TENMILE LAKES TOXIC ALGAL SAMPLING PROGRAM: 2011 DATA SUMMARY REPORT

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BACKGROUND

Long-term public health monitoring for potentially toxigenic cyanobacteria (blue-green algae) in Tenmile Lakes has occurred since 2002 (Kann 2008; Kann 2010; Jacoby and Kann 2007). Tenmile Lakes were again sampled in 2011 to assess the dynamics of potentially toxic blue-green algal species, including *Microcystis aeruginosa*, *Gloeotrichia echinulata*, and various *Anabaena* species. *Microcystis* and *Gloeotrichia* can produce hepatotoxins (known as microcystins), and *Anabaena* produces both neurotoxins (anatoxin-a) and microcystins. Both toxins are capable of harmful effects to animals and humans (Chorus and Bartram 1999). A toxic bloom of *M. aeruginosa* was first documented in Tenmile Lakes in September of 1997, prompting the Oregon Department of Health to issue a health advisory recommending that the lakes not be used for drinking water (numerous private homes around the lakes utilize treated lake water for potable purposes) and that contact recreation be avoided (Kann and Gilroy 1997). The goal of the 2011 sampling, performed by the Tenmile Lakes Basin Partnership, was to determine presence and cell density of these potentially toxigenic species at a limited number of sampling stations. Cell density of potentially toxigenic species was then compared to drinking water guidance levels for lakes and reservoirs (e.g., Yoo et al. 1995; Chorus and Bartram 1999), as well as State of Oregon recreational guideline values (Oregon DHS 2011; Stone and Bress 2007).

METHODS

Four long-term standard sampling stations (2 in each lake) were monitored to cover a major arm and open-water location in each lake (Fig. 1; red circles). Stations S8 and N16 are centrally located and S3 and N11 are located near the terminus of Templeton Arm and Big Creek Arm, respectively. These stations were sampled 7 times beginning July 11th and ending October 3rd, 2011.

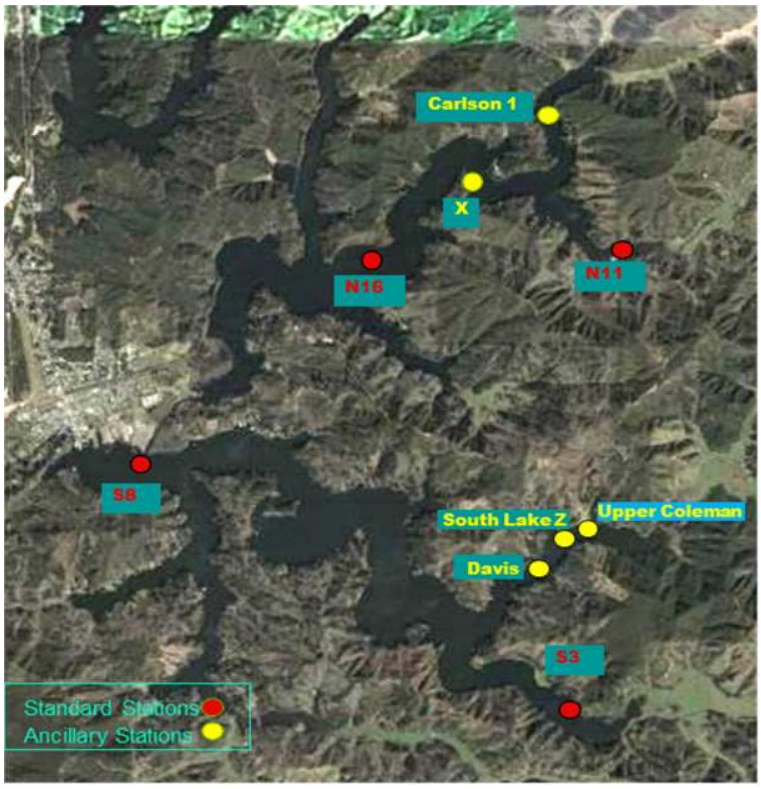

Figure 1. Location of standard and ancillary toxic algal sampling stations in Tenmile Lakes, 2011.

At these standard stations, samples were collected mid-day (to approximate conditions that may pose a maximum public health risk) and integrated over the upper 1/3 of the water column at the open-water stations (S8 and N16), and over the entire water column at the shallow stations (S3 sand N11). At each of the established sampling locations a vertical tow ranging between 1 to 2.5 meters of the water column (depending on location) was made using a 64-µm plankton net.

In addition, grab-samples were obtained from a series of ancillary stations (Fig. 1; yellow circles) that were sampled to assess blooms that were visibly noticeable in areas not overlapping the standard long-term stations. The protocol also calls for surface grab samples to be collected at the long-term stations when visible surface accumulations are present.

For both standard (where filtered contents of 3 replicate hauls were composited in a bucket) and ancillary stations, contents were placed in a 250 ml opaque sample bottle containing 1% Lugol's preservative and shipped to plankton taxonomist Jim Sweet of Aquatic Analysts, INC., who performed a microscopic analysis for algal cell density (cells ml^{-1}). The combined density of *Microcystis aeruginosa* (MSAE) and *Gloeotrichia echinulata* (GTEC) is computed in table 1 because both MSAE and GTEC are potential microcystin producers (Carey et al. 2007).

For toxin analyses at standard stations the contents of 3 replicate hauls taken with a tube sampler were composited in a bucket and then placed in a 1 liter bottle with no preservative and frozen at the TLBP office. Similarly, 1-Liter grab-samples from the ancillary stations were frozen and stored at the TLBP office. If cell density results received the following week from Aquatic Analysts, INC showed that density considerably exceeded the Alert Level 2 threshold of 2000 cells ml^{-1}, select frozen samples were then shipped overnight air to CyanoLab (division of GreenWater Labs in Palatka, FL) for the enzyme linked immunosorbent assay (ELISA) of microcystin toxin and LC/MS analysis to determine anatoxin-a (note: because health advisories and media outreach are initiated based upon cell density and not toxin concentration, toxin analysis is not prioritized when budgetary constraints exist or when cell counts are generally below 15,000 cells/ml).

RESULTS

2011 Trends-Standard Stations

Results from the first sample trip of July 11th showed low levels of blue-green algae, with station S8 exceeding the WHO Alert Level 1 drinking water guideline (Yoo et al. 1995; also known as the increased vigilance level for drinking water systems) of 500 cells ml^{-1} for potentially toxigenic species (Table 1; Figure 2: *Anabaena planctonica* had a cell density of 811 cells per ml), and station N11 exceeding the WHO Alert Level 2 drinking water guideline (Table 1; Figure 2: *Microcystis aeruginosa* had a cell density of 3,473 cells per ml). The Oregon Health Authority Public Health Division and local health services typically issue a public alert for drinking water lakes and reservoirs when the WHO Alert Level 2 drinking water guideline of 2000 cells ml^{-1} for potentially toxigenic species is exceeded . Given varying effectiveness of home-owner drinking water treatment systems and exceedance of Alert Level 2 for *Microcystis*, utilizing lake water for potable purposes was advised against at that time. Moreover, previous analysis indicate that *Microcystis* values exceeding 2000 cells/ml are generally associated with microcystin values >1 µg/L (Kann 2011).

On the following sample date of July 25th, samples showed that total *Anabaena* cell density at the standard South Lake station S3 increased to exceed the WHO Alert Level 2 guideline and station S8 showed an increase of M*icrocystis aeruginosa* and *Anabaena* exceeding the WHO alert level 1 guideline for both species. Station N11 in North Lake showed a decrease in *Microcystis*; however the cell density of 683 cells/mL still exceeded the WHO Alert Level 1 guideline. Levels of *Anabaena planctonica* (ABPL) at stations S3 and S8 continued to exceed the WHO Alert Level 1 guideline on August 8th, and *Microcystis* levels decreased relative to July, remaining below all Alert levels until August 22nd when station S8 at 2,744 cells/ml exceeded the WHO Alert level 2 guideline. Also on August 22nd, all standard stations exceeded the WHO Alert Level 1 guideline for *Anabaena.*

Overall biovolume for July and August was dominated by the cyanobacterium (blue-green) *Aphanizomenon flos-aquae* (APFA; Appendix I). Although APFA has been shown to produce neurotoxins in other areas of the world, doubt exists whether the reported species are in fact the same APFA found in this region, and evidence indicates that toxin-producing species differ from those typically occurring in Oregon or other areas of North America (Li et al. 2000). Various Chrysophytes, Cryptophytes, Dinoflagellates, Blue-greens, Greens and Diatoms comprised the remainder of the biovolume at all stations (Appendix I).

Anabaena began to increase at station S3 in September exceeding the Alert Level 2 guideline of 2000 cells/ml during both sampling events (September 6th and 20th). Remaining standard stations continued to exceed the WHO Alert Level 1 guideline for *Anabaena* on September 6th and stations S8 and N16 exceeded the WHO Alert Level 1 guideline on September 20th (Table 1; Figure 2). However, as noted in previous Technical Memos, the predominant *Anabaena* species was *Anabaena planctonica* (Appendix I), a species less commonly associated with toxin production. MSAE levels exceeded Alert Level 1 only at station N11 on September 6th and at stations S3, S8, and N16 on September 20th.

Overall, blue-green algae (cyanobacteria) decreased into October, with samples from October 3rd showing relatively low MSAE and total *Anabaena* levels at all open water stations In October the predominant species in South Lake switched from *Aphanizomenon flos-aquae* to *Anabaena planctonica* and the diatom *Melosira ambigua* (Appendix I). The North Lake continued to be dominated by A*phanizomenon flos-aquae* throughout September and October. The standard stations in North Tenmile Lake only exceeded the WHO alert level 2 guideline once during 2011 (N11 on 7/11) and the standard stations in South Tenmile Lake exceeded the WHO alert level 2 four times during 2011 (once for MSAE on 8/22, and 3x for total *Anabaena* on 7/25, 9/6, and 9/20). Given low *Microcystis* levels, microcystin toxin samples were not collected at the standard stations during the 2011 sampling period.

Cell densities of potentially toxigenic species at the standard open-water stations in both North and South Lakes remained well below OHA Recreational Guideline levels during 2011.

Table 1. Algal Cell Density for Potentially Toxigenic Species in Tenmile Lakes, 2011 (see below description for public health color coding). Blue shaded stations refer to ancillary stations located in the vicinity of visual blooms.

Station	*Date*	*Microcystis aeruginosa (cells/ml)*	*Gloeotrichia echinulata (cells/ml)*	*Microcystis + Gloeotrichia (cells/ml)*	*Anabaena flos-aquae (cells/ml)*	*Anabaena planktonica (cells/ml)*	*Anabaena circinalis (cells/ml)*	*Anabaena sp. (cells/ml)*	*Total Anabaena (cells/ml)*	Microcystin (µg/L)	Anatoxin-a (µg/L)	Paralytic Shellfish Toxins (µg/L)
S3	7/11/2011	0	0	0	142	81	0	0	223			
S8	7/11/2011	120	0	120	77	734	0	0	811			
N11	7/11/2011	3,473	0	3,473	186	15	0	0	201			
N16	7/11/2011	101	222	323	131	235	0	0	366			
S3	7/25/2011	0	0	0	152	3,864	0	0	4,016			
S8	7/25/2011	805	0	805	0	1,599	0	0	1,599			
N11	7/25/2011	683	0	683	96	0	0	0	96			
N16	7/25/2011	43	0	43	0	133	0	0	133			
S3	8/8/2011	134	0	134	0	1,634	170	0	1,804			
S8	8/8/2011	205	0	205	0	1,752	0	0	1,752			
N11	8/8/2011	0	0	0	0	485	0	0	485			
N16	8/8/2011	238	0	238	0	274	0	0	274			
S3	8/22/2011	0	0	0	0	1,782	0	0	1,782			
S8	8/22/2011	2,744	0	2,744	0	1,670	0	0	1,670			
N11	8/22/2011	0	0	0	0	618	0	0	618			
N16	8/22/2011	82	0	82	0	1,043	0	0	1,043			
South Lake Z	8/22/2011	96,643	0	96,643	0	939,046	0	0	939,046	0.7	ND	ND
South Lake Intake	8/24/2011									0.2		
South Lake Tap	8/24/2011									ND		
S3	9/6/2011	161	0	161	0	3,672	0	0	3,672			
S8	9/6/2011	421	0	421	0	1,821	0	0	1,821			
N11	9/6/2011	994	0	994	0	547	0	0	547			
N16	9/6/2011	0	0	0	0	601	0	0	601			
South Lake Z	9/6/2011	0	0	0	0	15,292,913	0	0	15,292,913	3.00	ND	
S3	9/20/2011	516	0	516	0	2,117	0	0	2,117			
S8	9/20/2011	1,525	0	1,525	0	775	0	0	775			
N11	9/20/2011	193	0	193	0	391	0	0	391			
N16	9/20/2011	864	0	864	0	648	0	0	648			
South Lake Z	9/20/2011	452,443	0	452,443	0	882,516	0	0	882,516	0.78		
Davis	9/20/2011	671,256	0	671,256	0	2,382,958	0	0	2,382,958	1.36		
Davis Dock 1	9/30/2011									0.95		
Davis Dock 2	9/30/2011									1.58		
Davis Tap	9/30/2011									0.09		
Coleman Upper	9/30/2011									1.03		
Upper Carlson	10/3/2011									0.78		
S3	10/3/2011	1,285	0	1,285	0	631	0	0	631			
S8	10/3/2011	705	0	705	0	579	0	0	579			
N11	10/3/2011	0	0	0	0	140	0	0	140			
N16	10/3/2011	531	0	531	0	283	0	0	283			
South Lake Z	10/3/2011	12,249	0	12,249	0	1,757	0	0	1,757	0.67		
Davis	10/3/2011	7,466	0	7,466	0	5,515	0	0	5,515	0.89		
South Lake Z	11/1/2011										ND	

*Exceeds World Health Organization Alert Level 1 increased vigilance guideline level of 500 cells/ml for potentially toxigenic species in drinking water systems.

**Exceeds World Health Organization Alert Level 2 public health posting guideline level of 2000 cells/ml for potentially toxigenic species in drinking water systems.

