Lake Tahoe Water Quality Investigations

Algal Bioassay • Phytoplankton • Atmospheric Nutrient Deposition • Periphyton

Annual Report

July 1, 2004 – June 30, 2005

Agreement No. 04-022-160-0

Submitted to:

State Water Resources Control Board
Lahontan Regional Water Quality Control Board

Submitted by:

Tahoe Environmental Research Center
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Project Overview

The following document is our annual report for work completed during the first year (July 1, 2004 to June 30, 2005) of Agreement No. 04-022-160-0: Lake Tahoe Water Quality Investigations by the U.C. Davis – Tahoe Environmental Research Center (TERC).

Under terms of this contract TERC is to provide the SWRCB with the following services: to "conduct long-term water quality research and monitoring at Lake Tahoe in support of the Lake Tahoe Interagency Monitoring Program".

The objective of this project is to continue monitoring critical ongoing long-term water quality parameters in Lake Tahoe. The data collected from this monitoring and the rich historical Tahoe data base as collected over the years by the TRG/TERC and other groups is currently being used to support the Tahoe TMDL. The algal bioassay and phytoplankton enumeration data is also being used in the Lake Clarity Model (UCD). In addition to the direct use of this data in environmental research and planning efforts, it is also used to support scientific journal publications as needed.

The primary research and monitoring tasks addressed in this project include:

Algal growth bioassay tests to assess nutrient limitation (Task 3). The purpose of this task is to determine the nutrient or nutrients which limit phytoplankton growth. These findings have been very important in current efforts toward lake restoration. They have highlighted the need for an expanded erosion control strategy. Bioassays are to be done six times per year using Lake Tahoe Water containing natural phytoplankton, collected at the TRG's Index station along the west shore.

Enumeration and identification of phytoplankton algae (Task 4). The purpose of this task is to provide ongoing information on phytoplankton species present in the water column, cell numbers and biovolume. This task is particularly critical since changes in the biodiversity of these algae are both indicators of pollution and affect food-chain structure. Implementation of this task allows TRG to determine if new and undesirable species are colonizing the lake. In addition, the size and composition of particles, including phytoplankton cells in the water, have a significant effect on light transmittance, and hence affect the famed clarity of Lake Tahoe. Characterization of phytoplankton dynamics in Lake Tahoe fills a critical knowledge gap, allowing for more informed management decisions. Phytoplankton samples are to be collected at the Index station about every 10-14 days and are to include a composite sample down to the Secchi depth, and a composite sample from the surface to 105m. Once a month additional samples will be collected from discreet depths (5,20,40,60,75 and 90 meters). Phytoplankton analysis is to include species present, cell numbers and biovolume measurements. Note, the scope of work for this task also provides for collection and archiving of zooplankton samples. Samples are collected from vertical tows (0-150 meters) every 10-14 days at the Index station and about monthly at the Mid-lake station. Samples are preserved, and archived for future analysis when needed.

Atmospheric deposition of nitrogen and phosphorus (Task 5). The purpose of this task is to provide ongoing information on nutrient loading via this important source to the lake. The historical TRG data shows that atmospheric deposition of nitrogen, and to a lesser extent phosphorus, is an important source of nutrients to the lake. Data collected from collectors located on buoys on the lake has proved valuable in providing estimates of N and P loading directly to the lake. Data from the lower Ward Valley station is partitioned into wet and dry deposition components, and allows assessment of loading from these two components of atmospheric deposition along the west shore. This monitoring has proved valuable in support of ongoing Lake Tahoe atmospheric deposition TMDL program work. Atmospheric deposition samples are to be collected from three primary sites: Ward Lake Level, Mid-lake (TB-1) and an additional buoy (TB-4) site, additional samples will be collected from the Upper Ward Valley station. Approximately 35 dry bucket samples and 30 wet samples are to be collected over the year at Ward Lake level, 30 dry-bulk samples and 15-30 snow tube samples are to be collected at the mid-lake station, and 30 dry-bulk samples are to be collected at an additional lake buoy station i.e. TB-4. Samples are to be analyzed for NO3-N, NH4-N, TKN, SRP, TP.

Monitoring of attached algae or periphyton along the shoreline (Task 6). The purpose of this monitoring is to assess levels of nearshore attached algae (periphyton) growth around the lake. The rate of periphyton growth is an indicator of local nutrient loading and long-term environmental changes. Monitoring trends in periphyton growth is important in assessing local and lake-wide nutrient loading trends, and may be used as a secondary indicator of the success of nutrient load reductions arising from environmental projects and future maximum clarity load (TMDL) implementation. Ten sites are to be monitored for periphyton biomass a minimum of eight times per year in this project. Six of the samplings are to be done between January to August when attached algae growth in the eulittoral zone (0.5m) is greatest; the remaining two samplings are to be done between September – December. Duplicate biomass samples will be taken from natural substrate at each site for a total of 160 samples per year. Biomass is to be reported as chlorophyll a and Ash Free Dry Weight (AFDW). On an annual basis during the spring, the relative level of growth at 39 additional sites will be assessed through visual observations of filament length and % cover, chlorophyll *a* analyses will be made on duplicate samples from about 18 of these sites.

The additional tasks associated with this project include: Project management (Task 1), quality assurance (Task 2), and data reporting (Task 7).

The summary of % work completed (based on a 3 year granting period) during the first year of the study (July 1, 2004-June 30, 2005) for each task is listed below:

Task	**% Completion** (for full 3 yr granting period)
1 – Project Management	33.333
2 – Quality Assurance	33.333
3 – Algal Growth Bioassays	33.333
4 – Phytoplankton Analysis	33.333
5 – Atmospheric Deposition of Nutrients	33.333
6 – Periphyton	33.333
7 - Reporting	33.333

Task 1. Project Management and Administration

1.1. Project oversight – Entailed sampling coordination, overall project coordination, discussions with staff, assist in data evaluation, interfacing with agency staff, and incorporation of data into other Basin research/monitoring projects
1.2. Quarterly invoicing – Entailed ensuring that contract requirements were met through completion of this quarterly status report and that report was submitted to the SWRCB Project Representative on schedule. Ensure that invoicing is properly carried out.

Task 2. Project Quality Assurance
Standardized QA/QC practices for components were followed as specified in the TRG QA/QC Manual were followed (M. Janik, E Byron, D. Hunter and J. Reuter. 1990. Lake Tahoe Interagency Monitoring Program: Quality Assurance Manual, 2nd Edition. Division of Environmental Studies, Univ. of California, Davis. 75 p.). For QA/QC applied to periphyton monitoring see Appendix entitled "Periphyton Quality Assurance Project Plan" in: (Hackley, S., B. Allen, D. Hunter, and J.Reuter. 2004. Lake Tahoe water quality investigations: algal bioassay, phytoplankton, atmospheric nutrient deposition, periphyton, May 1, 2002 – March 31, 2004. Report submitted to State Water Resources Control Board, Lahontan Regional Water Quality Control Board. U.C. Davis Tahoe Research Group, February, 2004).

Task 3. Algal Growth Bioassays

The response of Lake Tahoe water to nitrogen and phosphorus enrichment has been tested using algal bioassays since the 1960s. The long record of bioassays for Lake Tahoe, using a consistent method, has proved extremely useful for evaluating long-term changes. When combined with lake chemistry data, and information on atmospheric and watershed nutrient loading ratios, these simple enrichment bioassays have provided valuable complementary evidence on the temporal dynamics of nutrient limitation in the lake.

In a typical bioassay, lake water is collected from the upper photic zone (0-20 m water was used for these bioassays), pre-filtered through 80 µm mesh netting to remove the larger zooplankton and returned to the lab. The water is distributed among experimental flasks to which small amounts of N (20 µg N/L) or P (at two different levels: 2 µg P/L and 10 µg P/L) or the combination of both N and P are added. One set of flasks is left as a "control" and all treatments are triplicated. The flasks are then placed in a laboratory incubator under fluorescent lighting at ambient lake temperature and day length, and growth response of phytoplankton is measured over a period of six days. Relative growth was assessed by measuring changes in algal biomass (i.e. fluorescence or chlorophyll a). Treatments are "stimulatory" if the mean growth response exceeds the control at the $p=0.05$ level of significance.

<u>Summary of Results 2004-2005</u>

In this annual data summary we present the results for 6 separate bioassay experiments – three were conducted in 2004 (August, October, December) and three were conducted in 2005 (February, April, June). The results of each of the individual bioassays are presented in Table 1. The results for all bioassays done during the period 2002-2005 are summarized in Table 2.

During 2004-2005 a progression was seen from apparent N and P colimitation in summer of 2004 to P limitation during fall, winter and early spring back to N and P colimitation again in summer 2005. Only one bioassay was done in the summer of 2004. The results of this bioassay, done in August 2004 (Table 1a) showed that neither the N or P treatment was stimulatory alone, but the combination of N+P added together was stimulatory indicating likely N+P colimitation. In bioassays done in October (Table 1b) and December 2004 (Table 1c) and February (Table 1d) and April 2005 (Table 1e) P10 treatments were significantly stimulatory, while the lower level P2 treatment was also stimulatory in all of these except the October bioassay. This indicates P was likely limiting to algal growth from late fall 2004 to early spring 2005. The bioassay done in June 2005 (Table 1f) indicates a shift back to apparent N+P colimitation in early summer as neither N or P treatments were stimulatory alone but were stimulatory when added in combination.

The data for all bioassays done during the period 2002-2005 is summarized in Table 2. P limitation was generally prevalent during late fall, winter and spring periods during 2002-2005. Patterns for late spring through summer have shown more variation. In the summers of 2002, 2004 and 2005 N+P colimitation was prevalent, with neither N nor P alone causing stimulation of growth. However, during the summer of 2003 N added alone was stimulatory indicating presence of N limitation and the combination of N+P added together was even more stimulatory. In all (100%) of the bioassay experiments a combination of N+P was stimulatory reinforcing the fact that Lake Tahoe phytoplankton are still nutrient deficient and that controls of N and P inputs are important.

Table 1a. Bioassay done using 2,5,8,11,14,17,20m lake water collected 8/20/04.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response ="*"
Control	0.241	0.025	3		
N(20)	0.269	0.008	3	112	
P(2)	0.244	0.030	3	101	
P(10)	0.271	0.022	3	112	
N(20)P(2)	0.507	0.123	3	210	*
N(20)P(10)	0.597	0.039	2	248	*

Table 1b. Bioassay done using 2,5,8,11,14,17,20m lake water collected 10/28/04.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response ="*"
Control	0.348	0.006	3		
N(20)	0.361	0.009	3	104	
P(2)	0.359	0.032	3	103	
P(10)	0.396	0.020	3	114	*
N(20)P(2)	0.441	0.002	3	127	*
N(20)P(10)	0.645	0.008	3	185	*

Table 1c. Bioassay done using 2,5,8,11,14,17,20m lake water collected 12/11/04.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response ="*"
Control	0.310	0.008	3		
N(20)	0.306	0.008	3	99	
P(2)	0.414	0.016	3	134	*
P(10)	0.464	0.022	3	150	*
N(20)P(2)	0.498	0.008	3	161	*
N(20)P(10)	0.535	0.013	3	173	*

Table 1d. Bioassay done using 2,5,8,11,14,17,20m lake water collected 2/16/05.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response =“*”
Control	0.306	0.007	3		
N(20)	0.302	0.006	3	99	
P(2)	0.371	0.004	3	121	*
P(10)	0.373	0.012	3	122	*
N(20)P(2)	0.375	0.005	3	123	*
N(20)P(10)	0.390	0.018	3	127	*

Table 1e. Bioassay done using 2,5,8,11,14,17,20m lake water collected 4/15/05.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response =“*”
Control	0.338	0.006	3		
N(20)	0.327	0.007	3	97	
P(2)	0.651	0.040	3	193	*
P(10)	0.789	0.012	3	233	*
N(20)P(2)	0.723	0.020	3	214	*
N(20)P(10)	0.813	0.032	3	241	*

Table 1f. Bioassay done using 2,5,8,11,14,17,20m lake water collected 6/10/05.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response =“*”
Control	0.256	0.009	3		
N(20)	0.278	0.004	3	109	
P(2)	0.254	0.021	3	99	
P(10)	0.270	0.032	3	105	
N(20)P(2)	0.451	0.011	3	176	*
N(20)P(10)	0.613	0.013	3	239	*

Table 2. Summary of N and P bioassay treatment responses as % of control done in: (a) 2002, (b) 2003, (c) 2004, (d) 2005. Treatment responses statistically significantly different from the control at the p≤.05 level are indicated with borders and shading.

(a) 2002 Bioassays

	2/7/02	4/1/02	6/12/02	8/30/02	10/28/02	12/30/02
Control	100	100	100	100	100	100
N20	104	97	101	101	93	101
P2	154	-	-	108	-	116
P10	135	157	104	100	113	110
N20P2	139	-	-	157	151	118
N20P10	138	178	180	231	238	116

(b) 2003 Bioassays

	1/30/03	2/26/03	4/8/03	5/21/03	6/16/03	7/10/03	8/29/03	10/20/03	12/3/03
Control	100	100	100	100	100	100	100	100	100
N20	101	98	102	138	116	141	129	101	107
P2	112	129	168	101	99	100	100	100	98
P10	114	134	181	98	104	106	105	106	104
N20P2	141	136	178	253	248	221	196	187	124
N20P10	159	147	190	264	297	317	280	334	142

(c) 2004 Bioassays

	1/5/04	4/23/04	8/20/04	10/28/04	12/11/04
Control	100	100	100	100	100
N20	100	97	112	104	99
P2	133	112	101	103	134
P10	135	122	112	114	150
N20P2	132	153	210	127	161
N20P10	134	202	248	185	173

(d) 2005 Bioassays

	2/16/05	4/15/05	6/10/05
Control	100	100	100
N20	99	97	109
P2	121	193	99
P10	122	233	105
N20P2	123	214	176
N20P10	127	241	239

Task 4. Enumeration and Identification of Phytoplankton

Phytoplankton are the main primary producers in Lake Tahoe waters. Their role in the biotic system of the lake is central to the study of any biological organisms. Beyond that, they play an integral part in nutrient recycling and light penetration. Lake Tahoe phytoplankton samples have been collected and counted for many years. The long-term data has allowed us the luxury of looking at statistically valid changes through a mire of inter-annual variation.

Algal populations are cyclic on an annual basis. There are predictable patterns among the algal groups. The algal bio-volume and abundance are low in January/February. As the season progresses, there is a significant rise in diatom populations during the spring months. The greatest annual bio-volume is recorded during this time period. June is a transitional month. The water column is stable and phytoplankton separate into various niches within the euphotic zone. Algal bio-volume remains high but the composition of the community begins to change. Summer is a time of shared dominance between the diatoms and other algal groups. The total algal bio-volume begins to lessen in the fall. When the surface waters begin to mix, there is a marked decrease in abundance. The infusion of nutrients to the surface waters should stimulate growth but the timing of the event is over-powered by the physical parameters of low light and turbulence.

This level of predictability dissolves with deeper examination of the algal community. Working with the data at the species level is more complicated. From one year to the next there are often sweeping changes seen within the algal assemblage. General trends are sometimes difficult to find. Fortunately long-term, detailed monitoring of the phytoplankton has helped to lessen this variability and produce evidence of real change.

During this reporting period (July 2004 – June 2005) there were 149 phytoplankton samples collected and counted. The samples were preserved with Lugol's in the field and counted within two months of collection. The Utermöhl microscopic method was used for quantitative enumeration. Cells were counted and identified to species level when possible.

The data can be examined on many different levels and using a variety of methods.The most obvious data are the actual number of cells. Cell abundance helps the researcher visualize the actual community composition. For this reporting period the total phytoplankton abundance of algal groups are plotted in Figure 1. The most prominent groups, in terms of numbers, are Chlorophytes (green algae), Chrysophytes, and Diatoms. The average cell abundance is 347,600 cells/L. The highest cell count is seen in Fall 2004 where numbers reach over 700,000 cells/L. Most of these cells are located below the thermocline, waters greater than 40M in depth. Using cell abundance as a method to understand phytoplankton dynamics is somewhat misleading because small numerous cells are given unwarranted weight in the analysis.

