

## TECHNICAL MEMORANDUM

Results of Cyanobacteria and Microcystin Monitoring in the Vicinity of the Klamath Hydroelectric Project:

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## Introduction

This technical memorandum summarizes the results for the 2014 public health monitoring 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 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.

Results from the public health sampling are used to determine if public health advisories are warranted<sup>1</sup>. In addition to PacifiCorp's website ([www.pacificorp.com/es/hydro/hl/kr.html#](http://www.pacificorp.com/es/hydro/hl/kr.html#)), these memos are also posted on the Klamath Basin Monitoring Program's (KBMP) website ([www.kbmp.net](http://www.kbmp.net)) and inform the Blue Green Algae tracker on the KBMP website

The data summarized in this memorandum include results 2014 public health sampling events (see Appendix 1). During the 2014 public health sampling, 2 samples were sent for anatoxin a analysis since high levels (over 100,000 cells/mL) of *Anabaena* were detected. The results from that analysis were negative for this toxin (see Appendix 2).

## Methods

PacifiCorp is conducting public health 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.

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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, or 4) if microcystin is 8 µg/L or greater.

Public health samples are taken as grab samples offshore according to the standard operating procedure (SOP) developed by the Klamath Blue Green Algae Working Group ([www.kbmp.net/collaboration/klamath-hydroelectric-settlement-agreement-monitoring](http://www.kbmp.net/collaboration/klamath-hydroelectric-settlement-agreement-monitoring)). Samples collected for potentially toxic phytoplankton are preserved in Lugol's solution and sent to Aquatic Analysts in Friday Harbor, Washington for analysis. 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 2014.</b>		
<b>Location</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

The Klamath River station below Iron Gate dam (KBRI) was posted with a public health advisory on July 28<sup>th</sup>, and the advisory was lifted on October 22, 2014. Health advisories were posted at Copco reservoir on June 20<sup>th</sup> and at Iron Gate reservoir on July 25<sup>th</sup>. The health advisory signs on both reservoirs were lifted on December 11, 2015. Once the reservoirs were posted, public health samples (including algae cell counts and toxin) continued to be collected at the reservoir coves sites (Table1) throughout the summer however; the algae samples were not rushed and were not available for the bi-weekly BGA memos. This memo includes all the public health samples (rushed and non-rushed) and is the final public health dataset for PacifiCorp's 2014 public health monitoring.

