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 2019 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 2019 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 (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) 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 2019 public health sampling events to date and microcystin results from the 2019 baseline sampling events, respectively.

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[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 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 2019.

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 Dam to the Klamath River downstream of Iron Gate Reservoir (Table 2).

Table 2. Sites of microcystin baseline monitoring from Link Dam to the Klamath River downstream of Iron Gate reservoir during 2019.

Site Description	Approximate River Mile	Depth (m)	Sampling Entity	Site ID
Link 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.

Table 3. Summary of available public health laboratory algal identification and enumeration and microcystin results from sampling May and June 2019.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth	MSAE[1]	AFA[2]	DKFA[3]	Other [4],[5], [6], [7], [8], [9], [10], or [11]	Microcystin (µg/L)
5/21/2019	10:53	UKEP	N/A	ODEQ	UKEP19001	SG	*	*	*	*	0.11 C1, J
5/21/2019	11:09	UKHP	N/A	ODEQ	UKHP19001	SG	*	*	*	*	0.13 C1, J
5/21/2019	11:24	UKMP	N/A	ODEQ	UKMP19001	SG	*	*	*	*	4.1
5/21/2019	10:19	KEKP	234	ODEQ	KEKP19001	SG	*	*	*	*	0.10 C1, J
5/21/2019	10:04	BRTC	225	ODEQ	BRTC19001	SG	*	*	*	*	ND
5/18/2019	13:05	CRMC	201.5	PacifiCorp	KR19800	SG	0	0	0	0	ND
5/18/2019	12:30	CRCC	200.0	PacifiCorp	KR19801	SG	0	0	0	0	ND
5/18/2019	12:00	IRCC	192.8	PacifiCorp	KR19802	SG	0	0	0	0	ND
5/18/2019	11:50	IRJW	192.4	PacifiCorp	KR19803	SG	0	0	0	0	ND
5/18/2019	13:50	KRBI	189.7	PacifiCorp	KR19804	SG	0	0	0	0	ND
5/30/2019	11:20	UKEP	N/A	ODEQ	UKEP19002	SG	*	*	*	*	0.22
5/30/2019	11:38	UKHP	N/A	ODEQ	UKHP19002	SG	*	*	*	*	0.14 C1, J
5/30/2019	11:53	UKMP	N/A	ODEQ	UKMP19002	SG	*	*	*	*	0.10 C1, J
5/30/2019	10:37	KEKP	234	ODEQ	KEKP19002	SG	*	*	*	*	0.17
5/30/2019	10:23	BRTC	225	ODEQ	BRTC19002	SG	*	*	*	*	0.10 C1, J
6/8/2019	16:15	CRMC	201.5	PacifiCorp	KR18805	SG	0	508	0	36[10]	ND
6/8/2019	12:30	CRCC	200.0	PacifiCorp	KR19806	SG	0	2,113	58	0	0.11 C1, J
6/8/2019	11:15	IRCC	192.8	PacifiCorp	KR19807	SG	0	0	58	0	ND
6/8/2019	11:00	IRJW	192.4	PacifiCorp	KR19808	SG	0	0	0	0	ND
6/8/2019	17:05	KRBI	189.7	PacifiCorp	KR19809	SG	0	0	0	0	ND
6/12/2019	12:09	UKEP	N/A	ODEQ	UKEP19003	SG	*	*	*	*	0.16
6/12/2019	12:31	UKHP	N/A	ODEQ	UKHP19003	SG	*	*	*	*	1.4
6/12/2019	12:49	UKMP	N/A	ODEQ	UKMP18003	SG	*	*	*	*	0.10 C1, J
6/12/2019	11:26	KEKP	234	ODEQ	KEKP19003	SG	*	*	*	*	0.91
6/12/2019	11:09	BRTC	225	ODEQ	BRTC19003	SG	*	*	*	*	ND
6/24/2019	09:50	CRMC	201.5	PacifiCorp	KR19810	SG	0	809	0	0	ND
6/24/2019	08:40	CRCC	200.0	PacifiCorp	KR19811	SG	0	10,036	0	0	0.21
6/24/2019	08:15	IRCC	192.8	PacifiCorp	KR19812	SG	0	339	113	0	0.18
6/24/2019	07:50	IRJW	192.4	PacifiCorp	KR19813	SG	0	0	0	0	0.13 C1, J
6/24/2019	10:20	KRBI	189.7	PacifiCorp	KR19814	SG	0	738	0	0	ND
6/25/2019	12:15	UKEP	N/A	ODEQ	UKEP19004	SG	*	*	*	*	ND
6/25/2019	12:35	UKHP	N/A	ODEQ	UKHP19004	SG	*	*	*	*	0.18
6/25/2019	12:53	UKMP	N/A	ODEQ	UKMP18004	SG	*	*	*	*	0.18
6/25/2019	11:26	KEKP	234	ODEQ	KEKP19004	SG	*	*	*	*	0.15
6/25/2019	11:03	BRTC	225	ODEQ	BRTC19004	SG	*	*	*	*	ND