Lake Tahoe Phytoplankton
Full Composite Samples at Index Station

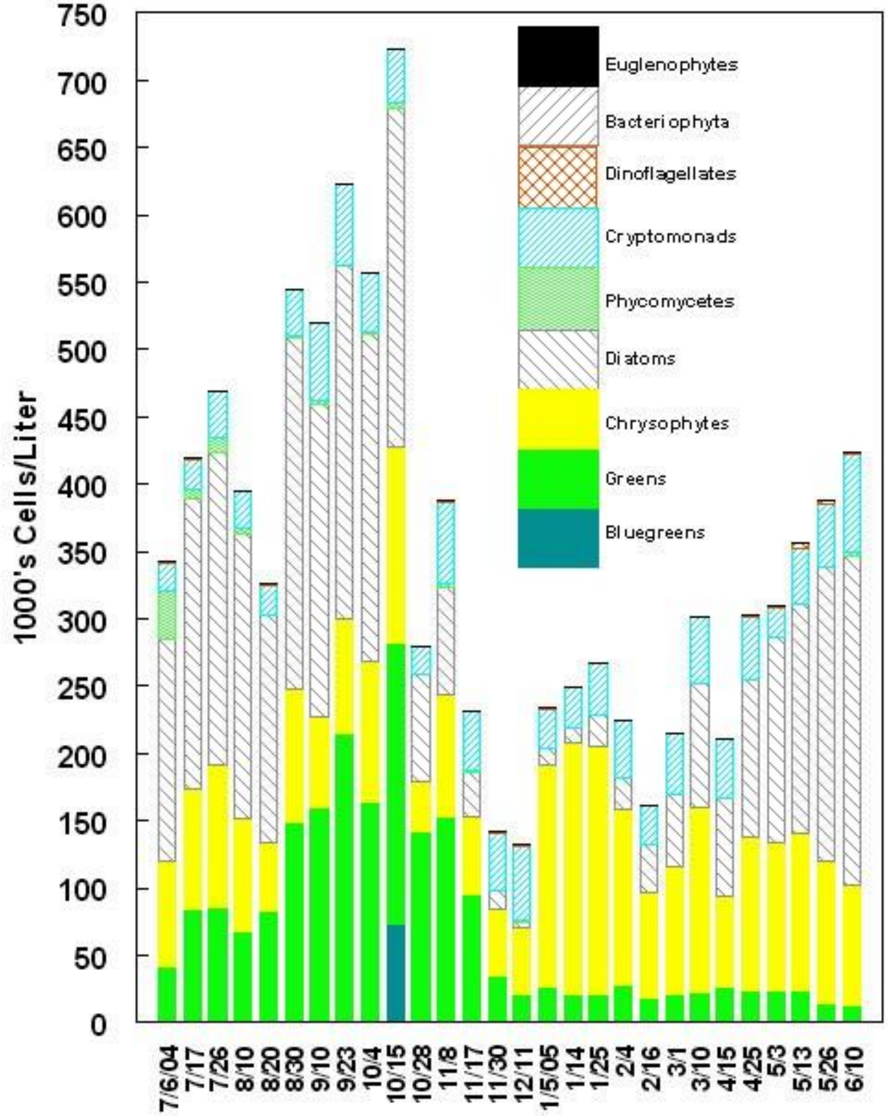


Figure 1: Cell Abundance

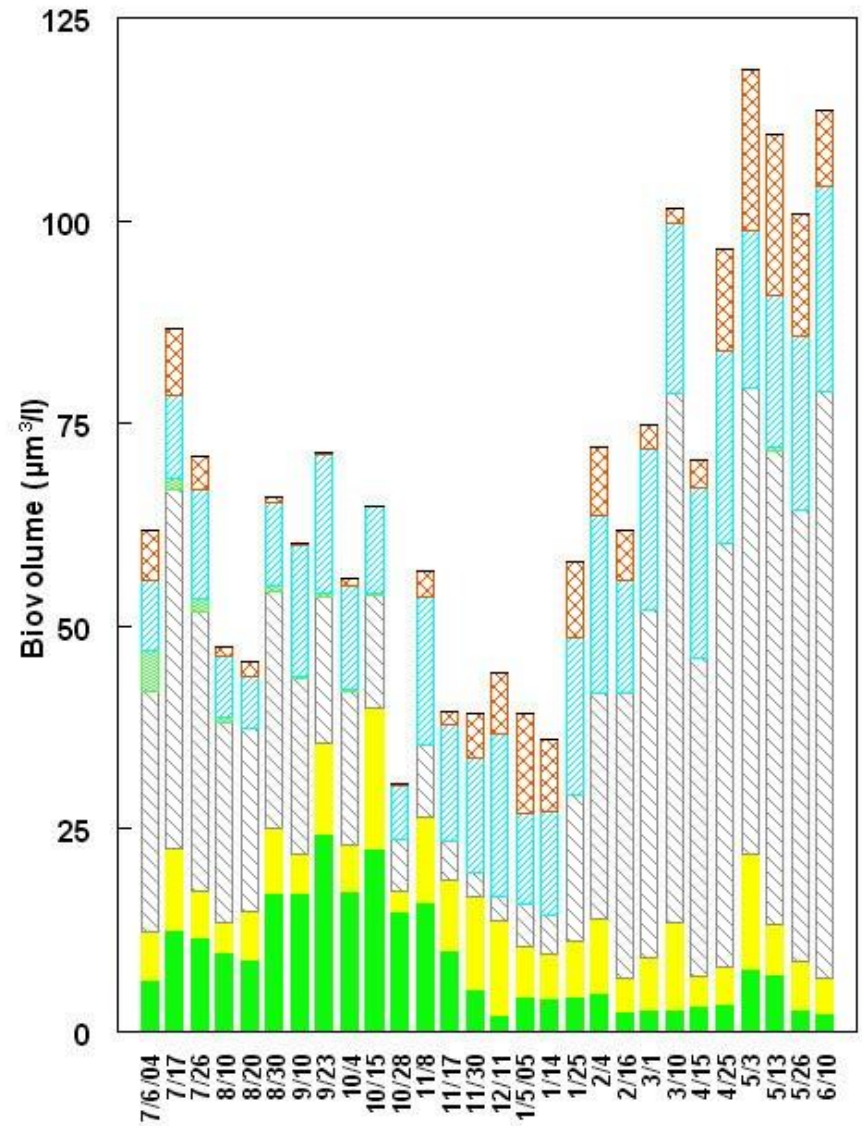


Figure 2: Biovolume

Another method of looking at the data is using algal bio-volume instead of cell numbers. Bio-volume gives information about cell size and metabolism. It is the most useful parameter for studies of primary productivity, nutrient recycling, and algal resource limitations. For this reporting period the bio-volume of algal groups are plotted in Figure 2. The average annual bio-volume (65 μm^3/L) is comparable to previous years. Diatoms are pervasive throughout the year. Chlorophytes, Cryptophytes and Dinoflagellates are sometimes dominant and certainly important community members. The influence of the small, numerous Chrysophytes is lessened in this analysis. The highest bio-volumes are seen in spring 2005, topping 100 μm^3/L. The dominant diatoms for this spring bloom are ***Stephanodiscus alpina*** and ***Cyclotella ocellata***, two centrics.

The diatoms are clearly dominant for 6 months. This has typically been observed in past years. However, an important trend has also been observed. The long-term data indicate that diatom dominance has lessened in its degree and its duration. Diatoms are now sharing their dominance, not only during the other half of the year but also to a greater degree during the spring bloom. This trend can be seen in the current data from the reported period.

One unexpected result from the bio-volume analysis is the performance of the green algae. It is not uncommon for one group or another to become prominent in any one year. Green algae can be a 'red flag', indicating the presence of higher nutrient levels. Therefore its continued presence could have implications for the trophic status of Lake Tahoe. During this reporting period the green algae have an average abundance of 71,000 cells/L and bio-volume of 8.8 μm^3/L. There is an average species richness of 12. For comparison, the same yearly time period in 2002-2003, which is a typical year, is surprisingly different. For that year the average abundance of green algae is 19,000 cells/L and and bio-volume of 3.8 μm^3/L. The average species richness is 10.

Another analysis that is useful for researchers studying the lake's visibility is the distribution and size of algal cells, especially in the shallow waters of the lake. Much of the decrease in visibility at Lake Tahoe is attributed to very small particles. Figure 3 shows the abundance of cells from the secchi composite samples (<30M). In this upper euphotic region the greatest cell concentrations are seen during the late spring, summer and into the fall. The fluctuations in cell concentrations are controlled most by the diatom populations. However, as mentioned before, the green algae have made significant community contributions. Figure 4 is a graph of the average cell size in these secchi composites. Note that during the winter and early spring months the cells are relatively large. Certainly overall algal biomass is low at this time of year and the surface waters of the lake are mixing often. Larger cells can stay buoyant and utilize the increased nutrient concentrations, even though ambient light levels are low. However, as the season changes the lake's physical motion begins to lessen, the thermocline sets up, ambient light levels increase, and surface nutrient concentrations decrease. The algal community in the upper euphotic zone responds with increasing biomass and a corresponding lessening of cell size.

Lake Tahoe Phytoplankton
Secchi Composite Samples at Index Station

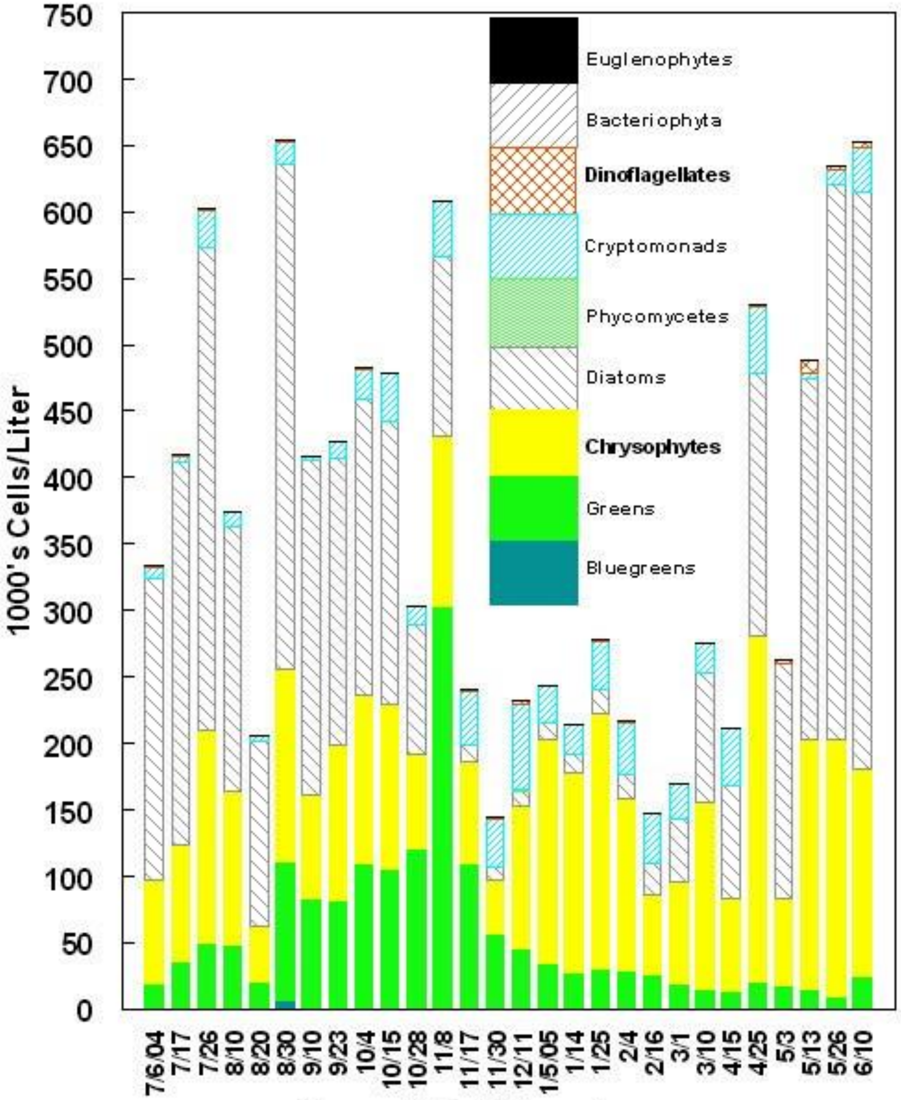


Figure 3: Cell Abundance

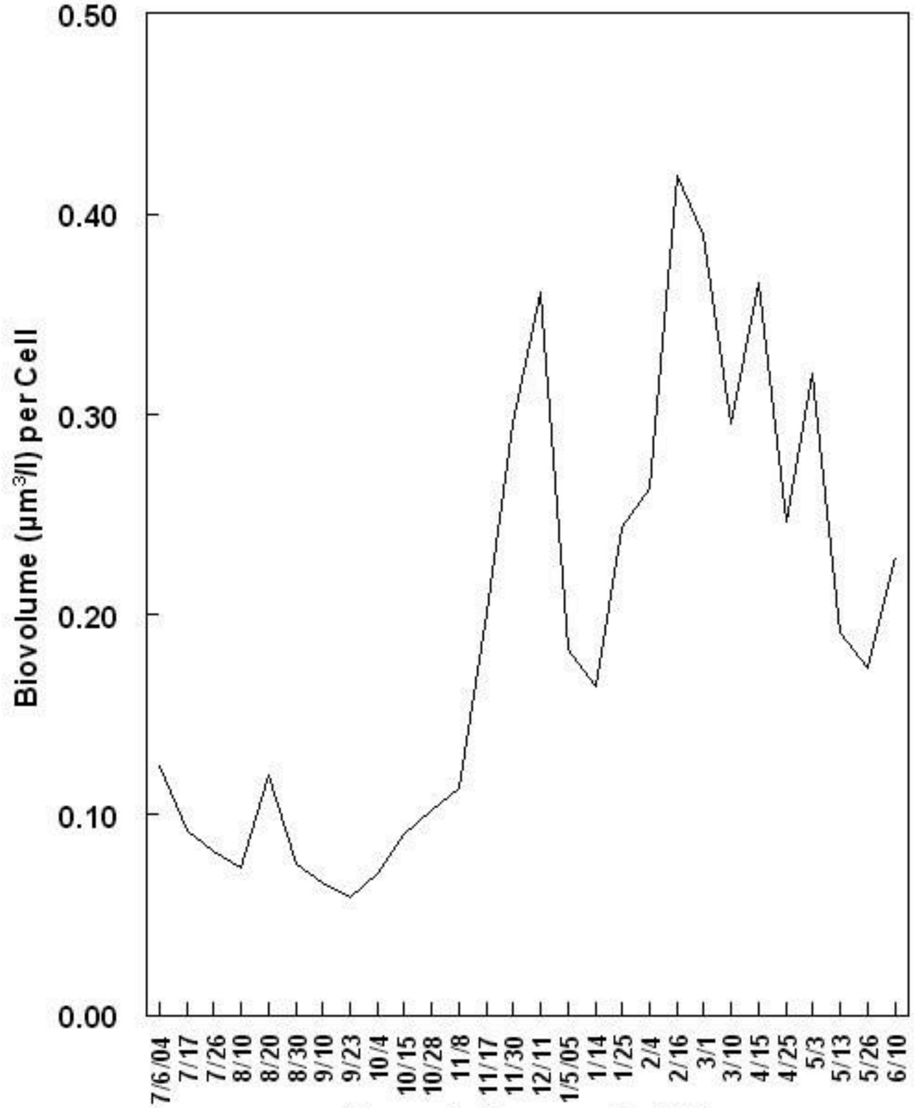


Figure 4: Average Cell Size

Smaller cells are better able to exploit this environment. Small size helps with buoyancy. Additionally, smaller cells generally have higher metabolism and a greater ability to uptake nutrients. Their increased numbers would certainly have some impact on the lake's water clarity.

Phytoplankton dynamics for this one year snap-shot are not unusual compared to previous years. The overall diversity of the algal community continues to remain high. So while there are bits of information that Lake Tahoe might be increasing in productivity, the collective view is that this is yet another year and another story. It is difficult to draw any long-term conclusions based only on this data.

Task 5. Atmospheric Deposition of Nitrogen and Phosphorus

Monitoring of atmospheric deposition is crucial to an understanding its role in degradation of the lake and for use in watershed management. The historical TRG/TERC data shows that atmospheric deposition of nitrogen, and to a lesser extent phosphorus, is an important source of nutrients to the lake. Increased deposition of nitrogen from anthropogenic sources was concluded by the TRG to be the cause of a fundamental shift in nutrient limitation in Lake Tahoe from N and P co-limitation to primarily P limitation. The clarity of Lake Tahoe has been shown to be strongly governed by the amounts of fine particles in the lake. Atmospheric deposition also contributes particles and particle-associated nutrients directly to the lake. The amount of precipitation, form (rain or snow) and timing impact stream discharges of sediments and nutrients into the lake which also impact lake clarity. The atmospheric deposition monitoring program of TERC provides information on nutrient loading from this source (atmospheric deposition both in the watershed on land and directly to the lake surface), as well as on precipitation timing and amounts. The data may also be valuable for providing information on past and current trends in atmospheric deposition.

The current contract provides for atmospheric monitoring at 3 primary stations: the lower Ward Lake Level station, and two stations located on the lake: the Mid-lake buoy station (TB-1) and an additional lake buoy (buoy station TB-4 was used in the first year of this study). Monitoring at an additional station in Upper Ward Valley was done as "extra" monitoring by TERC to continue the long record (30+ years) of atmospheric deposition data from this site.

Stations and Methods

Lower Ward Valley Lake Level Station

This station is located slightly south of the Ward Creek mouth on an estate, approximately 75-100 m back from the lake edge. It consists of a NovaLynx electrically-heated 8 inch diameter tipping bucket gage (TBG) located approximately 8 feet above the ground on a tower. The TBG was modified so that precipitation could also be caught for measurement. A datalogger connected to the TBG records each 0.01 inch of precipitation. This station also has an Aerochem Metrics model 301 wet/dry deposition sampler. This sampler contains two deposition collection buckets and moveable lid, which automatically covers one, or the other buckets depending on whether precipitation is detected by a sensor. A 3 ½ gallon standard HDPE plastic bucket is used in the Wet-side of the sampler. This "Wet bucket" is covered by the lid during dry periods and exposed when wet precipitation is detected during a storm event. The Dry-side contains a modified HDPE bucket with reduced side-wall height, filled with 4 liters of deionized water, (and contains a heater in winter). This "Dry-bucket" is exposed during dry periods and covered by the lid when precipitation is detected. Wet samples are collected from this station also on an event basis, or as wet buckets fill with snow. Dry samples are collected about every 7-10 days and are usually coordinated with lake buoy Dry-Bulk sample collection.

Mid-lake Buoy Station

This station is located in the northern middle portion of the lake. The station was located on a large anchored PVC spar buoy in earlier studies. During the current study the station was located on a large buoy (TB-1) in the north central portion of the lake (coordinates 39° 09.180 N and 120° 00.020 W)). The collector consists of a HDPE plastic bucket similar to the Aerochem Metrics modified dry collector. It is filled with 4 liters of deionized water when placed out. However, the bucket also contains plastic baffles to dampen splash from the bucket. Unlike the Dry bucket, this collector collects both wet and dry deposition and therefore is called a Dry-Bulk collector. The station also contains a Snow Tube for collection of wet precipitation and a small basic rain gage for verification of precipitation amounts. Sample collection from this station is done as much as possible on a regular basis (7-10 days if possible), however, lake conditions and weather govern frequency to a large extent. The raft/buoy also has a variety of scientific instrumentation for NASA's studies on the lake in addition to the atmospheric deposition collectors.

Northwest Lake (TB-4) Station

Station TB-4 (coordinates 39° 09.300 N and 120° 04.330 W) was located between the mid-lake (TB-1) station and Tahoe City. This was desirable since it provided a second collection site to compare with Mid-lake data. The station contained a Dry-Bulk sampler similar to that used on the Mid-lake station. Samples were collected on the same frequency as the Mid-lake samples. The station was supported on a large buoy (TB-4). The buoy has a variety of scientific instrumentation for NASA's studies on the lake in addition to the atmospheric deposition collectors. (Note for more detailed methods at the different stations see the TRG's Standard Operating Procedures for precipitation monitoring).

Upper Ward Valley Bench Station

This station is located in the north bowl of Ward Valley at 2200m elevation. It consists of a NovaLynx electrically-heated 8 inch tipping bucket rain/snow gage (TBG) located on a tower approximately 5 meters above an open meadow. The TBG top lies at the center of an alter-type wind screen. A datalogger connected to the TBG is used to record each 0.01 inch of precipitation. The TBG was modified so that precipitation could also be caught for measurement. This station also has a Snow Tube (ST) affixed to one pole of the tower. The Snow Tube consists of an approximately 4 1/2 foot length of 8 inch diameter PVC pipe, with a 8 inch diameter cap, and clean plastic liner bag is inserted to allow collection of precipitation. The ST orifice is at the same height as the TBG, but lies outside the alter-type wind screen.

Samples were usually collected from this station on an event-basis (i.e. after each storm). However some samples collected, caught multiple events or consisted of dry deposition samples into a dry Snow Tube after one or more weeks. Precipitation caught in the ST was usually used for analysis. Occasionally water caught by the TBG was analyzed if the ST sample was not available or was compromised.

Results

Data collected for this task include information on atmospheric deposition concentrations, nutrient loading, precipitation amounts and timing. Tables 1-6 present a summary of precipitation amounts, concentrations and nutrient loading from 7/1/04 through 6/30/05. A brief discussion of some of the more interesting features of the data during this year is also presented.

Table 1a. Precipitation amounts and N, P and H concentrations in bulk deposition at the Upper Ward Valley Station 7/1/04-6/30/05.

