# Final
# 2010-2015 Klamath River Blue-Green Algae Summary Report

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# Acknowledgements

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## I. Introduction

This report summarizes the presence of toxicogenic cyanobacteria in the Klamath River within the Yurok Indian Reservation (YIR) boundaries 2010 to 2015. The Yurok Tribe Environmental Program (YTEP) and the Karuk Tribe collaborated to monitor water quality conditions from downstream of Iron Gate Dam to the Klamath River Estuary. The Karuk Tribe will be publishing a report that summarizes the conditions from Orleans to just downstream of Iron Gate Dam. Results from water samples collected in 2010 indicated that the water quality in the Klamath River was negatively impacted by levels of the cyanobacterium *Microcystis aeruginosa* (MSAE) and its resultant toxin, microcystin.

Cyanobacteria, also known as blue-green algae (BGA), are commonly found in many freshwater systems across the world. The species of concern here are known as toxigenic species, since they have the potential to produce chemicals that are toxic to humans and animals. In general, the toxins produced by these algae can be divided into two groups, those which can cause liver damage (hepatotoxins) and those which can damage the central nervous system (neurotoxins), although other health effects are possible.

At least 46 species of cyanobacteria have been shown to be toxic to vertebrates (Chorus & Bartrum, 1999). Some of the more common toxin-producing genera include *Microcystis*, *Anabaena*, *Aphanizomenon*, *Lyngbya*, *Nodularia*, *Planktothrix*, *Nostoc* and *Cylindrospermopsis.* It should be noted that cyanobacteria likely produce toxins that have not been characterized.

*Microcystis aeruginosa* is a type of blue-green algae which releases the liver toxin microcystin when it dies and decomposes. Microcystin can cause rashes, skin irritation, conjunctivitis, nausea, vomiting, diarrhea, liver damage, tingling, numbness, paralysis, and death in humans and animals. Microcystin causes the most damage when it builds up in the liver; it also accumulates in other organs and in the muscle tissue of humans and animals. Microcystin is not excreted by humans and animals, so the dose can increase over time. When a large enough dose accumulates liver damage, increased liver size and death can result. Mortality in fish, domestic animals, and humans has been recorded following exposure to microcystin from a single-dose and from long-term exposure.

### Exposures Pathways

The primary exposure pathway of concern for exposure to cyanotoxins is through ingestion of water, although for Tribal members and subsistence fishers/harvesters, traditional foods and the procurement of foods, ceremonial practices, and cultural activities may contribute significantly to individuals toxin load. Skin irritation can result from exposure to the algae itself, however the cyanotoxins are not likely to cross the skin barrier and enter the bloodstream unless the skin is abraded by cuts, scrapes, and existing rashes and irritation. This likelihood is increased with commercial and subsistence fish net pulling. Inhalation of microcystin is possible, especially during activities such as water skiing, fishing, swimming, canoeing, or splashing, where contaminated water is aerosolized.

Ingestion of contaminated water can occur through both incidental and intentional pathways. Incidental ingestion most commonly occurs during recreation especially in turbid or discolored lakes. The risk of incidental ingestion of the toxin is particularly high for children playing in near-shore areas where algal scum tends to accumulate. Because of their small body size, children are at greater risk from exposure—it takes a smaller dose to make them sick than it does to sicken an adult. Exposure levels can be broadly defined as high, moderate and low based on recreational activity (Table 1).

Ta**ble 1. Exposure level of recreational activity (modified from Queensland Health, 2001).**

| Level of Exposure | Recreational Activity |
|---|---|
| High | Swimming, diving, water skiing |
| Moderate | Canoeing, sailing, rowing |
| Low to none | Fishing, pleasure cruising, picnicking, hiking |

At this time, there is insufficient information to determine the risk of consuming fish caught in waters with toxigenic cyanobacteria. Studies have shown that toxins mainly accumulate in the liver and other internal organs of fish, although microcystin has been detected in the fillet (Vasconcelos, 1999; de Magalhães et al., 2001). However, Fetcho 2006 reports that no microcystin was detected in salmon or steelhead filets collected from fish sampled at Weitchpec during the 2005 *Microcystis* bloom. At a minimum, the internal organs and skin should be removed and discarded prior to cooking fillets. Shellfish have been shown to accumulate cyanotoxins in edible tissue (Vasconcelos, 1999). It is recommended that people call the Department of Human Services for more information on fish consumption while advisories are in effect.

### Detrimental Environmental Effects of *Microcystis aeruginosa*

In addition to causing many known, well-documented human and animal health effects, microcystins can have a detrimental effect on the food chain by limiting growth of beneficial phytoplankton species, discouraging zooplankton feeding and population growth, decreasing total dissolved oxygen in the water column, and ultimately lowering success of fish and other large organisms.

“Even low microcystins concentration at the base of the food web poses a threat to the upper food web because microcystins may bioaccumulate.” The impact of *Microcystis* species on the quantity and quality of phytoplankton biomass available to the food web may be a greater threat to the food web than toxicity. Blooms can reduce growth of other phytoplankton species because of their buoyancy and ability to block light further down the water column, and their relative ability to out-compete species which cannot tolerate high light and temperatures at the surface. Dissolved microcystin in the water may also inhibit feeding by zooplankton (De Mott et al., 1991). In addition, high biomass produced by blooms and the associated decomposition can eventually impact fishery production through influence on dissolved oxygen concentration (Lehman et al., 2005).

### ***Microcystin Toxin Information***

WHO has established minimum tolerance levels for recreational contact with microcystin. Because of the time it takes to analyze water samples for the presence of microcystin, WHO recommends the use of cell counts per milliliter of water as a crude surrogate for concentrations of microcystin. However, because the toxin is released as the organism decomposes, the risk from microcystin presence in waters is at its greatest after the bloom has initially begun to decompose and increases until well after the last cells are observed in samples.

WHO has set the following thresholds for MSAE/microcystin concentrations in recreational waters:

| | *Microcystis* cells/milliliter | Microcystin micrograms/liter (µg/L) |
|---|---|---|
| Low Risk: | 20,000 | 4 |
| Moderate Risk: | 100,000 | 20 |
| Severe Risk | 10,000,000 *or* visible scum | 200 |

The consumption limit for microcystin is set as 0.04 micrograms per kilogram of bodyweight per day. However, because even the consumption of relatively low doses of microcystin over time will damage the liver of animals, continued consumption of known contaminated food sources is not recommended.

The State of CA has set thresholds for posting waterbodies to minimize impacts to recreational users in a document titled "Cyanobacteria in California Recreational Water Bodies Providing Voluntary Guidance about Harmful Algal Blooms, Their Monitoring, and Public Notification".

The State of CA's has set the following thresholds for posting recreational waters:

- Scums present containing toxigenic* species
- MSAE or *Planktothrix* ≥ 40,000 cells/ml
- Population of potentially toxigenic BGA species ≥ 100,000 cells/ml
- Concentration of microcystin ≥ 8 ppb

*Potentially toxic blue-green algae that have been detected in California include those of the genera *Anabaena, Microcystis, Aphanizomenon, and Gloeotrichia.* Additional blue green algae that are known to be potentially toxic may be added to this list.

The Office of Environmental Health Hazard Assessment has released its study on *Toxicological Summary and Suggested Action Levels to Reduce Potential Adverse Health Effects of Six Cyanotoxins.*

OEHHA computed health-based water concentration levels (also known as "action levels"), for people, pets and livestock. Health based concentrations in sport fish and shellfish were also computed. The human water levels are only applicable to incidental exposure through recreational use. They should not be used to judge the acceptability of drinking water concentrations. The exposure equations and RfDs described above were used to calculate suggested action levels. The following table shows the results of these computations.

**Action levels for selected scenarios**

| | Microcystins[1] | Anatoxin-a | Cylindro-spermopsin | Media (units) |
|---|---|---|---|---|
| Human recreational uses[2] | 0.8 | 90 | 4 | Water (µg/L) |
| Human fish consumption | 10 | 5000 | 70 | Fish (ng/g) ww[3] |
| Subchronic water intake, dog[4] | 2 | 100 | 10 | Water (µg/L) |
| Subchronic crust and mat intake, dog | 0.01 | 0.3 | 0.04 | Crusts and Mats (mg/kg) dw[5] |
| Acute water intake, dog[6] | 100 | 100 | 200 | Water (µg/L) |
| Acute crust and mat intake, dog | 0.5 | 0.3 | 0.5 | Crusts and Mats (mg/kg) dw[5] |
| Subchronic water intake, cattle[7] | 0.9 | 40 | 5 | Water (µg/L) |
| Subchronic crust and mat intake, cattle[7] | 0.1 | 3 | 0.4 | Crusts and Mats (mg/kg) dw[5] |
| Acute water intake, cattle[7] | 50 | 40 | 60 | Water (µg/L) |
| Acute crust and mat intake, cattle[7] | 5 | 3 | 5 | Crusts and Mats (mg/kg) dw[5] |

[1] Microcystins LA, LR, RR, and YR all had the same RfD so the action levels are the same.

[2] The most highly exposed of all the recreational users were 7- to-10-year-old swimmers.

Boaters and water-skiers are less exposed and therefore protected by these action levels. This level should not be used to judge the acceptability of drinking water concentrations.

[3] Wet weight or fresh weight.

[4] Subchronic refers to exposures over multiple days.

[5] Based on sample dry weight (dw).

[6] Acute refers to exposures in a single day.

[7] Based on small breed dairy cows because their potential exposure to cyanotoxins is greatest. See Section VI for action levels in beef cattle.

## II. <u>Methods</u>

YTEP follows methods as specified in the USEPA approved "Lower Klamath River Nutrient, Periphyton, Phytoplankton and Algal Toxin Sampling Analysis Plan (SAP)" for samples collected for baseline monitoring purposes. At each sample site, sample water was collected with a pre-rinsed churn splitter as specified in the grab sample protocol located in Appendix B. The 14 Liter churn was rinsed three times with distilled water followed by three rinses with site river water. Samples were drawn in a moving portion of the river in an attempt to collect water samples to represent the river as a whole. The churn splitter allowed for distribution of a homogenous water mixture into sample bottles used for algal identification and enumeration and testing for microcystin.

At each sampling location, samplers conducted an initial visual survey of the public access area to identify where surface grab samples would be collected to represent a reasonable maximum exposure at that public access location (referred to hereafter as the RME location – see Section 2.3). Because cyanobacteria can accumulate and dissipate rapidly, depending on sun and wind conditions, a location having a greater presence of cyanobacteria should be identified within each designated public access area, where the public is likely to come into contact with cyanotoxins.

The sampler waded to where the sample was collected, and that sample was collected before other work was done at that location to minimize collection from a disturbed water column. Care was taken to avoid collecting particulates that are re-suspended as the result of accessing the sampling location. Using a glass wide mouth jar a grab sample was collected from the upper 10 cm of the water column.

The sample bottle for identification and enumeration of algal species contained Lugol's preservative and the toxin sample was preserved by freezing the bottle. Both of these samples were drawn from the same churn of water because they are complementary to one another. All samples were labeled with the following information: date, time, sampler, sample site, study name. The sample ID was comprised of a two or three digit site ID and the date (e.g. TG090108).

If a sampling crew member identified an area along the river that had scum lines, an additional sample was collected at this site. The sample was labeled appropriately and photographs of the sample area were taken. Additional quality control measures were included in the sampling. At one site per trip a replicate split sample was sent to the laboratory to assess laboratory performance and to gain improved confidence in the data.

Environmental information was also recorded at the time water samples were collected. The data included water temperature, pH, specific conductance, dissolved oxygen and other observational notes. Water samples were also collected to be analyzed for the concentration of nutrient analytes and sent to Aquatic Research Inc. in Seattle, Washington (WA). Chain-of-custody (COC) sheets were also filled out to document the handling of the samples from the time of collection to the time of laboratory analysis. This is a standard procedure for handling samples.

Water samples that were collected for algae speciation and enumeration were mailed overnight to Aquatic Analysts for analysis. Microscope slides are prepared at the laboratory from each sample by filtering an appropriate aliquot of the sample through a 0.45 micrometer membrane filter (APHA Standard Methods, 1992, 10200.D.2; McNabb, 1960). A section is cut out and placed on a glass slide with immersion oil added to make the filter transparent, followed by placing a cover slip on top, with nail polish applied to the periphery for permanency. Most algae are identified by cross-referencing several taxonomic sources.

Algal units (defined as discrete particles - either cells, colonies, or filaments) are counted along a measured transect of the microscope slide with a Zeiss standard microscope (1000X, phase contrast). Algal units are measured accurately to 0.1 mm with a stage micrometer. The algal densities are calculated from the area observed (transect length times diameter of field of view), the effective filter area, and the volume of sample filtered. Only those algae that were believed to be alive at the time of collection (intact chloroplast) are counted. A minimum of 100 algal units are counted. (Standard Methods, 1992, 10200.F.2.c.). If toxic cyanobacteria are present in the 100 algal units count the taxonomist then counts 4 times that area but only for the toxic species. Average biovolume estimates of each species are obtained from calculations of microscopic measurements of each alga. The number of cells per colony, or the length of a filament, are recorded during sample analysis to arrive at biovolume per unit-alga. Average biovolumes for algae are stored in a computer, and measurements are verified for each sample analyzed.

Water samples that were collected for microcystin processing were stored in glass containers and mailed on ice overnight to USEPA Region 9 lab in Richmond, California for analysis using the enzyme linked immunosorbent assay (ELISA) method. These methods have been adapted to a commercial ELISA kit (Microcystin Plate Kit, EP-022) that is produced by Envirologix, Inc. (Portland Maine), which USEPA Region 9 lab in Richmond, CA employs and measures total microcystin. Additional water samples were submitted to the California Department of Fish and Game's Fish and Wildlife Water Pollution Control Laboratory in Rancho Cordova for the analysis of microcystin variants and anatoxin-a using liquid chromatography duel mass spectrometry (LC-MS/MS).

YTEP's real-time continuous water quality monitoring equipment on the Klamath River have phycocyanin probes that are designed to detect the presence of accessory pigment known to occur in *Microcystis aeurginosa* and other cyanobacteria. YTEP operates these data sondes according to the manufacturer's recommendations. Once the presence of MSAE was detected at sampling sites on the YIR additional samples were collected at the datasonde locations in the Klamath River to develop a relationship between the phycocyanin probe readings and blue-green algae laboratory cell counts.

## III. Site Selection

In general, the various sampling locations were chosen in order to represent the average ambient water conditions throughout the water column. The sites listed below indicate established sampling locations for the collection of water samples for nutrient analysis and phytoplankton speciation and enumeration from May through October on a biweekly interval.

YTEP collected water samples for toxin and algae speciation analysis at the following mainstem Klamath River locations (river miles are approximate):

- **WE - Klamath River at Weitchpec (upstream of Trinity River) – RM 43.5**
- **TC – Klamath River Above Tully Creek (downstream of Trinity River– RM 38.5**
- **TG - Klamath River at Turwar Boat Ramp – RM 6**
- **LES - Lower Estuary Surface – RM 0.5**

YTEP collected water samples for toxin and speciation analysis at the following major tributary location:

- **TR - Trinity River near mouth (above Klamath River confluence) – RM 0.5**

YTEP's datasondes on the Klamath River are close to the routine water sampling sites for Klamath River at Weitchpec and Klamath River at Turwar Boat Ramp, see figure 1. The Klamath River Above Tully Creek datasonde location is at the same location that routine water sampling site, see figure 1. The samples collected after datasonde maintenance occurred are denoted with a DCP (data collection platform) acronym to aid the sampling crew in tracking sample results.

YTEP collected water samples for toxin and speciation analysis at the following mainstem Klamath River datasonde locations (river miles are approximate):

- **WEDCP - Klamath River at Weitchpec (upstream of Trinity River) – RM 43.7**
- **TCDCP – Klamath River Above Tully Creek (downstream of Trinity River– RM 38.5**
- **KATDCP – Klamath River above Turwar – RM 8**

Figure 1. Map of phytoplankton and microcystin surface water monitoring locations, 2010- 2015.

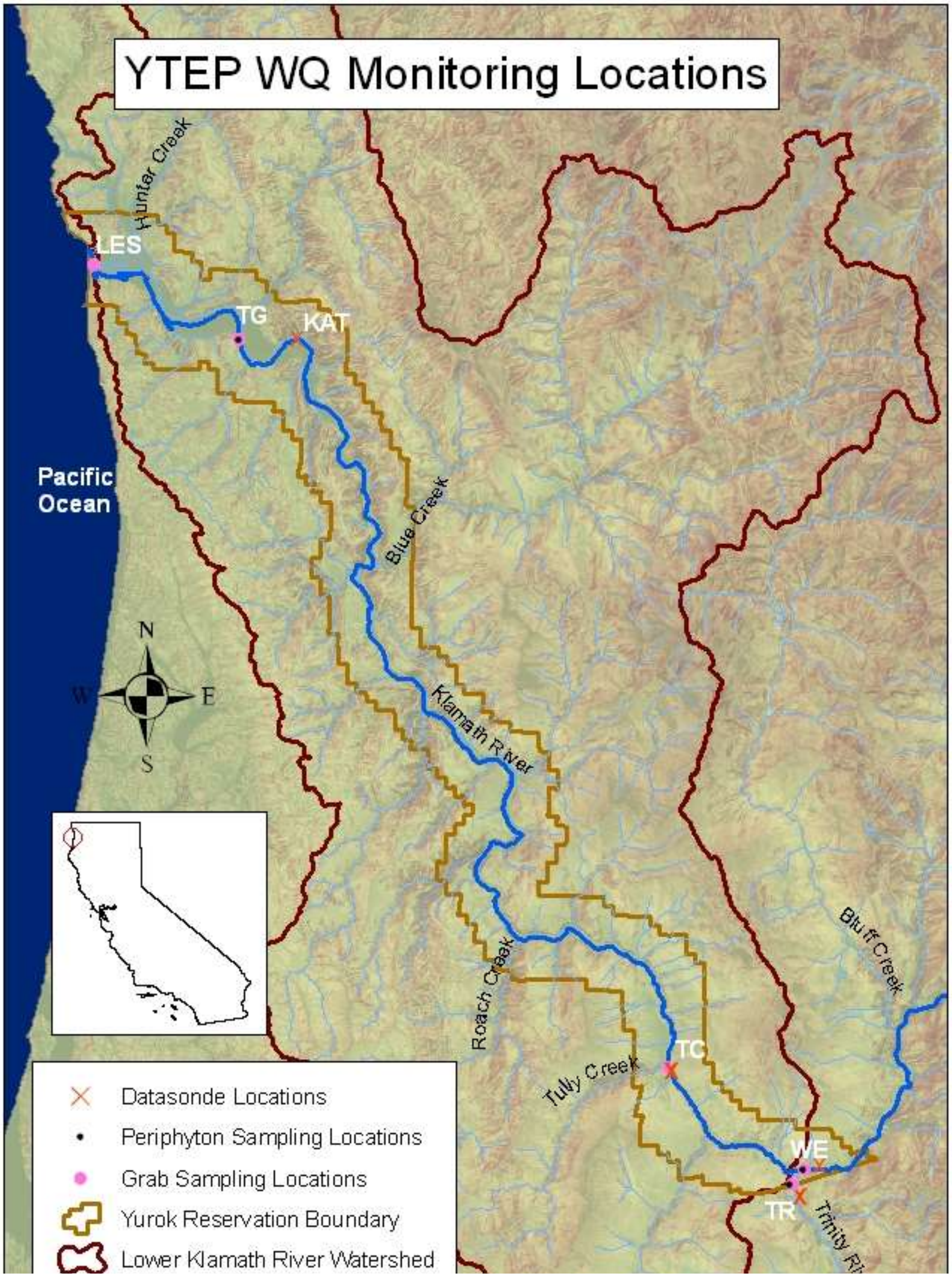

Figure 1Map of phytoplankton and microcystin surface water monitoring locations, 2010- 2015

## IV. Quality Assurance

YTEP follows methods as specified in the “Lower Klamath River Nutrient, Periphyton, Phytoplankton and Algal Toxin Sampling Analysis Plan (SAP)” approved by the USEPA in June 2008. These methods are consistent with the methods specified in the AIP SOP. Quality Assurance/Quality Control (QA/QC) of the collection, preparation and analysis of water samples for microcystin and phytoplankton speciation and enumeration was achieved by following a standard water sample collection protocol using a churn sampler and submitting samples to labs that follow strict protocol that have QA/QC measures. All field personnel that were involved in collection of water samples have been trained appropriately by the Water Division Program Manager and are properly supervised to ensure proper protocol is followed consistently throughout the monitoring season. Field crews collecting samples ensured representativeness of samples by selecting free-flowing water from established sampling locations and using a churn splitter to mix sample water once collected. All samples were transported to the appropriate laboratories following chain of custody procedures to ensure proper handling of the samples.

The collection and analysis of field replicate samples were performed during each sampling event to determine the labs’ precision of data. Since the Yurok and Karuk Tribes collaborated on this project it was necessary for each Tribe to alternate every other event to collect the QA/QC samples. YTEP collected QA/QC samples in the sampling event that was near the beginning of the month and the Karuk Tribe would collect the QA/QC samples near the end of the month. Field replicates were collected by splitting samples in the field using the churn splitter. One of the split samples was sent with its’ associated split with a different ID code for analysis of both algae identification and enumeration and microcystin so as to not alert lab staff of the fact that the samples were replicates.

