 298-square-mile (190,720 acres) area drained by the North Fork Vermilion River above the dam site (Figure 1). The river originates in Benton County, Indiana, and flows south to Danville, Illinois, where it is impounded to create Lake Vermilion. The river continues downstream and joins the Middle Fork and Salt Fork Rivers south of Danville, to become the Vermilion River. Water in the Vermilion River flows into the Wabash, Ohio, and Mississippi Rivers, and eventually into the Gulf of Mexico.

In Illinois, the watershed covers all or portions of T20N, R11W and R12W; T21N, R11W and R12W; T22N, R10W-R12W; T23N, R10W-12W; and of T24N, R10W-12W.

Average annual precipitation in the area is 39.00 inches, as measured at Danville (1925-2002), and the average runoff (1928–2001) is approximately 11.0 inches (Vermilion River at Danville).

The watershed mainly covers areas in Vermilion County and a small area in Iroquois County, Illinois. Approximately one-third of the watershed is in Benton and Warren Counties, Indiana. The highest point in the watershed is at an elevation of 820 ft NGVD. Approximately, 15,000 people live in the watershed and get their water from wells in the watershed or from Lake Vermilion.

Climatologic Conditions of the Study Area

The following climatologic summary for Danville, Illinois, is based on a period of record of more than 100 years (1897–2001). Data are from the Midwestern Regional Climate Center website (http://mrcc.sws.uiuc.edu/).

Danville 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 dominates the climatology in spring, fall, and winter with short-duration incursions of continental polar air from Canada in winter. Mid-winter high temperatures are typically between 0 and 5^{o}Celsius (^{o}C); summer highs are usually in the 25^{o}C range, with lows about 10^{o}C lower. Spring and fall are a mix of winter- and summerlike 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^{o}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 dewpoints between 15^{o}C and 20^{o}C and afternoon relative humidity in the 60 percent range. Usually about 25 days per year have temperatures greater than 30^{o}C; temperatures greater than 35^{o}C are infrequent.

Average (1971–2000) precipitation for Danville is just under 41 inches (104 cm), including about 19 inches (48 cm) of snow. There is considerable variability from year to year. About 120 days per year have measurable precipitation, of which about 40 days are associated with thunder and about 10 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.

Sixty percent of the mean annual precipitation falls in April September. The frost-free growing season averages about 169 days, beginning about April 25 and ending about October 11.

The highest temperature of record is 44.5^{o}C (112^{o}F on July 14, 1936); the lowest temperature of record is -32^{o}C (-26^{o}F on January 17, 1982). The wettest year of record is 1990, with 54.24 inches (138 cm); the driest year is 1901, with only 18.86 inches (47.9 cm). During the 105 years of record (1897–2002) there were:

5 years with more than 50 inches (125 cm) of precipitation
18 years with more than 45 inches (115 cm) of precipitation
25 years with less than 35 inches (90 cm) of precipitation
10 years with less than 30 inches (75 cm) of precipitation
17 years of incomplete record

Table 2 provides the daily precipitation record for the Danville station during the monitoring year May 1, 2000 to April 30, 2001. Also included in Table 2 are the monthly precipitation normal values for the period 1971–2000.

Geological and Soil Characteristics of the Drainage Basin

Drainage Area

The drainage area for Lake Vermilion is shown in Figure 1. The watershed area is 298 square miles (Table 1).

Geology, Soils, and Topography

The following description is based on information taken from Illinois State Geological Survey (ISGS) publications and maps and from Indiana Geological Survey maps and was summarized by Dr. Edward Mehnart of the ISGS. The geologic conditions in the Indiana portion of the watershed are presumed to be similar to those for the Illinois geology.

Most of the available information is mapped over a broad scale. These maps are meant to represent the broad patterns in the geologic deposits and not capture all of the details found in the geologic deposits. Thus, it is possible that some local conditions may vary from the published data and maps.

Geologic Conditions

The glacial drift covering the Illinois portion of this watershed varies from less than 25 to greater than 400 ft in thickness. Drift is a term to describe the glacial, alluvial, and other nonlithified deposits that are deposited on top of the bedrock. The drift is greater than 200 ft over most of the 17 Illinois townships that are included in the watershed. In general, the drift thickness increases toward the northern end of this watershed because of the presence of the Mahomet bedrock valley.

The surficial deposits found in the uplands to a depth of 50 ft are mapped predominantly as greater than 20 to 50 ft of silty and clayey diamictons of the Wedron Formation, possibly underlain by less than 20 ft of silty and clayey diamictons of the Glasford Formation. Various combinations of alluvium and outwash over diamictons are found in the lowlands.

For the Lake Vermilion area, geologic cross sections show that the distribution of sand-and-gravel aquifers is thickest in the Banner Formation. More importantly, these cross sections show the presence of sand and gravel directly beneath the lake. A pumping test of a well on the west side of the lake showed a hydraulic connection between the lake and the Banner sand and gravel (Larson et al., 1997).

For Indiana, similar geologic materials would be expected — silty and clayey diamictons in the upland areas and alluvium and/or outwash over diamictons in the lowlands. A map of surficial materials in the Indiana portion of this watershed (Wayne et al., 1966) shows

Table 2. Precipitation Record (inches) for Danville Area, 2000–2001

Date	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*April*
1	0.31			0.74			0.11	T	M			
2	0.13									T		0.12
3	0.02		0.08							T		0.15
4		0.06	0.16		0.26	0.28						
5	0.01	0.45	M	0.19		1.09				0.01		
6							0.34	T		0.07		
7	0.08			0.01			0.21	T				
8				0.07						T		0.04
9	1.27						1.66			0.96		0.84
10	0.15	0.77	T		0.63		0.03			T	0.07	T
11		0.16	0.07					1.08			0.01	
12		0.02			1.43			0.06	M			
13	0.42	0.35		T			0.45	0.32		0.01	0.02	0.24
14		1.68			0.06	0.03		0.02	0.02	0.22	0.79	0.03
15		T				0.26			0.02	T	0.08	
16	T	0.06				0.02		0.26		T		
17	0.08	0.12				0.08		0.08				
18	0.45	0.11		0.30				0.10				0.08
19	0.35		0.20					0.04	0.01			0.06
20	T	0.17			0.06			T	T			
21		1.30			0.07			0.06				0.12
22	0.07			0.12	0.24					0.02		
23	0.05			0.03		0.01						
24		1.82		0.34	0.46				M	0.74		
25		0.05			1.21		0.68			0.87		
26	0.17	0.02			0.01		0.06	0.02	0.29			
27	1.36	0.02							0.02		0.01	
28	0.47		T	0.15			0.02		0.08			
29		T						0.13	0.27		0.06	0.22
30			0.12					0.06	0.13		0.11	
31								0.01				
Total	5.08	7.16	0.63	1.95	4.43	1.77	3.45	2.35	0.84	2.90	1.15	1.90
Normals (1971–2000	4.47	4.70	4.39	3.94	3.03	3.04	3.53	2.79	2.05	1.99	3.17	3.86

Notes: M missing data; T trace; Blank spaces not applicable
Project year annual: 32.61 inches
Normal (1971–2000): 40.96 inches

Source: Midwestern Regional Climate Center (http:/mrcc.sws.uiuc.edu/, accessed 2002).

Wisconsinan age materials. In addition, this map shows some features not found in Illinois, kames and eskers, which can contain thick deposits of sand and gravel. Deposits of muck, peat, and marl are mapped at sporadic locations in the Indiana portion of the watershed. Muck, peat, and marl are deposited in lacustrine environments and generally do not yield a great deal of water.

The uppermost bedrock is mapped as the Pennsylvanian age, Carbondale and Spoon Formations, Mississippian age Middle Valmeyeran and Kinderhookian Formations, and Upper Devonian (Willman et al., 1967). In general, the bedrock gets older as one goes north in this watershed. The Mahomet bedrock valley eroded into the bedrock surface, exposing the older rocks (Mississippian and Devonian). The Carbondale Formation contains limestones, sandstones (channel and sheet facies), gray and fissile black shales, and coals. This formation contains the principal economic coals of Illinois, the Danville Coal (No. 7), the Herrin Coal (No. 6), the Springfield-Harrisburg Coal (No. 5), and the Colchester Coal (No. 2). The Spoon Formation is similar to the Carbondale Formation, but has less limestone and coal (Willman et al., 1975). The Mississippian age Middle Valmeyeran consists predominantly of limestones, siltstones, and sandstones. The Valmeyeran includes the Borden Siltstone, which may be the dominant unit in Vermilion County. The Mississippian age Kinderhookian Series is dominantly shale, but has a thin, extensive limestone near its top. The Upper Devonian Series consists largely of black and gray shales (Willman et al., 1975).

Hydrogeologic Conditions

The hydrogeologic conditions for the Illinois portion of this watershed were described by Selkregg and Kempton (1958). The probability of the occurrence of sand-and-gravel aquifers is generally rated as fair to good or good to excellent. In areas mapped as fair to good, sand-and-gravel aquifers in the drift are considered to have variable hydraulic conductivity and to be scattered and discontinuous. The areas mapped as good to excellent define the location of the Mahomet aquifer, which coincides with the Mahomet bedrock valley described earlier. The bedrock is not considered a significant source of water. Small groundwater supplies are obtained from sandstone, limestone, and fractured shales.

Based on the available information, it appears that the shallow geologic materials (less than 50 ft) in the area near the lake have variable hydraulic conductivity. Shallow sand and gravel would be expected to be found most consistently in the areas that include the Cahokia alluvium or the Henry Formation.

In this watershed, surface water and groundwater appear to interact in a number of ways. Surface water interacts with the groundwater within the alluvial sand-and-gravel deposits in the lowlands of the watershed. During normal and low river stages, groundwater is likely to discharge from the alluvial sands into the river. During high river stages, water from the river is likely to flow into the alluvial sands. Another interaction between surface water and groundwater is likely to occur where the Vermilion River has eroded through the sand-and-gravel deposits in the drift. These sand-and-gravel deposits may discharge water directly to the river or its tributaries or be connected with the alluvial deposits described above. Finally, limited available data show a hydraulic connection between Lake Vermilion and the sands and gravels of the Banner Formation.

The soils of the Lake Vermilion watershed are predominantly Drummer clay loam, Elliot silt loam, Blount silt loam, and Ashkum clay loam soil types. Slopes range from nearly level or depressional for the Drummer and Ashkum soils to undulating or rolling for the Blount and Elliot soils. All of these soil types have poor subsurface drainage in their natural condition.

The upland soils in the watershed are dark, prairie soils formed in glacial till deposits. Valley wall soils, formed under forest conditions, are lighter in color. Each of these soil types is generally underlain by a poorly drained subsoil that causes it to be highly susceptible to erosion (Wascher et al., 1938; USDA-SCS, 1982, USDA-SCS, 1996). Tile drains accomplish most agricultural drainage for the more level soils in the watershed. Direct surface drainage is effective when the surface is sloped.

Hydrologic Description of Lake Vermilion

Hydrologic System

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

the lake pool,
surface drainage from the North Fork of the Vermilion River, smaller tributaries to the lake, and direct runoff to the lake,
the local groundwater system,
direct precipitation to the lake,
evaporation from the lake surface, and
discharge through the spillway.

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 or building roofs), infiltration potential is very low. 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 the infiltration rate.

Much of the drainage from the upland portions of the watershed is influenced by subsurface tile drainage systems. 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 surface drainage channels. This process reduces the rate of runoff for the watershed and potential peak flows in the stream system.

As runoff enters the lake, the water level rises and the volume of water stored in the pool increases. Excess water is released through the spillway gate openings. Management of releases through the spillway gates minimizes the impacts of storm flows on the lake levels. During periods of low streamflow, releases through the spillway are constantly maintained to provide water at the water plant intakes located 2.5 stream miles downstream of the spillway.

Lake levels will generally follow a trend of steady decline through the summer months, when evaporation rates and spillway releases for water supply 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. Most years, a surplus of water is passed through the spillway during the spring rise.

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

Public Access to the Lake Area

There is a well-developed transportation network throughout the watershed. The major north-south highway is Illinois Route 1 which bisects the watershed (including the city of Danville). East-west routes include Interstate Highway 74, US Routes 150 and 136 (Illinois Route 1), Illinois Route 9, Illinois Route 49, and Illinois Route 119. There are also several railroads that traverse the watershed. The railroads include the Louisville & Nashville Railroad; the Chicago & Eastern Illinois Railroad; the Chicago, Milwaukee, St. Paul & Pacific Railroad; and the Norfolk & Western Railroad.

Lake Vermilion is accessible from Interstate Highway 74, US Route 136 (Illinois Route 1) through the city of Danville. Lake Vermilion is located immediately at the northwestern edge of Danville, and much of the east shore of the lake is residential frontage. In addition, there are approximately 2,000 ft of residential frontage located on the western shore of the lake north of the boat ramp. West Newell Road is at the north end of the lake. Denmark Road (Dallas Bowman Memorial Bridge) runs generally west and south of the lake (Figure 2).

Approximately 40 percent of the 14.3 miles of shoreline is residential and developed with numerous permanent homes and cottages along the lakeshore. Woodland makes up 40 percent of the shoreline on the west side of the lake. Wetland and developed recreation areas each have approximately 10 percent of the shoreline use. Most undeveloped shoreline is accessible for bank fishing.

There are two public parks along the west shore of Lake Vermilion. One park is at GAO Grotto located at the northwestern corner of the lower lake basin near the Dallas Bowman Memorial Bridge; and the other park is at the Jaycee’s Boat Ramp (Jaycee’s Park). There are parking spaces for 10 vehicles at GAO Grotto; and parking for 50 vehicles and 30 boat trailers at the Jaycee’s Park. There is one public boat dock at each park. Another public dock is located about 3,000 ft north of the Denmark Road Bridge on the western shore of the lake. The Danville Park District maintains the boat dock/launch. The distance from downtown Danville to the access point is approximately 2 miles. There is no public transportation to the lake site.

No fee is charged for the use of the park and the lake for fishing. There is a $50 annual registration fee for all boats used on the lake. Bank fishing is available at many open areas

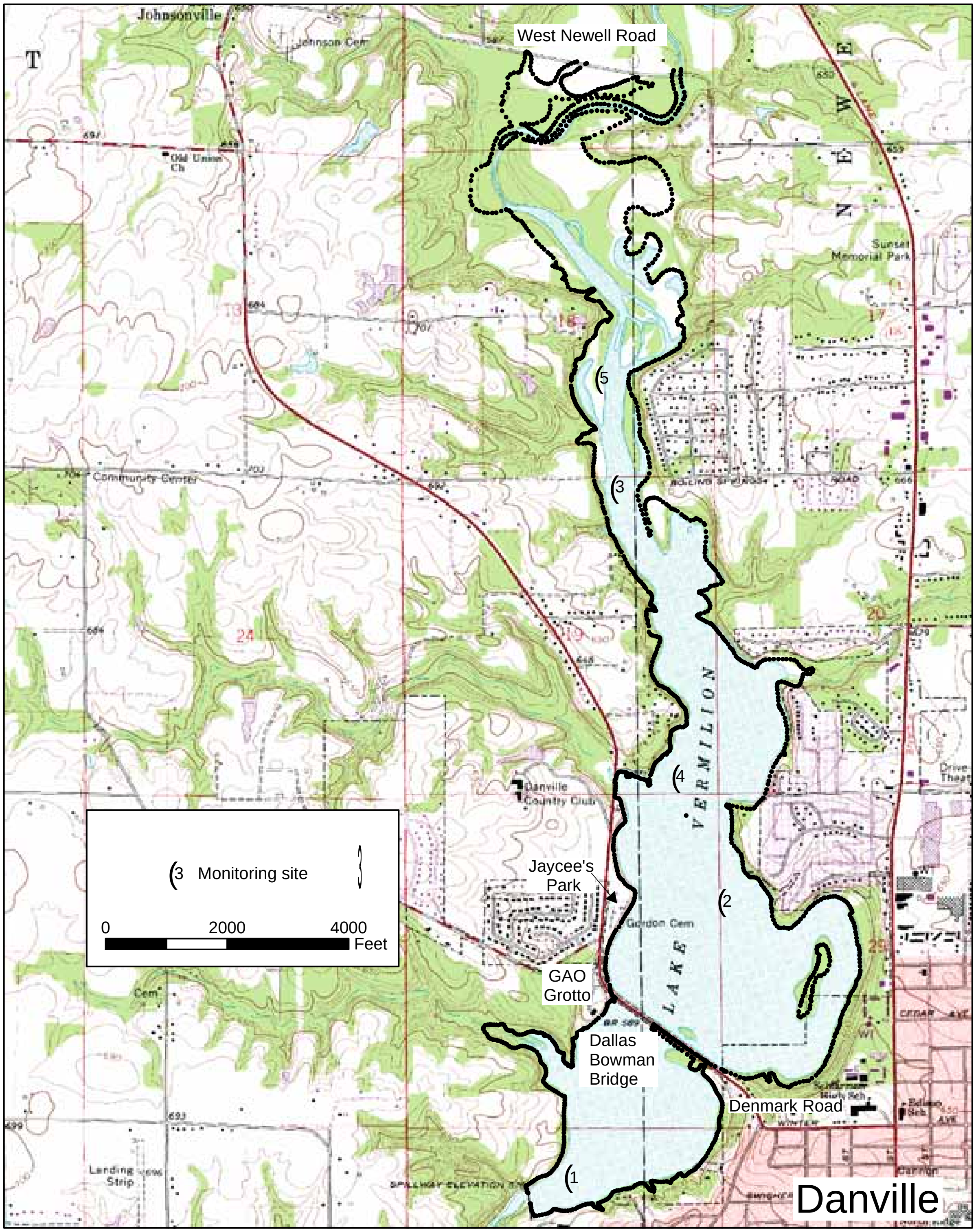


Figure 2. General location map for facilities at Lake Vermilion

(shoreline resident areas). There are no general limits on motor size or boat speed for the lake. The use of the lake is year round. Swimming is permitted at the GAO Grotto beach.

There is no camping facility, no shelter, and no boat rental. There is a concession stand, two public picnic areas, and restroom facilities. Facilities at the boat ramp are handicapped accessible. Waterfowl hunting and observation are allowed. There is no hiking trail in the wooded areas.

Size and Economic Structure of Potential User Population

Potential User Population

Lake Vermilion's user population includes the city of Danville and other residents in the area. As a recreational resource, Lake Vermilion is used primarily by persons with property adjacent to the lake or residents in Danville and the surrounding area. There is no attendance record so it is difficult to determine points of origin for visitors. As estimated by the Vermilion County Park District, the attendance is approximately 50,000 visitors annually. The lake probably receives its greatest use from Danville (population 33,900). In the watershed, potential user populations most likely to use the lake live in the towns of Hoopeston (21 miles north, population 5,965), Rossville (16 miles north, population 1,083), Alvin (11 miles north, population 316), and Bismarck (7 miles north, population 542). Other area towns include Rantoul (30 miles northwest, population 12,857) and Georgetown (13 miles south, population 3,628). The total population of these six communities is 24,091 according to the 2001–2002 Illinois Highway Map.

A majority of the users travel from within a 50-mile (80-kilometer or km) radius of Lake Vermilion, with the metropolitan areas of Champaign-Urbana (35 miles east) and Terre Haute, Indiana (50 miles southeast) contributing the most noncity users. Major population centers (cities/towns) within a 50-mile (80-km) radius of Lake Vermilion are listed in Table 3. The data are based on the 2001–2002 Illinois Highway Map. The demographic and economic information for counties that lie within a 50-miles radius of Lake Vermilion are given in Table 4 (University of Illinois, 1999; Rand McNally Company, 2001). The total population of the eight counties listed in Table 4 is 838,700.

Referring to Tables 3 and 4a, the population of Vermilion County was 84,300 on January 1, 2000. The largest city in Vermilion County is Danville (population 33,900), whose total population comprised 40.2 percent of the county's total population.

Economic Characteristics

The recent per-capita income of the 50-mile surrounding communities (Table 3) is available only for large cities (Data from the 2000 Census were not available at the time of this writing). The 1997 per-capita income for Danville was $15,101. Tables 4a and 4b show population and economic data for counties within 50 miles (80 km) of Lake Vermilion and list sources of employment. The per-capita income for the eight counties listed in Table 4a averages

Table 3. Demographic and Economic Data for Towns/Cities Surrounding Lake Vermilion

	Population			*Number*	*Persons*	*1997*
Town/city	*Total, 2001*	*Under 18 years, %*	*Over 65 years, %*	*of households*	*per household*	*Per-capita income, $*
Arcola	2,652	25.5	17.4	1,009	2.54	11,780
Catlin	2,087	29.2	10.8	801	2.71	13,010
Champaign	67,518	18.4	8.2	24,173	2.30	21,962
Danville	33,904	26.4	17.5	13,791	2.40	15,101
Fisher	1,647	28.2	12.1	576	2.65	13,489
Georgetown	3,628	28.7	15.7	1,447	2.54	9,568
Gibson City	3,373	23.6	22.8	1,431	2.30	12,569
Gilman	1,793	23.8	23.5	728	2.39	10,644
Hoopeston	5,965	27.3	17.2	2,332	2.49	11,205
Lake of the Wood	3,026	31.8	4.9	1,002	2.74	12,405
Mahomet	4,877	32.1	8.0	1,098	2.83	14,503
Milford	1,369	24.9	19.5	628	2.41	10,432
Monticello	5,138	23.5	17.8	1,816	2.44	15,531
Oakwood	1,502	27.5	10.8	585	2.62	11,327
Onarga	1,438	28.3	17.6	474	2.68	9,941
Paris	9,077	24.7	21.2	3,752	2.33	10,835
Paxton	4,525	26.5	17.9	1,682	2.48	11,193
Philo	1,314	28.8	12.5	375	2.74	15,215
Rantoul	12,857	29.0	5.8	5,461	2.75	11,360
Rossville	1,083	25.6	20.1	450	2.36	10,875
St. Joseph	2,912	27.8	11.8	776	2.63	13,861
Sheldon	1,232	25.5	18.3	430	2.50	10,950
Sidney	1,062	26.2	13.0	383	2.54	13,213
Thomasboro	1,233	25.4	11.5	500	2.50	12,854
Tilton	2,976	22.9	15.9	1,131	2.41	10,794
Tolono	2,700	28.0	9.8	1,005	2.59	11,588
Tuscola	4,448	25.0	15.5	1,708	2.43	12,685
Urbana	36,395	16.1	9.0	13,210	2.20	21,962
Villa Grove	2,553	28.9	12.9	1,022	2.68	10,971
Watseka	5,670	24.9	21.6	2,169	2.38	11,000
Westville	3,175	21.7	21.1	1,463	2.32	11,485

Source: University of Illinois, 1999; Rand McNally Company, 2001.

Table 4a. Population and Economic Data for Counties near Lake Vermilion

				Manufacturing						
County	*Area (square miles)*	*Population (01/01/00)*	*Wholesale (thousands $)*	*Number of establishments*	*Units*	*Number of employees*	*Value added (thousands, $)*	*Total number of establishments 1996*	*Total number of employees 1997*	*Per-capita income, $* 1997
Champaign	997	170,300	2,033,468	173	940	11,000	1,333,600	256	115,921	$21,962
Coles	508	52,000	370,765	56	429	5,600	609,900	74	33,589	$20,218
Douglas	417	19,900	211,349	59	64	1,500	91,400	47	11,255	$20,885
Edgar	624	19,200	135,159	28	28	1,000	51,700	45	8,816	$19,163
Ford	486	14,000	387,588	21	21	1,000	70,000	43	7,348	$22,667
Iroquois	1,116	31,200	276,291	41	68	1,800	96,700	42	14,693	$20,355
Piatt	440	167,000	249,449	16	20	500	27,800	41	6,119	$23,325
Vermilion	486	84,300	548,525	117	560	8,300	797,200	130	42,872	$19,566

Sources: Rand McNally Company, 2001
University of Illinois, 1999
Gaquin and DeBrandt, 2001

Table 4b. General Employment Categories for Counties near Lake Vermilion

County/County seat	*Major employment categories*
Champaign/Urbana	Education; governments; services (business, education, health, hotels, and social); retail trade; finance, insurance, and real estate; manufacturing (food and kindred products, textile and fiber products, primary metal industries, electrical equipment, and components); transportation and public utilities; construction; trucking; wholesale and retail trade; construction; and agriculture.
Coles/Charleston	Manufacturing (nondurable goods, electrical equipment and components); government; services (business, education, health, and social); retail trade; real estate; construction; and agriculture.
Douglas/Tuscola	Manufacturing (lumber); retail trade; services (automotive, food, finance, and health); government; finance, insurance, and real estate; construction; and agriculture.
Edgar/Paris	General and professional services; manufacturing (food, rubber, and plastics); retail trade; government; and agriculture.
Ford/Paxton	Professional and related services; wholesale and retail trade; manufacturing (textile and fiber products, primary metal industries, and electrical equipment and components); mining; trucking; governments; and agriculture.
Iroquois/Watseka	Services (business, health, personal, and social); retail trade; government; financial; and agriculture.
Piatt/Monticello	Services (business, engineering, financial, hotels and motels, and health); retail trade; government; finance; manufacturing (paper and allied products, printing and publishing, chemical and allied products, and primary metal industries); transportation and public utilities; wholesale trade; and agriculture.
Vermilion/Danville	Services (business, education, engineering, hotels and motels, and health); retail trade; manufacturing (automobile parts, chemical and allied products, fabricated metal products, and electronic equipment); government; finance, insurance, and real estate; wholesale trade; transportation and public utilities (tracking and communication); and agriculture.

Sources: Rand McNally Company, 2001
University of Illinois, 1999
Gaquin and DeBrandt, 2001

$20,770 with a range from $19,163 in Edgar County to $23,325 in Piatt County. The 1997 per-capita income for Vermilion County was $19,566.

Vermilion County had an average labor force of 38,550 in 1999. The 1999 per-capita income for Vermilion County was $20,436 as compared to $29,853 for the State of Illinois. The 1999 unemployment rate for Vermilion County was 6.0 percent as compared to the state average of 4.3 percent for Illinois. Approximately 97 percent of the labor force is in nonfarm employment (University of Illinois, 1999; Rand McNally Company, 2001).

Agriculture and agribusiness are the major enterprises in Vermilion County. The major crops grown in the watershed are corn and soybeans. For Vermilion County, the average farm size is 493 acres; the total value of farm income in 1997 was 140 million dollars. Sales from crops constituted 95.7 percent of total farm sales; and livestock and poultry farm sales constituted 4.3 percent of total sales. The average yields under high levels of management for present conditions are corn, 147 bushels; soybeans, 42 bushels; and wheat, 70 bushels per acre (Thomas Benjamin, USDA, personal communication, 2002).

A few light industrial plants, an underground coal mine, and several producing oil fields also contribute to the economy. The plants for the production and processing of canning crops (canneries) are located in Hoopeston, and one formerly operated in Rossville. The furthest downstream portion of the watershed has several rural nonfarm residential subdivisions. The major transportation facilities in Vermilion County include railroads, Interstate Highway 74, US Routes 136 and 150, and Illinois Routes 1, 9, 49, and 119. The transportation facilities (including railroads discussed later) provide adequate market outlets for the agricultural production of the watershed.

Historical Lake Uses

Public Water Supply (Water Treatment Plants)

The CIWC's treatment facility was completed in early 1992. This state-of-the-art plant was designed to produce up to 14 million gallons per day (mgd) of treated water. The plant improvements, completed in 2000, provided additional treatment for nitrate removal, chloramine disinfection, and improved performance in raw water screening, powdered activated carbon feed, filtration, and plant controls.

The public water-supply system for the Danville area is operated by the CIWC. Lake Vermilion impounds the North Fork Vermilion River. There is no intake structure in the lake. Water from Lake Vermilion is released at the spillway to supply a small holding basin at 2.5 river miles downstream and adjacent to the water treatment plant. The raw water intake is equipped with eight stainless steel screens feeding into two pump stations adjacent to the North Fork River containing a total of four submersible, floodproof raw water pumps with capacities ranging from 2 to 9 mgd each.

There are four Eimco Reactor Clarifiers used for softening and solids removal. Each unit is rated at 7 mgd. Ferric chloride is added for coagulation; and lime is dosed for water softening purposes. After the clarifiers, the water flows into a recarbonation basin where carbon dioxide is injected to lower the pH. The 69 ft 20 ft 21.5 ft concrete basin is used for pH adjustment. Hydrofluosilic acid is added at the outflow to enhance dental health.

The clarified and softened water from the recarbonation basin enters six dual-media filters (anthracite coal and filter sand) with a capacity of 2.8 mgd each. Phosphate is dosed to remove and prevent lime build-up on the filter media. The filters are used for the final polishing of the water. Air and water are used for filter backwash.

Water from the filter flows into a cleanwell (wetwell) with 1.25 million gallons total capacity. Chlorine and aqueous ammonia are added for disinfection purpose. Two halves, fully baffled, are used for maximum detention time.

There are four ion exchange units (10-ft diameter by 10-ft high ion exchange pressure vessels) for nitrate removal. Each unit is rated at 4.4 mgd. It is used as a "split-stream" treatment to reduce nitrate levels to below maximum allowable levels in finished water delivered to customers. Sodium hydroxide (for pH control), sodium chloride (for nitrate removal), and sodium thiosulfate (for dechlorination) are dosed in the ion exchange system.

The finished water then is pumped to a storage tank by four vertical turbine pumps (high service pumps) with a total pumping capacity that ranges from 2 to 9 mgd. They can pump purified water to an elevation of 285 ft above the treatment plant.

Full process and quality control are based on laboratory results of water chemistry. The treatment plant features an Illinois Department of Public Health-certified bacteriological laboratory.

Distributed programmable logic controller and personal computers control the processes with advanced graphics, data logging, and reporting capabilities.

Recreational Uses

Since the completion of Lake Vermilion, the lake and park areas have been popular for recreation purposes for the population from the area surrounding Danville. Recreational activities included boating (include high power boating and sail boating), swimming, sport fishing, water skiing, duck hunting, wildlife observations, picnicking, and aesthetic enjoyment. Estimated user populations are 80,000 people annually (Danville Park District, personal communication, 2001).

The recreational facilities around the lake area include a boat ramp, one concession stand, a swimming beach at the GAO Grotto, restrooms, and two picnic areas. There is no shelter, campground, hiking or horse trail, and no bicycle trail.

The Oldsmobile Balloon Classic was held until 2000 but was suspended in 2001 due to lack of funding. Hot air balloons were launched over the lake and there was usually a contest. The approximate date for this event was the second week in April.

The lake maintenance budgets were obtained from the Vermilion County Park District. Revenues received in fiscal year 2000–2001 were a total of $37,500. The lake income included

$35,000 from boat licenses and $2,500 from the concession store. The annual expenditure for Lake Vermilion in 2000–2001 was $17,500. The annual expenditures were mainly for salaries of park employees. Other expenditures were for maintenance and operation supplies, and utilities. Annual revenues exceeded expenses of $20,000 in 2000–2001. There are plans for future capital improvements, such as a boardwalk tower, more restrooms, and a concrete walkway.

Residential Uses

The CIWC owns all shoreline around the lake. Home sites have been developed on adjacent properties. There are approximately 70 houses built adjacent to the lake (50 along the east side and 20 along the west side).

Population Segments Adversely Affected by Lake Degradation

Degradation of Lake Vermilion has been a gradual process. The degradation problems are common to most lakes in central Illinois: siltation, pesticide introduction due to agricultural and residential practices within the watershed, residential development along a large portion of the shoreline, and the presence of nongame fish.

Siltation is caused by the sheet and rill erosion and ephemeral gully erosion from the watershed. Siltation in the lake has an effect on lake volume, and reduced water depth affects shoreline aesthetics and boat access. According to Bogner and Hessler (1999), sedimentation has reduced the potential capacity of Lake Vermilion from 13,209 ac-ft (4,304 million gallons) in 1925 to 7,971 ac-ft (2,597 million gallons) in 1998. The 1998 basin capacity was 60.3 percent of the 1925 potential basin capacity. For water-supply purposes, these volumes convert to capacities of 4,304 million gallons in 1925 and 2,597 million gallons in 1998. The potential capacity of the lake was 9,810 ac-ft (3,196 million gallons) in 1963 and 9,157 ac-ft (2,984 million gallons) in 1976.

The sedimentation rates for Lake Vermilion for the periods 1925–1963, 1963–1976, 1976–1998, and 1925–1998 indicate a steady decline in net sediment yield. Annual sedimentation rates for three separate periods, 1925–1963, 1963–1976, and 1976–1998, were 89.5, 50.2, and 53.9 ac-ft, respectively. The long-term average annual sediment yield from 1925–1998 was 71.8 ac-ft. These delivery rates show the need for continuing efforts to control watershed erosion, thereby reducing reservoir sedimentation rates.

Capacity loss rates as a result of lake sedimentation (0.54 percent per year) and watershed sediment yield rates (0.40 tons per acre) of the lake and its watershed are about average for Illinois impoundment lakes (Bogner and Hessler, 1999).

Lake Vermilion is used as a public drinking water source for Danville and several area communities, boat fishing, and bank fishing. The water quality and quantity are of utmost concern for the CIWC and its customers. Degradation of water quality of the lake water will increase the future cost of drinking water treatment, which may be passed on to water customers. In the past, increased treatment costs have not been directly passed on to customers. Water rates were increased in 1998 after the new water treatment plant was constructed to improve the finished water quality. A deteriorating fishery also could affect the group of up to 16,700 people, who fish to supplement family food supplies (Ken Konsis, Vermilion County Park District, personal communication, 2001).

Residential developments along the lake shoreline can contribute to lake deterioration. Potential impacts range from problems due to septic systems to vegetation removal resulting in less and unbalanced macrophyte growth. A consequence of vegetation removal is that many nongame fish, such as common carp, yellow bass, freshwater drum, and gizzard shad, may be present in higher densities. The solution of these problems is complicated and expensive or impossible to correct. Rotenone, a chemical used for control of undesirable fish, cannot be used in Lake Vermilion because it serves as a primary source for public water supply (Mike Mounce, IDNR, personal communication, 2000).

Comparison of Lake Uses to Other Lakes in the Region

Within 50 miles (80 km) of Lake Vermilion, there are 17 lakes listed in files of the IEPA. These lakes and information about size, maximum depth, existence of boat ramps, and lake use are listed in Table 5. Among these lakes, six lakes have surface areas greater than 100 acres. Lake Vermilion (878 acres) is the largest and the most significant water resource of the area.

Uses for most of these lakes and their surrounding areas as listed in Table 5 include recreation, boating, fishing, swimming, public water supply, and picnicking. Four lakes, including Lake Vermilion, are used as sources for public water supplies. Lake Vermilion with its park areas (approximately 500 acres) also provides excellent recreation facilities.

Point Source Discharges

Municipal wastewater treatment plants or industrial treatment facility effluents are point source discharges released at concentrated outfalls into a body of water. Point source discharges fall under the USEPA's National Pollutant Discharge Elimination System (NPDES) permit program. Three NPDES permitted facilities (two municipal and one school source) discharge into the Lake Vermilion watershed (Paul A. Brewer and Joe Koronkoski, IEPA, personal communication, 2001). The regulatory monitoring and sampling schedule as well as the constituents of concern and concentration limits are determined for each facility based on the size, treatments used, and the point of discharge.

One permitted discharge is the effluent of the city of Hoopeston Wastewater Treatment Plant, NPDES number IL0024830. The treatment facilities include bar screens, grit chambers, two Imhoff tanks, two oxidation ditches, and four sand filters (travel bridge rapid sand filters). Samples of the effluent are collected for regulatory monitoring three times per week. The outflow discharge is monitored on a continuous basis. The recent discharge monitoring report (April 2000–May 2001) with NPDES permitted limits is shown in Table 6, which indicates that the maximum discharge rate of the plant during the study period was 2.363 mgd. The average monthly flow ranges from 0.620 to 1.652 mgd with an annual average of 0.956 mgd. The pH values were between 7.2 and 7.9, which is within the acceptable NPDES permit range (6–9).

Table 5. Illinois Public Lakes within a 50-Mile Radius of Lake Vermilion

Lake code	*Lake name*	*County*	*Surface area, acres*	*Maximum depth, ft*	*Average depth, ft*	*Boat ramp*	*Lake use/ facilities*
REU	Champaign Sportsmens	Champaign	3	5	3.7		
RBU	Crystal	Champaign	7				
RBO	Homer	Champaign	83.0	19.0	7.4	2	BR,C,CN,P,PK
REG	Lake of The Woods	Champaign	23.2	28.0	9.7	1	BR,C,H,P,PK
REZE	Spring	Champaign	35	17	6		
RBP	Oakland	Coles	23.4	9	5.5	1	WS/P
RBK	Walnut Point	Douglas	58.7	31.0	11.5	1	C,P,PK,WH
RBL	Paris Twin East	Edgar	162.8	26.5	10.2	1	WS/ P
RBX	Paris Twin West	Edgar	56.7	8.5	3.3	1	BR,P,S
RFA	Iroquois	Iroquois	125.0	36.0	12.8	1	C,P,PK
RFE	Bayles	Iroquois	125.0	22.0	9.2		
RBR	Clear	Vermilion	7.0	53.0	16.5	1	C,P,PK
RBS	Georgetown	Vermilion	46.1	12	4.1	1	WS,P
RBM	Long	Vermilion	56.6	39.0	12.1	1	C,CN,PK
RBN	Mingo	Vermilion	170.0	41.0	11.5	1	P,S
RBD	Vermilion	Vermilion	878.0	21.8	9.1	2	WS/BR,C,P,S
RBY	Willow Creek	Vermilion	7.0	16.0	12	1	BR,P

Notes: *All lakes are used for fishing/boating, WS = water supply, BR = boat rental, C = camping area, CN = concession, F = fishing/boating, H = hiking, P = picnic area, PK = park, S = swimming/beach, WH = waterfowl hunting, and blank spaces = no data.

Sources: Jeff Mitzelfelt and Steve Kolsto, IEPA, personal communication, 2001; Sefton and Little (1984).

Table 6. Summary of Discharge Monitoring Report, City of Hoopeston, 2000–2001

					Carbonaceous BOD				*Total suspended solids*				*Ammonia, mg/L*	
	Flow, mgd		*pH*		*lb/day*		*mg/L*		*lb/day*		*mg/L*			
Date	*Avg.*	*Max.*	*Avg*	*Max.*	*Avg*	*Max.*	*Avg.*	*Max.*	*Avg*	*Max.*	*Avg*	*Max.*	*Avg*	*Max.*
2000														
May	1.097	1.82	7.6	7.8	20	31	2	4	24	70	3	8	0.19	0.33
June	0.843	1.61	7.2	7.6	27	58	4	11	18	36	2	5	0.38	0.62
July	0.906	1.747	7.3	7.8	25	46	3	5	15	34	2	4	0.22	0.3
August	0.62	1.491	7.3	7.6	14	36	2	5	13	33	2	5	0.24	0.48
September	0.67	1.428	7.3	7.6	11	15	2	3	11	21	2	4	0.23	0.38
October	0.692	1.753	7.2	7.9	12	23	2	4	17	36	3	7	0.18	0.42
November	0.884	1.869	7.6	7.8	18	79	2	5	24	55	4	6	0.21	0.47
December	0.945	2.292	7.4	7.6	12	19	2	3	20	41	2	5	0.20	0.36
2001														
January	0.973	2.114	7.4	7.7	25	97	2	6	33	153	3	9	0.18	0.23
February	1.652	2.102	7.2	7.5	19	41	1	3	33	90	2	5	0.11	0.21
March	1.163	2.363	7.4	7.6	19	59	2	8	13	45	1	6	0.16	0.64
April	1.03	2.12	7.2	7.7	56	265	6	15	51	380	4	22	0.20	0.90
Yearly ave.	0.956	1.892			22	64	3	6	23	83	3	7	0.21	0.45
Yearly max.	1.652	2.363	7.6	7.9	56	265	6	15	51	380	4	22	0.38	0.90
Yearly min.	0.62	1.428	7.2	7.5	11	15	1	3	11	21	1	4	0.11	0.21
NPDES limit	Report	Report	6	9	220	440	10	20	264	528	12	24	1.5* 2.1**	7.3* 5.8**

Notes: BOD - biochemical oxygen demand, mgd - million gallons per day, Avg. - average, Max. - maximum, and Min. - minimum.
*April–October.
**November–March.
Water quality monitored 3 times per week, flow continuously

Source: IEPA, Champaign Regional Office.

The monthly average carbonaceous biochemical oxygen demand (CBOD) loading rates ranged from 11 pounds per day (lb/day) in September 2000 to 56 lb/day in April 2001. The maximum loading rate was 265 lb/day in April 2001. Average monthly CBOD concentrations were between 1 (February 2001) and 6 mg/L (April 2001). The average and maximum of both CBOD loading rates and concentrations were within the NPDES permitted limits.

Table 6 also shows total suspended solids (TSS) loading rates as well as concentrations and ammonia-nitrogen (NH_3-N) concentrations monitored. Monthly average TSS loading rates ranged from a low of 11 lb/day in September 2000 to a high of 51 lb/day in April 2001, with a daily maximum of 380 lb/day in September. These values did not exceed the limits of 264 lb/day for a monthly average and 528 lb/day for the daily maximum loading rate. Average monthly TSS concentrations were between 1 and 4 mg/L with a maximum concentration of 22 mg/L found in April 2001. These TSS concentrations also did not exceed the NPDES limits. The average monthly ammonia concentrations in the Hoopeston effluents ranged from 0.11 in February 2001 to 0.38 mg/L in June 2000, with a maximum concentration of 0.90 mg/L. These NH_3-N concentrations were below the NPDES limits. The effluent standards for NH_3-N are 1.50 mg/L, (monthly average) and 7.30 mg/L (maximum concentration) during April–October, and 2.1 mg/L (monthly average) and 5.8 mg/L (maximum concentration) during November–March.

The May 2000–April 2001 discharge monitoring report for the village of Rossville wastewater treatment system is presented in Table 7. The NPDES number for this system is ILG580064. The treatment facility uses two lagoon systems as primary and secondary treatments. Two intermittent sand filters then polish the effluent. Samples of the effluent are collected for regulatory monitoring once monthly. The outflow discharge is monitored at least once per week. Table 7 shows that the average monthly flow rates range from 0.115 mgd in September 2000 to 0.28 mgd in December 2000, with a maximum flow of 0.397 mgd in January 2001. The 6.9–7.5 range of monthly pH values was in the permitted range of 6–9. The CBOD and TSS values were determined only once a month. The CBOD loading rates ranged from 1.2 lb/day in October 2000 to 34 lb/day in January 2001, with an average of 13.2 lb/day. The regulatory maximum limit is 150 lb/day. The CBOD concentrations were between 1.3 and 23.5 mg/L, with a mean of 11.5 mg/L. These values were under the maximum concentration limit of 40 mg/L. The ranges of TSS loading rates and concentrations were 6.3–30 lb/day and 8–28 mg/L, respectively, less than the limits of 169 lb/day and 45 mg/L. The averages of TSS loading rates and concentrations were 17 lb/day and 16 mg/L, respectively.

Bismarck-Henning School uses a septic tank system and four tertiary sand filters to treat the school's wastewater. The recent discharge monitoring report (one sample per month required) is presented in Table 8, which shows that the effluent flows ranged from 0.0040 mgd only in April 2001 to 0.0045 in other months during the study period. For the May 2000–April 2001 period, effluent pH levels were 7.4–7.9, in the permitted range of 6–9. The BOD loading rates ranged form 0.04 to 0.30 lb/day, with a mean of 0.16 lb/day. The BOD concentrations were 1–8 mg/L, with a mean of 4.3 mg/L. The observed BOD loading rates and concentrations were less than the limits of 2.34 lb/day and 10 mg/L, respectively. The TSS loading rates were 0.08–0.30 lb/day, with a mean of 0.14 lb/day; and TSS concentrations were 2–8 mg/L, with a mean of 4 mg/L. The TSS values did not exceed 2.8 lb/day and 12 mg/L effluent standards. The NH_3-N

Table 7. Summary of Discharge Monitoring Report, Village of Rossville, 2000–2001

	Flow, mgd		*pH*	*Carbonaceous BOD*		*Total suspended solids*	
Date	*Avg.*	*Max.*		*lb/day*	*mg/L*	*lb/day*	*mg/L*
2000							
May	0.132	0.168	7.2	5.9	7.5	6.3	8
June	0.145	0.257	7.0	2.8	3	13.1	14
July	0.131	0.203	7.4	10.3	8	25.7	20
August	0.131	0.171	7.3	8	7	19	17
September	0.115	0.175	7.2	6.4	6.8	14.9	16
October	0.125	0.214	7.3	1.2	1.3	7.7	8
November	0.17	0.339	7.4	6.6	6.8	11.7	12
December	0.28	0.33	7.2	24	19.5	30	24
2001							
January	0.241	0.397	7.5	34	16	17	8
February	0.235	0.394	7.4	30	23.5	13	10
March	0.163	0.266	6.9	21.5	23	26.2	28
April	0.142	0.2	7.2	12.5	15	20	24
Yearly ave.	0.168	0.260		13.6	11.5	17.1	16
Yearly max.	0.28	0.397	7.5	34.0	23.5	30.0	28
Yearly min.	0.115	0.168	6.9	1.2	1.3	6.3	8
NPDES limit	Report	Report	6-9	94 Avg 150 Max	25 Avg 40 Max	139 Avg 169 Max	37 Avg 45 Max

Notes: BOD – biochemical oxygen demand, mgd – million gallons per day, Avg. – average, Max. – maximum. Water quality monitored monthly, flow weekly

Source: IEPA, Champaign Regional Office.

Table 8. Summary of Discharge Monitoring Report for Bismarck-Henning School, 2000–2001

Date	*Flow, mgd*	*pH*	*BOD*		Total suspended solids		*Ammonia nitrogen, mg/L*
			lb/day	*mg/L*	*lb/day*	*mg/L*	
2000							
May	0.0045	7.7	0.14	3.7	0.11	3	0.2
June	0						
July	0						
August	0						
September	0.0045	7.8	0.04	1	0.3	8	1
October	0.0045	7.4	0.3	8	0.23	6	0.2
November	0.0045	7.7	0.23	6	0.08	2	4
December	0.0045	7.9	0.08	2	0.08	2	0.3
2001							
January	0.0045	7.7	0.26	7	0.15	4	6.61
February	0.0045	7.8	0.15	4	0.12	3	1.5
March	0.0045	7.8	0.15	4	0.12	3	1
April	0.004	7.5	0.1	3	0.1	3	0.2
Yearly average.	0.0033	7.7	0.16	4.3	0.14	3.8	1.7
Yearly maximum	0.0045	7.9	0.3	8	0.3	8	6.61
Yearly minimum	0	7.4	0.04	1	0.08	2	0.2
NPDES limit	Report	6 Minimum	2.34	10	2.8	12	1.5* 4**

Notes: BOD - biochemical oxygen demand and mgd - million gallons per day.
* April–October.
** November–March.
Water quality and flow monitored monthly

Source: IEPA, Champaign Regional Office.

concentrations in the plant effluent were between 0.2 and 6.61 mg/L (January 2001). The sample taken in January 2001 exceeded the 4.00 mg/L limit.

There are about 70 houses located around the lake shoreline. Approximately 40 percent of the houses discharge to the Danville wastewater treatment plant. The others, approximately 40 or 50 (David Cronk, CIWC, personal communication, 2002) use septic tanks to treat their wastewater. The influence of septic tank effluents on the lake was not determined and is outside the scope of this study.

Land Use and Nonpoint Pollution Loadings

Watershed Land Use

Land use in a given area is contingent on many factors, including geology, topography, soil types and characteristics, geographic location, population, and ownership. In Illinois, the predominant land use is agriculture, with approximately 70 percent of the acreage in the state in cropland and pasture. Major crops include corn, soybeans, wheat, and hay.

A breakdown of land use as a percentage of total acreage in the Lake Vermilion watershed is listed in Table 9. It includes cropland, pastureland and hayland, woodland, water, roads and railroads, and urban development by acreage and percent of watershed. The primary land use in the watershed is row crop production (88.0 percent); an additional 3.0 percent is in pasture or hay production. Forest, wetland, and wildlife and recreational areas make up 5.1 percent. Roads and urban development occupy 2.0 percent.

There are 150 farms in the Lake Vermilion watershed, with an average farm size of 65 acres. Land ownership is mostly private; lakes, parks, and forest preserves are publicly owned. There are two minority farmers. The major type of farming is cash grain. Approximately 70 percent of the farming consists of corn and soybean rotations; the rest is canning products (Thomas Benjamin, Vermilion County Soil and Water Conservation District or SWCD, Danville, Illinois, personal communication, 2001).

The soils of the watershed are well suited to agricultural production and are generally intensively cropped. Major crops grown are corn and soybeans with some wheat and vegetable crops used for canning, primarily sweet corn, squash, pumpkins, lima beans, and kidney beans. Many fields require artificial drainage (tiles or surface and open ditches) to attain maximum productivity, while others require protection from erosion for sustained productivity.

Similar to other watersheds in Illinois, subsurface drainage systems are commonly used on cropland in the Lake Vermilion 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 167,833 acres of cropland in the watershed, approximately 16,800 acres (10 percent) have a whole-field subsurface drainage system. As is true with other watersheds in Illinois, field tiles have been identified as potential conduits from agricultural land to ditches and then to lakes for some nutrients and pesticides in water. Approximately 80

Table 9. Land Use and Unprotected Acreage, Lake Vermilion Watershed

Type	*Land use* *Acres*	 *Percent of watershed*	*Unprotected area* *Acres*	 *Percent of watershed*
Agricultural				
Cropland	167,833	88.0	36,650	19.2
Pasture and hayland	5,721	3.0	300	0.15
Farmstead/others	1,907	1.0		
Feedlots	75	0.04		
Forest/wildlife	9,728	5.1	300	0.15
Roads/urban development	3,813	2.0		
Water	1,643	0.86		
Total	190,720	100	37,250	19.5

Note: Blank spaces - not applicable.

Source: Thomas Benjamin, Vermilion County SWCD, personal communication, 2002.

percent of the watershed land is adequately protected from erosion, which includes 78.2 percent of the cropland area and 97.4 percent of the remaining land-use areas (Table 9).

Nonpoint Pollution Sources

The primary sources of nonpoint pollution for the watershed are agricultural chemicals and fertilizers from tile drainage and eroded soils. There are no livestock operations in the watershed. A large urban area drains directly to the lake.

Watershed Soil Loss. Table 9 also shows that 19.2 percent (36,650 acres) of land in the watershed is reported to be inadequately protected from erosion; most are in cropland. As shown in Table 10, an estimated 1,500 acres of highly erodible soil is used for crop production in the Lake Vermilion watershed. Most of these highly erodible soils are in hayland, pasture, and woodland. According to the District Conservationist (Thomas Benjamin, Vermilion County SWCD, personal communication, 2002), the highly erodible soils in cropland are eroding at an average of 14 tons per acre per year. There are approximately 30,000 acres of potentially highly erodible soils in the watershed where sheet and rill erosion generate approximately 6.0 tons per acre per year. Another 20,000 acres of cropland erodes at an average of 4.5 tons per acre per year. The remaining 50,850 acres of cropland erodes at an estimated 2.5 tons per acre per year. The total erosion rate in the watershed is 418,125 tons per year.

Table 10 also presents the estimated soil erosion rates from different cropland sources. Assuming a sediment delivery rate of 70 percent off-field movement and 30 percent watershed transport efficiency, the yield factor would be 0.21 for most agricultural land except highly erodible land. The sediment yield factor used for highly erodible land is 0.40. For example, for the 20,000-acre category of "Other sloping cropland," the sediment yield is 18,900 (20,000 x 4.5 x 0.70 x 0.30) tons of eroded soils into Lake Vermilion annually. The total sediment yield from cropland in the Lake Vermilion watershed is reported to be an estimated 91,800 tons per year. This estimate was greater than the lake sediment survey result of 76,300 tons per year (Bogner and Hessler, 1999).

Nutrient Loadings. Nutrient loadings from nonpoint pollution sources within the watershed consist of nitrogen and phosphorus, which result primarily from runoff related to agricultural activities (crop production). Other sources include pasture and hayland, woodland, residential and other development, and atmospheric deposition.

A report by the Macoupin County SWCD (1995) indicated little contribution of plant nutrients from atmospheric deposition. Analytical results from the National Atmospheric Deposition Program (NADP) at the ISWS indicate that atmospheric nitrogen deposition in the watershed may be significant. Nitrogen deposition, like all other sources of nitrogen in the watershed, is subject to plant uptake as well as complex interactions within the soil chemistry system and the atmosphere.

Estimated total nitrogen (the sum of nitrite, nitrate, and total Kjeldahl nitrogen) and total phosphorus loads emanating from nonpoint sources for the entire watershed are shown in Table 11. The annual export rates per unit area for nitrogen and phosphorus were estimated from

Table 10. Total Erosion Rate and Sediment Yield from Cropland, Lake Vermilion Watershed

Source, cropland	*Area, acres*	*Erosion rate, tons/acre/year*	*Total erosion rate, tons/year*	*Sediment yield, tons/year*
Highly erodible land	1,500	14.0	21,000	8,400
Potentially highly erodible land	30,000	6.0	180,000	37,800
Other sloping cropland	20,000	4.5	90,000	18,900
Other cropland	50,850	2.5	127,125	26,696
(Subtotal erodible cropland)	(102,350)			
Nonerodible cropland	65,483	0.0		
Total	167,833		418,125	91,796

Note: Blank space - not applicable.

Source: Thomas Benjamin, Vermilion County SWCD, personal communication, 2002.

Table 11. Estimated Nonpoint Nutrient Loading Rates

		Total nitrogen		*Total phosphorus*	
Land use	*Acres*	*Export rate, lb/a/yr*	*Loading rate, lb/y*	*Export rate, lb/a/yr*	*Loading rate, lb/y*
Cropland and feedlots	167,833	8.6	1,440,000	0.50	83,900
Pasture and hayland	5,721	3.2	18,000	0.25	1,430
Woodland	9,728	1.3	13,000	0.10	970
Resident and farmstead	1,982	1.2	2,400	0.10	200
Roads and developments	3,813	0	0	0	0
Water	1643	0	0	0	0
Total	190,720		1,480,000		86,000

Note: lb/a/yr - pounds per acre per year; blank space - not applicable. The Champaign County SWCD provided export rates for nitrogen and total phosphorus.