***Exceeds State of Oregon Recreational Guideline Levels of 40,000 cells/ml for *Microcystis* or 100,000 cells/ml for *Anabaena*.

**** Exceeds the Oregon Department of Human Services and WHO drinking water microcystin guideline level of 1 µg/l.

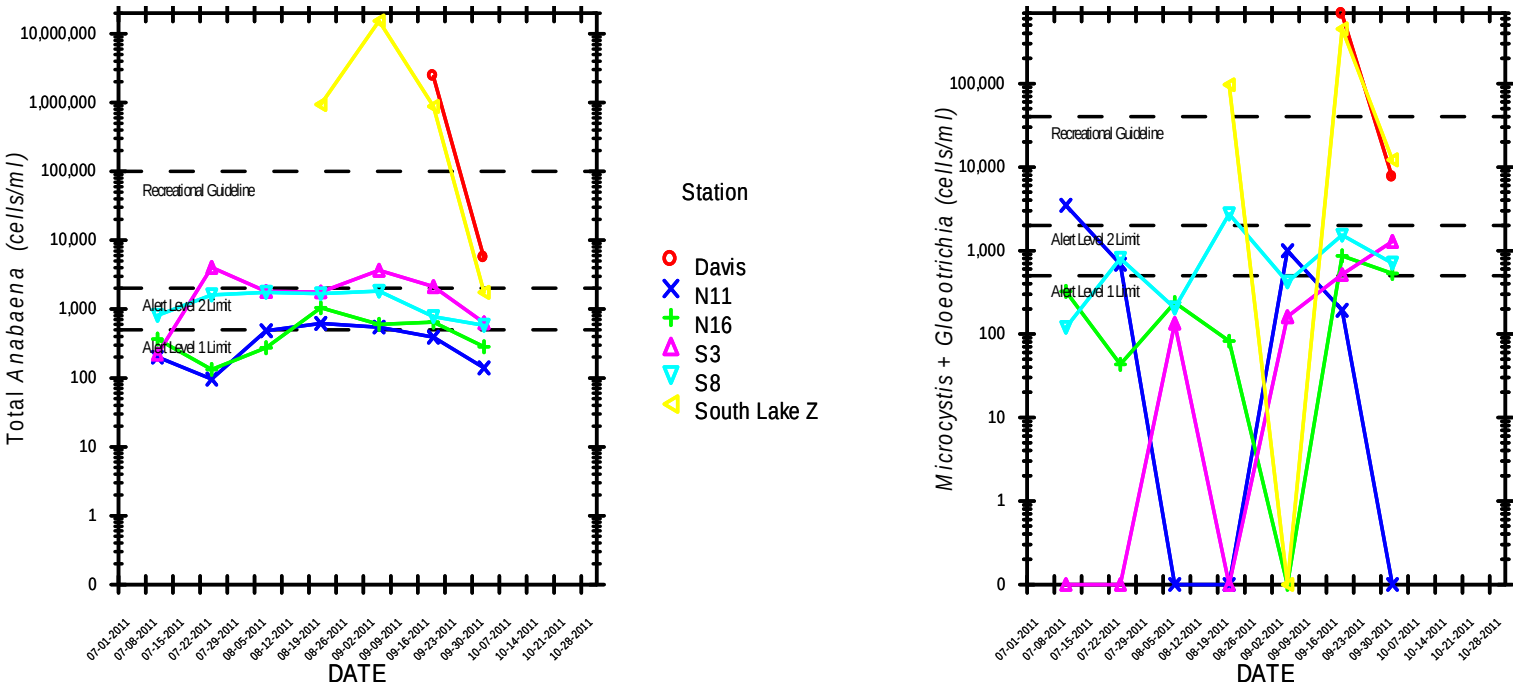

Figure 2. Cell Density of *Microcystis aeruginosa* and total *Anabaena* in Tenmile Lakes at all sampling stations, 2011.

2011 Trends-Ancillary Stations and Toxin Results

As noted above (see methods), several ancillary (non-standard) stations were sampled to account for patchy concentrations of cyanobacteria occurring in areas that did not overlap the standard stations (i.e., S3, S8, N11, and N16). The first such event was noted during the August 22nd sampling (Figure 3), and an additional sample was collected from South Tenmile at station South Lake Z (see Figure 1 above for location). Results from this station showed concentrations of both *Anabaena planctonica* and *Microcystis* to exceed the OHA Recreational Guideline Level of 40,000 cells/ml for *Microcystis* or 100,000 cells/ml for *Anabaena* (Table 2; ABPL: 939,046 cells/ml and MSAE: 96,643 cells/ml). Based on these results the Oregon Health Authority Harmful Algae Bloom Surveillance Program (OHA HABS) issued a recreational advisory for South Tenmile Lake (Appendix IV). A subsequent sample taken at station South Lake Z on September 6th showed no detectable *Microcystis* but a large increase in *Anabaena* (15,292,913 cells/ml) which continued to exceed the State of Oregon Recreational Guideline Level (Figures 3 and 4; Table 2).

On September 20th the South Lake Z station and Davis station (see Figure 1 above for location) both exceeded the State of Oregon Recreational Guideline Level for *Anabaena* and *Microcystis* (Table 2; Figure 2). On October 3rd stations "Z" and Davis decreased for both *Anabaena* and *Microcystis*, with station South Lake Z exceeding only the WHO Alert Level 2 for *Microcystis* and the WHO Alert Level 1 for *Anabaena*. The Davis station exceeded the WHO Alert Level 2 for both *Microcystis* and *Anabaena* on October 3rd (Table 2).

Table 2. Cell density and toxin results for Ancillary Stations, Tenmile Lakes, 2009-2011.

			Potentially Toxigenic Algal Species			Algal Toxins				
Station	Location	Date	Microcystis aeruginosa (cells/ml)	Total Anabaena (cells/ml)	Aphanizomenon flos-aquae (cells/ml)	Microcystin (µg/L)	Anatoxin-a (µg/L)	Saxitoxin (µg/L)	Paralytic Shellfish Toxins (µg/L)	Exceedance of microcystin TDI of 0.04 µg/kg/day for a 20kg (44lb) child ingesting 100 mls[1] (x greater than TDI)
X	North Lake	9/8/2009	300,940	605,160	560,880	20.0	ND	ND		2.5
South Lake Z	South Lake	9/15/2009	2,158,388	2,137	145,667	2365.0				295.6
South Lake Z	South Lake	9/21/2009	1,008,139	17,932	64,571	910.0				113.8
Z1	South Lake	10/5/2009	3,197,474	182,681	197,085	1410.0	0.6			176.3
Z1	South Lake	10/20/2009	4,664,468	853,143	886,215	1265.0	2.0			158.1
Carlson 1	North Lake	9/21/2010	3,051,153	1,232,887	46,020	460.0	ND			57.5
Carlson 1	North Lake	9/27/2010	5,939,379	314,811	69,913	149.0	ND			18.6
County Boat Ramp	South Lake	9/27/2010	1,518,783	2,301,942	17,826	705.0				88.1
X	North Lake	11/16/2010	4,446,479	669,090	1,155,026	645.0				80.6
N16	North Lake	11/29/2010	4,636	904	1,339	1.2				0.2
X	North Lake	11/29/2010	1,326,471	433,491	788,454	11.0				1.4
South Lake Z	South Lake	8/22/2011	96,643	939,046	67,864,225	0.7	ND		ND	0.1
South Lake Intake	South Lake	8/24/2011				0.2				0.0
South Lake Tap	South Lake	8/24/2011				ND				
South Lake Z	South Lake	9/6/2011	0	15,292,913	10,959,354	3.00	ND			0.4
South Lake Z	South Lake	9/20/2011	452,443	882,516	118,703					
Davis	South Lake	9/20/2011	671,256	2,382,958	108,030	1.36				
Davis Dock 1	South Lake	9/30/2011				0.95				0.1
Davis Dock 2	South Lake	9/30/2011				1.58				0.2
Davis Tap	South Lake	9/30/2011				0.09				0.0
Coleman Upper	South Lake	9/30/2011				1.03				
Upper Carlson	North Lake	10/3/2011				0.78				0.1
South Lake Z	South Lake	10/3/2011	12,249	1,757	835	0.67				0.1
Davis	South Lake	10/3/2011	7,466	5,515	4708	0.89				0.1
South Lake Z	South Lake	11/1/2011				NT	ND			

*Exceeds World Health Organization Alert Level 1 increased vigilance guideline level of 500 cells/ml for potentially toxigenic species in drinking water systems.

**Exceeds World Health Organization Alert Level 2 public health posting guideline level of 2000 cells/ml for potentially toxigenic species in drinking water systems.

***Exceeds State of Oregon Recreational Guideline Levels of 40,000 cells/ml for Microcystis or 100,000 cells/ml for Anabaena.

*** Exceeds the Oregon Department of Human Services and WHO drinking water microcystin guideline level of 1 µg/l.

ND= Non Detect

Figure 3. Bloom conditions at station South Lake Z, Tenmile Lakes August 22, and September 6, 2011 (see map above for location).

Figure 4. Bloom condition at station South Lake Z, September 6, 2011.

Initial algal toxin sampling in 2011 occurred at South Lake station Z on August 22nd, and despite a relatively high MSAE level of 96,643 cells/ml, microcystin toxin was relatively low at 0.7 µg/L (Appendix II; Table 2). Subsequent samples taken on August 24th near the intake of a home drinking water system (South Lake Intake) and of treated tap water (South Lake Tap) showed a low level of microcystin toxin (0.2 µg/L) at the intake and levels below detection in the treated tap water (Appendix II; Table 2). Although this comparison indicates toxin removal by the home treatment system, such sampling should be repeated at higher ambient toxin levels (such as those occurring in 2010) to ensure effective treatment is occurring.

On September 6th the South Lake Z sample station increased to 3 µg/L of microcystin, exceeding the OHA and WHO drinking water microcystin guideline level of 1 µg/L, but remained below the 8 µg/L recreational level. On September 20th a sample taken at the Davis Dock showed a microcystin level of 1.36 µg/L, also exceeding the ODHS and WHO drinking water guideline level. Several additional microcystin toxin samples were collected and analyzed by the TLBP on September 30th, with both the Davis dock and Coleman Upper stations exceeding the OHA and WHO drinking water guideline level (1.58 µg/L and 1.03 µg/L, respectively). By October 3rd the bloom had clearly declined and both South Lake Z and Davis were below the 1 µg/L drinking water guideline level.

Similar to previous results showing that *Anabaena planctonica* (ABPL) has not been found to be associated with the algal toxin anatoxin-a in Tenmile Lakes, anatoxin-a was not detected even at a cell density of >15,000,000 cells/ml on 9/6/2011 (Table 2). Previously detected low levels of anatoxin in 2009 (Table 2) were associated with *Anabaena flos-aquae*, a species more typically

associated with toxin production. Despite the declining bloom and both cell density and microcystin toxin levels below health advisory thresholds on October 3rd, OHA guidelines necessitated collecting an additional sample for anatoxin in order to lift the public health advisory[1]. Thus, an additional sample was collected at station South Lake Z on November 1st, with results showing that anatoxin-a was not detected (Table 2). OHA then lifted the advisory on November 21, 2011 (Appendix IV). The recreational advisory remained in effect for a total of 88 days in 2011.

As additional confirmation of the lack of toxin production by *Aphanizomenon flos-aquae* in Tenmile Lakes, a sample from 8/22/11 was also tested for a variety of Paralytic Shellfish Poisons (PSPs) including saxitoxin (Appendix II). As expected based on the lack of evidence for toxin production in this species of *Aphanizomenon* (e.g., Li et al. 2000), PSP's were not detected on 8/22/11 despite a cell density exceeding 67 million cells/ml.

2002-2011 Comparison

As noted in previous annual summaries (e.g., Kann 2008; 2011), density and consistency of detection of *Microcystis* in Tenmile Lakes during 2007 was somewhat higher than previous years, values in 2008 were more similar overall to years 2003-2006, and 2009 *Microcystis* cell densities (at standard stations only) were not only higher than 2008, but tended to be higher than all earlier years in terms of showing the greatest frequency of exceedance of the Alert Level 2 guideline. *Microcystis* cell densities in 2010 were somewhat lower than in 2009, similar to those in 2007, and generally higher with respect to Alert Level 2 exceedances than all other years except 2009 (Figure 5). *Microcystis* cell densities in 2011 were lower than the previous two years showing fewer Alert Level 2 exceedances (this trend is consistent with 2011 HAB results throughout the southern Oregon region, which tended to show reduced blooms compared to 2009 and 2010) . When evaluating the month of September, the month when *Microcystis* is consistently observed, and for which the most consistent sampling exists among years; aside from 2002 (which showed high *Microcystis* density) there was an apparent increase in the Alert Level 1 and Alert Level 2 exceedances between 2006 and 2010, but 2011 values declined to levels similar to 2007 and 2008 (Figure 6).

Although somewhat lower than 2007 and 2008, total *Anabaena* density continued to remain noticeably higher between 2007-2011 than for the previous 2002-2006 period, with numerous occurrences when cell density exceeded the Alert Level 2 guideline (Figure 6). As noted above, the predominant *Anabaena* species was *Anabaena planctonica* (Table 1), a species less commonly associated with toxin production than *Anabaena flos-aquae*. Unlike 2009 when *Anabaena flos-aquae* was found in high concentrations at non-standard locations (Kann 2010),

[1] Oregon Harmful algae bloom surveillance (Habs) Program Public Health advisory Guidelines: Harmful algae blooms in Freshwater bodies states that "Toxin analyses are required to lift public health advisories for HABs." Thus, even though neither *Aphanizomenon flos-aquae* nor *Anabaena planctonica* have been associated with toxin production in Tenmile Lakes, OHA is currently requiring toxin tests when these species are present in order to lift advisories.
http://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Documents/HABS%20Advisory%20Guidelines.2011WEB.pdf

Anabaena flos-aquae was not detected at high levels in 2010 or 2011. There was also an apparent increase in September total *Anabaena* after 2005 (Figure 6).

