

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 2020 public health monitoring for cyanobacteria species and an associated toxin, microcystin, from Upper Klamath Lake and within PacifiCorp's Klamath Hydroelectric Project (Project) from Keno Reservoir to the Klamath River downstream Iron Gate Dam. Microcystin results from 2020 baseline monitoring program are also included in the results summaries below. This monitoring is particularly focused on *Microcystis aeruginosa* (MSAE) which is known to produce microcystin. This monitoring also assesses the presence of other potentially-toxigenic cyanobacteria, including *Dolichospermum* sp., and others. 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 baseline and public health sampling are used in coordination with the appropriate public health authority to determine if public health advisories are warranted^{1,2}. In addition to PacifiCorp's website (<https://www.pacifiCorp.com/energy/hydro/klamath-river.html>), these memos are also posted on the Klamath Basin Monitoring Program's (KBMP) website (www.kbmp.net) and inform the Blue Green Algae tracker on the KBMP website.

The data in Appendix 1 and Appendix 2 summarize results from all of the 2020 public health sampling events to date and microcystin results from the 2020 baseline sampling events, respectively.

¹ The California State Water Resources Control Board (SWRCB) provides guidelines for posting advisories in recreation water (California SWRCB 2016) for Project waters in California. SWRCB recommends posting advisories in recreation waters at three levels based on laboratory testing for microcystin. The posting levels are Caution, Warning, and Danger at microcystin concentrations of 0.8, 6, and 20 µg/L respectively. Toxin producing cells at concentrations of over 4,000 cells/mL or blooms, scums, or mats would result in posting at the Caution level.

² Postings of Project waters in Oregon are coordinated with the Oregon Health Authority (OHA). The health advisory guideline for recreational use in Oregon waters is microcystin concentrations of 8 µg/L (OHA 2019).

Methods

PacifiCorp and the Oregon Department of Environmental Quality (ODEQ) are conducting public health sampling at ten sites (Table 1). Samples are collected and sent for laboratory analysis of potentially toxigenic cyanobacteria, notably MSAE and microcystin, from:

- Three shoreline sites in Upper Klamath Lake, Oregon
- One shoreline site in Keno Reservoir, Oregon
- One shoreline site in J.C. Boyle Reservoir, Oregon
- Four shoreline sites in coves in Copco and Iron Gate reservoirs (i.e., two cove sites in each reservoir), California
- One Klamath River site below Iron Gate Dam near the hatchery bridge, California

Table 1. Sites of cyanobacteria and microcystin public health monitoring in Upper Klamath Lake, Keno Reservoir, J.C Boyle Reservoir, Copco Reservoir, Iron Gate Reservoir, and the Klamath River during 2020.			
Location	Approximate River Mile	Sampling Entity	Site ID
Upper Klamath Lake at Eagle Ridge County Park	N/A	ODEQ	UKEP
Upper Klamath Lake at Howard's Bay Park	N/A	ODEQ	UKHP
Upper Klamath Lake at Moore Park	N/A	ODEQ	UKMP
Keno Reservoir at Keno Park	234.0	ODEQ	KEKP
J.C. Boyle Reservoir at Topsy Campground	225.0	ODEQ	BRTC
Copco Reservoir at Mallard Cove	201.5	PacifiCorp	CRMC
Copco Reservoir at Copco Cove	200.0	PacifiCorp	CRCC
Iron Gate Reservoir at Camp Creek	192.8	PacifiCorp	IRCC
Iron Gate Reservoir at John Williams Campground	192.4	PacifiCorp	IRJW
Klamath River below Iron Gate dam near Hatchery Bridge	189.7	PacifiCorp	KRBI

Samples are planned to be taken once in May, November, and December and twice per month in June, July, August, September, and October.

In addition to public health sampling, monthly and bi-monthly baseline sampling for microcystin is conducted by PacifiCorp and the U.S. Bureau of Reclamation (BOR) from May through October at 12 locations extending from Link River Dam to the Klamath River downstream of Iron Gate Reservoir (Table 2).