Data is thoroughly reviewed once received from the laboratory. YTEP is the primary organization responsible for data review, although the professional laboratories analyzing water quality samples will also note potential problems with outliers or other anomalies in sample results. Information regarding QA/QC procedures for the laboratory is available upon request. One hundred percent of laboratory-generated data was checked on receipt by the Project Manager for consistency and acceptability, including whether replicates are within specified targets and meet data quality objectives. Any unusual values outside the range of norm will be flagged and all aspects of field data sheets, shipping handling and laboratory handling and testing will be reviewed. Outliers will be identified and removed from the dataset if deemed necessary by the QA Officer. Water temperature, conductivity, pH and dissolved oxygen are measured in the field when samples are collected and values of these hand-held measurements can be used to check field conditions at the time of sampling.

The data manager visually inspects all entered data sets to check for inconsistencies with original field or laboratory data sheets. Where inconsistencies are encountered, data will be re-entered and re-inspected until the entered data is found to be satisfactory or results will be discarded. The Project Manager will maintain field datasheets and notebooks in the event that the QA Officer needs to review any aspect of sampling for QA/QC purposes.

# V. Results:

## Phytoplankton

Table 2 Phytoplankton results for baseline water samples collected with a churn splitter in the Lower Estuary 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Microcystin (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LES | 2/18/10 | 35.4 | ACMN | 16.5 | DTTN | 10.7 | NVCV | 10.7 | COPC | 8.7 | NZDS | 8.7 | 28 | PPLK | 0 | 0 | 0 | DNS |
| LES | 4/15/10 | 45.1 | ASFO | 32.5 | DTTN | 25.0 | COPC | 5.0 | NZFR | 4.2 | RHCU | 4.2 | 25 | PPLK | 0 | 0 | 0 | DNS |
| LES | 5/12/10 | 41.7 | ASFO | 32.4 | DTTN | 22.2 | ACMN | 9.3 | COPC | 8.3 | NZFR | 4.6 | 22 | PPLK | 0 | 0 | 0 | <0.18 |
| LES | 5/26/10 | 37.9 | DTTN | 46.5 | ACMN | 7.9 | COPC | 6.9 | GFAN | 5.9 | ASFO | 5.9 | 18 | PPLK | 0 | 0 | 0 | DNS |
| LES | 6/9/10 | 35.0 | DTTN | 26.7 | ACMN | 10.5 | COPC | 8.1 | RHCU | 7.0 | NZFR | 5.8 | 26 | PPLK | | | | |
| LES | 6/23/10 | 41.0 | DTTN | 49.1 | ACMN | 12.0 | COPC | 4.6 | RHCU | 3.7 | NZFR | 3.7 | 22 | PPLK | | | | |
| LES | 7/7/10 | 43.9 | DTTN | 72.9 | NZFR | 3.4 | ACMN | 3.4 | GFAN | 2.5 | GFSB | 2.5 | 20 | PPLK | | | | |
| LES | 7/21/10 | 44.5 | DTTN | 50.0 | SNUL | 9.0 | COPC | 8.0 | ACMN | 5.0 | CMAF | 3.0 | 23 | PPLK | | | | |
| LES | 8/11/10 | 41.6 | COPC | 20.0 | EPSX | 16.8 | DTTN | 10.5 | RDMN | 8.4 | NZFR | 6.3 | 23 | PPLK | | | | |
| LES | 8/25/10 | 33.6 | COPC | 40.7 | RDMN | 9.9 | EPSX | 9.9 | SNUL | 4.9 | NZFR | 4.9 | 19 | PPLK | | | | |
| LES | 9/8/10 | 46.9 | MSAE | 41.0 | EPSX | 16.4 | COPC | 11.5 | APFA | 5.7 | NZFR | 4.1 | 22 | PPLK | 22,550 | 739 | 0 | 5.8 |
| LES | 9/14/10 | 38.8 | MSAE | 98.6 | APFA | 1.4 | | | | | | | 2 | PPLK | 26,609 | 63 | 0 | 6.2 |
| LES | 9/22/10 | 36.0 | MSAE | 100.0 | | | | | | | | | 1 | PPLK | 18,277 | 0 | 0 | <1.8 |
| LES | 10/6/10 | 41.6 | MSAE | 25.7 | STHN | 21.0 | DTTN | 14.3 | COPC | 12.4 | RDMN | 7.6 | 17 | PPLK | | | | 4.2 |
| LES | 10/20/10 | 45.6 | STHN | 68.2 | DTTN | 11.7 | RDMN | 8.4 | MSAE | 5.2 | COPC | 1.9 | 12 | PPLK | 10,004 | 0 | 0 | 2.1 |
| LES | 11/17/10 | 32.5 | DTTN | 34.8 | COPC | 11.6 | ACMN | 10.1 | NZFR | 10.1 | EPSX | 4.3 | 23 | PPLK | 0 | 0 | 0 | <1.8 |
| LES | 12/15/10 | 46.6 | COPC | 18.2 | NZFR | 10.2 | RHCU | 9.1 | ACMN | 5.7 | EPSX | 5.7 | 29 | PPLK | 0 | 0 | 0 | dns |
| LES | 2/16/11 | 42.9 | DTTN | 19.4 | COPC | 17.3 | ACMN | 11.2 | ACLC | 6.1 | STHN | 5.1 | 29 | PPLK | 0 | 0 | 0 | DNS |
| LES | 3/16/11 | 40.4 | COPC | 21.8 | ACMN | 21.8 | GFAN | 10.9 | STAM | 5.5 | DTTN | 5.5 | 21 | PPLK | 0 | 0 | 0 | DNS |
| LES | 4/13/11 | 39.5 | STAM | 56.6 | GFOM | 8.5 | STHN | 5.7 | ACMN | 4.7 | DTTN | 3.8 | 19 | PPLK | 0 | 0 | 0 | DNS |
| LES | 5/10/11 | 44.5 | ASFO | 31.7 | DTTN | 22.1 | ACMN | 13.5 | COPC | 3.8 | GFSB | 3.8 | 22 | PPLK | 0 | 0 | 0 | ND |
| LES | 5/25/11 | 43.8 | DTTN | 62.4 | ACMN | 6.9 | NZDS | 5.0 | COPC | 3.0 | NZFR | 2.0 | 25 | PPLK | 0 | 0 | 0 | ND |
| LES | 6/8/11 | 43.2 | DTTN | 43.4 | ACMN | 11.1 | CMMN | 5.1 | COPC | 4.0 | ACLC | 3.0 | 29 | PPLK | 0 | 0 | 0 | ND |
| LES | 6/22/11 | 48.9 | DTTN | 43.1 | ACMN | 23.3 | MLGR | 6.9 | NZDS | 6.9 | NZFR | 6.0 | 16 | PPLK | 0 | 0 | 0 | ND |
| LES | 7/6/11 | 44.9 | DTTN | 36.2 | ACMN | 15.2 | NZFR | 6.7 | NZDS | 6.7 | RHCU | 5.7 | 27 | PPLK | 0 | 0 | 0 | ND |
| LES | 7/20/11 | 41.3 | DTTN | 22.0 | RHCU | 8.8 | ACMN | 6.6 | COPC | 6.6 | GFAN | 5.5 | 27 | PPLK | 0 | 0 | 0 | ND |
| LES | 8/10/11 | | | | | | | | | | | | 0 | PPLK | 0 | 0 | 0 | ND |
| les | 8/24/11 | 37.5 | COPC | 20.5 | CMAF | 13.4 | DTTN | 11.6 | CHX1 | 9.8 | NZFR | 6.3 | 27 | PPLK | 0 | 0 | 0 | ND |
| LES | 9/7/11 | 42.3 | MSAE | 32.8 | STHN | 12.8 | EPSX | 10.4 | COPC | 8.0 | DTTN | 7.2 | 24 | PPLK | 9,424 | 0 | 0 | 1.6 |
| LES | 9/21/11 | 40.3 | MSAE | 15.8 | STHN | 12.9 | COPC | 11.9 | DTTN | 9.9 | EPSX | 7.9 | 25 | PPLK | 1,831 | 263 | 0 | 0.38 |
| LES | 10/5/11 | 43.4 | MSAE | 34.5 | COPC | 12.8 | NZFR | 9.5 | EPSX | 6.8 | DTTN | 6.1 | 27 | PPLK | 12,778 | 75 | 0 | 4.3 |
| LES | 10/19/11 | 36.1 | RDMN | 20.2 | COPC | 20.2 | DTTN | 12.5 | NZFR | 9.6 | EPSX | 4.8 | 24 | PPLK | 340 | 0 | 0 | 0.26 |
| LES | 11/16/11 | 41.4 | DTTN | 55.7 | NZFR | 9.4 | DTVL | 6.6 | COPC | 3.8 | NVCV | 3.8 | 20 | PPLK | 0 | 0 | 0 | <0.18 |
| LES | 12/14/11 | 36.7 | DTTN | 34.5 | NZFR | 21.8 | NZDS | 12.6 | COPC | 4.6 | RHCU | 4.6 | 21 | PPLK | 0 | 0 | 0 | DNS |

Key to Species Codes is located in Combined Species List located in Appendix A

AFA = *Aphanizomenon flos-aquae MSAE = Microcystis aeruginosa ANA= Anabaena sp.*

Table 2(cont) Phytoplankton results for baseline water samples collected with a churn splitter in the Lower Estuary 2010-2015.

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LES | 0C | 3/21/12 | 32.7 | ACMN | 26.3 | STAM | 10.5 | COPC | 7.9 | DTTN | 6.6 | STHN | 5.3 | 25 | PPLK | 0 | 0 | 0 | DNS |
| LES | 0C | 4/18/12 | 31.8 | COPC | 18.0 | ACMN | 13.1 | DTTN | 11.5 | ASFO | 8.2 | NZDS | 4.9 | 23 | PPLK | 0 | 0 | 0 | DNS |
| LES | 0C | 5/16/12 | 39.7 | ACMN | 18.2 | NZDS | 15.9 | DTTN | 11.4 | GFOM | 10.2 | FRVA | 5.7 | 25 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 5/30/12 | 39.7 | DTTN | 42.3 | NZDS | 15.4 | ACMN | 13.5 | STHN | 7.7 | NZPC | 6.7 | 13 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 6/13/12 | 44.9 | DTTN | 66.1 | ACMN | 8.3 | STHN | 5.0 | NZDS | 3.3 | MLGR | 3.3 | 17 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 6/27/12 | 46.3 | DTTN | 74.0 | ACMN | 5.5 | STHN | 3.9 | MLGR | 1.6 | COPC | 1.6 | 18 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 7/11/12 | 65.2 | DTTN | 28.8 | RPGB | 25.2 | NZFR | 8.1 | STHN | 5.4 | EPSX | 4.5 | 24 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 7/25/12 | 38.4 | EPSX | 19.4 | NZFR | 18.4 | COPC | 12.6 | DTTN | 5.8 | ACMN | 5.8 | 26 | PPLK | 0 | 0 | 140 | ND |
| LES | 0C | 8/8/12 | 38.2 | COPC | 31.6 | GFAN | 13.3 | NZFR | 7.1 | AKFL | 7.1 | EPSX | 7.1 | 24 | PPLK | 0 | 0 | 0 | ND |
| LES | OC | 8/22/12 | 38.2 | COPC | 17.0 | CCMG | 12.3 | GFAN | 7.5 | NZFR | 5.7 | SNUL | 5.7 | 29 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 9/5/12 | 46.8 | MSAE | 54.7 | COPC | 5.3 | EPSX | 4.7 | STHN | 4.7 | SNUL | 4.7 | 24 | PPLK | 22,571 | 413 | 0 | 3.6 |
| | | | | | | | | | | | | | | | | 18,460 | 420 | 0 | DNS |
| LES | 0C | 9/19/12 | 43.7 | MSAE | 16.8 | STHN | 15.9 | COPC | 11.5 | EPSX | 10.6 | NZFR | 6.2 | 22 | PPLK | 4,741 | 92 | 0 | 1.0 |
| LES | 0C | 9/25/12 | 34.5 | MSAE | 100.0 | MSAE | | MSAE | | MSAE | | MSAE | | 1 | PPLK | 14,821 | 0 | 0 | 3.5 |
| LES | 0C | 10/3/12 | 56.0 | CMAF | 40.0 | MSAE | 20.7 | COPC | 9.0 | RHCU | 7.6 | ACMN | 4.1 | 22 | PPLK | 19,042 | 0 | 0 | 1.8 |
| LES | 0C | 10/17/12 | 39.2 | COPC | 23.6 | ACMN | 15.1 | NZFR | 14.2 | RDMN | 7.5 | DTTN | 3.8 | 29 | PPLK | 781 | 0 | 0 | 0.21 |
| LES | 0C | 11/14/12 | 34.5 | NZFR | 28.4 | COPC | 23.9 | NVCV | 3.4 | DTTN | 3.4 | RDMN | 3.4 | 30 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 3/20/13 | 45.9 | DTTN | 62.5 | ACMN | 8.6 | NZDS | 7.8 | CMMN | 4.7 | NVCV | 3.1 | 15 | PPLK | 0 | 0 | 0 | DNS |
| LES | 0C | 4/17/13 | 33.7 | ACMN | 28.7 | DTTN | 17.8 | RHCU | 6.9 | NZFR | 6.9 | GFAN | 5.9 | 21 | PPLK | 0 | 0 | 0 | DNS |
| LES | 0C | 5/8/13 | 43.0 | ACMN | 26.8 | DTTN | 19.6 | NZFR | 13.4 | RHCU | 4.5 | COPC | 4.5 | 24 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 5/22/13 | 44.0 | STHN | 63.1 | ACMN | 8.3 | COPC | 5.7 | RHCU | 3.8 | AFPR | 3.2 | 18 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 6/5/13 | 44.3 | COPC | 19.3 | ACMN | 17.4 | STHN | 11.9 | NZFR | 8.3 | DTTN | 5.5 | 27 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 6/19/13 | 40.0 | ACMN | 17.9 | COPC | 17.9 | NZFR | 12.8 | GFAN | 7.7 | SNUL | 6.4 | 29 | PPLK | 0 | 0 | 0 | ND |
| LES | | 7/4/13 | | | | | | | | | | | | | | 1,790 | 0 | 0 | DNS |
| LES | | 8/7/13 | | | | | | | | | | | | | | 2,374 | 396 | 0 | 0.56 |
| LES | | 8/21/13 | | | | | | | | | | | | | | 0 | 668 | 0 | SL |
| LES | | 9/11/13 | | | | | | | | | | | | | | 2,940 | 896 | 0 | 0.66 |
| LES | | 9/25/13 | | | | | | | | | | | | | | 29,119 | 559 | 0 | 0.57 |
| LES | 0C | 10/9/13 | 35.9 | COPC | 27.0 | NZFR | 11.2 | DTTN | 10.1 | RDMN | 7.9 | NVCV | 6.7 | 26 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 10/23/13 | 38.3 | DTTN | 73.0 | COPC | 6.4 | NZFR | 4.3 | RDMN | 2.8 | NVCV | 2.1 | 15 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 11/20/13 | 32.5 | NZFR | 31.3 | COPC | 18.8 | DTTN | 13.8 | RDMN | 3.8 | ACMN | 2.5 | 23 | PPLK | 0 | 0 | 0 | ND |
| LES | 0C | 3/19/14 | 34.7 | COPC | 30.4 | ACMN | 17.7 | RHCU | 7.6 | NZFR | 6.3 | NZDS | 5.1 | 19 | PPLK | 0 | 0 | 0 | DNS |
| LES | 0C | 4/16/14 | 41.0 | DTTN | 37.8 | ACMN | 28.7 | NZDS | 6.3 | COPC | 5.6 | NVCV | 4.2 | 19 | PPLK | 0 | 0 | 0 | DNS |
| LES | 0C | 5/7/14 | 41.3 | DTTN | 51.3 | ACMN | 11.8 | NZDS | 9.2 | NZFR | 3.4 | STHN | 3.4 | 18 | PPLK | 0 | 0 | 0 | 0.16$^{BQL}$ |
| LES | 0C | 5/21/14 | 40.0 | COPC | 23.0 | CMSN | 8.2 | NZCM | 6.6 | GFAN | 6.6 | SNUL | 4.9 | 25 | PPLK | 0 | 0 | 0 | 0.15$^{BQL}$ |
| LES | 0C | 6/11/14 | 39.7 | COPC | 21.9 | RDMN | 17.1 | ACMN | 13.3 | NZFR | 7.6 | NVCV | 5.7 | 22 | PPLK | 0 | 0 | 0 | ND |

Table 2 (cont.) Phytoplankton results for baseline water samples collected with a churn splitter in the Lower Estuary 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Microcyst in (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LES | 6/24/14 | 36.0 | COPC | 56.1 | RDMN | 12.1 | EPSX | 5.6 | RHCU | 2.8 | CXER | 2.8 | 21 | PPLK | 0 | 0 | 0 | ND |
| LES | 7/8/14 | 38.3 | COPC | 30.5 | RDMN | 20.0 | SLMN | 5.3 | STHN | 5.3 | NZFR | 5.3 | 25 | PPLK | 0 | 0 | 0 | 0.15$^{BQL}$ |
| LES | 7/22/14 | 32.6 | RDMN | 45.5 | COPC | 14.9 | CCMG | 10.9 | SCQD | 4.0 | AKFL | 3.0 | 20 | PPLK | 0 | 0 | 0 | ND |
| LES | 8/5/14 | 44.5 | MSAE | 41.5 | COPC | 11.3 | MLGR | 6.6 | NZPL | 6.6 | EPSX | 5.7 | 22 | PPLK | 12,428 | 0 | 0 | 0.47 |
| LES | 8/19/14 | 44.3 | RDMN | 34.4 | MSAE | 16.0 | COPC | 9.6 | SLMN | 4.8 | AKFL | 3.2 | 27 | PPLK | 6,927 | 0 | 0 | 0.38 |
| LES | 9/9/14 | 41.6 | RZXX | 29.7 | NZXX | 20.9 | CXER | 14.3 | GDXX | 7.7 | CZXX | 5.5 | 17 | PPLK | 0 | 0 | 0 | ND |
| LES | 9/23/14 | 41.4 | COPC | 26.8 | RDMN | 10.7 | SCQD | 7.1 | EPSX | 7.1 | DTTN | 5.4 | 24 | PPLK | 0 | 0 | 0 | 0.17$^{BQL}$ |
| LES | 10/7/14 | 30.8 | CXER | 27.4 | RDMN | 19.2 | DTTN | 12.3 | COPC | 12.3 | NZFR | 6.8 | 16 | PPLK | 0 | 32 | 0 | ND |
| LES | 10/22/14 | 34.6 | COPC | 36.1 | NZFR | 12.5 | ACMN | 5.6 | RHCU | 4.2 | NVCR | 4.2 | 23 | PPLK | 0 | 0 | 0 | ND |
| LES | 11/19/14 | 33.1 | COPC | 32.3 | NZFR | 22.2 | DTTN | 14.1 | EPSX | 5.1 | NZDS | 3.0 | 22 | PPLK |  |  |  |  |
| LES | 3/17/15 | 42.3 | DTTN | 38.5 | NVCV | 12.5 | NZDS | 9.4 | NZFR | 7.3 | GFSB | 4.2 | 21 | PPLK | 0 | 0 | 0 | DNS |
| LES | 4/14/15 | 46.5 | DTTN | 64.4 | NZDS | 6.8 | ACMN | 3.4 | NZCM | 2.7 | NZPC | 2.7 | 22 | PPLK | 0 | 0 | 0 | DNS |
| LES | 5/5/15 | 52.4 | ACMN | 17.6 | NZFR | 14.7 | STHN | 11.8 | DTTN | 8.8 | NVCV | 3.9 | 31 | PPLK | 0 | 0 | 0 | ND |
| LES | 5/19/15 | 36.6 | COPC | 23.9 | RHCU | 11.9 | ACMN | 9.0 | NZPC | 7.5 | NZFR | 6.0 | 24 | PPLK | * | * | * | ND |
| LES | 6/9/15 | 36.9 | COPC | 35.3 | RDMN | 16.7 | RHCU | 4.9 | NZFR | 4.9 | AFPR | 4.9 | 24 | PPLK | * | * | * | 0.16 |
| LES | 6/23/15 | 34.0 | COPC | 47.6 | AKFL | 9.5 | RDMN | 6.0 | CMSN | 4.8 | NZFR | 4.8 | 21 | PPLK | * | * | * | ND |
| LES | 7/7/15 | 38.0 | RDMN | 31.1 | COPC | 19.4 | AKFL | 17.5 | SLMN | 4.9 | DTTN | 2.9 | 21 | PPLK | 0 | 0 | 0 | 0.15 |
| LES | 7/21/15 | 39.3 | RDMN | 48.0 | STHN | 18.9 | COPC | 4.7 | SNUL | 3.9 | SLMN | 3.9 | 23 | PPLK | 0 | 0 | 0 | ND |
| LES | 8/3/15 | 42.6 | RDMN | 77.8 | NZPC | 3.0 | STHN | 3.0 | AKFL | 3.0 | EPSX | 2.6 | 18 | PPLK | 0 | 0 | 0 | 0.16 |
| LES | 8/18/15 | 34.1 | RDMN | 72.7 | STHN | 4.7 | SLMN | 3.1 | NZPL | 3.1 | DTTN | 3.1 | 14 | PPLK |  |  |  |  |
| LES | 9/8/15 | 30.6 | DTTN | 22.8 | CXER | 14.0 | COPC | 14.0 | RDMN | 12.3 | EPSX | 10.5 | 14 | PPLK | 0 | 0 | 0 | ND |
| LES | 9/22/15 | 28.6 | COPC | 32.1 | NZFR | 9.5 | EPSX | 8.3 | NVCV | 6.0 | ACMN | 4.8 | 25 | PPLK | 0 | 0 | 0 | DNS |
| LES | 10/6/15 | 38.0 | COPC | 35.1 | EPSX | 13.5 | RDMN | 6.8 | NZPC | 5.4 | NZFR | 4.1 | 25 | PPLK | 0 | 0 | 0 | ND |
| LES | 10/20/15 | 30.5 | COPC | 17.4 | NZFR | 10.5 | EPSX | 8.1 | RDMN | 8.1 | NZPC | 7.0 | 30 | PPLK | 0 | 0 | 0 | 0.17 |
| LES | 11/17/15 | 36.4 | NZFR | 39.8 | COPC | 12.2 | NVCR | 8.2 | NZDS | 5.1 | EPSX | 4.1 | 25 | PPLK | 0 | 0 | 0 | DNS |