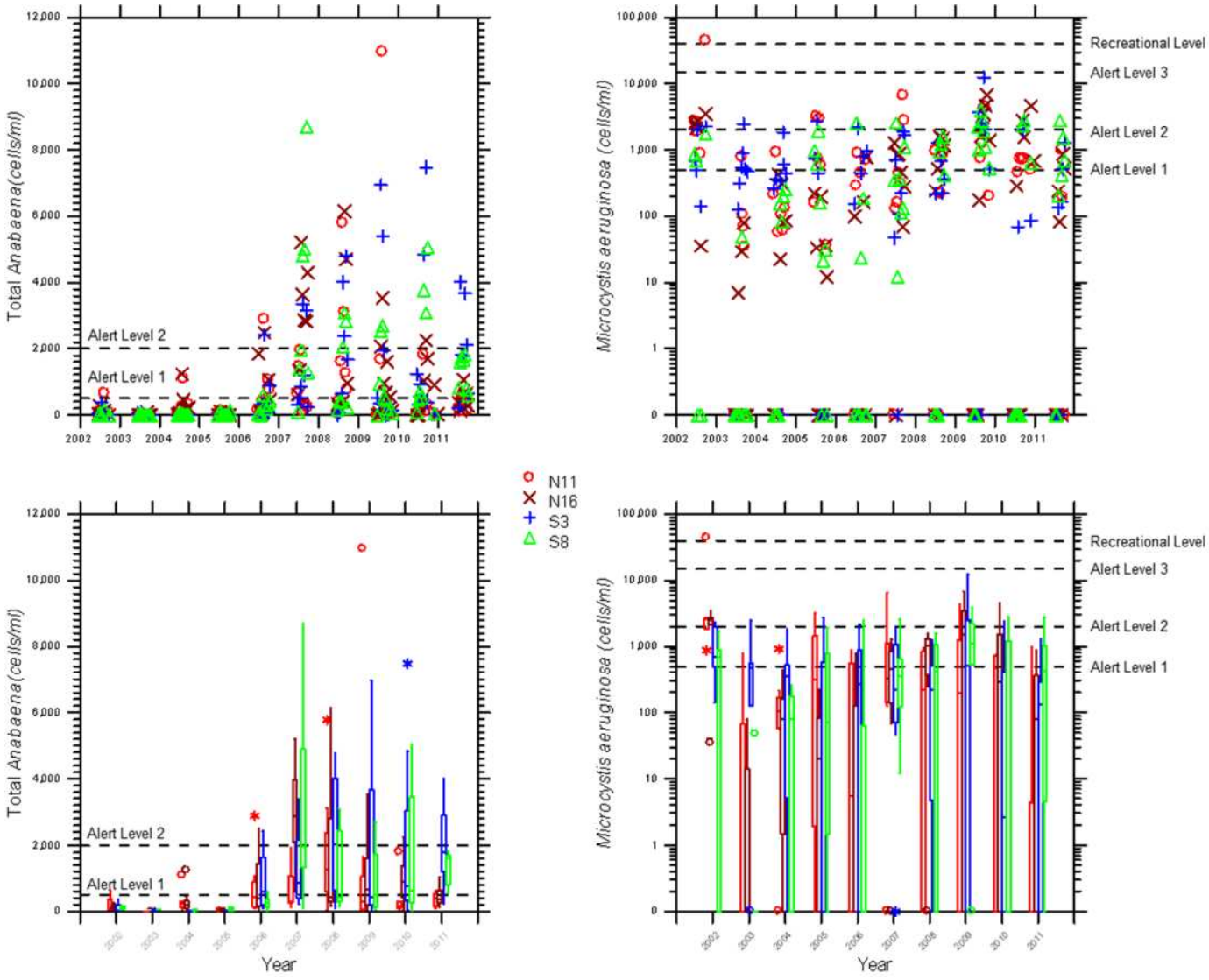

Figure 5. Cell density of *Microcystis aeruginosa* and *Anabaena flos-aquae* at standard open-water stations in Tenmile Lakes, 2002-2011; time-series of individual data points (a), and box plots grouped by station (b).

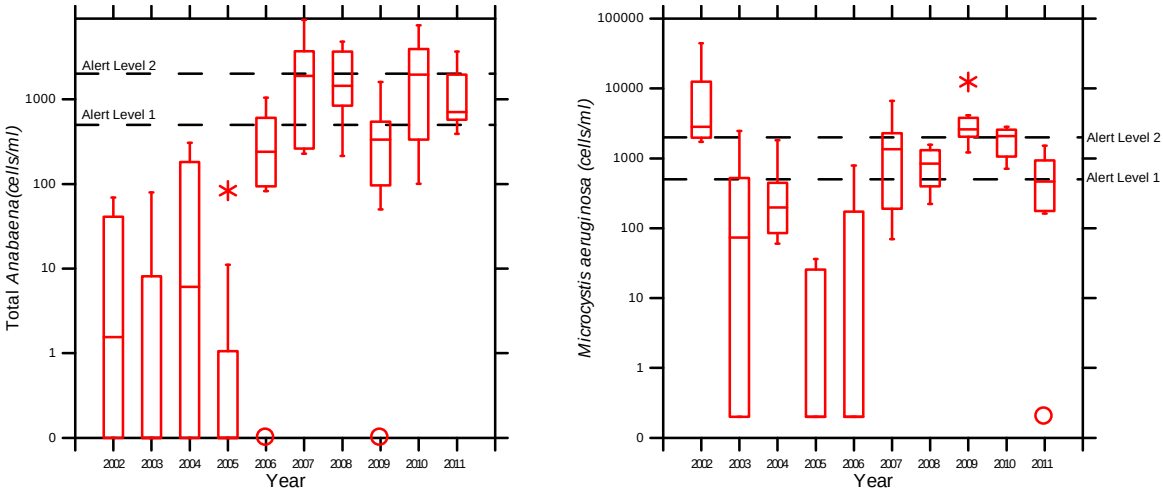

Figure 6. Cell density of *Microcystis aeruginosa* and total *Anabaena* in Tenmile Lakes during September, 2002-2011; boxes represent the distribution of both North and South Tenmile Lakes combined.

A scatter plot of microcystin concentration vs. *Microcystis* cell density for Tenmile Lakes in 2010 confirmed that an Alert Level 2 value of 2,000 cells/ml and an OHA recreational guideline value of 40,000 cells/ml were generally protective of public health with respect to preventing exceedances of the WHO drinking water guideline of 1 µg/L and the OHA recreational public health guideline value of 8 µg/L (Figure 7). However, despite levels of *Microcystis* exceeding 500,000 cells per ml in 2011, associated levels of microcystin were lower than expected based on previous years (Figure 7; Table 2). This phenomenon has been noted in other systems with either environmental factors, genetic factors, or both leading to variable ratios of toxin produced per unit algal density (Kann 2012; Bozarth et al.).

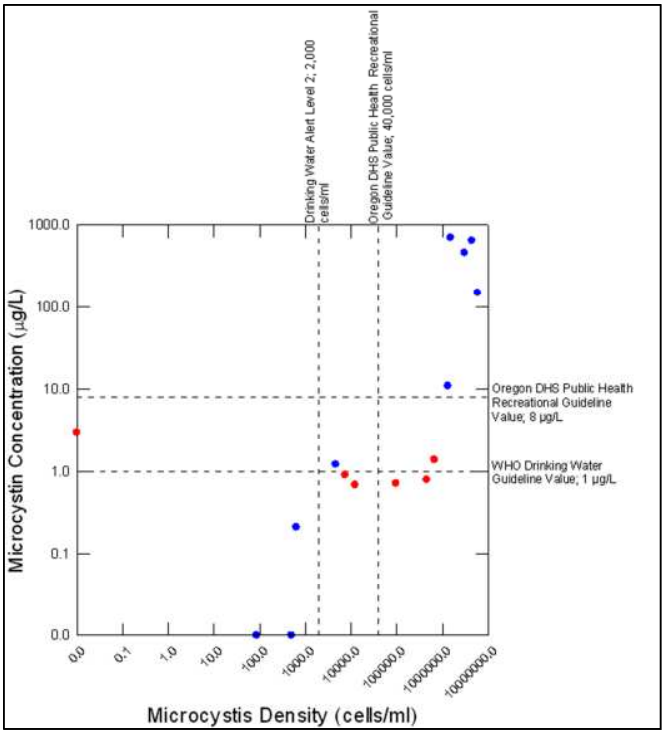

Figure 7. Scatter plot of microcystin vs. *Microcystis* cell density in Tenmile Lakes, 2010-2011; blue dots= 2010 values, red dots=2011 values, and dashed lines represent various public health thresholds.

Summary

Initial exceedances of public health guideline values for drinking water began in early July for *Anabaena* and *Microcystis* at standard sampling stations S8 and N11. These exceedances continued through October for MSAE and total *Anabaena*, during which time DHS and local health services issued a public alert (precipitated by exceedance of the WHO Alert Level 2 guideline of 2000 cells/ml for drinking water lakes and reservoirs). In addition, although cell density levels at the standard monitoring stations (stations S3, S8, N11, and N16) were still relatively low with respect to recreational guidelines (e.g., which would be 100,000 cells/ml for *Anabaena* and 40,000 cells/ml for *Microcystis*; Stone and Bress 2007), localized blooms and blue-green algal scums were noted that clearly had the potential to exceed recreational guidelines. Ancillary samples collected from these areas in South Tenmile Lake confirmed exceedance of recreational guidelines, and Oregon DHS (OHA) issued a public health advisory for South Tenmile between 8/25/2011 and 11/21/2011 (Oregon Harmful Algae Bloom Surveillance Health Advisories; http://oregon.gov/DHS/ph/hab/advisories.shtml). Maximum *Microcystis* values (occurring at station Davis on 9/20) exceeded the recreational advisory levels by over 16 times. The maximum total *Anabaena* value (occurring at the Davis station also on 9/20) exceeded the recreational advisory levels by over 23 times.

Select samples analyzed for algal toxins showed that only four samples exceeded the WHO 1 µg/L drinking water standard (Table 2). The maximum toxin level of 3 µg/L occurred on September 6th at the South Lake Z station, remaining below the 8 µg/L State of Oregon recreational posting guideline. Although the 2010 relationship between microcystin concentration vs. *Microcystis* cell density for Tenmile Lakes was more typical with respect to expected toxin prediction per unit cell density (confirming that an Alert Level 2 value of 2,000 cells/ml and an OHA recreational guideline value of 40,000 cells/ml were generally protective of public health with respect to preventing exceedances of the WHO drinking water guideline of 1 µg/L and the OHA recreational public health guideline value of 8 µg/L), levels of microcystin in 2011 were lower than expected based on the microcystin-cell density relationship for previous years. In addition cell density levels for *Microcystis* were notably lower than the previous two years.

Toxin analyses for anatoxin-a and PSPs continue to show that *Anabaena planctonica* and *Aphanizomenon flos-aquae* are not associated with toxin production in Tenmile Lakes.

Finally, because reported levels indicate the general trend but cannot guarantee that levels of potentially toxigenic species at a particular location do not exceed guideline values, and the fact that cyanobacterial cells have been previously reported in home-owner drinking water treatment systems (see Kann 2007), drinking water protection efforts should always be in place. Patchy distribution of blue-green algae and accumulation in localized areas commonly occurrs, and although levels of all potentially toxigenic cyanobacteria were well below the recreational guidelines of 40,000 cells/ml for *Microcystis* or 100,000 cells/ml for *Anabaena* at the standard sampling stations, they were greatly exceeded in adjacent areas.

Thus, as previously noted in Tenmile Lakes monitoring memoranda: "*…those utilizing the lake for drinking water should <u>always</u> follow Oregon Health Division recommendations for purification (attached). In addition, recreational users should <u>always</u> avoid contact with water*

whenever noticeable surface concentrations of algae are evident or when the lake has an obvious green to blue-green appearance."

Disclaimer

Due to the patchy nature of blue-green algal blooms it is possible for higher *Microcystis* and *Anabaena* densities (and therefore higher microcystin or anatoxin concentrations) to be present in areas not sampled in this survey, particularly along shorelines or during calm conditions of little to no wind. Given the lakes' demonstrated history of toxic *Microcystis* and *Anabaena* blooms, and the fact that all areas of the lake cannot be tested at all times, those utilizing the lake for drinking water should always follow Oregon Health Division recommendations for purification (see Appendix III). In addition, recreational users should always avoid contact with water whenever noticeable surface concentrations of algae are evident or when the lake has an obvious green to blue-green appearance. Moreover, because pets or other domestic animals are the most likely to ingest contaminated water, these animals should not be allowed access to the lakeshore whenever either noticeable surface concentrations of algae or an obvious green to blue-green appearance is evident.