Tab. 1a Samp. No.	Upper Ward V. Collection Date-Time	Snow Tube Precip. (in.)	Precip. Form	Collector Type	pH	H^+ (µg/l)	(Conc.) NO3-N (µg/l)	NH4-N (µg/l)	TKN (µg/l)	SRP (µg/l)	DP (µg/l)	TP (µg/l)	Notes
1	8/9/2004 16:35	T	R+DF	ST	NA	NA	145.60	365.27	4819.50	3.00	144.86	350.60	1
2	9/9/2004 14:30	0.00	DF	ST	NA	NA	37.58	64.19	650.81	25.94	40.18	80.27	2
3	9/23/2004 14:45	0.22	S	ST	NA	NA	446.20	323.16	3267.79	204.20	342.12	435.59	
4	10/8/2004 14:55	0.05	R	ST	NA	NA	99.52	152.20	571.65	3.64	12.48	24.33	3
5	10/14/2004 15:00	0.00	DF	ST	NA	NA	6.34	12.69	56.30	0.68	1.56	5.30	2
6	10/18/2004 13:30	3.18	RS	ST	5.09	8.13	48.86	85.73	93.09	1.14	4.37	5.61	
7	10/21/2004 15:10	3.15	RS	ST	5.15	7.08	14.97	14.45	49.70	0.07	2.21	19.91	
8	10/29/2004 15:30	2.68	S	ST	5.10	7.94	40.55	48.23	205.26	0.91	3.48	24.02	
9	11/4/2004 15:30	0.59	RS	ST	4.90	12.59	284.00	182.47	134.51	1.82	4.42	27.81	
10	11/12/2004 12:15	0.40	RS	ST	4.72	19.05	107.90	164.92	243.94	1.14	4.74	17.07	
11	11/22/2004 12:45	0.01	NA	ST	NA	NA	6.68	12.09	323.40	0.23	5.07	7.61	
12	11/29/2004 12:25	2.48	S	ST	5.19	6.46	22.85	11.45	44.87	0.46	5.07	7.29	
13	12/10/2004 10:40	6.70	RS	ST	5.22	6.03	34.10	12.30	58.09	1.14	5.27	9.19	13
14	12/27/2004 11:55	0.02	S	ST	NA	NA	7.16	23.42	62.46	1.12	4.75	8.87	29
15	1/3/2005 16:15	10.40	S	ST CORE	5.22	6.03	19.22	37.05	80.96	2.24	4.75	8.55	30
16	1/12/2005 16:10	9.90	S	TBG	5.50	3.16	18.67	18.47	92.02	0.00	5.40	10.84	31
17	1/27/2005 14:50	1.25	RS	ST	4.68	20.89	182.30	166.31	160.81	1.16	5.58	9.29	
18	1/31/2005 13:55	1.01	S	ST	5.20	6.31	14.39	14.77	36.62	0.46	4.96	15.48	
19	2/8/2005 16:25	0.70	S	ST	5.18	6.61	178.72	280.17	126.18	1.62	11.44	14.62	
20	2/23/2005 12:40	3.95	RS	ST	4.91	12.30	83.76	112.91	109.15	0.23	5.27	7.75	
21	2/28/2005 16:35	0.73	S	ST	5.20	6.31	36.86	36.47	39.68	0.69	5.58	7.59	
22	3/2/2005 14:15	0.70	S	ST	NA	NA	16.79	31.29	62.58	0.23	5.27	6.96	32
23	3/9/2005 11:00	T	S+DF	ST	NA	NA	1.84	8.61	36.83	0.46	1.58	3.46	33
24	3/21/2005 18:00	4.22	S	ST	4.22	60.26	30.85	33.23	58.22	2.31	5.05	5.53	
25	3/30/2005 16:50	6.40	S	ST	5.08	8.32	30.56	33.62	54.08	0.46	4.42	6.00	34

Tab. 1a	Upper Ward V.	Snow Tube					(Conc.)						
Samp.	Collection	Precip.	Precip.	Collector	pH	H^+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	(in.)	Form	Type		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	Notes
26	4/5/2005 14:10	0.81	S	ST	4.88	13.18	140.81	125.49	197.13	4.16	9.47	15.15	
27	4/13/2005 16:30	1.90	S	ST	5.00	10.00	58.80	65.68	92.78	0.23	5.36	7.26	
28	4/25/2005 15:40	0.64	RS	ST	4.93	11.75	394.28	478.52	524.14	11.57	16.10	30.98	
29	5/2/2005 15:35	1.09	RS	ST	4.70	19.95	253.70	456.52	471.67	4.63	13.35	16.85	
30	5/6/2005 17:30	0.65	RS	ST	4.60	25.12	108.32	110.17	174.71	2.32	3.81	15.26	
31	5/11/2005 16:50	3.04	RS	ST	5.20	6.31	47.91	96.00	132.20	1.62	3.49	13.99	
32	5/17/2005 17:05	2.95	RSG	ST	5.00	10.00	77.19	82.19		1.62	3.33	6.66	
33	5/20/2005 15:25	4.26	R	ST	5.10	7.94		223.00		2.55	3.81	4.13	
34	6/13/2005 17:45	2.88	RS	ST	5.01	9.77			102.59	3.92			
35	6/20/2005 13:00	1.36	RS	ST	4.91	12.30			213.85	5.77			

Table 1b. Precipitation N, P and H loads in bulk deposition at the Upper Ward Valley Station 7/1/04-6/30/05.

Tab. 1b Samp. No.	Upper Ward V. Collection Date-Time	Snow Tube Precip. (in.)	Precip. Form	H+ (g/ha)	NO3-N (g/ha)	(Load) NH4-N (g/ha)	TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
1	8/9/2004 16:35	T	R+DF	NA	22.44	56.30	742.81	0.46	22.33	54.04	1
2	9/9/2004 14:30	0.00	DF	NA	5.79	9.89	100.31	4.00	6.19	12.37	2
3	9/23/2004 14:45	0.22	S	NA	24.93	18.06	182.60	11.41	19.12	24.34	
4	10/8/2004 14:55	0.05	R	NA	15.34	23.46	88.11	0.56	1.92	3.75	3
5	10/14/2004 15:00	0.00	DF	NA	0.98	1.96	8.68	0.10	0.24	0.82	2
6	10/18/2004 13:30	3.18	RS	6.57	39.47	69.25	75.19	0.92	3.53	4.53	
7	10/21/2004 15:10	3.15	RS	5.66	11.98	11.56	39.76	0.06	1.77	15.93	
8	10/29/2004 15:30	2.68	S	5.41	27.60	32.83	139.72	0.62	2.37	16.35	
9	11/4/2004 15:30	0.59	RS	1.89	42.56	27.34	20.16	0.27	0.66	4.17	
10	11/12/2004 12:15	0.40	RS	1.94	10.96	16.76	24.78	0.12	0.48	1.73	
11	11/22/2004 12:45	0.01	NA	NA	1.03	1.86	49.84	0.04	0.78	1.17	
12	11/29/2004 12:25	2.48	S	4.07	14.39	7.21	28.26	0.29	3.19	4.59	
13	12/10/2004 10:40	6.70	RS	10.25	58.03	20.93	98.86	1.94	8.97	15.64	13
14	12/27/2004 11:55	0.02	S	NA	1.10	3.61	9.63	0.17	0.73	1.37	29
15	1/3/2005 16:15	10.40	S	15.92	50.77	97.87	213.86	5.92	12.55	22.59	30
16	1/12/2005 16:10	9.90	S	7.95	46.95	46.44	231.39	0.00	13.58	27.26	31
17	1/27/2005 14:50	1.25	RS	6.63	57.88	52.80	51.06	0.37	1.77	2.95	
18	1/31/2005 13:55	1.01	S	1.62	3.69	3.79	9.39	0.12	1.27	3.97	
19	2/8/2005 16:25	0.70	S	1.17	31.78	49.81	22.43	0.29	2.03	2.60	
20	2/23/2005 12:40	3.95	RS	12.34	84.04	113.28	109.51	0.23	5.29	7.78	
21	2/28/2005 16:35	0.73	S	1.17	6.83	6.76	7.36	0.13	1.03	1.41	
22	3/2/2005 14:15	0.70	S	NA	2.99	5.56	11.13	0.04	0.94	1.24	32
23	3/9/2005 11:00	T	S+DF	NA	0.28	1.33	5.68	0.07	0.24	0.53	33
24	3/21/2005 18:00	4.22	S	64.59	33.07	35.62	62.40	2.48	5.41	5.93	
25	3/30/2005 16:50	6.40	S	13.52	49.68	54.65	87.91	0.75	7.19	9.75	34
26	4/5/2005 14:10	0.81	S	2.71	28.97	25.82	40.56	0.86	1.95	3.12	

Tab. 1b	Upper Ward V.	Snow Tube				(Load)					
Samp.	Collection	Precip.	Precip.	H+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	(in.)	Form	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
27	4/13/2005 16:30	1.90	S	4.83	28.38	31.70	44.78	0.11	2.59	3.50	
28	4/25/2005 15:40	0.64	RS	1.91	64.09	77.79	85.20	1.88	2.62	5.04	
29	5/2/2005 15:35	1.09	RS	5.52	70.24	126.39	130.59	1.28	3.70	4.67	
30	5/6/2005 17:30	0.65	RS	4.15	17.88	18.19	28.84	0.38	0.63	2.52	
31	5/11/2005 16:50	3.04	RS	4.87	36.99	74.13	102.08	1.25	2.69	10.80	
32	5/17/2005 17:05	2.95	RSG	7.49	57.84	61.58		1.21	2.50	4.99	
33	5/20/2005 15:25	4.26	R	8.59		241.29		2.76	4.12	4.47	
34	6/13/2005 17:45	2.88	RS	7.15			75.05	2.87			
35	6/20/2005 13:00	1.36	RS	4.25			73.87	1.99			

Table 2a. Precipitation amounts and N, P and H concentrations in wet deposition at the Ward Valley Lake Level Station 7/1/04-6/30/05.

Tab. 2a	Ward Valley Lake Level Station Wet								Concentration					
Samp. No.	Collection Date-Time	Precip. (in)	Precip. Form	Collector Type	Wet Bkt Amt. (in)	pH	H^+ (µg/l)	NO3-N (µg/l)	NH4-N (µg/l)	TKN (µg/l)	SRP (µg/l)	DP (µg/l)	TP (µg/l)	Notes
1	7/2/2004 11:10	0.02	R	WET	0.02	NA	NA	1391.91	1953.63	NA	3.7	15.39	NA	
2	9/23/2004 15:15	0.06	S	WET	0.06	NA	NA	153.9	68.13	NA	8.82	17.89	NA	
3	10/8/2004 15:30	0.18	R	WET	0.18	NA	NA	346.7	273.4	929.93	1.59	2.5	23.07	
4	10/14/2004 15:35	0.01	R	WET	0.01	NA	NA	511.2	211.52					
5	10/18/2004 16:30	1.83	RS	WET	1.83	5.25	5.62	37.86	4.58	242.69	3.18	9.98	19.96	
6	10/21/2004 15:50	2.8	RS	WET	2.8	5.21	6.17	16.88	16.86	33.74	0.68	2.85	5.85	
7	10/25/2004 11:30	0.38	R	WET	0.38	5.2	6.31	30.71	10.94	207.05	1.14	3.48	5.37	
8	10/29/2004 16:15	1.83	S	WET	1.83	5.15	7.08	33.51	43.4	280.79	2.27	1.9	7.59	
9	11/4/2004 16:00	0.44	RS	WET	0.44	5.02	9.55	148.6	143.64	161.81	1.82	4.74	7.9	
10	11/12/2004 11:20	0.19	RS	WET	0.19	4.88	13.18	65.01	65.99	72.2	1.14	6.32	7.27	
11	11/29/2004 12:55	1.67	S+DF	WET-BULK	1.67	5.21	6.17	21.76	13.14	61.52	1.14	5.7	13.3	16
12	12/7/2004 11:20	1.38	S+DF	WET-BULK	1.38	5.2	6.31	32.1	14.83	57.46	0.68	5.38	8.87	17
13	12/10/2004 11:15	2.06	RS	WET-BULK	0.46*	4.9*	12.59*	62.39*	19.48*	74.08*	4.57*	7.29*	15.52*	18
14	1/3/2005 17:15	6.53	S+DF	WET-BULK	3.08*	5.2*	6.31*	21.34*	34.42*	75.62*	1.68*	4.43*	8.87*	35
15	1/7/2005 16:45	0.47	RS	WET	0.47	5.3	5.01	29.21	17.81	69.04	1.97	5.38	8.87	
16	1/9/2005 11:55	3.29	S+DF	WET-BULK	2.22*	5.25*	5.6*	14.73*	15.83*	63.93*	1.31*	4.44*	8.08*	36
17	1/12/2005 15:15	1.39	RS	WET-BULK	0.67*	5.4*	3.98*							37
18	1/27/2005 15:15	1.12	RS	WET	1.12	4.8	15.85	208.8	171.96	146.08	1.16	4.42	3.71	
19	1/31/2005 14:30	0.56	S	WET	0.56	4.88	13.18	13.93	19.55	70.56	0.69	3.16	5.88	
20	2/8/2005 16:55	0.17	S	WET	0.17	5.25	5.62	167.12	176.18	294.72	2.09	12.08	19.07	
21	2/23/2005 13:20	2.51	RS	WET-BULK	2.09*	4.89*	12.88*	76.51*	56.24*	81.05*	0.92*	5.89*	8.86*	38
22	2/28/2005 17:05	0.46	SDF	WET	0.46	5.35	4.47	15.59	13.18	19.92	0.46	2.22	7.91	39
23	3/2/2005 14:50	0.43	S	WET	0.43	5.34	4.57	16.29	18.98	168.32		4.96	7.59	
	3/7/2005 14:10	T			T									
24	3/21/2005 18:30	2.81	S	WET-BULK	1.04*	5.08*	8.32*	27.33*	28.7*	43.37*	1.39*	2.21*	5.05*	40

Tab. 2a Samp. No.	Ward Lake Level Collection Date-Time	Wet Precip. (in)	Precip. Form	Collector Type	Wet Bkt Amt. (in)	pH	H^+ (µg/l)	NO3-N (µg/l)	(Conc.) NH4-N (µg/l)	TKN (µg/l)	SRP (µg/l)	DP (µg/l)	TP (µg/l)	Notes
25	3/30/2005 17:20	5.29	RS	WET	5.29	5.2	6.31	27.27	29.88	44.06	8.54	12.63	7.89	
26	4/5/2005 15:45	0.42	S	WET	0.42	5	10.00	114.03	133.84	234.11	3	8.2	19.25	
27	4/13/2005 17:00	0.94	R?S	WET	0.94	5.1	7.94	57.64	65.26	123.88	1.85	6	10.73	
28	4/25/2005 16:10	0.42	RS	WET	0.42	5.32	4.79	234.57	281	387.04	3.01	5.37	15.49	
29	5/2/2005 16:10	0.66	R	WET	0.66	5.1	7.94	227.08	375.57	389.44	4.75	10.81	14.94	
30	5/6/2005 18:00	0.18	R	WET	0.18	4.8	15.85	169.05	162.08	182.64	2.55	14.3	20.03	
31	5/11/2005 17:15	1.84	RS	WET	1.84	5.2	6.31	33.46	89.49	117.07	1.39	12.4	12.72	
32	5/17/2005 17:35	1.43	RSG	WET	1.43	NA	NA	86.18	80.98		16.23	2.86	9.2	
33	5/20/2005 16:00	2.81	R	WET	2.81	5.2	6.31	143.9	167.27		2.21	3.49	4.76	
34	6/13/2005 18:05	1.21	RS	WET	1.21	5.2	6.31				0.46			
35	6/20/2005 13:25	0.94	RS?	WET	0.94	4.9	12.59				3.69			

(Note that "*" by a value indicates precipitation collected by wet bucket was less than total event precipitation.)

Table 2b. Precipitation loads and N, P and H concentrations in wet deposition at the Ward Valley Lake Level Station 7/1/04-6/30/05.

Tab. 2b	Ward Lake Level	Wet			Precip				(Load)				
					Amt. (in)								
Samp.	Collection	Precip.	Precip.	Collector	used for	H+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	(in.)	Form	Type	Loading	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
1	7/2/2004 11:10	0.02	R	WET	0.02	NA	7.07	9.92	NA	0.02	0.08	NA	
2	9/23/2004 15:15	0.06	S	WET	0.06	NA	2.35	1.04	NA	0.13	0.27	NA	
3	10/8/2004 15:30	0.18	R	WET	0.18	NA	15.85	12.50	42.52	0.07	0.11	1.05	
4	10/14/2004 15:35	0.01	R	WET	0.01	NA	1.30	0.54					
5	10/18/2004 16:30	1.83	RS	WET	1.83	2.61	17.60	2.13	112.81	1.48	4.64	9.28	
6	10/21/2004 15:50	2.8	RS	WET	2.8	4.39	12.01	11.99	24.00	0.48	2.03	4.16	
7	10/25/2004 11:30	0.38	R	WET	0.38	0.61	2.96	1.06	19.98	0.11	0.34	0.52	
8	10/29/2004 16:15	1.83	S	WET	1.83	3.29	15.58	20.17	130.52	1.06	0.88	3.53	
9	11/4/2004 16:00	0.44	RS	WET	0.44	1.07	16.61	16.05	18.08	0.20	0.53	0.88	
10	11/12/2004 11:20	0.19	RS	WET	0.19	0.64	3.14	3.18	3.48	0.06	0.31	0.35	
11	11/29/2004 12:55	1.67	S+DF	WET-BULK	1.67	2.62	9.23	5.57	26.10	0.48	2.42	5.64	16
12	12/7/2004 11:20	1.38	S+DF	WET-BULK	1.38	2.21	11.25	5.20	20.14	0.24	1.89	3.11	17
13	12/10/2004 11:15	2.06	RS	WET-BULK	0.46	1.47+	7.29+	2.28+	8.66+	0.53+	0.85+	1.81+	18
14	1/3/2005 17:15	6.53	S+DF	WET-BULK	6.53	10.47e	35.39e	57.09e	125.42e	2.79e	7.35e	14.71e	35
15	1/7/2005 16:45	0.47	RS	WET	0.47	0.60	3.49	2.13	8.24	0.24	0.64	1.06	
16	1/9/2005 11:55	3.29	S+DF	WET-BULK	3.29	4.68e	12.31e	13.23e	53.42e	1.09e	3.71e	6.75e	36
17	1/12/2005 15:15	1.39	RS	WET-BULK	0.67	0.68+							37
18	1/27/2005 15:15	1.12	RS	WET	1.12	4.51	59.40	48.92	41.56	0.33	1.26	1.06	
19	1/31/2005 14:30	0.56	S	WET	0.56	1.88	1.98	2.78	10.04	0.10	0.45	0.84	
20	2/8/2005 16:55	0.17	S	WET	0.17	0.24	7.22	7.61	12.73	0.09	0.52	0.82	
21	2/23/2005 13:20	2.51	RS	WET-BULK	2.09	6.84+	40.62+	29.86+	43.03+	0.49+	3.13+	4.70+	38
22	2/28/2005 17:05	0.46	SDF	WET	0.46	0.52	1.82	1.54	2.33	0.05	0.26	0.92	39
23	3/2/2005 14:50	0.43	S	WET	0.43	0.50	1.78	2.07	18.38		0.54	0.83	
24	3/21/2005 18:30	2.81	S	WET-BULK	1.04	2.20+	7.22+	7.58+	11.46+	0.37+	0.58+	1.33+	40

Tab. 2b	Ward Lake Level	Wet			Precip				(Load)				
					Amt. (in)								
Samp.	Collection	Precip.	Precip.	Collector	used for	H+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	(in.)	Form	Type	Loading	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
25	3/30/2005 17:20	5.29	RS	WET	5.29	8.48	36.64	40.15	59.20	11.47	16.97	10.60	
26	4/5/2005 15:45	0.42	S	WET	0.42	1.07	12.16	14.28	24.97	0.32	0.87	2.05	
27	4/13/2005 17:00	0.94	R?S	WET	0.94	1.90	13.76	15.58	29.58	0.44	1.43	2.56	
28	4/25/2005 16:10	0.42	RS	WET	0.42	0.51	25.02	29.98	41.29	0.32	0.57	1.65	
29	5/2/2005 16:10	0.66	R	WET	0.66	1.33	38.07	62.96	65.29	0.80	1.81	2.50	
30	5/6/2005 18:00	0.18	R	WET	0.18	0.72	7.73	7.41	8.35	0.12	0.65	0.92	
31	5/11/2005 17:15	1.84	RS	WET	1.84	2.95	15.64	41.82	54.71	0.65	5.80	5.94	
32	5/17/2005 17:35	1.43	RSG	WET	1.43	NA	31.30	29.41		5.90	1.04	3.34	
33	5/20/2005 16:00	2.81	R	WET	2.81	4.50	102.71	119.39		1.58	2.49	3.40	
34	6/13/2005 18:05	1.21	RS	WET	1.21	1.94				0.14			
35	6/20/2005 13:25	0.94	RS?	WET	0.94	3.01				0.88			

(Note- “+” indicates a portion of precipitation was also caught in dry bucket, therefore wet loading is underestimated; “e” indicates load was estimated using total event precipitation amount multiplied by the concentration of partial sample caught.)

