AVISTA CORPORATION

LAKE SPOKANE DISSOLVED OXYGEN
WATER QUALITY ATTAINMENT PLAN
2013 ANNUAL SUMMARY REPORT

WASHINGTON 401 CERTIFICATION
FERC LICENSE APPENDIX B, SECTION 5.6

SPOKANE RIVER HYDROELECTRIC PROJECT
FERC PROJECT NO. 2545

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March 20, 2014

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1.0 INTRODUCTION

The Washington Department of Ecology (Ecology) has determined that the dissolved oxygen (DO) levels in certain portions of the Spokane River and Lake Spokane do not meet Washington's water quality standards. Consequently, those portions of the river and lake are listed as impaired water bodies under Section 303d of the Clean Water Act. To address this, Ecology developed the Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load Water Quality Improvement Report (issued February 12, 2010).

Reduced DO levels are largely due to the discharge of nutrients into the Spokane River and Lake Spokane. Nutrients are discharged into the Spokane River and Lake Spokane by point sources, such as waste water treatment facilities and industrial facilities, and from non-point sources, such as tributaries, groundwater, and stormwater runoff, relating largely to land-use practices.

Avista Corporation (Avista) owns and operates the Spokane River Hydroelectric Project (Project), which consists of five dams on the Spokane River, including Long Lake Hydroelectric Development (HED) which creates Lake Spokane. Avista does not discharge nutrients into either the Spokane River or Lake Spokane. However, the impoundment creating Lake Spokane increases the residence time for water flowing down the Spokane River, and thereby influences the ability of nutrients contained in those waters to reduce DO levels.

Avista received a new, 50-year license for the Project from the Federal Energy Regulatory Commission (FERC) on June 18, 2009 (FERC 2009). The license incorporates a water quality certification (Certification) issued by Ecology under Section 401 of the Clean Water Act (Ecology 2009). As required by Section 5.6.C of the Certification, Avista submitted an Ecology-approved Lake Spokane Dissolved Oxygen Water Quality Attainment Plan (DO WQAP) to FERC on October 8, 2012. Avista began implementing the DO WQAP upon receiving FERC's December 19, 2012 approval.

DO WQAP

The DO WQAP addresses Avista's proportional level of responsibility as determined in the Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load (DO TMDL). It identified nine potentially reasonable and feasible measures to improve DO conditions in Lake Spokane, by reducing non-point source phosphorus loading into Lake Spokane. It also incorporated an implementation schedule to analyze, evaluate and implement such measures. In addition, it contains benchmarks and reporting sufficient for Ecology to track Avista's progress toward implementing the plan within the ten-year compliance period.

The DO WQAP included a prioritization of the nine reasonable and feasible mitigation measures based upon several criteria including, but not limited to, quantification of the phosphorus load reduction, DO response time, likelihood of success, practicality of implementation, longevity of load reduction, and assurance of obtaining credit. From highest to lowest priority, the following summarizes the results of the measure prioritization: reducing carp populations; managing aquatic weeds; acquiring, restoring, and enhancing wetlands; reducing phosphorus from Hangman Creek sediment loads; educating the public on improved septic system operations; reducing lawn area and providing native vegetation buffers; and converting grazing land to conservation or recreation use. One measure, which involved modifying the intake of an agricultural irrigation system, was removed from the list, as it was determined infeasible given it would likely create an adverse effect on crop production.

Based on preliminary evaluations, Avista proposed to focus its initial efforts on two measures: reducing carp populations and aquatic weed management, which were expected to have the greatest potential for phosphorus reduction.

As required by the DO WQAP, this report provides a summary of the 2013 baseline monitoring, implementation activities, effectiveness of the implementation activities, and proposed actions for 2014.

2.0 BASELINE MONITORING

Longitudinally, the lake can be classified as having three distinct zones which consist of a riverine, transition and lacustrine zone. Station LL5 is the most upstream station and is located within a riverine zone, Stations LL3 and LL4 are located in the transition zone, and Stations LL0 through LL2 are located in the lacustrine zone. **Figure 1** shows the locations of the six stations within Lake Spokane. Avista contracted with TetraTech to complete the baseline monitoring activities during 2013. Sample events were completed at the six lake stations, LL0 through LL5, during May through October.

Results of the monitoring are summarized in **Appendix A** (2013 Baseline Water Quality Monitoring Results, TetraTech 2014a) and include the water quality conditions in Lake Spokane as well as for its inflows and outflows, tables of water quality data collected for the DO WQAP, and a description of the general hydrologic and climatic conditions. Additionally, the report includes an analysis of the phytoplankton and zooplankton populations present during the 2013 sampling events. Highlights taken from the TetraTech Report are provided as follows.

- Weather conditions during 2013 varied slightly from the 30-year norms reported at the Spokane International Airport, with cooler than normal temperatures in the early spring, warmer than normal temperatures in May, July, August, and September, and below normal precipitation for most of the year. Peak flows in 2013 were significantly smaller than peak flows observed in previous years (2011 and 2012) and similar to peak flows observed in 2010. The annual mean daily flow during 2013 was 6,172 cubic feet per second (cfs).
- The residence time for the whole lake (June through October) was longer in 2013 (36.8 days) compared with the previous four years (2010-2012). By the first sampling event in June, mild stratification had developed at all stations, with the exception of LL4 and LL5. The water column did not stratify at LL4 until July, and LL5 experienced a brief stratification in July.
- While the extent and depth of the hypolimnion varied throughout the summer, for most of the sampling dates the hypolimnion depth ranged from about 10 to 20 meters (m) from the surface, being shallow in June and deepening later in the summer.
- The maximum temperature reached at the surface was 24°C in the limnetic zone and 25°C in the upper reservoir during July. Temperature was usually at or below 20°C at depths greater than 10 m in the limnetic zone.

- Conductivity varied from about 69 to 269 µ Siemens/cm (µS/cm) throughout the reservoir. Water with increased conductivity (150 µS/cm), comprised the interflow zone that extended from about 4 to 12 m at stations LL3, LL2, and LL1. The interflow was more distinct during late August and September, with conductivity exceeding 250 µS/cm at LL5, plunging to below 5 m at LL4, below 10 m at LL2, and between 10 and 25 m at LL1 and LL0. Much of the metalimnion in the lower reservoir is composed of a mixture of river inflow and bottom water from the transition zone that plunges to depths that approximate the density of that mixture.
- The water column profiles for pH showed a range of 6.6 to 9.1 at the six stations during 2013 with the highest pH values occurred during July, August, and September due to photosynthetic activity of phytoplankton.
- Maximum DO concentrations ranged from 11.6 to 13.4 milligrams per liter (mg/L) at the six stations, with higher values occurring in the lacustrine zone. Average water column DO ranged from 8.0 to 10.1 mg/L. Minimum DO concentrations of 0.0 to 0.9 mg/L occurred near the bottom at the two deepest stations, LLO (~154 ft) and LL1 (~108 ft), most likely due to sediment demand. These minimum DO concentrations were the lowest observed of the four years sampled (2010-2013), most likely reflecting that 2013 was the lowest inflow year.
- Total phosphorus (TP) concentrations ranged from 3.9 to 67 micrograms per liter (µg/L) during 2013. Soluble reactive phosphorus (SRP) concentrations ranged from non-detect (1.0 µg/L) to 27 µg/L. TP and SRP were usually highest at stations LL0, LL1, and LL2 in the hypolimnion (15 m and deeper) with higher levels starting in July. Volume-weighted water column TP concentrations for all stations were below 25 µg/L and for most of the period were below 20 µg/L.
- Total nitrogen (TN) concentrations at all six stations ranged from 281 to 1,873 µg/L over the monitoring period, with most of the TN consisting of nitrate+nitrite.
- Chlorophyll (chl) concentrations at the six stations ranged from 0.8 to 19.2 µg/L in 2013. Maximums at most sites were higher than in 2012. Chl was often highest at the 5 m depth, which was the case in 2012. Transparency ranged from 2.0 to 7.7 m throughout the reservoir during 2013.
- The composition of the phytoplankton taxa showed diatoms (*Chrysophyta*) to be dominant at the deep stations, based on both cell counts and biovolume with green algae (*Chlorophyta*) becoming more abundant at the two up reservoir sites (LL4 and LL5) during mid-summer. Cyanobacteria (blue-green algae) were not strongly represented at any site during 2013. This pattern is in marked contrast to 2012 when diatoms dominated during the spring at all sites, but cyanobacteria dominated cell counts at all sites in late summer, and green algae represented the greatest biovolume. The maximum counts and biomass of diatoms were 2-4 times greater during 2013 than 2012. The difference in taxa compositions between the years may be due to the longer residence times experienced in 2013 as compared to 2012.

Measures of Improvement

TetraTech, on behalf of Avista, used several standard limnological approaches to measure the lakes DO improvement over time. These approaches included comparing the minimum volume-weighted hypolimnetic DO over time, determining the lakes current trophic state index, and completing a habitat evaluation for rainbow trout. Results of these analyses are discussed in Attachment A, and are summarized below.

- The minimum volume-weighted hypolimnetic DO has substantially increased since 1977. In 1978, the City of Spokane's wastewater treatment plant implemented an 85% reduction in point-source TP in their discharge water. Prior to the TP reduction, minimum volume-weighted hypolimnetic DO ranged from 0.2 to 3.4 mg/L (1972 – 1977). Following the TP reduction, minimum volume-weighted hypolimnetic DO ranged from 2.1 to 4.9 mg/L (1978 – 1985). The current (2010 – 2013) minimum volume-weighted hypolimnetic DO ranged from 5.9 to 7.8 mg/L. This gradual, long-term increase in minimum DO may be due to a slow decline in DO demand of the bottom sediment and suggests an incredible recovery from pre-1977 conditions.

- The lakes tropic state, a general measure of biological production (utilizing concentrations of TP, chlorophyll, water clarity, etc.) is near borderline oligotrophic-mesotrophic for Lake Spokane, with the exception of the TP concentrations in the transition and riverine zones. The trophic state of the lake is an important index to measure, especially when evaluating the lake's habitat. A eutrophic state indicates high biological production within the lake, an oligotrophic state indicates low biological production, and mesotrophic is a state between the two. Given Lake Spokane measures at oligotrophic-mesotrophic at stations LL0 through LL3, further DO improvement could push Lake Spokane into an oligotrophic category. By limiting biological production in the lake it is possible that food sources for the current fish population, as well for future stocked fish could also be limited.

- An analysis of Lake Spokane's aquatic habitat specific to Washington's designated aquatic life use, core summer salmonid habitat was completed by TetraTech. TetraTech used a critical maximum temperature (18°C) and a minimum DO (6 mg/L) to compute the percent volume acceptable for growth for rainbow trout at the six stations for a high-flow year (2011) and a low-flow year (2013) (TetraTech 2014, Figures 95-106). Using this criteria, the results of the analysis indicated that trout would probably avoid the epilimnion during most of the summer due to temperature that approaches 25°C and prefer to seek cooler water deeper than 10 m. However, between 10 and 20 m, DO was usually near or above 6 mg/L during August and September, but never less than the often cited required minimum of 5 mg/L. These data suggest that rainbow trout are not severely limited by DO and are most likely inhabiting cooler water in metalimnion and upper portions of the hypolimnion. Additionally, the habitat volumes for temperature and DO together, as well as separately, were shown to indicate which factor was most limiting. TetraTech Figures 95-106 show that habitat was more restrictive during the low-flow year (2013) than the high-flow year (2011). Also, temperature restricts habitat far more than DO for this species and at all sites. Habitat for DO showed some restriction at LL0 during the very low-flow year, 2013, but very little restriction at other sites or years.

Monitoring Recommendations

Monitoring recommendations for 2014 include collecting additional phytoplankton samples at stations LL0 – LL2 at 5, 10, and 15 meter depths and at a 5 meter depth at LL3. This will allow further evaluation of the phytoplankton community composition and dynamics in the reservoir. Given this is a modification to the current QAPP a Revised QAPP was drafted and is included for Ecology's review and approval as **Appendix B** (Quality Assurance Project Plan for Lake Spokane Baseline Nutrient Monitoring, TetraTech 2014b). The Revised QAPP is very similar to the 2010 Lake Spokane Nutrient Monitoring QAPP (Publication No. 10-03-120), however includes the Addendum modifications approved by Ecology in 2012, along with the additional sampling depths. It also provides flexibility to include additional sampling depths in the future, should it be deemed useful in better understanding the lakes dynamics.

3.0 IMPLEMENTATION ACTIVITIES

3.1 Studies

Based on preliminary evaluations, Avista focused its initial efforts on two measures: reducing carp populations and aquatic weed management, which were identified as having a high potential for phosphorus reduction. Work done to date on these two studies is summarized below.

3.1.1 Carp Population Reduction Program

In order to investigate whether a carp population reduction program would improve water quality in Lake Spokane, in 2013 Avista selected Golder Associates (Golder) to assist in conducting the Lake Spokane Carp Population Abundance and Distribution Study. This purpose of the study is to better understand population abundance, distribution, and habitat use of carp, as well as to help define a carp population reduction program, that may benefit Lake Spokane water quality.

Per the schedule identified in the Carp Population Study Plan (Appendix C of the DO WQAP), activities that were conducted in 2013 under the Phase I Analysis included: quantifying carp abundance; investigating biological measures; identifying seasonal behavior, and testing-whole body phosphorus concentrations. This schedule was slightly modified based upon input we received during the contracting process, which indicated that quantifying carp abundance and investigating the biological measures would be better completed during the spring spawning season, not during the summer, as originally proposed and approved in the DO WQAP. As such, after consulting with Ecology and FERC regarding the schedule modification, it was determined the quantification of carp abundance and investigation of biological measures, along with testing the carp's phosphorus concentrations, would begin in the spring of 2014. In addition, while we had originally scheduled to identify the carps' seasonal behavior during the summer, this activity instead began during the fall of 2013.

The seasonal behavior identification work conducted in 2013 is summarized in the Lake Spokane Carp Population Abundance and Distribution Study 2013 Annual Report completed by Golder and attached as **Appendix C**. This report summarizes the capture and tagging of 20 carp in Lake Spokane, along with the tracking methods and results through December 2013. This report also summarizes the activities which will be conducted in 2014, which consist of both Phase I and Phase II Analyses as identified in Appendix C of the DO WQAP.

In compliance with our overall schedule, we anticipate presenting the findings of both the Phase I and Phase II Analyses to Ecology and FERC in the 2014 Annual Summary Report.

3.1.2 Aquatic Weed Management

There are approximately 940 acres of aquatic plants present in Lake Spokane, of which 315 acres consist of the non-native yellow floating heart and fragrant water lily (AquaTechnex 2012). Avista evaluated whether harvesting of these aquatic weeds, prior to their senescence, could prevent a substantial load of phosphorus from being released back into the water column, as well as prevent the reduction of dissolved oxygen through the decomposition of these weeds. In order to evaluate this, Avista contracted TetraTech to complete a Phase I Analysis, which: 1) assessed whether harvesting would be a reasonable and feasible activity to perform in Lake Spokane; 2) refined TP concentrations of relevant weed species in Lake Spokane; and 3) quantified TP load reductions associated with selected control methods. Results of the Phase I Analysis and Nutrient Reduction Evaluation are summarized below, with a more thorough discussion provided in the Feasibility of Lake Phosphorus Reduction by Aquatic Plant Removal in Lake Spokane (TetraTech 2014c), attached as **Appendix D**.

Phase I Analysis

As part of the Phase I Analysis, Avista evaluated the following variables in order to determine whether aquatic weed harvesting is a reasonable and feasible control method to reduce phosphorus in Lake Spokane.

Availability and operational requirements of an appropriate harvester

Rental of harvesters is not a viable option due to the uncertain availability of a limited number of machines in the Pacific Northwest. Thus, purchase of a harvester would be necessary to meet the desired time frame for plant removal. A harvester sized to complete this type of weed control would cost around $180,000 to $200,000 with an annual operating cost of approximately $100,000, depending upon disposal and distance to haul harvested plants. Operational costs for harvesting plants in Green Lake (Seattle, WA) over multiple years averaged $100,000 annually which included labor, transport, disposal, and all operational expenses for one harvester. Green Lake is used as a comparison as it has a similar acreage (259 acres), compared to the harvestable acreage present in Lake Spokane (290 acres).

A harvester would require at least one support boat to transfer the harvested weeds to the shore along with associated trailers to haul the harvester and support boat. Cut plants have to be removed from the lake and shoreline daily in order to minimize phosphorus loss from the plant to the lake. Assuming harvest of all the potential harvestable area in the six areas in Lake Spokane (290 acres, Table 7, TetraTech 2014c), total removal of 180 kg TP and operational costs stated above; cost per kg of TP would be between $556 and $1,112 on an annual basis.

Efficiency of harvester, given Lake Spokane's boat access limitations

The amount of time it takes to transfer the cut plants to the shore, limits the harvest efficiency rate. A large harvester has an approximate 10 foot wide cutting swath, and can cover on average 0.5 to 1.5 acres/hour. The amount of material cut by a harvester is about 20 cubic yards per day (1 truck load). That amounts to 3 to 4 off-loads of the harvester per day.

The areas which would be targeting the yellow floating heart and waterlily are dispersed in six areas throughout the lake (**Figure 1**). This would slow the efficiency of the harvester by increasing the amount of time it would take to unload the harvested plants to the shore at an appropriate distance, so that TP wouldn't leach back into the lake.

Effective harvest depth of yellow floating heart and water lily

Harvesting depths that can be achieved under standard operation are between 2 and 5 feet. Special modifications to harvesters can be made to allow harvest depth to a maximum of 6 feet but these harvesters have proven to be unstable where there is a potential for any wind and wave activity. Harvesters with these types of modifications would not be applicable for use in Lake Spokane.

A total of six sections (**Figure 2**) within Lake Spokane were identified as having extensive aquatic vegetation present on an annual basis. In order to determine the total potential harvestable acreage for these six areas, the 2012 Lake Spokane Aquatic Weed Survey (AquaTechnex) and the 2009 Lake Spokane Bathymetry (Northwest Hydro) were overlaid in a GIS analysis. Based upon the effective harvest depth of a harvester, and the amount of aquatic vegetation present within this depth, it appears 179 acres (out of the 315 acres surveyed in 2012) would be potentially harvestable acreage for the six sections, specific to harvesting yellow-floating heart and waterlily. A total of 290 acres (out of the 940 acres surveyed in 2012) would be potentially harvestable if yellow floating-heart, waterlily, Eurasian watermilfoil, and native species (pondweeds, elodea, and coontail) were considered.

Impacts to fish and aquatic invertebrates

Species of concern in Lake Spokane, as reported by the Washington Department of Fish and Wildlife (WDFW) Priority Species Habitat website, include rainbow trout and the western grebe. Given harvesting would be targeted for when the plants are dying in late summer and early fall, we do not anticipated an impact on trout as the reported effects of harvesting on fish are for warm water fish only, and the fact that trout are unlikely to frequent macrophyte beds in the late summer when temperatures reach 24 to 25 °C. As for western grebes, a recent 2013 WDFW survey indicated these birds nest in at least two of the six macrophtye bed sections (Granger Property and McLellan Conservation Property) and have been observed in at least two of the other macrophyte bed sections (Felton Slough and Sportsman's Paradise) within Lake Spokane (Personal Communication, Howard Ferguson, 1/21/14). As such, any harvesting conducted would have to take place following the typical nesting season which extends through August in Lake Spokane.

Besides potential impacts to the western grebe, dependent upon their nesting activities, the most significant impact of harvesting could be on the food base for invertebrates, fish and waterfowl.

Locations and limitations for disposal of harvested weeds

Of the six sections identified by Avista as having extensive aquatic vegetation present on an annual basis, five are located in the upper portion of the reservoir and one is located in the lower portion of Lake Spokane, downstream of the Lake Spokane (DNR) Campground. It appears that it would be cost-effective to transfer the harvested weeds out of the lake to land adjacent to the macrophyte bed, with enough of a buffer so that TP can't leach back into the water. This is a potential option for weeds harvested from section one as this section is adjacent to Avista-owned land.

The remaining sections (two through six) are either located in areas where the adjacent land is highly developed and/or the land owner would most likely not allow harvested weeds on their property. Given these five sections are within close proximity to either a public or community boat access location it is possible that they could be hauled to an off-site location (i.e. farm, compost facility, etc.).

Potential for nutrient pumping

According to observations by Moore et al. (1984), there is a high likelihood of nutrient pumping occurring as a result of harvesting aquatic plants. This is due to an increase in the transfer of phosphorus from the sediment via the remaining plant stems. Phosphorus leakage occurs until the cut plant stems are sealed (Moore et al. 1984). If this process were factored in, the potential phosphorus removed would be less due to increased internal loading from the remaining cut plant stems.

Nutrient Reduction Evaluation

Avista completed a Nutrient Reduction Evaluation to refine the TP concentrations of relevant aquatic weed species in Lake Spokane as well as to quantify TP load reduction associated with selected control methods. Results of this analysis are summarized below and more thoroughly discussed in **Appendix D.**

Refinement of TP Concentration Data for Relevant Weed Species

TetraTech collected six plant species in Lake Spokane, including Eurasian water-milfoil, yellow floating-heart, waterlily, pondweeds, common waterweed, and coontail. Three samples of each species were collected by cutting off the top 1-2 feet. The results of the TP analysis are summarized in Table 1 and indicate that the average TP content by dry weight (%) was very similar to those estimated in the DO WQAP, with the exception of yellow floating-heart and waterlily. Yellow floating-heart's TP content was less at 0.39% as compared with 0.684% which was estimated in the DO WQAP and the TP content of waterlily was higher at 0.34% than what was estimated in the DO WQAP, 0.27%. Two additional species sampled during the summer of 2013, common waterweed and coontail, could not be compared as their TP content by dry weight was not estimated in the DO WQAP.

Table 1: TP Concentrations of relevant Lake Spokane weed species sampled in 2013 and compared with the concentrations estimated in the DO WQAP.

Species	DO WQAP Estimated TP Content by Dry Weight (%)	2013 Sampled TP Content by Dry Weight (%)
Eurasian water-milfoil	0.21	0.22
Yellow floating-heart	0.684	0.39
Waterlily	0.27	0.34
Pondweeds	0.24	0.23
Common waterweed	Not Estimated in DO WQAP	0.19
Coontail	Not Estimated in DO WQAP	0.43

Quantification of TP Load Reduction for Selected Control Methods

Through the implementation of its Lake Spokane and Nine Mile Reservoir Aquatic Weed Management Program, Avista currently utilizes several methods to control invasive aquatic weeds within Lake Spokane. On an annual basis, these methods include a winter drawdown (dependent upon weather, energy demand, and operating conditions), herbicide application of up to 15 acres at public and community lake access sites, and removal by divers of up to 1 acre.

Upon further evaluation of each control method, it appears the quantification of the TP load for each of these control methods is difficult for the following reasons as described per control method.

The winter drawdown does not necessarily remove a certain quantity of invasive aquatic weeds in the years it is attempted, instead it attempts to stunt aquatic plant species preventing them from growing by freezing the soil for a two to three week time-period. Since receiving the Spokane River License in 2009, Avista has attempted a winter drawdown since 2010. Out of this timeframe, one successful drawdown was completed in 2012 for a period of 57 days, with a water elevation ranging from 11.16 to 13.90 feet below the normal full pool elevation. Given Avista anticipates achieving a successful drawdown once every four years, at this point in time there is not sufficient data to calculate a certain TP load reduction as a result of the winter drawdown.

With regard to the herbicide application, it should be noted that Avista does not target a specific weed species. Instead it targets a specific public and/or community lake access site designated each year, which can include up to 14 different plant species, having different TP concentrations. Given the variety of phosphorus content of the weed species in the small acreage that was treated (15 acres) and because the weeds are left in the lake to decompose we expect the amount of TP removed from the lake to be negligible. Avista is unable to provide an accurate TP load reduction of the herbicide application completed in Lake Spokane for the reasons stated above.

For the same reason, the small acreage (up to 1 acre) of plants that are pulled by divers is too small to calculate any real TP load reduction from the lake.

Recommendations

The total potential harvestable area in Lake Spokane, taking into account the effective harvest depth and plant coverage within that depth, is 290 acres. The average plant density for a typical plant community in Lake Spokane is 53 g/m^2, dry weight. By applying the average TP content of a plant community (including yellow floating-heart, waterlily, milfoil, pondweed, elodea, and coontail) to the plant density, TetraTech computed that the total amount of TP removed by harvesting in these 290 acres would be 180 kg, or 6 kg/day assuming a 30 day window for harvesting at senescence. The estimated removal rate of about 6 kg/day over 30 days is significantly less than the possible range reported in the DO WQAP.

The DO WQAP reported a TP reduction potential of 481-3,852 kg/yr or 16-128 kg/day if removed over a period of 30 days assumed here. The discrepancy is due largely to the assumption of a range in dry weight biomass of 50 to 400 g/m^2 , and that yellow floating heart phosphorus content was 0.68%. The harvestable biomass determined in Lake Spokane averaged only 53 g/m^2, the low end of the range cited in the DO WQAP, and yellow floating heart phosphorus content was less at 0.39%. Also, the lower projected effect of harvesting was partly due to the estimate of less total area covered by macrophytes and only a portion of that within the harvestable range of 290 acres in 2013.

Given Lake Spokane has about 10% of its area covered with macrophytes, and only a fraction of that area within the operational limits of harvesting (approximately 5 feet in depth), in addition to the relatively short water residence time (whole lake average) during summer (24 days in June-October, 2010-2013), the chance for a detectable effect on lake TP from harvest removal of plants is small. TetraTech computed the 180 kg of TP that could be removed by harvesting represents only 2.5% of the total loading to the lake.

Based upon these results, Avista does not recommend harvesting macrophytes in Lake Spokane at senescence, as a reasonable and feasible mitigation measure to reduce TP in Lake Spokane. However it will continue to implement the control methods (winter drawdown, herbicide application of up to 15 acres at public and community lake access sites, and removal by divers of up to 1 acre) currently utilized to control invasive aquatic weeds within Lake Spokane.

3.2 Implementation Measures

The following section highlights measures which Avista implemented, or assisted in the implementation in order to reduce phosphorus loading and improve DO concentrations in Lake Spokane.

3.2.1 Wetlands

Avista has acquired a 109 acre parcel on the Little Spokane River, the Sacheen Springs property, to fulfill its 42.51 acre wetland mitigation requirement identified in Section 5.3.G of the Certification. This 109 acre property contains over one-half mile of frontage along the West Branch of the Little Spokane River and is located within the Little Spokane River Watershed in Pend Oreille County. This property contains a highly valuable wetland complex with approximately 59 acres of emergent, scrub-shrub and forested wetlands and approximately 50 acres of adjacent upland forested buffer. Several seeps, springs, perennial and annual creeks are also found on the property. Avista believes that the benefits from preserving and/or protecting these high value wetlands and associated uplands from future development, logging, etc. is an excellent opportunity to fulfill its wetland obligations identified in the Certification. The property was purchased “in fee” and Avista will pursue a conservation easement in order to protect the property in perpetuity. Avista is in the process of developing a detailed site-specific wetland management plan for the property.

In addition, Avista and the Coeur d’Alene Tribe have acquired approximately 656 acres on upper Hangman Creek, within the southern portion of the Coeur d’Alene Tribe Reservation in Benewah County, Idaho approximately 10 miles east of the Washington-Idaho Stateline. Site-specific wetland management plans are currently being developed for these properties and include establishing long-term, self sustaining native emergent, scrub-shrub and/or forested wetlands, riparian habitat and associated uplands, through preservation, restoration and enhancement activities. These properties were all in agricultural use, including straightened creek beds prior to the acquisition. Given Hangman Creek is a significant contributor of sediment and associated phosphorus loading to the Spokane River, Avista anticipates a TP load reduction from the wetland mitigation work.

3.2.2 Land Protection

Avista has identified approximately 215 acres of land that is currently used for grazing under lease from Washington State Department of Natural Resources (DNR). This land is located within the south half of Section 16 in Township 27 North, Rand 40 E.W. M. in Stevens County. In 2013 Avista began pursuing leasing the 215 acres of land from DNR with the intent of placing the land in conservation use, and thereby eliminating grazing activities for the term of its License. Avista will continue pursuing this mitigation measure during 2014.

In addition, Avista owns several parcels of land, totaling 350 acres, which are located at the within 200 feet of the Lake Spokane shoreline in Spokane, Stevens, and Lincoln counties at the downstream end of the reservoir. During 2013 Avista continued to protect this area and will pursue identifying the potential TP load that could be avoided by maintaining a 200-foot buffer along the Avista-owned lake shoreline. Avista will pursue the quantification of this activity along the wetland/restoration enhancements as the 200-foot buffer should create similar sediment-filtering effects.

3.2.3 Bulkhead Removal

During 2012, Avista partnered with Ecology, the Spokane County Conservation District, the Stevens County Conservation District through an Ecology grant to identify two to five homeowners and encourage them to change to more naturalized shorelines. Progress to date includes the removal of an approximate 90 foot bulkhead located at the Staggs parcel in Spokane County. Through the Ecology grant, the bulkhead was replaced with a more naturalized shoreline. A time-lapse video produced by the Staggs features the bulkhead removal project is available for viewing at the following website: http://www.youtube.com/watch?v=luT0RZShJoY.

In addition, a design for an additional bulkhead removal project on an Avista-owned shoreline parcel was initiated during 2013.

3.2.4 Native Tree Planting

Avista and the Stevens County Conservation District planted 300 trees composed of native cottonwoods and willows along Lake Spokane's northern shoreline on Avista-owned property in April 2013. The tree planting was completed as part of the Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan. Once mature the trees will help reduce water temperature and improve habitat along the lake shoreline. Given, one of the areas planted consists of a very steep sandy slope, the trees should help reduce any natural sloughing of sediment, which may contain TP, into the river.

3.2.5 Education

Avista participated with others to support passage of a Washington law[1], effective January 2013, limiting the use of phosphorus (except for certain circumstances) in residential lawn fertilizers, which includes those adjacent to Lake Spokane in Spokane, Stevens, and Lincoln counties. Although the new law legally restricts use of fertilizer containing phosphorus, homeowner education will be important in actually reducing phosphorus loads to the lake.

During 2013, Avista participated with Ecology, the Stevens County Conservation District, and the Lake Spokane Association in working on public education documents to send to Lake Spokane shoreline owners regarding best management practices around the lake, including but not limited to, the benefits of natural shorelines with native vegetation buffers, proper disposal of lawn clippings and pet waste, use of phosphorus-free fertilizers, and regularly maintaining septic systems.

[1] Engrossed Substitute House Bill 1489, Water Quality – Fertilizer Restrictions, Approved by Governor Christine Gregoire April 14, 2011 with the exception of Section 4 which is vetoed. Effective Date January 1, 2013.

In addition, during 2013 Avista managed a booth at the Northern Idaho/Eastern Washington Annual Lakes Conference to provide education materials for lakeshore owners and community members.

Avista actively participates with the Lake Spokane Association and features articles regarding best management practices for shoreline homeowners in its quarterly Spokane River Newsletter which is distributed electronically to the Lake Spokane shoreline homeowners.

4.0 EFFECTIVENESS OF IMPLEMENTATION ACTIVITIES

Quantification of the implementation activities including wetlands, land protection, and bulkhead removal are in progress as described for each of these activities below.

- **Wetlands**
  Given Avista is still developing site-specific wetland management plans for the Sacheen Springs and Hangman Creek properties, along with the lack of trading ratios associated with the DO TMDL, Avista is currently unable to quantify a TP load reduction for these properties. Avista will more thoroughly evaluate TP reduction following the completion of the site-specific wetland management plans.

- **Land Protection**
  Avista will continue pursuing leasing the 215 acres of land from DNR with the intent of placing the land in conservation use, thereby eliminating grazing activities adjacent to the lake. Once this has been completed, Avista will provide a quantification of the estimated TP loading removed from eliminating the grazing activities.

  In addition, Avista owns several parcels of land, totaling 350 acres, which are located at the within 200 feet of the Lake Spokane shoreline in Spokane, Stevens, and Lincoln counties at the downstream end of the reservoir. During 2013 Avista continued to protect this area and will pursue identifying the potential TP load that could be avoided by maintaining a 200-foot buffer along the Avista-owned lake shoreline.

  Avista will pursue the quantification TP load reduction of the 200-foot buffer of the Avista owned Lake Spokane shoreline in the downstream portion of the reservoir along with the quantification of TP load reduction from the wetland/restoration enhancements as these two activities should create similar sediment-filtering effects.

- **Carp**
  Based upon the findings of the Lake Spokane Carp Population Abundance and Distribution Study, if a carp population reduction program is implemented Avista will quantify the associated TP reduction in Lake Spokane.

5.0 PROPOSED ACTIVITIES FOR 2014

The following activities are proposed for implementation in 2014.

- **Carp**

  Avista will continue to evaluate the potential carp population reduction measure, with final results of whether this measure if reasonable and feasible included in the 2014 Annual Summary Report.

- **Habitat Evaluation**

  Avista will meet with Ecology and the Washington Department of Fish and Wildlife (WDFW) to evaluate what we have learned and how to proceed.

  In addition, Avista is required by the License to stock 155,000 triploid rainbow trout (approximately six inches in length) in Lake Spokane. As part of the stocking requirement Avista and WDFW will complete a survey to evaluate the success of the stocking program within ten years of the initial stocking activities. We anticipate using the results from the survey to provide information regarding suitable habitat in Lake Spokane to support salmonids.

- **Wetlands**

  Develop site-specific wetland managment plans for the Sacheen Springs and Hangman Creek properties.

- **Land Protection**

  Continue to pursue the 215 acre lease of land from DNR with the intent of placing the land in conservation use, thereby eliminating grazing activities adjacent to the lake. Avista will also continue to protect the 200-foot buffer of Avista-owned shoreline located in the lower portion of the reservoir.

- **Bulkhead Removal**

  During 2014, Avista will work with the Stevens County Conservation District in design and permitting phase for an additional bulkhead removal project along an approximately 90 feet of Avista-owned shoreline parcel.

- **Education**

  Avista will continue to participle with Ecology, the Lake Spokane Association, the Stevens County Conservation District, and others to inform shoreline homeowners of best management practices they can implement to help protect the lake.

6.0 SCHEDULE

The implementation schedule, as presented in **Figure 3**, incorporates several benchmarks and decision points important in implementing the DO WQAP. Benchmarks and important milestones completed to date, and extending into 2015 include the following.

2012

- Prepared the DO WQAP, which identified nine potentially reasonable and feasible measures to improve DO conditions in Lake Spokane. Approval of the DO WQAP was obtained from Ecology on September 27, 2012 and from FERC on December 19, 2012.

2013 (Year 1)

- Conducted the baseline nutrient monitoring in Lake Spokane (May through October).
- Conducted the Aquatic Weed Management Phase I Analysis and Nutrient Reduction Evaluation.
- Initiated the Lake Spokane Carp Population Abundance and Distribution Study.
- Planted 300 trees on Lake Spokane.
- Assisted with a bulkhead removal on the Staggs parcel and began designing the bulkhead removal for the second property on Lake Spokane.
- Protected approximately 16-miles of Avista-owned shoreline.
- Acquired 109-acres of wetland property in the Little Spokane Watershed and 656-acres in the upper Hangman Creek Watershed.
- Continued education activities targeted at Lake Spokane shoreline homeowners.

2014 (Year 2)

- Prepared the 2013 DO WQAP Annual Summary Report and will submit to Ecology and FERC by February 1 and April 1, respectively.
- Will conduct baseline nutrient monitoring in Lake Spokane (May through October).
- Will continue to conduct the Lake Spokane Carp Population Abundance and Distribution Study and will provide a recommendation in the 2014 Annual Summary Report as to whether this measure is reasonable and feasible to implement in Lake Spokane.
- Will complete other mitigation measures as proposed in previous years Annual Summary Report.
- Will begin preparing the 2014 DO WQAP Annual Summary Report.

2015 (Year 3)

- Will submit the 2014 DO WQAP Annual Summary Report to Ecology and FERC by February 1 and April 1, respectively.
- Will conduct the baseline nutrient monitoring in Lake Spokane (May through October).
- Will complete other mitigation measures as proposed in previous years Annual Summary Report.
- Will begin preparing the 2015 DO WQAP Annual Summary Report.

7.0 REFERENCES

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TetraTech. 2014b. Quality Assurance Project Plan for Lake Spokane Baseline Nutrient Monitoring. January 2014.

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FIGURES

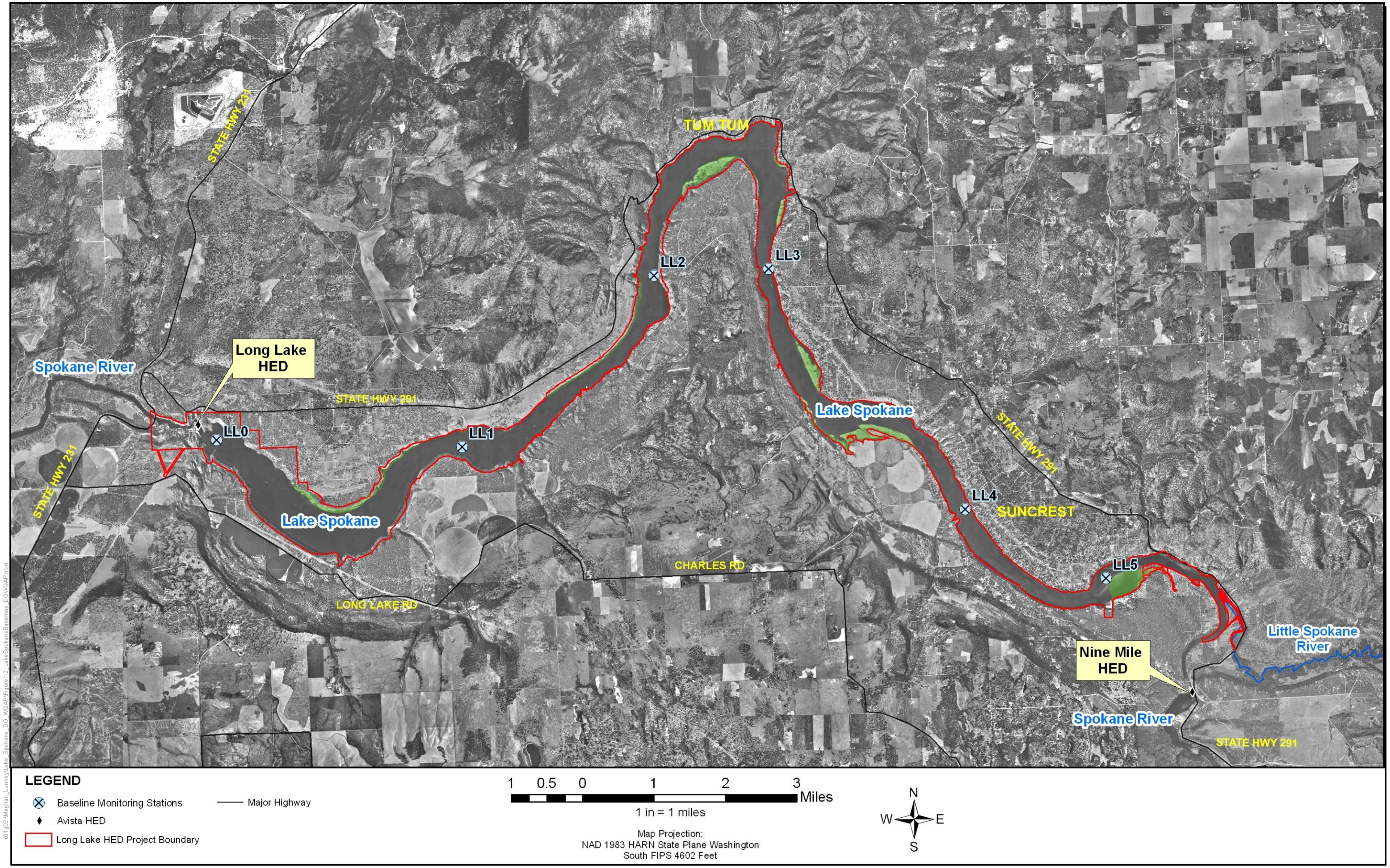

Figure 1. Lake Spokane Baseline Monitoring Stations

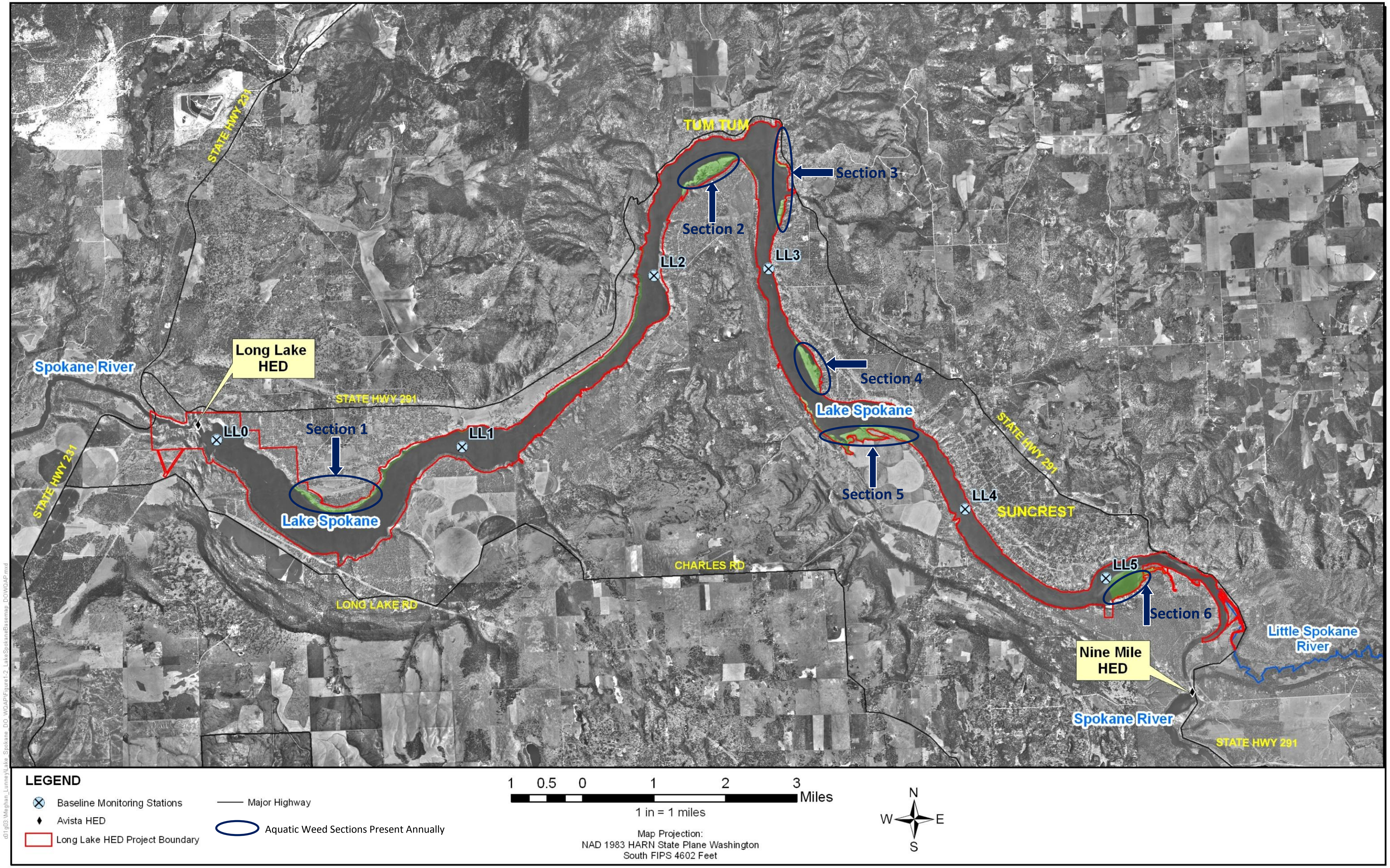

Figure 2. Lake Spokane Extensive Aquatic Weed Sections Present Annually

		Implementation Year[1]																																											
		2012				Year 1 2013				Year 2 2014				Year 3 2015				Year 4 2016				Year 5 2017				Year 6 2018				Year 7 2019				Year 8 2020				Year 9 2021				Year 10 2022			
	Activity	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
DO WQAP Submittal	Submit DO WQAP to Ecology		x																																										
	Receive approval from Ecology*			x																																									
	Submit DO WQAP to FERC*			x																																									
	Receive approval from FERC*				x																																								
Carp	Phase I Analysis: Identify location and population of carp							x	x	x	x	x																																	
	Summarize Phase I findings [2]*									x				x																															
	Phase II Analysis: Evaluate harvest technology									x	x	x	x																																
	Select carp removal method(s)												x																																
	Summarize Phase II findings[2] , consult and discuss with Ecology													x																															
	Determine with Ecology whether carp population reduction is reasonable and feasible to implement in Lake Spokane*														x																														
	If determined reasonable and feasible, implement measure; if not, revise implementation strategy, monitoring, and schedule*															x	x	x	x	x	x																								
	If implemented, monitor for nutrient reductions															x	x			x	x			x	x			x	x			x	x			x	x			x	x				
Aquatic Weed Management	Phase I Analysis: Evaluate feasibility of mechanical harvesting						x	x	x																																				
	Nutrient reduction evaluation							x	x																																				
	Summarize findings[2] , consult and discuss with Ecology*									x																																			
	Determine with Ecology whether aquatic weed harvesting is reasonable and feasible to implement in Lake Spokane*										x																																		
	If determined reasonable and feasible, implement measure; if not, revise implementation strategy, monitoring, and schedule*											x	x			x	x			x	x			x	x			x	x			x	x			x	x			x	x				
	If implemented, monitor for nutrient reductions											x	x			x	x			x	x			x	x			x	x			x	x			x	x			x	x				
	Implement yearly aquatic weed controls through separate program[3]											x	x			x	x			x	x			x	x			x	x			x	x			x	x			x	x				
Other Measures	Evaluate & implement additional measures, as appropriate																					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				
Monitoring & Modeling	Baseline Monitoring[4]		x	x	x		x	x	x		x	x	x		x	x	x		x	x	x																								
	Ongoing Habitat Analysis[5]										x	x			x	x			x	x			x	x			x	x			x	x			x	x			x	x					
	Site Specific Nutrient Reduction Analysis[6]																																												
	CE-QUAL Modeling																				x	x											x	x						x	x	x			
Compliance Reporting	DO WQAP Annual Summary Report*									x				x				x								x				x								x							
	Five, Eight, and Ten-Year Reports*																					x												x								x			

Notes:

(1) = Implementation Year dependent upon date of FERC approval.

(2) = Findings would be summarized in the DO WQAP Annual Summary/Report, which will be submitted to Ecology for review and approval.

(3) = Annual aquatic weed control activities implemented under the Lake Spokane and Nine Mile Reservoir Aquatic Weed Management Program.

(4) = Avista and Ecology will re-evaluate baseline nutrient monitoring program following the completeing of the 2016 season.

(5) = Ongoing in nature with periodic reporting to Ecology.

(6) = Dependent upon outcome of carp population reduction and aquatic weed management phased analyses.

Figure 3. DO WQAP Implementation Schedule (Figure 3-3, DO WQAP)

APPENDICES

APPENDIX A

2013 Baseline Water Quality Monitoring Results (TetraTech 2014a)

LAKE SPOKANE ANNUAL SUMMARY REPORT

2013 Baseline Water Quality Monitoring Results

Prepared for

AVISTA

SPOKANE, WASHINGTON

PREPARED BY:

Tetra Tech, Inc.

316 W. Boone Avenue, Suite 363
Spokane, WA 99201

January 2014

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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
µS/cm	micro Siemens per centimeter
AHOD	areal hypolimnetic oxygen deficit
Avista	Avista Utilities
chl	chlorophyll a
DNR	Department of Natural Resources
DO	dissolved oxygen
Ecology	Washington Department of Ecology
EWU	Eastern Washington University
HED	Hydroelectric Development
N	nitrogen
N+P	nitrogen plus phosphorus
ND	non-detect
NO_3+NO_2	Nitrate+nitrite
P	phosphorus
QAPP	Quality Assurance Project Plan
RM	river mile
SRP	soluble reactive phosphorus
TMDL	total maximum daily load
TN	total nitrogen or total persulfate nitrogen
TN:TP	total nitrogen to total phosphorus ratio
TP	total phosphorus
TSI	trophic state index

1. INTRODUCTION

Water quality problems in Lake Spokane due to eutrophication have been investigated on several occasions since the 1960s. Studies by the Washington Department of Ecology (Ecology) and Eastern Washington University (EWU) provided much of the background data for a waste allocation analysis by Harper-Owes in the 1980s (Patmont 1987). The EWU studies defined the extent of algal blooms and hypolimnetic anoxia, which led to phosphorus removal (85%) from the City of Spokane wastewater starting in 1977. That phosphorus removal greatly improved water quality in the reservoir. During the 1970s to 1980s, the EWU group, headed by Dr. R.A. Soltero, produced 14 reports documenting water quality problems before and after wastewater phosphorus removal. This work showed the direct links between phosphorus input and algal blooms on the one hand, and the effect of that algal production on reservoir dissolved oxygen (DO) on the other (Soltero et al. 1982).

The degree of water quality improvement that occurred in the past is important to recognize in assessing the reservoir's water quality today. For example, chlorophyll a (chl) decreased from an average of 20.5 micrograms per liter (µg/L) before phosphorus removal (5 years of data) to 11.1 µg/L after (7 years of data). Minimum hypolimnetic DO increased from an average of 1.4 mg/L before (5 years of data) to 3.6 mg/L after (7 years of data) (Patmont 1987).

Improvement in water quality continued during the subsequent 15 to 20 years; minimum DO has nearly doubled and chl has about halved. These long-term improvements will be discussed in perspective with current water quality conditions determined in 2013 and prospects for further improvement.

This report describes the monitoring effort by Tetra Tech in 2013 that includes *in situ* profiles of temperature, DO, pH, and conductivity, as well as, discrete sampling for nutrients, chl, phytoplankton and net zooplankton.

1.1. Report Purpose

Avista Corporation (Avista) owns and operates the Long Lake Hydroelectric Development (HED) on the Spokane River. Long Lake Dam created a reservoir, Lake Spokane, in a 23-mile stretch of the Spokane River that was, at one time, free flowing. Portions of the river, including Lake Spokane, experience seasonal patterns in DO concentrations, some of which do not meet Washington State's water quality standards. Ecology has been working, along with several stakeholders, to address these impairments through the development and implementation of a water quality improvement plan, or DO TMDL.

Ecology, with Avista, conducted a 2-year baseline sample collection effort that began in May 2010 and extended through October 2011 at six lake stations and two river stations. The main purpose was to gather more recent data to verify the baseline water quality conditions in 2001, which were used in the TMDL development process, and to account for any changes in water quality in the lake. Ecology and Avista collaborated on a monthly sampling routine extending from June through September in 2010 and 2011 in order to expand the frequency of observations at the six lake monitoring stations. To do that, Avista contracted with Tetra Tech.

Beginning in 2012, Avista took over monitoring of the six lake stations in Lake Spokane and will continue that effort through 2016. Ecology will continue to provide water quality data for the three Ecology river stations (54A090, 55B070, and 54A070). In 2016, Avista will evaluate the results and success of monitoring baseline nutrient conditions in Lake Spokane and will work with Ecology to define future monitoring goals for the lake. This may include assessing whether the monitoring parameters, locations, duration, and frequency should be modified.

2. MONITORING PROGRAM

Water quality samples were collected and *in situ* profiles were determined once per month in May and October and twice per month from June through September 2013 at the six in-lake locations (LL0, LL1, LL2, LL3, LL4, and LL5) (Figure 1). Station LL0 is located farthest downstream in the reservoir with a depth of 48-50 m. Station LL1 is located across from the Department of Natural Resources (DNR) campground at a depth of about 34 m. Station LL2 is down reservoir from the City of TumTum and Sunset Bay at a depth of about 26 m. Station LL3 is just up reservoir from Willow Bay at a depth of about 19 m. Station LL4 is across from Suncrest Park and boat launch at about 9 m depth. Station LL5 is the farthest up reservoir, slightly up reservoir from the Nine Mile Recreation Area on the north side of the river at about 6 m depth.

The reservoir can be divided into three zones representing varying morphometric characteristics. The upper portion of the reservoir is considered to be the riverine zone where depths are shallow and the reservoir has morphological characteristics similar to a large river. Station LL5 is within this riverine zone. Stations LL4 and LL3 are located within the transition zone of the reservoir, where the reservoir is transitioning from a riverine environment to a more lacustrine environment. Within the transition zone, depths are greater than in the riverine zone but the littoral areas are still similar to that seen in the riverine zone. Station LL3 is approximately 19 m deep and has a very small hypolimnion during stratification. Stations LL0, LL1, and LL2 are located in the lacustrine zone of the reservoir where there is both littoral and pelagic environments. Water depths in the lacustrine zone are much deeper than the rest of the reservoir.

The 2013 sampling schedule is summarized in Table 1. Discrete depth samples were collected at each lake sampling location (see Table 2) and were shipped to Aquatic Research Inc. for analyses. In 2013 an additional sample depth at Station LL4 was added at 4 m. Analyses were for nitrate plus nitrite, total persulfate nitrogen (TN), soluble reactive phosphorus (SRP), total phosphorus (TP), and chl. Samples were collected in accordance with methods and procedures outlined in Ecology's Quality Assurance Project Plan (QAPP), which was amended and approved by Ecology at the beginning of the 2012 monitoring season.

Water temperature, DO, pH, and conductivity were determined *in situ* at each of the six sampling locations by lowering a Hydrolab® multi-parameter water quality meter from the boat. The *in situ* measurements were collected at predetermined depths through the water column. The measurements were collected in accordance with the methods and procedures outlined in the Ecology QAPP. The water quality meter was calibrated according to manufacturer's directions and following standard measurement procedures.

Volume-weighted DO and TP concentrations for each station were determined for sampling dates using CE-QUAL-W2 model segment volumes, which corresponded to 2013 monitoring stations. Volumes for model segments were obtained from Avista and Golder Associates and are based on bathymetric surveys completed in 2009. The monitoring stations correspond to model segments as follows:

- Station LL0: Model Segment 188, Reservoir Zone: Lacustrine
- Station LL1: Model Segment 181, Reservoir Zone: Lacustrine
- Station LL2: Model Segment 175, Reservoir Zone: Lacustrine
- Station LL3: Model Segment 168, Reservoir Zone: Transition
- Station LL4: Model Segment 161, Reservoir Zone: Transition
- Station LL5: Model Segment 157, Reservoir Zone: Riverine

Water samples for phytoplankton were collected at 0.5 m depth at each of the six sampling locations. These samples provide information on phytoplankton dynamics seasonally and also longitudinally at several locations throughout the reservoir. A vertical zooplankton haul was collected at each of the six sampling locations from 1 m off the bottom through the water column. Both phytoplankton and zooplankton samples were sent to WATER Environmental Services, Inc. for analysis.

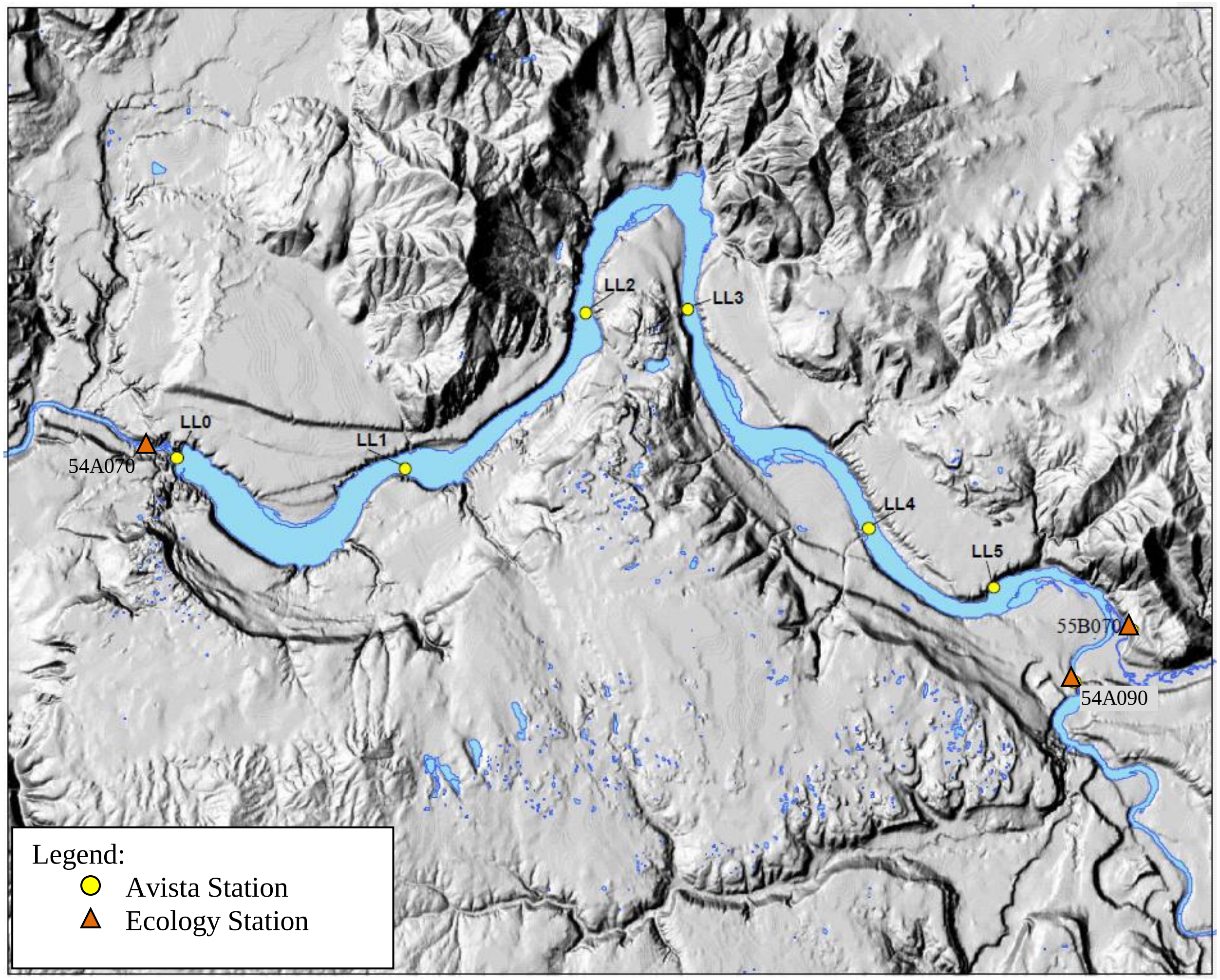

Figure 1. Lake Spokane Sampling Locations

Table 1. Lake Spokane Monitoring Schedule during 2013

Sample Date	Type of Samples Collected
May 13 – 14, 2013	Discrete Depth, *In situ*, Phytoplankton, and Zooplankton
June 11 – 12, 2013	
June 25 – 26, 2013	
July 9 – 10, 2013	
July 24 – 25, 2013	
August 5 – 6, 2013	
August 20 – 21, 2013	
September 9 – 10, 2013	
September 24 – 25, 2013	
October 14 – 15, 2013	

Table 2. Discrete Depth Samples for Stations Monitored in Lake Spokane during 2013(1)

	LL0	LL1	LL2	LL3	LL4	LL5
Depths (m)	0.5	0.5	0.5	0.5	0.5	0.5
	5	5	5	5	4	B-1
	15	20	15	10	B-1	
	30	B-1	B-1	B-1		
	B-1					

(1) B-1 is 1 m off the bottom.

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3. RESULTS

This section presents a summary of water quality constituents determined *in situ*, as well as nutrient, chl, phytoplankton, and zooplankton data from grab samples at discrete depths. The *in situ* data are presented in tabular form in Appendix A. All data from water samples collected in 2013 are presented in tabular form in Appendix B. Phytoplankton results are presented in Appendix C, and zooplankton results are in Appendix D.

The section also presents a brief summary of the water quality conditions of the primary inflows and outflows of Lake Spokane as well as a description of general hydrologic and climatic conditions for 2013.

3.1 Hydrologic and Climatic Conditions

Weather conditions during 2013 varied slightly from the 30-year norms reported at Spokane International Airport, with cooler than normal temperatures in the early spring, warmer than normal temperatures in May, July, August, and September, and below normal precipitation for most of the year. Temperatures ranged from a high of 99°F (37°C) on July 1 to a low of -2°F (-19°C) on December 8 as shown in Figure 2. The annual cumulative rainfall total was 11.36 inches (28.9 cm), which is well below normal for the Spokane International Airport (Figure 2). Drier than normal conditions began in February and continued through the spring. This is in contrast to early spring conditions in 2012 when a record 4.56 inches (11.6 cm) of rain fell at the Spokane International Airport (March 2013 rainfall was 0.82 inches (2.1 cm). June had above normal precipitation with the maximum recorded in one day; 1.12 inches (2.8 cm) on June 20. July was the driest month of the year with no recordable precipitation at the Spokane International Airport. Several large storms in August and September brought much needed precipitation to the Inland Northwest. October, November, and December were much drier than normal.

Figures 3 and 4 show inflows and outflows, respectively, for Lake Spokane during 2013. Inflows include all incoming waters to Lake Spokane, as calculated by Avista using lake elevation at midnight and outflow at midnight as recorded at Long Lake Dam. As expected, the inflows and outflows of Lake Spokane are very similar to each other, with only slight differences occurring during the early part of the year during the annual drawdown. Maximum inflows occurred during March, April, and May due to spring runoff. Peak flows in 2013 were significantly smaller than peak flows observed in previous years (2011 and 2012) and similar to peak flows observed in 2010 (Figure 5). Both the Spokane River and the Little Spokane River had average to slightly higher than average flows during March, April, and early May (Figures 6 and 7). Flows in the Spokane River from the middle of May through the middle of June were well below average (Figure 6). Flows in the Spokane River during the summer were slightly below the historical median for that time (Figure 6). Summer flows in the Little Spokane River, however, were higher than historical median, and were similar to the historical 90th percentile flows in August and September (Figure 7).

Water residence time during June – October in Lake Spokane was relatively short, ranging from 14 to 37 days for the whole lake during 2010-2013 (Table 3). The average for the past four years was 24 days, slightly less than 29 days during 1972-1985. These short residence times tend to minimize sedimentation loss and maximize the fraction of inflow TP concentration available to algae, but are not so short as to restrict algal bloom development. Residence times in the transition and riverine zones were much shorter, averaging 4.4 days (Table 3). Bloom development would be limited in these zones, especially in the spring.

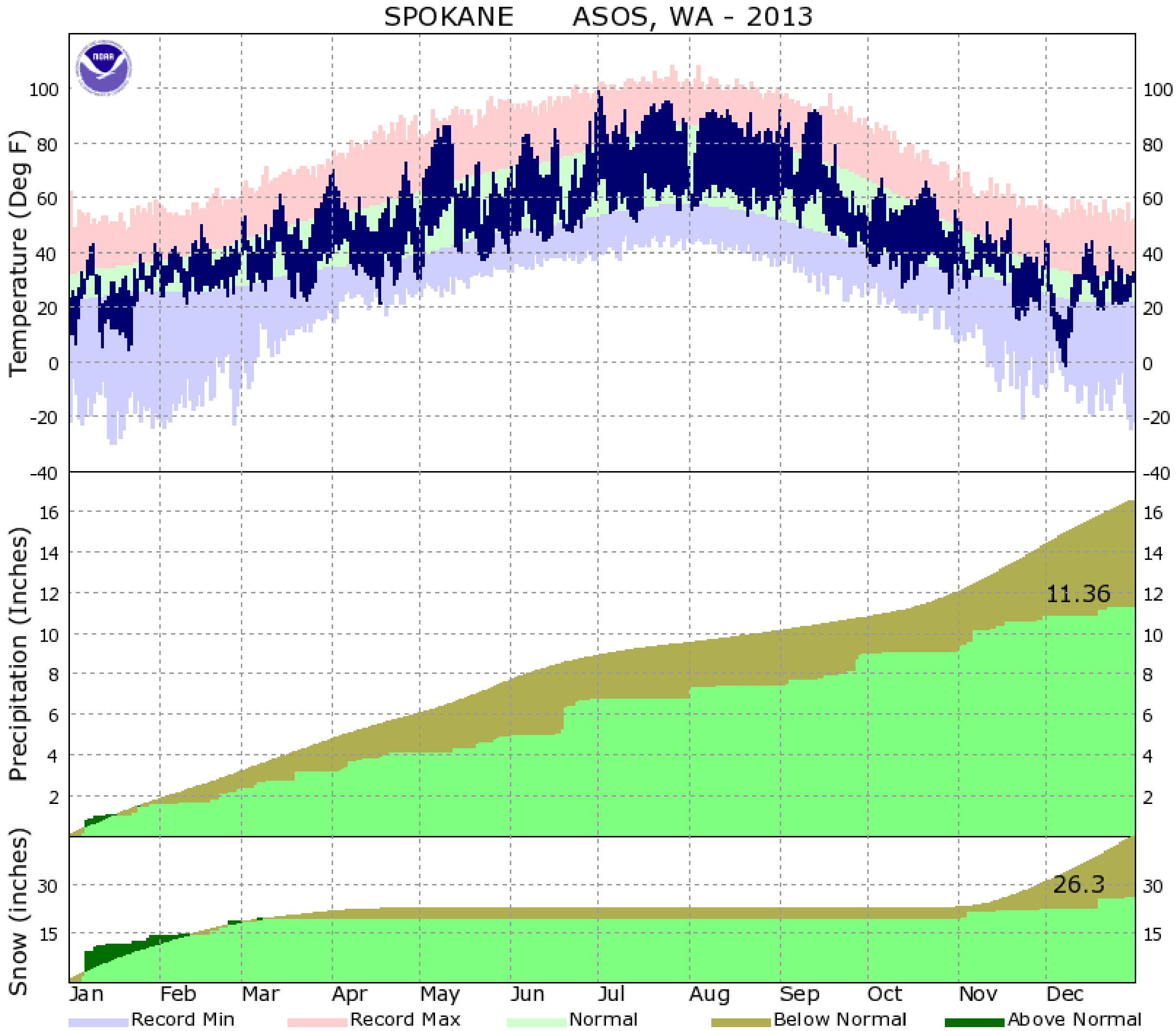

Figure 2. Temperature and Precipitation at Spokane International Airport for 2013

Table 3. Inflows and water residence times during 2010-2013

Year	Total Annual Flow Volume (cf x10[6])	Annual Mean Daily Flow (cfs)	Mean Daily Summer (June-Sept) Flow (cfs)	Mean Daily Summer (June-Oct) Flow (cfs)	Residence Time[1] Whole Lake (June-Oct, days)	Residence Time[1] Transition/Riverine Zones (June-Oct, days)
2010	167,113	5,299	5,193	4,671	23.9	4.5
2011	337,576	10,704	9,172	7,828	14.4	2.7
2012	293,971	9,296	6,594	5,768	19.4	3.6
2013	189,846	6,020	3,074	3,035	36.8	6.9

[1]residence time = lake volume/outflow

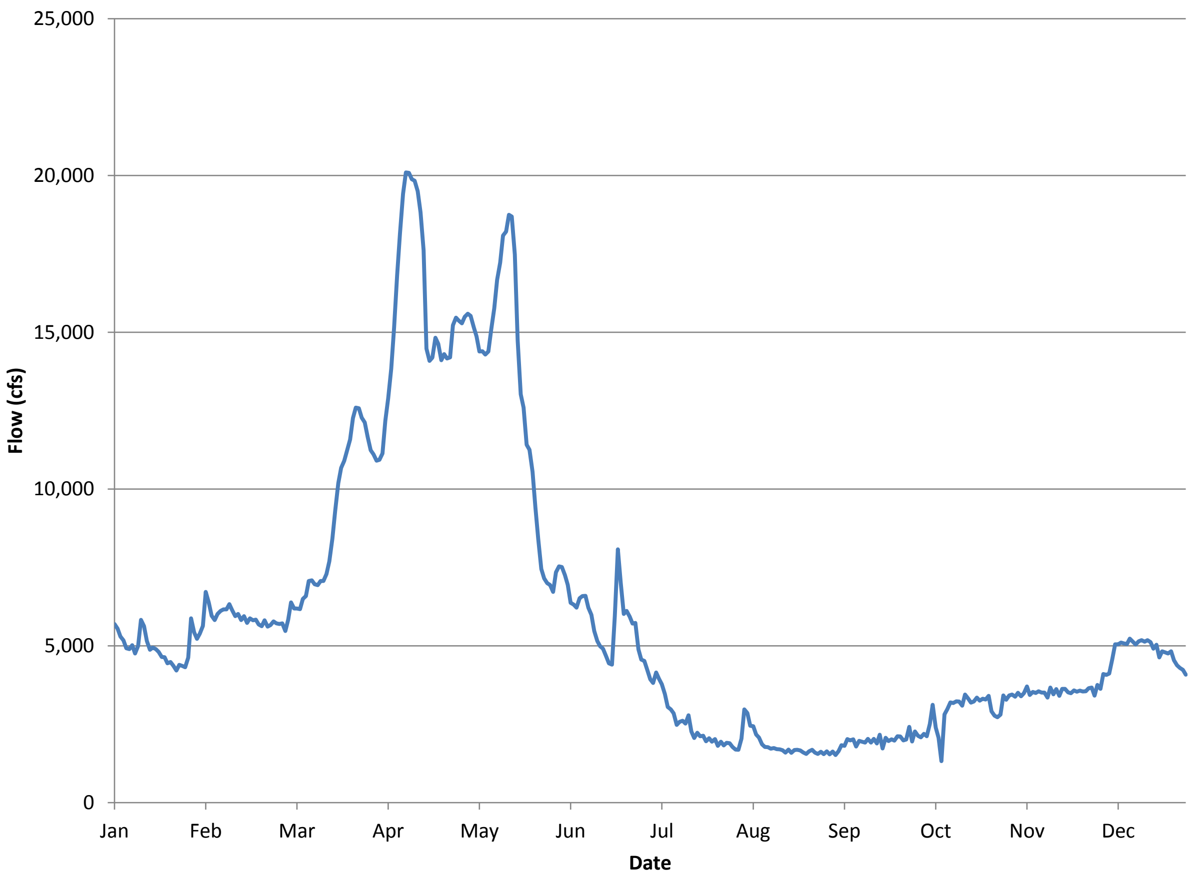

Figure 3. Total Inflow into Lake Spokane, 2013
(Inflows calculated based on midnight lake elevation and outflow as recorded at Long Lake Dam)

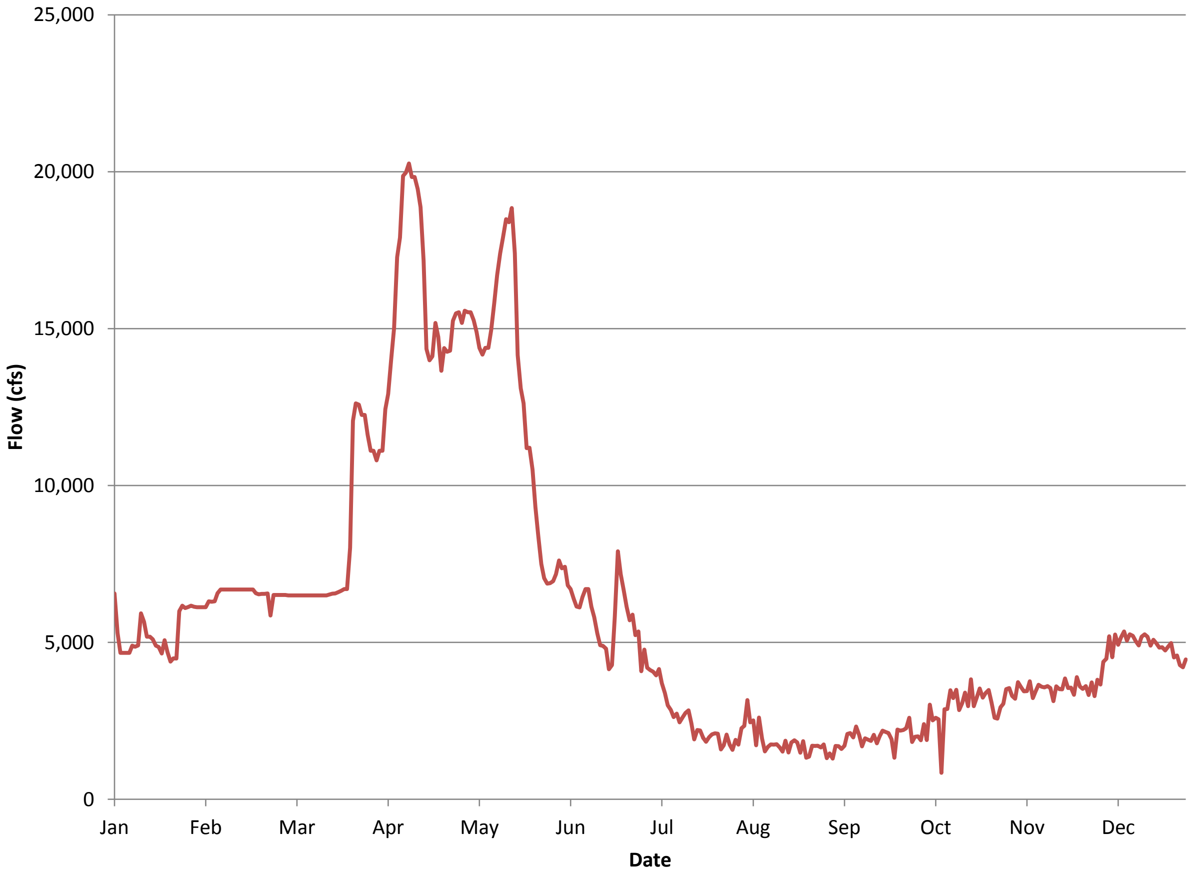

Figure 4. Total Outflow into Lake Spokane, 2013
(Outflows as reported at Long Lake Dam at midnight daily)

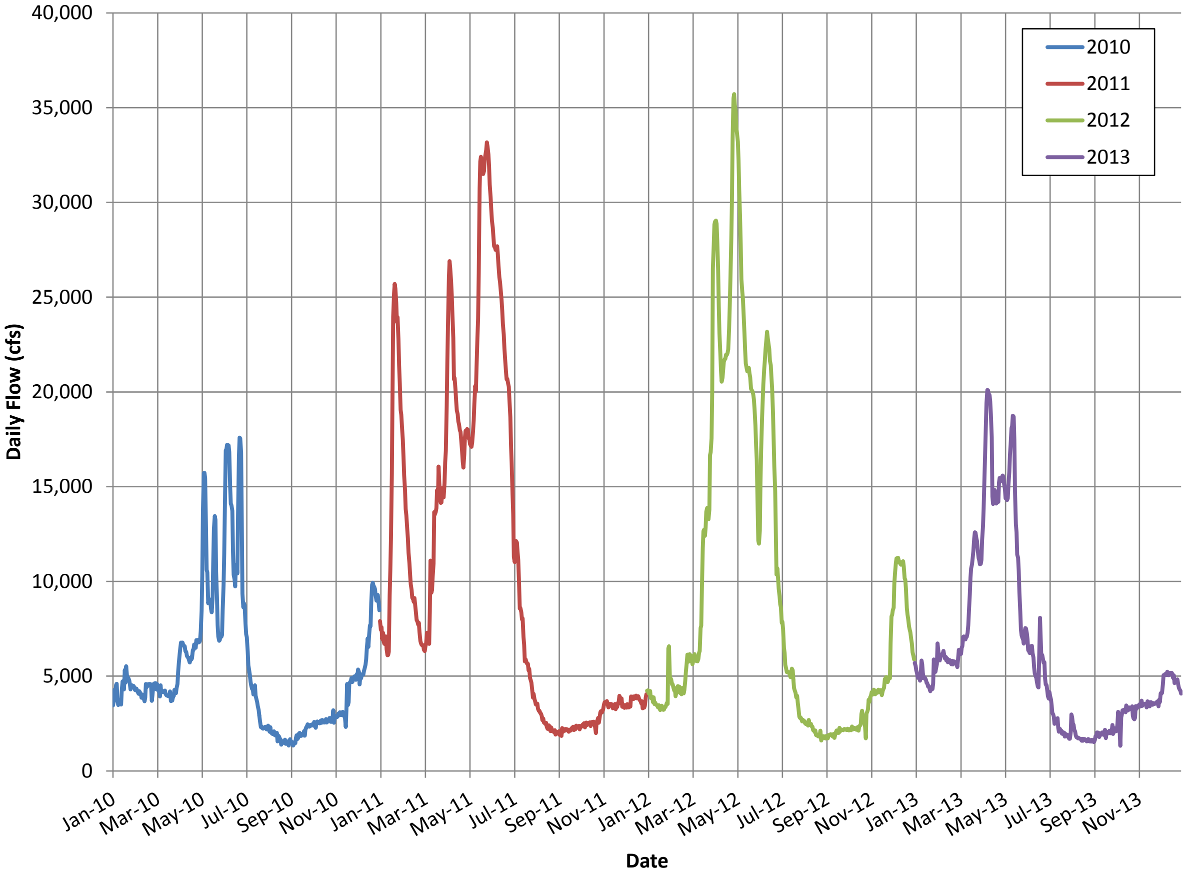

Figure 5. Total Inflows into Lake Spokane 2010-2013
(Inflows calculated based on midnight lake elevation and outflow as recorded at Long Lake Dam)

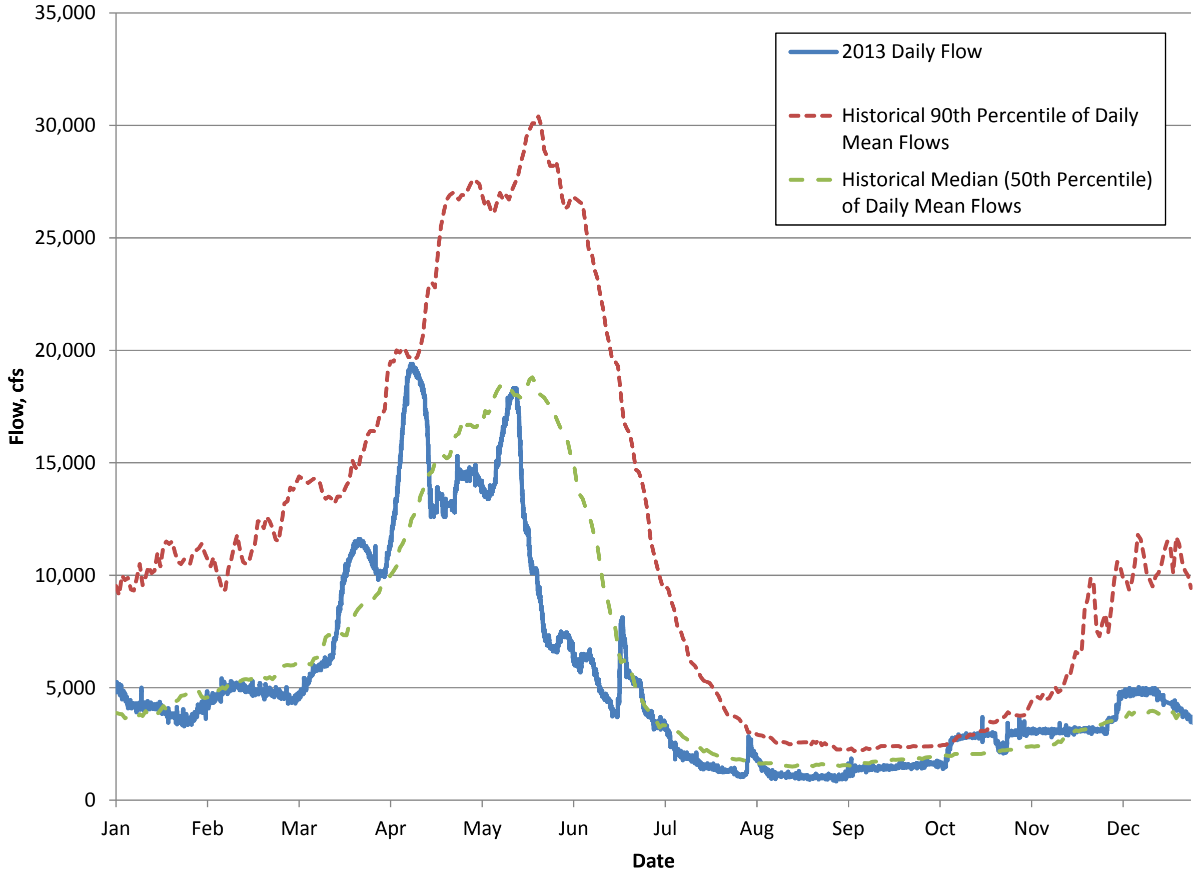

Figure 6. Spokane River at Spokane (USGS Gage # 12422500) Daily Flows, 2013 compared to Historical Daily Mean Flows

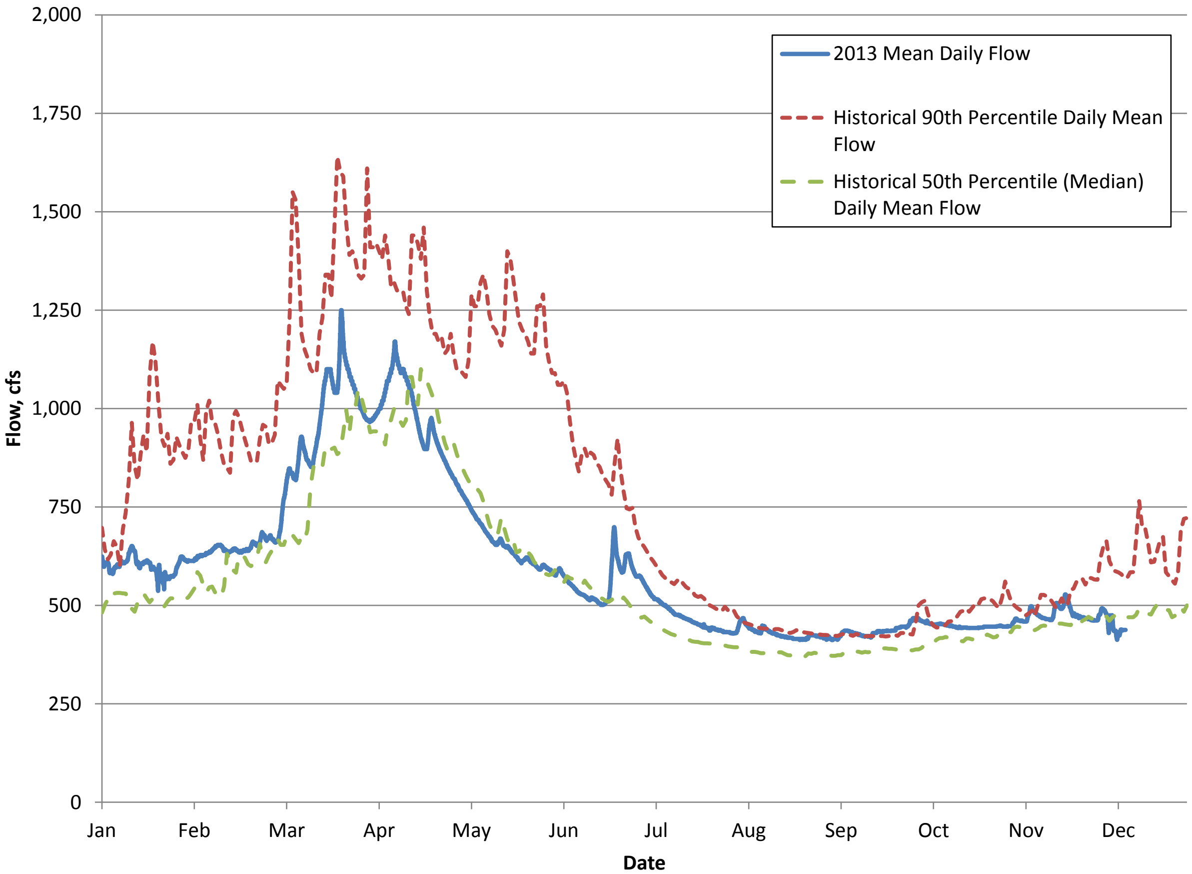

Figure 7. Little Spokane River near Dartford (USGS Gage # 12431500) Daily Flows, 2013 compared to Historical Daily Mean Flows

3.2 Water Quality Conditions

3.2.1 TEMPERATURE

The maximum temperature reached at the surface was 24°C in the limnetic zone and 25°C in the upper reservoir during July (Figures 8 through 13). Temperature was usually at or below 20°C at depths greater than 10 m in the limnetic zone.

Thermal stratification was evident in May during the first sampling event at stations LL0, LL1, and LL2. Temperatures near the bottom at these stations were lower than in 2012 (8 vs. 10°C) indicating the lake may not have completely mixed following winter stratification. The temperatures at the surface in May were also warmer for that time of year and were most likely due to the unseasonable warmth the region experienced in early May. The lake apparently completely mixed between the May and early June sampling events at these deeper stations. By the first sampling event in June, mild stratification had developed at all stations except for LL4 and LL5. The water column at LL4 did not stratify until July. Some stratification occurred, briefly, during late July and late August/early September at the shallowest station (LL5). The brief stratification at LL5 in July was interrupted by a very large storm event at the beginning of August which increased river flows (Figure 3).

Depth of mixing varied through the summer being around 4 to 5 m at the three most down reservoir stations and tended to persist in August when surface temperatures rose. Mixing depth persisted at 5 m at LL0 through the summer, but deepened to near 12 m at LL2 when surface water cooled in September. A similar pattern of rather shallow mixing depth occurred at stations LL3 and LL4 in July and August, but was more variable. Mixing depths at LL3 varied from 3 to 4 meters in July and August and then dropped to 10 meters in September, similar to station LL2. Mixing depths at LL4 were more consistent over the summer at around 3 meters.

The extent of the metalimnion and depth of the hypolimnion varied throughout the summer, which is typical in reservoirs that are strongly affected by river inflow and plunging interflows. Depth of the hypolimnion can be taken roughly at the inflection point where rate of temperature change with depth begins to slow and below where the rate of temperature change becomes minimal (Figures 8 through 10). For most dates the hypolimnion depth ranged from about 10 to 20 m, being shallow in June and deepening later in the summer. That variation is due to the river inflow plunging to different depths consistent with inflow density (temperature and conductivity). Conductivity profiles show the pattern of plunging inflows, which cause much of the temperature variation in the reservoir.

The water columns at stations LL0, LL1, and LL2 during the October sampling event were still slightly stratified. The deepening of the epilimnion at these stations in October indicates that the turnover process had begun.

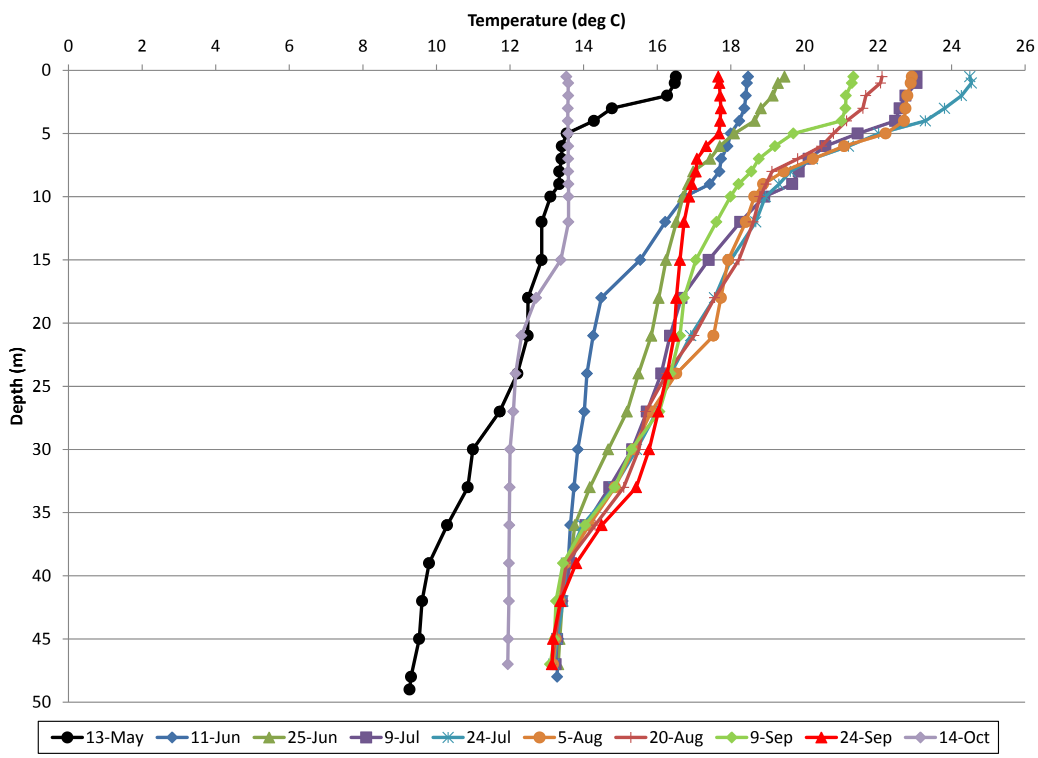

Figure 8. Temperature Profiles for Station LL0, May-October 2013

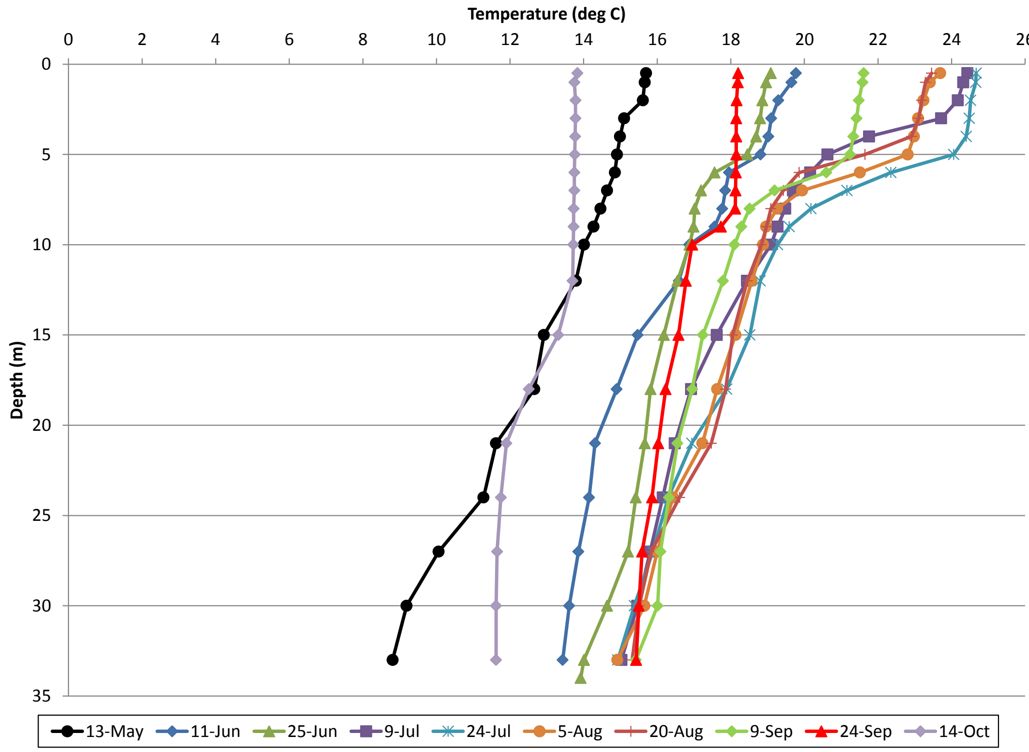

Figure 9. Temperature Profiles for Station LL1, May-October 2013

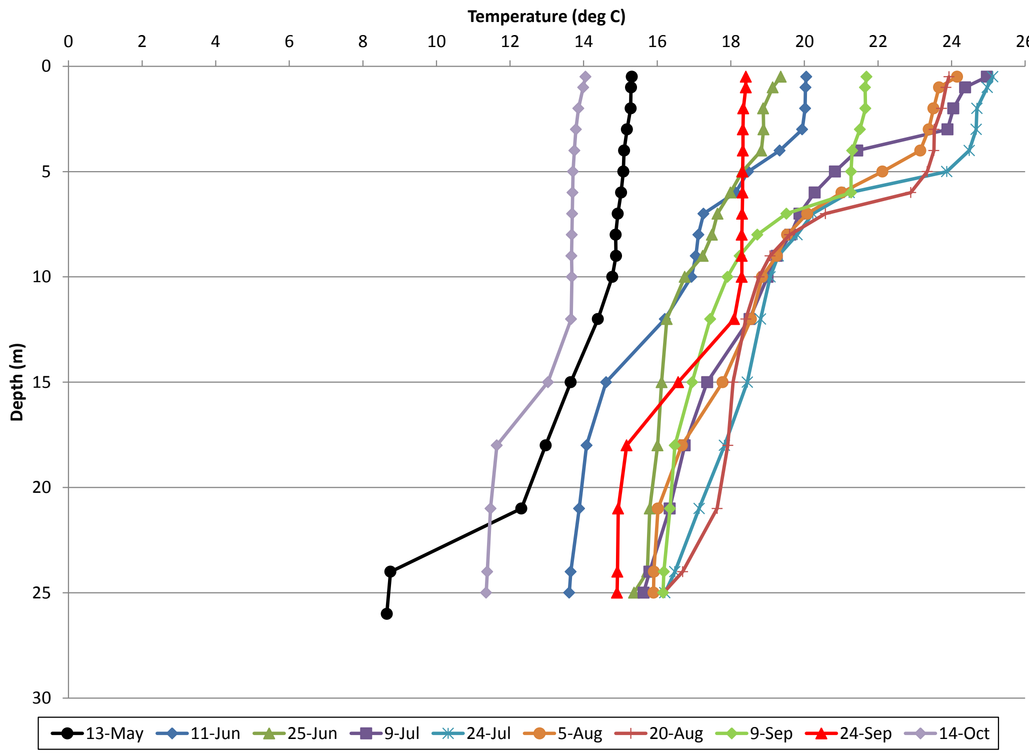

Figure 10. Temperature Profiles for Station LL2, May-October 2013

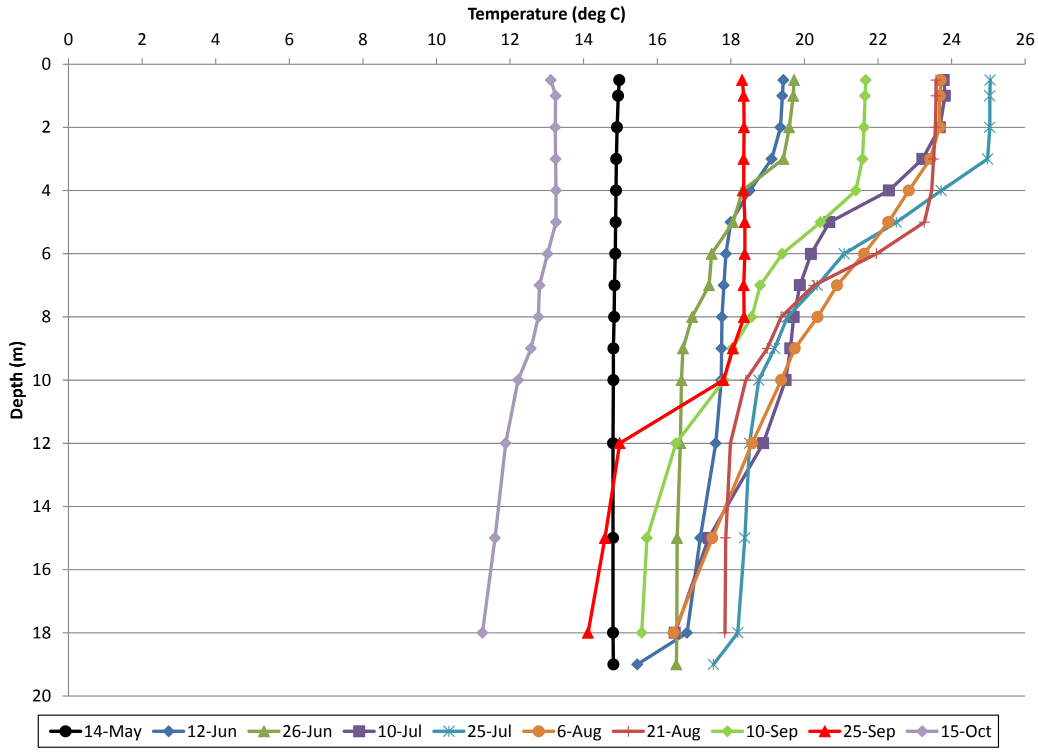

Figure 11. Temperature Profiles for Station <u>LL3</u>, May-October 2013

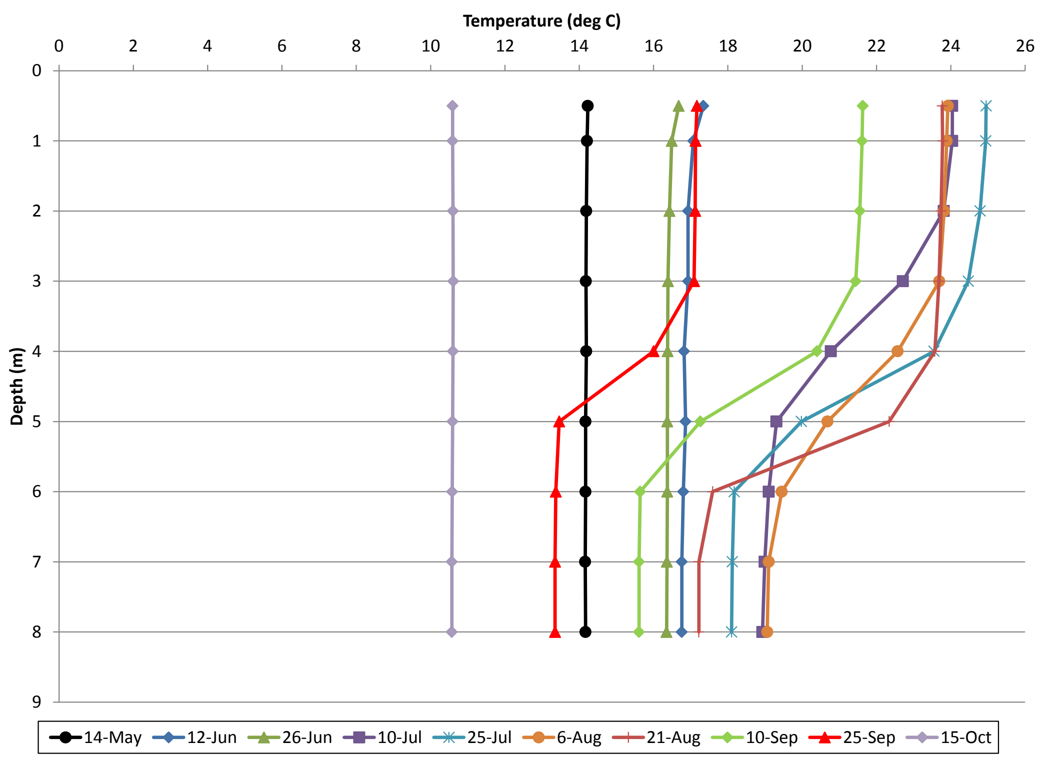

Figure 12. Temperature Profiles for Station <u>LL4</u>, May-October 2013

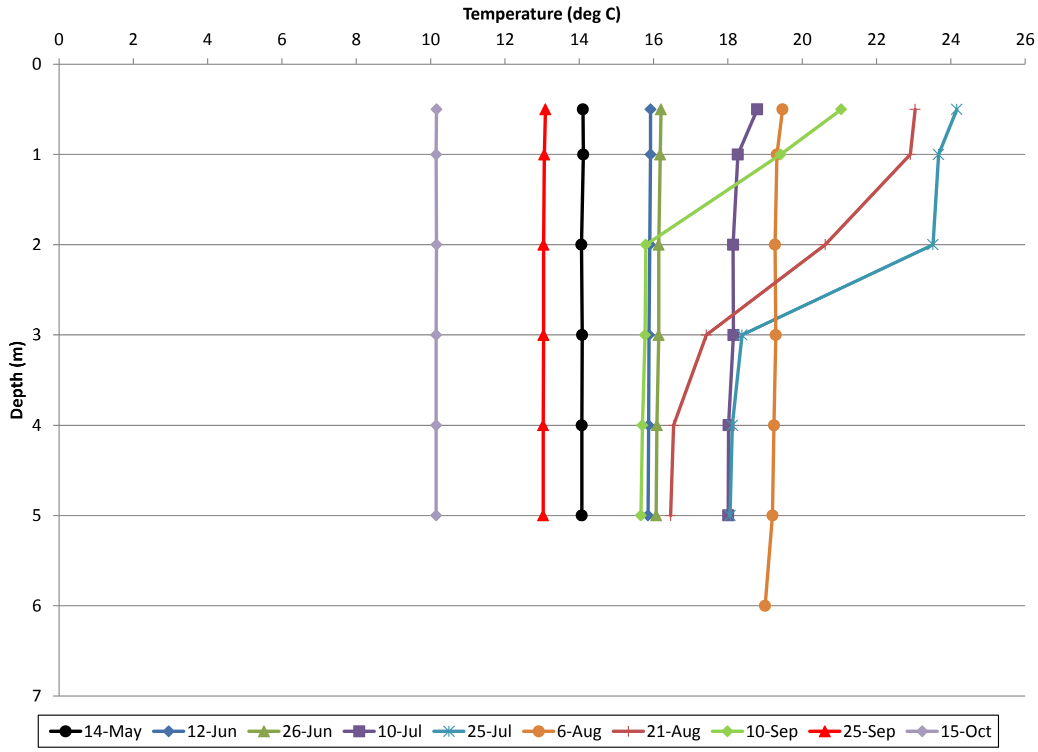

Figure 13. Temperature Profiles for Station LL5, May-October 2013

3.2.2 CONDUCTIVITY

Conductivity varied from about 69 to 269 µ Siemens/cm (µS/cm) throughout the reservoir (Figures 14 to 19). Conductivity is a conservative constituent, because it largely represents the major ions that are usually not influenced by gains and losses due to physical (sedimentation) or biological processes. During May and early June, when river flow was relatively high, conductivity was low due to dilution with inflow of low conductivity. Low conductivity was uniform, top to bottom, at all stations in May and at shallower stations in early June. As river flow decreased, inflow conductivity increased to 200 µS/cm on July 10 at LL5 (Figure 19). Water with increased conductivity, to around 150 µS/cm, comprised the interflow zone that extended from about 4 to 12 m at stations LL3, LL2, and LL1. At LL0, the interflow zone narrowed vertically as the inflow volume spread into the wider reservoir.

The interflow was more distinct during late August and September, with conductivity exceeding 250 µS/cm at LL5, plunging to below 5 m at LL4, below 10 m at LL2, and between 10 and 25 m at LL1 and LL0. Thus, the high-conductivity inflow spread vertically over a larger depth interval moving down reservoir. Much of the metalimnion in the lower reservoir is composed of a mixture of river inflow and bottom water from the transition zone that plunges to depths that approximate the density of that mixture.

The pattern of temperature and conductivity distribution in reservoirs with sizable inflows and relatively short water residence times is quite different than in lakes with relatively long water residence times. Temperature profiles in the latter tend to develop more gradually due to radiative heating and wind, with interflow having minimal effect. This also means that the loss of DO occurs mostly in the more stable hypolimnion in natural lakes, while DO depletion is often greater in the metalimnion in reservoirs due to plunging inflows that transport organic matter produced in the enriched riverine and transition zones (as well as in the inflowing river) into the metalimnion of the limnetic zone (Cooke et al. 2011). In natural lakes, hypolimnetic DO depletion is due to settled organic matter from the productive photic zone, as well as demand from bottom sediments. The same processes also occur in the reservoir, but are often over shadowed by the plunging inflows containing organic matter produced up reservoir.

