



2011

Chisago Lakes Chain of Lakes Watershed
Water Quality and Aquatic Invasive Species Monitoring

Chisago Lakes Lake Improvement District

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Definitions

Ammonia Nitrogen: An inorganic form of nitrogen contained in fertilizers, septic system effluent, and animal wastes. It is also a product of bacterial decomposition of organic matter. Ammonia nitrogen becomes a concern if high levels of the un-ionized form are present. In this form, it can be toxic to aquatic organisms. The presence of un-ionized ammonia is a function of the ammonia nitrogen concentration, pH, and temperature. Conversion of ammonia nitrogen to nitrite nitrogen by nitrification requires large quantities of oxygen which can kill aquatic organisms due to the lowered dissolved oxygen concentrations in water. The lowest reported limit is 0.02 mg/L. Any samples below 0.02 mg/L are reported as 0.02 mg/L or <0.02 mg/L.

Chlorophyll A (Chl-A): Photosynthetic pigment found in all green plants and the main pigment in algae. The concentration of chlorophyll A is used to estimate the amount of algae in surface water (MPCA). The lower the reading, the clearer the water will be.

Color of Filtered Water: This is a description of the color of the algae which remains after lake water is drawn through a filter. In order to provide an accurate description of the color, which can be compared year to year, the colors of the filtered water are compared to those colors illustrated in the Martha Stewart Living – complete color palette.

Secchi Disk (SD): A measure of water clarity taken with a black and white disk lowered into the water until it disappears, then raised until it barely appears and record a reading. The higher the reading, the clearer the water will be.

Temperature: A specific degree of hotness or coldness as indicated on or referred to a standard scale. Lakes in Chisago County meet the standard for temperature if the daily average temperature does not exceed 86.0°F.

Total Phosphorus (TP): A nutrient essential to the growth of all organisms and commonly the limiting factor in the primary productivity of surface water bodies. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particle form. Agricultural drainage, wastewater, and certain industrial discharges are typical source of phosphorus and can contribute to the eutrophication of surface water bodies (MPCA). The lower the reading, the clearer the water will be.

Physical Condition: Describe the physical condition of the lake water at your sampling site.				Recreational Suitability: Describe your opinion of how suitable the lake water is for recreation and aesthetics at your sampling site.			
1	Crystal clear water	4	High algae levels limited clarity and/or mild odor apparent	1	Beautiful, could NOT be better	4	Desire to swim and level of enjoyment of the lake substantially reduced because of algae levels (would not swim but boating okay)
2	Not quite crystal clear – a little algae present/visible	5	Severely high algae levels with the following: massive floating scums, strong foul odor, fish kill	2	Very minor aesthetic problems; excellent for swimming, boating		
3	Definite algae green, yellow, or brown color			3	Swimming /aesthetic enjoyment slightly impaired because of algae levels	5	Swimming and aesthetic enjoyment of the lake nearly impossible due to algae levels

Trophic Levels:

Trophic State Index: A formula used to determine the Trophic Level of a lake. Total Phosphorus, Chlorophyll A and Secchi Transparency will each have an individual trophic level that allows the parameters to be compared to one another when the actual values cannot be compared.

Oligotrophic: Clear water, oxygen throughout the year the hypolimnion (area below the thermocline). Water may be suitable for an unfiltered water supply. Salmon can occupy these lakes.

Mesotrophic: Water is moderately clear, increasing probability of lack of oxygen in the hypolimnion during summer. Iron, manganese, taste, and odor problems worsen. Walleye population may be predominant.

Eutrophic: The hypolimnion is without oxygen the majority of the year. There may be problems with the macrophyte plant population. Blue-green algae blooms may occur. The water supply may have episodes of severe taste and odor. Only warm water fisheries are present. Nuisance macrophytes, algae blooms, and very low transparency may discourage swimming and boating.

Hypereutrophic: Dense algae and macrophytes present. Rough fish dominate the fish population. The possibilities of summer fish kills exist.

Carlson Trophic State Index (Carlson, R.E. and J. Simpson. 1996. *A Coordinator's Guide to Volunteer Lake Monitoring Methods*. North American Lake Management Society.)

TSI	<30	30-40	40-50	50-60	60-70	70-80	>80
Chl- <i>a</i> (µg/L)	<0.95	0.95-2.6	2.6-7.3	7.3-20	20-56	56-155	>155
SD (m)	>8	8-4	4-2	2-1	0.5-1	0.25-0.5	<0.25
TP (µg/L)	<6	6-12	12-24	24-48	48-96	96-192	192-384

Project Objective

The purpose of the 2011 Chisago Lakes Chain of Lakes Watershed, Water Quality and Aquatic Invasive Species Monitoring program is to help achieve the following two goals identified in the 2011 Water Resource Management Plan:

Goal 1: Preserve, protect, and enhance water quality within the Chisago Chain of Lakes watershed. Objective 2: Annually monitor nutrients, aquatic life, and other parameters to determine water quality concentrations, trends, and loading. The resultant report will provide information about lake water quality and interpretation of trends.

Goal 8: Promote the reduction or control of non-native aquatic invasive species.

Past water quality monitoring has been useful in determining long term water quality trends. In addition, water quality monitoring data is essential for completing the Chisago Lakes Total Maximum Daily Load Study – a water quality protection and restoration plan for the Chisago Chain of Lakes. Continuing the water quality monitoring will help determine progress in obtaining water quality goals.

Visual inspections of the lakes were conducted looking for changes in the abundance or locations of aquatic invasive species, especially Eurasian Water Milfoil and Curly-leaf Pondweed. Potential interference with navigation was the primary consideration.

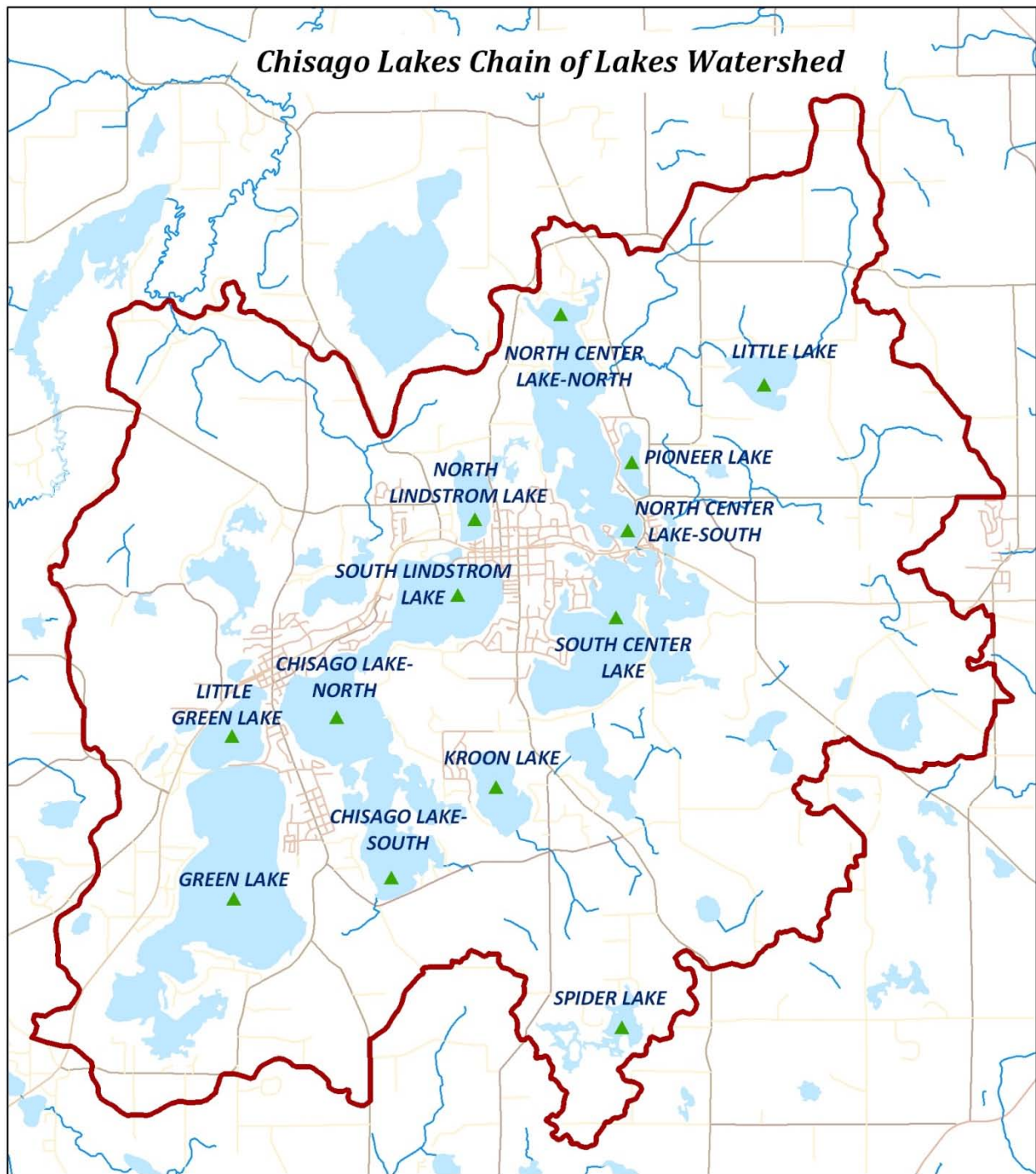
Ten lakes were monitored through this program in 2011. Two of these lakes (Chisago and North Center) had 2 monitoring locations each. Each lake was monitored 5 times, once a month, May through September. Samples were collected at the deepest part of the lakes.

Graphs represent 2011 data only. In some cases, 2009 & 2010 data is listed below the chart for comparison.

- Thanks to the Chisago Lakes Lake Improvement District for providing staff and funding for the program.
- Thanks to the Chisago Soil & Water Conservation District for providing review of data, interpretation, submittal to MPCA's EQUIS program, and preparation of this report.
- Special thanks to the Chisago County Sheriff's Department for use of a Water Patrol boat to collect samples.

*Graphs represent 2011 data only. In some cases, 2009 and 2010 data is listed below the chart for comparison.

Monitoring Locations



2011 Water Quality Monitoring Sites
Samples collected at the deepest location in the lake

- ▲ Lake Monitoring Sites
- ⬭ Watershed
- Lake
- ~ Stream

0 3,250 6,500 13,000 Feet



Explanation of Parameters

Parameter	Unit	MPCA Deep Lake Standard**	MPCA Shallow Lake Standard**	Expected Range Chisago County
Chlorophyll A	µg/L	14.0	20.0	5.0-22.0
Secchi Disk	Meters	>1.4	>1.0	1.5-3.2
Ammonia Nitrogen*	mg/L	No Standard	No Standard	None
*Minimum reporting level 0.02. Samples reported as 0.02 are actually 0.02 or less.				
Total Phosphorus	µg/L	40.0	60.0	23.0-50.0
Temperature	°F	Daily average should not exceed 86°F	Daily average should not exceed 86°F	None
A lake that fails to meet two of the three standards (Chlorophyll A, Secchi Disk, Total Phosphorus) may be considered "impaired".				

Source: Heiskary, 1991

**Standards are based on June-September average. Shallow lakes have a maximum depth of 15 feet or less, or more than 80% of the lake is shallow enough to support emergent vegetation (littoral area). Deep lakes are generally more than 15 feet deep and have less than 80% littoral area.

Lake Classification

Parameter	Oligotrophic	Mesotrophic	Eutrophic	Hyper-Eutrophic
Total Phosphorus (µg/L)	<12	13-24	24-96	>96
Chlorophyll A (µg/L)	<3	3-7	7-56	>56
Secchi Transparency (m)	>4.0	2.0-4.0	2.0-0.5	<0.5

Source: Osgood, 1989b, Osgood, 1989c

Lake Water Quality Grades

Grade	Percentile	Total Phosphorus (µg/L)	Chlorophyll A (µg/L)	Secchi Transparency (m)
A	<10	<23	<10	>3.0
B	10-30	23-32	10-20	2.2-3.0
C	30-70	32-68	20-48	1.2-2.2
D	70-90	68-152	48-77	0.7-1.2
F	>90	>152	>77	<0.7

Source: Metropolitan Council-pg. 12,

<http://www.metrocouncil.org/environment/RiversLakes/Lakes/07IntPurAcknMethResAn.pdf>

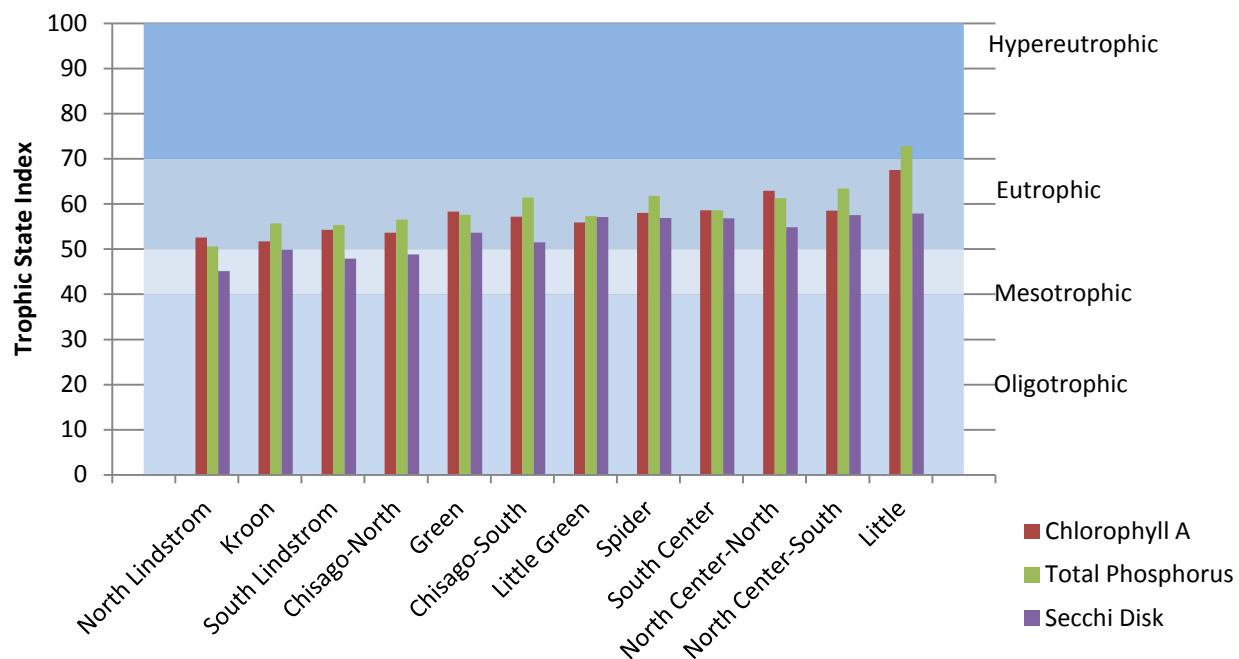
Grades are based on May-September average.

Rank of Lakes Monitored

Rank	Lake	Grade	Trophic State Index	Chlorophyll A (ug/L)	Secchi Disk (meters)	Total Phosphorus (ug/L)	Classification	Shallow versus Deep	Meets MPCA Standards
1	North Lindstrom	B	49.4	11.5	2.5	26.0	Eutrophic	Deep	Yes
2	Kroon	B	52.4	10.0	1.6	38.3	Eutrophic	Deep	Yes
3	South Lindstrom	B	52.5	13.8	1.9	38.5	Eutrophic	Deep	Yes
4	Chisago-North	B	53.0	12.8	1.9	42.8	Eutrophic	Deep	Yes
5	Green	C	56.5	18.8	1.3	45.5	Eutrophic	Deep	No
6	Chisago-South	C	56.7	18.3	1.2	60.8	Eutrophic	Shallow	Yes
7	Little Green	C	56.8	15.3	1.0	39.3	Eutrophic	Deep	No
8	Spider	C	58.0	17.0	1.1	51.5	Eutrophic	Shallow	Yes
9	South Center	C	58.0	21.0	1.0	47.5	Eutrophic	Deep	No
10	North Center-North	C	59.7	31.8	1.3	56.0	Eutrophic	Shallow	Yes
11	North Center-South	C	59.8	20.5	1.0	62.3	Eutrophic	Shallow	No
12	Little	C-	66.1	52.5	0.9	125.5	Eutrophic	Deep	No

*Shaded cells do not meet the Water Quality Standards in 2011

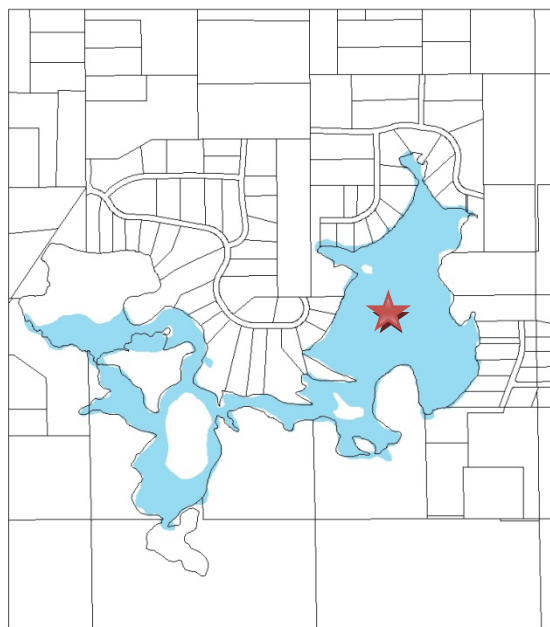
Lake Classification Charts



Lake 13-0019 Spider Lake



Spider Lake



Shallow Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	58.0	56.9	61.8	58.9
Classification	Eutrophic	Eutrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: C

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	16.4 µg/L	1.2 meters	54.6 µg/L		
Grade	B	C	C	C	8 th /12

MPCA Standards: Meets Standards

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Shallow lake)	20.0 µg/L	>1.0 meters	60.0 µg/L	
2011 Average (June-Sept)	17.0 µg/L	1.2 meters	51.5 µg/L	
Meets Standard	Yes	Yes	Yes	Yes

Chlorophyll A

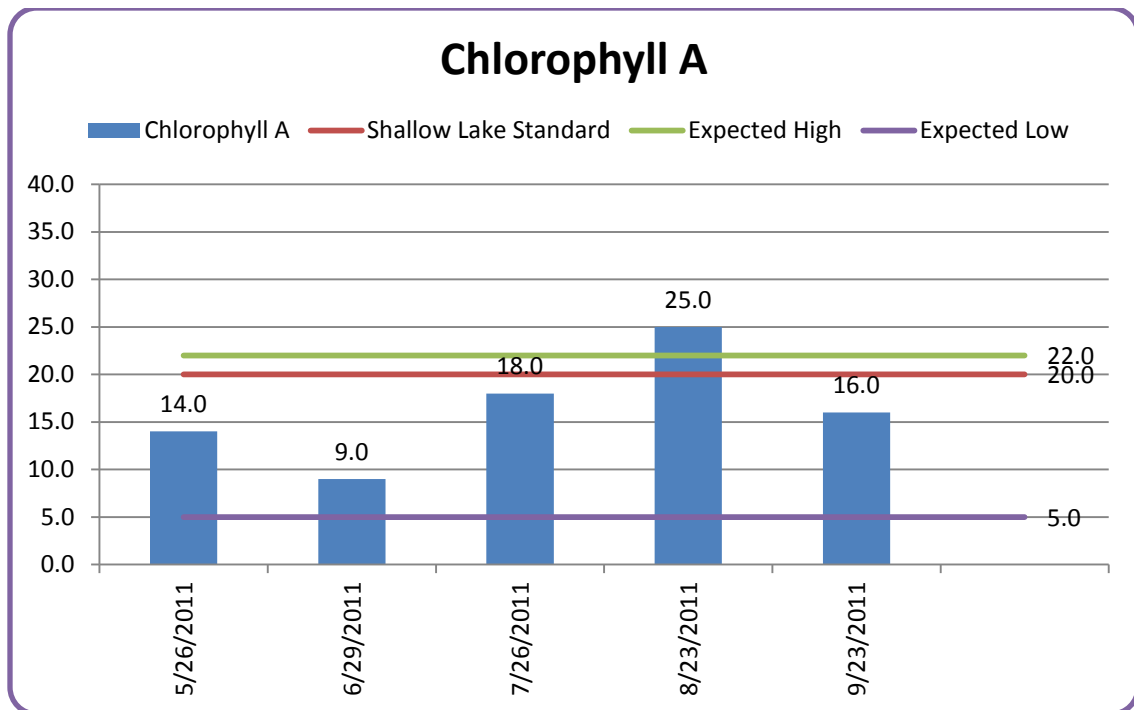
Expected Range:

5.0-22.0 µg/L

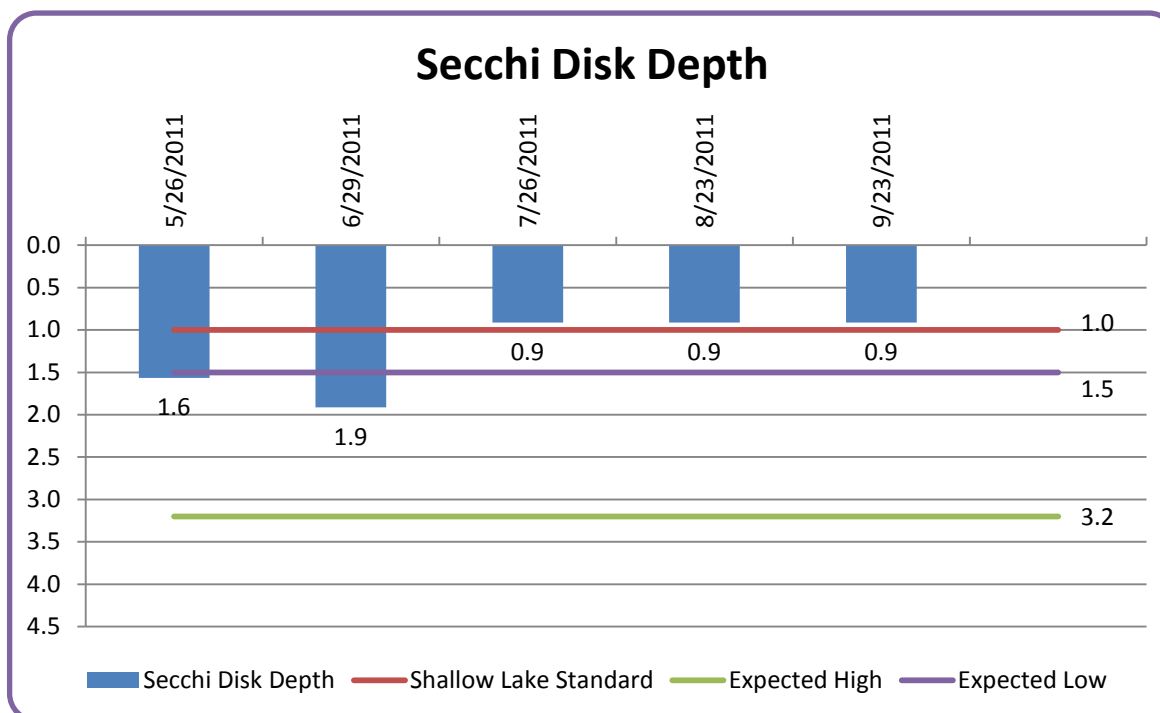
Shallow Lake

Standard: 20.0 µg/L

Four of five samples were within the expected range and below the standard. The average is also below the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	16.4 µg/L
Grade			B
Average (June-Sept)	NO DATA	NO DATA	17.0 µg/L
Meets Standard (20.0 µg/L)			Yes



Secchi Disk Depth

Expected Range:

1.5-3.2 meters

Shallow Lake

Standard: >1.0

meters

Clarity in this lake was poor. Three of the samples were below the standard, meaning the lake water was not clear.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	1.2 meters
Grade			C
Average (June-Sept)	NO DATA	NO DATA	1.2 meters
Meets Standard (>1.0 m)			Yes

Total Phosphorus

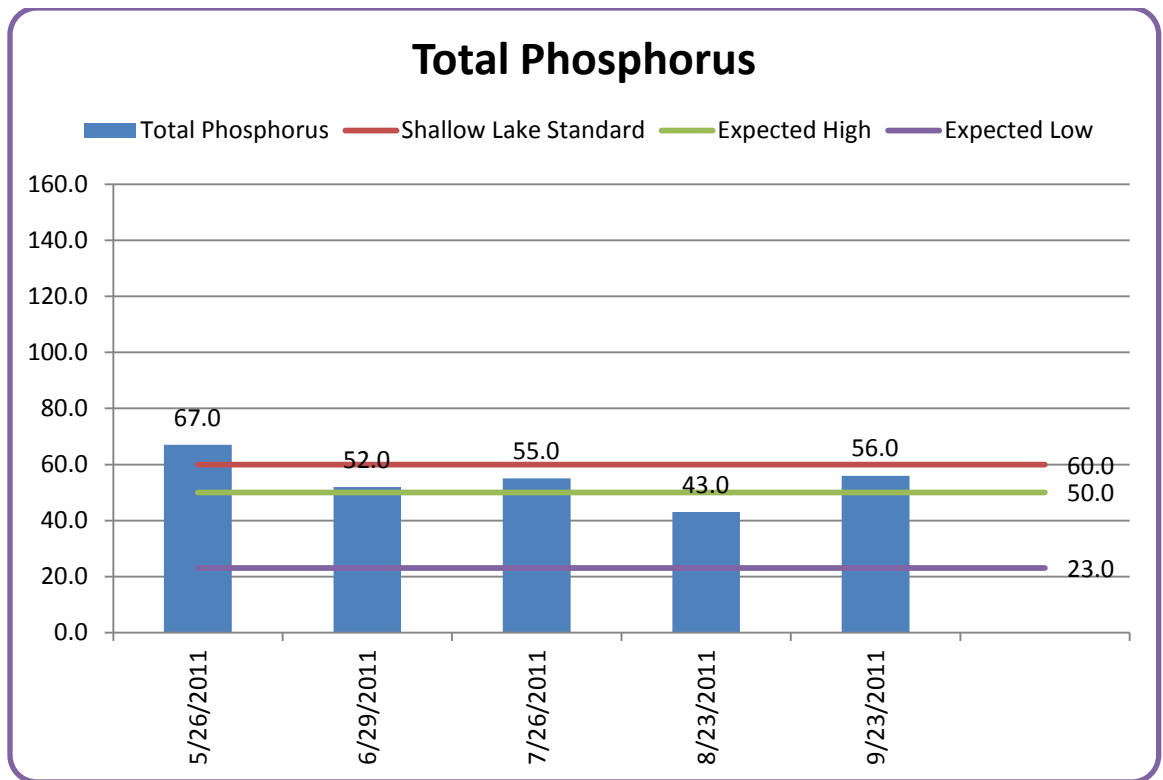
Expected Range:

23.0-50.0 µg/L

Shallow Lake

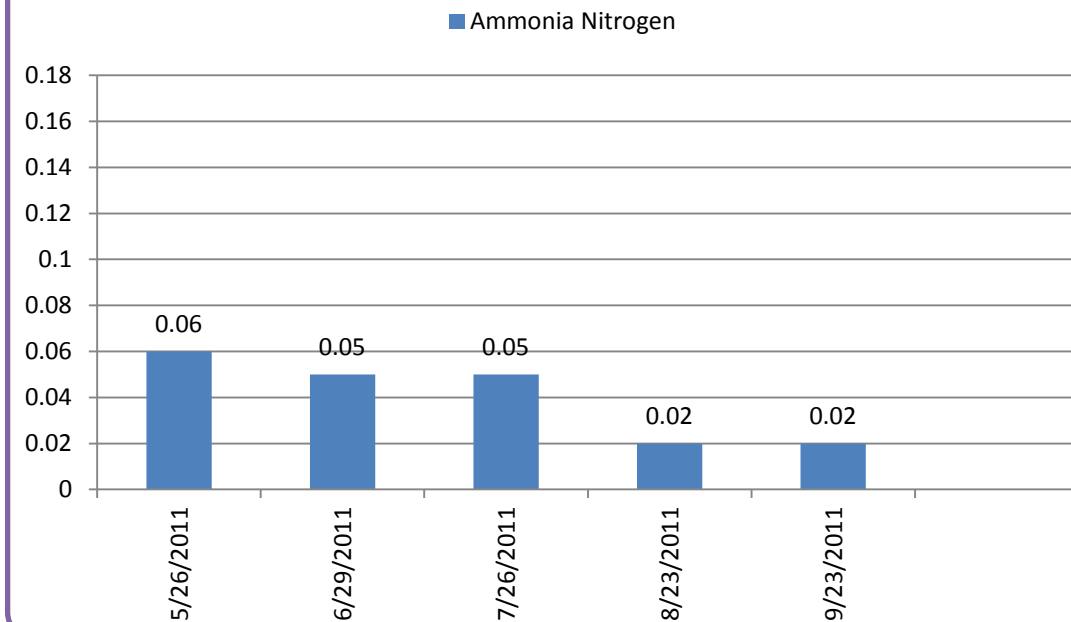
Standard: 60.0 µg/L

Most of the samples were above the expected range, but four out of five samples were still below the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	55.0 µg/L
Grade			C
Average (June-Sept)	NO DATA	NO DATA	52.0 µg/L
Meets Standard (60.0 µg/L)			Yes

Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Shallow Lake

Standard: None

There is no standard, but the ammonia nitrogen levels were very low.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	NO DATA	NO DATA	0.04

Temperature

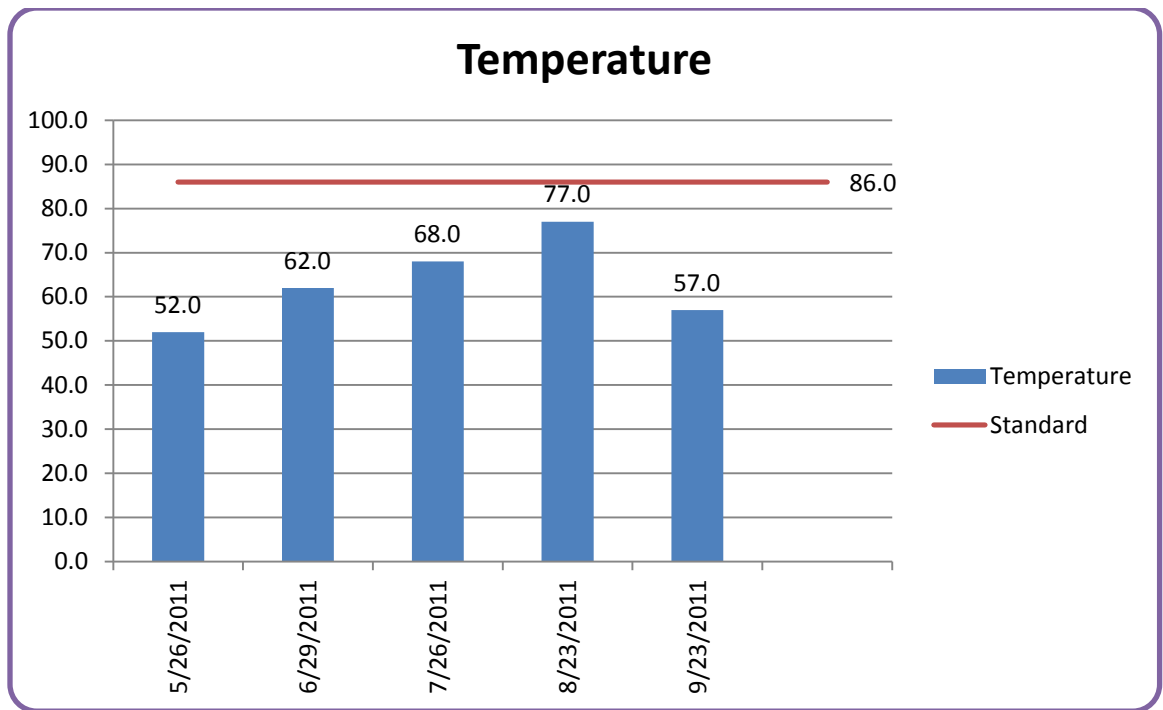
Expected Range:

None

Shallow Lake

Standard: The daily average shall not exceed 86.0°F

All temperatures were recorded below the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	NO DATA	NO DATA	63.2 °F
Meets Standard (Not to exceed 86.0°F)			Yes

Spider Lake General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		Curly-leaf pondweed coming up
June	4	4		Thick weeds, algae across ½ of east bay
July	4	4	Cornichon (army green)	Substantial filamentous algae
August	East Spider 4 West Spider 2	East Spider 4 West Spider 2	Cornichon (army green)	East Spider substantial filamentous algae, thick weeds. West Spider minimal algae and weeds.
September	East Spider 3 West Spider 1	East Spider 3 West Spider 1	Cornichon (army green)	Some algae toward center of East Spider, small amounts of filamentous algae and algae bands in channel between bays.

Chisago Lake



Deep Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	53.6	48.8	56.5	53.0
Classification	Eutrophic	Mesotrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: B

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	10.4 µg/L	2.2 meters	37.8 µg/L		
Grade	C	B	B	B	4 th /12

MPCA Standards: Meets Standards

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Deep lake)	14.0 µg/L	>1.4 meters	40.0 µg/L	
2011 Average (June-Sept)	12.8 µg/L	1.9 meters	42.8 µg/L	
Meets Standard	Yes	Yes	No	Yes

Chlorophyll A

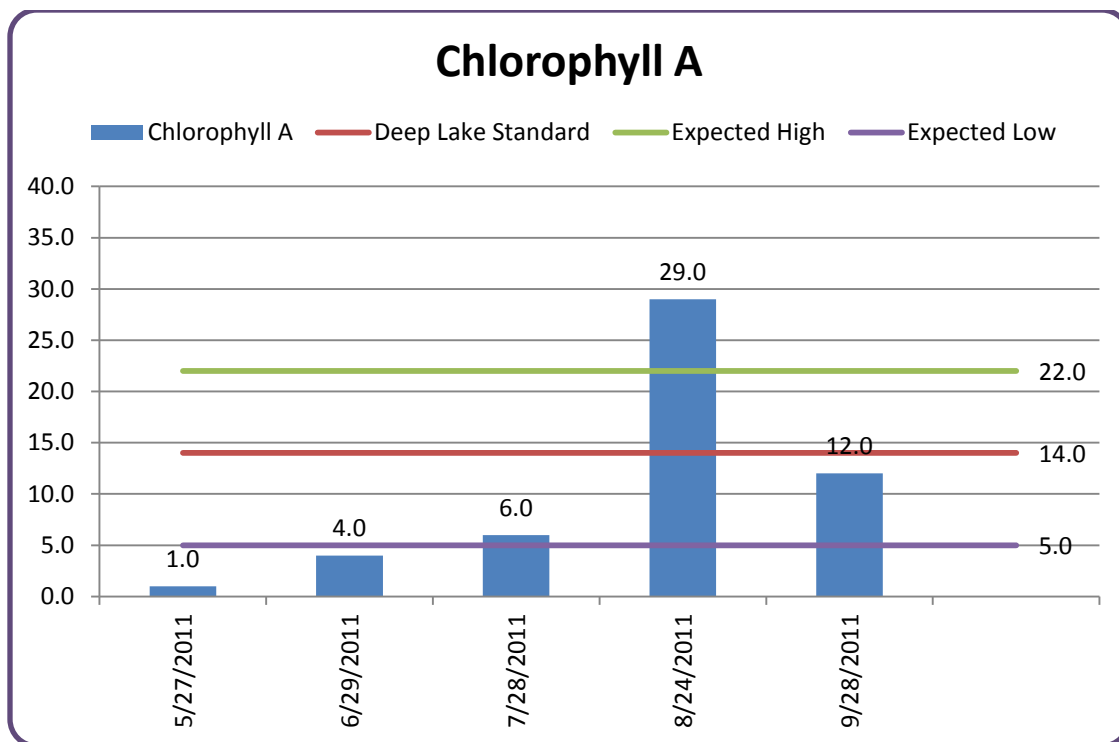
Expected Range:

5.0-22.0 µg/L

Deep Lake Standard:

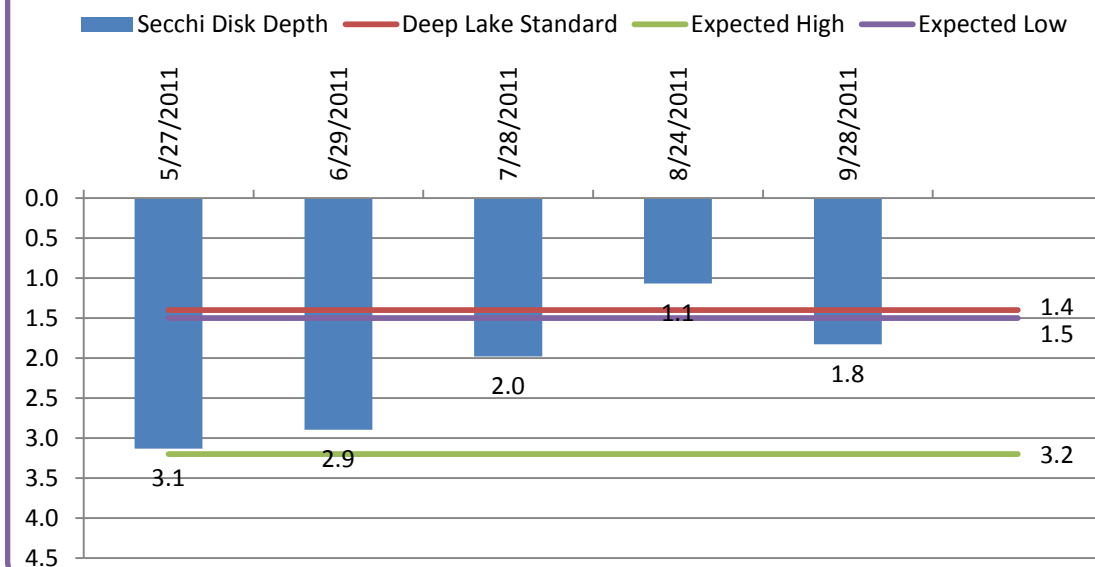
14.0 µg/L

Samples varied widely in this lake. Chlorophyll levels were below the expected range early, but were far above the standard in August. The average did meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	12.2 µg/L	31.3 µg/L	10.4 µg/L
Grade	B	C	B
Average (June-Sept)	13.7 µg/L	31.3 µg/L	12.8 µg/L
Meets Standard (14.0 µg/L)	Yes	No	Yes

Secchi Disk Depth



Secchi Disk Depth

Expected Range:

1.5-3.2 meters

Deep Lake Standard:

>1.4 meters

Most of the Secchi disk readings were within the expected range, with the exception of the August reading.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	2.3 meters	1.8 meters	2.2 meters
Grade	B	C	C
Average (June-Sept)	2.0 meters	1.8 meters	1.9 meters
Meets Standard (>1.4 m)	Yes	Yes	Yes

Total Phosphorus

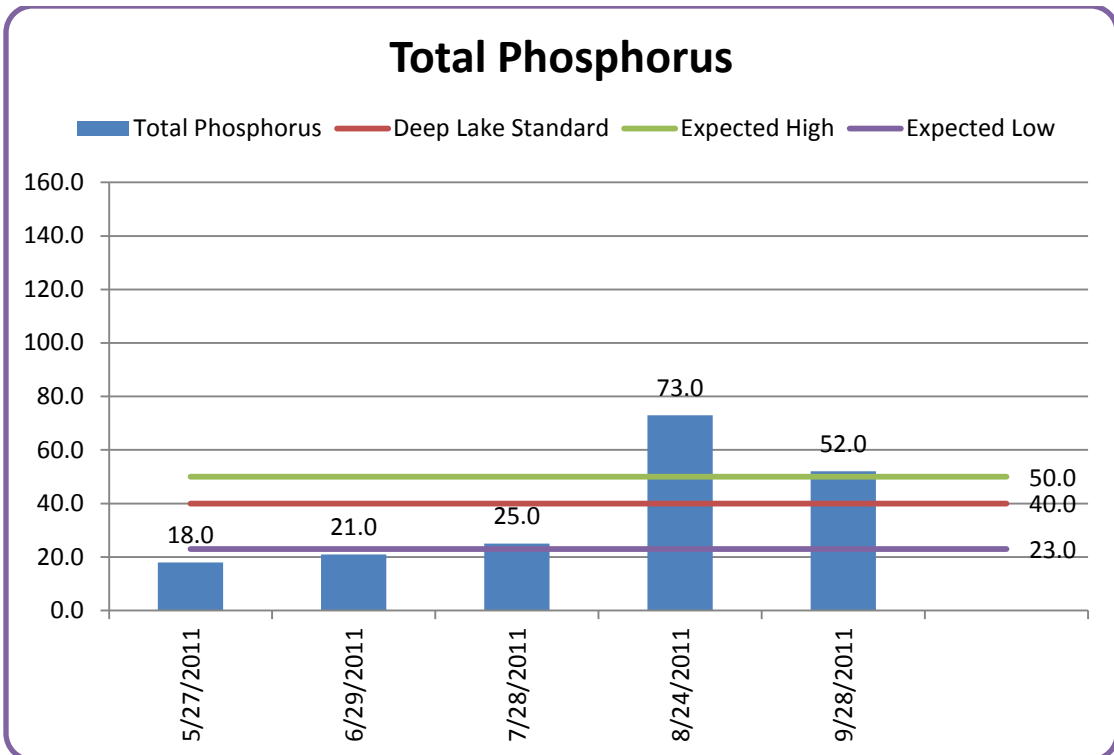
Expected Range:

23.0-50.0 µg/L

Deep Lake Standard:

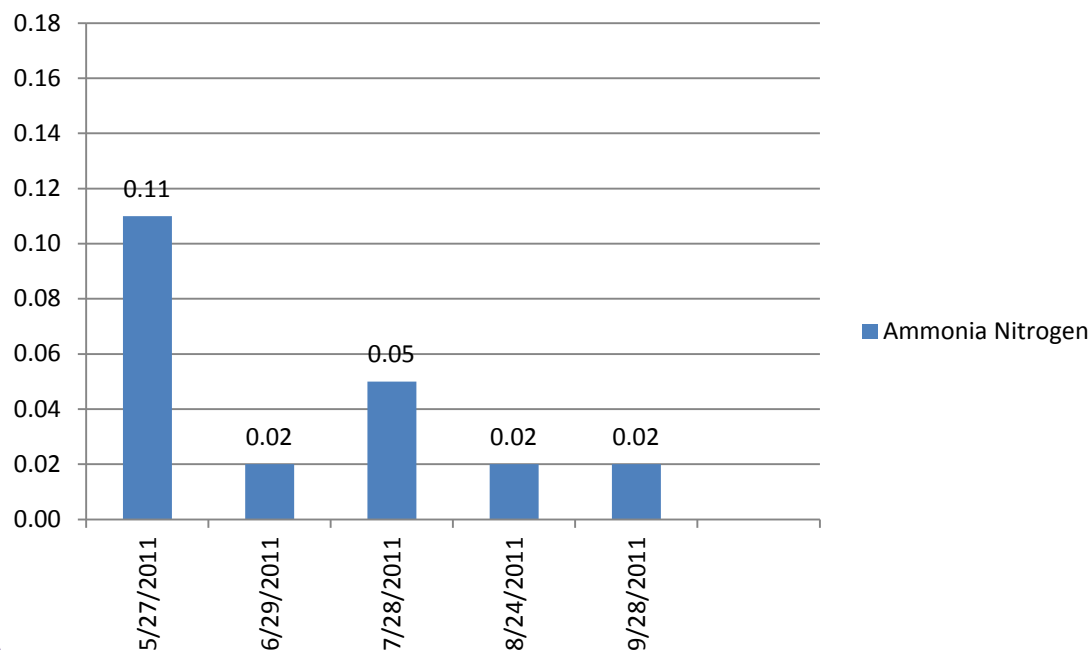
40.0 µg/L

Again, samples varied from being below the expected range and standard in early summer to exceeding the expected range and standard in late summer. The average did not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	28.0 µg/L	48.0 µg/L	37.8 µg/L
Grade	B	C	C
Average (June-Sept)	28.0 µg/L	48.0 µg/L	42.8 µg/L
Meets Standard (40.0 µg/L)	Yes	No	No

Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Deep Lake Standard: None

The ammonia nitrogen levels were low except for the first sample of the season, which was slightly elevated. This could be due to spring runoff.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	<0.05	<0.05	0.04

Temperature

Expected Range:

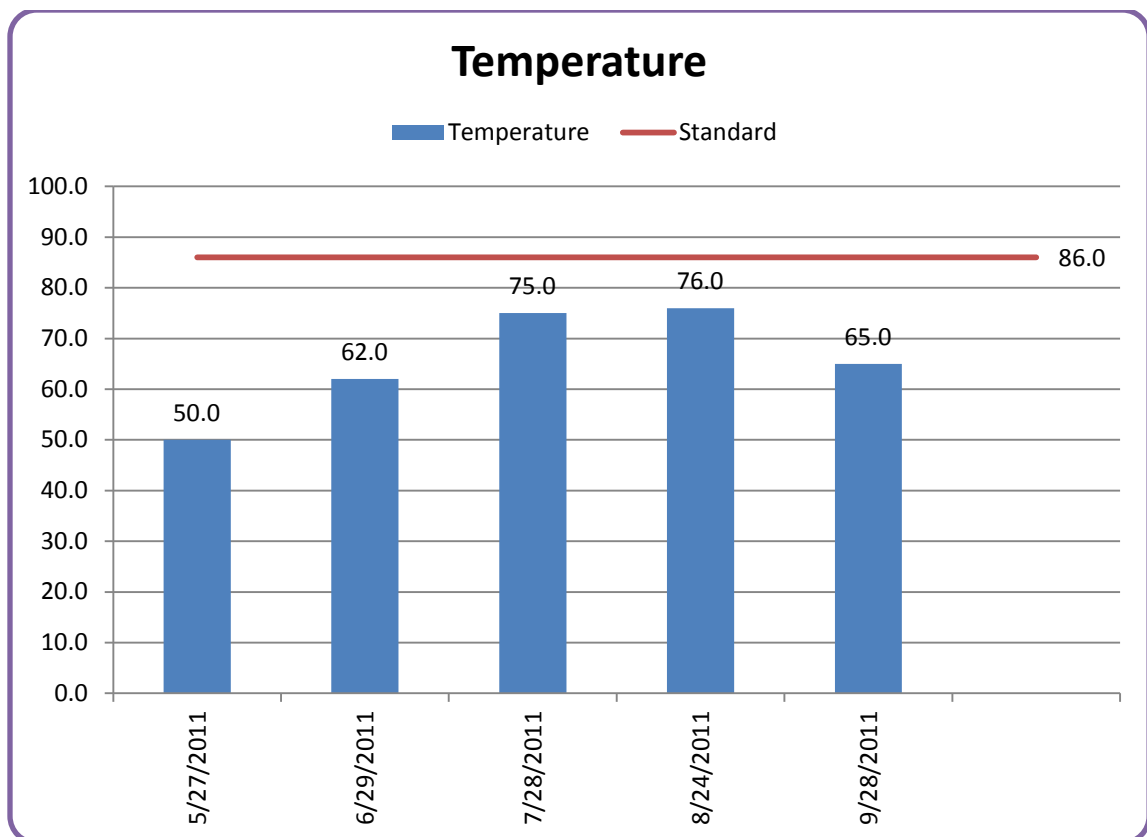
None

Deep Lake Standard:

The daily average shall not exceed

86.0°F

The temperatures were all below the standard.

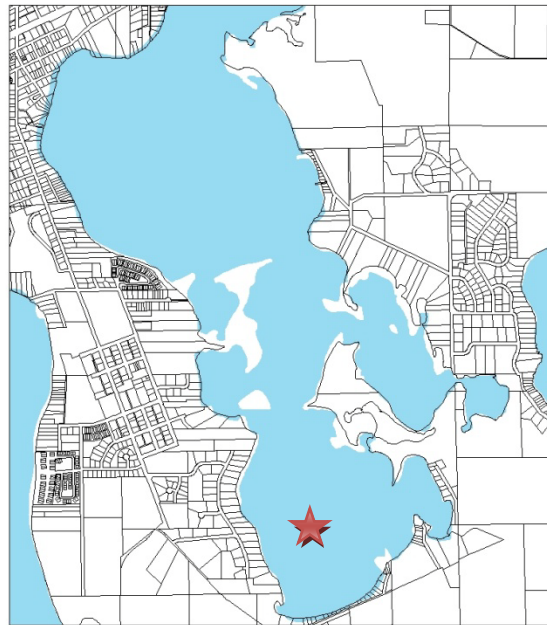


	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	71.8 °F	73.0 °F	65.6 °F
Meets Standard (Not to exceed 86.0°F)	Yes	Yes	Yes

Chisago Lake-North General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		Nothing noted - weeds
June	2	2		Minimal weeds at sampling location
July	2	2	Dried Chamomile (light brown)	Minimal weeds – curly-leaf still growing
August	2	2	Cornichon (army green)	Due to windy conditions minimal aquatic invasive weeds noted.
September	3	3	Beach grass (light army green)	Algae bloom in narrows.

