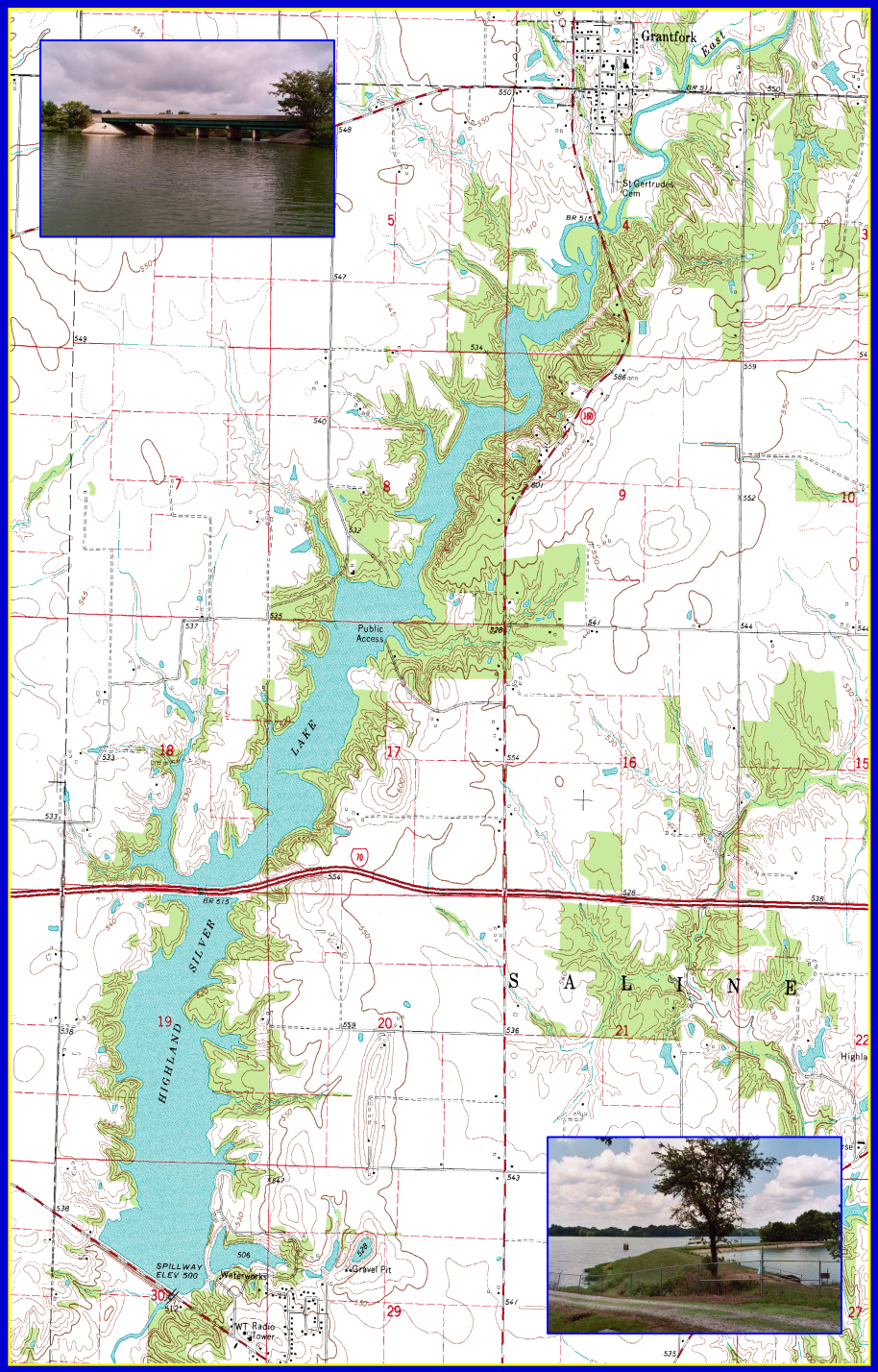
Illinois EPA Clean Lakes Program

Phase 1 Diagnostic/Feasibility Study of Highland Silver Lake, Highland, IL

Final Report – December 2008





Prepared and Submitted by:

HDR | CWI

with assistance from:

City of Highland
Illinois EPA
Illinois DNR
USDA NRCS
Madison Co. SWCD
HES, Inc.



Illinois Clean Lakes Program

Phase 1 Diagnostic/Feasibility Study of Highland Silver Lake, Madison County, Illinois

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Illinois Department of Natural Resources
USDA - Natural Resources Conservation Service
Madison County Soil and Water Conservation District
Heartland Ecosystem Services

December 2008

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Part 1

Diagnostic Study of Highland Silver Lake

Madison County, Highland, Illinois

INTRODUCTION

A Diagnostic Study was undertaken on Highland Silver Lake to identify and quantify existing water quality problems and other factors affecting the reservoir's recreational, aesthetic, and ecological qualities. The Illinois Environmental Protection Agency (Illinois EPA) funded 60 percent of the study under the Illinois Clean Lakes Program (ICLP), and the remaining 40 percent was funded by the City of Highland. The Illinois EPA was responsible for grant administration and program management. Heartland Ecosystem Services and HDR | CWI (formerly Cochran & Wilken, Inc.), conducted the research study with assistance from the City of Highland, Illinois Department of Natural Resources (IL DNR), the United States Department of Agriculture (USDA) - Natural Resources Conservation Service (NRCS), Madison County Soil and Water Conservation District, and the Illinois EPA.

A. Lake Identification and Location

Highland Silver Lake is a 550-acre (222.6 hectare) reservoir located in the eastern portion of Madison County, Illinois, approximately one mile northwest of Highland. The lake was constructed during 1960 to 1962 to provide a reliable water source to the City of Highland. The lake is impounded by a 2,668-foot earth filled dam with an "L" shaped spillway. The spillway has a combined length of 214.1 feet, a crest elevation of 500.0 feet above mean sea level (MSL), and a design discharge capacity of 9,700 cubic feet per second (CFS) (Backus and Associates, 1959).

The Highland Silver Lake watershed covers approximately 12,419 hectares (30,688 acres) of land. Two main tributaries of Silver Creek enter the lake from the north, East Fork Silver Creek and Little Silver Creek (Figure 1). These tributaries originate in northeastern Madison County and southeastern Bond County, respectively, and each flows approximately 5.0 miles before entering Highland Silver Lake. Several smaller inlet channels and storm drains enter the lake system at various points along the 19.3 km (12 miles) of shoreline. When built in 1962, Highland Silver Lake had a maximum depth of 9.14 meters (30.0 ft.) and a mean depth of 4.27 meters (14 ft.), and the average hydraulic retention time of the lake system was calculated to be approximately 0.518 years (Table 1). The original, 1962 storage capacity of Highland Silver Lake, was reported as 12,946,500 m^3 (10,500.0 acre-ft).

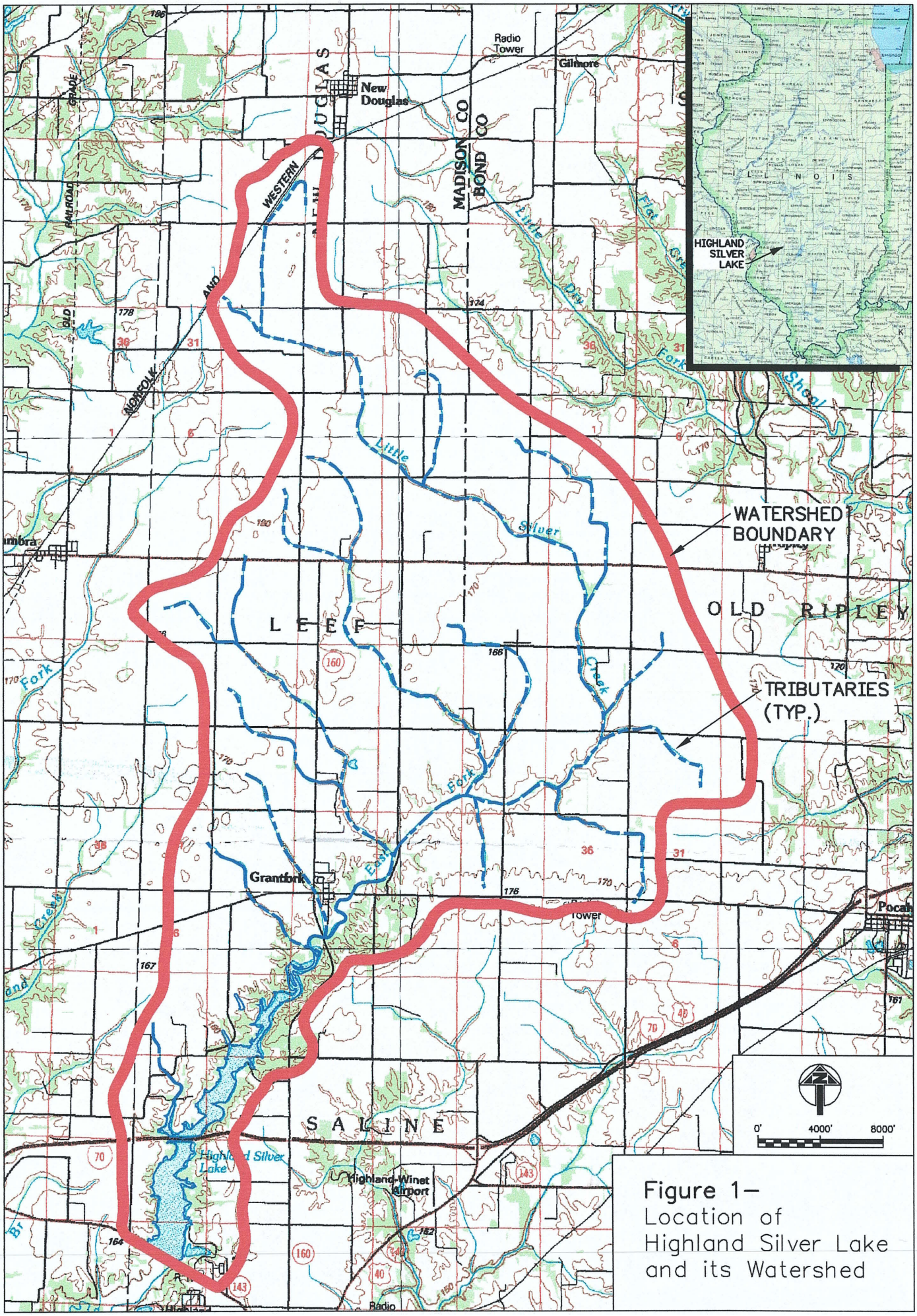


Figure 1–
Location of
Highland Silver Lake
and its Watershed

Table 1 – Lake Identification and Location

Parameter	Description
IEPA Storet Code	IL ROZA
State	Illinois
County	Madison
Ownership	City of Highland
Nearest Municipality	Highland & Grand Fork
USEPA Region	5
USEPA Major Basin	Lower Mississippi River
USEPA Minor Basin	Lower Kaskaskia River
Receiving Waterbody	Silver Creek
Applicable Water Quality Standards	State of Illinois Rules & Regulations, Title 35: Environmental Protection, Subtitle C: Water Pollution, Ch. 1: Pollution Control Board, Parts 302, Subpart B: General Use Water Quality Stds. And Subpart C: Public & Food Processing Water Supply Standards.
Surface Area	550 acres
Watershed Area	30,688 acres
Shoreline Length	12 miles
Maximum Depth	Original 30 Feet (Current 25 feet)
Mean Depth	Original 14.0 feet (Current 13.8 feet)
Normal Pool Elevation	500.0 feet above sea level
Hydraulic Retention Time	0.518 years
Storage Capacity	Original 10,500 acre/feet (Current 5,700 acre/feet)

Sources: Illinois EPA, ISWS, and Limno-Tech, Inc.
Notes: Original - 1962 (Current – 2004-05)

B. Geological and Soils Description of Drainage Basin

1. Geological and Topographical Description

Highland Silver Lake and its watershed are located in northeastern Madison and southwestern Bond Counties, in western south-central Illinois. The land surface of the region has been shaped mainly by running water and glacial ice. Pleistocene glaciers advanced across Illinois several times and then retreated, leaving behind rock debris. Till, outwash, loess, and the sediment of modern streams cover the bedrock surface of the region, resulting in a relatively level plain. The bedrock beneath the glacial deposits of the region consists of beds of sedimentary shale, sandstone, limestone, and dolomite. From the surface downward, the bedrock strata are as follows: Pennsylvanian, Mississippian, Devonian, Silurian, Ordovician, Cambrian, and Pre-Cambrian (Selkregg et al., 1957).

Elevations throughout the Highland Silver Lake watershed range from 630 feet MSL in the northernmost portion of the watershed to the lake elevation of 500 feet MSL in the southernmost portion of the watershed. The drainage systems are moderately well developed. The valleys are relatively shallow and streams typically have low gradients. The major tributaries to the lake are third and fourth-order streams, namely Little Silver Creek and East Fork Silver Creek. There are many other small, first-order streams that contribute directly to the lake (Makowski and Lee, 1985).

2. Groundwater Hydrology

The Illinois State Geological Survey (ISGS) publication entitled Groundwater Geology In South-Central Illinois: A Preliminary Geologic Report (1957) was consulted to help determine the occurrence of groundwater yielding strata present within the Highland Silver Lake watershed. The ISGS document suggests that the Pennsylvanian formation, which includes shale, sandstone, limestone, and coal, is the primary geologic formation within the watershed.

While most of Madison County has excellent groundwater bearing strata (especially in the western portion of the County nearest to the Mississippi River), the upland areas located near Highland Silver Lake have thin beds of sand and gravel

within the till that may yield enough water for small domestic wells. However, these localized sand and gravel deposits are generally found near the base of the till and due to their discontinuity, their locations cannot be easily predicted. Larger capacity wells (located on uplands), if present, tend to be large-diameter dug wells that penetrate to the base of the loess and obtain water at the contact between the loess and the underlying till (personal communication ISGS, 2005). Generally, the geologic substrata do not yield sufficient water for domestic wells.

3. Description of Soils

The major soil types occurring in the Highland Silver Lake watershed and surrounding area consist mainly of the Virden-Piasa-Darmstadt association in the upper portion of the watershed and the Hickory-Elco-Rozetta association in the more eroded portions of the watershed nearest to the lake. The Virden-Piasa-Darmstadt association consists of nearly level to moderately sloping, poorly drained and somewhat poorly drained soils that have a moderately slowly permeable or very slowly permeable subsoil formed in loess on uplands. The Hickory-Elco-Rozetta association consists of moderate sloping to steep, well-drained and moderately well drained soil that have a moderately permeable or moderately slowly permeable subsoil; formed in glacial till, loess, and loess over an older buried soil on uplands (USDA, NRCS, 2004).

An inventory of all soil types found in the Highland Silver Lake watershed is listed in Table 2. The listing for soil type contains a numerical description (e.g., 214C2) where the first number (214) indicates the soil name, the capital letter (C) provides a slope range and the third part (2) describes the degree of erosion. Some of the older soil classifications only contain their names and do not include the three parts previously described. Major soil type descriptions provided by the USDA, NRCS are summarized below in the order in which they are listed in the Soil Survey of Madison County, Illinois, 2004.

The poorly drained and low permeability characteristics of the Piasa and Darmstadt associations include high concentrations of sodium, which may indicate the presence of natric or sodic soils in portions of the Highland Silver Lake watershed. Natric soils are defined by the USDA as having a mineral horizon that contains more

than 15 percent saturation of exchangeable cations. Natric soils can undergo a process called sodication, where there is an increase in the percentage of exchangeable sodium. Sodium ions (Na^+) adsorb onto negatively charged soil (clay particles) through a process called cation ion exchange. The binding of Na^+ ions to negatively charged soil particles causes soil aggregates to disperse, which can clog soil pores and can render the soil impermeable to water. Natric and sodic soils are defined as having an exchangeable-sodium percentage of 15 or more (USDA, May 2004).

Table 2 – Watershed Soil Types

Soil Symbol	Soil Type
8E3	Hickory clay loam, 12 to 20 % slopes, severely eroded
8F	Hickory silt loam, 15 to 30 % slopes
16	Rushville silt loam
41B	Muscatine silt loam, 1 to 4 % slopes
46A	Herrick silt loam, 0 to 3 % slopes
50	Virden silty-clay loam
68	Sable silty-clay loam
70	Beaucoup silty-clay loam
113B	Oconee silt loam, 1 to 5 % slopes
119C3	Elco silty-clay loam, 5 to 10 % slopes, severely eroded
119D2	Elco silt loam, 10 to 15 % slopes, eroded
119D3	Elco silty-clay loam, 10 to 15 % slopes, severely eroded
120	Huey silt loam
127B	Harrison silt loam, 2 to 5 % slopes
214B	Hosmer silt loam, 2 to 5 percent slopes
278B	Stronghurst silt loam, 2 to 5 % slopes
279B	Rozetta silt loam, 2 to 5 % slopes
279C2	Rozetta silt loam, 5 to 10 % slopes, eroded
279C3	Rozetta silty clay loam, 5 to 10 % slopes, severely eroded
279D3	Rozetta silty clay loam, 10 to 15 % slopes, severely eroded
280D2	Fayette silt loam, 10 to 15 % slopes, eroded
280F	Fayette silt loam, 15 to 30% slopes
333	Wakeland silt loam
334	Birds silt loam
415	Orion silt loam
451	Lawson silt loam
474	Piasa silt loam
517A	Marine silt loam, 2 to 5 percent
517B	Marine silt loam, 0 to 2 percent
581B2	Tamalco silt loam, 2 to 5 % slopes eroded
583B	Pike silt loam, 2 to 5 % slopes
583C2	Pike silt loam, 5 to 10 % slopes, eroded
585E	Negley loam, 15 to 25 % slopes
620B2	Darmstadt silt loam, 5 to 5 % slopes, eroded
620C3	Darmstadt silty clay loam, 3 to 8 % slopes, severely eroded
801B	Orthents, silty, undulating
802B	Orthents, loamy, undulating
914C3	Atlas-Grantfork silty clay loams, 5 to 10 % slopes, severely eroded
916B	Darmstadt-Oconee silt loams, 1 to 5% slopes
920	Rushville-Huey silt loams
936F	Fayette-Hickory complex, 15 to 30 % slopes
941	Virden-Piasa silt loams
967F	Hickory-Gosport silt loams, 15 to 30 % slopes
993	Cowden-Piasa silt loams
995	Herrick-Piasa silt loams
3284	Tice silt loam, frequently flooded

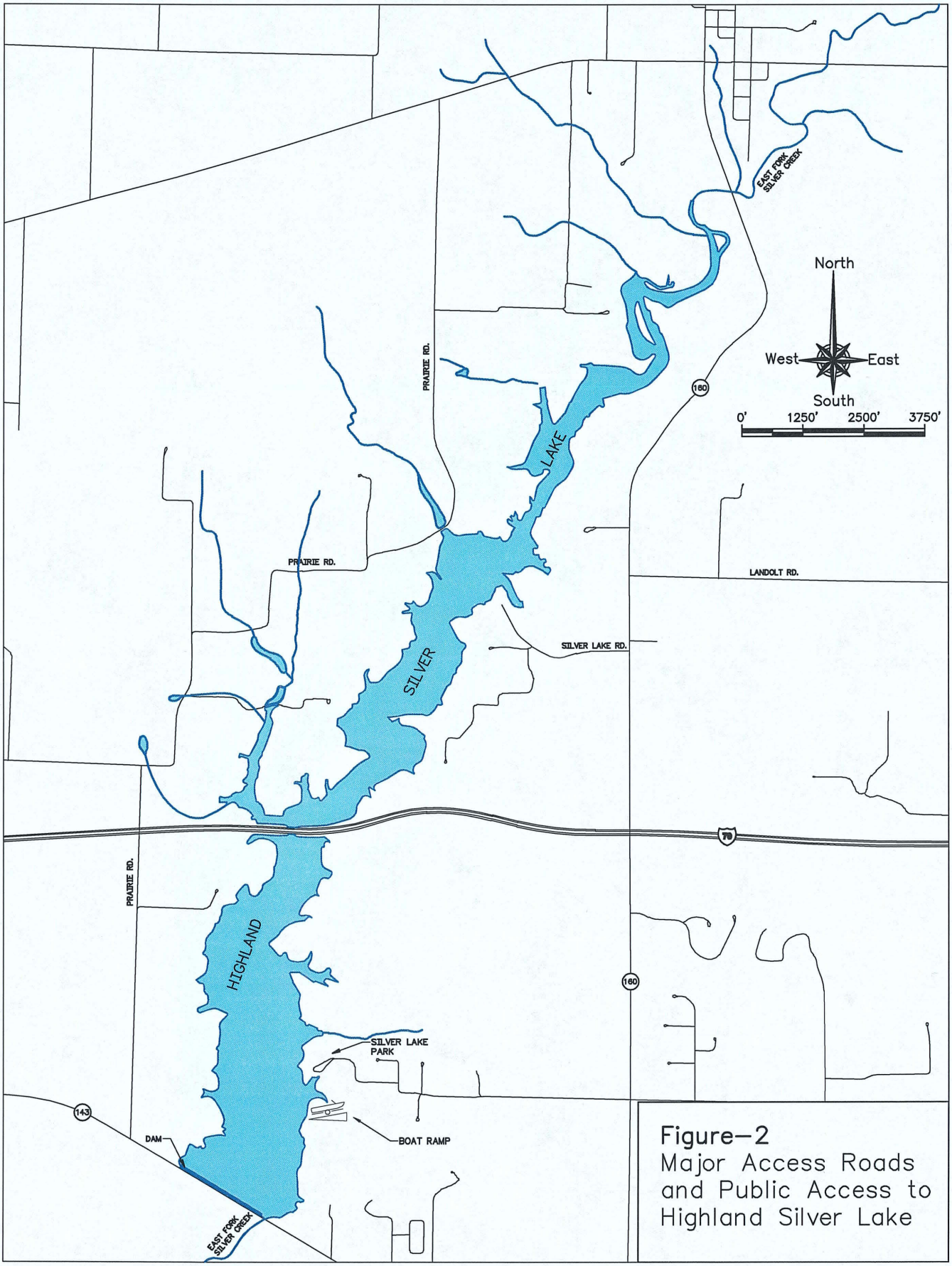
Source: United State Department of Agriculture, NRCS, 2004.

C. Description of Public Access

Public access to Highland Silver Lake and the surrounding area is managed by the City of Highland. Silver Lake Park is located on the north side of Route 143 and provides the following amenities (Table 3): fishing, five outdoor pavilions, restrooms, a playground, a sand volleyball court, an archery range, a 4.5-mile nature trail, a climbing wall, a boat ramp, and waterfowl hunting. The City of Highland has park rules and regulations for the public park system, which includes Silver Lake Park (City of Highland, 2005). The regulations are as follows:

- All picnic areas and pavilions are available on a first come first serve basis, when not reserved by organizations or for special events
- Swimming and water skiing are prohibited
- Alcohol is prohibited at all youth athletic events
- Littering or polluting of any park or Highland Silver Lake is prohibited
- Overnight camping is allowed for special groups with permission from the Director of Parks and Recreation
- Park dumpsters are to be used by park patrons only
- All boats are required to have a city boat license, 50-horsepower limit on all boats, and boaters are responsible for knowing rules and regulations

The City of Highland has estimated that the annual visitor-days to the Highland Silver Lake area are approximately 50,000 visitor-days per year (i.e., 1 user during 1 day = 1 visitor day) (Rosen personal communication, 2005). There are several major access roads that lead to Highland Silver Lake. Illinois Route 143 runs from east to west over the dam located at the south end of the lake. Route 143 can be accessed from Interstate 55 from the west (near Edwardsville) or from the east (near Highland). Interstate 70 also runs east to west and passes over the lake. The I-70 Bridge essentially bisects the lake, and there are exits from I-70 on to Rt. 143, which both lead to the lake. From the north and south, Illinois Route 160 passes along the east side of the lake from Grantfork to Highland. These major access roads are depicted on Figure 2. There is no public transportation directly to the lake at this time.



Figure–2
Major Access Roads and Public Access to Highland Silver Lake

Livestock also have access to Highland Silver Lake. Prior to when the lake was constructed in 1962, landowners and the City of Highland formed an agreement, which allowed property owners water rights in exchange for land for the City to construct the lake. These water rights have enabled the former and current landowners and their livestock to access to the lake. Select areas of Highland Silver Lake (i.e., north of the Interstate-70 Bridge) are used to water cattle (Rosen personal communication, 2005).

D. Description of Population Size and Economic Structure

The major population centers located within close proximity to the Highland Silver Lake system include the City of Highland and the Village of Grantfork. The total population for these towns as of the 2000 Census was 8,438 for Highland and 254 for Grantfork. In 2000, the total populations for Madison and Bond Counties were 258,941 and 17,633, respectively (US Census Bureau, 2005).

The largest industries for the Highland Silver Lake area as of the 2000 U.S. Census were educational, health, and social services (22.4 percent); manufacturing (16.7 percent); retail trade (11.4 percent); professional, scientific, management, and administration (9.7 percent); arts, entertainment, recreation, accommodation, and food services (8.4 percent); transportation, warehousing, and utilities (6.7 percent); and construction (5.8 percent). The industries making up the remaining 18.9 percent were finance, insurance, and real estate (5.7 percent); other services (4.9 percent); public administration (3.2 percent); information (2.6 percent); wholesale trade (2.3 percent); and agriculture, forestry, fishing, hunting, and mining (0.3 percent) (US Census Bureau, 2005).

In 2000, the median household incomes within Madison and Bond Counties were $41,514 and $37,680, and the median household incomes for Highland and Grantfork were $39,524 and $42,917, respectively (US Census Bureau, 2005).

E. Summary of Historical Lake Uses

Highland Silver Lake was completed in 1962 by the City of Highland as a public water supply. The lake is also used for recreation, mainly boating and fishing, with picnicking on adjacent park grounds (Makowski and Lee, 1985). Today the lake also

serves as the primary water supply for Highland, St. Jacob, Grantfork, and Pierron. Table 3 provides a list of the major recreational uses and associated facilities at Highland Silver Lake.

Table 3 - Major Recreational Uses and Facilities

Available Lake Uses	Available Recreational Facilities
Fishing	Entire Lake
Motor Boating	Entire Lake (50 Horsepower Limit *)
Recreational Facilities	Pavilions, Restrooms, and Numerous Playground Opportunities
Picnicking	Silver Lake Park
Hiking	4.5-mile trail near Silver Lake Park

* Horse power limit raised in 2008 from 25 HP to 50 HP.

F. Population Segments Adversely Affected by Lake Degradation

As mentioned previously, Highland Silver Lake is a public water supply for several municipalities (Highland, St. Jacob, Grantfork, and Pierron). In addition, the lake and its surrounding facilities are accessed by an estimated 50,000 visitor days annually (i.e., 1 user during 1 day = 1 visitor day). This utilization provides many secondary benefits such as revenue from local usage and tourism dollars. These revenue figures from lake usage and tourism are undocumented, but the public water supply provided by Highland Silver Lake enhances the prosperity of the entire region.

Degraded water quality and decreased access to the lake and surrounding facilities could significantly impact the local communities that utilize the lake and adjacent areas. Loss of desired water quality can also impact property values in local community and around the lake.

G. Comparison of Lake Uses to Other Lakes in Region

Figure 3 illustrates the public lakes greater than 20.0 acres (8.1 hectares) that are located within 80 km (50 miles) of Highland Silver Lake. Table 4 lists information for the public lakes greater than 20 acres that are located within an 80 km (50.0 mile) radius. There were a total of 26 lakes within the study area.

Figure–3
Area of Public Lakes
Located w/in 50 Miles
of Highland Silver Lake

SOURCE: MICROSOFT STREETS AND TRIPS 2002

Table 4 - Publicly Owned Lakes within 80 km (50 mi.)

Lake	State	County	Area (acres)	Max Depth (ft.)	Public Access	Launch Ramp	Recreational Facilities	Distance in Miles
Horseshoe Lake	IL	Madison	2,107	6	Y	Y	B,F,C,P	24
Carlyle Lake	IL	Clinton	24,580	35	Y	Y	B,F,C,P	26
Forbes Lake	IL	Marion	542	31	Y	Y	B,F,C,P	50
Lake Centralia	IL	Marion	450	23	Y	Y	B,P	38
Racoon Creek Reservoir	IL	Marion	970	8	Y	Y	B,P	40
Baldwin Lake	IL	St. Clair	2,018	42	Y	Y	B,F,C,P	39
Washington County Lake	IL	Washington	301	22	Y	Y	B,F,C,P	36
Pickneyville Reservoir	IL	Perry	165	33	Y	Y	B,F,P	48
Governor Bond Lake	IL	Bond	775	26	Y	Y	B,F,P	48
Greenfield Old City Lake	IL	Greene	22	17	Y	Y	B,F,P	47
Otter Lake	IL	Macoupin	723	51	Y	Y	B,F,C,P	45
Palmyra-Modesto Lake	IL	Macoupin	40	30	Y	Y	B,F	48
Lake Glenn Shoals	IL	Montgomery	1,085	25	Y	Y	B,F,C,P	30
Lake Lou Yeager	IL	Montgomery	1,304	31	Y	Y	B,F,C,P	29
Carlinville Lake	IL	Macoupin	168	19	Y	Y	B,F,C,P	33
Beaver Dam Lake	IL	Macoupin	57	9	Y	Y	B,F,C,P	34
Gillespie New City Lake	IL	Macoupin	207	30	Y	Y	B,F,C,P	26
Gillespie Old City Lake	IL	Macoupin	71	21	Y	Y	B,F,C,P	26
Lake Hillsboro	IL	Montgomery	94	23	Y	Y	B,F	46
Coffeen Lake	IL	Montgomery	1,070	58	Y	Y	B,F,P	23
Staunton Reservoir	IL	Macoupin	84	32	Y	Y	B,F	18
Mt. Olive New City Lake	IL	Macoupin	36	14	Y	Y	B,F	22
Mt. Olive Old City Lake	IL	Macoupin	36	29	Y	Y	B,F	21
Walton Park Lake	IL	Montgomery	30	10	Y	Y	B,F	25
Ramsey Lake	IL	Fayette	46	22	Y	Y	B,F,C,P	42
Vandalia Lake	IL	Fayette	660	30	Y	Y	B,F,C,P	35

B = Boating; SK = Skiing; C = Camping; P = Picnicking; F = Fishing; SW = Swimming

Source: Illinois State Atlas, 1980 and Illinois Atlas & Gazetteer, 2002.

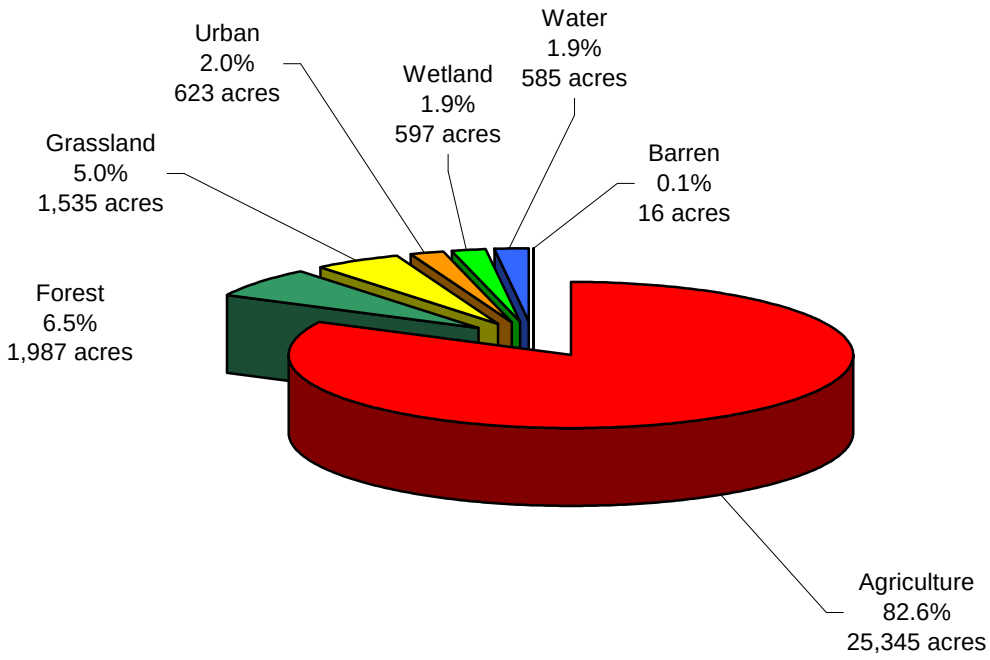
H. Description of Point Source Pollution Discharges

The only known existing point source (permitted) discharge within the Highland Silver Lake watershed is the Highland water treatment plant operated by the City of Highland. The National Pollutant Discharge Elimination System (NPDES) permit for the water plant is IL0001112. A review of the discharge monitoring report (DMR) data and facility inspection reports indicate that the Highland Water Treatment Plant is in compliance with its NPDES Permit (Illinois EPA, Freedom of Information, 2005).

I. Land Uses and Non-Point Source Pollution Loadings

The Highland Silver Lake watershed encompasses approximately 12,419 hectares (30,688 acres) of land in northeastern Madison and southwestern Bond Counties. The major land use occurring within the boundaries of the watershed is agriculture (row crops primarily) accounting for 82.6 percent of the total land use (Figure 4). The next most prevalent land uses are forest (6.5%), grassland (5.0%), urban (2.0%), wetlands (1.9%), water (1.9%), and barren (0.1%). Highland Silver Lake consists of 1.8 percent of the total watershed, with waterways and tributaries making up approximately 0.1%.

Figure 4 - Land Uses within Watershed.



Source: Limno-Tech, 2004

Table 5 estimates of the gross soil erosion and subsequent sediment yield for the Highland Silver Lake watershed. Each land use area was multiplied by an average estimated loading coefficient for suspended solids, total nitrogen, and total phosphorus (Conservation Needs Inventory, 1976). After further investigation, it was concluded that the initial average sediment yield of 25% was an underestimate of the actual annual sediment load that was being deposited into streams within the watershed, and a sediment delivery of 47% was determined to be more accurate (Madison County Soil and Water Conservation District, 1979).

Table 5 - Estimated Sediment Sources within Watershed

			Soil Erosion			Sediment Yield	
Land Use	Acres	Percent of Acres	TonsPer Acre/Yr	Total	Percent Sediment Yield	Tons/Acre/Yr	Tons Total
Urban	100	0.3%	1.0	100	25%	0.25	25
Woodland	1,810	5.8%	3.4	6,153	25%	0.85	1,538
Cropland	27,386	88.5%	8.2	224,562	25%	2.05	56,140
Pasture	816	2.6%	6.1	4,978	25%	1.525	1,244
Water	834	2.7%	NA	NA	NA	NA	NA
Initial Total	30,946	100.0%	7.6	235,793	25%	1.9	58,948
Revised Total	59,982	193.8%	7.6	465,332	47%	3.572	116,333

Source: Conservation Needs Inventory, 1976 and Madison Co. Soil & Water Conservation District, 1979.

Table 6 lists the estimated or theoretical annual nutrient loadings for total phosphorus and total nitrogen within the Highland Silver Lake watershed. Approximately, 116,333 tons/yr (1.06×10^8 kg/yr) of sediment, 104.6 tons/yr (94,892 kg/yr) of total nitrogen, and 14.7 tons/yr (13,336 kg/yr) of total phosphorus are annually delivered to waterways within the Highland Silver Lake watershed. It is important to note that not all of the nutrients and sediments delivered to waterways (i.e., creeks and small streams) within the watershed will be deposited within the lake. These differences between gross erosion, sediment delivery, and subsequent sediment deposition are often encountered in the actual measured concentrations. The difference suggests variances of the loading estimates in Tables 5 and 6. The annual loading estimates in Tables 5 and 6 generally do not account for non-point sources generated from eroded shoreline or variable conditions (i.e., drought or wet conditions).

Similar problems involving large discrepancies between estimated sediment and nutrient loading rates and those derived from watershed monitoring were reported for lake restoration studies conducted in Illinois by Cochran & Wilken, Inc. (1991) on Paris Twin Lakes, by Kothandaraman and Evans (1983) on Johnson Sauk Trail Lake and Lake Le-Aqua-Na, by Kirschner and Sefton (1983) on the Skokie Lagoons, and by the Illinois Natural History Survey (1983) on Lake of the Woods. These studies reported that estimated loading rates gave results much different than those derived from stream monitoring data. These differences are probably related to the spatial distribution of land use in the watershed, stormwater management practices, and the problems related to predicting average export rates for a non-homogeneous watershed.

Table 6 - Estimated Non-Point Source Loadings

Source	Phosphorus Loading Tons/Yr.	Phosphorus Loading Percent	Nitrogen Loading Tons/Yr.	Nitrogen Loading Percent
Tributaries (non-point load) - Little Silver Creek	12.3	83%	83.5	80%
Minor Tributaries & Immediate Drainage (non-point load)	2.2	15%	15.1	14%
Known Municipal Sewage Treatment Plants	0.1	1%	0.8	1%
Septic Tanks	0.0	0%	0.1	0%
Direct Precipitation	0.1	1%	5.2	5%
Subtotal	14.7	100%	104.6	100%

Source: National Eutrophication Survey and Madison Co. Soil & Water Conservation District, 1979.

J. Current and Past Restoration Activities

Highland Silver Lake and its watershed have been studied by the Illinois EPA, the Illinois State Water Survey (ISWS), the Madison County Soil and Water Conservation District, and the Southwestern Illinois Metropolitan and Regional Planning Commission. Despite these efforts, no major lake restoration efforts have been noted (Rosen personal communication, 2005).

In 2004, Highland Silver Lake was placed on the Illinois Section 303(d) List of Impaired Waters as a water body that is not meeting its designed uses. Sedimentation/siltation, high concentrations of total suspended solids, and excessive algal growth are conditions that have caused the lake to be listed for the following parameters: manganese, total phosphorus, dissolved oxygen, aldrin, and chlordane.

Based on the 303(d) listing, a Total Daily Maximum Load (TMDL) study was completed in October 2006 for Highland Silver Lake in an attempt to improve the lake, where it can fully support its designated uses: aquatics life, fish consumption, primary contact (swimming), and public water supply. The findings and recommendations of the TMDL Report, along with this Clean Lakes Phase 1 Report, will serve as a basis for funding and/or grants to design, implement, and complete various restoration activities within Highland Silver Lake and its watershed.

In early 2008, four solar powered circulars (Solar Bees) were installed within Highland Silver Lake. The units were positioned near the water supply intake in an attempt to control blue green algae and reduce subsequent taste and odor issues associated with the public water supply. The lower level emergency outlet was also repaired in 2008 (Wittenborn personal communication, 2008).

K. Baseline and Current Limnological Data

Baseline and current limnological data for Highland Silver Lake is based on historical and current sampling completed by the Illinois EPA ambient and volunteer lake monitoring programs (AMLP and VLMP). Current data was generated from samples collected during the Phase 1 monitoring year (September 2004 through October 2005). The historical data were obtained from the US EPA STORET Computerized Environmental Data System. Based on the completeness and availability of electronic data, data from 1981, 1983, 1985, 1988, 1990 and 1993 were used for this report. Summaries of the current and historical data are provided in Appendix A. Current and historical data for Highland Silver Lake were organized and analyzed by parameter according to the Illinois EPA ambient sampling period (May through October of each year). All data reported prior to the Phase 1 monitoring year (2004-05) is considered historical data.

1. Historical and Current Lake Water Quality

As stated, water quality data was obtained from the Illinois EPA ALMP and VLMP. The ALMP monitoring at Highland Silver Lake began in 1977, and it provides an intensive analysis of the limnological characteristics of the lake system and includes a

wide range of water quality parameters. The VLMP monitoring at Highland Silver Lake began in 1981 and supplements the more intensive Illinois EPA ALMP data collection (Illinois EPA personnel communication, 2005).

The Highland Silver Lake AMLP currently has three (3) sampling stations: ROZA-1, ROZA-2, and ROZA-3 (see Figure 5). ROZA-1 (Site 1) is the deepest sampling station and is located in the southern portion of the lake near the spillway and dam. ROZA-2 (Site 2) and ROZA-3 (Site 3) are located in the upper portions of the lake, north of the Interstate-70 Bridge. Historically there have been additional monitoring sites at Highland Silver Lake that are not currently sampled. Sites 4, 5, 6, 7, 9, and 10 were a part of other sampling programs. Sampling at those sites was terminated at various times between 1984 and 1987 (Illinois EPA personnel communication, 2005). Historical data for Sites 4, 5, 6, 7, 9, and 10 were not evaluated within this report.

Water quality sampling was conducted during the Phase 1 monitoring period between September 2004 and October 2005 at Sites 1, 2, and 3. During the yearlong sampling period, water quality samples were collected in order to establish a baseline or current (2004-05) conditions. Samples for the ALMP were collected by Illinois EPA personnel and the VLMP was subcontracted through and completed by Matt Shively of SCI Engineering, Inc. Surface samples were collected within 0.30 meters (1.0 ft.) of the surface at all three sampling locations in the lake. In addition to surface water samples, "bottom" samples were collected approximately two feet from the bottom at Site 1 - the deep-water sampling station. Sampling procedures for each trip also included a water transparency reading (Secchi depth), an integrated chlorophyll sample obtained at approximately twice the Secchi depth, and a dissolved oxygen and temperature profile (DO/Temp.). The Illinois EPA ALMP has produced a historical record of water quality data at Highland Silver Lake. A summary of historical and Phase 1 water quality data is provided in Appendix A. Historical and Phase 1 data collected from Sites ROZA-1 (Site 1), ROZA-2 (Site 2), and ROZA-3 (Site 3) were analyzed for comparative purposes in the following discussions.

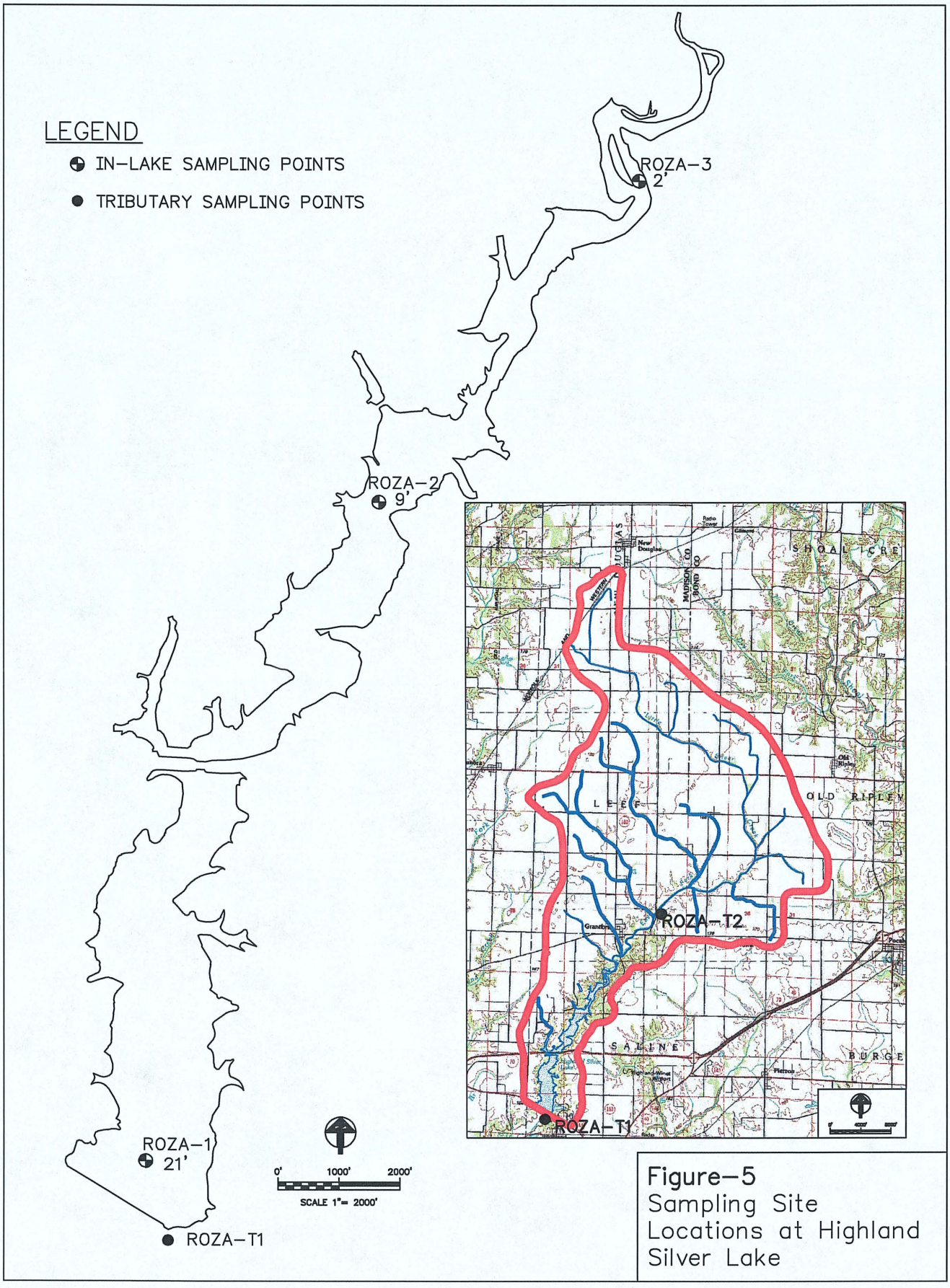


Figure-5
Sampling Site Locations at Highland Silver Lake

Illinois EPA Laboratory Audit

After the Phase 1 data was received, analyzed, and then included within the 2006 draft report, the Illinois EPA's Division of Laboratories completed an audit in October 2007 for data generated by Illinois EPA's Champaign laboratory between 2004 and 2005. As a result, the Illinois EPA added data qualifiers to many of the Phase 1 results for Highland Silver Lake. In reviewing the audited data for Highland Silver Lake, the Illinois EPA determined that some of the in-lake and tributary sample results failed to meet specific data quality control criteria and should not be used for any purpose (Appendix G). Appendix A contains the Phase 1 data for Highland Silver Lake and a list of the data qualifiers.

These unusable Phase 1 data include all results for total Kjeldahl nitrogen (TKN) and total ammonia-nitrogen (NH_3-N) and select results for total phosphorus (TP), total suspended solids (TSS), and volatile suspended solids (VSS). The unusable in-lake sample data impacts several of the Phase 1 report requirements (total nitrogen calculations, a total nitrogen budget, and limiting algal nutrient discussion, and those calculations and discussions that pertain to TKN, NH_3-N, and parameters with select qualified results). In addition to the in-lake samples, many of the tributary samples were also qualified and portions of that data were also determined to be unusable. Therefore, a nitrogen budget for Highland Silver Lake could not be completed for the Phase 1 period. Specific impacts associated with the Illinois EPA laboratory data audit are discussed within subsequent sections of this report.

Water Quality Data Analysis

Issues related to data quality are important to recognize, as erroneous results may lead to incorrect interpretation of the lake's condition, which can lead to inappropriate consideration and ultimate selection of management recommendations and improvement alternatives. In addition to the Illinois EPA's June 2008 review comments for the 2006 draft report (Appendix G), several criteria were used to review and evaluate the Phase 1 analytical results for Highland Silver Lake. Those subsequent review criteria included analysis of laboratory performance, professional judgment, and statistical methods.

1. June 2008 Illinois EPA Review Comments for 2006 Draft Report

The Illinois EPA stated in its June 4, 2008 review comments that NH_3-N and TKN results for the Phase 1 period failed to meet data quality objectives and should not be used. Based on this Illinois EPA recommendation, the NH_3-N and TKN results were eliminated from the Phase 1 analyses.

2. Laboratory Performance

Data qualifiers and testing limits of detection were used to assess laboratory performance. The Illinois EPA added data qualifiers to the Phase 1 data, as a result of the 2007 data audit (Appendix A). Appendix A also contains a list of definitions for the qualifiers used in the Phase 1 results. All results that contained an "X" qualifier (i.e., reported values should not be used for any purpose) were eliminated from the evaluation. Other data qualifiers evaluated for their usefulness included the following qualifiers:

- "Y" – The laboratory analysis was performed on an unpreserved or improperly preserved sample; and/or
- "Q" – Laboratory holding time was exceeded.

Most of the Y qualified results appeared to be associated with samples that were received at the laboratory above 4° C (39.2^{o} F). It was determined that elevated sample temperatures have minimal impacts on total and volatile suspended solids (TSS and VSS) and total phosphorus results (personal communication Prairie Analytical, 2008) and (Griesbach and Peters, 1991). Based on these findings, the Y qualified results are considered estimated values that do not appear to have a significant impact on the overall TSS, VSS, and total phosphorus results.

Upon reviewing the Q qualified results, it was determined that samples were generally analyzed within several days after the laboratory holding times had expired. These relatively minor holding time exceedences were not critical (personal communication Prairie Analytical, 2008). However, based on their qualified status, those results were also considered estimated values.

Testing limits of detection were also used to evaluate laboratory performance. Two laboratories (Illinois EPA laboratory in Champaign, IL and Teklab in Collinsville, IL) analyzed samples during the Phase 1 period. The Champaign laboratory completed the majority of the analyses with Teklab analyzing samples from only two sampling events on August 16 and October 12, 2005. Laboratory results contained elevated reporting limits for several parameters. In instances where the result value was reported as non-detect and there was an associated elevated reporting limit, values were estimated and evaluated at 50 percent of the respective reporting limit. The laboratory reporting limits for the Champaign lab and detection and reporting limits for Teklab are provided in Appendix A.

3. Statistical Analysis

Phase 1 results were also evaluated for anomalies or outliers. If the data result was already eliminated using the previous described methods, an outlier test was not performed on that particular result. The Grubbs' Test for Outliers (1969) at a 95 percent (0.05) significance level was used to detect and eliminate data outliers within the Phase 1 results. Data outliers are highlighted within the data tables in Appendix A.

A statistical program called StatPlus Professional 2007 was used to analyze the historical and remaining Phase 1 data. Given the varying number and small sample populations, a non-parametric statistical test called the Mann-Whitney U-test (comparing two-independent samples) was used to analyze the data sets. The Mann-Whitney test is used to compare two independent samples. It is similar to the T-test, but unlike the T-test, the Mann-Whitney U-test is valid even if the data sets are not normally distributed (Samuels and Witmer, 1999). The two-tailed U-Tests were performed at a 95 percent (p=0.05) significance level. The results of the Mann-Whitney analyses are discussed within subsequent sections of this report.

a. Water Transparency

Lake water transparency was measured using a simple, inexpensive device known as a Secchi disk. The Secchi disk is a 20.0 cm (7.9 inch) disk with alternating black and white patterns that is lowered into the water column until it disappears. The corresponding depth at which the disk is no longer visible with the naked eye is known as the Secchi depth.

The mean Secchi transparency depth at Site 1 during the Phase 1 period months of May through October was 22.2 inches and varied from 16.0 to 45.0 inches. The historical mean at Site 1 for the months of May through October was 14.1 inches. Table 7 summarizes the Phase 1 and historical Secchi transparency depth data for Highland Silver Lake. Overall, the mean and median Phase 1 values for all three sites increased compared to the historical values. This finding was unexpected, as more sediment has entered the lake and overall lake water quality has appeared to have decreased over time. A possible explanation for this finding is the subjective nature of collecting Secchi transparency depths (i.e., time of day and/or side of boat where readings were collected). The observed changes in Secchi transparency were statistically evaluated for ROZA-1. A Mann-Whitney U-test ($P<0.05$, two-tailed test) suggested no significant difference between the Phase 1 and historical data.

Throughout the monitoring year, Secchi transparency depths are often higher in the spring and lower in the summer months when algal productivity is typically the highest. For an agricultural watershed (characteristic of Highland Silver Lake), declines in Secchi transparency depth are usually attributed to an increase in suspended materials within the lake. An increase in algal productivity or an increase in suspended solids usually has a negative correlation with Secchi depth measurements due to a decrease in light penetration.

Table 7 - Secchi Disk Transparency Depths for Highland Silver Lake (ROZA)

Sampling Sites	Phase 1 Period					
	Number	Minimum	Maximum	Mean	Median	Std. Dev.
ROZA-1	12	16	45	22.2	20.0	8.0
ROZA-2	12	10	15	12.6	12.0	1.6
ROZA-3	12	6	13	8.5	8.0	2.1
	Historical Period					
	Number	Min.	Max.	Mean	Median	Std. Dev.
ROZA-1	9	4	38	16.2	12.0	11.4
ROZA-2	28	3	24	10.8	10.0	5.5
ROZA-3	30	3	20	7.2	7.0	3.2

Values reported in inches.
Phase 1 Period = May thru October 2005
Historical Period for ROZA = May thru October of 1981, 1983, 1985, 1988, 1990, 1993

b. pH and Alkalinity

When measuring the degree of acidity in a waterbody, a logarithmic scale ranging from 0 to 14 is used to measure the concentration of hydrogen ions. This scale is known as the pH scale. A measurement along the lower portion of the scale, 0 to 7 indicates the degree of acidity while a measurement along the upper portion, 7 to 14 indicates the degree of alkalinity. A seven on the pH scale is considered to be neutral. Generally, lakes in Illinois are well buffered by limestone bedrock, which may neutralize acidic activity. These lakes typically range from 6 to 9 on the pH scale.

Changes in pH during the monitoring period and throughout the year may be attributed to algal productivity, increased CO_2 from respiration accompanying decomposition, and nitrogen assimilation in the water column. Based on available data, pH measurements exhibited normal and expected fluctuations and remained similar to other Illinois lakes.

Buffering capacity is defined by the ability of the water body to neutralize acid. This capacity is better known as alkalinity. Total alkalinity measures the amount of acid needed to lower the pH of the water to 4.5. A high alkalinity concentration indicates an increased ability to neutralize pH and resist changes, whereas a low alkalinity concentration indicates that a water body is vulnerable to changes in pH.

Table 8 summarizes the Phase 1 and historical pH and total alkalinity data for Highland Silver Lake. During Phase 1 period (May-October), surface pH values at Site 1 had a mean of 8.3 and ranged from 7.5 to 9.0. The mean historical surface pH value (May through October) for Site 1 was 7.5. The pH and total alkalinity readings during the Phase 1 period were generally slightly higher than historical means for each in-lake sample site. These observed trends in pH and total alkalinity were statistically evaluated for ROZA-1. A Mann-Whitney U-test ($P<0.05$, two-tailed test) suggested a marginally significant difference between the Phase 1 and historical data for pH and a highly significant difference for total alkalinity.

Table 8 - pH and Total Alkalinity Values for Highland Silver Lake (ROZA)

Sampling Sites	Phase 1 Period											
	Number		Minimum		Maximum		Mean		Median		Std. Dev.	
	pH	T Alk	pH	T Alk	pH	T Alk	pH	T Alk	pH	T Alk	pH	T Alk
ROZA-1	11	5	7.5	110	9.0	144	8.3	120	8.3	116	0.5	14
ROZA-1B	9	3	7.0	92	8.7	136	7.8	116	8.1	120	0.7	22
ROZA-2	12	6	7.8	92	9.4	152	8.5	119	8.4	116	0.5	20
ROZA-3	11	6	7.2	118	8.9	190	8.1	164	8.1	8	0.6	27
	Historical Period											
	Number		Minimum		Maximum		Mean		Median		Std. Dev.	
	pH	T Alk	pH	T Alk	pH	T Alk	pH	T Alk	pH	T Alk	pH	T Alk
ROZA-1	15	19	6.4	30	8.7	85	7.6	59	7.4	65	0.8	18
ROZA-2	28	28	6.0	8	8.9	95	7.5	61	7.4	60	0.8	18
ROZA-3	29	29	6.4	35	9.0	125	7.5	74	7.4	60	0.8	29

Values reported in standard pH units and mg/l.
Phase 1 Period = May thru October 2005
Historical Period for ROZA = May thru October of 1981, 1983, 1985, 1988, 1990, 1993

c. Conductivity

Conductivity is a measure of water's ability to conduct an electrical current. The ability to carry a current is often driven by the dissolved materials present in a water column. These materials can include dissolved ions and other materials in the water and are directly proportional to the concentration of total dissolved solids (TDS) present in the water column.

Table 9 summarizes the May through October Phase 1 and historical conductance data for Highland Silver Lake. Measurements from the Phase 1

monitoring period were higher than the historical data collected but remained similar to values for other Illinois lakes (i.e., reservoirs with agricultural watersheds). The mean surface conductance value at Site 1 was 227.4 µmho/cm compared to the historical mean of 189.7 µmho/cm. This observed trend in conductance was evaluated for ROZA-1. A Mann-Whitney U-test ($P<0.05$, two-tailed test) suggested a marginally significant difference between the Phase 1 and historical data.

Table 9 - Conductance Values for Highland Silver Lake (ROZA)

Sampling Sites	Phase 1 Period					
	Number	Minimum	Maximum	Mean	Median	Std. Dev.
ROZA-1	7	191	258	227.4	243.0	29.6
ROZA-1B	8	177	274	214.4	200.5	38.2
ROZA-2	7	166	273	229.9	250.0	40.8
ROZA-3	6	173	400	293.7	298.5	94.9
	Historical Period					
	Number	Minimum	Maximum	Mean	Median	Std. Dev.
ROZA-1	12	146	238	189.7	196.0	28.6
ROZA-2	28	137	264	202.6	204.0	28.7
ROZA-3	30	120	354	245.4	239.5	49.8

Values reported in µmho/cm.
Phase 1 Period = May thru October 2005
Historical Period for ROZA = May thru October of 1981, 1983, 1985, 1988, 1990, 1993

d. Suspended Solids

Suspended solids concentrations in lakes most often consist of soil particles, organic material, and other debris that are present in the water column. Secchi transparency depth measurements and solids concentrations are inversely proportional. As the total suspended solids concentration increases at a given sampling location, the Secchi depth or water transparency often decreases. Total suspended solids concentrations can be an important indicator of the type and degree of turbidity in a lake as related to water quality. Total suspended solids (TSS) and volatile suspended solids (VSS) were measured to assess the concentration of suspended material in the water column at each sampling location. The difference between TSS concentration and VSS (i.e., volatile organic particles) concentration represents the inorganic portion of suspended particles present in the water column.

The Phase 1 TSS and VSS data contained several “X” qualified data that were eliminated from the evaluation. In addition, several of the TSS and VSS results were “Y” and/or “Q” qualified, as having elevated sample temperatures or exceeded the laboratory holding time for analyses. Those “Y” and/or “Q” qualified results were evaluated as estimated values. Elevated laboratory reporting limits were also encountered within the TSS and VSS data (i.e., 8 mg/L). Those non-detect results were analyzed at 50 percent of the elevated reporting limit or at a value of 4 mg/L.

Table 10 summarizes the Phase 1 and historical TSS and VSS values for the period of May through October. The mean Phase 1 TSS values were generally less than the historical TSS values, while the VSS values for the two periods remained similar. These results should be viewed with caution, as several of the TSS and VSS values were based on estimated values.

The TSS and VSS results at ROZA-1 were statistically evaluated. A Mann-Whitney U-test ($P<0.05$, two-tailed test) suggested no significant differences between the Phase 1 and historical data for TSS or VSS. It is possible that the lack of any observed variances can be due to the estimated Phase 1 TSS and VSS values associated with non-detect results with elevated laboratory detection limits.

Table 10 - Solids Values for Highland Silver Lake (ROZA)

Sampling Sites	Phase 1 Period											
	Number		Minimum		Maximum		Mean		Median		Std. Dev.	
	TSS	VSS	TSS	VSS	TSS	VSS	TSS	VSS	TSS	VSS	TSS	VSS
ROZA-1	15	15	4.0	2.0	14.0	11.0	8.9	5.4	10.0	4.0	3.4	2.5
ROZA-1B	13	15	4.0	2.0	17.0	10.0	11.3	5.2	12.0	4.0	4.0	2.2
ROZA-2	15	15	4.0	4.0	71.0	15.0	25.5	8.6	20.0	10.0	15.2	4.4
ROZA-3	15	15	15.0	4.0	167.0	23.0	67.3	13.1	60.0	12.0	41.9	6.3
	Historical Period											
	Number		Minimum		Maximum		Mean		Median		Std. Dev.	
	TSS	VSS	TSS	VSS	TSS	VSS	TSS	VSS	TSS	VSS	TSS	VSS
ROZA-1	13	9	4.0	2.0	32.0	12.0	14.6	5.3	9.0	4.0	10.7	3.2
ROZA-2	29	28	3.0	1.0	106.0	15.0	28.4	6.9	25.0	6.0	19.7	3.1
ROZA-3	29	29	15.0	3.0	270.0	44.0	78.5	16.8	68.0	15.0	49.2	9.5

Values reported in mg/l.
Phase 1 Period = May thru October 2005
Historical Period for ROZA = May thru October of 1981, 1983, 1985, 1988, 1990, 1993

In order to more accurately determine the types and amounts of suspended solids in the lake, a VSS analysis is often performed in conjunction with the TSS analysis. The VSS concentration often includes organic constituents, such as plankton and additional plant and animal debris that are present in the water column. The ratio of mean VSS to mean TSS concentrations at Site 1 was 61 percent. This ratio suggests that most of the suspended solids were organic in origin. As noted, these results should be viewed with caution, as several of the TSS and VSS values were based on estimated values. High levels of organically based solids are typically found in lakes with high algal productivity and chlorophyll levels.

e. Nitrogen

Nitrogen is one of a handful of chemicals that are essential in freshwater ecosystems. Biota in the lake greatly depend upon an interaction with the nitrogen cycle for daily activities. The diversity of species within a water body is often influenced by the degree of available nitrogen forms. These forms include gaseous nitrogen (N_2), nitrates (NO_3^-), nitrites (NO_2^-), ammonia nitrogen (NH_3-N), ammonium (NH_4^+), and dissolved organic nitrogen (DON). Inorganic forms of nitrogen, such as nitrate-nitrite and ammonia, found in excess may be detrimental to lake ecosystems. For example, Sawyer (1952) indicated that inorganic nitrogen concentrations in excess of 0.30 mg/L are considered sufficient to stimulate excessive algal growth. In addition, high concentrations of ammonia can be toxic to many fish and other aquatic organisms.

Nitrogen measurements conducted at Highland Silver Lake included NH_3-N, NO_2-NO_3, and total Kjeldahl nitrogen (TKN). TKN is a measurement of both organic and ammonia-nitrogen. The NH_3-N concentration represents only the ammonia-nitrogen or unionized nitrogen, NH_4^+ represents the ammonium or ionized nitrogen, and NO_2-NO_3 represents the nitrites and nitrates. A total nitrogen concentration can be obtained by adding the TKN to the NO_2-NO_3 measurements.

In general, the total nitrogen percentages provide a relationship of the sources of nitrogen in the water body. The increase in organic and ammonia sources of nitrogen may be correlated to an increase in biomass. Sources of increased organic nitrogen may include algae and macrophyte growth, while sources of ammonia nitrogen may be

from fish waste, atmospheric input, and decomposing organic material in the lake (by microbes and bacteria).

The Illinois General Water Quality Standards for ammonia-nitrogen vary according to water temperature and pH, with the allowable concentrations decreasing as temperature and pH increase. The allowable concentration of ammonia-nitrogen varies from 1.5 mg/L to 13.0 mg/L. Sources of ammonia-nitrogen may be from decomposition of organic material by bacteria, atmospheric sources, and fish excretion. Ammonia, in certain concentrations may be toxic to fish and other aquatic organisms and must be converted to ammonium (NH_4^+) through the formation of (NH_3OH) or nitrate (NO_3^-) before uptake by plants can occur. In contrast to ammonia, ammonium (NH_4^+) is not toxic to aquatic organisms and is readily available for uptake by phytoplankton and macrophytes. The total amount of ammonia and ammonium in the waterbody at any certain time is dependent upon the balance between pH, animal excretion, plant uptake, and activity of bacteria.

The 2007 Illinois EPA laboratory audit revealed that a critical distillation step prior to the analysis NH_3-N was not completed. Thus, all of the Phase 1 NH_3-N data was "X" qualified "not to be used for any purpose." A similar issue was encountered with the TKN results. The Illinois EPA audit determined that the TKN data failed to meet specific quality control criteria or failed to meet the data quality objectives. Therefore, the TKN data was "X" qualified. The Phase 1 NH_3-N and TKN data were not used and not evaluated.

The audited data contained numerous NO_2-NO_3 results that were "Y" qualified (samples analyzed with elevated temperatures). These "Y" qualified results were evaluated as estimated values. In addition, the Illinois EPA laboratory reporting limit for NO_2-NO_3 was raised to 0.1 mg/L. Non-detect NO_2-NO_3 results were analyzed at 50 percent of the elevated reporting limit or at a value of 0.05 mg/L.

Table 11 summarizes the usable Phase 1 NO_2-NO_3 and historical NH_3-N, TKN, and NO_2-NO_3 results for the period of May through October. As previously noted, the Phase 1 data for NH_3-N and TKN was determined to be unusable and thus is not included within the analyses.

The NO_2-NO_3 current and historical data were statistically evaluated for in-lake sites ROZA-1. A Mann-Whitney U-test ($P<0.05$, two-tailed test) determined no significant difference between the Phase 1 and historical data. This finding should be viewed with caution, as several of the Phase 1 NO_2-NO_3 values were estimated, based on elevated detection limits and non-detect results.

Table 11 - Nitrogen Values for Highland Silver Lake (ROZA)

Sampling Sites	Phase 1 Period																	
	Number			Minimum			Maximum			Mean			Median			Std. Dev.		
	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3
ROZA-1	NA	NA	13	NA	NA	0.78	NA	NA	2.60	NA	NA	1.37	NA	NA	1.26	NA	NA	0.55
ROZA-1B	NA	NA	14	NA	NA	0.52	NA	NA	7.33	NA	NA	2.18	NA	NA	1.25	NA	NA	2.24
ROZA-2	NA	NA	16	NA	NA	0.53	NA	NA	3.52	NA	NA	1.63	NA	NA	1.62	NA	NA	0.74
ROZA-3	NA	NA	17	NA	NA	0.78	NA	NA	2.72	NA	NA	1.59	NA	NA	1.46	NA	NA	0.70
	Historical Period																	
	Number			Minimum			Maximum			Mean			Median			Std. Dev.		
	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3	NH3-N	TKN	NO2-NO3
ROZA-1	15	13	16	0.01	0.07	0.01	0.41	1.70	1.50	0.10	0.97	0.37	0.10	0.95	0.22	0.10	0.48	0.43
ROZA-2	28	28	29	0.01	0.10	0.01	0.41	2.20	2.30	0.15	1.09	0.57	0.10	1.10	0.26	0.11	0.43	0.61
ROZA-3	29	29	29	0.03	0.10	0.01	0.84	4.40	4.01	0.27	2.15	0.57	0.20	2.00	0.27	0.24	0.86	0.95

Values reported in mg/l.
NA = Unusable data per IL EPA laboratory audit.
Phase 1 Period = May thru October 2005
Historical Period for ROZA = May thru October of 1981, 1983, 1985, 1988, 1990, 1993

The absence of Phase 1 TKN and NH_3-N data has large implications to this Phase 1 report. Many of the discussions concerning nitrogen (i.e., total nitrogen calculations, the total nitrogen budget, and limiting algal nutrient discussions) could not be completed.

f. Phosphorus

Phosphorus may be found in low concentrations in Illinois lakes throughout all seasonal periods of the year. Phosphorus is typically the limiting nutrient in lake ecosystems and additional or elevated loading of phosphorus to the lake will generally stimulate additional plant and algae growth. The control of phosphorus within a lake ecosystem is typically a primary focus for lake restoration and protection efforts. Often,

the majority of phosphorus that is delivered to streams and lakes is tightly bound to sediment particles that are running off agricultural fields and construction sites in the watershed. Additional sources of phosphorus may include internal recycling from anaerobic decomposition of organic matter at the bottom of the lake, leaking septic systems, waterfowl, atmospheric deposition, water and wastewater treatment plants, and other point sources of pollution. According to the Illinois General Water Use Standards, phosphorus as "P" should not exceed 0.05 mg/L in any reservoir or lake with a surface area of 8.1 hectares (20 acres) or more.

Table 12 summarizes the Phase 1 and historical total phosphorus (TP) and dissolved phosphorus (DP) results for the period of May through October. Several of the Phase 1 phosphorus samples received a "Y" data qualifier. Those qualified Phase 1 samples results were evaluated as estimated values.

The TP and DP TSS results at ROZA-1 were statistically evaluated. A Mann-Whitney U-test ($P<0.05$, two-tailed test) suggested no significant differences for the TP data and marginally significant changes between the Phase 1 and historical data. It is possible that the observed variances can be due to the estimated Phase 1 TP and DP values associated with non-detect results with elevated laboratory detection limits.

Table 12 - Phosphorus Values for Highland Silver Lake (ROZA)

Sampling	Phase 1 Period											
Sites	Number		Minimum		Maximum		Mean		Median		Std. Dev.	
	TP	DP	TP	DP	TP	DP	TP	DP	TP	DP	TP	DP
ROZA-1	16	15	0.088	0.033	0.568	0.354	0.257	0.158	0.202	0.140	0.138	0.106
ROZA-1B	16	15	0.107	0.034	2.245	1.975	0.861	0.608	0.568	0.250	0.761	0.680
ROZA-2	15	15	0.126	0.040	0.555	0.377	0.296	0.165	0.264	0.132	0.141	0.122
ROZA-3	14	16	0.196	0.039	1.000	1.000	0.516	0.248	0.490	0.180	0.273	0.237
	Historical Period											
	Number		Minimum		Maximum		Mean		Median		Std. Dev.	
	TP	DP	TP	DP	TP	DP	TP	DP	TP	DP	TP	DP
ROZA-1	11	13	0.030	0.000	0.446	0.183	0.218	0.070	0.240	0.056	0.115	0.061
ROZA-2	28	28	0.030	0.000	0.446	0.183	0.218	0.070	0.240	0.056	0.115	0.061
ROZA-3	29	29	0.115	0.030	1.010	0.904	0.376	0.190	0.273	0.088	0.235	0.230

Values reported in mg/l.
Phase 1 Period = May thru October 2005
Historical Period for ROZA = May thru October of 1981, 1983, 1985, 1988, 1990, 1993

Dissolved phosphorus is generally found in much smaller concentrations than total phosphorus and is readily available for uptake by biotic consumption. For this reason, dissolved phosphorus concentrations are variable and difficult to use as an indicator of nutrient availability. The mean surface DP concentrations ranged between 48% and 61% of the mean surface TP levels. The mean DP value for the bottom samples at Site 1 was 71% of the TP concentration. Higher concentrations of dissolved phosphorus can be indicative of their source, which is often anaerobic degeneration of organic matter from lake bottoms (Kothandaraman and Evans, 1983).

g. Chlorophyll

Chlorophyll measurements are commonly made in a lake to estimate the type and amount of algal productivity present in the water column. The chlorophyll a pigment is present in green algae, blue-green algae, and also in diatoms. This photosynthetic pigment is responsible for growth in the species that are typically found in Illinois and can be measured in order to estimate the type and amount of productivity in the water column. Chlorophyll a is often used to indicate the degree of eutrophication in a lake. For example, concentrations of chlorophyll a that exceed 20 µg/l indicate that a lake may be exhibiting eutrophic conditions (Illinois EPA, 1996).

In addition to the chlorophyll a concentrations, chlorophyll b, chlorophyll c, and phaeophytin can also be measured to further estimate 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 most common in diatom species and also serves as an auxiliary pigment. Algal productivity and diversity can be estimated by determining the concentrations of each pigment in the sample. For example, since green algal species contain both chlorophyll a and chlorophyll b, higher levels of both a and b may result if green algal species are dominant. Blue-green species contain only chlorophyll a pigments and lack chlorophyll b and c. High concentrations of only chlorophyll a may indicate that blue-green algal species are dominant. Diatom species contain both chlorophyll a and chlorophyll c pigments. Higher concentrations of both chlorophyll a and c may indicate that diatom species are dominant. Phaeophytin results from the breakdown of chlorophyll a, and a high

concentration indicates a stressed algal population and/or recent algal die-off. Phaeophytin has an absorption peak in the same spectral region as chlorophyll a and can sometimes cause chlorophyll a values to appear higher than the actual concentration. Corrected chlorophyll a values refer to a concentration determined by a modified laboratory method, which adjusts the chlorophyll a concentration when phaeophytin concentrations become significantly high. The Phase 1 and historical chlorophyll data in Appendix A indicate that chlorophyll a concentrations exceed the chlorophyll b and c concentrations, thus suggesting that blue-green algae have and continue to be the dominant algal species within the lake.

Table 13 contains the May through October Phase 1 and historical corrected chlorophyll a values for Highland Silver Lake. Chlorophyll a values increased between the Phase 1 and historical periods. A Mann-Whitney U-test ($P<0.05$, two-tailed test) for corrected chlorophyll a concentrations at ROZA-1 suggested that the Phase 1 and historical data sets were significantly different.

Table 13 - Chlorophyll a Values for Highland Silver Lake (ROZA)

Sampling	Phase 1 Period					
Sites	Number	Minimum	Maximum	Mean	Median	Std. Dev.
ROZA-1	12	5.9	137.0	59.9	54.5	35.2
ROZA-2	12	30.8	136.0	90.6	96.8	30.7
ROZA-3	12	43.8	171.0	100.6	99.0	38.0
	Historical Period					
	Number	Minimum	Maximum	Mean	Median	Std. Dev.
ROZA-1	7	3.3	44.0	22.2	22.4	17.4
ROZA-2	8	3.8	84.6	41.5	38.5	29.7
ROZA-3	6	13.4	149.5	88.2	91.5	55.0

Values reported in µg/L.
Phase 1 Period = May thru October 2005
Historical Period for ROZA = May thru October of 1981, 1983, 1985, 1988, 1990, 1993

h. Dissolved Oxygen and Temperature

During the Phase 1 monitoring period (2004-05) the Illinois General Use Water Quality Standards indicated that dissolved oxygen concentrations should not fall below 5.0 mg/L and should be at least 6.0 mg/L during 16 hours of any 24-hour period. Since the Phase 1 monitoring period, new Illinois General Use Water Quality Standards for dissolved oxygen have been developed pursuant to Section 302.206 of the Illinois Administrative Code.

Most aquatic organisms, including fish, require adequate concentrations of dissolved oxygen in the water column in order to survive. In temperate lakes with sufficient water depth (i.e., generally greater than 1.8 to 2.4 meters (6.0 to 8.0 ft)), there is a seasonal variation in temperature throughout the water column. Dissolved oxygen is an important component for respiration of aquatic life and thus is important for the overall health of the lake. Sources of oxygen can include inflow from tributaries, exchange with the atmosphere, and photosynthetic activity by aquatic plants and phytoplankton. Oxygen consumption on the other hand, can deplete valuable oxygen from the water column. Sources of oxygen consumption may include outflow, such as water discharge from the lake, respiration by fish and other oxygen consuming organisms, and biological consumption, such as the decomposition of dead plant and animal material.

As air temperatures rise in early spring, the upper layers of water warm up and mix with the colder water below as a result of wind and rain. Gradually, this mixing process diminishes and the lake begins to thermally stratify or separate into distinctly different layers. The upper layer of warmer water is known as the epilimnion and is separated from the lower cooler layer or hypolimnion by a transition zone known as the thermocline, where a rapid change in temperature generally occurs. The most important aspect of thermal stratification in relation to lake eutrophication is the summer stratification period when the hypolimnion becomes anaerobic or devoid of dissolved oxygen due to the increase in highly oxidizable material and the extended isolation from the atmosphere. When dissolved oxygen levels remain consistently below 5.0 mg/L and approach 0.0 mg/L, the conditions for chemical reduction become more favorable and the nutrient rich bottom sediments begin releasing nutrients such as ammonia and

phosphorus, and minerals such as iron, manganese, and copper to the overlying waters.

Dissolved oxygen and temperature data for Sites 1, 2, and 3 are located in Appendix C in tabular format. Isopleth charts developed for dissolved oxygen in mg/L or ppm (parts per million) and temperature (degrees Centigrade) (Figures 6A and 6B) reflect the seasonal variations for Site 1 during the 2004-05 Phase 1 monitoring period.

Dissolved oxygen levels for Site 1 ranged from a high of 14.7 mg/L near the surface to a low of 0.1 mg/L near the bottom during the summer months. Deeper locations displayed periods of depleted oxygen levels below a depth of 3.35 meters (11 ft.) indicating anaerobic conditions (DO less than 1.0 mg/L) between the months of June and September. This condition normally occurs due to a high oxygen demand as a result of decomposing material in the nutrient rich sediment. Thermal stratification began in late May as indicated by a decrease in DO and temperature per foot of water depth, and generally remained stratified until September.

2. Trophic Condition

The physical, chemical, and biological data obtained from baseline sampling are used to quantitatively describe the degree of eutrophication, or the trophic state, through the calculation of an index number. The trophic state index (TSI) number for the lake is of great value to the consultant or lake manager, and the user population. An index number, when properly interpreted, allows comparison of the existing condition of the lake with that of the past. Carlson (1977) has developed a useful trophic state index for lakes with algal turbidity and minimal aquatic vegetation (Table 14).

This index was based on the amount of algal biomass in surface water, using a scale of 0 to 100. The scale uses a log transformation of Secchi disk transparency values as a measure of algal biomass. The accuracy of Carlson's index may vary as a result of water coloration or suspended materials other than algae. Since chlorophyll and total phosphorus concentrations are often correlated with transparency, an index number can also be calculated from these parameters. The following table lists the TSI numbers from 0 to 100 with the associated Secchi depths, surface phosphorus and chlorophyll a concentrations.