Table 3. Phytoplankton results for baseline water samples collected with a churn splitter at the mouth of Trinity 2010-2015

| **Station** | **Date** | **TSI** | **Sp1** | **Sp1%** | **Sp2** | **Sp2%** | **Sp3** | **Sp3%** | **Sp4** | **Sp4%** | **Sp5** | **Sp5%** | **#Spp** | **Type** | **MSAE (cells/ml)** | **AFA (cells/ml)** | **ANA (cells/ml)** | **Other (cells/ml)** | **Microcystin (ug/L)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TR | 2/18/10 | 31.2 | DTTN | 22.5 | ACMN | 19.7 | COPC | 8.5 | RHCU | 5.6 | NVCV | 5.6 | 21 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 4/15/10 | 44.9 | DTTN | 47.6 | ACMN | 13.3 | GFSB | 4.8 | COPC | 3.8 | NZDS | 2.9 | 22 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 5/12/10 | 34.7 | DTTN | 28.3 | ACMN | 17.4 | CMMN | 9.8 | GFAN | 5.4 | COPC | 3.3 | 29 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 5/26/10 | 39.3 | DTTN | 57.0 | ACMN | 12.1 | CMMN | 4.7 | COPC | 4.7 | RHCU | 3.7 | 17 | PPLK | 0 | 0 | 0 | 0 | dns |
| TR | 6/9/10 | 39.2 | DTTN | 48.7 | ACMN | 19.7 | GFAN | 6.0 | CMAF | 2.6 | NZFR | 2.6 | 19 | PPLK | | | | | |
| TR | 6/23/10 | 38.4 | DTTN | 51.8 | ACMN | 16.1 | COPC | 6.2 | GFOM | 4.5 | RHCU | 3.6 | 17 | PPLK | | | | | |
| TR | 7/7/10 | 39.9 | DTTN | 66.3 | ACMN | 6.9 | COPC | 5.0 | GFAN | 4.0 | CMAF | 3.0 | 16 | PPLK | | | | | |
| TR | 7/21/10 | 38.0 | DTTN | 32.4 | COPC | 15.7 | CMAF | 11.8 | CMSN | 6.9 | ACMN | 5.9 | 21 | PPLK | | | | | |
| TR | 8/11/10 | 35.6 | COPC | 53.4 | CMAF | 7.8 | CMSN | 6.8 | DTTN | 4.9 | AFPR | 3.9 | 22 | PPLK | | | | | |
| TR | 8/25/10 | 35.2 | COPC | 38.6 | CMAF | 11.9 | CMSN | 8.9 | EPSX | 4.0 | NVCV | 4.0 | 27 | PPLK | | | | | |
| TR | 9/8/10 | 34.6 | COPC | 20.5 | CMMC | 19.7 | ACMN | 18.9 | GFAN | 6.6 | CMAF | 4.9 | 24 | PPLK | | | | | |
| TR | 9/22/10 | 33.7 | COPC | 29.1 | NVCV | 7.6 | CMAF | 7.6 | ACMN | 7.6 | GFAN | 7.6 | 23 | PPLK | | | | | |
| TR | 10/6/10 | 34.1 | DTTN | 23.3 | COPC | 8.7 | NZFR | 7.8 | RDMN | 6.8 | EPSX | 5.8 | 31 | PPLK | | | | | |
| TR | 10/20/10 | 31.0 | DTTN | 45.8 | ACMN | 11.1 | NZFR | 8.3 | COPC | 6.9 | EPSX | 5.6 | 18 | PPLK | | | | | |
| TR | 11/17/10 | 39.4 | DTTN | 79.0 | ACMN | 2.9 | SNMZ | 2.9 | NZFR | 2.9 | NVCV | 1.9 | 12 | PPLK | 0 | 0 | 0 | 0 | dns |
| TR | 12/15/10 | 40.5 | DTTN | 16.2 | GFAN | 12.2 | ACMN | 9.5 | EPSX | 8.1 | NZFR | 6.8 | 30 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 2/16/11 | 44.0 | DTTN | 45.6 | GFOM | 13.6 | NZFR | 5.6 | GFAN | 4.8 | ACMN | 4.0 | 19 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 3/16/11 | 44.0 | DTTN | 34.4 | RHCU | 7.8 | GFAN | 6.3 | ACMN | 4.7 | GFOM | 4.7 | 24 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 4/13/11 | 31.3 | DTTN | 42.4 | ACMN | 9.1 | GFOM | 7.6 | GFAN | 6.1 | CMMN | 6.1 | 17 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 5/10/11 | 31.1 | DTTN | 40.5 | ACMN | 16.7 | GFAN | 9.5 | COPC | 4.8 | CMSN | 4.8 | 15 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 5/25/11 | 39.9 | DTTN | 60.7 | ACMN | 12.8 | RHCU | 2.6 | HNAR | 2.6 | GFAN | 2.6 | 22 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 6/8/11 | 42.5 | DTTN | 66.7 | ACMN | 8.3 | GFAN | 3.3 | CMMN | 3.3 | ACLC | 1.7 | 19 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 6/22/11 | 44.7 | DTTN | 70.5 | ACMN | 8.0 | GFAN | 3.6 | GFSB | 3.6 | DTVL | 2.7 | 15 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 7/6/11 | 44.6 | DTTN | 75.8 | ACMN | 5.5 | SNUL | 3.9 | GFAN | 2.3 | GSHR | 1.6 | 18 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 7/20/11 | 35.7 | EPSX | 23.2 | COPC | 14.5 | DTTN | 7.2 | SNUL | 7.2 | GFSB | 7.2 | 21 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 8/10/11 | 32.2 | COPC | 38.5 | GFAN | 15.4 | CMAF | 13.5 | CMSN | 5.8 | NZPC | 5.8 | 14 | PPLK | | | | | |
| TR | 8/24/11 | 37.0 | COPC | 27.7 | GFAN | 13.4 | CMAF | 12.5 | SLMN | 7.1 | ACMN | 7.1 | 22 | PPLK | | | | | |
| TR | 9/7/11 | 34.9 | COPC | 35.1 | CMAF | 28.7 | GFAN | 8.5 | SNUL | 5.3 | RHCU | 4.3 | 15 | PPLK | | | | | |
| TR | 9/21/11 | 34.2 | COPC | 31.7 | CMAF | 23.8 | SNUL | 7.9 | GFAN | 4.8 | AFPR | 4.8 | 15 | PPLK | | | | | |
| TR | 10/5/11 | 39.1 | COPC | 19.4 | CMAF | 10.8 | EPSX | 10.8 | CMSN | 9.7 | DTTN | 7.5 | 24 | PPLK | | | | | |

Table 3 (cont.) Phytoplankton results for baseline water samples collected with a churn splitter at the mouth of Trinity 2010-2015

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Other (cells/ml) | Microcystin (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TR | 10/19/11 | 39.2 | DTTN | 68.3 | ACMN | 5.9 | SNUL | 5.0 | CMAF | 3.0 | COPC | 3.0 | 17 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 11/16/11 | 35.7 | DTTN | 69.2 | ACMN | 7.7 | NZFR | 3.4 | GFAN | 2.6 | NZDS | 2.6 | 19 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TR | 12/14/11 | 40.9 | DTTN | 90.9 | COPC | 1.3 | NZPC | 1.3 | NZFR | 1.3 | NZDS | 1.3 | 10 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 5/30/12 | 40.8 | DTTN | 63.8 | ACMN | 8.6 | GFAN | 6.7 | NZDS | 3.8 | SNRM | 1.9 | 19 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 6/27/12 | 39.6 | DTTN | 59.5 | ACMN | 8.1 | GFAN | 4.5 | EPSX | 3.6 | CMAF | 2.7 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 7/25/12 | 34.9 | COPC | 25.6 | EPSX | 13.3 | GFAN | 8.9 | CMSN | 6.7 | CMAF | 3.3 | 28 | PPLK | | | | | |
| TR | 8/22/12 | 34.9 | COPC | 33.0 | GFAN | 24.2 | CMAF | 7.7 | NZPC | 4.4 | EPSX | 4.4 | 19 | PPLK | | | | | |
| TR | 9/19/12 | 34.9 | CXER | 21.1 | COPC | 17.8 | APFA | 10.0 | MLGR | 6.7 | AKFL | 5.6 | 25 | PPLK | | | | | |
| TR | 10/17/12 | 29.5 | COPC | 20.0 | ACMN | 13.8 | SNUL | 10.8 | NZPC | 6.2 | EPSX | 6.2 | 21 | PPLK | | | | | |
| TR | 5/22/13 | 35.3 | DTTN | 31.3 | ACMN | 15.2 | GFAN | 10.1 | ACLC | 6.1 | COPC | 6.1 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 6/19/13 | 38.0 | DTTN | 20.2 | ACMN | 17.3 | GFAN | 11.5 | CMAF | 5.8 | COPC | 5.8 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 7/24/13 | 31.8 | COPC | 24.7 | ACMN | 10.6 | NVCV | 5.9 | NZPC | 5.9 | NZFR | 5.9 | 28 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 8/21/13 | 31.1 | AKFL | 20.0 | DTTN | 15.6 | COPC | 11.1 | EPSX | 11.1 | NZPC | 8.9 | 18 | PPLK | | | | | |
| TR | 9/25/13 | 23.7 | COPC | 18.8 | RHCU | 9.4 | DTTN | 9.4 | SNUL | 6.3 | EPSX | 6.3 | 20 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 10/23/13 | 34.6 | DTTN | 56.2 | ACMN | 8.3 | NZDS | 4.2 | CMMC | 4.2 | COPC | 4.2 | 21 | PPLK | | | | | |
| TR | 5/21/14 | 49.6 | EPSX | 83.2 | NZFR | 3.4 | COPC | 3.4 | ACMN | 1.7 | CMAF | 1.7 | 13 | PPLK | 0 | 0 | 0 | 37[1] | ND |
| TR | 6/25/14 | 32.7 | COPC | 67.4 | EPSX | 5.6 | SNUL | 4.5 | GFAN | 4.5 | CMSN | 2.2 | 18 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 7/23/14 | 31.7 | COPC | 48.2 | RDMN | 19.3 | NZAC | 3.6 | EPSX | 3.6 | CXER | 2.4 | 19 | PPLK | 0 | 54 | 18 | 0 | ND |
| TR | 8/20/14 | 31.1 | COPC | 31.9 | NZFR | 9.6 | SLMN | 6.4 | DTTN | 5.3 | SCDT | 5.3 | 26 | PPLK | 0 | 0 | 0 | 0 | $0.16^{BQL}$ |
| TR | 9/24/14 | 44.8 | EPSX | 13.8 | COPC | 12.3 | NVCV | 7.7 | CMSN | 6.2 | FRCV | 4.6 | 32 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 10/22/14 | 33.4 | ULXX | 26.2 | EPSX | 9.5 | COPC | 7.1 | FRCV | 4.8 | NVCV | 3.6 | 32 | PPLK | * | * | * | * | ND |
| TR | 5/20/15 | 38.1 | ACMN | 15.7 | COPC | 13.9 | DTTN | 13.9 | GFAN | 9.3 | NVCV | 5.6 | 26 | PPLK | * | * | * | * | ND |
| TR | 6/24/15 | 40.9 | COPC | 72.1 | GFAN | 4.1 | CMSN | 3.3 | AFPR | 3.3 | ACMN | 3.3 | 16 | PPLK | 0 | 0 | 0 | 0 | ND |
| TR | 7/22/15 | 36.7 | COPC | 52.5 | RDMN | 10.2 | EPSX | 8.5 | SNUL | 5.1 | NZAC | 3.4 | 19 | PPLK | * | * | * | * | ND |
| TR | 8/19/15 | 57.3 | ACMN | 24.4 | COPC | 16.8 | GFAN | 10.1 | EPSX | 8.4 | CMMN | 7.6 | 29 | PPLK | | | | | |
| TR | 9/23/15 | 36.4 | COPC | 18.7 | DTTN | 18.7 | RDMN | 15.0 | NVCR | 7.5 | NVCV | 3.7 | 27 | PPLK | * | * | * | * | ND |
| TR | 10/21/15 | 34.2 | RDMN | 22.2 | DTTN | 13.3 | COPC | 7.8 | EPSX | 6.7 | ACMN | 6.7 | 30 | PPLK | * | * | * | * | ND |

Table 4. Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Tully Creek 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Other (cells/ml) | Microcystin (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TC | 2/18/10 | 34.2 | DTTN | 15.3 | NZFR | 14.3 | NZDS | 9.2 | ACMN | 9.2 | COPC | 7.1 | 27 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 4/15/10 | 44.0 | ASFO | 43.1 | DTTN | 27.5 | CMMN | 6.9 | RHCU | 3.9 | ACMN | 2.9 | 17 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 5/12/10 | 41.4 | DTTN | 28.9 | ASFO | 22.2 | RHCU | 10.0 | ACMN | 8.9 | NZFR | 5.6 | 18 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| TC | 5/26/10 | 45.7 | CMAF | 22.5 | DTTN | 17.5 | EPSX | 16.3 | COPC | 8.8 | ASFO | 6.3 | 19 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 6/9/10 | 38.4 | DTTN | 31.2 | ACMN | 16.1 | COPC | 7.5 | NZFR | 5.4 | RHCU | 5.4 | 29 | PPLK |  |  |  |  |  |
| TC | 6/23/10 | 40.9 | DTTN | 43.1 | ACMN | 18.3 | NZFR | 6.4 | COPC | 5.5 | GFSB | 4.6 | 21 | PPLK |  |  |  |  |  |
| TC | 7/7/10 | 43.4 | DTTN | 53.8 | ACMN | 7.7 | COPC | 4.8 | CMAF | 4.8 | CMMN | 3.8 | 19 | PPLK |  |  |  |  |  |
| TC | 7/21/10 | 42.0 | COPC | 18.0 | SNUL | 12.0 | CMAF | 11.0 | EPSX | 11.0 | DTTN | 8.0 | 24 | PPLK |  |  |  |  |  |
| TC | 8/11/10 | 41.5 | COPC | 43.9 | EPSX | 23.5 | NZFR | 5.1 | CMSN | 5.1 | AKFL | 4.1 | 16 | PPLK |  |  |  |  |  |
| TC | 8/25/10 | 43.7 | COPC | 41.4 | EPSX | 23.4 | CMAF | 4.5 | RHCU | 4.5 | NVCR | 3.6 | 21 | PPLK |  |  |  |  |  |
| TC | 9/8/10 | 44.9 | MSAE | 70.3 | COPC | 9.1 | EPSX | 4.3 | NZFR | 2.9 | SCQD | 1.9 | 20 | PPLK |  |  |  |  | 3.8 |
| TC | 9/22/10 | 42.5 | MSAE | 27.8 | COPC | 24.6 | NZFR | 8.7 | EPSX | 5.6 | NVCR | 4.8 | 28 | PPLK |  |  |  |  | <1.8 |
| TC | 10/6/10 | 44.4 | MSAE | 31.5 | STHN | 16.7 | NZFR | 8.3 | COPC | 7.4 | RDMN | 4.6 | 28 | PPLK |  |  |  |  | 3.9 |
| TC | 10/20/10 | 47.2 | STHN | 35.6 | MSAE | 15.3 | NZFR | 12.7 | RDMN | 9.3 | COPC | 7.6 | 18 | PPLK |  |  |  |  | 3.2 |
| TC | 11/17/10 | 41.1 | DTTN | 26.3 | NZFR | 21.1 | ACMN | 9.5 | COPC | 6.3 | RHCU | 5.3 | 23 | PPLK | 0 | 0 | 0 | 0 | dns |
| TC | 12/15/10 | 47.1 | COPC | 34.6 | ACMN | 14.4 | NZFR | 7.7 | CMAF | 4.8 | NZDS | 3.8 | 27 | PPLK | 0 | 0 | 0 | 0 | dns |
| TC | 2/16/11 | 43.4 | DTTN | 23.8 | ACMN | 19.8 | NVCV | 7.1 | GFOM | 6.3 | RHCU | 6.3 | 23 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 3/16/11 | 44.8 | DTTN | 15.4 | COPC | 12.3 | ACMN | 9.2 | RHCU | 9.2 | STAM | 4.6 | 26 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 4/13/11 | 38.6 | STAM | 41.3 | STHN | 10.6 | DTTN | 7.7 | ACMN | 6.7 | COPC | 4.8 | 23 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 5/10/11 | 45.7 | ASFO | 38.3 | DTTN | 24.3 | ACMN | 4.3 | COPC | 3.5 | NZFR | 2.6 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 5/25/11 | 40.8 | DTTN | 64.3 | ACMN | 6.1 | COPC | 5.2 | STHN | 3.5 | RHCU | 3.5 | 18 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 6/8/11 | 47.0 | DTTN | 45.0 | ACMN | 14.7 | CMMN | 7.3 | FRVA | 4.6 | NZDS | 3.7 | 21 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 6/22/11 | 51.4 | DTTN | 37.7 | ACMN | 19.3 | MLGR | 11.4 | NZDS | 8.8 | RHCU | 2.6 | 22 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 7/6/11 | 44.4 | ACMN | 22.7 | DTTN | 19.1 | COPC | 7.3 | RHCU | 6.4 | GFAN | 6.4 | 30 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 7/20/11 | 37.9 | RHCU | 17.2 | COPC | 16.2 | CMSN | 10.1 | ACMN | 10.1 | EPSX | 7.1 | 27 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 8/10/11 | 36.7 | COPC | 54.6 | GFAN | 7.2 | RHCU | 7.2 | EPSX | 5.2 | SNUL | 3.1 | 20 | PPLK |  |  |  |  |  |
| TC | 8/24/11 | 40.7 | COPC | 58.8 | CMAF | 11.4 | EPSX | 9.6 | RHCU | 3.5 | GFAN | 1.8 | 18 | PPLK |  |  |  |  |  |
| TC | 9/7/11 | 44.2 | MSAE | 55.9 | EPSX | 14.0 | COPC | 13.3 | RHCU | 2.1 | NVCR | 2.1 | 18 | PPLK | 6,264 | 78 | 0 | 0 | 1.1 |
| TC | 9/21/11 | 46.4 | MSAE | 31.2 | COPC | 27.3 | EPSX | 16.9 | SCQD | 3.9 | NZFR | 3.9 | 19 | PPLK | 3,231 | 0 | 0 | 0 | 0.63 |
| TC | 10/5/11 | 53.4 | COPC | 37.3 | EPSX | 22.9 | MSAE | 6.8 | RHCU | 5.1 | NZFR | 4.2 | 23 | PPLK | 1,542 | 0 | 0 | 0 | 0.74 |
| TC | 10/19/11 | 46.4 | NZFR | 24.6 | COPC | 18.6 | DTTN | 15.3 | EPSX | 6.8 | NVCV | 4.2 | 24 | PPLK | 949 | 0 | 0 | 0 | 0.52 |
| TC | 11/16/11 | 47.0 | DTTN | 36.3 | NZFR | 30.1 | COPC | 7.1 | DTVL | 4.4 | SNMZ | 3.5 | 18 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| TC | 12/14/11 | 39.7 | DTTN | 34.0 | NZFR | 34.0 | COPC | 8.7 | SNMZ | 3.9 | NZDS | 3.9 | 13 | PPLK | 0 | 0 | 0 | 0 | DNS |

Table 4 (cont.). Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Tully Creek 2010-2015.

