

# Lake Lucille

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*2012 Year End Report*



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10/05/2012  
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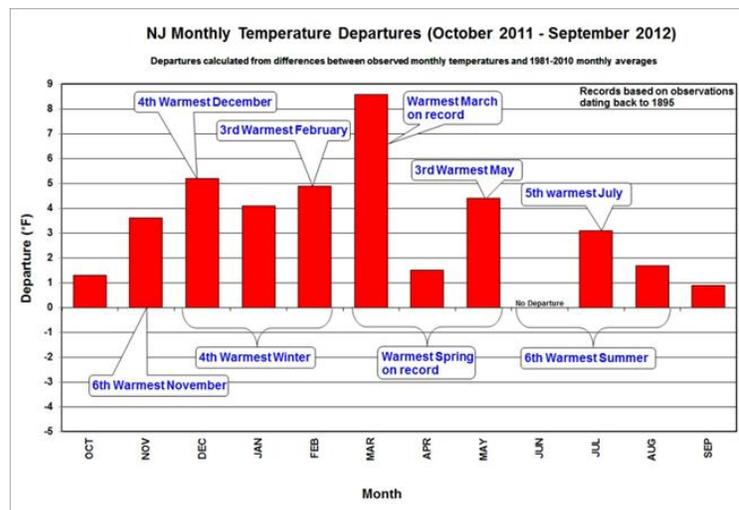
# 2012 YEAR END REPORT

## Lake Management Program Lake Lucille

### Summary:

Allied Biological was pleased to participate in the 2012 lake management plan for Lake Lucille. Water quality sampling was performed at the lake on two dates, May 2<sup>nd</sup> and August 17<sup>th</sup>. The data parameters collected were chosen to ascertain the overall health of the lake system. In concurrence with the first sampling date we also performed bathymetric mapping of the lake bottom and sediment sampling. The bathymetry results were sent in a previous report and are also included in the appendix. With this baseline data we hope to move forward with a long term management plan to provide continued service to Lake Lucille and the community.

In 2012 the mid-Atlantic region saw the warmest spring on record and one of the warmest summers (Fig 1). The early high temperatures seen in the region caused many lakes to experience early growing seasons for their aquatic plants and more frequent algal blooms than in previous years. Algae samples collected at Lake Lucille reflected this trend in the August sampling.



### Water Quality:

Water quality sampling parameters collected at Lake Lucille during the 2012 season included limnological measurements for temperature and dissolved oxygen, water clarity, pH, total hardness and alkalinity. The samples were collected at the lake station located in the eastern end of the lake, a map of the lake station location is located in the appendix. The water depth at the site was approximately nine feet. Dissolved oxygen and temperature readings were collected at two foot intervals through the

water column (Table 1). Temperature readings on both dates were consistent with normal seasonal levels for your region, and in August showed even mixing throughout the water column. The dissolved oxygen profile readings were higher throughout the water column during the August sampling than in May. Overall the dissolved oxygen levels are ideal for maintaining the biota in the lake system.

**Table 1: 2012 Temperature and Dissolved Oxygen Profiles**

Depth (Feet)	5/2/2012		8/17/2012	
	Temp (°C)	Dissolved Oxygen (mg/L)	Temp (°C)	Dissolved Oxygen (mg/L)
0'	14.0	11.52	25.7	12.11
2'	13.1	10.25	25.7	12.20
4'	12.2	7.72	25.6	12.05
6'	12.2	6.23	25.0	7.35
8'	11.9	6.35	24.2	7.11

**Table 2: 2012 Water Quality Parameters**

Parameter	Units	Date		Minimum Detectable Level
		5/2/12	8/17/12	
Ammonia	mg/L	<0.2	<0.2	0.2
Conductivity	µmhos/cm	329	350	1
Nitrate as N	mg/L	0.9	0.7	0.2
Nitrite	mg/L	<0.2	<0.2	0.2
Total Phosphorus	mg/L	0.07	0.07	0.01
Total Suspended Solids	mg/L	8	<3	3
Turbidity	NTU	5.91	4.98	1
Transparency	ft	2.75	3.0	-