Figure 6–A – Dissolved Oxygen Isopleth (mg/L) for Highland Silver Lake – Site 1

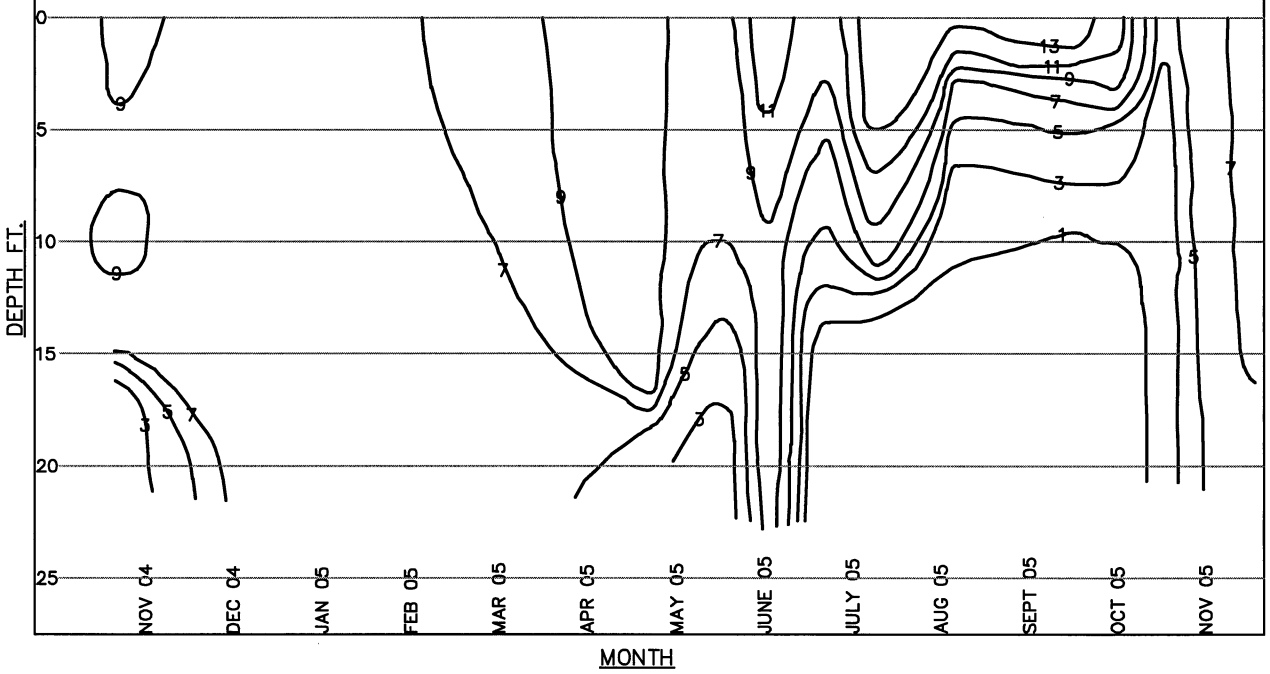


Figure 6–B – TEMP °C for Highland Silver Lake –Site 1

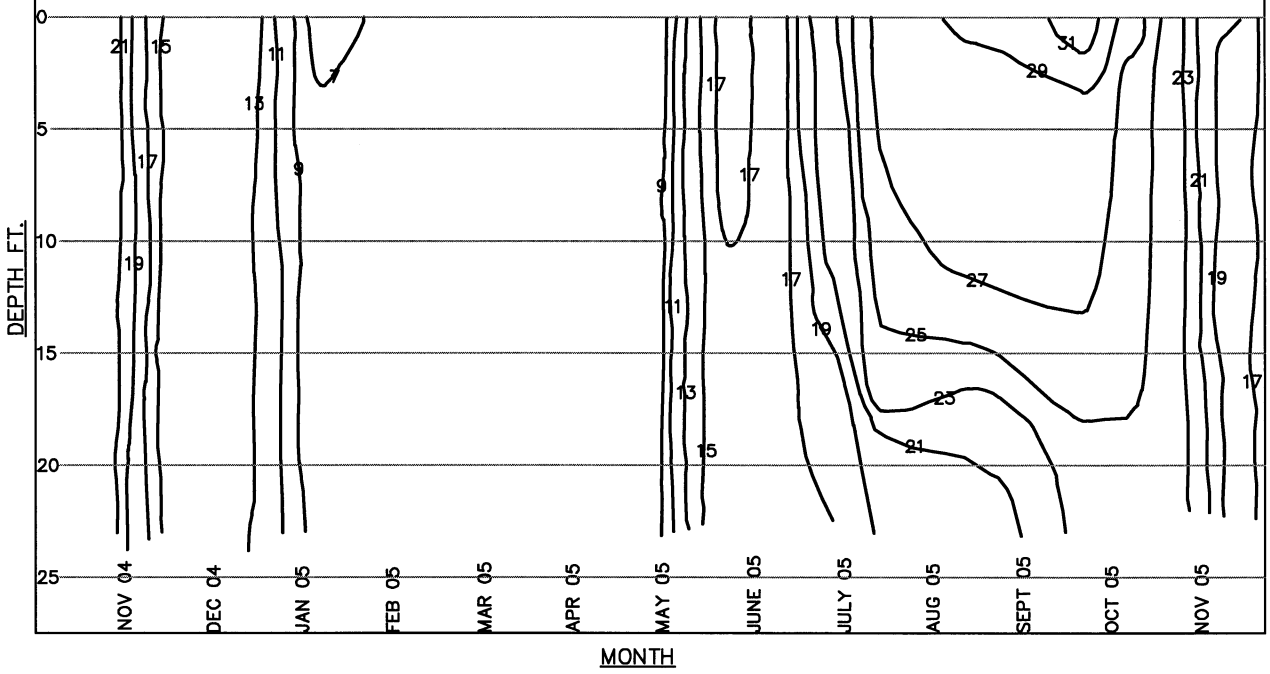


Table14 - Carlson's Completed Trophic State Index

TSI	Secchi Depth (m)	Secchi Depth (ft)	Surface Phos. (mg/m^3)	Surface Chloro. a (mg/m^3)
0	64	220	0.75	0.04
10	32	106	1.5	0.12
20	16	52.5	3	0.34
30	8	26	6	0.94
40	4	13	12	2.6
50	2	6.6	24	6.4
60	1	3.3 (39")	48	20
70	0.5	1.6 (20")	96	56
80	0.25	0.8 (10")	192	154
90	0.13	0.4 (5")	384	427
100	0.06	0.2 (2.5")	768	1,183

Source: Carlson, 1977

The trophic condition of Highland Silver Lake for each sampling site has been calculated according to the Trophic State Index (TSI) developed by Carlson (1977). Trophic state indices include Secchi disk transparency depth, total surface phosphorus, and chlorophyll a concentrations for Site 1, Site 2, and Site 3 during the Phase 1 monitoring period (2004-05) and historical data from 1981, 1983, 1985, 1988, 1990, and 1993. Historical data was based on data obtained from the US EPA STORET website. The calculated TSI values for Sites 1 through 3 are shown in Table 15.

Table 15 – TSI Values

		Secchi TSI	**Total Phos TSI**	**Chloro a TSI**
Phase I	Site 1	69.0	84.5	62.5
	Site 2	78.0	90.0	73.0
	Site 3	82.5	85.5	74.0
Historical	Site 1	75.0	82.5	59.0
	Site 2	80.0	82.5	61.0
	Site 3	85.0	89.5	70.5

According to the Lake Assessment Criteria as listed in the 1994-95 Illinois Water Quality Report (Illinois EPA, 1996), lakes having a mean Trophic State Index (TSI) greater than 50.0 and less than 70.0 are characterized as being eutrophic. The Phase 1 TSI values suggest that Highland Silver Lake is strongly eutrophic to hyper-eutrophic. Phase 1 TSI values decreased for Secchi disk transparency depth, while the TSI values for total phosphorus and chlorophyll increased.

3. Limiting Algal Nutrient

The weight to volume ratio of total nitrogen (mg/L) to total phosphorus (mg/L) is often used to determine which nutrient is limiting algal growth in a lake or reservoir. Since the nitrogen to phosphorus ratio (by weight in mg/L) in algal cell tissue is typically 7 to 1, it is assumed that when the ratio of total nitrogen (mg/L) to total phosphorus (mg/L) is greater than 10 to 1, phosphorus is generally the limiting nutrient (Horne, 1994). When ratios are less than 10 to 1, nitrogen is generally the limiting nutrient.

As previously noted in the nitrogen discussion, the analysis of the lake's limiting algal nutrient cannot be completed for the Phase 1 period without accurate TKN data. The historical in-lake data indicates that the total nitrogen to total phosphorus ratios for ROZA-1, ROZA-2, and ROZA-3 have been approximately 10. These findings suggest that the lake has historically been phosphorus-limited.

4. Sediment Quality and Sedimentation

a. Chemical Characteristics

Composite grab samples were collected at Sites 1, 2, and 3 during the Phase 1 monitoring period, and lake sediment samples were analyzed for metals and organics in the sediment. The Phase 1 sampling period results for metals and organics for Sites 1, 2, and 3 are listed in Tables 16 and 17. Most of the parameters were found to be within the low to normal range for Illinois lake sediment (Table 18). However, several inorganic and metal parameters (i.e., total phosphorus, Kjeldahl nitrogen, mercury, and barium) were slightly elevated. Several organic parameters (i.e., chlordane, dieldrin, DDT, and acetochlor) were detected in the sediment grab samples; however, the results suggested that the levels detected were in the normal range. Laboratory analyses of

the sediment samples suggest that the lake sediment is non-hazardous and would not likely require disposal in a special hazardous landfill or facility, if any sediment were to be removed.

Table 16 - Phase 1 Sediment Analysis for Metals

	Units	Site 1	Site2	Site 3
Phosphorus-P	mg/kg	1,580	1,002	784
Kjeldahl-N	mg/kg	20,600	26,000	22,000
% Solids	%	48.0	51.4	53.2
Soilds, Volatile	%	10.7	7.4	4.8
Mercury	mg/kg	<0.45	<0.41	<0.39
Potassium	mg/kg	1,900	1,500	840
Barium	mg/kg	280	180	120
Cadmium	mg/kg	0.37	0.45	0.24
Chromium	mg/kg	21.0	17.0	11.0
Copper	mg/kg	25.0	20.0	13.0
Iron	mg/kg	28,000	20,000	13,000
Lead	mg/kg	25.0	19.0	13.0
Manganese	mg/kg	1,300	630	400
Nickel	mg/kg	22.0	18.0	12.0
Silver	mg/kg	<0.5	<0.5	<0.5
Zinc	mg/kg	85	75	51
Arsenic	mg/kg	7.5	4.2	3.9

Table 17 - Phase 1 Sediment Analysis for Organics

	Units	Site 1	Site 2	Site 3
Total PCBs	µg/kg	<10	<10	<10
Hexachlorobenzene	µg/kg	<1	<1	<1
Trifluralin	µg/kg	<10	<10	<10
Alpha-BHC	µg/kg	<1	<1	<1
Gamma-BHC (Lindane)	µg/kg	<1	<1	<1
Atrazine	µg/kg	<50	<50	<50
Heptachlor	µg/kg	<1	<1	<1
Aldrin	µg/kg	<1	<1	<1
Alachlor	µg/kg	<10	<10	<10
Metribuzin	µg/kg	<10	<10	<10
Metolachlor	µg/kg	<25	<25	<25
Heptachlor Epoxide	µg/kg	<1	<1	<1
Pendimethalin	µg/kg	<10	<10	<10
Gamma-Chlordane	µg/kg	<2	<2	<2
Alpha-Chlordane	µg/kg	<2	<2	3.8
Total Alpha and Gamma Chlordane	µg/kg	<5	<5	3.8
Dieldrin	µg/kg	1.5	<1	1
Captan	µg/kg	<10	<10	<10
Cyanazine	µg/kg	<25	<25	<25
Endrin	µg/kg	<1	<1	<1
P,P'-DDE	µg/kg	<1	<1	<1
P,P'-DDD	µg/kg	<1	<1	<1
P,P'-DDT	µg/kg	<1	<1	1.1
Total DDT	µg/kg	<10	<10	1.1
Methoxychlor	µg/kg	<5	<5	<5
Acetochlor	µg/kg	35	<25	68

Table 18 - Classification of Illinois Lake Sediment

Parameter	Unit	Low	Normal	Elevated	Highly Elevated
PCB's	µg/kg	n/a	less than 10	10 to <89	89 or greater
Aldrin	µg/kg	n/a	less than 10	1 to <1.2	1.2 or greater
Diedrin	µg/kg	n/a	less than 3.4	3.4 to <15	15 or greater
DDT	µg/kg	n/a	less than 10	10 to 180	180 or greater
Chlordane	µg/kg	n/a	less than 5	5 to 12	12 or greater
Endrin	µg/kg	n/a	less than 1	n/a	1 or greater
Methoxychlor	µg/kg	n/a	less than 5	n/a	5 or greater
alpha-BHC	µg/kg	n/a	less than 1	n/a	1 or greater
gamma-BHC	µg/kg	n/a	less than 2	n/a	1 or greater
HCB	µg/kg	n/a	less than 3	n/a	1 or greater
Heptachlor Epoxide	µg/kg	n/a	less than 4	1 to <1.6	1.6 or greater
Phosphorus	mg/kg	less than 394	394 to <1115	1115 to <2179	2179 or greater
Total Kjeldahl Nitrogen	mg/kg	less than 1300	1300 to <5357	5357 to <11700	11700 or greater
Cadmium	mg/kg	n/a	less than 5	5 to <14	14 or greater
Copper	mg/kg	less than 16.7	16.7 to <100	100 to <590	590 or greater
Lead	mg/kg	less than 14	14 to <59	59 to <339	339 or greater
Mercury	mg/kg	n/a	less than 0.15	0.15 to <0.701	0.701 or greater
Cyanide	mg/kg	n/a	n/a	n/a	n/a
Arsenic	mg/kg	less than 4.1	4.1 to <14	14 to <95.5	95.5 or greater
Chromium	mg/kg	less than 13	13 to <27	27 to <49	49 or greater
Iron	mg/kg	less than 16000	16000 to <37000	37000 to <56000	56000 or greater
Manganese	mg/kg	less than 500	500 to <1700	1700 to <5500	5500 or greater
Zinc	mg/kg	less than 59	59 to <145	145 to <1100	1100 or greater
Nickel	mg/kg	less than 14.3	14.3 to <31	31 to 43	43 or greater
Silver	mg/kg	n/a	less than 0.1	0.1 to <1	1 or greater
Potassium	mg/kg	less than 410	410 to <2100	2100 to <2797	2797 or greater
Barium	mg/kg	less than 94	94 to <271	271 to <397	397 or greater

Source: Mitzlefelt, 1996

b. Sedimentation

Erosion and sedimentation are natural geomorphic processes that allow fine-grained silts, clays, and detritus to be delivered to lakes and reservoirs. Sedimentation can lead to a significant loss of original water depth and may be considered detrimental if allowed to progress. The average rate of reservoir capacity loss in Illinois has been reported to be approximately 0.6 percent per year (Roseboom et al., 1979). Lakes and reservoirs often act as sediment traps and are capable of trapping as much as 90 percent of the sediments that are carried from agricultural fields and unprotected construction sites. In addition to causing a loss in water depth and storage capacity, accumulated sediments can contribute to internal nutrient recycling from resuspension and/or anaerobic decomposition.

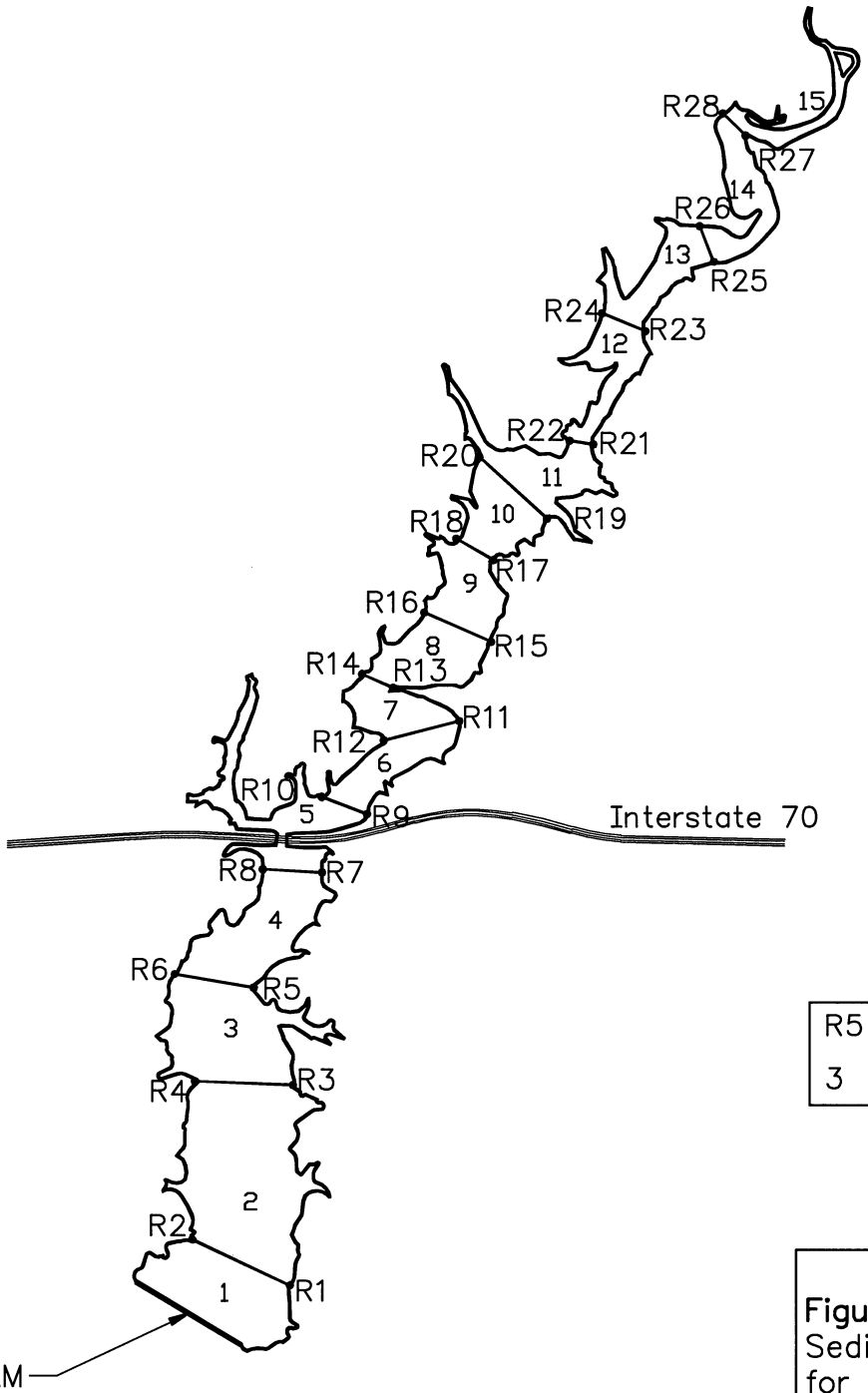
In 1999, the Illinois State Water Survey (ISWS) conducted a lake sedimentation survey at Highland Silver Lake to determine the storage and sedimentation conditions of the lake. The 1999-sedimentation survey divided the lake into segments (see Figure 7),

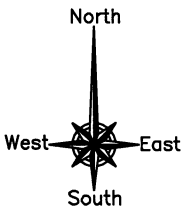
and cross-section transects mark the boundaries of each segment. Transects were located in the field using global positioning systems (GPS). Copies of the ISWS cross-sections are included within the ISWS Sedimentation Survey Report in Appendix D. A bathymetric map of Highland Silver Lake is shown in Figure 8.

The 1999 survey was conducted using an Odom Hydrographic Systems MK II fathometer for depth measurements and differentially corrected with a Leica 9600 System Geodetic Position System (GPS) for horizontal control across the transect. All navigation and data logging functions were controlled using Hypack, hydrographic survey software. The fathometer was calibrated daily prior to initiating measurements. For each lake cross-section, three to seven physical measurements of the water depth and sediment thickness were made with an aluminum-sounding pole. For sediment depths, the range pole was pushed through the soft sediment until the hard, original lake bottom was reached. The total length of pole at the water surface was then determined, and this length, less the water depth, yielded the actual sediment depth at the respective points.

The data from the soundings of the lake bottom were then plotted as cross-sections so that a profile of the existing sediment and the original lake bottom could be developed. The average end-area-method was applied to each of the cross sections to calculate the quantity of accumulated sediment and remaining water volume. The findings of the ISWS 1999-sedimentation survey were converted from acre-feet to cubic yards.

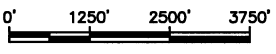
To account for additional sediment that has been deposited within the lake from 1999 through 2005 (i.e., time between the most recent ISWS sedimentation survey and the Phase 1 monitoring period), an average annual sedimentation rate from 1984-1999 of 21.9 acre-feet per year (35,331 cubic yards per year) was used to project current data (i.e., amount deposited as of 2005). The 1984-1999 rate was used based on the assumption that farming, tillage, and soil conservation practices have improved over the history of the lake, and thus gross soil erosion rates within the watershed should have subsequently improved as well. The results from 1999 sedimentation survey along with the estimated 2005 values are presented in Table 19.





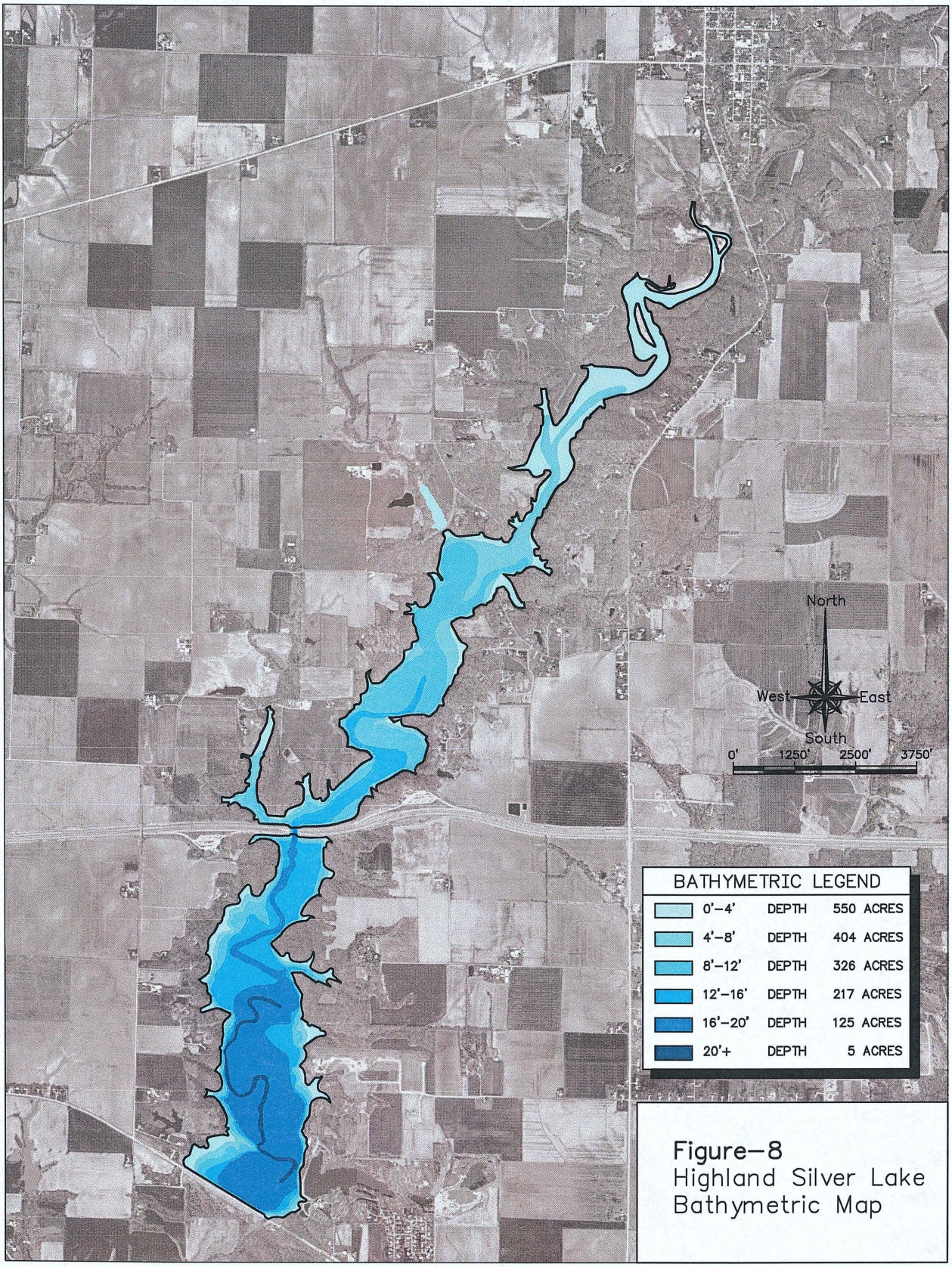
R5 Transect Endpoints

3 Lake Segments



Figure–7
Sedimentation Survey
for Highland Silver Lake

SOURCE: ISWS, 2001.



Figure–8
Highland Silver Lake
Bathymetric Map

SOURCE: ISWS, 2001.

Table 19 - ISWS Sedimentation Survey Results and Projected 2005 Data

Segment	Original (1962) Volume	Existing (1999) Volume	Estimated (2005) Volume	1999 Sediment Accumulation	2005 Estimated Sediment Accumulation *	1999 Capacity Loss	Estimated 2005 Capacity Loss
Units	Cubic Yards	Cubic Yards	Cubic Yards	Cubic Yards	Cubic Yards	Percentage	Percentage
1	1,282,600	1,113,200	1,098,281	169,400	184,319	13.2%	14.4%
2	2,857,213	2,470,013	2,435,914	387,200	421,300	13.6%	14.7%
3	1,542,347	1,337,453	1,319,409	204,893	222,938	13.3%	14.5%
4	1,177,733	1,009,947	995,170	167,787	182,563	14.2%	15.5%
5	845,387	703,413	690,910	141,973	154,477	16.8%	18.3%
6	556,600	451,733	442,498	104,867	114,102	18.8%	20.5%
7	506,587	374,293	362,643	132,293	143,944	26.1%	28.4%
8	643,720	467,867	452,380	175,853	191,340	27.3%	29.7%
9	484,000	372,680	362,876	111,320	121,124	23.0%	25.0%
10	471,093	350,093	339,437	121,000	131,656	25.7%	27.9%
11	521,107	356,547	342,054	164,560	179,052	31.6%	34.4%
12	343,640	180,693	166,343	162,947	177,297	47.4%	51.6%
13	280,720	109,707	94,646	171,013	186,074	60.9%	66.3%
14	221,027	77,440	64,795	143,587	156,232	65.0%	70.7%
15	80,667	32,267	28,004	48,400	52,662	60.0%	65.3%
Total	11,814,440	9,407,347	9,195,361	2,407,093	2,619,079	20.4%	22.2%

Source: ISWS, 2001.

* Based on annual average sedimentation rate from 1984-1999 of approx. 35,331 CY.

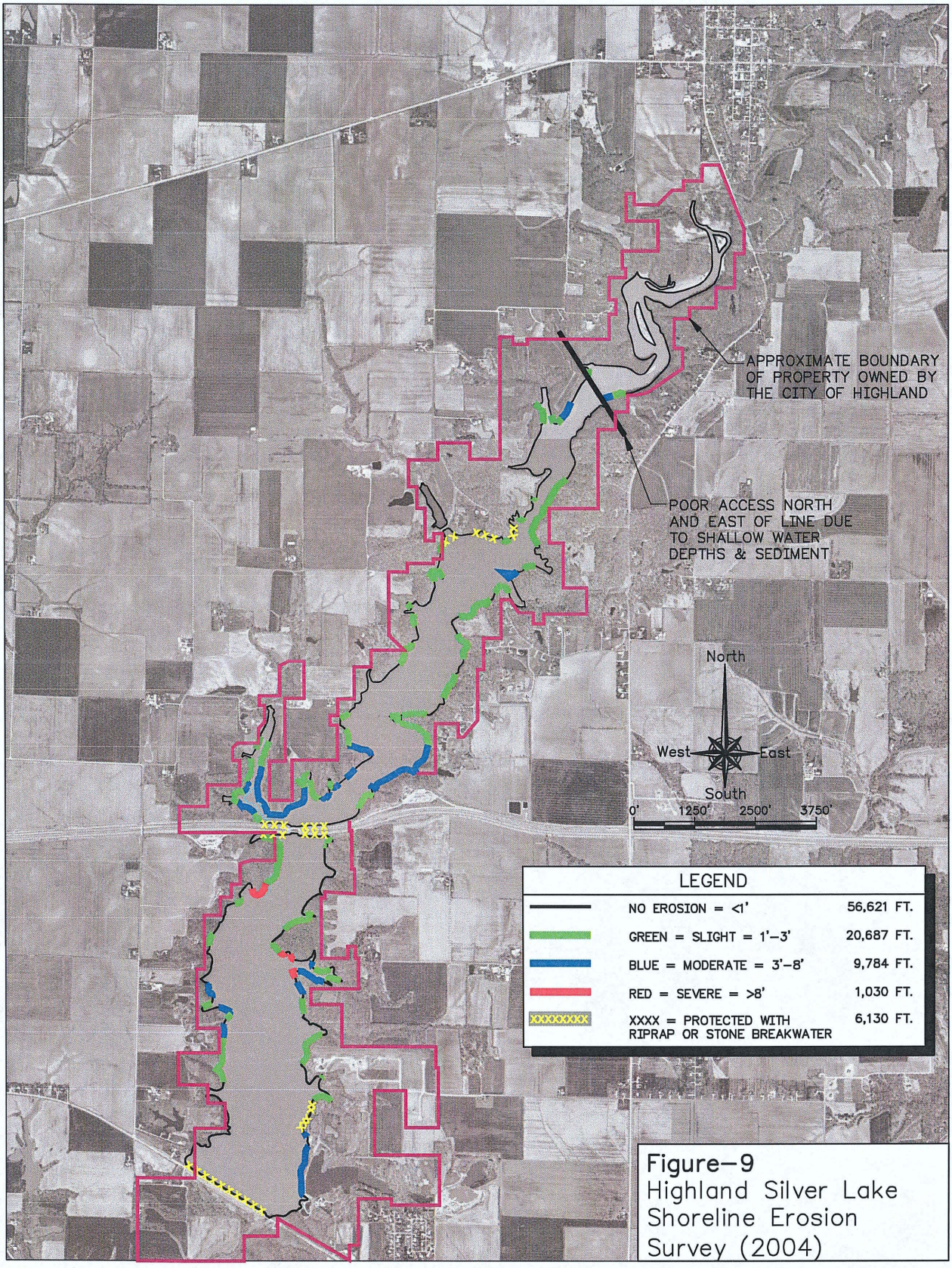
Based on the projected 2005 sedimentation data, an estimated 2,619,079 cubic yards of sediment have been deposited. This number represents an approximate 22.2 percent water storage capacity loss for the entire lake over the 43-year period between when the lake was constructed (1962) and the Phase 1 monitoring period 2004-05. This total capacity loss would suggest that an average of approximately 60,909 cubic yards of sediment has been deposited within the lake on an annual basis.

c. Shoreline Erosion

In 2004, staff from Heartland Ecosystem Services completed a shoreline erosion survey of Highland Silver Lake in order to determine the extent erosion contributes to lake water degradation. The initial 2004-shoreline survey was re-confirmed by Cochran & Wilken, Inc. staff in July 2005 (Figure 9). Eroded shoreline impairs lake usage and access by adding turbidity and decreasing storage capacity. The loss of shoreline soils in severe cases may also jeopardize the stability of infrastructure such as bridges, roads, docks, etc. In addition, shoreline loss reduces the overall aesthetic appeal of the lake.

The methodologies used during the survey rated erosion severity by vertical measurements of the eroded zones. An estimate was made to determine the horizontal length of each eroded zone and a vertical measurement was recorded and applied to the following criteria: bank heights of less than 1 foot were classified as having no erosion; bank heights of 1 to 3 ft. were classified as having slight erosion; bank heights greater than 3 ft. and less than 8 ft. were classified as having moderate erosion; and bank heights greater than 8 ft. were classified as having severe erosion.

An estimated 9,602 m. (31,501 ft.) of the 28,728 m. (94,252 ft.) of shoreline was classified as eroded during the 2005 survey. The largest classification of eroded shoreline was 6,305 m. (20,687 ft.) of slight shoreline erosion, which represented 65.7% of the total eroded shoreline length. Moderate shoreline erosion accounted for 2,982 m. (9,784 ft.) or 31.1% of the total eroded shoreline and severe erosion made up 3.3% of the total eroded shoreline with 314 m. (1,030 ft.).



Figure–9
Highland Silver Lake Shoreline Erosion Survey (2004)

Over its 43 years history, an estimated 36,674 cubic yards of soil has eroded from the shoreline of Highland Silver Lake. This estimated loading was calculated by extending the eroded bank into the lake at a projected slope of 3:1 (3 foot horizontal to 1 foot vertical) to form a typical triangular end area. Then, the length of the eroded shoreline in linear feet was multiplied by the projected end area for each degree of erosion. Since its construction, approximately 53,560 tons (48,588,704 kg) of soil have been delivered to Highland Silver Lake from shoreline erosion. These figures equate to annual sediment loadings of 622.5 tons/year (564,985 kg/year). The total tons of delivered soil were calculated using a dry unit weight of 50 pounds per cubic-ft.

Riprap has been placed along the shoreline in several locations in an attempt to stabilize the shoreline and reduce erosion (see Figure 9). Most of the existing riprap was installed in association with transportation projects (i.e., Interstate 70-Bridge and the Route 143-Dam) or by the City of Highland (i.e., near the water treatment plant). Most of these locations are considered to be successful stabilization measures. In addition to the general observations and measurements, areas in greatest need of remediation were documented and photographed (Appendix E). Shoreline erosion is most commonly attributed to wave action from strong winds and boats.

5. Hydrologic Budget

A hydrologic budget was developed in order to account for the total inflow and outflow of water for the Highland Silver Lake system during the Phase 1 (2004-05) monitoring period. The budget accounts for the inflows from the tributaries entering the lake, total precipitation to the watershed, and direct precipitation to the lake, as well as outflows consisting of evaporation, water withdrawals for the public water supply, and flow over the spillway. The hydrologic budget is a critical component and the basis for developing subsequent sediment and nutrient budgets. In general, the lake hydrologic budget for the Highland Silver Lake system was calculated assuming the following formula:

Change in Storage Capacity = Inflows – Outflows *

* Unaccounted flows are assumed to be the result of fluctuations in the groundwater inflows and outflows.

The hydrologic budget was developed by using daily precipitation readings collected at the water plant and daily water level (discharge) readings collected over the weir at the spillway located near the dam. The daily spillway outfall readings were used with the dam's spillway-rating curve to develop daily lake discharges. The daily spillway discharges and daily precipitation readings were found to occur at more regular intervals and to be more reliable and accurate in developing the hydrologic budget than the dozen or less flow measurements collected during the Phase 1 (2004-05) monitoring period.

Daily and monthly precipitation (rainfall) readings were applied to the lake and to the entire watershed, and runoff coefficients and sediment delivery ratios were used to model and predict the potential watershed inflows to the lake. Monthly evaporation rates and average monthly pumping rates at the water plant were also used to calculate outflows from the lake. Evaporation was determined using the methods described in "Lake Evaporation in Illinois" (Roberts and Stall, 1967).

The total calculated inputs for the Phase 1 monitoring year were 66,411,052 cubic-meters (53,861.4 acre-ft). An average inflow of 0.32% of the total hydrologic budget was unaccounted for and could be potentially attributed to groundwater inflows and outflows. Approximately 65,987,849 cubic-meters (53,518.1 acre-ft) of water left the lake and were delivered as outputs. Monthly water inputs and outputs were estimated for the Highland Silver Lake system from November 2004 to October 2005 (see Table 20).

Highland Silver Lake area experienced drought conditions (i.e., extreme temperatures compounded with lack of significant precipitation events) during the second half of the Phase 1 monitoring period. From May 2005 through October 2005, the Highland Silver Lake water levels did not exceed the spillway crest, and therefore, there was no discharge from the lake during this period. The 2005 drought conditions likely underestimate typical hydrologic conditions for the lake and the hydrologic budget for Highland Silver Lake.

Table 20 - Hydrologic Budget Summary

Month	Avg. Pool Level	Inputs			Outputs				Unaccounted Inflow
		Precip. from Watershed	Direct Lake Precip.	Net Inputs	Evapor. from Lake	Public Water Supply	Spillway Outflow	Net Outputs	
	Ft-ASL	Ac-Ft	Ac-Ft	Ac-Ft	Ac-Ft	Ac-Ft	Ac-Ft	Act-Ft	Ac-Ft
Nov-04	500.30	6,939.32	307.1	7,246.4	122.38	97.58	10,115.85	10,335.8	-3,089.4
Dec-04	500.20	2,796.44	123.8	2,920.2	93.96	90.47	8,423.92	8,608.3	-5,688.2
Jan-05	500.53	10,460.77	462.9	10,923.7	68.29	109.49	15,187.66	15,365.4	-4,441.8
Feb-05	500.27	2,433.94	107.7	2,541.7	71.04	120.51	8,886.08	9,077.6	-6,536.0
Mar-05	500.08	1,967.87	87.1	2,055.0	113.67	118.17	5,103.55	5,335.4	-3,280.4
Apr-05	500.05	2,744.66	121.5	2,866.1	202.13	108.07	3,094.26	3,404.5	-538.3
May-05	499.98	1,450.01	64.2	1,514.2	218.17	107.51	0.00	325.7	1,188.5
Jun-05	499.59	1,242.86	55.0	1,297.9	252.54	98.67	0.00	351.2	946.7
Jul-05	499.05	4,453.60	197.1	4,650.7	277.29	93.02	0.00	370.3	4,280.4
Aug-05	498.60	7,560.76	334.6	7,895.3	245.67	98.18	0.00	343.8	7,551.5
Sep-05	498.60	7,353.61	325.4	7,679.0	190.67	94.64	0.00	285.3	7,393.7
Oct-05	498.90	2,175.01	96.3	2,271.3	133.83	97.80	0.00	231.6	2,039.6
Sum	**acre-feet**	**51,578.9**	**2,282.5**	**53,861.4**	**1,989.6**	**1,234.1**	**50,811.3**	**53,518.1**	**-173.7**
	cubic meters	63,596,729	2,814,323	66,411,052	2,453,208	1,521,675	62,650,357	65,987,849	-214,187
Avg.	acre-feet	4,205.0	186.1	4,391.1	166.5	104.2	5,081.1	5,351.8	-960.7
	cubic meters	5,184,794	229,441	5,414,234	205,310	128,439	6,265,036	6,598,785	-1,184,551
		95.76%	**4.24%**	**100.00%**	**3.72%**	**2.31%**	**94.94%**	**100.00%**	**-0.32%**

6. Phosphorus and Nitrogen Budgets

Phosphorus (TP) and nitrogen (TKN and NO_3-NO_2) data were collected from two tributary samples (ROZA-T1 located at the spillway near the dam and ROZA-T2 located on Silver Creek, upstream of the lake) during the 2004-05 Phase 1 period (Appendix A). These tributary sample results are critical in the development of nutrient budgets (i.e., the amount of nitrogen and phosphorus that passes into and out of the lake).

As previously mentioned, the Illinois EPA completed an audit of the Phase 1 results in 2007. As a result, qualifiers were placed on some of the Phase 1 data. In some cases, it was determined that the data should not be used for any purpose. Those data included all TKN results, and as a result, a Phase 1 nitrogen budget cannot be completed.

Nearly half of the TP tributary sample results were qualified as having laboratory analysis was performed on unpreserved or improperly preserved samples. In those instances, samples were received at the laboratory above 4° C (39.2^o F). It was determined that elevated sample temperatures have minimal impacts on TP results. Based on these findings, these qualified results were evaluated as estimated values.

Phosphorus and nitrogen are generally considered to be the two main nutrients involved in algal growth and the lake eutrophication process. The Phase 1 monitoring results were used to estimate monthly inputs and outputs for total phosphorus. The methodologies for the collection and calculation of nutrient inputs and outputs were similar to those used in the hydraulic budget (Table 20) with the exception of the internal regeneration calculation, which was calculated as an additional input. Data was collected during the monitoring year and then loadings were estimated using a flow weighted average method. The total amount of a specific nutrient transported over a given period of time was calculated using the following equation (along with conversion factors):

$$T_i = (Q_i \times C_i)$$

where:

T_i = Total amount of nutrients transported during a particular period.

Q_i = Total flow of water entering or leaving the lake during a period.

C_i = Concentration of nutrients for the period being calculated.

During internal regeneration, phosphorus (P) is released from lake sediments into well aerated or oxic water. Jensen and Andersen (1992) have shown that Fe-bound phosphorus, when present in significant proportions in the sediment, may be a major source for internal phosphorus loading in shallow, eutrophic lakes, just as it may be in deeper, stratified lakes. Holdren and Armstrong (1980), per Fricker (1981) quoted literature values of sediment phosphorus release rates from several lakes in the United States for aerobic (0 to 13 P mg/m^2/day) and anaerobic conditions (0 to 50 [max. 150] P mg/m^2/day).

The calculated numbers were correlated with the hydrologic budget estimates for water movement and then converted to kilograms in order to estimate the total amount of nutrients flowing into and out of the lake during the sampling period. The estimated releases of phosphorus from sediment were based on rates determined by Fricker (1981). A rate of 25.0 mg/m^2/day (0.223 lbs/acre/day) for phosphorus was used to calculate an approximate internal nutrient load for the period of time that dissolved

oxygen levels were <1.0 mg/L (i.e., anoxic conditions). Internal nutrient loading rates of 7.0 mg/m^2/day (0.062 lbs/acre/day) for phosphorus were used when dissolved oxygen levels were >1.0 mg/L (i.e., oxic conditions).

The regeneration values for anaerobic conditions (i.e., dissolved oxygen levels below 1.0 mg/L) and aerobic conditions were multiplied by the approximate corresponding area of the lake bottom in order to arrive at a daily loading rate. These corresponding rates were used to determine the internal nutrient loadings throughout the Phase 1 monitoring period during times when the lake was anoxic and oxic. Atmospheric inputs were derived from regional concentrations obtained through the National Atmospheric Deposition Program (NADP) and applied to precipitation totals.

Table 21 displays the Phase 1 nutrient budget for phosphorus. Some of the phosphorus budget values were calculated with estimated values derived from qualified laboratory data; therefore, the following phosphorus budget values should be viewed with caution. The total gross loading to the lake from all sources was estimated to be 24,952.8 kg (27.5 tons) of phosphorus. Internal regeneration accounted for approximately 31.6 percent of the total phosphorus load. An estimated net load of 15,993.1 kg (17.6 tons) of phosphorus entered Highland Silver Lake during the Phase 1 sampling period.

As previously mentioned, the extreme drought conditions experienced during the Phase 1 period likely skewed the hydrologic budget. Given that the hydrologic budget served as the basis for the nutrient and sediment budgets, it is likely that those subsequent budgets were also impacted. During this period, there were reduced inputs or loadings from external sources (i.e., watershed runoff). Conversely, this lack of external loadings may have caused internal sources to appear greater, proportionately, than they might have normally been during a more typical year with more significant precipitation events.

Table 21 – Phosphorus Budget Summary

Month	Atmos. Inflow		Watershed & ROZA-T2 Inflows		Internal Regeneration		Watershed & ROZA-T1 Outflows		Net Phosphorus Load	
Units	**kg**	**tons**	**kg**	**tons**	**kg**	**tons**	**kg**	**tons**	**kg**	**tons**
Nov-04	4.5	0.005	3,410.1	3.8	464.0	0.51	1,794.4	2.0	2,084.2	2.3
Dec-04	0.7	0.001	855.4	0.9	479.5	0.53	1,805.1	2.0	-469.4	-0.5
Jan-05	10.2	0.011	3,200.0	3.5	479.5	0.53	1,895.3	2.1	1,794.3	2.0
Feb-05	0.6	0.001	744.6	0.8	433.1	0.48	1,119.7	1.2	58.5	0.1
Mar-05	0.4	0.000	242.7	0.3	479.5	0.53	1,414.9	1.6	-692.4	-0.8
Apr-05	0.7	0.001	484.1	0.5	464.0	0.51	930.2	1.0	18.7	0.0
May-05	0.2	0.000	486.5	0.5	762.5	0.84	0.0	0.0	1,249.2	1.4
Jun-05	0.1	0.000	587.2	0.6	1,011.7	1.12	0.0	0.0	1,599.0	1.8
Jul-05	1.8	0.002	1,666.3	1.8	1,045.5	1.15	0.0	0.0	2,713.7	3.0
Aug-05	5.3	0.006	2,089.0	2.3	1,045.5	1.15	0.0	0.0	3,139.8	3.5
Sep-05	5.0	0.006	1,871.6	2.1	737.9	0.81	0.0	0.0	2,614.5	2.9
Oct-05	0.4	0.000	1,403.1	1.5	479.5	0.53	0.0	0.0	1,883.1	2.1
Sum	**29.9**	**0.033**	**17,040.7**	**18.8**	**7,882.1**	**8.69**	**8,959.7**	**9.9**	**15,993.1**	**17.6**

Annual Totals	Total KG	Total Tons	Percent of Total
Atmospheric Inflow	29.9	0.03	0.1%
Watershed & ROZA-T2 Inflows	17,040.7	18.8	68.3%
Internal Regeneration	7,882.1	8.7	31.6%
Total Inflow	**24,952.8**	**27.5**	100.0%
Watershed & ROZA-T1 Outflows	8,959.7	9.9	100.0%
Total Outflow	**8,959.7**	**9.9**	100.0%
Net Phosphorus Load	**15,993.1**	**17.6**	

7. Sediment Budget

The system flow data calculated in the hydrologic budget (Table 20) were used to develop a sediment budget (Table 22), which indicates the amount of sediment entering and exiting the lake system. The flow values in the hydrologic budget and the corresponding tributary sample TSS concentrations were used to calculate sediment inputs and outputs for the lake. An estimate of 10 percent for bed load transport (Fitzpatrick and Harbison, 1986) was added to the monitored tributary inputs. Tributary samples do not typically account for sediment transported along the bottom of the tributary, because this material cannot be accurately monitored.

Out of the estimated 3,150,643 kg (3,473 tons) of sediment estimated to have entered Highland Silver Lake during the Phase 1 monitoring year, an estimated 2,583,407 kg (2,848 tons) were deposited in the lake. These results suggest an overall trap efficiency of approximately 82 percent. It was estimated that shoreline erosion has contributed a total of 622.8 tons of sediment to the lake each year.

Temporal and spatial variability between the historical and Phase 1 periods likely account for some of the variations observed in the “theoretical” loadings in Table 5 and

"actual" loadings in Tables 19 and 22. Drought conditions were experienced during the Phase 1 monitoring period, which likely underestimated typical watershed loadings in Table 22. Elevated laboratory detection limits and estimated values associated with the 2004-05 Illinois EPA data audit during the Phase 1 period also could have introduced additional variation in the watershed loadings. These potential loading estimations were likely compounded by gross erosion and sediment delivery rates for the watershed (Table 5) that were estimated and published in 1979.

Table 22 – Sediment Budget Summary

Month	Watershed & Site 2 Inflows		Shoreline Erosion		Bed Load Transport Est.		Watershed & Site 1 Outflows		Net Sediment Load	
Units	**kg**	**tons**	**kg**	**tons**	**kg**	**tons**	**kg**	**tons**	**kg**	**tons**
Nov-04	205,429.4	226.4	47,082.1	51.9	19,588.0	60.5	127,490.7	140.5	144,608.8	159.4
Dec-04	189,715.6	209.1	47,082.1	51.9	19,588.0	60.5	42,473.1	46.8	213,912.6	235.8
Jan-05	387,096.5	426.7	47,082.1	51.9	19,588.0	60.5	189,530.6	208.9	264,236.0	291.3
Feb-05	90,067.0	99.3	47,082.1	51.9	19,588.0	60.5	111,971.4	123.4	44,765.7	49.3
Mar-05	33,982.7	37.5	47,082.1	51.9	19,588.0	60.5	78,973.4	87.1	21,679.5	23.9
Apr-05	44,011.5	48.5	47,082.1	51.9	19,588.0	60.5	16,797.4	18.5	93,884.2	103.5
May-05	152,028.0	167.6	47,082.1	51.9	19,588.0	60.5	0.0	0.0	218,698.1	241.1
Jun-05	68,476.5	75.5	47,082.1	51.9	19,588.0	60.5	0.0	0.0	135,146.6	149.0
Jul-05	227,062.6	250.3	47,082.1	51.9	19,588.0	60.5	0.0	0.0	293,732.7	323.8
Aug-05	533,141.4	587.7	47,082.1	51.9	19,588.0	60.5	0.0	0.0	599,811.5	661.2
Sep-05	331,724.0	365.7	47,082.1	51.9	19,588.0	60.5	0.0	0.0	398,394.1	439.2
Oct-05	87,863.2	96.9	47,082.1	51.9	19,588.0	60.5	0.0	0.0	154,533.3	170.3
Sum	**2,350,598.5**	**2,591.1**	**564,984.9**	**622.8**	**235,059.8**	**259.1**	**567,236.6**	**625.3**	**2,583,406.6**	**2,847.7**

Annual Totals	Total KG	Total Tons	Percent of Total
Watershed & Site 2 Inflows	2,350,598.5	2,591.1	74.6%
Shoreline Erosion	564,984.9	622.8	17.9%
Bed Load Tranport Est.	235,059.8	259.1	7.5%
Total Inflow	**3,150,643.2**	**3,473.0**	100.0%
Watershed & Site 1 Outflows	567,236.6	625.3	100.0%
Total Outflow	**567,236.6**	**625.3**	100.0%
Net Sediment Load	**2,583,406.6**	**2,847.7**	

L. Biological Resources and Ecological Relationships

1. Phytoplankton

Phytoplankton analyses were completed for Highland Silver Lake by Dr. Larry O'Flaherty of Western Illinois University (WIU) in order to qualify and quantify the species present in the water column (Appendix B). Selected historical phytoplankton analyses were conducted on available sample data from Site 1 in 1987 and 2002. During the 2005-Phase 1 monitoring period, samples were collected from Sites 1 and 3 on the following dates: April 22, June 13, July 27, August 16, and October 12 (Table

23). All phytoplankton samples collected from 1987 through the present were analyzed using the Sweep Method (Sedgewick-Rafter counting cell).

Table 23 - Phytoplankton Summary

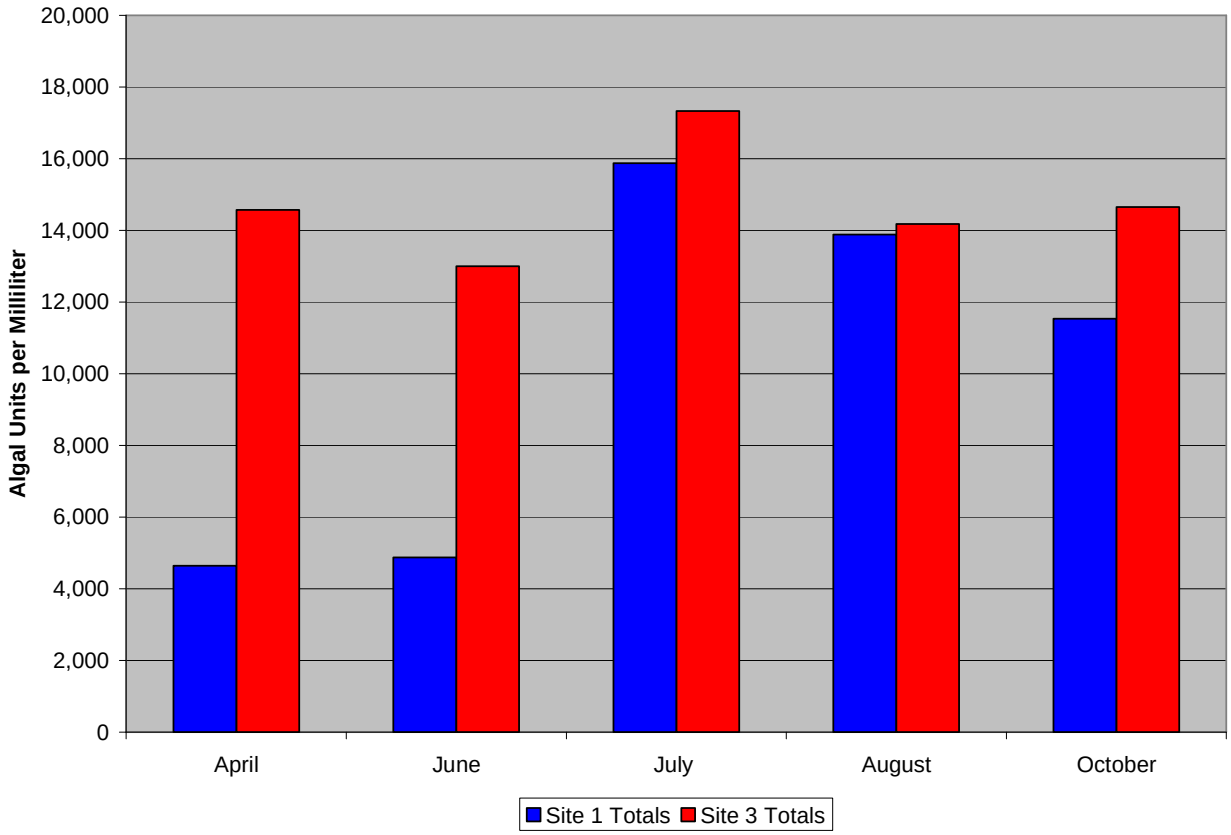
Phylum	April	June	July	August	October
Site 1					
Bacillariophyta	275	265	275	1,233	1,131
Chlorophyta	31	1,243	479	1,284	1,967
Chrysophyta	0	0	0	0	0
Cryptophyta	540	377	31	173	41
Cyanophyta	3,679	2,375	15,074	11,038	8,154
Euglenophyta	112	571	10	132	245
Pyrrhophyta	0	41	0	10	0
Xanthophyta	0	0	10	10	0
Totals	4,637	4,872	15,879	13,882	11,537
Site 3					
Bacillariophyta	897	438	2,497	2,100	1,080
Chlorophyta	2,191	2,161	1,967	2,691	3,567
Chrysophyta	0	0	0	10	0
Cryptophyta	112	31	112	41	367
Cyanophyta	10,926	9,764	11,741	8,571	8,133
Euglenophyta	357	540	958	734	1,508
Pyrrhophyta	0	20	41	20	0
Xanthophyta	92	51	20	10	0
Totals	14,575	13,005	17,336	14,177	14,656

Source: O'Flaherty, 2006

Note: All values represent the number of algal units per milliliter.

Phytoplankton analyses at Site 1 during the Phase 1 monitoring period showed that the total algal population ranged from a low of 4,637 (number of units/ml) in April to a high of 15,879 (number of units/ml) in July. Site 3 was similar in terms of total number of algal units and distribution of individual taxa with the dominant algal division being Cyanophyta (blue-greens). Figure 10 below shows the similarity of total phytoplankton for Sites 1 and 3 for the Phase 1 (2005) samples.

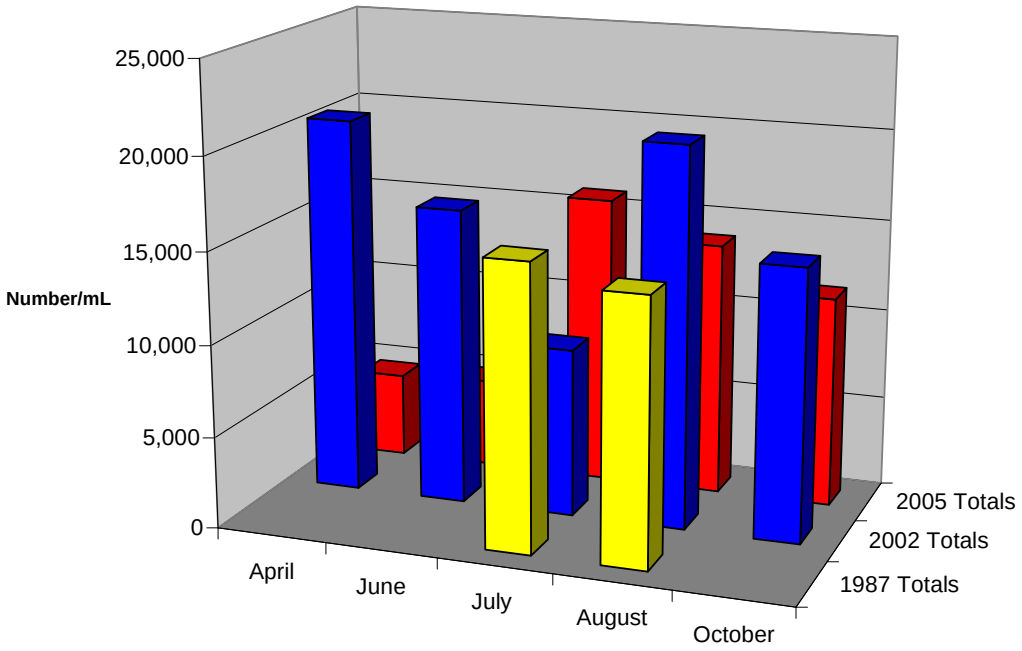
Figure 10 - Phytoplankton Comparison



Source: O'Flaherty, 2006.

A comparison of the 2002 and 2005 (Phase 1) Site 1 sample data with historical 1987 data shows that there has been an increase in total algal productivity in Highland Silver Lake (see Figure 11 below).

Figure 11 - Historical Site 1 Total Phytoplankton Comparison



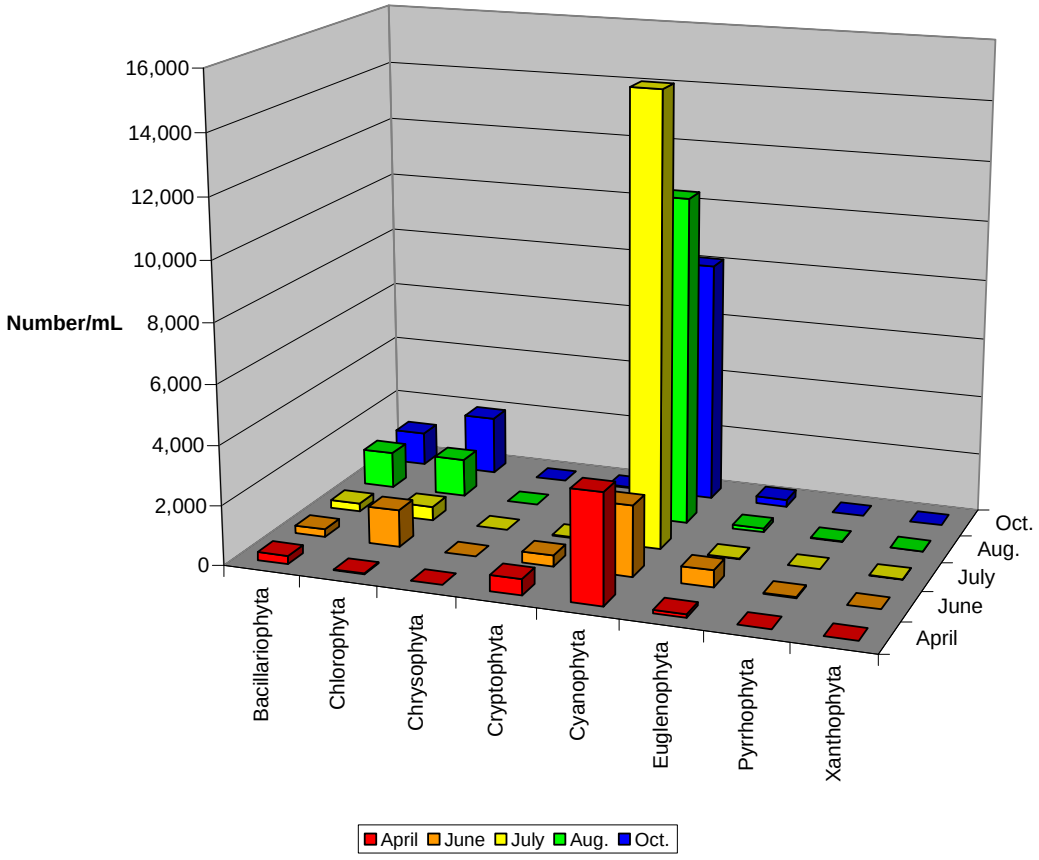
	April	June	July	August	October
1987 Totals			15,535	14,420	
2002 Totals	20,578	16,225	9,183	20,649	14,809
2005 Totals	4,637	4,872	15,879	13,882	11,537

1987 Totals 2002 Totals 2005 Totals

Source: O'Flaherty, 2006

In addition to the increased algal productivity found in the Phase 1 (2005) samples (see Figure 12), it is apparent that the phylum Cyanophyta (blue-green algae) has become dominant in Highland Silver Lake, especially during the summer months. This algal species is a nuisance blue-green that is generally indicative of highly eutrophic conditions.

Figure 12 - Site 1 Dominant Phytoplankton Comparison



Source: O'Flaherty, 2006

2. Fisheries Population

a. History

Highland Silver Lake has a diverse fish population and the Illinois Department of Natural Resources (IL DNR) has documented sixteen (16) species occurring in the lake (see Table 24). These species support and include multiple sport fish: black crappie, bluegill, brook silversides, common carp, channel catfish, flathead catfish, green sunfish, gizzard shad, largemouth bass, longear sunfish, redear sunfish, sauger, warmouth, white crappie, yellow bullhead catfish, and yellow bass. Generally, IL DNR indicates that the populations of most sport fish within Highland Lake are healthy. However, siltation and turbidity in the lake have diminished the quality of fish habitat.

b. Population Survey

Fish population surveys for Highland Silver Lake have typically been completed biennially in the fall (i.e., 1998, 2000, 2002, 2004, etc.) by the District 16 IL DNR fisheries biologist. Table 24 lists the major fish species known to occur in Highland Silver Lake.

Table 24 - Common Fish Species Encountered

ID Code	Species	Scientific Name
BLC	Black Crappie	*Pomoxis nigromaculatus*
BLG	Bluegill Sunfish	*Lepomis macrochirus*
BRS	Brook Silversides	*Labidesthes sicculus*
CAP	Common Carp	*Cyprinus carpio*
CCF	Channel Catfish	*Ictalurus punctatus*
FCF	Flathead Catfish	*Pylodictis olivaris*
GSF	Green Sunfish	*Lepomis cyanellus*
GZS	Gizzard Shad	*Dorosoma cepedianum*
LMB	Largemouth Bass	*Micropterus salmoides*
LOS	Longear Sunfish	*Lepomis mehalotis*
RSF	Redear Sunfish	*Lepomis microlophus*
SAR	Sauger	*Stizostedion canadense*
WAM	Warmouth	*Lepomis gulosus*
WHC	White Crappie	*Pomoxis annularis*
YEB	Yellow Bullhead Catfish	*Ameiurus natalis*
YLB	Yellow Bass	*Morone mississippiensis*

Source: IDNR, 2005

Lake management status reports for Highland Silver Lake were compiled by the District 16 IL DNR Fisheries Biologist. Summaries of the 1998, 2000, 2002, and 2004 Lake Management Status and Survey Reports for Highland Silver Lake are provided in Table 25. The terms for the abbreviations used within the IL DNR Fisheries Lake Management Reports follow Table 25.

Table 25 – Fish Population Survey Summary

Species	Parameter	1998	2000	2002	2004	LMP Objective
LMB						
	PSD	81	56	43	71	40-70
	RSD15	45	30	6	30	38
	RSD18	14	5	1	3	5
	RSD8-11.9	21	54	57	29	30
	RSD12-14.9	33	16	37	41	32
	Wr (150 mm)	97	95	97	96	90-110
	CPUE (fish/hr)	36	28	37	43	68
BLG						
	PSD	9	29	38	16	20-40
	RSD7	0	1	1	0	10-15
	Wr (100 mm)	97	100	106	101	90-110
GZS						
	PSD	3	5	0	0	30-60
	RSD<4	0	3	1	19	30
	RSD4-5.9	25	55	46	26	40
	RSD6-7.9	32	19	11	12	20
	RSD>8	43	23	42	42	10
	Wr (100 mm)	96	95	101	92	90-110
	CPUE (fish/hr)	55	64	121	73	150

Source: IL DNR, 2005

PSD – Proportional Stock Density is a way of representing the size structure of fish populations. It represents the percentage of "quality-size" fish that are at sexual maturity with a given population. The greater the PSD value, the greater percentage of "quality" fish there is within a particular population.

RSD4 (or 7,8,9,14,16,18) – Relative Stock Density is another way of representing the size structure of fish populations that corresponds to the percentage of fish of a given length or larger within a population. Hence, an RSD14 reading 25 for LMB indicates that 25 percent of the sexually mature LMB are at least 14-inches in length.

Wr – Weight Relative (to length) is a way of stating "plumpness" or "body condition" of a particular fish species. The higher the Wr value, the better the condition.

CPUE – Catch Per Unit of Effort is a way of representing the density of a species population. The higher the CPUE means there are a greater number of fish present.

General summaries of the major species sampled in the 2004-Lake Management Status Reports for Highland Silver Lake are as follows:

Largemouth Bass (LMB) – The LMB population has remained very stable. The CPUE in 2004 was 43 and was the highest recorded in the last five years; however, it remains below the Lake Management Plan objective of 68 for the lake. Generally, natural LMB reproduction and recruitment have been stunted. Future stocking of 4-inch LMB should improve the fishery, provided the state hatchery program can meet stocking demands.

Bluegill (BLG) – The BLG population within Highland Silver Lake remains poor, as gizzard shad (GZS) compete directly with BLG for resources. The proportional and relative stocking densities for BLG have both dropped below the objectives set forth in the Lake Management Plan, as no BLG greater than 7-inches were sampled in 2004. Improving the other fish populations (i.e., LMB and GZS) should indirectly improve the BLG population within the lake.

Gizzard Shad (GZS) – GZS numbers in 2004 were down from the previous survey. Generally, the CPUE for GZS has remained below the object of 150. In 2004, the PSD4 (GZS less than 4-inches) made up approximately 19 percent of the population. These smaller GZS provide excellent forage for larger predator species such as LMB. However, the GZS population remains somewhat disproportional as the PSD8 (GZS greater than 8-inches) remain high at 42 percent of the total population. These larger GZS provide little benefit, other than producing more GZS.

Channel Catfish (CCF) – A total of 16 CCF were sampled in 2004, which ranged from 16 to 27 inches in length. Highland Silver Lake maintains a good CCF fishery.

Common Carp (CAP) – The 2004 sampling included 19 CAP, ranging from 21 to 33-inches in length. Highland Silver Lake maintains a good CAP fishery.

Saugeye and Sauger (SARWAE and SAR) – While no SAR or SARWAE were surveyed in 2004, local anglers suggest these species are doing well, with many good-sized fish being caught.

c. Fish Contaminant Monitoring

Fish are nutritious, but some fish can contain chemicals such as polychlorinated biphenyls (PCBs), chlordane, and methyl mercury. These chemicals and substances get into the water and the food they consume, and over time, can build up (through a process called bioaccumulation) to levels which may cause health effects for people who then consume those fish. It is important to keep exposure to these chemicals as low as possible. The Illinois fish advisory helps you plan what sport fish to eat as well as how often they can be eaten. The fish advisory is not intended to discourage you from eating fish, but should be used as a guide to eating fish that are low in contaminants (IL DNR, 2006).

Mercury is found in the environment because of natural and human activities. When moving through the environment, mercury goes through a series of complex changes. Through these changes in lake and river sediments, an organic form of mercury, methyl mercury, is created. Methyl mercury is very persistent in the environment. Methyl mercury is transferred up the food chain to predator species, and can accumulate in people that eat these predator fish (IL DNR, 2006).

Methyl mercury is extremely toxic to humans and causes many adverse health effects. Health effects associated with eating methyl mercury-contaminated fish include impaired central nervous system function, kidney damage and failure, and gastrointestinal damage with higher methyl mercury exposure, and development delays in children with lower exposure. A recent report by the National Academy of Sciences concluded that the population at highest risk for adverse health effects is the children of women who eat large amounts of fish and seafood during pregnancy. This is due to the greater sensitivity of the developing nervous system of infants. In order to protect the

most sensitive populations, pregnant or nursing women, women of childbearing age, and children less than 15 years of age are advised to eat no more than one meal per week of predator fish (IL DNR, 2006).

In recent years, fish flesh analyses at Highland Silver Lake have identified elevated chlordane levels have been found in channel catfish (CCF). Table 26 lists the restrictive consumption advisory for chlordane advisory at Highland Silver Lake. The following fish advisory is for eating trimmed and skinned fish (except smelt). The advice in this table has been developed to protect infants, children and women of child bearing age. The advice may be over protective for women beyond child bearing age and adult men.

Table 26 – Special Fish Advisory

Species	Sizes	Advisory
CCF	>25”	1 meal / week

Source: IDNR, 2004.

Fish flesh analyses were completed during the Phase 1 sampling period (2004-05) on samples of largemouth bass (LMB) and white crappie (WHC) to determine the level of toxicity present in Highland Silver Lake fishes. The Phase 1 fillet analyses revealed acceptable U.S. Food and Drug Administration (USFDA) levels of contaminants. The USFDA action concentrations are listed in Table 27, and the recorded concentrations of fish contaminants for all fish flesh samples collected between 1995 and 2005 are listed in Table 28.

Table 27 - USFDA Action Level for Fish Flesh Analysis

Parameter	Action Level (ppm)
Chlordane	0.3
Dieldrin	0.3
Heptachlor Epoxide	0.3
PCB	2.0
Mercury	1.0
Total DDT	5.0

Source: USFDA

Table 28 - Fish Flesh Analyses

Species	Sampling Date	Avg Sample Wt. (Lbs)	Avg Sample Length. (In)	Total Chlordane	Total DDT	Dieldrin	Total PCBs	Mercury	Lipid Content
CAP	10/7/1996	4.04	20.5	0.06	0.01	0.02	<0.1	<0.1	1.1
CAP	10/7/1996	9.03	26.2	0.08	0.01	0.04	<0.1	<0.1	2.1
CAP	8/21/1997	7.79	25	0.16	0.01	0.04	<0.1	<0.1	4.7
CAP	8/21/1997	3.19	18.8	0.08	<0.01	0.02	<0.1	<0.1	3.2
CAP	9/8/1998	2.86	18.3	0.09	<0.01	0.06	<0.1	<0.1	2.6
CAP	9/8/1998	12.3	28	0.13	0.01	0.05	<0.1	<0.1	2.4
CCF	10/7/1996	3.95	21.7	0.13	0.02	0.06	<0.1	<0.1	2.4
CCF	10/7/1996	1.25	16.2	0.06	<0.01	0.03	<0.1	<0.1	2
CCF	8/21/1997	1.67	18	0.06	0.01	0.01	<0.1	<0.1	1.3
CCF	8/21/1997	6.8	25.8	0.24	0.02	0.06	<0.1	<0.1	3.5
CCF	9/8/1998	6.14	25.5	0.31	0.02	0.09	0.1	<0.1	2.4
CCF	9/8/1998	2.63	20.1	0.15	0.01	0.07	<0.1	<0.1	2.8
CCF	9/18/2000	1.89	18.6	0.12	<0.01	0.04	<0.1	<0.1	4.3
CCF	9/18/2000	5.01	23.1	0.05	<0.01	<0.01	<0.1	<0.1	0.92
CCF	9/11/2002	5.2	24.1	0.12	<0.01	0.08	<0.1	<0.1	2.3
CCF	9/11/2002	2.19	19.2	0.1	<0.01	0.06	<0.1	<0.1	5.6
LMB	6/22/2005	2.22	16.6	<0.02	<0.01	<0.01	<0.1	<0.1	0.45
WHC	6/2/2005	0.12	7.02	<0.02	<0.01	<0.01	<0.1	<0.1	0.33

All Units Report in mg/kg (ppm)

Source: Hornshaw, 2005.

d. Fisheries Management

The fisheries management report evaluated 2004 survey data and compared that data to the historical averages for the lake. Generally, considering observed fluctuations in certain fish populations, the 2004 survey data did not vary from the historical averages. The overall fisheries management objective for Highland Silver Lake has been to achieve a quality, diversified sport fishery. A record of supplemental fish stocking for Highland Silver Lake was reported along with a listing of the current Sport Fish Regulations that are in effect. The fish stocking summary for Highland Silver Lake is provided in Table 29.

Table 29 - Historical Fish Stocking Data

Date	Species	Number	Size
August-94	Saugeye (Walleye x Sauger)	7,944	4"
1995-1998	None	0	NA
June-99	Saugeye (Walleye x Sauger)	17,800	2"
June-00	Sauger	13,790	1.8"
May-01	Sauger	14,430	1.5"
June-02	Sauger	12,900	1.75"
June-03	Sauger	6,737	2"
August-04	Largemouth Bass	9,350	4"
June-04	Sauger	6,483	1.9"

Source: IL DNR, 2005

The current sport fish regulations in effect for Highland Silver Lake continue to be maintained in order to assist in achieving IL DNR management goals and to ensure a more balanced fishery. Table 30 provides a listing of the current regulations, as set forth by the Illinois Department of Natural Resources (IL DNR). The current sport fishing regulations are intended to improve the quality of large mouth bass, channel catfish, sauger, walleye, and saugeye (sauger x walleye hybrid) fishing within the lake.

Table 30 – Current Sport Fishing Regulations in Effect

Species	Regulation
All Fish	2 Pole Limit and Line Fishing Only
Channel Catfish	6 Fish Daily Creel Limit
Sauger	14" Minimum Length
Walleye	14" Minimum Length
Saugeye (Walleye x Sauger)	14" Minimum Length

Source: IDNR, 2005

3. Aquatic Vegetation

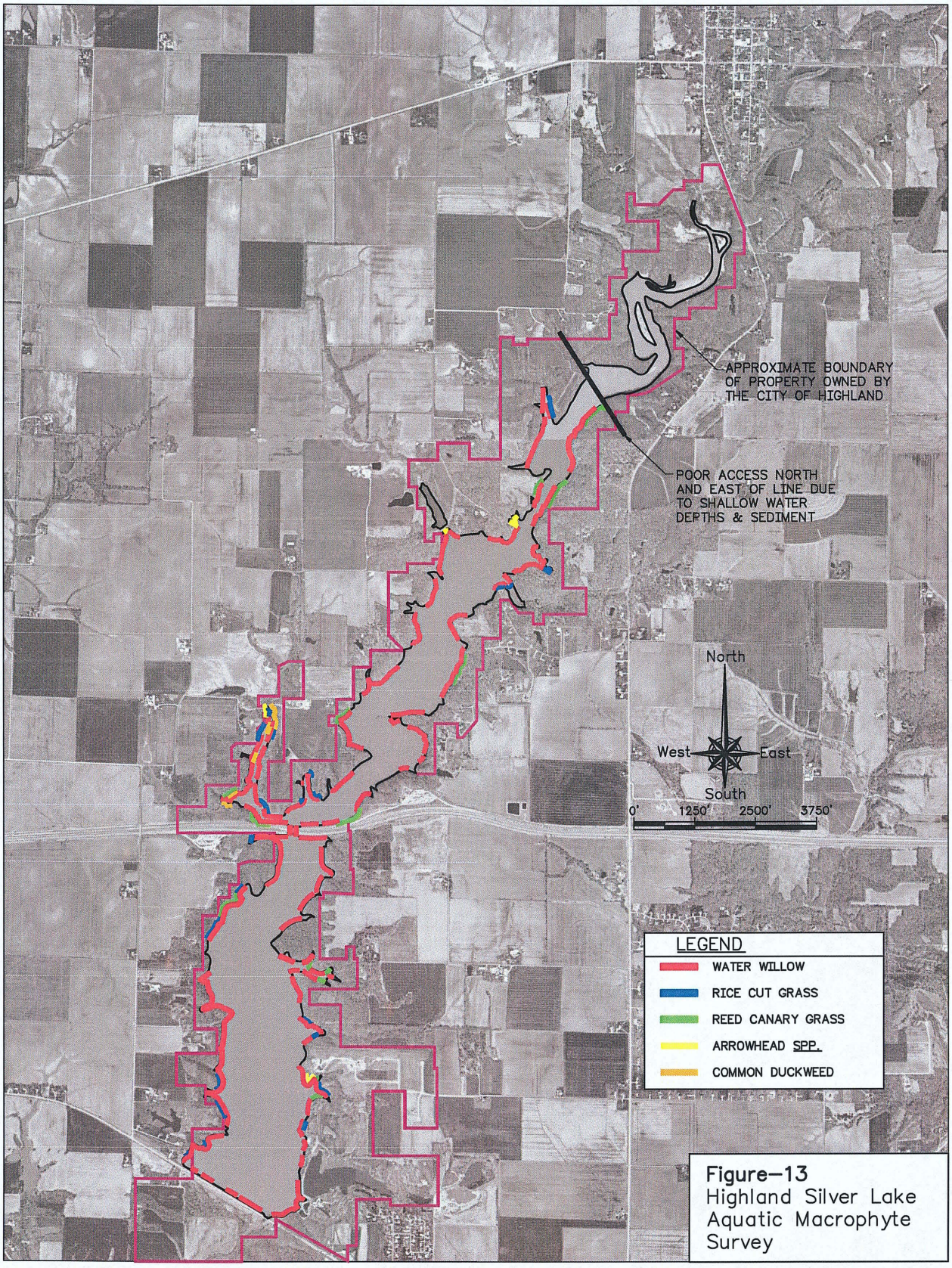
In July 2005, Cochran & Wilken, Inc. reconfirmed a 2004 aquatic macrophyte survey completed by Heartland Ecosystem Services. Due to the turbid conditions of the lake, the aquatic plant survey focused on species encountered along the shoreline. Aquatic plant species encountered were identified and then marked with the

approximate site locations on aerial photographs. Approximate sampling locations for Highland Silver Lake were plotted utilizing AutoCAD Map software (see Figure 13).

A total of five (5) aquatic macrophyte species (4 emergent and 1 floating) were identified during the plant survey in Highland Silver Lake (Table 31). Sample sites had water depth ranges from 0.5 to 2.5 feet. Results for the aquatic macrophyte survey for Highland Silver Lake were evaluated by the number of times a particular species was encountered over the total number of sample sites. Generally, water willow (*Decodon verticillatus*) was the most abundant species encountered.

Table 31 – Aquatic Macrophyte Species Encountered

Common Name	Scientififc Name	Type	Status
Water Willow	*Decodon verticillatus*	Emergent	Native
Rice Cut Grass	*Leersia Oryzoides*	Emergent	Native
Reed Canary Grass	*Phalaria arundinacea*	Emergent	Native
Arrowhead	*Sagittaria spp.*	Emergent	Native
Common Duckweed	*Lemna minor*	Floating	Native



Figure–13
Highland Silver Lake
Aquatic Macrophyte
Survey

Part 2

Feasibility Study of Highland Silver Lake

Highland, Madison County, Illinois

INTRODUCTION

Pursuant to the information collected and the observations made in the Diagnostic Study (Part 1) of this Report, a Feasibility Study (Part 2) was undertaken to investigate potential alternatives for restoring the water quality and enhancing the recreational and aesthetic qualities of Highland Silver Lake. A management plan was also developed within the Feasibility Study for consideration as a Phase 2 Clean Lakes Program implementation project. The Illinois Environmental Protection Agency (Illinois EPA) funded 60 percent of the Part 2 Feasibility Study under the Illinois Clean Lakes Program (ICLP), with the remaining 40 percent of funding contributed by the City of Highland. The Illinois EPA was also responsible for grant administration and program management. HDR | CWI completed the Feasibility Study, with assistance from the Illinois Department of Natural Resources, and the Illinois EPA.

A. Identification of Water Quality and Use Impairment Problems

The following discussion is a summary of the water quality and use impairment problems in Highland Silver Lake that were identified in the Diagnostic Section (Part 1) of this report.

1. Sedimentation and Shallow Water Depths

Excessive sedimentation can negatively impact any lake that serves as a public water supply or is used for recreational purposes, as there is the possibility of burying intake structures, reducing the lake's original water storage capacity, contributing to shallow water depths, and impacting habitat. Reservoir sedimentation is a natural process that can be accelerated or slowed by human activities in the watershed. In most cases, agricultural and development activities in the watershed increase sediment delivery to the lake due to increased exposure of the soil material to erosive forces.

The sedimentation of Highland Silver Lake has been well documented in sedimentation surveys completed by the Illinois State Water Survey (ISWS) in 1981, 1984, and 1999. The results of the 1999 ISWS survey were used to estimate the amount of accumulated sediment that had been deposited annually within the lake between the 1999 survey and the Phase 1 monitoring period in 2005. An estimated 2,619,079 cubic yards of sediment have been deposited throughout the lake between 1962 and 2005. For the entire lake, this volume of accumulated sediment represents an approximate 22.2 percent water storage capacity loss for the entire lake over the 43-year period. Most of the accumulated sediment is located throughout the upper end of the lake (i.e., above the Interstate-70 Bridge).

Accumulated sediments are generated from erosion within the watershed, as well as from the decomposition of dead and decaying algae and macrophytes within the lake. By their origin, these sediments are high in organic content and are nutrient rich, which create a loosely compacted substrate over the bottom of the lake. This loose, low density bottom sediment can be resuspended by bottom feeding fish, high wind conditions, boat turbulence, and storm inflows. As a result, the water quality in Highland

Silver Lake has been impacted by elevated suspended solids levels and decreased water transparencies. Removal of these excessive accumulated sediments, particularly in the shallow upper end of the lake, would improve in-lake water quality. This would be accomplished by removing an extensive internal nutrient (i.e., phosphorus and nitrogen) source that currently contributes to the lake's turbidity through sediment resuspension and by stimulating the in-lake algal population. These existing water quality conditions can cause taste and odor issues, which impact and complicate water treatment requirements. Sediment removal would also restore more desirable lake bottom conditions in the upper end of the lake that would enhance fish spawning habitat and improve trapping capability for future sediment and nutrients delivered to the lake. Figure 7 in Part 1 provides a map that illustrates the locations of the sedimentation survey transects and lake segments that were completed in 1999 by ISWS.

