**TECHNICAL MEMORANDUM**

# Results of Cyanobacteria and Microcystin Monitoring in the Vicinity of the Klamath Hydroelectric Project: June 22, 2009

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## Introduction

This technical memorandum summarizes the latest results of monitoring during 2009 for cyanobacteria species and the associated toxin microcystin in Copco and Iron Gate reservoirs in PacifiCorp's Klamath Hydroelectric Project (Project) and in one monitoring station in the Klamath River below Iron Gate dam. This monitoring is particularly focused on *Microcystis aeruginosa* (MSAE), a cyanobacterium with a recent history of summertime blooms in Copco and Iron Gate reservoirs that is known to produce microcystin. This monitoring also estimates the presence of other potentially-toxigenic cyanobacteria, including *Anabaena spp*. and *Planktothrix (Oscillatoria) spp*. This monitoring is being conducted pursuant to Interim Measure 12, Water Quality Monitoring, contained in the Klamath Hydroelectric Project Agreement in Principle (AIP) executed between the United States Department of Interior, the States of California and Oregon, and PacifiCorp.

The results specifically addressed in this memorandum are for samples collected on June 22, 2009. Subsequent memoranda such as this will be prepared every two weeks to report the results of continued monitoring. PacifiCorp plans to prepare a final report of the results and interpretation of the complete set of collected data after the conclusion of the sampling effort in winter 2009.

## Methods

PacifiCorp is conducting phytoplankton sampling for laboratory analysis of potentially-toxigenic cyanobacteria, notably MSAE, and microcystin at six sites in Copco and Iron Gate reservoirs and one site below Iron Gate dam as listed in Table 1, including:

- Two open-water reservoir sites in the lower ends of Iron Gate and Copco reservoirs (near the log booms). These sites are part of the basic water quality monitoring that is being performed under the 2009 AIP Measure 12 plan (in draft).
- Four shoreline sites in coves in Copco and Iron Gate reservoir (i.e., two cove sites in each reservoir).
- One Klamath River site below Iron Gate dam near the hatchery bridge.

Sampling will occur at the two open-water monitoring sites once per month in June through December. Samples will be taken at the shoreline locations in the reservoirs twice per month in June through October. Samples for the river site below Iron Gate dam will be collected twice per month in June, July and October and weekly in August and September.

Phytoplankton samples from the river sites are taken as grab samples offshore according to the standard operating procedure (SOP) developed by the Klamath Blue Green Algae Working Group (in draft). At the open-water reservoir sites public health samples will be collected according to the published SOP. Additional samples, including a grab sample at 0.5 m depth and an integrated sample over 8 m depth, will be collected as part of the baseline water quality monitoring.

Samples for phytoplankton speciation, density, and biovolume are preserved in Lugol's solution and sent to Aquatic Analysts in Milwaukie, Oregon for analysis. The laboratory analysis of phytoplankton speciation and density is done on prepared microscope slides of filtered samples using phase contrast microscopy. Species are counted as algal units of cell, filament, or colony depending on the natural growth form of the species. Algal forms are identified to species or otherwise to the lowest practicable taxonomic level. Biovolumes are estimated by multiplying the cell counts by the average geometric dimensions of the cells for a given phytoplankton taxa. Results for cyanobacteria species are reported as individual cells per milliliter.

Samples for determination of microcystin toxin are placed in a cooler on ice and shipped the EPA Region 9 Laboratory in Richmond, California. The samples are analyzed using the competitive Enzyme-Linked ImmunoSorbent Assay (ELISA) method based on the EnviroLogix QuantiPlate Kit for Microcystins. The quantitation limit is 0.16 µg/L or parts per billion (ppb). This test method does not distinguish between the specific microcystin congeners, but detects their presence to differing degrees. That is, ELISA test results yield one value as the sum of all measurable microcystin variants.