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TC | 3/21/12 | 34.1 | ACMN | 18.2 | STAM | 14.8 | COPC | 9.1 | RHCU | 6.8 | ACLC | 6.8 | 28 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 4/18/12 | 33.4 | COPC | 13.2 | DTTN | 11.3 | ACMN | 11.3 | NZFR | 8.5 | RHCU | 6.6 | 27 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 5/16/12 | 39.5 | ACMN | 25.2 | DTTN | 14.6 | STHN | 6.8 | NZDS | 5.8 | COPC | 5.8 | 28 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 5/30/12 | 44.5 | DTTN | 43.5 | ACMN | 13.9 | NZDS | 11.3 | NZPC | 5.2 | GFAN | 3.5 | 22 | PPLK | 0 | 0 | 0 | 0 | < 0.18 |
| TC | 6/13/12 | 46.0 | DTTN | 64.7 | ACMN | 6.0 | NZDS | 6.0 | STHN | 3.4 | CMMN | 3.4 | 17 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 6/27/12 | 47.6 | DTTN | 51.3 | ACMN | 10.3 | NZFR | 6.0 | NZDS | 4.3 | SNUL | 3.4 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 7/11/12 | 43.4 | NZFR | 16.4 | DTTN | 14.5 | ACMN | 11.8 | GFAN | 8.2 | COPC | 8.2 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 7/25/12 | 40.2 | COPC | 28.7 | EPSX | 18.1 | CMAF | 7.4 | GFAN | 6.4 | RHCU | 6.4 | 25 | PPLK | | | | | |
| TC | 8/8/12 | 46.6 | EPSX | 24.3 | COPC | 20.6 | GFAN | 9.3 | NZFR | 5.6 | GSHR | 4.7 | 25 | PPLK | | | | | |
| TC | 8/22/12 | 43.6 | EPSX | 26.9 | COPC | 18.3 | CMAF | 9.6 | AKFL | 9.6 | SCQD | 6.7 | 23 | PPLK | | | | | |
| TC | 9/5/12 | 50.8 | MSAE | 63.2 | NZFR | 6.3 | EPSX | 4.6 | COPC | 3.4 | RDMN | 2.9 | 30 | PPLK | 47,605 | 1,366 | 0 | 0 | 5.8 |
| TC | 9/19/12 | 42.0 | MSAE | 41.2 | EPSX | 14.0 | COPC | 13.2 | SHXX | 6.6 | NZFR | 4.4 | 21 | PPLK | | | | | |
| TC | 10/3/12 | 48.3 | MSAE | 26.6 | NZFR | 22.6 | COPC | 9.7 | EPSX | 8.9 | AKFL | 5.6 | 24 | PPLK | 5,088 | 0 | 0 | 0 | 1.1 |
| TC | 10/17/12 | 49.7 | NZFR | 23.1 | COPC | 19.2 | EPSX | 14.4 | SNUL | 7.7 | MSAE | 6.7 | 21 | PPLK | | | | | |
| TC | 11/14/12 | 42.6 | NZFR | 37.2 | COPC | 10.6 | DTTN | 8.8 | ACMN | 5.3 | NVCV | 4.4 | 30 | PPLK | | | | | |
| TC | 3/20/13 | 48.3 | DTTN | 48.2 | NZFR | 13.2 | ACMN | 12.3 | NZDS | 5.3 | GFAN | 3.5 | 19 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 4/17/13 | 36.7 | ACMN | 29.6 | DTTN | 16.3 | NZFR | 6.1 | NZDS | 5.1 | CMMN | 5.1 | 23 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 5/8/13 | 43.9 | ACMN | 34.6 | DTTN | 20.6 | NZFR | 8.4 | COPC | 5.6 | CMMN | 4.7 | 20 | PPLK | 0 | 0 | 311 | 0 | ND |
| TC | 5/22/13 | 41.4 | STHN | 39.4 | ACMN | 13.8 | NVCV | 6.4 | RHCU | 5.5 | NZFR | 4.6 | 18 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| TC | 6/5/13 | 48.5 | ACMN | 19.5 | DTTN | 11.5 | COPC | 10.3 | NZFR | 10.3 | RHCU | 5.7 | 27 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 6/19/13 | 44.6 | NZFR | 26.5 | ACMN | 15.3 | COPC | 13.3 | DTTN | 8.2 | RHCU | 4.1 | 23 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 7/10/13 | 43.2 | COPC | 27.0 | NZFR | 18.0 | EPSX | 16.0 | NVCV | 5.0 | ACMN | 5.0 | 23 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 7/24/13 | 50.3 | EPSX | 37.7 | COPC | 14.0 | NZFR | 9.6 | SNUL | 7.0 | AKFL | 3.5 | 23 | PPLK | 595 | 0 | 0 | 0 | 0.28 |
| TC | 8/7/13 | 47.8 | EPSX | 24.8 | STHN | 9.4 | MSAE | 8.5 | APFA | 7.7 | RDMN | 7.7 | 22 | PPLK | 4,228 | 1,268 | 0 | 0 | 0.56 |
| TC | 8/21/13 | 47.0 | COPC | 18.0 | EPSX | 14.6 | SCQD | 10.1 | SNUL | 10.1 | DTVL | 9.0 | 27 | PPLK | 0 | 0 | 0 | 0 | 0.15 |
| TC | 9/11/13 | 49.8 | MSAE | 68.6 | SNUL | 6.0 | APFA | 5.4 | EPSX | 4.7 | COPC | 2.7 | 25 | PPLK | 26,308 | 2,200 | 0 | 367[1] | 3.8 |
| TC | 9/25/13 | 43.7 | MSAE | 66.0 | COPC | 7.6 | SNUL | 6.2 | NZPL | 5.6 | NZFR | 3.5 | 17 | PPLK | 10,201 | 107 | 0 | 0 | 1.1 |
| TC | 10/9/13 | 43.3 | MSAE | 34.3 | COPC | 23.1 | NZFR | 6.5 | DTTN | 5.6 | SNUL | 4.6 | 25 | PPLK | | | | | |
| TC | 10/23/13 | 41.1 | NZFR | 29.2 | COPC | 18.0 | DTTN | 11.2 | GSHR | 5.6 | DTVL | 4.5 | 24 | PPLK | | | | | |
| TC | 11/20/13 | 60.0 | NZFR | 48.4 | DTTN | 11.8 | COPC | 9.2 | GSHR | 4.6 | SNUL | 3.9 | 23 | PPLK | 0 | 0 | 0 | 902[1] | ND |
| TC | 3/19/14 | 34.9 | COPC | 26.8 | NZFR | 17.3 | ACMN | 15.7 | DTTN | 7.1 | NZDS | 5.5 | 25 | PPLK | 0 | 64 | 0 | 0 | DNS |
| TC | 4/16/14 | 42.6 | DTTN | 47.1 | ACMN | 13.2 | NZDS | 5.9 | GFOM | 4.4 | GFAN | 3.7 | 22 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 5/7/14 | 43.9 | DTTN | 32.4 | NZDS | 18.9 | ACMN | 15.3 | NVCV | 6.3 | NZFR | 5.4 | 19 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 5/21/14 | 41.8 | APFA | 18.6 | RHCU | 12.8 | COPC | 9.3 | ACMN | 9.3 | EPSX | 8.1 | 27 | PPLK | 0 | 1,336 | 0 | 0 | ND |
| TC | 6/11/14 | 47.2 | COPC | 30.5 | ACMN | 14.3 | NZFR | 11.4 | RHCU | 4.8 | GFAN | 3.8 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 6/25/14 | 42.6 | COPC | 48.8 | EPSX | 12.8 | NZFR | 5.8 | AKFL | 4.7 | DTVL | 3.5 | 17 | PPLK | 0 | 0 | 0 | 0 | 0.16$^{BQL}$ |
| TC | 7/9/14 | 45.2 | COPC | 28.6 | EPSX | 15.3 | NZFR | 13.3 | RDMN | 6.1 | SNUL | 5.1 | 21 | PPLK | 0 | 0 | 0 | 0 | 0.15$^{BQL}$ |
| TC | 7/23/14 | 46.5 | EPSX | 28.7 | SNUL | 18.8 | COPC | 14.9 | AKFL | 7.9 | NZFR | 6.9 | 21 | PPLK | 0 | 62 | 0 | 0 | ND |
| TC | 8/6/14 | 54.3 | MSAE | 28.2 | COPC | 19.1 | NZPL | 12.7 | EPSX | 11.8 | NZCP | 5.5 | 19 | PPLK | | | | | |
| TC | 8/20/14 | 44.6 | EPSX | 24.1 | COPC | 22.9 | MSAE | 16.9 | SNUL | 3.6 | AKFL | 3.6 | 20 | PPLK | 3,420 | 0 | 282 | 0 | 0.26 |

Table 4 (cont.). Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Tully Creek 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Other (cells/ml) | Microcyst in (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | |
| TC | 9/10/14 | 48.6 | DTTN | 16.5 | COPC | 16.5 | EPSX | 12.2 | DTVL | 8.7 | RDMN | 6.1 | 25 | PPLK | 0 | 0 | 0 | 100[1] | ND |
| TC | 9/24/14 | 46.5 | COPC | 34.9 | EPSX | 18.6 | NVCR | 5.8 | FRCV | 3.5 | AFPR | 3.5 | 28 | PPLK | 83 | 0 | 0 | 99[1] | 0.19 |
| TC | 10/8/14 | 50.2 | COPC | 31.9 | NZFR | 12.9 | EPSX | 10.3 | RHCU | 6.0 | SNUL | 5.2 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 10/22/14 | 45.2 | COPC | 23.6 | NZFR | 12.4 | EPSX | 9.0 | FRCV | 5.6 | NVCR | 4.5 | 30 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 11/19/14 | 40.5 | NZFR | 23.5 | DTTN | 13.9 | COPC | 12.2 | NZDS | 7.0 | ACMN | 6.1 | 25 | PPLK | | | | | |
| TC | 3/18/15 | 45.1 | ACMN | 24.8 | DTTN | 22.5 | STHN | 9.3 | NZDS | 7.8 | NZFR | 6.2 | 23 | PPLK | 0 | 0 | 0 | 1,911[1] | DNS |
| TC | 4/15/15 | 49.8 | DTTN | 61.6 | NZFR | 7.5 | ACMN | 6.9 | NZDS | 4.4 | NVCV | 3.8 | 21 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TC | 5/6/15 | 47.6 | ACMN | 15.3 | RHCU | 11.8 | COPC | 10.6 | NZFR | 10.6 | NZDS | 4.7 | 29 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 5/20/15 | 45.5 | COPC | 19.8 | RHCU | 18.8 | NZFR | 15.8 | CMMN | 5.9 | ACMN | 5.0 | 22 | PPLK | * | * | * | * | ND |
| TC | 6/10/15 | 46.6 | COPC | 65.1 | GFAN | 3.8 | RHCU | 3.8 | NVCV | 2.8 | ACMN | 2.8 | 22 | PPLK | * | * | * | * | ND |
| TC | 6/24/15 | 41.3 | COPC | 54.1 | EPSX | 8.2 | SNUL | 7.1 | CMAF | 4.7 | RHCU | 3.5 | 19 | PPLK | * | * | * | * | ND |
| TC | 7/8/15 | 46.8 | EPSX | 24.1 | COPC | 20.4 | AKFL | 13.9 | SNUL | 4.6 | NZPL | 3.7 | 30 | PPLK | 0 | 0 | 0 | 0 | 0.18 |
| TC | 7/22/15 | 45.5 | NZPL | 22.8 | COPC | 20.8 | NZFR | 7.9 | STHN | 6.9 | NZPC | 5.0 | 25 | PPLK | | | | | |
| TC | 8/5/15 | 51.5 | PQX9 | 28.7 | MSAE | 25.0 | NZPL | 6.5 | NZFR | 5.6 | NVCV | 3.7 | 26 | PPLK | **8,268** | 0 | 0 | 5,178 | 0.70 |
| TC | 8/19/15 | 59.1 | GFAN | 16.4 | ACMN | 16.4 | EPSX | 14.8 | COPC | 6.6 | NZFR | 4.9 | 32 | PPLK | | | | | |
| TC | 9/9/15 | 44.9 | EPSX | 24.0 | DTTN | 21.3 | COPC | 8.0 | NZFR | 6.7 | NZDS | 5.3 | 22 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 9/22/15 | 42.0 | EPSX | 29.2 | COPC | 23.0 | NVCR | 11.5 | NZFR | 6.2 | ACMN | 4.4 | 26 | PPLK | * | * | * | * | 0.18 |
| TC | 10/7/15 | 42.1 | COPC | 25.0 | NZFR | 16.7 | NVCR | 11.7 | EPSX | 10.0 | NZDS | 4.2 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TC | 10/21/15 | 40.8 | COPC | 25.2 | NZFR | 17.1 | NVCR | 11.7 | SNRM | 5.4 | EPSX | 5.4 | 25 | PPLK | * | * | * | * | 0.20 |
| TC | 11/18/15 | 44.4 | NZFR | 37.9 | COPC | 10.5 | NVCR | 4.8 | DTTN | 4.8 | NZDS | 4.0 | 28 | PPLK | 0 | 0 | 0 | 0 | DNS |

Table 5 Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Turwar Gage 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Other (cells/ml) | Microcyst in (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TG | 2/18/10 | 39.2 | DTTN | 22.9 | NZFR | 15.6 | COPC | 9.4 | NZDS | 8.3 | NVCV | 6.2 | 24 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 4/15/10 | 43.2 | ASFO | 38.9 | DTTN | 22.2 | ACMN | 8.3 | RHCU | 4.6 | COPC | 3.7 | 20 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 5/12/10 | 41.5 | ASFO | 26.8 | DTTN | 18.8 | ACMN | 15.2 | CMMN | 3.6 | NVCV | 3.6 | 24 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| TG | 5/26/10 | 43.9 | DTTN | 44.0 | ACMN | 11.9 | COPC | 8.3 | ASFO | 7.3 | FRVA | 2.8 | 24 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 6/9/10 | 36.3 | DTTN | 30.3 | ACMN | 19.1 | COPC | 6.7 | CMMN | 4.5 | RHCU | 4.5 | 29 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 6/14/10 | 37.9 | DTTN | 23.2 | STHN | 18.2 | ACMN | 18.2 | COPC | 5.1 | RHCU | 4.0 | 25 | PPLK |  |  |  |  |  |
| TG | 6/23/10 | 40.6 | DTTN | 36.7 | ACMN | 20.2 | RHCU | 6.4 | NVCV | 5.5 | NZFR | 5.5 | 21 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 7/7/10 | 44.2 | DTTN | 78.6 | ACMN | 5.1 | COPC | 2.6 | CMAF | 1.7 | NZFR | 1.7 | 16 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 7/21/10 | 43.8 | DTTN | 30.4 | SNUL | 12.7 | NZFR | 9.8 | COPC | 8.8 | EPSX | 8.8 | 17 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 8/11/10 | 44.6 | COPC | 22.6 | DTTN | 12.3 | NZFR | 11.3 | EPSX | 10.4 | RDMN | 5.7 | 24 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 8/25/10 | 43.9 | COPC | 37.2 | EPSX | 9.1 | SCQD | 7.4 | CMAF | 5.8 | DTVL | 4.1 | 25 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 9/1/10 |  |  |  |  |  |  |  |  |  |  |  |  |  | 18,754 | 3,401 | 0 | 0 | 3.0 |
| TG | 9/8/10 | 48.8 | MSAE | 62.6 | EPSX | 7.0 | COPC | 7.0 | NZFR | 5.9 | APFA | 3.2 | 19 | PPLK | 31,660 | 1353 | 0 | 0 | 5.7 |
| TG | 9/15/10 |  |  |  |  |  |  |  |  |  |  |  |  |  | 36,205 | 135 | 0 | 0 | 4.6 |
| TG | 9/22/10 | 34.2 | MSAE | 98.8 | APFA | 1.2 |  |  |  |  |  |  | 2 | PPLK | 13,451 | 99 | 0 | 0 | <1.8 |
| TG | 9/29/10 |  |  |  |  |  |  |  |  |  |  |  |  |  | 16,755 | 0 | 0 | 0 | 4.6 |
| TG | 10/6/10 | 48.3 | STHN | 21.1 | MSAE | 18.3 | RDMN | 13.8 | DTTN | 12.8 | EPSX | 6.4 | 21 | PPLK | 0 | 0 | 0 | 0 | 5.1 |
| TG | 10/20/10 | 46.8 | STHN | 59.2 | RDMN | 9.5 | DTTN | 8.8 | COPC | 4.8 | EPSX | 3.4 | 16 | PPLK | 8,268 | 0 | 0 | 0 | 1.9 |
| TG | 11/17/10 | 37.6 | DTTN | 33.7 | NZFR | 10.9 | ACMN | 8.9 | DTVL | 4.0 | SNMZ | 4.0 | 26 | PPLK | 0 | 0 | 0 | 0 | dns |
| TG | 12/15/10 | 42.3 | COPC | 19.3 | NZFR | 12.0 | ACMN | 12.0 | DTTN | 7.2 | EPSX | 6.0 | 24 | PPLK | 0 | 0 | 0 | 0 | dns |
| TG | 2/16/11 | 45.1 | DTTN | 22.8 | COPC | 15.2 | ACMN | 12.0 | GFOM | 4.3 | NZFR | 4.3 | 30 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 3/16/11 | 45.2 | COPC | 16.5 | ACMN | 15.3 | DTTN | 8.2 | STAM | 7.1 | GFAN | 4.7 | 31 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 4/13/11 | 41.6 | STAM | 54.3 | STHN | 5.7 | COPC | 5.7 | ACMN | 3.8 | ASFO | 3.8 | 23 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 5/10/11 | 43.4 | ASFO | 38.9 | DTTN | 14.7 | STHN | 9.5 | COPC | 6.3 | ACMN | 3.2 | 26 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 5/25/11 | 40.5 | DTTN | 31.4 | ACMN | 21.0 | GFAN | 7.6 | COPC | 6.7 | SNUL | 4.8 | 21 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 6/8/11 | 46.6 | DTTN | 54.6 | NZDS | 8.4 | ACMN | 6.7 | CMMN | 4.2 | NZFR | 2.5 | 21 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 6/22/11 | 48.9 | DTTN | 42.3 | ACMN | 15.4 | CMMN | 9.8 | NZFR | 6.5 | MLGR | 4.9 | 20 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/6/11 | 44.4 | DTTN | 31.5 | ACMN | 20.2 | NZDS | 8.1 | COPC | 5.6 | NZFR | 5.6 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/20/11 | 39.3 | RHCU | 13.3 | COPC | 13.3 | ACMN | 11.7 | CMSN | 10.0 | AFPR | 6.7 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 8/10/11 |  |  |  |  |  |  |  |  |  |  |  | 0 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 8/24/11 | 40.7 | ACMN | 32.3 | COPC | 15.6 | ACLN | 9.4 | CMAF | 7.3 | AKFL | 5.2 | 19 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 9/7/11 | 49.0 | MSAE | 39.0 | STHN | 10.3 | COPC | 9.6 | EPSX | 7.4 | NZFR | 5.1 | 26 | PPLK | 15,025 | 258 | 0 | 0 | 1.5 |
| TG | 9/21/11 | 45.5 | MSAE | 35.4 | COPC | 19.2 | EPSX | 13.1 | SCQD | 7.7 | CMAF | 3.8 | 21 | PPLK | 3,412 | 223 | 0 | 0 | 0.52 |
| TG | 10/5/11 | 53.3 | MSAE | 22.0 | COPC | 19.7 | EPSX | 15.9 | NZFR | 10.6 | DTTN | 3.0 | 27 | PPLK | 8,719 | 0 | 0 | 0 | 2.2 |
| TG | 10/19/11 | 43.2 | COPC | 20.3 | DTTN | 14.4 | EPSX | 10.2 | MSAE | 9.3 | NVCR | 5.1 | 26 | PPLK | 559 | 0 | 0 | 0 | 0.26 |
| TG | 11/16/11 | 47.6 | DTTN | 50.0 | NZFR | 15.3 | DTVL | 5.9 | COPC | 5.1 | SNMZ | 4.2 | 22 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| TG | 12/14/11 | 37.6 | DTTN | 35.2 | NZFR | 21.3 | NZDS | 11.1 | NVCV | 5.6 | COPC | 4.6 | 18 | PPLK | 0 | 0 | 0 | 0 | DNS |

Table 5 (cont.) Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Turwar Gage 2010-2015.