Sources: Thomas Benjamin, Vermilion County SWCD, personal communication, 2002 values provided by the Champaign County SWCD. With these estimated export rates, approximately 1,480,000 pounds (740 tons) of nitrogen and 86,000 pounds (43 tons) of phosphorus are reported to be added to Lake Vermilion annually from the watershed, of which 99 percent of both nitrogen and phosphorus were contributed by agricultural activities.

Past and Current Watershed Protection/Restoration Activities

North Fork River Drainage Project

In 1988, an agreement was reached between the Vermilion County SWCD, Vermilion County, and the Division of Water Resources of Illinois Department of Transportation (now the Office of Water Resources in the IDNR), to develop and implement the North Fork River Drainage Project.

The agreement involved the 39 miles of the North Fork River and its two tributaries, Jordan Creek and Miller Branch, which added an additional 26 miles of waterway. Total drainage in the North Fork Special Service Area (NFSSA) in Vermilion County is approximately 117,000 acres.

The primary objectives of the project are to:

Improve agricultural drainage.
Provide improved outlets of agricultural tile on urban stormwater outlets.
Reduce flooding.
Stabilize eroding streambanks.
Stabilize streamflows.
Reduce erosion and sedimentation.
Keep the waterway free of dumped refuse, dead animals, and toxic wastes.

The NFSSA Committee is the governing body of the North Fork Vermilion River Drainage Project. The Committee consists of a nine-member Board, appointed by the Vermilion County Board, with a three-year term. The field and administrative work for NFSSA is the responsibility of the Executive Director, Park Allison.

Revenue for the NFSSA is acquired through special taxation not to exceed $60,000 annually on land that drains into the North Fork River and its tributaries. The maximum rate is 0.108/$100 valuation in rural areas and 0.065/$100 valuation in urban areas. The current rate (December 2000) is $0.0698, $0.0498, and $0.0391 per $100 valuation for rural areas, urban areas, and Rossville, respectively. The NFSSA budget for 2001 was $55,000 (Park Allison, NFSSA, personal communication, 2001).

In fiscal year 1996–1997, in order to implement a nutrient and/or pest management program to decrease the risk of contamination to water resources, 30 farms were selected to implement an Integrated Crop Management (ICM) plan. The Vermilion County SWCD provided technical and financial assistance to users to implement conservation practices in the watershed. By 1998, the project completed 20 acres of buffer strips, 3,000 no-till acres, 35 acres of waterways, 8,000 ft of terraces, 8 grade stabilization structures, 8 water and sediment control basins, 25 acres of planted trees, 15 acres of wildlife habitat, and 25 acres of timber stand improvement.

The Lake Vermilion Water Quality Coalition

The Lake Vermilion Water Quality Coalition (Coalition) was organized to promote high-quality drinking water by reducing nitrate and sediment loading in the North Fork of the Vermilion River and in Lake Vermilion. The other goal is to improve working relationships with agricultural producers in the North Fork River watershed. The Coalition stresses the ideal that everyone lives on the watershed, and everyone is responsible for cleaner water. Ninety percent of farm owners and operators in the watershed are aware of financial and technical assistance available for improving water quality.

During the March 1, 1999–February 28, 2002 period, work conducted by the Coalition included reducing nitrate and sediment loadings, habitat restoration, and informational and educational activities. Nutrient management plans were developed and implemented on 45,000 acres by 2002.

In order to meet or exceed state and federal erosion control guidelines, the use and installation of Best Management Practices (BMPs) have been increased. Ninety-eight percent of the land in the watershed is eroding at less than the tolerable amount and met the standards of the "T by 2000" program in 2001.

For habitat restoration, funding from the NRCS and IDNR were used to improve the quality and therefore the function of habitat by restoring native grass areas and improving forest stands, thereby improving water quality.

The Coalition conducted educational programs for community members of all ages. These programs included such topics as economic, legal, and environmental impacts of BMPs, health hazards, and basic watershed concepts. An ongoing education program will be provided to citizens throughout the watershed, which will enhance adoption of practices improving water quality. Educational programs increase public awareness of soil, water, and natural resources within the watershed for preservation and protection.

North Fork Vermilion River Habitat Enhancement Project

The IDNR is initiating a pilot habitat enhancement program to serve as an example of ecosystem management. This program is built upon a foundation of voluntary participation and the availability of incentives for program participants. The target area for this project is located in the North Fork River watershed within the Vermilion River basin in Vermilion County, Illinois. The approximately 135,000-acre area is part of the Resource Rich Areas identified through the IDNR's Critical Trends Assessment Project (CTAP). Four focus areas within this watershed have been identified. These focus areas were chosen based on existing vegetation conditions, ownership patterns, and the potential to address natural resource concerns and meet specific natural resource goals.

The purpose of this pilot project is twofold:

1. To protect, increase, and enhance the amount of wildland habitat in four categories (grasslands, forests, wetlands, and vegetation along stream corridors).

2. To develop an ecological planning process for use at any level of landscape planning to target specific natural resource issues.

Through the analysis of current and historical resource conditions, existing management practices and land use, the IDNR has developed future vegetation goals and program objectives. Technical and financial resources of the agency will be used to achieve program goals and objectives. The goals of this project are to:

Reduce habitat fragmentation.

Improve and protect water quality by reducing sedimentation and nitrates.

Maintain/improve stability of stream systems.

Create core areas for forest- and grassland-dependent species.

The project objectives are to:

Establish permanent easements within focus areas.

Protect existing habitat.

Create a minimum of 500-acre blocks of contiguous forest.

Create a minimum of 80-acre blocks of contiguous grass.

Establish grass or tree cover within a 300-ft zone along both sides of streams.

For the future implementation, the IDNR working with the Vermilion County SWCD will provide funding and technical assistance to landowners/operators willing to participate in the project. Financial incentives will be provided to create permanent easements and to assist landowners with establishing conservation practices that will meet the goals and objectives of this project. Future monitoring and assessments will provide IDNR and other conservation organizations with valuable information on the development and implementation of programs that have positive influences on the State's flora and fauna.

BASELINE 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 main tributary for 13 consecutive months, May 2000 – April 2001. 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, lakeshore erosion evaluation, and flow determinations were carried out as required. The historical data were obtained from the IEPA (STORET), other agencies, and publications.

Morphometric Data

The pertinent morphometric details for Lake Vermilion listed below were obtained from a 1999 survey conducted by ISWS. Calculations were based on a spillway elevation of 582.2 ft National Geodetic Vertical Datum (NGVD).

Item	*English units*		*System International units*	
Surface area	878	acres	355	hectares
Watershed area	190,720	acres	77,184	hectares
Maximum depth	21.8	ft	6.6	meters
Average depth	9.1	ft	2.8	meters
Shoreline length	14.3	miles	26.5	kilometers
Normal pool elevation	582.2	ft	177.5	meters
Storage capacity	7,971	ac-ft	9,832,000	cubic meters
Retention time	0.042	years	or 15.3	days

Materials and Methods

Field Measurements

In order to assess the current conditions of the lake, physical, chemical, and biological characteristics were monitored May 8, 2000–April 19, 2001. Within this assessment period, the lake was monitored twice a month from April to October and monthly from November to March. No samples were collected in December 2000 and February 2001 due to ice cover. During these sampling trips, the lake water samples were collected at three sites noted as sites 1 (lower lake, deepest water depth), 2 (mid-lake), and 5 (upper lake, shallow water) in Figure 2. Sites 1 and 2 correspond to sites that were sampled previously. Site 5 was located to serve as the sampling site for the upstream end of the lake for this study. Previously, samples had been collected at site 3 and site 4 (Figure 2). Site 3 was located in the upper reaches of the lake at the pre-1992 pool level. Site 4 was located upstream of the fill from the dam constructed in 1914. A total of 15 sampling trips were made for Stations 1S (surface), 2S, 5S, and 1B (bottom).

In addition, tributary water samples were collected during or after storm events at the North Fork River at Bismarck (RBD-02) and from the spillway outflow below the dam

(RBD-01). Thirty-seven samples were taken at the Bismarck site (inflow) and 13 samples at the spillway site (outflow).

For the regular lake water-quality analyses, grab water samples were taken at 0.3 meter or m (1 ft) below the surface as a surface sample and 0.6 m (2 ft) above the lake bottom for Station 1 as near bottom samples. However, for metals and organic analyses, grab water samples were taken at the mid-depth of Station 1, which is considered to be more representative for the water column. Only surface samples were taken for Stations 2 and 5 during the study period. Lake sediment samples also were collected once at Stations 1, 2, and 5 during this study period (Figure 2). Historical data were collected at Station 3 instead of Station 5.

The CIWC employees and IEPA personnel collected water and sediment samples for the baseline and historic database. All water and sediment chemistry analyses were completed by IEPA laboratories.

For most sampling runs, in-situ observations for temperature, dissolved oxygen (DO), and Secchi disc readings were made at the sampling sites on the lake. A DO meter with a 50-ft 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 ft) or 0.6-m (2 ft) 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 ft below), near the bottom (2 ft above the lake bottom if the water depth was greater than 10 ft), 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 m 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 (unfiltered) 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 IEPA 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 ft) above the bottom of the lake, and raised at a constant rate to the surface. This sampling approximates the limits of light penetration in the water column. For chlorophyll analysis, a measured amount of sample was filtered through a Whatman GF/C filter (4.7 centimeter or cm glass microfiber filter) using a laboratory vacuum system. 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 IEPA.

Macrophytes

The IEPA field staff conducted a macrophyte survey on September 6, 2000. 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 IEPA guidelines (1987).

Data Analyses

Historical water-quality data have been obtained from the IEPA's Ambient Lake Monitoring Program (ALMP) and Volunteer Lake Monitoring Program (VLMP). The ALMP of Lake Vermilion began in 1977 (1 sample) and continued in 1979 (2 samples), 1983 (1 sample), and 1997 (5 samples). All data prior to the 2000–2001 study period shall be considered historical data.

Current water-quality monitoring commenced on May 8, 2000, and continued through April 19, 2001. During the one-year sampling period, water and sediment quality samples were collected to establish a baseline for current conditions in Lake Vermilion.

For both the historical and baseline datasets, the water samples were collected either by IEPA personnel or by the CIWC. All samples were collected using water sample collection protocols established by the IEPA. Sampling frequencies for the current study were either monthly or bi-weekly. Historical samples were collected at irregular intervals from April–October for six years (Appendix A).

The analytical results of historical samples and baseline water samples (current study) from five sampling stations in Lake Vermilion 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 nitrogen), and total and dissolved phosphorus. Sampling dates and site depths also are given. During the current study, five samples were collected from mid-depth at Station 1 for metal, organics, and other water-quality analyses. The results for several water-quality characteristics are listed in Appendix B but are not discussed in the text.

For the data in Appendices A and B, a "k" indicates that the actual value is not known, but it is known to be less than the value shown. The value shown is the reporting limit (i.e., practical quantitative limit). For the purpose of evaluating the parameters examined, to determine whether a water-quality standard has been violated, the detection limit values were substituted for calculations in the statistical analyses. It should be noted that the statistical results (means) should be higher than the results using the actual values.

The observed data for each station are divided into two groups: historical and baseline (current study) data. The mean values of historical and baseline water-quality data for each station are summarized in Table 12. Because of the different sampling frequency and different numbers of samples, the statistical analysis of the difference of means for the historical and baseline study was not performed by the Student *t* test. However, rank-sum tests were performed for the difference in distributions between the historical and baseline datasets. The Mann-Whitney rank-sum tests were performed by Professor Gary C. Lin, Bradley University, Peoria, Illinois. The rank-sum test is a nonparametric statistic that compares distributions without specifying the form of the distributions. The results of the statistical analyses for Stations 1S, 1B, and 2S are presented in Table 13 and are discussed in the following sections.

In-Lake Water Quality

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 for water quality 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 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.

Table 12. Mean Values of Water Quality Characteristics for Current Study and Historical Data

Characteristics	*Station 1 surface*		*Station 1 Bottom*		*Station 2 surface*		*Station 5 surface*	
	Historical	*Current*	*Historical*	*Current*	*Historical*	*Current*	*Historical*	*Current*
Turbidity, NTU	12.4	75.8	14.6	73.6	14.0	14.2	19.5	30.4
Secchi transparency, in	17.7	22			15.5	17	10	14
Conductivity, mho/cm	520	486	531	491	511	522	550	550
Alkalinity, mg/L as $CaCO_3$								
Total	176	177	191	181	170	179	200	234
Phenolphthalein	3	1	3	0	3	1	4	1
Total suspended solids, mg/L	17	15	23	22	35	17	57	24
Volatile suspended solids, mg/L	5	5	5	5	9	5	9	6
Ammonia nitrogen, mg/L	0.14	0.10	0.21	0.15	0.12	0.06	0.13	0.03
Total Kjeldahl nitrogen, mg/L	0.87	1.04	0.79	1.23	1.08	0.99	1.08	0.90
Nitrate/nitrite nitrogen, mg/L	5.28	5.38	5.53	5.16	5.12	5.21	3.92	7.27
Total phosphorus, mg/L	0.077	0.060	0.082	0.062	0.115	0.054	0.163	0.068
Dissolved phosphorus, mg/L	0.035	0.027	0.034	0.027	0.031	0.024	0.044	0.041
Chlorophyll, g/L	50.70	31.39			36.17	37.85	24.38	25.40
Total depth, ft	17.3	20	19	20	10.5	10.5	4.1	5.8

Notes: NTU - nephelometric turbidity unit.
mg/L milligrams per liter.
$CaCO_3$ - calcium carbonate.
Blank space - not applicable or no data.

Table 13. Analyses of Rank-Sum Tests at a 95 Percent Confidence Level for Distributions of the Current Study versus Historical Data

Parameter	*Station 1 surface*	*Station 1 bottom*	*Station 2 surface*
Turbidity, NTU	=	=	=
Secchi transparency, inches	=	=	=
Total alkalinity, mg/L as $CaCO_3$	=	=	=
Suspended solids, mg/L			
Total	=	=	=
Volatile	=	=	=
Nitrogen, mg/L			
Ammonia	=	=	
Total Kjeldahl			=
Nitrate/nitrite	=	=	=
Phosphorus, mg/L			
Total	=	=	=
Dissolved	=	=	=
Chlorophyll *a*			=

Notes: - indicates the current distribution is greater than historical distribution.
- indicates the current distribution is less than historical distribution.
= indicates no significant difference between the two distributions.
NTU - nephelometric turbidity unit.
Blank space - not applicable.

During thermal stratification, the upper layer (epilimnion) is isolated from the lower layer (hypolimnion) of water by a temperature gradient (thermocline). 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 for aquatic plants. In a eutrophic lake, the hypolimnion becomes anaerobic, or devoid of oxygen, because of the increased concentration of highly oxidizable material, isolation from atmospheric oxygen, and limited photosynthetic conditions due to limited light penetration. Conditions of low DO are favorable for chemical reduction and more nutrients and minerals such as manganese and sulfur 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 portions of the nutrients that were trapped during the stagnation period become oxidated and precipitate. Therefore, a continuous supply of plant nutrients from the drainage basin is not necessary for sustained aquatic plant production. After an initial stimulus, the recycling of nutrients within a lake might be sufficient to sustain highly productive conditions for several years.

Aquatic life needs DO for respiration. Thus, adequate DO concentrations are necessary to maintain healthy conditions in the lake. Sources of oxygen include inflows (such as tributaries), precipitation, exchange with the atmosphere, and photosynthetic activities by phytoplankton and other aquatic plants. The DO can be reduced or consumed by outflow (such as spillway overflow and withdrawal from the lake), respiration of fish and other aquatic organisms, decomposition of dead plants and animals, and by sediment oxygen demand.

The temperature and dissolved oxygen concentration data for Lake Vermilion at Station 1 are shown, respectively, in Tables 14 and 15. Temperature and DO conditions for the lower basin of the lake did not stabilize during the summer. Consequently, it was not possible to plot

Table 14. Water Temperature Results, Lake Vermilion, Site 1

Depth (ft)	*05/08/2000*	*05/25/2000*	*06/06/2000*	*06/13/2000*	*06/22/2000*	*07/11/2000*	*07/12/2000*	*07/26/2000*	*08/02/2000*	*08/08/2000*	*08/29/2000*	*09/13/2000*	*09/28/2000*	*10/03/2000*	*10/12/2000*	*10/24/2000*	*11/15/2000*	*01/29/2001*	*03/28/2001*	*04/19/2001*	*04/26/2001*
0	20.3	21.0	20.7				26.4		26.2					18.5							
1	20.2	21.0	20.7	24.5	24.2	27.2	26.4	25.8	26.1	25.4	25.2	24.4	19.0	18.5	13.6	18.0	9.0	1.8	6.4	13.3	15.9
3	19.8	21.0	20.7	24.1	24.1	27.3	26.4	25.3	25.8	25.3	25.0	24.3	18.6	18.5	13.3	18.0	9.0	2.6	6.3	12.9	15.8
5	19.5	21.0	20.7	23.8	23.9	27.3	26.4	25.1	25.7	25.2	24.9	24.1	18.5	18.3	13.3	17.6	8.9	2.4	6.0	12.7	15.4
7	19.3	20.8	20.7	23.6	23.9	27.1	26.3	25.0	25.7	25.2	24.9	24.1	18.4	18.4	13.2	17.2	8.8	2.4	5.8	12.5	15.3
9	19.0	20.8	20.6	23.2	23.9	27.1	26.3	25.0	25.7		24.9	24.0	18.3	18.3	13.1	15.9	8.8	2.3	5.8	12.5	15.3
11	18.6	20.8	20.5	22.6	23.9	27.0	26.3	24.9	25.6	25.2	24.9	24.0	18.1	18.3	13.1	15.6	8.7	2.3	5.8	12.0	15.2
13	17.7	19.3	20.5	22.4	23.9	26.3	26.3	24.7	25.6	25.2	24.9	24.0	18.0	18.3	13.1	15.2	8.7	2.3	5.7	11.7	15.2
15	16.6	18.4	20.4	21.4	23.8	25.9	26.2	24.6	25.6	25.1	24.9	24.0	17.7	18.2	13.1	15.0	8.7	2.4	5.7	11.7	15.2
16	15.4						26.2														
17		18.2	20.3		23.8	25.6		24.6	25.4	25.1	24.9	24.0	17.5	17.7	13.0	15.0	8.7	2.5	5.7	11.8	15.2
18				21.2	23.7	25.5		24.5		25.0	24.8	24.0	17.5		12.9	15.0	8.7	2.5	5.6	11.7	15.2
19		18.0																			

Note: All temperature values are in °C.

Table 15. Dissolved Oxygen Results, Lake Vermilion, Site 1

Depth (ft)	*05/08/2000*	*05/25/2000*	*06/06/2000*	*06/13/2000*	*06/22/2000*	*07/11/2000*	*07/12/2000*	*07/26/2000*	*08/02/2000*	*08/08/2000*	*08/29/2000*	*09/13/2000*	*09/28/2000*	*10/03/2000*	*10/12/2000*	*10/24/2000*	*11/15/2000*	*01/29/2001*	*03/28/2001*	*04/19/2001*	*04/26/2001*
0	8.6	10.6	6.1				7.2		**4.7**					8.6							
1	8.4	10.6	6.1	8.1	8.4	9.1	7.2	14.1	**4.6**	6.7	5.5	7.0	8.2	8.5	10.1	15.3	9.4	6.8	8.9	7.4	8.4
3	7.8	10.3	6.0	7.4	8.5	9.0	7.2	11.4	**4.4**	6.0	5.0	6.7	8.3	8.3	10.1	14.3	9.4	7.7	8.4	6.4	8.3
5	7.0	9.3	6.0	6.3	7.8	9.3	7.0	8.8	**4.3**	5.0	**4.6**	5.7	7.9	7.8	9.9	14.4	9.4	9.9	8.6	5.8	8.1
7	6.5	9.2	6.0	6.5	7.2	8.1	6.8	7.4	**4.2**	**4.8**	**4.2**	5.6	7.9	7.9	9.6	14.5	9.5	11.4	8.6	8.4	8.2
9	5.8	8.8	6.0	5.9	7.6	8.0	6.8	7.6	**4.1**		**4.1**	5.9	7.6	7.9	9.3	10.6	9.3	11.7	8.8	9.0	8.2
11	**4.7**	9.0	5.9	5.2	7.5	6.9	6.8	**3.9**	**4.0**	**4.9**	**3.6**	5.7	7.6	8.0	9.1	9.2	9.4	12.1	8.9	7.1	8.7
13	**2.4**	5.3	5.9	5.1	7.3	**4.4**	6.8	**3.2**	**3.8**	**4.8**	**3.6**	5.6	7.3	7.8	8.8	8.3	9.5	12.5	8.9	7.0	9.1
15	**0.7**	**3.2**	5.9	**3.5**	7.1	**3.8**	6.8	**1.9**	**3.1**	**4.8**	**3.5**	5.6	6.6	7.7	8.8	7.2	9.5	12.7	9.2	5.9	9.0
16	**0.1**						6.8														
17		**2.1**	5.9		7.1	**2.0**		**2.0**	**1.6**	**4.1**	**2.9**	5.6	6.6	5.2	8.8	5.3	9.5	12.5	9.9	7.0	8.9
18				**2.8**	6.2	**1.6**		**1.8**		**3.0**	**2.0**	5.7	6.5		9.1	**4.5**	9.5	11.6	10.3	5.9	9.4
19		**0.8**																			

Notes: All dissolved oxygen values are mg/L.
Values in bold are below 5 mg/L.

iso-lines for any of the lake stations. Lake Vermilion had a maximum water depth of about 21 ft at Station 1 (mostly 19–20 ft) during the study year. Most water depths during the one-year study at Station 2 were in the 10–11 ft range; and 5–6 ft at Station 5 (Appendices B1 and B2).

For each sampling date, water temperatures were nearly uniform from surface to bottom at all three sampling stations (Table 14, Appendix C). The maximum temperature difference at Station 1 from surface to bottom was 3.0 C on May 29, 2001 (18.0–21.0 C) and on October 24, 2000 (15.0–18.0 C). There was no significant thermal stratification observed at Station 1. Midwestern lakes with water depths greater than 10 ft typically exhibit thermal stratification during summer months. The lack of thermal stratification in Lake Vermilion might be due to short retention time in the lake (15 days), combined with regular rainfall during the monitoring period. Another factor may be the constant flow of water through the spillway at the 6- to 10-ft depth, which may disrupt the formation of a thermocline except during prolonged low-flow periods. There is no destratifier installed in the lake.

Examination of the dissolved oxygen profiles at Station 1 (Table 15), shows that the DO levels began to decrease in the bottom waters in late May 2000. Moderate DO stratification was observed on May 25, July 11, July 26, August 28, August 29, and October 24, 2000 (Appendix C). However, on October 24, 2000, DO concentrations were very high (14 mg/L) in the top 10 ft and less than 5.0 mg/L only near the bottom below 18 ft. By comparison with precipitation records from Table 2, the formation of moderate DO stratifications generally occurred after several days of dry weather (without rainfall).

Generally water temperature and DO levels at Stations 2 and 5 were uniform in the water column (Appendix C). Maximum temperature gradient observed at Station 2 was 2.8 C on October 24, 2000. Moderate DO stratification at Station 2 occurred on July 27 and October 24, 2000, but with low DO of 5.4 mg/L (Appendix C). These incidences of stratification were due to supersaturation (DO concentration exceeds calculated saturation values) in the top 3–5 ft. Oxygen depletion occurred at depths below 10–12 ft from the surface. However, most DO levels in the water column at Station 2 were above 5.0 mg/L (Appendix C).

Station 5, which is relatively shallow (5–6 ft), exhibited minimal temperature gradient and very good oxygen conditions, except on September 13, 2000. The DO at the surface ranged from 4.8 mg/L on September 13, 2000 to 16.8 mg/L on October 24, 2000 (Appendix C).

Percent DO saturation values were determined from the observed DO and temperature records. 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 DO, mg/L

T = water temperature, C

The computed DO percent saturation values in Lake Vermilion at Stations 1, 2, and 5 also are included in Appendix C. The highest saturation values observed during the current study at Stations 1, 2, and 5 were 175, 181, and 182 percent, respectively. These highest values occurred on July 26, 2000 and October 24, 2000. Supersaturation of DO at Stations 2 and 5 also occurred on July 11, July 12, August 8, September 28, October 3, October 12, 2000, and January 29, 2001. In May 2000, DO saturation was less than 10 percent for the readings nearest the lake bottom. All other readings were near 20 percent or higher.

Turbidity. Turbidity is an expression of the property of water that causes light to be scattered and absorbed. As measured 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 by other microorganisms. Generally, turbidity in lake waters is influenced by sediment in runoff from a lake's watershed or shoreline erosion, algae in the water column, resuspension of lake bottom sediments by wind wave action, bottom-feeding fish, power boats, etc. Elevated turbidity values make the appearance of a lake less pleasing aesthetically.

For the historical records (1977–1997, warm weather samples) used in this study, the ranges of turbidity at Stations 1S, 2S, 3S, and 1B were, respectively, 5.2–20.0, 3.6–32.0, 8.0–37.0, and 7.4–24.0 NTU. The maximum turbidity for all stations was observed on different dates. The means and standard deviations of turbidity at these stations were, respectively, 12.4 6.0, 14.0 9.2, 19.5 9.7, and 14.6 6.2 NTU (Appendices A1-A4). It should be noted that the mean turbidity at each station is not the same as the annual average value.

Turbidity was determined for one or two current water samples. The average turbidity for Stations 1S, 2S, 5S, and 1B was 11.5, 14.2, 30.4, and 40.5 NTU, respectively (Appendices B1-B4). A high turbidity (76.8 NTU) was found at Station 1B on October 3, 2000. This might be due to sampling or laboratory error.

Secchi Disc Transparency. Secchi disc visibility is another measure of the lake's water transparency, which estimates 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 generally are 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 estimated as two to three times the Secchi disc depth (USEPA, 1980).

Suspended algae, microscopic aquatic animals, suspended matter (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.

Mean values of Secchi disc transparency at Stations 1, 2, and 5 were 20.6, 17.1, and 17.6 inches, respectively (Appendices B1-B3). The ranges were, respectively, 8–42, 8–42, and 8–60 inches. The lowest transparency was observed on June 6, 2000, at Stations 1 and 2 (Appendices B1–B3). Station 1 had the higher average Secchi disc transparency. The lowest Secchi disc transparency generally occurred at Station 5 due to shallower water depths. However, the winter period transparency at Station 5 was the highest for any station during the monitoring year.

The overall historical mean transparency for Stations 1, 2, and 3 was, respectively, 17.7, 15.5, and 10 inches (Appendices A1-A3). The ranges for these three stations were 10–24, 6–26, and 6–16 inches, respectively (Appendices A1-A3). The summer season distribution of transparency for historical data at Stations 1S and 2S was found to be similar to that for the current study (Table 13).

The IEPA's Lake Assessment Criteria (IEPA, 1978) state that Secchi depth values less than 18 inches indicate substantial lake-use impairment, and that 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, Stations 2 and 3 were classified as having substantial use impairment; Station 1 was considered as having moderate use impairment.

Chemical Characteristics

pH. The pH value, or hydrogen ion concentration, is a measurement of the acidity or alkaline characteristics in water. It is measured on a 0–14 scale. A pH of 7.0 is exactly neutral and ideal for water conditions. Values below 7.0 indicate acidic water, and values above 7.0 indicate basic (or alkaline) water. 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.

The pH directly affects the amount of unionized ammonia in water. An increase in pH values above 7.0 combined with high water temperatures will result in higher levels of unionized ammonia, which can stress or kill fish (pH>10). Shifts in pH levels can be attributed to a number of external processes, such as agricultural practices and atmospheric sources, as well as internal processes.

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 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, 2002) 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 for Stations 1S, 2S, 5S, and 1B were 7.5–8.2, 7.8–8.3, 7.8–8.3, and 7.5–8.0 (Appendices B1-B4).

The pH values of historical data (Appendices A1-A4) ranged from 7.5–8.5, 7.4–8.6, 7.3–8.6, respectively, for the three surface water sites (1S, 2S, and 3S) and from 6.5–8.7 in the bottom waters of Station 1. High pH values of the surface waters occurred at all stations on October 22, 1997. The pH values for historical and current studies at all stations fell within the range of Illinois standards, 6.5–9.0.

Alkalinity. The alkalinity of water is its capacity to accept protons. It is generally imparted from the bicarbonate, carbonate, and hydroxide components in the water. The source 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 the 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., 1998).

Total Alkalinity. During this study, the range of total alkalinity for the lake waters at Stations 1S, 2S, 5S, and 1B were 140–200, 170–185, 220–250, and 140–200, respectively; their means were, respectively, 177, 179, 234, and 181 mg/L as $CaCO_3$ (Appendices B1-B4). Total alkalinity at Stations 1S, 2S, and 1B is similar.

Historical data on total alkalinity at Stations 1S, 2S, 3S, and 1B ranged from 154–210, 110–210, 125–280, and 164–230 mg/L as $CaCO_3$, and the means for these stations were 176, 170, 200, and 191 mg/L as $CaCO_3$, respectively (Appendices A1-A4, Table 12). Total alkalinity (historical data) at Stations 1S and 2S had similar values.

As shown in Table 13, the distribution of lake water total alkalinity in the current study was not significantly different than in the past.

Phenolphthalein Alkalinity. Phenolphthalein alkalinity conditions (pH over 8.3) were found in the lake waters only during warm weather periods. Current phenolphthalein alkalinity concentrations never exceeded 5 mg/L as $CaCO_3$ (Appendix B). Historical data show peak phenolphthalein alkalinity at Stations 1S, 2S, 3S, and 1B were, respectively, 10, 16, 10, and 10 mg/L as $CaCO_3$ (Appendices A1 and A4).

Conductivity. Specific conductance provides a measure of the water's capacity to convey electric current and represents a measure of the dissolved mineral quality (salinity) of water. This property is related to the total concentration of ionized substances in water and the temperature at which the measurement is made. An electrical conductivity meter is used to determine salt content in water and the value is recorded in micromhos per centimeter (mho/cm). 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 determining factor in 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.

High soil salinity interferes with plant water uptake resulting in reduced plant growth and germination. Excessive amounts (>1,000 mho/cm) of salts running off into nearby water can become toxic to freshwater plants and fish. Animal wastes and some agricultural products may have a high salt content and can be a problem when overapplied to the land.

Conductivity in Lake Vermilion during the current study ranged from 451 mho/cm at Station 2S on October 3, 2000, to 655 mho/cm at Station 3S on June 6, 2000 (Appendices B1-B4). Mean conductivity values for lake waters at stations 1S, 2S, 5S, and 1B were, respectively, 486, 522, 550, and 491 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, 2002), which is approximately equivalent to a conductivity of 1,700 mho/cm. The observed conductivity values did not exceed this criterion.

Examination of the historical conductivity data (Appendices A1-A4) for Lake Vermilion shows that conductivity varies by more than 125 units within an annual period. For example, in 1997, conductivity ranged from 437 to 565 µmho/cm. Mean conductivity values for the historical data at Stations 1S, 2S, 3S, and 1B were 520, 511, 550, and 531 mho/cm, respectively.

Conductivity data for the 2000 summer season also show a wide range of values, from 456 to 544 µmho/cm. The rank-sum comparison of the current and historical data for conductivity for Stations 1S, 1B, and 2S indicates no significant change over time (Table 13).

Total Suspended Solids. Total suspended solids (TSS) are the portions of total solids retained by a filter $\leq$ 2.0 µm nominal pore size. Total solids is the term applied to the material residue left in the vessel after sample evaporation and subsequent drying of the residue 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). Nonvolatile suspended solids (NVSS) are the inorganic portion of TSS. Volatile suspended solids (VSS) are the organic portion of TSS. The material remaining after heating TSS at 500°C is NVSS, and the material lost during heating is VSS.

Total suspended solids represent the amount of all inorganic and organic materials suspended in the water column. Typical NVSS originate from the weathering and erosion of rocks and soils in a lake's watershed and from resuspension of lake sediments. Although VSS are derived from a variety of biological origins, in a lacustrine environment, they are composed mainly 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. High TSS can reduce photosynthetic activities below a given depth in the lake and subsequently decrease the amount of oxygen produced by algae and increase the potential to develop anoxic conditions. Anaerobic water may limit fish habitat 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 TSS concentration also may cause aesthetic problems in the lake.

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

Referring to Appendices A1-A4 for the historical data, mean TSS values at Stations 1S, 2S, 3S, and 1B were, respectively, 17, 35, 57, and 23 mg/L. In comparison, historical TSS values for Station 3S were higher than historical values for the other three stations. The TSS concentrations decrease as the water flows through the lake. The range of the historical TSS values for all stations was between 8 mg/L (Station 1S on June 28, 1979) and 97 mg/L (Station 3S on July 2, 1977).

As shown in Appendices B1-B4, during this study, the highest TSS concentration (64 mg/L) occurred on June 22, 2000 at Station 5S, because a storm producing 1.3 inches of rainfall occurred on June 21, 2000 (Table 2). Mean TSS values at Stations 1S, 2S, 5S, and 1B were 15, 17, 24, and 22 mg/L, respectively (Table 12). Their ranges were, respectively, 2–35, 2–44, 4–64, and 2–46 mg/L. As expected, higher TSS values were found in the surface waters at Station 5. The TSS distribution for the current study for Stations 1S, 1B, and 2S was not different than that for the historical data (Table 13).

According to the Illinois Lake Assessment Criteria (IEPA, 1978), water with TSS > 25 mg/L has a high lake-use impairment; TSS between 15 and 25 mg/L has moderate-use impairment; and TSS < 15 mg/L has minimal impairment. In this study, the number of samples that exceeded TSS levels of 25 mg/L was 14, 7, 42, and 33 percent of samples at Stations 1S, 2S, 5S, and 1B, respectively. At the same stations, the percent of samples having TSS values between 15 and 25 mg/L were 33, 60, 33, and 47 percent, respectively. On the basis of TSS values, waters at Station 1S can be classified as minimal impairment (more than 50 percent of the samples were below 15 mg/L); at Stations 2S, 5S, and 1B can be classified as at least moderately impaired (more than 50 percent of the samples had 15 mg/L or higher).

Volatile Suspended Solids. Volatile suspended solids (VSS) are the portions of TSS lost to ignition at 500 $\pm$ 50°C. They 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 mg/L (Station 5S on March 28, 2001) to 12 mg/L (Station 2S on May 8, 2000) during the current study. Mean concentrations of VSS were 5, 5, 6, and 5 mg/L at Station 1S, 2S, 5S, and 1B, respectively (Appendices B1-B4).

Appendices A1-A4 show that the historical mean VSS at Stations 1S, 2S, 3S, and 1B were5, 9, 9, and 5 mg/L, respectively. There were no statistical differences in VSS values of the historical and current data for any station (Table 13).

Nitrogen. Nitrogen generally is 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 excess nitrogen can cause algal blooms in surface waters and create public health problems. In some situations, nitrogen can be the limiting nutrient in natural systems. The IPCB has stipulated (IEPA, 2002) that nitrate not exceed 10 mg/L nitrate as nitrogen or 1 mg/L nitrite as nitrogen for public water-supply and food-processing waters.

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.

Nitrates are the primary end product of the aerobic decomposition of organic nitrogen, and as such they occur in polluted waters that have undergone self-purification or receive discharge from aerobic treatment processes. Nitrates also occur in percolating groundwaters. 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.

Concerns about nitrogen as a contaminant in water bodies are threefold. First, concentrations of nitrate plus nitrite as nitrogen are limited to 10 mg/L in public water supplies because of adverse physiological effects on infants and because traditional water treatment processes have no effect on the removal of nitrate. Second, a concentration in excess of 0.3 mg/L as nitrogen is considered sufficient to stimulate nuisance algal blooms (Sawyer, 1952). The third concern is the toxicity of unionized ammonia. The IEPA (2002) stipulates that ammonia as nitrogen and nitrate plus nitrite as nitrogen should not exceed 1.5 and 10.0 mg/L, respectively.

Vollenweider (1968) reports that laboratory tests show that as a general rule, planktonic algae use ammonia and nitrate, the two inorganic nitrogen forms 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. Several investigators have studied the use of nitrogenous organic compounds by algae (Hutchinson, 1957). However, Vollenweider (1968) cautions that the direct use of organic nitrogen by plankton has not been established definitely, citing that none of the 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) states that, because 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 A and B, the minimum ammonia-nitrogen (NH_3-N) concentration was less than 0.01 mg/L for all stations, especially during the current study. A "k" indicates that the actual value is not known, but is known to be less than the value shown. The value shown is the reporting limit (i.e., practical quantitative limit). The detectable level (0.01 for 0.01k) is used for statistical analysis purposes. This also is the case for nitrate plus nitrite-nitrogen.

Examination of observed data during this study in Appendices B1-B4 suggests that many (31-77 %) samples have NH_3-N levels less than the detectable limit of 0.01 mg/L. The maximum NH_3-N levels observed, during this study, for Stations 1S, 2S, 5S, and 1B were 0.55, 0.24, 0.14, and 0.64 mg/L, respectively. The mean ammonia concentrations at the same stations were low, 0.10, 0.06, 0.03, and 0.15 mg/L, respectively (Appendix B).

The Illinois General Use Water Quality Standards (IEPA, 2002) of NH_3-N vary according to water temperature and pH values, with the allowable concentration of NH_3-N decreasing as temperature and pH rise. High water temperatures and pH increase the toxicity of NH_3-N for fish and other aquatic organisms. The allowable concentration of NH_3-N for lake waters varied from 0.68 to 4.1 mg/L, depending on the available observations of temperature and pH values. The observed data in Lake Vermilion showed that the NH_3-N values are well within the lower limit of the standards.

For historical data, the mean NH_3-N concentrations for Stations 1S, 2S, 3S, and 1B were 0.14, 0.12, 0.13, and 0.21 mg/L, respectively (Appendices A1-A4). In comparison, the distribution of NH_3-N values for Stations 1S and 1B in the current study was no different than that of the historical data. In contrast, NH_3-N values for Station 2S in the current study were significantly less than the historical values (Table 13).

Total Kjeldahl Nitrogen. During this study, the ranges of TKN values at Station 1S, 2S, 5S, and 1B were 0.40–1.68, 0.06–1.51, 0.55–1.39, and 0.75–3.00 mg/L, respectively (Appendices B1-B4). Results in Appendices B1-B4 also show that mean TKN levels and standard deviations at these stations were 1.04   0.33, 0.99   0.36, 0.90   0.26, and 1.23   0.57 mg/L, respectively. All laboratory analyses for TKN in May 2000 or later were not subjected to established quality control criteria and should not be used to make management decisions.

For historical data, TKN ranged from 0.69–1.00, 0.67–2.50, 0.64–2.10, and 0.64–0.97 mg/L at Stations 1S, 2S, 3S, and 1B, respectively (Appendices A1-A4). Mean TKN concentrations and standard deviations for Stations 1S, 2S, 3S, and 1B were 0.87   0.11, 1.08   0.67, 1.08   0.51, and 0.79   0.11 mg/L , respectively (Table 12, Appendices A1-A4). The TKN value distribution at Stations 1S and 1B in this study were higher than the historical data, and there was no difference at Station 2S (Table 13).

The data for NH_3-N and TKN indicate that TKN in the water column was predominantly of organic origin (TKN minus NH_3-N). Organic nitrogen constituted approximately 88–97 percent of the TKN determined for the three surface water samples.

Nitrate/Nitrite-Nitrogen. Wide ranges of NO_3/NO_2-N concentrations were observed at each sampling station both during historical and current studies. During this study, the ranges of NO_3/NO_2 values for Stations 1S, 2S, 5S, and 1B were respectively 0.25–12.00, 0.17–14.00, 0.04–14.00, and 0.13–22.00 mg/L (Appendix B). The highest NO_3/NO_2-N concentration (14 mg/L) was found at Stations 2S and 5S on June 6, 2000. Mean NO_3/NO_2-N and standard deviations values for the four stations were 5.38   4.38, 5.21   4.61, 7.27   4.72, and 5.16   4.17 mg/L, respectively (Appendix B).

As can be seen in Appendices A1-A4, the historical ranges of NO_3/NO_2-N concentrations for Stations 1S, 2S, 3S, and 1B were from 0.12–12.30, 0.01–11.2, 0.01k–11.3, and 0.12–12.00 mg/L, respectively. The mean NO_3/NO_2-N concentrations were 5.28   3.91, 5.12   3.63, 3.92   3.66, and 5.53   4.09 mg/L, respectively. The NO_3/NO_2-N values distribution at Stations 1S, 1B, and 2S in this study was no different than that in the historical data (Table 13).

Comparison of the data for nitrate/nitrite-nitrogen (NO_3/NO_2-N) and TKN levels shows that total nitrogen in the water column was predominantly of inorganic origin (NO_3/NO_2-N was higher). These high nitrate levels in the North Fork Vermilion River and in Lake Vermilion are of particular concern to the North Fork Special Service Area.

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-µm filter).

Phosphorus as phosphate may occur in surface water or groundwater 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.

Phosphorus is one of the essential nutrients to the plant growth process. In many natural systems, phosphorus is probably the most limiting nutrient and the one most easily controlled by removal techniques. Because of this, it has received much attention in the study of eutrophication issues. Various facets of phosphorus chemistry and biology have been extensively studied in the natural environment.

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 amount of phosphorus being transported 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. There is disagreement in the literature on the availability of particulate phosphorus for biological up take (Ekholm and Krogerus, 2003). 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, 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. The TP in lake water is the more commonly used indicator of a lake's nutrient status and provides a conservative estimate of available P when P is determined to be limiting.

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 IPCB (IEPA, 2002, Title 35, page 10) stipulates the phosphorus rule. It states that "Phosphorus as P shall not exceed a concentration of 0.05 mg/L in any lake 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 lake or lake."

Total Phosphorus. During this study period, ranges of TP values observed were 0.024–0.134, 0.029–0.098, 0.029–0.163, and 0.038–0.135 mg/L for Stations 1S, 2S, 5S, and 1B, respectively (Appendices B1-B4). The maximum TP values for Stations 1S, 5S, and 1B were found on June 6, 2000; Station 2 on April 19, 2001 (also high on June 6, 2000). At these four stations, the mean TP concentrations and standard deviations were 0.060 0.035, 0.054 0.023, 0.68 0.037, and 0.062 0.030 mg/L, respectively (Appendices B1-B4).

In this study, 43 percent (6/14), 40 percent (6/15), 62 percent (8/13), and 60 percent (9/15) of samples collected from Stations 1S, 2S, 5S, and 1B, respectively, exceeded the 0.05 mg/L TP standard.

Appendices A1-A4 show that the range of historical TP concentrations in Lake Vermilion was between 0.033 (Station 1B on April 21, 1997) and 0.304 mg/L (Station 3S on June 9, 1997). The means and standard deviations of TP for stations and standard deviations for Stations 1S, 2S, 3S, and 1B were 0.077   0.030, 0.115   0.087, 0.163   0.097, and 0.082   0.032 mg/L, respectively. Historical TP values at Stations 1S, 2S, and 1B were lower than that at Station 3S. The current TP value distribution at Station 1S, 1B, and 2S was not significantly different than that for the historical data (Table 13).

Dissolved Phosphorus. During the study period, only four to six samples were analyzed for DP. Concentrations of DP for Stations 1S, 2S, 5S, and 1S ranged from 0.005–0.088, 0.008–0.071, 0.001–0.067, and 0.005–0.088 mg/L with means of 0.027, 0.054, 0.041, and 0.027 mg/L, respectively (Appendices B1-B4).

For the historical data in Appendices A1-A4, maximum DP concentrations in lake water samples at Stations 1S, 2S, 3S, and 1B were 0.101, 0.110, 0.155, and 0.065mg/L, respectively. The minimum DP for all four stations was less than the 0.001 mg/L minimum reporting level. The mean DP concentrations for these stations were 0.035, 0.031, 0.44, and 0.021 mg/L, respectively.

Table 13 suggests that there is no significant difference in DP distributions between the historical and current data.

Limiting Nutrient. The ratio of total nitrogen to total phosphorus in the epilimnion often can be used to determine the limiting algal nutrient. The nitrogen to phosphorus atomic weight ratio in algal cell tissue is typically 16:1, which indicates that both nutrients are equal in limiting algal growth. It is assumed that when the TN to TP ratio is between 10:1 and 20:1, both nutrients are in sufficient supply to sustain algal growth. If the ratio is 20:1 or greater, it is a strong indication that phosphorus is the limiting nutrient. A ratio of 10:1 or less is fairly indicative that nitrogen is limiting (USEPA, 1980).

When using a mass ratio (mg/L) in algal cell tissue, the TN:TP ratio is typically 7.2:1. When the mass ratio is greater than 7.2:1, phosphorus is the limiting nutrient. When the ratio is less than 7.2:1, nitrogen is the limiting factor. However, Horne (1994) used the TN:TP ratio of 10:1 to determine the limiting nutrient. For this report, the mass ratio of TN (mg/L): TP (mg/L) was calculated for each sample.

During this study period, the TN/TP (mass) ratios for Stations 1S, 2S, 5S, and 1B ranged from 21.9–356.3, 12.2–365.5, 33.6–370.3, and 16.4–378.9, respectively. The maximum TN:TP ratio for these stations was observed on July 12, 2000, March 28, 2001, July 12, 2000, and on July 12, 2000, respectively. All samples collected during this study have TN:TP ratios greater than 7.2:1. The mean TN:TP ratios for Stations 1S, 2S, 3S, and 1B were 119:1, 122:1, 140:1, and 118:1, respectively. These ratios indicate that phosphorus was typically the limiting nutrient during the current monitoring year. Therefore, it is concluded that Lake Vermilion is a phosphorus-limited lake. On the basis of historical data, the same conclusion (phosphorus-limited) was found.

Chlorophyll. All green plants contain chlorophyll *a*, which constitutes approximately 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 chlorophyllids, pheophorbids, and pheophytins. 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 extent of algal diversity and productivity. Chlorophyll *b* is most common in the green species and serves as an auxiliary pigment for photosynthesis. Chlorophyll *c* is common in diatom species and also serves as an auxiliary pigment for photosynthesis. Blue-green algae (Cyanophyta) contain only chlorophyll *a*, and lack chlorophyll *b* and *c*. High concentrations of only chlorophyll *a* in a particular sample may indicate that blue-green algae are dominant.

Both the green algae (Chlorophyta) and the euglenoids (Euglenophyta) contain chlorophyll *a* and *b*. High concentrations of both chlorophyll *a* and *b* suggest green algal species are dominant. Chlorophyll *a* and *c* are present in the diatoms, yellow-green and yellow-brown algae (Chrysophyta), as well as dinoflagellates (Pyrrhophyta). High levels of both chlorophyll *a* and c may indicate that diatoms are dominant. 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. Pheophytin has an absorption peak in the same spectral region as chlorophyll *a*. Corrected chlorophyll *a* values refer to a modified laboratory method necessary to make a correction when the pheophytin concentration becomes significantly high.

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.

Because chlorophyll *a* pigment is present in green algae, blue-green algae, and also in diatoms, chlorophyll *a* is often used to indicate the degree of eutrophication in a lake. In Illinois, concentrations of chlorophyll *a* exceeding 20 g/L indicate that a lake may be exhibiting eutrophic conditions (IEPA, 2000).

The observed, mean, and range of values for chlorophyll *a* and other pigments are given in Tables 16-17 for historical data and the current study (Stations 1, 2, and 3 or 5), respectively. The mean concentrations of chlorophyll *a* (corrected) in the lake (Stations 1-3) during the current

Table 16a. Historical Chlorophyll Concentrations, Lake Vermilion, Station 1

Sample date	*Chlorophyll a corrected (µg/L)*	*Chlorophyll a uncorrected (µg/L)*	*Chlorophyll b (µg/L)*	*Chlorophyll c (µg/L)*	*Pheophytin a (µg/L)*
06/28/79	170.00	154.00	24.00	12.00	20.00
09/05/79	28.00	27.00	4.00	3.00	1.00
05/18/83	1.95	2.11	0.24	1.17	0.00
06/09/97	2.83	4.45	0.40	0.00	0.00
Count	4	4	4	4	4
Maximum	170.00	154.00	24.00	12.00	20.00
Minimum	1.95	2.11	0.24	0.00	0.00
Average	50.70	46.89	7.16	4.04	5.25
S.D.	80.45	72.28	11.36	5.45	9.84

Notes: S.D. - Standard Deviation, *µg/L* - micrograms per liter.

Table 16b. Historical Chlorophyll Concentrations, Lake Vermilion, Station 2

Sample date	*Chlorophyll a corrected (µg/L)*	*Chlorophyll a uncorrected (µg/L)*	*Chlorophyll b (µg/L)*	*Chlorophyll c (µg/L)*	*Pheophytin a (µg/L)*
07/14/97	20.84	21.35	4.73	0.00	0.13
08/12/97	51.49	55.89	9.53	1.24	5.24
Count	2	2	2	2	2
Maximum	51.49	55.89	9.53	1.24	5.24
Minimum	20.84	21.35	4.73	0.00	0.13
Average	36.17	38.62	7.13	0.62	2.69
S.D.	21.67	24.42	3.39	0.88	3.61

Notes: S.D. - Standard Deviation, *µg/L* - micrograms per liter.

Table 16c. Historical Chlorophyll Concentrations, Lake Vermilion, Station 3

Sample date	*Chlorophyll a corrected (µg/L)*	*Chlorophyll a uncorrected (µg/L)*	*Chlorophyll b (µg/L)*	*Chlorophyll c (µg/L)*	*Pheophytin a (µg/L)*
04/21/97	16.53	14.64	0.65	0.00	0.00
10/22/97	32.24	38.00	3.86	1.52	7.96
Count	2	2	2	2	2
Maximum	32.24	38.00	3.86	1.52	7.96
Minimum	16.53	14.64	0.65	0.00	0.00
Average	24.38	26.32	2.26	0.76	3.98
S.D.	11.11	16.52	2.27	1.07	5.63

Notes: S.D. - Standard Deviation, *µg/L* - micrograms per liter.

Table 17a. Current Chlorophyll Concentrations, Lake Vermilion, Station 1

Sample date	*Chlorophyll a corrected (µg/L)*	*Chlorophyll a uncorrected (µg/L)*	*Chlorophyll b (µg/L)*	*Chlorophyll c (µg/L)*	*Pheophytin a (µg/L)*
05/08/00	38.7	43.4	6.14	5.00	6.14
06/06/00	10.7	15.6	3.95	2.91	8.01
07/12/00	20.0	37.8	27.7	45.4	32.3
07/26/00	58.7	77.6	35.8	56.7	32.8
08/02/00	32.0	40.4	4.75	5.61	12.6
09/13/00	51.8	50.9	6.54	8.18	0.00
09/28/00	77.2	74.5	8.53	11.2	0.00
10/03/00	42.4	50.4	11.2	21.8	12.2
10/24/00	32.0	32.5	0.47	9.32	0.00
11/15/00	6.79	10.1	4.12	17.1	5.84
01/29/01	24.0	30.3	15.3	24.0	11.1
03/28/01	11.8	12.0	0.00	2.35	0.00
04/19/01	7.92	6.49	1.43	0.55	0.00
04/26/01	25.4	28.0	4.51	7.93	3.14
Count	14	14	14	14	14
Maximum	77.2	77.6	35.8	56.7	32.8
Minimum	6.79	6.49	0	0.55	0
Average	31.39	36.43	9.32	15.58	8.87
S.D.	20.80	22.12	10.47	16.73	11.08

Notes: S.D. - Standard Deviation, *µg/L* - micrograms per liter.

Table 17b. Current Chlorophyll Concentrations, Lake Vermilion, Station 2

Sample date	*Chlorophyll a corrected (μg/L)*	*Chlorophyll a uncorrected (μg/L)*	*Chlorophyll b (μg/L)*	*Chlorophyll c (μg/L)*	*Pheophytin a (μg/L)*
05/08/00	40.0	48.1	11.3	8.56	12.3
06/06/00	21.4	18.0	2.87	2.58	0.00
07/12/00	45.4	62.9	35.8	94.2	32.2
07/26/00	61.4	84.0	53.4	72.5	41.4
08/02/00	42.3	50.2	5.54	8.14	11.3
09/13/00	87.9	108.0	68.2	128.0	38.9
09/28/00	19.3	39.7	25.4	43.3	36.2
10/03/00	69.5	73.5	28.0	33.1	6.45
10/24/00	41.2	49.7	3.79	14.9	12.1
11/15/00	20.0	28.1	12.2	20.5	0.00
01/29/01	19.4	19.8	1.10	2.75	0.00
03/28/01	11.9	12.8	3.95	9.86	1.32
04/19/01	24.4	23.2	2.00	5.85	0.00
04/26/01	25.8	25.7	1.07	5.16	0.00
Count	14	14	14	14	14
Maximum	87.9	108	68.2	128	41.4
Minimum	11.9	12.8	1.07	2.58	0
Average	33.85	45.98	18.19	32.10	13.73
S.D.	22.24	28.05	21.37	39.24	16.18

Notes: S.D. - Standard Deviation, *μg/L* - micrograms per liter.

Table 17c. Current Chlorophyll Concentrations, Lake Vermilion, Station 5

Sample date	*Chlorophyll a corrected (μg/L)*	*Chlorophyll a uncorrected (μg/L)*	*Chlorophyll b (μg/L)*	*Chlorophyll c (μg/L)*	*Pheophytin a (μg/L)*
06/06/00	16.0	12.6	11.8	14.9	0.00
07/12/00	13.4	18.0	14.6	19.2	9.08
07/26/00	21.4	76.4	71.9	115	100
08/02/00	35.5	45.5	12.1	7.30	15.8
09/13/00	22.0	25.4	8.62	11.6	5.50
09/28/00	28.6	32.3	7.15	18.6	5.58
10/03/00	52.2	55.5	4.29	8.48	2.94
10/24/00	69.2	74.0	0.00	14.0	3.79
11/15/00	15.8	17.2	2.98	11.3	1.93
01/29/01	1.57	4.03	1.55	3.49	4.20
03/28/01	0.94	1.41	0.95	2.92	0.90
04/19/01	20.0	20.7	0.86	3.81	0.06
04/26/01	33.6	35.1	18.6	29.7	3.44
Count	13	13	13	13	13
Maximum	69.2	76.4	71.9	115	100
Minimum	0.94	1.41	0.00	2.92	0.00
Average	25.40	32.16	11.95	20.02	11.79
S.D.	19.07	24.43	18.96	29.51	26.84

Notes: S.D. - Standard Deviation, *μg/L* - micrograms per liter.

study were, respectively, 31.39, 37.86, and 25.4   g/L (Table 17). The ranges of chlorophyll *a* were 6.79–77.2, 11.9–87.9, and 0.94–69.2   g/L, respectively. Chlorophyll values for Station 5 during the current study were lower than those for Stations 1 and 2 (Tables17a-17c). However, at Station 1, the mean chlorophyll *a* value was decreased compared with the summer mean of 1997 and 1998 (Tables 12 and 16).