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Appendix I: Aquatic Analysts, Inc. Phytoplankton Reports

Appendix II: GreenWater Labs Algal Toxin Results

Appendix III: Oregon DHS and Tenmile Lakes Harmful Algal Bloom Information

Appendix IV: Oregon Health Authority Public Health Advisory and Lifting Notice

Appendix I: Aquatic Analysts, Inc Phytoplankton Reports

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S3
Sample Depth:
Sample Date: 11-Jul-11

Total Density (#/mL): 119
Total Biovolume (um^3/mL): 299,558
Trophic State Index: 41.2

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Chlamydomonas sp.	34	28.3	10,925	3.6	green
2	Asterionella formosa	17	14.2	15,901	5.3	diatom
3	Aphanizomenon flos-aquae	16	13.2	17,790	5.9	bluegreen
4	Fragilaria crotonensis	15	12.3	220,256	73.5	diatom
5	Dinobryon sertularia	9	7.5	6,885	2.3	chrysophyte
6	Anabaena flos-aquae	7	5.7	9,009	3.0	bluegreen
7	Anabaena planctonica	6	4.7	14,354	4.8	bluegreen
8	Dinobryon sp.	3	2.8	420	0.1	chrysophyte
9	Cryptomonas erosa	3	2.8	1,748	0.6	cryptophyte
10	Gloeocystis ampla	2	1.9	861	0.3	green
11	Rhodomonas minuta	1	0.9	22	0.0	cryptophyte
12	Scenedesmus quadricauda	1	0.9	146	0.0	green
13	Nitzschia paleacea	1	0.9	110	0.0	diatom
14	Synedra rumpens	1	0.9	157	0.1	diatom
15	Achnanthes minutissima	1	0.9	56	0.0	diatom
16	Glenodinium sp.	1	0.9	784	0.3	dinoflagellate
17	Nitzschia frustulum	1	0.9	134	0.0	diatom

Aphanizomenon flos-aquae cells/mL =	282
Aphanizomenon flos-aquae heterocysts/mL =	7
Anabaena flos-aquae cells/mL =	134
Anabaena flos-aquae heterocysts/mL =	8
Anabaena planctonica cells/mL =	78
Anabaena planctonica heterocysts/mL =	3

Aquatic Analysts **Sample ID:** PW05

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S8
Sample Depth:
Sample Date: 11-Jul-11

Total Density (#/mL): 279
Total Biovolume (um^3/mL): 428,626
Trophic State Index: 43.7

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	125	44.8	149,958	35.0	bluegreen
2	Chlamydomonas sp.	41	14.7	13,311	3.1	green
3	Anabaena planctonica	34	12.1	129,619	30.2	bluegreen
4	Dinobryon sertularia	27	9.5	25,123	5.9	chrysophyte
5	Asterionella formosa	24	8.6	30,741	7.2	diatom
6	Fragilaria crotonensis	5	1.7	60,712	14.2	diatom
7	Dinobryon sp.	5	1.7	602	0.1	chrysophyte
8	Cryptomonas erosa	5	1.7	2,506	0.6	cryptophyte
9	Anabaena flos-aquae	5	1.7	4,842	1.1	bluegreen
10	Glenodinium sp.	2	0.9	1,686	0.4	dinoflagellate
11	Rhodomonas minuta	2	0.9	48	0.0	cryptophyte
12	Melosira ambigua	2	0.9	8,514	2.0	diatom
13	Microcystis aeruginosa	2	0.9	964	0.2	bluegreen

Aphanizomenon flos-aquae cells/mL =	2,380
Aphanizomenon flos-aquae heterocysts/mL =	43
Anabaena planctonica cells/mL =	708
Anabaena planctonica heterocysts/mL =	24
Anabaena planctonica akinetes/mL =	2
Microcystis aeruginosa cells/mL =	120
Anabaena flos-aquae cells/mL =	72
Anabaena flos-aquae heterocysts/mL =	5

Aquatic Analysts **Sample ID:** PW06

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N11
Sample Depth:
Sample Date: 11-Jul-11

Total Density (#/mL): 234
Total Biovolume (um^3/mL): 144,501
Trophic State Index: 35.9

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Microcystis aeruginosa	151	64.5	27,782	19.2	bluegreen
2	Aphanizomenon flos-aquae	42	17.8	57,597	39.9	bluegreen
3	Anabaena flos-aquae	12	5.3	11,694	8.1	bluegreen
4	Asterionella formosa	7	3.0	14,628	10.1	diatom
5	Dinobryon sertularia	6	2.4	2,460	1.7	chrysophyte
6	Melosira ambigua	3	1.2	14,686	10.2	diatom
7	Ulothrix sp.	3	1.2	2,881	2.0	green
8	Chlamydomonas sp.	3	1.2	900	0.6	green
9	Anabaena planctonica	1	0.6	2,535	1.8	bluegreen
10	Eunotia pectinalis	1	0.6	6,982	4.8	diatom
11	Cryptomonas erosa	1	0.6	720	0.5	cryptophyte
12	Glenodinium sp.	1	0.6	970	0.7	dinoflagellate
13	Cocconeis placentula	1	0.6	637	0.4	diatom
14	Rhodomonas minuta	1	0.6	28	0.0	cryptophyte

Microcystis aeruginosa cells/mL = 3,473

Aphanizomenon flos-aquae cells/mL = 914
Aphanizomenon flos-aquae heterocysts/mL = 68

Anabaena planctonica cells/mL = 14
Anabaena planctonica heterocysts/mL = 1

Anabaena flos-aquae cells/mL = 175
Anabaena flos-aquae heterocysts/mL = 11

Aquatic Analysts

Sample ID: PW07

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N16
Sample Depth:
Sample Date: 11-Jul-11

Total Density (#/mL): 550
Total Biovolume (um^3/mL): 1,006,079
Trophic State Index: 49.9

Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
Aphanizomenon flos-aquae	461	83.9	610,279	60.7	bluegreen
Asterionella formosa	23	4.1	35,935	3.6	diatom
Dinobryon sertularia	20	3.7	20,569	2.0	chrysophyte
Microcystis aeruginosa	10	1.8	807	0.1	bluegreen
Fragilaria crotonensis	10	1.8	271,023	26.9	diatom
Anabaena planctonica	8	1.4	41,516	4.1	bluegreen
Anabaena flos-aquae	5	0.9	8,444	0.8	bluegreen
Mallomonas sp.	3	0.5	958	0.1	chrysophyte
Sphaerocystis schroeteri	3	0.5	706	0.1	green
Gloeotrichia echinulata	3	0.5	13,712	1.4	bluegreen
Cryptomonas erosa	3	0.5	1,311	0.1	cryptophyte
Chlamydomonas sp.	3	0.5	819	0.1	green

Aphanizomenon flos-aquae cells/mL =	9,687
phanizomenon flos-aquae heterocysts/mL =	199
Microcystis aeruginosa cells/mL =	101
Anabaena planctonica cells/mL =	227
Anabaena planctonica heterocysts/mL =	8
Anabaena flos-aquae cells/mL =	126
Anabaena flos-aquae heterocysts/mL =	5
Gloeotrichia echinulata cells/mL =	202
Gloeotrichia echinulata heterocysts/mL =	20

Aquatic Analysts **Sample ID:** PW08

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S3
Sample Depth:
Sample Date: 25-Jul-11

Total Density (#/mL): 440
Total Biovolume (um^3/mL): 1,054,929
Trophic State Index: 50.2

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	251	57.1	348,180	33.0	bluegreen
2	Anabaena planctonica	148	33.6	676,057	64.1	bluegreen
3	Cryptomonas erosa	7	1.7	3,842	0.4	cryptophyte
4	Asterionella formosa	7	1.7	9,753	0.9	diatom
5	Surirella sp.	4	0.8	1,847	0.2	diatom
6	Mallomonas sp.	4	0.8	1,404	0.1	chrysophyte
7	Cocconeis placentula	4	0.8	1,699	0.2	diatom
8	Rhodomonas minuta	4	0.8	74	0.0	cryptophyte
9	Anabaena flos-aquae	4	0.8	9,901	0.9	bluegreen
10	Planktosphaeria gelatinosa	4	0.8	1,655	0.2	green
11	Sphaerocystis schroeteri	4	0.8	517	0.0	green

Anabaena planctonica cells/mL = 3,694
Anabaena planctonica heterocysts/mL = 126
Anabaena planctonica akinetes/mL = 44

Aphanizomenon flos-aquae cells/mL = 5,527
Aphanizomenon flos-aquae heterocysts/mL = 89

Anabaena flos-aquae cells/mL = 148
Anabaena flos-aquae heterocysts/mL = 4

Aquatic Analysts

Sample ID: PW09

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S8
Sample Depth:
Sample Date: 25-Jul-11

Total Density (#/mL): 999
Total Biovolume (um^3/mL): 1,624,130
Trophic State Index: 53.3

	Species	Density #/mL	Density Percent	Biovolume um ^{3}/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	867	86.8	1,092,276	67.3	bluegreen
2	Anabaena planctonica	55	5.5	281,134	17.3	bluegreen
3	Dinobryon sertularia	15	1.5	7,023	0.4	chrysophyte
4	Melosira ambigua	11	1.1	32,316	2.0	diatom
5	Mallomonas sp.	11	1.1	4,170	0.3	chrysophyte
6	Fragilaria crotonensis	7	0.7	184,350	11.4	diatom
7	Microcystis aeruginosa	7	0.7	6,438	0.4	bluegreen
8	Cryptomonas erosa	7	0.7	3,804	0.2	cryptophyte
9	Cosmarium sp.	4	0.4	768	0.0	green
10	Asterionella formosa	4	0.4	6,438	0.4	diatom
11	Chlamydomonas sp.	4	0.4	1,189	0.1	green
12	Cyclotella stelligera	4	0.4	201	0.0	diatom
13	Melosira granulata	4	0.4	4,024	0.2	diatom

Aphanizomenon flos-aquae cells/mL = 17,338
Aphanizomenon flos-aquae heterocysts/mL = 300

Anabaena planctonica cells/mL = 1,536
Anabaena planctonica heterocysts/mL = 59
Anabaena planctonica akinetes/mL = 4

Microcystis aeruginosa cells/mL = 805

Aquatic Analysts

Sample ID: PW10

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N11
Sample Depth:
Sample Date: 25-Jul-11

Total Density (#/mL): 978
Total Biovolume (um^3/mL): 1,374,131
Trophic State Index: 52.1

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	854	87.3	968,625	70.5	bluegreen
2	Dinobryon sertularia	43	4.4	67,836	4.9	chrysophyte
3	Fragilaria crotonensis	19	1.9	266,127	19.4	diatom
4	Microcystis aeruginosa	16	1.6	5,467	0.4	bluegreen
5	Asterionella formosa	9	1.0	5,535	0.4	diatom
6	Melosira ambigua	6	0.6	23,783	1.7	diatom
7	Melosira granulata	6	0.6	15,375	1.1	diatom
8	Synedra radians	3	0.3	1,118	0.1	diatom
9	Anabaena flos-aquae	3	0.3	6,243	0.5	bluegreen
10	Cryptomonas erosa	3	0.3	1,615	0.1	cryptophyte
11	Eunotia pectinalis	3	0.3	2,236	0.2	diatom
12	Gloeocystis ampla	3	0.3	3,181	0.2	green
13	Cosmarium sp.	3	0.3	652	0.0	green
14	Synedra ulna	3	0.3	6,181	0.4	diatom
15	Achnanthes minutissima	3	0.3	155	0.0	diatom

Aphanizomenon flos-aquae cells/mL = 15,375
Aphanizomenon flos-aquae heterocysts/mL = 426

Anabaena flos-aquae cells/mL = 93
Anabaena flos-aquae heterocysts/mL = 3

Microcystis aeruginosa cells/mL = 683

Aquatic Analysts

Sample ID: PW11

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N16
Sample Depth:
Sample Date: 25-Jul-11

Total Density (#/mL): 1,860
Total Biovolume (um^3/mL): 2,519,359
Trophic State Index: 56.5

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	1,804	97.0	2,159,388	85.7	bluegreen
2	Fragilaria crotonensis	21	1.2	324,720	12.9	diatom
3	Microcystis aeruginosa	4	0.2	344	0.0	bluegreen
4	Anabaena planctonica	4	0.2	23,581	0.9	bluegreen
5	Staurastrum gracile	4	0.2	2,319	0.1	green
6	Chlamydomonas sp.	4	0.2	1,396	0.1	green
7	Planktosphaeria gelatinosa	4	0.2	3,849	0.2	green
8	Synedra rumpens	4	0.2	601	0.0	diatom
9	Oocystis pusilla	4	0.2	928	0.0	green
10	Cryptomonas erosa	4	0.2	2,234	0.1	cryptophyte

Aphanizomenon flos-aquae cells/mL = 34,276
Aphanizomenon flos-aquae heterocysts/mL = 301

Microcystis aeruginosa cells/mL = 43

Anabaena planctonica cells/mL = 129
Anabaena planctonica heterocysts/mL = 4

Aquatic Analysts

Sample ID: PW12

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S3
Sample Depth:
Sample Date: 8-Aug-11

Total Density (#/mL): 2,412
Total Biovolume (um^3/mL): 3,741,424
Trophic State Index: 59.4

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	2,278	94.4	2,583,000	69.0	bluegreen
2	Anabaena planctonica	57	2.4	291,783	7.8	bluegreen
3	Fragilaria crotonensis	40	1.7	810,353	21.7	diatom
4	Dictyosphaerium ehrenbergianum	10	0.4	5,276	0.1	green
5	Anabaena circinalis	7	0.3	11,891	0.3	bluegreen
6	Melosira ambigua	3	0.1	11,838	0.3	diatom
7	Melosira granulata	3	0.1	7,369	0.2	diatom
8	Asterionella formosa	3	0.1	17,686	0.5	diatom
9	Chlamydomonas sp.	3	0.1	1,089	0.0	green
10	Microcystis aeruginosa	3	0.1	1,072	0.0	bluegreen
11	Rhodomonas minuta	3	0.1	67	0.0	cryptophyte

Aphanizomenon flos-aquae cells/mL = 41,000
Aphanizomenon flos-aquae heterocysts/mL = 10

Anabaena circinalis cells/mL = 167
Anabaena circinalis heterocysts/mL = 3

Anabaena planctonica cells/mL = 1,594
Anabaena planctonica heterocysts/mL = 40

Microcystis aeruginosa cells/mL = 134

Aquatic Analysts

Sample ID: PW13

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S8
Sample Depth:
Sample Date: 8-Aug-11

Total Density (#/mL): 2,073
Total Biovolume (um^3/mL): 3,022,252
Trophic State Index: 57.8

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	1,872	90.3	2,358,269	78.0	bluegreen
2	Anabaena planctonica	66	3.2	312,466	10.3	bluegreen
3	Melosira ambigua	53	2.6	131,998	4.4	diatom
4	Chlamydomonas sp.	29	1.4	9,338	0.3	green
5	Fragilaria crotonensis	12	0.6	175,836	5.8	diatom
6	Asterionella formosa	12	0.6	8,940	0.3	diatom
7	Melosira granulata	8	0.4	18,060	0.6	diatom
8	Melosira granulata angustissima	4	0.2	2,052	0.1	diatom
9	Achnanthes minutissima	4	0.2	205	0.0	diatom
10	Dinobryon sertularia	4	0.2	1,970	0.1	chrysophyte
11	Synedra radians	4	0.2	1,478	0.0	diatom
12	Microcystis aeruginosa	4	0.2	1,642	0.1	bluegreen