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TG | 2/22/12 | 36.3 | DTTN | 22.8 | NZFR | 20.8 | ACMN | 17.8 | RHCU | 7.9 | COPC | 6.9 | 21 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 3/21/12 | 30.7 | STAM | 17.0 | ACMN | 15.9 | COPC | 13.6 | DTTN | 8.0 | NZFR | 6.8 | 18 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 4/18/12 | 32.0 | DTTN | 18.2 | ASFO | 13.6 | ACMN | 10.6 | COPC | 7.6 | CMMN | 6.1 | 23 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 5/16/12 | 39.1 | DTTN | 14.7 | ACMN | 11.8 | CMMN | 10.8 | STHN | 10.8 | NZPC | 5.9 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 5/30/12 | 43.1 | DTTN | 38.1 | ACMN | 10.5 | STHN | 10.5 | NZDS | 8.6 | CMMN | 4.8 | 24 | PPLK | 0 | 0 | 0 | 0 | < 0.18 |
| TG | 6/13/12 | 48.5 | DTTN | 56.1 | ACMN | 7.5 | STHN | 7.5 | MLGR | 6.5 | NZDS | 4.7 | 16 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 6/27/12 | 47.8 | DTTN | 60.7 | STHN | 4.7 | NZDS | 4.7 | ACMN | 3.7 | CMMN | 3.7 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/11/12 | 47.0 | DTTN | 33.0 | NZFR | 10.1 | SNUL | 9.2 | STHN | 8.3 | COPC | 5.5 | 22 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/25/12 | 46.0 | COPC | 26.6 | EPSX | 16.5 | SCQD | 6.4 | GFAN | 5.5 | RHCU | 5.5 | 27 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 8/8/12 | 45.2 | COPC | 30.0 | NZFR | 10.0 | ACMN | 8.0 | GFAN | 8.0 | DTTN | 7.0 | 26 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 8/22/12 | 44.9 | COPC | 26.8 | EPSX | 17.0 | DTVL | 8.9 | SNUL | 8.0 | SCQD | 6.3 | 25 | PPLK | 83 | 0 | 28 | 0 | ND |
| TG | 9/5/12 | 53.0 | MSAE | 56.3 | NZFR | 7.2 | EPSX | 7.2 | COPC | 6.6 | DTVL | 4.2 | 22 | PPLK | 40,681 | 683 | 0 | 0 | 3.6 |
| TG | 9/19/12 | 44.9 | MSAE | 58.0 | COPC | 13.7 | EPSX | 7.6 | SNUL | 2.3 | AKFL | 2.3 | 20 | PPLK | 8,559 | 0 | 0 | 0 | 1.4 |
| TG | 10/3/12 | 47.0 | MSAE | 34.2 | COPC | 13.5 | NZFR | 9.9 | SNUL | 3.6 | AKFL | 2.7 | 32 | PPLK | 6,971 | 0 | 0 | 0 | 1.9 |
| TG | 10/17/12 | 52.0 | COPC | 25.0 | RHCU | 19.0 | NZFR | 7.8 | GFAN | 6.9 | EPSX | 4.3 | 30 | PPLK | 681 | 0 | 52 | 26[2] | < RL |
| TG | 11/14/12 | 40.1 | NZFR | 37.4 | COPC | 16.8 | DTTN | 6.5 | ACMN | 5.6 | RDMN | 3.7 | 23 | PPLK | 0 | 0 | 122 | 0 | ND |
| TG | 12/12/12 | 28.0 | COPC | 14.8 | SHXX | 13.0 | ACMN | 11.1 | NZFR | 9.3 | DTTN | 5.6 | 24 | PPLK | | | | | |
| TG | 2/20/13 | 41.7 | DTTN | 53.9 | ACMN | 8.7 | NZFR | 6.1 | NVCV | 5.2 | NZDS | 4.3 | 22 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 3/20/13 | 48.3 | DTTN | 63.6 | ACMN | 8.5 | NZFR | 7.6 | NZDS | 3.4 | CMMN | 3.4 | 17 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 4/17/13 | 37.2 | ACMN | 29.4 | DTTN | 11.8 | NZDS | 7.1 | RHCU | 7.1 | GFAN | 5.9 | 22 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 5/8/13 | 43.0 | ACMN | 24.8 | DTTN | 23.9 | NZFR | 9.2 | CMMN | 7.3 | RHCU | 6.4 | 21 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 5/22/13 | 44.8 | STHN | 59.1 | ACMN | 13.4 | NZFR | 4.3 | RHCU | 3.7 | COPC | 3.0 | 19 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 6/5/13 | 45.3 | ACMN | 19.6 | NZFR | 11.3 | DTTN | 9.3 | COPC | 9.3 | NVCV | 5.2 | 29 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 6/19/13 | 48.9 | ACMN | 21.6 | SNRM | 15.3 | DTTN | 10.8 | COPC | 6.3 | SNRD | 6.3 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/10/13 | 43.9 | COPC | 35.4 | NZFR | 20.4 | EPSX | 7.1 | DTTN | 3.5 | ACMN | 3.5 | 29 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| TG | 7/24/13 | 47.9 | STHN | 18.3 | COPC | 16.5 | NZFR | 12.2 | EPSX | 10.4 | CMAF | 4.3 | 29 | PPLK | 752 | 0 | 0 | 0 | 0.23 |
| TG | 8/7/13 | 45.4 | STHN | 28.0 | COPC | 11.9 | NZFR | 8.5 | RDMN | 6.8 | MSAE | 4.2 | 31 | PPLK | 1,687 | 184 | 0 | 0 | 0.42 |
| TG | 8/21/13 | 42.8 | COPC | 24.4 | SNUL | 17.4 | AKFL | 9.3 | EPSX | 8.1 | SCQD | 5.8 | 24 | PPLK | 0 | 164 | 0 | 0 | 0.20 |
| TG | 9/11/13 | 50.5 | MSAE | 41.1 | COPC | 15.6 | APFA | 8.5 | EPSX | 5.0 | NZFR | 4.3 | 26 | PPLK | 10,463 | 2,526 | 301 | 0 | 2 |
| TG | 9/25/13 | 45.4 | MSAE | 75.9 | COPC | 11.3 | NZPL | 2.6 | SNUL | 2.1 | EPSX | 1.5 | 16 | PPLK | 18,129 | 0 | 0 | 0 | 0.44 |
| TG | 10/9/13 | 43.7 | COPC | 37.5 | NZFR | 12.5 | EPSX | 10.7 | RHCU | 7.1 | ACMN | 5.4 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 10/23/13 | 38.5 | COPC | 36.7 | DTTN | 11.2 | EPSX | 7.1 | NZFR | 7.1 | GFSB | 6.1 | 21 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 11/20/13 | 46.7 | NZFR | 25.7 | DTTN | 21.2 | COPC | 12.4 | ACMN | 5.3 | SNUL | 5.3 | 22 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 12/18/13 | 45.9 | NZFR | 30.5 | DTTN | 16.9 | COPC | 11.9 | EPSX | 8.5 | ACMN | 5.9 | 22 | PPLK | 0 | 0 | 0 | 0 | DNS |

Table 5 (cont.) Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Turwar Gage 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Other (cells/ml) | Microcystin (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TG | 2/19/14 | 40.7 | NZFR | 20.7 | ACMN | 12.2 | COPC | 7.3 | RHCU | 7.3 | DTTN | 6.1 | 29 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 3/19/14 | 30.6 | COPC | 15.5 | NZFR | 13.8 | ACMN | 10.3 | NVCV | 10.3 | AFPR | 5.2 | 25 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 4/16/14 | 50.1 | DTTN | 32.0 | ACMN | 15.6 | NZFR | 13.9 | NZDS | 5.7 | CMMN | 4.1 | 26 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 5/7/14 | 46.2 | DTTN | 48.7 | ACMN | 10.9 | NZDS | 10.1 | CHXX | 5.0 | CMMN | 3.4 | 22 | PPLK | 0 | 0 | 0 | 0 | $0.15^{\mathrm{BQL}}$ |
| TG | 5/21/14 | 41.1 | COPC | 11.1 | RDMN | 9.9 | GFAN | 7.4 | CMMN | 7.4 | NZFR | 7.4 | 29 | PPLK | 0 | 0 | 0 | 0 | 0.19 |
| TG | 6/10/14 | 50.8 | COPC | 34.5 | NZFR | 10.9 | NVCV | 6.4 | ACMN | 6.4 | SCQD | 6.4 | 27 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 6/24/14 | 47.6 | COPC | 77.0 | SCQD | 5.3 | EPSX | 3.3 | RHCU | 2.0 | ACMN | 1.3 | 20 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/8/14 | 49.2 | COPC | 40.5 | ACMN | 9.5 | SLMN | 6.9 | NZFR | 6.0 | RHCU | 5.2 | 26 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/22/14 | 46.4 | COPC | 16.2 | SCQD | 15.2 | RHCU | 9.5 | DTVL | 5.7 | SCAC | 5.7 | 29 | PPLK | 8,904 | 0 | 0 | 0 | 0.44 |
| TG | 8/5/14 | 57.3 | COPC | 39.4 | MSAE | 6.4 | ACMN | 5.5 | SCQD | 4.6 | SLMN | 4.6 | 26 | PPLK | 4,780 | 0 | 108 | 0 | DNS |
| TG | 8/19/14 | 51.4 | COPC | 37.9 | EPSX | 8.3 | RDMN | 7.6 | SCQD | 6.8 | MSAE | 6.1 | 23 | PPLK | 2,708 | 0 | 0 | 0 | ND |
| TG | 9/9/14 | 54.9 | COPC | 33.1 | NZFR | 12.9 | DTTN | 8.9 | ACMN | 8.1 | SNUL | 6.5 | 23 | PPLK | 577 | 0 | 144 | 0 | $0.15^{\mathrm{BQL}}$ |
| TG | 9/23/14 | 46.1 | COPC | 33.0 | EPSX | 23.2 | FRCV | 5.4 | NZFR | 4.5 | RHCU | 4.5 | 23 | PPLK | 0 | 0 | 0 | 0 | 0.18 |
| TG | 10/7/14 | 41.7 | COPC | 29.5 | NZFR | 10.2 | EPSX | 5.7 | NVCV | 5.7 | DTTN | 4.5 | 30 | PPLK | 0 | 0 | 0 | 0 | 0.17 |
| TG | 10/22/14 | 47.2 | COPC | 37.7 | NZFR | 18.5 | ACMN | 5.4 | NVCV | 4.6 | EPSX | 3.8 | 24 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 11/19/14 | 43.6 | DTTN | 23.4 | NZFR | 19.4 | COPC | 14.5 | NVCV | 4.8 | ACMN | 4.8 | 29 | PPLK |  |  |  |  |  |
| TG | 12/17/14 | 38.5 | COPC | 26.5 | NZFR | 12.2 | ACMN | 10.2 | DTTN | 6.1 | RHCU | 5.1 | 27 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 2/24/15 | 26.1 | COPC | 25.9 | NZFR | 11.1 | GFAN | 7.4 | ACLC | 7.4 | ACMN | 7.4 | 15 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 3/17/15 | 45.3 | DTTN | 41.8 | NZDS | 7.4 | NVCV | 7.4 | NZFR | 6.6 | ACMN | 5.7 | 25 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 4/14/15 | 49.4 | DTTN | 61.5 | ACMN | 9.6 | NZDS | 8.3 | NZFR | 5.8 | NZPC | 3.2 | 18 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 5/5/15 | 50.6 | ACMN | 24.3 | STHN | 13.9 | NVCV | 8.7 | NZDS | 7.8 | NZFR | 6.1 | 30 | PPLK | * | * | * | * | ND |
| TG | 5/19/15 | 45.6 | COPC | 18.6 | NZFR | 10.3 | ACMN | 9.3 | NZAC | 7.2 | STHN | 5.2 | 27 | PPLK | * | * | * | * | ND |
| TG | 6/9/15 | 47.8 | COPC | 50.5 | NVCV | 5.3 | ACMN | 5.3 | NZFR | 4.2 | GFAN | 4.2 | 23 | PPLK | * | * | * | * | ND |
| TG | 6/23/15 | 50.5 | COPC | 47.2 | RHCU | 7.4 | NZFR | 6.5 | NVCR | 4.6 | SNUL | 3.7 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/7/15 | 52.2 | COPC | 16.4 | ACMN | 13.6 | NZFR | 11.8 | CCMG | 10.0 | NVCV | 5.5 | 30 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 7/21/15 | 52.5 | STHN | 25.2 | COPC | 15.3 | SNUL | 10.8 | RDMN | 7.2 | SLMN | 6.3 | 24 | PPLK | 1,049 | 0 | 0 | 0 | 0.35 |
| TG | 8/3/15 | 56.3 | RDMN | 19.4 | MLGR | 16.9 | EPSX | 10.5 | NZPL | 6.5 | SLMN | 6.5 | 29 | PPLK | **1,503** | 0 | 0 | 167[1] | 0.5 |
| TG | 8/18/15 | 49.1 | RDMN | 20.0 | EPSX | 13.7 | NZCP | 8.4 | DTTN | 7.4 | MSAE | 7.4 | 25 | PPLK |  |  |  |  |  |
| TG | 9/8/15 | 43.9 | COPC | 22.0 | EPSX | 20.3 | RDMN | 6.8 | DTTN | 6.8 | GSHR | 5.1 | 24 | PPLK | 0 | 0 | 0 | 0 | 0.15 |
| TG | 9/22/15 | 39.2 | COPC | 32.4 | EPSX | 18.3 | NVCR | 7.0 | DTTN | 4.2 | RDMN | 2.8 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 10/6/15 | 38.3 | COPC | 39.6 | EPSX | 11.9 | NZFR | 10.9 | NVCV | 5.9 | NZPC | 3.0 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| TG | 10/20/15 | 35.9 | COPC | 37.2 | EPSX | 10.5 | NVCR | 8.1 | FRCV | 7.0 | FRCN | 5.8 | 18 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 11/17/15 | 43.6 | NZFR | 33.0 | NZDS | 8.7 | FRCV | 4.9 | COPC | 4.9 | NVCR | 4.9 | 30 | PPLK | 0 | 0 | 0 | 0 | DNS |
| TG | 12/15/15 | 37.5 | COPC | 30.0 | NZFR | 10.0 | RHCU | 7.1 | ACMN | 4.3 | EPSX | 4.3 | 26 | PPLK | 0 | 0 | 0 | 0 | DNS |

Table 6. Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Weitchpec 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Other (cells/ml) | Microcystin (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WE | 2/18/10 | 36.5 | COPC | 22.1 | DTTN | 15.4 | RHCU | 10.6 | NZFR | 10.6 | ACMN | 9.6 | 23 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 4/15/10 | 45.0 | ASFO | 66.2 | ACMN | 6.6 | COPC | 6.6 | DTTN | 5.9 | NVCV | 2.9 | 15 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 5/12/10 | 38.5 | ASFO | 57.6 | DTTN | 20.2 | COPC | 4.0 | RHCU | 3.0 | CMMN | 3.0 | 15 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| WE | 5/26/10 | 39.2 | DTTN | 40.0 | ACMN | 10.0 | ASFO | 8.0 | RHCU | 7.0 | NZFR | 6.0 | 23 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| WE | 6/9/10 | 37.9 | ACMN | 18.1 | COPC | 14.5 | DTTN | 9.6 | STHN | 7.2 | NZFR | 7.2 | 25 | PPLK |  |  |  |  |  |
| WE | 6/15/10 | 41.1 | ACMN | 25.2 | DTTN | 12.1 | NZFR | 9.3 | RHCU | 7.5 | STHN | 6.5 | 27 | PPLK |  |  |  |  |  |
| WE | 6/23/10 | 41.4 | DTTN | 25.7 | ACMN | 19.3 | NZFR | 8.3 | NVCV | 7.3 | COPC | 7.3 | 22 | PPLK |  |  |  |  |  |
| WE | 7/7/10 | 42.4 | DTTN | 54.5 | ACMN | 17.0 | COPC | 7.1 | GFAN | 2.7 | GFSB | 1.8 | 20 | PPLK |  |  |  |  |  |
| WE | 7/21/10 | 43.1 | EPSX | 22.1 | COPC | 14.4 | DTTN | 12.5 | SNUL | 11.5 | ACMN | 8.7 | 25 | PPLK |  |  |  |  |  |
| WE | 8/11/10 | 43.2 | COPC | 36.4 | EPSX | 19.5 | NZFR | 10.2 | NVCR | 3.4 | SNUL | 3.4 | 21 | PPLK |  |  |  |  |  |
| WE | 8/25/10 | 43.5 | COPC | 46.4 | EPSX | 17.9 | SNUL | 8.0 | RHCU | 6.2 | SCQD | 2.7 | 22 | PPLK |  |  |  |  |  |
| WE | 9/8/10 | 45.9 | MSAE | 69.4 | COPC | 6.9 | EPSX | 5.6 | APFA | 2.8 | NZFR | 2.1 | 19 | PPLK | 20,671 | 902 | 0 | 0 | 5.5 |
| WE | 9/22/10 | 37.5 | MSAE | 100.0 |  |  |  |  |  |  |  |  | 1 | PPLK | 22,431 | 0 | 0 | 0 | <1.8 |
| WE | 10/6/10 | 45.9 | MSAE | 37.5 | COPC | 11.6 | RDMN | 8.0 | NZFR | 8.0 | STHN | 6.2 | 27 | PPLK |  |  |  |  | 4.2 |
| WE | 10/20/10 | 52.3 | STHN | 36.4 | COPC | 15.5 | NZFR | 9.3 | DTTN | 5.4 | EPSX | 3.9 | 26 | PPLK | 11,024 | 0 | 0 | 0 | 3.8 |
| WE | 11/17/10 | 43.4 | NZFR | 21.6 | COPC | 18.6 | DTTN | 17.5 | ACMN | 4.1 | CMMN | 4.1 | 26 | PPLK |  |  |  |  |  |
| WE | 12/15/10 | 46.3 | COPC | 27.1 | ACMN | 16.8 | NZFR | 11.2 | CMAF | 5.6 | RHCU | 3.7 | 24 | PPLK |  |  |  |  |  |
| WE | 2/16/11 | 36.4 | COPC | 21.1 | ACMN | 15.5 | RHCU | 9.9 | DTTN | 8.5 | NZDS | 7.0 | 24 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 3/16/11 | 40.5 | ACMN | 23.2 | DTTN | 14.5 | COPC | 11.6 | GFAN | 5.8 | NZFR | 5.8 | 21 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 4/13/11 | 43.2 | STAM | 53.4 | STHN | 14.6 | DTTN | 5.8 | GFAN | 3.9 | COPC | 1.9 | 22 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 5/10/11 | 49.3 | ASFO | 31.7 | DTTN | 22.2 | ACMN | 10.3 | STHN | 4.8 | STAM | 4.0 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 5/25/11 | 44.8 | DTTN | 51.9 | ACMN | 6.6 | STHN | 5.7 | COPC | 4.7 | RHCU | 3.8 | 26 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 6/8/11 | 48.3 | DTTN | 52.9 | ACMN | 11.5 | GFSB | 2.9 | CMMN | 2.9 | NZFR | 2.9 | 21 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 6/22/11 | 49.2 | ACMN | 25.0 | DTTN | 22.8 | MLGR | 9.6 | NZFR | 8.1 | NZDS | 5.9 | 22 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 7/6/11 | 40.6 | ACMN | 26.9 | RHCU | 10.2 | COPC | 10.2 | NZDS | 8.3 | DTTN | 7.4 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 7/20/11 | 38.3 | ACMN | 24.0 | COPC | 13.2 | CMSN | 10.7 | NZFR | 9.1 | RHCU | 6.6 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 8/10/11 |  |  |  |  |  |  |  |  |  |  |  | 0 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 8/24/11 | 44.3 | COPC | 52.0 | EPSX | 7.3 | GFSB | 4.1 | DTTN | 4.1 | RHCU | 3.3 | 27 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 9/7/11 | 51.7 | MSAE | 31.2 | EPSX | 18.0 | COPC | 15.6 | AKFL | 3.9 | RDMN | 3.1 | 24 | PPLK | 13,299 | 694 | 0 | 0 | 2.1 |
| WE | 9/21/11 | 50.6 | COPC | 20.2 | EPSX | 16.5 | MSAE | 15.6 | NZFR | 8.3 | STHN | 6.4 | 20 | PPLK | 3,651 | 390 | 0 | 0 | 0.93 |
| WE | 10/5/11 | 56.7 | COPC | 21.3 | EPSX | 16.4 | MSAE | 15.6 | NZFR | 14.8 | NVCR | 7.4 | 21 | PPLK | 8,439 | 0 | 0 | 0 | 1.6 |
| WE | 10/19/11 | 50.8 | MSAE | 24.5 | NZFR | 18.0 | COPC | 15.1 | RHCU | 7.2 | SNUL | 5.0 | 27 | PPLK | 6,085 | 0 | 0 | 0 | 0.76 |
| WE | 11/16/11 | 49.2 | NZFR | 30.8 | DTTN | 20.6 | COPC | 16.8 | SNUL | 4.7 | DTVL | 4.7 | 18 | PPLK | 0 | 0 | 0 | 0 | 0.23 |
| WE | 12/14/11 | 42.2 | DTTN | 26.7 | NZFR | 22.8 | COPC | 8.9 | ACMN | 7.9 | NZDS | 5.9 | 21 | PPLK | 0 | 0 | 0 | 0 | DNS |

