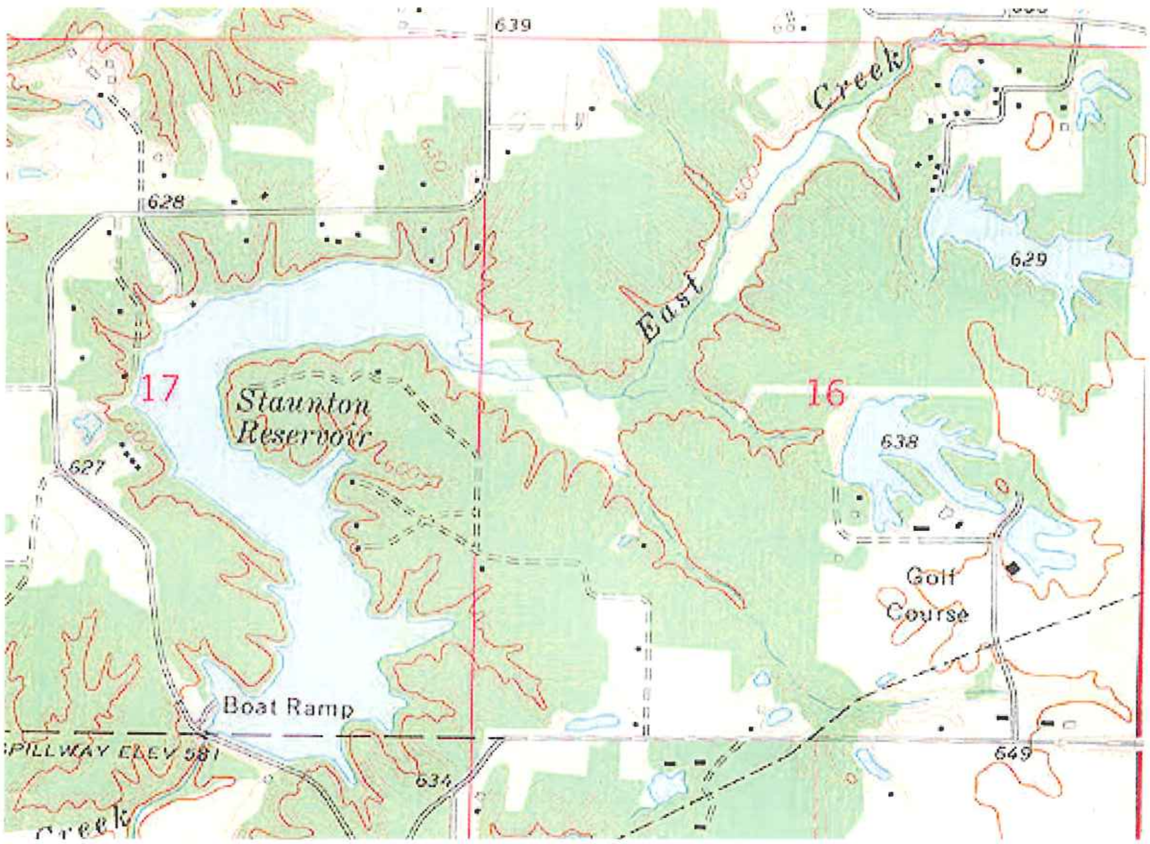
City of Staunton
Staunton Lake



Illinois Environmental Protection Agency

CLEAN LAKES PROGRAM

Phase 1 Diagnostic Feasibility Study

STAUNTON LAKE
CITY OF STAUNTON, MACOUPIN COUNTY, ILLINOIS

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ZAHNISER INSTITUTE
FOR ENVIRONMENTAL STUDIES

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DIAGNOSTIC STUDY

INTRODUCTION

Staunton Reservoir, constructed in 1926, is the principal source of treatable water for the Staunton Community Water Supply (CWS) water treatment facility. The lake is also a recreational resource for Macoupin County and surrounding counties. The lake provides drinking water for over 5,200 people in the City of Staunton and its service area. At 140 acres, the lake surface area receives inflow from a total watershed area of 2,668 acres. Approximately 36% of the watershed is cropland, with the remaining 64% composed of pasture, forest, urban and other land uses. The lake is entirely owned by the municipality of Staunton.

Historic data collected by the Illinois Environmental Protection Agency (IEPA) by way of its Ambient Lake Monitoring Program (ALMP), as well as data available from the local water treatment plant (WTP), indicated elevated levels of nutrients (nitrogen and phosphorus compounds). Eutrophication of the reservoir impacts fish and other wildlife, degrades the quality of raw water available to CWS and raises its operating costs, and reduces aesthetic and recreational benefits of the reservoir. Additionally, shoreline erosion and sedimentation decrease the lake volume and further exacerbate the aforementioned problems. Because the reservoir provides public drinking water and the fact that hunting and fishing are the primary form of recreation there, significant benefit exists in improving the quality of the water and habitat it provides.

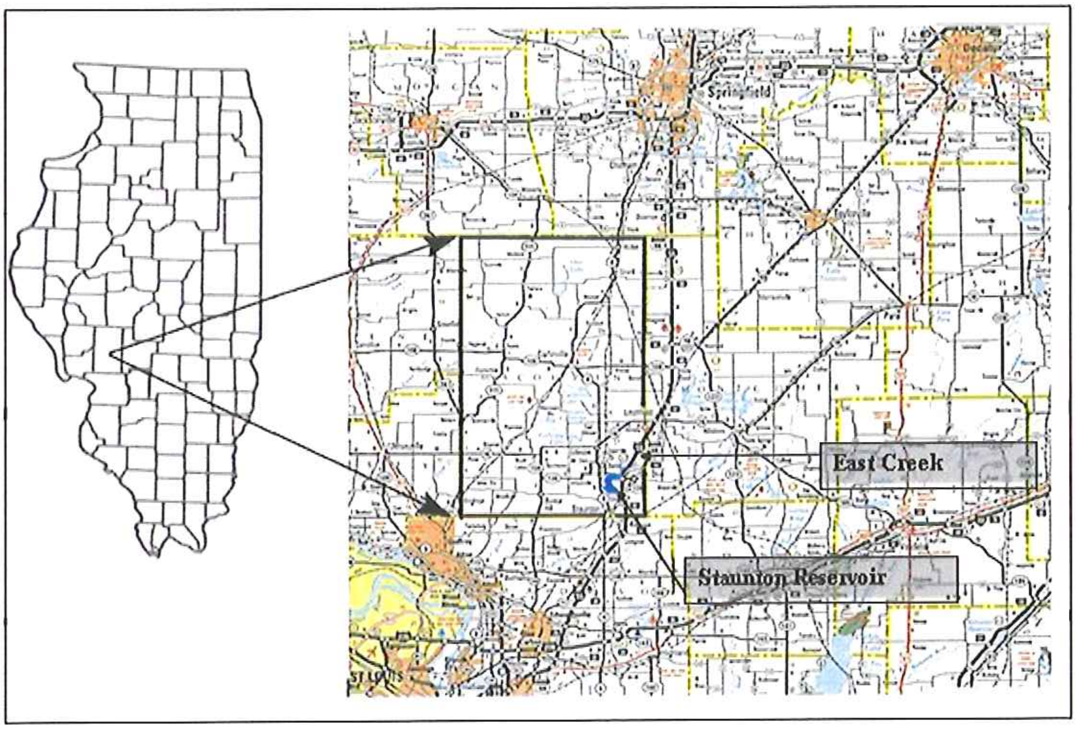
In an effort to develop a comprehensive understanding of water quality issues and to aid in developing scientifically sound restoration measures, the City of Staunton applied for a Phase I Diagnostic / Feasibility Study grant from the IEPA. In December of 2000 the City of Staunton submitted a final grant application to the IEPA to study Staunton Reservoir. The IEPA provided cost sharing for this study through their Clean Lakes Program, funded through the state-sponsored Conservation 2000 program in Illinois.

The City of Staunton subcontracted the data collection, data analyses and report drafting to the Zahniser Institute For Environmental Studies (ZIES), under the terms of an agreement dated May 1, 2001. ZIES also served as the primary liaison to IEPA on behalf of the City of Staunton.

Table 1. Lake Identification and Location

Lake Name	Staunton Reservoir
IEPA Lake Code	RJA
State	Illinois
County	Macoupin
Nearest City	Staunton
Latitude, Longitude of Corners Delineating Lake:	NW: Latitude 39°04' North / Longitude 89°47' West SW: Latitude 39°03' North / Longitude 89°47' West NE: Latitude 39°04' North / Longitude 89°46' West SE: Latitude 39°03' North / Longitude 89°46' West
USEPA Region	5
Major Basin	?07 Upper Mississippi?
Minor Basin	?14 Kaskaskia?
USGS Hydrologic Unit Code	07130012
Major Tributary	East Creek
Receiving Water Body	East Creek
Water Quality Standards	Title 35 Environmental Protection; Subtitle C Water Pollution; Chapter I Pollution Control Board; Part 302 Water Quality Standards

Figure 1. Lake Location



GEOLOGICAL AND SOILS DESCRIPTION OF THE DRAINAGE BASIN

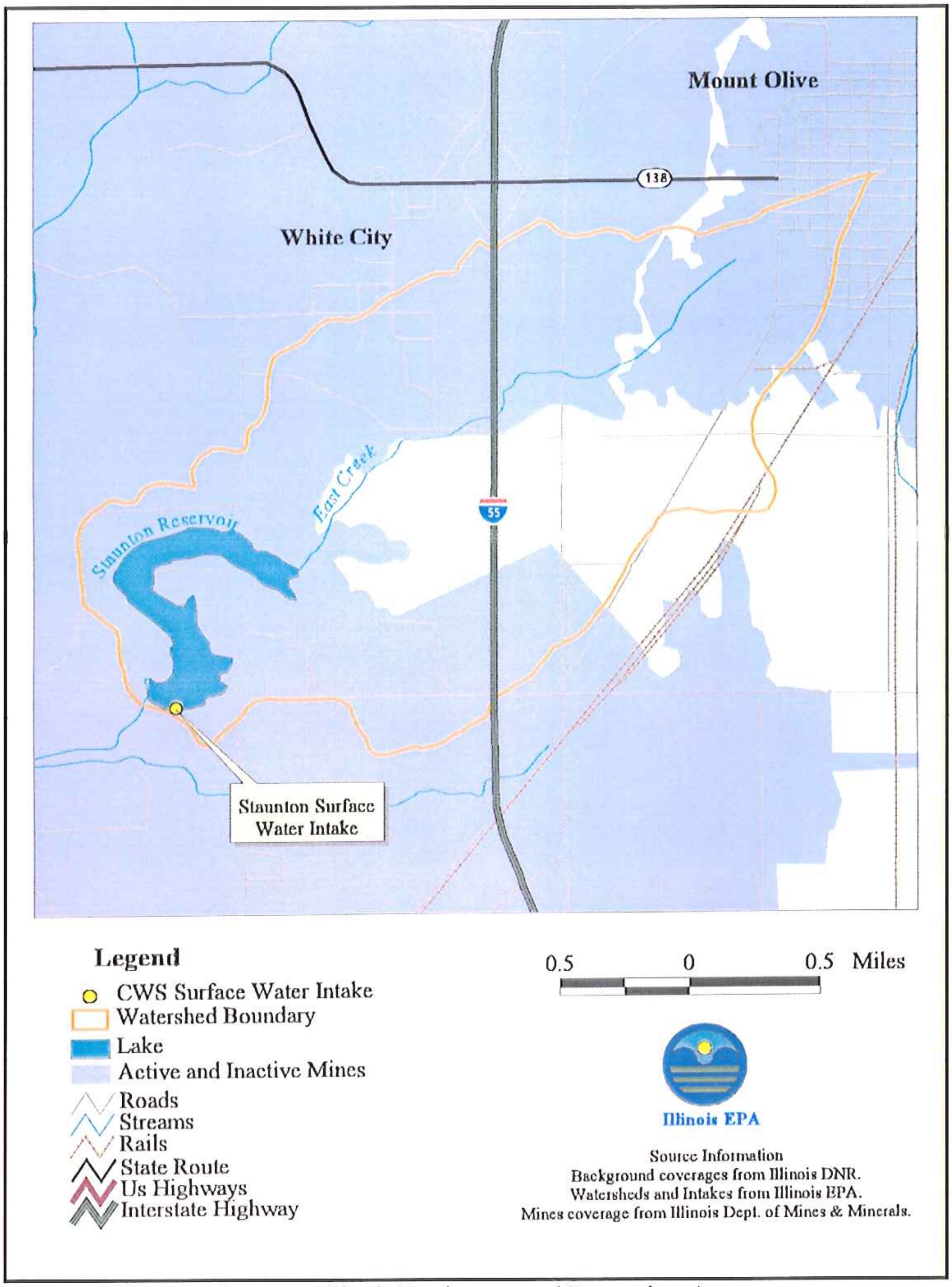
Geology

Staunton Reservoir lies in the eastern portion of the Springfield Plain, in the Illinois Basin of the Central Lowland Province. The area's stratigraphy is a product of the Illinoian glaciation of Pleistocene Epoch. The loess deposits produced by regional glaciation range from 50-150 inches (1.3 m to 3.8 m) thick in the Staunton Reservoir. Glacial till underlying this is Illinoisan moraine, of the Glasford formation. Bedrock in this area is Pennsylvanian in origin, of the Bond, Mattoon, Carbondale and Modesto formations (Figures 3 - 6). The following is taken from United States Geological Folio 220 (Lee, 1926): "The rocks of the Gillespie-Mt. Olive district are of sedimentary origin and consist of nearly horizontal beds of shale, sandstone, limestone, and coal, overlain by unconsolidated surficial deposits which almost entirely conceal them." Coal is and has been mined in the area of the Staunton Reservoir Watershed. Figure 2 illustrates the areas in the watershed that are or have been subject to mining.

Groundwater Hydrology

Sandstone and gravel aquifers are uncommon in the region of Hillsboro Lake. This is attributed to the imperviousness of the shale layers of the bedrock. The following is taken from Woller (1976): "Beneath the glacial deposits are the upper bedrock units of Pennsylvanian age. These rocks consist principally of shale with only thing beds of water-yielding sandstone or creviced limestone. Limited quantities of water for farm and domestic supplies are obtained from these units at depths of 70 - 200 ft below land surface in the extreme northern part and in local areas of the central and southeastern parts of the co9unty. Water contained in these rocks below depths of 200 ft usually is too highly mineralized for most uses." Groundwater exfiltration or infiltration does not appear to have a significant role in the water budget of Staunton Reservoir. Although coal mining has been prevalent in the area, mine tailings do not appear to be a significant source of contamination.

Figure 2. Mining in Staunton Reservoir Watershed



Source: Illinois Environmental Protection Agency

Figure 3. Geologic Map of Illinois

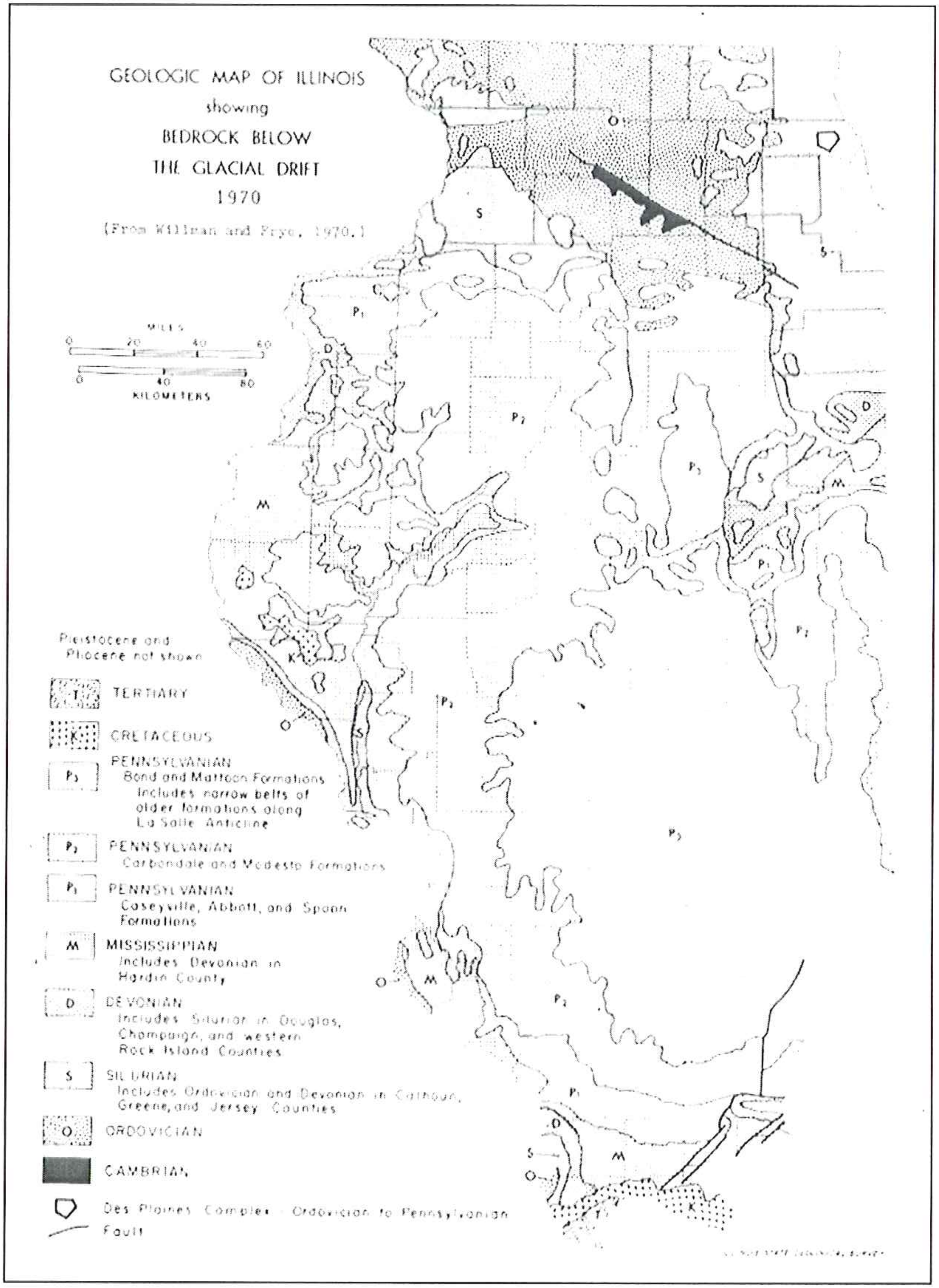


Figure 4. Loess Thickness in Illinois

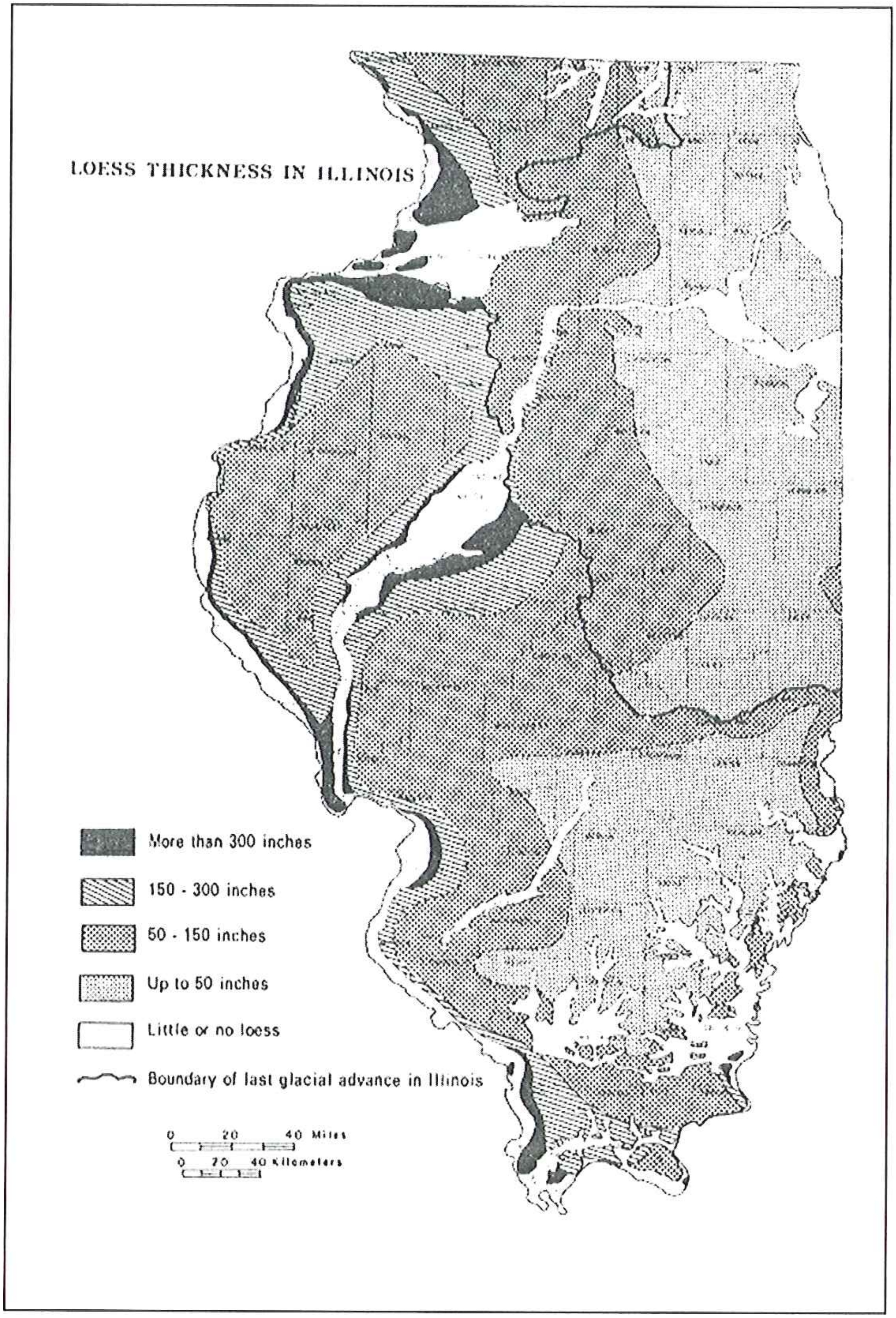


Figure 5, Physiographic Regions of Illinois

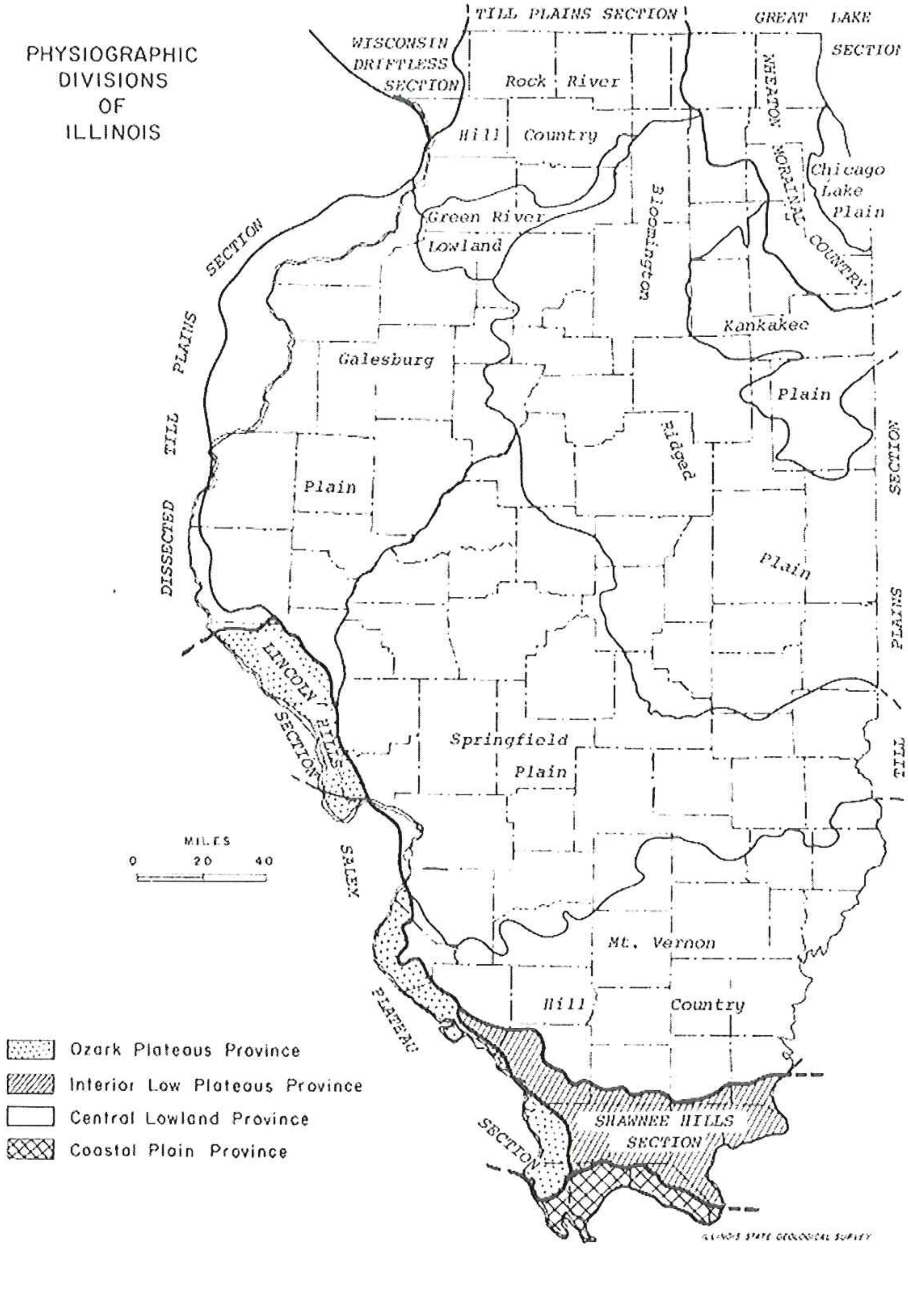
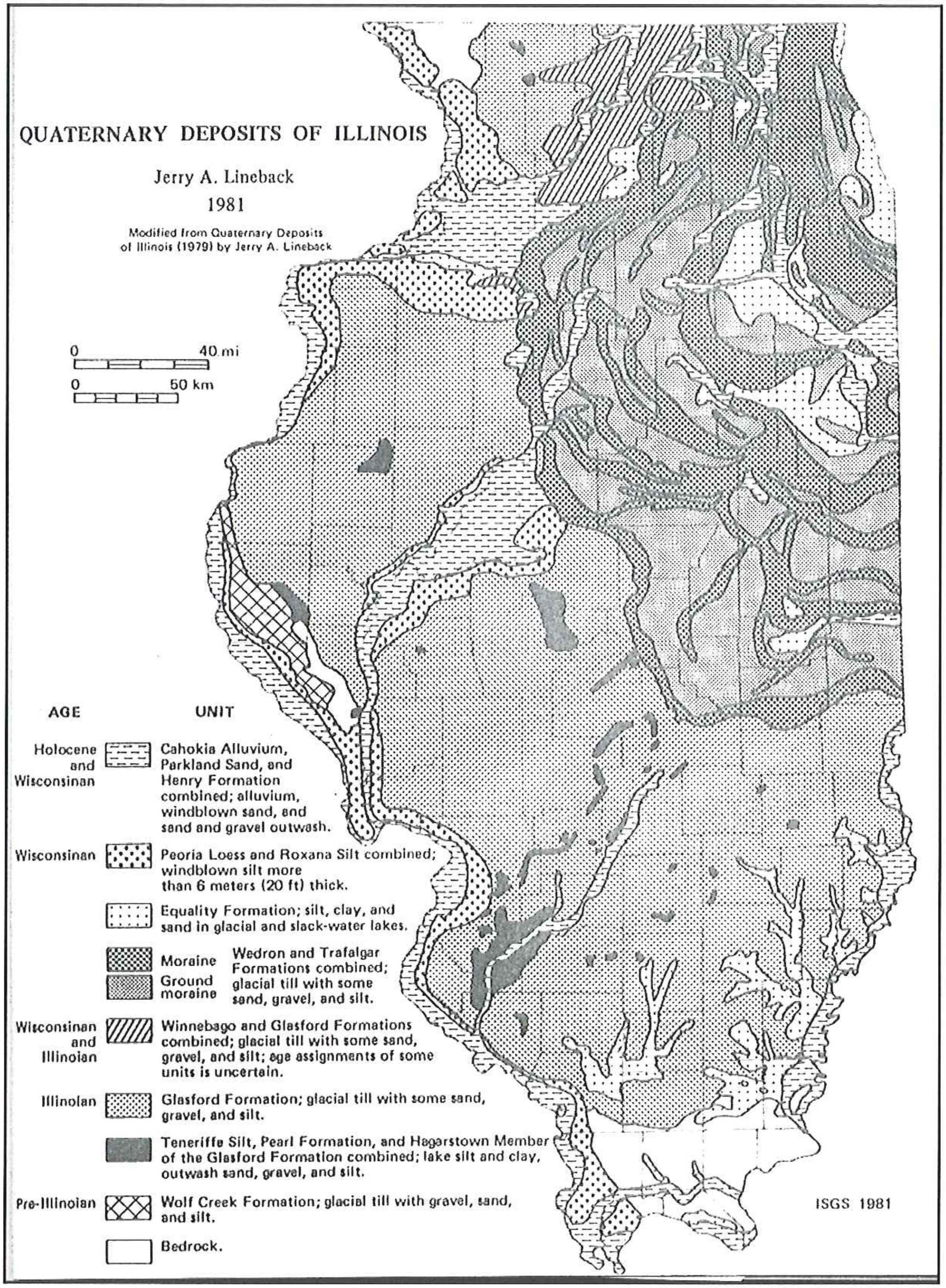


Figure 6, Quaternary Deposits in Illinois



Topography

The Staunton Reservoir watershed is comprised of two sub-basins. For the purposes of this report, these are known as the Staunton North sub-basin and the Stuanton South sub-basin. The general lay of the ground within the Hillsboro Lake watershed is slightly to moderately rolling, with moderately steep to steep areas bordering lake shore and tributaries. The Natural Resources Conservation Service Soil Survey of Macoupin County was used to estimate slope for these sub-basins. The total area of each soil type was measured with a planimeter, and calculated as a percentage. The percent slope for these soil types was then cross-referenced from the soil survey, and the percentage of acres falling into each slope was tabulated. Table 2 presents these results.

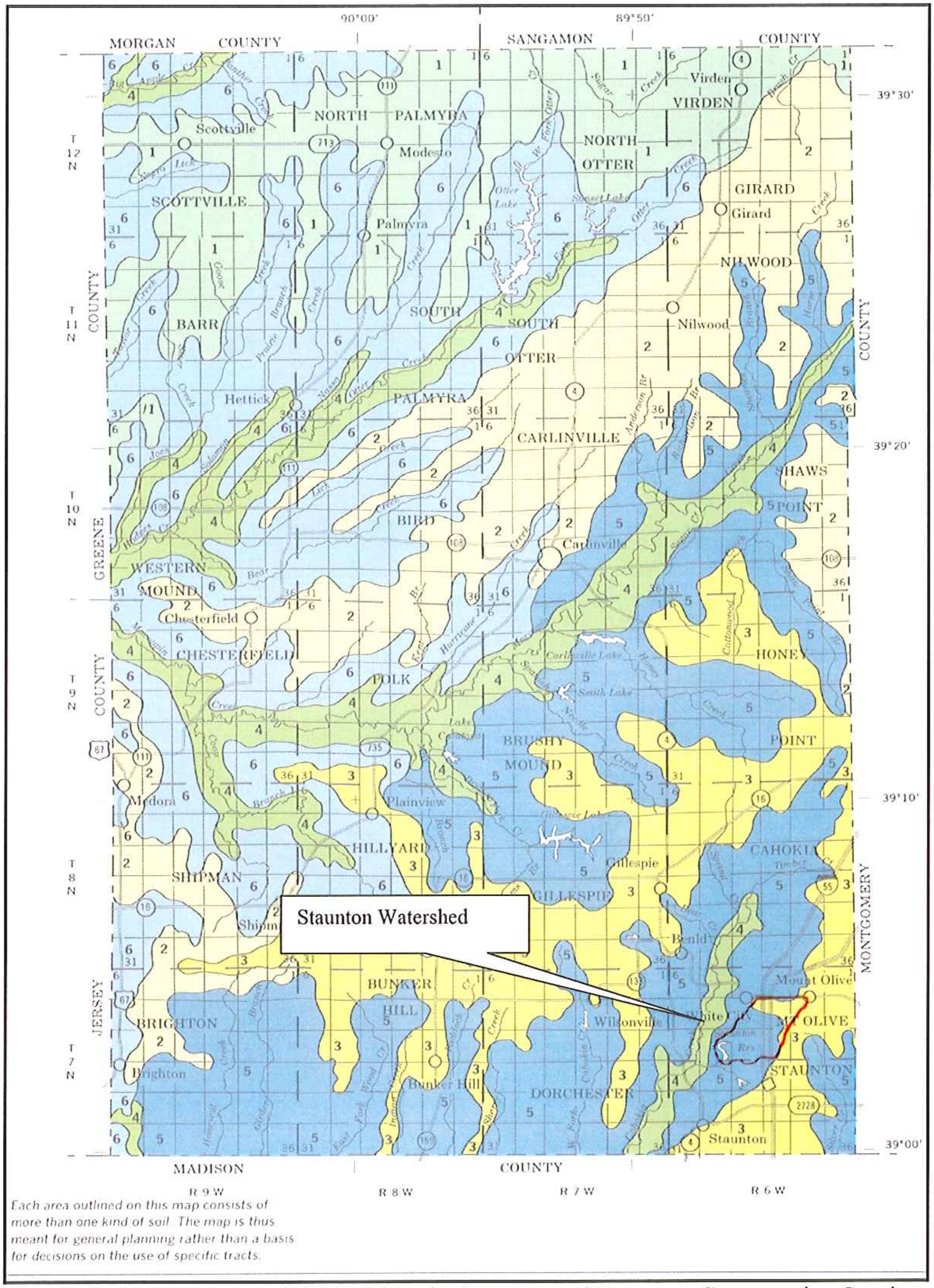
Table 2. Percent Slope

Percent Slope of Staunton Reservoir Watershed			
Slope	Sub-basin Percent Area		Total Watershed Percent Area
	Staunton North	Staunton South	
0-2%	64.37%	28.3%	46.63%
2-5%	13.49%	21.65%	17.69%
5-10%	5.03%	5.32%	5.21%
15-20%	6.88%	0.74%	3.84%
20-30%	6.45%	20.38%	13.52%
30-60%	2.38%	23.59%	13.08%

Soils

There are two major soil associations found in the Staunton Reservoir watershed. The Hickory-Marine-Hosmer Association is described in the Macoupin County Soil Survey as "Nearly level to very steep, well drained to somewhat poorly drained, moderately permeable, slowly permeable, or very slowly permeable soils formed in glacial till or in loess; on uplands." Slopes in this association range from 0 to 60%, presenting moderate to severe risk of erosion. This association comprises all of the Staunton South sub-basin, and approximately 59% of the Staunton North sub-basin. The second soil association found in the watershed is the Herrick-Piasa-Virden Association. It is described in the Macoupin County Soil Survey as "Nearly level, somewhat poorly drained and poorly drained, moderately slowly permeable soils formed in loess; on uplands." Slopes in this association are from 0 to 2%, and present a low risk of erosion. A map of these associations can be found in Figure 7, Soil Map of Staunton Reservoir Watershed.

Figure 7. Soil Map of Staunton Reservoir Watershed



Source: United States Department of Agriculture Natural Resource Conservation Service

SOIL LEGEND

1	IPAVA-VIRDEN ASSOCIATION: Nearly level to gently sloping, somewhat poorly drained and poorly drained, moderately slowly permeable soils formed in loess; on uplands
2	HERRICK-VIRDEN ASSOCIATION: Nearly level, somewhat poorly drained and poorly drained, moderately slowly permeable soils formed in loess; on uplands
3	HERRICK-PIASA-VIRDEN ASSOCIATION: Nearly level, somewhat poorly drained and poorly drained, moderately slowly permeable or very slowly permeable soils formed in loess; on uplands
4	COFFEEN-LAWSON-WAKELAND ASSOCIATION: Nearly level and very gently sloping, somewhat poorly drained, moderately permeable soils formed in alluvium; on flood plains
5	HICKORY-MARINE-HOSMER ASSOCIATION: Nearly level to very steep, well drained to somewhat poorly drained, moderately permeable, slowly permeable, or very slowly permeable soils formed in glacial till or in loess; on uplands
6	HICKORY-ROZETTA-KEOMAH ASSOCIATION: Nearly level to very steep, well drained to somewhat poorly drained, moderately permeable or moderately slowly permeable soils formed in glacial till or in loess; on uplands

Compiled 1987

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U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ILLINOIS AGRICULTURAL EXPERIMENT STATION

SECTIONALIZED
TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

GENERAL SOIL MAP

MACOUPIN COUNTY, ILLINOIS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

PUBLIC ACCESS AND BENEFIT

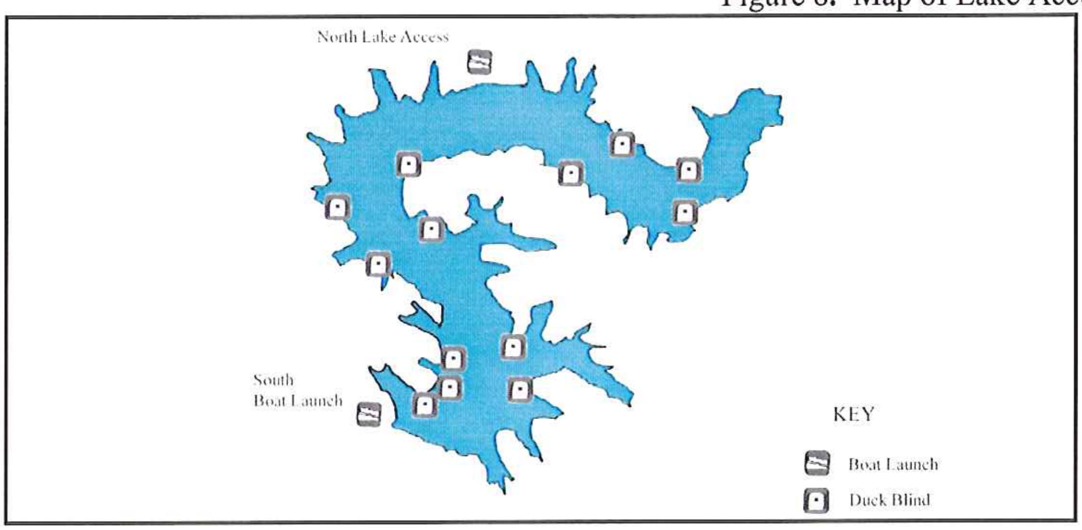
The lake provides substantial benefits to the local and regional population, including a local, safe drinking water supply and a highly valued recreational resource. Staunton Reservoir is a popular fishing location, attracting anglers with its clearer water and plentiful structure. Site-specific limits on catch numbers and sizes are 3 fish no smaller than 15" per day for largemouth bass, 6 channel catfish per day, and one fish of 36" minimum length for muskellunge. Fishing is not allowed during duck and goose hunting seasons.

Waterfowl hunting is also a popular recreational activity on Staunton Reservoir. The City of Staunton has thirteen designated duck blind locations on the lake Figure ?. Locations are available to residents through a lottery system. Drawings are held for vacant spots, with location recipients holding the rights to their location indefinitely. There is no municipal fee associated with this activity.

The public is allowed reasonably controlled access to the lake, including boat permits issued to both local and non-local users. Municipal boat licenses are available to residents for $10 for a boat with no motor, and $20 for a boat with a motor. For non-residents, the fees are $20 for a boat without a motor, and $30 for a boat with a motor. City Ordinances promote recreational uses without causing undue impact on the water supply surrounding ground. Prohibited activities include camping, open fires, and swimming.

The public has access to the reservoir through two boat ramps. The boat ramp and dock located at the southwest end of the lake (Figure ?) has a paved, one-lane ramp and a small wooden dock capable of mooring three to four boats. This access also offers a parking lot measuring approximately 180 ft. long and 75 feet wide. The parking lot area also serves as the turn-around and loading area. At the northwest end of the lake is a primitive boat ramp constructed of gravel. It also offers a small parking lot measuring approximately 100 ft. by 100 ft.

Figure 8. Map of Lake Access



Potential User Population

The Staunton Reservoir user population is comprised mainly of area residents, with additional constituency from the surrounding counties and as far away as the St. Louis metropolitan area. Within 50 miles, the potential user population is estimated to be 2,059,160. Table ? shows the populations of counties with at least half of their area within the 50 (80 km) radius. Table ? shows the populations of cities with populations greater than 10,000 with the 50 (80 km) radius. Population figures were taken from United States Census Bureau statistics. The nearest major metropolitan area near Staunton Reservoir is St. Louis, approximately 35 miles straight-line distance. The St. Louis metropolitan area includes Franklin, Jefferson, Lincoln, St. Louis, St. Charles, and Warren counties in Missouri, and Clinton, Jersey, Madison, Monroe, and St. Clair counties in Illinois with a combined population of 2,603,607. The locations of the cities and counties shown in Tables ? and ? are shown in Figure ?, Location Map. The other lakes within this radius with which Staunton Reservoir shares its potential user base are shown in Figure ?, Lakes Within 80 Km. Information on how Staunton Reservoir compares to these facilities can be found in Table ?, Lake Use Within 80 Km.

Table 3. Potential User Population by County

Counties Accessible Within 50 Mile (80 km) Radius	
County	*Population*
Bond	**17,633**
Christian	**35,372**
Clinton	**35,535**
Madison	**258,941**
Fayette	**21,802**
Greene	**14,761**
Jersey	**21,668**
Macoupin	**49,019**
St. Clair	**256,599**
Calhoun	**5,082**
Montgomery	**30,652**
St. Charles	**296,679**
St. Louis	**1,015,417**
total:	**2,059,160**

Table 4. Potential User Population by City

Cities With Populations ≥ 10,000 Within 50 Miles (80 km)	
City	*Population*
Alton	**30,496**
Belleville	**41,410**
Collinsville	**24,707**
Cahokia	**16,391**
Edwardsville	**21,491**
Fairview Heights	**15,034**
Granite City	**31,301**
O'Fallon	**21,910**
East St. Louis	**31,542**
Kirkwood, MO	**27,324**
St. Louis, MO	**348,189**
Taylorville	**11,427**
St. Charles, MO	**60,321**
Florissant, MO	**50,497**
University City, MO	**37,428**
Wood River	**11,296**
total:	**780,764**

Economic Characteristics of Macoupin County

Table 5, Household Income Comparison

Household Income in 1999					
	Macoupin County		Illinois		U. S.
Households	19,282	100.0%	4,592,740	100.0%	
$0-$10,000	1,787	9.3%	383,299	8.3%	9.5%
$10,000-$14,999	1,526	7.9%	252,485	5.5%	6.3%
$15,000-$24,999	2,800	14.5%	517,812	11.3%	12.8%
$25,000-$34,999	3,131	16.2%	545,962	11.9%	12.8%
$35,000-$49,999	3,813	19.8%	745,180	16.2%	16.5%
$50,000-$74,999	3,816	19.8%	952,940	20.7%	19.5%
$75,000 to $99,999	1,435	7.4%	531,760	11.6%	10.2%
$100,000 to $149,999	724	3.8%	415,348	9.0%	7.7%
$150,000 to $199,999	141	0.7%	119,056	2.6%	2.2%
$200,000 or more	109	0.6%	128,898	2.8%	2.4%
Median Household Income	36,190		46,590		

Figure 9. Household Income Comparison

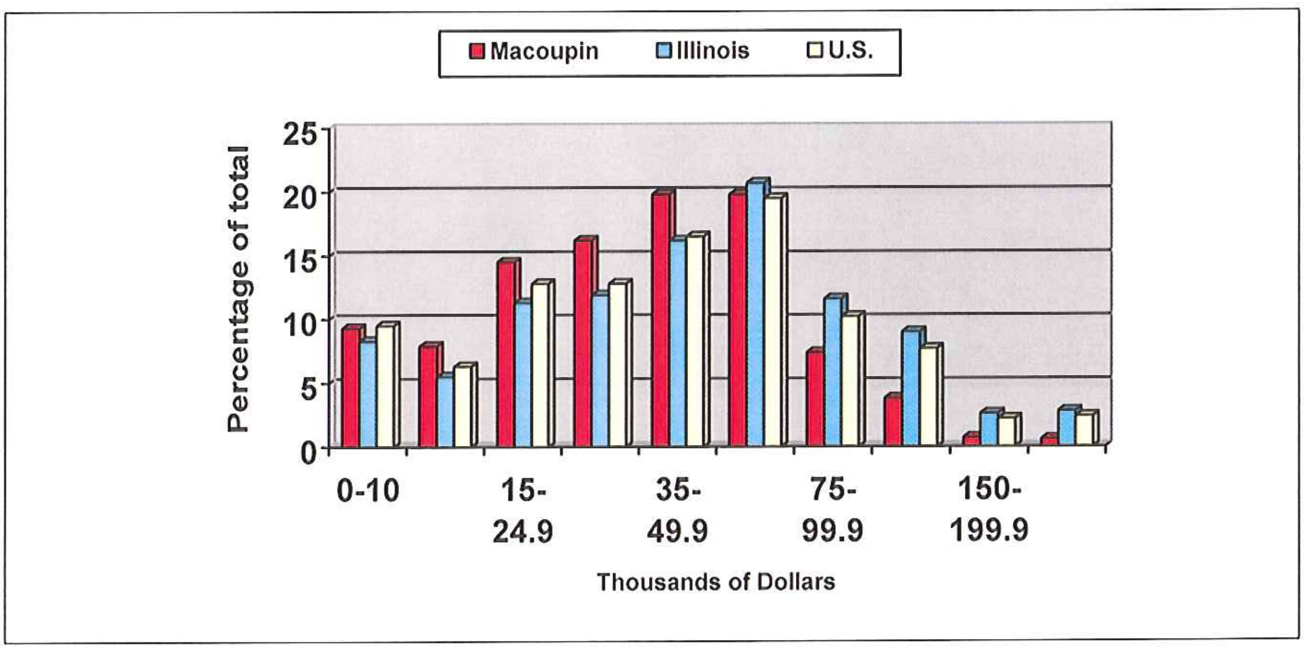


Figure 10, Employment Sectors in Macoupin County

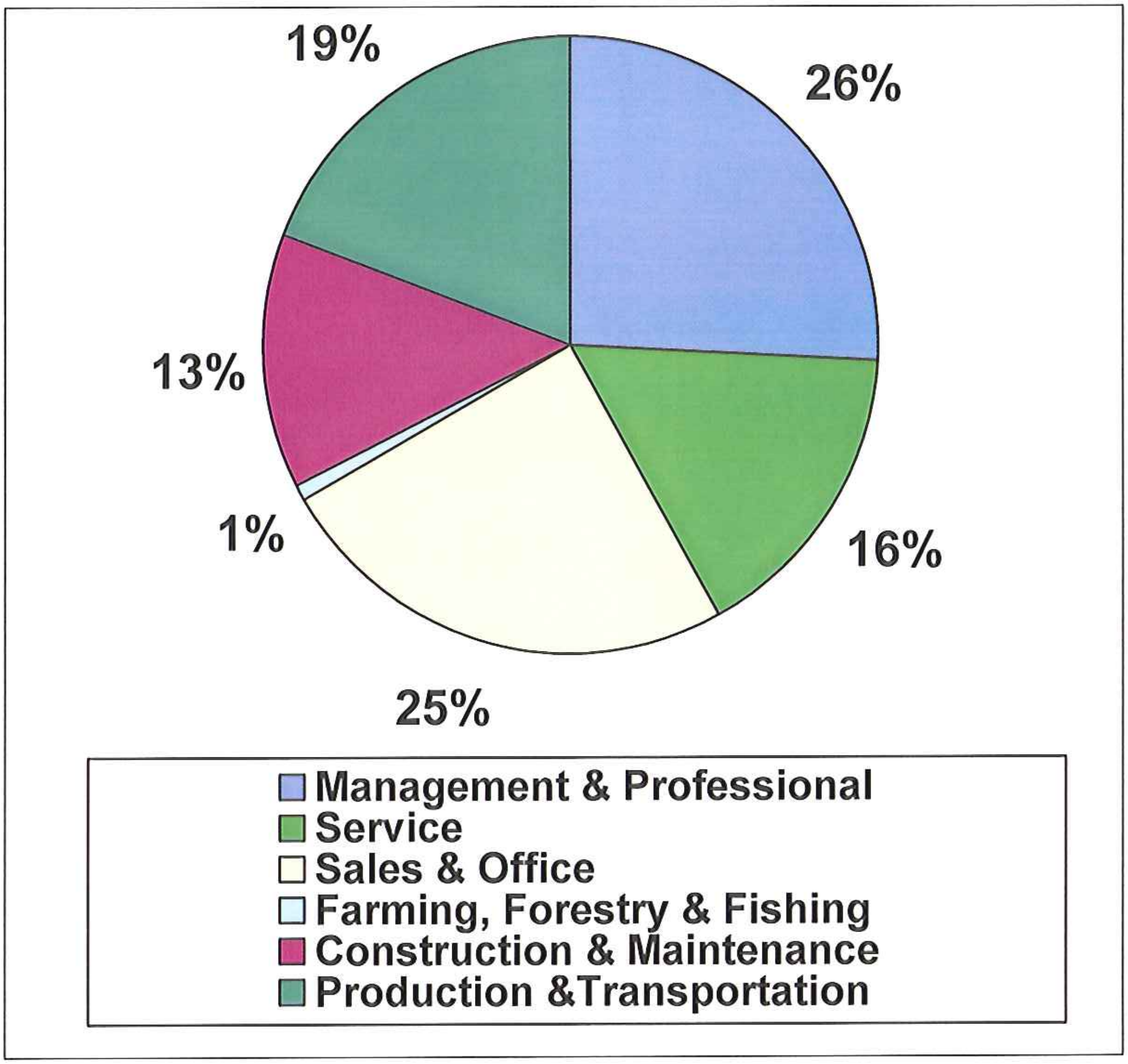


Figure 11. Lakes Within 80 Km

Lakes within 80km of Staunton Reservior

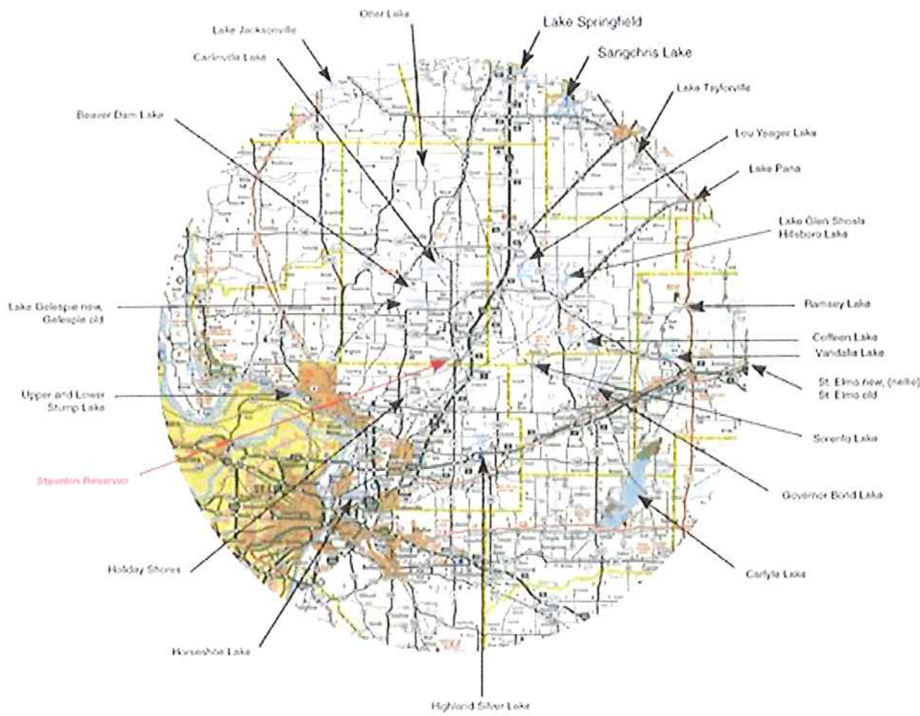


Table 6. Lakes within 80 kilometers of Staunton Reservior

	Code	Acres	Fishing	Boating	Hiking	Swimming	Hunting	Camping	Horseback
Staunton	RJA	84	X	X	X				
Glen Shoals	ROL	1,085	X	X	X			X	
Springfield	REF	3,797	X	X	X	X			
Sangchris	REB	2,321	X	X	X		X	X	
Otter	RDF	723	X	X					
Ramsey	ROE	46	X	X	X	X			
Taylorville	REC	1,286	X	X					
Hillsboro	ROT	94	X	X	X				
Old Gillespie	SDT	71	X	X	X			X	
New Gillespie	SDU	207	X	X	X				
Lou Yaeger	RON	1,304	X	X	X			X	
Coffeen	ROG	1,070	X	X	X	X			
Governor Bond	ROP	775	X	X	X			X	X
Greenville Old	ROY	22	X	X	X				
Highland Silver	ROZA	550	X	X	X				
Sorento	ROZH	11							
St. Elmo New (Nellie)	ROM	59	X	X	X				
St.Elmo Old	ROQ	25		X					
Carlyle	ROA	24,580	X	X	X	X	X	X	
Vandalia	ROD	660	X	X	X				
Beaver Dam	RDH	57	X	X	X	X	X	X	
Horseshoe	RJC	1,890	X	X	X	X	X	X	
Upper, Lower Stump	RDZO	540.7	X	X	X		X		
Pana	ROF	205	X	X					
Carlinville	RDG	168	X	X	X	X		X	
Jacksonville	RDI	442	X	X	X			X	
Holiday shores	RJN	430	X	X					

POPULATION SEGMENTS AFFECTED BY LAKE DEGRADATION

Staunton Reservoir serves the two main functions of public drinking water supply and recreational resource. It is clear that both of these main functions are negatively affected by hypereutrophication of the lake. Pollution sources such as sedimentation and nutrient loading are diminishing lake water quality, which in turn increases water treatment costs. Low visibility, caused by sediments and high nutrient-related algal blooms, negatively affect recreational uses such as boating, skiing as well as fishing.