2. Turbid Water

As noted previously in the Diagnostic Study portion of this report, turbidity or murkiness is created primarily by the presence of suspended solids such as soil particles, resuspended bottom sediments, and both living and dead plant/animal matter. During the lake's primary recreational use period from April through September, water clarity, as measured by Secchi disk transparency, averaged 21.1-inches at Site 1, 12.5-inches at Site 2, and 8.3-inches at Site 3 in 2005. The aesthetics of the lake are reduced by the brown, green and/or murky water appearance. Increased turbidity can also inhibit the growth of aquatic vegetation by limiting light penetration into the water column. The 2005 aquatic macrophyte survey for Highland Silver Lake indicated that the population of rooted, aquatic vegetation was degraded and dominated by emergent vegetation.

The factors that have contributed to the turbidity of Highland Silver Lake's water include runoff from a primarily agricultural watershed, the presence of nitric or sodic soils in the watershed, excessive phytoplankton growth (particularly blue-green algae), shoreline erosion, and permitting livestock to have access to the lake. These factors will be examined in the following paragraphs.

Typically, a lake's condition or status is reflected by its watershed. The watershed for Highland Silver Lake is highly agricultural (i.e., approximately 83%). Compared to other land use types with the watershed, agricultural fields tend to erode more easily due to their increased exposure to the elements. This increased exposure often translates into agricultural fields having higher sediment gross erosion rates and subsequent higher sediment and nutrient delivery ratios than other land use types. These higher sediment and nutrient delivery rates impact the lake and its water quality.

Many of the soils within the Highland Silver Lake watershed contain high levels of sodium and are classified as being sodic or natric. Natric (sodic) soils are characterized as being comprised of heavy clays, where much of the chlorine (Cl^-) ions have been leached or washed away, leaving sodium (Na^+) ions. The sodium ions bind to the electro-negative clay particles in the soil and prevent them from binding together when wet. Lack of binding between the clay particles leads to unstable soil, which may erode or become impermeable to both water and roots (Science.org, 2005). This phenomenon also allows sediment to remain in suspension, which increases lake turbidity. Within the Highland Silver Lake watershed, nitric (sodic) soils are generally caused by the presence of feldspar (a sodium rich mineral) within naturally occurring loess deposits. As the water table rises though the soil profile, the soils become eroded and sodium ions (Na^+) are released. A soil scientist for the Madison County Soil and Water Conservation District estimates that between 25 and 40 percent of the soil (approximately 7,675 to 12,275 acres) within the Highland Silver Lake is nitric or sodic (Berning, 2005 personal conversation).

The analyses of historical and Phase 1 phytoplankton data indicated high counts of algae in the water column, which increases overall lake turbidity. Among the in-lake monitoring sites sampled within Highland Silver Lake (i.e., Site 1 and Site 3), the standing crops ranged from a low of 4,637 to a high of 15,879 algal units per milliliter, and the predominant algae present was the nuisance, blue-green species (particularly *Gomphosphaeria lacustris*, *Anacystis montana*, and *Anabaena spiroides*). During the months of July and August, blue-green algae accounted for 81.5 and 70.5 percent of the total algal population for all the in-lake sample sites, thus exhibiting species dominance. The blue-greens are considered especially undesirable with regards to aesthetics

because of their tendency to form as scum and mats, and are not a desirable food source for most aquatic organisms (i.e., zooplankton and small fish). In addition, blue-greens can become toxic and can cause taste and odor problems, which can complicate water treatment and impact the public water supply.

Shoreline erosion has also contributed sediment and nutrient loadings to the lake, which has increased the amount of turbidity and has degraded water quality. Fine-grained particles (i.e., silt and clay) can remain suspended in the water column for extended periods of time and resuspended sediments may also release nutrients into the water column, thereby contributing to increased turbidity and algal growth. Sediment resuspension and turbidity resulting from wind and wave action in shallow, near-shore areas was evident and has reduced the aesthetic quality of Highland Silver Lake.

Allowing livestock to have direct access to Highland Silver Lake degrades water quality and complicates water treatment for the public water supply. Livestock waste byproducts present significant solids, nutrient, and bacterial loads that impair lake water quality, not to mention impact lake aesthetics. Allowing livestock to have direct lake access also increases lake turbidity though increased algal growth (stimulated by livestock wastes) and shoreline erosion.

3. Shoreline Erosion

In 2005, HDR | CWI re-confirmed a 2004 shoreline erosion survey that was completed by Heartland Ecological Services. The shoreline surveys evaluated the extent of shoreline erosion that has occurred within the Highland Silver Lake in order to determine the extent of its contribution to water quality and lake degradation. Shoreline erosion impairs lake usage and access by increasing lake turbidity, decreasing lake storage capacity, and by damaging valuable lakeshore property. The loss of shoreline soils may also jeopardize the stability of infrastructure, such as bridges, roads, and docks.

As discussed in Part 1, the shoreline survey was completed using the three-category classification scheme developed by Illinois EPA. The methodologies used

during the survey rated erosion severity by vertical measurements of the eroded zones. An estimate was made to determine the location and horizontal length of each eroded zone and a vertical measurement was recorded and applied to the following criteria: a bank height of 1.0 to 3.0 ft. was classified as slight, greater than 3.0 ft. and less than 8.0 ft. was classified as moderate, and greater than 8 ft. was classified as severe.

The shoreline erosion survey determined that approximately one-third of the total lake shoreline or approximately 9,602 meters (31,501 ft.) had experienced some degree of erosion. The extent of the shoreline erosion within Highland Silver Lake varied from slight to severe. The majority of the moderately and severely eroded shoreline areas occurred primarily within the main body (i.e., south of Interstate-70). These shorelines are more susceptible to erosion as they are exposed to the longest fetch distances where the highest waves typically occur. Approximately 314 meters (1,030 ft.) of shoreline was found to have severe erosion, 2,982 meters (9,784 ft.) exhibited moderate erosion, and 6,305 meters (20,687 ft.) of shoreline was found to have slight erosion. According to the 2005 shoreline erosion survey, approximately 33.4% of the 28.73 km (17.85 miles) shoreline was unprotected and has been negatively impacted by erosion.

Shoreline erosion can be caused by the following activities or actions: wind and wave action, pedestrian and livestock traffic, water level drawdowns, and a lack of near-shore vegetation. The general absence of near-shore vegetation or offshore rocks allows wind induced wave energy to reach and erode unprotected soils. Figure 9 in Part 1 illustrates the 2005 shoreline erosion survey for Highland Silver Lake.

4. Unbalanced Aquatic Vegetation Community

The aquatic plant community within Highland Silver Lake includes aquatic macrophytes (i.e., plants visible and identifiable to the naked eye) and phytoplankton (i.e., algae). Both are an extremely important component of a balanced lake ecosystem. Algae are plants that are typically microscopic in size and can either be free-floating or attached. Although individual algae are microscopic in size, they are often visible when large numbers are present due to their green or blue-green color.

The free-floating algae or phytoplankton are most commonly found in eutrophic reservoirs, such as Highland Silver Lake. Algae can provide food for aquatic insects, zooplankton, and fish. In addition, algae also provide oxygen, which is beneficial to all organisms. However, an overabundance of phytoplankton (algae) can result in adverse effects such as: increasing overall lake turbidity; shading out and limiting the growth of submergent macrophytes; algal blooms and surface scums that detract from lake aesthetics; night time algal respiration and/or rapid algal die-offs that can deplete dissolved oxygen levels and severely stress the fish population.

Algal growth is stimulated by high concentrations of nutrients in the water column. Measurements of inorganic phosphorus and inorganic nitrogen obtained during the Phase 1 monitoring period did not fall below the levels known to contribute to nuisance algal growth, (0.01 mg/l for inorganic phosphorus and 0.30 mg/l for inorganic nitrogen (Sawyer, 1952)), which suggests that algal blooms are often problematic within Highland Silver Lake. The Phase 1 data shows that the algal population was excessive during the 2004-05 monitoring year, reaching bloom conditions throughout the summer. When bloom conditions occur, the increased turbidity reduces light penetration throughout the water column that adversely impacts macrophyte growth.

The sources of Highland Silver Lake's high in-lake nutrient concentrations include inflows from the agricultural watershed runoff, resuspension of sediment, internal regeneration from anoxic lake bottom sediments, both living and dead plant/animal matter within the lake, stream bank and shoreline erosion, livestock waste byproducts, and atmospheric deposition. The phosphorus and nitrogen nutrient budgets that were developed from data obtained during the 2004-05 monitoring year indicate that watershed runoff provided the majority of the phosphorus and nitrogen influx to the lake. Internal regeneration was estimated to have contributed to some of the total phosphorus and nitrogen influx. This was primarily due to the periodic circulation or mixed conditions that result from prevailing winds and high flow conditions within the relatively shallow riverine reservoir system. Wind and flow induced circulation aids in-lake aeration and helps limit the presence of anoxic conditions and nutrient releases from lake-bottom sediments.

The 2005-aquatic plant survey for Highland Silver Lake identified several native emergent (above the water) macrophyte species within the littoral zones (shoreline) of the lake. Water willow (*Decodon verticillatus*) was found to be most abundant throughout the lake, inhabiting shallow waters generally less than 2 feet deep. No submerged (underwater) species were encountered during the aquatic plant survey. Turbidity along the littoral zones is the primary reason for the sparse and limited aquatic macrophyte population densities within Highland Silver Lake. Sporadic aquatic plant populations could secondarily be attributed to high nutrient levels that contribute to phytoplankton dominance.

5. Enhance Fishery and Aquatic Community

Given the lake's impaired water clarity, Highland Silver Lake is considered to have a fair to good fishery (Cronin personal communication, 2005). Ongoing fisheries management efforts have included a regular supplemental stocking program and the enforcement of sport fishing regulations with an emphasis on catch and release, length restrictions, and creel limits. Historically, the Illinois Department of Natural Resources (IL DNR) has stocked the following species into the lake: saugeye (walleye x sauger hybrid), sauger, and largemouth bass.

Recent population and creel census surveys completed by IL DNR fisheries biologists indicate that fish populations in Highland Silver Lake are generally stable for species such as largemouth bass, channel catfish, and carp; however, some of the fisheries management objectives are not being met for other species, such as bluegill and gizzard shad. In fish population surveys completed in 2002 and 2004, the bluegill population within Highland Silver Lake was poor with few fish greater than 7-inches being counted. Conversely forty-two percent of the gizzard shad surveyed were greater than eight-inches in length. In 2004, only nineteen percent of the shad surveyed were less than four-inches in length (i.e., a size suitable for forage). This data suggests that the gizzard shad population contains a disproportionate number of large fish, which are of little benefit other than to reproduce and further increase the shad population. The

gizzard shad population may be stunting the bluegill population through competition for food resources (Cronin personal communication, 2005).

The current habitat conditions of Highland Silver Lake (i.e., excessive sedimentation) combined with its life history may give gizzard shad an advantage over other more desirable sport fish in the lake. Gizzard shad are known to thrive in soft mud bottom reservoirs, such as Highland Silver Lake. Dense shad populations typically provide considerable forage as young for other predatory sport fishes, and their schooling behavior during the first year make them easy prey for larger fish. However, there is some controversy that surrounds their forage value, as shad can quickly outgrow the vulnerable forage size (i.e., able to reach four to six inches within the first year). As this occurs, the shad rapidly approach and attain nuisance levels in water bodies where predator populations are insufficient to control their numbers (MD DNR, on-line, 2006, and Wisener, 2005, and PFBC, 2000). Recent biennial IL DNR fisheries reports seem to reflect this trend.

Gizzard shad also have reproductive advantages, because eggs and sperm are broadcast or dispersed across the water's surface. The fertilized shad eggs sink to the bottom where they adhere to submerged objects. Conversely, more desirable sport fish, such as bluegill and largemouth bass, construct nests for spawning (PFBC, 2000 and MD DNR, on-line, 2006). Degraded lake water quality conditions (i.e., excessive turbidity) and a lack of suitable aquatic and spawning habitat (i.e., accumulated silt in the upper end of the lake) have stressed the existing sport fish population.

With improvements to lake water quality, clarity, and habitat, Highland Silver Lake can achieve an improved fish population.

B. OBJECTIVES OF THE LAKE MANAGEMENT PLAN

The goal of the lake management plan for Highland Silver Lake is to address the problems identified in the previous section, to protect and enhance existing lake uses, to increase recreational access and opportunities, and to improve the overall water quality. The lake management plan objectives that have been determined are as follows:

1. Reduce the amount of sediment, nutrients, and fecal bacteria being delivered to the lake.
2. Remove accumulated sediment that has caused shallow water depths in the upper end of the lake.
3. Improve water quality for aesthetics and to support a more balanced aquatic plant community.
4. Stabilize and protect eroded shoreline areas.
5. Enhance fisheries population and habitat for improved recreation.
6. Distribute educational brochure and implement programs to enhance the public's knowledge of lake and watershed ecosystems.

The following recreational use improvements will be achieved by addressing the comprehensive water quality objectives listed above.

1. Preserve and enhance existing lake uses: public water supply, fishing, boating, and aesthetics.
2. Increase local interest by increasing water clarity and improving water quality.
3. Increase areas available for recreational uses by maintaining and/or increasing the depth in the upper reaches of the lake.
4. Increase the sport fish populations in the lake by improving habitat, combined with continued stocking and fisheries management.

C. Alternatives for Achieving the Lake Management Plan Objectives

Each of the lake management plan objectives listed above has several alternative approaches or solutions that have been considered. These restoration and protection alternatives are described below with a summary of which would be most feasible for Highland Silver Lake. For most of the objectives, there are one or more restoration alternatives that clearly stand out relative to cost, benefits, and feasibility. Although taking no action whatsoever is also an alternative, the long-term cost of no action is often too high. Delaying any necessary actions could lead to more expensive projects at a later date as a result of continued lake degradation and lake eutrophication.

Objective #1: Reduce the amount of sediment, nutrients, and fecal bacteria being delivered to the lake.

Alternative Actions

Watershed Best Management Practices

The Madison County Soil and Water Conservation District (SWCD) and Natural Resources Conservation Service (NRCS) have estimated that the average slope within the watershed is approximately 3.5 percent. It is important to note that these slopes tend to increase as they approach the lake, making steeper slopes more susceptible to erosion. Table 32 and Figure 14 illustrate the varying land slopes within the Highland Silver Lake watershed.

Table 32 – Land Slopes within Watershed

Slope	Percentage	Acres
0-2%	49	15,037
2-5%	33	10,127
5-10%	11	3,376
10-15%	4	1,228
15-20%	3	921
Total	100	30,688

Source: Madison County Soil and Water Conservation District, 1979

The Madison County SWCD and NRCS have extensive knowledge of the Highland Silver Lake watershed. The predominant land cover within the watershed is a consistent agricultural rotation of corn, soybeans, and with lesser amounts of winter wheat and other small grains. Due to the flat topography, the majority of the farmland within the watershed continues to be conventionally tilled (i.e., 0 to 10 percent residue left on the fields) (Madison Co. NRCS, 2005). Limited areas within the watershed use conservation tillage practices - mulch till (i.e., 30 percent residue) and no till (i.e., 50 percent residue). The soil conservation tillage practices were generally only found in steeper sloping and highly erodable areas (NRCS personnel communication, 2005 and Limno-Tech, 2004). The Madison County District Conservationist also reported that few areas within the Highland Silver Lake watershed have participated in the Conservation Reserve Program (CRP) (Limno-Tech, 2004). The NRCS and SWCD have played an important role in the development and implementation of the many wet ponds, grassed waterways, and riparian buffer strips within the Highland Silver Lake watershed. To ensure that present and future watershed best management practices are implemented, continued cooperation and coordination with the NRCS and SWCD is strongly recommended.

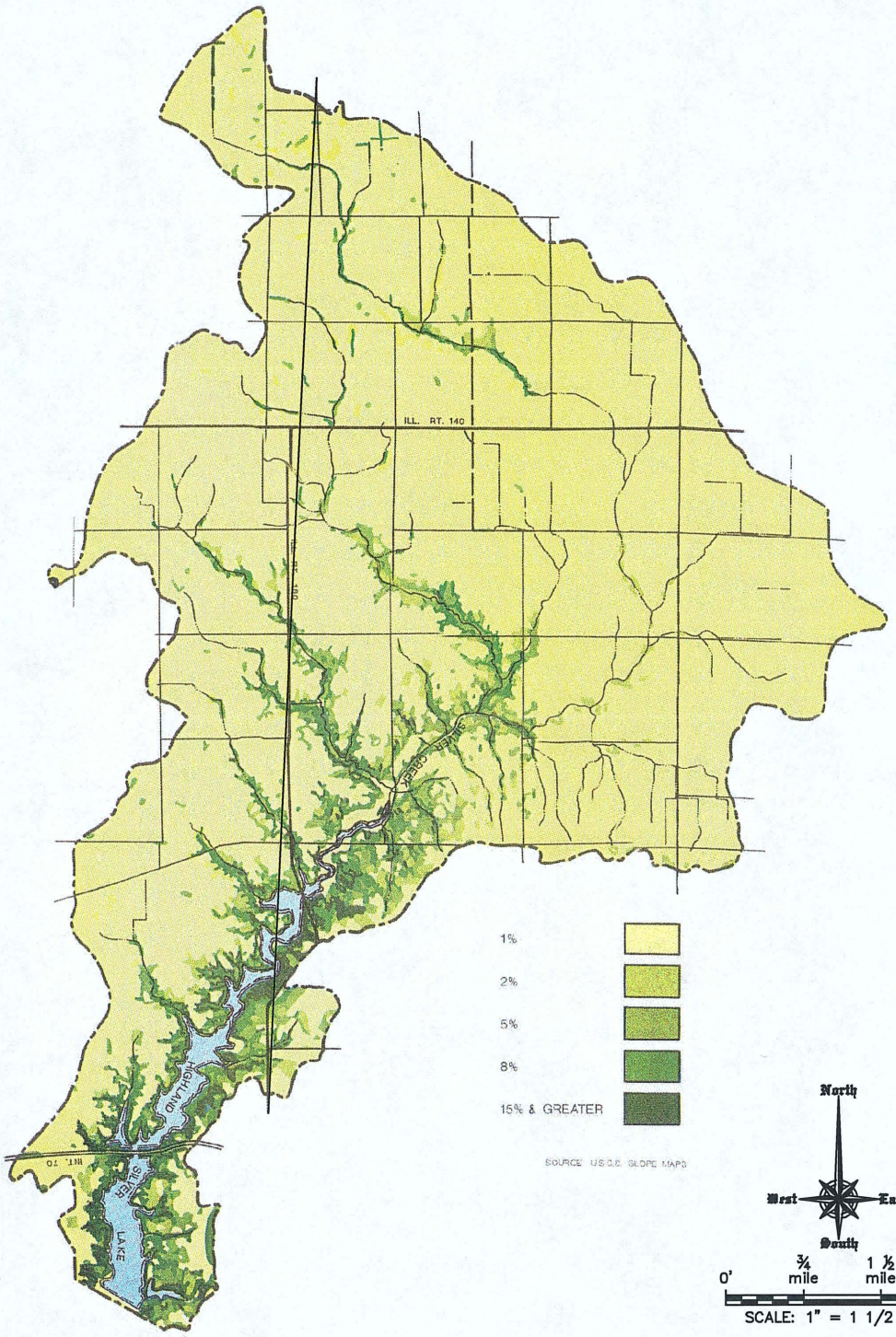
When used in conjunction with conservation tillage, agricultural best management practices (BMP's) (i.e., filter strips, grassed waterways, gully stabilization, sedimentation basins, and stream bank stabilization) have been found to be very effective at reducing sediment and nutrient yields to waterways (i.e., Silver Creek and Highland Silver Lake).

Filter strips are typically a strip of native grasses, trees, and shrubs that border a stream. They act to slow water flow and allow sediment, fertilizers, and pesticides to collect in the vegetated buffer zone. The trapped nutrients are utilized by the vegetation, and cleaner filtered water is allowed to enter the stream and lake. According to the "Lake and Reservoir Restoration Guidance Manual" (USEPA, 1990), properly installed and maintained filter strips or stream side buffer zones are capable of filtering or trapping from 67 to 84 percent of sediment and nutrients from sheet runoff on

four percent slopes. The NRCS has found that the optimum width for most installations is approximately 66 feet on both sides of the stream.

Grassed waterways can be very effective at preventing gully erosion. They force storm water runoff to flow down the center of an established grass strip, while minimizing soil erosion during the process. Besides preventing gully erosion, grass waterways can be effective filters that trap sediment and nutrients. However, they can lose their effectiveness if too much sediment builds up in the waterway. In order to maintain optimal effectiveness, they should be implemented with other practices such as conservation tillage and filter strips.

In addition to the watershed BMP's described above, there are other watershed alternatives that can be considered. Stream bank stabilization, gully stabilization, and sediment and nutrient control basins are restoration projects that will reduce soil erosion within the watershed and will contain eroded sediments and nutrients, which will reduce lake sedimentation and nutrient loading. These alternatives have a wide array of applications from major projects constructed on a main tributary or across a narrow section of the upper end of the lake to many smaller projects that could be implemented across smaller tributaries located in the upper reaches of the watershed.



Source: Madison Co. NRCS, 1979

Figure–14
Land Slopes within
Highland Silver Lake
Watershed

Stream Bank Erosion

Potentially eroded stream bank sites along Silver Creek (located south of Pocahontas Road and north of Route 160) were identified via USGS topographic maps, aerial photography, and City of Highland representatives. Most of the eroded banks within this stretch of Silver Creek were field confirmed and were found to have eroded bank heights that averaged 3 feet high. One eroded stream bank site - located near Grant Fork – contained a small section that had bank heights in excess of 10 feet. However, lateral recession rates at that location appeared to be minimal. None of the observed stream bank sites appeared to exhibit severe undercutting. While some stream bank erosion was noted in the field, it was not as extreme as initially anticipated.

Natric (Sodic) Soils in Watershed

The presence of natric (sodic) soils within the Highland Silver Lake watershed has had negative impacts. As stated in Part 1, excess sodium ions (Na^+) in sodic soils adsorb onto negatively charged soil (clay particles) through a process called cation ion exchange. The binding of Na^+ ions to negatively charged soil particles causes soil aggregates to disperse, which can clog soil pores and can render the soil impermeable to water, which causes fine colloidal soil particles to remain suspended in water or remain in suspension within the lake's water column. This process decreases water clarity and increases lake turbidity. In addition to lake impacts, sodic soils also have adverse impacts for agriculture. Other agricultural symptoms of sodic soils include less plant available water and poor soil tilth.

Sodic soils can be rehabilitated through reclamation. Typically, sodic soils are treated by replacing sodium ions (Na^+) with calcium ions (Ca^{2+}) from a soluble source. Since Ca^{2+} has a stronger charge than Na^+, it replaces Na^+ on exchange sites located on soil particles. This causes Na^+ to be released to the soil solution and makes it susceptible to removal via leaching. Several amendments (containing calcium) can be used to correct sodicity, including: gypsum ($CaSO_4$ $2H_2O$), lime ($CaCO_3$), calcium chloride ($CaCl_2$), elemental sulfur (S), and sulfuric acid materials (H_2SO_4).

The most common and economical amendment used on sodic soils is gypsum (McCauley and Jones, 2005 and Lamond and Whitney, 1992). Gypsum can be applied in a dry form or within irrigation water. It is slow reacting but will react in the soil over a long period of time. Fine gypsum (i.e., passing through a 60-mesh screen) should be used to maximize reactivity and effectiveness (McCauley and Jones, 2005). For these amendments to be effective, sodium-free water needs to be applied to leach Na^+ that is pushed off the exchange site by Ca^{2+} (J.G. Davis et al., 2004). Generally, gypsum is applied in the fall or early winter but can be applied at any time of the year and still be effective. Purity of gypsum is another consideration, as the product can vary from crude gypsum mined from open pits (i.e., 30 to 70 percent pure) to more refined gypsum product (nearly 100 percent pure). It is important to consider the level of purity when determining an application rate.

Generally for sodic soils, the Madison County Soil and Water Conservation District recommends applying 10 tons (20,000 lbs) of gypsum per acre (Berning, personal conversation, 2005). Approximately 76,750 to 122,750 tons of gypsum would be required to treat the estimated 7,675 to 12,275 acres within the watershed that are estimated to have sodic soils. The cost of gypsum, transportation, and application is approximately $50 to $70 per ton. Consequently, applying these quantities of gypsum to sodic soils within the Highland Silver Lake watershed may be cost prohibitive.

Restrict Livestock Lake Access

In addition to the sodic soils, livestock are also present within the watershed, and in some cases, livestock have direct access to the lake. Allowing livestock direct access to Highland Silver Lake, which is the source of the public water supply, is not a sound environmental lake management practice. It compromises lake water quality and degrades the public water supply. Through their by-products of metabolism, the livestock contribute directly to the sediment, nutrient, and fecal bacterial loading to Highland Silver Lake. The by-products can complicate and increase costs of water treatment, as the regulations and subsequent testing for surface water treatment plants are generally becoming more restrictive (Wittenborn personal communication, 2005). As this trend continues, more chemicals and water treatment procedures will be

required to comply with the new and future water treatment requirements. These water treatment practices will be increasingly difficult to comply with given that livestock currently have direct access to the lake. Appendix F contains the annual chemical costs for the Highland Water Treatment Plant from 2004-05, 2005-06, and the projected costs for 2006-07 (Wittenborn, 2006).

The University of California, Cooperative Extension has compiled several reports on waste loading into water bodies from livestock. On the average, a 1,000 lb. beef cow is capable of producing the following waste by-products (Johnstone-Wallace and Kennedy, 1944, Moore and Willrich, 1982, and Moore et al, 1988):

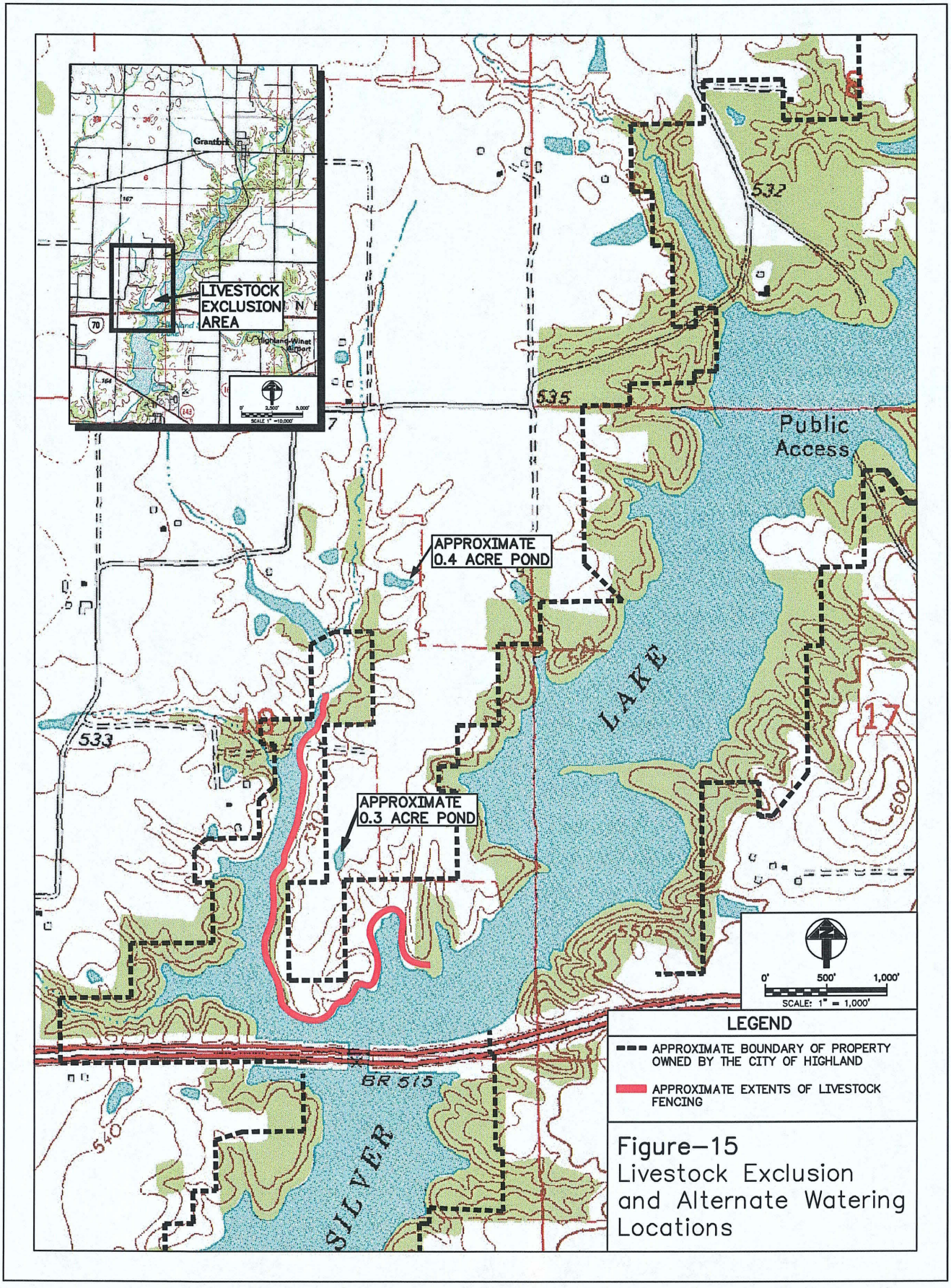
- 12 defecations per day;
- 60 lbs. Manure per day (88% water);
- 5 lbs. Manure per defecation (88% water);
- 0.34 lb. Nitrogen per day;
- 0.11 lb. Phosphorus per day;
- 0.24 lb. Potassium per day;
- 3.84×10^{10} fecal coliform bacteria per day; and
- 7.2×10^{8} fecal streptococci bacteria per day.

The University of California, Cooperative Extensive (2005) showed that any practice that reduces the amount of time cattle spend in a stream or lake will reduce manure loading and decrease the potential for adverse affects of water pollution from grazing livestock. Moore et al. (1993) found that providing an alternate drinking source can reduce in-stream and in-lake fecal deposition.

To help preserve and protect the public water supply and the lake, livestock should not be allowed direct access to Highland Silver Lake, and some form of exclusion system (i.e., fencing) should be installed (see Figure 15). Obtaining property easements required to install the livestock exclusion system should be a non-issue, as the City of Highland owns the land where livestock currently have direct access to the lake. Electric fencing and wire mesh fencing have been identified as potential livestock exclusion alternatives. The first option, electric fencing, could be installed quickly; however, the integrity and durability of this option appears to be more suited as a short-

term solution rather than a long-term solution. Wire mesh fencing would provide a permanent and more reliable solution to keep livestock out of the lake.

Figure 15 also illustrates several existing ponds (approximately 0.3 and 0.4 acres each), where livestock currently have access to water. With these existing ponds, it does not appear as if a new watering facility is warranted. These potential livestock watering locations should be evaluated, and if necessary, improved to accommodate the existing head of cattle in the area. These activities would help protect the lake and the public water supply by removing a direct source of solids, nutrient, and bacterial loading.



Figure–15
Livestock Exclusion and Alternate Watering Locations

In-Lake Sediment and Nutrient Control Basin

A sediment and nutrient control basin, consisting of either a free floating sediment control boom or curtain or a low-head dam structure, could be constructed to reduce flow velocities and allow sediment to be deposited within the upper end of the lake. The exact positioning and location of the structure would be determined in the design phase of the project through further hydraulic and engineering design studies. Since an in-lake structure would temporarily increase the upstream lake elevation by several feet, the final design would minimize the maximum water surface elevation so as to reduce flooding potential and impacts to properties and structures. Low flows would pass through the structure, potentially through a concrete culvert or an opening within the dam structure, which could allow small boat to pass upstream. Larger flows would be temporarily impounded behind the dam allowing sediment and nutrients to be deposited and retained. Three potential sediment and nutrient control basin structure locations are illustrated in Figure 16.

- Option 1 (approximate 250 ft. structure width) – least sediment and nutrient trapping capability with greatest lake access;
- Option 2 (approximate 500 ft. structure width) – more sediment and nutrient trapping capability with more lake access; and
- Option 3 (approximate 400 ft. structure width) - most sediment and nutrient trapping capability with least amount of lake access.

Removing accumulated sediment within the lake (see Objective #2) is strongly recommended and a prerequisite in order to further increase the effectiveness, longevity, and trapping capability of any nutrient and sediment control basin project. The potential sediment control basin (i.e. Options 1 through 3) are located within lake segments 14 and 15 (see Figure 7 and Table 19 from Part 1) from the 1999 ISWS sedimentation survey. These respective lake segments have lost an estimated 70.7 and 65.3 percent of their original-1962 water storage capacity to accumulated sediment.

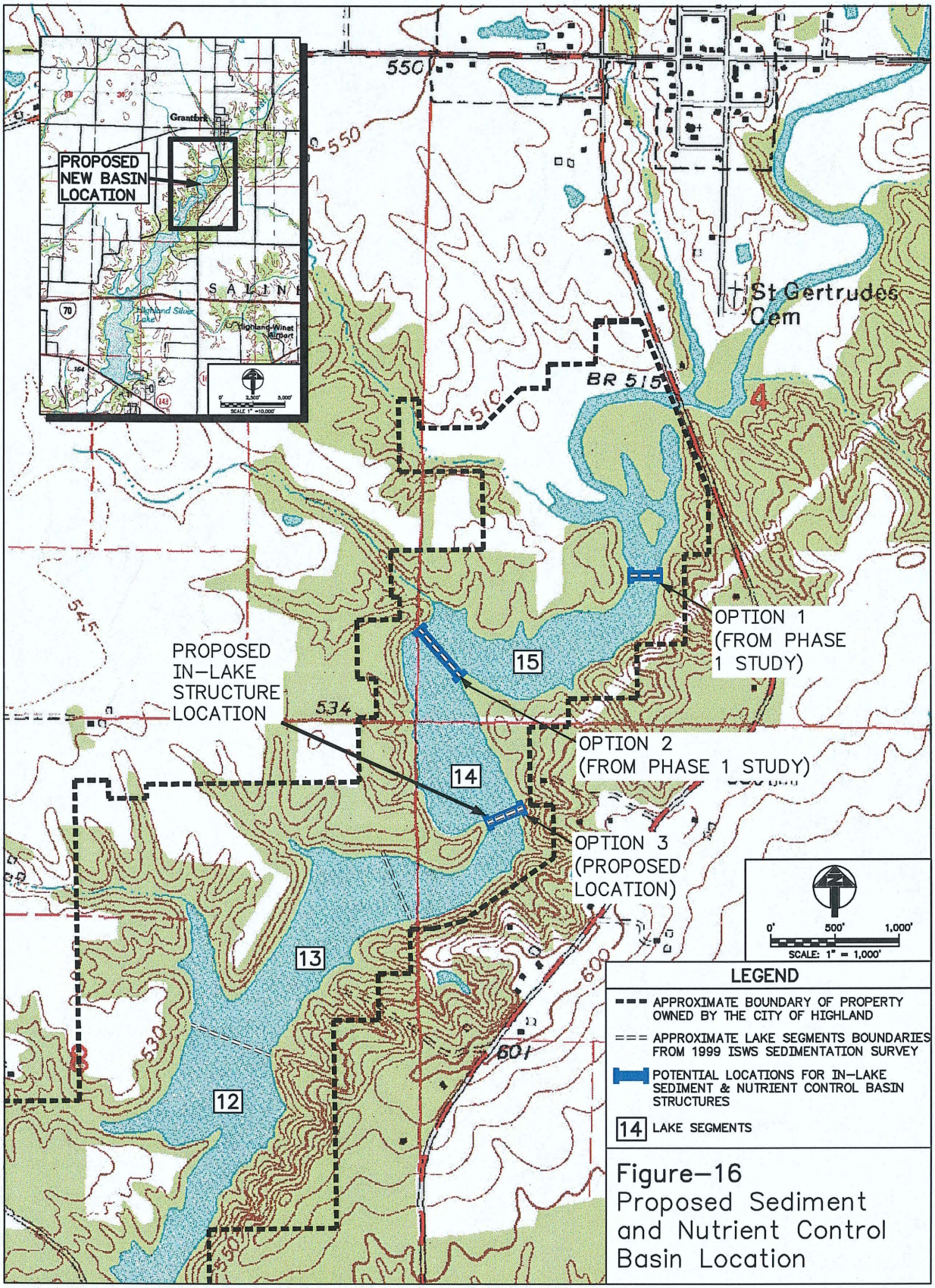


Figure-16
Proposed Sediment and Nutrient Control Basin Location

Proposed Actions

It is recommended that the City of Highland coordinate with NRCS and SWCD in Madison and Bond Counties to continue working with local land owners to promote and implement the following best management practices (BMP's) within the Highland Silver Lake watershed: terraces, conservation tillage, vegetated buffer strips, water and sediment control basins, grass waterways, and stream bank stabilization. In addition to BMP's, public information and education programs should be coordinated through the local NRCS and SWCD offices. These components are a vital component in connecting with landowners and farm operators to increase public awareness of resource management systems that reduce soil erosion within the watershed and in turn can improve the water quality of Highland Silver Lake. The education and technical assistance would primarily be targeted to watershed residents who have soil, water, plant, and resource problems.

Many of the aforementioned potential BMP projects within the Highland Silver Lake watershed would be located on privately owned lands, which can often create significant obstacles in acquiring land easements that are ultimately required to construct and implement these restoration projects. Therefore, to improve the probability that BMP's can and will be implemented, the proposed projects within this Report are located on land/property owned by the City of Highland. It is important to note that watershed BMP's located on privately owned lands can be achieved and should be pursued. Given their local presence and knowledge, the NRCS and SWCD offices will be critical allies in these endeavors.

In addition to the continued implementation of watershed BMP's and conservation tillage practices, construction of an in-lake sediment and nutrient control basin is suggested within the upper end of Highland Silver Lake. A main-stem basin option would control and trap sediment and nutrients from Silver Creek, which receives greater than 90 percent of the watershed's total drainage area. It would also significantly reduce the loads of sediment and nutrients (particularly phosphorus) that are deposited into Highland Silver Lake.

Table 33 provides opinions of probable cost for a proposed sediment and nutrient control basin project utilizing a low-head dam structure described in Figure 16. Officials for the City of Highland have reported that the local lake commission and the City may be willing to sacrifice the upper portions of the lake for a sediment control basin (Rosen and Wittenborn personal communications, 2006). Therefore, the control basin location outlined in Option 3 is recommended, to provide Highland Silver Lake with the most sediment and nutrient trapping capability. It is important to note that the opinions of costs in Table 33 only include capital construction costs and that operation and maintenance costs (i.e., debris and sediment removal) are not included.

Removing accumulated sediment within the lake (see Objective #2) is strongly recommended and a prerequisite in order to further increase the effectiveness, longevity, and trapping capability of the nutrient and sediment control basin project. The potential sediment control basin (i.e. Options 1 through 3) locations are within lake segments 14 and 15 (see Figure 7 and Table 19 from Part 1) from the 1999 ISWS sedimentation survey. These respective lake segments have lost an estimated 70.7 and 65.3 percent of their original-1962 water storage capacity to accumulated sediment.

Table 33 – Estimated Sediment and Nutrient Control Basin Costs

Option (Approx. Width)	Trapping Effectiveness & Capability	Lake Access Restrictions	Costs	Amounts
Option 1 (~250 Ft.)	Good	Best	Total Construction Costs	$345,000
			20% Design & Construction Engineering Costs	$69,000
			Total Estimate of Probable Cost	**$414,000**
Option 2 (~500 Ft.)	Better	Better	Total Construction Costs	$625,000
			20% Design & Construction Engineering Costs	$125,000
			Total Estimate of Probable Cost	**$750,000**
Option 3 (~400 Ft.)	Best	Good	Total Construction Costs	$525,000
			20% Design & Construction Engineering Costs	$105,000
			Total Estimate of Probable Cost	**$630,000**

In order, to exclude livestock from Highland Silver Lake, approximately 5,000 linear feet a wire-mesh fencing (approximately four-feet high) is suggested (see Figure 15). Improving the existing livestock watering locations, clearing, earthwork, and grading adjacent to existing ponds is also recommended. Table 34 provides the opinions of probable cost to install an exclusion system and to improve the existing pond per dewatering. Coordination of this project should be completed with assistance from NRCS and SWCD.

The City of Highland and the landowners along Highland Silver Lake are encouraged to cooperatively work to together to find and develop solutions that would benefit the landowners, the City of Highland, and the surrounding communities that depend on Highland Silver Lake for a public water supply. After suitable alternatives have been agreed upon for implementation, the City of Highland is also strongly encouraged to amend or develop an ordinance that prohibits livestock from having direct access to the lake.

Table 34 - Estimated Livestock Exclusion & Pond Improvement Costs

	Quantity	Cost per Unit	Estimated Cost
Wire Mesh Fencing w/ Barb Wire	5,000 LF	$4 per LF	$20,000
Drive Gates for Fence	2	$1,250 each	$2,500
Pond Improvements		Lump Sum	$5,000
Total Estimated Cost for Livestock Exclusion & Pond Improvements			$27,500
Estimating Contingency (10%)			$2,750
Opinions of Probable Cost			**$30,250**

Estimated Loading Reductions from Proposed Actions

Loading reductions for the sediment and nutrient control basin were estimated using the 1999 ISWS sedimentation survey results (35,331 cubic yards per year), the mean concentrations for sediment grab samples collected during the Phase 1 period, and the trapping efficiency of a sediment and nutrient basin with a similar design and application. The initial basin trapping efficiency was conservatively estimated at 50 percent. It should be noted that the basin's trapping efficiency will be reduced over time as accumulated material reduces its storage capacity. Table 35 provides the estimated loading reductions for sediment and nutrient control basins outlined in Table 33.

Load reductions achieved via excluding livestock from the lake were livestock waste byproduct estimates from Johnstone-Wallace and Kennedy (1944), Moore and Willrich (1982), Moore et al. (1988), and personal communication from several officials from the City of Highland (2005). Estimated annual loading reductions for solids (dry), phosphorus, and nitrogen are listed in Table 36.

Table 35 – Estimated Loading Reductions for Sediment and Nutrient Control Basin

	Sediment (tons/yr)	Phosphorus (tons/yr)
Sediment & Nutrient Control Basin	11,924.0	6.0

Initial estimated trapping efficiency - 50 percent.
Trapping efficiencies for subsequent years would be reduced as basin storage capacity is diminished.

Table 36 – Estimated Loading Reductions for Livestock Exclusion

	Solids (Dry)	Phosphorus	Nitrogen
Lbs/yr	13,140	289	894
tons/yr	6.57	0.14	0.45
kg/yr	5,960	131	405

Sources: Johnson-Wallace and Kennedy, 1944,
Moore and Willrich, 1982
Moore et al, 1988.
City of Highland, personal communicaiton, 2005.

Objective #2: Remove accumulated sediment that has caused shallow water depths in the upper ends of the lake.

Alternative Actions

The major alternatives for removing sediment accumulation in the upper end of Highland Silver Lake include extended water level drawdown, mechanical dredging, and hydraulic dredging. According to the projected 2005 accumulated sediment volume as discussed in Part 1, an estimated 2,619,079 cubic yards of sediment have been deposited over the 43-year history of the lake (i.e., 1962-2005). This estimated volume of accumulated sediment in 2005 suggests that approximately 60,909 cubic yards of sediment have been deposited on an average annual basis.

The prioritization of dredging areas in the more impacted shallow areas is critical to reducing the total dredging volume, as it provides a more cost-effective alternative to removing all of the accumulated material from the entire lake, particularly in deep water areas. In addition to a reduction in the total dredging volume, implementation of dredging could be completed in phases. The most critical dredging locations include segments #11 through #15 from the sedimentation survey (see Figure 7 in Part 1), where approximately 51.9% of the lake's original storage capacity has been lost in the upper end of the lake. The total estimated sediment volume in these prioritized locations is approximately 751,318 cubic yards.

a. Lake Water Level Drawdown and Compaction

Lowering the water level and allowing the sediment to dry and consolidate is an alternative for restoring lost water depths in some lakes. However, this treatment alternative is generally a limited solution for excessive sediment deposits. In order to assure optimum drying and compaction, the water level would have to be substantially lowered for a sufficient period of time. According to a study completed by Fox et al. (1977), approximately 180 days of exposure to drying conditions would produce a sediment consolidation ranging from 7 to 50 percent, with water losses ranging from 40 to 50 percent. It is anticipated that the sediment found in the upper arms of Highland Silver Lake would fall in the median range, and would thus be expected to consolidate approximately 25 percent.

In order to effectively reduce sediment volume in the upper end of Highland Silver Lake, water levels would have to be lowered significantly, which is not possible, due to the lake's relatively linear lake morphology and hydrologic regime. A drawdown, extended well into the spring or even into the summer months, would be nearly impossible to implement because of the extremely large watershed drainage area from Silver Creek and its tributaries. If it were possible, an extended drawdown may have many negative impacts to the public water supply, aquatic community and would impact the recreational use of the lake.

b. Mechanical Dredging

There are several methods of mechanical dredging or excavation presently available. The lake can either be dredged at normal pool with a dragline, or the water level could be lowered enough to allow low ground pressure excavation equipment into the dry lakebed. There are several advantages to dry lakebed excavation as compared to hydraulic or dragline dredging, such as the elimination of excessive turbidity or resuspended solids, and a smaller quantity of material to remove due to consolidation and compaction. However, there are many disadvantages and problems that could be encountered. The length of time required for the sediment to dewater and consolidate sufficiently enough to support excavation equipment may take longer than expected, if frequent rainfall events occur. Although this method could be accomplished for a limited dredging project at selected areas in the shallow upper ends of a lake, it is not a feasible option since the Highland Silver Lake watershed drains an extremely large area and would likely cause flooding problems within the dredging area.

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

c. Hydraulic Dredging

Hydraulic dredging involves a centrifugal pump mounted on a pontoon or hull, which uses suction to pull the loose sediment off the bottom and pump it through a polyethylene pipeline to a sediment retention area. Generally, a cutterhead is added to the intake of the suction line in order to loosen the accumulated or native sediment for easy transport and discharge. A slurry of sediment and water, generally ranging between 10 and 15 percent solids (by weight), can be pumped for distances as much as 10,000 to 15,000 feet or more with the use of booster pump(s). The efficiently pumped sediment slurry must be discharged into a suitably constructed earthen dike-walled containment area with adequate storage capacity. The sediment containment or retention area must be properly designed to allow sufficient retention time for the sediment particles to settle throughout the project, and allow the clear decant or effluent water to flow through the outlet structure back to the lake.

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

Proposed Actions

The proposed alternative for removing accumulated sediment from the upper end of Highland Silver Lake is by hydraulic dredging. As previously mentioned, lake segments #11 through #15 were identified as being the most critically impacted areas. Approximately 51.9 percent of the lake's original storage capacity has been lost to sedimentation and nearly 751,318 cubic yards have been deposited. During the engineering design phase, a detailed and updated sedimentation survey should be completed prior to bidding and implementation. Strategically removing as much accumulated sediment as possible from within this critical area of the lake will help

restore lake water quality by removing deposited materials and an internal nutrient source. In addition, water depths and storage capacity can be restored in the upper end of the lake.

The estimated quantity of accumulated sediment in the upper end of the lake is significant, where funding availability will likely dictate the quantity of material that is ultimately dredged. Therefore, three options with varying opinions of cost have been developed in Table 37, following a "good, better, and best" format to help illustrate hydraulic dredging possibilities for Highland Silver Lake.

Table 37 – Estimated Sediment Removal Costs

Option	Option 1	Option 2	Option 3
Dredging Area (Segments)	14 through 15	13 through 15	11 through 15
Approx. Cubic Yards Removed	208,894	394,968	751,318
Retention Site Costs	$208,894	$394,968	$751,318
Dredging Costs	$1,148,917	$1,974,840	$3,380,931
Subtotal	$1,357,811	$2,369,808	$4,132,249
10% Estimating & Construction Contingency	$135,781	$236,981	$413,225
20% Engineering & Permitting	$271,562	$473,962	$826,450
Total	$1,765,154	$3,080,750	$5,371,924

As mentioned, the presence of sodic or natric soils in the Highland Silver Lake watershed has impacted the lake's turbidity by allowing fine clay colloidal particles to remain in suspension in the lake's water column. This phenomenon will likely require the use of a polymer or floccing agent to treat and reduce the suspended solids concentrations within the effluent from dewatered sediments to meet the Illinois EPA effluent water quality standards. The addition of a floccing agent for effluent treatment will impact dredging unit costs.

In the upper portions of Highland Silver Lake, a maximum dredge cut depth of 8 to 10 feet or at least to the hard, original bottom (which ever comes first) is recommended. This maximum cut depth will minimize sediment resuspension, improve lake water quality and clarity and will provide improved recreational access. Removing as much accumulated sediment as is feasible will minimize sediment resuspension, extend the useful lifespan of the project, and provide a long-term benefit to the lake.

For the purpose of this Report, sediment removal Option #2 (i.e., 394,968 cubic yards) is recommended for Highland Silver Lake.

With hydraulic dredging, land will be required for the construction of a retention facility that will store and dewater dredged sediment. The amount of land required for this facility is directly proportional to the quantity of sediment that is dredged within Table 37. For recommended sediment removal Option #2, it is estimated that approximately 13.5 to 20 hectares (33 to 50 acres) will be required for a suitable retention and dewatering site. For the other sediment removal scenarios, Option #3 (i.e., largest dredge quantity) would typically require between 25 to 38 hectares (62 to 94 acres), whereas the smallest dredge quantity proposed (i.e., Option #1) would require between 7.2 to 11 hectares (18 to 27 acres).

The retention and dewatering site(s) ideally should be located within the watershed so that water from the dewatering site can drain back into the lake. Further evaluation and analysis will be required to find a suitable retention site location. The dredged sediment can be beneficially reused as fertile agricultural soil and/or fill, thus maintaining the value of the land. Costs for the land required for the retention site are not included with the opinions of probable cost listed in Table 37. It is important to note that if multiple small sites are required then costs will be higher than listed in Table 37.

Under dredging Option #2, the removal of 394,968 cubic yards of accumulated sediment would restore approximately 79,783,536 gallons or nearly four percent of the lake's original-1962 volume. Once removed, that volume that was once occupied by sediment would provide additional lake water storage capacity. One cubic yard occupies nearly 202 gallons of water. In 2005, the City of Highland averaged 1.3 million gallons per day (MGD) (Wittenborn personal communication, 2005), which translates to between 39 and 40 million gallons per month. Removing this modest volume would essentially provide the lake with an additional 79,783,536 gallons, which is approximately a two-month water supply for the City and surrounding communities. This added storage capacity would be invaluable during drought conditions.

Estimated Loading Reductions from Proposed Actions

Loading reductions for the proposed actions (i.e., sediment removal via hydraulic dredging) were estimated using the statewide mean sediment concentrations (Mitzelfelt, 1996) (see Table 13 in Part 1), in-lake sediment core samples collected during the Phase 1 monitoring period (2004-05) (see Table 11 in Part 1), and the typical mean dry bulk density for sediment (assumed to be 50 lbs/CF or 1,350 lbs/CY). Table 38 lists the estimated internal loading reductions from the removal of in lake sediments (outlined in Table 37).

Table 38 – Estimated Loading Reductions for Sediment Removal

Parameters	Units	Option 1	Option 2	Option 3
Volume Removed	CY	208,894	394,968	751,318
Sediment	Lbs/CY	1,350	1,350	1,350
Phosphorus*	mg/kg	1,122	1,122	1,122
Sediment	Lbs	282,006,900	533,206,800	1,014,279,300
	Tons	141,003	266,603	507,140
Phosphorus *	Lbs	516,717	976,988	1,858,450
	Tons	258	488	929

* Mean Phosphorus-P concentration of 1,122 mg/kg.

Objective #3: Improve water quality for aesthetics and to support a more balanced aquatic plant community

Alternative Actions

The aquatic plant community, which includes both algae and rooted macrophytes, has suffered in Highland Silver Lake due to decreased water clarity and high nutrient availability. Several nutrient sources of loading have been identified for Highland Silver Lake: non-point sources including agricultural runoff, in-lake sources such as internal regeneration from accumulated sediments, shoreline erosion, livestock waste by-products, and atmospheric deposition. The abundance of nutrients from these various sources has allowed blue-green algae to remain dominant over other more beneficial algal types, such as green algae, and aquatic macrophytes.

Also, the re-suspension of solids (i.e., turbidity) from accumulated bottom sediments and solids loading within the watershed has stunted aquatic plant populations within Highland Silver Lake. Increased turbidity from suspended solids of sodic soils within the watershed and an unbalanced algal population have reduced the photic zone by “shading out” light transmittance throughout the water column, which has adversely impacted the density and diversity of macrophyte populations, which are dominated by emergent aquatic plant species located in very shallow water close to shore.

The primary alternatives for improving water clarity and restoring a more balanced aquatic vegetation population include reducing solids and nutrient loading from the watershed or altering nutrient availability, restructuring the algae population so that blue-greens are not dominant, and reducing the amount of suspended sediment entering the lake during significant storm events.

Nutrients such as phosphorus and nitrogen can be controlled and reduced in many ways such as: implementing best management practices in the watershed and the construction of an in-lake sediment and nutrient control basin (discussed in Objective #1); and minimizing internal nutrient regeneration and sediment resuspension occurrences via hydraulic dredging (discussed in Objective #2). In addition, the stabilization of eroded shoreline will also reduce solids and nutrient loading to the lake (see Objective #4 to be discussed later).

Internal regeneration of phosphorus and nitrogen within Highland Silver Lake has been estimated to be a relatively minor component of the overall nutrient budgets, as the summer stratification does not typically develop for extended periods due to the relatively shallow water depths of the lake and an apparent weak thermocline. In addition, the lake is periodically mixed as a result of prevailing winds and the large volume of storm water runoff that flows into the relatively linear (i.e., riverine) lake from a large drainage area and through the spillway. This flow pattern during normal summer weather conditions apparently mixes the water within deeper portions of the reservoir and helps to limit the internal release of nutrients by maintaining oxygenated conditions near the bottom for most of the year. The exception to this periodic mixing may occur during exceptionally dry seasons or years.

Water clarity can also be improved by minimizing wind resuspension of existing sediment and nutrients in shallow water areas. This resuspension can be controlled or reduced by re-establishing a rooted aquatic macrophyte community and by removing soft accumulated sediment from the upper end of the lake (see Objective #2).

Other potential alternatives for reducing nutrient concentrations are nutrient diversion, dilution and flushing, discharge of hypolimnetic water, phosphorus inactivation/precipitation, and artificial circulation. Due to the lake's linear morphometry and the hydrologic features of its extensive watershed, it would be technically unfeasible and expensive to undertake a diversion or flow routing system for the control of nutrients. Dilution and flushing has been shown to be effective at reducing the concentration of nutrients in the water column by adding "nutrient poor" water. Flushing reduces algal biomass by increasing the loss rate of cells. However, dilution and flushing are not considered acceptable alternatives for Highland Silver Lake due to the lack of suitable groundwater resources. Hypolimnetic discharges are normally not a feasible solution for reservoirs, since anoxic conditions typically occur during the summer months when water conservation is critical due to lack of precipitation and excessive water loss from evaporation. In addition, the release of anoxic waters to Silver Creek from Highland Silver Lake would have negative impacts on the biota within the creek/stream.

Phosphorus precipitation and inactivation are techniques used to lower the concentration of phosphorus in the water column by either precipitating it out or preventing its release from sediments. Aluminum sulfate (alum) is added to the lake surface in order to precipitate the phosphorus to the lake bottom. Additional aluminum sulfate can be added to form a barrier to prevent phosphorus release from the sediment. The barrier can prevent or minimize phosphorus release into the overlying water column during anoxic conditions. Properly applied alum treatments can result in relatively long-term reductions of phosphorus in lakes where inflowing sources of phosphorus have been sufficiently controlled and the resuspension of bottom sediments is minimal. The cost of alum treatments has typically ranged from $640 to $1,280 per hectare ($260 to $520 per acre). Since the total surface area of Highland Silver Lake is approximately 550 acres, the cost for a whole lake alum treatment would range from

$143,000 to $286,000 for a single treatment. However, the lake's expansive drainage area (i.e., watershed) will continue to produce significant sediment and nutrient loadings and the lake's linear morphometry and rapid hydraulic residence time would also limit the effectiveness of alum treatments. Therefore, it appears highly unlikely that alum would be a suitable long-term alternative for controlling phosphorus concentrations within Highland Silver Lake.

Artificial aeration or circulation of lakes during the summer thermal stratification period is a practice commonly used to improve water quality conditions (i.e., increase dissolved oxygen concentrations). The primary improvements in water quality that may be attained as a result of artificial aeration or circulation are reduced nutrient loading from bottom sediments, reduced blue-green algal dominance, improved ecological diversity, and increased oxygen levels and chemical oxidation of substances in the entire water column.

Due to the shallow depths at Sites #2 and #3, the upper end of the lake experiences routine mixing or natural destratification via prevailing winds and natural inflows from the watershed. However, Site #1 – located near the dam, spillway, and public water supply intake – does experience some periods of stratification (despite the weak thermocline) at depths that vary between 11 and 13 feet (Figures 6A and 6B in Part 1). As previously mentioned, the City has experienced periodic taste and odor issues associated by blue-green algae within the lake (Wittenborn personal communication, 2005). Given these public water supply issues, an artificial aeration or circulation system could be useful in the lower portion of the lake (i.e., approximately 150 to 200 acres located near Site #1 and the public water supply intake). Artificial aeration or circulation, as previously mentioned, has been shown to be effective in improving ecological diversity by restructuring the algae populations (i.e., reducing blue-green algal dominance and allowing for a more diverse and desirable algal population) and improving water quality by increasing dissolved oxygen concentrations.

The two primary methods of lake aeration/circulation include artificial circulation and hypolimnetic aeration. Any system that is designed to mix or circulate the lake or provide aeration without maintaining the normal thermal structure is classified as an artificial circulation technique. Systems within this category include compressed air

and/or mechanical devices capable of lifting anoxic hypolimnetic water and circulating oxic surface waters in order to evenly distribute oxygenated water throughout the lake. A compressed air system is typically used to initiate rising air bubbles sufficient to reach the surface and flow out horizontally. The cold, dense water eventually sinks to a level of equal density and eventually establishes a whole lake mixing, if the system is sufficiently sized and designed. Hypolimnetic aeration is a method of providing dissolved oxygen to the bottom waters of a lake without disrupting the normal pattern of thermal stratification, which is typically reserved for deepwater lakes. For Highland Silver Lake, artificial circulation would be a suitable alternative to improve lake water quality and to restructure the algal population.

According to Lorenzen and Fast (1977), and many other aeration system experts, the general design requirement for sizing an aeration system is based on an optimum rate of compressed air delivery of 1.3 CFM per lake surface acre. This optimum formula has been observed to be effective at lower delivery rates, but the typical minimum rate is believed to be as low as 0.65 CFM per surface. This rationale can vary of course depending on the morphometry of the lake and the type of system being employed. Based on the bathymetry and morphometry of the lower portion of Highland Silver Lake, a compressed air delivery rate of 0.65 CFM per lake surface acre was used. Based on Lorenzen and Fast's findings and recommendations, a suitable system for the approximately 150 to 200 acres near Site #1 and the public water supply intake at Highland Silver Lake would be capable of providing a range of 98 to 130 CFM with an estimated power rating of approximately 40 to 80 horsepower.

A compressed air destratification system suitably sized for the lower portion of Highland Silver Lake would have an estimated cost of $155,000 to $185,000 installed. A desirable system would include weighted air hose and high efficiency diffusers with a well-ventilated and sound proofed air compressor house. The installed cost of a suitably sized Aspir-Air Venturi-type system is estimated to be approximately $230,000 to 250,000. The primary advantage of the Aspir-Air system is the greatly reduced space requirement on land for an appropriate power base and a reduced noise level. However, the primary disadvantage is the requirement of surface buoys to fasten the

necessary air hoses. Both systems essentially are destratification systems, with compressed air being the less expensive of the two alternatives.

The previously described aeration systems are more conventional as they both utilize electric power to operate air compressors. Solar Bee has developed solar-powered reservoir circulators, which would greatly reduce annual operation costs to control and prevent blue-green algal dominance. The Solar Bee SB10000 or SB10000v12 models have the ability to circulate up to 45 acres and cost $40,000 to $45,000 per unit installed. For Highland Silver Lake, the installed cost would range between $160,000 to $180,000 for four units and would aerate an area approximately 150 and 200 acres near the lake's water supply intake and Phase 1 monitoring Site 1.

Potential advantages with artificial circulation systems include (Kothandaraman and Evans, 1983):

1. Increased oxygen concentrations at the sediment/water interface can significantly reduce the rate of nutrients (i.e. phosphorus) released from the sediment.
2. Benthic flora and fauna populations are typically more diverse and abundant under well-oxygenated conditions, which can impart better food supplies for game/sport fish species.
3. A shift in algal populations may occur with a decrease in undesirable blue-green species. This is partly a result of lowering the water temperatures; blue-green algae are most tolerant of high surface water temperatures.
4. Oxidation of reduced organic and inorganic materials occurs. This is particularly advantageous to water supply lakes because taste, odor and color problems caused by iron, manganese, and hydrogen sulfide are eliminated or at least minimized.
5. Evaporation rates can be reduced in summer as a result of lower surface water temperatures.
6. Artificial destratification often results in increased water clarity.
7. Maintaining a sufficient dissolved oxygen level under ice cover may prevent occurrence of wintertime fish kills. However, a potential aeration system for

Highland Silver Lake would only operate while the lake is stratified (typically mid-May through mid-September).

Potential disadvantages with artificial circulation systems can include the following:

1. An increased heat budget can be caused in the lake that slightly lowers the temperature of the upper waters, whereas deep waters may be warmer by as much as 15° to 20°C, approximately the same temperature as the surface.
2. There may be a temporary increase in water turbidity resulting from the resuspension of bottom sediments.
3. Most investigations have resulted in a reduction of blue-green algae, but in some instances, there was little or no effect.
4. The oxygen demand of resuspended sediments may result in depressed dissolved oxygen concentrations, at least temporarily, that may be harmful to the fish.
5. Aeration may cause supersaturation of nitrogen gas, creating a potential danger for fish from gas bubble disease.

Proposed Actions

The following alternatives are proposed to be implemented in order to improve water quality for aesthetics and to support a more balanced aquatic plant community.

The first action is to promote the continued and increased use of soil conservation practices in the watershed that would reduce and minimize sediment and nutrient delivery to the lake (see Objective #1). Since much of the phosphorus entering the lake is bound to sediment, any action that involves reducing sediment delivery and deposition to the lake will also control phosphorus levels. In addition, nutrient management practices and BMP's should be encouraged throughout the watershed in order to minimize the amount of nutrient delivery. Since approximately eighty-eight percent of the watershed consists of agricultural land uses, the proper management of

fertilizer applications will gradually decrease the amount of nitrogen and phosphorus transported to the streams that enter the lake.

Secondly, the resuspension of soft sediment in the shallow waters of the upper end of the lake should be addressed via removal of accumulated sediment by hydraulic dredging (see Objective #2). Once internal lake nutrient concentrations are lowered and water clarity can improve, there should be a gradual re-establishment of a desirable diversity and growth of rooted macrophytes. Rooted aquatic vegetation will also minimize sediment resuspension in shallow water. Stabilizing eroded shoreline areas will also help reduce turbidity and is discussed in the following section (see Objective #4).

A third action that should be taken is artificial circulation by installing a suitably sized aeration system within the lower portion of Highland Silver Lake, near the public water supply intake. The increased oxygen levels and the artificial circulation flow may reduce the dominance of blue-green algae and may allow for a more diverse and desirable algal population. It can also improve lake water quality by increasing dissolved oxygen concentrations, which will expand and improve available fish habitat, and help to reduce internal nutrient regeneration. Four, solar-powered, Solar Bee SB10000 or SB10000v12 units are recommended to aerate the lower portion of Highland Silver Lake. The total cost would be in the range of $185,000 to $205,000 with an approximate cost of $160,000 to $180,000 to purchase and install the aeration units, plus $30,000 for engineering design and coordination.

In early 2008, the four Solar Bees were installed within Highland Silver Lake. The units were positioned near the water supply intake in an attempt to control blue green algae and subsequent taste and odor issues associated with the public water supply (Wittenborn personal communication, 2008).

Objective #4: Stabilize and Protect Eroded Shoreline Areas

The uncontrolled erosion of shoreline areas is another source of sediment and nutrient loading to the lake. As previously described, there are a number of factors that contribute to shoreline erosion at Highland Silver Lake including exposure to waves generated by strong prevailing winds, easily erodible shoreline soil types, fluctuating water levels, moderate visitor usage, and lack of nearshore aquatic vegetation and/or rock breakers.

Alternative Actions

According to the 2005-shoreline erosion survey data, there has been approximately 6,130 feet of shoreline stabilization work completed at Highland Silver Lake, where either riprap and/or concrete blocks have been utilized. The majority of this quantity was completed in conjunction with various transportation projects (i.e., Interstate-70 Bridge and the State Route 143). Despite these efforts, there is still a significant amount of eroded shoreline that is in need of stabilization (see Figure 9 in Part 1). Of the total amount of eroded shoreline, there are approximately 1,030 linear feet of severe erosion areas, 9,784 linear feet of moderate shoreline erosion, and 20,687 linear feet of slight shoreline erosion. The typical form of erosion observed at these locations was an exposed and undercut bank that, throughout time, will gradually allow the upper reaches of the shoreline slope to collapse. Photographs illustrating various types of shoreline erosion are shown in Appendix E.

Many products have been developed to control shoreline erosion and have improved the older methods. The following were considered when deciding the best approach for stabilizing the Highland Silver Lake shorelines: riprap (both crushed stone and rounded glacial stone) with bedding stone or filter fabric, erosion mats, plastic and natural geowebs, gabions, railroad ties, interlocking concrete blocks, and natural vegetative stabilization.

Vegetative covering is a method of shoreline stabilization that can provide protection by reducing wave action and by binding the soil with roots. In addition to the erosion control benefits, vegetative stabilization methods have the ability to absorb and

assimilate nutrients from runoff and, once established, require little or no maintenance since plants reproduce and often spread naturally. For the correct application, these more natural stabilization measures are aesthetically pleasing, provide habitat, and can be cost effective.

For some areas that are not subjected to large direct wave action that have slight (1 to 3 foot bank heights) shoreline erosion and gently sloping littoral zones, plant species such as prairie cord grass (*Spartina pectinata*) can be used. Prairie cord grass is an emergent, herbaceous perennial that is native to North America and has been proven to be excellent for erosion control with dense beds and deep root systems up to 2 ft. into the ground. The species is often found near water and wet areas, does well in poor soils, and tolerates seasonal flooding. The plant can spread aggressively, up to two ft. per year (Michigan State University Extension on-line, 1999). Prairie cord grass plugs can be planted within sand bags (approximately 2 ft. length by 1 ft. in width each) or within biodegradable fiber rolls and placed across the toe of the eroded bank. The sand bags would provide immediate shoreline protection along with a medium to hold the plantings in place until they could get established and rooted into the shoreline. This natural form of shoreline stabilization would establish native plants for erosion control and enhance habitat for wildlife (Erosion Control, 2000).

Officials in the St. Louis Regional Office for the United States Corps of Engineers (COE) have reported having success with more natural forms of shoreline stabilization. In certain applications, the COE is beginning to favor natural, more ecologically friendly methods of shoreline stabilization (Daily personal communication, 2006).

Riprap is another shoreline stabilization alternative that has proven to be very effective for reducing and preventing erosion. Riprap with underlying geotextile filter fabric would be ideal to address the moderately (3 to 8 ft. bank heights) and severely (>8 ft. bank heights) eroded banks of Highland Silver Lake. The advantages of riprap include its reliable longevity, ease of installation and relatively inexpensive cost over large areas. All riprap should be installed using either filter stone or filter fabric to prevent washout from behind the installed riprap (see Figures 17 and 18).

Figure 17 - Riprap Shoreline Protection with Geotextile Fabric



Figure 18 - Example of Offshore Riprap Breakwater



As a result of the shoreline erosion survey, the following shoreline stabilization recommendations have been developed. Riprap and filter fabric should be used for moderately and severely eroded shoreline and should be placed from the lake via barge or mechanical riprap boat along the undercut bank of the shoreline two (2) feet below and two (2) feet above normal pool (spillway elevation) at a 2 to 1 slope. When possible, bare areas above the riprap would be graded to a 3 to 1 horizontal to vertical slope and seeded. However, the eroded shoreline at Highland Silver Lake is typically bordered by wooded growth at or near the shoreline. Thus, flattening the slope of the shoreline may be difficult or impractical in most cases. Once the toe of the slope is protected from further undercutting by structural methods, the eroded slope will gradually slough until a state of equilibrium is reached. The estimated base cost of shoreline stabilization using gradation RR4 broken limestone riprap is approximately $75 per linear foot, plus allowances for contingencies, engineering, and permitting.

For areas of shoreline with gentle slopes that have been categorized as having slight bank erosion, emergent vegetation (i.e., prairie cord grass or other native emergent aquatic plants) within sandbags could be used for shallow littoral areas in order to minimize wave action on shore, thus protecting eroded banks from further undercutting. The estimated cost of implementing vegetative plantings for erosion control and shoreline stabilization is $25 per linear foot.

The current levels of shoreline erosion within Highland Silver Lake are too large to be addressed simultaneously. Therefore, a more sensible approach is suggested, where shoreline stabilization projects would be prioritized and completed based on the level of need in a series of phases. Subsequent shoreline surveys are recommended to monitor further lake shoreline erosion. This approach will more effectively utilize available funding from grants and cost-share sources to target the severely and moderately eroding shoreline areas that are most susceptible to erosion by being exposed to waves generated by prevailing winds.

The prioritized areas should include moderate and severe erosion areas that are most susceptible to additional erosion and exposed to maximum wave energy. All of the severely eroded shoreline (1,030 lineal feet) and approximately half of the 9,784

lineal feet of moderately shoreline erosion should be stabilized and protected with riprap and filter fabric. The estimated 4,892 lineal feet of stabilization for moderately eroded shoreline shall be prioritized according to severity of undercutting and exposure to maximum wind fetch and wave action. For select slightly eroded areas with bank heights ranging from >1 to <3 ft., vegetative plantings (approximately 2,500 linear feet) are suggested. A summary of the proposed shoreline stabilization costs for Highland Silver Lake is shown in Table 39.

Table 39 - Proposed Shoreline Stabilization Costs

Degree of Erosion	Length of Shoreline	Stabilization Method	Estimated Cost
Severe	1,030 LF	Riprap ($75/LF)	$77,250
Moderate	4,892 LF	Riprap ($75/LF)	$366,900
Slight	2,500 LF	Vegetation ($25/LF)	$62,500
Total Estimated Shoreline Stabilization Cost			$506,650
Estimating Contingency (10%)			$50,665
Engineering Design and Permitting (15%)			$75,998
Total Estimate of Probable Costs			**$633,313**

Shoreline stabilization work on this scale will require a Joint Application Permit from the Army Corps of Engineers (COE), the Illinois Environmental Protection Agency (Illinois EPA), and the Illinois Department of Natural Resources (IL DNR), particularly for riprap placed as fill material beneath the normal water level. The benefits of shoreline stabilization would include reduced sediment and nutrient loading, reduced turbidity, expanded shoreline habitat, improved aesthetic appearance, and prevention of further loss of valuable shoreline.

Estimated Loading Reductions from Proposed Actions

Loading reductions from the proposed actions (i.e., shoreline stabilization) were estimated using the Illinois EPA's Spreadsheet program entitled "Estimating Pollutant Load Reductions for Non-Point Source Pollution Control BMP's" and the in-lake sediment samples (i.e., mean concentrations) collected during the Phase 1 monitoring

period. Table 40 lists the estimated loading reductions from the stabilization of shoreline listed in Table 39.

Table 40 – Estimated Loading Reductions for Shoreline Stabilization

Classification of Eroded Shoreline	Linear Feet	TSS (tons/yr)	Phosphorus (Lbs/yr) *
Slight (1 to 3 ft. bank heights)	2,500	4	8
Moderate (3 to 8 ft. bank heights)	4,892	220	420
Severe (> 8 ft. bank heights)	1,030	185	354
Total	5,922	405	774

* Mean Sediment Phosphorus-P concentration of 1,122 mg/kg.

Objective #5: Enhance Fisheries Population and Habitat for Improved Recreational Opportunities

Alternative Actions

Considering the water quality issues and impairments, the fish population at Highland Silver Lake is considered to be fair to good (Cronin personnel communication, 2005). However, there are population structure imbalances (i.e., stunted bluegill population and excessive number of large gizzard shad) that could be improved and negative conditions (i.e., excessive siltation and loss of spawning habitat, excessive turbidity, blue-green algae dominance, and lack of bottom structure suitable for habitat) that should be addressed. Fisheries management efforts have included successful supplemental stocking, in addition to size regulations and catch limits, in an effort to reduce smaller fish and increase the sizes of individuals.

Several alternatives have been identified to address fish population imbalances potentially caused by the over abundance of large gizzard shad within Highland Silver Lake:

1. Periodic or annual lake drawdowns during the winter months to consolidate forage fish and to promote their predation.
2. Eradication of lake fish population and “starting over” through stocking.

3. Implement selective eradication of gizzard shad population, as gizzard shad are more susceptible to low concentrations of rotenone (McComas, 2003).
4. Shocking and selectively harvesting/removing large gizzard shad from the lake.
5. Continue to stock largemouth bass, sauger, saugeye (walleye x sauger hybrid) (i.e., more predator sport fish) to control gizzard shad population.
6. Consider stocking white bass and/or hybrid striped bass (species shown to be pelagic (i.e., roaming open water) predators of gizzard shad).
7. Install fish attractors/habitat structures to provide cover, and concentrate fish and improve angler opportunities.
8. Nothing – allow fish populations to continue to develop, as is.

Reviewing the aforementioned fisheries alternatives, the following observations have been made. As a public water supply lake, the application of rotenone or another selective eradication treatment may not be permitted. Attempting to restructure the existing fish population via stocking sport fish or by the removal of “rough” fish without implementing the following objectives will likely have limited results, since lake water conditions will not improve. Therefore, any serious attempt at restructuring the fish population should be made as other existing lake conditions are addressed.

- Objective #1 - Reduce sediment and nutrient loads from the watershed and reduce their subsequent delivery to the lake, which should improve water quality, fish habitat, and spawning opportunities.

- Objective #2 – Remove excessive amounts of accumulated sediments in shallow spawning or breeding waters, which will remove an internal loading source and in turn will improve habitat and spawning opportunities.

- Objective #3 - Improve water quality to support a more balanced aquatic plant community (i.e., reduce blue-green algae dominance); and improve aquatic macrophyte population to provide improved fish habitat.

- Objective #4 - Stabilize eroded shoreline areas (i.e., reduce sediment and nutrient loadings near shoreline and improve shallow water habitat and spawning areas).

The degraded water quality and excessive turbidity, the decline of diverse, native aquatic macrophytes, and the dominance of blue-green algae, have all had an adverse impact to the overall balance and health of the fish population. As discussed previously (see Objectives #1, #2, #3, and #4), sediment and nutrients entering the lake must be controlled and minimized in order to improve water clarity, restructure the algae population and allow desirable, native macrophytes to become established. The reduction of available phosphorus and nitrogen (from internal and external lake sources) will help to diversify the algae population and shift it away from blue-green dominance, which will in turn benefit the fish population.

Proposed Actions

The fishery at Highland Silver Lake will certainly benefit from the improved water quality from reduced sediment and nutrient inputs, and from the continued supplemental stocking and fishing regulations currently in effect. The IL DNR fisheries management plan includes continued biennial sampling and monitoring, routine stocking efforts, and enforcement of current fishing regulations. The following IL DNR management practices and regulations should be continued:

1) Walleye, Sauger, or hybrid Walleye (Saugeye) – 14-inch minimum length limit;
2) Biennial (every even year) spring fish population analysis consisting of electrofishing sampling; and

3) Routine stocking of largemouth bass fingerlings (4-inch), sauger fingerling (2-inch), and other species approved by the IL DNR District 16 Fisheries Biologist.

In addition to IL DNR fisheries management and regulations, fish attractors/habitat structures should be installed within the lake to provide cover and concentrate fish to improve angler opportunities. Rather than placing evergreen trees, which decompose quickly and can introduce unwanted nutrients into the lake, other more durable methods are recommended such as wooden log cribs, concrete block or rock rubble piles, stake beds, plastic structures, and bundled piping. The estimated costs are anticipated to be $250 each for log cribs, AquaCribs ©, and/or large riprap rubble mounds. It is recommended that structures or structure groupings be located and installed under the direction of the IL DNR District Fisheries Biologist. The total cost for the structures is estimated to be as much as $10,000, plus an additional 20 percent for planning, engineering, and technical consultation. Examples of potential fish attractors/habitat structures are shown in Figures 19 and 20.