Table 2. Sites of microcystin baseline monitoring from Link River Dam to the Klamath River downstream of Iron Gate reservoir during 2020.				
Site Description	Approximate River Mile	Depth (m)	Sampling Entity	Site ID
Link River Dam	254.4	0.5	BOR	KR254.4
Keno Reservoir at Miller Island	246.0	0.5	BOR	KR246.0
Klamath River below Keno Dam near a USGS Gage	231.8	0.5	BOR	KBK
Klamath River below JC Boyle Reservoir	224.6	0.5	PacifiCorp	KR22460
Klamath River at USGS Gage	219.5	0.5	PacifiCorp	KR21950
Klamath River above Shovel Creek	206.4	0.5	PacifiCorp	KR20642
Copco Reservoir at Buoy Line (surface)	198.7	0.5	PacifiCorp	KR19874
Copco Reservoir at Buoy Line (integrated)	198.7	0-8	PacifiCorp	KR19874
Klamath River below Copco 2 Reservoir	196.5	0.5	PacifiCorp	KR19645
Iron Gate Reservoir at Log Boom (surface)	190.2	0.5	PacifiCorp	KR19019
Iron Gate Reservoir at Log Boom (integrated)	190.2	0-8	PacifiCorp	KR19019
Klamath River below Hatchery Bridge	189.7	0.5	PacifiCorp	KR18973

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). Samples collected for potentially toxic phytoplankton are preserved in Lugol's solution and sent to Aquatic Analysts in Friday Harbor, Washington for analysis. The samples are labeled "Rush" for timely analysis and only potentially toxic cyanobacteria are identified and enumerated. 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 U.S. Environmental Protection Agency (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 with a detection limit of 0.10 µg/L and a quantification limit of 0.15 µg/L. 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.

Results

All public health samples (Table 3) and baseline microcystin samples (Tables 4 and 5) were collected as planned. Appendix 3 includes the raw phytoplankton results for the samples reported in Table 3.

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Table 3. Summary of available public health laboratory algal identification and enumeration and microcystin results from sampling October 2020.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth	MSAE ⁽¹⁾	AFA ⁽²⁾	DKFA ⁽³⁾	Other ^{(4),(5), (6), (7), (8), (9), (10), (11), (12), or (13)}	Microcystin (µg/L)
10/05/2020	11:35	UKEP	N/A	ODEQ	UKEP20209	SG	NA	NA	NA	NA	1.9
10/05/2020	11:58	UKHP	N/A	ODEQ	UKHP20209	SG	NA	NA	NA	NA	13
10/05/2020	12:15	UKMP	N/A	ODEQ	UKMP20209	SG	NA	NA	NA	NA	2.7
10/05/2020	10:38	KEKP	234	ODEQ	KEKP20209	SG	NA	NA	NA	NA	0.14 ^{C1, J}
10/05/2020	10:18	BRTC	225	ODEQ	BRTC20209	SG	NA	NA	NA	NA	0.16
10/11/2020	16:40	CRMC	201.5	PacifiCorp	KR20841	SG	NA	NA	NA	NA	28
10/11/2020	13:15	CRCC	200.0	PacifiCorp	KR20842	SG	NA	NA	NA	NA	120
10/11/2020	10:50	IRCC	192.8	PacifiCorp	KR20843	SG	NA	NA	NA	NA	4.5
10/11/2020	10:35	IRJW	192.4	PacifiCorp	KR20844	SG	NA	NA	NA	NA	15
10/11/2020	14:15	KRBI	189.7	PacifiCorp	KR20845	SG	NA	NA	NA	NA	0.31
10/19/2020	12:28	UKEP	N/A	ODEQ	UKEP20210	SG	NA	NA	NA	NA	22
10/19/2020	12:50	UKHP	N/A	ODEQ	UKHP20210	SG	NA	NA	NA	NA	26
10/19/2020	13:10	UKMP	N/A	ODEQ	UKMP20210	SG	NA	NA	NA	NA	7.8
10/19/2020	11:11	KEKP	234	ODEQ	KEKP20210	SG	NA	NA	NA	NA	0.24
10/19/2020	10:34	BRTC	225	ODEQ	BRTC20210	SG	NA	NA	NA	NA	0.22
10/25/2020	16:40	CRMC	201.5	PacifiCorp	KR20846	SG	NA	NA	NA	NA	3.2
10/25/2020	16:00	CRCC	200.0	PacifiCorp	KR20847	SG	NA	NA	NA	NA	0.83
10/25/2020	15:25	IRCC	192.8	PacifiCorp	KR20848	SG	NA	NA	NA	NA	0.24
10/25/2020	15:15	IRJW	192.4	PacifiCorp	KR20849	SG	NA	NA	NA	NA	0.17
10/25/2020	17:20	KRBI	189.7	PacifiCorp	KR20850	SG	NA	NA	NA	NA	0.20

¹MSAE = *Microcystis aeruginosa* (cells/mL)

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

³DKFA = *Dolichospermum flos-aquae* (cells/mL)

Other = Cells/mL of either ⁴*Planktothrix (Oscillatoria) sp.*, ⁵*Gloeotrichia echinulata*, ⁶*Dolichospermum sp.*, ⁷*Lyngbya sp.*, ⁸*Dolichospermum circinalis*, ⁹*Dolichospermum planctonica*, ¹⁰*Planktothrix (Oscillatoria) limosa*, ¹¹*Pseudanabaena spp.*, ¹²*Limnothrix sp.*, or ¹³*Cylindrospermopsis sp.*

"NA" indicates Not Applicable; analyses for toxic algae from public health samples are only conducted from May – July.