General Public - City Services

High treatment plant costs and expensive processes reduce the amount of discretionary funds available for other City functions and programs. For instance, the City of Staunton has to treat the lake with copper sulfate in order to clarify the water for treatment. This results in significant expense for the City.

Recreational Fisherman

The lowered visibility and dissolved oxygen levels can have serious consequences for game fish. Low body weight, fecundity (birth rates) and periodic fish kills dramatically reduce the average age and body mass of standing stock. In addition, some areas of the lake are or will become inaccessible to fishing boats.

Lake Residents and Property Owners

Aesthetic effects are common, but are hard to quantify economically. Water discoloration, algal blooms, and odors, related to high nutrient loading, all have aesthetic as well as use-related effects. Shoreline erosion and property damage are direct effects associated with maintenance related needs at the lake. Finally, sedimentation has dramatically reduced or impaired access to boat docks and shoreline areas, which historically were available for boat and canoe access.

LAND USES AND NONPOINT POLLUTION LOADING

Macoupin County Tillage Practices

According to the Illinois Soil Transect Survey summary, 75% of the cropland in Macoupin County is farmed using conservation tillage. Conservation tillage can greatly reduce the amount of soil erosion and help reduce the amount of sedimentation that collects in lakes. Conservation tillage also helps reduce nutrient loading from agriculture runoff.

Table 7 Macoupin County Tillage Practices

	Corn/acres	Soybean/acres	Small grains/acres	Total
Conventional	117381	22324	0	139705
Reduced	37447	60491	0	97938
Mulch	3601	23044	0	26645
No-Till	12242	43928	0	56170
N/A/ Unknown	0	0	12242	12242
Total	**170671**	**149787**	**12242**	**332700**
Percent Conservation Tillage	**31%**	**85%**	**Unknown**	**54%**

Source: Illinois Soil Conservation Transect Survey Summary

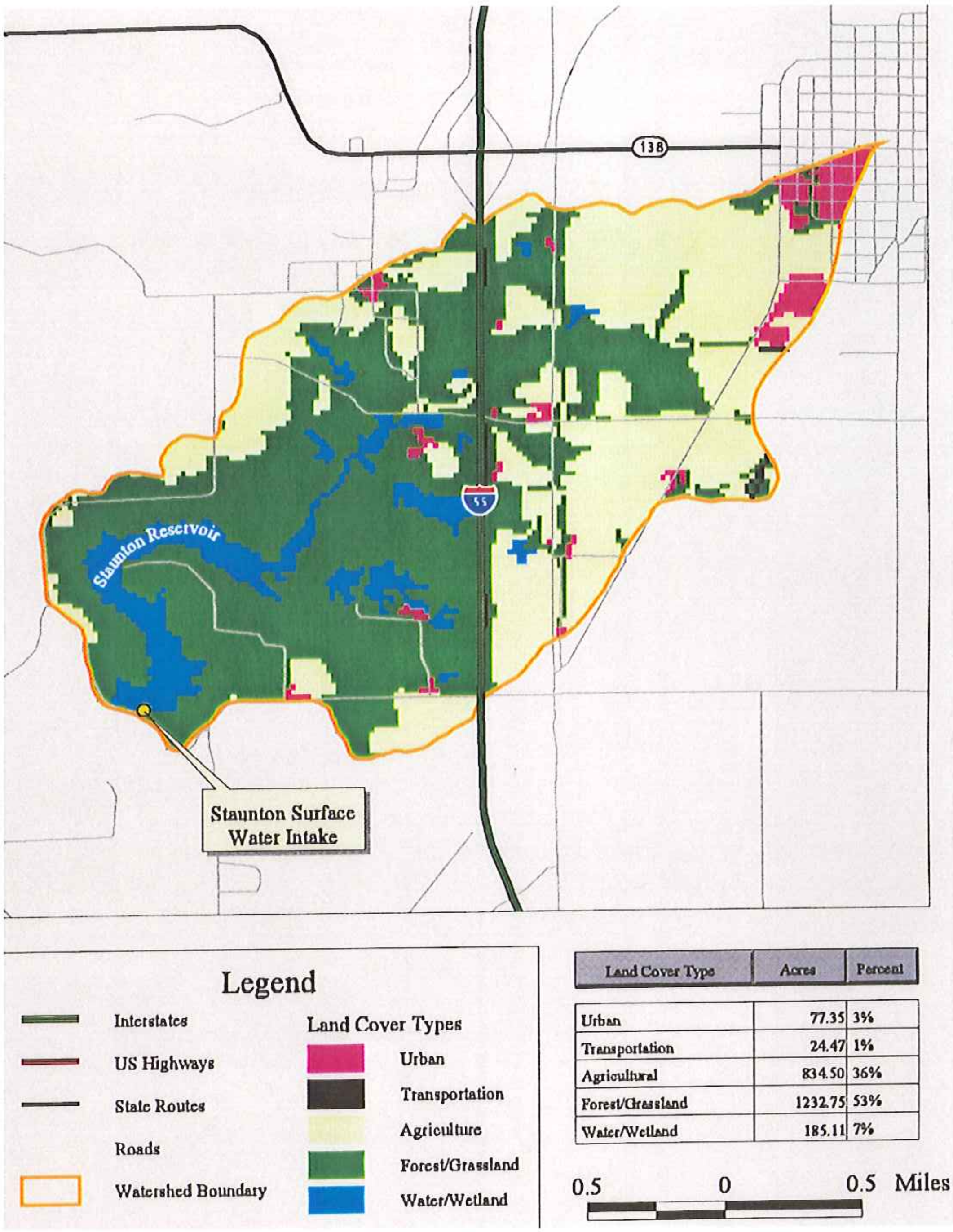
Staunton Reservoir Watershed Land Use

The watershed surrounding Staunton Reservoir is dominated by forest and grasslands. Fifty-three percent of the land is forest and grasslands. Next to forest and grasslands agriculture is the next dominant land use making up thirty-six percent of the land cover. Three percent of the land is urban and one percent is transportation. Runoff from agricultural land can contribute significantly to the sediment and nutrient loads for a lake. Sediments bring fertilizers and pesticides that are deposited into the lake. High amounts of phosphorus and nitrogen run off contribute to the eutrophication of the lake by increasing algae growth. This algae growth also contributes to turbidity and lack of water clarity. Residential activities in the watershed can also contribute to sedimentation and nutrient loading of the lake. Lawn fertilizers from homes as well as nutrients from septic systems contribute to the nutrients entering the lake. Construction projects can add large amounts of sediment to the lake if control structures are not in place. Lake front property that is not properly protected with rip-rap or other erosion control material can contribute significant amounts of sedimentation to the lake.

Watershed Delineation

In an effort to develop a better understanding of the non-point pollution contribution information from the Source Water Assessment Program was used to obtain information about the different types of land use in the watershed (Figure 12).

Figure 12 Watershed Delineation



Land Cover Type	Acres	Percent
Urban	77.35	3%
Transportation	24.47	1%
Agricultural	834.50	36%
Forest/Grassland	1232.75	53%
Water/Wetland	185.11	7%

Source: USGS & IEPA

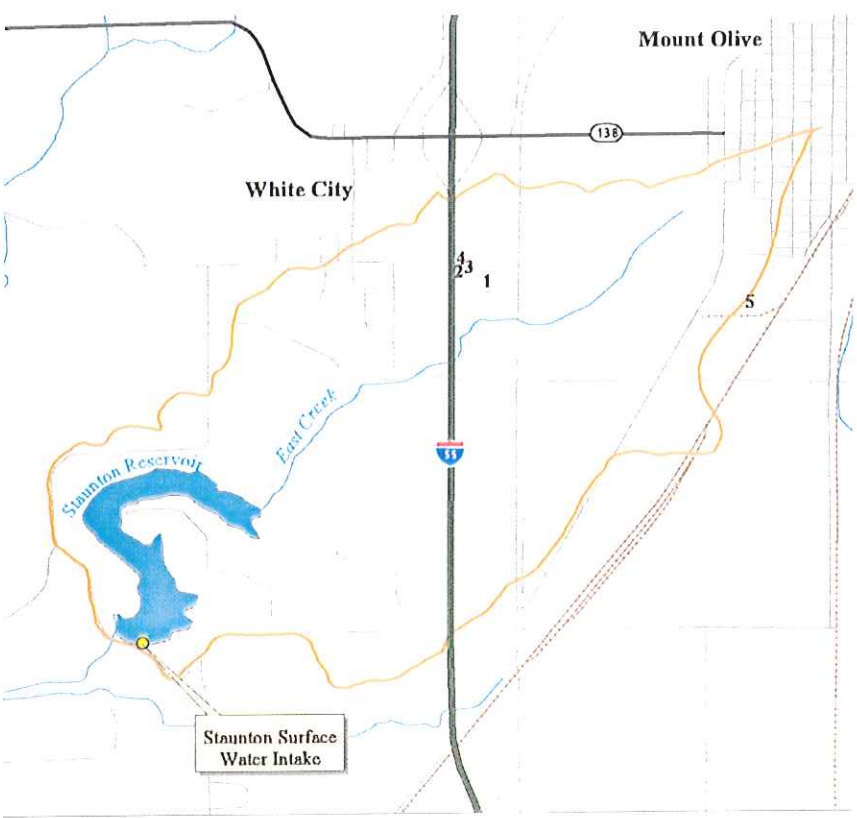
POTENTIAL POINT SOURCE SITES

The IEPA has identified 5 locations in the watershed as being potential point sources for contamination. These are listed in table and their location is identified in figure 13.

Table 8 Potential Point Source Sites

MAP ID	FACILITY NAME	SOURCE TYPE
1	MIDWEST PETROLEUM CO	LEAKING UNDERGROUND STORAGE TANK
2	MT OLIVE SCHOOL DIST 5	RESOURCE CONSERVATION AND RECOVERY ACT[2] SITE
3	HANO BUSINESS FORMS INC	RESOURCE CONSERVATION AND RECOVERY ACT[2] SITE
4	GEORGIA PACIFIC	RESOURCE CONSERVATION AND RECOVERY ACT[2] SITE
5	NEKOOSA PKG MT OLIVE BOX PLANT	RESOURCE CONSERVATION AND RECOVERY ACT[2] SITE

Figure 13 Potential Point Source Site Locations



Illinois EPA

Source Information
RCRA and CERCLA sites obtained from USEPA.
TRI, NPDES, LUST, Cleanups, Landfills, Intakes and Watershed Boundaries from Illinois EPA.

HYDROLOGIC, SEDIMENT AND NUTRIENT BUDGETS

An annual water budget was calculated for Staunton Lake. This is a best estimate of the amount of water coming into and leaving the lake. To determine the amount of water entering the lake a stream staff gauges were placed in the major tributaries as close to the lake as possible. City staff members recorded the stream height on the staff gauge on a daily basis. A cross-section of the stream was measured at the gauge sites. A relationship was established for the area of the cross-section in relationship to staff gauge height. Next, flow measurements in feet-per-second were measured use a Global Water flow measuring instrument. Next, flow and area measurements were combined to establish a relationship between staff height and cubic feet-per-second of water passing the cross-section. Calculations were then used to determine the acre-feet per day of water entering the lake for each measured tributary. In addition to water flowing in from the watershed, rain which fell directly onto the lake surface was calculated from daily rain amounts recorded at the park office just north of the lake.

An additional staff gauge was placed near the outflow of the lake. It was used to determine the height of water flowing out of the lake. This information was used to calculate the amount of water flowing out of the lake over the spillway. The calculations were made using weir equations: $Q=CLH^{(3/2)}$, where Q is the water discharged in cubic feet-per-second, C is the coefficient based on H, L is the length of the outlet (Haan 1994). Evaporation was calculated using 50 years of historical evaporation rates in Illinois (Roberts 1967). Water withdraws by the water treatment plant were also considered as part of the out-flow. All of the in-flow and out-flow data is presented in Table 9.

Table 9 **Hydrologic Budget for Staunton Lake 2001-2002**

Month	In Flow: Tributaries in acre feet	Rainfall in acre feet	Total In	Out Flow: Drinking water withdraws in acre feet	Flow over spillway in acre feet	Evaporation in acre feet	Total Out
May	94	39	133	55	113	55	223
Jun	1414	30	1444	53	0	63	116
July	0	21	21	55	0	71	126
Aug	0	50	50	55	0	60	115
Sep	17	29	46	53	0	40	93
Oct	478	96	574	55	0	27	82
Nov	324	42	366	53	0	13	66
Dec	1417	46	1463	55	381	6	442
Jan	393	0	393	55	103	6	164
Feb	276	0	276	51	175	10	236
Mar	1953	23	1976	55	486	22	563
Apr	499	45	544	53	527	39	619
Total	6865	421	7286	648	1785	412	2845

Estimated Sediment and Nutrient Loading from the Tributaries
Nutrients and sediment can enter the tributaries from a variety of different sources: fertilizers, livestock waste, septic systems, lake sediments, atmospheric sources, wildlife, etc. Nutrients from atmospheric sources, lake sediments, and wildlife are described below.

Nutrients and sediments coming from the tributaries were measured during rain events and concentration relationships were developed between acre-feet of water and measured concentrations of nutrients and sediments. Using daily water volumes calculated from staff gage flow relationship, the nutrients and sediments in kilograms were calculated for each tributary using best fit equations.

Estimated Atmospheric Nutrient Loading
Nutrients in the atmosphere should be considered non-point sources of pollution. These nutrients can enter the lake indirectly by washing in from the watershed or by directly depositing on the water surface. Of the principle nutrients, phosphorus and nitrogen, nitrogen is found in higher concentrations in the atmosphere. Nitrogen is deposited into the atmosphere primarily from burning fossil fuels. Automobiles and power plants are the two main sources of nitrogen. In the area around Staunton Lake, deposits of nitrogen can be expected in the range of 1.3 – 1.8 tons per square mile or an average of 1.55 tons per square mile (Pucket 1994).

Phosphorus is found in much lower concentrations than nitrogen. Phosphorus concentrations in the rural area surrounding Staunton Lake would be found at .03 milligrams of phosphorus per liter of rainwater (Litke 1999). Using these estimates, 339 Kg of nitrogen and 2 Kg of phosphorus are deposited directly onto the Lake surface every year (Table 10).

Estimated Nutrient Loads from Lake Sediment
The lake itself can be a major contributor of nutrient loading. Nutrients bound in the sediments on the bottom of the lake, as well as nutrients in dying plant material, contribute to the nutrient loading of the lake. When the dissolved oxygen level near the bottom of the lake is depleted, phosphorus trapped in the sediments is released. During fall turnover phosphorus , along with nitrogen, is released back into the epilimnion of the lake where it can be used by algae and other plants. This process is referred to as internal loading. The stratification necessary to promote this process occurs in the south end of the lake. The surface area of the lake bottom that would experience anaerobic conditions was determined from the bathymetric map to be 218,700 m^2. Assuming a phosphorus release rate of 15mg/m^2/day (Nurnberg 1984) and a nitrogen release rate of 120 mg/m^2/day (Fillos 1975), approximately 267 kg of phosphorus and 2,134 kg of nitrogen were released from the sediments (Table 10). This nutrient release would generally occur during the five months when oxygen was depleted near the bottom of the lake.

Estimated Nutrient Loads from Birds
Birds can contribute significant amounts of nutrients to the lake when found in large numbers. A bird survey was conducted on Staunton Lake to estimate the number and types of birds using the lake (Table 19). Bird counts on Staunton Lake were not found in large enough numbers to significantly contribute to the lakes nutrient loading

Estimated Sediment from Shoreline Erosion

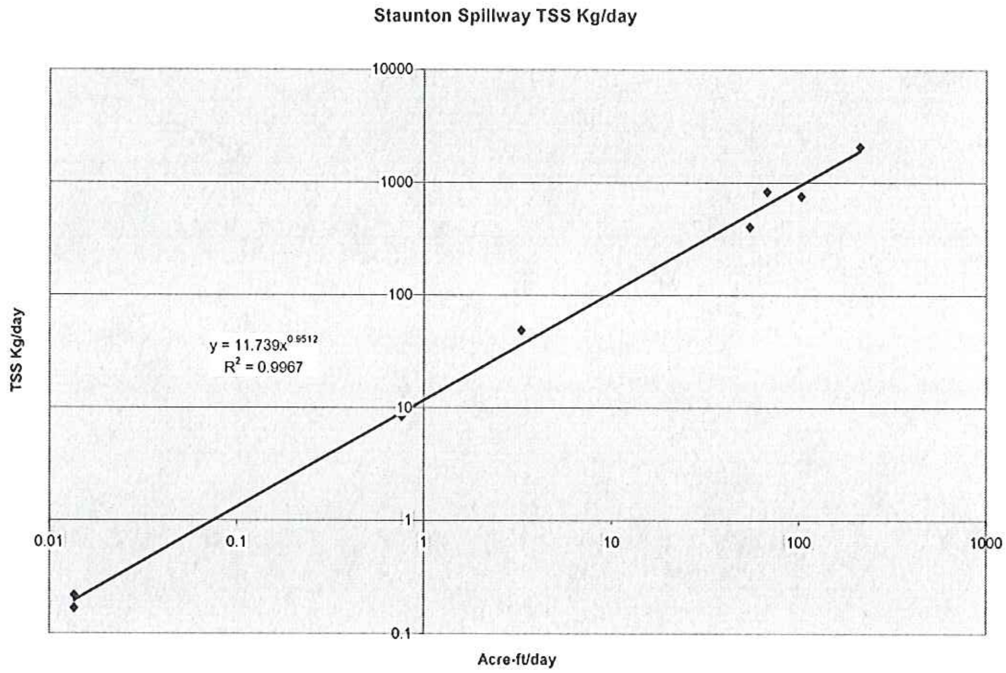
Using information from the shoreline erosion study (Figure 40), calculations were made to estimate the amount of sediment delivered to the lake from shoreline erosion. Using estimates of 40lbs of soil per linear foot entering the lake from areas with severe erosion, 30lbs per linear foot for areas with moderate erosion, and 20lbs per linear foot for areas that are undercut, approximately 22,469 kg per year of soil enters the lake from shoreline erosion (Hill 1994). This amounts to 0.2% of the total sediment entering the Lake (Table 10).

Table 10

NUTRIENT AND SEDIMENT BUDGET FOR STAUNTON LAKE

INFLOW	TOTAL PHOSPHORUS Kg/yr	%	TOTAL NITROGEN Kg/yr	%	TOTAL SUSPENDED SOLIDS Kg/yr	%
TRIBUTARY						
RJA02	4,213	94.0%	31,732	92.8%	11,987,045	99.8%
ATMOSPHERIC	2	0.0%	339	1.0%	N/A	
INTERNAL	267	6.0%	2,134	6.2%	N/A	
SHORELINE	N/A		N/A		22,469	0.2%
Total Inflow	**4,482**	**100%**	**34,205**	**100%**	**12,009,514**	**100%**
OUTFLOW						
SPILLWAY	214	5%	2,847	8%	17,536	0.15%
DRINKING WATER	59	1%	972	3%	5,980	0.05%
Total Outflow	273	6%	3,819	11%	23,516	0.20%
NET LOADING	**TOTAL PHOSPHORUS Kg/yr**	**%Retained**	**TOTAL NITROGEN Kg/yr**	**%Retained**	**TOTAL SUSPENDED SOLIDS Kg/yr**	**%Retained**
	4,209	**94%**	**30,386**	**89%**	**11,985,998**	**99.80%**

Figure 14 Total Suspended solids Loading



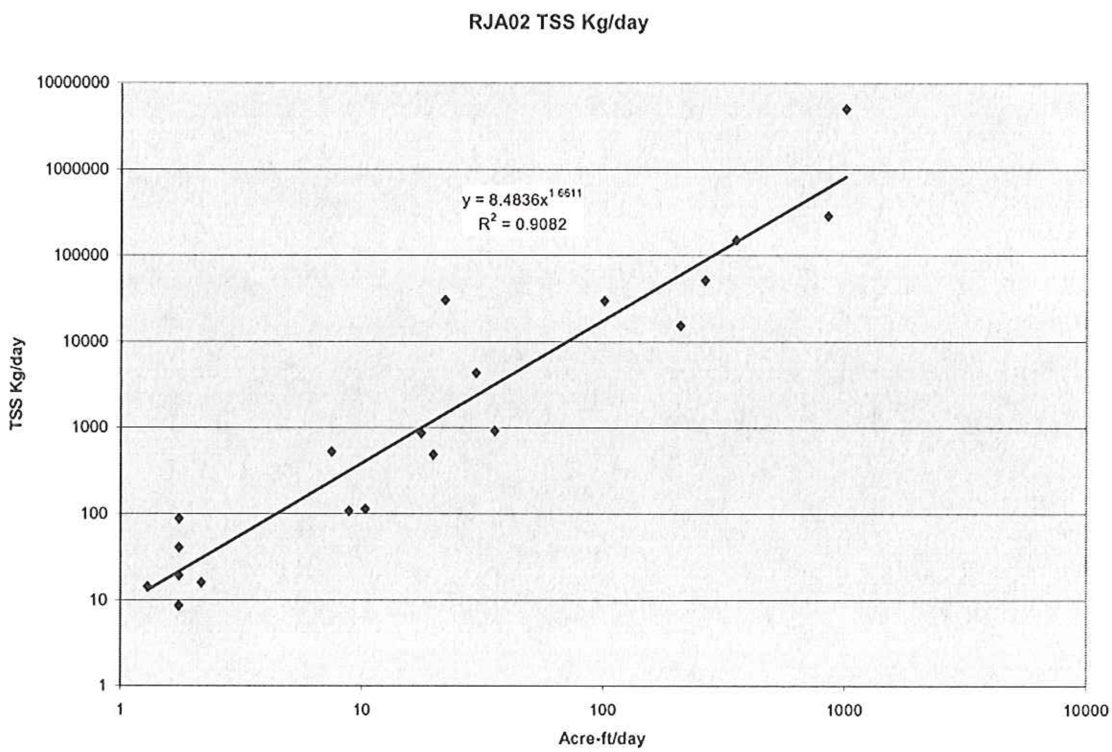
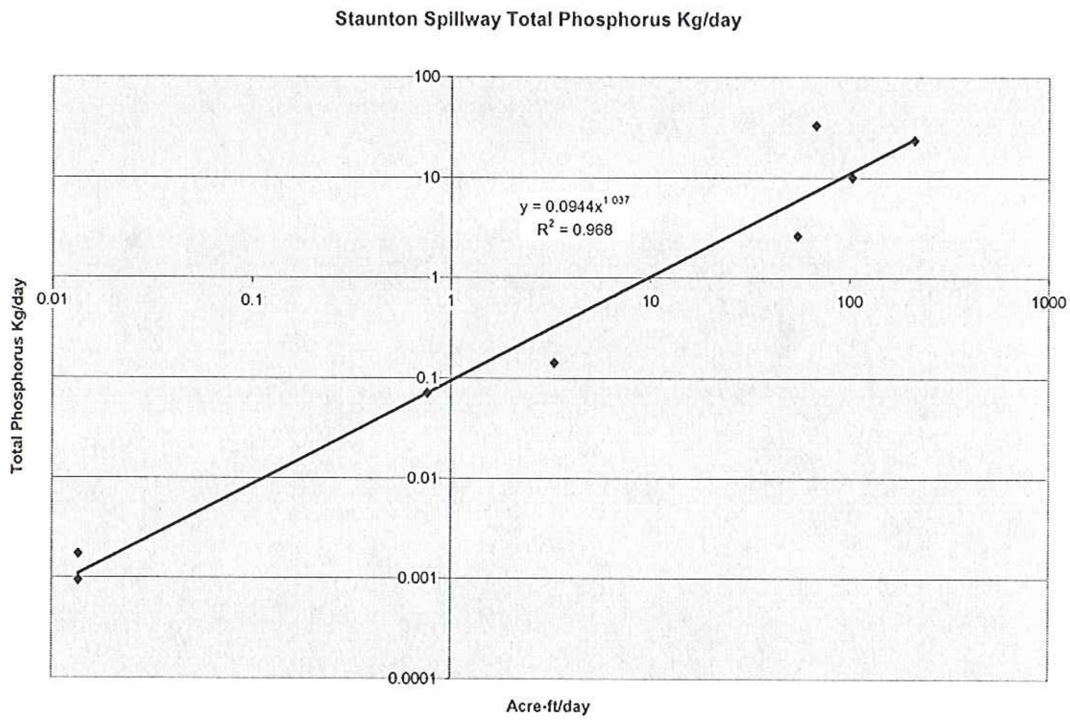


Figure 15 Total Phosphorus Loading



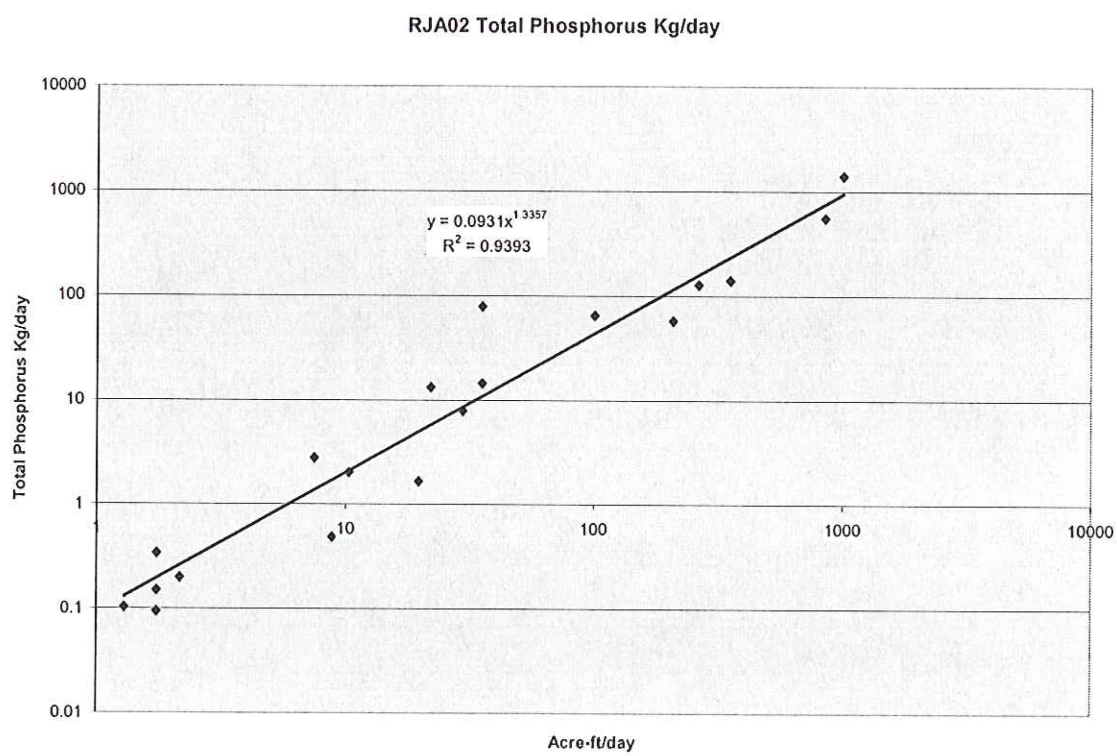
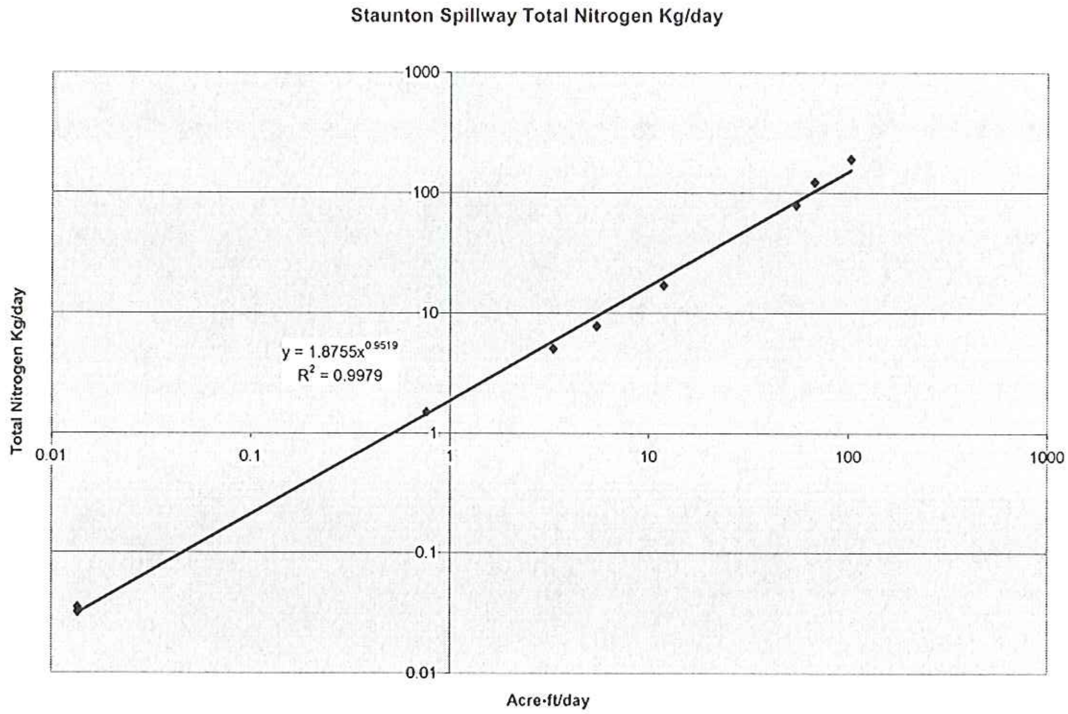
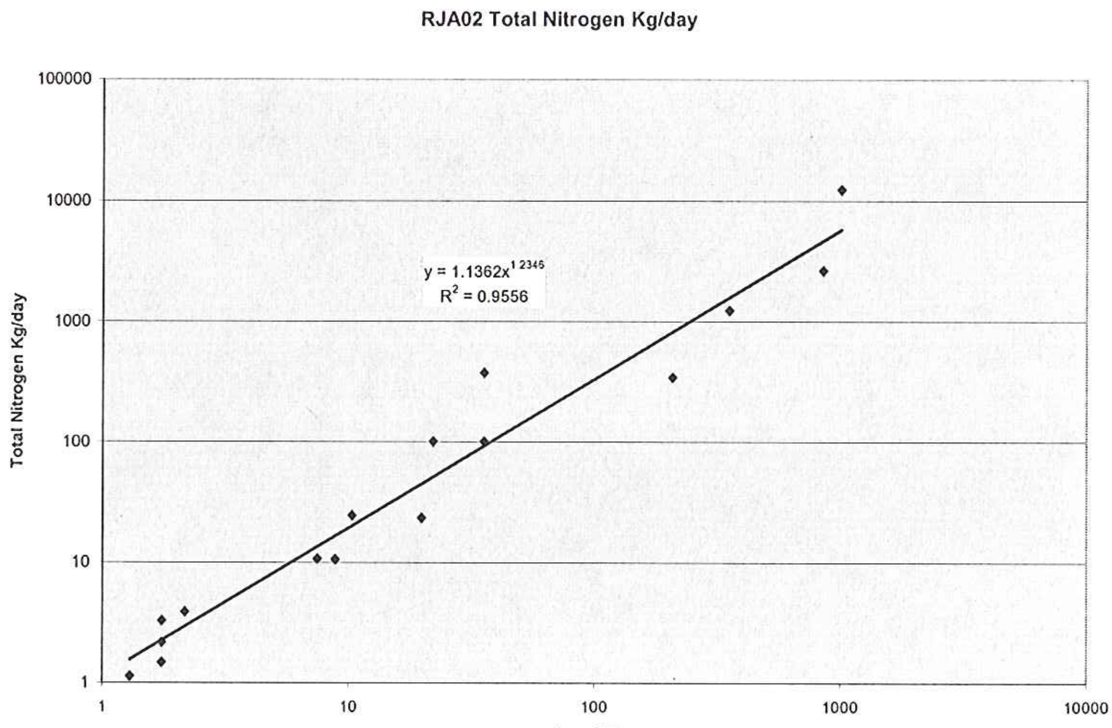


Figure 16 Total Nitrogen Loading





BASELINE LIMNOLOGICAL DATA

Morphometric Data

The physical characteristics of Staunton Lake can be summed up as morphometric data for the lake. This is existing data on size, depth, retention time, etc. (Table 11).

Table 11 Morphometric Data

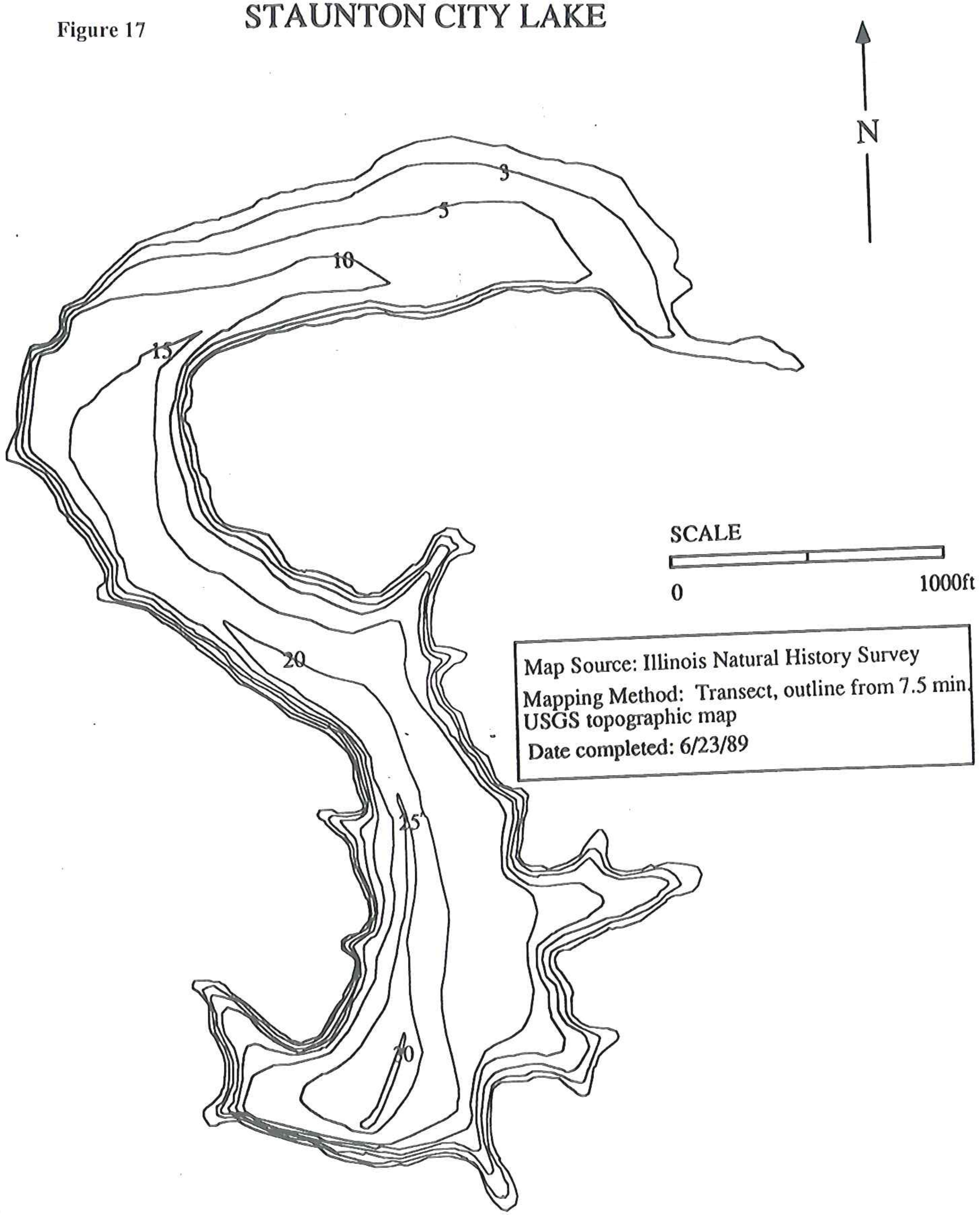
Watershed Area	2,668 acres	1,080 hectares
Surface Area	140 acres	57 hectares
Shoreline Length	26.6 miles	42.8 Kilometers
Mean Depth	14 feet	4.3 meters
Maximum Depth	36 feet	11 meters
Volume	2,000 acre-feet	2,400,000 cubic meters
Retention Time	3.2 years	
Lake Type	Reservoir / Dam & Spillway	
Year Constructed	1926/ raised 9 feet in 1996	

Bathymetric Map

A bathymetric map of the bottom of the lake was obtained with permission from the Sportsman's Connection. This map demonstrates the depths of the lake. The map was produced by the IDNR but was most readily available through the Sportsman's Connection. This demonstrates the bottom contours and depths of the lake (Figure 17).

Figure 17

STAUNTON CITY LAKE



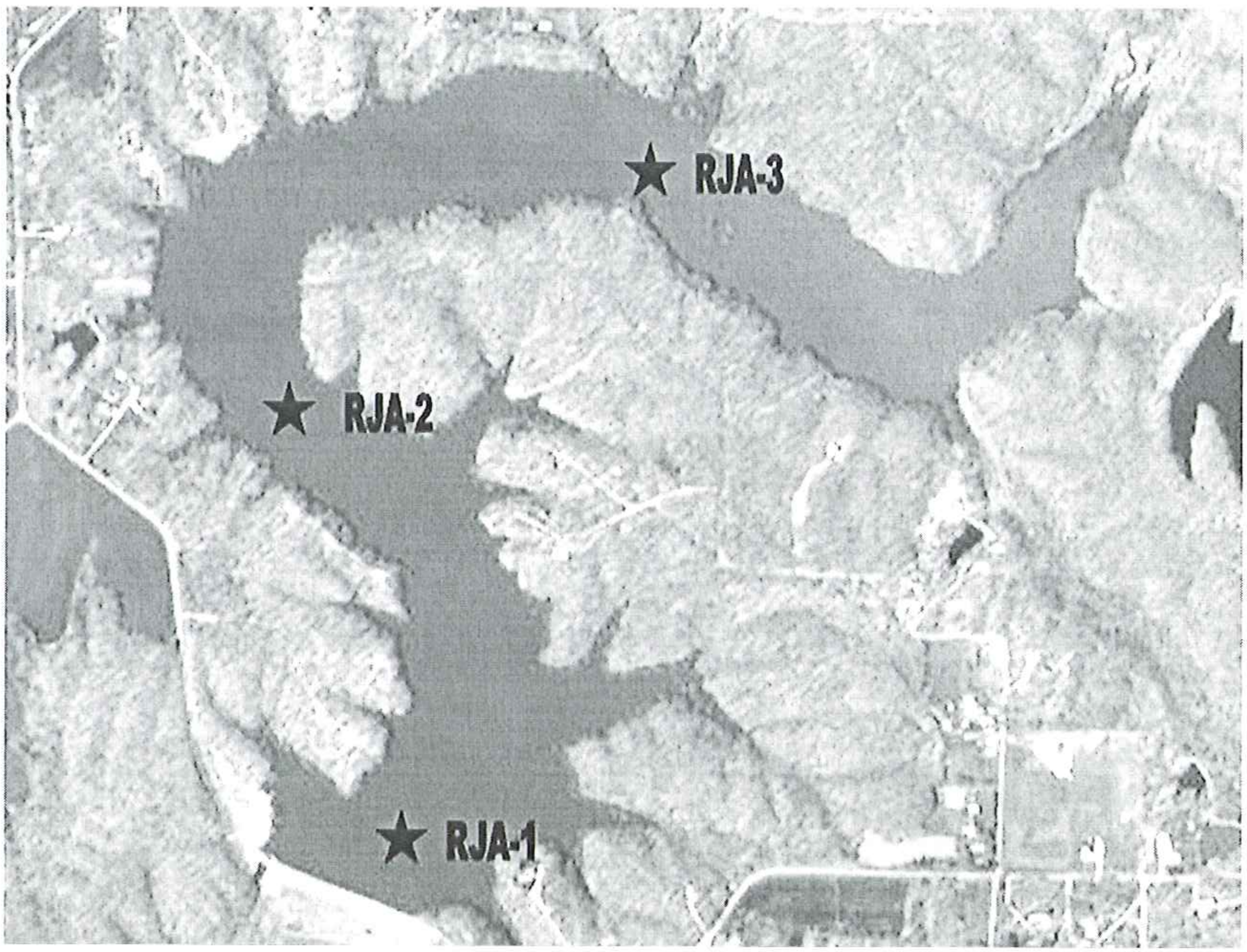
Map Source: Illinois Natural History Survey
Mapping Method: Transect, outline from 7.5 min. USGS topographic map
Date completed: 6/23/89

Lake Monitoring

Under the IEPA's ambient lake monitoring program Staunton Reservoir has been historically sampled at three sites (Table 12): RJA-1t (top sample), RRJA-1m (medium depth) and RRJA-1b (bottom sample) near the spillway; RJA-2 in the middle of the lake; and RJA-3 at the northeast end of the lake.

ZIES staff collected samples at the same historical sites RJA-1t, RJA-1b, RJA-2 and RJA-3. Samples were collected according to IEPA protocol and sent to IEPA laboratories for analyses. Samples were analyzed for total suspended solids (TSS), volatile suspended solids (VSS), total phosphorus, dissolved phosphorus, Kjeldahl nitrogen, nitrate + nitrite nitrogen and ammonia nitrogen. In addition to samples analyzed at IEPA laboratories ZIES staff tested for pH, temperature, and dissolved oxygen on-site using a Hydrolab water quality sampling probe.

Figure 18 Lake Sampling Sites



Historical Data for Staunton Lake

The IEPA has sampled Staunton Lake since 1983 under their Ambient Lake Monitoring Program (ALMP) and this historical data is presented in Table 12 for comparison purposes to 2001-2002 data.

Table 12 Staunton Lake Historical Data 1983-1997

	RJA-1b	RJA-1t	RJA-2	RJA-3
Ammonia Nitrogen				
Minimum	0.1 mg/L (1989)	0.1 mg/L (83, 89)	0.01 mg/L (1996)	0.01 mg/L (1996)
Maximum	4.2 mg/L (1996)	0.27 mg/L (1996)	0.26 mg/L (1997)	0.26 mg/L (1997)
Average	1.24 mg/L	0.1 mg/L	0.11 mg/L	0.10 mg/L
Median	0.55 mg/L	0.1 mg/L	0.10 mg/L	0.10 mg/L
Kjeldahl Nitrogen				
Minimum	0.9 mg/L (1983)	0.25 mg/L (1996)	0.66 mg/L (1996)	0.8 mg/L (83,89)
Maximum	4.2 mg/L (1996)	1.78 mg/L (1996)	2.14 mg/L (1996)	1.99 mg/L (1996
Average	1.9 mg/L	0.95 mg/L	1.03 mg/L	1.0 mg/L
Median	1.3 mg/L	0.82 mg/L	0.85 mg/L	0.89 mg/L
pH				
Minimum	6.5 (1983)	7.5 (1997)	7.4 (1997)	7.2 (1983)
Maximum	7.6 (1996)	8.5 (1989)	8.4 (1996)	8.3 (1996)
Average	7.1	8	7.9	7.8
Median	7.1	8.1	7.9	7.8
Secchi				
Minimum	N/A	24 inches (1983)	20 inches (1996)	12 inches (1989)
Maximum	N/A	208 inches (1996)	96 inches (1996)	60 inches (1996)
Average	N/A	47 inches	45 inches	34 inches
Median	N/A	38 inches	44 inches	30 inches
Chlorophyll a				
Minimum	N/A	8.2 ug/L (1996)	7.2 ug/L (1983)	9.8 ug/L (1983)
Maximum	N/A	102 ug/L (1989)	76 ug/L (1989)	56 ug/L (1989)
Average	N/A	32.0 ug/L	30.6 ug/L	32.2 ug/L
Median	N/A	20.3 ug/L	18.6 ug/L	23.3 ug/L
Nitrate + Nitrite Nitrogen				
Minimum	0.01 mg/L (1996)	0.01 mg/L (1996)	0.09 mg/L (1996)	0.01 mg/L (1996)
Maximum	0.25 mg/L (1996)	0.21 mg/L (89,97)	0.30 mg/L (1996)	0.29 mg/L (1996)
Average	0.09 mg/L	0.09 mg/L	0.12 mg/L	0.10 mg/L
Median	0.10 mg/L	0.10 mg/L	0.10 mg/L	0.10 mg/L
Phosphorus				
Minimum	0.09 mg/L (1989)	0.02 mg/L (1989)	0.03 mg/L (1996)	0.04 mg/L (1996)
Maximum	1.46 mg/L (1996)	0.12 mg/L (1989)	0.13 mg/L (1996)	0.16 mg/L (1996)
Average	0.41 mg/L	0.06 mg/L	0.07 mg/L	0.07 mg/L
Median	0.14 mg/L	0.06 mg/L	0.06 mg/L	0.06 mg/L

Source: EPA STORET Data

CURRENT LIMNOLOGICAL DATA

Suspended Materials

High concentrations of suspended materials in the water can have adverse effects on a lake's health. Suspended materials in the water can have a significant impact on the plant and animal species in a lake environment. Highly turbid waters will decrease the amount of available sunlight, which will reduce the amount of plant material and limit the depth at which plant life will be found. Turbid waters will affect reproduction, eggs and larva and can irritate fish gills and reduce the growth rate of fish and other species.