Table 1. Sites of Cyanobacteria and Microcystin Public Health Monitoring in Copco and Iron Gate Reservoirs during 2009

| Location | Approximate River Mile | Site ID |
|---|---|---|
| Copco reservoir at Mallard Cove ramp | 201.5 | CRMC |
| Copco reservoir at Copco Cove ramp | 200.0 | CRCC |
| Copco reservoir near dam at cable line | 198.6 | CR01 |
| Iron Gate reservoir at Camp Creek ramp | 192.8 | IRCC |
| Iron Gate reservoir at Williams campground | 192.4 | IRJW |
| Iron Gate reservoir near dam at log boom | 190.2 | IR01 |
| Klamath R. at Iron Gate Hatchery bridge | 189.7 | KRBI |

# Results

## Samples of June 22, 2009

Five samples were collected for public health purposes on June 22, 2009. Samples were collected from Mallard Cove and Copco Cove in Copco reservoir, from Jay Williams campground and Camp Creek campground in Iron Gate reservoir, and from the Klamath River below Iron Gate dam near the Iron Gate hatchery bridge. Samples were sent to the EPA Region 9 laboratory for analysis for microcystin, and to Aquatic Analysts for cyanobacteria species identification and enumeration. Results for microcystin analysis for June 22 samples are not yet available.

The results of cyanobacteria species identification and enumeration are summarized in Table 2; cumulative data are included in Appendix 1. Two cyanobacteria species were present in the samples collected on June 22, 2009; *Anabaena flos-aquae*, and *Aphanizomenon flos-aquae*. Both species have been reported to produce anatoxin, a potentially dangerous neurotoxin (Codd et al 2005), although *Aphanizomenon* does not appear to produce toxins in Upper Klamath Lake or the Klamath River. Both species were observed at all sites sampled except for Mallard Cove on Copco reservoir where *Anabaena* was absent. The concentration of *Anabaena flos-aquae* at Camp Creek in Iron Gate reservoir could present a low risk of adverse health effects to individuals engaging in water contact recreation.[1] The abundance of *Anabaena flos-aquae* at Camp Creek in Iron Gate reservoir and *Aphanizomenon flos-aquae* at Copco Cove in Copco Reservoir approached or exceeded the WHO recommended guidelines. The abundance of cyanobacteria at other sites was relatively low. Laboratory data sheets are included as Appendix 2.

Table 2. Summary of cyanobacteria and microcystin public health monitoring results in Copco and Iron Gate Reservoirs on June 22, 2009.

| Date | Sample | Location[1] | Species | Biovolume, $\mu m^3$/mL | Rank[2] | Cells/mL |
|---|---|---|---|---|---|---|
| 6/22/09 | KR9064 | CRMC | *Aphanizomenon flos-aquae* | 826,007 | 1 | 13,111 |
| 6/22/09 | KR9065 | CRCC | *Anabaena flos-aquae* | 61,364 | 4 | 916 |
| | | | *Aphanizomenon flos-aquae* | 1,262,193 | 1 | 20,035 |
| 6/22/09 | KR9066 | IRJW | *Anabaena flos-aquae cells/mL* | 22,136 | 12 | 330 |
| | | | *Aphanizomenon flos-aquae* | 272,567 | 3 | 4,326 |
| 6/22/09 | KR9067 | IRCC | *Anabaena flos-aquae* | 1,303,884 | 1 | 19,461 |
| | | | *Aphanizomenon flos-aquae* | 406,734 | 2 | 6,456 |
| 6/22/09 | KR9068 | KRBI | *Aphanizomenon flos-aquae* | 83,305 | 2 | 1,322 |
| | | | *Anabaena flos-aquae* | 14,238 | 10 | 213 |

[1]CRMC = Copco reservoir at Mallard Cove ramp, CRCC = Copco reservoir at Copco Cove ramp, IRCC = Iron Gate reservoir at Camp Creek ramp, IRJW = Iron Gate reservoir at Williams campground, KRBI = Klamath R. at Iron Gate Hatchery bridge
[2]Rank = The rank of the species in the sample based on the count of algal units.

# References

Codd, G. A., J. Lindsay, F. M. Young, L. F. Morrison, and J. S. Metcalf. 2005. Harmful cyanobacteria: from mass mortalities to management measures. In Harmful Cyanobacteria, J. Juisman, H. C. P. Matthijs, and P. M. Visser eds. Springer 2005.