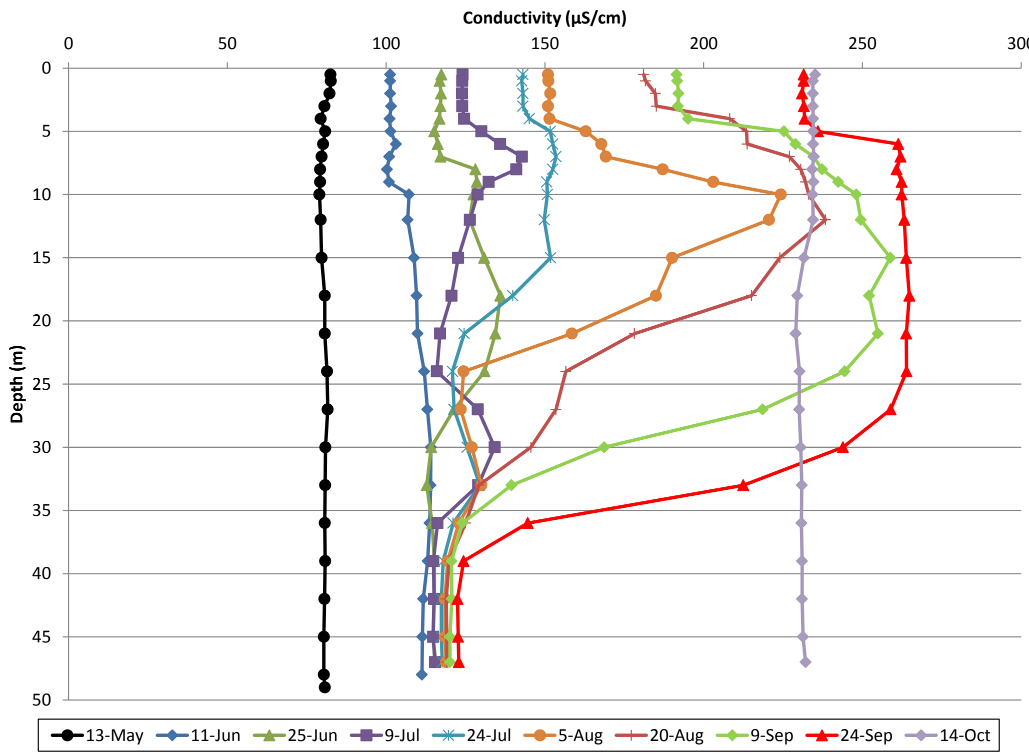

Figure 14. Conductivity Profiles for Station LL0, May-October 2013

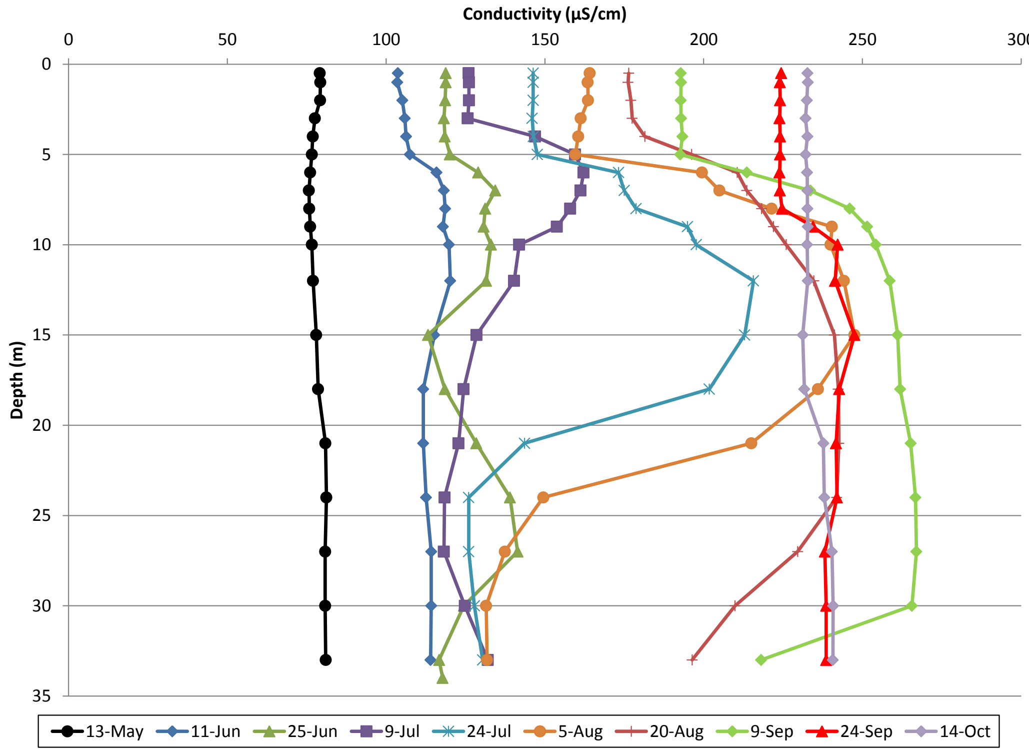

Figure 15. Conductivity Profiles for Station LL1, May-October 2013

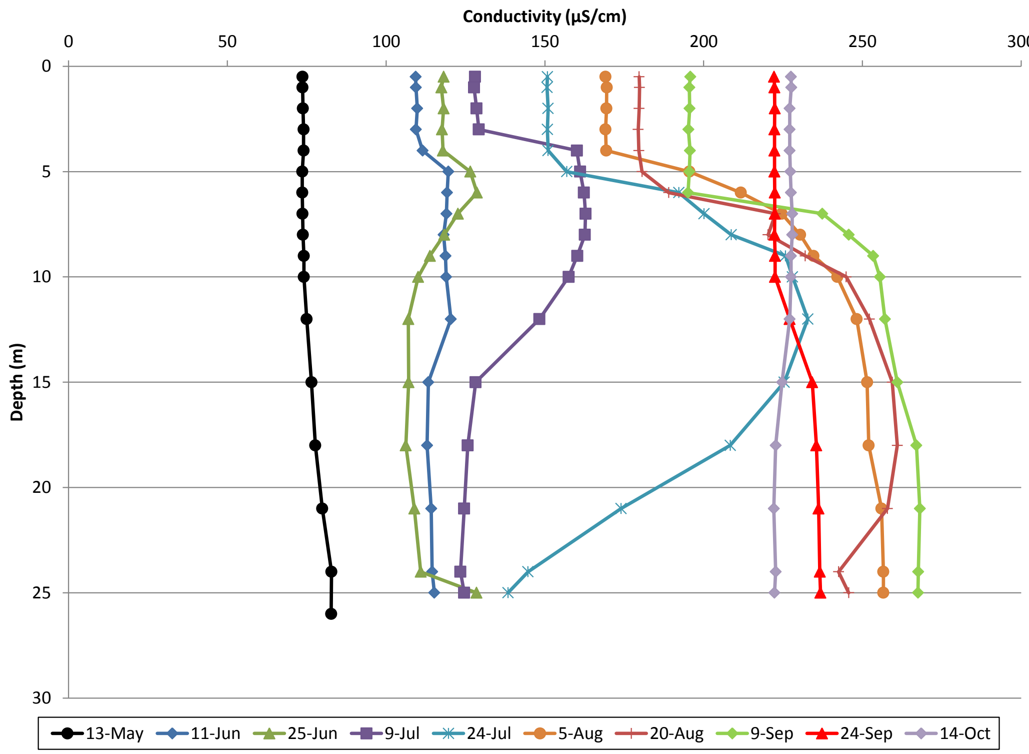

Figure 16. Conductivity Profiles at Station LL2, May-October 2013

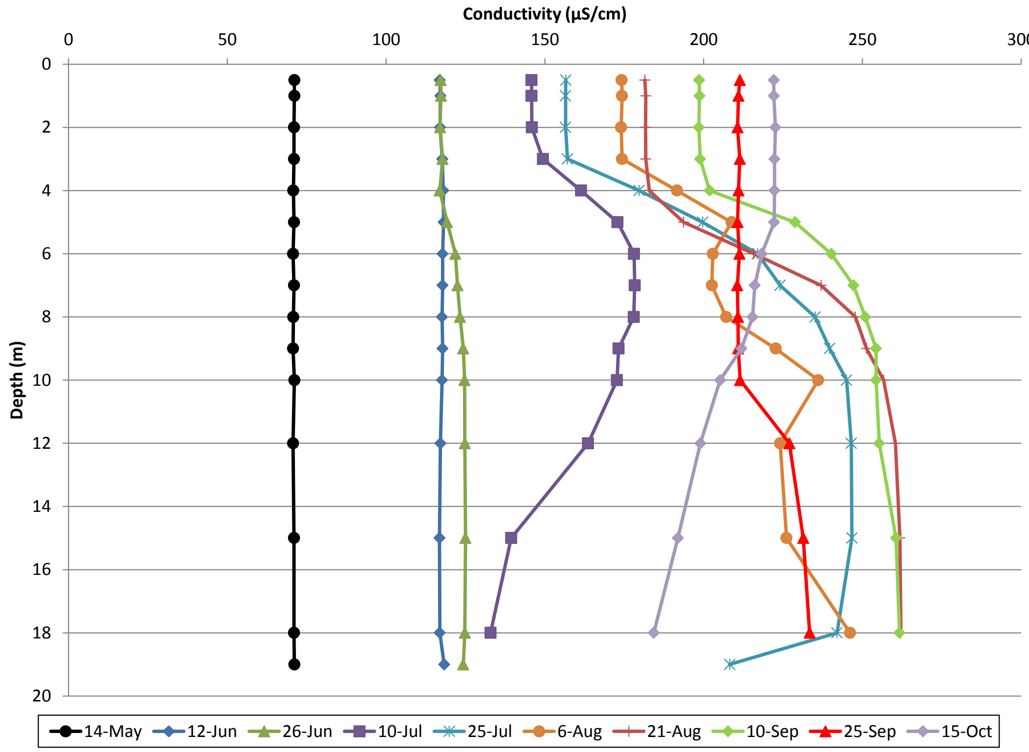

Figure 17. Conductivity Profiles at Station LL3, May-October 2013

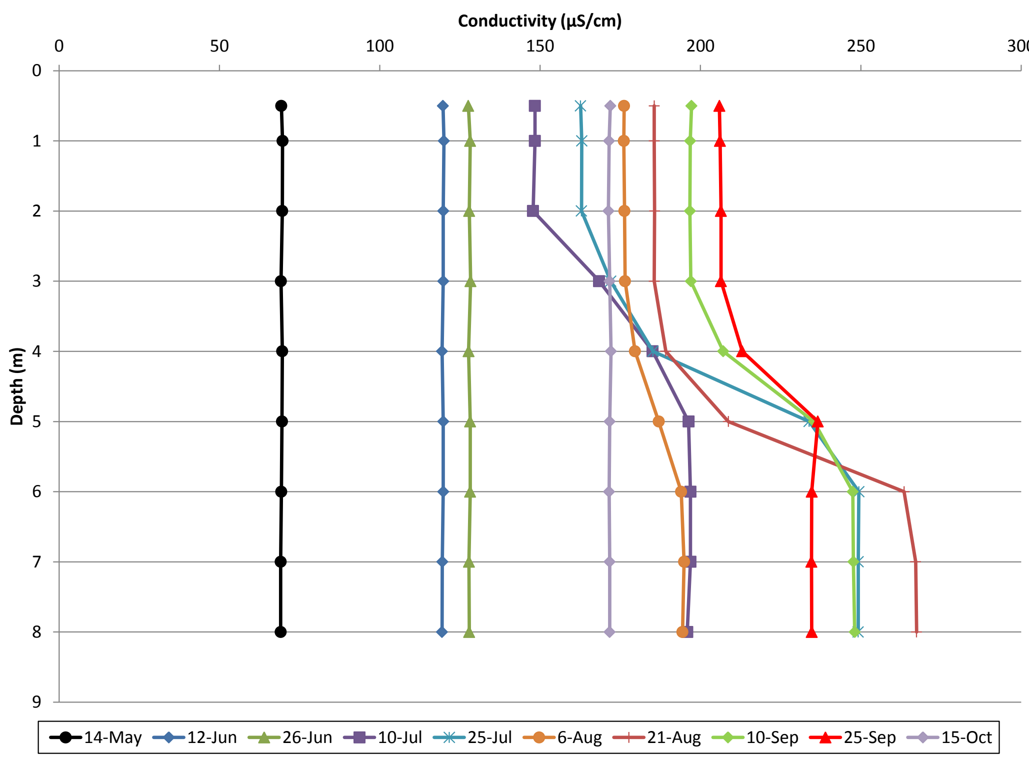

Figure 18. Conductivity Profiles at Station LL4, May-October 2013

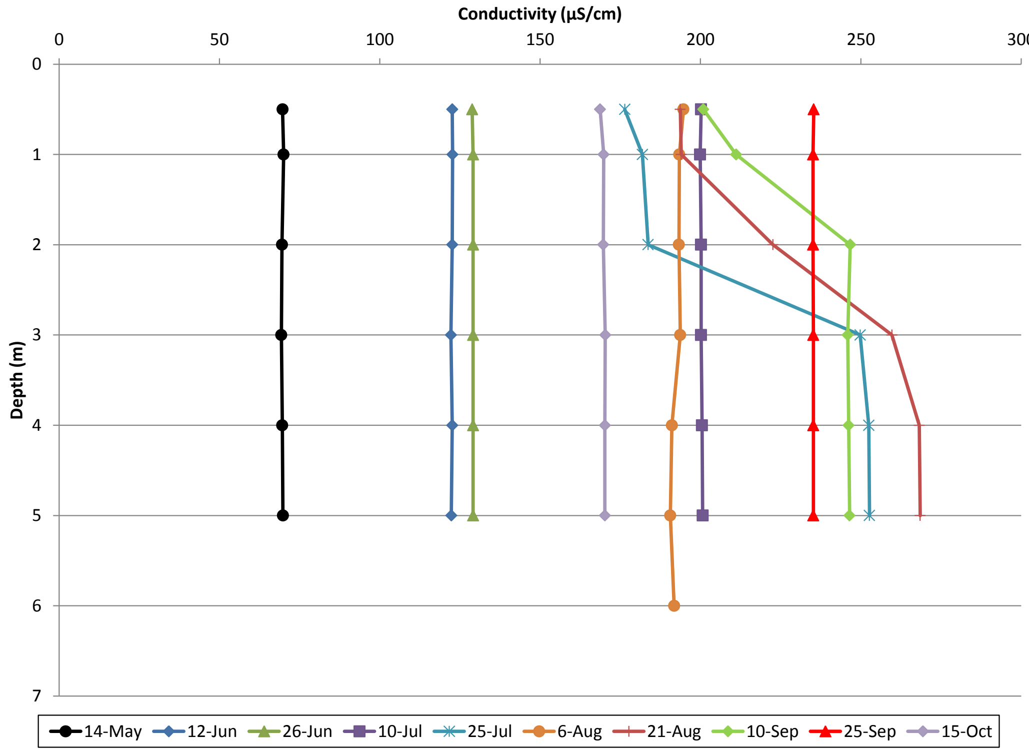

Figure 19. Conductivity Profiles at Station LL5, May-October 2013

3.2.3 DISSOLVED OXYGEN

Maximum DO concentrations ranged from 11.6 to 13.4 mg/L at the six stations, with higher values occurring in the lacustrine zone (Figures 20 to 25). Concentrations were especially high between 3 and 6 m in July at station LL0, likely due to photosynthetic activity (Figure 20). Maximum DO concentrations in 2010 ranged from 10.7 to 14.5 mg/L, in 2011 from 11.9 to 12.4 mg/L, and in 2012 from 11.4 to 12.5 mg/L. Minimum DO concentrations occurred near the bottom at the two deepest stations. The DO profiles in August and September indicate that the low values near the bottom were probably due to sediment demand (Figures 20 and 21). Concentrations in the hypolimnion below 20 to 25 m declined more or less with time at these two sites. Minimum DO concentrations in 2010 – 2012 also occurred at the two deepest stations (LL0 and LL1), but minimum DO concentrations in 2011 were significantly higher (3.2, 6.9 mg/L) at those sites than those observed in 2013 (0.0, 0.9 mg/L), in 2012 (1.6, 0.5 mg/L), or in 2010 (0.13, 2.3 mg/L). Minimum DO concentrations in 2013 were the lowest observed of the four years, probably due to the lowest inflow. The higher minimum DO in 2011 was also probably due to higher inflow and a shorter water residence time. Average water column DO in 2013 ranged from 8.0 to 10.1 mg/L, with the lowest values at the two deepest stations due to near-bottom low concentrations.

The effect of interflow, as indicated by conductivity, on DO depletion was most pronounced during September at stations LL0, LL1, and LL2 in the lacustrine zone, and also at LL3 in the transition zone. There was some evidence of greater DO depletion from the interflow zone in August but to a lesser extent. Although the DO profile patterns were similar, the effect of interflow on DO in 2013 was not as pronounced as in 2012 at the deeper stations. DO depletion in the metalimnion to levels less than 6 mg/L occurred only during the September 9-10 sampling event in 2013. This DO depletion rate is due to organic matter transported from up-reservoir with the plunging density dependent interflow. This pattern of DO depletion, being greater in the interflow/metalimnion, is typical of reservoirs with high inflows and short water residence times (Thornton at al. 1990). This pattern persisted in October at LL0, but concentrations in the hypolimnion were much higher than in August and September.

Volume-weighted DO concentrations for each station and sampling date were calculated using DO concentrations from 9 m and deeper and CE-QUAL-W2 model segment volumes, provided by Avista and Golder Associates, below 8.5 m (Table 4). The lacustrine zone average DO includes concentrations from LL0, LL1, and LL2 but not the very small portion of the hypolimnion at station LL3.

Table 4. Volume-Weighted DO Concentrations in Lake Spokane, during May-October 2013, using DO Concentrations Determined from 9 meters and Deeper

Station	Volume-Weighted DO (mg/L), Below 8.5 meters									
	May 13-14	June 11-12	June 25-26	July 9-10	July 24-25	August 5-6	August 20-21	September 9-10	September 24-25	October 14-15
LL0	11.2	9.85	8.23	7.93	6.56	5.76	4.83	4.36	4.83	9.24
LL1	10.9	9.72	8.57	8.65	6.87	6.30	6.33	6.40	6.87	9.10
LL2	10.5	9.40	9.23	8.13	7.44	8.30	7.65	7.22	8.17	9.64
LL3	10.4	10.0	9.16	7.40	8.47	8.80	9.01	8.28	9.06	10.2
LL4	No hypolimnion									
LL5	No hypolimnion									
Lacustrine Zone only Average (LL0, LL1, LL2)	10.9	9.7	8.7	8.2	7.0	6.8	6.3	6.0	6.6	9.3

Volume-weighted DO concentrations for the hypolimnion from 15 m and deeper were also calculated using the model segment volumes (Table 5). The lowest volume-weighted hypolimnetic DO observed in 2013 was during the September 9-10 sampling event at station LL0 (3.92 mg/L). This is 1 mg/L lower than the minimum volume-weighted hypolimnetic DO observed in 2012 at LL0. The minimum average hypolimnetic DO in the lacustrine zone (5.8 mg/L) was observed during the August 20-21 sampling event.

Average lacustrine, volume-weighted DOs were similar from 9 m and deeper and from 15 m and deeper are similar (Tables 4 and 5). In July and August, average DOs were higher using concentrations from 9 m and deeper. However, there was little difference in September, because then DO was lower between 5 and 15 m, which is within the metalimnion/interflow zone of the reservoir.

The rationale for including depths between 8.5 and 15 m for the TMDL was to include DOs in the metalimnion that are lower at times than in the hypolimnion. However, in Lake Spokane, including the metalimnetic DO usually did not produce higher volume-weighted values. In fact, the average seasonal (May to October) lacustrine DO for depths greater than 8.5 m and 15 m were very similar – 7.9 vs. 7.7 mg/L, indicating a rather mild effect of DOs in the metalimnion. In 2012, the average seasonal lacustrine DO was the same for depths greater than 8.5 m and 15 m – 8.6 mg/L. Depletion rate of DO in the metalimnion from plunging incoming water may have been greater in the past when algal biomass was higher, but the effect seems to be minimal now corresponding to the decrease in overall algal primary production.

Table 5. Volume-Weighted Hypolimnetic DO Concentrations in Lake Spokane, during May-October 2013, using DO Concentrations Determined from 15 meters and Deeper

Station	Volume-weighted DO (mg/L), Below 15 meters									
	May 13-14	June 11-12	June 25-26	July 9-10	July 24-25	August 5-6	August 20-21	September 9-10	September 24-25	October 14-15
LL0	11.1	9.41	8.02	7.22	6.09	5.31	4.17	3.92	4.41	9.19
LL1	10.9	9.49	8.43	7.98	6.03	5.11	5.72	6.73	6.97	9.04
LL2	10.6	9.21	9.02	7.64	6.33	8.43	7.37	7.88	8.46	9.85
LL3	10.4	9.63	9.10	5.79	7.48	9.09	8.75	8.84	9.25	10.2
LL4	--	--	--	--	--	--	--	--	--	--
LL5	--	--	--	--	--	--	--	--	--	--
Lacustrine Zone only Average (LL0, LL1, LL2)	10.9	9.4	8.5	7.6	6.1	6.3	5.8	6.2	6.6	9.4
Whole Hypolimnetic Average (LL0, LL1, LL2, LL3)	10.7	9.4	8.6	7.2	6.5	7.0	6.5	6.8	7.3	9.6

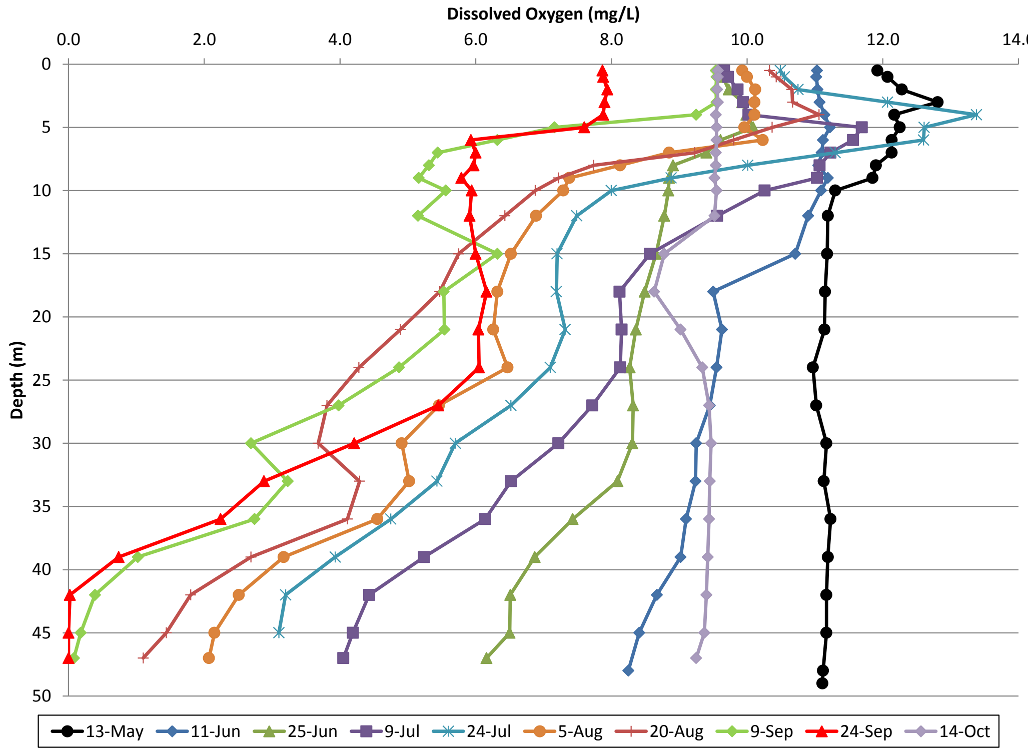

Figure 20. DO Profiles for Station LL0, May-October 2013

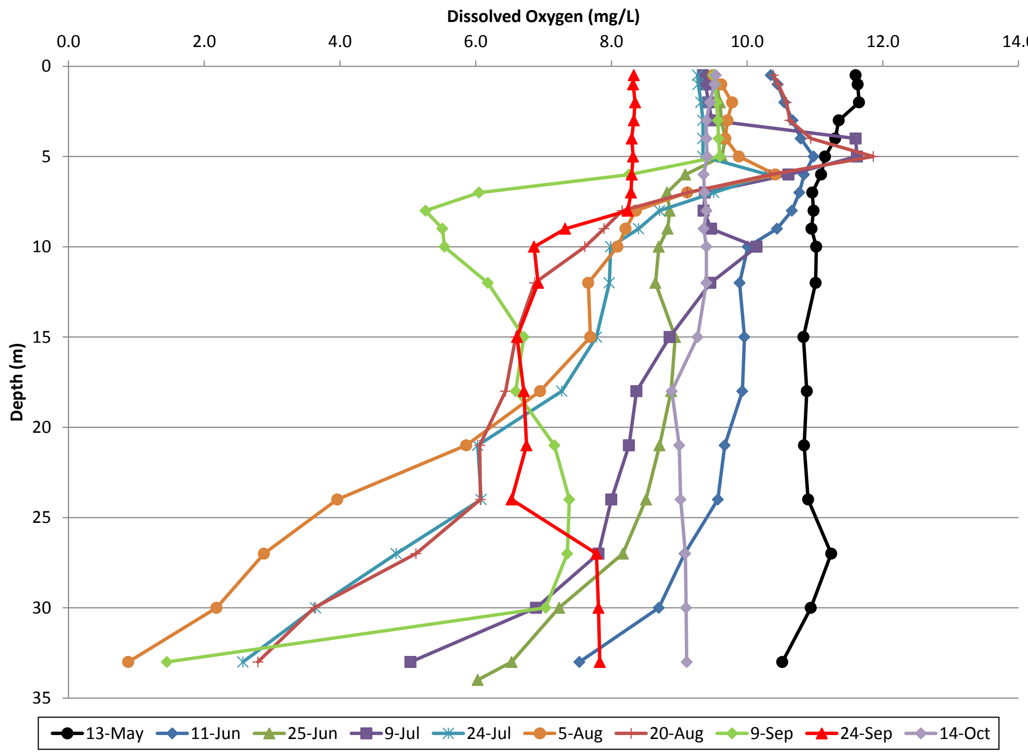

Figure 21. DO Profiles for Station LL1, May-October 2013

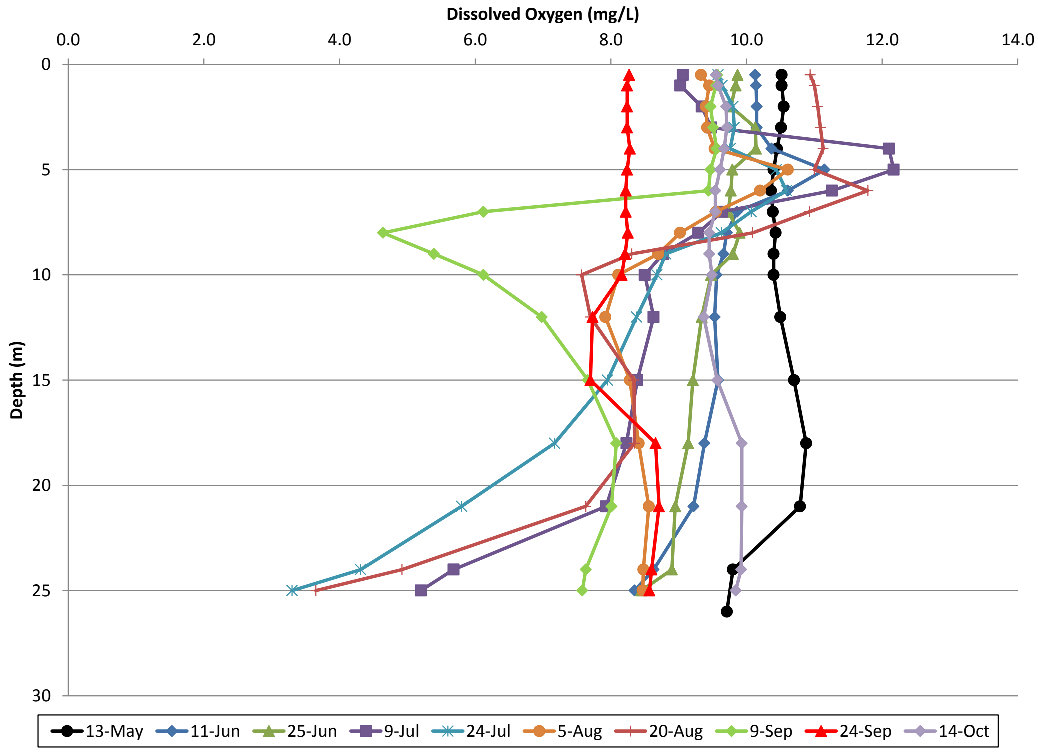

Figure 22. DO Profiles at Station LL2, May-October 2013

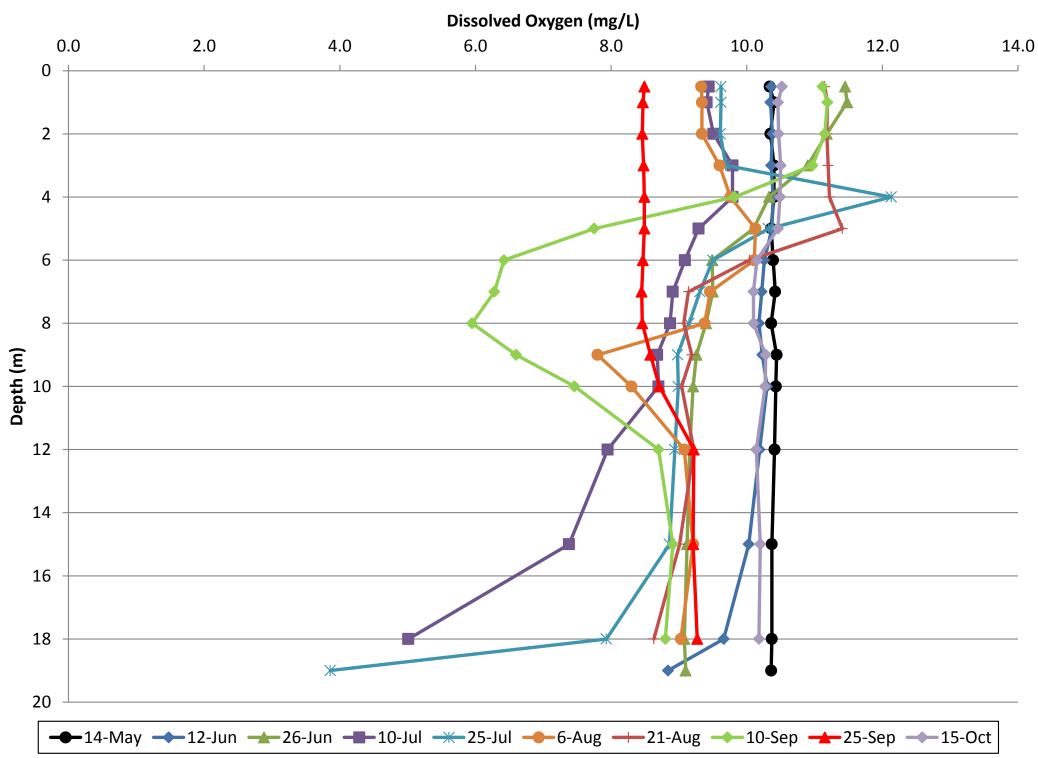

Figure 23. DO Profiles at Station LL3, May-October 2013

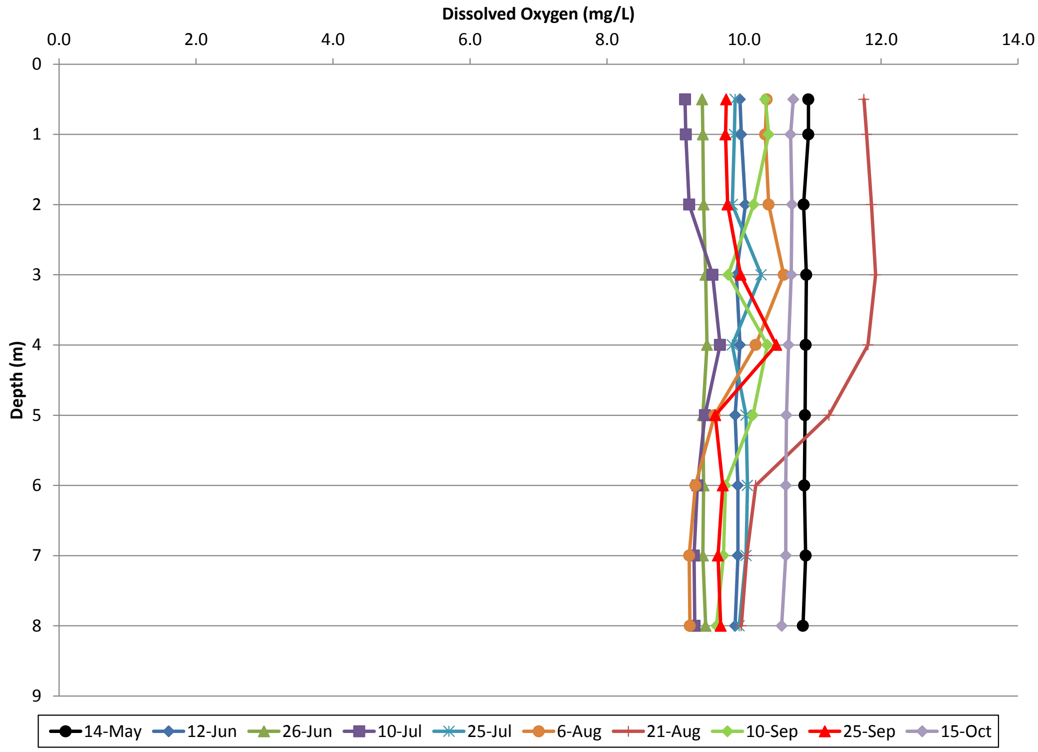

Figure 24. DO Profiles at Station LL4, May-October 2013

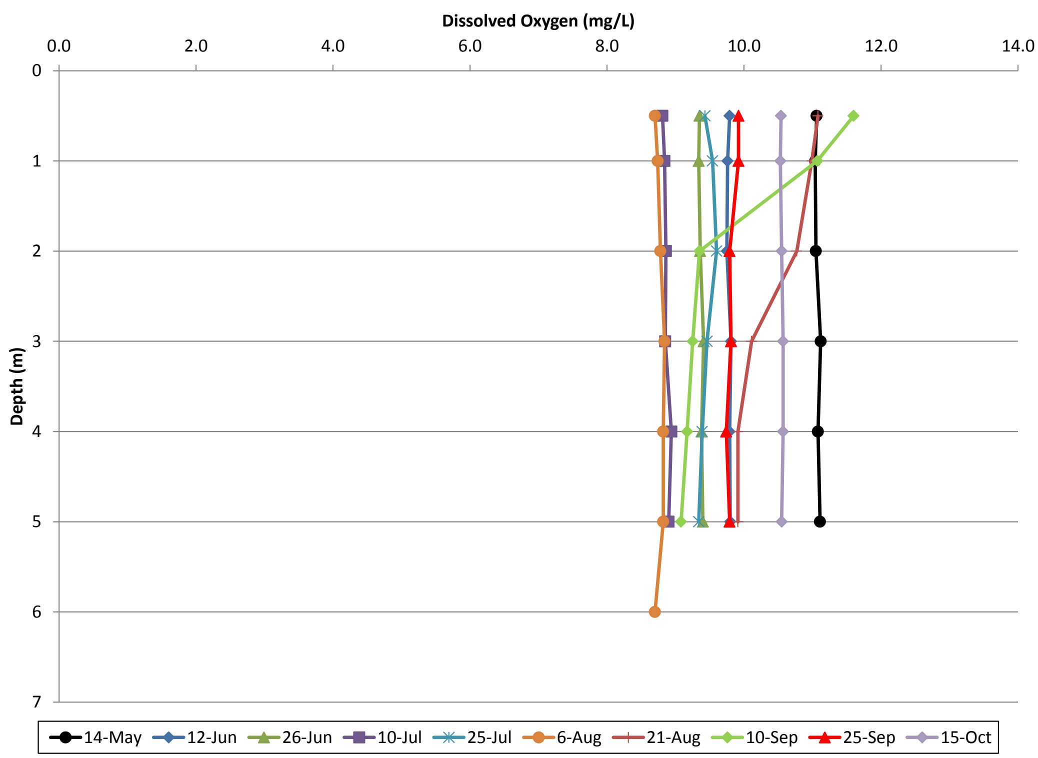

Figure 25. DO Profiles at Station LL5, May-October 2013

3.2.4 PH

The water column profiles for pH showed a range of 6.6 to 9.1 at the six stations during 2013 (Figures 26 through 31). Water column averages were narrower, ranging less than one pH unit, 7.3 to 8.0. The highest pH values occurred during July, August, and September due to photosynthetic activity of phytoplankton. Intense phytoplankton photosynthesis can raise pH to levels above 10, which did not occur. The high levels (9.0 to 9.1) occurred in the top 5 to 6 m at all stations, even at station LL5 in the riverine zone. This is different than conditions observed in 2012 where pH levels at LL5 remained well below 9.0, which may be due to shorter water residence time at that site. In 2013, on the other hand, residence times was longer, especially in late summer, allowing more time for photosynthetic activity. Chl concentration at LL5 peaked on September 10 at 9.6 µg/L, corresponding to the peak in pH.

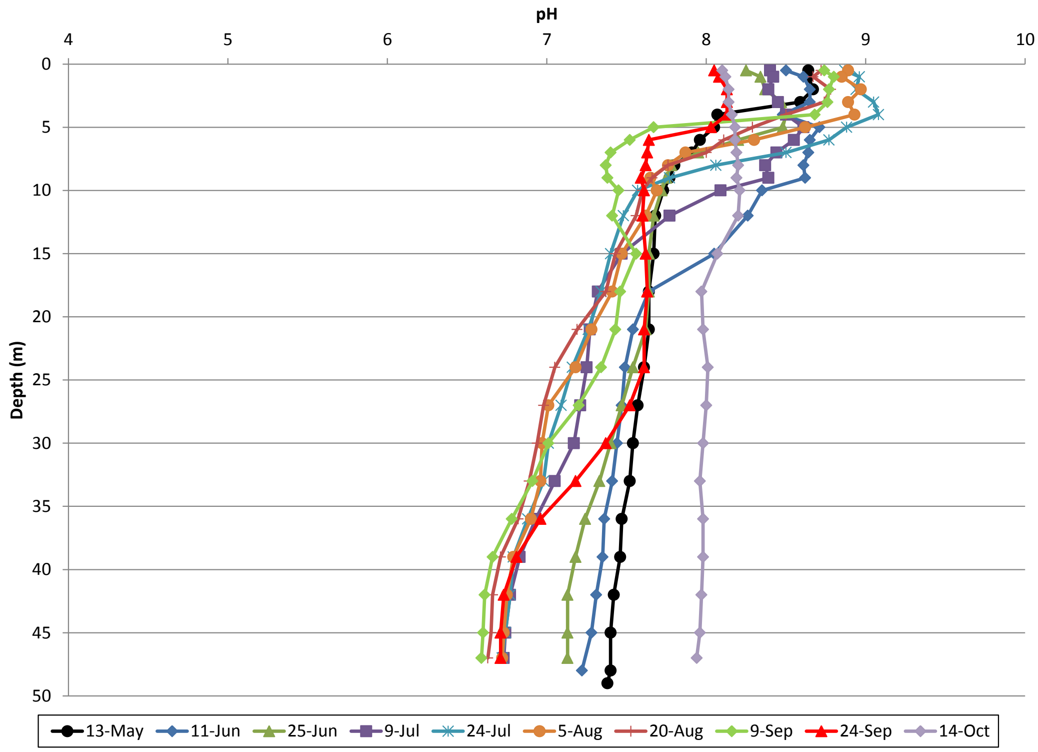

Figure 26. pH Profiles for Station LL0, May-October 2013

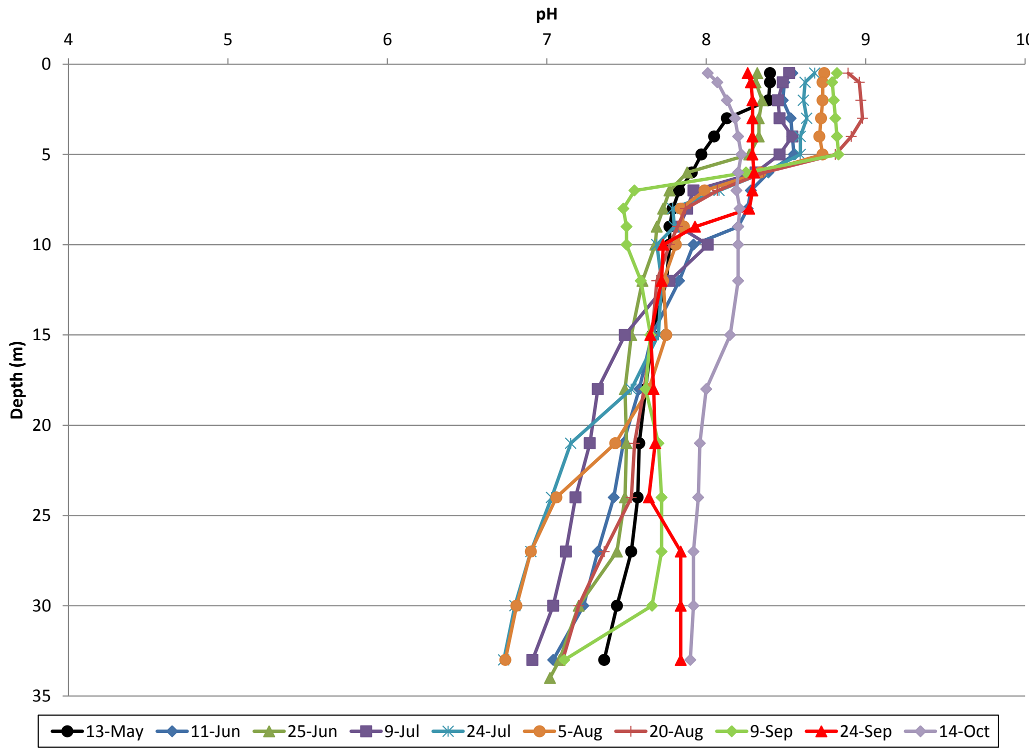

Figure 27. pH Profiles for Station LL1, May-October 2013

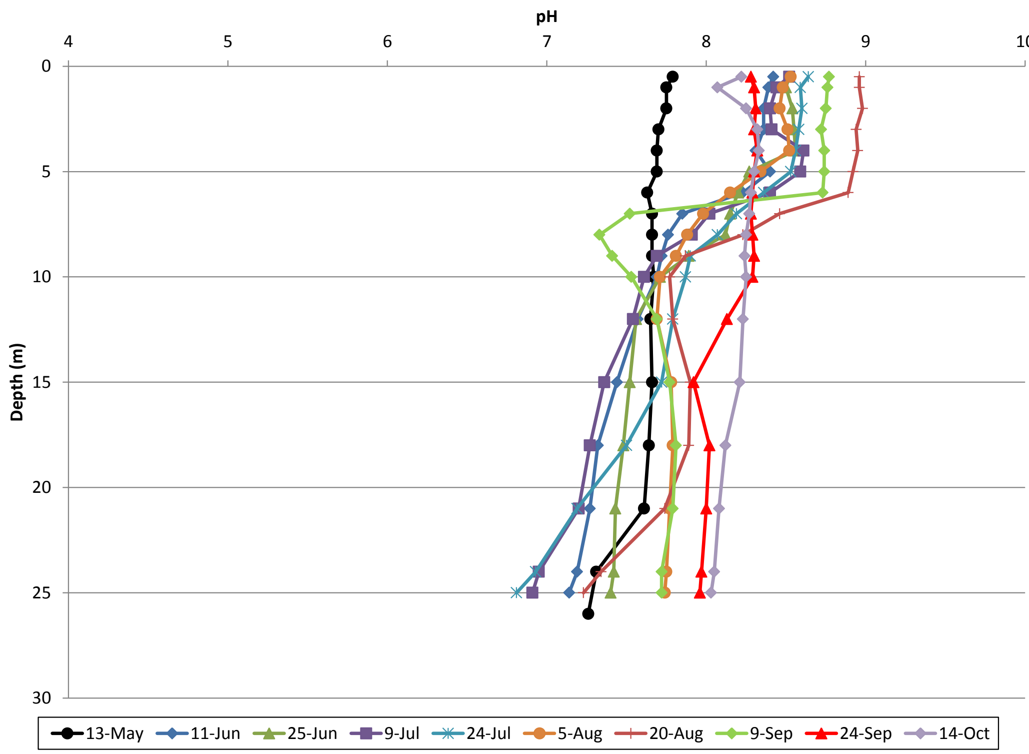

Figure 28. pH Profiles at Station LL2, May-October 2013

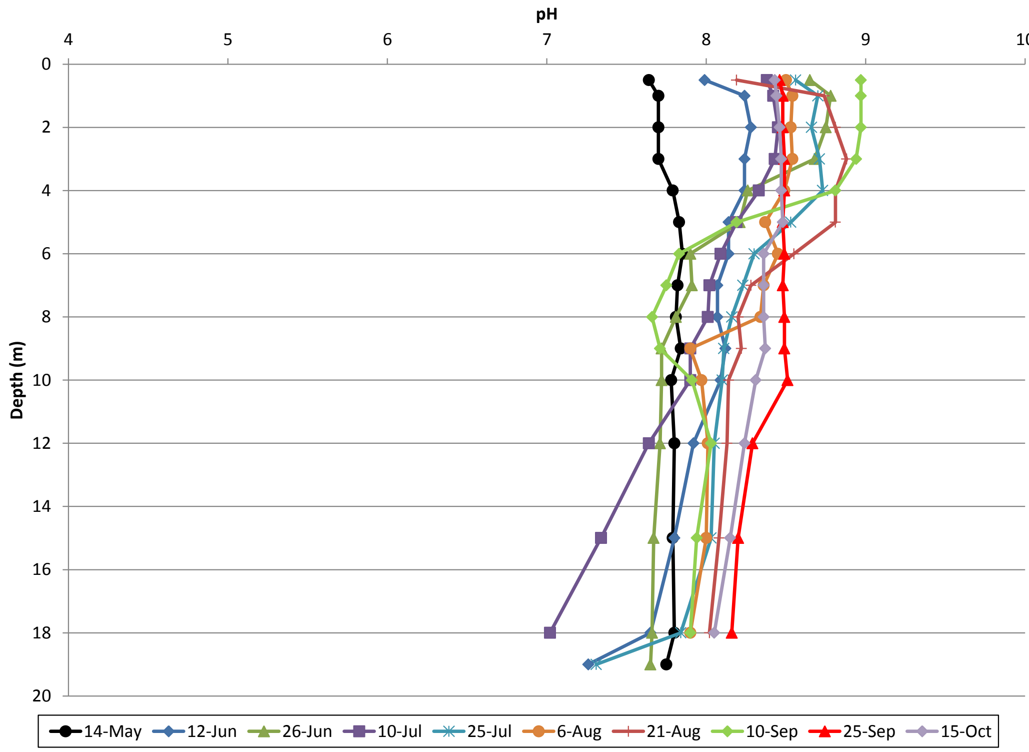

Figure 29. pH Profiles at Station LL3, May-October 2013

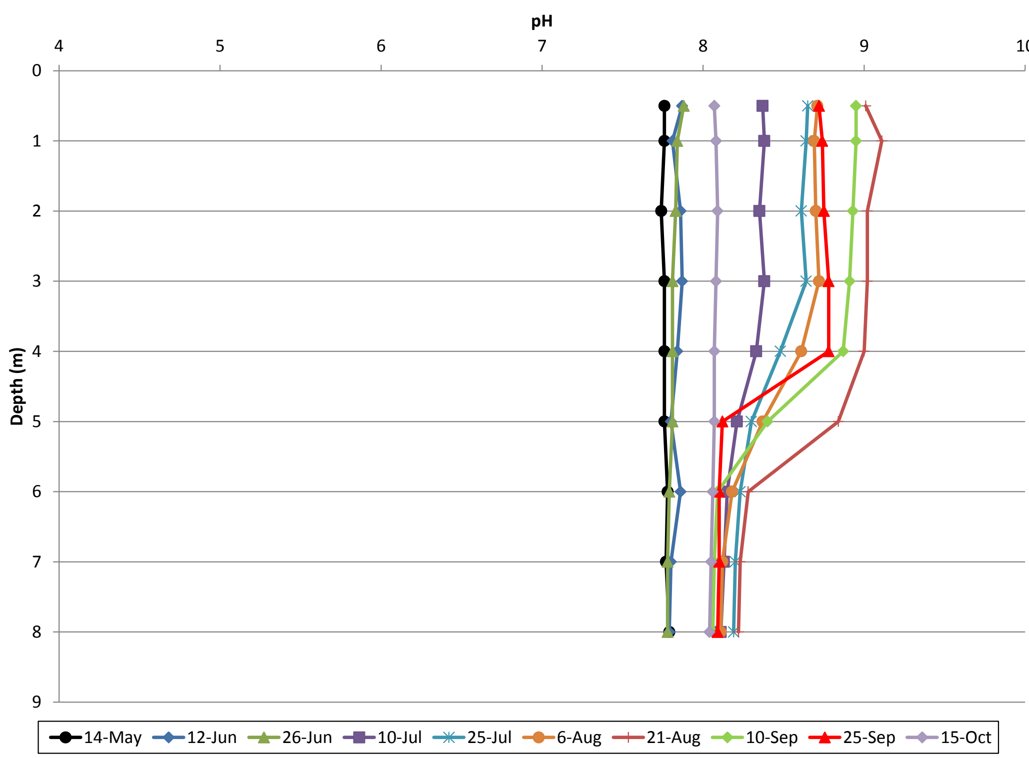

Figure 30. pH Profiles at Station LL4, May-October 2013

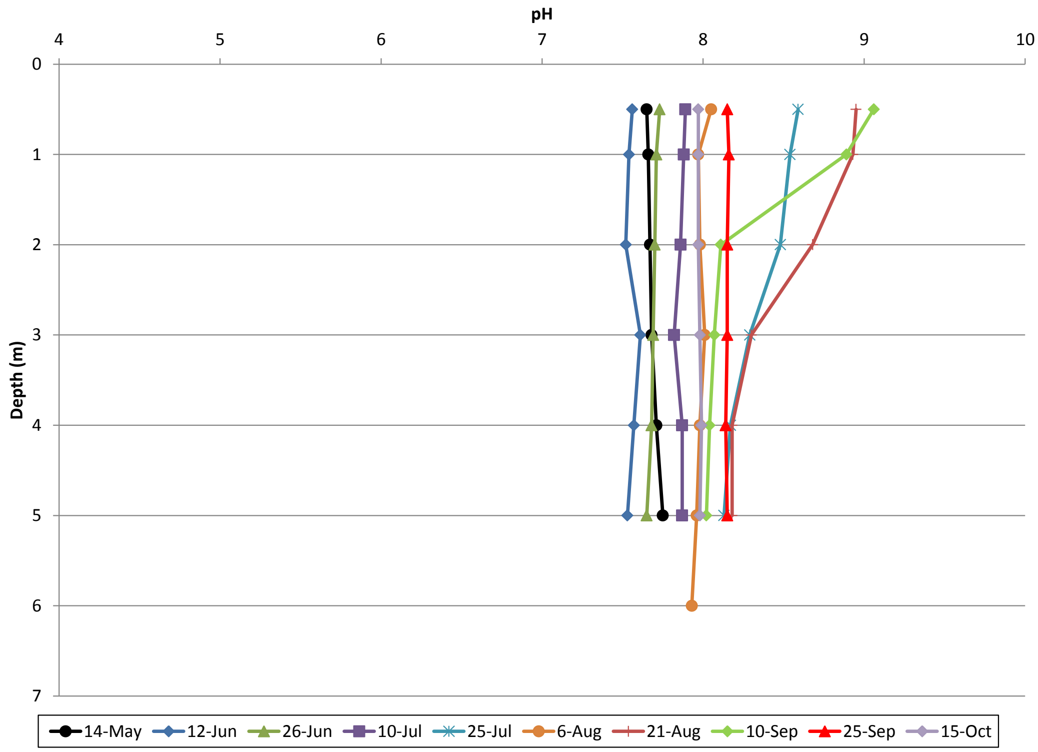

Figure 31. pH Profiles at Station LL5, May-October 2013

3.2.5 NUTRIENTS

Phosphorus

TP concentrations ranged from 3.9 to 67 µg/L during 2013. SRP concentrations ranged from 1.0 (non-detect [ND]) to 27 µg/L. TP and SRP were usually highest at stations LL0, LL1, and LL2 in the hypolimnion (15 m and deeper) with higher levels starting in July (Figures 32 through 37). At these three stations, TP at 5 m was often higher than at 15 or 20 m with peaks occurring at various times throughout the summer. In contrast, TP at 5 m at these stations in 2012 was relatively stable. At LL0, TP at 5 m was higher than at 15 m for most of the summer (Figure 32).

The increase in bottom SRP at LL0 – LL2 began with decreasing DO with maximum concentrations occurring with minimum DO at stations LL1 and LL2. At station LL0, peak bottom SRP occurred in early July and again at the end of August. Minimum DO at LL1 was ≤ 2 mg/L on two occasions, early August and early September and minimum DO at LL2 was never less than 2 mg/L. Peak TP and SRP concentrations were greatest at LL2, where bottom DO was the highest of the three stations. This varies from last year where peak concentrations coincided with minimum DO at LL1. Bottom DOs in the lacustrine zone were much lower in 2013 than in 2012, yet TP and SRP reached higher levels in 2012 – 60 v. 30 µg/L TP at LL1. Anoxia is apparently not the only factor driving internal loading.

TP and SRP concentrations at station LL3 were higher at the bottom of the water column (Figures 38 and 39). This is in contrast to 2012 where TP peaked at 5 m in October. The peaks in bottom TP and SRP in early July do correspond with low DOs, although not anoxia conditions. Nonetheless, internal loading was apparently occurring at LL3.

TP at LL4 began to increase in July and was variable throughout the rest of the summer (Figure 40). TP peaked at 4 m in both early August and late September, and were almost always higher than those observed at the surface and usually higher than concentrations at the bottom. Peak TP concentrations in late September corresponded to peak chl concentrations. SRP concentrations at LL4 were very stable, almost always below 5 µg/L, with occasional spikes at the bottom throughout the summer (Figure 41).

TP concentrations at station LL5 were relatively stable throughout the period with the exception of a large spike in late August and early September at the 0.5 m (Figures 42). Water column TP concentrations were usually around 15 µg/L or less and showed little indication of internal loading. There was a large storm event at the beginning of September that could have caused the large spike in TP observed in early September. SRP concentrations at LL5 were usually below 5 µg/L with the exception of the bottom sample on September 10 when SRP was 5.9 µg/L.

Surface TP concentrations in the lacustrine zone (LL0, LL1, LL2) were relatively stable during the period and slightly lower than those in the transition and riverine zones. Epilimnion concentrations in the lacustrine zone were variable through the period due to their variability at the 5 m depth. Epilimnetic mean TP in the lacustrine zone peaked in May, again in early July and again in late September with intermediate declines (Figure 44). This is a much different pattern than observed in previous years where there was a general downward trend throughout the summer (Figure 44). Samples from within the metalimnion/interflow zone (10 to 20 m) showed an increase in SRP during the summer when bottom SRP was high. That increase in SRP may indicate diffusion from the hypolimnion.

Volume-weighted water column TP concentrations at the six stations were fairly similar for most of the year (Table 6; Figure 45). TP concentrations were slightly lower at LL1 and LL0 than at other sites during the beginning of the period but tended to be higher in July. TP at stations LL4 and LL5 were usually higher than at down reservoir stations during August and September (Figure 45; Table 6). However, volume-weighted TP concentrations for all stations were below 25 µg/L and for most of the period below 20 µg/L. The generally higher water column TPs at LL4 and LL5 during August and September in 2013 are in contrast to the pattern in 2012 and may indicate a greater effect of internal loading with the lower late summer flows and longer water residence time in 2013. Internal loading occurs in the riverine and transition zones of reservoirs, despite usually oxic conditions at the sediment-water interface (Cooke et al. 2011).

Table 6. Volume-Weighted Water Column TP Concentrations for Monitoring Stations in 2013

2013 Sampling Event	Volume Weighted Water Column TP (µg/L)					
	LL0	LL1	LL2	LL3	LL4	LL5
May 13-14	13	14	17	19	17	16
June 11-12	12	11	11	14	12	12
June 25-26	10	11	12	18	14	15
July 9-10	21	14	21	18	13	12
July 24-25	12	20	14	12	13	11
August 5-6	15	14	20	17	27	10
August 20-21	18	10	11	20	21	28
September 9-10	14	11	13	17	24	50
September 24-25	12	22	16	15	33	13
October 14-15	13	11	11	15	10	10
Mean	14	14	15	17	19	18
Summer Mean (Jun-Sep)	14	14	15	16	20	19

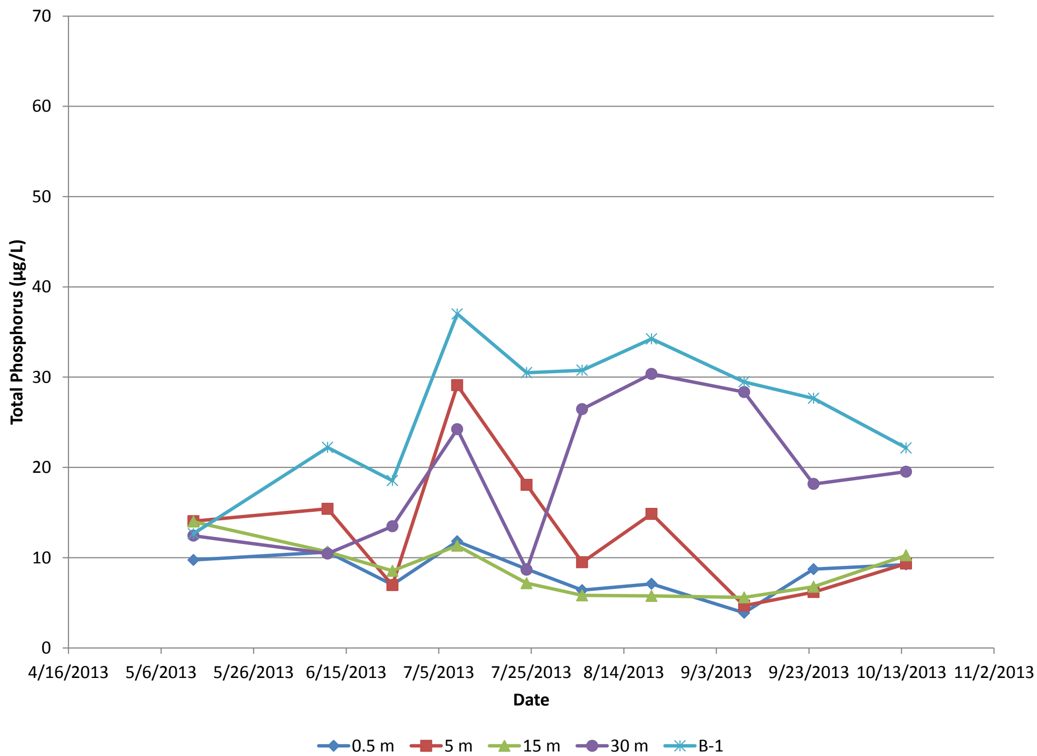

Figure 32. TP Concentrations (µg/L) at Station LL0, May-October 2013

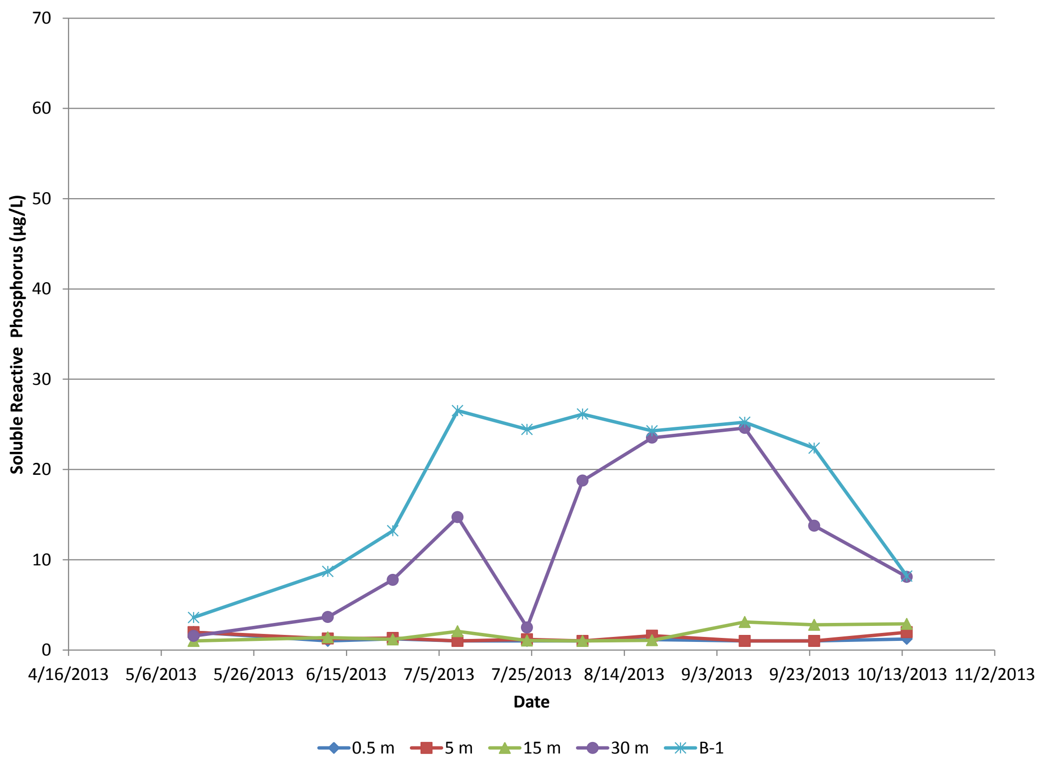

Figure 33. SRP Concentrations (µg/L) at Station LL0, May-October 2013

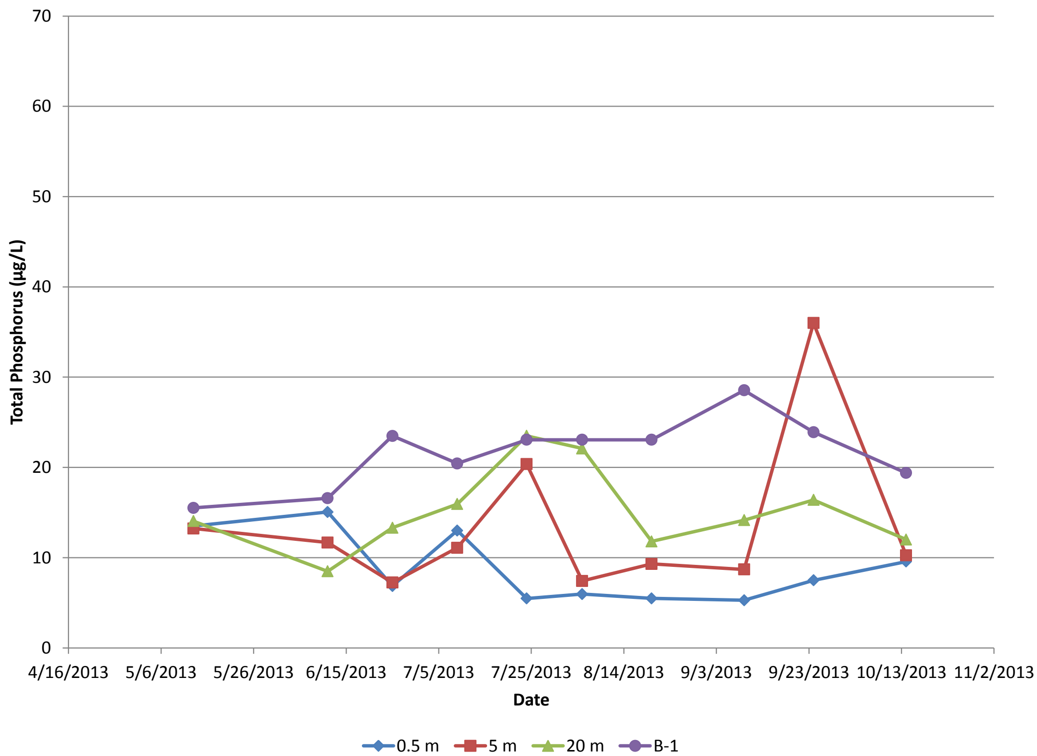

Figure 34. TP Concentrations (µg/L) at Station LL1, May-October 2013

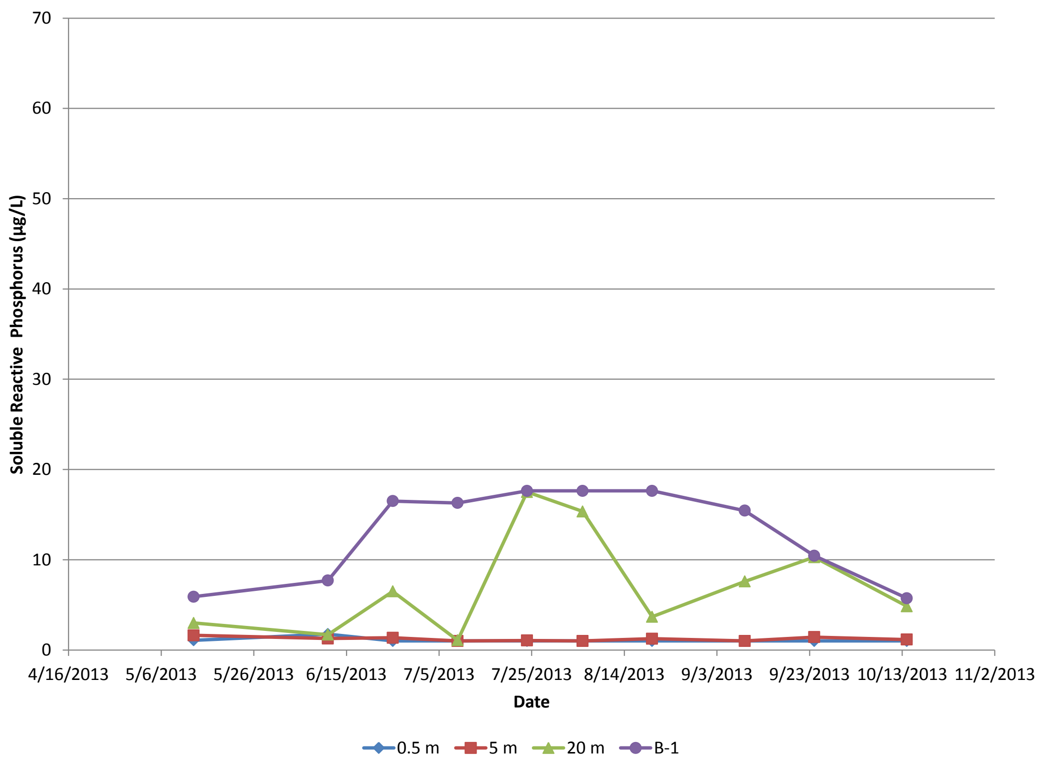

Figure 35. SRP Concentrations (µg/L) at Station LL1, May-October 2013

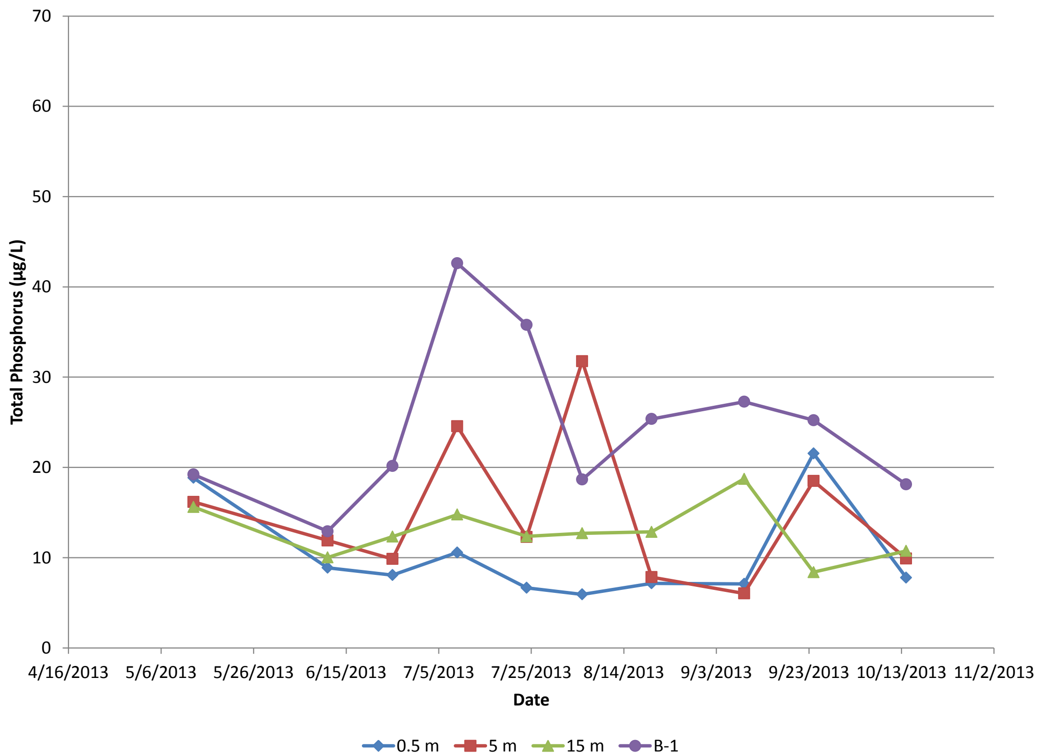

Figure 36. TP Concentrations (µg/L) at Station LL2, May-October 2013

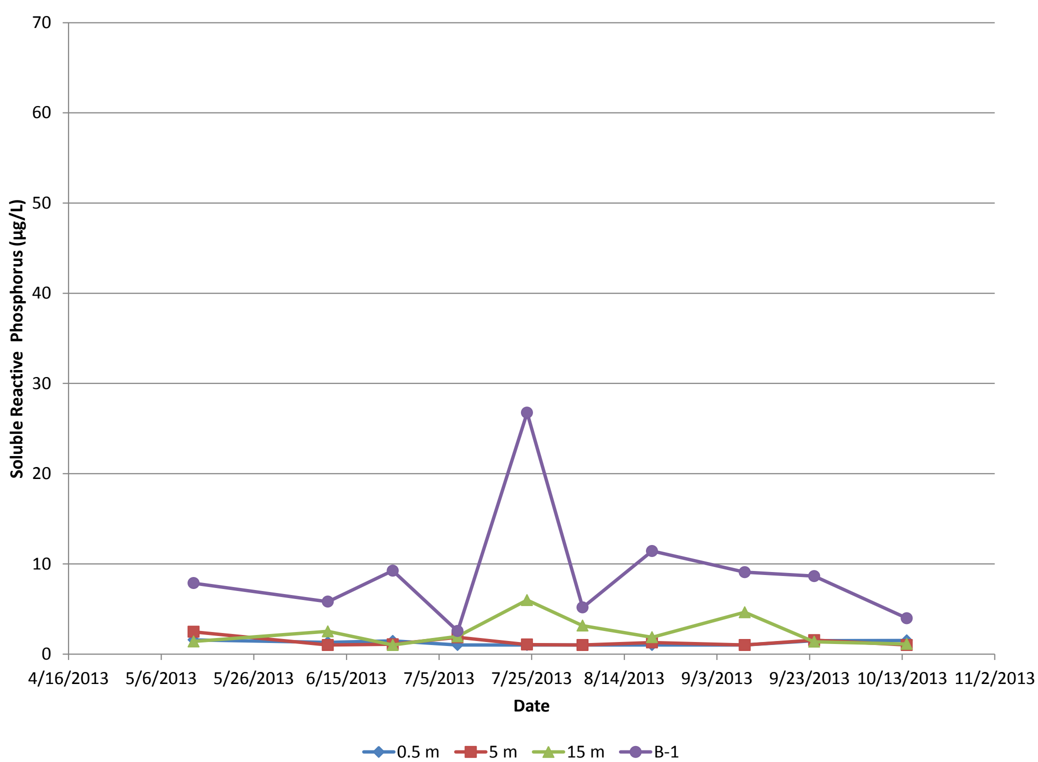

Figure 37. SRP Concentrations (µg/L) at Station LL2, May-October 2013

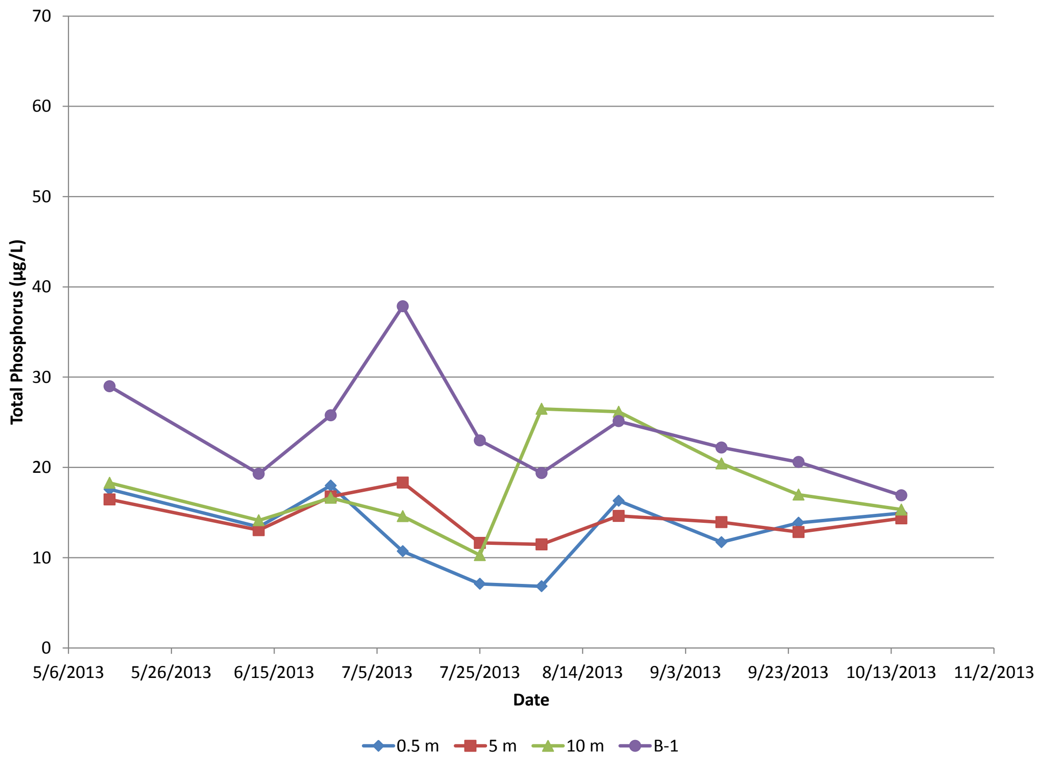

Figure 38. TP Concentrations (µg/L) at Station LL3, May-October 2013

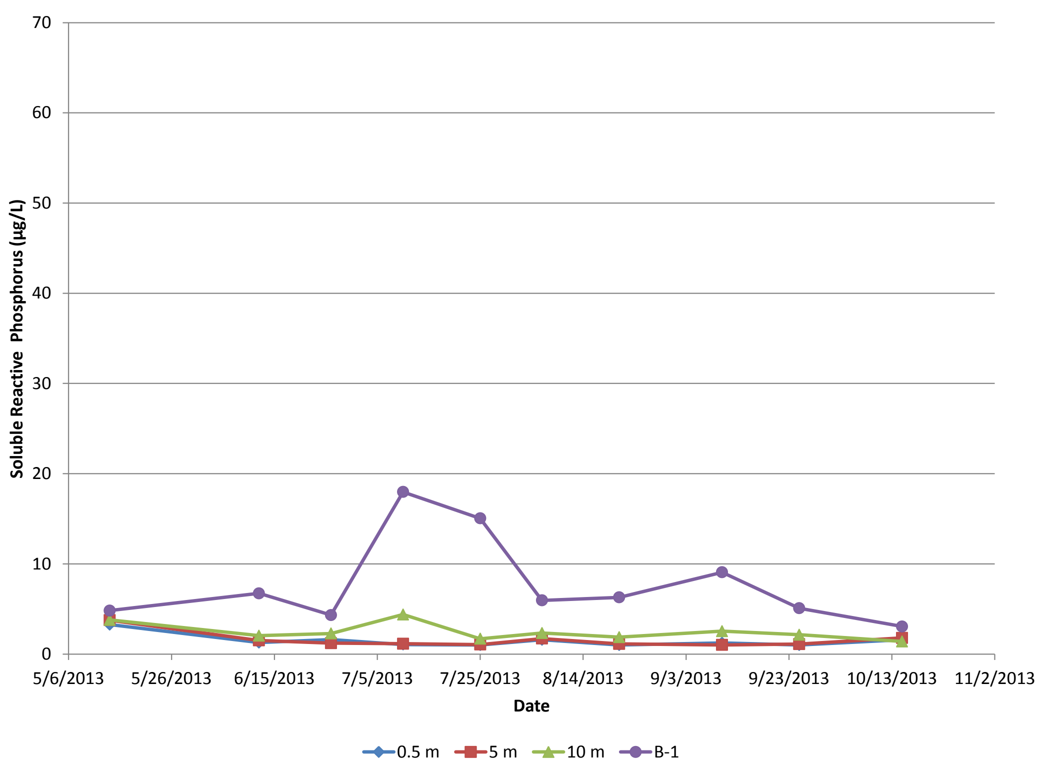

Figure 39. SRP Concentrations (µg/L) at Station LL3, May-October 2013

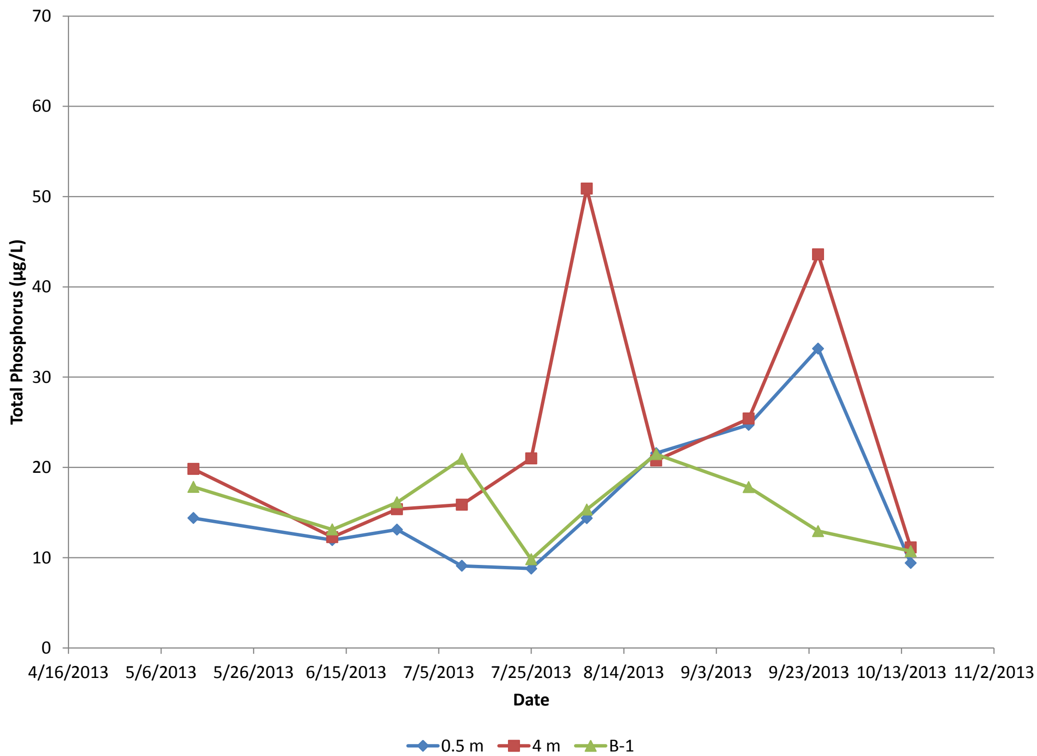

Figure 40. TP Concentrations (µg/L) at Station LL4, May-October 2013

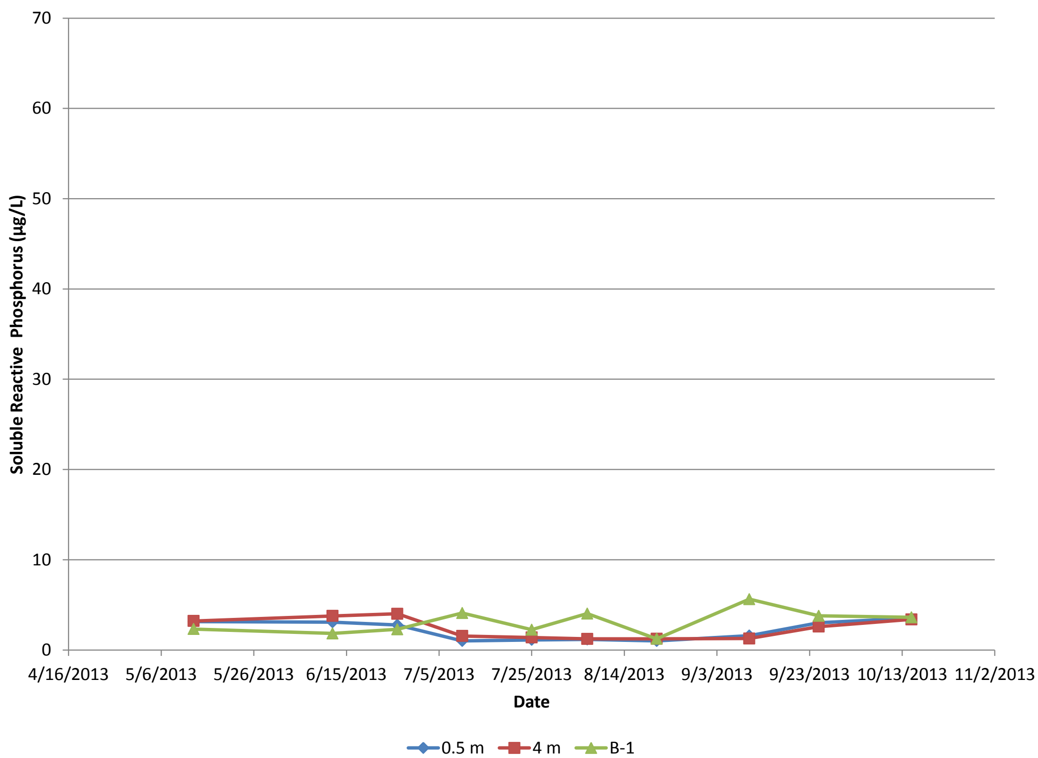

Figure 41. SRP Concentrations (µg/L) at Station LL4, May-October 2013

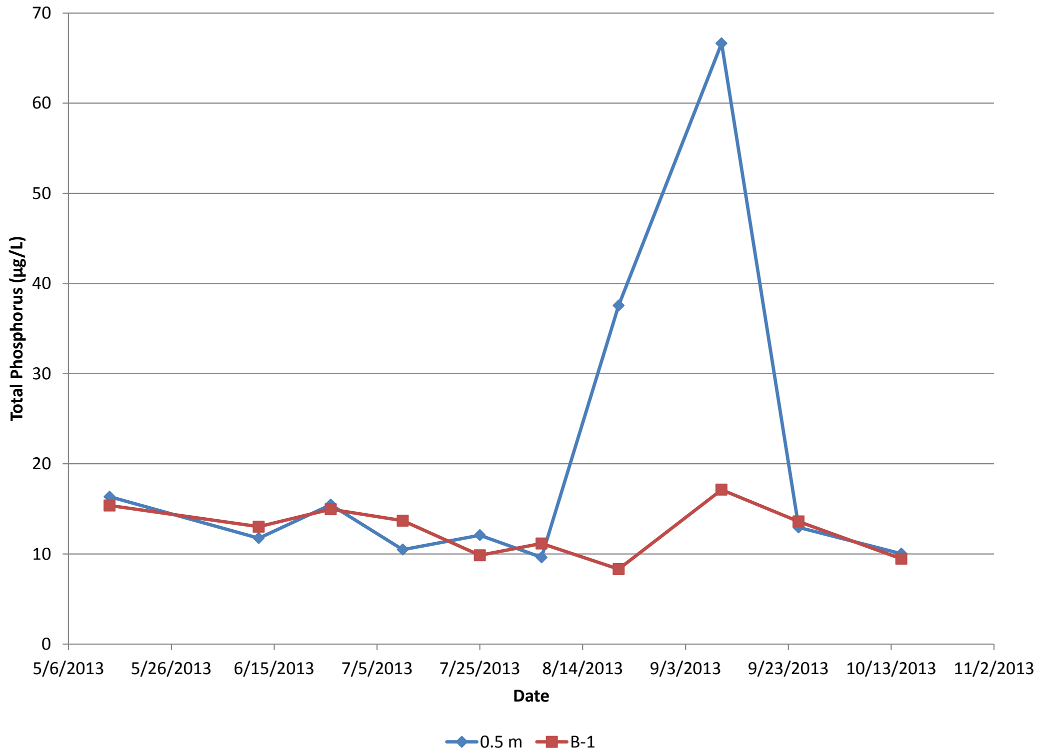

Figure 42. TP Concentrations (µg/L) at Station LL5, May-October 2013

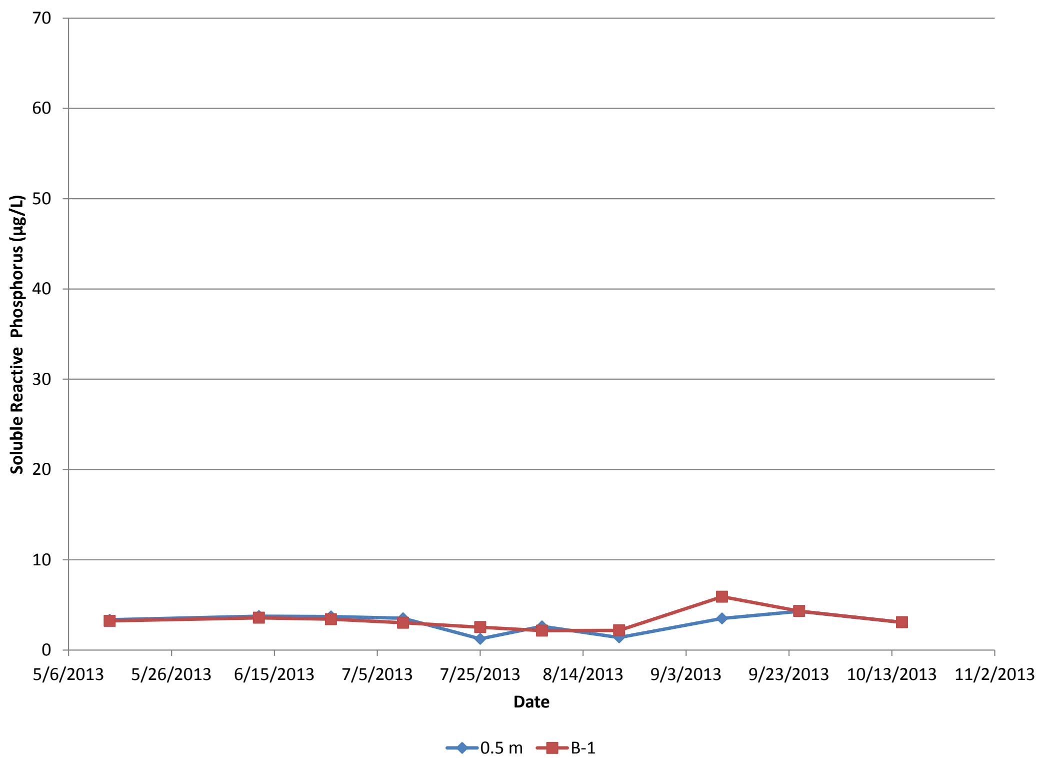

Figure 43. SRP Concentrations (µg/L) at Station LL5, May-October 2013

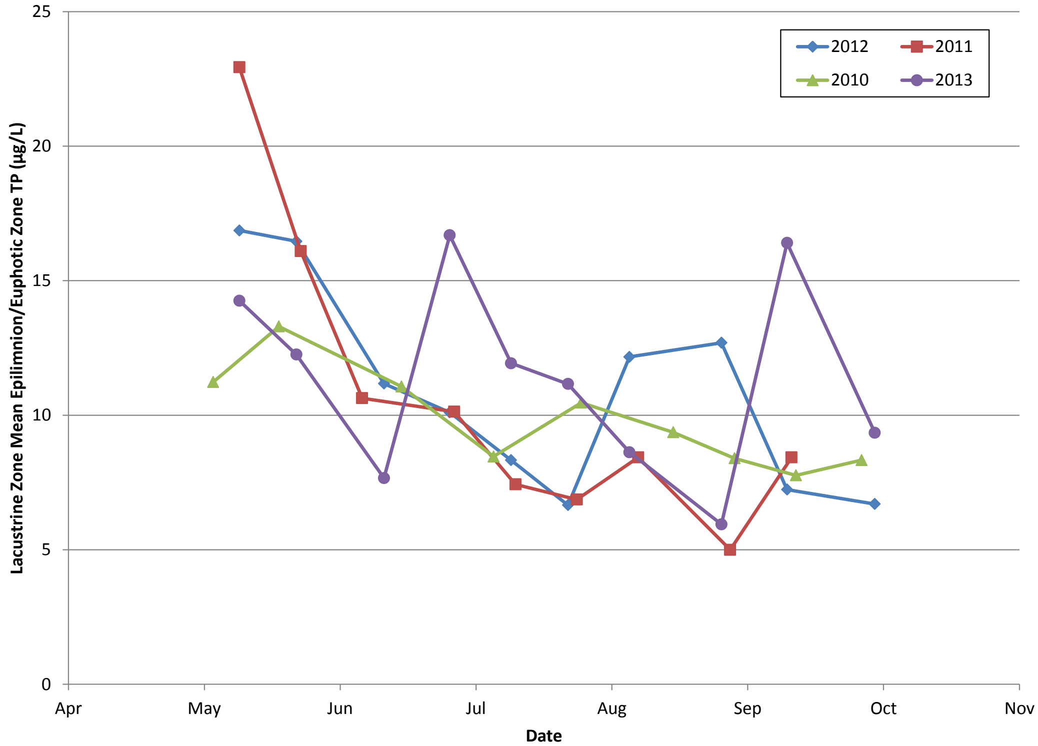

Figure 44. Mean Epilimnion TP Concentrations in the Lacustrine Zone in Lake Spokane, 2010-2013

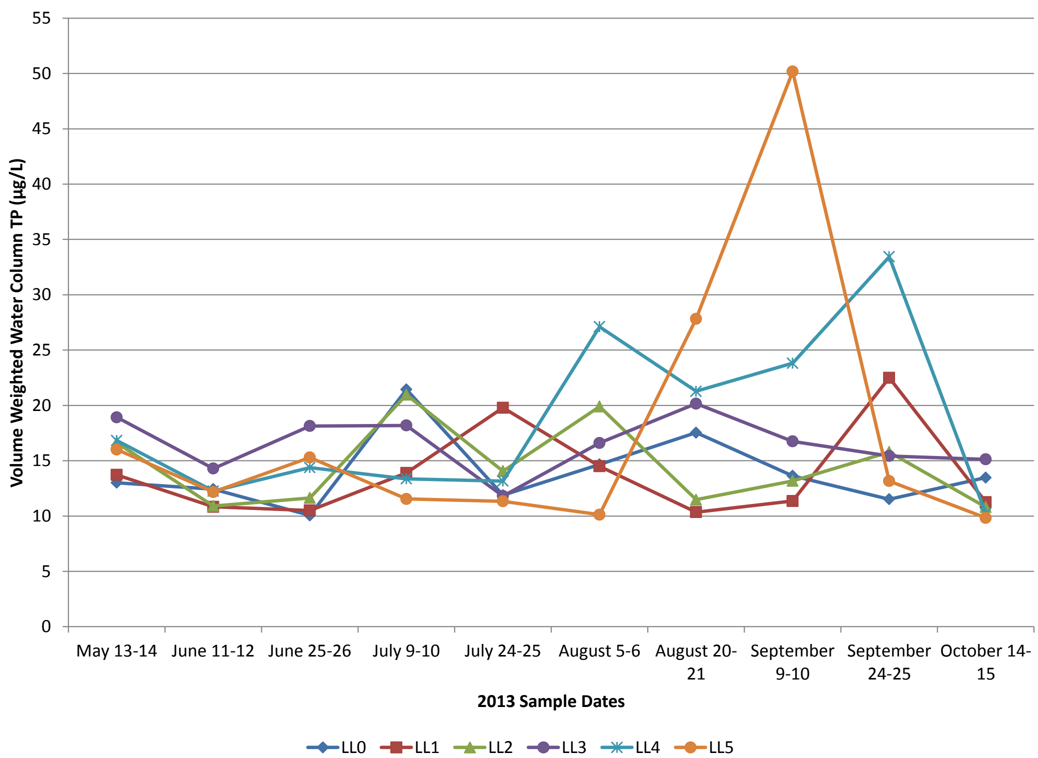

Figure 45. Volume-Weighted Water Column TP Concentrations, 2013

Nitrogen

Total nitrogen (TN) concentrations at all six stations ranged from 281 to 1873 µg/L over the monitoring period. Nitrate+nitrite N (NO_3+NO_2-N) concentrations ranged from 160 to 1578 µg/L over the monitoring period. Thus, most of the TN is nitrate+nitrite.

The lowest levels of nitrogen occurred in May at all sites. Nitrogen increased, for the most part, throughout the reservoir during the monitoring period (Figures 46 through 57). Starting in July, concentrations in the metalimnion and upper hypolimnion increased more than in the epilimnion at most sites. Higher concentrations were generally observed in the hypolimnion and bottom water at all stations during the monitoring period, except at station LL0 where nitrogen concentrations at the bottom were much lower than concentrations observed at 15 and 30 m and in some instances lower than those observed at the surface. Bottom concentrations at LL0 increased in October when the water column began to mix.

Increased hypolimnetic and metalimnetic concentrations in late summer may be due to a combination of internal loading and plunging of river inflow; note that late summer hypolimnetic and metalimnetic concentrations were roughly equal to those at LL5, the inflow. That may be due to groundwater being an important source of inflow N during late summer low flow (see 3.2.9). Station LL5 had the highest maximum concentrations measured of all stations monitored in 2013.

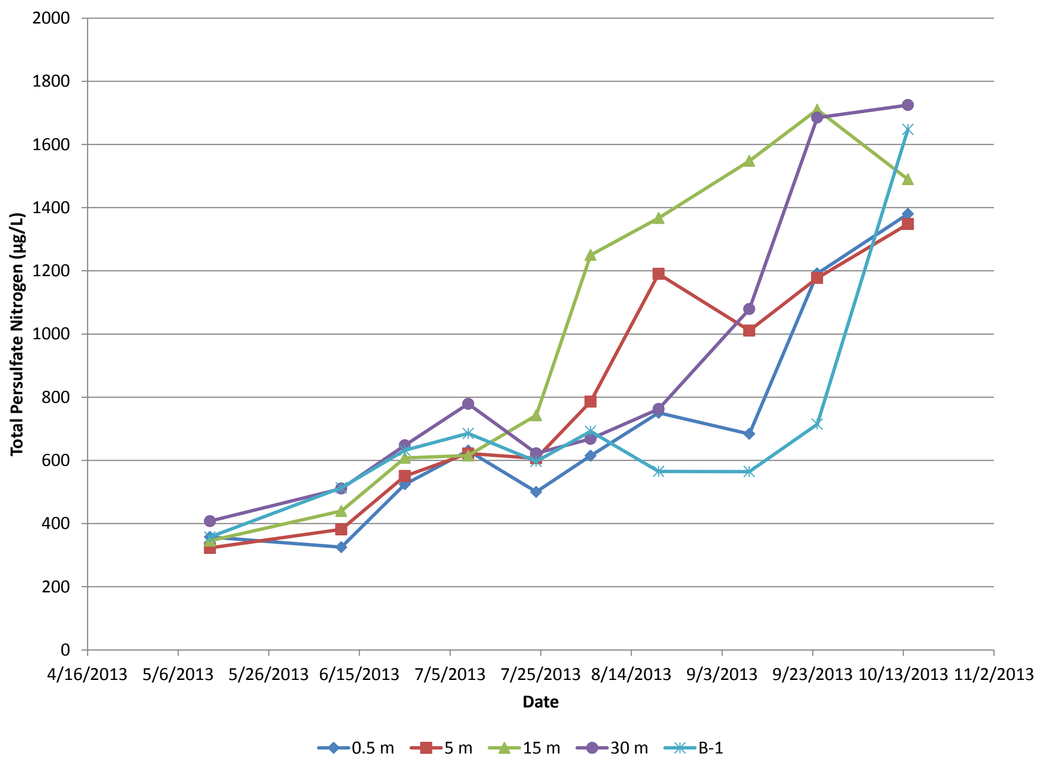

Figure 46. TN Concentrations (µg/L) at Station LL0, May-October 2013

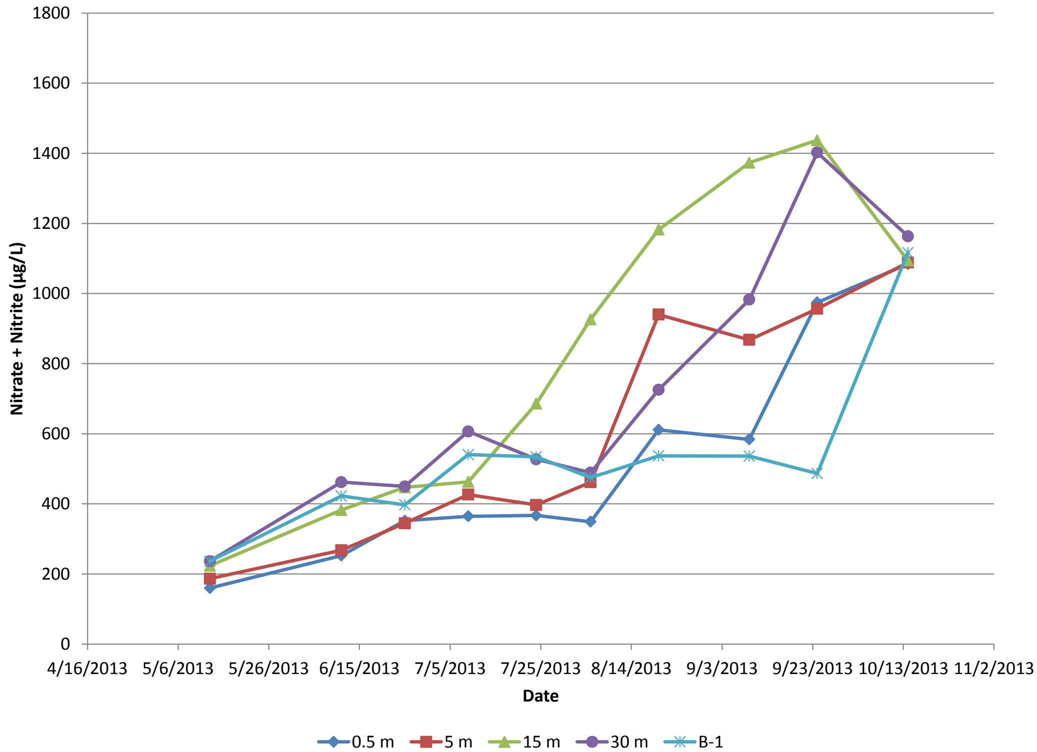

Figure 47. NO_3+NO_2 Concentrations (µg/L) at Station <u>LL0</u>, May-October 2013

Figure 48. TN Concentrations (µg/L) at Station <u>LL1</u>, May-October 2013

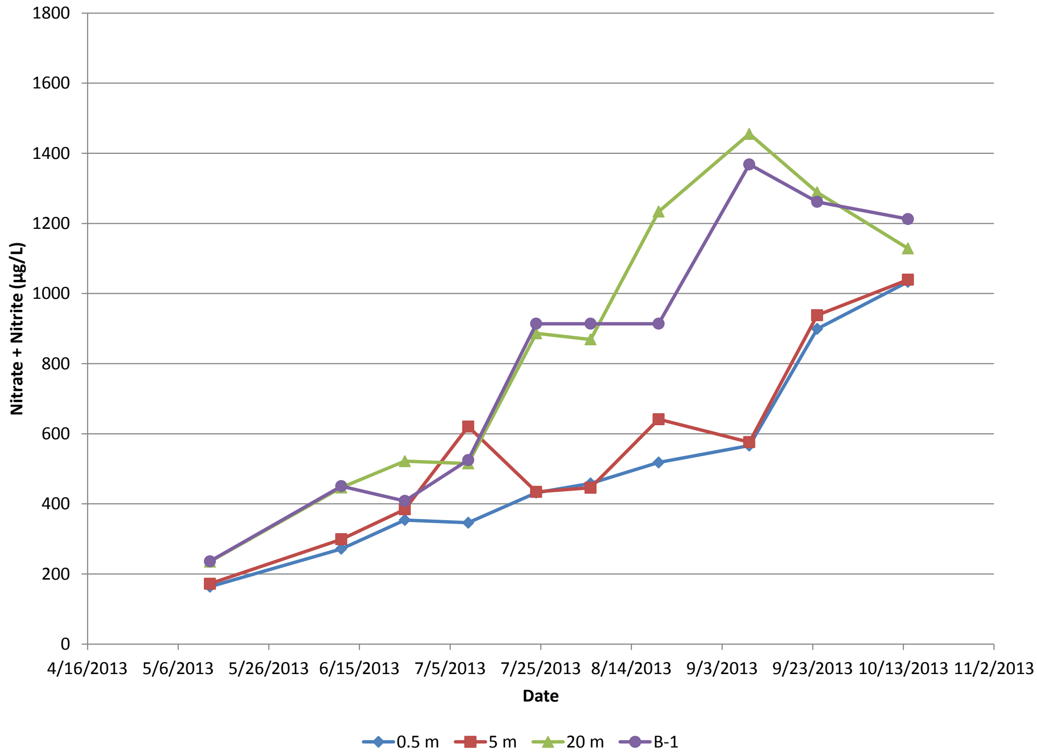

Figure 49. NO_3+NO_2 Concentrations (µg/L) at Station LL1, May-October 2013

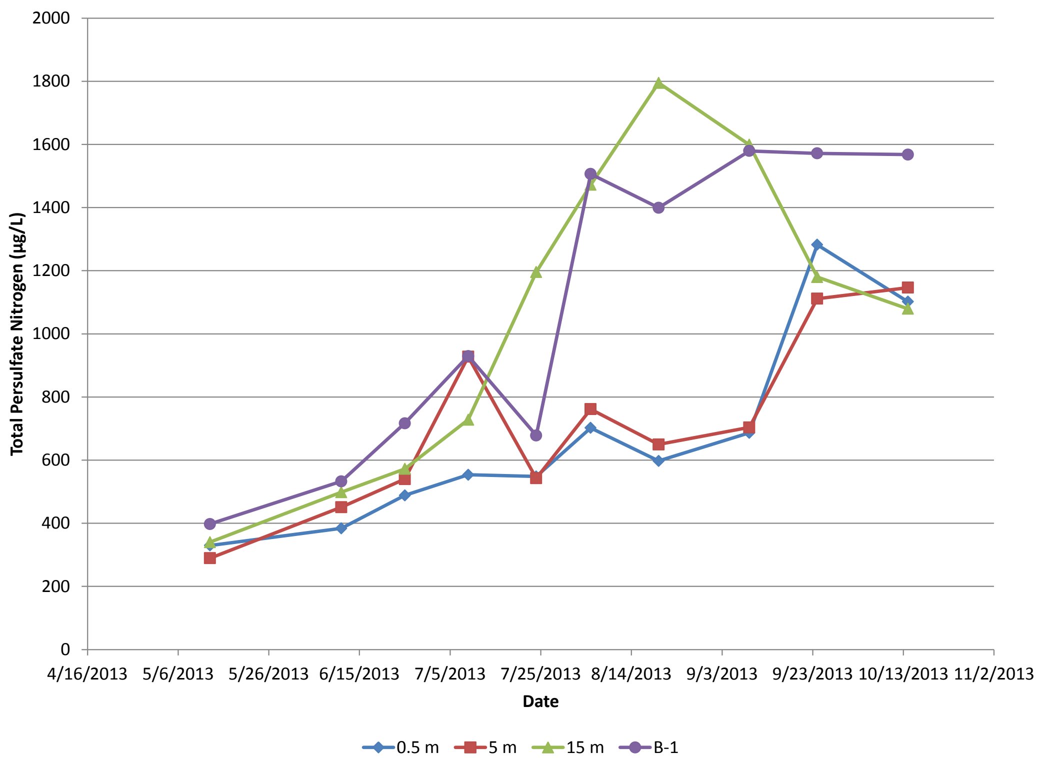

Figure 50. TN Concentrations (µg/L) at Station LL2, May-October 2013

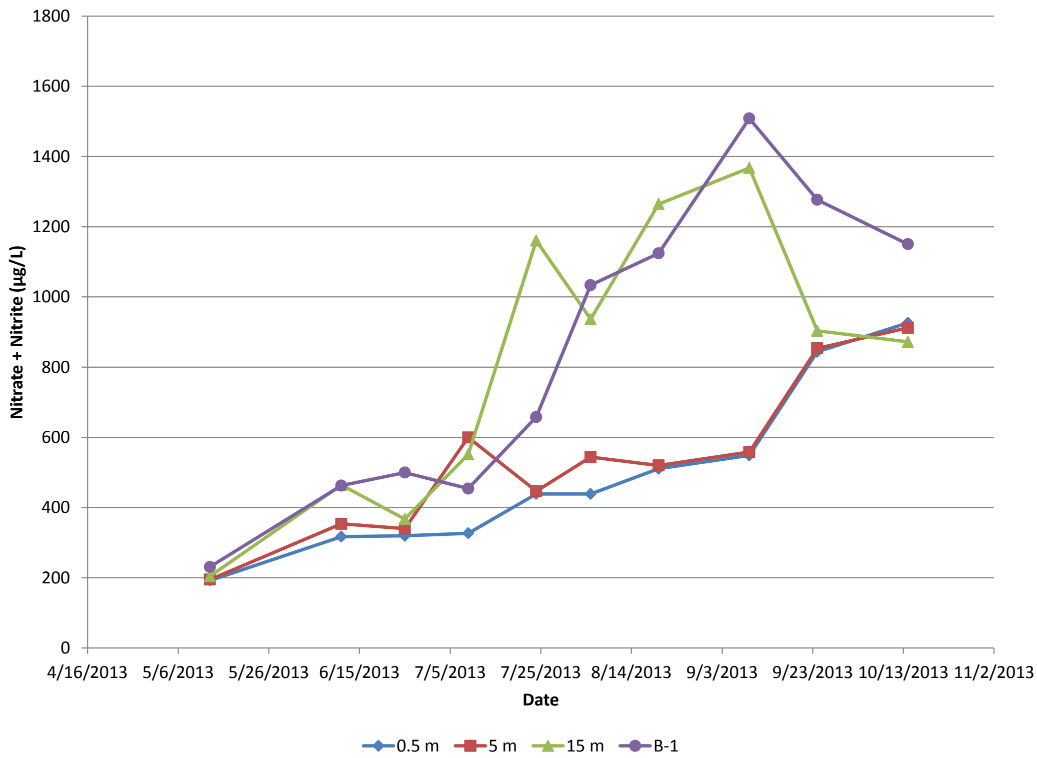

Figure 51. NO_3+NO_2 Concentrations (µg/L) at Station LL2, May-October 2013

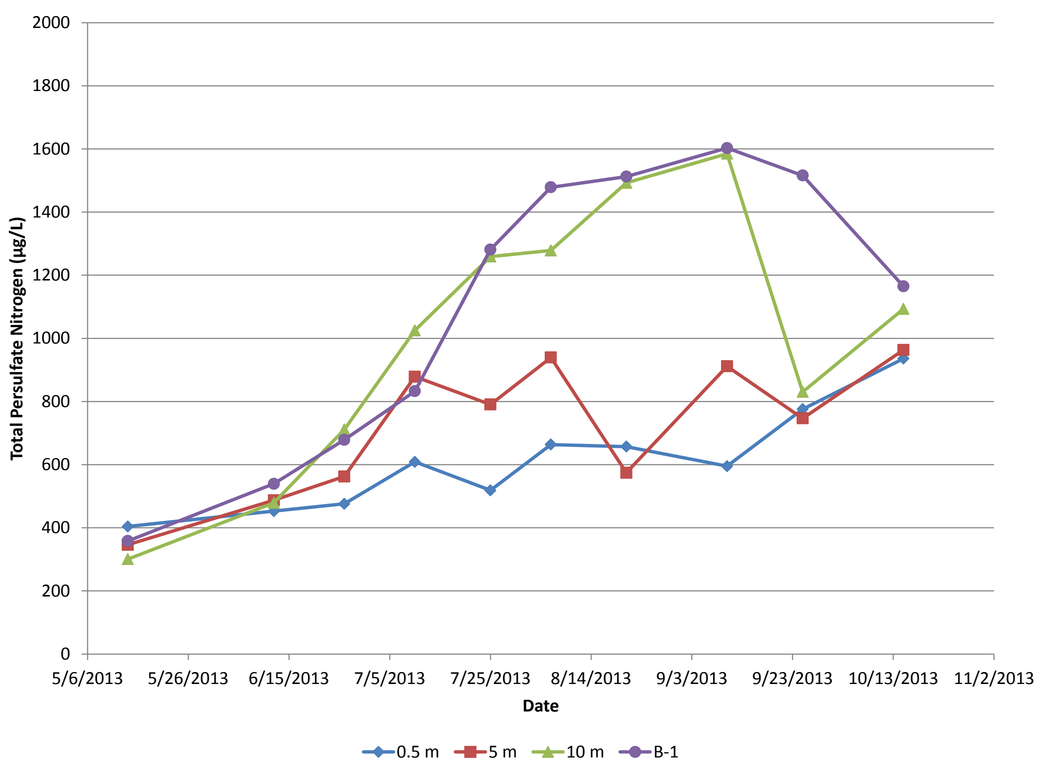

Figure 52. TN Concentrations (µg/L) at Station LL3, May-October 2013

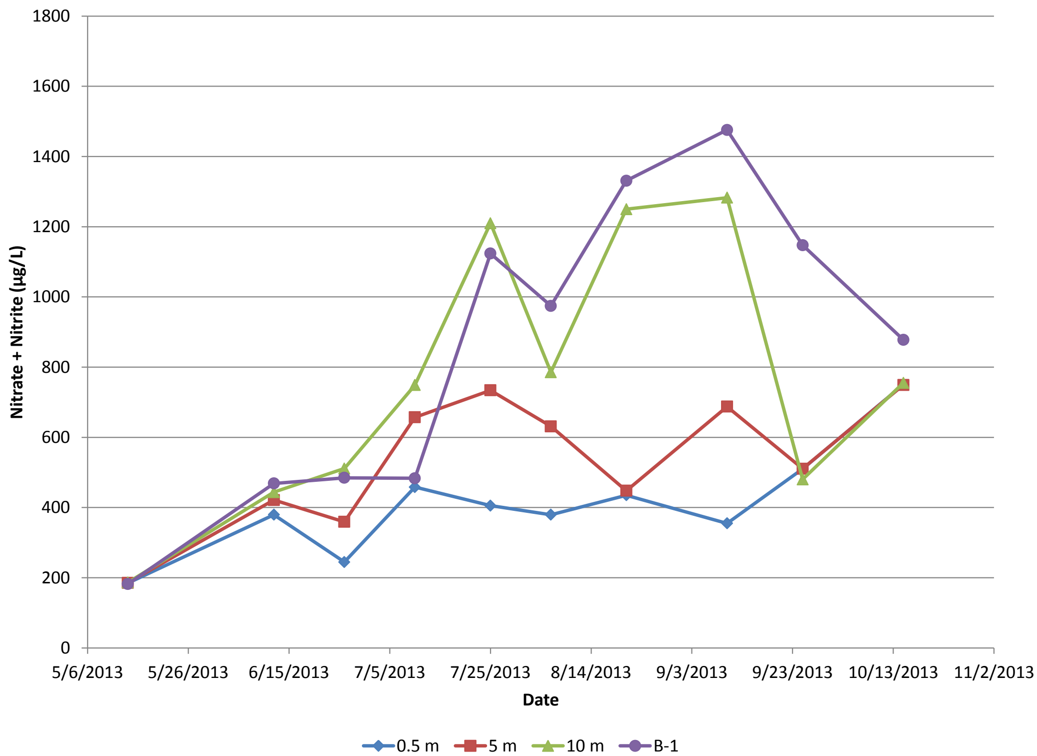

Figure 53. NO3+NO2 Concentrations (µg/L) at Station LL3, May-October 2013

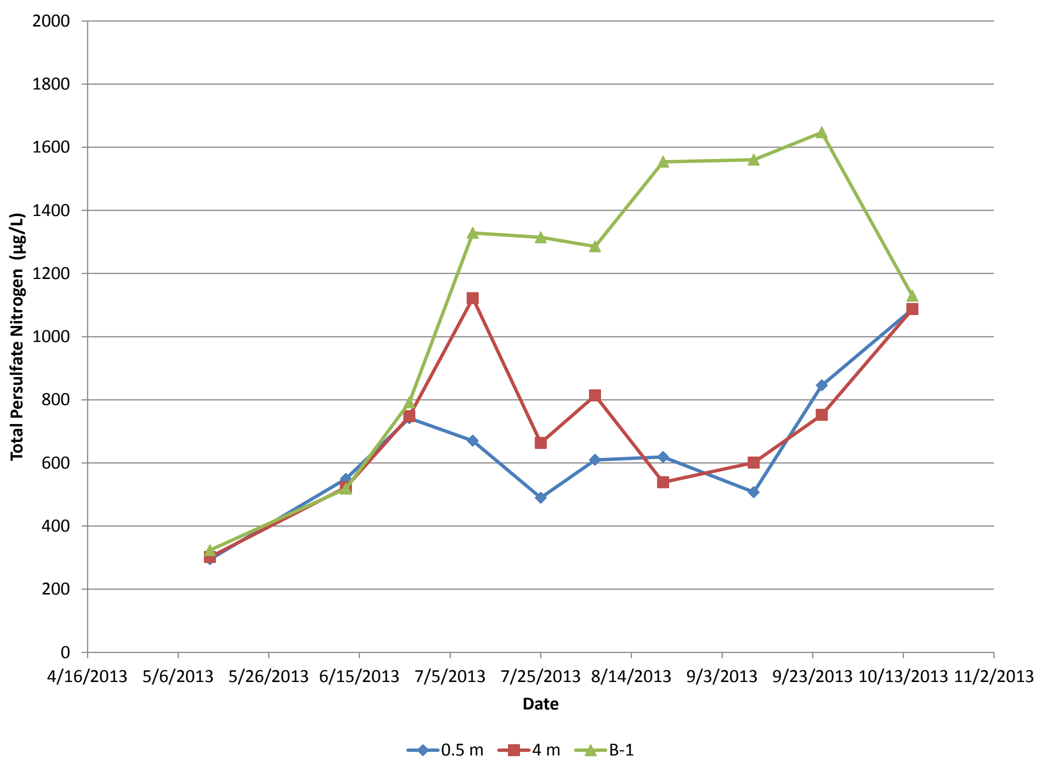

Figure 54. TN Concentrations (µg/L) at Station LL4, May-October 2013

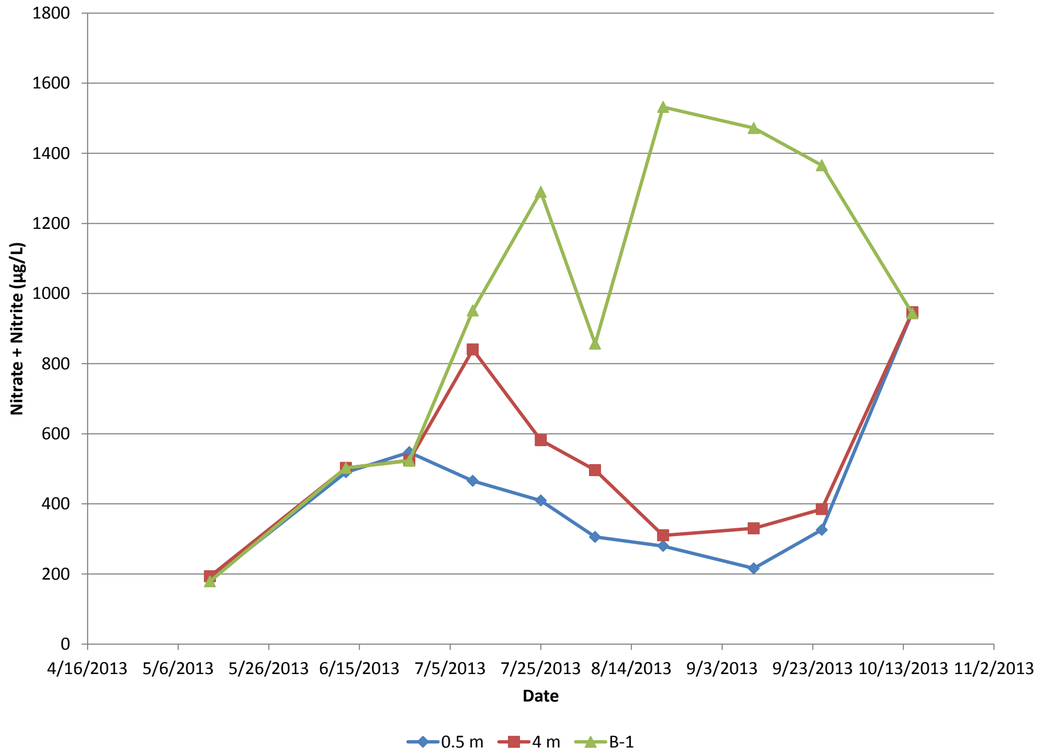

Figure 55. NO_3+NO_2 Concentrations (µg/L) at Station LL4, May-October 2013

Figure 56. TN Concentrations (µg/L) at Station LL5, May-October 2013

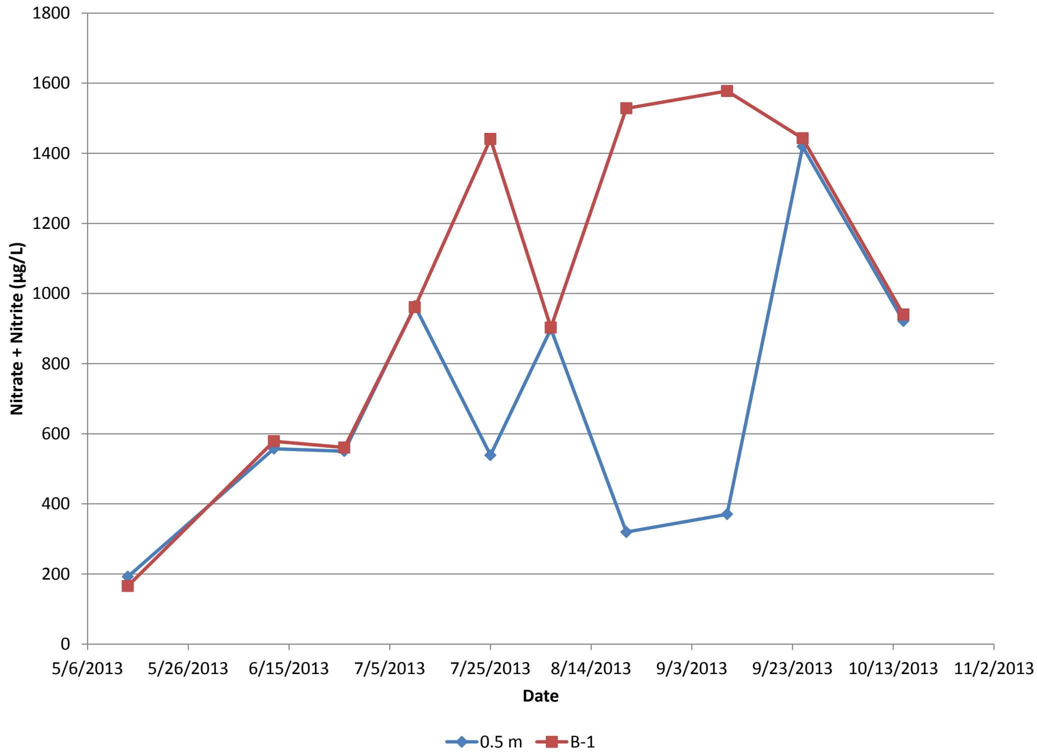

Figure 57. NO_3+NO_2 Concentrations (µg/L) at Station LL5, May-October 2013

3.2.6 PHYTOPLANKTON

Chlorophyll concentrations at the six stations ranged from 0.8 to 19.2 µg/L in 2013. Maximums at most sites were higher than in 2012. Chl was often highest at the 5 m depth, which was the case in 2012. (Figures 58 through 63). However, chl differed more seasonally than with depth at the three up reservoir sites.