There are several ways that suspended materials in Staunton Lake were measured. The components measured included: total suspended solids (TSS), volatile suspended solids (VSS), non-volatile suspended solids (NVSS) and Secchi depth. Water samples were collected by ZIES staff and analyzed for TSS and VSS at IEPA laboratories. NVSS was determined by comparing TSS to VSS. Secchi depth was measured and recorded by ZIES staff when water samples were collected.

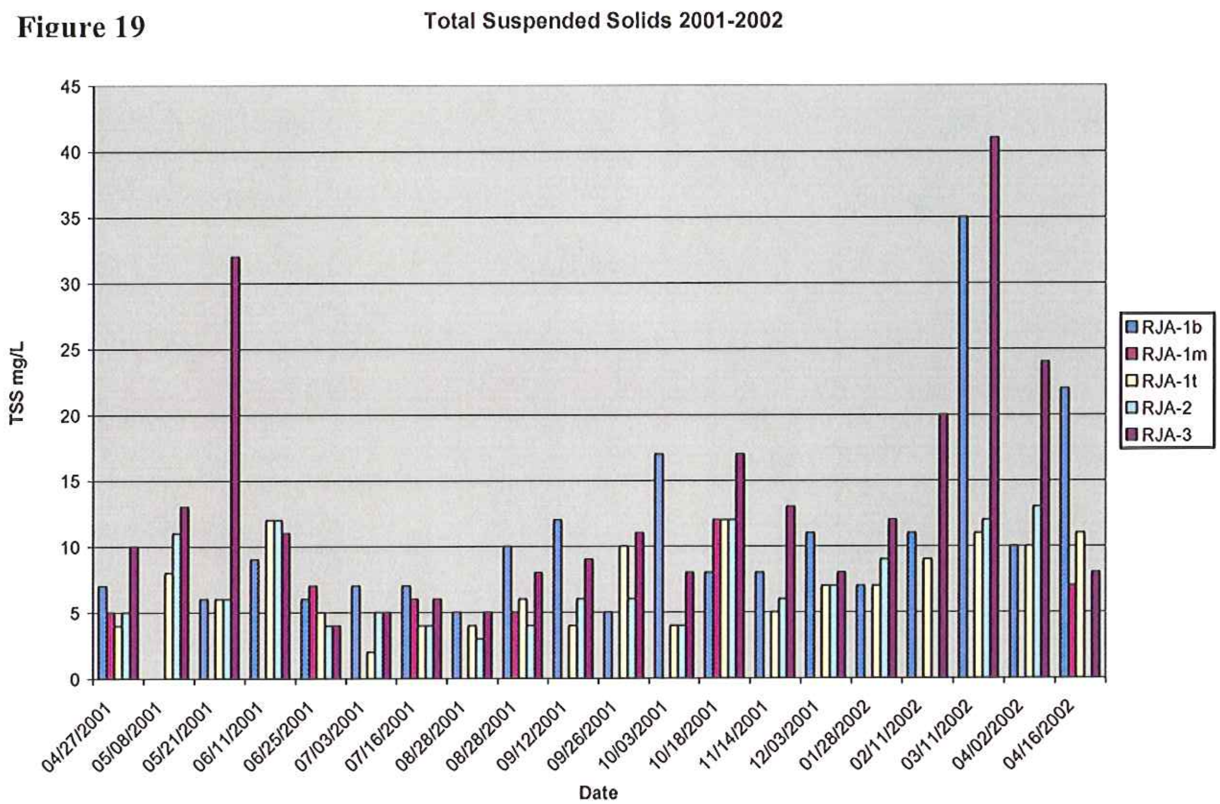
Peak concentrations of TSS, VSS and NVSS corresponded with rain events on several dates (Figures 19,20,21). In Staunton Lake, rainfall runoff most likely accounts for most of the suspended materials and turbidity in the lake water. Fish, especially carp, can also stir the sediments near the bottom of the lake adding to the turbidity. RJA-3 had more turbid waters than the other sites in the lake (Figure 21). This site is located on the headwaters of the lake. Such an area would experience highly turbid waters after a rain and would be more susceptible to alga blooms from nutrient runoff.

The relationship between VSS and NVSS gives an indication of the source of suspended solids in the water. Both VSS and NVSS levels were relatively low and indicate good water quality. NVSS tended to be higher in the spring months. This distribution is likely an indication that soil washing in from the tributaries or bottom sediments being stirred up are more significant contributors of the turbidity than algae in the spring and algae growth seems to be more significant in the summer months.

Total Suspended Solids

Total suspended solids (TSS) is a measurement of all of the suspended material in the water including both organic and inorganic materials. Total suspended solids would include materials such as algae, decaying plant materials, minerals, and soil particles. Total suspended solids peaked 3/11/2002 at 41mg/L at RJA-3 on the north end of the lake. At the south end of the lake, site RJA-1b, the TSS peaked at 35mg/L also on 3/11/2002. (Figure 19).

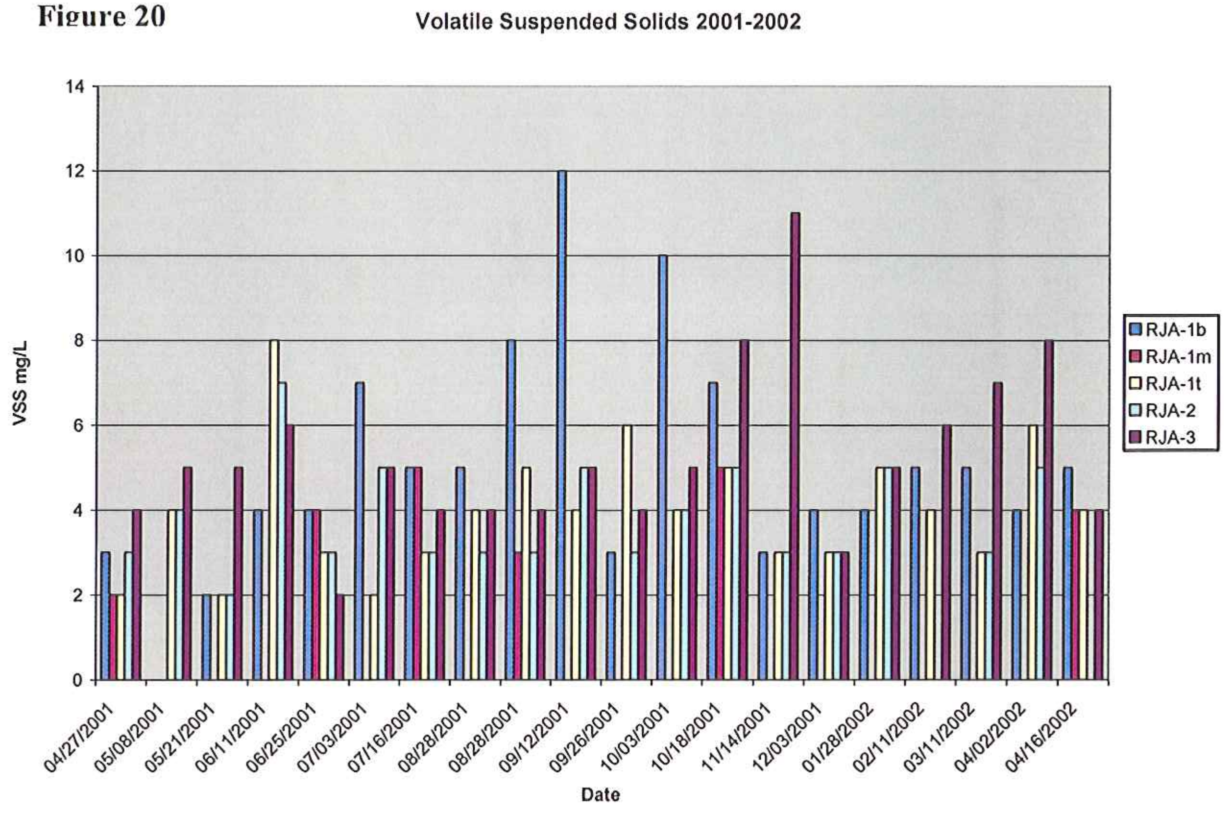
Figure 19



Volatile Suspended Solids

Volatile suspended solids (VSS) is a measurement of only the organic material suspended in the water. This material would include algae, decaying plant material and all other organic material suspended in the water (Figure 9). VSS peaked 9/12/2001 at 12mg/L at RJA-1b on the south end of the lake. At the north end of the lake, site RJA-3, the TSS peaked at 11mg/L also on 11/14/2001. (Figures 20).

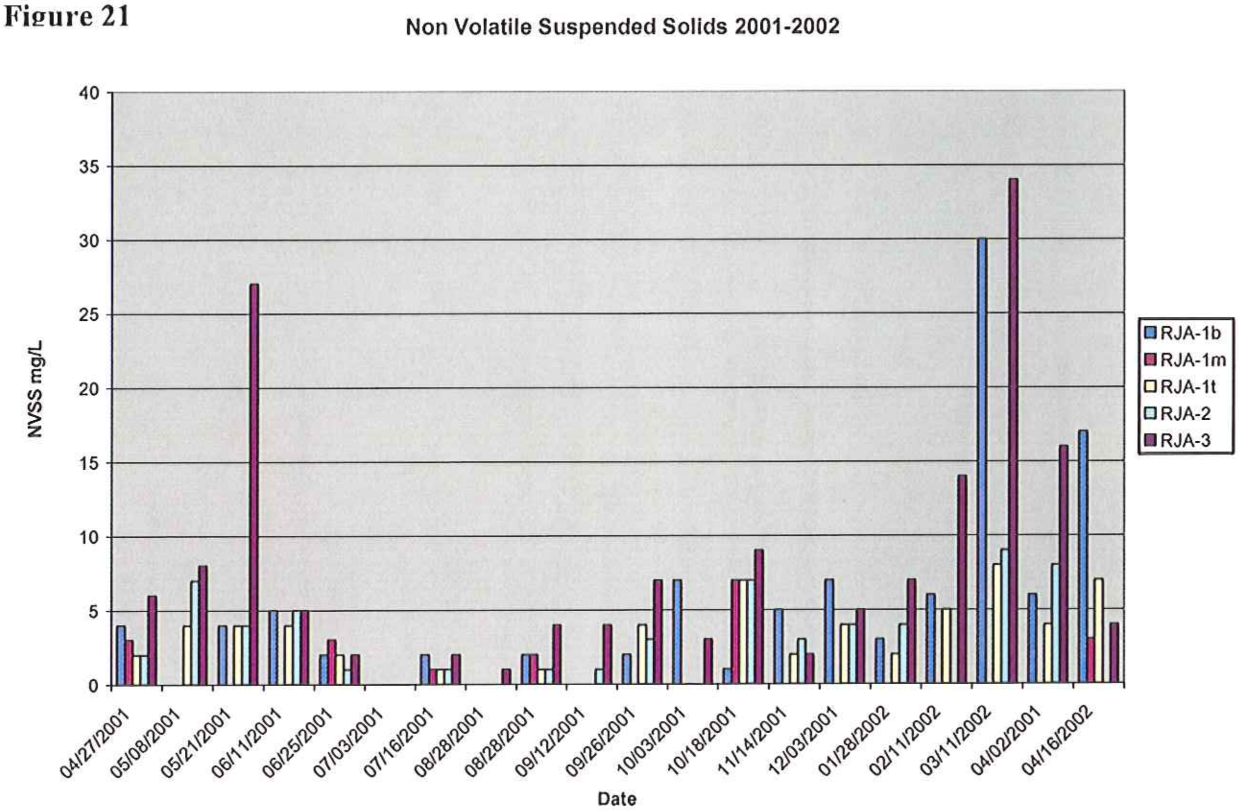
Figure 20



Non-Volatile Suspended Solids

Non-Volatile Suspended Solids (NVSS) is the portion of TSS that is not VSS. NVSS is the non-organic portion of TSS. NVSS is used by the IEPA as a parameter in their Aquatic Life Use Impairment Index (ALI). There were two times during the year that any sites showed NVSS levels as High according to IEPA standards (above 20mg/L). The peak in 2001occurred at site RJA-3 on 3/11/2001 with a level of 27mg/L. RJA-3 peaked on 3/11/2002 at 34mg/L. RJA-1b had high concentrations of NVSS on 3/11/2002 with a level of 30mg/L. (Figure 21).

Figure 21

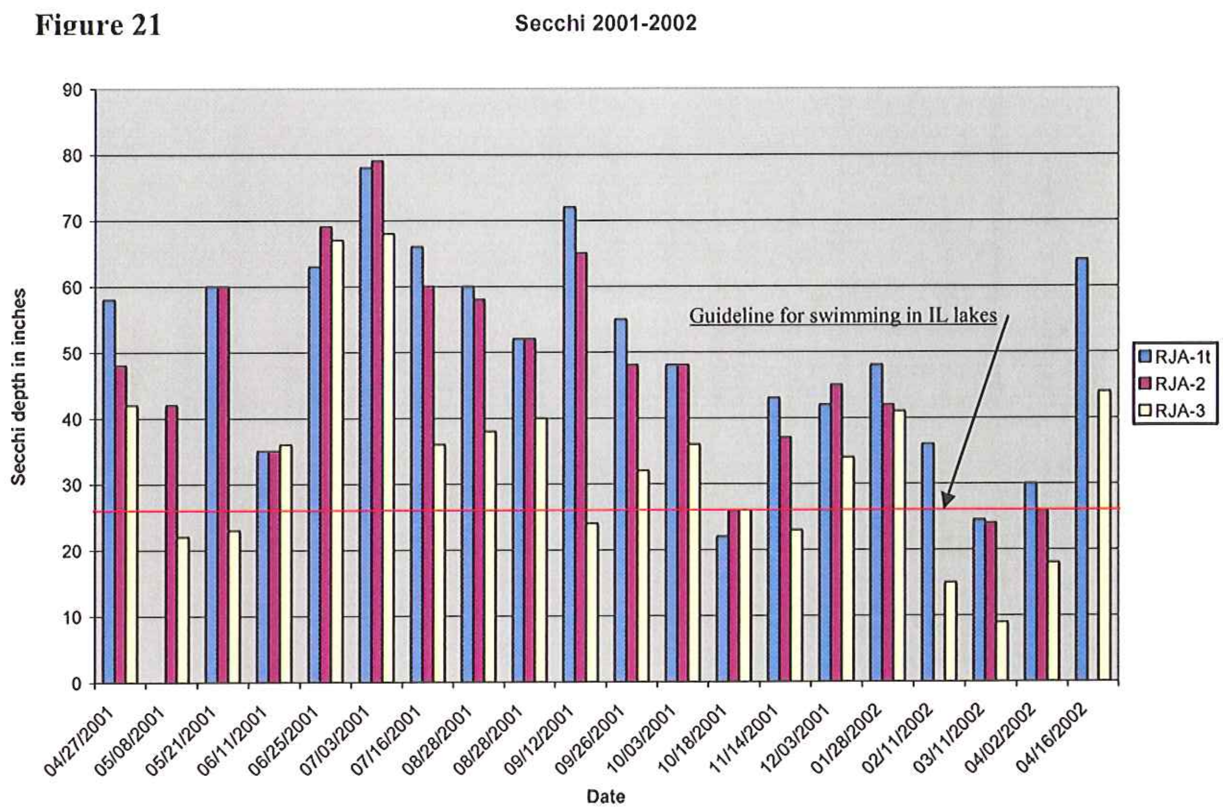


Secchi

The Secchi disk is one of the most widely used tools to measure water clarity. Secchi transparency and color are used to determine criteria for lake water quality. The Secchi disk is a simple circular disk divided into alternate black and white quadrants. The disk is lowered into the water and the depth at which it can no longer be seen is the Secchi depth. It is one of the criteria in Carlson's Trophic State Index, which is used to determine the trophic status (Carlson 1977). Photosynthesis can generally occur at 2-3 times the Secchi depth (Kirschner 1995).

Secchi readings are a parameter used in calculating the Trophic status of a lake. The IEPA uses the trophic status as a parameter in both their guidelines for Aquatic Life Use Impairment (ALI) and their Recreation Use Impairment (RUI). The IEPA also uses Secchi readings as a parameter in their swimming guidelines. All the secchi readings must be greater than 24 inches to gain full support for swimming (Illinois 305(b) Report). For Staunton Lake there was one date (3/11/2002) when the Secchi reading for all sites was less than the 24 inches. Throughout the swimming season the Secchi reading at all sites were greater than 24 inches. Historically the water clarity in Staunton Lake has averaged 47.0 inches at RJA-1t, 45.0 inches at RJA-2 and 34.0 inches at RJA-3 (Table 12).

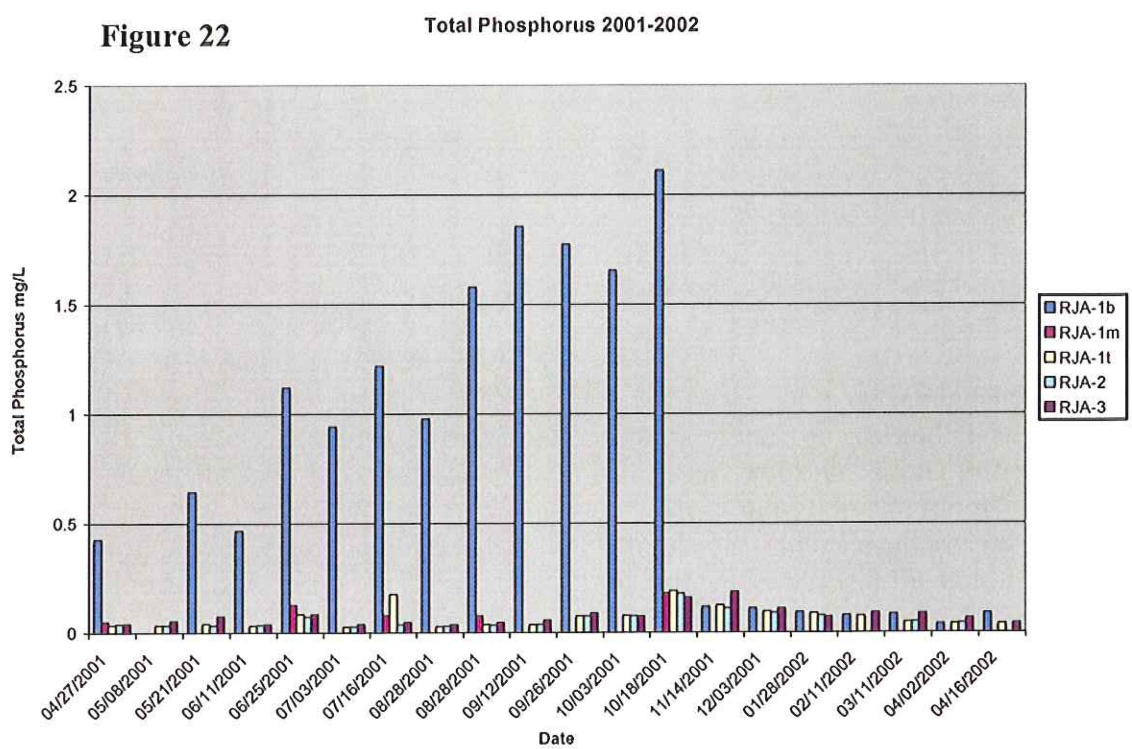
Figure 21



Phosphorus

Phosphorus is a required nutrient for plant growth. The over- or under-abundance of phosphorus is a likely factor in determining the amount of macrophyte and algae growth in a lake. High phosphorus concentrations can lead to lake eutrophication. Phosphorus is not always readily available for plant consumption. Most phosphorus in runoff is tightly bound to soil particles and therefore not available to plants. This phosphorus is considered to be in an insoluble form. If dissolved oxygen levels near the bottom of the lake become low, anaerobic decomposition of organic materials will release phosphorus in a soluble form readily available for plant use (Hill 1994). Phosphorus control is a key component to good lake management and restoration. The Illinois standard for phosphorus states that phosphorus as P shall not exceed 0.05 mg/L in any reservoir or lake with a surface area of 8.1 hectares or more. With the exception of the RJA-1b site, Phosphorous levels in Staunton lake were below or only slightly above the .05 level throughout the year. The peak for RJA-1t was reached on 10/18/2001 with with a level of 0.19mg/L. The peak of 0.185 for RJA-3 was reached on 11/14/2001. (Figure 22). The highest levels occurred at the bottom of the lake during the months from April through October. The peak at RJA-1b was 2.11mg/L. When oxygen is available in the water, the phosphorous is bound to solids in the sediment. As oxygen levels at the bottom of the lake decrease in the summer months, phosphorus is released into the water column. This release of free phosphorus acts as a nutrient source for algae.

Figure 22



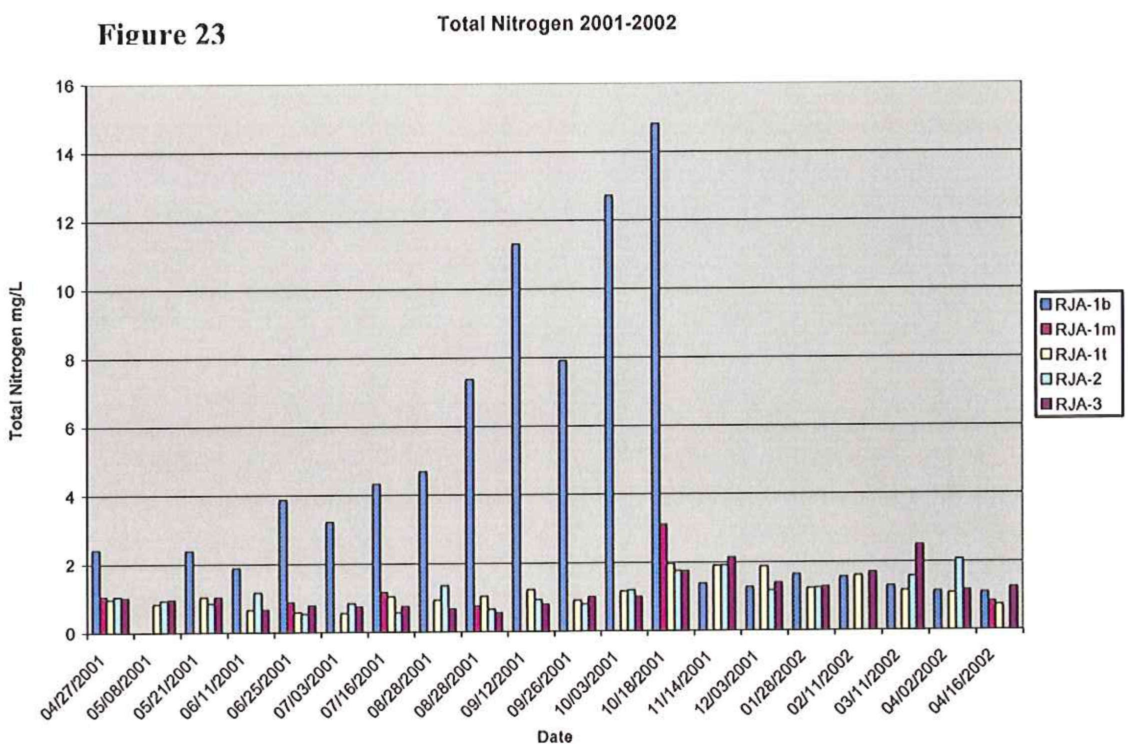
Nitrogen

Nitrogen is an important nutrient for plant growth as its availability will affect plant and algae growth leading to eutrophication of a lake. The forms of nitrogen sampled for included total nitrogen, ammonia nitrogen, nitrate + nitrite nitrogen and total kjeldahl nitrogen.

Total Nitrogen

Kjeldahl nitrogen is ammonia nitrogen plus organic nitrogen. Total nitrogen is the sum of kjeldahl nitrogen and nitrite + nitrate nitrogen. It is used to determine the ratio of nitrogen to phosphorus. This determination will yield the limiting nutrient for a lake. A ratio of total nitrogen to total phosphorus of greater than 7:1 is defined as a phosphorus limited lake. Staunton Lake had a ratio of 22.7:1 and therefore phosphorus is the limiting nutrient. It should be noted that nitrogen is much harder to control than phosphorus. Total nitrogen levels peaked in the lake at ROT-1b on 9/12/01 at 18 mg/L (Figure 23). The historical total nitrogen average of 1.32mg/L is 73% of the 2001-2002 levels of 1.80mg/L. This fact supports the need to control nitrogen levels in the lake and like the phosphorus is probably associated with low oxygen levels at the bottom of the lake in the summer months.

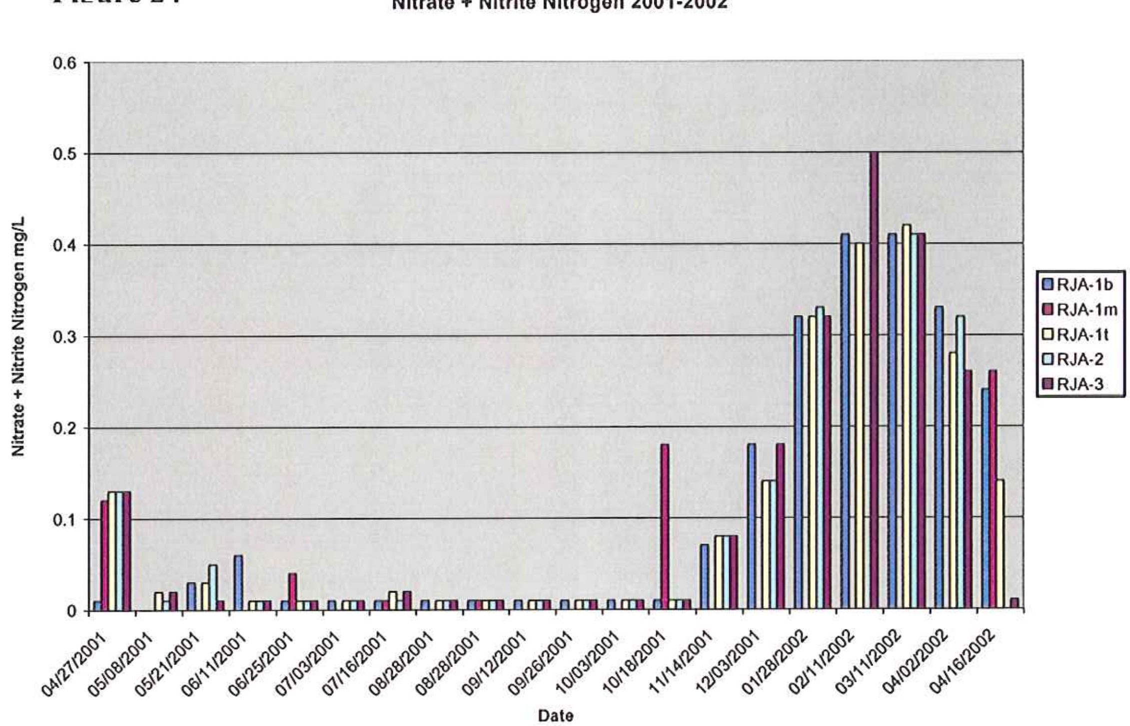
Figure 23



Nitrate + Nitrite Nitrogen

Nitrate + Nitrite nitrogen are inorganic forms of nitrogen which can enter a lake through agricultural runoff, septic tank effluent and other forms of waste. Due to the fact that increased levels of nitrates can cause physiological effects for infants less than 6 months old, nitrate concentrations are of particular concern for drinking water reservoirs. The standard for nitrate is 10mg/L. Concentrations greater than 10 mg/L can have dangerous effects for infants. All samples for Staunton Lake fell below 10 mg/L (Figure 24). At no time during the year of study did the 2001-2002 nitrate + nitrite nitrogen average values reach the historic averages of 1.0mg/L. The nitrate + nitrite nitrogen levels began to climb in the fall of 2002 and reached their peak of 0.5mg/L at RJA-3 on 2/11/2002. The levels then began to decline and followed a pattern that would be consistent with the levels observed in the spring or 2001.

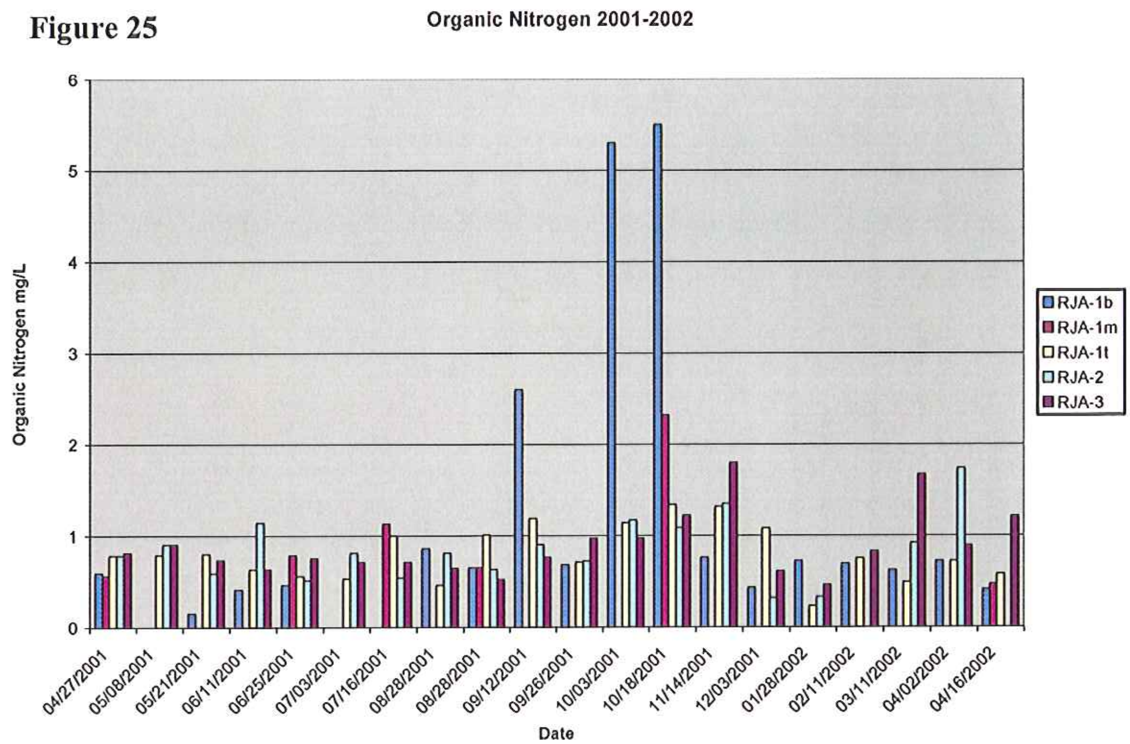
Figure 24



Organic Nitrogen

Organic nitrogen can enter a lake through decaying organic matter, septic systems, agricultural waste and waterfowl. On all but one sampling date (12/06/2001) levels in Staunton Lake were above 1 mg/L. The overall average organic nitrogen levels for 2001-2002 were higher (0.95mg/L) than the historic average (0.83mg/L). The 2001-2002 levels peaked on 10/18/2001 at RJA-1b with a level of 5.5mg/L (Figure 25). For both sites RJA-2 and RJA-3 the 2001-2002 averages for organic nitrogen were higher than historical averages with a 2001-2002 average of 0.92 mg/L compared to the historic average of 0.11mg/L for RJA-2 and a 2001-2002 average of 0.9mg/L compared to the historic average of 0.1mg/L for RJA-3. (Table 13).

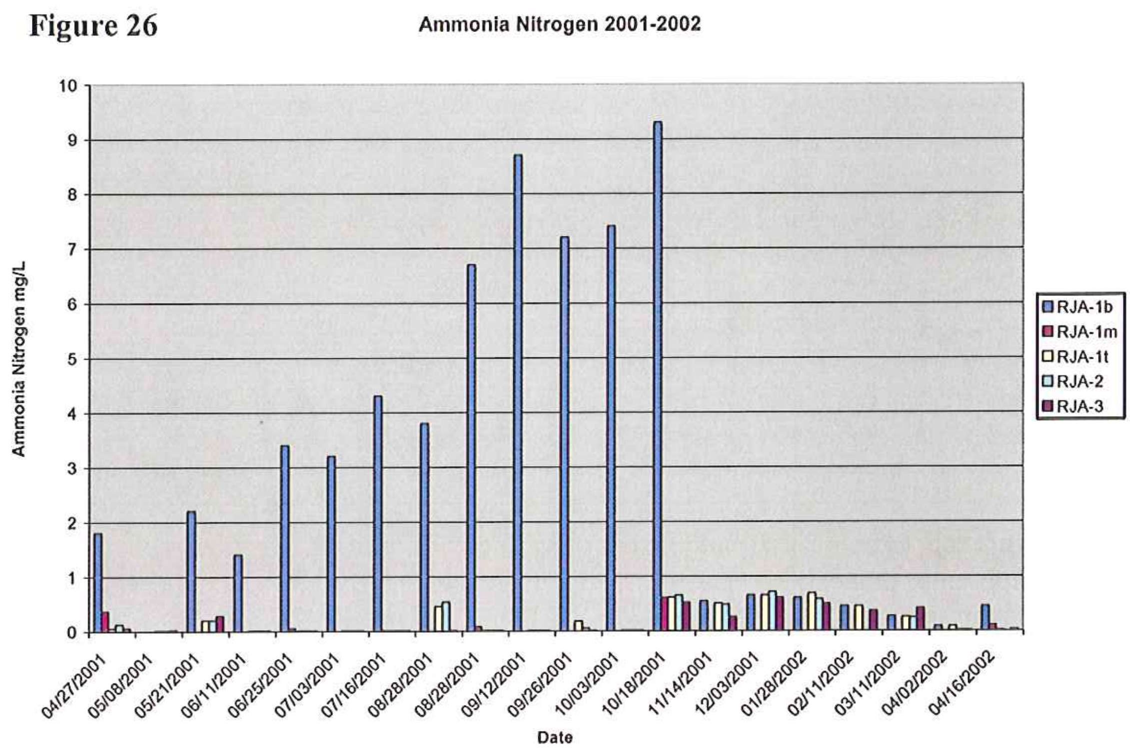
Figure 25



Ammonia Nitrogen

Ammonia nitrogen is the form of nitrogen that is most readily usable for plant growth. High ammonia concentrations can also have adverse affects on fish and other aquatic organisms. Ammonia is made available after bacterial decomposition of organic matter, found in the sediment at the bottom of the Lake. The pollution control board Part 302 states that total ammonia shall in no case exceed 15 mg/L. Excluding the bottom sample from RJA-1, there were no occasions when the samples from Staunton Lake were above 0.71mg/L. None of the samples, including RJA-1, exceeded the 15mg/L standard (Figure 26). The peak concentration of 9.3 on 10/18/2001 was found at RJA-1b at the bottom of the lake, which would be expected. These peak concentrations are most commonly a result of bacterial decomposition processes. All sites showed higher levels of ammonia nitrogen in 2001-2002 than historic averages. Lake site RJA-1t 2001-2002 levels were 0.2mg/L compared to the historic average of 0.10mg/L. Site RJA-2 2001-2002 levels were 0.20mg/L compared to the historic average of 0.11mg/L. Site RJA-3 2001-2002 levels were 0.16mg/L compared to the historic average of 0.10mg/L. (Table 12, Figure 26).

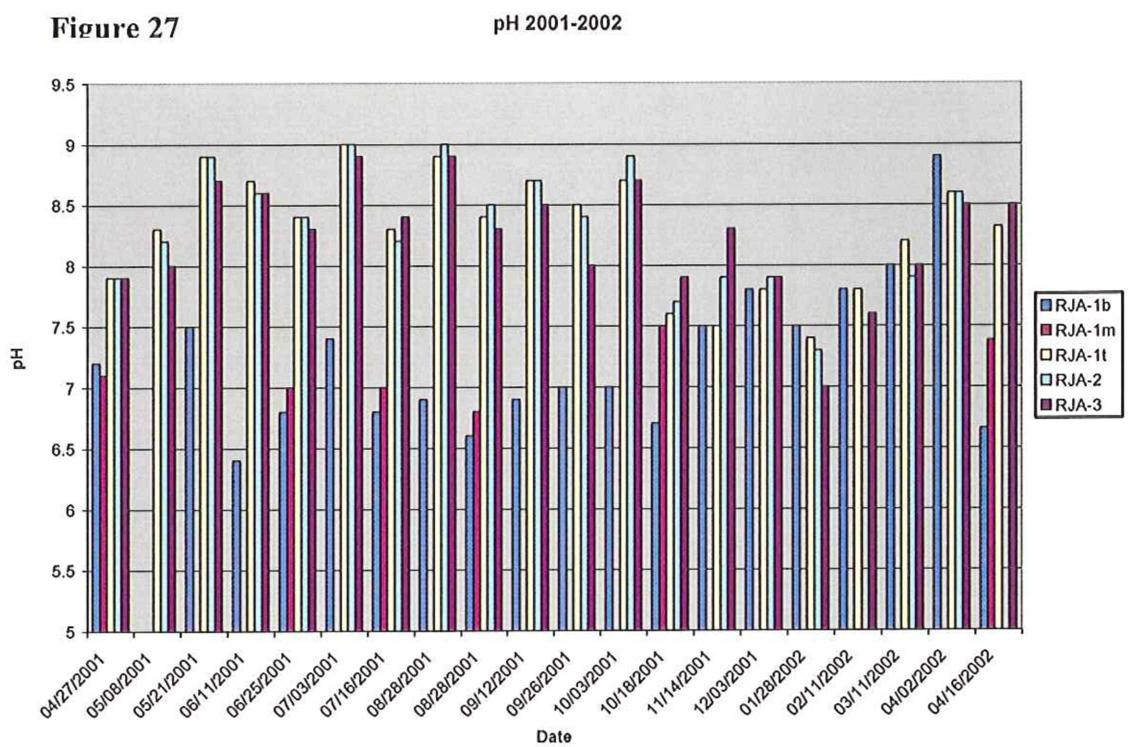
Figure 26



pH

A lake's pH is a measure of the acidity of the water. pH measures the hydrogen ions present in solution on a scale of 0-14. A reading of 7 is neutral. A reading higher than 7 is basic or alkaline. A reading less than 7 is acidic. The pH range for most lakes is between 6 and 9. The pH standard in Illinois is within the range of 6.5 to 9 except for natural causes. The loss of carbon dioxide during photosynthesis results in an increase in pH of the photic, or lighted, zone. As decomposition occurs near the bottom of the lake, the pH will decrease. Therefore pH levels near the bottom of the lake are often lower than near the surface. Organic material is decomposing and photosynthesis is not occurring. The pH levels in Staunton Lake near the bottom were recorded to be lower than the pH at the surface. The pH in Staunton Lake fell within the range of 6.5 and 9 during the study. (Figure 27). The water in Staunton Lake during the study period was more alkaline than acidic. Historical lake average pH for site ROT-1 is 8.9, ROT-2 is 8.8 and ROT-3 is 8.7. The 2001-2002 lake average pH for site ROT-1 was 8.5, ROT-2 was 8.5 and ROT-3 was 8.3. (Table 12, Figure 27).

Figure 27



Dissolved Oxygen and Temperature

Dissolved oxygen is an important factor in the overall health of a lake. Oxygen levels are a key factor in fish health. Low oxygen levels can cause fish kills and limited oxygen levels can decrease the number of fish for a given lake. Low levels of oxygen near the bottom allow nutrients to be released adding to the eutrophication of the lake.

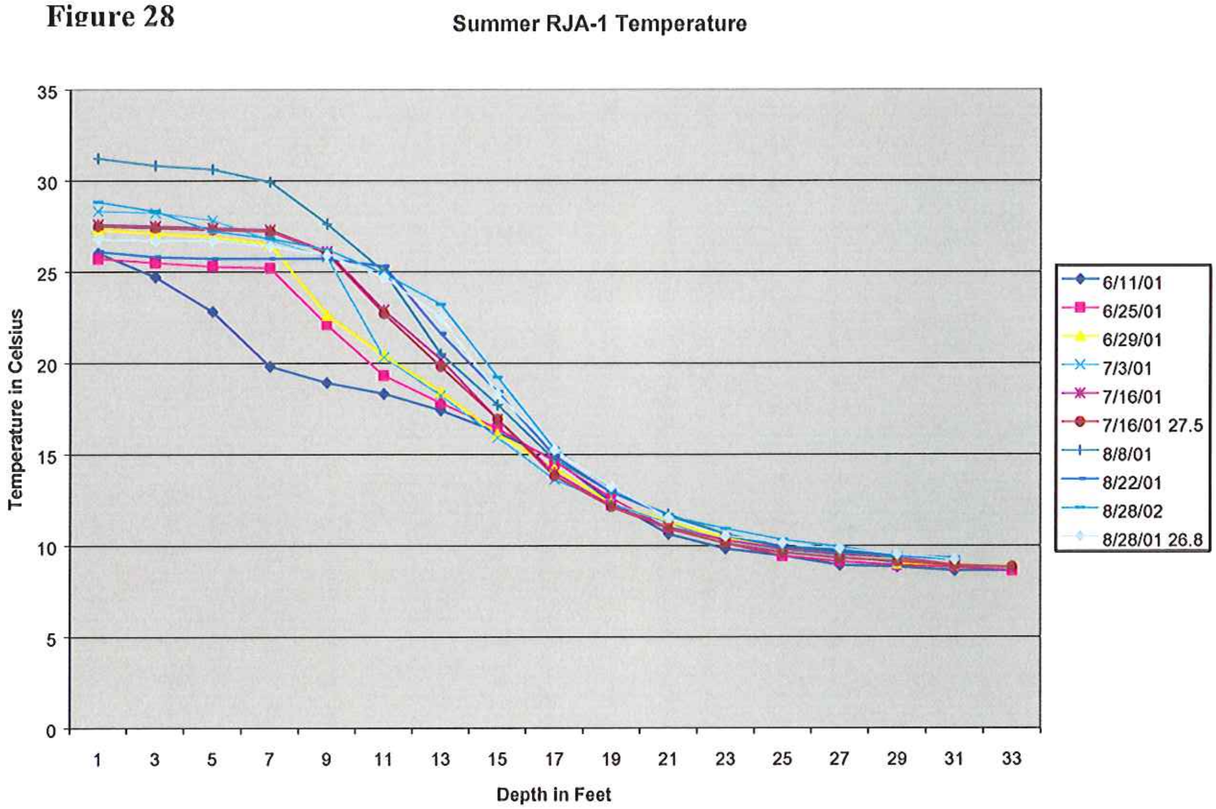
Lake oxygen level is controlled by a variety of factors. Plants and algae release oxygen into the water through photosynthesis. Wave action on the surface adds oxygen to the water. Microbial respiration, during decomposition of organic materials in the lake, uses oxygen.

Water temperature is important for a variety of biological and chemical processes in the lake. Different types of algae grow better at different temperatures. Density gradients due to temperature differences cause the stratification of lakes. Cold water remains near the bottom of the lake and microbial decomposition of organic materials depletes the oxygen levels. As long as the lake remains stratified the oxygen continues to deplete.

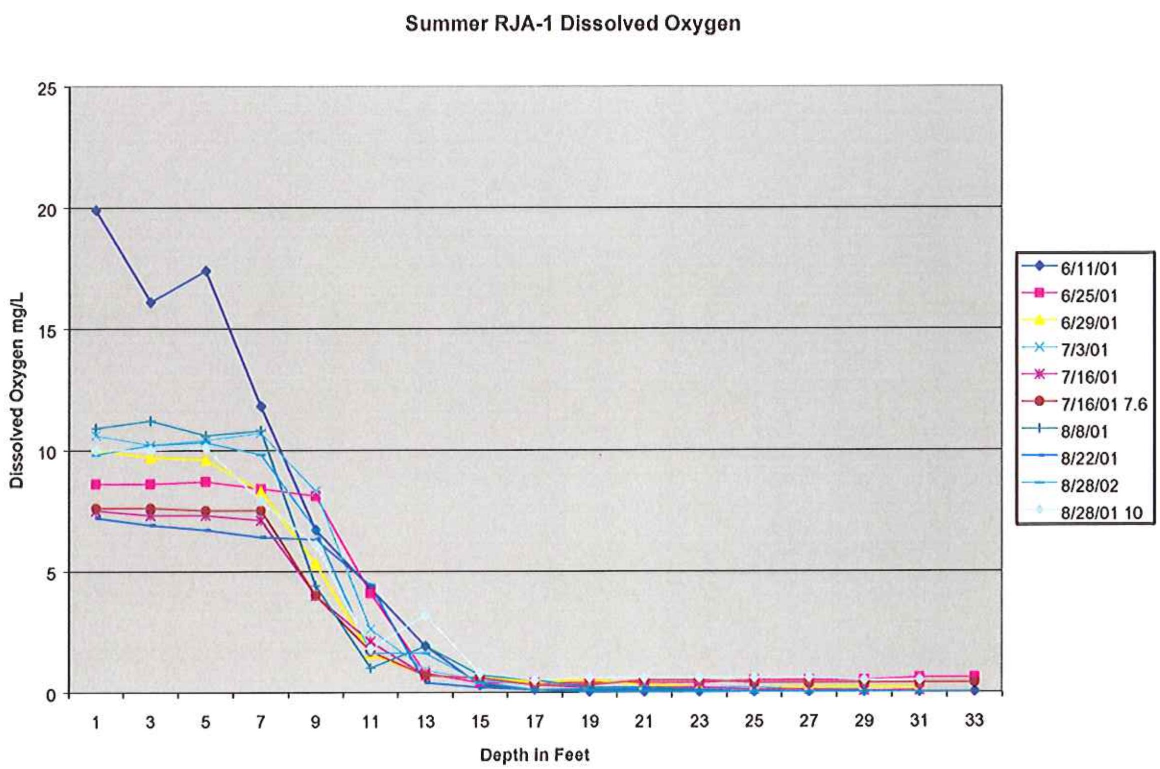
Regulations set by the IEPA and Illinois Pollution Control Board (IPCB) state the dissolved oxygen (DO) shall not fall below 6 mg/L for a 16 hour period and never allowing the DO to fall below 5 mg/L at 1 foot depth (IPCB Part 302). Levels below 3 mg/L will likely cause fish kills.

The deep portions of Staunton Reservoir demonstrate conditions found in a typically stratified lake. During the winter, the temperature was uniform throughout the lake and dissolved oxygen was well mixed at all depths. During the late spring and summer months, the late stratified. The cold water sank to the bottom of the lake and warm water remained near the surface. Wind action and algae growth kept the upper levels oxygen rich while microbial decomposition processes near the bottom depleted the available oxygen. Chemical reactions are allowed to take place under low oxygen condition which release nutrients bound to the sediments. During the fall as the temperature changed the water mixed and dissolved oxygen and temperature levels became more uniform at all depths. This mixing also mixed the released nutrients from the bottom resulting in internal loading. This stratified condition was found in the southern portions of the lake RJA-1 and RJA-2 (Figures 28,29).