Figure 19 - Fish Attractor/Habitat Structure Alternatives

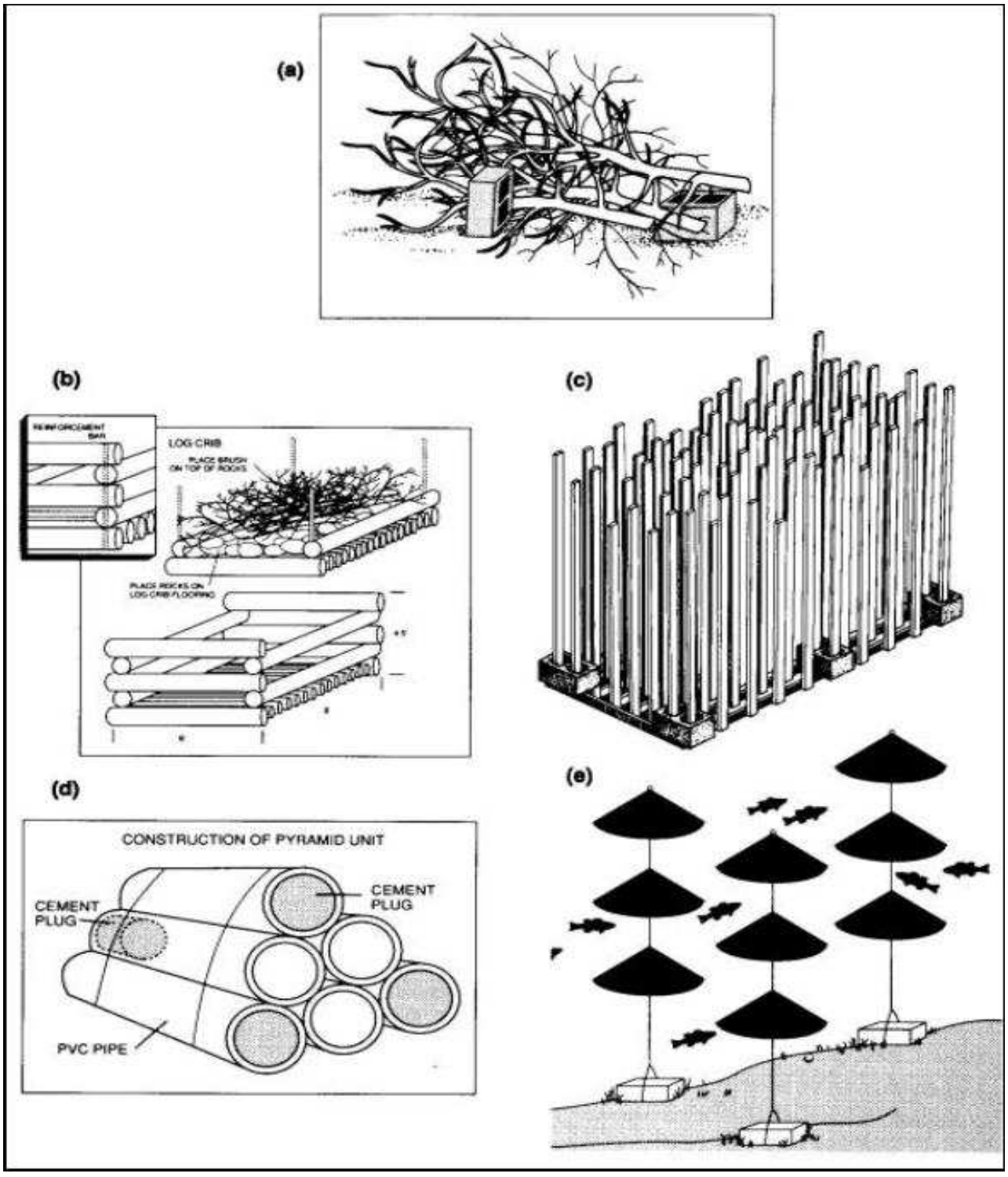
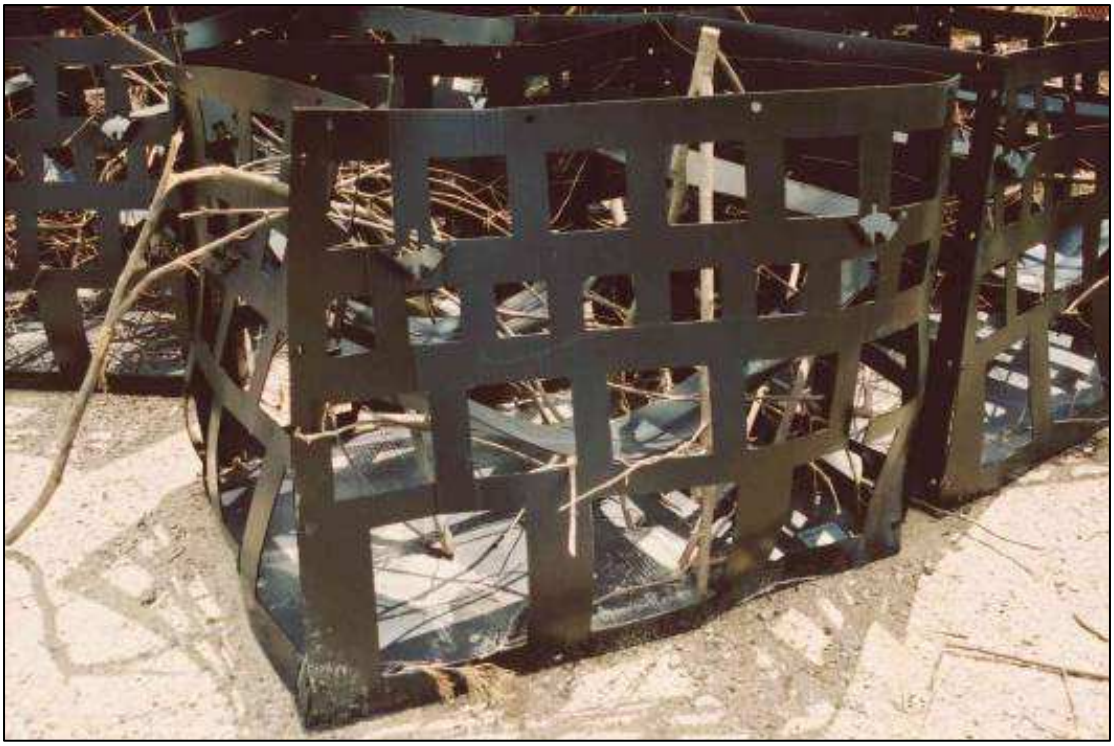


Figure 20 - Log Crib and AquaCribs© Fish Attractors/Habitat Structures





D. Benefits Expected from Implementation of Lake Management Plan

Once implemented, the following alternatives in the proposed lake management plan will generate a wide range of water quality improvements that will provide sediment and nutrient (phosphorus) loading reductions, and recreational use benefits for Highland Silver Lake.

1) Recommended watershed alternatives will reduce the amount of sediment and nutrients entering and being deposited within the lake. It is estimated that changes in tillage practices and the installation of conservation practices in the watershed, combined with the construction of an in-lake sediment and nutrient control basin will reduce the incoming sediment and nutrient load (particularly phosphorus). Reducing sediment and nutrient inflows or loading to the lake will improve water quality and clarity, which will subsequently improve the public water supply and recreational opportunities.
2) The removal of approximately 394,968 cubic yards of accumulated sediment (assumes Sediment Removal Option 2) will improve water quality and clarity by removing an internal lake nutrient source (i.e., nutrient recycling from resuspension). Also water depths in the upper portion of the lake will be increased, which will increase lake storage capacity and also improve lake habitat and other recreational opportunities. This estimated quantity will provide an additional two months of water based on 2005 consumption rates.
3) Install an in-lake aeration system within the lower portion of Highland Silver Lake. Circulation or aeration of the lower 150 to 200 acres of the lake (near in-lake sampling Site #1 and the public water supply intake) will restructure the algae populations (i.e., reducing blue-green algal dominance and allowing for a more diverse and desirable algal population) and improve lake water quality by increasing dissolved oxygen concentrations. These actions will benefit the public water supply and may reduce treatment costs.
4) Stabilization of lake shoreline areas to reduce sediment and nutrient loading, prevent further lake degradation, and improve water clarity and quality. An

estimated 1,030 ft. of severely and 4,892 ft. (i.e., half the 9,782 ft.) of moderately eroded shoreline, and 2,500 ft. of slightly eroded shoreline is proposed for stabilization out of a total of 31,501 ft. of eroded shoreline. This will stabilize approximately 26.7 percent of the eroded shoreline along the lake and reduce sediment and nutrient (phosphorus) loading. More importantly, it will protect shoreline for continued recreational enjoyment.

5) A more balanced aquatic vegetation community can be achieved with improved water quality (i.e., fewer available nutrients) and clarity (less turbidity). These improvements will allow for a more diverse algae population that is no longer dominated by nuisance blue-green algae. The reduction in sediment loading from in-lake and watershed sources (via dredging and improved watershed practices) will also reduce phosphorus loading considerably, since most phosphorus entering the lake is bound to sediment particles. Nitrogen loading will also be reduced by the continued implementation of BMP's within the watershed by streamside filter strips and grass waterways, combined with improved tillage practices.

6) A more balanced fish population can be achieved through improved water quality and clarity, the continuance of the existing IL DNR fisheries management program, and expanded fish habitat. The more diverse algal population will provide a better food source for zooplankton and grazers, which will in turn benefit the entire fish population. A healthier, more balanced aquatic plant community will provide improved habitat and the fish habitat structures will also benefit the fish population and fishing opportunities.

7) Improved water quality and clarity will improve the public water supply and also enhance lake aesthetics. The removal of nutrient rich sediment and the reduction of sediment and nutrients entering the lake, together with the various habitat improvements and shoreline stabilization will improve the water clarity and overall water quality of the lake.

Table 41 shows the use estimates for Highland Silver Lake as provided by the City of Highland, along with the projected use and benefits following the lake restoration program. Prior studies completed by the IL DNR Planning Division have estimated that a 20 percent increase in total lake usage can be expected with the implementation of a lake restoration program that will improve and protect water quality, fisheries, and recreational opportunities. The economic value was calculated using a multiplier of 1.5 as suggested by Griffith and Associates (1990). It is estimated that the proposed restoration program has the potential to generate a total of $1.2 million in economic benefits over a ten-year period, and does not include the probable increase in revenues for area merchants as a result of greater lake usage.

A report prepared by JACA Corporation (1980) for the USEPA assessed the economic benefits derived from 28 projects in the Section 314 - Clean Lake Program. The report found that a total return in benefits of $4.15 per total project dollar was realized. The projects produced benefits in 12 categories that included recreation, aesthetics, flood control, economic development, fish and wildlife, agriculture, property value, public health, public water supply, education, research and development cost, and pollution reduction. The report also indicated that while many benefits could not be measured in monetary terms, the success of many Clean Lakes Program projects appears to have been a catalyst for other community activities.

Table 41 - Projection of Benefits

Recreational Use	Baseline Usage(a)	Projected Usage(a)	Change in Usage(a)	Value of Baseline Usage(b)	Value of Projected Usage(b)	Value of Annual Increment(b)	Value of Benefit(c) (10 Year)	Total Economic Benefit Using 1.5 Economic Multiplier
Combined Usage	52,000	62,400	10,400	$402,480	$482,976	$80,496	$804,960	$1,207,440

(a) - in annual user days unless otherwise noted
(b) - in current dollars
(c) - net present value over duration of benefits

Source: City of Highland
Illinois DNR Planning Division
Griffith and Associates

E. Phase 2 Monitoring Program

Table 42 presents the proposed water quality-monitoring program for a one-year period following completion of the proposed lake restoration activities. This program is essentially the same as that conducted under the Phase 1 study except that no sediment or fish samples will be analyzed.

Table 42 - Phase 2 Water Quality Monitoring Program

Parameter	Sampling Frequency
Total Phosphorus	M,S,T
Dissolved Phosphorus	M,S
Ammonia-Nitrogen	M,S,T
NO_2 +NO_3 -Nitrogen	M,S,T
Kjeldahl-Nitrogen	M,S,T
Total Suspended Solids	M,S,T
Volatile Suspended Solids	M,S
Turbidity	M,S
pH	M,S
Alkalinity	M,S
Conductivity	M,S
Chlorophyll a, b, c	M,S
Phytoplankton	M,S
Transparency - Secchi Disc	M,S
Diss. Oxygen/Temperature Profile	M,S

Key: M = monthly sampling (12 times per year by the City of Highland/ HDR | CWI)
S = summer (Apr., June, July, Aug., & Oct. by Illinois EPA)
T = Storm event tributary sampling (as required by the City of Highland/ HDR | CWI)

All parameters except chlorophyll (a, b, c), phytoplankton, Secchi transparency and dissolved oxygen/temperature profiles will be taken one foot below the surface at Sites 1, 2, and 3, and one foot above the bottom at Site 1.

F. Budget and Schedule

The total estimated costs and budget for restoration projects identified within the Phase 1 Report are summarized in Table 43. It is important to note that these costs

have been adjusted for inflation (i.e., increases in fuel and raw materials costs) since the May 2006 draft report.

Under the Clean Lakes program, the schedule for the Phase 2 restoration projects would normally be submitted by the end of 2009, and the completed Phase 1 Report would serve as informational backup for the Phase 2 grant application. The Illinois EPA would review the application in the winter of 2009 and the Phase 2 Grant approval could be anticipated by spring of 2010. However, the implementation of the lake and watershed restoration projects described within this Report and listed in Table 43 will ultimately depend of the availability of future funding of the state Clean Lakes Program. With uncertain state funding options, there are other funding programs. The Illinois EPA has funded some Clean Lakes Phase 2 projects with Federal funds from the US EPA's Section 319-Non-Point Source Pollution Control Program.

Therefore, rather than committing to the conventional and fixed Clean Lakes Phase 2 budget and schedule, where funding and restoration projects are specified beforehand, a more open and flexible budget and schedule approach is proposed under the 319-Program. This more flexible approach will consist of preparing separate, individual 319-grant applications that are based on the findings and recommendations of this Phase 1 Report. This method will allow lake and watershed restoration projects to be identified and grant applications submitted, as various match-funding sources become available.

Several general criteria are suggested in selecting future lake and watershed restoration projects (see Table 43). Priority should be given to those management alternatives that will have the greatest immediate impact on reducing sediment and nutrient (particularly phosphorus) loadings to the lake. Also restoration projects located on public or City-owned lands tend to be more feasible to implement and complete than those located on privately owned land. Typically, publicly owned land projects have fewer issues with land access and land acquisition issues. Using this restoration project selection rationale, all of the eroded shoreline on Highland Silver Lake is located on public lands that are either managed and/or owned by the City of Highland. Stabilizing eroded shoreline will significantly reduce the sediment and nutrient (i.e., phosphorus and nitrogen) loading to the lake. A watershed and lake restoration project that has the

potential to significantly reduce external sediment and nutrient loading is constructing an in-lake sediment and nutrient control basin at the upper end of the lake. To enhance the trapping efficiency and longevity of the project, accumulated sediment in the upper end of the lake should be removed before an in-lake control basin is considered.

Table 43 - Total Budget Lake and Watershed Restoration Programs

Potential Restoration Alternatives	Estimated Cost	Funding Source(s)
1 Watershed Protection		
a) Filter Strips, Terraces, Grassed Waterways, Nutrient Mgmt., Streambank Stabil., & Education	N/A	USDA NRCS and SWCD (Cost not included Budget)
b) Sediment & Nutrient Basin - Option 3	$525,000	Illinois EPA & City of Highland
20% Design & Construction Engineering	$105,000	Illinois EPA & City of Highland
Subtotal	$630,000	Illinois EPA & City of Highland
c) Fencing (5,000 LF) & Gates	$22,500	Illinois EPA & City of Highland
Pond Improvements	$5,000	Illinois EPA & City of Highland
Estimating Contingency (10%)	$2,750	Illinois EPA & City of Highland
Subtotal	$30,250	Illinois EPA & City of Highland
Total Watershed Protection Cost	***$660,250***	Illinois EPA & City of Highland
2 Sediment Removal		
a) Hydraulic Dredging (Option 2 - Approx. 394,968 CY)	$1,974,840	City of Highland
b) Sediment Storage & Retention Site Construction	$394,968	Illinois EPA & City of Highland
c) Estimating & Construction Contingency (10%)	$236,981	City of Highland
d) Design, Construction, & Permitting (20%)	$473,962	Illinois EPA & City of Highland
Total Sediment Removal	***$3,080,750***	Illinois EPA & City of Highland
3 In-Lake Aeration System		
a) Aeration System - Lower Portion of Highland Silver Lake	$200,000	Illinois EPA & City of Highland
b) Engineering Design & Coordination (15%)	$30,000	Illinois EPA & City of Highland
Total Lake Aeration System Cost	***$230,000***	Illinois EPA & City of Highland
4 Shoreline Stabilization		
a) Severe – Riprap (1,030 LF)	$77,250	Illinois EPA & City of Highland
b) Moderate – Riprap (4,892 LF)	$366,900	Illinois EPA & City of Highland
c) Slight - Vegetation (2,500 LF)	$62,500	Illinois EPA & City of Highland
d) Estimating & Construction Contingency (10%)	$50,665	Illinois EPA & City of Highland
e) Design, Construct.& Permitting (15%)	$75,998	Illinois EPA & City of Highland
Total Shoreline Stabilization Cost	***$633,313***	Illinois EPA & City of Highland
5 Fisheries Management		
a) Fish Attractor & Habitat Structures	$10,000	Illinois EPA & City of Highland
b) Engineering & Technical Assistance	$2,000	Illinois EPA & City of Highland
c) Supplemental Stocking, Surveys, etc.	N/A	IL DNR and City of Highland
Total Fisheries Management Cost	***$12,000***	Illinois EPA & City of Highland
6 Lake Restoration Technical Consultation And Phase 2 Report	***$45,000***	Illinois EPA & City of Highland
7 Phase 2 Sampling, Monitoring and Lab Analysis by IEPA	***$15,000***	Illinois EPA & City of Highland (labor for sampling/monitor.)
8 Public Education Program	***$5,000***	Illinois EPA & City of Highland
Total Proposed Phase 2 Budget	**$4,681,313**	Illlinois EPA & City of Highland

Given the magnitude of the lake and watershed restoration projects described in Part 2 of this Report and listed in Table 43, it is recommended that future projects are selected based on the availability of future match funds by the City of Highland, Federal, and state/local funding sources. This “phased” approach will allow individual projects to be completed in a reasonable time frame, as funding becomes available.

The suggested work schedule shown in Table 44 is based on the assumption that the Illinois Clean Lakes Program funding will be available and that the Phase 2 grant award would be made at the end of 2009, which would allow a project start date of March 2010. The restoration alternatives would be implemented between 2010 and 2013, with post restoration monitoring being completed in the year 2012. If future restoration projects are funded through the Section-319, Non-Point Source Pollution Program, an alternate work schedule (other than what is proposed in Table 43) will be required as part of subsequent 319-Program grant applications.

Table 44. Proposed Clean Lakes Phase 2 Project Schedule

Activity	2010 A M J J A S O N D	2011 J F M A M J J A S O N D	2012 J F M A M J J A S O N D	2013 J F M A M J J A S O N D
Implementation of Watershed	x x x x x x x x	x x x x x x x x	x x x x x x x x	x x x x x x x x
Land Treatment Practices				
Sediment Removal	x x x x x x x x	x x x x x x x x	x x x x x x x x	
Sediment & Nutrient Control Basin	x x x x x x x x	x x x x x x x x	x x x x x x x x	
Aeration/Destratification System		x x x x x x		
Shoreline Stabilization	x x x x x x	x x x x x x	x x x x x x	
Fish Habitat Structures		x x x x		
Fisheries Management	x x x x x x x x	x x x x x x x x	x x x x x x x x	x x x x x x x x
Surveys, Stocking, Habitat, etc.				
Public Education Program	x x x x x x x x

appropriated by the state legislature (http://www.epa.state.il.us/water/conservation-2000/iclp.html).

The IL EPA receives Federal funds through Section 319(h) of the Clean Water Act to help implement Illinois' Nonpoint Source Pollution (NPS) Management Program (319 Program). The purpose of the 319 Program is to work cooperatively with local units of government and other organizations toward protecting water quality by controlling NPS pollution. The 319 Program emphasizes: funding for implementing cost-effective corrective and preventative best management practices (BMPs) on a watershed scale; funding for the demonstration of new and innovative BMPs on a non-watershed scale; and the development of information/education NPS pollution control programs. The maximum Federal funding, under the 319 Program, is 60 percent of the total project cost. The remaining 40 percent is the responsibility of the applicant. The local match is limited to money or in-kind services to complete the approved project tasks. Local match can also be provided by the contractor, sub-contractor, project partners, and state grants (such as an ICLP Phase 2 grant). Local match cannot be Federal funds or funds used to match another Federal program. The annual deadline for Section 319-grant applications is August 1 (http://www.epa.state.il.us/water/watershed/forms/319-application.pdf).

Some of the larger-scale restoration projects may be more challenging to implement and may require additional funding, potentially from the City of Highland or other funding sources. To reduce internal nutrient sources already present within the lake, excessive amounts of accumulated sediment must be removed. While removing sediment would dramatically improve lake water quality, dredging is an expensive and large-scale project. The Illinois EPA does not typically help finance (the actual dredging portion of the project); however, the Illinois EPA has assisted in financing various components associated with dredging such as engineering, permitting, and retention site construction. To implement a dredging project, the City of Highland would likely be primarily responsible for funding.

Soil conservation practices implemented in the Highland Silver Lake watershed will likely be funded through the USDA Conservation Reserve Program (CRP) administered by the local Madison and Bond County Natural Resources Conservation

Service and the Soil and Water Conservation District. Within the watershed, participating landowners may provide matching funds and the USDA CRP Program may provide the remaining grant funds. An alternative may include assistance to the participatory landowners with matching contributions from the City of Highland.

H. Relationship to Other Pollution Control Programs

The ICLP intends that Phase 1 studies and subsequent Phase 2 restoration projects should be coordinated with all other applicable programs of other agencies that deal with water-related environmental concerns. ICLP funds are generally limited to those projects that apply an integrated watershed management approach toward improving and protecting the lake's water quality and recreational opportunities. The proposed Phase 2 or Section 319 restoration project(s) will be consistent with Illinois EPA's "Non-Point Source Management Program Report," which has been developed to provide an overview of ongoing and new program initiatives to address the water resource problems identified in the "Illinois Water Quality Report." To help measure and monitor progress of the proposed Phase 2 or Section 319 projects, Highland Silver Lake will continue to be monitored through the AMLP and VLMP.

The Illinois DNR has provided supplemental stocking and ongoing fisheries management assistance prior to 1994 through an agreement between the City of Highland and Illinois DNR. Also, the Madison and Bond County Soil and Water Conservation Districts and the USDA Natural Resources Conservation Service continues to provide assistance to landowners in the watershed related to soil and nutrient conservation, and have been committed to providing assistance in implementing the watershed land treatment practices through the Conservation Reserve Program and other similar programs such as The Wildlife Habitat Incentives Program (WHIP) and The Wetland Reserve Program (WRP).

I. Public Participation Summary

Public meetings were held at City Hall in Highland, IL on April 20 and June 19, 2006 to discuss the findings and recommendations of the Phase 1 Study and Report

and to solicit any questions and/or comments from City and local officials, the local lake commission, and the concerned local residents. A public notice was issued by the City of Highland in the local newspaper prior to the public meeting. Questions generated at the public meeting regarded water quality, sediment removal, watershed BMPs, stream bank erosion, and lake shoreline erosion. Generally, most of the questions were positive and informational, particularly with regard to logistics and implementation.

On June 4, 2008, the Illinois EPA issued comments for the draft report, which was submitted in May 2006 (Appendix G). HDR | CWI reviewed the comments and made modifications to the final report.

J. Operation and Maintenance Plan

If awarded a Phase 2 Clean Lakes or a Section-319 grant, the City of Highland will be responsible for the operation and maintenance of all recommended alternatives such as the shoreline stabilization, sediment removal and lake deepening, an in-lake sediment and nutrient control basin, fisheries management, and watershed land treatment practices. Shoreline erosion control measures will be inspected annually and repaired or replanted as required by the City of Highland. Watershed land treatment practices will be coordinated by the City of Highland with the Madison and Bond County Soil and Water Conservation Districts and the local USDA Natural Resources Conservation District. They will be inspected annually to insure continued effectiveness and participation in the CRP Program. Fisheries management activities will be continued by the Illinois DNR fisheries biologist on a biennial basis. The City of Highland will cooperatively monitor the coordination of the fish habitat structures in cooperation with the Illinois DNR.

K. Permit Requirements

Sediment removal from the upper end of the lake will require a Joint Application Permit from the U.S. Army Corps of Engineers (COE), the Illinois EPA, and the Illinois DNR. Since it is recommended to remove the sediment hydraulically while the lake is at normal pool, a Section 401 Water Quality Certification from the Illinois EPA for

discharging the clarified effluent water back to the lake will also be needed. Since an upland retention and dewatering site will be required for placement of the dredged sediment, a Phase 1 Archeological Survey will be required and submitted to the Illinois Historic Preservation Agency to insure that no significant cultural resources are present. A dam construction and operating permit may also be required from the Illinois DNR, Office of Water Resources for the sediment storage and dewatering impoundment. Structural shoreline stabilization work will also require a Joint Application Permit from the COE and can be included as part of the 404 Permit required for sediment removal. Coordination and consultation with the Illinois DNR, Illinois EPA, USDA Natural Resources Conservation Service, and the U.S. Fish and Wildlife Service will also be necessary. The permit application process will be initiated after the Phase 1 report is completed, and approval for funding of the Phase 2 Implementation Project is granted.

L. Environmental Evaluation

Will the project displace people?

The proposed project(s) are not anticipated to displace any people from residences or places of business.

Will the project deface existing residences or residential areas?

The proposed project(s) are not anticipated to have adverse impacts on residential areas. All in-lake and shoreline stabilization requirements will be completed within the City of Highland boundaries. No watershed land treatment practices will impact residential areas.

Will the project likely lead to changes in established land use patterns or an increase in development pressure?

The proposed project(s) will not likely lead to changes in established land use patterns as the predominant restoration area is located within the limits of Highland Silver Lake.

Will the project affect prime agricultural land or activities?

There will be no permanent negative impacts on prime agricultural lands from the project. Soil conservation measures applied in the watershed will help maintain soil fertility and control erosion on agricultural lands.

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

Highland Silver Lake and the surrounding land will have enhanced recreational, environmental and aesthetic value as a result of the proposed project.

Will the project adversely affect land or structures of historic, architectural, archeological, or cultural value?

In order to acquire a permit to construct a sediment retention and dewatering pond for the future storage of dredged sediment, a Phase 1 Archeological Survey will be completed to insure that no cultural resources are present.

Will the project lead to a significant long-range increase in energy demands?

There will be no long-term increase in energy demands as a result of the proposed project(s).

Will the project adversely affect short-term or long-term ambient air quality?

No long-term increase in traffic volume is expected as a result of the proposed project(s). Occasional short-term increases may occur during the installation of structural shoreline stabilization techniques. All construction equipment is expected to comply with noise and air pollution standards. Very few areas are bordered by residential development. Effects outside the immediate area of the implementation activities are not anticipated.

If the project involves the use of in-lake chemical treatment, will it cause short-term or long-term adverse impacts?

No short- or long-term adverse impacts are expected from the proper application of herbicide to selectively control excessive aquatic vegetation for public access and/or fisheries management purposes.

Will the project involve modification or construction in floodplain areas?

Shoreline stabilization practices would occur within the 100-year floodplain, which borders the lake. Structural shoreline stabilization and protection practices will be primarily utilized, and the planting of terrestrial and near shore emergent and submergent species resistant to erosive forces will be utilized when possible. There will eventually be accumulated sediment removed from the upper end of the lake, which will be completed in conjunction with an in-lake sediment and nutrient control basin.

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

No long-term adverse impacts will result from project activities. Shoreline erosion control practices may involve regrading and/or installation of structural practices such as riprap. Shoreline stabilization, as well as hydraulic dredging and construction of the sediment control basin, may include short-term impacts such as higher localized turbidity, restricted access in certain areas during construction, and minimal landscape damage from heavy equipment.

Will the proposed project have a significant adverse effect on fish and wildlife, wetlands, or other wildlife habitat?

No significant adverse effects on fish and wildlife, wetlands, or other wildlife habitat will occur as a result of the proposed project(s).

Will the project adversely impact threatened or endangered species?

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

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REFERENCES

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APPENDIX A

Guidance for Use of Qualified Analytical Results

Definition of Data Qualifier	IEPA Lab Qualifier Code	Suburban Qualifier Code	Prairie Qualifier Code	Teklab Qualifier Code
Averaged Result (Only to be used for Fish Field Data and Bacteria data).	A			
Value calculated. (Used for bacteria results and for calculated hardness value; reported result was calculated from other available data.)	C			
Estimated value: Analyte was detected between the specified reporting limit (RL) and the method detection limit (MDL).	J	J	J	J
Surrogate compound recovery limits have not been met	J1			
Internal Standard criteria were not met	J2	Q		
The reported value failed to meet the established quality control criteria for either precision or accuracy possibly due to matrix effects.	J3			
The sample matrix interfered with the ability to make any accurate determination (i.e. oily samples, high mineral content in SOCs, etc.)	J4			MI
“Blank Spike failed high, result was non-detect - impact on data may be minimal”	J5			
“Blank Spike failed high – possible high bias or false positive result”	J6			
“Blank Spike failed low – possible low bias or false non-detect result”	J7			
Spike recovery outside accepted limits.		S		S
The concentration of the analyte was above the acceptable level for quantitation (For bacteria, result calculated as if the smallest filtration volume had a count of 200).	L	E	E	E
Presence of material verified (i.e., positive detection). Value is estimated.	M			
Holding time exceeded.	Q	H	H	H
Sample received past holding time.			HT	
Test results provided by outside source.	S			
Indicates the analyte was detected in both the sample and the associated method blank and was outside method blank acceptance criteria.	V	B	B	B
Reported value should not be used. Some or all of the quality control data for the analyte were outside acceptance criteria, and the presence or absence of the analyte cannot be determined from the data.	X			
The laboratory analysis was performed on an unpreserved or improperly preserved sample.	Y			
Not detected. *Note: For Surface Water Section results, the ND qualifier should be used when the analyte is not detected at the method detection limit (MDL).*	ND	ND	ND	ND
Reporting limit				RL
RL (reporting limit) adjusted to MDL (method detection limit)			M	
RPD (Relative percent diffierence) outside acceptable recovery limits.		R	R	R
Dilution factor				DF
Not reported	NR			
Absent	_A			
Present	_P			
Results are not compliant with the NELAC standards	#			
Non-NELAP accredited for this analysis.	*	c		
Refer to case narraitive for specific requirements.		G		
Data Qualifiers Unique to Bacterial Samples				
Too Numerous to Count	TNTC	TNTC		TNTC
Mean of two or more colony counts within the acceptable range and at the same dilution.	A			
Results based on colony counts outside the acceptable range.	B			
Calculated. Two or more colony counts within the acceptable range, but at different dilutions.	C			

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Station Code	Sample Date	Depth ft.	Turb. NTU	Secchi In.	Cond. umho/cm	pH	TALK mg/l	PALK mg/l	TSS mg/l	VSS mg/l	NH3-N mg/l	TKN mg/l	NO2-NO3 mg/l	TPhos mg/l	DPhos mg/l	Total Depth
ROZA 1	05/21/81					7.9										
ROZA 1	06/18/81						70		13				0.02		0.010	
ROZA 1	07/30/81						30		8		0.10					
ROZA 1	09/03/81										0.04					
ROZA 1	10/06/81						70						0.58		0.013	
ROZA 1	03/16/83	1	120.0	5	194	6.8	45	0	42	22	0.26	2.40	3.20	0.440	0.140	21
ROZA 1	04/12/83	1	54.0	7	247	6.7	40	0	14	8	0.12	1.60	1.40	0.230	0.120	22
ROZA 1	05/10/83	1	54.0	4	146	6.4	40	0	6	3	0.11	1.70	0.42	0.310	0.140	21
ROZA 1	06/07/83	1	48.0	4	168	6.4	35	0	30	7	0.04	1.40	1.10	0.240	0.000	29
ROZA 1	07/27/83	1	16.0	12	182	7.3	40	0	7	3	0.10	1.50	1.50	0.180	0.100	22
ROZA 1	08/30/83	1	3.9	38	199	7.8	55	0	4	2	0.01	0.07	0.29	0.030	0.010	21
ROZA 1	10/05/83	1	8.1		204	7.3	50	0	32	4	0.16	0.70	0.73	0.120	0.040	26
ROZA 1	11/18/83	1	9.1	9	202	7.3	50	0	14	2	0.10	0.55	1.10	0.090	0.040	22
ROZA 1	12/29/83	1	90.0						32	2	0.21	1.60	0.94	0.460	0.300	
ROZA 1	04/29/85				168	7.1										
ROZA 1	06/10/85						50		9			1.10				
ROZA 1	07/24/85				160	6.7	40	0					0.02			
ROZA 1	09/04/85										0.10	0.70				
ROZA 1	10/16/85					7.4						0.70	0.14	0.271	0.025	
ROZA 1	04/20/88			20					57	7		1.10	0.21			
ROZA 1	05/19/88						45						0.20			
ROZA 1	06/23/88						70	15								
ROZA 1	07/13/88					8.6	70	10					0.23			
ROZA 1	08/22/88					7.8					0.16					
ROZA 1	09/20/88												0.10			
ROZA 1	10/20/88						75	0			0.10					
ROZA 1	04/25/90				254							1.10		0.100	0.045	
ROZA 1	05/22/90											1.60				
ROZA 1	06/11/90										0.10			0.446	0.183	
ROZA 1	08/14/90				238											
ROZA 1	09/20/90			14	206		85	10	5							
ROZA 1	10/11/90					7.0										
ROZA 1	04/06/93	1	31.0	11	171	7.6	65	0	20	6	0.58	1.88	1.30	0.368	0.254	25
ROZA 1	06/23/93	1	5.4	22	209	8.6	85	10	7	4	0.05	0.95	0.06	0.127	0.056	22
ROZA 1	07/21/93	1	5.4	29	220	8.7	70	10	14	8	0.01	0.68	0.01	0.130	0.071	25
ROZA 1	08/23/93	1	6.6	12	193	8.5	80	10	31	12	0.04	0.51	0.01	0.287	0.136	20
ROZA 1	10/18/93	1	30.0	11	151	7.1	65	0	24	5	0.41	0.97	0.47	0.257	0.128	24
Average		**1**	**34.4**	**14.1**	**195**	**7.5**	**58**	**4**	**19**	**6**	**0.14**	**1.14**	**0.64**	**0.240**	**0.095**	**23**
Median		**1**	**23.0**	**12**	**197**	**7.3**	**55**	**0**	**14**	**5**	**0.10**	**1.10**	**0.36**	**0.240**	**0.071**	**22**
Minimum		**1**	**3.9**	**4**	**146**	**6.4**	**30**	**0**	**4**	**2**	**0.01**	**0.07**	**0.01**	**0.030**	**0.000**	**20**
Maximum		**1**	**120.0**	**38**	**254**	**8.7**	**85**	**15**	**57**	**22**	**0.58**	**2.40**	**3.20**	**0.460**	**0.300**	**29**
Std. Dev.		**0.00**	**35.58**	**9.93**	**31.52**	**0.73**	**16.78**	**5.37**	**14.55**	**5.18**	**0.14**	**0.56**	**0.76**	**0.13**	**0.08**	**2.54**
Count	**37**	**14**	**14**	**14**	**18**	**20**	**23**	**18**	**19**	**15**	**20**	**20**	**22**	**17**	**19**	**13**
ROZA 2	05/21/81			15	264	8.3	75	10	17	12	0.03	1.00	0.08	0.084	0.023	12
ROZA 2	06/18/81			16	245	7.6	70	0	23	11	0.05	1.00	0.02	0.080	0.027	12
ROZA 2	07/30/81			10	185	6.9	40	0	25	6	0.24	1.30	0.15	0.171	0.084	12
ROZA 2	09/03/81			18	200	7.9	50	0	17	9	0.02	1.00	0.01	0.095	0.028	12
ROZA 2	10/06/81			10	219	7.2	60	0	13	5	0.23	1.20	0.24	0.079	0.030	12
ROZA 2	03/16/83	1	64.0	7	300	6.9	60	0	54	22	0.70	1.10	1.30	0.260	0.070	10
ROZA 2	04/12/83	1	50.0	5	282	6.6	60	0	34	8	0.26	2.70	0.62	0.280	0.110	10
ROZA 2	05/10/83	1	48.0	5	137	6.0	45	0	20	2	0.36	1.60	0.26	0.310	0.130	9
ROZA 2	06/07/83	1	46.0	3	170	6.2	30	0	40	8	0.31	2.20	2.30	0.330	0.510	10
ROZA 2	07/27/83	1	17.0	11	195	7.5	45	0	14	5	0.10	1.30	0.98	0.130	0.040	9
ROZA 2	08/30/83	1	4.0	24	212	7.3	50	0	25	15	0.10	0.10	0.25	0.100	0.030	8

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Station Code	Sample Date	Depth ft.	Turb. NTU	Secchi In.	Cond. umho/cm	pH	TALK mg/l	PALK mg/l	TSS mg/l	VSS mg/l	NH3-N mg/l	TKN mg/l	NO2-NO3 mg/l	TPhos mg/l	DPhos mg/l	Total Depth
ROZA 2	10/05/83	1	9.0	8	206	7.2	45	0	44	8	0.10	0.80	0.69	0.110	0.050	8
ROZA 2	11/18/83	1	8.0	8	202	7.0	45	0	18	3	0.25	0.10	1.21	0.170	0.090	9
ROZA 2	04/29/85			11	208	7.5	70	0	29	7	0.66	2.00	0.44	0.164	0.057	10
ROZA 2	06/10/85			6	204	7.2	45	0	10	1	0.10	1.10	1.55	0.192	0.142	9
ROZA 2	07/24/85			6	167	6.4	30	0	21	2	0.10	0.80	1.42	0.215	0.100	11
ROZA 2	09/04/85			8	207	6.5	50	0	25	6	0.14	1.00	0.98	0.173	0.055	9
ROZA 2	10/16/85			3	193	7.5	40	0	36	4	0.10	0.80	1.49	0.213	0.031	9
ROZA 2	04/20/88			2	255	6.7	45	10	64	9	0.36	1.60	1.70	0.260	0.097	9
ROZA 2	05/19/88			16	251	8.8	60	15	16	6	0.10	1.20	0.81	0.103	0.037	9
ROZA 2	06/23/88			12	160	8.5	85	5	26	9	0.10	1.40	0.10	0.144	0.036	8
ROZA 2	07/13/88			9	248	8.1	75	5	21	6	0.10	1.60	0.10	0.136	0.045	7
ROZA 2	08/22/88			10	204	7.3	95	0	34	8	0.21	0.90	0.10	0.221	0.083	7
ROZA 2	09/20/88			11	205	8.2	95	0	26	6	0.10	1.30	0.10	0.140	0.054	7
ROZA 2	10/20/88			13	199	8.2	90	0	17	5	0.10	1.40	0.10	0.127	0.022	7
ROZA 2	04/25/90			12	279	7.6	80	0	33	8	0.16	1.60	1.50	0.320	0.195	10
ROZA 2	05/22/90			4	160	6.9	60	0	106	12	0.37	1.60	0.45	0.617	0.480	9
ROZA 2	06/11/90			5	183	7.0	80	0	52	6	0.23	0.80	0.86	0.603	0.478	10
ROZA 2	08/14/90			9	204	7.5	70	0	33	5	0.01	1.10	1.50	0.515	0.112	10
ROZA 2	09/20/90			10	205	7.0	75	0	53	8	0.18	0.90	0.49	0.110	0.030	9
ROZA 2	10/11/90			10	199	7.6	70	0	39	7	0.03	0.70	0.88	0.418	0.217	9
ROZA 2	04/06/93	1	56.0	6	233	7.6	80	0	34	7	1.80	4.24	2.10	0.363	0.020	10
ROZA 2	06/23/93	1	4.4	20	223	8.9	90	50	8	6	0.20	1.13	0.10	0.211	0.114	10
ROZA 2	07/21/93	1	4.0	21	219	8.9	80	10	15	7	0.02	0.10	0.03	0.286	0.149	11
ROZA 2	08/23/93	1							3				0.01			
ROZA 2	10/18/93	1	28.0	9	208	7.1	8	0	46	8	0.41	1.25	0.47	0.535	0.352	10
Average		**1**	**28.2**	**10.1**	**212**	**7.4**	**61**	**3**	**30**	**7**	**0.24**	**1.25**	**0.71**	**0.236**	**0.118**	**10**
Median		**1**	**22.5**	**10**	**205**	**7.3**	**60**	**0**	**26**	**7**	**0.14**	**1.13**	**0.48**	**0.192**	**0.070**	**9**
Minimum		**1**	**4.0**	**2**	**137**	**6.0**	**8**	**0**	**3**	**1**	**0.01**	**0.10**	**0.01**	**0.079**	**0.020**	**7**
Maximum		**1**	**64.0**	**24**	**300**	**8.9**	**95**	**50**	**106**	**22**	**1.80**	**4.24**	**2.30**	**0.617**	**0.510**	**12**
Std. Dev.		**0.00**	**23.12**	**5.27**	**36.08**	**0.74**	**20.61**	**9.01**	**19.20**	**3.85**	**0.32**	**0.74**	**0.66**	**0.15**	**0.13**	**1.46**
Count	**36**	**13**	**12**	**35**	**35**	**35**	**35**	**35**	**36**	**35**	**35**	**35**	**36**	**35**	**35**	**35**
ROZA 3	05/21/81			3	214	6.5	45	0	270	44	0.45	2.60	2.70	0.664	0.274	3
ROZA 3	06/18/81			8	260	7.9	70	0	66	17	0.04	1.90	0.03	0.220	0.280	2
ROZA 3	07/30/81			7	120	6.4	35	0	90	17	0.44	2.10	0.32	0.642	0.320	2
ROZA 3	09/03/81			7	155	8.0	45	0	70	15	0.12	1.60	0.07	0.254	0.067	2
ROZA 3	10/06/81			7	215	7.8	60	0	95	15	0.03	1.60	0.02	0.194	0.042	2
ROZA 3	03/16/83	1	62.0	5	448	6.9	95	0	166	40	1.98	4.50	1.10	0.340	0.080	3
ROZA 3	04/12/83	1	44.0	4	346	6.7	80	0	100	18	0.39	2.40	0.52	0.420	0.110	2
ROZA 3	05/10/83	1	46.0	4	262	6.4	45	0	88	32	0.57	2.40	0.40	0.350	0.040	2
ROZA 3	06/07/83	1	44.0	20	230	6.5	35	0	15	3	0.53	4.40	2.80	0.390	0.075	3
ROZA 3	07/27/83	1	17.0	5	228	7.3	55	0	120	15	0.16	1.63	0.40	0.220	0.150	2
ROZA 3	08/30/83	1	12.0	8	232	7.3	75	0	60	35	0.22	2.44	0.10	0.270	0.500	2
ROZA 3	10/05/83	1	10.0	10	226	7.4	50	0	66	14	0.20	1.50	0.21	0.180	0.040	3
ROZA 3	11/18/83	1	19.0	6	236	6.9	45	0	41	10	0.51	1.85	0.81	0.450	0.270	2
ROZA 3	04/29/85			8	327	8.3	100	0	75	19	0.43	2.70	0.01	0.280	0.104	2
ROZA 3	06/10/85			5	269	6.9	50	0	100	10	0.80	2.70	4.01	0.273	0.238	3
ROZA 3	07/24/85			6	244	7.3	45	0	23	7	0.10	3.60	0.31	0.369	0.057	2
ROZA 3	09/04/85			8	241	6.5	50	0	95	13	0.27	2.00	0.33	0.226	0.046	2
ROZA 3	10/16/85			3	215	8.1	50	0	62	10	0.11	2.00	0.54	0.233	0.030	2
ROZA 3	04/20/88			6	357	8.2	65	10	57	13	0.10	2.30	0.77	0.235	0.065	2
ROZA 3	05/19/88			10	354	7.5	45	10	45	12	0.28	2.00	0.16	0.272	0.090	2
ROZA 3	06/23/88			3	319	8.4	115	15	98	22	0.10	1.00	0.10	0.345	0.064	2
ROZA 3	07/13/88			6	288	8.5	110	15	65	17	0.10	3.20	0.10	0.335	0.070	2
ROZA 3	08/22/88			6	302	8.2	115	10	64	16	0.10	2.40	0.11	0.402	0.072	2

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Station Code	Sample Date	Depth ft.	Turb. NTU	Secchi In.	Cond. umho/cm	pH	TALK mg/l	PALK mg/l	TSS mg/l	VSS mg/l	NH3-N mg/l	TKN mg/l	NO2-NO3 mg/l	TPhos mg/l	DPhos mg/l	Total Depth
ROZA 3	09/20/88			8	307	8.1	110	10	77	14	0.10	2.40	0.10	0.269	0.072	2
ROZA 3	10/20/88			9	301	8.2	95	10	37	12	0.10	2.50	0.21	0.262	0.047	2
ROZA 3	04/25/90			7	387	7.3	90	0	58	10	0.30	2.00	0.71	0.645	0.425	3
ROZA 3	05/22/90			4	238	7.1	90	0	166	20	0.39	2.00	0.35	0.856	0.656	3
ROZA 3	06/11/90			6	249	7.0	120	0	76	12	0.79	1.20	0.27	0.995	0.764	3
ROZA 3	08/14/90			7	230	8.1	100	0	126	36	0.21	3.90	0.44	0.335	0.095	3
ROZA 3	09/20/90			9	227	8.9	95	10	73	22	0.06	2.00	0.07	0.250	0.050	3
ROZA 3	10/11/90			7	241	7.1	60	0	56	9	0.12	2.00	0.11	1.010	0.904	3
ROZA 3	04/06/93	1	44.0	6	421	7.7	120	0	104	16	0.64	2.69	1.80	0.281	0.073	3
ROZA 3	06/23/93	1	9.8	9	316	8.0	125	0	38	12	0.27	2.10	0.30	0.395	0.112	2
ROZA 3	07/21/93	1	14.0	11	162	7.0	60	0	44	10	0.20	1.70	0.70	0.115	0.088	2
ROZA 3	08/23/93	1	13.0	7	217	9.0	100	10	68	20	0.84	0.10	0.01	0.429	0.150	2
ROZA 3	10/18/93	1	45.0	6	265	6.9	88	0	23	5	0.09	1.46	1.30	0.155	0.128	3
Average		**1**	**29.2**	**7.0**	**268**	**7.5**	**76**	**3**	**80**	**17**	**0.34**	**2.25**	**0.62**	**0.377**	**0.185**	**2**
Median		**1**	**19.0**	**7**	**247**	**7.4**	**73**	**0**	**69**	**15**	**0.22**	**2.05**	**0.32**	**0.308**	**0.089**	**2**
Minimum		**1**	**9.8**	**3**	**120**	**6.4**	**35**	**0**	**15**	**3**	**0.03**	**0.10**	**0.01**	**0.115**	**0.030**	**2**
Maximum		**1**	**62.0**	**20**	**448**	**9.0**	**125**	**15**	**270**	**44**	**1.98**	**4.50**	**4.01**	**1.010**	**0.904**	**3**
Std. Dev.		**0.00**	**18.38**	**3.00**	**70.63**	**0.73**	**28.38**	**4.99**	**47.46**	**9.49**	**0.36**	**0.88**	**0.89**	**0.22**	**0.21**	**0.49**
Count	**36**	**13**	**13**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**	**36**

Highland Silver Lake
IEPA Chemical Analysis Data
Lake Samples - Phase I

Station Code	Sample Date	Sample Time	Depth ft.	Temp C	Secchi In.	Cond. umho/cm	pH	TALK mg/l	PALK mg/l	TSS mg/l	Data Qualifiers	VSS mg/l	Data Qualifiers	NH3-N mg/l	Data Qualifiers	TKN mg/l	Data Qualifiers	NO2-NO3 mg/l	Data Qualifiers	TPhos mg/l	Data Qualifiers	DPhos mg/l	Data Qualifiers	Total Depth
ROZA-1	09/27/04	10:10	1		21.0	207.0	8.8	112.0	2.0	12.0		11.0		<0.05	ND	<0.5	J,X,ND	0.05	ND	0.145		0.047		23.0
ROZA-1	10/19/04	9:40	1	3	25.0	192.0	8.3	NR	NR	9.0		5.0		0.060		0.82	X,Y	0.11	Y	0.101	J	0.033		23.0
ROZA-1	11/08/04	9:35	1	3	28.0	191.0	8.0	NR	NR	10.0	Q	4.0	Q,ND	0.060		2.60	X	0.16		NR		NR		25.0
ROZA-1	12/06/04	9:30	1	3	15.0	182.0	7.8	NR	NR	9.0		4.0	ND	0.270		1.26	X	0.32		NR		NR		24.0
ROZA-1	03/29/05	9:13	1	6	9.0	177.0	8.5	NR	NR	12.0		4.0	ND	0.300		1.15	X	0.68		0.215	X	NS		21.0
ROZA-1	04/22/05	11:00	1	4	15.0	210.0	7.5	NR	NR	4.0	ND	4.0	ND	<0.5	ND	<0.5	X,J,ND	0.87		0.196		0.140		23.0
ROZA-1	04/22/05	11:55	1	2	12.0	194.0	8.5	NR	NR	4.0	ND	4.0	ND	0.130		<0.5	X,J,ND	0.92		0.247		0.158		22.0
ROZA-1	05/08/05	13:15	1	6	45.0	NR	NR	NR	NR	10.0		4.0	J,ND	0.050	ND	0.78	X	0.92		0.208		0.150		25.0
ROZA-1	05/29/05	11:00	1	3	21.0	NR	NR	NR	NR	10.0		4.0	J,ND	0.050	ND	1.53	X	0.18		0.088		0.057		25.0
ROZA-1	06/13/05	10:00	1	8	28.0	243.0	8.3	110.0	0.0	4.0	Y,J,ND	6.0	Y,J	0.050	Y,ND	<0.5	Y,X,J,ND	0.05	Y,J,ND	0.168	Y	0.097	Y	22.0
ROZA-1	06/19/05	13:15	1	11	25.0	NR	NR	NR	NR	4.0	Y,J,ND	2.0	Y,J	0.160	Y	0.95	Y,X	0.05	Y,J,ND	0.184	Y	0.115	Y	24.0
ROZA-1	07/10/05	13:00	1	9	17.0	NR	NR	NR	NR	12.0		4.0	Y	0.100	Y,ND	1.36	X,Y	0.05	Y,ND	0.191	Y	0.142	Y	24.0
ROZA-1	07/27/05	11:45	1	12	17.0	249.0	9.0	116.0	4.0	11.0	Y	9.0		0.100	ND	0.96		0.05	J4,ND	0.358		0.243		18.0
ROZA-1	08/16/05	12:15	1	7	21.0	252.0	8.8	120.0	13.0	9.0		7.0		0.190		1.62		0.03		0.441		0.319		
ROZA-1	08/21/05	14:30	1	3	18.0					13.0	Q,X	11.0	Q,X	0.100	J,ND	2.21	Q,X	0.01		0.374				18.0
ROZA-1	09/04/05	11:20	1	4	16.0					14.0	X	12.0	X	<0.1	ND			0.05	J4,ND	0.568		0.354		22.0
ROZA-1	09/18/05	12:30	1	5	20.0					12.0	X	8.0	X	0.380				0.05	ND	0.441		0.334		22.0
ROZA-1	10/12/05	1:40	1		20.0	258.0	7.7	144.0	13.0	14.0		9.0		0.130		1.68		0.07		0.237		0.122		
ROZA-1	10/23/05	12:30	1		18.0					12.0	Q,X	6.0	Q,X	0.180		0.90	Q,X	0.05	ND	0.168		0.061		25.0
Average			**1.0**		**20.6**	**214.1**	**8.3**	**120.4**	**6.4**	**9.7**		**6.2**		**0.144**		**1.371**		**0.246**		**0.255**		**0.158**		**22.7**
Median			**1.0**		**20.0**	**207.0**	**8.3**	**116.0**	**4.0**	**10.0**		**5.0**		**0.115**		**1.3**		**0.1**		**0.208**		**0.140**		**23.0**
Minimum			**0.5**		**9.0**	**177.0**	**7.5**	**110.0**	**0.0**	**4.0**		**2.0**		**0.050**		**0.8**		**0.0**		**0.088**		**0.033**		**18.0**
Maximum			**1.0**		**45.0**	**258.0**	**9.0**	**144.0**	**13.0**	**14.0**		**12.0**		**0.380**		**2.6**		**0.9**		**0.568**		**0.354**		**25.0**
Std. Dev.			**0.1**		**7.7**	**30.5**	**0.5**	**13.7**	**6.2**	**3.4**		**3.0**		**0.1**		**0.6**		**0.3**		**0.1**		**0.1**		**2.2**
Count			**19.0**		**19.0**	**11.0**	**11.0**	**5.0**	**5.0**	**19.0**		**19.0**		**16.0**		**13.0**		**19.0**		**17.0**		**15.0**		**17.0**
ROZA-1	06/13/05	10:00	9		28.0	245.0	7.5	110.0	0.0	4.0	ND	4.0	ND	<0.05	ND	<0.5	X,J,ND	0.05	J,ND	0.192		0.127		22.0
ROZA-1	07/27/05	11:45	9		17.0	250.0	8.7	120.0	2.0	11.0		8.0		<0.1	ND	1.40		0.05	J,ND	0.345		0.244		18.0
ROZA-1	08/16/05	12:15	9		21.0	NR	NR	NR	NR	10.0		7.0		0.160		1.34		0.04		0.422		0.311		18.0
ROZA-1	10/12/05	11:40	9		20.0	NR	NR	NR	NR	13.0		6.0		0.140		1.51		0.07		0.232		0.129		18.0
Average			**9.0**		**21.5**	**247.5**	**8.1**	**115.0**	**1.0**	**9.5**		**6.3**		**0.150**		**1.417**		**0.053**		**0.298**		**0.203**		**19.0**
Median			**9.0**		**20.5**	**247.5**	**8.1**	**115.0**	**1.0**	**10.5**		**6.5**		**0.150**		**1.4**		**0.1**		**0.289**		**0.187**		**18.0**
Minimum			**9.0**		**17.0**	**245.0**	**7.5**	**110.0**	**0.0**	**4.0**		**4.0**		**0.140**		**1.3**		**0.0**		**0.192**		**0.127**		**18.0**
Maximum			**9.0**		**28.0**	**250.0**	**8.7**	**120.0**	**2.0**	**13.0**		**8.0**		**0.160**		**1.5**		**0.1**		**0.422**		**0.311**		**22.0**
Std. Dev.			**0.0**		**4.7**	**3.5**	**0.8**	**7.1**	**1.4**	**3.9**		**1.7**		**0.0**		**0.1**		**0.0**		**0.1**		**0.1**		**2.0**
Count			**4.0**		**4.0**	**2.0**	**2.0**	**2.0**	**2.0**	**4.0**		**4.0**		**2.0**		**3.0**		**4.0**		**4.0**		**4.0**		**4.0**
ROZA-1B	09/27/04	10:10	21			220.0	7.2			17.0		10.0		0.100		<0.5	X,J,ND	0.05	J,ND	0.168		0.084		23.0
ROZA-1B	10/19/04	9:40	21	3		192.0	8.1			15.0		4.0	ND	0.070		1.11	X	0.11		0.107	J	0.034		23.0
ROZA-1B	11/08/04	9:35	23	3		191.0	8.1			8.0	Q	4.0	Q,ND	0.060		0.81	X	0.16						25.0
ROZA-1B	12/06/04	9:30	22	3		182.0	8.1			4.0		2.0		0.290				0.32						24.0
ROZA-1B	03/29/05	9:13	19	6		177.0	8.7			8.0		4.0	ND	0.290		1.11	J3,X	0.68		0.258	X			21.0
ROZA-1B	04/22/05	11:00	21	4		209.0	7.0	92.0	0.0	8.0		4.0	ND	<0.05	ND	0.62	X	0.82		0.235		0.138		23.0
ROZA-1B	04/22/05	11:11	20	2		270.0	8.5			<8	ND	4.0	ND	<0.05	ND	0.52	X	0.91		0.243		0.152		22.0
ROZA-1B	05/08/05	13:30	23	6		NR	NR	NR	NR	8.0		4.0	J,ND	0.120		<0.5	X,J,ND	0.91		0.268		0.143		25.0
ROZA-1B	05/29/05	11:00	23	3		NR	NR	NR	NR	14.0		4.0	J,ND	0.350		1.46	X	0.22		0.329		0.250		25.0
ROZA-1B	06/13/05	10:00	20	8		274.0	7.0	120.0	0.0	<8	J,ND	4.0	J,ND	<0.05	J,ND	1.10	X	0.05	J,ND	0.793		0.631		22.0
ROZA-1B	06/19/05	13:15	22	11		NR	NR	NR	NR	16.0	Y	4.0	Y,J,ND	1.150	Y	1.84	Y,X	0.05	Y,J,ND	1.533	Y	1.615	Y	23.0
ROZA-1B	07/10/05	13:00	23	9		NR	NR	NR	NR	12.0	Y	8.0	Y	2.850	Y	3.38	X,Y	0.05	Y,ND	2.045	Y	1.182	Y	25.0
ROZA-1B	07/27/05	11:45	16	12		NR	7.1	136.0	0.0	10.0		7.0		<0.1	ND	1.68		0.05	J,ND	0.784		0.642		18.0
ROZA-1B	08/16/05	12:15	20	7		NR	NR	NR	NR	12.0		8.0		4.840		7.33		0.02		1.870		1.740		
ROZA-1B	08/21/05	14:30	21	3		NR	NR	NR	NR	18.0	Q,X	12.0	Q,X	5.610		7.07	Q,X	0.05	J,ND	2.245		1.975		23.0
ROZA-1B	09/04/05	12:00	20	4						40.0	X	20.0	X	6.710				0.05	J,ND	1.789		2.499		22.0
ROZA-1B	09/18/05	12:45	20	5						17.0	X	9.0	X	0.450				0.10	J,ND	0.571		0.340		22.0
ROZA-1B	10/12/05	11:40	21			NR	NR	NR	NR	15.0		7.0		0.140		1.39		0.08		0.230		0.124		
ROZA-1B	10/23/05	12:45	25			NR	NR	NR	NR	13.0	Q,X	6.0	Q,X	0.210		1.03	Q,X	0.05	J,ND	0.564		0.067		24.0
Average			**21.11**					**116.0**	**0.0**	**13.82**		**6.58**		**1.549**		**2.18**		**0.25**		**0.825**		**0.726**		**22.94**
Median			**21.00**					**120.0**	**0.0**	**13.00**		**4.00**		**0.290**		**1.25**		**0.08**		**0.564**		**0.295**		**23.00**
Minimum			**16.00**					**92.0**	**0.0**	**4.00**		**2.00**		**0.060**		**0.52**		**0.02**		**0.107**		**0.034**		**18.00**
Maximum			**25.00**					**136.0**	**0.0**	**40.00**		**20.00**		**6.710**		**7.33**		**0.91**		**2.245**		**2.499**		**25.00**
Std. Dev.			**1.94**			**38.18**	**0.68**	**22.27**	**0.00**	**7.84**		**4.17**		**2.30**		**2.24**		**0.32**		**0.75**		**0.81**		**1.78**
Count			**19.00**			**8.00**	**9.00**	**3.00**	**3.00**	**17.00**		**19.00**		**15.00**		**14.00**		**19.00**		**17.00**		**16.00**		**17.00**
ROZA-2	09/27/04	13:30	1		12.0	210.0	8.3	108.0		37.0		15.0		<0.05	ND	0.53	X	0.05	ND	0.155		0.053		8.0
ROZA-2	10/19/04	10:20	1	3	14.0	191.0	8.8			71.0		15.0		<0.05	ND	2.60	X	0.69		1.400	J,L	1.000	L	8.0
ROZA-2	11/08/04	10:25	1	3	11.0	198.0	8.2			20.0	Q	4.0	Q,ND	0.130		1.89	X	0.10						9.0
ROZA-2	12/06/04	10:15	1	3	8.0	156.0	8.0			14.0		4.0	ND	<0.05	J,ND	1.50	X	0.34		<0.01	X,ND			9.0

Highland Silver Lake
IEPA Chemical Analysis Data
Lake Samples - Phase I

Station Code	Sample Date	Sample Time	Depth ft.	Temp C	Secchi In.	Cond. umho/cm	pH	TALK mg/l	PALK mg/l	TSS mg/l	Data Qualifiers	VSS mg/l	Data Qualifiers	NH3-N mg/l	Data Qualifiers	TKN mg/l	Data Qualifiers	NO2-NO3 mg/l	Data Qualifiers	TPhos mg/l	Data Qualifiers	DPhos mg/l	Data Qualifiers	Total Depth
ROZA-2	03/29/05	10:24	1	6	8.0	239.0	8.7			4.0	ND	4.0	ND	0.380		1.35	X	0.53		0.408	X			9.0
ROZA-2	04/22/05	12:20	1	4	15.0	255.0	9.0	92.0	10.0	20.0		4.0	ND	<0.05	ND	1.56	X	0.27		0.126		0.045		8.0
ROZA-2	04/22/05	12:21	1	2	14.0	235.0	9.4			22.0		8.0		<0.05	ND	<0.50	J,X,ND	0.26		0.131		0.048		9.0
ROZA-2	05/08/05	15:00	1	6	15.0	166.0	7.9			18.0		4.0	J,ND	<0.05	ND	1.98	X	0.05	J,ND	0.236		0.040		9.0
ROZA-2	05/29/05	15:30	1	3	12.0	NR	NR	NR	NR	36.0		10.0		<0.05	ND	1.89	X	0.05	J,ND	0.190		0.095		8.0
ROZA-2	06/13/05	10:45	1	8	13.0	273.0	8.0	118.0	0.0	26.0		10.0		0.050		0.54	X	0.05	J,ND	0.258		0.132		8.0
ROZA-2	06/19/05	14:00	1	11	15.0	NR	NR	NR	NR	18.0	Y	4.0	Y,J,ND	0.070	Y	0.89	Y,X	0.05	Y,J,ND	0.264	Y	0.153	Y	8.0
ROZA-2	07/10/05	14:00	1	9	11.0	NR	NR	NR	NR	20.0		10.0		<0.1	Y,ND	1.67	X,Y	0.05	J,Y,ND	0.389	Y	0.244	Y	8.0
ROZA-2	07/27/05	12:30	1	12	12.0	258.0	9.0	114.0	4.0	20.0	Y	15.0		<0.1	ND	1.80	Y	0.05	Y	0.408	J3	0.288		7.0
ROZA-2	08/16/05	13:05	1	7	14.0	261.0	8.4	128.0	13.0	22.0		11.0		0.370		1.91		0.04		0.555		0.377		
ROZA-2	08/21/05	13:00	1	3	14.0	NR	NR	NR	NR	18.0	Q,X	11.0	Q,X	<0.1		3.52	Q,X	0.05	ND	0.466		0.327		7.0
ROZA-2	09/04/05	12:45	1	4	12.0					18.0	X	11.0	X	<0.1	J,ND			0.05	ND	0.485		0.315		7.0
ROZA-2	09/18/05	13:30	1	5	10.0					26.0	X	12.0	X	0.180				0.05	J,ND	0.365		0.245		7.0
ROZA-2	10/12/05	12:20	1		12.0	250.0	7.8	152.0	12.0	34.0		11.0		0.110		1.37		0.02		0.276		0.074		
ROZA-2	10/23/05	14:30	1		11.0					22.0	X,Q	6.0	Q,X	0.260		1.08	Q,X	0.05	J,ND	0.130		0.042		9.0
Average			**1**		**12.3**	**224**	**8.5**	**119**	**8**	**24.53**		**8.89**		**0.194**		**1.63**		**0.15**		**0.367**		**0.217**		**8.1**
Median			**1**		**12**	**237**	**8**	**116**	**10**	**20**		**10**		**0.155**		**1.62**		**0.05**		**0.276**		**0.143**		**8.0**
Minimum			**1**		**8**	**156**	**8**	**92**	**0**	**4**		**4**		**0.050**		**0.53**		**0.02**		**0.126**		**0.040**		**7.0**
Maximum			**1**		**15**	**273**	**9**	**152**	**13**	**71**		**15**		**0.380**		**3.52**		**0.69**		**1.400**		**1.000**		**9.0**
Std. Dev.			**0.00**		**2.13**	**39.15**	**0.51**	**20.23**	**5.59**	**13.63**		**4.05**		**0.13**		**0.74**		**0.19**		**0.30**		**0.24**		**0.78**
Count			**19**		**19**	**12**	**12**	**6**	**5**	**19**		**19**		**8**		**16**		**19**		**17**		**16**		**17**
ROZA-3	09/27/04	11:40	1		7.0	221.0	7.3	118.0	0.0	82.0		19.0		<0.05	ND	1.70	X	0.05	J,ND	NR		0.039		3.0
ROZA-3	10/19/04	10:55	1	3	5.0	173.0	8.4			125.0		23.0		<0.05	J,ND	2.18	X	0.86		1.000	J,L	1.000	L	3.0
ROZA-3	11/08/04	11:05	1	3	7.0	215.0	8.2			60.0	Q	8.0	Q	0.240		1.75	X	0.20		NR		NR		2.0
ROZA-3	12/06/04	10:50	1	3	9.0	287.0	8.4			15.0		4.0	ND	0.100		1.39	X	0.67		NR		NR		3.0
ROZA-3	03/29/05	10:48	1	6	5.0	466.0	8.8			76.0		12.0		0.820		2.56	X	2.09		0.316	X	NR		3.0
ROZA-3	04/22/05	13:00	1	4	10.0	475.0	8.0	176.0	0.0	90.0		18.0		<0.05	ND	0.78	X	0.05	J	0.244		0.086	J3	2.0
ROZA-3	04/22/05	12:56	1	2	9.0	439.0	8.9			64.0		12.0		<0.05	ND	1.10	X	0.05	J,ND	0.229		0.086		2.0
ROZA-3	05/08/05	16:00	1	6	13.0	NR	NR	NR	NR	28.0		4.0	J,ND	0.100		0.83	X	0.05	J,ND	0.196		0.096		2.0
ROZA-3	05/29/05	13:30	1	3	9.0	NR	NR	NR	NR	34.0		8.0		<0.05	ND	2.72	X	0.12		0.238		0.129		2.0
ROZA-3	06/13/05	11:10	1	8	12.0	400.0	7.3	186.0	0.0	30.0		12.0		0.340		0.98	Y,X	0.05	J,ND	0.590		0.329		2.0
ROZA-3	06/19/05	15:00	1	11	8.0	NR	NR	NR	NR	60.0	Y	10.0	Y	0.240	Y	0.99	Y,X	0.04	Y,J,ND	0.439	X	0.237	Y	2.0
ROZA-3	07/10/05	14:30	1	9	7.0	NR	NR	NR	NR	36.0	Y	10.0	Y	<0.1	Y,ND	1.46	Y,X	0.05	Y,J4,J7,ND	0.731	J3,Y	0.364	Y	2.0
ROZA-3	07/27/05	13:00	1	12	7.0	371.0	8.1	190.0	0.0	167.0		21.0		<0.1	J,ND	0.87		0.05	ND	0.846		0.417		2.0
ROZA-3	08/16/05	13:30	1	7	7.0	361.0	8.1	168.0	14.0	107.0		23.0		0.140		2.61		0.04		0.774		0.308		
ROZA-3	08/21/05	11:30	1	3	9.0	NR	NR	NR	NR	58.0	Q,X	16.0	Q,X	<0.1	J,ND	2.46	Q,X	0.05	ND	0.732		0.364		2.0
ROZA-3	09/04/05	13:45	1	4	6.0					65.0	X	13.0	X	<0.1	J,ND			0.05	ND	0.640		0.231		1.5
ROZA-3	09/18/05	14:15	1	5	7.0					69.0	X	20.0	X	<0.1	J,ND			0.05	J,ND	0.374		0.116		3.5
ROZA-3	10/12/05	12:40	1		9.0	236.0	7.2	146.0	13.0	35.0		13.0		0.100		1.90		0.02		0.389		0.110		
ROZA-3	10/23/05	16:50	1		8.0					47.0	Q,X	10.0	Q,X	0.160		0.82	Q,X	0.05	J,ND	0.242		0.049		2.5
Average			**1**		**8.1**	**331**	**8.1**	**164**	**5**	**65.68**		**13.47**		**0.249**		**1.59**		**0.24**		**0.499**		**0.248**		**2.3**
Median			**1**		**8**	**361**	**8**	**172**	**0**	**60**		**12**		**0.160**		**1**		**0**		**0.414**		**0.180**		**2.0**
Minimum			**1**		**5**	**173**	**7**	**118**	**0**	**15**		**4**		**0.100**		**1**		**0**		**0.196**		**0.039**		**1.5**
Maximum			**1**		**13**	**475**	**9**	**190**	**14**	**167**		**23**		**0.820**		**3**		**2**		**1.000**		**1.000**		**3.5**
Std. Dev.			**0.00**		**2.08**	**109.25**	**0.58**	**27.42**	**6.98**	**37.29**		**5.87**		**0.23**		**0.70**		**0.50**		**0.26**		**0.24**		**0.56**
Count			**19.00**		**19.00**	**11.00**	**11.00**	**6.00**	**6.00**	**19.00**		**19.00**		**9.00**		**17.00**		**19.00**		**16.00**		**16.00**		**17.00**

Statistics were calculated using all data shown.
X qualified data or data not used per IL EPA request
Non-detect results - estimated value represents 50% of laboratory reporting limit
Data outlier removed from evaluation

Highland Silver Lake
IEPA Chemical Analysis Data
Tributary Samples - Phase I

Station Code	Sample Date	Sample Time	Staff	Sample Depth	Temp C	Cond. umho/cm	DO mg/l	TSS mg/l	Data Qualifiers	VSS mg/l	Data Qualifiers	NH3-N mg/l	Data Qualifiers	TKN mg/l	Data Qualifiers	NO2-NO3 mg/l	Data Qualifiers	TPhos mg/l	Data Qualifiers	DPhos mg/l	Data Qualifiers
ROZA-T1	10/14/04	18:45		1.0		-	-	12.0		4.0	ND	0.080		0.84		0.08		0.173		-	
ROZA-T1	10/18/04	7:15		1.0		-	-	10.0		4.0	ND	0.050		0.82		0.11		0.090		-	
ROZA-T1	10/23/04	7:10		1.0		-	-	9.0		4.0	ND	0.100		0.90		0.15		0.071		-	
ROZA-T1	10/26/04	18:30		1.0	12	-	-	16.0	Q,Y	4.0	Q,Y,ND	0.050	Y	0.19		NR	Y	NR		-	
ROZA-T1	11/01/04	16:20		1.0	9	-	-	NR		NR		0.050	Y	NR		0.17	Y	0.072	Y	-	
ROZA-T1	11/11/04	7:00		1.0	10	-	-	10.0	Y	4.0	Y,ND	<0.05	Y,ND	0.67	X,Y	0.17	Y	NR		-	
ROZA-T1	11/24/04	10:20		1.0	NR	-	-	64.0	X,Y	14.0	X,Y	0.140	Y	1.37	X,Y	0.24	Y	NR		-	
ROZA-T1	11/30/04	15:50		1.0	6			4.0	ND	4.0	ND	0.250				0.24		NR			
ROZA-T1	12/04/04	4:50		1.0	8			4.0	ND	4.0	ND	0.300	Y	1.36		0.32	Y	NR			
ROZA-T1	12/06/04	9:30		1.0		182.0		4.0	Y,ND	4.0	Y,ND	0.270		1.26	X	0.32					
ROZA-T1	03/29/05	9:13		1.0		177.0		12.0		4.0	ND	0.300		1.15		0.68		0.215			
ROZA-T1	04/22/05	11:00		1.0		210.0		4.0	ND	4.0	ND	<0.05		0.05		0.87		0.196		0.140	
ROZA-T1	04/22/05	11:55		1.0		194.0		4.0	ND	4.0	ND	0.130		0.05		0.92		0.247		0.158	
ROZA-T1	05/08/05	13:15		1.0				10.0		4.0	ND	<0.05		0.78		0.92	Y	0.208		0.150	
ROZA-T1	05/12/05	13:00		1.0	17			8.0	Y	4.0	Y,ND	0.070	Y	<0.5	Y,X,J,ND	0.78	Y	0.168	Y		
ROZA-T1	05/20/05	14:20		1.0	16			12.0	Y	4.0	Y,J,ND	<0.05	Y,J,ND	0.51	Y,X	0.05	Y,J,ND	0.150	Y		
ROZA-T1	06/13/05	21:00		1.0	18			10.0	Y	4.0	Y,J,ND	<0.05	Y,ND	0.15	Y,X	0.05	Y,J,ND	0.150	Y		
ROZA-T1	07/12/05	9:30		1.0	23			18.0	Y	8.0	Y	<0.1	Y,ND	1.19	Y,X	0.05	Y,J,ND	0.235	Y		
ROZA-T1	07/13/05	8:30		1.0	22			14.0	Y	8.0	Y	<0.1	Y,J,ND	1.28	X,Y	0.05	J7,J,Y,ND	0.266	Y		
ROZA-T1	07/27/05	5:50		1.0	10			28.0	Y	12.0	Y	<0.1	Y,J,ND	0.65	Y	0.05	Y,J,ND	0.354	Y		
ROZA-T1	08/05/05	8:20		1.0	24			4.0	Y,Q	4.0	Y,Q,	<0.1	Y,J,ND	1.35	Y	0.05	Y,ND	0.363	Y		
ROZA-T1	08/14/05	5:30		1.0				10.0	Y,X,Q	8.0	Y,X,Q	<0.1	Y	0.92	Y,X	0.05	Y,J,ND	0.383	Y		
ROZA-T1	08/16/05	8:15		1.0	20			10.0	Y,X,Q	8.0	Y,X,Q	0.180	Y	1.08	Y,X	0.05	Y,J,ND	0.465	Y		
ROZA-T1	08/26/05	16:00		1.0	22			13.0	Y,X	10.0	Y	<0.1	Y,J,ND	1.23	Y,X	0.05	Y,J,ND	0.418	Y		
ROZA-T1	08/26/05	17:30		1.0	11			8.0	Y,X	5.0	Y,X	0.180	Y	1.63	Y,Q,X	0.05	Y,J,ND	0.414	Y		
ROZA-T1	09/14/05	8:30		1.0	17			5.0		5.0	Y,X	0.270	Y			0.05	Y,J,ND	0.487	Y		
ROZA-T1	09/15/05	17:00		1.0	23			15.0	Y,X	7.0	X,Y	<0.1	ND			0.05	Y,J,ND	0.448	Y		
ROZA-T1	09/20/05	5:15		1.0	6			8.0	X	7.0	X,Y	<0.1	ND			0.71		1.106			
ROZA-T1	09/25/05	17:30		1.0	8			6.0	Y,X	6.0	Y,X	0.150	Y	1.47	Q,Y,X	0.23	Y	0.369	Y		
ROZA-T1	09/29/05	6:00		1.0	8			10.0	Y,X	6.0	X,Y	0.110	Y	1.18	Q,Y,X	0.25	Y	0.318	Y		
ROZA-T1	10/21/05	8:00		1.0				12.0	Y,X	5.0	Y,X	0.170	Y	0.85	Q,Y,X	0.05	Y,J,ND	0.181	Y		
ROZA-T1	10/31/05	14:30		1.0				6.0	Q,X	6.0	Q,X	0.330		1.12	Q,X	0.14	J3	0.105	Y		
Average								**11.61**		**5.77**		**0.17**		**0.93**		**0.26**		**0.294**		**0.149**	
Median								**10.00**		**4.00**		**0.15**		**1.00**		**0.14**		**0.241**		**0.150**	
Minimum								**4.00**		**4.00**		**0.05**		**0.05**		**0.05**		**0.071**		**0.140**	
Maximum								**64.00**		**14.00**		**0.33**		**1.63**		**0.92**		**1.106**		**0.158**	
Std. Dev.								**10.97**		**2.58**		**0.09**		**0.45**		**0.29**		**0.21**		**0.01**	
Count								**31.00**		**31.00**		**19.00**		**26.00**		**31.00**		**26.00**		**3.00**	
ROZA-T2	09/27/04	13:50		1.0		306	4.13	23		7		<0.05		<0.5	ND	0.05	ND	0.146		0.064	
ROZA-T2	10/14/04	18:30		1.0	14	-	-	11	Y	5	Y	<0.05	Y,ND	0.85	X,Y	0.05	J,Y,ND	0.192	Y,J3	NR	
ROZA-T2	10/18/04	7:00		1.0				48		9		<0.05	ND	1.21		0.05		0.245		NR	
ROZA-T2	10/19/04	12:25		1.0	3			21		13		<0.05	ND	<0.5	X,ND	0.01		0.198	J	NR	
ROZA-T2	10/23/04	7:30		1.0	14			23	Y	7	Y	<0.05	Y,ND	0.84	X,Y	0.04		NR		NR	
ROZA-T2	10/26/04	18:45		1.0	12			193	Q,Y	26	Q,Y	0.33	Y	NR		0.38	Y	NR		NR	
ROZA-T2	11/01/04	16:00		1.0	9	-	-	NR		NR		<0.05	J,Y,ND	NR		0.48	Y	1.000	L	NR	
ROZA-T2	11/08/04	12:40		1.0	3	265	8.2	10		4	ND	0.06		1.04		0.27		NR		NR	
ROZA-T2	11/11/204	6:45		1.0	10	-	-	184	Y,X	24	Y,X	1.12	Y	2.94	X,Y	0.64	Y	NR		NR	
ROZA-T2	11/24/04	10:00		1.0	NR	-	-	116	Y,X	16	Y,X	0.1	Y	2.07	X,Y	0.58	Y	NR		NR	
ROZA-T2	11/30/04	15:30		1.0	6	-	-	4	ND	14		<0.05	J,ND	NR		0.4		NR		NR	
ROZA-T2	12/06/04	12:00	3.3	1.0	8	236	10.4	44		4	ND	<0.05	ND	1.44		0.42		NR		NR	
ROZA-T2	12/06/04	5:10		1.0	8	-	-	66	Y	8	Y	0.09	Y	1.72	X	0.7	Y	NR		NR	
ROZA-T2	03/29/05	12:05	3	1.0		513	13.1	14		4	ND	0.21		1.27		2.22		0.005	ND	NR	
ROZA-T2	04/22/05	14:10	1	1.0	4	613	5.7	12		4	ND	0.19		1.23		0.18		0.148		NR	
ROZA-T2	04/22/05	14:00	1.5	1.0	2	665	5.7	14		4	ND	0.23		1.27		0.17		0.138		0.085	
ROZA-T2	05/08/05	18:30		1.0	6			12		4	ND	0.18		1.02		0.11		0.129		0.066	
ROZA-T2	05/12/05	13:15		1.0	17			150	Y	20	Y	0.52	Y	1.24	Y,X	1.1	Y	0.329	Y	NR	
ROZA-T2	05/20/05	14:00		1.0	16			136	Y	16	Y	0.86	Y	1.79	Y,X	1.88	Y	0.358	Y	NR	
ROZA-T2	05/29/05	10:30	1.5	1.0	3			42		4	ND	0.58	Y	2.12	Y,X	0.22		0.275		0.111	
ROZA-T2	06/13/05	12:40	0.5	1.0	8	552	3.9	4		4	ND	0.53	Y	1.11	Y,X	0.06		0.383		0.248	
ROZA-T2	06/13/05	20:30		1.0	18			76	Y	12	Y	0.53	Y	NR	Y,X	0.05	Y,J,ND	0.343	Y	NR	
ROZA-T2	06/19/05	11:30	1.22	1.0	11			54	Y	10	Y	0.36	Y	1.38	Y,X	0.05	Y,J,ND	0.250	Y	NR	