"C1" indicates the reported concentration for this analyte is below the quantitation limit.

"J" indicates the reported result for this analyte should be considered an estimated value.

Table 4. Summary of October 2020 baseline laboratory microcystin results for samples collected in Oregon.							
Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
10/6/2020	09:25	KR254.4	254.4	BOR	2020KHSA-73	0.5	0.57
10/6/2020	08:25	KR246.0	246.0	BOR	2020KHSA-76	0.5	0.22
10/6/2020	10:40	KBK	231.8	BOR	2020KHSA-77	0.5	0.15
10/10/2020	15:30	KR22460	224.6	PacifiCorp	KR20136	0.5	0.54
10/10/2020	16:10	KR21950	219.5	PacifiCorp	KR20137	0.5	ND
10/20/2020	10:45	KR254.4	231.8	BOR	2020KHSA-79	0.5	0.11 ^{C1, J}

"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)

"C1" indicates the reported concentration for this analyte is below the quantitation limit.

"J" indicates the reported result for this analyte should be considered an estimated value.

Table 5. Summary of October 2020 baseline laboratory microcystin results for samples collected in California.							
Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
10/11/2020	16:10	KR20642	206.4	PacifiCorp	KR20132	0.5	ND
10/11/2020	12:10	KR19874	198.7	PacifiCorp	KR20128	0.5	0.49
10/11/2020	12:30	KR19874	198.7	PacifiCorp	KR20129	0-8	0.43
10/11/2020	11:15	KR19645	196.5	PacifiCorp	KR20127	0.5	2.4
10/11/2020	08:05	KR19019	190.2	PacifiCorp	KR20123	0.5	1.2
10/11/2020	09:40	KR19019	190.2	PacifiCorp	KR20124	0-8	0.33
10/11/2020	14:25	KR18973	189.7	PacifiCorp	KR20122	0.5	0.25
10/11/2020	14:35	KR18973	189.7	PacifiCorp	KR20135	0.5	0.32
10/25/2020	17:25	KR18973	189.7	PacifiCorp	KR20138	0.5	0.4

"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)

References

California SWRCB 2016. Draft Statewide Voluntary Guidance on CyanoHABs in Recreational Waters.

Available online at:

http://www.mywaterquality.ca.gov/monitoring_council/cyanohab_network/docs/triggers.pdf

Oregon Health Authority. 2019. Oregon Harmful Algal Bloom Surveillance (HABS) Program – Recreational Use Public Health Advisory Guidelines, Cyanobacterial Blooms in Freshwater Bodies. 27 pp. Available online at:

<https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAE/BL/OOMS/Documents/Advisory-Guidelines-Harmful-Cyanobacterial-Blooms-Recreational-Waters.pdf>

Appendix 1 Cyanobacteria Species and Microcystin Data for 2020 Public Health Samples