Table 3a. N and P concentrations in dry deposition at the Ward Valley Lake Level Station 7/1/04-6/30/05.

Tab.3a	Ward Valley Lake Level Station Dry								Concentration					
Samp. No.	Start Date-Time	Collection Date-Time	Vol. Liters	Precip. Form	Collector Type	pH	H^+ (µg/l)	NO3-N (µg/l)	NH4-N (µg/l)	TKN (µg/l)	SRP (µg/l)	DP (µg/l)	TP (µg/l)	Notes
1	6/24/2004 15:55	7/2/2004 11:10	2.745	DF	DRY	5.00	10.00	57.81	1.44	285.43	2.54	8.31	32.79	
2	7/2/2004 11:10	7/19/2004 10:25	0.798	DF	DRY	NA	NA	19.82	13.58	956.26	13.13	32.12	80.29	
3	7/19/2004 10:25	7/28/2004 10:45	2.219	DF	DRY	NA	NA	10.72	7.11	373.67	1.15	7.24	19.84	
4	7/28/2004 10:45	8/9/2004 17:00	1.455	DF	DRY	NA	NA	17.13	10.09	1524.91	0.17	9.87	13.27	
5	8/9/2004 17:00	8/16/2004 13:20	2.913	DF	DRY	NA	NA	14.49	2.52	326.21	0.14	4.46	9.48	
6	8/16/2004 13:20	9/1/2004 16:00	1.153	DF	DRY	NA	NA	32.60	12.35	112.93	11.24	30.13	88.67	
7	9/1/2004 16:00	9/9/2004 15:00	2.894	DF	DRY	NA	NA	9.41	7.01	201.99	0.17	6.59	5.93	
8	9/9/2004 15:00	9/17/2004 15:45	2.745	DF	DRY	NA	NA	5.78	7.45	269.45	3.23	10.99	19.60	
9	9/17/2004 15:45	9/24/2004 14:35	2.982	DF	DRY	4.85	14.13	12.86	21.00	218.64	4.25	10.99	13.38	
10	9/24/2004 14:35	10/5/2004 18:07	3.082	DF	DRY	NA	NA	16.01	NES	231.10	1.36	1.25	5.93	
11	10/5/2004 18:07	10/14/2004 15:35	3.250	DF	DRY	NA	NA	1.44	2.60	194.79	1.14	3.12	10.92	
12	10/14/2004 15:35	10/25/2004 11:30	3.767	DF	DRY	NA	NA	1.36	11.38	356.16	0.46	50.30	69.16	
13	10/25/2004 11:30	10/29/2004 16:15	3.675	DF	DRY	NA	NA	4.54	6.33	44.29	0.91	3.48	4.74	
14	10/29/2004 16:15	11/12/2004 11:20	3.827	DF	DRY	NA	NA	20.09	75.21	294.20	0.68	3.79	9.80	23
15	11/12/2004 11:20	11/22/2004 12:00	2.723	DF	DRY	NA	NA	10.88	9.76	356.50	0.57	4.43	11.72	
16	11/22/2004 12:00	11/29/2004 12:55	3.464	DF	DRY	NA	NA	6.71	9.76	35.30	5.25	5.38	8.24	24
17	11/29/2004 12:55	12/10/2004 11:15	4.790	DF+RS	DRY-BULK	5.38	4.17	16.32	11.87	124.52	1.60	6.02	11.09	25
18	12/10/2004 11:15	12/20/2004 11:15	2.920	DF	DRY	NA	NA	15.24	34.24	81.80	0.69	4.75	20.59	
19	12/20/2004 11:15	12/27/2004 12:30	2.893	DF	DRY	NA	NA	5.77	35.54	54.65	NA	4.75	13.62	
20	12/27/2004 12:30	1/3/2005 17:15	3.933	DF+S	DRY-BULK	NA	NA	13.85	23.37	62.46	0.44	4.75	8.08	50
21	1/3/2005 17:15	1/12/2005 15:15	5.093	DF+RS	DRY-BULK	5.25	5.62							51
22	1/12/2005 15:15	1/21/2005 11:45	3.230	DF	DRY	NA	NA	7.88	20.85	44.37	1.16	5.58	6.19	
23	1/21/2005 11:45	1/24/2005 16:30	3.646	DF	DRY	NA	NA	5.03	9.13	24.97	0.46	2.21	2.17	
24	1/24/2005 16:30	2/4/2005 17:00	2.903	DF	DRY	NA	NA	9.48	3.02	43.41		12.40	17.80	
25	2/4/2005 17:00	2/15/2005 10:30	2.920	DF	DRY	NA	NA	NA	18.05	74.49	0.70	11.13	15.26	

Tab.3a	Ward Lake Level	Dry							(Conc.)					
Samp.	Start	Collection	Vol.	Precip.	Collector	pH	H^+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	Notes
26	2/15/2005 10:30	2/23/2005 13:20	4.250	DF+RS	DRY-BULK	NA	NA							50
27	2/23/2005 13:20	3/7/2005 14:10	5.042	DF	DRY	NA	NA	5.10	9.69	41.80	1.15	5.35	11.80	
28	3/7/2005 14:10	3/9/2005 11:25	3.500	DF	DRY	NA	NA	1.71	5.37	34.57	1.15	3.78	4.72	53
29	3/9/2005 11:25	3/18/2005 14:10	2.328	DF	DRY	NA	NA	15.09	14.01	51.15	12.70	6.00	20.83	
30	3/18/2005 14:10	3/22/2005 12:15	5.946	DF+RS	DRY-BULK	NA	NA							52
31	3/22/2005 12:15	3/31/2005 17:15	0.510	DF+S	DRY	NA	NA	39.65	33.29	199.21	8.54	13.88	36.92	54
32	3/31/2005 17:15	4/14/2005 14:00	3.165	DF	DRY	NA	NA	27.66	18.05	116.62	2.54	5.05	14.86	55
33	4/14/2005 14:00	4/25/2005 16:10	1.744	DF	DRY	NA	NA	49.32	47.05	137.22	3.70	6.63	18.34	
34	4/25/2005 16:10	5/4/2005 15:15	2.424	DF	DRY	NA	NA	27.08	32.96	70.27	1.16	12.71		56
35	5/4/2005 15:15	5/20/2005 16:00	2.116	DF	DRY	NA	NA	62.55	48.41		4.64	5.08	10.79	
36	5/20/2005 16:00	5/26/2005 11:00	2.902	DF	DRY	NA	NA	6.57	14.74		8.81	15.87		
37	5/26/2005 11:00	6/8/2005 14:00	1.952	DF	DRY	NA	NA				32.77			57
38	6/8/2005 14:00	6/20/2005 13:25	2.780	DF	DRY	NA	NA				11.54			

Table 3b. N and P loads in dry deposition at the Ward Valley Lake Level Station 7/1/04-6/30/05.

Tab.3b	Ward Valley Lake Level Station Dry							(Load)					
Samp.	Start	Collection	Vol.	Precip.	Collector	H+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
1	6/24/2004 15:55	7/2/2004 11:10	2.745	DF	DRY	5.42	31.32	0.78	154.63	1.38	4.50	17.76	
2	7/2/2004 11:10	7/19/2004 10:25	0.798	DF	DRY	NA	3.12	2.14	150.60	2.07	5.06	12.64	
3	7/19/2004 10:25	7/28/2004 10:45	2.219	DF	DRY	NA	4.69	3.11	163.64	0.50	3.17	8.69	
4	7/28/2004 10:45	8/9/2004 17:00	1.455	DF	DRY	NA	4.92	2.90	437.88	0.05	2.83	3.81	
5	8/9/2004 17:00	8/16/2004 13:20	2.913	DF	DRY	NA	8.33	1.45	187.54	0.08	2.56	5.45	
6	8/16/2004 13:20	9/1/2004 16:00	1.153	DF	DRY	NA	7.42	2.81	25.70	2.56	6.86	20.18	
7	9/1/2004 16:00	9/9/2004 15:00	2.894	DF	DRY	NA	5.37	4.00	115.37	0.10	3.76	3.39	
8	9/9/2004 15:00	9/17/2004 15:45	2.745	DF	DRY	NA	3.13	4.04	145.97	1.75	5.95	10.62	
9	9/17/2004 15:45	9/24/2004 14:35	2.982	DF	DRY	8.31	7.57	12.36	128.67	2.50	6.47	7.87	
10	9/24/2004 14:35	10/5/2004 18:07	3.082	DF	DRY	NA	9.74	NES	140.57	0.83	0.76	3.61	
11	10/5/2004 18:07	10/14/2004 15:35	3.250	DF	DRY	NA	0.92	1.67	124.94	0.73	2.00	7.00	
12	10/14/2004 15:35	10/25/2004 11:30	3.767	DF	DRY	NA	1.01	8.46	264.78	0.34	37.39	51.42	
13	10/25/2004 11:30	10/29/2004 16:15	3.675	DF	DRY	NA	3.29	4.59	32.12	0.66	2.52	3.44	
14	10/29/2004 16:15	11/12/2004 11:20	3.827	DF	DRY	NA	C	C	C	C	C	C	23
15	11/12/2004 11:20	11/22/2004 12:00	2.723	DF	DRY	NA	5.85	5.25	191.58	0.31	2.38	6.30	
16	11/22/2004 12:00	11/29/2004 12:55	3.464	DF	DRY	NA	4.59	6.67	24.13	3.59	3.68	5.63	24
17	11/29/2004 12:55	12/10/2004 11:15	4.790	DF+RS	DRY-BULK	3.94	15.43	11.22	117.71	1.51	5.69	10.48	25
18	12/10/2004 11:15	12/20/2004 11:15	2.920	DF	DRY	NA	8.78	19.73	47.14	0.40	2.74	11.87	
19	12/20/2004 11:15	12/27/2004 12:30	2.893	DF	DRY	NA	3.29	20.29	31.20	NA	2.71	7.78	
20	12/27/2004 12:30	1/3/2005 17:15	3.933	DF+S	DRY-BULK	NA	10.75	18.14	48.48	0.34	3.69	6.27	50
21	1/3/2005 17:15	1/12/2005 15:15	5.093	DF+RS	DRY-BULK	5.65							51
22	1/12/2005 15:15	1/21/2005 11:45	3.230	DF	DRY	NA	5.02	13.29	28.28	0.74	3.56	3.95	
23	1/21/2005 11:45	1/24/2005 16:30	3.646	DF	DRY	NA	3.62	6.57	17.97	0.33	1.59	1.56	
24	1/24/2005 16:30	2/4/2005 17:00	2.903	DF	DRY	NA	5.43	1.73	24.87		7.10	10.20	
25	2/4/2005 17:00	2/15/2005 10:30	2.920	DF	DRY	NA	NA	10.40	42.93	0.40	6.41	8.79	

Tab.3b	Ward Lake Level	Dry						(Load)					
Samp.	Start	Collection	Vol.	Precip.	Collector	H+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
26	2/15/2005 10:30	2/23/2005 13:20	4.250	DF+RS	DRY-BULK	NA							50
27	2/23/2005 13:20	3/7/2005 14:10	5.042	DF	DRY	NA	5.07	9.64	41.59	1.14	5.32	11.74	
28	3/7/2005 14:10	3/9/2005 11:25	3.500	DF	DRY	NA	1.18	3.71	23.88	0.79	2.61	3.26	53
29	3/9/2005 11:25	3/18/2005 14:10	2.328	DF	DRY	NA	6.93	6.44	23.50	5.83	2.76	9.57	
30	3/18/2005 14:10	3/22/2005 12:15	5.946	DF+RS	DRY-BULK	NA							52
31	3/22/2005 12:15	3/31/2005 17:15	0.510	DF+S	DRY	NA	3.99	3.35	20.05	0.86	1.40	3.72	54
32	3/31/2005 17:15	4/14/2005 14:00	3.165	DF	DRY	NA	17.28	11.27	72.84	1.59	3.15	9.28	55
33	4/14/2005 14:00	4/25/2005 16:10	1.744	DF	DRY	NA	16.98	16.19	47.23	1.27	2.28	6.31	
34	4/25/2005 16:10	5/4/2005 15:15	2.424	DF	DRY	NA	12.95	15.77	33.62	0.55	6.08		56
35	5/4/2005 15:15	5/20/2005 16:00	2.116	DF	DRY	NA	26.12	20.22		1.94	2.12	4.51	
36	5/20/2005 16:00	5/26/2005 11:00	2.902	DF	DRY	NA	3.76	8.44		5.05	9.09		
37	5/26/2005 11:00	6/8/2005 14:00	1.952	DF	DRY	NA				12.62			57
38	6/8/2005 14:00	6/20/2005 13:25	2.780	DF	DRY	NA				6.33			

Table 4a. Precipitation amounts, pH, N and P concentrations in bulk deposition collected in Snow Tube collector at the Mid-Lake Buoy (TB-1) Station 7/1/04 to 6/30/05.

Tab.4a	Mid-lake	Snow Tube								Concentration				
Samp.	Start	Collection	Precip.	Precip.	Collector	pH	H^+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	(in.)	Form	Type		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	Notes
1	6/24/2004 13:00	7/2/2004 14:14	0.00	DF	ST	NA	NA	43.80	24.46	174.48	15.73	19.86	32.18	2
	7/2/2004 14:14	7/17/2004 11:25	0.00	DF	ST	NA	NA							2
	7/17/2004 11:25	7/27/2004 11:10	0.00	DF	ST	NA	NA							2
2	7/27/2004 11:10	8/9/2004 9:55	T	R+DF	ST	NA	NA	87.73	21.72	141.24	0.34	7.64	15.48	2
3	8/9/2004 9:55	8/16/2004 11:00	0.00	DF	ST	NA	NA	50.10	11.28	81.25	0.97	5.09	9.16	2
	8/16/2004 11:00	8/31/2004 8:40	0.00											
4	8/31/2004 8:40	9/9/2004 12:40	0.00	DF	ST	NA	NA	25.45	13.18	216.23	3.93	7.22	14.00	2
5	9/9/2004 12:40	9/17/2004 9:05	0.00	DF	ST	NA	NA	9.51	7.42	81.30	0.14	5.34	0.94	2
6	9/17/2004 9:05	9/24/2004 9:45	0.02	RS+DF	ST	NA	NA	395.50	63.71	224.85	8.62	14.91	28.62	5
	9/24/2004 9:45	10/5/2004 12:35	0.00											
	10/5/2004 12:35	10/14/2004 10:20	0.00	DF	ST	NA	NA	NA	NA	NA	NA	NA	NA	2
7	10/14/2004 10:20	10/22/2004 11:10	1.95+	DF+RS	ST	4.97	10.72	410.70	213.62	321.42	23.19	28.13	56.57	28
8	10/22/2004 11:10	10/29/2004 11:40	0.84	DF+S	ST	4.90	12.59	264.78	140.57	243.03	14.55	17.07	32.24	
9	10/29/2004 11:40	11/15/2004 13:50	0.37	DF+RS	ST	4.42	38.02	807.00	532.02	835.70	19.10	24.02	40.77	
10	11/15/2004 13:50	11/29/2004 15:45	0.61	DF+S	ST	4.90	12.59	333.70	128.15	244.83	6.39	10.45	29.78	
11	11/29/2004 15:45	12/10/2004 14:00	0.88	DF+RS	ST	4.99	10.23	199.49	58.81	207.90	8.22	9.50	26.92	
12	12/10/2004 14:00	12/24/2004 8:30	0.00	DF	ST	NA	NA	28.12	29.91		2.30	5.07		2
13	12/24/2004 8:30	1/6/2005 11:40	0.54+	DF+S	ST	NA	NA	114.30	65.90	779.52	2.98	5.38	22.81	28
14	1/6/2005 11:40	1/13/2005 13:50	0.43+	DF+RS	ST	5.13	7.41							28
15	1/13/2005 13:50	1/24/2005 15:50	0.01	DF+R	ST	NA	NA	235.00	70.57	128.21	2.31	2.84	3.40	41
16	1/24/2005 15:50	2/4/2005 16:30	0.01+	DF+RS	ST	5.20	6.31	27.47	4.29	45.66	0.23	2.22	10.81	42
17	2/4/2005 16:30	2/24/2005 14:25	0.53+	DF+RS	ST	4.51	30.90	419.90	358.42	411.56	5.75	11.15	18.67	28
18	2/24/2005 14:25	3/9/2005 10:40	0.34	DF+S	ST	4.60	25.12	270.00	294.48	430.41	5.08	9.13	13.85	
19	3/9/2005 10:40	3/16/2005 10:23	T	DF+T	ST	NA	NA	272.70	9.26	36.80	3.69	10.10	10.73	43
20	3/16/2005 10:23	3/24/2005 10:05	0.03+	DF+RS	ST	NA	NA	7.13	6.45	43.37	1.62	4.74	10.73	44

Tab.4a	Mid-Lake	Snow Tube							(Conc.)					
Samp.	Start	Collection	Precip.	Precip.	Collector	pH	H^+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	(in.)	Form	Type		(μg/l)	(μg/l)	(μg/l)	(μg/l)	(μg/l)	(μg/l)	(μg/l)	Notes
21	3/24/2005 10:05	3/31/2005 9:35	0.39+	DF+RS	ST	NA	NA	193.42	127.24	217.86	5.08	10.10	17.67	28
22	3/31/2005 9:35	4/14/2005 13:20	0.03	DF+S	ST	NA	NA	28.63	45.96	160.16	9.25	15.79	23.71	
23	4/14/2005 13:20	4/22/2005 15:00	0.02	DF+RS	ST	NA	NA	31.33	38.34	73.30	2.54	4.10	9.48	46
24	4/22/2005 15:00	5/25/2005 16:20	0.69	DF+RSG	ST	NA	NA	409.25	432.57		39.89	48.24	74.26	
25	5/25/2005 16:20	6/8/2005 8:35	0.07	DF+RS	ST	NA	NA				15.12			48
26	6/8/2005 8:35	6/20/2005 11:34	0.16	DF+RS	ST	NA	NA				16.85			
27	6/20/2005 11:34	6/29/2005 10:50	0.00	DF	ST	NA	NA			92.17	5.31			49

Table 4b. Precipitation amounts, pH, N and P loads in bulk deposition collected in Snow Tube collector at the Mid-Lake Buoy (TB-1) Station 7/1/04 to 6/30/05.