## 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

## Cyanobacteria Species data for 2014 Public Health Samples

**Table 3.** Summary of public health monitoring: 2014

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), (10), or (11)</sup>	Microcystin (µg/L)
5/20/2014	9:40	CRMC	201.5	KR14800	SG	0	0	0	0	ND
5/20/2014	11:15	CRCC	200.0	KR14801	SG	0	0	0	0	ND
5/20/2014	10:45	IRCC	192.8	KR14802	SG	0	0	0	0	ND
5/20/2014	10:30	IRJW	192.8	KR14803	SG	0	0	0	87 <sup>(11)</sup>	ND
6/10/2014	11:35	CRMC	201.5	KR14806	SG	0	0	0	253 <sup>(5)</sup>	0.23
6/9/2014	12:00	CRCC	200.0	KR14807	SG	0	0	256,920	0	ND
6/9/2014	11:20	IRCC	192.8	KR14808	SG	0	0	1,756	165 <sup>(5)</sup>	ND
6/9/2014	10:50	IRJW	192.8	KR14809	SG	0	0	433	0	ND
6/9/2014	15:45	KRBI	189.7	KR14810	SG	0	0	0	0	ND
6/18/2014	11:25	CRMC	201.5	KR14812	SG	7,996	24	516	0	0.18
6/18/2014	15:15	CRCC	200.0	KR14813	SG	6,213	0	73,449	0	0.44
6/18/2014	14:50	IRCC	192.8	KR14814	SG	132	0	1,202	185 <sup>(10)</sup>	ND
6/18/2014	14:35	IRJW	192.8	KR14815	SG	0	0	5,117	0	ND
6/23/2014	14:10	KRBI	189.7	KR14816	SG	23	70	258	120 <sup>(7)</sup>	0.22
6/24/2014	7:50	CRMC	201.5	KR14817	SG	0	0	0	0	0.32
6/24/2014	12:00	CRCC	200.0	KR14818	SG	66,452	0	396,368	0	9
6/24/2014	11:40	IRCC	192.8	KR14819	SG	6,085	0	6,116	123 <sup>(10)</sup>	0.3
6/24/2014	11:25	IRJW	192.8	KR14820	SG	0	0	1,273	0	0.16
7/8/2014	13:00	CRMC	201.5	KR14821	SG	2,818,750	854	0	0	210
7/9/2014	12:45	CRCC	200.0	KR14822	SG	12,402,500	0	0	0	230
7/9/2014	15:15	IRCC	192.8	KR14823	SG	25,287	344	2,091	0	2.4
7/9/2014	15:30	IRJW	192.8	KR14824	SG	5,891	0	0	0	1
7/9/2014	13:30	KRBI	189.7	KR14825	SG	135	65	0	0	ND
7/22/2014	16:15	CRMC	201.5	KR14826	SG	19,219,538	0	0	0	2,400
7/22/2014	17:30	CRCC	200.0	KR14827	SG	29,028,918	100,970	0	0	4,600
7/22/2014	18:00	IRCC	192.8	KR14828	SG	125,836	2,323	0	1,743 <sup>(6)</sup>	6.3
7/22/2014	18:10	IRJW	192.8	KR14829	SG	35,633,333	654,500	0	0	1,400
7/22/2014	18:35	KRBI	189.7	KR14830	SG	6,146	543	0	0	1.5
8/5/2014	10:10	CRMC	201.5	KR14832	SG	21,770,146	0	15,033	0	1,400
8/12/2014	10:15	CRCC	200.0	KR14833	SG	5,882,223	0	0	0	1,200
8/5/2014	12:35	IRCC	192.8	KR14834	SG	274,669	0	0	7,935 <sup>(6)</sup>	3.6
8/5/2014	13:00	IRJW	192.8	KR14835	SG	57,709	0	0	476 <sup>(6)</sup>	2.2
8/5/2014	13:50	KRBI	189.7	KR14836	SG	8,559	40	0	0	1.3
8/12/2014	11:15	KRBI	189.7	KR14837	SG	6,606	423	0	0	0.76
8/19/2014	10:00	CRMC	201.5	KR14838	SG	23,677,500	0	0	0	2,400
8/19/2014	11:25	CRCC	200.0	KR14839	SG	18,317,790	0	0	0	600
8/19/2014	12:00	IRCC	192.8	KR14840	SG	351,941	4,027	0	24,161 <sup>(6)</sup>	NA
8/19/2014	12:10	IRJW	192.8	KR14841	SG		0	0	0	NA
8/19/2014	12:40	KRBI	189.7	KR14842	SG	20,246	0	0	0	0.72
8/25/2014	11:50	KRBI	189.7	KR14844	SG	18,311	363	0	0	0.25
9/1/2014	15:40	KRBI	189.7	KR14845	SG	3,409	0	0	0	ND