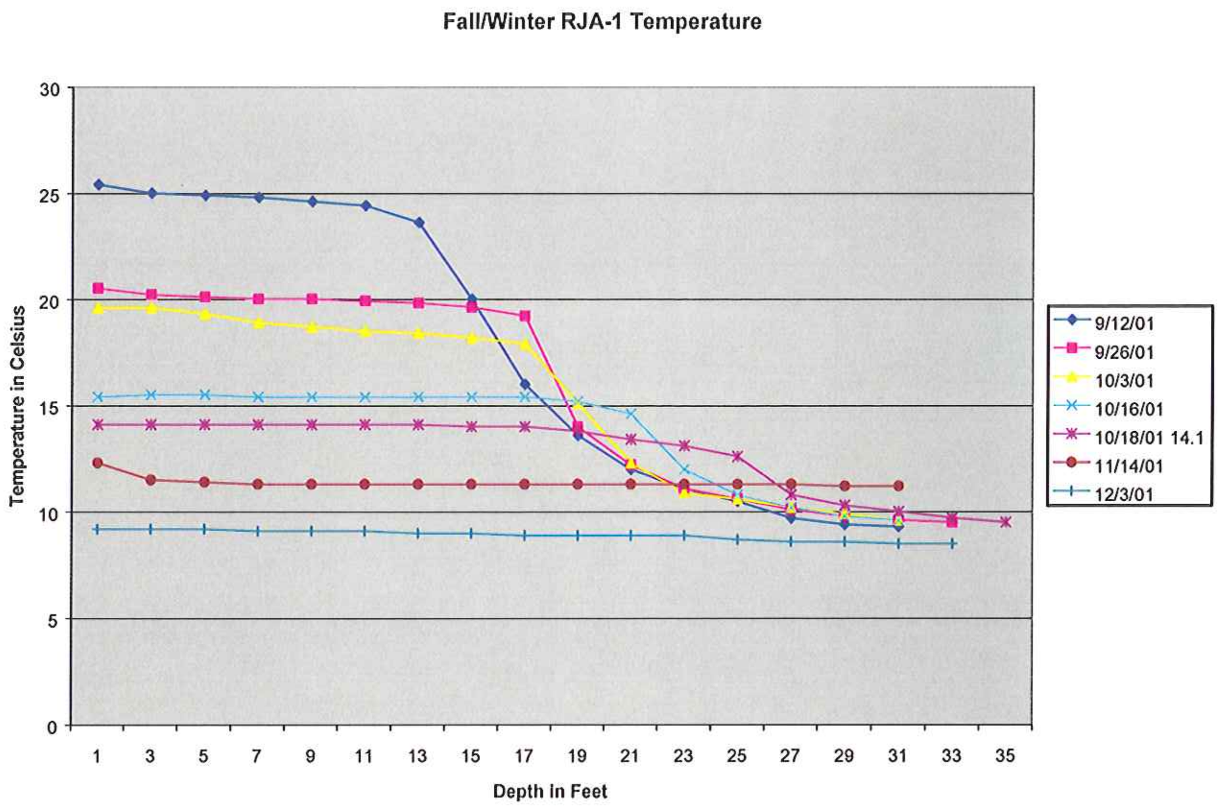
Figure 28

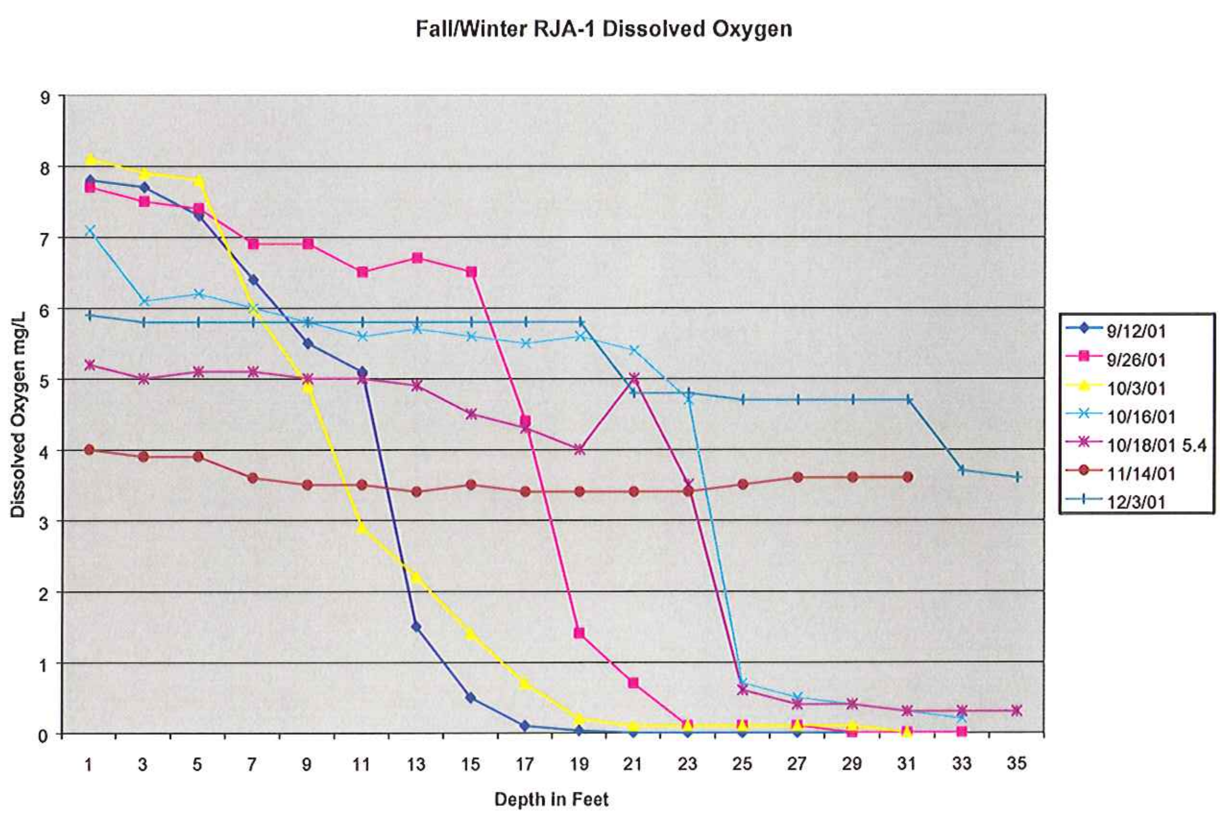


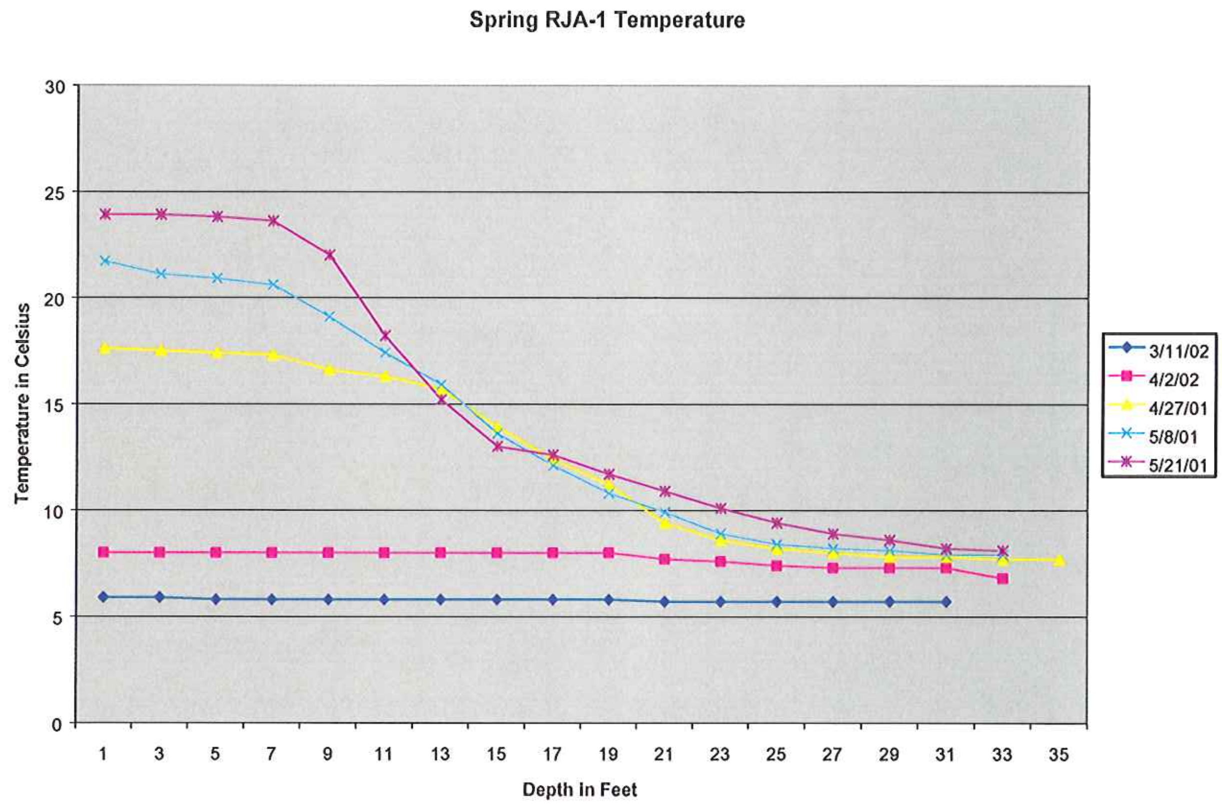
Summer RJA-1 Temperature
Temperature in Celsius
Depth in Feet
35
30
25
20
15
10
5
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
6/11/01
6/25/01
6/29/01
7/3/01
7/16/01
7/16/01 27.5
8/8/01
8/22/01
8/28/02
8/28/01 26.8



Summer RJA-1 Dissolved Oxygen
Dissolved Oxygen mg/L
Depth in Feet
25
20
15
10
5
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
6/11/01
6/25/01
6/29/01
7/3/01
7/16/01
7/16/01 7.6
8/8/01
8/22/01
8/28/02
8/28/01 10


Fall/Winter RJA-1 Temperature
Temperature in Celsius
0
5
10
15
20
25
30
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35
Depth in Feet
9/12/01
9/26/01
10/3/01
10/16/01
10/18/01 14.1
11/14/01
12/3/01


Fall/Winter RJA-1 Dissolved Oxygen
Dissolved Oxygen mg/L
0
1
2
3
4
5
6
7
8
9
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35
Depth in Feet
9/12/01
9/26/01
10/3/01
10/16/01
10/18/01 5.4
11/14/01
12/3/01


Spring RJA-1 Temperature
Temperature in Celsius
Depth in Feet
3/11/02
4/2/02
4/27/01
5/8/01
5/21/01

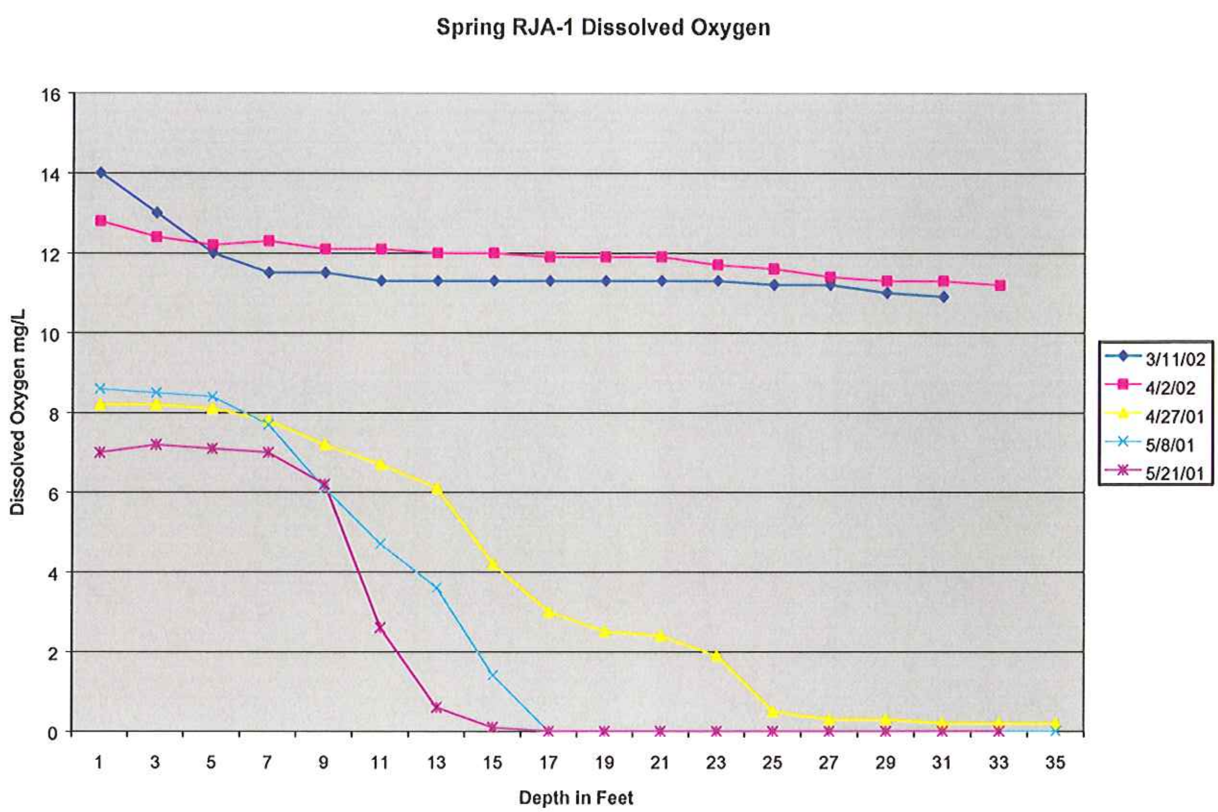
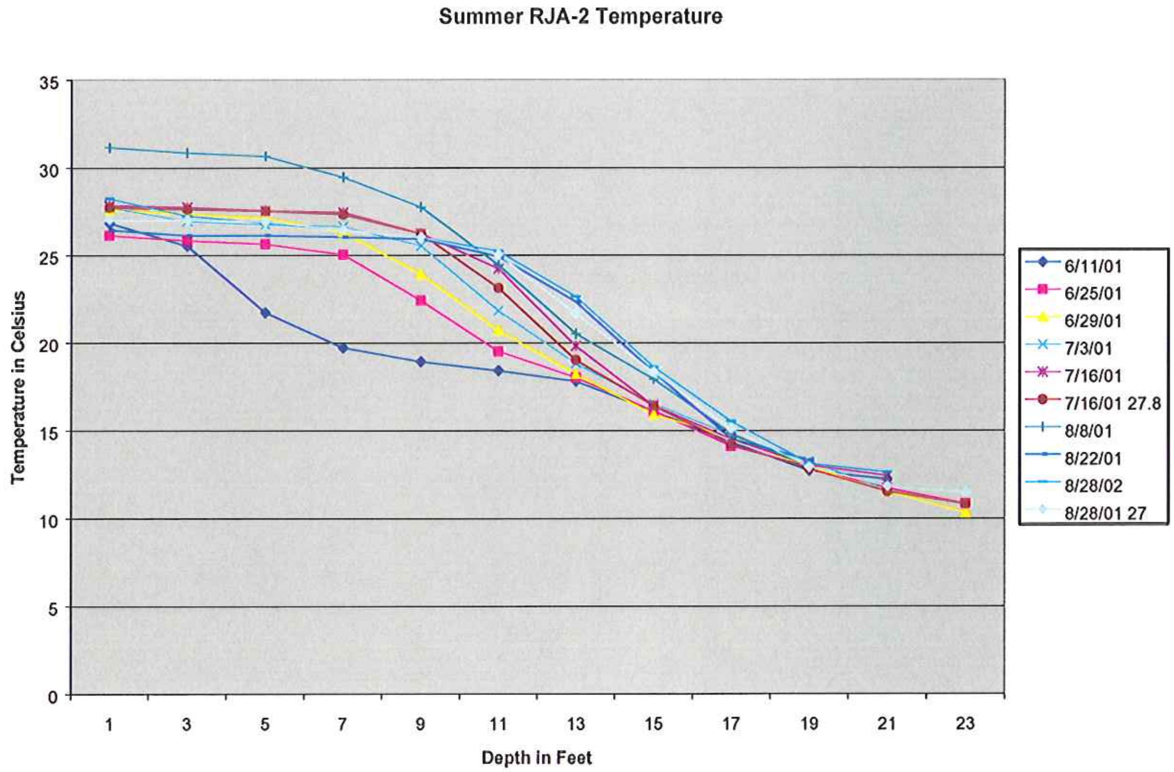
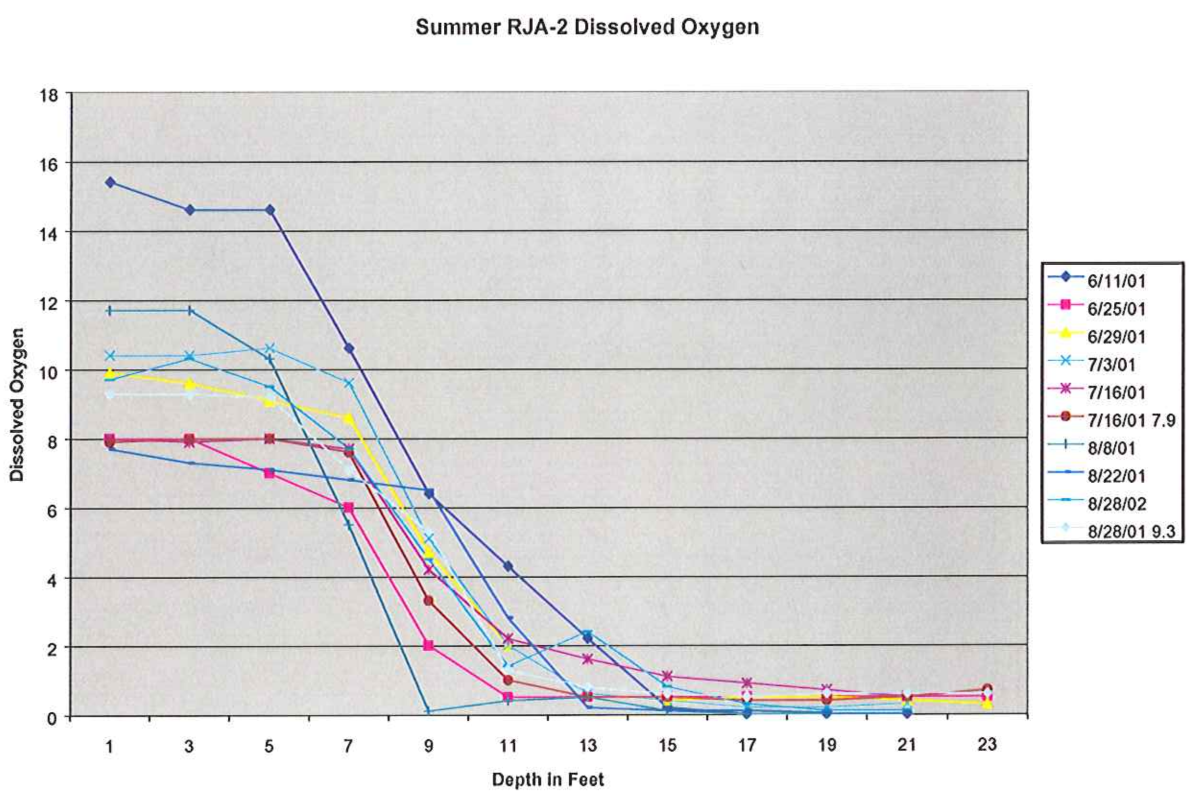
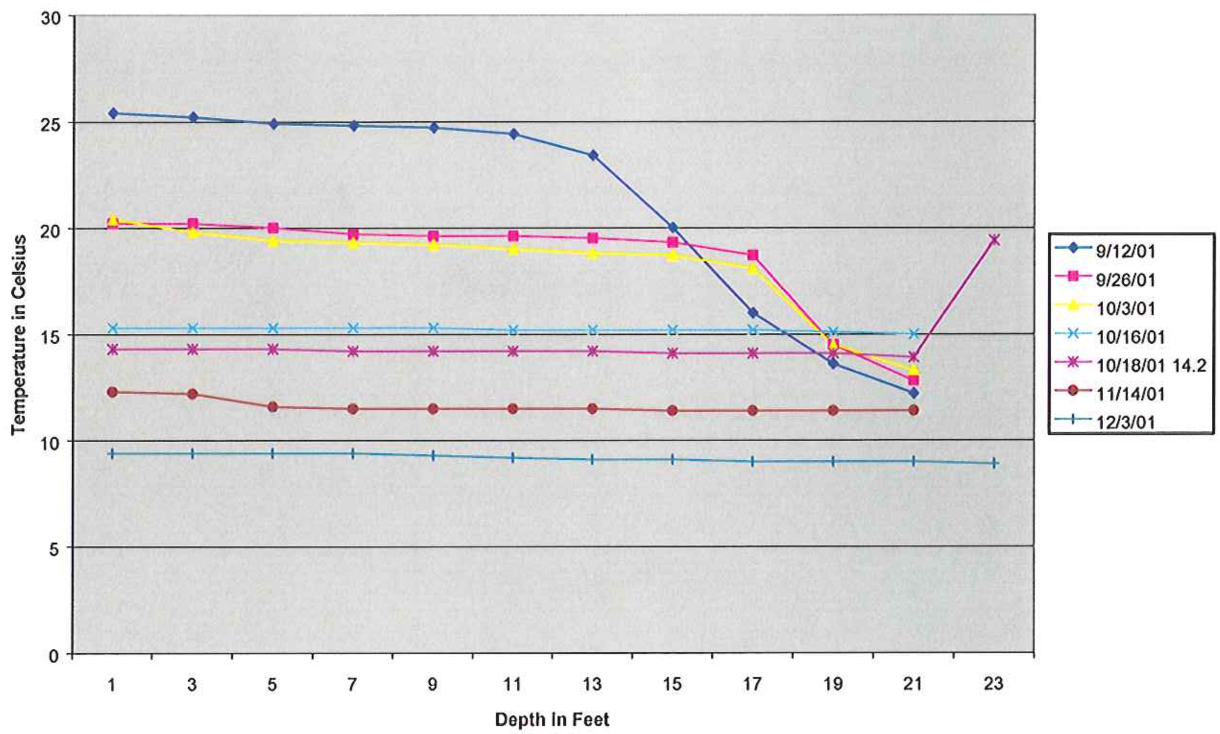

Spring RJA-1 Dissolved Oxygen
Dissolved Oxygen mg/L
Depth in Feet
3/11/02
4/2/02
4/27/01
5/8/01
5/21/01

Figure 29

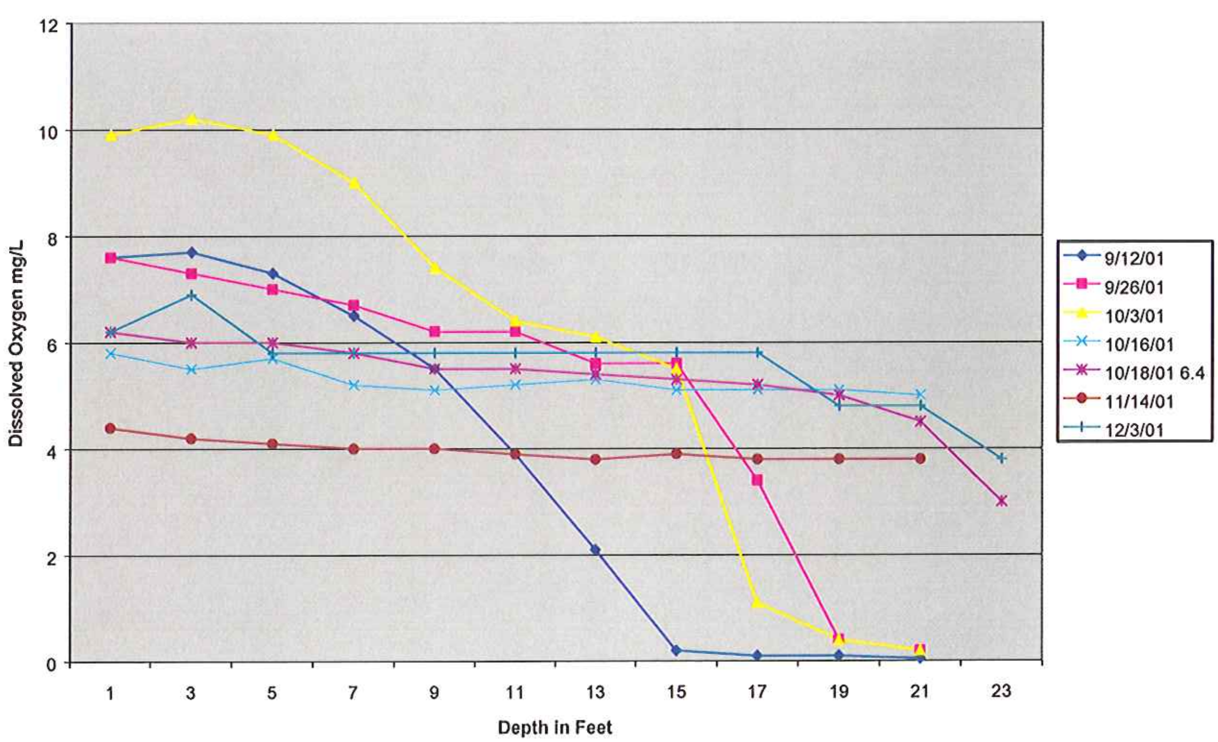

Summer RJA-2 Temperature
Temperature in Celsius
35
30
25
20
15
10
5
0
1
3
5
7
9
11
13
15
17
19
21
23
Depth in Feet
6/11/01
6/25/01
6/29/01
7/3/01
7/16/01
7/16/01 27.8
8/8/01
8/22/01
8/28/02
8/28/01 27

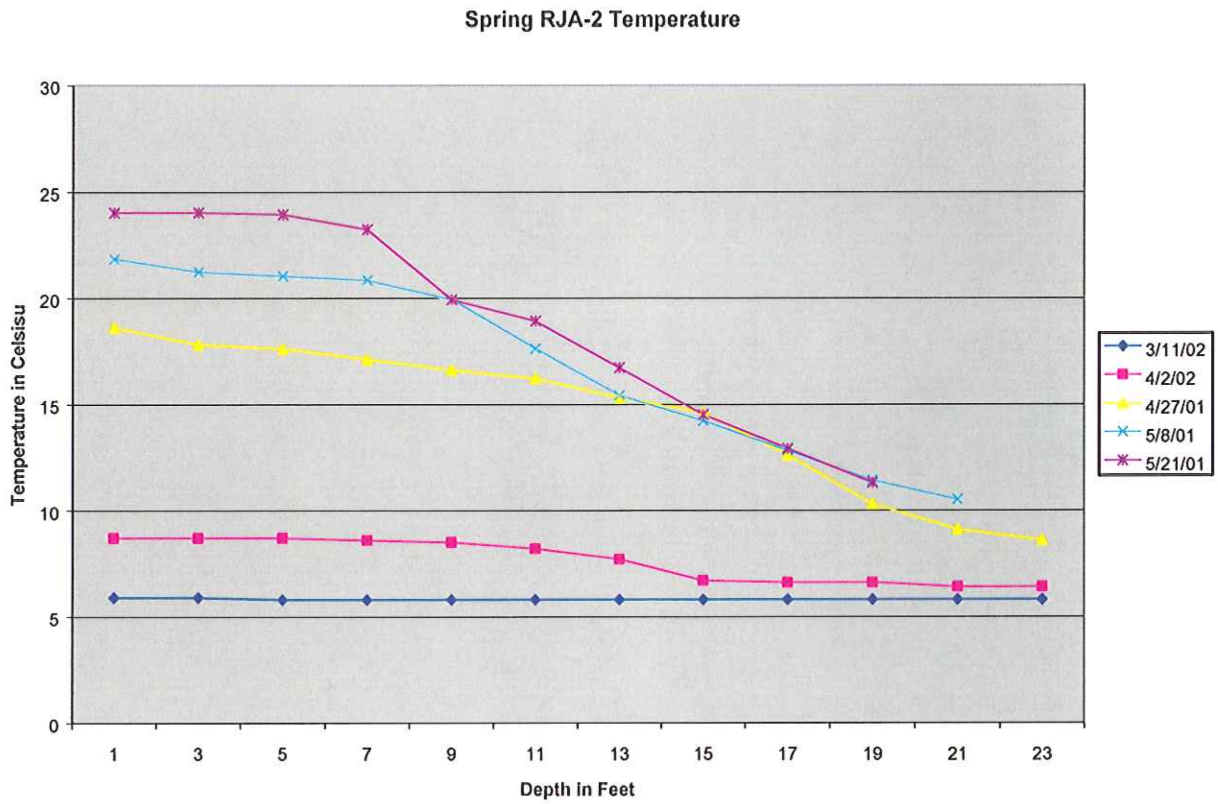

Summer RJA-2 Dissolved Oxygen
Dissolved Oxygen
18
16
14
12
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
19
21
23
Depth in Feet
6/11/01
6/25/01
6/29/01
7/3/01
7/16/01
7/16/01 7.9
8/8/01
8/22/01
8/28/02
8/28/01 9.3

Fall/Winter RJA-2 Temperature



Fall/Winter RJA-2 Dissolved Oxygen




Spring RJA-2 Temperature
Temperature in Celsisu
30
25
20
15
10
5
0
1
3
5
7
9
11
13
15
17
19
21
23
Depth in Feet
3/11/02
4/2/02
4/27/01
5/8/01
5/21/01

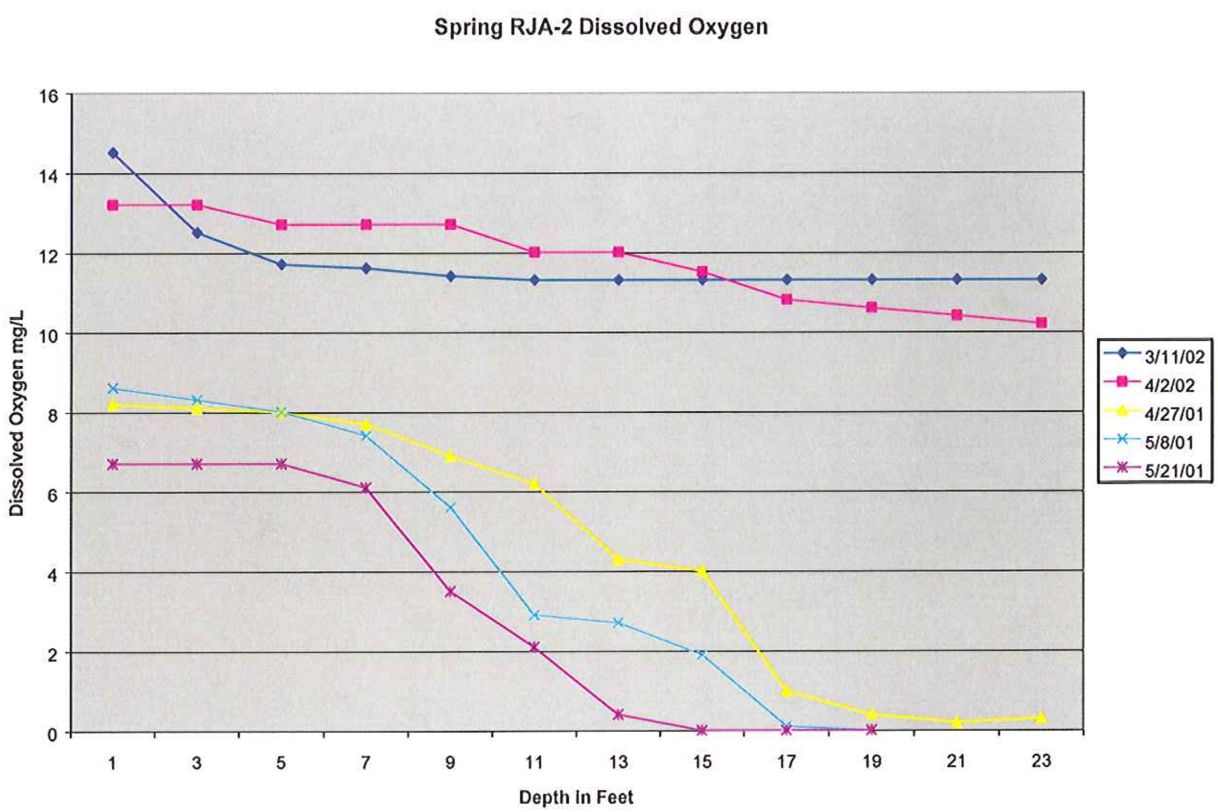
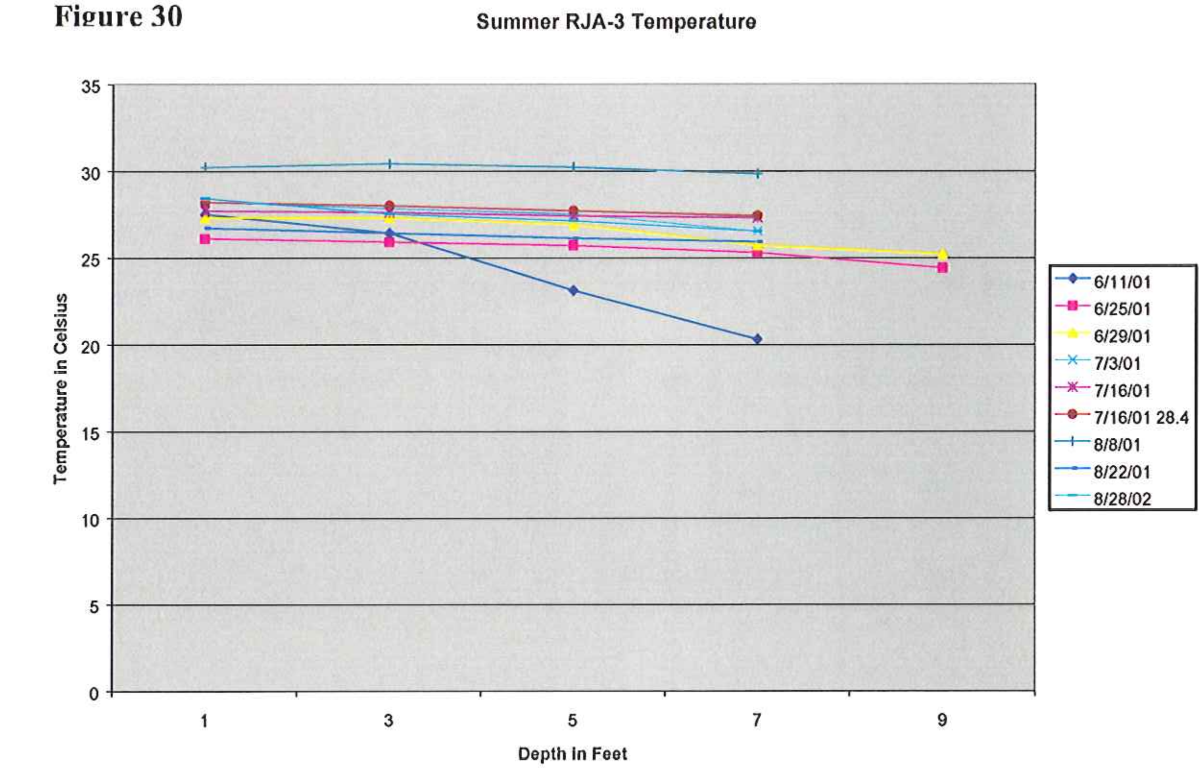
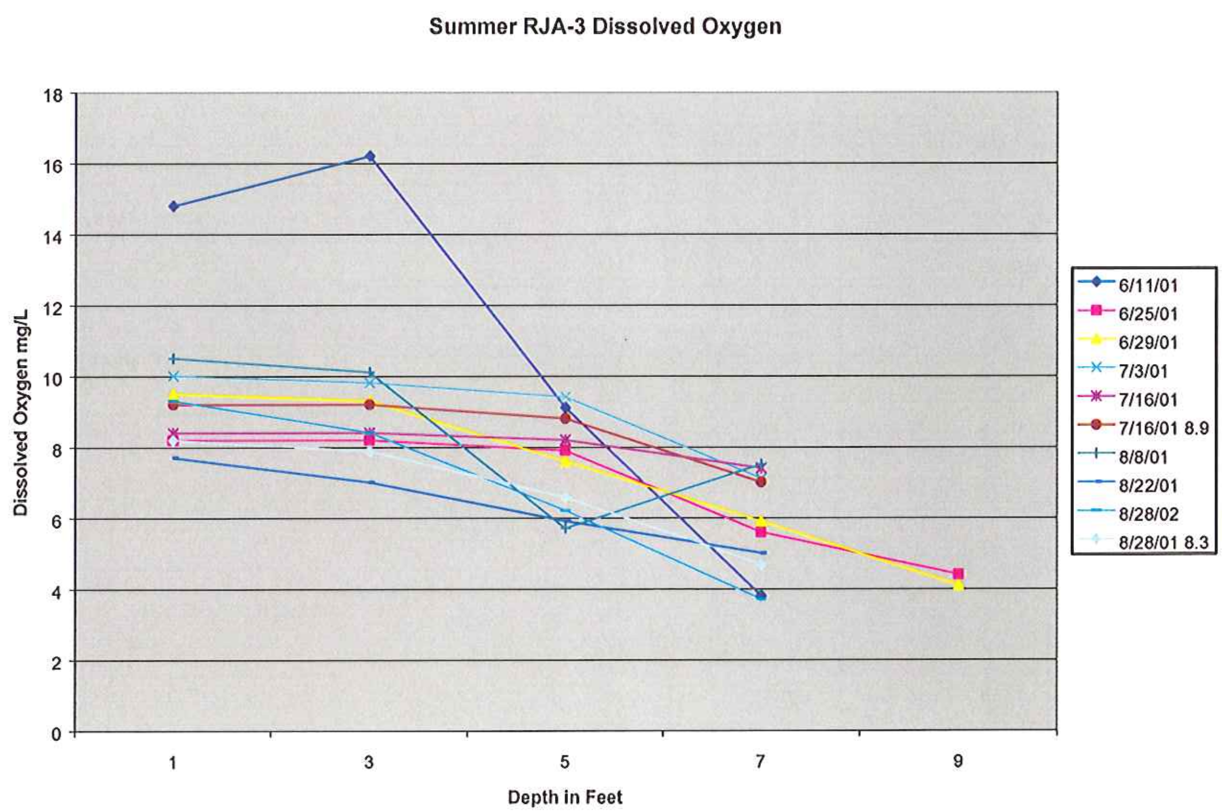

Spring RJA-2 Dissolved Oxygen
Dissolved Oxygen mg/L
16
14
12
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
19
21
23
Depth In Feet
3/11/02
4/2/02
4/27/01
5/8/01
5/21/01

Figure 30

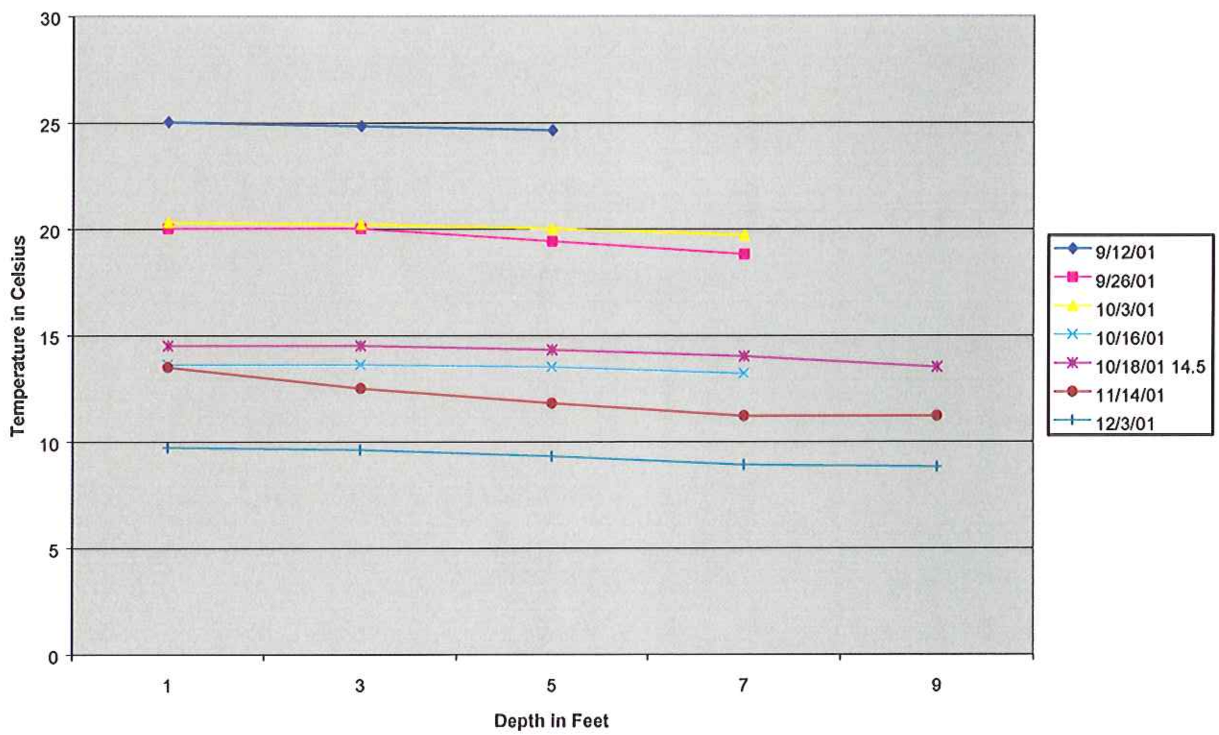


Summer RJA-3 Temperature
35
30
25
20
15
10
5
0
Temperature in Celsius
1
3
5
7
9
Depth in Feet
6/11/01
6/25/01
6/29/01
7/3/01
7/16/01
7/16/01 28.4
8/8/01
8/22/01
8/28/02

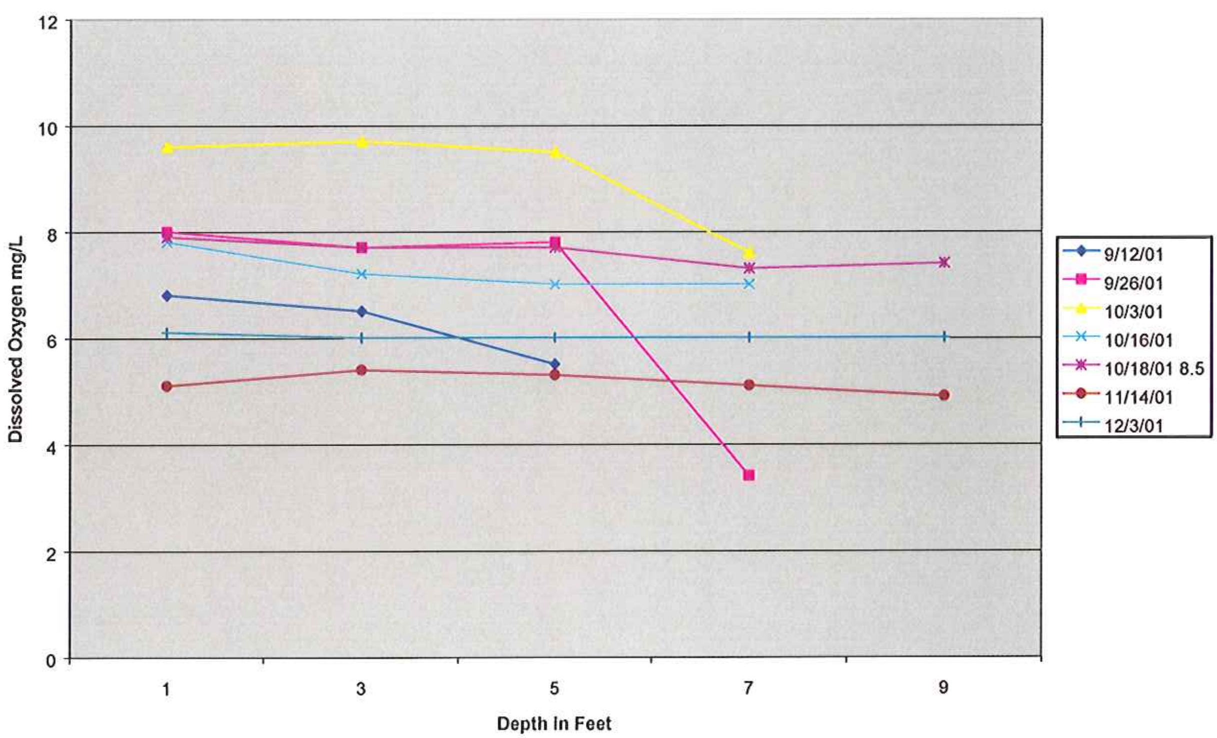


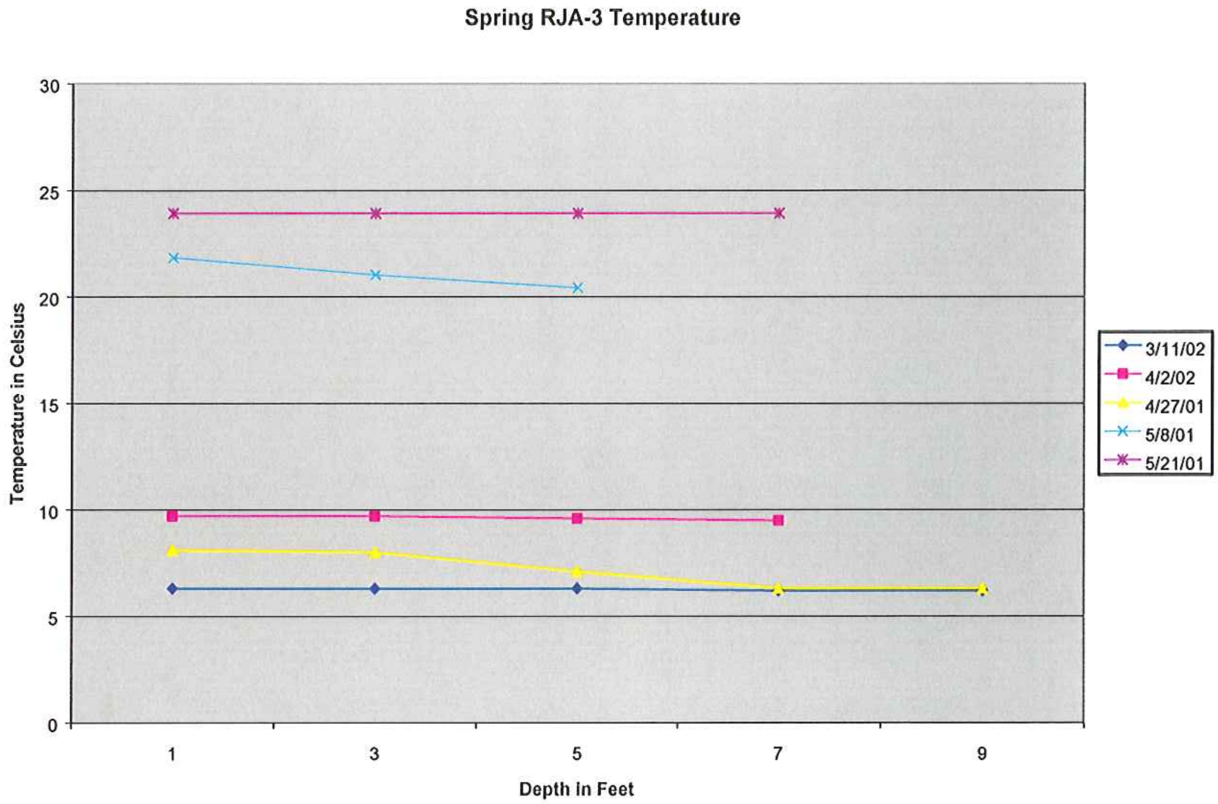
Summer RJA-3 Dissolved Oxygen
18
16
14
12
10
8
6
4
2
0
Dissolved Oxygen mg/L
1
3
5
7
9
Depth in Feet
6/11/01
6/25/01
6/29/01
7/3/01
7/16/01
7/16/01 8.9
8/8/01
8/22/01
8/28/02
8/28/01 8.3

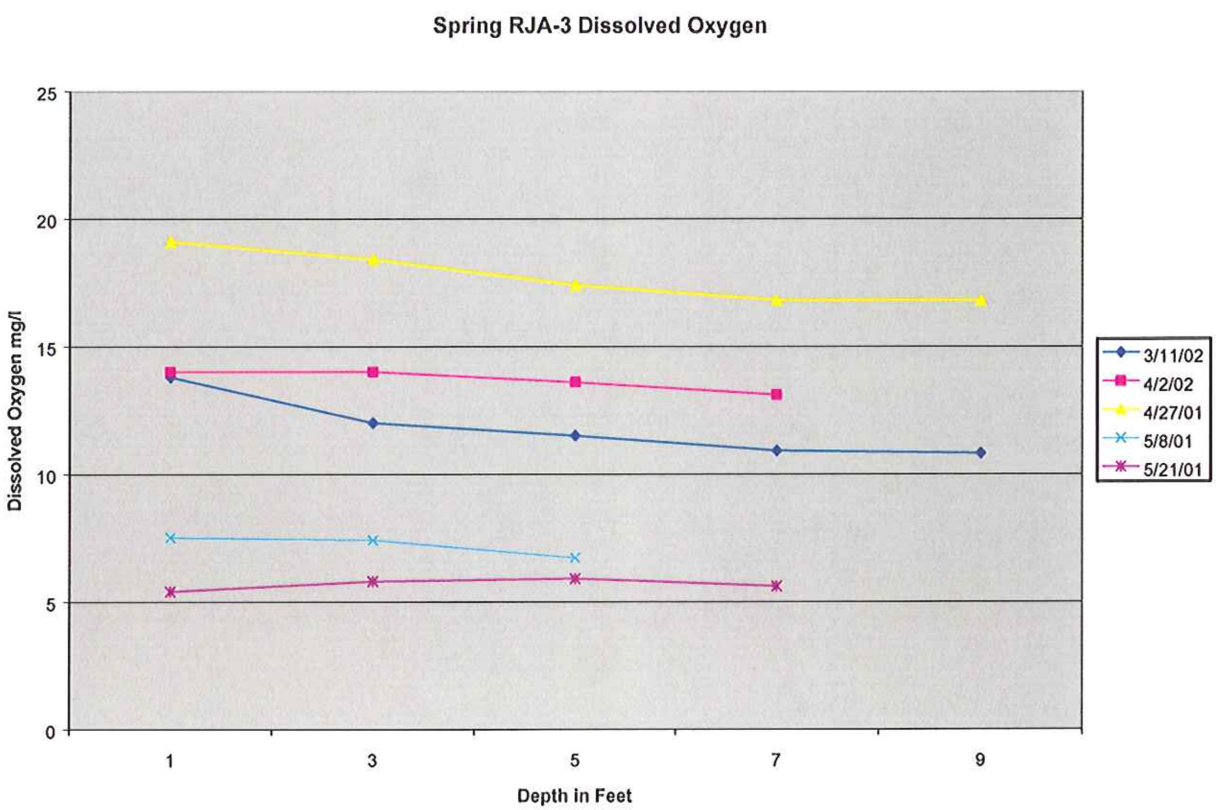
Fall/Winter RJA-3 Temperature



Fall/Winter RJA-3 Dissolved Oxygen




Spring RJA-3 Temperature
30
25
20
15
10
5
0
Temperature in Celsius
1
3
5
7
9
Depth in Feet
3/11/02
4/2/02
4/27/01
5/8/01
5/21/01

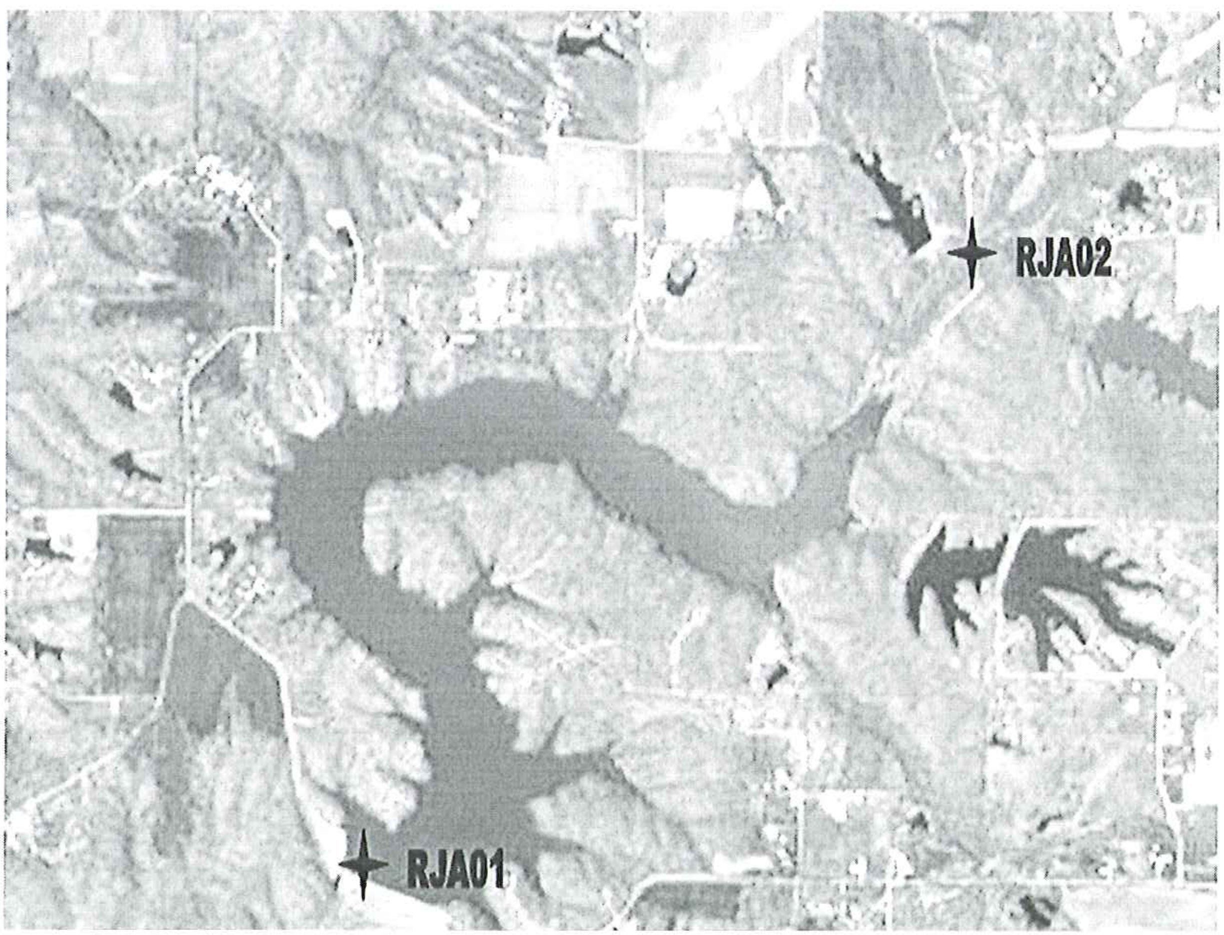

Spring RJA-3 Dissolved Oxygen
25
20
15
10
5
0
Dissolved Oxygen mg/l
1
3
5
7
9
Depth in Feet
3/11/02
4/2/02
4/27/01
5/8/01
5/21/01

TRIBUTARY MONITORING

In an effort to collect data on water and nutrients entering Staunton Reservoir over the study period staff gauges were placed on the major tributary and at the spillway. A staff gauge is a measuring rod that allows relational water depths to be observed and recorded in tenths of a foot. A cross section of the tributary was measured. The relationship between the staff gauge reading the cross-sectional area was used to determine volumes of water entering the lake. The tributary staff gauge was located just up stream of the access road that crosses east creek. It was labeled RJA02. Another staff gauge was located at the spillway and was used to determine the outflow. The spillway staff gauge was labeled RJA01.