Ammonia and Nitrate levels were below detectable limits on both sampling dates. Total Suspended Solids were slightly elevated on the first sampling date in May and below detectable limits on the August sampling date. This difference could be due to rain events which occurred just prior to the first sampling date causing turbulence in the water column. Turbidity also decreased between sampling dates but was considered within normal standards on both visits. Elevated turbidity and total suspended solid levels could be connected to the ongoing issues with the construction site up stream from Lake Lucille and should continue to be monitored closely. Conductivity levels were similar on both dates and within reasonable limits. Both nitrate and phosphorus were above the threshold level that can promote excessive phytoplankton production and aquatic plant growth. Normally phosphorus is the limiting factor in an aquatic system and continued elevated levels may cause excessive algal growth which can be a stressor to the other biota in the system.

Bathymetric mapping showed the lake to have a mean depth of 5.4 feet and a maximum depth of 10.3 feet near the outlet on the east end of the lake. Sediment sampling was conducted at six sites throughout the lake and sent for evaluation. The samples were analyzed for percent moisture and grain size and the results are attached in the appendix. If issues with silt and sediment accumulation continue at Lake Lucille due to the upstream construction problems these results will serve as a baseline to compare to.

### **Phytoplankton Sampling:**

Two phytoplankton samples were taken at Lake Lucille in 2012 coinciding with the water quality sampling dates. The samples were collected at the lake station and transported back to Allied Biological for examination in our lab. The May assemblage had moderate phytoplankton density and diversity with a favorable mix of green algae and golden algae that is normal for the season. The second sample, collected in August showed a significant increase in algal density, specifically in the green algae. This increase could be a result of continued high nutrient levels in the system. No nuisance blue-green algae were observed on either sampling date. The full reports can be viewed in the appendix.

### **Discussion and Recommendations:**

The 2012 season was our first season working with the Lake Lucille Association. The data collected will serve as a baseline for future assessment and management. Lake Lucille consists of a 15 acre basin that is part of the Crum Creek water shed. During the 2012 season the lake experienced issues with turbidity due to on-going construction problems within the watershed. The initial analysis of the system showed elevated nutrient levels and decreased water clarity from historical norms. Fluctuations in turbidity in the lake basin were reported by residents as more significant following rain events throughout the 2012 season.

In 2013, lake management at Lake Lucille should concentrate on closely monitoring the water quality in the system using the parameters already in place. However, in the upcoming season we would recommend an increase in the frequency of sampling to better assess the stability and inputs in the system. Sampling three times during the season, in April, June and August, would better help to delineate the nutrient and algal trends in the system.

A survey of the aquatic vegetation in the basin and the surrounding wetland areas is also recommended. This survey will help us to move forward with long term planning for Lake Lucille. No aquatic vegetation was observed during our two sampling visits. Vegetation can be beneficial in filtering both nutrients and silt in an aquatic system. With the proper assessment of the current vegetation at Lake Lucille we can recommend strategies to help control some of the turbidity and nutrient flow that was observed during the 2012 season.

There are a number of strategies for nutrient and sediment control that could be implemented at Lake Lucille. Some of these include aquascaping in target areas which can help to filter nutrients and slow sediment deposition. Native plants utilize phosphorus and nitrates pulling them from the system thus reducing nutrients available to sustain algal blooms. They can also add aesthetics to the lake when emergent plants with showy flowers are included in the planning. Shoreline planting of native trees and shrubs can also help to absorb nutrients and slow sediment influx from lawns and roadways. Allied Biological would be pleased to help you develop plans for these ideas as we move forward. An aquascaping project at Lake Lucille would cost approximately three to four thousand dollars and would be dependent on a survey of the lake to determine suitable planting areas.