Date	Time	Location	RM	Sample ID	Depth	MSAE <sup>(1)</sup>	AFA(2)	ANA(3)	Other <sup>(6), (7), (8), (9), (10), or (11)</sup>	Microcystin (µg/L)
9/8/2014	13:40	CRMC	201.5	KR14846	SG	1,628,611	0	0	0	420
9/8/2014	12:40	CRCC	200.0	KR14847	SG	13,248,125	0	0	33162 <sup>(6)</sup>	1,100
9/8/2014	12:15	IRCC	192.8	KR14848	SG	31,263	0	171(7)	0	0.22
9/8/2014	12:00	IRJW	192.8	KR14849	SG	80,653	0	0	0	0.69
9/8/2014	14:05	KRBI	189.7	KR14850	SG	2,974	0	0	0	ND
9/15/2014	9:15	KRBI	189.7	KR14851	SG	4,102	0	0	0	0.27
9/22/2014	17:15	CRMC	201.5	KR14852	SG	9,782,721	0	0	0	3,600
9/23/2014	9:50	CRCC	200.0	KR14853	SG	15,138,462	0	0	21,026 <sup>(6)</sup>	NA
9/23/2014	8:35	IRCC	192.8	KR14854	SG	1,470,260	0	0	2,082 <sup>(6)</sup>	12
9/23/2014	9:15	IRJW	192.8	KR14855	SG	251,132	0	0	0	11
9/22/2014	16:30	KRBI	189.7	KR14856	SG	11,778	0	0	0	0.27
10/6/2014	16:00	CRMC	201.5	KR14858	SG	11,580,745	0	0	0	330
10/7/2014	8:50	CRCC	200.0	KR14859	SG	5,522,671	731,835	0	0	69
10/7/2014	9:50	IRCC	192.8	KR14860	SG	86,469	0	0	0	6.4
10/7/2014	10:20	IRJW	192.8	KR14861	SG	0	0	0	0	0.33
10/7/2014	11:40	KRBI	189.7	KR14862	SG	44	18	0	0	ND
10/22/2014	17:50	CRCC	200.0	KR14864	SG	2,319	0	0	0	0.48
10/20/2014	17:30	IRCC	192.8	KR14865	SG	1,277,833	0	0	0	28
10/20/2014	17:15	IRJW	192.8	KR14866	SG	0	0	0	0	0.29
10/20/2014	14:30	KRBI	189.7	KR14867	SG	0	0	0	0	ND
10/27/2014	14:25	CRCC	200.0	KR14869	SG	49,229	2,631,204	0	0	4.4
10/27/2014	15:00	IRCC	192.8	KR14870	SG	83,242	0	0	0	0.78
10/27/2014	15:15	IRJW	192.8	KR14871	SG	0	0	0	0	ND
11/2/2014	12:05	CRCC	200.0	KR14875	SG	352	22,360	0	0	ND
11/3/2014	11:05	IRCC	192.8	KR14876	SG	33,519	0	0	0	2
11/3/2014	11:15	IRJW	192.8	KR14877	SG	0	0	0	123 <sup>(5)</sup>	ND
11/19/2014	12:55	CRCC	200.0	KR14879	SG	0	247,979	0	0	ND
11/19/2014	12:35	IRCC	192.8	KR14880	SG	1,538	0	0	0	0.19
11/19/2014	12:25	IRJW	192.8	KR14881	SG	0	0	0	0	ND

<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* or

<sup>11</sup>*Planktothrix (Oscillatoria) limosa*

“0” value indicates non-detect by analytical laboratory

“NA” value indicates sample loss

“ND” value indicates result less than quantitation limit (0.18 µg/L) by analytical laboratory

## Appendix 2

### California Fish and Game Results: Microcystin Congeners, Domoic/Okadaic Acid, Nodularin, and Anatoxin A

		SampleID	KR14807			SampleID	KR14818
		Date	6/9/2014			Date	6/24/2014
		Time	12:00			Time	12:00
	Estimated MDL**	Reporting Limit	Measured Value		Estimated MDL**	Reporting Limit	Measured Value
Biotoxin Analytes	ppb (ug/L)	ppb (ug/L)	ppb (ug/L)		ppb (ug/L)	ppb (ug/L)	ppb (ug/L)
MC-RR	0.054	0.108	ND		0.056	0.111	ND
MC-Desmethyl-RR	0.054	0.108	ND		0.056	0.111	ND
MC-LR	0.054	0.108	ND		0.056	0.111	0.591
MC-Desmethyl-LR	0.054	0.108	ND		0.056	0.111	ND
MC-YR	0.054	0.108	ND		0.056	0.111	ND
MC-LA	0.054	0.108	0.452		0.056	0.111	10.1
MC-LW	0.108	0.270	ND		0.111	0.278	ND
MC-LF*	0.270	0.541	ND		0.278	0.556	ND
MC-LY	0.108	0.270	ND		0.111	0.278	ND
Domoic acid	0.054	0.108	ND		0.056	0.111	ND
Okadaic acid	0.108	0.270	ND		0.111	0.278	ND
Nodularin	0.054	0.108	ND		0.056	0.111	ND
Anatoxin A	0.50	1.00	ND		0.50	1.00	ND
*MC-LF screening only							
**Method Detection Limit							