[1]MSAE = *Microcystis aeruginosa* (cells/mL)
[2]AFA = *Aphanizomenon flos-aquae* (cells/mL)
[3]DKFA = *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,* or [11]*Pseudanabaena* spp.
"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.
"0" value indicates non-detect by analytical laboratory
"*" value indicates no result available

Table 4. Summary of May and June 2019 baseline laboratory microcystin results for samples collected in Oregon.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/7/2019	08:45	KR246.0	246.0	BOR	2019KHSA-22	0.5	ND
5/7/2019	11:00	KBK	231.8	BOR	2019KHSA-23	0.5	ND
5/5/2019	08:15	KR22460	224.6	PacifiCorp	KR19047	0.5	0.10 C1, J
5/5/2019	09:20	KR21950	219.5	PacifiCorp	KR19048	0.5	ND
6/4/2019	09:00	KR246.0	246.0	BOR	2019KHSA-32	0.5	0.12 C1, J
6/4/2019	11:20	KBK	231.8	BOR	2019KHSA-33	0.5	ND
6/9/2019	8:35	KR22460	224.6	PacifiCorp	KR19064	0.5	0.14 C1, J
6/9/2019	9:20	KR21950	219.5	PacifiCorp	KR19065	0.5	0.10 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 May and June 2019 baseline laboratory microcystin results for samples collected in California.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/4/2019	15:30	KR20642	206.4	PacifiCorp	KR19043	0.5	ND
5/4/2019	13:30	KR19874	198.7	PacifiCorp	KR19039	0.5	ND
5/4/2019	13:40	KR19874	198.7	PacifiCorp	KR19040	0-8	ND
5/4/2019	12:30	KR19645	196.5	PacifiCorp	KR19038	0.5	ND
5/4/2019	09:30	KR19019	190.2	PacifiCorp	KR19034	0.5	ND
5/4/2019	9:55	KR19019	190.2	PacifiCorp	KR19035	0-8	ND
6/8/2019	15:45	KR20642	206.4	PacifiCorp	KR19060	0.5	0.16
6/8/2019	13:00	KR19874	198.7	PacifiCorp	KR19056	0.5	ND
6/8/2019	13:15	KR19874	198.7	PacifiCorp	KR19057	0-8	0.12 C1, J
6/8/2019	11:45	KR19645	196.5	PacifiCorp	KR19055	0.5	ND
6/8/2019	9:00	KR19019	190.2	PacifiCorp	KR19051	0.5	ND
6/8/2019	9:20	KR19019	190.2	PacifiCorp	KR19052	0-8	ND
6/8/2019	17:15	KR18973	189.7	PacifiCorp	KR19063	0.5	ND
6/24/2019	10:30	KR18973	189.7	PacifiCorp	KR19066	0.5	ND

"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.

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/HARMFULALGAEBLOOMS/Documents/Advisory-Guidelines-Harmful-Cyanobacterial-Blooms-Recreational-Waters.pdf

