TECHNICAL MEMORANDUM

Results of Cyanobacteria and Microcystin Monitoring in the Vicinity of the Klamath Hydroelectric Project: June 7, 2010

Prepared for: Tim Hemstreet (PacifiCorp)
Linda Prendergast (PacifiCorp)

Prepared by: Richard Raymond

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Introduction

This technical memorandum summarizes the latest results of monitoring during 2010 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 that is known to produce microcystin, with a recent history of summertime blooms in Copco and Iron Gate reservoirs. 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 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 results addressed in this memorandum are specifically for samples collected on June 7, 2010. Subsequent memoranda such as this will be prepared every two weeks to report the results of continued monitoring.

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:

- 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.
- 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 2010 KHSA Measure 15 water quality monitoring plan. The plan is available on the Regional Board's website.[1]

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. Sampling will occur at the two open-water monitoring sites once per month in April through December.

[1] http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/klamath_river/

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. This SOP is an appendix to the 2010 KHSA Measure 15 water quality monitoring plan. Additional samples 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. 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 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 0.16 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 2010.

Location	Approximate River Mile	Site ID
Copco Reservoir at Mallard Cove ramp	201.5	CRMC
Copco Reservoir at Copco Cove ramp	200.0	CRCC
Iron Gate Reservoir at Camp Creek ramp	192.8	IRCC
Iron Gate Reservoir at Williams campground	192.4	IRJW
Klamath River below Iron Gate dam near hatchery bridge	189.7	KRBI

Results

Samples of June 7, 2010

Five samples were collected for public health purposes on June 7, 2010 from shoreline stations in Copco and Iron Gate reservoirs and the Klamath River below Iron Gate dam. Aliquots were sent to the EPA Region 9 laboratory for analysis for microcystin, and to Aquatic Analysts for cyanobacteria species identification and enumeration. Results from EPA for microcystin analyses for samples collected on June 7 are not yet available.

The results of cyanobacteria species identification and enumeration are summarized in Table 2. Only one cyanobacteria species was observed in these samples; *Anabaena flos-aquae*;which was observed at low abundance in Copco reservoir at Copco Cove. No other samples included toxic cyanobacteria.

Table 2. Summary of cyanobacteria public health monitoring on June 7, 2010.

Date	Sample	Location	Species	Biovolume, $\mu m^3/mL$	Cells/mL
06/07/10	KR10076	KRBI	*NA*	0	0
06/07/10	KR10078	CRMC	*NA*	0	0
06/07/10	KR10079	CRCC	*Anabaena flos-aquae*	4,700	70
06/07/10	KR10080	IRJW	*NA*	0	0
06/07/10	KR10081	IRCC	*NA*	0	0

References

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).

Appendix 1

Cumulative Species data for 2010 Public Health Samples.

Date	Sample	Location	Species	Biovolume, $\mu m^3/mL$	Cells/mL
05/27/10	KR10070	KRBI	*NA*	0	0
05/27/10	KR10072	CRMC	*NA*	0	0
05/27/10	KR10073	CRCC	*Anabaena flos-aquae*	8,324	124
05/27/10	KR10074	IRJW	*NA*	0	0
05/27/10	KR10075	IRCC	*NA*	0	0
06/07/10	KR10076	KRBI	*NA*	0	0
06/07/10	KR10078	CRMC	*NA*	0	0
06/07/10	KR10079	CRCC	*Anabaena flos-aquae*	4,700	70
06/07/10	KR10080	IRJW	*NA*	0	0
06/07/10	KR10081	IRCC	*NA*	0	0

Appendix 2

Laboratory Data Sheets for June 7, 2010 Public Health Samples.

Phytoplankton Sample Analysis

Sample:	Klamath Basin
Sample Site:	KR 10076
Sample Depth:	
Sample Date:	7-Jun-10
Total Density (#/mL):	<3
Total Biovolume (um^3/mL):	
Trophic State Index:	

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	No Toxic Algae Present	<3				

Note: Toxic Algae Only

Aquatic Analysts **Sample ID:** NP48

Phytoplankton Sample Analysis

Sample:	Klamath Basin
Sample Site:	KR 10078
Sample Depth:	
Sample Date:	7-Jun-10
Total Density (#/mL):	<3
Total Biovolume (um^3/mL):	
Trophic State Index:	

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	No Toxic Algae Present	<3				

Note: Toxic Algae Only

Aquatic Analysts **Sample ID:** NP49

Phytoplankton Sample Analysis

Sample:	Klamath Basin
Sample Site:	KR 10079
Sample Depth:	
Sample Date:	7-Jun-10
Total Density (#/mL):	16
Total Biovolume (um^3/mL):	4,711
Trophic State Index:	12.6

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	Anabaena flos-aquae	16	100.0	4,711	100.0	bluegreen

Anabaena flos-aquae cells/mL = 70

Note: Toxic Algae Only

Aquatic Analysts **Sample ID:** NP50

Phytoplankton Sample Analysis

Sample:	Klamath Basin
Sample Site:	KR 10080
Sample Depth:	
Sample Date:	7-Jun-10
Total Density (#/mL):	<2
Total Biovolume (um^3/mL):	
Trophic State Index:	

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent	Group
1	No Toxic Algae Present	<2				

Note: Toxic Algae Only

Aquatic Analysts **Sample ID:** NP51

Phytoplankton Sample Analysis

Sample:	Klamath Basin
Sample Site:	KR 10081
Sample Depth:	
Sample Date:	7-Jun-10
Total Density (#/mL):	<2
Total Biovolume (um^3/mL):	
Trophic State Index:	

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
1	No Toxic Algae Present	<2			

Note: Toxic Algae Only

Aquatic Analysts **Sample ID:** NP52