Chlorophyll *a* concentration at each station peaks in summer and fall and reaches its annual maximum in September or October. During this study, the maximum values of chlorophyll *a* (corrected) for Stations 1, 2, and 5 were on September 28, 2000, September 13, 2000, and October 24, 2000, respectively.

Historical maximum values of chlorophyll *a* (corrected) for Stations 1, 2, and 3 were 170.00 (June 28, 1979), 51.49 (August 14, 1997), and 32.24   g/L (June 6, 1995), respectively. In the past, only two or four samples were collected for chlorophyll analyses. Comparison of the distributions of chlorophyll *a* concentrations between the historical and current study showed decreased concentrations at Station 1 and no change at Station 2 (Table 13).

Examination of data in Table 16 suggests that chlorophyll *b* and *c* and pheophytin *a* concentrations in Lake Vermilion were also variable. These indicate that algal species in the lake are diversified.

Metals. Four water samples for metals analyses were taken from the mid-depth at Station 1 on May 8, July 12, August 2, and October 3, 2000. Results of 20 metals (with other chemical parameters) are presented in Table 18. Nine elements (in most or all samples) were found to be less than the reporting limit: beryllium, cadmium, chromium, cobalt, copper, nickel, silver, vanadium, and zinc.

The IPCB (IEPA, 2002) stipulated chemical constituent concentrations for secondary contact and indigenous aquatic life standards as follows: barium, 5 mg/L; boron, 1.0 mg/L; chromium, 0.011 mg/L; manganese, 1.0 mg/L; silver, 1.1 mg/L; and zinc, 1.0 mg/L. Metals concentrations of Lake Vermilion were well below these standards.

Organics. Four water samples for organics analyses were taken from the mid-depth at Station 1 on June 6, July 12, August 2, and October 3, 2000. Results of 35 organics analyses shown in Table 19 suggest that concentrations of 30 out of 35 parameters tested were below the reporting limit in all samples. Atrazine (0.33–10.0   g/L) dicamba (4.9   g/L), metribuzin (0.12   g/L), metolachlor (0.25–3.1   g/L) and diethylhexyphth (0.79–0.90   g/L) were detected in one to four samples. The IEPA has set limits for atrazine (<3.0   g/L of MCL) and diethylhexyphth (<6.0   g/L of MCL). Only the June 6, 2000 sample (10.0   g/L) exceeded the atrazine limit.

Table 18. Metals Concentrations, Lake Vermilion, Station 1, Mid-depth

Parameters	*05/08/00*	*07/12/00*	*08/02/00*	*10/03/00*
Calcium, mg/L	46	56	48	44
Magnesium, mg/L	31	26	28	29
Potassium, mg/L	1.9	1.6	2.3	2.1
Sodium, mg/L	15	5.3	6.1	8.6
Aluminum, g/L	130	140	120	200
Barium, g/L	37	39	37	39
Beryllium, g/L	1 k	1 k	1 k	1 k
Boron, g/L	61	45	51	61
Cadmium, g/L	3 k	3 k	3 k	3 k
Chromium, g/L	5 k	5 k	5 k	5 k
Cobalt, g/L	10 k	10 k	10 k	10 k
Copper, g/L	10 k	10 k	10 k	10k
Iron, g/L	220	210	160	280
Manganese, g/L	77	34	38	52
Nickel, g/L	25 k	25 k	25 k	25 k
Silver, g/L	3 k	3 k	3 k	3 k
Strontium, g/L	120	89	95	100
Vanadium, g/L	5 k	6.0	5 k	5 k
Zinc, g/L	100 k	100 k	100 k	100 k
Hardness, mg/L as $CaCO_3$	244 C	245 C	233 C	229 C
Sample depth, ft	11	9	9	9
Total water depth, ft	18	18	19	19

Notes: Samples were taken at mid-depth.
A C indicates a calculated value.
A k indicates that the actual value is known to be less than the value given.

Table 19. Organic Concentrations, Lake Vermilion, Station 1, Mid-depth

Parameters	*06/06/00*	*07/12/00*	*08/02/00*	*10/03/00*
2,4-D, g/L	7.0 k	1.0 k	1.0 k	1.0 k
Pentachlorophenol (PCP), g/L	0.1 k	0.1 k	0.1 k	0.1 k
Silvex, g/L	5.0 k	5.0 k	5.0 k	5.0 k
Dalapon, g/L	20 k	20 k	20 k	20 k
Dicamba, g/L	4.9	0.25 k	0.25 k	0.25 k
Dinoseb, g/L	0.7 k	0.7 k	0.7 k	0.7 k
Picloram, g/L	50 k	50 k	50 k	50 k
Acifluorfen, g/L	0.5 k	0.5 k	0.5 k	0.5 k
Hexaclcyclopentdiene, g/L	5.0 k	5.0 k	5.0 k	5.0 k
Propachlor, g/L	0.5 k	0.5 k	0.5 k	0.5 k
Trifluralin (Treflan), g/L	0.05 k	0.05 k	0.05 k	0.05 k
Hexachlorobenzene, g/L	0.1 k	0.1 k	0.1 k	0.1 k
Simazine, g/L	0.4 k	0.4 k	0.4 k	0.4 k
Atrazine, g/L	10	0.74	0.51	0.33
Lindane, g/L	0.02 k	0.02 k	0.02 k	0.02 k
Metribuzin, g/L	0.12	0.1 k	0.1 k	0.1 k
Alachlor, g/L	0.2 k	0.2 k	0.2 k	0.2 k
Heptachlor, g/L	0.04 k	0.04 k	0.04 k	0.04 k
Metolachlor, g/L	3.10	0.37	0.25	0.25 k
Cyanazine, g/L	0.5 k	0.5 k	0.5 k	0.5 k
Dacthal, g/L	0.5 k	0.5 k	0.5 k	0.5 k
Aldrin, g/L	0.05 k	0.05 k	0.05 k	0.05 k
Heptachlor epoxide, g/L	0.02 k	0.02 k	0.02 k	0.02 k
Chlordane, g/L	0.2 k	0.2 k	0.2 k	0.2 k
Butachlor, g/L	0.5 k	0.5 k	0.5 k	0.5 k
Total DDT, g/L	1.0 k	1.0 k	1.0 k	1.0 k
Dieldrin, g/L	0.05 k	0.05 k	0.05 k	0.05 k
Endrin, g/L	0.2 k	0.2 k	0.2 k	0.2 k
Diethylhexyladipate, g/L	40 k	40 k	40 k	40 k
Methoxychlor, g/L	4.0 k	4.0 k	4.0 k	4.0 k
Diethylhexylphth, g/L	0.90	0.60 k	0.60 k	0.60 k
Benzo (A) pyrene, g/L	0.02 k	0.02 k	0.02 k	0.02 k
Acetochlor, g/L	1.0 k	1.0 k	1.0 k	1.0 k
Toxaphene, g/L	1.0 k	1.0 k	1.0 k	1.0 k
Total PCB, g/L	0.4 k	0.4 k	0.4 k	0.4 k

Note: Samples were taken at mid-depth.
A k indicates that the actual value is known to be less than the value given.

Biological Characteristics

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., 1998). Macrophytes may include submerged, emerged, and floating plants and filamentous algae. Most lakes and ponds have aquatic vegetation that may beneficially and/or adversely affect 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 in the lake can interfere with recreational activities (fishing, boating, skiing, etc.); have adverse affects on aquatic life (overpopulation of small fish and benthic invertebrates); cause fish kills; affect taste and odor in water due to decomposition of dense weed beds; block water movement and retard heat transfer, create vertical temperature gradients; and destroy 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.

During the current study, the IEPA conducted a macrophyte survey on September 7, 2000. The following seven species of macrophytes were observed: water willow (*Justica americana*), cattails (*Typha* sp.), arrowhead (*Sagittaria* sp.), curlyleaf pondweed (*Potamogeton crispus*), sago pondweed (*Potamogetonpectinatus*), water lily (*Nymphae* sp.) and coontail (*Ceratophyllum demersum*).

Arrowhead was the dominant macrophyte (87.92 percent) followed by cattail with 7.81 percent, waterwillow (3.71 percent), water lily (0.33 percent), coontail (0.185 percent), sago pondweed (0.03 percent), and curlyleaf pondweed (0.02 percent). Most macrophytes observed were located on the northeastern side of Lake Vermilion.

Cochran & Wilken, Inc. and the Illinois State Water Survey made supplemental observations of the aquatic macrophyte conditions in the lake on September 17, 2002. The 2000 survey results and supplemental observations are plotted in Figure 3. Supplemental observations were made to better document conditions in the shallow upper end of the lake, which was inundated by raising the spillway in 1992. Previously listed macrophytes were observed along with scattered areas of spatterdock, large leaf pondweed, and creeping water primrose. Typical species found to occur along shorelines included arrowhead, water willow, cattails, and creeping water primrose. Species found in open to semi-protected shallow water included spatterdock, water lily, large leaf pondweed, sago pondweed, curly leaf pondweed, and coontail.

Because residential development tends to reduce macrophyte growth near the shore, the lack of aquatic vegetation on other parts of Lake Vermilion continues to be a problem. Significant attention should be given to developing an improved aquatic community in the lake.

Water Quality of Surface Inflows and Outflows

The inflows and spillway outflow water quality also was monitored. The inflow site, Station T2 (RBD-02), is located at a bridge near Bismarck on the North Fork Vermilion River. The outflow site T1 (RBD-01) is located at the spillway. Water samples were taken at either or both stations during and after rainfall events. Thirteen and 37 samples were collected form Stations T1 and T2 during this study, respectively. All of the samples collected were analyzed for turbidity, conductivity, pH, TSS, VSS, NH_3-N, TKN, NO_2/NO_3-N, and TP. The laboratory results for these samples and a statistical summary for the parameters monitored are presented in Appendix D (D1-D2).

It can be seen from Appendix D2 for the tributary site, during or after storm events, high levels of turbidity, TSS, VSS, TKN, NO_2/NO_3-N, and TP were observed (5/27–6/1/00, 7/5/00, 7/11/00 and 2/5/01, 2/9/01, and 2/25–28/01). During storm periods, total alkalinity decreased.

The water-quality characteristics of the inflow (Appendix D1) and outflow (Appendix D2) were compared. The changes in mean concentrations from Station T2 to Station T1 (spillway) for the parameters monitored were from 86 to 370 NTU (turbidity), 611 to 528 mho/cm (conductivity), 178 to 113 mg/L as $CaCO_3$ (total alkalinity), 137 (increased) to 161 mg/L (TSS), 23 (increased) to 29 mg/L (VSS), 0.15 (increased) to 0.21 mg/L (NH_3-N), 1.22 (increased) to 1.88 mg/L (TKN), 9.20 to 8.30 mg/L (NO_2/NO_3-N), and 0.244 (increased) to 0.429 mg/L (TP).

Trophic State

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

Limnologists generally classify lakes into one of three trophic states: oligotrophic, mesotrophic, or eutrophic. Oligotrophic lakes are known for their clean, cold waters and lack of aquatic plants or algae due to low nutrient levels. There are few oligotrophic lakes in the Midwest. At the other extreme, eutrophic lakes are characterized by high nutrient levels and are likely to be very productive in terms of plant 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. Most Midwestern lakes are eutrophic. A hypereutrophic lake 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 with trapped sediments and decayed organic matter until it becomes a shallow marsh or emergent wetland.

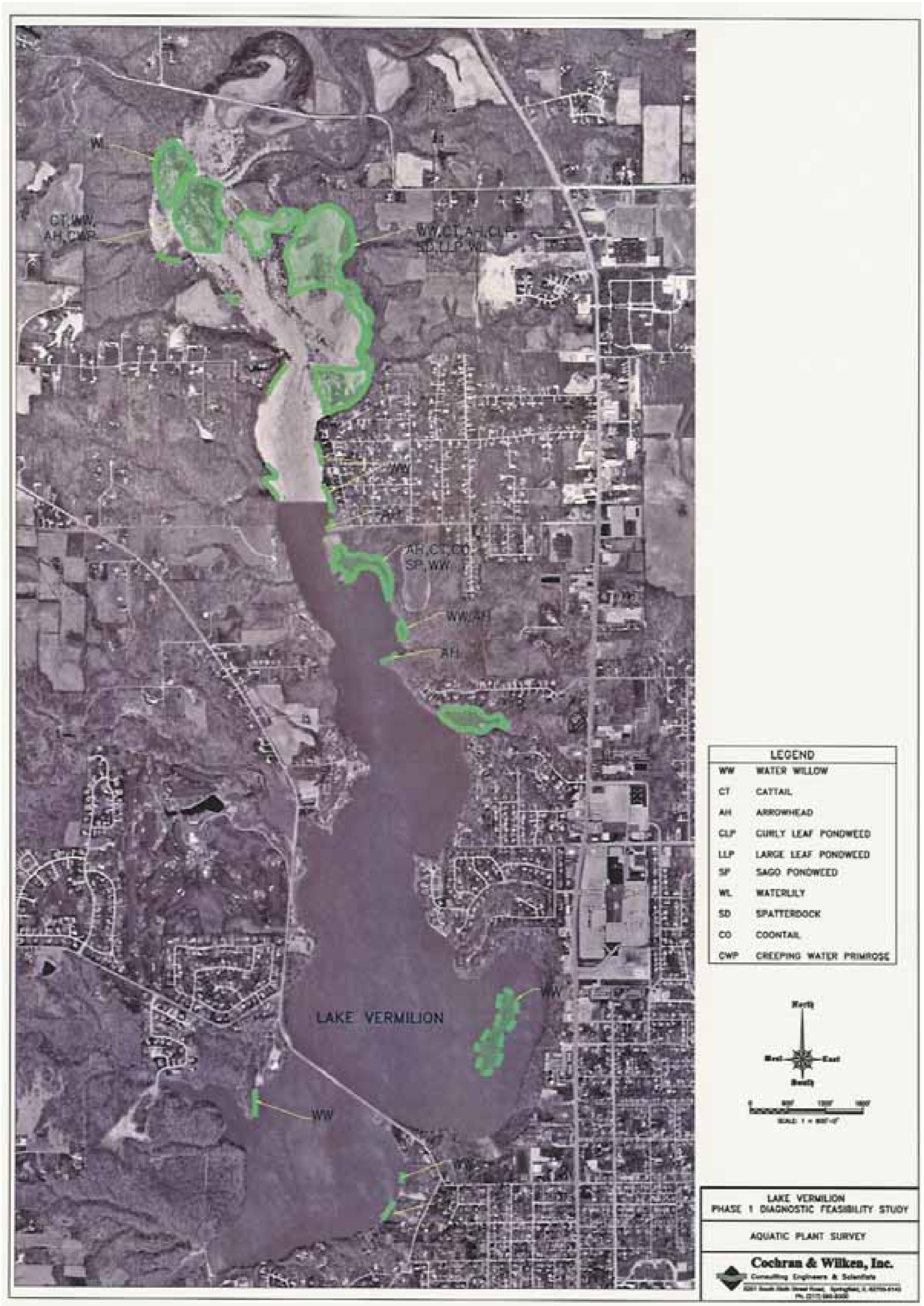


Figure 3. Macrophyte distribution in Lake Vermilion, September 17, 2002

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 (µg/L), and TP in micrograms per liter as follows:

on the basis of SD,	$TSI = 60 - 14.4 \ln (SD)$	(1)
on the basis of CHL,	$TSI = 9.81 \ln (CHL) + 30.6$	(2)
on the basis of TP,	$TSI = 14.42 \ln (TP) + 4.15$	(3)

The TSI is based on the amount of algal biomass in surface water, generally using a scale of 0 to 100. Each increment of ten in the TSI represents a theoretical doubling of biomass in the lake. 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 TSI values for Lake Vermilion 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 20. The trophic state of each station or of the lake average was categorized using mean TSI values and the information provided in Table 21.

The mean TSI values shown in Table 20 suggest that values calculated using the three parameters vary for each station and for each study period. Higher TSI values (>100) are found by the calculations CHL-TSI in historical data. The TP-TSI and CHL-TSI (including current CHL-TSI) gave comparable values. When considering the results of the TSI calculations, one should keep in mind the assumptions on which the Carlson formulas 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 prohibit a large algal standing crop from developing, or grazing by zooplankton affects algal populations.

As mentioned previously, Lake Vermilion is phosphorus limited for algal growth, thus TP-TSI is included for the overall TSI calculations. The overall average TSI values for Stations 1, 2, and 5 using three TSI values during the current study were 64.2, 65.7, and 65.6, respectively. Based on the TSI evaluations, all three stations are classified as eutrophic.

Table 20. Statistical Summary of Trophic State Index (TSI) and Trophic State of Lake Vermilion

TSI/ Trophic state	*Station 1* 1977–1997	*Station 1* 2000–2001	*Station 2* 1977–1997	*Station 2* 2000–2001	*Station 3* 1977–1997	*Station 5* 2000–2001
SD-TSI						
Count	8	5	8	5	8	4
Maximum	79.7	83.0	87.1	83.0	87.1	78.7
Minimum	67.1	64.9	66.0	70.0	73.0	73.0
Mean	72.1	69.4	74.9	73.0	80.8	75.7
Trophic state	Hyper-eutrophic	Eutrophic	Hyper-eutrophic	Hyper-eutrophic	Hyper-eutrophic	Hyper-eutrophic
CHL-TSI						
Count	4	14	2	14	2	13
Maximum	147.8	73.2	137.0	74.5	132.4	72.2
Minimum	105.7	49.4	128.2	54.9	125.9	30.0
Mean	124.3	62.1	132.6	64.7	129.2	58.0
Trophic state	Hyper-eutrophic	Eutrophic	Hyper-eutrophic	Eutrophic	Hyper-eutrophic	Eutrophic
TP-TSI						
Count	7	14	8	13	8	13
Maximum	71.9	74.8	85.4	69.8	86.6	77.6
Minimum	57.3	50.0	55.4	52.7	55.4	52.7
Mean	65.7	61.2	69.1	59.5	73.4	63.3
Trophic state	Eutrophic	Eutrophic	Eutrophic	Eutrophic	Hyper-eutrophic	Eutrophic
Overall						
Count	19	33	18	32	14	30
Mean	79.2	64.2	81.3	65.7	84.7	65.7
Trophic state	Hyper-eutrophic	Eutrophic	Hyper-eutrophic	Eutrophic	Hyper-eutrophic	Eutrophic

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

Table 21. Quantitative Definitions of Lake Trophic States

Trophic state	*Secchi disc transparency (in.)*	*Secchi disc transparency (m)*	*Chlorophyll a (µg/L)*	*Total phosphorus, lake surface (µg/L)*	*Trophic State Index*
Oligotrophic	>145	>3.7	<2.5	<12	<40
Mesotrophic	>79– 145	>2.0– 3.7	2.5–<7.5	12–<25	40–<50
Eutrophic	>18– 79	>0.5– 2.0	7.5–<55	25–<100	50–<70
Hypereutrophic	18	0.5	55	100	70

Source: IEPA (2000).

During the 1977-1997 period, the overall average TSI values for Stations 1, 2, and 3 were 79.2, 81.3, and 84.7, respectively (Table 20). These historical values indicate that the lake waters could be classified as hypereutrophic or a lower quality condition than the current conditions. The mean Lake Vermilion TSI for all stations for the current data analysis decreased from the TSI values determined using the historical data. This improved condition may be a result of climatic and hydrologic conditions prevalent during the monitoring year or the altered condition of the lake since the spillway height was increased.

Use-Support Analysis

Definition

An analysis of use support for Lake Vermilion was conducted using methodology developed by the IEPA (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, 2002). 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.

For Lake Vermilion, the lake-use support and level of attainment were determined for aquatic life, recreation, swimming, drinking water supply, and overall lake use, using methodologies described by the IEPA (2000).

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 rating reflects the degree of attainment of the "fishable goal" of the Clean Water Act; the RUI rating reflects the degree to which a lake can provide pleasure boating, canoeing, and aesthetic enjoyment.

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 overall 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 uses (aquatic life, fish consumption, recreation, swimming uses, drinking water supply), the overall use support of the lake was assessed. The overall use-support methodology aggregates the use support attained for each lake use 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 Lake Vermilion

Support of designated uses in Lake Vermilion was determined based on Illinois' use-support assessment criteria using data from both Stations 1 and 2 (IEPA, 2000). The use-support analysis results for the lake were assessed as full support (based on a score of zero RUI points) for aquatic life, full support (zero points) for fish consumption, partial support (one point) for recreation, partial support (one point) for swimming, and partial support (one point) for drinking-water-supply uses. For overall use, Lake Vermilion during 2000–2001 can be classified as having partial use support (0.60 RUI points).

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 groundwater 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 biological 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 from 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 IEPA (J. Mitzelfelt, personal communication, 1996) revised classification of lake sediments as shown in Table 22. 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 risk to human health or the aquatic biota.

Nutrients and Metals

Sediment samples were collected at Stations 1, 2, and 5 on July 12, 2000. Results of nutrients and metals concentrations are given in Table 23. Examination of these data in Table 23 shows that mercury and silver concentrations were below the detectable levels. For all parameters measured, with the exception of total organic carbon, total solids, and silver, concentrations at Stations 1 and 2 were higher than at Station 5. The TKN concentrations were highest at Station 2. All other measured parameters followed the trend of Station 1 > Station 2 > Station 5.

Table 22. Classification of Lake Sediments (revised 1996)

Parameters	*Detection limit**	*Low*	*Normal*	*Elevated*	*Highly elevated*
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 g/kg.
BHC - benzene hexachloride.
DDT - dichloro-diphenyl-trichloro-ethane.
HCB - hexachlorobenzene.
n/a - data not available.
PCB - polychlorinated biphenyls.

Source: J. Mitzelfelt, IEPA, personal communication, 1996.

Table 23. Sediment Quality of Lake Vermilion, July 12, 2000

Parameters	*Station 1*	*Station 2*	*Station 5*
Phosphorus, mg/kg	1,070	817	802
Kjeldahl-nitrogen, mg/kg	2,000	2,380	1,270
Total organic carbon, %	2.3	2.3	3.3
Total solids, % of wet sample	44.5	46.1	47.4
Volatile solids, % of wet sample	10.3	8.0	7.8
Arsenic, mg/kg	20	15	14
Barium, mg/kg	340	280	220
Cadmium, mg/kg	1.0	1.0	1.0
Chromium, mg/kg	55	46	36
Copper, mg/kg	61	53	42
Iron, mg/kg	72,000	57,000	46,000
Lead, mg/kg	52	44	36
Manganese, mg/kg	1,900	1,800	1,600
Mercury, mg/kg	0.10 k	0.10 k	0.10 k
Nickel, mg/kg	64	54	43
Potassium, mg/kg	5,200	4,200	3,300
Silver, mg/kg	0.7 k	0.7 k	0.9
Zinc, mg/kg	240	200	160
Water depth, ft	18	11	6

Note: A k indicates that the actual value is known to be less than the value given.

On the basis of the classification given in Table 22, nickel and potassium concentrations at Stations 1, 2, and 5 were highly elevated. Chromium and iron were highly elevated at Station 1; and iron was highly elevated at Station 2. Iron was elevated at Station 5. All three stations had elevated levels of arsenic and zinc. Barium and manganese were elevated at Stations 1 and 2. Chromium was elevated at Stations 2 and 5.

At all three stations, phosphorus, cadmium, and lead were at normal levels. Levels of TKN were normal at Stations 1 and 2, and low at Station 5. For Station 5, other parameters determined (barium, copper, lead, and manganese) were considered normal for Illinois lakes. Bottom sediments near Station 5 will require more evaluation of sediment metals quality if dredging is determined to be an option for the restoration phase.

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 trichloroethane (DDT) present a somewhat unique problem in aquatic systems because of their potential for bioaccumulation in fish. 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 24 presents the current observed sediment concentrations of tested organochlorine compounds. Examination of this table indicates that almost all of the 25 parameters assessed at all three stations were below detection levels, with the except P,P'-DDD at Stations 1 (1.1 mg/L) and 2 (1.4 mg/L). These levels are slightly higher than the detectable limit. The parameter P,P'-DDD was not included in the sediment classification list (Table 22). Sediment quality results 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

A shoreline condition survey of the lake by C&W and ISWS was a visual inspection of the accessible shoreline of the lake on September 17, 2002. Each section of the bank was rated on the basis of IEPA guidelines (1994). The results of this survey are shown in Figure 4. The shoreline condition is summarized as follows:

Condition	*Definition*	*Affected length, linear ft*	*Total shoreline length, percent*
Severe	8 ft or more exposed bank	5,429	7.2
Moderate	3–8 ft of exposed bank	2,322	3.1
Slight	0–3 ft of exposed bank	4,344	5.8
Existing stabilization	Artificially armored by rock or shore wall	12,497	16.6

Note: Total shoreline = 75,400 linear ft.

Table 24. Organochlorine Compounds Tested for Sediments in Lake Vermilion, July 12, 2000

Organic compounds, g/kg	*Station 1*	*Station 2*	*Station 5*
Total PCBs	10 k	10 k	10 k
Hexachlorobenzene	1.0 k	1.0 k	1.0 k
Trifluralin	10 k	10 k	10 k
Alpha-BHC	1.0 k	1.0 k	1.0 k
Gamma-BHC(lindane)	1.0 k	1.0 k	1.0 k
Atrazine	50 k	50 k	50 k
Heptachlor	1.0 k	1.0 k	1.0 k
Aldrin	1.0 k	1.0 k	1.0 k
Alachlor	10 k	10 k	10 k
Metribuzin	10 k	10 k	10 k
Metolachlor	25 k	25 k	25 k
Heptachlor epoxide	1.0 k	1.0 k	1.0 k
Pendimethalin	10 k	10 k	10 k
Gamma-chlordane	2.0 k	2.0 k	2.0 k
Alpha-chlordane	2.0 k	2.0 k	2.0 k
Total & chlordane	5.0 k	5.0 k	5.0 k
Dieldrin	1.0 k	1.0 k	1.0 k
Captan	10 k	10 k	10 k
Cyanazine	25 k	25 k	25 k
Endrin	1.0 k	1.0 k	1.0 k
P,P'-DDE	1.1	1.4	1.0 k
P,P'-DDD	1.0 k	1.4	1.0 k
P,P'-DDT	1.0 k	1.0 k	1.0 k
Total DDT	10 k	10 k	10 k
Methoxychlor	5 k	5 k	5 k

Notes: A k indicates that the actual value is known to be less than value given.
PCB - polychlorinated biphenyls.
BHC - benzene haxachlorine.
DDE - dichloro-diphenyl ethylene.
DDD - dichloro-diphenyl dichloroethane.
DDT - dichloro-diphenyl trichloroethane.

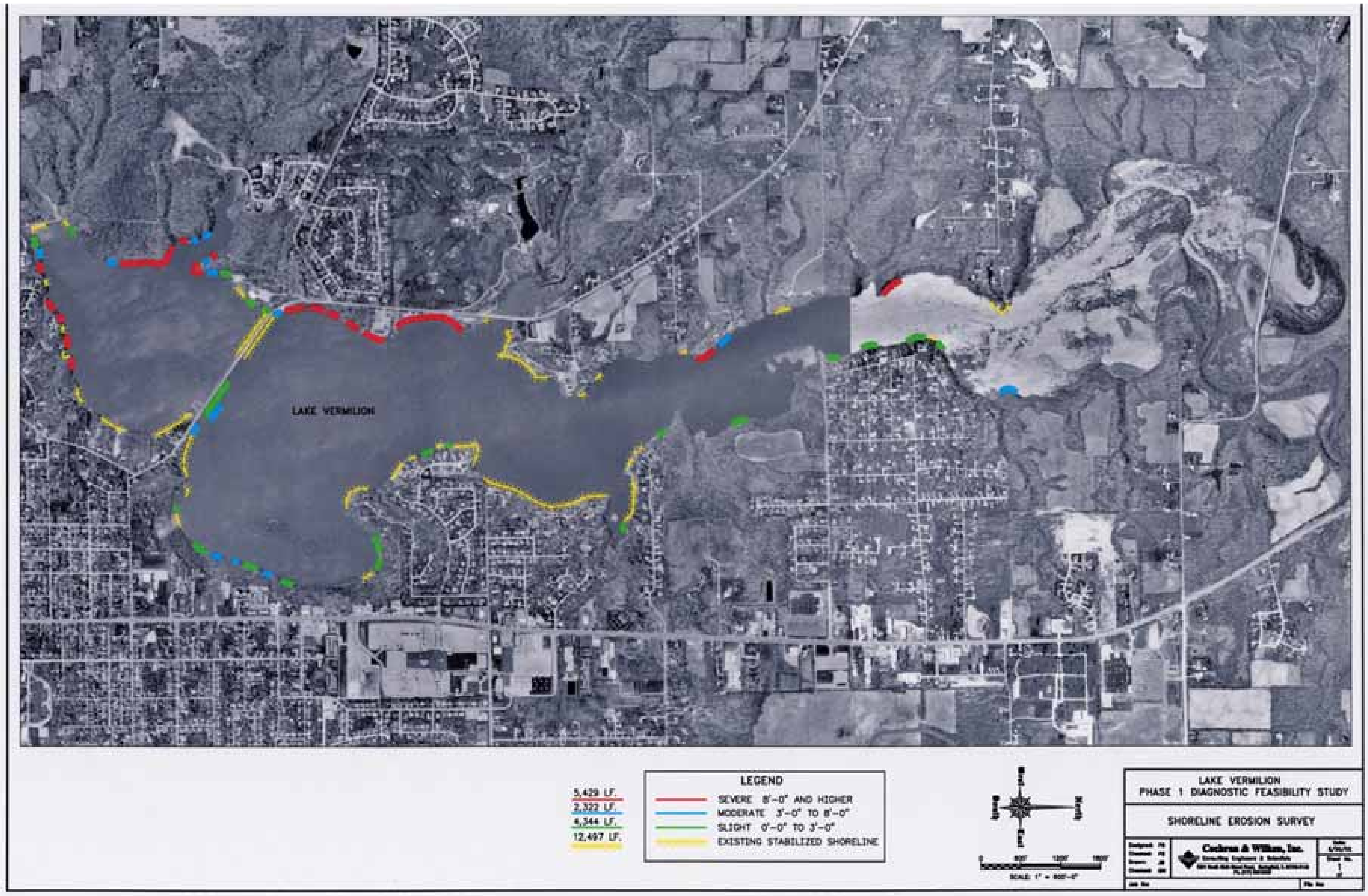


Figure 4. Bank erosion survey for Lake Vermilion, September 17, 2002

Lake Sedimentation Survey

Sedimentation of a reservoir is a natural process that can be either accelerated or slowed by human activities in the watershed. In general, sedimentation of a lake is presumed to be unintentionally accelerated as a secondary impact of other developments within the watershed. For example, construction and agricultural activities in a lake watershed generally are presumed to increase sediment delivery to the lake due to increased exposure of soil material to erosive forces.

Reductions of the sedimentation rate in a lake due to human impacts almost always are the result of programs intentionally designed to reduce soil and streambank erosion, and they are often the result of implementing lake remediation programs. These programs may include, but are not limited to, implementation of watershed erosion control practices, streambank and lakeshore stabilization, stream energy dissipaters, and lake dredging.

Sedimentation of a reservoir is the final stage of a three-step sediment transport process. The three steps are watershed erosion by sheet, rill, gully, and/or streambank erosion; sediment transport in a defined stream system; and deposition of the sediment, in which stream energy is reduced such that the sediment can no longer be transported either in suspension or as bedload. Sediment deposition can occur throughout the stream system.

Lake sedimentation occurs when sediment-laden water in a stream enters the reduced flow velocity regime of a lake. As water velocity is reduced, suspended sediment is deposited in patterns related to the size and fall velocity of each particle. During this process, soil particles are partially sorted by size along the longitudinal axis of the lake. Larger and heavier sand and coarse silt particles are deposited in the upper end of the lake; finer silts and clay particles tend to be carried further into the lake.

Several empirical methods have been developed for estimating sedimentation rates in Illinois (ISWS, 1967; Upper Mississippi River Basin Commission, 1970; Singh and Durgunoglu, 1990). These methods use regionalized relationships between watershed size and lake sedimentation rates. As estimates, they serve well within limits. A more precise measure of the sedimentation rate is provided by conducting a sedimentation survey of the reservoir. The sedimentation survey provides detailed information on distribution patterns within the lake as well as defining temporal changes in overall sedimentation rates.

Sedimentation Survey Methods

The ISWS conducted sedimentation surveys of Lake Vermilion in 1963 (Neibel and Stall, 1964) and 1976 (Bogner and Gibb, 1977). The 1998 sedimentation survey of Lake Vermilion (Figure 5) repeated as closely as possible a series of survey lines established during the 1963 survey. In 1963, cross sections were laid out at 18 lines across the lake, surveyed, and monumented by installing 4-inch by 4-inch concrete posts to mark the transect ends. During the 1976 and 1998 surveys, these survey lines were resurveyed to define temporal changes in lakebed topography.

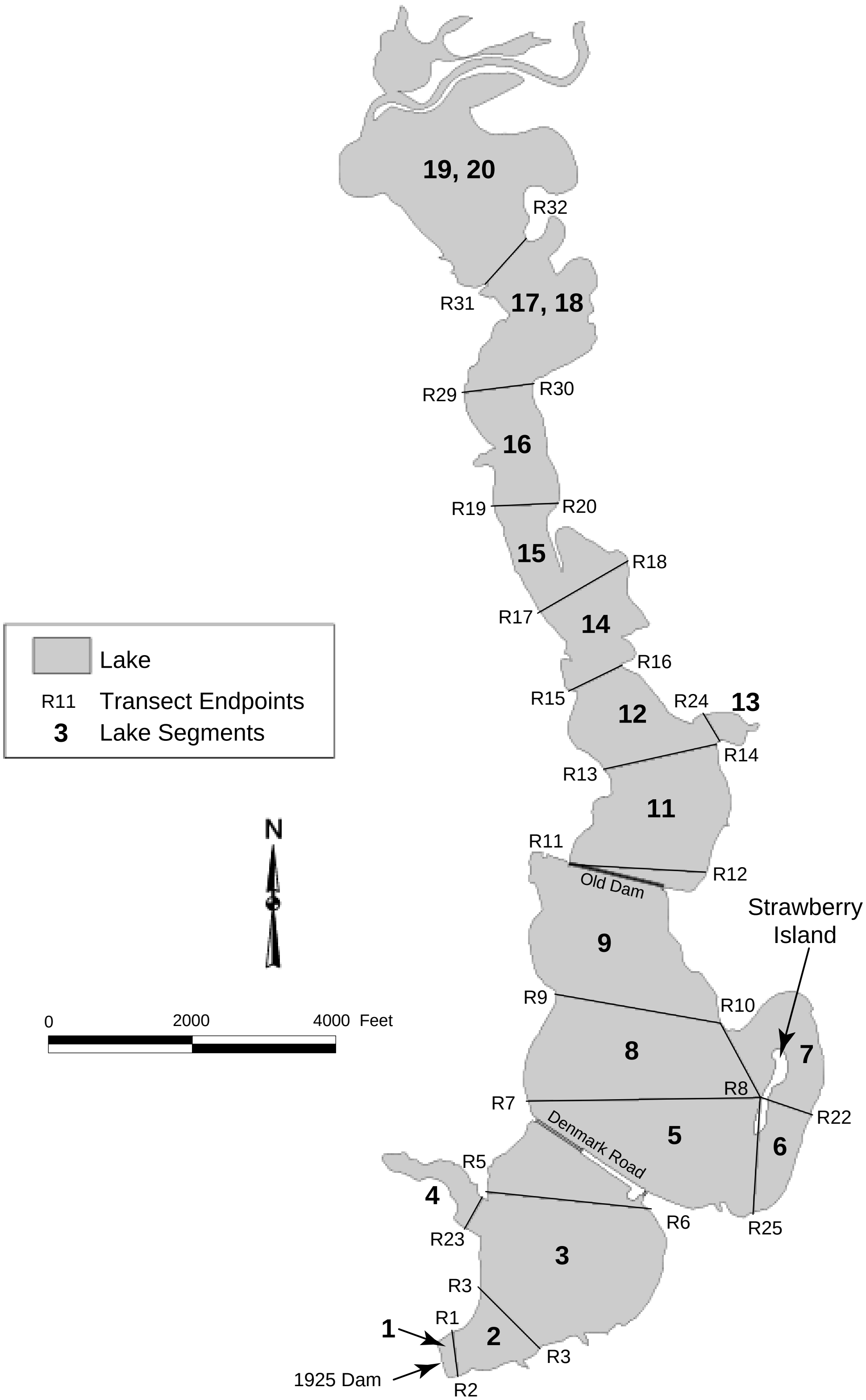


Figure 5. Survey plan for Lake Vermilion, 1998

For the 1963 and 1976 sedimentation surveys, horizontal distances along the cross-sectional transects were measured by stretching a marked polyethylene cable between corresponding range end monuments. Water depth (vertical control) was referenced to the water surface, and all depths were adjusted to the spillway crest elevation. Depth measurements were made by lowering an aluminum sounding pole to the top of the sediment surface to measure the existing water depth. The pole then was used to probe to the original bottom as determined by the initial point of resistance to the sediment probe.

The 1998 survey was conducted using an Odom Hydrographic Systems MK II fathometer for depth measurement and a differentially corrected Geodetic Position Systems (GPS) for horizontal control across the transect. The GPS system units used were either a Trimble Pathfinder GPS or a Leica 9600 System. All navigation and data logging functions were controlled using Hypack, a hydrographic survey software. The GPS positions were differentially corrected using RTCM correction signals broadcast by the U.S. Coast Guard from St. Louis, Missouri, or Rock Island, Illinois.

The fathometer was calibrated daily prior to initiating measurements. Calibration checks at the end of most work days showed daily variations of 0.1–0.2 ft in a profile at one-foot depth intervals. For each main lake cross section, three to five physical measurements of the water depth and sediment thickness were made with an aluminum sounding pole.

Plots of all surveyed cross sections from 1963, 1976, and 1998 are presented in Appendix I of Bogner and Hessler (1999). For comparison, the 1998 pole measurements also are plotted in that appendix as point data. These water-depth measurements with the pole show a close correspondence with the 1998 depth sounder readings. Comparison of the original lake depth for the 1998 pole readings and the full cross-section data collected for the 1963 and 1976 surveys shows a good match in the deeper areas of the lake (R1-R2 through R9-R10). In shallower water areas, the sediments have become more consolidated and difficult to penetrate due to occasional exposure events prior to the 1991 spillway modification.

Lake Basin Volumes

Calculations of the lake capacities were made using the method described in *the National Engineering Handbook* of the U.S. Soil Conservation Service (USDA-SCS, 1968). This method requires the surface area of the lake segments, the cross-sectional area and widths of their bounding segments, and a shape factor to determine the original and present volume of each segment. These volumes are then summed to determine the total lake volume. The reference elevation used for the lake was the top of the spillway gates, 582.2 ft NGVD.

The volume calculation results of the three surveys are presented in Table 25. Given the 1991 change in lake elevation, the analysis of sedimentation rates required the use of a potential capacity for the pre-1991 lake volumes. For consistency, the volumes discussed in the remainder of this report are relative to the capacity of the valley basin below the reference spillway elevation of 582.2 ft NGVD. This potential capacity corresponds to the volume of lake storage that would have been achieved if the original 1925 lake had been constructed in the valley at the

Table 25. Reservoir Capacity and Capacity Loss Analysis, Lake Vermilion

Period	*Capacity*	*Capacity loss for period*	*Cumulative capacity loss*	*Period annual capacity loss rate*	*Cumulative annual capacity loss rate*
a) Analysis in units of ac-ft					
1925	13,209				
1925–1963	9,810	3,399	3,399	89.5	89.5
1963–1976	9,157	653	4,052	50.2	79.5
1976–1998	7,971	1,186	5,238	53.9	71.8
b) Analysis in units of million gallons					
1925	4,304				
1925–1963	3,196	1,108	1,108	29.1	29.1
1963–1976	2,984	213	1,320	16.4	25.9
1976–1998	2,597	386	1,707	17.6	23.4

Note: Lake surface area is 878 acres for 1998.
Capacity shown is for the sedimentation survey conducted at the end of the period.

1991 spillway elevation. Prior to 1991, it was physically impossible to maintain the pool level at this elevation, so the capacity discussed is defined as the potential capacity.

Sedimentation has reduced the basin capacity from 13,209 ac-ft in 1925 to 7,971 ac-ft in 1998. The 1998 basin capacity was 60.3 percent of the 1925 potential basin capacity. For water-supply purposes, these volumes convert to capacities of 4,304 million gallons in 1925 and 2,597 million gallons in 1998. The potential capacity of the lake in 1963 was 9,810 ac-ft (3,196 million gallons), and in 1976 it was 9,157 ac-ft (2,984 million gallons).

The 1998 water depths for the lake were used to generate the volume distribution curve data in Figure 6 and the bathymetric map in Figure 7. Figure 6 can be used to determine reservoir capacity below a given stage elevation. For example, the water volume below the 4-foot depth contour (shown by the dashed line in Figure 6) is 4,543 ac-ft. With time and continued sedimentation, the relationships shown in Figure 6 will become obsolete. Alteration of the spillway elevation or the implementation of a dredging program likewise would alter these relationships.

During the 1998 survey, much of the area inundated because of the 1991 spillway level increase was found to have a depth of 4–5 ft. Much of the inundated area had been part of the original lake. Earlier sedimentation surveys found that 165 acres of the original surface area of the lake had become terrestrial. Analyses of aerial photography verify that in 1936, 11 years after construction of the present dam and 23 years after construction of the old dam, the lake covered an area approximately equal to the present extent of the lake. By 1976, sediment had filled most of this 165-acre area and had formed exposed land above the then existing lake pool level.

Sedimentation Rates

Analysis of the sedimentation rates for Lake Vermilion was made in terms of delivery rates from the watershed and accumulation rates in the reservoir. The in-lake accumulation rate provides a means of extrapolating future lake conditions from past and present lake conditions in order to evaluate the integrity of the lake as a water-supply source as well as a recreational resource. The watershed delivery rates are the link between soil erosion processes in the watershed, sediment transport processes, and water-supply quantity impacts in the reservoir. These delivery rates measure the actual sediment yield from the watershed, including reduced sediment transport due to field and in-stream redeposition.

The sedimentation rates for Lake Vermilion and its watershed are given in Table 26 and Table 27 for the periods 1925–1963, 1963–1976, 1976–1998, and 1925–1998. These rates indicate a steady decline in net sediment yield from the watershed from 89.5 ac-ft from 1925–1963 to 53.9 ac-ft annually from 1976–1998. The long-term average annual sediment yield from 1925–1998 was 71.8 ac-ft. These delivery rates show the need for continuing efforts to control watershed erosion, thereby reducing reservoir sedimentation rates.

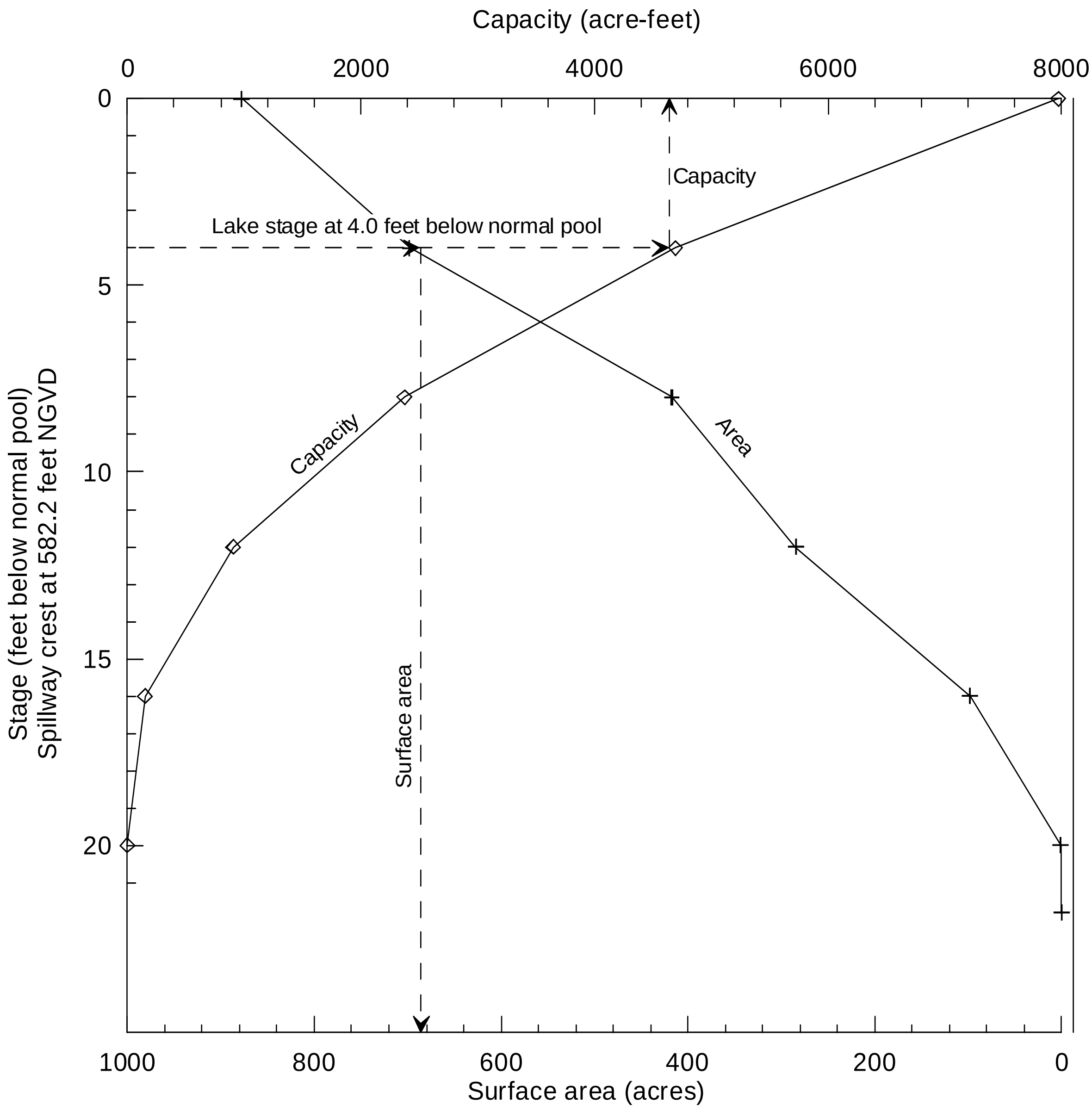


Figure 6. Stage vs. volume vs. area relationship for Lake Vermilion, 1998

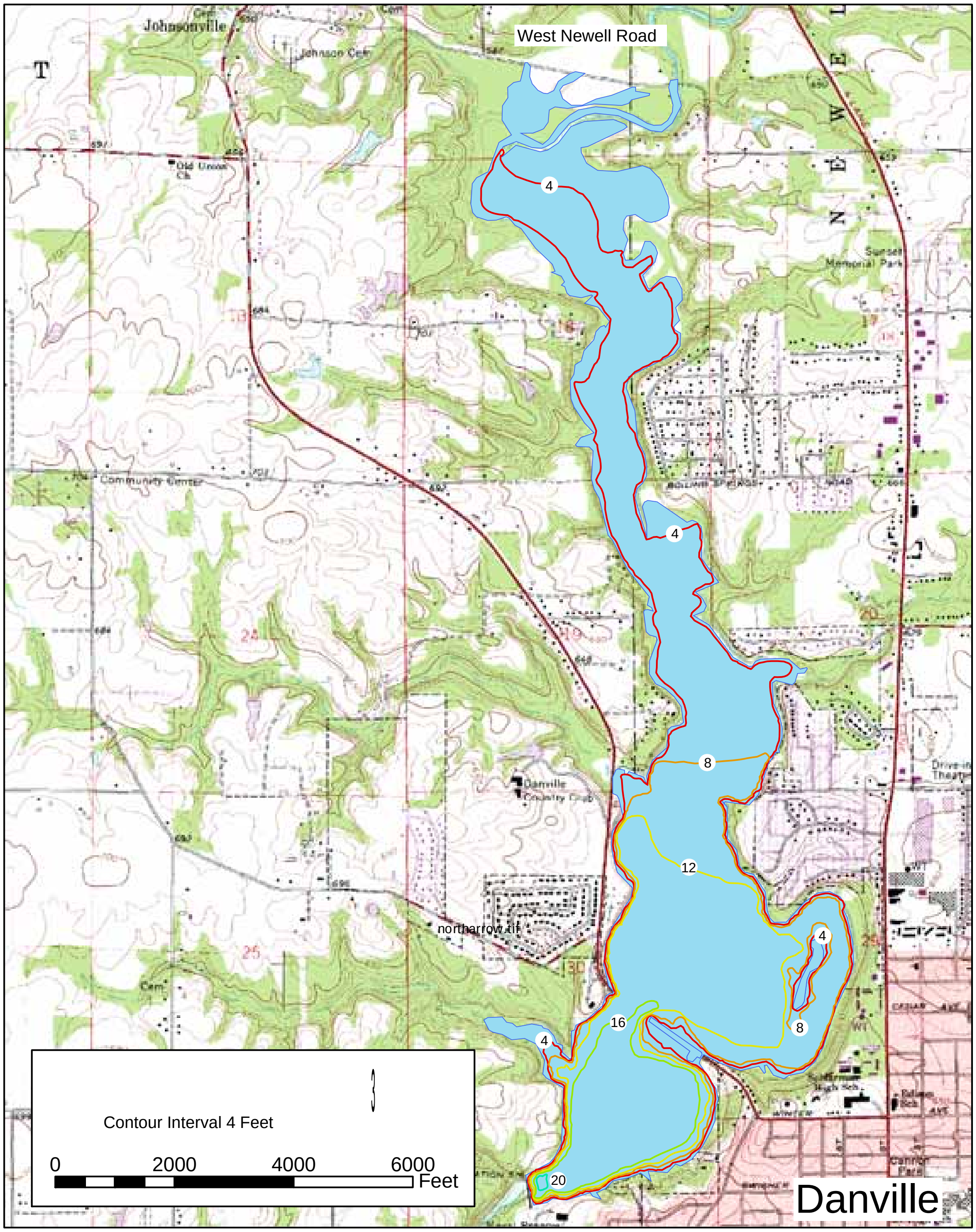


Figure 7. Bathymetric map of Lake Vermilion, 1998

Table 26. Computed Sediment Delivery Rates from the Watershed for Each Sedimentation Period

	Annual deposition rates			
Period	*acre-ft*	*acre-ft per square mile*	*cubic ft per acre*	*tons per acre*
1925–1963	89.5	0.30	20.4	0.52
1963–1976	50.2	0.17	11.5	0.28
1976–1998	53.9	0.18	12.3	0.28
1925–1998	71.8	0.24	16.4	0.40

Note: Total watershed area is 298 square miles.

Table 27. Capacity Loss Rates (percent) Relative to Original Lake Capacity

Period	*Per period*	*Cumulative*	*Period annual loss*	*Cumulative annual loss*
1925–1963	25.7	25.7	0.68	
1963–1976	4.9	30.7	0.38	
1976–1998	9.0	39.7	0.41	0.54

Factors Affecting Lake Sedimentation Rates

Sedimentation rates in a lake can vary over time due to changes in either watershed or in-lake conditions. Changes in climatic and watershed conditions, such as altered precipitation patterns, land-use patterns, and streamflow variability, also affect the sediment delivery rates to the lake.

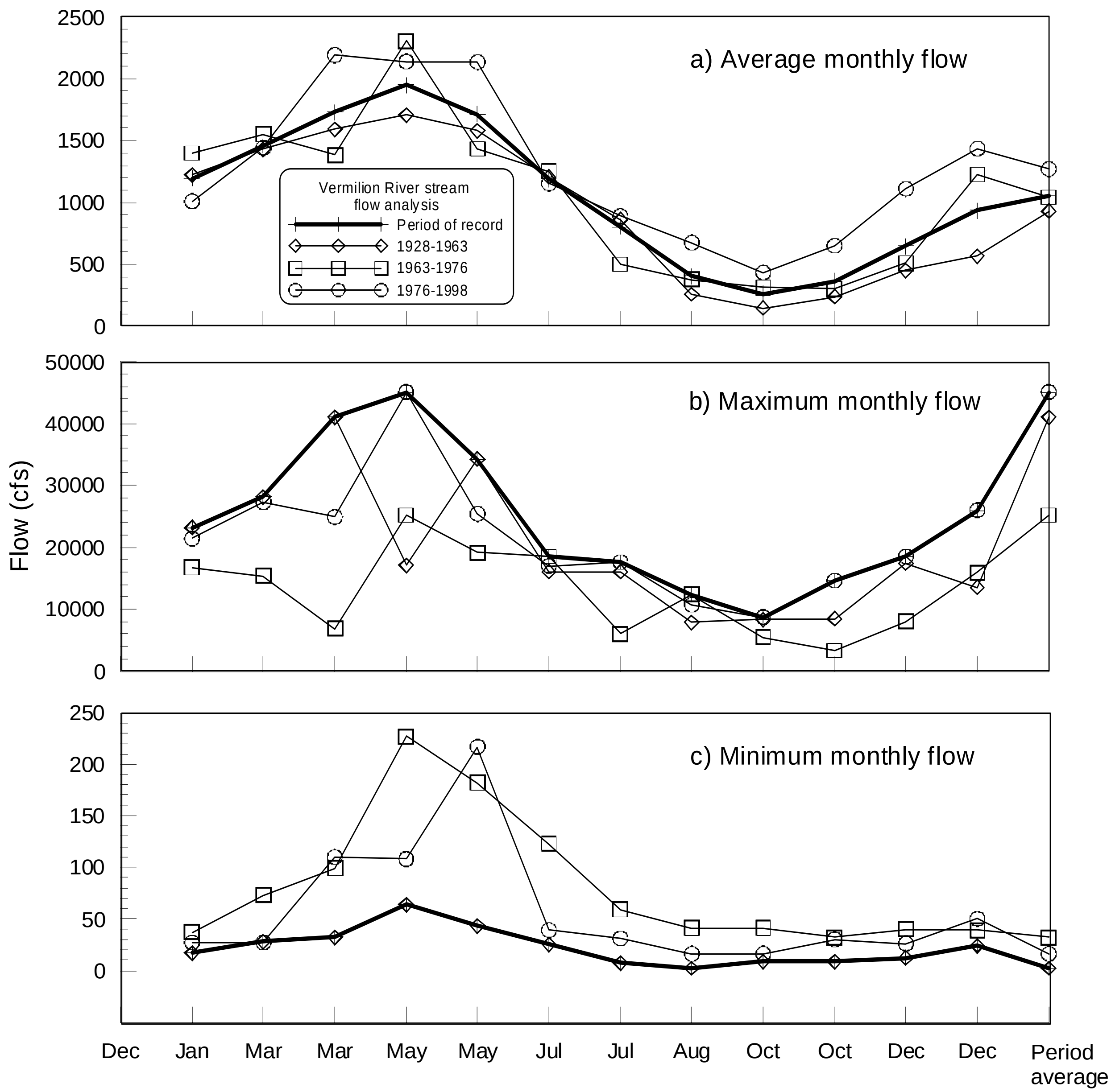
In-lake conditions with impacts on sedimentation rates involve the variation of trap efficiency (due to reduced storage capacity) and sediment consolidation. Sedimentation conditions for Lake Vermilion are further complicated by the old dam that predated the present dam. This older structure would have accumulated sediment in the upper end of Lake Vermilion prior to 1925. The annual rate of sedimentation of the lake prior to 1925 cannot be determined today. The old lake would have had a lower trap efficiency due to its smaller size than the larger lake that formed behind the 1925 structure. The old lake would therefore have had a lower sediment accumulation rate.