Chl was higher in May at the two deepest stations (LL0 and LL1) than at the shallower stations where there were lower levels in the spring and higher in summer (Figures 61, 62, and 63). Chl concentrations at the shallower stations peaked in September, with highest concentration observed at LL4 on September 25 (19.2 µg/L). The pattern at LL5 in 2013 was similar to that in 2012 with the maximum occurring in September. These peaks correspond to the dates in which the water column at LL5 was stratified and residence time was high.

A large storm event occurred on the first of August that increased flow. The increase in chl concentrations at LL5 followed this storm event. Large green colonies of algae were observed on the surface at LL5 on August 21 and appeared to be the beginning of a scum formation. These large algal colonies were also present on September 10 at LL5 as well as LL4 and LL3. However, a large, scum formation had not developed. This contrasts with previous years (2010 and 2012) in which a thick scum of accumulated algae (primarily cyanobacteria) occurred upstream of LL4, just downstream of the Nine Mile Falls boat launch and at LL5.

Composition of the phytoplankton taxa showed diatoms (*Chrysophyta*) to be dominant at the deep stations, based on both cell counts and biovolume (Figures 64-71). Green algae (*Chlorophyta*) became more abundant at the two up reservoir sites during mid-summer (Figures 72-75). Cyanobacteria were not strongly represented at any site during 2013. That pattern is in marked contrast to 2012 when diatoms dominated during the spring at all sites, but cyanobacteria dominated cell counts at all sites in late summer, but green algae represented the greatest biovolume. Also, the maximum counts and biomass of diatoms were 2-4 times greater during 2013 than 2012. However, cyanobacteria cell counts were several time greater at mid reservoir sites (LL1 – LL4) during 2012.

The difference in taxa compositions between the years may be related to the markedly different residence times; which were nearly double for both the whole lake (37 vs. 19 days) and the transition/riverine zones (6.9 vs. 3.6 days) in 2013 versus 2012. Phytoplankton was more abundant at LL5 in 2013 than 2012, which may have been due to longer residence time. Also, cyanobacteria were more abundant at LL5 in 2013. However, cyanobacteria would have been expected to dominate the algal community with longer residence times and not diatoms that did, because cyanobacteria are slower growing and cannot tolerate shorter residence times. While residence time may partly explain the difference at LL5, its effect at the other sites is not apparent. Thus, there are likely other factors that account for the marked difference in composition, nutrients probably do not explain the difference; TP concentrations were not appreciably different between the years (Figure 44).

The pattern of phytoplankton distribution showing maximum chl, cell density, and biovolume at LL4, and corresponding lower levels at LL5 in the riverine zone, may indicate an in-reservoir source of phosphorus and algal-generated organic matter that probably provides DO demand to the limnetic zone meta- and hypolimnion. This source of organic matter from phytoplankton was much greater in the 1970s and 1980s, before and after wastewater phosphorus decrease. Average summer chl before and after phosphorus reduction was 20 and 11 µg/L and average biovolume was 7.1 and 2.7 mm^3/L. That is compared to summer averages for 2013 of 3.9 µg/L and 2.0 mm^3/L.

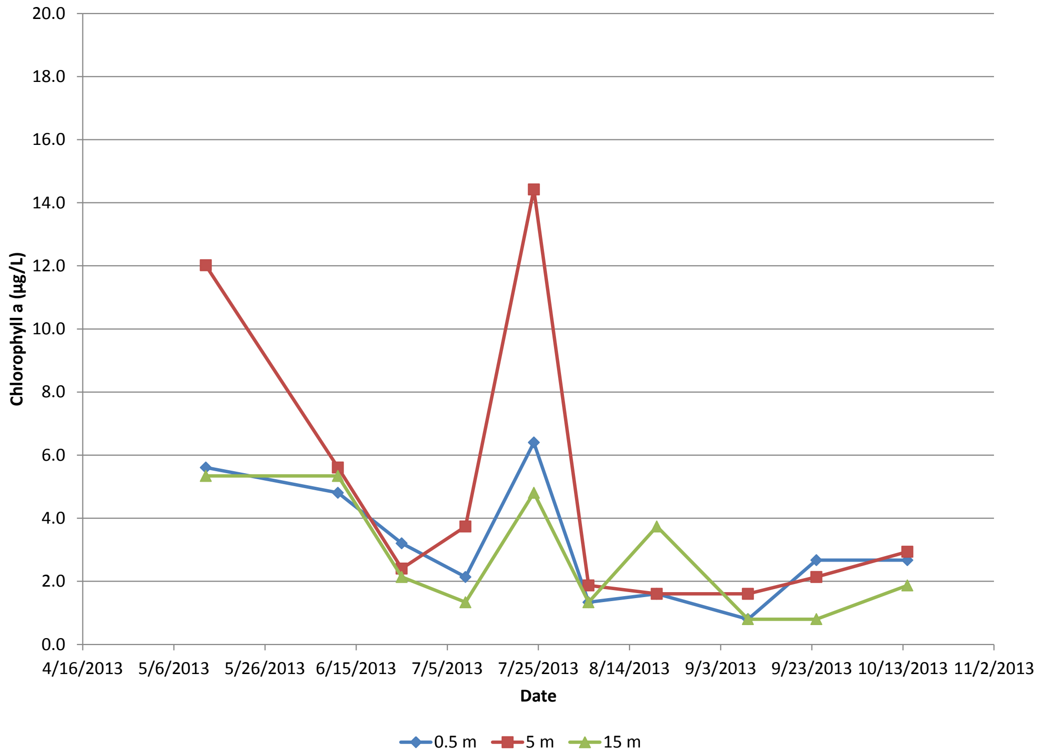

Figure 58. Chl Concentrations (µg/L) at Station LL0, May-October 2013

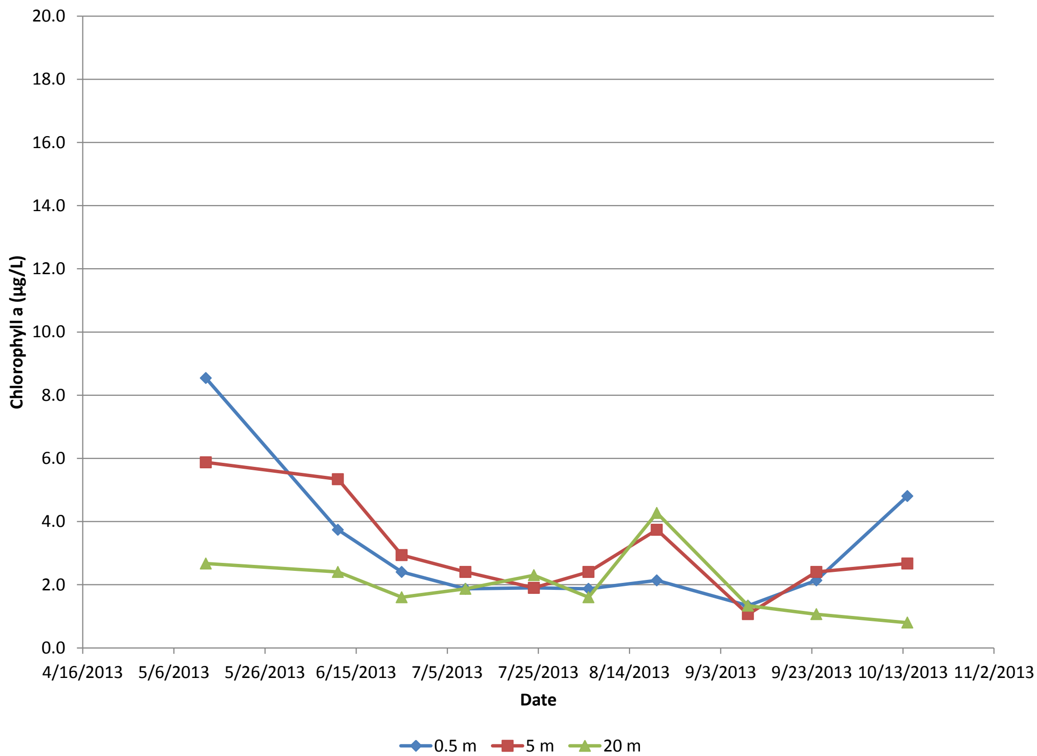

Figure 59. Chl Concentrations (µg/L) at Station LL1, May-October 2013

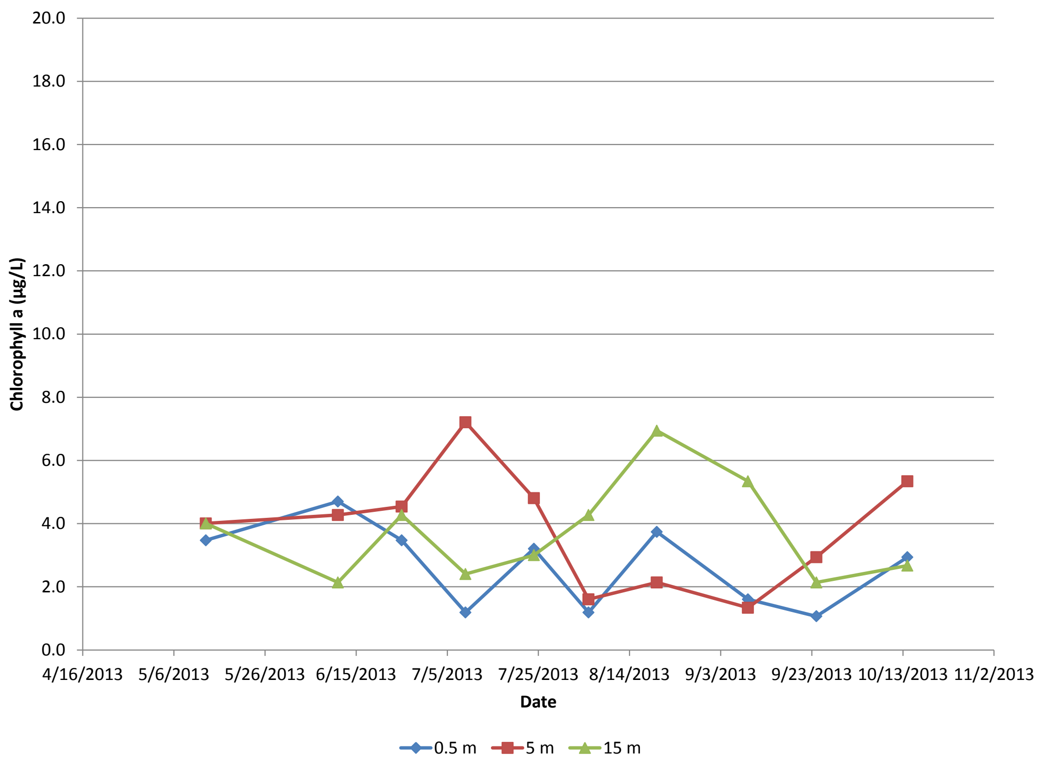

Figure 60. Chl Concentrations (µg/L) at Station LL2, May-October 2013

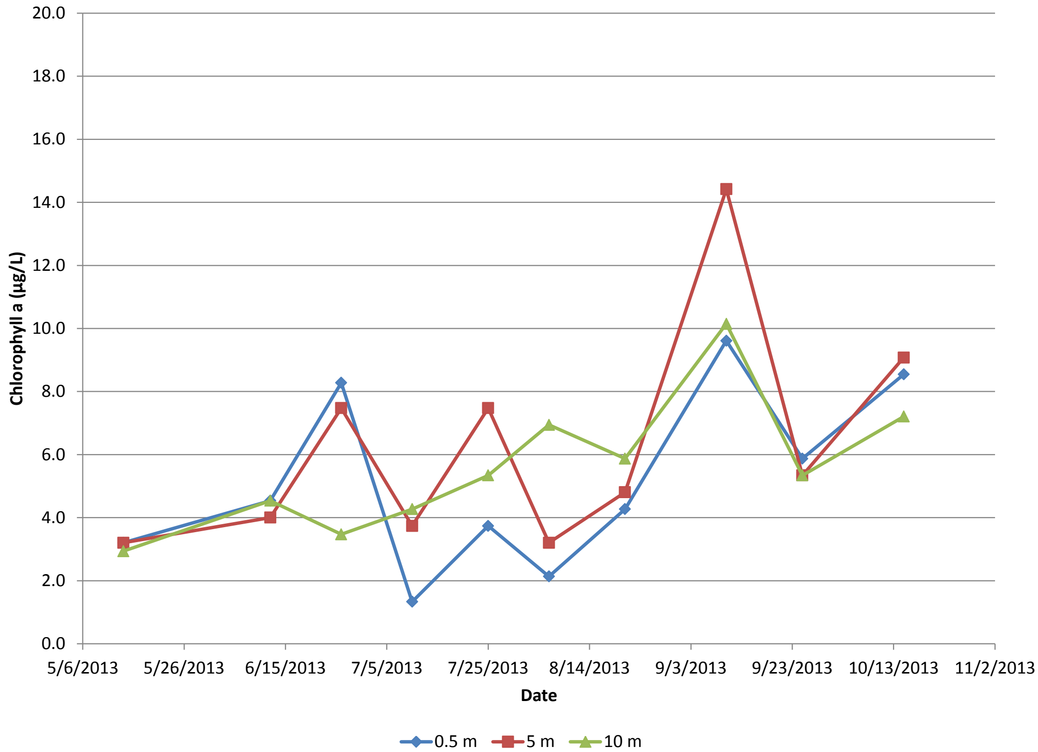

Figure 61. Chl Concentrations (µg/L) at Station LL3, May-October 2013

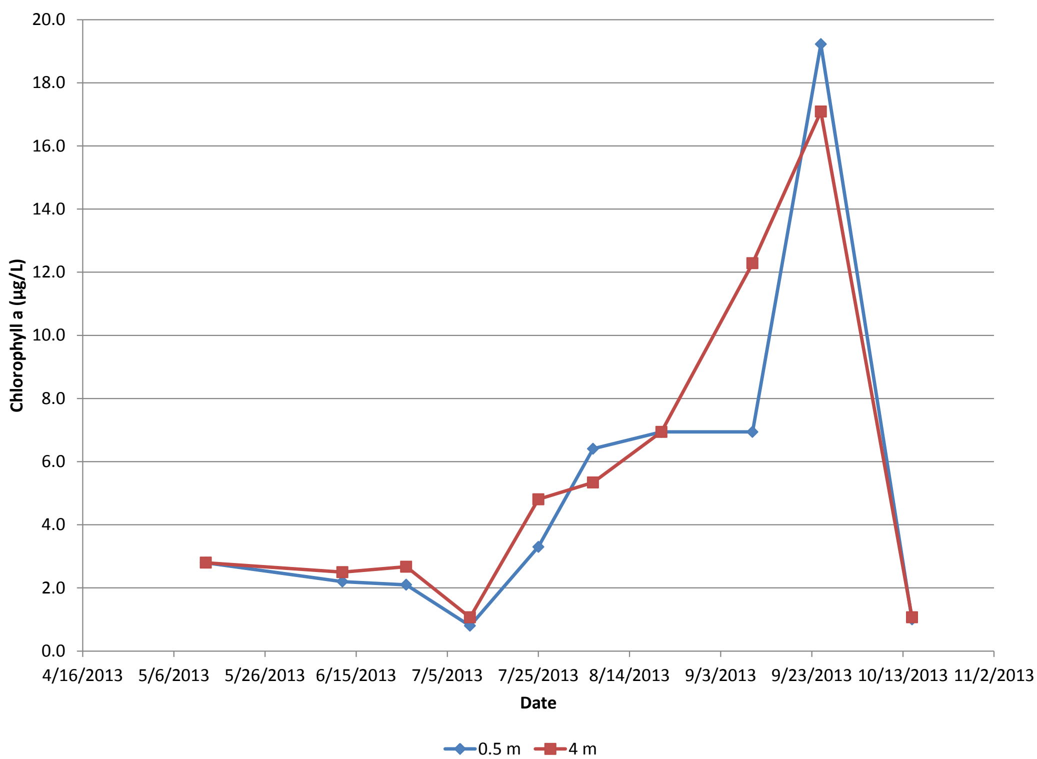

Figure 62. Chl Concentrations (µg/L) at Station LL4, May-October 2013

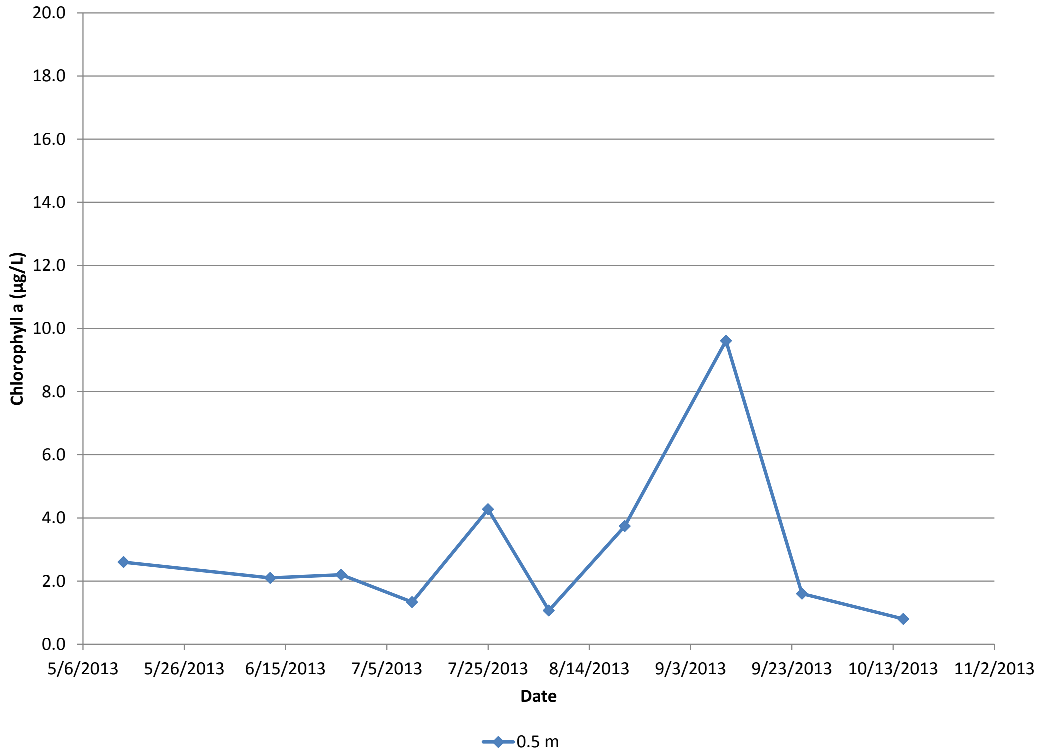

Figure 63. Chl Concentrations (µg/L) at Station LL5, May-October 2013

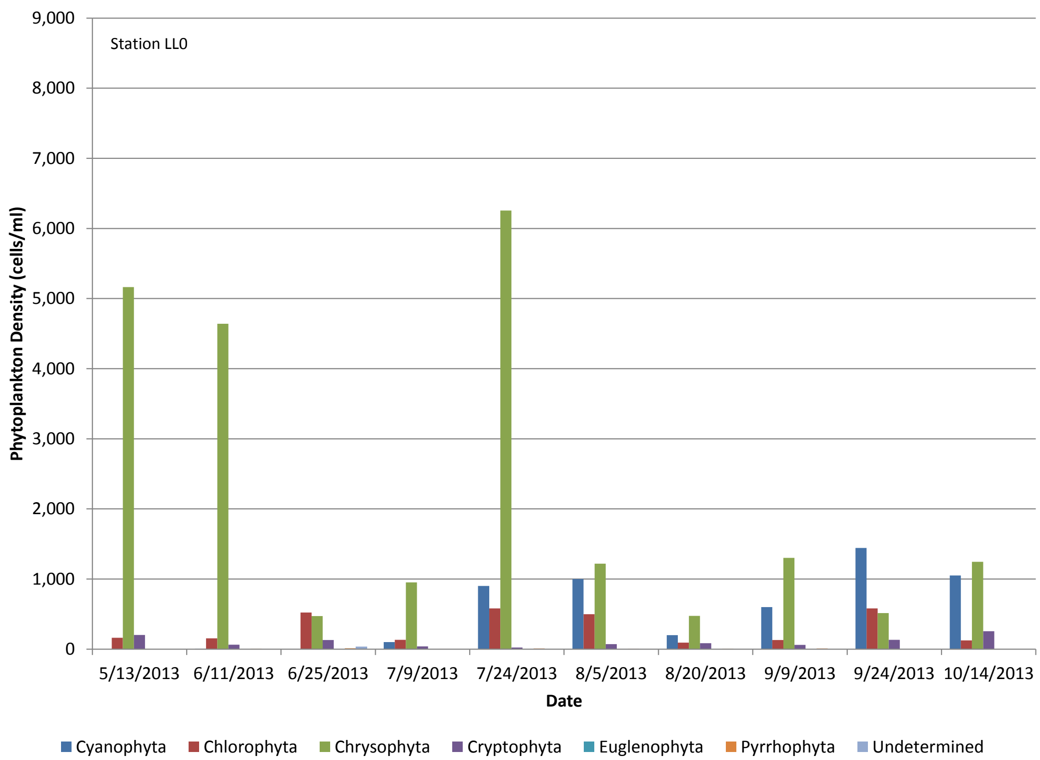

Figure 64. Phytoplankton Density (cells/ml) at Station LL0, May-October 2013

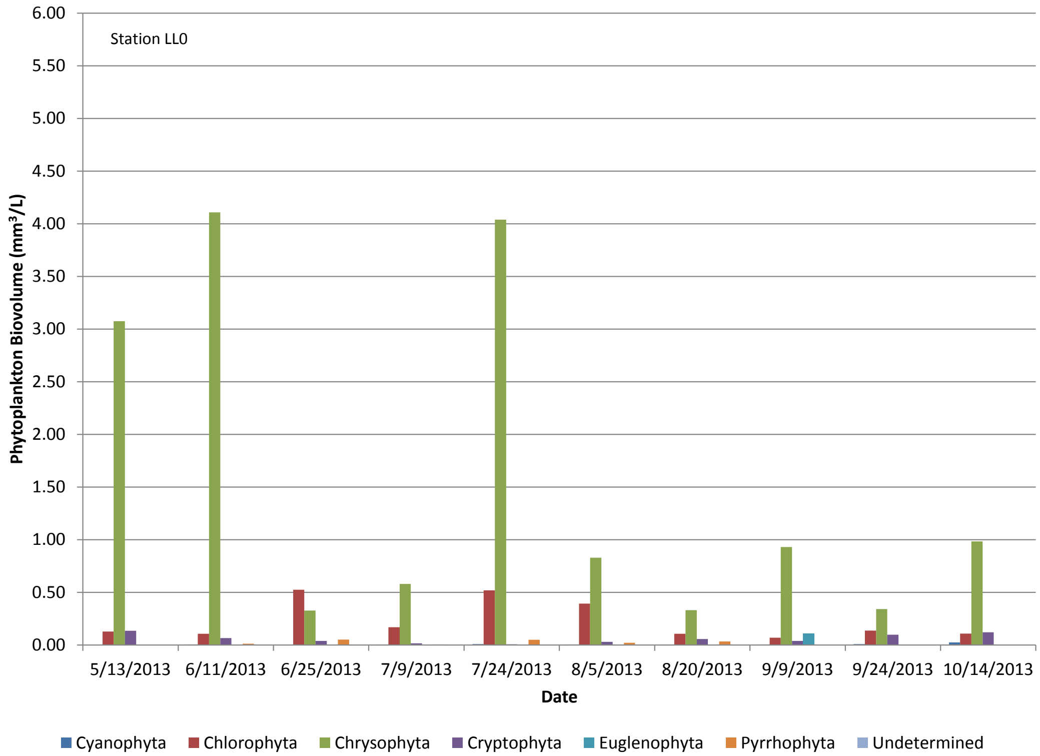

Figure 65. Phytoplankton Volume (mm^3/L) at Station LL0, May-October 2013

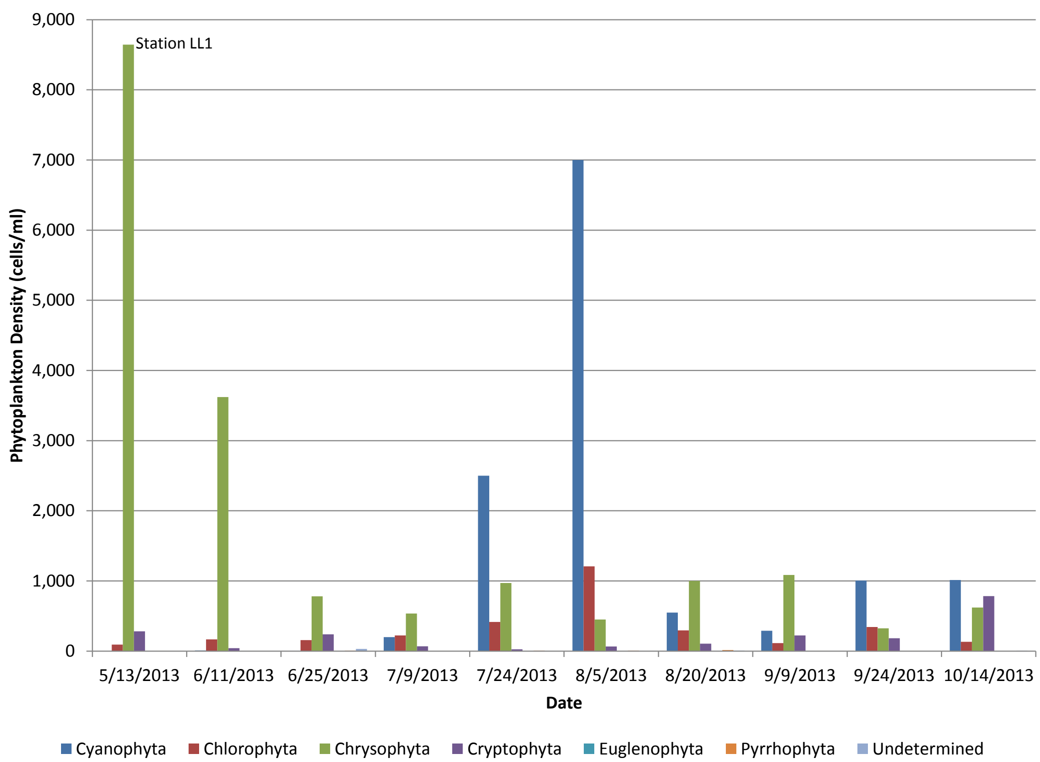

Figure 66. Phytoplankton Density (cells/ml) at Station LL1, May-October 2013

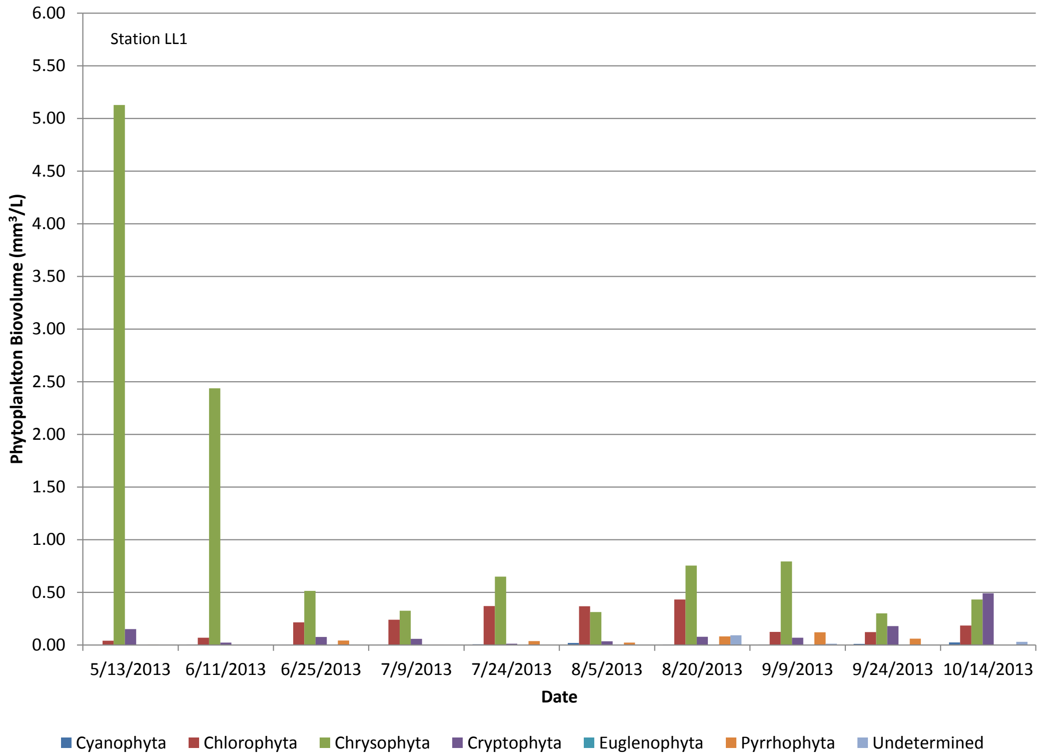

Figure 67. Phytoplankton Volume (mm^3/L) at Station LL1, May-October 2013

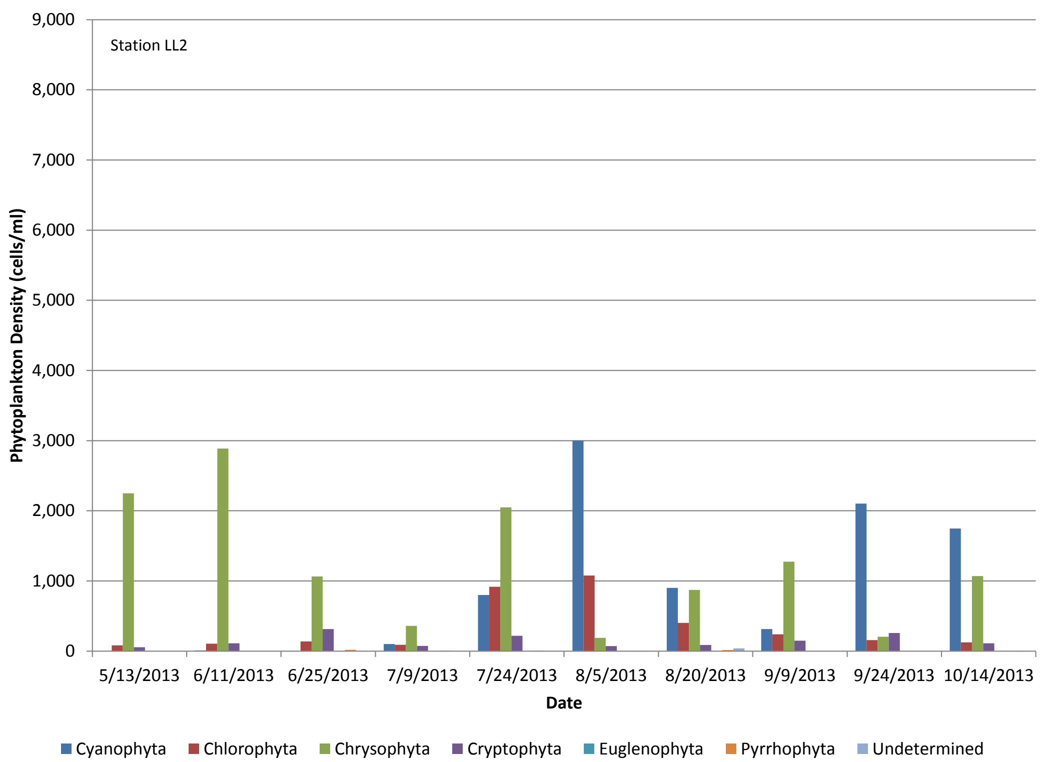

Figure 68. Phytoplankton Density (cells/ml) at Station LL2, May-October 2013

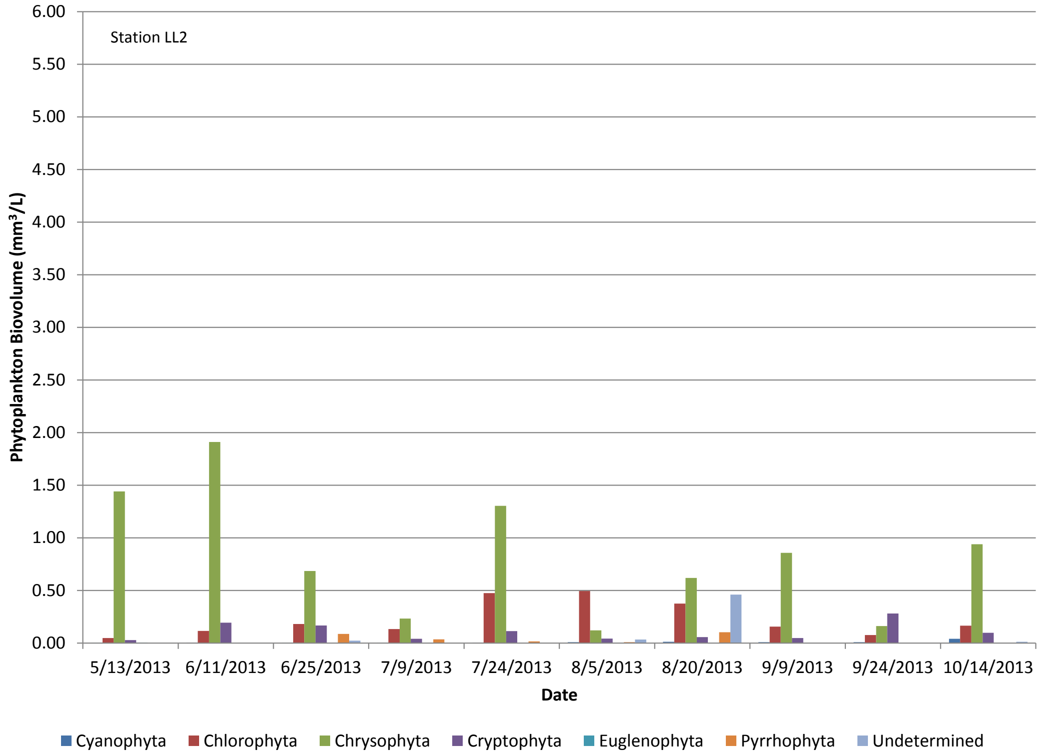

Figure 69. Phytoplankton Volume (mm^3/L) at Station LL2, May-October 2013

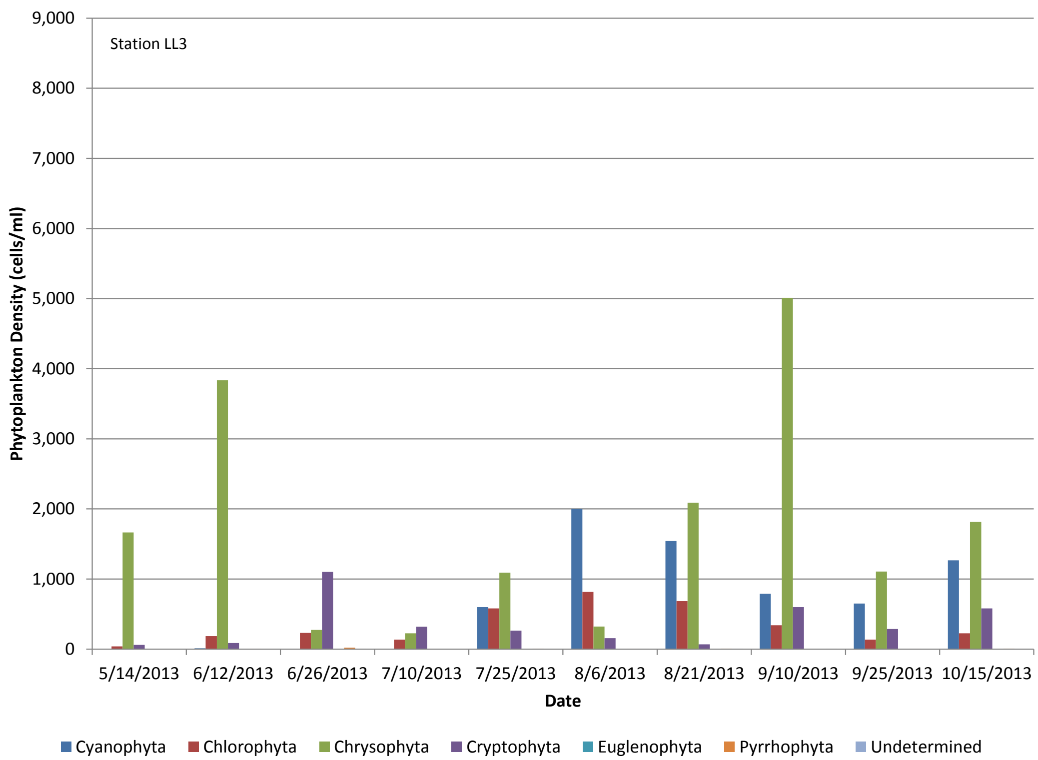

Figure 70. Phytoplankton Density (cells/ml) at Station LL3, May-October 2013

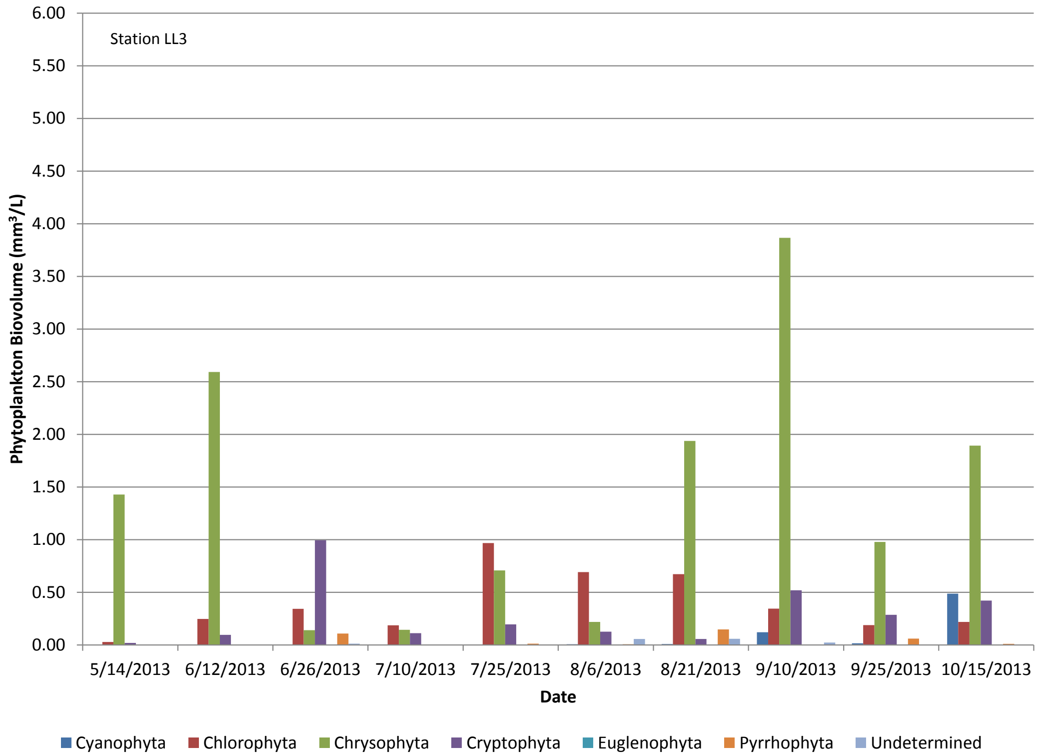

Figure 71. Phytoplankton Volume (mm^3/L) at Station LL3, May-October 2013

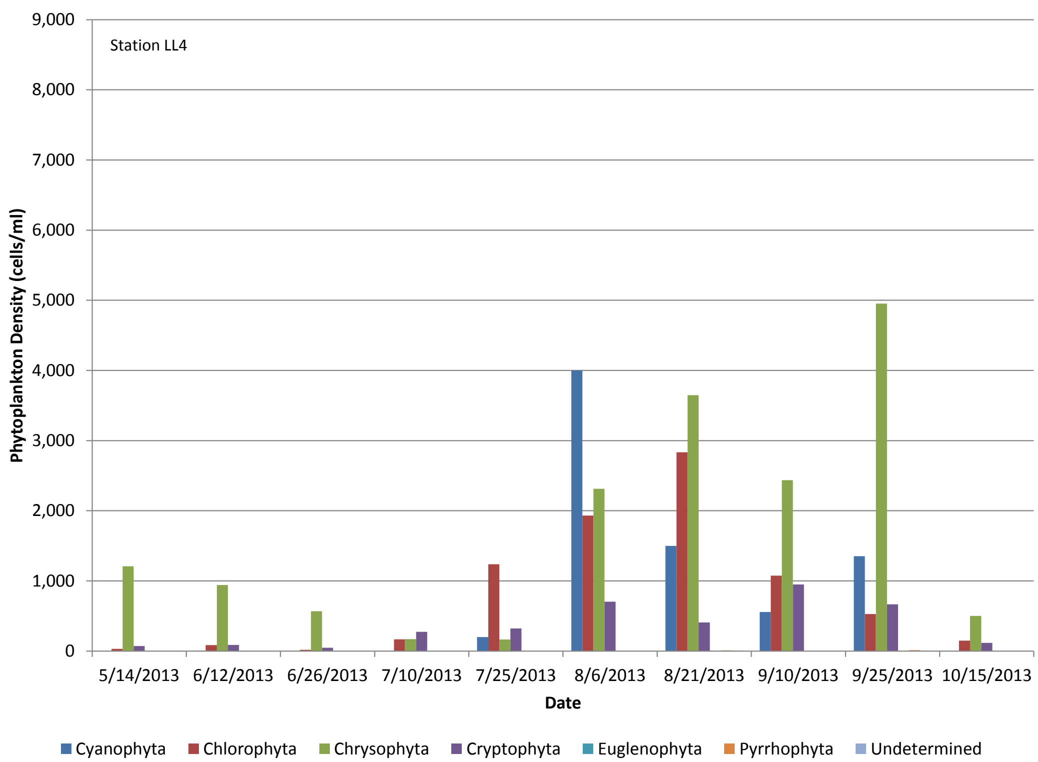

Figure 72. Phytoplankton Density (cells/ml) at Station LL4, May-October 2013

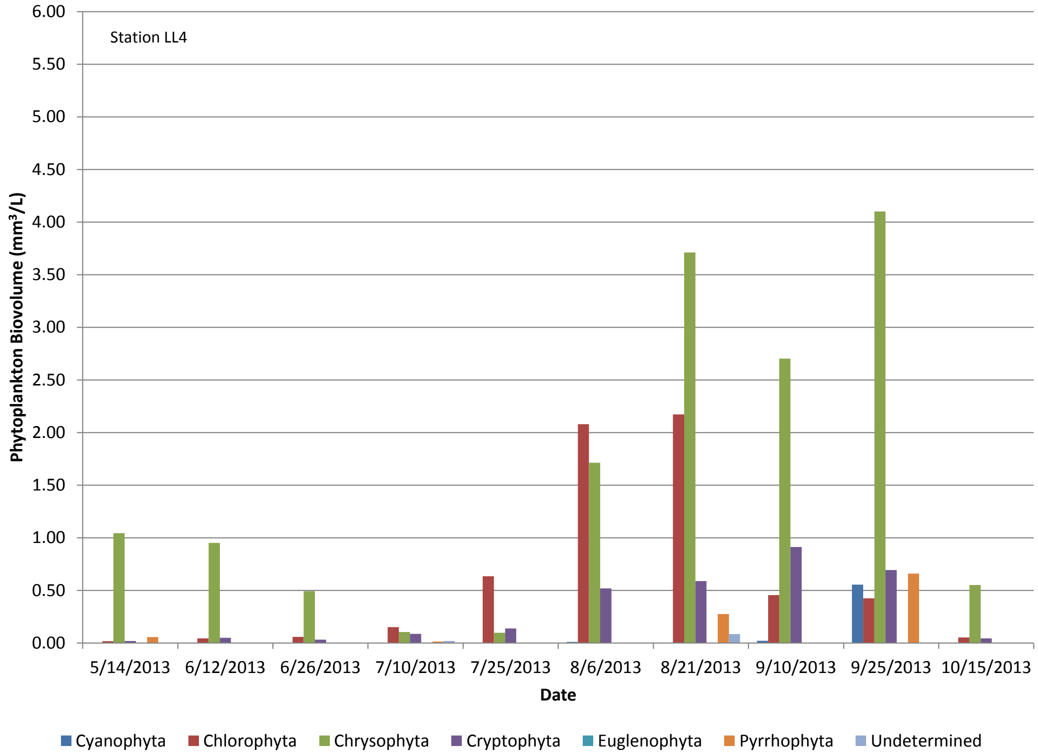

Figure 73. Phytoplankton Volume (mm^3/L) at Station LL4, May-October 2013

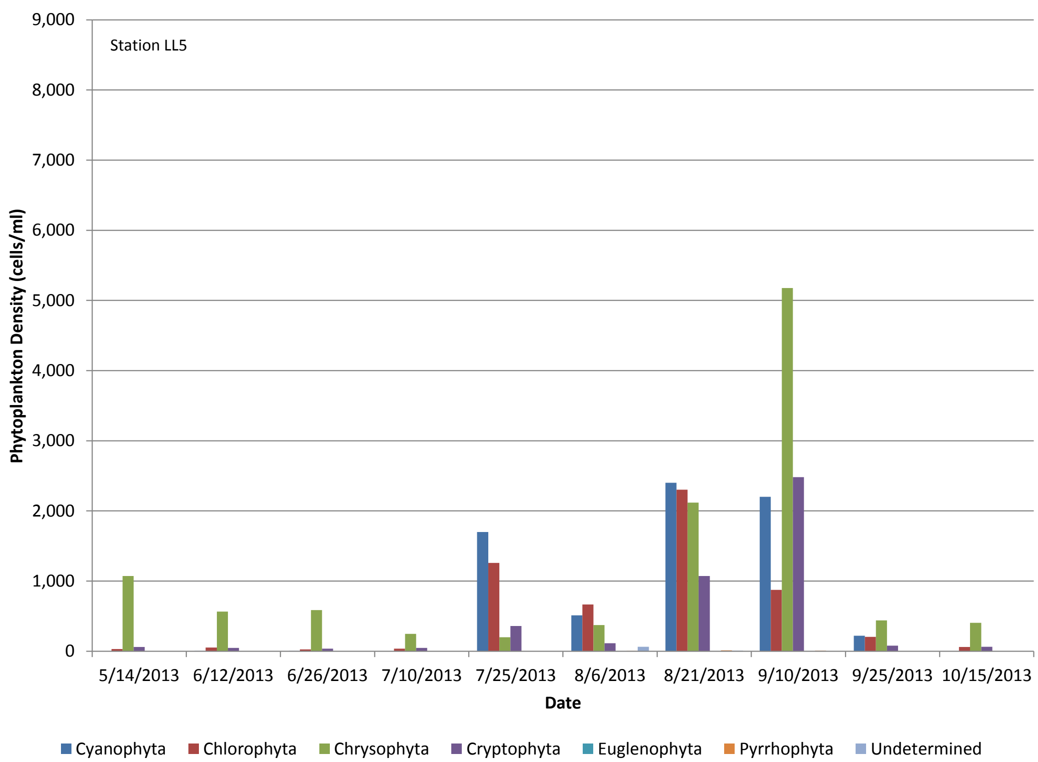

Figure 74. Phytoplankton Density (cells/ml) at Station LL5, May-October 2013

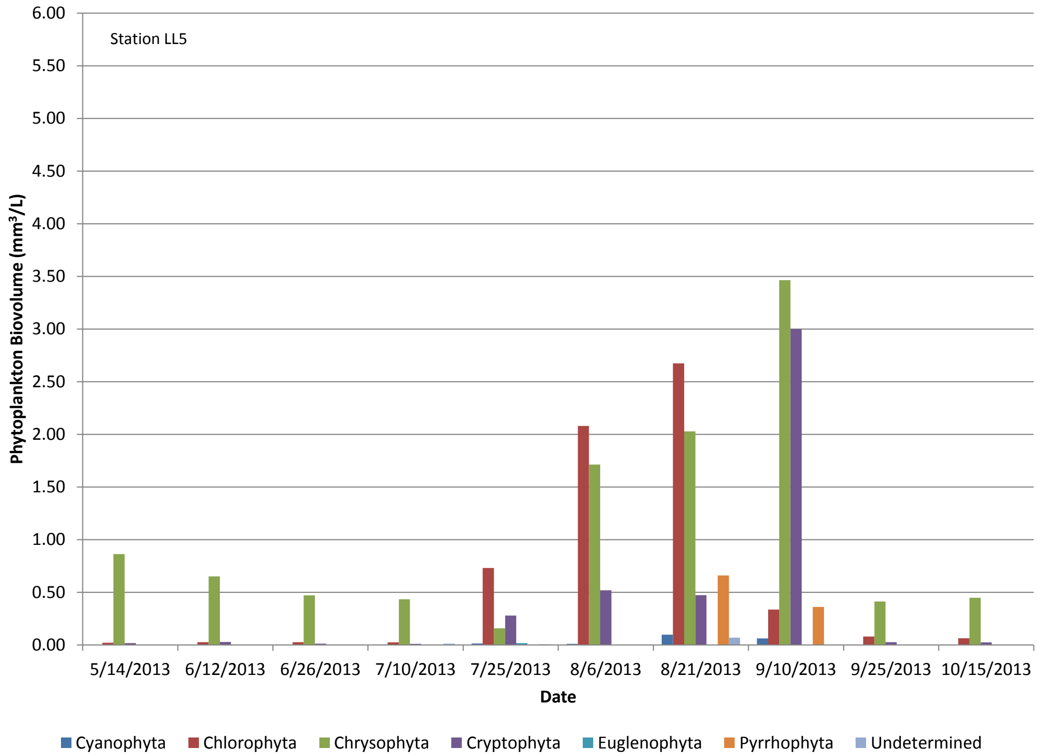

Figure 75. Phytoplankton Volume (mm^3/L) at Station LL5, May-October 2013

3.2.7 TRANSPARENCY (SECCHI DISK DEPTH)

Transparency ranged from 2.0 to 7.7 m throughout the reservoir during 2013 (Figures 76 through 81). The maximums occurred at different times, depending on station, but were coincident with low chl concentrations. The minimums for most stations were in May when inflow was high and light attenuation was affected by non-algal particulate matter. The minimum at LL4 was in late September which corresponded to peak chl concentrations at that station and throughout the reservoir. Except during May and early June, transparency was determined largely by phytoplankton.

As is the case for most reservoirs with relatively large inflows carrying non-algal suspended matter, transparency increased down reservoir with greatest transparency occurring in the lacustrine zone. Much of that trend was due to longer water retention time and greater loss of particulate matter through settling, as well as plunging inflows that tend to isolate the limnetic epilimnion allowing even more settling time from the upper layer.

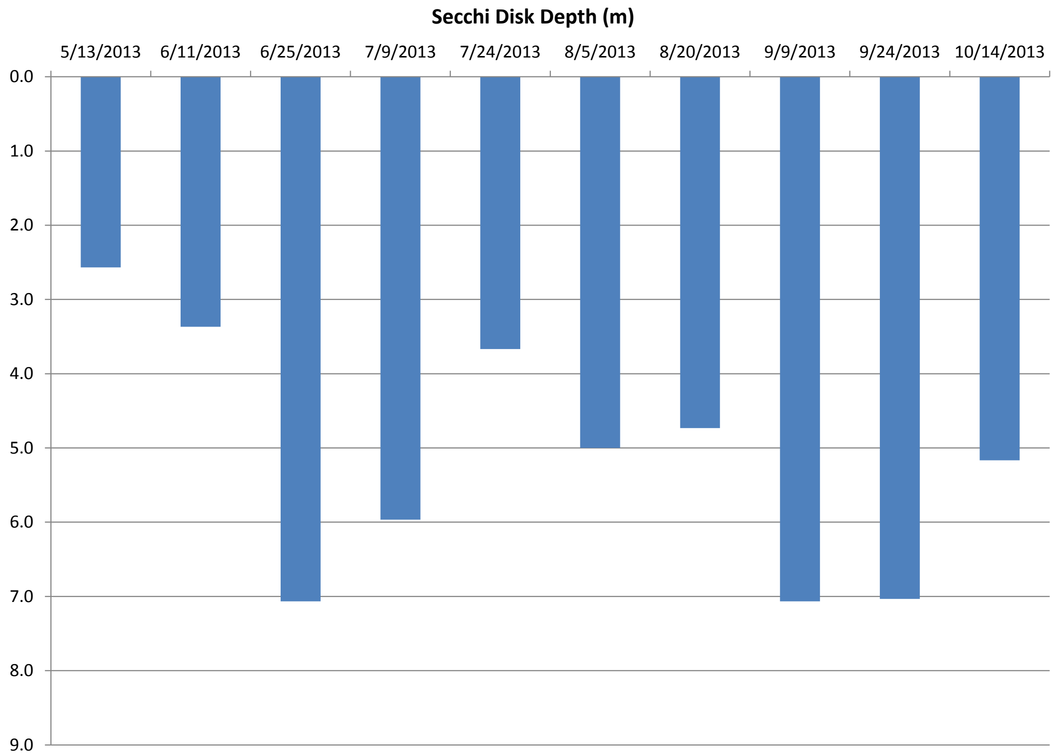

Figure 76. Secchi Disk Depths (m) for Station LL0, May-October 2013

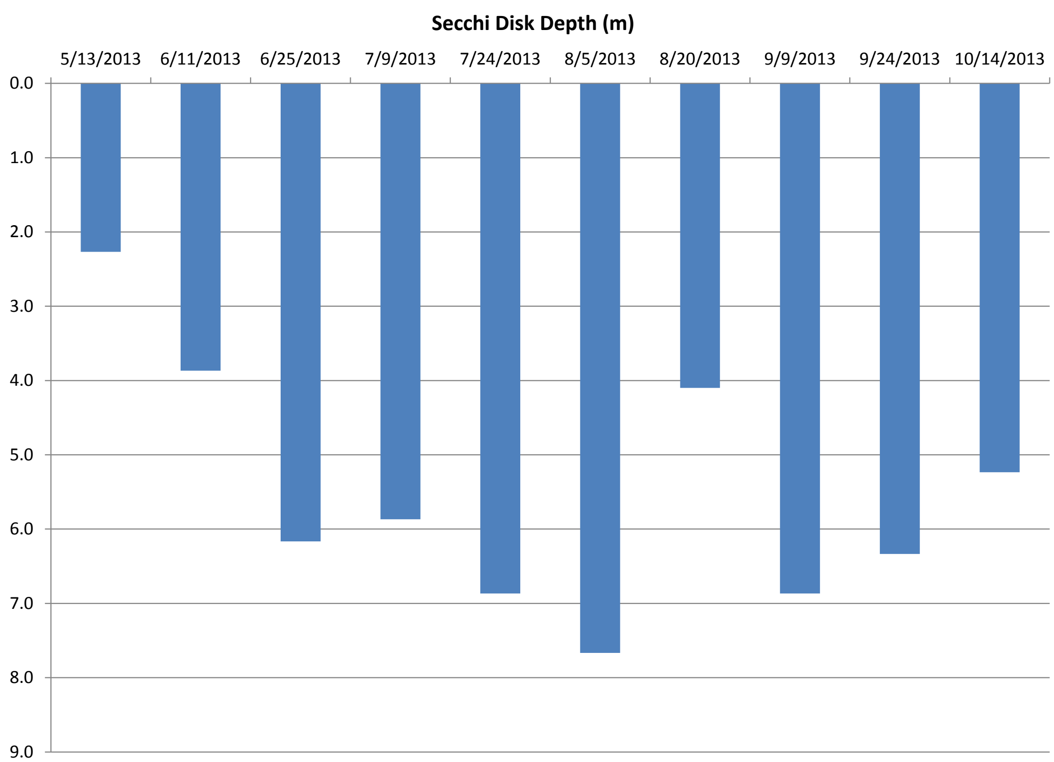

Figure 77. Secchi Disk Depths (m) at Station LL1, May-October 2013

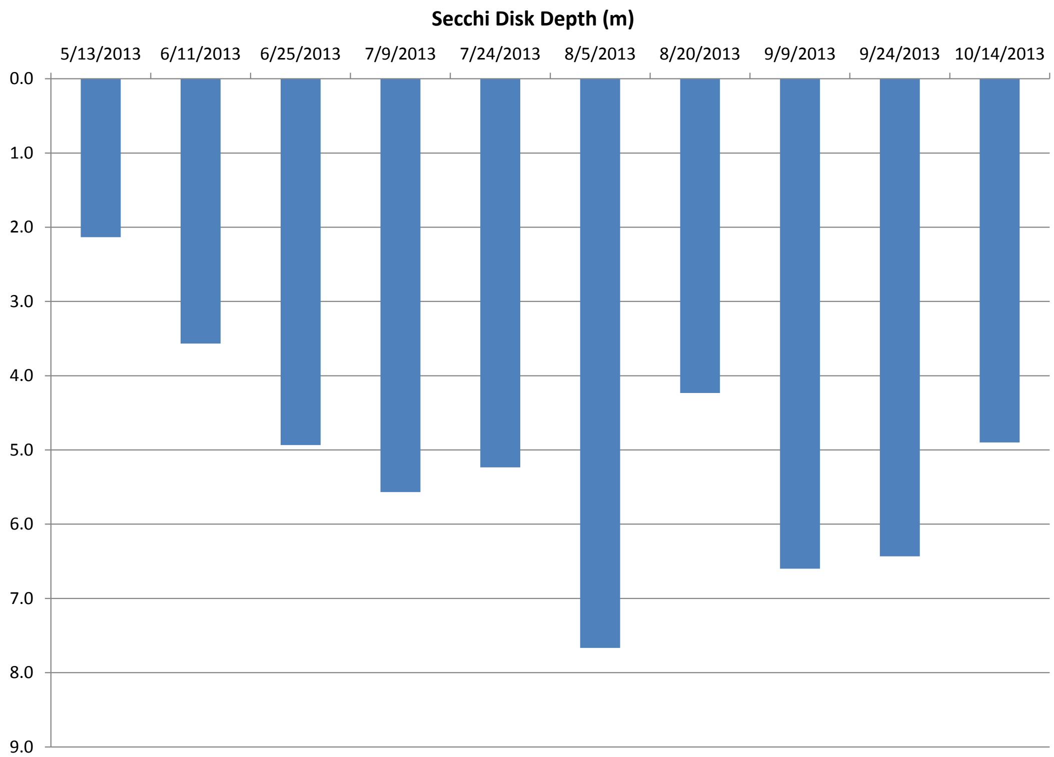

Figure 78. Secchi Disk Depths (m) at Station LL2, May-October 2013

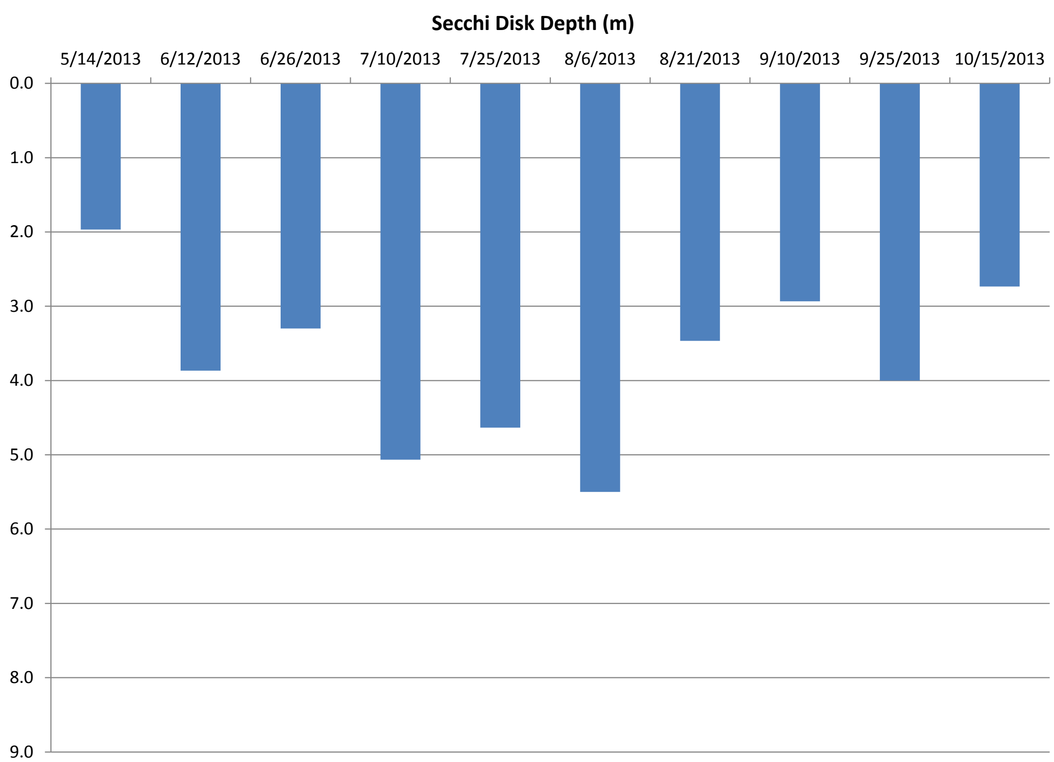

Figure 79. Secchi Disk Depths (m) at Station LL3, May-October 2013

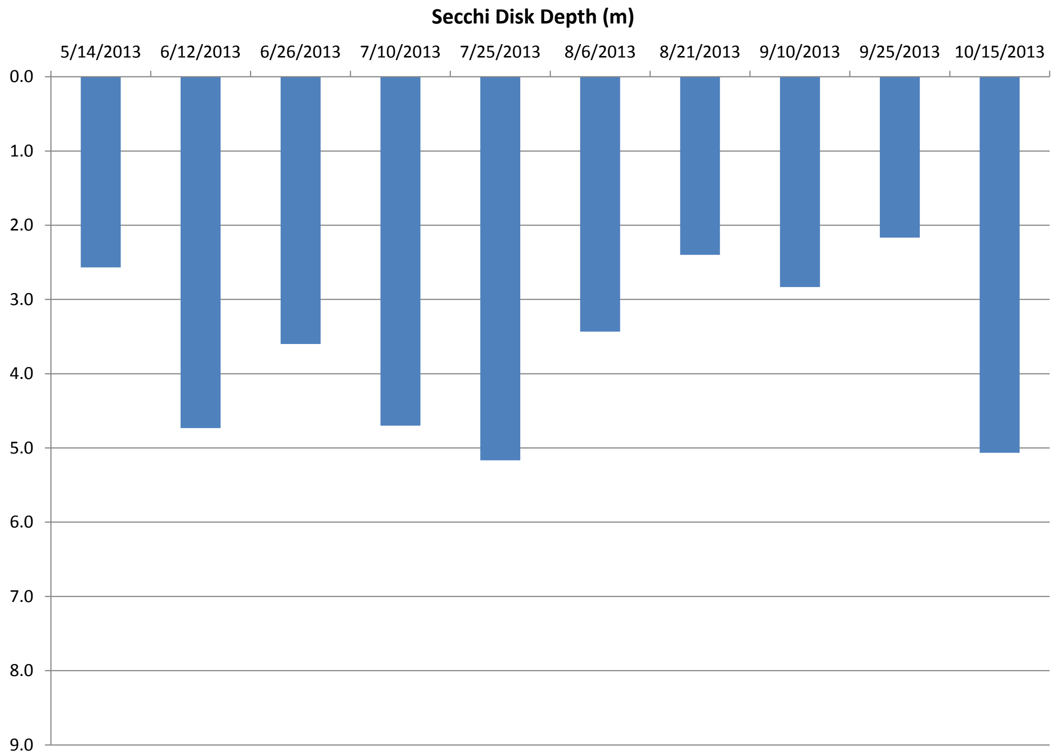

Figure 80. Secchi Disk Depths (m) at Station LL4, May-October 2013

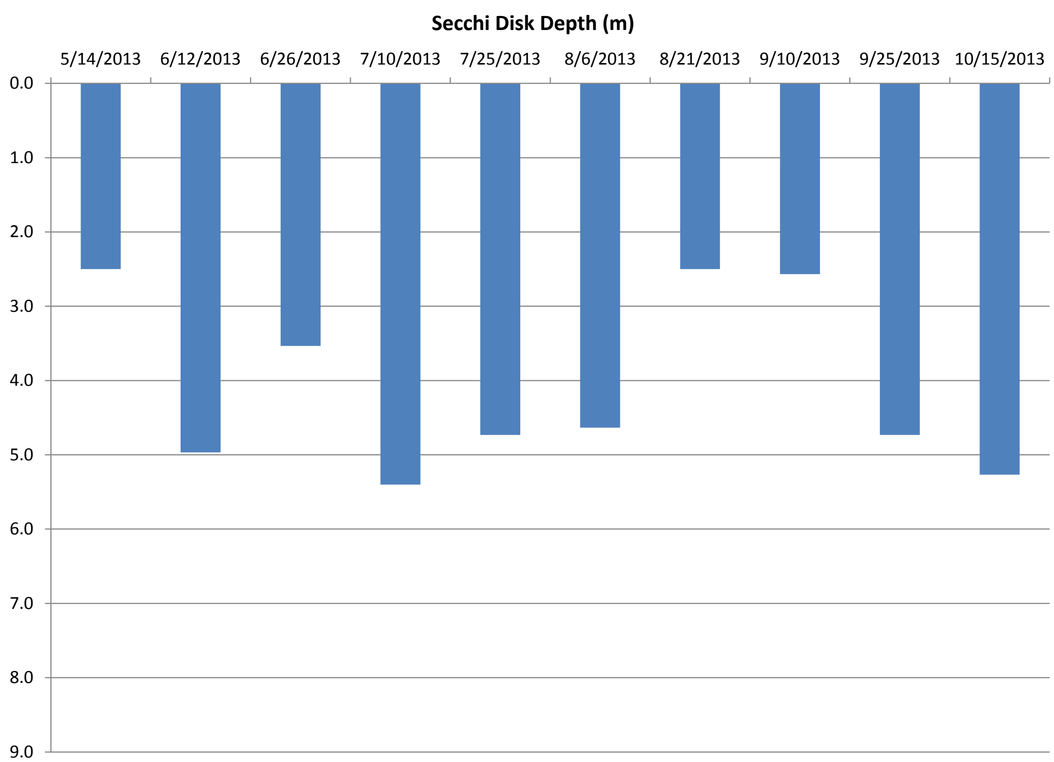

Figure 81. Secchi Disk Depths (m) at Station LL5, May-October 2013

3.2.8 ZOOPLANKTON

Rotifers dominate the zooplankton density (abundance) in the spring and summer at most stations, especially in the lacustrine zone (Figures 82 through 93). However, they are relatively small and did not dominate spring and early summer biomass. Cladocerans (C*ladocera*) are the largest zooplankton and dominated biomass at all stations for most of the period. Calanoid zooplankton were relatively unimportant in contrast to natural lakes in which they usually dominate in the spring.

Density and biomass of *Cladocera*, as well as other groups, were probably artificially reduced at the deeper limnetic stations because animals were sampled by net hauls from approximately 1 m off the reservoir bottom. Zooplankton are much less likely to occur in the hypolimnion where food particles, especially phytoplankton, are scarcer. Multiplying concentrations by net haul depth, giving density and biomass per surface area, tends to even out the station differences (Table 7). That is especially apparent at LL4 and LL5 with very high summer mean density, up to 25.7 and 56.2/L (Table 7) and biomass (up to 362 µg/L at LL4, and 774 µg/L at LL5). Thus, part of the reason for the high *Cladocera* density and biomass is a concentration effect with smaller net haul depths. However, rotifer densities were actually greatest at the deeper sites. That may be due to rotifers being detritus and bacteria eaters; abundance of such particles may occur at high concentrations in the upper hypolimnion and lower metalimnion.

Cladocera density at station LL4 exceeded 15/L on four occasions during July and September (Figure 90). Even correcting for net haul depth, densities were third highest at station LL4. Summer mean *Cladocera* density at station LL5 was the highest of all six stations even correcting for net haul depth (Table 7). This summer mean however, is driven by *Cladocera* density on two sampling dates in the summer, August 21 and September 10. These two dates had *Cladocera* densities of 60/L and 381/L, which is the maximum density observed at all sites. On August 21, *Cladocera* at LL5 were balanced between both *Daphnia* and *Bosmina longirostris* however on September 10 *Bosmina longirostris* accounted for 91% of the total *Cladocera* density at LL5.

Compared to 2012, *Cladocera* density at all stations in 2013 is significantly higher, ranging from 1.7 to 9 times higher. The highest summer mean *Cladocera* density observed in 2012 was at station LL0 with nearly 82,00/m^2, corrected for net haul depth. In 2013 at station LL0 summer mean *Cladocera* density (corrected for net haul depth) was over 254,000 or more than 3 times that in 2012. The largest difference was observed at station LL5 where *Cladocera* density in 2012 was slightly over 31,000/m^2 (corrected for net haul depth) and in 2013 the density was nearly 281,000/m^2 (Table 7). *Cladocera* (including *Daphnia*) also had the largest individual biomasses in August and September at all sites, with maximums averaging 230 µg/L, compared to maximum *Cladocera* mass in August 2012 that averaged only 80 µg/L.

Because of their large size, *Cladocera* are usually the most important grazers, with *Daphnia* being the largest. *Daphnia* size at LL4 ranged from 1.0 to 2.8 mm, mostly between 1.75 to 2.1 mm. At that size they are the favorite food for planktivorous fish. Moreover, *Daphnia* had "helmets," which occur when predation is low. One reason for large, helmeted *Daphnia* may be due to epilimnetic temperatures in July and August of 24°C to near 25°C, which is well above the maximum for growth (18°C) and preferred temperature (14°C) for rainbow trout. Trout were probably well down in the metalimnion seeking layers with lower temperature (less than 20°C). Epilimnetic temperature was similarly high in 2012 as well, and helmeted *Daphnia* were present. Whether *Daphnia* were concentrated in the epilimnion is unknown due to vertical net haul sampling. Another factor that may account for larger abundance and biomass of *Cladocerns* in 2013 is the doubling of water retention time, compared to 2012, especially in the riverine zone. Also, the greater abundance of diatoms in 2013, which are a more appropriate food size for *Daphnia* than cyanobacteria may have been a factor.

Table 7. Summer Mean Density of *Cladocera* at the Six Stations Corrected for Depth of Net Haul to Aerial Units

Station	Net Haul Depth (m)	No./L	No./m^3	No./m^2
LL0	47	5.41	5,413	254,388
LL1	33	4.14	4,136	136,483
LL2	25	4.33	4,331	108,265
LL3	18	5.09	5,085	91,533
LL4	8	25.7	25,726	205,804
LL5	5	56.2	56,154	280,768

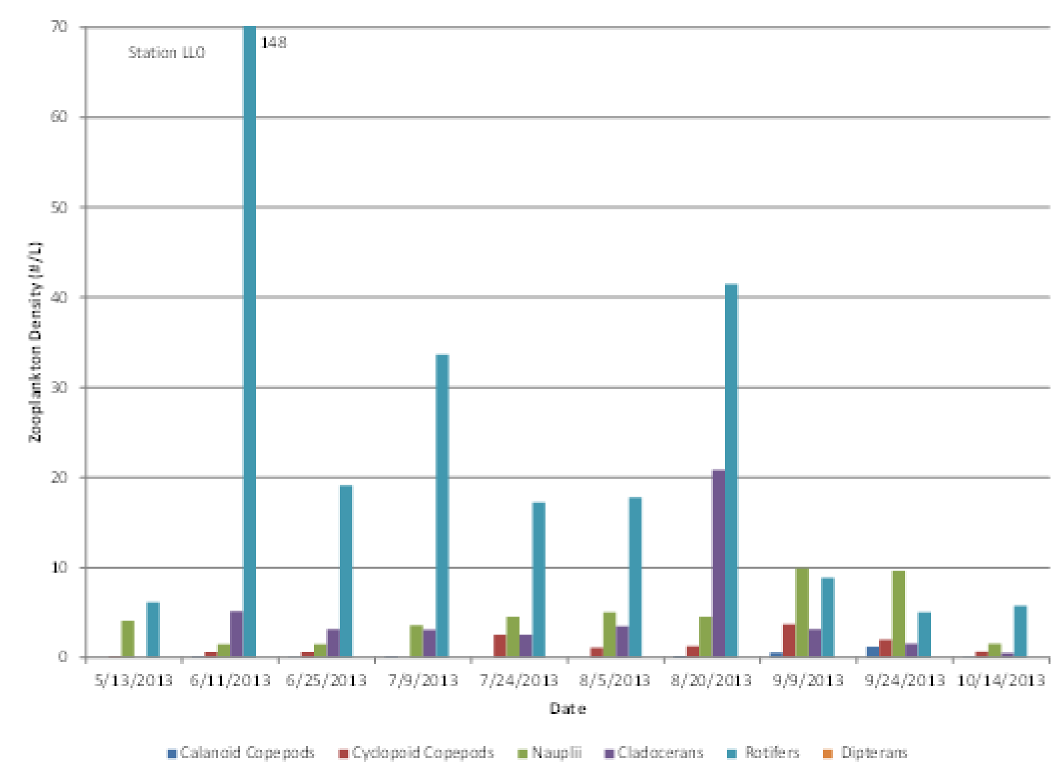

Figure 82. Zooplankton Density (#/L) at Station LL0, May-October 2013

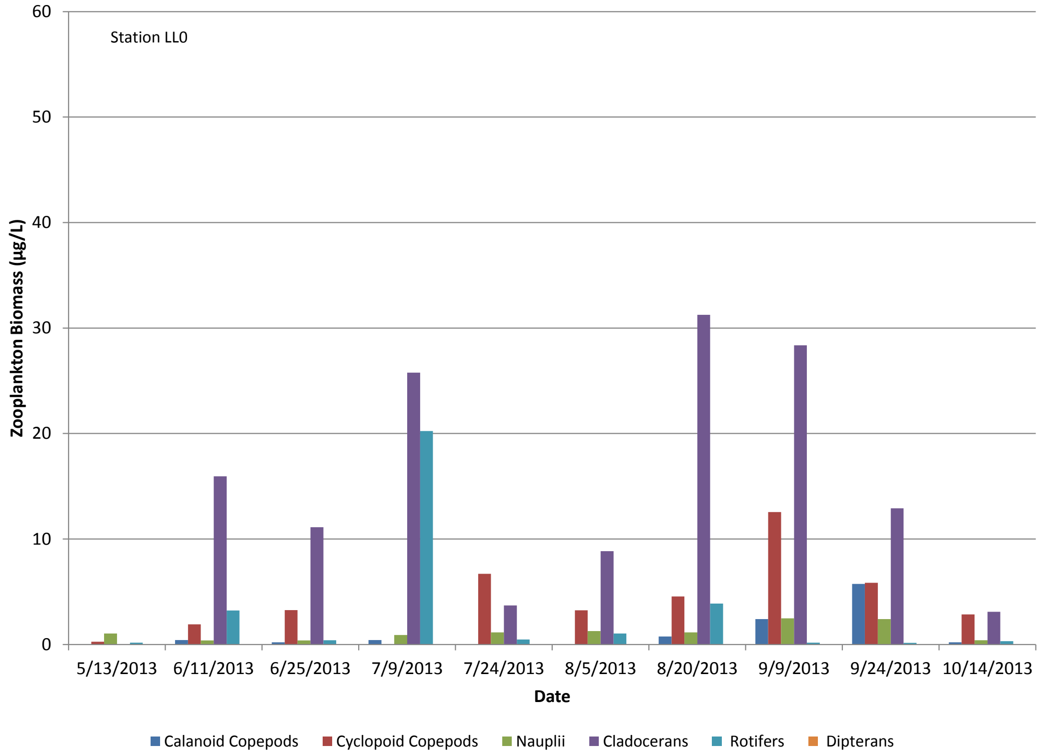

Figure 83. Zooplankton Biomass (µg/L) at Station LL0, May-October 2013

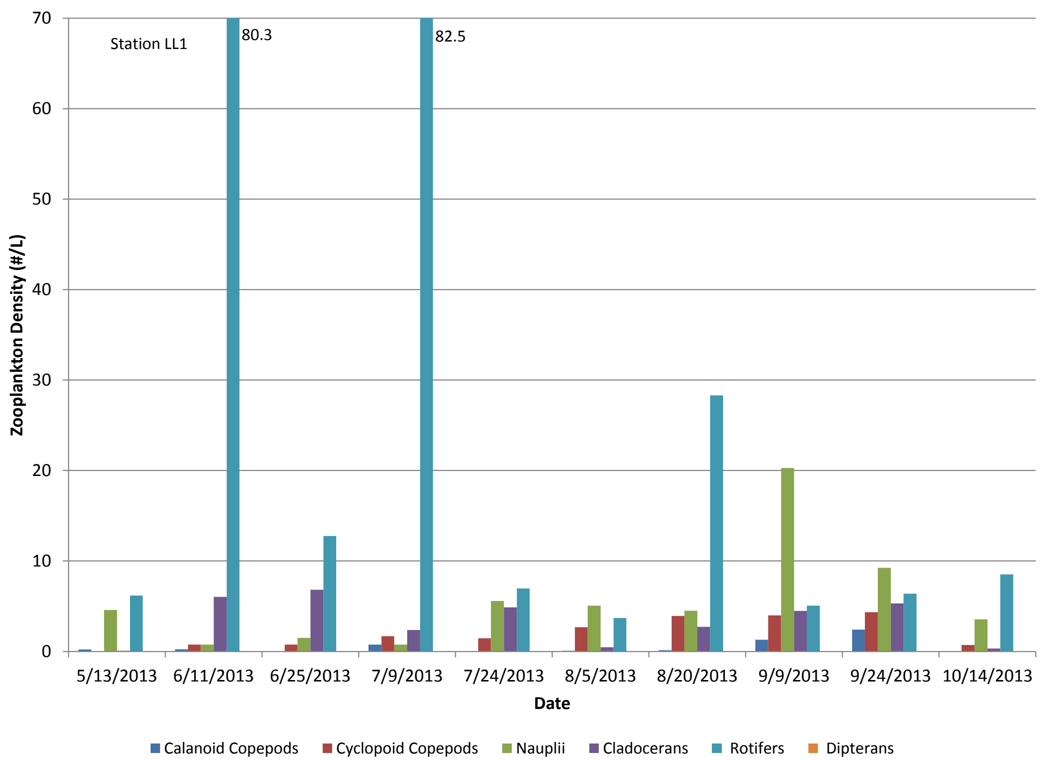

Figure 84. Zooplankton Density (#/L) at Station LL1, May-October 2013

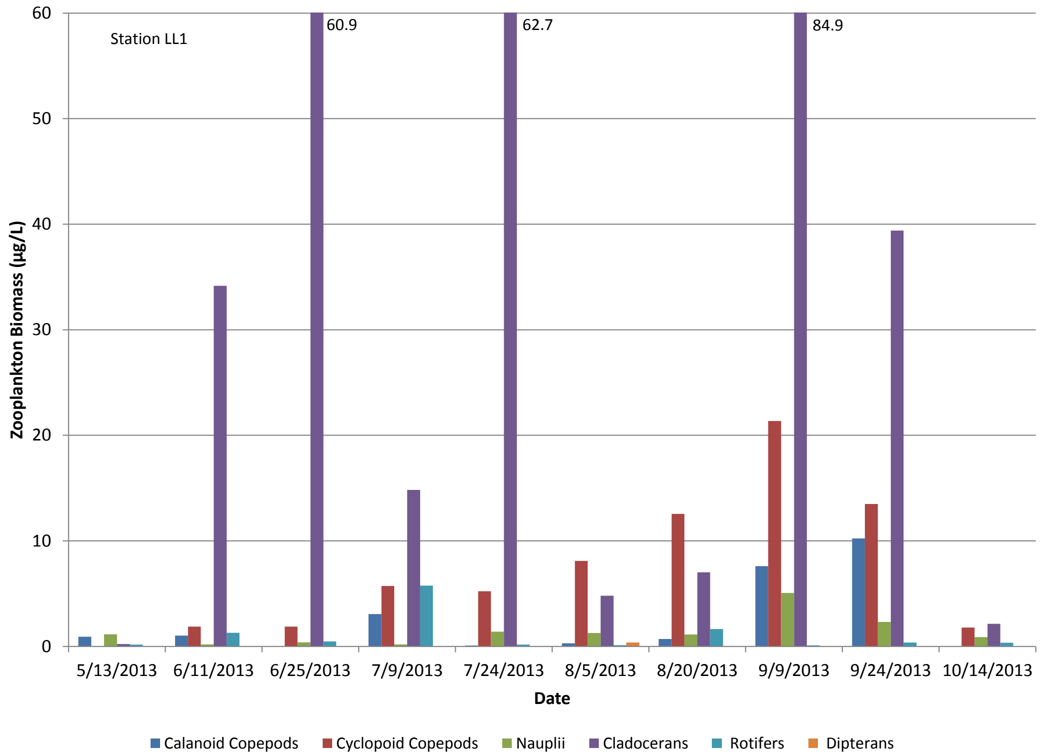

Figure 85. Zooplankton Biomass (µg/L) at Station LL1, May-October 2013

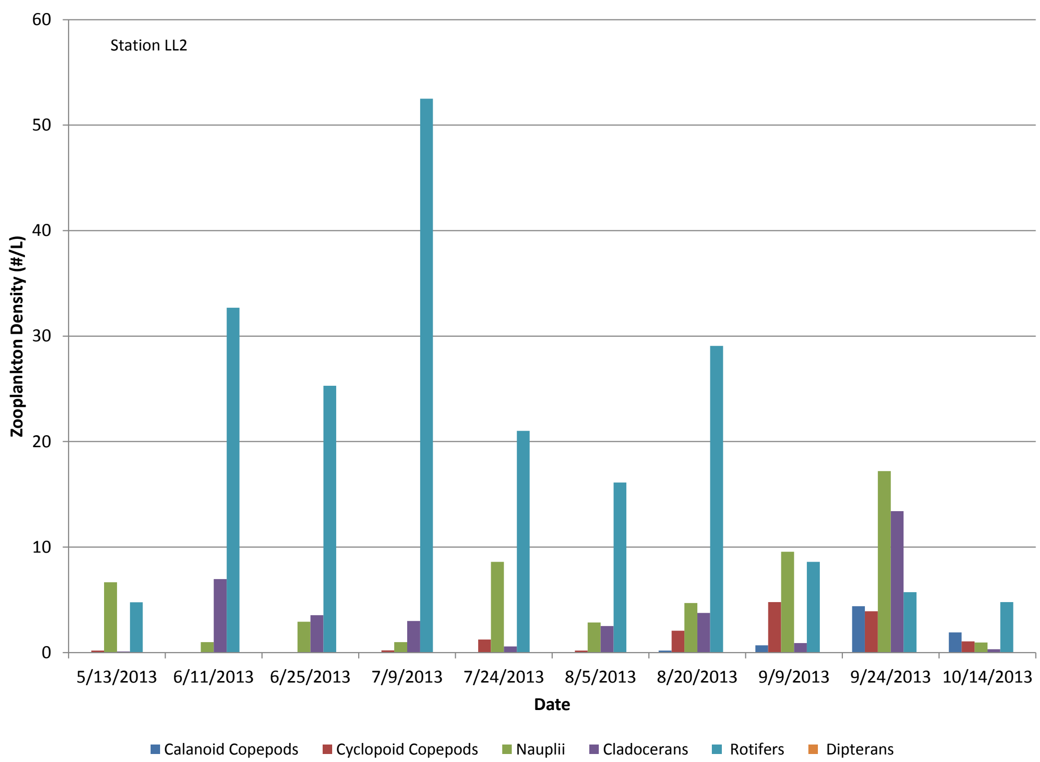

Figure 86. Zooplankton Density (#/L) at Station LL2, May-October 2013

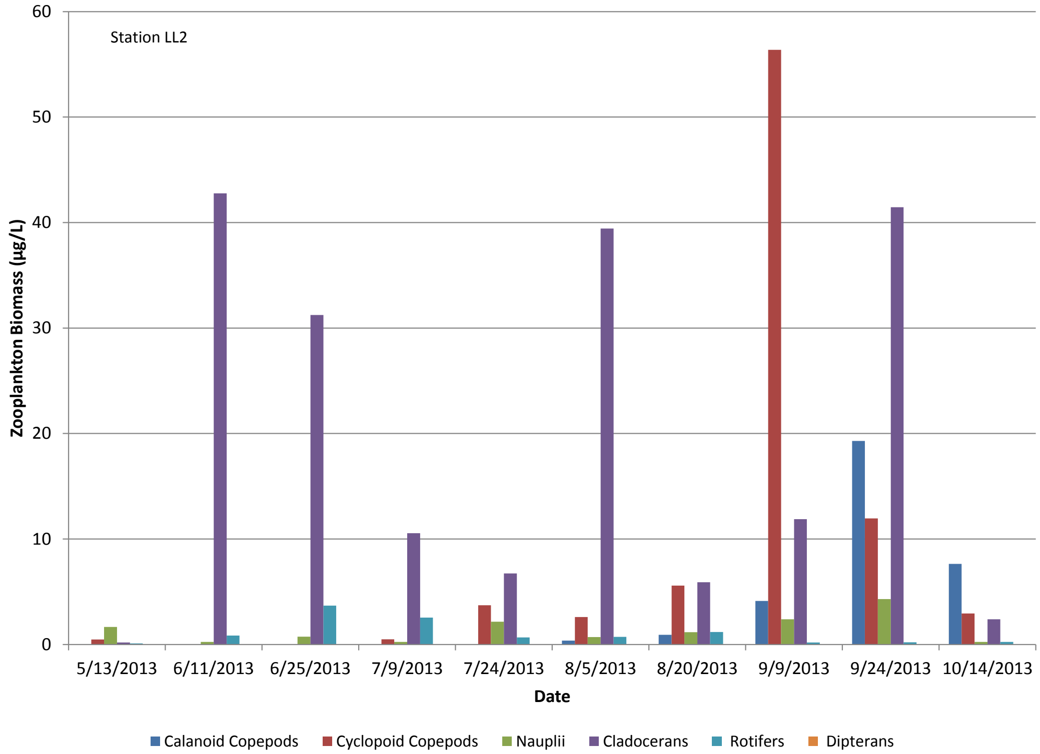

Figure 87. Zooplankton Biomass (µg/L) at Station LL2, May-October 2013

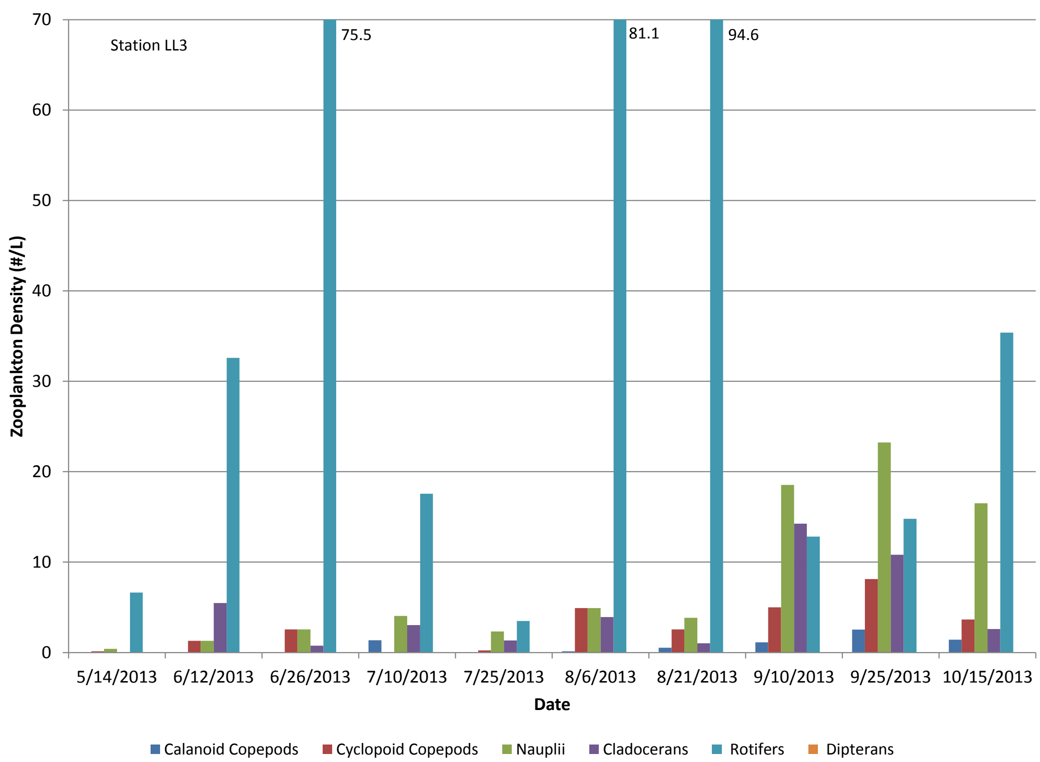

Figure 88. Zooplankton Density (#/L) at Station LL3, May-October 2013

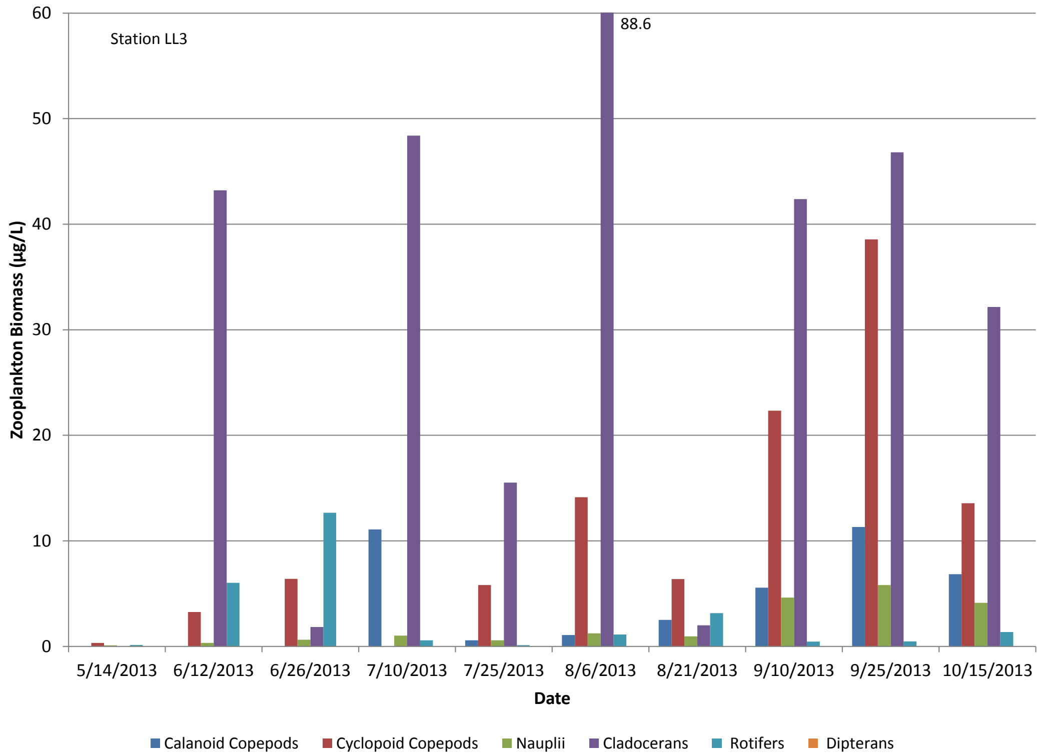

Figure 89. Zooplankton Biomass (µg/L) at Station LL3, May-October 2013

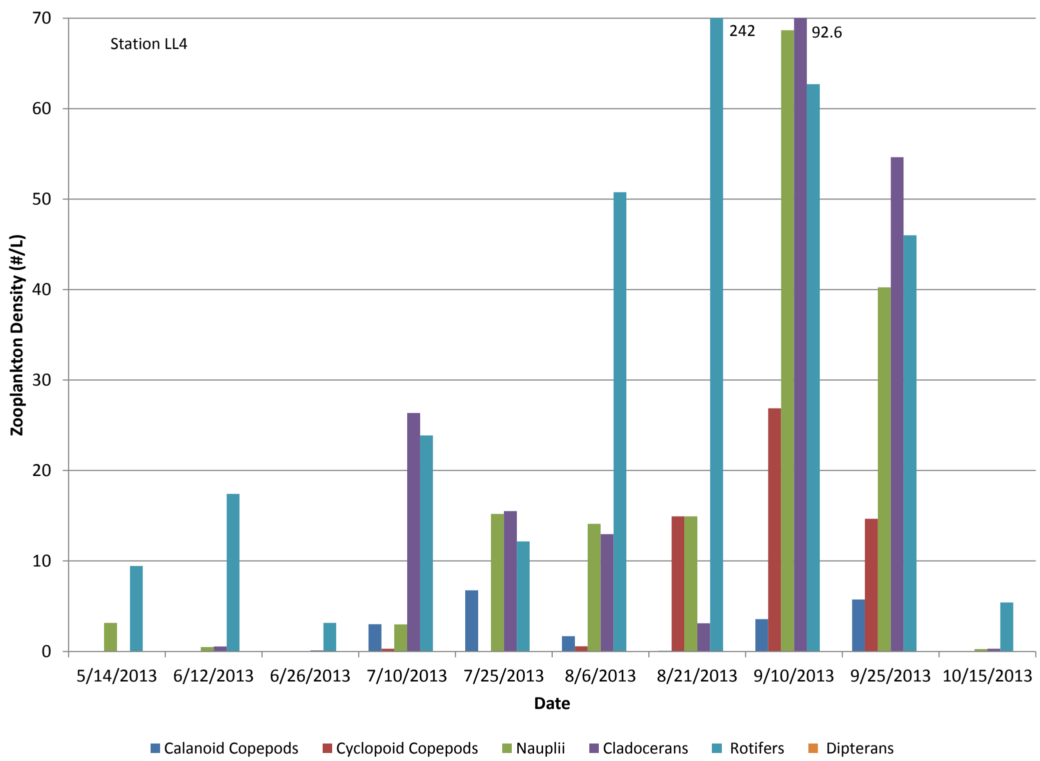

Figure 90. Zooplankton Density (#/L) at Station LL4, May-October 2013

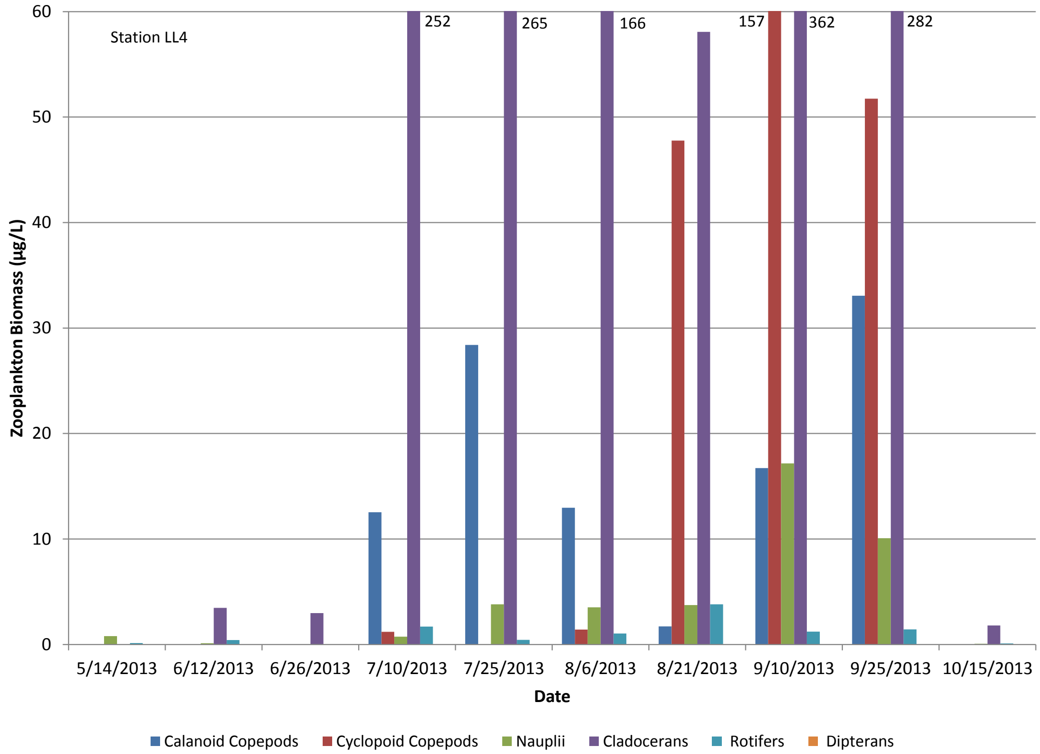

Figure 91. Zooplankton Biomass (µg/L) at Station LL4, May-October 2013

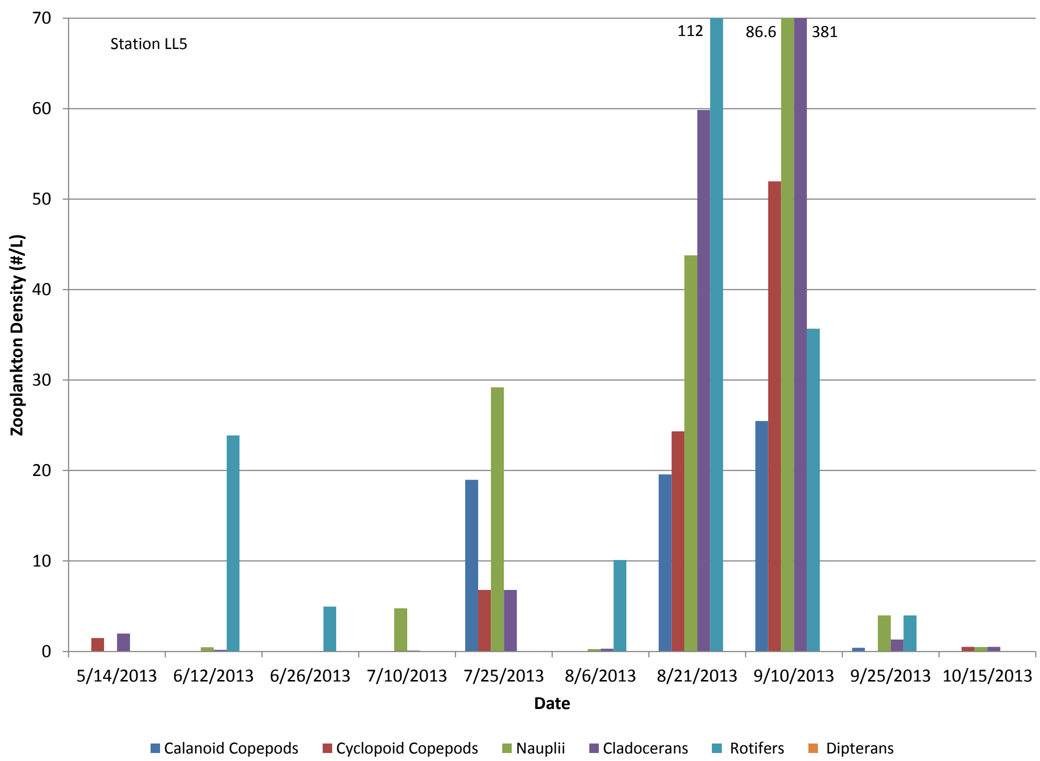

Figure 92. Zooplankton Density (#/L) at Station LL5, May-October 2013

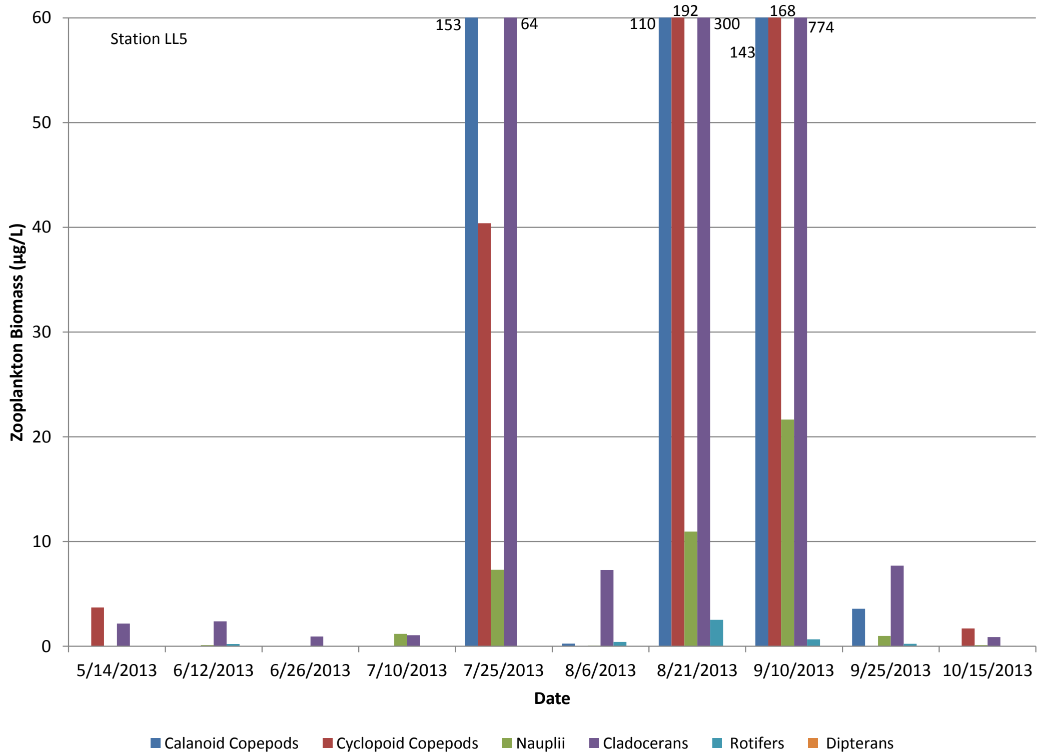

Figure 93. Zooplankton Biomass (µg/L) at Station LL5, May-October 2013

3.2.9 SPOKANE RIVER AT NINE MILE BRIDGE AND LITTLE SPOKANE RIVER NEAR MOUTH

Ecology monitors water quality in the Spokane River and Little Spokane River a short distance upstream of its confluence with Lake Spokane. The Spokane River at Nine Mile Bridge station, (54A090) is located approximately 0.1 mile downstream of Nine Mile Dam at River Mile (RM) 58. According to Ecology's River and Stream Water Quality Monitoring website, this station is a "basin" station with data collected during Water Year 2013 (February 2013 through December 2013).