City personnel recorded daily staff gauge readings at RJA01 and RJA02. During storm events ZIES staff collected water samples form these sampling sites and recorded staff heights for each site. Water samples were collected and shipped according to IEPA protocol to IEPA laboratories for analysis. Water samples were analyzed for total suspended solids (TSS), volatile suspended solids (VSS), phosphorus, nitrate+nitrite nitrogen, ammonia nitrogen, and kjeldahl nitrogen. ZIES staff tested for pH on site using a Hydrolab probe during collection of the other water samples. ZIES also measured flow using a Global Water Works flow probe. The flow data was used to determine the sediment and nutrient loading to the lake.

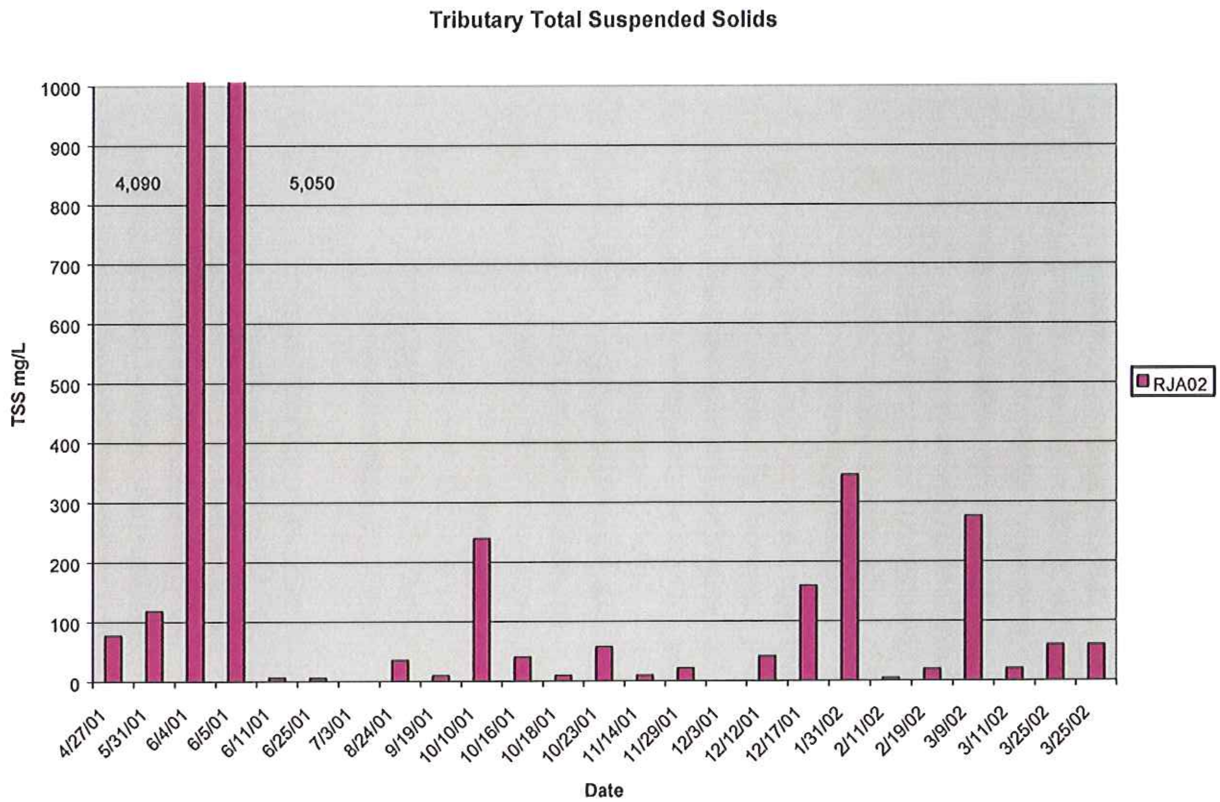
Figure 31 Tributary Sampling Sites



Total Suspended Solids

Total suspended solids (TSS) is a measurement of all the suspended material in the water including both organic and inorganic materials. This would include materials such as algae, decaying plant materials, minerals, and soil particles. Peak levels corresponded with rain events. Values of TSS were used to calculate sediment loading.

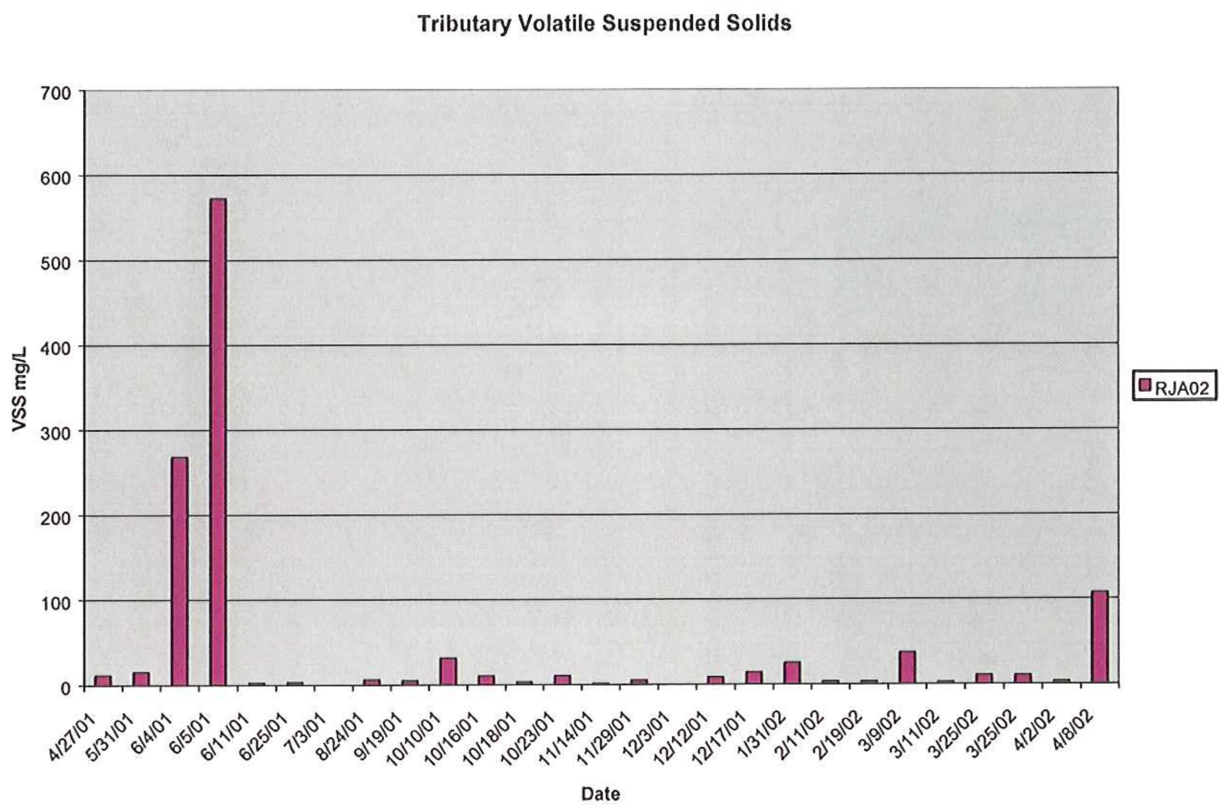
Figure 32



Volatile Suspended Solids

Volatile suspended solids (VSS) is a measurement of only the organic material suspended in the water. This material would include algae, decaying plant material and all other organic material suspended in the water.

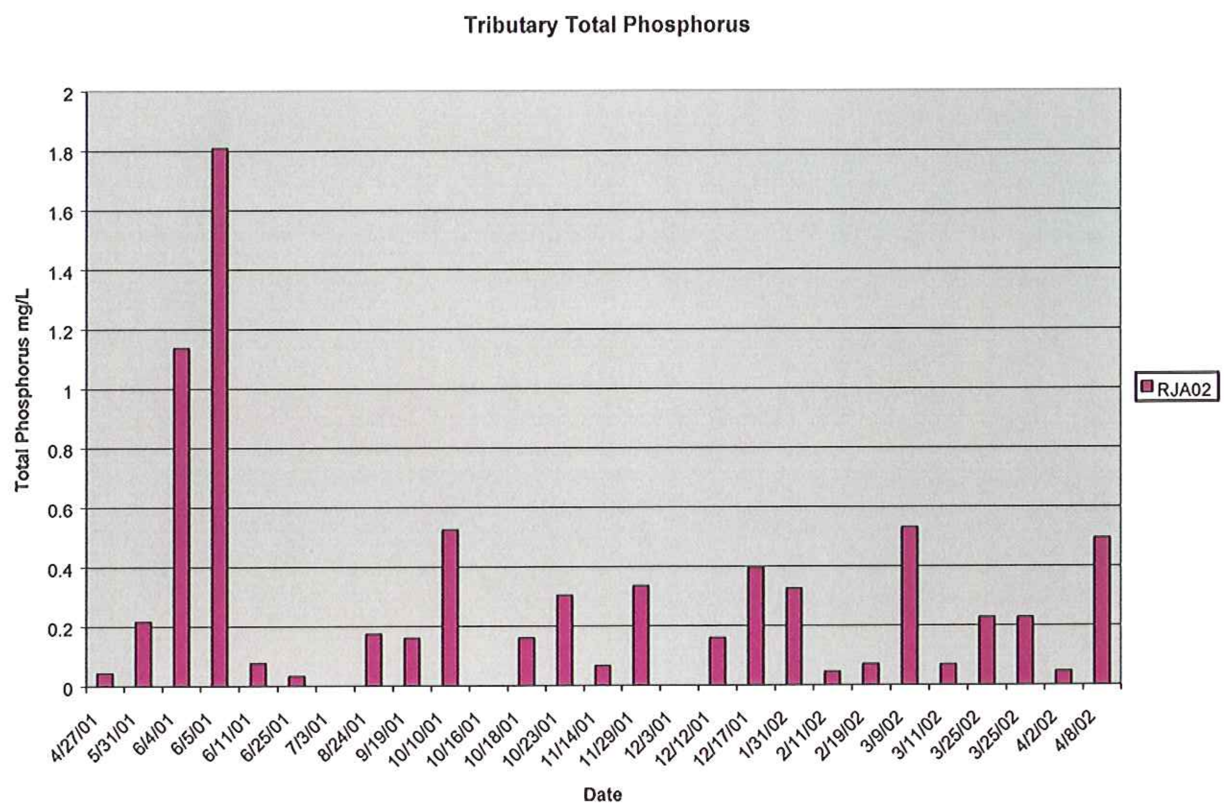
Figure 33



Phosphorus

Phosphorus is a component found in both agricultural and residential fertilizer. It can also leach from septic systems and feed lots. Large amounts of phosphorus runoff can lead to poor water quality in the lake. High phosphorus levels can lead to algae bloom and poor water quality. The ICPB Part 302 states phosphorus as P shall not exceed 0.05 mg/L in any reservoir or lake with a surface are of 8.3 acres or more, or in any stream at the point where it enters any such reservoir or lake. The tributary exceeded this standard on most dates.

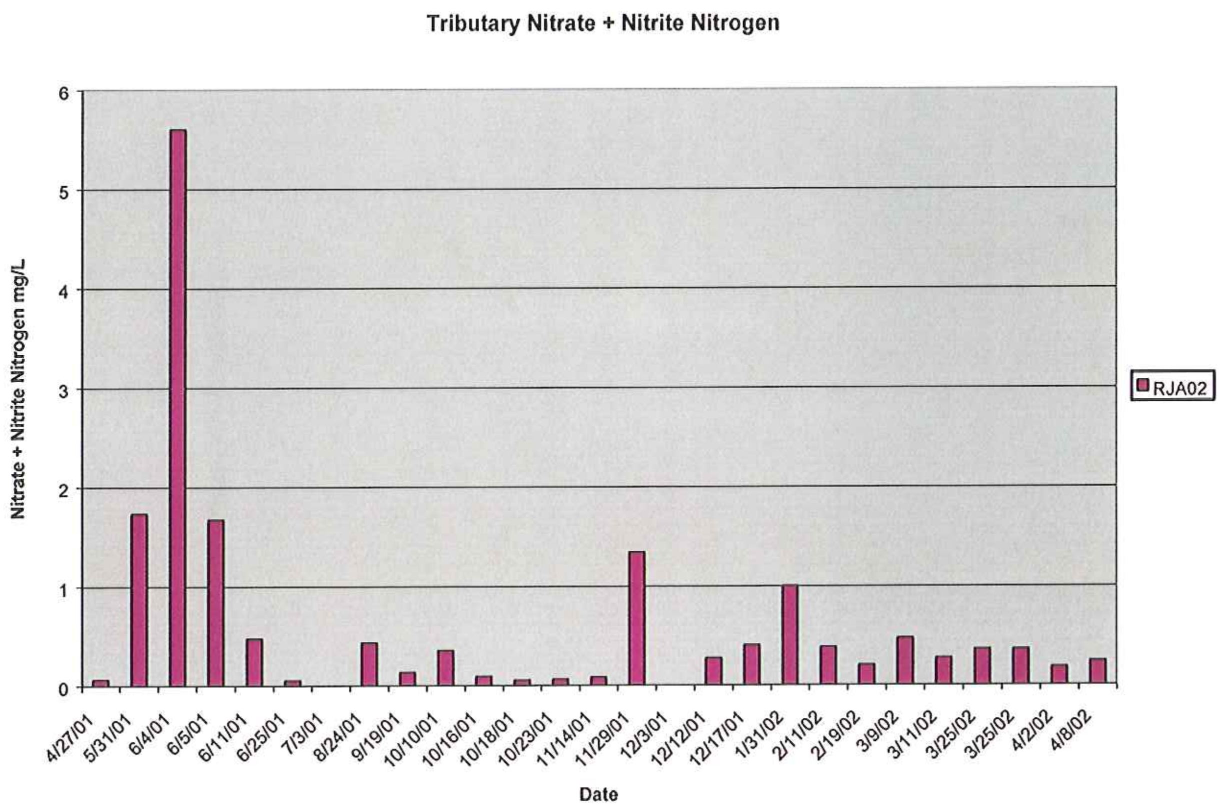
Figure 34



Nitrate + Nitrite Nitrogen

Nitrate and nitrite are inorganic forms of nitrogen, which can enter a lake through agricultural runoff, septic tank effluent and other forms of waste (Meyers 1999). The highest concentrations were found in May and June.

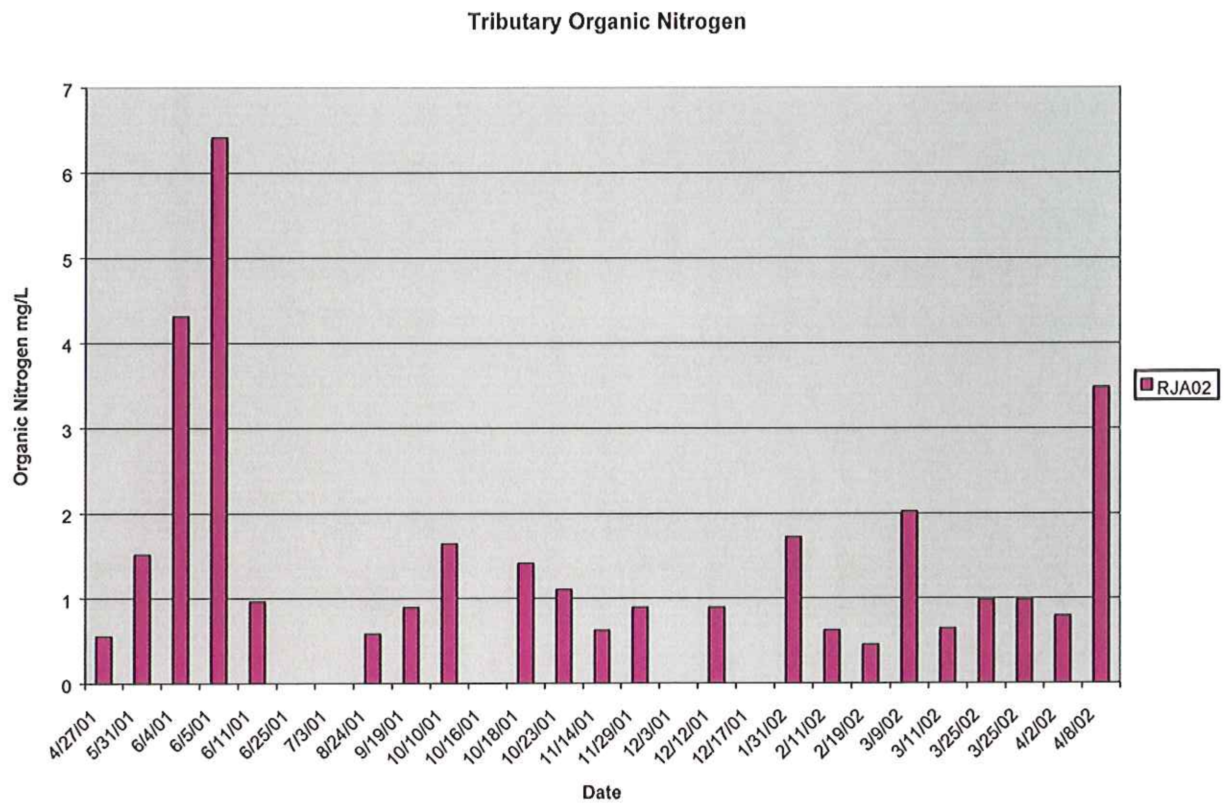
Figure 35



Organic Nitrogen

Kjeldahl nitrogen is ammonia nitrogen plus organic nitrogen. Organic nitrogen is calculated by subtracting ammonia nitrogen form kjeldahl nitrogen. Organic nitrogen can enter tributaries through decaying organic matter, septic systems and agricultural waste (Myers 1999). Organic nitrogen peaked in the tributary in June.

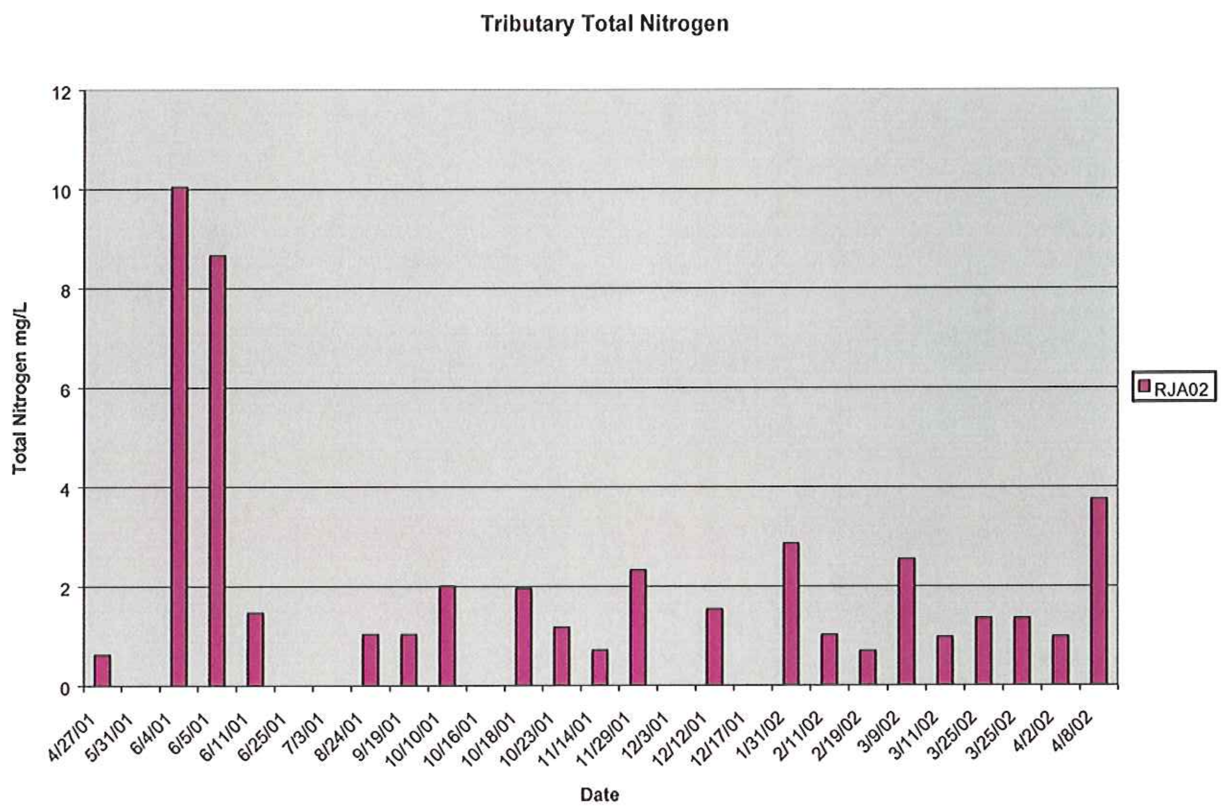
Figure 36



Total Nitrogen

Total nitrogen is the sum of all nitrogen. It is calculated by adding kjeldahl nitrogen and nitrate and nitrite nitrogen. The highest concentrations were found in June.

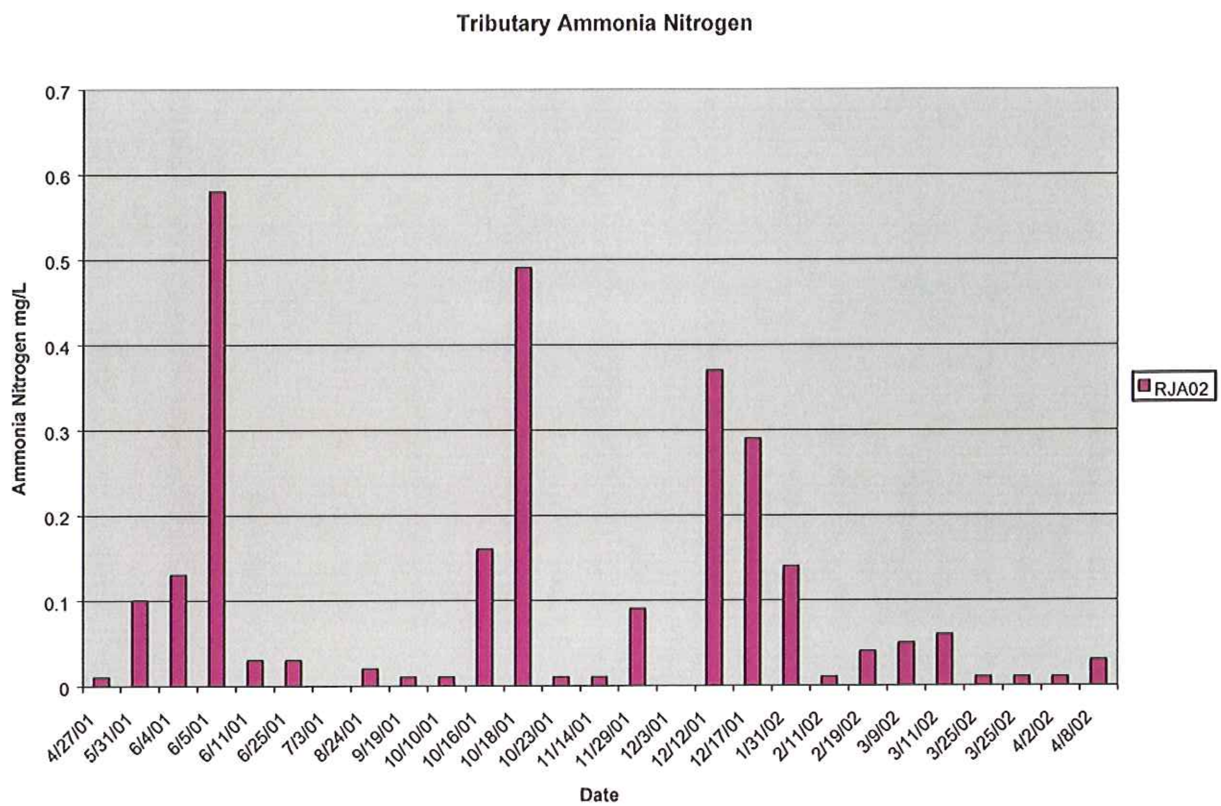
Figure 37



Ammonia Nitrogen

Ammonia nitrogen is the form of nitrogen that is most readily usable for plant growth. High ammonia concentrations can also have adverse affects on fish and other aquatic organisms. The IPCB Part 302 states that total ammonia shall in no case exceed 15 mg/L. No tributary samples exceeded this standard.

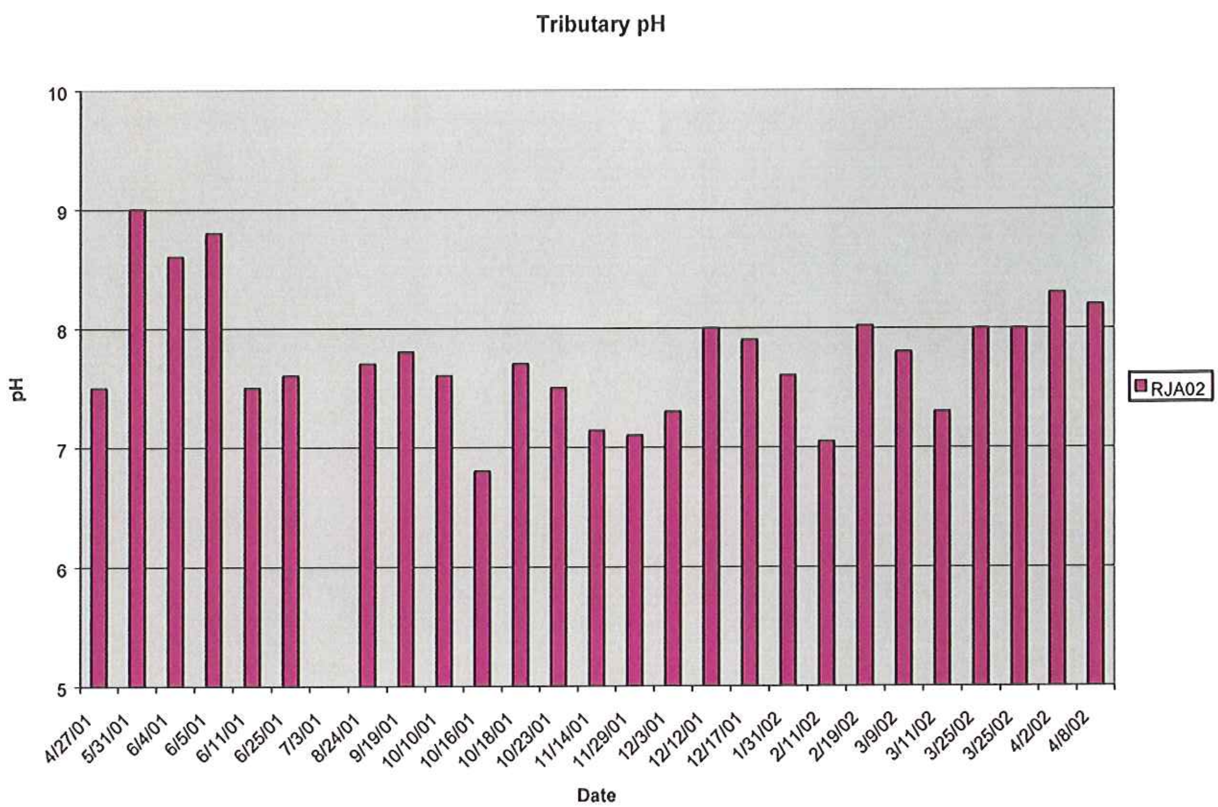
Figure 38



pH

PH measures the acidity of water. PH measures the hydrogen ions present in solution on a scale of 0-14. A reading of 7 is neutral. A reading higher than 7 is basic or alkaline. A reading less that 7 is acidic. The Illinois standard states that the pH should be within the range of 6.5 and 9 except for natural causes. PH was measured and the time other water samples were collected. The pH in the tributary was within the standard on all sample dates.

Figure 39



SEDIMENT SURVEY

Sediment Survey

As a part of the Clean Lakes Study, in 2001, the Illinois EPA conducted a sediment survey of Glenn Shoals Lake. The following are excerpt from this report. Sediment samples were collected to be analyzed by the IEPA Lab in Springfield, at selected, locations, RJA-1, RJA-2, and RJA-3. These samples helped to characterize the sediment in general

All samples were collected using a bucket auger, through up to 34 feet of water. The sediment samples represent the "hard bottom' sediments that could not be penetrated with the depth finder. The "soft sediments" can not be sampled with this type of sampling equipment due to their very high water content.

These data (Tables 13 and 14) reveal the types of materials that have been trapped in the sediment. The information will give baseline data to make informed decisions about restoration techniques, including dredging of the lake bottom. High concentrations of pesticides and heavy metals in the sediment could affect the dredging options.

Table 13 **Staunton Lake Sediments Organic**

	RJA-1 UG/KG	RJA-2	RJA-3
Total PCBS	10K	10K	10K
Hexachlorobenzene	1.0K	1.0K	1.0K
Trifluralin	10K	10K	10K
Alpha-BHC	1.0K	1.0K	1.0K
Gamma-BHC (Lindane)	1.0K	1.0K	1.0K
Atrazine	50K	50K	50K
Heptachlor	1.0K	1.0K	1.0K
Aldrin	1.0K	1.0K	1.0K
Alachlor	10K	10K	10K
Metribuzin	10K	10K	10K
Metolachlor	25K	25K	25K
Heptachlor Epoxide	1.0K	1.0K	1.0K
Pendimethalin	10K	10K	10K
Gamma-Chlordane	2.0K	2.0K	2.0K
Alpha-Chlordane	2.0K	2.0K	2.0K
Total Alpha and Gammas Chlordane	5.0K	5.0K	5.0K
Dieldrin	1.0K	1.0K	1.0K
Captan	10K	10K	10K
Cyanazine	25K	25K	25K
Endrin	1.0K	1.0K	1.0K
P P'-DDE	1.0K	1.0K	1.0K
P P'-DDD	1.0K	1.0K	1.0K
P P'-DDT	1.0K	1.0K	1.0K
Total DDT	10K	10K	10K
Methoxychlor	5.0K	5.0K	5.0K

Table 14 **Sediment Metals**

	RJA-1	RJA-2	RJA-3
Sample Depth in feet	34	24	9
Phosphorus-P, Sed.	685	761	553
Kjedahl-N, Sed	20000	19300	9760
Solids, Vol, Sed.	15.5%	14.4%	13.5%
Mercury, Sed.	0.10K	0.10K	0.10K
Barium, Sed.	230	240	110
Chromium, Sed.	23	24	16
Iron, Sed.	31000	31000	15000
Manganese, Sed.	1500	1500	570
Silver, Sed.	0.5	0.5K	0.5K
Toc, Sed.	3.7%	3%	2.0%
Solids, % Wet Sample	31.40%	32.00%	28.10%
Arsenic, Sed.	11	11	5.2
Potassium, SE d/wt	2130	2190	1300
Cadmium, Sed.	2.5K	2.5K	3.5K
Copper, Sed.	690	710	320
Lead, Sed.	31	32	19
Nickel, Sed.	22	22	15
Zinc, Sed.	97	95	75
collected by:	EPA	EPA	EPA

Units of measure mg/Kg

	Detection Limit	Low	Normal	Elevated	Highly Elevated
Phosphorus-P, Sed.	0.1mg/Kg	less than 394	394<1115	1115<2179	2179 or greater
Kjedahl-N, Sed	1.0mg/Kg	less than 1300	1300<5357	5357<11700	11700 or greater
Mercury, Sed.	0.1 mg/Kg	n/a	less than 0.15	0.15<0.701	.701 or greater
Barium, Sed.	1.0mg/Kg	less than 94	94<271	271<397	397 or greater
Chromium, Sed.	10mg/Kg	less than 13	13<27	27<49	49 or greater
Iron, Sed.	10mg/Kg	less than 1600	1600<37000	37000<56000	56000 or greater
Manganese, Sed.	10mg/Kg	less than 500	500<1700	1700<5500	5500 or greater
Silver, Sed.	0.1mgKg	n/a	less than 0.1	0.1<1	1 or greater
Arsenic, Sed.	0.5mg/Kg	less than 4.1	4.1<14	14<95.5	95.5 or greater
Potassium, SE d/wt	10mg/Kg	lesss than 410	410<2100	2100<2797	2797 or greater
Cadmium, Sed.	0.1mg/Kg	n/a	less than 5	5<14	14 or greater
Copper, Sed.	10mg/Kg	less than 16.7	16.7<100	100<590	590 or greater
Lead, Sed.	0.1mg/Kg	less than 14	14<59	59<339	339 or greater
Nickel, Sed.	1.0mg/Kg	less than 14.3	14.3<31	31<43	43 or greater
Zinc, Sed.	10mg/Kg	less than 59	59<145	145<1100	1100 or greater

SHORELINE EROSION

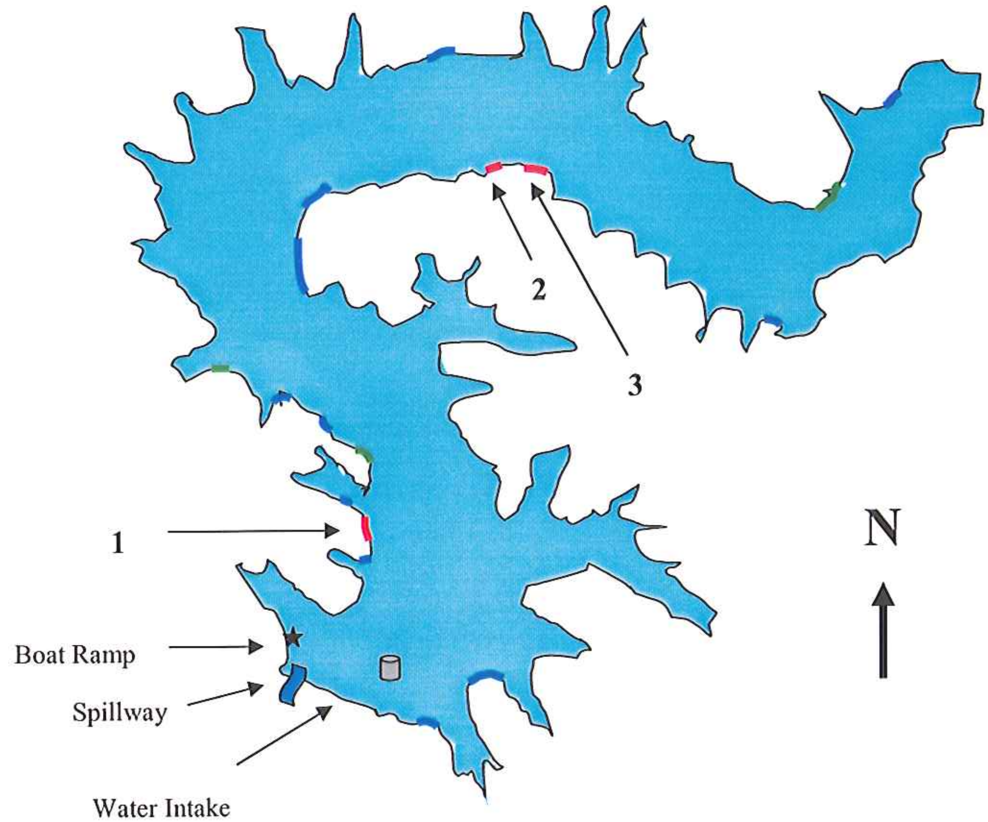
Shoreline erosion is important to consider when looking at the overall health of a lake. Erosion can affect a lake in many ways including sedimentation, loss of shoreline vegetation, interference with light, release of nutrients, stressed fish, oxygen depletion and loss of underwater habitat. (Fuller 1997). Sedimentation due to erosion can have a significant impact on the volume of the lake over time. Although shoreline erosion is not the only source, it can contribute significantly to this problem. Erosion can affect shoreline vegetation and habitats by destroying plants and trees near the shoreline. Suspended sediments will interfere with light, interfering with the food chain. Nutrients eroded into the lake can increase algae growth and lead to oxygen depletion. Fish like bass rely on sight to feed. Increased turbidity can affect their feeding. Erosion degrades both plant and fish habitats.

There are several causes for shoreline erosion - some of them are controllable and some of them are not. Some of the causes include loss of vegetation, powerboat waves, wind-generated waves and ice. The loss of vegetation on or near the shoreline makes the shoreline more susceptible to erosion. High-speed boats can increase the erosion on lakes. The size of the wave generated by a boat is a function of the water displaced by the boat and the speed at which the boat is traveling. In the case of some bass boats, which are designed to skim across the surface, they create smaller waves because they displace less water. Waves generated from the wind also contribute to shoreline erosion (Fuller 1997).

To obtain a better understanding of the shoreline erosion situation, ZIES staff did an intensive survey of the shoreline around Staunton Reservoir (Figure 40). A map was generated in which areas of the shoreline were labeled in the following manner: undercut, slight bank erosion 1-3 ft, moderate bank erosion 3-8 ft and severe bank erosion 8 + ft.

The survey concluded that there was 195 feet of severe shoreline erosion, 387 feet of moderate shoreline erosion, and 1,526 feet of slight shoreline erosion. The survey also concluded that there was no visible undercutting along the studied shoreline. However, at certain times of the year, when the water level drops below average capacity some undercutting is visible as can be seen in the photographs below.

Figure 40 Staunton Reservoir Erosion Survey 2001



Legend

Severe Erosion (>8 Feet)	
Moderate Erosion (>3 <8)	
Slight Erosion (1 – 3)	
Boat Ramp	★
Spillway	
Water Intake	

Severe Erosion Index

Length x Width

1. 105' x 44'
2. 30' x 12'
3. 60' x 16

TROPHIC CONDITION

The trophic status of a lake is a phrase that refers to the current degree of eutrophication. Eutrophication is the process of increased nutrient loads, biological productivity and the filling of a lake with sediment and organic materials. The trophic status gives an understanding of water quality problems and the biological aging of a lake. There are four main trophic status characterizations.

Oligotrophic lakes have low nutrient levels resulting in small quantities of macrophytes and algae. The water in oligotrophic lakes is usually well oxygenated because little decomposition is taking place.

Mesotrophic lakes have moderate nutrient levels resulting in moderate biological aging.

Eutrophic lakes are rich in nutrients resulting in high biological production of algae and macrophytes. Biological processes in eutrophic lakes speed the aging of the lake by collecting dead and decaying plant material in the bottom of the lake. This decomposing material releases nutrients back into the water leading to increased algae and macrophytes. Decomposition leads to low oxygen levels near the bottom of the lake.

Hypereutrophic lakes are extremely nutrient rich and productive. These lakes often have large quantities of aquatic plants and high concentrations of algae. They can experience alga blooms, which can result in low oxygen levels and fish kills.

According to the phytoplankton report Staunton Lake was mesotrophic with some tendencies toward becoming eutrophic during the study period.

BIOLOGICAL MONITORING

In addition to the physical and chemical measurements taken several biological parameters were studied as part of the project. These studies included a phytoplankton survey, chlorophyll a analysis, macrophyte survey, fish survey and bacteriological analysis, and wildlife and livestock estimates.

Phytoplankton

Phytoplankton are microscopic algae that live suspended in the water column. Developing an understanding of the types of phytoplankton found in the lake will give insight into the lake's health. High levels of blue green algae (Cyanobacteria) are usually an indicator of a eutrophic lake because they thrive in organically rich waters. Phytoplankton are at the bottom of the food chain, providing food material for larger organisms including fish. Communities of phytoplankton are good indicators of a lake's trophic status and can influence the overall biological health of a lake. They influence food availability, light penetration, and oxygen availability. As a means to meet EPA water treatment standards the city treats the lake with copper sulfate. Copper sulfate treatment can have adverse affect on phytoplankton and other invertebrates.

Algae Genera Cell Density and Cell Volumes

As part of the Clean Lakes program ZIES staff collected water samples to be tested for genera, cell density and cell volumes. Phytoplankton analysis was conducted at Western Illinois University in the lab of Dr. Larry M. O'Flaherty. The report is as follows:

Lake Staunton Report

Lake Staunton was sampled at three sites (1, 2, 3) in 2001 on 27 April, 25 June, 16 July, 28 August and 18 October (Tables: List of Taxa; Summary of Numbers and Biovolumes of Organisms-Each Site). No record of sampling in earlier years was available. Blue-greens (Cyanophyta) dominated the phytoplankton at each site on 27 April, 16 July and 18 October (Table: Phytoplankton Totals; Graphs: Total Phytoplankton; Cyanophyta). Green algae (Chlorophyta) were the most abundant (1000 or more/mL) on 25 June and 28 August (Graph: Chlorophyta).

Diatoms **(Bacillariophyta)** reached their peak densities at each site on 18 October (367/mL-Site 1; 479/mL-Site 2; 377/mL-Site 3) (Table: Phytoplankton Totals; Graph: Bacillariophyta). *Cyclotella meneghiniana* was responsible for all of these peak densities (Table: Numbers and Biovolumes of Individual Taxa-Each Site). It was the most numerous at Site 1 on 27 April at 112/mL (accompanied by *Nitzschia acicularis* at 10/mL) and 16 July at 163/mL with *Nitzschia palea* at 20/mL. On 25 June, *Nitzschia palea* was the only diatom present and it was in a density of 10/mL. At Site 2 on 27 April, *C. meneghiniana* and *N. palea* were each at 10/mL (Table: Numbers and Biovolumes of Individual Taxa-Site 2). On 25 June, the former was at 71/mL and the latter at 10/mL. *C. meneghiniana* was at 173/mL, *Nitzchia linearis* at 20/mL and *N. palea* at 61/mL on 16 July. Finally on 28 August, *C. meneghiniana* was at 92/mL and a *Cyclotella* sp. (girdle view) at 10/mL. There were no diatoms in the sample taken at Site 3 on 27 April (Table: Numbers and Biovolumes of Individual Taxa-Site 3). *C. meneghiniana* was the only one present on 25 June and formed the total density of 143/mL. On 16 July, it was at 326/mL and was accompanied only by *N. palea* at 41/mL. *C. meneghinana* was at 51/mL on 28 August with a *C.* sp. at 41/mL and *Melosira italica* var. *tenuissima* "Present". All of these diatoms are those indicative of eutrophic lakes . The species of *Nitzschia* are tolerant of high levels of organic materials with *N. palea* the most tolerant. These diatoms form on the bottom in shallow areas of a lake or are washed into a lake from the bottom of streams that empty into a lake. In either case, they continue their development as members of the phytoplankton. Their densities, however, were low on every date on which they appeared which is a positive sign for Lake Staunton in terms of condition. The restriction of total density mostly to one species (*C. meneghiniana*) was not a positive sign for the lake.