Aphanizomenon flos-aquae cells/mL = 37,433
Aphanizomenon flos-aquae heterocysts/mL = 460

Anabaena planctonica cells/mL = 1,707
Anabaena planctonica heterocysts/mL = 45

Microcystis aeruginosa cells/mL = 205

Aquatic Analysts

Sample ID: PW14

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N11
Sample Depth:
Sample Date: 8-Aug-11

Total Density (#/mL): 2,519
Total Biovolume (um^3/mL): 3,620,001
Trophic State Index: 59.1

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	2,421	96.1	3,355,725	92.7	bluegreen
2	Anabaena planctonica	17	0.7	86,877	2.4	bluegreen
3	Synedra radians	17	0.7	6,104	0.2	diatom
4	Melosira granulata	14	0.5	33,571	0.9	diatom
5	Cocconeis placentula	7	0.3	3,120	0.1	diatom
6	Melosira granulata angustissima	7	0.3	10,173	0.3	diatom
7	Synedra rumpens	7	0.3	949	0.0	diatom
8	Asterionella formosa	7	0.3	1,492	0.0	diatom
9	Dinobryon sertularia	7	0.3	814	0.0	chrysophyte
10	Eunotia pectinalis	3	0.1	2,442	0.1	diatom
11	Fragilaria crotonensis	3	0.1	113,937	3.1	diatom
12	Synedra cyclopum	3	0.1	2,865	0.1	diatom
13	Cryptomonas erosa	3	0.1	1,763	0.0	cryptophyte
14	Achnanthes minutissima	3	0.1	170	0.0	diatom

Aphanizomenon flos-aquae cells/mL = 53,265
Aphanizomenon flos-aquae heterocysts/mL = 339

Anabaena planctonica cells/mL = 475
Anabaena planctonica heterocysts/mL = 10

Aquatic Analysts

Sample ID: PW15

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N16
Sample Depth:
Sample Date: 8-Aug-11

Total Density (#/mL): 2,713
Total Biovolume (um^3/mL): 3,585,444
Trophic State Index: 59.1

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	2,627	96.8	3,475,803	96.9	bluegreen
2	Fragilaria crotonensis	60	2.2	49,985	1.4	diatom
3	Anabaena planctonica	15	0.5	49,004	1.4	bluegreen
4	Asterionella formosa	6	0.2	7,200	0.2	diatom
5	Cryptomonas erosa	3	0.1	1,547	0.0	cryptophyte
6	Microcystis aeruginosa	3	0.1	1,904	0.1	bluegreen

Aphanizomenon flos-aquae cells/mL = 55,171
Aphanizomenon flos-aquae heterocysts/mL = 431

Anabaena planctonica cells/mL = 268
Anabaena planctonica heterocysts/mL = 6

Microcystis aeruginosa cells/mL = 238

Aquatic Analysts

Sample ID: PW16

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S3
Sample Depth:
Sample Date: 22-Aug-11

Total Density (#/mL): 4,179
Total Biovolume (um^3/mL): 5,751,496
Trophic State Index: 62.5

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	4,065	97.3	5,121,294	89.0	bluegreen
2	Anabaena planctonica	67	1.6	318,878	5.5	bluegreen
3	Ceratium hirundinella	12	0.3	115,904	2.0	dinoflagellate
4	Fragilaria crotonensis	12	0.3	168,888	2.9	diatom
5	Melosira granulata	8	0.2	15,178	0.3	diatom
6	Melosira granulata angustissima	8	0.2	9,856	0.2	diatom
7	Rhodomonas minuta	4	0.1	79	0.0	cryptophyte
8	Synedra radians	4	0.1	1,419	0.0	diatom

Aphanizomenon flos-aquae cells/mL = 81,290
Aphanizomenon flos-aquae heterocysts/mL = 1,206

Anabaena planctonica cells/mL = 1,743
Anabaena planctonica heterocysts/mL = 39

Aquatic Analysts

Sample ID: PW17

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S8
Sample Depth:
Sample Date: 22-Aug-11

Total Density (#/mL): 935
Total Biovolume (um^3/mL): 1,773,040
Trophic State Index: 54.0

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	780	83.4	1,080,983	61.0	bluegreen
2	Anabaena planctonica	58	6.2	298,483	16.8	bluegreen
3	Melosira ambigua	19	2.1	43,460	2.5	diatom
4	Melosira granulata	16	1.7	37,378	2.1	diatom
5	Fragilaria crotonensis	16	1.7	244,658	13.8	diatom
6	Microcystis aeruginosa	13	1.4	21,955	1.2	bluegreen
7	Asterionella formosa	10	1.0	7,903	0.4	diatom
8	Pinnularia sp.	3	0.3	1,294	0.1	diatom
9	Cocconeis placentula	3	0.3	1,489	0.1	diatom
10	Navicula anglica	3	0.3	1,165	0.1	diatom
11	Achnanthes minutissima	3	0.3	162	0.0	diatom
12	Eunotia pectinalis	3	0.3	2,330	0.1	diatom
13	Rhodomonas minuta	3	0.3	65	0.0	cryptophyte
14	Ceratium hirundinella	3	0.3	31,715	1.8	dinoflagellate

Aphanizomenon flos-aquae cells/mL = 17,158
Aphanizomenon flos-aquae heterocysts/mL = 113

Anabaena planctonica cells/mL = 1,631
Anabaena planctonica heterocysts/mL = 39

Microcystis aeruginosa cells/mL = 2,744

Aquatic Analysts

Sample ID: PW18

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N11
Sample Depth:
Sample Date: 22-Aug-11

Total Density (#/mL): 4,419
Total Biovolume (um^3/mL): 6,172,124
Trophic State Index: 63.0

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	4,349	98.4	6,027,830	97.7	bluegreen
2	Anabaena planctonica	22	0.5	111,424	1.8	bluegreen
3	Cryptomonas erosa	9	0.2	4,523	0.1	cryptophyte
4	Gomphonema clevei	4	0.1	391	0.0	diatom
5	Melosira ambigua	4	0.1	7,685	0.1	diatom
6	Cocconeis placentula	4	0.1	2,001	0.0	diatom
7	Eunotia pectinalis	4	0.1	3,131	0.1	diatom
8	Oocystis pusilla	4	0.1	939	0.0	green
9	Melosira granulata angustissima	4	0.1	2,175	0.0	diatom
10	Tabellaria fenestrata	4	0.1	10,438	0.2	diatom
11	Navicula cryptocephala	4	0.1	805	0.0	diatom
12	Achnanthes lanceolata	4	0.1	783	0.0	diatom

Aphanizomenon flos-aquae cells/mL = 95,680
Aphanizomenon flos-aquae heterocysts/mL = 739

Anabaena planctonica cells/mL = 609
Anabaena planctonica heterocysts/mL = 9

Aquatic Analysts

Sample ID: PW19

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N16
Sample Depth:
Sample Date: 22-Aug-11

Total Density (#/mL): 2,736
Total Biovolume (um^3/mL): 3,778,942
Trophic State Index: 59.4

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	2,697	98.6	3,568,371	94.4	bluegreen
2	Anabaena planctonica	31	1.1	186,649	4.9	bluegreen
3	Melosira granulata	4	0.2	21,532	0.6	diatom
4	Fragilaria crotonensis	2	0.1	1,731	0.0	diatom
5	Microcystis aeruginosa	2	0.1	659	0.0	bluegreen

Aphanizomenon flos-aquae cells/mL = 56,641
Aphanizomenon flos-aquae heterocysts/mL = 593

Anabaena planctonica cells/mL = 1,020
Anabaena planctonica heterocysts/mL = 23

Microcystis aeruginosa cells/mL = 82

Aquatic Analysts **Sample ID:** PW20

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: Z
Sample Depth:
Sample Date: 22-Aug-11

Total Density (#/mL): 3,272,971
Total Biovolume (um^3/mL): 4,441,560,750
Trophic State Index: 110.4

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	3,221,429	98.4	4,261,950,000	96.0	bluegreen
2	Anabaena planctonica	48,321	1.5	168,013,607	3.8	bluegreen
3	Microcystis aeruginosa	1,611	0.0	773,143	0.0	bluegreen
4	Fragilaria crotonensis	1,611	0.0	10,824,000	0.2	diatom

Aphanizomenon flos-aquae cells/mL = 67,650,000
Aphanizomenon flos-aquae heterocysts/mL = 214,225

Anabaena planctonica cells/mL = 918,107
Anabaena planctonica heterocysts/mL = 20,939

Microcystis aeruginosa cells/mL = 96,643

Aquatic Analysts

Sample ID: PW21

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S3
Sample Depth:
Sample Date: 6-Sep-11

Total Density (#/mL): 1,361
Total Biovolume (um^3/mL): 2,456,027
Trophic State Index: 56.3

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	1,180	86.7	1,635,593	66.6	bluegreen
2	Anabaena planctonica	128	9.4	658,149	26.8	bluegreen
3	Melosira granulata	20	1.5	51,879	2.1	diatom
4	Microcystis aeruginosa	8	0.6	1,284	0.1	bluegreen
5	Fragilaria crotonensis	8	0.6	47,203	1.9	diatom
6	Melosira ambigua	8	0.6	21,278	0.9	diatom
7	Ceratium hirundinella	4	0.3	39,336	1.6	dinoflagellate
8	Chlamydomonas sp.	4	0.3	1,305	0.1	green

Aphanizomenon flos-aquae cells/mL = 25,962
Aphanizomenon flos-aquae heterocysts/mL = 654

Microcystis aeruginosa cells/mL = 161

Anabaena planctonica cells/mL = 3,596
Anabaena planctonica heterocysts/mL = 68
Anabaena planctonica akinetes/mL = 8

Aquatic Analysts

Sample ID: PW22

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S8
Sample Depth:
Sample Date: 6-Sep-11

Total Density (#/mL): 248
Total Biovolume (um^3/mL): 620,713
Trophic State Index: 46.4

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Anabaena planctonica	66	26.7	326,504	52.6	bluegreen
2	Aphanizomenon flos-aquae	58	23.3	72,854	11.7	bluegreen
3	Melosira granulata	52	20.8	133,452	21.5	diatom
4	Microcystis aeruginosa	25	10.0	3,370	0.5	bluegreen
5	Melosira ambigua	19	7.5	62,396	10.1	diatom
6	Cocconeis placentula	10	4.2	4,750	0.8	diatom
7	Fragilaria crotonensis	4	1.7	10,408	1.7	diatom
8	Sphaerocystis schroeteri	4	1.7	867	0.1	green
9	Gomphonema angustatum	2	0.8	372	0.1	diatom
10	Melosira varians	2	0.8	2,685	0.4	diatom
11	Rhodomonas minuta	2	0.8	41	0.0	cryptophyte
12	Asterionella formosa	2	0.8	1,363	0.2	diatom
13	Ulothrix sp.	2	0.8	1,652	0.3	green

Anabaena planctonica cells/mL =	1,784
Anabaena planctonica heterocysts/mL = '	27
Anabaena planctonica akinetes/mL =	10
Microcystis aeruginosa cells/mL =	421
Aphanizomenon flos-aquae cells/mL =	1,156
Aphanizomenon flos-aquae heterocysts/mL =	29

Aquatic Analysts

Sample ID: PW23

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N11
Sample Depth:
Sample Date: 6-Sep-11

Total Density (#/mL): 523
Total Biovolume (um^3/mL): 954,789
Trophic State Index: 49.5

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	398	75.9	526,012	55.1	bluegreen
2	Ceratium hirundinella	23	4.4	227,289	23.8	dinoflagellate
3	Anabaena planctonica	20	3.8	98,225	10.3	bluegreen
4	Melosira ambigua	20	3.8	60,887	6.4	diatom
5	Cryptomonas erosa	10	1.9	5,169	0.5	cryptophyte
6	Melosira granulata angustissima	10	1.9	8,200	0.9	diatom
7	Synedra radians	7	1.3	2,386	0.2	diatom
8	Rhodomonas minuta	3	0.6	66	0.0	cryptophyte
9	Chlamydomonas sp.	3	0.6	1,077	0.1	green
10	Cocconeis placentula	3	0.6	1,524	0.2	diatom
11	Nitzschia acicularis	3	0.6	928	0.1	diatom
12	Mallomonas sp.	3	0.6	1,259	0.1	chrysophyte
13	Gomphonema subclavatum	3	0.6	1,988	0.2	diatom
14	Cyclotella stelligera	3	0.6	182	0.0	diatom
15	Sphaerocystis schroeteri	3	0.6	3,711	0.4	green
16	Trachelomonas volvocina	3	0.6	6,245	0.7	euglenoid
17	Microcystis aeruginosa	3	0.6	7,952	0.8	bluegreen
18	Fragilaria capucina mesolepta	3	0.6	1,690	0.2	diatom

Aphanizomenon flos-aquae cells/mL = 8,349
Aphanizomenon flos-aquae heterocysts/mL = 179

Anabaena planctonica cells/mL = 537
Anabaena planctonica heterocysts/mL = 10

Microcystis aeruginosa cells/mL = 994

Aquatic Analysts

Sample ID: PW24

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N16
Sample Depth:
Sample Date: 6-Sep-11

Total Density (#/mL): 1,176
Total Biovolume (um^3/mL): 1,706,292
Trophic State Index: 53.7

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	1,129	96.0	1,564,918	91.7	bluegreen
2	Anabaena planctonica	19	1.6	109,761	6.4	bluegreen
3	Cryptomonas erosa	10	0.8	5,030	0.3	cryptophyte
4	Melosira granulata	8	0.7	19,154	1.1	diatom
5	Melosira granulata angustissima	3	0.2	2,764	0.2	diatom
6	Synedra radians	1	0.1	498	0.0	diatom
7	Fragilaria construens venter	1	0.1	332	0.0	diatom
8	Synedra ulna	1	0.1	2,750	0.2	diatom
9	Cocconeis placentula	1	0.1	636	0.0	diatom
10	Chlamydomonas sp.	1	0.1	449	0.0	green