Table A1. Summary of 2020 public health laboratory algal identification and enumeration microcystin results.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth	MSAE ⁽¹⁾	AFA ⁽²⁾	DKFA ⁽³⁾	Other ^{(4),(5), (6), (7), (8), (9), (10), (11), (12), or (13)}	Microcystin (µg/L)
5/28/2020	16:25	CRMC	201.5	PacifiCorp	KR20800	SG	0	0	0	588 ¹⁰	*
5/28/2020	14:50	CRCC	200.0	PacifiCorp	KR20801	SG	0	0	0	17,134 ¹⁰	*
5/28/2020	14:10	IRCC	192.8	PacifiCorp	KR20802	SG	0	0	0	0	*
5/28/2020	13:45	IRJW	192.4	PacifiCorp	KR20803	SG	0	0	0	0	*
5/28/2020	15:30	KRBI	189.7	PacifiCorp	KR20804	SG	0	0	0	132 ¹⁰	*
5/XX/2020	XX:XX	UKEP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	UKHP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	UKMP	N/A	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	KEKP	234	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
5/XX/2020	XX:XX	BRTC	225	ODEQ	XXXX	SG	NS	NS	NS	NS	NS
6/9/2020	18:20	CRMC	201.5	PacifiCorp	KR20805	SG	0	0	0	0	*
6/9/2020	15:05	CRCC	200.0	PacifiCorp	KR20806	SG	0	0	0	0	*
6/9/2020	12:20	IRCC	192.8	PacifiCorp	KR20807	SG	0	0	0	0	*
6/9/2020	11:10	IRJW	192.4	PacifiCorp	KR20808	SG	0	889	0	0	*
6/9/2020	16:00	KRBI	189.7	PacifiCorp	KR20809	SG	0	0	0	0	*
6/15/2020	11:04	UKEP	N/A	ODEQ	UKEP20001	SG	0	113,266	4,131	0	0.48 ^{A3, J}
6/15/2020	11:26	UKHP	N/A	ODEQ	UKHP20001	SG	0	133,581	0	0	0.16 ^{A3, J}
6/15/2020	11:47	UKMP	N/A	ODEQ	UKMP20001	SG	0	78,771	515	0	0.11 ^{A3, C1, J}
6/XX/2020	XX:XX	KEKP	234	ODEQ	KEKP20001	SG	NS	NS	NS	NS	NS
6/15/2020	10:05	BRTC	225	ODEQ	BRTC20001	SG	0	6,765	82	0	0.30 ^{A3, J}
6/23/2020	11:05	CRMC	201.5	PacifiCorp	KR20810	SG	0	0	0	0	*
6/23/2020	09:40	CRCC	200.0	PacifiCorp	KR20811	SG	689	11,581	0	0	*
6/23/2020	09:05	IRCC	192.8	PacifiCorp	KR20812	SG	599	82	3,050	381 ¹⁰	*
6/23/2020	08:50	IRJW	192.4	PacifiCorp	KR20813	SG	0	17	0	51 ¹³	*
6/23/2020	11:50	KRBI	189.7	PacifiCorp	KR20814	SG	0	0	0	0	*
6/30/2020	11:30	UKEP	N/A	ODEQ	UKEP20202	SG	0	540,815	0	0	0.41 ^{A3, J}
6/30/2020	11:58	UKHP	N/A	ODEQ	UKHP20202	SG	0	233,242	0	0	0.20 ^{A3, J}
6/30/2020	12:18	UKMP	N/A	ODEQ	UKMP20202	SG	0	181,709	0	0	0.10 ^{A3, C1, J}
6/30/2020	10:36	KEKP	234	ODEQ	KEKP20202	SG	0	137,471	0	0	0.18 ^{A3, J}
6/30/2020	10:12	BRTC	225	ODEQ	BRTC20202	SG	0	16,363	0	743 ¹⁰	0.23 ^{A3, J}
7/8/2020	14:30	CRMC	201.5	PacifiCorp	KR20815	SG	276,238	56,375	20,500	0	28 ^{A3, J}
7/8/2020	12:05	CRCC	200.0	PacifiCorp	KR20816	SG	975	9,341	115	0	0.17
7/8/2020	9:30	IRCC	192.8	PacifiCorp	KR20817	SG	261	93,478	6,681	0	0.44
7/8/2020	9:15	IRJW	192.4	PacifiCorp	KR20818	SG	379	28,928	252	0	0.27
7/8/2020	15:15	KRBI	189.7	PacifiCorp	KR20819	SG	0	195	0	54 ¹⁰	ND
7/13/2020	11:45	UKEP	N/A	ODEQ	UKEP20203	SG	0	832,032	0	0	0.43
7/13/2020	12:12	UKHP	N/A	ODEQ	UKHP20203	SG	0	105,703	0	0	0.11 ^{C1, J}
7/13/2020	12:35	UKMP	N/A	ODEQ	UKMP20203	SG	0	3,695,193	0	0	0.10 ^{C1, J}
7/13/2020	10:45	KEKP	234	ODEQ	KEKP20203	SG	15,445	171,874	0	0	3.7
7/13/2020	10:20	BRTC	225	ODEQ	BRTC20203	SG	0	11,528	0	0	0.13 ^{C1, J}
7/21/2020	16:55	CRMC	201.5	PacifiCorp	KR20820	SG	230,075	107,148	1,634	0	22
7/21/2020	15:45	CRCC	200.0	PacifiCorp	KR20821	SG	168,695	2,645,867	17,443	0	43
7/21/2020	15:15	IRCC	192.8	PacifiCorp	KR20822	SG	0	42,019	0	67,423,099 ⁵	37