Chisago Lake



Shallow Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	57.2	51.5	61.4	56.7
Classification	Eutrophic	Eutrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: C

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	15.0 µg/L	1.8 meters	52.8 µg/L		
Grade	B	C	C	C	6 th /12

MPCA Standards: Meets Standards

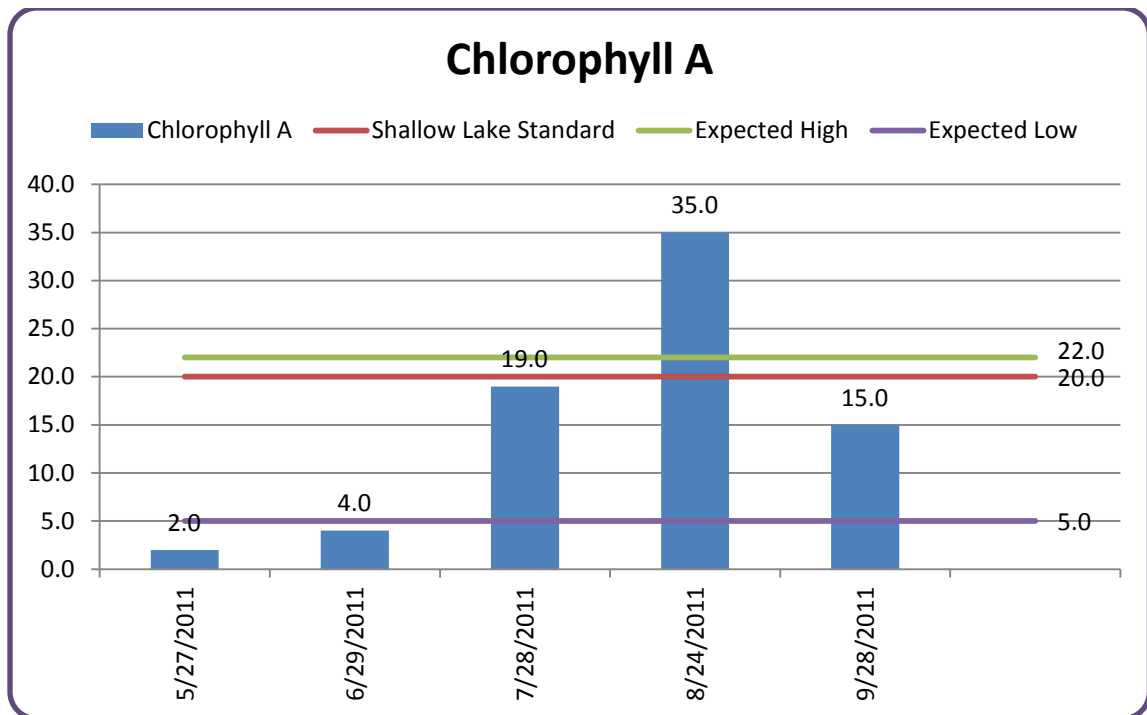
	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Shallow lake)	20.0 µg/L	>1.0 meters	60.0 µg/L	
2011 Average (June-Sept)	18.3 µg/L	1.2 meters	60.8 µg/L	
Meets Standard	Yes	Yes	No	Yes

Chlorophyll A

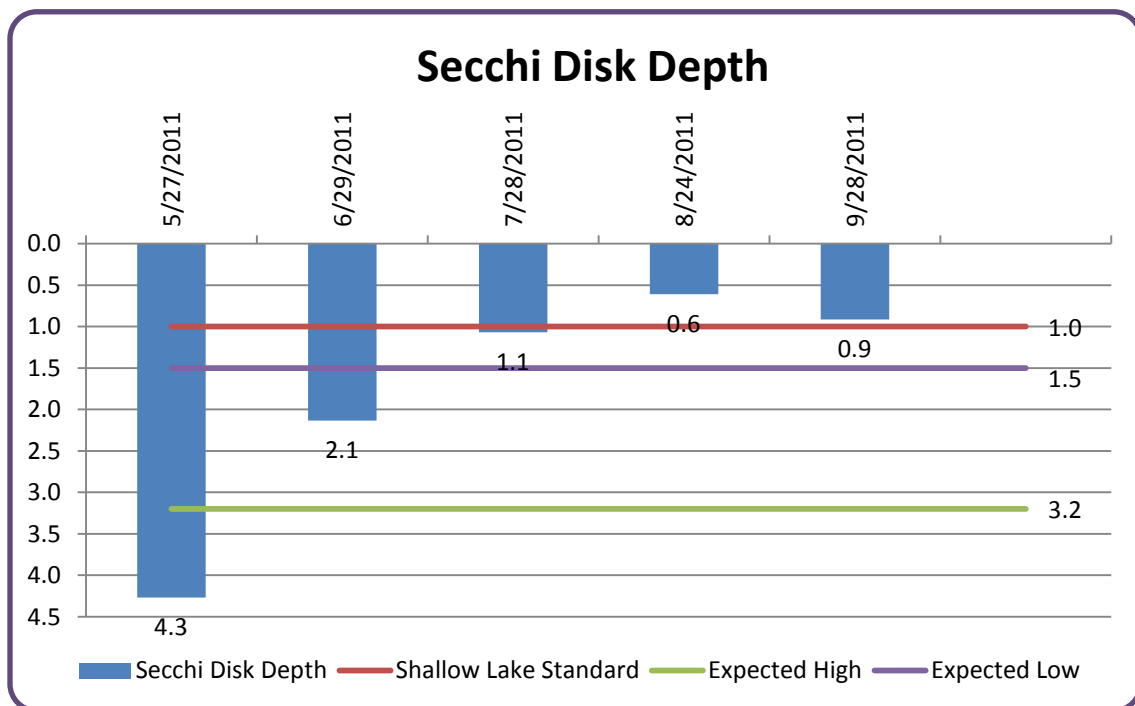
Expected Range:
5.0-22.0 µg/L

*Shallow Lake
Standard: 20.0 µg/L*

Most of the samples were within the expected range. The August sample was the highest and exceeded the standard. However, the average does meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	15.8 µg/L	42.6 µg/L	15.0 µg/L
Grade	B	C	B
Average (June-Sept)	19.1 µg/L	57.7 µg/L	18.3 µg/L
Meets Standard (20.0 µg/L)	Yes	No	Yes



Secchi Disk Depth

Expected Range:
1.5-3.2 meters

*Shallow Lake
Standard: >1.0
meters*

While two of the samples did not meet the standard, the average for the lake does meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	1.8 meters	1.3 meters	1.8 meters
Grade	C	C	C
Average (June-Sept)	1.7 meters	1.1 meters	1.2 meters
Meets Standard (>1.0 m)	Yes	Yes	Yes

Total Phosphorus

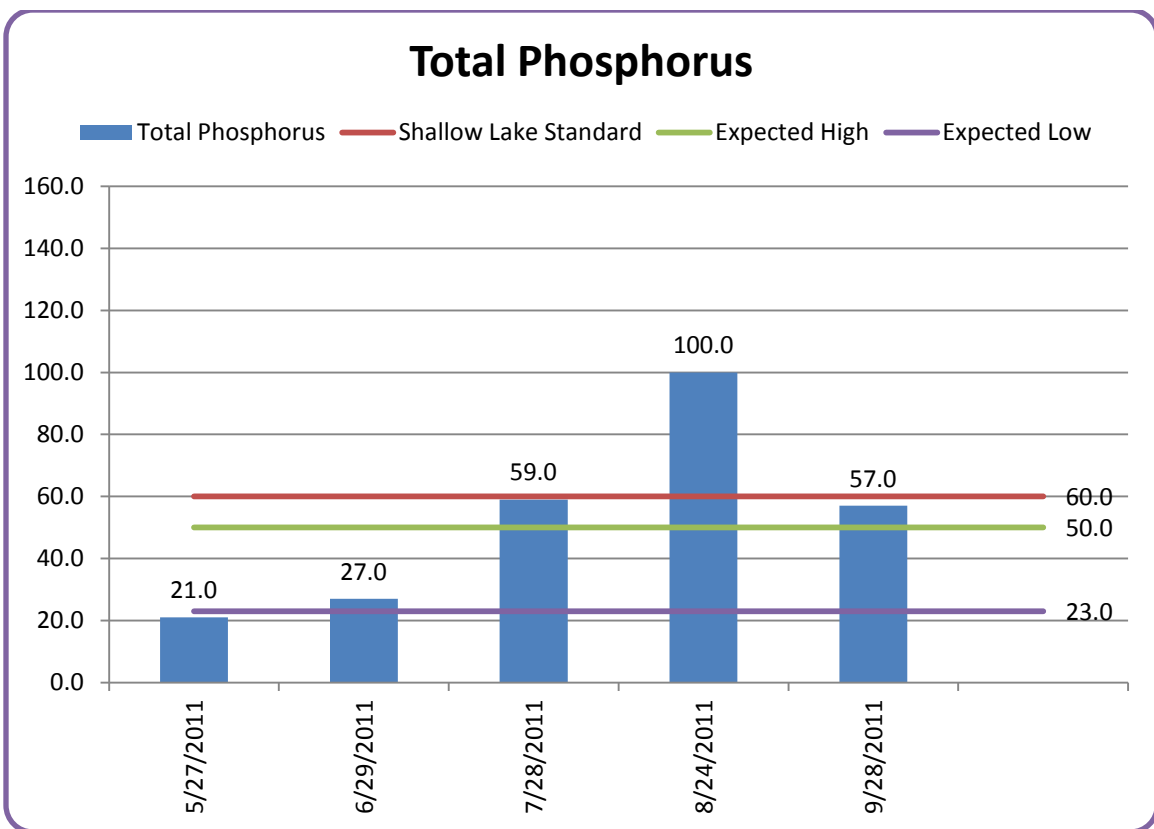
Expected Range:

23.0-50.0 µg/L

Shallow Lake

Standard: 60.0 µg/L

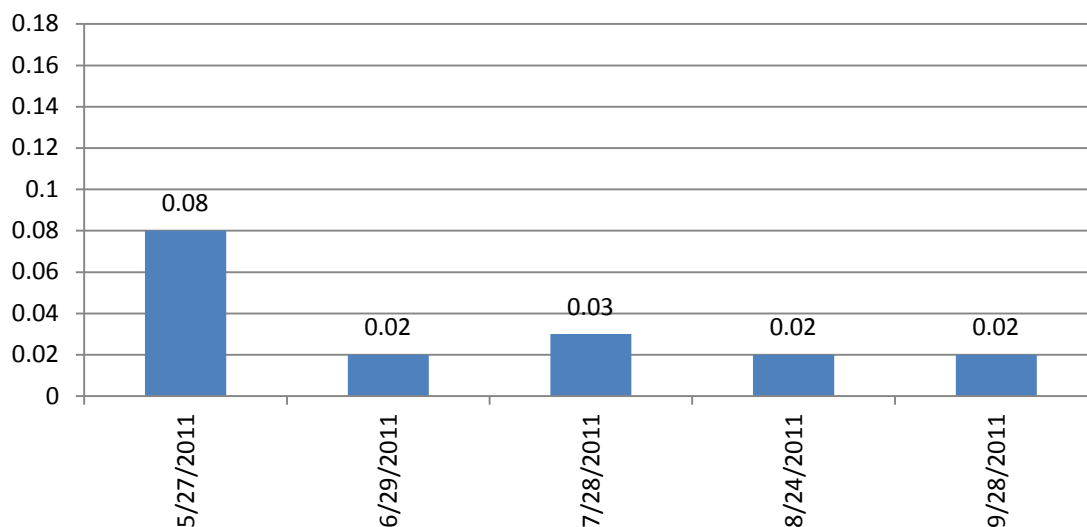
The three late summer samples were the highest. July and September were just below the standard, but August was far above it. The average was just above the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	38.0 µg/L	69.0 µg/L	52.8 µg/L
Grade	C	D	C
Average (June-Sept)	42.0 µg/L	80.0 µg/L	60.8 µg/L
Meets Standard (60.0 µg/L)	Yes	No	No

Ammonia Nitrogen

Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Shallow Lake Standard: None

Nitrogen levels were low, except for the May sample, which was slightly elevated. This could be due to spring runoff.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	<0.05	<0.05	0.03

Temperature

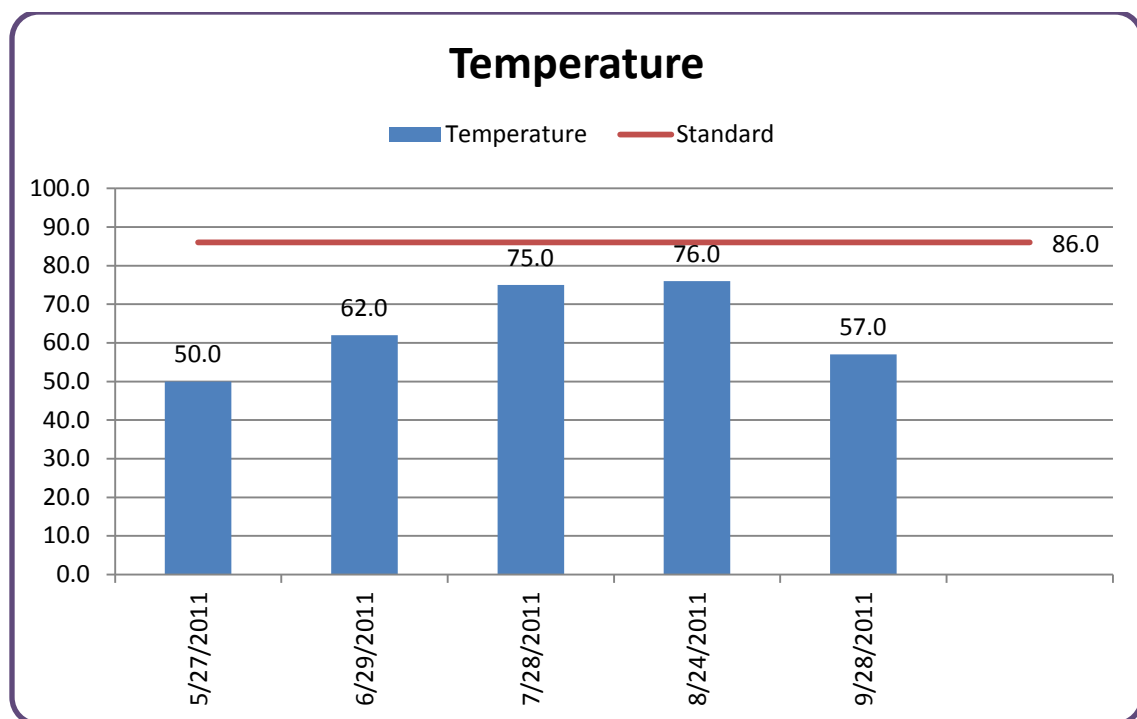
Expected Range:

None

Shallow Lake

Standard: The daily average shall not exceed 86.0 °F

All temperatures were below the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	No Data	No Data	64.0 °F
Within Expected Range			Yes

Chisago Lake-South General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2	Dark Grey Clear	No weeds noted
June	2	2	Green	Minimal weeds at sampling location
July	2	2	Dried Chamomile (brown)	Slimmer's slough merits spraying milfoil, curly-leaf, for navigation
August	2	2	Cornichon	Due to windy conditions minimal aquatic invasive weeds noted
September	3	3	Cornichon	Minimal milfoil in Slimmer's slough

Lake 13-0013
Kroon Lake

Kroon Lake



Deep Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	51.7	49.9	55.7	52.4
Classification	Eutrophic	Eutrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: B

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	8.6 µg/L	2.0 meters	35.6 µg/L		
Grade	A	C	C	B	2 nd /12

MPCA Standards: Meets Standards

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Deep lake)	14.0 µg/L	>1.4 meters	40.0 µg/L	
2011 Average (June-Sept)	10.0 µg/L	1.6 meters	38.3 µg/L	
Meets Standard	Yes	Yes	Yes	Yes

Chlorophyll A

Expected Range:

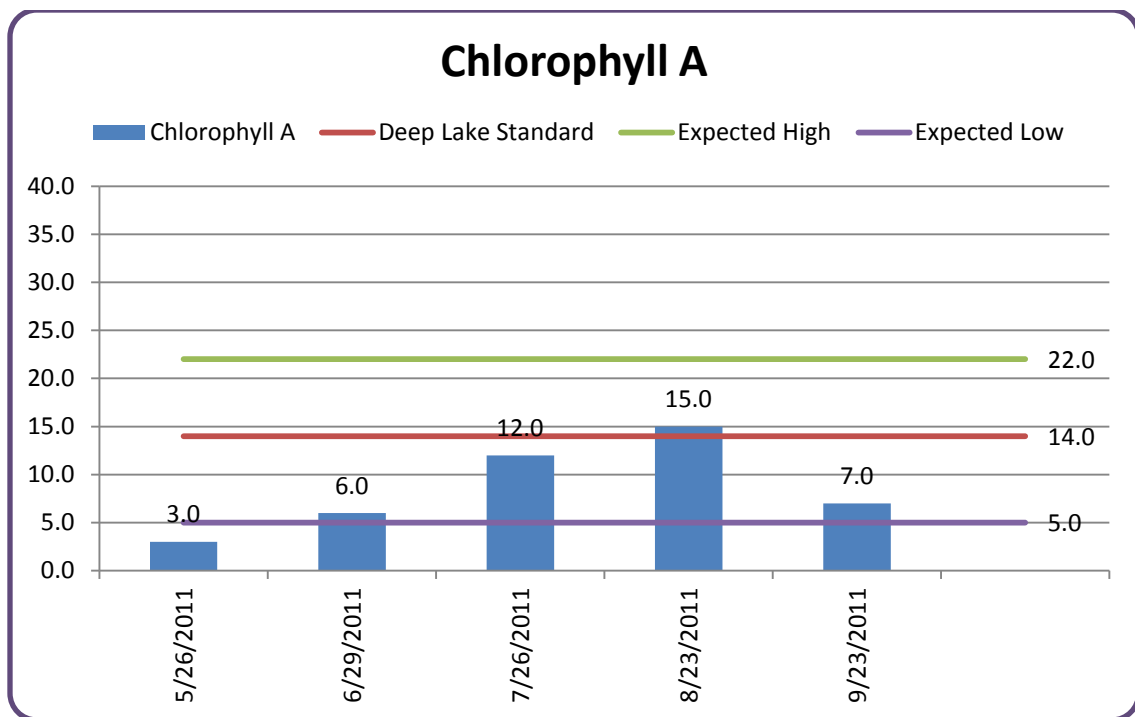
5.0-22.0 µg/L

Deep Lake Standard:

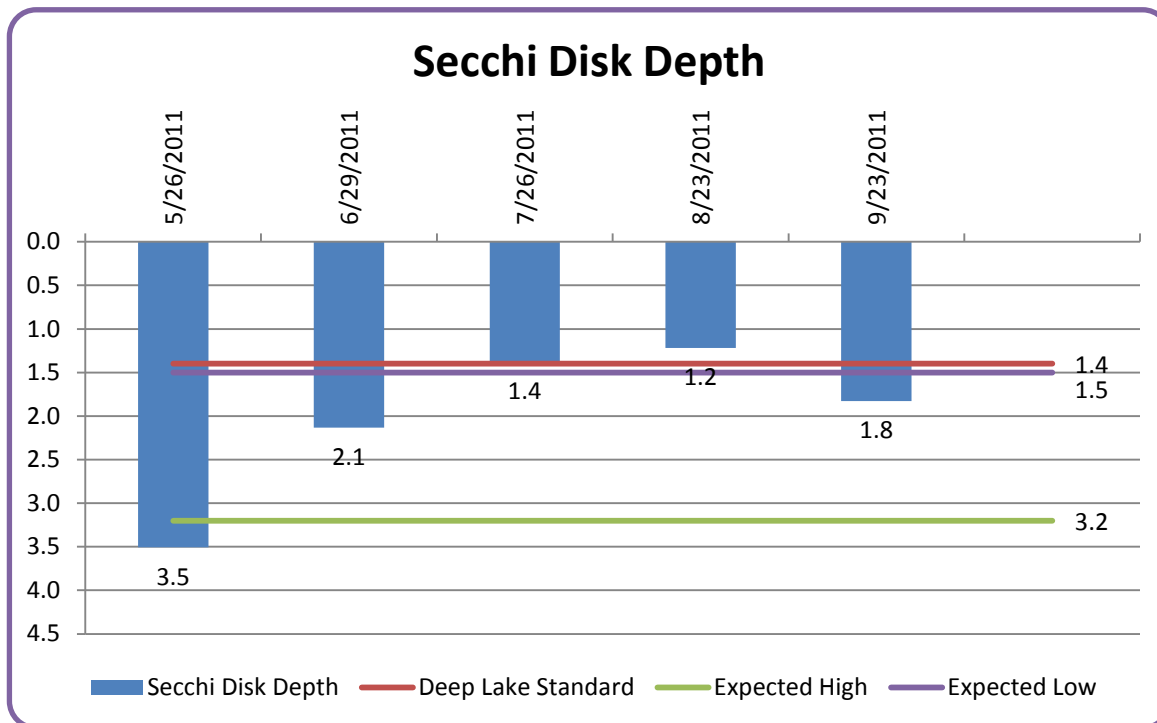
14.0 µg/L

Most of the samples were within the expected range.

One sample did not meet the standard, but the average does meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	10.8 µg/L	20.3 µg/L	8.6 µg/L
Grade	B	C	A
Average (June-Sept)	13.6 µg/L	20.3 µg/L	10.0 µg/L
Meets Standard (14.0 µg/L)	Yes	No	Yes



Secchi Disk Depth

Expected Range:

1.5-3.2 meters

Deep Lake Standard:

>1.4 meters

Only the August reading did not meet the standard, although two other samples were on the edge. The average does meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	1.9 meters	1.7 meters	2.0 meters
Grade	C	C	C
Average (June-Sept)	1.3 meters	1.7 meters	1.6 meters
Meets Standard (>1.4 m)	No	Yes	Yes

Total Phosphorus

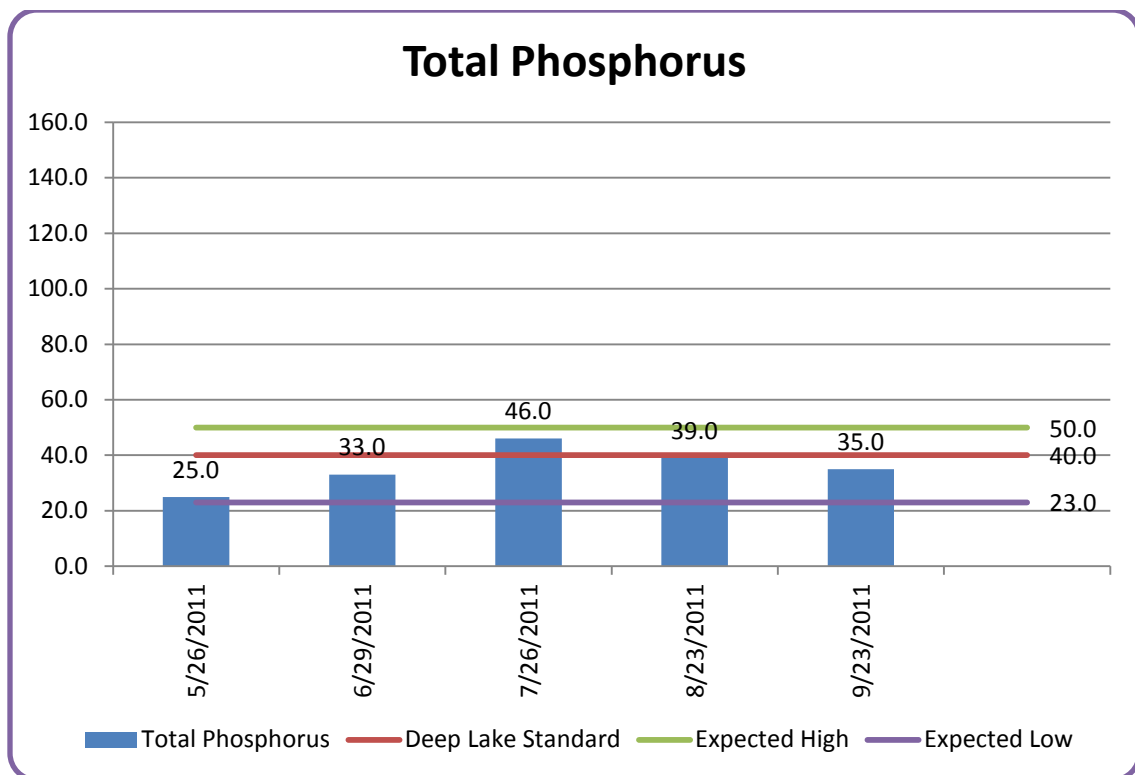
Expected Range:

23.0-50.0 µg/L

Deep Lake Standard:

40.0 µg/L

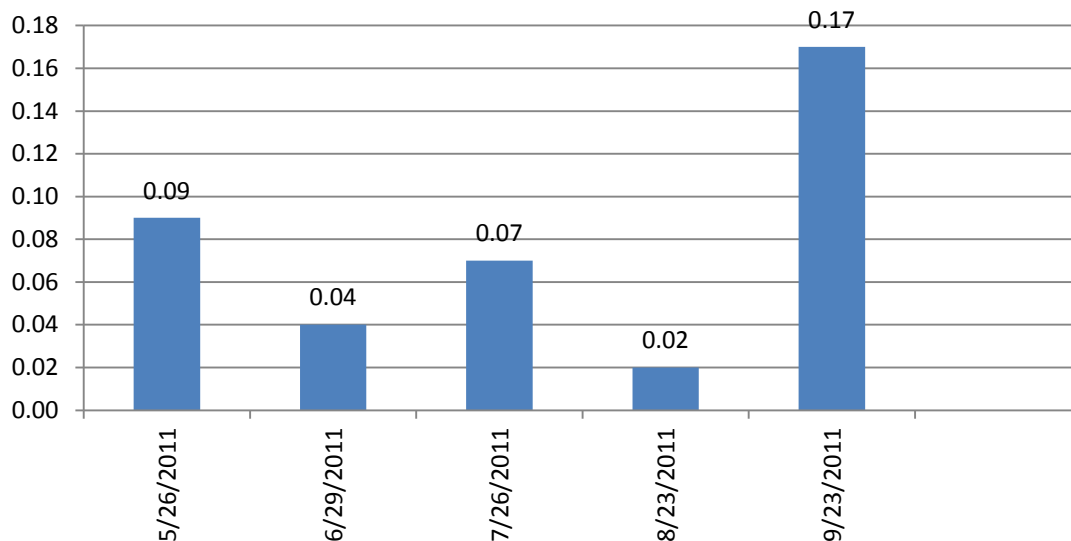
All samples were within the expected range and the average met the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	35.0 µg/L	31.0 µg/L	35.6 µg/L
Grade	C	B	C
Average (June-Sept)	37.0 µg/L	31.0 µg/L	38.3 µg/L
Meets Standard (40.0 µg/L)	Yes	Yes	Yes

Ammonia Nitrogen

■ Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Deep Lake Standard: None

The higher spring sample may be due to spring runoff while the high fall sample may be due to flushing from a nearby agricultural field, or a failing septic system.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	0.09	<0.05	0.08

Temperature

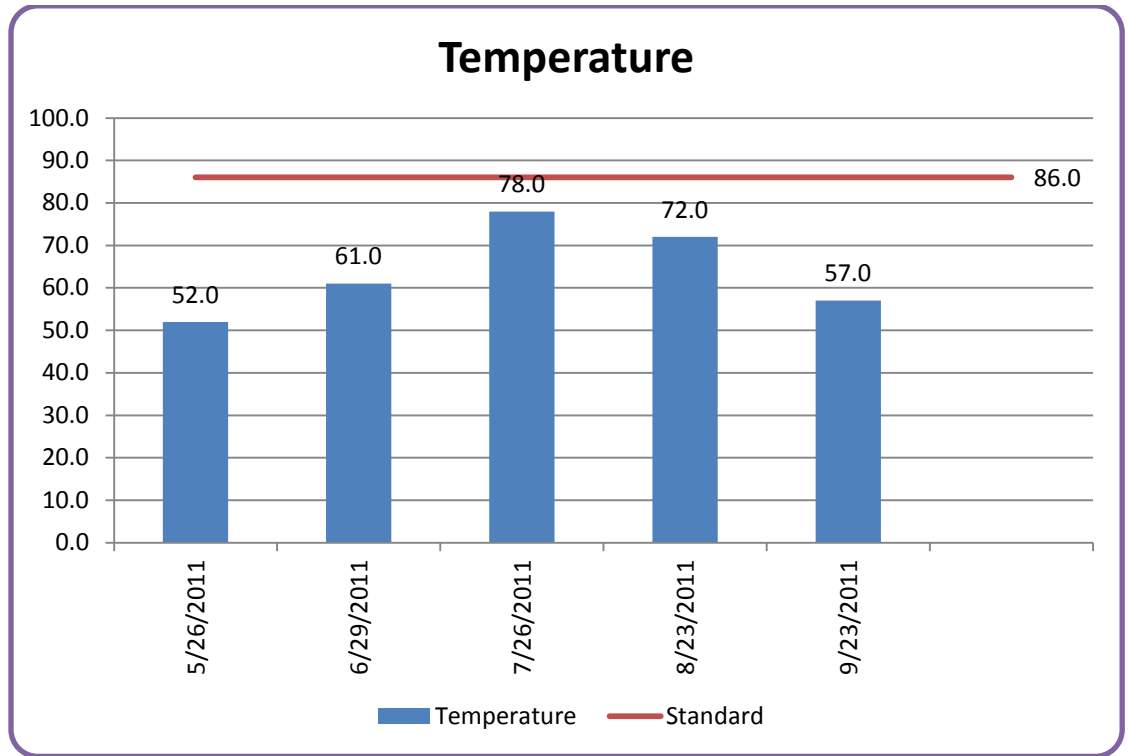
Expected Range:

None

Deep Lake Standard:

The daily average shall not exceed 86.0°F

All temperatures met the standard.