It is recommended that copper sulfate, an algaecide, be used as necessary for the control of algal blooms at Lake Lucille. With proper monitoring, algal blooms can be addressed early on and be prevented from becoming problematic and causing a disruption of lake use by residents.

Again, we wish to thank the Lake Lucille Association for the opportunity to assist you in the management program for you lake and we look forward to working with you in the 2013 season.

Sincerely,

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**Appendix:**

**Lake Lucille, Lake Station:**

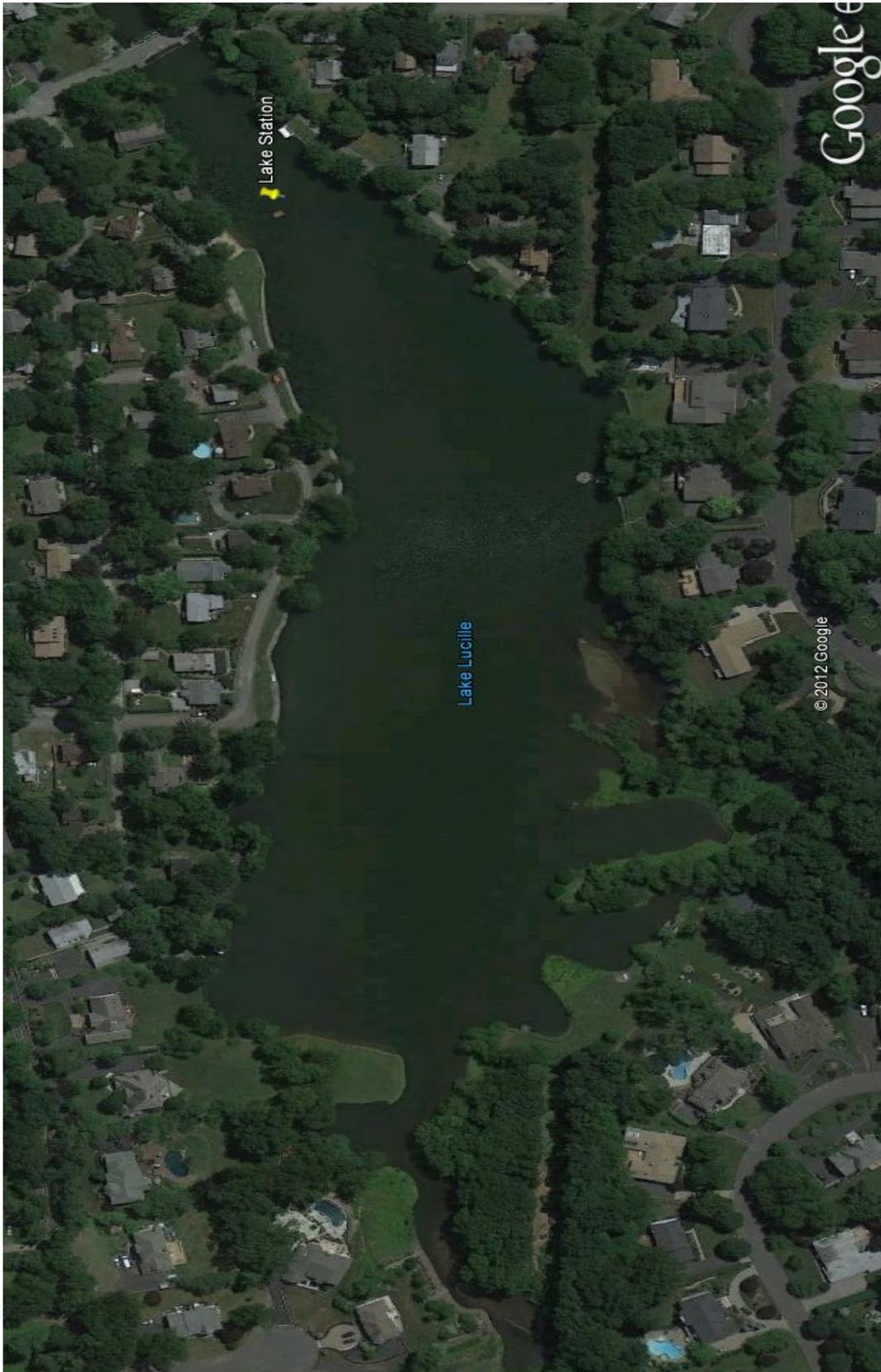


Figure 1: Lake Lucille, Lake Station

## Water Quality Parameters:

### Temperature

Temperature is measured in degrees Celsius, and is very important to aquatic biota. Several factors affect temperature in a lake system, including air temperature, season, wind, water flow through the system, and shade trees. Turbidity can also increase water temperature as suspended particles absorb sun rays more efficiently. Water depth also affects temperature. In general, deeper water remains cooler during the summer months.

Temperature preferences vary among aquatic biota. Since water temperature typically varies between 5 °C and 30 °C during the season, most aquatic biota can flourish under this wide range of temperatures. Of more concern is thermal shock, which occurs when temperature rapidly changes in a short amount of time. Some aquatic biota can become stressed when temperature changes as little as 1-2 °C in a 24 hour period.

### Dissolved Oxygen

Dissolved Oxygen is the measurement of the amount of oxygen freely available to aquatic biota in water. Several factors play a role in affecting the amount of dissolved oxygen in the water. These factors include temperature (warmer water holds less dissolved oxygen), low atmospheric pressure (such as higher altitude) decreases the solubility of oxygen, mineral content of the water can reduce the water's dissolved oxygen capacity, and water mixing (via wind, flow over rocks, or thermal upwelling) increases dissolved oxygen in the water. In addition, an over abundance of organic matter, such as dead algae or plants causes rapid aerobic bacteria growth. During this growth, bacteria consume oxygen during respiration, which can cause the water's dissolved oxygen to decrease.