As a rough estimate of the impact of the sedimentation of the old lake on the 1925–1963 sedimentation rates for Lake Vermilion, the 1963 sediment accumulation can be averaged over the 49 years from 1914 instead of the 38 years from 1925. The 49-year sedimentation rate is 69.4 ac-ft per year in contrast to the 89.5 ac-ft per year during the 38-year period. In reality, the sedimentation rate for the 1925–1963 period probably is somewhere between these values.

Representative streamflow values for the Vermilion River at Danville from October 1928–September 1996 are shown in Figure 8. (**Note**: The lake was constructed in 1925 but the streamgage did not operate until 1928.) The most important of these plots for analysis of lake sedimentation are the maximum flows and the average flows. High sediment transport rates are closely related to peak water discharge periods (Demissie et al., 1983; Bhowmik et al., 1993).

The plots in Figure 8 indicate that average flows for most months have been higher during the most recent (1976–1998) sedimentation study period for Lake Vermilion. This observation is consistent with statistical analyses of streamflow records presented in IDNR (1999), which indicate that average streamflow since 1965 has been 20 percent higher than in previous years. This increase in flow was observed to coincide with an increase in annual precipitation. This suggests that sediment delivery to the lake should be somewhat higher during the latter two survey periods. Instead, the latter two survey periods show lower sedimentation relative to the 1925–1963 period. This suggests that other watershed conditions have been larger factors in determining Lake Vermilion sedimentation rates.

The trap efficiency (percentage portion of sediment captured by the reservoir) of the lake was determined using a predictive equation developed by Dendy (1974) based on the relationship between the annual capacity to inflow ratio and sediment-holding capacity. The trap efficiency of Lake Vermilion was 75 percent in 1925, meaning that 75 percent of all sediment entering the lake was trapped in the lake basin. In the following years, as sediment accumulation reduced the volume of the basin, the holding time for water entering the lake was reduced. This reduction in holding time meant that there was less time for sediment to drop out of suspension and the trap efficiency was reduced. By 1963 and 1976, the trap efficiency was reduced to 67



Note: Maximum and minimum lines and symbols for sub-periods are hidden when they are coincident with the period of record (heavier line) in the figure.

Figure 8. Comparison of a) average monthly flow, b) maximum monthly flow, and c) minimum monthly flow for the Vermilion River near Danville for the three sedimentation periods (1928–1963, 1963–1976, and 1976–1998) and the period of record of the station

and 65 percent, respectively. The 1991 increase in spillway elevation meant that the lake basin volume was again increased, thereby increasing trap efficiency to 74 percent.

Gradual consolidation of lake sediments affects the calculated sedimentation rate of the lake by reducing the volume of accumulated sediments. Sediments accumulate on the bottom of the lake in a very loose, fluid mass. As these sediments are covered by continued sedimentation or are exposed by occasional lake drawdown, they are subject to compaction. This process reduces the volume of the sediments while increasing the weight per unit volume. Thus, the tonnage of the sediments accumulated during a period of time will not change, but the volume of the sediments may be reduced over time by up to 50 percent. This is also consistent with a reduced volumetric sedimentation rate over time. Consolidation of sediments would be most pronounced in the north end of Lake Vermilion. The exposure of sediment in the terrestrial deposits previously mentioned and the shallow water deposits that are subject to frequent exposure due to lake level drawdown would be consolidated on an annual basis.

Overall, sedimentation rates for Lake Vermilion were high for the initial period (1925–1963) with a possible range of 69–89 ac-ft per year. Sedimentation rates for subsequent periods (1963–1976 and 1976–1998) have been considerably lower with slight variations that may reflect variations in streamflow conditions.

Sediment Distribution

The distribution of sediment in the lake is shown in Table 28. This table lists the average sediment thickness and mass distribution for the lake and for each lake calculation segment as shown in Figure 5. Sediment thickness ranges from 2.3 to 9.3 ft. The most significant accumulation by either measure, depth or mass, is in the segments north of Denmark Road and north beyond the old dam.

Density analyses of the sediment samples (Appendix II, Bogner and Hessler, 1999) indicate that sediment north of the old dam has greater unit weight than sediment south of the old dam. In general, coarser sediments are expected to be deposited in the upstream portion of a lake where the entrainment velocity of the stream is reduced to the much slower velocities of a lake environment. These coarser sediments tend to be denser when settled and are subject to drying and higher compaction rates as a result of more frequent drawdown exposure in the shallow water environment. As the remaining sediment load of the stream is transported through the lake, increasingly finer particle sizes and decreasing unit weight are observed.

Sediment Particle-Size Distribution

A total of 16 lakebed sediment samples were collected for particle-size distribution analysis. The laboratory analyses for these samples are presented in Figure 9. Analyses shown in Figure 9a and 9b are particle-size distribution plots for samples collected from the top surface of the accumulated sediments near the center of the designated cross section. These samples show extremely uniform characteristics south of the old dam area (Figure 9a). Surface sediment samples collected north of the old dam show a tendency to become slightly finer from upstream to downstream. This reduction in deposited sediment particle sizes is consistent with

Table 28. Sediment Distribution in Lake Vermilion

Segment from Figure 5	*Sediment accumulation (ac-ft)*	*Sediment weight (tons)*	*Sediment thickness (ft)*	*Sediment per segment acre (tons)*
1	19	13,769	7.1	5,296
2	137	110,387	7.9	6,344
3	560	464,383	5.6	4,648
4	66	54,647	6.1	5,060
5	692	609,088	6.2	5,497
6	125	120,385	2.6	2,498
8	671	648,726	8.1	7,844
9	876	770,804	9.2	8,071
11	598	836,437	9.3	13,069
12	267	368,044	6.7	9,224
13	22	29,223	4.9	6,641
14	154	207,648	4.8	6,469
15	195	267,294	6.3	8,622
16	233	320,873	6.8	9,382
17	283	381,766	4.9	6,548
19	341	420,928	2.3	2,879
Totals	5,238	5,624,404	6.0	6,406

Note: The original (1963) lake survey plan included several lake segments that have not been surveyed for the 1976 or 1998 surveys. Adjacent lake segments have been combined in this analysis. The segment number listed is the lower numbered segment from the original survey plan.

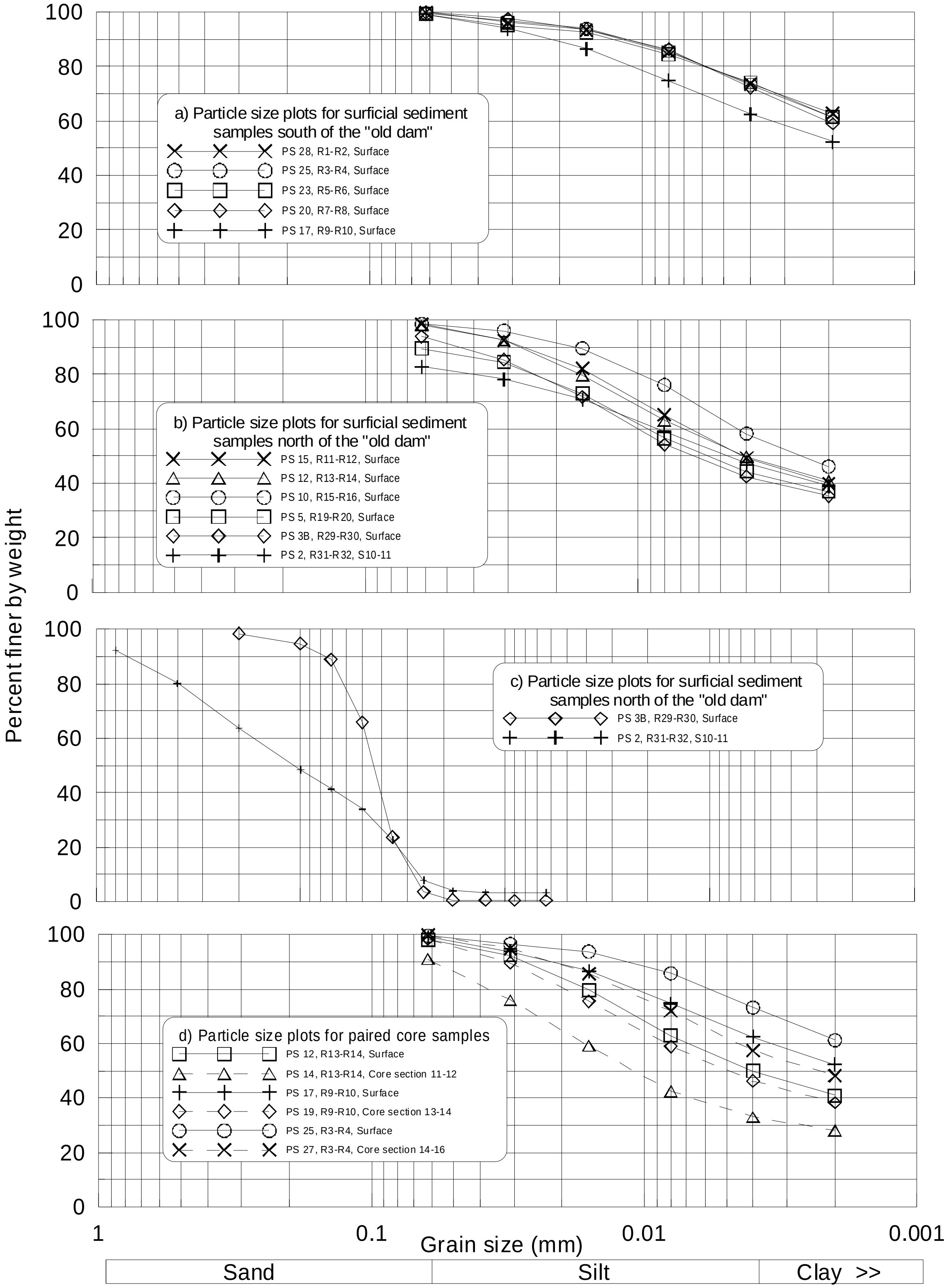


Figure 9. Particle-size (ps) distributions for Lake Vermilion sediment samples

all other Illinois impoundment lakes for which particle-size-distribution data are available. This trend in particle-size distribution is a result of the natural sorting of suspended sediments in the lake environment. Coarser sediments are deposited as the inflowing streamwater is first slowed upon entering the lake. As water moves through the lake, the suspended sediments become finer as the coarser-sized fractions fall out of suspension. At the dam, the suspended sediments are predominantly composed of colloidal and organic materials.

Field examination of two samples indicated sand size material (Figure 9c). Both samples were collected near channel areas of the north end of the lake. All other samples were composed of clay and fine silt-size sediment materials. This would be consistent with general observations concerning sediment distribution in Illinois lakes (Fitzpatrick et al., 1987; Bogner, 1986). These and other sources indicate that the occurrences of sand exceeding 10 percent are unusual for samples collected from lake sediments. In this case the sand was associated with the redevelopment of the stream channel since 1991.

Three sets of samples (Figure 9d) were collected to analyze vertical variations in particle-size distribution. These samples show a temporal trend toward finer sediments in the surface layer at each sample site. This observation is counter to the usual trend in lake sediments. Surficial sediment, the most recently deposited sediment, tends to be coarser over time at a given point. This is due to the downlake shift in the initial depositional environment of the lake due to the loss of trap efficiency of the upper end of the lake. Over time, the initial depositional zone in the lake will move further down the lake because of water volume loss to sedimentation. For Lake Vermilion, this tendency was interrupted by the 1991 spillway increase, which re-established upstream sediment storage capacity.

Hydrologic Budget

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

storage change = inflows - outflows

In general, inflows to the lake include direct precipitation, watershed runoff, groundwater inflow, and pumped input. Outflows include surface evaporation, discharge at the lake outlet, groundwater outflow, and withdrawals. Watershed runoff to the lake was gaged for the area upstream of the USGS station on the North Fork near Bismarck. For this site, provisional discharge records were obtained from the USGS Web site. Final data for this site will not be available in time for the completion of this study. The inflow for the portion of the watershed to the lake below the gage at Bismarck was estimated using a watershed area ratio for the gaged watershed area.

For Lake Vermilion, pumped inputs are not a significant factor because there are no existing pumped inputs to the lake. Groundwater interaction both as inputs and outputs from the lake system has been noted in the geological discussion as potential factors. The groundwater interaction could not be adequately measured for this analysis but will be included in the discussion of undocumented factors. All other factors have been 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 (May 2000–April 2001) during the diagnostic phase of the project. Table 29 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.

The following discussion of the lake-level management system is based on personal observation of the system over a one-year period. It is presented only in the context of preparing a hydrologic budget and should not be construed as adequately describing the detailed operating protocols used by CIWC to manage the spillway and lake levels.

The lake-level management system for Lake Vermilion is somewhat unique for Illinois water-supply impoundments. Most water-supply systems are designed to remove raw (untreated) water directly from an intake structure in the lake. Water releases downstream generally are limited to excess flow capacity when the lake storage requirement has been satisfied. At Lake Vermilion, a constant release of water at the spillway maintains a flow to the treatment plant intakes 2.5 miles downstream. This release always includes some excess water that maintains some flow downstream of the treatment plant.

During storm flows, there is sufficient capacity at the spillway gates to pass almost any flow volume to maintain a stable lake level. The operation of the gates is coordinated by monitoring upstream flow rates and adjusting gate openings at any time interval necessary to maintain a stable lake level. For the one-year observation period, the operating system was very effective. In no case did the observed lake level exceed the projected pool level. Lake levels also never exceeded one foot below the projected pool level.

Lake level variations were so small that storage factors were not major factors in the hydrologic analysis for either a monthly basis or the annual record. In most other years, storage would be a significant factor in the analysis. For example, the lake level was down by more than 4 ft in winter 1999–2000.

Most elements of this analysis were evaluated on the basis of data collected during the monitoring period. These data included:

Inflow to the lake for the area above the USGS gage was directly gaged (262 sq mi of the 298-sq-mi drainage area).

Inflow from the remaining nonlake area was estimated as a ratio of its area to the gaged area: (298-262-1.37)/262 or 13.2 percent.

Direct precipitation on the lake surface was determined on the basis of the National Weather Service precipitation record for Danville times the surface area of the lake, 1.37 sq mi or 878 acres.

Reservoir storage change was determined on the basis of direct monitoring of the lake level during the study. Data were collected by CIWC staff usually on a daily basis.

Table 29. Summary of Hydrologic Fluxes for Lake Vermilion, May 2000–April 2001

	Inflow						*Outflow*					
Date	*Discharge at Bismarck* (ac-ft)	*Direct precipitation* (inches)	*Direct precipitation* (ac-ft)	*Total Measured inflow* (ac-ft)	*Ungaged portion* (ac-ft)	*Total inflow* (ac-ft)	*Discharge at spillway* (ac-ft)	*Evaporation rates* (inches)	*Evaporation rates* (ac-ft)	*Total outflow* (ac-ft)	*Storage* (ac-ft)	*Discrepancy* (ac-ft)
2000												
May	14,826	5.08	372	15,198	1,960	17,157	17,459	4.00	293	17,751	-9	-585
June	18,999	7.16	524	19,523	2,511	22,034	21,673	4.85	355	22,027	9	-2
July	10,712	0.63	46	10,758	1,416	12,174	11,183	5.50	402	11,585	158	430
August	2,658	1.95	143	2,800	351	3,151	2,566	4.71	345	2,911	-255	495
September	1,019	4.43	324	1,343	135	1,477	1,948	3.31	242	2,190	-325	-388
October	1,074	1.77	130	1,204	142	1,346	1,634	2.01	147	1,781	18	-453
November	3,339	3.45	252	3,592	441	4,033	3,916	0.82	60	3,976	492	-435
December	3,738	2.35	172	3,910	494	4,404	3,940	0.33	24	3,965	-351	791
2001												
January	12,085	0.84	61	12,146	1,597	13,743	9,018	0.31	23	9,041	35	4,667
February	54,629	2.90	212	54,841	7,220	62,062	66,499	0.61	45	66,544	184	-4,667
March	12,534	1.15	84	12,618	1,657	14,274	13,264	1.39	102	13,366	114	795
April	12,149	1.90	139	12,288	1,606	13,894	14,666	2.68	196	14,862	-79	-890
Annual	147,762	33.61	2,459	150,221	19,529	169,750	167,766	30.52	2,233	170,000	-9	-240

Note: See text for primary data sources.

Spillway discharge also was determined using records maintained by CIWC staff for water level and spillway gate openings.

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

These values initially were determined for time periods based on the frequency of measurement and then were combined into monthly values that could in turn be combined into annual values.

The summary of these analyses made for a monthly basis is presented in Table 29. Table 30 summarizes the hydrologic budget for the one-year monitoring period. The relative importance of each inflow and outflow component can be be seen in the measures of each value as a percentage of the total inflow volume. During this period, 1.5 percent of the inflow volume to the lake was direct precipitation on the lake surface, 87.0 percent was measured at the Bismarck gaging station, and 11.5 percent was estimated runoff from the ungaged portion of the watershed. Outflow volume was 1.3 percent evaporation and 98.8 percent spillway discharge. The change in storage was less than 0.1 percent.

The discrepancy factor listed in the last column of Table 29 resulted from minor discrepancies in the basic dataset. These include such problems as discharge rating errors due to ice formation, precipitation and evaporation values, and the spillway discharge rating. The large discrepancies in January and February are due to the timing of a storm that affected the stream gage at Bismarck on January 31 and the lake level on February 1. The annual discrepancy factor is less than 0.15 percent of the annual inflow/outflow volumes.

Sediment and Nutrient Fluxes

Sediment and nutrient fluxes for the lake were analyzed using the inflow and outflow volumes determined by 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. For the suspended sediment and the phosphorus load, sufficient data were collected and analyzed to define the variation of the constituent concentration with discharge rates and time by interpolating between data points. Analysis for total nitrogen concentrations appeared to be related more to seasonal factors rather than flow-related factors. Nitrogen concentrations were determined by seasonal average values.

Determination of the suspended sediment and phosphorus inputs and suspended sediment, nitrogen, and phosphorus discharges from the lake was made using a series of interpolated concentration values between measured or inserted points in the time series. The interpolated concentrations were determined for each incremental discharge determined for the hydrologic analysis. Total nitrogen loading to the lake was determined using a seasonal average relationship as follows:

Total nitrogen

May 1, 2000–July 15, 2000	13.0 mg/L
July 16, 2000–August 15, 2000	7.5 mg/L
August 16, 2000–November 20, 2000	1.6 mg/L
November 21, 2000–April 30, 2001	13 mg/L

Table 30. Annual Summary of Hydrologic Fluxes for Lake Vermilion, May 2000–April 2001

Source	*Inflow volume (ac-ft)*	*Outflow volume (ac-ft)*	*Inflow (percent)*	*Outflow (percent)*
Storage change	9			
Direct precipitation	2,459		1.5	
Surface inflow				
Gaged at Bismarck	147,762		87.0	
Ungaged	19,529		11.5	
Spillway discharge		167,766		98.8
Evaporation		2,233		1.3
Totals	169,759	170,000		

Notes: Percentages based on total inflow volume.
Blank spaces - not applicable.

Inserted points in the water-quality datasets refer to the process of placing an unmeasured value for phosphorus and suspended sediment concentrations at the start of a storm event. This alters the application of the higher concentration values for these parameters to the storm discharges and not to the low-flow period preceding the storm. For example, a low-flow sediment concentration value may be collected a week before the start of a storm event. The next sediment concentration sample is collected during the storm event and reflects the higher sediment load due to the storm runoff. An inserted point at the initiation of the storm event extends the sediment concentration value of the preceding week to that point in the hydrograph, thus improving the calculation of interpolated concentration values for that period.

For these water-based sites, concentration is in milligrams per liter. These concentrations were weighted by the incremental discharges corresponding to each concentration value to determine nutrient loading. The results of this analysis are summarized in Table 31 on a monthly basis and Table 32 for the May 2000–April 2001 annual period.

For the one-year monitoring period, the sediment input from the watershed of 45,593 tons represented an annual yield of 0.24 tons per acre from the watershed. This input of sediment was offset by the discharge of 20,171 tons of sediment at the spillway. By subtracting of the outflow of sediment from the lake from the inflow to the lake, the sediment accumulation in the lake for the one-year monitoring period was 25,422 tons. This is an accumulation of 0.133 tons for the year and is comparable to the annualized rate of 0.28 tons of sediment accumulation determined by the 1998 sedimentation survey and presented in Table 26.

No precipitation chemistry samples were collected for this study. Average precipitation chemistry results for a 1997–1998 study of Homer Lake in Champaign County were used to estimate direct precipitation chemistry inputs. These values were 13.9 mg/L of nitrogen and 1.6 mg/L of phosphorous (Lin and Bogner, 2000)

Total nitrogen load from the watershed was 2,580 tons, with an additional 47.4 tons of nitrogen from direct precipitation. This was offset by 1,837 tons of nitrogen discharged at the spillway. There were 791 tons of nitrogen (30.1 percent of the source nitrogen) deposited in Lake Vermilion.

Total phosphorus input to Lake Vermilion was 78.7 tons, of which 73.2 tons originated from watershed runoff and 5.46 tons came from precipitation. Spillway phosphorus discharge from the lake was 53.7 tons. There were 25 tons of phosphorus (31.7 percent of the source phosphorus) deposited in the lake.

All of the sediment input to the lake and 98.2 and 93.1 percent, respectively, of the nitrogen and phosphorus input to the lake originate in the watershed. Just over 44 percent of the sediment input, 69.9 percent of the nitrogen input, and 68.3 percent of the phosphorus input to the lake, leave the lake in flow over the spillway.

Table 31. Monthly Summary of Sediment and Nutrient Fluxes for Lake Vermilion, May 2000–April 2001

	Nutrient inflow to the lake										
	At Bismarck (gage)			*For ungaged area*			*For direct precipitation*		*Total inflow*		
Date	*Sediment (tons)*	*Nitrogen (tons)*	*Phosphorus (tons)*	*Sediment (tons)*	*Nitrogen (tons)*	*Phosphorus (tons)*	*Nitrogen (tons)*	*Phosphorus (tons)*	*Sediment (tons)*	*Nitrogen (tons)*	*Phosphorus (tons)*
2000											
April	107	57.9	0.66	14	7.7	0.09	3.6	0.41	121	69.2	1.16
May	6,255	270.7	7.18	827	35.8	0.95	7.0	0.81	7,082	313.5	8.93
June	3,236	324.8	4.43	428	42.9	0.59	9.9	1.14	3,664	377.7	6.15
July	1,829	181.1	2.02	242	23.9	0.27	0.9	0.10	2,071	206.0	2.39
August	56	21.2	0.43	7	2.8	0.06	2.7	0.31	63	26.7	0.79
September	18	2.1	0.21	2	0.3	0.03	6.1	0.70	20	8.5	0.94
October	6	2.4	0.18	1	0.3	0.02	2.4	0.28	7	5.2	0.48
November	21	19.7	0.41	3	2.6	0.05	4.8	0.55	23	27.1	1.01
December	56	68.3	0.51	7	9.0	0.07	3.2	0.37	63	80.5	0.95
2001											
January	5,240	213.5	7.87	693	28.2	1.04	1.2	0.13	5,933	242.9	9.04
February	23,108	871.8	39.17	3,054	115.2	5.18	4.0	0.46	26,162	991.0	44.80
March	339	245.1	1.61	45	32.4	0.21	1.6	0.18	384	279.1	2.01
Annual	40,271	2,278.8	64.67	5,322	301.2	8.55	47.4	5.46	45,593	2627.4	78.68

Table 31. Concluded

Date	*Discharge at spillway* Sediment (tons)	*Discharge at spillway* Nitrogen (tons)	*Discharge at spillway* Phosphorus (tons)	*Deposition in lake* Sediment (tons)	*Deposition in lake* Nitrogen (tons)	*Deposition in lake* Phosphorus (tons)
2000						
April	57	14.9	0.19	65	54.3	0.97
May	1,687	151.3	2.02	5,395	162.2	6.92
June	1,247	350.6	2.81	2,417	27.1	3.34
July	454	176.8	0.99	1,617	29.1	1.40
August	18	21.2	0.10	45	5.4	0.69
September	43	6.4	0.13	-23	2.2	0.82
October	31	3.6	0.09	-24	1.6	0.40
November	73	9.8	0.32	-49	17.3	0.69
December	61	20.9	0.49	2	59.6	0.47
2001						
January	74	80.7	1.51	5,859	162.2	7.53
February	15,428	788.5	39.75	10,733	202.5	5.06
March	999	211.8	5.32	-615	67.3	-3.31
Annual	20,171	1,836.6	53.72	25,422	790.8	24.96

Table 32. Annual Summary of Sediment and Nutrient Fluxes for Lake Vermilion, May 2000–April 2001

Source	*Sediment load* (*tons*)	*Sediment load* (*percent of total*)	*Total nitrogen* (*tons*)	*Total nitrogen* (*percent of total*)	*Total phosphorus* (*tons*)	*Total phosphorus* (*percent of total*)
Annual sediment and nutrient inflows						
North Fork at Bismarck	40,271	88.3	2,279	86.7	64.67	82.2
Ungaged area	5,322	11.7	301.2	11.5	8.55	10.9
Direct precipitation on the lake			47.4	1.8	5.46	6.9
Total	45,593		2,627		78.68	
Outflow at spillway	20,171	44.2	1,837	69.9	53.72	68.3
Deposition in lake	25,422	55.8	790.8	30.1	24.96	31.7

Internal regeneration of phosphorus is a mechanism by which phosphorus held in the lake sediments becomes available for use in biological processes. The rate of release is dependent on the aerobic condition of the water-sediment interface. Highly anaerobic conditions are more conducive to the release of phosphorus from the sediments.

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/meter^2/year (g/m^2/year) under aerobic conditions and 20 g/m^2/year under anaerobic conditions. The condition of the bottom waters at Lake Vermilion for the monitoring year was never severely anaerobic because thermal stratification never became established. Using the value of 5 g/m^2/year, as much as 19.6 tons of phosphorus may have been regenerated from the sediments of Lake Vermilion during the monitoring year.

BIOLOGICAL RESOURCES AND ECOLOGICAL RELATIONSHIPS

Lake Vermilion and its surrounding woodland and a park provide habitat for fish, waterfowl, shorebirds, and other wildlife. The total area managed by the Vermilion Park District is approximately 1,400 acres, of which 878 acres is water surface. According to biologists, being a large lake makes Lake Vermilion more attractive to wildlife. The abundance of natural community and species diversity is a significant attraction to many users of the area.

Two IDNR publications, *Vermilion River Area Assessment, Volume 3 - Living Resources* (IDNR, 1999) and *The Vermilion River Basin - An Inventory of the Region's Resources* (IDNR, 2000) documented the natural resources in the Vermilion River basin. These describe in detail the natural vegetative communities, birds, mammals, amphibians, and aquatic biota in the Vermilion River watershed. Common species as well as threatened and endangered species of plants and animals are listed.

Local Fauna

Fish

History. Construction of the lake originally was completed in 1925. Since 1940, the IDNR (formerly Illinois Department of Conservation) has stocked fish in Lake Vermilion. Bass and bluegill were stocked in the early 1940s. In addition, crappie, perch, and mixed fish have been stocked in later years. The records of the fish stocking with recent lake management activities are summarized in the cumulative history (first six pages) of Appendix F. Historically, fish stocked in the lake were bluegill, largemouth bass, white crappie, walleye, perch, bullhead, channel catfish, muskie, and mixed fish. The species of fish stocked in recent years were largemouth bass, muskie, and walleye.

A fish kill was recorded on June 30, 1964. No recent fish kills have been reported. Fish flesh analyses were carried out by the IEPA recently (August 29, 1999) and during this study (August 21, 2000).

Appendix F also includes the recent (2002) Lake Management Primary Report prepared by the IDNR. Reports include fishing regulations, fish stocking history, lake management plan progress, fish population survey, stocking success survey, creel surveys, and recommendations.

Fishing Rules. The IDNR set the fishing rules as follows:

Pole and line fishing only (per person), except that a sport fisherman may take carp and carpsuckers by pitchfork, gigs, bow and arrow, or bow and arrow devices north of Boiling Spring Road, but not within 300 ft around the wetland boardwalk.
Two hooks or lures per pole.
Trotline and jug fishing are allowed north of Boiling Spring Road.
A 15-inch minimum length on largemouth or smallmouth bass.
A six fish daily limit on largemouth or smallmouth bass.

A 9-inch minimum length on crappies.
A 25 fish daily limit on crappies.
A 48-inch length and one daily creel limit on muskies.
All others - no limit.

Population Survey. The IDNR has conducted three standard full fish population surveys at Lake Vermilion during June 1996, June 1997, and May 2001. A level 1, long-term standardized fish population (community) survey was conducted on May 29, 2001. The lake was surveyed using an AC-powered electrofishing boat for a total of 150 minutes on three pre-planned routes.

The species collected were enumerated, weighed, and measured in length. Species then were categorized into groups by length. Each group was given a condition factor rating to estimate the overall health. The condition factor is a constant that relates height and width to length for estimation of the growth rates of fish. The statistical results of these three fish population surveys are presented in Appendix F. A total of 573 fish were collected during the 2001 survey. Longear sunfish, bluegill, largemouth bass, white crappie, gizzard shad, green sunfish, and yellow bass composed 21.5, 17.6, 16.5, 12.9, 10.3, 7.3, and 5.8 percent of the fish population, respectively.

A general summary of the major fish species (largemouth bass, bluegill, and white crappie) collected from the 2001 survey follows. The Catch Per Hour (CPH) of electrofishing for largemouth bass was 41, which meets the objective of 40–60 fish per hour. The proportional stock density (PSD) is defined as the number of quality size fish compared to the whole catch fish population based upon bass 200 mm (8-inch) and longer. The PSD or percentage greater than 300 mm (12-inch) was 70 percent, which falls within the optimal range of 40–70 percent. The RSD-15 (relative stock density or percentage greater than 380 mm or 15-inch) was 33 percent, which is above the optimal range of 10–30 percent. The body condition of the bass as expressed by relative weight was 95, which meets the 95–105 optimal range.

On October 3, 2001, a largemouth bass survey was conducted. The bass population was doing very well. The stocking program appears to be working very well in building up the largemouth bass population in Lake Vermilion.

The CPH for bluegill was 44, which is below the management objective of 100–250. Based on bluegill 80 mm (3-inch) and longer, 54 percent were greater than 150 mm (6-inch). This is above the 20–40 percent optimal range. No bluegills collected were over 200 mm (8-inch). Body condition as expressed by relative weight was 102, which is within the optimal range of 95–105.

The CPH for white crappie was 29, which meets the objective of 25–50. Based upon crappie 130 mm (5-inch) and longer, 7 percent were over 200 mm (8-inch). This value is below the optimal range of 40–60 percent. Of white crappie 130 mm and longer, one percent were longer than 250 mm. The optimal range for this size group is 10–20 percent. Body condition using relative weight was 87, well below the 95–105 optimal range. The crappie population is considered fair (average).

The walleye and muskie populations have a few fish left and offer a little hope to anglers for an additional species. The channel catfish population continues to be good, and has been removed from the Illinois Department of Public Health Fish Consumption Advisory List.

The fisheries biologist recommended the following:

Continue the largemouth bass stocking program.
Maintain the current fishing regulations.
Conduct a largemouth bass survey again in the fall.
Conduct a fish community survey in May/June 2003.

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. 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 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. Federal action levels are listed in Table 33.

Fish flesh samples were collected by the IDNR and analyzed by the IEPA. Analyses were performed for channel catfish fillets (without skin) on May 6 and August 29, 1999. During this study, fish flesh samples (fillets without skin) of carp and largemouth bass were analyzed on August 21, 2000; and samples of channel catfish were analyzed on November 2, 2000. The results of fish flesh analyses are given in Tables 33 and 34. Most of the organochlorine tests were below detection levels. Total chlordane, total DDT and analogs, dieldrin, total PCBs, and heptachlor epoxide concentrations were lower than the action levels.

Birds

The watershed is typical of primarily agricultural areas of east-central Illinois. Most nonagricultural habitats exist in narrow riparian areas where the terrain is too steep to plow, usually along the major steams and river systems. Bird species composition in the watershed is typical for agricultural portions of the state; breeding species have benefited from several large public land holdings. These areas contain a variety of grassland and wetland habitats, as well as restored prairies, riparian forest, upland forest, and open lake. Because a number of excellent birders operate in the area, far more is known about the birds here than in any other agricultural area. The approximately 270 bird species that regularly visit the area represent approximately 90 percent of 300 species that regularly occur in the state (IDNR, 1999).

About 140 of those species breed or formerly bred in this area (IDNR, 1999). Currently four State-endangered species (northern harrier, upland sandpiper, short-eared owl, and Henslow's sparrow) and five State-threatened species (pied-billed grebe, least bittern, red-shouldered hawk, brown creeper, and loggerhead shrike) breed here. In 2001 and 2002, several

Table 33. Results of Fish Flesh Analyses, Lake Vermilion, 1999

Organics	*Channel catfish* *05/06/99*	*Channel catfish* *08/29/99*	*Federal action level*
Aldrin	0.01 k	0.01 k	
Total chlordane	0.06	0.05	0.3
Total DDT and analogs	0.07	0.07	5.0
Dieldrin	0.04	0.02	0.3
Endrin	0.01 k	0.01 k	
Total PCBs	0.1 k	0.1 k	2.0
Heptachlor	0.01 k	0.01 k	
Heptachlor epoxide	0.01 k	0.01 k	0.3
Toxaphene	1.0 k	1.0 k	
Methoxychlor	0.05 k	0.05 k	
Hexachlorobenzene	0.01 k	0.01 k	
Alpha-BHC	0.01 k	0.01 k	
Gamma-BHC	0.01 k	0.01 k	
Mirex	0.01 k	0.01 k	
Lipid content, percent	2.4	2.4	
Number of fish	4	4	
Sample weight, pounds	2.10	2.10	
Length, inches	19.5	22.2	

Notes: Unit - g/g, unless specified, fillet samples.
A k indicates that the actual value is known to be less than value the given.
BHC - benzene hexachloride.
DDT - dichloro-diphenyl-trichloro-ethane.
PCBs - polychlorinated biphenyls.
Blank spaces - no data or not applicable.

Table 34. Results of Fish Flesh Analyses, Lake Vermilion, 2000

	08/21/00				*11/02/00*	
Organics	*Carp*		*Largemouth bass*		*Channel catfish*	
Aldrin	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Total chlordane	0.04	0.02	0.02 k	0.02 k	0.04	0.04
Total DDT and analogs	0.05	0.03	0.01 k	0.02	0.06	0.04
Dieldrin	0.02	0.01	0.01 k	0.01 k	0.02	0.01
Endrin	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Total PCBs	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Heptachlor	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Heptachlor epoxide	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Toxaphene	1.0 k	1.0 k	1.0 k	1.0 k	1.0 k	1.0 k
Methoxychlor	0.05 k	0.05 k	0.05 k	0.05 k	0.05 k	0.05 k
Hexachlorobenzene	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Alpha-BHC	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Gamma-BHC	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Mirex	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k	0.01 k
Lipid content, percent	4.1	1.6	0.61	0.82	2.5	3.1
Number of fish	4	4	5	4	3	5
Sample weight, pounds	3.39	5.79	2.24	2.88	2.20	1.07
Length, inches	20.0	24.9	15.9	17.8	19.0	16.3

Notes: Unit - g/g, unless specified, fillet samples.
A k indicates that the actual value is known to be less than the value given.
BHC - benzene hexachloride.
DDT - dichloro-diphenyl-trichloro-ethane.
PCBs - polychlorinated biphenyls.

bald eagles nested in the upper lake area. While several species have disappeared from the area, including the passenger pigeon, Carolina parakeet, and greater prairie chicken, the wild turkey has been reestablished successfully, especially along the Middle Fork and Big and Little Vermilion River valleys where it nests in scrublands and prairies adjacent to forest (IDNR, 2000).

Habitat quality for birds is good, but there is potential for improvement. For example, upland forests could be managed to maintain oak trees, and floodplain forests to maintain sycamores. A high priority in the basin should be to restore forested wetlands. Also, grasslands should be expanded to at least 100 acres and be burned or mowed on a three-year schedule to accommodate grassland birds. As the breeding habitat continues to improve, perhaps the sandhill crane, Swainson's hawk, and yellow-headed blackbird will return, not only as migrants, but once again to breed along the Vermilion River (IDNR, 2000).

Canada geese (*Branta canadensis*) and ducks (mostly mallards, *Anas platyrhynchos*) migrate through Illinois in fall and spring. There are no quantitative data for bird populations in the study area. Waterfowl supported by the lake include migratory use by all species of common ducks, geese, and wading birds. Some shorebird use is noted in late summer on mud flats. Breeding bird use should include wood ducks, and green-backed herons.

Gwiazda (1996) reported that one gram of the feces of mallard ducks contains 8.5 mg phosphorus and 53.1 mg nitrogen. The mallard defecated 0.42 g of phosphorus and 2.62 g of nitrogen per day per individual in Poland. Manny et al. (1994) determined that the daily nutrient load to Wintergreen Lake, Michigan, by an average, migrant Canada goose was 24.86 g carbon, 1.57 g nitrogen, and 0.49 g phosphorus. They proposed annual phosphorus loading rate as follows:

Annual phosphorus loading rate (in g/year) = k   UD

where k = 0.49 for geese
= 0.22 for dabbling duck
= 0.19 for diving duck
UD = effective use days

No waterfowl survey has been conducted by the IDNR. However, according to Ken Konsis (Director of Vermilion County Conservation District, personal communication, 2000), there are approximately 100 resident ducks and 1,000 migrant geese around Lake Vermilion. The geese stay from a few days to one week during the spring and fall migrations. It is not known whether the resident population is dabbling or diving ducks.

Assuming k = 0.20 for 100 ducks with 50 percent UD during a year, annual phosphorus loading rate by ducks is 3,650 g phosphorus/year (0.20   100   365   0.5) or 8.05 lb phosphorus/year. For 1,000 migrant geese, assuming the 5 UD each for spring and fall, the annual phosphorus loading rate would be 4,900 g phosphorus/year (0.49   1,000   5   2) or 10.80 lb phosphorus/year. The total phosphorus loading rate by waterfowl is an estimated 8,550 g phosphorus/year or 18.85 lb phosphorus/year.

By proportion (using Manny et al. nutrient ratios), annual nitrogen and carbon loading rates would be, respectively, 27,400 g nitrogen/year (8,550   1.57/0.49, or 60.4 lb nitrogen/year) and 434,000 g carbon/year (8,550   24.86/0.49, or 956 lb carbon/year).

For nitrogen and phosphorus, these values are 0.002 and 0.01 percent, respectively, of the annual nutrient input to the lake.

Mammals

Jack Williams (1930) wrote in the *History of Vermilion County*, "As late as 1857 there were a great many deer here. Wolves were as thick as rabbits as late as 1858. Of a flock of sheep which had gotten away from a man in the northern part of the township eighty were killed in one night by wolves." Wolves have been extirpated from the county and the state for quite some time, while the white tail deer has enjoyed a successful re-introduction (IDNR, 2000).

Forty-six species representing 78 percent of the state's 59 mammal species are known to be in the basin. Two of these species are listed as federally endangered, the Indiana bat and the State-threatened river otter (IDNR, 1999). As part of the IDNR's river otter re-introduction program, 30 otters were released in the basin between 1996 and 1997. The first released otter at Kennekuk County Park was witnessed by 2,000 interested spectators, many of whom had provided funding for the otters. Since then, otter sightings are reported in the Vermilion County Conservation District newsletter. In 1998, the newsletter reported that an adult otter with young was sighted in an area where otters had not been released, a promising sign for the otter's future in the Vermilion River basin (IDNR, 2000).

Mammal species known or likely to occur in the area are restricted to forested habitats. They are the hoary bat, eastern chipmunk, southern flying squirrel, woodland vole, gray fox, Virginia opossum, red bat, fox and gray squirrels, white-footed mouse, raccoon, and white-tailed deer (IDNR, 1999). Other bats, such as little brown bat, big brown bat, northern long-eared bat, eastern pipisstrelle, and evening bat forage in forested habitats and nest in trees or by man-made structures such as buildings. The federally endangered Indiana bat has been found at two locations in the Vermilion River area. One of these is a maternity colony that roosts primarily between slabs of exfoliating bark on dead trees. Roost trees have been located in both upland and floodplain forests; most of the trees are relatively large with a diameter of at least 30 cm (IDNR, 2000).

Mammal species restricted to prairie/grassland habitats are the least shrew, 13-lined and Franklin's ground squirrels, western harvest mouse, deer mouse, prairie and meadow voles, badger, southern shrew, northern short-tailed shrew, eastern cottontail, woodchuck, southern bog lemming, meadow jumping mouse, and red fox (IDNR, 1999).

Mammal species in the watershed requiring wetland or aquatic habitats are the beaver, muskrat, and river otter. Raccoons and opossums are most abundant in areas near water. Other species such as bats, southern shrew, northern short-tailed shrew, southern bog lemming, and meadow jumping mouse use emergent wetlands (IDNR, 1999).

Reptiles and Amphibians

Chester Loomis wrote, "Of reptiles, they have rattle-snakes, of two kinds, large and small; black snakes, copper heads, and the glass snake. The latter is a curiosity. Upon striking a slight blow with a small stick, it will generally break into several pieces." [The glass snake is actually a lizard with a break-away tail] (IDNR, 2000).

Twenty-three amphibian species and 27 reptile species occur in the Vermilion River watershed, representing 57 percent of the amphibian species and 45 percent of the reptiles that regularly occur in the state. The State-endangered silvery salamander (*Ambystoma platineum*) and the State-threatened four-toed salamander (*Hemidactylium scutatum*) are known to exist in the Vermilion River area. The status of the State-threatened Kirtland's snake (*Clonophis kirtlandii*) is uncertain, but the State-endangered eastern massasauga (*Sistrurus catenatus*) has been extirpated from the area due to the draining of prairie wetlands (IDNR, 1999). Jack

Williams wrote, "There were lots badgers, rattlesnakes were everywhere. They were so plentiful that on a single farm a hundred were killed in one season. They were dangerous neighbors. They seem as adverse to civilization as any of the wild animals. As soon as the prairie grass was plowed or cultivated they disappeared. Scarcely any of them have been seen here since 1870" (IDNR, 2000).

The State-threatened four-toed salamander is associated with undisturbed forests containing seeps or bogs, although they may also be found near rocky, spring-fed creeks. Females congregate near woodland ponds in March and April for egg laying and brooding. The most common nest sites are in sphagnum mats, but grass hummocks, leaf litter, rotten logs, and undercut streambanks also are used. The nests are situated so the larvae fall directly into the water when the eggs hatch. The main threat to this species is draining the breeding ponds or artificially stocking them with fish.

The Middle Fork Woods Nature Preserve, a remnant of the vast mesic forest that once occurred in the area, harbors the state's only native colony of the endangered silvery salamander. This salamander inhabits underground burrows and runways constructed by rodents and shrews in forested areas. During late winter adults come to the surface and migrate to woodland ponds and wetlands to reproduce during late winter: these ponds must be fishless and retain water until the aquatic larvae transform into terrestrial juveniles, usually in mid-June. What makes the silvery salamander unique is that it requires the presence of the smallmouth salamander to stimulate embryonic development. Silvery salamanders have no males. The population at the Middle Fork shares this bizarre characteristic with silvery salamanders in other areas of its range, but takes it one step further—it interbreeds with the smallmouth salamander.

River Biota

The Vermilion River and its tributaries support a large diversity of aquatic species: 97 species of fishes, 45 species of mussels, 16 species of large crustaceans, and 540 species of aquatic macroinvertebrates (IDNR, 1999).

Chester Loomis again writes, "Fish in great numbers are every where swimming in its waters. Some of them of 15 or 20 pounds weight" (IDNR, 2000). Today, the headwaters are dominated by creek chubs and orangethroat darters; the creeks by spotfin, sand and striped shiners, stonecats, and jonny darters; and the larger river habitats by bluntnose minnows, golden redhorses, longear sunfish, and spotted bass. Listed species from the area include the State-threatened river redhorse and the State-endangered bigeye chub, bigeye shiner, river chub, northern madtom, Iowa darter, eastern sand darter, and bluebreast darter (IDNR, 1999). The bluebreast darter is found in Illinois only within the Vermilion River area. Once near extirpation in Illinois, this species has made a dramatic comeback following recent improvements in water quality (IDNR, 2000).

The North Fork Vermilion River supports the greatest concentration of rare, threatened, or endangered mussels in Illinois and its protection is crucial to the continued survival of those species. A ten-square-mile area in Vermilion County supports as many freshwater mussel species as the entire Illinois River. Ten endangered mussel species are still thought to be present in the drainage: slippershell, clubshell, rabbitsfoot, wavy-rayed lampmussel, round hickorynut, kidneyshell, purple lilliput, rayed bean, rainbow, and little spectaclecase. Many of these are found nowhere else in Illinois. The clubshell, also listed as federally endangered, was thought to have been extirpated from the state, but a live clubshell was found in the North Fork Vermilion

River in September1998. This is the only known population of clubshell in the state (IDNR, 2000).

Local Flora

The native vegetation of the Vermilion River area was mostly tallgrass prairie. Forest, savannas, and wetlands were concentrated primarily on the slopes, ravines, and bottomlands. Beginning with the flowering of skunk cabbage in late February, to the final goldenrods of Indian Summer, the Vermilion River basin is a curious mix of plant species.

Twenty-eight percent of the state's flora (908 taxa) grow in the basin. Four State-threatened species (fibrous-rooted sedge, drooping sedge, Willdenow's sedge, and false hellebore) and two State-endangered plants (Wolf's bluegrass and Queen of the Prairie) are found here. Several populations of fibrous-rooted sedge and false hellebore are found in the Vermilion River area, whereas Queen of the Prairie is represented by 50 plants and drooping sedge by 20 plants, each in a single location (IDNR, 1999). The population of Wolf's bluegrass is found at the base of a seep that has been actively slumping. As a result, the population is not secure, and it could soon be extirpated. Five species that occurred historically within the area have been extirpated for many years: heartleaved plantain, prairie dandelion, white lady's slipper, showy lady's slipper, and buffalo clover (IDNR, 2000).

Forest

Approximately 5.2 percent of Vermilion River watershed remains in forest cover currently. There are nine natural preserves in Vermilion County. Certain native species (black snakeroot and honewort) are often abundant in grazed forests. Other plants are honey locust, Missouri gooseberry, prickly ash, red haw, and Rubus species. Exotic species are garlic mustard, Japanese barberry, multiflora rose, and Osage orange.

The dominant canopy species in dry upland forests are white oak and black oak. Occasional species include Chinquapin oak, red cedar, shagbark hickory, mockernut hickory, pignut hickory, shingle oak, and white ash.

Common to occasional canopy species in floodplain forest are American elm, bitternut hickory, black walnut, box elder, cottonwood, green ash, hackberry, honey locust, mockernut hickory, pin oak, silver maple, and slippery elm. Subcanopy species include red haw and red mulberry. Shrubs and vines include common blackberry, elderberry, bristly catbrier, leatherflower, poison ivy, riverbank grape, and trumpet creeper.

Prairie

Approximately 8.5 percent of Vermilion River watershed is tallgrass prairie. Common grass in dry-mesic prairie include crested hair grass, Indian grass, little bluestem, panic grass, porcupine grass, and prairie dropseed. Common grass species in the mesic prairie include big bluestem, Indian grass, little bluestem, panic grass, porcupine grass, prairie dropseed, and prairie switch grass.

Common grass species in wet-mesic prairie include big bluestem, blue-joint grass, Indian grass, and prairie cord grass. Blue-joint grass and prairie cord grass also are characterized as wet prairie grass species. Big bluestem, Indian grass, little bluestem, poverty oak grass, and side oaks gramma are found in hill prairie areas (IDNR, 1999).

Prairies support not only the common species of prairie dock, coneflower, and big bluestem, but also the unusual species, such as Indian paintbrush and ladies' tresses orchids. Here species are present that are restricted to rich forest habitats: squirrel corn, Gleason's trillium, celandine poppy, and hepatica. Also present are species that are of extremely limited occurrence in Illinois: squaw root, fire pink, yellow lady's slipper, and beech drops, a parasite of the equally restricted American beech (IDNR, 2000).

Savanna

Savannas are characterized by scattered, open-growth trees, with or without shrubs, and a continuous herbaceous groundcover typically dominated by graminoid species (grasses and sedges) and numerous forbs. Three savannas subclasses are recognized in Illinois: savanna (generally on fine-textured soils), sand savannas and barrens (prairie flora on shallow soils, within an otherwise forested landscape). The common species in dry-mesic savana include oak and white oak. The occasional species are black cherry, blue ash, chinquapin oak, sassafras, shagbark hickory, shingle oak, and white ash. A few rare plants occur in savanna habitats include buffalo clover, ear-leafed foxglove, and prairie trout-lily.

Species established in mesic savanna include American elm, basswood, blue ash, hackberry, honey locust, red oak, sassafras, shagbark hickory, slippery elm, sugar maple, white oak, and yellow poplar (IDNR, 1999).

Wetland

There are approximately 9,438 acres of wetland in the Vermilion River watershed. Wetland community classifactions include mesic, wet-mesic, wet floodplain forest (about 64 percent of total), marsh (17.3 percent), swamp, shrub swamp, seep, calcareous seep, and spring.

Characteristic graminoid species in marsh include the grasses fowl manna grass, prairie cord grass, reed canary grass, Virginia wild rye, and several species of sedges. Common forb and other monocot species include arrowleaf, blue flag, clearweed, common boneset, common cattail, common water horehound, field mint, fog fruit, groundnut, pale dock, swamp milkweed, sweet flag, water hemloak, and water smartweed. Black willow, green ash, and silver maple are common trees associated with marshes in the area.

Within the Vermilion River watershed, dominant canopy species are black ash, green ash, and silver maple. Occasional trees include American elm, cottonwood, Ohio buckeye, swamp white oak, and sycamore. The dominant shrub species is button bush. Occasional shrubs include bladdernut, hazelnut, Missouri gooseberry, prickly ash, and spicebush.

Common herbaceous species include beggar ticks, bitter cress, blue flag, blue skullcap, clearweed, common beggar ticks, common water plantain, dotted smartweed, duckweed, grasses, green stemmed Joe Pye weed, late goldenrod, panicled aster, sedges, sensitive fern, shining bedstraw, side-flowered aster, spotted touch-me-not, three-seeded mercury, water parsnip, white avens, and yellow water crowfoot (IDNR, 1999)

Seeps are wetland communities characterized by a constant diffused flow of groundwater, typically from the lower portions of slopes of glacial moraines, ravines, and terraces. Three high-quality seep communities are found in the Vermilion River area, and all three are nature preserves. Howard's Hollow Seep is a one-acre wetland in the 30-acre Forest Glen Forest Preserve. Forest Glen Seep is a seep community on a terrace above the Vermilion River in the northeast corner of Forest Glen Forest Preserve. The third seep community is found within Windfall Prairie Nature Preserve.

Herbaceous species in seep and swamp areas include a diverse assortment of graminoid. Forb species including arrowleaf, blue lobelia, blue skullcap, bog clearweed, bulrush, common boneset, common cattail, cup plant, dotted smartweed, false nettle, fen thistle, goldenglow, boneset, late goldenrod, grasses (fowl manna grass, reed canary grass, rice cutgrass, stout wood reed, and white grass), marsh fleabane, marsh marigold, panicled aster, sedges, side-flowered aster, skunk cabbage, spotted touch-me-not, swamp buttercup, swamp milkweed, sweet-scented bedstraw, water parsnip, and white avens. Woody plants include alternate leaved dogwood, American elm, black ash, gray dogwood, green ash, pale dogwood, poison ivy, riverbank grape, and Virginia creeper.

Common species of macrophytes include American bulrush (Scirpus americanus), beggar ticks, bog clearweed, clearweed, common boneset, common cattail, common horsetail, common mountain mint, Dudley's rush, grass-of-Parnassus, grasses (common red reed and rice cut grass), Jerusalem artichoke, nodding beggar ticks, pale dock, Riddel's goldenrod, rough-leaf goldenrod, sedges, scouring rush, side-flowered aster, spotted touch-me-not, white turtlehead, scouring rush, spotted Joe Pye weed, swamp wood betony, and whorled loosestrife. Occasional shrubs include heart-leaved willow and sandbar willow (IDNR, 1999).

REFERENCES

American Public Health Association, American Water Works Association, and Water Environment Federation. 1998. *Standard Methods for the Examination of Water and Wastewater*, 20th ed. APHA, Washington, DC.

Bhowmik, N.G., W.C. Bogner, J.A. Slowikowski, and J.R. Adams. 1993. *Source Monitoring and Evaluation of Sediment Inputs for Peoria Lake.* Illinois Department of Energy and Natural Resources Report number ILENR/RE-WR-93/01, Springfield, IL.