Ecology's Little Spokane River near Mouth station (55B070), which is located on the Little Spokane River at RM 1.1, is a long-term station, according to its website. Sampling efforts at these two stations were conducted by Ecology in accordance with the Stream Ambient Monitoring QAPP (Ecology 2003).

Water quality data available for the Spokane River at Nine Mile Bridge for 2013 are summarized below in Tables 8 and 9. The data are preliminary and have not been finalized by Ecology. Shaded values indicate exceedance of water quality standards or a strong contrast with historical results, according to Ecology's website.

Table 8. Spokane River at Nine Mile Bridge In Situ Water Quality Data, 2013

Date	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (µmhos/cm)
2/6/2013	5.3	13.3	7.92	116
3/6/2013	5.3	12.5	7.86	104
4/3/2013	7.2	12.6	7.83	80
5/8/2013	12.3	11.2	7.88	73
6/5/2013	**18.2**	11	**8.19**	110
7/10/2013	19.4	**9.2**	8.30	190
8/8/2013	18.7	9.7	8.41	196
9/11/2013	16.9	10.2	8.34	226
10/15/2013	11.5	9.6	8.13	236
11/5/2013	8.4	10.7	7.95	155
12/3/2013	6.2	11.5	7.94	146

Note: Shaded values indicate an exceedance of water quality standards or strong contrast to historical results.

Table 9. Spokane River at Nine Mile Bridge Conventional Water Quality Data, 2013

Date	Total Phosphorus (µg/L)	Soluble Reactive Phosphorus (µg/L)	Total Reactive Phosphorus (µg/L)	Total Nitrogen (µg/L)	NO_3+NO_2 (µg/L)
2/6/2013	32.5	14.7	17.3	1,540	1,400
3/6/2013	20.9	8.9	10.8	856	739
4/3/2013	11.4	3.9	4.2	328	274
5/8/2013	9.7	4.0	3.6	237	209
6/5/2013	10.2	5.8	5.8	538	463
7/10/2013	14.3	9.3	9.3	1,200	1,100
8/8/2013	No data	6.1	No data	No data	No data
9/11/2013	14.1	8.3	9.0	1,550	1,480
10/15/2013	21.3	11.2	10.7	1,460	1,450
11/5/2013	16.3	11.4	12.0	928	902
12/3/2013	14.9	10.7	11.4	864	802

Note: Shaded values indicate an exceedance of water quality standards or strong contrast to historical results.

Water quality data available for the Little Spokane River for water year 2013 are summarized below in Tables 10 and 11. The data are preliminary and have not been finalized by Ecology. Shaded values indicate exceedance of water quality standards or a strong contrast with historical results, according to Ecology's website.

Table 10. Little Spokane River near Mouth In Situ Water Quality Data, 2013

Date	Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (µmhos/cm)
10/17/2012	10.6	9.9	8.30	278
11/7/2012	9.9	9.9	8.26	**265**
12/5/2012	7.6	10.2	8.15	**236**
1/9/2013	5.9	10.7	8.05	246
2/6/2013	6.6	11.1	8.16	230
3/6/2013	6.1	10.7	8.09	207
4/3/2013	11.2	9.5	7.99	191
5/8/2013	15.8	**9**	8.15	224
6/5/2013	**16.4**	10	7.99	251
7/10/2013	No data	9.9	8.35	259
8/8/2013	**16.5**	10	8.33	274
9/11/2013	14.9	**10.3**	8.25	283
10/15/2013	10.5	9.7	8.23	280
11/5/2013	7.9	10	8.21	278
12/3/2013	5.3	10.6	8.22	271

Note: Shaded values indicate an exceedance of water quality standards or strong contrast to historical results.

Table 11. Little Spokane River near Mouth Conventional Water Quality Data, 2013

Date	Total Phosphorus (µg/L)	Soluble Reactive Phosphorus (µg/L)	Total Reactive Phosphorus (µg/L)	Total Nitrogen (µg/L)	NO_3+NO_2 (µg/L)
10/17/2012	11.4	6.8	6.8	1,300	**126**
11/7/2012	18.7	13.1	14.6	1,260	1,190
12/5/2012	31.8	18.5	**19.7**	**1,130**	**1,000**
1/9/2013	23.2	16.3	17.7	1,230	1,130
2/6/2013	32.0	17.1	20.5	1,140	1,080
3/6/2013	38.6	19.0	21.1	1,010	862
4/3/2013	43.3	18.3	20.8	669	594
5/8/2013	31.1	19.0	20.6	895	804
6/5/2013	19.3	12.1	12.6	1,090	936
7/10/2013	17.4	13.5	13	1,070	986
8/8/2013	16.8	12.8	12.9	1,250	1,110
9/11/2013	16.4	9.3	9.7	1,230	1,120
10/15/2013	14.8	9.3	8.6	1,260	**1,550**
11/5/2013	12.0	8.1	8.4	1,270	1,130
12/3/2013	20.6	12.9	14.0	1,350	1,250

Note: Shaded values indicate an exceedance of water quality standards or strong contrast to historical results.

Total N and nitrate+nitrite-N are high in both the Spokane and Little Spokane Rivers in late summer. Those levels, 1,200 to 1,500 TN, with most being nitrate+nitrite, roughly match the levels in the meta and hypolimnion of the lacustrine zone. This suggests that plunging river inflows were the source of the high summer N concentrations, with groundwater being an important contributor.

3.2.10 SPOKANE RIVER DOWNSTREAM OF LONG LAKE DAM

This site is also a “basin” station with data collected during October 2009 through September 2010 (Water Year 2010); however, Ecology did not conduct monitoring during 2013.

4. DISCUSSION

4.1 Dissolved Oxygen Assessment

Recent data indicate that the potential for improvement in the reservoir's DO resource is close to the reservoir's potential, or already has been achieved. The reservoir's DO has steadily improved since 85% of point-source effluent phosphorus was removed in 1977. That is shown in Figure 94, which was modified from Patmont (1987). During 1972 to 1977, minimum volume-weighted hypolimnetic DO ranged from 0.2 to 3.4 mg/L, with a mean of 1.4 mg/L. After phosphorus removal, there was a gradual improvement in minimum DO, increasing to means of 2.5 mg/L during 1978 to 1981, and to 4.5 mg/L during 1982 to 1985 (Patmont 1987). A generation later, minimum DO averaged 6.6 mg/L during 2010 to 2013. That progression is evident in Figure 94.

Some of the variability about the line in Figure 94 is due to water inflow and residence time – higher inflows produced higher DO minimums in the 1970s through 1980s (Patmont 1987). Specifically, the high minimum DOs in 1974 – 1975 had the highest June – October inflows during 1960 to 1985. Also, the range in recent minimum DO was proportionate to June – October flow. Nevertheless, the principal control on minimum hypolimnetic DO before and after phosphorus reduction, as well as during 2010 to 2013, has been riverine inflow TP those years.

The gradual, long-term increase in minimum DO may be due to a slow decline in DO demand of the bottom sediment. Patmont cited sediment DO demand of 1.08 g/m^2 per day determined throughout the reservoir in 1981 by Wagstaff and Soltero (1982). That rate was 40% of the total areal hypolimnetic oxygen deficit (AHOD) rate of 2.64 g/m^2 per day during that summer. Sediment DO demand would be expected to decline much slower than water column demand because; 1) sediment organic matter accumulation during the lake's eutrophic, pre-phosphorus reduction period was not readily accessible to DO in the overlying water (diffusion of DO into sediment is slow), and 2) algal production declined rather quickly from a summer mean chl of 20.4 µg/L during 1972 to 1977 before phosphorus removal to 13.9 µg/L during 1978 to 1981 and 9.1 µg/L during 1982 to 1985, both after phosphorus removal (Patmont 1987). Much of the three-fold increase in minimum DO after phosphorus removal was probably due to the reduction of chl by more than half and three-fold decrease in algal biovolume, because a carbon balance showed that most of the DO demand resulted from phytoplankton production and bottom sediment (Patmont 1987).

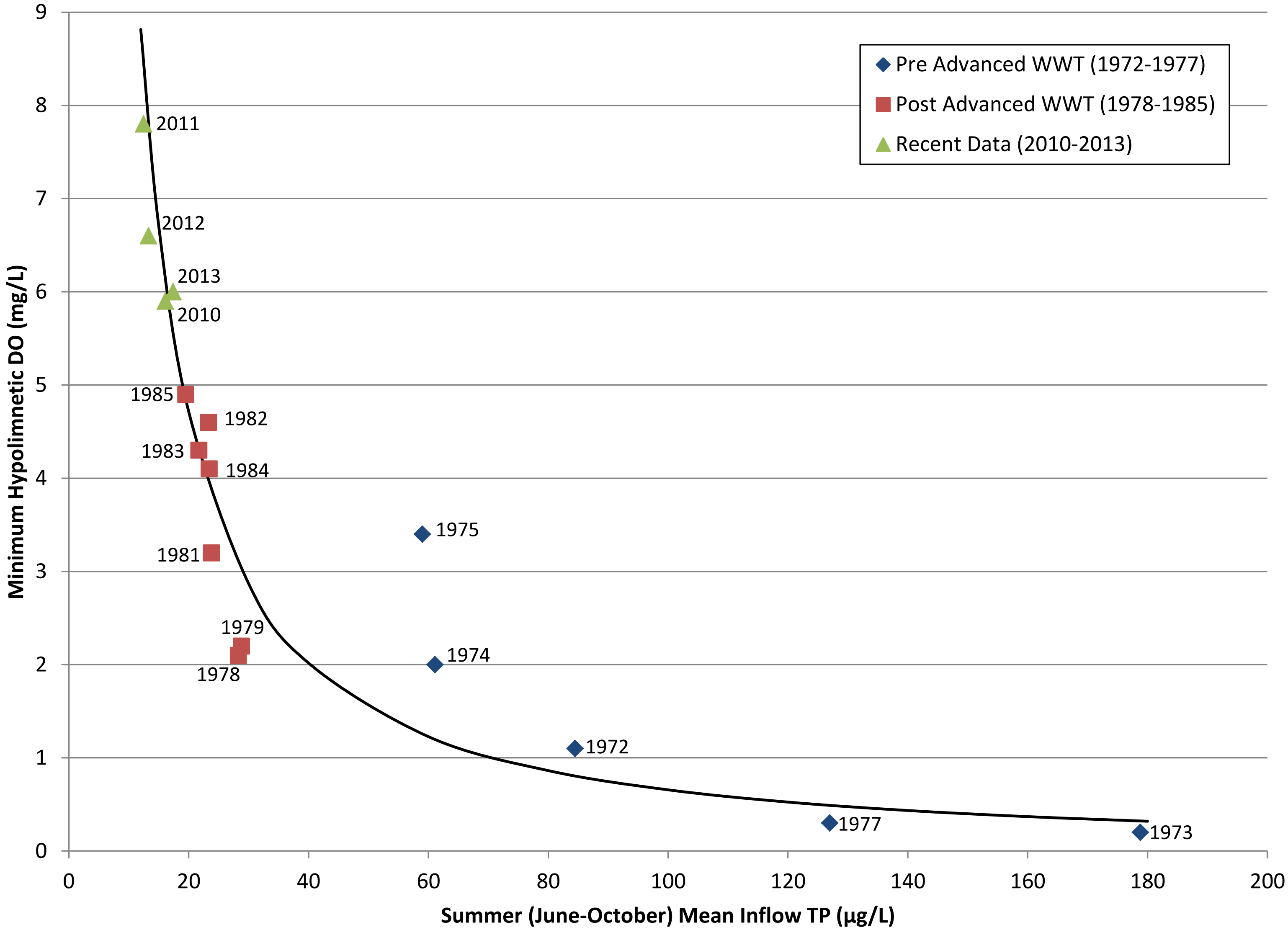

Figure 94. June-October Volume-Weighted Mean Inflow TP Concentrations related to Minimum Volume Weighted Hypolimnetic DO Concentrations before and after Advanced Wastewater Treatment. Concentrations from 1972 through 1985 from observed loading at Nine Mile Dam (Patmont 1987). Mean inflow TP Concentrations from 2010-2013 were taken as Mean TP Concentrations at Station LL5, in lieu of loading data from Nine Mile Dam.

AHOD is another indicator that suggests DO resources in the reservoir have increased markedly and may have nearly reached their potential for improvement. AHOD is the product of DO depletion rate in g/m^2 per day and hypolimnetic mean depth. That measure of whole water column DO demand, including sediment, ranged from 2.2 to 6.3 g/m^2 per day before to 1.8 to 2.6 g/m^2 per day after phosphorus removal (Patmont 1987). The rate in 2000 was 0.75 g/m^2 per day and 0.57, 0.67, and 0.85 g/m^2 per day in 2010, 2011, and 2012. The rate in 2013 was 0.58 g/m^2 per day indicating that DO depletion rate may have reached a plateau-similarly indicated by minimum DO (Figure 94). A gradual but sure decline in AHOD following phosphorus reduction is to be expected. Lake Washington AHOD decreased from a mean of 0.71 ± 0.1 g/m^2 per day during 1957 to 1969 before wastewater diversion to 0.58 ± 0.05 g/m^2 per day in 1970 to 1983, to what is probably an equilibrium of 0.47 ± 0.09 g/m^2 per day for this now oligotrophic lake (the AHOD was 0.42 g/m^2 per year in 1933 before eutrophication; Lehman 1988).

The recent rate in Lake Spokane is only 1.25 times the latest, probably equilibrium, rate in Lake Washington. That is another indication that DO resources may be near their potential for improvement. Reservoirs tend to have higher AHODs than lakes due to higher inflows and temperature. Walker (1985) determined AHODs for 34 lakes and 37 U.S. Army Corps of Engineers reservoirs. His results show that rates for reservoirs averaged 40% higher than for lakes, when correlated with chl.

The three indicators of DO depletion, 1) observed versus "no source" predicted minimum DO at depths greater than 8.5 m, 2) minimum hypolimnetic (greater than 15 m) DO and AHOD, and 3) the increase in the latter two since wastewater phosphorus removal, all suggest that DO resources in Lake Spokane either have already reached or are near the reservoir's potential for improvement. There is still DO demand in the metalimnion and hypolimnion water column as indicated by the DO profiles. Also, sediment demand is still present, indicated by the lowest DO occurring near the bottom. However, sediment demand has obviously diminished, because AHODs, which include the water column plus the sediment demand, are now much less than the sediment demand alone determined in 1981 (1.08 g/m^2 per day). While there is still demand in the water column and sediment, the lack of a trend in AHOD since 2000 and much of a difference between observed minimum DO and predicted "no source" DO suggests that there is not much capacity left for further improvement in DO.

4.1.1 DO AND FISH HABITAT

Fish can be "squeezed" in summer between epilimnetic water that is too warm and deeper layers that are sufficiently cool but with DO that is too low. The threat to cold water species can be assessed by determining the depth intervals with temperature and DO that are within the optimum ranges for growth. For rainbow trout, the maximum of the optimum temperature for growth is 18°C and the minimum for DO is 6 mg/L (USFWS 1984). Their preferred temperature is 14°C (Welch and Jacoby 2004). The minimum DO required is usually cited as 5 mg/L, recognizing that higher DO levels also occur (EPA 1986; USFWS 1984). Using these criteria, trout would probably avoid the epilimnion during most of the summer due to temperature that approaches 25°C and prefer to seek cooler water deeper than 10 m (Figures 7 to 10). However, between 10 and 20 m, DO was usually near or above 6 mg/L during August and September, but never less than the often cited required minimum of 5 mg/L (Figures 20 to 23). These data suggest that rainbow trout are not severely limited by DO and are most likely inhabiting cooler water in metalimnion and upper portions of the hypolimnion.

Using these critical maximum temperature and minimum DO, percent of volume acceptable for growth were computed for rainbow trout at the six stations for a high-flow year (2011) and a low-flow year (2013) (Figure 95-106). Habitat volumes for temperature and DO together, as well as separately, are shown to indicate which factor was most limiting. Figures 95-106 show that habitat was more restrictive during the low-flow year (2013) than the high-flow year (2011). Also, temperature restricts habitat far more than DO for rainbow trout at all sites. Habitat for DO showed some restriction at LL0 during the very low-flow year, 2013, but very little restriction at other sites or years. Moreover, most of the lost habitat due to DO at LL0 was below 25 m where trout are not likely to inhabit anyway.

Also of significance, with respect to fish distribution is the large size of *Daphnia* that occurred at all sites and with helmets that indicate low predation. Although it’s not known for sure that the large *Daphnids* that occurred in August, coincident with epilimnetic temperature above the optimum for trout, were in the epilimnion, they also were present in August at the upper shallow sites that were relatively warm at most depths. Thus, epilimnetic temperature, above the optimum, may have prevented fish predation on *Daphnia*.

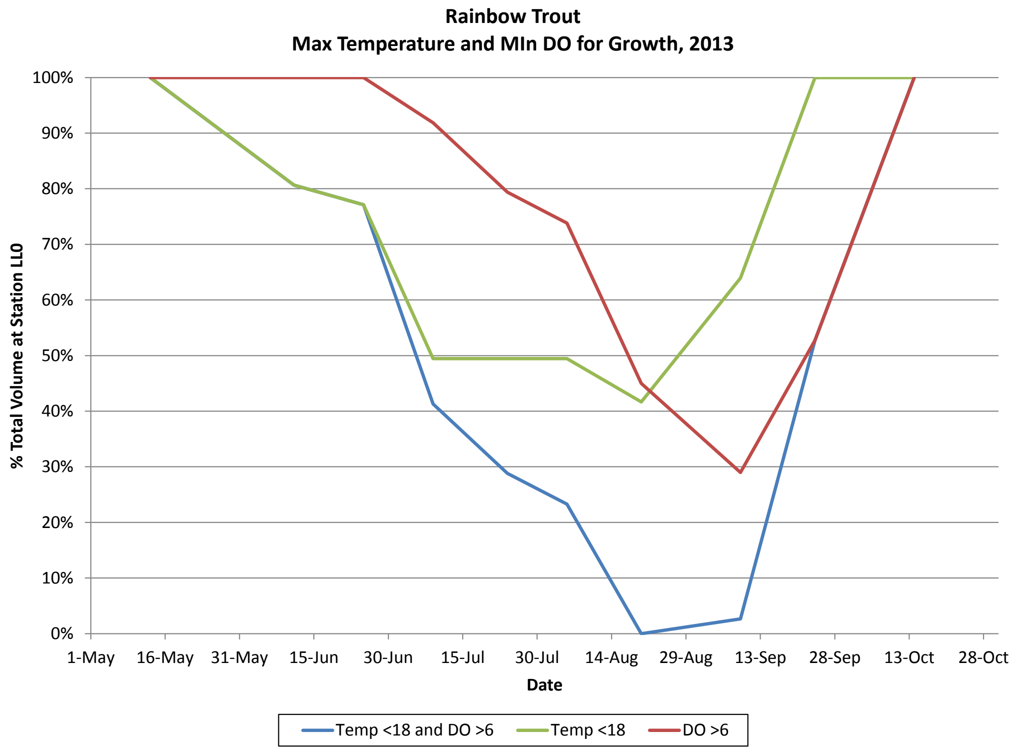

Figure 95. Habitat Conditions at Station LL0 for Rainbow Trout in 2013, a Low Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

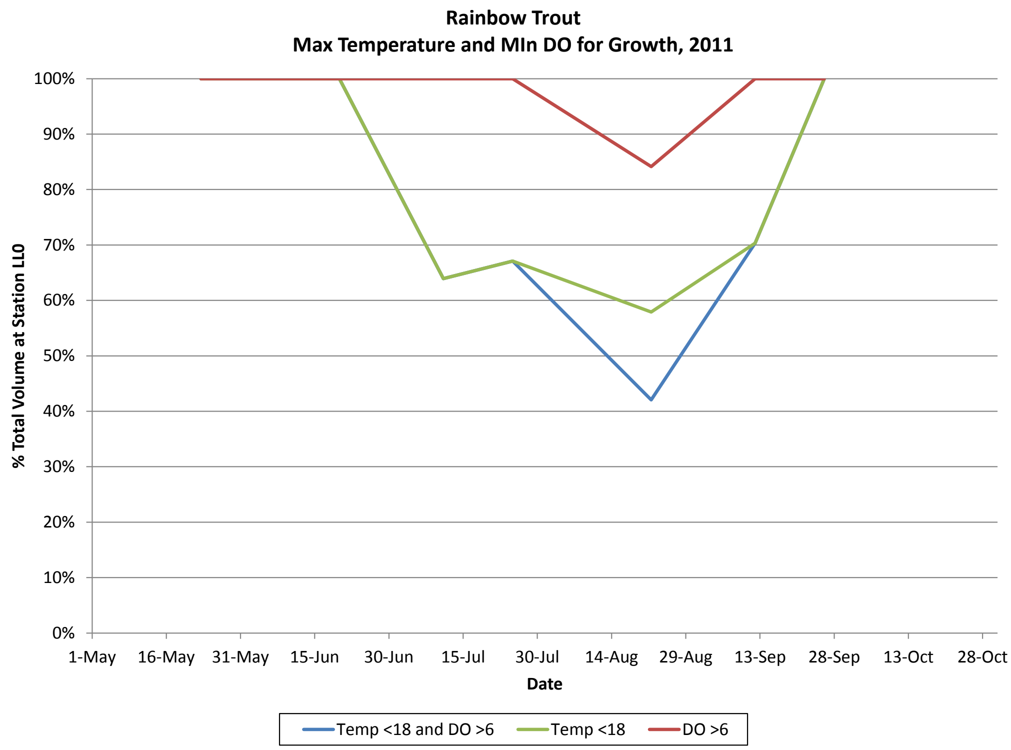

Figure 96. Habitat Conditions at Station LL0 for Rainbow Trout in 2011, a High Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

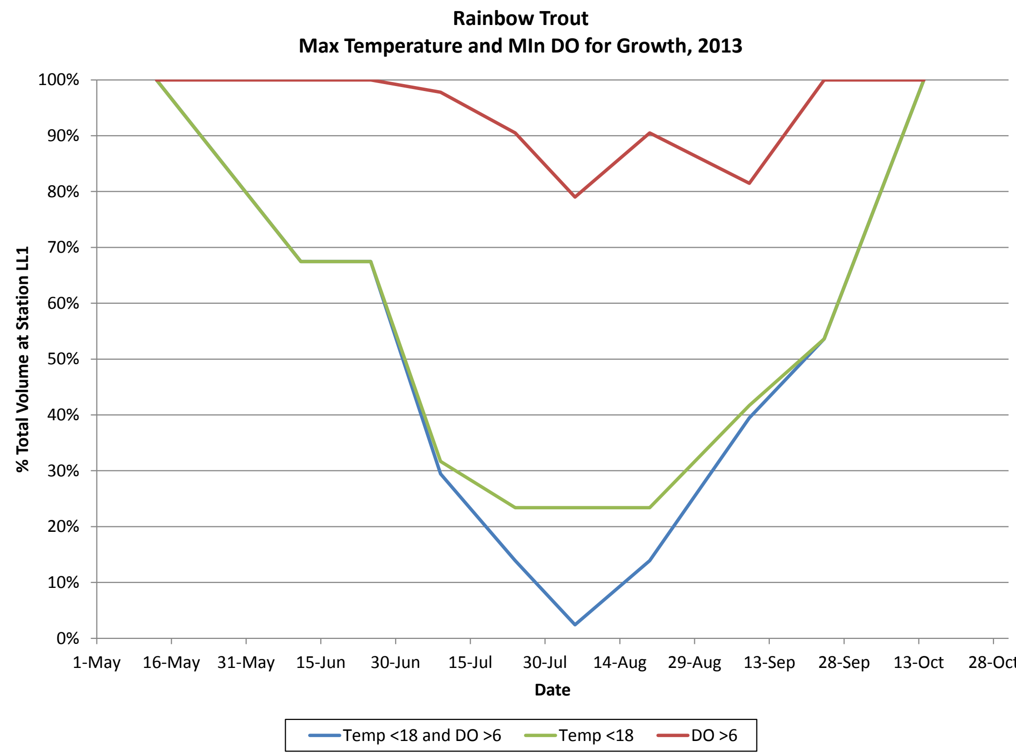

Figure 97. Habitat Conditions at Station LL1 for Rainbow Trout in 2013, a Low Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

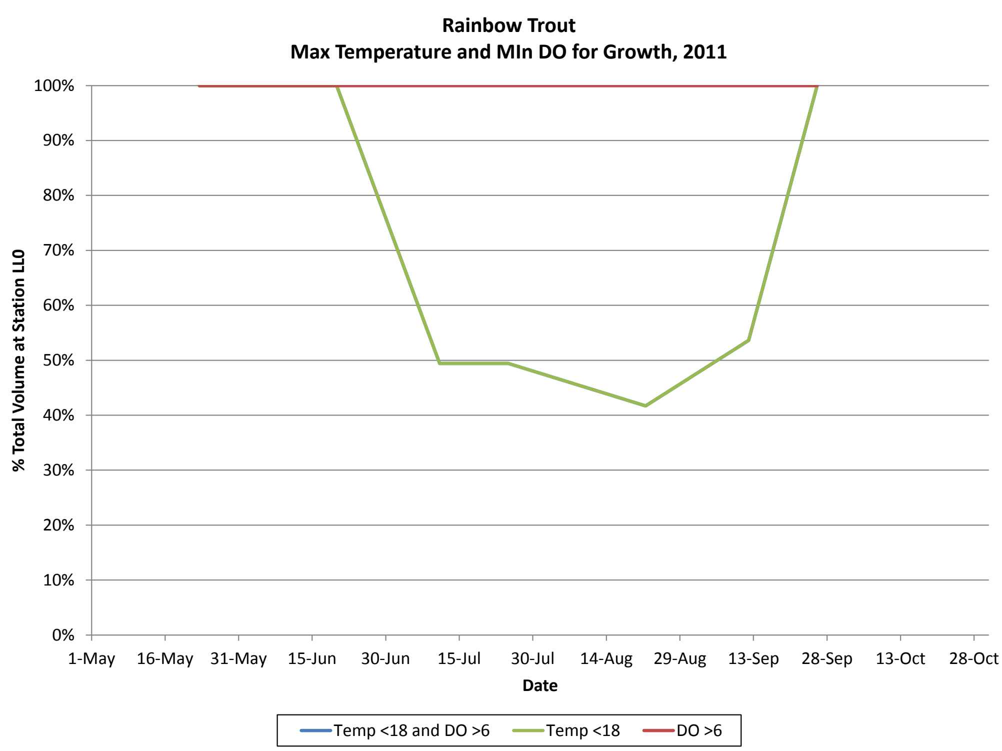

Figure 98. Habitat Conditions at Station LL1 for Rainbow Trout in 2011, a High Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

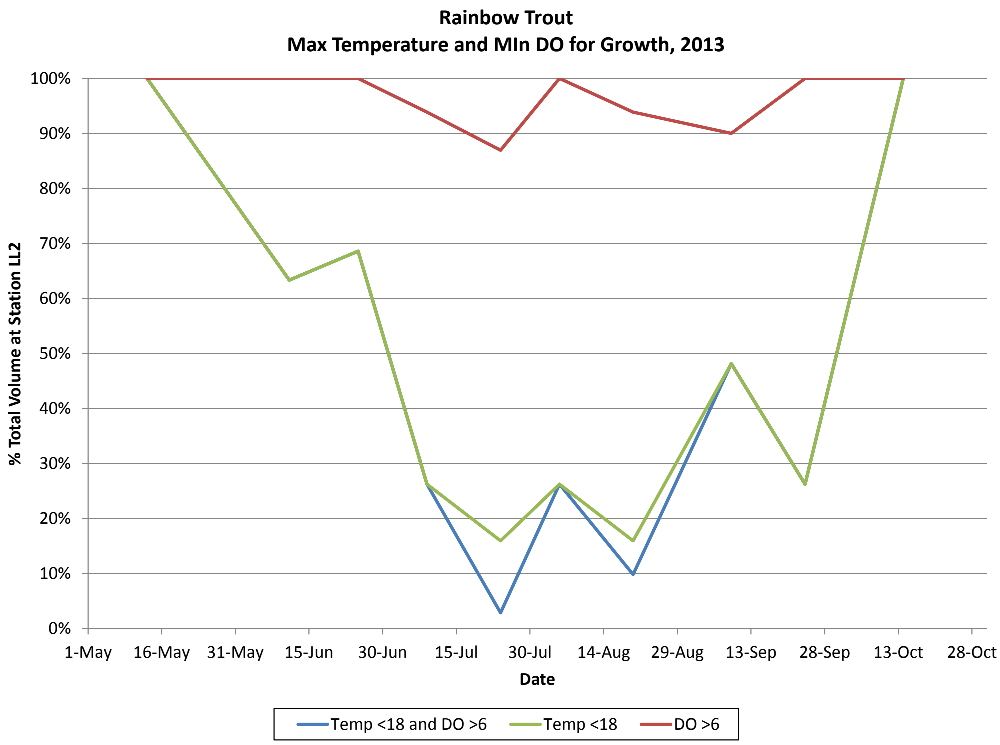

Figure 99. Habitat Conditions at Station LL2 for Rainbow Trout in 2013, a Low Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

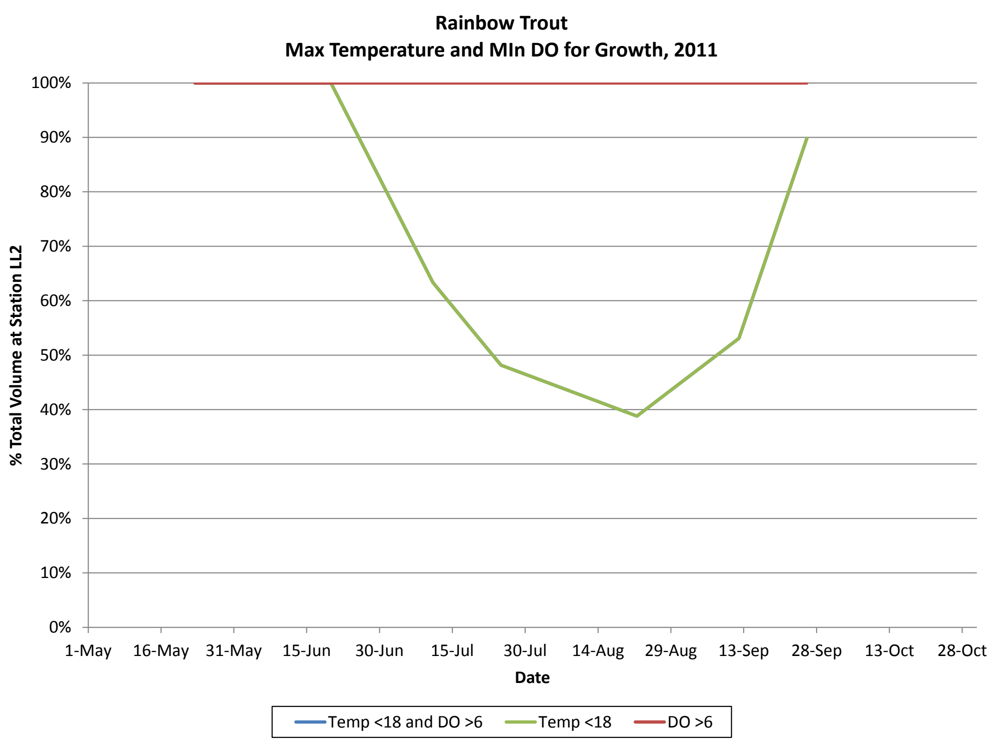

Figure 100. Habitat Conditions at Station LL2 for Rainbow Trout in 2011, a High Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

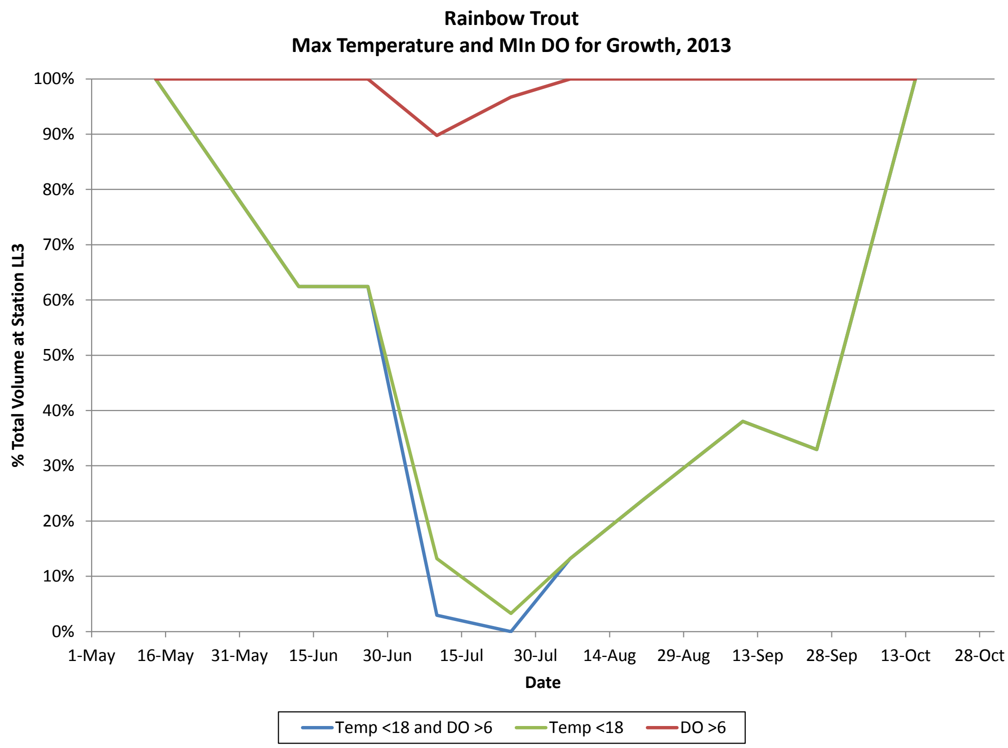

Figure 101. Habitat Conditions at Station LL3 for Rainbow Trout in 2013, a Low Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

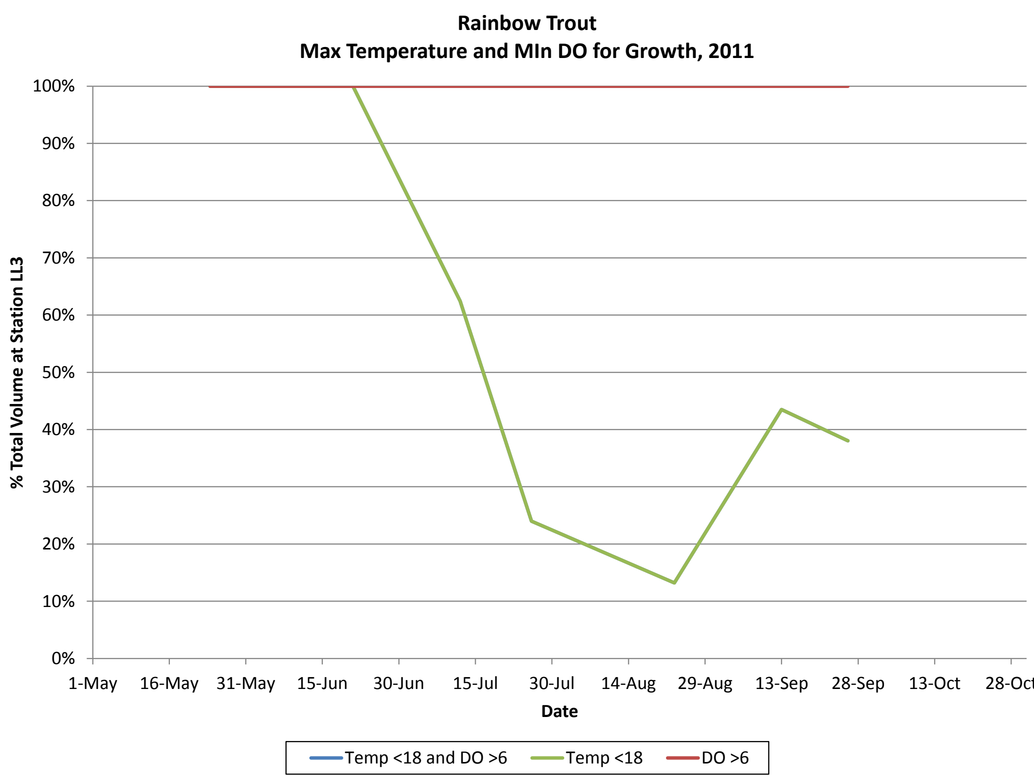

Figure 102. Habitat Conditions at Station LL3 for Rainbow Trout in 2011, a High Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

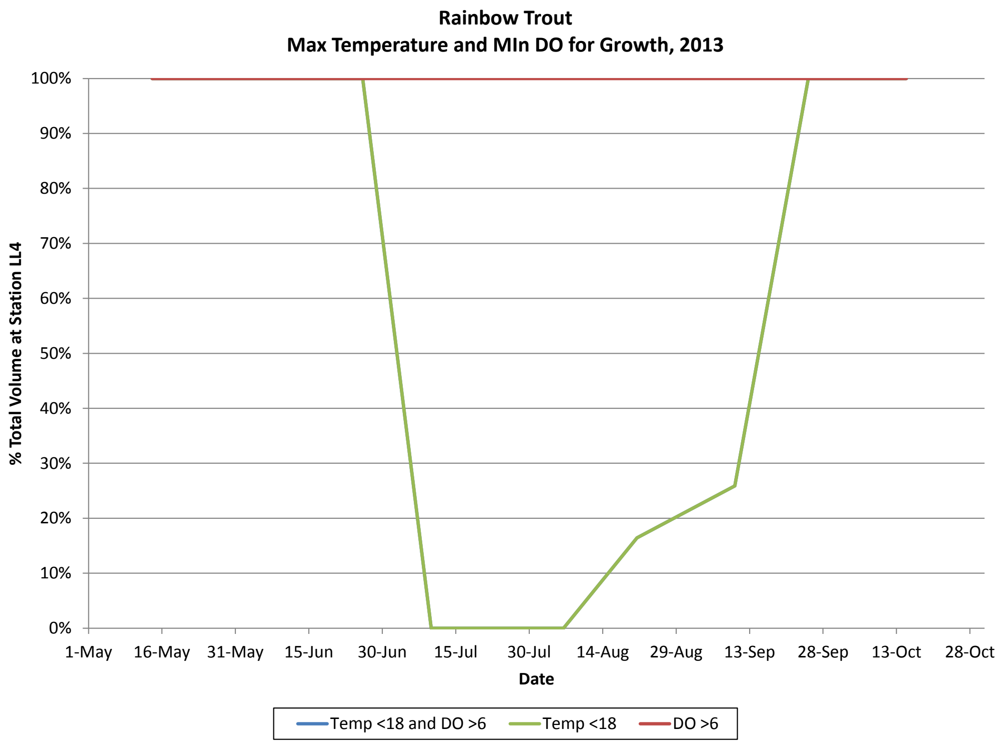

Figure 103. Habitat Conditions at Station LL4 for Rainbow Trout in 2013, a Low Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

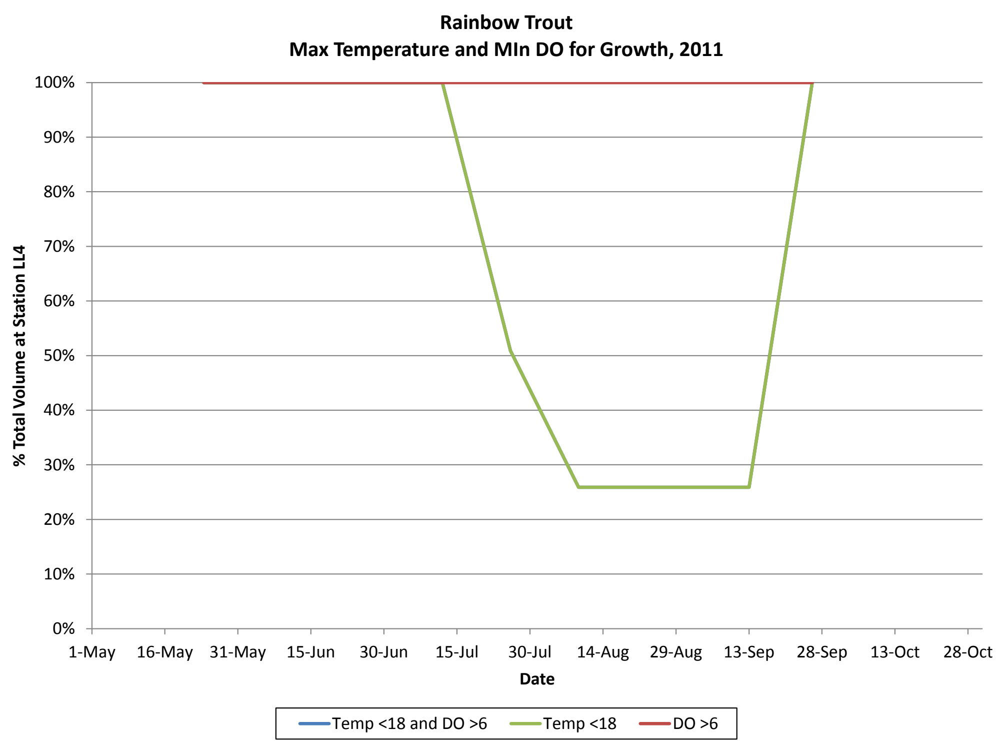

Figure 104. Habitat Conditions at Station LL4 for Rainbow Trout in 2011, a High Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

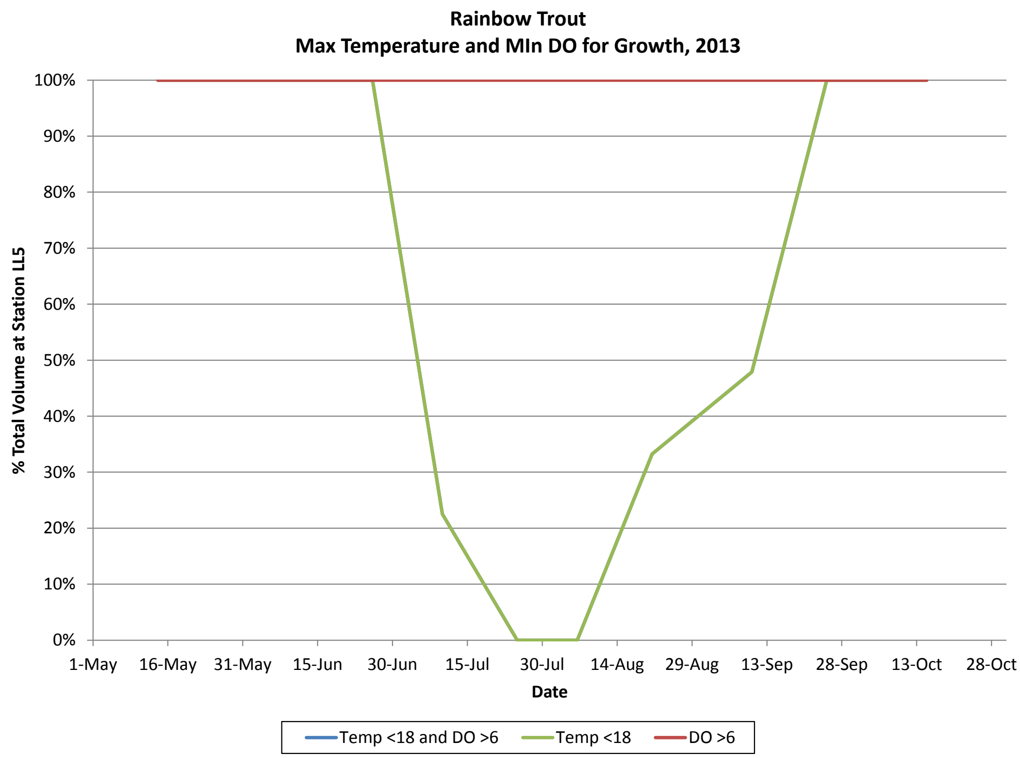

Figure 105. Habitat Conditions at Station LL5 for Rainbow Trout in 2013, a Low Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

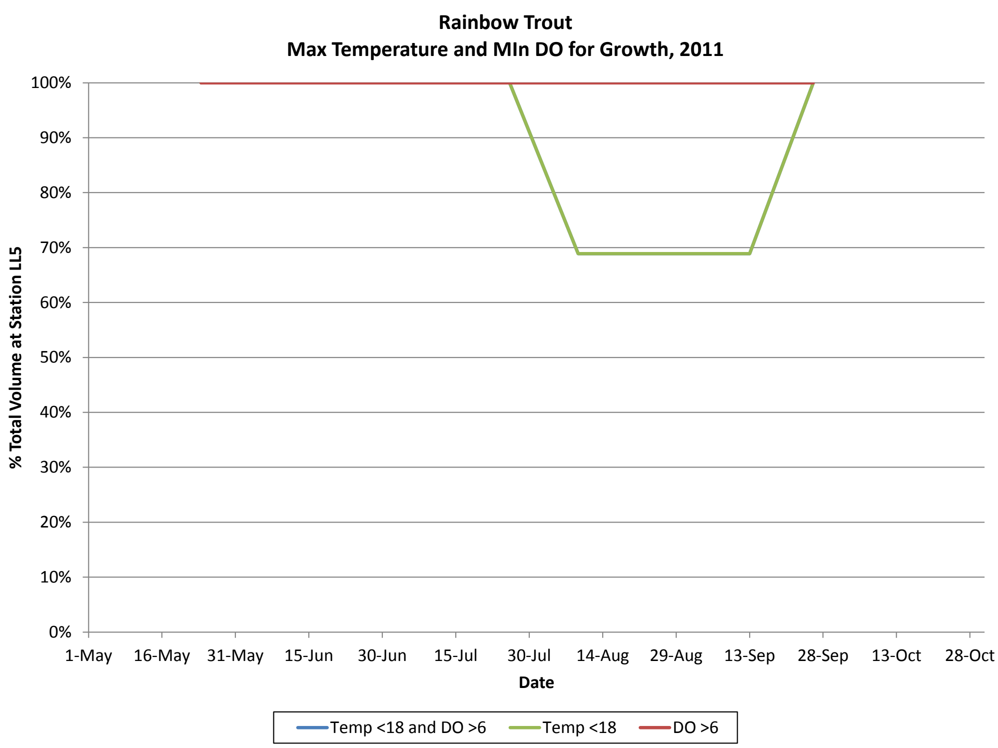

Figure 106. Habitat Conditions at Station LL5 for Rainbow Trout in 2011, a High Flow Year, Based on Maximum Temperature and Minimum DO for Growth.

4.2 Phosphorus Assessment

Summer (June to September) epilimnetic mean TP concentrations in 2013 were higher than in 2011, but similar to those in 2010 and 2012 (Figure 107). Summer mean TP at station LL5 in 2013 was much higher than means observed in previous years and was the maximum observed epilimnetic TP concentration in 2013. Summer mean epilimnetic TP in 2013 were calculated using concentrations at 0.5 and 5 m for stations LL0 to LL2, and concentrations at 0.5 m for stations LL3 to LL5. Summer means for 2010 and 2011 are based on averages from euphotic zone composite samples. The much lower TP concentrations in 2011 than observed in 2010, 2012, and 2013 may have been due to the wet year. Summer mean TP decreased slightly through the reservoir in all 4 years with TP at station LL0 being the lowest. That down reservoir trend is due to increasing water retention time and settling in the limnetic zone and plunging of inflow water that avoids the epilimnion (Thornton et al. 1990).

Summer hypolimnetic TPs were lower in 2013 than in 2010 and slightly less than in 2012 with exception of late July and late September. To compare data, hypolimnetic TP in 2012 and 2013 was calculated using samples collected at 20 m and deeper. This excludes the top 5 m of the hypolimnion, which is necessary in order to compare 2012 and 2013 data based on composite samples collected in 2010 and 2011. The composites in 2010 and 2011 were collected at various depths from 21 m and deeper. Hypolimnetic TPs calculated for stations LL0 and LL1 were volume-weighted while concentrations for station LL2 were from 1 m meter off the bottom only. Hypolimnetic TP for the lacustrine zone was determined for stations LL0, LL1, and LL2 for all 4 years (Figure 108).

Internal P loading (sediment P release) is indicated during 2010 and 2012 starting at the beginning of July (Figure 108). There is much less indication of sustained increase in hypolimnetic TP in 2011 or 2013. Maximum hypolimnetic TP in 2013 was similar to that in 2011 and much less than in the other two years (Figure 108). The lower TPs in 2011 may be due in part to lack of anoxia. Minimum DO in 2011 was 3.2 mg/L at station LL0 and 6.9 mg/L at station LL1 - above the 2.0 mg/L level which indicates that anoxia may exist at the sediment-water interface. Minimum volume-weighted hypolimnetic DO in 2011 (7.8 mg/L) was also much higher than that observed in 2010 (5.9 mg/L), 2012 (6.6 mg/L), and 2013 (6.0 mg/L).

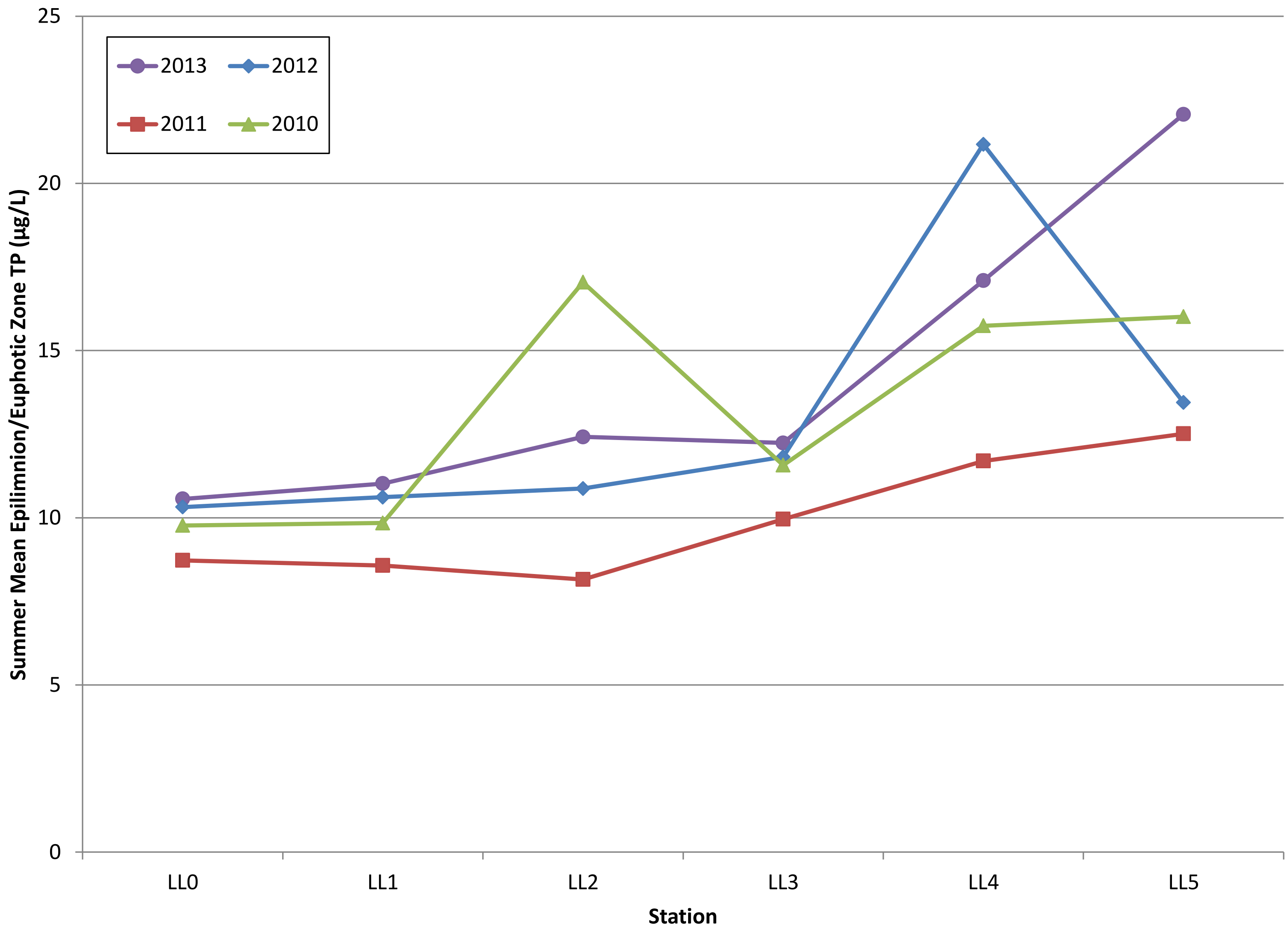

Figure 107. Summer Mean Epilimnion/Euphotic Zone TP Concentrations, 2010-2013
(Data is presented from down reservoir to up reservoir left to right.)

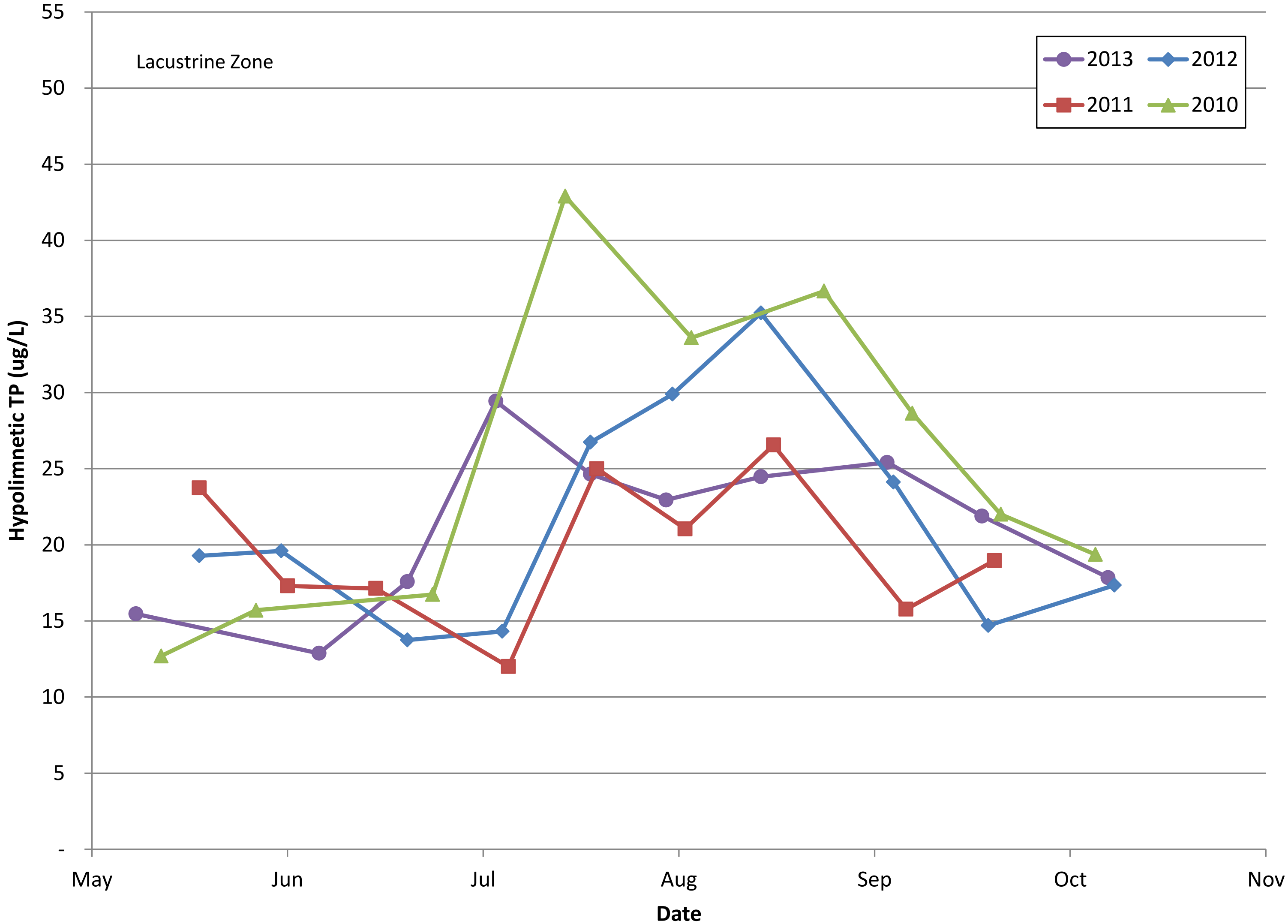

Figure 108. Lacustrine Zone Mean Hypolimnetic TP Concentrations, 2010-2013

4.3 Trophic State

Lake Spokane was at or near borderline oligotrophic-mesotrophic on average in all zones for the last 4 years, except for TP in the transition and riverine zones (Tables 12 and 13). TP averaged slightly greater than the oligotrophic-mesotrophic boundary of 10 µg/L in the transition and riverine zones (Tables 12 and 13). The trophic state index (TSI) values were similarly at or just slightly over the TSI of 40 - the oligo-mesotrophic boundary (Table 14). TSI values lower than 40 would be indicative of oligotrophic conditions. TSI values between 40 and 50 are most often associated with mesotrophy.

Thus, Lake Spokane water quality is very good, especially for a reservoir in Eastern Washington, well known for naturally productive lakes. The lake's high indicator values near or at the oligo-mesotrophic level are also consistent with markedly improved indicators of DO. Further, improvement of DO may mean further movement of trophic state into the oligotrophic range. Given that growth and production of trout is a function of food supply as well as DO/temperature habitat, further benefits to water quality as a result of a ten-fold reduction in P in City of Spokane discharges may not in turn benefit trout, which may not now be limited by DO. Further consideration of possible negative effects of continued oligotrophication on trout, a subject well covered in the literature, seems warranted.

Table 12. 2013 and 2012 Summer (June to September) Epilimnetic Means Compared to 2010 and 2011Summer Euphotic Zone Means in Lacustrine, Transition, and Riverine Zones in Lake Spokane

Year	Lacustrine (0.5, 5 m)			Transition (0.5 m)			Riverine Zone (0.5 m)		
	TP (ug/L)	Chl (ug/L)	Secchi (m)	TP (ug/L)	Chl (ug/L)	Secchi (m)	TP (ug/L)	Chl (ug/L)	Secchi (m)
2010	9.8	5.1	5.1	13.7	4.7	3.7	16.0	3.2	3.6
2011	9.1	3.3	5.8	10.8	1.9	4.7	12.5	1.4	4.8
2012	10.6	4.8	4.4	16.5	4.0	3.9	13.4	2.7	4.7
2013	11.3	3.0	5.7	14.7	5.5	3.9	22.1	3.2	4.1
Average	10.2	4.0	5.2	13.9	4.0	4.1	16.0	2.6	4.3

Table 13. Trophic State Boundaries

Parameter	Oligo-Mesotrophic	Meso-Eutrophic
TP (µg/L)	10	30
Chl (µg/L)	3	9
Secchi (m)	4	2

Source: Nurnberg 1996

Table 14. Trophic State Index Values for Lacustrine, Transition, and Riverine Zones in Lake Spokane, 2013

2013	Lacustrine	Transition	Riverine
TSI-TP	39	43	49
TSI-Chl	41	47	42
TSI-Secchi	35	41	40
TSI-Average	39	44	43

As the effect of decreasing inflow TP on the lake's DO resources and trophic state show, P is the controlling nutrient in the reservoir, justifying the emphasis of P reduction in the 1970s, rather than on nitrogen (N) or nitrogen plus phosphorus (N+P) together. The reservoir inflow total nitrogen to total phosphorus ratio (TN:TP) during 1974 to 1978 before effluent P reduction averaged 15 and bioassays indicated that N or N+P limited algal growth 60% of the time on average (Patmont 1987). Recently, there has been an increasing emphasis for removing N as well as P, which as the whole-lake data show would have been an extreme and unnecessary expense (Schindler 2012; Welch 2009). Removing P alone has greatly improved water quality of this reservoir and the TN:TP ratio has been marked by an increase of three to four fold on average, compared to Patmont's pre-P removal inflow ratios (Table 15). Before P reduction the phytoplankton community was dominated by blue-green algae (cyanobacteria), most of which were N fixers, so removing N too would not have been cost effective.

Also pertinent with respect to the importance of P and the present quality of Lake Spokane is the similarity of TSI values for TP, chl, and transparency. Chlorophyll TSI is often high (low concentrations) and Secchi TSI is high (low transparency) in reservoirs due to non-algal particulate matter. The similar TSIs, even in the transition and riverine zones where non-algal turbidity is usually highest, demonstrate the direct link between TP and transparency and through chl to transparency.

There was, nevertheless, a trend in P utilization moving from the riverine zone into the limnetic zone. The ratio of chl:TP increased in a down reservoir direction from a 2010 to 2013 average of 0.17 in the riverine zone to 0.28 in the transition zone to 0.40 in the limnetic zone. The average for lakes is usually around 0.25 to 0.35, so the lowest ratio in the riverine suggests some limitation by light (non-algal turbidity) and or availability of P.

Table 15. Total Nitrogen to Total Phosphorus ratios for 2013 by station; calculated using summer mean Epilimnion TP and TN

Station	2013 TN:TP
LL0	68.3
LL1	61.5
LL2	55.0
LL3	48.5
LL4	36.8
LL5	47.5

4.4 Monitoring Recommendations for 2014

Based on 2013 monitoring results, it is recommended that in late July and late August 2014 additional phytoplankton samples be collected at stations LL0, LL1, and LL2 at 5 and 10/15 m depths and at LL3 at 5 m depth. Currently phytoplankton samples are collected at 0.5 m only at all stations. In 2013 peaks in chl were observed at 5 m and in the metalimnion in the lacustrine zone. Collecting additional phytoplankton samples would allow further evaluation of phytoplankton community composition and dynamics in the reservoir.

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APPENDIX A – Lake Spokane *In Situ* Monitoring Data

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Table A-1. Station LL0 *In Situ* Water Quality Data, 2013

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
5/13/2013	0.5	16.51	8.64	82.5	11.92	128.8		2.6
5/13/2013	1	16.48	8.64	82.6	12.07	130.3		
5/13/2013	2	16.27	8.67	82.2	12.28	132		
5/13/2013	3	14.77	8.59	80.6	12.81	133.4		
5/13/2013	4	14.28	8.07	79.4	12.17	125.4		
5/13/2013	5	13.54	8.05	80.8	12.25	124.1	12.4	
5/13/2013	6	13.41	7.96	80.2	12.13	122.6		
5/13/2013	7	13.4	7.91	79.7	12.13	122.6		
5/13/2013	8	13.34	7.8	79.2	11.9	120.1		
5/13/2013	9	13.34	7.77	79.2	11.85	119.6		
5/13/2013	9*	13.29	7.77	79.2	11.38	114.7		
5/13/2013	10	13.1	7.73	79	11.3	113.4		
5/13/2013	12	12.86	7.68	79.4	11.19	111.7		
5/13/2013	15	12.86	7.67	79.7	11.18	111.1	11.3	
5/13/2013	18	12.49	7.64	80.7	11.15	110.4		
5/13/2013	21	12.48	7.64	80.7	11.14	110.3		
5/13/2013	24	12.2	7.61	81.4	10.97	107.8		
5/13/2013	27	11.72	7.57	81.6	11.02	107.2		
5/13/2013	30	10.99	7.54	80.9	11.17	106.9		
5/13/2013	33	10.85	7.52	80.8	11.13	106.1		
5/13/2013	33*	10.87	7.52	81.2	11.14	106.3		
5/13/2013	36	10.29	7.47	80.7	11.23	105.6		
5/13/2013	39	9.8	7.46	80.8	11.19	104.1		
5/13/2013	42	9.61	7.42	80.6	11.17	103.5		
5/13/2013	45	9.53	7.4	80.4	11.17	103.2		
5/13/2013	48	9.31	7.4	80.4	11.12	102.2		
5/13/2013	49	9.27	7.38	80.7	11.11	102		
6/11/2013	0.5	18.47	8.5	101.3	11.03	124.7		3.4
6/11/2013	1	18.44	8.61	101.3	11.02	124.6		
6/11/2013	2	18.41	8.65	101.3	11.04	124.6		
6/11/2013	3	18.37	8.65	101.6	11.07	124.9		
6/11/2013	4	18.23	8.48	101.1	11.14	125.5		
6/11/2013	5	18	8.71	101.4	11.22	125.6	11.2	
6/11/2013	6	17.91	8.65	103.1	11.12	124.3		
6/11/2013	7	17.74	8.64	101	11.1	123.6		
6/11/2013	8	17.69	8.61	100.3	11.05	122.9		
6/11/2013	9	17.43	8.62	100.9	11.19	123.9		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
6/11/2013	9*	17.44	8.61	100.4	11.15	123.4		
6/11/2013	10	16.74	8.35	107.2	11.09	120.9		
6/11/2013	12	16.22	8.26	106.8	10.9	117.6		
6/11/2013	15	15.54	8.05	108.8	10.71	113.9	10.4	
6/11/2013	18	14.48	7.64	109.6	9.5	103.3		
6/11/2013	21	14.26	7.54	109.9	9.63	99.5		
6/11/2013	24	14.09	7.49	112	9.55	98.4		
6/11/2013	27	14.02	7.47	113	9.45	97.2		
6/11/2013	30	13.84	7.44	114.1	9.25	94.8		
6/11/2013	33	13.74	7.41	114	9.24	94.4		
6/11/2013	33*	13.74	7.39	113.6	9.19	93.9		
6/11/2013	36	13.64	7.36	113.7	9.1	93		
6/11/2013	39	13.58	7.35	113.1	9.02	91.9		
6/11/2013	42	13.43	7.31	111.7	8.67	88		
6/11/2013	45	13.31	7.28	111.4	8.41	85.2		
6/11/2013	48	13.28	7.22	111.3	8.25	83.5		
6/25/2013	0.5	19.46	8.25	117.4	9.58	110.6		7.1
6/25/2013	1	19.28	8.34	116.9	9.64	111		
6/25/2013	2	19.14	8.37	117.3	9.73	111.6		
6/25/2013	3	18.82	8.47	117.1	9.93	113.2		
6/25/2013	4	18.65	8.5	116.8	9.99	113.5		
6/25/2013	5	18.09	8.48	115.2	10.09	113.3	9.8	
6/25/2013	6	17.7	8.2	116.3	9.61	107.1		
6/25/2013	7	17.44	7.95	117.1	9.4	104.2		
6/25/2013	8	16.98	7.78	128.1	8.91	97.8		
6/25/2013	9	16.84	7.75	128.6	8.85	96.9		
6/25/2013	9*	16.79	7.74	128.6	8.87	97		
6/25/2013	10	16.7	7.72	127.5	8.84	96.5		
6/25/2013	12	16.52	7.67	126.3	8.78	95.5		
6/25/2013	15	16.24	7.64	130.9	8.66	93.7	8.6	
6/25/2013	18	16.04	7.64	136	8.49	91.4		
6/25/2013	21	15.84	7.62	134.4	8.36	89.6		
6/25/2013	24	15.49	7.54	131	8.27	88		
6/25/2013	27	15.18	7.47	121.4	8.32	88		
6/25/2013	30	14.67	7.4	114.2	8.31	86.9		
6/25/2013	33	14.17	7.33	112.8	8.09	83.6		
6/25/2013	33*	14.15	7.33	112.9	8.16	84.3		
6/25/2013	36	13.76	7.24	114.5	7.43	76.1		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
6/25/2013	39	13.64	7.18	115.2	6.87	70.2		
6/25/2013	42	13.42	7.13	115.2	6.51	66.2		
6/25/2013	45	13.35	7.13	114.8	6.5	66		
6/25/2013	47	13.31	7.13	115.6	6.16	62.5		
7/9/2013	0.5	23.05	8.4	124.1	9.66	118.3		6.0
7/9/2013	1	23.05	8.42	124	9.72	119.1		
7/9/2013	2	22.75	8.39	123.9	9.86	120.1		
7/9/2013	3	22.59	8.45	124	9.94	120.8		
7/9/2013	4	22.47	8.5	124.6	10.02	121.4		
7/9/2013	5	21.45	8.61	130	11.69	138.8	11.6	
7/9/2013	6	20.57	8.55	135.9	11.56	135		
7/9/2013	7	20.12	8.44	142.8	11.23	130		
7/9/2013	8	19.85	8.37	141	11.07	127.4		
7/9/2013	9	19.67	8.39	132.3	11.03	126.7		
7/9/2013	9*	19.58	8.37	132.4	11.07	126.7		
7/9/2013	10	18.91	8.09	128.8	10.26	115.9		
7/9/2013	12	18.26	7.77	126.4	9.56	106.5		
7/9/2013	15	17.4	7.47	122.7	8.57	93.8		
7/9/2013	18	16.66	7.32	120.6	8.12	87.5		
7/9/2013	21	16.35	7.27	117	8.15	87.3		
7/9/2013	24	16.11	7.25	116	8.13	86.7		
7/9/2013	27	15.72	7.21	128.9	7.72	81.6		
7/9/2013	30	15.32	7.17	134.2	7.22	75.6		
7/9/2013	33	14.7	7.05	129	6.52	67.4		
7/9/2013	33*	14.75	7.03	129.1	6.5	67.3		
7/9/2013	36	14.05	6.93	116.2	6.14	62.6		
7/9/2013	39	13.64	6.83	114.9	5.24	52.9	5.55	
7/9/2013	42	13.41	6.77	115.1	4.43	44.5		
7/9/2013	45	13.28	6.74	114.8	4.19	42		
7/9/2013	47	13.24	6.73	115.4	4.05	40.5		
7/24/2013	0.5	24.5	8.87	143.1	10.49	132.9		3.7
7/24/2013	1	24.54	8.96	142.7	10.55	133.7		
7/24/2013	2	24.27	8.94	143.1	10.75	135.6		
7/24/2013	3	23.81	9.05	143.1	12.07	150.9		
7/24/2013	4	23.29	9.08	145.1	13.38	165.6		
7/24/2013	5	22.02	8.88	151.7	12.61	152.3	13.1	
7/24/2013	6	21.2	8.77	152.5	12.6	149.8		
7/24/2013	7	20.22	8.5	153.5	11.3	131.8		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
7/24/2013	8	19.62	8.06	152.5	10.01	115.3		
7/24/2013	9	19.31	7.77	150.6	8.88	101.7		
7/24/2013	9*	19.33	7.78	150.7	8.87	101.7		
7/24/2013	10	18.94	7.57	150.8	8	90.9		
7/24/2013	12	18.68	7.48	149.8	7.49	84.6		
7/24/2013	15	18	7.4	151.8	7.2	80.3	7.05	
7/24/2013	18	17.56	7.34	139.9	7.19	79.4		
7/24/2013	21	16.91	7.26	124.6	7.32	79.8		
7/24/2013	24	16.37	7.16	120.9	7.1	76.6		
7/24/2013	27	15.99	7.09	121.4	6.52	69.7		
7/24/2013	30	15.44	7.01	125.5	5.7	60.2		
7/24/2013	33	14.82	6.98	129.5	5.43	56.6		
7/24/2013	33*	14.78	6.98	128.8	5.47	57		
7/24/2013	36	13.97	6.88	121.1	4.75	48.6		
7/24/2013	39	13.53	6.79	118	3.93	39.8		
7/24/2013	42	13.44	6.77	117.4	3.2	32.4		
7/24/2013	45	13.28	6.74	117.4	3.1	31.2		
7/24/2013	47	13.19	6.72	117.7	3	30.2		
8/5/2013	0.5	22.92	8.89	151	9.93	121.9		5.0
8/5/2013	1	22.89	8.85	151.1	10	122.7		
8/5/2013	2	22.8	8.97	151.7	10.12	124		
8/5/2013	3	22.75	8.89	151	10.11	123.7		
8/5/2013	4	22.71	8.93	151.5	10.11	123.6		
8/5/2013	5	22.21	8.62	162.9	9.96	120.6	10.2	
8/5/2013	6	21.08	8.3	167.8	10.23	121.1		
8/5/2013	7	20.23	7.87	169.2	8.85	103.1		
8/5/2013	8	19.44	7.76	187.1	8.13	93.9		
8/5/2013	9	18.88	7.65	203	7.38	83.7		
8/5/2013	9*	18.89	7.65	197.4	7.29	82.7		
8/5/2013	10	18.64	7.69	224.3	7.29	82.2		
8/5/2013	12	18.41	7.62	220.6	6.89	77.4		
8/5/2013	15	17.93	7.47	190.1	6.52	72.5		
8/5/2013	18	17.73	7.41	185	6.32	70		
8/5/2013	21	17.53	7.28	158.5	6.26	68.8		
8/5/2013	24	16.52	7.18	124.4	6.47	69.8		
8/5/2013	27	15.84	7.01	123.5	5.46	58.1		
8/5/2013	30	15.35	6.97	127	4.91	51.7		
8/5/2013	33	14.85	6.96	130	5.02	52.3		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
8/5/2013	33*	14.86	6.97	130.1	5.02	52.3		
8/5/2013	36	14.15	6.9	122.9	4.55	46.6		
8/5/2013	39	13.5	6.79	119.4	3.17	32.1	3.85	
8/5/2013	42	13.35	6.75	118.5	2.51	25.3		
8/5/2013	45	13.24	6.73	118.5	2.15	21.7		
8/5/2013	47	13.17	6.72	118.9	2.07	20.8		
8/20/2013	0.5	22.11	8.72	181.1	10.33	124.7		4.7
8/20/2013	1	22.07	8.67	181.7	10.43	125.8		
8/20/2013	2	21.67	8.78	184.8	10.66	127.6		
8/20/2013	3	21.59	8.74	185.1	10.67	127.5		
8/20/2013	4	21.15	8.5	208.2	11.06	131		
8/20/2013	5	20.79	8.29	213.5	10.37	121.9	10.5	
8/20/2013	6	20.47	8.11	213.7	9.8	114.5		
8/20/2013	7	19.82	8	227	9.23	106.6		
8/20/2013	8	19.12	7.76	230.6	7.74	88.1		
8/20/2013	9	18.96	7.66	232.1	7.22	81.9		
8/20/2013	9*	18.93	7.63	232.4	7.16	81.1		
8/20/2013	10	18.79	7.6	233.1	6.88	77.7		
8/20/2013	12	18.61	7.56	238.4	6.43	72.4		
8/20/2013	15	18.22	7.43	224	5.75	64.2	5.8	
8/20/2013	18	17.56	7.37	215.1	5.47	60.3		
8/20/2013	21	17	7.19	178.2	4.89	53.2		
8/20/2013	24	16.26	7.05	156.6	4.28	45.9		
8/20/2013	27	15.69	6.98	153.5	3.81	40.4		
8/20/2013	30	15.5	6.94	145.6	3.68	38.8		
8/20/2013	33	15.09	6.89	129.2	4.29	44.9		
8/20/2013	33*	15.02	6.87	129.2	4.29	44.8		
8/20/2013	36	14.31	6.82	125	4.11	42.2		
8/20/2013	39	13.53	6.71	119.9	2.69	27.2		
8/20/2013	42	13.38	6.66	118.9	1.8	18.1		
8/20/2013	45	13.23	6.65	119.1	1.44	14.5		
8/20/2013	47	13.12	6.63	119.1	1.1	11		
9/9/2013	0.5	21.33	8.74	191.5	9.54	113.6		7.1
9/9/2013	1	21.29	8.8	191.7	9.55	113.7		
9/9/2013	2	21.13	8.77	192.1	9.54	113.1		
9/9/2013	3	21.12	8.76	191.9	9.55	113.3		
9/9/2013	4	21.01	8.68	195.1	9.25	109.4		
9/9/2013	5	19.7	7.67	225.3	7.16	82.6		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
9/9/2013	6	19.2	7.52	228.9	6.32	72.2		
9/9/2013	7	18.76	7.4	234.6	5.44	61.5	6.1	
9/9/2013	8	18.56	7.37	237.3	5.31	59.9		
9/9/2013	9	18.21	7.38	242.4	5.16	57.7		
9/9/2013	9*	18.17	7.39	242.2	5.1	57		
9/9/2013	10	17.99	7.45	248.1	5.56	61.9		
9/9/2013	12	17.61	7.41	249.5	5.15	57		
9/9/2013	15	17.05	7.56	258.8	6.32	61.9	6.15	
9/9/2013	18	16.73	7.46	252.1	5.53	60		
9/9/2013	21	16.62	7.43	254.9	5.54	59.9		
9/9/2013	24	16.36	7.34	244.4	4.87	52.5		
9/9/2013	27	16.06	7.2	218.6	3.98	42.6		
9/9/2013	30	15.3	7.01	168.7	2.69	28.3		
9/9/2013	33	14.84	6.91	139.5	3.23	33.7		
9/9/2013	33*	14.82	6.88	139.3	3.24	33.7		
9/9/2013	36	14.04	6.78	124	2.74	28.1		
9/9/2013	39	13.44	6.66	120.6	1.02	10.3		
9/9/2013	42	13.25	6.61	120.7	0.39	3.9		
9/9/2013	45	13.21	6.6	120.1	0.18	1.8		
9/9/2013	47	13.09	6.59	120.1	0.08	0.8		
9/24/2013	0.5	17.66	8.05	231.5	7.87	87.5		7.0
9/24/2013	1	17.69	8.08	231.5	7.88	87.8		
9/24/2013	2	17.71	8.13	231	7.94	88.4		
9/24/2013	3	17.73	8.13	231.6	7.9	88		
9/24/2013	4	17.71	8.13	231.8	7.88	87.7		
9/24/2013	5	17.68	8.03	236	7.6	84.6	7.85	
9/24/2013	6	17.33	7.64	261.3	5.93	65.5		
9/24/2013	7	17.08	7.63	262	6	66		
9/24/2013	8	17.05	7.62	260.8	5.97	65.6		
9/24/2013	9	16.94	7.59	262.4	5.79	63.4		
9/24/2013	9*	16.93	7.59	262.4	5.78	63.3		
9/24/2013	10	16.87	7.61	262.4	5.94	65		
9/24/2013	12	16.73	7.6	263.2	5.91	64.4		
9/24/2013	15	16.62	7.62	263.8	6	65.3	6.05	
9/24/2013	18	16.52	7.63	264.8	6.16	66.9		
9/24/2013	21	16.46	7.61	263.8	6.04	65.5		
9/24/2013	24	16.27	7.61	263.9	6.05	65.4		
9/24/2013	27	16.03	7.52	258.9	5.45	58.6		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
9/24/2013	30	15.78	7.37	243.9	4.21	45		
9/24/2013	33	15.43	7.18	212.5	2.88	30.6		
9/24/2013	33*	15.39	7.16	209.1	2.77	29.3		
9/24/2013	36	14.49	6.96	144.6	2.24	23.3		
9/24/2013	39	13.8	6.81	124.4	0.74	7.6		
9/24/2013	42	13.37	6.73	122.5	0.02	0.3		
9/24/2013	45	13.17	6.71	122.7	0	0		
9/24/2013	47	13.14	6.71	122.9	0	0		
10/14/2013	0.5	13.53	8.1	235.1	9.57**			5.2
10/14/2013	1	13.58	8.12**	234.4	9.57**			
10/14/2013	2	13.58	8.14**	234.4	9.56**			
10/14/2013	3	13.57	8.14**	234.4	9.57**			
10/14/2013	4	13.57	8.16**	234.5	9.54**			
10/14/2013	5	13.58	8.18**	234.5	9.55**		9.66	
10/14/2013	6	13.58	8.18**	234.5	9.55**			
10/14/2013	7	13.58	8.19**	234.7	9.54**			
10/14/2013	8	13.58	8.2**	234.2	9.54**			
10/14/2013	9	13.59	8.19**	234.6	9.52**			
10/14/2013	9*	13.59	8.21**	234.5	9.53**			
10/14/2013	10	13.59	8.21**	234.3	9.55**			
10/14/2013	12	13.59	8.2**	234.5	9.52**			
10/14/2013	15	13.38	8.07**	231.6	8.78**		8.98	
10/14/2013	18	12.71	7.97**	229.5	8.63**			
10/14/2013	21	12.31	7.98**	229	9.02**			
10/14/2013	24	12.15	8.01**	230.2	9.34**			
10/14/2013	27	12.09	8**	230.1	9.44**			
10/14/2013	30	12	7.98**	230.6	9.47**			
10/14/2013	33	11.99	7.96**	230.9	9.45**			
10/14/2013	33*	11.99	7.98**	230.5	9.45**			
10/14/2013	36	11.98	7.98**	230.8	9.44**			
10/14/2013	39	11.97	7.98**	231	9.42**		9.04	
10/14/2013	42	11.97	7.97**	231	9.4**			
10/14/2013	45	11.95	7.96**	231.3	9.37**			
10/14/2013	47	11.94	7.94**	232.1	9.25**			

*QA/QC measurement for Hydrolab
**Hydrolab malfunctioned and calibration could not take place until later in the day on 10/14/13. pH values were adjusted based on laboratory results by -1.0 and DO measurements were adjusted by +0.5 mg/L.
***Secchi disk depths average of 3 measurements

Table A-2. Station LL1 *In Situ* Water Quality Data, 2013

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
5/13/2013	0.5	15.7	8.4	79.1	11.6	123.2		2.3
5/13/2013	1	15.66	8.4	79.3	11.63	123.5		
5/13/2013	2	15.61	8.39	79.2	11.65	123.5		
5/13/2013	3	15.1	8.13	77.6	11.35	119		
5/13/2013	3*	15.14	8.15	77.9	11.41	119.7		
5/13/2013	4	14.99	8.05	76.9	11.3	118.2		
5/13/2013	5	14.91	7.97	76.6	11.15	116.5	10.9	
5/13/2013	6	14.85	7.91	76.1	11.09	115.7		
5/13/2013	7	14.638	7.83	75.7	10.96	113.9		
5/13/2013	8	14.46	7.79	75.8	10.98	113.6		
5/13/2013	9	14.27	7.77	76.1	10.95	112.8		
5/13/2013	10	14.01	7.77	76.6	11.02	112.8		
5/13/2013	12	13.79	7.75	77	11.01	112.2		
5/13/2013	15	12.92	7.66	78	10.83	108.3		
5/13/2013	18	12.66	7.62	78.6	10.88	108.1		
5/13/2013	18*	12.63	7.63	79	10.86	107.8		
5/13/2013	21	11.62	7.58	80.9	10.84	105.2	no data; bottle broke in transit	
5/13/2013	24	11.28	7.57	81.2	10.9	105		
5/13/2013	27	10.06	7.53	80.8	11.24	105.2		
5/13/2013	30	9.19	7.44	80.8	10.94	100.3		
5/13/2013	33	8.81	7.36	81	10.52	95.6		
6/11/2013	0.5	19.77	8.54	103.7	10.35	120.1		3.9
6/11/2013	1	19.65	8.49	103.5	10.45	121		
6/11/2013	2	19.29	8.48	105.1	10.55	121.3		
6/11/2013	3	19.1	8.53	105.9	10.67	122.2		
6/11/2013	3*	19.1	8.52	106.5	10.7	122.6		
6/11/2013	4	19.02	8.54	106.3	10.79	123.4		
6/11/2013	5	18.81	8.55	107.5	10.98	125	11.2	
6/11/2013	6	17.95	8.39	115.9	10.84	121.3		
6/11/2013	7	17.85	8.28	118.2	10.77	120.2		
6/11/2013	8	17.77	8.26	118.6	10.66	118.9		
6/11/2013	9	17.56	8.2	117.9	10.44	115.9		
6/11/2013	10	16.87	7.92	119.8	10.01	109.5		
6/11/2013	12	16.59	7.83	120.2	9.89	107.7		
6/11/2013	15	15.47	7.66	115.2	9.96	105.7		
6/11/2013	18	14.9	7.58	111.7	9.93	104.1		
6/11/2013	18*	14.84	7.57	112	9.95	104.2		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
6/11/2013	21	14.31	7.48	111.7	9.67	100.1	9.6	
6/11/2013	24	14.15	7.42	112.6	9.57	98.8		
6/11/2013	27	13.86	7.32	114.2	9.08	93		
6/11/2013	30	13.61	7.23	114.2	8.7	88.7		
6/11/2013	33	13.43	7.04	114	7.53	76.5		
6/25/2013	0.5	19.09	8.32	118.8	9.48	108.7		6.2
6/25/2013	1	18.96	8.31	118.8	9.55	109.2		
6/25/2013	2	18.86	8.35	118.6	9.6	109.6		
6/25/2013	3	18.8	8.33	118.2	9.62	109.7		
6/25/2013	3*	18.79	8.34	118.6	9.62	109.6		
6/25/2013	4	18.69	8.33	118.5	9.68	110		
6/25/2013	5	18.45	8.27	120.1	9.63	109	9.5	
6/25/2013	6	17.56	7.88	129	9.09	101		
6/25/2013	7	17.19	7.77	134.4	8.82	97.2		
6/25/2013	8	17.02	7.73	131.2	8.86	97.3		
6/25/2013	9	16.99	7.69	130.7	8.83	96.9		
6/25/2013	10	16.88	7.68	133	8.7	95.3		
6/25/2013	12	16.55	7.6	131.5	8.65	94.1		
6/25/2013	15	16.18	7.53	113.2	8.94	96.5		
6/25/2013	18	15.82	7.49	118.5	8.88	95.1		
6/25/2013	18*	15.81	7.49	119.1	8.87	95.1		
6/25/2013	21	15.66	7.5	128.4	8.71	93	8.55	
6/25/2013	24	15.42	7.49	139	8.51	90.4		
6/25/2013	27	15.21	7.44	141.4	8.17	86.4		
6/25/2013	30	14.64	7.2	124.5	7.23	75.5		
6/25/2013	33	14.01	7.08	116.7	6.53	67.3		
6/25/2013	34	13.92	7.02	117.8	6.03	62		
7/9/2013	0.5	24.43	8.52	126	9.35	117.5		5.9
7/9/2013	1	24.32	8.48	126.1	9.39	117.8		
7/9/2013	2	24.17	8.45	126.1	9.43	118		
7/9/2013	3	23.72	8.46	125.7	9.48	117.7		
7/9/2013	3*	23.71	8.5	125.8	9.5	117.8		
7/9/2013	4	21.76	8.54	146.9	11.6	138.6		
7/9/2013	5	20.63	8.46	159.5	11.62	135.9	11.1	
7/9/2013	6	20.16	8.31	162.2	10.61	122.9		
7/9/2013	7	19.69	7.92	161.2	9.38	107.7		
7/9/2013	8	19.48	7.88	158	9.36	107		
7/9/2013	9	19.27	7.83	153.8	9.47	107.8		
7/9/2013	10	19.09	8.01	141.9	10.14	115		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
7/9/2013	12	18.44	7.77	140.3	9.46	105.8		
7/9/2013	15	17.62	7.49	128.5	8.86	97.5		
7/9/2013	18	16.92	7.32	124.4	8.37	90.7		
7/9/2013	18*	16.88	7.34	124.6	8.38	90.8		
7/9/2013	21	16.48	7.27	122.8	8.26	88.7	7.9	
7/9/2013	24	16.15	7.18	118.4	8	85.3		
7/9/2013	27	15.81	7.12	118.2	7.81	82.7		
7/9/2013	30	15.46	7.04	124.8	6.89	72.4		
7/9/2013	33	15.03	6.91	132	5.04	52.5		
7/24/2013	0.5	24.67	8.68	146.3	9.27	117.8		6.9
7/24/2013	1	24.66	8.62	146.3	9.28	117.9		
7/24/2013	2	24.52	8.61	146.3	9.32	118.1		
7/24/2013	3	24.48	8.63	146	9.35	118.5		
7/24/2013	3*	24.48	8.61	146	9.35	118.4		
7/24/2013	4	24.4	8.59	146.4	9.35	118.2		
7/24/2013	5	24.06	8.59	147.6	9.35	117.4	9.1	
7/24/2013	6	22.35	8.36	173.2	10.31	125.1		
7/24/2013	7	21.16	8.08	175	9.51	113		
7/24/2013	8	20.18	7.79	178.7	8.71	101.5		
7/24/2013	9	19.59	7.8	194.9	8.4	96.7		
7/24/2013	10	19.27	7.69	197.7	7.99	91.4		
7/24/2013	12	18.8	7.72	215.7	7.97	90.4		
7/24/2013	15	18.52	7.7	212.9	7.78	87.7		
7/24/2013	18	17.89	7.53	201.8	7.27	80.9		
7/24/2013	18*	17.86	7.52	200.2	7.24	80.5		
7/24/2013	21	16.94	7.15	143.6	6.03	65.8	6.3	
7/24/2013	24	16.3	7.03	126	6.08	65.4		
7/24/2013	27	15.88	6.9	126	4.83	51.6		
7/24/2013	30	15.38	6.8	127.8	3.64	38.4		
7/24/2013	33	14.93	6.73	130.4	2.57	26.9		
8/5/2013	0.5	23.69	8.74	164.1	9.5	118.4		7.7
8/5/2013	1	23.41	8.73	163.5	9.62	119.2		
8/5/2013	2	23.24	8.73	163.6	9.78	120.8		
8/5/2013	3	23.09	8.72	161.3	9.71	119.6		
8/5/2013	3*	23.09	8.71	161.9	9.66	119		
8/5/2013	4	22.98	8.71	160.5	9.68	119		
8/5/2013	5	22.81	8.73	159.6	9.88	121	9.7	
8/5/2013	6	21.51	8.34	199.5	10.42	124.5		
8/5/2013	7	19.94	7.99	205	9.12	105.7		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
8/5/2013	8	19.26	7.84	221.4	8.36	95.6		
8/5/2013	9	18.96	7.86	240.4	8.21	93.3		
8/5/2013	10	18.88	7.81	240	8.09	91.7		
8/5/2013	12	18.57	7.73	244.2	7.66	86.3		
8/5/2013	15	18.13	7.75	247.5	7.69	85.9		
8/5/2013	18	17.63	7.64	236	6.95	76.8		
8/5/2013	18*	17.65	7.63	236	7	77.4		
8/5/2013	21	17.23	7.43	215	5.86	64.2	6.6	
8/5/2013	24	16.43	7.06	149.5	3.96	42.8		
8/5/2013	27	16	6.9	137.4	2.88	30.7		
8/5/2013	30	15.65	6.81	131.5	2.18	23.1		
8/5/2013	33	14.92	6.74	131.8	0.88	9.2		
8/20/2013	0.5	23.46	8.89	176.4	10.39	128.6		4.1
8/20/2013	1	23.29	8.96	176.2	10.46	129.1		
8/20/2013	2	23.19	8.97	177.1	10.58	130.4		
8/20/2013	3	23.11	8.98	177.5	10.63	130.7		
8/20/2013	3*	23.1	8.94	177.6	10.7	131.6		
8/20/2013	4	22.91	8.91	181.5	10.94	134.1		
8/20/2013	5	21.65	8.81	196.2	11.86	141.9	10.3	
8/20/2013	6	19.86	8.36	210.6	10.34	119.5		
8/20/2013	7	19.43	8.07	213.6	9.12	104.4		
8/20/2013	8	19.09	7.87	218.3	8.16	92.8		
8/20/2013	9	18.97	7.82	222	7.89	89.4		
8/20/2013	10	18.83	7.77	226	7.61	86.1		
8/20/2013	12	18.45	7.69	234.7	6.87	77.1		
8/20/2013	15	18.05	7.66	241.2	6.59	73.4		
8/20/2013	18	17.86	7.61	242.4	6.44	71.4		
8/20/2013	18*	17.83	7.61	242.3	6.48	71.8		
8/20/2013	21	17.47	7.55	242.6	6.06	66.7	6.05	
8/20/2013	24	16.61	7.53	241.9	6.07	65.6		
8/20/2013	27	15.84	7.36	229.6	5.12	54.4		
8/20/2013	30	15.51	7.2	209.9	3.62	38.2		
8/20/2013	33	15.32	7.1	196.4	2.79	29.3		
9/9/2013	0.5	21.61	8.82	192.8	9.51	113.8		6.9
9/9/2013	1	21.58	8.79	192.9	9.53	114		
9/9/2013	2	21.48	8.8	192.8	9.55	114		
9/9/2013	3	21.42	8.81	192.9	9.57	114.2		
9/9/2013	3*	21.41	8.85	192.9	9.56	114		
9/9/2013	4	21.33	8.82	193.3	9.58	114		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
9/9/2013	5	21.24	8.83	192.6	9.6	114	9.2	
9/9/2013	6	20.6	8.25	213.6	8.26	97		
9/9/2013	7	19.19	7.55	233.6	6.05	69		
9/9/2013	8	18.51	7.48	246	5.26	59.3		
9/9/2013	9	18.29	7.5	251.5	5.51	61.7		
9/9/2013	10	18.1	7.5	254.2	5.54	61.9		
9/9/2013	12	17.79	7.59	258.6	6.18	68.5		
9/9/2013	15	17.24	7.65	261.1	6.71	73.6		
9/9/2013	18	16.95	7.62	261.9	6.59	71.8		
9/9/2013	18*	16.96	7.62	262	6.61	72.1		
9/9/2013	21	16.55	7.7	265.2	7.16	77.4	7.2	
9/9/2013	24	16.32	7.72	266.7	7.38	79.4		
9/9/2013	27	16.09	7.72	267	7.35	78.7		
9/9/2013	30	16.01	7.66	265.6	7.03	75.1		
9/9/2013	33	15.42	7.11	218.1	1.45	15.3		
9/24/2013	0.5	18.2	8.26	224.4	8.33	93.7		6.3
9/24/2013	1	18.19	8.28	224	8.32	93.6		
9/24/2013	2	18.16	8.29	224.1	8.35	93.8		
9/24/2013	3	18.15	8.29	223.9	8.33	93.6		
9/24/2013	3*	18.16	8.3	224	8.3	93.3		
9/24/2013	4	18.15	8.29	224.1	8.3	93.2		
9/24/2013	5	18.15	8.29	224.1	8.32	93.5	8.05	
9/24/2013	6	18.14	8.3	223.9	8.3	93.2		
9/24/2013	7	18.13	8.29	224	8.29	93.1		
9/24/2013	8	18.12	8.27	224.7	8.24	92.5		
9/24/2013	9	17.73	7.93	234.5	7.32	81.6		
9/24/2013	10	16.95	7.73	242.2	6.86	75.2		
9/24/2013	12	16.78	7.72	241.4	6.92	75.6		
9/24/2013	15	16.58	7.65	247.5	6.61	71.9		
9/24/2013	18	16.23	7.67	242.7	6.71	72.4		
9/24/2013	18*	16.23	7.67	242.6	6.68	72.1		
9/24/2013	21	16.03	7.68	241.7	6.75	72.5	6.6	
9/24/2013	24	15.86	7.64	242	6.53	69.9		
9/24/2013	27	15.59	7.84	238.2	7.78	82.8		
9/24/2013	30	15.5	7.84	238.6	7.81	83		
9/24/2013	33	15.43	7.84	238.6	7.83	83.1		
10/14/2013	0.5	13.83	8.01	232.7	9.54**			5.2
10/14/2013	1	13.75	8.07	232.8	9.52**			
10/14/2013	2	13.78	8.13	232.5	9.45**			

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
10/14/2013	3	13.78	8.18	232.1	9.4**			
10/14/2013	3*	13.78	8.15	232.6	9.32**			
10/14/2013	4	13.77	8.2	232.7	9.4**			
10/14/2013	5	13.76	8.22	232.1	9.41**		9.36	
10/14/2013	6	13.75	8.2	232.6	9.36**			
10/14/2013	7	13.75	8.19	232.7	9.37**			
10/14/2013	8	13.73	8.21	232.7	9.4**			
10/14/2013	9	13.73	8.2	232.8	9.36**			
10/14/2013	10	13.72	8.2	232.6	9.4**			
10/14/2013	12	13.7	8.2	232.8	9.4**			
10/14/2013	15	13.31	8.15	231.2	9.27**			
10/14/2013	18	12.51	8	231.7	8.89**			
10/14/2013	18*	12.53	8	231.7	8.85**			
10/14/2013	21	11.9	7.96	237.7	9**		9.05	
10/14/2013	24	11.75	7.95	238	9.02**			
10/14/2013	27	11.65	7.92	240.4	9.09**			
10/14/2013	30	11.62	7.92	240.8	9.1**			
10/14/2013	33	11.62	7.9	240.7	9.11**			

*QA/QC measurement for Hydrolab
** Hydrolab malfunctioned and calibration could not take place until later in the day on 10/14/13. DO measurements were adjusted by +0.5 mg/L even after calibration based on laboratory Winkler results. pH was successfully calibrated and were similar to laboratory results.
***Secchi disk depths average of 3 measurements

Table A-3. Station LL2 *In Situ* Water Quality Data, 2013

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
5/13/2013	0.5	15.31	7.79	73.7	10.52	110.8		2.1
5/13/2013	1	15.29	7.75	73.7	10.52	110.7		
5/13/2013	2	15.28	7.75	73.8	10.55	111.1		
5/13/2013	3	15.18	7.7	74	10.51	110.4		
5/13/2013	4	15.1	7.69	74	10.45	109.6		
5/13/2013	4*	15.1	7.69	73.8	10.44	109.5		
5/13/2013	5	15.08	7.69	73.6	10.4	109	10.5	
5/13/2013	6	15.02	7.63	73.6	10.36	108.5		
5/13/2013	7	14.93	7.66	73.7	10.39	108.6		
5/13/2013	8	14.87	7.66	73.8	10.43	108.8		
5/13/2013	9	14.88	7.66	74.1	10.4	108.5		
5/13/2013	10	14.78	7.67	74.1	10.4	108.3		
5/13/2013	12	14.39	7.65	75	10.5	108.4		
5/13/2013	15	13.65	7.66	76.5	10.7	108.7	10.6	
5/13/2013	18	12.97	7.64	77.7	10.88	108.9		
5/13/2013	21	12.31	7.61	79.9	10.79	106.4		
5/13/2013	21*	12.37	7.62	80.4	10.83	107		
5/13/2013	24	8.75	7.31	82.8	9.8	88.9		
5/13/2013	26	8.65	7.26	82.7	9.71	87.9		
6/11/2013	0.5	20.05	8.42	109.3	10.13	118.3		3.6
6/11/2013	1	20.03	8.39	109.4	10.14	118.3		
6/11/2013	2	20.02	8.36	109.8	10.15	118.4		
6/11/2013	3	19.94	8.36	109.4	10.15	118.2		
6/11/2013	4	19.33	8.31	111.5	10.37	119.3		
6/11/2013	4*	19.23	8.34	113.4	10.46	120.1		
6/11/2013	5	18.47	8.4	119.6	11.15	126.1	11.4	
6/11/2013	6	18.13	8.23	119.2	10.61	119.2		
6/11/2013	7	17.26	7.85	119	9.86	108.8		
6/11/2013	8	17.12	7.76	118.1	9.71	107.8		
6/11/2013	9	17.05	7.72	118.7	9.66	106		
6/11/2013	10	16.93	7.69	118.9	9.56	104.7		
6/11/2013	12	16.21	7.57	120.4	9.53	102.8		
6/11/2013	15	14.61	7.44	113.3	9.58	99.9	9.5	
6/11/2013	18	14.08	7.32	112.9	9.38	96.7		
6/11/2013	21	13.88	7.27	114.2	9.22	94.6		
6/11/2013	21*	13.9	7.28	114.1	9.18	94.2		
6/11/2013	24	13.65	7.19	114.5	8.63	88		
6/11/2013	25	13.61	7.14	115.2	8.35	85.2		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
6/25/2013	0.5	19.36	8.52	118.1	9.87	113.7		4.9
6/25/2013	1	19.14	8.5	117.4	9.84	112.9		
6/25/2013	2	18.88	8.54	118.1	9.77	111.5		
6/25/2013	3	18.89	8.55	117.6	10.13	115.7		
6/25/2013	4	18.83	8.56	117.9	10.14	115.7		
6/25/2013	4*	18.83	8.56	117.7	10.13	115.5		
6/25/2013	5	18.31	8.27	126.5	9.79	110.5		
6/25/2013	6	17.99	8.2	128.6	9.77	109.5	no winkler collected	
6/25/2013	7	17.64	8.15	122.6	9.73	108.3	caught in thunderstorm	
6/25/2013	8	17.49	8.12	118.3	9.9	109.8		
6/25/2013	9	17.24	7.89	113.8	9.8	108.1		
6/25/2013	10	16.75	7.71	110.1	9.48	103.6		
6/25/2013	12	16.26	7.56	107	9.34	101		
6/25/2013	15	16.12	7.52	107.1	9.21	99.3		
6/25/2013	18	16.01	7.48	106.2	9.14	98.3		
6/25/2013	21	15.8	7.43	108.9	8.95	95.8		
6/25/2013	21*	15.79	7.43	109.3	8.94	95.8		
6/25/2013	24	15.73	7.42	110.9	8.9	95.1		
6/25/2013	25	15.37	7.4	128.5	8.45	89.7		
7/9/2013	0.5	24.96	8.52	128	9.06	115.1		5.6
7/9/2013	1	24.37	8.44	127.7	9.025	116.2		
7/9/2013	2	24.05	8.4	128.5	9.34	116.7		
7/9/2013	3	23.89	8.41	129.2	9.48	118		
7/9/2013	4	21.44	8.61	160.1	12.1	143.7		
7/9/2013	4*	21.37	8.62	160.6	12.18	144.5		
7/9/2013	5	20.83	8.59	161.1	12.17	142.8	11.6	
7/9/2013	6	20.28	8.4	162.3	11.26	130.8		
7/9/2013	7	19.87	8.02	162.8	9.64	111.2		
7/9/2013	8	19.62	7.91	162.6	9.29	106.5		
7/9/2013	9	19.25	7.69	160.2	8.77	99.8		
7/9/2013	10	19	7.61	157.5	8.5	96.2		
7/9/2013	12	18.51	7.54	148.3	8.63	96.8		
7/9/2013	15	17.36	7.36	128.2	8.39	91.8	8.1	
7/9/2013	18	16.75	7.27	125.7	8.23	88.8		
7/9/2013	21	16.34	7.2	124.6	7.93	84.9		
7/9/2013	21*	16.36	7.2	124.1	7.9	84.7		
7/9/2013	24	15.79	6.95	123.4	5.68	60.2		
7/9/2013	25	15.63	6.91	124.6	5.2	54.8		
7/24/2013	0.5	25.12	8.64	150.8	9.58	122.7		5.2