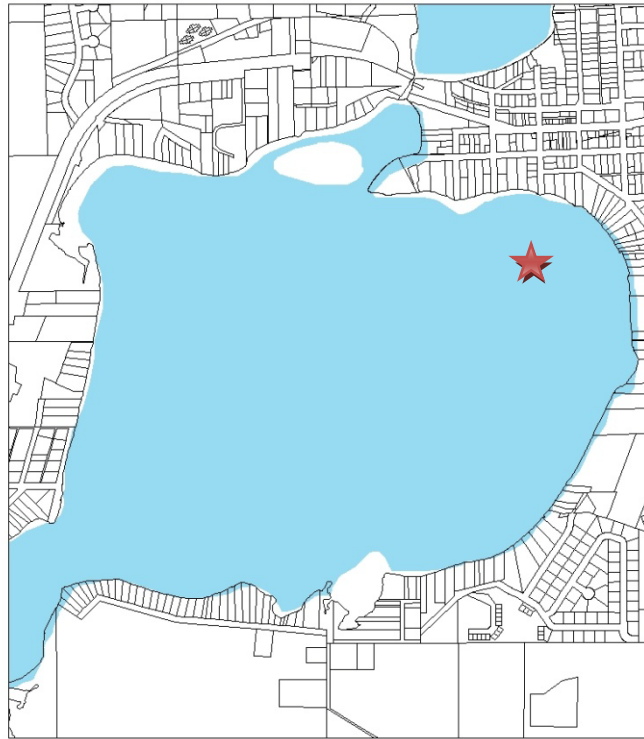


	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	73.3 °F	NO DATA	64.0 °F
Meets Standard (Not to exceed 86.0°F)	Yes		Yes

Kroon Lake General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		Curly-leaf coming up
June	2	2		Minimal curly-leaf
July	2	2	Cornichon (army green)	Curly-leaf still present. Coontail, large-leaf pondweed noted
August	2	2	Dried chamomile (light brown)	Substantially lower weed density on south side of lake in 2010 compared to 2011
September	2	2	Parchment paper (light brown/green)	Minimal aquatic invasive weeds – milfoil or curly-leaf

South Lindstrom Lake



Deep Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	54.3	47.9	55.3	52.5
Classification	Eutrophic	Mesotrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: B

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	11.2 µg/L	2.3 meters	34.6 µg/L		
Grade	B	B	C	B	3 rd /12

MPCA Standards: Meets Standards

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Deep lake)	14.0 µg/L	>1.4 meters	40.0 µg/L	
2011 Average (June-Sept)	13.8 µg/L	1.9 meters	38.5 µg/L	
Meets Standard	Yes	Yes	Yes	Yes

Chlorophyll A

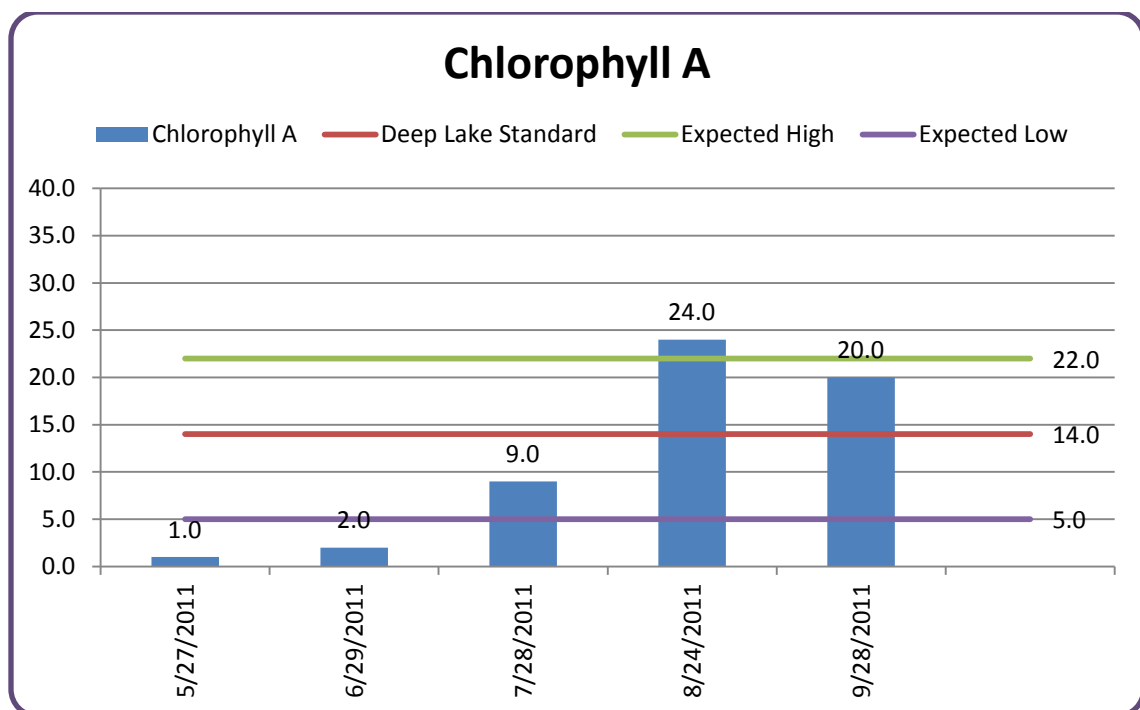
Expected Range:

5.0-22.0 µg/L

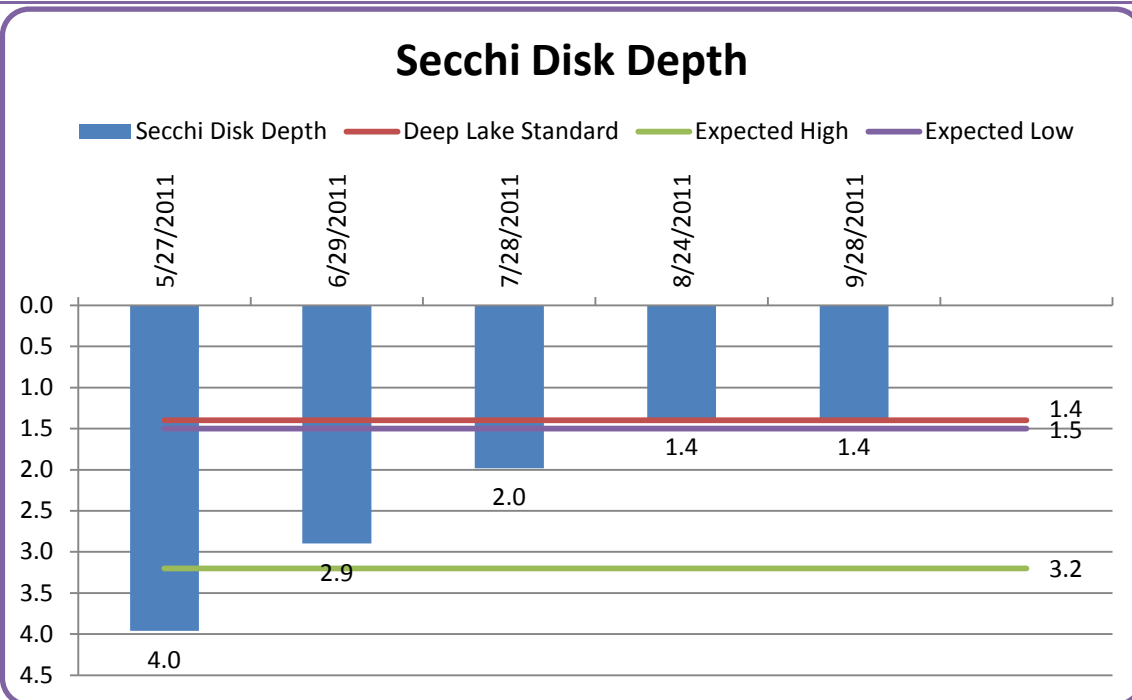
Deep Lake Standard:

14.0 µg/L

Late season samples did not meet the standard. The overall average just barely met the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	11.8 µg/L	20.0 µg/L	11.2 µg/L
Grade	B	B	B
Average (June-Sept)	13.2 µg/L	20.0 µg/L	13.8 µg/L
Meets Standard (14.0 µg/L)	Yes	No	Yes



Secchi Disk Depth

Expected Range:

1.5-3.2 meters

Deep Lake Standard:

>1.4 meters

Most of the year, excluding the late summer months, the water clarity in this lake is very good. The averages meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	3.3 meters	1.9 meters	2.3 meters
Grade	A	C	B
Average (June-Sept)	2.9 meters	1.9 meters	1.9 meters
Meets Standard (>1.4 m)	Yes	Yes	Yes

Total Phosphorus

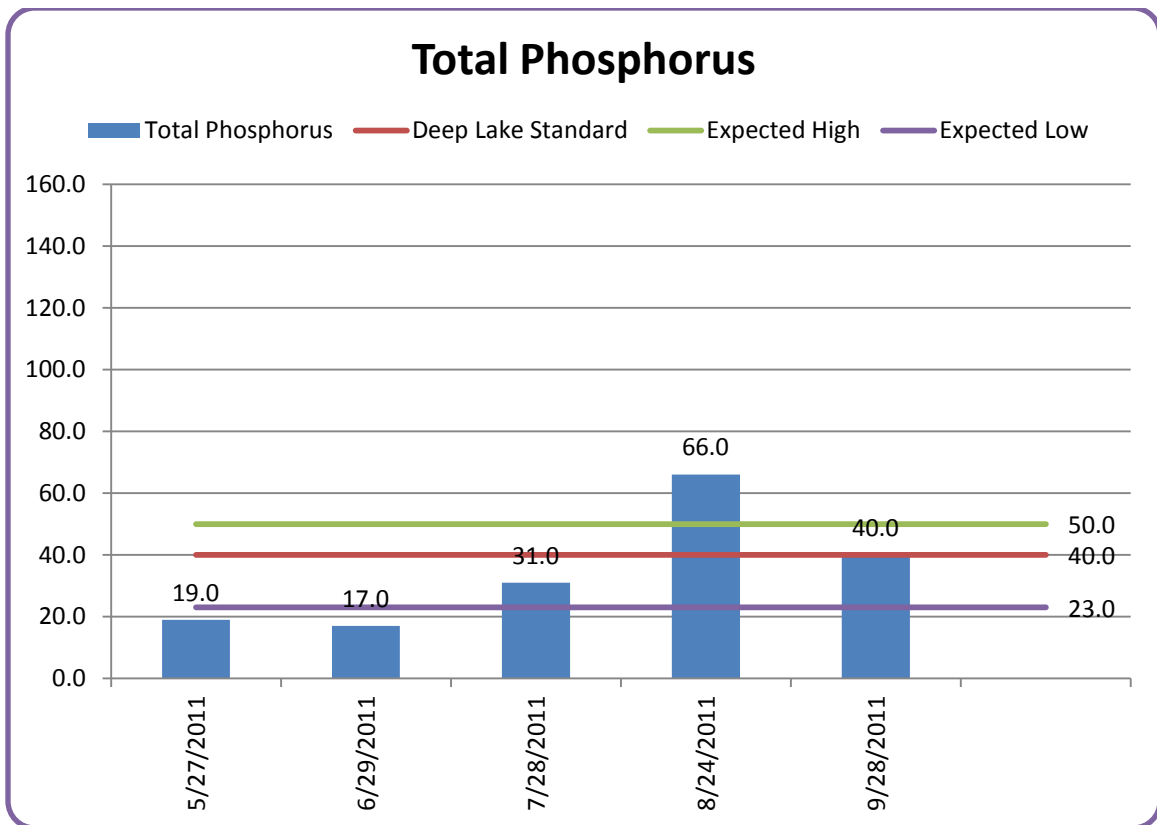
Expected Range:

23.0-50.0 µg/L

Deep Lake Standard:

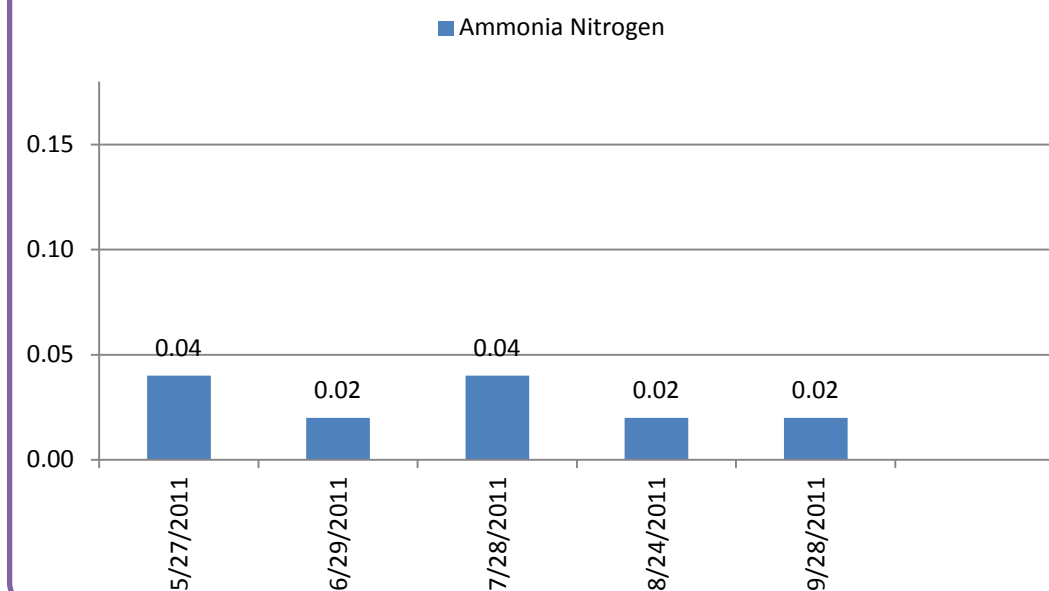
40.0 µg/L

Three samples were below the standard, one sample was right at the standard, and one exceeded the standard. The average does meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	26.0 µg/L	38.0 µg/L	34.6 µg/L
Grade	B	C	C
Average (June-Sept)	27.0 µg/L	38.0 µg/L	38.5 µg/L
Meets Standard (40.0 µg/L)	Yes	Yes	Yes

Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Deep Lake Standard:
None

All samples were very low.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	<0.05	<0.05	0.03

Temperature

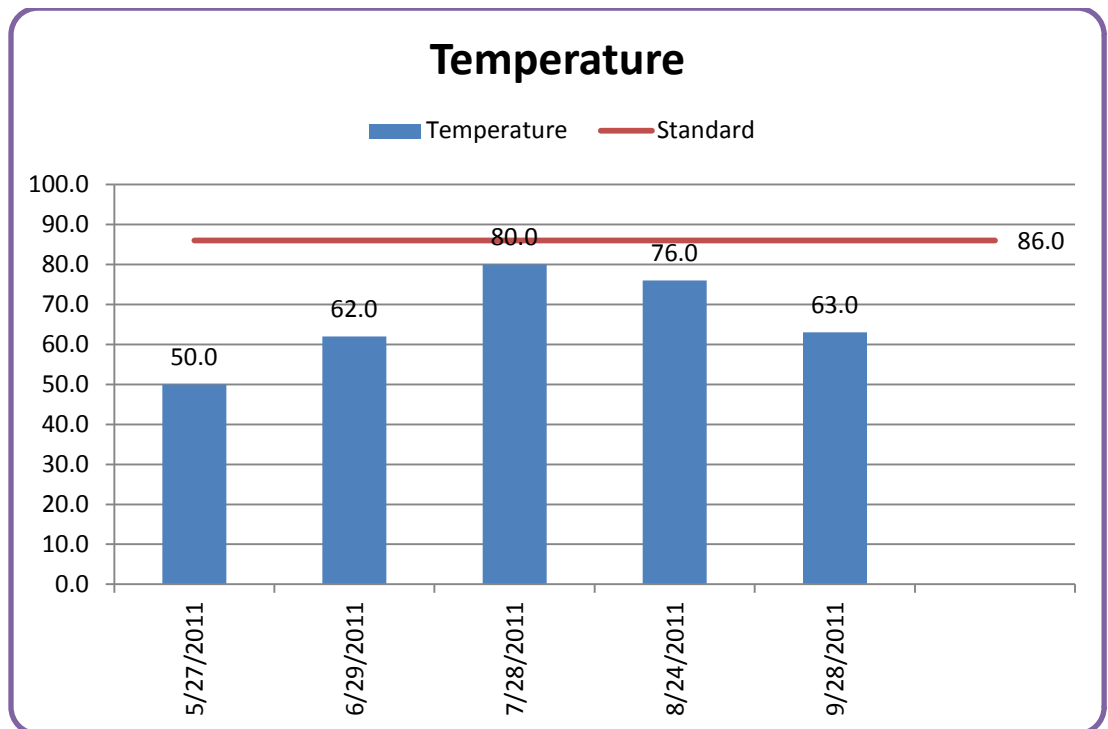
Expected Range:

None

Deep Lake Standard:

The daily average shall not exceed 86.0°F

All temperatures were below the standard.



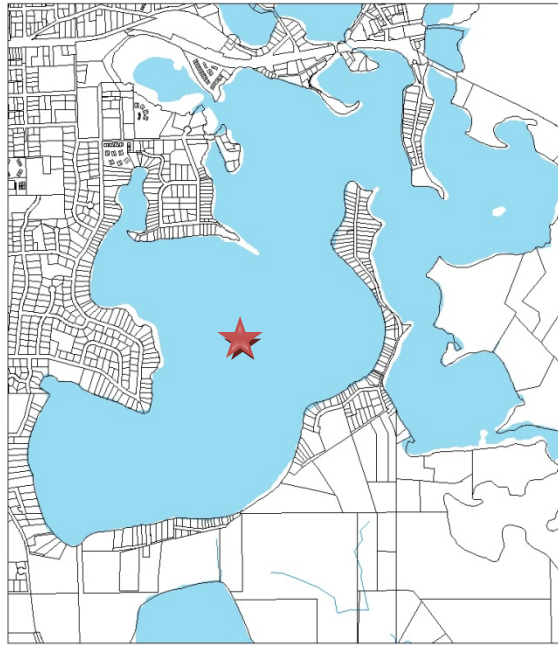
	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	73.2 °F	72.5 °F	66.2 °F
Meets Standard (Not to exceed 86.0°F)	Yes	Yes	Yes

South Lindstrom Lake General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		No weeds noted
June	2	2		Milfoil in north east bay
July	2	2	Beach grass (light army green)	North east bay minimal curly-leaf and milfoil
August	2	2	Cornichon (brown/green)	Windy, weed viewing difficult, minimal milfoil by Lindstrom park/beach
September	3	3	Beach grass (light army green)	No algae blooms seen today. Heavy algae blooms two weeks earlier along north shore and swimming beach

Lake 13-0027
South Center Lake

South Center Lake



Deep Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	58.6	56.8	58.6	58.0
Classification	Eutrophic	Eutrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: C

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	17.4 µg/L	1.2 meters	43.6 µg/L		
Grade	B	C-D	C	C	9 th /12

MPCA Standards: Impaired

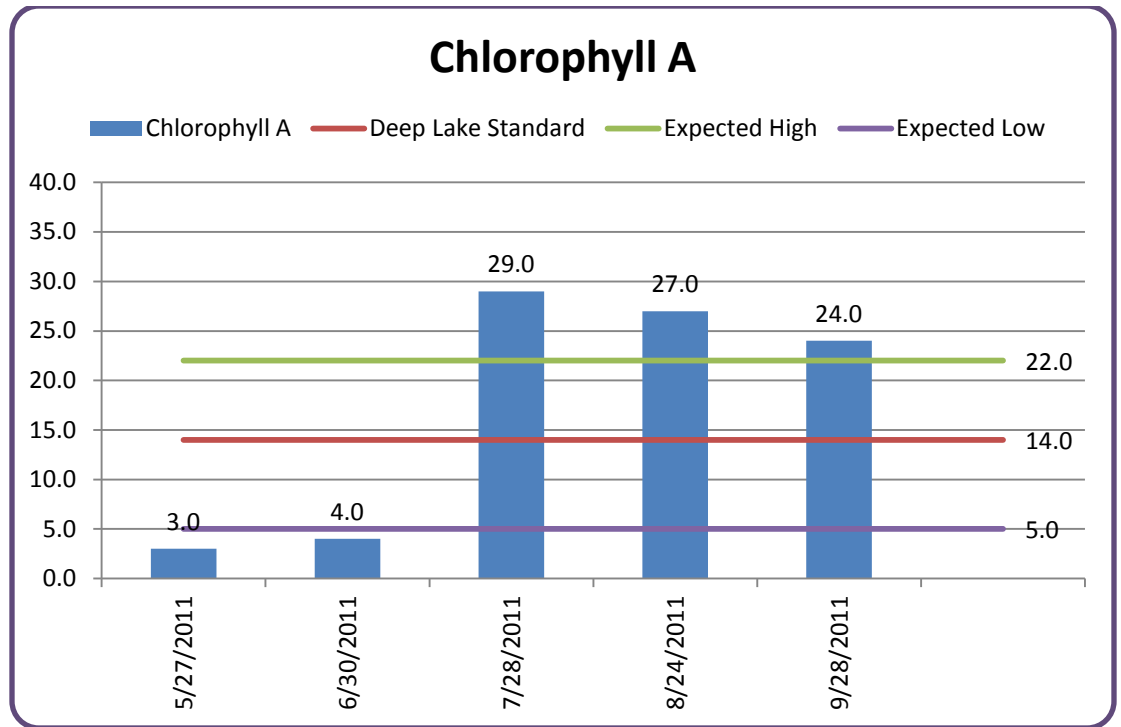
	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Deep lake)	14.0 µg/L	>1.4 meters	40.0 µg/L	
2011 Average (June-Sept)	21.0 µg/L	1.0 meter	47.5 µg/L	
Meets Standard	No	No	No	No

Chlorophyll A

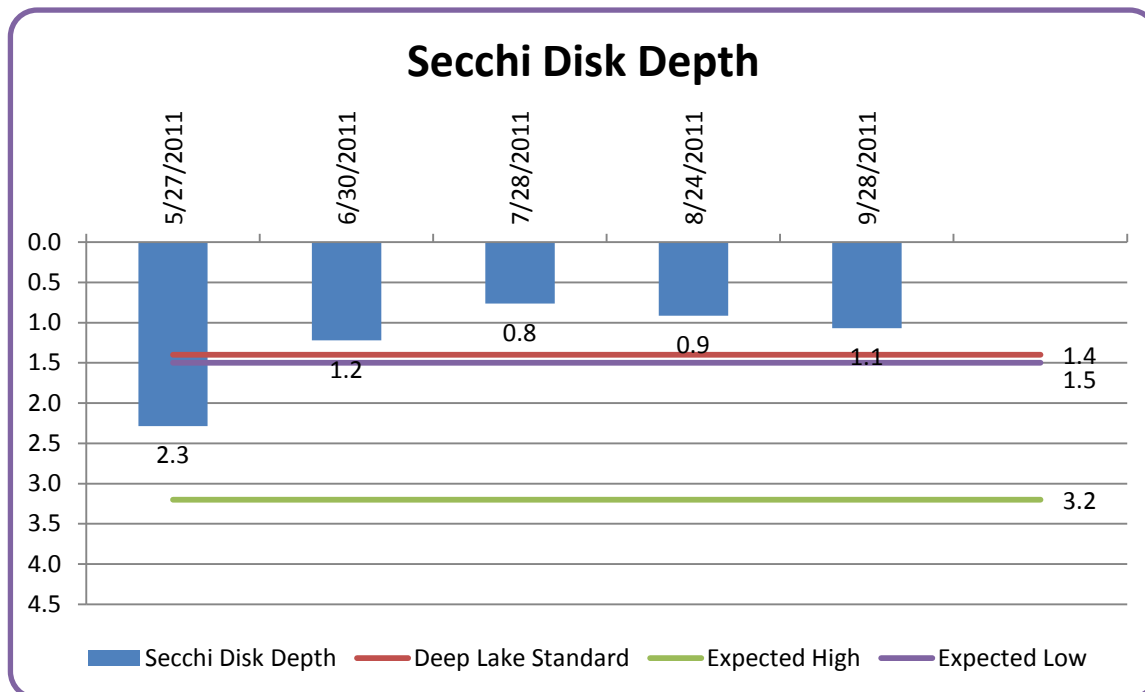
Expected Range: 5.0-22.0 µg/L

Deep Lake Standard: 14.0 µg/L

July through September readings are all above the standard. The average does not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	17.4 µg/L
Grade			B
Average (June-Sept)	NO DATA	NO DATA	21.0 µg/L
Meets Standard (14.0 µg/L)			No