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Table A1 cont.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth	MSAE ⁽¹⁾	AFA ⁽²⁾	DKFA ⁽³⁾	Other ^{(4),(5), (6), (7), (8), (9), (10), (11), (12), or (13)}	Microcystin (µg/L)
7/21/2020	15:00	IRJW	192.4	PacifiCorp	KR20823	SG	0	6,025	1,148	80,130 ⁵	2.5
7/21/2020	17:30	KRBI	189.7	PacifiCorp	KR20824	SG	0	0	0	0	ND
7/28/2020	11:30	UKEP	N/A	ODEQ	UKEP20204	SG	0	45,794	289	0	ND
7/28/2020	11:56	UKHP	N/A	ODEQ	UKHP20204	SG	0	245,721	0	0	ND
7/28/2020	12:15	UKMP	N/A	ODEQ	UKMP20204	SG	0	1,023,597	0	0	ND
7/28/2020	10:38	KEKP	234	ODEQ	KEKP20204	SG	0	198,948	0	0	ND
7/28/2020	10:15	BRTC	225	ODEQ	BRTC20204	SG	0	0	0	0	ND
8/5/2020	16:25	CRMC	201.5	PacifiCorp	KR20825	SG	NA	NA	NA	NA	62
8/5/2020	13:00	CRCC	200.0	PacifiCorp	KR20826	SG	NA	NA	NA	NA	290
8/5/2020	10:15	IRCC	192.8	PacifiCorp	KR20827	SG	NA	NA	NA	NA	260
8/5/2020	10:00	IRJW	192.4	PacifiCorp	KR20828	SG	NA	NA	NA	NA	4.3
8/5/2020	13:55	KRBI	189.7	PacifiCorp	KR20829	SG	NA	NA	NA	NA	0.24
8/10/2020	11:37	UKEP	N/A	ODEQ	UKEP20205	SG	NA	NA	NA	NA	3.2
8/10/2020	12:05	UKHP	N/A	ODEQ	UKHP20205	SG	NA	NA	NA	NA	ND
8/10/2020	12:23	UKMP	N/A	ODEQ	UKMP20205	SG	NA	NA	NA	NA	0.10 ^{C1, J}
8/10/2020	10:42	KEKP	234	ODEQ	KEKP20205	SG	NA	NA	NA	NA	ND
8/10/2020	10:21	BRTC	225	ODEQ	BRTC20205	SG	NA	NA	NA	NA	ND
8/18/2020	14:50	CRMC	201.5	PacifiCorp	KR20830	SG	NA	NA	NA	NA	3,600
8/18/2020	13:35	CRCC	200.0	PacifiCorp	KR20831_Aug	SG	NA	NA	NA	NA	46,000
8/18/2020	13:05	IRCC	192.8	PacifiCorp	KR20832_Aug	SG	NA	NA	NA	NA	11
8/18/2020	12:50	IRJW	192.4	PacifiCorp	KR20833_Aug	SG	NA	NA	NA	NA	11
8/18/2020	15:30	KRBI	189.7	PacifiCorp	KR20834_Aug	SG	NA	NA	NA	NA	0.21
8/24/2020	11:18	UKEP	N/A	ODEQ	UKEP20206	SG	NA	NA	NA	NA	0.12 ^{C1, J}
8/24/2020	11:43	UKHP	N/A	ODEQ	UKHP20206	SG	NA	NA	NA	NA	ND
8/24/2020	12:00	UKMP	N/A	ODEQ	UKMP20206	SG	NA	NA	NA	NA	0.1 ^{C1, J}
8/24/2020	10:24	KEKP	234	ODEQ	KEKP20206	SG	NA	NA	NA	NA	ND
8/24/2020	10:02	BRTC	225	ODEQ	BRTC20206	SG	NA	NA	NA	NA	ND
9/8/2020	11:53	UKEP	N/A	ODEQ	UKEP20207	SG	NA	NA	NA	NA	1.5
9/8/2020	12:18	UKHP	N/A	ODEQ	UKHP20207	SG	NA	NA	NA	NA	1.9
9/8/2020	12:35	UKMP	N/A	ODEQ	UKMP20207	SG	NA	NA	NA	NA	110
9/8/2020	10:52	KEKP	234	ODEQ	KEKP20207	SG	NA	NA	NA	NA	0.18
9/8/2020	10:30	BRTC	225	ODEQ	BRTC20207	SG	NA	NA	NA	NA	0.17
9/16/2020	19:10	CRMC	201.5	PacifiCorp	KR20831_Sept	SG	NA	NA	NA	NA	1.7
9/16/2020	15:00	CRCC	200.0	PacifiCorp	KR20832_Sept	SG	NA	NA	NA	NA	510
9/16/2020	13:50	IRCC	192.8	PacifiCorp	KR20833_Sept	SG	NA	NA	NA	NA	2.2
9/16/2020	13:30	IRJW	192.4	PacifiCorp	KR20834_Sept	SG	NA	NA	NA	NA	220
9/16/2020	17:30	KRBI	189.7	PacifiCorp	KR20835	SG	NA	NA	NA	NA	0.72
9/22/2020	11:25	UKEP	N/A	ODEQ	UKEP20208	SG	NA	NA	NA	NA	ND
9/22/2020	11:48	UKHP	N/A	ODEQ	UKHP20208	SG	NA	NA	NA	NA	99
9/22/2020	12:05	UKMP	N/A	ODEQ	UKMP20208	SG	NA	NA	NA	NA	1.2
9/22/2020	10:34	KEKP	234	ODEQ	KEKP20208	SG	NA	NA	NA	NA	0.15
9/22/2020	10:15	BRTC	225	ODEQ	BRTC20208	SG	NA	NA	NA	NA	ND
9/27/2020	17:00	CRMC	201.5	PacifiCorp	KR20836	SG	NA	NA	NA	NA	190
9/27/2020	15:50	CRCC	200.0	PacifiCorp	KR20837	SG	NA	NA	NA	NA	4.0
9/27/2020	15:25	IRCC	192.8	PacifiCorp	KR20838	SG	NA	NA	NA	NA	1.6
9/27/2020	15:10	IRJW	192.4	PacifiCorp	KR20839	SG	NA	NA	NA	NA	1.8
9/27/2020	17:40	KRBI	189.7	PacifiCorp	KR20840	SG	NA	NA	NA	NA	2.5