Dissolved oxygen has a wide range, from 0 mg/L to 20 mg/L. To support diverse aquatic biota, 5-6 mg/L is minimally required, but 9-10 mg/L is an indicator of better overall water quality. Dissolved oxygen reading of below 4 mg/L is stressful to most aquatic organisms, especially fish.

### Water Clarity

Transparency (or visibility) is measured with a Secchi disc, and can provide an experienced biologist with a quick determination of a lake's water quality. In short, higher visibility indicates a cleaner (and healthier) aquatic system. Cloudy conditions could indicate nutrient rich sediments entering the lake or excessive algal blooms due to nutrient availability, leading to a degradation of water quality.

Clear conditions allow greater light penetration and the establishment of a deeper photic zone. The photic zone is the depth of active photosynthesis carried out by plants and algae. A byproduct of photosynthesis is dissolved oxygen, required for use by higher aquatic organisms, such as zooplankton and fish.



### Alkalinity

Alkalinity is the measure of the water's capacity to neutralize acids. A higher alkalinity can buffer the water against rapid pH changes, which in turn prevents undue stress on aquatic biota due to fluctuating pH levels. The alkalinity of a lake is primarily a function of the watersheds soil and rock composition.

Limestone, dolomite and calcite are all a source of alkalinity. High levels of precipitation in a short amount of time can decrease the water's alkalinity. A typical freshwater lake has an alkalinity of 20-200 mg/L. A lake with a low alkalinity typically also has a low pH, which can limit the diversity of aquatic biota.

## **pH**

The measurement of acidity or alkalinity of the water is called pH (the "potential for hydrogen"). Several factors can impact the pH of a lake, including precipitation in a short amount of time, rock and soil composition of the watershed, algal blooms (increase the pH), and aquatic plant decomposition (decreases the pH). A pH level of 6.5 to 7.5 is considered excellent, but most lake systems fall in the range of 6.0 to 8.5. Aquatic biota can become stressed if the pH drops below 6.0, or increases above 8.5 for an extended amount of time.