Table 6 (cont.) Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Weitchpec 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Other (cells/ml) | Microcystin (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WE | 3/21/12 | 38.3 | STAM | 25.6 | ACMN | 14.6 | COPC | 9.8 | RHCU | 4.9 | ACLN | 4.9 | 26 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 4/18/12 | 34.9 | ACMN | 17.2 | ASFO | 16.2 | COPC | 8.1 | GFAN | 7.1 | DTTN | 6.1 | 32 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 5/16/12 | 41.1 | ACMN | 23.9 | COPC | 8.3 | NZDS | 7.3 | DTTN | 7.3 | NZFR | 6.4 | 31 | PPLK | 0 | 0 | 0 | 198[1] | ND |
| WE | 5/30/12 | 48.1 | DTTN | 39.2 | ACMN | 13.7 | NZDS | 12.7 | COPC | 4.9 | FRVA | 3.9 | 19 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 6/13/12 | 49.1 | DTTN | 51.8 | ACMN | 15.8 | MLGR | 8.8 | CMMN | 4.4 | DTVL | 2.6 | 18 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 6/27/12 | 47.2 | DTTN | 34.5 | ACMN | 12.7 | NZFR | 7.3 | COPC | 6.4 | STHN | 5.5 | 26 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 7/11/12 | 46.1 | ACMN | 18.0 | CMAF | 12.0 | COPC | 10.0 | NZFR | 9.0 | DTTN | 7.0 | 23 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 7/25/12 | 42.9 | COPC | 25.7 | NZFR | 11.0 | ACMN | 10.1 | RHCU | 10.1 | EPSX | 7.3 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 8/8/12 | 43.7 | COPC | 41.5 | EPSX | 17.0 | SCQD | 6.6 | SNUL | 4.7 | AKFL | 4.7 | 22 | PPLK | 0 | 0 | 0 | 0 | < 0.18 |
| WE | 8/22/12 | 44.7 | EPSX | 18.7 | COPC | 17.9 | NZFR | 7.3 | SCQD | 7.3 | AKFL | 5.7 | 26 | PPLK | 385 | 193 | 0 | 0 | ND |
| WE | 9/5/12 | 52.9 | MSAE | 60.6 | NZFR | 6.7 | EPSX | 6.7 | APFA | 3.6 | COPC | 3.1 | 28 | PPLK | 57,792 | 2,104 | 0 | 0 | 8.6 |
| WE | 9/19/12 | 46.1 | MSAE | 31.5 | NZFR | 14.9 | COPC | 14.3 | EPSX | 10.1 | SCQD | 4.2 | 29 | PPLK | 8,202 | 0 | 0 | 0 | 1.6 |
| WE | 9/26/12 | 41.4 | MSAE | 100.0 | MSAE |  | MSAE |  | MSAE |  | MSAE |  | 1 | PPLK |  |  |  |  |  |
| WE | 10/3/12 | 48.4 | MSAE | 36.4 | NZFR | 19.4 | COPC | 10.1 | EPSX | 7.8 | SNUL | 3.9 | 21 | PPLK | 12,870 | 129 | 0 | 0 | 1.5 |
| WE | 10/17/12 | 52.2 | NZFR | 44.9 | COPC | 13.9 | SNUL | 10.8 | EPSX | 4.4 | RHCU | 4.4 | 24 | PPLK | 141 | 0 | 0 | 0 | 0.22 |
| WE | 11/14/12 | 46.0 | NZFR | 43.0 | COPC | 21.5 | NVCV | 6.5 | DTVL | 5.4 | ACMN | 4.3 | 17 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 3/20/13 | 50.1 | DTTN | 31.3 | ACMN | 22.6 | NZFR | 13.9 | CMMN | 5.2 | NVCV | 4.3 | 18 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 4/17/13 | 36.9 | ACMN | 30.6 | NZFR | 10.8 | DTTN | 7.2 | RHCU | 7.2 | ACLN | 6.3 | 27 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 5/8/13 | 47.1 | ACMN | 41.1 | DTTN | 14.0 | RHCU | 7.5 | NZDS | 6.5 | CMMN | 4.7 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 5/22/13 | 43.4 | STHN | 31.8 | ACMN | 25.2 | GFAN | 5.6 | CMMN | 4.7 | COPC | 4.7 | 23 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| WE | 6/5/13 | 48.0 | ACMN | 22.5 | COPC | 17.5 | NZFR | 11.7 | CMAF | 7.5 | NZDS | 6.7 | 23 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 6/19/13 | 42.3 | COPC | 27.2 | NZFR | 22.8 | ACMN | 13.2 | RHCU | 6.1 | STAM | 4.4 | 21 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 7/10/13 | 45.0 | COPC | 31.0 | EPSX | 21.0 | NZFR | 10.0 | SNUL | 7.0 | SCQD | 6.0 | 17 | PPLK | 0 | 0 | 0 | 0 | <0.18 |
| WE | 7/24/13 | 49.6 | EPSX | 32.5 | COPC | 16.3 | SCQD | 8.1 | SNUL | 7.3 | NZFR | 7.3 | 25 | PPLK | 733 | 0 | 0 | 0 | 0.27 |
| WE | 8/7/13 | 53.2 | EPSX | 18.5 | STHN | 11.3 | SCQD | 8.9 | COPC | 8.1 | SNUL | 6.5 | 28 | PPLK | 2,272 | 1,913 | 0 | 3,417[2] | 0.72 |
| WE | 8/21/13 | 49.2 | EPSX | 15.0 | COPC | 14.0 | SNUL | 11.0 | NZFR | 6.0 | SCQD | 5.0 | 32 | PPLK | 513 | 513 | 0 | 0 | 0.2 |
| WE | 9/11/13 | 54.7 | MSAE | 76.0 | SNUL | 6.6 | APFA | 4.2 | COPC | 3.2 | EPSX | 2.9 | 17 | PPLK | 54,120 | 3,207 | 0 | 0 | 6.5 |
| WE | 9/25/13 | 50.5 | MSAE | 42.9 | NZFR | 13.0 | COPC | 9.0 | SNUL | 7.3 | NZPL | 6.2 | 20 | PPLK | 12,097 | 265 | 0 | 0 | 1.2 |
| WE | 10/9/13 | 42.5 | NZFR | 28.9 | COPC | 15.8 | EPSX | 9.6 | ACMN | 4.4 | SNUL | 4.4 | 27 | PPLK | 0 | 0 | 0 | 0 | 0.15 |
| WE | 10/23/13 | 44.2 | NZFR | 35.5 | DTTN | 13.1 | COPC | 7.5 | NVCV | 5.6 | SNUL | 4.7 | 26 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 11/20/13 | 62.3 | NZFR | 43.2 | DTTN | 10.8 | NVCV | 8.1 | COPC | 6.3 | GFSB | 3.6 | 22 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 3/19/14 | 37.0 | NZFR | 26.5 | COPC | 24.5 | NVCV | 7.1 | ACMN | 6.1 | NZDS | 4.1 | 24 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 4/16/14 | 44.4 | DTTN | 26.6 | ACMN | 16.5 | NZDS | 11.9 | COPC | 9.2 | NZFR | 7.3 | 24 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 5/7/14 | 46.7 | DTTN | 26.2 | NZDS | 22.4 | ACMN | 19.6 | NZFR | 8.4 | COPC | 4.7 | 16 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 5/21/14 | 40.5 | COPC | 23.1 | ACMN | 10.3 | RHCU | 7.7 | GSHR | 7.7 | NZFR | 5.1 | 28 | PPLK | 0 | 47 | 0 | 0 | ND |

Table 6 (cont.) Phytoplankton results for baseline water samples collected with a churn splitter in the Klamath River at Weitchpec 2010-2015.

| Station | Date | TSI | Sp1 | Sp1% | Sp2 | Sp2% | Sp3 | Sp3% | Sp4 | Sp4% | Sp5 | Sp5% | #Spp | Type | MSAE (cells/ml) | AFA (cells/ml) | ANA (cells/ml) | Other (cells/ml) | Microcystin (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WE | 6/11/14 | 48.7 | COPC | 46.3 | NZFR | 17.4 | ACMN | 9.9 | EPSX | 6.6 | NVCV | 3.3 | 21 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 7/9/14 | 48.4 | COPC | 41.7 | EPSX | 16.7 | NZFR | 5.0 | SCQD | 4.2 | GSHR | 4.2 | 27 | PPLK | 0 | 82 | 0 | 0 | 0.20 |
| WE | 7/23/14 | 52.1 | EPSX | 27.4 | COPC | 16.3 | SNUL | 12.6 | NZFR | 11.9 | GSHR | 3.7 | 23 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 8/6/14 | 55.8 | MSAE | 29.7 | EPSX | 14.9 | NZPL | 12.9 | COPC | 9.9 | NZFR | 5.9 | 24 | PPLK | 51,543 | 0 | 0 | 0 | 1.2 |
| WE | 8/20/14 | 47.4 | COPC | 27.9 | MSAE | 16.2 | EPSX | 10.8 | NZFR | 9.0 | NVCV | 5.4 | 27 | PPLK | 3,530 | 147 | 0 | 98[1] | 0.3 |
| WE | 9/10/14 | 47.0 | COPC | 17.9 | EPSX | 16.3 | NZFR | 8.1 | DTVL | 6.5 | MSAE | 4.9 | 29 | PPLK | 697 | 0 | 0 | 0 | ND |
| WE | 9/24/14 | 54.2 | COPC | 25.7 | EPSX | 9.8 | DTVL | 9.1 | NZFR | 7.6 | SNUL | 6.1 | 29 | PPLK | 301 | 0 | 0 | 940[1] | 0.24 |
| WE | 10/8/14 | 56.8 | COPC | 27.5 | NZFR | 13.7 | ACMN | 7.8 | EPSX | 7.8 | NVCV | 4.9 | 25 | PPLK | 0 | 0 | 0 | 0 | 0.18 |
| WE | 10/22/14 | 51.0 | NZFR | 31.0 | COPC | 20.6 | ACMN | 8.7 | EPSX | 4.8 | NVCV | 4.0 | 28 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 11/19/14 | 40.7 | NZFR | 32.3 | DTTN | 12.1 | COPC | 11.1 | NZDS | 7.1 | ACMN | 4.0 | 26 | PPLK |  |  |  |  |  |
| WE | 3/18/15 | 43.5 | ACMN | 17.6 | STHN | 14.8 | NZFR | 7.4 | DTTN | 7.4 | COPC | 5.6 | 29 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 4/15/15 | 52.2 | DTTN | 64.0 | ACMN | 6.7 | NVCV | 3.9 | NZFR | 3.9 | NZDS | 3.9 | 22 | PPLK | 0 | 0 | 0 | 0 | DNS |
| WE | 5/6/15 | 50.6 | ACMN | 21.8 | NZFR | 19.3 | STHN | 16.8 | NZDS | 9.2 | CMMN | 4.2 | 26 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 5/20/15 | 46.0 | COPC | 32.7 | NZFR | 12.2 | RHCU | 9.2 | ACMN | 9.2 | CMMN | 5.1 | 23 | PPLK | * | * | * | * | ND |
| WE | 6/10/15 | 42.0 | COPC | 74.4 | RHCU | 6.0 | NZFR | 2.6 | ACMN | 2.6 | NVCR | 1.7 | 17 | PPLK | * | * | * | * | ND |
| WE | 6/24/15 | 40.9 | COPC | 47.2 | EPSX | 10.1 | NZFR | 6.7 | CMSN | 4.5 | SNUL | 4.5 | 20 | PPLK | * | * | * | * | ND |
| WE | 7/8/15 | 46.6 | EPSX | 26.7 | COPC | 20.0 | AKFL | 18.3 | NZPL | 5.0 | NZPC | 4.2 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 7/22/15 | 47.4 | NZPL | 22.7 | COPC | 21.2 | NZFR | 9.1 | RDMN | 6.8 | EPSX | 5.3 | 25 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 8/5/15 | 51.8 | MSAE | 26.6 | RDMN | 10.1 | PQX9 | 9.4 | NZPL | 9.4 | NZFR | 6.5 | 29 | PPLK | **12,237** | 0 | 0 | 2,345 | **0.96** |
| WE | 8/19/15 | 57.1 | EPSX | 15.1 | NZCP | 12.7 | DTTN | 11.9 | MSAE | 11.1 | COPC | 7.9 | 25 | PPLK |  |  |  |  |  |
| WE | 9/9/15 | 46.2 | EPSX | 29.1 | DTTN | 12.0 | COPC | 8.5 | NZFR | 8.5 | SNUL | 6.0 | 24 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 9/22/15 | 46.8 | NZFR | 22.2 | EPSX | 12.0 | COPC | 11.1 | NVCR | 8.3 | DTTN | 4.6 | 27 | PPLK | 0 | 0 | 0 | 0 | 0.2 |
| WE | 10/7/15 | 41.1 | NZFR | 31.5 | NVCR | 14.6 | COPC | 11.2 | NVCV | 7.9 | ACMN | 6.7 | 18 | PPLK | 0 | 0 | 0 | 0 | ND |
| WE | 10/21/15 | 44.5 | NZFR | 28.7 | COPC | 18.3 | NVCR | 6.1 | NVCV | 5.2 | SNMZ | 4.3 | 30 | PPLK | 0 | 79 | 0 | 0 | 0.22 |
| WE | 11/18/15 | 46.0 | NZFR | 32.6 | NZDS | 9.3 | NVCV | 6.2 | ACMN | 5.4 | RHCU | 5.4 | 32 | PPLK | 0 | 0 | 0 | 0 | DNS |

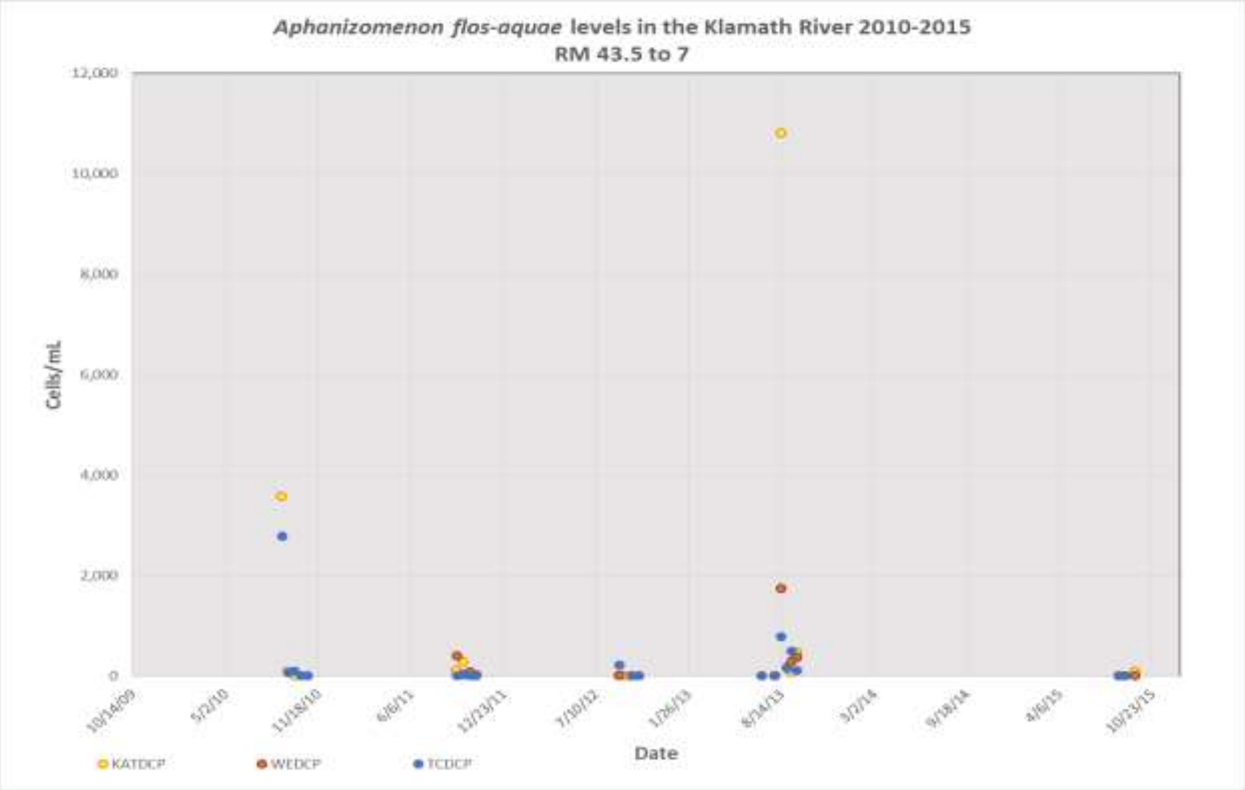

Figure 2. *Aphanizomenon flos-aquae* levels for water samples in the Klamath River from RM 43.5 to RM 7 2010-2015

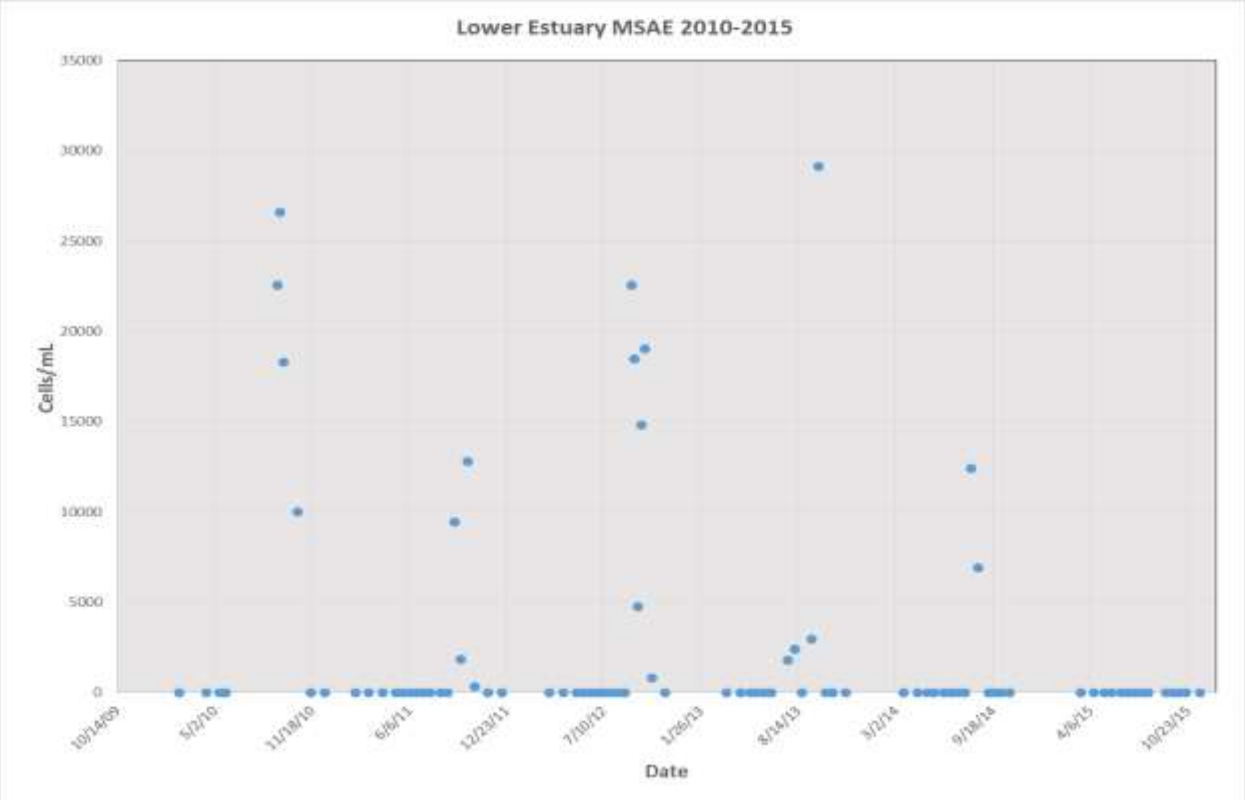

Figure 3. *Microcystis aeruginosa* levels for water samples collected in the Klamath River from the Lower Estuary 2010-2015.

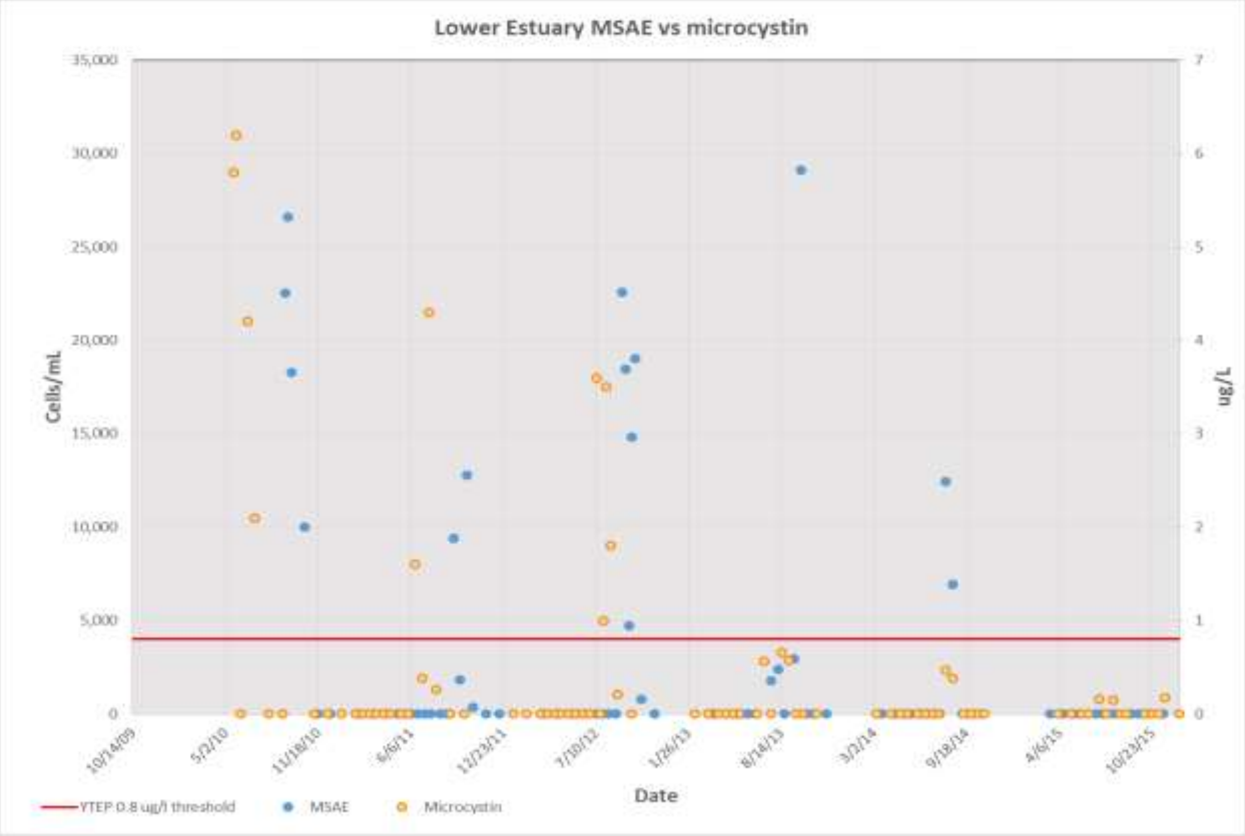

Figure 4. *Microcystis aeruginosa* levels vs microcystin for water samples collected in the Lower Estuary 2010-2015