Aphanizomenon flos-aquae cells/mL = 24,840
Aphanizomenon flos-aquae heterocysts/mL = 64

Anabaena planctonica cells/mL = 600
Anabaena planctonica heterocysts/mL = 1

Aquatic Analysts

Sample ID: PW25

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: Z
Sample Depth:
Sample Date: 6-Sep-11

Total Density (#/mL): 1,219,866
Total Biovolume (um^3/mL): 3,417,562,383
Trophic State Index: 108.5

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Anabaena planctonica	625,858	51.3	2,748,768,559	80.4	bluegreen
2	Aphanizomenon flos-aquae	587,638	48.2	666,381,165	19.5	bluegreen
3	Cryptomonas erosa	1,593	0.1	828,107	0.0	cryptophyte
4	Synedra tenera	1,593	0.1	477,754	0.0	diatom
5	Chlamydomonas sp.	1,593	0.1	517,567	0.0	green
6	Cymbella minuta	1,593	0.1	589,230	0.0	diatom

Anabaena planctonica cells/mL = 15,020,593
Anabaena planctonica heterocysts/mL = 261,172
Anabaena planctonica akinetes/mL = 11,148

Aphanizomenon flos-aquae cells/mL = 10,577,479
Aphanizomenon flos-aquae heterocysts/mL = 281,875

Aquatic Analysts

Sample ID: PW26

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S3
Sample Depth:
Sample Date: 20-Sep-11

Total Density (#/mL): 687
Total Biovolume (um^3/mL): 1,138,739
Trophic State Index: 50.8

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	377	54.9	498,822	43.8	bluegreen
2	Anabaena planctonica	72	10.5	383,743	33.7	bluegreen
3	Melosira ambigua	72	10.5	127,770	11.2	diatom
4	Microcystis aeruginosa	52	7.5	4,132	0.4	bluegreen
5	Asterionella formosa	36	5.3	37,384	3.3	diatom
6	Melosira granulata	26	3.8	14,204	1.2	diatom
7	Cryptomonas erosa	10	1.5	5,372	0.5	cryptophyte
8	Fragilaria crotonensis	10	1.5	8,677	0.8	diatom
9	Mallomonas sp.	5	0.8	1,963	0.2	chrysophyte
10	Chlamydomonas sp.	5	0.8	1,679	0.1	green
11	Staurastrum gracile	5	0.8	2,789	0.2	green
12	Rhodomonas minuta	5	0.8	103	0.0	cryptophyte
13	Fragilaria vaucheria	5	0.8	1,487	0.1	diatom
14	Ceratium hirundinella	5	0.8	50,616	4.4	dinoflagellate

Aphanizomenon flos-aquae cells/mL = 7,918
Aphanizomenon flos-aquae heterocysts/mL = 36
Aphanizomenon flos-aquae akinetes/mL = 21

Anabaena planctonica cells/mL = 2,097
Anabaena planctonica heterocysts/ml = 10
Anabaena planctonica akinetes/mL = 10

Microcystis aeruginosa cells/mL = 516

Aquatic Analysts

Sample ID: PW27

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S8
Sample Depth:
Sample Date: 20-Sep-11

Total Density (#/mL): 296
Total Biovolume (um^3/mL): 365,637
Trophic State Index: 42.6

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Microcystis aeruginosa	153	51.5	12,201	3.3	bluegreen
2	Melosira ambigua	49	16.6	127,045	34.7	diatom
3	Anabaena planctonica	31	10.4	135,561	37.1	bluegreen
4	Asterionella formosa	24	8.0	22,328	6.1	diatom
5	Aphanizomenon flos-aquae	13	4.3	15,213	4.2	bluegreen
6	Synedra radians	4	1.2	1,307	0.4	diatom
7	Cocconeis placentula	4	1.2	1,670	0.5	diatom
8	Cryptomonas erosa	4	1.2	1,888	0.5	cryptophyte
9	Dinobryon sertularia	4	1.2	436	0.1	chrysophyte
10	Fragilaria crotonensis	2	0.6	45,754	12.5	diatom
11	Rhodomonas minuta	2	0.6	36	0.0	cryptophyte
12	Navicula cryptocephala veneta	2	0.6	172	0.0	diatom
13	Synedra rumpens	2	0.6	254	0.1	diatom
14	Rhizosolenia eriensis	2	0.6	172	0.0	chrysophyte
15	Staurastrum dejectum	2	0.6	726	0.2	green
16	Dictyosphaerium ehrenbergianum	2	0.6	871	0.2	green

Microcystis aeruginosa cells/mL = 1,525

Anabaena planctonica cells/mL = 741
Anabaena planctonica heterocysts/ml = 34

Aphanizomenon flos-aquae cells/mL = 241
Aphanizomenon flos-aquae heterocysts/mL = 4

Aquatic Analysts

Sample ID: PW28

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N11
Sample Depth:
Sample Date: 20-Sep-11

Total Density (#/mL): 243
Total Biovolume (um^3/mL): 937,102
Trophic State Index: 49.4

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	110	45.2	117,538	12.5	bluegreen
2	Ceratium hirundinella	73	30.2	717,010	76.5	dinoflagellate
3	Microcystis aeruginosa	19	7.9	1,540	0.2	bluegreen
4	Anabaena planctonica	10	4.0	70,469	7.5	bluegreen
5	Melosira ambigua	8	3.2	18,145	1.9	diatom
6	Cocconeis placentula	6	2.4	2,657	0.3	diatom
7	Gomphonema subclavatum	4	1.6	2,310	0.2	diatom
8	Cryptomonas erosa	4	1.6	2,002	0.2	cryptophyte
9	Trachelomonas volvocina	2	0.8	3,629	0.4	euglenoid
10	Navicula cryptocephala	2	0.8	356	0.0	diatom
11	Achnanthes minutissima	2	0.8	96	0.0	diatom
12	Asterionella formosa	2	0.8	424	0.0	diatom
13	Selenastrum minutum	2	0.8	924	0.1	green

Microcystis aeruginosa cells/mL = 193

Aphanizomenon flos-aquae cells/mL = 1,866
Aphanizomenon flos-aquae heterocysts/mL = 44

Anabaena planctonica cells/mL = 385
Anabaena planctonica heterocysts/ml = 6

Aquatic Analysts

Sample ID: PW29

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N16
Sample Depth:
Sample Date: 20-Sep-11

Total Density (#/mL): 824
Total Biovolume (um^3/mL): 1,080,509
Trophic State Index: 50.4

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	665	80.6	879,400	81.4	bluegreen
2	Microcystis aeruginosa	86	10.5	6,913	0.6	bluegreen
3	Anabaena planctonica	23	2.8	114,950	10.6	bluegreen
4	Melosira ambigua	13	1.6	31,321	2.9	diatom
5	Dictyosphaerium ehrenbergianum	7	0.8	3,191	0.3	green
6	Cryptomonas erosa	7	0.8	3,456	0.3	cryptophyte
7	Ankistrodesmus falcatus	7	0.8	166	0.0	green
8	Sphaerocystis schroeteri	3	0.4	931	0.1	green
9	Ceratium hirundinella	3	0.4	32,570	3.0	dinoflagellate
10	Rhodomonas minuta	3	0.4	66	0.0	cryptophyte
11	Nitzschia acicularis	3	0.4	931	0.1	diatom
12	Synedra ulna	3	0.4	6,614	0.6	diatom

Aphanizomenon flos-aquae cells/mL = 13,959
Aphanizomenon flos-aquae heterocysts/mL = 399

Microcystis aeruginosa cells/mL = 864

Anabaena planctonica cells/mL = 628
Anabaena planctonica heterocysts/ml = 20

Aquatic Analysts

Sample ID: PW30

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: Z
Sample Depth:
Sample Date: 20-Sep-11

Total Density (#/mL): 70,717
Total Biovolume (um^3/mL): 171,498,703
Trophic State Index: 87.0

	Species	Density #/mL	Density Percent	Biovolume um ^{3}/mL	Biovolume Percent	Group
1	Anabaena planctonica	37,884	53.6	159,453,756	93.0	bluegreen
2	Microcystis aeruginosa	23,813	33.7	3,619,546	2.1	bluegreen
3	Aphanizomenon flos-aquae	6,855	9.7	7,341,919	4.3	bluegreen
4	Cocconeis placentula	1,082	1.5	497,904	0.3	diatom
5	Chlamydomonas sp.	361	0.5	117,260	0.1	green
6	Melosira ambigua	361	0.5	425,022	0.2	diatom
7	Dinobryon sertularia	361	0.5	43,296	0.0	chrysophyte

Microcystis aeruginosa cells/mL =	452,443
Anabaena planctonica cells/mL =	871,332
Anabaena planctonica heterocysts/ml =	9,381
Anabaena planctonica akinetes/mL =	1,804
Aphanizomenon flos-aquae cells/mL =	116,538
Aphanizomenon flos-aquae heterocysts/mL =	2,165

Aquatic Analysts **Sample ID:** PW31

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: Davis
Sample Depth:
Sample Date: 20-Sep-11

Total Density (#/mL): 245,428
Total Biovolume (um^3/mL): 444,568,530
Trophic State Index: 93.8

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Anabaena planctonica	167,814	68.4	429,939,349	96.7	bluegreen
2	Microcystis aeruginosa	67,126	27.4	5,370,047	1.2	bluegreen
3	Aphanizomenon flos-aquae	6,293	2.6	6,739,828	1.5	bluegreen
4	Melosira ambigua	1,049	0.4	1,853,295	0.4	diatom
5	Scenedesmus quadricauda	1,049	0.4	272,698	0.1	green
6	Chlamydomonas sp.	1,049	0.4	340,872	0.1	green
7	Achnanthes minutissima	1,049	0.4	52,442	0.0	diatom

Microcystis aeruginosa cells/mL = 671,256

Anabaena planctonica cells/mL = 2,349,395
Anabaena planctonica heterocysts/ml = 25,172
Anabaena planctonica akinetes/mL = 8,391

Aphanizomenon flos-aquae cells/mL = 106,981
Aphanizomenon flos-aquae heterocysts/mL = 1,049

Aquatic Analysts

Sample ID: PW32

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S3
Sample Depth:
Sample Date: 3-Oct-11

Total Density (#/mL): 319
Total Biovolume (um^3/mL): 568,602
Trophic State Index: 45.8

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Microcystis aeruginosa	107	33.6	10,279	1.8	bluegreen
2	Melosira ambigua	56	17.6	148,996	26.2	diatom
3	Aphanizomenon flos-aquae	54	16.8	64,084	11.3	bluegreen
4	Asterionella formosa	21	6.7	23,085	4.1	diatom
5	Anabaena planctonica	19	5.9	113,160	19.9	bluegreen
6	Dinobryon sertularia	13	4.2	1,606	0.3	chrysophyte
7	Ceratium hirundinella	11	3.4	104,934	18.5	dinoflagellate
8	Chlamydomonas sp.	8	2.5	2,610	0.5	green
9	Cryptomonas erosa	8	2.5	4,176	0.7	cryptophyte
10	Synedra rumpens	5	1.7	750	0.1	diatom
11	Fragilaria crotonensis	5	1.7	89,943	15.8	diatom
12	Synedra radians	3	0.8	964	0.2	diatom
13	Mallomonas sp.	3	0.8	1,017	0.2	chrysophyte
14	Rhodomonas minuta	3	0.8	54	0.0	cryptophyte
15	Melosira granulata	3	0.8	2,945	0.5	diatom

Microcystis aeruginosa cells/mL = 1,285

Aphanizomenon flos-aquae cells/mL = 1,017
Aphanizomenon flos-aquae heterocysts/mL = 21

Anabaena planctonica cells/mL = 618
Anabaena planctonica heterocysts/ml = 13

Aquatic Analysts

Sample ID: PW33

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: S8
Sample Depth:
Sample Date: 3-Oct-11

Total Density (#/mL): 164
Total Biovolume (um^3/mL): 225,054
Trophic State Index: 39.1

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Microcystis aeruginosa	64	39.1	5,638	2.5	bluegreen
2	Melosira ambigua	36	21.7	73,369	32.6	diatom
3	Anabaena planctonica	21	13.0	105,511	46.9	bluegreen
4	Asterionella formosa	12	7.2	4,698	2.1	diatom
5	Aphanizomenon flos-aquae	11	6.5	14,798	6.6	bluegreen
6	Synedra rumpens	6	3.6	830	0.4	diatom
7	Dinobryon sertularia	4	2.2	427	0.2	chrysophyte
8	Cocconeis placentula	2	1.4	1,091	0.5	diatom
9	Melosira granulata	2	1.4	5,220	2.3	diatom
10	Fragilaria crotonensis	2	1.4	11,958	5.3	diatom
11	Chlamydomonas sp.	1	0.7	386	0.2	green
12	Tabellaria flocculosa	1	0.7	700	0.3	diatom
13	Synedra radians	1	0.7	427	0.2	diatom

Anabaena planctonica cells/mL = 577
Anabaena planctonica heterocysts/ml = 2

Aphanizomenon flos-aquae cells/mL = 235
Aphanizomenon flos-aquae heterocysts/mL = 13

Microcystis aeruginosa cells/mL = 705

Aquatic Analysts

Sample ID: PW34

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N11
Sample Depth:
Sample Date: 3-Oct-11

Total Density (#/mL): 860
Total Biovolume (um^3/mL): 1,321,184
Trophic State Index: 51.9

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	819	95.3	1,083,442	82.0	bluegreen
2	Ceratium hirundinella	20	2.4	199,144	15.1	dinoflagellate
3	Anabaena planctonica	6	0.7	25,659	1.9	bluegreen
4	Eunotia pectinalis	2	0.2	1,463	0.1	diatom
5	Chlamydomonas sp.	2	0.2	660	0.0	green
6	Scenedesmus denticulatus	2	0.2	274	0.0	green
7	Melosira ambigua	2	0.2	1,197	0.1	diatom
8	Melosira granulata	2	0.2	7,824	0.6	diatom
9	Fragilaria vaucheria	2	0.2	585	0.0	diatom
10	Cocconeis placentula	2	0.2	935	0.1	diatom