Appendix 1

Cyanobacteria Species and Microcystin Data for 2019 Public Health Samples

Table A1. Summary of 2018 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], or [11]	Microcystin (µg/L)
5/21/2019	10:53	UKEP	N/A	ODEQ	UKEP19001	SG	*	*	*	*	0.11 C1, J
5/21/2019	11:09	UKHP	N/A	ODEQ	UKHP19001	SG	*	*	*	*	0.13 C1, J
5/21/2019	11:24	UKMP	N/A	ODEQ	UKMP19001	SG	*	*	*	*	4.1
5/21/2019	10:19	KEKP	234	ODEQ	KEKP19001	SG	*	*	*	*	0.10 C1, J
5/21/2019	10:04	BRTC	225	ODEQ	BRTC19001	SG	*	*	*	*	ND
5/18/2019	13:05	CRMC	201.5	PacifiCorp	KR19800	SG	0	0	0	0	ND
5/18/2019	12:30	CRCC	200.0	PacifiCorp	KR19801	SG	0	0	0	0	ND
5/18/2019	12:00	IRCC	192.8	PacifiCorp	KR19802	SG	0	0	0	0	ND
5/18/2019	11:50	IRJW	192.4	PacifiCorp	KR19803	SG	0	0	0	0	ND
5/18/2019	13:50	KRBI	189.7	PacifiCorp	KR19804	SG	0	0	0	0	ND
5/30/2019	11:20	UKEP	N/A	ODEQ	UKEP19002	SG	*	*	*	*	0.22
5/30/2019	11:38	UKHP	N/A	ODEQ	UKHP19002	SG	*	*	*	*	0.14 C1, J
5/30/2019	11:53	UKMP	N/A	ODEQ	UKMP19002	SG	*	*	*	*	0.10 C1, J
5/30/2019	10:37	KEKP	234	ODEQ	KEKP19002	SG	*	*	*	*	0.17
5/30/2019	10:23	BRTC	225	ODEQ	BRTC19002	SG	*	*	*	*	0.10 C1, J
6/8/2019	16:15	CRMC	201.5	PacifiCorp	KR18805	SG	0	508	0	36[10]	ND
6/8/2019	12:30	CRCC	200.0	PacifiCorp	KR19806	SG	0	2,113	58	0	0.11 C1, J
6/8/2019	11:15	IRCC	192.8	PacifiCorp	KR19807	SG	0	0	58	0	ND
6/8/2019	11:00	IRJW	192.4	PacifiCorp	KR19808	SG	0	0	0	0	ND
6/8/2019	17:05	KRBI	189.7	PacifiCorp	KR19809	SG	0	0	0	0	ND
6/12/2019	12:09	UKEP	N/A	ODEQ	UKEP19003	SG	*	*	*	*	0.16
6/12/2019	12:31	UKHP	N/A	ODEQ	UKHP19003	SG	*	*	*	*	1.4
6/12/2019	12:49	UKMP	N/A	ODEQ	UKMP18003	SG	*	*	*	*	0.10 C1, J
6/12/2019	11:26	KEKP	234	ODEQ	KEKP19003	SG	*	*	*	*	0.91
6/12/2019	11:09	BRTC	225	ODEQ	BRTC19003	SG	*	*	*	*	ND
6/24/2019	09:50	CRMC	201.5	PacifiCorp	KR19810	SG	0	809	0	0	ND
6/24/2019	08:40	CRCC	200.0	PacifiCorp	KR19811	SG	0	10,036	0	0	0.21
6/24/2019	08:15	IRCC	192.8	PacifiCorp	KR19812	SG	0	339	113	0	0.18
6/24/2019	07:50	IRJW	192.4	PacifiCorp	KR19813	SG	0	0	0	0	0.13 C1, J
6/24/2019	10:20	KRBI	189.7	PacifiCorp	KR19814	SG	0	738	0	0	ND
6/25/2019	12:15	UKEP	N/A	ODEQ	UKEP19004	SG	*	*	*	*	ND
6/25/2019	12:35	UKHP	N/A	ODEQ	UKHP19004	SG	*	*	*	*	0.18
6/25/2019	12:53	UKMP	N/A	ODEQ	UKMP18004	SG	*	*	*	*	0.18
6/25/2019	11:26	KEKP	234	ODEQ	KEKP19004	SG	*	*	*	*	0.15
6/25/2019	11:03	BRTC	225	ODEQ	BRTC19004	SG	*	*	*	*	ND

[1]MSAE = *Microcystis aeruginosa* (cells/mL)
[2]AFA = *Aphanizomenon flos-aquae* (cells/mL)
[3]DKFA = *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,* or [11]*Pseudanabaena* spp.
"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.
"0" value indicates non-detect by analytical laboratory
"*" value indicates no result available