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10/05/2020	11:35	UKEP	N/A	ODEQ	UKEP20209	SG	NA	NA	NA	NA	1.9
10/05/2020	11:58	UKHP	N/A	ODEQ	UKHP20209	SG	NA	NA	NA	NA	13
10/05/2020	12:15	UKMP	N/A	ODEQ	UKMP20209	SG	NA	NA	NA	NA	2.7
10/05/2020	10:38	KEKP	234	ODEQ	KEKP20209	SG	NA	NA	NA	NA	0.14 ^{C1, J}
10/05/2020	10:18	BRTC	225	ODEQ	BRTC20209	SG	NA	NA	NA	NA	0.16
10/11/2020	16:40	CRMC	201.5	PacifiCorp	KR20841	SG	NA	NA	NA	NA	28
10/11/2020	13:15	CRCC	200.0	PacifiCorp	KR20842	SG	NA	NA	NA	NA	120
10/11/2020	10:50	IRCC	192.8	PacifiCorp	KR20843	SG	NA	NA	NA	NA	4.5
10/11/2020	10:35	IRJW	192.4	PacifiCorp	KR20844	SG	NA	NA	NA	NA	15
10/11/2020	14:15	KRBI	189.7	PacifiCorp	KR20845	SG	NA	NA	NA	NA	0.31
10/19/2020	12:28	UKEP	N/A	ODEQ	UKEP20210	SG	NA	NA	NA	NA	22
10/19/2020	12:50	UKHP	N/A	ODEQ	UKHP20210	SG	NA	NA	NA	NA	26
10/19/2020	13:10	UKMP	N/A	ODEQ	UKMP20210	SG	NA	NA	NA	NA	7.8
10/19/2020	11:11	KEKP	234	ODEQ	KEKP20210	SG	NA	NA	NA	NA	0.24
10/19/2020	10:34	BRTC	225	ODEQ	BRTC20210	SG	NA	NA	NA	NA	0.22
10/25/2020	16:40	CRMC	201.5	PacifiCorp	KR20846	SG	NA	NA	NA	NA	3.2
10/25/2020	16:00	CRCC	200.0	PacifiCorp	KR20847	SG	NA	NA	NA	NA	0.83
10/25/2020	15:25	IRCC	192.8	PacifiCorp	KR20848	SG	NA	NA	NA	NA	0.24
10/25/2020	15:15	IRJW	192.4	PacifiCorp	KR20849	SG	NA	NA	NA	NA	0.17
10/25/2020	17:20	KRBI	189.7	PacifiCorp	KR20850	SG	NA	NA	NA	NA	0.20

¹MSAE = *Microcystis aeruginosa* (cells/mL)

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

³DKFA = *Dolichospermum flos-aquae* (cells/mL)

Other = Cells/mL of either ⁴*Planktothrix (Oscillatoria)* sp., ⁵*Gloeotrichia echinulata*, ⁶*Dolichospermum* sp., ⁷*Lyngbya* sp., ⁸*Dolichospermum circinalis*, ⁹*Dolichospermum planctonica*, ¹⁰*Planktothrix (Oscillatoria) limosa*, ¹¹*Pseudanabaena* spp, ¹²*Limnothrix* sp., or ¹³*Cylindrospermopsis* sp.

"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)

"C1" indicates the reported concentration for this analyte is below the quantitation limit.

"A3" the sample was prepped/analyzed past the recommended holding time.

"J" indicates the reported result for this analyte should be considered an estimated value.