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[1] The World Health Organization (WHO) has recommended guidelines for safe recreational water environments based on a low, moderate, or high probability of adverse health effects from exposure to concentrations of cyanobacterial cells and microcystin toxins in recreational waters (WHO 2003). The WHO guideline values for low and moderate probability of adverse health in recreational waters are 20,000 and 100,000 cyanobacterial cells/mL, respectively. WHO equates these cell count values to microcystin toxin concentrations of 4 µg/L and 20 µg/L, respectively (WHO 2003). The WHO guideline for high probability of adverse health effects is a narrative; i.e., "Cyanbacterial scum formation in areas where whole-body contact and/or risk of ingestion/aspiration occur". No specific cyanobacterial cell or microcystin concentrations are provided by WHO for high probability of adverse health effects. The WHO (2003) guidance values were derived from calculations based on a 20 kg child that would swim for up to two hours (in a day) and would accidentally ingest 0.05 L of water per hour.

The California State Water Resources Control Board (SWRCB 2007) and Oregon Department of Health Services (ODHS 2005) provide guidelines for posting advisories in recreation waters. These guidelines were developed using information provided in WHO (2003). Both SWRCB (2007) and ODHS (2005) recommend posting advisories in recreation waters under three circumstances: (1) if "scum is present associated with toxigenic species"; (2) if scum is not present, but the density of *Microcystis* or *Planktothrix* is 40,000 cells/ml or greater; and (3) if scum is not present, but the density of all potentially toxigenic BGA is 100,000 cells/ml or greater. Based on WHO (2003) information, SWRCB (2007) and ODHS (2005) indicate that cell counts of 40,000 cells/mL and 100,000 cells/mL equate to microcystin toxin concentrations of 8 µg/L and 20 µg/L, respectively.

ODHS. 2005. Public Health Advisory Guidance for Toxigenic Cyanobacteria in Recreational Waters. Oregon Department of Human Services, Environmental Toxicology Program.

PacifiCorp. 2008. Agreement in Principle to address issues pertaining to the resolution of certain litigation and other controversies in the Klamath Basin, including a path forward for possible Facilities removal. U.S. Secretary of the Interior, November 18, 2008.

SWRCB. 2007. Cyanobacteria in California Recreational Water Bodies: Providing Voluntary Guidance about Harmful Algal Blooms, Their Monitoring, and Public Notification. June 2007. Document provided as part of Blue-green Algae Work Group of State Water Resources Control Board (SWRCB) and Office of Environmental Health and Hazard Assessment (OEHHA).

World Health Organization (WHO). 2003. Guidelines for safe recreational waters, Volume 1 – Coastal and fresh waters, Chapter 8: Algae and cyanobacteria in fresh water. WHO Publishing, Geneva, pp. 136-158.

# Appendix 1

## Cumulative Data for 2009 Public Health Samples.

| Date | Sample | Location[1] | Species | Biovolume, $\mu m^3$/mL | Rank[2] | Cells/mL |
|---|---|---|---|---|---|---|
| 6/8/09 | KR9059 | CRMC | *Anabaena flos-aquae* | 271,627,386 | 1 | 4,054,140 |
| 6/8/09 | KR9060 | CRCC | *Anabaena flos-aquae* | 1,019,824 | 2 | 15,221 |
| | | | *Aphanizomenon flos-aquae* | 9,471 | 26 | 150 |
| 6/8/09 | KR9061 | IRJW | *Anabaena flos-aquae* | 18,829,827 | 1 | 281,042 |
| 6/8/09 | KR9062 | IRCC | *Anabaena flos-aquae* | 83,936 | 2 | 1,253 |
| 6/8/09 | KR9063 | KRBI | *Aphanizomenon flos-aquae* | 12,353 | 26 | 196 |
| | | | *Anabaena flos-aquae* | 9,306 | 27 | 139 |
| 6/22/09 | KR9064 | CRMC | *Aphanizomenon flos-aquae* | 826,007 | 1 | 13,111 |
| 6/22/09 | KR9065 | CRCC | *Anabaena flos-aquae* | 61,364 | 4 | 916 |
| | | | *Aphanizomenon flos-aquae* | 1,262,193 | 1 | 20,035 |
| 6/22/09 | KR9066 | IRJW | *Anabaena flos-aquae* | 22,136 | 12 | 330 |
| | | | *Aphanizomenon flos-aquae* | 272,567 | 3 | 4,326 |
| 6/22/09 | KR9067 | IRCC | *Anabaena flos-aquae* | 1,303,884 | 1 | 19,461 |
| | | | *Aphanizomenon flos-aquae* | 406,734 | 2 | 6,456 |
| 6/22/09 | KR9068 | KRBI | *Aphanizomenon flos-aquae* | 83,305 | 2 | 1,322 |
| | | | *Anabaena flos-aquae* | 14,238 | 10 | 213 |

[1]CRMC = Copco reservoir at Mallard Cove ramp, CRCC = Copco reservoir at Copco Cove ramp, IRCC = Iron Gate reservoir at Camp Creek ramp, IRJW = Iron Gate reservoir at Williams campground, KRBI = Klamath R. at Iron Gate Hatchery bridge

[2]Rank = The rank of the species in the sample based on the count of algal units.