Most aquatic biota are adapted to specific pH ranges. When the pH fluctuates rapidly, it can cause changes in aquatic biota diversity. Immature stages of aquatic insects and juvenile fish are more sensitive to low pH values than their adult counterparts. Therefore, a low pH can actually inhibit the hatch rate and early development of these organisms.

## **Conductivity**

Conductivity is the measure of water's ability to conduct an electrical current, and is measured in umhos/cm, the higher the number of charged particles (ions) in the water, the easier for electricity to pass through it. Conductivity is useful in lake management by estimating the dissolved ionic matter in the water, the lower the conductivity, the higher the quality of water (oligotrophic). A higher conductivity usually indicates an abundance of plant nutrients (total phosphorous and nitrate), or eutrophic conditions. Industrial discharge, road salt runoff, and septic tank leaching can increase conductivity. Distilled water has a conductivity of 0.5 to 2.0 umhos/cm, while drinking water conductivity typically ranges from 50 to 1,500 umhos/cm. Conductivity below 500 umhos/cm is considered ideal in a lake system.

## **Nitrate**

Nitrates are chemical compounds derived from nitrogen and oxygen. Nitrogen is needed by all plants and animals to make proteins needed for growth and reproduction. Nitrates are generated during plant and animal decomposition, from man-made sources, and from livestock and waterfowl sources. Man-made sources of nitrates include septic system leaching, fertilizer runoff, and improperly treated wastewater. Freshwater lake systems can potentially receive large nitrate inputs from waterfowl, specifically large flocks of Canada geese. An increase in nitrate levels can in turn cause an increase in total phosphorous levels. A nitrate level greater than 0.3 mg/L can promote excessive growth of aquatic plants and algae.

## **Total Phosphorous**

Total phosphorous is a chemical compound derived from phosphorous and oxygen. Total phosphorous is usually present in freshwater in low concentrations, and is often the limiting nutrient to aquatic plant growth. However, man-made sources of phosphorous include septic system leaching, fertilizer runoff, and improperly treated wastewater. These phosphorous inputs usually enter a freshwater lake system during rain events, and bank erosion.

A total phosphorous level greater than 0.03 mg/L can promote excessive aquatic plant growth and decomposition, either in the form of algal blooms, or nuisance quantities of aquatic plants. This process is called eutrophication, and when induced or sped up by man-made nutrient inputs, it is called cultural eutrophication. As a result of this excessive growth, recreational activities, such as swimming, boating, and fishing in the lake can be negatively impacted. In addition, aerobic bacteria will thrive under these conditions, causing a decrease in dissolved oxygen levels which can negatively impact aquatic biota such as fish.

### **Turbidity**

Turbidity is the measurement of lack of water clarity, and is measured in NTU. Suspended solids in the water column cause an increase in turbidity. Therefore, the lower the turbidity measurement, the clearer the water is. The leading sources of turbidity include soil erosion, waste discharge, urban runoff, flooding, dredging operations, increased flow rates, or algae blooms. An overabundance of bottom feeding fish, such as carp, can also increase turbidity due to constant grazing and disturbing of fine bottom sediments. A turbidity of 25 NTU or less is desirable for a lake. Ideal trout waters have a turbidity of 10 NTU or less, but most aquatic biota can be sustained in water with a turbidity of 50 NTU or less. Although a turbidity level of 5.0 NTU or greater is generally considered visible to the observer, there is some industry discussion on value of turbidity measurements in relation to aesthetics

Turbidity can affect a lake in many ways. These include temperature increases (as suspended particles absorb more sunlight), reduced light penetration (which reduces aquatic plant habitat in the littoral zone), and negative fish impacts. Negative impacts on fish population include suspended solids clogging and damaging fish gills, reduced clarity affecting the ability of predatory fish to locate food by sight, and inhibit proper egg and larval development.