Tab.4b Samp. No.	Mid-lake Start Date-Time	Snow Tube Collection Date-Time	Precip. (in.)	Precip. Form	Collector Type	H+ (g/ha)	NO3-N (g/ha)	(Load) NH4-N (g/ha)	TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
1	6/24/2004 13:00	7/2/2004 14:14	0.00	DF	ST	NA	6.75	3.77	26.89	2.42	3.06	4.96	2
	7/2/2004 14:14	7/17/2004 11:25	0.00	DF	ST								2
	7/17/2004 11:25	7/27/2004 11:10	0.00	DF	ST								2
2	7/27/2004 11:10	8/9/2004 9:55	T	R+DF	ST	NA	13.52	3.35	21.77	0.05	1.18	2.39	2
3	8/9/2004 9:55	8/16/2004 11:00	0.00	DF	ST	NA	7.72	1.74	12.52	0.15	0.78	1.41	2
	8/16/2004 11:00	8/31/2004 8:40	0.00										
4	8/31/2004 8:40	9/9/2004 12:40	0.00	DF	ST	NA	3.92	2.03	33.33	0.61	1.11	2.16	2
5	9/9/2004 12:40	9/17/2004 9:05	0.00	DF	ST	NA	1.47	1.14	12.53	0.02	0.82	0.14	2
6	9/17/2004 9:05	9/24/2004 9:45	0.02	RS+DF	ST	NA	60.96	9.82	34.66	1.33	2.30	4.41	5
	9/24/2004 9:45	10/5/2004 12:35	0.00										
	10/5/2004 12:35	10/14/2004 10:20	0.00	DF	ST	NA	NA	NA	NA	NA	NA	NA	2
7	10/14/2004 10:20	10/22/2004 11:10	1.95+	DF+RS	ST	5.31	203.42	105.81	159.20	11.49	13.93	28.02	28
8	10/22/2004 11:10	10/29/2004 11:40	0.84	DF+S	ST	2.69	56.49	29.99	51.85	3.10	3.64	6.88	
9	10/29/2004 11:40	11/15/2004 13:50	0.37	DF+RS	ST	3.57	75.84	50.00	78.54	1.80	2.26	3.83	
10	11/15/2004 13:50	11/29/2004 15:45	0.61	DF+S	ST	1.95	51.70	19.86	37.93	0.99	1.62	4.61	
11	11/29/2004 15:45	12/10/2004 14:00	0.88	DF+RS	ST	2.29	44.59	13.15	46.47	1.84	2.12	6.02	
12	12/10/2004 14:00	12/24/2004 8:30	0.00	DF	ST	NA	4.33	4.61		0.35	0.78		2
13	12/24/2004 8:30	1/6/2005 11:40	0.54+	DF+S	ST	NA	15.68	9.04	106.92	0.41	0.74	3.13	28
14	1/6/2005 11:40	1/13/2005 13:50	0.43+	DF+RS	ST	0.81							28
15	1/13/2005 13:50	1/24/2005 15:50	0.01	DF+R	ST	NA	36.44	10.94	19.88	0.36	0.44	0.53	41
16	1/24/2005 15:50	2/4/2005 16:30	0.01+	DF+RS	ST	0.97	4.23	0.66	7.04	0.04	0.34	1.67	42
17	2/4/2005 16:30	2/24/2005 14:25	0.53+	DF+RS	ST	4.16	56.53	48.25	55.40	0.77	1.50	2.51	28
18	2/24/2005 14:25	3/9/2005 10:40	0.34	DF+S	ST	2.17	23.32	25.43	37.17	0.44	0.79	1.20	
19	3/9/2005 10:40	3/16/2005 10:23	T	DF+T	ST	NA	42.03	1.43	5.67	0.57	1.56	1.65	43
20	3/16/2005 10:23	3/24/2005 10:05	0.03+	DF+RS	ST	NA	1.11	1.00	6.75	0.25	0.74	1.67	44

Tab.4b	Mid-lake	Snow Tube						(Load)					
Samp.	Start	Collection	Precip.	Precip.	Collector	H+	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	(in.)	Form	Type	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
21	3/24/2005 10:05	3/31/2005 9:35	0.39+	DF+RS	ST	NA	19.16	12.60	21.58	0.50	1.00	1.75	28
22	3/31/2005 9:35	4/14/2005 13:20	0.03	DF+S	ST	NA	4.41	7.08	24.68	1.43	2.43	3.65	
23	4/14/2005 13:20	4/22/2005 15:00	0.02	DF+RS	ST	NA	4.83	5.91	11.30	0.39	0.63	1.46	46
24	4/22/2005 15:00	5/25/2005 16:20	0.69	DF+RSG	ST	NA	71.73	75.81		6.99	8.45	13.01	
25	5/25/2005 16:20	6/8/2005 8:35	0.07	DF+RS	ST	NA				2.33			48
26	6/8/2005 8:35	6/20/2005 11:34	0.16	DF+RS	ST	NA				0.68			
27	6/20/2005 11:34	6/29/2005 10:50	0.00	DF	ST	NA			14.21	0.82			49

Table 4c. Precipitation amounts, pH, N and P load per day in bulk deposition to Snow Tube collector at the Mid-Lake Buoy (TB-1) Station 7/1/04 to 6/30/05.

Tab.4c Samp. No.	Mid-lake Start Date-Time	Snow Tube Collection Date-Time	Precip. (in.)	Precip. Form	Collector Type	H (g/ha/d)	NO3-N (g/ha/d)	Loading NH4-N (g/ha/d)	Rate TKN (g/ha/d)	SRP (g/ha/d)	DP (g/ha/d)	TP (g/ha/d)	Notes
1	6/24/2004 13:00	7/2/2004 14:14	0.00	DF	ST	NA	0.84	0.47	3.34	0.30	0.38	0.62	2
	7/2/2004 14:14	7/17/2004 11:25	0.00	DF	ST	NA							2
	7/17/2004 11:25	7/27/2004 11:10	0.00	DF	ST	NA							2
2	7/27/2004 11:10	8/9/2004 9:55	T	R+DF	ST	NA	1.04	0.26	1.68	0.00	0.09	0.18	2
3	8/9/2004 9:55	8/16/2004 11:00	0.00	DF	ST	NA	1.10	0.25	1.78	0.02	0.11	0.20	2
	8/16/2004 11:00	8/31/2004 8:40	0.00										
4	8/31/2004 8:40	9/9/2004 12:40	0.00	DF	ST	NA	0.43	0.22	3.64	0.07	0.12	0.24	2
5	9/9/2004 12:40	9/17/2004 9:05	0.00	DF	ST	NA	0.19	0.15	1.60	0.00	0.10	0.02	2
6	9/17/2004 9:05	9/24/2004 9:45	0.02	RS+DF	ST	NA	8.67	1.40	4.93	0.19	0.33	0.63	5
	9/24/2004 9:45	10/5/2004 12:35	0.00										
	10/5/2004 12:35	10/14/2004 10:20	0.00	DF	ST								2
7	10/14/2004 10:20	10/22/2004 11:10	1.95+	DF+RS	ST	0.66	25.32	13.17	19.81	1.43	1.73	3.49	28
8	10/22/2004 11:10	10/29/2004 11:40	0.84	DF+S	ST	0.38	8.05	4.27	7.39	0.44	0.52	0.98	
9	10/29/2004 11:40	11/15/2004 13:50	0.37	DF+RS	ST	0.21	4.44	2.93	4.60	0.11	0.13	0.22	
10	11/15/2004 13:50	11/29/2004 15:45	0.61	DF+S	ST	0.14	3.67	1.41	2.69	0.07	0.11	0.33	
11	11/29/2004 15:45	12/10/2004 14:00	0.88	DF+RS	ST	0.21	4.08	1.20	4.25	0.17	0.19	0.55	
12	12/10/2004 14:00	12/24/2004 8:30	0.00	DF	ST	NA	0.31	0.33		0.03	0.06		2
13	12/24/2004 8:30	1/6/2005 11:40	0.54+	DF+S	ST	NA	1.19	0.69	8.14	0.03	0.06	0.24	28
14	1/6/2005 11:40	1/13/2005 13:50	0.43+	DF+RS	ST	0.11							28
15	1/13/2005 13:50	1/24/2005 15:50	0.01	DF+R	ST	NA	3.29	0.99	1.79	0.03	0.04	0.05	41
16	1/24/2005 15:50	2/4/2005 16:30	0.01+	DF+RS	ST	0.09	0.38	0.06	0.64	0.00	0.03	0.15	42
17	2/4/2005 16:30	2/24/2005 14:25	0.53+	DF+RS	ST	0.21	2.84	2.42	2.78	0.04	0.08	0.13	28
18	2/24/2005 14:25	3/9/2005 10:40	0.34	DF+S	ST	0.17	1.82	1.98	2.89	0.03	0.06	0.09	
19	3/9/2005 10:40	3/16/2005 10:23	T	DF+T	ST	NA	6.01	0.20	0.81	0.08	0.22	0.24	43

Tab.4c	Mid-lake	Snow Tube						Loading	Rate				
Samp.	Start	Collection	Precip.	Precip.	Collector	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	(in.)	Form	Type	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	Notes
20	3/16/2005 10:23	3/24/2005 10:05	0.03+	DF+RS	ST	NA	0.14	0.13	0.85	0.03	0.09	0.21	44
21	3/24/2005 10:05	3/31/2005 9:35	0.39+	DF+RS	ST	NA	2.75	1.81	3.09	0.07	0.14	0.25	28
22	3/31/2005 9:35	4/14/2005 13:20	0.03	DF+S	ST	NA	0.31	0.50	1.74	0.10	0.17	0.26	
23	4/14/2005 13:20	4/22/2005 15:00	0.02	DF+RS	ST	NA	0.60	0.73	1.40	0.05	0.08	0.18	46
24	4/22/2005 15:00	5/25/2005 16:20	0.69	DF+RSG	ST	NA	2.17	2.29		0.21	0.26	0.39	
25	5/25/2005 16:20	6/8/2005 8:35	0.07	DF+RS	ST	NA				0.17			48
26	6/8/2005 8:35	6/20/2005 11:34	0.16	DF+RS	ST	NA				0.06			
27	6/20/2005 11:34	6/29/2005 10:50	0.00	DF	ST	NA			1.58	0.09			49

Table 5a. N, P, and H concentrations in dry-bulk deposition (buoy bucket collector) at the Mid-Lake Buoy (TB-1) Station 7/1/04-6/30/05.

Tab.5a	Mid-lake Station	Dry-Bulk								Concentration				
Samp.	Start	Collection	Vol.	Precip.	Collector	pH	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	Notes
1	6/24/2004 13:00	7/2/2004 14:14	1.070	DF	DRY-BULK	4.6	25.12	231.25	186.17	311.67	10.64	13.24	39.72	
2	7/2/2004 14:14	7/17/2004 11:25	0.000	DF	DRY-BULK	NA		357.21	357.88	568.28	4.84	15.43	45.65	6
3	7/17/2004 11:25	7/27/2004 11:10	0.168	DF	DRY-BULK	NA		374.17	368.4	984.72	4.15	14.48	43.77	7
4	7/27/2004 11:10	8/9/2004 9:55	0.000	DF+T	DRY-BULK	NA		368.6	311.01	545.45	0.3	8.6	18	6
5	8/9/2004 9:55	8/16/2004 11:00	1.330	DF	DRY-BULK	4.7	19.95	145.7	123.2	297.26	0.29	3.82	7.26	
6	8/16/2004 11:00	8/31/2004 8:40	0.000	DF	DRY-BULK	NA		273.15	216.98	332.45	1.3	5.97	11.35	6
7	8/31/2004 8:40	9/9/2004 12:40	0.100	DF	DRY-BULK	NA		360.6	387.7	651.99	3.58	8.79	60.36	9
8	9/9/2004 12:40	9/17/2004 9:05	0.150	DF	DRY-BULK	NA		209.3	225.25	351.91	2.34	6.91	10.89	10
9	9/17/2004 9:05	9/24/2004 9:45	0.725	DF+RS	DRY-BULK	4.5	31.62	244.5	224.23	299.03	4.73	9.42	13.38	
10	9/24/2004 9:45	10/5/2004 12:35	1.420	DF	DRY-BULK	4.59	25.70	148.6	131.03	293.46	3.52	5.3	8.11	
11	10/5/2004 12:35	10/14/2004 10:20	0.140	DF	DRY-BULK	4.51	30.90	473.2	510.91	811.16	4.09	12.16	31.82	11
12	10/14/2004 10:20	10/22/2004 11:10	2.243	DF+RS	DRY-BULK	5.3	5.01	71.94	430.6	240.52	12.28	12.33	34.77	
13	10/22/2004 11:10	10/29/2004 11:40	1.992	DF+RS	DRY-BULK	4.92	12.02	53.93	24.32	112.39	13.64	13.59	22.76	
14	10/29/2004 11:40	11/15/2004 13:50	0.230	DF+RS	DRY-BULK	4.11	77.62	1740	1561.77	1656.58	16.82	20.23	96.4	58
15	11/15/2004 13:50	11/29/2004 15:45	1.113	DF+S	DRY-BULK	4.8	15.85	136.38	74.88	91.73	1.37	6.18	14.89	
16	11/29/2004 15:45	12/10/2004 14:00	1.160	DF+RS	DRY-BULK	5	10.00	90.32	34.92	183.51	3.42	6.97	17.74	
17	12/10/2004 14:00	12/24/2004 8:30	0.737	DF	DRY-BULK	4.82	15.14	196.5	117.79	377.92	1.52	5.7	18.69	
18	12/24/2004 8:30	1/6/2005 11:40	0.670	DF+S	DRY-BULK	4.78	16.60	166.85	117.05	410.77	1.16	5.7	20.91	
19	1/6/2005 11:40	1/13/2005 13:50	1.754	DF+S	DRY-BULK	5.1	7.94							
20	1/13/2005 13:50	1/24/2005 15:50	1.876	DF+S	DRY-BULK	4.82	15.14	104.7	14.77	344.98	0.23	4.1	1.55	
21	1/24/2005 15:50	2/4/2005 16:30	0.796	DF+RS	DRY-BULK	4.8	15.85	C	C	C	C	C	C	
22	2/4/2005 16:30	2/24/2005 14:25	1.352	DF+RS	DRY-BULK	4.8	15.85	258.2	187.2	232.35	2.07	6.51	8.54	
23	2/24/2005 14:25	3/9/2005 10:40	0.830	DF+S	DRY-BULK	4.78	16.60	264.52	193.4	503.62	2.54	6.61	10.7	
24	3/9/2005 10:40	3/16/2005 10:23	0.920	DF+T	DRY-BULK	5.37	4.27	236	101.45	153.59	6	10.41	14.52	59
25	3/16/2005 10:23	3/24/2005 10:05	1.903	DF+RS	DRY-BULK	4.98	10.47	73.08	49.86	118.35	0.92	6	6.63	60

Tab.5a	Mid-lake Station	Dry-Bulk							(Conc.)					
Samp.	Start	Collection	Vol.	Precip.	Collector	pH	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	Notes
26	3/24/2005 10:05	3/31/2005 9:35	1.353	DF+RS	DRY-BULK	4.98	10.47	48.74	26.37	62.02	0.46	4.73	5.68	61
27	3/31/2005 9:35	4/14/2005 13:20	1.000	DF+RS	DRY-BULK	5.3	5.01	176.02	156.76	311.16	10.64	16.1	23.4	62
28	4/14/2005 13:20	4/22/2005 15:00	0.840	DF+RS	DRY-BULK	4.9	12.59	120.12	89.45	189.75	4.16	6	24.66	
29	4/22/2005 15:00	5/25/2005 16:20	0.500	DF+RSG	DRY-BULK	4.73	18.62	481.62	607.59		55.19	77.75	94.26	63
30	5/25/2005 16:20	6/8/2005 8:35	0.500	DF+RS	DRY-BULK	5	10.00				14.31			64
31	6/8/2005 8:35	6/20/2005 11:34	0.539	DF+RS	DRY-BULK	4.4	39.81				59.08			65
32	6/20/2005 11:34	6/29/2005 10:50	1.009	DF	DRY-BULK	4.8	15.85			419.23	2.77			

Table 5b. N, P, and H loads in dry-bulk deposition (buoy bucket collector) at the Mid-Lake Buoy (TB-1) Station 7/1/04-6/30/05.

Tab.5b Samp. No.	Mid-lake Station Start Date-Time	Dry-Bulk Collection Date-Time	Vol. Liters	Precip. Form	Collector Type	H (g/ha)	NO3-N (g/ha)	(Load) NH4-N (g/ha)	TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
1	6/24/2004 13:00	7/2/2004 14:14	1.070	DF	DRY-BULK	5.30	48.83	39.31	65.81	2.25	2.80	8.39	
2	7/2/2004 14:14	7/17/2004 11:25	0.000	DF	DRY-BULK	NA	35.25	35.31	56.08	0.48	1.52	4.50	6
3	7/17/2004 11:25	7/27/2004 11:10	0.168	DF	DRY-BULK	NA	36.92	36.35	97.17	0.41	1.43	4.32	7
4	7/27/2004 11:10	8/9/2004 9:55	0.000	DF+T	DRY-BULK	NA	38.26	32.28	56.62	0.03	0.89	1.87	6
5	8/9/2004 9:55	8/16/2004 11:00	1.330	DF	DRY-BULK	5.24	38.24	32.34	78.02	0.08	1.00	1.91	
6	8/16/2004 11:00	8/31/2004 8:40	0.000	DF	DRY-BULK	NA	56.71	45.05	69.02	0.27	1.24	2.36	6
7	8/31/2004 8:40	9/9/2004 12:40	0.100	DF	DRY-BULK	NA	35.58	38.26	64.34	0.35	0.87	5.96	9
8	9/9/2004 12:40	9/17/2004 9:05	0.150	DF	DRY-BULK	NA	41.31	44.45	69.45	0.46	1.36	2.15	10
9	9/17/2004 9:05	9/24/2004 9:45	0.725	DF+RS	DRY-BULK	4.52	34.98	32.08	42.79	0.68	1.35	1.91	
10	9/24/2004 9:45	10/5/2004 12:35	1.420	DF	DRY-BULK	7.58	43.81	38.63	86.51	1.04	1.56	2.39	
11	10/5/2004 12:35	10/14/2004 10:20	0.140	DF	DRY-BULK	3.11	47.63	51.42	81.64	0.41	1.22	3.20	11
12	10/14/2004 10:20	10/22/2004 11:10	2.243	DF+RS	DRY-BULK	2.22	31.85	190.61	106.47	5.44	5.46	15.39	
13	10/22/2004 11:10	10/29/2004 11:40	1.992	DF+RS	DRY-BULK	4.73	21.20	9.56	44.18	5.36	5.34	8.95	
14	10/29/2004 11:40	11/15/2004 13:50	0.230	DF+RS	DRY-BULK	3.52	78.98	70.89	75.19	0.76	0.92	4.38	58
15	11/15/2004 13:50	11/29/2004 15:45	1.113	DF+S	DRY-BULK	3.48	29.96	16.45	20.15	0.30	1.36	3.27	
16	11/29/2004 15:45	12/10/2004 14:00	1.160	DF+RS	DRY-BULK	2.29	20.68	7.99	42.01	0.78	1.60	4.06	
17	12/10/2004 14:00	12/24/2004 8:30	0.737	DF	DRY-BULK	2.20	28.58	17.13	54.97	0.22	0.83	2.72	
18	12/24/2004 8:30	1/6/2005 11:40	0.670	DF+S	DRY-BULK	2.19	22.06	15.48	54.31	0.15	0.75	2.76	
19	1/6/2005 11:40	1/13/2005 13:50	1.754	DF+S	DRY-BULK	2.89							
20	1/13/2005 13:50	1/24/2005 15:50	1.876	DF+S	DRY-BULK	5.89	40.78	5.75	134.36	0.09	1.60	0.60	
21	1/24/2005 15:50	2/4/2005 16:30	0.796	DF+RS	DRY-BULK	2.62	C	C	C	C	C	C	
22	2/4/2005 16:30	2/24/2005 14:25	1.352	DF+RS	DRY-BULK	4.45	72.47	52.54	65.22	0.58	1.83	2.40	
23	2/24/2005 14:25	3/9/2005 10:40	0.830	DF+S	DRY-BULK	2.72	43.33	31.68	82.49	0.42	1.08	1.75	
24	3/9/2005 10:40	3/16/2005 10:23	0.920	DF+T	DRY-BULK	0.81	45.07	19.38	29.33	1.15	1.99	2.77	59
25	3/16/2005 10:23	3/24/2005 10:05	1.903	DF+RS	DRY-BULK	3.93	27.45	18.73	44.45	0.35	2.25	2.49	60

Tab.5b	Mid-lake Station	Dry-Bulk						(Load)					
Samp.	Start	Collection	Vol.	Precip.	Collector	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
26	3/24/2005 10:05	3/31/2005 9:35	1.353	DF+RS	DRY-BULK	2.94	13.69	7.41	17.42	0.13	1.33	1.60	61
27	3/31/2005 9:35	4/14/2005 13:20	1.000	DF+RS	DRY-BULK	0.99	34.74	30.94	61.41	2.10	3.18	4.62	62
28	4/14/2005 13:20	4/22/2005 15:00	0.840	DF+RS	DRY-BULK	2.09	19.91	14.83	31.46	0.69	0.99	4.09	
29	4/22/2005 15:00	5/25/2005 16:20	0.500	DF+RSG	DRY-BULK	1.93	49.99	63.07		5.73	8.07	9.78	63
30	5/25/2005 16:20	6/8/2005 8:35	0.500	DF+RS	DRY-BULK	0.99				1.41			64
31	6/8/2005 8:35	6/20/2005 11:34	0.539	DF+RS	DRY-BULK	4.23				6.28			65
32	6/20/2005 11:34	6/29/2005 10:50	1.009	DF	DRY-BULK	3.32			87.82	0.58			

Table 5c. N, P, and H loading per day in dry-bulk deposition (buoy bucket collector) at the Mid-Lake Buoy (TB-1) Station 7/1/04-6/30/05.