Aphanizomenon flos-aquae cells/mL = 17,197
Aphanizomenon flos-aquae heterocysts/mL = 144

Anabaena planctonica cells/mL = 140

Aquatic Analysts

Sample ID: PW35

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: N16
Sample Depth:
Sample Date: 3-Oct-11

Total Density (#/mL): 471
Total Biovolume (um^3/mL): 575,077
Trophic State Index: 45.9

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Aphanizomenon flos-aquae	396	84.0	448,520	78.0	bluegreen
2	Microcystis aeruginosa	44	9.4	4,247	0.7	bluegreen
3	Melosira ambigua	9	2.0	33,720	5.9	diatom
4	Anabaena planctonica	8	1.7	51,525	9.0	bluegreen
5	Melosira granulata	5	1.1	17,698	3.1	diatom
6	Dinobryon sertularia	3	0.6	322	0.1	chrysophyte
7	Ankistrodesmus falcatus	1	0.3	34	0.0	green
8	Scenedesmus quadricauda	1	0.3	349	0.1	green
9	Fragilaria crotonensis	1	0.3	18,020	3.1	diatom
10	Dictyosphaerium ehrenbergianum	1	0.3	644	0.1	green

Aphanizomenon flos-aquae cells/mL = 7,119
Aphanizomenon flos-aquae heterocysts/mL = 80

Anabaena planctonica cells/mL = 282
Anabaena planctonica heterocysts/ml = 1

Microcystis aeruginosa cells/mL = 531

Aquatic Analysts

Sample ID: PW36

Phytoplankton Sample Analysis

Sample: Tenmile Lake
Sample Site: Z
Sample Depth:
Sample Date: 3-Oct-11

Total Density (#/mL): 1,810
Total Biovolume (um^3/mL): 622,283
Trophic State Index: 46.4

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Microcystis aeruginosa	1,114	61.5	97,995	15.7	bluegreen
2	Ankistrodesmus falcatus	139	7.7	3,480	0.6	green
3	Synedra rumpens	104	5.8	14,616	2.3	diatom
4	Cryptomonas erosa	87	4.8	45,239	7.3	cryptophyte
5	Anabaena planctonica	70	3.8	318,414	51.2	bluegreen
6	Aphanizomenon flos-aquae	70	3.8	52,617	8.5	bluegreen
7	Scenedesmus denticulatus	35	1.9	6,264	1.0	green
8	Synedra tenera	35	1.9	10,440	1.7	diatom
9	Glenodinium sp.	35	1.9	24,360	3.9	dinoflagellate
10	Rhodomonas minuta	17	1.0	348	0.1	cryptophyte
11	Melosira ambigua	17	1.0	20,497	3.3	diatom
12	Fragilaria crotonensis	17	1.0	14,616	2.3	diatom
13	Scenedesmus quadricauda	17	1.0	1,131	0.2	green
14	Chlamydomonas sp.	17	1.0	5,655	0.9	green
15	Lyngbya sp.	17	1.0	3,480	0.6	bluegreen
16	Gomphonema angustatum	17	1.0	3,132	0.5	diatom

Microcystis aeruginosa cells/mL = 12,249

Anabaena planctonica cells/mL = 1,740
Anabaena planctonica heterocysts/ml = 17

Aphanizomenon flos-aquae cells/mL = 835

Lyngbya sp. cells/mL = 174

Aquatic Analysts

Sample ID: PW37

Sample: Tenmile Lake
Sample Site: Davis
Sample Depth:
Sample Date: 3-Oct-11

Total Density (#/mL): 2,423
Total Biovolume (um^3/mL): 2,124,723
Trophic State Index: 55.3

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Microcystis aeruginosa	747	30.8	59,727	2.8	bluegreen
2	Aphanizomenon flos-aquae	274	11.3	293,729	13.8	bluegreen
3	Anabaena planctonica	244	10.1	981,474	46.2	bluegreen
4	Synedra rumpens	168	6.9	25,811	1.2	diatom
5	Ankistrodesmus falcatus	152	6.3	4,190	0.2	green
6	Melosira ambigua	91	3.8	312,305	14.7	diatom
7	Rhodomonas minuta	76	3.1	1,524	0.1	cryptophyte
8	Sphaerocystis schroeteri	61	2.5	34,130	1.6	green
9	Cyclotella stelligera	61	2.5	3,352	0.2	diatom
10	Lyngbya sp.	61	2.5	10,361	0.5	bluegreen
11	Melosira distans alpigena	46	1.9	18,398	0.9	diatom
12	Cryptomonas erosa	46	1.9	23,769	1.1	cryptophyte
13	Dinobryon sertularia	46	1.9	7,131	0.3	chrysophyte
14	Asterionella formosa	46	1.9	33,185	1.6	diatom
15	Chlamydomonas sp.	46	1.9	14,856	0.7	green
16	Synedra radians	30	1.3	10,970	0.5	diatom
17	Scenedesmus denticulatus	30	1.3	4,114	0.2	green
18	Fragilaria crotonensis	30	1.3	217,577	10.2	diatom
19	Scenedesmus sp.	30	1.3	6,095	0.3	green
20	Cocconeis placentula	15	0.6	7,009	0.3	diatom
21	Gloeocystis ampla	15	0.6	3,901	0.2	green
22	Nitzschia capitellata	15	0.6	5,485	0.3	diatom
23	Synedra tenera	15	0.6	4,571	0.2	diatom
24	Selenastrum minutum	15	0.6	609	0.0	green
25	Achnanthes minutissima	15	0.6	762	0.0	diatom
26	Trachelomonas volvocina	15	0.6	28,721	1.4	euglenoid
27	Mallomonas sp.	15	0.6	5,790	0.3	chrysophyte
28	Crucigenia quadrata	15	0.6	5,180	0.2	green

Aphanizomenon flos-aquae cells/mL = 4,662
Aphanizomenon flos-aquae heterocysts/mL = 46

Microcystis aeruginosa cells/mL = 7,466

Anabaena planctonica cells/mL = 5,363
Anabaena planctonica heterocysts/ml = 76
Anabaena planctonica akinetes/mL = 76

Lyngbya sp. cells/mL = 518

Aquatic Analysts

Sample ID: PW38

Appendix II: GreenWater Labs Algal Toxin Results

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Anatoxin-a and Microcystin Analysis Report

Project: TLBP (Tenmile South Lake)

Sample Identification	Sample Collection Date
South Lake Z	110822
South Lake Intake	110824
South Lake Tap	110824

Toxin – Anatoxin-a (ANTX-A), microcystin (MC)

Sample Prep – The samples were ultra-sonicated to lyse cells and release toxins. Solid phase extraction (SPE) was utilized for ANTX-A extraction and preconcentration (100x). Duplicate samples were spiked (Lab Fortified Matrix, LFM) with 0.1 µg/L ANTX-A and/or 1.0 µg/L MCLR, which provided quantitative capability and additional qualitative confirmation.

Analytical Methodology – Liquid chromatography/ mass spectrometry/ mass spectrometry (LC/MS/MS) was utilized for the determination of ANTX-A. The $[M+H]^+$ ion for ANTX-A (*m/z* 166) was fragmented and the major product ions (*m/z* 149, 131, 107, and 91) provided both specificity and sensitivity. The current methodology established a limit of detection (LOD) of 0.05 µg/L and a limit of quantification (LOQ) of 0.1 µg/L for ANTX-A.

A microcystins enzyme linked immunosorbent assay (ELISA) was utilized for the quantitative and sensitive congener-independent detection of MCs. The current assay is sensitive to down to an LOD/LOQ of 0.15 µg/L for total MCs. The average recovery of a laboratory fortified blank (LFB) spiked with 1 µg/L MCLR was 105%.

Summary of ANTX-A/MC Results

Sample	ANTX-A level (µg/L)	MC level (µg/L)
South Lake Z	ND	≈ 0.7
South Lake Intake	–	≈ 0.2
South Lake Tap	–	ND

ND = Not detected above the LOD
LOD = 0.05 µg/L (ANTX-A), 0.15 µg/L (MC)
LOQ = 0.1 µg/L (ANTX-A), 0.15 µg/L (MC)

Submitted by: Mark T. Aubel, Ph.D.
Date: 9/7/11

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Tenmile Lakes Basin Partnership

MICROCYSTIN RESULTS

Tested on: **8/30/2011**
Method: **Enzyme-Linked ImmunoSorbent Assay (ELISA)**
Analyte: **Microcystins**
Analyzed by: **Amanda Foss**

Sample ID/ Date Collected	Initial Conc. Factor	Dilution Ratio	Assay Value, ug/L	Final Dilution Factor	Avg. LFB Recovery(%)	Avg. LFM Recovery (%)	Final Concentration (ug/L)	Average (ug/L)
Tenmile South Lake Z	1x	none	0.68	1	105	-	0.7	0.7
8/22/11	1x	none	0.71	1	105	-	0.7	
Tenmile South Lake Intake Epi	1x	none	0.15	1	105	121	0.2	0.2
8/24/11	1x	none	0.20	1	105	121	0.2	
Tenmile South Lake Tap	1x	none	ND	1	105	-	ND	ND
8/24/11	1x	none	ND	1	105	-	ND	

ND = Not detected above LOD/LOQ
LOD/LOQ = 0.15 µg/L
LFB = 1.0 µg/L MCLR
LFM = 1.0 µg/L MCLR

Submitted by: Mark T. Aubel, Ph.D.
Date: 8/30/2011

Submitted to: Jason Fredrickson
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Paralytic Shellfish Toxin Data Report
Project: Tenmile Lakes Basin Partnership

Sample Identification	Sample Collection Date
South Lake Station Z	8/22/11

Toxins – Paralytic Shellfish Toxins (PSPs, saxitoxins)

Sample Preparation
PSPs
The sample was sonicated to homogenize and release intracellular toxins. Seventy-five milliliters of sample was frozen and lyophilized at -50 °C. A duplicate sample was prepared in the same way, spiked at a concentration of 1 ppb dcGTX2&3, 1 ppb C1&C2, 0.5 ppb dcSTX, 0.5 ppb GTX2&3, 2 ppb GTX 5, and 1 ppb STX added to the solution. The lyophilized samples were reconstituted in 75% acidified MeOH and blown to dryness. The sample and spiked sample were reconstituted in 0.75 mL of 0.003 M HCl for a 100x pre-concentration.

The Lawrence, Niedzwiadek, Menard method (2005) of prechromatographic oxidation and LC-fluorescence is the accepted AOAC International Official First Action Method due to the successful quantification of multiple variants of PSTs. Standards used to calibrate this method included saxitoxin (STX), decarbamoylsaxitoxin (dcSTX), gonyautoxin 2&3 (GTX2&3), gonyautoxin 5 (GTX5), decarbamoylgonyautoxin 2&3 (dcGTX2&3) and N-sulfocarbamoyl-gonyautoxin-2 and -3 (C1&2). The peroxide oxidation technique employed was as follows; 25 µL 10% (w/v) aqueous H_2O_2 was added to 250 µL 1 M NaOH and vortexed. One hundred microliters of sample and standards were added to the oxidant solution and allowed to react for 2 minutes at room temperature. Concentrated glacial acetic acid (25µL) was added to acidify the purine group and allow for fluorescence determination. Oxidation products were analyzed within 4 hours of their oxidation.

Analytical Methodology

PSPs
LC/FL
The AOAC LC/FL method was utilized with adaptations to achieve resolution of toxins. Fluorescence was monitored with an excitation of 340 nm and an emission of 396 nm. Paralytic shellfish toxins in samples were evaluated by comparing peak areas to standards and standard addition techniques.

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Summary of Results

Sample	STX (µg/L)	dcSTX (µg/L)	C1&C2 (µg/L)	dcGTX2&3 (µg/L)	dcSTX/ dcNEO (µg/L)	GTX2&3 (µg/L)	GTX 5 (µg/L)
Station Z	ND	ND	ND	ND	ND	ND	ND

ND = Not detected above the detection limit
Detection Limits = LC/FL: 0.2 µg/L STX, 0.1 µg/L C1C2, 0.1 µg/L dcGTX2&3, 0.1 µg/L dcSTX, 0.5 GTX 2&3, 1 µg/L GTX5, 1 µg/L dcNEO ELISA: 0.05 µg/L
Limit of Quantification = LC/FL: 0.4 µg/L STX, 0.2 µg/L C1C2, 0.2 µg/L dcGTX2&3, 0.2 µg/L dcSTX, 1 GTX 2&3, 2 µg/L GTX5, 2 µg/L dcNEO ELISA: 0.05 µg/L

LC/FL
Paralytic shellfish toxins were not detected utilizing the pre-column peroxide oxidation method.

References:
AOAC, 2005. Paralytic shellfish poison. Biological method. First action 1959. Official Methods of Analysis of the AOAC. Method 49.10.01.

Lawrence, J.F., Niedzwiadek, B., Menard, C., 2005. Quantitative determination of paralytic shellfish poisoning toxins in shellfish using prechromatographic oxidation and liquid chromatography with fluorescence detection: collaborative study. J. AOAC Int. 88, 1714-1732.

Submitted by: Mark T. Aubel, Ph.D.
Date: 9/7/11

Submitted to: Jason Fredrickson
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Microcystin Analysis Report

Project: TLBP (Tenmile South Lake)

Sample Identification	Sample Collection Date
South Lake Z	110906

Toxin – Microcystin (MC)

Sample Prep – The sample was ultra-sonicated to lyse cells and release toxins. A sample dilution (1:10) was necessary to accommodate the calibrated range for the microcystin (ELISA) analysis.

Analytical Methodology – A microcystins enzyme linked immunosorbent assay (ELISA) was utilized for the quantitative and sensitive congener-independent detection of MCs. The current assay is sensitive to down to an LOD/LOQ of 0.15 µg/L for total MCs. The average recovery of a laboratory fortified blank (LFB) spiked with 1 µg/L MCLR was 104%.

Summary of MC Results

Sample	MC level (µg/L)
South Lake Z	≈ 3

LOD/LOQ = 0.15 µg/L

Submitted by: Mark T. Aubel, Ph.D.