# Appendix 2

## Laboratory Data Sheets for June 22, 2009 Public Health Samples.

## Phytoplankton Sample Analysis

**Sample:** Klamath Basin
**Sample Site:** KR 9064
**Sample Depth:**
**Sample Date:** 22-Jun-09

**Total Density (#/mL):** 1,756
**Total Biovolume ($um^3$/mL):** 2,050,729
**Trophic State Index:** 55.0

| | Species | Density #/mL | Density Percent | Biovolume $um^3$/mL | Biovolume Percent |
|---|---|---|---|---|---|
| 1 | Aphanizomenon flos-aquae | 596 | 33.9 | 826,007 | 40.3 |
| 2 | Rhodomonas minuta | 467 | 26.6 | 9,342 | 0.5 |
| 3 | Melosira granulata | 322 | 18.3 | 1,027,636 | 50.1 |
| 4 | Chlamydomonas sp. | 97 | 5.5 | 31,409 | 1.5 |
| 5 | Cryptomonas erosa | 32 | 1.8 | 16,751 | 0.8 |
| 6 | Cocconeis placentula | 32 | 1.8 | 14,819 | 0.7 |
| 7 | Stephanodiscus hantzschii | 32 | 1.8 | 3,866 | 0.2 |
| 8 | Nitzschia palea | 16 | 0.9 | 2,899 | 0.1 |
| 9 | Rhoicosphenia curvata | 16 | 0.9 | 1,885 | 0.1 |
| 10 | Chromulina sp. | 16 | 0.9 | 322 | 0.0 |
| 11 | Stephanodiscus astraea minutula | 16 | 0.9 | 5,638 | 0.3 |
| 12 | Fragilaria construens | 16 | 0.9 | 72,160 | 3.5 |
| 13 | Schroderia sp. | 16 | 0.9 | 725 | 0.0 |
| 14 | Amphora ovalis | 16 | 0.9 | 9,310 | 0.5 |
| 15 | Melosira varians | 16 | 0.9 | 20,939 | 1.0 |
| 16 | Asterionella formosa | 16 | 0.9 | 3,544 | 0.2 |
| 17 | Nitzschia frustulum | 16 | 0.9 | 1,933 | 0.1 |
| 18 | Nitzschia amphibia | 16 | 0.9 | 1,546 | 0.1 |

Aphanizomenon flos-aquae cells/mL = 13,111
Aphanizomenon flos-aquae heterocysts/mL = 177

**Aquatic Analysts** **Sample ID:** ML23

## Phytoplankton Sample Analysis

**Sample:** Klamath Basin
**Sample Site:** KR 9065
**Sample Depth:**
**Sample Date:** 22-Jun-09

**Total Density (#/mL):** 2,043
**Total Biovolume (um$^3$/mL):** 1,815,813
**Trophic State Index:** 54.1

| | Species | Density #/mL | Density Percent | Biovolume um$^3$/mL | Biovolume Percent |
|---|---|---|---|---|---|
| 1 | Aphanizomenon flos-aquae | 1,336 | 65.4 | 1,262,193 | 69.5 |
| 2 | Melosira granulata | 191 | 9.3 | 367,305 | 20.2 |
| 3 | Rhodomonas minuta | 87 | 4.2 | 1,735 | 0.1 |
| 4 | Anabaena flos-aquae | 83 | 4.1 | 61,364 | 3.4 |
| 5 | Fragilaria vaucheriae | 69 | 3.4 | 23,979 | 1.3 |
| 6 | Cocconeis placentula | 52 | 2.5 | 23,938 | 1.3 |
| 7 | Rhoicosphenia curvata | 52 | 2.5 | 6,089 | 0.3 |
| 8 | Stephanodiscus hantzschii | 35 | 1.7 | 4,163 | 0.2 |
| 9 | Melosira varians | 17 | 0.8 | 11,275 | 0.6 |
| 10 | Gomphonema subclavatum | 17 | 0.8 | 10,408 | 0.6 |
| 11 | Ankistrodesmus falcatus | 17 | 0.8 | 434 | 0.0 |
| 12 | Trachelomonas volvocina | 17 | 0.8 | 32,698 | 1.8 |
| 13 | Chromulina sp. | 17 | 0.8 | 347 | 0.0 |
| 14 | Nitzschia frustulum | 17 | 0.8 | 2,082 | 0.1 |
| 15 | Navicula pupula | 17 | 0.8 | 4,683 | 0.3 |
| 16 | Nitzschia palea | 17 | 0.8 | 3,122 | 0.2 |