Secchi Disk Depth

Expected Range: 1.5-3.2 meters

Deep Lake Standard: >1.4 meters

The clarity is far below the expected range and does not meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	1.2 meters
Grade			C-D
Average (June-Sept)	NO DATA	NO DATA	1.0 meter
Meets Standard (>1.0 m)			No

Total Phosphorus

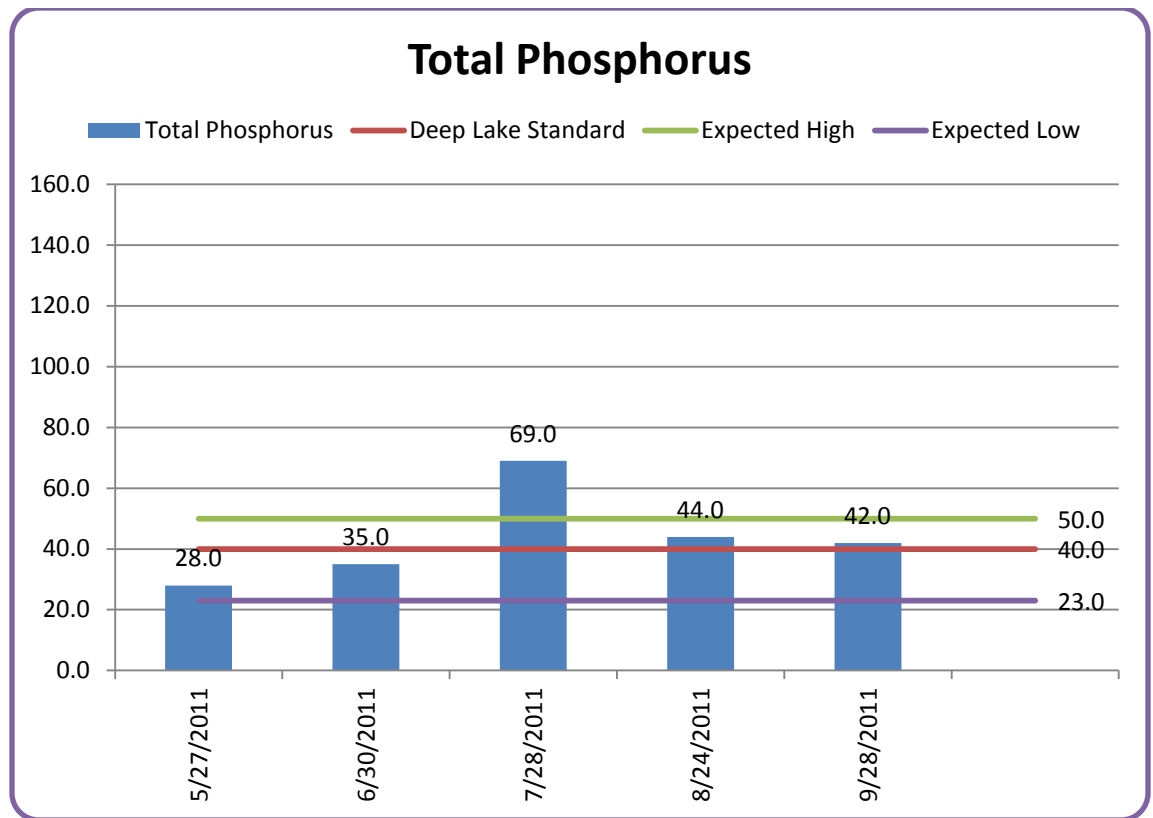
Expected Range:

23.0-50.0 µg/L

Deep Lake Standard:

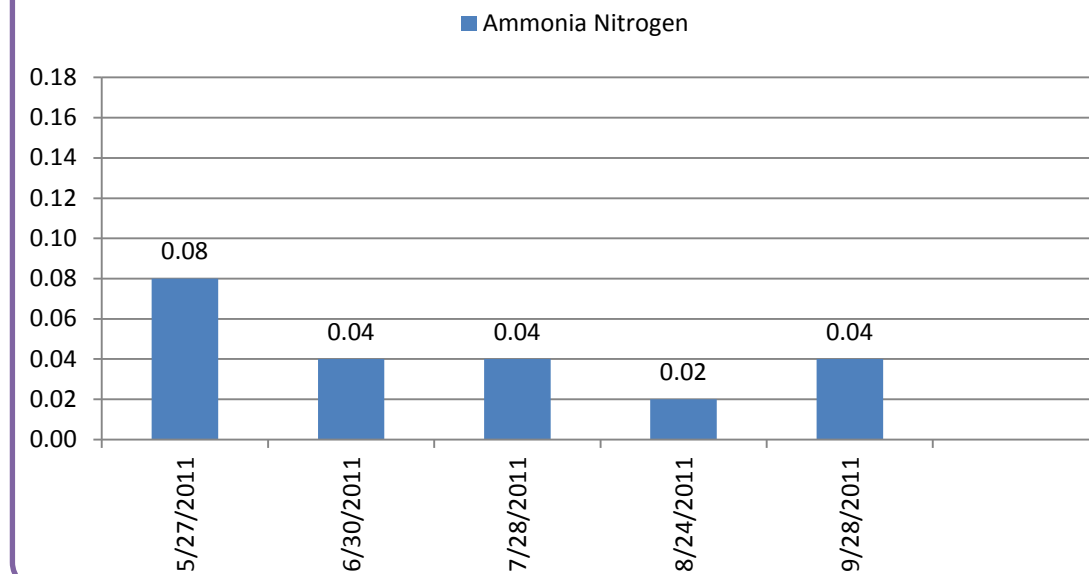
40.0 µg/L

Three of five samples were above the standard. The average for the season does not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	43.6 µg/L
Grade			C
Average (June-Sept)	NO DATA	NO DATA	47.5 µg/L
Meets Standard (40.0 µg/L)			No

Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Deep Lake Standard: None

The May sample was elevated, which could be caused by spring runoff.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	NO DATA	NO DATA	0.04

Total Suspended Solids

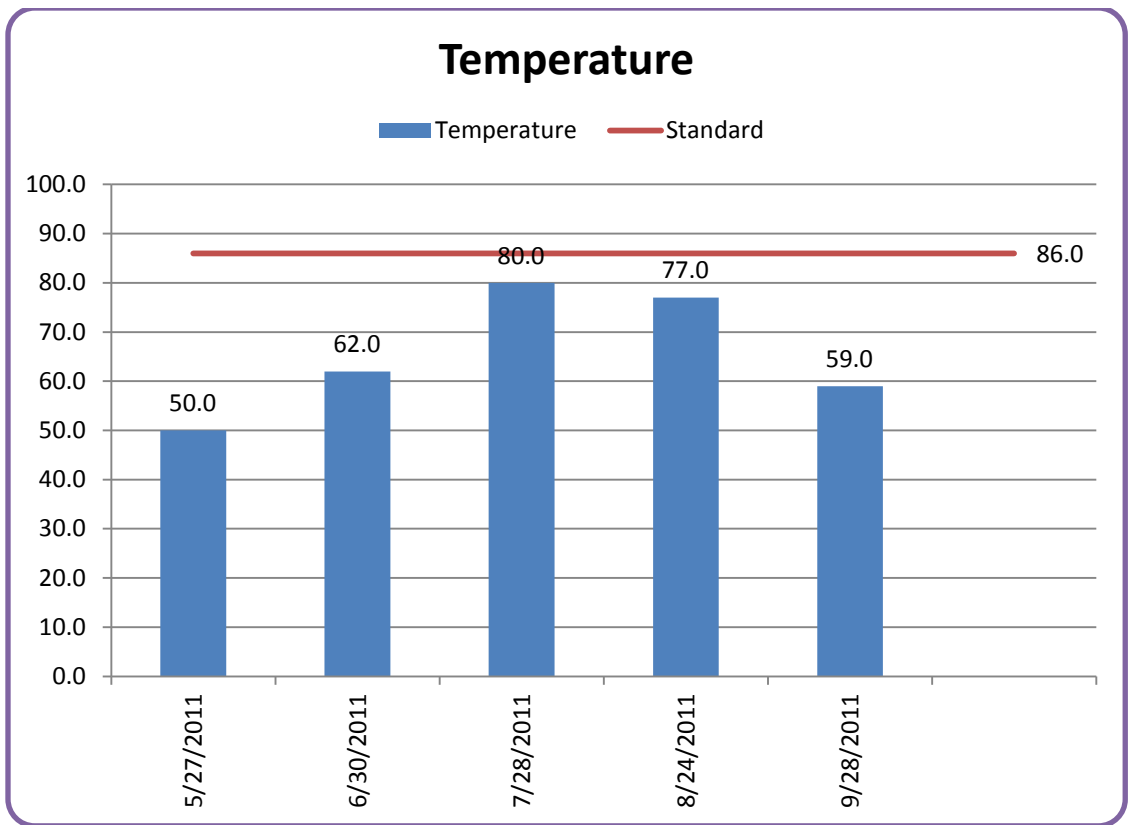
Expected Range:

2.0-6.0 mg/L

Deep Lake Standard:

None

All temperatures met the standard.

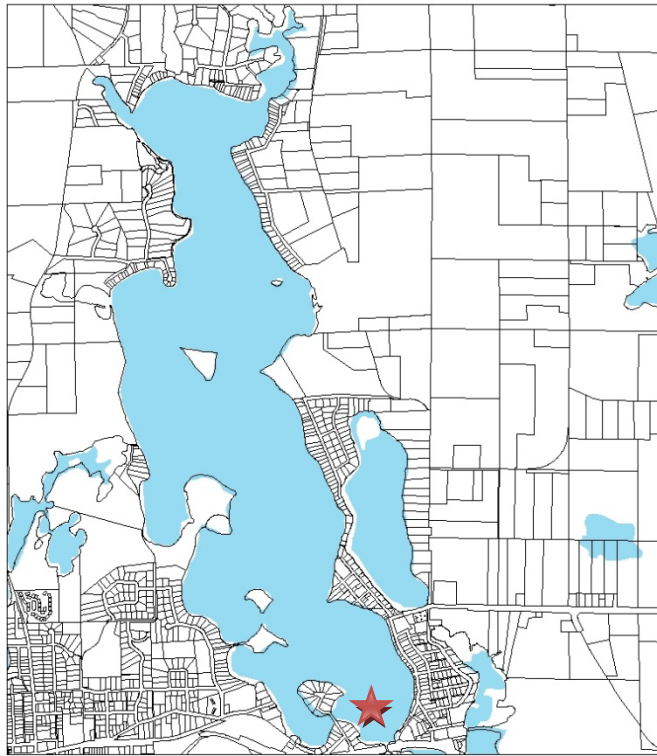


	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	NO DATA	NO DATA	65.6 mg/L
Within Expected Range			Yes

South Center Lake General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		Nothing noted
June	2	2		Milfoil heavy in north east bay and near public access, minimal elsewhere
July	3	3	Beach grass (light army green)	Narrow band of milfoil in NE bay. Some milfoil near underpass to N. Center. No curly-leaf
August	2	2	Cornichon (army green)	East bay, milfoil in patches (Hazelden), minimal by boat landing
September	4+	4+	Cornichon (army green)	Algae bloom across lake. Milfoil near public access and along north east bay. Dramatic decrease in milfoil density and area in 2011 versus 2010

North Center Lake



Shallow Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	58.5	57.5	63.4	59.8
Classification	Eutrophic	Eutrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: C

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	17.2 µg/L	1.2 meters	61.0 µg/L		
Grade	B	C-D	C	C	11 th /12

MPCA Standards: Impaired

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Shallow lake)	20.0 µg/L	>1.0 meters	60.0 µg/L	
2011 Average (June-Sept)	20.5 µg/L	1.0 meters	62.3 µg/L	
Meets Standard	No	No	No	No

Chlorophyll A

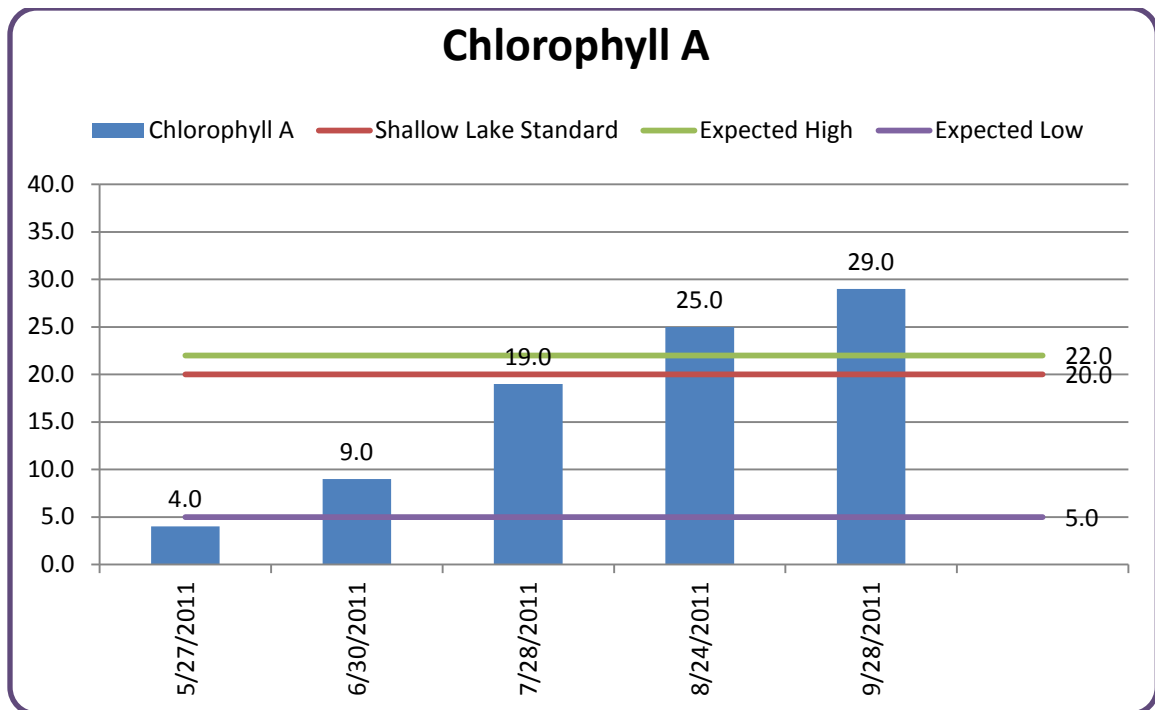
Expected Range:

5.0-22.0 µg/L

Shallow Lake

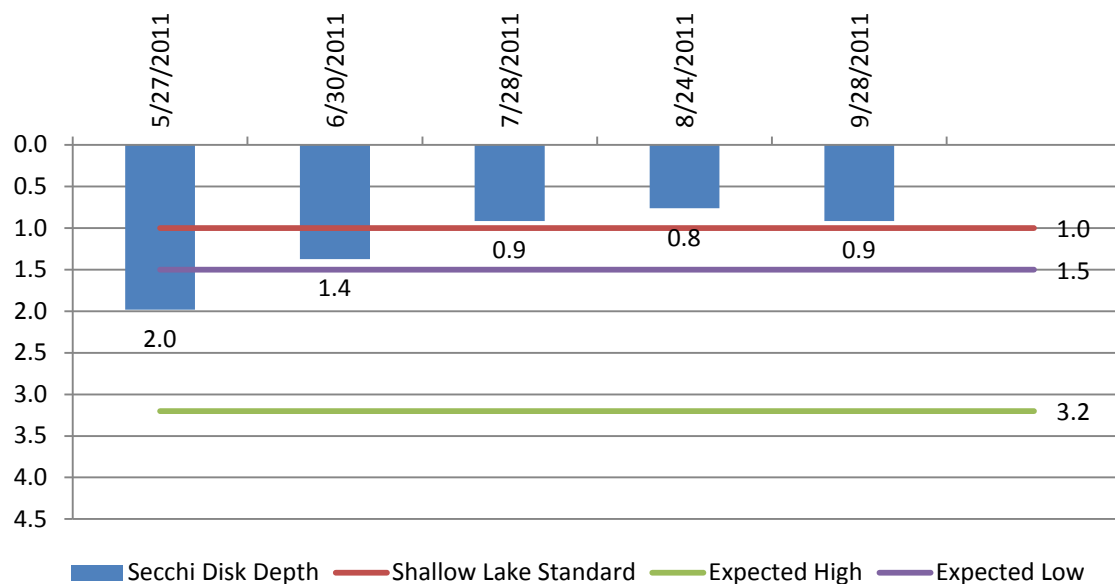
Standard: 20.0 µg/L

The readings from August and September were above the standard. The average was just above the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	24.9 µg/L	19.5 µg/L	17.2 µg/L
Grade	C	B	B
Average (June-Sept)	29.9 µg/L	22.8 µg/L	20.5 µg/L
Meets Standard (20.0 µg/L)	No	No	No

Secchi Disk Depth



Secchi Disk Depth

Expected Range:

1.5-3.2 meters

Shallow Lake

Standard: >1.0 meters

Secchi disk depths for July, August, and September did not meet the standard. The average also did not meet the standard, although it is very close.

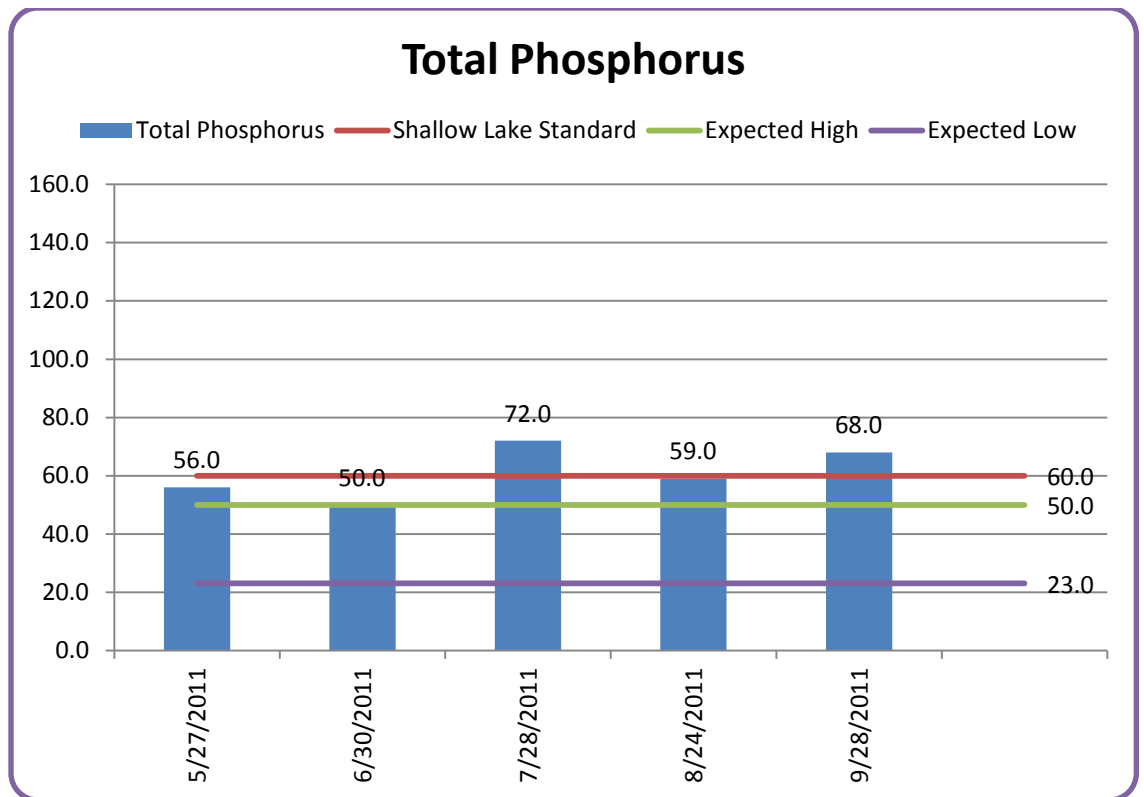
	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	1.6 meters	1.4 meters	1.2 meters
Grade	C	C	C-D
Average (June-Sept)	1.4 meters	1.2 meters	1.0 meter
Meets Standard (>1.0 m)	Yes	Yes	No

Total Phosphorus

Expected Range:
23.0-50.0 µg/L

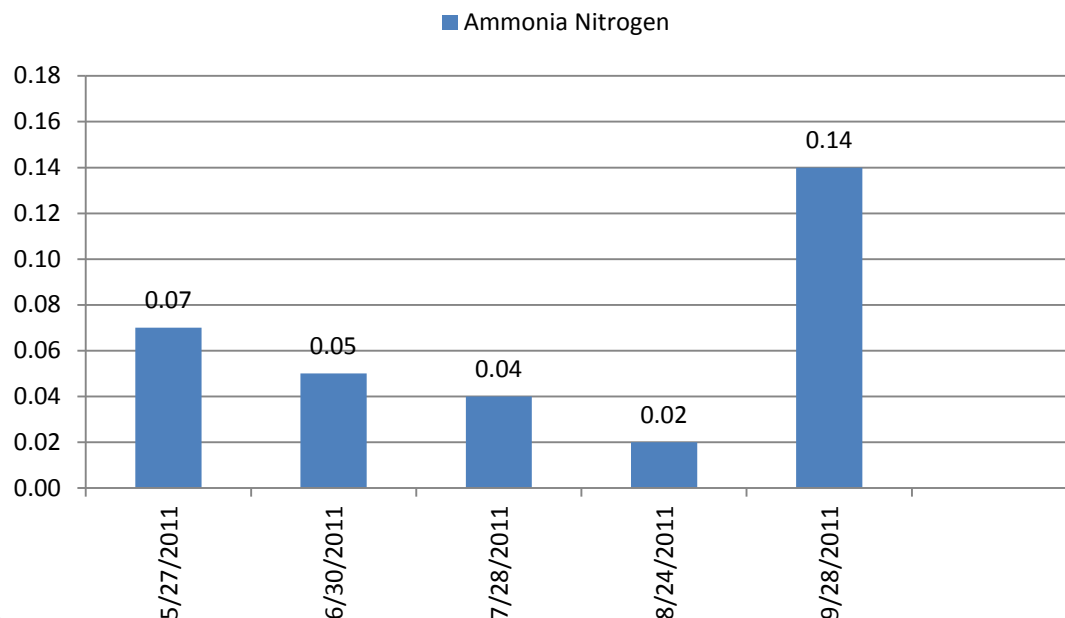
Shallow Lake
Standard: 60.0 µg/L

All five samples were at or above the expected range, with three samples also above the standard. The average did not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	70.0 µg/L	60.0 µg/L	61.0 µg/L
Grade	D	C	C
Average (June-Sept)	78.0 µg/L	65.0 µg/L	62.3 µg/L
Meets Standard (60.0 µg/L)	No	No	No

Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Shallow Lake Standard: None

The samples on this lake were generally higher than other lakes. The highest sample was taken in September, which could be caused by runoff associated from a rainfall event.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	<0.05 mg/L	<0.05 mg/L	0.06 mg/L

Temperature

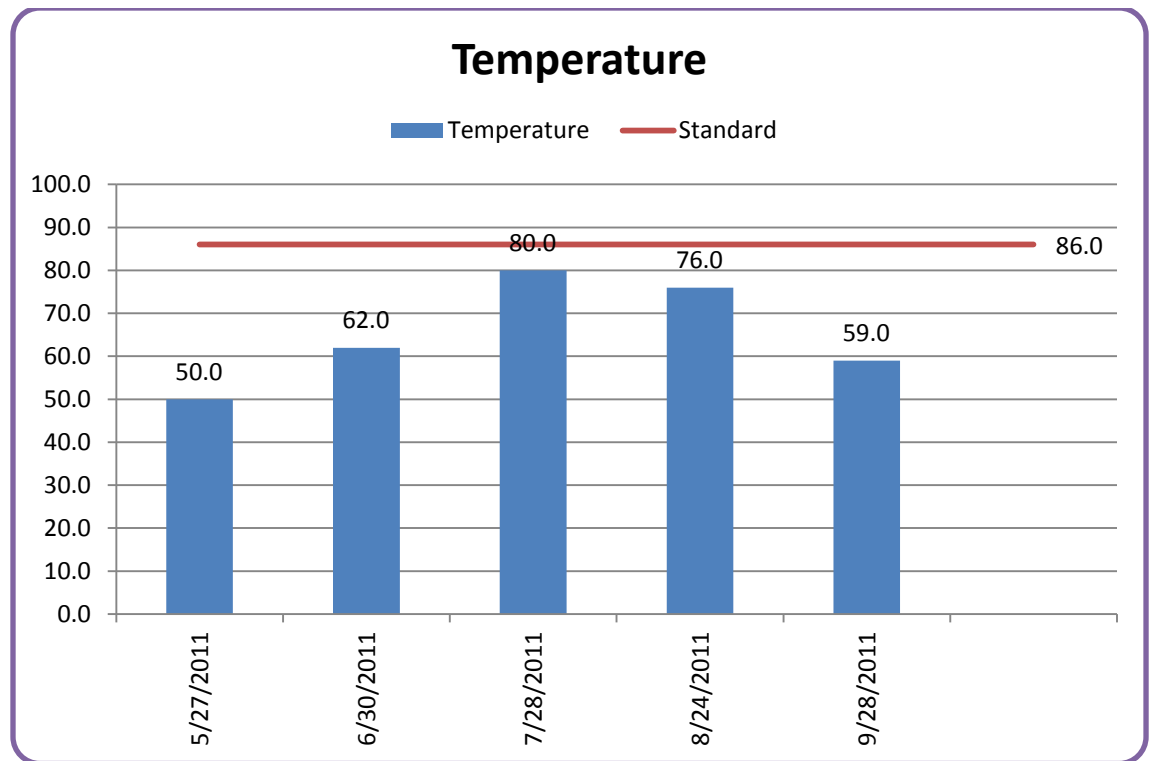
Expected Range:

None

Shallow Lake

Standard: The daily average shall not exceed 86.0°F

No temperatures exceeded the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	69.8 °F	NO DATA	65.4 °F
Within Expected Range			Yes