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
7/24/2013	1	24.97	8.59	150.7	9.64	123.1		
7/24/2013	2	24.69	8.6	151	9.8	124.6		
7/24/2013	3	24.67	8.58	150.8	9.82	124.7		
7/24/2013	4	24.48	8.56	151	9.76	123.6		
7/24/2013	4*	24.52	8.58	151.2	9.76	123.6		
7/24/2013	5	23.87	8.53	156.9	10.44	130.7	10.3	
7/24/2013	6	21.22	8.36	192.2	10.59	126		
7/24/2013	7	20.23	8.19	200.1	10.07	117.5		
7/24/2013	8	19.8	8.07	208.7	9.63	111.4		
7/24/2013	9	19.29	7.9	225.8	8.81	100.9		
7/24/2013	10	19.07	7.87	228	8.68	99		
7/24/2013	12	18.81	7.79	232.8	8.38	95.1		
7/24/2013	15	18.45	7.72	225.4	7.95	89.5	8.15	
7/24/2013	18	17.83	7.5	208.4	7.17	79.7		
7/24/2013	21	17.14	7.19	174	5.8	63.5		
7/24/2013	21*	17.17	7.18	174.6	5.77	63.3		
7/24/2013	24	16.48	6.93	144.7	4.31	46.6		
7/24/2013	25	16.21	6.81	138.4	3.3	35.4		
8/5/2013	0.5	24.15	8.53	169.1	9.33	117.3		7.7
8/5/2013	1	23.66	8.48	169.5	9.45	117.6		
8/5/2013	2	23.51	8.46	169.4	9.4	116.7		
8/5/2013	3	23.38	8.51	169.1	9.42	116.7		
8/5/2013	4	23.15	8.52	169.3	9.53	117.5		
8/5/2013	4*	23.08	8.5	168.9	9.55	117.6		
8/5/2013	5	22.12	8.34	195.5	10.61	128.3		
8/5/2013	6	21.01	8.15	211.7	10.2	120.7		
8/5/2013	7	20.08	7.98	224.6	9.55	110.9		
8/5/2013	8	19.53	7.88	230.4	9.02	103.7		
8/5/2013	9	19.25	7.81	234.6	8.7	99.4		
8/5/2013	10	18.85	7.71	242.1	8.11	92		
8/5/2013	12	18.55	7.69	248.2	7.92	89.2		
8/5/2013	15	17.78	7.78	251.5	8.28	91.8	8.15	
8/5/2013	18	16.67	7.79	252	8.41	91.1		
8/5/2013	21	16.02	7.77	256	8.56	91.5		
8/5/2013	21*	15.97	7.76	256.1	8.55	91.3		
8/5/2013	24	15.91	7.75	256.6	8.48	90.4	8.3	
8/5/2013	25	15.9	7.74	256.6	8.47	90.3		
8/20/2013	0.5	23.93	8.96	179.7	10.94	136.6		4.2
8/20/2013	1	23.85	8.96	179.8	11	137.2		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
8/20/2013	2	23.73	8.98	179.7	11.05	137.6		
8/20/2013	3	23.53	8.94	179.4	11.09	137.5		
8/20/2013	4	23.52	8.95	179.6	11.13	138		
8/20/2013	4*	23.51	8.97	179.7	11.08	137.4		
8/20/2013	5	23.34	8.92	180.6	11	135.9	10.7	
8/20/2013	6	22.89	8.89	189	11.79	144.4		
8/20/2013	7	20.57	8.46	222.6	10.93	128		
8/20/2013	8	19.6	8.23	220.3	10.09	115.9		
8/20/2013	9	19.07	7.87	232	8.31	94.4		
8/20/2013	10	18.77	7.77	244.9	7.57	85.6		
8/20/2013	12	18.41	7.79	252.2	7.7	86.4		
8/20/2013	15	18.06	7.9	259.4	8.34	92.8	7.7	
8/20/2013	18	17.92	7.89	261	8.35	92.7		
8/20/2013	21	17.63	7.74	257.9	7.63	84.2		
8/20/2013	21*	17.63	7.72	257.9	7.52	83		
8/20/2013	24	16.69	7.34	242.5	4.92	53.2		
8/20/2013	25	16.17	7.23	245.7	3.65	39.1		
9/9/2013	0.5	21.69	8.77	195.8	9.57	114.7		6.6
9/9/2013	1	21.65	8.76	195.5	9.55	114.4		
9/9/2013	2	21.66	8.75	195.6	9.47	113.5		
9/9/2013	3	21.51	8.72	195.2	9.51	113.7		
9/9/2013	4	21.3	8.74	195.7	9.56	113.8		
9/9/2013	4*	21.3	8.74	195.6	9.54	113.4		
9/9/2013	5	21.27	8.74	195.5	9.47	112.6	9.3	
9/9/2013	6	21.27	8.73	195.1	9.44	112.3		
9/9/2013	7	19.51	7.52	237.4	6.12	70.3		
9/9/2013	8	18.72	7.33	245.7	4.64	52.4		
9/9/2013	9	18.24	7.41	253.4	5.39	60.4		
9/9/2013	10	17.91	7.53	255.5	6.12	68.1		
9/9/2013	12	17.44	7.69	257.1	6.98	76.9		
9/9/2013	15	16.95	7.77	261	7.66	83.5	7.4	
9/9/2013	18	16.48	7.81	267	8.08	87.2		
9/9/2013	21	16.35	7.79	268.1	8.01	86.2		
9/9/2013	21*	16.34	7.8	268.3	8.01	86.2		
9/9/2013	24	16.18	7.72	267.6	7.63	81.8		
9/9/2013	25	16.16	7.72	267.5	7.58	81.2		
9/24/2013	0.5	18.41	8.28	222.2	8.27	93.4		6.4
9/24/2013	1	18.41	8.3	222.3	8.24	93.1		
9/24/2013	2	18.34	8.31	222.4	8.24	93		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
9/24/2013	3	18.33	8.3	222.3	8.24	92.9		
9/24/2013	4	18.33	8.32	222.3	8.28	93.3		
9/24/2013	4*	18.33	8.3	222.4	8.29	93.5		
9/24/2013	5	18.32	8.3	222.3	8.24	92.9	7.85	
9/24/2013	6	18.32	8.29	222.4	8.22	92.7		
9/24/2013	7	18.31	8.28	222.4	8.22	92.7		
9/24/2013	8	18.3	8.29	222.3	8.25	93		
9/24/2013	9	18.3	8.3	222.5	8.21	92.5		
9/24/2013	10	18.3	8.29	222.5	8.16	92		
9/24/2013	12	18.09	8.13	227.1	7.73	86.8		
9/24/2013	15	16.57	7.92	234.2	7.7	83.8	7.3	
9/24/2013	18	15.17	8.02	235.5	8.66	91.4		
9/24/2013	21	14.94	8	236.2	8.71	91.4		
9/24/2013	21*	14.95	8	236.4	8.71	91.5		
9/24/2013	24	14.92	7.97	236.6	8.6	90.3		
9/24/2013	25	14.91	7.96	236.8	8.57	89.9		
10/14/2013	0.5	14.05	8.22	227.5	9.55**			4.9
10/14/2013	1	13.99	8.07	227.6	9.58**			
10/14/2013	2	13.86	8.25	227.1	9.7**			
10/14/2013	3	13.79	8.32	227.1	9.71**			
10/14/2013	4	13.75	8.33	227.1	9.67**			
10/14/2013	4*	13.73	8.3	227.6	9.7**			
10/14/2013	5	13.71	8.3	227.3	9.61**		9.54	
10/14/2013	6	13.7	8.28	227.5	9.54**			
10/14/2013	7	13.69	8.27	227.9	9.54**			
10/14/2013	8	13.68	8.25	227.9	9.45**			
10/14/2013	9	13.67	8.24	227.5	9.45**			
10/14/2013	10	13.68	8.25	227.5	9.49**			
10/14/2013	12	13.66	8.23	227.1	9.37**			
10/14/2013	15	13.03	8.21	224.7	9.57**			
10/14/2013	18	11.64	8.12	222.7	9.93**			
10/14/2013	21	11.47	8.08	222.1	9.93**		10.1	
10/14/2013	21*	11.48	8.08	222.4	9.95**			
10/14/2013	24	11.38	8.05	222.7	9.92**			
10/14/2013	25	11.35	8.03	222.3	9.84**			

*QA/QC measurement for Hydrolab
** Hydrolab malfunctioned and calibration could not take place until later in the day on 10/14/13. DO measurements were adjusted by +0.5 mg/L even after calibration based on laboratory Winkler results. pH was successfully calibrated and were similar to laboratory results
***Secchi disk depths average of 3 measurements

Table A-4. Station LL3 *In Situ* Water Quality Data, 2013

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
5/14/2013	0.5	14.97	7.64	71.1	10.34	107.5		2.0
5/14/2013	1	14.94	7.7	71.1	10.4	108.1		
5/14/2013	2	14.91	7.7	71	10.35	107.5		
5/14/2013	3	14.89	7.7	71	10.4	108		
5/14/2013	4	14.88	7.79	70.8	10.4	108		
5/14/2013	5	14.87	7.83	71	10.36	107.5	10.5	
5/14/2013	6	14.86	7.85	70.7	10.39	107.8		
5/14/2013	7	14.84	7.82	71	10.42	108.1		
5/14/2013	8	14.83	7.81	70.8	10.36	107.4		
5/14/2013	9	14.81	7.84	70.7	10.44	108.2		
5/14/2013	9*	14.82	7.81	70.6	10.42	108		
5/14/2013	10	14.81	7.78	71.1	10.43	108.1	10.7	
5/14/2013	12	14.8	7.8	70.7	10.41	107.8		
5/14/2013	15	14.8	7.79	71	10.37	107.4		
5/14/2013	18	14.8	7.8	71	10.37	107.5		
5/14/2013	19	14.81	7.75	71.1	10.36	107.4		
6/12/2013	0.5	19.43	7.99	116.9	10.36	118.6		3.9
6/12/2013	1	19.4	8.24	117.1	10.35	118.4		
6/12/2013	2	19.35	8.28	117	10.38	118.6		
6/12/2013	3	19.11	8.24	117.7	10.36	117.8		
6/12/2013	4	18.52	8.24	118	10.39	116.8		
6/12/2013	5	18	8.14	118.1	10.37	115.3	10.1	
6/12/2013	6	17.87	8.14	117.8	10.26	113		
6/12/2013	7	17.81	8.07	117.8	10.22	113.2		
6/12/2013	8	17.76	8.07	117.6	10.18	112.7		
6/12/2013	9	17.75	8.12	117.8	10.23	113.1		
6/12/2013	9*	17.75	8.13	117.9	10.3	113.9		
6/12/2013	10	17.74	8.09	117.6	10.3	113.9	9.8	
6/12/2013	12	17.59	7.92	117.1	10.19	112.3		
6/12/2013	15	17.17	7.8	116.8	10.03	109.7		
6/12/2013	18	16.81	7.65	116.9	9.66	104.8		
6/12/2013	19	15.46	7.26	118.3	8.84	93.1		
6/26/2013	0.5	19.72	8.65	117.2	11.45	132.1		3.3
6/26/2013	1	19.7	8.78	117.3	11.48	132.3		
6/26/2013	2	19.59	8.75	117	11.18	128.5		
6/26/2013	3	19.43	8.68	117.8	10.9	125		
6/26/2013	4	18.32	8.26	116.9	10.33	115.8		
6/26/2013	5	18.06	8.21	119.2	10.1	112.6	9.55	

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
6/26/2013	6	17.48	7.9	121.8	9.49	104.6		
6/26/2013	7	17.41	7.91	122.5	9.5	104.5		
6/26/2013	8	16.95	7.81	123.3	9.4	102.4		
6/26/2013	9	16.7	7.72	124.3	9.26	100.4		
6/26/2013	9*	16.7	7.73	124.7	9.23	100		
6/26/2013	10	16.66	7.72	124.7	9.21	99.8	9.05	
6/26/2013	12	16.63	7.71	124.8	9.16	99.1		
6/26/2013	15	16.54	7.67	125	9.12	98.6		
6/26/2013	18	16.53	7.66	124.8	9.08	98.1		
6/26/2013	19	16.52	7.65	124.3	9.1	98.3		
7/10/2013	0.5	23.79	8.38	145.8	9.44	118		5.1
7/10/2013	1	23.82	8.42	145.8	9.41	117.7		
7/10/2013	2	23.68	8.45	145.9	9.51	118.6		
7/10/2013	3	23.21	8.43	149.4	9.79	121.1		
7/10/2013	4	22.3	8.33	161.4	9.79	118.9		
7/10/2013	5	20.68	8.19	172.9	9.29	109.3	9.3	
7/10/2013	6	20.18	8.09	178.1	9.09	106		
7/10/2013	7	19.88	8.02	178.3	8.91	103.2		
7/10/2013	8	19.71	8.01	178	8.87	102.4		
7/10/2013	9	19.62	7.9	173.2	8.68	100		
7/10/2013	9*	19.62	7.91	173.2	8.68	100		
7/10/2013	10	19.49	7.9	172.7	8.7	100	8.5	
7/10/2013	12	18.88	7.64	163.6	7.95	90.2		
7/10/2013	15	17.4	7.34	139.4	7.38	81.3		
7/10/2013	18	16.48	7.02	132.9	5.01	54.1		
7/25/2013	0.5	25.05	8.56	156.6	9.62	122.9		4.6
7/25/2013	1	25.04	8.7	156.5	9.62	122.8		
7/25/2013	2	25.04	8.66	156.5	9.61	122.8		
7/25/2013	3	24.98	8.71	157.1	9.69	123.6		
7/25/2013	4	23.72	8.73	179.7	12.13	151.4		
7/25/2013	5	22.5	8.53	199.7	10.32	125.7	10.9	
7/25/2013	6	21.08	8.3	217	9.5	122.6		
7/25/2013	7	20.35	8.23	224.1	9.31	108.7		
7/25/2013	8	19.54	8.16	235.1	9.15	105.1		
7/25/2013	9	19.19	8.11	239.7	8.98	102.5		
7/25/2013	9*	19.14	8.12	239.8	9.01	102.9		
7/25/2013	10	18.76	8.1	245	8.99	101.7	8.8	
7/25/2013	12	18.51	8.05	246.5	8.94	100.7		
7/25/2013	15	18.38	8.03	246.7	8.86	99.4		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
7/25/2013	18	18.19	7.84	242	7.93	88.5		
7/25/2013	19	17.53	7.31	208.2	3.86	42.5		
8/6/2013	0.5	23.71	8.5	174.2	9.33	116.4		5.5
8/6/2013	1	23.68	8.54	174.3	9.34	116.3		
8/6/2013	2	23.67	8.53	174	9.34	116.5		
8/6/2013	3	23.42	8.54	174.3	9.6	119.1		
8/6/2013	4	22.84	8.49	191.6	9.76	119.8		
8/6/2013	5	22.28	8.37	208.8	10.13	123	9.65	
8/6/2013	6	21.62	8.45	202.9	10.11	121.3		
8/6/2013	7	20.89	8.36	202.6	9.46	111.8		
8/6/2013	8	20.36	8.34	207.1	9.38	109.8		
8/6/2013	9	19.74	7.9	222.7	7.8	90.2		
8/6/2013	9*	19.69	7.88	223	7.75	89.5		
8/6/2013	10	19.37	7.97	236.1	8.3	95.2	8.45	
8/6/2013	12	18.58	8.01	224.1	9.08	102.5		
8/6/2013	15	17.5	8	226.1	9.21	101.7		
8/6/2013	18	16.45	7.9	246.1	9.03	97.5		
8/21/2013	0.5	23.58	8.19	181.5	11.15	138.2		3.5
8/21/2013	1	23.58	8.74	181.8	11.19	138.7		
8/21/2013	2	23.56	8.81	181.7	11.18	138.6		
8/21/2013	3	23.51	8.88	181.8	11.2	138.6		
8/21/2013	4	23.46	8.81	182.9	11.22	138.7		
8/21/2013	5	23.26	8.81	193.7	11.41	140.5	10.4	
8/21/2013	6	21.96	8.55	215.8	10.04	120.6		
8/21/2013	7	20.26	8.28	237	9.14	106.2		
8/21/2013	8	19.37	8.2	247.8	9.07	103.6		
8/21/2013	9	18.99	8.22	251.3	9.19	104.1		
8/21/2013	9*	18.9	8.2	252	9.14	103.4		
8/21/2013	10	18.41	8.14	256.7	9.04	101.2	8.8	
8/21/2013	12	17.99	8.13	260.4	9.22	102.4		
8/21/2013	15	17.86	8.08	261.8	9.01	99.8		
8/21/2013	18	17.84	8.02	262.1	8.63	95.6		
9/10/2013	0.5	21.67	8.97	198.6	11.12	133.1		2.9
9/10/2013	1	21.65	8.97	198.7	11.19	133.8		
9/10/2013	2	21.62	8.97	198.5	11.15	133.4		
9/10/2013	3	21.58	8.94	198.9	10.97	131.1		
9/10/2013	4	21.4	8.81	201.9	9.82	116.8		
9/10/2013	5	20.44	8.19	228.8	7.75	90.5	9.9	
9/10/2013	6	19.4	7.83	240.2	6.42	73.3		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
9/10/2013	7	18.8	7.75	247.2	6.28	71		
9/10/2013	8	18.57	7.66	250.9	5.95	67		
9/10/2013	9	18.04	7.71	254.3	6.6	73.4		
9/10/2013	9*	18.05	7.74	254.1	6.64	73.9		
9/10/2013	10	17.82	7.91	254.3	7.46	82.7		
9/10/2013	12	16.51	8.03	255.3	8.7	93.8		
9/10/2013	15	15.72	7.94	260.6	8.91	94.4	8.7	
9/10/2013	18	15.58	7.9	261.7	8.8	93.1		
9/25/2013	0.5	18.31	8.46	211.4	8.49	95.9		4.0
9/25/2013	1	18.35	8.48	211	8.47	95.8		
9/25/2013	2	18.36	8.48	210.7	8.46	95.6		
9/25/2013	3	18.35	8.49	211.4	8.48	95.7		
9/25/2013	4	18.35	8.49	211	8.49	96.1		
9/25/2013	5	18.38	8.48	210.7	8.49	95.9	8.2	
9/25/2013	6	18.38	8.49	211.3	8.47	95.7		
9/25/2013	7	18.35	8.48	210.6	8.45	95.4		
9/25/2013	8	18.36	8.49	210.8	8.46	95.7		
9/25/2013	9	18.06	8.49	210.9	8.58	96.6		
9/25/2013	9*	18.16	8.49	210.5	8.49	95.5		
9/25/2013	10	17.8	8.51	211.5	8.71	97.1	8.25	
9/25/2013	12	14.98	8.29	227	9.22	97.4		
9/25/2013	15	14.58	8.2	231.4	9.21	95.8		
9/25/2013	18	14.12	8.16	233.4	9.27	95.7		
10/15/2013	0.5	13.11	8.43	222.1	10.52**			2.7
10/15/2013	1	13.24	8.44	222.1	10.46**			
10/15/2013	2	13.23	8.46	222.6	10.47**			
10/15/2013	3	13.24	8.47	222.3	10.5**			
10/15/2013	4	13.25	8.47	222.3	10.49**			
10/15/2013	5	13.25	8.48	222.2	10.46**		10.4	
10/15/2013	6	13.02	8.36	218.3	10.15**			
10/15/2013	7	12.8	8.36	216.1	10.1**			
10/15/2013	8	12.77	8.36	215.4	10.1**			
10/15/2013	9	12.57	8.37	211.9	10.28**			
10/15/2013	9*	12.66	8.38	211.9	10.3**			
10/15/2013	10	12.22	8.31	205.2	10.27**		10.1	
10/15/2013	12	11.88	8.24	199	10.14**			
10/15/2013	15	11.59	8.15	191.9	10.2**			
10/15/2013	18	11.25	8.05	184.3	10.18**			

*QA/QC measurement for Hydrolab

** Hydrolab malfunctioned and calibration could not take place until later in the day on 10/14/13. DO measurements were adjusted by +0.5 mg/L even after calibration based on laboratory Winkler results. pH was successfully calibrated and were similar to laboratory results
***Secchi disk depths average of 3 measurements

Table A-5. Station LL4 *In Situ* Water Quality Data, 2013

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
5/14/2013	0.5	14.23	7.76	69.3	10.94	111.9		2.57
5/14/2013	1	14.21	7.76	69.7	10.94	111.9		
5/14/2013	2	14.19	7.74	69.6	10.87	111.1		
5/14/2013	3	14.18	7.76	69.2	10.91	111.5		
5/14/2013	4	14.19	7.76	69.6	10.9	111.4		
5/14/2013	5	14.17	7.76	69.5	10.89	111.3		
5/14/2013	5*	14.17	7.77	69.2	10.88	111.2		
5/14/2013	6	14.17	7.78	69.3	10.88	111.2		
5/14/2013	7	14.16	7.77	69.1	10.9	111.3		
5/14/2013	8	14.17	7.79	69.1	10.86	111		
6/12/2013	0.5	17.34	7.87	119.7	9.94	109		4.73
6/12/2013	1	17.07	7.81	120	9.96	108.7		
6/12/2013	2	16.93	7.86	119.8	10.02	109		
6/12/2013	3	16.93	7.87	119.8	9.89	107.6		
6/12/2013	4	16.82	7.84	119.4	9.94	107.8		
6/12/2013	5	16.86	7.8	119.8	9.87	107.2		
6/12/2013	5*	16.83	7.86	120	9.91	107.5		
6/12/2013	6	16.8	7.86	119.8	9.91	107.4		
6/12/2013	7	16.76	7.8	119.5	9.91	107.4		
6/12/2013	8	16.76	7.79	119.4	9.87	106.9		
6/26/2013	0.5	16.68	7.88	127.6	9.39	101.7		3.60
6/26/2013	1	16.49	7.84	128.2	9.4	101.5		
6/26/2013	2	16.43	7.83	127.9	9.41	101.4		
6/26/2013	3	16.39	7.81	128.3	9.44	101.7		
6/26/2013	4	16.38	7.81	127.7	9.46	101.9	9.05	
6/26/2013	5	16.37	7.81	128.2	9.4	101.2		
6/26/2013	5*	16.36	7.8	127.9	9.4	101.2		
6/26/2013	6	16.37	7.79	128.2	9.41	101.3		
6/26/2013	7	16.36	7.78	127.8	9.4	101.2		
6/26/2013	8	16.35	7.78	127.9	9.44	101.5		
7/10/2013	0.5	24.04	8.37	148.4	9.14	114.7		4.70
7/10/2013	1	24.04	8.38	148.4	9.15	114.9		
7/10/2013	2	23.81	8.35	147.8	9.2	115		
7/10/2013	3	22.71	8.38	168.4	9.54	116.8		
7/10/2013	4	20.77	8.33	185.1	9.65	113.8		
7/10/2013	5	19.31	8.21	196.3	9.43	108		
7/10/2013	5*	19.29	8.2	196.6	9.41	107.8		
7/10/2013	6	19.1	8.15	196.9	9.32	106.3		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
7/10/2013	7	18.99	8.13	196.9	9.27	105.5		
7/10/2013	8	18.93	8.11	195.9	9.28	105.5		
7/25/2013	0.5	24.95	8.65	162.6	9.87	125.9		5.17
7/25/2013	1	24.94	8.64	163	9.86	125.7		
7/25/2013	2	24.79	8.61	162.9	9.83	125		
7/25/2013	3	24.47	8.64	172	10.25	129.6		
7/25/2013	4	23.55	8.48	185.2	9.83	122.1		
7/25/2013	5	19.98	8.3	233.9	10.03	116.3		
7/25/2013	5*	20.39	8.33	229.4	10.02	117.1		
7/25/2013	6	18.17	8.23	249.4	10.05	112.4		
7/25/2013	7	18.12	8.2	249.2	10.03	112		
7/25/2013	8	18.1	8.19	249.2	9.93	110.8		
8/6/2013	0.5	23.92	8.71	176.2	10.33	129.4		3.43
8/6/2013	1	23.89	8.69	176.1	10.31	129.2		
8/6/2013	2	23.82	8.7	176.3	10.36	129.6		
8/6/2013	3	23.69	8.72	176.5	10.58	132		
8/6/2013	4	22.57	8.61	179.6	10.17	124.2		
8/6/2013	5	20.68	8.37	187	9.57	112.6		
8/6/2013	5*	20.5	8.33	188	9.55	112		
8/6/2013	6	19.45	8.18	194	9.29	106.7		
8/6/2013	7	19.1	8.12	194.9	9.2	104.9		
8/6/2013	8	19.06	8.11	194.4	9.21	105		
8/21/2013	0.5	23.77	9.01	185.6	11.75	146.2		2.40
8/21/2013	1	23.78	9.11	185.6	11.79	146.7		
8/21/2013	2	23.74	9.02	185.7	11.86	147.4		
8/21/2013	3	23.68	9.02	185.6	11.92	148.1		
8/21/2013	4	23.57	9	189.2	11.81	146.4		
8/21/2013	5	22.34	8.84	208.7	11.24	136.1		
8/21/2013	5*	22.28	8.83	208.9	11.26	136.2		
8/21/2013	6	17.59	8.28	263.5	10.17	122		
8/21/2013	7	17.22	8.23	267.1	10.04	109.8		
8/21/2013	8	17.22	8.22	267.4	9.96	108.9		
9/10/2013	0.5	21.63	8.95	197.2	10.31	123.2		2.83
9/10/2013	1	21.61	8.95	196.8	10.36	123.9		
9/10/2013	2	21.55	8.93	196.7	10.14	121.1		
9/10/2013	3	21.44	8.91	197	9.77	116.5		
9/10/2013	4	20.4	8.87	207.1	10.34	120.7		
9/10/2013	5	17.26	8.4	235.4	10.13	111		
9/10/2013	5*	17.3	8.42	235	10.25	112.4		

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
9/10/2013	6	15.64	8.09	247.5	9.73	103		
9/10/2013	7	15.61	8.07	247.7	9.7	102.7		
9/10/2013	8	15.61	8.06	248.1	9.6	101.6		
9/25/2013	0.5	17.17	8.72	205.9	9.74	107.3		2.17
9/25/2013	1	17.13	8.74	206.1	9.73	107.4		
9/25/2013	2	17.12	8.75	206.4	9.76	107.5		
9/25/2013	3	17.09	8.78	206.4	9.95	109.5		
9/25/2013	4	16	8.78	213	10.47	112.9		
9/25/2013	5	13.46	8.12	236.6	9.58	97.5		
9/25/2013	5*	13.45	8.1	236	9.57	97.2		
9/25/2013	6	13.37	8.1	234.7	9.69	98.2		
9/25/2013	7	13.35	8.1	234.6	9.62	97.6		
9/25/2013	8	13.35	8.09	234.7	9.66	98.1		
10/15/2013	0.5	10.59	8.07	171.9	10.72**			5.07
10/15/2013	1	10.59	8.08	171.5	10.68**			
10/15/2013	2	10.6	8.09	171.3	10.7**			
10/15/2013	3	10.61	8.08	171.7	10.69**			
10/15/2013	4	10.6	8.07	172.1	10.65**			
10/15/2013	5	10.59	8.07	171.7	10.62**			
10/15/2013	5*	10.6	8.07	171.7	10.62**			
10/15/2013	6	10.58	8.06	171.5	10.61**			
10/15/2013	7	10.57	8.05	171.7	10.61**			
10/15/2013	8	10.57	8.04	171.7	10.55**			

*QA/QC measurement for Hydrolab

** Hydrolab malfunctioned and calibration could not take place until later in the day on 10/14/13. DO measurements were adjusted by +0.5 mg/L even after calibration based on laboratory Winkler results. pH was successfully calibrated and were similar to laboratory results

***Secchi disk depths average of 3 measurements

Table A-6. Station LL5 *In Situ* Water Quality Data, 2013

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
5/14/2013	0.5	14.1	7.65	69.7	11.06	112.9		2.50
5/14/2013	1	14.11	7.66	70	11.04	112.7		
5/14/2013	2	14.06	7.67	69.5	11.05	112.6		
5/14/2013	3	14.08	7.68	69.3	11.12	113.4		
5/14/2013	4	14.07	7.71	69.6	11.08	113		
5/14/2013	5	14.07	7.75	69.8	11.11	113.3		
6/12/2013	0.5	15.92	7.56	122.6	9.79	104.3		4.97
6/12/2013	1	15.92	7.54	122.7	9.76	103.9		
6/12/2013	2	15.9	7.52	122.6	9.75	103.7		
6/12/2013	3	15.88	7.61	122.2	9.81	104.3		
6/12/2013	4	15.87	7.57	122.6	9.79	104.1		
6/12/2013	5	15.85	7.53	122.3	9.8	104.2		
6/26/2013	0.5	16.2	7.73	128.8	9.35	100.3		3.53
6/26/2013	1	16.18	7.71	129.1	9.34	100.1		
6/26/2013	2	16.14	7.7	129.1	9.36	100.3		
6/26/2013	3	16.14	7.69	129.1	9.41	100.7		
6/26/2013	4	16.09	7.68	129.1	9.38	100.3		
6/26/2013	5	16.07	7.65	129.1	9.4	100.5		
7/10/2013	0.5	18.79	7.89	200.2	8.81	99.9		5.40
7/10/2013	1	18.27	7.88	199.9	8.84	99.2		
7/10/2013	2	18.14	7.86	200.2	8.86	99.2		
7/10/2013	3	18.15	7.82	200.2	8.85	99		
7/10/2013	4	18.02	7.87	200.5	8.94	99.8		
7/10/2013	5	18.01	7.87	200.7	8.9	99.3		
7/25/2013	0.5	24.16	8.59	176.4	9.43	118.6		4.73
7/25/2013	1	23.67	8.54	181.9	9.54	118.8		
7/25/2013	2	23.52	8.48	183.7	9.6	119.2		
7/25/2013	3	18.38	8.29	249.8	9.46	106.2		
7/25/2013	4	18.12	8.17	252.5	9.39	104.8		
7/25/2013	5	18.06	8.13	252.7	9.34	104.2		
8/6/2013	0.5	19.47	8.05	194.7	8.7	100		4.63
8/6/2013	1	19.32	7.97	193.4	8.74	100.1		
8/6/2013	2	19.27	7.98	193.3	8.78	100.6		
8/6/2013	3	19.29	8.01	193.7	8.84	101.2		
8/6/2013	4	19.24	7.98	191.1	8.82	100.9		
8/6/2013	5	19.2	7.96	190.6	8.82	100.8		
8/6/2013	6	19	7.93	191.8	8.7	99		
8/21/2013	0.5	23.04	8.95	193.7	11.08	136		2.50

Date	Depth (m)	Temperature (°C)	pH	Cond (µS/cm)	DO (mg/l)	DO Sat (%)	Winkler DO (mg/L)	Secchi Disk Depth (m)***
8/21/2013	1	22.91	8.93	194	10.99	134.5		
8/21/2013	2	20.62	8.68	222.6	10.77	126.1		
8/21/2013	3	17.42	8.3	259.7	10.11	110.9		
8/21/2013	4	16.54	8.18	268.2	9.91	106.7		
8/21/2013	5	16.46	8.18	268.5	9.91	106.6		
9/10/2013	0.5	21.05	9.06	200.9	11.6	137.2		2.57
9/10/2013	1	19.42	8.89	211.1	11.07	126.8		
9/10/2013	2	15.79	8.11	246.7	9.35	99.2		
9/10/2013	3	15.77	8.07	245.9	9.25	98.2		
9/10/2013	4	15.7	8.04	246.2	9.17	97.2		
9/10/2013	5	15.66	8.02	246.5	9.08	96.2		
9/25/2013	0.5	13.09	8.15	235.3	9.92	100.1		4.73
9/25/2013	1	13.06	8.16	235.1	9.92	100		
9/25/2013	2	13.04	8.15	235.1	9.79	98.7		
9/25/2013	3	13.04	8.15	235.2	9.81	98.9		
9/25/2013	4	13.03	8.14	235.2	9.74	98.2		
9/25/2013	5	13.03	8.15	235.2	9.79	98.9		
10/15/2013	0.5	10.16	7.97	168.7	10.54**			5.27
10/15/2013	1	10.15	7.97	169.8	10.53**			
10/15/2013	2	10.16	7.97	169.7	10.55**			
10/15/2013	3	10.15	7.98	170.3	10.57**			
10/15/2013	4	10.15	7.99	170.2	10.57**			
10/15/2013	5	10.15	7.98	170.2	10.55**			

*QA/QC measurement for Hydrolab
** Hydrolab malfunctioned and calibration could not take place until later in the day on 10/14/13. DO measurements were adjusted by +0.5 mg/L even after calibration based on laboratory Winkler results. pH was successfully calibrated and were similar to laboratory results
***Secchi disk depths average of 3 measurements

APPENDIX B – Lake Spokane Laboratory Monitoring Data

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Table B-1. Lake Spokane Lab Data, 2013

Station LL0

Date	TP (µg/L)				
	0.5 m	5 m	15 m	30 m	B-1
5/13/2013	9.7	14.0	14.0	12.4	12.6
6/11/2013	10.6	15.4	10.6	10.4	22.2
6/25/2013	7.0	6.9	8.5	13.5	18.5
7/9/2013	11.8	29.1	11.3	24.2	37.0
7/24/2013	8.7	18.1	7.2	8.7	30.5
8/5/2013	6.4	9.5	5.8	26.5	30.8
8/20/2013	7.1	14.9	5.8	30.4	34.2
9/9/2013	3.9	4.7	5.6	28.3	29.5
9/24/2013	8.7	6.2	6.8	18.2	27.6
10/14/2013	9.2	9.3	10.3	19.5	22.2

Date	SRP (µg/L)				
	0.5 m	5 m	15 m	30 m	B-1
5/13/2013	2.0	2.0	<1.0	1.6	3.6
6/11/2013	<1.0	1.3	1.4	3.7	8.7
6/25/2013	1.2	1.3	1.2	7.8	13.2
7/9/2013	<1.0	<1.0	2.1	14.7	26.5
7/24/2013	<1.0	1.2	1.0	2.5	24.4
8/5/2013	<1.0	<1.0	<1.0	18.8	26.1
8/20/2013	1.2	1.6	1.1	23.5	24.3
9/9/2013	<1.0	<1.0	3.1	24.6	25.2
9/24/2013	<1.0	<1.0	2.8	13.8	22.4
10/14/2013	1.2	2.0	2.9	8.1	8.2

Date	Chl (µg/L)		
	0.5 m	5 m	15 m
5/13/2013	5.6	12.0	5.3
6/11/2013	4.8	5.6	5.3
6/25/2013	3.2	2.4	2.1
7/9/2013	2.1	3.7	1.3
7/24/2013	6.4	14.4	4.8
8/5/2013	1.3	1.9	1.3
8/20/2013	1.6	1.6	3.7
9/9/2013	0.8	1.6	0.8
9/24/2013	2.7	2.1	0.8
10/14/2013	2.7	2.9	1.9

Date	TPN (µg/L)				
	0.5 m	5 m	15 m	30 m	B-1
5/13/2013	358	323	346	408	357
6/11/2013	325	382	440	511	513
6/25/2013	524	550	608	648	632
7/9/2013	631	622	615	779	685
7/24/2013	500	607	743	622	597
8/5/2013	615	786	1250	668	692
8/20/2013	750	1190	1367	763	565
9/9/2013	684	1011	1548	1079	564
9/24/2013	1191	1177	1710	1685	715
10/14/2013	1380	1348	1490	1725	1648

Date	NO3+NO2 (µg/L)				
	0.5 m	5 m	15 m	30 m	B-1
5/13/2013	160	186	223	237	236
6/11/2013	252	268	382	462	423
6/25/2013	352	344	447	450	397
7/9/2013	364	426	463	607	540
7/24/2013	367	397	686	527	534
8/5/2013	349	462	926	489	475
8/20/2013	611	940	1182	725	537
9/9/2013	584	868	1373	983	536
9/24/2013	975	957	1437	1402	487
10/14/2013	1084	1088	1094	1163	1116

Station LL1

Date	TP (µg/L)			
	0.5 m	5 m	20 m	B-1
5/13/2013	13.5	13.2	14.1	15.5
6/11/2013	15.1	11.7	8.5	16.6
6/25/2013	6.9	7.2	13.3	23.5
7/9/2013	13.0	11.1	15.9	20.4
7/24/2013	5.5	20.4	23.5	23.1
8/5/2013	6.0	7.4	22.1	23.1
8/20/2013	5.5	9.3	11.8	23.1
9/9/2013	5.3	8.7	14.1	28.5
9/24/2013	7.5	36.0	16.4	23.9
10/14/2013	9.6	10.3	12.0	19.4

Date	SRP (µg/L)			
	0.5 m	5 m	20 m	B-1
5/13/2013	1.1	1.6	3.0	5.9
6/11/2013	1.8	1.3	1.7	7.7
6/25/2013	<1.0	1.4	6.5	16.5
7/9/2013	<1.0	<1.0	1.1	16.3
7/24/2013	<1.0	1.1	17.5	17.6
8/5/2013	<1.0	<1.0	15.3	17.6
8/20/2013	<1.0	1.3	3.7	17.6
9/9/2013	<1.0	<1.0	7.6	15.4
9/24/2013	<1.0	1.4	10.3	10.4
10/14/2013	<1.0	1.2	4.8	5.7

Date	Chl (µg/L)		
	0.5 m	5 m	20 m
5/13/2013	8.5	5.9	2.7
6/11/2013	3.7	5.3	2.4
6/25/2013	2.4	2.9	1.6
7/9/2013	1.9	2.4	1.9
7/24/2013	1.9	1.9	2.3
8/5/2013	1.9	2.4	1.6
8/20/2013	2.1	3.7	4.3
9/9/2013	1.3	1.1	1.3
9/24/2013	2.1	2.4	1.1
10/14/2013	4.8	2.7	0.8

Date	TPN (µg/L)			
	0.5 m	5 m	20 m	B-1
5/13/2013	320	329	385	431
6/11/2013	379	393	467	510
6/25/2013	516	558	675	628
7/9/2013	591	876	829	846
7/24/2013	525	530	904	925
8/5/2013	684	675	1497	925
8/20/2013	643	805	1623	925
9/9/2013	684	791	1584	1577
9/24/2013	1086	1105	1592	1584
10/14/2013	1259	1312	1439	1767

Date	NO3+NO2 (µg/L)			
	0.5 m	5 m	20 m	B-1

5/13/2013	164	172	235	236
6/11/2013	272	299	446	450
6/25/2013	354	384	522	408
7/9/2013	346	620	515	525
7/24/2013	432	434	886	914
8/5/2013	458	446	869	914
8/20/2013	518	641	1234	914
9/9/2013	566	576	1455	1368
9/24/2013	899	938	1289	1261
10/14/2013	1033	1039	1129	1212

Station LL2

Date	TP (µg/L)			
	0.5 m	5 m	15 m	B-1
5/13/2013	18.8	16.2	15.6	19.2
6/11/2013	8.9	11.9	10.0	12.9
6/25/2013	8.1	9.9	12.3	20.2
7/9/2013	10.6	24.6	14.8	42.6
7/24/2013	6.7	12.3	12.4	35.8
8/5/2013	5.9	31.8	12.7	18.7
8/20/2013	7.2	7.8	12.9	25.4
9/9/2013	7.1	6.0	18.7	27.3
9/24/2013	21.5	18.5	8.4	25.2
10/14/2013	7.8	9.9	10.7	18.1

Date	SRP (µg/L)			
	0.5 m	5 m	15 m	B-1
5/13/2013	1.6	2.5	1.4	7.9
6/11/2013	1.3	<1.0	2.5	5.8
6/25/2013	1.5	1.1	<1.0	9.2
7/9/2013	<1.0	1.9	2.0	2.5
7/24/2013	<1.0	1.1	6.0	26.8
8/5/2013	<1.0	<1.0	3.2	5.2
8/20/2013	<1.0	1.3	1.9	11.4
9/9/2013	<1.0	<1.0	4.6	9.1
9/24/2013	1.5	1.5	1.4	8.6
10/14/2013	1.5	<1.0	1.1	4.0

Date	Chl (µg/L)		
	0.5 m	5 m	15 m
5/13/2013	3.5	4.0	4.0

6/11/2013	4.7	4.3	2.1
6/25/2013	3.5	4.5	4.3
7/9/2013	1.2	7.2	2.4
7/24/2013	3.2	4.8	3.0
8/5/2013	1.2	1.6	4.3
8/20/2013	3.7	2.1	6.9
9/9/2013	1.6	1.3	5.3
9/24/2013	1.1	2.9	2.1
10/14/2013	2.9	5.3	2.7

Date	TPN (µg/L)			
	0.5 m	5 m	15 m	B-1
5/13/2013	330	289	340	397
6/11/2013	384	451	498	533
6/25/2013	488	540	572	717
7/9/2013	554	927	728	930
7/24/2013	548	543	1196	678
8/5/2013	702	762	1472	1507
8/20/2013	598	650	1795	1400
9/9/2013	687	704	1599	1580
9/24/2013	1282	1112	1180	1572
10/14/2013	1102	1146	1080	1568

Date	NO3+NO2 (µg/L)			
	0.5 m	5 m	15 m	B-1
5/13/2013	192	195	204	231
6/11/2013	317	354	464	462
6/25/2013	319	340	367	499
7/9/2013	327	600	551	454
7/24/2013	439	447	1161	658
8/5/2013	439	544	936	1034
8/20/2013	511	520	1264	1124
9/9/2013	548	558	1368	1509
9/24/2013	844	853	903	1277
10/14/2013	926	912	872	1150

Station LL3

Date	TP (µg/L)			
	0.5 m	5 m	10 m	B-1
5/14/2013	17.6	16.4	18.3	29.0
6/12/2013	13.4	13.0	14.1	19.3
6/26/2013	18.0	16.8	16.6	25.8
7/10/2013	10.7	18.3	14.6	37.8
7/25/2013	7.1	11.6	10.3	23.0
8/6/2013	6.8	11.5	26.5	19.4
8/21/2013	16.3	14.6	26.2	25.1
9/10/2013	11.7	13.9	20.4	22.2
9/25/2013	13.9	12.8	17.0	20.6
10/15/2013	14.9	14.4	15.3	16.9

Date	SRP (µg/L)			
	0.5 m	5 m	10 m	B-1
5/14/2013	3.3	3.7	3.8	4.8
6/12/2013	1.3	1.5	2.0	6.7
6/26/2013	1.6	1.2	2.3	4.3
7/10/2013	1.1	1.1	4.4	18.0
7/25/2013	<1.0	1.1	1.7	15.0
8/6/2013	1.6	1.7	2.3	6.0
8/21/2013	<1.0	1.1	1.9	6.3
9/10/2013	1.2	1.0	2.5	9.1
9/25/2013	<1.0	1.1	2.1	5.1
10/15/2013	1.6	1.8	1.4	3.1

Date	Chl (µg/L)		
	0.5 m	5 m	10 m
5/14/2013	3.2	3.2	2.9
6/12/2013	4.5	4.0	4.5
6/26/2013	8.3	7.5	3.5
7/10/2013	1.3	3.7	4.3
7/25/2013	3.7	7.5	5.3
8/6/2013	2.1	3.2	6.9
8/21/2013	4.3	4.8	5.9
9/10/2013	9.6	14.4	10.1
9/25/2013	5.9	5.3	5.3
10/15/2013	8.5	9.1	7.2

Date	TPN (µg/L)			
	0.5 m	5 m	10 m	B-1
5/14/2013	404	346	301	358
6/12/2013	453	487	479	539
6/26/2013	476	563	711	679
7/10/2013	609	879	1025	833
7/25/2013	519	791	1259	1281
8/6/2013	664	939	1278	1479
8/21/2013	657	574	1493	1512
9/10/2013	595	911	1585	1603
9/25/2013	776	747	830	1516
10/15/2013	936	963	1093	1165

Date	NO3+NO2 (µg/L)			
	0.5 m	5 m	10 m	B-1
5/14/2013	184	185	186	182
6/12/2013	379	421	444	469
6/26/2013	245	359	511	485
7/10/2013	458	657	749	483
7/25/2013	405	734	1210	1124
8/6/2013	379	631	786	975
8/21/2013	435	448	1250	1331
9/10/2013	355	688	1283	1476
9/25/2013	510	511	480	1147
10/15/2013	751	749	755	878

Station LL4

Date	TP (µg/L)		
	0.5 m	4 m	B-1
5/13/2013	14.4	19.8	17.8
6/12/2013	11.9	12.3	13.1
6/26/2013	13.1	15.4	16.1
7/10/2013	9.1	15.9	20.9
7/25/2013	8.8	21.0	9.8
8/6/2013	14.4	50.9	15.3
8/21/2013	21.6	20.8	21.5
9/10/2013	24.7	25.4	17.8
9/25/2013	33.2	43.6	12.9
10/15/2013	9.4	11.1	10.7

Date	SRP (µg/L)		
	0.5 m	4 m	B-1
5/13/2013	3.1	3.2	2.3
6/12/2013	3.1	3.8	1.8
6/26/2013	2.8	4.0	2.3
7/10/2013	1.0	1.5	4.1
7/25/2013	1.1	1.4	2.3
8/6/2013	1.2	1.2	4.0
8/21/2013	1.0	1.2	1.2
9/10/2013	1.6	1.3	5.6
9/25/2013	3.0	2.6	3.8
10/15/2013	3.5	3.4	3.6

Date	Chl (µg/L)	
	0.5 m	4 m
5/13/2013	2.8	2.8
6/12/2013	2.2	2.5
6/26/2013	2.1	2.7
7/10/2013	0.8	1.1
7/25/2013	3.3	4.8
8/6/2013	6.4	5.3
8/21/2013	6.9	6.9
9/10/2013	6.9	12.3
9/25/2013	19.2	17.1
10/15/2013	1.0	1.1

Date	TPN (µg/L)		
	0.5 m	4 m	B-1
5/13/2013	295	302	324
6/12/2013	550	523	519
6/26/2013	742	748	792
7/10/2013	670	1122	1329
7/25/2013	489	663	1315
8/6/2013	610	814	1286
8/21/2013	619	539	1554
9/10/2013	507	601	1560
9/25/2013	846	752	1647
10/15/2013	1087	1087	1129

Date	NO3+NO2 (µg/L)		
	0.5 m	4 m	B-1
5/13/2013	184	193	179

6/12/2013	490	502	502
6/26/2013	547	524	523
7/10/2013	465	840	951
7/25/2013	409	582	1290
8/6/2013	306	496	857
8/21/2013	280	310	1532
9/10/2013	216	330	1472
9/25/2013	326	385	1366
10/15/2013	947	947	943

Station LL5

Date	TP (µg/L)	
	0.5 m	B-1
5/14/2013	16.3	15.4
6/12/2013	11.8	13.0
6/26/2013	15.5	15.0
7/10/2013	10.5	13.7
7/25/2013	12.1	9.8
8/6/2013	9.6	11.2
8/21/2013	37.6	8.3
9/10/2013	66.6	17.1
9/25/2013	12.9	13.6
10/15/2013	10.0	9.5

Date	SRP (µg/L)	
	0.5 m	B-1
5/14/2013	3.3	3.2
6/12/2013	3.8	3.6
6/26/2013	3.7	3.4
7/10/2013	3.5	3.0
7/25/2013	1.2	2.5
8/6/2013	2.6	2.1
8/21/2013	1.4	2.2
9/10/2013	3.5	5.9
9/25/2013	4.3	4.3
10/15/2013	3.1	3.1

Date	Chl (µg/L)
	0.5 m
5/14/2013	2.6
6/12/2013	2.1

6/26/2013	2.2
7/10/2013	1.3
7/25/2013	4.3
8/6/2013	1.1
8/21/2013	3.7
9/10/2013	9.6
9/25/2013	1.6
10/15/2013	0.8

Date	**TPN (µg/L)**	
	0.5 m	**B-1**
5/14/2013	281	284
6/12/2013	577	581
6/26/2013	834	722
7/10/2013	1256	1249
7/25/2013	627	1873
8/6/2013	1321	1259
8/21/2013	732	1549
9/10/2013	1293	1602
9/25/2013	1753	1729
10/15/2013	1030	1025

Date	**NO3+NO2 (µg/L)**	
	0.5 m	**B-1**
5/14/2013	192	165
6/12/2013	557	579
6/26/2013	550	561
7/10/2013	964	961
7/25/2013	539	1441
8/6/2013	899	903
8/21/2013	320	1528
9/10/2013	370	1578
9/25/2013	1419	1443
10/15/2013	921	940

APPENDIX C – Lake Spokane Phytoplankton Data

(See PDF of Laboratory Data)

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LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 5/13/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL0 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
Ankistrodesmus falcatus	44.00	97	4,263	
Ankistrodesmus falcatus	20.00	188	3,761	
Oocystis sp.	10.00	1,507.20	15,072	single cells>20um
Oocystis sp.	4.00	130.83	523	
* *Pediastrum tetras*	4.00	769.30	3,077	small col<15um diam
* *Scenedesmus quadricauda*	2.00	593.46	1,187	4-cell colony
* *Scenedesmus bijuga*	3.00	256.43	769	4 cell colony;deterior
undet filamentous green	5.00	1,187.31	5,937	cells collapsed
colonial nannoplankton (sph)	18.00	448.69	8,076	
unicell (sph) nannoplktn	10.00	5,572.45	55,725	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	22.00	267.95	5,895	some w/lamellate cell
unicell (sph) nannoplktn	20.00	1,149.76	22,995	some w/lamellate cell
Taxon Subtotal	**162**		**127,281**	
Chrysophyta				
Rhizochrysis sp.	8.00	6,028.80	48,230	
chrysophyte (unicell)	132.00	1,149.76	151,769	
chrysophyte (unicell)	264.00	267.95	70,738	
Bacillariophyceae				
Asterionella formosa	4,400.00	562.69	2,475,827	
Cocconeis sp.	1.00	1,208.90	1,209	
Cyclotella sp.	2.00	5,319.16	10,638	
Gomphonema sp.	5.00	1,470.00	7,350	
Hannaea arcus	1.00	615.44	615	
Aulacoseira/Melosira spp.complex	5.00	1,406.72	7,034	
Melosira varians	12.00	9,420.00	113,040	large cell
Nitzschia sp.	1.00	518.10	518	
Synedra ulna	1.00	7,840.00	7,840	
Synedra sp.	110.00	90.67	9,973	
Synedra sp.	88.00	211.56	18,617	
Synedra sp.	55.00	370.44	20,374	
Synedra sp.	1.00	483.56	484	
Synedra sp.	1.00	1,177.50	1,178	
Urosolenia (Rhizosolenia) sp.	20.00	6,028.80	120,576	delicate cells
undet pennate diatom	55.00	143.92	7,915	naviculoid cell
undet pennate diatom	1.00	471.00	471	naviculoid cell
Taxon Subtotal	**5163**		**3,074,397**	
Cryptophyta				
Cryptomonas spp.	50.00	2,000.18	100,009	assoc w/detritus
cryptomonad	10.00	1,036.20	10,362	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	143.00	172.29	24,638	assoc w/detritus
Taxon Subtotal	**203**		**135,009**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**5,528**	**Total Volume**	**3,336,686**	**3.337**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**2.93**	Percent Chlorophyta	**3.81**	
Percent Chrysophyta	**93.40**	Percent Chrysophyta	**92.14**	
Percent Cryptophyta	**3.67**	Percent Cryptophyta	**4.05**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 5/13/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
Ankistrodesmus falcatus	33.00	97	3,197	
Ankistrodesmus falcatus	20.00	188	3,761	
Quadrigula sp.	4.00	253.29	1,013	
* *Scenedesmus bijuga*	3.00	508.68	1,526	4-cell colony
unicell (sph) nannoplktn	33.00	904.32	29,843	some w/lamellate cell
Taxon Subtotal	**93**		**39,340**	
Chrysophyta				
Rhizochrysis sp.	8.00	7,075.47	56,604	
chrysophyte (unicell)	88.00	1,149.76	101,179	
chrysophyte (unicell)	165.00	267.95	44,211	
Bacillariophyceae				
Asterionella formosa	7,920.00	562.69	4,456,489	
Cocconeis sp.	5.00	1,208.90	6,045	
Cyclotella sp.	10.00	1,538.60	15,386	tiny cells<14 um diam
Cymbella sp.	1.00	17,960.80	17,961	cells>100um length
Fragilaria crotonensis	40.00	600.00	24,000	
Gomphonema sp.	10.00	1,050.00	10,500	
Aulacoseira/Melosira spp.complex	78.00	2,198.00	171,444	
Aulacoseira/Melosira spp.complex	28.00	588.75	16,485	slender cells
Nitzschia sp.	2.00	331.01	662	
Synedra ulna	2.00	7,280.00	14,560	
Synedra sp.	8.00	1,758.40	14,067	
Synedra sp.	165.00	90.67	14,960	
Synedra sp.	30.00	199.47	5,984	
Synedra sp.	60.00	370.44	22,226	
Tabellaria fenestrata	1.00	4,704.00	4,704	
Urosolenia (Rhizosolenia) sp.	20.00	6,028.80	120,576	delicate cells
undet pennate diatom	2.00	1,350.00	2,700	
undet pennate diatom	1.00	6,154.40	6,154	naviculoid cell
Taxon Subtotal	**8644**		**5,126,898**	
Cryptophyta				
Cryptomonas spp.	50.00	2,000.18	100,009	assoc w/detritus
cryptomonad	12.00	1,036.20	12,434	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	220.00	172.29	37,904	assoc w/detritus
Taxon Subtotal	**282**		**150,348**	
Euglenophyta				
Pyrrhophyta				
Peridiniales	1.00	3,108.60	3,109	
Taxon Subtotal	**1.00**		**3,109**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**9,020**	**Total Volume**	**5,319,694**	**5.320**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**1.03**	Percent Chlorophyta	**0.74**	
Percent Chrysophyta	**95.83**	Percent Chrysophyta	**96.38**	
Percent Cryptophyta	**3.13**	Percent Cryptophyta	**2.83**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.01**	Percent Pyrrhophyta	**0.06**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 5/13/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	1.00	1,201.76	1,202	threadlike fil<3um width;no sheath
Taxon Subtotal	**1**		**1,202**	
Chlorophyta				
Ankistrodesmus falcatus	33.00	97	3,197	
Ankistrodesmus falcatus	33.00	182	6,018	
* *Pediastrum tetras*	2.00	1,271.70	2,543	small col<20um diam
* *Scenedesmus bijuga flexuosus*	2.00	8,205.87	16,412	robust 16+cell colony
unicell (sph) nannoplktn	1.00	5,572.45	5,572	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**81**		**48,103**	
Chrysophyta				
Dinobryon sp.	6.00	357.96	2,148	deterior cells
Rhizochrysis sp.	5.00	7,075.47	35,377	
chrysophyte (unicell)	44.00	1,149.76	50,590	
chrysophyte (unicell)	66.00	267.95	17,684	
Bacillariophyceae				
Asterionella formosa	1,824.00	562.69	1,026,343	
Cocconeis sp.	1.00	3,140.00	3,140	
Cyclotella sp.	2.00	2,009.60	4,019	
Cymbella sp.	1.00	8,792.00	8,792	
Fragilaria sp.	24.00	600.00	14,400	
Gomphonema sp.	3.00	1,575.00	4,725	
Gomphonema sp.	5.00	3,087.00	15,435	
Hannaea arcus	4.00	556.83	2,227	
Aulacoseira/Melosira spp.complex	25.00	1,406.72	35,168	
Aulacoseira/Melosira spp.complex	12.00	2,486.88	29,843	
Melosira varians	4.00	9,420.00	37,680	large cell
Navicula sp.	22.00	219.80	4,836	
Navicula sp.	11.00	879.20	9,671	
Nitzschia sp.	22.00	471.00	10,362	
Nitzschia sp.	11.00	1,099.00	12,089	
Nitzschia sp.	1.00	5,775.00	5,775	cells>100um length
Pinnularia sp.	2.00	1,648.50	3,297	
Surirella sp.	1.00	12,096.00	12,096	
Synedra sp.	7.00	2,051.47	14,360	
Synedra sp.	22.00	90.67	1,995	
Synedra sp.	10.00	199.47	1,995	
Synedra sp.	22.00	370.44	8,150	
Tabellaria sp.	1.00	1,680.00	1,680	
undet pennate diatom	44.00	188.40	8,290	naviculoid cell
undet pennate diatom	1.00	457.92	458	naviculoid cell
undet pennate diatom	22.00	2,268.00	49,896	naviculoid cell
undet pennate diatom	24.00	345.60	8,294	chain of cells
Taxon Subtotal	**2249**		**1,440,814**	
Cryptophyta				
Cryptomonas spp.	10.00	2,000.18	20,002	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	44.00	172.29	7,581	assoc w/detritus
Taxon Subtotal	**54**		**27,583**	
Euglenophyta				
Trachelomonas sp.	1.00	2,571.14	2,571	smooth wall
Taxon Subtotal	**1**		**2,571**	
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**2,386**	**Total Volume**	**1,520,273**	**1.520**
Percent Cyanophyta	**0.04**	Percent Cyanophyta	**0.08**	
Percent Chlorophyta	**3.39**	Percent Chlorophyta	**3.16**	
Percent Chrysophyta	**94.26**	Percent Chrysophyta	**94.77**	
Percent Cryptophyta	**2.26**	Percent Cryptophyta	**1.81**	
Percent Euglenophyta	**0.04**	Percent Euglenophyta	**0.17**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 5/14/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	
Ankistrodesmus falcatus	10.00	182	1,824	
Oocystis sp.	1.00	635.85	636	single cells
Quadrigula sp.	4.00	167.47	670	
* *Scenedesmus bijuga*	1.00	837.33	837	4-cell colony
unicell (sph) nannoplktn	2.00	4,186.67	8,373	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**38**		**27,669**	
Chrysophyta				
Dinobryon sp.	15.00	384.65	5,770	deterior cells
filamentous chrysophyte	50.00	158.96	7,948	deterior cells
chrysophyte (unicell)	110.00	1,149.76	126,474	
chrysophyte (unicell)	200.00	267.95	53,589	
Bacillariophyceae				
Asterionella formosa	864.00	562.69	486,162	
Cocconeis sp.	1.00	1,099.00	1,099	
Cocconeis sp.	1.00	2,355.00	2,355	
Cyclotella sp.	22.00	678.24	14,921	tiny cells-12 um diam
Cymbella sp.	3.00	2,344.53	7,034	
Fragilaria sp.	10.00	630.00	6,300	
Fragilaria crotonensis	20.00	562.50	11,250	
Gomphonema sp.	3.00	2,646.00	7,938	
Hannaea arcus	8.00	828.96	6,632	
Aulacoseira/Melosira spp.complex	84.00	617.40	51,862	slender cells
Aulacoseira/Melosira spp.complex	35.00	1,727.00	60,445	
Aulacoseira/Melosira spp.complex	42.00	3,077.20	129,242	
Melosira varians	2.00	9,420.00	18,840	large cell
Navicula sp.	2.00	483.56	967	
Navicula sp.	4.00	3,077.20	12,309	
Navicula sp.	4.00	5,128.67	20,515	
Navicula sp.	2.00	22,608.00	45,216	
Nitzschia sp.	10.00	392.50	3,925	
Nitzschia sp.	2.00	549.50	1,099	
Nitzschia sp.	2.00	1,318.80	2,638	
Nitzschia sp.	1.00	10,368.00	10,368	cells>180um length
Pinnularia sp.	2.00	6,154.40	12,309	
Pinnularia sp.	1.00	26,690.00	26,690	
Surirella sp.	1.00	99,000.00	99,000	
Synedra sp.	6.00	2,512.00	15,072	
Synedra sp.	66.00	90.67	5,984	
Synedra sp.	12.00	199.47	2,394	
Synedra sp.	12.00	404.12	4,849	
Synedra sp.	1.00	1,471.88	1,472	
Tabellaria fenestrata	10.00	5,040.00	50,400	
Tabellaria flocculosa	4.00	2,744.00	10,976	
undet pennate diatom	10.00	190.49	1,905	naviculoid cell
undet pennate diatom	10.00	170.08	1,701	naviculoid cell
undet pennate diatom	10.00	314.31	3,143	naviculoid cell
undet pennate diatom	10.00	3,150.00	31,500	
undet pennate diatom	10.00	879.20	8,792	naviculoid cell
undet pennate diatom	2.00	28,574.00	57,148	cells>120um length
Taxon Subtotal	**1664**		**1,428,232**	
Cryptophyta				
Cryptomonas spp.	4.00	2,000.18	8,001	assoc w/detritus
cryptomonad	2.00	1,036.20	2,072	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	55.00	172.29	9,476	assoc w/detritus
Taxon Subtotal	**61**		**19,549**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,763**	**Total Volume**	**1,475,451**	**1.475**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**2.16**	Percent Chlorophyta	**1.88**	
Percent Chrysophyta	**94.38**	Percent Chrysophyta	**96.80**	
Percent Cryptophyta	**3.46**	Percent Cryptophyta	**1.32**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE PHYTOPLANKTON
DATE: 5/14/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	1.00	686.88	687	threadlike fil<3um width;no sheath
Taxon Subtotal	**1**		**687**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	
Ankistrodesmus falcatus	2.00	182	365	
Oocystis sp.	1.00	468.91	469	single cells
colonial nannoplankton (sph)	8.00	87.07	697	
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**31**		**16,859**	
Chrysophyta				
Dinobryon sp.	3.00	487.22	1,462	deterior cells
filamentous chrysophyte	28.00	158.96	4,451	deterior cells
chrysophyte (unicell)	55.00	1,149.76	63,237	
chrysophyte (unicell)	132.00	267.95	35,369	
Bacillariophyceae				
Asterionella formosa	672.00	562.69	378,126	
Cocconeis sp.	1.00	1,318.80	1,319	
Cyclotella sp.	4.00	1,538.60	6,154	
Cymbella sp.	1.00	2,578.99	2,579	
Fragilaria sp.	10.00	756.00	7,560	
Fragilaria crotonensis	10.00	562.50	5,625	
Gomphonema constrictum	1.00	5,376.00	5,376	
Gomphonema sp.	10.00	1,680.00	16,800	
Aulacoseira/Melosira spp.complex	35.00	3,165.12	110,779	
Aulacoseira/Melosira spp.complex	82.00	569.91	46,733	slender cells;term spine
Aulacoseira/Melosira spp.complex	4.00	2,653.30	10,613	
Melosira varians	12.00	9,420.00	113,040	large cell
Navicula sp.	20.00	663.17	13,263	
Navicula sp.	10.00	3,516.80	35,168	
Nitzschia sp.	10.00	502.40	5,024	
Nitzschia sp.	4.00	1,538.60	6,154	
Nitzschia sp.	1.00	6,300.00	6,300	
Synedra ulna	1.00	12,800.00	12,800	
Synedra sp.	4.00	2,260.80	9,043	
Synedra sp.	20.00	90.67	1,813	
Synedra sp.	10.00	199.47	1,995	
Synedra sp.	10.00	370.44	3,704	
Synedra sp.	2.00	1,648.50	3,297	
Tabellaria fenestrata	12.00	4,872.00	58,464	
Tabellaria flocculosa	2.00	2,744.00	5,488	
undet pennate diatom	10.00	143.92	1,439	naviculoid cell
undet pennate diatom	10.00	285.74	2,857	naviculoid cell
undet pennate diatom	1.00	25,200.00	25,200	naviculoid cell
undet pennate diatom	2.00	3,516.80	7,034	naviculoid cell
undet pennate diatom	20.00	1,758.40	35,168	naviculoid cell
Taxon Subtotal	**1209**		**1,043,436**	
Cryptophyta				
Cryptomonas spp.	2.00	2,000.18	4,000	assoc w/detritus
cryptomonad	4.00	1,036.20	4,145	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	66.00	172.29	11,371	assoc w/detritus
Taxon Subtotal	**72**		**19,516**	
Euglenophyta				
Pyrrhophyta				
Peridiniales	1.00	56,620.48	56,620	thecate
Taxon Subtotal	**1.00**		**56,620**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,314**	**Total Volume**	**1,137,119**	**1.137**
Percent Cyanophyta	**0.08**	Percent Cyanophyta	**0.06**	
Percent Chlorophyta	**2.36**	Percent Chlorophyta	**1.48**	
Percent Chrysophyta	**92.01**	Percent Chrysophyta	**91.76**	
Percent Cryptophyta	**5.48**	Percent Cryptophyta	**1.72**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.08**	Percent Pyrrhophyta	**4.98**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 5/14/2013
STATION: Lk Spokane-LL5 (0.5m)

SAMPLE STATUS: Lugol preserved
NOTE: many empty diatom frustules

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudanabaenaceae	1.00	686.88	687	threadlike fil<3um width;no sheath
Taxon Subtotal	**1**		**687**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	
Ankistrodesmus falcatus	10.00	171	1,710	
unicell (sph) nannoplktn	1.00	4,186.67	4,187	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**31**		**21,226**	
Chrysophyta				
Dinobryon sp.	12.00	471.00	5,652	deterior cells
filamentous chrysophyte	35.00	254.34	8,902	deterior cells
chrysophyte (unicell)	55.00	1,149.76	63,237	
chrysophyte (unicell)	100.00	267.95	26,795	
Bacillariophyceae				
Asterionella formosa	640.00	562.69	360,120	
Cyclotella sp.	1.00	5,319.16	5,319	
Cymbella sp.	2.00	1,846.32	3,693	
Fragilaria crotonensis	20.00	562.50	11,250	
Gomphonema constrictum	1.00	3,087.00	3,087	
Gomphonema sp.	4.00	1,680.00	6,720	
Aulacoseira/Melosira spp.complex	45.00	1,077.02	48,466	
Aulacoseira/Melosira spp.complex	10.00	3,165.12	31,651	
Aulacoseira/Melosira spp.complex	22.00	628.00	13,816	slender cells
Aulacoseira/Melosira spp.complex	21.00	2,260.80	47,477	
Melosira varians	6.00	9,420.00	56,520	large cell
Navicula sp.	4.00	996.43	3,986	
Navicula sp.	2.00	1,934.24	3,868	
Navicula sp.	4.00	3,140.00	12,560	
Nitzschia sp.	10.00	518.10	5,181	
Synedra ulna	1.00	5,600.00	5,600	
Synedra sp.	4.00	2,177.07	8,708	
Synedra sp.	10.00	90.67	907	
Synedra sp.	12.00	370.44	4,445	
Tabellaria fenestrata	3.00	4,704.00	14,112	
Tabellaria sp.	2.00	3,528.00	7,056	
Urosolenia (Rhizosolenia) sp.	1.00	6,028.80	6,029	delicate cells
undet pennate diatom	20.00	170.08	3,402	naviculoid cell
undet pennate diatom	4.00	183.17	733	naviculoid cell
undet pennate diatom	10.00	6,300.00	63,000	
undet pennate diatom	1.00	2,058.00	2,058	
undet pennate diatom	10.00	2,110.08	21,101	naviculoid cell
undet pennate diatom	1.00	6,698.67	6,699	naviculoid cell
Taxon Subtotal	**1073**		**862,149**	
Cryptophyta				
Cryptomonas spp.	3.00	2,000.18	6,001	assoc w/detritus
cryptomonad	2.00	1,036.20	2,072	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	55.00	172.29	9,476	assoc w/detritus
Taxon Subtotal	**60**		**17,549**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,165**	**Total Volume**	**901,610**	**0.902**
Percent Cyanophyta	**0.09**	Percent Cyanophyta	**0.08**	
Percent Chlorophyta	**2.66**	Percent Chlorophyta	**2.35**	
Percent Chrysophyta	**92.10**	Percent Chrysophyta	**95.62**	
Percent Cryptophyta	**5.15**	Percent Cryptophyta	**1.95**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/11/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL0 (0.5m) **NOTE:**

Taxon		Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta					
+	Oscillatoriales: Pseudanabaenaceae	1.00	2,992.03	2,992	threadlike fil<4um width;thin sheath
+	Oscillatoriales: Pseudanabaenaceae	5.00	400.59	2,003	threadlike fil<3um width;no sheath
	Taxon Subtotal	**6**		**4,995**	
Chlorophyta					
	Ankistrodesmus falcatus	55.00	97	5,329	
	Coelastrum microporum	16.00	113.04	1,809	
	Oocystis sp.	2.00	226.08	452	
*	*Pandorina sp.*	4.00	8,205.87	32,823	small-cell colonies
	Pandorina sp.	16.00	628.00	10,048	
*	*Pediastrum tetras*	1.00	769.30	769	small col<20um diam
	Quadrigula sp.	28.00	253.29	7,092	
*	*Scenedesmus quadricauda*	2.00	256.43	513	4-cell colony
*	*Scenedesmus bijuga*	2.00	256.43	513	4 cell colony;deterior
	colonial nannoplankton (sph)	8.00	113.04	904	
	unicell (sph) nannoplktn	1.00	9,198.11	9,198	some w/lamellate cell;cell>20um
	unicell (sph) nannoplktn	10.00	1,149.76	11,498	some w/lamellate cell
	unicell (sph) nannoplktn	8.00	3,052.08	24,417	some w/lamellate cell
	Taxon Subtotal	**153**		**105,365**	
Chrysophyta					
	Dinobryon bavaricum (tenta)	10.00	327.08	3,271	deterior cells
	Mallomonas sp.	8.00	3,483.31	27,866	
	Rhizochrysis sp.	10.00	6,028.80	60,288	
	chrysophyte (unicell)	44.00	1,149.76	50,590	
	chrysophyte (unicell)	110.00	267.95	29,474	
Bacillariophyceae					
	Asterionella formosa	3,600.00	562.69	2,025,677	
	Cyclotella sp.	10.00	1,607.68	16,077	
	Fragilaria crotonensis	300.00	600.00	180,000	
	Aulacoseira/Melosira spp.complex	12.00	2,034.72	24,417	
	Navicula sp.	1.00	2,512.00	2,512	
	Nitzschia sp.	1.00	2,880.00	2,880	
	Synedra sp.	3.00	2,143.05	6,429	
	Synedra sp.	77.00	90.67	6,981	
	Synedra sp.	110.00	211.56	23,271	
	Synedra sp.	121.00	370.44	44,823	
	Synedra sp.	30.00	483.56	14,507	
	Tabellaria flocculosa	8.00	3,920.00	31,360	
	Urosolenia (Rhizosolenia) sp.	165.00	6,028.80	994,752	delicate cells
	Urosolenia (Rhizosolenia) sp.	20.00	28,134.40	562,688	delicate robust cells
	Taxon Subtotal	**4640**		**4,107,863**	
Cryptophyta					
	Cryptomonas spp.	30.00	2,000.18	60,005	assoc w/detritus
	small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
	Taxon Subtotal	**63**		**65,691**	
Euglenophyta					
Pyrrhophyta					
	small dinoflagellate	5.00	1,582.56	7,913	tiny cell;thecal plates obscure
	small dinoflagellate	1.00	4,144.80	4,145	small cell;thecal plates obscure
	Taxon Subtotal	**6.00**		**12,058**	
Undetermined					

			(um3/ml)	(mm3/L)
Total Number/ml	**4,868**	**Total Volume**	**4,295,972**	**4.296**
Percent Cyanophyta	**0.12**	Percent Cyanophyta	**0.12**	
Percent Chlorophyta	**3.14**	Percent Chlorophyta	**2.45**	
Percent Chrysophyta	**95.32**	Percent Chrysophyta	**95.62**	
Percent Cryptophyta	**1.29**	Percent Cryptophyta	**1.53**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.12**	Percent Pyrrhophyta	**0.28**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/11/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	10.00	343.36	3,434	threadlike fil<3um width;no sheath
Taxon Subtotal	**10**		**3,434**	
Chlorophyta				
Ankistrodesmus falcatus	33.00	97	3,197	deterior cells
Coelastrum microporum	16.00	523.33	8,373	
Oocystis sp.	8.00	105.98	848	
Pandorina sp.	16.00	205.15	3,282	
* *Pandorina /Eudorina spp asmblg.*	1.00	8,205.87	8,206	small-cell col<30um diam
Quadrigula sp.	20.00	253.29	5,066	
* *Scenedesmus quadricauda*	8.00	256.43	2,051	4-cell colony
* *Scenedesmus quadricauda*	8.00	167.47	1,340	2-cell colony
* *Scenedesmus bijuga*	2.00	256.43	513	4-cell colony
colonial nannoplankton (sph)	24.00	381.51	9,156	
colonial nannoplankton (sph)	16.00	113.04	1,809	
unicell (sph) nannoplktn	12.00	1,436.03	17,232	some w/lamellate cell
unicell (sph) nannoplktn	2.00	4,186.67	8,373	some w/lamellate cell
Taxon Subtotal	**166**		**69,447**	
Chrysophyta				
Dinobryon sp.	15.00	468.91	7,034	deterior cells
Mallomonas sp.	11.00	3,483.31	38,316	
Rhizochrysis sp.	5.00	7,075.47	35,377	
chrysophyte (unicell)	3.00	9,905.65	29,717	cell>25um
chrysophyte (unicell)	20.00	1,149.76	22,995	
chrysophyte (unicell)	440.00	267.95	117,897	
Bacillariophyceae				
Asterionella formosa	2,600.00	522.50	1,358,490	
Fragilaria crotonensis	260.00	600.00	156,000	
Fragilaria crotonensis	30.00	750.00	22,500	cells>100um length
Synedra sp.	8.00	1,758.40	14,067	
Synedra sp.	44.00	90.67	3,989	
Synedra sp.	30.00	199.47	5,984	
Synedra sp.	50.00	370.44	18,522	
Synedra sp.	4.00	659.40	2,638	
Urosolenia (Rhizosolenia) sp.	100.00	6,028.80	602,880	delicate cells
Taxon Subtotal	**3620**		**2,436,406**	
Cryptophyta				
Cryptomonas spp.	8.00	2,000.18	16,001	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
Taxon Subtotal	**41**		**21,687**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**3,837**	**Total Volume**	**2,530,974**	**2.531**
Percent Cyanophyta	**0.26**	Percent Cyanophyta	**0.14**	
Percent Chlorophyta	**4.33**	Percent Chlorophyta	**2.74**	
Percent Chrysophyta	**94.34**	Percent Chrysophyta	**96.26**	
Percent Cryptophyta	**1.07**	Percent Cryptophyta	**0.86**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/11/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	10.00	286.13	2,861	threadlike fil<3um width;no sheath
Taxon Subtotal	**10**		**2,861**	
Chlorophyta				
Ankistrodesmus falcatus	22.00	97	2,131	
* *Botryococcus sp.*	1.00	22,670.80	22,671	small col<40um diam
* *Pediastrum tetras*	1.00	1,271.70	1,272	small col<20um diam
Quadrigula sp.	20.00	253.29	5,066	
* *Scenedesmus quadricauda*	2.00	256.43	513	4-cell colony
* *Scenedesmus bijuga*	3.00	732.67	2,198	4 cell colony
* *Scenedesmus bijuga flexuosus*	1.00	1,406.72	1,407	12-16cell colony
Tetraedron minimum	1.00	576.00	576	
colonial nannoplankton (sph)	32.00	113.04	3,617	
* colonial nannoplankton (sph)	2.00	13,129.39	26,259	dense sph colony w/compres cells
unicell (sph) nannoplktn	5.00	5,572.45	27,862	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	15.00	1,436.03	21,540	some w/lamellate cell
Taxon Subtotal	**105**		**115,112**	
Chrysophyta				
Mallomonas sp.	6.00	3,483.31	20,900	
Rhizochrysis sp.	2.00	7,075.47	14,151	
chrysophyte (unicell)	5.00	1,356.48	6,782	
chrysophyte (unicell)	1.00	4,186.67	4,187	cell>20um
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	88.00	267.95	23,579	
chrysophyte (unicell)	1.00	2,872.05	2,872	ellip cells
Bacillariophyceae				
Amphora sp.	1.00	2,120	2,120	
Asterionella formosa	2,400.00	562.69	1,350,451	
Fragilaria sp.	12.00	720.00	8,640	
Fragilaria crotonensis	280.00	600.00	168,000	
Nitzschia sp.	1.00	923.16	923	
Nitzschia sp.	1.00	5,775.00	5,775	cells>100um length
Synedra sp.	1.00	2,051.47	2,051	
Synedra sp.	10.00	90.67	907	
Synedra sp.	5.00	199.47	997	
Synedra sp.	5.00	370.44	1,852	
Tabellaria fenestrata	1.00	4,704.00	4,704	
Urosolenia (Rhizosolenia) sp.	44.00	6,028.80	265,267	delicate cells
Taxon Subtotal	**2886**		**1,909,454**	
Cryptophyta				
Cryptomonas spp.	92.00	2,000.18	184,017	assoc w/detritus
cryptomonad	8.00	1,036.20	8,290	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	10.00	172.29	1,723	assoc w/detritus
Taxon Subtotal	**110**		**194,029**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**3,111**	**Total Volume**	**2,221,456**	**2.221**
Percent Cyanophyta	**0.32**	Percent Cyanophyta	**0.13**	
Percent Chlorophyta	**3.38**	Percent Chlorophyta	**5.18**	
Percent Chrysophyta	**92.77**	Percent Chrysophyta	**85.96**	
Percent Cryptophyta	**3.54**	Percent Cryptophyta	**8.73**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/12/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	1.00	1,201.76	1,202	threadlike fil<3um width;thin sheath
+ Oscillatoriales: Pseudoanabaenaceae	10.00	286.13	2,861	threadlike fil<3um width;no sheath
Taxon Subtotal	**11**		**4,063**	
Chlorophyta				
Ankistrodesmus falcatus	33.00	97	3,197	
Closterium sp.	1.00	588.75	589	
Dictyosphaerium sp.	16.00	87.07	1,393	
Oocystis sp.	1.00	635.85	636	single cells
* *Pandorina sp.*	3.00	15,825.60	47,477	small colonies w/compres cells
Pandorina sp.	24.00	423.90	10,174	
* *Pediastrum tetras*	1.00	1,271.70	1,272	small col<20um diam
Quadrigula sp.	22.00	253.29	5,572	
* *Scenedesmus bijuga*	4.00	401.92	1,608	4-cell colony
* *Scenedesmus bijuga*	1.00	2,051.47	2,051	robust 4-cell colony
* *Scenedesmus bijuga flexuosus*	1.00	1,025.73	1,026	16+cell colony
* *Scenedesmus quadricauda*	8.00	256.43	2,051	4-cell colony
undet colonial desmid	6.00	1,046.67	6,280	linear colony of robust ovate cells
colonial nannoplankton (sph)	16.00	267.95	4,287	cell pairs/quads
* colonial nannoplankton (sph)	4.00	13,129.39	52,518	dense sph colony w/compres cells
unicell (sph) nannoplktn	15.00	4,186.67	62,800	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	30.00	1,436.03	43,081	some w/lamellate cell
Taxon Subtotal	**186**		**246,011**	
Chrysophyta				
Dinobryon sp.	10.00	384.65	3,847	deterior cells
Mallomonas sp.	5.00	3,215.36	16,077	
Rhizochrysis sp.	2.00	7,075.47	14,151	
filamentous chrysophyte	12.00	158.96	1,908	deterior cells
chrysophyte (unicell)	10.00	1,356.48	13,565	
chrysophyte (unicell)	10.00	4,186.67	41,867	cell>20um
chrysophyte (unicell)	77.00	1,149.76	88,532	
chrysophyte (unicell)	100.00	267.95	26,795	
Bacillariophyceae				
Asterionella formosa	3,200.00	562.69	1,800,602	
Cocconeis sp.	1.00	1,099.00	1,099	
Fragilaria crotonensis	220.00	600.00	132,000	
Gomphonema sp.	3.00	1,470.00	4,410	
Navicula sp.	1.00	816.40	816	
Synedra sp.	12.00	2,512.00	30,144	
Synedra sp.	60.00	90.67	5,440	
Synedra sp.	26.00	199.47	5,186	
Synedra sp.	22.00	404.12	8,891	
Tabellaria fenestrata	16.00	4,200.00	67,200	
Urosolenia (Rhizosolenia) sp.	44.00	6,028.80	265,267	delicate cells
Urosolenia (Rhizosolenia) sp.	2.00	28,134.40	56,269	delicate robust cells
undet pennate diatom	1.00	7,536.00	7,536	
Taxon Subtotal	**3834**		**2,591,600**	
Cryptophyta				
Cryptomonas spp.	44.00	2,000.18	88,008	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	44.00	172.29	7,581	assoc w/detritus
Taxon Subtotal	**88**		**95,589**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	1,055.04	1,055	tiny cell;thecal plates obscure
Taxon Subtotal	**1.00**		**1,055**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**4,120**	**Total Volume**	**2,938,318**	**2.938**
Percent Cyanophyta	**0.27**	Percent Cyanophyta	**0.14**	
Percent Chlorophyta	**4.51**	Percent Chlorophyta	**8.37**	
Percent Chrysophyta	**93.06**	Percent Chrysophyta	**88.20**	
Percent Cryptophyta	**2.14**	Percent Cryptophyta	**3.25**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.02**	Percent Pyrrhophyta	**0.04**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/12/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	2.00	486.43	973	threadlike fil<3um width;no sheath
+ Oscillatoriales: Pseudoanabaenaceae	3.00	286.13	858	threadlike fil<3um width;no sheath
Taxon Subtotal	**5**		**1,831**	
Chlorophyta				
Ankistrodesmus falcatus	22.00	97	2,131	
Ankistrodesmus falcatus	4.00	182	729	
* *Pediastrum tetras*	1.00	1,271.70	1,272	small col<20um diam
Quadrigula sp.	8.00	253.29	2,026	
Staurastrum chaetocerus (tenta)	1.00	2,213.64	2,214	
Tetraedron minimum	1.00	576.00	576	
undet filamentous green	10.00	1,256.00	12,560	
colonial nannoplankton (sph)	8.00	87.07	697	
unicell (sph) nannoplktn	20.00	381.51	7,630	some w/lamellate cell
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**85**		**44,196**	
Chrysophyta				
Dinobryon bavaricum	1.00	392.50	393	deterior cells
Dinobryon sp.	5.00	384.65	1,923	deterior cells
filamentous chrysophyte	6.00	158.96	954	deterior cells
chrysophyte (unicell)	1.00	4,186.67	4,187	cell>20um
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	66.00	267.95	17,684	
chrysophyte (unicell)	4.00	1,139.82	4,559	ellip cells<30um
Bacillariophyceae				
Amphora sp.	2.00	2,120	4,239	
Asterionella formosa	480.00	562.69	270,090	
Cocconeis sp.	1.00	1,318.80	1,319	
Gomphonema sp.	6.00	2,205.00	13,230	
Hannaea arcus	4.00	791.28	3,165	
Aulacoseira/Melosira spp.complex	4.00	3,165.12	12,660	
Aulacoseira/Melosira spp.complex	8.00	510.25	4,082	slender cells;term spine
Melosira varians	10.00	9,420.00	94,200	large cell
Navicula sp.	10.00	663.17	6,632	
Navicula sp.	10.00	2,637.60	26,376	
Nitzschia sp.	20.00	361.10	7,222	
Nitzschia sp.	2.00	502.40	1,005	
Nitzschia sp.	6.00	6,930.00	41,580	
Pinnularia sp.	1.00	3,956.40	3,956	
Synedra ulna	6.00	14,080.00	84,480	
Synedra sp.	36.00	2,260.80	81,389	
Synedra sp.	66.00	90.67	5,984	
Synedra sp.	30.00	199.47	5,984	
Synedra sp.	10.00	370.44	3,704	
Synedra sp.	4.00	1,224.60	4,898	
Tabellaria flocculosa	2.00	2,744.00	5,488	
Urosolenia (Rhizosolenia) sp.	24.00	6,028.80	144,691	delicate cells
undet pennate diatom	77.00	285.74	22,002	naviculoid cell
undet pennate diatom	1.00	10,290.00	10,290	naviculoid cell>130um
undet pennate diatom	5.00	3,360.00	16,800	
undet pennate diatom	2.00	2,637.60	5,275	naviculoid cell
undet pennate diatom	10.00	1,632.80	16,328	naviculoid cell
Taxon Subtotal	**942**		**952,065**	
Cryptophyta				
Cryptomonas spp.	16.00	2,000.18	32,003	assoc w/detritus
cryptomonad	5.00	1,036.20	5,181	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	66.00	172.29	11,371	assoc w/detritus
Taxon Subtotal	**87**		**48,555**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,119**	**Total Volume**	**1,046,647**	**1.047**
Percent Cyanophyta	**0.45**	Percent Cyanophyta	**0.17**	
Percent Chlorophyta	**7.60**	Percent Chlorophyta	**4.22**	
Percent Chrysophyta	**84.18**	Percent Chrysophyta	**90.96**	
Percent Cryptophyta	**7.77**	Percent Cryptophyta	**4.64**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/12/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL5 (0.5m) **NOTE: many empty diatom frustules**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudanabaenaceae	1.00	1,201.76	1,202	threadlike fil<3um width;no sheath
+ Oscillatoriales: Pseudanabaenaceae	4.00	286.13	1,145	threadlike fil<3um width;no sheath
Taxon Subtotal	**5**		**2,346**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	
* *Pediastrum tetras*	1.00	1,004.80	1,005	small col<20um diam
Quadrigula sp.	2.00	253.29	507	
Tetraedron minimum	1.00	576.00	576	
colonial nannoplankton (sph)	8.00	87.07	697	
unicell (sph) nannoplktn	20.00	381.51	7,630	some w/lamellate cell
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**52**		**25,743**	
Chrysophyta				
chrysophyte (unicell)	3.00	4,186.67	12,560	cell>20um
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	44.00	267.95	11,790	
Bacillariophyceae				
Amphora sp.	1.00	2,237	2,237	
Asterionella formosa	288.00	562.69	162,054	
Cocconeis sp.	1.00	1,208.90	1,209	
Cyclotella sp.	5.00	2,009.60	10,048	
Gomphonema sp.	4.00	1,470.00	5,880	
Gomphonema sp.	1.00	2,646.00	2,646	
Hannaea arcus	5.00	791.28	3,956	
Aulacoseira/Melosira spp.complex	3.00	3,165.12	9,495	
Aulacoseira/Melosira spp.complex	12.00	2,260.80	27,130	
Melosira varians	16.00	9,420.00	150,720	large cell
Navicula sp.	1.00	612.30	612	
Navicula sp.	1.00	1,657.92	1,658	
Navicula sp.	1.00	1,884.00	1,884	
Navicula sp.	3.00	3,077.20	9,232	
Nitzschia sp.	6.00	376.80	2,261	
Nitzschia sp.	3.00	5,670.00	17,010	cells>120um length
Synedra ulna	6.00	8,568.00	51,408	
Synedra sp.	15.00	2,313.13	34,697	
Synedra sp.	44.00	90.67	3,989	
Synedra sp.	5.00	211.56	1,058	
Synedra sp.	4.00	370.44	1,482	
Synedra sp.	1.00	628.00	628	
Tabellaria fenestrata	1.00	5,880.00	5,880	
Tabellaria flocculosa	2.00	2,744.00	5,488	
Urosolenia (Rhizosolenia) sp.	10.00	6,028.80	60,288	delicate cells
undet pennate diatom	44.00	293.07	12,895	naviculoid cell
undet pennate diatom	2.00	703.36	1,407	naviculoid cell
undet pennate diatom	1.00	1,764.00	1,764	
undet pennate diatom	10.00	1,256.00	12,560	naviculoid cell
Taxon Subtotal	**565**		**651,220**	
Cryptophyta				
Cryptomonas spp.	8.00	2,000.18	16,001	assoc w/detritus
cryptomonad	5.00	1,036.20	5,181	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
Taxon Subtotal	**46**		**26,868**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**668**	**Total Volume**	**706,178**	**0.706**
Percent Cyanophyta	**0.75**	Percent Cyanophyta	**0.33**	
Percent Chlorophyta	**7.78**	Percent Chlorophyta	**3.65**	
Percent Chrysophyta	**84.58**	Percent Chrysophyta	**92.22**	
Percent Cryptophyta	**6.89**	Percent Cryptophyta	**3.80**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/25/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL0 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
* *Coelastrum sp.*	1.00	4,186.67	4,187	small colonies<20um
Oocystis sp.	1.00	593.46	593	
* *Pandorina sp.*	13.00	9,420.00	122,460	small colonies<40um
Pandorina sp.	384.00	628.00	241,152	
Quadrigula sp.	2.00	253.29	507	
* *Scenedesmus bijuga flexuosus*	4.00	1,406.72	5,627	8-16-cell colony
Schroederia/Ankyra spp. Grp (tenta)	10.00	125.60	1,256	cells deteriorated
undet colonial desmid	64.00	1,017.36	65,111	linear col of 16+robust ovate cells
colonial nannoplankton (sph)	16.00	113.04	1,809	
unicell (sph) nannoplktn	8.00	7,234.56	57,876	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	20.00	1,149.76	22,995	some w/lamellate cell
Taxon Subtotal	**523**		**523,573**	
Chrysophyta				
Mallomonas sp.	4.00	3,215.36	12,861	
chrysophyte (unicell)	3.00	4,186.67	12,560	cell>20um
chrysophyte (unicell)	55.00	1,149.76	63,237	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Asterionella formosa	144.00	562.69	81,027	
Fragilaria crotonensis	200.00	675.00	135,000	
Synedra sp.	5.00	90.67	453	
Synedra sp.	1.00	211.56	212	
Synedra sp.	1.00	370.44	370	
Synedra sp.	1.00	449.02	449	
Urosolenia (Rhizosolenia) sp.	1.00	6,028.80	6,029	delicate cells
Taxon Subtotal	**470**		**326,936**	
Cryptophyta				
Cryptomonas spp.	7.00	2,000.18	14,001	assoc w/detritus
cryptomonad	3.00	1,036.20	3,109	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	120.00	172.29	20,675	assoc w/detritus
Taxon Subtotal	**130**		**37,785**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	6.00	2,260.80	13,565	tiny cell;thecal plates obscure
small dinoflagellate	7.00	5,388.24	37,718	small cell;thecal plates obscure
Taxon Subtotal	**13.00**		**51,282**	
Undetermined				
undeter colony	32.00	33.49	1,072	deterior cells<4um diam
Taxon Subtotal	**32.00**		**1,072**	

			(um3/ml)	(mm3/L)
Total Number/ml	**1,168**	**Total Volume**	**940,648**	**0.941**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**44.78**	Percent Chlorophyta	**55.66**	
Percent Chrysophyta	**40.24**	Percent Chrysophyta	**34.76**	
Percent Cryptophyta	**11.13**	Percent Cryptophyta	**4.02**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**1.11**	Percent Pyrrhophyta	**5.45**	
Percent Undetermined	**2.74**	Percent Undetermined	**0.11**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/25/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	1.00	801.17	801	threadlike fil<3um width;no sheath
Taxon Subtotal	**1**		**801**	
Chlorophyta				
* *Pandorina sp.*	6.00	8,205.87	49,235	small colonies<28um
Pandorina sp.	64.00	334.93	21,436	
Quadrigula sp.	12.00	370.91	4,451	robust cells
* *Scenedesmus quadricauda*	1.00	401.92	402	4-cell colony
* *Scenedesmus bijuga flexuosus*	3.00	1,205.76	3,617	8-16 cell colony
Schroederia/Ankyra spp. Grp (tenta)	22.00	125.60	2,763	deterior cells
Schroederia/Ankyra spp. grp	3.00	431.75	1,295	
undet colonial desmid	8.00	3,483.31	27,866	linear col of 8+ robust ovate cells
colonial nannoplankton (sph)	8.00	381.51	3,052	
unicell (sph) nannoplktn	10.00	7,234.56	72,346	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	20.00	1,436.03	28,721	some w/lamellate cell
Taxon Subtotal	**157**		**215,184**	
Chrysophyta				
Mallomonas sp.	1.00	3,483.31	3,483	
chrysophyte (unicell)	2.00	7,234.56	14,469	cell>20um
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	66.00	267.95	17,684	
Bacillariophyceae				
Asterionella formosa	112.00	562.69	63,021	
Fragilaria crotonensis	550.00	675.00	371,250	
Aulacoseira/Melosira spp.complex	25.00	664.90	16,622	slender cells
Synedra sp.	2.00	370.44	741	
undet pennate diatom	1.00	1,260.00	1,260	
Taxon Subtotal	**781**		**513,826**	
Cryptophyta				
Cryptomonas spp.	18.00	2,000.18	36,003	assoc w/detritus
cryptomonad	2.00	1,036.20	2,072	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	220.00	172.29	37,904	assoc w/detritus
Taxon Subtotal	**240**		**75,980**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	3.00	2,260.80	6,782	tiny cell;thecal plates obscure
small dinoflagellate	5.00	6,857.76	34,289	small cell;thecal plates obscure
Taxon Subtotal	**8.00**		**41,071**	
Undetermined				
undeter colony	32.00	33.49	1,072	deterior cells<4um diam
Taxon Subtotal	**32.00**		**1,072**	

			(um3/ml)	(mm3/L)
Total Number/ml	**1,219**	**Total Volume**	**847,934**	**0.848**
Percent Cyanophyta	**0.08**	Percent Cyanophyta	**0.09**	
Percent Chlorophyta	**12.88**	Percent Chlorophyta	**25.38**	
Percent Chrysophyta	**64.07**	Percent Chrysophyta	**60.60**	
Percent Cryptophyta	**19.69**	Percent Cryptophyta	**8.96**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.66**	Percent Pyrrhophyta	**4.84**	
Percent Undetermined	**2.63**	Percent Undetermined	**0.13**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/25/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	1.00	228.91	229	threadlike fil<3um width;no sheath
Taxon Subtotal	**1**		**229**	
Chlorophyta				
Ankistrodesmus falcatus	4.00	97	388	cells deteriorated
* *Pandorina sp.*	15.00	8,205.87	123,088	small colonies<28um
Pandorina sp.	96.00	334.93	32,154	
* *Scenedesmus bijuga*	1.00	3,751.25	3,751	8-cell colony
Schroederia/Ankyra spp. Grp (tenta)	10.00	167.47	1,675	cells deteriorated
unicell (sph) nannoplktn	1.00	5,572.45	5,572	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**137**		**180,988**	
Chrysophyta				
Mallomonas sp.	1.00	3,483.31	3,483	
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	100.00	267.95	26,795	
chrysophyte (unicell)	1.00	1,808.64	1,809	ellip cells<30um
Bacillariophyceae				
Asterionella formosa	120.00	602.88	72,346	
Fragilaria crotonensis	820.00	675.00	553,500	
Synedra sp.	1.00	1,884.00	1,884	
Taxon Subtotal	**1065**		**685,111**	
Cryptophyta				
Cryptomonas spp.	52.00	2,000.18	104,009	assoc w/detritus
cryptomonad	20.00	1,036.20	20,724	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	242.00	172.29	41,695	assoc w/detritus
Taxon Subtotal	**314**		**166,428**	
Euglenophyta				
Pyrrhophyta				
Peridinium inconspicuum	3.00	1,582.56	4,748	tiny-cell
small dinoflagellate	4.00	3,108.60	12,434	tiny cell;thecal plates obscure
small dinoflagellate	10.00	6,857.76	68,578	small cell;thecal plates obscure
Taxon Subtotal	**17.00**		**85,760**	
Undetermined				
undeter unicell	2.00	11,488.21	22,976	dense cell<30um diam
Taxon Subtotal	**2.00**		**22,976**	

			(um3/ml)	(mm3/L)
Total Number/ml	**1,536**	**Total Volume**	**1,141,492**	**1.141**
Percent Cyanophyta	**0.07**	Percent Cyanophyta	**0.02**	
Percent Chlorophyta	**8.92**	Percent Chlorophyta	**15.86**	
Percent Chrysophyta	**69.34**	Percent Chrysophyta	**60.02**	
Percent Cryptophyta	**20.44**	Percent Cryptophyta	**14.58**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**1.11**	Percent Pyrrhophyta	**7.51**	
Percent Undetermined	**0.13**	Percent Undetermined	**2.01**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/26/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
* *Pandorina sp.*	1.00	8,205.87	8,206	small colonies<28um
* *Scenedesmus bijuga*	2.00	837.33	1,675	4-cell colony
* *Scenedesmus quadricauda*	1.00	256.43	256	4-cell colony
undet desmid	1.00	18,990.72	18,991	
colonial nannoplankton (sph)	24.00	113.04	2,713	
colonial nannoplankton (sph)	16.00	1,149.76	18,396	
* colonial nannoplankton (sph)	1.00	13,129.39	13,129	dense sph colony w/compres cells
unicell (sph) nannoplktn	10.00	4,186.67	41,867	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	165.00	1,436.03	236,944	some w/lamellate cell
Taxon Subtotal	**231**		**343,146**	
Chrysophyta				
chrysophyte (unicell)	33.00	1,149.76	37,942	
chrysophyte (unicell)	132.00	267.95	35,369	
chrysophyte (unicell)	4.00	1,808.64	7,235	ellip cells<30um
Bacillariophyceae				
Asterionella formosa	64.00	602.88	38,584	
Cymbella sp.	2.00	1,641.17	3,282	
Fragilaria crotonensis	20.00	600.00	12,000	
Synedra sp.	1.00	1,695.60	1,696	
Synedra sp.	5.00	90.67	453	
Synedra sp.	14.00	211.56	2,962	
Taxon Subtotal	**275**		**139,523**	
Cryptophyta				
Cryptomonas spp.	440.00	2,000.18	880,079	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	660.00	172.29	113,713	assoc w/detritus
Taxon Subtotal	**1,100**		**993,792**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	8.00	3,108.60	24,869	tiny cell;thecal plates obscure
small dinoflagellate	12.00	6,857.76	82,293	small cell;thecal plates obscure
Taxon Subtotal	**20.00**		**107,162**	
Undetermined				
undeter unicell	1.00	11,488.21	11,488	dense cell<30um diam
Taxon Subtotal	**1.00**		**11,488**	

			(um3/ml)	(mm3/L)
Total Number/ml	**1,627**	**Total Volume**	**1,595,111**	**1.595**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**14.20**	Percent Chlorophyta	**21.51**	
Percent Chrysophyta	**16.90**	Percent Chrysophyta	**8.75**	
Percent Cryptophyta	**67.61**	Percent Cryptophyta	**62.30**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**1.23**	Percent Pyrrhophyta	**6.72**	
Percent Undetermined	**0.06**	Percent Undetermined	**0.72**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/26/2013 — **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) — **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudoanabaenaceae	2.00	801.17	1,602	threadlike fil<3um width;no sheath
Taxon Subtotal	**2**		**1,602**	
Chlorophyta				
Quadrigula sp.	2.00	253.29	507	
* *Scenedesmus bijuga*	1.00	508.68	509	4-cell colony
undet filamentous green	4.00	7,912.80	31,651	
unicell (sph) nannoplktn	1.00	11,488.21	11,488	cell>20um
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**18**		**58,515**	
Chrysophyta				
Dinobryon sp.	1.00	487.22	487	deterior cells
Mallomonas sp.	1.00	2,872.05	2,872	
chrysophyte (unicell)	33.00	1,149.76	37,942	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Asterionella formosa	352.00	602.88	212,214	
Cocconeis sp.	8.00	1,208.90	9,671	
Cyclotella sp.	2.00	3,454.00	6,908	
Gomphonema sp.	5.00	1,470.00	7,350	
Aulacoseira/Melosira spp.complex	4.00	1,077.02	4,308	
Melosira varians	10.00	9,420.00	94,200	large cell
Navicula sp.	10.00	374.18	3,742	
Navicula sp.	4.00	2,888.80	11,555	
Nitzschia sp.	2.00	439.60	879	
Nitzschia sp.	4.00	6,352.50	25,410	
Pinnularia sp.	1.00	3,956.40	3,956	
Synedra sp.	4.00	1,884.00	7,536	
Synedra sp.	22.00	90.67	1,995	
Synedra sp.	2.00	229.69	459	
Synedra sp.	1.00	1,318.80	1,319	
Tabellaria fenestrata	4.00	4,704.00	18,816	
Tabellaria flocculosa	2.00	2,352.00	4,704	
undet pennate diatom	22.00	143.92	3,166	naviculoid cell
undet pennate diatom	2.00	285.74	571	naviculoid cell
undet pennate diatom	2.00	2,880.00	5,760	naviculoid cell
undet pennate diatom	5.00	1,632.80	8,164	naviculoid cell
undet pennate diatom	10.00	268.80	2,688	chain of cells
Taxon Subtotal	**568**		**491,411**	
Cryptophyta				
Cryptomonas spp.	8.00	2,000.18	16,001	assoc w/detritus
Cryptomonas sp.	1.00	5,652.00	5,652	assoc w/detritus
cryptomonad	4.00	1,036.20	4,145	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
Taxon Subtotal	**46**		**31,484**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	659.40	659	tiny cell;thecal plates obscure
Taxon Subtotal	**1.00**		**659**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**635**	**Total Volume**	**583,671**	**0.584**
Percent Cyanophyta	**0.31**	Percent Cyanophyta	**0.27**	
Percent Chlorophyta	**2.83**	Percent Chlorophyta	**10.03**	
Percent Chrysophyta	**89.45**	Percent Chrysophyta	**84.19**	
Percent Cryptophyta	**7.24**	Percent Cryptophyta	**5.39**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.16**	Percent Pyrrhophyta	**0.11**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 6/26/2013 | **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL5 (0.5m) | **NOTE: many empty diatom frustules**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudanabaenaceae	4.00	801.17	3,205	threadlike fil<3um width;no sheath
Taxon Subtotal	**4**		**3,205**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	
* *Scenedesmus bijuga*	2.00	593.46	1,187	4-cell colony
undet filamentous green	2.00	2,692.55	5,385	
unicell (sph) nannoplktn	1.00	4,186.67	4,187	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**25**		**26,088**	
Chrysophyta				
Dinobryon divergens	1.00	669.87	670	deterior cells
Dinobryon sp.	10.00	418.67	4,187	deterior cells
Rhizochrysis sp.	1.00	7,075.47	7,075	
chrysophyte (unicell)	44.00	1,149.76	50,590	
chrysophyte (unicell)	44.00	267.95	11,790	
Bacillariophyceae				
Asterionella formosa	320.00	522.50	167,199	
Cyclotella sp.	1.00	5,319.16	5,319	
Cyclotella sp.	10.00	678.24	6,782	tiny cells-12 um diam
Fragilaria crotonensis	20.00	562.50	11,250	
Hannaea arcus	2.00	791.28	1,583	
Aulacoseira/Melosira spp.complex	14.00	3,165.12	44,312	
Melosira varians	8.00	9,420.00	75,360	large cell
Navicula sp.	4.00	3,140.00	12,560	
Nitzschia sp.	3.00	439.60	1,319	
Nitzschia sp.	1.00	1,099.00	1,099	
Nitzschia sp.	1.00	6,300.00	6,300	cells>100um length
Synedra ulna	3.00	4,480.00	13,440	
Synedra sp.	6.00	2,313.13	13,879	
Synedra sp.	33.00	90.67	2,992	
Synedra sp.	1.00	211.56	212	
Synedra sp.	3.00	370.44	1,111	
Tabellaria flocculosa	1.00	3,360.00	3,360	
undet pennate diatom	22.00	130.83	2,878	naviculoid cell
undet pennate diatom	6.00	157.00	942	naviculoid cell
undet pennate diatom	22.00	293.07	6,447	naviculoid cell
undet pennate diatom	4.00	4,725.00	18,900	naviculoid cell
Taxon Subtotal	**585**		**471,555**	
Cryptophyta				
Cryptomonas spp.	2.00	2,000.18	4,000	assoc w/detritus
cryptomonad	2.00	1,036.20	2,072	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
Taxon Subtotal	**37**		**11,758**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	1,055.04	1,055	tiny cell;thecal plates obscure
Taxon Subtotal	**1.00**		**1,055**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**652**	**Total Volume**	**513,661**	**0.514**
Percent Cyanophyta	**0.61**	Percent Cyanophyta	**0.62**	
Percent Chlorophyta	**3.83**	Percent Chlorophyta	**5.08**	
Percent Chrysophyta	**89.72**	Percent Chrysophyta	**91.80**	
Percent Cryptophyta	**5.67**	Percent Cryptophyta	**2.29**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.15**	Percent Pyrrhophyta	**0.21**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/9/2013 SAMPLE STATUS: Lugol preserved
STATION: Lk Spokane-LL0 (0.5m) NOTE:

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	100.00	2.68	268	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	1.00	572.27	572	threadlike fil<3um width;no sheath
Taxon Subtotal	**101**		**840**	
Chlorophyta				
Ankistrodesmus falcatus	5.00	97	484	cells deteriorated
Oocystis sp.	6.00	1,013.17	6,079	
* *Pandorina sp.*	1.00	9,420.00	9,420	small colonies<40um
* *Scenedesmus quadricauda*	2.00	256.43	513	4-cell colony
* *Scenedesmus bijuga*	1.00	508.68	509	4 cell colony
* *Scenedesmus bijuga*	2.00	937.81	1,876	8-cell colony
Schroederia/Ankyra spp. Grp (tenta)	5.00	150.72	754	cells deteriorated
colonial nannoplankton (sph)	16.00	113.04	1,809	
unicell (sph) nannoplktn	5.00	4,186.67	20,933	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	88.00	1,436.03	126,370	some w/lamellate cell
Taxon Subtotal	**131**		**168,747**	
Chrysophyta				
Mallomonas sp.	9.00	2,666.91	24,002	
chrysophyte (unicell)	33.00	1,149.76	37,942	
chrysophyte (unicell)	100.00	267.95	26,795	
Bacillariophyceae				
Asterionella formosa	80.00	602.88	48,230	
Fragilaria crotonensis	600.00	675.00	405,000	
Synedra sp.	44.00	90.67	3,989	
Synedra sp.	74.00	199.47	14,761	
Synedra sp.	5.00	449.02	2,245	
Synedra sp.	3.00	1,648.50	4,946	
Urosolenia (Rhizosolenia) sp.	1.00	6,028.80	6,029	delicate cells
undet pennate diatom	1.00	359.01	359	naviculoid cell
undet pennate diatom	1.00	4,320.00	4,320	
undet pennate diatom	1.00	376.80	377	naviculoid cell
Taxon Subtotal	**952**		**578,995**	
Cryptophyta				
Cryptomonas spp.	2.00	2,000.18	4,000	assoc w/detritus
cryptomonad	5.00	1,036.20	5,181	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
Taxon Subtotal	**40**		**14,867**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	5,388.24	5,388	small cell;thecal plates obscure
Taxon Subtotal	**1.00**		**5,388**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,225**	**Total Volume**	**768,837**	**0.769**
Percent Cyanophyta	**8.24**	Percent Cyanophyta	**0.11**	
Percent Chlorophyta	**10.69**	Percent Chlorophyta	**21.95**	
Percent Chrysophyta	**77.71**	Percent Chrysophyta	**75.31**	
Percent Cryptophyta	**3.27**	Percent Cryptophyta	**1.93**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.08**	Percent Pyrrhophyta	**0.70**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/9/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	200.00	2.68	536	cells<2um;irreg,clathrate col
Taxon Subtotal	**200**		**536**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	deterior cells
Dictyosphaerium sp.	8.00	87.07	697	
Pandorina sp.	32.00	334.93	10,718	
* *Pediastrum boryanum*	1.00	5,769.75	5,770	
* *Scenedesmus quadricauda*	1.00	256.43	256	4-cell colony
* *Scenedesmus bijuga*	4.00	468.91	1,876	4-cell colony
Schroederia/Ankyra spp. Grp (tenta)	10.00	150.72	1,507	deterior cells
Schroederia/Ankyra spp. grp	2.00	431.75	864	
colonial nannoplankton (sph)	44.00	381.51	16,786	
unicell (sph) nannoplktn	10.00	5,572.45	55,725	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	100.00	1,436.03	143,603	some w/lamellate cell
Taxon Subtotal	**222**		**238,769**	
Chrysophyta				
Mallomonas sp.	1.00	2,110.08	2,110	
Mallomonas sp.	5.00	2,872.05	14,360	
chrysophyte (unicell)	77.00	1,149.76	88,532	
chrysophyte (unicell)	100.00	267.95	26,795	
Bacillariophyceae				
Asterionella formosa	32.00	522.50	16,720	
Fragilaria crotonensis	200.00	675.00	135,000	
Gomphonema sp.	1.00	2,100.00	2,100	
Synedra sp.	3.00	1,758.40	5,275	
Synedra sp.	7.00	824.25	5,770	
Synedra sp.	30.00	90.67	2,720	
Synedra sp.	64.00	199.47	12,766	
Synedra sp.	14.00	370.44	5,186	
Urosolenia (Rhizosolenia) sp.	1.00	6,028.80	6,029	delicate cells
undet pennate diatom	1.00	1,890.00	1,890	
Taxon Subtotal	**536**		**325,253**	
Cryptophyta				
Cryptomonas spp.	16.00	2,000.18	32,003	assoc w/detritus
cryptomonad	20.00	1,036.20	20,724	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
Taxon Subtotal	**69**		**58,413**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	1,582.56	1,583	tiny cell;thecal plates obscure
Taxon Subtotal	**1.00**		**1,583**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,028**	**Total Volume**	**624,553**	**0.625**
Percent Cyanophyta	**19.46**	Percent Cyanophyta	**0.09**	
Percent Chlorophyta	**21.60**	Percent Chlorophyta	**38.23**	
Percent Chrysophyta	**52.14**	Percent Chrysophyta	**52.08**	
Percent Cryptophyta	**6.71**	Percent Cryptophyta	**9.35**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.10**	Percent Pyrrhophyta	**0.25**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/9/2013 | **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) | **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	100.00	2.68	268	cells<2um;irreg,clathrate col
Taxon Subtotal	**100**		**268**	
Chlorophyta				
Oocystis sp.	1.00	593.46	593	
* *Scenedesmus bijuga*	4.00	167.47	670	2 cell colony
* *Scenedesmus bijuga*	1.00	256.43	256	4 cell colony
Schroederia/Ankyra spp. Grp (tenta)	10.00	150.72	1,507	cells deteriorated
undet filamentous green	4.00	1,962.50	7,850	
colonial nannoplankton (sph)	8.00	1,436.03	11,488	
unicell (sph) nannoplktn	2.00	9,198.11	18,396	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	4.00	3,052.08	12,208	
unicell (sph) nannoplktn	55.00	1,436.03	78,981	some w/lamellate cell
Taxon Subtotal	**89**		**131,951**	
Chrysophyta				
Mallomonas sp.	2.00	1,808.64	3,617	
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Asterionella formosa	24.00	522.50	12,540	
Fragilaria crotonensis	250.00	675.00	168,750	
Synedra sp.	2.00	2,260.80	4,522	
Synedra sp.	2.00	199.47	399	
Synedra sp.	1.00	437.79	438	
Synedra sp.	1.00	1,177.50	1,178	
Taxon Subtotal	**359**		**231,475**	
Cryptophyta				
Cryptomonas spp.	11.00	2,000.18	22,002	assoc w/detritus
cryptomonad	8.00	1,036.20	8,290	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	55.00	172.29	9,476	assoc w/detritus
Taxon Subtotal	**74**		**39,768**	
Euglenophyta				
Pyrrhophyta				
Peridinium inconspicuum	2.00	1,582.56	3,165	tiny-cell
small dinoflagellate	2.00	6,857.76	13,716	small cell;thecal plates obscure
dinoflagellate	1.00	17,803.80	17,804	
Taxon Subtotal	**5.00**		**34,684**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**627**	**Total Volume**	**438,146**	**0.438**
Percent Cyanophyta	**15.95**	Percent Cyanophyta	**0.06**	
Percent Chlorophyta	**14.19**	Percent Chlorophyta	**30.12**	
Percent Chrysophyta	**57.26**	Percent Chrysophyta	**52.83**	
Percent Cryptophyta	**11.80**	Percent Cryptophyta	**9.08**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.80**	Percent Pyrrhophyta	**7.92**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/10/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
Ankistrodesmus falcatus	1.00	182	182	
Coelastrum microporum	16.00	267.95	4,287	
Oocystis sp.	1.00	2,051.47	2,051	unicells>20um
Oocystis sp.	1.00	1,013.17	1,013	single cells
Oocystis sp.	8.00	635.85	5,087	
Schroederia/Ankyra spp. grp	10.00	150.72	1,507	cells deteriorated
Schroederia/Ankyra spp. grp	1.00	222.55	223	
colonial nannoplankton (sph)	16.00	1,149.76	18,396	
unicell (sph) nannoplktn	5.00	5,572.45	27,862	cell>20um
unicell (sph) nannoplktn	10.00	3,052.08	30,521	
unicell (sph) nannoplktn	66.00	1,436.03	94,778	some w/lamellate cell
Taxon Subtotal	**135**		**185,908**	
Chrysophyta				
Mallomonas sp.	10.00	1,139.82	11,398	
chrysophyte (unicell)	33.00	1,149.76	37,942	
chrysophyte (unicell)	110.00	267.95	29,474	
Bacillariophyceae				
Asterionella formosa	40.00	562.69	22,508	
Fragilaria sp.	10.00	630.00	6,300	
Synedra sp.	5.00	2,826.00	14,130	
Synedra sp.	11.00	1,695.60	18,652	
Synedra sp.	2.00	126.93	254	
Synedra sp.	4.00	370.44	1,482	
undet pennate diatom	2.00	238.12	476	naviculoid cell
Taxon Subtotal	**227**		**142,616**	
Cryptophyta				
Cryptomonas spp.	14.00	2,000.18	28,003	assoc w/detritus
Cryptomonas sp.	1.00	5,652.00	5,652	assoc w/detritus
cryptomonad	30.00	1,036.20	31,086	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	275.00	172.29	47,380	assoc w/detritus
Taxon Subtotal	**320**		**112,121**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**682**	**Total Volume**	**440,644**	**0.441**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**19.79**	Percent Chlorophyta	**42.19**	
Percent Chrysophyta	**33.28**	Percent Chrysophyta	**32.37**	
Percent Cryptophyta	**46.92**	Percent Cryptophyta	**25.44**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/10/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
Ankistrodesmus falcatus	1.00	182	182	
Oocystis sp.	1.00	2,051.47	2,051	large unicells>20um
Oocystis sp.	8.00	1,013.17	8,105	
* *Pediastrum tetras*	2.00	2,653.30	5,307	small col<25um diam
* *Scenedesmus bijuga*	1.00	508.68	509	4-cell colony
* *Scenedesmus bijuga flexuosus*	2.00	2,373.84	4,748	robust 16+cell colony
Schroederia/Ankyra spp. Grp(tenta)	10.00	150.72	1,507	cells deteriorated
undet colonial desmid	4.00	1,465.33	5,861	linear colony of robust ovate cells
colonial nannoplankton (ell)	16.00	169.56	2,713	
colonial nannoplankton (sph)	64.00	87.07	5,572	
* colonial nannoplankton (sph)	5.00	9,905.65	49,528	dense ovoid col; Pandorina?
unicell (sph) nannoplktn	44.00	1,436.03	63,185	some w/lamellate cell
Taxon Subtotal	**168**		**150,238**	
Chrysophyta				
Mallomonas sp.	11.00	1,657.92	18,237	
Mallomonas sp.	3.00	2,666.91	8,001	
chrysophyte (unicell)	33.00	1,149.76	37,942	
chrysophyte (unicell)	100.00	267.95	26,795	
Bacillariophyceae				
Asterionella formosa	16.00	562.69	9,003	
Cyclotella sp.	1.00	2,009.60	2,010	
Synedra sp.	1.00	1,884.00	1,884	
Synedra sp.	4.00	211.56	846	
Taxon Subtotal	**169**		**104,718**	
Cryptophyta				
Cryptomonas spp.	13.00	2,000.18	26,002	assoc w/detritus
cryptomonad	18.00	1,036.20	18,652	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	242.00	172.29	41,695	assoc w/detritus
Taxon Subtotal	**273**		**86,349**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	2.00	6,857.76	13,716	small cell;thecal plates obscure
Taxon Subtotal	**2.00**		**13,716**	
Undetermined				
undeter unicell	1.00	18,840.00	18,840	dense cell<40um diam
Taxon Subtotal	**1.00**		**18,840**	

			(um3/ml)	(mm3/L)
Total Number/ml	**613**	**Total Volume**	**373,860**	**0.374**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**27.41**	Percent Chlorophyta	**40.19**	
Percent Chrysophyta	**27.57**	Percent Chrysophyta	**28.01**	
Percent Cryptophyta	**44.54**	Percent Cryptophyta	**23.10**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.33**	Percent Pyrrhophyta	**3.67**	
Percent Undetermined	**0.16**	Percent Undetermined	**5.04**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/10/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL5 (0.5m) **NOTE: many empty diatom frustules**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
* *Pediastrum tetras*	1.00	1,271.70	1,272	small col<20um diam
* *Scenedesmus bijuga*	3.00	256.43	769	4-cell colony
* *Scenedesmus quadricauda*	1.00	937.81	938	8-cell colony
Schroederia/Ankyra spp. Grp (tenta)	10.00	150.72	1,507	cells deteriorated
unicell (sph) nannoplktn	1.00	4,186.67	4,187	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**36**		**24,002**	
Chrysophyta				
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	66.00	267.95	17,684	
Bacillariophyceae				
Cocconeis sp.	5.00	1,208.90	6,045	
Cocconeis sp.	5.00	2,355.00	11,775	
Cyclotella sp.	8.00	5,319.16	42,553	
Cyclotella sp.	1.00	8,616.16	8,616	
Gomphonema sp.	4.00	1,470.00	5,880	
Melosira varians	8.00	9,420.00	75,360	large cell
Navicula sp.	10.00	612.30	6,123	
Navicula sp.	5.00	1,281.12	6,406	
Navicula sp.	1.00	3,140.00	3,140	
Nitzschia sp.	2.00	439.60	879	
Synedra ulna	15.00	7,056.00	105,840	
Synedra sp.	1.00	3,736.60	3,737	
Synedra sp.	15.00	2,313.13	34,697	
Synedra sp.	10.00	90.67	907	
Synedra sp.	2.00	211.56	423	
undet pennate diatom	22.00	117.75	2,591	naviculoid cell
undet pennate diatom	22.00	1,764.00	38,808	
undet pennate diatom	22.00	1,632.80	35,922	naviculoid cell
Taxon Subtotal	**246**		**432,680**	
Cryptophyta				
cryptomonad	2.00	1,036.20	2,072	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	44.00	172.29	7,581	assoc w/detritus
Taxon Subtotal	**46**		**9,653**	
Euglenophyta				
Pyrrhophyta				
Undetermined				
undeter unicell	1.00	11,488.21	11,488	dense cell<30um diam
Taxon Subtotal	**1.00**		**11,488**	

			(um3/ml)	(mm3/L)
Total Number/ml	**329**	**Total Volume**	**477,823**	**0.478**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**10.94**	Percent Chlorophyta	**5.02**	
Percent Chrysophyta	**74.77**	Percent Chrysophyta	**90.55**	
Percent Cryptophyta	**13.98**	Percent Cryptophyta	**2.02**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.30**	Percent Undetermined	**2.40**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/24/2013
STATION: Lk Spokane-LL0 (0.5m)

SAMPLE STATUS: Lugol preserved
NOTE:

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	100.00	47.69	4,769	cells<5um;aerotopes?;ovate col;lt col muc
Anacystis (Aphanothece/Anathece)spp.	800.00	2.68	2,144	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	1.00	400.59	401	threadlike fil<3um width;no sheath
Taxon Subtotal	**901**		**7,313**	
Chlorophyta				
Coelastrum microporum	8.00	267.95	2,144	
Crucigenia irregularis/rectangularis asmblg	4.00	174.14	697	
Dictyosphaerium sp.	8.00	87.07	697	
Nephrocytium sp.	8.00	2,051.47	16,412	
Oocystis sp.	10.00	1,507.20	15,072	single cells>20um
Oocystis sp.	22.00	1,013.17	22,290	
Oocystis sp.	12.00	593.46	7,122	
* *Pediastrum boryanum*	1.00	10,257.33	10,257	
Quadrigula sp.	14.00	253.29	3,546	
* *Scenedesmus bijuga*	1.00	256.43	256	4 cell colony
* *Scenedesmus bijuga*	1.00	1,186.92	1,187	8-cell colony
* *Scenedesmus bijuga flexuosus*	2.00	2,034.72	4,069	8-16-cell colony
undet colonial desmid	14.00	1,256.00	17,584	linear col of 16+robust ovate cells
colonial nannoplankton (sph)	256.00	150.46	38,517	
unicell (sph) nannoplktn	55.00	4,186.67	230,267	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	165.00	904.32	149,213	some w/lamellate cell
Taxon Subtotal	**581**		**519,328**	
Chrysophyta				
Dinobryon sp.	80.00	502.40	40,192	deterior cells
chrysophyte (unicell)	66.00	1,149.76	75,884	
chrysophyte (unicell)	100.00	267.95	26,795	
chrysophyte (unicell)	1.00	4,408.56	4,409	ellip cells
Bacillariophyceae				
Amphora sp.	2.00	8,082	16,165	
Asterionella formosa	176.00	602.88	106,107	
Fragilaria crotonensis	4,330.00	600.00	2,598,000	
Fragilaria crotonensis	1,470.00	787.50	1,157,625	
Gomphonema sp.	1.00	1,470.00	1,470	
Pinnularia sp.	1.00	5,385.10	5,385	
Synedra sp.	5.00	126.93	635	
Synedra sp.	20.00	199.47	3,989	
Synedra sp.	3.00	535.76	1,607	
Taxon Subtotal	**6255**		**4,038,263**	
Cryptophyta				
Cryptomonas spp.	1.00	2,000.18	2,000	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	22.00	172.29	3,790	assoc w/detritus
Taxon Subtotal	**23**		**5,791**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	9.00	5,388.24	48,494	small cell;thecal plates obscure
Taxon Subtotal	**9.00**		**48,494**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**7,769**	**Total Volume**	**4,619,189**	**4.619**
Percent Cyanophyta	**11.60**	Percent Cyanophyta	**0.16**	
Percent Chlorophyta	**7.48**	Percent Chlorophyta	**11.24**	
Percent Chrysophyta	**80.51**	Percent Chrysophyta	**87.42**	
Percent Cryptophyta	**0.30**	Percent Cryptophyta	**0.13**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.12**	Percent Pyrrhophyta	**1.05**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/24/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	2,500.00	2.68	6,699	cells<2um;irreg,clathrate col
Taxon Subtotal	**2,500**		**6,699**	
Chlorophyta				
* *Botryococcus sp.*	2.00	8,205.87	16,412	small col<40um diam
Crucigenia irregularis/rectangularis asmblg	48.00	174.14	8,359	
Oocystis sp.	2.00	7,092.21	14,184	large,unicells>20um
Oocystis sp.	1.00	1,013.17	1,013	
Quadrigula sp.	16.00	253.29	4,053	
* *Scenedesmus bijuga flexuosus*	4.00	3,768.00	15,072	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	5.00	1,172.27	5,861	8-16 cell colony
colonial nannoplankton (sph)	240.00	150.46	36,109	
colonial nannoplankton (sph)	64.00	1,149.76	73,585	
unicell (sph) nannoplktn	12.00	11,488.21	137,859	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
unicell (sph) nannoplktn	10.00	4,186.67	41,867	some w/lamellate cell
Taxon Subtotal	**414**		**368,734**	
Chrysophyta				
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Asterionella formosa	72.00	522.50	37,620	
Fragilaria crotonensis	420.00	600.00	252,000	
Fragilaria crotonensis	400.00	787.50	315,000	
Gomphonema sp.	2.00	2,100.00	4,200	
Taxon Subtotal	**971**		**648,852**	
Cryptophyta				
Cryptomonas spp.	4.00	2,000.18	8,001	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	22.00	172.29	3,790	assoc w/detritus
Taxon Subtotal	**26**		**11,791**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	1,582.56	1,583	tiny cell;thecal plates obscure
small dinoflagellate	5.00	6,857.76	34,289	small cell;thecal plates obscure
Taxon Subtotal	**6.00**		**35,871**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**3,917**	**Total Volume**	**1,071,947**	**1.072**
Percent Cyanophyta	**63.82**	Percent Cyanophyta	**0.62**	
Percent Chlorophyta	**10.57**	Percent Chlorophyta	**34.40**	
Percent Chrysophyta	**24.79**	Percent Chrysophyta	**60.53**	
Percent Cryptophyta	**0.66**	Percent Cryptophyta	**1.10**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.15**	Percent Pyrrhophyta	**3.35**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/24/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	800.00	2.68	2,144	cells<2um;irreg,clathrate col
Taxon Subtotal	**800**		**2,144**	
Chlorophyta				
Crucigenia irregularis/rectangularis asmblg	32.00	174.14	5,572	
Nephrocytium sp.	8.00	615.44	4,924	
Nephrocytium sp.	4.00	4,747.68	18,991	
Oocystis sp.	36.00	1,013.17	36,474	
Oocystis sp.	18.00	593.46	10,682	
* *Pediastrum boryanum*	1.00	2,564.33	2,564	
* *Pediastrum boryanum*	1.00	5,769.75	5,770	
* *Pediastrum boryanum*	1.00	23,079.00	23,079	large col<100um diam
Quadrigula sp.	52.00	253.29	13,171	
* *Scenedesmus bijuga*	2.00	256.43	513	4 cell colony
* *Scenedesmus bijuga flexuosus*	10.00	1,172.27	11,723	12-16cell colony
* *Scenedesmus bijuga flexuosus*	2.00	5,425.92	10,852	robust 16+cell colony
Schroederia/Ankyra spp. Grp (tenta)	10.00	150.72	1,507	cells deteriorated
undet colonial desmid	56.00	1,256.00	70,336	linear colony of robust ovate cells
colonial nannoplankton (sph)	640.00	267.95	171,486	
unicell (sph) nannoplktn	1.00	20,569.09	20,569	cell>25um
unicell (sph) nannoplktn	2.00	4,186.67	8,373	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	40.00	1,436.03	57,441	some w/lamellate cell
Taxon Subtotal	**916**		**474,027**	
Chrysophyta				
chrysophyte (unicell)	5.00	4,186.67	20,933	cell>20um
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	44.00	267.95	11,790	
chrysophyte (unicell)	10.00	1,046.67	10,467	ellip cells<30um
Bacillariophyceae				
Asterionella formosa	24.00	482.30	11,575	
Fragilaria crotonensis	1,600.00	600.00	960,000	
Fragilaria crotonensis	330.00	787.50	259,875	
Synedra sp.	12.00	199.47	2,394	
Synedra sp.	1.00	706.50	707	
undet pennate diatom	1.00	628.00	628	naviculoid cell
Taxon Subtotal	**2049**		**1,303,663**	
Cryptophyta				
Cryptomonas spp.	32.00	2,000.18	64,006	assoc w/detritus
cryptomonad	20.00	1,036.20	20,724	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	165.00	172.29	28,428	assoc w/detritus
Taxon Subtotal	**217**		**113,158**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	2.00	1,055.04	2,110	tiny cell;thecal plates obscure
small dinoflagellate	2.00	6,857.76	13,716	small cell;thecal plates obscure
Taxon Subtotal	**4.00**		**15,826**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**3,986**	**Total Volume**	**1,908,817**	**1.909**
Percent Cyanophyta	**20.07**	Percent Cyanophyta	**0.11**	
Percent Chlorophyta	**22.98**	Percent Chlorophyta	**24.83**	
Percent Chrysophyta	**51.40**	Percent Chrysophyta	**68.30**	
Percent Cryptophyta	**5.44**	Percent Cryptophyta	**5.93**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.10**	Percent Pyrrhophyta	**0.83**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/25/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	600.00	2.68	1,608	cells<2um;irreg,clathrate col
Taxon Subtotal	**600**		**1,608**	
Chlorophyta				
* *Botryococcus sp.*	1.00	418,666.67	418,667	mod col-100um diam
Cosmarium sp.	1.00	1,526.04	1,526	
Crucigenia irregularis/rectangularis asmblg	32.00	174.14	5,572	
Nephrocytium sp.	2.00	1,046.67	2,093	
Oocystis sp.	20.00	1,013.17	20,263	
Oocystis sp.	44.00	635.85	27,977	
* *Pediastrum boryanum*	3.00	2,564.33	7,693	small col<28um
Quadrigula sp.	8.00	253.29	2,026	
* *Scenedesmus bijuga*	4.00	256.43	1,026	4-cell colony
* *Scenedesmus bijuga flexuosus*	16.00	5,425.92	86,815	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	42.00	1,172.27	49,235	12-16-cell colony
Schroederia/Ankyra spp. grp	5.00	150.72	754	cells deteriorated
undet colonial desmid	98.00	1,256.00	123,088	linear colony of robust ovate cells
colonial nannoplankton (ell)	16.00	84.78	1,356	
colonial nannoplankton (sph)	160.00	150.46	24,073	
colonial nannoplankton (sph)	64.00	1,436.03	91,906	
unicell (sph) nannoplktn	4.00	4,186.67	16,747	
unicell (sph) nannoplktn	60.00	1,436.03	86,162	some w/lamellate cell
Taxon Subtotal	**580**		**966,979**	
Chrysophyta				
Mallomonas sp.	1.00	3,215.36	3,215	
chrysophyte (unicell)	5.00	4,186.67	20,933	cell>20um
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Fragilaria crotonensis	800.00	600.00	480,000	
Fragilaria crotonensis	200.00	787.50	157,500	
Gomphonema sp.	2.00	1,470.00	2,940	
Navicula sp.	1.00	345.40	345	
Synedra sp.	1.00	1,695.60	1,696	
Synedra sp.	1.00	211.56	212	
Synedra sp.	1.00	370.44	370	
undet pennate diatom	1.00	309.55	310	naviculoid cell
Taxon Subtotal	**1090**		**707,553**	
Cryptophyta				
Cryptomonas spp.	56.00	2,000.18	112,010	assoc w/detritus
cryptomonad	54.00	1,036.20	55,955	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	154.00	172.29	26,533	assoc w/detritus
Taxon Subtotal	**264**		**194,498**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	1,055.04	1,055	tiny cell;thecal plates obscure
small dinoflagellate	2.00	5,388.24	10,776	small cell;thecal plates obscure
Taxon Subtotal	**3.00**		**11,832**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**2,537**	**Total Volume**	**1,882,470**	**1.882**
Percent Cyanophyta	**23.65**	Percent Cyanophyta	**0.09**	
Percent Chlorophyta	**22.86**	Percent Chlorophyta	**51.37**	
Percent Chrysophyta	**42.96**	Percent Chrysophyta	**37.59**	
Percent Cryptophyta	**10.41**	Percent Cryptophyta	**10.33**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.12**	Percent Pyrrhophyta	**0.63**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/25/2013
STATION: Lk Spokane-LL4 (0.5m)

SAMPLE STATUS: Lugol preserved
NOTE:

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	200.00	2.68	536	cells<2um;irreg,clathrate col
Taxon Subtotal	**200**		**536**	
Chlorophyta				
Cosmarium sp.	1.00	4,599.05	4,599	
Nephrocytium sp.	6.00	1,507.20	9,043	
Kirchneriella/Nephrocytium spp.asmblg	8.00	183.17	1,465	
Oocystis sp.	8.00	2,051.47	16,412	large unicells>20um
Oocystis sp.	8.00	1,013.17	8,105	
Oocystis sp.	32.00	226.08	7,235	
* *Pediastrum boryanum*	1.00	10,257.33	10,257	
* *Scenedesmus bijuga*	1.00	593.46	593	4-cell colony
* *Scenedesmus bijuga flexuosus*	15.00	5,425.92	81,389	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	80.00	1,172.27	93,781	12-16-cell colony
Schroederia/Ankyra spp. Grp(tenta)	33.00	150.72	4,974	cells deteriorated
undet colonial desmid	154.00	1,256.00	193,424	linear colony of robust ovate cells
colonial nannoplankton (ell)	16.00	143.92	2,303	stellate colony
colonial nannoplankton (sph)	800.00	150.46	120,365	
colonial nannoplankton (sph)	24.00	1,436.03	34,465	
unicell (sph) nannoplktn	50.00	904.32	45,216	some w/lamellate cell
Taxon Subtotal	**1,237**		**633,626**	
Chrysophyta				
chrysophyte (unicell)	33.00	1,149.76	37,942	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Fragilaria crotonensis	75.00	600.00	45,000	
Taxon Subtotal	**163**		**97,679**	
Cryptophyta				
Cryptomonas spp.	28.00	2,000.18	56,005	assoc w/detritus
Cryptomonas sp.	1.00	5,652.00	5,652	
cryptomonad	30.00	1,036.20	31,086	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	264.00	172.29	45,485	assoc w/detritus
Taxon Subtotal	**323**		**138,228**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,923**	**Total Volume**	**870,069**	**0.870**
Percent Cyanophyta	**10.40**	Percent Cyanophyta	**0.06**	
Percent Chlorophyta	**64.33**	Percent Chlorophyta	**72.82**	
Percent Chrysophyta	**8.48**	Percent Chrysophyta	**11.23**	
Percent Cryptophyta	**16.80**	Percent Cryptophyta	**15.89**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 7/25/2013
STATION: Lk Spokane-LL5 (0.5m)

SAMPLE STATUS: Lugol preserved
NOTE: many empty diatom frustules

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	200.00	47.69	9,538	cells<5um;aerotopes?;ovate col;lt col muc
Anacystis (Aphanothece/Anathece)spp.	1,500.00	2.68	4,019	cells<2um;irreg,clathrate col
Taxon Subtotal	**1,700**		**13,557**	
Chlorophyta				
Ankistrodesmus falcatus	1.00	114	114	
Crucigenia irregularis/rectangularis asmblg	48.00	174.14	8,359	
Nephrocytium sp.	8.00	1,507.20	12,058	
Oocystis sp.	12.00	1,013.17	12,158	
Oocystis sp.	20.00	593.46	11,869	
* *Pediastrum boryanum*	3.00	4,710.00	14,130	
* *Pediastrum boryanum*	1.00	20,771.10	20,771	mod col<100um diam
* *Pediastrum tetras*	4.00	1,570.00	6,280	small col<28um diam
Quadrigula sp.	2.00	253.29	507	
* *Scenedesmus bijuga*	5.00	508.68	2,543	4-cell colony
* *Scenedesmus bijuga flexuosus*	30.00	5,425.92	162,778	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	50.00	1,172.27	58,613	12-16-cell colony
* *Scenedesmus quadricauda*	1.00	334.93	335	4-cell colony
Schroederia/Ankyra spp. grp (tenta)	20.00	150.72	3,014	cells deteriorated
Schroederia/Ankyra spp. grp	5.00	366.33	1,832	
Staurastrum sp.(tri)	1.00	9,494.24	9,494	triangular semi-cells
undet colonial desmid	77.00	1,256.00	96,712	linear colony of robust ovate cells
colonial nannoplankton (ell)	40.00	143.92	5,757	
colonial nannoplankton (sph)	800.00	150.46	120,365	
colonial nannoplankton (sph)	80.00	1,436.03	114,882	
unicell (sph) nannoplktn	2.00	11,488.21	22,976	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	50.00	904.32	45,216	some w/lamellate cell
Taxon Subtotal	**1,260**		**730,763**	
Chrysophyta				
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	44.00	267.95	11,790	
chrysophyte (unicell)	10.00	1,266.47	12,665	ellip cells
Bacillariophyceae				
Cyclotella sp.	1.00	678.24	678	tiny cells-12 um diam
Fragilaria sp.	75.00	540.00	40,500	
Fragilaria crotonensis	30.00	600.00	18,000	
Gomphonema sp.	5.00	1,470.00	7,350	
Aulacoseira/Melosira spp.complex	2.00	1,077.02	2,154	
Melosira varians	2.00	9,420.00	18,840	large cell
Navicula sp.	1.00	870.41	870	
Nitzschia sp.	1.00	329.70	330	
Synedra sp.	3.00	1,957.27	5,872	
Synedra sp.	1.00	126.93	127	
Synedra sp.	1.00	211.56	212	
Tabellaria fenestrata	2.00	6,720.00	13,440	
Taxon Subtotal	**200**		**158,122**	
Cryptophyta				
Cryptomonas spp.	100.00	2,000.18	200,018	assoc w/detritus
cryptomonad	40.00	1,036.20	41,448	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	220.00	172.29	37,904	assoc w/detritus
Taxon Subtotal	**360**		**279,370**	
Euglenophyta				
Euglena sp.	1.00	17,232.32	17,232	
Taxon Subtotal	**1**		**17,232**	
Pyrrhophyta				
Undetermined				
undeter unicell	1.00	7,121.52	7,122	ovate cell<40umw/term spines
Taxon Subtotal	**1.00**		**7,122**	

			(um3/ml)	(mm3/L)
Total Number/ml	**3,522**	**Total Volume**	**1,206,166**	**1.206**
Percent Cyanophyta	**48.27**	Percent Cyanophyta	**1.12**	
Percent Chlorophyta	**35.78**	Percent Chlorophyta	**60.59**	
Percent Chrysophyta	**5.68**	Percent Chrysophyta	**13.11**	
Percent Cryptophyta	**10.22**	Percent Cryptophyta	**23.16**	
Percent Euglenophyta	**0.03**	Percent Euglenophyta	**1.43**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.03**	Percent Undetermined	**0.59**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/5/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL0 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	1,000.00	2.68	2,679	cells<2um;irreg,clathrate col
Taxon Subtotal	**1,000**		**2,679**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
Crucigenia irregularis/rectangularis asmblg	40.00	174.14	6,966	
Oocystis sp.	2.00	1,013.17	2,026	
Oocystis sp.	2.00	4,747.68	9,495	large unicells>30um
Oocystis sp.	12.00	593.46	7,122	
Oocystis sp.	12.00	226.08	2,713	
* *Pediastrum boryanum*	1.00	5,769.75	5,770	
* *Scenedesmus bijuga*	3.00	1,134.75	3,404	8-cell colony
* *Scenedesmus bijuga flexuosus*	7.00	2,373.84	16,617	12-16-cell colony
Schroederia/Ankyra spp. grp (tenta)	5.00	150.72	754	cells deteriorated
Tetraedron minimum	1.00	784.00	784	
undet colonial desmid	95.00	1,256.00	119,320	linear col of 16+robust ovate cells
colonial nannoplankton (sph)	24.00	448.69	10,769	
colonial nannoplankton (sph)	200.00	150.46	30,091	
unicell (sph) nannoplktn	30.00	4,186.67	125,600	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	55.00	904.32	49,738	some w/lamellate cell
Taxon Subtotal	**499**		**392,137**	
Chrysophyta				
Dinobryon sociale(tenta)	35.00	785.00	27,475	deterior cells
Mallomonas sp.	4.00	2,666.91	10,668	
chrysophyte (unicell)	1.00	4,186.67	4,187	cell>20um
chrysophyte (unicell)	10.00	1,149.76	11,498	
chrysophyte (unicell)	100.00	267.95	26,795	
Bacillariophyceae				
Asterionella formosa	4.00	602.88	2,412	
Cymbella sp.	1.00	5,744.11	5,744	
Fragilaria crotonensis	500.00	600.00	300,000	
Fragilaria crotonensis	550.00	787.50	433,125	
Gomphonema sp.	1.00	1,470.00	1,470	
Aulacoseira/Melosira spp.complex	6.00	490.63	2,944	slender cells
Synedra sp.	3.00	126.93	381	
Synedra sp.	2.00	336.77	674	
Synedra sp.	1.00	535.76	536	
Taxon Subtotal	**1218**		**827,906**	
Cryptophyta				
Cryptomonas spp.	5.00	2,000.18	10,001	assoc w/detritus
cryptomonad	10.00	1,036.20	10,362	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	55.00	172.29	9,476	assoc w/detritus
Taxon Subtotal	**70**		**29,839**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	2.00	2,260.80	4,522	tiny cell;thecal plates obscure
small dinoflagellate	3.00	5,388.24	16,165	small cell;thecal plates obscure
Taxon Subtotal	**5.00**		**20,686**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**2,792**	**Total Volume**	**1,273,247**	**1.273**
Percent Cyanophyta	**35.82**	Percent Cyanophyta	**0.21**	
Percent Chlorophyta	**17.87**	Percent Chlorophyta	**30.80**	
Percent Chrysophyta	**43.62**	Percent Chrysophyta	**65.02**	
Percent Cryptophyta	**2.51**	Percent Cryptophyta	**2.34**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.18**	Percent Pyrrhophyta	**1.62**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/5/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	7,000.00	2.68	18,756	cells<2um;irreg,clathrate col
Taxon Subtotal	**7,000**		**18,756**	
Chlorophyta				
Crucigenia irregularis/rectangularis asmblg	220.00	174.14	38,311	
Oocystis sp.	1.00	2,355.00	2,355	large unicells>20um
Oocystis sp.	16.00	105.98	1,696	
* *Pediastrum boryanum*	1.00	5,769.75	5,770	small col<40um diam
* *Scenedesmus bijuga*	4.00	937.81	3,751	8-cell colony
* *Scenedesmus bijuga flexuosus*	8.00	4,559.28	36,474	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	20.00	1,406.72	28,134	12-16 cell colony
Schroederia/Ankyra spp. grp (tenta)	10.00	150.72	1,507	deterior cells
colonial nannoplankton (ell)	32.00	334.93	10,718	cells>10um length
colonial nannoplankton (sph)	176.00	381.51	67,146	
colonial nannoplankton (sph)	672.00	150.46	101,107	
colonial nannoplankton (sph)	16.00	1,149.76	18,396	
unicell (sph) nannoplktn	30.00	1,436.03	43,081	some w/lamellate cell
unicell (sph) nannoplktn	2.00	4,186.67	8,373	some w/lamellate cell
Taxon Subtotal	**1,208**		**366,819**	
Chrysophyta				
Dinobryon sociale(tenta)	60.00	785.00	47,100	deterior cells
Mallomonas sp.	2.00	1,507.20	3,014	
Rhizochrysis sp.	2.00	7,075.47	14,151	
chrysophyte (unicell)	10.00	1,149.76	11,498	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Fragilaria crotonensis	160.00	600.00	96,000	
Fragilaria crotonensis	160.00	787.50	126,000	
Taxon Subtotal	**449**		**312,500**	
Cryptophyta				
Cryptomonas spp.	5.00	2,000.18	10,001	assoc w/detritus
cryptomonad	16.00	1,036.20	16,579	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	44.00	172.29	7,581	assoc w/detritus
Taxon Subtotal	**65**		**34,161**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	3.00	2,260.80	6,782	tiny cell;thecal plates obscure
small dinoflagellate	3.00	5,388.24	16,165	small cell;thecal plates obscure
Taxon Subtotal	**6.00**		**22,947**	
Undetermined				

			(um3/ml)	**(mm3/L)**
Total Number/ml	**8,728**	**Total Volume**	**755,183**	**0.755**
Percent Cyanophyta	**80.20**	Percent Cyanophyta	**2.48**	
Percent Chlorophyta	**13.84**	Percent Chlorophyta	**48.57**	
Percent Chrysophyta	**5.14**	Percent Chrysophyta	**41.38**	
Percent Cryptophyta	**0.74**	Percent Cryptophyta	**4.52**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.07**	Percent Pyrrhophyta	**3.04**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/5/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	3,000.00	2.68	8,038	cells<2um;irreg,clathrate col
Taxon Subtotal	**3,000**		**8,038**	
Chlorophyta				
Ankistrodesmus falcatus	5.00	97	484	cells deteriorated
Crucigenia irregularis/rectangularis asmblg	144.00	174.14	25,076	
Oocystis sp.	5.00	2,355.00	11,775	single cells
Oocystis sp.	6.00	1,013.17	6,079	
Oocystis sp.	1.00	7,598.80	7,599	large unicells>30um
Oocystis sp.	4.00	226.08	904	
Quadrigula sp.	4.00	253.29	1,013	
* *Scenedesmus bijuga*	2.00	937.81	1,876	8-cell colony
* *Scenedesmus bijuga flexuosus*	30.00	1,406.72	42,202	12-16cell colony
* *Scenedesmus bijuga flexuosus*	10.00	5,425.92	54,259	robust 16+cell colony
Schroederia/Ankyra spp. asmblg (tenta)	5.00	150.72	754	cells deteriorated
undet colonial desmid	135.00	1,256.00	169,560	linear colony of robust ovate cells
colonial nannoplankton (ell)	16.00	95.38	1,526	
colonial nannoplankton (sph)	640.00	150.46	96,292	
colonial nannoplankton (sph)	48.00	904.32	43,407	
unicell (sph) nannoplktn	22.00	1,436.03	31,593	some w/lamellate cell
Taxon Subtotal	**1,077**		**494,399**	
Chrysophyta				
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	44.00	267.95	11,790	
Bacillariophyceae				
Fragilaria crotonensis	70.00	600.00	42,000	
Fragilaria crotonensis	50.00	787.50	39,375	
Navicula sp.	1.00	879.20	879	
Synedra sp.	1.00	370.44	370	
Taxon Subtotal	**188**		**119,709**	
Cryptophyta				
Cryptomonas spp.	8.00	2,000.18	16,001	assoc w/detritus
cryptomonad	18.00	1,036.20	18,652	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	44.00	172.29	7,581	assoc w/detritus
Taxon Subtotal	**70**		**42,234**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	1,582.56	1,583	tiny cell;thecal plates obscure
small dinoflagellate	1.00	6,857.76	6,858	small cell;thecal plates obscure
Taxon Subtotal	**2.00**		**8,440**	
Undetermined				
undeter unicell	2.00	16,411.73	32,823	dense cell<40um diam
Taxon Subtotal	**2.00**		**32,823**	

			(um3/ml)	(mm3/L)
Total Number/ml	**4,339**	**Total Volume**	**705,644**	**0.706**
Percent Cyanophyta	**69.14**	Percent Cyanophyta	**1.14**	
Percent Chlorophyta	**24.82**	Percent Chlorophyta	**70.06**	
Percent Chrysophyta	**4.33**	Percent Chrysophyta	**16.96**	
Percent Cryptophyta	**1.61**	Percent Cryptophyta	**5.99**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.05**	Percent Pyrrhophyta	**1.20**	
Percent Undetermined	**0.05**	Percent Undetermined	**4.65**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/6/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	2,000.00	2.68	5,359	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	1.00	801.17	801	threadlike fil<3um width;no sheath
Taxon Subtotal	**2,001**		**6,160**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
Ankistrodesmus falcatus	2.00	182	365	
Cosmarium sp.	2.00	7,630.20	15,260	
Crucigenia irregularis/rectangularis asmblg	80.00	174.14	13,931	
Oocystis sp.	4.00	2,051.47	8,206	unicells>20um
Oocystis sp.	20.00	1,013.17	20,263	
Oocystis sp.	6.00	4,408.56	26,451	cell>20um
* *Pediastrum boryanum*	1.00	5,769.75	5,770	small col<50um
* *Pediastrum boryanum*	1.00	16,027.08	16,027	mod col<100um diam
* *Pediastrum duplex*	1.00	3,461.85	3,462	small col<50um
* *Scenedesmus bijuga*	10.00	937.81	9,378	8-cell colony
* *Scenedesmus bijuga flexuosus*	12.00	5,425.92	65,111	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	60.00	1,289.49	77,370	12-16-cell colony
Schroederia/Ankyra spp. Asmblg	5.00	150.72	754	cells deteriorated
undet colonial desmid	215.00	1,256.00	270,040	linear colony of robust ovate cells
colonial nannoplankton (ell)	16.00	90.08	1,441	
colonial nannoplankton (sph)	320.00	150.46	48,146	
unicell (sph) nannoplktn	1.00	9,198.11	9,198	cell>20um
unicell (sph) nannoplktn	10.00	4,186.67	41,867	
unicell (sph) nannoplktn	40.00	1,436.03	57,441	some w/lamellate cell
Taxon Subtotal	**816**		**691,450**	
Chrysophyta				
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	55.00	267.95	14,737	
chrysophyte (unicell)	4.00	1,657.92	6,632	ellip cells<30um
Bacillariophyceae				
Cyclotella sp.	1.00	4,179.34	4,179	
Fragilaria crotonensis	120.00	600.00	72,000	
Fragilaria crotonensis	120.00	787.50	94,500	
Synedra sp.	1.00	126.93	127	
Taxon Subtotal	**323**		**217,470**	
Cryptophyta				
Cryptomonas spp.	30.00	2,000.18	60,005	assoc w/detritus
cryptomonad	50.00	1,036.20	51,810	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	77.00	172.29	13,266	assoc w/detritus
Taxon Subtotal	**157**		**125,082**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	1.00	1,582.56	1,583	tiny cell;thecal plates obscure
small dinoflagellate	1.00	5,388.24	5,388	small cell;thecal plates obscure
Taxon Subtotal	**2.00**		**6,971**	
Undetermined				
undeter unicell	2.00	28,486.08	56,972	dense ovate cell<40um diam
Taxon Subtotal	**2.00**		**56,972**	

			(um3/ml)	(mm3/L)
Total Number/ml	**3,301**	**Total Volume**	**1,104,105**	**1.104**
Percent Cyanophyta	**60.62**	Percent Cyanophyta	**0.56**	
Percent Chlorophyta	**24.72**	Percent Chlorophyta	**62.63**	
Percent Chrysophyta	**9.78**	Percent Chrysophyta	**19.70**	
Percent Cryptophyta	**4.76**	Percent Cryptophyta	**11.33**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.06**	Percent Pyrrhophyta	**0.63**	
Percent Undetermined	**0.06**	Percent Undetermined	**5.16**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/6/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	4,000.00	2.68	10,718	cells<2um;irreg,clathrate col
Taxon Subtotal	**4,000**		**10,718**	
Chlorophyta				
Ankistrodesmus falcatus	5.00	182	912	
Coelastrum sp.	32.00	904.32	28,938	
* *Coelastrum sp.*	10.00	4,186.67	41,867	small col<20um diam
Crucigenia irregularis/rectangularis asmblg	64.00	174.14	11,145	
Eudorina sp.	64.00	523.33	33,493	
Kirchneriella sp.	4.00	50	201	
Oocystis sp.	22.00	2,051.47	45,132	large unicells>20um
Oocystis sp.	60.00	1,013.17	60,790	
Oocystis sp.	40.00	226.08	9,043	
* *Pandorina /Eudorina spp asmblg.*	10.00	3,349.33	33,493	compres cells;col<20um
* *Pediastrum boryanum*	1.00	16,027.08	16,027	
* *Scenedesmus quadricauda*	11.00	628.00	6,908	4-cell colony
* *Scenedesmus quadricauda*	1.00	5,861.33	5,861	robust 4-cell colony
* *Scenedesmus bijuga*	40.00	1,465.33	58,613	8-cell colony
* *Scenedesmus bijuga flexuosus*	77.00	5,425.92	417,796	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	250.00	1,289.49	322,373	12-16-cell colony
Schroederia/Ankyra spp. asmblg(tenta)	20.00	150.72	3,014	cells deteriorated
Schroederia/Ankyra spp. asmblg	2.00	797.87	1,596	
Schroederia/Ankyra spp. asmblg(tenta)	1.00	1,483.65	1,484	cell>70um
undet colonial desmid	532.00	1,256.00	668,192	linear colony of robust ovate cells
colonial nannoplankton (sph)	80.00	523.33	41,867	
colonial nannoplankton (sph)	480.00	150.46	72,219	
unicell (sph) nannoplktn	5.00	11,488.21	57,441	cell>25um
unicell (sph) nannoplktn	10.00	4,186.67	41,867	cell>20um
unicell (sph) nannoplktn	110.00	904.32	99,475	some w/lamellate cell
Taxon Subtotal	**1,931**		**2,079,748**	
Chrysophyta				
Mallomonas sp.	1.00	4,823.04	4,823	
Mallomonas sp.	1.00	2,666.91	2,667	
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Fragilaria crotonensis	1,040.00	600.00	624,000	
Fragilaria crotonensis	1,100.00	787.50	866,250	
Aulacoseira/Melosira spp.complex	55.00	1,153.95	63,467	cells w/term spine
Aulacoseira/Melosira spp.complex	30.00	3,617.28	108,518	cells w/term spine
Navicula sp.	1.00	879.20	879	
Synedra sp.	5.00	126.93	635	
Synedra sp.	1.00	211.56	212	
Synedra sp.	1.00	628.00	628	
Taxon Subtotal	**2312**		**1,712,111**	
Cryptophyta				
Cryptomonas spp.	176.00	2,000.18	352,032	assoc w/detritus
cryptomonad	88.00	1,036.20	91,186	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	440.00	172.29	75,808	assoc w/detritus
Taxon Subtotal	**704**		**519,026**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**8,947**	**Total Volume**	**4,321,603**	**4.322**
Percent Cyanophyta	**44.71**	Percent Cyanophyta	**0.25**	
Percent Chlorophyta	**21.58**	Percent Chlorophyta	**48.12**	
Percent Chrysophyta	**25.84**	Percent Chrysophyta	**39.62**	
Percent Cryptophyta	**7.87**	Percent Cryptophyta	**12.01**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/6/2013
STATION: Lk Spokane-LL5 (0.5m)

SAMPLE STATUS: Lugol preserved
NOTE: many empty diatom frustules

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	500.00	2.68	1,340	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	10.00	286.13	2,861	threadlike fil<3um width;no sheath
Taxon Subtotal	**510**		**4,201**	
Chlorophyta				
Ankistrodesmus falcatus	44.00	97	4,263	cells deteriorated
Ankistrodesmus falcatus	22.00	171	3,761	
* *Coelastrum sp.*	1.00	8,205.87	8,206	small colonies
Crucigenia irregularis/rectangularis asmblg	32.00	174.14	5,572	
Nephrocytium sp.	8.00	1,256.00	10,048	
Oocystis sp.	4.00	1,013.17	4,053	
* *Pediastrum boryanum*	1.00	2,649.38	2,649	small colonies<30um
* *Pediastrum tetras*	2.00	1,570.00	3,140	small col<28um diam
Quadrigula sp.	8.00	253.29	2,026	
* *Scenedesmus bijuga*	5.00	732.67	3,663	robust 4-cell colony
* *Scenedesmus bijuga*	33.00	256.43	8,462	4-cell colony
* *Scenedesmus quadricauda*	1.00	732.67	733	4-cell colony
* *Scenedesmus sp.*	1.00	1,238.21	1,238	robust 4-cell colony
Staurastrum sp.	1.00	9,494.24	9,494	triangular semi-cells
colonial nannoplankton (ell)	16.00	95.38	1,526	
colonial nannoplankton (sph)	256.00	150.46	38,517	
colonial nannoplankton (sph)	120.00	1,436.03	172,323	
unicell (sph) nannoplktn	110.00	904.32	99,475	some w/lamellate cell
Taxon Subtotal	**665**		**379,151**	
Chrysophyta				
Dinobryon bavaricum	6.00	366.33	2,198	deterior cells
Dinobryon sociale/sertularia asmblg (tenta)	25.00	602.88	15,072	deterior cells
Mallomonas sp.	1.00	2,666.91	2,667	
chrysophyte (unicell)	2.00	10,131.73	20,263	ellip cell>25um
chrysophyte (unicell)	100.00	1,149.76	114,976	
chrysophyte (unicell)	100.00	267.95	26,795	
chrysophyte (unicell)	20.00	1,266.47	25,329	ellip cells
Bacillariophyceae				
Amphora sp.	1.00	2,473	2,473	
Cyclotella sp.	10.00	2,009.60	20,096	
Cymbella sp.	2.00	2,373.84	4,748	
Fragilaria sp.	10.00	600.00	6,000	
Fragilaria crotonensis	20.00	600.00	12,000	
Gomphonema sp.	10.00	1,470.00	14,700	
Melosira varians	6.00	9,420.00	56,520	large cell
Navicula sp.	10.00	706.50	7,065	
Navicula sp.	10.00	2,637.60	26,376	
Nitzschia sp.	5.00	502.40	2,512	
Nitzschia sp.	1.00	8,190.00	8,190	cells>100um length
Synedra sp.	7.00	2,491.07	17,437	
Synedra sp.	10.00	126.93	1,269	
Synedra sp.	1.00	211.56	212	
Tabellaria fenestrata	6.00	3,465.00	20,790	
undet pennate diatom	10.00	1,638.00	16,380	
Taxon Subtotal	**373**		**424,069**	
Cryptophyta				
Cryptomonas spp.	3.00	2,000.18	6,001	assoc w/detritus
cryptomonad	22.00	1,036.20	22,796	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	88.00	172.29	15,162	assoc w/detritus
Taxon Subtotal	**113**		**43,959**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	5.00	1,055.04	5,275	tiny cell;thecal plates obscure
Taxon Subtotal	**5.00**		**5,275**	
Undetermined				
undeter colony	64.00	33.49	2,144	sph cells<4um
Taxon Subtotal	**64**		**2,144**	

			(um3/ml)	(mm3/L)
Total Number/ml	**1,730**	**Total Volume**	**858,798**	**0.859**
Percent Cyanophyta	**29.48**	Percent Cyanophyta	**0.49**	
Percent Chlorophyta	**38.44**	Percent Chlorophyta	**44.15**	
Percent Chrysophyta	**21.56**	Percent Chrysophyta	**49.38**	
Percent Cryptophyta	**6.53**	Percent Cryptophyta	**5.12**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.29**	Percent Pyrrhophyta	**0.61**	
Percent Undetermined	**3.70**	Percent Undetermined	**0.25**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/20/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL0 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	200.00	2.68	536	cells<2um;irreg,clathrate col
Taxon Subtotal	**200**		**536**	
Chlorophyta				
Oocystis sp.	3.00	1,013.17	3,040	
* *Scenedesmus bijuga*	2.00	1,134.75	2,270	8-cell colony
* *Scenedesmus bijuga flexuosus*	3.00	2,373.84	7,122	12-16-cell colony
undet colonial desmid	21.00	1,256.00	26,376	linear col of 16+robust ovate cells
colonial nannoplankton (sph)	32.00	150.46	4,815	
unicell (sph) nannoplktn	10.00	4,186.67	41,867	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	22.00	904.32	19,895	some w/lamellate cell
Taxon Subtotal	**93**		**105,383**	
Chrysophyta				
Mallomonas sp.	1.00	2,666.91	2,667	
colonial chrysophyte	8.00	523.33	4,187	
chrysophyte (unicell)	77.00	1,149.76	88,532	
chrysophyte (unicell)	100.00	267.95	26,795	
Bacillariophyceae				
Fragilaria crotonensis	80.00	600.00	48,000	
Fragilaria crotonensis	200.00	787.50	157,500	
Synedra sp.	8.00	336.77	2,694	
undet pennate diatom	1.00	512.87	513	naviculoid cell
Taxon Subtotal	**475**		**330,887**	
Cryptophyta				
Cryptomonas spp.	20.00	1,857.31	37,146	assoc w/detritus
cryptomonad	10.00	1,036.20	10,362	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	55.00	172.29	9,476	assoc w/detritus
Taxon Subtotal	**85**		**56,984**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	6.00	5,388.24	32,329	small cell;thecal plates obscure
Taxon Subtotal	**6.00**		**32,329**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**859**	**Total Volume**	**526,119**	**0.526**
Percent Cyanophyta	**23.28**	Percent Cyanophyta	**0.10**	
Percent Chlorophyta	**10.83**	Percent Chlorophyta	**20.03**	
Percent Chrysophyta	**55.30**	Percent Chrysophyta	**62.89**	
Percent Cryptophyta	**9.90**	Percent Cryptophyta	**10.83**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.70**	Percent Pyrrhophyta	**6.14**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/20/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	50.00	47.69	2,384	cells<5um;aerotopes?;small ovate col;lt col mucous
Anacystis (Aphanothece/Anathece)spp.	500.00	2.68	1,340	cells<2um;irreg,clathrate col
Taxon Subtotal	**550**		**3,724**	
Chlorophyta				
Crucigenia irregularis/rectangularis asmblg	8.00	174.14	1,393	
Oocystis sp.	2.00	2,355.00	4,710	large unicells>20um
Oocystis sp.	2.00	1,013.17	2,026	
Oocystis sp.	12.00	319.15	3,830	
* *Pandorina /Eudorina spp asmblg.*	1.00	8,205.87	8,206	compres cellsl;col<30um diam
* *Pediastrum boryanum*	1.00	2,943.75	2,944	small col<40um diam
Quadrigula sp.	12.00	253.29	3,040	
* *Scenedesmus bijuga*	8.00	937.81	7,503	8-cell colony
* *Scenedesmus bijuga flexuosus*	10.00	4,559.28	45,593	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	1.00	1,406.72	1,407	12-16 cell colony
Staurastrum sp	1.00	2,171.50	2,172	
Tetraedron minimum	1.00	784.00	784	
undet colonial desmid	42.00	1,256.00	52,752	linear col of 8+ robust ovate cells
colonial nannoplankton (sph)	80.00	150.46	12,036	
colonial nannoplankton (sph)	4.00	1,149.76	4,599	
unicell (sph) nannoplktn	66.00	1,436.03	94,778	some w/lamellate cell
unicell (sph) nannoplktn	44.00	4,186.67	184,213	some w/lamellate cell
Taxon Subtotal	**295**		**431,985**	
Chrysophyta				
Dinobryon sociale(tenta)	300.00	635.85	190,755	deterior cells
Mallomonas sp.	10.00	2,666.91	26,669	
Rhizochrysis sp.	3.00	7,075.47	21,226	
colonial chrysophyte	8.00	523.33	4,187	
chrysophyte (unicell)	110.00	1,149.76	126,474	
chrysophyte (unicell)	100.00	267.95	26,795	
Bacillariophyceae				
Asterionella formosa	8.00	562.69	4,502	
Fragilaria crotonensis	70.00	600.00	42,000	
Fragilaria crotonensis	370.00	787.50	291,375	
Navicula sp.	3.00	911.86	2,736	
Synedra sp.	2.00	120.89	242	
Synedra sp.	5.00	199.47	997	
Synedra sp.	5.00	370.44	1,852	
Synedra sp.	4.00	612.30	2,449	
undet pennate diatom	1.00	11,869.20	11,869	naviculoid cell
Taxon Subtotal	**999**		**754,128**	
Cryptophyta				
Cryptomonas spp.	15.00	2,000.18	30,003	assoc w/detritus
cryptomonad	36.00	1,036.20	37,303	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	55.00	172.29	9,476	assoc w/detritus
Taxon Subtotal	**106**		**76,782**	
Euglenophyta				
Pyrrhophyta				
Peridiniales	15.00	5,388.24	80,824	thecate
Taxon Subtotal	**15.00**		**80,824**	
Undetermined				
undeter unicell	8.00	11,488.21	91,906	dense cell<30um diam
Taxon Subtotal	**8.00**		**91,906**	

			(um3/ml)	(mm3/L)
Total Number/ml	**1,973**	**Total Volume**	**1,439,348**	**1.439**
Percent Cyanophyta	**27.88**	Percent Cyanophyta	**0.26**	
Percent Chlorophyta	**14.95**	Percent Chlorophyta	**30.01**	
Percent Chrysophyta	**50.63**	Percent Chrysophyta	**52.39**	
Percent Cryptophyta	**5.37**	Percent Cryptophyta	**5.33**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.76**	Percent Pyrrhophyta	**5.62**	
Percent Undetermined	**0.41**	Percent Undetermined	**6.39**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/20/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	100.00	47.69	4,769	cells<5um;aerotopes?;small ovate col;lt col mucous
Anacystis (Aphanothece/Anathece)spp.	800.00	2.68	2,144	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	2.00	2,403.51	4,807	threadlike fil<3um width;no sheath
Taxon Subtotal	**902**		**11,719**	
Chlorophyta				
Cosmarium sp.	2.00	8,164.00	16,328	
Crucigenia irregularis/rectangularis asmblg	40.00	174.14	6,966	
Oocystis sp.	5.00	2,355.00	11,775	single cells
Oocystis sp.	1.00	7,092.21	7,092	large unicells>30um
Oocystis sp.	14.00	593.46	8,308	
* *Pandorina /Eudorina spp asmblg.*	10.00	8,205.87	82,059	compres cellsl;col<30um diam
* *Pediastrum boryanum*	1.00	2,564.33	2,564	small col<30um diam
Quadrigula sp.	10.00	177.31	1,773	
* *Scenedesmus bijuga*	2.00	256.43	513	4 cell colony
* *Scenedesmus bijuga*	8.00	937.81	7,503	8-cell colony
* *Scenedesmus bijuga flexuosus*	20.00	1,406.72	28,134	12-16cell colony
* *Scenedesmus bijuga flexuosus*	4.00	5,425.92	21,704	robust 16+cell colony
Schroederia/Ankyra spp. Grp (tenta)	5.00	150.72	754	cells deteriorated
Tetraedron minimum	4.00	784.00	3,136	
undet colonial desmid	63.00	1,256.00	79,128	linear colony of robust ovate cells
colonial nannoplankton (sph)	40.00	381.51	15,260	cell pairs/quads
colonial nannoplankton (sph)	128.00	150.46	19,258	
unicell (sph) nannoplktn	44.00	1,436.03	63,185	some w/lamellate cell
Taxon Subtotal	**401**		**375,440**	
Chrysophyta				
Dinobryon sociale(tenta)	350.00	635.85	222,548	deterior cells
Mallomonas sp.	1.00	1,657.92	1,658	
Rhizochrysis sp.	5.00	7,075.47	35,377	
chrysophyte (unicell)	33.00	1,149.76	37,942	
chrysophyte (unicell)	88.00	267.95	23,579	
Bacillariophyceae				
Fragilaria crotonensis	100.00	600.00	60,000	
Fragilaria crotonensis	250.00	787.50	196,875	
Hannaea arcus	1.00	556.83	557	
Aulacoseira/Melosira spp.complex	20.00	1,507.20	30,144	cells w/term spine
Navicula sp.	4.00	1,172.27	4,689	
Synedra sp.	2.00	90.67	181	
Synedra sp.	15.00	199.47	2,992	
Synedra sp.	3.00	370.44	1,111	
Taxon Subtotal	**872**		**617,654**	
Cryptophyta				
Cryptomonas spp.	4.00	2,000.18	8,001	assoc w/detritus
cryptomonad	40.00	1,036.20	41,448	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	44.00	172.29	7,581	assoc w/detritus
Taxon Subtotal	**88**		**57,030**	
Euglenophyta				
Pyrrhophyta				
Peridiniales	15.00	6,857.76	102,866	thecate
Taxon Subtotal	**15.00**		**102,866**	
Undetermined				
undeter unicell	40.00	11,488.21	459,529	dense cell<40um diam
Taxon Subtotal	**40.00**		**459,529**	

			(um3/ml)	(mm3/L)
Total Number/ml	**2,318**	**Total Volume**	**1,624,238**	**1.624**
Percent Cyanophyta	**38.91**	Percent Cyanophyta	**0.72**	
Percent Chlorophyta	**17.30**	Percent Chlorophyta	**23.11**	
Percent Chrysophyta	**37.62**	Percent Chrysophyta	**38.03**	
Percent Cryptophyta	**3.80**	Percent Cryptophyta	**3.51**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.65**	Percent Pyrrhophyta	**6.33**	
Percent Undetermined	**1.73**	Percent Undetermined	**28.29**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/21/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	20.00	47.69	954	cells<5um;aerotopes?;small ovate col;lt col mucous
Anacystis (Aphanothece/Anathece)spp.	1,500.00	2.68	4,019	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	2.00	1,001.46	2,003	threadlike fil<3um width;no sheath
col cyanophyte(Aphanocapsa?Microcystaceae?)	20.00	17.15	343	dense pack cells<4um;aerotopes?
Taxon Subtotal	**1,542**		**7,319**	
Chlorophyta				
Ankistrodesmus falcatus	5.00	97	484	cells deteriorated
Ankistrodesmus falcatus	4.00	171	684	
Crucigenia irregularis/rectangularis asmblg	32.00	174.14	5,572	
Eudorina sp.	32.00	267.95	8,574	
Nephrocytium sp.	2.00	763.02	1,526	
Oocystis sp.	7.00	1,013.17	7,092	
Oocystis sp.	24.00	95.38	2,289	
* *Pandorina /Eudorina spp asmblg.*	8.00	3,768.00	30,144	compres-cells col<30um
* *Pediastrum boryanum*	1.00	2,564.33	2,564	small col<28um
Quadrigula sp.	2.00	253.29	507	
* *Scenedesmus bijuga*	6.00	256.43	1,539	4-cell colony
* *Scenedesmus bijuga*	10.00	937.81	9,378	8-cell colony
* *Scenedesmus bijuga flexuosus*	16.00	5,425.92	86,815	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	18.00	1,406.72	25,321	12-16-cell colony
* *Scenedesmus quadricauda*	5.00	2,917.94	14,590	robust 8-cell colony
Staurastrum sp	1.00	2,517.31	2,517	
Tetraedron minimum	4.00	784.00	3,136	
undet colonial desmid	215.00	1,256.00	270,040	linear colony of robust ovate cells
colonial nannoplankton (sph)	176.00	150.46	26,480	
colonial nannoplankton (sph)	40.00	904.32	36,173	
* colonial nannoplankton (ell)	1.00	455.93	456	ellip cells w/term spines
unicell (sph) nannoplktn	10.00	4,186.67	41,867	
unicell (sph) nannoplktn	66.00	1,436.03	94,778	some w/lamellate cell
Taxon Subtotal	**685**		**672,526**	
Chrysophyta				
Dinobryon sociale(tenta)	950.00	635.85	604,058	deterior cells
Rhizochrysis sp.	1.00	7,075.47	7,075	
chrysophyte (unicell)	44.00	1,149.76	50,590	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Cocconeis sp.	1.00	1,099.00	1,099	
Cyclotella sp.	4.00	4,179.34	16,717	
Fragilaria crotonensis	100.00	600.00	60,000	
Fragilaria crotonensis	170.00	787.50	133,875	
Aulacoseira/Melosira spp.complex	625.00	1,406.72	879,200	cells w/term spine
Aulacoseira/Melosira spp.complex	30.00	3,391.20	101,736	cells w/term spine
Aulacoseira/Melosira spp.complex	42.00	759.88	31,915	slender cells w/term spine
Navicula sp.	3.00	483.56	1,451	
Navicula sp.	1.00	870.41	870	
Nitzschia sp.	1.00	1,208.90	1,209	cells>100um length
Nitzschia sp.	2.00	5,760.00	11,520	cells>120um length
Synedra sp.	10.00	126.93	1,269	
Synedra sp.	20.00	211.56	4,231	
Synedra sp.	20.00	370.44	7,409	
Synedra sp.	5.00	765.38	3,827	
Synedra sp.	3.00	1,413.00	4,239	
undet pennate diatom	1.00	879.20	879	naviculoid cell
Taxon Subtotal	**2088**		**1,937,906**	
Cryptophyta				
Cryptomonas spp.	15.00	2,000.18	30,003	assoc w/detritus
cryptomonad	20.00	1,036.20	20,724	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
Taxon Subtotal	**68**		**56,412**	
Euglenophyta				
Trachelomonas sp. (sph)	1.00	2,571.14	2,571	smooth wall
Taxon Subtotal	**1**		**2,571**	
Pyrrhophyta				
Ceratium hirundinella	2.00	60,000.00	120,000	
Peridiniales	5.00	5,388.24	26,941	thecate
Taxon Subtotal	**7.00**		**146,941**	
Undetermined				
undeter unicell	5.00	11,488.21	57,441	dense sph cell<40um diam
Taxon Subtotal	**5.00**		**57,441**	

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/21/2013
STATION: Lk Spokane-LL3 (0.5m)
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			(um3/ml)	(mm3/L)
Total Number/ml	**4,396**	**Total Volume**	**2,881,117**	**2.881**
Percent Cyanophyta	**35.08**	Percent Cyanophyta	**0.25**	
Percent Chlorophyta	**15.58**	Percent Chlorophyta	**23.34**	
Percent Chrysophyta	**47.50**	Percent Chrysophyta	**67.26**	
Percent Cryptophyta	**1.55**	Percent Cryptophyta	**1.96**	
Percent Euglenophyta	**0.02**	Percent Euglenophyta	**0.09**	
Percent Pyrrhophyta	**0.16**	Percent Pyrrhophyta	**5.10**	
Percent Undetermined	**0.11**	Percent Undetermined	**1.99**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/21/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	1,500.00	2.68	4,019	cells<2um;irreg,clathrate col
Taxon Subtotal	**1,500**		**4,019**	
Chlorophyta				
Ankistrodesmus falcatus	4.00	182	729	
* *Coelastrum sp.*	10.00	4,186.67	41,867	small col<20um diam
Cosmarium sp.	2.00	5,744.11	11,488	
Crucigenia irregularis/rectangularis asmblg	160.00	174.14	27,862	
Crucigenia sp.	16.00	55.26	884	
Nephrocytium sp.	6.00	1,808.64	10,852	
Oocystis sp.	4.00	13,129.39	52,518	large unicells>30um
Oocystis sp.	16.00	2,051.47	32,823	large unicells>20um
Oocystis sp.	8.00	1,013.17	8,105	
Oocystis sp.	16.00	296.35	4,742	
Pandorina sp.	40.00	1,055.04	42,202	
* *Pandorina /Eudorina spp asmblg.*	6.00	3,349.33	20,096	compres cells;col<20um
* *Pediastrum boryanum*	1.00	16,027.08	16,027	mod col-80um diam
* *Pediastrum tetras*	1.00	2,260.80	2,261	small col<25um diam
Quadrigula sp.	2.00	253.29	507	
* *Scenedesmus quadricauda*	10.00	334.93	3,349	4-cell colony
* *Scenedesmus quadricauda*	2.00	1,641.17	3,282	robust 4-cell colony
* *Scenedesmus bijuga*	10.00	593.46	5,935	4-cell colony
* *Scenedesmus bijuga*	33.00	1,465.33	48,356	8-cell colony
* *Scenedesmus bijuga flexuosus*	55.00	5,425.92	298,426	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	100.00	1,289.49	128,949	12-16-cell colony
Schroederia/Ankyra spp. asmblg(tenta)	22.00	150.72	3,316	cells deteriorated
Schroederia/Ankyra spp. grp	5.00	366.33	1,832	
Staurastrum sp	2.00	3,723.47	7,447	
Tetraedron sp.	1.00	2,872.05	2,872	
undet colonial desmid	745.00	1,256.00	935,720	linear colony of robust ovate cells
colonial nannoplankton (sph)	440.00	523.33	230,267	
colonial nannoplankton (sph)	1,056.00	150.46	158,882	
unicell (sph) nannoplktn	5.00	4,186.67	20,933	cell>20um
unicell (sph) nannoplktn	55.00	904.32	49,738	some w/lamellate cell
Taxon Subtotal	**2,833**		**2,172,266**	
Chrysophyta				
Dinobryon sp.	35.00	487.22	17,053	deterior cells
Rhizochrysis sp.	3.00	7,075.47	21,226	
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	44.00	267.95	11,790	
Bacillariophyceae				
Fragilaria sp.	20.00	480.00	9,600	
Fragilaria crotonensis	600.00	600.00	360,000	
Fragilaria crotonensis	800.00	787.50	630,000	
Gomphonema sp.	5.00	2,205.00	11,025	
Aulacoseira/Melosira spp.complex	1,825.00	1,153.95	2,105,959	cells w/term spine
Aulacoseira/Melosira spp.complex	100.00	3,617.28	361,728	cells w/term spine
Aulacoseira/Melosira spp.complex	160.00	628.00	100,480	slender cells;term spine
Melosira varians	2.00	9,420.00	18,840	large cell
Navicula sp.	2.00	374.18	748	
Navicula sp.	2.00	787.51	1,575	
Surirella sp.	1.00	18,900.00	18,900	
Synedra sp.	4.00	126.93	508	
Synedra sp.	10.00	199.47	1,995	
Synedra sp.	6.00	370.44	2,223	
Synedra sp.	4.00	1,256.00	5,024	
Synedra sp.	1.00	2,747.50	2,748	
undet pennate diatom	1.00	4,923.52	4,924	
Taxon Subtotal	**3647**		**3,711,639**	
Cryptophyta				
Cryptomonas spp.	231.00	2,000.18	462,042	assoc w/detritus
cryptomonad	110.00	1,036.20	113,982	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	66.00	172.29	11,371	assoc w/detritus
Taxon Subtotal	**407**		**587,395**	
Euglenophyta				
Pyrrhophyta				
Ceratium hirundinella	4.00	60,000.00	240,000	
Peridiniales	2.00	4,144.80	8,290	thecate
small dinoflagellate	4.00	6,857.76	27,431	small cell;thecal plates obscure
Taxon Subtotal	**10.00**		**275,721**	
Undetermined				
undeter unicell	6.00	14,130.00	84,780	dense cell<40um diam
Taxon Subtotal	**6.00**		**84,780**	

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/21/2013
STATION: Lk Spokane-LL4 (0.5m)
page 2

			(um3/ml)	(mm3/L)
Total Number/ml	**8,403**	**Total Volume**	**6,835,819**	**6.836**
Percent Cyanophyta	**17.85**	Percent Cyanophyta	**0.06**	
Percent Chlorophyta	**33.71**	Percent Chlorophyta	**31.78**	
Percent Chrysophyta	**43.40**	Percent Chrysophyta	**54.30**	
Percent Cryptophyta	**4.84**	Percent Cryptophyta	**8.59**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.12**	Percent Pyrrhophyta	**4.03**	
Percent Undetermined	**0.07**	Percent Undetermined	**1.24**	
***= colony**	**+=filament**			

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/21/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL5 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	1,000.00	2.68	2,679	cells<2um;irreg,clathrate col
Gomphosphaeria sp.	100.00	28.26	2,826	
Microcystis sp.	1,000.00	87.07	87,070	small col<20-500 cells<6um w/aerotopes;lt. col mucous
col cyanophyte (Aphanocapsa?)	300.00	14.13	4,239	dense pack cells<4u;aerotopes?;,irreg col
Taxon Subtotal	**2,400**		**96,814**	
Chlorophyta				
Ankistrodesmus falcatus	22.00	97	2,131	cells deteriorated
* *Coelastrum sp.*	12.00	8,205.87	98,470	small colonies
Cosmarium sp.	4.00	5,744.11	22,976	
Crucigenia irregularis/rectangularis asmblg	160.00	174.14	27,862	
Crucigenia sp.	20.00	104.67	2,093	
Dictyosphaerium sp.	160.00	87.07	13,931	
Nephrocytium sp.	2.00	1,356.48	2,713	
Oocystis sp.	56.00	1,013.17	56,738	
Oocystis sp.	2.00	13,129.39	26,259	large,unicells>30um
Oocystis sp.	6.00	5,861.33	35,168	unicells>20um
Oocystis sp.	80.00	593.46	47,477	
Pandorina sp.	16.00	334.93	5,359	
* *Pandorina /Eudorina spp asmblg.*	5.00	3,349.33	16,747	small colonies<20um
* *Pediastrum duplex*	1.00	6,410.83	6,411	small col<70um diam
* *Pediastrum tetras*	1.00	1,570.00	1,570	small col<28um diam
Quadrigula sp.	14.00	227.96	3,191	
* *Scenedesmus bijuga*	10.00	256.43	2,564	4-cell colony
* *Scenedesmus bijuga*	55.00	2,026.35	111,449	robust 8-cell colony
* *Scenedesmus bijuga flexuosus*	132.00	5,425.92	716,221	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	145.00	1,289.49	186,977	12-16-cell colony
* *Scenedesmus quadricauda*	1.00	847.80	848	robust 4-cell colony
Schroederia/Ankyra spp. grp (tenta)	44.00	150.72	6,632	cells deteriorated
Schroederia/Ankyra spp. grp	10.00	366.33	3,663	
Staurastrum sp	4.00	3,844.97	15,380	
Tetraedron minimum	4.00	784.00	3,136	
Tetraedron sp.	1.00	1,046.67	1,047	
undet colonial desmid	560.00	1,256.00	703,360	linear colony of robust ovate cells
colonial nannoplankton (sph)	240.00	150.46	36,109	
colonial nannoplankton (sph)	416.00	904.32	376,197	
unicell (sph) nannoplktn	10.00	4,186.67	41,867	cell>20um
unicell (sph) nannoplktn	110.00	904.32	99,475	some w/lamellate cell
Taxon Subtotal	**2,303**		**2,674,022**	
Chrysophyta				
Rhizochrysis sp.	1.00	7,075.47	7,075	
chrysophyte (unicell)	44.00	1,149.76	50,590	
chrysophyte (unicell)	77.00	267.95	20,632	
Bacillariophyceae				
Epithemia sp.	1.00	14,130	14,130	
Fragilaria sp.	50.00	600.00	30,000	
Fragilaria crotonensis	260.00	600.00	156,000	
Fragilaria crotonensis	1,000.00	825.00	825,000	
Gomphonema sp.	10.00	1,470.00	14,700	
Aulacoseira/Melosira spp.complex	570.00	1,153.95	657,752	some w/term spines
Aulacoseira/Melosira spp.complex	30.00	3,391.20	101,736	some w/term spines
Aulacoseira/Melosira spp.complex	58.00	628.00	36,424	slender cells;some w/term spines
Melosira varians	6.00	9,420.00	56,520	large cell
Navicula sp.	5.00	787.51	3,938	
Navicula sp.	1.00	35,168.00	35,168	cells>100um length
Synedra ulna	1.00	17,360.00	17,360	
Synedra sp.	2.00	126.93	254	
Synedra sp.	2.00	211.56	423	
Taxon Subtotal	**2118**		**2,027,701**	
Cryptophyta				
Cryptomonas spp.	126.00	2,000.18	252,023	assoc w/detritus
cryptomonad	66.00	1,036.20	68,389	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	880.00	172.29	151,617	assoc w/detritus
Taxon Subtotal	**1,072**		**472,029**	
Euglenophyta				
Trachelomonas sp.	1.00	2,571.14	2,571	smooth wall
Taxon Subtotal	**1**		**2,571**	
Pyrrhophyta				
Ceratium hirundinella	11.00	60,000.00	660,000	
Taxon Subtotal	**11.00**		**660,000**	
Undetermined				
undeter unicell	6.00	11,488.21	68,929	sph cell<30um
Taxon Subtotal	**6**		**68,929**	

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 8/21/2013
STATION: Lk Spokane-LL5 (0.5m)

			(um3/ml)	(mm3/L)
Total Number/ml	**7,911**	**Total Volume**	**6,002,067**	**6.002**
Percent Cyanophyta	**30.34**	Percent Cyanophyta	**1.61**	
Percent Chlorophyta	**29.11**	Percent Chlorophyta	**44.55**	
Percent Chrysophyta	**26.77**	Percent Chrysophyta	**33.78**	
Percent Cryptophyta	**13.55**	Percent Cryptophyta	**7.86**	
Percent Euglenophyta	**0.01**	Percent Euglenophyta	**0.04**	
Percent Pyrrhophyta	**0.14**	Percent Pyrrhophyta	**11.00**	
Percent Undetermined	**0.08**	Percent Undetermined	**1.15**	
***= colony**	**+=filament**			

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/9/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL0 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	500.00	2.68	1,340	cells<2um;irreg,clathrate col
colonial cyanophyte	100.00	14.13	1,413	dense pack cells<4um;aerotopes?;irreg col
Taxon Subtotal	**600**		**2,753**	
Chlorophyta				
Crucigenia irregularis/rectangularis asmblg	40.00	174.14	6,966	
Oocystis sp.	4.00	1,013.17	4,053	
Oocystis sp.	8.00	468.91	3,751	
* *Scenedesmus bijuga*	2.00	1,186.92	2,374	8-cell colony
undet colonial desmid	21.00	1,256.00	26,376	linear col of 16+robust ovate cells
colonial nannoplankton (sph)	32.00	150.46	4,815	
unicell (sph) nannoplktn	22.00	904.32	19,895	some w/lamellate cell
Taxon Subtotal	**129**		**68,229**	
Chrysophyta				
Dinobryon sociale (tenta)	500.00	635.85	317,925	deterior cells
chrysophyte (unicell)	10.00	1,149.76	11,498	
chrysophyte (unicell)	33.00	267.95	8,842	
Bacillariophyceae				
Asterionella formosa	8.00	442.11	3,537	
Fragilaria crotonensis	20.00	600.00	12,000	
Fragilaria crotonensis	730.00	787.50	574,875	
Navicula sp.	1.00	414.48	414	
Taxon Subtotal	**1302**		**929,091**	
Cryptophyta				
Cryptomonas spp.	8.00	1,857.31	14,858	assoc w/detritus
cryptomonad	18.00	1,036.20	18,652	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	33.00	172.29	5,686	assoc w/detritus
Taxon Subtotal	**59**		**39,196**	
Euglenophyta				
Pyrrhophyta				
Ceratium hirundinella	1.00	60,000.00	60,000	
small dinoflagellate	9.00	5,388.24	48,494	small cell;thecal plates obscure
Taxon Subtotal	**10.00**		**108,494**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**2,100**	**Total Volume**	**1,147,763**	**1.148**
Percent Cyanophyta	**28.57**	Percent Cyanophyta	**0.24**	
Percent Chlorophyta	**6.14**	Percent Chlorophyta	**5.94**	
Percent Chrysophyta	**62.00**	Percent Chrysophyta	**80.95**	
Percent Cryptophyta	**2.81**	Percent Cryptophyta	**3.41**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.48**	Percent Pyrrhophyta	**9.45**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/9/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	50.00	47.69	2,384	cells<5um;aerotopes?;small ovate col;lt col mucous
Anacystis (Aphanothece/Anathece)spp.	200.00	2.68	536	cells<2um;irreg,clathrate col
colonial cyanophyte	40.00	14.13	565	dense pack cells<4um;aerotopes?;irreg col
Taxon Subtotal	**290**		**3,486**	
Chlorophyta				
Oocystis sp.	6.00	1,013.17	6,079	
Oocystis sp.	4.00	468.91	1,876	
* *Pediastrum tetras*	1.00	1,271.70	1,272	small col<20um diam
* *Scenedesmus bijuga*	1.00	567.38	567	4-cell colony
* *Scenedesmus bijuga flexuosus*	3.00	1,406.72	4,220	12-16 cell colony
undet colonial desmid	21.00	1,256.00	26,376	linear col of 8+ robust ovate cells
colonial nannoplankton (sph)	40.00	150.46	6,018	
unicell (sph) nannoplktn	30.00	1,436.03	43,081	some w/lamellate cell
unicell (sph) nannoplktn	8.00	4,186.67	33,493	cells>20um
Taxon Subtotal	**114**		**122,982**	
Chrysophyta				
Dinobryon sociale (tenta)	400.00	635.85	254,340	deterior cells
chrysophyte (unicell)	10.00	1,149.76	11,498	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Fragilaria crotonensis	50.00	600.00	30,000	
Fragilaria crotonensis	550.00	787.50	433,125	
Gomphonema sp.	1.00	1,470.00	1,470	
Aulacoseira/Melosira spp.complex	14.00	3,165.12	44,312	cells w/term spine
Navicula sp.	1.00	1,281.12	1,281	
Synedra sp.	1.00	706.50	707	
Synedra sp.	1.00	199.47	199	
undet pennate diatom	1.00	1,440.00	1,440	
Taxon Subtotal	**1084**		**793,108**	
Cryptophyta				
Cryptomonas spp.	12.00	1,928.75	23,145	assoc w/detritus
cryptomonad	10.00	1,036.20	10,362	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	200.00	172.29	34,458	assoc w/detritus
Taxon Subtotal	**222**		**67,965**	
Euglenophyta				
Pyrrhophyta				
Ceratium hirundinella	2.00	60,000.00	120,000	
Taxon Subtotal	**2.00**		**120,000**	
Undetermined				
undeter unicell	1.00	11,488.21	11,488	dense cell<30um diam
Taxon Subtotal	**1.00**		**11,488**	

			(um3/ml)	(mm3/L)
Total Number/ml	**1,713**	**Total Volume**	**1,119,030**	**1.119**
Percent Cyanophyta	**16.93**	Percent Cyanophyta	**0.31**	
Percent Chlorophyta	**6.65**	Percent Chlorophyta	**10.99**	
Percent Chrysophyta	**63.28**	Percent Chrysophyta	**70.87**	
Percent Cryptophyta	**12.96**	Percent Cryptophyta	**6.07**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.12**	Percent Pyrrhophyta	**10.72**	
Percent Undetermined	**0.06**	Percent Undetermined	**1.03**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/9/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	60.00	47.69	2,861	cells<5um;aerotopes?;small ovate col;lt col mucous
Anacystis (Aphanothece/Anathece)spp.	200.00	2.68	536	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudoanabaenaceae	4.00	1,144.53	4,578	threadlike fil<3um width;no sheath
colonial cyanophyte	50.00	14.13	707	dense pack cells<4um;aerotopes?;irreg col
Taxon Subtotal	**314**		**8,682**	
Chlorophyta				
Crucigenia irregularis/rectangularis asmblg	16.00	174.14	2,786	
Oocystis sp.	4.00	1,013.17	4,053	
Oocystis sp.	10.00	468.91	4,689	
* *Pediastrum tetras*	1.00	1,271.70	1,272	small col<20um diam
Quadrigula sp.	2.00	253.29	507	
* *Scenedesmus bijuga*	1.00	256.43	256	4 cell colony
* *Scenedesmus bijuga*	4.00	1,773.05	7,092	8-cell colony
* *Scenedesmus bijuga flexuosus*	2.00	1,406.72	2,813	12-16cell colony
Staurastrum sp.	1.00	8,137.92	8,138	triangular semi- cells
undet colonial desmid	32.00	1,256.00	40,192	linear colony of robust ovate cells
colonial nannoplankton (sph)	120.00	150.46	18,055	
colonial nannoplankton (sph)	16.00	1,436.03	22,976	
unicell (sph) nannoplktn	30.00	1,436.03	43,081	some w/lamellate cell
Taxon Subtotal	**239**		**155,910**	
Chrysophyta				
Dinobryon sociale (tenta)	450.00	635.85	286,133	deterior cells
colonial chrysophyte	40.00	65.42	2,617	cells<5um
chrysophyte (unicell)	44.00	1,149.76	50,590	
chrysophyte (unicell)	100.00	267.95	26,795	
chrysophyte (unicell)	2.00	1,013.17	2,026	ellip cells<30um
Bacillariophyceae				
Fragilaria crotonensis	130.00	600.00	78,000	
Fragilaria crotonensis	480.00	787.50	378,000	
Gomphonema sp.	3.00	1,575.00	4,725	
Aulacoseira/Melosira spp.complex	15.00	1,780.38	26,706	cells w/term spine
Synedra sp.	1.00	126.93	127	
Synedra sp.	7.00	199.47	1,396	
Synedra sp.	1.00	370.44	370	
undet pennate diatom	1.00	170.08	170	naviculoid cell
Taxon Subtotal	**1274**		**857,654**	
Cryptophyta				
Cryptomonas spp.	7.00	2,000.18	14,001	assoc w/detritus
cryptomonad	10.00	1,036.20	10,362	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	132.00	172.29	22,743	assoc w/detritus
Taxon Subtotal	**149**		**47,106**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,976**	**Total Volume**	**1,069,352**	**1.069**
Percent Cyanophyta	**15.89**	Percent Cyanophyta	**0.81**	
Percent Chlorophyta	**12.10**	Percent Chlorophyta	**14.58**	
Percent Chrysophyta	**64.47**	Percent Chrysophyta	**80.20**	
Percent Cryptophyta	**7.54**	Percent Cryptophyta	**4.41**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/10/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	300.00	54.33	16,300	cells<5um;aerotopes?;small ovate col;lt col mucous
Anacystis (Aphanothece/Anathece)spp.	400.00	2.68	1,072	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudoanabaenaceae	90.00	1,144.53	103,008	threadlike fil<3um width;no sheath
Taxon Subtotal	**790**		**120,380**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
Dictyosphaerium sp.	32.00	87.07	2,786	
* *Pediastrum boryanum*	1.00	5,233.33	5,233	small col<40um
* *Pediastrum duplex*	1.00	6,154.40	6,154	small col<70um diam
* *Scenedesmus bijuga*	1.00	1,071.79	1,072	8-cell colony
* *Scenedesmus bijuga flexuosus*	3.00	5,425.92	16,278	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	5.00	1,406.72	7,034	12-16-cell colony
* *Scenedesmus quadricauda*	1.00	256.43	256	4-cell colony
undet colonial desmid	46.00	1,256.00	57,776	linear colony of robust ovate cells
colonial nannoplankton (sph)	88.00	150.46	13,240	
colonial nannoplankton (sph)	16.00	1,436.03	22,976	
unicell (sph) nannoplktn	5.00	4,186.67	20,933	cells>20um
unicell (sph) nannoplktn	132.00	1,436.03	189,556	some w/lamellate cell
Taxon Subtotal	**341**		**344,264**	
Chrysophyta				
Dinobryon sociale/sertularia asmblg	3,820.00	635.85	2,428,947	deterior cells
Mallomonas sp.	5.00	3,483.31	17,417	
chrysophyte (unicell)	66.00	1,149.76	75,884	
chrysophyte (unicell)	200.00	267.95	53,589	
Bacillariophyceae				
Asterionella formosa	16.00	401.92	6,431	
Cymbella sp.	1.00	1,641.17	1,641	
Cymbella sp.	1.00	7,253.40	7,253	
Fragilaria crotonensis	320.00	712.50	228,000	
Gomphonema sp.	5.00	1,470.00	7,350	
Aulacoseira/Melosira spp.complex	140.00	3,391.20	474,768	
Aulacoseira/Melosira spp.complex	12.00	588.75	7,065	slender cells
Aulacoseira/Melosira spp.complex	325.00	1,406.72	457,184	
Synedra ulna	3.00	17,920.00	53,760	
Synedra sp.	2.00	1,695.60	3,391	
Synedra sp.	44.00	199.47	8,777	
Synedra sp.	40.00	370.44	14,818	
Synedra sp.	10.00	765.38	7,654	
undet pennate diatom	1.00	11,869.20	11,869	naviculoid cell
Taxon Subtotal	**5011**		**3,865,798**	
Cryptophyta				
Cryptomonas spp.	165.00	2,000.18	330,030	assoc w/detritus
Cryptomonas sp.	5.00	5,652.00	28,260	
cryptomonad	100.00	1,036.20	103,620	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	330.00	172.29	56,856	assoc w/detritus
Taxon Subtotal	**600**		**518,766**	
Euglenophyta				
Pyrrhophyta				
Undetermined				
undeter unicell	2.00	11,488.21	22,976	dense cell<30um diam
Taxon Subtotal	**2.00**		**22,976**	

			(um3/ml)	**(mm3/L)**
Total Number/ml	**6,744**	**Total Volume**	**4,872,184**	**4.872**
Percent Cyanophyta	**11.71**	Percent Cyanophyta	**2.47**	
Percent Chlorophyta	**5.06**	Percent Chlorophyta	**7.07**	
Percent Chrysophyta	**74.30**	Percent Chrysophyta	**79.34**	
Percent Cryptophyta	**8.90**	Percent Cryptophyta	**10.65**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.03**	Percent Undetermined	**0.47**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/10/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	150.00	54.33	8,150	cells<5um;aerotopes?;small ovate col;lt col mucous
+ Oscillatoriales: Pseudoanabaenaceae	8.00	858.40	6,867	threadlike fil<3um width;no sheath
colonial cyanophyte	400.00	14.13	5,652	dense pack cells<4um;aerotopes?;irreg col
Taxon Subtotal	**558**		**20,669**	
Chlorophyta				
* *Botryococcus sp.*	1.00	8,205.87	8,206	small col<40um diam
Cosmarium sp.	1.00	4,599.05	4,599	
Dictyosphaerium sp.	96.00	87.07	8,359	
Kirchneriella sp.	8.00	46	368	
Oocystis sp.	5.00	2,051.47	10,257	large unicells>20um
Oocystis sp.	8.00	1,013.17	8,105	
Quadrigula sp.	8.00	253.29	2,026	
* *Scenedesmus bijuga*	1.00	256.43	256	4-cell colony
* *Scenedesmus bijuga*	1.00	2,051.47	2,051	robust 4-cell colony
* *Scenedesmus bijuga flexuosus*	8.00	1,406.72	11,254	12-16-cell colony
Staurastrum chaetocerus (tenta)	1.00	2,416.14	2,416	
Tetraedron minimum	5.00	576.00	2,880	
undet colonial desmid	63.00	1,256.00	79,128	linear colony of robust ovate cells
colonial nannoplankton (ell)	40.00	117.75	4,710	
colonial nannoplankton (sph)	12.00	1,766.25	21,195	
colonial nannoplankton (sph)	640.00	150.46	96,292	
colonial nannoplankton (sph)	56.00	904.32	50,642	
unicell (sph) nannoplktn	10.00	4,186.67	41,867	cell>20um
unicell (sph) nannoplktn	110.00	904.32	99,475	some w/lamellate cell
Taxon Subtotal	**1,074**		**454,088**	
Chrysophyta				
Dinobryon sociale (tenta)	20.00	635.85	12,717	deterior cells
Mallomonas sp.	12.00	2,666.91	32,003	
Rhizochrysis sp.	1.00	7,075.47	7,075	
chrysophyte (unicell)	55.00	1,149.76	63,237	
chrysophyte (unicell)	88.00	267.95	23,579	
Bacillariophyceae				
Asterionella formosa	24.00	401.92	9,646	
Fragilaria crotonensis	850.00	675.00	573,750	
Fragilaria crotonensis	80.00	862.50	69,000	
Aulacoseira/Melosira spp.complex	1,200.00	1,406.72	1,688,064	cells w/term spine
Aulacoseira/Melosira spp.complex	50.00	3,391.20	169,560	cells w/term spine
Aulacoseira/Melosira spp.complex	40.00	588.75	23,550	slender cells;term spine
Nitzschia sp.	1.00	3,626.70	3,627	cells>200um
Synedra sp.	10.00	126.93	1,269	
Synedra sp.	2.00	211.56	423	
Synedra sp.	1.00	370.44	370	
undet pennate diatom	3.00	7,875.00	23,625	naviculoid cell>130um
Taxon Subtotal	**2437**		**2,701,496**	
Cryptophyta				
Cryptomonas spp.	295.00	2,000.18	590,053	assoc w/detritus
Cryptomonas sp.	5.00	5,652.00	28,260	
cryptomonad	210.00	1,036.20	217,602	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	440.00	172.29	75,808	assoc w/detritus
Taxon Subtotal	**950**		**911,723**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**5,019**	**Total Volume**	**4,087,977**	**4.088**
Percent Cyanophyta	**11.12**	Percent Cyanophyta	**0.51**	
Percent Chlorophyta	**21.40**	Percent Chlorophyta	**11.11**	
Percent Chrysophyta	**48.56**	Percent Chrysophyta	**66.08**	
Percent Cryptophyta	**18.93**	Percent Cryptophyta	**22.30**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/10/2013
STATION: Lk Spokane-LL5 (0.5m)

SAMPLE STATUS: Lugol preserved
NOTE: many empty diatom frustules

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	800.00	54.33	43,467	cells<5um;aerotopes?;ovate col;lt col mucous
Anacystis (Aphanothece/Anathece)spp.	200.00	2.68	536	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	1.00	400.59	401	threadlike fil<3um width;no sheath
colonial cyanophyte	1,200.00	14.13	16,956	dense pack cells<4um;aerotopes?;irreg col
Taxon Subtotal	**2,201**		**61,360**	
Chlorophyta				
* *Coelastrum sp.*	1.00	4,186.67	4,187	small colonies
Oocystis sp.	8.00	1,013.17	8,105	deterior cells
* *Scenedesmus bijuga*	2.00	1,773.05	3,546	8-cell colony
* *Scenedesmus bijuga*	1.00	4,287.15	4,287	robust 8-cell colony
undet colonial desmid	7.00	1,256.00	8,792	linear colony of robust ovate cells
colonial nannoplankton (ell)	16.00	117.75	1,884	
colonial nannoplankton (sph)	240.00	381.51	91,562	
colonial nannoplankton (sph)	480.00	150.46	72,219	
unicell (sph) nannoplktn	10.00	4,186.67	41,867	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	110.00	904.32	99,475	some w/lamellate cell
Taxon Subtotal	**875**		**335,925**	
Chrysophyta				
Mallomonas sp.	1.00	3,483.31	3,483	
Mallomonas sp.	4.00	2,872.05	11,488	
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Asterionella formosa	8.00	401.92	3,215	
Cyclotella sp.	1.00	8,616.16	8,616	
Fragilaria sp.	180.00	462.00	83,160	
Fragilaria crotonensis	4,900.00	675.00	3,307,500	
Gomphonema sp.	2.00	1,764.00	3,528	
Synedra sp.	2.00	90.67	181	
Synedra sp.	1.00	211.56	212	
undet pennate diatom	1.00	1,764.00	1,764	
Taxon Subtotal	**5177**		**3,463,180**	
Cryptophyta				
Cryptomonas spp.	1,210.00	2,000.18	2,420,218	assoc w/detritus
Cryptomonas sp.	5.00	5,652.00	28,260	
cryptomonad	385.00	1,036.20	398,937	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	880.00	172.29	151,617	assoc w/detritus
Taxon Subtotal	**2,480**		**2,999,032**	
Euglenophyta				
Pyrrhophyta				
Ceratium hirundinella	6.00	60,000.00	360,000	
Taxon Subtotal	**6.00**		**360,000**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**10,739**	**Total Volume**	**7,219,496**	**7.219**
Percent Cyanophyta	**20.50**	Percent Cyanophyta	**0.85**	
Percent Chlorophyta	**8.15**	Percent Chlorophyta	**4.65**	
Percent Chrysophyta	**48.21**	Percent Chrysophyta	**47.97**	
Percent Cryptophyta	**23.09**	Percent Cryptophyta	**41.54**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.06**	Percent Pyrrhophyta	**4.99**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/24/2013 | **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL0 (0.5m) | **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	1,400.00	2.68	3,751	cells<2um;irreg,clathrate col
Coelosphaerium/Snowella spp. grp	40.00	22.44	898	tiny cell grps @ col mucous edge;fibrils?
+ Oscillatoriales: Pseudanabaenaceae	3.00	915.62	2,747	threadlike fil<3um width;thin sheath?
Taxon Subtotal	**1,443**		**7,396**	
Chlorophyta				
Coelastrum microporum	8.00	904.32	7,235	
Crucigenia irregularis/rectangularis asmblg	224.00	174.14	39,007	
Oocystis sp.	1.00	1,507.20	1,507	single cells>20um
Oocystis sp.	1.00	1,013.17	1,013	
Oocystis sp.	10.00	468.91	4,689	
Oocystis sp.	8.00	130.83	1,047	
Quadrigula sp.	4.00	344.42	1,378	robust cells
* *Scenedesmus bijuga flexuosus*	2.00	5,425.92	10,852	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	1.00	1,406.72	1,407	12-16 cell colony
undet colonial desmid	14.00	1,256.00	17,584	linear col of 16+robust ovate cells
colonial nannoplankton (sph)	288.00	113.04	32,556	
unicell (sph) nannoplktn	20.00	904.32	18,086	some w/lamellate cell
Taxon Subtotal	**581**		**136,360**	
Chrysophyta				
Dinobryon sociale (tenta)	200.00	635.85	127,170	deterior cells
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	44.00	267.95	11,790	
chrysophyte (unicell)	1.00	1,393.11	1,393	ellip cells
Bacillariophyceae				
Fragilaria crotonensis	80.00	600.00	48,000	
Fragilaria crotonensis	160.00	787.50	126,000	
Navicula sp.	1.00	483.56	484	
Synedra sp.	6.00	90.67	544	
undet pennate diatom	1.00	769.30	769	naviculoid cell
Taxon Subtotal	**515**		**341,444**	
Cryptophyta				
Cryptomonas spp.	26.00	1,857.31	48,290	assoc w/detritus
cryptomonad	36.00	1,036.20	37,303	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	70.00	172.29	12,060	assoc w/detritus
Taxon Subtotal	**132**		**97,654**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**2,671**	**Total Volume**	**582,854**	**0.583**
Percent Cyanophyta	**54.02**	Percent Cyanophyta	**1.27**	
Percent Chlorophyta	**21.75**	Percent Chlorophyta	**23.40**	
Percent Chrysophyta	**19.28**	Percent Chrysophyta	**58.58**	
Percent Cryptophyta	**4.94**	Percent Cryptophyta	**16.75**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/24/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	1,000.00	2.68	2,679	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	5.00	1,281.87	6,409	threadlike fil<3um width;sheath?
Taxon Subtotal	**1,005**		**9,089**	
Chlorophyta				
Crucigenia irregularis/rectangularis asmblg	176.00	174.14	30,648	
Oocystis sp.	2.00	2,355.00	4,710	single cells
Oocystis sp.	1.00	1,013.17	1,013	
Oocystis sp.	4.00	468.91	1,876	
Oocystis sp.	4.00	105.98	424	
Quadrigula sp.	4.00	253.29	1,013	
* *Scenedesmus bijuga flexuosus*	2.00	1,406.72	2,813	12-16 cell colony
undet colonial desmid	21.00	1,256.00	26,376	linear col of 8+ robust ovate cells
colonial nannoplankton (sph)	104.00	150.46	15,647	
unicell (sph) nannoplktn	26.00	1,436.03	37,337	some w/lamellate cell
Taxon Subtotal	**344**		**121,858**	
Chrysophyta				
Dinobryon sociale (tenta)	70.00	635.85	44,510	deterior cells
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	33.00	267.95	8,842	
Bacillariophyceae				
Fragilaria crotonensis	20.00	600.00	12,000	
Fragilaria crotonensis	130.00	787.50	102,375	
Aulacoseira/Melosira spp.complex	48.00	2,198.00	105,504	cells w/term spine
undet pennate diatom	1.00	1,641.17	1,641	naviculoid cell
Taxon Subtotal	**324**		**300,167**	
Cryptophyta				
Cryptomonas spp.	56.00	1,928.75	108,010	assoc w/detritus
Cryptomonas sp.	1.00	5,934.60	5,935	
cryptomonad	50.00	1,036.20	51,810	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	77.00	172.29	13,266	assoc w/detritus
Taxon Subtotal	**184**		**179,021**	
Euglenophyta				
Pyrrhophyta				
Ceratium hirundinella	1.00	60,000.00	60,000	
Taxon Subtotal	**1.00**		**60,000**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**1,858**	**Total Volume**	**670,134**	**0.670**
Percent Cyanophyta	**54.09**	Percent Cyanophyta	**1.36**	
Percent Chlorophyta	**18.51**	Percent Chlorophyta	**18.18**	
Percent Chrysophyta	**17.44**	Percent Chrysophyta	**44.79**	
Percent Cryptophyta	**9.90**	Percent Cryptophyta	**26.71**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.05**	Percent Pyrrhophyta	**8.95**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/24/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	2,000.00	2.68	5,359	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	2.00	572.27	1,145	threadlike fil<3um width;no sheath
colonial cyanophyte	100.00	14.13	1,413	dense pack cells<4um;aerotopes?;irreg col
Taxon Subtotal	**2,102**		**7,916**	
Chlorophyta				
Crucigenia irregularis/rectangularis asmblg	48.00	174.14	8,359	
Oocystis sp.	1.00	1,013.17	1,013	
Oocystis sp.	4.00	226.08	904	
* *Scenedesmus bijuga flexuosus*	3.00	1,406.72	4,220	12-16cell colony
* *Scenedesmus bijuga flexuosus*	1.00	5,425.92	5,426	robust 16+cell colony
undet colonial desmid	14.00	1,256.00	17,584	linear colony of robust ovate cells
colonial nannoplankton (sph)	64.00	150.46	9,629	
colonial nannoplankton (sph)	4.00	904.32	3,617	
unicell (sph) nannoplktn	1.00	4,186.67	4,187	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	15.00	1,436.03	21,540	some w/lamellate cell
Taxon Subtotal	**155**		**76,480**	
Chrysophyta				
Dinobryon divergens	15.00	847.80	12,717	deterior cells
Dinobryon sociale (tenta)	30.00	635.85	19,076	deterior cells
chrysophyte (unicell)	10.00	1,149.76	11,498	
chrysophyte (unicell)	22.00	267.95	5,895	
chrysophyte (flagel-unicell)	10.00	130.83	1,308	flagel clavate cells
Bacillariophyceae				
Asterionella formosa	8.00	562.69	4,502	
Fragilaria crotonensis	100.00	787.50	78,750	
Aulacoseira/Melosira spp.complex	8.00	3,165.12	25,321	
Synedra sp.	1.00	199.47	199	
undet pennate diatom	1.00	1,071.79	1,072	naviculoid cell
Taxon Subtotal	**205**		**160,337**	
Cryptophyta				
Cryptomonas spp.	90.00	2,000.18	180,016	assoc w/detritus
Cryptomonas sp.	2.00	5,652.00	11,304	
cryptomonad	70.00	1,036.20	72,534	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	95.00	172.29	16,368	assoc w/detritus
Taxon Subtotal	**257**		**280,222**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**2,719**	**Total Volume**	**524,955**	**0.525**
Percent Cyanophyta	**77.31**	Percent Cyanophyta	**1.51**	
Percent Chlorophyta	**5.70**	Percent Chlorophyta	**14.57**	
Percent Chrysophyta	**7.54**	Percent Chrysophyta	**30.54**	
Percent Cryptophyta	**9.45**	Percent Cryptophyta	**53.38**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/25/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anabaena sp.	30.00	401.92	12,058	linear fil;compres barrel-shp cells;sph hetero
Anacystis (Aphanothece/Anathece)spp.	500.00	2.68	1,340	cells<2um;irreg,clathrate col
Coelosphaerium/Snowella spp. grp	120.00	22.44	2,693	tiny cell grps @ col mucous edge;fibrils?
Taxon Subtotal	**650**		**16,090**	
Chlorophyta				
* *Botryococcus sp.*	1.00	8,205.87	8,206	small col<40um diam
* *Coelastrum microporum*	1.00	3,349.33	3,349	small col<20um diam
Kirchneriella/Nephrocytium spp.asmblg	4.00	183.17	733	
Oocystis sp.	1.00	2,051.47	2,051	unicells>20um
Oocystis sp.	4.00	1,013.17	4,053	
Oocystis sp.	16.00	95.38	1,526	
* *Pediastrum duplex*	1.00	28,260.00	28,260	large col>120um diam
Quadrigula sp.	4.00	344.42	1,378	robust cells
* *Scenedesmus arcuatus*	1.00	736.85	737	8-cell colony
* *Scenedesmus bijuga*	3.00	1,296.86	3,891	8-cell colony
* *Scenedesmus bijuga flexuosus*	1.00	5,425.92	5,426	robust 16+cell colony
Staurastrum sp	1.00	13,319.68	13,320	robust cells
Tetraedron minimum	1.00	784.00	784	
undet colonial desmid	50.00	1,256.00	62,800	linear colony of robust ovate cells
colonial nannoplankton (sph)	16.00	150.46	2,407	
colonial nannoplankton (sph)	8.00	904.32	7,235	
unicell (sph) nannoplktn	3.00	4,186.67	12,560	
unicell (sph) nannoplktn	20.00	1,436.03	28,721	some w/lamellate cell
Taxon Subtotal	**136**		**187,435**	
Chrysophyta				
chrysophyte (unicell)	44.00	1,149.76	50,590	
chrysophyte (unicell)	55.00	267.95	14,737	
chrysophyte (unicell)	5.00	1,657.92	8,290	ellip cells<30um
Bacillariophyceae				
Asterionella formosa	80.00	482.30	38,584	
Fragilaria crotonensis	160.00	600.00	96,000	
Fragilaria crotonensis	600.00	787.50	472,500	
Aulacoseira/Melosira spp.complex	32.00	3,617.28	115,753	
Aulacoseira/Melosira spp.complex	14.00	628.00	8,792	slender cells
Aulacoseira/Melosira spp.complex	108.00	1,507.20	162,778	
Nitzschia sp.	2.00	1,884.00	3,768	
Synedra sp.	1.00	989.10	989	
Tabellaria fenestrata	1.00	5,390.00	5,390	
undet pennate diatom	4.00	143.92	576	naviculoid cell
Taxon Subtotal	**1106**		**978,746**	
Cryptophyta				
Cryptomonas spp.	96.00	2,000.18	192,017	assoc w/detritus
Cryptomonas sp.	4.00	5,652.00	22,608	
cryptomonad	44.00	1,036.20	45,593	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	143.00	172.29	24,638	assoc w/detritus
Taxon Subtotal	**287**		**284,856**	
Euglenophyta				
Pyrrhophyta				
Ceratium hirundinella	1.00	60,000.00	60,000	
Taxon Subtotal	**1.00**		**60,000**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**2,180**	**Total Volume**	**1,527,127**	**1.527**
Percent Cyanophyta	**29.82**	Percent Cyanophyta	**1.05**	
Percent Chlorophyta	**6.24**	Percent Chlorophyta	**12.27**	
Percent Chrysophyta	**50.73**	Percent Chrysophyta	**64.09**	
Percent Cryptophyta	**13.17**	Percent Cryptophyta	**18.65**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.05**	Percent Pyrrhophyta	**3.93**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/25/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anabaena sp.	30.00	551.07	16,532	linear fil;compres barrel-shp cells;sph hetero
Anabaena spiroides	800.00	628.00	502,400	sph cells<12um;reg spiral filaments
Aphanocapsa/Microcystis spp. complex	100.00	54.33	5,433	cells<5um;aerotopes?;small ovate col;lt col mucous
Coelosphaerium/Snowella spp. grp	60.00	22.44	1,346	tiny cell grps @ col mucous edge;fibrils?
+ Oscillatoriales: Pseudanabaenaceae	3.00	515.04	1,545	threadlike fil<3um width;no sheath
Microcystis wesenbergii/aeruginosa asmblg	100.00	87.07	8,707	small col<100 cells<6um w/aerotopes;thick col mucous
Microcystis aeruginosa	200.00	87.07	17,414	ovate col<200 cells<6um w/aerotopes;lt. col mucous
colonial cyanophyte	60.00	14.13	848	dense pack cells<4um;aerotopes?;irreg col
Taxon Subtotal	**1,353**		**554,226**	
Chlorophyta				
* *Botryococcus sp.*	1.00	8,205.87	8,206	small col<40um diam
Oocystis sp.	1.00	5,861.33	5,861	large unicells>30um
Oocystis sp.	12.00	1,013.17	12,158	
Oocystis sp.	2.00	593.46	1,187	
Oocystis sp.	8.00	226.08	1,809	
Quadrigula sp.	12.00	253.29	3,040	
Staurastrum sp	1.00	13,658.08	13,658	robust cells
Staurastrum chaetocerus (tenta)	1.00	2,416.14	2,416	
undet colonial desmid	35.00	1,256.00	43,960	linear colony of robust ovate cells
colonial nannoplankton (sph)	40.00	1,766.25	70,650	
colonial nannoplankton (sph)	160.00	150.46	24,073	
colonial nannoplankton (sph)	32.00	904.32	28,938	
unicell (sph) nannoplktn	1.00	9,198.11	9,198	cell>20um
unicell (sph) nannoplktn	220.00	904.32	198,950	some w/lamellate cell
Taxon Subtotal	**526**		**424,104**	
Chrysophyta				
Mallomonas sp.	1.00	3,077.20	3,077	
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	33.00	267.95	8,842	
Bacillariophyceae				
Asterionella formosa	104.00	482.30	50,160	
Fragilaria sp.	40.00	756.00	30,240	
Fragilaria crotonensis	800.00	675.00	540,000	
Fragilaria crotonensis	3,900.00	862.50	3,363,750	
Gomphonema sp.	1.00	1,680.00	1,680	
Aulacoseira/Melosira spp.complex	50.00	1,507.20	75,360	cells w/term spine
Nitzschia sp.	1.00	2,176.02	2,176	cells>100um
Taxon Subtotal	**4952**		**4,100,580**	
Cryptophyta				
Cryptomonas spp.	250.00	2,000.18	500,045	assoc w/detritus
Cryptomonas sp.	10.00	5,652.00	56,520	assoc w/detritus
cryptomonad	77.00	1,036.20	79,787	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	330.00	172.29	56,856	assoc w/detritus
Taxon Subtotal	**667**		**693,209**	
Euglenophyta				
Pyrrhophyta				
Ceratium hirundinella	11.00	60,000.00	660,000	
Taxon Subtotal	**11.00**		**660,000**	
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**7,509**	**Total Volume**	**6,432,118**	**6.432**
Percent Cyanophyta	**18.02**	Percent Cyanophyta	**8.62**	
Percent Chlorophyta	**7.00**	Percent Chlorophyta	**6.59**	
Percent Chrysophyta	**65.95**	Percent Chrysophyta	**63.75**	
Percent Cryptophyta	**8.88**	Percent Cryptophyta	**10.78**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.15**	Percent Pyrrhophyta	**10.26**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 9/25/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL5 (0.5m) **NOTE: many empty diatom frustules**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Aphanocapsa/Microcystis spp. complex	20.00	54.33	1,087	cells<5um;aerotopes?;ovate col;lt col mucous
Anacystis (Aphanothece/Anathece)spp.	200.00	2.68	536	cells<2um;irreg,clathrate col
Taxon Subtotal	**220**		**1,623**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
Ankistrodesmus falcatus	4.00	114	456	
Kirchneriella/Nephrocytium spp.asmblg	4.00	244.92	980	
Oocystis sp.	4.00	2,355.00	9,420	cell>20um
Oocystis sp.	10.00	1,013.17	10,132	deterior cells
* *Pediastrum boryanum*	1.00	9,231.60	9,232	small col<70um diam
* *Pediastrum tetras*	5.00	1,570.00	7,850	small col<28um diam
* *Scenedesmus bijuga*	20.00	256.43	5,129	4-cell colony;deterior
* *Scenedesmus quadricauda*	10.00	256.43	2,564	4-cell colony
colonial nannoplankton (sph)	120.00	150.46	18,055	
unicell (sph) nannoplktn	16.00	904.32	14,469	some w/lamellate cell
Taxon Subtotal	**204**		**79,255**	
Chrysophyta				
chrysophyte (unicell)	1.00	4,186.67	4,187	cell>20um
chrysophyte (unicell)	10.00	1,149.76	11,498	
chrysophyte (unicell)	22.00	267.95	5,895	
chrysophyte (unicell)	1.00	1,768.87	1,769	ellip cells
Bacillariophyceae				
Amphora sp.	2.00	2,237	4,475	
Cocconeis sp.	10.00	1,208.90	12,089	
Cocconeis sp.	10.00	2,355.00	23,550	
Cymbella sp.	2.00	7,033.60	14,067	
Epithemia sp.	2.00	2,077	4,154	
Fragilaria sp.	21.00	420.00	8,820	
Gomphonema sp.	6.00	1,764.00	10,584	
Hannaea arcus	1.00	1,055.04	1,055	
Aulacoseira/Melosira spp.complex	5.00	1,077.02	5,385	
Melosira varians	4.00	9,420.00	37,680	large cell
Navicula sp.	10.00	706.50	7,065	
Navicula sp.	14.00	2,637.60	36,926	
Navicula sp.	4.00	3,516.80	14,067	
Nitzschia sp.	10.00	329.70	3,297	
Nitzschia sp.	3.00	2,386.40	7,159	
Pinnularia sp.	1.00	3,077.20	3,077	
Synedra ulna	1.00	14,112.00	14,112	
Synedra ulna	1.00	9,072.00	9,072	
Synedra sp.	5.00	1,957.27	9,786	
Synedra sp.	10.00	126.93	1,269	
Synedra sp.	10.00	211.56	2,116	
Tabellaria fenestrata	2.00	3,360.00	6,720	
undet pennate diatom	33.00	222.42	7,340	naviculoid cell
undet pennate diatom	20.00	293.07	5,861	naviculoid cell
undet pennate diatom	22.00	703.36	15,474	naviculoid cell
undet pennate diatom	55.00	1,764.00	97,020	naviculoid cell
undet pennate diatom	140.00	192.00	26,880	chain of cells
Taxon Subtotal	**438**		**412,449**	
Cryptophyta				
Cryptomonas spp.	2.00	2,000.18	4,000	assoc w/detritus
cryptomonad	11.00	1,036.20	11,398	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	66.00	172.29	11,371	assoc w/detritus
Taxon Subtotal	**79**		**26,770**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**941**	**Total Volume**	**520,096**	**0.520**
Percent Cyanophyta	**23.38**	Percent Cyanophyta	**0.31**	
Percent Chlorophyta	**21.68**	Percent Chlorophyta	**15.24**	
Percent Chrysophyta	**46.55**	Percent Chrysophyta	**79.30**	
Percent Cryptophyta	**8.40**	Percent Cryptophyta	**5.15**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 10/14/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL0 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	1,000.00	2.68	2,679	cells<2um;irreg,clathrate col
Coelosphaerium/Snowella spp. grp	40.00	22.44	898	tiny cell grps @ col mucous edge;fibrils?
+ Oscillatoriales: Pseudanabaenaceae	10.00	2,117.38	21,174	threadlike fil<3um width;thin sheath?
Taxon Subtotal	**1,050**		**24,751**	
Chlorophyta				
Ankistrodesmus falcatus	2.00	125	251	
Oocystis sp.	5.00	1,013.17	5,066	
* *Pediastrum duplex*	1.00	29,437.50	29,438	mod col-100um diam
Quadrigula sp.	4.00	253.29	1,013	
* *Scenedesmus quadricauda*	1.00	256.43	256	4-cell colony
undet colonial desmid	7.00	1,256.00	8,792	linear col of 16+robust ovate cells
colonial nannoplankton (sph)	48.00	113.04	5,426	
unicell (sph) nannoplktn	2.00	4,186.67	8,373	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	55.00	904.32	49,738	some w/lamellate cell
Taxon Subtotal	**125**		**108,353**	
Chrysophyta				
Dinobryon divergens	10.00	602.88	6,029	deterior cells
Mallomonas sp.	1.00	2,461.76	2,462	
Rhizochrysis sp.	1.00	8,205.87	8,206	
chrysophyte (unicell)	10.00	4,186.67	41,867	cell>20um
chrysophyte (unicell)	33.00	1,149.76	37,942	
chrysophyte (unicell)	100.00	267.95	26,795	
chrysophyte (flagel-unicell)	33.00	196.25	6,476	flagel clavate cells
Bacillariophyceae				
Asterionella formosa	20.00	562.69	11,254	
Asterionella formosa	500.00	803.84	401,920	cell>100um
Cyclotella sp.	10.00	1,607.68	16,077	
Fragilaria crotonensis	20.00	600.00	12,000	
Fragilaria crotonensis	500.00	787.50	393,750	cell>100um
Aulacoseira/Melosira spp.complex	5.00	1,406.72	7,034	
Aulacoseira/Melosira spp.complex	2.00	5,626.88	11,254	robust cell
Nitzschia sp.	1.00	392.50	393	
Taxon Subtotal	**1246**		**983,457**	
Cryptophyta				
Cryptomonas spp.	26.00	2,000.18	52,005	assoc w/detritus
Cryptomonas sp.	2.00	5,652.00	11,304	
Cryptomonas sp.	1.00	13,715.52	13,716	
cryptomonad	5.00	1,036.20	5,181	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	220.00	172.29	37,904	assoc w/detritus
Taxon Subtotal	**254**		**120,109**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**2,675**	**Total Volume**	**1,236,669**	**1.237**
Percent Cyanophyta	**39.25**	Percent Cyanophyta	**2.00**	
Percent Chlorophyta	**4.67**	Percent Chlorophyta	**8.76**	
Percent Chrysophyta	**46.58**	Percent Chrysophyta	**79.52**	
Percent Cryptophyta	**9.50**	Percent Cryptophyta	**9.71**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 10/14/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL1 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anacystis (Aphanothece/Anathece)spp.	1,000.00	2.68	2,679	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	14.00	1,573.73	22,032	threadlike fil<3um width;sheath?
Taxon Subtotal	**1,014**		**24,712**	
Chlorophyta				
Oocystis sp.	8.00	468.91	3,751	
* *Pediastrum duplex*	1.00	9,616.25	9,616	mod col<80um diam
Quadrigula sp.	4.00	370.91	1,484	robust cells
* *Scenedesmus bijuga*	1.00	256.43	256	4-cell colony
* *Scenedesmus bijuga flexuosus*	1.00	1,406.72	1,407	12-16 cell colony
Schroederia/Ankyra spp. asmblg (tenta)	10.00	150.72	1,507	deterior cells
colonial nannoplankton (sph)	16.00	381.51	6,104	
colonial nannoplankton (sph)	16.00	1,436.03	22,976	
unicell (sph) nannoplktn	66.00	1,436.03	94,778	some w/lamellate cell
unicell (sph) nannoplktn	10.00	4,186.67	41,867	cells>20um;some w/lamellate cell
Taxon Subtotal	**133**		**183,747**	
Chrysophyta				
Dinobryon divergens	10.00	636.37	6,364	deterior cells
Mallomonas sp.	1.00	2,872.05	2,872	
Rhizochrysis sp.	1.00	7,075.47	7,075	
chrysophyte (unicell)	88.00	1,149.76	101,179	
chrysophyte (unicell)	220.00	267.95	58,948	
chrysophyte (flagel-unicell)	10.00	196.25	1,963	flagel clavate cells
Bacillariophyceae				
Asterionella formosa	16.00	643.07	10,289	
Cyclotella sp.	10.00	1,538.60	15,386	tiny cells<14 um diam
Fragilaria crotonensis	10.00	600.00	6,000	
Fragilaria crotonensis	220.00	787.50	173,250	
Aulacoseira/Melosira spp.complex	22.00	1,153.95	25,387	
Aulacoseira/Melosira spp.complex	10.00	2,198.00	21,980	cells w/term spine
Synedra sp.	3.00	199.47	598	
Synedra sp.	1.00	370.44	370	
Taxon Subtotal	**622**		**431,662**	
Cryptophyta				
Cryptomonas spp.	106.00	2,000.18	212,019	assoc w/detritus
Cryptomonas sp.	15.00	5,934.60	89,019	
Cryptomonas sp.	2.00	13,715.52	27,431	
cryptomonad	55.00	1,036.20	56,991	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	605.00	172.29	104,237	assoc w/detritus
Taxon Subtotal	**783**		**489,697**	
Euglenophyta				
Pyrrhophyta				
Undetermined				
undeter unicell	4.00	7,234.56	28,938	dense cell<30um diam
Taxon Subtotal	**4.00**		**28,938**	