Aphanizomenon flos-aquae cells/mL = 20,035
Aphanizomenon flos-aquae heterocysts/mL = 208

Anabaena flos-aquae cells/mL = 916
Anabaena flos-aquae heterocysts/mL = 503
Anabaena flos-aquae akinetes/mL = 42

**Aquatic Analysts** **Sample ID:** ML24

## Phytoplankton Sample Analysis

**Sample:** Klamath Basin
**Sample Site:** KR 9066
**Sample Depth:**
**Sample Date:** 22-Jun-09

**Total Density (#/mL):** 1,539
**Total Biovolume (um$^3$/mL):** 2,068,875
**Trophic State Index:** 55.1

| | Species | Density #/mL | Density Percent | Biovolume um$^3$/mL | Biovolume Percent |
|---|---|---|---|---|---|
| 1 | Melosira granulata | 577 | 37.5 | 1,269,093 | 61.3 |
| 2 | Fragilaria construens | 262 | 17.0 | 381,777 | 18.5 |
| 3 | Aphanizomenon flos-aquae | 144 | 9.4 | 272,567 | 13.2 |
| 4 | Fragilaria vaucheriae | 131 | 8.5 | 37,758 | 1.8 |
| 5 | Fragilaria construens venter | 118 | 7.7 | 18,690 | 0.9 |
| 6 | Cocconeis placentula | 52 | 3.4 | 24,123 | 1.2 |
| 7 | Nitzschia frustulum | 52 | 3.4 | 6,293 | 0.3 |
| 8 | Rhoicosphenia curvata | 39 | 2.6 | 5,982 | 0.3 |
| 9 | Stephanodiscus hantzschii | 39 | 2.6 | 4,720 | 0.2 |
| 10 | Nitzschia amphibia | 39 | 2.6 | 3,776 | 0.2 |
| 11 | Sphaerocystis schroeteri | 26 | 1.7 | 9,177 | 0.4 |
| 12 | Anabaena flos-aquae | 18 | 1.2 | 22,136 | 1.1 |
| 13 | Ankistrodesmus falcatus | 13 | 0.9 | 328 | 0.0 |
| 14 | Stephanodiscus astraea minutula | 13 | 0.9 | 4,589 | 0.2 |
| 15 | Gomphonema subclavatum | 13 | 0.9 | 7,866 | 0.4 |

Aphanizomenon flos-aquae cells/mL = 4,326
Aphanizomenon flos-aquae heterocysts/mL = 79