Highland Silver Lake
IEPA Chemical Analysis Data
Tributary Samples - Phase I

Station Code	Sample Date	Sample Time	Staff	Sample Depth	Temp C	Cond. umho/cm	DO mg/l	TSS mg/l	Data Qualifiers	VSS mg/l	Data Qualifiers	NH3-N mg/l	Data Qualifiers	TKN mg/l	Data Qualifiers	NO2-NO3 mg/l	Data Qualifiers	TPhos mg/l	Data Qualifiers	DPhos mg/l	Data Qualifiers
ROZA-T2	07/10/05	11:15	1.08	1.0				50		14		<0.1	Y	1.42	Y,X	0.05	Y,J,ND	0.203	Y	NR	
ROZA-T2	07/12/05	9:00	0.67	1.0	23			34	Y	8	Y	0.34	Y	1.25	Y,X	0.05	Y,J,ND	0.238	Y	NR	
ROZA-T2	07/13/05	8:00	0.67	1.0	22			24	Y	10	Y	0.57	Y	1.45	Y,X	0.05	J7,Y,J,ND	0.357	Y	NR	
ROZA-T2	07/27/05	6:10	0.5	1.0				66		15		0.42	Y	1.13		0.12		0.315	Y	NR	
ROZA-T2	08/05/05	8:00	0.3	1.0	24			208	Y,Q	30	Y,Q,	0.34	Y	1.6	Y	0.05	Y,J,ND	0.282	Y	NR	
ROZA-T2	08/14/05	5:00	0.4	1.0	20			70	Y,X,Q	13	Y,X,Q	0.13	Y	0.84	Y,X	0.05	Y,J,ND	0.194	Y	NR	
ROZA-T2	08/16/05	8:30	0.4	1.0	22			41	Y,X,Q	10	Y,X,Q	0.25	Y	0.93	Y,X	0.05	Y,J,ND	0.196	Y	NR	
ROZA-T2	08/21/05	10:00	1.34	1.0	6			24		7		0.3	Y	1.51		0.05	ND	0.443		0.298	
ROZA-T2	08/26/05	16:30	0.4		22			63	Y,X	13	Y,X	0.42	Y	1.57	Q,Y,X	0.05	Y,J,ND	0.246			
ROZA-T2	08/26/05	17:00	0.4		11			15	Y	5	Y	0.27	Y	0.7	Q,Y,X	0.05	Y,J,ND	0.279	Y		
ROZA-T2	09/04/05	9:15	1.18		4			34		14		<0.1	Y			0.08		0.243		0.102	
ROZA-T2	09/14/05	8:00	0.4		17			35	X,Y	8	X,Y	0.21	Y			0.06		0.163	Y		
ROZA-T2	09/15/05	16:30	0.4		23			147	X,Y	23	X,Y	0.24	Y			0.05	Y,J,ND	0.213	Y		
ROZA-T2	09/18/05	10:30	0.98		5			33		7		0.48				0.05	ND	0.145		0.05	
ROZA-T2	09/20/05	17:45	1		6			107	X	18	X	0.38		1.42	Q,X	0.05	J,ND	0.391			
ROZA-T2	09/25/05	18:00	1		8			266	Y,X	29	Y,X	<0.1	Y,ND	1.23	Q,Y,X	0.61	Y	1.181	Y		
ROZA-T2	09/29/05	17:30	1		8			119	Y,X	16	Y,X	<0.1	J,Y,ND	1.02	Q,Y,X	0.35	Y	0.935	Y		
ROZA-T2	10/12/05	13:40	1					42		17		0.11		2.92		0.03		0.523		0.233	
ROZA-T2	10/21/05	7:30	1					31	Y,X	8	Y,X	<0.1	J,Y,ND	0.9	Q,Y,X	0.05	Y,J,ND	0.338	Y		
ROZA-T2	10/23/05	11:15	1					18		6		0.19		0.95		0.05	ND	0.237		0.096	
ROZA-T2	10/31/05	14:00	1					16	Q,X	17	Q,X	<0.1	ND	1.39	Q,,X	0.05	J,ND	0.523		0.233	
Average			**1.01**					**62.79**		**11.79**		**0.35**		**1.38**		**0.275**		**0.327**		**0.144**	
Median			**1.00**					**41.00**		**10.00**		**0.32**		**1.26**		**0.050**		**0.248**		**0.102**	
Minimum			**0.30**					**4.00**		**4.00**		**0.06**		**0.70**		**0.010**		**0.005**		**0.050**	
Maximum			**3.30**					**266.00**		**30.00**		**1.12**		**2.94**		**2.220**		**1.181**		**0.298**	
Std. Dev.								**62.77**		**7.11**		**0.23**		**0.52**		**0.46**		**0.25**		**0.09**	
Count			**0.70**					**43.00**		**43.00**		**30.00**		**34.00**		**44.00**		**36.00**		**11.00**	

Statistics were calculated using all data shown.
X qualified data or data not used per IL EPA request
Non-detect results - estimated value represents 50% of laboratory reporting limit
Data outlier removed from evaluation

Highland Silver Lake
IEPA Chemical Analysis Data
Chlorophyll Samples -- Historical Data

Station Code	Sample Date	Chlorophyll a Uncorrected (ug/L)	Chlorophyll a Corrected (ug/L)	Chlorophyll b (ug/L)	Chlorophyll c (ug/L)	Phaeophytin (ug/L)
ROZA 1	03/16/83	5.43		7.23	32.46	21.95
ROZA 1	04/12/83	1.28	1.28	0.00	0.00	0.00
ROZA 1	05/10/83	2.89	3.30	0.30	0.70	0.00
ROZA 1	06/07/83	4.23	5.26	3.14	9.56	0.00
ROZA 1	07/27/83	26.80	22.39	4.92	10.67	7.68
ROZA 1	08/30/83					
ROZA 1	10/05/83					
ROZA 1	11/18/83	3.07	2.06	0.68	2.53	1.77
ROZA 1	12/29/83					
ROZA 1	04/06/93	29.06	31.15	0.00	1.93	0.00
ROZA 1	06/23/93	48.70	43.96	8.84	1.19	6.19
ROZA 1	07/27/93	42.17	42.97	5.53	2.04	0.00
ROZA 1	08/23/93	35.28	29.67	2.66	8.30	7.71
ROZA 1	10/18/93	8.99	8.01	1.17	3.74	1.34
Average		**18.90**	**19.01**	**3.13**	**6.65**	**4.24**
Median		**8.99**	**15.20**	**2.66**	**2.53**	**1.34**
Minimum		**1.28**	**1.28**	**0.00**	**0.00**	**0.00**
Maximum		**48.70**	**43.96**	**8.84**	**32.46**	**21.95**
Std. Dev.		**17.82**	**17.09**	**3.10**	**9.34**	**6.68**
ROZA 2	03/16/83	6.70	5.58	0.00	0.00	1.64
ROZA 2	04/12/83	1.88	1.38	0.00	0.00	0.66
ROZA 2	05/10/83	3.78	3.79	0.00	0.00	0.00
ROZA 2	06/07/83	8.95	8.70	5.52	1.40	1.25
ROZA 2	07/27/83	46.81	44.55	3.38	4.81	3.10
ROZA 2	08/30/83	30.75	25.46	5.81	8.53	9.20
ROZA 2	10/05/83					
ROZA 2	11/18/83	4.64	3.88	1.71	3.65	1.50
ROZA 2	04/06/93	14.88	16.43	0.17	2.44	0.00
ROZA 2	06/23/93	57.04	55.31	10.17	3.15	0.76
ROZA 2	07/27/93	85.67	84.61	13.82	3.88	0.00
ROZA 2	08/23/93	86.96	77.43	10.85	4.63	12.28
ROZA 2	10/18/93	35.00	32.50	7.66	10.45	3.25
Average		**31.92**	**29.97**	**4.92**	**3.58**	**2.80**
Median		**22.82**	**20.95**	**4.45**	**3.40**	**1.38**
Minimum		**1.88**	**1.38**	**0.00**	**0.00**	**0.00**
Maximum		**86.96**	**84.61**	**13.82**	**10.45**	**12.28**
Std. Dev.		**31.15**	**29.44**	**4.85**	**3.29**	**3.92**
ROZA 3	03/16/83	23.55	20.71	3.70	8.06	4.84
ROZA 3	04/12/83	3.60	2.28	0.00	0.00	2.09
ROZA 3	05/10/83					
ROZA 3	06/07/83	77.91	79.54	24.95	5.52	0.00
ROZA 3	07/27/83	103.21	103.44	22.63	8.44	0.65
ROZA 3	08/30/83	142.96	143.79	18.03	37.18	0.00
ROZA 3	10/05/83					
ROZA 3	11/18/83	11.47	6.70	10.37	36.99	9.95
ROZA 3	04/06/93	31.36	35.60	1.51	2.88	0.00
ROZA 3	06/23/93					
ROZA 3	07/27/93	41.59	39.77	10.79	5.13	1.99
ROZA 3	08/23/93	152.74	149.52	19.04	4.32	0.00
ROZA 3	10/18/93	17.50	13.35	7.85	12.56	7.21
Average		**60.59**	**59.47**	**11.89**	**12.11**	**2.67**
Median		**36.48**	**37.69**	**10.58**	**6.79**	**1.32**
Minimum		**3.60**	**2.28**	**0.00**	**0.00**	**0.00**
Maximum		**152.74**	**149.52**	**24.95**	**37.18**	**9.95**
Std. Dev.		**55.27**	**55.97**	**8.89**	**13.59**	**3.52**

Highland Silver Lake
IEPA Chemical Analysis Data
Chlorophyll Samples -- Phase I

Station Code	Sample Date	Sample Depth	Chlorophyll a Uncorrected (ug/L)	Chlorophyll a Corrected (ug/L)	Chlorophyll b (ug/L)	Chlorophyll c (ug/L)	Phaeophytin (ug/L)
ROZA-1	09/27/04	1.8	NR	NR	NR	NR	NR
ROZA-1	10/19/04	2.1	NR	NR	NR	NR	NR
ROZA-1	11/08/04	4.7	NR	NR	NR	NR	NR
ROZA-1	12/06/04	2.5	NR	NR	NR	NR	NR
ROZA-1	03/29/05	1.5	7.38	7.4	<1	<1	<1
ROZA-1	04/22/05	3.0	16.1	18.1	<1	2.13	<1
ROZA-1	04/22/05	2.0	11.80	10.60	<1	1.52	1.33
ROZA-1	05/08/05	2.0	3.67	5.93	<1	1.80	<1
ROZA-1	05/29/05	3.0	24.30	25.90	2.29	2.10	<1
ROZA-1	06/13/05	5.0	54.20	57.00	6.59	3.39	<1
ROZA-1	06/19/05	4.0	47.60	52.00	4.25	3.48	<1
ROZA-1	07/10/05	3.0	31.90	31.30	3.46	2.38	<1
ROZA-1	07/27/05	3.0	80.20	80.40	<1	3.35	<1
ROZA-1	08/16/05	4.0	89.00	84.00	<1	4.87	2.92
ROZA-1	08/21/05	3.0	93.30	92.90	<1	4.22	<1
ROZA-1	09/04/05	3.0	140.00	137.00	1.55	7.90	<1
ROZA-1	09/18/05	3.0	55.40	50.70	<1	3.30	4.59
ROZA-1	10/12/05	3.0	70.20	64.20	1.23	3.23	6.05
ROZA-1	10/23/05	3.0	44.30	37.20	1.27	3.29	9.53
Average		**2.98**	**51.29**	**50.31**	**2.95**	**3.35**	**4.88**
Median		**3.00**	**47.60**	**50.70**	**2.29**	**3.30**	**4.59**
Minimum		**1.50**	**3.67**	**5.93**	**1.23**	**1.52**	**1.33**
Maximum		**5.00**	**140.00**	**137.00**	**6.59**	**7.90**	**9.53**
Std. Dev.		**0.93**	**38.21**	**37.00**	**1.97**	**1.61**	**3.14**
ROZA-2	09/27/04	1.0	NR	NR	NR	NR	NR
ROZA-2	10/19/04	1.2	NR	NR	NR	NR	NR
ROZA-2	11/08/04	1.8	NR	NR	NR	NR	NR
ROZA-2	12/06/04	0.7	NR	NR	NR	NR	NR
ROZA-2	03/29/05	1.3	24.10	21.60	1.32	4.39	2.87
ROZA-2	04/22/05	3.0	83.90	89.10	3.82	12.60	<1
ROZA-2	04/22/05	2.0	84.00	88.70	5.11	10.80	<1
ROZA-2	05/08/05	2.0	82.40	92.10	3.55	12.50	<1
ROZA-2	05/29/05	2.0	62.10	68.90	4.96	5.23	<1
ROZA-2	06/13/05	2.0	88.20	97.20	16.30	5.98	<1
ROZA-2	06/19/05	2.0	27.50	30.80	1.73	3.37	<1
ROZA-2	07/10/05	2.0	86.70	98.50	<1	5.18	<1
ROZA-2	07/27/05	2.0	118.00	136.00	<1	6.33	<1
ROZA-2	08/16/05	2.0	106.00	98.90	2.37	7.08	5.33
ROZA-2	08/21/05	2.0	133.00	130.00	<1	8.31	<1
ROZA-2	09/04/05	2.0	89.00	87.50	5.84	4.76	<1
ROZA-2	09/18/05	2.0	110.00	107.00	4.52	5.82	<1
ROZA-2	10/12/205	2.0	104.00	96.30	4.81	4.72	7.33
ROZA-2	10/23/05	2.0	48.90	43.70	1.62	3.03	6.03
Average		**1.84**	**83.19**	**85.75**	**4.66**	**6.67**	**5.39**
Median		**2.00**	**86.70**	**92.10**	**4.17**	**5.82**	**5.68**
Minimum		**0.70**	**24.10**	**21.60**	**1.32**	**3.03**	**2.87**
Maximum		**3.00**	**133.00**	**136.00**	**16.30**	**12.60**	**7.33**
Std. Dev.		**0.49**	**31.23**	**32.47**	**3.97**	**3.06**	**1.87**
ROZA-3	09/27/04	1.2	NR	NR	NR	NR	NR
ROZA-3	10/19/04	0.4	NR	NR	NR	NR	NR
ROZA-3	11/08/04	1.2	NR	NR	NR	NR	NR
ROZA-3	12/06/04	0.8	NR	NR	NR	NR	NR
ROZA-3	03/29/05	0.9	24.90	25.20	2.94	5.70	<1
ROZA-3	04/22/05	1.0	72.40	75.40	6.34	8.42	<1
ROZA-3	04/22/05	1.0	72.80	72.10	5.72	8.13	<1
ROZA-3	05/08/05	1.0	96.20	97.00	3.16	14.30	<1
ROZA-3	05/29/05	1.0	83.40	91.40	4.40	6.93	<1
ROZA-3	06/13/05	1.0	33.80	43.80	6.56	4.21	<1
ROZA-3	06/19/05	1.0	53.90	57.60	5.66	4.96	<1
ROZA-3	07/10/05	1.0	67.90	76.00	<1	3.28	<1
ROZA-3	07/27/05	1.0	139.00	149.00	8.40	10.50	<1
ROZA-3	08/16/05	1.0	138.00	127.00	13.90	10.60	11.90
ROZA-3	08/21/05	1.0	120.00	101.00	13.10	12.70	25.40
ROZA-3	09/04/05	1.0	139.00	125.00	15.80	8.65	16.50
ROZA-3	09/18/05	1.0	185.00	171.00	14.80	13.00	13.30
ROZA-3	10/12/05	1.0	112.00	107.00	6.80	6.54	2.41
ROZA-3	10/23/05	1.0	67.20	61.80	3.83	4.05	5.66
Average		**0.97**	**93.70**	**92.02**	**7.96**	**8.13**	**12.53**
Median		**1.00**	**83.40**	**91.40**	**6.45**	**8.13**	**12.60**
Minimum		**0.40**	**24.90**	**25.20**	**2.94**	**3.28**	**2.41**
Maximum		**1.20**	**185.00**	**171.00**	**15.80**	**14.30**	**25.40**
Std. Dev.		**0.16**	**44.49**	**39.59**	**4.51**	**3.49**	**8.15**

NR = Not Analyzed

Highland Silver Lake
IEPA Chemical Analysis Data
Sediment Metals

		Highland Silver Lake								
Date Sampled	Units	08/17/05	08/17/05	08/17/05	Avg.	Median	Min.	Max.	Std. Dev.	Data Qualifier
Time		12:15	13:05	13:30						
Sample ID		ROZA-1	ROZA-2	ROZA-3						
Collector		MDB	MDB	MDB						
Depth of Sample		22	7	2						
Sample Matrix		Soil	Soil	Soil						
Date Received		09/16/05	09/16/05	09/16/05						
Phosphorus-P	mg/kg	1,580	1,002	784	1,122	1,002	784	1,580	411.43	
Kjeldahl-N	mg/kg	20,600	26,000	22,000	22,867	22,000	20,600	26,000	2,802.38	X
% Solids	%	48.0	51.4	53.2	51	51	48	53	2.64	
Soilds, Volatile	%	10.7	7.4	4.8	8	7	5	11	2.96	
Mercury	mg/kg	<0.45	<0.41	<0.39	<0.42					Q,ND
Potassium	mg/kg	1,900	1,500	840	1,413	1,500	840	1,900	535.29	
Barium	mg/kg	280	180	120	193	180	120	280	80.83	
Cadmium	mg/kg	0.37	0.45	0.24	0.35	0	0	0	0.11	
Chromium	mg/kg	21.0	17.0	11.0	16	17	11	21	5.03	
Copper	mg/kg	25.0	20.0	13.0	19	20	13	25	6.03	
Iron	mg/kg	28,000	20,000	13,000	20,333	20,000	13,000	28,000	7,505.55	
Lead	mg/kg	25.0	19.0	13.0	19	19	13	25	6.00	
Manganese	mg/kg	1,300	630	400	777	630	400	1,300	467.58	
Nickel	mg/kg	22.0	18.0	12.0	17	18	12	22	5.03	
Silver	mg/kg	<0.5	<0.5	<0.5	<0.5					
Zinc	mg/kg	85	75	51	70	75	51	85	17.47	
Arsenic	mg/kg	7.5	4.2	3.9	5	4	4	8	2.00	

NR = Not Analyzed
ND = Not Detected

Statistics were calculated using all data shown (usable and unusable).
X qualified data or data not used per IL EPA request

Highland Silver Lake
IEPA Chemical Analysis Data
Water Metals

		Highland Silver Lake									
Date Sampled	Units	04/22/05	06/13/05	07/27/05	08/16/05	10/12/05	Avg.	Median	Min.	Max.	Std. Dev.
Time		11:00	10:00	11:45	11:45	11:40					
Sample ID		ROZA-1	ROZA-1	ROZA-1	ROZA-1	ROZA-1					
Collector		MDB	MDB	MDB	MDB	MDB					
Depth of Sample		10	9	9	9	10					
Depth of Site		23	22	18	22	23					
Sample Matrix		Water	Water	Water	Water	Water					
Date Received		04/27/05	06/14/05	07/29/05	08/19/05	10/14/05					
Arsenic, T	µg/l	1.5	4.6	11	11	11	7.82	11	1.5	11	4.49
Lead, T	µg/l	<5	<5	<5	<5	<5					
Selenium, T	µg/l	<2	<2	<2	<2	<2					
Calcium, T	µg/l	21	22	25	25	25	23.6	25	21	25	1.95
Magnesium, T	µg/l	6.1	6.5	7.3	7.1	7.8	6.96	7.1	6.1	7.8	0.67
Sodium, T	µg/l	9.4	11.0	12.0	13.0	12.0	11.48	12	9.4	13	1.36
Potassium, T	µg/l	5.9	5.6	6.3	6.2	6.7	6.14	6.2	5.6	6.7	0.42
Aluminum, T	µg/l	1200	130	130	160	120	348	130	120	1200	476.52
Barium, T	µg/l	56	42	57	24	59	47.6	56	24	59	14.81
Boron, T	µg/l	21	21	25	30	36	26.6	25	21	36	6.43
Beryllium, T	µg/l	<1	<1	<1	<1	<1					
Cadmium, T	µg/l	<3	<3	<3	<3	<3					
Chromium, T	µg/l	<5	<5	<5	<5	<5					
Copper, T	µg/l	<10	<10	<10	<10	<10					
Cobalt, T	µg/l	<10	<10	<10	<10	<10					
Iron, T	µg/l	1500	240	200	190	260	478	240	190	1500	572.03
Manganese, T	µg/l	82	160	230	240	160	174.4	160	82	240	63.93
Nickel, T	µg/l	<5	<5	<5	<5	<5					
Silver, T	µg/l	<3	<3	<3	<3	<3					
Strontium, T	µg/l	70	70	84	83	84	78.2	83	70	84	7.50
Vanadium, T	µg/l	<5	<5	<5	<5	<5					
Zinc, T	µg/l	<10	<10	<10	<10	<10					
Hardness Calc.	µg/l	78	82	93	91	95	87.8	91	78	95	7.40

NR = Not Analyzed
ND = Not Detected

Highland Silver Lake
IEPA Chemical Analysis Data
Sediment Organics

			Highland Silver Lake	
Date Sampled	Units	08/16/05	08/16/05	08/16/05
Time		12:15	12:15	12:15
Sample ID		ROZA-1	ROZA-2	ROZA-3
Depth of Site		22	7	2
Sample Matrix		Soil	Soil	Soil
Date Received		09/14/05	09/14/05	09/14/05
Total PCBs	µg/kg	<10	<10	<10
Hexachlorobenzene	µg/kg	<1	<1	<1
Trifluralin	µg/kg	<10	<10	<10
Alpha-BHC	µg/kg	<1	<1	<1
Gamma-BHC (Lindane)	µg/kg	<1	<1	<1
Atrazine	µg/kg	<50	<50	<50
Heptachlor	µg/kg	<1	<1	<1
Aldrin	µg/kg	<1	<1	<1
Alachlor	µg/kg	<10	<10	<10
Metribuzin	µg/kg	<10	<10	<10
Metolachlor	µg/kg	<25	<25	<25
Heptachlor Epoxide	µg/kg	<1	<1	<1
Pendimethalin	µg/kg	<10	<10	<10
Gamma-Chlordane	µg/kg	<2	<2	<2
Alpha-Chlordane	µg/kg	<2	<2	3.8
Total Alpha and Gamma Chlordane	µg/kg	<5	<5	3.8
Dieldrin	µg/kg	1.5	<1	1
Captan	µg/kg	<10	<10	<10
Cyanazine	µg/kg	<25	<25	<25
Endrin	µg/kg	<1	<1	<1
P,P'-DDE	µg/kg	<1	<1	<1
P,P'-DDD	µg/kg	<1	<1	<1
P,P'-DDT	µg/kg	<1	<1	1.1
Total DDT	µg/kg	<10	<10	1.1
Methoxychlor	µg/kg	<5	<5	<5
Acetochlor	µg/kg	35	<25	68

Hightlighted results above detection limit.

Highland Silver Lake
IEPA Chemical Analysis Data
Water Organics

		Highland Silver Lake									
Date Sampled	Units	04/22/05	06/13/05	07/27/05	08/16/05	10/12/05	Avg.	Median	Min.	Max.	Std. Dev.
Time		11:00	10:00	11:45	12:15	11:40					
Sample ID		ROZA-1	ROZA-1	ROZA-1	ROZA-1	ROZA-1					
Collector		MDB	MDB	MDB	MDB	MDB					
Depth of Sample		10	9	9	9	10					
Depth of Site		23	22	18	22	23					
Sample Matrix		Water	Water	Water	Water	Water					
Date Received		04/27/05	06/14/05	07/27/05	08/19/05	10/14/05					
Hexachlorobenzene	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Trifluralin	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Alpha-BHC	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Gamma-BHC (Lindane)	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Atrazine	µg/l	<0.1	0.28	0.78	0.2	0.25	0.38	0.27	0.2	0.78	0.27
Heptachlor	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Aldrin	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Acetochlor	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Alachlor	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02					
Metribuzin	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05					
Metolachlor	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Heptachlor Epoxide	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Pendimethalin	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05					
Gamma-Chlordane	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Alpha-Chlordane	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Total Alpha and Gamma Chlordane	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Dieldrin	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Captan	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05					
Cyanazine	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Endrin	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
P,P'-DDE	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
P,P'-DDD	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
P,P'-DDT	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01					
Total DDT	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Methoxychlor	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05					
Total PCBs	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
2,4-D	µg/l	<1	<1	<1	<1	<1					
Pentchlorophenol (PCP)	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
2,4,5,TP (Silvex)	µg/l	<5	<5	<5	<5	<5					
Dalapon	µg/l	<20	<20	<20	<20	<20					
Dicamba	µg/l	<0.25	<0.25	<0.25	<0.25	<0.25					
Dinoseb	µg/l	<0.7	<0.7	<0.7	<0.7	<0.7					
Picloram	µg/l	<50	<50	<50	<50	<50					
Acifluorfen	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5					
Epto	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5					
Butylate	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2					
Phorate	µg/l	<0.25	<0.25	<0.25	<0.25	<0.25					
Terbufos	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Fonofos	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Diazinon	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05					
Methyl Parathion	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Malathion	µg/l	<0.15	<0.15	<0.15	<0.15	<0.15					
Chlorpyrifos	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1					
Atrazine	µg/l	<0.1	0.27	0.38	0.5	0.32	0.37	0.35	0.27	0.5	0.10

Hightlighted results above detection limit.

Parameters	Illinois EPA – Laboratory Reporting Limits (mg/L)	Teklab – Minimum Detection and Laboratory Reporting Limits (mg/L)
TSS	1.0, 4.0, and 8.0	5.0 and 6.0
VSS	1.0, 4.0, and 8.0	5.7 and 6.0
NH_3-N	0.05 and 0.1	NA
TKN	0.5	0.4 and 0.8
NO_3-NO_2	0.1, 0.2, and 0.5	0.004 and 0.01
TP	0.01 and 0.02	0.01 and 0.02
DP	0.01 and 0.02	0.01 and 0.02

APPENDIX B

March 27, 2006

Lake Highland Silver (ROZA) Report

Lake Highland Silver was sampled at three sites (1, 2, 3) on 10 July, 1977 and on 14 June and 5 September, 1979. These samples were examined using the "Membrane Filter Method" and data from these dates are not included in this report. Sampling was done at Site 1 on 8 July and 13 August, 1987, 22 March, 20 April, 19 May, 23 June, 13 July, 22 August, 20 September, 20 October and 10 November, 1988, 12 April, 5 June, 10 July, 22 August and 2 October, 2002 and 22 April, 13 June, 27 July, 16 August and 12 October, 2005. Site 3 was sampled in 2005 on the same dates as those for Site 1 (Table: 2; Figures: 2005). Samples taken in 1987, 1988, 2002 and 2005 were examined using the "Sweep Method". Comparisons in this report will involve all of the dates in each year with the exception of the 22 March, 20 April, 19 May, 20 September and 10 November, 1988. Even though the 20 April, 1988 sample date was close to dates in April, 2002 and 2005, it will not be included in discussions in this report due to the presence of sediment that made recognition and counting of algae difficult.

Phytoplankters produced their peak density of 32,098/mL for all years on 13 July, 1988 (Tables: 1; 2; Figures: Total Phytoplankton-Site 1; 2005). Other densities at Site 1 were 15,640/mL on 8 July and 14,447/mL on 13 August, 1987, 15,833/mL on 23 June, 20,655/mL on 22 August and 30,104/mL on 20 October, 1988, 20,578/mL on 12 April, 16,226/mL on 5 June, 9183/mL on 10 July, 20,588/mL on 22 August and 15,074/mL on 2 October, 2002 and 4637/mL on 22 April, 4872/mL on 13 June, 15,879/mL on 27 July, 13,882/mL on 16 August and 11,537/mL on 12 October (Tables: 1; 2; Figures: Total Phytoplankton). At Site 3 in 2005, totals were 14,575/mL on 22 April, 13,005/mL on 13 June, 17,336/mL on 27 July, 14,177/mL on 16 August and 14,656/mL on 12 October (Table: 2; Figure: Total Phytoplankton-2005). Totals at Site 1 in 1987, 1988 and 2002 (except for July) were greater than they were in 2005. In 2005,

Site 3 totals were much higher than those at Site 1. Blue-greens (Phylum Cyanophyta) were abundant (1000 or more/mL or One Million or more/mL) and the dominant group on each of the dates sampled in each year.

Diatoms (Phylum Bacillariophyta) reached their peak density for all years at Site 3 on 27 July, 2005. This density was 2497/mL (Tables: 1; 2; Figures: Bacillariophyta-2005). Their densities in 1987 were 45/mL on 8 July and 580/mL on 13 August. In 1988, they were in a density of 30/mL on 23 June, 74/mL on 13 July, 402/mL on 22 August and 15/mL on 20 October. Densities in 2002 were "zero" on 12 April, 41/mL on 5 June, 775/mL on 10 July, 1580/mL on 22 August and 2201/mL on 2 October. In 2005, they were at 275/mL at Site 1 and 897/mL at Site 3 on 22 April, 265/mL at Site 1 and 438/mL at Site 3 on 13 June, 275/mL at Site 1 and 2497/mL at Site 3 on 27 July, 1233/mL at Site 1 and 2100/mL at Site 3 on 16 August and 1131/mL at Site 1 and 1080/mL at Site 3 on 12 October. Except on 12 October, densities in 2005 were higher at Site 3 than at Site 1. Peak densities in each year except for the 27 July, 2005 sample taken at Site 3 were reached in August. *Cyclotella meneghiniana* was responsible for most of the totals obtained at sites 1 and 3 on 22 April, 2005 (Tables: 4/22/2005-Site 1; 3). It was in a density of 265/mL at Site 1 and 826/mL at Site 3. *Melosira distans* was "Present" (not in a countable form) at Site 1 on 22 April, 2005 and was the only diatom in the sample taken on 12 April, 2002 (See Report dated April 28, 2003). *Synedra delicatissima* var. *delicatissima* in a density of 10/mL was the only other diatom in the 22 April, 2005 sample taken at Site 1. *Nitzschia acicularis* in a density of 51/mL and *Nitzschia palea* at 20/mL were the remaining diatoms found at Site 3 on 22 April, 2005. *C. meneghiniana* was common to three of the four samples taken in June. Its density at Site 1 on 13 June, 2005 was 265/mL (Table: 6/13/2005-Site 1). It was in a density of 41/mL on 5 June, 2002 and not in the sample taken on 23 June,

1988. Its density at Site 3 on 13 June, 2005 was 306/mL (Table: 6/13/2005-Site 3). *M. italica* var. *tenuissima* was "Present" and the only other diatom in the samples taken on 23 June, 2005 and 5 June, 2002 at Site 1. It was in a density of 15/mL accompanied by *M. distans* ("Present") and *N. palea* (15/mL) on 23 June, 1988. The sample taken at Site 3 on 13 June contained three diatoms in addition to *C. meneghiniana.* These three were *Navicula cryptocephala* var. *cryptocephala* in a density of 10/mL, *Nitzschia linearis* at 20/mL and *N. palea* at 102/mL. *C. meneghiniana* was common to the five samples taken in July of the four years. It was in a density of 183/mL at Site 1 and 1325/mL at Site 3 on 27 July, 2005, at 683/mL at Site 1 on 10 July, 2002, 45/mL on 13 July, 1988 and 45/mL and the only diatom in the sample from 8 July, 1987 (Tables: 7/27/2005-Site 1; 3). *N. acicularis* was at both sites in 2005 (31/mL-Site 1; 255/mL-Site 3) as were *N. linearis* (20/mL-Site 1; 306/mL-Site 3), *N. palea* (31/mL-Site 1; 571/mL-Site 3) and *S. delicatissima* var. *delicatissima* (10/mL-each site). *M. italica* var. *tenuissima* was "Present" at Site 3 on 27 July, 2005 and at Site 1 on 10 July, 2002 and at 15/mL on 13 July, 1988. *M. distans* was "Present" at Site 3 on 27 July, 2005 and not seen at Site 1 or in samples taken in earlier years. *N. linearis* was in a density of 15/mL on 13 July, 1988 and *N. palea* at 92/mL on 10 July, 2002. *C. meneghiniana* was common to August samples in each of the years as was *N. palea.* The former was at 713/mL at Site 1 and 877/mL at Site 3 on 16 August, 2005 (Tables: 8/16/2005-Site 1; 3). In the sample taken on 22 August, 2002, it was in a density of 1243/mL. It was at 193/mL on 22 August, 1988 and 536/mL on 13 August, 1987. *N. palea* was in a density of 285/mL at Site 1 and 408/mL at Site 3 on 16 August, 2005, at 112/mL in 2002, 30/mL in 1988 and 15/mL in 1987. Other taxa seen at Site 1 on 16 August, 2005 included *M. italica* var. *tenuissima* "Present", *N. acicularis* at 31/mL and *N. linearis* at 204/mL. Those at Site 3 on that date were *M. distans* "Present", *N. cryptocephala* var. *cryptocephala* at

316/mL, a *Navicula* sp. at 10/mL, *N. acicularis* at 316/mL, *N. linearis* at 143/mL and *S. delicatissima* var. *delicatissima* at 31/mL. Additional taxa at Site 1 on 22 August, 2002 included *M. distans* and *M. italica* var. *tenuissima* each "Present", a *Navicula* sp. (different from that in 2005) at 10/mL, *N. linearis* at 102/mL, *S. delicatissima* var. *delicatissima* at 10/mL and two species of *Tabellaria* with one at 82/mL and the other at 20/mL. The only other diatom in the 22 August, 1988 sample other than the two mentioned above was *N. linearis* at 179/mL. The 13 August, 1987 sample contained *M. italica* var. *italica* and *M. italica* var. *tenuissima* each "Present" and *N. acicularis* and *S. delicatissima* var. *delicatissima* each at 15/mL. Six diatom taxa were common to samples taken on 12 October, 2005 and 2 October, 2002 (Tables: 10/12/2005-Site 1; 3). These six and their densities in each sample were *C. meneghiniana* (836/mL-Site 1; 561/mL-Site 3; 1478/mL-2002), *M. distans* and *M. italica* var. *tenuissima* ("Present" in each sample), *N. acicularis* (10/mL-Site 1; 143/mL-Site 3; 82/mL-2002), *N. linearis* (143/mL-Site 1; 61/mL-Site 3; 122/mL-2002) and *N. palea* (132/mL-Site 1; 306/mL-Site 3; 255/mL-2002). *C. meneghiniana* in a density of 15/mL was the only diatom in the 20 October, 1988 sample. Other taxa seen in the samples included a *Tabellaria* sp. in the Site 1 sample and *S. delicatissima* var. *delicatissima* at Site 3 on 12 October, 2005 with each at 10/mL and two species of *Tabellaria* (not the same as at Site 1 in 2005) with one at 224/mL and the other at 20/mL on 2 October, 2002. Diatom taxa seen in each of the years were those typically found in eutrophic lakes. In addition, the presence of species of *Nitzschia* was an indicator of high levels of organic materials in the water in the lake. These diatoms are tolerant of such concentrations with *N. palea* the most tolerant. Their densities at Site 3 in 2005 indicated that organic materials were at higher levels at this site than at Site 1.

Green algae (Chlorophyta) were in higher densities in each of the samples taken at Site 3

in 2005 than they were in any of the samples taken at Site 1 in 2005, 2002, 1988 or 1987. They reached their peak density of 3567/mL on 12 October, 2005 at Site 3 and were in densities at the same site of 2191/mL on 22 April, 2160/mL on 13 June, 1967/mL on 27 July and 2691/mL on 16 August (Table: 2; Figure: Chlorophyta-2005). Totals for Site 1 in 2005 were 31/mL on 22 April, 1243/mL on 13 June, 479/mL on 27 July, 1284/mL on 16 August and 1967/mL on 12 October. In 1987, their total densities were 119/mL on 8 July and 2426/mL on 13 August (Table: 1; Figure: Chlorophyta-Site 1). Densities in 1988 at Site 1 were 685/mL on 23 June, 1057/mL on 13 July, 1012/mL on 22 August and 104/mL on 20 October. Totals for 2002 at Site 1 were 41/mL on 12 April, 122/mL on 5 June, 387/mL on 10 July, 2385/mL on 22 August and 1957/mL on 2 October. The only green algae in the sample taken at Site 1 on 22 April, 2005 were two species of *Cosmarium* (Table: 4/22/2005-Site 1). One (5.0 x 5.0 μm) was at 10/mL and the other at 20/mL. The former was in a density of 173/mL at Site 3 on that date (Table: 4/22/2005-Site 3). It was accompanied by a number of taxa in the numerous category (100 or more/mL) including *Ankistrodesmus falcatus* var. *acicularis* at 632/mL, *A. falcatus* var. *mirabilis* at 214/mL, *Carteria multifilis* at 194/mL, *Kirchneriella lunaris* var. *lunaris* at 204/mL, *Scenedesmus abundans* at 122/mL and *Tetraedron trigonum* var. *trigonum* at 224/mL. The four taxa seen in the sample taken on 12 April, 2002 were each in a density of 10/mL. These taxa were *A. falcatus* var. *acicularis*, *Closterium acutum* (in a density of 31/mL at Site 3 in 2005), a *Cosmarium* sp. and *Schroederia setigera* (at 10/mL at Site 3 in 2005). Two of the 14 taxa seen in the sample taken on 13 June, 2005 at Site 1 were numerous (Table: 6/13/2005-Site 1). *C. multifilis* was in a density of 683/mL and a *Carteria* sp. at 143/mL. None of the taxa seen in the sample taken on 5 June, 2002 was numerous. *C. multifilis* was in a density of 134/mL in the sample taken on 13 June, 1988 with *Carteria* sp. at 119/mL and *Schroederia setigera* at 193/mL.

C. multifilis was at 132/mL in the Site 3 sample taken on 13 June, 2005 accompanied by *A. falcatus* var. *acicularis* at 204/mL (Table: 6/13/2005-Site 3). The latter was at 41/mL at Site 1, 10/mL in 2002 and 60/mL in 1988. *Coelastrum microporum* was at 122/mL at Site 3 (71/mL-Site 1) with the *Cosmarium* sp. (5.0 x 5.0 μm) seen in April at 173/mL (not in Site 1, 2002 or 1988 samples), *Crucigenia rectangularis* at 143/mL (10/mL-Site 1; not in 2002 or 1988), *Crucigenia tetrapedia* at 112/mL (not in Site 1, 2002 or 1988 samples), *K. lunaris* var. *lunaris* at 285/mL (31/mL-Site 1; 10/mL-2002) and *S. abundans* at 408/mL (92/mL-Site 1; "Present"-2002). Other taxa common to two, three or four of the samples included *Actinastrum hantzschii* var. *fluviatile* (10/mL-Site 1; 30/mL-1988), *Closterium acutum* ("Present"-Site 3; 10/mL-2002; 30/mL-1988), *Dictyosphaerium pulchellum* (61/mL-Site 1; 82/mL-Site 3; 51/mL-2002), *Elakatothrix viridis* (10/mL-sites 1 and 3; 15/mL-1988), *Micractinium pusillum* (10/mL-2002; 30/mL-1988), *Nephrocytium limneticum* (31/mL-Site 3; 15/mL-1988), *Oocystis borgei* (31/mL-Site 1; 92/mL-Site 3), *Pediastrum duplex* var. *gracilimum* (20/mL-Site 1; 10/mL-Site 3), *Schroederia setigera* (10/mL-Site 3; 31/mL-2002; 193/mL-1988), *T. trigonum* var. *trigonum* (31/mL-Site 1; 92/mL-Site 3; 15/mL-1988) and *Treubaria setigerum* (10/mL-Site 1; 20/mL-Site 3). *D. pulchellum* at 183/mL was the only green alga in the numerous category at Site 1 on 27 July, 2005 (Table: 7/27/2005-Site 1). It was at 612/mL at Site 3 on that date (Table: 7/27/2005-Site 3). Other algae numerous at Site 3 on 27 July, 2005 included *A. hantzschii* var. *fluviatile* at 143/mL (71/mL-Site 1; 30/mL-1988), *A. falcatus* var. *acicularis* at 194/mL (51/mL-Site 1; 60/mL-1988; 45/mL-1987), *Chlorogonium elongatum* var. *elongatum* at 112/mL (not at Site 1; 71/mL-2002; 15/mL-1988) and *S. abundans* at 224/mL (41/mL-Site 1; 45/mL-1988; 15/mL-1987). *C. multifilis* was in a density of 193/mL and *Carteria* sp. (No. 1) at 432/mL on 13 July, 1988. The former was in lower densities in 2005 (20/mL-Site 1; 41/mL-Site 3) and 2002

(10/mL). The latter was not in the sample taken at Site 1 in 2005 but at 51/mL at Site 3. It was in a density of 41/mL on 10 July, 2002. The sample taken at Site 1 on 16 August, 2005 contained 21 taxa (Table: 8/16/2005-Site 1). The one at Site 3 on that date had 26 (Table: 8/16/2005-Site 3). The number of taxa in the 22 August, 2002 sample was 21, that on 22 August, 1988 was 15 and on 13 August, 1987, it was 12. Only two of the 21 taxa in the Site 1 sample taken on 16 August, 2005 two were numerous. They were *C. microporum* in a density of 163/mL and *D. pulchellum* at 540/mL. The sample taken at Site 3 on that date contained 11 taxa in the numerous category including *A. hantzschii* var. *fluviatile* at 183/mL, *Ankistrodesmus convolutus* at 132/mL, *A. falcatus* var. *acicularis* at 336/mL, *C. multifilis* at 173/mL, *C. elongatum* var. *elongatum* at 112/mL, *C. rectangularis* at 153/mL, *D. pulchellum* at 245/mL, *K. lunaris* var. *lunaris* at 153/mL, *S. abundans* at 296/mL, *S. setigera* at 132/mL and *T. trigonum* var. *trigonum* at 275/mL. The 22 August, 2002 sample had six taxa that were numerous including *A. hantzschii* var. *fluviatile* at 194/mL, *A. falcatus* var. *acicularis* at 112/mL, *C. microporum* at 102/mL, *D. pulchellum* at 856/mL, *K. lunaris* var. *lunaris* at 194/mL and *S. abundans* at 438/mL. Those in that category in the 22 August, 1988 were *A. falcatus* var. ac*icularis* and *Carteria* sp. (No. 1) each at 104/mL and *D. pulchellum* at 432/mL while those in the 13 August, 1987 sample were *C. multifilis* at 551/mL, *Carteria* sp. (No. 1) at 104/mL, *Carteria* sp. (No. 2) at 1101/mL and *C. microporum* at 357/mL. Many of the taxa that were numerous in one sample in 2005 were usually in lower densities in others. *C. microporum* was one such alga with its density at 163/mL at Site 1 as mentioned and 41/mL at Site 3 in 2005. Others included *A. hantzschii* var. *fluviatile* at 183/mL at Site 3 in 2005 (61/mL-Site 1), *C. multifilis* at 173/mL at Site 3 in 2005 (61/mL-Site 1; 51/mL-2002; 89/mL-1988; 551/mL-1988), *C. elongatum* var. *elongatum* at 112/mL at Site 3 (41/mL-Site 1; 31/mL-2002; 15/mL-1988), *C.*

rectangularis at 153/mL at Site 3 (41/mL-Site 1; 20/mL-2002; 30/mL-1988; 45/mL-1987), *K. lunaris* var. *lunaris* at 153/mL at Site 3 (51/mL-Site 1; 194/mL-2002), *S. abundans* at 296/mL at Site 3 (82/mL-Site1; 438/mL-2002; 45/mL-1988; 30/mL-1987), *S. setigera* at 132/mL at Site 3 (not at Site 1; 82/mL-2002; 45/mL-1988 and 1987) and *T. trigonum* var. *trigonum* at 275/mL at Site 3 (10/mL-Site 1; 61/mL-2002). Twenty-six taxa were in the sample taken at Site 1 on 12 October, 2005 (Table: 10/12/2005-Site 1). There were 28 in the Site 3 sample taken on the same date (Table: 10/12/2005-Site 3). The sample taken on 2 October, 2002 had 27 taxa and in the one from 20 October, 1988, there were only five. Taxa in the numerous category in at least one sample and common to the samples from 2005, 2002 and 1988 included *A. hantzschii* var. *fluviatile* (143/mL-Site 1; 102/mL-Site 3; 92/mL-2002), *A. convolutus* (20/mL-Site 1; 112/mL-Site 3; 31/mL-2002), *A. falcatus* var. *acicularis* (224/mL-Site 1; 693/mL-Site 3; 194/mL-2002), *C. elongatum* var. *elongatum* (112/mL-Site 1; 143/mL-Site 3; 20/mL-2002), *Cosmarium* sp. with the dimensions 5.0 x 5.0 μm and seen earlier (51/mL-Site 1; 438/mL-Site 3; 10/mL-2002), *D. pulchellum* (713/mL-Site 1; 204/mL-Site 3; 571/mL-2002), *K. lunaris* var. *lunaris* (143/mL-Site 1; 561/mL-Site 3; 204/mL-2002), *O. borgei* (10/mL-Site 1; 20/mL-Site 3; 102/mL-2002), *S. abundans* (122/mL-Site 1; 285/mL-Site 3; 204/mL-2002), *T. trigonum* var. *trigonum* (31/mL-Site 1; 194/mL-Site 3; 20/mL-2002) and *Tetrastrum heterocanthum* (31/mL-Site 1; 122/mL-Site 3; 10/mL-2002). The Site 3 samples taken on 12 October, 2005 had an additional taxon (*A. falcatus* var. *mirabilis*) in the numerous category (234/mL) and it was not in the other two samples. The five species in the sample taken on 20 October, 1988 were *C. acutum* at 30/mL (20/mL-Site 1; 10/mL-Site 3; not in 2002), *E. viridis* at 15/mL (10/mL-Site 3 only), *Nephrocytium limneticum* at 15/mL (51/mL-2002 only), *O. borgei* at 15/mL (10/mL-Site 1; 20/mL-Site 3; 102/mL-2002) and *S. setigera* at 30/mL (31/mL-Site 1; 20/mL-Site 3; 61/mL-

2002). Taxa seen in each of the years were those indicative of a lake in a eutrophic condition. In addition, most of these green algae seen in 2005 and earlier were members of the Order Chlorococcales. These included the genera *Actinastrum*, *Ankistrodesmus*, *Chodatella*, *Clostridium*, *Coelastrum*, *Conochaete*, *Crucigenia*, *Dictyosphaerium*, *Elakatothrix*, *Golenkinia*, *Kirchneriella*, *Micractinium*, *Nephrocytium*, *Oocystis*, *Pediastrum*, *Scenedesmus*, *Schroederia*, *Tetraedron*, *Tetrastrum* and *Treubaria* (Table: List of taxa-2005). Other genera were in the Order Volvocales including *Carteria*, *Chlorogonium*, *Coccomonas*, *Phacotus* and *Spermatozoopsis* or in the Order Zygnematales (*Closterium*, *Cosmarium*, *Staurastrum*). The higher total density of green algae at Site 3 in 2005 and the higher densities of members of the Volvocales indicated that this site was more productive, shallower and probably had a higher level of organic materials in its water. It was in a sense pond-like.

Members of the Phylum Chrysophyta were not counted in samples taken at Site 1 in any of the years (Table: 1). The chrysophyte, *Heliapsis mutabilis*, was responsible for the 10/mL observed at Site 3 on 16 August, 2005 (Tables: 2; 8/16/2005-Site 3). This alga is found in eutrophic lakes, but is not common. Chrysophytes typically develop higher densities when temperature and competition are low. The first condition should have been met in April and October, 2005, but the latter undoubtedly prevented their development on those dates.

Cryptomonas erosa and a *Cryptomonas* sp. were the two species of the Phylum Cryptophyta observed in samples taken in each of the years (Table: List of taxa-each year). These cryptomonads reached their peak density of 856/mL for all years on 10 July, 2002 (Tables: 1; 2; Figures: Cryptophyta-Site 1; 2005). Totals for 2005 were 540/mL at Site 1 and 112/mL at Site 3 on 22 April, 377/mL at Site 1 and 31/mL at Site 3 on 13 June, 31/mL at Site 1 and 112/mL at Site 3 on 27 July, 173/mL at Site 1 and 41/mL at Site 3 on 16 August and 41/mL at Site 1 and

367/mL at Site 3 on 12 October. They were in a total density of 74/mL on 8 July and 45/mL on 13 August, 1987. Densities in 1988 were 119/mL on 23 June, 179/mL on 13 July, 357/mL on 22 August and 15/mL on 20 October. In 2002, they were at "zero" on 12 April, 71/mL on 5 June, 856/mL on 10 July, 112/mL on 22 August and 183/mL on 2 October. *C. erosa* was in a density of 41/mL at Site 1 and 10/mL at Site 3 in the samples taken on 22 April, 2005 (Tables: 4/22/2005-Site 1; 3). *Cryptomonas* sp. was at 499/mL at Site 1 and 102/mL at Site 3 on that date. In the sample taken on 13 June, 2005 at Site 1, *C. erosa* was in a density of 10/mL with *Cryptomonas* sp. at 367/mL (Table: 6/13/2005-Site 1). The former was at 10/mL and the latter at 61/mL on 5 June, 2002. In the sample taken on 23 June, 1988, the former was at 74/mL and the latter at 45/mL. *Cryptomonas* sp. was responsible for the total of 31/mL obtained at Site 3 on 13 June, 2005 (Table: 6/13/2005-Site 3). *Cryptomonas* sp. was the only species seen in the samples taken on 27 July, 2005 (Tables: 7/27/2005-Site 1; 3). It was in a density of 31/mL at Site 1 and 112/mL at Site 3. It had been at 744/mL on 10 July, 2002 accompanied by *C. erosa* at 112/mL. In the sample taken on 13 July, 1988, *C. erosa* was at 74/mL and the *Cryptomonas* sp. at 104/mL. The former in a density of 74/mL was the only cryptomonad in a countable density on 8 July, 1987. The sample taken at Site 1 on 16 August, 2005 contained only *Cryptomonas* sp. in a density of 173/mL (Table: 8/16/2005-Site 1). Both species were in the sample taken at Site 3 on that date with *C. erosa* at 10/mL and *Cryptomonas* sp. at 31/mL (Table: 8/16/2005-Site 3). Densities of these two on 22 August, 2002 were 10/mL and 102/mL, respectively. On 22 August, 1988, they were 327/mL and 30/mL. Only *C. erosa* in a density of 45/mL was in the sample taken on 13 August, 1987. *Cryptomonas* sp. was responsible for the total of 41/mL obtained at Site 1 and that of 367/mL at Site 3 on 12 October, 2005 (Tables: 10/12/2005-Site 1; 3). *C. erosa* was in a density of 31/mL in the sample taken on 2 October, 2002 accompanied by

Cryptomonas sp. at 153/mL. The former was at 15/mL on 20 October, 1988 and was the only cryptomonad in that sample. *Cryptomonas* sp. often appears in higher densities following an application of an algicide probably in response to the higher levels of organic materials produced by the destruction of other photosynthetic organisms. It was the only species present on some of the dates and this may have resulted from the presence of such high levels of organic materials.

Blue-greens (Cyanophyta) reached their peak density for all years on 13 July, 1988. Their total density on that date was 30,506/mL (Table: 1; Figure: Cyanophyta-Site 1). Other densities in 1988 were 14,970/mL on 23 June, 18,750/mL on 22 August and 29,911/mL on 20 October. Densities in 1987 were 15,402/mL on 8 July and 11,310/mL on 13 August. In 2002, totals were 20,537/mL on 12 April, 15,971/mL on 5 June, 7073/mL on 10 July, 16,440/mL on 22 August and 10,488/mL on 2 October. Except for the sample taken on 27 July, 2005 when the density was higher at 15,074/mL than on 10 July, 2002 , densities at Site 1 were lower than those in the earlier years. Other densities at Site 1 in 2005 were 3679/mL on 22 April, 2375/mL on 13 June, 11,038/mL on 16 August and 8154/mL on 12 October (Table: 2; Figure: Cyanophyta-2005). Totals at Site 3 in 2005 were 10,926/mL on 22 April, 9764/mL on 13 June, 11,741/mL on 27 July, 8571/mL on 16 August and 8133/mL on 12 October. *Anacystis montana* and *Gomphosphaeria lacustris* were the only blue-greens in the samples taken at Site 1 on 22 April, 2005 and 12 April, 2002 (Table: 4/22/2005-Site 1). *A. montana* was in a density of 2344/mL in the first sample and 8867/mL in the second. *G. lacustris* was at 1335/mL in 2005 and 11,670/mL in 2002. The Site 3 sample taken on 22 April, 2005 contained these two accompanied by four other species (Table: 4/22/2005-Site 3). *A. montana* was in a density of 6737/mL and *G. lacustris* at 4026/mL with *Dactylococcopsis acicularis* and *Raphidiopsis curvata* each at 10/mL, *Merismopedia quadruplicata* at 31/mL and *Schizothrix calcicola* at

112/mL. Seven taxa were in the sample taken on 13 June, 2005 at Site 1 (Table: 6/13/2005-Site 1). *Anabaena spiroides* var. *crassa* was in a density of 71/mL, *A. montana* at 1223/mL, *Aphanizomenon flos-aquae* at 51/mL, *G. lacustris* at 917/mL, *M. quadruplicata* at 10/mL, *Microcystis aeruginosa* at 31/mL and *S. calcicola* at 71/mL. The sample taken on 5 June, 2002 contained *A. montana* at 6513/mL, *G. lacustris* at 9448/mL and *S. calcicola* at 10/mL. In that from 23 June, 1988, *A. montana* was in a density of 6071/mL, *A. flos-aquae* at 30/mL, *G. lacustris* at 8720/mL and *M. quadruplicata* at 149/mL. The Site 3 sample taken on 13 June, 2005 had *A. montana* at 6584/mL, *Dactylococcopsis rhaphidioides* at 10/mL, *G. lacustris* at 3129/mL, *M. quadruplicata* at 10/mL and *S. calcicola* at 31/mL (Table: 6/13/2005-Site 3). Thirteen taxa were in the sample taken at Site 1 on 27 July, 2005 with 11 at Site 3 on that date (Tables: 7/27/2005-Site 1; 3). Taxa common to Site 1 and 3 in 2005 included *A. spiroides* var. *crassa* (1142/mL-Site 1; 61/mL-Site 3), an *Anabaena* sp. (5.0 x 50.0 μm) at 71/mL-Site 1 and 10/mL-Site 3, *A. montana* (1254/mL-Site 1; 4118/mL-Site 3), *A. flos-aquae* (153/mL-Site 1; 20/mL-Site 3), *G. lacustris* (2945/mL-Site 1; 3975/mL-Site 3), *M. quadruplicata* (1702/mL-Site 1; 591/mL-Site 3), *M. aeruginosa* (550/mL-Site 1; 31/mL-Site 3), *R. curvata* (2619/mL-Site 1; 510/mL-Site 3) and *S. calcicola* 4067/mL-Site 1; 2293/mL-Site 3). Two other species of *Anabaena* were at Site 1 along with *Anabaenopsis elenkinii* at 10/mL and a *Cylindrospermum* sp. at 459/mL. The sample taken at Site 3 contained two species of *Dactylococcopsis* with *D. acicularis* at 61/mL and *D. rhaphidioides* at 71/mL. Samples from earlier years contained *A. spiroides* var. *crassa* (193/mL-1988; 30/mL-1987), *A. montana* (2742/mL-2002; 6310/mL-1988; 13,318/mL-1987), *A. flos-aquae* (74/mL-1988; 119/mL-1987), *G. lacustris* (4311/mL-2002; 2604/mL-1988; 1711/mL-1987), *M. quadruplicata* (10/mL-2002; 268/mL-1988), *R. curvata* (18,393/mL-1988; 15/mL-1987) and *S. calcicola* (10/mL-2002; 2664/mL-1988; 208/mL-1987).

Taxa common to samples from both sites taken on 16 August, 2005 included *A. spiroides* var. *crassa* at 377/mL at Site 1, 10/mL at Site 3, *A. montana* at 1101/mL-Site 1, 3516/mL-Site 3, *A. flos-aquae* at 214/mL-Site 1, 10/mL-Site 3, *D. rhaphidioides* at 122/mL-Site 1; 245/mL-Site 3, *G. lacustris* at 2049/mL-Site 1, 1794/mL-Site 3, *M. quadruplicata* at 989/mL-Site 1, 683/mL-Site 3, *M. aeruginosa* at 153/mL-Site 1, 10/mL-Site 3, *R. curvata* at 2354/mL-Site 1, 1142/mL-Site 3 and *S. calcicola* at 3455/mL-Site 1 and 1162/mL-Site 3 (Tables: 8/16/2005-Site 1; 3). Other taxa at Site 1 included an *Anabaena* sp. at 20/mL, *A. elenkinii* at 10/mL, the *Cylindrospermum* sp. seen in July at 82/mL and *D. acicularis* at 112/mL. Many of the taxa seen at Site 1 in 2005 were in samples from earlier years including *A. spiroides* var. *crassa* (377/mL-2005; 408/mL-2002; 30/mL-1988; 45/mL-1987), *A. montana* (1101/mL-2005; 2711/mL-2002; 7887/mL-1988; 7232/mL-1987), *A. flos-aquae* (214/mL-2005; 561/mL-2002; 149/mL-1988; 208/mL-1987), *G. lacustris* (2049/mL-2005; 2691/mL-2002; 3363/mL-1988; 967/mL-1987), *M. quadruplicata* (989/mL-2005; 1233/mL-2002; 3408/mL-1988; 45/mL-1987), *M. aeruginosa* (153/mL-2005; 275/mL-2002; not in 1988 or 1987), *R. curvata* (2354/mL-2005; 4953/mL-2002; 1533/mL-1988; 1607/mL-1987) and *S. calcicola* (3455/mL-2005; 3608/mL-2002; 2381/mL-1988; 1205/mL-1987). Twelve taxa were in the sample taken at Site 1 and eight in that taken at Site 3 on 12 October, 2005 (Tables: 10/12/2005-Site 1; 3). Taxa common to these samples and to at least one of those taken in earlier years included *A. spiroides* var. *crassa* (132/mL-Site 1; 10/mL-Site 3; 51/mL-2002), *A. montana* (1773/mL-Site 1; 5228/mL-Site 3; 3588/mL-2002; 21,444/mL-1988), *G. lacustris* (2212/mL-Site 1; 1488/mL-Site 3; 4056/mL-2002; 8438/mL-1988), *M. quadruplicata* (347/mL-Site 1; 255/mL-Site 3; 887/mL-2002; 30/mL-1988), *M. aeruginosa* (153/mL-Site 1; 10/mL-Site 3; 31/mL-2002), *R. curvata* (275/mL-Site 1; 10/mL-Site 3; 530/mL-2002) and *S. calcicola* (2986/mL-Site 1; 1121/mL-Site 3; 1192/mL-2002). *A.*

elenkinii was in a density of 31/mL at Site 1 and 10/mL at Site 3 in October, 2005, but not counted in 2002 or 1988. *A. flos-aquae* was at 51/mL at Site 1 on 12 October, 2005, not at Site 3 on that date and at 82/mL on 2 October, 2002. *Cylindrospermum* sp. seen earlier was at 31/mL and *D. rhapidioides* at 102/mL at Site 1 in October, 2005 and not in samples taken at Site 3 or those from 2002 and 1988. Based on the presence of the three taxa indicative of a body of water in a eutrophic condition, this lake was in such a state in 2005 as it was in earlier years. The three taxa that provide a clue to lake condition are *Anabaena spiroides* var. *crassa*, *Aphanizomenon flos-aquae* and *Microcystis aeruginosa*. The former was in a "bloom density" (1000 or more/mL or One Million or more/ L) on 27 July, 2005 at Site 1. The other two were in lower densities and did not produce this density on any date in 2005 or earlier. Densities of each of these indicator taxa were lower at Site 3 than at Site 1 in 2005. It is possible that this site had a higher level of organic materials, was too shallow for their development or was treated with an algicide. The presence of *Dactylococcopsis acicularis* and *D. rhaphidioides* at Site 3 and not at Site 1 would support the suggestion that organic materials were in the water at that site. Water temperatures were at 25 C or higher in each of the years examined. This conclusion came from the presence of *Raphidiopsis curvata* in abundance (1000 or more/mL) in July, 2005 at Site 1 and August, 2005 at both sites and at Site 1 in July, 1988 and August of 1987, 1988 and 2002. This organism forms high densities when water temperature reaches 25 C. Another indicator of high temperatures, *Anabaenopsis elenkinii*, was in samples from 2005 although in low densities. The presence of *Merismopedia quadruplicata* and *Schizothrix calcicola* indicated the shallow areas were present in the lake. These blue-greens along with the *Cylindrospermum* sp. form on the bottom in such shallows and eventually become part of the phytoplankton community. It is interesting to note that the planktonic blue-greens (*Anabaena spiroides* var. *crassa*,

Aphanizomenon flos-aquae, *Microcytis aeruginosa*) and those that develop on the bottom in the shallows (*Cylindrospermum* sp., *Merismopedia quadruplicata*, *Schizothrix calcicola*) were in higher densities at Site 1 than at Site 3 in 2005. As was mentioned, depth may have played a role in these differences or these organisms were concentrated at Site 1 due to a drawing of water from the lake. Lake managers may be able to more accurately address the latter suggestion.

Euglenoids (Euglenophyta) were at their peak density for all years at Site 3 on 12 October, 2005. This density was 1508/mL with 357/mL on 22 April, 540/mL on 13 June, 958/mL on 27 July and 734/mL on 16 August (Table: 2; Figure: Euglenophyta-2005). At Site 1 in 2005, total densities were 112/mL on 22 April, 571/mL on 13 June, 10/mL on 27 July, 132/mL on 16 August and 245/mL on 12 October. In 1987, they were not counted or "zero" on 8 July and were at 45/mL on 13 August (Table: 1: Euglenophyta-Site 1). Totals in 1988 were 15/mL on 23 June, 208/mL on 13 July, 134/mL on 22 August and 60/mL on 20 October. Densities in 2002 were "zero" on 12 April, 20/mL on 5 June, 82/mL on 10 July, 71/mL on 22 August and 245/mL on 2 October. Two species of *Euglena* and nine of *Trachelomonas* were in the 22 April, 2005 sample taken at Site 1 (Table: 4/22/2005-Site 1). *Trachelomonas volvocina* in a density of 20/mL was the only species in a density >10/mL. No taxa were in the counts on the sample taken on 12 April, 2002. *Euglena acutissima* was "Present" in the samples taken at sites 1 and 3 in 2005 (Tables: 4/22/2005-Site 1; Site 3). At Site 3, it was accompanied by eight other species of *Euglena*, *T. volvocina* at 163/mL and five other species of *Trachelomonas*. Of the eight species of *Euglena*, one was at 51/mL, two at 20/mL and five at 10/mL. The five species of *Trachelomonas* were each at 10/mL. The 13 June, 2005 sample taken at Site 1 contained 11 species of *Trachelomonas* and no other euglenoids (Table: 6/13/2005-Site 1). *T. volvocina* at 418/mL was the only species in the numerous category. One other species was at

61/mL. *T. hispida* and the remaining eight species were each in a density of 10/mL. A *Trachelomonas* sp. at 20/mL was the only euglenoid in the 5 June, 2002 sample. A different *Trachelomonas* sp. filled that role in the 23 June, 1988 sample. The Site 3 sample taken on 13 June, 2005 had 12 species of *Euglena* including *E. oxyuris* at 10/mL, *Phacus acuminatus* at 51/mL and *T. volvocina* at 204/mL and 10 other species of *Trachelomonas* (Table: 6/13/2005-Site 3). Nine species of *Euglena* in addition to *E. oxyuris* were each at 10/mL. Two species of *Euglena* were each at 20/mL. One *Trachelomonas* sp. was in a density of 41/mL, one at 20/mL and the remaining eight each at 10/mL. *T. volvocina* was the only euglenoid in the sample taken at Site 1 on 27 July, 2005 (Table: 7/27/2005-Site 1). It was in a density of 10/mL. In the sample taken at Site 3 on that date, it was at 489/mL and accompanied by 14 species of *Euglena* including *E. acutissima* at 31/mL, *P. acuminatus* at 31/mL and *P. pyrum* at 10/mL and 15 other species of *Trachelomonas* (Table: 7/27/2005-Site 3). In the sample taken on 10 July, 2002, *T. volvocina* was at 31/mL, a *Trachelomonas* sp. at 10/mL and a second at 41/mL. *T. hispida* was at 15/mL, *T. volvocina* at 149/mL and three *Trachelomonas* sp. were each at 15/mL in the 13 July, 1988 sample. Three species of *Euglena*, *T. volvocina* and a second species of *Trachelomonas* were in the sample taken at Site 1 on 16 August, 2005 (Table: 8/16/2005-Site 1). None of the species seen at Site 1 on 16 August, 2005 was numerous. *T. volvocina* was in the highest density at 82/mL. The sample taken at Site 3 on 16 August, 2005 contained 18 species of *Euglena* including *E. acutissima* at 20/mL, *P. acuminatus* at 61/mL and *P. pyrum* at 10/mL, *T. volvocina* at 143/mL and 25 other species of *Trachelomonas* with all but one in a density of 10/mL (Table: 8/16/2005-Site 3). None of the species of *Euglena* was numerous. *T. volvocina* in a density of 71/mL was the only euglenoid in the 22 August, 2002 sample. In the 22 August, 1988 sample, *Euglena viridis* was at 15/mL as was *T. hispida*. They were accompanied by *T.*

volvocina at 30/mL and three species of *Trachelomonas* with one at 45/mL and the other two each at 15/mL. The 13 August, 1987 sample contained *Euglena gracilis*, *T. volvocina* and a *Trachelomonas* sp. each in a density of 15/mL. Two species of *Euglena*, *T. volvocina* and two other species of *Trachelomonas* were in the sample taken at Site 1 on 12 October, 2005 (Table: 10/12/2005-Site1). *T. volvocina* was the only one in the numerous category in a density of 194/mL. The sample taken at Site 3 on that date contained 25 species of *Euglena* including *E. acutissima*, *P. acuminatus*, *Phacus longicauda*, *P. pyrum* and 12 species of *Trachelomonas* including *T. volvocina* (Table: 10/12/2005-Site 3). Once again, *T. volvocina* in a density of 989/mL was the only euglenoid that was numerous. It was in a density of 163/mL in the sample taken on 2 October, 2002 accompanied by *E. viridis* at 20/mL, two species of *Euglena* each at 10/mL, *T. hispida* and three other species of *Trachelomonas* each at 10/mL. *T. volvocina* was in a density of 45/mL in the sample 20 October, 1988 with the only other euglenoid, *Trachelomonas* sp., at 15/mL. The number of species and densities of those species were consistently low at Site 1 in each of the years sampled. The reverse was the case at Site 3 in 2005. It had a high number of species and higher densities of *Trachelomonas volvocina* than at Site 1 on each of the dates sampled except for 13 June. The high number of species on each date in 2005 at Site 3 would lend support to the suggestion of high levels of organic materials in the water at this site and to an indication of it having been shallower than Site 1.

Dinoflagellates (Pyrrhophyta) were not numerous (100 or more/mL) on any date in any of the years. They were at "zero" on 8 July and 15/mL on 13 August, 1987 (Table: 1). In 1988, they were in a density of 15/mL on 23 June, 74/mL on 13 July (their highest density for all of the years) and "zero" on 22 August and 20 October. Totals for 2002 were "zero" on all of the dates except 10 July when they were in a density of 10/mL. They were at "zero" at Site 1 and Site 3 in

2005 on 22 April and 12 October and at that level on 27 July at Site 1 as well (Table: 2). They were at 41/mL at Site 1 on 13 June and at Site 3 on 27 July. Their density on 13 June at Site 3 and 16 August at Site 3 was 20/mL. They were in a density of 10/mL at Site 1 on 16 August, 2005. *Ceratium hirundinella* in a density of 20/mL and *Glenodinium gymnodinium* and a *Glenodinium* sp. each at 10/mL formed the total density of 41/mL obtained at Site 1 on 13 June, 2005 (Table: 6/13/2005-Site 1). *C. hirundinella* was in a density of 15/mL on 23 June, 1988. An unknown dinoflagellate was responsible for the density of 20/mL obtained at Site 3 on 13 June, 2005 (Table: 6/13/2005-Site 3). In the sample taken at Site 3 on 27 July, 2005, two species of *Glenodinium* were each at 10/mL with a third at 20/mL (Table: 7/27/2005-Site 3). *C. hirundinella* at 10/mL formed the total for dinoflagellates on 10 July, 2002. It was in a density of 74/mL on 13 July, 1988 and "Present" on 8 July, 1987. A *Glenodinium* sp. was responsible for the density of 10/mL at Site 1 and a second was at 20/mL at Site 3 in samples taken on 16 August, 2005 (Tables: 8/16/2005-Site 1; 3). *C. hirundinella* had produced the 15/mL seen on 13 August, 1987. These algae are indicative of a lake in a eutrophic condition.

Yellow-green algae or members of the Phylum Xanthophyta were not observed in any of the samples from 1987, 1988 or 2002 (Table: 1). In 2005, they reached their peak density of 92/mL on 22 April at Site 3 (Table: 2). Densities on the other dates at that site were 51/mL on 13 June, 20/mL on 27 July, 10/mL on 16 August and "zero" on 12 October. At Site 1, they were at "zero" on 22 April, 13 June and 12 October and in a density of 10/mL on 27 July and 16 August. Two species were responsible for the total of 92/mL obtained for the sample taken at Site 3 on 22 April (Table: 4/22/2005-Site 3). *Centritractus belanophorus* was in a density of 82/mL and *Ophiocytium capitatum* var. *capitatum* at 10/mL on that date. The former produced the total of 51/mL seen in the sample taken at Site 3 on 13 June, 2005 (Table: 6/13/2005). The

same was true for the 10/mL at Site 1 and the 20/mL at Site 3 on 27 July, 2005 and the 10/mL found on 16 August, 2005 at sites 1 and 3 (Tables: 7/27/2005-Site 1; 3; 8/16/2005-Site 1; 3). Both of the yellow-greens seen in 2005 are found in eutrophic lakes.

Summary

Lake Highland Silver was eutrophic in 2005 just as it was in 2002, 1988 and 1987. This conclusion is based on the presence of indicators of such a condition seen in each of the years sampled. These organisms were diatoms, green algae, blue-greens and euglenoids. The diatoms included *Cyclotella meneghiana* and *Melosira italica* var. *tenuissima*. Most of the green algae seen were members of the Order Chlorococcales. The number of genera in this order and the high densities of individual taxa supported the designation of the lake as "eutrophic". Three other indicators of such a status were present. They are the blue-greens *Anabaena spiroides* var. *crassa* that produced a "bloom density" (1000 or more/mL or One Million of more/L) in July, 2005, *Aphanizomenon flos-aquae* and *Microcystis aeruginosa*. Neither of the last two taxa was in a "bloom density". Water in Lake Highland Silver reached a temperature of 25 C and was probably higher in the middle of the summer. *Raphidiopsis curvata* is an indicator of such temperatures and it was at high densities (1000 or more/mL) at both sites in 2005 although it did not reach the exceedingly high density (18,393/mL) observed in July, 1988. Samples taken at Site 3 in 2005 contained photosynthetic organisms found in water containing a high level of organic materials and their presence gave the impression that Site 3 was pond-like. These organisms included species of the diatom genus *Nitzschia*, green algal flagellates including *Carteria*, *Chlorogonium*, *Phacotus* and *Spermatozoopsis*, high densities of members of the green algal Order Chlorococcales, blue-greens in the genus *Dactylococcopsis* and large numbers of species of *Euglena* and *Trachelomonas* along with three species of *Phacus*. The presence of a

species of *Cylindrospermum*, *Merismopedia quadruplicata* and *Schizothrix calcicola* indicated that extensive shallows were in the basin of the lake during 2005. These shallows were undoubtedly in place in earlier years as well. Overall, the condition of the lake remained about the same as in 2002 even though a severe drought occurred in Illinois in 2005.

Table 1: Phytoplankton Totals for Lake Highland Silver Site 1.

Phylum	April	June	July	August	October
Bacillariophyta-2005	275	265	275	1233	1131
Bacillariophyta-2002	0	41	775	1580	2201
Bacillariophyta-1988		30	74	402	15
Bacillariophyta-1987			45	580	
Chlorophyta-2005	31	1243	479	1284	1967
Chlorophyta-2002	41	122	387	2385	1957
Chlorophyta-1988		685	1057	1012	104
Chlorophyta-1987			119	2426	
Chrysophyta-2005	0	0	0	0	0
Chrysophyta-2002	0	0	0	0	0
Chrysophyta-1988		0	0	0	0
Chrysophyta-1987			0	0	
Cryptophyta-2005	540	377	31	173	41
Cryptophyta-2002	0	71	856	112	183
Cryptophyta-1988		119	179	357	15
Cryptophyta-1987			74	45	
Cyanophyta-2005	3679	2375	15074	11038	8154
Cyanophyta-2002	20537	15971	7073	16440	10488
Cyanophyta-1988		14970	30506	18750	29911
Cyanophyta-1987			15402	11310	
Euglenophyta-2005	112	571	10	132	245
Euglenophyta-2002	0	20	82	71	245
Euglenophyta-1988		15	208	134	60
Euglenophyta-1987			0	45	
Pyrrhophyta-2005	0	41	0	10	0
Pyrrhophyta-2002	0	0	10	0	0
Pyrrhophyta-1988		15	74	0	0
Pyrrhophyta-1987			0	15	
Xanthophyta-2005	0	0	10	10	0
Xanthophyta-2002	0	0	0	0	0
Xanthophyta-1988		0	0	0	0
Xanthophyta-1987			0	0	
Totals-2005	4637	4872	15879	13882	11537
Totals-2002	20578	16226	9183	20588	15074
Totals-1988		15833	32098	20655	30104
Totals-1987			15640	14447	

Table 2: Phytoplankton Totals for Lake Highland Silver Sites 1 and 3 in 2005.

Phylum	22 April	13 June	27 July	16 August	12 October
Bacillariophyta-Site 1	275	265	275	1233	1131
Bacillariophyta-Site 3	897	438	2497	2100	1080
Chlorophyta-Site 1	31	1243	479	1284	1967
Chlorophyta-Site 3	2191	2160	1967	2691	3567
Chrysophyta-Site 1	0	0	0	0	0
Chrysophyta-Site 3	0	0	0	10	0
Cryptophyta-Site 1	540	377	31	173	41
Cryptophyta-Site 3	112	31	112	41	367
Cyanophyta-Site 1	3679	2375	15074	11038	8154
Cyanophyta-Site 3	10926	9764	11741	8571	8133
Euglenophyta-Site 1	112	571	10	132	245
Euglenophyta-Site 3	357	540	958	734	1508
Pyrrhophyta-Site 1	0	41	0	10	0
Pyrrhophyta-Site 3	0	20	41	20	0
Xanthophyta-Site 1	0	0	10	10	0
Xanthophyta-Site 3	92	51	20	10	0
Totals-Site 1	4637	4872	15879	13882	11537
Totals-Site 3	14575	13005	17336	14177	14656

Table 3. Summary of numbers and biovolumes of organisms in Lake Highland Silver Site 1 in 2005.

22 April, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	275.184	70867
CHLOROPHYTA	30.576	5324.3
CHRYSOPHYTA	0	0
CRYPTOPHYTA	540.176	173623.8
CYANOPHYTA	3679.312	821825.7
EUGLENOPHYTA	112.112	761275.2
PYRRHOPHYTA	0	0
XANTHOPHYTA	0	0
TOTALS	4637.36	1832916
ARTHROPODA	0	0
PROTOZOA	20.384	1350805.9
ROTATORIA	10.192	3001789.6
TOTALS-ANIMALS	30.576	4352595.5

13 June, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	264.992	52680.4
CHLOROPHYTA	1243.424	1407307.2
CHRYSOPHYTA	0	0
CRYPTOPHYTA	377.104	79061.3
CYANOPHYTA	2374.736	2773813.8
EUGLENOPHYTA	570.752	1055087.1
PYRRHOPHYTA	40.768	3556184.4
XANTHOPHYTA	0	0
TOTALS	4871.776	8924134.2
ARTHROPODA	0	0
PROTOZOA	10.192	101310.5
ROTATORIA	20.384	479085.2
TOTALS-ANIMALS	30.576	580395.7

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27 July, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	275.184	101208.7
CHLOROPHYTA	479.024	1569902.3
CHRYSOPHYTA	0	0
CRYPTOPHYTA	30.576	4503.8
CYANOPHYTA	15073.968	33982628.2
EUGLENOPHYTA	10.192	7497.2
PYRRHOPHYTA	0	0
XANTHOPHYTA	10.192	120072
TOTALS	15879.136	35785812.2
ARTHROPODA	0	0
PROTOZOA	50.96	459773.3
ROTATORIA	0	0
TOTALS-ANIMALS	50.96	459773.3

16 August, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	1233.232	485547.9
CHLOROPHYTA	1284.192	3772259.9
CHRYSOPHYTA	0	0
CRYPTOPHYTA	173.264	25521.8
CYANOPHYTA	11037.936	12805559.9
EUGLENOPHYTA	132.496	218443.1
PYRRHOPHYTA	10.192	31518.8
XANTHOPHYTA	10.192	120072
TOTALS	13881.504	17458923.4
ARTHROPODA	0	0
GASTROTRICHA	10.192	544824.5
PROTOZOA	71.344	4897838
ROTATORIA	10.192	239542.6
TOTALS-ANIMALS	91.728	5682205.1

Summary (Site 1) p. 3

12 October, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	1131.312	391967
CHLOROPHYTA	1967.056	4902296
CHRYSOPHYTA	0	0
CRYPTOPHYTA	40.768	6005.1
CYANOPHYTA	8153.6	9171913
EUGLENOPHYTA	244.608	316951.9
PYRRHOPHYTA	0	0
XANTHOPHYTA	0	0
TOTALS	11537.344	14789133
ARTHROPODA	0	0
PROTOZOA	30.576	432925.6
ROTATORIA	0	0
TOTALS-ANIMALS	30.576	432925.6

Table 4. Summary of numbers and biovolumes of organisms in Lake Highland Silver Site 3 in 2005.

