

## TECHNICAL MEMORANDUM

Results of Cyanobacteria and Microcystin Monitoring in the Vicinity of the Klamath Hydroelectric Project: July 11<sup>th</sup> and 16<sup>th</sup>, 2013

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## Introduction

This technical memorandum summarizes the results for the public health monitoring conducted July 11<sup>th</sup> and July 16<sup>th</sup>, 2013 for cyanobacteria species and the associated toxin, microcystin, in Copco and Iron Gate reservoirs within PacifiCorp's Klamath Hydroelectric Project (Project) and at 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 and that is known to produce microcystin. This monitoring also estimates the presence of other potentially-toxic cyanobacteria, including *Anabaena* spp., *Planktothrix (Oscillatoria)* spp. and others. This monitoring is being conducted pursuant to Interim Measure 15, Water Quality Monitoring Activities, contained in the Klamath Hydroelectric Settlement Agreement (KHSA) executed between the United States Department of Interior, the states of California and Oregon, PacifiCorp, and other parties.

The data summarized in this memorandum also include results the previous 2013 public health sampling events (see Appendix 1).

## Methods

PacifiCorp is conducting phytoplankton sampling at 5 sites (Table 1) for laboratory analysis of potentially toxigenic cyanobacteria, notably MSAE, and microcystin at:

- Four shoreline sites in coves in Copco and Iron Gate reservoirs (i.e., two cove sites in each reservoir).
- One Klamath River site below Iron Gate Dam near the hatchery bridge.

Samples are planned to be taken at shoreline locations in the reservoirs once in May; and twice per month in June, July, August, September, October, and November. Samples to be collected from the river site below Iron Gate Dam are scheduled to be collected according to the discretion of the sampling entity (PacifiCorp) based on river conditions.

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 (<http://www.kbmp.net/collaboration/klamath-hydroelectric-settlement-agreement-monitoring>). Additional samples, collected at open water sites in Copco and Iron Gate reservoirs, 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 potentially toxic phytoplankton are preserved in Lugol's solution and sent to Aquatic Analysts in Friday Harbor, Washington for analysis. The laboratory analysis of phytoplankton speciation and abundance is performed 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. 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 to 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 0.18 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 measurable microcystin variants.

<b>Table 1. Sites of cyanobacteria and microcystin public health monitoring in Copco and Iron Gate reservoirs and the Klamath River during 2013.</b>		
<b>Location<sup>a</sup></b>	<b>Approximate River Mile</b>	<b>Site ID</b>
Copco Reservoir at Mallard Cove	201.5	CRMC
Copco Reservoir at Copco Cove	200.0	CRCC
Iron Gate Reservoir at Camp Creek	192.8	IRCC
Iron Gate Reservoir at John Williams campground	192.4	IRJW
Klamath River below Iron Gate dam near hatchery bridge	189.7	KRBI

## Results

Laboratory data sheets for the July 11<sup>th</sup> and 16<sup>th</sup> sampling are provided in Appendix 2. A summary of these result sheets is contained within Table 2. Because the cell counts were above the California posting guidelines<sup>1</sup>, Copco and Iron Gate reservoirs were posted with public health advisories on June 18 and June 27, respectively (Appendix 1). The Klamath River below Iron Gate dam site (KRBI) continues to be below the posting guidelines.

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<sup>1</sup> The California State Water Resources Control Board provides guidelines for posting advisories in recreation water (SWRCB 2010). SWRCB recommends 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.

**Table 2.** Summary of public health monitoring (July 11<sup>th</sup> and 16<sup>th</sup>, 2013).

Date	Time	Location	RM	Sample ID	Depth	MSAE <sup>(1)</sup>	AFA <sup>(2)</sup>	ANA <sup>(3)</sup>	Other <sup>(6), (7), (8), (9), or (10)</sup>	Microcystin (µg/L)
7/11/2013	14:35	KRBI	189.7	KR13821	SG	16,443	0	0	0	*
7/16/2013	12:20	KRBI	189.7	KR13828	SG	10,585	537	0	0	*

<sup>1</sup>MSAE = *Microcystis aeruginosa* (cells/mL)

<sup>2</sup>AFA = *Aphanizomenon flos-aquae* (cells/mL)

<sup>3</sup>ANA = *Anabaena flos-aquae* (cells/mL)

Other = either <sup>5</sup>*Planktothrix (Oscillatoria) sp.* or <sup>6</sup>*Gloeotrichia echinulata* or <sup>7</sup>*Anabaena sp.* or

<sup>8</sup>*Lyngbya sp.* (cells/mL) or <sup>9</sup>*Anabaena circinalis* (cells/mL) or <sup>10</sup>*Anabaena planctonica*

(cells/mL)

“0” value indicates non-detect by analytical laboratory

“\*” value indicates results were not available upon the date this memo was submitted and will be included in subsequent memos as availability allows

## References

SWRCB. 2010. Cyanobacteria in California Recreational Water Bodies: Providing Voluntary Guidance about Harmful Algal Blooms, Their Monitoring, and Public Notification. July 2010. 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).