As was noted, green algae (**Chlorophyta**) dominated the phytoplankton at each site on 25 June and 28 August (Table: Phytoplankton Totals; Graphs: Total Phytoplankton; Chlorophyta). They were abundant (1000 or more/mL) on all the other dates except 16 July at Site 2 when they reached a total density of 999/mL. All of the taxa seen in 2001 were those typical of eutrophic lakes (Table: List of Taxa). *Dictyosphaerium pulchellum*, *Oocystis borgei* and *Schroederia setigera* were the only green algae found in every sample. The total number of different green algal taxa was a plus in terms of the condition of the lake.

At Site 1 on 27 April, the green algae in a density of 100 or more/mL included *Oocystis borgei* at 1294/mL, *Schroederia setigera* at 255/mL, *Dictyosphaerium pulchellum* at 214/mL and *Oocystis pusilla* at 122/mL (Table: Numbers and Biovolumes of Individual Taxa-Site 1). At Site 2 on 27 April, the number of different taxa was lower, but *O. borgei* was at 1192/mL or nearly the density it had at Site 1. Both *D. pulchellum* and *S. setigera* were at 306/mL. *O. pusilla* was in a density of 92/mL which was slightly less than its density at Site 1. At Site 3 on 27 April, the ranking of the green algae was *O. borgei* at 1284/mL, *D. pulchellum* at 214/mL, *S. setigera* at 143/mL and *Coelastrum microporum* at 102/mL (Table: Numbers and Biovolumes of Individual Taxa-Site 3). *O. pusilla* was at only 71/mL at Site 3. It is not typical for the dominant alga (in this case *Oocystis borgei*) and others in high numbers to be in such close densities at each site since the sites characteristically differ in their physical and chemical characteristics. On 27 April, they may still have differed, but water in the lake may have been evenly mixed throughout its basin or the sites may have been close together. As was noted, however, there were differences in the number of taxa and in the densities of some of the greens such as *O. pusilla* and *C. microporum*.

On 25 June at Site 1, *Coelastrum cambricum* was the most numerous green alga at 846/mL followed by *Carteria* sp. (No. 1) at 377/mL, *Carteria multifilis* at 234/mL, *D. pulchellum* at 163/mL and a *Cosmarium* sp. (7.5 x 7.5 μm) at 102/mL. At Site 2 on that date, *C. cambricum* was at 489/mL, a *Cosmarium* sp. (15.0 x 15.0 μm) at 194/mL and another *C.* sp. (15.0 x 12.5 μm) at 112/mL. The other greens seen in densities of 100 or more/mL at Site 1 were all in densities <100/mL at Site 2. Site 3 had the lowest density of *C. cambricum* (234/mL), but the densities of *C. multifilis* (183/mL) and *D. pulchellum* (132/mL) were closer to those at Site 1 than they were at Site 2. *Oocystis borgei* was at 132/mL at Site 3 as well. It was at 61/mL at Site 1 and 82/mL at Site 2 on 25 June.

Seven taxa were in densities >100/mL at Site 1 on 16 July. Their rank order based on density is *C. cambricum* (214/mL), *O. borgei* (204/mL), *D. pulchellum* and *Schroederia setigera* (each at 173/mL), *C. multifilis*, *C. microporum* and a *Cosmarium* sp. (10.0 x 6.0 μm) each at 102/mL. At Site 2, the ranking is *O. borgei* (214/mL), *C. cambricum* (163/mL) and *D. pulchellum* (153/mL). *C. microporum* and the *Cosmarium* sp. were not in the sample taken at

Site 2 and *C. multifilis* was at 71/mL. At Site 3, the ranking is *Carteria multifilis* (367/mL), *O. borgei* (245/mL), *D. pulchellum* (173/mL) and *C. cambricum* (122/mL). *C. microporum* was at 20/mL, *S. setigera* at 71/mL and the *Cosmarium* sp. seen at Site 1 was not present.

At Site 1 on 28 August, *D. pulchellum* was at 2100/mL, *O. borgei* at 234/mL, *C. cambricum* at 194/mL, *C. multifilis* at 173/mL and *Ankistrodesmus falcatus* var. *acicularis* and *Scenedesmus abundans* each at 102/mL. At Site 2, *D. pulchellum* was at 3465/mL, *C. cambricum* at 275/mL, *O. borgei* at 153/mL, *C. multifilis* at 122/mL and *Schroederia setigera* at 112/mL. The other two taxa present at >100/mL at Site 1 were in the sample from Site 2, but at densities <100/mL. At Site 3, *D. pulchellum* was at 2242/mL, *C. cambricum* at 204/mL, *S. setigera* at 153/mL, *O. borgei* at 122/mL and *Phacotus lenticularis* and *S. abundans* each at 102/mL. *P. lenticularis* was in the samples from sites 1 and 2, but was again in lower densities than it was at Site 3.

Finally, on 18 October at Site 1, *C. cambricum* was at 1121/mL, *O. borgei* at 194/mL, *S. setigera* at 122/mL and *D. pulchellum* at 102/mL. At Site 2, *C. cambricum* was at exactly the same density as at Site 1 (1121/mL), *O. borgei* at 153/mL and *D. pulchellum* at 122/mL. *S. setigera* was at 92/mL. At Site 3, *C. cambricum* was at 1131/mL, *S. setigera* at 153/mL and *O. borgei* at 143/mL. *D. pulchellum* was at 71/mL.

These examinations for each site on each date indicate that the sites were similar in terms of the taxa present and the most numerous taxa were in close to the same density at each site on each date. Once again, this indicates that the water in the lake was evenly mixed from site to site or the sites themselves were close together.

No chrysophytes (**Chrysophyta**) were seen in the samples from 2001 (Table: List of Taxa). These algae appear in lakes when water temperatures and competition from other algae are low. The temperature may have been low enough on 27 April and 18 October, but competition from both the green algae and the blue-greens was apparently still high based on the total densities of each (Table: Phytoplankton Totals).

Cryptomonads (**Cryptophyta**) were not abundant (1000 or more/mL) on any date in 2001 (Table: Phytoplankton Totals; Graph: Cryptophyta). They were not in the samples from 27 April which was unusual for this group. They reached their peak density of 82/mL on 25 June at Site 1 and were at lower densities on 16 July, 28 August and 18 October. At Site 2, they reached their peak of 448/mL (the highest for all three sites) on 25 June and again were in lower densities on the following dates. At Site 3, they peaked at 143/mL on 16 July and were at 51/mL on 25 June, 102/mL on 28 August and 112/mL on 18 October. *Cryptomonas erosa* was present at sites 2 and 3 only on 18 October (Table: List of Taxa). *C.* sp. (No. 1) was the only cryptomonad present at Site 1 and at sites 2 and 3 on 25 June, 16 July and 28 August. At sites 2 and 3 on 18, October it was more numerous than *C. erosa* (Table: Numbers and Biovolumes of Individual Taxa-Each Site). *C.* sp. (No. 1) is more tolerant of high levels of organic materials than *C. erosa* and it appears in lakes after a heavy rain, an algicide treatment or if a destratifier is in place. It low density on each date indicated that it was never an important contributor to the phytoplankton totals.

As was mentioned, the blue-greens (**Cyanophyta**) dominated the phytoplankton on three of the five dates sampled in 2001 (Table: Phytoplankton Totals; Graphs: Total Phytoplankton; Cyanophyta). They reached their peak densities on 18 October at each site (7929/mL-Site 1; 7226/mL-Site 2; 6136/mL-Site 3) and were abundant (>1000/mL) on all the remaining dates except 25 June at Site 3 (764/mL) and 28 August at Site 2 (877/mL). The innocuous blue-green, *Gomphosphaeria lacustris*, dominated these totals on every date except 28 August at Site 3 when *Anacystis montana* filled that role. *Anacystis* was second to *Gomphosphaeria* in terms of density on all the dates and sites except for this one date and site. These two are considered innocuous because they do not cause tastes or odors in water supplies and they do not produce toxins. They do, however, increase turbidity and may impart a color to the water. The three blue-greens indicative of eutrophic conditions in lakes or the movement toward eutrophic conditions in lakes were present in Lake Staunton in 2001. *Anabaena spiroides* var. *crassa* was in the samples taken at each site only on 16 July (61/mL-Site 1; 10/mL-Site 2; 245/mL-Site 3). *Aphanizomenon flos-aquae* was at all three sites on 25 June and 16 July and at only Site 2 on 18 October (Table: List of Taxa). At Site 1, it was 61/mL on 25 June and 347/mL on 16 July (Table: Numbers and Biovolumes of Individual Taxa-Site 1). At Site 2, *Aphanizomenon* was 61/mL on 25 June, 296/mL on 16 July and 10/mL on 18 October (Table: Numbers and Biovolumes of Individual Taxa-Site 2). At Site 3, it was at 31/mL on 25 June and 571/mL on 16 July (Table: Numbers and Biovolumes of Individual Taxa-Site 3). The last total was the highest for any date or site in 2001. *Microcystis aeruginosa* was in the samples taken on 28 August. It was at 20/mL at Site 1, 71/mL at Site 2 and 41/mL at Site 3. *Schizothrix calcicola* was present only at sites 1 and 2 and only at densities well under 100/mL. *Merismopedia quadruplicata* was only at Site 1 on 16 July at a density of only 61/mL. These two blue-greens are indicative of the presence of shallow areas in lakes since they develop on the bottom in those areas, enter the water column and continue their development as phytoplankters. Since they were in such low densities in Lake Staunton, the lake must not have had extensive shallow areas in 2001.

Euglenoids (**Euglenophyta**) reached their peak density (102/mL) at Site 1 on 27 April, were not in countable numbers on 25 June, 16 July or 28 August and were at only 20/mL on 18 October (Table: Phytoplankton Totals; Graph: Euglenophyta). At sites 2 and 3, they peaked on 18 October (102/mL-Site 2; 132/mL-Site 3) and were at lower densities on the rest of the dates. *T. volvocina* formed half (51/mL) of the total density of euglenoids on 27 April and all of the total on 18 October at Site 1 (Table: Numbers and Biovolumes of Individual Taxa-Site 1). At Site 2, it formed a majority (51/mL) of the total on 27 April and all of the totals on the other dates (Table: Numbers and Biovolumes of Individual Taxa-Site 2). At Site 3, *T. volvocina* was responsible for a majority (41/mL) of the total of 61/mL on 27 April, 25 June (61/mL out of 71/mL) and 18 October (122/mL out of 132/mL). It was one of six species of *Trachelomonas* present on 16 July. Each was at a density of 10/mL. On 28 August, it was one of two species present and again, each was at a density of 10/mL. Basically, euglenoids were not major contributors to the total density of phytoplankton.

Ceratium hirundinella was the only dinoflagellate (**Pyrrhophyta**) seen the samples from 2001 (Table: List of Taxa). It was "Present" in the sample taken on 28 August at Site 2 (Table: Numbers and Biovolumes of Individual Taxa). *C. hirundinella* is another indicator of eutrophic conditions in lakes.

Summary

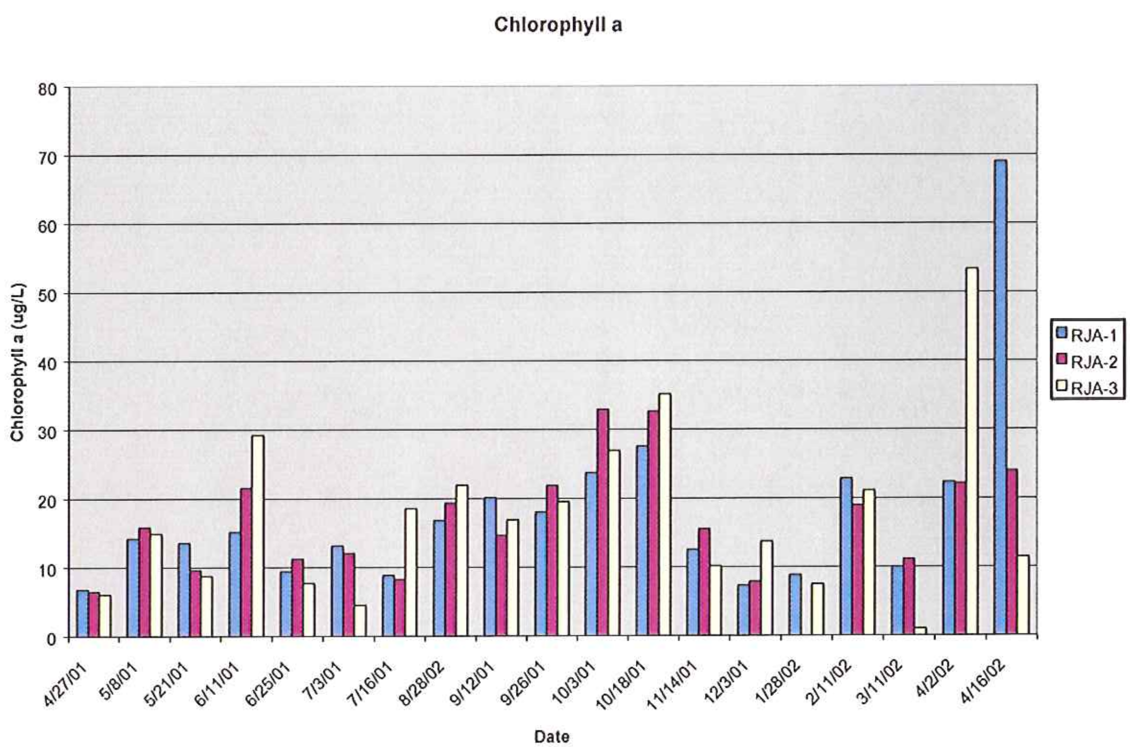
Lake Staunton was mesotrophic in 2001, but was closer to the eutrophic side than it was to the oligotrophic side. This conclusion that it was a mesotrophic lake is based on a number of characteristics. First, blue-greens did not dominate the phytoplankton on every date. Second, they were in low densities during most of 2001 and the innocuous taxa, *Gomphosphaeria lacustris* and *Anacystis montana*, were the most abundant members of the group on each date. Third, the green algae dominated on two dates with one being 28 August and although all the taxa were characteristic of eutrophic lakes, the total green algal density was distributed among a number of taxa on each date sampled in 2001. Fourth, the domination by green algae on 28 August was a good sign since blue-greens typically are the most abundant group in August in eutrophic lakes. It is possible that an algicide treatment was applied to Lake Staunton during the period from 16 July to 28 August. If this were the case, a drop in blue-green densities in that period would have allowed the greens to fill the void by 28 August. This means the lake could have been closer to being eutrophic than was surmised from the phytoplankton data. Lake managers should have an answer for this speculation. In any case, the fifth characteristic in support of the conclusion that the lake is mesotrophic is the observation of low densities of *Cryptomonas* sp. (No. 1) and the *Trachelomonas* spp. which showed that the lake was apparently not heavily loaded with organic materials. Finally, the low densities of *Merismopedia quadruplicata* and *Schizothrix calcicola* indicated a lack of extensive shallow areas in the lake. The determination that Lake Staunton was closer to a eutrophic condition than an oligotrophic one is based on a number of factors as well. Even though they were not in high densities, the presence of the diatom *Cyclotella meneghiniana* and the three species of *Nitzschia* (*N. acicularis, N. linearis* and *N. palea*) supported this determination. Further support was given by the presence of *Anabaena spiroides* var. *crassa*, *Aphanizomenon flos-aquae* and *Microcystis aeruginosa*. None of these three indicators of a eutrophic condition was at a "bloom" density (1000 or more/mL or One Million or more/L), but *A. spiroides* var. *crassa* was at 245/mL at Site 3 on 16 July and *Aphanizomenon* was at 347/mL at Site 1, 296/mL at Site 2 and 571/mL at Site 3 on the same date. *Microcystis* was at low densities (<100/mL) only on 28 August. These organisms may expand their densities in the years following 2001. The lack of chrysophytes in the 27 April date points toward a lake in a eutrophic condition, but this may have more to do with the time of sampling than the actual status of Lake Staunton.

Chlorophyll a

Chlorophyll a is a pigment found in all green plants and is necessary for photosynthesis. The amount of chlorophyll a found in the water is used as a measure of the amount of algae present in the water. Chlorophyll is the key element needed for photosynthesis. It is the basic ingredient for all life in a lake. Chlorophyll a concentrations are used as a variable in determining the degree of eutrophication and trophic status of a lake. According to the Illinois 305(b) report, chlorophyll a samples in lakes which fall between 7.5μg/L and 55μg/L can be classified as eutrophic and concentrations higher than 55μg/L can be classified as hypereutrophic. The 305(b) guidelines for listing of overall use support impairment in lakes uses the ranges between 20-92μg/L as slight, ranges between 92-426μg/L as moderate and anything higher than 426μg/L as High. Chlorophyll a samples were collected at seven sites by ZIES staff as part of the Illinois Volunteer Lake Monitoring Program (VLMP) and analyzed at IEPA laboratories. All sample values were corrected for pheophytin a. The corrected chlorophyll a values equal only the living chlorophyll a.

Chlorophyll a was found in the slightly elevated range on most dates. Chlorophyll a peaked at moderately elevated levels at all sites on 6/12/02. RJA-1 peaked at 69 μg/L on April 16th. RJA-2 peaked at 32.6 μg/L on October 18th. RJA-3 peaked at 53 μg/L on April 2nd.

Figure 41



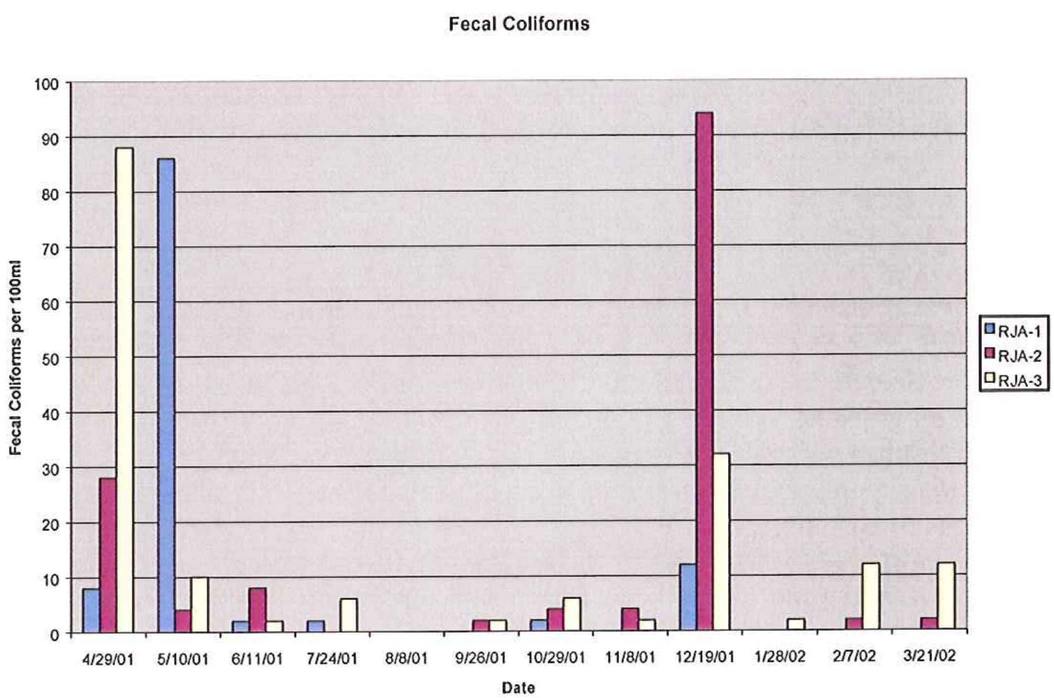
Bacteriology

Bacteriological samples were taken to check for fecal coliforms bacteria (Figure 42). Fecal coliforms are indicators of possible human and animal waste contamination. It is important for drinking and recreational waters to be free from pathogenic organisms. High levels of coliforms and streptococcus are often a result of leaching of septic systems, feedlot runoff, large waterfowl populations, cattle grazing and run-off from wildlife areas. The Illinois standards for fecal coliforms state that they shall not exceed a geometric mean of 200 per 100 ml nor shall more than 10% of at least five samples during any 30-day period exceed 400 per 100 ml in protected waters. Protected waters are areas that support primary contact or flow through or are adjacent to parks or residential areas (IPCB Part 302.209). The IEPA 305(b) water quality report sets a guideline of non-support for swimming when the geometric mean of all fecal coliforms samples is greater than or equal to 200 per100ml or 25% of all samples exceeds 400 per 100 ml. Fecal coliforms are bacteria found in the gastrointestinal tract of warm-blooded animals.

Bacteriological samples were collected by ZIES staff and analyzed at Madison county environmental labs in Edwardsville Illinois.

Samples at RJA-1 peaked on 5/10/01 at 86/100ml. Samples at RJA-2 peaked on 12/19/01 at 94/100ml. Samples at RJA-3 peaked on 4/29/01 at 88/100ml. There were no dates when the fecal coliforms exceeded 400 per 100 ml at any of the sites.

Figure 42



Fish

Fisheries are a major concern for Staunton Reservoir. Fishing is one of the main recreational activities that take place on the lake. Staunton Reservoir is known for its quality fishing. Sport fishers come from a large area for bass, bluegill, crappie, catfish and muskellunge. Maintaining quality-fishing stocks is an important component for overall lake management. The Illinois Department of Natural Resources has done a very good job managing the fisheries for Staunton Reservoir, in part through the efforts of Jeffrey Pontnack, IDNR Fisheries Manager. Water quality can have a direct impact on the fish population in the lake.

As part of the Clean Lakes requirement Jeffrey Pontnack of the IDNR conducted a fish flesh analysis. Fish were sampled using electro fishing (AC). All samples were within the regulatory limits for the specific compounds analyzed (Table 17). The IDNR in cooperation with the City sets fishing regulations including number and size limits in addition to developing a lake management plan which involves conducting regular fish surveys.

Table 15 - Fish Stocking Records

Year	Species	Number	Size
1995	Channel Catfish	3,540	8.5"
1995	Largemouth Bass	1,420	4.0"
1996	Channel Catfish	2,832	8.0"
1996	Largemouth Bass	1,423	4.0"
1997	Channel Catfish	2,669	8.2"
1997	Largemouth Bass	4,252	4.0"
1997	Bluegill	14,000	1.0"
1998	Channel Catfish	1,845	8.0"
1998	Largemouth Bass	1,420	4.0"
1999	Channel Catfish	1,200	10.0"
1999	Largemouth Bass	1,420	4.0"
1999	Muskellunge	84	11.0"
1999	Channel Catfish	800	8.0"

Source: IDNR & Sportsman's Connection

Table 16 - Fish Length as Sampled by the IDNR Fall 1999

Species	0-5	6-8	9-11	12-14	15-19	20-24	Total
Bluegill	61	21					82
Largemouth Bass	3	4	4	11	22		44
Channel Catfish			2	1	1	1	5

Source: IDNR & Sportsman's Connection

Table 17 Fish Tissue Samples from Staunton Reservoir

Collected by: IDNR	J. Pontnack	ELECTRO FISHING (AC)	
Date: 10/12/2001			
SPECIES	**LARGEMOUTH BASS SMALL**	**CARP SMALL**	**CARP LARGE**
# of Fish	5	5	5
ALDRIN	.01K	.01K	.01K
TOTAL CHLORDANE	.02K	.02K	.02K
TOTAL DDT AND ANALOGS	.01K	.01K	.01K
DIELDRIN	.01K	.01K	.01K
TOTAL PCBS	0.1K	0.1K	0.1K
HEPTACHLOR	.01K	.01K	.01K
HEPTACHLOR EPOXIDE	.01K	.01K	.01K
TOXAPHENE	1.0K	1.0K	1.0K
METHOXYCHLOR	.05K	.05K	.05K
HEXACHLOROBENZENE	.01K	.01K	.01K
GAMMA-BHC (LINDANE)	.01K	.01K	.01K
ALPHA-BHC	.01K	.01K	.01K
MIREX	.01K	.01K	.01K
ENDRIN	.01K	.01K	.01K
LIPID CONTENT %	0.67	1.1	2.0
# OF INDIV. IN SAMPLE	5	5	5
SAMPLE WEIGHT LBS	1.30A	8.43A	5.50A
FISH SPECIES (NUM)	31	12	12
FISH SPECIES-ALPHA	LMB	C	C
ANATOMY (NUMERIC)	86	86	86
ANALYZING AGENCY	1	1	1
LENGTH OF FISH INCH	14.0A	15.6A	23.3A
ALL CHEMICALS IN UG/G		NOTE: K = LESS THAN VALUE	

STAUNTON CITY LAKE

Habitat Description as a Proportion of Total shoreline and shoreline sampled By Electrofishing

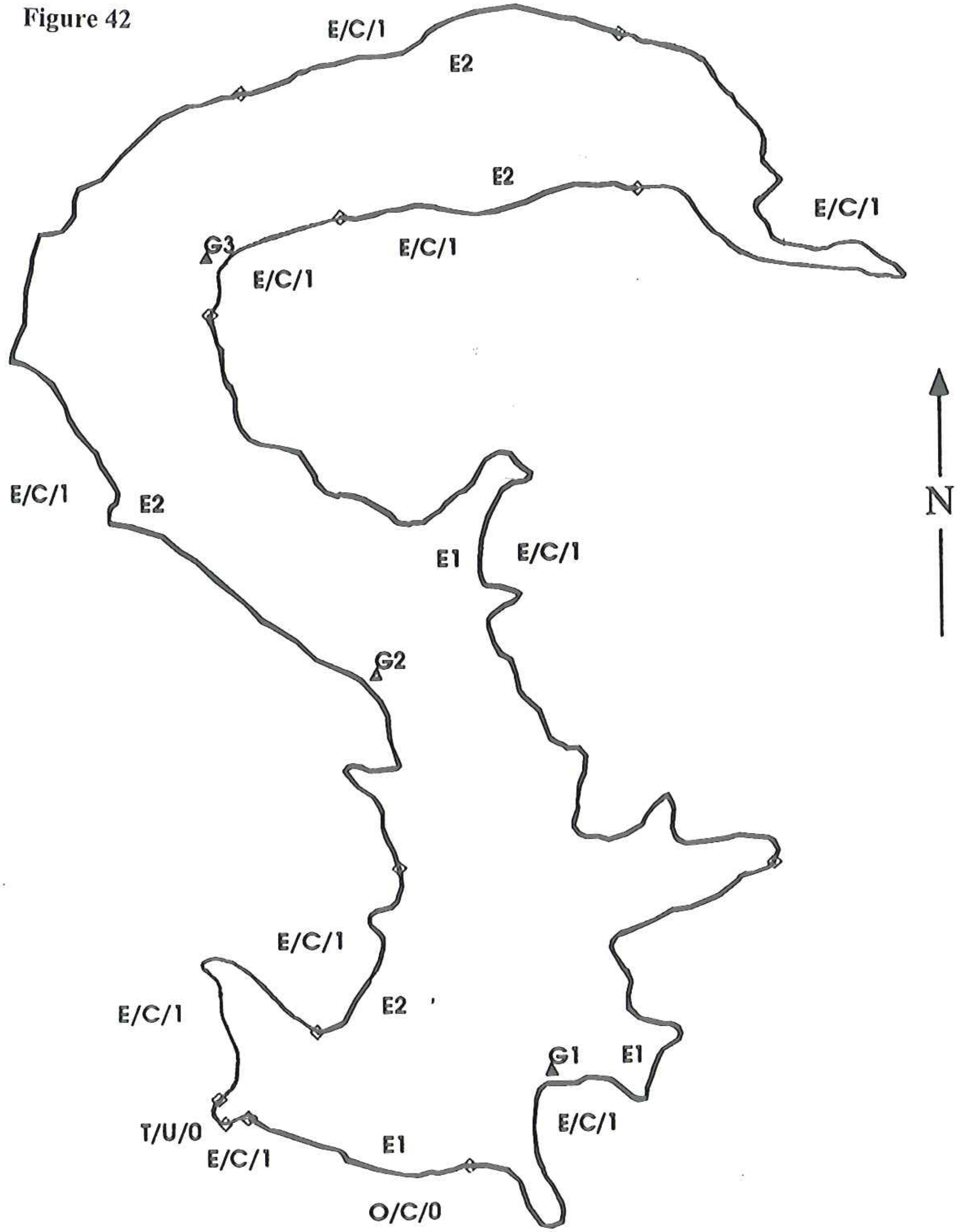
Habitat Type	Percent of Total shoreline	Percent of total Shoreline Sampled by Electrofishing
E/C/1	95	73
O/C/0	4	
T/U/O	1	

Fish Species Present in Lake (Based on **IDOC** sampling):

Black Crappie
Blackspotted Topminnow
Bluegill
Bowfin
Carp
Golden Shiner
Green sunfish
Largemouth Bass
Redear Sunfish
Warmouth
White Crappie
Yellow Bullhead
Yellow Perch

STAUNTON CITY LAKE

Figure 42



Habitat Codes (given as a three character code: Habitat/Substrate/Hard Cover)

Habitat:	Substrate:	Hard Cover Rating:
W = Woody debris	M = Mud or silt	0 = 0% woody debris and no docks.
E = Emergent vegetation	C = Clay	1 = 0% woody debris with docks or 1-33% woody debris.
R = Rip rap	S = Sand	2 = 1-33% woody debris with many docks or 34-66% woody debris.
O = Open area	G = Gravel	3 = 34-66% woody debris with many docks or greater than 67% woody debris.
D = Docks	B = Rock or boulder	
T = Retaining wall or dam face	U = Unknown	
U = Unknown		

Information compiled by the **Illinois Natural History Survey**, completed 6/23/89

1996 (31) STAUNTON CITY LAKE. GEAR E SPECIES FREQUENCY ADJUSTED FOR SAMPLING

BLC 2	BLG 88	CAP 1	CCF 2	FCF 1	GOS 2
GSF 3	LMB 43	PUD 2	RSF 4	WHC 1	YLB 1

Total Frequency: 150

Table 1996 (31) Staunton City Lake. Gear E. LMB Length Frequency/Condition Index

Length Group		Total L-Freq	Means Weight		No. Weighed	Mean Condition			
MM	**Inches**		**Grams**	**LBS**		**Wr**	**(95%)**	**KN**	**(95%)**
100-109	3.9-4.3	5	11.8	0.03	4	83	(37)	0.89	(0.4)
110-119	4.3-4.7	3	15.0	0.03	3	87	(76)	0.93	(0.8)
120-129	4.7-5.1	2	21.5	0.05	2	91	(400)	0.97	(4.3)
130-139	5.1-5.5	0	-	-	0	-	-	-	-
140-149	5.5-5.9	1	34.0	0.07	1	84	-	0.89	-
150-159	5.9-6.3	2	47.0	0.10	2	105	(68)	1.11	(0.7)
160-169	6.3-6.7	6	53.6	0.12	5	90	(15)	0.96	(0.2)
170-179	6.7-7.1	1	68.0	0.15	1	107	-	1.14	-
180-189	7.1-7.5	1	82.0	0.15	1	102	-	1.08	-
190-199	7.5-7.9	0	-	-	0	-	-	-	-
200-209	7.9-8.3	0	-	-	0	-	-	-	-
210-219	8.3-8.7	0	-	-	0	-	-	-	-
220-229	8.7-9.1	2	151.5	0.33	2	97	(16)	1.02	(0.2)
230-239	9.1-9.4	1	178.0	0.39	1	103	-	1.08	-
240-249	9.4-9.8	0	-	-	0	-	-	-	-
250-259	9.8-10.2	3	200.0	0.44	3	90	(9)	0.94	(0.1)
260-269	10.2-10.6	3	228.7	0.50	3	88	(23)	0.92	(0.2)
270-279	10.6-11.0	1	278.0	0.61	1	100	-	1.05	-
280-289	11.0-11.4	1	270.0	0.60	1	83	-	0.87	-
290-299	11.4-11.8	3	306.7	0.68	3	84	(14)	0.88	(0.1)
300-309	11.8-12.2	1	335.0	0.74	1	84	-	0.88	-
310-319	12.2-12.6	1	370.0	0.82	1	86	-	0.90	-
320-329	12.6-13.0	1	420.0	0.93	1	81	-	0.85	-
330-339	13.0-13.4	1	464.0	1.02	1	83	-	0.87	-
340-349	13.4-13.8	1	480.0	1.06	1	79	-	0.82	-
350-359	13.8-14.2	0	-	-	0	-	-	-	-
360-369	14.2-14.6	1	660.0	1.45	1	89	-	0.93	-
370-379	14.6-15.0	0	-	-	0	-	-	-	-
380-389	15.0-15.4	0	-	-	0	-	-	-	-
392-399	15.4-15.7	1	782.0	1.72	1	82	-	0.85	-
400-409	15.7-16.1	0	-	-	0	-	-	-	-
410-419	16.1-16.5	0	-	-	0	-	-	-	-
420-429	16.5-16.9	0	-	-	0	-	-	-	-

430-439	16.9-17.3	0	-	-	0	-	-	-	-
440-449	17.3-17.7	0	-	-	0	-	-	-	-
450-459	17.7-18.1	0	-	-	0	-	-	-	-
460-469	18.1-18.5	0	-	-	0	-	-	-	-
470-479	18.5-18.9	0	-	-	0	-	-	-	-
480-489	18.9-19.3	1	1650.0	3.64	1	95	-	0.99	-

TOTAL 43 41

1996 (31)E. STAUNTON CITY LAKE. GEAR E. LMB Stock Index Table

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Year	Stock N 20cm, 7.9in	YAR (N) 15cm, 5.9in		PSD (N) 30cm,11.8 in		RSD1 (N) 40cm,15.7cm		RSD2 (N) 45cm, 17.7in		RSD3 (N) 50cm, 19.7in	
1996	22	0.5	(11)	36.4	(8)	4.5	(1)	4.5	(1)	0.0	(0)

Table 1999 (FAL1)E. Staunton City Lake BLG Length Frequency/Condition

Length Group		**Total L-Freq**	**Means Weight**		**No. Weighed**	**Mean Condition**			
MM	**Inches**		**Grams**	**LBS**		**Wr**	**(95%)**	**KN**	**(95%)**
30-39	1.2-1.6	1	-	-	0	-	-	-	-
40-49	1.6-2.0	14	-	-	0	-	-	-	-
50-59	2.0-2.4	43	-	-	0	-	-	-	-
60-69	2.4-2.8	7	-	-	0	-	-	-	-
70-79	2.8-3.1	1	-	-	0	-	-	-	-
80-89	3.1-3.5	2	-	-	0	-	-	-	-
90-99	3.5-3.9	3	7.3	0.02	3	48	(38)	0.48	(0.4)
100-109	3.9-4.3	4	14.2	0.03	4	68	(29)	0.70	(0.3)
110-119	4.3-4.7	5	31.4	0.07	5	105	(11)	1.11	(0.1)
120-129	4.7-5.1	3	36.3	0.08	3	98	(51)	1.05	(0.5)
130-139	5.1-5.5	1	35.0	0.08	1	81	-	0.88	-
140-149	5.5-5.9	2	50.0	0.11	2	82	(6)	0.92	(0.0)
150-159	5.9-6.3	0	-	-	0	-	-	-	-
160-169	6.3-6.7	3	84.3	0.19	3	88	(29)	1.01	(0.3)
170-179	6.7-7.1	0	-	-	0	-	-	-	-
180-189	7.1-7.5	1	118.0	0.26	1	88	-	1.04	-

TOTALS: 88 22

Table 1996(31) Staunton City Lake. GEAR E. BLG CPUE in number of fish per hour or set

Millimeters	Inches	1E1	1E2:	E
30-39	1.2-1.6	2.0	-	1.0
40-49	1.6-2.0	24.0	-	12.0
50-59	2.0-2.4	68.0	18.0	43.0
60-69	2.4-2.8	10.0	4.0	7.0
70-79	2.8-3.1	2.0	-	1.0
80-89	3.1-3.5	4.0	-	2.0
90-99	3.5-3.9	4.0	2.0	3.0
100-109	3.9-4.3	6.0	2.0	4.0
110-119	4.3-4.7	6.0	4.0	5.0
120-129	4.7-5.1	6.0	-	3.0
130-139	5.1-5.5	2.0	-	1.0
140-149	5.5-5.9	4.0	-	2.0
150-159	5.9-6.3	-	-	-
160-169	6.3-6.7	4.0	2.0	3.0
170-179	6.7-7.1	-	-	-
180-189	7.1-7.5	2.0	-	1.0

1996 (31)E. STAUNTON CITY LAKE. GEAR E. BLG Stock Index Table

Year	Stock N 8cm, 3.1in	YAR (N) 30cm, 11.8in		PSD (N) 15cm,5.9 in		RSD1 (N) 18cm,7.1cm		RSD2 (N) 20cm, 7.9in		RSD3 (N) 23cm, 9.1in	
1996	24	3.7	(88)	16.7	(4)	4.2	(1)	0.0	(0)	0.0	(0)

Table 1999 (FAL1)E. Staunton City Lake CCF Length Frequency/Condition

Length Group		Total L-Freq	Means Weight		No. Weighed	Mean Condition			
MM	Inches		Grams	LBS		Wr	(95%)	KN	(95%)
300-309	11.8-12.2	1	222.0	0.49	1	95	-	1.08	-
310-319	12.2-12.6	0	-	-	0	-	-	-	-
320-329	12.6-13.0	0	-	-	0	-	-	-	-
330-339	13.0-13.4	0	-	-	0	-	-	-	-
340-349	13.4-13.8	0	-	-	0	-	-	-	-
350-59	13.8-14.2	0	-	-	0	-	-	-	-
360-369	14.2-14.6	0	-	-	0	-	-	-	-
370-379	14.6-15.0	0	-	-	0	-	-	-	-
380-389	15.0-15.4	0	-	-	0	-	-	-	-
390-399	15.4-15.7	0	-	-	0	-	-	-	-
400-409	15.7-16.1	0	-	-	0	-	-	-	-
410-419	16.1-16.5	0	-	-	0	-	-	-	-
420-429	16.5-16.9	1	589.0	1.30	1	82	-	0.93	-
	TOTALS:	2			2				

Table 1996(31) Staunton City Lake. GEAR E. CCF CPUE in number of fish per hour or set

Millimeters	Inches	1E1	1E2:	E
300-309	11.8-12.2	2.0	-	1.0
310-319	12.2-12.6	-	-	-
320-329	12.6-13.0	-	-	-
330-339	13.0-13.4	-	-	-
340-349	13.4-13.8	-	-	-
350-59	13.8-14.2	-	-	-
360-369	14.2-14.6	-	-	-
370-379	14.6-15.0	-	-	-
380-389	15.0-15.4	-	-	-
390-399	15.4-15.7	-	-	-
400-409	15.7-16.1	-	-	-
410-419	16.1-16.5	-	-	-
420-429	16.5-16.9	2.0	-	1.0

1996 (31)E. STAUNTON CITY LAKE. GEAR E. CCF Stock Index Table

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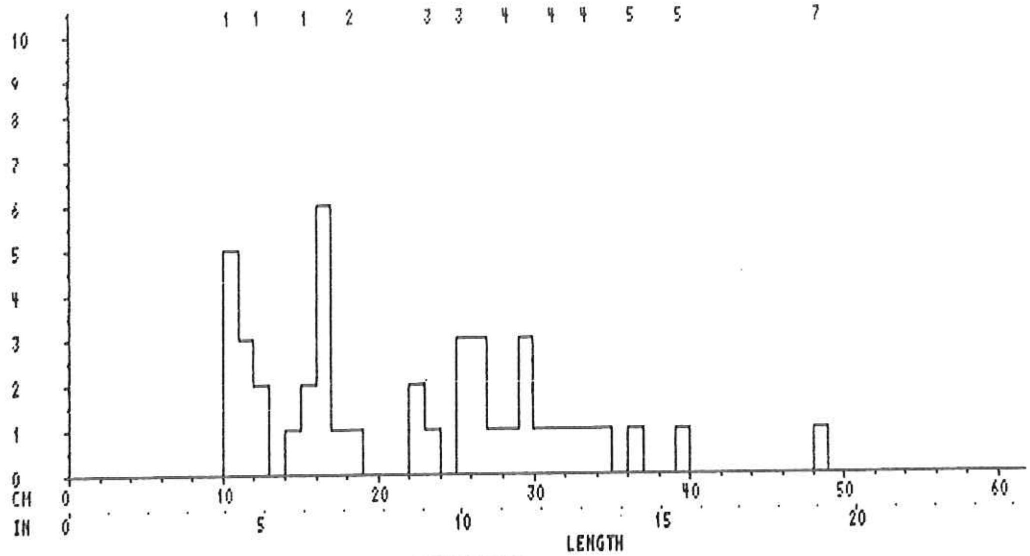
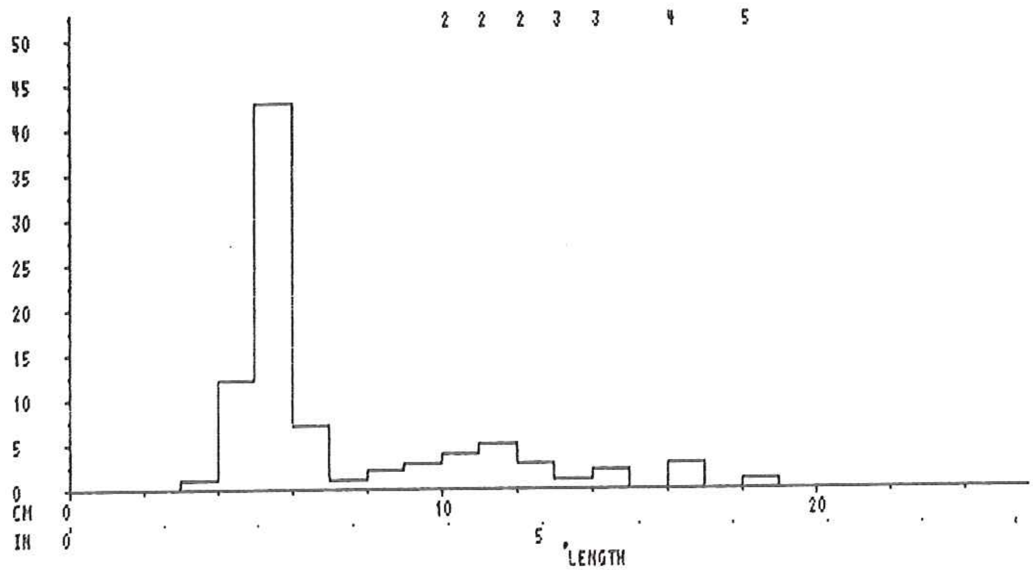
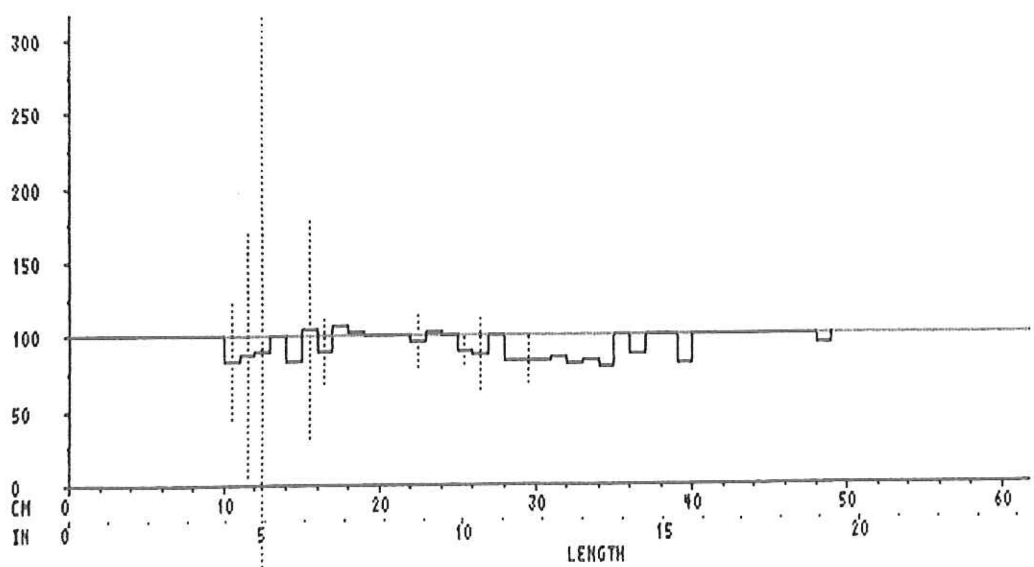
Year	Stock N 28cm, 11.0in	YAR (N) 23cm, 9.1in		PSD (N) 41cm,16.1 in		RSD1 (N) 46cm,18.1cm		RSD2 (N) 51cm, 20.1in		RSD3 (N) 61cm, 24.0in	
1996	2	0.0	(0)	50.0	(1)	0.0	(0)	0.0	(0)	0.0	(0)



FREQUENCY VS. FISH LENGTH 43 LARGEMOUTH BASS
AGE GROUP IN YEARS IS SHOWN AT TOP.
LENGTH FREQUENCY HISTO W/ AGE OF LMB AT STAUNTON CITY LAKE-FALL 1996.



FREQUENCY VS. FISH LENGTH 88 BLUEGILL
AGE GROUP IN YEARS IS SHOWN AT TOP.
LENGTH FREQUENCY HISTO W/ AGE OF BLG AT STAUNTON CITY LAKE-FALL 1996.