North Center Lake-South General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		Floating milfoil
June	2	2		Minimal invasive weeds. Dramatic decrease in milfoil density and area in 2011 versus 2010
July	3	3	Beach grass (light army green)	West bay murky. Many turions visible
August	3	3	Beach grass (light army green)	Milfoil surfacing in areas near Calendar Isle sprayed this spring for milfoil. Curly leaf turions and heavy milfoil in south west bay. Milfoil seed heads along west point
September	4+	4+	Cornichon (army green)	Algae bloom across lake. Milfoil redeveloping along west bay shoreline area and around west peninsula. Milfoil surfacing, algae bloom and freshwater bryozoans found along shore of Calendar Isle

North Center Lake



Shallow Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	62.9	54.8	61.3	59.7
Classification	Eutrophic	Eutrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: C

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	26.8 µg/L	1.4 meters	61.3 µg/L		
Grade	C	C	C	C	10 th /12

MPCA Standards: Impaired but in 2011 Meets Standards

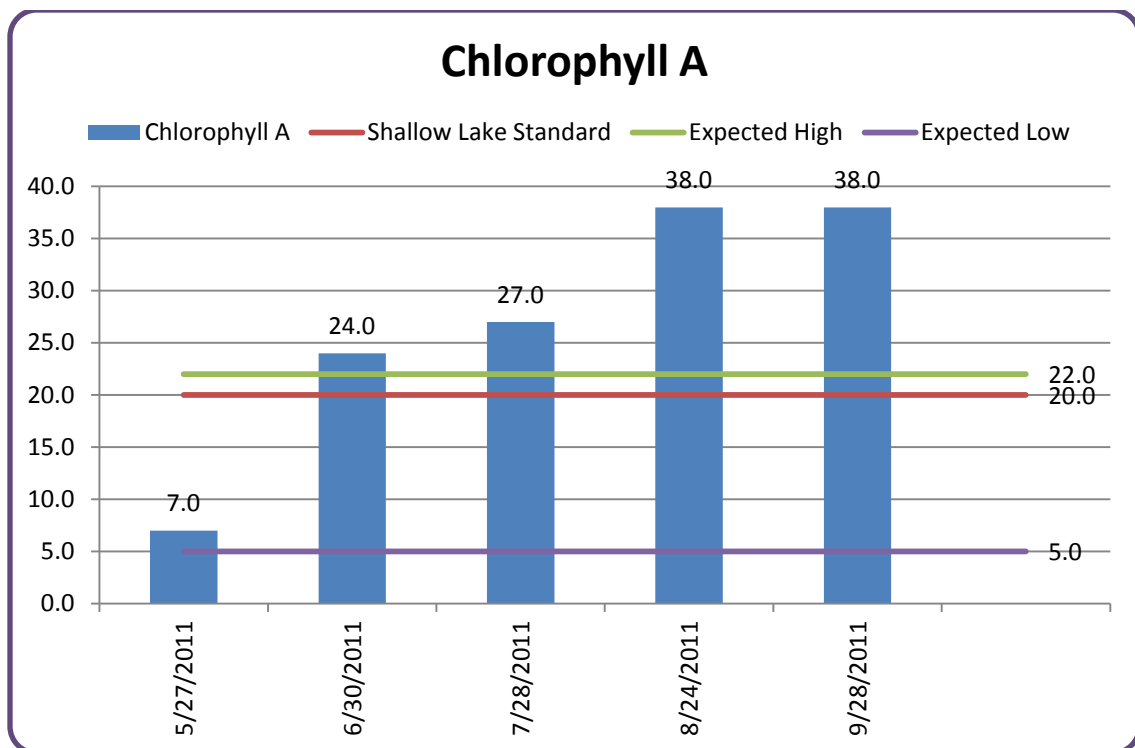
	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Shallow lake)	20.0 µg/L	>1.0 meters	60.0 µg/L	
2011 Average (June-Sept)	31.8 µg/L	1.3 meters	56.0 µg/L	
Meets Standard	No	Yes	Yes	Yes

Chlorophyll A

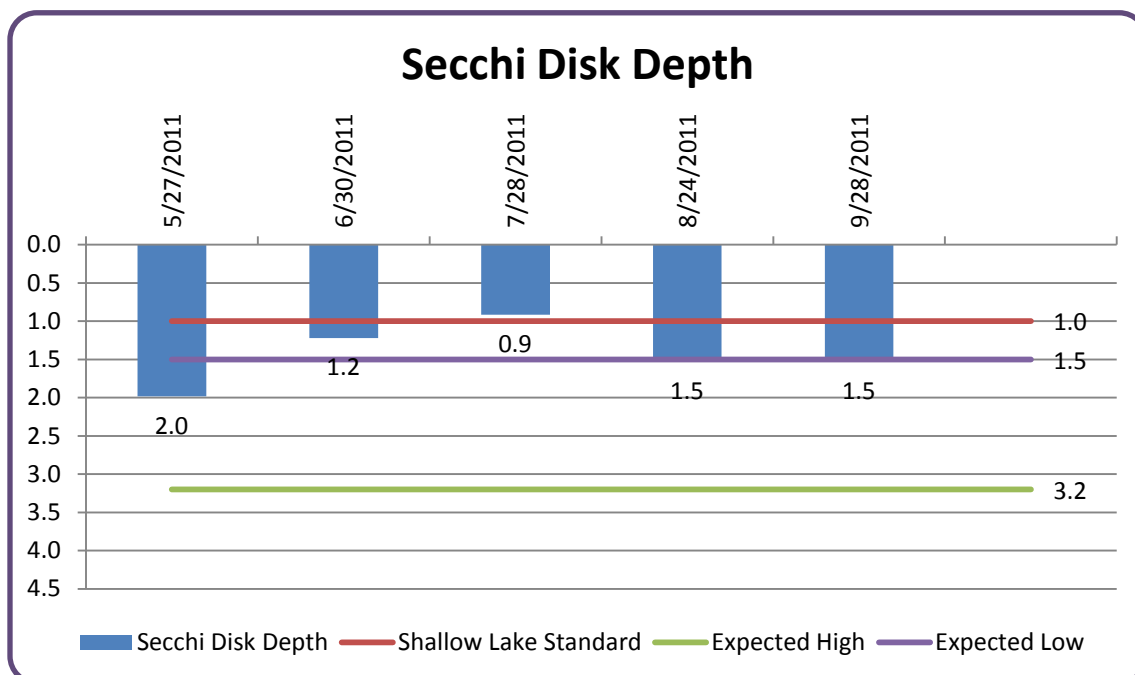
Expected Range:
5.0-22.0 µg/L

Shallow Lake
Standard: 20.0 µg/L

Four of five readings were above the standard and outside the expected range. The average does not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	40.9 µg/L	31.2 µg/L	26.8 µg/L
Grade	C	C	C
Average (June-Sept)	49.5 µg/L	39.0 µg/L	31.8 µg/L
Meets Standard (20.0 µg/L)	No	No	No



Secchi Disk Depth

Expected Range: 1.5-3.2 meters

Shallow Lake
Standard: >1.0 meters

Clarity in this lake does meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	0.9 meters	1.1 meters	1.4 meters
Grade	D	D	C
Average (June-Sept)	0.7 meters	0.8 meters	1.3 meters
Meets Standard (>1.0 m)	No	No	Yes

Total Phosphorus

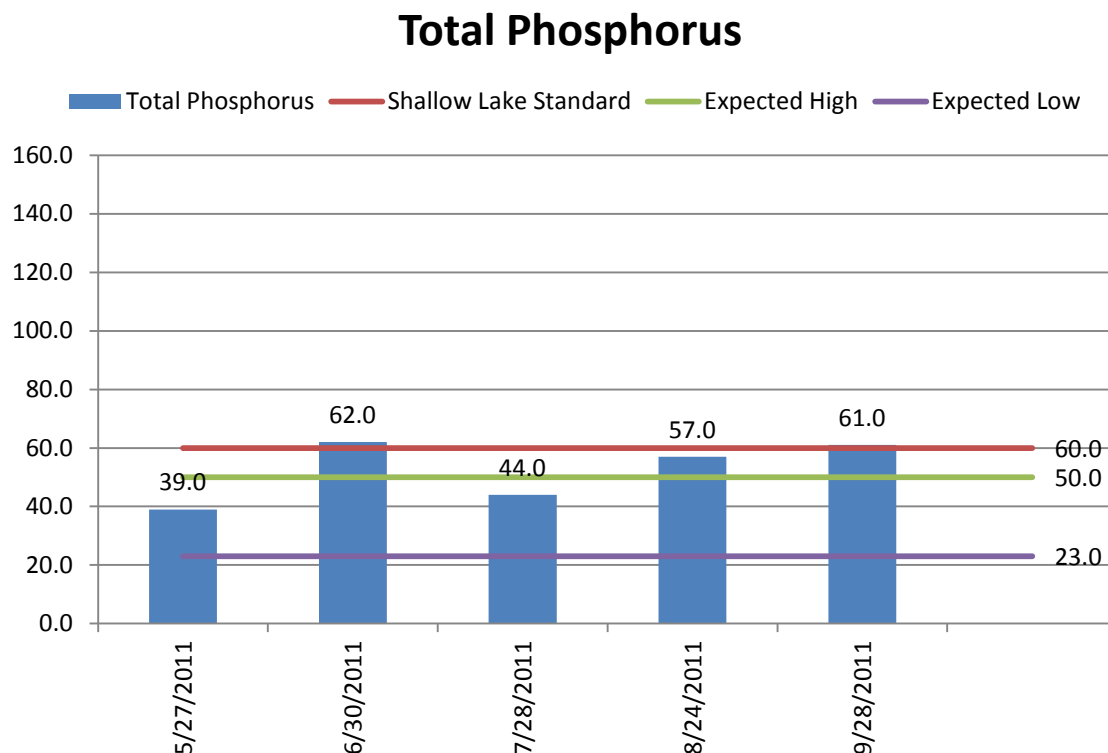
Expected Range:

23.0-50.0 µg/L

Shallow Lake

Standard: 60.0 µg/L

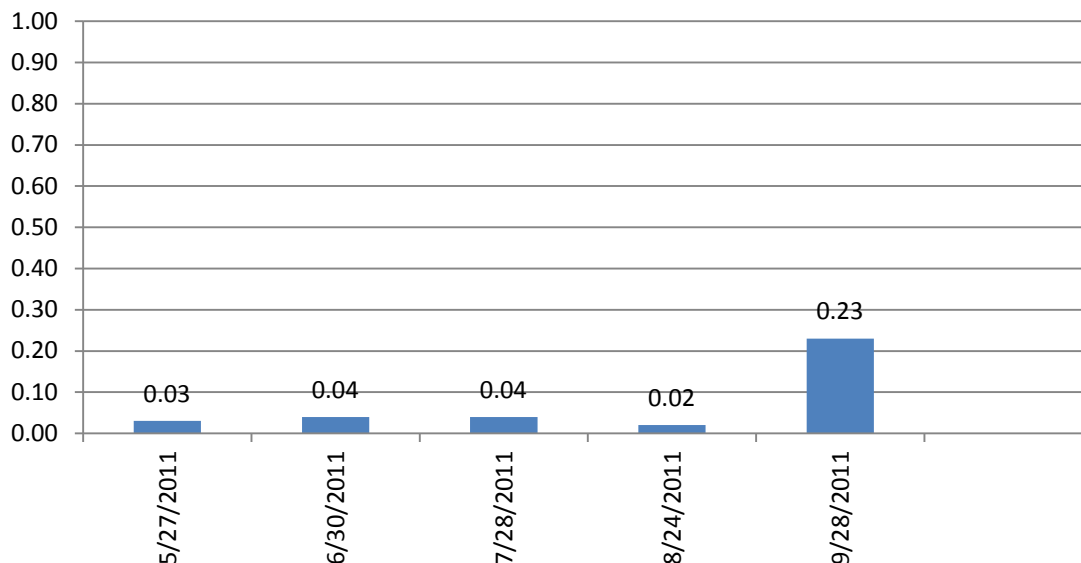
Two samples were above the standard, but the overall average meets the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	80.0 µg/L	74.0 µg/L	52.6 µg/L
Grade	D	D	C
Average (June-Sept)	87.0 µg/L	82.0 µg/L	56.0 µg/L
Meets Standard (60.0 µg/L)	No	No	Yes

Ammonia Nitrogen

■ Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Shallow Lake Standard: None

Samples were low except for the September sample. This could be explained by agricultural runoff or a failing septic system.

This chart cannot be directly compared to other Ammonia Nitrogen charts in this report due to a difference in scale.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	<0.05 mg/L	<0.05 mg/L	0.07 mg/L

Temperature

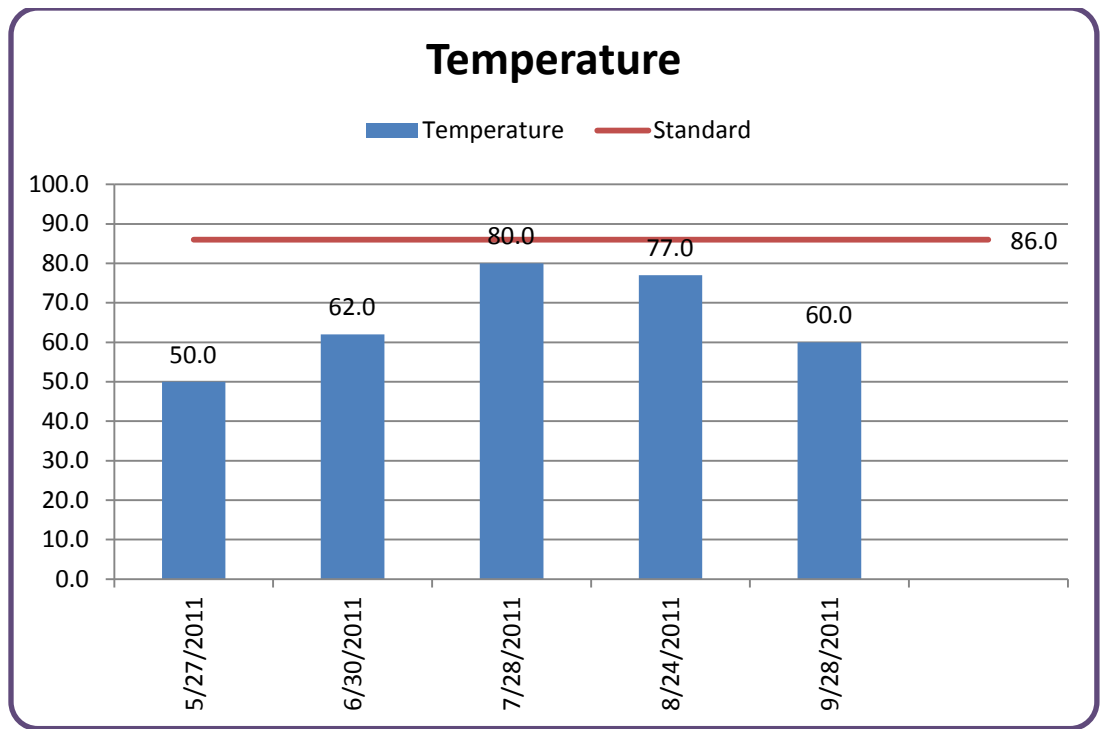
Expected Range:

None

Shallow Lake

Standard: The daily average shall not exceed 86.0°F

The temperatures were below 86°F.

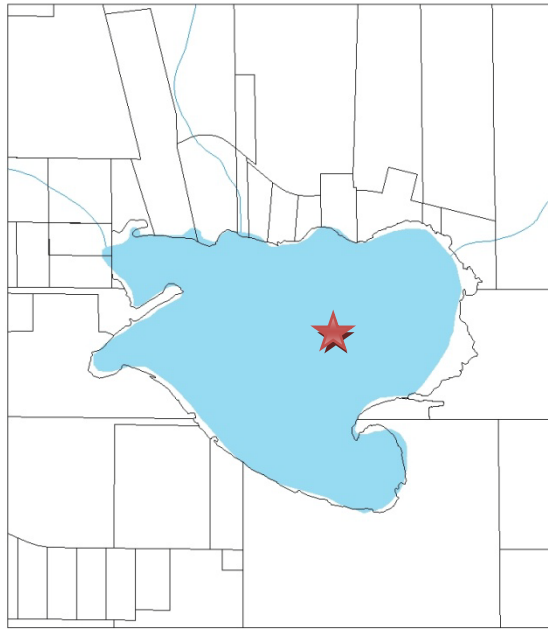


	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	71.7 °F	NO DATA	65.8°F
Meets Standard (Not to exceed 86.0°F)	Yes		Yes

North Center Lake-North General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	OTHER NOTES
May	2	2		Nothing noted
June	2	2		Minimal invasive weeds. Dramatic decrease in milfoil density and area in 2011 versus 2010
July	3	3	Cornichon (army green)	No visible aquatic invasive weeds at north end of lake
August	3	3	Beach grass (light army green)	No noticeable milfoil
September	4+	4+	Beach grass (light army green)	Substantial algae on surface, milfoil surfacing on west bay

Little Lake



Deep Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	67.5	57.9	72.8	66.1
Classification	Eutrophic	Eutrophic	Hypereutrophic	Eutrophic

Overall Lake Quality Grade: C-

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	43.2 µg/L	1.2 meters	117.0 µg/L		
Grades	C	C-D	D	C-	12 th /12

MPCA Standards: Impaired

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Deep lake)	14.0 µg/L	>1.4 meters	40.0 µg/L	
2011 (June-Sept)	52.5 µg/L	0.9 meters	125.5 µg/L	
Meets Standard	No	No	No	No

Chlorophyll A

Expected Range:

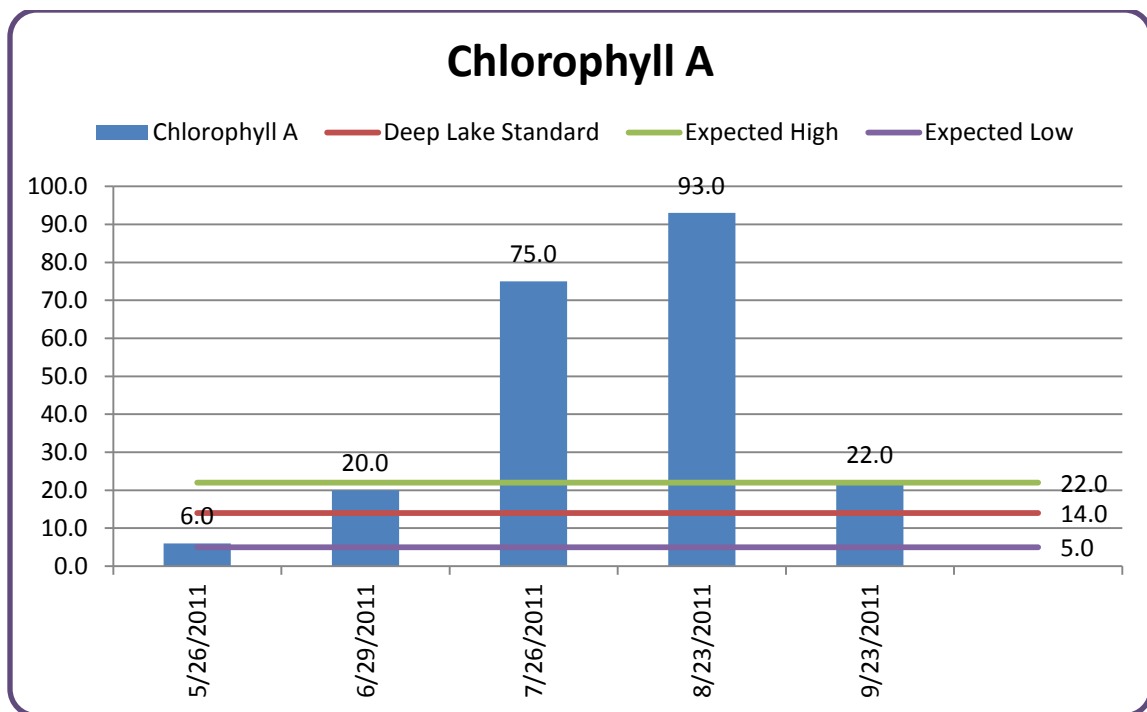
5.0-22.0 µg/L

Deep Lake Standard:

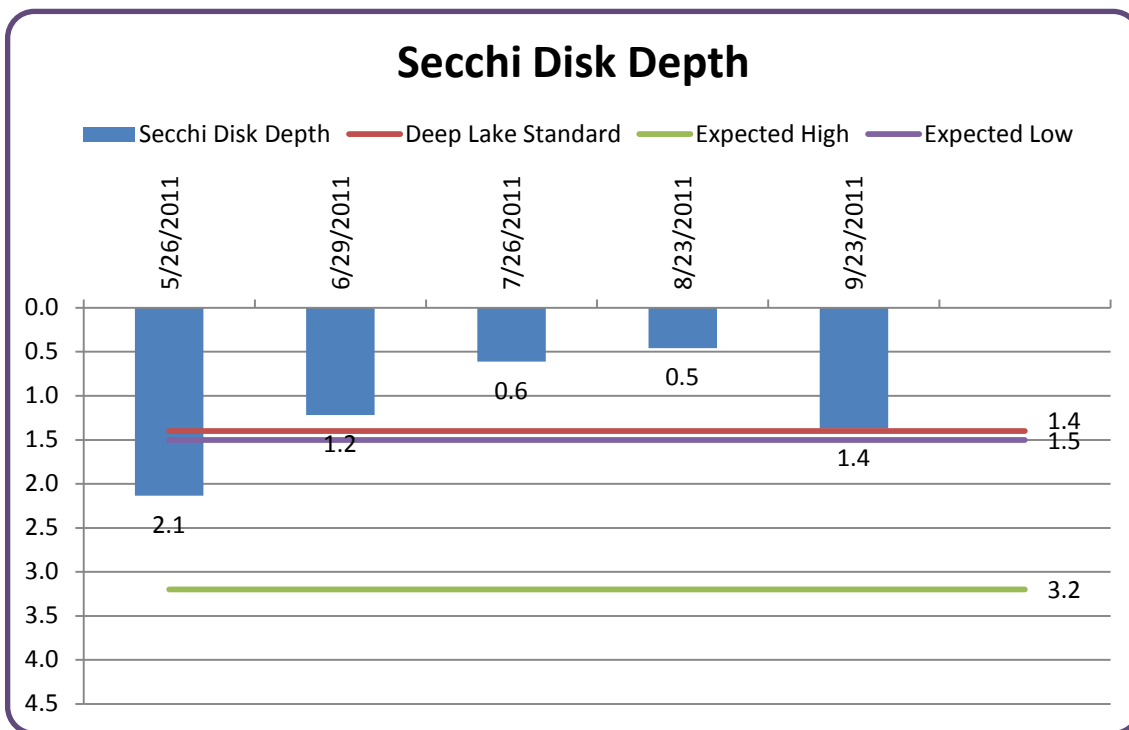
14.0 µg/L

Four of five readings exceed the standard, with the July and August samples reading very high.

This chart cannot be directly compared to other Chlorophyll A charts in this report due to a difference in scale.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	43.2 µg/L
Grade			C
Average (June-Sept)	NO DATA	NO DATA	52.5 µg/L
Meets Standard (14.0 µg/L)			No



Secchi Disk Depth

Expected Range: 1.5-3.2 meters

Deep Lake Standard: >1.4 meters

The clarity is very poor. This lake does not meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	1.2 meters
Grade			C-D
Average (June-Sept)	NO DATA	NO DATA	0.9 meters
Meets Standard (>1.4 m)			No

Total Phosphorus

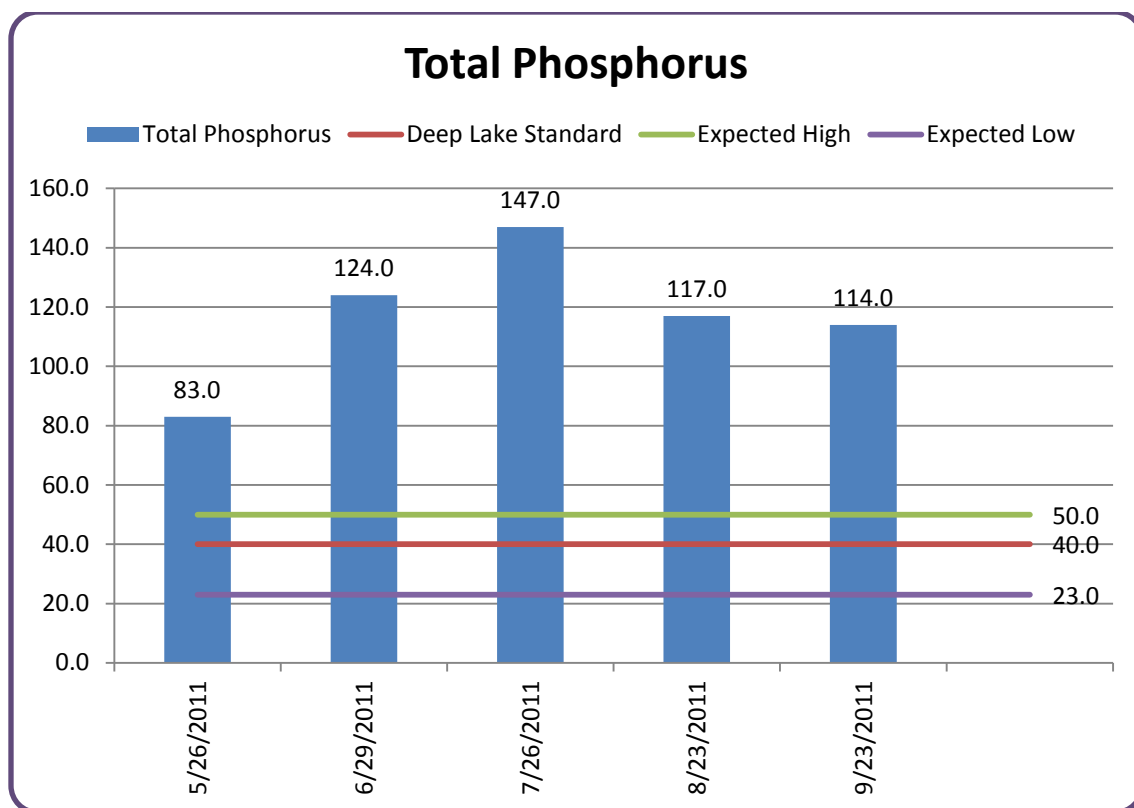
Expected Range:

23.0-50.0 µg/L

Deep Lake Standard:

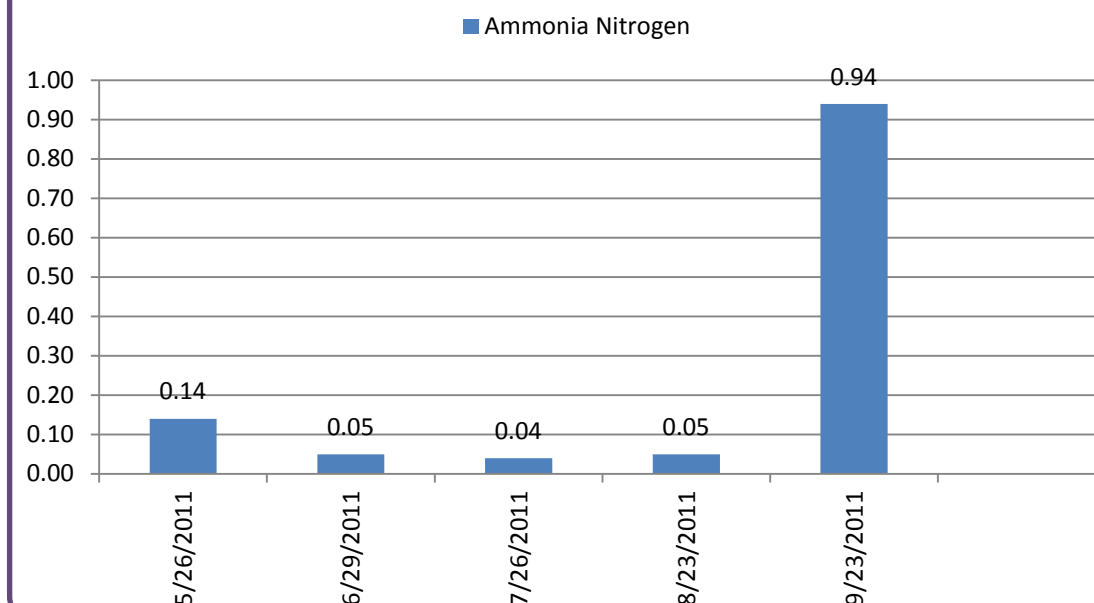
40.0 µg/L

The readings are extremely high. This lake does not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	NO DATA	NO DATA	117.0 µg/L
Grade			D
Average (June-Sept)	NO DATA	NO DATA	125.5 µg/L
Meets Standard (60.0 µg/L)			No

Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Shallow Lake Standard: None

Samples were low except for the September sample. This could be explained by agricultural runoff or a failing septic system.