Bogner, W.C. 1986. *Sedimentation Survey of Lake Pittsfield, Pike County, Illinois*. Illinois State Water Survey Contract Report 401, Champaign, IL.

Bogner,W., and J. Gibb. 1977. *Sediment Survey of Lake Vermilion, Danville, Illinois*. Illinois State Water Survey Letter Report, Urbana, IL.

Bogner, W.C., and K.E. Hessler. 1999. *Sedimentation Survey of Lake Vermilion, Vermilion County, Illinois.* Illinois State Water Survey Contract Report 643, Champaign, IL.

Brune, G.M. 1953. Trap Efficiency of Reservoirs. *American Geophysical Union* **34**:407-418.

Carlson, R.E. 1977. A Trophic State Index for Lakes. *Limnology and Oceanography* **22**(2):361–369.

Committee on Sanitary Engineering Research. 1960. Solubility of Atmospheric Oxygen in Water. *Journal of the Sanitary Engineering Division* **82**(12):1115–1130.

Demissie, M., N.G. Bhowmik, and J.R Adams. 1983. *Hydrology, Hydraulics, and Sediment Transport, Kankakee and Iroquois Rivers.* Illinois State Water Survey Report of Investigation 103, Urbana, IL.

Dendy, F.E. 1974. Sediment Trap Efficiency of Small Reservoirs. *Transactions of the American Society of Agricultural Engineers* **15**(5):898–901.

Ekblom, P. and K. Krogerus. 2003. Determining Algal-available Phosphorus of differing Origin: Routine Phosphorus Analysis Versus Algal Assays. Hydrobiologia **492**: 29-42

.

Fitzpatrick, W.P., W.C. Bogner, and N.G. Bhowmik. 1987. *Sedimentation and Hydrologic Processes in Lake Decatur and Its Watershed*. Illinois State Water Survey Report of Investigation 107, Champaign, IL.

Gaquin, D.A., and K.A. DeBrandt (eds.). 2001. *2001 County and City Extra: Annual Metro, City and County Data Book*. 10th ed., Bernan Essential Government Publications, Labham, MD.

Great Lakes Upper Mississippi River Board of State Sanitary Engineers. 1975. *Recommended Standards for Bathing Beaches*. Health Education Service, Albany, NY.

Gwiazda R. 1996. Contribution of water birds to nutrient loading to the ecosystem of mesotrophic reservoir. *Ekologia Polska* **44**(3/4): 289–297.

Hudson, H.L., R.J. Kirschner, and J.J. Clark. 1992. *Clean Lakes Program, Phase 1 Diagnostic/Feasibility Study of McCullom Lake, McHenry County, Illinois*. Northeastern Illinois Planning Commission, Chicago, IL.

Hutchinson, G.E. 1957. *A Treatise on Limnology, Vol. 1: Geography, Physics, and Chemistry*. John Wiley & Sons, Inc., New York, NY.

Illinois Department of Natural Resources. 1999. *Vermilion River Area Assessment-Volume 3: Living Resources*. IDNR, Springfield, IL.

Illinois Department of Natural Resources. 2000. *The Vermilion River Basin - An Inventory of the Region's Resources.* IDNR, Springfield, IL.

Illinois Environmental Protection Agency. 1978. *Assessment and Classification of Illinois Lakes, Vol. II*. IEPA, Springfield, IL.

Illinois Environmental Protection Agency. 1987. *Quality Assurance and Field Methods Manual*. Division of Water Pollution Control, Planning Section, IEPA, Springfield, IL.

Illinois Environmental Protection Agency. 1994. *Field Quality Assurance Manual, Section H: Lake Monitoring, Revision No. 3*. Division of Water Pollution Control, Planning Section, IEPA, Springfield, IL.

Illinois Environmental Protection Agency. 1998. *Illinois Water Quality Report 1998 Update.* Bureau of Water, IEPA, Springfield, IL.

Illinois Environmental Protection Agency. 2000. *Illinois Water Quality Report 2000.* IEPA/BOW/00-005, Bureau of Water, IEPA, Springfield, IL.

Illinois Environmental Protection Agency. 2002. *Title 35: Environmental Protection, Subtitle C: Water Pollution*. State of Illinois, Rules and Regulations, IEPA, Springfield, IL.

Illinois State Water Survey. 1967. *Reservoir Sedimentation*. Illinois State Water Survey Technical Letter 3A, Champaign, IL.

Indiana Department of Environmental Management. 1992. *Indiana 305(b) Report 1990–91*. Office of Water Management, Indianapolis, IN.

Kelly, M.H., and R.L. Hite. 1981. *Chemical Analysis of Surficial Sediments from 63 Illinois Lakes, Summer 1979*. Illinois Environmental Protection Agency, Springfield, IL.

Larson, D.R., J.P. Kempton, and S. Meyer. 1997. *Geologic, Geophysical, and Hydrologic Investigations for a Supplemental Municipal Groundwater supply, Danville, Illinois*. Illinois State Geological Survey and Illinois State Water Survey Cooperative Groundwater Report 18, Urbana, IL.

Lin, S.L., and W.C. Bogner. 2000. *Phase I: Diagnostic-Feasibility Study of Homer Lake, Champaign County, Illinois.* Illinois State Water Survey Contract Report 2000-13, Champaign, IL.

Lin, S.D, W.C. Bogner, and R.K. Raman. 1999. *Phase I: Diagnostic-Feasibility Study of Otter Lake, Macoupin County, Illinois.* Illinois State Water Survey Contract Report 652, Champaign, IL.

Lin, S.D., R.K. Raman, W.C. Bogner, J.A. Slowikowski, G.S. Roadcap, and D.L. Hullinger. 1996. *Diagnostic-Feasibility Study of Wolf Lake, Cook County, Illinois, and Lake County, Indiana.* Illinois State Water Survey Contract Report 604, Champaign, IL.

Mackenthun, K.M. 1969. *The Practice of Water Pollution Biology*. U.S. Department of the Interior, Federal Water Pollution Control Administration, Washington, DC.

Macoupin County Soil and Water Conservation District. 1995. *Otter Lake Ecosystem Plan*. Macoupin County, Carlinville, IL.

Manny, B.A., W.C. Johnson, and R.G. Wetzel. 1994. Nutrient addition by waterfowl to lakes and reservoirs: Prediction their effects on productivity and water quality. *Hydrobiologia* **279–280**(0):121–132.

Neibel, D.W., and J.B. Stall. 1964. *Report on Sedimentation in Lake Vermilion, Danville, Illinois*. Illinois State Water Survey Letter Report, Urbana, IL.

Rand McNally Company. 2001. *Rand McNally 2001 Commercial Atlas and Marketing Guide*, 132th ed., Rand McNally Co., Chicago, IL.

Roberts, W., and J.B. Stall. 1967. *Lake Evaporation in Illinois*. Illinois State Water Survey Report of Investigation 57, Urbana, IL.

Sawyer, C.N. 1952. Some Aspects of Phosphate in Relation to Lake Fertilization. *Sewage and Industrial Wastes* **24**(6):768–776.

Sefton, D.F. and J.R. Little. 1984. *Classification/needs assessment of Illinois lakes for protection, restoration, and management*. IEPA, Springfield, IL.

Selkregg, L.F., and J.P. Kempton. 1958. *Groundwater Geology in East-Central Illinois, A Preliminary Geologic Report*. Illinois State Geological Survey Circular 248, Urbana, IL.

Singh, K.P. 1978. *Water Supply Alternatives for the City of Danville.* Illinois State Water Survey Contract Report 196, Urbana, IL

Singh, K.P., and A. Durgunoglu. 1990. *An Improved Method for Estimating Future Reservoir Storage Capacities: Application to Surface Water Supply Reservoirs in Illinois, Second Edition*. Illinois State Water Survey Contract Report 493, Champaign, IL.

U.S. Department of Agriculture, Natural Resources Conservation Service. 1996. *Soil Survey of Vermilion County, Illinois.* Illinois Agricultural Experiment Station Soil Report 141, Urbana, IL.

U.S. Department of Agriculture-Soil Conservation Service. 1968. *SCS National Engineering Handbook, Section 3, Sedimentation*. USDA-SCS, Washington, DC.

U.S. Department of Agriculture-Soil Conservation Service. 1982. *Soil Survey of Iroquois County*. Illinois Agricultural Experiment Station Soil Report 115, Urbana, IL.

U.S. Environmental Protection Agency. 1980. *Clean Lakes Program Guidance Manual*. EPA 440/5-81-003. Office of Water Regulation and Standards, Washington, DC.

U.S. Food and Drug Administration. 1998. *Fish and Fishery Products Hazards and Controls Guidelines* (vm.cfsan.fda.gov/~dms/haccp-2i.html accessed 2002).

U.S. Geological Survey. 1974. *Hydrologic Unit Map-1974, State of Illinois*. USGS, Reston, VA.

U.S. Geological Survey. 1979. *Water Resources Data for Illinois.* Water-Data Report IL-79-l. USGS, Champaign, IL.

University of Illinois. 1999. *Statistics in Illinois*. Champaign, IL.

Upper Mississippi River Comprehensive Basin Study Coordinating Committee. 1970. *Upper Mississippi River Comprehensive Basin Study, Volume III.* "Appendix G: Fluvial Sediment". Prepared by: U.S. Army Engineer District, Rock Island; Department of the Interior, U.S. Geological Survey; Department of Agriculture, Soil Conservation Service; and the State of Illinois. U.S. Army Engineer District, Rock Island, IL.

Vollenweider, R.A. 1968. *Scientific Fundamentals of Lakes and Flowing Waters, with Particular Reference to Nitrogen and Phosphorus as Factors in Eutrophication*. DAS/CSI/68.27. Organization for Economic Cooperation and Development, Paris, France.

Wang, W.C., W.T. Sullivan, and R.L. Evans. 1973. *A Technique for Evaluating Algal Growth Potential in Illinois Surface Waters*. Illinois State Water Survey Report of Investigation 72. Urbana, IL.

Wascher, H., R.S. Smith, and L.H. Smith. 1938. *Vermilion County Soils.* University of Illinois-Agriculture Experiment Station Soils Report 62, Urbana, IL.

Wayne, W.J., G.H. Johnson, and S.J. Keller. 1966. *Geologic Map of the 1 x 2 Danville Quadrangle, Indiana and Illinois, Showing Bedrock and Unconsolidated Deposits.* Indiana Geological Survey Regional Geologic Map, No. 2, Indianapolis, IN.

J.M. Williams. 1930. *History of Vermilion County, Illinois*. Historical Pub. Co., Topeka, KS, Indianapolis, IN.

Willman, H.B. and others. 1967. *Geological Map of Illinois, 1:500,000 scale.* Illinois State Geological Survey, Urbana, IL.

Willman, H. B., E. Atherton, T.C. Buschbach, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon. 1975. *Handbook of Illinois Stratigraphy.* Illinois State Geological Survey Bulletin 95, Urbana, IL.

APPENDIX A. HISTORICAL WATER QUALITY CHARACTERISTICS, LAKE VERMILION

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

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans-parency (in.)*	*Conduc-tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos-phorus (mg/L)*	*Total depth (ft)*
07/02/77	0		21.6	580	8.00	160		15	5	0.00		3.00			
06/28/79	1	5.5	22.0	630	7.55	210	0	8	3	0.06	0.80	5.10	0.050	0.020	
09/05/79	1	5.2	16.0	434	8.50	160	0	11	3	0.01	1.00	3.80	0.050	0.010 k	14.0
05/18/83	1	15.0	10.0	507	7.60	170	0	19	8	0.10 k	0.80	8.00	0.110	0.101	12.5
04/21/97	1	8.0	24.0	565	8.10	190	10	19	6	0.04	0.69	7.80	0.040	0.010	20.0
06/09/97	1	17.0	12.0	537	7.50	170	0	30	5	0.12	0.97	12.30	0.107	0.053	20.0
07/14/97															
08/12/97	1	16.0	18.0	437	7.80	154	0	20	4	0.50	0.88	2.10	0.084	0.026	19.0
10/22/97	1	20.0	18.0	472	8.50	196	10	17	5	0.27	0.94	0.12	0.096	0.026	18.0
Count		7	8	8	8	8	7	8	8	8	7	8	7	7	6
Maximum		20	24	630	8.5	210	10	30	8	0.50	1.00	12.30	0.110	0.101	20
Minimum		5.2	10	434	7.5	154	0	8	3	0.00	0.69	0.12	0.040	0.010	12.5
Average		12.4	17.7	520		176	3	17	5	0.14	0.87	5.28	0.077	0.035	17.3
S.D.		6.0	4.9	70		20	5	7	2	0.17	0.11	3.91	0.030	0.032	3.2

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

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

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans-parency (in.)*	*Conduc-tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos-phorus (mg/L)*	*Total depth (ft)*
07/02/77	0		15.6	590	8.4	168		23	6	0.10		2.40	0.110		
06/28/79	1	32.0	10.0	595	8.0	110	0	68	27	0.03	2.50	4.20	0.280	0.020	
09/05/79	1	3.6	12.0	515	8.4	190	0	15	4	0.02	0.70	3.80	0.060	0.010 k	7.0
05/18/83	1	16.0	10.0	550	7.6	195	0	59	9	0.10 k	1.00	8.80	0.114	0.054	6.5
04/21/97	1	6.1	18.0	578	8.0	210	0	19	6	0.06	0.69	7.70	0.035	0.008	10.0
06/09/97	1	11.0	6.0	426	7.4	120	0	80	14	0.14	1.14	11.20	0.244	0.110	20.0
07/14/97	1	7.2	26.0	428	8.2	174	6	18	6	0.06	0.87	6.20	0.054	0.009	11.0
08/12/97	1	17.0	18.0	444	8.0	162	0	19	5	0.34	0.67	1.78	0.069	0.018	10.0
10/22/97	1	19.0	24.0	474	8.6	200	16	11	3	0.21	1.10	0.01 k	0.073	0.018	9.0
Count		8	9	9	9	9	8	9	9	9	8	9	9	8	7
Maximum		32	26	595	8.6	210	16	80	27	0.34	2.5	11.2	0.280	0.110	20
Minimum		3.6	6	426	7.4	110	0	11	3	0.02	0.67	0.01	0.035	0.008	6.5
Average		14.0	15.5	511		170	3	35	9	0.12	1.08	5.12	0.115	0.031	10.5
S.D.		9.2	6.7	70		35	6	26	8	0.10	0.60	3.63	0.087	0.035	4.5

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

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

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans-parency (in.)*	*Conduc-tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos-phorus (mg/L)*	*Total depth (ft)*
07/02/77	0		6.0	620	8.4	198		97	16	0.00		1.20	0.300		
06/28/79	1	37.0	6.0	610	7.8	220	10	66	16	0.02	2.10	3.70	0.240	0.020	
09/05/79	1	30.0	6.0	660	8.0	280	0	58	5	0.03	0.70	3.60	0.160	0.070	3.0
05/18/83	1	14.0	7.0	596	7.6	215	0	52	5	0.10 k	0.80	1.30	0.098	0.028	2.5
04/21/97	1	8.0	16.0	585	8.0	210	0	14	5	0.13	0.64	7.40	0.035	0.007	5.0
06/09/97	1	22.0	6.0	402	7.3	125	0	86	12	0.13	1.60	11.30	0.304	0.155	5.0
07/14/97	1	15.0	14.0	521	8.0	182	8	36	6	0.09	0.87	5.70	0.083	0.018	5.0
08/12/97	1	13.0	10.0	460	7.9	168	0	78	14	0.45	0.84	1.11	0.142	0.032	5.0
10/22/97	1	17.0	16.0	496	8.6	200	10	23	6	0.21	1.10	0.01 k	0.102	0.018	3.0
Count		8	9	9	9	9	8	9	9	9	8	9	9	8	7
Maximum		37	16	660	8.6	280	10	97	16	0.45	2.1	11.3	0.304	0.155	5
Minimum		8	6	402	7.3	125	0	14	5	0.00	0.64	0.01	0.035	0.007	2.5
Average		19.5	10	550		200	4	57	9	0.13	1.08	3.92	0.163	0.044	4.1
S.D.		9.7	4	85		42	5	28	5	0.14	0.51	3.66	0.097	0.049	1.2

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

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

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans- parency (in.)*	*Conduc- tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol- phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia- nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite- nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos- phorus (mg/L)*	*Total depth (ft)*
07/02/77															
06/28/79	14	20.0		630	7.31	230	0	20	4	0.24	0.90	4.50	0.080	0.040	
09/05/79	12	9.1		517	7.50	170	0	16	4	0.10	0.70	4.10	0.050	0.010 k	
05/18/83	10	24.0		542	7.50	190	0	35	5	0.10 k	0.80	8.40	0.123	0.065	
04/21/97	18	7.4		565	7.90	200	10	15	6	0.07	0.64	7.70	0.033	0.007	18.0
06/09/97	18	10.0		539	7.50	186	0	34	6	0.21	0.97	12.00	0.106	0.053	19.0
07/14/97															
08/12/97	17	14.0		451	7.40	164	0	28	5	0.54	0.75	1.92	0.101	0.035	20.0
10/22/97	16	18.0		474	8.30	200	10	16	3	0.23	0.77	0.12	0.082	0.025	20.0
Count		7		7	7	7	7	7	7	7	7	7	7	7	4
Maximum		24.0		630	8.3	230	10	35	6	0.54	0.97	12.00	0.123	0.065	20
Minimum		7.4		451	7.3	164	0	15	3	0.07	0.64	0.12	0.033	0.007	18
Average		14.6		531		191	3	23	5	0.21	0.79	5.53	0.082	0.034	19
S.D.		6.2		59		22	5	9	1	0.16	0.11	4.09	0.032	0.021	1

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

APPENDIX B. CURRENT WATER QUALITY CHARACTERISTICS, LAKE VERMILION

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

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans-parency (in.)*	*Conduc-tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos-phorus (mg/L)*	*Total depth (ft)*
05/08/2000	1	8.6	28	544	8.2	174	5	11	6	0.01 k	0.49	2.4	0.037	0.017	18
05/25/2000	1		20					14	7	0.01 k	1.18	2.7	0.039		21
06/06/2000	1		8	484	7.5	170	0	35	7	0.15	1.44	12	0.134	0.088	19
06/13/2000			14												
06/22/2000	1							14	4	0.01 k		10		0.021	20
07/12/2000	1		24	485	7.9	200	0	11	5	0.15	1.12	9.3	0.029	0.005	18
07/26/2000	1							11	8	0.01	0.4	7.7	0.04		20
08/02/2000	1		28	463	8	140	0	2	2	0.01 k	0.9	6.39	0.024	0.008	19
08/08/2000			26												
08/29/2000			16												
09/13/2000	1		18					15	8	0.01 k	1.04	1.3	0.046		20
09/28/2000	1		16					22	4	0.01 k	0.95	1.05	0.063		20
10/03/2000	1	14.3	24	456	8.05	200	0	16	5	0.01 k	1.01	0.87	0.042	0.02	19
10/12/2000			12												
10/24/2000	1		22					11	6	0.01 k	1	0.25	0.032		20
11/15/2000	1		18					15	4	0.34	0.93	0.43	0.062		21
01/29/2001	1		42					5	4	0.55	1.22	5.1	0.127		21
03/28/2001	1		14					16	3	0.07	1.26	9.2	0.081		20
04/19/2001	1		16					26	4	0.15	1.68	12	0.087		20
04/26/2000			24												
Count		2	18	5	5	5	5	15	15	7	14	15	14	6	15
Maximum		14.3	42	544	8.2	200	5	35	8	0.55	1.68	12	0.134	0.088	21
Minimum		8.6	8	456	7.5	140	0	2	2	0.01	0.4	0.25	0.024	0.005	18
Average		11.5	20.6	486.4	7.9	176.8	1.0	14.9	5.1	0.20	1.04	5.38	0.1	0.027	19.7
S.D.		4.0	7.8	34.6	0.3	24.9	2.2	8.0	1.8	0.18	0.33	4.38	0.0	0.031	1.0

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

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

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans-parency (in.)*	*Conduc-tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos-phorus (mg/L)*	*Total depth (ft)*
05/08/2000	1	13.2	18	554	8.2	185	0	20	12	0.06	0.06	0.44	0.041	0.016	11
05/25/2000	1		16					16	7	0.01 k	1.14	3.3	0.037		11
06/06/2000	1		8	622	7.8	180	0	44	5	0.01 k	1.13	14	0.095	0.071	5
06/13/2000			14												
06/22/2000	1							16	5	0.01 k	0.7	9.9	0.029		11
07/12/2000	1		20	509	8.1	180	0	14	5	0.08	1.51	9.7	0.035	0.01	11
07/26/2000	1							15	9	0.01 k	1.08	7.2	0.046		11
08/02/2000	1		20	473	8.2	170	0	2	2	0.01 k	0.74	5.7	0.042	0.008	10
08/08/2000			16												
08/29/2000			16												
09/13/2000	1		12					22	7	0.01 k	0.75	1.1	0.053		11
09/28/2000	1		14					19	4	0.01 k	1.06	0.86	0.052		11
10/03/2000	1	15.1	18	451	8.32	180	5	18	6	0.01 k	1.02	0.63	0.04	0.015	10
10/12/2000			18												
10/24/2000	1		18					13	6	0.01	1.23	0.17	0.03		11
11/15/2000	1		16					14	4	0.2	0.81	0.21	0.061		11
01/29/2001	1		42					6	3	0.19	0.9	5.5	0.084		11
03/28/2001	1		15					16	3	0.01 k	1.41	9.5	0.072		11
04/19/2001	1		10					21	4	0.24	1.35	9.9	0.098		11
04/26/2000			16												
Count		2	18	5	5	5	5	15	15	6	15	15	15	5	15
Maximum		15.1	42	622	8.32	185	5	44	12	0.24	1.51	14	0.098	0.071	11
Minimum		13.2	8	451	7.8	170	0	2	2	0.01	0.06	0.17	0.029	0.008	5
Average		14.2	17.1	521.8	8.1	179.0	1.0	17.1	5.5	0.13	0.99	5.21	0.1	0.024	10.5
S.D.		1.3	7.0	68.3	0.2	5.5	2.2	9.1	2.6	0.09	0.36	4.61	0.0	0.026	1.6

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

Appendix B3. Current Water Quality Characteristics, Lake Vermilion, Station 5 Surface

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans-parency (in.)*	*Conduc-tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos-phorus (mg/L)*	*Total depth (ft)*
05/08/2000															
05/25/2000	1		16					23	5	0.01 k	0.89	9.5	0.041		6
06/06/2000	1		10	655	7.8	240	0	27	6	0.01 k	0.76	14	0.097	0.067	6
06/13/2000			14												
06/22/2000	1							64	8	0.01 k	0.97	12	0.163		5
07/12/2000	1		12	490	7.9	250	0	20	4	0.01 k	0.96	11	0.085	0.063	6
07/26/2000	1							21	8	0.01 k	1.02	6.6	0.035		6
08/02/2000	1		16	540	8.3	220	5	13	7	0.01 k	0.64	4	0.033	0.01	6
08/08/2000			10												
08/29/2000			8												
09/13/2000	1		8												
09/28/2000	1		10					26	6	0.01 k	1.39	0.41	0.067		6
10/03/2000	1	30.4	16	514	8.21	225	0	26	7	0.01 k	1.32	0.29	0.055	0.022	5
10/12/2000			12												
10/24/2000	1		12					23	8	0.01 k	1	0.04	0.046		6
11/15/2000	1		16							0.08	0.55	8.1	0.102		6
01/29/2001	1		54					4	2	0.01 k	0.57	7.7	0.064		5
03/28/2001	1		60					7	1	0.06	0.84	9.9	0.029		6
04/19/2001	1		16					32	4	0.14	0.8	11	0.071		6
04/26/2000			10												
Count		1	17	4	4	4	4	12	12	3	13	13	13	4	13
Maximum		30.4	60	655	8.3	250	5	64	8	0.14	1.39	14	0.163	0.067	6
Minimum		30.4	8	490	7.8	220	0	4	1	0.06	0.55	0.04	0.029	0.01	5
Average		30.4	17.6	549.8	8.1	233.8	1.3	23.8	5.5	0.09	0.90	7.27	0.1	0.041	5.8
S.D.			15.1	73.1	0.2	13.8	2.5	15.1	2.4	0.04	0.26	4.72	0.0	0.029	0.4

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

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

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans-parency (in.)*	*Conduc-tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos-phorus (mg/L)*	*Total depth (ft)*
05/08/00	16	4.2		566	7.5	200	0	20	10	0.24	0.89	2.1	0.045	0.014	18
05/25/00	19							19	3	0.64	1.32	2.8	0.073		21
06/06/00	17			482	7.5	165	0	46	7	0.04	1.59	12.0	0.135	0.088	19
06/22/00	18							38	7	0.01 k	0.77	9.9	0.045		20
07/12/00	16			488	7.9	200	0	13	4	0.01	1.21	9.4	0.028	0.006	18
07/26/00	18							24	7	0.16	3.00	7.3	0.052		20
08/02/00	17			463	8	140	0	8	4	0.17	0.95	5.9	0.028	0.005	19
09/13/00	18							22	6	0.01 k	0.75	1.4	0.049		20
09/28/00	18							27	5	0.01 k	0.96	1.04	0.067		20
10/03/00	17	76.8		456	8.05	200	0	15	5	0.01 k	0.97	0.88	0.041	0.021	19
10/24/00	18							34	6	0.26	1.36	0.38	0.054		20
11/15/00	18							15	5	0.23	0.77	0.13	0.055		21
01/29/01	19							2	2	0.23	0.89	5.0	0.066		21
03/28/01	18							18	4	0.08	1.59	9.3	0.084		20
04/19/01	18							28	4	0.17	1.45	9.8	0.112		20
Count		2		5	5	5	5	15	15	15	15	15	15	5	15
Maximum		76.8		566	8.05	200	0	46	10	0.64	3.00	12.00	0.135	0.088	21
Minimum		4.2		456	7.5	140	0	2	2	0.01	0.75	0.13	0.028	0.005	18
Average		40.5		491		181	0	22	5	0.15	1.23	5.16	0.062	0.027	20
S.D.		51.3		44		27	0	11	2	0.17	0.57	4.17	0.030	0.035	1

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

Appendix B5. Current Water Quality Characteristics, Lake Vermilion, Station 1 Mid-Depth

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Secchi trans-parency (in.)*	*Conduc-tivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Dissolved phos-phorus (mg/L)*	*Total depth (ft)*
05/08/00	9	7.9		548	8	200	0	16	10	0.11	0.62	2.4	0.037		18
05/25/00															
06/06/00	8			481	7.5	170	0	40	5	0.11	1.74	12.0	0.135		19
06/22/00															
07/12/00	9			487	7.9	200	0	12	4	0.01 k	1.38	9.4	0.024	0.004	18
07/26/00															
08/02/00	9			465	7.8	150	0	4	3	0.01 k	0.88	6.3	0.026	0.005	19
09/13/00															
09/28/00															
10/03/00	9	16.2		456	8.02	160	0	16	5	0.01 k	0.99	0.85	0.043	0.021	19
10/24/00															
11/15/00															
01/29/01															
03/28/01															
04/19/01															
Count		2		5	5	5	5	5	5	5	5	5	5	3	5
Maximum		16.2		548	8.02	200	0	40	10	0.11	1.74	12.00	0.135	0.021	19
Minimum		7.9		456	7.5	150	0	4	3	0.01	0.62	0.85	0.024	0.004	18
Average		12.1		487	8	176	0	18	5	0.05	1.12	6.19	0.053	0.010	18.6
S.D.		5.9		36	0	23		13	3	0.05	0.44	4.66	0.047	0.010	0.5

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

APPENDIX C. TEMPERATURE AND DISSOLVED OXYGEN DATA, LAKE VERMILION

Appendix C. Temperature and Dissolved Oxygen Data

	Station 1				*Station 2*				*Station 5*			
Date	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*
05/25/00	0	21.0	10.6	119.9								
	1	21.0	10.6	119.9								
	3	21.0	10.3	116.5								
	5	21.0	9.3	105.2								
	7	20.8	9.2	103.6								
	9	20.8	8.8	99.1								
	11	20.8	9.0	101.4								
	13	19.3	5.3	57.9								
	15	18.4	3.2	34.3								
	17	18.2	2.1	22.4								
	19	18.0	0.8	8.5								
06/06/00	0	20.7	6.1	68.5	0	20.1	7.6	84.4	0	18.4	7.7	82.6
	1	20.7	6.1	68.5	1	20.1	7.8	86.6	1	18.4	7.6	81.5
	3	20.7	6.0	67.4	3	20.0	7.4	82.0	3	18.3	7.6	81.4
	5	20.7	6.0	67.4					4	18.2	7.5	80.1
	7	20.7	6.0	67.4								
	9	20.6	6.0	67.3								
	11	20.5	5.9	66.1								
	13	20.5	5.9	66.1								
	15	20.4	5.9	65.9								
	17	20.3	5.9	65.8								
06/22/00	1	24.2	8.4	101.2					1	21.7	6.9	79.1
	3	24.1	8.5	102.2					2	21.3	7.0	79.6
	5	23.9	7.8	93.4					3	20.7	7.0	78.7
	7	23.9	7.2	86.2								
	9	23.9	7.6	91.0								
	11	23.9	7.5	89.8								
	13	23.9	7.3	87.4								
	15	23.8	7.1	84.8								
	17	23.8	7.1	84.8								
	18	23.7	6.2	74.0								
07/11/00	1	27.2	9.1	116.1	1	27.1	9.2	117.0	1	26.5	8.0	100.6
	3	27.3	9.0	114.9	3	27.1	9.0	114.5	2	26.1	7.6	94.9
	5	27.3	9.3	118.6	5	27.1	8.9	113.2	3	25.2	7.0	86.0
	7	27.1	8.1	113.0	7	27.1	8.7	110.7	4	24.9	6.9	84.2
	9	27.1	8.0	111.8	9	27.0	8.7	110.5	5	24.7	6.7	81.5
	11	27.0	6.9	87.7								
	13	26.3	4.4	55.1								
	15	25.9	3.8	47.3								

Appendix C. Continued

	Station 1				Station 2				Station 5			
Date	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*
07/11/00	17	25.6	2.0	24.8								
	18	25.5	1.6	19.8								
07/12/00	0	26.4	7.2	90.5	0	26.7	8.7	109.8	0	25.2	7.0	86.0
	1	26.4	7.2	90.5	1	26.7	8.7	109.8	1	25.2	6.9	84.8
	3	26.4	7.2	90.5	3	26.5	8.6	108.2	3	23.2	5.9	69.3
	5	26.4	7.0	87.9	5	26.2	7.9	98.9	4	23.0	5.9	69.4
	7	26.3	6.8	85.2	7	25.9	8.1	100.7				
	9	26.3	6.8	85.2	9	25.2	7.5	92.1				
	11	26.3	6.8	85.2								
	13	26.3	6.8	85.2								
	15	26.2	6.8	85.1								
	16	26.2	6.8	85.1								
07/26/00	1	25.8	14.1	175.2	1	26.2	14.5	181.5	1	25.8	14.0	173.9
	3	25.3	11.4	140.2	3	25.8	14.8	183.9	2	25.9	14.5	180.3
	5	25.1	8.8	107.8	5	25.2	10.4	127.8	3	25.5	13.9	171.6
	7	25.0	7.4	90.5	7	25.0	7.6	92.9	4	24.8	12.5	152.3
	9	25.0	7.6	92.9	9	24.9	5.4	65.9				
	11	24.9	3.9	47.6								
	13	24.7	3.2	30.9								
	15	24.6	1.9	23.1								
	17	24.6	2.0	24.3								
	18	24.5	1.8	21.8								
08/02/00	0	26.2	4.7	58.8	0	26.4	5.2	65.3	0	27.0	5.6	71.1
	1	26.1	4.6	57.4	1	26.3	5.2	65.2	1	26.8	5.6	70.9
	3	25.8	4.4	54.6	3	26.3	5.2	65.2	3	25.6	4.5	55.7
	5	25.7	4.3	53.3	5	26.2	5.0	62.6	4	25.2	4.1	50.4
	7	25.7	4.2	52.0	7	26.1	4.8	59.9				
	9	25.7	4.1	50.0	8	26.0	4.7	58.6				
	11	25.6	4.0	49.5								
	13	25.6	3.8	47.0								
	15	25.6	3.1	38.4								
	17	25.4	1.6	19.7								
08/08/00	1	25.4	6.7	82.6	1	25.7	8.4	104.1	1	26.2	6.9	86.4
	3	25.3	6.0	73.8	3	25.7	8.4	104.1	2	25.9	8.0	99.5
	5	25.2	5.0	61.4	5	25.7	8.4	104.1	3	25.6	7.9	97.8
	7	25.2	4.8	59.0	7	25.7	8.3	102.9	4	25.4	7.7	94.9
	9				9	25.7	8.2	101.6				
	11	25.2	4.9	60.2								
	13	25.2	4.8	59.0								
	15	25.1	4.8	58.8								

Appendix C. Continued

	Station 1				*Station 2*				*Station 5*			
Date	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*
	17	25.1	4.1	50.2								
	18	25.0	3.0	36.7								
08/29/00	1	25.2	5.5	67.6	1	25.8	7.6	94.4	1	25.9	6.7	83.3
	3	25.0	5.0	61.1	3	25.6	7.6	94.1	2	25.6	6.0	74.3
	5	24.9	4.6	56.2	5	25.5	7.4	91.4	3	25.2	5.2	63.9
	7	24.9	4.2	51.3	7	25.4	7.0	86.3	4	24.8	3.5	42.6
	9	24.9	4.1	50.0	9	25.3	6.8	83.6	5	24.8	3.3	40.2
	11	24.9	3.6	44.0								
	13	24.9	3.6	44.0								
	15	24.9	3.5	42.7								
	17	24.9	2.9	35.4								
	18	24.8	2.0	24.4								
09/13/00	1	24.4	7.0	84.5	1	24.1	7.1	85.3	1	23.6	4.8	57.1
	3	24.3	6.7	80.8	3	24.0	6.6	79.2	2	23.4	4.5	53.4
	5	24.1	5.7	68.5	5	23.7	5.9	70.4	3	23.1	3.3	38.9
	7	24.1	5.6	67.3	7	23.6	5.7	67.9	4	22.9	2.7	31.6
	9	24.0	5.9	70.8	9	23.5	5.5	65.3	5	22.9	2.7	31.6
	11	24.0	5.7	68.4								
	13	24.0	5.6	67.2								
	15	24.0	5.6	67.2								
	17	24.0	5.6	67.2								
	18	24.0	5.7	68.4								
09/28/00	1	19.0	8.2	90.3	1	18.9	9.4	101.8	1	19.2	10.9	118.9
	3	18.6	8.3	89.3	3	18.0	8.3	88.3	2	17.6	9.6	101.3
	5	18.5	7.9	84.9	5	17.8	8.4	89.0	3	16.6	8.6	88.8
	7	18.4	7.9	84.8	7	17.4	8.0	84.0	4	16.5	8.0	82.4
	9	18.3	7.6	81.4	9	17.2	7.6	79.5	5	16.5	6.6	68.0
	11	18.1	7.6	81.0								
	13	18.0	7.3	77.7								
	15	17.7	6.6	69.8								
	17	17.5	6.6	69.5								
	18	17.5	6.5	68.4								
10/03/00	0	18.5	8.6	92.5	0	19.4	10.0	109.5	0	20.0	9.4	104.2
	1	18.5	8.5	91.4	1	19.4	9.9	108.8	1	20.0	9.3	103.1
	3	18.5	8.3	89.2	3	19.0	9.9	107.5	3	19.3	7.9	76.5
	5	18.3	7.8	83.5	5	18.7	9.3	100.3				
	7	18.4	7.9	84.8	7	18.7	9.2	99.2				
	9	18.3	7.9	84.6	8	18.7	9.2	99.2				
	11	18.3	8.0	85.7								
	13	18.3	7.8	83.5								

Appendix C. Continued

	Station 1				Station 2				Station 5			
Date	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*
10/03/00	15	18.2	7.7	82.3								
	17	17.7	5.2	55.0								
10/12/00	1	13.6	10.1	97.5	1	13.7	13.7	164.6	1	12.1		
	3	13.3	10.1	96.8	3	13.5	13.0	125.2	2	12.0		
	5	13.3	9.9	94.9	5	13.2	12.6	120.6	3	11.9		
	7	13.2	9.6	91.9	7	13.1	13.0	120.0	4	11.9		
	9	13.1	9.3	88.7	9	13.0	12.2	116.2	5	11.2		
	11	13.1	9.1	86.8								
	13	13.1	8.8	84.0								
	15	13.1	8.8	84.0								
	17	13.0	8.8	83.8								
	18	12.9	9.1	86.5								
10/24/00	1	18.0	15.3	162.8	1	18.2	15.0	160.3	1	18.9	16.8	182.0
	3	18.0	14.3	152.1	3	16.5	10.4	107.1	2	18.6	16.1	173.3
	5	17.6	14.4	151.8	5	15.8	8.5	86.2	3	17.8	13.2	139.8
	7	17.2	14.5	151.7	7	15.6	7.3	73.7	4	16.8	8.3	86.0
	9	15.9	10.6	101.6	9	15.4	5.6	56.3	5	16.8	4.1	42.5
	11	15.6	9.2	92.9								
	13	15.2	8.3	80.0								
	15	15.0	7.2	69.8								
	17	15.0	5.3	49.9								
	18	15.0	4.5	44.9								
11/15/00	1	9.0	9.4	81.4	1	7.8	10.9	91.6	1	5.1	11.8	92.9
	3	9.0	9.4	81.4	3	7.8	10.9	91.6	2	5.1	11.9	93.3
	5	8.9	9.4	81.2	5	7.8	10.7	89.9	3	5.2	11.9	93.6
	7	8.8	9.5	81.8	7	7.7	10.8	90.5	4	5.2	11.9	93.6
	9	8.8	9.3	80.1	9	7.7	10.8	90.5	5	5.1	11.8	92.5
	11	8.7	9.4	80.8								
	13	8.7	9.5	81.6								
	15	8.7	9.5	81.6								
	17	8.7	9.5	81.6								
	19	8.7	9.5	81.6								
01/29/01	1	1.8	6.8	48.8	1	1.9	7.0	50.4	1	0.3	15.5	106.7
	3	2.6	7.7	56.5	3	1.9	10.9	78.4	2	0.3	15.0	103.8
	5	2.4	9.9	72.2	5	1.9	11.4	82.0	3	0.5	14.7	101.7
	7	2.4	11.4	83.2	7	1.9	10.9	78.4	4	0.6	14.6	101.3
	9	2.3	11.7	85.1	9	1.9	10.2	71.9	5	0.8	14.6	101.9
	11	2.3	12.1	88.0								
	13	2.3	12.5	90.9								
	15	2.4	12.7	92.6								

Appendix C. Concluded

	Station 1				*Station 2*				*Station 5*			
Date	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*	*Depth, ft*	*Temp., °C*	*DO, mg/L*	*% sat.*
01/29/01	17	2.5	12.5	91.4								
	19	2.5	11.6	85.8								
03/28/01	1	6.4	8.9	72.2								
	3	6.3	8.4	68.0								
	5	6.0	8.6	64.2								
	7	5.8	8.6	68.6								
	9	5.8	8.8	70.2								
	11	5.8	8.9	71.0								
	13	5.7	8.9	70.9								
	15	5.7	9.2	73.6								
	17	5.7	9.9	78.8								
	18	5.6	10.3	79.4								
04/19/01	1	13.3	7.4	70.9	1	13.1	4.1	39.1	1	11.0	9.7	88.2
	3	12.9	6.4	60.8	3	12.9	4.4	41.8	2	11.9	9.8	91.0
	5	12.7	5.8	54.9	5	12.8	4.0	37.9	3	10.9	9.6	87.0
	7	12.5	8.4	79.1	7	12.8	5.7	54.0	4	10.9	9.6	87.0
	9	12.5	9.0	84.7	9	12.8	6.2	58.8	5	10.9	9.6	87.0
	11	12.0	7.1	66.0								
	13	11.7	7.0	64.7								
	15	11.7	5.9	46.2								
	17	11.8	7.0	64.8								
	18	11.7	5.9	49.0								
04/26/01	1	15.9	8.4	85.4	1	16.4	9.7	99.7	1	16.1	9.0	91.9
	3	15.8	8.3	84.2	3	16.3	9.9	101.5	2	15.8	9.0	91.3
	5	15.4	8.1	81.4	5	16.3	10.0	103.1	3	15.7	8.9	90.1
	7	15.3	8.2	82.2	7	16.2	10.1	103.4	4	16.0	8.9	90.6
	9	15.3	8.2	82.2	9	16.2	10.1	103.4	5	15.5	8.9	89.7
	11	15.2	8.7	87.1								
	13	15.2	9.1	91.1								
	15	15.2	9.0	90.1								
	17	15.2	8.9	89.1								
	18	15.2	9.4	94.1								

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

APPENDIX D. WATER QUALITY CHARACTERISTICS FOR INFLOWS AND OUTFLOWS, LAKE VERMILION, 2000–2001

Appendix D1. Water Quality Characteristics for Spillway (RBD-01), Lake Vermilion, 2000–2001

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Conductivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenol-phthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Total depth (ft)*
05/27/00	1.0	22	610	8.0	170	1 k	28	9	0.05	1.17	3.0	0.037	20
05/28/00	1.0	100	610	8.2	153	1 k	142	38	0.06	1.71	5.3	0.092	20
05/29/00	1.0	90	600	8.2	137	1 k	78	34	0.16	0.88	6.0	0.106	20
05/30/00	1.0	130	600	7.9	95.0	1 k	86	42	0.21	1.58	11.0	0.208	20
06/01/00	1.0		480	7.7	106	1 k	58	8	0.10		11.0	0.166	20
06/26/00	1.0		500	8.0	155		86	12	0.01k		15.0	0.166	
02/10/01	1.0		550	7.9	119		84	11	0.31	2.15	7.5	0.487	
02/26/01	1.0		340	7.8	17.4		597	80	0.09	3.16	6.6	0.867	18
02/27/01	1.0		400	8.1	26.0	1 k	388	54	0.49	3.16	7.5	0.887	
02/28/01	1.0		490	7.9	58.1	1 k	326	50	0.52	2.64	7.9	0.787	
			390	7.9	78.8	1 k	150	23	0.39	2.40	8.1	0.669	
03/05/01	1.0		480	8.0	128	1 k	48	7	0.27	1.10	9.2	0.371	
03/26/01	1.0		810	8.3	232	10	17	4	0.08	0.73	9.7	0.74	
Count		4	13	13	13		13	13	13	11	13	13	6
Maximum		130	810	8.3	232		597	80	0.52	3.16	15	0.887	20
Minimum		22	340	7.7	17.4		17	4	0.01	0.73	3	0.037	18
Average		86	528		113		161	29	0.21	1.88	8.3	0.429	20
S.D.		46	123		60		172	23	0.17	0.88	3.0	0.323	1

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – Standard Deviation.

Appendix D2. Water Quality Characteristics for Tributary (Inflow, RBD-02), Lake Vermilion, 2000–2001

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Conductivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenolphthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/ Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Total depth (ft)*
05/25/00	1						22	5	0.07		10.	0.141	3
05/27/00	1	900	610	7.7	20.2	1 k	770	90	0.21	1.62	9	0.612	4
05/28/00	1	400	610	7.8	50.8	1 k	340	76	0.13	1.57	13	0.484	6
05/29/00	1	120	600	7.9	111	1 k	160	104	0.01 k	1.55	17	0.261	3
05/30/00	1	60	600	8.1	158	1 k	120	58	0.01 k	1.06	18	0.160	3
06/01/00	1		600	8.3	185	1 k	76	11	0.04		16	0.113	
06/07/00	1		660	8.1	211	1 k	26	3	0.02	0.28	14	0.085	
06/19/00	1				217	1 k	17	3	0.01 k	0.28	13	0.085	
07/05/00	1						464	56	0.01 k	1.42	9.9	0.268	
07/11/00	1		490	7.7	131	1 k	208	32	0.01 k	1.05	11	0.018	
07/24/00	1		780	8.3		1 k	10	3	0.01 k	0.60	7	0.073	
08/08/00	1		690	8.4	234	1	20	3	0.30	1.27	5.8	0.114	
08/23/00	1		630	8.3	217	1 k	11	3	0.07	1.04	1.49	0.149	
09/12/00	1		730	8.5	225	1 k	19	3	0.27	0.30	1.01	0.156	
10/02/00	1		780	8.4			4		0.03	0.60	1.29	0.167	
10/17/00	1		650	8.2	241	1 k	3	1	0.01 k	0.27	2.2	0.076	
10/30/00	1		660	8.3	274	1 k	4	2	0.16	0.26	0.31	0.147	
11/06/00	1		710	7.7	276	1 k	6	2	0.01 k	0.10k	0.16	0.113	
11/20/00	1		820	8.3	256	1 k	3	1	0.01 k		10	0.073	
12/04/00	1		820	8.3	248	1 k	2	1	0.14	1.28	8.2	0.105	
12/14/00	1		880	8.1	236		6	2	0.05	1.09	10	0.074	
01/02/01	1		510	8.3	251		2	1	0.01 k	0.58	7.6	0.144	
02/05/01	1		580	8.6	209	6	19	4	0.44	0.78	10.2	0.299	
02/09/01	1		410	7.9	115		462	49	0.28	3.16	9.2	0.406	5
02/10/01	1		440	7.7	73.9		443	48	0.10	2.86	9.3	0.579	6
02/12/01	1		500	8.1			43	5	0.01 k	1.85	12	0.170	
02/13/01	1		620	8.1			48	6	0.01 k	1.04	12	0.131	
02/25/01	1		350	8.1	81.2	1 k	816	108	0.39	5.26	5.2	1.400	8
02/26/01	1		420	7.5	23.4		442	58	0.26	2.91	8.2	0.985	7
02/27/01	1		480	8.2	93	1 k	254	34	0.20	2.00	11	0.558	
02/28/01	1		450	8.1	149	1 k	124	18	0.17	1.09	11	0.353	

Appendix D2. Concluded

Sample date	*Sample depth (ft)*	*Turbidity (NTU)*	*Conductivity (µmho/cm)*	*pH*	*Total alkalinity (mg/L as $CaCO_3$)*	*Phenolphthalein alkalinity (mg/L as $CaCO_3$)*	*TSS (mg/L)*	*VSS (mg/L)*	*Ammonia-nitrogen (mg/L)*	*Total Kjeldahl nitrogen (mg/L)*	*Nitrate/Nitrite-nitrogen (mg/L)*	*TP (mg/L)*	*Total depth (ft)*
03/01/01	1		450	8.0	167	1 k	68	10	0.08	0.86	11	0.245	
03/05/01	1		500	8.2		1 k	17	3	0.08	0.49	11	0.090	
03/19/01	1		690	8.3	199		14	2	0.01 k	0.64	13	0.043	
03/26/01	1		700	8.4	207	12	2	1	0.01	0.28	11	0.037	
04/09/01	1		730	8.0	221	1 k	10	2	0.05		9.2	0.046	
04/23/01	1		630	8.3	208		17	3	0.05	0.91	11	0.060	
Count		4	34	34	31	3	37	36	24	33	37	37	10
Maximum		900	880	8.6	276	12	816	108	0.44	5.26	18	1.4	8
Minimum		60	350	7.5	20.2	1	2	1	0.01	0.1	0.16	0.018	2
Average		370	611		178		137	23	0.15	1.22	9.20	0.244	5
S.D.		383	132		74		216	32	0.12	1.06	4.50	0.283	2

Notes: TSS – Total Suspended Solids, VSS – Volatile Suspended Solids, TP – Total Phosphorus, NTU – nephelometric turbidity unit, µmho/cm – micromhos per centimeter, mg/L – milligrams per liter, $CaCO_3$ – calcium carbonate, Blank spaces – no data, k – actual value is known to be less than the value given, S.D. – standard deviation.

APPENDIX E. RECENT FISH MANAGEMENT RECORDS FOR LAKE VERMILION

COUNTY Vermilion

CUMULATIVE HISTORY WATER (NAME) Lake Vermilion

DATE	ENTRY
6/15/40	Stocked 15 breeder bass.
9/30/40	Stocked 7,500 breeder bluegill, bass and crappie
10/1/40	Stocked 10,000 breeder bluegill, bass and crappie
10/3/40	Stocked 15,000 " " " &, "
5/31/41	Stocked 18 breeder bass
6/1/42	Stocked 17 breeder bass
10/20/43	Stocked 5,000 crappie and bluegill
11/3/44	Stocked 10,000 bass and bluegill
10/4/45	Stocked 3,600 bass
6/19/46	Stocked 30 bass, perch, bluegill
6/22/49	" 150 crappie (37 tagged)
4/27/54	" 600 crappie
4/27/54	" 175 bluegill
4/27/54	" 25 bullheads
5/10/55	" 400 mixed fish
5/1/56	" 800 " "
5/25/57	" 300 " "
6/21/58	" 800 " "
11/20/58	Lake survey - fish population analysis
4/23/59	Stocked 400 Mixed "fish
6/11/59	Fish population analysis
2/29/60	Lake survey - fish population analysis - sounding map
5/25/60	Letter from Bill Harth to local newspaper
6/30/64	Supplemental survey - fish kill investigation
8/24,25/65	Supplemental survey - fish population analysis

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F.M. 1.0 Distribution: State and Public - District, Area, Central Office
1/66

COUNTY Vermilion

FISH STOCKING RECORD

WATER (NAME) Lake Vermilion

DATE	SPECIES	NO.	Size Range or Avr. Wgt.	CONDITION	SOURCE	REMARKS
6/15/40	LMB	15	Breeder			
9/30/40	LMB. BLG, WHC	7,500	"			
10/1/40	"	10,000	"			
10/3/40	"	15,000	"			
5/31/41	LMB	18	"		Havana	
6/1/42	"	17	"		"	
10/20/43	WHC, BLG	5000	"		"	
11/3/44	LMB, BLG	10000			Genesee	
10/4/45	LMB	3600	Fing.		Sp. Grove	
6/19/46	LMB, BLG, Perch	30			Havana	
6/22/49	WHC tagged	150			Havana	
4/27/54	WHC	600			Havana	
"	BLG	175			"	
"	Bullheads	25			"	
5/10/55	Mixed	400			"	
5/1/56	"	800			"	
5/25/57	"	300			"	
6/21/58	"	800			"	
4/23/59	"	400			"	
5/4/84	WAE	666000	Fry		Sandridge	
7/21/86	WAE	5500	4 inch		LaSallee	
6/3/87	WAE	33000	2"	Good	LaSallee	
5/26/88	WAE	33000	2"	Good	Jake Wolf	
5/24/89	WAE	33000	2"	Good	Jake Wolf	
5/30/90	WAE	33000	1.7"	Good	Jake Wolf	

F.M. 2.0 Distribution: State and Public—District, Area, Central Offices (8/70)

(26664—10M—12-70) 2-0

CUMULATIVE HISTORY

COUNTY: VERMILION

WATER (NAME): LAKE VERMILION

DATE	ENTRY
8/4/70	Water physics and chemistry
8/9/78	Fish population analysis
8/20/80	Fish population analysis
7/29/81	Fish population analysis
7/21/82	Fish population analysis and commercial fishing analysis
7/6/83	Fish population analysis and contaminant sample
7/7/84	Fish population analysis and contaminant sample
5/22/85	Fish population analysis and contaminant sample
5/14/86	Fish population analysis and contaminant sample
5/26/87	Fish population analysis and contaminant sample
6/3/87	Hatchery stocked 33,000 2" WAE - Lake temp 85°F - truck temp 80°F
5/26/88	Fish population analysis and contaminant sample
-/26/88	Stocked 33,000 1.7" WAE
5/25/89	Fish population survey & contaminant samples collected
5/24/89	Stocked 1 3/4" WAE in Lake Vermilion - 33,000
9/22/89	While collecting fish for National Hunting & Fishing Days we collected 90 WAE in 40 minutes of shocking - all were of legal size except 3.
5/30/90	Stocked 33,300; 1.7" WAE fingerlings.
6/18/90	Conducted game fish survey and collected contaminant samples
5/8/91	Conducted a gamefish survey and collected contaminant samples
5/29/91	Hatchery stocked 26,640 walleye fingerlings - 2"
5/27/92	Hatchery stocked 26,640 two inch walleyes
5/28-29/92	Conducted a major fish population survey and collected contaminant samples.
7/9/92	Interstate Water Co. and the VCCD stocked 27,000 two in largemouth bass and 27,000 two inch walleye
9/10/92	Hatchery stocked 13,268, four to six inch largemouth bass
10/2/92	Hatchery stocked 1000 ten inch muskies
5/3/93	Stocked 3000 LMB - were given a right pelvic fin clip - Purchased by ISW & VCCD

Distribution: State and Public District Area Central Office

COUNTY VERMILION

FISH STOCKING HISTORY

WATER (NAME) LAKE VERMILION

DATE	SPECIES	NO.	Size Range or Avr. Wgt.	CONDITION	SOURCE	REMARKS
5/29/91	WAE	26,640	2"	Good	Jake Wolf	
5/27/92	WAE	26,640	2"	Good	Jake Wolf	
7/9/92	WAE	27,000	2"	Good		Purchased by ISW & VCCD
7/9/92	LMB	27,000	2"	Good		Purchased by ISW & VCCD
9/10/92	LMB	13,268	4-6"	Good	Jake Wolf	Marked with freeze brand
10/2/92	MUE	1,000	10"	Good	Jake Wolf	First stocking
5/3/93	LMB	3,000				
8/5/93	LMB	13,318	4-6"	Good	Jake Wolf	Rt. Pelvic clip
11/16/93	MUE	1000	8-9"		Penn.	
5/12/94	LMB	3000	7"			Given a left pelvic clip
6/2/94	WAE	26,640	2"	Good	Jake Wolf	
8/9/94	LMB	13,320	4.7"	Good	Jake Wolf	Left Pelvic Clip
5/10/95	LMB	2,727	8-10"	Excellent	Private	Rt. Pelvic Clip - purchased by ISW & VCCD
6/2/95	WAE	40,000	1.6"	Good	Jake Wolf	
5/10/96	LMB	2720	6-8"	Good		Rt. Pectoral Fin Clipped - purcha by Consumers Water Co. & VCCD
6/20/96	WAE	36,000	2"	Good		
8/26/96	LMB	18,100	4"	Good	Jake Wolf	470 lbs. total; 1/2 freeze branded
10/29/96	MUE	1,000	8.6"	Good	Jake Wolf	
5/8/97	LMB	2600	8"	Good		Fountain Bluff - fish given left pelvic fin clip
6/18/97	WAE	36000	1.5"	Good	Jake Wolf	
9/2/97	LMB	18025	4.0"	Good	Jake Wolf	9025 freeze branded

F.M. 2.0 Distribution: State and Public—District, Area, Central Offices (8/70)

(26662—10M—12-70) 2-o

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISHERIES — COUNTY VERMILION

CUMULATIVE HISTORY — WATER (NAME) LAKE VERMILION

DATE	ENTRY
5/3/93	Stocked 3000 LMB - were given a right pelvic fin clip - were
	purchased by ISW & VCCD
5/25/93	Game fish survey, checked for marked bass and collected
	contaminant samples.
5/26/93	Hatchery stocked walleyes - 26,640 - 2"
8/5/93	Hatchery stocked 13318, 4" LMB - Freeze branded
10/26/93	Shocked for 70 minutes to collect walleye and LMB. High water
	and colder temp may have hampered our efforts, though a fair
	sample of LMB was collected
11/16/93	Hatchery stocked 1000, 8-9" MUE from Penn.
1994	
5/12/94	Stocked 3000, 7" LMB - were given a left pelvic fin clip
05/24/94	Conducted LMB Survey
06/02/94	Hatchery stocked 26,640 - 2'WAE
08/09/94	Hatchery stocked 13,320 - freeze branded LMB (4.7")
04/95	1 day WAE Supplemental Gill Net Survey (ery, very windy) 35 nice CCF: no WAE
05/10/95	LMB stocked 2727, Avg. Size 7.5", good shape, VCCD pays-all LMB given right pelvic clip, fish from Larry Brown
04/25/95	FM 23
06/08/95	Fish Population Survey (storms)also 06/15/95, 06/20/95
06/02/95	40,000, 1.5" WAE stocked by Jake Wolf staff.
10/19/95	Log jam at Spillway removal
05/10/96	LMB stocked (2720), 6-8"/7" Avg., good shape, VCCD & Water Co. Pays-all LMB given right pectoral fin clip, fish from Larry Brown
06/20/96	Hatchery stocked 36,600, 2" WAE
08/23/96	LMB Survey (40 min.)-Set Gill Nets for CCF contaminates
08/26/96	Hatchery stocked 18,100, 4" LMB (JW)
10/29/96	Hatchery stocked 1000, 8.6" MUE (JW) / 1000, 8.6" Muskies
01/18/97	Lake Management Status Report completed
05/08/97	Stocked 2600, 8" LMB- Left pelvic fin clip
06/11/97	36,000, 1.5" Walleye fingerling
09/02/97	18,025 LMB 4.0" (9025 Freeze branded - 9000 - not) J.W.
09/30/97	Game Fish Survey LMB, WAE

F.M. 1.0 (8/70)

COUNTY Vermilion

FISH STOCKING HISTORY

WATER (NAME) Lake Vermilion

DATE	SPECIES	NUMBER	SIZE RANGE or AVR. WEIGHT	CONDITION	SOURCE	REMARKS
05/06/98	LMB	2400	8"	Good	Private	right pelvic fin clip
08/11/98	LMB	18000	4"	Good	JWFH	
08/19/98	MUE	1000	10"	Good	JWFH	
05/06/99	LMB	2400	8"	Good	Private	left pelvic fin clip
06/07/99	MUE	5000	4"	Good	JWFH	
08/17/99	LMB	18000	4"	Good	JWFH	
08/17/99	MUE	1000	11.3"	Good	JWFH	
05/11/2000	LMB	2400	9"	Good	Private	right pelvic fin clip
08/??/2000	LMB	18000	4"	Good	JWFH	

FM 2.0

County Vermilion

Location: T Blount 20N R 10,11,12W 17,18 ,20, 29,30, 31 Newell

LAKE SURVEY

Nearest Town: Danville

Date February 29, 1960

Water (Name) Lake Vermilion

Owner Interstate Water Company

Address of owner Danville, Illinois

Lessee --

Address of Lessee --

Person Contacted M. W. Sanders Identification: Superintendent

Address of Person Contacted Danville, Illinois

Classification of Ownership: State ___ Public ___ Club X Private ___

1. Area (Acres) 612 Source SCS Office

Maximum Depth 27 Source Sounded

Average Depth 12 Source Sounded

Acres feet 7344 Gallons 2,393,040,744

Shoreline length: Feet -- Miles --

2. Watershed size (acres) 267 sq. mi. Source consulting engineers

Topography and soils Silt loam

Other waters in watershed North fork of the Vermilion

Ownership Private

3. Type of Dam Concrete Height ~~35' w/roadway~~ 45' w/roadway Year Constructed 1925

Condition of Dam Good (550' long - 250' concrete - 300' earth embankment)

4. Type and size of drain -- Condition --

Spillway 210 foot long Condition Good (broken concrete)

Gauge Reading: 25.0 Stage -2.0

5. Primary Usage City water supply and recreation

F.M. 1.0
2/59

(Continued)

6. History of Past Water Levels None

7. Use of Shoreline:

No. boat liveries 4 No. Resorts 0 No. Cottages 0

Swimming 3 beaches Waterfowl hunting north end

Boats: No. Private 1,000 No. State 1 (conservation officer's)

Motors allowed Yes Size limits None Speed limit (Safe Speed)

8. Previous stocking record (dates, species, and numbers) Refer to Fish stocking record - F.M. 9.0

9. Pollution (Type and Kind) None

10. Erosion (extent) Medium Load from Watershed

11. Biological characteristics:

Winter and/or summer kill None

Common species of aquatic plants Cattails & Lotus or Water Lily - Very abundant in north end of lake - filamentous algae - floating broadleaf pondweed.