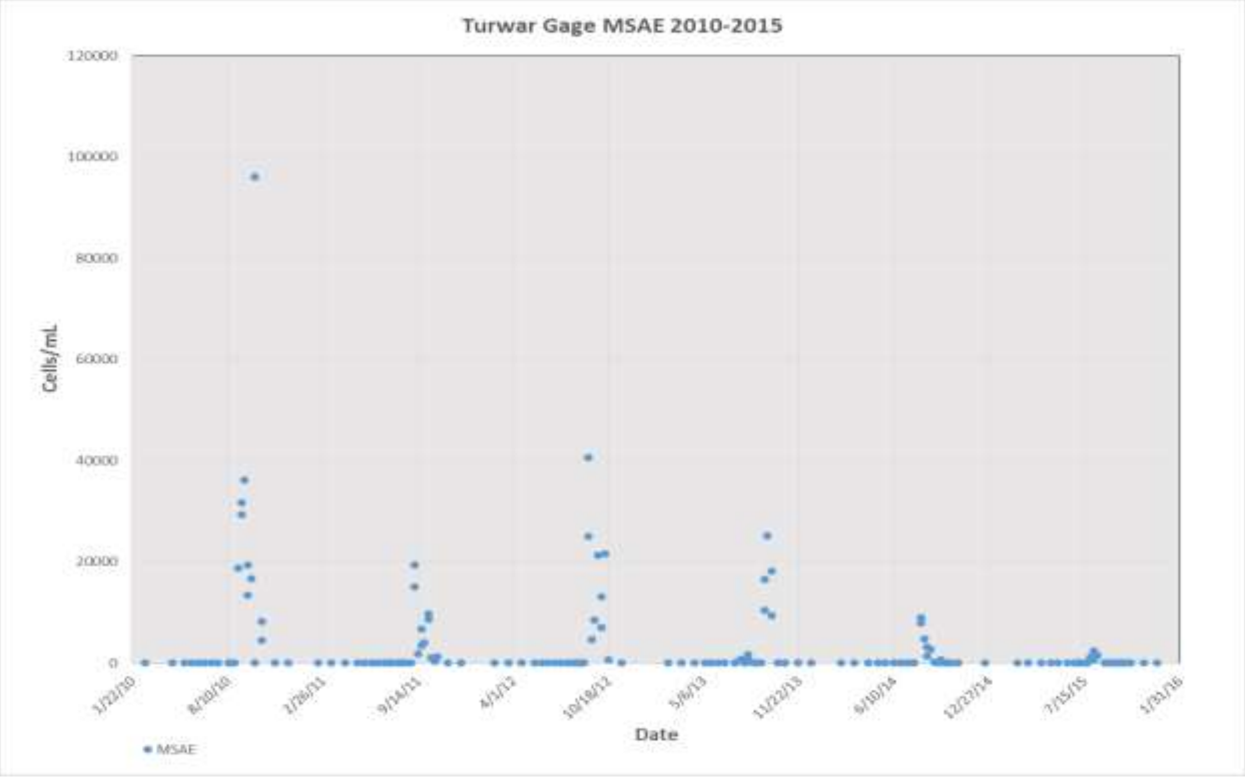

Figure 5. *Microcystis aeruginosa* levels for water samples collected in the Klamath River from the Turwar Gage 2010-2015.

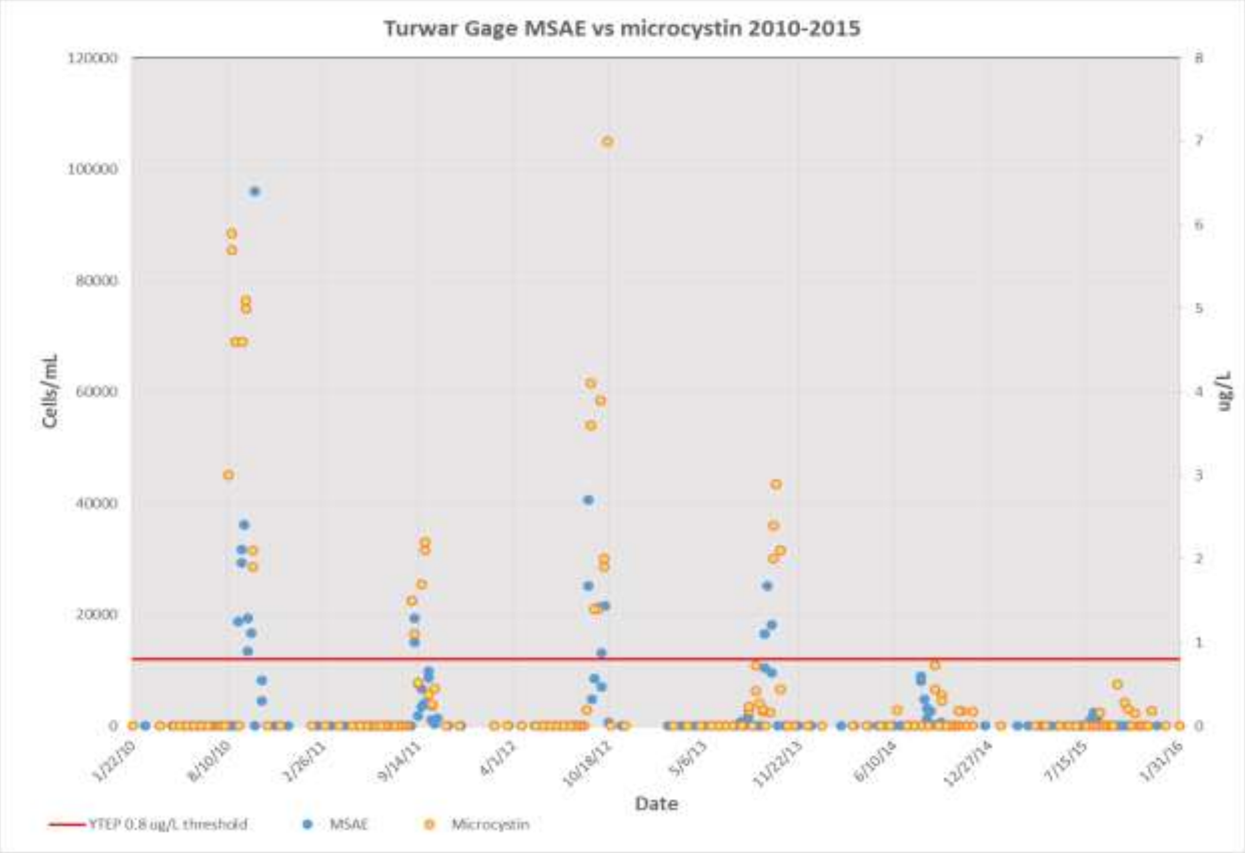

Figure 6. *Microcystis aeruginosa* levels vs microcystin for water samples collected at Turwar gage 2010-2015

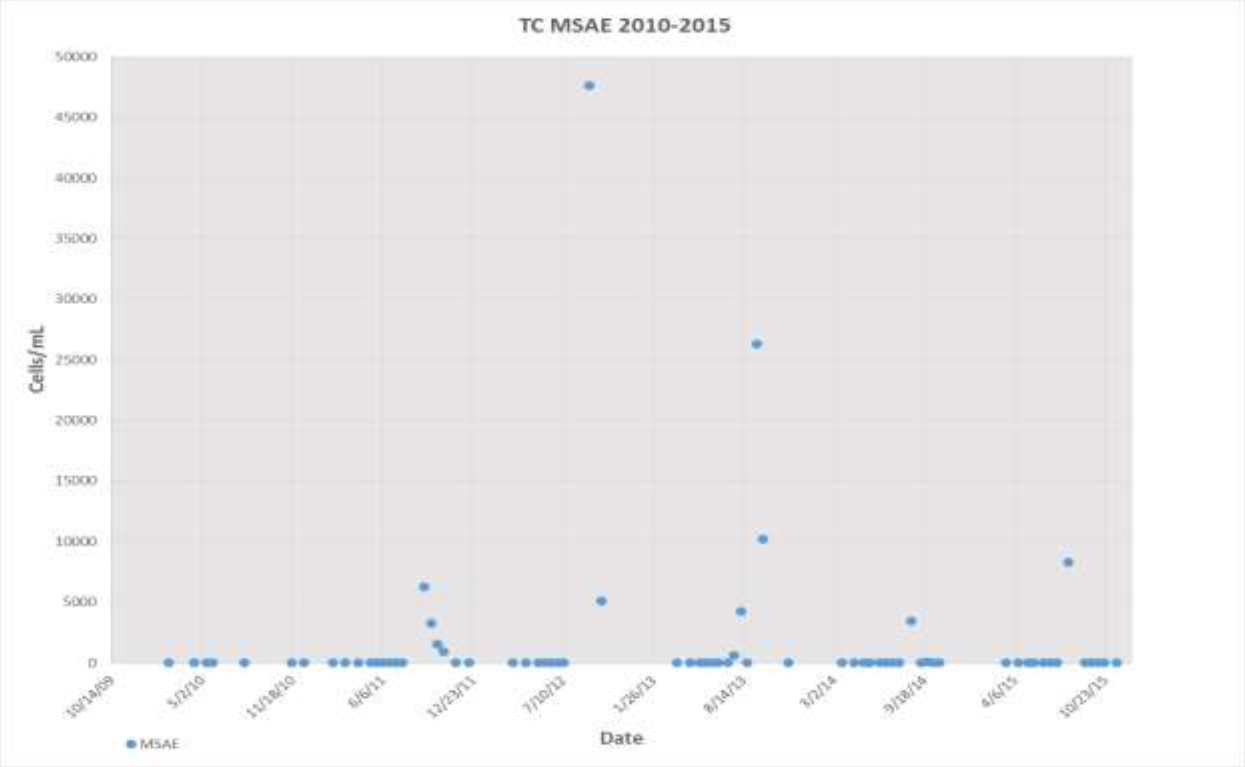

Figure 7. *Microcystis aeruginosa* levels for water samples collected in the Klamath River from Tully Creek 2010-2015.

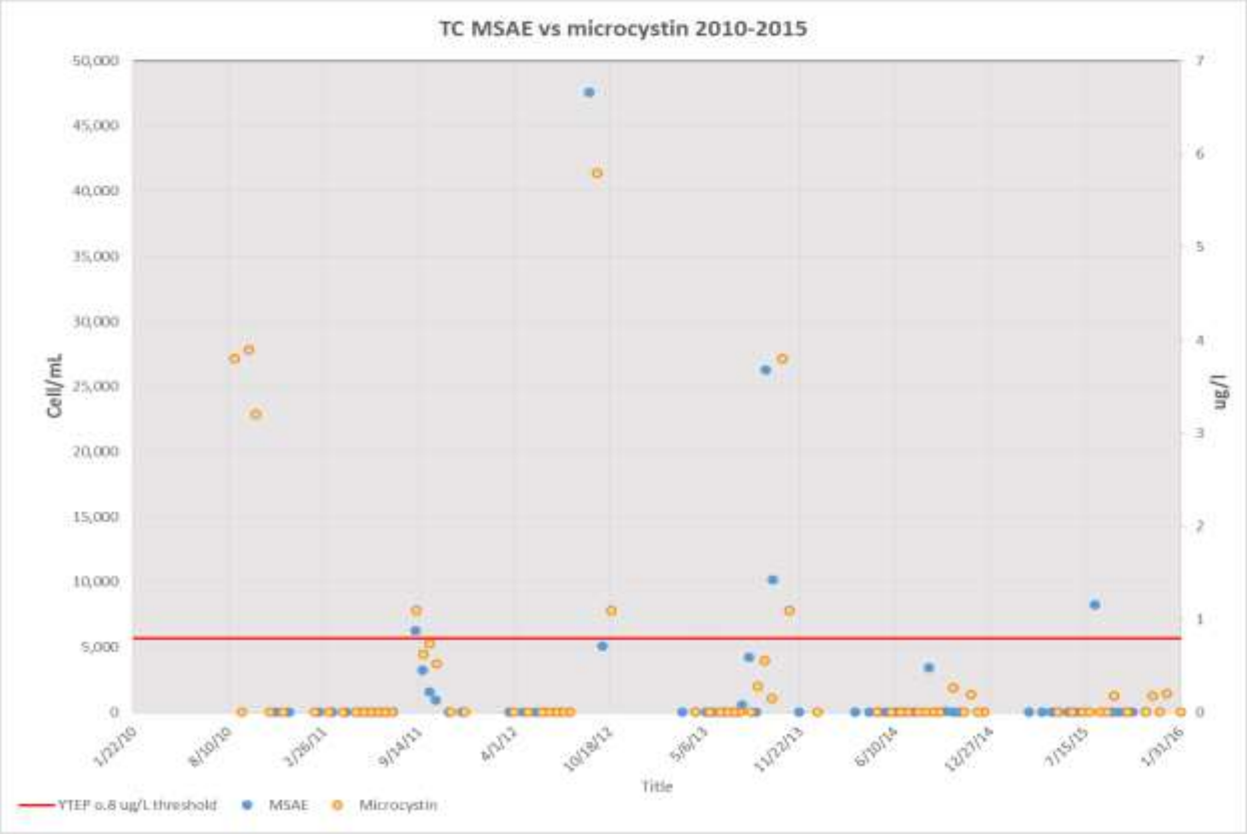

Figure 8. *Microcystis aeruginosa* levels vs microcystin for water samples collected in the Klamath River at Tully Creek 2010-2015.

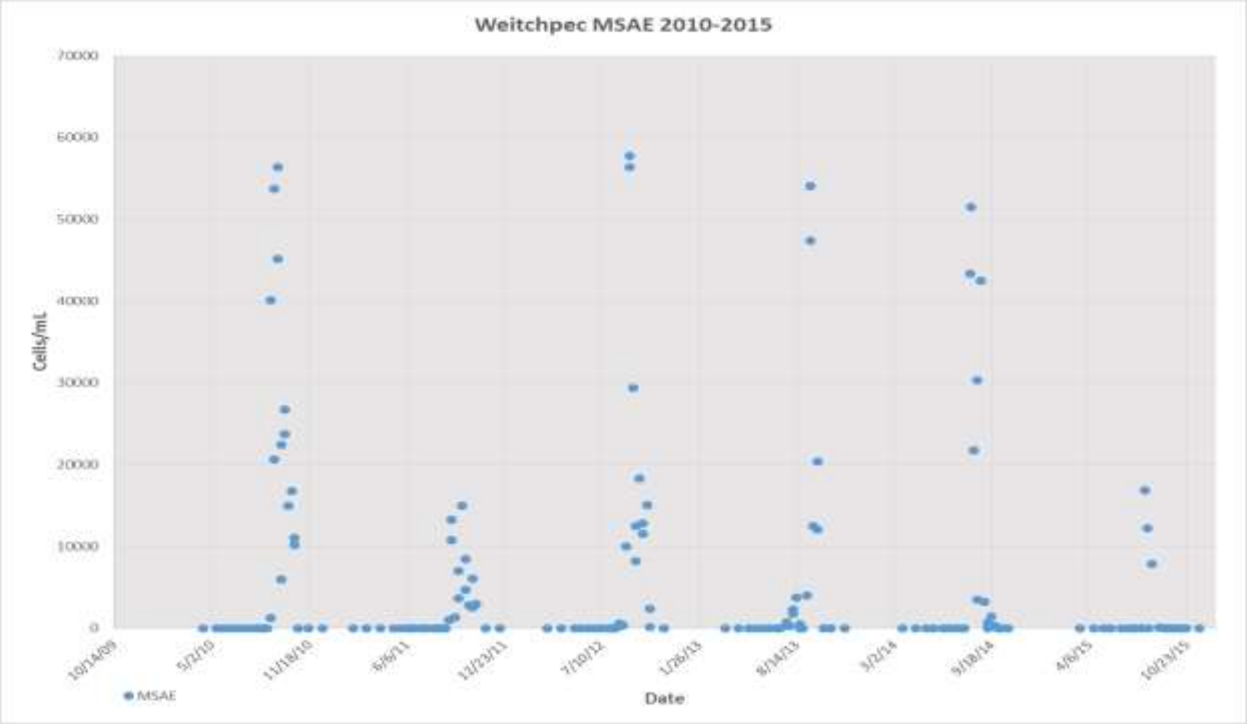

Figure 9. *Microcystis aeruginosa* levels for water samples collected in the Klamath River from Weitchpec 2010-2015

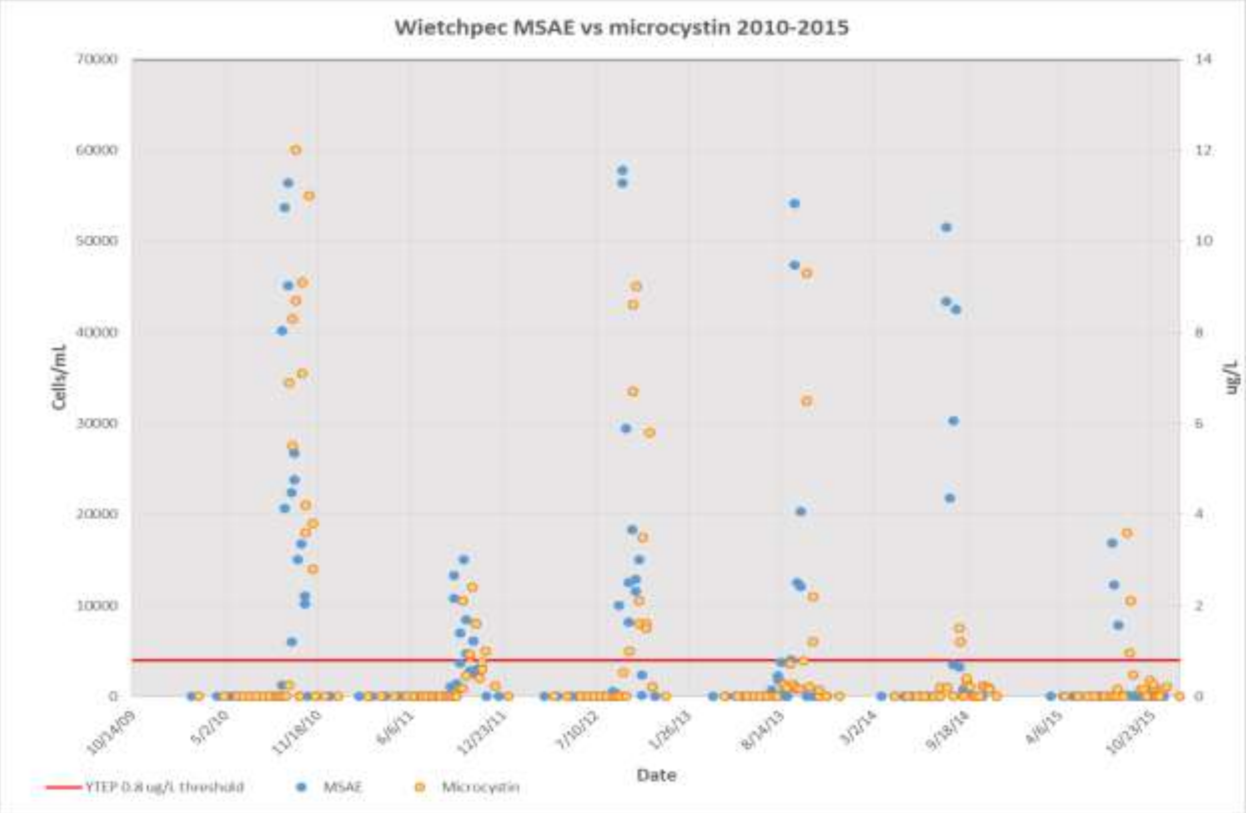

Figure 10. *Microcystis aeruginosa* levels vs microcystin for water samples collected in the Klamath River at Weitchpec 2010-2015.