Tab.5c	Mid-lake Station	Dry-Bulk						Loading	Rate			
Samp.	Start	Collection	Vol.	Precip.	Collector	H	NO3-N	NH4-N	TKN	SRP	DP	TP
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)
1	6/24/2004 13:00	7/2/2004 14:14	1.070	DF	DRY-BULK	0.66	6.07	4.88	8.17	0.28	0.35	1.04
2	7/2/2004 14:14	7/17/2004 11:25	0.000	DF	DRY-BULK	NA	2.37	2.37	3.77	0.03	0.10	0.30
3	7/17/2004 11:25	7/27/2004 11:10	0.168	DF	DRY-BULK	NA	3.70	3.64	9.73	0.04	0.14	0.43
4	7/27/2004 11:10	8/9/2004 9:55	0.000	DF+T	DRY-BULK	NA	2.96	2.49	4.37	0.00	0.07	0.14
5	8/9/2004 9:55	8/16/2004 11:00	1.330	DF	DRY-BULK	0.74	5.43	4.59	11.07	0.01	0.14	0.27
6	8/16/2004 11:00	8/31/2004 8:40	0.000	DF	DRY-BULK	NA	3.81	3.02	4.63	0.02	0.08	0.16
7	8/31/2004 8:40	9/9/2004 12:40	0.100	DF	DRY-BULK	NA	3.88	4.17	7.02	0.04	0.09	0.65
8	9/9/2004 12:40	9/17/2004 9:05	0.150	DF	DRY-BULK	NA	5.26	5.66	8.85	0.06	0.17	0.27
9	9/17/2004 9:05	9/24/2004 9:45	0.725	DF+RS	DRY-BULK	0.64	4.98	4.57	6.09	0.10	0.19	0.27
10	9/24/2004 9:45	10/5/2004 12:35	1.420	DF	DRY-BULK	0.68	3.94	3.47	7.78	0.09	0.14	0.22
11	10/5/2004 12:35	10/14/2004 10:20	0.140	DF	DRY-BULK	0.35	5.35	5.77	9.17	0.05	0.14	0.36
12	10/14/2004 10:20	10/22/2004 11:10	2.243	DF+RS	DRY-BULK	0.28	3.96	23.72	13.25	0.68	0.68	1.92
13	10/22/2004 11:10	10/29/2004 11:40	1.992	DF+RS	DRY-BULK	0.67	3.02	1.36	6.29	0.76	0.76	1.27
14	10/29/2004 11:40	11/15/2004 13:50	0.230	DF+RS	DRY-BULK	0.21	4.62	4.15	4.40	0.04	0.05	0.26
15	11/15/2004 13:50	11/29/2004 15:45	1.113	DF+S	DRY-BULK	0.25	2.13	1.17	1.43	0.02	0.10	0.23
16	11/29/2004 15:45	12/10/2004 14:00	1.160	DF+RS	DRY-BULK	0.21	1.89	0.73	3.84	0.07	0.15	0.37
17	12/10/2004 14:00	12/24/2004 8:30	0.737	DF	DRY-BULK	0.16	2.08	1.24	3.99	0.02	0.06	0.20
18	12/24/2004 8:30	1/6/2005 11:40	0.670	DF+S	DRY-BULK	0.17	1.68	1.18	4.14	0.01	0.06	0.21
19	1/6/2005 11:40	1/13/2005 13:50	1.754	DF+S	DRY-BULK	0.41						
20	1/13/2005 13:50	1/24/2005 15:50	1.876	DF+S	DRY-BULK	0.53	3.68	0.52	12.12	0.01	0.14	0.05
21	1/24/2005 15:50	2/4/2005 16:30	0.796	DF+RS	DRY-BULK	0.24	C	C	C	C	C	C
22	2/4/2005 16:30	2/24/2005 14:25	1.352	DF+RS	DRY-BULK	0.22	3.64	2.64	3.28	0.03	0.09	0.12
23	2/24/2005 14:25	3/9/2005 10:40	0.830	DF+S	DRY-BULK	0.21	3.37	2.47	6.42	0.03	0.08	0.14

Tab5c	Mid-lake Station	Dry-Bulk					Loading	Rate				
Samp.	Start	Collection	Vol.	Precip.	Collector	H	NO3-N	NH4-N	TKN	SRP	DP	TP
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)
24	3/9/2005 10:40	3/16/2005 10:23	0.920	DF+T	DRY-BULK	0.12	6.45	2.77	4.20	0.16	0.28	0.40
25	3/16/2005 10:23	3/24/2005 10:05	1.903	DF+RS	DRY-BULK	0.49	3.44	2.34	5.56	0.04	0.28	0.31
26	3/24/2005 10:05	3/31/2005 9:35	1.353	DF+RS	DRY-BULK	0.42	1.96	1.06	2.50	0.02	0.19	0.23
27	3/31/2005 9:35	4/14/2005 13:20	1.000	DF+RS	DRY-BULK	0.07	2.45	2.19	4.34	0.15	0.22	0.33
28	4/14/2005 13:20	4/22/2005 15:00	0.840	DF+RS	DRY-BULK	0.26	2.47	1.84	3.90	0.09	0.12	0.51
29	4/22/2005 15:00	5/25/2005 16:20	0.500	DF+RSG	DRY-BULK	0.06	1.51	1.91		0.17	0.24	0.30
30	5/25/2005 16:20	6/8/2005 8:35	0.500	DF+RS	DRY-BULK	0.07				0.10		
31	6/8/2005 8:35	6/20/2005 11:34	0.539	DF+RS	DRY-BULK	0.35				0.52		
32	6/20/2005 11:34	6/29/2005 10:50	1.009	DF	DRY-BULK	0.37			9.79	0.06		

Table 6a. N, P, and H concentrations in dry-bulk deposition (buoy bucket collector) at the Northwest Buoy (TB-4) Station 7/1/04-6/30/05.

Tab.6a	Buoy TB-4	Dry-Bulk						Concentration						
Samp.	Start	Collection	Vol.	Precip.	Collector	pH	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	Notes
1	6/24/2004 12:28	7/2/2004 13:53	0.81	DF	DRY-BULK	4.6	25.12	183.95	166.62	245.48	7.17	7.39	23.4	
2	7/2/2004 13:53	7/17/2004 10:50	0	DF	DRY-BULK	NA		352.74	553.24	745.15	5.07	12.91	41.25	6
3	7/17/2004 10:50	7/27/2004 9:10	0.017	DF	DRY-BULK	NA		397.39	865.06	1101.18	2.07	9.76	25.82	12
4	7/27/2004 9:10	8/9/2004 9:22	0	DF	DRY-BULK	NA		261.2	134.67	389.5	48.2	61.13	105.5	6
5	8/9/2004 9:22	8/16/2004 10:40	1.317	DF	DRY-BULK	4.55	28.18	142.7	130.5	256.37	0.29	4.78	9	
6	8/16/2004 10:40	8/31/2004 8:22	0	DF	DRY-BULK	NA		214.3	190.43	328.64	1.5	7.53	16.49	8
7	8/31/2004 8:22	9/9/2004 12:05	0	DF	DRY-BULK	NA		332.6	221.12	618.25	5.04	7.22	21.78	6
8	9/9/2004 12:05	9/17/2004 8:36	0	DF	DRY-BULK	NA		158.6	169.73	270.95	1.77	6.59	9.02	8
9	9/17/2004 8:36	9/24/2004 9:20	0.836	DF+RS	DRY-BULK	4.52	30.20	173	168.25	350.75	3.75	8.47	21.16	
10	9/24/2004 9:20	10/5/2004 11:57	0.935	DF	DRY-BULK	4.5	31.62	176.9	140.79	310.37	4.55	8.73	25.27	
11	10/5/2004 11:57	10/14/2004 9:55	0.375	DF	DRY-BULK	4.35	44.67	490.4	451.83	795.21	5.46	13.1	44.6	
12	10/14/2004 9:55	10/22/2004 10:40	2.73	DF+RS	DRY-BULK	5.2	6.31	50.45	194.26	252.07	1.36	6.01	11.69	
13	10/22/2004 10:40	10/29/2004 11:15	1.93	DF+RS	DRY-BULK	4.95	11.22	65.98	28.7	52.57	1.14	3.16	5.37	
14	10/29/2004 11:15	11/15/2004 16:10	0.349	DF+RS	DRY-BULK	4.2	63.10	1322.58	721.93	991.88	8.53	9.8	26.23	
15	11/15/2004 16:10	11/29/2004 16:08	1.333	DF+S	DRY-BULK	4.89	12.88	155.06	69.38	163.61	1.37	5.07	10.77	
16	11/29/2004 16:08	12/10/2004 13:40	1.394	DF+RS	DRY-BULK	5.18	6.61	74.36	27.52	85.07	4.79	6.02	14.25	
17	12/10/2004 13:40	12/24/2004 9:00	0.799	DF	DRY-BULK	4.7	19.95	179.8	106.97	299.75	0.87	5.07	8.55	
18	12/24/2004 9:00	1/6/2005 11:20	0.825	DF+S	DRY-BULK	4.82	15.14	108.7	106.55	199.15	2.37	5.07	10.45	
19	1/6/2005 11:20	1/13/2005 14:30	2.034	DF+S	DRY-BULK	5.1	7.94							
20	1/13/2005 14:30	1/24/2005 16:20	1.959	DF+S	DRY-BULK	4.9	12.59							
21	1/24/2005 16:20	2/4/2005 16:55	1.257	DF+RS	DRY-BULK	4.68	20.89	266.18	61.66	144.16	1	10.81	13.03	
22	2/4/2005 16:55	2/24/2005 14:50	1.682	DF+RS	DRY-BULK	4.7	19.95	281.7	194.44	298.63	2.07	11.13	18.99	
23	2/24/2005 14:50	3/9/2005 11:20	1.009	DF+S	DRY-BULK	4.89	12.88	140.81	157	290.78	2.54	5.35	8.18	
24	3/9/2005 11:20	3/16/2005 10:45	0.843	DF	DRY-BULK	5.28	5.25	103.25	89.17	224.43	5.08	9.15	17.67	
25	3/16/2005 10:45	3/24/2005 10:40	3.098	DF+RS	DRY-BULK	4.98	10.47	49.8	36.9	71.7	0.92	4.42	5.36	

Tab.6a	Buoy TB-4	Dry-Bulk							(Conc)					
Samp.	Start	Collection	Vol.	Precip.	Collector	pH	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	Notes
26	3/24/2005 10:40	3/31/2005 10:05	1.491	DF+RS	DRY-BULK	4.9	12.59	41.59	31.02	71.35	0.23	5.05	5.68	
27	3/31/2005 10:05	4/14/2005 13:55	1.0005	DF+RS	DRY-BULK	5.37	4.27	155.9	166.08	260.37	2.31	3.79	13.28	66
28	4/14/2005 13:55	4/22/2005 15:20	0.935	DF+RS	DRY-BULK	4.9	12.59	102.13	70.4	88.98	2.54	5.37	8.85	
29	4/22/2005 15:20	5/25/2005 16:44	0.511	DF+RSG	DRY-BULK	4.5	31.62	700.38	947.12		82.33	93.3	128.53	67
30	5/25/2005 16:44	6/8/2005 9:00	0.5	DF+RS	DRY-BULK	4.5	31.62				10.15			68
31	6/8/2005 9:00	6/20/2005 11:52	0.411	DF+RS	DRY-BULK	4.4	39.81				21			69
32	6/20/2005 11:52	6/29/2005 10:30	0.587	DF	DRY-BULK	4.6	25.12				3.23			

Table 6b. N, P, and H loading in dry-bulk deposition (buoy bucket collector) at the Northwest Buoy (TB-4) Station 7/1/04-6/30/05

Tab.6b	Buoy TB-4	Dry-Bulk							(Load)				
Samp.	Start	Collection	Vol.	Precip.	Collector	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
1	6/24/2004 12:28	7/2/2004 13:53	0.81	DF	DRY-BULK	4.02	29.41	26.64	39.24	1.15	1.18	3.74	
2	7/2/2004 13:53	7/17/2004 10:50	0	DF	DRY-BULK		36.61	57.43	77.35	0.53	1.34	4.28	6
3	7/17/2004 10:50	7/27/2004 9:10	0.017	DF	DRY-BULK		39.37	85.70	109.10	0.21	0.97	2.56	12
4	7/27/2004 9:10	8/9/2004 9:22	0	DF	DRY-BULK		25.77	13.29	38.43	4.76	6.03	10.41	6
5	8/9/2004 9:22	8/16/2004 10:40	1.317	DF	DRY-BULK	7.71	39.02	35.68	70.09	0.08	1.31	2.46	
6	8/16/2004 10:40	8/31/2004 8:22	0	DF	DRY-BULK		44.49	39.53	68.23	0.31	1.56	3.42	8
7	8/31/2004 8:22	9/9/2004 12:05	0	DF	DRY-BULK		32.82	21.82	61.01	0.50	0.71	2.15	6
8	9/9/2004 12:05	9/17/2004 8:36	0	DF	DRY-BULK		32.93	35.24	56.25	0.37	1.37	1.87	8
9	9/17/2004 8:36	9/24/2004 9:20	0.836	DF+RS	DRY-BULK	4.98	28.54	27.76	57.87	0.62	1.40	3.49	
10	9/24/2004 9:20	10/5/2004 11:57	0.935	DF	DRY-BULK	5.84	32.64	25.98	57.27	0.84	1.61	4.66	
11	10/5/2004 11:57	10/14/2004 9:55	0.375	DF	DRY-BULK	3.31	36.29	33.44	58.85	0.40	0.97	3.30	
12	10/14/2004 9:55	10/22/2004 10:40	2.73	DF+RS	DRY-BULK	3.40	27.18	104.66	135.81	0.73	3.24	6.30	
13	10/22/2004 10:40	10/29/2004 11:15	1.93	DF+RS	DRY-BULK	4.50	26.44	11.50	21.06	0.46	1.27	2.15	
14	10/29/2004 11:15	11/15/2004 16:10	0.349	DF+RS	DRY-BULK	4.35	91.09	49.72	68.32	0.59	0.67	1.81	
15	11/15/2004 16:10	11/29/2004 16:08	1.333	DF+S	DRY-BULK	3.57	42.91	19.20	45.28	0.38	1.40	2.98	
16	11/29/2004 16:08	12/10/2004 13:40	1.394	DF+RS	DRY-BULK	1.82	20.46	7.57	23.40	1.32	1.66	3.92	
17	12/10/2004 13:40	12/24/2004 9:00	0.799	DF	DRY-BULK	3.31	29.82	17.74	49.72	0.14	0.84	1.42	
18	12/24/2004 9:00	1/6/2005 11:20	0.825	DF+S	DRY-BULK	2.59	18.62	18.25	34.11	0.41	0.87	1.79	
19	1/6/2005 11:20	1/13/2005 14:30	2.034	DF+S	DRY-BULK								
20	1/13/2005 14:30	1/24/2005 16:20	1.959	DF+S	DRY-BULK								
21	1/24/2005 16:20	2/4/2005 16:55	1.257	DF+RS	DRY-BULK	5.18	66.03	15.30	35.76	0.25	2.68	3.23	
22	2/4/2005 16:55	2/24/2005 14:50	1.682	DF+RS	DRY-BULK	6.62	93.51	64.54	99.13	0.69	3.69	6.30	
23	2/24/2005 14:50	3/9/2005 11:20	1.009	DF+S	DRY-BULK	2.70	29.50	32.89	60.91	0.53	1.12	1.71	
24	3/9/2005 11:20	3/16/2005 10:45	0.843	DF	DRY-BULK	0.87	17.18	14.84	37.34	0.85	1.52	2.94	

Tab.6b	Buoy TB-4	Dry-Bulk						(Load)					
Samp.	Start	Collection	Vol.	Precip.	Collector	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	(g/ha)	Notes
25	3/16/2005 10:45	3/24/2005 10:40	3.098	DF+RS	DRY-BULK	6.40	30.45	22.56	43.84	0.56	2.70	3.28	
26	3/24/2005 10:40	3/31/2005 10:05	1.491	DF+RS	DRY-BULK	3.90	12.87	9.60	22.09	0.07	1.56	1.76	
27	3/31/2005 10:05	4/14/2005 13:55	1.0005	DF+RS	DRY-BULK	0.84	30.78	32.79	51.41	0.46	0.75	2.62	66
28	4/14/2005 13:55	4/22/2005 15:20	0.935	DF+RS	DRY-BULK	2.44	19.82	13.67	17.27	0.49	1.04	1.72	
29	4/22/2005 15:20	5/25/2005 16:44	0.511	DF+RSG	DRY-BULK	3.19	70.63	95.51		8.30	9.41	12.96	67
30	5/25/2005 16:44	6/8/2005 9:00	0.5	DF+RS	DRY-BULK	3.28				1.05			68
31	6/8/2005 9:00	6/20/2005 11:52	0.411	DF+RS	DRY-BULK	3.40				1.79			69
32	6/20/2005 11:52	6/29/2005 10:30	0.587	DF	DRY-BULK	2.91				0.37			

Table 6c. N, P, and H loading per day in dry-bulk deposition (buoy bucket collector) at the Northwest Buoy (TB-4) Station 7/1/04-6/30/05