			(um3/ml)	(mm3/L)
Total Number/ml	**2,556**	**Total Volume**	**1,158,755**	**1.159**
Percent Cyanophyta	**39.67**	Percent Cyanophyta	**2.13**	
Percent Chlorophyta	**5.20**	Percent Chlorophyta	**15.86**	
Percent Chrysophyta	**24.33**	Percent Chrysophyta	**37.25**	
Percent Cryptophyta	**30.63**	Percent Cryptophyta	**42.26**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.16**	Percent Undetermined	**2.50**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 10/14/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL2 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anabaena sp.	30.00	551.07	16,532	linear fil;compres barrel-shp cells>10um;sph hetero
Anabaena spiroides (crassa)	10.00	680.33	6,803	sph cells>12um;reg spiral filaments
Anacystis (Aphanothece/Anathece)spp.	1,500.00	2.68	4,019	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	6.00	1,802.63	10,816	threadlike fil<3um width;no sheath
colonial cyanophyte	200.00	14.13	2,826	dense pack cells<4um;aerotopes?;irreg col
Taxon Subtotal	**1,746**		**40,996**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
* *Coelastrum sp.*	1.00	8,205.87	8,206	small colonies
Crucigenia irregularis/rectangularis asmblg	4.00	174.14	697	
Oocystis sp.	4.00	468.91	1,876	
* *Scenedesmus bijuga flexuosus*	3.00	5,425.92	16,278	robust 16+cell colony
Schroederia/Ankyra spp. asmblg (tenta)	22.00	150.72	3,316	cells deteriorated
undet colonial desmid	18.00	1,256.00	22,608	linear colony of robust ovate cells
colonial nannoplankton (sph)	8.00	150.46	1,204	
unicell (sph) nannoplktn	11.00	4,186.67	46,053	some w/lamellate cell;cell>20um
unicell (sph) nannoplktn	44.00	1,436.03	63,185	some w/lamellate cell
Taxon Subtotal	**125**		**164,391**	
Chrysophyta				
Rhizochrysis sp.	3.00	7,075.47	21,226	
chrysophyte (unicell)	100.00	1,149.76	114,976	
chrysophyte (unicell)	200.00	267.95	53,589	
chrysophyte (flagel-unicell)	10.00	130.83	1,308	flagel clavate cells
Bacillariophyceae				
Asterionella formosa	48.00	803.84	38,584	celsl>100um
Cyclotella sp.	10.00	2,009.60	20,096	
Fragilaria crotonensis	500.00	787.50	393,750	
Aulacoseira/Melosira spp.complex	135.00	1,907.55	257,519	cells w/term spine
Aulacoseira/Melosira spp.complex	58.00	588.75	34,148	slender cells
Navicula sp.	1.00	2,009.60	2,010	
Synedra sp.	1.00	126.93	127	
Synedra sp.	2.00	229.69	459	
Synedra sp.	2.00	824.25	1,649	
Taxon Subtotal	**1070**		**939,442**	
Cryptophyta				
Cryptomonas spp.	35.00	2,000.18	70,006	assoc w/detritus
Cryptomonas sp.	1.00	5,652.00	5,652	
cryptomonad	10.00	1,036.20	10,362	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	66.00	172.29	11,371	assoc w/detritus
Taxon Subtotal	**112**		**97,392**	
Euglenophyta				
Pyrrhophyta				
Undetermined				
undeter unicell	1.00	11,488.21	11,488	dense cell<30um diam
Taxon Subtotal	**1.00**		**11,488**	

			(um3/ml)	(mm3/L)
Total Number/ml	**3,054**	**Total Volume**	**1,253,709**	**1.254**
Percent Cyanophyta	**57.17**	Percent Cyanophyta	**3.27**	
Percent Chlorophyta	**4.09**	Percent Chlorophyta	**13.11**	
Percent Chrysophyta	**35.04**	Percent Chrysophyta	**74.93**	
Percent Cryptophyta	**3.67**	Percent Cryptophyta	**7.77**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.03**	Percent Undetermined	**0.92**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 10/15/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL3 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Anabaena sp.	55.00	551.07	30,309	linear fil;compres barrel-shp cells>10um;sph hetero
Anabaena spiroides	100.00	680.33	68,033	sph cells<12um;reg spiral filaments
Anacystis (Aphanothece/Anathece)spp.	1,000.00	2.68	2,679	cells<2um;irreg,clathrate col
+ Oscillatoriales: Pseudanabaenaceae	10.00	1,859.86	18,599	threadlike fil<3um width;no sheath
colonial cyanophyte	100.00	14.13	1,413	dense pack cells,irreg col
* *Woronichinia spp.*	1.00	366,333.33	366,333	small disinteg colonies<100um diam;fibrils
Taxon Subtotal	**1,266**		**487,367**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
Oocystis sp.	4.00	635.85	2,543	
Pandorina sp.	16.00	886.53	14,184	compres cells
* *Scenedesmus bijuga*	4.00	1,134.75	4,539	8-cell colony
* *Scenedesmus bijuga flexuosus*	1.00	5,425.92	5,426	robust 16+cell colony
* *Scenedesmus bijuga flexuosus*	2.00	1,406.72	2,813	12-16-cell colony
* *Scenedesmus quadricauda*	1.00	648.43	648	4-cell colony
Schroederia/Ankyra spp. asmblg (tenta)	22.00	150.72	3,316	cells deteriorated
undet colonial desmid	21.00	1,256.00	26,376	linear colony of robust ovate cells
colonial nannoplankton (sph)	80.00	150.46	12,036	
unicell (sph) nannoplktn	4.00	11,488.21	45,953	cell>25um
unicell (sph) nannoplktn	5.00	4,186.67	20,933	cell>20um
unicell (sph) nannoplktn	55.00	1,436.03	78,981	some w/lamellate cell
Taxon Subtotal	**225**		**218,719**	
Chrysophyta				
Dinobryon divergens	30.00	847.80	25,434	deterior cells
Dinobryon sociale (tenta)	80.00	635.85	50,868	deterior cells
Mallomonas sp.	22.00	1,945.75	42,807	
Rhizochrysis sp.	4.00	7,075.47	28,302	
chrysophyte (unicell)	10.00	9,905.65	99,057	cell>25um
chrysophyte (unicell)	44.00	4,186.67	184,213	cell>20um
chrysophyte (unicell)	154.00	1,149.76	177,064	
chrysophyte (unicell)	330.00	267.95	88,422	
Bacillariophyceae				
Amphora sp.	2.00	9,232	18,463	
Asterionella formosa	16.00	562.69	9,003	
Asterionella formosa	80.00	803.84	64,307	cells>100um length
Cocconeis sp.	10.00	2,355.00	23,550	
Cyclotella sp.	10.00	2,009.60	20,096	
Fragilaria crotonensis	750.00	787.50	590,625	
Aulacoseira/Melosira spp.complex	116.00	2,355.00	273,180	
Aulacoseira/Melosira spp.complex	125.00	1,507.20	188,400	
Navicula sp.	10.00	518.10	5,181	
Synedra sp.	10.00	126.93	1,269	
Synedra sp.	10.00	222.26	2,223	
Taxon Subtotal	**1813**		**1,892,464**	
Cryptophyta				
Cryptomonas spp.	120.00	2,000.18	240,022	assoc w/detritus
Cryptomonas sp.	5.00	5,652.00	28,260	
Cryptomonas sp.	2.00	13,715.52	27,431	
cryptomonad	55.00	1,036.20	56,991	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	400.00	172.29	68,917	assoc w/detritus
Taxon Subtotal	**582**		**421,620**	
Euglenophyta				
Pyrrhophyta				
small dinoflagellate	5.00	1,055.04	5,275	tiny cell;thecal plates obscure
small dinoflagellate	1.00	5,388.24	5,388	small cell;thecal plates obscure
Taxon Subtotal	**6.00**		**10,663**	
Undetermined				

			(um3/ml)	**(mm3/L)**
Total Number/ml	**3,892**	**Total Volume**	**3,030,834**	**3.031**
Percent Cyanophyta	**32.53**	Percent Cyanophyta	**16.08**	
Percent Chlorophyta	**5.78**	Percent Chlorophyta	**7.22**	
Percent Chrysophyta	**46.58**	Percent Chrysophyta	**62.44**	
Percent Cryptophyta	**14.95**	Percent Cryptophyta	**13.91**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.15**	Percent Pyrrhophyta	**0.35**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 10/15/2013 **SAMPLE STATUS: Lugol preserved**
STATION: Lk Spokane-LL4 (0.5m) **NOTE:**

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
+ Oscillatoriales: Pseudanabaenaceae	1.00	400.59	401	threadlike fil<3um width;no sheath
Taxon Subtotal	**1**		**401**	
Chlorophyta				
Ankistrodesmus falcatus	10.00	97	969	cells deteriorated
Ankistrodesmus falcatus	4.00	125	502	
Nephrocytium sp.	2.00	678.24	1,356	
Oocystis sp.	4.00	226.08	904	
Pandorina sp.	4.00	1,055.04	4,220	
* *Pediastrum tetras*	5.00	1,570.00	7,850	small col<25um diam
Quadrigula sp.	2.00	317.93	636	robust cells
* *Scenedesmus bijuga*	4.00	732.67	2,931	4-cell colony
colonial nannoplankton (sph)	96.00	150.46	14,444	
colonial nannoplankton (sph)	8.00	523.33	4,187	
unicell (sph) nannoplktn	10.00	1,436.03	14,360	some w/lamellate cell
Taxon Subtotal	**149**		**52,359**	
Chrysophyta				
chrysophyte (unicell)	22.00	1,149.76	25,295	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Amphora sp.	1.00	7,253	7,253	
Asterionella formosa	60.00	562.69	33,761	
Cyclotella sp.	10.00	2,009.60	20,096	
Cymbella sp.	1.00	11,429.60	11,430	
Fragilaria sp.	6.00	756.00	4,536	
Fragilaria crotonensis	30.00	862.50	25,875	
Gomphonema sp.	22.00	1,575.00	34,650	
Aulacoseira/Melosira spp.complex	14.00	2,355.00	32,970	cells w/term spine
Aulacoseira/Melosira spp.complex	4.00	4,945.50	19,782	
Melosira varians	8.00	9,420.00	75,360	large cell
Navicula sp.	22.00	439.60	9,671	
Navicula sp.	33.00	580.27	19,149	
Navicula sp.	10.00	2,888.80	28,888	
Navicula sp.	1.00	21,100.80	21,101	
Nitzschia sp.	10.00	361.10	3,611	
Nitzschia sp.	1.00	8,820.00	8,820	
Nitzschia sp.	1.00	8,007.00	8,007	
Synedra sp.	4.00	2,260.80	9,043	
Synedra sp.	10.00	90.67	907	
Synedra sp.	10.00	126.93	1,269	
Synedra sp.	10.00	211.56	2,116	
undet pennate diatom	22.00	143.92	3,166	naviculoid cell
undet pennate diatom	10.00	329.70	3,297	naviculoid cell
undet pennate diatom	10.00	5,376.00	53,760	
undet pennate diatom	10.00	2,009.60	20,096	naviculoid cell
undet pennate diatom	4.00	6,280.00	25,120	naviculoid cell>100um
undet pennate diatom	100.00	268.80	26,880	chain of cells
Taxon Subtotal	**501**		**550,646**	
Cryptophyta				
Cryptomonas spp.	10.00	2,000.18	20,002	assoc w/detritus
cryptomonad	6.00	1,036.20	6,217	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	100.00	172.29	17,229	assoc w/detritus
Taxon Subtotal	**116**		**43,448**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**767**	**Total Volume**	**646,853**	**0.647**
Percent Cyanophyta	**0.13**	Percent Cyanophyta	**0.06**	
Percent Chlorophyta	**19.43**	Percent Chlorophyta	**8.09**	
Percent Chrysophyta	**65.32**	Percent Chrysophyta	**85.13**	
Percent Cryptophyta	**15.12**	Percent Cryptophyta	**6.72**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

LAKE SPOKANE
LAKE PHYTOPLANKTON
DATE: 10/15/2013
STATION: Lk Spokane-LL5 (0.5m)

SAMPLE STATUS: Lugol preserved
NOTE: many empty diatom frustules

Taxon	Cells(Col)/ml	µm3/cell	µm3/ml	comments
Cyanophyta				
Chlorophyta				
Oocystis sp.	4.00	2,355.00	9,420	cell>20um
Oocystis sp.	2.00	593.46	1,187	
Oocystis sp.	4.00	296.35	1,185	
* *Pediastrum duplex*	1.00	14,424.38	14,424	mod col-80um diam
* *Pediastrum tetras*	2.00	1,570.00	3,140	small col<28um diam
Quadrigula sp.	8.00	253.29	2,026	
* *Scenedesmus bijuga*	6.00	256.43	1,539	4-cell colony;deterior
undet filamentous green	4.00	2,813.44	11,254	
colonial nannoplankton (sph)	8.00	150.46	1,204	
unicell (sph) nannoplktn	20.00	904.32	18,086	some w/lamellate cell
Taxon Subtotal	**59**		**63,465**	
Chrysophyta				
Dinobryon divergens	20.00	669.87	13,397	deterior cells
Mallomonas sp.	4.00	2,872.05	11,488	
chrysophyte (unicell)	12.00	1,149.76	13,797	
chrysophyte (unicell)	55.00	267.95	14,737	
Bacillariophyceae				
Amphora sp.	2.00	9,232	18,463	
Asterionella formosa	40.00	562.69	22,508	
Cocconeis sp.	10.00	1,208.90	12,089	
Cocconeis sp.	10.00	2,355.00	23,550	
Cymbella sp.	1.00	7,033.60	7,034	
Gomphonema sp.	22.00	1,470.00	32,340	
Gomphonema sp.	2.00	2,646.00	5,292	
Melosira varians	5.00	9,420.00	47,100	large cell
Navicula sp.	11.00	188.40	2,072	
Navicula sp.	22.00	706.50	15,543	
Navicula sp.	11.00	2,637.60	29,014	
Nitzschia sp.	10.00	329.70	3,297	
Nitzschia sp.	1.00	2,512.00	2,512	
Nitzschia sp.	1.00	6,825.00	6,825	cells>100um length
Nitzschia sp.	1.00	8,925.00	8,925	cells>120um length
Pinnularia sp.	1.00	1,318.80	1,319	
Synedra sp.	3.00	2,313.13	6,939	
Synedra sp.	3.00	1,957.27	5,872	
Synedra sp.	11.00	126.93	1,396	
Synedra sp.	11.00	200.02	2,200	
Tabellaria fenestrata	5.00	5,880.00	29,400	
Tabellaria flocculosa	1.00	2,744.00	2,744	
undet pennate diatom	22.00	117.75	2,591	naviculoid cell
undet pennate diatom	22.00	244.66	5,382	naviculoid cell
undet pennate diatom	11.00	703.36	7,737	naviculoid cell
undet pennate diatom	11.00	1,995.00	21,945	naviculoid cell
undet pennate diatom	11.00	3,675.00	40,425	
undet pennate diatom	11.00	1,758.40	19,342	naviculoid cell
undet pennate diatom	42.00	230.40	9,677	chain of cells
Taxon Subtotal	**405**		**446,953**	
Cryptophyta				
Cryptomonas spp.	6.00	2,000.18	12,001	assoc w/detritus
cryptomonad	3.00	1,036.20	3,109	assoc w/detritus
small cryptomonads incl. Rhodomonas spp.	55.00	172.29	9,476	assoc w/detritus
Taxon Subtotal	**64**		**24,586**	
Euglenophyta				
Pyrrhophyta				
Undetermined				

			(um3/ml)	(mm3/L)
Total Number/ml	**528**	**Total Volume**	**535,004**	**0.535**
Percent Cyanophyta	**0.00**	Percent Cyanophyta	**0.00**	
Percent Chlorophyta	**11.17**	Percent Chlorophyta	**11.86**	
Percent Chrysophyta	**76.70**	Percent Chrysophyta	**83.54**	
Percent Cryptophyta	**12.12**	Percent Cryptophyta	**4.60**	
Percent Euglenophyta	**0.00**	Percent Euglenophyta	**0.00**	
Percent Pyrrhophyta	**0.00**	Percent Pyrrhophyta	**0.00**	
Percent Undetermined	**0.00**	Percent Undetermined	**0.00**	

***= colony** **+=filament**

APPENDIX D – Lake Spokane Zooplankton Data

(See PDF of Laboratory Data)

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CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0
DATE: 13-May-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella dense; Melosira conspic

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	103	0	2.5	258
Nauplii	calanoid+cyclopoid		<.3	4,128	0	0.25	1,032
Class Branchiopoda(cladocerans)							
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Notholca sp.	truncated posterior extension		0.15	516	0	0.022	11
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer	pink color		0.12	516	0	0.04	21
Polyarthra sp.	appen pair not evid		0.11	3,612	0	0.03	108
Synchaeta sp.	small sp.;body contracted		0.14	1,548	0	0.025	39
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	ug/L
	10,424	**10.42**	**1,469**	**1.47**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.99		17.56	
% Nauplii	39.60		70.25	
% Cladocerans	0.00		0.00	
% Rotifers	59.41		12.19	
% Dipterans	0.00		0.00	

Number of species in sample **5**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 13-May-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella dense; Melosira conspic;very few Microcystis col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar epischurids		0.7-1.0	229	0	4	917
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	4,584	0	0.25	1,146
Class Branchiopoda(cladocerans)							
Bosmina longirostris	immatures		0.3-0.35	76	0	1.5	115
Leptodora kindtii			3.0-6.0	3	0	40	107
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	76	0	0.02	2
Keratella cochlearis			0.17	764	0	0.01	8
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	5,348	0	0.03	160
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	ug/L
	11,081	**11.08**	**2,454**	**2.45**
% Calanoid Copepods	2.07		37.36	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	41.37		46.70	
% Cladocerans	0.71		9.03	
% Rotifers	55.85		6.91	
% Dipterans	0.00		0.00	

Number of species in sample **6**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 13-May-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella dense; Melosira conspic

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	191	0	2.5	476
Nauplii	calanoid+cyclopoid		<.3	6,669	0	0.25	1,667
Class Branchiopoda(cladocerans)							
Alona sp.	*A. quadrangularis-like*		0.45-0.56	95	0	2	191
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis			0.17	2,858	0	0.01	29
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer	pink color		0.12	953	0	0.04	38
Polyarthra sp.	appen pair not evid		0.11	953	0	0.03	29
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	11,718	**11.72**	**2,429**	**2.43**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	1.63		19.61	
% Nauplii	56.91		68.63	
% Cladocerans	0.81		7.84	
% Rotifers	40.65		3.92	
% Dipterans	0.00		0.00	

Number of species in sample **5**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 14-May-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic; Melosira less conspic

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	133	0	2.5	332
Nauplii	calanoid+cyclopoid		<.3	398	0	0.25	100
Class Branchiopoda(cladocerans)							
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	1,327	0	0.02	27
Keratella cochlearis			0.17	2,654	0	0.01	27
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	1,327	0	0.03	40
Type 3 (mostly malleoramates)							
Conochilus sp.	mod organisms		0.15	1,327	0	0.027	36
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	7,166	**7.17**	**560**	**0.56**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	1.85		59.24	
% Nauplii	5.56		17.77	
% Cladocerans	0.00		0.00	
% Rotifers	92.59		22.99	
% Dipterans	0.00		0.00	

Number of species in sample **5**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4
DATE: 14-May-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella/Melosira less conspic

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	3,152	0	0.25	788
Class Branchiopoda(cladocerans)							
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis f. tecta(tenta)	small form;no posterior spine		0.14	3,152	0	0.005	16
Keratella cochlearis			0.17	3,152	0	0.01	32
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	3,152	0	0.03	95
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	12,606	**12.61**	**930**	**0.93**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	25.00		84.75	
% Cladocerans	0.00		0.00	
% Rotifers	75.00		15.25	
% Dipterans	0.00		0.00	

Number of species in sample **4**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5
DATE: 14-May-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: diatoms sparse; mainly Asterionella; detrital particles/silt

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	1,486	0	2.5	3,715
Class Branchiopoda(cladocerans)							
Bosmina longirostris	immatures		0.28-0.3	1,982	0	1.1	2,180
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Type 2 (mostly illoricate virgates/incudates)							
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	3,468	**3.47**	**5,895**	**5.90**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	42.86		63.03	
% Nauplii	0.00		0.00	
% Cladocerans	57.14		36.97	
% Rotifers	0.00		0.00	
% Dipterans	0.00		0.00	

Number of species in sample **2**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0
DATE: 11Jun-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar Epischura		<1.0	103	0	4	413
Order Cyclopoida							
Copepodid			0.5-0.7	516	0	2.5	1,290
Diacyclops bicuspidatus thomasi	mod-sized females	<0.9	1.2-1.25	103	3	6	619
Nauplii	calanoid+cyclopoid		<.3	1,548	0	0.25	387
Class Branchiopoda(cladocerans)							
Daphnia	immatures;mostly D.retrocurva		1.0-1.2	1,032	0	8	8,257
Bosmina longirostris			0.385-0.42	2,064	2.5	2.5	5,160
Bosmina longirostris	immatures		0.28-0.3	2,064	0	1.1	2,271
Polyphemus pediculus			1.2-1.4	26	0	10	258
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	1,548	0	0.02	31
Keratella cochlearis			0.17	63,989	0	0.01	640
Keratella crassa			0.21	516	0	0.025	13
Keratella earlineae			0.20	1,548	0	0.019	29
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.50	52	0	2	103
Gastropus stylifer	pink color		0.12	1,548	0	0.04	62
Polyarthra sp.	appen pair not evid		0.11	9,289	0	0.03	279
Synchaeta sp.	body contracted		0.21	6,192	0	0.08	495
Synchaeta sp.	small sp.;body contracted		0.14	61,925	0	0.025	1,548
Type 3 (mostly malleoramates)							
Collotheca sp. (small)			0.10	516	0	0.006	3
Undetermined Rotifers							
Undeter illoricate rotifer	illoricate sac-like body;2 tiny toes?		0.10	516	0	0.017	9
Undeter loricate rotifer	loricate		0.14	516	0	0.02	10

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	155,612	**155.61**	**21,878**	**21.88**
% Calanoid Copepods	0.07		1.89	
% Cyclopoid Copepods	0.40		8.73	
% Nauplii	0.99		1.77	
% Cladocerans	3.33		72.89	
% Rotifers	95.21		14.73	
% Dipterans	0.00		0.00	

Number of species in sample **16**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 11-Jun-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic;

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar epischurids		0.7-1.0	225	0	4	901
Copepodid	late instar Epischura		1.7-1.8	3	0	15	41
Epischura nevadensis		1.9-2.0	2.10	3	20	27	73
Order Cyclopoida							
Copepodid			0.5-0.7	751	0	2.5	1,877
Nauplii	calanoid+cyclopoid		<.3	751	0	0.25	188
Class Branchiopoda(cladocerans)							
Daphnia	immatures;mostly D.retroW/tall helm		1.0-1.2	3,753	0	8	30,024
Daphnia pulex/pulicaria	young pulex-like females		1.70	14	0	25	338
Daphnia retrocurva	tall retrocurved helmet		1.75	14	0	20	270
Bosmina longirostris			0.385-0.42	751	2.5	2.5	1,877
Bosmina longirostris	immatures		0.28-0.3	1,501	0	1.1	1,651
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis			0.17	56,295	0	0.01	563
Keratella crassa			0.21	751	0	0.025	19
Notholca squamula/michiganensis asmblg	lorica wrinkles not evid		0.15	751	0	0.02	15
Notholca sp.	short posterior extension		0.16	751	0	0.014	11
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	3,753	0	0.03	113
Synchaeta sp.	body contracted		0.21	2,252	0	0.08	180
Synchaeta sp.	small sp.;body contracted		0.15	15,763	0	0.025	394
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	88,078	**88.08**	**38,533**	**38.53**
% Calanoid Copepods	0.26		2.63	
% Cyclopoid Copepods	0.85		4.87	
% Nauplii	0.85		0.49	
% Cladocerans	6.85		88.65	
% Rotifers	91.19		3.36	
% Dipterans	0.00		0.00	

Number of species in sample **11**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 11-Jun-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic; Melosira evid

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	991	0	0.25	248
Class Branchiopoda(cladocerans)							
Daphnia	immat; D.retro w/tall helm/few D.pulex		1.0-1.2	4,954	0	8	39,632
Daphnia retrocurva	tall retrocurved helmet	1.00	1.75-2.1	36	8	27	963
Bosmina longirostris	immatures		0.28-0.3	1,982	0	1.1	2,180
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	991	0	0.01	10
Keratella cochlearis			0.17	17,834	0	0.01	178
Keratella crassa			0.21	991	0	0.025	25
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.21	991	0	0.15	149
Polyarthra sp.	appen pair not evid		0.11	5,945	0	0.03	178
Synchaeta sp.	body contracted		0.21	2,972	0	0.08	238
Synchaeta sp.	small sp.;body contracted		0.14	2,972	0	0.025	74
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	40,658	**40.66**	**43,875**	**43.87**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	2.44		0.56	
% Cladocerans	17.15		97.49	
% Rotifers	80.42		1.94	
% Dipterans	0.00		0.00	

Number of species in sample 10
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 12-Jun-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic; Melosira less conspic

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)	
PHYLUM ARTHROPODA								
Subphylum Crustacea								
Subclass Copepoda								
Order Calanoida								
Order Cyclopoida								
Copepodid			0.5-0.7	1,304	0	2.5	3,259	
Nauplii	calanoid+cyclopoid		<.3	1,304	0	0.25	326	
Class Branchiopoda(cladocerans)								
Daphnia	immatures; mostly D.retro w/tall helmets		1.0-1.2	3,911	0	8	31,288	
Daphnia pulex/pulicaria	pulex-like females		2.10	130	0	45	5,867	
Daphnia retrocurva	tall retrocurved helmet		1.6-1.75	130	8	20	2,607	
Bosmina longirostris			0.385-0.42	1,304	2.5	2.5	3,259	
Leptodora kindtii			3.0-6.0	5	0	40	188	
Class Insecta								
Order Diptera								
PHYLUM ROTIFERA								
Type 1 (mostly loricated malleates)								
Keratella cochlearis			0.17	5,215	0	0.01	52	
Keratella crassa			0.21	1,304	0	0.025	33	
Notholca squamula/michiganensis asmblg	lorica wrinkles not evid		0.15	2,607	0	0.02	52	
Type 2 (mostly illoricate virgates/incudates)								
Asplanchna sp.	collapsed body		0.63	1,304	0	4	5,215	
Polyarthra sp.	appen pair not evid		0.11	2,607	0	0.03	78	
Synchaeta sp.	body contracted		0.21	2,607	0	0.08	209	
Synchaeta sp.	small sp.;body contracted		0.15	11,733	0	0.025	293	
Type 3 (mostly malleoramates)								
Undetermined Rotifers								
Undeter illoricate rotifer	illoricate sac-like body;2 tiny toes?		0.10	5,215	0	0.017	89	
		Total Density					**Total Dry Wt. Biomass**	
		#/m3	**#/L**				**ug/m3**	**ug/L**
		40,680	**40.68**				**52,815**	**52.81**
% Calanoid Copepods		0.00					0.00	
% Cyclopoid Copepods		3.20					6.17	
% Nauplii		3.20					0.62	
% Cladocerans		13.47					81.81	
% Rotifers		80.12					11.40	
% Dipterans		0.00					0.00	

Number of species in sample **12**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES — *WATER Environmental Services, Inc.*
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4 — **SAMPLE STATUS: Isopropyl alch-glycer pres**
DATE: 12-Jun-2013 — **COMMENTS: Asterionella/Melosira less conspic**

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)	
PHYLUM ARTHROPODA								
Subphylum Crustacea								
Subclass Copepoda								
Order Calanoida								
Order Cyclopoida								
Nauplii	calanoid+cyclopoid		<.3	498	0	0.25	124	
Class Branchiopoda(cladocerans)								
Daphnia	immat;mostly D.retro w/tall helm/few D.g.m.		1.0-1.2	249	0	8	1,990	
Daphnia galeata mendotae	small fem;helmet w/pt		1.5-1.75	22	5	25	560	
Daphnia retrocurva	tall retrocurved helmet		1.4-1.75	32	8	20	647	
Bosmina longirostris	immatures		0.28-0.3	249	0	1.1	274	
Class Insecta								
Order Diptera								
PHYLUM ROTIFERA								
Type 1 (mostly loricated malleates)								
Euchlanis sp.			0.22	2,488	0	0.08	199	
Keratella cochlearis			0.17	7,464	0	0.01	75	
Type 2 (mostly illoricate virgates/incudates)								
Polyarthra sp.	appen pair not evid		0.11	2,488	0	0.03	75	
Type 3 (mostly malleoramates)								
Conochilus sp.	small organisms		0.10-0.12	2,488	0	0.008	20	
Undetermined Rotifers								
Undeter illoricate rotifer	illoricate sac-like body;2 tiny toes?		0.10	2,488	0	0.017	42	
		Total Density					**Total Dry Wt. Biomass**	
		#/m3	**#/L**				**ug/m3**	**ug/L**
		18,466	**18.47**				**4,006**	**4.01**
% Calanoid Copepods		0.00					0.00	
% Cyclopoid Copepods		0.00					0.00	
% Nauplii		2.69					3.11	
% Cladocerans		2.99					86.65	
% Rotifers		94.31					10.25	
% Dipterans		0.00					0.00	

Number of species in sample **9**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES — *WATER Environmental Services, Inc.*
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5 — **SAMPLE STATUS: Isopropyl alch-glycer pres**
DATE: 12-Jun-2013 — **COMMENTS: diatoms sparse; mainly Asterionella; detrital particles/silt**

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)	
PHYLUM ARTHROPODA								
Subphylum Crustacea								
Subclass Copepoda								
Order Calanoida								
Order Cyclopoida								
Nauplii	calanoid+cyclopoid		<.3	478	0	0.25	119	
Class Branchiopoda(cladocerans)								
Daphnia	immatures;D.retro w/tall helm		1.0-1.2	88	0	8	707	
Daphnia retrocurva	tall retrocurved helmet		1.4-1.75	84	8	20	1,682	
Class Insecta								
Order Diptera								
PHYLUM ROTIFERA								
Type 1 (mostly loricated malleates)								
Keratella cochlearis			0.17	14,331	0	0.01	143	
Monostyla sp.			0.09	4,777	0	0.005	23.9	
Monostyla sp.			0.12	4,777	0	0.01	47.8	
Type 2 (mostly illoricate virgates/incudates)								
Type 3 (mostly malleoramates)								
Undetermined Rotifers								
		Total Density					**Total Dry Wt. Biomass**	
		#/m3	**#/L**				**ug/m3**	**ug/L**
		24,536	**24.54**				**2,723**	**2.72**
% Calanoid Copepods		0.00					0.00	
% Cyclopoid Copepods		0.00					0.00	
% Nauplii		1.95					4.39	
% Cladocerans		0.70					87.72	
% Rotifers		97.35					7.89	
% Dipterans		0.00					0.00	

CLIENT: AVISTA UTILIIES *WATER Environmental Services, Inc.*
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0 **SAMPLE STATUS: Isopropyl alch-glycer pres**
DATE: 25 Jun-2013 **COMMENTS: Asterionella conspic;other fil diatoms evid**

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar Epischura		<1.0	52	0	4	207
Order Cyclopoida							
Diacyclops bicuspidatus thomasi	mod-sized females	<0.9	1.2-1.25	569	3	6	3,261
Nauplii	calanoid+cyclopoid		<.3	1,553	0	0.25	388
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.retroW/tall helm+Dpul		1.0-1.2	518	0	8	4,141
Daphnia pulex/pulicaria	young females		1.75-1.9	9	0	30	280
Daphnia retrocurva	tall rnd retrocurved helm;males pres	1.00	1.4-1.75	521	8	20	4,216
Bosmina longirostris			0.35-0.38	104	2.5	2	207
Bosmina longirostris	immatures		0.28-0.3	2,070	0	1.1	2,277
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	1,035	0	0.01	10
Keratella cochlearis	small form		0.14	8,282	0	0.006	50
Keratella earlineae			0.20	1,035	0	0.019	20
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer	pink color		0.12	518	0	0.04	21
Polyarthra sp.	appen pair not evid		0.11	1,035	0	0.03	31
Synchaeta sp.	body contracted		0.21	1,553	0	0.08	124
Synchaeta sp.	small sp.;body contracted		0.14	5,176	0	0.025	129
Type 3 (mostly malleoramates)							
Undetermined Rotifers							
Undeter loricate rotifer	loricate;body crushed		0.14	518	0	0.02	10

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	24,548	**24.55**	**15,373**	**15.37**
% Calanoid Copepods	0.21		1.35	
% Cyclopoid Copepods	2.32		21.21	
% Nauplii	6.33		2.53	
% Cladocerans	13.13		72.34	
% Rotifers	78.02		2.57	
% Dipterans	0.00		0.00	

Number of species in sample **12**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 25-Jun-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella&Fragil conspic; some Melosira&Eudorina col evid

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	751	0	2.5	1,877
Nauplii	calanoid+cyclopoid		<.3	1,501	0	0.25	375
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.retroW/tall helm+Dpul		1.0-1.2	4,504	0	8	36,029
Daphnia pulex/pulicaria	young pulicaria-like females		1.75-2.0	75	0	30	2,252
Daphnia retrocurva	tall retrocurved helmet		1.75-2.0	751	0	27	20,266
Bosmina longirostris			0.35-0.38	751	2.5	2	1,501
Bosmina longirostris	immatures		0.28-0.3	751	0	1.1	826
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	3,002	0	0.006	18
Keratella earlineae			0.20	751	0	0.019	14
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.21	751	0	0.15	113
Polyarthra sp.	appen pair not evid		0.11	6,755	0	0.03	203
Synchaeta sp.	body contracted		0.21	1,501	0	0.08	120
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density		Total Dry Wt. Biomass	
	#/m3	**#/L**	**ug/m3**	**ug/L**
	21,843	**21.84**	**63,594**	**63.59**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	3.44		2.95	
% Nauplii	6.87		0.59	
% Cladocerans	31.27		95.72	
% Rotifers	58.42		0.74	
% Dipterans	0.00		0.00	

Number of species in sample **9**

Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 25-Jun-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic; Melosira &Fragil evid;deterior Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	2,919	0	0.25	730
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.retroW/tall helm+Dpul		1.0-1.2	1,946	0	8	15,570
Daphnia pulex/pulicaria	young pulicaria-like females		1.75-1.9	18	0	30	525
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75	11	5	25	268
Daphnia retrocurva	tall retrocurved helmet	1.00	1.75-2.1	18	8	27	473
Daphnia retrocurva	tall rnd retrocurved helmet		1.50	973	0	14	13,623
Bosmina longirostris			0.385-0.42	97	2.5	2.5	243
Bosmina longirostris	immatures		0.28-0.3	487	0	1.1	535
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	3,892	0	0.006	23
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.45-0.49	1,946	0	1.5	2,919
Gastropus stylifer	pink color		0.12	973	0	0.04	39
Polyarthra sp.	appen pair not evid		0.11	4,866	0	0.03	146
Synchaeta sp.	body contracted		0.21	3,892	0	0.08	311
Synchaeta sp.	small sp.;body contracted		0.14	9,731	0	0.025	243
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	31,769	**31.77**	**35,650**	**35.65**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	9.19		2.05	
% Cladocerans	11.17		87.62	
% Rotifers	79.64		10.33	
% Dipterans	0.00		0.00	

Number of species in sample **10**
Other invertebrates represented ostracods

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 26-Jun-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic; some Melosira&Fragil;few deterior Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	2,561	0	2.5	6,402
Nauplii	calanoid+cyclopoid		<.3	2,561	0	0.25	640
Class Branchiopoda(cladocerans)							
Daphnia	immat; mostly D.retro w/tall helmets		1.0-1.2	128	0	8	1,024
Bosmina longirostris	immatures		0.28-0.3	512	0	1.1	563
Alona sp.	*A. quadrangularis-like*		0.42-0.45	128	0	2	256
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	5,122	0	0.006	31
Keratella earlineae			0.20	5,122	0	0.019	97
Monostyla sp.			0.13	1,280	0	0.02	26
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.35-0.42	8,963	0	1	8,963
Asplanchna sp.	collapsed body		0.28-0.32	1,280	0	0.5	640
Gastropus stylifer	pink color		0.12	1,280	0	0.04	51
Polyarthra sp.	appen pair not evid		0.11	19,206	0	0.03	576
Polyarthra major	appen pair not evid		0.14	3,841	0	0.07	269
Synchaeta sp.	body contracted		0.21	23,047	0	0.08	1,844
Synchaeta sp.	small sp.;body contracted		0.15	6,402	0	0.025	160
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	81,434	**81.43**	**21,543**	**21.54**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	3.14		29.72	
% Nauplii	3.14		2.97	
% Cladocerans	0.94		8.56	
% Rotifers	92.77		58.75	
% Dipterans	0.00		0.00	

Number of species in sample **12**
Other invertebrates representeostracods

CLIENT: AVISTA UTILIIES — ***WATER Environmental Services, Inc.***
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4 — **SAMPLE STATUS: Isopropyl alch-glycer pres**
DATE: 26-Jun-2013 — **COMMENTS: diatoms less conspic**

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	22	0	0.25	6
Class Branchiopoda(cladocerans)							
Daphnia retrocurva	tall retrocurved helmet	1.00	1.75-2.1	110	8	27	2,978
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	3,152	0	0.006	19
Type 2 (mostly illoricate virgates/incudates)							
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	3,284	**3.28**	**3,003**	**3.00**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	0.67		0.18	
% Cladocerans	3.36		99.19	
% Rotifers	95.97		0.63	
% Dipterans	0.00		0.00	

Number of species in sample **3**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES — ***WATER Environmental Services, Inc.***
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5 — **SAMPLE STATUS: Isopropyl alch-glycer pres**
DATE: 26-Jun-2013 — **COMMENTS: diatoms sparse; mainly Asterionella; detrital particles/silt**

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	17	0	0.25	4
Class Branchiopoda(cladocerans)							
Daphnia retrocurva	tall retrocurved helmet	1.00	1.75-2.1	35	8	27	936
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	4,954	0	0.006	30
Type 2 (mostly illoricate virgates/incudates)							
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	5,006	**5.01**	**970**	**0.97**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	0.35		0.45	
% Cladocerans	0.69		96.49	
% Rotifers	98.96		3.06	
% Dipterans	0.00		0.00	

Number of species in sample **3**
Other invertebrates represente aquatic insect pieces

CLIENT: AVISTA UTILIIES — *WATER Environmental Services, Inc.*
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0 — **SAMPLE STATUS: Isopropyl alch-glycer pres**
DATE: 9 Jul-2013 — **COMMENTS: Asterionella conspic;other fil diatoms evid;few Aphanocapsa/Microcystis col?**

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar Epischura		<1.0	104	0	4	414
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	3,623	0	0.25	906
Class Branchiopoda(cladocerans)							
Daphnia	larger immatures		1.2-1.4	518	0	10	5,176
Daphnia pulex/pulicaria	v.large pulex-like ovig females		2.8+	19	5	100	1,863
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-1.9	518	5	30	15,528
Bosmina longirostris			0.35-0.38	1,035	2.5	2	2,070
Bosmina longirostris	immatures		0.28-0.3	1,035	0	1.1	1,139
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	518	0	0.01	5
Keratella cochlearis	small form		0.14	4,658	0	0.006	28
Keratella earlineae			0.20	5,176	0	0.019	98
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.63-0.7	2,070	0	6	12,423
Asplanchna sp.	collapsed body		0.35-0.42	5,694	0	1.2	6,832
Asplanchna sp.	collapsed body		0.21-0.28	1,035	0	0.3	311
Gastropus stylifer	pink color		0.14	1,553	0	0.05	78
Polyarthra sp.	appen pair not evid		0.11	7,247	0	0.03	217
Synchaeta sp.	body contracted		0.21	518	0	0.08	41
Synchaeta sp.	small sp.;body contracted		0.14	4,658	0	0.025	116
Type 3 (mostly malleoramates)							
Undetermined Rotifers							
Undeter loricate rotifer	illoricate crumpled;Euchlanis-like		0.25	518	0	0.15	78

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	40,496	**40.50**	**47,325**	**47.32**
% Calanoid Copepods	0.26		0.87	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	8.95		1.91	
% Cladocerans	7.72		54.47	
% Rotifers	83.08		42.74	
% Dipterans	0.00		0.00	

Number of species in sample **12**
Other invertebrates represented: ostracods

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 9-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic; some Melosira&col greensl evid

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar epischurids		0.7-1.0	764	0	4	3,056
Order Cyclopoida							
Copepodid			0.5-0.7	1,528	0	2.5	3,820
Acanthocyclops vernalis			1.5-1.75	76	3	20	1,528
Diacyclops bicuspidatus thomasi	small females	<0.9	1.05-1.2	76	3	5	382
Nauplii	calanoid+cyclopoid		<.3	764	0	0.25	191
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retroW/tall helm+Dpul/pulic		1.0-1.2	1,528	0	8	12,224
Daphnia retrocurva	round retrocurved helmet		1.50	76	0	14	1,070
Bosmina longirostris			0.35-0.38	764	2.5	2	1,528
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	1,528	0	0.01	15
Keratella cochlearis	small form		0.14	3,820	0	0.006	23
Keratella earlineae			0.20	47,369	0	0.019	900
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.45-0.49	2,292	0	1.5	3,438
Asplanchna sp.	collapsed body		0.35	764	0	0.56	428
Gastropus stylifer	pink color		0.12-0.13	764	0	0.04	31
Polyarthra sp.	appen pair not evid		0.11	12,224	0	0.03	367
Synchaeta sp.	body contracted		0.21	3,820	0	0.08	306
Synchaeta sp.	small sp.;body contracted		0.15	7,640	0	0.025	191
Type 3 (mostly malleoramates)							
Undetermined Rotifers							
Undeter illoricate rotifer	illoricate sac-like body		0.10	2,292	0	0.025	57

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	88,090	**88.09**	**29,554**	**29.55**
% Calanoid Copepods	0.87		10.34	
% Cyclopoid Copepods	1.91		19.39	
% Nauplii	0.87		0.65	
% Cladocerans	2.69		50.15	
% Rotifers	93.67		19.47	
% Dipterans	0.00		0.00	

Number of species in sample **14**
Other invertebrates represented: ostracods

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 9-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Asterionella conspic; Melosira &Fragil evid;deterior Aphano/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	198	0	2.5	495
Nauplii	calanoid+cyclopoid		<.3	991	0	0.25	248
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.gm+Dpul/pulic		1.0-1.2	991	0	8	7,926
Daphnia pulex/pulicaria	pulicaria-like females		2.10	7	8	45	312
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.60	7	5	20	139
Bosmina longirostris	immatures		0.28-0.3	1,982	0	1.1	2,180
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	4,954	0	0.006	30
Keratella earlineae			0.20	20,807	0	0.019	395
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.35	1,982	0	0.56	1,110
Polyarthra sp.	appen pair not evid		0.11	11,890	0	0.03	357
Synchaeta sp.	body contracted		0.21	5,945	0	0.08	476
Synchaeta sp.	small sp.;body contracted		0.14	6,936	0	0.025	173
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	56,688	**56.69**	**13,840**	**13.84**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.35		3.58	
% Nauplii	1.75		1.79	
% Cladocerans	5.27		76.28	
% Rotifers	92.63		18.35	
% Dipterans	0.00		0.00	

Number of species in sample **9**
Other invertebrates representec ostracods

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 10-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Fragillaria conspic; some Melosira;few deterior Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	mid-instar epischurids		1-1.2	1,352	0	8	10,812
Epischura nevadensis	males	1.9-2.1	2.10	10	20	27	266
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	4,055	0	0.25	1,014
Class Branchiopoda(cladocerans)							
Daphnia	immatures; mostly D.retro w/tall helmets		1.0-1.2	1,892	0	8	15,137
Daphnia pulex/pulicaria	pulicaria-like females		1.75-1.9	34	0	30	1,014
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-1.9	676	5	30	20,273
Daphnia retrocurva	tall retrocurved helmet		1.75-2.0	405	0	27	10,947
Daphnia sp.	rnd domed helmet;D.thorata-like		1.75-2.0	34	0	30	1,014
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella earlineae			0.20	2,703	0	0.019	51
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	1,352	0	0.03	41
Synchaeta sp.	body contracted		0.21	2,703	0	0.08	216
Synchaeta sp.	small sp.;body contracted		0.15	10,812	0	0.025	270
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	26,027	**26.03**	**61,056**	**61.06**
% Calanoid Copepods	5.23		18.15	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	15.58		1.66	
% Cladocerans	11.68		79.25	
% Rotifers	67.51		0.95	
% Dipterans	0.00		0.00	

Number of species in sample **8**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4
DATE: 10-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: diatoms less conspic

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar Epischura		<1.0	2,986	0	4	11,943
Epischura nevadensis	males	2.00	2.10	22	20	27	597
Order Cyclopoida							
Mesocyclops edax	small males	0.9-1.0	1.33-1.4	299	4	15	1,194
Nauplii	calanoid+cyclopoid		<.3	2,986	0	0.25	746
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retro/D.pulic/ D.g.m.		1.0-1.2	23,885	0	8	191,083
Daphnia pulex/pulicaria	pulicaria-like females		2.10	55	0	45	2,486
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75	2,090	5	27	56,429
Bosmina longirostris			0.385-0.42	299	2.5	2.5	746
Leptodora kindtii			3.0-6.0	33	0	40	1,326
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	2,986	0	0.006	18
Type 2 (mostly illoricate virgates/incudates)							
Synchaeta sp.	body contracted		0.21	20,900	0	0.08	1,672
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	#/L	Total Dry Wt. Biomass ug/m3	ug/L
	56,540	**56.54**	**268,239**	**268.24**
% Calanoid Copepods	5.32		4.67	
% Cyclopoid Copepods	0.53		0.45	
% Nauplii	5.28		0.28	
% Cladocerans	46.63		93.97	
% Rotifers	42.25		0.63	
% Dipterans	0.00		0.00	

Number of species in sample **9**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5
DATE: 10-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: diatoms sparse; mainly Asterionella; detrital particles/silt

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	4,777	0	0.25	1,194
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retro w/tall helm+D.pulic		1.0-1.2	88	0	8	707
Daphnia retrocurva	tall retrocurved helmet		1.4-1.75	18	8	20	354
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Type 2 (mostly illoricate virgates/incudates)							
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	#/L	Total Dry Wt. Biomass ug/m3	ug/L
	4,883	**4.88**	**2,255**	**2.25**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	97.83		52.97	
% Cladocerans	2.17		47.03	
% Rotifers	0.00		0.00	
% Dipterans	0.00		0.00	

Number of species in sample **3**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0
DATE: 24 Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Fragillaria conspic;other fil diatoms; col greens;few Aphanocapsa/Microcystis col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	2,541	0	2.5	6,352
Acanthocyclops vernalis			1.50	2	3	20	38
Diacyclops bicuspidatus thomasi	small females/males	<0.9	1.05-1.2	51	3	5	254
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	2	4	25	47
Nauplii	calanoid+cyclopoid		<.3	4,574	0	0.25	1,143
Class Branchiopoda(cladocerans)							
Daphnia	immatures;mostly Dpul/pulic		1.0-1.2	51	0	8	407
Daphnia pulex/pulicaria	young D. pulicaria-like females		1.70	2	0	25	47
Bosmina longirostris			0.35-0.38	508	2.5	2	1,016
Bosmina longirostris	immatures		0.28-0.3	2,033	0	1.1	2,236
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	508	0	0.01	5
Keratella cochlearis	small form		0.14	3,049	0	0.006	18
Keratella earlineae			0.20	4,066	0	0.019	77
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	2,541	0	0.03	76
Polyarthra sp.	appen pair not evid		0.14	2,033	0	0.07	142
Synchaeta sp.	body contracted		0.21	508	0	0.08	41
Synchaeta sp.	small sp.;body contracted		0.14	4,574	0	0.025	114
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	27,042	**27.04**	**12,015**	**12.01**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	9.60		55.69	
% Nauplii	16.91		9.52	
% Cladocerans	9.59		30.85	
% Rotifers	63.90		3.95	
% Dipterans	0.00		0.00	

Number of species in sample **10**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 24-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: fil diatoms & col greens evid

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Epischura nevadensis		2.10	2.20	3	22	30	81
Order Cyclopoida							
Copepodid			0.5-0.7	1,394	0	2.5	3,485
Mesocyclops edax	small males	0.9-1.0	1.6+	70	4	25	1,742
Nauplii	calanoid+cyclopoid		<.3	5,576	0	0.25	1,394
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retroW/tall helm+Dpul/pulic		1.0-1.2	3,485	0	8	27,880
Daphnia pulex/pulicaria	young pulicaria-like females		1.75-2.0	697	0	30	20,910
Daphnia retrocurva	tall retrocurved helmet		1.75	697	0	20	13,940
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella earlineae			0.20	3,485	0	0.019	66
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	2,091	0	0.03	63
Synchaeta sp.	small sp.;body contracted		0.15	1,394	0	0.025	35
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	18,891	**18.89**	**69,595**	**69.59**
% Calanoid Copepods	0.01		0.12	
% Cyclopoid Copepods	7.75		7.51	
% Nauplii	29.52		2.00	
% Cladocerans	25.83		90.13	
% Rotifers	36.90		0.24	
% Dipterans	0.00		0.00	

Number of species in sample **7**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 24-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Fragilarial conspic; Melosira & Asterionella evid;deterior Aphano/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	955	0	2.5	2,389
Diacyclops bicuspidatus thomasi	small females/males	<0.9	1.05-1.2	191	3	5	955
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	96	4	25	382
Nauplii	calanoid+cyclopoid		<.3	8,599	0	0.25	2,150
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.gm+Dpul/pulic		1.0-1.2	478	0	8	3,822
Daphnia pulex/pulicaria	young pulicaria-like females		1.75-1.9	18	0	30	530
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-1.9	35	5	30	1,061
Daphnia retrocurva	tall rnd retrocurved helmet	1.00	1.4-1.75	18	8	20	354
Leptodora kindtii			2.0-3.0	18	0	15	265
Leptodora kindtii			3.0-6.0	18	0	40	707
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	955	0	0.01	10
Keratella cochlearis	small form		0.14	3,822	0	0.006	23
Keratella earlineae			0.20	955	0	0.019	18
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	6,688	0	0.03	201
Polyarthra sp.	appen pair not evid		0.14	955	0	0.07	67
Synchaeta sp.	body contracted		0.21	2,866	0	0.08	229
Synchaeta sp.	small sp.;body contracted		0.14	4,777	0	0.025	119
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	31,444	**31.44**	**13,281**	**13.28**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	3.95		28.06	
% Nauplii	27.35		16.19	
% Cladocerans	1.86		50.74	
% Rotifers	66.85		5.02	
% Dipterans	0.00		0.00	

Number of species in sample **11**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 25-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Fragillaria conspic;col greens; few deterior Aphanocapsa/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	mid instar Epischura		1.5-1.75	14	0	15	210
Epischura nevadensis	females	1.9-2.1	2.10	14	20	27	377
Order Cyclopoida							
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	233	4	25	5,820
Nauplii	calanoid+cyclopoid		<.3	2,328	0	0.25	582
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.retro+D.pulic+D.gm		1.0-1.2	1,164	0	8	9,312
Daphnia pulex/pulicaria	pulex-like females		2.10	58	0	45	2,619
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-1.9	116	5	30	3,492
Leptodora kindtii			2.00	9	0	10	93
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	1,164	0	0.006	7
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	1,164	0	0.03	35
Polyarthra sp.	appen pair not evid		0.14	1,164	0	0.07	81
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	7,429	**7.43**	**22,628**	**22.63**
% Calanoid Copepods	0.38		2.59	
% Cyclopoid Copepods	3.13		25.72	
% Nauplii	31.34		2.57	
% Cladocerans	18.14		68.57	
% Rotifers	47.01		0.55	
% Dipterans	0.00		0.00	

Number of species in sample **8**

Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4
DATE: 25-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: diatoms less conspic;col greens; few deterior Aphanocapsa/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	608	0	4	2,433
Copepodid	early instar Epischura		<1.0	6,082	0	4	24,328
Epischura nevadensis	males+females	2.00	2.10	66	20	27	1,635
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	15,205	0	0.25	3,801
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.pulic+D.g.m.		1.0-1.2	9,123	0	8	72,983
Daphnia pulex/pulicaria	young pulicaria-like females		1.75-1.9	304	0	30	9,123
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-2.1	6,082	5	30	182,458
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.14	3,041	0	0.07	213
Synchaeta sp.	small sp.;body contracted		0.15	9,123	0	0.025	228
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	49,634	**49.63**	**297,201**	**297.20**
% Calanoid Copepods	13.61		9.55	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	30.63		1.28	
% Cladocerans	31.25		89.02	
% Rotifers	24.51		0.15	
% Dipterans	0.00		0.00	

Number of species in sample **6**

Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5
DATE: 25-Jul-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: diatoms sparse;few col greens; few deterior Aphanocapsa/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	diaptomids+epischurids		0.7-1.0	9,731	0	4	38,924
Skistodiaptomus reighardi		1.15-1.22	1.2-1.4	6,812	7	10	65,198
Epischura nevadensis	males	2.00	2.10	2,433	20	27	48,655
Order Cyclopoida							
Copepodid			0.5-0.7	4,866	0	2.5	12,164
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	1,946	4	25	28,220
Nauplii	calanoid+cyclopoid		<.3	29,193	0	0.25	7,298
Class Branchiopoda(cladocerans)							
Daphnia	immatures;mostly D.gal.mend		1.0-1.2	4,866	0	8	38,924
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-2.1	487	5	40	19,462
Ceriodaphnia sp.			0.60-0.70	487	0	3.5	1,703
Bosmina longirostris			0.35-0.38	487	2.5	2	973
Alona sp.	*A. quadrangularis-like*		0.8-0.9	487	0	6	2,919
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Type 2 (mostly illoricate virgates/incudates)							
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	61,792	**61.79**	**264,442**	**264.44**
% Calanoid Copepods	30.71		57.77	
% Cyclopoid Copepods	11.02		15.27	
% Nauplii	47.24		2.76	
% Cladocerans	11.02		24.20	
% Rotifers	0.00		0.00	
% Dipterans	0.00		0.00	

Number of species in sample **7**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0
DATE: 5 Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Fragillaria conspic;other fil diatoms; col greens;few Aphanocapsa/Microcystis col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	1,016	0	2.5	2,541
Diacyclops bicuspidatus thomasi	small females	<0.9	1.05-1.2	51	3	5	254
Mesocyclops edax	males/large females	0.9-1.0	1.5-1.6	104	4	25	454
Nauplii	calanoid+cyclopoid		<.3	5,082	0	0.25	1,270
Class Branchiopoda(cladocerans)							
Daphnia	immatures;mostly Dpul/pulic		1.0-1.2	508	0	8	4,066
Bosmina longirostris			0.385-0.42	1,016	2.5	2.5	2,541
Bosmina longirostris	immatures		0.28-0.3	2,033	0	1.1	2,236
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	508	0	0.01	5
Keratella cochlearis	small form		0.14	508	0	0.006	3
Keratella earlineae			0.20	1,525	0	0.019	29
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	3,049	0	0.03	91
Polyarthra sp.	appen pair not evid		0.14	6,607	0	0.07	462
Synchaeta sp.	small sp.;body contracted		0.14	1,016	0	0.025	25
Trichocerca cylindrica	assoc w/eutroph		0.35	3,049	0	0.13	396
Type 3 (mostly malleoramates)							
Undetermined Rotifers							
Undeter illoricate rotifer	tube-like illoricate body		0.14	1,525	0	0.015	23

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	27,597	**27.60**	**14,398**	**14.40**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	4.24		22.56	
% Nauplii	18.41		8.82	
% Cladocerans	12.89		61.42	
% Rotifers	64.45		7.19	
% Dipterans	0.00		0.00	

Number of species in sample **11**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 5-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: fil diatoms & col greens evid;Dinobryon/ Ceratium/deterior Aphanocapsa/Microcystis col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	72	0	4	290
Order Cyclopoida							
Copepodid			0.5-0.7	2,171	0	2.5	5,428
Diacyclops bicuspidatus thomasi	small females	<0.9	1.05-1.2	507	3	5	2,533
Mesocyclops edax	large females	0.9-1.0	1.6+	5	4	25	134
Nauplii	calanoid+cyclopoid		<.3	5,067	0	0.25	1,267
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retro+Dpulic+D.gm		1.0-1.2	362	0	8	2,895
Daphnia pulex/pulicaria	v.large pulicaria-like females		2.3-2.6	13	5	75	1,004
Daphnia galeata mendotae	v. large ovig fem;helmet w/pt		2.45	13	5	50	670
Bosmina longirostris			0.385-0.42	72	2.5	2.5	181
Latona sp.			1.4-1.75	3	0	20	54
Class Insecta							
Order Diptera							
Chaoborus sp. (mod)			7.00-8.00	3	0	130	348
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	1,448	0	0.01	14
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	1,448	0	0.03	43
Synchaeta sp.	body contracted		0.17	724	0	0.06	43
Trichocerca cylindrica	assoc w/eutroph		0.35	72	0	0.13	9
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	11,980	**11.98**	**14,914**	**14.91**
% Calanoid Copepods	0.60		1.94	
% Cyclopoid Copepods	22.40		54.28	
% Nauplii	42.29		8.49	
% Cladocerans	3.87		32.21	
% Rotifers	30.81		0.74	
% Dipterans	0.02		2.33	

Number of species in sample **13**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 5-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Fragilaria conspic;col greens/Dinobryon/ Ceratium evid;deterior Aphanocap/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Epischura nevadensis	females/males	2.10	2.20	14	22	30	370
Order Cyclopoida							
Copepodid			0.5-0.7	95	0	2.5	237
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	95	4	25	2,371
Nauplii	calanoid+cyclopoid		<.3	2,845	0	0.25	711
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.gm+Dpulic+D retro		1.0-1.2	1,897	0	8	15,173
Daphnia pulex/pulicaria	young females		1.70	95	0	25	2,371
Daphnia pulex/pulicaria	large pulicaria-like females		2.3-2.6	35	5	75	2,632
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		2.10	474	5	40	18,967
Leptodora kindtii			3.0-6.0	7	0	40	285
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	2,845	0	0.006	17
Keratella crassa			0.21	948	0	0.025	24
Keratella earlineae			0.20	1,897	0	0.019	36
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer	pink color		0.14	948	0	0.05	47
Polyarthra sp.	appen pair not evid		0.11	1,897	0	0.03	57
Polyarthra sp.	appen pair not evid		0.14	7,587	0	0.07	531
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	21,679	**21.68**	**43,828**	**43.83**
% Calanoid Copepods	0.07		0.84	
% Cyclopoid Copepods	0.87		5.95	
% Nauplii	13.12		1.62	
% Cladocerans	11.57		89.96	
% Rotifers	74.37		1.62	
% Dipterans	0.00		0.00	

Number of species in sample **11**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 6-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Fragillaria conspic;col greens;few Ceratium;deterior Aphanocapsa/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar epischurids		0.7-1.0	123	0	4	491
Epischura nevadensis	females	2.10	2.3-2.5	15	20	40	590
Order Cyclopoida							
Copepodid			0.5-0.7	3,686	0	2.5	9,215
Mesocyclops edax	males	0.9-1.0	1.5-1.6	1,229	4	25	4,915
Nauplii	calanoid+cyclopoid		<.3	4,915	0	0.25	1,229
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.pulic+D.gm		1.0-1.2	2,457	0	8	19,659
Daphnia pulex/pulicaria	large pulicaria-like females		2.2-2.45	123	0	60	7,372
Daphnia galeata mendotae	large ovig fem;tall helmet w/pt		2.1-2.6	1,229	5	50	61,434
Bosmina longirostris	immatures		0.28-0.3	123	0	1.1	135
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	1,229	0	0.02	25
Keratella cochlearis	small form		0.14	4,915	0	0.006	29
Keratella cochlearis			0.17	3,686	0	0.01	37
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	4,915	0	0.03	147
Polyarthra sp.	appen pair not evid		0.14	2,457	0	0.07	172
Synchaeta sp.	small sp.;body contracted		0.15	4,915	0	0.025	123
Type 3 (mostly malleoramates)							
Conochilus sp.	small organisms/small sph col		0.10-0.12	58,976	0	0.01	590
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	94,991	**94.99**	**106,162**	**106.16**
% Calanoid Copepods	0.14		1.02	
% Cyclopoid Copepods	5.17		13.31	
% Nauplii	5.17		1.16	
% Cladocerans	4.14		83.46	
% Rotifers	85.37		1.06	
% Dipterans	0.00		0.00	

Number of species in sample **11**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4
DATE: 6-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: diatoms less conspic;col greens;
Ceratium;few deter Aphanocapsa/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	282	0	4	1,128
Copepodid	early instar Epischura		<1.0	846	0	4	3,384
Skistodiaptomus reighardi	small females	1.15-1.22	1.2-1.4	282	7	10	2,820
Epischura nevadensis	males+females	2.00	2.10	282	20	27	5,640
Order Cyclopoida							
Copepodid			0.5-0.7	564	0	2.5	1,410
Nauplii	calanoid+cyclopoid		<.3	14,099	0	0.25	3,525
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.pulic+D.g.m.		1.0-1.2	2,820	0	8	22,558
Daphnia pulex/pulicaria	young pulicaria-like females		1.75-2.1	282	0	35	9,869
Daphnia galeata mendotae	small fem;helmet w/pt		1.5-1.75	2,820	5	25	70,495
Daphnia galeata mendotae	ovig fem;helmet w/pt		2.10	1,410	5	40	56,396
Bosmina longirostris	immatures		0.28-0.3	5,640	0	1.1	6,204
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	8,459	0	0.006	51
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	16,919	0	0.03	508
Trichocerca cylindrica	assoc w/eutroph		0.35	2,820	0	0.13	367
Type 3 (mostly malleoramates)							
Collotheca sp. (small)			0.10	22,558	0	0.005	113
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	80,082	**80.08**	**184,466**	**184.47**
% Calanoid Copepods	2.11		7.03	
% Cyclopoid Copepods	0.70		0.76	
% Nauplii	17.61		1.91	
% Cladocerans	16.20		89.73	
% Rotifers	63.38		0.56	
% Dipterans	0.00		0.00	

Number of species in sample **10**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5
DATE: 6-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: diatoms sparse;few col greens; few deterior Aphanocapsa/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Skistodiaptomus reighardi	small females	1.15-1.22	1.2-1.4	25	7	10	253
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	253	0	0.25	63
Class Branchiopoda(cladocerans)							
Daphnia galeata mendotae	small fem;helmet w/pt		1.5-1.6	253	5	22	5,561
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-2.1	51	5	34	1,719
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	2,528	0	0.006	15
Monostyla sp.			0.14	5,055	0	0.015	76
Type 2 (mostly illoricate virgates/incudates)							
Trichocerca cylindrica	assoc w/eutroph		0.35	2,528	0	0.13	329
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	#/L	Total Dry Wt. Biomass ug/m3	ug/L
	10,692	**10.69**	**8,015**	**8.01**
% Calanoid Copepods	0.24		3.15	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	2.36		0.79	
% Cladocerans	2.84		90.82	
% Rotifers	94.56		5.23	
% Dipterans	0.00		0.00	

Number of species in sample **5**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0
DATE: 20 Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: fil diatoms;col greens;Ceratium; some Aphanocapsa/Microcystis? col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	diaptomids		0.7-1.0	102	0	4	407
Skistodiaptomus reighardi	small males	1.15-1.22	1.2-1.4	51	7	10	356
Order Cyclopoida							
Copepodid			0.5-0.7	1,016	0	2.5	2,541
Diacyclops bicuspidatus thomasi	small females	<0.9	1.05-1.2	152	3	5	762
Mesocyclops edax	males/large females	0.9-1.0	1.5-1.6	135	4	25	1,253
Nauplii	calanoid+cyclopoid		<.3	4,574	0	0.25	1,143
Class Branchiopoda(cladocerans)							
Bosmina longirostris	large females		0.50	508	0	3.5	1,779
Bosmina longirostris			0.385-0.42	5,082	2.5	2.5	12,705
Bosmina longirostris	immatures		0.28-0.3	15,246	0	1.1	16,771
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	508	0	0.01	5
Keratella cochlearis	small form		0.14	2,541	0	0.006	15
Keratella cochlearis			0.17	1,525	0	0.01	15
Keratella earlineae			0.20	4,066	0	0.019	77
Monostyla sp.			0.10	508	0	0.008	4.1
Type 2 (mostly illoricate virgates/incudates)							
Asplanchna sp.	collapsed body		0.63-0.7	305	0	6	1,830
Gastropus stylifer	pink color		0.14	2,033	0	0.05	102
Ploesoma hudsoni			0.35-0.42	508	0	0.45	229
Polyarthra sp.	appen pair not evid		0.11	13,721	0	0.03	412
Polyarthra sp.	appen pair not evid		0.14	8,131	0	0.07	569
Synchaeta sp.	small sp.;body contracted		0.14	1,525	0	0.025	38
Trichocerca cylindrica	assoc w/eutroph		0.35	3,557	0	0.13	462
Trichocerca similis			0.16	508	0	0.02	10
Type 3 (mostly malleoramates)							
Undetermined Rotifers							
Undeter loricate rotifer	loricate		0.17	508	0	0.02	10
Undeter loricate rotifer	illoricate		0.18	1,525	0	0.06	91

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	68,336	**68.34**	**41,586**	**41.59**
% Calanoid Copepods	0.22		1.83	
% Cyclopoid Copepods	1.91		10.96	
% Nauplii	6.69		2.75	
% Cladocerans	30.49		75.16	
% Rotifers	60.68		9.31	
% Dipterans	0.00		0.00	

Number of species in sample **17**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 20-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Melosira conspic;col greens/Dinobryon/ Ceratium/deterior Aphanocapsa/Microcystis col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	64	0	4	257
Skistodiaptomus reighardi	small males	1.15-1.22	1.2-1.4	64	7	10	450
Order Cyclopoida							
Copepodid			0.5-0.7	2,574	0	2.5	6,434
Diacyclops bicuspidatus thomasi	small males	<0.9	1.05-1.2	643	3	5	1,930
Mesocyclops edax	large females	0.9-1.0	1.6+	708	4	25	4,182
Nauplii	calanoid+cyclopoid		<.3	4,504	0	0.25	1,126
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.galmen		1.0-1.2	64	0	8	515
Daphnia pulex/pulicaria	young pulicaria-like females		1.70	13	0	25	322
Daphnia galeata mendotae	ovig fem;rnd helmet		1.75-2.1	64	5	34	2,187
Bosmina longirostris			0.35-0.38	1,287	2.5	2	2,574
Bosmina longirostris	immatures		0.28-0.3	1,287	0	1.1	1,415
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	1,287	0	0.01	13
Keratella cochlearis	small form		0.14	3,217	0	0.006	19
Keratella earlineae			0.20	1,930	0	0.019	37
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	5,147	0	0.03	154
Polyarthra sp.	appen pair not evid		0.14	10,294	0	0.07	721
Synchaeta sp.	small sp.;body contracted		0.15	1,287	0	0.025	32
Trichocerca cylindrica	assoc w/eutroph		0.35	5,147	0	0.13	669
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	39,581	**39.58**	**23,037**	**23.04**
% Calanoid Copepods	0.33		3.07	
% Cyclopoid Copepods	9.92		54.46	
% Nauplii	11.38		4.89	
% Cladocerans	6.86		30.44	
% Rotifers	71.52		7.14	
% Dipterans	0.00		0.00	

Number of species in sample **12**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 20-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Melosira conspic;deterior Aphanocapsa/ Microcystis col?/Ceratium & col greens pres

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomid		0.7-1.0	94	0	4	375
Skistodiaptomus reighardi	small females/males	1.05-1.1	1.15-1.2	101	5	9	533
Order Cyclopoida							
Copepodid			0.5-0.7	1,875	0	2.5	4,689
Acanthocyclops vernalis			1.5-1.6	7	3	20	143
Mesocyclops edax		0.9-1.0	1.5-1.6	188	4	25	750
Nauplii	calanoid+cyclopoid		<.3	4,689	0	0.25	1,172
Class Branchiopoda(cladocerans)							
Bosmina longirostris			0.385-0.49	938	2.5	3	2,813
Bosmina longirostris	immatures		0.28-0.3	2,813	0	1.1	3,094
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	2,813	0	0.006	17
Keratella earlineae			0.20	2,813	0	0.019	53
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	15,004	0	0.03	450
Polyarthra sp.	appen pair not evid		0.14	4,689	0	0.07	328
Synchaeta sp.	body contracted		0.21	938	0	0.08	75
Synchaeta sp.	small sp.;body contracted		0.14	938	0	0.025	23
Trichocerca cylindrica	assoc w/eutroph		0.35	1,875	0	0.13	244
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	39,774	**39.77**	**14,760**	**14.76**
% Calanoid Copepods	0.49		6.15	
% Cyclopoid Copepods	5.20		37.81	
% Nauplii	11.79		7.94	
% Cladocerans	9.43		40.02	
% Rotifers	73.09		8.07	
% Dipterans	0.00		0.00	

Number of species in sample **9**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 21-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Melosira conspic;col greens;few Ceratium;deterior Aphanocapsa/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	383	0	4	1,533
Copepodid	mid-instar epischurids		1-1.2	10	0	8	79
Skistodiaptomus reighardi	males	1.15-1.22	1.40	128	7	12	894
Order Cyclopoida							
Copepodid			0.5-0.7	2,556	0	2.5	6,389
Nauplii	calanoid+cyclopoid		<.3	3,833	0	0.25	958
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.gm		1.0-1.2	128	0	8	1,022
Bosmina longirostris	immatures		0.28-0.3	894	0	1.1	984
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	10,223	0	0.006	61
Keratella earlineae			0.20	2,556	0	0.019	49
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	31,945	0	0.03	958
Polyarthra sp.	appen pair not evid		0.14	11,500	0	0.07	805
Polyarthra sp.	appen pair not evid		0.20	1,278	0	0.15	192
Synchaeta sp.	body contracted		0.21	3,833	0	0.08	307
Synchaeta sp.	small sp.;body contracted		0.15	8,945	0	0.025	224
Trichocerca cylindrica	assoc w/eutroph		0.35	2,556	0	0.13	332
Trichocerca similis			0.16	1,278	0	0.02	26
Trichocerca sp.	small		0.10	2,556	0	0.007	18
Type 3 (mostly malleoramates)							
Conochilus sp.	small organisms/small sph colonies		0.10-0.12	17,889	0	0.01	179
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	102,491	**102.49**	**15,010**	**15.01**
% Calanoid Copepods	0.51		16.70	
% Cyclopoid Copepods	2.49		42.57	
% Nauplii	3.74		6.38	
% Cladocerans	1.00		13.37	
% Rotifers	92.26		20.98	
% Dipterans	0.00		0.00	

Number of species in sample **13**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4
DATE: 21-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS:Melosira conspic; deter Aphanocapsa/ Microcystis col?/Ceratium;col greens

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	mid instar Epischura		1.4-1.7	55	0	15	829
Epischura nevadensis	large females	2.3-2.5	2.3-2.5	22	27	40	884
Order Cyclopoida							
Copepodid			0.5-0.7	5,971	0	2.5	14,928
Diacyclops bicuspidatus thomasi	mostly males	<0.9	1.05-1.2	2,986	3	5	8,957
Mesocyclops edax	mostly males	0.9-1.0	1.5-1.6	5,971	4	25	23,885
Nauplii	calanoid+cyclopoid		<.3	14,928	0	0.25	3,732
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.g.m.		1.0-1.2	1,194	0	8	9,554
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75	1,493	5	27	40,307
Daphnia galeata mendotae	large ovig fem;helmet w/pt		2.5-2.8	131	5	60	7,882
Bosmina longirostris	immatures		0.28-0.3	299	0	1.1	328
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Euchlanis sp.			0.25	2,986	0	0.087	260
Keratella cochlearis	small form		0.14	29,857	0	0.006	179
Keratella cochlearis			0.17	2,986	0	0.01	30
Keratella earlineae			0.20	2,986	0	0.019	57
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	14,928	0	0.03	448
Polyarthra sp.	appen pair not evid		0.14	8,957	0	0.07	627
Trichocerca cylindrica	assoc w/eutroph		0.35	2,986	0	0.13	388
Trichocerca similis			0.16	5,971	0	0.02	119
Trichocerca sp.	small		0.10	2,986	0	0.007	21
Type 3 (mostly malleoramates)							
Conochilus sp.	small organisms		0.10-0.12	167,197	0	0.01	1,672
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	274,890	**274.89**	**115,087**	**115.09**
% Calanoid Copepods	0.03		1.49	
% Cyclopoid Copepods	5.43		41.51	
% Nauplii	5.43		3.24	
% Cladocerans	1.13		50.46	
% Rotifers	87.98		3.30	
% Dipterans	0.00		0.00	

Number of species in sample **13**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5
DATE: 21-Aug-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Ceratium conspic;Aphanocapsa/ Microcystis col?/few fil diatoms&col greens

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	4,866	0	4	19,462
Copepodid	early instar Epischura		0.7-1.0	4,866	0	4	19,462
Skistodiaptomus reighardi	small females	1.15-1.22	1.2-1.4	9,731	7	10	68,117
Epischura nevadensis	males	2.00	2.10	107	20	27	2,515
Order Cyclopoida							
Copepodid			0.5-0.7	4,866	0	2.5	12,164
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	19,462	4	25	180,025
Nauplii	calanoid+cyclopoid		<.3	43,790	0	0.25	10,947
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.gal.mend		1.0-1.2	9,731	0	8	77,849
Daphnia galeata mendotae	small fem;helmet w/pt		1.5-1.6	4,866	5	22	107,042
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-2.1	973	5	34	33,086
Ceriodaphnia sp.	C dubia/reticulata asmblg		0.70-0.77	487	0	4	1,946
Bosmina longirostris			0.50	4,866	0	3.5	17,029
Bosmina longirostris			0.385-0.42	14,597	2.5	2.5	36,492
Bosmina longirostris	immatures		0.28-0.3	24,328	0	1.1	26,760
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	24,328	0	0.006	146
Keratella cochlearis			0.17	29,193	0	0.01	292
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	43,790	0	0.03	1,314
Trichocerca cylindrica	assoc w/eutroph		0.35	4,866	0	0.13	633
Trichocerca similis			0.16	4,866	0	0.02	97
Type 3 (mostly malleoramates)							
Conochilus sp.	small organisms		0.10-0.12	4,866	0	0.01	49
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	259,440	**259.44**	**615,427**	**615.43**
% Calanoid Copepods	7.54		17.80	
% Cyclopoid Copepods	9.38		31.23	
% Nauplii	16.88		1.78	
% Cladocerans	23.07		48.78	
% Rotifers	43.13		0.41	
% Dipterans	0.00		0.00	

Number of species in sample **11**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0
DATE: 9 Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: fil diatoms;col greens;Ceratium; some Aphanocapsa/Microcystis? col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	diaptomids		0.7-1.0	471	0	4	1,884
Skistodiaptomus reighardi	small males	1.15-1.22	1.2-1.4	52	7	10	523
Order Cyclopoida							
Copepodid			0.5-0.7	3,140	0	2.5	7,849
Mesocyclops edax	males/large females	0.9-1.0	1.5-1.6	628	4	25	4,709
Nauplii	calanoid+cyclopoid		<.3	9,942	0	0.25	2,485
Class Branchiopoda(cladocerans)							
Daphnia	large immat;mosty D.g.m&D retro		1.2-1.4	2,616	0	10	26,163
Daphnia pulex/pulicaria	pulex-like females		2.10	9	0	45	424
Daphnia galeata mendotae	ovig fem;helmet w/pt		1.75-2.1	35	5	34	1,192
Bosmina longirostris	immatures		0.28-0.3	523	0	1.1	576
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	4,186	0	0.006	25
Keratella cochlearis			0.17	523	0	0.01	5
Keratella earlineae			0.20	1,570	0	0.019	30
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	1,570	0	0.03	47
Polyarthra sp.	appen pair not evid		0.14	523	0	0.07	37
Trichocerca sp.			0.18	523	0	0.05	26
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density		Total Dry Wt. Biomass	
	#/m3	**#/L**	**ug/m3**	**ug/L**
	26,312	**26.31**	**45,975**	**45.97**
% Calanoid Copepods	1.99		5.24	
% Cyclopoid Copepods	14.32		27.32	
% Nauplii	37.78		5.41	
% Cladocerans	12.10		61.67	
% Rotifers	33.81		0.37	
% Dipterans	0.00		0.00	

Number of species in sample **10**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 9-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Microcystis/Aphanocapsa col conspic; some Melosira&Fragillaria;Ceratium/col greens

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	724	0	4	2,895
Skistodiaptomus reighardi	small males/females	1.05-1.1	1.2-1.4	579	5	10	4,705
Order Cyclopoida							
Copepodid			0.5-0.7	1,448	0	2.5	3,619
Mesocyclops edax	large females	0.9-1.0	1.6+	2,533	4	25	17,733
Nauplii	calanoid+cyclopoid		<.3	20,266	0	0.25	5,067
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.galmen		1.0-1.2	2,895	0	8	23,162
Daphnia galeata mendotae	v. large ovig fem;helmet w/pt		2.10	1,448	5	40	57,904
Daphnia retrocurva	tall retrocurved helmet		1.75-2.0	145	0	27	3,909
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	2,895	0	0.006	17
Keratella earlineae			0.20	724	0	0.019	14
Type 2 (mostly illoricate virgates/incudates)							
Trichocerca sp.			0.18	1,448	0	0.05	72
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	35,104	**35.10**	**119,096**	**119.10**
% Calanoid Copepods	3.71		6.38	
% Cyclopoid Copepods	11.34		17.93	
% Nauplii	57.73		4.25	
% Cladocerans	12.78		71.35	
% Rotifers	14.43		0.09	
% Dipterans	0.00		0.00	

Number of species in sample **7**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 9-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Melosira&Fragil;deterior Aphanocapsa/ Microcystis col?/Ceratium & col greens pres

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomid		0.7-1.0	287	0	4	1,146
Skistodiaptomus reighardi	small females/males	1.05-1.1	1.15-1.2	382	5	9	2,675
Epischura nevadensis	females/males	2.10	2.20	14	22	30	311
Order Cyclopoida							
Copepodid			0.5-0.7	1,911	0	2.5	4,777
Mesocyclops edax		0.9-1.0	1.5-1.6	2,866	4	25	51,592
Nauplii	calanoid+cyclopoid		<.3	9,554	0	0.25	2,389
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.gm+Dpul/pul		1.0-1.2	764	0	8	6,115
Daphnia pulex/pulicaria	v.large pulex-like females		2.5-2.8	11	5	85	901
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		2.10	96	5	40	3,822
Daphnia galeata mendotae	huge ovig fem;helmet w/pt		2.45	14	5	50	707
Daphnia retrocurva	tall retro helmt;huge ovig fem		2.45	7	8	48	339
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	955	0	0.02	19
Keratella cochlearis	small form		0.14	955	0	0.006	6
Keratella cochlearis			0.17	1,911	0	0.01	19
Keratella earlineae			0.20	2,866	0	0.019	54
Type 2 (mostly illoricate virgates/incudates)							
Trichocerca sp.			0.18	1,911	0	0.05	96
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	24,505	**24.50**	**74,969**	**74.97**
% Calanoid Copepods	2.79		5.51	
% Cyclopoid Copepods	19.49		75.19	
% Nauplii	38.99		3.19	
% Cladocerans	3.64		15.85	
% Rotifers	35.09		0.26	
% Dipterans	0.00		0.00	

Number of species in sample **10**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 10-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Melosira&Fragil;col greens;few Ceratium;deterior Aphanocapsa/Microcystis col?

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diap+episch		0.7-1.0	855	0	4	3,421
Skistodiaptomus reighardi	males	1.05-1.1	1.2-1.3	285	5	10	2,138
Order Cyclopoida							
Copepodid	early instar Mesocyclops+sp.		0.5-0.7	1,425	0	2.5	3,563
Mesocyclops edax	young females	<0.8	1.15-1.25	713	3	10	7,126
Mesocyclops edax	males/large females	0.9-1.0	1.5-1.6	2,860	4	25	11,648
Nauplii	calanoid+cyclopoid		<.3	18,528	0	0.25	4,632
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retroW/tall helm		1.0-1.2	2,851	0	8	22,804
Daphnia retrocurva	tall retrocurved helmet		1.6-1.75	10	8	20	197
Ceriodaphnia lacustris			0.70	1,425	0	3.5	4,988
Bosmina longirostris			0.385-0.42	2,851	2.5	2.5	7,126
Bosmina longirostris	immatures		0.28-0.3	1,425	0	1.1	1,568
Chydorus sp.			0.25-0.28	5,701	0	1	5,701
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	1,425	0	0.02	29
Keratella cochlearis	small form		0.14	1,425	0	0.006	9
Type 2 (mostly illoricate virgates/incudates)							
Gastropus stylifer	pink color		0.14	1,425	0	0.05	71
Polyarthra sp.	appen pair not evid		0.11	4,276	0	0.03	128
Polyarthra sp.	appen pair not evid		0.14	2,851	0	0.07	200
Type 3 (mostly malleoramates)							
Conochilus sp.	small organisms		0.10-0.12	1,425	0	0.01	14
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	51,757	**51.76**	**75,363**	**75.36**
% Calanoid Copepods	2.20		7.38	
% Cyclopoid Copepods	9.66		29.64	
% Nauplii	35.80		6.15	
% Cladocerans	27.56		56.24	
% Rotifers	24.78		0.60	
% Dipterans	0.00		0.00	

Number of species in sample **13**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4
DATE: 10-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS:deterior Microcystis/Aphanocapsa col/ Melosira& Fragil evid

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	2,986	0	4	11,943
Skistodiaptomus reighardi	small females	1.05-1.1	1.2-1.4	597	6	10	4,777
Order Cyclopoida							
Copepodid	Mesocyclops + Cyc sp.		0.5-0.7	8,957	0	2.5	22,393
Mesocyclops edax	mostly males	0.9-1.0	1.5-1.6	17,914	4	25	134,355
Nauplii	calanoid+cyclopoid		<.3	68,670	0	0.25	17,168
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retroW/tall helm		1.0-1.2	23,885	0	8	191,083
Daphnia retrocurva	tall retrocurved helmet		1.50	5,971	0	14	83,599
Ceriodaphnia lacustris			0.35-0.5	8,957	0	2	17,914
Bosmina longirostris			0.385-0.42	2,986	2.5	2.5	7,464
Bosmina longirostris	immatures		0.28-0.3	41,799	0	1.1	45,979
Chydorus sp.			0.25-0.35	8,957	0	1.8	16,123
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	14,928	0	0.006	90
Monostyla sp.			0.10	2,986	0	0.005	14.9
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	14,928	0	0.03	448
Polyarthra sp.	appen pair not evid		0.14	5,971	0	0.07	418
Type 3 (mostly malleoramates)							
Conochilus sp.	small organisms		0.10-0.12	23,885	0	0.01	239
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	254,379	**254.38**	**554,006**	**554.01**
% Calanoid Copepods	1.41		3.02	
% Cyclopoid Copepods	10.56		28.29	
% Nauplii	27.00		3.10	
% Cladocerans	36.38		65.37	
% Rotifers	24.65		0.22	
% Dipterans	0.00		0.00	

Number of species in sample **11**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5
DATE: 10-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Ceratium conspic;Aphanocapsa/ Microcystis col/few fil diatoms&col greens

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	15,287	0	4	61,146
Skistodiaptomus reighardi	small females	1.05-1.1	1.2-1.4	10,191	6	10	81,529
Order Cyclopoida							
Copepodid			0.5-0.7	40,764	0	2.5	101,911
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	11,210	4	25	66,242
Nauplii	calanoid+cyclopoid		<.3	86,624	0	0.25	21,656
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retroW/tall helm		1.0-1.2	3,567	0	8	28,535
Ceriodaphnia lacustris			0.35-0.5	25,478	0	2	50,955
Ceriodaphnia lacustris			0.56	5,096	0	2.5	12,739
Bosmina longirostris			0.385-0.49	157,962	2.5	3	473,885
Bosmina longirostris	immatures		0.28-0.3	188,535	0	1.1	207,389
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	25,478	0	0.006	153
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	5,096	0	0.03	153
Polyarthra sp.	appen pair not evid		0.14	5,096	0	0.07	357
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	580,382	**580.38**	**1,106,650**	**1106.65**
% Calanoid Copepods	4.39		12.89	
% Cyclopoid Copepods	8.96		15.19	
% Nauplii	14.93		1.96	
% Cladocerans	65.58		69.90	
% Rotifers	6.15		0.06	
% Dipterans	0.00		0.00	

Number of species in sample **7**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0
DATE: 24 Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Microcystis/Aphanocapsa col evid; some Dinobryon/fil diatoms/col greens

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	diaptomids		0.7-1.0	508	0	4	2,033
Copepodid	early instar Epischura		<1.0	508	0	4	2,033
Skistodiaptomus reighardi	small males/females	1.05-1.15	1.15-1.25	254	6	9	1,677
Order Cyclopoida							
Copepodid			0.5-0.7	1,525	0	2.5	3,811
Mesocyclops edax	males/large females	0.9-1.0	1.5-1.6	508	4	25	2,033
Nauplii	calanoid+cyclopoid		<.3	9,656	0	0.25	2,414
Class Branchiopoda(cladocerans)							
Daphnia	larger immat;mosty D.g.m&D retro		1.2-1.4	1,016	0	10	10,164
Daphnia pulex/pulicaria	young pulex-like females		1.75-2.1	11	0	35	391
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		2.1-2.45	9	5	45	423
Daphnia retrocurva	tall rnd retrocurved helm;large females	1.00	1.75-2.0	51	8	27	1,372
Bosmina longirostris	immatures		0.28-0.3	508	0	1.1	559
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia bostoniensis			0.11(body)	1,016	0	0.01	10
Kellicottia longispina			0.21(body)	508	0	0.02	10
Keratella cochlearis	small form		0.14	1,525	0	0.006	9
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	1,016	0	0.03	30
Polyarthra sp.	appen pair not evid		0.14	508	0	0.07	36
Polyarthra sp.	appen pair not evid		0.20	508	0	0.1	51
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	19,637	**19.64**	**27,057**	**27.06**
% Calanoid Copepods	6.47		21.22	
% Cyclopoid Copepods	10.35		21.60	
% Nauplii	49.17		8.92	
% Cladocerans	8.13		47.71	
% Rotifers	25.88		0.54	
% Dipterans	0.00		0.00	

Number of species in sample **12**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 24-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Microcystis/Aphanocapsa col; Melosira&Fragillaria;Ceratium/col greens sparse

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar epischurids		0.7-1.0	710	0	4	2,842
Copepodid	early instar diaptomids		0.7-1.0	1,421	0	4	5,683
Skistodiaptomus reighardi	small males/females	1.05-1.15	1.2-1.4	284	6	10	1,705
Order Cyclopoida							
Copepodid			0.5-0.7	3,552	0	2.5	8,880
Copepodid	late instar Mesocyclops		0.9-1.05	710	0	4	2,842
Mesocyclops edax	large females	0.9-1.0	1.6+	71	4	25	1,776
Nauplii	calanoid+cyclopoid		<.3	9,235	0	0.25	2,309
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.gm+Dretro+Dpul		1.0-1.2	2,842	0	8	22,733
Daphnia pulex/pulicaria	large pulicaria-like females		2.1-2.45	27	0	60	1,620
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		1.75-2.1	71	5	34	2,415
Daphnia galeata mendotae	v. large ovig fem;tall helmet w/pt		2.45	13	5	50	671
Daphnia retrocurva	tall retro helmt;large fem/epphip fem	1.00	2.00	142	8	40	5,683
Daphnia retrocurva	round retrocurved helmet		1.50	71	0	14	995
Daphnia sp.	rnd domed helmet;D.thorata-like		2.45	13	0	50	671
Ceriodaphnia lacustris	immatures		0.35	710	0	1.5	1,066
Bosmina longirostris			0.385-0.42	1,421	2.5	2.5	3,552
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	2,131	0	0.03	64
Polyarthra sp.	appen pair not evid		0.14	4,262	0	0.07	298
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	27,688	**27.69**	**65,804**	**65.80**
% Calanoid Copepods	8.72		15.55	
% Cyclopoid Copepods	15.65		20.51	
% Nauplii	33.35		3.51	
% Cladocerans	19.18		59.88	
% Rotifers	23.09		0.55	
% Dipterans	0.00		0.00	

Number of species in sample **10**

Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 24-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Microcystis col evid;fil diatoms
Ceratium & col greens pres

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomid		0.7-1.0	955	0	4	3,822
Copepodid	early instar epischurid		0.7-1.0	2,866	0	4	11,465
Skistodiaptomus reighardi	small females/males	1.05-1.15	1.15-1.2	573	6	9	4,013
Order Cyclopoida							
Copepodid			0.5-0.7	3,822	0	2.5	9,554
Mesocyclops edax		0.9-1.0	1.5-1.6	96	4	25	2,389
Nauplii	calanoid+cyclopoid		<.3	17,197	0	0.25	4,299
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.gm;few Dretro+Dpul/pul		1.0-1.2	2,866	0	8	22,930
Daphnia pulex/pulicaria	large pulex-like females		2.1-2.45	11	0	60	636
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		1.75-2.1	18	5	34	601
Ceriodaphnia lacustris	immatures		0.35	1,911	0	1.5	2,866
Ceriodaphnia sp.	*C. quadrangula-like*		0.63-0.70	955	0	3.5	3,344
Bosmina longirostris			0.385-0.42	1,911	2.5	2.5	4,777
Bosmina longirostris	immatures		0.28-0.3	5,732	0	1.1	6,306
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	955	0	0.02	19
Keratella cochlearis			0.17	955	0	0.01	10
Type 2 (mostly illoricate virgates/incudates)							
Ascomorpha (Chromogaster) ovalis			0.11	955	0	0.02	19
Polyarthra sp.	appen pair not evid		0.11	955	0	0.03	29
Polyarthra sp.	appen pair not evid		0.14	1,911	0	0.07	134
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	44,646	**44.65**	**77,212**	**77.21**
% Calanoid Copepods	9.84		25.00	
% Cyclopoid Copepods	8.77		15.47	
% Nauplii	38.52		5.57	
% Cladocerans	30.02		53.70	
% Rotifers	12.84		0.27	
% Dipterans	0.00		0.00	

Number of species in sample **13**

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 25-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Fragil& Microcystis conspic;Melosira; Ceratium;col greens pres

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	1,057	0	4	4,227
Copepodid	early instar epischurids		0.7-1.0	1,057	0	4	4,227
Skistodiaptomus reighardi	small females/males	1.05-1.15	1.15-1.25	423	6	9	2,853
Order Cyclopoida							
Copepodid	early instar Mesocyclops		0.5-0.7	6,340	0	2.5	15,850
Mesocyclops edax	males/large females	0.9-1.0	1.5-1.6	1,796	4	25	22,718
Nauplii	calanoid+cyclopoid		<.3	23,246	0	0.25	5,812
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retroW/tall helm+Dgm		1.0-1.2	3,170	0	8	25,360
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		1.75-2.1	50	5	34	1,689
Daphnia retrocurva	tall retrocurved helmet		1.75-2.0	211	0	27	5,706
Ceriodaphnia lacustris			0.5-0.56	2,113	0	2.5	5,283
Bosmina longirostris			0.50	1,057	0	3.5	3,698
Bosmina longirostris	immatures		0.28-0.3	3,170	0	1.1	3,487
Chydorus sp.			0.30	1,057	0	1.5	1,585
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	5,283	0	0.02	106
Keratella earlineae			0.20	1,057	0	0.019	20
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	6,340	0	0.03	190
Polyarthra sp.	appen pair not evid		0.14	2,113	0	0.07	148
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	59,539	**59.54**	**102,957**	**102.96**
% Calanoid Copepods	4.26		10.98	
% Cyclopoid Copepods	13.67		37.46	
% Nauplii	39.04		5.64	
% Cladocerans	18.19		45.46	
% Rotifers	24.85		0.45	
% Dipterans	0.00		0.00	

Number of species in sample **11**

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4
DATE: 25-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS:deterior Microcystis/Aphanocapsa col /Ceratium & Fragil evid

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomids		0.7-1.0	1,438	0	4	5,750
Copepodid	early instar Epischura		<1.0	1,438	0	4	5,750
Skistodiaptomus reighardi	small females/males	1.05-1.15	1.15-1.25	2,875	6	9	21,563
Order Cyclopoida							
Copepodid	Mesocyclops + Cyc sp.		0.5-0.7	8,625	0	2.5	21,563
Copepodid	late instar Mesocyclops		0.9-1.05	2,875	0	4	11,500
Mesocyclops edax	mostly males	0.9-1.0	1.5-1.6	3,163	4	25	18,688
Nauplii	calanoid+cyclopoid		<.3	40,251	0	0.25	10,063
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.retroW/tall helm		1.0-1.2	11,500	0	8	92,003
Daphnia retrocurva	tall retrocurved helmet		1.4-1.6	8,625	0	14	120,754
Ceriodaphnia lacustris			0.42-0.56	11,500	0	2.5	28,751
Bosmina longirostris			0.385-0.49	5,750	2.5	3	17,251
Bosmina longirostris	immatures		0.28-0.3	11,500	0	1.1	12,650
Chydorus sp.			0.25-0.35	5,750	0	1.8	10,350
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	17,251	0	0.006	104
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	17,251	0	0.03	518
Polyarthra sp.	appen pair not evid		0.14	11,500	0	0.07	805
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	161,292	**161.29**	**378,063**	**378.06**
% Calanoid Copepods	3.57		8.75	
% Cyclopoid Copepods	9.09		13.69	
% Nauplii	24.96		2.66	
% Cladocerans	33.87		74.53	
% Rotifers	28.52		0.38	
% Dipterans	0.00		0.00	

Number of species in sample **10**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5
DATE: 25-Sep-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Ceratium/fil diatoms v. sparse/ few Anabaena fil

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Skistodiaptomus reighardi	small females	1.05-1.15	1.15-1.25	398	6	9	3,583
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	3,981	0	0.25	995
Class Branchiopoda(cladocerans)							
Daphnia	immat;mostly D.retroW/tall helmets		1.0-1.2	398	0	8	3,185
Daphnia galeata mendotae	small fem;helmet w/pt		1.5-1.75	123	5	25	3,085
Bosmina longirostris			0.385-0.42	398	2.5	2.5	995
Bosmina longirostris	immatures		0.28-0.3	398	0	1.1	438
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Type 2 (mostly illoricate virgates/incudates)							
Synchaeta sp.	body contracted		0.17	3,981	0	0.06	239
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	9,678	**9.68**	**12,520**	**12.52**
% Calanoid Copepods	4.11		28.62	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	41.14		7.95	
% Cladocerans	13.62		61.53	
% Rotifers	41.14		1.91	
% Dipterans	0.00		0.00	

Number of species in sample **5**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL0
DATE: 14 Oct-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Melosira conspic;also large Microcystis wesen col evid

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	diaptomids		0.7-1.0	53	0	4	211
Order Cyclopoida							
Copepodid	early instar Mesocyclops		0.5-0.7	527	0	2.5	1,318
Copepodid	late instar Mesocyclops		0.9-1.05	53	0	4	211
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	53	4	25	1,318
Nauplii	calanoid+cyclopoid		<.3	1,581	0	0.25	395
Class Branchiopoda(cladocerans)							
Daphnia	larger immat;mosty D.retro&Dg.m.		1.2-1.4	211	0	10	2,108
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		2.1-2.45	6	5	45	254
Daphnia retrocurva	fem tall rnd retro helm;males pres	1.00	1.4-1.75	15	8	20	306
Bosmina longirostris			0.385-0.42	105	2.5	2.5	264
Bosmina longirostris	immatures		0.28-0.3	158	0	1.1	174
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	527	0	0.02	11
Keratella earlineae			0.20	527	0	0.019	10
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	1,054	0	0.03	32
Polyarthra sp.	appen pair not evid		0.14	3,689	0	0.07	258
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	8,559	**8.56**	**6,867**	**6.87**
% Calanoid Copepods	0.62		3.07	
% Cyclopoid Copepods	7.39		41.44	
% Nauplii	18.47		5.76	
% Cladocerans	5.79		45.21	
% Rotifers	67.74		4.52	
% Dipterans	0.00		0.00	

Number of species in sample **8**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL1
DATE: 14-Oct-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Melosira conspic;also Fragil & Microcystis spp.;few Ceratium/Pediastrum

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)	
PHYLUM ARTHROPODA								
Subphylum Crustacea								
Subclass Copepoda								
Order Calanoida								
Order Cyclopoida								
Copepodid			0.5-0.7	710	0	2.5	1,776	
Copepodid	late instar Mesocyclops		0.9-1.05	4	0	4	14	
Nauplii	calanoid+cyclopoid		<.3	3,552	0	0.25	888	
Class Branchiopoda(cladocerans)								
Daphnia	immatures;mostly DretroWtall helm		1.0-1.2	142	0	8	1,137	
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		1.75-2.1	11	5	34	362	
Daphnia retrocurva	ovig femW/tall retro helm;males pres		1.75-2.0	92	0	27	575	
Chydorus sp.			0.25-0.28	71	0	1	71	
Class Insecta								
Order Diptera								
PHYLUM ROTIFERA								
Type 1 (mostly loricated malleates)								
Kellicottia longispina			0.21(body)	710	0	0.02	14	
Keratella cochlearis	small form		0.14	710	0	0.006	4	
Type 2 (mostly illoricate virgates/incudates)								
Gastropus sp.	pink color		0.11	710	0	0.02	14	
Polyarthra sp.	appen pair not evid		0.11	2,842	0	0.03	85	
Polyarthra sp.	appen pair not evid		0.14	2,842	0	0.07	199	
Type 3 (mostly malleoramates)								
Undetermined Rotifers								
Undeter loricate rotifer	loricate?;body crumpled		0.15	710	0	0.05	36	
		Total Density					**Total Dry Wt. Biomass**	
		#/m3	**#/L**				**ug/m3**	**ug/L**
		13,107	**13.11**				**5,176**	**5.18**
% Calanoid Copepods		0.00					0.00	
% Cyclopoid Copepods		5.45					34.59	
% Nauplii		27.10					17.16	
% Cladocerans		2.41					41.45	
% Rotifers		65.04					6.81	
% Dipterans		0.00					0.00	

Number of species in sample **9**

Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL2
DATE: 14-Oct-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: Melosira&Microcystis col evid; few Pediastrum col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar diaptomid		0.7-1.0	955	0	4	3,822
Copepodid	early instar epischurid		0.7-1.0	955	0	4	3,822
Order Cyclopoida							
Copepodid	early instar Mesocyclops		0.5-0.7	955	0	2.5	2,389
Mesocyclops edax	males;large females	0.9-1.0	1.5-1.6	102	4	25	549
Nauplii	calanoid+cyclopoid		<.3	955	0	0.25	239
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.gm+DretroWtall retro helm		1.0-1.2	191	0	8	1,529
Daphnia pulex/pulicaria	young pulicaria-like females		1.60	3	0	20	57
Daphnia galeata mendotae	ovig fem;tall helmet w/pt		1.75-2.1	7	5	34	244
Daphnia retrocurva	ovig femW/tall retrocurved helm	1.00	1.75-2.1	14	8	27	387
Chydorus sp.			0.25-0.35	96	0	1.8	172
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	1,911	0	0.02	38
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.14	2,866	0	0.07	201
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	9,012	**9.01**	**13,447**	**13.45**
% Calanoid Copepods	21.20		56.84	
% Cyclopoid Copepods	11.74		21.85	
% Nauplii	10.60		1.78	
% Cladocerans	3.45		17.76	
% Rotifers	53.01		1.78	
% Dipterans	0.00		0.00	

Number of species in sample **9**

Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL3
DATE: 15-Oct-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS:Melosira conspic;some Ceratium& Microcystis col pres

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Copepodid	early instar epischurids		0.7-1.0	1,180	0	4	4,718
Skistodiaptomus reighardi	small females/males	1.05-1.15	1.15-1.25	236	6	9	2,123
Order Cyclopoida							
Copepodid	early instar Mesocyclops		0.5-0.7	2,359	0	2.5	5,898
Mesocyclops edax	males/large females	0.9-1.0	1.5-1.6	1,297	4	25	7,667
Nauplii	calanoid+cyclopoid		<.3	16,513	0	0.25	4,128
Class Branchiopoda(cladocerans)							
Daphnia	immat;D.retroW/tall helm		1.0-1.2	1,180	0	8	9,436
Daphnia retrocurva	epphip females;mod retro helmets		1.50	236	0	14	3,303
Daphnia retrocurva	females w/tall retrocurved helmet		1.6-1.75	944	8	20	18,872
Ceriodaphnia sp.	*C. quadrangula-like*		0.63-0.70	118	0	3.5	413
Bosmina longirostris	immatures		0.28-0.3	118	0	1.1	130
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Kellicottia longispina			0.21(body)	5,898	0	0.02	118
Keratella cochlearis	small form		0.14	8,257	0	0.006	50
Keratella earlineae			0.20	1,180	0	0.019	22
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	5,898	0	0.03	177
Polyarthra sp.	appen pair not evid		0.14	14,154	0	0.07	991
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	59,566	**59.57**	**58,046**	**58.05**
% Calanoid Copepods	2.38		11.79	
% Cyclopoid Copepods	6.14		23.37	
% Nauplii	27.72		7.11	
% Cladocerans	4.36		55.39	
% Rotifers	59.41		2.34	
% Dipterans	0.00		0.00	

Number of species in sample **10**
Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL4
DATE: 15-Oct-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: algae very sparse-few fil diatoms, Ceratium, Microcystis wesen col

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Nauplii	calanoid+cyclopoid		<.3	271	0	0.25	68
Class Branchiopoda(cladocerans)							
Daphnia	immatures;D.retroW/tall helm		1.0-1.2	111	0	8	889
Daphnia retrocurva	ovig fem;tall retrocurved helmet		1.4-1.6	54	0	14	759
Bosmina longirostris	immatures		0.28-0.3	135	0	1.1	149
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Keratella cochlearis	small form		0.14	2,709	0	0.006	16
Type 2 (mostly illoricate virgates/incudates)							
Polyarthra sp.	appen pair not evid		0.11	2,709	0	0.03	81
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	5,990	**5.99**	**1,961**	**1.96**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	0.00		0.00	
% Nauplii	4.52		3.45	
% Cladocerans	5.02		91.57	
% Rotifers	90.46		4.97	
% Dipterans	0.00		0.00	

Number of species in sample **5**

Other invertebrates represented:

CLIENT: AVISTA UTILIIES
PROJECT: LAKE SPOKANE ZOOPLANKTON
STATION: LK SPOKANE--LL5
DATE: 15-Oct-2013

WATER Environmental Services, Inc.