Extent and coverage of aquatic plants Only in north end of lake.

12. Fish Spawning Conditions: Good

13. Species Composition: See Form F.M. 11.0 - Fish Population Analysis Summary
Bass, crappie, bluegill, carp, golden shiner, longear sunfish, black bullhead, orangespotted, yellow bass, channel catfish, quillback, carpsucker, warmouth, white sucker and redhorse.

14. Natural reproduction of young of the year fish Bluegill, longear sunfish, green sunfish and bass.

15. History of Past Management Recommendations: None (has been stocked periodically)

16. Special Conditions and Problems: Is stocked annually with load of fish (problem).

17. RECOMMENDATIONS Purpose of Lake Vermilion Survey which was done on June 10, 1959 and June 11, 1959, was to determine what species of fish were present, their abundance, condition, size ranges, age, and what recommendations could be made to improve the sport fishery. Only a well balanced program, in which every factor in fishery management is utilized to best advantage, will provide satisfactory angling condition in Lake Vermilion. 1. The stocking of fish of any kind is not necessary as there is a well established fish population present. The fishermen would not benefit by the addition of more fish because most of the stocked fish would not survive due to competition with the native species and the abundance of rough fish present and poor stream habitat conditions. 2. Commercial fishermen should be allowed to harvest the rough fish under contract, and under the close supervision of law enforcement personnel of the Department of Conservation. Removing a sufficient number of the abundant rough fish may improve the game fish population, and also this commercial fish resource would be utilized to a greater extent than it is at present. 3. A complete watershed conservation program would definitely improve the game fish habitat of the lake. This program would include contour farming, strip cropping, grassed waterways, crop rotation, erosion control, terracing, pastures, and cover crops for all the farmland within the watershed. This type of program would reduce the soil loss from the cultivated fields and would minimize the destructive force of fast runoff water into the lake. Interested land owners should contact their county soil conservation office. 4. Pollution, other than silt, was not observed, but if it should occur, necessary action should be taken to control it. ~~5. Permission should be obtained before trespassing on private land.~~ 5. Keep all sizes of fish caught, except possibly for the very small bass, flathead catfish and channel catfish. This may accelerate the growth of the remaining fish by providing more food and space for them, and which in turn, may prevent the fish from becoming small and stunted.

18. Biologist George Zebrun & Rudy Stinauer Dates June 10 & 11, 1959

Time 9 AM - 5PM Weather Sunny, Clear Air Temp. 78°F.

Copies to: District, Zone, Central Office
Louis Zamberletti, Conservation Officer, Vermilion Co.

F.M. 1.2
2/59

PUBLIC LAKES

County Vermilion

Name of lake: Lake Vermilion

Owner: Interstate Water Co Address Danville

Distance and direction from nearest town: 1 Mile North of Danville

Legal location (dam): Township 20N Range 11-12W 1/4 Sec. 29,30,31

Type of lake: Natural: Bottom land lake ___ Glacial ___ Sink hole ___
Other (specify) Water Reservoir

Year constructed: 1925 Dam height (ft) 35.0

Surface acres 659 Max. depth (ft) 32.0 Av. depth (ft) 13.0
Shoreline length (miles) 12.0 Watershed size (acres) 170,880

Primary usage Water Supply

367 / 640 / 160 / 1602 / 170880

Facilities: (check)

Camping: Permitted: Yes ___ No X
Sites: Yes ___ No ___ Number ___
Fee: Yes ___ No ___ Amount ___

Boating: Permitted: Yes X No ___
Launching ramp /X/ Number 1
Water skiing /X/
Motor size limit None (H.P.) Speed limit ___ (MPH)
License fee /X/ Amount 1.00
Boat liveries /X/ Number 1

Other: Year around residences /X/ many Cabins /X/ many
Swimming permitted: Yes ___ No X
Bath house / / Beach / / Pool / / Life guard / /
Ice skating permitted: Yes X No ___ Ice fishing: Yes X No ___
Picnic areas / / Number ___
Concession stand / /
Park entrance fee: Yes ___ No ___ Amount ___
Museum / / Amount ___ Waterfowl hunting / /

Fish:

Species composition (list species of fish known to be present in order of abundance): Yellow bass, channel catfish, carp, bullheads, buffalo, largemouth bass, crappies, bluegill, green sunfish, longear sunfish

Three principal species caught by anglers: yellow bass, ~~channel catfish~~ ~~carp~~ crappie, Channel catfish

Biologist Arnold W. Fritz Date 20 Dec 63

1991

STATE AND PUBLIC LAKE INVENTORY REPORT

0113

Lake name: LAKE VERMILION Classification: State ____, Public COOP

County: VERMILION, Township: 20N, Range: 11E, 1/4 Section: 17 (of dam)

Distance & direction from nearest town: Northeast side of Danville

Owner: Interstate Water Company, Lessee: Vermilion Co. Conservation Dist.

Name of Park (if applicable): JAYCEE PARK

LAKE DATA:

Surface acres: 666, Max. depth (ft.): 27, Av. depth (ft.): 12

Year built: 1925, Year rebuilt: ____, Shoreline length (mi.): 12.0

Watershed size (acres): 170,880, Size of drain (inches): ____

Siltation: Severe x, Moderate ____, or Light ____

Total Alkalinity (ppm): 220, Specific Conductance (umho/cm): 620, TDS (ppm): 453

Type of Lake: Natural: Bottomland lake ___, Glacial ___, Sink hole ___

Artificial: Dug ___, Dug & dammed x, Quarry ___, Gravel Pit ___, Borrow Pit ___, Stripmine ___.

Use of Lake (check): Potable water supply x, Industrial water supply ___, Cooling lake ___, Flood control ___, Erosion control ___, Recreation x, Other (list): ____.

Recreational Uses of Lake (check):

Fishing x, Trotline fishing x, Motorboating x, Motor size limit ____ H. P., Speed limit ____ MPH, Water-skiing x, Number launching ramps 2, Boat rental ___, Campgrounds ___, Picnicking x, Waterfowl hunting ___, Swimming beach x.

(Continued on reverse side)

F.M. 23.0 1/79

:c: Jim Langbein/... Lutterle ... 5-31-89

ILLINOIS DEPARTMENT OF CONSERVATION

DIVISION OF FISH AND WILDLIFE RESOURCES

FISH STOCKING RECORD

DATE 5-24-89

NAME OF WATER: Lake Vermilion CLASSIFICATION: PUBLIC

CONTACT NAME: Ron Pennock
Executive Director TYPE: SUP

ADDRESS: Vermilion County Conservation District
R. R. 1, Box 215

CITY: Danville STATE: Il ZIP CODE: 61832

TELEPHONE NUMBER: (office number)
217/442-1691 HATCHERY: 9050
217/442-7561 (Lake Vermilion park office)

DIRECTIONS FROM NEAREST TOWN: Lonnie Dykemiller - Park Superintendent

WATER # 0113

DISTRICT 8

PROJECT

REGION 3

COUNTY Vermilion

TOWNSHIP

RANGE

¼ SECTION

	SPECIES NAME	SIZE STOCKED	QUANTITY SHIPPED	QUANTITY STOCKED	QUANTITY ORDERED	STK. COMP.	REARING AREA
1)	WAE	2"		33,300	33,300		
2)							
3)							
4)							
5)							

COMMENTS

FIELD COMMENTS

DELIVERY MADE BY: Gilbert Evans DATE: 5-24-89

Signature of person receiving fish: Sheila MacDonald

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422-0504

LAKE PERIODIC REPORT

Period of Report: 1987-1989 Date of Report: 22 March 1990
District Fisheries Biologist: Gary Lutterbie
Lake Name: Lake Vermilion Acreage: 666 County: Vermilion Park
Facility: Vermilion Co. Conservation Dist Classification: Public-Coop

Management Activities Completed:

Surveys Conducted Over The Last Three Years:

26 May 1987 - Fish Flesh Samples and Gamefish Survey
26 May 1988 - Fish Flesh Samples and Gamefish Survey
26 May 1988 - Surveyed Gamefish Population Below the Dam
25 May 1989 - Conducted Major Fish Population Survey and Collected Fish Flesh Samples.
23 May 1989 - Surveyed Gamefish Population Below Dam
22 Sep 1989 - Collected Fish For National Hunting & Fishing Days and Also Collected and Measured a Large Number of Walleyes

Fishing Regulations:

	Length Limit	Daily Creel Limit
Largemouth Bass -	15 inches	6
Walleye -	14 inches	6

The walleye length limit also applies to the North Fork River below the dam down to the water company's pump house.

Approvals:
Submitted By: Gary Lutterbie Date: 22 March 1990

Approved By: ____________ Date: ____________

Approved By: ____________ Date: ____________

Reports will include the following sections:
1. Management Activities Completed
2. Discussion of Biological Surveys and Creels
3. Lake Management Plan Progress
4. Recommended Management Activities for Next Reporting Periods

On 25 May 1989 Lake Vermilion was surveyed with the electroshocker for two hours. A total of 1267 fish belonging to 24 species was collected. The Catch Per Hour of Electroshocking (CPE) was 634. Table 2 gives the CPE of fish collected in surveys conducted between 1980 and 1989. In 1987 and 1988 only select gamefish were collected.

The water chemistry and other data are presented in Table 2A for the surveys conducted since 1980. The pH was remained fairly consistant, though there does appear to be an increase in conductivity, total alkalinity and total dissolved solids. This would not be unexpected. Aquatic vegetation is sparse in this lake. There is a small patch of water lilies and some willows.

Largemouth bass - 109 bass ranging in length from 4-19 inches (110-499mm) were collected. Bass composed 8.6% of the total catch and had a CPE of 54.4. This is the second highest CPE in the last 10 years. In 1983 the CPE had reached 58.3. From 1986 through 1988 the CPE was 39, 42 and 22 respectively. The Catch/Minute of bass 6 inches and longer was 0.8, with 1.0 being considered good. In fact for a lake of this size this could be considered good. In 1987 and 1988 this value was 0.7 and 0.3 respectively (Table 3). The PSD (see Table 3 for definition) was 46% in 1989, compared to 88% in 1987 and 83% in 1988. The optimal range is 40-60%. The RSD-15" was 16% in 1989, compared to 43 and 28% in 1987 and 1988. The optimal range for this index is 10-20%. The Relative Weight value was between 93 and 97 for bass longer than 8 inches and 87 for smaller bass. The optimal range would be 90-100. Age 1 through age 7 bass were collected. Most of the bass (44%) were age 3 fish, followed closely by age 1 bass (30%). The bass showed average growth rates when compared to state averages. The average length for age 1 through 7 bass was 6, 9, 11.4, 14, 16, 17.5 and 19.5 inches respectively. Overall the bass population looks very good. Hopefully they will obtained a good spawn when the lake is raised.

Walleye - 12 fish ranging in length from 8-16 inches were collected. Walleye comprised 1% of the sample and had a CPE of 6. Walleyes were first stocked in the lake in 1984. The following table outlines the walleye stocking history.

YEAR	NUMBER	SIZE
1984	666000	Fry
1986	5500	4"
1987	33000	2"
1988	33000	2"
1989	33000	2"

The 8" fish was stocked in 1989 (age 1), those between 10-12 inches were stocked in 1988 (age 2); and the 15.5-16 inch fish were stocked in 1987 (age 3). The CPE has increased steadily from 3 in 1987 to 6 in 1989. In the May sample 17% of the walleyes collected were of legal size.

On the same day the spillway area was also surveyed for 22 minutes using the cartop boat. A total of 99 walleyes ranging in length from 8-21 inches was collected.

On 22 September while collecting fish in the lake for the National Hunting and Fishing Days 90 walleyes were picked up in 40 minutes of shocking.

YEAR STOCKED	AGE	NUMBER	LENGTH RANGE
1989	0+	1	10"
1988	I+	78	13.5-17.5"
1987	II+	9	17.5-19.3"
1986	III+	3	21.2-22.0"

From the three collections it appears that the walleye is well suited to Lake Vermilion. It should develop into an attractive fishery for the area.

White Crappie- 10 fish ranging in length from 7-13.5 inches were collected. Crappies comprised 0.8% of the samples and had a CPE of 5. The CPE from 1986 through 1988 was 7, 5 and 1.3 respectively. The PSD (refer to Table 3) was 90% in 1989. In 1986 it was 71% and in 1987 and 1988 it was 100%. The optimal range is 40-60%. The RSD-10" was the same as the PSD in 1986, 1988 and 1989 which also exceeded the optimal range. In 1987 the RSD was 80%. The Relative Weight of this species was 93, which would be considered good. The major problem with the crappie population is its low density. Hopefully when the lake level is increase they will get off a good spawn.

Bluegill- 148 fish ranging in length from 2-7 inches were collected. Bluegill comprised 11.7% of the collection and had a CPE of 74. The CPE in 1985 and 1986 was 58 and 50 respectively. The PSD (refer to Table 3) was 21% in 1989 and 12 in 1986. The PSD in 1989 fell just within the optimal range of 20-40%. The Relative Weight of the bluegill was 93, which would be considered good. The bluegill population appears to be improving in both numbers and size.

Channel Catfish - 20 fish ranging in length from 7-24 inches were collected. They comprised 1.6% of the catch and had a CPE of 10. The CPE from 1986 through 1988 was 5, 3 and 2 respectively. The catfish showed good size distribution. The average Relative Weight was 95 which would be considered good. Though the Relative Weights were slightly less than 90 for the younger catfish. The catfish continue to do well in this lake. This can probably be contributed to the riverine habitat.

Other species collected, their percent composition and CPE can be found in Table 1.

OBSERVATIONS:

The influence of the North Fork of the Vermilion River is obvious when the species composition of the sample is examined. There are probably not many lakes that have such a high species diversity. The largemouth bass, channel catfish, bluegill and walleye populations look very good in the lake. The white crappies are of nice size though their densities could be higher. Hopefully they will get a good spawn when the lake is raised.

LAKE MANAGEMENT PLAN PROGRESS:

Most of goals set out in the Lake Management Plan were met (refer to the following Table). Following the creel census to be conducted in 1990, the harvest rates will be evaluated.

ILLINOIS DEPARTMENT OF CONSERVATION

DIVISION OF FISHERIES

FISH STOCKING RECORD

sk ✓
5-31

PASSENGER SIDE ALL

DATE 05/28/1991

NAME OF WATER: LAKE VERMILION	CLASSIFICATION: PUBL	WATER #	0113
CONTACT NAME: RON PENNOCK, EXEC. DIR.	TYPE: SUP	DISTRICT	8
ADDRESS: R. R. 1, BOX 215		PROJECT	
CITY: DANVILLE	STATE: IL ZIP CODE: 61832	REGION	3
TELEPHONE NUMBER: 217/442-1691	HATCHERY: 9000	COUNTY	VERMILION
DIRECTIONS FROM NEAREST TOWN:		TOWNSHIP	-0-
217/442-7561 - LONNIE DYKEMILLER, PARK SUPERINTENDENT		RANGE	-0-
		¼ SECTION	-0-

	SPECIES NAME	SIZE STOCKED	QUANTITY SHIPPED	QUANTITY STOCKED	QUANTITY ORDERED	STK. COMP.	REARING AREA
1)	WAE	1.6	26640	26640	26640	Y	9000
2)							
3)							
4)							
5)							

COMMENTS

1047/lb 25.4 lb 666 acres

-0-

-0-

FIELD COMMENTS

DELIVERY MADE BY: Bill G. DATE: 5/29/90

Signature of person receiving fish: Jim Amor

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422-0504

✓

ILLINOIS DEPARTMENT OF CONSERVATION

DIVISION OF FISH AND WILDLIFE RESOURCES

FISH STOCKING RECORD

DATE 5/25/90

NAME OF WATER: VERMILLION CLASSIFICATION: PUBL

CONTACT NAME: TYPE: SUP

ADDRESS:

CITY: STATE: ZIP CODE:

TELEPHONE NUMBER: HATCHERY: 9000

DIRECTIONS FROM NEAREST TOWN:

WATER # 0 ~~074~~ 113

DISTRICT 8

PROJECT

REGION III

COUNTY VERMILLION

TOWNSHIP

RANGE

¼ SECTION

	SPECIES NAME	SIZE STOCKED	QUANTITY SHIPPED	QUANTITY STOCKED	QUANTITY ORDERED	STK. COMP.	REARING AREA
1)	WAE	1.7	33300	33300	33300	Y	9000
2)							
3)							
4)							
5)							

COMMENTS

VERM.
ST IS ALL — ST 29 10,332 at 796/lb 13.0 lb 48.7 lb total
35.7 lb 13.0 lb 23,998 at 644/lb 35.7 lb

FIELD COMMENTS

DELIVERY MADE BY: [signature] DATE: 5/30/90

Signature of person receiving fish: [signature]

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IL 422-0504

ILLINOIS DEPARTMENT
OF CONSERVATION
DIVISION OF FISHERIES

SUPPLEMENTAL SURVEY

COUNTY: Vermilion
T 20N R 11W S 17
Directions from nearest town:
N.E. side of Danville
Date of Inspection: 18 June 1990

Name of Water Lake Vermilion Owner Interstate Water Co.
Address 322 N. Gilbert P.O. Box 907 Phone 217/442-3063
Danville, IL 61834 Michael O'Brien
Lessee Vermilion Co. Conservation Dist.
Person Contacted Ron Pennock VCCD Identification Director
Address R.R. 1, Box 215 Phone 217/442-1691
Danville, IL 61832
Water Classification: State __ Public-Coop XX Public-Other __
Organizational __ Commercial __ Private __ Stream __

Survey Initiated By: District Fishery Biologist
Water Size: 666 Acres or _____ Miles.
Date of Last Inspection: 25 May 1989
Purpose of Survey: Contaminant Fish Flesh Sample

Observation, Comments, Recommendations:

At 1030 hours the air temperature = 81 F; water temperature = 78 F; pH = 7.9; total alkalinity = 239; conductivity = 620; secchi disc = 8".

The lake was surveyed for 1.25 hours to collected enough fish for a contaminant sample. All largemouth bass, white crappie, channel catfish and walleyes were also collected, weighed and measured.

Largemouth bass - 86 bass ranging in length from 110-529mm (4-21 inches) were collected. The CPH in 1990 was 68.8 bass per hour of shocking. This value between 1981 through 1989 was 22, 22, 58, 19, 25, 39, 41, 22 and 54. The catch per minute of bass 150mm (6 in) and longer was 1.0, up from the 0.78 found in 1989. In 1987 and 1988 this value was 0.7 and 0.26. The goal is 1 per minute which was met this year. The PSD = 47% in 1990. For the years 1981 through 1989 this value was 58, 8, 88, 60, 75, 65, 88%, 83 and 46%. The optimal range for PSD is 40-60%. The bass population continues to exhibit good PSD values. The RSD-380 (15 in) was 9% in 1990. This RSD value for 1983 through 1989 was 32, 30, 35, 19, 43, 28 and 16%. The optimal range for the RSD is 10-20%, thus in almost every year the optimal range has been exceeded. In 1990 however it fell slightly below. The body condition for bass less than 330mm (13 in) was below average, with average to good body conditions for those bass larger than 330mm (13 in). Overall the bass population looks good.

Biologist: Gary Lutterbie Date: 15 Nov 1990
FM 5.0

Walleye - only one walleye was collected in 1990 which was 440mm long. In 1989, 12 walleyes ranging in length from 200-409 mm (8-16 in) were collected. In 1988, 5 walleyes ranging in length from 377-450mm (14.8-17.7 in) were collected. In 1987 3 walleyes ranging in length from 170-245mm (6.7-9.6 in) were collected. Walleyes were first stocked into the lake on 4 May 1984, when 666,000 fry were stocked. A second stocking occurred in July 1986 when 5500, 4 inch fingerlings were stocked. In each [redacted] June from 1987 through 1990 33,300 two inch walleyes have been stocked.

White Crappies - 36 crappies ranging in length from 172-312mm (7-12 in) were collected. The CPH was 28.8 and the PSD = 78%. Body condition was below average. The crappie population appears to be making a come back.

Contaminant samples were obtained from five carp, largemouth bass, five white crappies, and three channel catfish. One whole carp sample was also sent in.

Recommendations:

1. A major survey will be conducted on the lake in May 1992.

2. Fish contaminant samples will be taken in 1991.

3. With the lake not being raised until 1991, the Interstate Water Co. and the Vermilion Co. Conservation District should try and fund a fish stocking program for the spring of 1991. It is a unique opportunity when the water level in a lake is increased and then maintained. This will inundate an additional 400 acres. This situation usually is ideal for the successful stocking of fingerling walleye and muskies. The fish population will expand in 1991 to accommidate this increase in habitat. Whether this habitat will be filled with carp and suckers, which could lead to higher turbidity in the lake, or whether it will be filled with game fish is up to you. The Department of Conservation is committed to stocking the fingerling walleye as in the past, and hopefully will be able to provide muskie fingerlings in both 1991 and 1992, and in the future. But it is very doubtful as to whether or not additional fish could be found in the state hatchery for 1991 to take advantage of this unique opportunity.

   Therefore if possible 35,000, two inch walleye should be stocked in June 1991.

4. The length limit on largemouth bass will remain at 15 inches in 1991, with the walleye length limit remaining at 14 inches.

LAKE VERMILION
LAKE MANGEMENT PLAN PROGRESS

FISH SPECIES	GOAL	YEAR 1986	1987	1988	1989	1990	MEETS GOAL
Largemouth Bass							
No. Caught		39	41	33	109	86	
Catch/Hour	60	39	41	22	54	69	yes
No./Min > 150mm (6")	1.0	0.65	0.70	0.26	0.78	1.00	yes
PSD (%)	40-60	65%	88%	83%	46%	47%	yes
RSD-380mm (15")	10-20	19%	43%	28%	16%	9%	almost
% Legal-size	25	43%	52%	33%	24%	9%	no
Relative Weight	90-100	99	98	89	92	90	no
Ave Ln. Harvest	15.5"	--	--	--	--		
Ave Wt. Harvest	1.5 lbs	--	--	--	--		
Lbs./Acre Harvested	15	--	--	--	--		
Bluegill							
No. Caught		50	--	--	148	--	
Catch/Hour		50	--	--	74	--	
No./Min > 80mm (3")		0.7	--	--	1.1	--	
PSD (%)	20-40	12%	--	--	21%	--	
RSD-8" (%)	5-10	0%	--	--	0%	--	
Relative Weight	90-100	93	--	--	108	--	
Ave Ln. Harvested	6"	--	--	--	--		
Ave Wt. Harvested	0.15 lbs	--	--	--	--		
Lbs/ Acre Harvested	30	--	--	--	--		
Walleye							
No. Caught		0	3	5	12	1	
Catch/Hour	5.0	--	3.0	3.3	6	0.8	no
PSD (%) 15"/10"	40-60		0%	80%	18%	--	no
%Legal-size	25	--	0%	100%	17%	--	no
Lbs./Acre Harvested	2-3	--	--	--	--		
White Crappie							
No. Caught		7	5	2	10	36	
Catch/Hour		7.0	5.0	1.3	5	28.8	
PSD	40-60	71%	100%	100%	90%	78%	exceeds
RSD-250mm (10")	10-20	71%	80%	100%	90%	14%	yes
Relative Weight	90-100	95	--	82	93	86	no
Ave Ln. Harvested	8"	--	--	--	--		
Ave Wt. Harvested	0.25 lbs	--	--	--	--		
Lbs./Acre Harvested	25	--	--	--	--		
Channel Catfish							
No. Caught		5	3	3	20	9	
Catch/Hour		5.0	3.0	2.0	10	7.2	
% > 350mm (14")		60%	100%	33%	15%	22%	good
Relative Weight	90-100	98	--			86	no
Ave Ln. Harvested	14"	--	--	--	--		
Ave Wt. Harvested	1.0 lbs	--	--	--	--		
Lbs./Acre Harvested	25	--	--	--	--		

Table 3. Water Chemistry Data From Lake Vermilion, 1981-1990.

PARAMETER	7/21 1981	7/21 1982	6/06 1983	6/07 1984	5/22 1985	5/14 1986	5/26 1987	5/26 1988	5/25 1989	6/18 1990
Time Hours	--	1030	--	1245	1430	1400	1430	0900	0900	1030
Air Temp (F)	68	84	--	80	78	83	86	65	71	81
Water Temp (F)	71	81	--	76	68	72	76	64	68	78
pH	8.4	8.7	--	8.4	8.6	8.0	8.4	8.5	8.0	7.9
Conductivity						500	580	600	660	620
Tot. Alkalinity	148	230	--	145	200	154	--	256	239	239
Secchi Disc	9"	24"	--	13"	11"	8"	16"	12"	11"	8"

ADMINISTRATIVE RULE PROPOSAL FORM
PART 810, SPORT FISHING REGULATIONS

Name of Water: Lake Vermilion Acres: 666 will be 1000

County: Vermilion Region: 3 Distict: 8

Classification: Public-Co Fish Species Affected: CCF

Current Regulation: None

Proposed Regulation: 2 Pole and Line Fishing Only, except trot line and jug fishing will be allowed in the No Wake Area North of Boiling Springs Road where the power lines cross the lake.

Biolgoical Justification: (Mortality, Growth Rate, Recruitment, Population Indices, Socio-Economic Impacts, Impacts To Other Species, Alternative Regulations Considered, Improvement In Angler Harvest or Catch)

This is more of a safety issue than biological. The area that has been commonly fished with trot lines and jugs will soon be flooded when the level of the dam is increased in the spring of 1992. This area will then be accessible by water skiers. To prevent other water users from becoming entangled in trot lines or jug lines it was thought best to restrict their uses to certain parts of the lake.

Signatures:

Submittor: [signature] Date: 8 October 1991

Supervisor: ______________________ Date: ______________________

Illinois Department of Conservation
life and land together

office memorandum

to: Mike Conlin

from: Gary Lutterbie

date: 8 October 1991

subject: Ad Order For Lake Vermilion

The lake level will be increased by 5 feet during the Spring of 1992. The Vermilion County Conservation District, Interstate Water Compnay and our Conservation Police Officer are concerned that if trot lines and jugs are permitted in the lake where previously used they will interfer with other water-related users, primarily skiers.

The reason for submiting the proposal so late is that shoreline work has just been completed which will now allow the water company to raise the level of the lake.

ILLINOIS DEPARTMENT
OF CONSERVATION
DIVISION OF FISHERIES

SUPPLEMENTAL SURVEY

COUNTY: Vermilion
T 20N R 11W S 17
Directions from nearest town:
N.E. side of Danville
Date of Inspection: 9 May & 3 June 1991

Name of Water Lake Vermilion Owner Interstate Water Co.
Address 322 N. Gilbert P.O. Box 907 Phone 217/442-3063
Danville, IL 61834 Michael O'Brien
Lessee Vermilion Co. Conservation Dist.
Person Contacted Ron Pennock VCCD Identification Director
Address R.R. 1, Box 215 Phone 217/442-1691
Danville, IL 61832
Water Classification: State __ Public-Coop XX Public-Other __
Organizational __ Commercial __ Private __ Stream __

Survey Initiated By: District Fishery Biologist
Water Size: 666 Acres or ____ Miles.
Date of Last Inspection: 18 June 1990
Purpose of Survey: Contaminant Fish Flesh & Game Fish Survey

Observation, Comments, Recommendations:

At 1030 hours the air temperature = 74 F; water temperature = 64 F; pH = 8.8; total alkalinity = 222; conductivity = 680; secchi disc = 1'9".

The lake was surveyed for 1.5 hours to collected fish for a contaminant sample. Not enough channel catfish were collected, so an additional survey was conducted on 3 June 1991 for 30 minutes to collect just channel catfish. All largemouth bass, white crappie, channel catfish and walleyes were also collected, weighed and measured.

Largemouth bass - 59 bass ranging in length from 110-457mm (4-18 inches) were collected. The CPH in 1991 was 39.3 bass per hour of shocking. This value between 1981 through 1990 was 22, 22, 58, 19, 25, 39, 41, 22, 54 and 68.8. The catch per minute of bass 150mm (6 in) and longer was 0.6. In 1987, 1988, 1989 and 1990 this value was 0.7, 0.26, 0.78 and 1.0. The goal is 1 per minute which was met this year. The PSD = 76% in 1991. For the years 1981 through 1990 this value was 58, 8, 88, 60, 75, 65, 88%, 83, 46% and 47%. The optimal range for PSD is 40-60%. The bass population continues to exhibit good PSD values. The RSD-380 (15 in) was 18% in 1991. This RSD value for 1983 through 1990 was 32, 30, 35, 19, 43, 28, 16 and 9%. The optimal range for the RSD is 10-20%, thus in almost every year the optimal range has been exceeded. In 1990 however it fell slightly below. The body condition for bass less than 274mm (10.7 in) was below average, with average to good body conditions for those bass larger than 330mm (13 in). Overall the bass population looks good though the numbers were down.

Biologist: Gary Lutterbie Date: 28 October 1991
FM 5.0

Walleye - No walleyes were collected in 1991. Only one walleye was collected in 1990 which was 440mm long. In 1989, 12 walleyes ranging in length from 200-409 mm (8-16 in) were collected. In 1988, 5 walleyes ranging in length from 377-450mm (14.8-17.7 in) were collected. In 1987 3 walleyes ranging in length from 170-245mm (6.7-9.6 in) were collected. Walleyes were first stocked into the lake on 4 May 1984, when 666,000 fry were stocked. A second stocking occurred in July 1986 when 5500, 4 inch fingerlings were stocked. In each of June from 1987 through 1991 33,300 two inch walleyes have been stocked.

White Crappies - 56 crappies ranging in length from 177-338mm (7-13.3 inches) were collected. The CPH was 37, with a PSD of 88% and an RSD-250 (10inches) Of 32%. Optimal ranges for PSD and RSD are 40-60 and 10-20% respectively. Thus the numbers were up while maintaineng excellent sizes. In 1990, 36 crappies ranging in length from 172-312mm (7-12 in) were collected. The CPH was 28.8 and the PSD = 78%. Body condition was below average in both years though this may be more of a problem with the standard than the fish.. The crappie population appears to be making a come back.

Channel Catfish - On 3 June 1991 the lake was stocked again for 30 minutes resulting in the collection of 16 channel catfish off the old dam. They ranged in length from 283-610mm (11-24 inches).

Contaminant samples were obtained from five carp, largemouth bass, five white crappies, and five channel catfish. One whole carp sample was also sent in.

Recommendations:

1. A major survey will be conducted on the lake in May 1992.

2. Fish contaminant samples will be taken in 1992.

3. With the lake not being raised until 1992, the Interstate Water Co. and the Vermilion Co. Conservation District should try and fund a fish stocking program for the spring of 1992. It is a unique opportunity when the water level in a lake is increased and then maintained. This will inundate an additional 400 acres. This situation usually is ideal for the successful stocking of fingerling largemouth bass, walleye and muskies. The fish population will expand in 1991 to accommidate this increase in habitat. Whether this habitat will be filled with carp and suckers, which could lead to higher turbidity in the lake, or whether it will be filled with game fish is up to you. The Department of Conservation is committed to stocking the fingerling walleye as in the past, and hopefully will be able to provide muskie fingerlings in 1992 and in the future. But it is very doubtful as to whether or not additional fish could be found in the state hatchery for 1992 to take advantage of this unique opportunity.

   Therefore if possible 50,000 two inch largemouth bass and/or 35,000, two inch walleye should be stocked in May or June 1992.

4. The length limit on largemouth bass will remain at 15 inches in 1992, with the walleye length limit remaining at 14 inches.

5. Have proposed a new Administrative Order permitting only 2 pole and line fishing only, except trot line and jug fishing will be allowed in the No Wake Area North of Boiling Springs Road where the power lines cross the lake. If approved it will take affect in April 1992.

ILLINOIS DEPARTMENT OF CONSERVATION

DIVISION OF FISHERIES

FISH STOCKING RECORD

Please update our records

DATE 4/04/95

AME OF WATER: VERMILION, LAKE CLASSIFICATION: PUBL

ONTACT NAME: RON PENNOCK, EXEC. DIR. TYPE: SUP

DDRESS: R. R. 1, BOX 215

TY: DANVILLE STATE: IL ZIP CODE: 61832

ELEPHONE NUMBER: 217/442-1691 HATCHERY: 9000

RECTIONS FROM NEAREST TOWN:

217/442-7561 - LONNIE DYKEMILLER, PARK SUPERINTENDENT

West Ramp 12:00 Noon

WATER # 113

DISTRICT 13

PROJECT

REGION 3

COUNTY VERMILION

TOWNSHIP

RANGE

¼ SECTION

666 Ac

1140/lb

35.1 #

	SPECIES NAME	SIZE STOCKED	QUANTITY SHIPPED	QUANTITY STOCKED	QUANTITY ORDERED	STK. COMP.	REARING AREA
1)	WAE	~~2~~ 1.6"	40,000 ~~26640~~	40,000	40,000	Y	JW
2)							
3)							
4)							
5)							

COMMENTS

FIELD COMMENTS

/ERY MADE BY: Tom Blessmen DATE: 6-2-95

ture of person receiving fish: M Stephen Kolle

169

422-0504

MEMO TO: DON W. DUFFORD

FROM: M. STEPHEN PALLO *MSPallo*

DATE: DECEMBER 8, 1995

SUBJECT: EVALUATION OF SUPPLEMENTAL STOCKING OF LARGEMOUTH BASS

Name and Description of Water Area: LAKE VERMILION is located on the north edge of Danville. It is owned by Interstate Water Company (ISW) with the Vermilion County Conservation District (VCCD) managing the recreational aspects of the lake. The lake elevation was raised five feet in 1992 causing the lake to increase from 666 to 900 acres. The lake currently has a maximum depth of 32 feet and an average depth of 14 feet. The lake was built in 1925 and due to the large watershed, the upper end of the lake had silted in substantially. With the increase in the spillway elevation, the upper portion of the lake is once again usable for recreational boating and fishing.

Largemouth Bass Stocking History: The following largemouth bass stocking program has occurred since 1992:

Year	Size	Number	Source
1992	2.0	27,000	ISW and VCCD
1992	4.2	13,326	IDNR-Freeze branded
1993	4.0	13,318	IDNR-Freeze branded
1993	5-8	3,000	ISW and VCCD Fin clipped
1994	3-4	13,320	IDNR-Freeze branded
1994	5-8	3,000	ISW and VCCD Fin clipped
1995	8-10	2,727	ISW/VCCD Fin clipped
1995	4	13,300	IDNR-Freeze branded

Rationale for Stocking: The opportunity to enhance the bass population came when the lake level was increased in 1992 and flooded an extensive amount of shoreline vegetation. This provided excellent cover and food for young fish. Stocking was done to get bass in this new habitat. Reproduction had been a problem in this lake in past years. Thus, to enhance natural recruitment, the stocking of larger fingerlings was continued.

Methods of Assessment: This lake has been surveyed annually since 1980 during the Spring using AC electrofishing boats.

Summary of Assessment Results and Comparison with Stocking Success Criterion: The bass population has benefitted greatly due to the stocking program. Electrofishing catch-per-hour (CPE) has increased each year since 1992. CPE of all bass in the late 1980's averaged 40; since 1992,

ILLINOIS DEPARTMENT
OF CONSERVATION
DIVISION OF FISHERIES

SUPPLEMENTAL SURVEY

COUNTY: Vermilion
T 20N R 11E S 17
Direction from nearest town: NE side of Danville

Date of Inspection: 26 Oct 1993

Name of Water Lake Vermilion Owner InterState Water

Address Phone

Lessee Vermilion County Conservation District

Person Contacted Ken Konsis Identification Director

Address Kennekuk Cove Co. Park Phone 217/442-1691

Water Clasification: State ___ Public X Organizational ___
Commercial ___ Private ___ Stream ___

Survey Initiated By: District Fishery Biologist
Water Size: 900 Acres or ___ Miles.
Date of Last Inspection: 25 May 1993
Purpose of Survey: Monitor Walleye Population

Observation, Comments, Recommendations:

The lake was surveyed for 60 minutes at night (1905 to 2005 hours) with only walleyes and largemouth bass being collected. Four walleyes were collected ranging in length from 317 to 363mm. A total of 47 largemouth bass were collected. Of the bass between 130-170mm; 7 out of the the eight fish had freeze brand marks. Of the 26 bass between 180 to 280mm; 12 of them had right ventral fin clips.

Attached is the raw data.

Biologist: Gary Lutterbie Date: 29 Oct 1993
FM 5.0

WATER CHEMISTRY DATA FROM LAKE VERMILION TAKEN DURING SURVEYS

PARAMETER	7/21 1981	7/21 1982	6/06 1983	6/07 1984	5/22 1985	5/14 1987	5/26 1987	5/26 1988	5/25 1989	6/18 1990	5/09 1991	5/25 1992
TIME HOURS		1030		1245	1430	1400	1430	0900	0900	1030	1030	1000
AIR TEMP F	68	84		80	78	83	86	65	71	81	74	68
WATER TEMP F	71	81		76	68	72	76	64	68	78	64	64
PH	8.4	8.7		8.4	8.6	8	8.4	8.5	8	7.9	8.8	8.4
CONDUCTIVITY						500	580	600	660	620	680	680
TOT. ALKALINITY	148	230		145	200	154		256	239	239	222	205
SECCHI DISC	9"	24"		13"	11"	8"	16"	12"	11"	8"	1'9"	1'11"

IN 1992 THE WATER LEVEL HAD JUST BEEN RAISED 5 FT INCREASING THE SURFACE ACERAGE FROM 666 TO 900

CATCH PER EFFORT OF FISH SPECIES BY GEAR FROM LAKE VERMILION 28-29 MAY 1992.

SPECIES	ELECT	TRAP NETS	GILL NETS
LARGEMOUTH BASS	12.0		
WALLEYE	0.0		
MUSKIE	0.0		
WHITE CRAPPIE	7.7	6.3	1.0
BLUEGILL	8.7	3.0	0.3
GREEN SUNFISH	3.3		
LONGEAR SUNFISH	6.7		
ORAGNESPOTTED SUN	2.0		
WARMOUTH			
CHANNEL CATFISH	1.0		8.3
FLATHEAD CATFISH			0.3
BLACK BULLHEAD			
YELLOW BULLHEAD			
TADPOLE MADTOM			
QUILLBACK	4.0		4.3
RIVER CARPSUCKER			
HIGHFIN CARPSUCKER			
GOLDEN REDHORSE	2.7		1.3
SILVER REDHORSE			
WHITE SUCKER			
SPOTTED SUCKER	0.7		0.7
HOG SUCKER			
GIZZARD SHAD	181.3		14.7
CARP	8.7		5.3
BULLHEAD MINNOW	0.3		
GOLDEN SHINER	2.3	0.3	13.7
SPOTFIN SHINER	11.0		
RED SHINER			
EMERALD SHINER			
BLUNTNOSE SHINER			
BROOK SILVERSIDES	10.7		
LOGPERCH			
YELLOW BASS	1.7		7.3
EFFORT HRS.	3.0	3.0	3.0

LAKE MANAGEMENT STATUS REPORT

DATE OF REPORT: 3/19/93 FISH MANAGER: GARY LUTTERBIE DIST: 8

LAKE NAME: Lake Vermilion COUNTY: Vermilion WATER NO: 0113

OWNERSHIP (STATE, PUB-CO, PUB-OT): Public-Coop. ACREAGE: 900

LAKE MANAGEMENT STATUS REPORTS WILL INCLUDE THE FOLLOWING SECTIONS:

1. Listings of the Sport Fishing Regulations in Effect.
2. Listing of Fisheries Management Activities Completed with Evaluation of Success.
3. Lake Management Plan Progress Table.
4. Recommendations for Observed Problem Trends.

FISHING REGULATIONS:

1. Largemouth bass 15" length limit with a creel limit of 6/day
2. Muskellunge 36" length limit and a creel limit of 1/day
3. Walleye 14" length limit and a creel limit of 6/day
4. Pole and line fishing only, except trot line and jug fishing allowed north of Boiling Springs Road

CURRENT FISH MANAGEMENT ACTIVITIES:

1. Lake was raised five feet this year, increased lake from 666 to 900 acres. This created a lot a submerged vegetation.
2. On 5/27/92 IDOC stocked 26,640 two inch walleye.
3. On 5/28-29/92 conducted a major fish population survey and collected contaminant samples. First survey when trap and gill nets were used.
4. On 7/9/92 Interstate Water Company and the Vermilion Co. Conservation District stocked 27,000 two inch largemouth bass and 27,000 two inch walleyes.
5. On 9/10/92 IDOC stocked 13,268 four to six inch largemouth bass.
6. On 10/2/92 IDOC stocked 1000 ten inch muskies.
7. The last creel census was conducted in 1990.

RECOMMENDATIONS:

1. A fish population surveyed should be conducted in late May or early June to evaluate the recent stockings and collected contaminant samples.
2. Interstate Water Company and VCCD should stock 6000 eight inch largemouth bass in May 1993 and annually there after until the population can take care of itself.
3. The IDOC will stock 26,640 two inch walleye, 13,268 four to eight inch largemouth bass and 1000 ten inch muskies.
4. Interstate Water Comapny and VCCD should apply for a boat access grant under the Dingell-Johnson/Wallop-Breaux Sport Fish Restoration and Enhancement Program to build a break water structure in front of the boat ramp. The break water structure could possibly be expanded into serving as a fishing pier as well thus increasing bank fishing access which is badly needed on this lake.

SIGNATURES:

Gary Lutterbie 3/19/93

District Fisheries Manager Date

Regional Fisheries Admin. Date

LAKE VERMILION
LAKE MANAGEMENT PLAN PROGRESS

SPECIES/CRITERIA	GOAL OPTIMAL RANGE	1987	1988	1989	1990	1991	1992a	RATING
LARGEMOUTH BASS								
CATCH/HOUR	60	41	22	54	69	39.3	12	POOR
NO./MIN > 150MM 6"	1	0.7	0.26	0.78	1	0.7	0.2	POOR
300MM/200MM	40-60%	88	83	46	47	76	76	POOR
380MM/200MM	10-20%	43	28	16	9	18	24	FAIR
% LEGAL	25%	52	33	24	9	17	19	FAIR
RELATIVE WEIGHT	95-104	98	89	92	90	99	97	GOOD
AVE LN HARVESTED	15.5"				15.2			
AVE WEIGHT HARVESTED	1.5 LBS				1.87			
LBS/ACRE HARVESTED	5-10 lbs				0.94			
BLUEGILL								
CATCH/HOUR	250-450			74			8.7	POOR
NO./MIN > 80mm 3"	2.5-3.5/min.			1.1			0.1	POOR
150mm/80mm	20-40%			21			75	POOR
200mm/80mm	5-10%			0			0	POOR
RELATIVE WEIGHT	95-104			108			125	GOOD
AVE LN HARVESTED	6"				5.6			
AVE WEIGHT HARVESTED	0.15 lbs				0.13			
LBS/ACRE HARVESTED	30				0.5			
WALLEYE								
CATCH/HOUR	5.0	3	3.3	6	0.8			POOR
380mm/250mm	40-60%	0	80	18				POOR
510mm/150mm	10-20%	0	0	0	0			POOR
RELATIVE WEIGHT	95-104							POOR
AVE LN HARVESTED	18"				16.4			
AVE WEIGHT HARVESTED	3.5 lbs				1.49			
LBS/ACRE HARVESTED	2-3 lbs				0.66			
WHITE CRAPPIE								
CATCH/HOUR		5	1.3	5	28.8	37	7.7	
200mm/130mm	40-60%	100	100	90	78	88	100	POOR
250mm/130mm	10-20%	80	100	90	14	32	96	POOR
RELATIVE WEIGHT	95-104		82	93	86	94	89	FAIR
AVE LN HARVESTED	8"				8			
AVE WEIGHT HARVESTED	0.25 lbs				0.23			
LBS/ACRE HARVESTED	25				2.47			
CHANNEL CATFISH								
CATCH/HOUR		3	2	10	7.2	32	1	
%> 350mm 14"	80%	100	33	15	22	81	67	FAIR
RELATIVE WEIGHT	95-104				86		89	FAIR
AVE LN HARVESTED	16"				14.4			
AVE WEIGHT HARVESTED	1.25 lbs				0.84			
LBS/ACRE HARVESTED	10-20 lbs				2.05			

a - Electroshocking data only. Lake raised 5 ft.

LAKE VERMILION 1992 REPORT

The lake level was raised during the winter 1991 and spring 1992. This increased the acreage of the lake from 666 to approximately 900 acres. A large quantity of terrestrial vegetation was inundated thus creating excellent habitat for small fish. Knowing that this would be a temporary situation Interstate Water Company and the Vermilion County Conservation District were asked to purchase two inch walleye and largemouth bass to be stocked into this newly created habitat. They were willing to help take advantage of this opportunity to help increase the gamefish populations in the lake. The IDOC was also able to provide some largemouth bass fingerlings in addition to normal stocking of walleye and this year muskies. The survival rate should be higher under these circumstances than they would be after the flooded vegetation has decomposed. It is also hoped that their would be a good natural spawn by the largemouth bass and white crappie in 1992. There usually is under these situations. Unfortunately carp and other less desirable species will get good spawns off as well. So it was hoped that by stocking additional gamefish that they would establish first and be able to help prey on the other species, thus reducing their chances of increasing their populations as much.

Future stockings of fish species would require larger-sized fingerlings since they would not have all of the flooded vegetation to escape predation.

The increase in water level and all of the flooded vegetation made it difficult to collect fish during the 1992 survey. Plus it spread the fish that had occupied a 666 acre lake over 900 acres of water. This is the major reason the poor results indicated by the survey. This should change as the fish population expands and as the flood vegetation decomposes, allowing better access to the fish.

During the 1992 survey trap and gill nets were used to collect some of the other species of fish. This will be done periodically, since this is one way of monitoring certain species which are not collected adequately by electroshocking. The data was kept separate so as to be able to compare it with previous surveys. However the rise in the water level and the flood vegetation make this survey's results difficult to compare with previous surveys. The only portion of the data that may be comparible would be size structure indices and relative weights.

CATCH PER EFFORT OF NUMBER OF FISH COLLECTED BY ELECTROSHOCKING IN LAKE VERMILION

SPECIES	8/20 1980	7/21 1981	7/21 1982	6/06 1983	8/07 1984	5/22 1985	5/14 1986	5/26 1987	5/26 1988	5/25 1989	6/18 1990	5/9 6/3 1991	5/28 1992
LARGEMOUTH BASS	2.6	22.0	22.0	58.3	19.0	25.0	39.0	41.0	22.0	54.5	69.0	39.3	12.0
WALLEYE								3.0	3.3	6.0	0.8	0.0	0.0
MUSKIE													0.0
WHITE CRAPPIE	18.8	69.0	37.0	5.1	4.5	22.0	7.0	5.0	1.3	5.0	28.8	37.0	7.7
BLUEGILL	1.7	40.0	16.0	11.4	17.0	58.0	50.0			74.0			8.7
GREEN SUNFISH	0.9	1.0	2.0	5.7	1.0					8.5			3.3
LONGEAR SUNFISH	8.6	12.0	29.0	15.4	22.5	30.0	17.0			85.5			6.7
ORAGNESPOTTED SUNF		22.0	1.0	1.7	0.5	3.0	3.0			1.0			2.0
WARMOUTH				0.6			1.0						
CHANNEL CATFISH	0.9	7.0	1.0		5.5		5.0	3.0	2.0	10.0	7.2	32.0	1.0
FLATHEAD CATFISH		1.0						1.0		0.5			
BLACK BULLHEAD		1.0		2.3	4.5	6.0	5.0			3.0			
YELLOW BULLHEAD					0.5								
TADPOLE MADTOM				0.6									
QUILLBACK	1.7	1.0	5.0			2.0				22.0			4.0
RIVER CARPSUCKER				0.6	5.0								
HIGHFIN CARPSUCKER		1.0	1.0										
GOLDEN REDHORSE	1.0	33.0	32.0	18.3	9.0	9.0	18.0			6.5			2.7
SILVER REDHORSE				1.0									
WHITE SUCKER		4.0		9.7		2.0	3.0			1.0			
SPOTTED SUCKER		1.0	1.0	2.9			1.0			1.0			0.7
HOG SUCKER			1.0	0.6						1.0			
GIZZARD SHAD	76.6	372.0	86.0	154.9	102.5	516.0	288.0			317.0			181.3
CARP	7.7	20.0	6.0	27.4	17.0	21.0	18.0	6.0	7.0	10.0			8.7
BULLHEAD MINNOW		10.0	2.0			5.0	3.0			1.5			0.3
GOLDEN SHINER		3.0	1.0	0.6	2.5	1.0	2.0			0.5			2.3
SPOTFIN SHINER		1.0			0.5	1.0	1.0						11.0
RED SHINER										1.5			
EMERALD SHINER										2.5			
BLUNTNOSE SHINER					0.5								
BROOK SILVERSIDES	3.0	7.0	4.0	33.7			4.0			6.0			10.7
LOGPERCH		3.0	3.0			1.0				0.5			
YELLOW BASS	13.7	32.0	3.0	16.6		51.0	232.0			14.5			1.7
EFFORT HRS.	1.2	1.0	1.0	1.8	2.0	1.0	1.0	1.0	1.5	2.0		1.5 & 0.5	3.0

WALLEYE FIRST STOCKED IN 5/1984

IN 1987, 1988 AND 1990 ONLY MAJOR GAMEFISH SPECIES WERE COLLECTED ALONG WITH CONTAMINANT SAMPLE.