"O" value indicates non-detect by analytical laboratory

"**" value indicates no result available

"NS" indicates Not Sampled

"NA" indicates Not Applicable; analyses for toxic algae from public health samples are only conducted from May – July.

Appendix 2

Microcystin Data for 2020 Baseline Samples

Table A2-1. Summary of 2020 baseline laboratory microcystin results for samples collected in Oregon.							
Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/17/2020	11:40	KR246.0	246.0	BOR	2020KHSA-22	0.5	ND ^{A3, J}
5/17/2020	10:30	KBK	231.8	BOR	2020KHSA-23	0.5	ND ^{A3, J}
5/17/2020	07:40	KR22460	224.6	PacifiCorp	KR20047	0.5	*
5/17/2020	08:40	KR21950	219.5	PacifiCorp	KR20048	0.5	*
6/9/2020	08:50	KR246.0	246.0	BOR	2020KHSA-32	0.5	3.9 ^{A3, J}
6/9/2020	11:35	KBK	231.8	BOR	2020KHSA-33	0.5	ND ^{A3, J}
6/8/2020	15:05	KR22460	224.6	PacifiCorp	KR20064	0.5	*
6/8/2020	15:50	KR21950	219.5	PacifiCorp	KR20065	0.5	*
7/7/2020	09:15	KR254.4	254.4	BOR	2020KHSA-40	0.5	ND ^{A3, J}
7/7/2020	08:20	KR246.0	246.0	BOR	2020KHSA-43	0.5	ND ^{A3, J}
7/7/2020	10:40	KBK	231.8	BOR	2020KHSA-44	0.5	0.13 ^{A3, J}
7/7/2020	15:00	KR22460	224.6	PacifiCorp	KR20082	0.5	ND
7/7/2020	15:35	KR21950	219.5	PacifiCorp	KR20083	0.5	ND
7/21/2020	09:00	KR254.4	254.4	BOR	2020KHSA-46	0.5	ND
8/4/2020	09:00	KR254.4	254.4	BOR	2020KHSA-51	0.5	ND
8/4/2020	11:00	KR246.0	246.0	BOR	2020KHSA-54	0.5	ND
8/4/2020	10:10	KBK	231.8	BOR	2020KHSA-55	0.5	ND
8/4/2020	17:00	KR22460	224.6	PacifiCorp	KR20100	0.5	ND
8/4/2020	17:40	KR21950	219.5	PacifiCorp	KR20101	0.5	ND
8/18/2020	08:40	KBK	231.8	BOR	2020KHSA-57	0.5	ND
9/2/2020	08:40	KR254.4	254.4	BOR	2020KHSA-62	0.5	*
9/2/2020	11:25	KR246.0	246.0	BOR	2020KHSA-65	0.5	*
9/2/2020	10:30	KBK	231.8	BOR	2020KHSA-66	0.5	*
9/9/2020	10:15	KR254.4	231.8	BOR	2020KHSA-68	0.5	0.34
9/17/2020	07:15	KR22460	224.6	PacifiCorp	KR20118	0.5	1.1
9/17/2020	07:55	KR21950	219.5	PacifiCorp	KR20119	0.5	ND
10/6/2020	09:25	KR254.4	254.4	BOR	2020KHSA-73	0.5	0.57
10/6/2020	08:25	KR246.0	246.0	BOR	2020KHSA-76	0.5	0.22
10/6/2020	10:40	KBK	231.8	BOR	2020KHSA-77	0.5	0.15
10/10/2020	15:30	KR22460	224.6	PacifiCorp	KR20136	0.5	0.54
10/10/2020	16:10	KR21950	219.5	PacifiCorp	KR20137	0.5	ND
10/20/2020	10:45	KR254.4	231.8	BOR	2020KHSA-79	0.5	0.11 ^{C1, J}

"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)

"A3" the sample was prepped/analyzed past the recommended holding time

"J" indicates the reported result for this analyte should be considered an estimated value.