Anabaena flos-aquae cells/mL = 330
Anabaena flos-aquae heterocysts/mL = 16

**Aquatic Analysts** **Sample ID:** ML25

## Phytoplankton Sample Analysis

**Sample:** Klamath Basin
**Sample Site:** KR 9067
**Sample Depth:**
**Sample Date:** 22-Jun-09

**Total Density (#/mL):** 1,637
**Total Biovolume ($um^3$/mL):** 2,377,851
**Trophic State Index:** 56.1

| | Species | Density #/mL | Density Percent | Biovolume $um^3$/mL | Biovolume Percent |
|---|---|---|---|---|---|
| 1 | Anabaena flos-aquae | 649 | 39.6 | 1,303,884 | 54.8 |
| 2 | Aphanizomenon flos-aquae | 340 | 20.8 | 406,734 | 17.1 |
| 3 | Melosira granulata | 139 | 8.5 | 397,560 | 16.7 |
| 4 | Chlamydomonas sp. | 108 | 6.6 | 35,138 | 1.5 |
| 5 | Gomphonema subclavatum | 62 | 3.8 | 37,068 | 1.6 |
| 6 | Rhodomonas minuta | 62 | 3.8 | 1,236 | 0.1 |
| 7 | Fragilaria construens | 62 | 3.8 | 48,436 | 2.0 |
| 8 | Cocconeis placentula | 46 | 2.8 | 21,314 | 0.9 |
| 9 | Nitzschia palea | 31 | 1.9 | 5,560 | 0.2 |
| 10 | Rhoicosphenia curvata | 15 | 0.9 | 1,807 | 0.1 |
| 11 | Fragilaria vaucheriae | 15 | 0.9 | 4,448 | 0.2 |
| 12 | Nitzschia amphibia | 15 | 0.9 | 1,483 | 0.1 |
| 13 | Sphaerocystis schroeteri | 15 | 0.9 | 17,299 | 0.7 |
| 14 | Trachelomonas volvocina | 15 | 0.9 | 29,114 | 1.2 |
| 15 | Nitzschia paleacea | 15 | 0.9 | 1,514 | 0.1 |
| 16 | Stephanodiscus hantzschii | 15 | 0.9 | 1,853 | 0.1 |
| 17 | Ankistrodesmus falcatus | 15 | 0.9 | 386 | 0.0 |
| 18 | Fragilaria capucina mesolepta | 15 | 0.9 | 63,016 | 2.7 |

Aphanizomenon flos-aquae cells/mL = 6,456
Aphanizomenon flos-aquae heterocysts/mL = 31

Anabaena flos-aquae cells/mL = 19,461
Anabaena flos-aquae heterocysts/mL = 942
Anabaena flos-aquae akinetes/mL = 93

**Aquatic Analysts** **Sample ID:** ML26

## Phytoplankton Sample Analysis

**Sample:** Klamath Basin
**Sample Site:** KR 9068
**Sample Depth:**
**Sample Date:** 22-Jun-09

**Total Density (#/mL):** 434
**Total Biovolume (um$^3$/mL):** 500,364
**Trophic State Index:** 44.9

| | Species | Density #/mL | Density Percent | Biovolume um$^3$/mL | Biovolume Percent |
|---|---|---|---|---|---|
| 1 | Melosira granulata | 170 | 39.2 | 345,971 | 69.1 |
| 2 | Aphanizomenon flos-aquae | 66 | 15.3 | 83,305 | 16.6 |
| 3 | Cocconeis placentula | 47 | 10.9 | 21,724 | 4.3 |
| 4 | Ankistrodesmus falcatus | 28 | 6.5 | 708 | 0.1 |
| 5 | Nitzschia frustulum | 19 | 4.4 | 2,267 | 0.5 |
| 6 | Cryptomonas erosa | 14 | 3.3 | 7,367 | 1.5 |
| 7 | Achnanthes lanceolata | 9 | 2.2 | 1,700 | 0.3 |
| 8 | Rhodomonas minuta | 9 | 2.2 | 189 | 0.0 |
| 9 | Chlamydomonas sp. | 9 | 2.2 | 3,070 | 0.6 |
| 10 | Anabaena flos-aquae | 9 | 2.0 | 14,238 | 2.8 |
| 11 | Synedra delicatissima | 5 | 1.1 | 3,117 | 0.6 |
| 12 | Cocconeis klamathensis | 5 | 1.1 | 1,322 | 0.3 |
| 13 | Gloeocystis ampla | 5 | 1.1 | 2,418 | 0.5 |
| 14 | Melosira varians | 5 | 1.1 | 3,070 | 0.6 |
| 15 | Gomphonema angustatum | 5 | 1.1 | 850 | 0.2 |
| 16 | Gomphonema subclavatum | 5 | 1.1 | 2,834 | 0.6 |
| 17 | Synedra radians | 5 | 1.1 | 1,700 | 0.3 |
| 18 | Stephanodiscus astraea minutula | 5 | 1.1 | 1,653 | 0.3 |
| 19 | Nitzschia dissipata | 5 | 1.1 | 1,270 | 0.3 |
| 20 | Asterionella formosa | 5 | 1.1 | 1,039 | 0.2 |
| 21 | Rhoicosphenia curvata | 5 | 1.1 | 553 | 0.1 |

Aphanizomenon flos-aquae cells/mL = 1,322
Aphanizomenon flos-aquae heterocysts/mL = 7

Anabaena flos-aquae cells/mL = 213
Anabaena flos-aquae heterocysts/mL = 8

**Aquatic Analysts** **Sample ID:** ML27