### **Total Suspended Solids**

Total suspended solids refer to all of the particulate matter suspended in the water column. When these solids settle to the bottom of a water body (a process called siltation), they become sediments. There are two components that make up total suspended solids: inorganic and organic. The inorganic portion is usually considerably higher than the organic portion and includes silts, clays, and soils. Organic solids include algae, zooplankton, bacteria and organic debris. All these solids create turbid (or "muddy") conditions. The geology and vegetation of a watershed affect the amount of suspended solids that enter a lake system. Most suspended solids originate from accelerated soil erosion from agricultural operations, logging activities, and construction activities. Another source is the disturbance of bottom sediments from dredging activities, grazing of bottom feeding fish, and recreational activities such as boating.

# Phytoplankton Reports:

5/2/2012

MICROSCOPIC EXAMINATION OF WATER											
Sample from: Lake Lucille											
Collection Date: 5/2/12				Examination Date: 5/3/12				Amount Examined: 200 ml.			
Site A: Lake Station				Site B:				Site C:			
BACILLARIOPHYTA (Diatoms)	A	B	C	CHLOROPHYTA (Green Algae)	A	B	C	CYANOPHYTA (Blue-green Algae)	A	B	C
<i>Asterionella</i>				<i>Ankistrodesmus</i>				<i>Anabaena</i>			
<i>Cyclotella</i>				<i>Chlamydomonas</i>				<i>Anacystis</i>			
<i>Cymbella</i>	30			<i>Chlorella</i>				<i>Aphanizomenon</i>			
<i>Diatoma</i>				<i>Chlorococcum</i>				<i>Coelosphaerium</i>			
<i>Fragilaria</i>				<i>Closterium</i>	10			<i>Gomphosphseria</i>			
<i>Melosira</i>				<i>Coelastrum</i>				<i>Lyngbya</i>			
<i>Navicula</i>				<i>Eudorina</i>				<i>Microcystis</i>			
<i>Nitzschia</i>				<i>Mougeotia</i>				<i>Oscillatoria</i>			
<i>Pinnularia</i>				<i>Oedogonium</i>				<i>Pseudoanabaena</i>			
<i>Rhizosolenia</i>				<i>Oocystis</i>				<i>Synechocystis</i>			
<i>Stephanodiscus</i>	130			<i>Pandorina</i>				<i>Agmenellum</i>			
<i>Stauroneis</i>				<i>Pediastrum</i>							
<i>Synedra</i>	10			<i>Phytoconis</i>				<b>PROTOZOA</b>			
<i>Tabellaria</i>				<i>Rhizoclonium</i>				<i>Actinophrys</i>			
<i>Cocconeis</i>				<i>Scenedesmus</i>	50						
CHRYSTOPHYTA (Golden Algae)	A	B	C	<i>Spirogyra</i>				EUGLENOPHYTA (Euglenoids)	A	B	C
				<i>Staurostrum</i>				<i>Euglena</i>			
<i>Dinobryon</i>	180			<i>Sphaerocystis</i>	180			<i>Phacus</i>			
<i>Mallomonas</i>				<i>Ulothrix</i>	10			<i>Trachelomonas</i>			
<i>Synura</i>				<i>Volvox</i>							
<i>Tribonema</i>				<i>Zygnema</i>							
<i>Uroglenopsis</i>				<i>Aulacoseira</i>							
				<i>Dictyosphaerium</i>	30			PYRRHOPHYTA (Dinoflagellates)	A	B	C
				<i>Gloeocystis</i>	30			<i>Ceratium</i>			
				<i>Botryococcus</i>	50			<i>Peridinium</i>			
<b>SITE</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>NOTES:</b> This is the first sampling event of 2012. The phytoplankton density is considered moderate with moderate-high sample diversity. The assemblage is dominated by a mixture of green algae which accounts for 51% of the total phytoplankton observed. Golden algae (25%) and diatoms (24%) round out the assemblage on this date. The phytoplankton density is considered ideal for this time of the season. Water clarity is considered poor, possibly impacted from recent heavy rainfall events.							
<b>TOTAL GENERA:</b>	11										
<b>TRANSPARENCY:</b>	2.75'										
<b>ORGANISMS PER MILLILITER:</b>	710										