1999 (FAL1)E. STAUNTON CITY LAKE. SPECIES FREQUENCY

BLC 3	BLG 82	CAP 3	CCF 2	GSF 22
LMB 44	PUD 13	RSF 4	YLB 6	

Total Frequency: 179

Table 1999 (FAL1)E. Staunton City Lake LMB Length Frequency/Condition

Length Group		Total L-Freq	Means Weight		No. Weighed	Mean Condition			
MM	Inches		Grams	LBS		Wr	(95%)	KN	(95%)
110-119	4.3-4.7	2	21.0	0.05	2	112	(37)	1.20	(0.4)
120-129	4.7-5.1	0	-	-	0	-	-	-	-
130-139	5.1-5.5	1	31.0	0.07	1	105	-	1.11	-
140-149	5.5-5.9	0	-	-	0	-	-	-	-
150-159	5.9-6.3	0	-	-	0	-	-	-	-
160-169	6.3-6.7	2	49.5	0.11	2	94	(23)	1.00	(0.2)
170-179	6.7-7.1	1	69.0	0.15	1	92	-	0.98	-
180-189	7.1-7.5	0	-	-	0	-	-	-	-
190-199	7.5-7.9	0	-	-	0	-	-	-	-
200-209	7.9-8.3	1	102.0	0.22	1	94	-	1.00	-
210-219	8.3-8.7	0	-	-	0	-	-	-	-
220-229	8.7-9.1	0	-	-	0	-	-	-	-
230-239	9.1-9.4	0	-	-	0	-	-	-	-
240-249	9.4-9.8	1	159.0	0.35	1	80	-	0.85	-
250-259	9.8-10.2	0	-	-	0	-	-	-	-
260-269	10.2-10.6	1	254.0	0.56	1	93	-	0.97	-
270-279	10.6-11.0	1	247.0	0.54	1	86	-	0.90	-
280-289	11.0-11.4	0	-	-	0	-	-	-	-
290-299	11.4-11.8	0	-	-	0	-	-	-	-
300-309	11.8-12.2	1	382.0	0.84	1	94	-	0.99	-
310-319	12.2-12.6	0	-	-	0	-	-	-	-
320-329	12.6-13.0	1	485.0	1.07	1	95	-	0.99	-
330-339	13.0-13.4	2	493.0	1.09	2	90	(30)	0.94	(0.3)
340-349	13.4-13.8	0	-	-	0	-	-	-	-
350-359	13.8-14.2	3	621.3	1.37	3	93	(6)	0.97	(0.1)
360-369	14.2-14.6	3	660.0	1.45	3	90	(15)	0.94	(0.2)
370-379	14.6-15.0	2	776.5	1.71	2	99	(12)	1.03	(0.1)
380-389	15.0-15.4	5	770.4	1.70	5	90	(5)	0.94	(0.1)
392-399	15.4-15.7	4	885.5	1.95	4	94	(17)	0.98	(0.2)
400-409	15.7-16.1	2	976.5	2.15	2	97	(6)	1.01	(0.1)
410-419	16.1-16.5	3	985.3	2.17	3	90	(17)	0.93	(0.2)
420-429	16.5-16.9	0	-	-	0	-	-	-	-
430-439	16.9-17.3	1	1145.0	2.52	1	94	-	0.97	-
440-449	17.3-17.7	0	-	-	0	-	-	-	-

450-459	17.7-18.1	1	1249.0	2.75	1	86	-	0.90	-
460-469	18.1-18.5	3	1618.0	3.57	3	101	(16)	1.05	(0.2)
470-479	18.5-18.9	1	1461.0	3.22	1	90	-	0.93	-
480-489	18.9-19.3	2	1943.0	4.28	2	107	(128)	1.11	(1.3)

TOTAL 44 44

1999 (FAL1)E. STAUNTON CITY LAKE. LMB Stock Index Table

- -

Year	Stock N 20cm, 7.9in	YAR (N) 15cm, 5.9in		PSD (N) 30cm,11.8 in		RSD1 (N) 40cm,15.7cm		RSD2 (N) 45cm, 17.7in		RSD3 (N) 50cm, 19.7in	
1999	38	0.1	(3)	89.5	(34)	34.2	(13)	18.4	(7)	0.0	(0)

Table 1999 (FAL1)E. Staunton City Lake BLG Length Frequency/Condition

Length Group		**Total L-Freq**	**Means Weight**		**No. Weighed**	**Mean Condition**			
MM	**Inches**		**Grams**	**LBS**		**Wr**	**(95%)**	**KN**	**(95%)**
60-69	2.4-2.8	4	-	-	0	-	-	-	-
70-79	2.8-3.1	1	-	-	0	-	-	-	-
80-89	3.1-3.5	6	9.0	0.02	1	89	-	0.86	-
90-99	3.5-3.9	20	15.0	0.03	1	89	-	0.92	-
100-109	3.9-4.3	20	17.8	0.04	6	84	(12)	0.86	(0.1)
110-119	4.3-4.7	4	26.8	0.06	4	95	(15)	1.00	(0.2)
120-129	4.7-5.1	3	30.3	0.07	3	80	(10)	0.86	(0.1)
130-139	5.1-5.5	0	-	-	0	-	-	-	-
140-149	5.5-5.9	3	52.7	0.12	3	86	(17)	0.97	(0.2)
150-159	5.9-6.3	9	66.7	0.15	3	83	(8)	0.95	(0.1)
160-169	6.3-6.7	9	80.3	0.18	6	83	(6)	0.96	(0.1)
170-179	6.7-7.1	2	74.0	0.16	2	68	(85)	0.80	(1.0)
180-189	7.1-7.5	1	98.0	0.22	1	74	-	0.88	-

TOTALS: 82 30

1999 (FAL1)E. STAUNTON CITY LAKE. BLG Stock Index Table

- -

Year	Stock N 8cm, 3.1in	YAR (N) 2cm, 0.8in		PSD (N) 15cm,5.9 in		RSD1 (N) 17cm,6.7cm		RSD2 (N) 20cm, 7.9in		RSD3 (N) 22cm, 8.7in	
1999	77	0.0	(0)	27.3	(21)	3.9	(3)	0.0	(0)	0.0	(0)

Table 1999 (FAL1)E. Staunton City Lake CCF Length Frequency/Condition

Length Group		Total L-Freq	Means Weight		No. Weighed	Mean Condition			
MM	Inches		Grams	LBS		Wr	(95%)	KN	(95%)
410-419	16.1-16.5	1	549.0	1.21	1	86	-	0.98	-
420-429	16.5-16.9	1	776.0	1.71	1	108	-	1.23	-
	TOTALS:	2			2				

1999 (FAL1)E. STAUNTON CITY LAKE. CCF Stock Index Table

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Year	Stock N	YAR (N)	PSD (N)	RSD1 (N)	RSD2 (N)	RSD3 (N)
	28cm, 11.0in	22cm, 8.7in	41cm,16.1 in	45cm,17.7cm	50cm, 19.7in	60cm, 23.6in

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1999	2	0.0 (0)	100.0 (2)	0.0 (0)	0.0 (0)	0.0 (0)

1999 (FAL1)E. STAUNTON CITY LAKE. SPECIES FREQUENCY

CAP 1	CCF 5	YLB 42		

Total Frequency: 48

Table 1999 (FAL1)E. Staunton City Lake CCF Length Frequency/Condition

Length Group		Total L-Freq	Means Weight		No. Weighed	Mean Condition			
MM	Inches		Grams	LBS		Wr	(95%)	KN	(95%)
230-239	9.1-9.4	1	95.0	0.21	1	98	-	1.11	-
240-249	9.4-9.8	0	-	-	0	-	-	-	-
250-259	9.8-10.2	0	-	-	0	-	-	-	-
260-269	10.2-10.6	0	-	-	0	-	-	-	-
270-279	10.6-11.0	0	-	-	0	-	-	-	-
280-289	11.0-11.4	0	-	-	0	-	-	-	-
290-299	11.4-11.8	1	187.0	0.41	1	86	-	0.98	-
300-309	11.8-12.2	0	-	-	0	-	-	-	-
310-319	12.2-12.6	0	-	-	0	-	-	-	-
320-329	12.6-13.0	1	260.0	0.57	1	85	-	0.96	-
330-339	13.0-13.4	0	-	-	0	-	-	-	-
340-349	13.4-13.8	0	-	-	0	-	-	-	-
350-59	13.8-14.2	0	-	-	0	-	-	-	-
360-369	14.2-14.6	0	-	-	0	-	-	-	-
370-379	14.6-15.0	0	-	-	0	-	-	-	-
380-389	15.0-15.4	0	-	-	0	-	-	-	-
390-399	15.4-15.7	0	-	-	0	-	-	-	-
400-409	15.7-16.1	0	-	-	0	-	-	-	-
410-419	16.1-16.5	0	-	-	0	-	-	-	-
420-429	16.5-16.9	0	-	-	0	-	-	-	-
430-439	16.9-17.3	0	-	-	0	-	-	-	-

440-449	17.3-17.7	0	-	-	0	-	-	-	-
450-459	17.7-18.1	0	-	-	0	-	-	-	-
460-469	18.1-18.5	0	-	-	0	-	-	-	-
470-479	18.5-18.9	0	-	-	0	-	-	-	-
480-489	18.9-19.3	0	-	-	0	-	-	-	-
490-499	19.3-19.7	0	-	-	0	-	-	-	-
500-509	19.7-20.1	1	1250.0	2.75	1	96	-	1.10	-
510-519	20.1-20.5	0	-	-	0	-	-	-	-
520-529	20.5-20.9	0	-	-	0	-	-	-	-
530-539	20.9-21.3	0	-	-	0	-	-	-	-
540-549	21.3-21.7	0	-	-	0	-	-	-	-
550-559	21.7-22.0	0	-	-	0	-	-	-	-
560-569	22.0-22.4	0	-	-	0	-	-	-	-
570-579	22.4-22.8	0	-	-	0	-	-	-	-
580-589	22.8-23.2	1	1820.0	4.01	1	89	-	102	-
	TOTALS:	5			5				

1999 (FAL1)E. STAUNTON CITY LAKE. CCF Stock Index Table

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Year	Stock 28cm, 11.0in	N	YAR 22cm, 8.7in	(N)	PSD 41cm,16.1 in	(N)	RSD1 45cm,17.7cm	(N)	RSD2 50cm, 19.7in	(N)	RSD3 60cm, 23.6in	(N)
1999		4	0.0	(0)	50.0	(2)	50.0	(2)	50.0	(2)	0.0	(0)

Table 2002 (FAL1)E. Staunton City Lake. Species Frequency

BGH 1	BLC 1	BLG 260	BOW 2	CAP 7	CCF 10	GSF 15
LMB 37	RSF 4	WHC 2	YEP 1	YLB 19		

Total Frequency: 359

Table 2002 (FAL1)E. Staunton City Lake LMB Length Frequency/Condition

Length Group		**Total L-Freq**	**Means Weight**		**No. Weighed**	**Mean Condition**			
MM	**Inches**		**Grams**	**LBS**		**Wr**	**(95%)**	**KN**	**(95%)**
170-179	6.7 - 7.1	1	64.0	0.14	1	99	-	1.05	-
180-189	7.1 - 7.5	0	-	-	0	-	-	-	-
190-199	7.5 – 7.9	1	91.0	0.20	1	99	-	1.05	-
200-209	7.9 – 8.3	2	111.0	.024	2	98	(95)	1.03	(1.0)

210-219	8.3 – 8.7	6	122.2	0.27	5	95	(10)	1.00	(0.1)
220-229	8.7 – 9.1	1	138.0	0.30	1	93	-	0.98	-
230-239	9.1 – 9.4	2	143.0	0.32	2	80	(59)	0.84	(0.6)
240-249	9.4 – 9.8	1	195.0	0.43	1	103	-	1.08	-
250-259	9.8 – 10.2	0	-	-	0	-	-	-	-
260-269	10.2 – 10.6	3	229.0	0.50	3	90	(27)	0.94	(0.3)
270-279	10.6 – 11.0	1	228.0	0.50	1	80	-	0.84	-
280-289	11.0 – 11.4	2	308.0	0.68	2	94	(110)	0.99	(1.2)
290-299	11.4 – 11.8	3	321.7	0.71	3	91	(29)	0.95	(0.3)
300-309	11.8 – 12.2	1	340.0	0.75	1	81	-	0.84	-
310-319	12.2 – 12.6	0	-	-	0	-	-	-	-
320-329	12.6 – 13.0	1	456.0	1.01	1	90	-	0.94	-
330-339	13.0 – 13.4	3	517.0	1.14	2	94	(44)	0.98	(0.3)
340-349	13.4 – 13.8	0	-	-	0	-	-	-	-
350-359	13.8 – 14.2	1	611.0	1.35	1	92	-	0.96	-
360-369	14.2 – 14.6	1	360.0	0.79	1	51	-	0.53	-
370-379	14.6 – 15.0	1	906.0	2.00	1	112	-	1.17	-
380-389	15.0 – 15.4	0	-	-	0	-	-	-	-
390-399	15.4 – 15.7	3	1010.0	2.23	3	108	(15)	1.13	(0.2)
400-409	15.7 – 16.1	0	-	-	0	-	-	-	-
410-419	16.1 – 16.5	0	-	-	0	-	-	-	-
420-429	16.5 – 16.9	1	1175.0	2.59	1	101	-	1.05	-
430-439	16.9 – 17.3	0	-	-	0	-	-	-	-

440-449	17.3 – 17.7	0	-	-	0	-	-	-	-
450-459	17.7 – 18.1	0	-	-	0	-	-	-	-
460-469	18.1 – 18.5	0	-	-	0	-	-	-	-
470-479	18.5 – 18.9	0	-	-	0	-	-	-	-
480-489	18.9 – 19.3	0	-	-	0	-	-	-	-
490-499	19.3 – 19.7	0	-	-	0	-	-	-	-
500-509	19.7 – 20.1	1	2080.0	4.58	1	100	-	1.04	-
540-519	20.1 – 20.5	0	-	-	0	-	-	-	-
520-529	20.5 – 20.9	1	2565.0	5.65	1	109	-	1.13	-
	TOTALS:	37			35				

Table 2002 (FAL1)E. Staunton City Lake BLG Length Frequency/Condition

Length Group		Total L-Freq	Means Weight		No. Weighed	Mean Condition			
MM	Inches		Grams	LBS		Wr	(95%)	KN	(95%)
30 - 39	1.2 – 1.6	2	-	-	0	-	-	-	-
40 - 49	1.6 – 2.0	16	-	-	0	-	-	-	-
50 – 59	2.0 – 2.4	12	-	-	0	-	-	-	-
60 – 69	2.4 – 2.8	20	-	-	0	-	-	-	-
70 – 79	2.8 – 3.1	12	-	-	0	-	-	-	-
80 – 89	3.1 – 3.5	20	6.3	0.01	3	57	(33)	0.56	(0.3)
90 – 99	3.5 – 3.9	12	10.3	0.02	3	70	(31)	0.70	(0.3)
100-109	3.9 – 4.3	28	17.8	0.04	5	79	(11)	0.81	(0.1)
110-119	4.3 – 4.7	18	20.7	0.05	7	74	(12)	0.78	(0.1)
120-129	4.7 – 5.1	26	32.2	0.07	5	88	(15)	0.95	(0.2)

130-139	5.1 – 5.5	40	39.0	0.09	9	82	(11)	0.90	(0.1)
140-149	5.5 – 5.9	30	50.4	0.11	7	84	(11)	0.94	(0.1)
150-159	5.9 – 6.3	24	59.8	0.13	8	83	(6)	0.94	(0.1)
	TOTALS:	260				47			

Table 2002 (FAL1)E. Staunton City Lake CCF Length Frequency/Condition

Length Group		Total L-Freq	Means Weight		No. Weighed	Mean Condition			
MM	**Inches**		**Grams**	**LBS**		**Wr**	**(95%)**	**KN**	**(95%)**
210-219	8.3 – 8.7	1	82.0	0.18	1	107	-	1.21	-
220-229	8.7 – 9.1	0	-	-	0	-	-	-	-
230-239	9.1 – 9.4	0	-	-	0	-	-	-	-
240-249	9.4 – 9.8	0	-	-	0	-	-	-	-
250-259	9.8 – 10.2	0	-	-	0	-	-	-	-
260-269	10.2 – 10.6	0	-	-	0	-	-	-	-
270-279	10.6 – 11.0	0	-	-	0	-	-	-	-
280-289	11.0 - 11.4	0	-	-	0	-	-	-	-
290-299	11.4 – 11.8	0	-	-	0	-	-	-	-
300-309	11.8 – 12.2	0	-	-	-	-	-	-	-
310-319	12.2 – 12.6	0	-	-	0	-	-	-	-
320-329	12.6 – 13.0	0	-	-	0	-	-	-	-
330-339	13.0 – 13.4	0	-	-	0	-	-	-	-
340-349	13.4 – 13.8	0	-	-	0	-	-	-	-
350-359	13.8 – 14.2	0	-	-	0	-	-	-	-
360-	14.2 – 14.6	0	-	-	0	-	-	-	-

369									
370-379	14.6 – 15.0	0	-	-	0	-	-	-	-
380-389	15.0 – 15.4	0	-	-	0	-	-	-	-
390-399	15.4 – 15.7	0	-	-	0	-	-	-	-
400-409	15.7 – 16.1	2	517.5	1.14	2	87	(44)	0.99	(0.5)
410-419	16.1 – 16.5	0	-	-	0	-	-	-	-
420-429	16.5 – 16.9	0	-	-	0	-	-	-	-
430-439	16.9 – 17.3	1	905.0	1.99	1	116	-	1.33	-
440-449	17.3 – 17.7	0	-	-	0	-	-	-	-
450-459	17.7 – 18.1	0	-	-	0	-	-	-	-
460-469	18.1 – 18.5	0	-	-	0	-	-	-	-
470-479	18.5 – 18.9	2	1125.0	2.48	2	111	(56)	1.27	(0.6)
480-489	18.9 – 19.3	0	-	-	0	-	-	-	-
490-499	19.3 – 19.7	0	-	-	0	-	-	-	-
500-509	19.7 – 20.1	0	-	-	0	-	-	-	-
510-519	20.1 – 20.5	1	1180.0	2.60	1	89	-	1.02	-
520-529	20.5 – 20.9	0	-	-	0	-	-	-	-
530-539	20.9 – 21.3	0	-	-	0	-	-	-	-
540-549	21.3 – 21.7	0	-	-	0	-	-	-	-
550-559	21.7 – 22.0	2	1750.0	3.86	2	102	(102)	1.17	(1.2)
560-569	22.0 – 22.4	0	-	-	0	-	-	-	-
570-579	22.4 – 22.8	0	-	-	0	-	-	-	-
580-589	22.8 – 23.2	0	-	-	0	-	-	-	-
590-	23.2 – 23.6	0	-	-	0	-	-	-	-

599									
600-609	23.6 – 24.0	0	-	-	0	-	-	-	-
610-619	24.0 – 24.4	0	-	-	0	-	-	-	-
620-629	24.4 – 24.8	0	-	-	0	-	-	-	-
630-639	24.8 – 25.2	0	-	-	0	-	-	-	-
640-649	25.2 – 25.6	1	3270.0	7.21	1	115	-	1.33	-

TOTALS: 10 10

STAUNTON CITY LAKE FALL 2002 SURVEY

2002 (FAL1)G. STAUNTON CITY LAKE. SPECIES FREQUENCY

G 2	CAP 2	CCF 1	YLB 9

Table 2002 (FAL1)E. Staunton City Lake CCF Length Frequency/Condition

Length Group		**Total L-Freq**	**Means Weight**		**No. Weighed**	**Mean Condition**			
MM	**Inches**		**Grams**	**LBS**		**Wr**	**(95%)**	**KN**	**(95%)**
490-499	19.3 – 19.7	1	1285.0	2.83	1	106	-	1.21	-

TOTALS: 1

Macrophyte Survey

Macrophytes are used by the IEPA as one determining factor of aquatic life health and recreational use impairment indicator (ALI, RUI). The quality of a lake can be impaired by an over abundance of aquatic and semi aquatic plants. Macrophytes play an important role in the ecology of a lake. Macrophytes can provide shelter for fish, slow erosion, provide habitat for waterfowl, oxygen source and absorb nutrients that are coming into the lake. The amount of aquatic or semi-aquatic macrophytes located in Staunton Reservoir would be considered slight to minimal. This is likely a result of steep banks and water level fluctuations.

ZIES did an extensive macrophyte survey during July and August 2001. This survey consisted of collecting and mapping macrophytes throughout the lake. Eight areas with significant macrophyte growth were identified. These were labeled A-H. Plants in these areas were identified by their scientific name and common name when available (Steyermark 1999). The density of each type of plant was identified as sparse, moderate, or dense. This information was used to generate a map (Figure 42) and table 18)

Staunton Reservoir contains many small coves throughout the main body of the lake. Several of the largest coves were considered separate areas for the macrophyte survey. The reservoir has steep banks around most of the lake leaving little room for aquatic macrophytes. Most of the plants found range from emergent to upland types of vegetation. All areas in the lake except area F were similar in nature with steep banks and little vegetation. The most common species in these areas were *Boehmeria cylindrica*, *Cephalanthus occidentalis*, and *Jussiaea repens*. Area F however is the cove where East Creek the only tributary enters the lake. This area is the most diverse section of the lake with many species appearing only in this cove. Most of them are sparse but this area greatly enhances the diversity of the macrophytes.

Figure 43

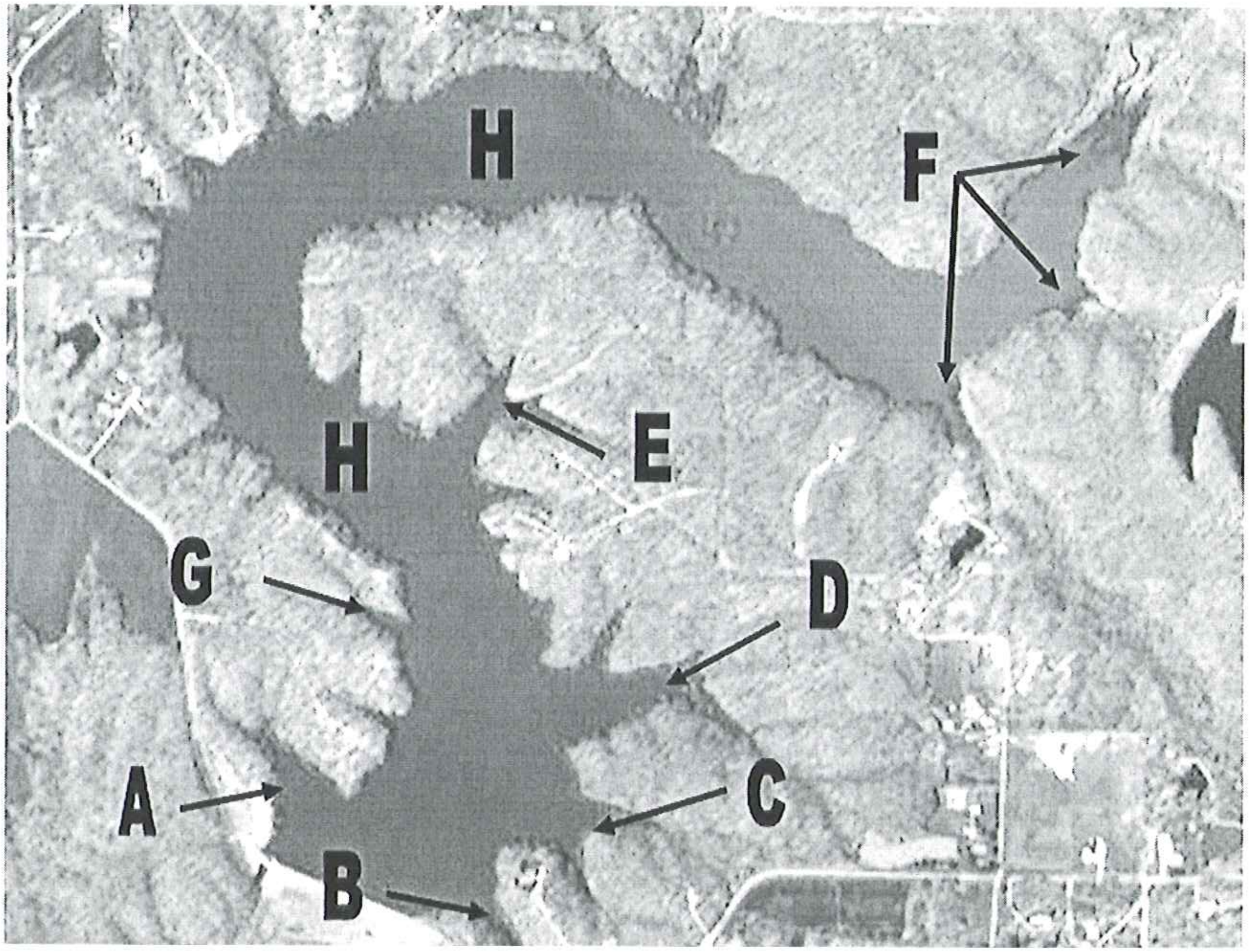

Table 18 - Staunton Reservoir

Plant Name	Location X Density							
	A	B	C	D	E	F	G	H
Acer negundo						M		
Agrimonia pubescens	S		S					
Ammania auriculata		S		M		D		S
Andropogon gerardii								S
Asclepias incarnata			S			S		S
Aster spp.	S							S
Aureolaria grandifolia					S		S	S
Bidens comosa						S		
Bidins spp.		S	S			S		S
Boehmeria cylindrica	M	M	M	M	D	M	D	M
Campsus radicans		S						
Carex cristatella	S	D				S		
Carex hirsutella	S							
Carex hystricina						S		
Cephalanthus occidentalis	M	S	M	M	S	M	S	M
Chasmanthium latifolium		S	S	M	S		S	S
Commelina communis	S		S			S		S
Cornus obliqua				S	S	M	M	M
Croton glandulosa		S				S		S
Cyperus erythrorhizos						S		
Cyperus strigosus	S	D				D		S
Desmodium glutinosum	S	S	S	S			M	S
Echinacea purpurea		S			S			S
Echinochloa crusgalli						D		S
Eleocharis ovata						M		
Elymus virginica	S	S				S		S
Eupatorium rugosum		S			S		S	S
Euphorbia corrolata		S		S			S	S
Geum canadense	S	S	S					S
Heliopsis helianthoides	S	S	S	M	S	S	S	S
Hibiscus militaris						S		
Hypericum punctatum						S		
Hystrix patula	S		S	S	S	S	S	S
Impatiens capensis	S	M	M			S	S	M
Ipomea pandurata		S						S
Juncus balticus						S		
Juncus effusus				S		S		
Juncus torreyi						S		
Jussiaea repens	S	S	S	M	M	M	M	S
Justicia americana						S		S
Lactuca floridana	S							S

Leersia oryzoides	M		M	D	M	M	D	
Lindernia anagallidea				M		M		S
Lipea lanceolata	M	S		M		M		
Ludwigia alternifolia	S							S
Lycopus americanus	S	S	S	S	S	M	S	S
Lysimachia nummularia	M	m	S	S	S	M	S	M
Mentha arvensis				S	S	S		S
Mimulus ringens	M	S	S	S		S	S	S
Parthenocissus quinquefolia		S					M	S
Penthorum sedoides		S		S		S		S
Phragmites australis						D		
Polygonum coccinium	M	S	S		S	M		S
Polygonum hydropiperoides	S		S	M	S	S		S
Polygonum lapathafolium		S				S		S
Polygonum persicaria	S		S			S		S
Populus deltoides						S		
Prunella vulgaris						S		
Ptelea trifoliata						S	S	
Ranunculus abortivus						S		
Rhus radicans	S	S	A			M	M	S
Rhus typhina					S			
Rosa multiflora		S	S	S	S	S	S	S
Rudbeckia hirta						S		S
Rumex crispus						S		
Sagittaria latifolia						S		
Salix interior						D		
Sambucus canadensis						S		
Schoenoplectus pungens					S			
Scirpus atrovirens						S		
Scirpus cyperinus						S		
Scutellaria incana	S	S		S		S	S	
Scutellaria laterifolia			S			S		S
Silphium perfoliatum								S
Silphium terebinthinaceum								S
Solidago canadensis		S	S		S	S		S
Typha latifolia	S					D	S	
Verbena urticafolia						S		
Vernonia spp.				S				S
Veronicastrum virginicum	S	S				S		S
Vitis spp.			S					
Xanthium spp.						S		

Waterfowl and Bird Survey

To develop an understanding of the numbers and types of birds and waterfowl using the lake ZIES staff recorded bird observations while taking water samples throughout the lake. During the winter and spring Greenville College ornithology students volunteered to help monitor waterfowl and other birds. This information was used to compile a table of the types of birds that would be directly on or near the water (Table 23). Birds can contribute significant amount of pollution to a lake through fecal matter if they are found in large numbers throughout the year. There were very few waterfowl observed on Staunton lake. This could be a result of the time that staff looked for birds. It also should be noted that there are several hunting blinds which would discourage waterfowl from remaining on the lake. However, in the fall there were 10-15 Canada Geese observed on the lake on most days. There were never large enough numbers of waterfowl observed to have a major impact on the water quality, although birds most likely play a small role in water pollution and nutrient loading to the lake.

Table 19 Bird Count Estimates

Common Name	Scientific Name	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
Canada Goose	*Branta canadensis*							10	15	12	15	10	10
Great Blue Heron	*Ardea herodias*		5	5	5							4	
Ring Billed Gull	*Larus delawarensis*						10				10	10	
Kingfisher	*Ceryle alcyon*				2								

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REFERENCES

American Public Health Association. 1995. Standard Methods for the Examination of Water and Wastewater. 19th Edition. Washington D.C.

Berggren, Dwain. 1979. Guide to the Geology of the Carlinville Area, Macoupin County, Illinois. Illinois State Geological Survey. Urbana Illinois.

Brater, E. F. and H. W. King. 1976. Handbook of Hydraulics: For the Solution of Hydraulic Engineering_Problems. 6th Edition. McGraw-Hill, New York.

Buchanan, T. J. and Somers, W. P. 1974, Stage Measurements at Gauging Stations, Techniques of Water-Resources Investigations of the United States Geological Survey, Book 3 Chapter A7.

Carlson, R.E. 1977. A trophic state index for lakes. Limnology and Oceanography 22(2): 361-69.

Carter, R. W. and Davidian, J, General Procedure for Gauging Streams, Techniques of Water-Resources Investigations of the United States Geological Survey, Book 3 Chapter A6.

Clark, G.M., Mueller, D.K., and Mast, M.A. 2000. Nutrient Concentrations and Yields in Undeveloped_Streams Basins of the United States, Water Resource Association, v. 36 no. 4 p. 849-860.

Fuller, D. R. 1997. Understanding, Living with, and Controlling Shoreline Erosion: A Guidebook for_Shoreline Property Owners. 2nd Edition. Tip of the Mitt Watershed Council. Conway, MI.

Governor Bond Lake Planning Committee. 1999. Governor Bond Lake Resource Plan. Governor Bond Lake planning Committee.

Haan, C.T., B.J. Barfield, J.C. Hayes. 1994. Design Hydrology and Sedimentology for Small Catchments. Academic Press San Diego, CA 588 p.

Hill, R. A., H.L. Hudson, J.J. Clark, T. R. Gray and R. J. Kirschner. 1994. Clean Lakes Program: Phase I Diagnostic Feasibility Study of Herrick Lake, Dupage County Illinois. Forest Preserve District DuPage County Planning and Development Department and The Northeastern Illinois Planning Commission Natural Resources Department.

Illinois Pollution Control Board. 1990. Illinois Pollution Control Board Part 302 Water Quality Standards. Springfield Illinois.

Kirschner, R. J. .1995. A Guide to Illinois Lake Management, Northeastern Illinois Planning Commission Chicago Illinois.

Lee, Wallace. 1926. Gillespie-Mount Olive Folio, Illinois. Illinois State Geological Survey/United States Geological Survey. USA.

Litke, D. W. 1999. Review of Phosphorus Control Measures in the United States and their Effects on Water Quailty. USGS WRI99-4007

Manny, B. A., W. C. Johnson and R. G. Wetzel. 1994. Nutrient additions by waterfowl to lakes and reservoirs: predicting their effects on productivity and water quality. Hydrobiologia. 279/280: 121-132.

Marbut C., .2000. Governor Bond Lake Management Status Report Illinois Department of Natural Resources.

Nielsen, L. A. and Johnson, D.L. .1983. Fisheries Techniques, American Fisheries Society.

North American Lake Management Society. 1989. Management Guide for lakes and reservoirs. North American Lake Management Society. Washington D.C. 42 p.

North American Lake Management Society. 1990. The Lake and Reservoir Restoration Guidance Manual. 2nd Edition. EPA 440/4-90-006. U.S. Environmental Protection Agency, Washington D.C. 339 p.

North American Lake Management Society. 1990. Monitoring Lake and Reservoir Restoration: Technical_Supplement to the Lake and Reservoir Restoration Guidance Manual. EPA 440/4-90-007. U.S. Environmental Protection Agency, Washington D.C.

Nurnberg, G.K. 1984. The Prediction of Internal Phosphorus Load in Lakes with Anoxic Hypolimonia. Journal of the American Society of Limnology and Oceanography: 29(1) 111-124.

Pucket, L. J. 1993. Nonpoint and Point Sources of Nitrogen in Major Watersheds of the United States. USGS WRI94-4001

Rantz, S.E. 1982. Measurement and Computation of Streamflow. Geological Survey Water-Supply Paper 2175. U.S. Governmental Printing Office, Washington, D.C.

Riggs, H. C. and Hardison, C. H., 1989, Storage Analyses for Water Supply, Techniques of Water-Resources Investigations of the United States Geological Survey, Book 4 Chapter B2.

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

Steyermark, J.A. 1999, Steyemark Flora of Missouri. Iowa State University Press. Ames Iowa.

Taylor, W.D. 1979. Phytoplankton Water Quality Relationships in U.S. Lakes, Part VII: Comparison of Some New and Old Indices and Measurements of Trophic State. Environmental Monitoring and Support Laboratory Las Vegas, Nevada 51 p. EPA 600/3-79-079

Terres, J. K. .1980. The Audubon Society Encyclopedia of North American Birds. Alfred A. Knopf New York.

U.S. Environmental Protection Agency. 1993. Fish and Fisheries Management in Lakes and Reservoirs: Technical Supplement to the Lake and Reservoir Restoration Guidance Manual. EPA 841-R-93-002. Environmental Protection Agency, Washington D.C. 321 p.

U.S. Environmental Protection Agency. 1882. Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA 600/4-82-029. Environmental Monitoring and Support Laboratory Cincinnati, OH 401 p.

U.S. Environmental Protection Agency. 1984. Lake and Reservoir Management. EPA 440/5/84-001 Office of Water and Regulations and Standards Washington, D.C.

U.S. Department of Agriculture Soil Conservation Service. 1983. Soil Survey of Bond County, Illinois. Illinois Agricultural Experiment Station. Bond County, IL

U.S. Geological Survey. 1982. Measurement and Computation of Streamflow: Volume 2. Computation of Discharge, Geological Survey Water-Supply Paper 2175.

U.S. Geological Society. 1973. Storage Analyses for Water Supply: Techniques of Water-Resources Investigations of the United States Geological Survey Book 4 Chapter B2.

Winslow, L. 1995. Greenville Area Geology: The Geological Framework of Greenville, Illinois Guide 1995/A Greenville College.

Wisconsin Department of Natural Resources. 1974. Survey of Lake Rehabilitation Techniques and Experiences. Technical Bulletin No. 75. Department of Natural Resources. Madison, Wisconsin.

Woller, Dorothy M. 1976. Public Groundwater Supplies in Macoupin County. Illinois State Water Survey, Urbana Illinois.

Yoo, K. H. and Boyd, C.E.. 1993. Hydrology and Water Supply for Pond Aquaculture. Chapman and Hall New York.

Part 2

FEASABILITY STUDY OF STAUNTON RESERVOIR

INTRODUCTION

This study has identified many causes of impairment issues for Staunton Reservoir. Restoration proposals will be directed at solving the most significant of these, including high sedimentation, stream bank erosion and high nutrient inputs from the watershed and the lake sediments.

Recommended methods for restoring and enhancing lake water quality can be sorted into several categories. These categories include watershed practices, In-lake practices and General practices.

As with any restoration proposals it is important that all involved parties have an opportunity to voice their opinions. Using the information found in Part 1 of this Phase I Clean Lakes study, the restoration proposals described in Part 2 should be reviewed for comment by all interested parties and agreements made before submittal of this report for Clean Lakes Phase II funding.

EXISTING LAKE QUALITY PROBLEMS AND THEIR CAUSES

According to the IEPA 303(d) Report Staunton Reservoir was assessed for its designated uses and the following areas were impaired: Overall use partial support (threatened), Swimming partial support (minor impairment), Recreation partial support(minor impairment). Causes for these impairments include: Nutrients, siltation, metals, organic enrichment, suspended solids, noxious aquatics. The sources that contribute to the impairments include: Non-irrigated crop production, hydrologic/habitat modification, stream bank, other, in-place contaminants.

Clean Lakes data from this study identify many of these same problems for the Lake including:

High Levels of Nutrients including Phosphorus

The nutrient budget estimates 34,205 kilograms of Nitrogen and 4,482 Kilograms of Phosphorus entered the lake during the study period. The nutrient budget estimates 6% of the phosphorus and 6.2% of the nitrogen enters the lake from internal cycling. Phosphorus is especially of concern since it was identified to be the limiting nutrient for the lake. Phosphorus can lead to algal blooms.

Low Dissolved Oxygen and Internal Nutrient Release

During the summer month the lake stratified and oxygen was depleted near the lake bottom. This resulted in internal nutrient loading of 267 Kg of phosphorus and 2,134 Kg of nitrogen to the lake. It also results in which releases other chemicals such as manganese and iron which cause problems for water treatment .

Sediment entering the Lake from Watershed and Lake Shoreline

The sediment budget estimates 12,009,514 Kg of Suspended Solids entering the lake from the watershed. This can be a result of a variety of different forms of erosion. One of the major sources can be stream bank erosion. The study also identified 22,460 Kg of sediment entering the lake directly from the shoreline.

OBJECTIVES FOR LAKE RESTORATION

Lake management involves the management of complex ecosystems and restoration involves a number of entities with varied interests. However, overall lake restoration and management can be designed in a fashion to meet the majority of the desired outcomes which can benefit all of those interested in better water quality. The restoration program should be evaluated and opportunities for comment should be given to all interested parties if the program is to be successful.

Objective 1 - Reduce Nutrient Loading

Objective 2 - Improve the aquatic life in the lake

Objective 3 - Reduce Sedimentation

Objective 4 - Improve the recreational use of the lake

Objective 5 - Improve raw water before treatment

Objective 6 - Educate the public on the importance of good water quality

WATERSHED ALTERNATIVES

Alternative 1 Construction of shallow water wetlands: Meets objective 1, 2, 3, 4, 5

Construction of a shallow water wetland to slow the flow of water flow during storm events and to act as a sediment catch and filtering mechanism on areas in the watershed would have the added benefits of providing improved wildlife habitat and possibly duck hunting areas. The estimated costs for these structures would be $75,000 - $200,000 depending on site location.

Figure 44

Source: University of Illinois Extension

Alternative 2 Stream bank stabilization: Meets objectives 2,3 and 4

Stream banks can be a major contributor of sediments to the lake. The NRCS has identified stream bank erosion as a major contributor of sedimentation in watersheds with similar characteristics as those found in the Staunton watershed. The stabilization of 400 feet of stream banks using rock riffles, and rip-rap and bio-stabilization throughout the watershed will have a significant impact on sediment reduction. Estimated cost for this is $30,000.

Figure 45 Rip-Rap Stabilization

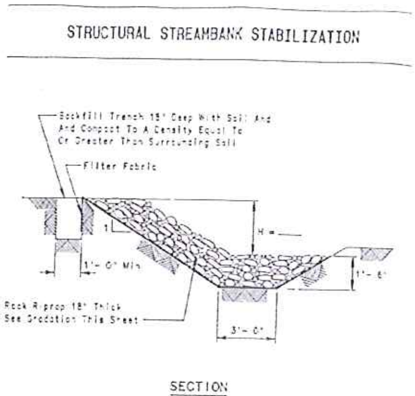

Figure 46 Rock Riffles

Source: NRCS/University of Illinois Extension

Alternative 3 Promote Conservation Practices: Meets objectives 1,2,3,4,5 and 6

Field Borders--Installing field borders around fields will reduce the amount of sediments and nutrients entering the lake which will improve the water clarity and quality. It will have the added benefit of increasing wildlife habitat. This will be accomplished through educational programs conducted by NRCS or the Extension office at no cost to the city.

Figure 47

Source: University of Illinois Extension

Conservation tillage—Conservation practices can significantly improve the amounts of sediments entering the lake. No-Till planting through untilled crop residue will significantly reduce erosion and maintain or improve soil organic matter.

Figure 48

Source: University of Illinois Extension

IN-LAKE ALTERNATIVES

Alternative 4 Shoreline stabilization: Meets objectives 2,3 and 4

The shoreline erosion survey conducted by ZIES indicated the erosion of 1,913 linear feet of slight to moderate erosion and 195 linear feet of severe erosion. Cost estimates for having a company rip-rap the lake would be $40 per linear foot for most areas and $80 + for areas with severe erosion. Using these estimates it would cost $78,000 to rip-rap the entire lake. It is recommended that the areas with severe erosion be addressed first at an estimated cost of $18,000. It is recommended that the remaining $60,000 would be implemented over a two year period.

Alternative 5 Installation of an aeration system near the water intake structure: Meets objectives 1,2,4,5

The diagnostic portion of the report demonstrates that during the summer months the lake stratifies and oxygen is depleted near the bottom of the lake. The lake of oxygen in the lake has several negative effects including fisheries, nutrient loading and water supply quality. Aeration can increase fish and other aquatic animal habitat, prevent fish kills, and improve the quality of domestic water supplies and decrease treatment costs. There are several different types of systems that can be used. The best system is a Hypolimnetic aeration that adds oxygen to the lower portions of the lake without mixing the water temperatures. The estimated cost for this system would be $220,000.

GENERAL ALTERNATIVES

Alternative 6 Review and updating of city ordinances related to the lake: Meets objectives 1,2,3,4,5

A review of current city ordinances related to the lake should happen. Items of interest would include septic system requirements, construction practices including docks and other lake structures.

Alternative 7 Lake Educational Programs: Meets objective 1,2,3,4 and 6

It is important to educate the public on the importance of water quality and ways that individuals can help improve it. This will be accomplished through water quality publications being made available and lake seminars for school groups and interested persons. The cost estimate for these programs is $2,000 per year.

Source: Illinois EPA

Phase 2 Monitoring Program

As part of the restoration program the EPA requires monitoring of the practices implemented in the program. This will give all parties data to evaluate the effectiveness of the restoration program.

The IEPA should continue to monitor the lake under its ambient lake monitoring program. The city should begin monitoring the lake under the IEPA's volunteer lake monitoring program and to have a comprehensive year of monitoring after the restoration elements are in place. This monitoring program would be an expansion of the Volunteer program monitor all months of the year and include tributary monitoring program similar to that in the clean lakes study. The cost estimate is $35,000/year

Tributary Monitoring

Water Quantity
1. Stage-discharge relationships or permanent stations
2. Flow characteristics

Water Quality
1. Total Phosphorus
2. Nitrate + Nitrite Nitrogen
3. Ammonia Nitrogen

4. Total Suspended Solids
5. Non-Volatile Suspended Solids
6. pH

Frequency

Once monthly with an additional 12-15 storm samples each year

In-Lake Monitoring

Water Quality

1. Total Phosphorus
2. Nitrate + Nitrite Nitrogen
3. Ammonia Nitrogen
4. Total Suspended Solids
5. Non-Volatile Suspended Solids
6. Secchi Depth
7. Temperature and DO profiles
8. pH

Frequency

Once monthly at all historical sampling sites

SOURCES OF MATCHING FUNDS

Funding sources for this program include both state and federal agencies, as well as the City of Hillsboro and private sources (foundations, watershed land owners, etc.). The following tables provide details regarding the potential funding sources for this program as it is implemented.

Funding associated with larger projects, such as dredging and rip-rapping the entire lake constitutes a substantial investment by the various granting sources and may not be financially feasible.

Table 20 Staunton Reservoir Restoration Alternatives, Funding and Mechanism

		Begin	IEPA	Fed EPA	SWCS				
Restoration Alternative	Total	**Spring 2004**	**PH II/ LEAP**	**Section 319**	**IL Dept of Ag**	**City**	**Other**	**Source**	**Mechanism**
Watershed Alternatives									
Shallow Water Wetlands	$200,000	$ 125,000	$ 50,000	$ 75,000				PHII/319	Contractor
Stream Bank	$ 30,000	$ 30,000			22,500	3,750	3,750	Dept Ag	SWCS
Conservation Practices	N/A								NRCS
In-Lake Alternatives									
Shoreline Stabilization	$ 78,000	$ 78,000	$ 31,400	$ 31,400		$ 10,000		PhII/319/City	Contractor
Aeration System	$220,000	$ 220,000	$110,000	$110,000				PhII/319	Contractor
General Alternatives									
Review City Ordinances	N/A								City
Lake Education	$ 2,000	$ 2,000	$ 1,500			$ 500		LEAP	GC
Monitoring		$ 35,000				$ 35,000		City	GC
			PH II/ LEAP	**Section 319**	**IL Dept of Ag**	**City**	**Other**		
	Total	$ 490,000.00	$ 192,900.00	$ 216,400.00	$ 22,500.00	$ 49,250.00	$ 3,750.00		
	Percent		39%	44%	5%	10%	1%		

OPERATIONS AND MAINTENANCE PLAN

The city of Staunton as owner of Staunton Reservoir is primarily responsible for operation and maintenance of the lake and the various components of the restoration program. There are components that will not be under their jurisdiction and legal agreements about access and maintenance of these components need to be made before the construction of these elements. The operation and maintenance aspects of each program component are as follows:

Sediment Control Structures

PERMITS FOR RESTORATION PLAN

Various permits will be required before implementation of several of the restoration proposals.

Core of Engineers section 404 A permitting will be required for some shoreline stabilization, dredging some sediment control structure, and storm water wetland systems.

Illinois Department of Water Resources floodway permits will be submitted for shoreline stabilization, dredging, brood pond, Meisenhimer road structure, Irving cove structure and sediment control structures.

The State Historical Preservation will be notified of all of the projects and will respond with potential for archaeological resources at project sites.

Illinois EPA Division of Water Pollution Control permit is required for retention ponds for hydraulic dredging.

The Illinois Department of Water Resources dam permit is required to construct or modify embankments which impound more than a certain size body of water. The structure at Meisenhimer road will need these permits. The structure on Irving cove will need IDWR permits if it impounds more than 50-acre-feet and the embankments are greater than 6 feet in height.

ENVIRONMENTAL EVALUATION

1. Displacement of People. The restoration plan will not displace any people.

2. Defacement of Residential Areas. The restoration plan will not deface any residential areas.

3. Changes in Land Use Pattern. The restoration plan will not change land use pattersns.

4. Impacts on Prime Agricultural Land. There will be no negative changes to prime agricultural lands. Many of the practices will improve and maintain the prime agricultural land in the watershed.

5. Impacts on Parkland, Other Public Land and Scenic Resources. There will be no impacts to parklands, public or scenic resources as a consequence of any activities under this restoration program.

6. Impacts on Historic, Architectural, Archaeological or Cultural Resources. There will be no impacts to cultural resources of any kind as a consequence of any activities under this restoration program.

7. Long Range Increases in Energy Demand. There will be no long range increases in energy demand as a consequence of any activities under this restoration program.

8. Changes in Ambient Air Quality or Noise Levels. There will be no long term changes in ambient air quality or noise levels as a consequence of any activities under this restoration program. There are likely to be periodic, short-term increases associated with construction of various components of the restoration plan.

9. Adverse Effect of Chemical Treatment. Chemical treatment is not a recommended as part of the restoration plan.

10. Compliance with Executive Order 11988 on Floodplain Management. This project complies with EO 11988 on Floodplain Management. All projects will be designed not to cause an increase in flood levels.

11. Dredging and Other Channel, Bed or Shoreline Modifications. Channel modifications, such as stream bank stabilization, will occur in areas which are not jurisdictional waters of the United States under Section 404 of the Clean Water Act. Shoreline stabilization will be conducted in a manner consistent with National permit for such activities.

12. Adverse Effects on Wetlands and Related Resources. There will be no adverse effects on wetland and related resources as a consequence of any activities under this restoration program. Wetlands and wildlife habitat, riparian buffers and other such resources will be created and enhanced under this program.

13. Feasible Alternatives to Proposed Projects. The restoration plan appears to be the best means to meet the objective set forth in this report. However, it might not be possible to implement all aspects of the plan due to funding constraints. It would be possible to implement smaller portions of this plan.

14. Other Necessary Mitigation Measures. There are not other mitigation measures necessary as part of this restoration program.