## Appendix 1

### Cumulative Cyanobacteria Species data for 2013 Public Health Samples

**Table 3.** Summary of public health monitoring: 2013

Date	Time	Location	RM	Sample ID	Depth	MSAE <sup>(1)</sup>	AFA <sup>(2)</sup>	ANA <sup>(3)</sup>	Other <sup>(6), (7), (8), (9), or (10)</sup>	Microcystin (µg/L)
5/20/2013	9:40	CRMC	201.5	KR13800	SG	0	0	0	0	ND
5/20/2013	11:15	CRCC	200.0	KR13801	SG	0	0	90	0	ND
5/20/2013	10:45	IRCC	192.8	KR13802	SG	0	0	0	0	ND
5/20/2013	10:30	IRJW	192.4	KR13803	SG	0	0	0	0	ND
5/20/2013	11:20	CRCC <sub>dup</sub>	201.5	KR13804	SG	0	0	0	0	ND
6/06/2013	14:15	CRMC	201.5	KR13805	SG	9,429	0	379,340	0	10
6/06/2013	16:00	CRCC	200.0	KR13806	SG	12,403	0	88,088	0	2.4
6/06/2013	15:30	IRCC	192.8	KR13807	SG	839	0	5,264	0	0.22
6/06/2013	15:15	IRJW	192.4	KR13808	SG	23	0	615	0	0
6/06/2013	15:20	IRJW <sub>dup</sub>	201.5	KR13809	SG	18	0	483	0	0.15
6/20/2013	16:30	CRMC	201.5	KR13811	SG	802,969	4,205	475,179	0	240
6/20/2013	15:45	CRCC	200.0	KR13812	SG	13,903	303	454	0	2.1
6/20/2013	13:05	IRCC	192.8	KR13813	SG	3,679	0	300,667	0	2.6
6/20/2013	12:45	IRJW	192.4	KR13814	SG	61,419	2,967	665,967	14,539	24
6/20/2013	15:45	CRCC <sub>dup</sub>	201.5	KR13815	SG	3,794	0	3,502	0	2.0
7/11/2013	14:35	KRBI	189.7	KR13821	SG	16,443	0	0	0	*
7/16/2013	12:20	KRBI	189.7	KR13828	SG	10,585	537	0	0	*

<sup>1</sup>MSAE = *Microcystis aeruginosa* (cells/mL)

<sup>2</sup>AFA = *Aphanizomenon flos-aquae* (cells/mL)

<sup>3</sup>ANA = *Anabaena flos-aquae* (cells/mL)

Other = either <sup>5</sup>*Planktothrix (Oscillatoria) sp.* or <sup>6</sup>*Gloeotrichia echinulata* or <sup>7</sup>*Anabaena sp.* or

<sup>8</sup>*Lyngbya sp.* (cells/mL) or <sup>9</sup>*Anabaena circinalis* (cells/mL) or <sup>10</sup>*Anabaena planctonica*

“0” value indicates non-detect by analytical laboratory

“\*” value indicates results were not available upon the date this memo was submitted and will be included in subsequent memos as availability allows

## Appendix 2

### Laboratory Data Sheets July 11<sup>th</sup> and July 16<sup>th</sup>, 2013 Public Health Sampling

Phytoplankton Sample Analysis					
Sample:	Klamath Basin				
Sample Site:	KR 13821				
Sample Depth:					
Sample Date:	11-Jul-13				
Total Density (#/mL):	658				
Total Biovolume (um <sup>3</sup> /mL):	131,542				
Trophic State Index:	35.3				
	Density	Density	Biovolume	Biovolume	
Species	#/mL	Percent	um <sup>3</sup> /mL	Percent	Group
1 Microcystis aeruginosa	658	100.0	131,542	100.0	bluegreen
	Microcystis aeruginosa cells/mL = 16,443				
Note: Toxic Algae Only					
Aquatic Analysts	Sample ID: RE74				

Phytoplankton Sample Analysis					
Sample:	Klamath Basin				
Sample Site:	KR 13828				
Sample Depth:					
Sample Date:	16-Jul-13				
Total Density (#/mL):	568				
Total Biovolume (um <sup>3</sup> /mL):	118,503				
Trophic State Index:	34.5				
	Density	Density	Biovolume	Biovolume	
Species	#/mL	Percent	um <sup>3</sup> /mL	Percent	Group
1 Microcystis aeruginosa	529	93.2	84,678	71.5	bluegreen
2 Aphanizomenon flos-aquae	38	6.8	33,825	28.5	bluegreen
	Microcystis aeruginosa cells/mL = 10,585				
	Aphanizomenon flos-aquae cells/mL = 537				
Note: Toxic Algae Only					
Aquatic Analysts	Sample ID: RE81				