MUSKIES FIRST STOCKED IN 10/1992.

IN 1992 LAKE HAD JUST BEEN RAISED 5 FT FLOODING A LOT OF VEG. THIS MADE SAMPLING DIFFICULT, RESULTING IN THE LOW CATCH RATES.

ILLINOIS DEPARTMENT
OF CONSERVATION
DIVISION OF FISHERIES

SUPPLEMENTAL SURVEY

COUNTY: Vermilion
T 20N R 11E S 17
Direction from nearest town: NE side of Danville

Date of Inspection: 25 May 1993

Name of Water Lake Vermilion Owner InterState Water

Address Phone

Lessee Vermilion County Conservation District

Person Contacted Ken Konsis Identification Director

Address Kennekuk Cove Co. Park Phone 217/442-1691

Water Clasification: State ___ Public X Organizational ___
Commercial ___ Private ___ Stream ___

Survey Initiated By: District Fishery Biologist
Water Size: 900 Acres or ___ Miles.
Date of Last Inspection: 28-29 May 1992
Purpose of Survey: Largemouth bass survey

Observation, Comments, Recommendations:

The lake was divided into 3 Stations and sampled for a total of 2 hr and 15 minutes. A total of 113 bass was collected of which 43 (38%) were marked. The 43 marked bass were all from the 3000 bass stocked on 3 May 1993. The lake received 27,000, 2" bass on 9 July 1992; 13,268, 4-6" branded bass from Jake Wolf on 10 Sept 1992.

The lake was raised 5 feet during the winter 1991, thus excellent conditions existed for survival of the bass stocked in 1992.

Biologist: Gary Lutterbie Date: 10 May 1994
FM 5.0

Illinois Department of Conservation
Division of Fisheries

COUNTY Vermilion
WATER Lake Vermilion
DATE OF COLLECTIO 25 May 1993

FISH POPULATION ANALYSIS
Using old Wr values

SPECIES	LENGTH GROUP	NUMBER	PERCENT OF TOTAL	AVERAGE WEIGHT	RELATIVE WEIGHT	STANDARD WEIGHT
Largemouth bass	330-339	1	0.88	616	114	538
	340-349	4	3.54	581	96	605.6
	350-359	4	3.54	692	104	663.4
	360-369	4	3.54	672	93	724.9
	370-379	3	2.65	806	102	790.2
	380-389	5	4.42	840	98	859.4
	390-399	3	2.65	984	106	932.7
	400-409	1	0.88	980	97	1010
	410-419		0.00		0	1092
	420-429	2	1.77	1348	114	1178
	430-439	3	2.65	1260	99	1269
	440-449	4	3.54	1420	104	1364
	450-459	2	1.77	1640	112	1465
	460-469	1	0.88	1650	105	1570
	470-479	1	0.88	1815	108	1680
	480-489		0.00		0	1796
	490-499		0.00		0	1916
	500-509		0.00		0	2043
	510-519		0.00		0	2175
	520-529		0.00		0	2312
	530-539		0.00		0	2456
	540-549		0.00		0	2605
	550-559		0.00		0	2761
	560-569		0.00		0	2923
	570-579		0.00		0	3091
	580-589		0.00		0	3266
	590-599		0.00		0	3447
TOTAL		113	100.00		ERR	

Sampling Time Involve 2 hr 15 min   Method of Collection: Electroshocking

Biologist: Gary Lutterbie   Date of Report: 5/9/94

F.M. 12.0

Illinois Department of Conservation COUNTY Vermilion

Division of Fisheries WATER Lake Vermilion

DATE OF COLLECTIO 25 May 1993

FISH POPULATION ANALYSIS

Using old Wr values at mid mm group (i.e. for 100-109, 105 standard weight was used)

SPECIES	LENGTH GROUP	NUMBER	PERCENT OF TOTAL	AVERAGE WEIGHT	RELATIVE WEIGHT	STANDARD WEIGHT
Largemouth bass	<60		0.00			
	70-79	1	0.88	4		
No. 200-299 =	80-89		0.00			
32	90-99		0.00			
No. 300-379 =	100-109		0.00		0	13.6
22	110-119	2	1.77	18	99	18.2
No. 380-509 =	120-129		0.00		0	23.7
22	130-139		0.00		0	30.3
No. 510-599 =	140-149		0.00		0	38.1
0	150-159	1	0.88	43	91	47.1
PSD (%) =	160-169	2	1.77	58	101	57.5
57.9	170-179	4	3.54	61	88	69.4
RSD-15 (%) =	180-189	19	16.81	80	97	82.9
28.9	190-199	8	7.08	101	103	98.1
	200-209	5	4.42	109	95	115
	210-219	6	5.31	130	97	133.9
	220-229		0.00		0	154.8
	230-239	2	1.77	146	82	177.9
	240-249	1	0.88	177	87	203.2
	250-259	4	3.54	220	95	230.8
	260-269	4	3.54	244	93	261
	270-279	5	4.42	285	97	293.7
	280-289	1	0.88	385	117	329.2
	290-299	4	3.54	366	100	367.5
	300-309	1	0.88	440	108	408.7
	310-319	2	1.77	466	103	453
	320-329	3	2.65	450	90	500.5

Sampling Time Involve 2 hr 15 min Method of Collection: Electroshocking

Biologist: G. Lutterbie Date of Report: 5/9/94

F.M. 12.0

MEMO TO: DON W. DUFFORD

FROM: M. STEPHEN PALLO *M S Pallo*

DATE: DECEMBER 8, 1995

SUBJECT: EVALUATION OF SUPPLEMENTAL STOCKING OF LARGEMOUTH BASS

Name and Description of Water Area: LAKE VERMILION is located on the north edge of Danville. It is owned by Interstate Water Company (ISW) with the Vermilion County Conservation District (VCCD) managing the recreational aspects of the lake. The lake elevation was raised five feet in 1992 causing the lake to increase from 666 to 900 acres. The lake currently has a maximum depth of 32 feet and an average depth of 14 feet. The lake was built in 1925 and due to the large watershed, the upper end of the lake had silted in substantially. With the increase in the spillway elevation, the upper portion of the lake is once again usable for recreational boating and fishing.

Largemouth Bass Stocking History: The following largemouth bass stocking program has occurred since 1992:

Year	Size	Number	Source
1992	2.0	27,000	ISW and VCCD
1992	4.2	13,326	IDNR-Freeze branded
1993	4.0	13,318	IDNR-Freeze branded
1993	5-8	3,000	ISW and VCCD Fin clipped
1994	3-4	13,320	IDNR-Freeze branded
1994	5-8	3,000	ISW and VCCD Fin clipped
1995	8-10	2,727	ISW/VCCD Fin clipped
1995	4	13,300	IDNR-Freeze branded

Rationale for Stocking: The opportunity to enhance the bass population came when the lake level was increased in 1992 and flooded an extensive amount of shoreline vegetation. This provided excellent cover and food for young fish. Stocking was done to get bass in this new habitat. Reproduction had been a problem in this lake in past years. Thus, to enhance natural recruitment, the stocking of larger fingerlings was continued.

Methods of Assessment: This lake has been surveyed annually since 1980 during the Spring using AC electrofishing boats.

Summary of Assessment Results and Comparison with Stocking Success Criterion: The bass population has benefitted greatly due to the stocking program. Electrofishing catch-per-hour (CPE) has increased each year since 1992. CPE of all bass in the late 1980's averaged 40; since 1992, CPE increased to 60 - a 50% increase. This increase occurred in all size groups of bass with 22% of the population being of legal size (15"). This is considered in the optional range (10-20%) for bass in this size group. CPE of bass greater than 8 inches in length has also increased considerably to a high of 61 in 1995. Previously, this CPE averaged near 30. Stocked bass made up from 15 to 41% of the annual electrofishing samples. Bass continue to have good condition due to an abundant forage supply of gizzard shad.

Name and Description of Water Area: PARIS EAST AND WEST LAKES are located on the north edge of Paris, along Route 1 in Edgar County. Paris East Lake covers 163 surface acres with a maximum depth of 21 feet and an average depth of 8 feet. Paris West Lake covers 75 surface acres with a maximum depth of 9 feet and an average depth of 4 feet. The lakes are the primary water supply for the City of Paris. Recreational use includes fishing, swimming, boating, and limited waterfowl hunting. A large portion of the lake shoreline has been developed for residential use. Limited public boat launching facilities are available.

Largemouth Bass Stocking History: Years of poor natural recruitment of bass resulted in low densities of bass in the Paris Lakes. Poor catch per effort in electrofishing surveys, good body condition factor, and high size structure indices all provided biological support of this conclusion. The 14 inch minimum length limit, implemented in 1985, does not appear to be helping the population to recover on its own. Supplemental stockings over a three to five year span are being evaluated as to their potential to revitalize the largemouth bass population. Increased densities, coupled with protective size limits, may allow the fishery to become self-sustaining once again. A total of 14,340 three to four inch bass were stocked in 1994 and 1995.

Method of Assessment: This fishery has been evaluated every two years through two 60 minute electrofishing surveys. An additional survey was conducted in 1995.

Summary of Assessment Results: Since this is only the second year that largemouth bass have been stocked, no detailed assessment has been made. An impressive number of 16-21 inch largemouth bass were collected in the 1994 and 1995 surveys.

Comparison with Stocking Success Criterion: Not applicable.

ILLINOIS
DEPARTMENT OF
NATURAL RESOURCES

524 South Second Street, Springfield 62701-1787 Jim Edgar, Governor ● Brent Manning, Director

Lake Verm.

February 9, 1996

Lee Wright, Deputy Director
Vermilion County Conservation District
22296-A Henning Road
Danville, IL 61834

REFERENCE: Stocking Records - Lakes Mingo and Vermilion

Dear Lee:

As we recently discussed, enclosed are stocking records for Lakes Mingo and Vermilion. There were records prior to 1984; however, these are old and not of much use today. Also, Lake Mingo was renovated by the IDNR in late 1983 and restocked in 1984 so that year seemed a good place to start for both lakes.

Also as we discussed, I've enclosed extra copies of these stocking reports (on original IDNR letterhead) for posting at the concession areas of both lakes. If you need additional copies of this information for Board Meetings, the Visitor's Center, etc., please contact me or Donna Anderson. We will update and provide you these records annually so you can share this information.

Do not hesitate to contact us if you need additional fisheries information.

Sincerely,

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

M. Stephen Pallo

M. Stephen Pallo
District Fisheries Biologist
Kennekuk Cove County Park
22296-C Henning Road
Danville, IL 61834
217/443-0529

MSP/da
Enc. - Stocking Records - Lakes Mingo and Vermilion
cc: D.W. Dufford, Region Admr./Champaign
Ken Konsis, Director VCCD
Todd Seilhymer, Lake Vermilion
Sabrina Hilsheimer, Consumers Illinois Water Co., 322 N. Gilbert, Danville

ILLINOIS
DEPARTMENT OF
NATURAL RESOURCES

524 South Second Street, Springfield 62701-1787

Jim Edgar, Governor ● Brent Manning, Director

FISH STOCKING RECORD

LAKE VERMILION (SINCE 1984)

YEAR STOCKED	FISH STOCKED	SIZE AT STOCKING	NO. OF FISH STOCKED
1984	Walleye	Fry	666,000
1986	Walleye	4"	5,500
1987	Walleye	2"	33,000
1988	Walleye	2"	33,000
1989	Walleye	2"	33,000
1990	Walleye	2"	33,300
1991	Walleye	2"	26,640
1992	Walleye	2"	26,640
	Walleye	2"	27,000 *
	Largemouth Bass	2"	27,000
	Largemouth Bass	5"	13,268
	Muskellunge	10"	1,000
1993	Largemouth Bass	5"	13,318
	Walleye	2"	26,640
1994	Largemouth Bass	5"	13,320
1995	Largemouth Bass	9"	2,727 *
	Walleye	2"	40,000

*These fish stocked by the Vermilion County Conservation District and Consumers Illinois Water Company.

Effective July 1, 1995, the Illinois Department of Natural Resources was created through the consolidation of the Illinois Department of Conservation, Department of Mines and Minerals, Abandoned Mined Lands Reclamation Council, the Department of Transportation's Division of Water Resources, and the Illinois State Museum and Scientific Surveys from the Illinois Department of Energy and Natural Resources.

[printed on recycled and recyclable paper]

COOL AND COLDWATER STOCKING PRIORITY

LAKE: Lake Vermilion

SPECIES: Hybrid Striped Bass (SBH)

COUNTY: Vermilion

#/ACRES: 10

REGION: 3 DISTRICT: 12

TOTAL #: 9000

BIOLOGIST: Steve Pallo

SIZE: 1.5" fingerlings

DATE: April 29, 1996

WHEN: June/July 1997

RECOMMENDATION: ____ ADDITION: XX DELETION: ____ PRIORITY CHANGE: ____

LAKE CLASSIFICATION: PUCO

SURFACE ACREAGE: 900

RATIONALE/JUSTIFICATION:

Lake Vermilion is a typical central Illinois water supply reservoir with a good LMB population, excellent CCF, fair WHC, and fair BLG. Gizzard shad provide an abundant forage base. To utilize this forage, we have previously stocked MUE (only once in 1992) and WAE (since 1984). These stockings have not produced significant fisheries in the lake; however, a WAE fishery does exist downstream of the lake's dam, primarily in the tailwater area. It is hoped that stocking SBH's will provide an additional fishery in the lake. They should prey on the abundant GZS and undoubtedly a tailwater fishery will develop. M. Stephen Pallo 4/29/96

ANALYSIS OF REGIONAL PRIORITY: (By Regional Supervisor)

HIGH: ________ MEDIUM: ________ LOW: ________

REASON FOR RATING:

APPROVED BY SUPERVISOR: ________ DATE: ________

File - Also update FM2.0

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

DIVISION OF FISHERIES

FISH STOCKING RECORD

NAME OF WATER: Lake Vermillion
CLASSIFICATION: PUBL
WATER #: 113

CONTACT NAME: Steve Pallo
TYPE: SUP
DISTRICT: 12

ADDRESS: Kennekuk Cove County Park 22296-C Henning Road
PROJECT:

CITY: Danville
STATE: IL
ZIP: 61834
REGION: 3

TELEPHONE NUMBER: 217-443-0529
HATCHERY: 9010
COUNTY: Vermillion

DIRECTIONS FROM NEAREST TOWN:
REARING AREA: 9010
ACRES: 666

OFFICIAL USE ONLY

DATE ENTERED ____ INITIALS ____

CC: DFM ✓ RFM ✓ FILE ____

	SPECIES NAME	SIZE STOCKED		QUANTITY		POUNDS
		LENGTH	NO/LB.	STOCKED	ORDERED	
1)	WAE	2"	1000	36000	36000	36
2)						
3)						
4)						
5)						

COMMENTS

FIELD COMMENTS

DELIVERY MADE BY: Lay N Rendal
DATE: 06/20/96

186

Signature of person receiving fish: X Linda Dice

IL 422-0504

ILLINOIS DEPARTMENT OF CONSERVATION
DIVISION OF FISHERIES

FISH STOCKING RECORD

DATE 5/10/96

)F WATER: Lake Vermilion CLASSIFICATION: PUCO

WATER # 113

CT NAME: Ken Konsis TYPE:

DISTRICT 12

SS: Kennekuk Cove County Park
22296-A Henning Rd.
Danville, STATE: IL ZIP CODE: 61834

PROJECT

REGION 3

ONE NUMBER: 217/442-1691 HATCHERY:

COUNTY Vermilion

ONS FROM NEAREST TOWN:

TOWNSHIP 20N

Northeast side of Danville

RANGE 11E

¼ SECTION 17

SPECIES NAME	SIZE STOCKED	QUANTITY			STK. COMP.	REARING AREA
		SHIPPED	STOCKED	ORDERED		
LMB	6-8"/7" AVG	2720	2720	2720		

COMMENTS

Very nice LMB - pellet reared from Larry Brown.
Paid for by VCCD + Water Company

FIELD COMMENTS

ADE BY: Larry Brown DATE:

person receiving fish: M Stephen Pallis 5/10/96

3/96 MSP
0113 4/18/97 MSP

STATE AND PUBLIC LAKE INVENTORY REPORT

Lake name: LAKE VERMILION Classification: State____, Public COOP

County: VERMILION, Township: 20N, Range: 11E, 1/4 Section: 17 (of dam

Distance & direction from nearest town: Northwest side of Danville

Owner: Consumers Illinois Water Company ~~XXXXXXXXXXXXXXXXXXXXXXX~~, Lessee: Vermilion Co. Conservation Dist.

Name of Park (if applicable): JAYCEE PARK

LAKE DATA: Lake level raised 5 ft. in 1992.

Surface acres: 900 ~~XXX~~, Max. depth (ft.): 27, Av. depth (ft.): 12

Year built: 1925, Year rebuilt:____, Shoreline length (mi.): 12.0

Watershed size (acres): 170,880, Size of drain (inches):____

Siltation: Severe x, Moderate____, or Light____

Total Alkalinity (ppm): 220, Specific Conductance (umho/cm): 620, TDS (ppm): 453

Type of Lake: Natural: Bottomland lake___, Glacial___, Sink hole___

Artificial: Dug___, Dug & dammed x, Quarry___, Gravel Pit___, Borrow Pit___, Stripmine___.

Use of Lake (check): Potable water supply x, Industrial water supply___, Cooling lake___, Flood control___, Erosion control___, Recreation x, Other (list):____.

Recreational Uses of Lake (check):

Fishing x, Trotline fishing x, Motorboating x, Motor size limit___ H.P., Speed limit___ MPH, Water-skiing x, Number launching ramps 2, Boat rental___, Campgrounds___, Picnicking x, Waterfowl hunting___, Swimming beach x.

(Continued on reverse side)

ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

MEMORANDUM

to: Don Dufford

from: M. Stephen Pallo

date: December 20, 1996

subject: Muskie Status

FISHERIES DISTRICT 12: CHAMPAIGN, DOUGLAS, EDGAR, IROQUOIS, AND VERMILION COUNTIES

LAKE VERMILION - This 900 acre lake has received limited stockings of pure muskie since 1992. Stocking history is as follows:

YEAR	NUMBER	SIZE AT STOCKING
1992	1000	10 inches
1993	1000	8-9 inches
1996	1000	8.6 inch

Very few muskie have been collected by our surveys. Creel surveys have not been conducted since muskie were stocked. However, muskies are reported to have been caught and kept or released on numerous occasions. This angler data comes from the one boat ramp - concession on the lake via Vermilion County Conservation District staff. Muskie are also known to inhabit the Lake Vermilion spillway area. In 1996, 6 muskie were collected by electrofishing. These fish ranged from 34 to 39 inches. All fish were released. Currently, a 36" size limit is in effect for Lake Vermilion.

PARIS TWIN LAKES AND LAKE OF THE WOODS - Tiger muskies have been stocked into the Paris Twin Lakes (220 acres) since 1985. Lake of the Woods (25.5 acres) has received tiger muskies since 1982.

These small lakes were both part of the muskie research sponsored by the Department.

Both lakes have limited boat access. Fisheries surveys have shown that tiger muskies are a rare occurrence in either lake. However, on rare occasions, a fish is landed by anglers. For example, only 14 fish have been reported from the angler Volunteer Creel Program from Paris Lakes in 2 years.

A stocking history for both lakes follows:

PARIS TWIN LAKES - Stocking History

YEAR	NUMBER	SIZE
1985	220	8"
1986	220	8"
1987	220	5"
1987	220	8"
1988	220	8"
1989	220	8"
1990	2500	4"
1990	2208	8"
1990	2000	10"
1991	3400	8"
1992	163	10"
1993	660	10"
1994	2318	10"
1995	2500	10"
1996	660	10"

<u>LAKE OF THE WOODS</u> - Stocking History

YEAR	NUMBER	SIZE
1982	250	8-9"
1983	NONE	
1984	49	8"
1985	NONE	
1986	25	8"
1987	25	5"
1987	25	8"
1988	25	8"
1989	25	8"
1990	55	10"
1991	58	10"
1992	25	10"
1993	90	10"
1994	396	10"
1995	51	10"
1996	76	10"

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

MEMORANDUM

to: Don Dufford

from: M. Stephen Pallo

date: December 20, 1996

subject: Walleye Status Report

The following can be submitted to Springfield per their 12/2/96 request.

WALLEYE STATUS REPORT

FISHERIES DISTRICT 12: CHAMPAIGN, DOUGLAS, EDGAR, IROQUOIS, AND VERMILION COUNTIES

LAKE VERMILION - Lake Vermilion (900 acres) has been stocked with walleye since 1984. The stocking history is as follows:

YEAR	NUMBER	SIZE
1984	666,000	Fry
1985	None	
1986	5,500	4"
1987	33,000	2"
1988	33,000	2"
1989	33,000	2"
1990	33,000	1.7"
1991	26,640	2" fingerlings
1992	53,640	2" fingerlings
1993	None	

YEAR	NUMBER	SIZE
1994	26,640	2" fingerlings
1995	40,000	1.6" fingerlings
1996	36,000	2" fingerlings

Lake Vermilion has been sampled specifically for walleye during the spring "spawn" in April. During these surveys in 1995 and 1996, walleyes were not collected in nets. Plans were to electrofish below the spillway; however, high water and lack of access prevented this. Local anglers do report catching walleye. Most fish are reported caught from rip-rap along the dam, rip-rap along the Bowman Bridge, and a flooded low head dam east of the public boat launch. Walleye are also reported to be caught in the Lake Vermilion tailwater area. Anglers can fish from shore or wade the shallow riffles (water flow permitting) at the tailwater. Most walleye are reported to be 14 to 17" in length. Occasionally, 22" fish are reported in the tailwater area.

ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

MEMORANDUM

to: Don Dufford

from: M. Stephen Pallo

date: December 20, 1996

subject: Evaluation of Supplemental Stocking of Largemouth Bass

The following should be submitted to Springfield per their 12/2/96 request.

Name and Description of Water Area: **LAKE VERMILION** is located on the north edge of Danville. It is owned by Consumers ~~Illinois Water~~ Company (CIWC) with the Vermilion County Conservation District (VCCD) managing the recreational aspects of the lake. The spillway was raised five feet in 1992, causing the lake to increase from 666 to 900 acres. The lake currently has a maximum depth of 32 feet and an average depth of 14 feet. The lake was built in 1925. With the increase in the spillway elevation, the upper portion of the lake is once again usable for recreational boating and fishing. Considerable fisheries habitat resulted from the water level increase.

Largemouth Bass Stocking History: The following largemouth bass stocking program has occurred since 1992:

Year	Size (inches)	Number	Source
1992	2.0	27,000	CIWC and VCCD
1992	4.2	13,326	IDOC - Freeze branded
1993	4.0	13,318	IDOC - Freeze branded
1993	5-8	3,000	CIWC and VCCD Fin clipped
1994	3-4	13,320	IDOC - Freeze branded
1994	5-8	3,000	CIWC and VCCD Fin clipped
1995	8-10	2,727	CIWC/VCCD Fin clipped
1995	4	13,300	IDNR - Freeze branded
1996	6-8	2,720	CIWC/VCCD Fin clipped
1996	4	18,100	IDNR - Freeze branded

Rationale for Stocking: The opportunity to enhance the bass population came when the lake level was increased. This provided excellent cover and food for young fish.

Stocking was done to get bass immediately into this new habitat. Reproduction had been a problem in this lake in past years. Thus, to enhance natural recruitment, the stocking of larger fingerlings was continued.

Methods of Assessment: This lake has been surveyed annually since 1980 during the spring using AC electrofishing boats.

Summary of Assessment Results and Comparison with Stocking Success Criterion: The bass population has benefited greatly due to the stocking program. Electrofishing catch-per-hour (CPE) has increased since 1992. CPE of all bass in the late 1980's averaged 40; since 1992, CPE increased to 60 - a 50% increase. This increase occurred in all size groups of bass with 22% of the population being of legal size (15 inches). This is considered in the optional range (10-20%) for bass in this size group. CPE of bass greater than 8 inches in length has also increased considerably to a high of 61 in 1995. Previously, this CPE averaged near 30. Stocked bass made up from 15 to 41% of the annual electrofishing samples. Bass continue to have good condition due to an abundant forage supply of gizzard shad. In 1996, volunteer angler harvest reports (VAHR's) indicated that stocked bass were indeed being caught by anglers. These reports will be continued in future years.

Name and Description of Water Area: **PARIS EAST AND WEST LAKES** are located on the north edge of Paris, along Route 1 in Edgar County. Paris East Lake covers 163 acres with a maximum depth of 21 feet and an average depth of 8 feet. Paris West Lake covers 75 acres with a maximum depth of 9 feet and an average depth of 4 feet. The lakes are the primary water supply for the city of Paris. Recreational use includes fishing, swimming, boating, and limited waterfowl hunting. A large portion of the lake shoreline has been developed for residential use. Limited public boat launching facilities are available.

Largemouth Bass Stocking History: Years of poor natural recruitment resulted in low densities of largemouth bass in the Paris Lakes. The 14 inch minimum length limit, implemented in 1985, did not appear to be helping the population to recover on its own. Supplemental stockings are being evaluated over a five year span. Increased densities, coupled with protective size limits, may allow the fishery to become self-sustaining once again. A total of 14,340, four inch bass were stocked in 1994 and 1995. The IDNR did not stock any largemouth bass in either lake in 1996.

Method of Assessment: This fishery has been evaluated every two years through two 60 minute electrofishing surveys. An additional survey was conducted in 1995. The next survey will occur in 1997.

Summary of Assessment Results: Since only three stockings of largemouth bass have taken place, no detailed assessment has been made. Size structure of young fish appears to have improved. An impressive number of 16-21 inch largemouth bass were collected in the 1994 and 1995 surveys.

Comparison with Stocking Success Criterion: Not applicable.

ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

MEMORANDUM

to: Don Dufford

from: M. Stephen Pallo

date: December 20, 1996

subject: Bass Status Report

The following should be submitted to Springfield per their 12/2/96 request.

FISHERIES DISTRICT 12: CHAMPAIGN, IROQUOIS, EDGAR, DOUGLAS, AND VERMILION COUNTIES

file

LAKE VERMILION - The largemouth bass population continues to look good and should continue to improve especially with the cooperative stocking program of the Vermilion County Conservation District (VCCD), Consumers Illinois Water Company (CIWC), and the Illinois Department of Natural Resources (IDNR). The lake level was raised five feet in 1992, greatly increasing fisheries habitat all around the lake's shoreline. Two thousand seven hundred twenty (2,720), six to eight inch bass were stocked by VCCD/CIWC and an additional 18,100 bass, four inches long, were stocked by the IDNR in 1996. Since 1992, a total of 107,111 largemouth bass were stocked. Electrofishing catch-per-hour (CPE) has increased each year since 1992. CPE in the late 1980's averaged 40. Since lake filling and the VCCD/CIWC/IDNR stocking, CPE has averaged 60 - a 50% increase. This increase occurred in all size groups of fish with 22% of the bass being 15" or greater in 1995. Marked (i.e. stocked) fish made up from 15 to 41% of the sample. Obviously, the stocking program is producing the desired results with a considerable percentage of the fish growing to over 15". Natural reproduction and survival has also been excellent. Volunteer angler harvest reports also indicate that stocked bass are being caught. The VAHR's were started in 1996 and will continue in years to come. With a strong gizzard shad population, body condition of bass has been and will continue to be good. A 15" length limit, 6 creel limit is in effect for bass in Lake Vermilion. Walleye and muskie are also stocked in Lake Vermilion.

PARIS TWIN LAKES - Paris Twin Lakes are the water supply for the City of Paris. The East Lake is 163 acres and the West Lake is 57 acres. Both lakes are rather shallow and dredging to increase the capacity of the water supply is underway.

In recent history (1994 and 1995), the lakes were stocked with a total of 14,340 bass, 4" in length. These lakes have a good forage base of gizzard shad and bass growth is good. In 1996, the IDNR did not stock any bass. Bass from the earlier stocking should be of legal size in 1997. Tiger muskie are also stocked in the Paris East Lake. A 14" minimum length limit and 6 fish daily creel limit is enforced for the Paris Twin Lakes.

Lake Management Status Report

Date of Report: 1/17/97	**Fisheries Manager:** Steve Pallo	**District:** 12
Lake Name: LAKE VERMILION	**County:** Vermilion	**Water #:** 113
Ownership (STATE, PUBC, PUBO): PUBC	**Acreage:** 900	

LM STATUS REPORTS WILL INCLUDE THE FOLLOWING SECTIONS:

1. Listing of the Sport Fish Regulations in Effect
2. Listing of Fisheries Management Activities Completed with Evaluation of Success
3. Lake Management Plan Progress Table
4. Recommendations for Observed Problem Trends

1. Sport Fishing Regulations:
   A. 2 pole and line fishing only.
   B. Muskellunge: 36: minimum length limit; 1 per day creel limit.
   C. Walleye: 14" minimum length limit; 6 per day creel limit.
   D. Largemouth bass: 15" minimum length limit; 6 per day creel limit.

2. Management Activities Completed:

   1995

   A. April 1995: 3-300 foot gill nets (2" mesh) were set to check on the walleye population. 36 adult Channel catfish were collected, no Walleye.
   B. May 10, 1995: 2727 Largemouth bass were stocked by the VCCD. Fish had an average length of 7.5" and all were given a right pelvic clip by VCCD and IDNR staff.
   C. June 8, 15, 16, 20, 1995: A fish population analysis was conducted. Locally heavy storms interrupted some sampling days. 3 hours of AC daylight electrofishing and 3 trap nets set overnight made up this sample.

   1994

   D. May 12, 1994: VCCD stocked 3000, 7" Largemouth bass. All fish were given a left pelvic clip by VCCD and IDNR staff.
   E. May 24, 1994: Largemouth bass electrofishing survey completed.
   F. June 2, 1994: Hatchery stocked 26,640, 2" Walleye.
   G. August 9, 1994: Hatchery stocked 13,320, 4.7" Largemouth bass. These fish were marked by a freeze brand.

--continued--

SIGNATURES:

M. Stephen Pallo
District Fisheries Manager   Date 1/18/97   Regional Fisheries Administrator   Date

FM 43.0

3. **LAKE VERMILION** - Lake Management Plan Progress Report

SPECIES	CRITERIA	GOAL	1991	1992*	1993	1995	1995 RATING**
LMB	CPH>6"	60/hr.	39	1	49	67	Excellent
	CPE	60	39	12	50	76	Excellent
	PSD	40-60	76	76	60	64	Fair
	RSD-15"	10-20	18	24	29	27	Fair
	%>15"	25	17	19	19	21	Fair
	Wr	95-104	99	97	---	97	Good
BLG	CPE	250-450/hr.	---	9	---	64	Poor
	CPE>3"	150-210/hr.	---	6	---	44	Poor
	PSD	20-40	---	75	---	41	Good
	RSD-8"	5-10	---	0	---	0	Poor
	Wr	95-104	---	125	---	101	Good
WAE	CPE	5/hr.	---	---	---	0	Poor
	PSD	40-60	---	---	---	0	Poor
	RSD-20"	10-20	---	---	---	0	Poor
	Wr	95-104	---	---	---	0	Poor
WHC	CPE	---	37	8	---	39	---
	PSD	40-60	88	100	---	97	Poor
	RSD-10"	10-20	32	96	---	36	Poor
	Wr	95-104	94	89	---	85	Fair
CCF	CPE	---	3	1	---	2	---
	%>14"	80%	81	67	---	67	Fair
	Wr	95-104	---	89	---	---	---

*Lake level raised 5' during winter of 1991-spring 1992. Lake size went from 666 to 900 acres according to owner.

**Excellent - Value exceeds goal by 10%
Good - Value meets or exceeds goal
Fair - Value is close (+/-10%) to goal
Poor - Value does not meet goal

4. **Recommendations:**

A. A major survey should be conducted in 1997.
B. A sport species survey (LMB, WHC, etc.) should be conducted in 1996.
C. The stocking program for Walleye, Muskellunge, and Largemouth bass should be continued.
D. Park staff continue to show a concern for anglers taking excessive numbers of crappie. Additional creel surveys do not seem to be possible (due to budget). To prevent the perception of over harvest of crappie, we will promote a 25 fish per day creel limit within our Ad. rulemaking process.
E. Existing rules (see 1 of this report) appear to be adequate to protect the fine fishery that is developing on Lake Vermilion.
F. If money is available, Channel catfish should be tested for contaminants.

5. **Lake Narrative:**

A. Physical conditions:

Air temp = 84 degrees F	Water temp = 78.8 degrees F
TDS = 264	pH = 9.3
Conductivity = 529	Total Alkalinity = 222
Secchi = 2.8'	

B. Sampling protocol:

a.) Assisted by Mike Warnick and Mark Pittman (VCCD).
b.) 3-60 minute electrofishing runs (AC, daylight) at established locations.
3 trap nets set overnight at established locations.

C. Persons contacted:

a.) Mark Pittman - Vermilion County Conservation District
b.) Todd Seilhymer - Vermilion County Conservation District, Lake Patrol
c.) Ken Konsis - Vermilion County Conservation District, Executive Director
d.) Dallas Bowman - CPO Vermilion County

D. Observations and Analysis:

1. **LARGEMOUTH BASS:**

230 bass ranging in length from 86 to 507mm (3.4 to 20.3 inches) were collected. Total CPE and CPE>6" were at all time highs of 76 and 67 respectively. This fishery has been monitored since the early 1980's almost annually. PSD and RSD-15 were both rated fair at 64 and 27 respectively. The % of bass greater than 15 inches was fair at 21%. Condition (Wr) was good. Those criteria that rated only fair were very near the good ratings which indicates that a healthy bass population exists in Lake Vermilion.

These good ratings can be attributed to several factors:

1.) Lake level increase during winter 1991-spring 1992. This "flooding" inundated excellent spawning, escape, and feeding cover for bass.
2.) The stocking program by the VCCD and IDNR has directly and indirectly increased the bass population. Directly the bass population increased 43%, 40%, and 18% in 1993, 1994, and 1995 respectively. These increases were measured by fin clipped or freeze branded fish. Indirectly the entire population increased from a base CPE of 40 (from 1986 to 1991) to a CPE of 61 in 1995, excluding stocked fish. This 50% increase in population level was likely related to increased spawning success of natural and stocked fish in the excellent habitat provided by the lake level increase.

Largemouth bass should continue to be stocked to enhance the population. Excellent forage in the form of gizzard shad is available and bass should continue to grow well.

2. **BLUEGILL:**

212 Bluegill ranging in length from 40 to 186mm (1.6 to 7.4 inches). All criteria for Bluegill were rated poor except for condition (Wr=125) which was good. Bluegill may not do well in Lake Vermilion as there is likely considerable intra and inter specific competition with other fishes.

3. **WALLEYE:**

No Walleye were collected in 1995. Walleye have not routinely been collected in the lake; however, a reasonable fishery is reported to occur downstream of Lake Vermilion at the dam's spillway area. Walleye have also been reported by anglers 5-6 miles upstream of Lake Vermilion.

4. **WHITE CRAPPIE:**

118 Crappie were collected ranging in length from 131 to 353mm (5.2 to 14.1 inches). Population parameters of PSD and RSD-10" were rated as poor because these values were far too high (97 and 36 respectively). Approximately 36% of the population is longer than 10 inches, thus anglers should be happy. Very few fish less than 8" in length were collected and no fish were less than 6" long. This could easily be related to the time of sampling - early summer, and smaller fish are likely to occur. A majority of the fish greater than 8" were from the 1992 year class - the year the lake level was increased. This "boom" to the population will not likely last forever but to lengthen this boom a creel limit of 25 fish per day will be proposed. If approved, it should go into effect in the spring of 1997.

Crappie grew well in Lake Vermilion reaching at least 8" and up to 10" in 3 growing seasons since the lake level was increased. Condition of Crappie was a bit light at a Wr of 85. This is likely related to Crappie feeding extensively on small Gizzard shad which were just becoming available in late June.

5. **CHANNEL CATFISH:**

Only 6 Channel catfish ranging in length from 332 to 544mm (13.3 to 21.8 inches) were collected. Gill nets were not set during this survey because it was at peak angler use (late June) and due to likely mortality caused by warm water temperatures (85 degrees F). Gill nets were set in April to assess the Walleye population and an excellent population of 4 to 6 pound Channel catfish was sampled. However, these fish have a Level 3 advisory (ie. do not consume).

6. **ADDITIONAL SPECIES:**

The following species and CPE were found:

Black crappie - 3

Brook silverside - <1
Common Carp - 24
Flathead catfish - <1

Golden redhorse - 1
Golden shiner - 2
Green sunfish - 5

Green sunfish/Warmouth Hybrid - <1
Gizzard shad - 180
Highfin carpsucker - <1
Longear sunfish/Bluegill Hybrid - 1
Longear sunfish - 11
Orange spotted sunfish - <1
Spotted sucker - <1

Warmouth - <1	Quillback - 21
Yellow bullhead - 1	Yellow bass - 5

7. **GENERAL OBSERVATIONS**:

Lake Vermilion has a very diverse fish population. During this one survey, 23 species were collected: 33 species are known to occur. The bright spot is the Bass fishery especially since the stocking program began. Crappie (both White and Black) fishing should be good for the next couple of years as the 1992 year class moves through the system. Channel catfish are numerous and of good size but a Level 3 advisory exists. Walleye and Muskellunge are most often encountered by anglers at the lake's spillway. Growth of all predatory species is good as Gizzard shad are abundant.

LAKE MANAGEMENT STATUS REPORT

DATE OF REPORT: 4/21/98 FISH MANAGER: GARY LUTTERBIE DIST: 10

LAKE NAME: **LAKE VERMILION** COUNTY: VERMILION WATER NO: 113

OWNERSHIP (STATE, PUB-CO, PUB-OT): PUBLIC-COOP ACREAGE: 900

LAKE MANAGEMENT STATUS REPORTS WILL INCLUDE THE FOLLOWING SECTIONS:

1. Listings of the Sport Fishing Regulations in Effect.
2. Listing of Fisheries Management Activities Completed with Evaluation of Success.
3. Lake Management Plan Progress Table.
4. Recommendations for Observed Problem Trends.

Fishing Regulations:

1. 15" length and 6 creel limit on largemouth bass
2. 9" length and 25 creel limit on crappies
3. Pole and line fishing only, trotline and jug fishing allowed north of Boiling Springs Road.
6. 48" length and 1 daily creel limit on muskie.

Current Fish Management Activities:

1. On 8 May 1997 stocked 2600, 8" largemouth bass. Fish were given a left pelvic fin clip.
2. On 11 Jun 1997 stocked 36,000, 1.5" walleye fingerlings.
3. On 18 Jun 1997 a fish population survey was conducted using electrofishing only. Good populations of largemouth bass and white crappie were observed. No walleye or muskie were seen.
4. On 2 Sep 1997 stocked 18,025, 4" largemouth bass, of which 9025 were freeze branded.
5. On 30 Sep 1997 a gamefish survey was conducted to collected largemouth bass, walleye and muskie, plus to pick up contaminant samples. Again good largemouth bass and white crappie populations were observed. A lot of young-of-the-year walleye were observed during this survey, but no muskies were seen.
6. A creel survey was conducted during 1997.

Recommendations:

1. It was decided to drop this lake from the walleye stocking program since very few were surviving, even though good numbers of young-of-the-year walleyes were collected this fall. This was only about the second year class to develop in this lake since 1987 when stocking began.

2. The muskie population is also poor, with only two fish being collected ever since the program was started. If they don't start showing up soon, this stocking program may also be curtailed.

3. The stocking of 2600, 8"largemouth bass in May is working and should be continued. The fish should be fin clipped so that their contribution to the fishery can be assessed.

4. A game fish survey should be conducted in the fall and contaminant sampled will be collected during the year.

SIGNATURES:

Gary Lutterbie 4/21/98

District Fisheries Manager Date Regional Fisheries Admin. Date

LAKE VERMILION
LAKE MANAGEMENT PLAN PROGRESS

SPECIES/CRITERIA	GOAL OPTIMAL RANGE	June 1995	June 1997					RATING
LARGEMOUTH BASS								
CATCH/HOUR	40-60	76	72					Excel
NO./min > 150mm 6"	0.5-1.0	1.1	1.6					Excel
PSD 300mm/200mm	40-70%	64	50					Excel
RSD 380mm/200mm	10-30%	27	12					Good
RELATIVE WEIGHT	95-104	97	90					Fair
YOUNG/ADULT RATIO	1-10		0.03					Poor
AVE WEIGHT HARVESTED	1.5 lbs		3.3					Excel
LBS/ACRE HARVESTED	5-10 lbs		3.3					Fair
WHITE CRAPPIE								
CATCH/HOUR	25-50	39	92					Excel
PSD 200/130	40-60%	97	73					Excel
RSD-229	20-30%		28					Good
RSD-250	10-20%	36	8					Good
RELATIVE WEIGHT	90-100	85	81					Poor
AVE LN HARVESTED	8-9"		10"					Excel
AVE WEIGHT HARVESTED	.25-.5 lbs		0.41					Good
LBS/ACRE HARVESTED	10-20 lbs		6.2					Fair
BLUEGILL								
CATCH/HOUR	100-250	64	129					Good
NO./MIN>80mm	1.0-3.0	44	1.4					Good
PSD 150mm/80mm	20-40%	41	51					Excel
RSD-8 200mm/80mm	5-10%	0	0					Poor
RELATIVE WEIGHT	95-105	101	92					Fair
AVE LN HARVESTED	6"		6.1"					Good
LBS/ACRE HARVESTED	10-20 lbs		0.28					Poor
CHANNEL CATFISH								
CATCH/HOUR	5-15	2	4.6					Poor
PSD 410/280	40-70%		67					Good
RELATIVE WEIGHT	95-105		105					Good
AVE LN HARVESTED	16"		14.4"					Good
AVE WEIGHT HARVESTED	1.25 lbs		0.82					Good
LBS/ACRE HARVESTED	5-15 lbs		1.44					
MUSKELLUNGE								
CATCH/HOUR	1	0	0					Poor
PSD 760/510	?							Poor
RSD 970/510	?							Poor
% LEGAL (>48")	48" IN 1997							Poor
RELATIVE WEIGHT	95-105							Poor
AVE LN HARVESTED	50"							Poor
CATCH PER HOUR	0.01							Poor

Lake Vermilion Primary Report

On 18 June 1997 Lake Vermilion was surveyed using three sampling sites. Sampling sites 1 and 3 were surveyed using a D.C. electrofishing boat for 30 minutes and site 2 was surveyed for 45 minutes. The total time sampling was 1.75 hours. The D.C. was run on High, 40% and 60 DC. Refer to map for location of sampling sites.

Date	Time	Water Temp	Air Temp	pH	Total Alkalinity	Conduct-ivity	Secchi Disc
6/18/97	0845	74F	82F	7.9	154	380	10"

A total of 626 fish were collected of which bluegill comprised 35.9%, white crappie, 25.7% and largemouth bass, 20.1% of the survey, with eight other species making up the remaining 18.3%.

Largemouth Bass - 126 bass ranging in length from 120-509mm (4-20") were collected. The Catch Per Hour (CPH) of electrofishing was 72, which is above our goal of 60/hr. The following is based upon bass 200mm (8") and longer. The PSD or % > than 300mm (12") was 50%, which falls within the optimal range of 40-60%. The RSD-15 or % > than 380mm (15") was 12% which falls within the optimal range of 10-20%. The length limit on bass in this lake is also 15", so 12% would be considered of legal size. The body condition of the bass as expressed by Relative Weight was 90, which is below the 95-105 optimal range. Bass fishing should be good in 1998.

Largemouth Bass Stocking Program - Of the 120 bass over 200mm (8") in length that were collected in June 1997, 21 or 17.5% were fin clipped. In 1994 and 1995 marked bass comprised 41 and 15% of the collection respectively. The number of marked bass, the year they were stocked and their (length range) were: 7, 1997 (203-267mm); 7, 1995 (286-312mm); 6, 1994 (338-385mm) and 1, 1993 (472mm). Below is a table indicating the number of bass stocked, the date and mark.

Date	Number	Size	Mark	Source
7/9/92	27,000	2"	None	VCCD & ISW
	13,268	4-6"	None	IDOC
5/3/93	3,000	5-8"	Right Pelvic	VCCD & ISW
8/5/93	13,318	4"	Freeze Brand	IDOC
5/12/94	3,000	7"	Left Pelvic	VCCD & ISW
8/9/94	13,320	4.7"	Freeze Brand	IDOC
5/10/95	2,727	7.5"	Right Pelvic	VCCD
5/10/96	2,720	7"	Right Pectoral	VCCD & ISW
8/26/96	18,100	4"		IDNR
5/8/97	2,600	8"	Left Pelvic	VCCD
9/2/97	18,025	4"	½ Freeze Brand	IDNR

The ~~tagging~~ stocking program appears to be working very nicely in building up the largemouth bass population in Lake Vermilion.

Bluegill - 225 bluegill ranging in length from 40-199mm (1.6-8") were collected. The CPH for bluegill was 128.6, which is a little below what we usually see on other lakes, though is not bad. Based on bluegill 80mm (3") and longer, 51% were greater than 150mm (6"). This is slightly larger than the 20-40% optimal range. However this is not considered a problem by any means. No bluegills were collected over 200mm (8"). Body condition as expressed by Relative Weight was 92 which is just below the optimal range of 95-105. Bluegill fishing should be good in 1998.

White Crappie - 161 white crappie ranging in length from 90-339mm (33.5-13.4") were collected. The CPH for crappies was 92 which would be considered good. Based upon crappie 130mm (5") and longer, 73% were over 200mm (8"). This value exceeds the optimal range of 40-60% for this size crappie. Crappies 250mm (10") and longer comprised 8% of the collection. The optimal range for this size group is 10-20%, so this value fell slightly below. Crappie 300mm (12") and longer made up 2% of the population. This value falls within the optimal range of 1-5%. Body condition using Relative Weight was 81 which well below the 95-105 optimal range. The reason for this is unknown, possibly a shortage of appropriate food at this time. The crappie population is considered excellent and should provide good fishing. Only one black crappie was collected.

Other Fish Species Collected:

Species	Number	Length Range	Relative Weight	Fishing Out Look
Green Sunfish	9	50-149mm	101	Not sought
Channel Catfish	8	180-609mm	105	Good
Flathead Catfish	1	265	89	Fair
Yellow Bass	51	100-289mm	--	Fair, but small
Longear Sunfish	40	40-159mm	--	Not sought
Warmouth	3	100-179mm	--	Too few
Bluegill-Green Hybrid	1	165	--	Too few

Observations:

The largemouth bass and white crappie populations look very good and should offer some of the better fishing in central Illinois for those anglers who venture here. The walleyes have not shown up in any numbers for several years. Therefore it was decided to discontinue stocking them. Muskies are possibly facing the same fate if they don't start showing up in the surveys or at the boat ramp. The channel catfish population continues to be strong, though also remains on the Advisory list.

Recommendations:

- Continue the largemouth bass stocking program. It would be nice to get the local bass club more involved. We should consider stocking them on a weekend day when they might be more available to help.

- Maintain the current fishing regulations.
- Continue to monitor the muskie population, and determine if they should continue to be stocked.
- Continue the contaminant monitoring program.
- Conduct a largemouth bass survey again in the fall.