22 April, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	896.896	189608.8
CHLOROPHYTA	2191.28	1144468.8
CHRYSOPHYTA	0	0
CRYPTOPHYTA	112.112	40028
CYANOPHYTA	10925.824	5693596.7
EUGLENOPHYTA	356.72	1435955.1
PYRRHOPHYTA	0	0
XANTHOPHYTA	91.728	965578.9
TOTALS	14574.56	9469236.3
ARTHROPODA	0	0
PROTOZOA	30.576	2366745.4
ROTATORIA	0	0
TOTALS-ANIMALS	30.576	2366745.4

13 June, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	438.256	112956
CHLOROPHYTA	2160.704	1692773.2
CHRYSOPHYTA	0	0
CRYPTOPHYTA	30.576	4503.8
CYANOPHYTA	9763.936	5103349.3
EUGLENOPHYTA	540.176	2453399.2
PYRRHOPHYTA	20.384	2038.4
XANTHOPHYTA	50.96	600359.8
TOTALS	13004.992	9969379.7
ARTHROPODA	10.192	110315750
PROTOZOA	0	0
ROTATORIA	0	0
TOTALS-ANIMALS	10.192	110315750

Summary (Site 3) p. 2

27 July, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	2497.04	920261.1
CHLOROPHYTA	1967.056	4618795.1
CHRYSOPHYTA	0	0
CRYPTOPHYTA	112.112	16514.1
CYANOPHYTA	11741.084	7034721.1
EUGLENOPHYTA	958.048	2358965.9
PYRRHOPHYTA	40.768	222633.1
XANTHOPHYTA	20.384	240143.9
TOTALS	17336.492	15412034.3
ARTHROPODA	0	0
GASTROTRICHA	10.192	576343.3
PROTOZOA	61.152	3575881.4
ROTATORIA	30.576	718627.7
TOTALS-ANIMALS	101.92	4870852.4

16 August, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	2099.552	825679.4
CHLOROPHYTA	2690.688	3503498.8
CHRYSOPHYTA	10.192	1592
CRYPTOPHYTA	40.768	29519
CYANOPHYTA	8571.472	4893749.9
EUGLENOPHYTA	733.824	2828552.1
PYRRHOPHYTA	20.384	504300.2
XANTHOPHYTA	10.192	120072
TOTALS	14177.072	12706963.4
ARTHROPODA	0	0
PROTOZOA	40.768	633385.9
ROTATORIA	10.192	239542.6
TOTALS-ANIMALS	50.96	872928.5

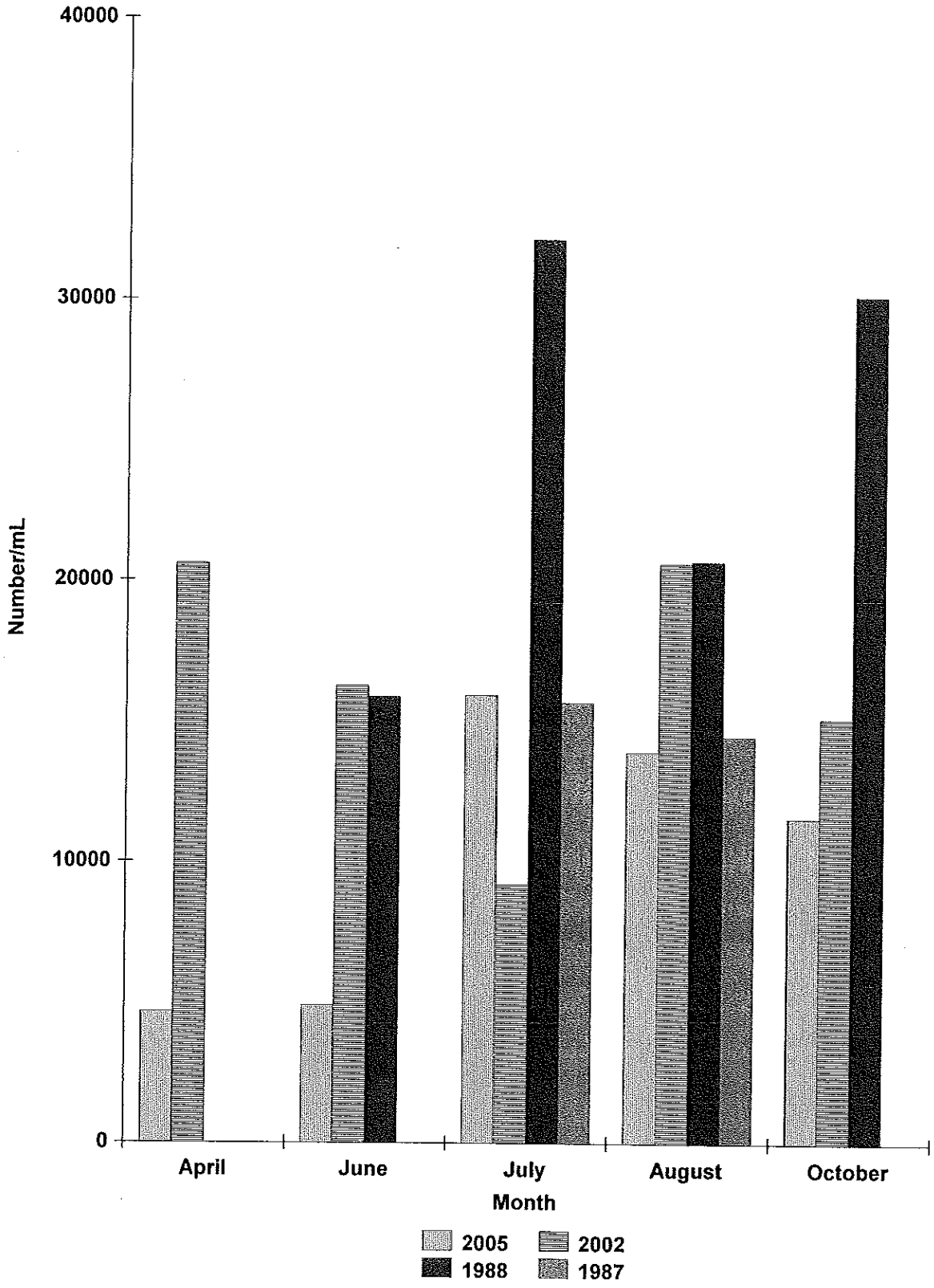
Summary (Site 3) p. 3

12 October, 2005

Phylum	Number/mL	Total Volume
BACILLARIOPHYTA	1080.352	328985.5
CHLOROPHYTA	3567.2	2846096.5
CHRYSOPHYTA	0	0
CRYPTOPHYTA	366.912	54046.1
CYANOPHYTA	8133.216	4386697.1
EUGLENOPHYTA	1508.416	4315879.8
PYRRHOPHYTA	0	0
XANTHOPHYTA	0	0
TOTALS	14656.096	11931705
ARTHROPODA	0	0
PROTOZOA	10.192	80048
ROTATORIA	0	0
TOTALS-ANIMALS	10.192	80048

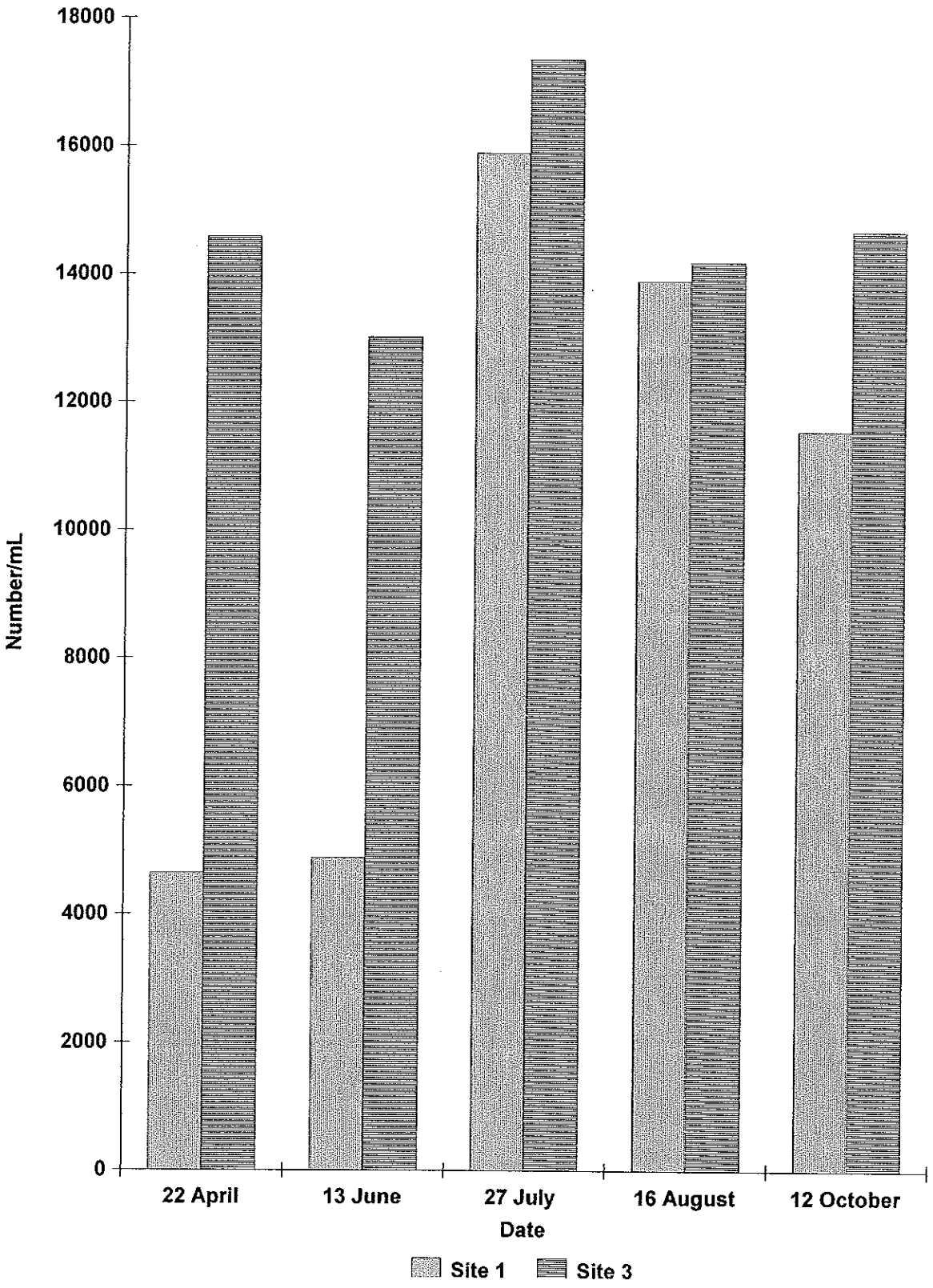
Lake Highland Silver

Total Phytoplankton-Site 1



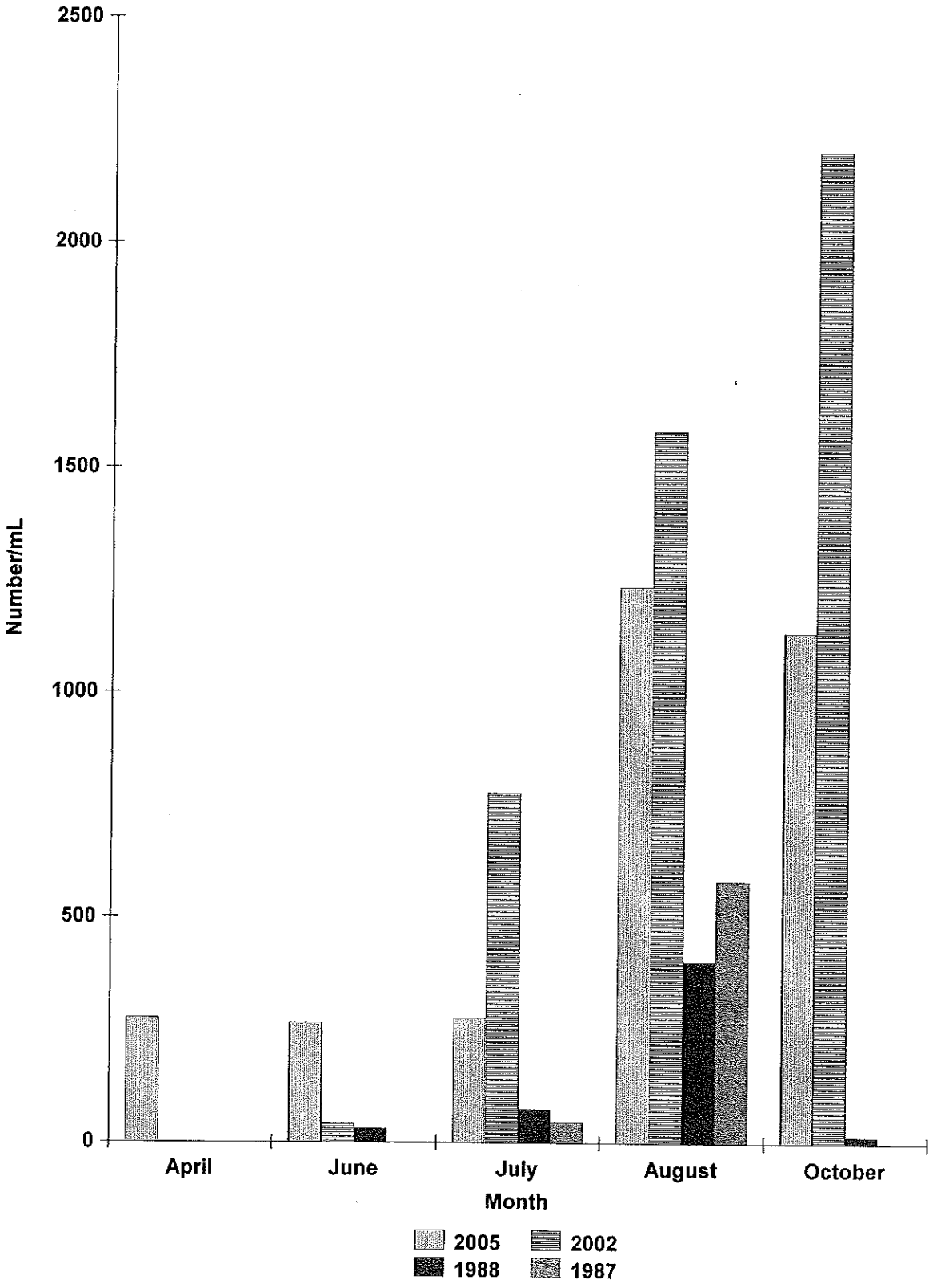
Lake Highland Silver

Total Phytoplankton-2005



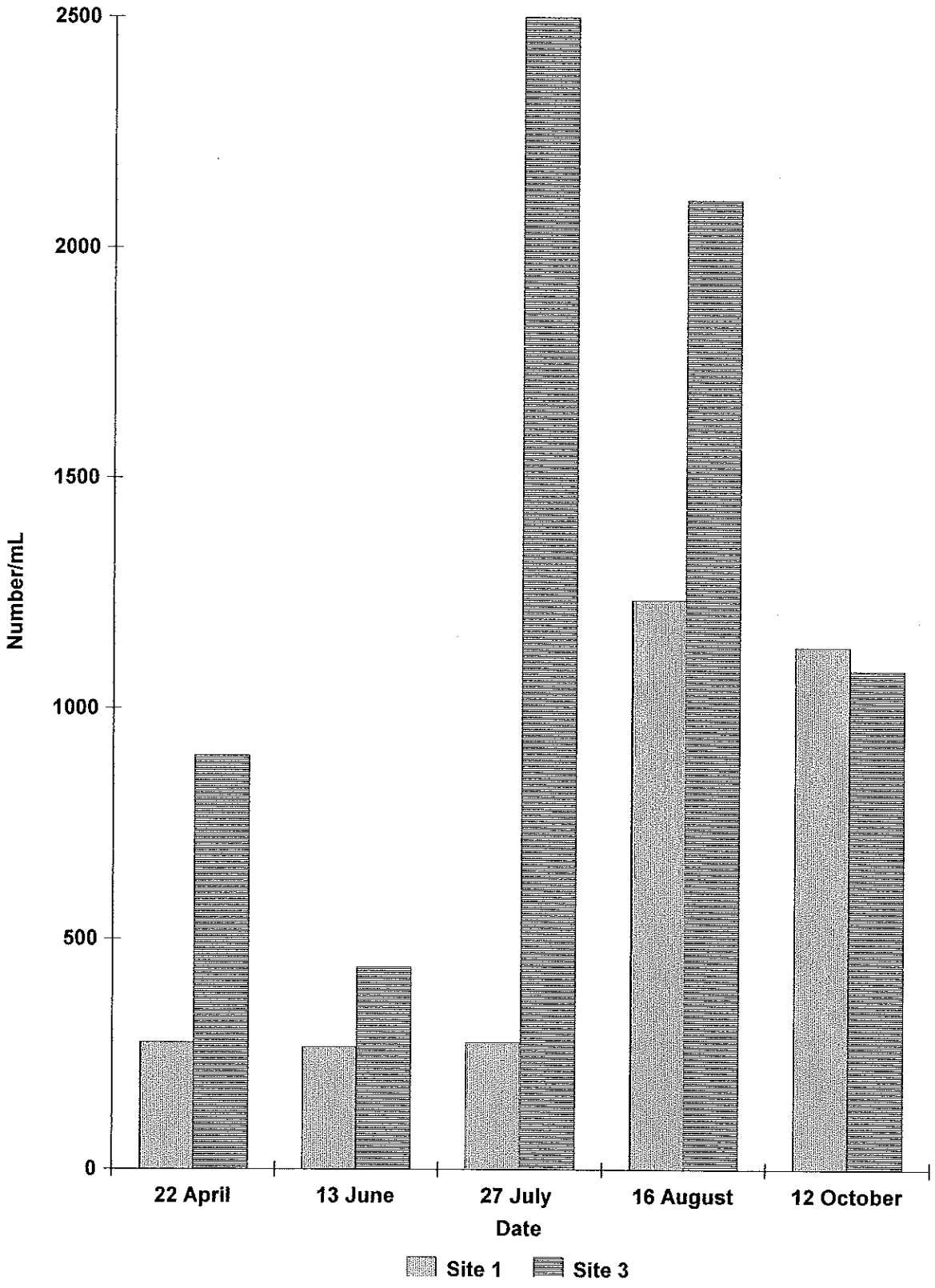
Lake Highland Silver

Bacillariophyta-Site 1



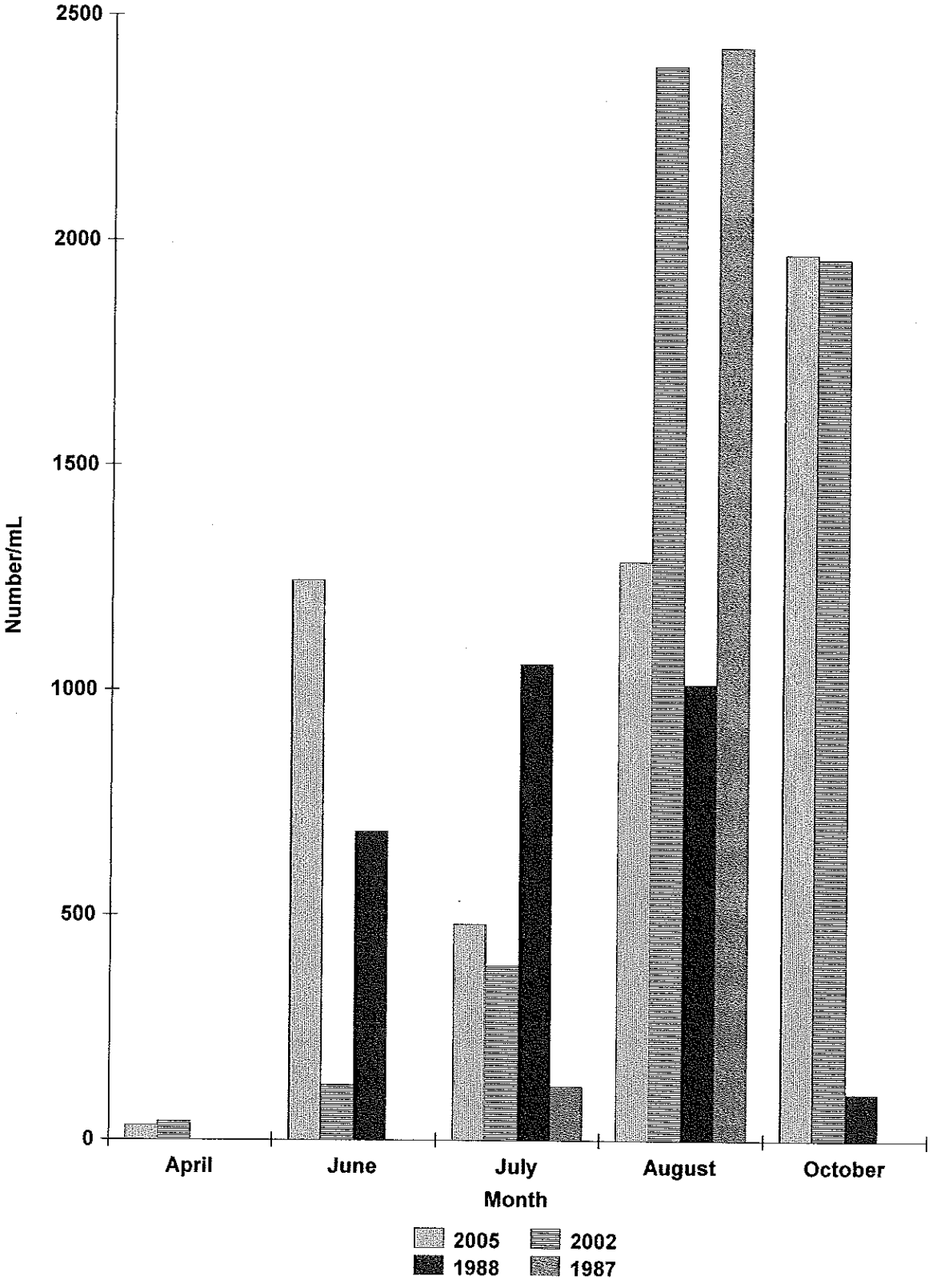
Lake Highland Silver

Bacillariophyta-2005



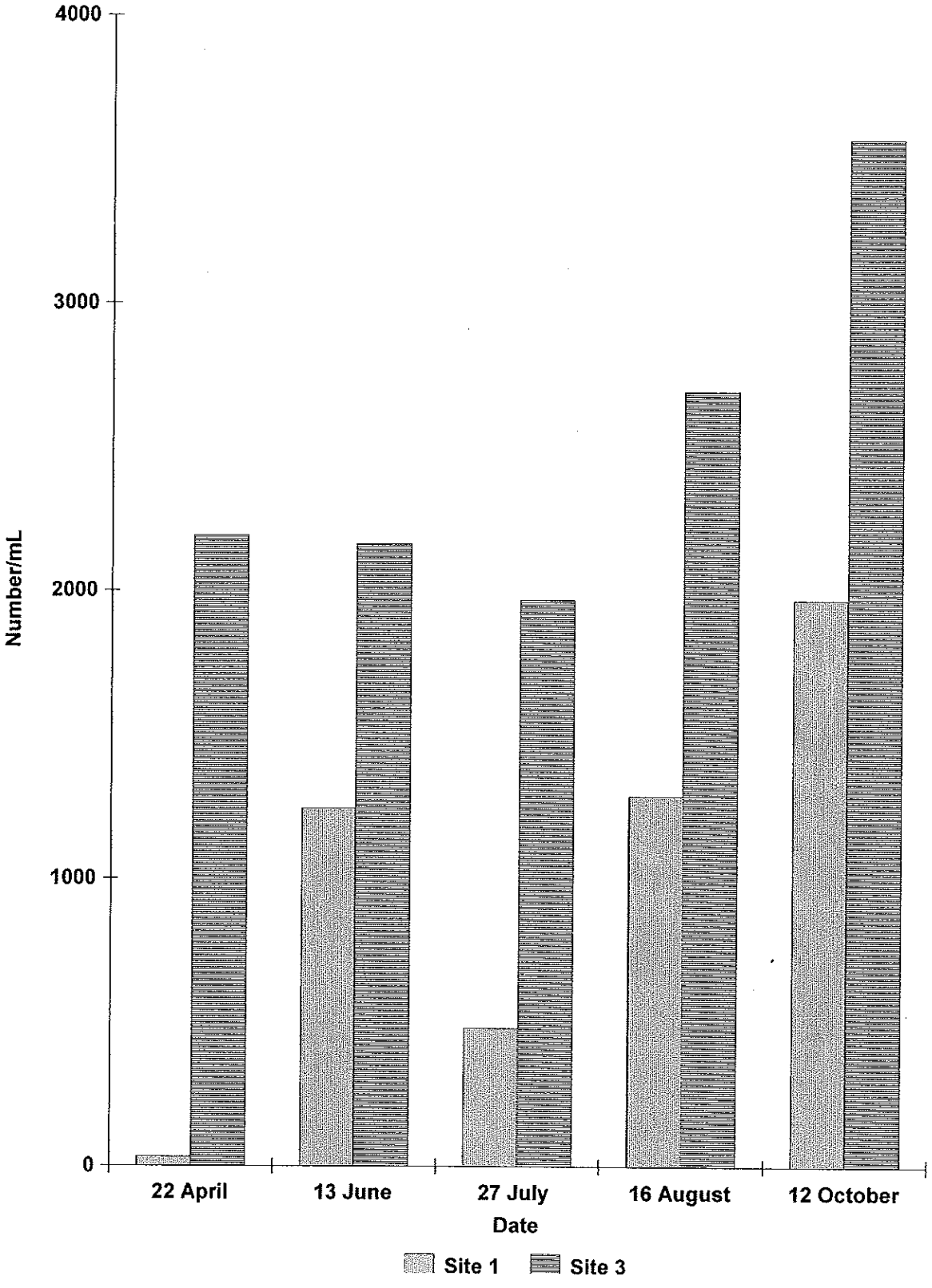
Lake Highland Silver

Chlorophyta-Site 1



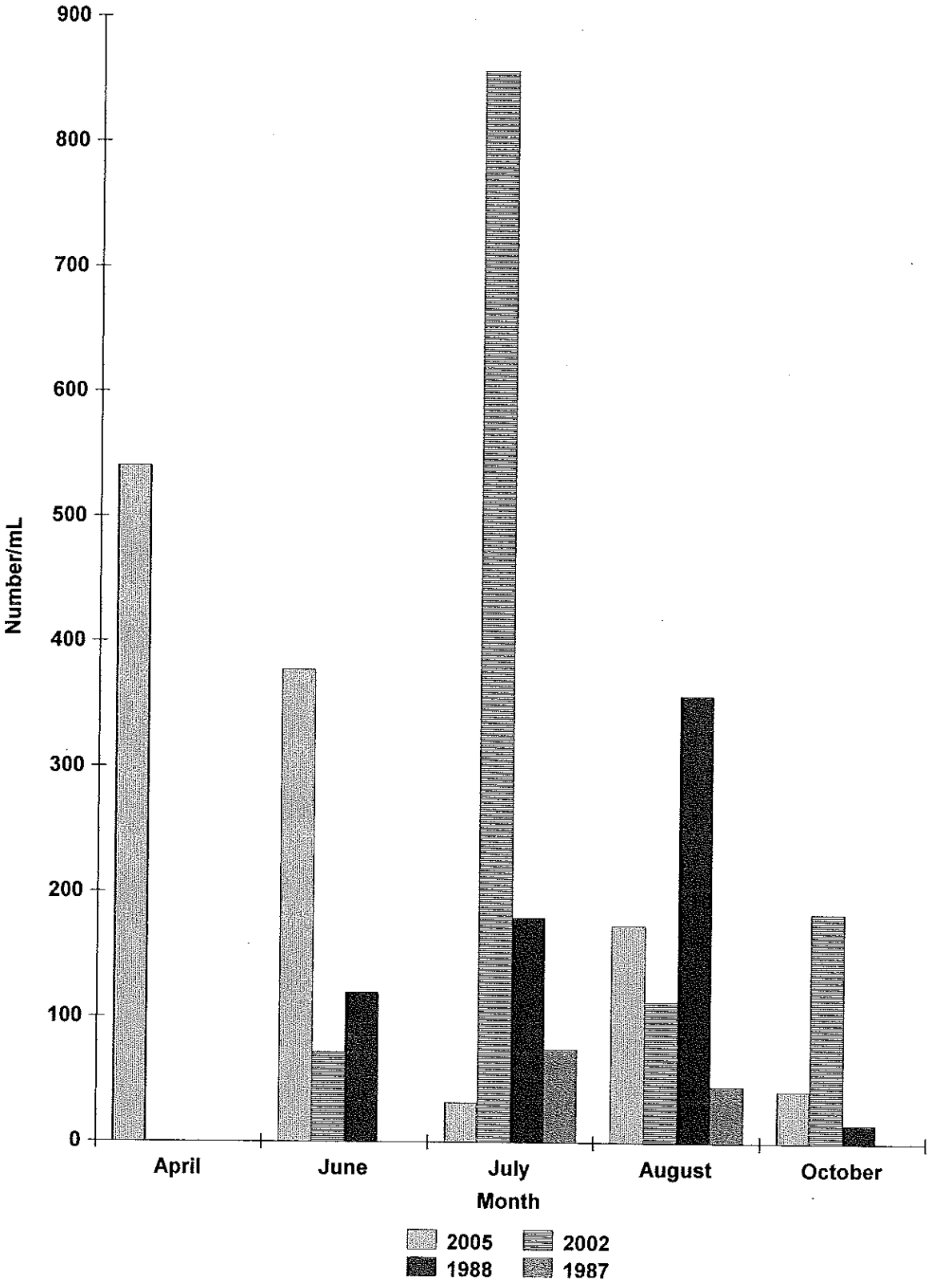
Lake Highland Silver

Chlorophyta-2005



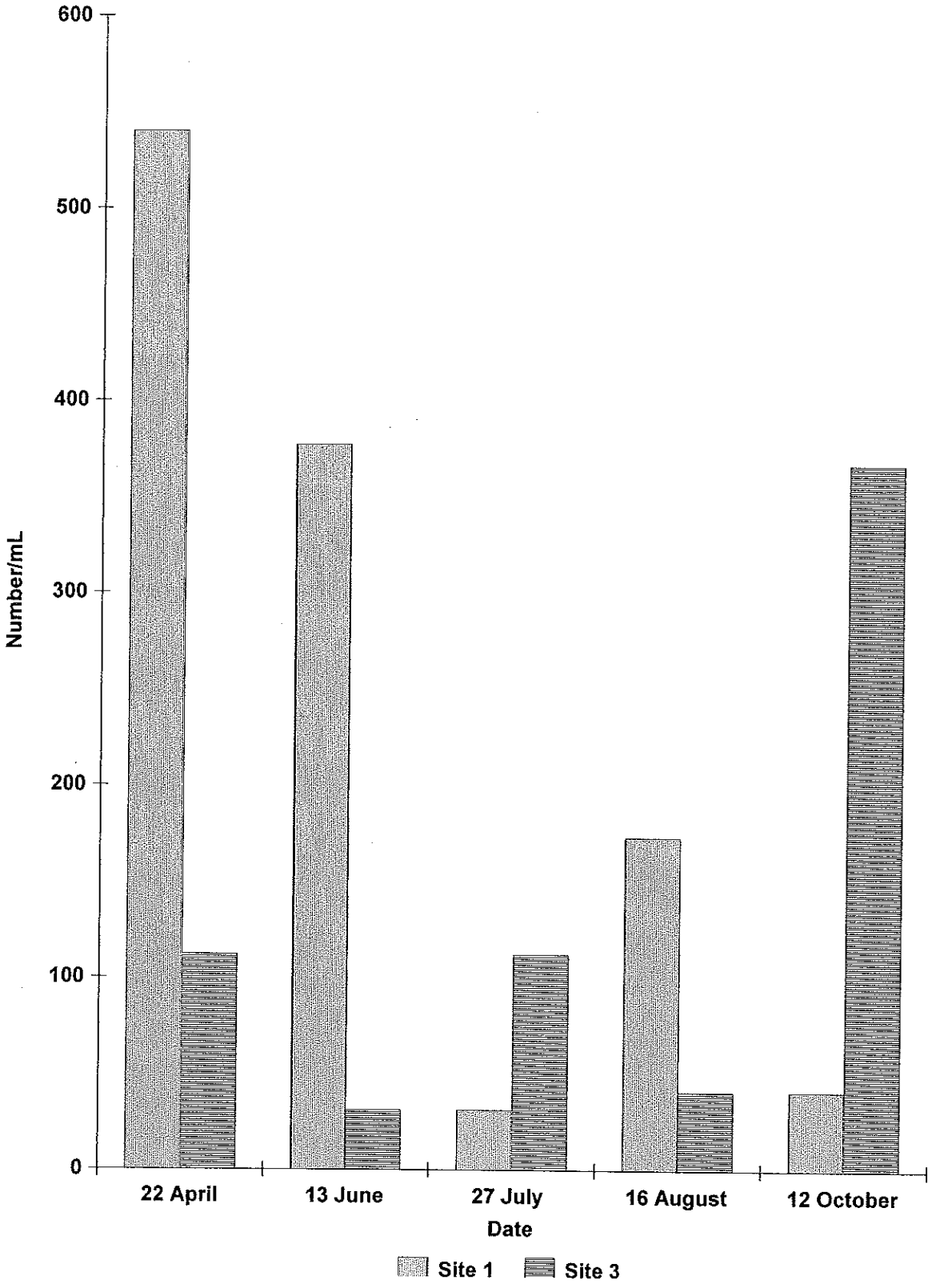
Lake Highland Silver

Cryptophyta-Site 1



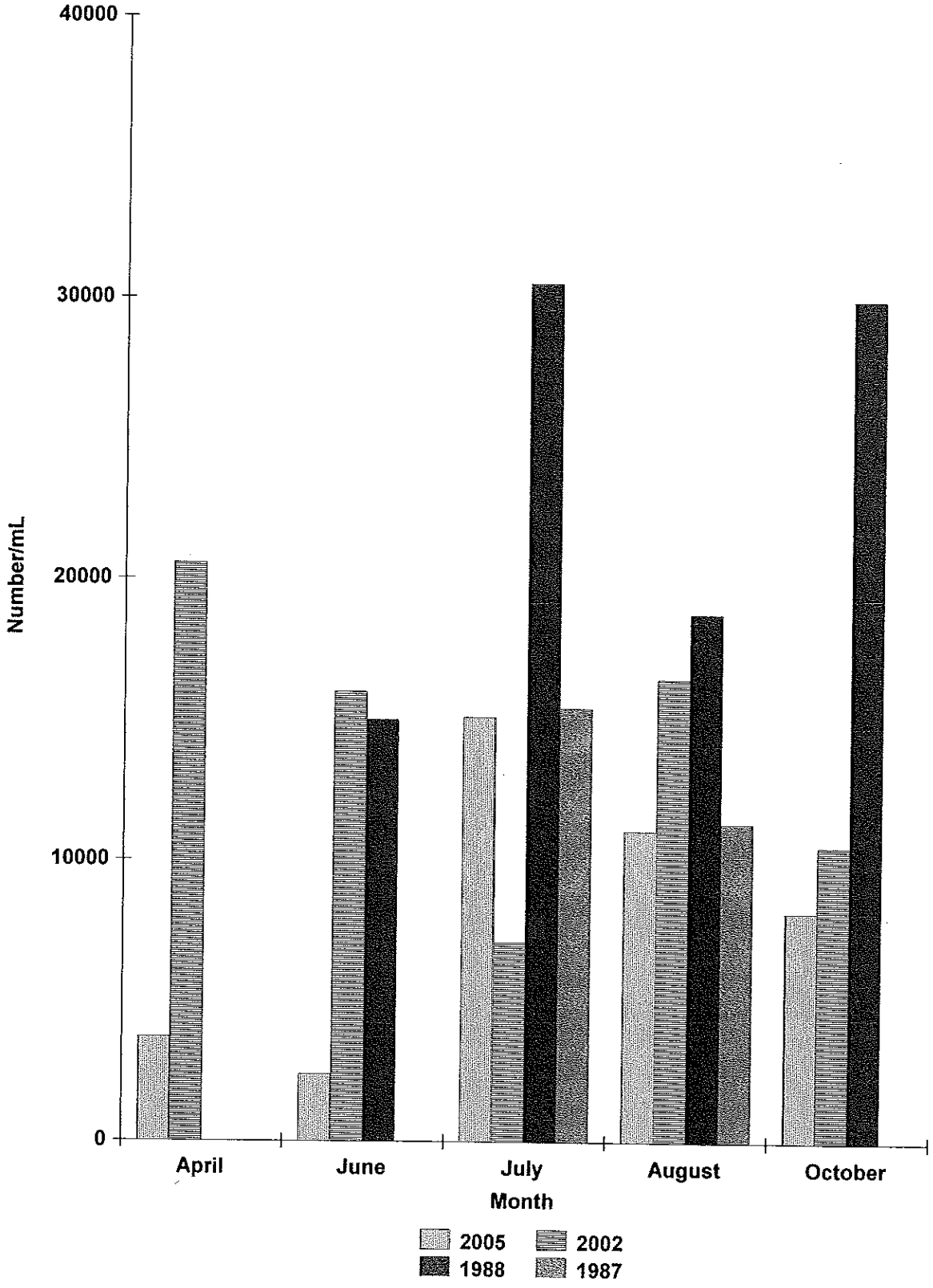
Lake Highland Silver

Cryptophyta-2005



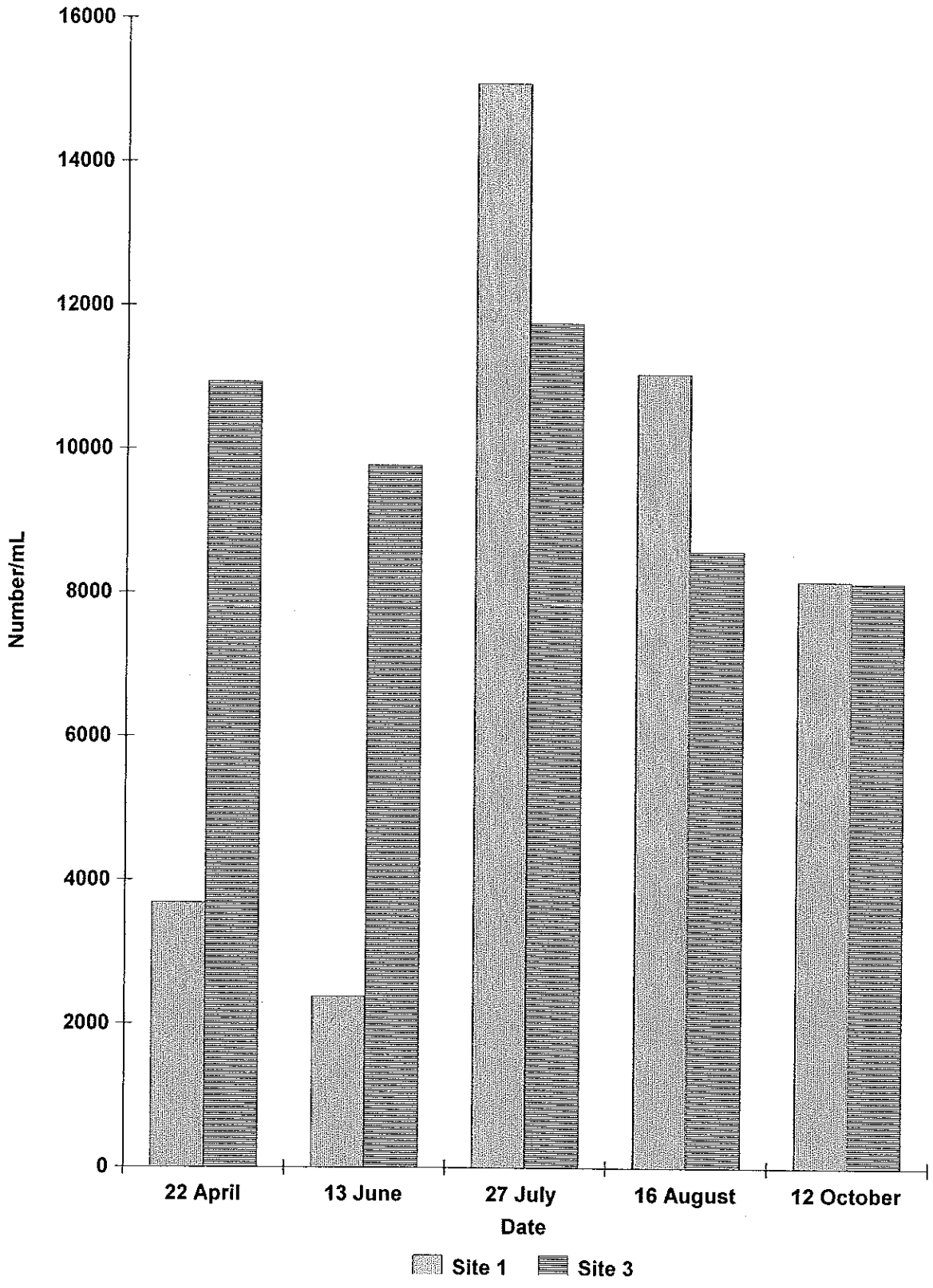
Lake Highland Silver

Cyanophyta-Site 1



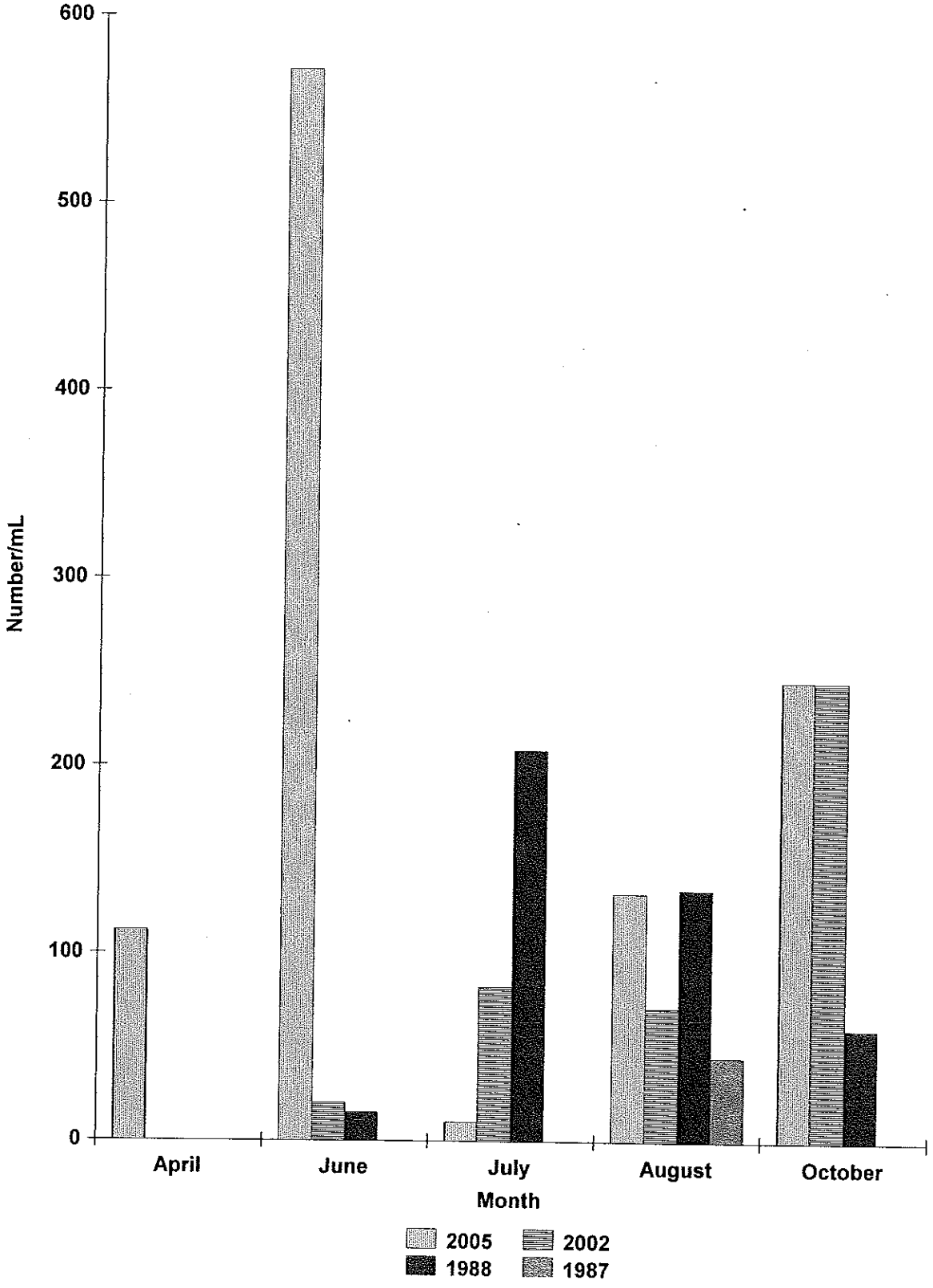
Lake Highland Silver

Cyanophyta-2005



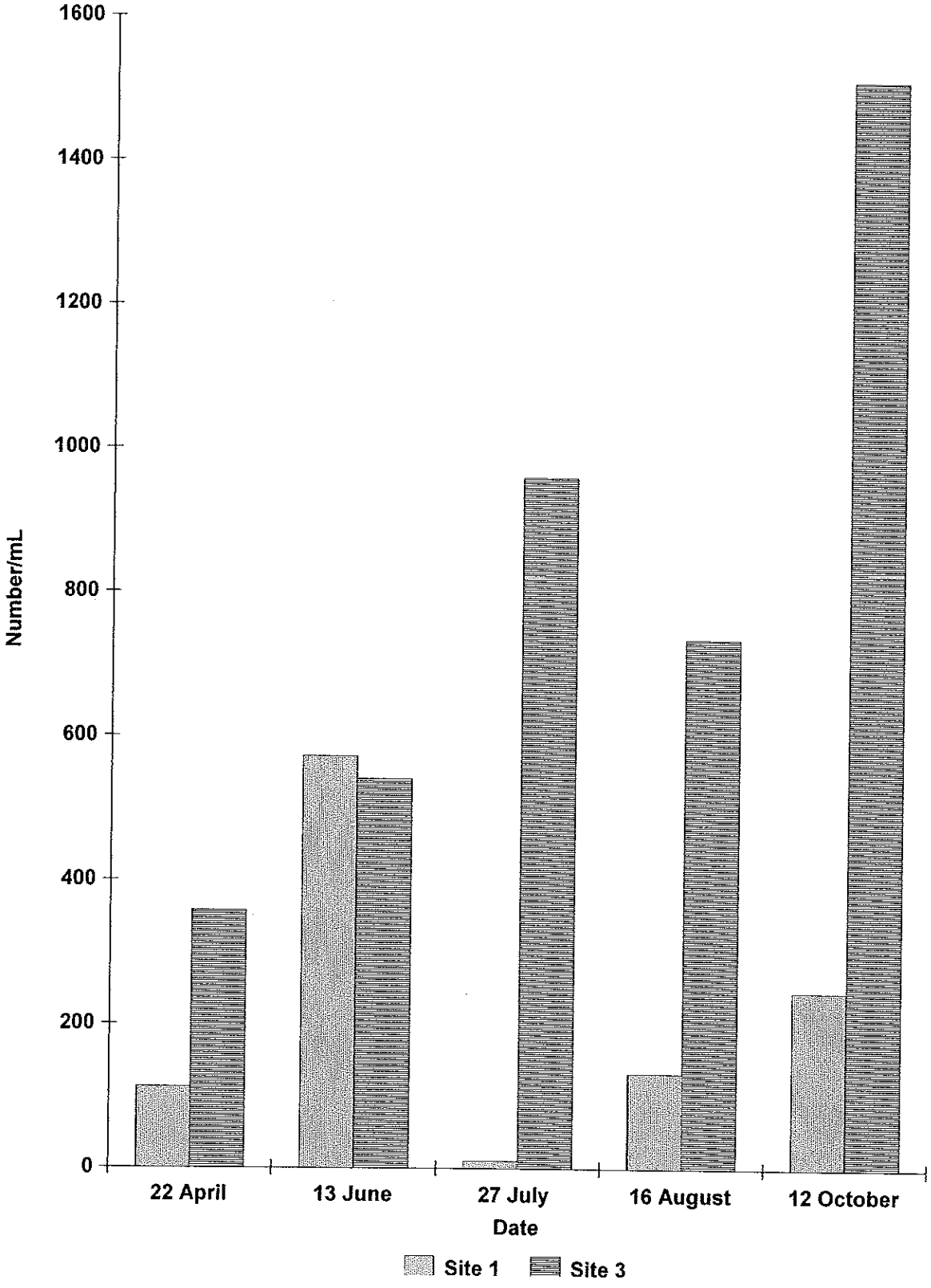
Lake Highland Silver

Euglenophyta-Site 1



Lake Highland Silver

Euglenophyta-2005



List of taxa found in samples from Lake Highland Silver (ROZA) during 2005.

Taxa*	Date and Site Found
BACILLARIOPHYTA	
Cyclotella meneghiniana Kuetz.	4-22, 6-13, 7-27, 8-16, 10-12 (Both Sites)
Fragilaria sp.	7-27(3)
Melosira	
M. distans (Ehr.) Kuetz.	4-22(1), 7-27(3), 8-16(3), 10-12(1,3)
M. italica (Ehr.) Kuetz. var. *tenuissima* (Grun.) Muell.	6-13(1), 7-27(3), 8-16(1), 10-12(1,3)
Navicula	
N. cryptocephala (Kuetz.) var. *cryptocephala*	6-13, 7-27, 8-16 (All Site 3)
N. sp.	8-16(3)
Nitzschia	
N. acicularis (Kuetz.) Wm. Sm.	4-22(3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
N. linearis (Ag.) Wm. Sm.	6-13(3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
N. palea (Kuetz.) Wm. Sm.	4-22(3), 6-13(3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
Synedra delicatissima Wm. Sm. var. *delicatissima*	4-22(1), 7-27(1,3), 8-16(3), 10-12(3)
Tabellaria sp.	10-12(1)
CHLOROPHYTA	
Actinastrum hantzschii Lag. var. *fluviatile* Schroed.	6-13(1), 7-27(1,3), 8-16(1,3), 10-12(1,3)
Ankistrodesmus	
A. convolutus Corda	6-13(3), 8-16(3), 10-12(1,3)
A. falcatus (Corda) Ralfs var. *acicularis* (A. Br.) G. S. West	4-22(3), 6-13(1,3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
A. falcatus var. *mirabilis* (West & West) G. S. West	4-22, 6-13, 7-27, 10-12 (All Site 3)

Taxa	Date and Site Found
Carteria	
C. multifilis (Fres.) Dill.	4-22(3), 6-13(1,3), 7-27(1,3), 8-16(1,3), 10-12(1)
C. sp. (No. 1)	6-13(1,3), 7-27(3), 8-16(3), 10-12(3)
Chlorogonium elongatum (Dang.) Franze var. *elongatum*	4-22(3), 7-27(3), 8-16(1,3), 10-12(1,3)
Chodatella quadriseta Lemm.	8-16(1)
Closterium acutum (Lyngb.) Breb.	4-22(3), 6-13(3), 7-27(1), 10-12(1,3)
Clostridium lunula Rein.	6-13(3), 10-12(1)
Coccomonas orbicularis Stein	6-13, 7-27 (Both Site 3)
Coelastrum	
C. cambricum Arch.	7-27(3), 8-16(1), 10-12(1)
C. microporum Naeg.	4-22(3), 6-13(1,3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
Conochaete comosa Kleb.	8-16(1), 10-12(3)
Cosmarium	
C. sp. (5.0 x 5.0 μm)	4-22(1,3), 6-13(3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
C. sp. (6.0 x 7.5 μm)	4-22(1)
C. sp. (7.5 x 7.5 μm)	8-16, 10-12 (Both Site 3)
C. sp. (10.0 x 10.0 μm)	8-16(3)
C. sp. (10.0 x 15.0 μm)	7-27(3)
Crucigenia	
C. fenestrata Schmid.	10-12(1,3)
C. quadrata Morren	6-13(3)

Taxa	Date and Site Found
Crucigenia (Cont.)	
C. rectangularis (A. Br.) Gray	6-13, 7-27, 8-16, 10-12 (Both Sites)
C. tetrapedia (Kirch.) W. & G. S. West	6-13, 7-27, 8-16, 10-13 (All Site 3)
Dictyosphaerium pulchellum Fres.	4-22(3), 6-13(1,3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
Elakatothrix viridis (Snow) Printz	6-13(1,3), 7-27(1), 8-16(1), 10-12(3)
Golenkinia radiata Chod.	7-27(1)
Kirchneriella lunaris (Kirch.) Moeb. var. *lunaris*	4-22(3), 6-13(1,3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
Micractinium pusillum Fres.	4-22(3), 10-12(1)
Nephrocytium limneticum (G. M. Sm.) G. M. Sm.	6-13, 8-16 (Both Site 3)
Oocystis borgei Snow	6-13(1,3), 7-27(3), 8-16(1,3), 10-12(1,3)
Pediastrum	
P. duplex Meyen var. *gracilimum* West & West	6-13(1,3), 10-12(1)
P. tetras (Ehr.) Ralfs var. *tetraodon* (Corda) Hansg.	10-12(3)
Phacotus lenticularis (Ehr.) Stein	8-16(1)
Scenedesmus	
S. abundans (Kirch.) Chod.	4-22(3), 6-13(1,3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
S. arcuatus Lemm. var. *platydisca* G. M. Sm.	7-27(3), 8-16(3), 10-12(1)
S. bijuga (Turp.) Lag. var. *alternans* (Rein.) Borge	6-13(3)
S. denticulatus Lag.	4-22, 6-13 (Both 3)
S. dimorphus (Turp.) Kuetz.	4-22(3), 6-13(3), 7-27(3), 8-16(1,3), 10-12(1,3)

Taxa	Date and Site Found
Scenedesmus (Cont.)	
S. incrassatulus Bohlin var. *incrassatulus*	10-12(1)
S. obliquus (Turp.) Kuetz.	10-12(1,3)
S. opoliensis Rich	7-27(3), 8-16(1,3), 10-12(3)
S. quadricauda (Turp.) Breb.	7-27(3)
Schroederia setigera (Schroed.) Lemm.	4-22(3), 6-13(3), 7-27(1), 8-16(3), 10-12(1,3)
Spermatozoopsis exultans Korsh.	8-16(3)
Staurastrum	
S. sp. (10.0 x 15.0 μm)	4-22(3)
S. sp. (20.0 x 25.0 μm)	6-13(3)
Tetraedron	
T. caudatum (Corda) Hansg. var. *caudatum*	10-12(3)
T. caudatum var. *longispinum* Lemm.	7-27(3)
T. constrictum G. M. Sm.	6-13(3), 7-27(1,3), 8-16(1)
T. gracile (Rein.) Hansg.	10-12(1)
T. minimum (A. Br.) Hansg.	4-22(3), 6-13(3), 7-27(3), 8-16(1,3)
T. muticum (A. Br.) Hansg. var. *muticum*	6-13(3)
T. regulare Kuetz. var. *incus* Teiling	7-27, 10-12 (Both Site 3)
T. trigonum (Naeg.) Hansg. var. *trigonum*	4-22(3), 6-13(1,3), 7-27(3), 8-16(1,3), 10-12(1,3)
Tetrastrum heterocanthum (Nordst.) Chod.	4-22(3), 6-13(3), 8-16(3), 10-12(1,3)
Treubaria setigerum (Arch.) G. M. Sm.	6-13(1,3), 8-16(3)
CHRYSOPHYTA	

Taxa	Date and Site Found
Heliapsis mutabilis Pascher	8-16(3)
CRYPTOPHYTA	
Cryptomonas	
C. erosa Ehr.	4-22(1,3), 6-13(1), 8-16(3)
C. sp. (No. 1)	4-22, 6-13, 7-27, 8-16, 10-12 (Both Sites)
CYANOPHYTA	
Anabaena	
A. spiroides Kleb. var. *crassa* Lemm.	6-13(1), 7-27(1,3), 8-16(1,3), 10-12(1,3)
A. sp. (2.5 x 25.0 μm)	7-27, 8-16 (Both Site 1)
A. sp. (3.0 x 30.0 μm)	7-27(1)
A. sp. (5.0 x 50.0 μm)	7-27(1,3), 10-12(1)
Anabaenopsis elenkinii Miller	7-27(1), 8-16(1), 10-12(1,3)
Anacystis montana (Lightf.) Dr. & Daily	4-22, 6-13, 7-27, 8-16, 10-12 (Both Sites)
Aphanizomenon flos-aquae Born. *et* Flah.	6-13(1), 7-27(1,3), 8-16(1,3), 10-12(1)
Cylindrospermum sp. (2.5 x 25.0 μm)	7-27, 8-16, 10-12 (All Site 1)
Dactylococcopsis	
D. acicularis Lemm.	4-22(3), 7-27(3), 8-16(1)
D. rhaphidioides Hansg.	6-13(3), 7-27(3), 8-16(1,3), 10-12(1)
Gomphosphaeria lacustris Chod.	4-22, 6-13, 7-27, 8-16, 10-12 (Both Sites)
Merismopedia quadruplicata Trev.	4-22(3), 6-13(1,3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
Microcystis aeruginosa Kuetz.	6-13(1), 7-27(1,3), 8-16(1,3), 10-12(1,3)
Raphidiopis curvata Fritsch & Rich	4-22(3), 7-27(1,3), 8-16(1,3), 10-12(1,3)

Taxa	Date and Site Found
Schizothrix calcicola Gom.	4-22(3), 6-13(1,3), 7-27(1,3), 8-16(1,3), 10-12(1,3)
EUGLENOPHYTA	
Euglena	
E. acutissima Lemm.	4-22(1,3), 7-27(3), 8-16(3), 10-12(3)
E. oxyuris Ehr.	6-13(3)
E. sp. (5.0 x 22.5 μm)	10-12(3)
E. sp. (5.0 x 30.0 μm)	4-22(3)
E. sp. (5.0 x 35.0 μm)	8-16(3)
E. sp. (5.0 x 42.5 μm)	10-12(3)
E. sp. (6.0 x 20.0 μm)	6-13(3)
E. sp. (6.0 x 22.5 μm)	10-12(3)
E. sp. (6.0 x 25.0 μm)	7-27(3)
E. sp. (7.5 x 30.0 μm)	10-12(3)
E. sp. (7.5 x 35.0 μm)	10-12(3)
E. sp. (7.5 x 45.0 μm)	10-12(3)
E. sp. (8.0 x 37.5 μm)	10-12(3)
E. sp. (10.0 x 15.0 μm)	7-27(3)
E. sp. (10.0 x 20.0 μm)	7-27(3)
E. sp. (10.0 x 20.0 μm)	10-12(3)
E. sp. (10.0 x 20.0 μm)	10-12(3)
E. sp. (10.0 x 22.5 μm)	4-22(3)

Taxa	Date and Site Found
Euglena (Cont.)	
E. sp. (10.0 x 22.5 μm)	6-13(3)
E. sp. (10.0 x 22.5 μm)	7-27(3)
E. sp. (10.0 x 25.0 μm)	8-16(1)
E. sp. (10.0 x 25.0 μm)	10-12(3)
E. sp. (10.0 x 25.0 μm)	8-16(3)
E. sp. (10.0 x 25.0 μm)	8-16(3)
E. sp. (10.0 x 32.5 μm)	10-12(1)
E. sp. (10.0 x 35.0 μm)	8-16(3)
E. sp. (10.0 x 40.0 μm)	7-27(3)
E. sp. (10.0 x 40.0 μm)	8-16(3)
E. sp. (10.0 x 45.0 μm)	10-12(3)
E. sp. (10.0 x 50.0 μm)	6-13(3)
E. sp. (10.0 x 50.0 μm)	8-16(3)
E. sp. (10.0 x 55.0 μm)	7-27(3)
E. sp. (10.0 x 55.0 μm)	10-12(3)
E. sp. (10.0 x 65.0 μm)	8-16(3)
E. sp. (11.0 x 30.0 μm)	7-27(3)
E. sp. (11.0 x 35.0 μm)	10-12(3)
E. sp. (11.0 x 45.0 μm)	8-16(1)
E. sp. (12.0 x 30.0 μm)	10-12(3)
E. sp. (12.0 x 35.0 μm)	8-16(3)

Taxa	Date and Site Found
Euglena (Cont.)	
E. sp. (12.5 x 21.0 μm)	8-16(1)
E. sp. (12.5 x 35.0 μm)	6-13(3)
E. sp. (12.5 x 35.0 μm)	6-13, 7-27 (Both Site 3)
E. sp. (12.5 x 35.0 μm)	6-13(3)
E. sp. (12.5 x 35.0 μm)	7-27(3)
E. sp. (12.5 x 35.0 μm)	8-16(3)
E. sp. (12.5 x 37.5 μm)	10-12(3)
E. sp. (12.5 x 42.5 μm)	8-16(3)
E. sp. (12.5 x 50.0 μm)	4-22(3)
E. sp. (15.0 x 17.5 μm) (encysted)	10-12(3)
E. sp. (15.0 x 20.0 μm)	10-12(1)
E. sp. (15.0 x 20.0 μm)	4-22(3)
E. sp. (15.0 x 20.0 μm)	6-13(3)
E. sp. (15.0 x 20.0 μm)	10-12(3)
E. sp. (15.0 x 25.0 μm)	7-27(3)
E. sp. (15.0 x 25.0 μm)	8-16(3)
E. sp. (15.0 x 25.0 μm)	10-12(3)
E. sp. (15.0 x 27.5 μm)	8-16(3)
E. sp. (15.0 x 27.5 μm)	10-12(3)
E. sp. (15.0 x 30.0 μm)	4-22(3)
E. sp. (15.0 x 30.0 μm)	8-16(3)

Taxa	Date and Site Found
Euglena (Cont.)	
E. sp. (15.0 x 30.0 μm)	8-16(3)
E. sp. (15.0 x 35.0 μm)	4-22(3)
E. sp. (15.0 x 35.0 μm)	6-13(3)
E. sp. (15.0 x 35.0 μm)	10-12(3)
E. sp. (15.0 x 35.0 μm)	10-12(3)
E. sp. (15.0 x 45.0 μm)	10-12(3)
E. sp. (15.0 x 50.0 μm)	6-13(3)
E. sp. (16.0 x 35.0 μm)	6-13(3)
E. sp. (17.5 x 30.0 μm)	7-27(3)
E. sp. (17.5 x 35.0 μm)	4-22(3)
E. sp. (17.5 x 45.0 μm)	8-16(3)
E. sp. (17.5 x 90.0 μm)	4-22(3)
E. sp. (20.0 x 20.0 μm)	10-12(3)
E. sp. (20.0 x 27.5 μm)	8-16(3)
E. sp. (20.0 x 35.0 μm)	7-27(3)
E. sp. (20.0 x 65.0 μm)	8-16(3)
E. sp. (22.5 x 45.0 μm)	7-27(3)
E. sp. (25.0 x 35.0 μm)	6-13(3)
E. sp. (30.0 x 40.0 μm)	10-12(3)
E. sp. (35.0 x 40.0 μm)	4-22(1)

Taxa	Date and Site Found
Phacus	
P. acuminatus Stokes	6-13, 7-27, 8-16, 10-12 (All Site 3)
P. longicauda (Ehr.) Duj.	10-12(3)
P. pyrum (Ehr.) Stein	7-27, 8-16, 10-12 (All Site 3)
Trachelomonas	
T. hispida (Perty) Stein	6-13(1)
T. volvocina Ehr.	4-22, 6-13, 7-27, 8-16, 10-12 (Both Sites)
T. sp. (cyl.-gran.) (10.0 x 11.0 μm)	10-12(3)
T. sp. (cyl.-gran.) (10.0 x 15.0 μm)	10-12(3)
T. sp. (cyl.-gran.) (10.0 x 20.0 μm)	8-16(3)
T. sp. (cyl.-gran.) (12.0 x 15.0 μm)	7-27, 8-16 (Both Site 3)
T. sp. (cyl.-gran.) (12.5 x 15.0 μm)	7-27(3)
T. sp. (cyl.-gran.) (12.5 x 15.0 μm)	8-16(3)
T. sp. (cyl.-gran.) (12.5 x 16.0 μm)	10-12(3)
T. sp. (cyl.-gran.) (12.5 x 17.5 μm)	10-12(3)
T. sp. (cyl.-gran.) (15.0 x 16.0 μm)	6-13(3)
T. sp. (cyl.-gran.) (15.0 x 20.0 μm)	6-13(1)
T. sp. (cyl.-gran.) (15.0 x 20.0 μm)	7-27(3)
T. sp. (cyl.-gran.) (15.0 x 20.0 μm)	8-16(3)
T. sp. (cyl.-gran.) (15.0 x 20.0 μm)	10-12(3)
T. sp. (cyl.-gran.) (15.0 x 20.0 μm)	10-12(3)
T. sp. (cyl.-gran.) (15.0 x 25.0 μm)	8-16(3)

Taxa	Date and Site Found
Trachelomonas (Cont.)	
T. sp. (cyl.-gran.) (15.0 x 25.0 μm)	6-13(1)
T. sp. (cyl.-gran.) (20.0 x 21.0 μm)	6-13(3)
T. sp. (cyl.-gran.-collar) (11.0 x 17.5 μm)	8-16(3)
T. sp. (cyl.-gran.-collar) (12.5 x 17.5 μm)	8-16(3)
T. sp. (cyl.-gran.-collar) (12.5 x 20.0 μm)	7-27(3)
T. sp. (cyl.-gran.-collar) (15.0 x 18.0 μm)	8-16(3)
T. sp. (cyl.-gran.-collar) (15.0 x 20.0 μm)	6-13(1)
T. sp. (cyl.-gran.-collar) (15.0 x 21.0 μm)	10-12(3)
T. sp. (cyl.-gran.-collar) (15.0 x 25.0 μm)	7-27(3)
T. sp. (cyl.-gran.-collar) (17.0 x 20.0 μm)	8-16(3)
T. sp. (cyl.-gran.-collar) (17.5 x 20.0 μm)	6-13(3)
T. sp. (cyl.-gran.-collar) (20.0 x 25.0 μm)	6-13(3)
T. sp. (cyl.-gran.-collar) (22.5 x 25.0 μm)	4-22(3)
T. sp. (cyl.-gran.-neck) (15.0 x 23.0 μm)	8-16(3)
T. sp. (cyl.-gran.-neck) (15.0 x 25.0 μm)	8-16(3)
T. sp. (cyl.-gran.-neck) (20.0 x 23.0 μm)	4-22(1)
T. sp. (cyl.-gran.-neck) (20.0 x 30.0 μm)	10-12(3)
T. sp. (cyl.-gran.-short neck) (12.5 x 15.0 μm)	7-27(3)
T. sp. (cyl.-gran.-short neck) (15.0 x 20.0 μm)	8-16(3)
T. sp. (cyl.-gran.-short neck) (15.0 x 25.0 μm)	8-16(3)
T. sp. (cyl.-gran.-short neck) (17.5 x 25.0 μm)	4-22(3)

Taxa	Date and Site Found
Trachelomonas (Cont.)	
T. sp. (cyl.-gran.-short neck) (20.0 x 25.0 μm)	4-22(1)
T. sp. (cyl.-smooth) (10.0 x 22.5 μm)	7-27(3)
T. sp. (cyl.-smooth) (11.0 x 25.0 μm)	8-16(3)
T. sp. (cyl.-smooth) (12.5 x 20.0 μm)	8-16(1)
T. sp. (cyl.-smooth) (15.0 x 16.0 μm)	4-22(3)
T. sp. (cyl.-smooth) (15.0 x 20.0 μm)	6-13(1)
T. sp. (cyl.-smooth) (17.0 x 21.0 μm)	6-13(1)
T. sp. (cyl.-smooth) (17.5 x 20.0 μm)	10-12(1)
T. sp. (cyl.-smooth) (17.5 x 21.0 μm)	6-13(1)
T. sp. (cyl.-smooth) (18.0 x 20.0 μm)	6-13(3)
T. sp. (cyl.-smooth) (20.0 x 25.0 μm)	6-13(1)
T. sp. (cyl.-smooth-collar) (12.5 x 15.0 μm)	8-16(3)
T. sp. (cyl.-smooth-collar) (16.0 x 20.0 μm)	4-22(1)
T. sp. (cyl.-smooth-neck) (12.5 x 17.0 μm)	6-13(1)
T. sp. (cyl.-smooth-neck) (16.0 x 21.0 μm)	4-22(1)
T. sp. (cyl.-smooth-short neck) (12.0 x 12.5 μm)	10-12(1)
T. sp. (cyl.-smooth-short neck) (17.5 x 25.0 μm)	4-22(3)
T. sp. (spherical-collar) (15.0 μm)	4-22(1)
T. sp. (spherical-gran.) (10.0 μm)	7-27(3)
T. sp. (spherical-gran.) (12.0 μm)	4-22(1)
T. sp. (spherical-gran.) (12.5 μm)	4-22(3)

Taxa	Date and Site Found
Trachelomonas (Cont.)	
T. sp. (spherical-gran.) (15.0 μm)	4-22(1)
T. sp. (spherical-gran.) (15.0 μm)	6-13(3)
T. sp. (spherical-gran.) (15.0 μm)	7-27(3)
T. sp. (spherical-gran.) (15.0 μm)	8-16(3)
T. sp. (urn-shape) (10.0 x 20.0 μm)	8-16(3)
T. sp. (urn-shape) (10.0 x 22.5 μm)	7-27(3)
T. sp. (urn-shape) (10.0 x 22.5 μm)	8-16(3)
T. sp. (urn-shape) (10.0 x 25.0 μm)	6-13(3)
T. sp. (urn-shape) (10.0 x 27.5 μm)	7-27(3)
T. sp. (urn-shape) (10.0 x 30.0 μm)	6-13, 8-16 (Both Site 3)
T. sp. (urn-shape) (11.0 x 25.0 μm)	7-27(3)
T. sp. (urn-shape) (12.5 x 25.0 μm)	6-13(3)
T. sp. (urn-shape) (12.5 x 25.0 μm)	8-16(3)
T. sp. (urn-shape) (15.0 x 20.0 μm)	8-16(3)
T. sp. (urn-shape) (15.0 x 22.5 μm)	6-13(1)
T. sp. (urn-shape) (15.0 x 22.5 μm)	8-16(3)
T. sp. (urn-shape) (15.0 x 30.0 μm)	7-27(3)
T. sp. (urn-shape) (15.0 x 35.0 μm)	8-16(3)
T. sp. (urn-shape) (15.0 x 35.0 μm)	8-16(3)
T. sp. (urn-shape) (16.0 x 37.5 μm)	8-16(3)
T. sp. (urn-shape) (17.5 x 22.5 μm)	10-12(3)

Taxa	Date and Site Found
Trachelomonas (Cont.)	
T. sp. (urn-shape) (17.5 x 25.0 μm)	10-12(3)
T. sp. (urn-shape) (17.5 x 29.0 μm)	4-22(1)
T. sp. (urn-shape) (17.5 x 30.0 μm)	10-12(3)
T. sp. (urn-shape) (17.5 x 40.0 μm)	7-27(3)
T. sp. (urn-shape) (20.0 x 50.0 μm)	7-27(3)
T. sp. (urn-shape) (30.0 x 50.0 μm)	6-13(3)
PYRRHOPHYTA	
Unknown Dinoflagellate (cyst)	6-13(3)
Ceratium hirundinella (O. F. Muell.) Duj.	6-13(1)
Glenodinium	
G. gymnodinium Penard	6-13(1)
G. sp. (15.0 x 17.5 μm)	8-16(1)
G. sp. (15.0 x 20.0 μm)	7-27(3)
G. sp. (17.5 x 25.0 μm)	6-13(1)
G. sp. (17.5 x 25.0 μm)	7-27(3)
G. sp. (20.0 x 20.0 μm)	7-27(3)
G. sp. (30.0 x 35.0 μm)	8-16(3)
XANTHOPHYTA	
Centritractus belanophorus Lemm.	4-22(3), 6-13(3), 7-27(1,3), 8-16(1,3)
Ophiocytium capitatum Wolle var. *ophiocytium*	4-22(3)
ARTHROPODA	

Taxa	Date and Site Found
Cyclops sp. (Adult)	6-13(3)
GASTROTRICHA	
Unknown Gastrotrich (27.5 x 90.0 μm)	8-16(1)
Unknown Gastrotrich (30.0 x 80.0 μm)	7-27(3)
PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-	
Unknown Ciliate (10.0 x 25.0 μm)	8-16(1)
Unknown Ciliate (17.5 μm)	8-16(1)
Unknown Ciliate (17.5 x 30.0 μm)	8-16(1)
Unknown Ciliate (20.0 μm)	7-27(1)
Unknown Ciliate (21.0 x 36.0 μm)	8-16(3)
Unknown Ciliate (22.5 x 25.0 μm)	6-13(1)
Unknown Ciliate (22.5 x 25.0 μm)	7-27(3)
Unknown Ciliate (30.0 μm)	4-22(1)
Unknown Ciliate (30.0 x 45.0 μm)	7-27(3)
Unknown Ciliate (35.0 x 50.0 μm)	8-16(3)
Unknown Ciliate (40.0 μm)	4-22(3)
Unknown Ciliate (40.0 x 60.0 μm)	8-16(3)
Unknown Ciliate (45.0 μm)	4-22(1)
Unknown Ciliate (45.0 x 60.0 μm)	7-27(3)
Unknown Ciliate (47.5 x 60.0 μm)	7-27(3)
Unknown Ciliate (55.0 x 160.0 μm)	8-16(1)

Taxa	Date and Site Found
Unknown Ciliate (60.0 x 70.0 μm)	4-22(3)
	Order Oligotrichida-Family Halteriidae
Halteria sp. (25.0 μm)	7-27, 10-12 (Both Site 1)
	Order Sessilia-Family Vorticellidae
Vorticella	
V. sp. (22.5 x 30.0 μm)	7-27(3)
V. sp. (40.0 μm)	8-16(1)
V. sp. (40.0 μm)	10-12(1)
V. sp. (45.0 μm)	8-16(1)
Sub-Phylum Mastigophora-Class Zoomastigophorea-	
Unknown Flagellate (10.0 x 10.0 μm)	4-22(3), 7-27(1), 8-16(3), 10-12(1)
Unknown Flagellate (20.0 x 25.0 μm)	10-12(3)
Unknown Flagellate (17.5 x 30.0 μm)	7-27(1)
Sub-Phylum Sarcodina	
Unknown Amoeba (30.0 x 35.0 μm)	7-27(1)
ROTATORIA-Class Monogonata-Order Ploima- Family Brachionidae	
Brachionus sp. (50.0 x 150.0 μm)	4-22(1)
	-Family Trichocercidae
Trichocerca sp. (15.0 x 133.0 μm)	6-13(1), 7-27(3), 8-16(1,3)

*These taxa were found in counts.