APPENDIX A

LAKE Staunton

DATE 4-27-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm³)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	112.112	22287.9
Nitzschia acicularis	2.5 x 87.5	429.5	10.192	4377.5
CHLOROPHYTA				
Ankistrodesmus falcatus var. *acicularis*	1.25 x 18.0	22.1	10.192	225.2
Coelastrum microporum	20.0 (col.-diam.)	4188.8	40.768	170769.0
Dictyosphaerium *D. ehrenbergianum*	12.5 x 22.5	2761.2	10.192	28142.2
D. pulchellum	20.0 (col.-diam.)	4188.8	214.032	896537.2
Kirchneriella obesa var. *major*	5.0 x 10.0	196.3	10.192	2000.7
Oocystis *O. borgei*	12.5 (diam.)	1022.7	1294.384	1323766.5
O. pusilla	20.0 (diam.)	4188.8	122.304	512307.0
Scenedesmus abundans	7.5 x 15.0	577.3	20.384	11767.7
Schroederia setigera	2.5 x 52.5	257.7	254.800	65662.0
CHRYSOPHYTA-None				
CRYPTOPHYTA-None				
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	560.560	293509.2

LAKE Staunton

DATE 4-27-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	1753.024	917883.4
EUGLENOPHYTA				
Trachelomonas				
T. volvocina	11.2	735.6	50.960	37486.2
T. sp. (cyl.-gran.)	15.0 x 17.5	3092.5	10.192	31518.8
T. sp. (cyl.-gran.-short neck)	12.5 x 20.0	2454.4	Present	
T. sp. (cyl.-gran.-short neck)	20.0 x 21.0	6597.3	20.384	134479.4
T. sp. (cyl.-smooth-collar)	15.0 x 17.5	3092.5	10.192	31518.8
T. sp. (cyl.-smooth-short neck)	12.5 x 27.5	3374.8	10.192	34396.0
PYRRHOPHYTA-None				
ANIMAL MATERIAL-None				

LAKE Staunton

DATE 6-25-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm³)	No./mL	VOLUME
BACILLARIOPHYTA				
Nitzschia palea	3.0 x 25.0	176.7	10.192	1800.9
CHLOROPHYTA				
Carteria				
C. multifilis	7.5 (diam.)	220.9	234.416	51782.5
C. sp. (No. 1)	15.0 x 20.0	3534.3	377.104	1332798.6
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	845.936	1494938.0
C. microporum	20.0 (col.-diam.)	4188.8	101.920	426922.5
Cosmarium				
C. sp.	7.5 x 7.5	331.3	101.920	33766.1
C. sp.	10.0 x 10.0	785.4	50.960	40024.0
C. sp.	15.0 x 12.5	2208.9	50.960	112565.5
C. sp.	20.0 x 15.0	4712.4	10.192	48028.8
Crucigenia rectangularis	8.0 x 8.0 x 1.0	64.0	30.576	1956.9
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	163.072	683076.0
Elakatothrix viridis	2.5 x 15.0	73.6	30.576	2250.4
Eudorina elegans	50.0 (col.-diam.)	65450.0	10.192	667066.4
Oocystis borgei	12.5 (diam.)	1022.7	61.152	62540.2
Scenedesmus abundans	7.5 x 15.0	577.3	81.536	47070.7

LAKE Staunton

DATE 6-25-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Schroederia setigera	2.5 x 52.5	257.7	20.384	5253.0
Staurastrum oxycanthum	60.0 x 45.0	127234.4	10.192	129677.3
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	81.536	12010.3
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	163.072	85384.5
Aphanizomenon flos-aquae	5.0 x 50.0	981.7	61.152	60032.9
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	794.976	416249.4
Schizothrix calcicola	2.0 x 10.0	31.4	10.192	320.0
EUGLENOPHYTA-None				
PYRRHOPHYTA-None				
ANIMAL MATERIAL				
PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-Order Oligotrichida-Family Halteriidae				
Halteria sp.	25.0 (diam.)	8181.4	20.384	166765.6

LAKE Staunton

DATE 7-16-01 SITE 1

TAXA	SIZE (µm)	UNIT VOL. (µm^3)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	163.072	32418.7
Nitzschia palea	3.0 x 25.0	176.7	20.384	3601.9
CHLOROPHYTA				
Ankistrodesmus falcatus var. *acicularis*	1.25 x 18.0	22.1	10.192	225.2
Carteria				
C. multifilis	7.5 (diam.)	220.9	101.920	22514.1
C. sp. (No. 1)	15.0 x 20.0	3534.3	10.192	36021.6
Chodatella citriformis	12.5 x 20.0	2454.4	10.192	25015.2
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	214.032	378237.4
C. microporum	20.0 (col.-diam.)	4188.8	10.192	42692.2
Cosmarium				
C. sp.	10.0 x 6.0	471.2	101.920	48024.7
C. sp.	10.0 x 7.5	589.1	10.192	6004.1
Crucigenia				
C. quadrata	10.0 x 10.0 x 1.0	100.0	20.384	2038.4
C. rectangularis	8.0 x 8.0 x 1.0	64.0	61.152	3913.7
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	173.264	725768.2
Elakatothrix viridis	2.5 x 15.0	73.6	50.960	3750.7

LAKE Staunton

DATE 7-16-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm³)	No./mL	VOLUME
Kirchneriella lunaris var. *lunaris*	5.0 x 12.5	245.4	10.192	2501.1
Oocystis borgei	12.5 (diam.)	1022.7	203.840	208467.2
Pediastrum tetras var. *tetraodon*	24.0 x 2.0	904.8	10.192	9221.7
Phacotus lenticularis	7.5 x 12.5	552.2	10.192	5628.0
Scenedesmus arcuatus var. *platydisca*	7.0 x 10.0	441.8	10.192	4502.8
Schroederia setigera	2.5 x 52.5	257.7	173.264	44650.1
Treubaria setigerum	12.5	312.5	10.192	3185.0
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	50.960	7506.4
CYANOPHYTA				
Anabaena				
A. spiroides var. *crassa*	10.0 x 100.0	7854.0	61.152	480287.8
A. sp.	5.0 x 50.0	981.7	30.576	30016.5
Anacystis montana	10.0 (col.-diam.)	523.6	356.720	186778.6
Aphanizomenon flos-aquae	5.0 x 50.0	981.7	346.528	340186.5
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	988.624	517643.5
Merismopedia				
M. quadruplicata	25.0 x 25.0 x 2.5	1562.5	61.152	95550.0

LAKE Staunton

DATE 7-16-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Schizothrix calcicola	2.0 x 10.0	31.4	20.384	640.1
EUGLENOPHYTA-None				
PYRRHOPHYTA-None				
ANIMAL MATERIAL				
PROTOZOA-Sub-Phylum Mastigophora-Class Zoomastigophora				
Unknown Flagellate	7.5 x 10.0	441.8	10.192	4502.8

LAKE Staunton

DATE 8-28-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm³)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	71.344	14183.2
CHLOROPHYTA				
Ankistrodesmus falcatus var. *acicularis*	1.25 x 18.0	22.1	101.920	2252.4
Carteria multifilis	7.5 (diam.)	220.9	173.264	38274.0
Chlorogonium elongatum var. *elongatum*	5.0 x 20.0	392.7	20.384	8004.8
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	193.648	342214.7
C. microporum	20.0 (col.-diam.)	4188.8	61.152	256153.5
Cosmarium sp.	10.0 x 7.5	589.1	10.192	6004.1
Crucigenia rectangularis	8.0 x 8.0 x 1.0	64.0	40.768	2609.2
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	2099.552	8794603.4
Elakatothrix viridis	2.5 x 15.0	73.6	20.384	1500.3
Kirchneriella lunaris var. *lunaris*	5.0 x 12.5	245.4	20.384	5002.2
Oocystis				
O. borgei	12.5 (diam.)	1022.7	234.416	239737.2
O. pusilla	20.0 (diam.)	4188.8	40.768	170769.0
Pediastrum duplex var. *gracilimum*	17.0 x 2.0	454.0	30.576	13881.5

LAKE Staunton

DATE 8-28-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Phacotus lenticularis	7.5 x 12.5	552.2	10.192	5628.0
Scenedesmus				
S. abundans	7.5 x 15.0	577.3	101.920	58838.4
S. denticulatus	7.0 x 15.0	577.3	10.192	5883.8
Schroederia setigera	2.5 x 52.5	257.7	20.384	5253.0
Staurastrum sp.	22.5 x 17.5	6958.1	10.192	70917.0
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	50.960	7506.4
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	468.832	245480.4
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	662.480	346874.5
Microcystis aeruginosa	40.0 (col.-diam.)	33510.4	20.384	683076.0
EUGLENOPHYTA-None				
PYRRHOPHYTA-None				
ANIMAL MATERIAL				
PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-Order Oligotrichida-Family Halteriidae				
Halteria sp.	25.0 (diam.)	8181.2	10.192	83382.8

LAKE Staunton

DATE 10-18-01 SITE 1

TAXA	SIZE (μm)	UNIT VOL. (μm³)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	366.912	72942.1
CHLOROPHYTA				
Carteria sp. (No. 1)	15.0 x 20.0	3534.3	30.576	108064.8
Closterium acutum	2.5 x 62.5	306.8	10.192	3126.9
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	1121.120	1981243.2
C. microporum	20.0 (col.-diam.)	4188.8	10.192	42692.2
Crucigenia rectangularis	8.0 x 8.0 x 1.0	64.0	10.192	652.3
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	101.920	426922.5
Errerella bornhemiensis	25.0 x 25.0 x 2.5	3125.0	10.192	31850.0
Oocystis				
O. borgei	12.5 (diam.)	1022.7	193.648	198043.8
O. pusilla	20.0 (diam.)	4188.8	30.576	128076.7
Scenedesmus				
S. abundans	7.5 x 15.0	577.3	10.192	5883.8
S. arcuatus var. *platydisca*	7.0 x 10.0	441.8	20.384	9005.7
Schroederia setigera	2.5 x 52.5	257.7	122.304	31517.7
Staurastrum oxycanthum	22.5 x 17.5	6958.1	Present	
Tetraedron trigonum var. *trigonum*	26.0	239.0	10.192	2435.9

LAKE Staunton

DATE 10-18-01 SITE 1

TAXA	SIZE (µm)	UNIT VOL. (μm^3)	No./mL	VOLUME
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	30.576	4503.8
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	1681.680	880527.6
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	6217.120	3255284.0
Schizothrix calcicola	2.0 x 10.0	31.4	10.192	320.0
EUGLENOPHYTA				
Trachelomonas volvocina	11.2 (diam.)	735.6	20.384	14994.5
PYRRHOPHYTA-None				
ANIMAL MATERIAL				
PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-Order Oligotrichida-Family Halteriidae				
Halteria sp.	25.0 (diam.)	8181.2	10.192	83382.8

Summary of numbers and biovolumes of organisms for Lake Staunton Site 1 in 2001.

Date	Phylum	No./mL	Volume
4-27-01	Bacillariophyta	122.304	26665.4
	Chlorophyta	1977.248	3011177.5
	Chrysophyta	0	0

	Cryptophyta	0	0
	Cyanophyta	2313.584	1211392.6
	Euglenophyta	101.920	269399.2
	Pyrrhophyta	0	0
	Total	4515.056	4518634.7
	Arthropoda	0	0
	Protozoa	0	0
	Rotatoria	0	0
	Total	0	0
6-25-01	Bacillariophyta	10.192	1801.0
	Chlorophyta	2181.088	5139716.9
	Chrysophyta	0	0
	Cryptophyta	50.960	7506.4
	Cyanophyta	1151.696	1275430.9
	Euglenophyta	0	0
	Pyrrhophyta	0	0
	Total	4474.288	11324647.0
	Arthropoda	0	0
	Protozoa	10.192	83382.8
	Rotatoria	0	0
	Total	10.192	83382.8

Date	Phylum	No./mL	Volume
7-16-01	Bacillariophyta	183.456	36020.6

	Chlorophyta	1202.656	1572361.4
	Chrysophyta	0	0
	Cryptophyta	50.960	7506.4
	Cyanophyta	1865.136	1651103.0
	Euglenophyta	0	0
	Pyrrhophyta	0	0
	Total	3302.208	3266991.4
	Arthropoda	0	0
	Protozoa	10.192	4502.8
	Rotatoria	0	0
	Total	10.192	4502.8
8-28-01	Bacillariophyta	71.344	14183.2
	Chlorophyta	3200.288	10027526.5
	Chrysophyta	0	0
	Cryptophyta	50.960	7506.4
	Cyanophyta	1151.696	1275430.9
	Euglenophyta	0	0
	Pyrrhophyta	0	0
	Total	4474.288	11324647.0
	Arthropoda	0	0
	Protozoa	10.192	83382.8
	Rotatoria	0	0
	Total	10.192	83382.8

Date	Phylum	No./mL	Volume
10-18-01	Bacillariophyta	366.912	72942.1
	Chlorophyta	1681.680	2969515.5
	Chrysophyta	0	0
	Cryptophyta	30.576	4503.8
	Cyanophyta	7929.376	4819207.6
	Euglenophyta	0	0
	Pyrrhophyta	0	0
	Total	10028.928	7881163.5
	Arthropoda	0	0
	Protozoa	10.192	83382.8
	Rotatoria	0	0
	Total	10.192	83382.8

LAKE Staunton

DATE 4-27-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm³)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	10.192	2026.2
Nitzschia palea	3.0 x 25.0	176.7	10.192	1800.9
CHLOROPHYTA				
Coelastrum microporum	20.0 (col.-diam.)	4188.8	30.576	128076.7
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	305.760	1280767.4
Oocystis				
O. borgei	12.5 (diam.)	1022.7	1192.464	1219532.9
O. pusilla	20.0 (diam.)	4188.8	91.728	384230.2
Scenedesmus abundans	7.5 x 15.0	577.3	30.576	17651.5
Schroederia setigera	2.5 x 52.5	257.7	305.760	78794.4
CHRYSOPHYTA-None				
CRYPTOPHYTA-None				
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	580.944	304182.3
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	1722.448	901873.8
Schizothrix calcicola	2.0 x 10.0	31.4	10.192	320.0
Spirulina subsala	2.5 x 25.0	122.7	20.384	2501.1

LAKE Staunton

DATE 4-27-01 SITE 2

TAXA	SIZE (µm)	UNIT VOL. (µm^3)	No./mL	VOLUME
EUGLENOPHYTA				
Trachelomonas				
T. volvocina	11.2	735.6	50.960	37486.2
T. sp. (cyl.-gran.-short neck)	15.0 x 17.5	3092.5	10.192	31518.8
T. sp. (cyl.-smooth-short neck)	12.5 x 15.0	1840.8	20.384	37522.9
PYRRHOPHYTA-None				
ANIMAL MATERIAL				

PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-Order Odontostomatida-Family Tintinnidae

Codonella sp.	42.5 x 54.0	76605.7	10.192	780765.3

LAKE Staunton

DATE 6-25-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm³)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	71.344	14183.2
Nitzschia acicularis	2.5 x 87.5	429.5	10.192	4377.5
CHLOROPHYTA				
Ankistrodesmus falcatus var. *acicularis*	1.25 x 18.0	22.1	10.192	225.2
Carteria				
C. multifilis	7.5 (diam.)	220.9	71.344	15759.9
C. sp. (No. 1)	15.0 x 20.0	3534.3	91.728	324194.3
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	489.216	864542.5
C. microporum	20.0 (col.-diam.)	4188.8	81.536	341538.0
Cosmarium				
C. sp.	15.0 x 12.5	2208.9	112.112	247644.2
C. sp.	15.0 x 15.0	2650.7	193.648	513302.8
Crucigenia rectangularis	8.0 x 8.0 x 1.0	64.0	30.576	1956.9
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	91.728	384230.2
Elakatothrix viridis	2.5 x 15.0	73.6	10.192	750.1
Nephrocytium limneticum	8.75	350.8	20.384	7150.7
Oocystis borgei	12.5 (diam.)	1022.7	81.536	83386.9

LAKE Staunton

DATE 6-25-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Scenedesmus				
S. abundans	7.5 x 15.0	577.3	61.152	35303.0
S. arcuatus var. *platydisca*	7.0 x 10.0	441.8	10.192	4502.8
Schroederia setigera	2.5 x 52.5	257.7	20.384	5253.0
Treubaria setigerum	12.5	312.5	20.384	6370.0
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	448.448	66056.4
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	264.992	138749.8
Aphanizomenon flos-aquae	5.0 x 50.0	981.7	61.152	60032.9
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	896.896	46914.7
EUGLENOPHYTA				
Trachelomonas volvocina	11.2	735.6	10.192	7497.2
PYRRHOPHYTA-None				
ANIMAL MATERIAL				
PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-Order Oligotrichida-Family Halteriidae				
Halteria sp.	25.0 (diam.)	8181.2	10.192	83382.8

LAKE Staunton

DATE 7-16-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	173.264	34444.9
Nitzschia				
N. linearis	5.0 x 70.0	1374.4	20.384	28015.8
N. palea	3.0 x 25.0	176.7	61.152	10805.6
CHLOROPHYTA				
Ankistrodesmus falcatus var. *acicularis*	1.25 x 18.0	22.1	30.576	675.7
Carteria				
C. multifilis	7.5 (diam.)	220.9	71.344	15759.9
C. sp. (No. 1)	15.0 x 20.0	3534.3	30.576	108064.8
Chlorogonium elongatum var. *elongatum*	5.0 x 20.0	392.7	10.192	4002.4
Chodatella				
C. citriformis	12.5 x 20.0	2454.4	20.384	50030.5
C. quadriseta	5.0 x 10.0	196.3	20.384	4001.4
Coelastrum cambricum	15.0 (col.-diam.)	1767.2	163.072	288180.8
Cosmarium				
C. sp.	10.0 x 10.0	785.4	30.576	24014.4
C. sp.	15.0 x 12.5	2208.9	10.192	22513.1
Crucigenia rectangularis	8.0 x 8.0 x 1.0	64.0	30.576	1956.9
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	152.880	640383.7

LAKE Staunton

DATE 7-16-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Elakatothrix viridis	2.5 x 15.0	73.6	71.344	5250.9
Oocystis borgei	12.5 (diam.)	1022.7	214.032	218890.5
Phacotus lenticularis	7.5 x 12.5	552.2	20.384	11256.0
Scenedesmus abundans	7.5 x 15.0	577.3	40.768	23535.4
Schroederia setigera	2.5 x 52.5	257.7	71.344	18385.3
Treubaria setigerum	12.5	312.5	10.192	3185.0
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	132.496	19516.7
CYANOPHYTA				
Anabaena				
A. spiroides var. *crassa*	10.0 x 100.0	7854.0	81.536	640383.7
A. sp.	5.0 x 50.0	981.7	10.192	10005.5
Anacystis montana	10.0 (col.-diam.)	523.6	468.832	245480.4
Aphanizomenon flos-aquae	5.0 x 50.0	981.7	295.568	290159.1
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	1172.080	613701.1
Schizothrix calcicola	2.0 x 10.0	31.4	20.384	640.1
EUGLENOPHYTA				
Trachelomonas volvocina	11.2	735.6	10.192	7497.2
PYRRHOPHYTA-None				

LAKE Staunton

DATE 7-16-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME

ANIMAL MATERIAL-None

LAKE Staunton

DATE 8-28-01 SITE 2

TAXA	SIZE (µm)	UNIT VOL. (µm³)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella				
C. meneghiniana	11.2 (diam.)	198.8	91.728	18235.5
C. sp. (girdle view)	25.0 x 2.0	981.7	10.192	10005.5
CHLOROPHYTA				
Ankistrodesmus falcatus var. *acicularis*	1.25 x 18.0	22.1	81.536	1801.9
Carteria				
C. multifilis	7.5 (diam.)	220.9	122.304	27017.0
C. sp. (No. 1)	15.0 x 20.0	3534.3	20.384	72043.2
Chlorogonium elongatum var. *elongatum*	5.0 x 20.0	392.7	20.384	8004.8
Chodatella citriformis	12.5 x 20.0	2454.4	10.192	25015.2
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	275.184	486305.2
C. microporum	20.0 (col.-diam.)	4188.8	91.728	384230.2
Cosmarium				
C. sp.	10.0 x 10.0	785.4	20.384	16009.6
C. sp.	15.0 x 15.0	2650.7	10.192	27015.9
C. sp.	15.0 x 15.0	2650.7	10.192	27015.9
C. sp.	17.5 x 22.5	5411.9	30.576	165474.2
Crucigenia rectangularis	8.0 x 8.0 x 1.0	64.0	20.384	1304.6

LAKE Staunton

DATE 8-28-01 SITE 2

TAXA	SIZE (µm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	3465.280	14515364.0
Errerella bornhemiensis	25.0 x 25.0 x 5.0	3125.0	10.192	31850.0
Oocystis				
O. borgei	12.5 (diam.)	1022.7	152.880	156350.4
O. pusilla	20.0 (diam.)	4188.8	71.344	298845.7
Pediastrum				
P. duplex var. *gracilimum*	17.0 x 2.0	454.0	40.768	18508.7
P. simplex var. *duodenarium*	60.0 x 2.0	5654.9	10.192	57634.7
Phacotus lenticularis	7.5 x 12.5	552.2	50.960	28140.1
Scenedesmus abundans	7.5 x 15.0	577.3	40.768	23535.4
Schroederia setigera	2.5 x 52.5	257.7	112.112	28891.3
Tetraedron constrictum	20.0 x 22.5	7068.6	10.192	72043.2
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	50.960	7506.4
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	397.488	208124.7
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	407.680	213461.2
Microcystis aeruginosa	40.0 (col.-diam.)	33510.4	71.344	2390765.9

LAKE Staunton

DATE 8-28-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
EUGLENOPHYTA				
Trachelomonas volvocina	11.2 (diam.)	735.6	10.192	7497.2
PYRRHOPHYTA				
Ceratium hirundinella	50.0 x 237.5	155414.1	Present	
ANIMAL MATERIAL				
ROTATORIA-Class Monogonata-Order Ploima-				
Unknown Rotifer	100.0 x 230.0	1806414.2	Present	
		Family Brachionidae		
Brachionus sp.	55.0 x 100.0	237582.7	Present	

LAKE Staunton

DATE 10-18-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm³)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	479.024	95230.0
CHLOROPHYTA				
Carteria multifilis	7.5 (diam.)	220.9	20.384	4502.8
Closterium acutum	2.5 x 62.5	306.8	10.192	3126.9
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	1121.120	1981243.2
C. microporum	20.0 (col.-diam.)	4188.8	50.960	213461.2
Crucigenia				
C. fenestrata	10.0 x 10.0 x 1.0	100.0	10.192	1019.2
C. quadrata	10.0 x 10.0 x 1.0	100.0	40.768	4076.8
C. rectangularis	8.0 x 8.0 x 1.0	64.0	10.192	652.3
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	122.304	512307.0
Kirchneriella lunaris var. *lunaris*	5.0 x 12.5	245.4	10.192	2501.1
Micractinium pusillum	15.0 (col.-diam.)	1767.2	10.192	18011.1
Nephrocytium limneticum	8.75	350.8	10.192	3575.4
Oocystis				
O. borgei	12.5 (diam.)	1022.7	152.880	156350.4
O. pusilla	20.0 (diam.)	4188.8	20.384	85384.5

DATE 10-18-01 SITE 2

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Pediastrum duplex var. *gracilimum*	17.0 x 2.0	454.0	10.192	4627.2
Schroederia setigera	2.5 x 52.5	257.7	91.728	23638.3
Staurastrum oxycanthum	60.0 x 45.0	127234.4	20.384	2593546.0
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas *C. erosa*	12.5 x 20.0	2454.4	10.192	25015.2
C. sp. (No. 1)	5.0 x 7.5	147.3	40.768	6005.1
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	2028.206	1061969.7
Aphanizomenon flos-aquae	5.0 x 50.0	981.7	10.192	10005.5
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	5187.728	2716294.3
EUGLENOPHYTA				
Trachelomonas volvocina	11.2	735.6	101.920	74972.4
PYRRHOPHYTA-None				
ANIMAL MATERIAL				
PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-Order Oligotrichida-Family Halteriidae				
Halteria sp.	25.0 (diam.)	8181.2	20.384	166765.6

Summary of numbers and biovolumes of organisms for Lake Staunton Site 2 in 2001.

Date	Phylum	No./mL	Volume
4-27-01	Bacillariophyta	20.384	3827.1
	Chlorophyta	1956.864	3109053.1
	Chrysophyta	0	0
	Cryptophyta	0	0
	Cyanophyta	2333.968	1208877.2
	Euglenophyta	81.536	106527.9
	Pyrrhophyta	0	0
	Total	4392.752	4428285.3
	Arthropoda	0	0
	Protozoa	10.192	780765.3
	Rotatoria	0	0
	Total	10.192	780765.3
6-25-01	Bacillariophyta	81.536	18560.7
	Chlorophyta	1396.304	2836110.5
	Chrysophyta	0	0
	Cryptophyta	448.448	66056.4
	Cyanophyta	1223.040	245697.4
	Euglenophyta	10.192	7497.2
	Pyrrhophyta	0	0
	Total	3159.520	3173922.2
	Arthropoda	0	0

	Protozoa	10.192	83382.8
	Rotatoria	0	0
	Total	10.192	83382.8

Date	Phylum	No./mL	Volume
7-16-01	Bacillariophyta	254.800	73266.3
	Chlorophyta	998.816	1440086.7
	Chrysophyta	0	0
	Cryptophyta	132.496	19516.7
	Cyanophyta	2048.592	1800369.9
	Euglenophyta	10.192	7497.2
	Pyrrhophyta	0	0
	Total	3444.896	3340736.8
	Arthropoda	0	0
	Protozoa	0	0
	Rotatoria	0	0
	Total	0	0
8-28-01	Bacillariophyta	101.920	28241.0
	Chlorophyta	4678.128	16472401.2
	Chrysophyta	0	0
	Cryptophyta	50.960	7506.4
	Cyanophyta	876.512	2812351.8
	Euglenophyta	10.192	7497.2

	Pyrrhophyta	0	0
	Total	5717.712	19327997.6
	Arthropoda	0	0
	Protozoa	0	0
	Rotatoria	0	0
	Total	0	0

Date	Phylum	No./mL	Volume
10-18-01	Bacillariophyta	479.024	95230.0
	Chlorophyta	1712.256	5608023.6
	Chrysophyta	0	0
	Cryptophyta	50.960	31020.3
	Cyanophyta	7226.126	3788269.5
	Euglenophyta	101.920	74972.4
	Pyrrhophyta	0	0
	Total	9570.286	9597515.8
	Arthropoda	0	0
	Protozoa	20.384	166765.6
	Rotatoria	0	0
	Total	20.384	166765.6

LAKE Staunton

DATE 4-27-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
BACILLARIOPHYTA-None				
CHLOROPHYTA				
Ankistrodesmus falcatus var. *acicularis*	1.25 x 18.0	22.1	50.960	1126.2
Coelastrum microporum	20.0 (col.-diam.)	4188.8	101.920	426922.5
Dictyosphaerium *D. pulchellum*	20.0 (col.-diam.)	4188.8	214.032	896537.2
Elakatothrix viridis	2.5 x 15.0	73.6	20.384	1500.3
Oocystis *O. borgei*	12.5 (diam.)	1022.7	1284.192	1313343.1
O. pusilla	20.0 (diam.)	4188.8	71.344	298845.7
Scenedesmus abundans	7.5 x 15.0	577.3	30.576	17651.5
Schroederia setigera	2.5 x 52.5	257.7	142.688	36770.7
CHRYSOPHYTA-None				
CRYPTOPHYTA-None				
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	968.240	506970.5
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	1977.248	1035287.0
Spirulina subsala	2.5 x 25.0	122.7	30.576	3751.7
EUGLENOPHYTA				

LAKE Staunton

DATE 4-27-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Trachelomonas				
T. volvocina	11.2	735.6	40.768	29988.9
T. sp. (cyl.-smooth)	40.0 x 45.0	56548.6	10.192	576343.3
T. sp. (cyl.-smooth-short neck)	17.5 x 22.5	5411.9	10.192	55158.1

PYRRHOPHYTA-None

ANIMAL MATERIAL-None

LAKE Staunton

DATE 6-25-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	142.688	28366.4
CHLOROPHYTA				
Carteria				
C. multifilis	7.5 (diam.)	220.9	183.456	40525.4
C. sp. (No. 1)	15.0 x 20.0	3534.3	50.960	180107.9
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	234.416	414260.0
C. microporum	20.0 (col.-diam.)	4188.8	61.152	256153.5
Cosmarium				
C. sp.	10.0 x 10.0	785.4	71.344	56033.6
C. sp.	17.5 x 17.5	4209.2	30.576	128700.4
Crucigenia rectangularis	8.0 x 8.0 x 1.0	64.0	20.384	1304.6
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	132.496	554999.2
Elakatothrix viridis	2.5 x 15.0	73.6	10.192	750.1
Eudorina elegans	50.0 (col.-diam.)	65450.0	30.576	2001199.2
Kirchneriella lunaris var. *lunaris*	5.0 x 12.5	245.4	10.192	2501.1
Oocystis borgei	12.5 (diam.)	1022.7	132.496	135503.6
Scenedesmus abundans	7.5 x 15.0	577.3	61.152	35303.0
Schroederia setigera	2.5 x 52.5	257.7	10.192	2626.5

LAKE Staunton

DATE 6-25-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Staurastrum oxycanthum	60.0 x 45.0	127234.4	10.192	1296773.0
Tetraedron constrictum	20.0 x 22.5	7068.6	Present	
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	50.960	7506.4
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	224.224	117403.7
Aphanizomenon flos-aquae	5.0 x 50.0	981.7	30.576	30016.5
Coccochloris peniocystis	40.0 (col.-diam.)	33570.4	10.192	341538.0
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	499.408	261490.0
EUGLENOPHYTA				
Trachelomonas				
T. volvocina	11.2	735.6	61.152	44983.4
T. sp. (cyl.-smooth-short neck)	17.5 x 22.5	5411.9	10.192	55158.1
PYRRHOPHYTA-None				
ANIMAL MATERIAL-None				

LAKE Staunton

DATE 7-16-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella meneghiniana	11.2 (diam.)	198.8	326.144	64837.4
Nitzschia palea	3.0 x 25.0	176.7	40.768	7203.7
CHLOROPHYTA				
Carteria				
C. multifilis	7.5 (diam.)	220.9	366.912	81050.9
C. sp. (No. 1)	15.0 x 20.0	3534.3	10.192	36021.6
Chlorogonium elongatum var. *elongatum*	5.0 x 20.0	392.7	71.344	28016.8
Chodatella quadriseta	5.0 x 10.0	196.3	20.384	4001.4
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	122.304	216135.6
C. microporum	20.0 (col.-diam.)	4188.8	20.384	85384.5
Cosmarium				
C. sp.	8.0 x 5.0	251.3	50.960	12806.2
C. sp.	15.0 x 15.0	2650.7	20.384	54031.9
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	173.264	725768.2
Elakatothrix viridis	2.5 x 15.0	73.6	61.152	4500.8
Eudorina elegans	50.0 (col.-diam.)	65450.0	10.192	667066.4
Kirchneriella				
K. lunaris var. *dianae*	2.5 x 12.5	61.4	10.192	625.8

LAKE Staunton

DATE 7-16-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Kirchneriella (Cont.)				
K. obesa var. *major*	5.0 x 10.0	196.3	40.768	8002.8
Oocystis borgei	12.5 (diam.)	1022.7	244.608	250160.6
Phacotus lenticularis	7.5 x 12.5	552.2	91.728	50652.2
Scenedesmus abundans	7.5 x 15.0	577.3	30.576	17651.5
Schroederia setigera	2.5 x 52.5	257.7	71.344	18385.3
Treubaria setigerum	12.5	312.5	30.576	9555.0
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	142.688	21017.9
CYANOPHYTA				
Anabaena spiroides var. *crassa*	10.0 x 100.0	7854.0	244.608	1921151.2
Anacystis montana	10.0 (col.-diam.)	523.6	744.016	389566.8
Aphanizomenon flos-aquae	5.0 x 50.0	981.7	570.752	560307.2
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	1691.872	885864.2
EUGLENOPHYTA				
Trachelomonas				
T. hispida	25.0 x 30.0	14726.2	10.192	150089.4
T. volvocina	11.2	735.6	10.192	7497.2
T. sp. (cyl.-gran.)	12.5 x 15.0	1840.8	10.192	18761.4

LAKE Staunton

DATE 7-16-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Trachelomonas (Cont.)				
T. sp. (cyl.-smooth)	12.5 x 16.0	1963.5	10.192	20012.0
T. sp. (spherical-gran.)	15.0 (diam.)	1767.2	10.192	18011.3
T. sp. (urn-shape)	20.0 x 30.0	9424.8	10.192	96057.6
PYRRHOPHYTA-None				
ANIMAL MATERIAL				
PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-Order Oligotrichida-Family Halteriidae				
Halteria sp.	25.0 (diam.)	8181.2	10.192	83382.8
Sub-Phylum Mastigophora-Class Zoomastigophorea				
Unknown Flagellate	15.0 x 15.0	2650.7	20.384	54031.9

LAKE Staunton

DATE 8-28-01 SITE 3

TAXA	SIZE (µm)	UNIT VOL. (µm^3)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella				
C. meneghiniana	11.2 (diam.)	198.8	50.960	10130.8
C. sp. (girdle view)	20.0 x 2.0	628.3	40.768	25614.5
Melosira italica var. *tenuissima*	5.0 x 14.0	2748.9	Present	
CHLOROPHYTA				
Ankistrodesmus falcatus var. *acicularis*	1.25 x 18.0	22.1	91.728	2027.2
Carteria				
C. multifilis	7.5 (diam.)	220.9	40.768	9005.7
C. sp. (No. 1)	15.0 x 20.0	3534.3	10.192	36021.6
Chlorogonium elongatum var. *elongatum*	5.0 x 20.0	392.7	10.192	4002.4
Chodatella citriformis	12.5 x 20.0	2454.4	10.192	25015.2
Closterium acutum	2.5 x 62.5	306.8	20.384	6253.8
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	203.840	360226.0
C. microporum	20.0 (col.-diam.)	4188.8	30.576	128076.7
Cosmarium				
C. sp.	10.0 x 10.0	785.4	20.384	16009.6
C. sp.	20.0 x 15.0	4712.4	20.384	96057.6
Crucigenia rectangularis	8.0 x 8.0 x 1.0	64.0	40.768	2609.2

LAKE Staunton

DATE 8-28-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	2242.240	9392294.9
Elakatothrix viridis	2.5 x 15.0	73.6	20.384	1500.3
Errerella bornhemiensis	25.0 x 25.0 x 5.0	3125.0	20.384	63700.0
Oocystis				
O. borgei	12.5 (diam.)	1022.7	122.304	125080.3
O. pusilla	20.0 (diam.)	4188.8	40.768	170769.0
Pediastrum				
P. duplex var. *gracilimum*	17.0 x 2.0	454.0	50.960	23135.8
P. simplex var. *duodenarium*	60.0 x 2.0	5654.9	10.192	57634.7
Phacotus lenticularis	7.5 x 12.5	552.2	101.920	56280.2
Scenedesmus abundans	7.5 x 15.0	577.3	101.920	58838.4
Schroederia setigera	2.5 x 52.5	257.7	152.880	39397.2
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas sp. (No. 1)	5.0 x 7.5	147.3	101.920	15012.8
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	764.400	400239.8
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	377.104	197451.6
Microcystis aeruginosa	40.0 (col.-diam.)	33510.4	40.768	1366151.9

LAKE Staunton

DATE 8-28-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
EUGLENOPHYTA				
Trachelomonas				
T. volvocina	11.2	735.6	10.192	7497.2
T. sp. (cyl.-gran.)	12.5 x 15.0	1840.8	10.192	18761.4

PYRRHOPHYTA-None

ANIMAL MATERIAL-None

LAKE Staunton

DATE 10-18-01 SITE 3

TAXA	SIZE (µm)	UNIT VOL. (µm^3)	No./mL	VOLUME
BACILLARIOPHYTA				
Cyclotella				
C. meneghiniana	11.2 (diam.)	198.8	377.104	74968.3
CHLOROPHYTA				
Ankistrodesmus falcatus				
var. *acicularis*	1.25 x 18.0	22.1	20.384	450.5
Carteria				
C. multifilis	7.5 (diam.)	220.9	50.960	11257.1
C. sp. (No. 1)	15.0 x 20.0	3534.3	30.576	108064.8
Coelastrum				
C. cambricum	15.0 (col.-diam.)	1767.2	1131.312	1999254.5
C. microporum	20.0 (col.-diam.)	4188.8	10.192	42692.2
Cosmarium sp.	15.0 x 15.0	2650.7	10.192	27015.9
Crucigenia				
C. quadrata	10.0 x 10.0 x 1.0	100.0	30.576	3057.6
C. rectangularis	8.0 x 8.0 x 1.0	64.0	20.384	1304.6
Dictyosphaerium				
D. pulchellum	20.0 (col.-diam.)	4188.8	71.344	298845.7
Elakatothrix viridis	2.5 x 15.0	73.6	20.384	1500.3
Errerella bornhemiensis	25.0 x 25.0 x 5.0	3125.0	30.576	95550.0
Kirchneriella lunaris				
var. *lunaris*	5.0 x 12.5	245.4	10.192	2501.1

LAKE Staunton

DATE 10-18-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
Oocystis				
O. borgei	12.5 (diam.)	1022.7	142.688	145927.0
O. pusilla	20.0 (diam.)	4188.8	61.152	256153.5
Scenedesmus				
S. abundans	7.5 x 15.0	577.3	30.576	17651.5
S. arcuatus var. *platydisca*	7.0 x 10.0	441.8	10.192	4502.8
Schroederia setigera	2.5 x 52.5	257.7	152.880	39397.2
Staurastrum oxycanthum	60.0 x 45.0	127234.4	10.192	1296773.0
CHRYSOPHYTA-None				
CRYPTOPHYTA				
Cryptomonas				
C. erosa	12.5 x 20.0	2454.4	30.576	75045.7
C. sp. (No. 1)	5.0 x 7.5	147.3	81.536	12010.3
CYANOPHYTA				
Anacystis montana	10.0 (col.-diam.)	523.6	1753.024	917883.4
Gomphosphaeria lacustris	10.0 (col.-diam.)	523.6	4382.560	2294708.4
EUGLENOPHYTA				
Trachelomonas				
T. volvocina	11.2	735.6	122.304	89966.8
T. sp. (cyl.-smooth)	15.0 x 20.0	3534.3	10.192	36021.6
PYRRHOPHYTA-None				

DATE 10-18-01 SITE 3

TAXA	SIZE (μm)	UNIT VOL. (μm^3)	No./mL	VOLUME
ANIMAL MATERIAL				
PROTOZOA-Sub-Phylum Ciliophora-Class Ciliata-Order Odontostomatida-Family Tintinnidae				
Codonella sp.	70.0 x 100.0	384844.8	10.192	3922338.2
ROTATORIA-Class Monogonata-Order Ploima-Family Brachionidae				
Brachionus sp.	70.0 x 110.0	423329.2	Present	

Summary of numbers and biovolumes of organisms for Lake Staunton Site 3 in 2001.

Date	**Phylum**	**No./mL**	**Volume**
4-27-01	Bacillariophyta	0	0
	Chlorophyta	1916.096	2992697.2
	Chrysophyta	0	0
	Cryptophyta	0	0
	Cyanophyta	2976.064	1546009.2
	Euglenophyta	61.152	661490.3
	Pyrrhophyta	0	0
	Total	4953.312	5200196.7
	Arthropoda	0	0
	Protozoa	0	0
	Rotatoria	0	0

	Total	0	0
6-25-01	Bacillariophyta	142.688	28366.4
	Chlorophyta	1049.776	5106741.1
	Chrysophyta	0	0
	Cryptophyta	50.960	7506.4
	Cyanophyta	764.400	750448.2
	Euglenophyta	71.344	100141.5
	Pyrrhophyta	0	0
	Total	2079.168	5993203.6
	Arthropoda	0	0
	Protozoa	0	0
	Rotatoria	0	0
	Total	0	0

Date	**Phylum**	**No./mL**	**Volume**
7-16-01	Bacillariophyta	366.912	72041.1
	Chlorophyta	1447.264	2269817.5
	Chrysophyta	0	0
	Cryptophyta	142.688	21017.9
	Cyanophyta	3251.248	3756889.4
	Euglenophyta	61.152	310428.9
	Pyrrhophyta	0	0
	Total	5269.264	6430194.8
	Arthropoda	0	0

	Protozoa	30.576	137414.7
	Rotatoria	0	0
	Total	30.576	137414.7
8-28-01	Bacillariophyta	91.728	35745.3
	Chlorophyta	3363.360	10673935.8
	Chrysophyta	0	0
	Cryptophyta	101.920	15012.8
	Cyanophyta	1182.272	1963843.3
	Euglenophyta	20.384	26258.6
	Pyrrhophyta	0	0
	Total	4759.664	12714795.8
	Arthropoda	0	0
	Protozoa	0	0
	Rotatoria	0	0
	Total	0	0

Date	Phylum	No./mL	Volume
10-18-01	Bacillariophyta	377.104	74968.3
	Chlorophyta	1844.752	4351899.3
	Chrysophyta	0	0
	Cryptophyta	112.112	87056.0
	Cyanophyta	6135.584	3212591.8
	Euglenophyta	132.496	125988.4

Pyrrhophyta	0	0
Total	8602.048	7852503.8
Arthropoda	0	0
Protozoa	10.192	3922338.2
Rotatoria	0	0
Total	10.192	3922338.2

CHAPTER 31

RECREATION

ARTICLE I - LAKE STAUNTON

31-1-1 DEFINITIONS. When used in this Chapter, the following words and terms shall have the meanings herein prescribed:

Craft. Any boat or raft not permanently attached to the shore.

Drainage Area. The entire area of land and water that drains into the reservoir or into the East Fork of Cahokia Creek, or any tributary or other stream above said public water supply dam.

Intake. The place where the water supply for the City is taken from the reservoir.

Marginal Land. The land owned or controlled by the City adjacent to the shoreline and not flooded by the waters of the reservoir.

Reservoir. The artificial lake and water impounded therein by means of the public water supply dam constructed across the valley of the East Fork of Cahokia Creek in Macoupin County, Illinois, and by any other structure or structures heretofore or hereafter constructed within the limits of the herein defined drainage area, which are used or for use as a public water supply for the City. The reservoir is hereby named and designated Lake Staunton.

Shoreline. The extended point where the plane of the surface waters of the reservoir touches land at spillway elevation.

Watercourse. Any stream, natural or artificial channel, spring or depression of any kind in which water flows continuously or intermittently over any part of the drainage area, directly or indirectly, into any part of the reservoir.

31-1-2 BOATING REGULATIONS. Boating regulations in Lake Staunton shall be subject to the owner's risk and to the following restrictions.

(A) Use of Certain Boats Restricted. Use of boats exceeding ten (10) horsepower are prohibited on Lake Staunton except as may be authorized by special concession granted by the City Council.

(1) Boats operating on Lake Staunton that are equipped with a motor larger than 10 H.P. must have that motor trimmed up to capacity. This motor can be used within fifty (50) feet of the boat ramp for loading purposes only.

(B) Licensing Requirements.

(1) Boat License. All boats operating on Lake Staunton are required to have a license (sticker) which must be displayed near the State Registration number. Unless issued for a special event, such license shall expire on the next ensuing March 30 and shall be annually renewed before said craft may be lawfully propelled or used on the lake.

(2) The license (sticker) shall be obtained from the City Clerk's office or in the event of

unavailability, they may be obtained from the Staunton Police Department.

(C) License Fees.

(1) Battery Powered Trolling Motors and Rowboats. In order to provide a fund to be used to defray the expense and inspection of said crafts on the lake and to enforce the provisions of this Section, said applications for or renewal of license must be accompanied by the payment of an annual license fee of Ten Dollars ($10.00) for residents of the City of Staunton. Non-resident fees shall be Twenty Dollars ($20.00). Residents are those applicants living within the City limits.

(2) Motors Up to Ten (10) Horsepower. To help defray the cost and inspection of said crafts on the lake and to enforce the provision of this Section, said applications for or renewal of license must be accompanied by the payment of an annual license fee of Fifteen Dollars ($15.00) for residents of the City of Staunton. Non-resident fees shall be Thirty Dollars ($30.00). Residents are those applicants living within the City limits.

(D) Boats to be Registered. All boats shall be registered according to the provisions of the Illinois Boat Registration and Safety Act.

(E) Using Boats for Business Purposes. The business of renting crafts for hire or carrying passengers for hire on Lake Staunton is prohibited, except as may be authorized by special concession granted by the City Council.

(F) Boat Equipment and Condition.

(1) Unnecessary Noise, Mufflers. No craft shall be used or operated or any horn or sound device so as to create a nuisance or disturb the quiet or any person. All motors shall be equipped with mufflers.

(2) Lights. The running of any craft after dark without proper lighting is prohibited, as according to law.

(G) Enforcement.

(1) Enforcement of the provision of this entire section shall be mandatory and enforced by the proper authorities.

(2) Lake Staunton is under the jurisdiction and laws set forth by the Corp of Engineers and the Department of Conservation.

(H) Penalties. Any person violating any of the provisions of this Section shall be punished by a fine of not less than One Hundred Dollars ($100.00) nor more than Seven Hundred Fifty Dollars ($750.00), and each day that the condition or act in violation of this Section remain or continue, shall be deemed to be a separate and distinct offense.

(I) Disposition and Uses of Revenues. All license fees, fines and penalties shall be placed in the General Fund or such other fund as may be directed by the City Council.

31-1-3 FISHING REGULATIONS.

(A) State Game and Fish Code Adopted. No person shall take or catch or attempt to take or catch fish of any kind from the City Reservoir contrary to the provision of the Illinois State Game and Fish Code. The provisions of said Code are hereby adopted and made a part of this Section and it shall be unlawful to take or catch or attempt to take or catch fish from the reservoir of a smaller size or in greater numbers than permitted by said Code or with equipment or in a manner or method or at times and between dates prohibited by said Code. Any violation of the terms of the State Game and Fish Code, as the same may be from time to time amended, and shall constitute a violation of this Section and shall be punished hereunder.

(B) Trout Lines, Bank Lines and Jugging Lines. Trout lines, bank lines and jugging lines are prohibited on Lake Staunton. (Ord. No. 1098; 01-29-97)

(C) Fishing During Duck and Geese Season. Fishing from any boat or water craft is prohibited during the State Duck and Geese hunting season. The Lake will be closed to boaters during duck season except to those who have registered duck blinds and boat traffic will only be allowed for travel to and from blinds. (Ord. No. 1098; 01-29-97)

(D) Authority to Suspend Fishing Privileges. The privilege of fishing in Lake Staunton or any part thereof may be suspended by the City at any time and the posting of any authorized sign on any part of the lake shall suspend the privilege of fishing at such location.

31-1-4 DOCKS.

(A) Docks will be allowed to be built on Lake Staunton.

(B) Docks will be numbered and will require a permit that must be renewed annually. There will be no fee for this permit.

(C) All docks must be well maintained or the yearly permit will not be reissued.

(D) There will be no permanent docks. All docks must be "Flotation Docks". The use of metal barrels for a flotation dock is prohibited.

(E) If styrofoam is used, it must be covered to prevent animals or mammals from destroying.

(F) These docks will be under the same laws and regulations of the Corp of Engineers.

31-1-5 DUCK BLINDS. The following regulations shall apply to duck blinds.

(A) Each Duck Blind shall be numbered by the City.

(B) Permits shall be obtained to build duck blinds. There will be no fee for this permit.

(C) There shall be no portable blinds--stationary only.

(D) Duck blind owners shall sign up in the City Clerk's office by September 1 of every year to retain his rights to his blind, or such blind will be forfeited to the lottery draw.

(E) Blinds shall be brushed and signed for or will be forfeited to a lottery draw.

(F) Blinds shall be maintained at all times of the year and used during that season or that blind shall be forfeited to the lottery draw.

(G) Blinds shall be built only in the designated numbered area provided by the City Council.

(H) The lottery shall be held on the second (2nd) Monday in September by the Staunton City Council. The recipients of the duck blind shall have two (2) weeks to register following letter notification; failure to register will result in forfeiture and a re-draw for said blind. (Ord. No. 1098;

01-29-97)

(I) The applicant need not be present for this drawing.

(J) Proper hunting license and F.O.I.D. card shall be presented prior to applications being accepted for the lottery draw.

31-1-6 CERTAIN ACTIVITIES RESTRICTED. These activities shall be restricted as follows:

(A) Picnicking and Camping. Picnicking and camping are prohibited on the Lake except:

(1) Upon such portions of the marginal land and at such times as may be designated by the City for such purpose or purposes.

(2) By any custodian and custodians of the marginal land, their families and guests and upon such portions of the marginal land as may have been leased to him.

(3) Any person picnicking, camping or making other use of the marginal land shall keep the premises neat and clean, pick up and remove in a sanitary manner all paper, garbage, rubbish and debris and before leaving the premises, put out any fire made by him.

(B) Swimming and Bathing. Swimming and bathing are prohibited in the reservoir except at such points as may hereafter be designated by the Council. If areas are designated for swimming, such swimming shall be done at the risk of the swimmer.

(C) The use of jet-skis and recreational vehicles are prohibited on Lake Staunton.

(D) Use of Firearms. No person shall fire or discharge any firearm or any description on the lake or within the limits of the marginal land except as permitted by Section 31-1-7 of this Chapter. However, the City may authorize any person to use firearms, traps or other means to destroy any predatory or otherwise undesirable bird or acquatic animal life. (Ord. No. 1098; 01-29-97)

(E) Fires. No fires shall be lighted or used on the marginal land except at such places as may be designated by the City for such purposes and except by any custodian on the marginal land leased by him.

(G) Glass Containers. It shall be unlawful to bring or possess glass beverage containers on lake property.

31-1-7 PROHIBITED ACTS AND CONDITIONS.

(A) Generally. All ordinances of the City relating to misdemeanors and nuisances within the corporate limits are hereby declared to apply to Lake Staunton and the marginal land and premises adjacent thereto, and to the water pumping and filtration plant and adjacent grounds which are owned by the City.

(B) Injury to Property. No person shall willfully, maliciously or negligently cut, break, climb on, carry away, conceal or deface any tree, shrub, plant, turf or grass or take down, alter, mar, mame, injure or destroy any sign, trailer marker, placard, notice, post, barrier, pile or buoy posted or placed or growing by the City or authorized to be posted or placed by the City on the lake and marginal land.

(C) Opening Hydrants. No person shall open any fire hydrant of the City except a duly authorized fireman or agent of the City.

(D) Prohibited Grounds. No person shall go upon any portion of the lake or marginal land where, by a sign or notice posted or authorized to be posted by the City, persons are prohibited from going.

(E) Pollution of Waters. No person shall, in any part of the drainage area, place, throw, discharge or cause to be discharged any sewage, garbage, decayed or other matter into and so as to directly or indirectly pollute or tend to pollute the reservoir or other waters from which the City obtains a water supply.

(F) Animals. No person shall cause or permit any domestic livestock or poultry to run at large on the marginal land. Any livestock or poultry found at large thereon may be taken by the City and sold to pay the expense of taking, keeping, advertising and selling such livestock or poultry.

(G) Hunting, Trapping, Removing Eggs From Nests. No person shall trap, catch, kill or wound or attempt to trap, catch, kill or wound any bird or animal, take any bird egg or molest or rob any next of any bird or animal on the lake or marginal land. This subsection shall not be construed to prohibit the hunting of ducks, geese or other game birds allowed by State or Federal Laws.

(H) Intoxicated Persons. No intoxicated person shall enter or remain in or around the lake or public grounds or marginal land.

31-1-8 LAKE POLICE OFFICERS. It shall be the duty of police officers of the City and such special police as may be designated or appointed to enforce the provisions of this Chapter. The Mayor and City Council may appoint such special police as may be deemed necessary for the purposes of this Chapter, who shall qualify by taking oath and giving bond in the same manner as regular police officers.

31-1-9 FISH LIMITS FOR LAKE. The following regulations shall apply to persons fishing in the Staunton Lake.

(A) Large Mouth Bass. Fifteen (15) inches in length. Limit of three (3) per day.

(B) Channel Catfish. No length. Limit of six (6) per day.

(C) Pole and Line Fishing Only. Limit of two (2) poles with no more than two (2) hooks per line.

(D) No Trot Lines -- Bank Lines -- or Jugs - governed by Department of Conservation.

Recreation 31-1-8

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