Appendix 2
Microcystin Data for 2019 Baseline Samples

Table A2-1. Summary of 2018 baseline laboratory microcystin results for samples collected in Oregon.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/7/2019	08:45	KR246.0	246.0	BOR	2019KHSA-22	0.5	ND
5/7/2019	11:00	KBK	231.8	BOR	2019KHSA-23	0.5	ND
5/5/2019	08:15	KR22460	224.6	PacifiCorp	KR19047	0.5	0.10 C1, J
5/5/2019	09:20	KR21950	219.5	PacifiCorp	KR19048	0.5	ND
6/4/2019	09:00	KR246.0	246.0	BOR	2019KHSA-32	0.5	0.12 C1, J
6/4/2019	11:20	KBK	231.8	BOR	2019KHSA-33	0.5	ND
6/9/2019	8:35	KR22460	224.6	PacifiCorp	KR19064	0.5	0.14 C1, J
6/9/2019	9:20	KR21950	219.5	PacifiCorp	KR19065	0.5	0.10 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 A2-2. Summary of 2019 baseline laboratory microcystin results for samples collected in California.

Date	Time	Site ID	RM	Sampling Entity	Sample ID	Depth (m)	Microcystin (µg/L)
5/4/2019	15:30	KR20642	206.4	PacifiCorp	KR19043	0.5	ND
5/4/2019	13:30	KR19874	198.7	PacifiCorp	KR19039	0.5	ND
5/4/2019	13:40	KR19874	198.7	PacifiCorp	KR19040	0-8	ND
5/4/2019	12:30	KR19645	196.5	PacifiCorp	KR19038	0.5	ND
5/4/2019	09:30	KR19019	190.2	PacifiCorp	KR19034	0.5	ND
5/4/2019	9:55	KR19019	190.2	PacifiCorp	KR19035	0-8	ND
6/8/2019	15:45	KR20642	206.4	PacifiCorp	KR19060	0.5	0.16
6/8/2019	13:00	KR19874	198.7	PacifiCorp	KR19056	0.5	ND
6/8/2019	13:15	KR19874	198.7	PacifiCorp	KR19057	0-8	0.12 C1, J
6/8/2019	11:45	KR19645	196.5	PacifiCorp	KR19055	0.5	ND
6/8/2019	9:00	KR19019	190.2	PacifiCorp	KR19051	0.5	ND
6/8/2019	9:20	KR19019	190.2	PacifiCorp	KR19052	0-8	ND
6/8/2019	17:15	KR18973	189.7	PacifiCorp	KR19063	0.5	ND
6/24/2019	10:30	KR18973	189.7	PacifiCorp	KR19066	0.5	ND

"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.

Appendix 3
Laboratory Phytoplankton Results

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR19800	
Sample Depth:	0	
Sample Date:	18-May-19	1305
Total Density (#/mL):	<4	
Total Biovolume (um^3/mL):		
Trophic State Index:		

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-	-	-	-	-
1	No Toxic Algae Present	<4			

Aquatic Analysts

Sample ID: WD16

Sample:	Klamath Basin
Sample ID:	KR19801
Sample Depth:	0
Sample Date:	18-May-19 1230

Total Density (#/mL):	<4
Total Biovolume (um^3/mL):	
Trophic State Index:	

	Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-	-	-	-	-
1	No Toxic Algae Present	<4			

Aquatic Analysts

Sample ID: WD17

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR19802
Sample Depth: 0
Sample Date: 18-May-19 1200

Total Density (#/mL): <8
Total Biovolume (um^3/mL):
Trophic State Index:

Species		Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-		-	-	-
No Toxic Algae Present		<8			

Aquatic Analysts

Sample ID: WD18

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR19803
Sample Depth: 0
Sample Date: 18-May-19 1150

Total Density (#/mL): <4
Total Biovolume (um^3/mL):
Trophic State Index:

	Species		Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-	-		-	-	-
1	No Toxic Algae Present		<4			

Aquatic Analysts **Sample ID:** WD19

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR19804
Sample Depth: 0
Sample Date: 18-May-19 1350

Total Density (#/mL): <5
Total Biovolume (um^3/mL):
Trophic State Index:

Species		Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-		-	-	-
No Toxic Algae Present		<5			

Aquatic Analysts

Sample ID: WD20

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR19805	
Sample Depth:		
Sample Date:	8-Jun-19	1615

Total Density (#/mL):	25
Total Biovolume (um^3/mL):	34,194
Trophic State Index:	25.7

Species	**Density #/mL**	**Density Percent**	**Biovolume um^3/mL**	**Biovolume Percent**
Aphanizomenon flos-aquae	23	92.9	31,993	93.6
Oscillatoria limosa	2	7.1	2,202	6.4