Station Date: 04/22/2005 Station Location: ROZA Lake Highland Silver Station Information: 1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	264.992	52680.4
BACILLARIOPHYTA	Melosira	distans		6.0 x 60.0	1696.5	Present	
BACILLARIOPHYTA	Synedra	delicatissima	delicatissima	4.0 x 142.0	1784.4	10.192	18186.6
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	10.192	1000.9
CHLOROPHYTA	Cosmarium	sp.		6.0 x 7.5	212.1	20.384	4323.4
CRYPTOPHYTA	Cryptomonas	erosa		12.5 x 20.0	2454.4	40.768	100061
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	499.408	73562.8
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	2344.16	122740.1
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	1335.152	699085.6
EUGLENOPHYTA	Euglena	acutissima		7.5 x 117.5	5191	Present	
EUGLENOPHYTA	Euglena	sp.		35.0 x 40.0	38484.5	10.192	392234
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	20.384	14994.5
EUGLENOPHYTA	Trachelomonas	sp.		20.0 x 23.0	7225.7	10.192	73644.3
EUGLENOPHYTA	Trachelomonas	sp.		20.0 x 25.0	7854	10.192	80048
EUGLENOPHYTA	Trachelomonas	sp.		16.0 x 20.0	4021.2	10.192	40984.1
EUGLENOPHYTA	Trachelomonas	sp.		16.0 x 21.0	4222.3	10.192	43033.7
EUGLENOPHYTA	Trachelomonas	sp.		15.0 (diam.)	1767.2	10.192	18011.3
EUGLENOPHYTA	Trachelomonas	sp.		15.0 (diam.)	1767.2	10.192	18011.3
EUGLENOPHYTA	Trachelomonas	sp.		12.0 (diam.)	904.8	10.192	9221.7
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 29.0	6975.3	10.192	71092.3
PROTOZOA	Unknown Ciliate			30.0 (diam.)	84822.9	10.192	864515
PROTOZOA	Unknown Ciliate			45.0 (diam.)	47713	10.192	486290.9
ROTATORIA	Brachionus	sp.		50.0 x 150.0	294524.1	10.192	3001789.6

Station Date: 06/13/2005 Station Location: ROZA Lake Highland Silver Station Information: 1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	264.992	52680.4
BACILLARIOPHYTA	Melosira	italica	tenuissima	5.0 x 14.0	2748.9	Present	
CHLOROPHYTA	Actinastrum	hantzschii	fluviatile	25.0 (diam.)	8181.2	10.192	83382.8
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	40.768	901
CHLOROPHYTA	Carteria	multifilis		7.5 (diam.)	220.9	682.684	150844.6
CHLOROPHYTA	Carteria	sp.		15.0 x 20.0	3534.3	142.688	504302.2
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	71.344	298845.7
CHLOROPHYTA	Crucigenia	rectangularis		8.0 x 8.0 x 1.0	64	10.192	652.3
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	61.152	256153.5
CHLOROPHYTA	Elakatothrix	viridis		2.5 x 15.0	73.6	10.192	750.1
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	30.576	7503.4
CHLOROPHYTA	Oocystis	borgei		12.5 (diam.)	1022.7	30.576	31270.1
CHLOROPHYTA	Pediastrum	duplex	gracilimum	17.0 x 2.0	454	20.384	9254.3
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	91.728	52954.6
CHLOROPHYTA	Tetraedron	trigonum	trigonum	26	239	30.576	7307.7
CHLOROPHYTA	Treubaria	setigerum		12.5	312.5	10.192	3185
CRYPTOPHYTA	Cryptomonas	erosa		12.5 x 20.0	2454.4	10.192	25015.2
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	366.912	54046.1
CYANOPHYTA	Anabaena	spiroides	crassa	10.0 x 100.0	7854	71.344	560335.8
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	1223.04	640383.7
CYANOPHYTA	Aphanizomenon	flos-aquae		5.0 x 50.0	981.7	50.96	50027.4
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	917.28	480287.8
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	10.192	15925
CYANOPHYTA	Microcystis	aeruginosa		40.0 (diam.)	33510.4	30.576	1024613.9
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	71.344	2240.2
EUGLENOPHYTA	Trachelomonas	hispida		25.0 x 30.0	14726.2	10.192	150089.4
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	417.872	307386.6
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	10.192	36021.6
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 25.0	4417.9	10.192	45027.2
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	10.192	36021.6
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	10.192	36021.6
EUGLENOPHYTA	Trachelomonas	sp.		17.0 x 21.0	4766.6	10.192	48581.2
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 21.0	5051.1	10.192	51480.8
EUGLENOPHYTA	Trachelomonas	sp.		20.0 x 25.0	7854	10.192	80048

Station Date: 06/13/2005 Station Location: ROZA Lake Highland Silver Station Information: 1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 17.0	2086.2	10.192	21262.6
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 22.5	3976.1	61.152	243146.5
PYRRHOPHYTA	Ceratium	hirundinella		50.0 x 237.5	155414.1	20.384	3167961
PYRRHOPHYTA	Glenodinium	gymnodinium		31.0 x 42.5	32077.8	10.192	326936.9
PYRRHOPHYTA	Glenodinium	sp.		17.5 x 25.0	6013.2	10.192	61286.5
PROTOZOA	Unknown Ciliate			22.5 x 25.0	9940.2	10.192	101310.5
ROTATORIA	Trichocerca	sp.		15.0 x 133.0	23503	20.384	479085.2

Station Date: 07/27/2005 Station Location: ROZA Lake Highland Silver Station Information: 1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	183.456	36471.1
BACILLARIOPHYTA	Nitzschia	acicularis		2.5 x 87.5	429.5	30.576	13132.4
BACILLARIOPHYTA	Nitzschia	linearis		5.0 x 70.0	1374.4	20.384	28015.8
BACILLARIOPHYTA	Nitzschia	palea		3.0 x 25.0	176.7	30.576	5402.8
BACILLARIOPHYTA	Synedra	delicatissima	delicatissima	4.0 x 142.0	1784.4	10.192	18186.6
CHLOROPHYTA	Actinastrum	hantzschii	fluviatile	25.0 (diam.)	8181.2	71.344	583679.5
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	50.96	1126.2
CHLOROPHYTA	Carteria	multifilis		7.5 (diam.)	220.9	20.384	4502.8
CHLOROPHYTA	Closterium	acutum		2.5 x 62.5	306.8	10.192	3126.9
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	20.384	85384.5
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	10.192	1000.9
CHLOROPHYTA	Crucigenia	rectangularis		8.0 x 8.0 x 1.0	64	10.192	652.3
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	183.456	768460.5
CHLOROPHYTA	Elakatothrix	viridis		2.5 x 15.0	73.6	10.192	750.1
CHLOROPHYTA	Golenkinia	radiata		15.0 (diam.)	1767.2	10.192	18011.3
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	20.384	5002.2
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	40.768	23535.4
CHLOROPHYTA	Schroederia	setigera		2.5 x 52.5	257.7	10.192	2626.5
CHLOROPHYTA	Tetraedron	constrictum		20.0 x 22.5	7068.6	10.192	72043.2
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	30.576	4503.8
CYANOPHYTA	Anabaena	spiroides	crassa	10.0 x 100.0	7854	1141.504	8965372.4
CYANOPHYTA	Anabaena	sp.		2.5 x 25.0	122.7	61.152	7503.4
CYANOPHYTA	Anabaena	sp.		3.0 x 30.0	212.1	40.768	8646.9
CYANOPHYTA	Anabaena	sp.		5.0 x 50.0	981.7	71.344	70038.4
CYANOPHYTA	Anabaenopsis	elenkinii		5.0 x 50.0	981.7	10.192	10005.5
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	1253.616	656393.3
CYANOPHYTA	Aphanizomenon	flos-aquae		5.0 x 50.0	981.7	152.88	150082.3
CYANOPHYTA	Cylindrospermum	sp.		2.5 x 25.0	122.7	458.64	56275.1
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	2945.488	1542257.5
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	1702.064	2659475
CYANOPHYTA	Microcystis	aeruginosa		40.0 (diam.)	33510.4	550.368	18443051
CYANOPHYTA	Raphidiopsis	curvata		5.0 x 25.0	490.9	2619.344	1285835.9
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	4066.608	127691.5
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	10.192	7497.2

Station Date: 07/27/2005 Station Location: ROZA Lake Highland Silver Station Information: 1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
XANTHOPHYTA	Centritractus	belanophorus		10.0 x 150.0	11781	10.192	120072
PROTOZOA	Unknown Ciliate			20.0 (diam.)	4188.8	10.192	42692.2
PROTOZOA	Halteria	sp.		25.0 (diam.)	8181.2	10.192	83382.8
PROTOZOA	Unknown Flagellate			10.0 x 10.0	785.4	10.192	8004.8
PROTOZOA	Unknown Flagellate			17.5 x 30.0	7215.8	10.192	73543.4
PROTOZOA	Unknown Amoeba			30.0 x 35.0	24740	10.192	252150.1

Station Date: 08/16/2005 Station Location: ROZA Lake Highland Silver Station Information: 1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	713.44	141831.9
BACILLARIOPHYTA	Melosira	italica	tenuissima	5.0 x 14.0	2748.9	Present	
BACILLARIOPHYTA	Nitzschia	acicularis		2.5 x 87.5	429.5	30.576	13132.4
BACILLARIOPHYTA	Nitzschia	linearis		5.0 x 70.0	1374.4	203.84	280157.7
BACILLARIOPHYTA	Nitzschia	palea		3.0 x 25.0	176.7	285.376	50425.9
CHLOROPHYTA	Actinastrum	hantzschii	fluviatile	25.0 (diam.)	8181.2	61.152	500296.7
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	40.768	901
CHLOROPHYTA	Carteria	multifilis		7.5 (diam.)	220.9	61.152	13508.5
CHLOROPHYTA	Chlorogonium	elongatum	elongatum	5.0 x 20.0	392.7	71.344	28016.8
CHLOROPHYTA	Chodatella	quadriseta		5.0 x 10.0	1963	10.192	2000.7
CHLOROPHYTA	Coelastrum	cambricum		15.0 (diam.)	1767.2	10.192	18011.3
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	163.072	683076
CHLOROPHYTA	Conochaete	comosa		20	4188.8	10.192	42692.2
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	10.192	1000.9
CHLOROPHYTA	Crucigenia	rectangularis		8.0 x 8.0 x 1.0	64	40.768	2609.2
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	540.176	2262689.2
CHLOROPHYTA	Elakatothrix	viridis		2.5 x 15.0	73.6	10.192	750.1
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	50.96	12505.6
CHLOROPHYTA	Oocystis	borgei		12.5 (diam.)	1022.7	10.192	10423.4
CHLOROPHYTA	Phacotus	lenticularis		7.5 x 12.5	552.2	20.384	11256
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	81.536	47070.7
CHLOROPHYTA	Scenedesmus	dimorphus		12.5 x 10.0	1227.2	20.384	25015.2
CHLOROPHYTA	Scenedesmus	opoliensis		12.5 x 15.0	1840.8	10.192	18761.4
CHLOROPHYTA	Tetraedron	constrictum		20.0 x 22.5	7068.6	10.192	72043.2
CHLOROPHYTA	Tetraedron	minimum		7.5	421.8	40.768	17195.9
CHLOROPHYTA	Tetraedron	trigonum	trigonum	26	239	10.192	2435.9
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	173.264	25521.8
CYANOPHYTA	Anabaena	spiroides	crassa	10.0 x 100.0	7854	377.104	2961774.8
CYANOPHYTA	Anabaena	sp.		2.5 x 25.0	122.7	20.384	2501.1
CYANOPHYTA	Anabaenopsis	elenkinii		5.0 x 50.0	981.7	10.192	10005.5
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	1100.736	576345.4
CYANOPHYTA	Aphanizomenon	flos-aquae		5.0 x 50.0	981.7	214.032	210115.2
CYANOPHYTA	Cylindrospermum	sp.		2.5 x 25.0	122.7	81.536	10004.5
CYANOPHYTA	Dactylococcopsis	acicularis		2.0 x 60.0	188.5	112.112	21133.1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
CYANOPHYTA	Dactylococcopsis	rhaphidioides		2.5 x 15.0	73.6	122.304	9001.6
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	2048.592	1072642.7
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	988.624	1544725
CYANOPHYTA	Microcystis	aeruginosa		40.0 (diam.)	33510.4	152.88	5123069.9
CYANOPHYTA	Raphidiopsis	curvata		5.0 x 25.0	490.9	2354.352	1155751.3
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	3455.088	108489.8
EUGLENOPHYTA	Euglena	sp.		10.0 x 25.0	1963.5	10.192	20012
EUGLENOPHYTA	Euglena	sp.		11.0 x 45.0	4276.5	20.384	87172.2
EUGLENOPHYTA	Euglena	sp.		12.5 x 21.0	2577.1	10.192	26265.8
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	81.536	59977.9
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 20.0	2454.4	10.192	25015.2
PYRRHOPHYTA	Glenodinium	sp.		15.0 x 17.5	3092.5	10.192	31518.8
XANTHOPHYTA	Centritractus	belanophorus		10.0 x 150.0	11781	10.192	120072
GASTROTRICHA	Unknown Gastrotrich			27.5 x 90.0	53456.1	10.192	544824.5
PROTOZOA	Unknown Ciliate			10.0 x 25.0	1963.5	10.192	20012
PROTOZOA	Unknown Ciliate			17.5 (diam.)	2806.2	10.192	28600.8
PROTOZOA	Unknown Ciliate			17.5 x 30.0	7215.8	20.384	147086.9
PROTOZOA	Unknown Ciliate			55.0 x 160.0	380132.4	10.192	3874309.4
PROTOZOA	Vorticella	sp.		40.0 (diam.)	33510.4	10.192	341538
PROTOZOA	Vorticella	sp.		45.0 (diam.)	47713	10.192	486290.9
ROTATORIA	Trichocerca	sp.		15.0 x 133.0	23503	10.192	239542.6

Station Date: 10/12/2005 Station Location: ROZA Lake Highland Silver Station Information: 1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	835.744	166145.9
BACILLARIOPHYTA	Melosira	distans		6.0 x 60.0	1696.5	Present	
BACILLARIOPHYTA	Melosira	italica	tenuissima	5.0 x 14.0	2748.9	Present	
BACILLARIOPHYTA	Nitzschia	acicularis		2.5 x 87.5	429.5	10.192	4377.5
BACILLARIOPHYTA	Nitzschia	linearis		5.0 x 70.0	1374.4	142.688	196110.4
BACILLARIOPHYTA	Nitzschia	palea		3.0 x 25.0	176.7	132.496	23412
BACILLARIOPHYTA	Tabellaria	sp.		4.0 x 15.0	188.5	10.192	1921.2
CHLOROPHYTA	Actinastrum	hantzschii	fluviatile	25.0 (diam.)	8181.2	142.688	1167359
CHLOROPHYTA	Ankistrodesmus	convolutus		2.5 x 15.0	73	20.384	1488
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	224.224	4955.4
CHLOROPHYTA	Carteria	multifilis		7.5 (diam.)	220.9	40.768	9005.7
CHLOROPHYTA	Chlorogonium	elongatum	elongatum	5.0 x 20.0	392.7	112.112	44026.4
CHLOROPHYTA	Closterium	acutum		2.5 x 62.5	306.8	20.384	6253.8
CHLOROPHYTA	Clostridium	lunula		4.0 x 20.0	251.3	30.576	7683.7
CHLOROPHYTA	Coelastrum	cambricum		15.0 (diam.)	1767.2	10.192	18011.3
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	81.536	341538
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	50.96	5004.3
CHLOROPHYTA	Crucigenia	fenestrata		10.0 x 10.0 x 1.0	100	10.192	1019.2
CHLOROPHYTA	Crucigenia	rectangularis		8.0 x 8.0 x 1.0	64	40.768	2609.2
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	713.44	2988457.4
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	142.688	35015.6
CHLOROPHYTA	Micractinium	pusillum		15.0 (diam.)	1767.2	10.192	18011.3
CHLOROPHYTA	Oocystis	borgei		12.5 (diam.)	1022.7	10.192	10423.4
CHLOROPHYTA	Pediastrum	duplex	gracilimum	17.0 x 2.0	454	10.192	4627.2
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	122.304	70606.1
CHLOROPHYTA	Scenedesmus	arcuatus	platydisca	7.0 x 10.0	441.8	10.192	4502.8
CHLOROPHYTA	Scenedesmus	dimorphus		12.5 x 10.0	1227.2	30.576	37522.9
CHLOROPHYTA	Scenedesmus	incrassatulus	incrassatulus	15.0 x 10.0	1767.1	20.384	36020.6
CHLOROPHYTA	Scenedesmus	obliquus		15.0 x 20.0	3534.3	10.192	36021.6
CHLOROPHYTA	Schroederia	setigera		2.5 x 52.5	257.7	30.576	7879.4
CHLOROPHYTA	Tetraedron	gracile		25.0 x 25.0 x 1.0	625	10.192	6370
CHLOROPHYTA	Tetraedron	trigonum	trigonum	26	239	30.576	7307.7
CHLOROPHYTA	Tetrastrum	heterocanthum		10.0 x 10.0 x 1.0	100	30.576	30576
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	40.768	6005.1

Station Date: 10/12/2005 Station Location: ROZA Lake Highland Silver Station Information: 1

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
CYANOPHYTA	Anabaena	spiroides	crassa	10.0 x 100.0	7854	132.496	1040623.5
CYANOPHYTA	Anabaena	sp.		5.0 x 50.0	981.7	61.152	60032.9
CYANOPHYTA	Anabaenopsis	elenkinii		5.0 x 50.0	981.7	30.576	30016.5
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	1773.408	928556.4
CYANOPHYTA	Aphanizomenon	flos-aquae		5.0 x 50.0	981.7	50.96	50027.4
CYANOPHYTA	Cylindrospermum	sp.		2.5 x 25.0	122.7	30.576	3751.7
CYANOPHYTA	Dactylococcopsis	rhaphidioides		2.5 x 15.0	73.6	101.92	7501.3
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	2211.664	1158027.2
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	346.528	541450
CYANOPHYTA	Microcystis	aeruginosa		40.0 (diam.)	33510.4	152.88	5123069.9
CYANOPHYTA	Raphidiopsis	curvata		5.0 x 25.0	490.9	275.184	135087.8
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	2986.256	93768.4
EUGLENOPHYTA	Euglena	sp.		10.0 x 32.5	2552.5	10.192	26015.1
EUGLENOPHYTA	Euglena	sp.		15.0 x 20.0	3534.3	10.192	36021.6
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	193.648	142447.5
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 20.0	4810.6	20.384	98059.3
EUGLENOPHYTA	Trachelomonas	sp.		12.0 x 12.5	1413.7	10.192	14408.4
PROTOZOA	Halteria	sp.		25.0 (diam.)	8181.2	10.192	83382.8
PROTOZOA	Vorticella	sp.		40.0 (diam.)	33510.4	10.192	341538
PROTOZOA	Unknown Flagellate			10.0 x 10.0	785.4	10.192	8004.8

Station Date: 04/22/2005 Station Location: ROZA Lake Highland Silver Station Information: 3

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	825.552	164119.7
BACILLARIOPHYTA	Nitzschia	acicularis		2.5 x 87.5	429.5	50.96	21887.3
BACILLARIOPHYTA	Nitzschia	palea		3.0 x 25.0	176.7	20.384	3601.8
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	631.904	13965.1
CHLOROPHYTA	Ankistrodesmus	falcatus	mirabilis	2.5 x 100.0	490.7	214.032	105025.5
CHLOROPHYTA	Carteria	multifilis		7.5 (diam.)	220.9	193.648	42776.8
CHLOROPHYTA	Chlorogonium	elongatum	elongatum	5.0 x 20.0	392.7	61.152	24014.4
CHLOROPHYTA	Closterium	acutum		2.5 x 62.5	306.8	30.576	9380.7
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	61.152	256153.5
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	173.264	17014.5
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	81.536	341538
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	203.84	50022.3
CHLOROPHYTA	Micractinium	pusillum		15.0 (diam.)	1767.2	20.384	36022.6
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	122.304	70606.1
CHLOROPHYTA	Scenedesmus	denticulatus		7.0 x 15.0	577.3	20.384	11767.7
CHLOROPHYTA	Scenedesmus	dimorphus		12.5 x 10.0	1227.2	81.536	100061
CHLOROPHYTA	Schroederia	setigera		2.5 x 52.5	257.7	10.192	2626.5
CHLOROPHYTA	Staurastrum	sp.		10.0 x 15.0	150	10.192	1528.8
CHLOROPHYTA	Tetraedron	minimum		7.5	421.8	10.192	4299
CHLOROPHYTA	Tetraedron	trigonum	trigonum	26	239	224.224	53589.5
CHLOROPHYTA	Tetrastrum	heterocanthum		10.0 x 10.0 x 1.0	100	40.768	4076.8
CRYPTOPHYTA	Cryptomonas	erosa		12.5 x 20.0	2454.4	10.192	25015.2
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	101.92	15012.8
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	6736.912	3527447.1
CYANOPHYTA	Dactylococcopsis	acicularis		2.0 x 60.0	188.5	10.192	1921.2
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	4025.84	2107929.8
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	30.576	47775
CYANOPHYTA	Raphidiopsis	curvata		5.0 x 25.0	490.9	10.192	5003.3
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	112.112	3520.3
EUGLENOPHYTA	Euglena	acutissima		7.5 x 117.5	5191	Present	
EUGLENOPHYTA	Euglena	sp.		5.0 x 30.0	589	10.192	6003.1
EUGLENOPHYTA	Euglena	sp.		10.0 x 22.5	1767.1	10.192	18010.3
EUGLENOPHYTA	Euglena	sp.		12.5 x 50.0	6135.9	50.96	312685.5
EUGLENOPHYTA	Euglena	sp.		15.0 x 20.0	3534.3	20.384	72043.2

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
EUGLENOPHYTA	Euglena	sp.		15.0 x 30.0	5301.4	10.192	54031.9
EUGLENOPHYTA	Euglena	sp.		15.0 x 35.0	6185	10.192	63037.5
EUGLENOPHYTA	Euglena	sp.		17.5 x 35.0	8418.5	10.192	85801.4
EUGLENOPHYTA	Euglena	sp.		17.5 x 90.0	21647.5	20.384	441262.6
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	163.072	119955.8
EUGLENOPHYTA	Trachelomonas	sp.		22.5 x 25.0	9940.2	10.192	101310.5
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 25.0	6013.2	10.192	61286.5
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 16.0	2827.4	10.192	28816.9
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 25.0	6013.2	10.192	61286.5
EUGLENOPHYTA	Trachelomonas	sp.		12.5 (diam.)	1022.7	10.192	10423.4
XANTHOPHYTA	Centritractus	belanophorus		10.0 x 150.0	11781	81.536	960575.6
XANTHOPHYTA	Ophiocytium	capitatum	capitatum	5.0 x 25.0	490.9	10.192	5003.3
PROTOZOA	Unknown Ciliate			40.0 (diam.)	33510.4	10.192	341538
PROTOZOA	Unknown Ciliate			60.0 x 70.0	197920.2	10.192	2017202.6
PROTOZOA	Unknown Flagellate			10.0 x 10.0	785.4	20.384	16009.6

Station Date: 06/13/2005 Station Location: ROZA Lake Highland Silver Station Information: 3

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	305.76	60785.1
BACILLARIOPHYTA	Navicula	cryptocephala	cryptocephala	6.15 x 20.3	603	10.192	6145.8
BACILLARIOPHYTA	Nitzschia	linearis		5.0 x 70.0	1374.4	20.384	28015.8
BACILLARIOPHYTA	Nitzschia	palea		3.0 x 25.0	176.7	101.92	18009.3
CHLOROPHYTA	Ankistrodesmus	convolutus		2.5 x 15.0	73	10.192	744
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	203.84	4504.9
CHLOROPHYTA	Ankistrodesmus	falcatus	mirabilis	2.5 x 100.0	490.7	40.768	20004.9
CHLOROPHYTA	Carteria	multifilis		7.5 (diam.)	220.9	132.496	29268.4
CHLOROPHYTA	Carteria	sp.		15.0 x 20.0	3534.3	20.384	72043.2
CHLOROPHYTA	Closterium	acutum		2.5 x 62.5	306.8	Present	
CHLOROPHYTA	Clostridium	lunula		4.0 x 20.0	251.3	10.192	2561.2
CHLOROPHYTA	Coccomonas	orbicularis		15.0 x 17.5	3092.5	10.192	31518.8
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	122.304	512307
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	173.264	12010.3
CHLOROPHYTA	Crucigenia	quadrata		10.0 x 10.0 x 1.0	100	10.192	1019.2
CHLOROPHYTA	Crucigenia	rectangularis		8.0 x 8.0 x 1.0	64	142.688	9132
CHLOROPHYTA	Crucigenia	tetrapedia		7.5 x 7.5 x 1.0	56.2	112.112	6300.7
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	81.536	341538
CHLOROPHYTA	Elakatothrix	viridis		2.5 x 15.0	73.6	10.192	750.1
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	285.376	70031.3
CHLOROPHYTA	Nephrocytium	limneticum		8.75	350.8	30.576	10726.1
CHLOROPHYTA	Oocystis	borgei		12.5 (diam.)	1022.7	91.728	93810.3
CHLOROPHYTA	Pediastrum	duplex	gracilimum	17.0 x 2.0	454	10.192	4627.2
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	407.68	235353.7
CHLOROPHYTA	Scenedesmus	bijuga	alternans	5.0 x 10.0	196.3	20.384	4001.4
CHLOROPHYTA	Scenedesmus	denticulatus		7.0 x 15.0	577.3	10.192	5883.8
CHLOROPHYTA	Scenedesmus	dimorphus		12.5 x 10.0	1227.2	10.192	12507.6
CHLOROPHYTA	Schroederia	setigera		2.5 x 52.5	257.7	10.192	2626.5
CHLOROPHYTA	Staurastrum	sp.		20.0 x 25.0	7854	10.192	80048
CHLOROPHYTA	Tetraedron	constrictum		20.0 x 22.5	7068.6	10.192	72043.2
CHLOROPHYTA	Tetraedron	minimum		7.5	421.8	50.96	21494.9
CHLOROPHYTA	Tetraedron	muticum	muticum	18	648	10.192	6604.4
CHLOROPHYTA	Tetraedron	trigonum	trigonum	26	239	91.728	21923
CHLOROPHYTA	Tetrastrum	heterocanthum		10.0 x 10.0 x 1.0	100	10.192	1019.2

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
CHLOROPHYTA	Treubaria	setigerum		12.5	312.5	20.384	6370
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	30.576	4503.8
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	6584.032	3447399.1
CYANOPHYTA	Dactylococcopsis	rhaphidioides		2.5 x 15.0	73.6	10.192	750.1
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	3128.944	1638315
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	10.192	15925
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	30.576	960.1
EUGLENOPHYTA	Euglena	oxyuris		15.0 x 142.5	25181.8	10.192	256652.9
EUGLENOPHYTA	Euglena	sp.		6.0 x 20.0	565.5	10.192	5763.6
EUGLENOPHYTA	Euglena	sp.		10.0 x 22.5	1767.1	10.192	18010.3
EUGLENOPHYTA	Euglena	sp.		10.0 x 50.0	3927	20.384	80048
EUGLENOPHYTA	Euglena	sp.		12.5 x 35.0	4295.1	10.192	43775.7
EUGLENOPHYTA	Euglena	sp.		12.5 x 35.0	4295.1	10.192	43775.7
EUGLENOPHYTA	Euglena	sp.		12.5 x 35.0	4295.1	10.192	43775.7
EUGLENOPHYTA	Euglena	sp.		15.0 x 20.0	3534.3	10.192	36021.6
EUGLENOPHYTA	Euglena	sp.		15.0 x 35.0	6185	10.192	63037.5
EUGLENOPHYTA	Euglena	sp.		15.0 x 50.0	8835.7	20.384	180106.9
EUGLENOPHYTA	Euglena	sp.		16.0 x 35.0	7037.2	10.192	71723.1
EUGLENOPHYTA	Euglena	sp.		25.0 x 35.0	17180.6	10.192	175104.7
EUGLENOPHYTA	Phacus	acuminatus		20.0 x 28.0	9047.8	50.96	461075.9
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	203.84	149944.7
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 16.0	2827.4	10.192	28816.9
EUGLENOPHYTA	Trachelomonas	sp.		20.0 x 21.0	6597.3	10.192	67239.7
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 20.0	4810.6	10.192	49029.6
EUGLENOPHYTA	Trachelomonas	sp.		20.0 x 25.0	7854	10.192	80048
EUGLENOPHYTA	Trachelomonas	sp.		18.0 x 20.0	5089.4	10.192	51871.2
EUGLENOPHYTA	Trachelomonas	sp.		15.0 (diam.)	1963.5	10.192	20012
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 25.0	1963.5	20.384	40024
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 30.0	2356.2	40.768	96057.6
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 25.0	3068	10.192	31269.1
EUGLENOPHYTA	Trachelomonas	sp.		30.0 x 50.0	35342.9	10.192	360214.8
PYRRHOPHYTA	Dinoflagellate			10.0 x 10.0 x 1.0	100	20.384	2038.4
XANTHOPHYTA	Centritractus	belanophorus		10.0 x 150.0	11781	50.96	600359.8

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
ARTHROPODA	Cyclops	sp.		175.0 x 450.0	10823759	10.192	110315750

Station Date: 07/27/2005 Station Location: ROZA Lake Highland Silver Station Information: 3

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	1324.76	263402
BACILLARIOPHYTA	Fragilaria	sp.		2.5 x 20.0	98.2	20.834	2001.7
BACILLARIOPHYTA	Melosira	distans		6.0 x 60.0	1696.5	Present	
BACILLARIOPHYTA	Melosira	italica	tenuissima	5.0 x 14.0	2748.9	Present	
BACILLARIOPHYTA	Navicula	cryptocephala	cryptocephala	6.15 x 20.3	603	10.192	6145.8
BACILLARIOPHYTA	Nitzschia	acicularis		2.5 x 87.5	429.5	254.8	109436.6
BACILLARIOPHYTA	Nitzschia	linearis		5.0 x 70.0	1374.4	305.76	420236.5
BACILLARIOPHYTA	Nitzschia	palea		3.0 x 25.0	176.7	570.752	100851.9
BACILLARIOPHYTA	Synedra	delicatissima	delicatissima	4.0 x 142.0	1784.4	10.192	18186.6
CHLOROPHYTA	Actinastrum	hantzschii	fluviatile	25.0 (diam.)	8181.2	142.688	1167359
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	193.648	4279.6
CHLOROPHYTA	Ankistrodesmus	falcatus	mirabilis	2.5 x 100.0	490.7	20.384	10002.4
CHLOROPHYTA	Carteria	multifilis		7.5 (diam.)	220.9	40.768	9005.7
CHLOROPHYTA	Carteria	sp.		15.0 x 20.0	3534.3	50.96	180107.9
CHLOROPHYTA	Chlorogonium	elongatum	elongatum	5.0 x 20.0	392.7	112.112	44026.4
CHLOROPHYTA	Coccomonas	orbicularis		15.0 x 17.5	3092.5	10.192	31518.8
CHLOROPHYTA	Coelastrum	cambricum		15.0 (diam.)	1767.2	10.192	18011.3
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	50.96	213461.2
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	40.768	4003.4
CHLOROPHYTA	Cosmarium	sp.		10.0 x 15.0	1178.1	10.192	12007.2
CHLOROPHYTA	Crucigenia	rectangularis		8.0 x 8.0 x 1.0	64	71.344	4566
CHLOROPHYTA	Crucigenia	tetrapedia		7.5 x 7.5 x 1.0	56.2	10.192	572.8
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	611.52	2561534.9
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	61.152	15006.7
CHLOROPHYTA	Oocystis	borgei		12.5 (diam.)	1022.7	20.834	20846.7
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	224.224	129444.5
CHLOROPHYTA	Scenedesmus	arcuatus	platydisca	7.0 x 10.0	441.8	20.384	9005.7
CHLOROPHYTA	Scenedesmus	dimorphus		12.5 x 10.0	1227.2	30.576	37522.9
CHLOROPHYTA	Scenedesmus	opoliensis		12.5 x 15.0	1840.8	10.192	18761.4
CHLOROPHYTA	Scenedesmus	quadricauda		4.5 x 13.5	214.7	20.384	4376.4
CHLOROPHYTA	Tetraedron	caudatum	longispinum	10.0 x 10.0 x 2.0	200	10.192	2038.4
CHLOROPHYTA	Tetraedron	constrictum		20.0 x 22.5	7068.6	10.192	72043.2
CHLOROPHYTA	Tetraedron	minimum		7.5	421.8	30.576	12897
CHLOROPHYTA	Tetraedron	regulare	incus	15.0 x 15.0 x 1.0	225	10.192	2293.2

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
CHLOROPHYTA	Tetraedron	trigonum	trigonum	26	239	142.688	34102.4
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	112.112	16514.1
CYANOPHYTA	Anabaena	spiroides	crassa	10.0 x 100.0	7854	61.152	480287.8
CYANOPHYTA	Anabaena	sp.		5.0 x 50.0	981.7	10.192	10005.5
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	4117.568	2155958.6
CYANOPHYTA	Aphanizomenon	flos-aquae		5.0 x 50.0	981.7	20.384	20011
CYANOPHYTA	Dactylococcopsis	acicularis		2.0 x 60.0	188.5	61.152	11527.2
CYANOPHYTA	Dactylococcopsis	rhaphidioides		2.5 x 15.0	73.6	71.344	5250.9
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	3974.88	2081247.1
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	591.136	923650
CYANOPHYTA	Microcystis	aeruginosa		40.0 (diam.)	33510.4	30.576	1024613.9
CYANOPHYTA	Raphidiopsis	curvata		5.0 x 25.0	490.9	509.5	250162.6
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	2293.2	72006.5
EUGLENOPHYTA	Euglena	acutissima		7.5 x 117.5	5191	30.576	158720
EUGLENOPHYTA	Euglena	sp.		6.0 x 25.0	706.9	10.192	7204.7
EUGLENOPHYTA	Euglena	sp.		10.0 x 15.0	1178.1	20.384	24014.4
EUGLENOPHYTA	Euglena	sp.		10.0 x 20.0	1570.8	10.192	16009.6
EUGLENOPHYTA	Euglena	sp.		10.0 x 22.5	1767.1	20.384	36020.6
EUGLENOPHYTA	Euglena	sp.		10.0 x 40.0	3141.6	30.576	96057.6
EUGLENOPHYTA	Euglena	sp.		10.0 x 55.0	4319.7	40.768	176105.5
EUGLENOPHYTA	Euglena	sp.		11.0 x 30.0	2851	10.192	29057.4
EUGLENOPHYTA	Euglena	sp.		12.5 x 35.0	4295.1	10.192	43775.7
EUGLENOPHYTA	Euglena	sp.		12.5 x 35.0	4295.1	10.192	43775.7
EUGLENOPHYTA	Euglena	sp.		15.0 x 25.0	4417.9	10.192	45027.2
EUGLENOPHYTA	Euglena	sp.		17.5 x 30.0	7215.8	10.192	73543.4
EUGLENOPHYTA	Euglena	sp.		20.0 x 35.0	10995.6	10.192	112067.2
EUGLENOPHYTA	Euglena	sp.		22.5 x 45.0	17892.3	10.192	182358.3
EUGLENOPHYTA	Phacus	acuminatus		20.0 x 28.8	9047.8	30.576	276645.5
EUGLENOPHYTA	Phacus	pyrum		10.0 x 32.5	2552.5	10.192	26015.1
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	489.216	359867.3
EUGLENOPHYTA	Trachelomonas	sp.		12.0 x 15.0	1696.5	10.192	17290.7
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 15.0	1840.8	10.192	18761.4
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	10.192	36021.6

Station Date: 07/27/2005 Station Location: ROZA Lake Highland Silver Station Information: 3

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 20.0	2454.4	10.192	25015.2
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 25.0	4417.9	10.192	45027.2
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 15.0	1840.8	10.192	18761.4
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 22.5	1767.1	10.192	18010.3
EUGLENOPHYTA	Trachelomonas	sp.		10.0 (diam.)	523.6	10.192	5336.5
EUGLENOPHYTA	Trachelomonas	sp.		15.0 (diam.)	1963.5	10.192	20012
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 22.5	1767.1	50.96	90051.4
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 27.5	2159.8	10.192	22012.7
EUGLENOPHYTA	Trachelomonas	sp.		11.0 x 25.0	2375.8	10.192	24214.2
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 30.0	5301.4	10.192	54031.9
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 40.0	9621.1	10.192	98058.3
EUGLENOPHYTA	Trachelomonas	sp.		20.0 x 50.0	15708	10.192	160095.9
PYRRHOPHYTA	Glenodinium	sp.		15.0 x 20.0	3534.3	10.192	36021.6
PYRRHOPHYTA	Glenodinium	sp.		17.5 x 25.0	6013.2	20.384	122573.1
PYRRHOPHYTA	Glenodinium	sp.		20.0 x 20.0	6283.2	10.192	64038.4
XANTHOPHYTA	Centritractus	belanophorus		10.0 x 150.0	11781	20.384	240143.9
GASTROTRICHA	Gastrotrich			30.0 x 80.0	56548.6	10.192	576343.3
PROTOZOA	Unknown Ciliate			22.5 x 25.0	9940.2	10.192	101310.5
PROTOZOA	Unknown Ciliate			30.0 x 45.0	31808.6	10.192	324193.2
PROTOZOA	Unknown Ciliate			45.0 x 60.0	95425.8	20.384	1945159.5
PROTOZOA	Unknown Ciliate			47.5 x 60.0	106323.2	10.192	1083646
PROTOZOA	Vorticella	sp.		22.5 x 30.0	11928.2	10.192	121572.2
ROTATORIA	Trichocerca	sp.		15.0 x 133.0	23503	30.576	718627.7

Station Date: 08/16/2005 Station Location: ROZA Lake Highland Silver Station Information: 3

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	876.512	174250.6
BACILLARIOPHYTA	Melosira	distans		6.0 x 60.0	1696.5	Present	
BACILLARIOPHYTA	Navicula	cryptocephala	cryptocephala	6.15 x 20.3	603	315.952	190519
BACILLARIOPHYTA	Navicula	sp.		5.0 x 12.5	245.4	10.192	2501.1
BACILLARIOPHYTA	Nitzschia	acicularis		2.5 x 87.5	429.5	315.952	135701.4
BACILLARIOPHYTA	Nitzschia	linearis		5.0 x 70.0	1374.4	142.688	196110.4
BACILLARIOPHYTA	Nitzschia	palea		3.0 x 25.0	176.7	407.68	72037.1
BACILLARIOPHYTA	Synedra	delicatissima	delicatissima	4.0 x 142.0	1784.4	30.576	54559.8
CHLOROPHYTA	Actinastrum	hantzschii	fluviatile	25.0 (diam.)	8181.2	183.456	1500890.2
CHLOROPHYTA	Ankistrodesmus	convolutus		2.5 x 15.0	73	132.496	9672.2
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	336.336	7433
CHLOROPHYTA	Carteria	multifilis		7.5 (diam.)	220.9	173.264	38274
CHLOROPHYTA	Carteria	sp.		15.0 x 20.0	3534.3	50.96	180107.9
CHLOROPHYTA	Chlorogonium	elongatum	elongatum	5.0 x 20.0	392.7	112.112	44026.4
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	40.768	170769
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	40.768	4003.4
CHLOROPHYTA	Cosmarium	sp.		7.5 x 7.5	331.3	20.384	6753.2
CHLOROPHYTA	Cosmarium	sp.		10.0 x 10.0	785.4	71.344	56033.6
CHLOROPHYTA	Crucigenia	rectangularis		8.0 x 8.0 x 1.0	64	152.88	9784.3
CHLOROPHYTA	Crucigenia	tetrapedia		7.5 x 7.5 x 1.0	56.2	50.96	2864
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	244.608	1024613.9
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	152.88	37516.8
CHLOROPHYTA	Nephrocytium	limneticum		8.75	350.8	10.192	3575.4
CHLOROPHYTA	Oocystis	borgei		12.5 (diam.)	1022.7	20.384	20846.7
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	295.568	170631.4
CHLOROPHYTA	Scenedesmus	arcuatus	platydisca	7.0 x 10.0	441.8	10.192	4502.8
CHLOROPHYTA	Scenedesmus	dimorphus		12.5 x 10.0	1227.2	50.96	62538.1
CHLOROPHYTA	Scenedesmus	opoliensis		12.5 x 15.0	1840.8	10.192	18761.4
CHLOROPHYTA	Schroederia	setigera		2.5 x 52.5	257.7	132.496	34144.2
CHLOROPHYTA	Spermatozoopsis	exultans		2.5 x 15.0	73.6	30.576	2250.4
CHLOROPHYTA	Tetraedron	minimum		7.5	421.8	50.96	21494.9
CHLOROPHYTA	Tetraedron	trigonum	trigonum	26	239	275.184	65769
CHLOROPHYTA	Tetrastrum	heterocanthum		10.0 x 10.0 x 1.0	100	30.576	3057.6
CHLOROPHYTA	Treubaria	setigerum		12.5	312.5	10.192	3185

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
CHRYSOPHYTA	Heliapsis	mutabilis		12.5 x 12.5 x 1.0	156.2	10.192	1592
CRYPTOPHYTA	Cryptomonas	erosa		12.5 x 20.0	2454.4	10.192	25015.2
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	30.576	4503.8
CYANOPHYTA	Anabaena	spiroides	crassa	10.0 x 100.0	7854	10.192	80048
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	3516.24	1841103.2
CYANOPHYTA	Aphanizomenon	flos-aquae		5.0 x 50.0	981.7	10.192	10005.5
CYANOPHYTA	Dactylococcopsis	rhaphidioides		2.5 x 15.0	73.6	244.608	18003.1
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	1793.792	939229.5
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	682.864	1066975
CYANOPHYTA	Microcystis	aeruginosa		40.0 (diam.)	33510.4	10.192	341538
CYANOPHYTA	Raphidiopsis	curvata		5.0 x 25.0	490.9	1141.504	560364.3
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	1161.888	36483.3
EUGLENOPHYTA	Euglena	acutissima		7.5 x 117.5	5191	20.384	105813.3
EUGLENOPHYTA	Euglena	sp.		5.0 x 35.0	687.2	10.192	7003.9
EUGLENOPHYTA	Euglena	sp.		10.0 x 25.0	1963.5	20.384	40024
EUGLENOPHYTA	Euglena	sp.		10.0 x 25.0	1963.5	10.192	20012
EUGLENOPHYTA	Euglena	sp.		10.0 x 35.0	2748.9	10.192	28016.8
EUGLENOPHYTA	Euglena	sp.		10.0 x 40.0	3141.6	30.576	96057.6
EUGLENOPHYTA	Euglena	sp.		10.0 x 50.0	3927	10.192	40024
EUGLENOPHYTA	Euglena	sp.		10.0 x 65.0	5105.1	20.384	104062.4
EUGLENOPHYTA	Euglena	sp.		12.0 x 35.0	3958.4	20.384	80688
EUGLENOPHYTA	Euglena	sp.		12.5 x 35.0	4295.1	10.192	43775.7
EUGLENOPHYTA	Euglena	sp.		12.5 x 42.5	5215.5	10.192	53156.4
EUGLENOPHYTA	Euglena	sp.		15.0 x 25.0	4417.9	10.192	45027.2
EUGLENOPHYTA	Euglena	sp.		15.0 x 27.5	4859.6	10.192	49529
EUGLENOPHYTA	Euglena	sp.		15.0 x 30.0	5301.4	20.384	108063.7
EUGLENOPHYTA	Euglena	sp.		15.0 x 30.0	5301.4	10.192	54031.9
EUGLENOPHYTA	Euglena	sp.		17.5 x 45.0	10823.8	10.192	110316.2
EUGLENOPHYTA	Euglena	sp.		20.0 x 27.5	8639.4	10.192	88052.8
EUGLENOPHYTA	Euglena	sp.		20.0 x 65.0	20420.3	10.192	208123.7
EUGLENOPHYTA	Phacus	acuminatus		20.0 x 28.8	9047.8	61.152	553291.1
EUGLENOPHYTA	Phacus	pyrum		10.0 x 32.5	2552.5	10.192	2605.1
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	142.688	104961.3

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 20.0	1570.8	10.192	16009.6
EUGLENOPHYTA	Trachelomonas	sp.		12.0 x 15.0	1696.5	10.192	17290.7
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 15.0	1840.8	10.192	18761.4
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	10.192	36021.6
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 25.0	4417.9	10.192	45027.2
EUGLENOPHYTA	Trachelomonas	sp.		11.0 x 17.5	1663.1	10.192	16950.3
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 17.5	2147.6	10.192	21888.3
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 18.0	3180.9	10.192	32419.7
EUGLENOPHYTA	Trachelomonas	sp.		17.0 x 20.0	4539.6	10.192	46267.6
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 23.0	4064.4	10.192	41424.4
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 25.0	4417.9	10.192	45027.2
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	10.192	36021.6
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 25.0	4417.9	10.192	45027.2
EUGLENOPHYTA	Trachelomonas	sp.		11.0 x 25.0	2375.8	10.192	24214.2
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 15.0	1840.8	10.192	18761.4
EUGLENOPHYTA	Trachelomonas	sp.		15.0 (diam.)	1963.5	10.192	20012
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 20.0	1570.8	10.192	16009.6
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 25.0	1767.1	10.192	18010.3
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 30.0	2356.2	10.192	24014.4
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 25.0	3068	10.192	31269.1
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	20.384	72043.2
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 22.5	3976.1	10.192	40524.4
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 35.0	6185	10.192	63037.5
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 35.0	6185	10.192	63037.5
EUGLENOPHYTA	Trachelomonas	sp.		16.0 x 37.5	7539.8	10.192	76845.6
PYRRHOPHYTA	Glenodinium	sp.		30.0 x 35.0	24740	20.384	504300.2
XANTHOPHYTA	Centritractus	belanophorus		10.0 x 150.0	11781	10.192	120072
PROTOZOA	Unknown Ciliate			21.0 x 36.0	12469	10.192	127084
PROTOZOA	Unknown Ciliate			35.0 x 50.0	48105.6	10.192	490292.8
PROTOZOA	Unknown Ciliate			40.0 x 60.0	75398.2	Present	
PROTOZOA	Unknown Flagellate			10.0 x 10.0	785.4	20.384	16009.6
ROTATORIA	Trichocerca	sp.		15.0 x 133.0	23503	10.192	239542.6

Station Date: 10/12/2005 Station Location: ROZA Lake Highland Silver Station Information: 3

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
BACILLARIOPHYTA	Cyclotella	meneghiniana		11.2 (diam.)	198.8	560.56	111439.3
BACILLARIOPHYTA	Melosira	distans		6.0 x 60.0	1696.5	Present	
BACILLARIOPHYTA	Melosira	italica	tenuissima	5.0 x 14.0	2748.9	Present	
BACILLARIOPHYTA	Nitzschia	acicularis		2.5 x 87.5	429.5	142.688	61284.5
BACILLARIOPHYTA	Nitzschia	linearis		5.0 x 70.0	1374.4	61.152	84047.3
BACILLARIOPHYTA	Nitzschia	palea		3.0 x 25.0	176.7	305.76	54027.8
BACILLARIOPHYTA	Synedra	delicatissima	delicatissima	4.0 x 142.0	1784.4	10.192	18186.6
CHLOROPHYTA	Actinastrum	hantzschii	fluviatile	25.0 (diam.)	8181.2	101.92	833827.9
CHLOROPHYTA	Ankistrodesmus	convolutus		2.5 x 15.0	73	112.112	8184.2
CHLOROPHYTA	Ankistrodesmus	falcatus	acicularis	1.25 x 18.0	22.1	693.056	15316.5
CHLOROPHYTA	Ankistrodesmus	falcatus	mirabilis	2.5 x 100.0	490.7	234.416	115027.9
CHLOROPHYTA	Carteria	sp.		15.0 x 20.0	3534.3	20.384	72043.2
CHLOROPHYTA	Chlorogonium	elongatum	elongatum	5.0 x 20.0	392.7	142.688	56033.6
CHLOROPHYTA	Closterium	acutum		2.5 x 62.5	306.8	10.192	3126.9
CHLOROPHYTA	Coelastrum	microporum		20.0 (diam.)	4188.8	10.192	42692.2
CHLOROPHYTA	Conochaete	comosa		10.0 x 25.0	1963.5	10.192	20012
CHLOROPHYTA	Cosmarium	sp.		5.0 x 5.0	98.2	438.256	43036.7
CHLOROPHYTA	Cosmarium	sp.		7.5 x 7.5	331.3	20.384	6753.2
CHLOROPHYTA	Crucigenia	fenestrata		10.0 x 10.0 x 1.0	100	10.192	1019.2
CHLOROPHYTA	Crucigenia	rectangularis		8.0 x 8.0 x 1.0	64	50.96	3261.4
CHLOROPHYTA	Crucigenia	tetrapedia		7.5 x 7.5 x 1.0	56.2	30.576	1718.4
CHLOROPHYTA	Dictyosphaerium	pulchellum		20.0 (diam.)	4188.8	203.84	853845
CHLOROPHYTA	Elakatothrix	viridis		2.5 x 15.0	73.6	10.192	750.1
CHLOROPHYTA	Kirchneriella	lunaris	lunaris	5.0 x 12.5	245.4	560.56	137561.4
CHLOROPHYTA	Oocystis	borgei		12.5 (diam.)	1022.7	20.384	20846.7
CHLOROPHYTA	Pediastrum	tetras	tetraodon	24.0 x 2.0	904.8	10.192	9221.7
CHLOROPHYTA	Scenedesmus	abundans		7.5 x 15.0	577.3	285.376	164747.6
CHLOROPHYTA	Scenedesmus	dimorphus		12.5 x 10.0	1227.2	81.536	100061
CHLOROPHYTA	Scenedesmus	obliquus		15.0 x 20.0	3534.3	50.96	180107.9
CHLOROPHYTA	Scenedesmus	opoliensis		12.5 x 15.0	1840.8	40.768	75045.7
CHLOROPHYTA	Schroederia	setigera		2.5 x 52.5	257.7	20.384	5253
CHLOROPHYTA	Tetraedron	caudatum	caudatum	10.0 x 10.0 x 2.0	200	10.192	2038.4
CHLOROPHYTA	Tetraedron	regulare	incus	15.0 x 15.0 x 1.0	225	71.344	16052.4
CHLOROPHYTA	Tetraedron	trigonum	trigonum	26	239	193.648	46281.9

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
CHLOROPHYTA	Tetrastrum	heterocanthum		10.0 x 10.0 x 1.0	100	122.304	12230.4
CRYPTOPHYTA	Cryptomonas	sp.		5.0 x 7.5	147.3	366.912	54046.1
CYANOPHYTA	Anabaena	spiroides	crassa	10.0 x 100.0	7854	10.192	80048
CYANOPHYTA	Anabaenopsis	elenkinii		5.0 x 50.0	981.7	10.192	10005.5
CYANOPHYTA	Anacystis	montana		10.0 (diam.)	523.6	5228.496	2737640.5
CYANOPHYTA	Gomphosphaeria	lacustris		10.0 (diam.)	523.6	1488.032	779133.6
CYANOPHYTA	Merismopedia	quadruplicata		25.0 x 25.0 x 2.5	1562.5	254.8	398125
CYANOPHYTA	Microcystis	aeruginosa		40.0 (diam.)	33510.4	10.192	341538
CYANOPHYTA	Raphidiopsis	curvata		5.0 x 25.0	490.9	10.192	5003.3
CYANOPHYTA	Schizothrix	calcicola		2.0 x 10.0	31.4	1121.12	35203.2
EUGLENOPHYTA	Euglena	acutissima		7.5 x 117.5	5191	20.384	105813.8
EUGLENOPHYTA	Euglena	sp.		5.0 x 22.5	441.8	10.192	4502.8
EUGLENOPHYTA	Euglena	sp.		5.0 x 42.5	834.5	10.192	8505.2
EUGLENOPHYTA	Euglena	sp.		6.0 x 22.5	636.2	20.384	12968.3
EUGLENOPHYTA	Euglena	sp.		7.5 x 30.0	1325.4	20.384	27017
EUGLENOPHYTA	Euglena	sp.		7.5 x 35.0	1546.3	30.576	47279.7
EUGLENOPHYTA	Euglena	sp.		7.5 x 45.0	1988	20.384	40523.4
EUGLENOPHYTA	Euglena	sp.		8.0 x 37.5	1885	20.384	38423.8
EUGLENOPHYTA	Euglena	sp.		10.0 x 20.0	1570.8	10.192	16009.6
EUGLENOPHYTA	Euglena	sp.		10.0 x 20.0	1570.8	20.384	32019.2
EUGLENOPHYTA	Euglena	sp.		10.0 x 25.0	1963.5	10.192	20012
EUGLENOPHYTA	Euglena	sp.		10.0 x 45.0	3534.3	20.384	72043.2
EUGLENOPHYTA	Euglena	sp.		10.0 x 55.0	4319.7	10.192	44026.4
EUGLENOPHYTA	Euglena	sp.		11.0 x 35.0	3326.2	10.192	33900.6
EUGLENOPHYTA	Euglena	sp.		12.0 x 30.0	3392.9	10.192	34580.4
EUGLENOPHYTA	Euglena	sp.		12.5 x 37.5	4601.9	10.192	46902.6
EUGLENOPHYTA	Euglena	sp.		15.0 x 17.5	3092.5	10.192	31518.8
EUGLENOPHYTA	Euglena	sp.		15.0 x 20.0	3534.3	20.384	72043.2
EUGLENOPHYTA	Euglena	sp.		15.0 x 25.0	4417.9	10.192	45027.2
EUGLENOPHYTA	Euglena	sp.		15.0 x 27.5	4859.6	10.192	49529
EUGLENOPHYTA	Euglena	sp.		15.0 x 35.0	6185	10.192	63037.5
EUGLENOPHYTA	Euglena	sp.		15.0 x 35.0	6185	10.192	63037.5
EUGLENOPHYTA	Euglena	sp.		15.0 x 45.0	7952.1	10.192	81047.8

Station Date: 10/12/2005 Station Location: ROZA Lake Highland Silver Station Information: 3

Phylum	Genus	Specific Epithet	Variety	Organism Size	Unit Volume	Number/mL	Total Volume
EUGLENOPHYTA	Euglena	sp.		20.0 x 20.0	6283.2	10.192	64038.4
EUGLENOPHYTA	Euglena	sp.		30.0 x 40.0	28274.3	10.192	288171.7
EUGLENOPHYTA	Phacus	acuminatus		20.0 x 28.8	9047.8	30.576	276645.5
EUGLENOPHYTA	Phacus	longicauda		35.0 x 152.5	146722.1	10.192	1495391.6
EUGLENOPHYTA	Phacus	pyrum		10.0 x 32.5	2552.5	20.384	52030.2
EUGLENOPHYTA	Trachelomonas	volvocina		11.2 (diam.)	735.6	988.624	727231.8
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 11.0	863.9	10.192	8804.9
EUGLENOPHYTA	Trachelomonas	sp.		10.0 x 15.0	1178.1	10.192	12007.2
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 16.0	1963.5	10.192	20012
EUGLENOPHYTA	Trachelomonas	sp.		12.5 x 17.5	2147.6	10.192	21888.3
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	Present	
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 20.0	3534.3	10.192	36021.6
EUGLENOPHYTA	Trachelomonas	sp.		15.0 x 21.0	3711	10.192	37822.5
EUGLENOPHYTA	Trachelomonas	sp.		20.0 x 30.0	9424.8	10.192	96057.6
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 25.0	6013.2	10.192	61286.5
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 22.5	5411.9	10.192	55158.1
EUGLENOPHYTA	Trachelomonas	sp.		17.5 x 30.0	7215.8	10.192	73543.4
PROTOZOA	Unknown Flagellate			20.0 x 25.0	7854	10.192	80048

APPENDIX C

Highland Silver Lake
IEPA Chemical Analysis Data
Temperature-Dissolved Oxygen Profiles

09/27/04 10:10 ROZA-1			10/19/04 9:40 ROZA-1			11/08/04 9:35 ROZA-1			12/06/04 9:30 ROZA-1			03/29/05 9:13 ROZA-1			04/22/05 11:20 ROZA-1			04/22/05 11:20 ROZA-1			05/08/05 12:30 ROZA-1			05/29/05 11:00 ROZA-1			06/13/05 16:15 ROZA-1			06/19/05 16:15 ROZA-1			07/10/05 12:30 ROZA-1			07/27/05 12:30 ROZA-1			08/16/05 14:00 ROZA-1			08/21/05 14:00 ROZA-1			09/04/05 14:00 ROZA-1			09/18/05 14:00 ROZA-1			10/12/05 11:40 ROZA-1			10/23/05 13:30 ROZA-1		
Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO
0	22.8	9.2	0	14.4	*	0	13.5	8.2	0	7.1	6.8	0	9	9.3	0	18.1	8.7	0	18.2	8.3	0	16.4	12	0	22.5	10.2	0	26.2	8.4	0	28.3	13.9	0	29	13	0	29.1	5.8	0	27.6	4.7	0	31.7	14.4	0	27.4	11.6	0	23.8	4.5	0	19.7	8.7	0	17.1	8.7
1	22.8	9.1	1	14.4	*	1	13.5	8.2	1	7.1	6.8	1	8.9	9.3	1	18.2	8.4	1	18.2	8.3	1	16.2	11.7	1	22.4	10	1	26.2	8.3	1	28.3	13.8	1	29	12.9	1	29	5.5	1	27.6	4.7	1	31.6	14.7	1	27.3	11.4	1	23.8	4.4	1	18.8	7.3	1	17.1	8.5
3	22.8	9.1	3	14.4	*	3	13.5	8.1	3	7	6.7	3	8.6	9.4	3	18.2	8.3	3	18.1	8.3	3	15.8	11.5	3	22.2	8.9	3	26.2	8.3	3	28.3	13.3	3	28.1	7.2	3	29.1	5.3	3	27.6	4.6	3	29.1	9.6	3	26.3	9.3	3	23.6	3.6	3	18.7	7.3	3	17.1	8.4
5	22.8	8.9	5	14.4	*	5	13.5	8.1	5	7	6.7	5	8.2	9.5	5	18.1	8.3	5	18	8.4	5	15	10.6	5	21.9	7.6	5	26.2	8.3	5	28.2	13	5	27.8	4.8	5	29.1	4.6	5	27.5	4.3	5	28.8	5.3	5	26.2	5.8	5	23.5	3.4	5	18.6	6.9	5	17.1	8.2
7	22.7	8.9	7	14.4	*	7	13.5	8.1	7	7	6.7	7	8.2	9.4	7	18	8.2	7	18	8.3	7	14.8	10.2	7	21.6	6.4	7	26	7.7	7	26.5	11	7	27.6	3.1	7	29.1	4.7	7	27.5	4.2	7	28.3	3.8	7	26.2	4	7	23.5	3.2	7	18.6	6.6	7	17.1	8.2
9	22.7	9	9	14.4	*	9	13.5	8	9	7	6.7	9	8.1	9.5	9	18	8.4	9	18	8.4	9	14.5	9.1	9	21.5	5.5	9	25.6	5.2	9	26.3	9.2	9	27.5	2.3	9	29.1	4.5	9	27.5	4.1	9	28	1.3	9	26	1.2	9	23.5	3.2	9	18.6	6.6	9	17.1	8.2
11	22.7	9.3	11	14.4	*	11	13.5	8	11	7	6.7	11	8.1	9.5	11	16.3	6.4	11	16.3	6.2	11	14.4	8.5	11	21.1	4.3	11	24.8	3.1	11	26	7.5	11	27.3	1.1	11	29	4.2	11	27.5	4.1	11	27.6	0.2	11	25.9	0.9	11	23.5	3.2	11	18.5	6.6	11	17.1	8.2
13	22.7	8.7	13	14.4	*	13	13.5	7.9	13	7	6.7	13	8	9.4	13	15.8	5.9	13	15.6	5.3	13	14.4	8	13	20.3	2.1	13	24.5	2.5	13	25.4	1.5	13	26.1	0.1	13	29	4	13	27.5	4.2	13	27	0.2	13	25.8	0.4	13	23.4	3	13	18.5	6.6	13	17.1	8.2
15	22.5	7.5	15	14.4	*	15	13.5	7.9	15	7	6.7	15	8	9.3	15	15.4	5	15	15	3.9	14	14.4	8	15	19.4	0.5	15	23.9	1.1	15	24.5	0.1	15	24.6	0.1	15	28.6	3.4	15	27.3	2.9	15	26.4	0.2	15	25.7	0.2	15	23.4	2.8	15	18.5	6.5	15	17.1	8.3
17	22.4	1.1	17	14.4	*	17	13.5	7.9	17	7	6.7	17	7.9	9.1	17	14.9	4	17	14.8	3.5	17	14.4	7.7	17	18.3	0.1	17	21.4	0.4	17	23.9	0.1	17	22.8	0.1	17	24.2	0.5	17	25.1	0.4	17	25.8	0.2	17	25.4	0.2	17	23.4	2.5	17	18.5	6.4	17	17.1	8.1
19	22.3	0.4	19	14.4	*	19	13.5	7.9	19	7	6.7	19	7.9	4.2	19	14.7	3.6	19			19	14.3	7.4	19	17.4	0.1	19	19.7	0.3	19	20.5	0.1	19	21.1	0.1	19			19	24	0.3	19	24.2	0.2	19	24.5	0.2	19	23.4	2.4	19	18.5	6.4	19	17.1	8.2
21	22.3	0.2	21	14.4	*	21	13.4	7.9	21	7	6.7	21			21	14.7	3.2	21			21	14.3	7.2	21	17.2	0.1	21	19.6	0.2	21	19.7	0.1	21	20.8	0.1	21			21	23.3	0.2	21	23.3	0.2	21	23.4	2.4	21	18.5	6.4	21	17.1	6.6
23			23	14.4	*	23	13.4	7.9	23			23			23			23			23	14.3	7.2	23	16.9	0.1	23			23			23	20.3	0.1	23			23			23			23			23	17.1	3.1
																																																				25	17.1	2.9

09/27/04 11:05 ROZA-2			10/19/04 10:20 ROZA-2			11/08/04 10:25 ROZA-2			12/06/04 10:15 ROZA-2			03/29/05 10:24 ROZA-2			04/22/05 12:30 ROZA-2			04/22/05 12:30 ROZA-2			05/08/05 13:30 ROZA-2			06/29/05 15:30 ROZA-2			06/13/05 14:15 ROZA-2			06/19/05 14:15 ROZA-2			07/10/05 13:30 ROZA-2			07/27/05 13:30 ROZA-2			08/16/05 13:00 ROZA-2			08/21/05 13:00 ROZA-2			09/04/05 13:00 ROZA-2			09/18/05 13:00 ROZA-2			10/12/05 14:45 ROZA-2			10/23/05 14:45 ROZA-2		
Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO	Depth ft	Temp C	DO
0	22.4	8.2	0	13.6	*	0	12.7	5.7	0	5.9	8	0	9.3	9.5	0	21.2	12.3	0	21	11.8	0	*	*	0	23.3	10.8	0	27.7	6.8	0	28.7	12.9	0	29.4	12.4	0	30.7	7.3	0	27.7	4.9	0	31.4	14.6	0	28.4	13	0	23.9	7.7	0	19.7	9.6	0	16	7.4
1	22.4	7.9	1	13.6	*	1	12.7	5.6	1	5.9	7.8	1	9.4	9.5	1	21.1	12	1	21	12	1	*	*	1	23.3	10.8	1	27.5	6.7	1	28.6	12.6	1	29.4	12.1	1	30.7	5.9	1	27.7	4.8	1	31.1	15.3	1	28.1	12.5	1	23.8	7.5	1	18.5	8	1	16.1	7.1
3	22.4	7.8	3	13.5	*	3	12.7	5.6	3	5.9	7.8	3	9.4	9.6	3	20.6	10.4	3	20.6	10.8	3	*	*	3	22.8	9.6	3	27.4	6.3	3	26	4.7	3	28.8	11.3	3	30.7	5.1	3	27.5	3.6	3	29.7	8.6	3	26.3	7.6	3	23.7	7.4	3	17.9	7	3	16.1	7.3
5	22.2	7.4	5	13.5	*	5	12.7	5.6	5	5.8	7.6	5	9.2	9.7	5	20.5	9.7	5	20.5	9.4	5	*	*	5	22.7	8.6	5	27.3	6.3	5	25.7	4.4	5	28	4.7	5	30.6	4.9	5	27.4	3.5	5	29	2.5	5	25.5	3.6	5	23.6	7.2	5	17.6	6.8	5	16.1	7.1
7	22.2	6.5	7			7	12.6	5.5	7	5.8	7.5	7	9	9.7	7	20.4	9	7	20.1	6.4	7	*	*	7	22.6	6.3	7	27.3	6	7	25.5	3.8	7	27.6	0.6	7			7			7			7	25.5	2.9	7	23.2	4.6	7	17.5	6.1	7	16.2	7
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0	20.9	5.6	0	12.1	*	0	11.4	4.5	0	5.9	8.6	0	12.1	7.8	0	23	7.7	0	22.8	7.4	0	22.5	*	0	23.8	8.1	0	27.6	3.9	0	28.9	10.7	0	30.4	11	0	29.5	4.7	0	26.5	6.8	0	31.4	7.8	0	29.8	10	0	24.1	11.3	0	17.5	7.4	0	14.3	8.1
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APPENDIX D

Contract Report 2001-05

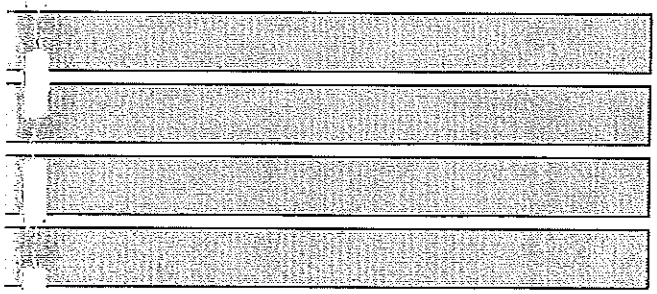
Sedimentation Survey of Highland Silver Lake, Madison County, Illinois

by

William C. Bogner

Prepared for
The City of Highland

March 2001



Illinois State Water Survey
Watershed Science Section
Champaign, Illinois

A Division of the Illinois Department of Natural Resources

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Abstract

Sedimentation detracts from the use of any water supply lake by reducing lake depth and volume, with a reduction of reserve water supply capacity and possible burying of intake structures. Sedimentation of a reservoir is a natural process that can be accelerated or slowed by human activities in the watershed.

Silver Lake is located in Madison County, one mile northwest of Highland, Illinois. The location of the dam is 38° 46' 00" north latitude and 89° 42' 05" west longitude in Section 30, T.4N., R.5W., Madison County, Illinois. The dam impounds the East Fork of Silver Creek, a tributary of Silver Creek in the Kaskaskia River basin. The watershed is a portion of Hydrologic Unit 07140204 as defined by the U.S. Geological Survey. Construction of the lake was completed in 1962. The Silver Lake watershed consists of the 47.1-square-mile area drained by the East Fork of Silver Creek above the dam site.

Land use in the watershed of the lake is mainly agricultural. Average annual precipitation in the area is 38.98 inches as measured at Greenville (1961-1990), and the average runoff (1912-1998) is approximately 10.0 inches (Shoal Creek near Breese). The average annual lake evaporation rate is 35.2 inches per year at St. Louis, Missouri.

The Illinois State Water Survey conducted sedimentation surveys of Silver Lake in 1981 and 1984. In 1981, cross sections were laid out at 14 lines across the lake and surveyed. Sedimentation surveys of Silver Lake in 1984 and 1999 repeated as closely as possible the series of survey lines established during the 1981 survey.

Sedimentation has reduced the capacity of Silver Lake from 7,322 acre-feet or ac-ft (2,386 million gallons) in 1962 to 5,832 ac-ft (1,900 million gallons) in 1999. The sediment accumulation rates in the lake have averaged 40.3 ac-ft per year from 1962-1999. Annual sedimentation rates for three separate periods, 1962-1981, 1981-1984, and 1984-1999, were 51.2, 63.0, and 21.9 ac-ft, respectively.

Density analyses of the sediment samples indicate that sediment in the northern (upstream) portions of the lake has greater unit weight than sediment in the southern end of the lake. 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.

The sedimentation rate for Highland Silver Lake is similar to the rates for other Illinois lakes of similar size and character. The sedimentation rate for Silver Lake is in the low to average range compared to other Illinois lakes.

Sedimentation Survey of Highland Silver Lake, Madison County, Illinois

Introduction

The Illinois State Water Survey (ISWS), in cooperation with the City of Highland, Illinois, conducted a sedimentation survey of Highland Silver Lake during the fall of 1999. The survey was undertaken to provide information on the storage and sedimentation conditions of the lake. Highland Silver Lake is owned and operated by the city. The city withdraws water from the lake as the sole raw water source of the public water supply for the community.

Sedimentation detracts from the use of any water supply lake by reducing lake depth and volume, with a reduction of reserve water supply capacity and possible burying of intake structures. Sedimentation of a reservoir is a natural process that can be accelerated or slowed by human activities in the watershed. In general, sedimentation of a lake is presumed to be accelerated unintentionally as a secondary impact of other developments within the watershed. For example, construction and agricultural activities in a lake watershed generally are found 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 might include, but are not limited to, the implementation of watershed erosion control practices (such as reduced tillage and other farming or development 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, which reduces stream energy such that the sediment can no longer be transported either in suspension or as bed load. 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 for estimating sedimentation rates in Illinois have been developed (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. A sedimentation survey

provides detailed information on distribution patterns within the lake and defines temporal changes in overall sedimentation rates.

Acknowledgments

The project was funded by the City of Highland. Dick Aten was project manager. Steve Shultz and Kevin Kehrer assisted with monument recovery.

This project was conducted by the author as part of his regular duties at the Illinois State Water Survey under the administrative guidance of Derek Winstanley, Chief, and Manoutchehr Heidari, Acting Head, and Mike Demissie, Head of the Watershed Science Section. Richard Allgire and K. Erin Hessler Bauer assisted with the field data collection. Yi Han analyzed the sediment samples. Don Roseboom and Shun Dar Lin provided technical review. Eva Kingston edited the report. Linda Hascall reviewed the graphics.

Views expressed in this report are those of the author and do not necessarily reflect the views of the sponsor or the Illinois State Water Survey.

Lake Information

Silver Lake (figure 1) is located in Madison County, one mile northwest of Highland, Illinois. The location of the dam is 38° 46' 00" north latitude and 89° 42' 05" west longitude in Section 30, T.4N., R.5W., Madison County, Illinois. The dam impounds the East Fork of Silver Creek, a tributary of Silver Creek in the Kaskaskia River basin. The watershed is a portion of Hydrologic Unit 07140204 as defined by the U.S. Geological Survey (USGS, 1988).

Reservoir and Water Supply History

The earliest Water Survey file report on water supply or sewerage conditions in Highland is dated March 31, 1912. This report was prepared by Ralph Hilscher on the basis of a town visit on February 6, 1912. The following history has been prepared using Mr. Hilscher's and later reports. Mr. Hilscher's observations were that the town had no public water supply or sewage system. Household water was obtained from private, dug wells generally in the range of 20 to 40 feet deep. Mr. Hilscher considered these wells to be highly susceptible to contamination but noted that there had been no major outbreaks of typhoid although 12 cases had been diagnosed during the period 1907 to 1912 and resulted in three deaths. In about 1910 (two years prior to the 1912 visit) the city had contracted with an engineering firm to evaluate potential public water supply options for the community. The engineer's report recommended the construction of an impounding reservoir north of town, a water works, and distribution system. This plan was not approved by the voters.

Water for fire fighting was available from a series of cisterns located every few blocks in town. Water for street sprinkling was collected in a cistern and distributed through town by a piping system. These systems were not used for household purposes.

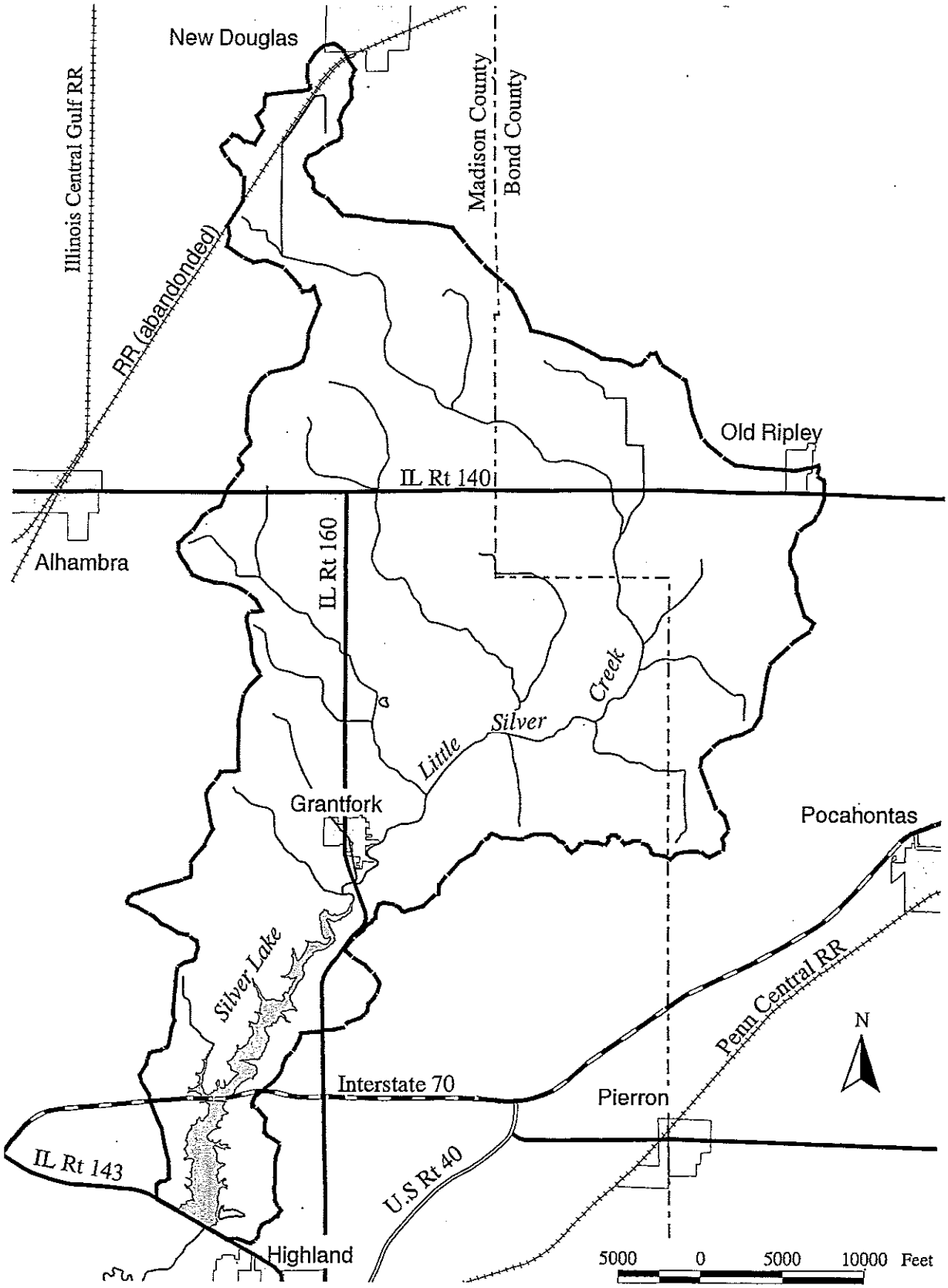


Figure 1. Location and watershed delineation for Silver Lake

The two major industries in town were a brewery and a condensed milk factory. In about 1902, these companies combined forces to build two small ponds north of town. Following the defeat of the public water supply initiative, these two companies again combined resources and constructed an impoundment at the site of the old city reservoir. This lake was partially fed by springs in the watershed. This lake with the previously constructed ponds and occasional withdrawals from the East Branch of Silver Creek provided sufficient water for the operation of both businesses.

Over the next 20 years, several other potential reservoir sites and ground-water supplies were investigated. The reservoir sites generally were not well suited to construction of an adequate reservoir. Local ground-water conditions were not conducive to development as a source of supply. Any aquifers potentially having adequate water to develop were too highly mineralized to treat economically.

A 1923 ISWS file report notes that the brewery was then a soft drink manufacturer, and the condensed milk company was shipping whole milk. There had been no change in public water supply conditions. The pump station for withdrawing water from the creek had silted in, and sewerage was becoming a significant concern.

The Highland public water supply system was installed in 1925. No direct information about this system was available in ISWS file reports It appears that the city purchased the brewery/milk plant reservoir and installed a water works plant and distribution system.

At the time of a May 11, 1944 file report, the city was providing water using the old lake as a pump storage reservoir for water taken from the creek. The report estimated that only one-third of the water supply came from the direct watershed of the lake and two-thirds were taken from the creek.

During the early 1950s, southern Illinois experienced a severe and prolonged period of drought. Several file reports available from this period indicate that the lake level was being maintained by pumping water from the creek. Several emergency measures were implemented:

- Hauling 726 truckloads or 3.25 million gallons of water (August 1954).
- Installing a pump from what remained of the lake to the intake structure.
- Bringing in additional pump capacity to move water from the creek to the lake.
- Excavating a channel to intercept spring flow from sites south of Route 143.

In September 1954, with one Hammond, Indiana Civil Defense 1,500-gallon-per-minute (gpm) pump, a used 1,500 gpm pump from Breese, and existing pumping capacity, 6,800 gpm of pump capacity was available to intercept water from the creek and divert it into the reservoir. Water use had been reduced to about one-half of the pre-drought conditions.

The first indication of action to construct the new lake is in a 1954 water plant inspection report. Review of aerial photography taken in Spring 1962 indicates that the lake was just starting to fill. Inspection reports indicate that the lake was in use in September 1962.

Highland became a regional water supplier when bulk water connections were made to Pierron in Bond County (1972), Grant Fork (1975), and St. Jacob's (about 1980). An automatic pressure valve controls the St. Jacob's connection which supplements an existing well supply.

From 1981 to 1986, the Silver Lake watershed was selected as one of 13 experimental Rural Clean Water Program sites. The watershed was also selected as one of five of the 13 watersheds for a comprehensive monitoring and evaluation program under the direction of the Agricultural Stabilization and Conservation Service of the U.S. Department of Agriculture. As part of the monitoring program, sedimentation surveys were conducted for the lake in 1981 and 1984.

Watershed

The Silver Lake watershed consists of the 47.1-square-mile area drained by the East Fork of Silver Creek above the dam site (figure 1). The highest point in the watershed is at an elevation of 640 feet National Geodetic Vertical Datum or NGVD (southeast of New Douglas), and the normal pool elevation of the lake is 500.0 feet NGVD.

Land use in the watershed of the lake is mainly agricultural. Average annual precipitation in the area is 38.98 inches as measured at Greenville (1961-1990), and the average runoff (1912-1998) is approximately 10.0 inches (Shoal Creek near Breese). The average annual lake evaporation rate is 35.2 inches per year at St. Louis, Missouri, the closest available station (Roberts and Stall, 1967).

The upland soils in the watershed are in the Virden-Piasa-Darmstadt Association (USDA-SCS, 1986). These soils are nearly level to moderately sloping and may have some drainage problems due in part to the poor permeability of the subsoil. This association is usually formed in loess on broad, upland plains originally covered by prairie grasses. Slopes range from 0 to 8 percent.

Soils in stream depressions are in the Hickory-Elco-Rosetta Association (USDA-SCS, 1986). These soils are moderately sloping to steep and generally well drained. Subsoils have moderately slow permeability. These soils formed in glacial till, loess, and loess over an older buried soil on valley side slopes and in narrow upland ridges. The original soils formed mainly under deciduous forest cover. Slopes range from 5 to 30 percent.

Lake Sedimentation Surveys

The ISWS conducted sedimentation surveys of Silver Lake in 1981 (Bogner, 1982) and 1984 (Makowski et al., 1986). In 1981, cross sections were laid out at 14 lines across the lake and surveyed. During the 1984 and 1999 surveys, these survey lines were resurveyed to define temporal changes in lakebed topography. During the 1984 survey, the range ends were monumented by installing 4-inch by 4-inch concrete posts to mark the transect ends. The 1999 sedimentation survey of Silver Lake (figure 2) repeated as closely as possible the series of survey lines established during the 1981 survey.

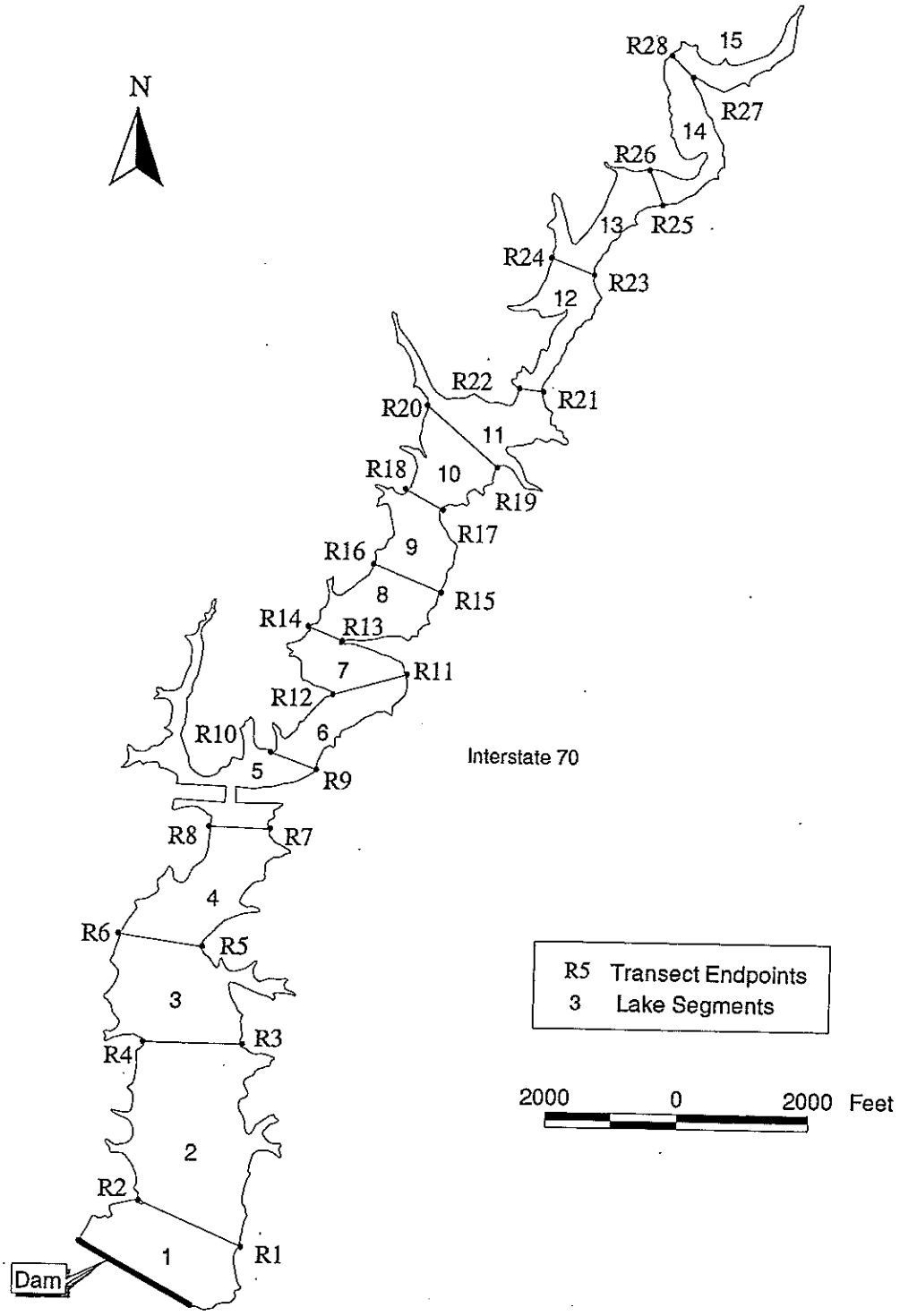


Figure 2. Survey plan for Silver Lake, 1999

For the 1981 and 1984 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 depth data were adjusted to the spillway crest elevation. Depth measurements were made using an aluminum sounding pole lowered to the top of the sediment surface to measure the existing water depth. The pole was then used to probe to the original bottom as determined by the initial point of resistance to the sediment probe.

The 1999 survey was conducted using an Odom Hydrographic Systems MK II fathometer for depth measurement and a differentially corrected Leica 9600 System Geodetic Position System (GPS) for horizontal control across the transect. All navigation and data logging functions were controlled using Hypack, a hydrographic survey software. The GPS positions were differentially corrected using Radio Technical Commission for Maritime Services (RTCM) correction signals broadcast by the U.S. Coast Guard from St. Louis, Missouri.

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 feet in a profile at one-foot depth intervals. For each main lake cross section, three to seven physical measurements of the water depth and sediment thickness were made with an aluminum sounding pole. The three upstream cross sections in the lake were resurveyed in 1999 with the traditional cable and pole method due to shallow depths.

Plots of all cross sections surveyed from 1981, 1984, and 1999 are presented in appendix I. For comparison, the 1999 pole measurements also are plotted in appendix I as point data. These water-depth measurements with the pole show a close correspondence with the 1999 depth sounder readings. Comparison of the original lake depth for the 1999 pole readings to the full cross-sectional data collected for the 1981 and 1984 surveys shows a good match for most measurements made.

Lake Basin Volumes

Calculations of the lake capacities were made using methods 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, 500.0 feet NGVD. Table 1 presents the volume calculation results of the three surveys.

Sedimentation has reduced the basin capacity from 7,322 acre-feet (ac-ft) in 1962 to 5,832 ac-ft in 1999. The 1999 basin capacity was 79.4 percent of the 1962 potential basin capacity. For water supply purposes, these volumes convert to capacities of 2,386 million gallons in 1962 and 1,900 million gallons in 1999. The capacity of the lake in 1981 was 6,349 ac-ft (2,069 million gallons), and 6,160 ac-ft (2,007 million gallons) in 1984.

Table 1. Reservoir Capacity and Capacity Loss Analysis

Period	*Capacity*	*Capacity loss for period*	*Cumulative capacity loss*	*Period annual capacity loss rate*	*Cumulative annual capacity loss rate*
a) Analysis in units of acre-feet					
1962	7,322				
1962-1981	6,349	973	973	51.2	51.2
1981-1984	6,160	189	1,162	63.0	52.8
1984-1999	5,832	328	1,491	21.9	40.3
b) Analysis in units of million gallons					
1962	2,386				
1962-1981	2,069	317	317	17	17
1981-1984	2,007	62	379	21	17
1984-1999	1,900	107	486	7	13

Note: Lake surface area was 600 acres for 1999.
Capacity shown is for the sedimentation survey conducted at the end of the period.

The 1999 water depths for the lake were used to generate the bathymetric map in figure 3 and the volume distribution curve data in figure 4. Figure 4 can be used to determine the capacity of the reservoir below a given stage elevation. For example, the water volume below the 4-foot depth contour (shown by the dashed line in figure 4) is 3,869 ac-ft. With time and continued sedimentation, the relationships shown in figure 4 will become obsolete. Alteration of the spillway elevation, or the implementation of a dredging program would likewise alter these relationships.

Sedimentation Rates

Sedimentation rates for Silver Lake were analyzed in terms of delivery rates from the watershed and accumulation rates in the reservoir. The watershed delivery processes and 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 delivery rate is determined by dividing the volume or mass of sediment deposited in the lake over a period of time by the length of the time period. This value is then divided by the area of the watershed and presented in a range of unit values.