Tab.6c	Buoy TB-4	Dry-Bulk						Loading	Rate				
Samp.	Start	Collection	Vol.	Precip.	Collector	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	Notes
1	6/24/2004 12:28	7/2/2004 13:53	0.81	DF	DRY-BULK	0.50	3.65	3.31	4.87	0.14	0.15	0.46	
2	7/2/2004 13:53	7/17/2004 10:50	0	DF	DRY-BULK		2.46	3.86	5.20	0.04	0.09	0.29	6
3	7/17/2004 10:50	7/27/2004 9:10	0.017	DF	DRY-BULK		3.96	8.63	10.99	0.02	0.10	0.26	12
4	7/27/2004 9:10	8/9/2004 9:22	0	DF	DRY-BULK		1.98	1.02	2.95	0.37	0.46	0.80	6
5	8/9/2004 9:22	8/16/2004 10:40	1.317	DF	DRY-BULK	1.09	5.53	5.06	9.94	0.01	0.19	0.35	
6	8/16/2004 10:40	8/31/2004 8:22	0	DF	DRY-BULK		2.99	2.65	4.58	0.02	0.10	0.23	8
7	8/31/2004 8:22	9/9/2004 12:05	0	DF	DRY-BULK		3.58	2.38	6.66	0.05	0.08	0.23	6
8	9/9/2004 12:05	9/17/2004 8:36	0	DF	DRY-BULK		4.19	4.49	7.16	0.05	0.17	0.24	8
9	9/17/2004 8:36	9/24/2004 9:20	0.836	DF+RS	DRY-BULK	0.71	4.06	3.95	8.23	0.09	0.20	0.50	
10	9/24/2004 9:20	10/5/2004 11:57	0.935	DF	DRY-BULK	0.53	2.94	2.34	5.16	0.08	0.15	0.42	
11	10/5/2004 11:57	10/14/2004 9:55	0.375	DF	DRY-BULK	0.37	4.07	3.75	6.60	0.05	0.11	0.37	
12	10/14/2004 9:55	10/22/2004 10:40	2.73	DF+RS	DRY-BULK	0.42	3.38	13.03	16.91	0.09	0.40	0.78	
13	10/22/2004 10:40	10/29/2004 11:15	1.93	DF+RS	DRY-BULK	0.64	3.76	1.64	3.00	0.07	0.18	0.31	
14	10/29/2004 11:15	11/15/2004 16:10	0.349	DF+RS	DRY-BULK	0.25	5.29	2.89	3.97	0.03	0.04	0.11	
15	11/15/2004 16:10	11/29/2004 16:08	1.333	DF+S	DRY-BULK	0.25	3.07	1.37	3.23	0.03	0.10	0.21	
16	11/29/2004 16:08	12/10/2004 13:40	1.394	DF+RS	DRY-BULK	0.17	1.88	0.69	2.15	0.12	0.15	0.36	
17	12/10/2004 13:40	12/24/2004 9:00	0.799	DF	DRY-BULK	0.24	2.16	1.29	3.60	0.01	0.06	0.10	
18	12/24/2004 9:00	1/6/2005 11:20	0.825	DF+S	DRY-BULK	0.20	1.42	1.39	2.60	0.03	0.07	0.14	
19	1/6/2005 11:20	1/13/2005 14:30	2.034	DF+S	DRY-BULK	0.45							
20	1/13/2005 14:30	1/24/2005 16:20	1.959	DF+S	DRY-BULK	0.44							
21	1/24/2005 16:20	2/4/2005 16:55	1.257	DF+RS	DRY-BULK	0.47	5.99	1.39	3.24	0.02	0.24	0.29	
22	2/4/2005 16:55	2/24/2005 14:50	1.682	DF+RS	DRY-BULK	0.33	4.70	3.24	4.98	0.03	0.19	0.32	
23	2/24/2005 14:50	3/9/2005 11:20	1.009	DF+S	DRY-BULK	0.21	2.29	2.56	4.74	0.04	0.09	0.13	

Tab.6c	Buoy TB-4	Dry-Bulk						Loading	Rate				
Samp.	Start	Collection	Vol.	Precip.	Collector	H	NO3-N	NH4-N	TKN	SRP	DP	TP	
No.	Date-Time	Date-Time	Liters	Form	Type	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	(g/ha/d)	Notes
24	3/9/2005 11:20	3/16/2005 10:45	0.843	DF	DRY-BULK	0.13	2.46	2.13	5.35	0.12	0.22	0.42	
25	3/16/2005 10:45	3/24/2005 10:40	3.098	DF+RS	DRY-BULK	0.80	3.81	2.82	5.48	0.07	0.34	0.41	
26	3/24/2005 10:40	3/31/2005 10:05	1.491	DF+RS	DRY-BULK	0.56	1.85	1.38	3.17	0.01	0.22	0.25	
27	3/31/2005 10:05	4/14/2005 13:55	1.0005	DF+RS	DRY-BULK	0.06	2.17	2.32	3.63	0.03	0.05	0.19	66
28	4/14/2005 13:55	4/22/2005 15:20	0.935	DF+RS	DRY-BULK	0.30	2.46	1.70	2.14	0.06	0.13	0.21	
29	4/22/2005 15:20	5/25/2005 16:44	0.511	DF+RSG	DRY-BULK	0.10	2.14	2.89		0.25	0.28	0.39	67
30	5/25/2005 16:44	6/8/2005 9:00	0.5	DF+RS	DRY-BULK	0.24				0.08			68
31	6/8/2005 9:00	6/20/2005 11:52	0.411	DF+RS	DRY-BULK	0.28				0.15			69
32	6/20/2005 11:52	6/29/2005 10:30	0.587	DF	DRY-BULK	0.33				0.04			

Table Legend and Notes:

Table Legend:

Precipitation Form: (S=snow; R=rain; DF= dry fall (Dry deposition); H=hail; G=grauple; NA=information on type not available; T=trace of precip.)

Collector Type: (ST= 8 in. dia. Snow tube; TBG= 8 in. dia. Electrically heated tipping bucket rain and snow gauge; Wet= Aerochem Metrics Wet Bucket; Dry= Dry-Bulk bucket with 4 liter deionized water added, placed in dry-side of Aerochem Metrics sampler; Dry-Bulk= Aerochem Metrics bucket with reduced side height, filled with 4 liters of deionized H2O)

pH: (NES= not enough sample); C= sample contaminated; NA= not measured

Nutrient Concentrations: (C= sample contamination; NA= Not available or not enough sample for analysis; note units are micrograms/liter).

Nutrient Loading: (C= sample contamination; NA= Not available or not enough sample for analysis; note units are grams/ hectare, data reported to 2 decimal points).

Nutrient Loading rate: (C= sample contamination; NA= Not available or not enough sample for analysis; note units are grams/ hectare/day, data reported to 2 decimal points)

Table Notes:

(1) ST had much pollen, bugs, algae, added 500ml deionized H2O to process; (2) ST dry, added 500ml deionized H2O to process; (3) added 462ml of deionized water to 38 ml sample to process; (5) added 481ml deionized water to 19ml sample to process; (6) bucket dry, added 500ml deionized water to process; (7) added 332 ml deionized water to 168 ml sample to process; (8) bucket dry, added 1000 ml deionized water to process; (9) added 400ml deionized water to 100ml sample to process; (10) added 850ml deionized water to 150ml sample to process (11) added 370ml deionized water to 140ml of sample to process; (12) added 485ml deionized water to 17ml of sample to process; (13) ST bridged with snow, TBG bottles overflowed, used datalogger amount recorded of 6.70 inches as estimate of total for this storm; (16) wet bucket had snow 2 inches above bucket rim, Aerochem Metrics lid frozen over dry-side collector, sample caught some dry deposition; (17) snow 3 inches above bucket rim, Aerochem lid stuck over dry bucket; (18) much of precipitation caught in dry bucket this period, loading is for 0.46 inches of wet precipitation caught only, remainder included with dry-bulk; (23) Dry bucket caught 5 aspen leaves, added 2 liters of deionized water during period; (24) Aerochem Metrics lid frozen over dry-side, missed some of dry deposition this period; (25) Dry bucket caught much of precipitation this storm; (28) small leak in ST; (29) 19 ml of precipitation, added 481ml deionized water for processing; (30) 5 feet of new snow when sampled, had compacted, ST and TBG bottles full, missed some of storm, logger recorded 8.40 inches, but likely under-represents snowfall, collected snow core to depth of old snow pack for chemistry, water content was 12.12 inches, appears to over-represent snowfall, SNOTEL precipitation estimate during period at Ward #3 was 10.4 inches, used this as estimate for this storm; (31) approximately 4 feet of new snow when sampled, had compacted, ST and TBG bottles full, missed some of storm, logger recorded 7.86 inches, but likely under-represents snowfall, collected snow core to snowboard placed out prior to storm, water content was 9.90 inches, use this for amount, SNOTEL precipitation amount was 9.8 inches for this period at Ward #3, used TBG water for chemistry; (32) used TBG amount of 0.70 inches; (33) 4ml of precipitation, added 496ml of deionized water to bring to 500ml for processing; (34) TBG overflowed and ST may have as well, missed some of storm, logger recorded 7.69 inches, appears to have over-recorded, used 6.4 inches precipitation, based on SNOTEL amount of 6.1 inches for 3/22-3/30 and accounting for precipitation on 3/21 after last collection at 1800; (35) approximately 4 ½ feet of snow this period, covered wet/dry sampler, collected snow in bucket + snow over bucket for chemistry, but only about ½ the snow which fell was collected, used the snow collected as representative of snow chemistry and logger amount 6.53 inches as actual precipitation, some snow fell in the dry bucket, appears to be a small amount; (36) approximately 2 feet of snow this period, over-topped sampler, collected bucket and snow over bucket, and ran chemistry for both, used TBG total of 3.76-0.47=3.29 inches for period, took avg. conc. for buckets applied to 3.29 inches for load; (37) the dry bucket caught a significant portion of this storm estimate 0.72 inches fell in dry bucket; (38) the dry bucket caught precipitation this period, estimated 0.42 inches; (39) wet bucket caught some dry deposition this period, wire to station crept down with snow back pulling plug out of socket and cutting power; (40) Aerochem Metrics malfunction, dry bucket caught portion of precipitation this period, wet caught 1.04 inches and dry caught 1.77 inches; (41) 5ml of sample, added 498 ml deionized water to process; (42) ST had pin-hole leak, 9ml of sample, added 491ml of deionized water to process; (43) trace of precipitation, added 500ml of deionized water to process; (44) sample probably leaked, 27 ml of precipitation, added 478 ml to process; (45) Important note for Lower Ward Wet loading data: the loading precipitation amount is only that precipitation amount caught in the wet bucket, this differs from the total precipitation (which is shown with the concentration data in the upper portion of the table); (46) ST caught 16 ml precip added 484ml of deionized water to process; (48) ST caught 57ml of precip added 443ml deionized water to process; (49) ST dry, added 500ml deionized water to process; (50) dry bucket caught a portion of precipitation this period; (51) dry bucket caught much of storm this period; (52) dry bucket caught much of precipitation this period, bucket nearly full, spilled portion when removed due to bucket being nearly full; (53) no heater this period, bucket froze during portion of collection period, some sample spilled in transport due to ice in bucket, use data with caution; (54) bucket placed out dry this period to

check function of Aerochem Metrics sampler, 33ml of precipitation caught in dry, added 477ml of deionized water to process; (55) added 1 additional liter of deionized water to dry bucket during period; (56) changed Aerochem Metrics sensor and motor to improve function on 5/3/05; (57) dead ladybug in sample; (58) sample filter very dirty; (59) small piece black debris and 1 small bug in sample; (60) small black flake and debris in sample; (61) metal flake in sample; (62) added 1 liter deionized water to process part of dead fly in sample; (63) bucket dry, added 500ml deionized water to process, many small black bugs and small piece of green organic mater in sample; (64) bucket had 57ml of water in it, added 443ml deionized water to process; (65) strong winds during period, some pollen in sample; (66) bucket dry, added 1 liter deionized water to process; (67) 4-5 small black bugs, a couple of larger bugs in sample; (68) 80 ml of sample + 420ml of deionized water; (69) windy during period, sample filter dirty, pollen and silt?;

During July 1, 2004-June 30, 2005, 164 samples were collected from the 3 primary stations (38 dry bucket and 35 wet bucket samples from the Ward Lake Level station, 32 dry-bulk samples from each of the lake buoy stations and 27 Mid-lake snow tube samples). 35 additional samples were collected from the Upper Ward Valley station. Samples were analyzed for ammonium (NH4-N), nitrate (NO3-N), total Kjeldahl nitrogen (TKN), soluble reactive phosphorus (SRP) and total phosphorus (TP). In addition all samples were analyzed for total dissolved phosphorus (DP) and pH was analyzed in wet precipitation and lake buoy Dry-bulk samples.

The year ending June 30, 2005 was characterized by significant precipitation, heavy mid-winter snow storms, and significant late-season precipitation. A total of 78.32 inches of precipitation fell at the Upper Ward Station and 48.73 inches at the Lower Ward station during July 1 2004- June 30, 2005. Figure 1 gives an indication of the distribution of precipitation during the study period (it shows the precipitation amounts measured at the Lower Ward Lake Level Station during wet bucket sample collection periods). Significant precipitation occurred throughout the period from October 2004 through June 2005. The long duration of the precipitation this year is in contrast to a more "average" year when monthly precipitation often tapers off in April and May.

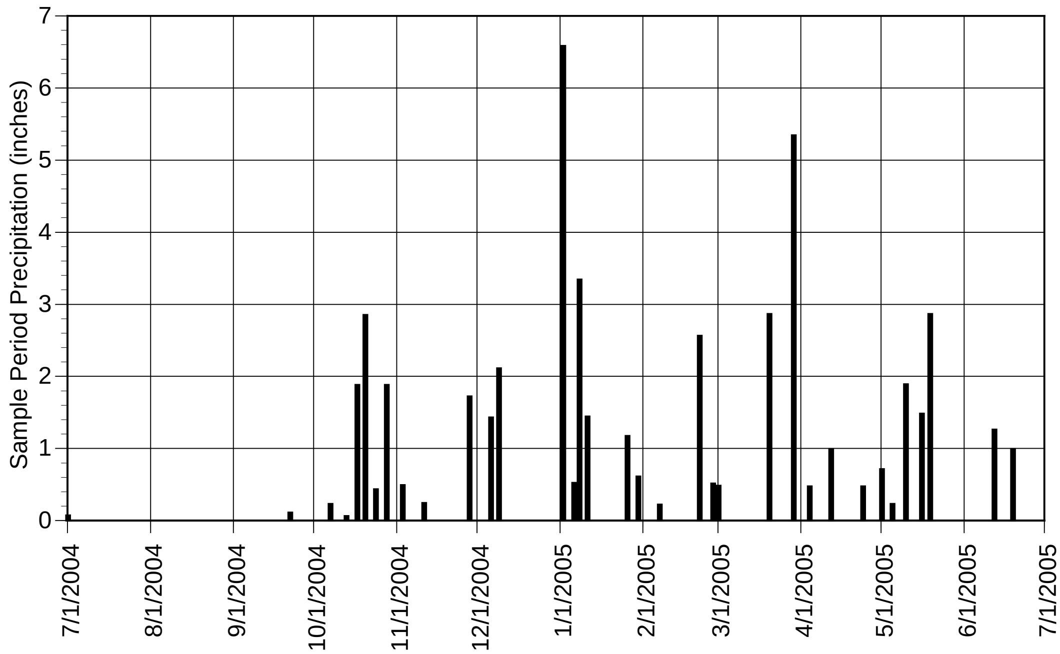


Figure 1. Chart showing precipitation amounts occurring at the Ward Valley Lake Level station during sample collection periods 7/1/04-6/30/05. Each vertical bar corresponds to the total amount of precipitation which occurred during a particular collection period, in some cases two or more wet buckets were combined in a collection period, (the date under each bar is the final collection date of the sample(s)).

The year was characterized by several important precipitation periods. First, a series of fall storms (10/17-11/4/04) dropped significant amounts of snow with some periods of rain at the Upper Ward Valley station, with significant amounts of rain and snow in lower Ward Valley. These storms helped establish an early season snowpack (particularly in the upper watershed). During 12/27/04-1/3/05 and 1/6-1/11/05 periods of very heavy snow occurred in the Tahoe basin leaving about 6-7 feet of snow at lower Ward with 9 feet of new snow at Upper Ward. These storms built up the snowpack significantly. During the last 13 days of March 2005 over 8 inches of precipitation fell at the lower Ward station (snow with some rain) with over 10 inches at the Upper Ward site (primarily as snow). These storms augmented the late season snowpack and combined with a cool April to help delay the spring snowmelt. Finally, significant precipitation occurred in May, with very significant rain events 5/15-5/16 and 5/17-5/19. Mild temperatures, strong winds and moderate rain associated with the 5/17-5/19 event combined with the melting snowpack to produce very high flows in streams along the west shore.

One of the main objectives of the atmospheric deposition monitoring is to provide data on loads of N and P contributed from atmospheric deposition. In this annual summary, we looked at annual loading rates (grams N or P deposited/ hectare/ day) for 4 sites during July 2004-June 2005. Table 7 presents preliminary estimates of loading rates for: bulk precipitation at the Upper Ward site, wet and dry precipitation at the lower Ward site and dry-bulk precipitation for the two buoy stations. Data from Water Year 2003 are also shown for comparison. Generally small differences in nitrogen and phosphorus loading rates by station were observed between the two annual periods although precipitation was significantly greater for the year ending June 30, 2005 (2004/05). Some significant differences among years were apparent however: i.e. TN was higher at all stations in WY2003 compared with 2004/05 and DIN loading was higher in dry-bulk samples from lake buoys in WY2003 compared with 2004/05. As data for the rest of WY2005 is completed, we will soon be able to compare trends for loading over a period of several Water Years.

We also looked at the Dry-bulk loading rate values for all samples collected from the mid-lake and TB-4 buoys during the year to see whether any trends were apparent in the data. Figures 2 to 6 present the DIN (NO3-N + NH4-N), TN, SRP, particulate P and TP loading rates respectively, observed over the course of the year at the two lake buoy stations. (Note, not all the data for June 2005 was available at the time of this report). Patterns of DIN loading were very similar at Mid-lake and TB-4 (Figure 2). DIN loading rates appeared slightly higher during July-November than from December through May. There also appeared to be a mid-winter "dip" in DIN loading rates in December and January. Patterns for TN loading (Figure 3) were also roughly similar at the two stations with greater variation and slightly higher values observed in the July-November period than from December through May. The pattern for SRP loading rates (Figure 4) was different. Values of SRP loading were relatively low from July 2004 until April 2005 at Mid-lake then appeared to increase slightly. At TB-4 the loading rates were more consistent throughout the year and only a couple of the samples had elevated SRP loading after April.

One trend that was very interesting was that observed for Particulate P (Figure 5). Particulate P was determined by subtracting the DP loading rate from the TP loading rate and represents the loading rate for the particulate P fraction removed by filtration onto a GF/F glass fiber filter (effective pore size about 0.7 µm). The particulate P rate was elevated above typical values for 5 sampling dates at Mid-lake and 6 sampling dates at TB-4 during the summer/early fall period, July-October 2004. Particulate phosphorus deposition appeared to be elevated during much of this period. It is possible that deposition of particles in general were increased during this period. Interestingly, the TP loading rate data only hinted at such a trend as TP values tended to show more consistent levels through much of the year with a few elevated values during the period July through Oct.

Table 7. Preliminary estimates of loading rates (grams/ hectare/ day) of N and P at the Upper and Lower Ward Valley and lake buoy stations TB-1 and TB-4 7/1/04-6/30/05. Annual data collected for Water Year 2003 (10/1/02-9/30/03) are also shown for comparison. For dry loading rate, total grams/hectare for analyzed samples were divided by the total number of sampling days represented by analyzed samples. To determine a daily loading rate for Wet or Wet/Bulk precipitation samples, the annual total load for a nutrient was first extrapolated by dividing the load total for samples analyzed (some samples did not have data for all analyses) by the proportion of total precipitation analyzed (amount of precipitation analyzed for a nutrient/ total annual precipitation). This number was divided by 365 days to give the estimate of daily loading rate.