8/17/2012

MICROSCOPIC EXAMINATION OF WATER											
Sample from: Lake Lucille											
Collection Date: 8/17/12				Examination Date: 8/17/12				Amount Examined: 200 ml.			
Site A: Lake Station				Site B:				Site C:			
BACILLARIOPHYTA (Diatoms)	A	B	C	CHLOROPHYTA (Green Algae)	A	B	C	CYANOPHYTA (Blue-green Algae)	A	B	C
<i>Asterionella</i>				<i>Ankistrodesmus</i>				<i>Anabaena</i>			
<i>Cyclotella</i>				<i>Chlamydomonas</i>				<i>Anacystis</i>			
<i>Cymbella</i>				<i>Chlorella</i>				<i>Aphanizomenon</i>			
<i>Diatoma</i>				<i>Chlorococcum</i>				<i>Coelosphaerium</i>			
<i>Fragilaria</i>	30			<i>Closterium</i>	10			<i>Gomphospheria</i>			
<i>Melosira</i>				<i>Coelastrum</i>	3390			<i>Lyngbya</i>			
<i>Navicula</i>				<i>Eudorina</i>				<i>Microcystis</i>			
<i>Nitzschia</i>				<i>Mougeotia</i>				<i>Oscillatoria</i>			
<i>Pinnularia</i>				<i>Oedogonium</i>				<i>Pseudoanabaena</i>			
<i>Rhizosolenia</i>				<i>Oocystis</i>				<i>Synechocystis</i>			
<i>Stephanodiscus</i>	170			<i>Pandorina</i>				<i>Agmenellum</i>			
<i>Stauroneis</i>				<i>Pediastrum</i>	10						
<i>Synedra</i>				<i>Phytoconis</i>				<b>PROTOZOA</b>			
<i>Tabellaria</i>				<i>Rhizoclonium</i>				<i>Actinophrys</i>			
<i>Cocconeis</i>				<i>Scenedesmus</i>	70						
CHRYSOPHYTA (Golden Algae)	A	B	C	<i>Spirogyra</i>				EUGLENOPHYTA (Euglenoids)	A	B	C
				<i>Staurastrum</i>	20			<i>Euglena</i>			
<i>Dinobryon</i>				<i>Sphaerocystis</i>	10			<i>Phacus</i>			
<i>Mallomonas</i>	10			<i>Ulothrix</i>	90			<i>Trachelomonas</i>			
<i>Synura</i>				<i>Volvox</i>	20						
<i>Tribonema</i>				<i>Zygnema</i>							
<i>Uroglenopsis</i>				<i>Aulacoseira</i>							
				<i>Dictyosphaerium</i>				PYRRHOPHYTA (Dinoflagellates)	A	B	C
				<i>Gloeocystis</i>				<i>Ceratium</i>	90		
				<i>Botryococcus</i>				<i>Peridinium</i>			
				<i>Microtinium</i>	60						
<b>SITE</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>NOTES:</b> The phytoplankton density has increased significantly (>5x) since the first sampling of the season and is considered high. The diversity also increased slightly and is also now considered high. The assemblage is dominated by a mixture of green algae, specifically <i>Coelastrum</i> . Golden algae and diatoms were also observed in small amounts. Water clarity continues to be poor, probably due to increased phytoplankton density in the water column.							
<b>TOTAL GENERA:</b>	13										
<b>TRANSPARENCY:</b>	3'										
<b>ORGANISMS PER MILLILITER:</b>	3800										