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. To determine the accumulation rate, the sediment deposition

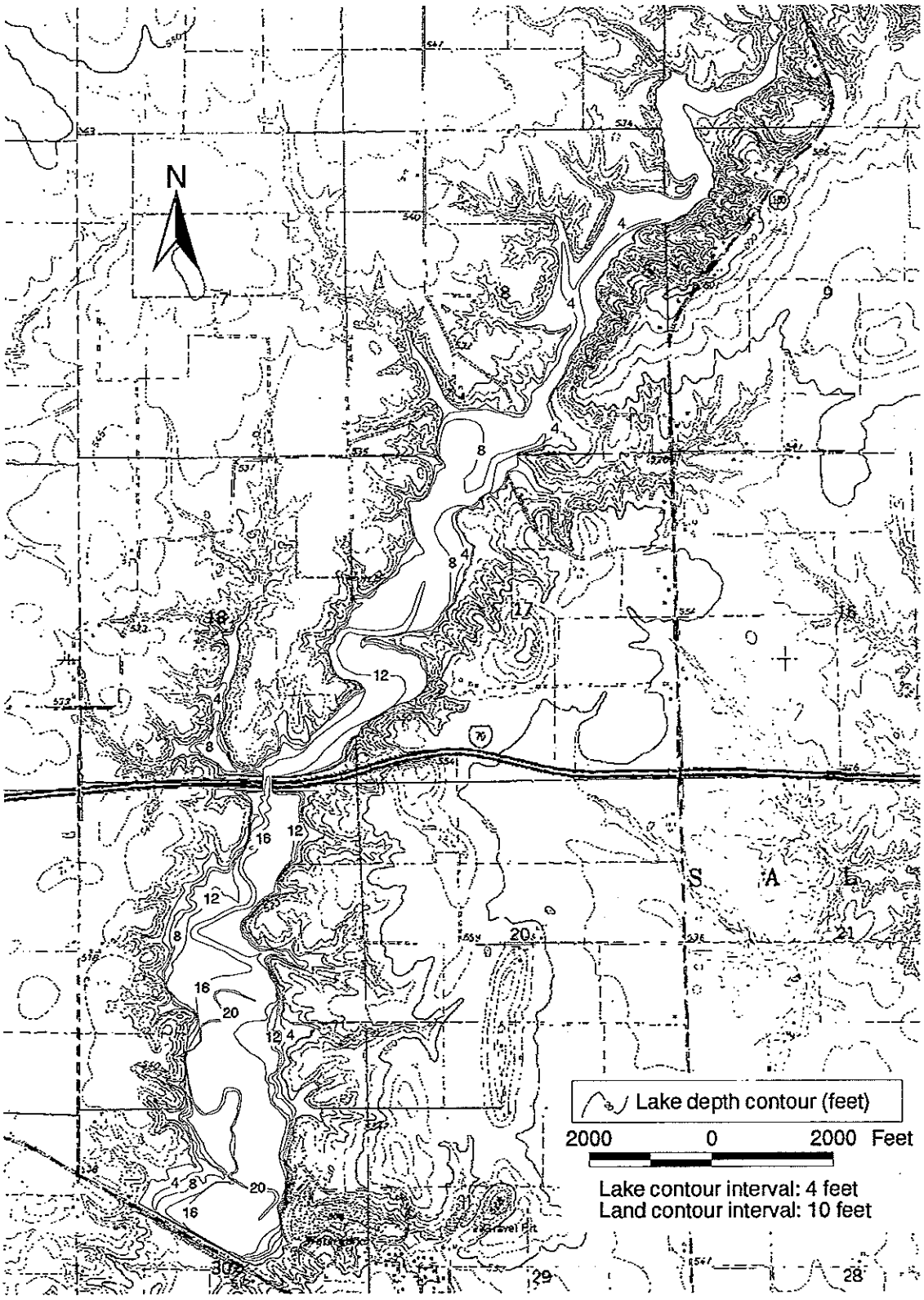


Figure 3. Bathymetric map of Silver Lake

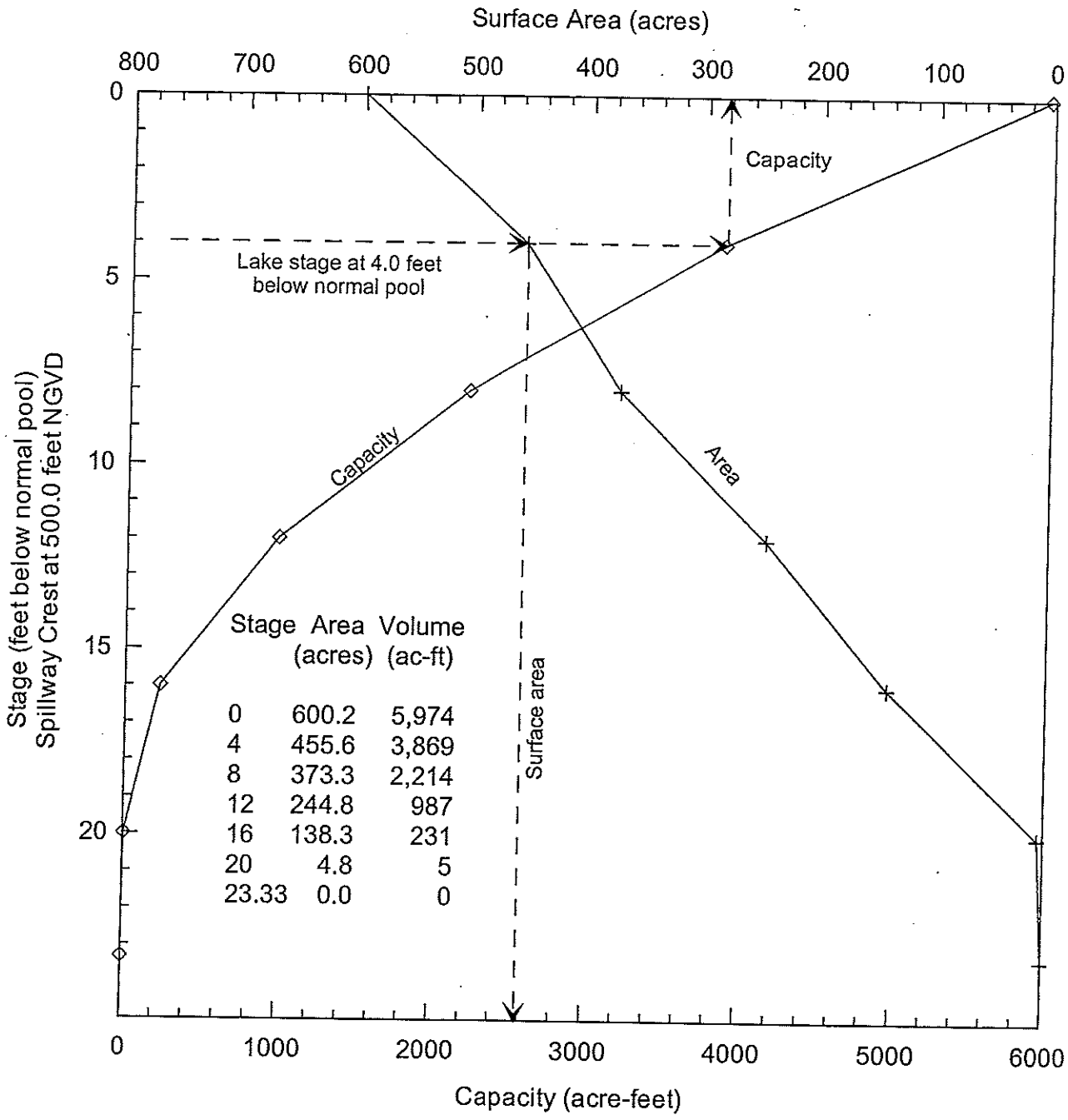


Figure 4. Stage vs. volume vs. area relationship for Silver Lake, 1999

volume is divided by the original capacity of the reservoir and converted to a percent. This value is then divided by the time between surveys to convert it to a rate of capacity loss per year. This sedimentation rate is determined for each sedimentation period as well as cumulatively for the life of the reservoir.

Tables 2 and 3 provide the sedimentation rates for Silver Lake and its watershed for the periods 1962-1981, 1981-1984, 1984-1999, and 1962-1999. These rates indicate a decline in net sediment yield from the watershed from 51 ac-ft from 1962-1981 to 22 ac-ft annually from 1984-1999. The long-term average annual sediment yield from 1962-1999 was 40 ac-ft. These delivery rates show the need for continuing efforts to control watershed erosion, thereby reducing reservoir sedimentation rates.

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 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 that also affect sedimentation rates involve the variation of trap efficiency (due to reduced storage capacity) and sediment consolidation.

Figure 5 shows representative streamflow values for the East Fork Shoal Creek near Coffeen from October 1963-September 1997 (USGS web page, 2000). 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 5 indicate that average flows for most months were higher during the 1981-1984 sedimentation study period for Silver Lake. Average flows for the 1962-1981 and 1984-1999 sedimentation periods were very similar on both a monthly and annual basis. This suggests that sediment delivery to the lake should be somewhat higher during the 1981-1984 survey period with the other two periods being very similar.

In contrast to the observations of the average flow characteristics, the monthly and annual peak discharges tend to be lower during the 1981 to 1984 period. In the case of peak flows, the 1984 to 1999 period shows a tendency to higher peak flows. This is particularly true for the late Spring and late Fall periods when row cropped fields would be most exposed. These higher peak flows would also be expected to indicate a higher potential soil loss rate.

Instead, sedimentation rates for the middle sedimentation period are somewhat higher, but the sedimentation rate for the latter (1984 to 1999) period is significantly less than the rate for either of the earlier periods. This suggests that other watershed conditions have been larger factors in determining Silver Lake sedimentation rates after 1984. This may indicate that the watershed treatment program implemented under the Rural Clean Water Program (1981-1986) was a positive influence on sediment delivery to the lake.

The results of this flow analysis should be treated cautiously due to the short time periods involved. This is particularly true of the 3-year time period for the 1981 to 1984 period. For the peak flow analysis for this period, three short-time frame values are included in this data set.

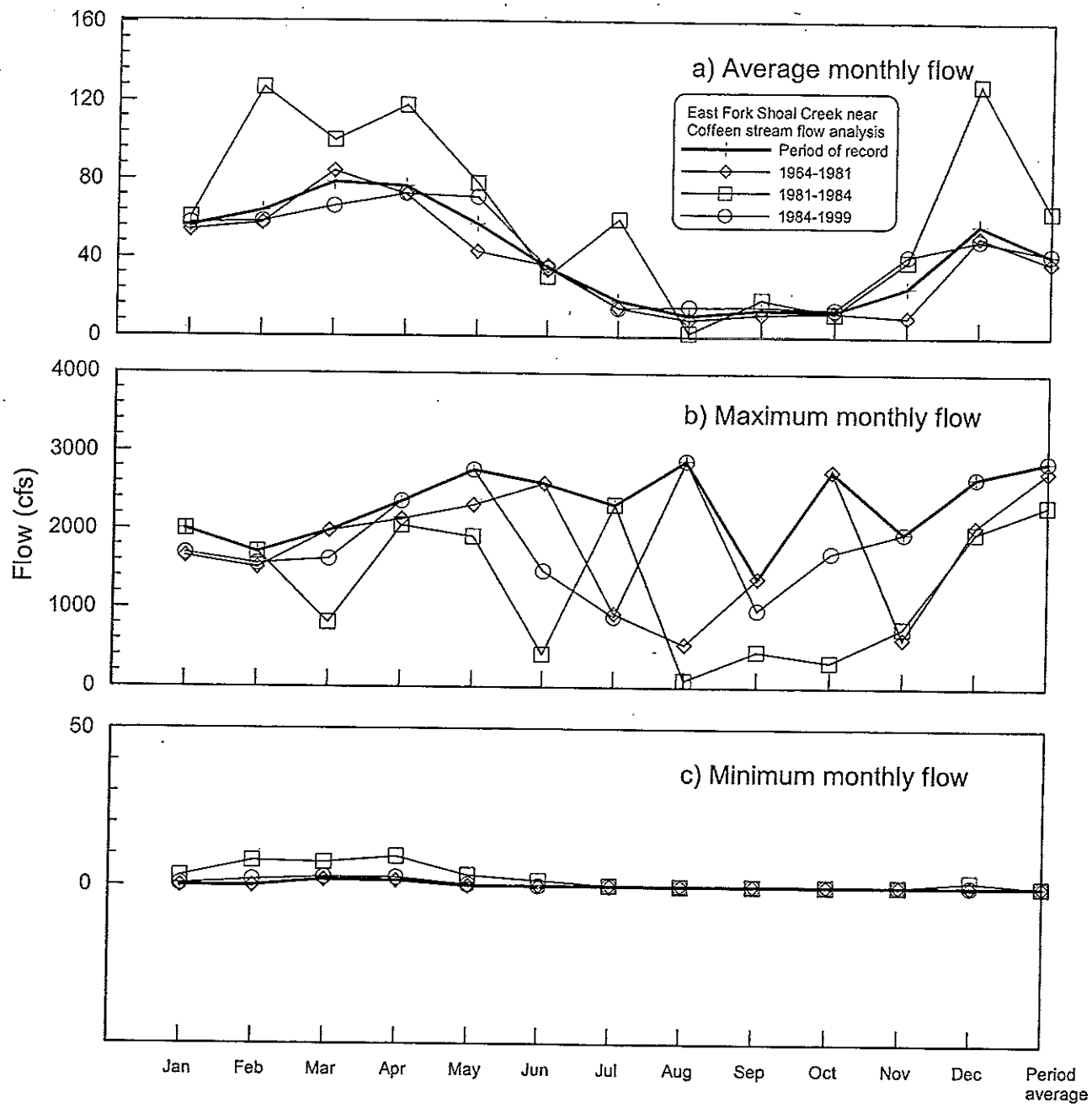
Table 2. Computed Sediment Delivery Rates from the Watershed for Each Sedimentation Period

	Annual deposition rates			
Period	*Acre-feet*	*Acre-feet per square mile*	*Cubic feet per acre*	*Tons per acre*
1962-1981	51	1.09	74.0	
1981-1984	63	1.34	91.0	
1984-1999	22	0.46	31.6	
1962-1999	40	0.86	58.2	1.19

Note: Total watershed area is 47.1 square miles.

Table 3. Capacity Loss Rates (percent) Relative to Original Lake Capacity

Period	*Per period*	*Cumulative*	*Period annual loss*	*Cumulative annual loss*
1962-1981	13.29	13.29	0.70	0.70
1981-1984	2.58	15.87	0.86	0.72
1984-1999	4.49	20.36	0.30	0.55
1962-1999	20.36	20.36	0.55	0.55



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 5. Comparison of a) average, b) maximum, and c) minimum monthly flow for the East Fork Shoal Creek near Coffeen for the three sedimentation periods (1964-1981, 1981-1984, and 1984-1999) and the full record of the station (1964-1999) .

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 Silver Lake was 92.7 percent in 1962, meaning that 92.7 percent of all sediment entering the lake was trapped in the lake basin. In general, as sediment accumulation reduces the volume of the lake basin, the holding time for water entering the lake is reduced. This reduction in holding time means less time for sediment to drop out of suspension and a reduction in trap efficiency. Due to the large capacity of Silver Lake relative to the size of its watershed, the trap efficiency of the lake has not been significantly reduced. In 1999, the trap efficiency was 91.5 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 Silver Lake. Some portions of the upper end of the lake are being exposed even at normal pool level. The exposure of sediment in these terrestrial deposits 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 Silver Lake were high for the initial periods (1962-1984) with a range of 74 to 91 cubic feet per acre per year. Sedimentation rates for the period 1984-1999 have been considerably lower.

Sediment Distribution

Table 4 shows the distribution of sediment in the lake. This table lists the average sediment thickness and mass distribution for the lake and for each lake calculation segment as shown in figure 2. Sediment thickness ranges from 1.9 to 4.1 feet. The most significant accumulation by either measure, depth or mass, is in segments 12 and 13 in the northern portion of the lake.

Density analyses of the sediment samples (appendix II) indicate that sediment in the northern (upstream) portions of the lake has greater unit weight than sediment in the southern end of the lake. 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. Appendix III presents the laboratory analyses for these samples. Figure 6 A-C shows particle

Table 4. Sediment Distribution in Silver Lake

Segment from figure 2	*1962 volume (ac-ft)*	*1981 volume (ac-ft)*	*1984 volume (ac-ft)*	*1999 volume (ac-ft)*	*1999 sediment accumulation (ac-ft)*	*1999 sediment weight (tons)*	*1999 sediment thickness (feet)*	*1999 sediment per segment acre (tons)*
1	795	728	709	690	105	84,553	2.0	1,584
2	1,771	1,623	1,609	1,531	240	193,260	2.1	1,683
3	956	869	862	829	127	80,440	1.9	1,205
4	730	652	638	626	103	93,016	2.0	1,813
5	524	460	454	436	87	66,860	1.9	1,489
6	345	306	294	280	65	45,341	2.5	1,746
7	314	267	242	232	82	56,779	3.5	2,392
8	399	323	302	290	109	104,455	3.2	3,096
9	300	247	246	231	69	66,452	2.4	2,291
10	292	240	232	217	75	68,033	2.7	2,408
11	323	257	245	221	102	119,356	2.8	3,292
12	213	156	142	112	100	112,906	4.0	4,499
13	174	119	101	68	105	94,256	4.1	3,673
14	137	78	64	48	89	103,252	3.4	3,904
15	50	24	19	20	31	35,694	2.1	2,408
Totals	7,322	6,349	6,160	5,832				
Averages					1,491	1,324,652	2.5	2,207

Notes: Averages are whole lake averages, not column averages.

size distribution plots for samples collected from the top surface of the accumulated sediments. These samples show the tendency for sediment particle size to decrease from upstream to downstream in the lake. This reduction in deposited sediment particle sizes is consistent with 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 stream water 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.

All samples were composed of clay and silt 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 sediment.

Two sets of samples (shown in figure 6D) were collected to analyze vertical variations in particle size distribution. These samples show a temporal trend toward coarser sediments in the surface layer at each sample site. This observation is also consistent with general trends in lake sediments. Surficial sediment, the most recently deposited sediment, tends to be coarser with 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. With time, the initial depositional zone in the lake will move further down the lake because of water volume loss to sedimentation.

Evaluation and Comparison to Other Illinois Lakes

The sedimentation rate for Highland Silver Lake is similar to the rates for other Illinois lakes of similar size and character. Table 5 presents comparative data for other selected Illinois lakes from ISWS lake sedimentation files and for Silver Lake. The sedimentation rate for Silver Lake is in the low to average range compared to the other lakes. The drainage areas of all of the other lakes in this list are also from rural watersheds.

Maintaining the water supply storage capacity of Silver Lake is essential for the maintenance of an adequate water supply for Highland. In addition to water supply, Silver Lake also provides a much needed water-based recreational resource for the Madison County area.

Capacity loss rate (0.55 percent per year) and watershed sediment yield rate (1.19 tons per acre) of the lake and its watershed over the 1962-1999 period are about average for Illinois impoundment lakes.

The capacity loss rate of 0.55 percent per year determined by this study is considerably lower than the values in the 1981 (0.70 percent per year) and 1984 (0.86 percent per year) reports.

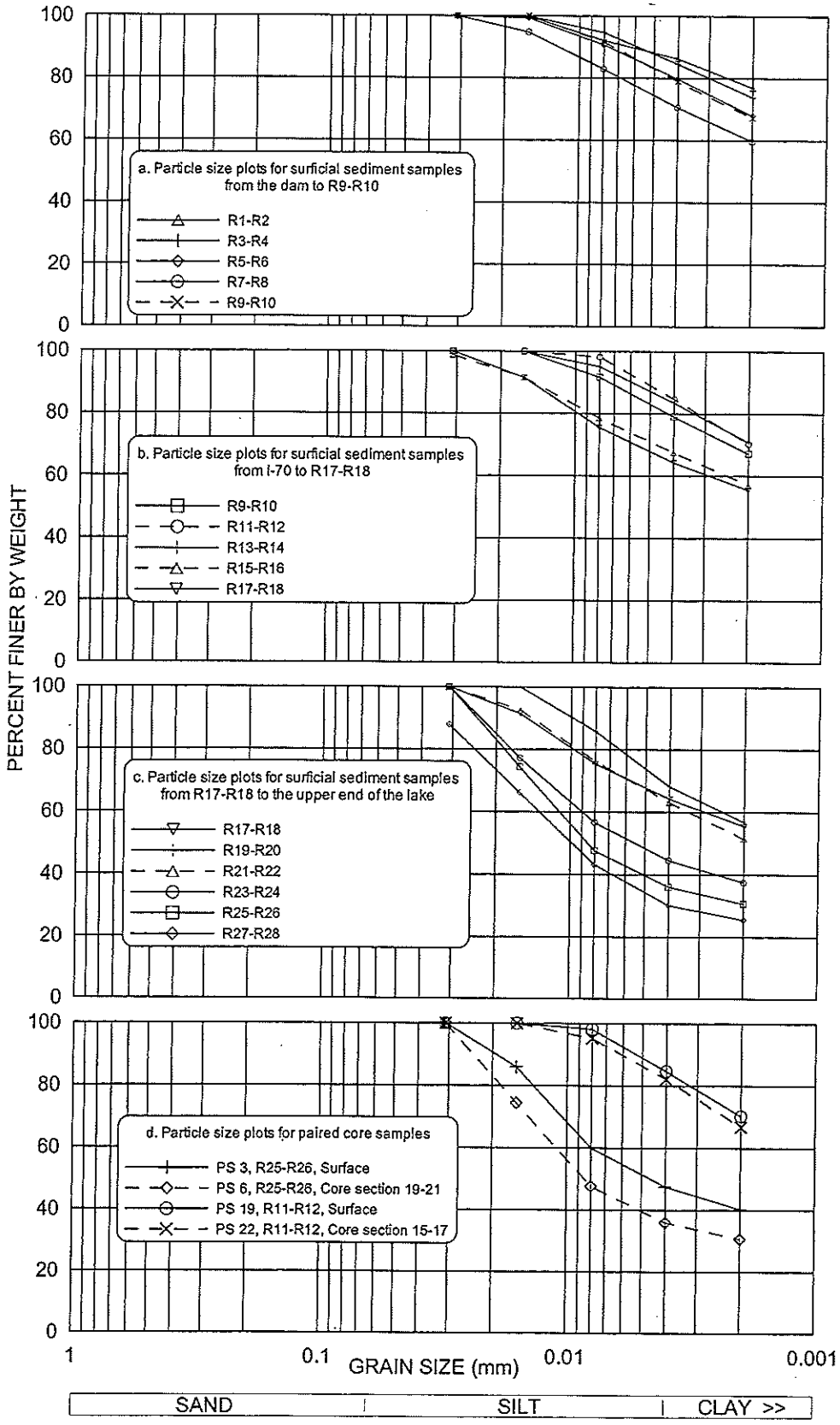


Figure 6. Particle size (PS) distributions for Silver Lake sediment samples

Table 5. Comparison of Highland Silver Lake and Other Illinois Lakes

Lake	*County*	*Survey year*	*Lake age (years)*	*Watershed area (sq. mi.)*	*As-built capacity (ac-ft)*	*Surveyed capacity (ac-ft)*	*Annual volume loss (percent)*
Otter Lake	Macoupin	1998	30	20.3	16,140	15,040	0.23
Lake Pittsfield	Pike	1992	31	11.1	3,563	2,679	0.80
Lake Taylorville	Christian	1977	15	131.3	9,410	7,920	1.06
Raccoon Lake	Marion	1993	50	48.6	5,580	4,090	0.53
Lake Springfield	Sangamon	1984	50	265	59,900	52,200	0.26
Lake Lou Yeager	Montgomery	1977	11	115	15,800	13,900	1.09
Silver Lake	Madison	1999	37	47.1	7,320	5,830	0.55

Notes: sq. mi. = square miles; ac-ft = acre-feet

Summary

The Illinois State Water Survey has conducted a sedimentation survey of Silver Lake in Highland, Illinois. The lake, originally constructed in 1962, is the raw water source for the Highland public water supply. Previous lake sedimentation surveys were conducted in 1981 and 1984. The operating elevation for the reservoir is 500.0 feet NGVD.

Sedimentation has reduced the capacity of Silver Lake from 7,322 ac-ft (2,386 million gallons) in 1962 to 5,832 ac-ft (1,900 million gallons) in 1999. The sediment accumulation rates in the lake have averaged 40.3 ac-ft per year from 1962-1999. Annual sedimentation rates for three separate periods, 1962-1981, 1981-1984, and 1984-1999 were 51.2, 63.0, and 21.9 ac-ft, respectively.

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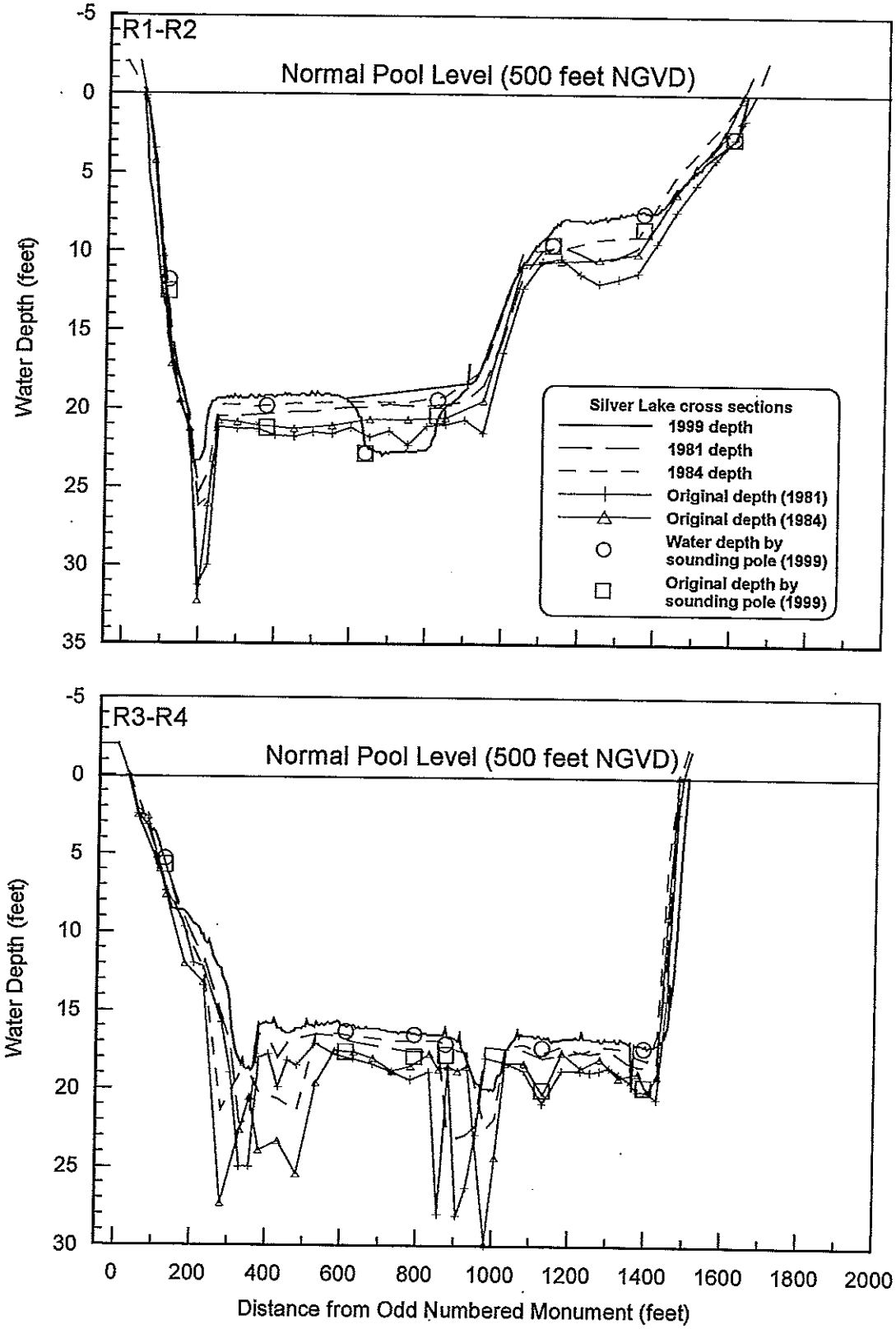
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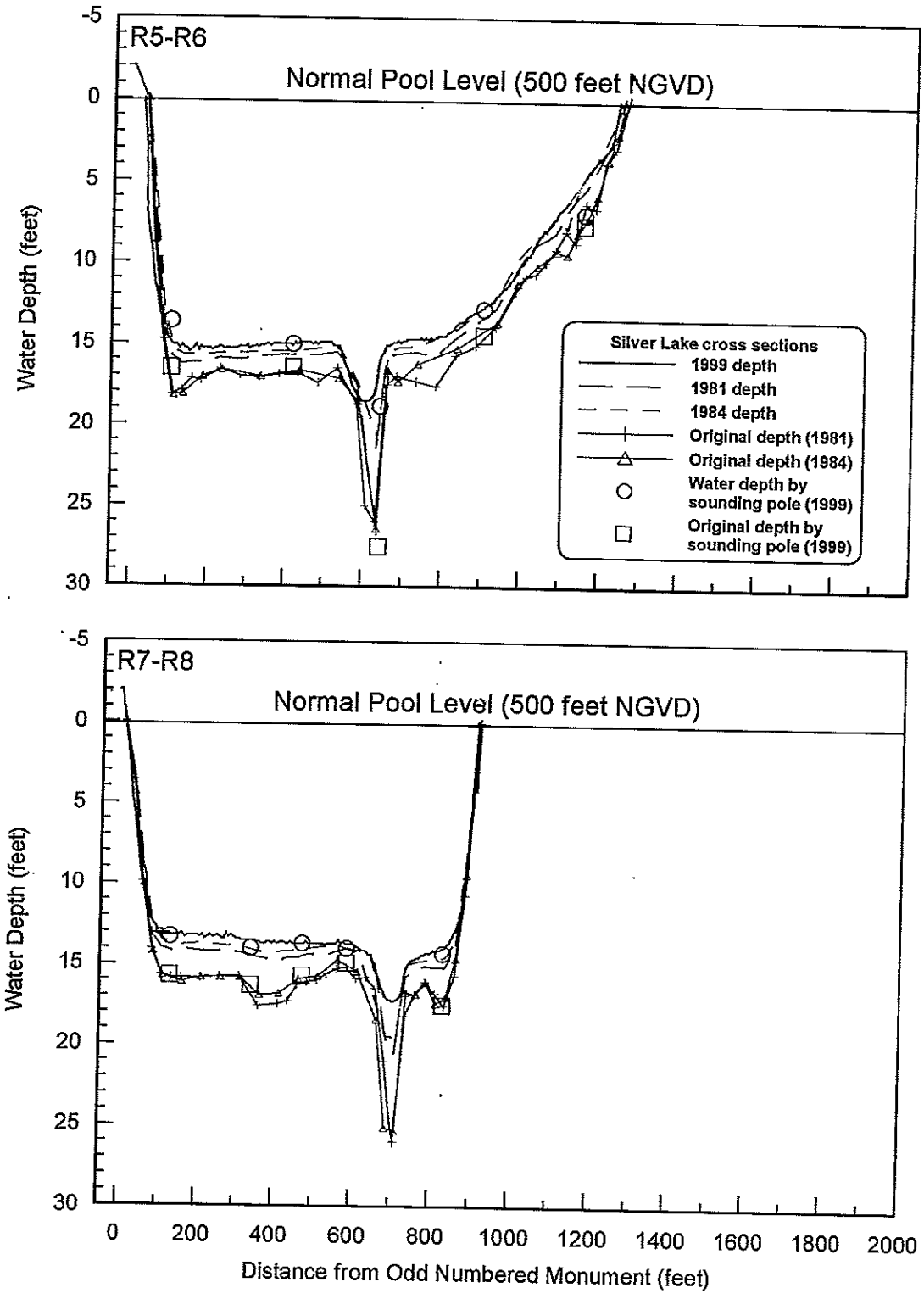
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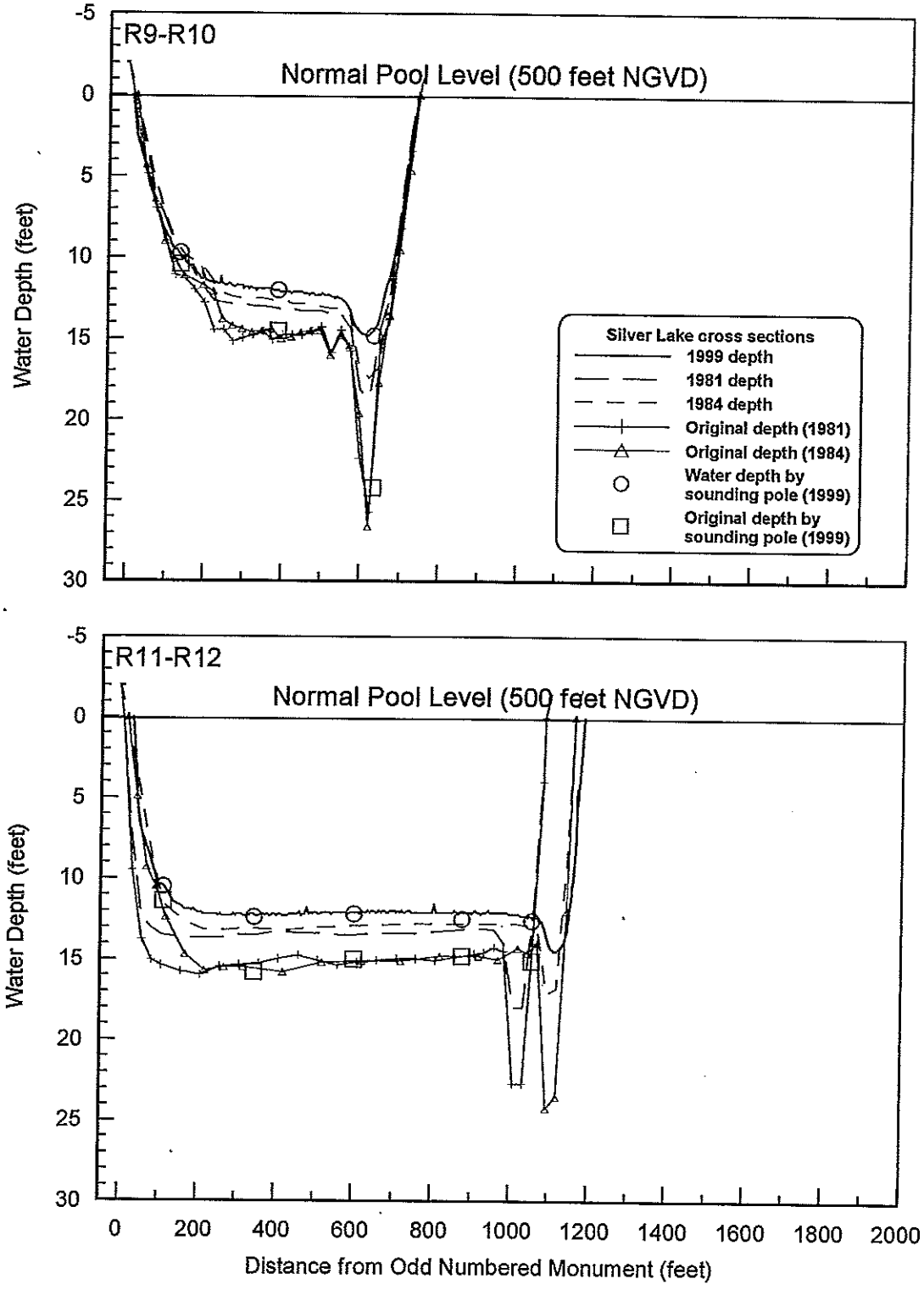
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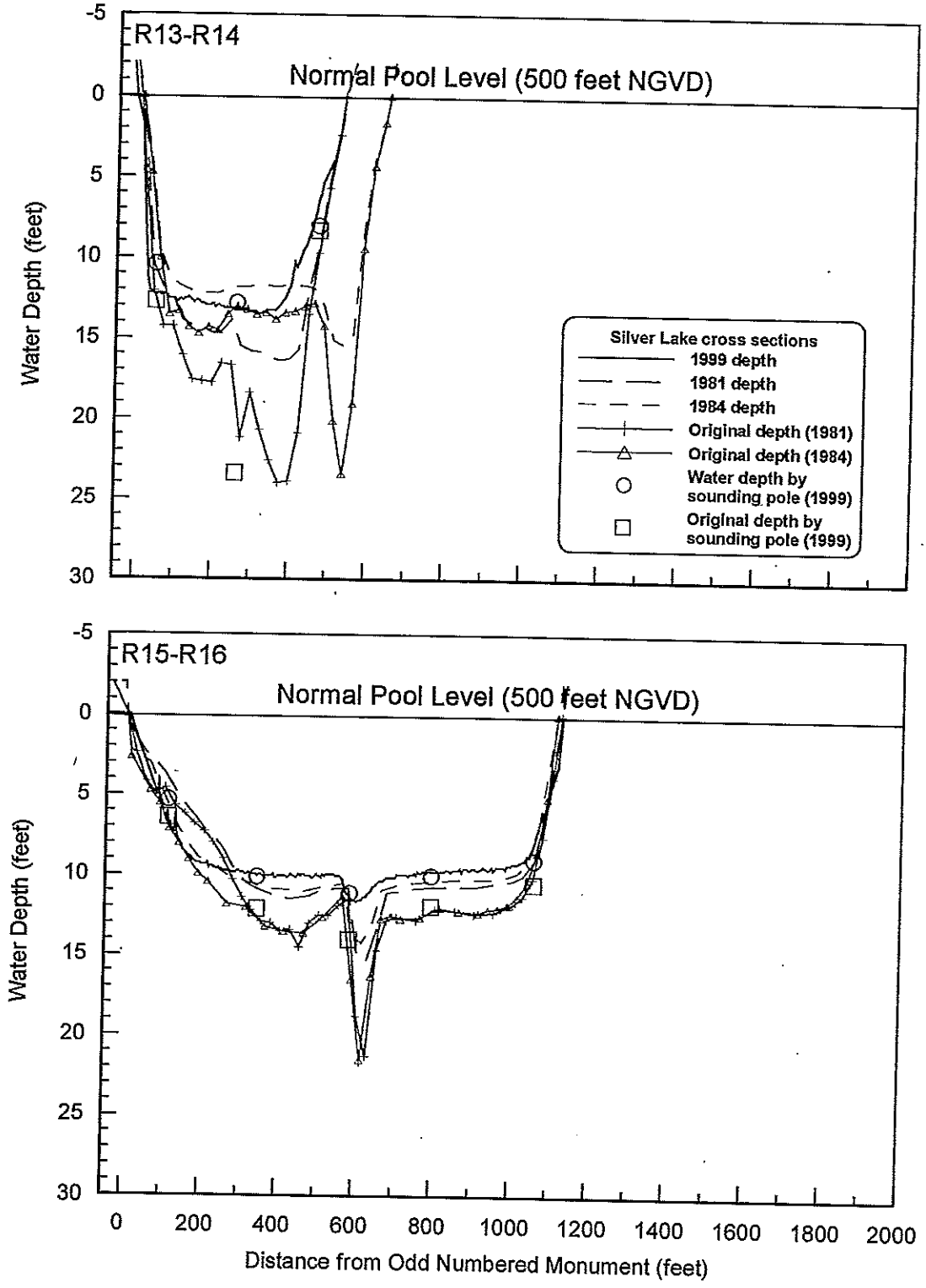
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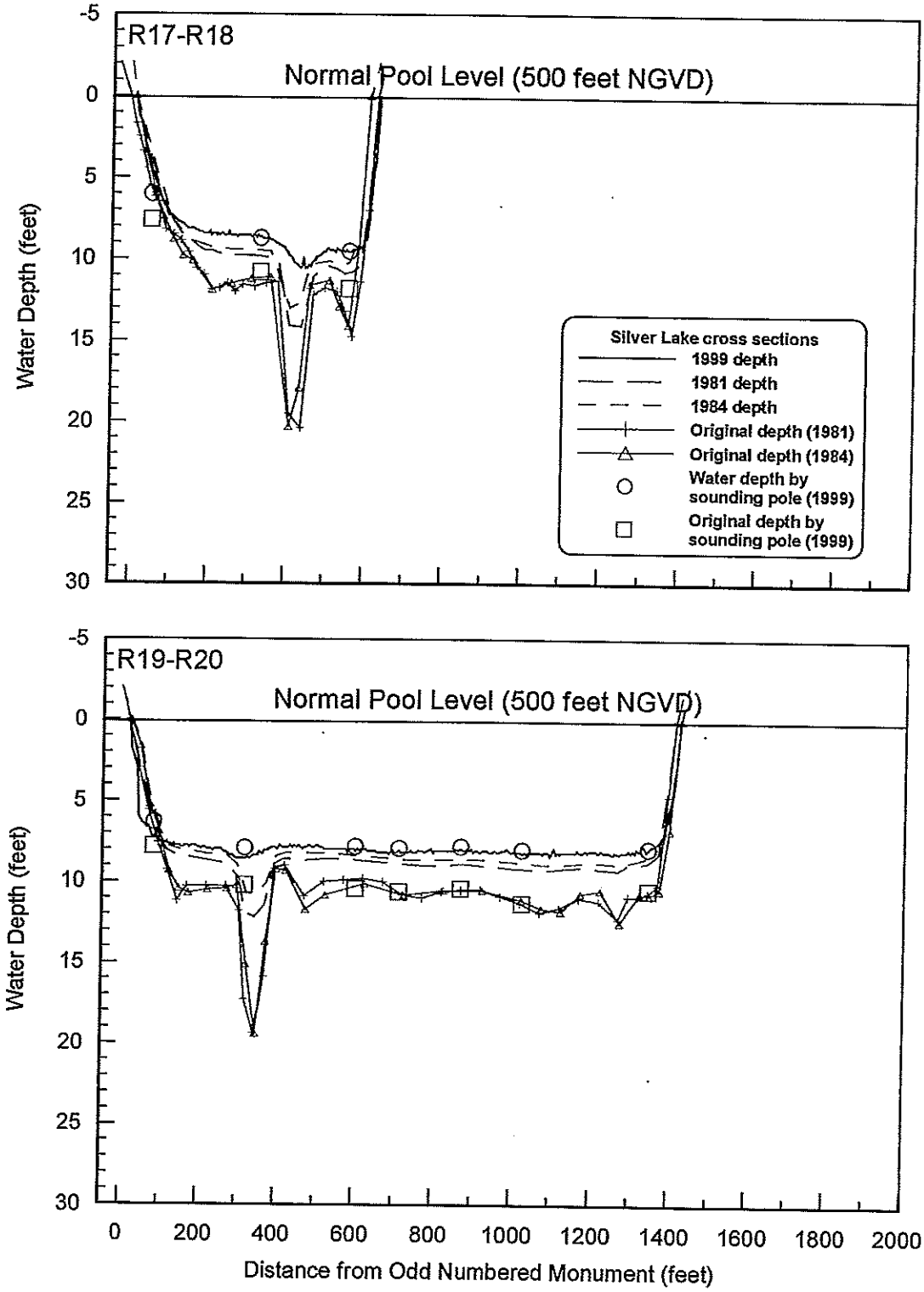
Appendix I. Cross Sections of Silver Lake Transects

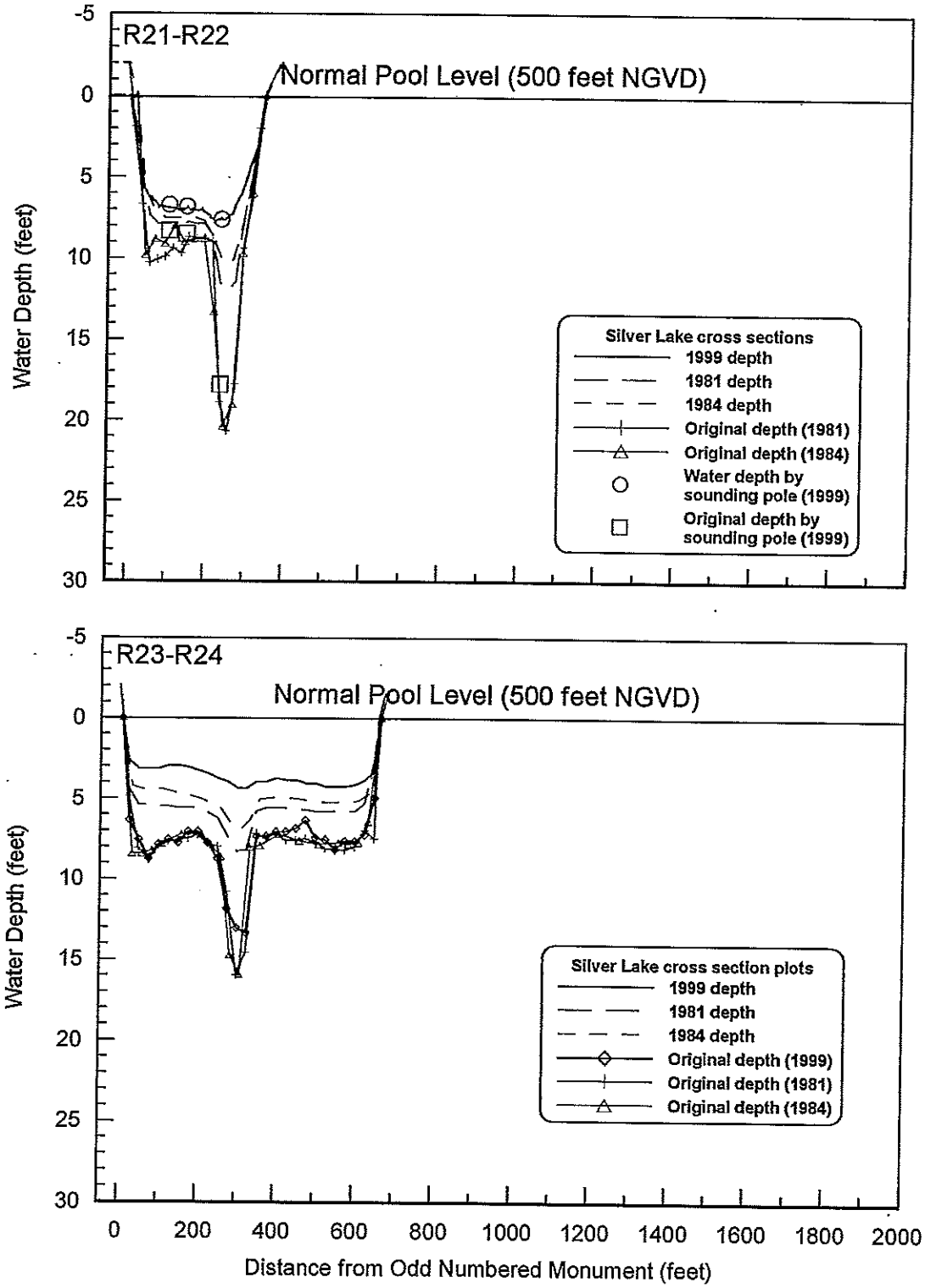

R1-R2
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
-5
0
5
10
15
20
25
30
35
Silver Lake cross sections
1999 depth
1981 depth
1984 depth
Original depth (1981)
Original depth (1984)
Water depth by sounding pole (1999)
Original depth by sounding pole (1999)
R3-R4
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance from Odd Numbered Monument (feet)

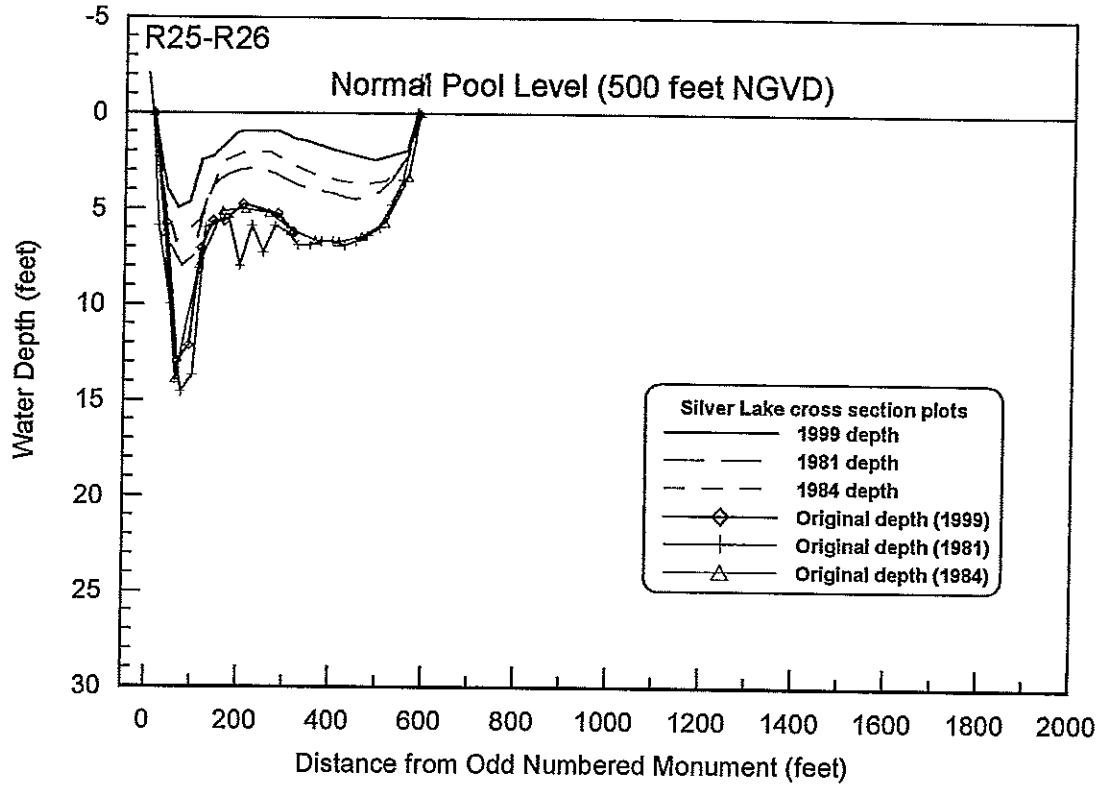

R5-R6
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
-5
0
5
10
15
20
25
30
Silver Lake cross sections
1999 depth
1981 depth
1984 depth
Original depth (1981)
Original depth (1984)
Water depth by sounding pole (1999)
Original depth by sounding pole (1999)
R7-R8
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance from Odd Numbered Monument (feet)

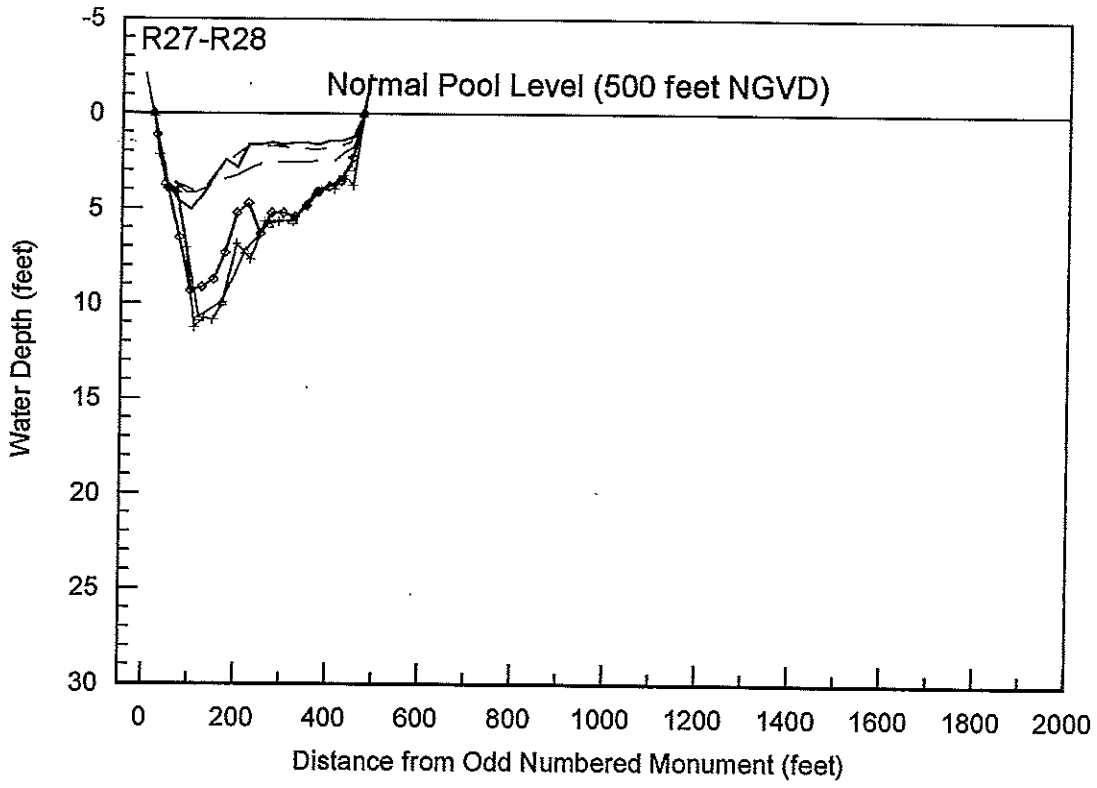

R9-R10
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
-5
0
5
10
15
20
25
30
Silver Lake cross sections
1999 depth
1981 depth
1984 depth
Original depth (1981)
Original depth (1984)
Water depth by sounding pole (1999)
Original depth by sounding pole (1999)
R11-R12
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance from Odd Numbered Monument (feet)


R13-R14
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
-5
0
5
10
15
20
25
30
Silver Lake cross sections
1999 depth
1981 depth
1984 depth
Original depth (1981)
Original depth (1984)
Water depth by sounding pole (1999)
Original depth by sounding pole (1999)
R15-R16
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance from Odd Numbered Monument (feet)


R17-R18
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
-5
0
5
10
15
20
25
30
Silver Lake cross sections
1999 depth
1981 depth
1984 depth
Original depth (1981)
Original depth (1984)
Water depth by sounding pole (1999)
Original depth by sounding pole (1999)
R19-R20
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance from Odd Numbered Monument (feet)


R21-R22
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
-5
0
5
10
15
20
25
30
Silver Lake cross sections
1999 depth
1981 depth
1984 depth
Original depth (1981)
Original depth (1984)
Water depth by sounding pole (1999)
Original depth by sounding pole (1999)
R23-R24
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
Silver Lake cross section plots
1999 depth
1981 depth
1984 depth
Original depth (1999)
Original depth (1981)
Original depth (1984)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance from Odd Numbered Monument (feet)


R25-R26
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
-5
0
5
10
15
20
25
30
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance from Odd Numbered Monument (feet)
Silver Lake cross section plots
1999 depth
1981 depth
1984 depth
Original depth (1999)
Original depth (1981)
Original depth (1984)


R27-R28
Normal Pool Level (500 feet NGVD)
Water Depth (feet)
-5
0
5
10
15
20
25
30
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance from Odd Numbered Monument (feet)

Appendix II. Sediment Core Sample Unit Weight Results

Sample number	*Location*	*Sediment layers*	*Unit weight (pounds per cubic foot)*
2	R27-R28	5-8	53.4
4	R25-R26	4-7	37.8
5	R25-R26	16-19	44.4
8	R23-R24	2-5	46.9
9	R23-R24	16-19	56.4
11	R21-R22	4-7	53.8
13	R19-R20	7-10	41.5
15	R17-R18	4-7	44.2
17	R15-R16	5-8	43.9
19	R13-R14	9-12	31.8
20	R11-R12	3-6	29.4
21	R11-R12	12-15	34.3
24	R9-R10	6-9	35.2
26	R7-R8	6-9	41.4
28	R5-R6	10-13	29.1
30	R3-R4	7-10	36.9

Appendix III. Sediment Particle Size Distribution Sample Results

Particle size (millimeters)	*Sample number*				
	PS-1 R27-R28	*PS-3 R25-R26*	*PS-6 R25-R26*	*PS-7 R23-R24*	*PS-10 R21-R22*
0.062					
0.031	87.9	100	100	100	100
0.016	66.2	86	74.4	77.2	92.6
0.008	43.3	60	47.7	56.7	76.2
0.004	30.2	47.6	36.1	44.6	63.1
0.002	25.5	40.3	30.7	37.5	51.4

Particle size (millimeters)	*Sample number*				
	PS-12 R19-R20	*PS-14 R17-R18*	*PS-16 R15-R16*	*PS-18 R13-R14*	*PS-19 R11-R12*
0.062					
0.031	100	100	98.7	100	100
0.016	100	91.5	91.5	100	100
0.008	85.9	75.5	78.5	95.1	98.2
0.004	68.2	64.3	67.5	83.5	84.7
0.002	56.8	55.5	57.2	70.8	70.3

Particle size (millimeters)	*Sample number*					
	PS-22 R11-R12	*PS-23 R9-R10*	*PS-25 R7-R8*	*PS-27 R5-R6*	*PS-29 R3-R4*	*PS-31 R1-R2*
0.062						
0.031	100	100	100	100	100	100
0.016	100	100	94.8	99.4	100	99.9
0.008	95.2	91.7	82.9	90.7	94.7	92.2
0.004	82.1	79	70.6	79.8	84.6	86.3
0.002	66.8	67.2	59.6	67.9	73.8	76.9

APPENDIX E

Highland Silver Lake
Photographs

















































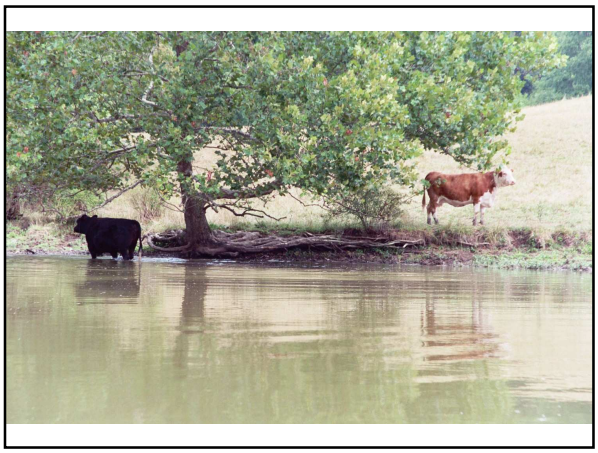






























































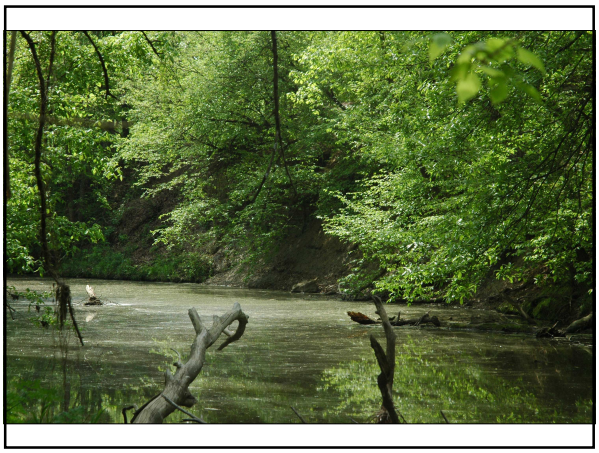






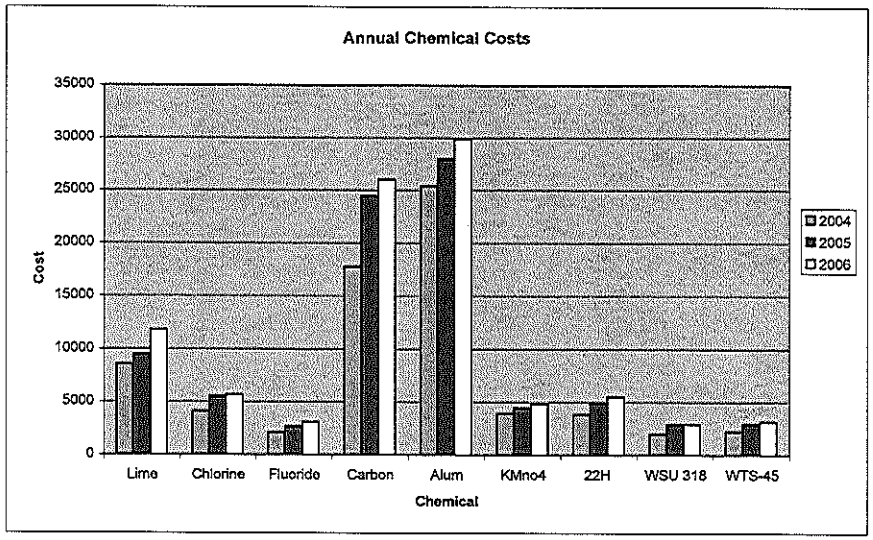


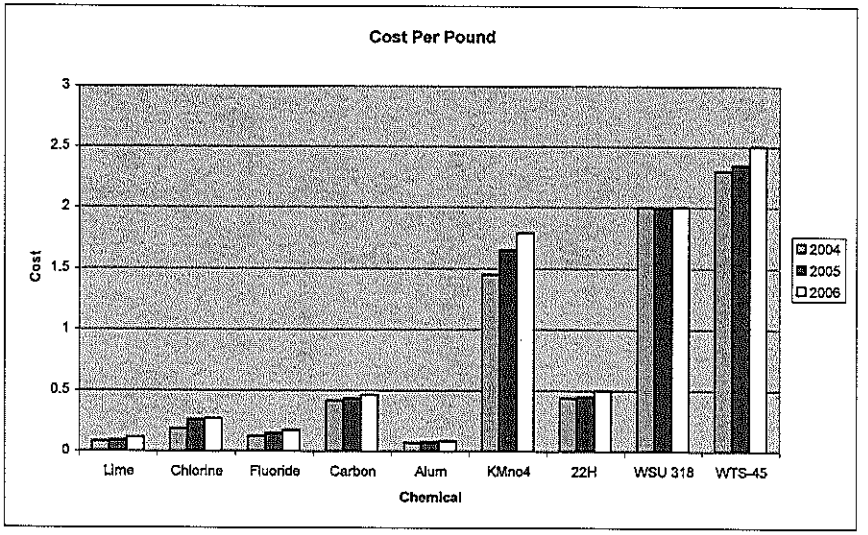




APPENDIX F

Chemical	2004 Actual Annual Usage Jan-Dec	2005 Actual Annual Usage Jan-Dec	Unit	Cost Per Unit 04 - 05	Cost Per Unit 05 - 06	Cost Per Unit 06-07	2004 Actual Annual Cost	2005 Actual Annual Cost	06-07 Projected Annual Cost	Increase 05-06 to 06-07 Budget	% Increase
Lime	104,310	103,100	Pounds	$0.0820	$0.0920	$0.1145	$8,553.4200	$9,485.20	$11,804.95	$2,319.75	19.65%
Chlorine	22,310	21,130	Pounds	$0.1835	$0.2615	$0.2685	$4,093.8850	$5,525.50	$5,673.41	$147.91	2.61%
Fluoride	16,890	17,714	Pounds	$0.1240	$0.1500	$0.1730	$2,094.3600	$2,657.10	$3,064.52	$407.42	13.29%
Carbon	42,800	56,250	Pounds	$0.4150	$0.4350	$0.4625	$17,762.0000	$24,468.75	$26,015.63	$1,546.88	5.95%
Alum	355,496	358,831	Dry Pounds	$0.0715	$0.078025	$0.083235	$25,417.9640	$27,997.79	$29,867.30	$1,869.51	6.26%
KMno4	2,697	2,698	Pounds	$1.45	$1.65	$1.79	$3,910.6500	$4,451.70	$4,829.42	$377.72	7.82%
22H	8,705	10,975	Pounds	$0.44	$0.45	$0.47	$3,830.2000	$4,938.75	$5,158.25	$219.50	4.26%
WSU 318	977	1,441	Pounds	$2.00	$2.00	$2.00	$1,954.0000	$2,882.00	$2,882.00	$0.00	0.00%
WTS-45	965	1,257	Pounds	$2.30	$2.35	$2.40	$2,219.5000	$2,952.78	$3,015.60	$62.82	2.08%
Total							$69,835.98	$85,359.56	$92,311.07	$6,951.51	7.53%


Annual Chemical Costs
35000
30000
25000
20000
15000
10000
5000
0
Cost
Lime
Chlorine
Fluoride
Carbon
Alum
KMno4
22H
WSU 318
WTS-45
Chemical
2004
2005
2006


Cost Per Pound
3
2.5
2
1.5
1
0.5
0
Cost
Lime
Chlorine
Fluoride
Carbon
Alum
KMno4
22H
WSU 318
WTS-45
Chemical
2004
2005
2006

APPENDIX G

217/782-3362

June 4, 2008

Mr. Mark Rosen, Director
Parks and Recreation Department
1100 Main Street
Highland, Illinois 62249

Re: Financial Assistance Agreement #24009
Diagnostic-Feasibility Study of Highland Silver Lake

Dear Mr. Rosen:

This letter is in reference to Financial Assistance Agreement #24009 between the City of Highland and the Illinois Environmental Protection Agency (Illinois EPA). As stated in the Agreement, the Phase I Study is to be developed according to *Appendix B: Requirements for Phase I Diagnostic-Feasibility Studies and Environmental Evaluations* as found in the Illinois Clean Lakes Program (ICLP) financial assistance application package. Furthermore, the information required in Appendix B is to be obtained and presented following the guidance and format provided in the document entitled *Appendix E*: *Protocol for the Conduct of Phase I Diagnostic-Feasibility Studies and Environmental Evaluations.*

The draft report entitled *Phase I Diagnostic/Feasibility Study of Highland Silver Lake, Highland, IL* (Final Draft – May 2006) was reviewed against the above-referenced documents. A detailed summary of the comments associated with the review are attached. In addition, a copy of the reviewed draft report was provided to HDR, Inc. Many additional comments and identification of typographical errors were made within this copy. These comments should be considered when developing the final report document. Once completed, the Illinois EPA requests five hard copies of the report and one electronic version submitted in pdf format.

I want to bring to your attention certain data quality problems that may affect the quality of this report. These problems have been described in detail in the attached, but briefly, the results of a data audit revealed specific data quality problems for certain analytes reported in this study. As a result, we recommend that specific data sets be excluded from analysis in this study and that other data sets be examined in more detail for usability in this study.

These data quality problems are an unfortunate obstacle for completing this report. On behalf of the Illinois EPA, I sincerely apologize for the inconveniences and delays caused as a result of this issue. We are willing to work with you toward a resolution. Please feel free to contact me with questions regarding this letter. I can be reached by telephone at 217/782-3362, or by email at teri.holland@illinois.gov. Thank you for your continued patience.

Sincerely,

Teri Holland
Lakes Unit
Surface Water Section
Bureau of Water

Attachments

cc: Peter Berrini, HDR, Inc.
Ryan Keith, HDR, Inc.
Gregg Good, Illinois EPA
Mike Bundren, Illinois EPA

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Report Name: **Phase I Diagnostic/Feasibility Study of Highland Silver Lake, Highland, IL (Final Draft – May 2006)**

Report prepared by: Cochran & Wilken, Inc.
Report reviewed by: Mike Bundren, Environmental Protection Specialist, Southern Monitoring Unit, Marion Regional Office, Illinois EPA.
A few additional comments have been provided by Teri Holland, Environmental Protection Specialist, Bureau of Water, Illinois EPA.

The above draft document has been reviewed against the document entitled Appendix E: *Protocol for the Conduct of Phase I Diagnostic-Feasibility Studies and Environmental Evaluations.* For the most part, comments were included within the text of the report (see enclosed draft report). Please refer to the comments within the text for additional comments and for identification of typographical errors.

One of the greatest concerns for this report involves the data used; both current and historical. The authors recognize on pg. 17 that "Highland Silver Lake and its watershed have been extensively studied over the last twenty-five years;" however, that fact is not reflected in this report. The only data included in the historical dataset were two years worth of Ambient Lake Monitoring data (1983 and 1993). During the early 1980's there was a comprehensive monitoring effort conducted at the lake and in the watershed as part of the Rural Clean Water Program (RCWP). The Ambient Lake Monitoring Program has been monitoring the lake ever since that time and the City of Highland has actively participated in the Volunteer Lake Monitoring Program since its inception in 1981. An additional effort was made by the City to collect atrazine data as part of a Ciba Geigy Corporation study in the 1990s. All of these monitoring efforts are significant in terms of the historical dataset.

This study was never intended to be a stand-alone study. Rather, since there had been a considerable lag time since the RCWP, this study was intended to build upon the conclusions drawn from that program and to determine what recommendations were still relevant and what may have changed.

There were significant problems with the current dataset as well.

1. Specific Data Quality Issues to consider:

- Subsequent to receipt of this draft report, the IEPA Bureau of Water has received results from a data audit conducted by the IEPA Division of Laboratories for all results reported from the IEPA Champaign laboratory during the years of 2004 and 2005. As a result of this data audit, qualifiers were added to many results. In reviewing the post-audit data for Silver Lake, many results reported for TKN during the study period were qualified with an "X." A list of data qualifiers and their meaning is attached to help with data interpretation; however in general, "X"-qualified data should not be used for any purpose. Therefore, for the study period, the following report requirements may be incomplete or missing entirely: total nitrogen calculations, total nitrogen budget, and limiting algal nutrient discussion. The report must reflect the fact that TKN results for the study period failed to meet specific data quality control criteria or failed to meet data quality objectives and were not used. This comment must also be included in subsequent sections containing missing requirements (e.g.

nutrient budget and limiting algal nutrient).

- In addition to "X"-qualified results, it was determined that the Champaign Laboratory did not perform a distillation step prior to the analysis for ammonia nitrogen. Therefore, results for ammonia nitrogen analyzed during the study period may be subject to interferences. I also recommend that these results not be used in this report. A new data disclaimer reflects the problem with ammonia nitrogen results. Include a copy of the new disclaimer in the report.
- Reported results for certain other analytes (e.g. nitrate + nitrite, total and dissolved phosphorus, and TSS and VSS) also had qualifiers, or combination of qualifiers, that were determined to be unusable for Integrated Report purposes (Sections 305(b) and 303(d) of the Clean Water Act). Although the results were deemed unusable for Integrated Report purposes, these results should be interpreted for usability in this study. This means that the value should be analyzed in terms of method detection and reporting limits, and actual holding times. These post-audit data results will be made available to you for evaluation.

2. p. 21. Regarding the discussion of the General Disclaimer for Illinois EPA (IEPA) data. The paraphrasing of the disclaimer misrepresents the overall intent of the disclaimer. It would be better to state something like the following: Phase I data were received from the Illinois EPA with two disclaimers. In those disclaimers certain analytes from specified time periods were identified as being unfit for use in the Integrated Report pursuant to Sections 305(b) and 303(d) of the Clean Water Act because results failed to meet specific data quality control criteria or failed to meet data quality objectives. Although data were unfit for 305(b) and 303(d) purposes, those data may be useful for other purposes, such as for Illinois Clean Lakes Program objectives. To help determine data usability for this project, data were statistically evaluated by Cochran & Wilken, Inc…… (it's ok to use the language in the disclaimer so that the correct meaning is conveyed). Be sure to provide a detailed description of the statistical tests performed as part of this analysis. Otherwise it is impossible for the reader to decide which data should be included and which should be excluded. For example, the report states that for the Phase I study "most parameters were generally within one (1) standard deviation of their respective historical means," however, I find that most historical means were calculated on two report values (in some cases a single value was used). Since one cannot calculate a standard deviation from a single (or two) data point, I am wondering what standard deviation was used. If the standard deviation used is the one reported in the appendix table for each site, it is important to note what the standard deviation is. In Appendix A, the standard deviation for Secchi Transparency Depth varies from 18.4 inches at site 3 to 35.6 at site 1. With such large variability in values, it would not be difficult to obtain a value that falls within 1 standard deviation.
3. Data qualifiers (as reported in data tables in Appendix A) must be reported with a result value, otherwise they have no meaning.

The following comments are by section:

(a)(1)	**Lake Identification and Location** 1. p. 4. Table 1.What is Subpart B for Applicable Water Quality Standards? 2. Missing the name of the receiving water body.

(a)(2)	**Geological and Soils Description of Drainage Basin** 1. Missing a description of each subbasin within the lake drainage area. 2. Missing soil loss estimates per basin.
(a)(3)	**Description of Public Access** 1. Information is not presented in tabular form (Item B) regarding type of recreational activity, responsible party, capacities, limits on use, etc.
(a)(4)	**Description of Size and Economic Structure of Potential User Population** 1. Information is not presented in tabular or graphic form.
(a)(5)	**Summary of Historical Lake Uses** 1. This section must be expanded. Missing statistics on present and historical usage by type of use 2. Missing an analysis of the relationship between historical trends in lake water quality, uses, and usage. 3. Provide quantities of water used for public water supply needs. Are there livestock or agricultural uses of the lake as well?
(a)(6)	**Population Segments Adversely Affected by Lake Degradation** 1. Provide specific information on population segments adversely affected by lake degradation. Tourism is mentioned, but no specific information provided. Same with public water supply.
(a)(7)	**Comparison of Lake Uses to Uses of Other Lakes in Region** 1. Requirement met
(a)(8)	**Inventory of Point Source Pollution Discharges** 1. Check Alhambra, Livingston and Marine for NPDES permits for small lagoon systems which discharge to Silver Cr. Provide information in tabular form.
(a)(9)	**Land Uses and Nonpoint Pollutant Loadings** 1. Fig. 5, p. 15. Break down agriculture percentage into cropland and livestock.
(a)(10)	**Baseline and Current Limnological Data** 1. p. 18. Identify which uses are impaired and what causes are identified with each impaired use. 2. See general comments above for data used. 3. p. 23. Simplify graph. Graphs are not in color making interpretation difficult. The historic mean for all three sites in May represents a single data point. Other historic means represent two data points (very misleading). See additional comments in text. 4. p. 26. Total suspended solids (TSS) = nonvolatile suspended solids (NVSS) + volatile suspended solids (VSS). 5. p. 27. It looks like TSS may be significantly higher at site 3 than at sites 1 or 2. 6. The font for the dissolved oxygen / temperature data presented in Appendix D is way too small to read. Please enlarge.

(a)(10)	**Baseline and Current Limnological Data (cont.)** 7. p. 40. Do not average TSI values for Secchi Transparency, TP, and chlorophyll. The fact that there is such a large range (> 30 TSI points) between those values indicates that there most likely is not a correlation between chlorophyll a and total phosphorus in the lake. 8. p. 42. Unfortunately, you are not be able to calculate TN:TP ratios for the Phase I sampling year. You would be able to calculate those ratios based on historic data to see if they show the same thing. 9. p. 44. Tables 11 and 12. If results in Tables 11 are from samples collected through the ALMP, they are from surficial grab samples, not core. 10. p. 44 Mitzelfelt's Classification of Illinois Lake Sediment report does not suggest that elevated or highly elevated concentrations are hazardous or non-hazardous. Categories are based solely on plus or minus one or two standard deviations from the mean concentration found in Illinois sediment samples looked at.
(a)(11)	**Biological Resources and Ecological Relationships** 1. p. 61, 62. Clarify the apparent discrepancy on these pages of whether there was increased or decreased algal productivity during the study period. 2. Tables 21, 22, and 24. It would be best not to abbreviate fish species names and index names in these tables. 3. p. 67. There is no explanation for what the advisory at Highland Silver Lake for chlordane in fish tissue means. There is also no explanation for the data presented in table 24. What is the reader to do with these results? 4. p. 68. Fish Consumption Advisories are based on a risk based process developed in the *Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory* (2006 Integrated Report). The process requires the determination of a Health Protection Value (HPV) for a contaminant, which is then used with five assumed meal consumption frequencies. HPVs are used instead of USFDA action levels for mercury, PCBs and chlordane when determining specific fish consumption advisories for those contaminants. 5. There is no mention of the statewide mercury advisory in fish tissue. 6. p. 70. Was a waterfowl or bird survey conducted as part of the study? 7. Macrophyte survey provided no quantitative information. A percent abundance should be provided for each species and an overall macrophyte percentage for the lake should be provided. There is no indication in the text of the report if the abundance of macrophytes in the lake is typical/average or not. 8. Were bacteria samples collected during the study year?
(b)(1)	**Pollution Control and Restoration Procedures** 1. Should be natric, not nitric soils. Correct the errors. 2. p. 79. Under the Identification of Water Quality and Use Impairment Problems, item #5 is not stated as a problem statement. Reword.

(b)(1)	**Pollution Control and Restoration Procedures (cont.)** 3. p. 81. It is much more useful when goals and objectives of a lake management program are specific and quantifiable so that success can be measured and one knows when the objective has been met. 4. Legend for Fig. 28 is illegible. 5. The Rural Clean Water Program (RCWP) determined that suspended sediments were from natric soils with a slope of less than 2%. BMP installation was targeted to those "critical" areas. It would be interesting to see where those critical areas were and if they would still be considered critical areas today. Are any of the bmps installed as part of the RCWP still being managed today? If not, why not? If so, have they helped to improve water quality? 6. p. 93. Will the area above the proposed nutrient/sediment control structure be accessible to boat or foot traffic or could it be used for a wildlife/plant (macrophyte) refuge? 7. See comments in on pages 102 and 104. Statements seem to be contradictory.
(b)(2)	**Benefits Expected From Restoration** 1. p. 122. Table 37. Define uses.
(b)(3)	**Phase 2 Monitoring Program** 1. Requirement met
(b)(4)	**Schedule and Budget** 1. Requirement met
(b)(5)	**Sources of Matching Funds** 1. Requirement met
(b)(6)	**Relationship to Other Pollution Control Programs** 1. Requirement met
(b)(7)	**Public Participation Summary** 1. See comment in text, p. 129
(b)(8)	**Operation and Maintenance Plan** 1. Requirement met
(b)(9)	**Copies of Permits or Pending Applications** 1. Requirement met
(c)(1-14)	**Environmental Evaluation** 1. (c)(11) is missing a discussion of dredging impacts

Recommendations:

1. Incorporate all relevant historical information into this report.

2. Review the current dataset in light of potential new qualifiers.
3. Correct all typographical errors as noted in the report.

DRAFT List of Bureau of Water Data Qualifiers (STORET Remark Codes)
Updated: May 24, 2006

Data Qualifiers Used by IEPA Division of Laboratories

A	Averaged Result (Only to be used for Fish Field Data).
B	Results based upon colony counts outside the acceptable range.
C	Value calculated. Value reported was not measured directly, but was calculated from other available data.
J	Estimated value. The laboratory cannot support the validity of the number. *Note: for Surface Water Section samples, this qualifier should be used when the analyte is detected between the specified reporting limit (RL) and the method detection limit (MDL).*
J1	Surrogate compound recovery limits have not been met
J2	Internal Standard criteria was not met
J3	The reported value failed to meet the established quality control criteria for either precision or accuracy possibly due to matrix effects.
J4	The sample matrix interfered with the ability to make any accurate determination (i.e. oily samples, high mineral content in SOCs, etc.)
J5	"Blank Spike failed high, result was non-detect - impact on data may be minimal"
J6	"Blank Spike failed high – possible high bias or false positive result"
J7	"Blank Spike failed low – possible low bias or false non-detect result"
L	Actual value not known, but known to be greater than value shown. To be used when the concentration of the analyte is above the acceptable level for quantitation. Value shown is the highest acceptable level for quantitation.
M	Presence of material verified (i.e., positive detection). Value is estimated.
Q	Holding time exceeded.
S	Test results provided by outside source.
V	Indicates the analyte was detected in both the sample and the associated method blank and was outside method blank acceptance criteria.
X	Reported value should not be used. Some or all of the quality control data for the analyte were outside acceptance criteria, and the presence or absence of the analyte cannot be determined from the data.
Y	The laboratory analysis was performed on an unpreserved or improperly preserved sample.

ND	Not detected. *Note: For Surface Water Section results, the ND qualifier should be used when the analyte is not detected at the method detection limit (MDL).*
NR	Not reported
_A	Absent
_P	Present
TNTC	Too Numerous to Count (Microbiological samples)
#	Results are not compliant with the NELAC standards
*	Non-NELAP accredited

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Additional Disclaimer for Ammonia Results

More recently discovered and not mentioned in the disclaimer language above, ammonia analyses performed by the Illinois EPA Champaign laboratory and that used the USEPA methd 350.1 (i.e., samples collected 01/01/2004 through approximately July 2006) did not include a distillation step and therefore the ammonia results are subject to inaccuracies attributable to interferences from color or turbidity in the ambient water sample. This fact is not necessarily reflected in the data qualifiers provided with the results.