"*" value indicates no result available

Table A2-2. Summary of 2020 baseline laboratory microcystin results for samples collected in California.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/16/2020	18:20	KR20642	206.4	PacifiCorp	KR20043	0.5	*
5/16/2020	15:10	KR19874	198.7	PacifiCorp	KR20039	0.5	*
5/16/2020	16:10	KR19874	198.7	PacifiCorp	KR20040	0-8	*
5/16/2020	14:20	KR19645	196.5	PacifiCorp	KR20038	0.5	*
5/16/2020	11:10	KR19019	190.2	PacifiCorp	KR20034	0.5	*
5/16/2020	11:40	KR19019	190.2	PacifiCorp	KR20035	0-8	*
6/9/2020	17:45	KR20642	206.4	PacifiCorp	KR20060	0.5	*
6/9/2020	13:50	KR19874	198.7	PacifiCorp	KR20056	0.5	*
6/9/2020	14:10	KR19874	198.7	PacifiCorp	KR20057	0-8	*
6/9/2020	12:55	KR19645	196.5	PacifiCorp	KR20055	0.5	*
6/9/2020	09:15	KR19019	190.2	PacifiCorp	KR20051	0.5	*
6/9/2020	09:50	KR19019	190.2	PacifiCorp	KR20052	0-8	*
7/8/2020	13:50	KR20642	206.4	PacifiCorp	KR20078	0.5	ND
7/8/2020	10:55	KR19874	198.7	PacifiCorp	KR20074	0.5	0.40
7/8/2020	11:10	KR19874	198.7	PacifiCorp	KR20075	0-8	ND
7/8/2020	10:00	KR19645	196.5	PacifiCorp	KR20073	0.5	ND
7/8/2020	7:10	KR19019	190.2	PacifiCorp	KR20069	0.5	0.23
7/8/2020	7:35	KR19019	190.2	PacifiCorp	KR20070	0-8	0.13 ^{C1, J}
7/8/2020	15:20	KR18973	189.7	PacifiCorp	KR20068	0.5	ND
7/8/2020	15:30	KR18973	189.7	PacifiCorp	KR20081	0.5	ND
7/21/2020	17:35	KR18973	189.7	PacifiCorp	KR20084	0.5	ND
8/5/2020	15:55	KR20642	206.4	PacifiCorp	KR20096	0.5	ND
8/5/2020	11:40	KR19874	198.7	PacifiCorp	KR20092	0.5	27
8/5/2020	11:55	KR19874	198.7	PacifiCorp	KR20093	0-8	4.3
8/5/2020	10:45	KR19645	196.5	PacifiCorp	KR20091	0.5	3.3
8/5/2020	07:55	KR19019	190.2	PacifiCorp	KR20087	0.5	1.7
8/5/2020	08:20	KR19019	190.2	PacifiCorp	KR20088	0-8	0.42
8/5/2020	14:05	KR18973	189.7	PacifiCorp	KR20086	0.5	ND
8/5/2020	14:15	KR18973	189.7	PacifiCorp	KR20099	0.5	ND
8/18/2020	15:35	KR18973	189.7	PacifiCorp	KR20102	0.5	0.12 ^{C1, J}
9/16/2020	19:40	KR20642	206.4	PacifiCorp	KR20114	0.5	1.8
9/16/2020	15:30	KR19874	198.7	PacifiCorp	KR20110	0.5	4.2
9/16/2020	15:50	KR19874	198.7	PacifiCorp	KR20111	0-8	1.9
9/16/2020	14:20	KR19645	196.5	PacifiCorp	KR20109	0.5	840
9/16/2020	11:25	KR19019	190.2	PacifiCorp	KR20105	0.5	2.6
9/16/2020	12:10	KR19019	190.2	PacifiCorp	KR20106	0-8	1.2
9/16/2020	17:40	KR18973	189.7	PacifiCorp	KR20104	0.5	0.67
9/16/2020	17:50	KR18973	189.7	PacifiCorp	KR20117	0.5	0.45
9/27/2020	17:45	KR18973	189.7	PacifiCorp	KR20120	0.5	4.1
10/11/2020	16:10	KR20642	206.4	PacifiCorp	KR20132	0.5	ND
10/11/2020	12:10	KR19874	198.7	PacifiCorp	KR20128	0.5	0.49

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Table A2-2 cont.							
10/11/2020	12:30	KR19874	198.7	PacifiCorp	KR20129	0-8	0.43
10/11/2020	11:15	KR19645	196.5	PacifiCorp	KR20127	0.5	2.4
10/11/2020	08:05	KR19019	190.2	PacifiCorp	KR20123	0.5	1.2
10/11/2020	09:40	KR19019	190.2	PacifiCorp	KR20124	0-8	0.33
10/11/2020	14:25	KR18973	189.7	PacifiCorp	KR20122	0.5	0.25
10/11/2020	14:35	KR18973	189.7	PacifiCorp	KR20135	0.5	0.32
10/25/2020	17:25	KR18973	189.7	PacifiCorp	KR20138	0.5	0.4

"ND" value indicates a result less than the laboratory analytical detection limit (0.1 µg/L)
 "C1" indicates the reported concentration for this analyte is below the quantitation limit.
 "J" indicates the reported result for this analyte should be considered an estimated value.
 "**" value indicates no result available

Appendix 3

No Laboratory Phytoplankton Results