Date: 9/9/11

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Tenmile Lakes Basin Partnership

MICROCYSTIN RESULTS

Tested on: 9/9/2011
Method: Enzyme-Linked ImmunoSorbent Assay (ELISA)
Analyte: Microcystins
Analyzed by: Amanda Foss

Sample ID/ Date Collected	Initial Conc. Factor	Dilution Ratio	Assay Value, ug/L	Final Dilution Factor	Avg. LFB Recovery(%)	Avg. LFM Recovery (%)	Final Concentration (ug/L)	Average (ug/L)
Tenmile South Lake Z	1x	1:10	0.31	10	104	-	3.1	3
9/6/11	1x	1:10	0.24	10	104	-	2.4	

LOD/LOQ = 0.15 µg/L
LFB = 1.0 µg/L MCLR
LFM = 1.0 µg/L MCLR

Submitted by: Mark T. Aubel, Ph.D.
Date: 9/9/2011

Submitted to: Jason Fredrickson
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GreenWater laboratories aquatic analysis ... research ... consulting

Anatoxin-a Analysis Report

Project: TLBP (Tenmile Lake)

Sample Identification	Sample Collection Date
Tenmile Lake (Site Z)	111101

Toxin – Anatoxin-a (ANTX-A)

Sample Prep — The sample was ultra-sonicated to lyse cells and release toxins. Solid phase extraction (SPE) was utilized for ANTX-A extraction and preconcentration (100x). A duplicate sample was spiked (Lab Fortified Matrix, LFM) with 0.1 [tg/L ANTX-A, which provided quantitative capability and additional qualitative confirmation.

Analytical Methodology — Liquid chromatography/ mass spectrometry/ mass spectrometry (LC/MS/MS) was utilized for the determination of ANTX-A. The $[M+H]^+$ ion for ANTX-A (*m/z* 166) was fragmented and the major product ions (*m/z* 149, 131, 107, and 91) provided both specificity and sensitivity. The current methodology established a limit of detection (LOD) of 0.05 [tg/L and a limit of quantification (LOQ) of 0.1 p,g/L for ANTX-A.

Summary of ANTX-A Results

Sample	ANTX-A level (n / L)
Tenmile Lake (Site Z)	ND

ND = Not detected above the LOD LOD = 0.05 [tg/L (ANTX-A) LOQ = 0.1 [tg/L (ANTX-A)

Submitted by:Mark T. Aubel, Ph.D.

Date: 11/18/11

TLBP Toxin Analysis - Tenmile Lakes Watershed				
Report Date	10/4/2011			
Analysts:	Richard Litts			
	Jason Frederickson			
ELISA Kit #				
Sample ID	**Location**	**Collection Date and Time**	**Measured Microcystin levels (µg/L)**	**Reported Microcystin levels (µg/L)**
1	Davis Dock	9/30/2011	0.95	BVML
2*	Davis Tap	9/30/2011	0.09	BVML
3	Davis Dock	10/3/2011	0.89	BVML
4	Z	9/20/2011	0.78	BVML
5	Z	10/3/2011	0.67	BVML
6	Upper Carlson	10/3/2011	0.78	BVML
7	Davis Dock	9/20/2011	1.36	BVML
8	Davis Dock	9/30/2011	1.58	1.58
10	Coleman Upper	9/30/2011	1.03	BVML
Measuring limits:				
* Vaild Undiluted measurement range:				
	Freeze and Thaw lysis:	.15 - 5.0 µg/L		
	QuikLyse:	.17 - 5.55 µg/L		
Valid 1:10 dilution measurement range:				
	Freeze and Thaw lysis:	1.5 - 50.0 µg/L		
	QuikLyse:	1.7 - 55.5 µg/L		
Note: all samples ran at 1:10 unless marked with *				
BVML: Below Valid Measurement Limit				

Appendix III: Oregon DHS and Tenmile Lakes Harmful Algal Bloom Information

O**regon Health Division**
Drinking water treatment guidance
August 31, 2001

DHS Contact Information:

Harmful Algae Program Coordinator: Jennifer Ketterman at 877-290-6767
If she is not available call the main line for the Office of Environmental
Public Health at: (971) 673 – 0440 or
Toll Free: (877) 290 – 6767.

1. Treatment systems should consist of sand filtration followed by chlorination, followed by activated charcoal filtration. It is essential that sand filtration be done before disinfection to remove as many algal cells as possible without killing or rupturing them.

2. Chlorination systems should be capable of maintaining at least 1 ppm of chlorine residual for at least 20 minutes contact time before the water enters the activated charcoal system.

3. The final step in the process should be effective activated charcoal treatment to remove toxin remaining after the sand filtration and disinfection processes.

4. All treatment equipment used should meet NSF standard 53, and should be adequately sized to treat the maximum amount of water that you use. Treatment equipment needs regular monitoring and servicing to assure that it functions properly.

5. Ideally all water entering your home should be treated as recommended. It is possible to treat only water used in the kitchen, but this increases chances that animals or pets would inadvertently drink untreated water.

As more monitoring is done and toxin levels are measured this advisory may be altered. The advisory is to remain in effect until specifically changed or lifted by county and state health officials.

FACT SHEET

TOXIC *MICROCYSTIS* BLOOMS IN TENMILE LAKES

(information modified from Oregon Health Division Document: Hazards from *Microcystis aeruginosa* in Fresh Water – http://www.ohd.hr.state.or.us/esc/docs/mafact.htm)

➢ What is a toxic bloom of *Microcystis aeruginosa*?

Microcystis aeruginosa is a species of blue-green algae that grows naturally in many surface waters. In most bodies of fresh water and most weather conditions it does not pose a hazard to wildlife or human beings. However, under certain conditions (such as when the water is warm with abundant nutrients) *Microcystis aeruginosa* can grow more rapidly than normal. The result can be excessive numbers of large colonies that form floating masses on the water surface or that are dispersed within the water column. These occurrences are called "algal blooms". *Microcystis aeruginosa* can produce natural toxins (called microcystins) that are very potent, and these toxins are higher in concentration during bloom conditions. The microcystin toxins are produced and contained inside the *Microcystis* cells, and are released to the water when the cells die and disintegrate. Also, since the cells are very small, they can be ingested along with the water. Toxin levels in a water body tend to be higher near shorelines and at the surface of the water where animal and human contact is most likely.

➢ What are the primary toxic effects of these blooms?

The primary toxic effect of microcystins is on the liver. At very high doses, death of liver cells and destruction of blood vessels in the liver can result in serious injury and possibly death. Though less is known about the long-term effects of microcystin toxins, animal studies have shown these toxins can cause chronic liver damage and may promote the formation of liver tumors. These effects are more likely to occur if exposure is frequent over a long period of time.

The levels of toxin necessary to produce immediate or acute illness in humans and animals are much higher than levels that may cause chronic liver injury. Drinking water standards are usually based on chronic effects. Currently, there is no drinking water standard in the U.S. for microcystins. Canada, Australia, and Great Britain have developed a guideline level of 1 microgram toxin per liter of water, or 1 part per billion (1 ppb). During algal blooms, toxin levels can greatly exceed 1 ppb.

➢ How is it determined when the water becomes safe once a bloom is reported?

Changes in weather or in other conditions in a water body influence the growth of blue-green algae. Generally, cooler weather, rainfall, and reduced sunshine will lead to reductions in algal growth and toxin levels. Algal blooms generally peak and die off rapidly and toxin levels in the water decline over days or weeks. Only blue-green algae experts can distinguish visually between different kinds of algal growth, and are able to determine when blooms have disappeared. Testing of the water is the only way to be certain that toxin levels are no longer dangerous.

➢ When does the Oregon Health Division Issue Warnings?

Drinking Water -- When measured or estimated toxin levels reach 1 ug/l the Department of Human Services, Office of Public Health Systems issues public advisories or warnings. These will include warnings regarding the use of water for drinking or food preparation unless the water has been treated following specific guidelines for destroying and removing toxins. Animals should be kept away from water during periods when microcystin toxin levels exceed 1 ug/l, because drinking the water can cause serious or even fatal illness.

Contact Recreation -- If levels are high enough to pose hazards for swimming, water-skiing or other direct skin contact activities, the advisories will warn against water contact. Generally skin hazards occur where the water has a green or blue-green color or where there are visible clumps or mats of algae present in the water. When measured toxin levels reach 5 ug/L or cell counts reach 15,000 cells/ml, contact recreation is considered unsafe.

➢ Can testing ensure that all areas of the lake are safe?

No, due to the patchy nature of blue-green algal blooms it is possible for higher *Microcystis* densities (and therefore higher microcystin toxin concentrations) to be present in areas not sampled in a given survey, particularly along shorelines or during calm conditions of little to no wind. Therefore, when a lake has a demonstrated history of algal toxicity or the presence of known toxin producing algal species, those utilizing the lake for drinking water should always follow Oregon Health Division recommendations for purification. In addition, recreational users should always avoid contact with water whenever noticeable surface concentrations of algae are evident or when the lake has an obvious green to blue-green appearance.

➢ Are domestic animals at risk during blooms?

Yes, pets or other domestic animals are the most likely to ingest contaminated water, these animals should not be allowed access to the lakeshore whenever either noticeable surface concentrations of algae or an obvious green to blue-green appearance is evident.

➢ Is it safe to eat fish and other aquatic life?

Clams, mussels, snails and other shellfish should not be eaten during microcystin advisory periods, but it is believed that fish can be safely eaten if they are cleaned and all internal organs discarded. Internal organs of such fish may be toxic even to animals.

➢ How much does testing cost?

Samples must be shipped to qualified laboratories for analysis. A microscopic determination to quantify the number of Microcystis colonies and cells costs $90 per sample. A specialized test to analyze for the microcystin toxin concentration costs $100 per sample (overnight shipping costs not included), and for anatoxins the cost is $250/sample .

NOTE: Additional information can be obtained online from the Oregon Harmful Algae Bloom Surveillance Program: http://www.oregon.gov/DHS/ph/hab/

Appendix IV: Oregon Health Authority Public Health Advisory and Lifting Notice

Aug. 25, 2011

Media contact: Christine Stone, Oregon Public Health, 971-673-1282, desk; 503-602-8027, cell; Christine.l.stone@state.or.us.
Technical questions: Jennifer Ketterman, Oregon Public Health, 971-673-0431; Bonnie Widerburg, Oregon Public Health, 971-673-0976.

Oregon Public Health Division issues advisory for South Tenmile Lake *High algae levels found in Coos County South Tenmile Lake*

A health advisory prompted by high algae levels found in SouthTenmile Lake, located 10 miles north of North Bend, was issued today by Oregon Health Authority's Public Health Division and Coos County Health Department officials.

Water monitoring has confirmed the presence of blue-green algae that can produce toxins harmful to humans and animals. These algae levels are likely to be associated with dangerous toxin concentrations in the water, according to World Health Organization guidelines.

Swallowing or inhaling water droplets should be avoided, as well as skin contact with water by humans or animals.

Drinking water from South Tenmile Lake is especially dangerous. Oregon Public Health officials advise campers and other South Tenmile Lake visitors that toxins cannot be removed by boiling, filtering or treating the water with camping-style filters.

People who draw in-home water directly from South Tenmile Lake are advised to use an alternative water source because private treatment systems are not proven effective in removing algae toxins. However, public drinking water systems can reduce algae toxins through proper filtration and disinfection. If people on public water systems have questions about treatment and testing, they should contact their water supplier.

Oregon health officials recommend that people who choose to eat fish from waters where algae blooms are present should remove all fat, skin and organs before cooking since toxins are more likely to collect in these tissues.

Additionally, public health officials advise that people should not eat freshwater clams from SouthTenmile Lake. Crayfish muscle can be eaten, but internal organs and liquid fat should be discarded.

Exposure to toxins can produce symptoms of numbness, tingling and dizziness that can lead to difficulty breathing or heart problems and require immediate medical attention. Symptoms of skin irritation, weakness, diarrhea, nausea, cramps and fainting should also receive medical attention if they persist or worsen. Children and pets are particularly susceptible.

The public will be advised when the concern no longer exists.

With proper precautions to avoid water contact, people are encouraged to visit South Tenmile Lake and enjoy activities such as camping, hiking, biking, picnicking, fishing and bird watching. Boating is safe as long as speeds do not create excessive water spray, which could lead to inhalation risk.

For local information contact the Tenmile Lake Basin Partnership, 541-759-2414.

For health information, contact the Harmful Algae Bloom Surveillance (HABS) program at 971-673-0400 or www.healthoregon.org/hab; also contact the Oregon Public Health Division toll-free information line at 1-877-290-6767 or Coos County Health Department at 541-756-2020.

The HABS program maintains a current list of all health advisories on its Website. To find out if an advisory has been issued or lifted for a specific water body, visit www.healthoregon.org/hab and click on “Current Lake Conditions.”

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The Oregon Health Authority is at the forefront of lowering and containing costs, improving quality and increasing access to health care in order to improve the lifelong health of Oregonians.

PUBLIC HEALTH DIVISION

John A. Kitzhaber, M.D., Governor

Oregon Health Authority

www.oregon.gov/OHA

News release

Nov. 21, 2011

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Algae advisory lifted for South Tenmile Lake

Health officials confirm reduced blue-green algae levels

A health advisory prompted by high algae levels found in South Tenmile Lake, located 10 miles north of North Bend, was lifted today by the Oregon Health Authority's Public Health Division and Coos County Health Department officials. The advisory went into effect Aug. 25, 2011.

Water monitoring has confirmed reduced levels of blue-green algae that can produce toxins harmful to humans and animals.

These reduced levels are not likely to be associated with dangerous toxin concentrations in the water, according to World Health Organization guidelines.

Oregon health officials advise people who recreate in Oregon water bodies to always be alert to signs of algae blooms. People and their pets should avoid water contact if there are visible clumps of algae in the water.

For local information, contact the Tenmile Lake Basin Partnership, 541-759-2414.

For health information, contact the Harmful Algae Bloom Surveillance program at 971-673-0400 or healthoregon.org/hab; also contact Oregon Public Health's toll-free information line at 1-877-290-6767 or Coos County Health Department at 541-756-2020.