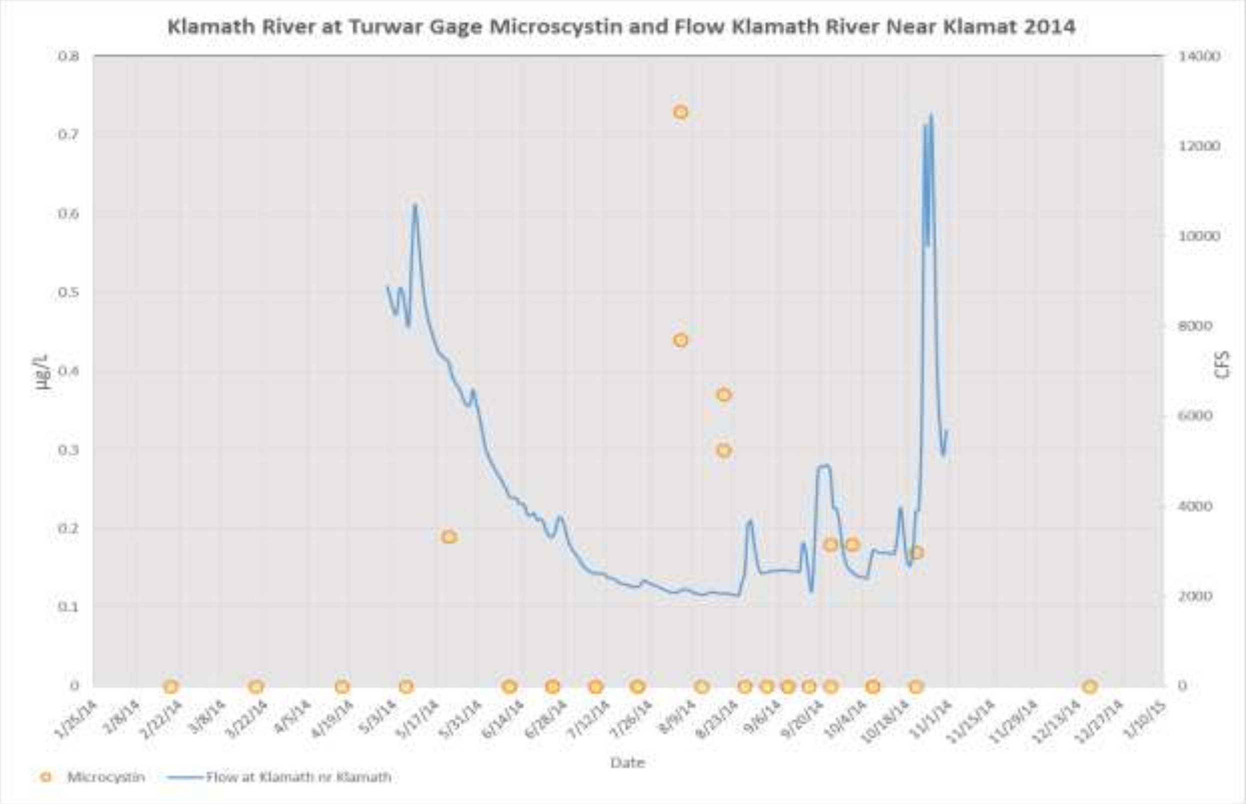

Figure 11. TG microcystin levels vs flow at Klamath nr Klamath 2014.

## VI. Discussion:

## Water Samples

### ***Aphanizomenon flos-aquae***

*Aphanizomenon flos-aquae* (APF9) is a species of concern due to its ability to produce toxins and its abundance in the reservoirs managed by PacifiCorp located upstream of the YIR.

**2010**

APF9 was first detected in the Klamath River on June 9, 2010 at the WE monitoring site. APF9 continued to be present at relatively low levels in the Klamath River at multiple sampling sites from August 31, 2010 until October 20, 2010. The highest level of 5,412 cells/ml was recorded at the WE monitoring site on September 1, 2010. APF9 was detected in both baseline and public health samples.

**2011**

APF9 was first detected in the Klamath River on September 1, 2011 at the WE monitoring site. APF9 continued to be present at relatively low levels in the Klamath River at multiple sampling sites from September 1, 2011 until October 26, 2011. The highest level of 694 cells/ml was recorded at the WE monitoring site on September 7, 2011. APF9 was detected in both baseline and public health samples.

**2012**

APF9 was first detected in the Klamath River on August 16, 2012 at the WE monitoring site. APF9 continued to be present at relatively low levels in the Klamath River at multiple sampling sites from August until October 17, 2012. The highest level of 2,104 cells/ml was recorded at the WE monitoring site on September 5, 2010. APF9 was detected in both baseline and public health samples.

**2013**

APF9 was first detected in the Klamath River on August 7, 2013 at the WE monitoring site. APF9 continued to be present at relatively low levels in the Klamath River at multiple sampling sites from August until September 25, 2013. The highest level of 5,403 cells/ml was recorded at the WE monitoring site on September 11, 2013. APF9 was detected in both baseline and public health samples.

**2014**

APF9 was first detected in the Klamath River on May 21, 2014 at the WE monitoring site. APF9 continued to be present at relatively low levels in the Klamath River at multiple sampling sites from May until August 20, 2014. The highest level of 147 cells/ml was recorded at the WE monitoring site on August 20, 2014. APF9 was detected in both baseline and public health samples.

**2015**

APF9 was first detected in the Klamath River on August 26, 2015 at the WE monitoring site. APF9 was only detected during 2 sampling events. August 26th and October 21, 2015 with the highest concentration being at WE on August 26, 2015 with a level of 79 cells/ml APF9 was detected in both baseline and public health samples.

***Microcystis aeruginosa***

*Microcystis aeruginosa* (MSAE) was found in water samples collected for baseline and public health purposes and was present in the Klamath River reach located within the YIR from RM 44 to RM 0.5 Summary information for the occurrence of MSAE in this river reach is presented in figures 4, 6, 8, and 10 for the years 2010-2015 (WE, WEDCP, TC, TCDCP, KASR, KATDCP, TG and LES). MSAE was not detected in any of the water samples collected at the Trinity River monitoring site from 2010-2015. On September 24, 2014 there was a detection of Microcystin. The level was 0.16 and considered to be BQL (Below the Quantification Limit) by the lab.

**2010**

MSAE was first detected in the Klamath River on August 31, 2010 at the WE sampling site. The sampling event for baseline water quality samples on this day reported 40,139 which exceeds State of California's Recommended Recreational Threshold of 40,000 cells/ml. MSAE was detected in samples until the October 20, 2010. The highest sample occurred on September 15, 2010 with 56,375 cells/mL MSAE was not detected in the Klamath River on the last three monitoring events of the season that took place in October, November and December 2010.

**2011**

MSAE was first detected in the Klamath River on September 1, 2011 at the WE sampling site. The sampling event for baseline water quality samples on this day reported 1,034 cells/mL. MSAE was detected in samples until the October 26, 2011. The highest sample occurred on September 28, 2011 with 15,024 cells/mL. MSAE was not detected in the Klamath River on the last two monitoring events of the season that took place in November and December 2011.

**2012**

MSAE was first detected in the Klamath River on August 16, 2012 at the WE sampling site. The sampling event for baseline water quality samples on this day reported 551 cells/mL. MSAE was detected in samples until October 17, 2012. The highest sample occurred on September 28, 2012 with 56,423 cells/mL. MSAE was not detected in the Klamath River on the last two monitoring events of the season that took place in November and December 2012.

**2013**

MSAE was first detected in the Klamath River on July 24, 2013 at the WE sampling site. The sampling event for baseline water quality samples on this day reported 344 cells/mL. MSAE was detected in samples until September 25, 2013. The highest sample occurred on September 11, 2013 with 54,120 cells/mL. MSAE was not detected in the Klamath River on the last three monitoring events of the season that took place in September, October, and November. 2013.

**2014**

MSAE was first detected in the Klamath River on July 28, 2014 at the WE sampling site. The sampling event for baseline water quality samples on this day reported 43,363 cells/mL. MSAE was detected in samples until September 24, 2014. The highest sample occurred on August 6, 2014 with 51,543 cells/mL. MSAE was not detected in the Klamath River on the last two monitoring events of the season that took place in October, and November. 2014.

**2015**

MSAE was first detected in the Klamath River on July 28, 2015 at the TG sampling site. The sampling event for baseline water quality samples on this day reported 1,049 cells/mL. MSAE was detected in samples until September 2, 2015. The highest sample occurred on July 29, 2015 with 16,871 cells/mL. MSAE was not detected in the Klamath River on the last eight monitoring events of the season that took place in September, October, and November. 2015.

These results indicate that MSAE is typically present in the Klamath River within the YIR for two to four months between 2010 and 2015. MSAE concentrations in the Klamath River show a steady decline from 2010-2015. There also seems to be a longitudinal trend with WE almost always getting the first detections of MSAE, the highest concentrations, and the longest presence in the year with cell densities occurring at the end of September into October. In August, the public health samples that were collected near the bank in slower moving water had higher concentrations of MSAE when compared to the baseline sampling sites. As river flows began to drop and the edge water habitats received less water the baseline sampling sites that are at locations where the water is well mixed had higher levels of MSAE.

The timing of the MSAE peak is significant because of the presence of adult salmon and steelhead migrating upstream during this time period. This is also a time of increased cultural and recreational use of the Klamath River by both Tribal Members and sport fishermen. The Yurok Tribe posting guidelines for protection of human health are located in Appendix A. YTEP observed that MSAE was not always a reliable indicator for the presence of cyanotoxins, *microcystin* in particular. 2010-2012 shows sample events where Microcystin is present at posting levels when MSAE is not. (Figures 4, 6 and 8) It can be also stated at certain times that MSAE cell counts are above the 40,000 cells/mL and the toxin levels are not above posting guidelines. In 2014 YTEP lowered its posting guidelines based upon the 2012 study by OEHHA; **TOXICOLOGICAL SUMMARY AND SUGGESTED ACTION LEVELS TO REDUCE POTENTIAL ADVERSE HEALTH EFFECTS OF SIX CYANOTOXINS.**

## ***Anabaena spp.***

*Anabaena spp.* is also a species of concern due to their ability to produce toxins. *Anabaena spp.* was detected at low levels in water samples collected in the Klamath and Trinity River monitoring sites located within the YIR from RM 44 to RM 0.5 (WE, WEDCP, TC, TCDCP, KASR, KATDCP, TG, LES and TR). A*nabaena spp.* was detected in both baseline and public health samples and was present for almost three months at low levels (August-October for 2010-2015).(see tables 4-8)

## **Microcystin**

The water samples submitted for microcystin analysis were analyzed by USEPA's laboratory utilizing the ELISA method. Microcystin followed a similar trend to *Microcystis aeruginosa* concentrations in the Klamath River 2010- 2015. In 2014 and 2015 microcystin only reached the 0.8µg/L at WE once and all other sites stayed below that threshold. These results were opposite from what was expected given the drought and low flows in the Klamath River for those years.

For water year 2014 it seems that the pulse flows released down the Klamath River had a beneficial effect for reducing microcystin levels. In June, July and August as the river descended to baseline flows, toxin levels increased. When the pulse flows came in late August and again in mid-September, toxin levels dropped to zero shortly thereafter. (Figure 11) In 2015 it seems to be a combination of pulse flow and smoke from wildfires in the upper portion of the YIR that aided in reducing temperatures and potentially reducing conditions for MSAE and associated toxins. Sampling results indicate that microcystin was present in the Klamath River within the YIR July to November for most years (see tables 4-8). Microcystin and other cyanotoxins of concern have proved difficult to predict according to river conditions. Future monitoring over different water years should help with this issue and hopefully provide a better understanding of microcystin and how it migrates through the Lower Klamath River.

**2010**

Microcystin was first detected in the Klamath River at TG on August 31, 2010 with a result of 3.0µg/L. Microcystin was detected in water samples until October 20, 2010. The highest concentration occurred on September 15, 2010 with a concentration of 12.0 µg/L at WE. In 2010 YTEP was following the State of California's Recommended Recreational Threshold of 8µg/L for posting guidelines. In hindsight the river would have been posted earlier and for a longer period of time based on the new posting guidelines. (Appendix A)

**2011**

Microcystin was first detected in the Klamath River at WE on September 1, 2011 with a result of 0.18µg/L. Microcystin was detected in water samples until November 16, 2011. The highest concentration occurred on September 5, 2011 with a concentration of 4.3µg/L at LES.

**2012**

Microcystin was first detected in the Klamath River at WE on August 8, 2012 with a result of 0.18µg/L. Microcystin was detected in water samples until November 17, 2012. The highest concentration occurred on September 13, 2012 with a concentration of 9.0µg/L at WE.

**2013**

Microcystin was first detected in the Klamath River at TC on May 22, 2013 with a result of 0.18µg/L. Microcystin was detected in water samples until October 9, 2013. The highest concentration occurred on September 11, 2013 with a concentration of 9.3µg/L at WE.

**2014**

Microcystin was first detected in the Klamath River at WE and TC on June 25, 2014 with a result of 0.18µg/L. Microcystin was detected in water samples until October 8, 2014. The highest concentration occurred on August 5, 2014 with a concentration of 1.5µg/L at WE.

**2015**

Microcystin was first detected in the Klamath River at WE (0.17µg/L) and TC (0.18µg/L) on July 8, 2015. Microcystin was detected in water samples until October 21, 2015. The highest concentration occurred on July 29, 2015 with a concentration of 3.6µg/L at WE.

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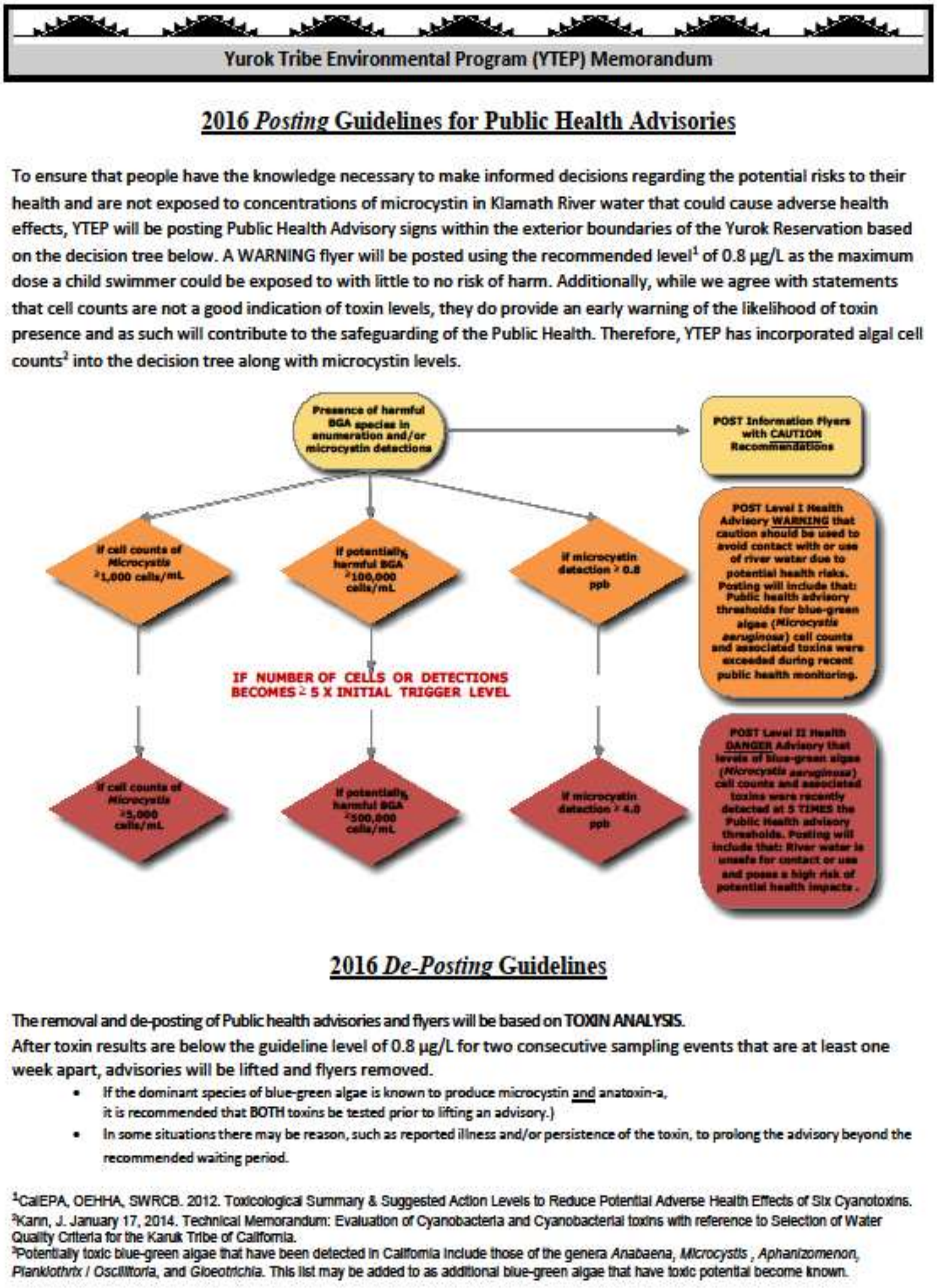
# Appendix A



**Yurok Tribe Environmental Program (YTEP) Memorandum**

## 2016 *Posting* Guidelines for Public Health Advisories

To ensure that people have the knowledge necessary to make informed decisions regarding the potential risks to their health and are not exposed to concentrations of microcystin in Klamath River water that could cause adverse health effects, YTEP will be posting Public Health Advisory signs within the exterior boundaries of the Yurok Reservation based on the decision tree below. A WARNING flyer will be posted using the recommended level[1] of 0.8 µg/L as the maximum dose a child swimmer could be exposed to with little to no risk of harm. Additionally, while we agree with statements that cell counts are not a good indication of toxin levels, they do provide an early warning of the likelihood of toxin presence and as such will contribute to the safeguarding of the Public Health. Therefore, YTEP has incorporated algal cell counts[2] into the decision tree along with microcystin levels.

Presence of harmful BGA species in enumeration and/or microcystin detections

POST Information Flyers with CAUTION Recommendations

If cell counts of *Microcystis* ≥1,000 cells/mL

If potentially harmful BGA ≥100,000 cells/mL

If microcystin detection > 0.8 ppb

POST Level I Health Advisory WARNING that caution should be used to avoid contact with or use of river water due to potential health risks. Posting will include that: Public health advisory thresholds for blue-green algae (*Microcystis aeruginosa*) cell counts and associated toxins were exceeded during recent public health monitoring.

IF NUMBER OF CELLS OR DETECTIONS BECOMES ≥ 5 X INITIAL TRIGGER LEVEL

If cell counts of *Microcystis* ≥5,000 cells/mL

If potentially harmful BGA ≥500,000 cells/mL

If microcystin detection > 4.0 ppb

POST Level II Health DANGER Advisory that levels of blue-green algae (*Microcystis aeruginosa*) cell counts and associated toxins were recently detected at 5 TIMES the Public Health advisory thresholds. Posting will include that: River water is unsafe for contact or use and poses a high risk of potential health impacts .

## 2016 *De-Posting* Guidelines

The removal and de-posting of Public health advisories and flyers will be based on TOXIN ANALYSIS.

After toxin results are below the guideline level of 0.8 µg/L for two consecutive sampling events that are at least one week apart, advisories will be lifted and flyers removed.

- If the dominant species of blue-green algae is known to produce microcystin and anatoxin-a, it is recommended that BOTH toxins be tested prior to lifting an advisory.)
- In some situations there may be reason, such as reported illness and/or persistence of the toxin, to prolong the advisory beyond the recommended waiting period.

[1] CalEPA, OEHHA, SWRCB. 2012. Toxicological Summary & Suggested Action Levels to Reduce Potential Adverse Health Effects of Six Cyanotoxins.

[2] Kann, J. January 17, 2014. Technical Memorandum: Evaluation of Cyanobacteria and Cyanobacterial toxins with reference to Selection of Water Quality Criteria for the Karuk Tribe of California.

[3] Potentially toxic blue-green algae that have been detected in California include those of the genera *Anabaena*, *Microcystis* , *Aphanizomenon*, *Planktothrix / Oscillitoria*, and *Gloeotrichia*. This list may be added to as additional blue-green algae that have toxic potential become known.

# Appendix B
# Grab Sample Protocol

‘Grab sampling’ refers to water samples obtained by dipping a collection container into the upper layer of a body of water and collecting a water sample (USGS File Report -00213). For quality assurance/quality control (QA/QC) purposes replicate, and blank bottle sets will be prepared and collected for one site each sampling period. These additional bottle sets will be handled, prepared and filled following the same protocol used for regular bottle sets and samples. General water quality parameters will also be measured with a freshly calibrated portable multi-probe water quality instrument during grab samples and recorded onto data sheets.

Upon arrival at each site, the sampling churn will be rinsed three times with distilled water. The goal of rinsing is ‘equipment decontamination – the removal from equipment, residues from construction and machining and the removal of substances adhering to equipment from previous exposure to environmental and other media’ (USGS Open File Report 00213). After rinsing with D.I. water, the churn will be rinsed three times with stream water. The churn is then fully submerged into the stream and filled to the lid with sample water. Completely filling the churn allows for all samples to be filled from one churn; thereby minimizing differences in water properties and quality between samples.

Proper use of the churn guarantees the water is well mixed before the sample is collected. The churn should be stirred at a uniform rate by raising or lowering the splitter at approximately 9 inches per second (Bel-Art Products, 1993). This mixing must continue while the bottles are being filled. If filling is stopped for some reason, the stirring rate must be resumed before the next sample is drawn from the churn. As the volume of water in the churn decreases, the round trip frequency increases as the velocity of the churn splitter remains the same. Care must be taken to avoid breaking the surface of the water as the splitter rises toward the top of the water in the churn.

Sample bottles and chemical preservatives used were provided by associated laboratories and were considered sterile prior to field usage. Sample bottles without chemical preservatives were rinsed with stream water from the churn 2-3 times before filling with sample water. In the case of bottles that contained chemical preservatives, bottles were not rinsed before sample collection and care was taken to avoid over-spillage that would result in chemical preservative loss. Collected samples will be placed in coolers on ice or dry ice for transport to contracted laboratories for analysis.

## QA/QC – Replicate bottle set

To ensure laboratory and sampling accuracy, one site every sampling period was randomly selected to receive one additional QA/QC bottle set. This bottle set contain replicate water samples. Replicate samples are obtained using the same process as regular samples. These are used to assure the laboratory maintains precision within results.

All bottle sets are then placed on ice and are transported to the associated laboratories. All grab samples were processed within 24 hours or within known laboratory holding periods.

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Lurry,D.L. and C.M. Kolbe. Interagency field manual for the collection of Water Quality Data. USGS Publication, Open File Report 00-213.