Aphanizomenon flos-aquae cells/mL =	508
Oscillatoria limosa cells/mL =	36

Aquatic Analysts

Sample ID: WD31

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR19806	
Sample Depth:		
Sample Date:	8-Jun-19	1230

Total Density (#/mL):	115
Total Biovolume (um^3/mL):	136,980
Trophic State Index:	35.5

Species	**Density #/mL**	**Density Percent**	**Biovolume um^3/mL**	**Biovolume Percent**
Aphanizomenon flos-aquae	111	96.7	133,126	97.2
Dolichospermum flos-aquae	4	3.3	3,854	2.8

Aphanizomenon flos-aquae cells/mL =	2,113
Dolichospermum flos-aquae cells/mL =	58

Aquatic Analysts

Sample ID: WD32

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR19807
Sample Depth:
Sample Date: 8-Jun-19 1115

Total Density (#/mL): 3
Total Biovolume (um^3/mL): 3,874
Trophic State Index: 11.4

Species	Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-	-	-	-
Dolichospermum flos-aquae	3	100.0	3,874	100.0

Dolichospermum flos-aquae cells/mL = 58

Aquatic Analysts

Sample ID: WD33

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR19808
Sample Depth:
Sample Date: 8-Jun-19 1100

Total Density (#/mL): <4
Total Biovolume (um^3/mL):
Trophic State Index:

Species		Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-		-	-	-
No Toxic Algae Present		<4			

Aquatic Analysts

Sample ID: WD34

Phytoplankton Sample Analysis

Sample: Klamath Basin
Sample ID: KR19809
Sample Depth:
Sample Date: 8-Jun-19 1705

Total Density (#/mL): >2
Total Biovolume (um^3/mL):
Trophic State Index:

Species		Density #/mL	Density Percent	Biovolume um^3/mL	Biovolume Percent
-	-		-	-	-
No Toxic Algae Present		>2			

Aquatic Analysts

Sample ID: WD35

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR19810	
Sample Depth:		
Sample Date:	24-Jun-19	950
Total Density (#/mL):	39	
Total Biovolume (um³/mL):	50,998	
Trophic State Index:	28.5	

	Species	Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
-	-	-	-	-	-
1	Aphanizomenon flos-aquae	39	100.0	50,998	100.0

Aphanizomenon flos-aquae cells/mL = 809

Aquatic Analysts

Sample ID: WD36

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR19811	
Sample Depth:		
Sample Date:	24-Jun-19	840

Total Density (#/mL):	401
Total Biovolume (um^3/mL):	632,297
Trophic State Index:	46.5

Species	**Density #/mL**	**Density Percent**	**Biovolume um^3/mL**	**Biovolume Percent**
Aphanizomenon flos-aquae	401	100.0	632,297	100.0

Aphanizomenon flos-aquae cells/mL = 10,036

Aquatic Analysts

Sample ID: WD37

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR19812	
Sample Depth:		
Sample Date:	24-Jun-19	815
Total Density (#/mL):	23	
Total Biovolume (um^3/mL):	28,936	
Trophic State Index:	24.5	

Species	**Density #/mL**	**Density Percent**	**Biovolume um^3/mL**	**Biovolume Percent**
-	-	-	-	-
Aphanizomenon flos-aquae	17	75.0	21,363	73.8
Dolichospermum flos-aquae	6	25.0	7,573	26.2

Aphanizomenon flos-aquae cells/mL =	339
Dolichospermum flos-aquae cells/mL =	113

Aquatic Analysts **Sample ID:** WD38

Total Biovolume (um³/mL):
Trophic State Index:

Species		Density #/mL	Density Percent	Biovolume um³/mL	Biovolume Percent
-	-		-	-	-
No Toxic Algae Present		<9			

Aquatic Analysts

Sample ID: WD39

Phytoplankton Sample Analysis

Sample:	Klamath Basin	
Sample ID:	KR19814	
Sample Depth:		
Sample Date:	24-Jun-19	1020

Total Density (#/mL):	39
Total Biovolume (um^3/mL):	46,466
Trophic State Index:	27.8

Species	**Density #/mL**	**Density Percent**	**Biovolume um^3/mL**	**Biovolume Percent**
Aphanizomenon flos-aquae	39	100.0	46,466	100.0

Aphanizomenon flos-aquae cells/mL = 738

Aquatic Analysts

Sample ID: WD40