SAMPLE STATUS: Isopropyl alch-glycer pres
COMMENTS: phytos v. sparse/

ITIS Taxon	Comments	Ave lngth male(mm)	Ave lngth fem (mm)	#/m3	Estim. Dry wt.bm ug/male	Estim. Dry wt.bm ug/fem	Tot bm(ug/m3)
PHYLUM ARTHROPODA							
Subphylum Crustacea							
Subclass Copepoda							
Order Calanoida							
Order Cyclopoida							
Copepodid			0.5-0.7	487	0	2.5	1,216
Mesocyclops edax	large females	0.9-1.0	1.5-1.6	19	4	25	487
Nauplii	calanoid+cyclopoid		<.3	487	0	0.25	122
Class Branchiopoda(cladocerans)							
Daphnia	immat;mostly D.retroW/tall helmets		1.0-1.2	19	0	8	156
Alona sp.	*A. quadrangularis-like*		0.45-0.49	487	0	1.5	730
Class Insecta							
Order Diptera							
PHYLUM ROTIFERA							
Type 1 (mostly loricated malleates)							
Type 2 (mostly illoricate virgates/incudates)							
Type 3 (mostly malleoramates)							
Undetermined Rotifers							

	Total Density #/m3	Total Density #/L	Total Dry Wt. Biomass ug/m3	Total Dry Wt. Biomass ug/L
	1,499	**1.50**	**2,710**	**2.71**
% Calanoid Copepods	0.00		0.00	
% Cyclopoid Copepods	33.77		62.84	
% Nauplii	32.47		4.49	
% Cladocerans	33.77		32.68	
% Rotifers	0.00		0.00	
% Dipterans	0.00		0.00	

Number of species in sample **3**

Other invertebrates represented:

APPENDIX B

Quality Assurance Project Plan for Lake Spokane Baseline Nutrient Monitoring (TetraTech 2014b)

Quality Assurance Project Plan

for

Lake Spokane Baseline Nutrient Monitoring

In Support of
Lake Spokane Dissolved Oxygen Water Quality Attainment Plant
Spokane River Hydroelectric Project
FERC Project No. 2545

Washington 401 Certification,
Section 5.6

January 2014

PREPARED BY:

Tetra Tech, Inc.

316 W. Boone Avenue, Suite 363
Spokane, WA 99201

PREPARED FOR:

Avista

1411 East Mission Ave
PO Box 3727 MSC-1
Spokane, WA 99220

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Approval Signatures:

Meghan Lunney, Project Manager (Avista) Date: 3/18/2014

Elvin "Speed" Fitzhugh, Spokane River License Manager (Avista) Date: 3/19/14

Robert Plotnikoff, Project Manager (Tetra Tech, Inc.) Date: 3/18/2014

Shannon Brattebo, Technical Lead (Tetra Tech, Inc.) Date: 3/18/2014

Jim Ross, Project Manager (Ecology - EAP) Date: 3/20/2014

****Signatures for this QAPP were obtained following Ecology's March 13, 2014 approval of the Lake Spokane DO WQAP 2013 Annual Summary Report.**

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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
µS/cm	micro Siemens per centimeter
Avista	Avista Utilities
chl	chlorophyll a
DO	dissolved oxygen
Ecology	Washington Department of Ecology
EWU	Eastern Washington University
HED	Hydroelectric Development
N	nitrogen
N+P	nitrogen plus phosphorus
ND	non-detect
NO_3+NO_2	Nitrate+nitrite
P	phosphorus
QAPP	Quality Assurance Project Plan
RM	river mile
SRP	soluble reactive phosphorus
TMDL	total maximum daily load
TN	total nitrogen or total persulfate nitrogen
TN:TP	total nitrogen to total phosphorus ratio
TP	total phosphorus

BACKGROUND

The Washington Department of Ecology (Ecology) has determined that the dissolved oxygen (DO) levels in certain portions of the Spokane River and Lake Spokane do not meet Washington's water quality standards. Consequently, those portions of the River and Lake are listed as impaired water bodies under Section 303d of the Clean Water Act. In response, Ecology developed the Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load Water Quality Improvement Report (DO TMDL), issued on February 12, 2010.

Reduced DO levels are largely due to the discharge of nutrients into the Spokane River and Lake Spokane. Nutrients are discharged into the Spokane River and Lake Spokane by point sources, such as waste water treatment facilities and industrial facilities, and from non-point sources, such as tributaries, groundwater, and stormwater runoff, relating largely to land-use practices.

Avista Corporation (Avista) owns the Spokane River Hydroelectric Project (Project), which consists of five dams on the Spokane River, including Long Lake Hydroelectric Development (HED) which creates Lake Spokane. Avista does not discharge nutrients into either the Spokane River or Lake Spokane. However, the impoundment creating Lake Spokane increases the residence time for water flowing down the Spokane River, and thereby influences the ability of nutrients contained in those waters to reduce DO levels.

Avista received a new, 50-year license for the Project from the Federal Energy Regulatory Commission (FERC) on June 18, 2009 (FERC 2009). The license incorporates a water quality certification (Certification) issued by Ecology under Section 401 of the Clean Water Act (Ecology 2009). As required by Section 5.6.C of the Certification, Avista submitted an Ecology-approved Lake Spokane Dissolved Oxygen Water Quality Attainment Plan (DO WQAP) to FERC on October 8, 2012. Avista began implementing the DO WQAP, upon receiving FERC's December 19, 2012 approval.

During 2010 and 2011, Ecology and Avista conducted regular critical-period (May to October) sampling on Lake Spokane, and Ecology conducted sampling on the Spokane and Little Spokane River. The sampling was completed under the Ecology approved Quality Assurance Project Plan, Lake Spokane Nutrient Monitoring (Publication No. 10-03-120, October 2010) for nutrients, dissolved oxygen, and measures of productivity. The purpose of this monitoring was to collect baseline information during the finalization of the DO TMDL. During 2012 and 2013, Avista took over the regular critical-period (May to October) monitoring for all scheduled sampling events on Lake Spokane after providing an addendum to the Quality Assurance Project Plan, Lake Spokane Nutrient Monitoring, which Ecology subsequently approved.

As required under its DO WQAP, Avista will continue to conduct the Lake Spokane Nutrient Monitoring until 2016 at which time it will evaluate the results and success of monitoring baseline nutrient conditions in Lake Spokane and will work with Ecology to define future monitoring goals for the lake.
Avista is compiling this revised QAPP in order to formally incorporate the modifications made in the 2012 QAPP Addendum. Avista would also like to note that it anticipates Ecology will continue to conduct the water quality monitoring at the two upstream river stations (54A090 - Spokane River at

Ninemile Bridge and 55B070 - Little Spokane River near Mouth) along with the river station downstream of Long Lake Dam (54A070 Spokane River at Long Lake).

WATERBODY DESCRIPTION

The Spokane River begins at the outlet of Coeur d'Alene Lake in Idaho and flows 111 miles to the Columbia River. The river, including the Coeur d'Alene Lake catchment, drains an area of about 6,640 square miles in two states. Approximately 2,295 square miles are within eastern Washington with the remainder of the watershed in Idaho. Most residents in the watershed live in the Spokane metropolitan area.

There are seven hydroelectric dams downstream from the outlet of Coeur d'Alene Lake which significantly influences the dynamics of the Spokane River. Avista owns and operates five Hydroelectric Developments (HEDs) on the Spokane River in northern Idaho and eastern Washington, in and near the City of Spokane (Figure 1). The five Washington dams are run-of-the river (flow-through) types except for Long Lake Dam, which creates Lake Spokane. Lake Spokane is a 5,060 acre reservoir which is approximately 23.5 miles long and has a normal full-pool elevation of 1,536 ft (Figure 2). The reservoir transitions from a shallow riverine environment (generally less than 25 feet deep) in its upper reaches, to a deeper lacustrine environment at the lower end of the reservoir near the dam. The maximum depth of the reservoir is approximately 202 ft.

Table 1 lists the state water quality criteria for dissolved oxygen that apply to the Spokane River and Lake Spokane. In addition, the Spokane River has the following specific water quality criteria, per WAC 173-201A-130, from Long Lake Dam (RM 33.9) to Nine Mile Bridge (RM 58.0), which encompasses all of Lake Spokane:

- The average euphotic zone concentration of total phosphorus (TP) shall not exceed 25 µg/L during the period of June 1 to October 31.

Table 1. Designated Aquatic Life Uses and DO Criteria for the Spokane River as Defined in the 2006 Water Quality Standards.

Portion of the Waterbody	Aquatic Life Uses	DO Criteria
Spokane River (from Nine Mile Bridge to the Idaho Border)	Migration/Rearing/Spawning	DO shall exceed 8.0 mg/L. If "natural conditions"[a] are less than the criteria, the natural conditions shall constitute the water quality criteria.
Lake Spokane (from Long Lake Dam to Nine Mile Bridge)	Core Summer Habitat	No measurable (0.2 mg/L) decrease from natural conditions.
Spokane Arm of Lake Roosevelt (from confluence of Columbia River and Spokane River to Little Falls Dam)	N/A	DO shall not be less than 8.0 mg/L[b].

[a]Washington water quality standards (WAC 173-201A-020) defines "natural conditions" or "natural background levels" as "surface water quality that was present before any human-caused pollution. When estimating natural conditions in the headwaters of a disturbed watershed, it may be necessary to use the less disturbed conditions of a neighboring or similar watershed as a reference condition."
[b]Spokane Tribe of Indians Surface Water Quality Standards (Resolution 2003-259).

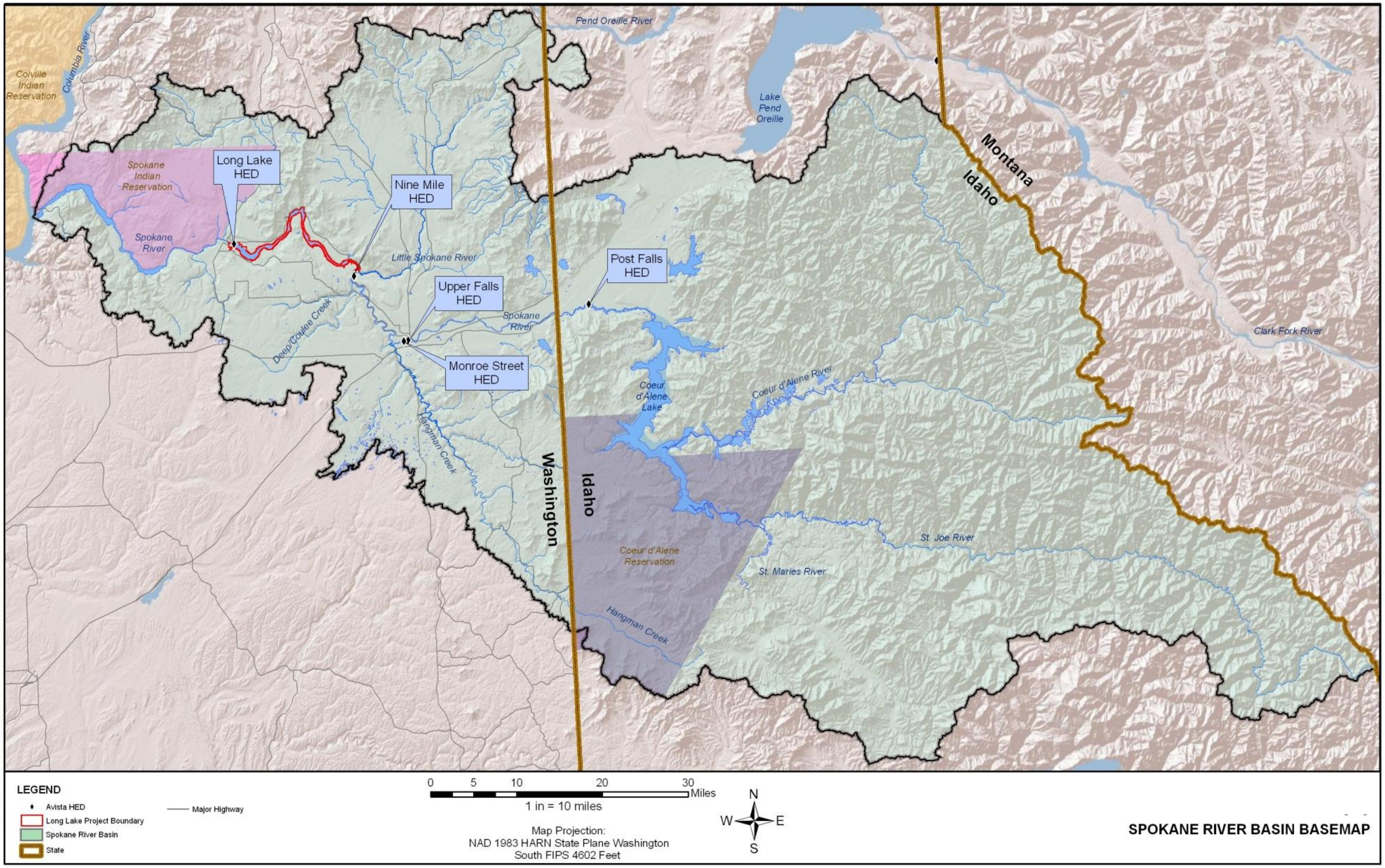

Figure 1. Spokane River Basin.

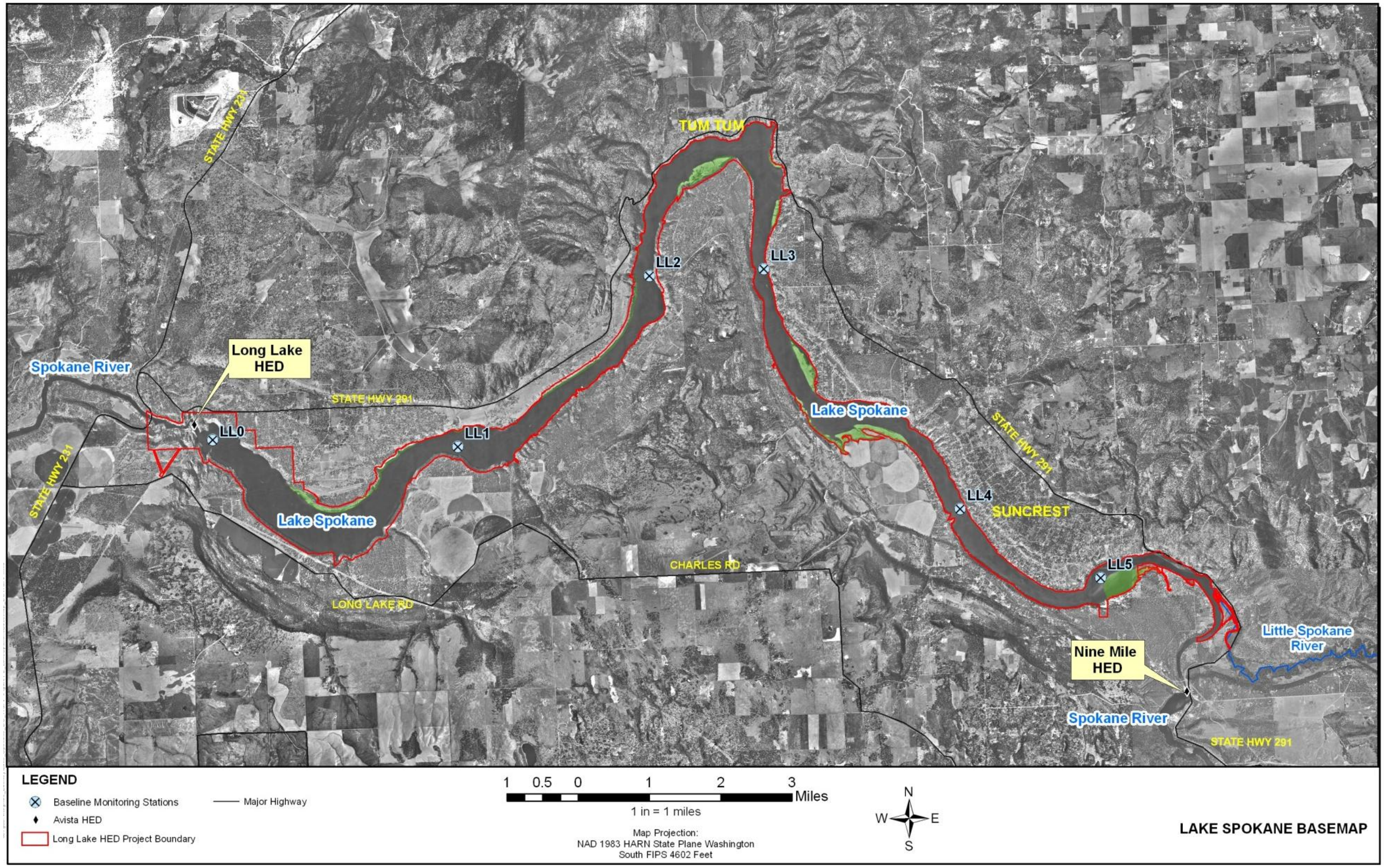

Figure 2. Lake Spokane Monitoring Locations.

PROJECT DESCRIPTION

In 2010, Avista teamed with Ecology to implement a two-year nutrient monitoring program for Lake Spokane to support the DO TMDL effort. The program included conducting one sampling event in May and October, and two sampling events per month from June through September. The sampling was conducted at six lake monitoring stations in Lake Spokane and two upstream river stations (samples at upstream river stations collected by Ecology staff). These six lake monitoring stations were included in previous Lake Spokane sampling studies (Figure 2), including Ecology's Spokane River and Lake Spokane (Long Lake) Pollutant Loading Assessment for Protecting Dissolved Oxygen (Cusimano 2004). All sampling was completed in accordance with the Quality Assurance Project Plan (QAPP) developed by Ecology (Ecology 2010).

The goal of this project is to continue baseline water quality monitoring at the six stations in Lake Spokane until 2016. Avista anticipates Ecology will provide the water quality data from the two upstream river stations (54A090 - Spokane River at Ninemile Bridge and 55B070 - Little Spokane River near Mouth), monitored by Ecology, and a river station downstream of Long Lake Dam (54A070 Spokane River at Long Lake). In 2016, Avista will evaluate the results and success of monitoring baseline nutrient conditions in Lake Spokane and will work with Ecology to define future monitoring goals for the lake. This may include assessing whether the monitoring parameters, locations, duration, and frequency should be modified.

Information in this QAPP is organized to provide sampling and analysis methods that will generate data and interpretations necessary to address the following objectives:

Objective 1. Conduct field sampling and data analysis. For each year, collect samples twice per month from June through September and once per month in May and October at the six lake monitoring stations established by Ecology in the 2010 QAPP (Ecology 2010).

Objective 2. Evaluate nutrient and DO concentrations in Lake Spokane. Ensure field crews consistently follow methods and procedures as outlined in this QAPP to collect data that can be used in trend analysis with past and future data collected in a similar manner.

Objective 3. Complete an annual summary report. The report will include analysis of water quality data collected as part of this QAPP and will include simple presentation of the monitoring data, as well as more comprehensive analysis using statistical methods and graphical display. The report will effectively depict relationships between observed water quality and benchmarking criteria or modeling results.

Previous monitoring (2010 and 2011) at Lake Spokane included a longer list of water quality parameters than will be collected and analyzed with the monitoring effort associated with this QAPP. The need to collect all nutrient, physical and chemical parameters was re-examined based on: 1) the relationship of each parameter in directly or indirectly influencing DO concentrations in the water column, and 2) the examination of previous monitoring data that could be used to identify sources of impairment and the dynamics leading to this degradation of water quality.

Based on this analysis of existing information, the need to sample ammonia-nitrogen, alkalinity, chloride, Total Dissolved Solids (TDS), Dissolved Organic Carbon (DOC) and Total Organic Carbon (TOC) was determined not necessary to address nutrient and DO issues in the reservoir. Removing these analytes was addressed in the Ecology-approved 2012 QAPP Addendum.

The following is rationale for the decision to reduce the number of parameters analyzed beginning with the 2012 monitoring program:

- Ammonia-nitrogen concentrations are extremely low in Lake Spokane. Within the epilimnion, ammonia-nitrogen was undetectable and in the hypolimnion concentrations averaged 0.03 mg/L. This is an insignificant concentration and will not promote primary productivity in the reservoir or contribute to potential toxicity downstream. Given that the hypolimnion is aerobic, internally generated ammonia will be readily oxidized to nitrate. Also, nitrate is the most bio-available inorganic form of nitrogen that promotes primary production and by measuring nitrate Avista will be able to assess nitrogen limitation relative to soluble reactive phosphorus (SRP).

- Alkalinity, chloride and TDS can be used as tracers that identify sources of water (i.e. groundwater) and contaminants into the reservoir. However, data collected as part of this monitoring effort were not intended for use in source-tracing, as monitoring frequency and duration of other water sources (including WWTPs, Little Spokane River, and Hangman Creek) may differ from the Lake Spokane stations. Alkalinity, chloride, and TDS are conservative constituents (not biologically interactive) so water sources to Lake Spokane can be determined from historic data when those sources, as well as Lake Spokane are monitored. Furthermore, conductivity is determined in the field and this physical parameter is a strong indicator for determining flow direction through Lake Spokane than is alkalinity, chloride, or TDS.

- DOC and TOC ranged from undetectable to approximately 1 mg/L in Lake Spokane. At these concentrations, DOC and TOC would not be used to supplement explanation for DO depletion or have correlation with primary production in algal biomass.

ORGANIZATION AND SCHEDULE

The organizational aspects of a program provide the framework for conducting tasks. The organizational structure can also facilitate project performance and adherence to quality control (QC) procedures and quality assurance (QA) requirements. Key project roles are filled by those persons responsible for ensuring the collection of valid data and the routine assessment of the data for precision and accuracy, as well as the data users and the person(s) responsible for approving and accepting final products and deliverables. The project organization chart, presented in Table 2, includes titles and responsibilities among participants and data users. The responsibilities of these persons are described below. Table 3 reports project Task timelines to ensure that deliverables are completed on time. The schedule presented in Table 3 applies to each year of monitoring (2012-2015). Specific dates for sampling events will be determined in the late winter/early spring of each year prior to the first sampling event in May. Sampling events during May and October will occur around the middle of the month. Sampling events in June through September we be every other week, usually starting the second week of June and will take into account any holidays which may disrupt schedule and lake access.

Table 2. Project Organization and responsibilities for each of the team members.

STAFF	TITLE	RESPONSIBILITIES
Meghan Lunney	Avista Project Manager	Avista's project manager. She clarifies scope of the project, provides internal review of the QAPP, and approves the final QAPP for delivery to Ecology. Reviews draft and final annual summary reports and provides all coordination between Avista and Ecology.
Robert Plotnikoff	Tetra Tech Project Manager	Tetra Tech primary contact for project management. Reviews QAPP as well as annual summary reports prior to delivery to Avista.
Harry Gibbons, PhD	Tetra Tech QA Officer	Tetra Tech senior environmental scientist that reviews and approves content of the reports.
Shannon Brattebo, PE	Tetra Tech Principal Field Investigator	Tetra Tech's principal field investigator and technical lead. She oversees all field sampling activities and adherence to QAPP. She conducts data QA/QC review, analyzes and interprets data and writes the draft and final summary reports.
Gene Welch, PhD	Tetra Tech Senior Limnologist	Tetra Tech's senior limnologist responsible for data analysis and evaluation and report writing.
Jessica Blizard	Tetra Tech Aquatic Scientist	Tetra Tech's aquatic scientist responsible for prepping and entering data into EIM.

Table 3. Project Schedule and Timeline for each Year of Monitoring.

Project Task	Completion Date
Lake Spokane Sampling Events (includes water and *in-situ* field data collection)	May (one event) June (two events) July (two events) August (two events) September (two events) October (one event)
Provide Avista Data Deliverables (per sampling event)	Within 14 days of each sampling event
Receive All Laboratory Results	No later than November 30th
EIM Data Upload	No later than December 31st
Submit Draft Monitoring Summary Report to Avista	December 27th
Submit Final Monitoring Summary Report to Avista	January 27th (following year) or Within 30 days of receipt of comments
Avista to Submit Final Monitoring Summary Report to Ecology	February 1st (following year)

QUALITY OBJECTIVES

Measurement quality objectives (MQOs) are the performance or acceptance criteria for individual data quality indicators, including precision, bias, and sensitivity (Ecology 2004). The MQOs for this project are presented in Table 4. Industry standard field methods will be used throughout this project to minimize measurement bias (systematic error) and to improve precision (to reduce random error). All laboratory-bound samples will be collected, preserved, stored, and otherwise managed using accepted procedures for maintaining sample integrity prior to analysis (Ecology 1993).

Table 4. Measurement Quality Objectives

Parameter	Method	Expected Range of Values	Check Standard (LCS)	Duplicate Samples	Matrix Spikes/Matrix Spike Duplicates	Method Detection Limits
			% Recovery	RPD	% Recovery, RPD	
Field						
pH	Hydrolab MS5 MiniSonde®	6.0 to 9.0 units	NA	± 0.1 pH units	NA	0.1
Conductivity	Hydrolab MS5 MiniSonde®	50 to 500 µS/cm	NA	± 5 %	NA	0.1 µS/cm
Temperature	Hydrolab MS5 MiniSonde®	1.0 to 30°C	NA	± 5 %	NA	0.01°C
Dissolved Oxygen (LDO)	Hydrolab MS5 MiniSonde®	1.0 to 12 mg/L	NA	± 5 %	NA	0.2 mg/L
Secchi Disk Depth	Hydrolab MS5 MiniSonde®	1 to 10 m	NA	±0.1 m	NA	0.1 m
Laboratory						
Chlorophyll a	SM[a]-10200H	1 to 25 µg/L	NA	±20%	NA	0.1 µg/L
Total Nitrogen (Total Persulfate Nitrogen)	SM-4500NC	0.5 to 50 mg/L	±10%	±20%	±20%	0.050 mg/L
Total Phosphorus	SM-4500PF	0.005 to 0.25 mg/L	±10%	±20%	±20%	0.002 mg/L
Soluble Reactive Phosphorus	SM-4500PF	0.001 to 0.05 mg/L	±10%	±20%	±20%	0.001 mg/L
Nitrate+Nitrate-N	SM-4500NO3F	0.01 to 30 mg/L	±10%	±20%	±20%	0.010 mg/L
Dissolved Oxygen (Winkler)	EPA 360.2	1.0 to 12 mg/L	NA	±0.1 mg/L	NA	0.1 mg/L
Phytoplankton	Microscope examination	NA	NA	±20%	NA	Cells/L
Zooplankton	Microscope examination	NA	NA	±20%	NA	# organisms/L

[a]SM: Standard Methods for the Examination of Water and Wastewater, 21st Edition (APHA et al. 2005)

Frequency of Quality Control Samples - For samples analyzed at a commercial laboratory, the type and frequency of the quality control samples to be analyzed are summarized in Table 5. Field replicates will not be collected for DO samples analyzed by the laboratory using Winkler titration.

Table 5. Quality Control Samples

Type of Quality Control Sample	Description	Frequency
Method Blank	Reagent grade sample matrix analyzed to provide an indication of laboratory contamination.	One per sample batch. Maximum sample batch equals 20 samples.
Check Sample	Generally purchased, prepared independently from analytical standards and used to provide an indication of the accuracy of the analytical determination.	Random through the study, but not more than twice annually.
Laboratory Duplicate	A second aliquot of a sample, processed in exactly the same manner.	One per sample batch. Maximum sample batch equals 20 samples.
Matrix Spike	An aliquot of a sample to which known quantities of analytes are added, processed in exactly the same manner.	One per sample batch. Maximum sample batch equals 20 samples.
Field Replicate	A split sample, labeled in a similar manner as regular samples, submitted to laboratory, and processed in exactly the same manner.	One per sample event.

Precision - Precision is defined as the degree to which a set of observations or measurements of the same property conform when obtained under similar conditions. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms. Laboratory replicates for assessment of precision will be analyzed at no less than a 5 percent frequency of the total number of samples submitted to the laboratory.

For sample results that exceed the reporting detection limit (RDL), the relative percent difference (RPD) will be less than or equal to 20 percent. No criteria are presented for duplicates that are below the RDL, as these data are provided for informational purposes only. When one or more of the results is below the RDL, professional judgment will be used in determining the compliance of the data to project requirements.

Bias - Bias provides an indication of the accuracy of the analytical data. To assess analytical bias, method blanks that are below detection limits, reporting limits, and percent recovery of target analytes from reagent matrix will be employed. Check samples will be used to provide compliance criteria for bias. The percent recovery of the matrix spikes and standard reference materials will be less than or equal to ± 20 percent. The use of matrix spike recovery will provide additional information regarding method performance on actual samples. The laboratory will use professional judgment regarding reanalysis triggered by matrix spike recovery.

Representativeness - Sample representativeness is the degree to which data accurately and precisely represent a characteristic of a population. Representativeness will be addressed at two distinct points in the data collection process. During sample collection, the use of generally accepted sampling procedures applied in a consistent manner throughout the project will help ensure that samples are representative of conditions at the point where the sample was taken. During subsampling (sample aliquot removal) in the laboratory, samples will be inverted several times to ensure that the analytical subsample is well mixed and therefore representative of the sample container's contents. Depending upon the sampling parameter, samples will be collected at different depths as discussed in the sampling plan.

Completeness - Completeness is a measure of the amount of valid data needed to meet the project's objectives. Completeness will be judged by the amount of valid data compared to the data expected. Valid data are those data in compliance with the data quality criteria as presented in this section, and in compliance with required holding times. While the goal for the criteria described above is 100 percent completeness, a level of 95 percent completeness will be considered acceptable. However, any time data are incomplete, decisions regarding resampling and/or reanalysis will be made. These decisions will take into account the project data quality objectives as presented above.

Comparability - Comparability is a measure of the confidence with which one dataset can be compared to another. This is a qualitative assessment and is addressed primarily by sampling design through use of comparable sampling procedures or, for monitoring programs, through consistent sampling of stations over time. In the laboratory, comparability is assured through the use of comparable analytical procedures and ensuring that project staff are trained in the proper application of the procedures. Within-study comparability will be assessed through analytical performance (quality control samples).

SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

Sampling Schedule

Avista will conduct baseline nutrient monitoring in Lake Spokane each year during the critical time period, May through October, starting in 2012 and ending in 2015. In 2016, Avista will evaluate the results and success of monitoring baseline nutrient conditions in Lake Spokane and will work with Ecology to define future monitoring goals for the reservoir. Sampling will be conducted once per month in May and October, near the middle of the month, and twice per month in June through September. Twice per month sampling will attempt to be every two weeks starting the second week in June with some shifting of schedule due to holidays and lake access. Samples will be collected early in the week if possible (Monday through Wednesday) to ensure adequate time for receipt by the laboratory and that all holding times for analysis are met.

Field Crew

A one-team field crew, consisting of two people, will collect water samples and field measurements at all lake sampling sites. The field team will consist of a field team lead that is responsible for ensuring all proper sampling techniques are applied and samples are collected in accordance with this QAPP. The field team lead will also be responsible for reviewing field sheets and field data collected at the end of each day and notifying Avista if any issues arise during sampling. All field crew members must have a WA State Boaters Education Card and be experienced with all sampling equipment.

Sampling Locations and Timing of Sampling

Water samples and field measurement profiles will be collected at six sites on Lake Spokane, described in Table 6 and shown in Figure 2. These six sites have been well-established from previous studies on Lake Spokane (Long Lake) by Dr. Raymond Soltero at Eastern Washington University and others (Soltero et al. 1974). These six sites were sampled as part of Ecology and Avista's 2010 and 2011 monitoring efforts. Avista anticipates Ecology will continue to conduct water quality monitoring at the two upstream river stations (54A090 - Spokane River at Ninemile Bridge and 55B070 - Little Spokane River near Mouth) along with the river station downstream of Long Lake Dam (54A070 Spokane River at Long Lake).

The field crew will ensure they are sampling at the correct locations on the reservoir by verifying their position with a handheld GPS unit. Notes on environmental conditions that may affect GPS accuracy, such as cloudy or overcast conditions, will be recorded on the field data sheets.

Each sampling event will consist of two days. On the first day, samples will be collected at the deepest and most downstream sampling locations, LL0, LL1, and LL2. The second day samples will be collected at the upper three, shallower, locations, LL3, LL4, and LL5. On each day samples at the most downstream station will be collected first.

Table 6. Lake Spokane Sampling Sites.

Site ID	Description	RM	Longitude	Latitude
LL0	Lake Spokane @ Station 0 (near Long Lake dam)	32.66	-117.83381	47.83400
LL1	Lake Spokane @ Station 1	37.62	-117.76001	47.83060
LL2	Lake Spokane @ Station 2	42.06	-117.70030	47.86374
LL3	Lake Spokane @ Station 3	46.42	-117.66569	47.86416
LL4	Lake Spokane @ Station 4	51.47	-117.60955	47.81382
LL5	Lake Spokane @ Station 5	54.20	-117.56812	47.79866

Parameters

Water samples collected will be analyzed for TP, SRP, Total Nitrogen (TN), Nitrate+Nitrite, and chlorophyll a. Samples will also be collected and analyzed for DO by Winkler titration. Aquatic Research, Inc. will conduct all laboratory analyses for the parameters listed above. Discrete depth samples will be collected at each sampling location. Table 7 summarizes discrete sample depths for each location. However, additional depths may be sampled if deemed necessary to evaluate baseline nutrients in Lake Spokane.

Samples will also be collected at each of the six sampling locations for phytoplankton analysis. These samples will be collected at 0.5 m depth at each sampling location. Additional sampling depths may be sampled if necessary. Zooplankton net hauls will be collected at each location from 1 meter of the bottom through the water column. Both phytoplankton and zooplankton samples will be shipped to WATER Environmental Services for analysis.

The field crew will measure water temperature, DO, pH, and conductivity in Lake Spokane *in-situ* using a Hydrolab® MS5 multi-parameter water quality sonde. Field staff will lower the Hydrolab® from the boat and record field measurements at predetermined intervals through the water column.

Secchi disk transparency will be measured at each sampling location. Field staff will collect three Secchi disk depth measurements with a standard black and white Secchi disk at each location. The average of these three measurements will be determined as the Secchi disk depth reading.

SAMPLING PROCEDURES

Field staff upon arrival at each sampling location in Lake Spokane will record the following information on water-proof field sheets. Field sheets will be prepared by the Field crew lead prior to each sampling event. Detailed information on field sheets will include:

- Date
- Time
- Field Staff Initials
- Number/type of samples collected
- Weather observations
- In-situ field measurements
- Unusual conditions (presence of oil sheen, algal abundance, nuisance conditions, bald eagle sightings, etc.)

Water samples will be collected at discrete depths at each of the six monitoring locations in Lake Spokane. Table 7 summarizes sample depths for each sampling location. Samples will be collected using a Van Dorn bottle with graduated rope to ensure that samples are collected from the correct depths. The Van Dorn bottle will be triple-rinsed with distilled water between each station. The process of lowering the open sampler to depth will also provide a local-water rinse prior to sample collection. The deepest sample will also be collected first at each site.

Table 7. Sample Collection Depths (meters) at each Lake Spokane Sampling Location.

Station	LL0	LL1	LL2	LL3	LL4	LL5
Depths (m)	0.5	0.5	0.5	0.5	0.5	0.5
	5	5	5	5	4	B-1
	15	20	15	10	B-1	
	30	B-1	B-1	B-1		
	B-1[a]					

[a]B-1 is 1 meter off the bottom.

All samples collected will be emptied from the Van Dorn bottle into pre-cleaned containers supplied by the laboratory. Sample parameters, containers, volumes, preservation requirements and holding times are listed in Table 8. Chlorophyll a and SRP samples will not be field filtered; instead sample containers will be shipped to Aquatic Research, Inc. within the 24-hour holding time for unfiltered samples and processed by the laboratory upon receipt.

Water samples will be analyzed for nitrate+nitrite, TN, SRP, TP, and chlorophyll a. Dissolved oxygen will be determined by Winkler titration in the 5 and 10/15/20 m samples to ensure the accuracy of the Hydrolab® multi-parameter sonde. Winkler bottles will be filled by attaching a length of tubing to the nozzle of the Van Dorn sampler and flushing the Winkler bottle from the bottom with three times the volume of the bottle, similar to the use of a standard DO funnel. Winkler titration Reagents 1 and 2 will be added to the DO samples in the field (1 mL of each reagent). Samples will not be collected at stations LL4 and LL5 for Winkler titration. If low DO concentrations are measured at different depths in the reservoir with the Hydrolab®, then DO samples may be determined with Winkler titration at those depths in addition to or in place off samples at 5/10/15/20 depths. Chlorophyll a will be analyzed in the top 3 samples collected at LL0, LL1, LL2, and LL3, the 0.5 and 4 m sample at station LL4, and the 0.5 m sample at LL5.

Phytoplankton samples will be collected at each sampling location at 0.5 m depth using a Van Dorn bottle. Phytoplankton samples will be preserved with Lugol's solution (10 to 15 drops). Zooplankton net hauls will be collected at each location from 1 meter off the bottom through the water column. Each zooplankton sample will be preserved with a glycerin-alcohol mixture.

Each sample container will have a label and will be labeled with an inedible marker before the time of collection. Samples labels will include site designation, date, time, and type of sample. All samples for laboratory analysis will be stored on ice and shipped to Aquatic Research, Inc. and WATER Environmental Services (phytoplankton and zooplankton) as soon as possible and within the holding times listed in Table 8. All samples will be accompanied with a Chain of Custody (COC) form. The COC form acts as a record of sample shipment and a catalog of the contents of each shipment, in addition to maintaining a complete record of evidentiary custody transfer. The COC will contain the following, at a minimum:

- Field Staff Initials
- Project Name
- Page Number (i.e. 1 of 1)
- Sample Location
- Collection date and time
- Number of containers
- Type of analysis required
- Laboratory recipient signature
- Laboratory receipt date and time

Immediately following the packing of each shipping container, each container (cooler) will be secured with packaging tape.

Table 8. Containers, Preservation Requirements, and Holding Times for Samples Collected.

Parameter	Sample Matrix	Container	Preservative	Holding Time	Sample Depths
Chlorophyll a	Water	1000 mL amber poly	Cool to 4°C; 24 hrs to filter	28 days after filtration	LL0, LL1, LL2, and LL3: Top 3 depths LL4: 0.5 and 4 m LL5: 0.5 m
Total Phosphorus	Water	250 ml clear poly	Cool to 4°C	28 days	All depths
Soluble Reactive Phosphorus	Water		Cool to 4°; 24 hrs to filter	48 hours after filtration	All depths
Total Nitrogen (Total Persulfate Nitrogen)	Water		Cool to 4°C	28 days	All depths
Nitrate+Nitrite	Water		Cool to 4°C	28 days	All depths
Dissolved Oxygen	Water	300 mL glass Winkler Titration bottle	Cool to 4°C; 1 mL Reagent 1 and 1 mL Reagent 2	48 hours	LL0, LL1, LL2, and LL3: 5/10/15/20 depths, possible additional depths determined by field crew lead
Phytoplankton	Water	500 mL clear poly	Cool to 4°C; Lugol's Solution (10 to 15 drops)	3 months	0.5 m
Zooplankton	Water	250 mL clear poly	Cool to 4°C; Glycerin-Alcohol Mixture 1:1	3 months	From 1 m off bottom through water column

MEASUREMENT PROCEDURES

Field

Field staff will collect profiles of water temperature, conductivity, pH, and DO at each monitoring location using a Hydrolab® multi-parameter water quality sonde (MS5). Field measurement profiles will consist of discrete measurements recorded at the depths listed in Table 9. Field measurements will be collected at 3 meter intervals starting at the interflow zone (12 m) to the bottom of the lake. The last measurement will be collected 1 meter off the bottom of the lake. Calibration of the Hydrolab® will be completed by field staff each morning of a sampling event according to manufacturer's instructions using known calibration solutions. Field staff will ensure that calibration solutions are within the labeled expiration dates. When sampling activities are completed for the day, field staff will perform calibration checks on the Hydrolab® instrument. Calibration data sheets will be kept by the field staff and delivered to Avista with remaining products upon completion of each sampling event.

Table 9. In-situ Field Measurement Profile Depths (m) for Lake Spokane Sampling Locations.

LL0	LL1	LL2	LL3	LL4	LL5
0.5	0.5	0.5	0.5	0.5	0.5
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	B-1
7	7	7	7	7	
8	8	8	8	B-1	
9	9	9	9		
10	10	10	10		
12	12	12	12		
15	15	15	15		
18	18	18	B-1		
21	21	21			
24	24	24			
27	27	B-1			
30	30				
33	B-1				
36					
39					
42					
45					
B-1*					

*B-1: 1 meter off the bottom of the lake

Water transparency will be monitored at each sampling location using a Secchi Disk. Field staff will collect 3 Secchi disk depth measurements at each sampling location using a standard black and white

Secchi disk. The average of the three measurements will be determined as the Secchi disk depth reading for that location.

Laboratory

All water samples will be analyzed by Aquatic Research, Inc., an Ecology certified laboratory for drinking water analyses. Aquatic Research will analyze all samples according to methods and method detection limits outlined in Table 4 and observing standard laboratory quality control procedures. The contract laboratory QMP is on file with Ecology detailing their quality assurance procedures. Standard laboratory turnaround time is 21 working days. Any issues regarding analytical data quality will be resolved through regular communication with the laboratory project manager.

QUALITY CONTROL

Field Quality Assurance

Quality control activities in the field will include adherence to documented procedures and the comprehensive documentation of sample collection information included on field datasheets. A rigidly enforced chain-of-custody program will ensure sample integrity and identification. The chain-of-custody procedure documents the handling of each sample from the time the sample is collected to the arrival of the sample at the laboratory.

Standard protocols for measuring surface water will be followed throughout the monitoring effort. All field measurement equipment (Hydrolab®) will be cleaned and inspected prior to use to verify that it is working properly. The Hydrolab® multi-parameter water quality sonde will be calibrated according to the manufacturers' instructions at the beginning and end of each sampling day. All pertinent information about the Hydrolab® instrument will be recorded either on the field datasheets or the calibration data sheet.

Field measurements collected during each sampling event will conform to the quality control parameters listed below in Table 10. Quality control measurements will be taken at intervals summarized in Table 11. Field measurement DO, conductivity, pH, and temperature profiles will not be replicated in their entirety but instead every 10th measurement throughout the day will be replicated. Field measured DO will be compared to Winkler titration DO analyzed by the laboratory.

Table 10. Hydrolab® Equipment Quality Control Requirements.

Parameter	Replicate Samples	Field Calibration Check Standards	Calibration Drift End Check
Dissolved Oxygen	RPD ≤ 20%	NA	± 5%
Temperature	± 0.3°C	NA	NA
Conductivity	RPD ≤ 10%	± 10%	± 10%
pH	± 0.2 units	± 0.2 units	±0.3 units

Accurate records of dates, times, field staff name(s), sampling location, and other observations will be assured through the use of standardized field datasheets specifically designed for this monitoring effort. All field datasheets will be checked by the field crew lead at the completion of sampling and prior to leaving the site to ensure all measurements and sampling-related data were accurately recorded.

Field duplicates will consist of a sample, collected and labeled in a similar manner as a regular sample. The duplicate will be submitted to the laboratory and processed in exactly the same manner as a regular sample. Field duplicates will be collected at one per sample batch, with a sample batch maximum of 20 samples.

Field blanks will be collected during each sampling event to assess areas of bias and determine if any level of contamination is occurring due to sample equipment. Field blanks will be made by transferring deionized water (provided by the laboratory) from the Van Dorn sampler to designated sample containers. Table 11 summarizes frequency of field replicates and field blanks for this monitoring effort.

Table 11. Summary of Field and Laboratory Quality Control Requirements.

Parameter	Field Replicates	Check Standard	Method Blank	Duplicates	Matrix Spikes/Matrix Spike Duplicates
Field Measurements					
Temperature	1/10 samples	NA	NA	NA	NA
Dissolved Oxygen	1/10 samples	*NA*	NA	NA	NA
Conductivity	1/10 samples	1/run	NA	NA	NA
pH	1/10 samples	1/run	NA	NA	NA
Laboratory Analyses					
Total Phosphorus	NA	1/batch	1/batch	1/20 samples	1/20 samples
Soluble Reactive Phosphorus	NA	1/batch	1/batch	1/20 samples	1/20 samples
Total Nitrogen (TPN)	NA	1/batch	1/batch	1/20 samples	1/20 samples
Nitrate+Nitrite	NA	1/batch	1/batch	1/20 samples	1/20 samples
Chlorophyll a	NA	NA	NA	1/20 samples	NA

Laboratory Quality Assurance

All samples will be analyzed by an accredited commercial laboratory, Aquatic Research Inc. in Seattle, WA. Aquatic Research is accredited by Ecology, and participates in audits and inter-laboratory studies by Ecology and EPA. Performance and system audits have verified the performance of the laboratory standard operating procedures, which include preventative maintenance and data reduction procedures.

Aquatic Research routinely performs quality control procedures for a variety of projects. These procedures include but are not limited to: duplicates (relative percent difference), spikes (percent recovery), duplicate samples, and laboratory blanks. Laboratory results include a quality control report for each batch of samples analyzed for this project. These routine laboratory, quality control procedures will be used to demonstrate laboratory precision and accuracy and that the measurement quality objectives have been met. If quality control requirements are not met, then all those analyses will be repeated with fresh reagents and new standards. If analysis still fails to meet quality control requirements that sample will be declared invalid and not used in the data analysis.

Aquatic Research will inform the Avista project manager or principal field investigator as soon as possible if any sample is lost, damaged, mislabeled, or is a result outside of the expected range (Table 4).

DATA MANAGEMENT PROCEDURES

Field measurement data will be stored in the Hydrolab® Surveyor during the sampling event. At the completion of each sampling day, the stored data will be transferred to waterproof field data sheets and then entered into an EXCEL spreadsheet as soon as possible. All field data will be evaluated again the measurement quality objectives and field quality control requirements. This database will be used for analysis and to create tables for upload into Ecology’s Environmental Information Management (EIM) system.

Sample result data received from the laboratory will be entered into an EXCEL spreadsheet upon receipt. This spreadsheet will be used for analysis and to create tables for upload to Ecology’s Environmental Information Management (EIM) system. Upon receipt, laboratory analytical data will be evaluated against the measurement quality objectives and laboratory quality assurance documentation will be reviewed.

All spreadsheet files, field datasheets, and laboratory documents created for this monitoring effort will be kept with the project data files.

AUDITS AND REPORTS

Tetra Tech, Inc. will complete and submit to Avista a draft annual monitoring summary report that summarizes the results for the water quality monitoring conducted that year, as well as an assessment of DO TMDL compliance, nutrient summary, and recommendations for future monitoring. Tetra Tech will submit this draft report by December 31st of each year. Avista will then have the opportunity to provide edits and comments and Tetra Tech will revise the summary report as needed and provide Avista a final version within 30 days of receiving Avista's comments. Avista will then submit the annual summary report to Ecology and FERC by February 1st each year following monitoring activities.

DATA VERIFICATION AND VALIDATION

Data verification requires confirmation by examination or provision of objective evidence that the requirements of these specified quality control acceptance criteria are met. Each step of the data collection and analysis process must be evaluated and its conformance to the protocols established in this QAPP verified, including:

- Sampling design
- Sample collection procedures
- Analytical procedures
- Quality control
- Data format reduction and processing data

Validation involves detailed examination of the complete data package using professional judgment to determine whether the established procedures were followed. Data validation will be primarily completed by the principal field investigator.

Aquatic Research Inc. and Water Environmental Services, Inc. staff will review all laboratory analysis for this monitoring effort to verify that the methods and protocols specified in the QAPP were followed; that all instrument calibrations, quality control checks, and intermediate calculations were performed appropriately; and that the final reported data are consistent, correct, and complete, with no omissions or errors.

Evaluation criteria will include the acceptability of instrument calibrations, procedural blanks, spike sample analysis, precision data, laboratory control sample analysis, and the appropriateness of assigned data qualifiers, if any.

The principal field investigator will review the laboratory data packages and case narratives to determine if the results met the measurement quality objectives for bias, precision, and accuracy for that sampling event and to ensure that all analyses specified on the COC form were performed. Field duplicate and field blank results will be evaluated and compared to the quality objectives. Based on these assessments, the sample data will be accepted, accepted with appropriate qualifications, or rejected.

After the laboratory and field data have been reviewed and verified by the principal field investigator, they will be independently reviewed by QA officer for errors before closing out the effort. The initial data review will consist of a 10 percent random sampling of the project data. If any errors are discovered during the initial data review, a full independent review will be undertaken QA officer.

DATA QUALITY (USUABILITY) ASSESSMENT

The principal field investigator will verify that all field measurements and laboratory data have met the appropriate quality objectives. If results fall outside the quality objectives, then the principal field investigator will make the decision of whether to quality or reject the data. If the data are qualified, then the principal field investigator will determine how to use that data for analysis.

Data collected as part of this monitoring effort, in accordance with this QAPP, will be used to summarize baseline nutrient conditions in Lake Spokane and to fulfill the monitoring requirements as described in the *Lake Spokane Dissolved Oxygen Water Quality Attainment Plan* (Avista 2012) and Avista's Washington Section 401 Certification , Section 5.6.

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APPENDIX C

Lake Spokane Carp Population Abundance and Distribution Study, 2013 Annual Report (Golder Associates 2014)

January 28, 2014 Project No. 073-93081-09.005

Meghan Lunney
Avista Corporation
1411 E. Mission Ave.
Spokane, WA 99202

RE: LAKE SPOKANE CARP POPULATION ABUNDANCE AND DISTRIBUTION STUDY 2013 ANNUAL REPORT

Dear Meghan:

This letter summarizes the Lake Spokane Carp Population Abundance and Distribution Study tasks that Golder Associates Inc. (Golder) conducted in 2013. In addition, primary tasks planned for 2014 are described.

1.0 2013 ACTIVITIES

The primary tasks were capture and tagging of Common Carp (*Cyprinus carpio*), referred to as carp in this report, in mid-October of 2013 and tracking the tagged carp between October 30 and December 30 of 2013.

1.1 Capture and Tagging

On October 17, 2013, a crew of staff from Golder and Avista Corporation (Avista) captured 20 carp, implanted combined acoustic radio transmitter (CART) tags into them, and released them after the carp had recovered from the anesthesia and could swim on their own volition. Boat electro-fishing was conducted at two sites that were selected to maximize carp captures. A site near Sportsman's Paradise at approximately river kilometer (RKM) 81 was sampled in morning fog and another site located near Lake Forest Community (Felton Slough) at approximately RKM 78.5 was sampled in early afternoon sunshine. The overall average carp capture per unit effort (CPUE) was 27.9 carp per hour, with 27.2 carp per hour for the morning sampling and 29.7 carp per hour for the afternoon sampling. Fork lengths of the 20 carp were 545 to 705 millimeters (21.5 to 27.8 inches). Table 1-1 summarizes CPUE and length data for the event. Ten of the 20 carp weighed more than 5.0 kilograms (11.0 pounds), which was the upper limit for the scale used. All carp with fork length greater than 625 millimeters (24.6 inches) weighed more than 5 kilograms (11.0 pounds). The minimum weight was 3.2 kilograms (7.2 pounds).

Each of the 20 carp had a passive integrated transponder (PIT) tag inserted on the left side into musculature below the dorsal fin, and a 16-gram CART tag surgically implanted in its abdominal cavity through a 15 millimeters incision posterior of the anal fin. The 16-gram CART tag was 0.5% of the weight for the lightest carp. The CART tags selected for this study are Lotek Model MM-RC-11-45, which are 12-millimeters diameter, 78- millimeters long, have a dry weight of 16 grams, and an expected battery life of 736 days when programmed for 60-second (+/- 2 seconds) interval acoustic signals and 10 to 10.5 second radio signals.[1] Following each surgery, the carp's recovery from anesthesia and general condition was monitored, and once the surgery team determined the carp had recovered from anesthesia, the fish was released.

[1] Lotek. 2013. The CART Series Combined Acoustic/Radio Transmitters. Accessed at http://www.lotek.com/cart.pdf on January 6, 2014.

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Table 1-1: Summary for Carp Capture and Tagging Event Conducted on October 17, 2013.

Parameter	Minimum	Maximum	Weighted Average
Catch per Unit Effort, CPUE (carp / hour)	27.2	29.7	27.9
Fork Length (millimeters)	545	705	608

1.2 Tracking

1.2.1 Methods

On October 16, 2013, the Golder-Avista crew conducted range testing of the CART tags to facilitate development of tracking procedures based on the detectability of the radio and acoustic signals from CART tags under different boat operations and environmental conditions. Results of these tests demonstrated that radio detection worked well for tags that were shallow (even when in a weed bed), and acoustic detection was better for deep tags. Adverse effects of hydraulic noise and boat speed on acoustic detection would prevent effectively detecting locations with the motor running, and would therefore not be as efficient as long as radio detections are possible. Therefore, we planned to track radio signals as long as detection levels remain above 75 percent of the tags. If tag detection levels fell to 50 percent or less in a single tracking session or less than 75 percent for two consecutive tracking sessions, we planned to switch to tracking acoustic signals to attempt to increase detection levels. Radio and/or acoustic tracking will be conducted as appropriate for future tracking.

A period of approximately 2 weeks was allowed to give the carp time to redistribute throughout Lake Spokane after the tags were implanted and they were released on October 17, 2013. Then tracking events were conducted at roughly 1-week intervals during November, followed by approximately 2-week intervals in December.

1.2.2 Results

Results for the seven tracking sessions conducted in 2013 are summarized in Table 1-2. The average detection rate over all tracking sessions was 89 percent. Tracking-session specific detection rates were 15 to 20 (75 to 100 percent) of the 20 tags. More than half of the sessions detected at least 18 (90 percent) of the 20 tags. Sixteen of the 20 tags were detected in at least six of the seven tracking events. The tags with the minimum number of detections (i.e., 4) were in two of the three largest carp, based on fork length.

The location for each carp's release and detections are displayed in the map series (Figure 1-1). October 17, 2013 releases occurred in a reach of 9.9 kilometers extending from RKM 87.5 (the Nine Mile Recreation Area) to RKM 77.6 (near the Lake Forest Community). Detections during tracking sessions occurred as far up-reservoir as RKM 85.1, which is approximately 0.5 kilometer down-reservoir of the Lake Ridge Park Community boat launch, and as far down-reservoir as RKM 72.5 near Tumtum. However, most detections occurred between RKM 79.0 and 80.5, near Sportsman's Paradise, where the majority of tagged carp were congregated between late October and mid-December tracking sessions. During late December, the majority of tagged carp were more widely distributed throughout an approximate 6.0-kilometer-long reach of the reservoir than in earlier tracking sessions.

Table 1-2: Summary of CART Tag Detections

Tag Code	17-Oct Fork Length (millimeters)	30-Oct	6-Nov	13-Nov	21-Nov	3-Dec	16-Dec	30-Dec	Number of Sessions Detected	Percentage of Sessions Detected
11	625	No	Yes	No	Yes	Yes	Yes	Yes	5	71%
12	565	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
13	595	No	Yes	Yes	Yes	Yes	Yes	Yes	6	86%
14	560	Yes	Yes	Yes	Yes	Yes	Yes	No	6	86%
15	580	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
16	565	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
17	570	No	Yes	Yes	Yes	Yes	Yes	No	5	71%
18	585	Yes	No	Yes	Yes	Yes	Yes	Yes	6	86%
19	705	No	Yes	No	No	Yes	Yes	Yes	4	57%
20	680	No	No	No	Yes	Yes	Yes	Yes	4	57%
21	700	Yes	Yes	Yes	Yes	No	Yes	Yes	6	86%
22	600	Yes	Yes	No	Yes	Yes	Yes	Yes	6	86%
23	560	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
24	650	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
25	590	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
26	630	Yes	Yes	Yes	Yes	Yes	Yes	No	6	86%
27	615	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
28	545	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
29	595	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
30	640	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7	100%
Total Number Detected	**N/A**	**15**	**18**	**16**	**19**	**19**	**20**	**17**	**124**	**N/A**
Percentage Detected	**N/A**	**75%**	**90%**	**80%**	**95%**	**95%**	**100%**	**85%**	**N/A**	**89%**

Note: N/A is not applicable.

Figure 1-1. Tagged Carp Release and Detection Locations by Tracking Session

2.0 PLANNED 2014 ACTIVITIES

Golder in coordination with Avista will accomplish the following primary tasks during 2014:

- Continue tracking: Conduct tracking sessions at approximately two-week intervals during January through September, and approximately weekly intervals in October of 2014.
- Mark – Recapture, Bayesean Method
  - Mark session during pre-spawning or spawning period: Capture carp from areas of spawning and non-spawning then uniquely mark them with PIT tags.[2]
  - Recapture session in late summer: Capture carp from widely distributed areas with different weedbed types (e.g., communities dominated by Eurasian watermilfoil, pondweeds, yellow floating heart and water lily, and minimal to no weeds).
  - Estimate carp population: Use if warranted, a Hierachial Bayesian Model, which allows efficient modeling of spatial and temporal variations, to estimate carp abundance. Actual methods to be used will be determined by the statistician after all data are collected and validity of assumptions of various analytical approaches are addressed.
- Office Studies
  - Potential carp total phosphorus (TP) load estimate: Collect[3] and analyze whole-body carp samples for TP concentrations and use results to refine conversion from carp biomass to TP load.
  - Carp excretions and bioturbations: Identify approaches to estimate TP loadings from carp excretions and bioturbation then use this insight to estimate TP loads from these two processes and develop a sampling program aimed at quantifying effects of carp excretions and bioturbation.
  - Carp removal techniques: Evaluate and recommend reasonable and feasible technologies to contribute to meeting Avista's proportional level of responsibility for depressed dissolved oxygen in Lake Spokane.

3.0 CLOSING

This document was prepared in conjunction with Dana Schmidt of Golder Associates Ltd. We hope you found this information useful. Please contact me if you have any questions.

Regards,

GOLDER ASSOCIATES INC.

Brian Mattax
Certified Lake Manager (13-06M)

Robert H. Anderson, LHG
Senior Hydrologist, Principal

BM/RHA/tp

[2] Initial capture method will be boat electro-fishing. Other technologies will be considered and potentially implemented, based on rate of success at capturing carp.
[3] Whole-body carp samples will be collected during the summer recapture session, so as to avoid affecting estimates of carp abundance.

APPENDIX D

Feasibility of Lake Phosphorus Reduction by Aquatic Plant Removal in Lake Spokane (TetraTech 2014c)

FINAL REPORT

Feasibility of Lake Phosphorus Reduction by Aquatic Plant Removal in Lake Spokane

Prepared for

AVISTA

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January 2014

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1. Introduction

The following report assesses the feasibility of removing phosphorus by harvesting through an analysis of the phosphorus content of six aquatic plant species in Lake Spokane while considering potential phosphorus losses to the water column that may occur relative to the harvesting process. A preliminary analysis of harvesting in Lake Spokane was conducted in the Lake Spokane Dissolved Oxygen Water Quality Attainment Plan (DO WQAP) (Avista, 2012) which described the potential for phosphorus removal through harvesting aquatic plants by removal of plant total phosphorus (TP). It was hypothesized that because the reservoir's oxygen quantity has been shown to directly relate to the input and loading of TP, any removal in plant mass and corresponding TP could theoretically improve dissolved oxygen (DO) content, assuming that most of the plant phosphorus was recycled to the water from the sediment as internal loading via root uptake and plant senescence. The objective of the current study is to assess the feasibility and potential effectiveness of net TP removal from harvestable areas relative to other defined sources of TP to the reservoir and provide a summary of literature relative to on the effect on lake TP from harvesting.

As part of this analysis, TP concentrations were refined for relevant weed species in Lake Spokane.

2. Evidence for Harvest-Caused Phosphorus Reduction

Mechanical harvesting of aquatic plants is one of several methods to reduce plant biomass for improved recreational use in lakes during summer (Cooke et al., 2005). Two important reasons for choosing harvesting for plant management is that the plant mass is removed by non-chemical means and not left in the lake to decompose. At the same time, harvesting plants throughout the summer removes nutrients from the lake as part of the plant mass removed prior to senescence. That benefit was advocated by several researchers in the 1970s and 1980s, who produced estimates of the quantities of TP that could be removed by harvesting. Rooted aquatic plants have also been shown to absorb most of their phosphorus from the sediment (see review in Welch and Jacoby, 2004). Moreover, much of that plant phosphorus may be released into the water column upon plant senescence. Therefore, plant removal could theoretically reduce internal phosphorus loading and lake-TP content. A review of this literature is in Cooke et al. (2005).

Some of the most thorough research was conducted in Lake Wingra, Wisconsin, where decay of Eurasian water-milfoil accounted for half of the lake's internal loading (Carpenter, 1980, 1983; Smith and Adams, 1986). In Half Moon Lake, Wisconsin, 20% of internal phosphorus loading was due to decomposition of *Potamogeton crispus*, an invasive pond weed (James et al., 2002). However, other plant species may not senesce as readily during late summer and release phosphorus to the water column, so their contribution to internal phosphorus loading and algal production would be less important. For example *Egeria densa* (Brazilian Elodea) obtains nearly all its phosphorus needs from the sediment, as do most rooted macrophytes, and decomposes slowly, requiring half a year to lose half its biomass, three times longer than the pondweed *Potamogetan praelongus* (Gabrielson et al., 1984; Welch et al., 1994). For comparison, Eurasian water-milfoil lost half of its biomass in 20 - 45 days (Nicholas and Keeney, 1973; Bastardo, 1979).

While there are several cases where the potential effect of plant harvesting was projected to substantially reduce internal phosphorus loading, by eliminating plants prior to senescence, there are no cases where harvesting actually reduced whole lake TP content. In fact, where that potential effect was investigated, there was either no effect on lake TP or algae, or algal productivity increased (see Cooke et al., 2003; p.360-361). In one case, Long Lake, Kitsap County, Washington (339 acres), after three years of harvesting primarily *E. densa*, in which 69% of the lake's peak biomass was removed; there was no effect on long-term plant biomass while lake TP actually increased during the harvesting years (Welch et al., 1994). An analysis of the 19 years of data from Long Lake showed that years with low macrophyte biomass were accompanied with high TP and algal biomass and years with high macrophyte biomass had low TP and algal biomass (Jacoby et al., 2001). Therefore, subsequent management of water quality and macrophytes in Long Lake has focused on removal of milfoil and left the expansive beds of *E. densa* largely intact as an impediment to internal loading (Tetra Tech, 2011).

Harvesting a floating tussock community, comprised of Hydrilla, water hyacinth and water lettuce in Lake Istokpoga, FL, did reduce phosphorus concentrations slightly in the harvested versus un-harvested experimental plots (Alam et al., 1996). However, the lake is large and no evidence was presented as to the whole-lake effect of an expanded harvesting operation.

Some of the possible explanations for the failure of harvesting to reduce lake TP and algal biomass were enumerated in Cooke et al. (2005, p. 361):

1. Denuding the littoral area of plants may have allowed more transport of phosphorus to the pelagic area (open water) and an increase in phosphorus, because plants in the intact littoral zone were acting as a nutrient sink rather than a source.
2. Removal of plant mass may have had a delayed rather than immediate effect on lake TP or harvesting may not have continued long enough.
3. Phosphorus removed with plants may have been a small fraction of total input (internal + external), with no effect on lake TP detected.
4. Some other factor(s) in the complex ecosystem may have compensated for the plant phosphorus removed, hence no effect on lake TP was detected.

3. Quantification of TP Concentrations for Relevant Weed Species

In order to determine the TP concentrations of relevant weed species in Lake Spokane, six plant species in Lake Spokane were collected and analyzed for phosphorus content; yellow floating-heart, waterlily, Eurasian water-milfoil, pondweeds, common waterweed and coontail (non-rooted). Prior to the sampling, Avista provided a map which displayed six areas throughout the lake where there were large areas of macrophyte beds (Figure 1). The sampling was conducted in the lower portion of the reservoir in order to avoid macrophyte beds which may have been treated with herbicides.

For each of the species, three samples were collected by cutting off the top 1-2 feet. The plants were gently treated in a salad spinner to remove excess surficial water and then weighed. Samples were then placed in plastic Ziploc bags in a cooler and shipped to Aquatic Research within 24 hours where they were dried and analyzed for wet/dry weight and TP content.

3.1 Results

The phosphorus content (by dry weight) of the six macrophyte species sampled in the reservoir is shown in Tables 1 and 2 and summarized below. Variability among the three samples of each species was small (Table 2).

- The average TP concentration of the yellow floating-heart samples was 3.9 mg/g (0.39%).
- The average TP concentration of the waterlily samples was 3.4 mg/g (0.34%).
- The average TP concentration of the Eurasian watermilfoil samples was 2.2 mg/g (0.22%).
- The average TP concentration of the pondweed samples was 2.3 mg/g (0.23%).
- The average TP concentration of the common waterweed samples was 1.9 mg/g (0.19%).
- The average TP concentration of the coontail samples was 4.3 mg/g (0.43%)

Comparing the average TP content (by dry weight) of the Lake Spokane samples to the values estimated in the DO WQAP indicates the values were very similar for Eurasian watermilfoil and pondweed at 0.21% and 0.24%, respectively. However the average TP content for yellow floating-heart was much less than what was estimated in the DO WQAP (0.39% vs. 0.684% in the DO WQAP). Conversely, the average TP content for waterlily was slightly higher than what was estimated in the DO WQAP (0.34% vs. 0.27% in the DO WQAP). An estimate of TP content for common waterweed and coontail was not provided in the DO WQAP.

Table 1. Phosphorus content and dry weight of six macrophyte species collected in September, 2013 in Lake Spokane.

Plant Species	Sample ID	Field Wet Weight (g)	% Solids	% Water	TP (mg/g)
Yellow Floating Heart	YFH-1	31	5.88%	94.1%	4.5
Yellow Floating Heart	YFH-2	22	5.66%	94.3%	4.8
Yellow Floating Heart	YFH-3	38	5.74%	94.3%	2.3
Water Lily	WL-1	99	9.78%	90.2%	4.8
Water Lily	WL-2	132	12.9%	87.1%	2.5
Water Lily	WL-3	79	10.6%	89.4%	2.9
Eurasian Watermilfoil	EW-1	14	5.94%	94.1%	2.3
Eurasian Watermilfoil	EW-2	14	7.10%	92.9%	2.8
Eurasian Watermilfoil	EW-3	12	11.0%	89.0%	1.3
Pond Weeds	PW-1	14	11.5%	88.5%	1.6
Pond Weeds	PW-2	35	6.94%	93.1%	2.3
Pond Weeds	PW-3	30	5.40%	94.6%	2.9
Common Waterweed	CW-1 elodea	7	11.9%	88.1%	1.9
Common Waterweed	CW-2 elodea	5	6.40%	93.6%	1.3
Common Waterweed	CW-3 elodea	14	9.12%	90.9%	2.5
Coontail	C1	4	8.28%	91.7%	3.8
Coontail	C2	9	7.97%	92.0%	3.0
Coontail	C3	9	6.99%	93.0%	6.3

Table 2. Average total phosphorus concentrations in Lake Spokane macrophytes.

Species	Total P mg/g	Stdev	Average % Solids	Stdev	Average % Water	Stdev
Yellow Floating Heart	3.9 (0.39%)	1.4	5.8%	0.1%	94%	0.1%
Water Lily	3.4 (0.34%)	1.3	11.1%	1.6%	89%	1.6%
Eurasian Watermilfoil	2.2 (0.22%)	0.77	8.0%	2.7%	92%	2.7%
Pondweed	2.3 (0.23%)	0.67	8.0%	3.2%	92%	3.2%
Common Waterweed	1.9 (0.19%)	0.61	9.1%	2.8%	91%	2.8%
Coontail	4.3 (0.43%)	1.7	7.7%	0.7%	92%	0.7%

4. Quantification of TP Concentrations, Biomass, and Leakage Rate for Relevant Weed Community

Given that aquatic plants in Lake Spokane occur in communities, a second sampling was completed in order to determine the TP content and biomass (weight/area) of two separate plant communities. This presents a more realistic approach as to how a harvester would operate in Lake Spokane.

As such, plants were collected from two dominant communities in the lake which included a yellow floating-heart dominated community and a submersed species dominated community. The yellow floating-heart dominated community consisted of yellow floating-heart, waterlily and some submersed species and the submersed species dominated community consisted of Eurasian water-milfoil, pondweeds, *Elodea*, and coontail.

In addition to determining the TP content and biomass, an analysis was also conducted to quantify the loss of phosphorus due to leakage in the harvesting process. The samples were collected and treated in the same manner as for plant TP analysis.

Three separate leaching scenarios were evaluated, including: 1) leaching while on harvester; 2) leaching while left on-shore; and 3) leaching from being cut and left in the water.

In order to determine phosphorus released in the first two scenarios, the following experiment was conducted. Upon returning from the field, plant samples were laid on a grid with ¼" to ½" contractor plastic mesh over a Rubbermaid tub with 0.5 L of deionized water. Samples were allowed to dry on the grids for 4 days (See Figures 1 and 2). Water samples were removed daily and the 0.5 L replaced in the tubs. Sample bottles were shipped within 24 hours to Aquatic Research Inc. for TP analysis. After sample collection on the 2nd and 3rd days the plants on the grids were spritzed with deionized water to mimic precipitation/dew conditions and phosphorus leakage due to those conditions. A Rubbermaid tub with a grid was used as a control and sampled daily. After each day's sample was collected the control tub was rinsed and re-filled with 0.5 L of deionized water. After 4 days, the dried plants were collected in Ziploc bags and sent to Aquatic Research Inc. for TP and dry weight determination.

Figure 1. Yellow floating heart plant samples.

Figure 2. Submersed aquatic plant dominated plant sample.

In order to determine phosphorus leaching from plants cut and left in the water, the following was conducted. A third set of plants was collected from the two dominant communities and handled in a similar fashion to simulate the harvesting process, with respect to the loss of phosphorus from plant mass left in the lake or on the shore. Plant samples were placed in 5 gallon buckets with 3 gallons of tap water (Figure 3). The Ziploc bags with the plant samples were rinsed with deionized water into the 5 gallon buckets to capture any leaked phosphorus. Lids were loosely placed on the buckets to limit evaporation and debris from entering. Water was subsampled from each bucket after 24 hours, 48 hours, and 7 days. The amount of water withdrawn from each bucket was recorded. Prior to subsampling, water/plants in the bucket were gently stirred to ensure a representative sample. A 5 gallon bucket with 3 gallons of tap water served as a control and subsampled in a similar manner as buckets with plants. Plants were removed after 7 days, gently spun in a salad spinner to remove excess water, weighed, and placed in Ziploc bags for analysis of TP and dry weight. Tap water was used in the buckets to mimic lake water.

Figure 3. Experiment #3 bucket setup.

4.1 Phosphorus Loss from Harvested Plants on Harvester and Left On-Shore

There was substantial TP loss from harvested plants placed on plastic grids over containers of deionized water (Table 3). This experiment simulated the effect of leaving cut plants along the shore or on the harvester for a period of time. TP loss occurred within one day for submersed species (pondweeds and Elodea, Table 3). For yellow floating heart dominated communities, initial TP loss was low. However, plants dried rapidly; note high % solids (dry fraction) in Table 3. To simulate rain and dewy conditions, plants were lightly sprayed with deionized water on days two and three of the experiment. Little additional TP loss was observed with submersed plant species (Table 3). However, TP loss increased markedly from yellow floating-heart on day four after the spraying, especially from yellow floating-heart with milfoil and coontail, but apparently not so much from yellow floating-heart alone. The apparent greater loss, and in a shorter timeframe, from submersed species early in the experiment is likely due to their more fragile stem and leaf structure than for floating leaf plants (i.e. yellow floating heart and water lily).

While these losses appear large in terms of TP concentration in the water, especially in the case of yellow floating-heart with some submerged species, they actually amount to a small fraction of TP contained in the plants. For the largest loss from yellow floating-heart and milfoil (329 µg/L) the total TP lost, was 165 µg (0.17 mg), which is < 0.1 % of the 266 mg (5.5 mg P/g x 60 g x 0.806 solids) that was in the plant mass after the experiment. Even that quantity of TP would not be significant in terms of its addition to lake water column TP. Given a quantity of 60 g/m^2 of dry weight biomass harvested, leakage of 0.17 mg/m^2 in a 3 m water column would amount to < 0.1 mg/m^3 (µg/L) increase.

Table 3. Phosphorus loss from harvested plants allowed to dry on plastic grids and exposed to light precipitation or dewy conditions on Day 2 and Day 3.

Dominant Plant Community	Plant Species	Wet Weight (g)	Water TP µg/L Day 1	Day 2	Day 3	Day 4	TP (mg/g)	% Solids	% Water
Yellow Floating Heart	YFH	63	5.3	<2.0	2.3	10.9	4.5	75.0%	25.0%
Yellow Floating Heart	YFH w/ coontail	67	20.5	<2.0	2.4	137.1	5.6	79.4%	20.6%
Yellow Floating Heart	YFH w/ milfoil	60	6.2	<2.0	38.0	285.4	5.5	80.6%	19.4%
Yellow Floating Heart	YFH	68	5.3	4.1	3.8	33.6	6.0	64.3%	35.7%
Submersed	Coontail & *P. pectinatus*	53	16.7	2.3	2.3	2.7	1.8	79.9%	20.1%
Submersed	*P. Richardsoni*	50	268.3	<2.0	<2.0	4.3	1.3	86.0%	14.0%
Submersed	Coontail, Elodea, *obtusifolius*	60	7.1	3.6	2.8	2.2	2.2	82.0%	18.0%
Submersed	*P. pectinatus*, water nymph, Coontail, Elodea	69	154.6	4.8	<2.0	<2.0	2.3	85.4%	14.6%
Control	No plants	--	2.7	<2.0	<2.0	<2.0	--	--	--

Biomass estimates in Lake Spokane in a relatively high density area ranged from 29 to 81 g/m^2 dry weight (Table 4), so an assumption of 60 g/m^2 harvested for this example is reasonable. All other phosphorus losses from plants in Table 3 are much less.

Table 4. Submersed and floating aquatic plant densities in a dense Yellow Floating Heart bed near Tumtum, WA September 3, 2013.

Area (sq.m)	Wet Weight (g)	% Solids	% Water	g/m^2	Plant Species
0.74	847	7.08%	92.9%	81	YFH, WL, submersed
0.50	332	7.37%	92.6%	50	YFH, WL, milfoil
0.50	247	5.89%	94.1%	29	YFH, WL

4.2 Phosphorus Loss from Harvested Plants Cut and Left in the Lake

The effect on lake TP from plants cut and left in the lake was also examined (Table 5). Again, cut plants in a yellow floating heart dominated community leaked more TP than plants from a submersed aquatic plant community (Table 5). Contrary to the loss from dried or dying plants harvested and removed or washed onto shore, cut plants left in the lake would lose a large fraction of their TP over a week due to decomposition. The largest amount lost after 7 days was 2.08 mg/L (corrected for TP measured in the control) from a dry weight biomass of 4.8 g (118 g wet wt. x 0.041 solids). The loss of 2.08 µg/L is a total mass in the bucket of 23.7 mg TP (11.4 L x 2.08 mg/L) compared to 23.1 mg in the 4.8 g of dry weight plant biomass at the end of the experiment (4.8 g x 4.83 mg/g P). Assuming conservation of mass, total mass of TP lost was 50%. Losses from the other three samples of a yellow floating heart dominated community were less; ranging from 0.42 to 1.51 mg/L (corrected for TP measured in the control, Table 5). Unremoved cut plants would yield their TP content back into the water in a rather short time, negating some of the effort of harvesting to remove TP that would have entered the water earlier than naturally through plant senescence.

Table 5. Phosphorus loss from cut plants left in the lake during harvesting.

Plant Community	Plant Species	Field Wet Weight (g)	Water TP (µg/L) 24 hours	Water TP (µg/L) 48 hours	Water TP (µg/L) 7 days	Wet Weight @ 7 days (g)	TP (mg/g)	% Solids	% Water
Yellow Floating Heart	YFH	115	36.1	27.0	523	117	3.5	4.3%	95.7%
Yellow Floating Heart	YFH, Elodea, Coontail	188	50.8	21.6	755	202	3.1	4.6%	95.4%
Yellow Floating Heart	YFH	149	24.9	23.7	2090	118	4.8	4.1%	95.9%
Yellow Floating Heart	YFH & Coontail	147	46.6	103.7	1612	126	7.1	4.2%	95.8%
Submersed	Curly, Coontail, *P. pectinatus*	24	16.7	13.2	18	20	1.6	15.5%	84.5%
Submersed	*P. pectinatus*, *obtusifolius*	28	11.1	19.1	48	32	3.7	7.1%	92.9%
Submersed	Coontail, Milfoil	38	27.7	35.5	58	37	4.7	4.8%	95.2%
Submersed	Milfoil, Elodea, *P. pectinatus*, *obtusifolius*	27	39.3	24.2	36	24	3.1	7.4%	92.6%
Control	No plants	--	7.0	8.7	10	--	--	--	--

5. Depths and Areas of Plant Groups

Area and depths (max, min, and mean) in aquatic plant beds were compiled for three plant groups in six sections of the lake using GIS analysis, which overlaid the 2012 Lake Spokane Aquatic Weed Survey (AquaTechnex) and the 2009 Lake Spokane Bathymetry Survey (Northwest Hydro) as shown in Figure 4.

These sections have extensive aquatic vegetation that is present on an annual basis. Depths and areas for each section are shown in Table 6 with a summary in Table 7. Milfoil was not the dominant plant in any section, while YFH was the most abundant plant in sections 2, 5, and 6. The total area of aquatic plant groups compiled during this analysis was less than the area identified during the 2012 Aquatic Weed Survey. This analysis included only six specific areas of dense aquatic vegetation, instead of aquatic plant distribution throughout the entire lake. Total potential harvestable acreage for the six areas was determined by a ratio between mean and maximum physical depths and relative plant height of the community structure. For example, elodea grows to a maximum height of 4 feet but can grow at depths greater than 20 ft so is not entirely harvestable. Coontail on the other hand will almost always grow to the surface therefore a portion of it is always in the harvestable range.

Table 6. Aquatic plant area (acres) and depth (ft) in six selected lake sections (Figure 4).

	Yellow Floating Heart and Water Lily	Eurasian Water Milfoil	Native Species (Pondweeds, Elodea, Coontail)
Section 1			
Max Depth	10	20	14
Min Depth	0	8	0
Mean Depth	**4**	**15**	**8**
Total Acres	**21**	**18**	**40**
Section 2			
Max Depth	14	20	NA
Min Depth	0	8	-
Mean Depth	**6**	**14**	**-**
Total Acres	**50**	**20**	**0**
Section 3			
Max Depth	8	24	26
Min Depth	0	2	0
Mean Depth	**5**	**11**	**11**
Total Acres	**13**	**13**	**20**
Section 4			
Max Depth	10	18	14
Min Depth	0	2	0
Mean Depth	**4**	**10**	**8**
Total Acres	**26**	**20**	**30**
Section 5			
Max Depth	12	24	16
Min Depth	0	12	0
Mean Depth	**5**	**17**	**9**
Total Acres	**58**	**5**	**48**
Section 6			
Max Depth	6	18	24
Min Depth	0	10	0
Mean Depth	**4**	**13**	**8**
Total Acres	**55**	**7**	**77**

Table 7. Summary of depths and areas that characterized six sections with consistently high density of aquatic macrophytes in Lake Spokane (Figure 4).

	Yellow Floating Heart/ Water Lily	Eurasian Water Milfoil	Native Species (Pondweeds, Elodea, Coontail)
Mean Depth (ft) for Areas 1-6:	5	14	9
Mean Min Depth (ft) for Areas 1-6:	0	7	0
Mean Max Depth (ft) for Areas 1-6:	10	21	19
Total Acreage for Areas 1-6:	223	83	215
2012 Survey Acreage:	315	233	392
Potential Harvestable Acreage for Areas 1-6	**179**	**43**	**68**

6. Effectiveness of Plant Harvesting

This analysis assumes that only a fraction of the total areas surveyed for the three plant groups (Table 7) can be harvested in late summer to remove plant TP that otherwise may be released to the water through plant senescence and decay and may be a significant contributor to late summer algal blooms. The three plant species groupings characterized in the six sections (Table 7, Figure 4) were not the same as the three groups sampled for biomass density (Table 4). Therefore, the total potential harvestable area (290 ac, 117 ha; Table 7) and average plant density (53 g/m^2 dry weight, Table 4) were used to estimate TP removal by harvesting. Plant biomass was sampled to simulate harvesting, i.e., only the top three feet of plants were removed. Also, the average TP content of yellow floating heart and water lily (3.7 mg/g), milfoil (2.2 mg/g) and pondweed, *Elodea* and coontail (2.8 mg/g) together was 2.9 mg/g (Table 2), which was used to estimate TP removal by harvesting. **The result is 180 kg of TP available for removal by harvesting**:

$$53 \text{ g/m}^2 \times 2.9 \text{ mg/g} \times (117 \text{ ha} \times 10^4 \text{ m}^2) \times 10^{-6} \text{ (kg/mg)}$$

By comparison, the daily input of TP from river inflow was 210 kg during the summers (June-October) of 2010-2012, for a total summer input of 25,200 kg TP. Harvesting all the 180 kg would represent only 0.71% the summer external input of TP (plus plant TP). However, assume that harvesting that biomass during a month in late summer would remove the internal loading that otherwise may come from in-lake senescence and decay of the plants. In that case, the TP removal by harvesting would represent 3% of the monthly external loading (plus plants) - still a relatively small fraction. Also, all the plant TP removed by harvesting, if left to senescence would not be immediately recycled back to the water column, but would contribute to sediment TP.

Another source of TP in the reservoir is sediment release. Release rates from sediment cores taken in plant beds under anoxic conditions averaged 20 mg/m^2 per day at one site and 7 mg/m^2 per day at the other site (Owens and Cornwell, 2009). The aerobic release rate from three plant bed sites averaged 3 mg/m^2 per day. Sediment overlying water in aquatic plant beds is often anoxic, but assuming some combination of anoxic/oxic conditions, a site-weighted mean rate would be 7.2 mg/ m^2 per day. For the

117 ha (290 ac) of plant biomass, the daily potential input from sediment release would be about 8.5 kg/day or 1.4 times more TP removed then by daily harvesting (6 kg) assuming 30 days of harvesting.

There would also be TP lost by harvesting through leakage from cut plant remains that were left in the ake to decompose in the water, cut remains washed onto the shore and leakage during transport from the lake. The latter two sources would be relatively insignificant at only about 0.1% of the removed mass, or about 0.01 kg/day from harvested and removed plants; that is, if the plants dried they would tend to hold their TP. Loss from cut plants left in the lake to decompose would be much greater on the order of 0.5 kg/day (after 7 days), assuming there is 10% loss (a generally observed fraction) of biomass during harvesting (0.1 x 6 kg/day x 0.8). Assuming the 117 ha (290 ac) could be harvested in a month and the mass harvestable and removed would have senesced and added to internal loading, the effectiveness of harvesting would reduce total TP loading during that month by about 2.5% (Table 8).

Table 8. Estimated TP removed assuming plant biomass harvested would have senesced and released TP to the water over 30 days of harvesting or senescence and decay.

Average plant biomass, dry weight	53 g/m^2
Total biomass 6 sections (117 ha)	62 x 10^3 kg
Estimated biomass removed/ day (assuming 30 days of harvesting)	2,067 kg
Mean TP content	2.9 mg/g
TP released via senescence/day[1]	6 kg
External TP loading/ day	210 kg
Internal TP loading/day	8.5 kg
Total loading/ day	225 kg
TP removed via harvesting/day	6 kg
TP leakage with harvesting/ day	0.5 kg
Net TP removal with harvesting/day	5.5 kg
% TP loading reduced by harvesting	2.5

[1] assume complete loss of TP

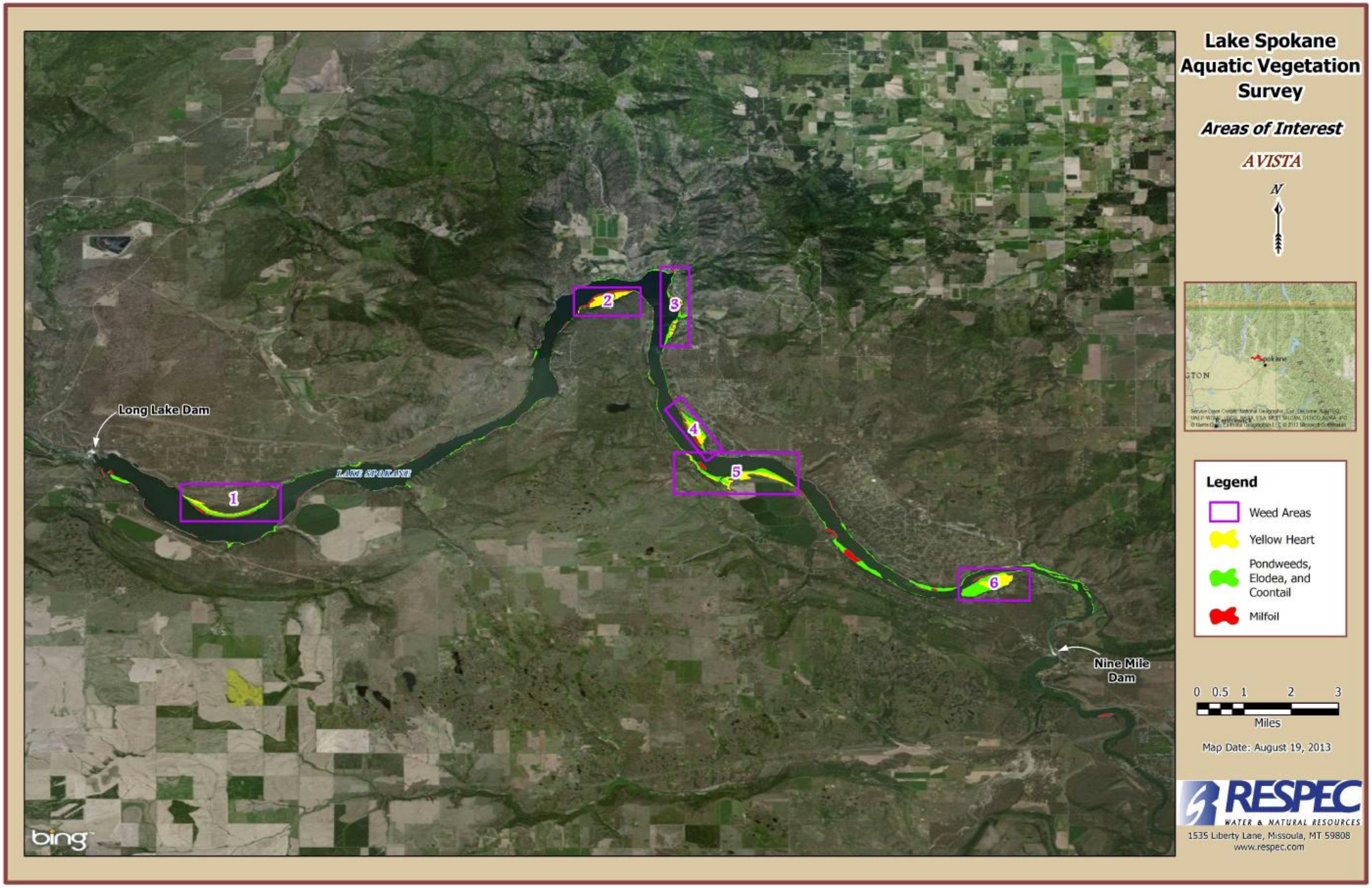

Figure 4. Location of lake six sections surveyed by GIS to determine the depth range and area of three different plant groups.

7. Phase I Analysis

In addition to the quantification of TP that would be removed from harvesting, the following variables were evaluated to assist Avista in determining whether aquatic weed harvesting is a reasonable and feasible control method to reduce phosphorus in Lake Spokane.

7.1 Availability and Operational Requirements of an Appropriate Harvester

Rental of harvesters is not a viable option due to uncertain availability of a limited number of machines in the Pacific Northwest. Thus, purchase of a harvester would be necessary to meet the desired time frame for plant removal. A harvester, sized to complete this type of weed control would cost around $180,000 to $200,000 with an annual operating cost of approximately $100,000, depending upon disposal and distance to haul harvested plants. Operational costs for harvesting plants in Green Lake (Seattle, WA) over multiple years averaged $100,000 annually which included labor, transport, disposal, and all operational expenses for one harvester. Green Lake is used as a comparison as it has a similar acreage (259 acres), compared to the harvestable acreage present in Lake Spokane (290 acres). Cut plants have to be removed from the lake and shoreline daily in order to minimize phosphorus loss from the plant to the lake. Assuming harvest of all the potential harvestable area in the six areas in Lake Spokane (290 ac, 117 ha, Table 7), total removal of 180 kg TP and operational costs stated above; cost per kg of TP would be between $556 and $1,112 on an annual basis.

7.2 Efficiency of Harvester, Given Lake Spokane's Boat Access Limitations

The amount of time it takes to transfer the cut plants to the shore, limits the harvest efficiency rate. A large harvester can travel at speed of 1 mile per hour, has an approximate 10 foot wide cutting swath, and can cover on average 0.5 to 1.5 acres/hour. The amount of material cut by a harvester is about 20 cubic yards per day (1 truck load). That amounts to 3 to 4 off-loads of the harvester per day.

7.3 Effective harvest depth of yellow floating heart and water lily

Harvesting depths that can be achieved under standard operation are between 2 and 5 feet. Special modifications to harvesters can be made to allow harvest depth to a maximum of 6 feet but these harvesters have proven to be unstable where there is a potential for any wind and wave activity. Harvesters with these types of modifications would not be applicable for use in Lake Spokane.

7.4 Impacts to Fish and Aquatic Invertebrates

Harvesting macrophytes has been found to remove relatively large numbers of macro and micro invertebrates, small fish, and even reptiles (turtles) and amphibians (frogs), based on results from several harvesting projects (Cooke et al., 2005). While thousands of fish were removed in some cases, the size of removed fish was usually small. There is little or no evidence that removal of juvenile fish by harvesting had a significant effect on a lake's total population, as reported in Cooke et al. (2005).

The species of concern in Lake Spokane, as reported by WA Dept. of Fish and Wildlife, which may be affected by harvesting, are rainbow trout and the western grebe. The reported effects of harvesting on fish involved warm water fish only. There is a possibility that juvenile trout and forage fish could be removed with harvesting. However, juvenile trout may not frequent macrophyte beds in late summer when water temperatures reach 24 to 25°C, well above the optimum for trout. WDFW has indicated that based upon surveys conducted in 2013, western grebes have been found to nest in up to two to three of the six sections of macrophyte beds analyzed for this study (Lunney, personal communication). As such, any harvesting conducted would have to take place following the typical nesting season which typically extends through August in Lake Spokane.

Besides potential impacts to the western grebe, dependent upon their nesting activities, the most significant negative effect of harvesting may be on the food base for invertebrates, fish and waterfowl. Macrophytes, as well as their attached invertebrates, can be consumed directly by waterfowl, and the macroinvertebrates by fish. Also, the organic matter from senescing macrophytes enters the detritus food web leading to fish and waterfowl. Evidence for the effects of macrophyte, either positive or negative, is all from warm water lakes.

7.5 Potential for Nutrient Pumping

According to observations by Moore et al. (1984), there is a high likelihood of nutrient pumping occurring as a result of harvesting aquatic plants. This is due to an increase in the transfer of phosphorus from the sediment via the remaining plant stems. Phosphorus leakage occurs until the cut plant stems are sealed (Moore et al. 1984). If this process were factored in, the potential phosphorus removed would be less due to increased internal loading from the remaining cut plant stems.

8. Discussion of Aquatic Weed Harvesting in Lake Spokane

This analysis shows that harvesting macrophytes would not be a cost-effective process to reduce TP loading in Lake Spokane. Macrophyte removal would represent only a small percent of the lake's TP input from external (river inflow) and internal sources. Harvesting has been tried as a method to reduce lake TP, but there is no evidence of success even in small lakes with macrophytes covering a relatively large fraction of the lake's area and water residence time of a year or more. For Lake Spokane, with only about 10% of its area covered with macrophytes and only a fraction of that area within the operational limits of harvesting, in addition to the relatively short water residence time during summer (24 days in June-October, 2010-2013), the chance for a detectable effect on lake TP from harvest removal of plants is small. The analysis in Table 8 shows that harvesting having a detectable effect on whole lake TP is remote.

A noticeable effect of harvesting on TP would be most likely in the transition and riverine zones due to a higher area of macrophyte-to-lake surface ratio. However, water residence time is very short in these zones; averaging 4.4 days in June-October, 2010-2013. That means that during the assumed 30-day harvesting period, water (and TP) in those zones would be replaced nearly seven times, allowing minimum time for removal of would-be TP input from macrophyte senescence to affect TP concentration in those zones. Also, internal loading is greater in those zones and is three times the rate of TP removal by macrophytes in survey section 5 and 6, which have about half the macrophyte coverage (Figure 4 and Table 8). Therefore, if harvesting were to have a noticeable effect on TP it would occur in the whole lake, because internal loading from sediment and macrophyte senescence in the transition and riverine zones contributes TP to the limnetic zone rather quickly as indicated by the short water retention time in those zones. Also, the lack of evidence for a positive effect on TP in lakes where a large fraction of TP input could potentially be removed by harvesting should be considered in any further assessment of costs and benefits.

The estimated removal rate of about 6 kg/day for 30 days in Table 8 is significantly less than the possible range reported in the DO WQAP (2012) of 481-3,852 kg/yr or 16-128 kg/day if removed over a period of 30 days assumed here. The discrepancy is due largely to the assumption of a range in dry weight biomass of 50 to 400 g/m^2 and that yellow floating heart phosphorus content was 0.68%. The harvestable biomass determined in Lake Spokane averaged only 53 g/m^2, the low end of the range cited in the DO WQAP, and yellow floating heart phosphorus content was less at 0.39%. Also, the lower projected effect of harvesting was partly due to the estimate of less total area covered by macrophytes - 523 ac (212 ha) and only a portion of that within the harvestable range 290 ac (117 ha) in 2013.

9. Summary and Conclusions of Aquatic Weed Harvesting in Lake Spokane

1. Leakage of phosphorus would occur from cut plants lost back to the lake during harvesting. However, those losses would be a relatively small fraction of the phosphorus removed. Dried or even wetted plants washed onto the beach or piled on shore would not lose a significant fraction of their phosphorus, at least initially, according to these experimental results.

2. Harvesting of 290 ac (117 ha) would not be an effective means to further reduce total TP loading to Lake Spokane, even if done in a relatively short time prior to senescence. From this analysis, the fraction of total loading that could be removed is estimated at only 2.5%. That low fraction and the high cost of harvesting render that method to be a poor choice to further reduce TP loading.

3. Actually observing a reduction in lake TP by macrophyte harvesting in Lake Spokane is considered a very remote possibility, considering the low fraction of loading that could potentially be removed and the failure of harvesting elsewhere to show positive effects, especially since the potential fraction of TP loading removed in the other cases were much greater than for Lake Spokane.

10. Phosphorus Control with Current Macrophyte Controls

Macrophyte controls currently in place in Lake Spokane are winter drawdown, herbicide application (15 acres) and removal by divers of about 1 acre total per year. None of these methods have ever been recommended for effective phosphorus removal. Winter drawdown provides a strip parallel to shore in which plants are desiccated and are slow to colonize in summer. However, plant beds usually reestablish beyond the depth of drawdown, so there may not be substantial effect on total biomass reduction unless drawdown depth and turbidity is sufficient to limit the depth of colonization as was shown in Pend Oreille Lake. In any event, there are no quantitative data to evaluate the effects of drawdown on total biomass to estimate how much less plant biomass has been due to drawdown.

Herbicide application simply kills plants and leaves them in the lake to decompose and release their phosphorus. Also, the areas treated with herbicides and diver removal are too small to expect any detectable effect on whole lake or even nearshore TP.

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APPENDIX E

Agency Consultation

AVISTA

January 31, 2014

Patrick McGuire, Water Quality Program
Washington Department of Ecology
Eastern Regional Office
4601 N Monroe Street
Spokane, WA 99205-1295

Subject: Lake Spokane Dissolved Oxygen Water Quality Attainment Plan, 2013Annual Summary Report

Dear Mr. McGuire:

I have enclosed the Lake Spokane Dissolved Oxygen Water Quality Attainment Plan 2013 Annual Summary Report (Annual Report) for your review and approval. The Annual Report was completed in accordance with the Lake Spokane Dissolved Oxygen Water Quality Attainment Plan, required by the Spokane River Hydroelectric Project License (License) Appendix B, Section 5.6.C of the Washington Department of Ecology Section 401 Water Quality Certification.

As we discussed in our January 21, 2014 meeting, the Annual Report provides a summary of the 2013 baseline monitoring, implementation activities, effectiveness of the implementation activities, and proposed actions of the upcoming year. The Annual Report also includes a recommendation to not pursue harvesting macrophytes in Lake Spokane at senescence based upon the results of the Aquatic Weed Management Study.

Additionally, Appendix B of the Annual Report includes a revised Quality Assurance Project Plan for Lake Spokane Baseline Nutrient Monitoring (QAPP). The revisions to the QAPP are based upon discussions with Jim Ross with Ecology and Meghan Lunney and clarify Avista's sampling methods.

We request your review of the Annual Report by **March 3, 2014**. This will allow us time to incorporate your comments and recommendations as appropriate, and submit it to the Federal Energy Regulatory Commission by **April 1, 2014**.

Please feel free to call me at (509) 495-4643 if you have any questions about the Annual Report.

Sincerely,

Meghan Lunney

Meghan Lunney
Aquatic Resource Specialist

Enclosure

cc: Dave Knight, Ecology
Jim Ross, Ecology
Chad Brown, Ecology
Speed Fitzhugh, Avista

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DEPARTMENT OF ECOLOGY
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MAR 1 4 2014

March 13, 2014

Ms. Meghan Lunney
Aquatic Resource Specialist
Avista Corporation
1411 East Mission Avenue, MSC-1
Spokane, WA 99220-3727

RE: Request for Ecology Review and Approval – *Lake Spokane Dissolved Oxygen Water Quality Attainment Plan, 2013 Annual Summary Report*
Spokane River Hydroelectric Project, No. P-2545

Dear Ms. Lunney:

The Department of Ecology (Ecology) has reviewed the *Lake Spokane Dissolved Oxygen Water Quality Attainment Plan, 2013 Annual Summary Report* sent to Ecology on January 31, 2014. The report is a requirement in Section 5.6.C of the 401Water Quality Certification.

Ecology APPROVES the *Lake Spokane Dissolved Oxygen Water Quality Attainment Plan, 2013 Annual Summary Report* as submitted. The report meets the 401 Water Quality Certification conditions and requirements for Section 5.6.C, "Dissolved Oxygen, Lake Spokane", and Section 5.10.C, "Water Quality Monitoring, Reporting Results".

We would like to provide the following comments:

The 2013 Annual Summary Report meets the overall requirements in the Dissolved Oxygen (D.O.) Attainment Plan (October 2012). The Report is an excellent compilation and analysis of the data trends to date, understanding that data from upcoming years may require adjustments to the phosphorous reduction strategy.

Ecology encourages Avista to continue using an adaptive management approach that incorporates yearly data analysis and evaluates long term trends. Avista's willingness to adjust implementation strategies will hopefully result in improvements in the dissolved oxygen situation in Lake Spokane. Ecology encourages Avista to keep in mind lower priority phosphorous reduction options as well as exploring means to achieve D.O. attainment with strategies that don't involve phosphorous reduction. For example, although removing aquatic weeds may not be a good strategy in 2014, it may be viable in the future.

Ecology is looking forward to seeing next year's results and reports. We are also interested to learn how implementation of TMDL and water quality attainment plans reflect projected D.O. and useable habitat improvements in Lake Spokane.

Please contact me at (509) 329-3567 or pmcg461@ecy.wa.gov if you have any questions.

Sincerely,

Pat McGuire

Patrick McGuire
Eastern Region FERC License Coordinator
Water Quality Program

PDM:jb

cc: Elvin "Speed" Fitzhugh, Avista

AVISTA'S RESPONSE TO ECOLOGY'S APPROVAL LETTER

These comments pertain specifically to the Lake Spokane Dissolved Oxygen Water Quality Attainment Plan 2013 Annual Summary Report.

Avista Response

We appreciate Ecology's comments and concur that data from upcoming years may require adjustments to the phosphorus reduction strategy as well as applying adaptive management strategies (such as aquatic weed control, etc.) in the future. Avista will continue to work with Ecology in the future as it implements the DO WQAP.