This chart cannot be directly compared to other Ammonia Nitrogen charts in this report due to a difference in scale.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	NO DATA	NO DATA	0.24 mg/L

Temperature

Expected Range:

None

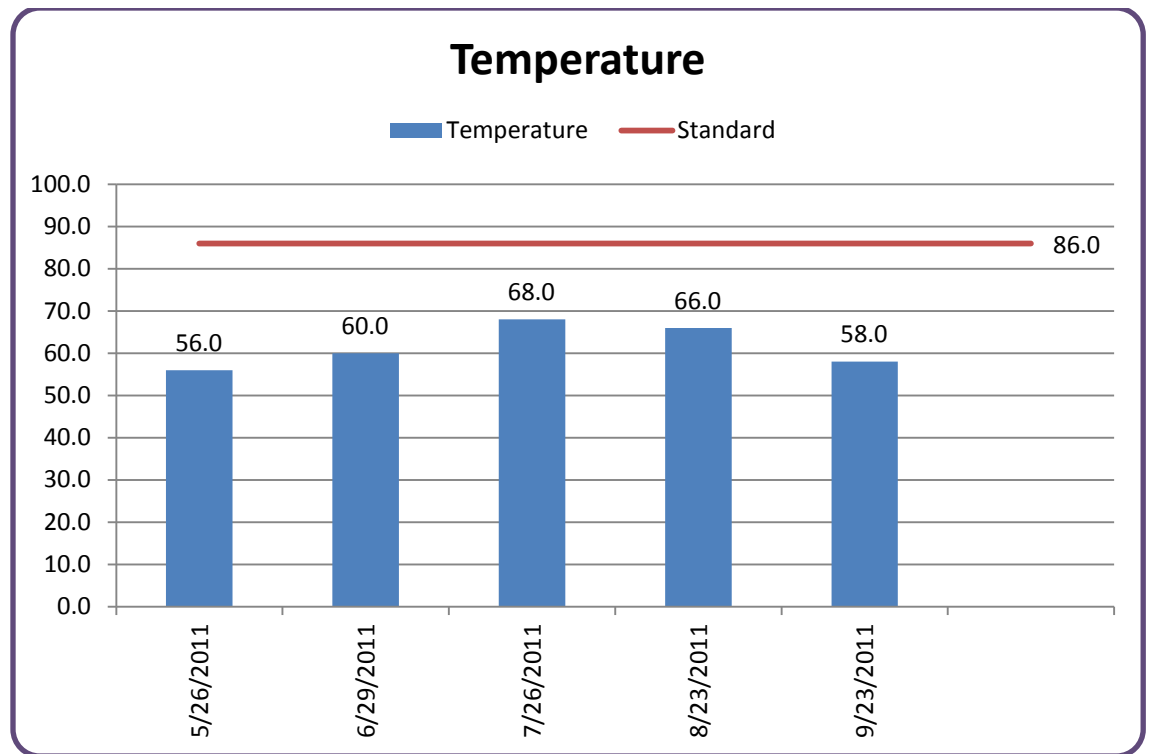
Deep Lake Standard:

The daily average

shall not exceed

86.0°F

The temperatures
meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	NO DATA	NO DATA	61.6 °F
Meets Standard (Not to exceed 86.0°F)			Yes

Little Lake General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		
June	2	2		Minimal aquatic invasive weeds present
July	3	3	Bay leaf (pea green)	Minimal aquatic invasive weeds present
August	4	4	Bay leaf (pea green)	Minimal aquatic invasive weeds present
September	3	3	Cornichon (army green)	Minor algae bloom

North Lindstrom Lake



Deep Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	52.6	45.1	50.6	49.4
Classification	Eutrophic	Mesotrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: B

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	9.4 µg/L	2.8 meters	25.0 µg/L		
Grades	A	B	B	B	1 st /12

MPCA Standards: Meets standards

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Deep lake)	14.0 µg/L	>1.4 meters	40.0 µg/L	
2011 Average (June-Sept)	11.5 µg/L	2.5 meters	26.0 µg/L	
Meets Standard	Yes	Yes	Yes	Yes

Chlorophyll A

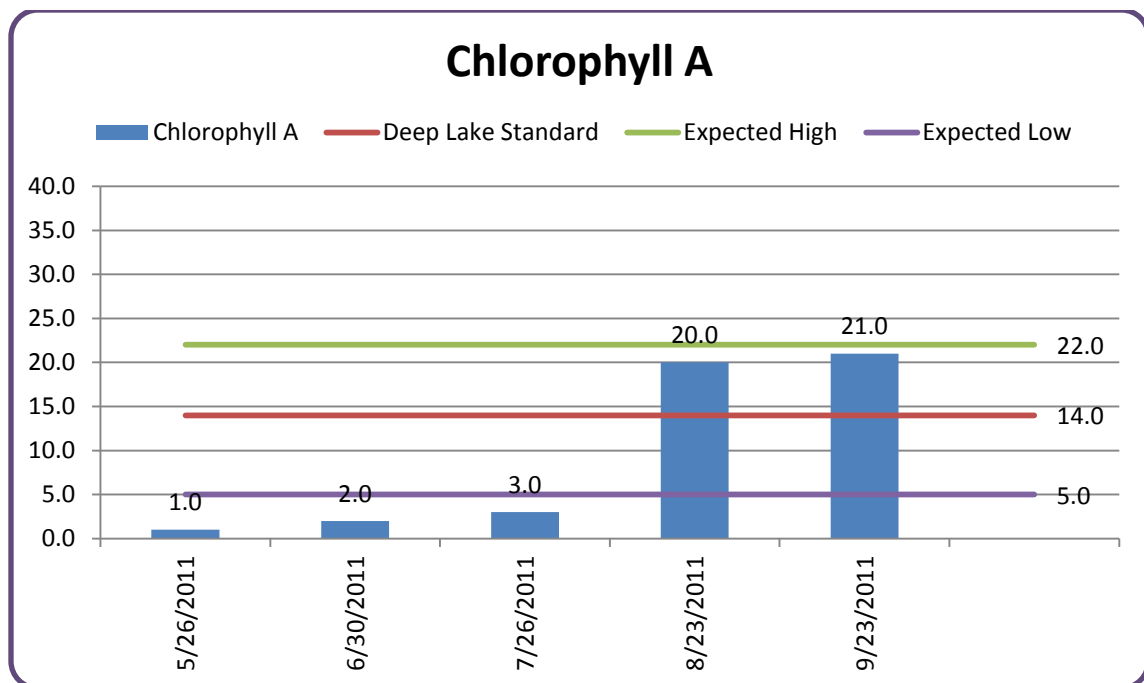
Expected Range:

5.0-22.0 µg/L

Deep Lake Standard:

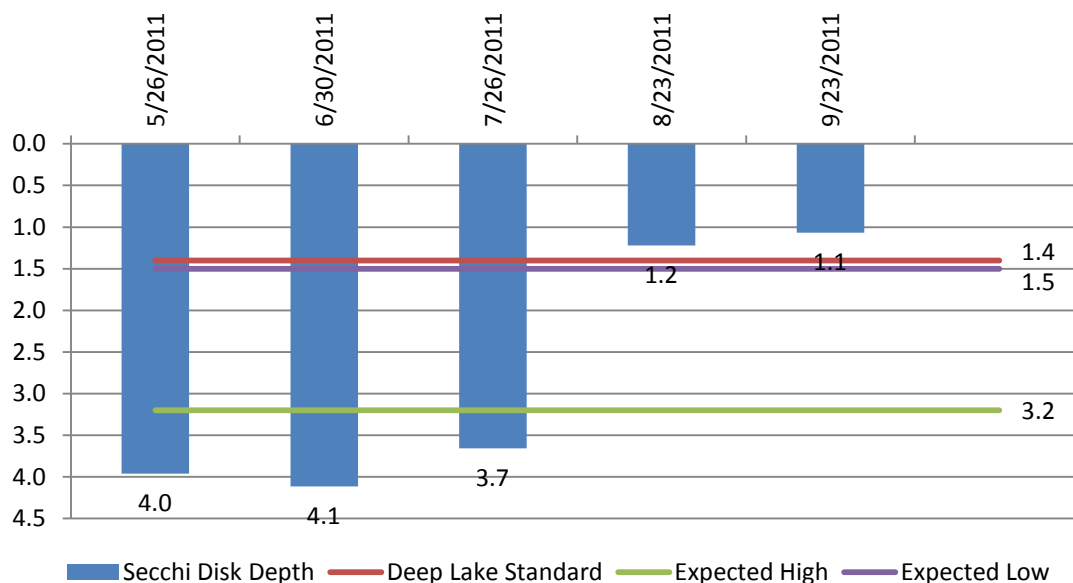
14.0 µg/L

The August and September samples were above the standard, but still within the expected range. The average meets the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	14.0 µg/L	17.7 µg/L	9.4 µg/L
Grade	B	B	A
Average (June-Sept)	15.6 µg/L	19.6 µg/L	11.5 µg/L
Meets Standard (14.0 µg/L)	No	No	Yes

Secchi Disk Depth



Secchi Disk Depth

Expected Range: 1.5-

3.2 meters

Deep Lake Standard:

>1.4 meters

Water clarity is very good at the beginning of the season, but falls below standard at the end. However, the overall average does meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	2.0 meters	2.1 meters	2.8 meters
Grade	C	C	B
Average (June-Sept)	1.5 meters	2.1 meters	2.5 meters
Meets Standard (>1.4 m)	Yes	Yes	Yes

Total Phosphorus

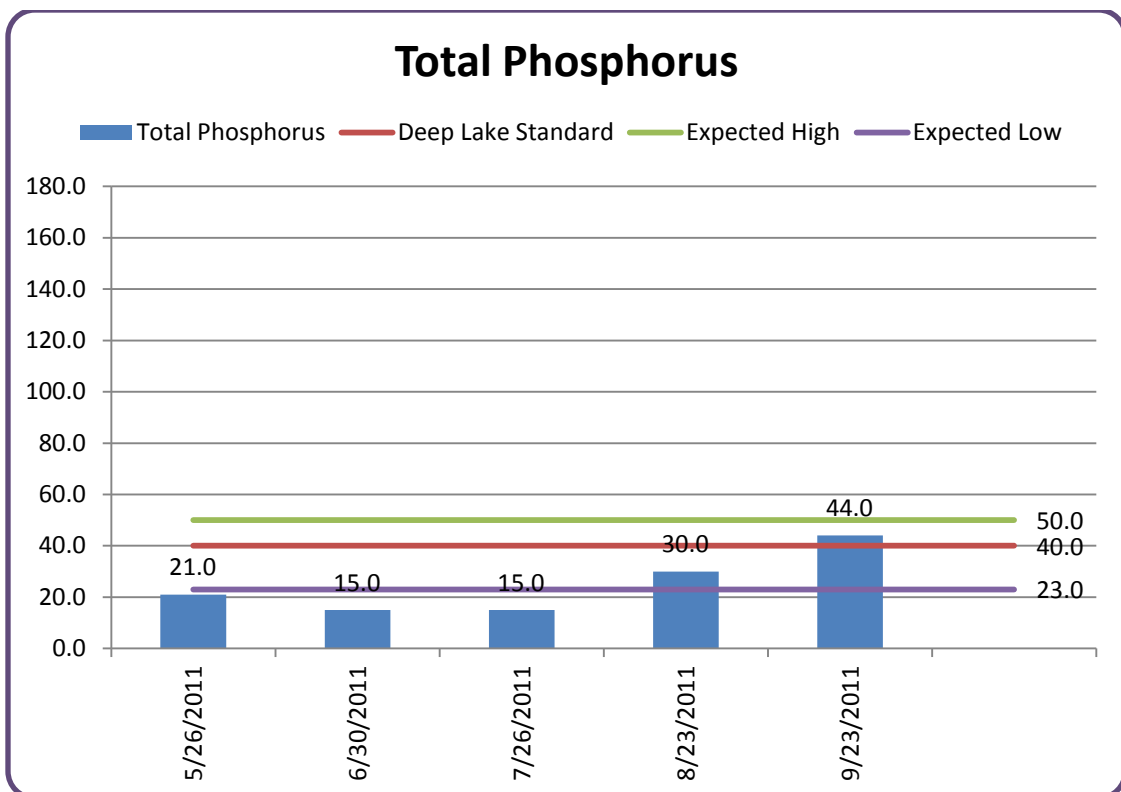
Expected Range:

23.0-50.0 µg/L

Deep Lake Standard:

40.0 µg/L

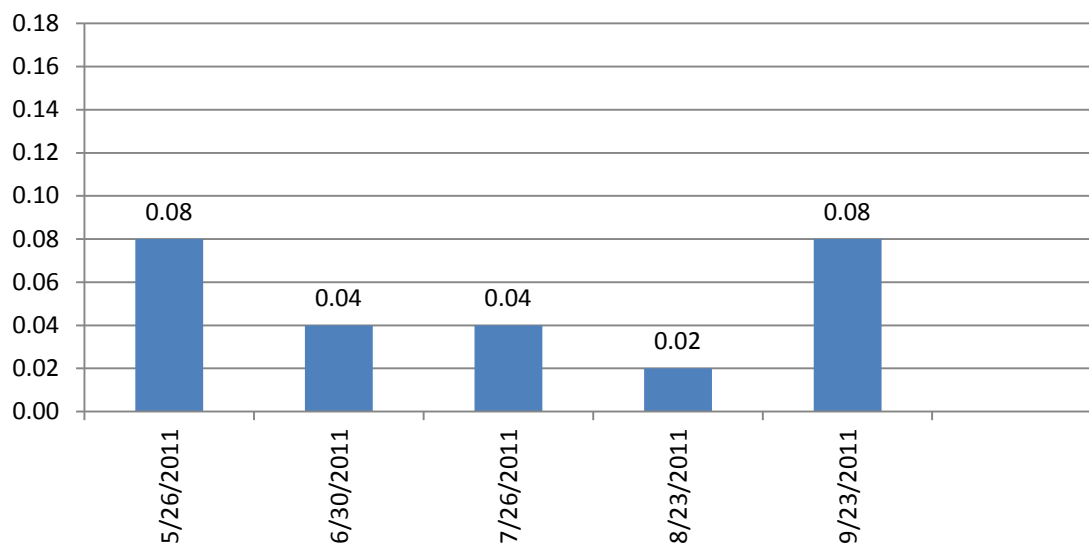
Early season samples were low, while August and September samples were within the expected range. The average meets the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	33.0 µg/L	34.0 µg/L	25.0 µg/L
Grade	C	C	B
Average (June-Sept)	32.0 µg/L	33.0 µg/L	26.0 µg/L
Meets Standard (40.0 µg/L)	Yes	Yes	Yes

Ammonia Nitrogen

■ Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Deep Lake Standard: None

The May and September samples were slightly elevated. This could be caused by runoff events.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	0.1 mg/L	0.1 mg/L	0.05 mg/L

Temperature

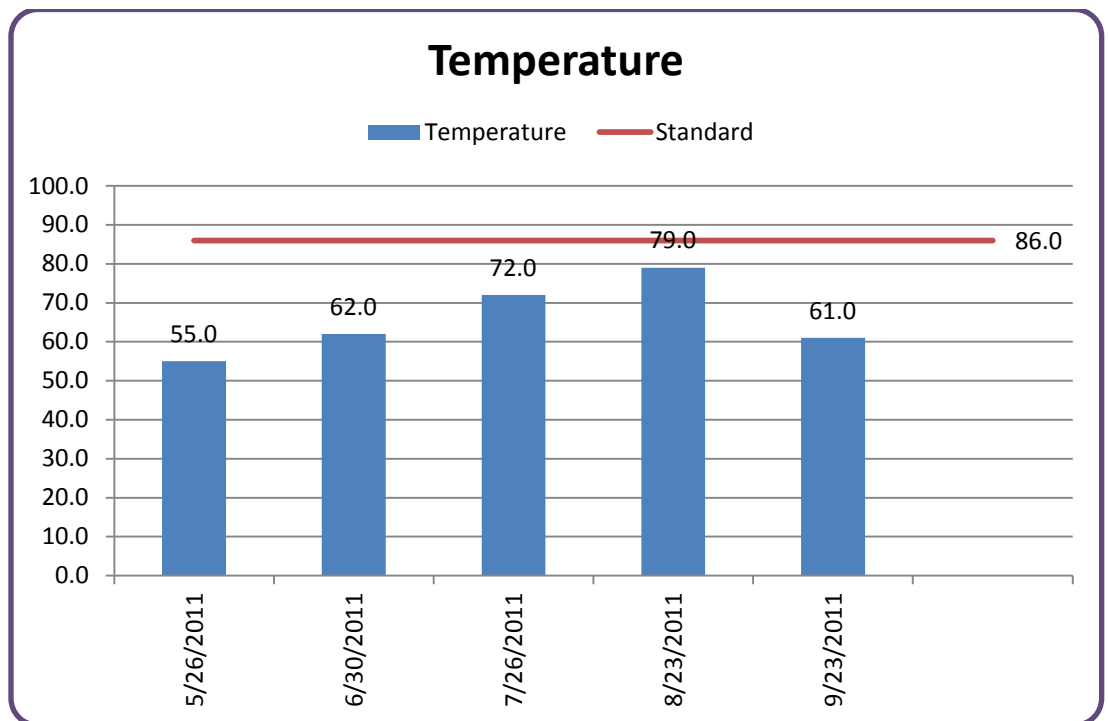
Expected Range:

None

Deep Lake Standard:

The daily average shall not exceed 86.0°F

The temperatures meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	NO DATA	NO DATA	65.8 °F
Meets Standard (Not to exceed 86.0°F)			Yes

North Lindstrom Lake General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		Minimal weeds
June	2	2		Minimal aquatic invasive weeds
July	2	2	Eiderdown (light gray/brown)	No aquatic invasive weeds observed
August	2	2	Beach grass (light army green)	Minimal aquatic invasive weeds observed. Algae bloom along north side of lake
September	3	3	Beach grass (light army green)	Algae bloom near south landing. Milfoil along shallow edges, north shoreline

Lake 13-0041-01
Little Green Lake



Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	55.9	57.1	57.3	56.8
Classification	Eutrophic	Eutrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: C

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	13.2 µg/L	1.2 meters	40.0 µg/L		
Grade	B	C-D	C	C	7 th /12

MPCA Standards

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Deep lake)	14.0 µg/L	>1.4 meters	40.0 µg/L	
2011 Average (June-Sept)	15.3 µg/L	1.0 meters	39.25 µg/L	
Meets Standard	No	No	Yes	No

Chlorophyll A

Expected Range:

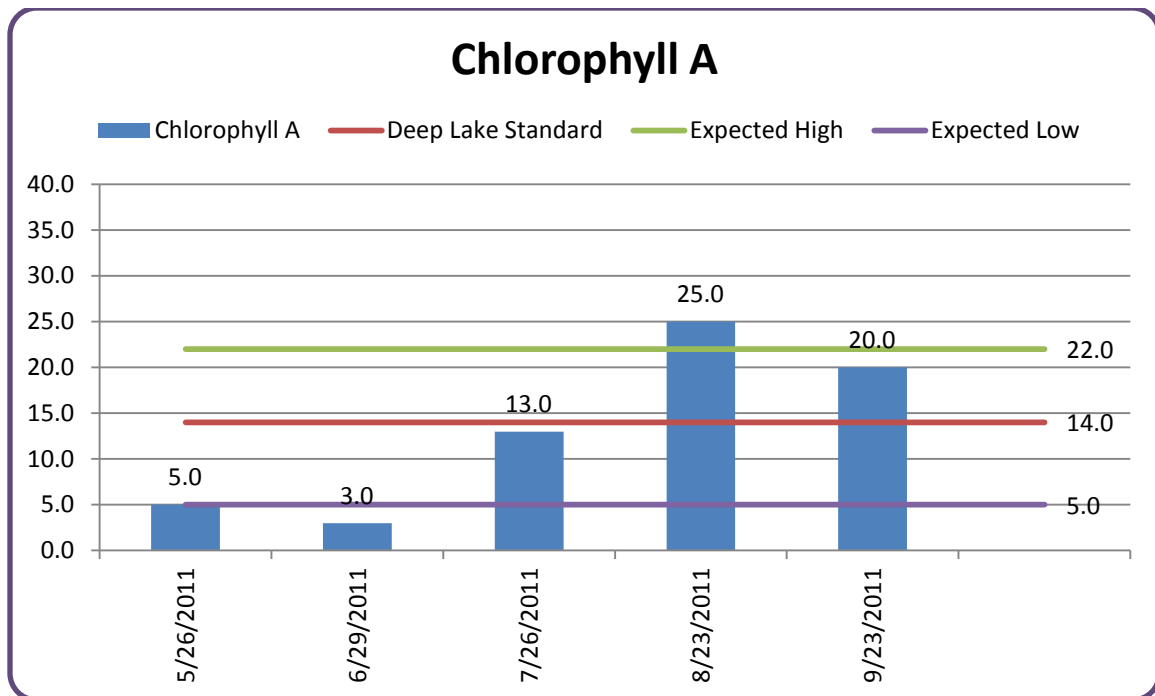
5.0-22.0 µg/L

Deep Lake Standard:

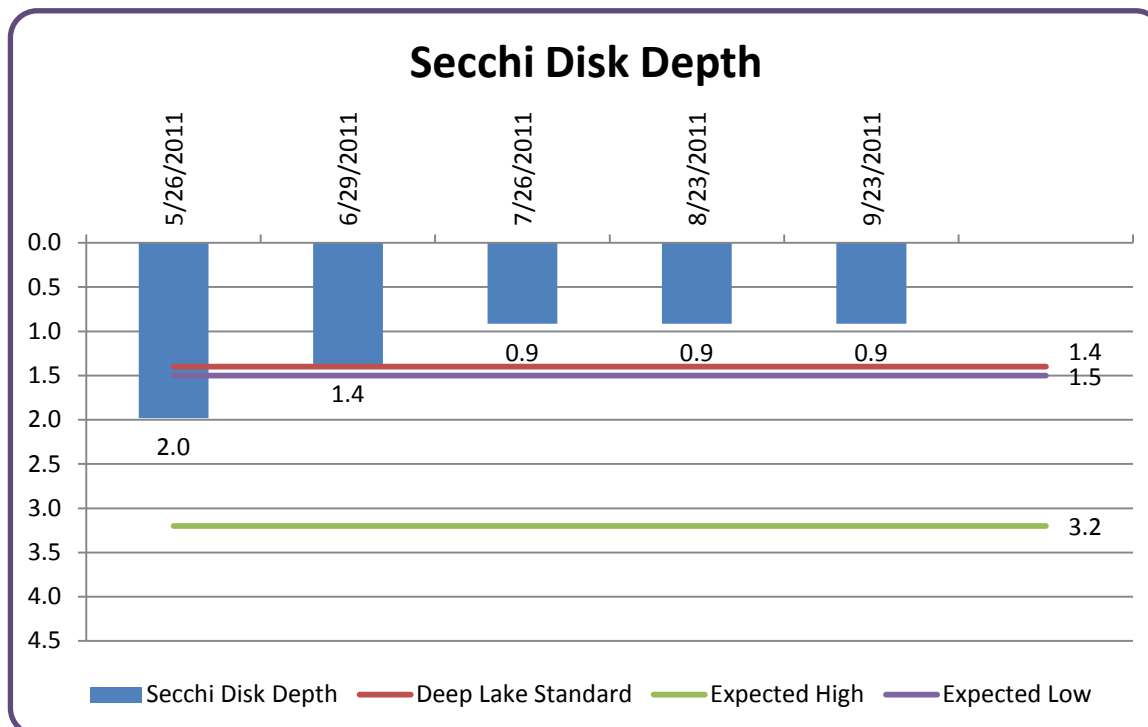
14.0 µg/L

The two late season samples are above the standard.