1997 LAKE VERMILION CREEL CENSUS INFORMATION

	1997
Dates of Survey	3/15 to 10/31
Percent of Periods Sampled	25.3
Number of Interviews	1786
Fishing Effort Total (Hrs/Acre)	47
Boat	39
Shore	8
Percent Completed Trips	58.4
Weekday Effort (Hrs/Acre)	23
Weekend Effort (Hrs/Acre)	24
Ave. Length of Fishing Trip (Hrs)	4.2
Boat (Hrs)	4.2
Shore (Hrs)	2.8
Mean Distance Traveled	9.9
Success Rating (1 Low, 10 High)	4.7
Percent Anglers Fishing For:	
Anything	23.4
Channel Catfish	5.9
Largemouth Bass	40.6
Bluegill	0.7
Crappie	27.8
Walleye	0
Muskie	0
White Bass	0.1
Yellow Bass	1.3
Carp	0.1
Percent of Illegal Catches Observed	4.3

FISH HARVESTED AND CAUGHT

NUMBER PER ACRE

Species	Caught	Harvested
Largemouth Bass	18.76	1.46
White Crappie	31.56	14.98
Channel Catfish	3.12	1.77
Bluegill	4.76	1.82
Yellow Bass	7.52	4.52
Walleye	0.01	0
Total	66.88	25.13

POUNDS PER ACRE

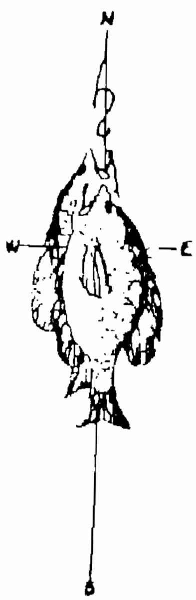
Species	Caught	Harvested
Largemouth Bass	19.06	3.31
White Crappie	9.6	6.15
Channel Catfish	1.97	1.45
Bluegill	0.62	0.28
Yellow Bass	1.3	0.83
Walleye	0.02	0.01
Total	33.1	12.38

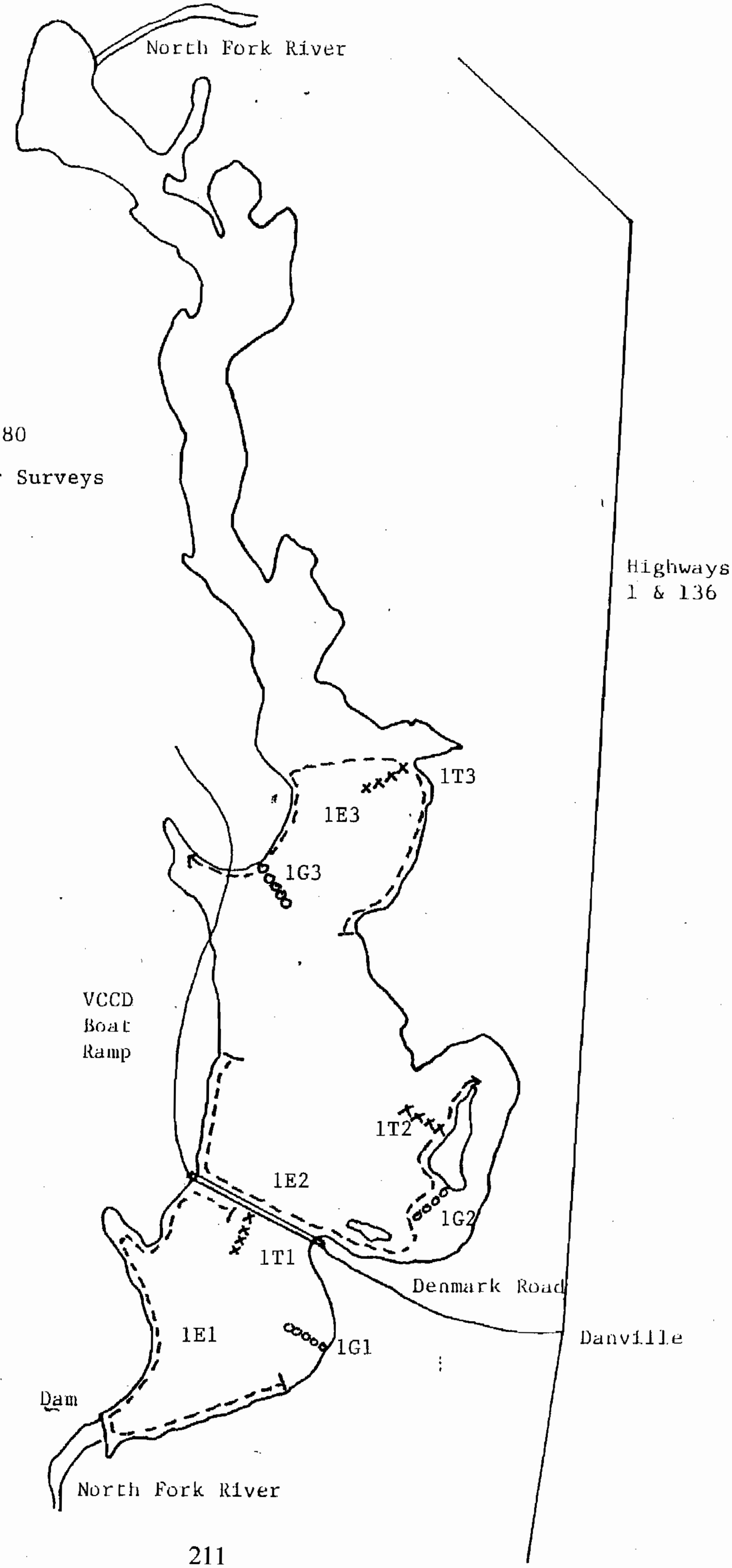
LAKE VERMILION

T20N R11E Sec 17

Surface Acres: 666
Maximum Depth: 27'
Average Depth: 12'
Acre Feet Water: 7992
Miles Shoreline: 12
Watershed Acres: 170,880

Sampling Map for Major Surveys





E⁻⁻ORT TABLE FOR THE FULL DAY *** DAY ***

REGION :=3 LAKE :=LAKE VERMILLION
DISTRICT :=10 YEAR :=97
ACREAGE :933 SAMPLING RATIO :=351/1386 = 25.3%
NUMBER OF INTERVIEWS:1786

YEAR PERIOD 03/15 TO 04/08 OF SECTION 1
YEAR PERIOD 04/09 TO 04/30 OF SECTION 1
YEAR PERIOD 05/01 TO 05/31 OF SECTION 1
YEAR PERIOD 06/01 TO 06/15 OF SECTION 1
YEAR PERIOD 06/16 TO 08/31 OF SECTION 1
YEAR PERIOD 09/01 TO 09/30 OF SECTION 1
YEAR PERIOD 10/01 TO 10/31 OF SECTION 1
YEAR PERIOD 03/15 TO 04/08 OF SECTION 2
YEAR PERIOD 04/09 TO 04/30 OF SECTION 2
YEAR PERIOD 05/01 TO 05/31 OF SECTION 2
YEAR PERIOD 06/01 TO 06/15 OF SECTION 2
YEAR PERIOD 06/16 TO 08/31 OF SECTION 2
YEAR PERIOD 09/01 TO 09/30 OF SECTION 2
YEAR PERIOD 10/01 TO 10/31 OF SECTION 2

	ANGL HRS	95% CONF INTVL		HRS/ ACRE	95% CONF INTVL		% EFF INTVD
OAT FISHING:							
WEEKDAY	17816	15893-19739	(11%)	19	17-21	(11%)	11.88
WKND/HOL	18827	16585-21069	(12%)	20	18-23	(12%)	27.22
STR TOTAL	36643	33741-39545	(8%)	39	36-42	(8%)	19.76
SHORE FISHING:							
WEEKDAY	4340	3184-5496	(27%)	5	3-6	(27%)	7.95
WKND/HOL	3236	2728-3744	(16%)	3	3-4	(16%)	18.40
STR TOTAL	7576	6327-8825	(16%)	8	7-9	(16%)	12.41
BOAT/SHORE COALESCED:							
WEEKDAY	21723	19440-24006	(11%)	23	21-26	(11%)	11.33
WKND/HOL	21581	19212-23950	(11%)	23	21-26	(11%)	26.51
STR TOTAL	43304	40063-46545	(7%)	46	43-50	(7%)	18.89
BOAT/SHORE STRATIFIED:							
WEEKDAY	22157	19964-24350	(10%)	24	21-26	(10%)	11.11
WKND/HOL	22064	19771-24357	(10%)	24	21-26	(10%)	25.93
S.R TOTAL	44221	41097-47345	(7%)	47	44-51	(7%)	18.50

REGION :=3 LAKE :=LAKE VERMILLION
DISTRICT :=10 YEAR :=97
ACREAGE :933 SAMPLING RATIO :=702/2772 = 25.3%
RATIO OF EFFORT HOURS INTERVIEWED := 8181.6/44224.2 = 18.5%
NUMBER OF INTERVIEWS: 1786

COMBINED ACROSS STRATA:

YEAR PERIOD 03/15 TO 04/08 OF SECTION 1
YEAR PERIOD 04/09 TO 04/30 OF SECTION 1
YEAR PERIOD 05/01 TO 05/31 OF SECTION 1
YEAR PERIOD 06/01 TO 06/15 OF SECTION 1
YEAR PERIOD 06/16 TO 08/31 OF SECTION 1
YEAR PERIOD 09/01 TO 09/30 OF SECTION 1
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YEAR PERIOD 04/09 TO 04/30 OF SECTION 2
YEAR PERIOD 05/01 TO 05/31 OF SECTION 2
YEAR PERIOD 06/01 TO 06/15 OF SECTION 2
YEAR PERIOD 06/16 TO 08/31 OF SECTION 2
YEAR PERIOD 09/01 TO 09/30 OF SECTION 2
YEAR PERIOD 10/01 TO 10/31 OF SECTION 2

MSC SPECIES CAUGHT:
LMB BLG WHC YLB CCF GSF WAE SMB BLC ORS
SUBSTRATUM:
DAY PERIODS STRATIFIED
WEEKDAY/WEEKEND: WEEKDAY/WEEKEND STRATIFIED
FISHING TYPE: BOAT/SHORE STRATIFIED
FISH: CAUGHT

SPEC	#/HR	95% CI		# CAUGHT	95% CI		#/HA	#/ACRE
BLB	.010	+-.049	(378 %)	222	16-427	(93 %)	.59	.24
CAP	.007	.000-.014	(98 %)	208	93-323	(55 %)	.55	.22
FCF	.000	+-.000	(236 %)	6	+-19	(236 %)	.02	.00
LOS	.002	.000-.004	(60 %)	147	67-228	(55 %)	.39	.16
ROB	.000	+-.000	(430 %)	2	+-11	(430 %)	.00	.00
SAB	.000	+-.000	(257 %)	5	+-19	(257 %)	.01	.00
WAM	.004	+-.048	(105 %)	28	+-334	(109 %)	.07	.03
WHS	.000	+-.003	(312 %)	23	+-91	(290 %)	.06	.03
YEB	.007	.003-.010	(48 %)	243	127-360	(48 %)	.64	.26
MSC	.873	.772-.974	(12 %)	61511	53292-69729	(13 %)	162.91	65.93
TOT	.905	.802-1.008	(11 %)	62395	54142-70649	(13 %)	165.25	66.88

SPEC	KG/HR	95% CI		KG CAUGHT	95% CI		KG/HA	AVG WT(G)
BLB	.001	+-.006	(477 %)	24	-47	(100 %)	.063	107.0
CAP	.006	+-.017	(187 %)	112	3-222	(97 %)	.298	540.6
FCF	..000	+-.000	(236 %)	8	+-26	(236 %)	.020	1320.1
LOS	.000	.000-.000	(64 %)	6	3-9	(51 %)	.016	39.9
ROB	.000	+-.000	(430 %)	.	+-.67127	(430 %)	.000	63.3
SAB	.000	+-.000	(257 %)	4	+-13	(257 %)	.010	688.8
WAM	.000	+-.002	(113 %)	1	+-16	(115 %)	.003	44.2
WHS	.000	+-.001	(312 %)	10	+-40	(290 %)	.027	437.9
YEB	.001	.000-.002	(55 %)	47	25-68	(46 %)	.123	191.4
MSC	.187	.164-.210	(12 %)	13797	12228-15366	(11 %)	36.540	224.3
TOT	.196	.172-.221	(12 %)	14009	12433-15584	(11 %)	37.100	224.5

SPEC	LB/HR	95% CI		LB CAUGHT	95% CI		LB/ACRE	AVG WT(LB)
BLB	.002	+-.014	(477 %)	52	-105	(100 %)	.056	.2359
CAP	.013	+-.038	(187 %)	248	7-489	(97 %)	.266	1.1918
FCF	.000	+-.000	(236 %)	17	+-56	(236 %)	.018	2.9103
LOS	.000	.000-.000	(64 %)	13	6-19	(51 %)	.014	.0879
ROB	.000	+-.000	(430 %)		+-1	(430 %)	.000	.1395
SAB	.000	+-.001	(257 %)	8	+-29	(257 %)	.009	1.5186
WAM	.000	+-.005	(113 %)	3	+-34	(115 %)	.003	.0974
WHS	.000	+-.003	(312 %)	22	+-88	(290 %)	.024	.9654
YEB	.003	.001-.005	(55 %)	103	56-150	(46 %)	.110	.4220
MSC	.413	.363-.463	(12 %)	30417	26958-33876	(11 %)	32.601	.4945
TOT	.433	.380-.487	(12 %)	[illegible]	27410-34357	(11 %)	33.101	.4950

HARVESTED AND CPUE TABLE *** DAY ***

REGION :=3 LAKE :=LAKE VERMILLION
DISTRICT :=10 YEAR :=97
ACREAGE :933 SAMPLING RATIO :=702/2772 = 25.3%
RATIO OF EFFORT HOURS INTERVIEWED := 8181.6/44224.2 = 18.5%
NUMBER OF INTERVIEWS: 1786

COMBINED ACROSS STRATA:

YEAR PERIOD 03/15 TO 04/08 OF SECTION 1
YEAR PERIOD 04/09 TO 04/30 OF SECTION 1
YEAR PERIOD 05/01 TO 05/31 OF SECTION 1
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YEAR PERIOD 05/01 TO 05/31 OF SECTION 2
YEAR PERIOD 06/01 TO 06/15 OF SECTION 2
YEAR PERIOD 06/16 TO 08/31 OF SECTION 2
YEAR PERIOD 09/01 TO 09/30 OF SECTION 2
YEAR PERIOD 10/01 TO 10/31 OF SECTION 2

MSC SPECIES CAUGHT:
CAP LOS YEB BLB FCF WAM WHS SAB ROB OPS
SUBSTRATUM:
DAY PERIODS STRATIFIED
WEEKDAY/WEEKEND: WEEKDAY/WEEKEND STRATIFIED
FISHING TYPE: BOAT/SHORE STRATIFIED
FISH: HARVESTED

SPEC	#/HR	95% CI		# HARVST	95% CI		#/HA	#/ACRE
BLC		*** NOT RECORDED ***			*** NOT RECORDED ***			
BLG	.045	.006-.084	(87 %)	1696	972-2420	(43 %)	4.49	1.82
CCF	.031	.021-.040	(31 %)	1647	1096-2199	(33 %)	4.36	1.77
GSF	.002	+-.005	(122 %)	95	3-187	(97 %)	.25	.10
LMB	.026	.015-.037	(41 %)	1364	960-1768	(30 %)	3.61	1.46
SMB	.000	+-.000	(430 %)	6	+-32	(430 %)	.02	.00
WAE	.000	+-.000	(134 %)	6	+-13	(125 %)	.02	.00
WHC	.182	.132-.231	(27 %)	13972	10904-17040	(22 %)	37.00	14.98
YLB	.066	.034-.099	(49 %)	4217	1900-6534	(55 %)	11.17	4.52
MSC	.015	.007-.023	(55 %)	444	256-631	(42 %)	1.17	.48
TOT	.367	.299-.435	(18 %)	23446	19439-27453	(17 %)	62.09	25.13

SPEC	KG/HR	95% CI		KG HARVST	95% CI		KG/HA	AVG WT(G)
BLC		*** NOT RECORDED ***			*** NOT RECORDED ***			
BLG	.003	.000-.006	(87 %)	119	64-174	(46 %)	.316	70.3
CCF	.010	.006-.014	(40 %)	613	411-814	(33 %)	1.622	371.9
GSF	.000	+-.000	(205 %)	6	+-15	(127 %)	.017	67.6
LMB	.024	.013-.036	(47 %)	1400	948-1853	(32 %)	3.709	1026.9
SMB	.000	+-.000	(430 %)	4	+-21	(430 %)	.010	645.2
WAE	.000	+-.000	(139 %)	4	+-9	(130 %)	.011	708.7
WHC	.032	.022-.042	(30 %)	2603	2029-3177	(22 %)	6.894	186.3
YLB	.006	.004-.008	(35 %)	353	205-500	(42 %)	.934	83.6
MSC	.007	+-.018	(157 %)	135	25-245	(82 %)	.358	304.6
TOT	.083	.066-.100	(20 %)	5237	4460-6015	(15 %)	13.870	223.4

SPEC	LB/HR	95% CI		LB HARVST	95% CI		LB/ACRE	AVG WT(LB)
BLC		*** NOT RECORDED ***			*** NOT RECORDED ***			
BLG	.007	.000-.012	(87 %)	263	142-384	(46 %)	.282	.1550
CCF	.023	.014-.032	(40 %)	1351	906-1795	(33 %)	1.448	.8200
GSF	.000	+-.001	(205 %)	14	+-32	(127 %)	.015	.1489
LMB	.054	.029-.079	(47 %)	3087	2089-4085	(32 %)	3.309	2.2639
SMB	.000	+-.000	(430 %)	9	+-45	(430 %)	.009	1.4224
WAE	.000	+-.000	(139 %)	9	+-21	(130 %)	.010	1.5624
WHC	.071	.049-.092	(30 %)	5739	4473-7005	(22 %)	6.151	.4107
YLB	.013	.009-.018	(35 %)	777	452-1102	(42 %)	.833	.1843
MSC	.016	+-.040	(157 %)	298	55-541	(82 %)	.319	.6716
TOT	.183	.146-.220	(20 %)	11546	9833-13260	(15 %)	12.375	.4925

HARVESTED AND CPUE TABLE *** DAY ***
REGION :=3 LAKE :=LAKE VERMILLION
DISTRICT :=10 YEAR :=97
ACREAGE :933 SAMPLING RATIO :=702/2772 = 25.3%
RATIO OF EFFORT HOURS INTERVIEWED := 8181.6/44224.2 = 18.5%
NUMBER OF INTERVIEWS: 1786

COMBINED ACROSS STRATA:

YEAR PERIOD 03/15 TO 04/08 OF SECTION 1
YEAR PERIOD 04/09 TO 04/30 OF SECTION 1
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YEAR PERIOD 06/01 TO 06/15 OF SECTION 2
YEAR PERIOD 06/16 TO 08/31 OF SECTION 2
YEAR PERIOD 09/01 TO 09/30 OF SECTION 2
YEAR PERIOD 10/01 TO 10/31 OF SECTION 2

MSC SPECIES CAUGHT:
LMB BLG WHC YLB CCF GSF WAE SMB BLC OPS
SUBSTRATUM:
DAY PERIODS STRATIFIED
WEEKDAY/WEEKEND: WEEKDAY/WEEKEND STRATIFIED
FISHING TYPE: BOAT/SHORE STRATIFIED
FISH: HARVESTED

SPEC	#/HR	95% CI		# HARVST	95% CI		#/HA	#/ACRE
BLB	.002	+-.017	(102 %)	42	+-238	(465 %)	.11	.05
CAP	.006	+-.013	(120 %)	120	35-204	(71 %)	.32	.13
FCF		*** NOT RECORDED ***			*** NOT RECORDED ***			
LOS	.002	.000-.003	(72 %)	93	34-152	(64 %)	.25	.10
ROB		*** NOT RECORDED ***			*** NOT RECORDED ***			
SAB		*** NOT RECORDED ***			*** NOT RECORDED ***			
WAM	.000	+-.002	(257 %)	4	+-12	(257 %)	.00	.00
WHS	.000	+-.003	(312 %)	23	+-91	(290 %)	.06	.03
YEB	.004	.001-.007	(66 %)	162	51-273	(69 %)	.43	.18
MSC	.352	.285-.419	(19 %)	23002	19014-26990	(17 %)	60.92	24.66
TOT	.367	.299-.435	(18 %)	23446	19439-27453	(17 %)	62.09	25.13

SPEC	KG/HR	95% CI		KG HARVST	95% CI		KG/HA	AVG WT(G)
BLB	.000	+-.002	(986 %)	6	+-23	(300 %)	.015	136.4
CAP	.006	+-.017	(202 %)	84	+-193	(129 %)	.223	705.1
FCF		*** NOT RECORDED ***			*** NOT RECORDED ***			
LOS	.000	.000-.000	(77 %)	4	2-7	(61 %)	.011	45.3
ROB		*** NOT RECORDED ***			*** NOT RECORDED ***			
SAB		*** NOT RECORDED ***			*** NOT RECORDED ***			
WAM	.000	+-.000	(257 %)		+-.36613	(257 %)	.000	29.3
WHS	.000	+-.001	(312 %)	10	+-40	(290 %)	.027	437.9
YEB	.000	.000-.002	(73 %)	30	11-50	(65 %)	.081	188.1
MSC	.076	.062-.090	(19 %)	5102	4330-5874	(15 %)	13.513	221.8
TOT	.083	.066-.100	(20 %)	5237	4460-6015	(15 %)	13.870	223.4

SPEC	LB/HR	95% CI		LB HARVST	95% CI		LB/ACRE	AVG WT(LB)
BLB	.000	+-.005	(986 %)	13	+-51	(300 %)	.014	.3006
CAP	.012	+-.037	(202 %)	186	+-426	(129 %)	.199	1.5544
FCF		*** NOT RECORDED ***			*** NOT RECORDED ***			
LOS	.000	.000-.000	(77 %)	9	4-15	(61 %)	.010	.0998
ROB		*** NOT RECORDED ***			*** NOT RECORDED ***			
SAB		*** NOT RECORDED ***			*** NOT RECORDED ***			
WAM	.000	+-.000	(257 %)		+-.80719	(257 %)	.000	.0646
WHS	.000	+-.003	(312 %)	22	+-88	(290 %)	.024	.9654
YEB	.002	.000-.004	(73 %)	67	23-111	(65 %)	.072	.4146
MSC	.167	.136-.199	(19 %)	11248	9546-12950	(15 %)	12.056	.4890
TOT	.183	.146-.220	(20 %)	11546	9833-13260	(15 %)	12.375	.4925

REGION :=3 LAKE :=LAKE VERMILLION
DISTRICT :=10 YEAR :=97
ACREAGE :933 SAMPLING RATIO :=702/2772 = 25.3%
RATIO OF EFFORT HOURS INTERVIEWED := 8181.6/44224.2 = 18.5%
NUMBER OF INTERVIEWS: 1786

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YEAR PERIOD 03/15 TO 04/08 OF SECTION 1
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YEAR PERIOD 09/01 TO 09/30 OF SECTION 2
YEAR PERIOD 10/01 TO 10/31 OF SECTION 2

MSC SPECIES CAUGHT:
CAP LOS YEB BLB FCF WAM WHS SAB ROB ORS
SUBSTRATUM:
DAY PERIODS STRATIFIED
WEEKDAY/WEEKEND: WEEKDAY/WEEKEND STRATIFIED
FISHING TYPE: BOAT/SHORE STRATIFIED
FISH: CAUGHT

SPEC	#/HR	95% CI		# CAUGHT	95% CI		#/HA	#/ACRE
BLC	.000	+-.000	(430 %)	11	+-57	(430 %)	.03	.01
BLG	.098	.052-.143	(47 %)	4436	3178-5695	(28 %)	11.75	4.76
CCF	.053	.039-.068	(26 %)	2911	2220-3602	(24 %)	7.71	3.12
GSF	.003	.000-.006	(93 %)	146	45-247	(69 %)	.39	.16
LMB	.234	.192-.275	(18 %)	17503	15028-19978	(14 %)	46.36	18.76
SMB	.000	+-.000	(240 %)	21	+-64	(197 %)	.06	.02
WAE	.000	+-.001	(505 %)	10	+-47	(359 %)	.03	.01
WHC	.348	.279-.416	(20 %)	29446	22584-36307	(23 %)	77.98	31.56
YLB	.137	.090-.184	(35 %)	7018	4510-9526	(36 %)	18.59	7.52
MSC	.032	.013-.051	(60 %)	893	611-1174	(32 %)	2.36	.96
TOT	.905	.802-1.008	(11 %)	62395	54142-70649	(13 %)	165.25	66.88

SPEC	KG/HR	95% CI		KG CAUGHT	95% CI		KG/HA	AVG WT(G)
BLC	.000	+-.000	(430 %)		+-5	(430 %)	.003	93.3
BLG	.006	.003-.009	(57 %)	261	165-358	(37 %)	.692	58.9
CCF	.014	.009-.018	(32 %)	835	601-1068	(28 %)	2.211	286.7
GSF	.000	+-.000	(177 %)	8	+-16	(101 %)	.022	55.9
LMB	.109	.088-.130	(20 %)	8066	6877-9255	(15 %)	21.362	460.8
SMB	.000	+-.000	(341 %)	9	+-35	(300 %)	.023	402.7
WAE	.000	+-.000	(436 %)	7	+-26	(272 %)	.018	686.1
WHC	.047	.037-.058	(22 %)	4062	3182-4941	(22 %)	10.757	137.9
YLB	.011	.007-.015	(34 %)	548	373-723	(32 %)	1.451	78.1
MSC	.009	+-.020	(120 %)	212	99-325	(53 %)	.561	237.3
TOT	.196	.172-.221	(12 %)	14009	12433-15584	(11 %)	37.100	224.5

SPEC	LB/HR	95% CI		LB CAUGHT	95% CI		LB/ACRE	AVG WT(LB)
BLC	.000	+-.000	(430 %)	2	+-12	(430 %)	.002	.2058
BLG	.013	.006-.021	(57 %)	576	364-789	(37 %)	.618	.1299
CCF	.030	.021-.040	(32 %)	1840	1325-2355	(28 %)	1.972	.6321
GSF	.000	+-.001	(177 %)	18	+-36	(101 %)	.019	.1233
LMB	.240	.193-.287	(20 %)	17783	15160-20405	(15 %)	19.060	1.0160
SMB	.000	+-.000	(341 %)	19	+-76	(300 %)	.020	.8879
WAE	.000	+-.001	(436 %)	15	+-57	(272 %)	.016	1.5126
WHC	.104	.081-.127	(22 %)	8954	7015-10894	(22 %)	9.597	.3041
YLB	.024	.016-.032	(34 %)	1208	823-1594	(32 %)	1.295	.1722
MSC	.020	+-.045	(120 %)	467	218-715	(53 %)	.500	.5231
TOT	.433	.380-.487	(12 %)	[illegible]883	27410-34357	(11 %)	33.101	.4950

TABLE LAKE VERMILLION 1997 DAY CREEL FINAL REPORT
DAYTIME DATA FOR LAKE=LAKE VERMILLION CREEL BEGUN IN YEAR=97

SECTION 1	FROM	03/15	TO	04/08
SECTION 1	FROM	04/09	TO	04/30
SECTION 1	FROM	05/01	TO	05/31
SECTION 1	FROM	06/01	TO	06/15
SECTION 1	FROM	06/16	TO	08/31
SECTION 1	FROM	09/01	TO	09/30
SECTION 1	FROM	10/01	TO	10/31
SECTION 2	FROM	03/15	TO	04/08
SECTION 2	FROM	04/09	TO	04/30
SECTION 2	FROM	05/01	TO	05/31
SECTION 2	FROM	06/01	TO	06/15
SECTION 2	FROM	06/16	TO	08/31
SECTION 2	FROM	09/01	TO	09/30
SECTION 2	FROM	10/01	TO	10/31

HOURS PER COMPLETED TRIP:

	MEAN	95% CONF.INTVL. OF MEAN		MIN.	MAX.	#SAMPLES
BOAT	4.2	4.1 - 4.3	(3%)	.5	11	858
SHORE	2.8	1.8 - 3.7	(34%)	.8	5.7	15
BOAT & SHORE	4.2	4.1 - 4.3	(3%)	.5	11	873

?80 SAMPLES WERE FROM SPLIT INTERVIEWS OF COMPLETED TRIPS
8.4% OF ALL 1496 INTERVIEWS WERE COMPLETED TRIPS

SUPPLEMENTARY DATA:

QUESTION	MEAN	95% CONF.INTVL. OF MEAN		MIN.	MAX.	#SAMPLES
DISTANCE TRAVELLED IN MILES	9.9	9.2 - 10.6	(7%)	1	246	1391
SUCCESS RATING 1-10?	4.7	4.6 - 4.8	(3%)	1	10	1390

IS CATCH ILLEGAL?
CLERK NOTED 65 OUT OF 1496 INTERVIEWS HAD ILLEGAL CATCHES

INTERVIEWS (AND %) PER SPECIES SOUGHT

ANY	350	(23.4%)	LMB	608	(40.6%)
WHC	411	(27.5%)	YLB	20	(1.3%)
CRP	5	(.3%)	CCF	56	(3.7%)
CAT	33	(2.2%)	BLG	11	(.7%)
WHB	1	(.1%)	CAP	1	(.1%)

PARTY SIZE VS. # INTERVIEWS

BOAT		SHORE	
1	418	1	146
2	702	2	125
3	57	3	29
4	10	4	8
5		5	1
6		6	
7		7	
8		8	
9		9	
10+		10+	

TABLE LAKE VERMILLION 1997 DAY CREEL FINAL REPORT CONTINUED
DAYTIME DATA FOR LAKE=LAKE VERMILLION CREEL BEGUN IN YEAR=97

FISH HARVESTED/RELEASED BY # ANGLER-COMPLETED TRIPS FOR DIFFERENT TAXA

HARVESTED FISH:

ALL SIZES #LMB	#ANGLERS	ALL SIZES #SMB	#ANGLERS	ALL SIZES #SMB	#ANGLERS	ALL SIZES #CCF	#ANGLERS	ALL SIZES #CCF	#ANGLERS
0	1357	0	1506	16		0	1434	16	1
1	108	1		17		1	28	17	
2	30	2		18		2	16	18	
3	11	3	1	19		3	15	19	
4	1	4		20		4	3	20	
5		5		21		5	5	21	
6		6		22		6	2	22	
7		7		23		7	1	23	
8		8		24		8	2	24	
9		9		25		9		25	
10		10		26		10		26	
11		11		27		11		27	
12		12		28		12		28	
13		13		29		13		29	
14		14		30		14		30	
15+		15		31+		15		31+	

RELEASED FISH:

ALL SIZES #LMB	#ANGLERS	ALL SIZES #SMB	#ANGLERS	ALL SIZES #SMB	#ANGLERS	ALL SIZES #CCF	#ANGLERS	ALL SIZES #CCF	#ANGLERS
0	631	0	1504	16		0	1415	16	
1	244	1	2	17		1	56	17	
2	216	2		18		2	17	18	
3	125	3	1	19		3	7	19	
4	108	4		20		4	4	20	
5	62	5		21		5	2	21	
6	37	6		22		6	4	22	
7	18	7		23		7		23	
8	15	8		24		8	1	24	
9	9	9		25		9		25	
10	22	10		26		10	1	26	
11	4	11		27		11		27	
12	4	12		28		12		28	
13	2	13		29		13		29	
14	1	14		30		14		30	
15+	9	15		31+		15		31+	

(TAXA FOR L.FREQS.= LMB SMB CCF)

TABLE LAKE VERMILLION 1997 DAY CREEL FINAL REPORT CONTINUED
DAYTIME DATA FOR LAKE=LAKE VERMILLION CREEL BEGUN IN YEAR=97

; FISH HARVESTED/RELEASED BY # ANGLER-COMPLETED TRIPS FOR DIFFERENT TAXA

HARVESTED FISH:

ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES	
#BLC	#ANGLERS	#WHC	#ANGLERS	#WHC	#ANGLERS	#BLG	#ANGLERS	#BLG	#ANGLERS
0	1507	0	1071	16		0	1398	16	
1		1	45	17	1	1	58	17	
2		2	65	18	5	2	21	18	
3		3	73	19	1	3	16	19	
4		4	67	20	2	4	4	20	
5		5	51	21		5	4	21	
6		6	27	22		6	1	22	
7		7	11	23		7	1	23	
8		8	24	24		8		24	
9		9	8	25	4	9		25	
10		10	16	26		10		26	
11		11	6	27		11	1	27	
12		12	6	28		12		28	
13		13	12	29		13		29	
14		14		30		14	1	30	
15+		15	12	31+		15	2	31+	

RELEASED FISH:

ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES	
#BLC	#ANGLERS	#WHC	#ANGLERS	#WHC	#ANGLERS	#BLG	#ANGLERS	#BLG	#ANGLERS
0	1505	0	999	16		0	1353	16	
1	2	1	62	17		1	51	17	
2		2	82	18	3	2	53	18	
3		3	84	19		3	27	19	
4		4	70	20	11	4	9	20	2
5		5	30	21		5	3	21	
6		6	30	22		6	6	22	
7		7	13	23	2	7	1	23	
8		8	40	24		8	1	24	
9		9	1	25	2	9		25	
10		10	30	26		10	1	26	
11		11	3	27		11		27	
12		12	9	28		12		28	
13		13	18	29		13		29	
14		14		30		14		30	
15+		15	15	31+	3	15		31+	

(TAXA FOR L.FREQS.= BLC WHC BLG)

TABLE LAKE VERMILLION 1997 DAY CREEL FINAL REPORT CONTINUED
DAYTIME DATA FOR LAKE=LAKE VERMILLION CREEL BEGUN IN YEAR=97

; FISH HARVESTED/RELEASED BY # ANGLER-COMPLETED TRIPS FOR DIFFERENT TAXA

HARVESTED FISH:

ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES	
#GSF	#ANGLERS	#WAE	#ANGLERS	#WAE	#ANGLERS	#YLB	#ANGLERS	#YLB	#ANGLERS
0	1501	0	1505	16		0	1430	16	
1	6	1	2	17		1	34	17	
2		2		18		2	4	18	
3		3		19		3	6	19	
4		4		20		4	3	20	1
5		5		21		5	2	21	
6		6		22		6	4	22	
7		7		23		7		23	
8		8		24		8	7	24	
9		9		25		9		25	
10		10		26		10		26	
11		11		27		11		27	
12		12		28		12	5	28	
13		13		29		13	6	29	
14		14		30		14		30	
15+		15		31+		15	4	31+	1

RELEASED FISH:

ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES	
#GSF	#ANGLERS	#WAE	#ANGLERS	#WAE	#ANGLERS	#YLB	#ANGLERS	#YLB	#ANGLERS
0	1499	0	1507	16		0	1427	16	
1	7	1		17		1	38	17	
2	1	2		18		2	13	18	
3		3		19		3	6	19	
4		4		20		4	9	20	
5		5		21		5	2	21	
6		6		22		6	3	22	
7		7		23		7		23	
8		8		24		8	6	24	
9		9		25		9		25	
10		10		26		10	2	26	
11		11		27		11		27	
12		12		28		12		28	
13		13		29		13		29	
14		14		30		14		30	
15+		15		31+		15	1	31+	

(TAXA FOR L.FREQS.= GSF WAE YLB ')

TABLE LAKE VERMILLION 1997 DAY CREEL FINAL REPORT CONTINUED
DAYTIME DATA FOR LAKE=LAKE VERMILLION CREEL BEGUN IN YEAR=97

FISH HARVESTED/RELEASED BY # ANGLER-COMPLETED TRIPS FOR DIFFERENT TAXA

HARVESTED FISH:

ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES	
#BLB	#ANGLERS	#YEB	#ANGLERS	#YEB	#ANGLERS	#CAP	#ANGLERS	#CAP	#ANGLERS
0	1507	0	1501	16		0	1507	16	
1		1	2	17		1		17	
2		2	4	18		2		18	
3		3		19		3		19	
4		4		20		4		20	
5		5		21		5		21	
6		6		22		6		22	
7		7		23		7		23	
8		8		24		8		24	
9		9		25		9		25	
10		10		26		10		26	
11		11		27		11		27	
12		12		28		12		28	
13		13		29		13		29	
14		14		30		14		30	
15+		15		31+		15		31+	

RELEASED FISH:

ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES		ALL SIZES	
#BLB	#ANGLERS	#YEB	#ANGLERS	#YEB	#ANGLERS	#CAP	#ANGLERS	#CAP	#ANGLERS
0	1505	0	1498	16		0	1498	16	
1		1	7	17		1	9	17	
2	1	2	2	18		2		18	
3	1	3		19		3		19	
4		4		20		4		20	
5		5		21		5		21	
6		6		22		6		22	
7		7		23		7		23	
8		8		24		8		24	
9		9		25		9		25	
10		10		26		10		26	
11		11		27		11		27	
12		12		28		12		28	
13		13		29		13		29	
14		14		30		14		30	
15+		15		31+		15		31+	

(TAXA FOR L.FREQS.= BLB YEB CAP)

ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
DIVISION OF FISHERIES

SUPPLEMENTAL SURVEY

COUNTY: Vermilion
T 20N R 11E S 17
Direction from nearest town: Northeast Side of Danville

Date of Inspection: 9/29/97

Name of Water Lake Vermilion Owner Interstate Water Co.

Address Vermilion Co. Conservation Dist Phone 217/442-1691

Lessee Kenekuk Cove County Park R.R. 1 Box 215 Danville, IL 61832

Person Contacted Ken Konsis Identification Site Sup.

Address ______ Phone ______

Water Classification: State ___ Public XX Organizational ___
Commercial ___ Private ___ Stream ___

Survey Initiated By: District Fisheries Biologist
Water Size: 900 Acres or ______ Miles.
Date of Last Inspection: June 18 1997
Purpose of Survey: Largemouth Bass, Walleye and Muskie Survey

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Observation, Comments, Recommendations:

The fish population was surveyed for 2 hours using the DC Electrofishing Boat. Only largemouth bass, walleye and muskie were collected along with contaminant samples.

Largemouth Bass - 193 bass were collected, giving a Catch-Per-Unit-Effort of 96.5 which is excellent. A catch per minute of bass 150mm (>6") and larger was 1.3 which is also very good. Young-of-the-year bass made up 22% of all bass collected indicating that a fair spawn occurred in 1997. The PSD = 70%; RSD-380 =20%; and RSD-510 =0.6%. The size structure based upon these results is also very good. The average Relative Weight was 92 which is just below the 95-105 optimal range.

Mark Largemouth Bass: Of the 45 bass under 170mm, 9 or 20% were freeze branded. Only 50% of the 18,025 four inch bass stocked on 9/2/97 were branded. Therefore 40% of these bass collected would have come from this stocking. Two bass, 306 and 312mm also had freeze brands that came from previous stockings.

Biologist: Gary Lutterbie Date: 22 Apr 1998
FM 5.0

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISHERIES

FISH STOCKING RECORD

Name of Water LAKE VERMILION	Classification: PUBLIC	Water #: 0113
Contact Name: GARY LUTTERBIE	Type:SUP	District: 1
Address:		Project:
City:	State: / Zip:	Region: 1
Phone#:	Hatchery: 9000 / Rearing Area: 9000	County: VERMILION
Directions From nearest town:		Acres: 900
		Official Use Only Date Entered 6/14 Initials [illegible] CC:DFM___ RFM___ File___

	Species Name	Size Stocked		Quantity		Pounds
		Length	No/Lb.	Stocked	Ordered	
1)	MUE	4.0	99.0	5000	5000	50.5
2)						
3)						
4)						
5)						

Comments

ST-11= 99.0 FISH/LB

Field Comments

[illegible] Tim [illegible] [illegible] ramp 78°

Delivery made by [signature] Date 6-7-99

Signature of person receiving fish_______________

IL 422-0504

ILLINOIS DEPARTMENT
OF NATURAL RESOURCES
DIVISION OF FISHERIES

SUPPLEMENTAL SURVEY

COUNTY: Vermilion
T 20N R 11E W S 17
Direction from nearest town: Northeast Side of Danville

Date of Inspection: 10/03/01

Name of Water Lake Vermilion Owner Interstate Water Co.

Address Vermilion Co. Conservation Dist Phone 217/442-1691

Lessee Kenekuk Cove County Park R.R. 1 Box 215 Danville, IL 61832

Person Contacted Ken Konsis Identification Site Sup.

Address ______ Phone ______

Water Classification: State ___ Public XX Organizational ___
Commercial ___ Private ___ Stream ___

Survey Initiated By: District Fisheries Biologist
Water Size: 900 Acres or ______ Miles.
Date of Last Inspection: September 29, 1997
Purpose of Survey: Largemouth Bass Survey

Observation, Comments, Recommendations:

The fish population was surveyed for 1.5 hours using the DC electrofishing boat. Largemouth bass, walleye and muskie were collected along with contaminant samples.

In 1992 a largemouth bass stocking program was initiated to increase the density of largemouth bass. On 11 May 2001, 1,600 8-inch largemouth bass were stocked. These fish were given a left pelvic fin clip. On 13 August 2001, approximately 18,000 4-inch largemouth bass were stocked from the State Hatchery System.

Largemouth Bass Data Collected During October 2001 Night Survey

Size Range	No. Of Bass	Indices
000-199mm	44	PSD=61
200-299mm	20	RSD-380=33
300-379mm	14	RSD-509=0
380-509mm	17	Catch/Hr=63.3
>510mm	0	Wr=94

Biologist: Mike Garthaus Date: ______
FM 5.0

Density

The catch per hour of largemouth bass exceeded the management objective of 40-60 bass per hour. Even with the small portion of the stocked bass being marked, 6.3% of the bass collected were marked. Approximately 46% of the bass collected were below eight inches. The density of the bass population is excellent, but the stocking of largemouth bass is needed to maintain the density.

Size Structure

Proportional stock density met the management objective of 40-70, while the relative stock density exceeded the management objective of 10-30. The size structure of the bass population is excellent.

Condition

Body condition failed to meet the management objective for relative weight. The objective is 95-104. With a relative weight of 94, the body condition is still considered good.

MANAGEMENT RECOMMENDATIONS

1. Continue to stock 18,000 4-inch largemouth bass and 2,600 eight-inch largemouth bass.
2. Conduct gamefish survey for largemouth bass in fall of 2002.

SPECIES: LARGEMOUTH BASS
LAKE: LAKE VERMILION
COUNTY: VERMILION
ACRES: 900
GEAR: ELECTROFISHING - DAY SURVEY

									Relative Weight								
YEAR	TOTAL NUMBER AND CPE		0-149 0-5.9	<S 150-199 6-7.9	S-Q 200-299 8-11.9	Q-P 300-379 12-14.9	P-M 380-509 15-19.9	M-T 510-629 20-24.9	<S 150-199 6-7.9	S-Q 200-299 8-11.9	Q-P 300-379 12-14.9	P-M 380-509 15-19.9	M-T 510-629 20-24.9	PSD	RSD-P	RSD-M	EFFORT
	NO.=	95	26	18	20	14	17										
2001	CPE=	63.3	17.3	12.0	13.3	9.3	11.3	0.0	90	90	98	99		61	33	0	1.5
	%		27	19	21	15	18	0									

LAKE MANAGEMENT STATUS REPORT

DATE OF REPORT: 2/15/02 FISH MANAGER: MIKE GARTHAUS DIST: 10

LAKE NAME: **LAKE VERMILION** COUNTY: VERMILION WATER NO: 113

OWNERSHIP (STATE, PUB-CO, PUB-OT): PUBLIC-COOP ACREAGE: 900

LAKE MANAGEMENT STATUS REPORTS WILL INCLUDE THE FOLLOWING SECTIONS:

1. Listings of the Sport Fishing Regulations in Effect.
2. Listing of Fisheries Management Activities Completed with Evaluation of Success.
3. Lake Management Plan Progress Table.
4. Recommendations for Observed Problem Trends.

Fishing Regulations:

1. 15" length and 6 creel limit on largemouth bass
2. 9" length and 25 creel limit on crappies
3. Pole and line fishing only, Except that sport fisherman may take carp and carpsuckers by pitchfork, gigs, bow and arrow, or bow and arrow devices north of Boiling Springs Road, but not within 300 feet around the wetland boardwalk.
4. Trotline and jug fishing allowed north of Boiling Springs Road.
5. 48" length and 1 daily creel limit on muskie.

Current Fish Management Activities:

A) Stockings:

Date	Number	Size	Species
5/06/98	2,400	8"	Largemouth Bass
8/11/98	18,000	4"	Largemouth Bass
8/19/98	1,000	10"	Muskie
5/06/99	2,400	8"	Largemouth Bass
6/07/99	5,000	4"	Muskie
8/17/99	18,000	4"	Largemouth Bass
8/17/99	1,000	11.3"	Muskie
5/11/00	2,400	9"	Largemouth Bass
8/15/00	18,000	4"	Largemouth Bass
5/11/01	1,600	8"	Largemouth Bass
8/13/01	18,000	4"	Largemouth Bass

B) Surveys:

1. On May 29, 2001 a fish community survey was conducted. The largemouth bass population looks very good and should offer some good fishing in central Illinois for those anglers who venture here. The crappie population is average and anglers should do good in 2002. The walleye and muskie population have a few fish left and offer a little hope to anglers for an additional species. The channel catfish population continues to be good. Channel catfish were removed from the contaminant list.

2. On October 3, 2001 a largemouth bass survey was conducted. The bass population is doing great and stockings should continue.

Recommendations:

1. Continue the largemouth bass stocking program.
2. Maintain the current fishing regulations.
3. Conduct a largemouth bass survey again in the fall.
4. Conduct fish community survey in May/June of 2003.

SIGNATURES:

Mike Garthaus 2-15-02

District Fisheries Manager Date Regional Fisheries Admin. Date

COUNTY Vermilion

FISH STOCKING HISTORY

WATER (NAME) Lake Vermilion

DATE	SPECIES	NUMBER	SIZE RANGE or AVR. WEIGHT	CONDITION	SOURCE	REMARKS
05/06/98	LMB	2400	8"	Good	Private	right pelvic fin clip
08/11/98	LMB	18000	4"	Good	JWFH	
08/19/98	MUE	1000	10"	Good	JWFH	
05/06/99	LMB	2400	8"	Good	Private	left pelvic fin clip
06/07/99	MUE	5000	4"	Good	JWFH	
08/17/99	LMB	18000	4"	Good	JWFH	
08/17/99	MUE	1000	11.3"	Good	JWFH	
05/11/2000	LMB	2400	9"	Good	Private	right pelvic fin clip
08/15/2000	LMB	18000	4"	Good	JWFH	
05/11/2001	LMB	1600	8"	Good	Private	left pelvic fin clip
08/13/2001	LMB	18000	4"	Good	JWFH	

FM 2.0

LAKE VERMILION
LAKE MANAGEMENT PLAN PROGRESS

SPECIES/CRITERIA	OBJECTIVE OPTIMAL RANGE	June 1995	June 1997	May 2001				RATING
LARGEMOUTH BASS								
CATCH/HOUR	40-60	76	72	41				Good
NO./min > 150mm 6"	0.5-1.0	1.1	1.6	0.62				Good
PSD 300mm/200mm	40-70%	64	50	70				Good
RSD 380mm/200mm	10-30%	27	12	33				Good
RELATIVE WEIGHT	95-104	97	90	95				Good
AVE WEIGHT HARVESTED	1.5 lbs		3.3					Good
LBS/ACRE HARVESTED	5-10 lbs		2.3					Fair
WHITE CRAPPIE								
CATCH/HOUR	25-50	39	92	29				Good
PSD 200/130	40-60%	97	73	7				Poor
RSD-229	20-30%		28	4				Poor
RSD-250	10-20%	36	8	1				Poor
RELATIVE WEIGHT	90-100	85	81	87				Fair
AVE LN HARVESTED	8-9"		10"					Good
AVE WEIGHT HARVESTED	.25-.5 lbs		0.41					Good
LBS/ACRE HARVESTED	10-20 lbs		6.2					Fair
BLUEGILL								
CATCH/HOUR	100-250	64	129	44				Poor
NO./MIN>80mm	1.0-3.0	0.7	1.4	0.67				Poor
PSD 150mm/80mm	20-40%	41	51	54				Good
RSD-8 200mm/80mm	5-10%	0	0	0				Poor
RELATIVE WEIGHT	95-105	101	92	102				Good
AVE LN HARVESTED	6"		6.1"					Good
LBS/ACRE HARVESTED	10-20 lbs		0.28					Poor
CHANNEL CATFISH								
CATCH/HOUR	5-15	2	4.6	1.3				Poor
PSD 410/280	40-70%		67	67				Good
RELATIVE WEIGHT	95-105		105	97				Good
AVE LN HARVESTED	16"		14.4"					Good
AVE WEIGHT HARVESTED	1.25 lbs		0.82					Good
LBS/ACRE HARVESTED	5-15 lbs		1.44					

Lake Vermilion Primary Report

On 29 May 2001 Lake Vermilion was surveyed using three sampling sites. Sampling sites 1 and 2 were surveyed using a AC electrofishing boat for 1 hour and site 3 was surveyed for 30 minutes. The total time sampling was 2.5 hours.

Date	Time	Water Temp	Air Temp	pH	Total Alkalinity	Conduct-ivity	Secchi Disc
6/18/97	0845	74F	82F	7.9	154	380	10"
5/29/01	1030	68F	73F	8.4	205	535	

The survey resulted in the collection of 573 fish. The percentage that each species comprises of the sample is given below.

Percentage of Fish Collected During 2001 June Survey

Species	Percentage
Black Crappie	0.2
Bluegill	17.6
Brook Silverside	0.3
Common Carp	1.2
Channel Catfish	0.5
Flathead Catfish	0.5
Golden Redhorse	1.7
Green Sunfish	7.3
Gizzard Shad	10.3
Longear SunfishXBluegill	0.5
Largemouth Bass	16.5
Longear Sunfish	21.5
Muskie	0.2
Red Shiner	1.2
Spotted Sucker	0.2
Quillback	0.9
Walleye	0.2
Warmouth	0.5
White Crappie	12.9
Yellow Bass	5.8

Largemouth Bass - The Catch Per Hour (CPH) of electrofishing was 41, which meets the objective of 40-60/hr. The following is based upon bass 200mm (8") and longer. The PSD or % > than 300mm (12") was 70%, which falls within the optimal range of 40-70%. The RSD-15 or % > than 380mm (15") was 33% which is above the optimal range of 10-30%. The body condition of the bass as expressed by Relative Weight was 95, which meets the 95-105 optimal range. Bass fishing should be good in 2002.

Largemouth Bass Stocking Program - Of the 120 bass collected in June 2001, 20 or 21.3% were fin clipped. Below is a table indicating the number of bass stocked, date, and mark.

Date	Number	Size	Mark	Source
7/09/92	27,000	2"	None	VCCD & ISW
	13,268	4-6"	None	IDNR
5/03/93	3,000	5-8"	Right Pelvic	VCCD & ISW
8/05/93	13,318	4"	Freeze Brand	IDNR
5/12/94	3,000	7"	Left Pelvic	VCCD & ISW
8/09/94	13,320	4.7"	Freeze Brand	IDNR
5/10/95	2,727	7.5"	Right Pelvic	VCCD
5/10/96	2,720	7"	Right Pectoral	VCCD & ISW
8/26/96	18,100	4"		IDNR
5/08/97	2,600	8"	Left Pelvic	VCCD
9/02/97	18,025	4"	½ Freeze Brand	IDNR
5/06/98	2,400	8"	Right Pelvic	VCCD
8/11/98	18,000	4"		IDNR
5/06/99	2,400	8"	Left Pelvic	VCCD
8/17/99	18,000	4"		IDNR
5/11/00	2,400	9"	Right Pelvic	VCCD
8/15/00	18,000	4"		IDNR
5/11/01	1,600	8"	Left Pelvic	VCCD
8/13/01	18,000	4"		IDNR

The stocking program appears to be working very nicely in building up the largemouth bass population in Lake Vermilion.

Bluegill - The CPH for bluegill was 44, which is below the management objective of 100-250. Based on bluegill 80mm (3") and longer, 54% were greater than 150mm (6"). This is above the 20-40% optimal range. No bluegills were collected over 200mm (8"). Body condition as expressed by Relative Weight was 102, which is within the optimal range of 95-105. Bluegill fishing should be fair in 2001.

White Crappie - The CPH for white crappie was 29, which meets the objective of 25-50. Based upon crappie 130mm (5") and longer, 7% were over 200mm (8"). This value is below the optimal range of 40-60%. Of white crappie 130mm and longer, 1% were longer than 250mm. The optimal range for this size group is 10-20%. Body condition using Relative Weight was 87 which well below the 95-105 optimal range. The crappie population is considered fair and should provide average fishing.

Observations:

The largemouth bass population looks very good and should offer some good fishing in central Illinois for those anglers who venture here. The crappie population is average and anglers should do good in 2002. The walleye and muskie population have a few fish left and offer a little hope to anglers for an additional species. The channel catfish population continues to be good. Channel catfish were removed from the contaminant list.

Recommendations:

- Continue the largemouth bass stocking program.
- Maintain the current fishing regulations.
- Conduct a largemouth bass survey again in the fall.
- Conduct fish community survey in May/June of 2003.

SPECIES: LARGEMOUTH BASS
LAKE: LAKE VERMILION
COUNTY: VERMILION
ACRES: 900
GEAR: ELECTROFISHING

YEAR	TOTAL NUMBER AND CPE		0-149 0-5.9	<S 150-199 6-7.9	S-Q 200-299 8-11.9	Q-P 300-379 12-14.9	P-M 380-509 15-19.9	M-T 510-629 20-24.9	>T >630 >25	PSD	RSD-P	RSD-M	EFFORT
	NO.=	94	1	3	27	33	28	2	0				
2001	CPE=	37.6	0.4	1.2	10.8	13.2	11.2	0.8	0.0	70	33	2.2	2.5
	%		1	3	29	35	30	2	0				

SPECIES: BLUEGILL
LAKE: LAKE VERMILION
COUNTY: VERMILION
ACRES: 900
GEAR: ELECTROFISHING

YEAR	TOTAL NUMBER AND CPE			<S <80 <3"	S-Q 80-149 3-5.9"	Q-P 150-199 6-7.9"	P-M 200-249 8-9.9"	M-T 250-299 10-11.9"	>T >300 >12"	PSD	RSD-P	RSD-M	EFFORT
	NO.=	101		0	46	55	0	0					
2001	CPE=	40.4		0.0	18.4	22.0	0.0	0.0	0.0	54	0	0	2.5
	%			0	46	54	0	0	0				

SPECIES: CHANNEL CATFISH
LAKE: LAKE VERMILION
COUNTY: VERMILION
ACRES: 900
GEAR: ELECTROFISHING

YEAR	TOTAL NUMBER AND CPE			<S <280 <11"	S-Q 280-409 11-15.9"	Q-P 410-609 16-23.9"	P-M 610-709 24-27.9"	M-T 710-909 28-35.9"	>T >910 >36"	PSD	RSD-P	RSD-M	EFFORT
	NO.=	3		0	1	2	0	0					
2001	CPE=	1.2		0.0	0.4	0.8	0.0	0.0	0.0	67	0	0	2.5
	%			0	33	67	0	0	0				

SPECIES: WHITE CRAPPIE
LAKE: LAKE VERMILION
COUNTY: VERMILION
ACRES: 900
GEAR: ELECTROFISHING

YEAR	TOTAL NUMBER AND CPE			<S <130 <5"	S-Q 130-199 5-7.9"	Q-P 200-249 8-9.9"	P-M 250-299 10-11.9"	M-T 300-379 12-14.9"	>T >380 >15"	PSD	RSD-P	RSD-M	EFFORT
	NO.=	74		0	69	4	1						
2001	CPE=	29.6		0.0	27.6	1.6	0.4	0.0	0.0	7	1	0	2.5
	%			0	93	5	1	0	0				

SPECIES:CARP
LAKE: LAKE VERMILION
COUNTY: VERMILION
ACRES: 900
GEAR: ELECTROFISHING

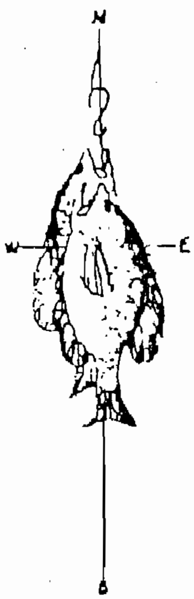
YEAR	TOTAL NUMBER AND CPE		<S <200 <8"	<S 200-279 8-10.9"	S-Q 280-409 11-15.9	Q-P 410-529 16-20.9"	P-M 530-659 21-25.9	M-T 660-839 26-32.9	>T >840 >33"	PSD	RSD-P	RSD-M	EFFORT
	NO.=	7	0	0	0	1	5	1					
2001	CPE=	2.8	0.0	0.0	0.0	0.4	2.0	0.4	0.0	100	86	14	2.5
	%		0	.0	0	14	71	14	0				

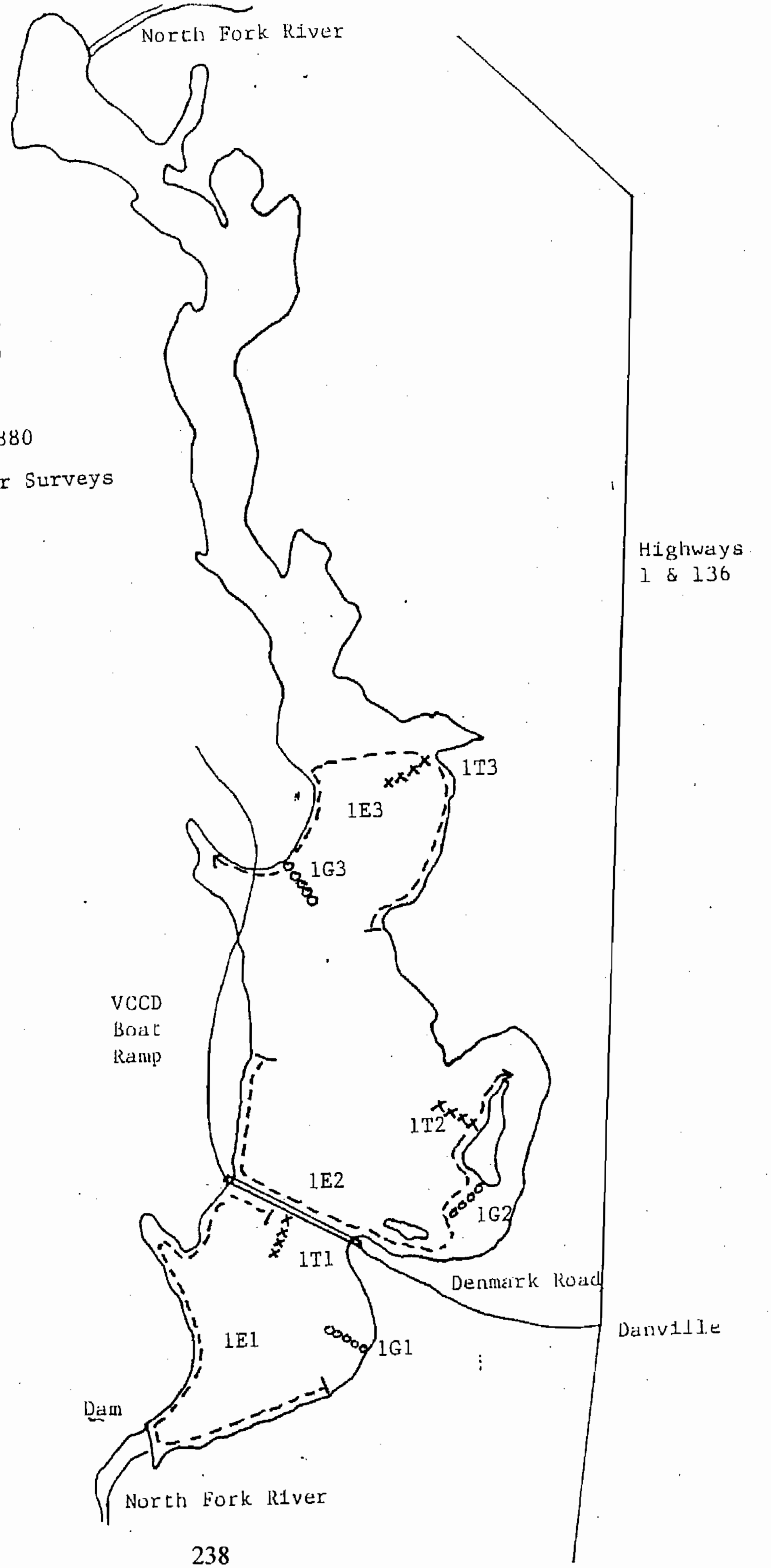
LAKE VERMILION

T20N R11E Sec 17

Surface Acres: 666
Maximum Depth: 27'
Average Depth: 12'
Acre Feet Water: 7992
Miles Shoreline: 12
Watershed Acres: 170,880

Sampling Map for Major Surveys





Illinois State WATER Survey (1895)

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