Although early season readings are low, the average does not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	14.6 µg/L	10.0 µg/L	13.2 µg/L
Grade	B	B	B
Average (June-Sept)	16.8 µg/L	14.4 µg/L	15.3 µg/L
Meets Standard (14.0 µg/L)	No	No	No



Secchi Disk Depth

Expected Range:

1.5-3.2 meters

Deep Lake Standard:

>1.4 meters

Three of four samples did not meet the standard. The average also did not meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	1.4 meters	1.8 meters	1.2 meters
Grade	C	C	C-D
Average (June-Sept)	1.3 meters	1.1 meters	1.0 meter
Meets Standard (>1.4 m)	No	No	No

Total Phosphorus

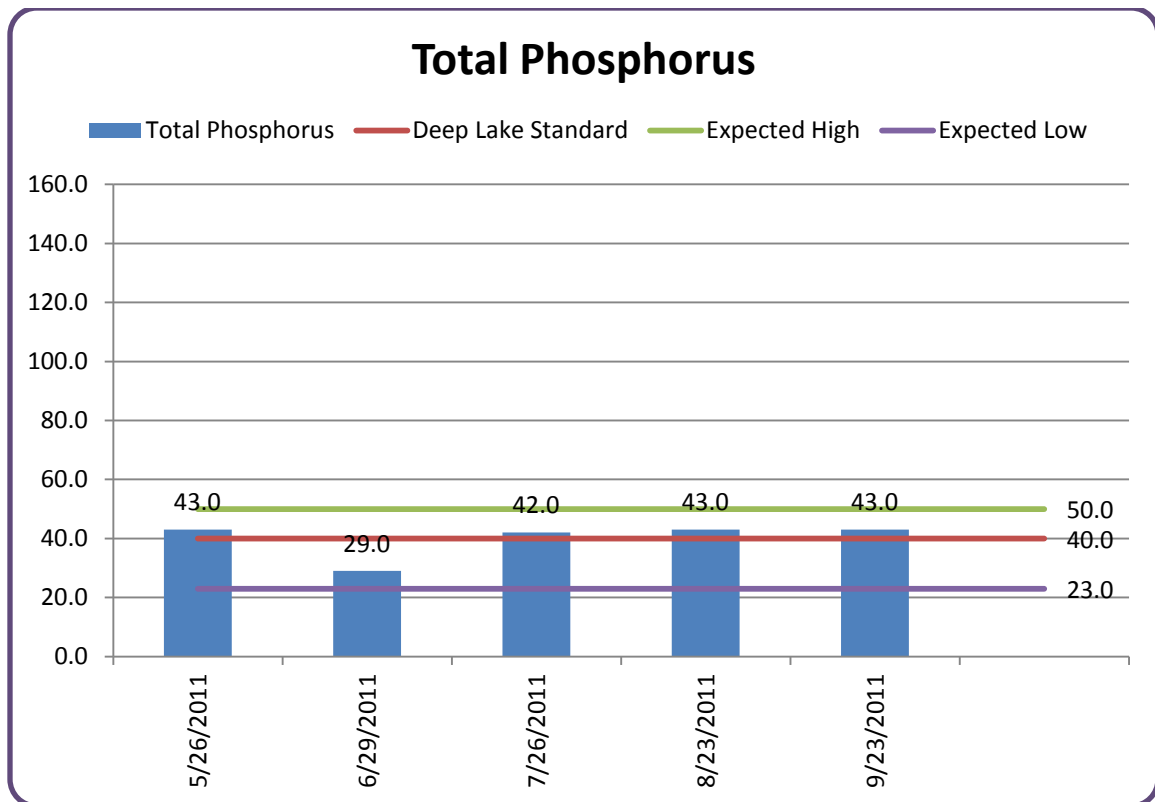
Expected Range:

23.0-50.0 µg/L

Deep Lake Standard:

40.0 µg/L

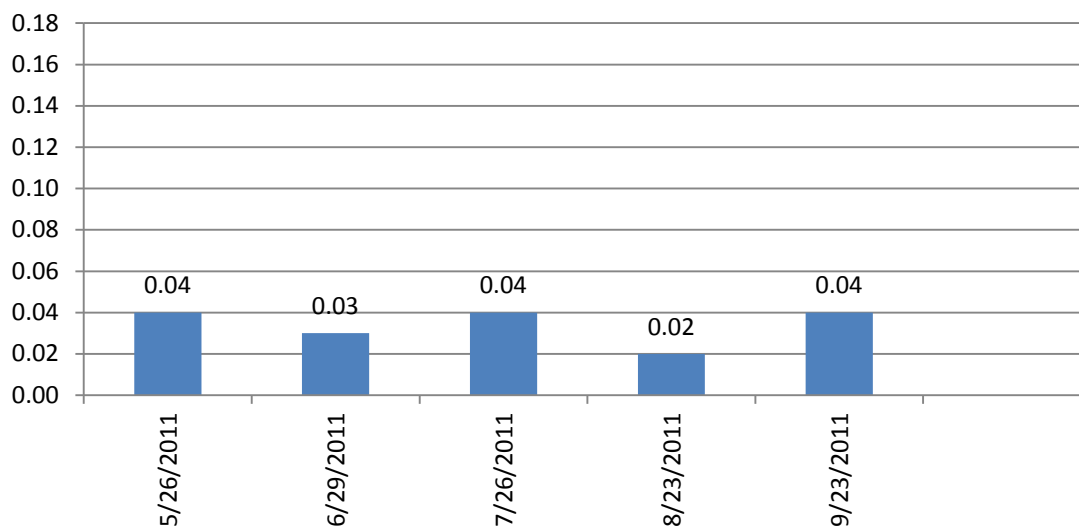
Four of five samples were above the standard. The lake is just barely meeting the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	54.0 µg/L	32.0 µg/L	40.0 µg/L
Grade	C	B-C	C
Average (June-Sept)	58.0 µg/L	41.0 µg/L	39.3 µg/L
Meets Standard (40.0 µg/L)	No	No	Yes

Ammonia Nitrogen

■ Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Deep Lake Standard: None

Samples were low throughout the season.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	<0.05 mg/L	<0.05 mg/L	0.03 mg/L

Temperature

Expected Range:

None

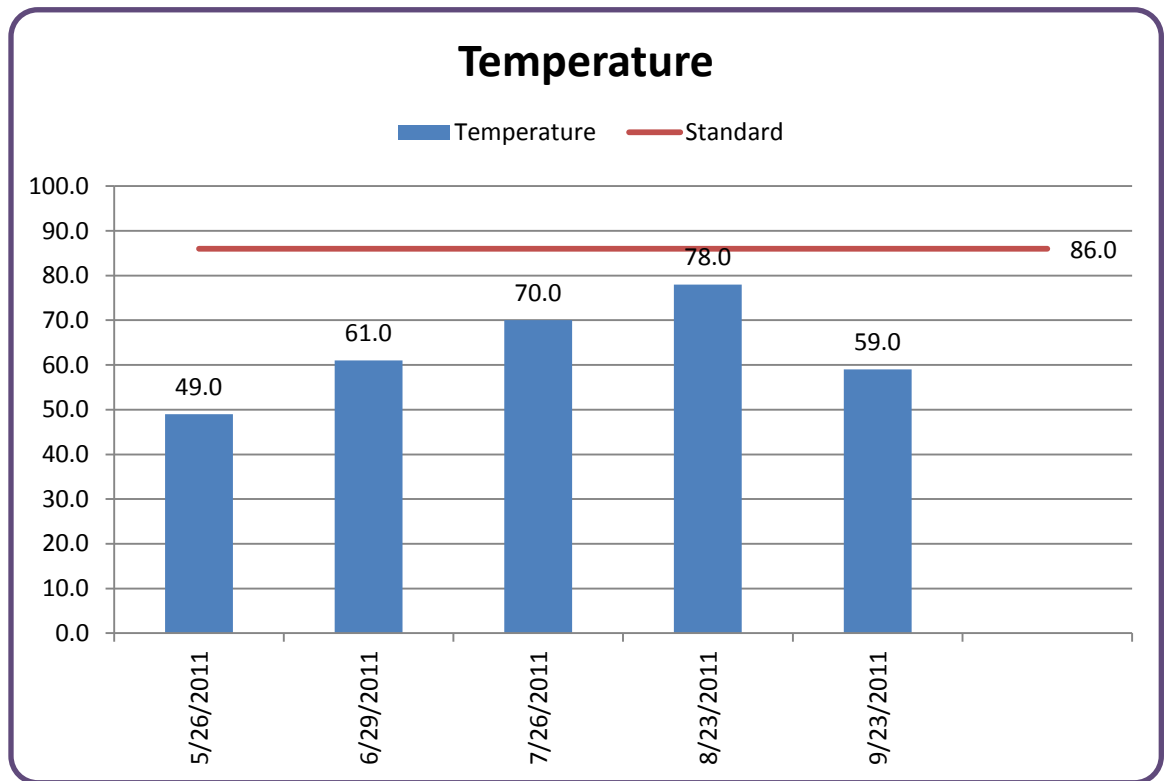
Deep Lake Standard:

The daily average

shall not exceed

86.0°F

The temperatures
meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	74.9 °F	74.0 °F	63.4 °F
Meets Standard (Not to exceed 86.0°F)	Yes	Yes	Yes

Little Green Lake General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	OTHER NOTES
May	2	2		Floating milfoil
June	2	2		Minimal weeds. Buoys need to be moved to original locations
July	3	3	Beach grass (light army green)	No aquatic invasive weeds observed
August	2	2	Cornichon (brown/green)	Minimal aquatic invasive weeds
September	4	4	Parchment Paper (light brown/green)	Algae bloom at landing. Photos taken

Green Lake



Deep Lake

Lake Classification: EUTROPHIC

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Classification
Trophic State Index	58.3	53.6	57.6	56.5
Classification	Eutrophic	Eutrophic	Eutrophic	Eutrophic

Overall Lake Quality Grade: C

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall Grade	Rank
2011 Average (May-Sept)	16.8 µg/L	1.6 meters	40.6 µg/L		
Grade	B	C	C	C	5 th /12

MPCA Standards

	Chlorophyll A	Secchi Disk Depth	Total Phosphorus	Overall
MPCA Standard (Deep lake)	14.0 µg/L	>1.4 meters	40.0 µg/L	
2011 Average (June-Sept)	18.8 µg/L	1.3 meters	45.5 µg/L	
Meets Standard	No	No	No	No

Chlorophyll A

Expected Range:

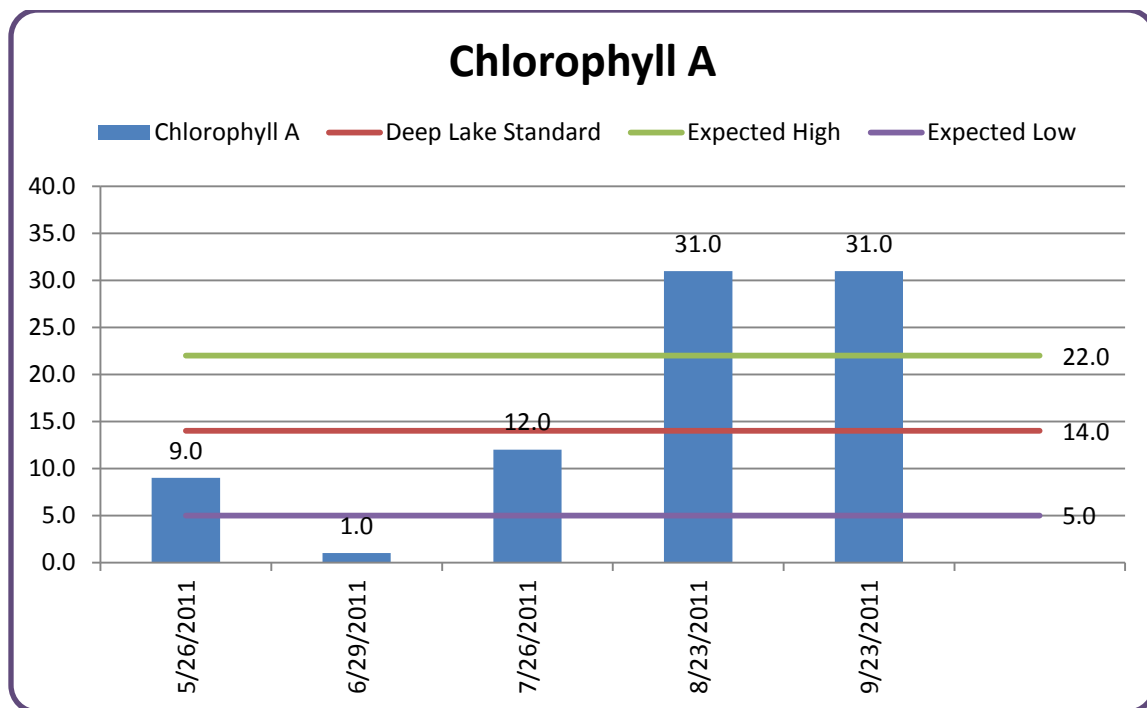
5.0-22.0 µg/L

Deep Lake Standard:

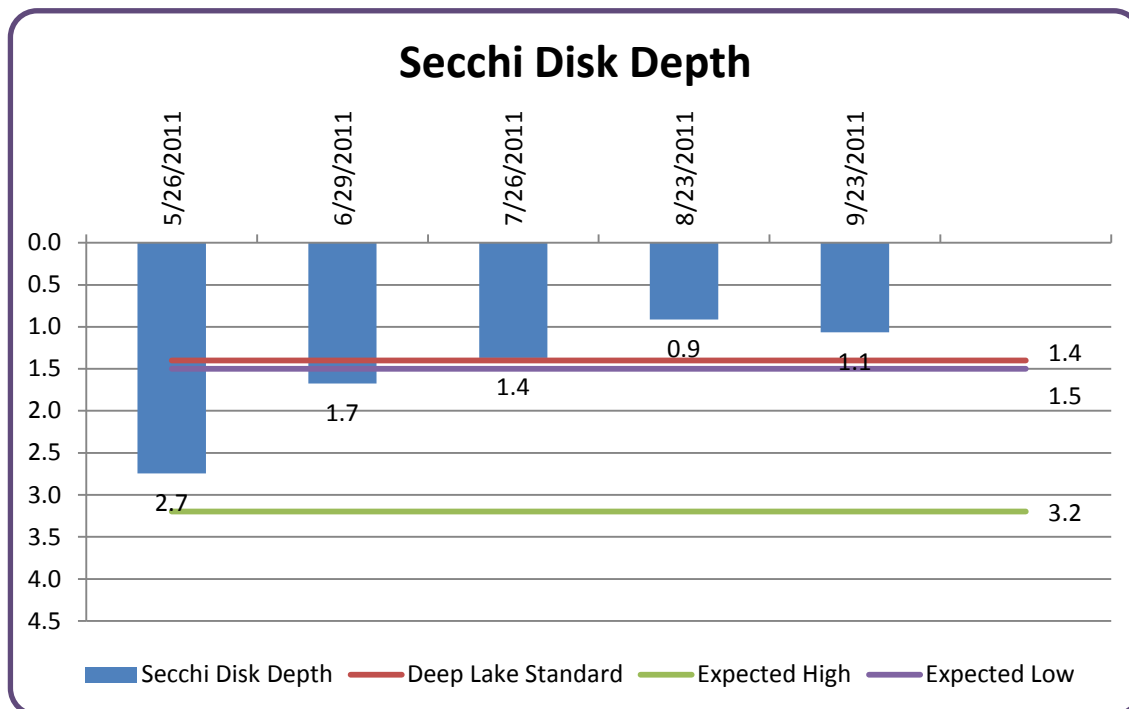
14.0 µg/L

Late season samples were well above the standard and the expected range.

The average did not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	28.4 µg/L	14.0 µg/L	16.8 µg/L
Grade	C	B	B
Average (June-Sept)	34.8 µg/L	20.2 µg/L	18.8 µg/L
Meets Standard (14.0 µg/L)	No	No	No



Secchi Disk Depth

Expected Range: 1.5-3.2 meters

Deep Lake Standard: >1.4 meters

Clarity did not meet the standard July through September. The average also did not meet the standard.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	2.5 meters	2.4 meters	1.6 meters
Grade	B	B	C
Average (June-Sept)	2.4 meters	1.5 meters	1.3 meters
Meets Standard (>1.4 m)	Yes	Yes	No

Total Phosphorus

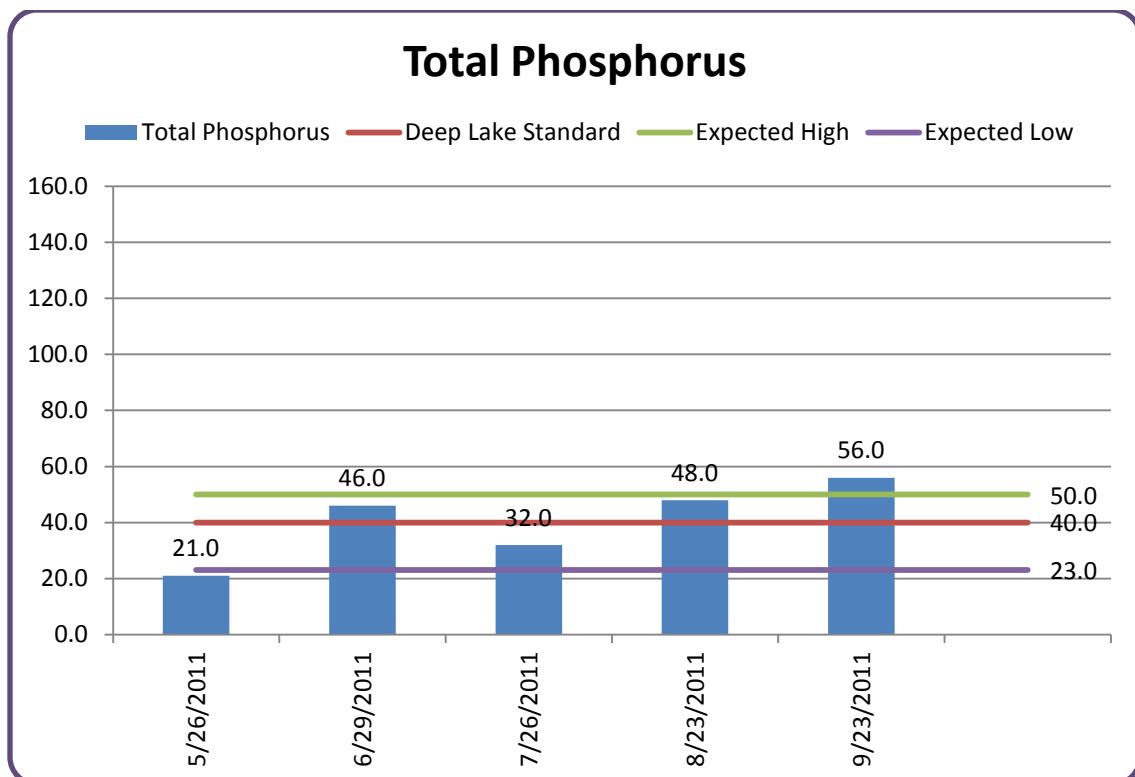
Expected Range:

23.0-50.0 µg/L

Deep Lake Standard:

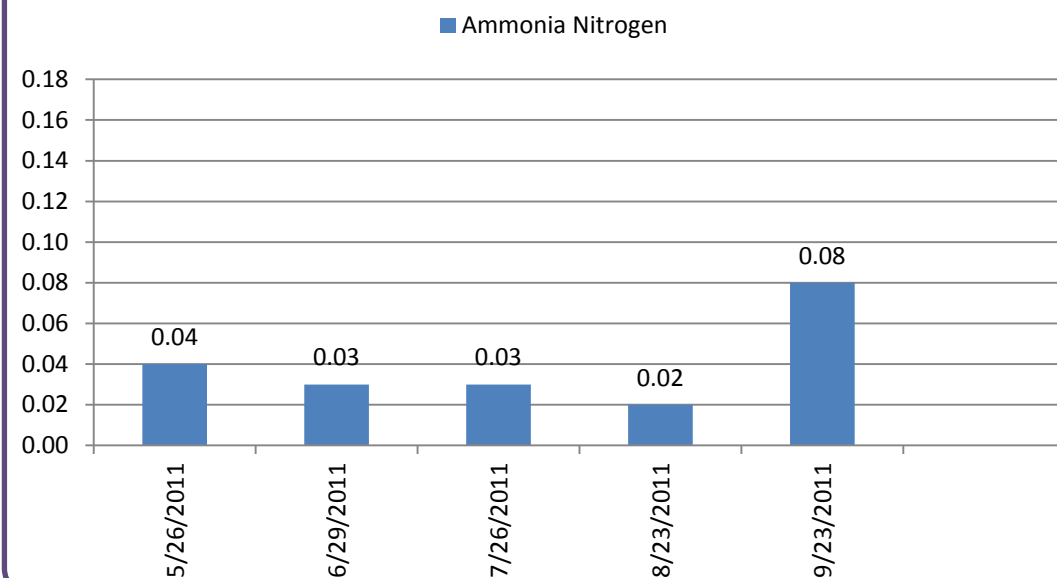
40.0 µg/L

Three of four samples were above the standard. The average did not meet the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average (May-Sept)	51.0 µg/L	22.0 µg/L	40.6 µg/L
Grade	C	A	C
Average (June-Sept)	57.0 µg/L	24.0 µg/L	45.5 µg/L
Meets Standard (40.0 µg/L)	No	Yes	No

Ammonia Nitrogen



Ammonia Nitrogen

Expected Range: None

Deep Lake Standard: None

The September sample was slightly higher than the rest. This could be caused by a runoff event.

	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	<0.05 mg/L	0.09 mg/L	0.04 mg/L

Temperature

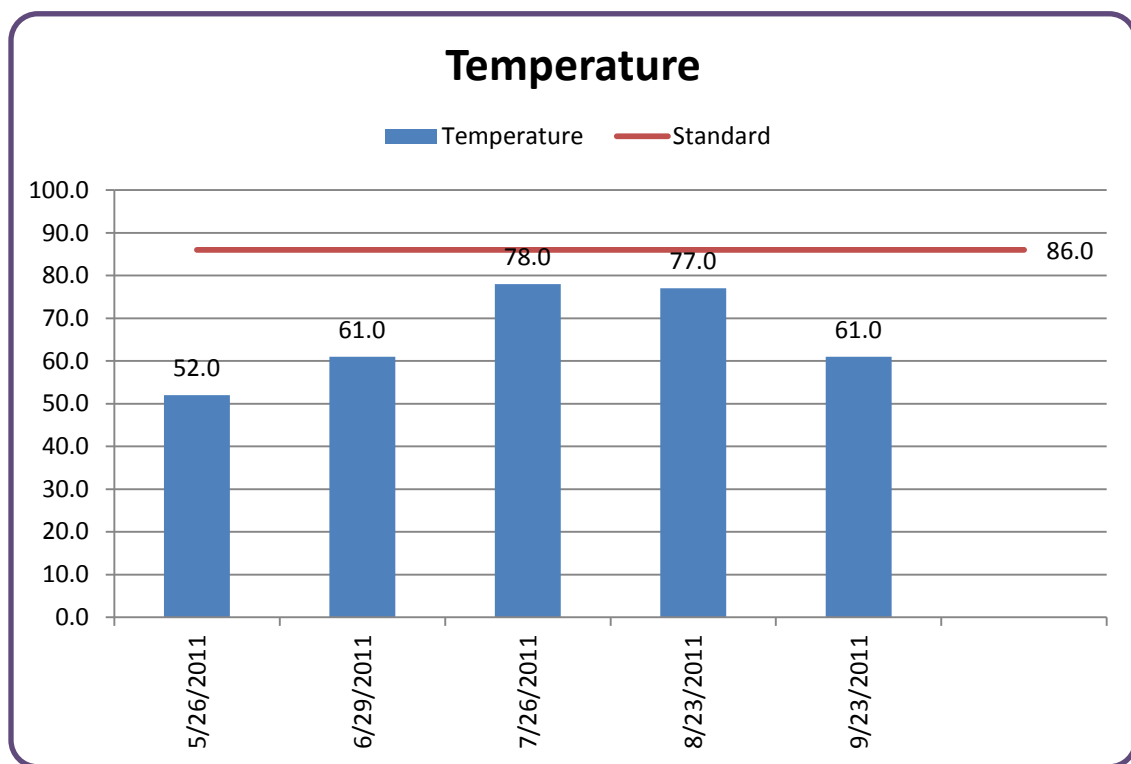
Expected Range:

None

Deep Lake Standard:

The daily average shall not exceed 86.0°F.

The temperatures met the standard.



	2009 (Not Graphed)	2010 (Not Graphed)	2011
Average	74.8 °F	72.9 °F	65.8 °F
Meets Standard (Not to exceed 86.0°F)	Yes	Yes	Yes

Green Lake General Observations

MONTH	PHYSICAL CONDITION	RECREATIONAL SUITABILITY	COLOR OF FILTERED WATER	GENERAL LAKE OBSERVATIONS/ AQUATIC INVASIVE SPECIES
May	2	2		Under surface milfoil and curly-leaf in south west bay
June	2	2		Minimal milfoil except south west bay area
July	2	2	Beach grass (light army green)	South west bay merits spraying milfoil for navigation
August	2	2	Cornichon (army green)	South bay thick milfoil – navigation issues
September	4	4	Beach grass (light army green)	Algae present

Chisago Lakes Lake Improvement District