	Precip.	**NO3-N**	**NH4-N**	**TKN**	**SRP**	**DP**	**TP**
	(in)	**g/ha/d**	**g/ha/d**	**g/ha/d**	**g/ha/d**	**g/ha/d**	**g/ha/d**
(7/1/04-6/30/05) Loading							
Upper Ward ST (Wet/Bulk)	78.32	2.92	4.13	9.06	0.13	0.42	0.83
Lower Ward (Wet)	48.73	1.70	1.85	3.32	0.09	0.19	0.28
Lower Ward (Dry)		0.73	0.90	10.20	0.19	0.51	0.94
Lower Ward (Wet+Dry)		2.43	2.75	13.52	0.28	0.70	1.22
TB-4 (Dry-Bulk)		3.16	2.94	5.07	0.08	0.17	0.31
Mid-lake TB-1 (Dry-Bulk)	7.92+	3.22	3.11	5.82	0.11	0.17	0.33
WY2003 (10/1/02-9/30/03) Loading							
Upper Ward ST (Wet/Bulk)	68.49	3.87	3.05	10.47	0.15	0.24	0.32
Lower Ward (Wet)	40.92	1.67	1.31	4.11	0.09	0.13	0.24
Lower Ward (Dry)		1.04	0.75	13.05	0.23	0.55	1.26
Lower Ward (Wet+Dry)		2.71	2.06	17.16	0.32	0.68	1.5
TR-3/TB-4 (Dry-Bulk)		3.89	3.42	7.67	0.05	0.09	0.33
Mid-lake (Dry-Bulk)	6.9-7.9**	3.98	3.27	8.02	0.06	0.12	0.27

+ Note- precipitation was underestimated at mid-lake due to snow tube problems on several dates.
** - Estimated from snow tube amounts and simple rain gage on buoy.

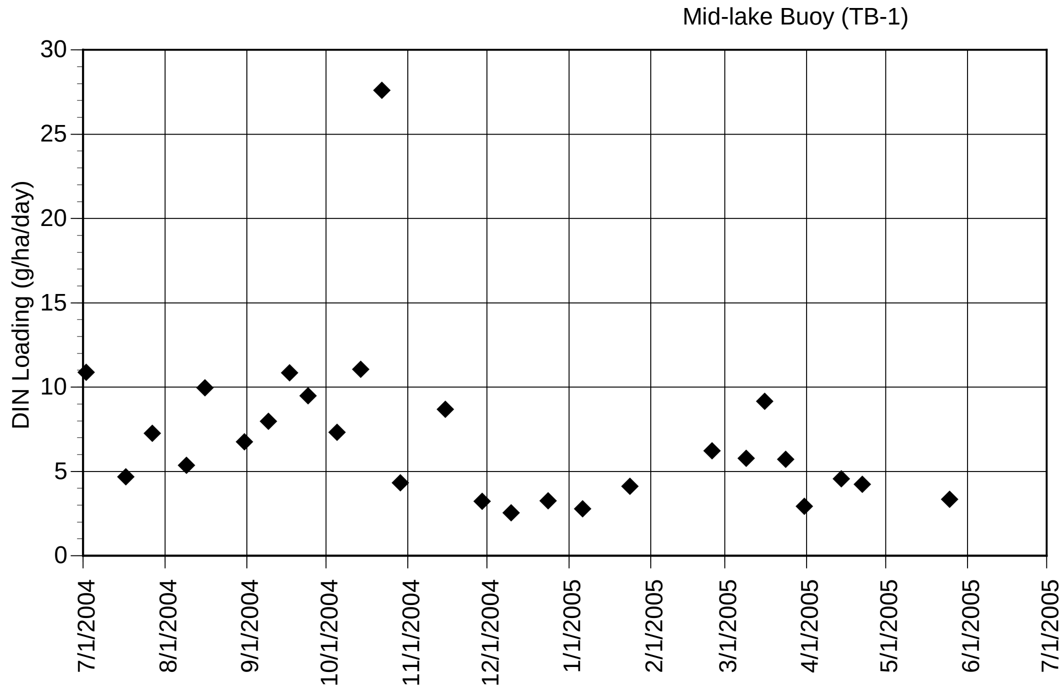


Figure 2a. Total dissolved inorganic nitrogen (DIN) loading (g/ha/day) in Dry-Bulk samples collected at the Mid-lake buoy station (TB-1) 7/1/04-6/30/05.

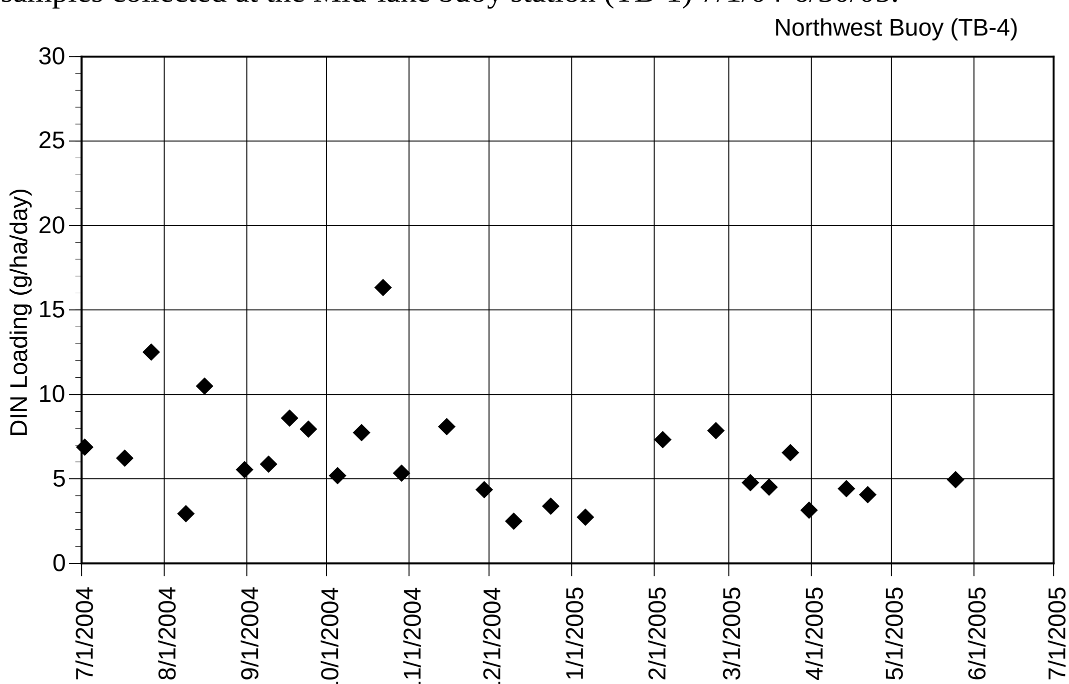


Figure 2b. Total dissolved inorganic nitrogen (DIN) loading (g/ha/day) in Dry-Bulk samples collected at the TB-4 buoy 7/1/04-6/30/05.

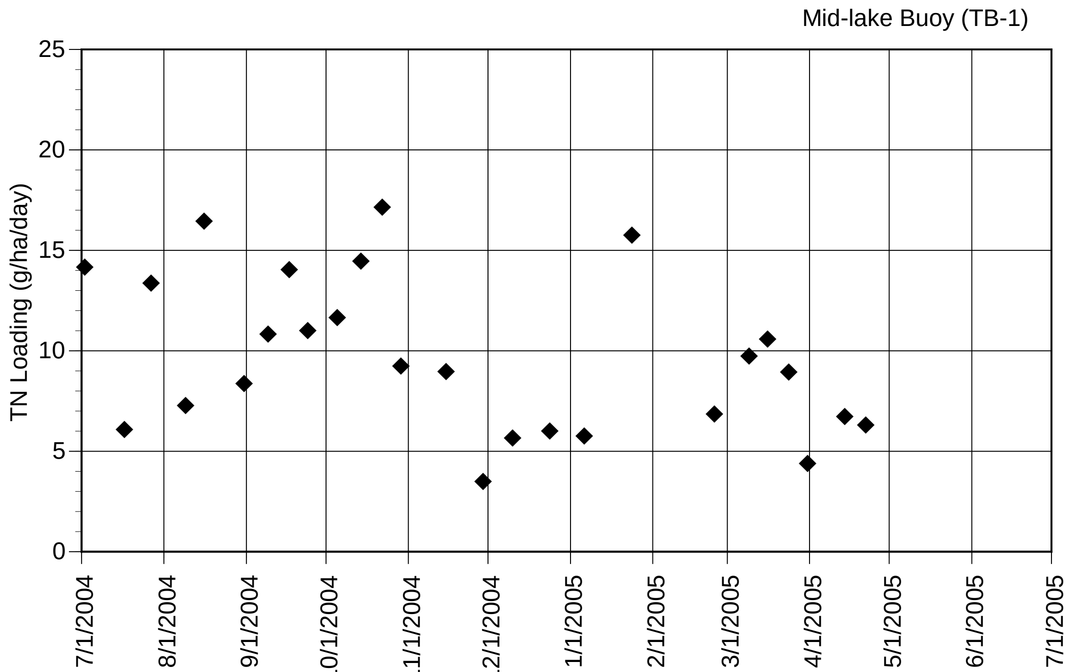


Figure 3a. Total nitrogen (TN) loading (g/ha/day) in Dry-Bulk samples collected at the Mid-lake buoy station (TB-1) 7/1/04-6/30/05.

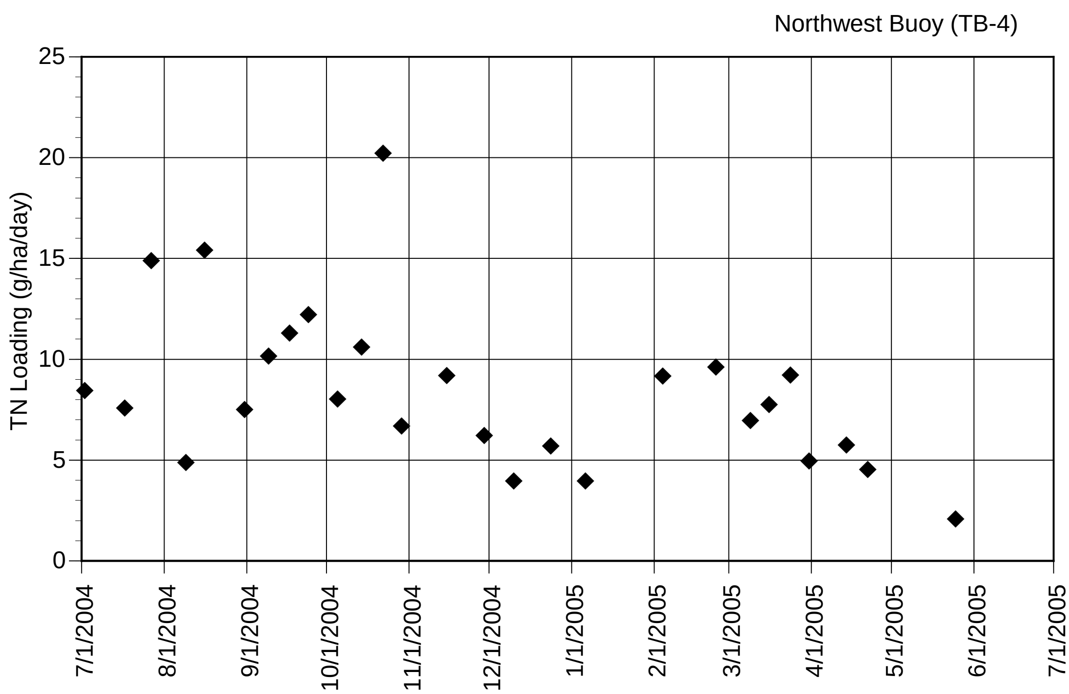


Figure 3b. Total nitrogen (TN) loading (g/ha/day) in Dry-Bulk samples collected at the TB-4 buoy 7/1/04-6/30/05.

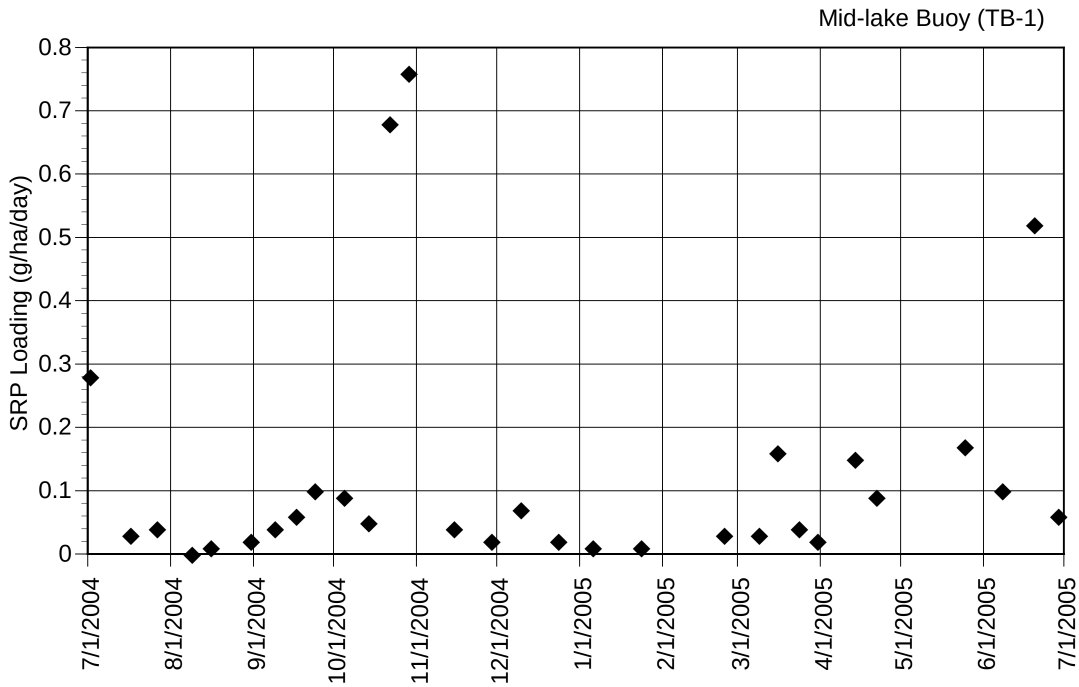


Figure 4a. Soluble reactive phosphorus (SRP) loading (g/ha/day) in Dry-Bulk samples collected at the Mid-lake buoy station (TB-1) 7/1/04-6/30/05.

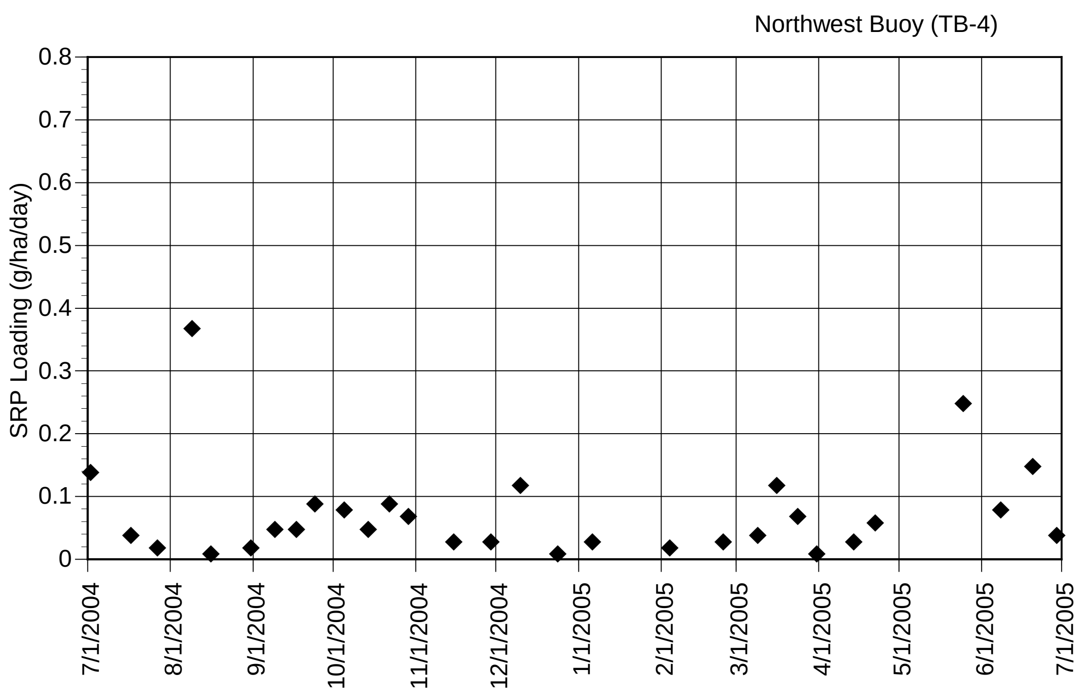


Figure 4b. Soluble reactive phosphorus (SRP) loading (g/ha/day) in Dry-Bulk samples collected at the TB-4 buoy 7/1/04-6/30/05.

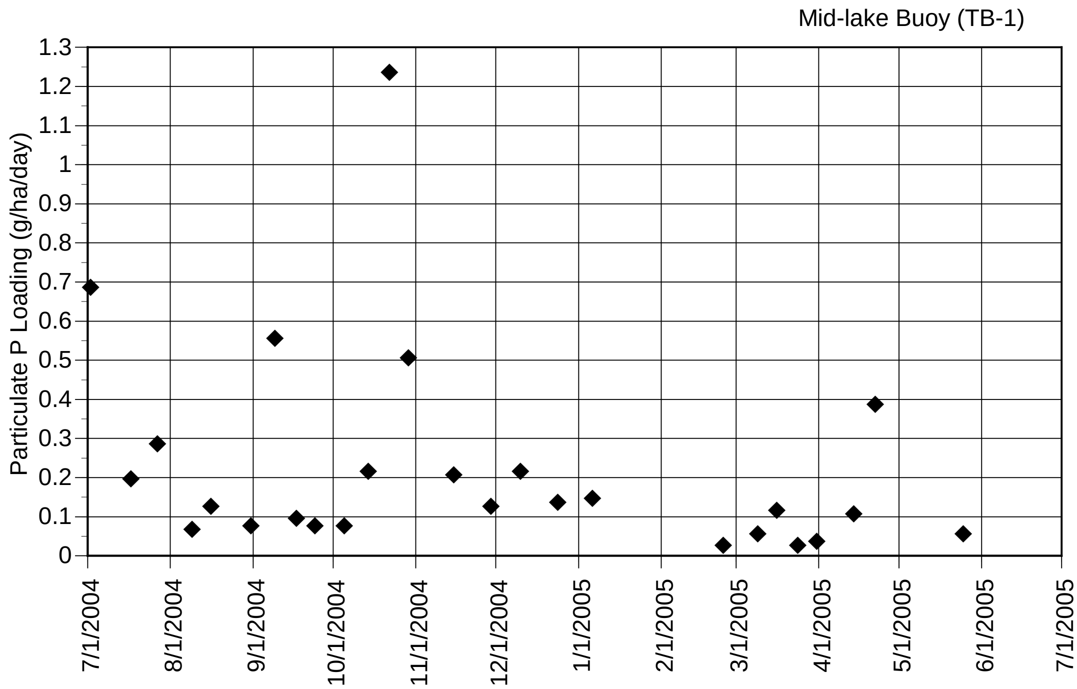


Figure 5a. Particulate phosphorus loading (TP-DP) (g/ha/day) in Dry-Bulk samples collected at the Mid-lake buoy station (TB-1) 7/1/04-6/30/05.

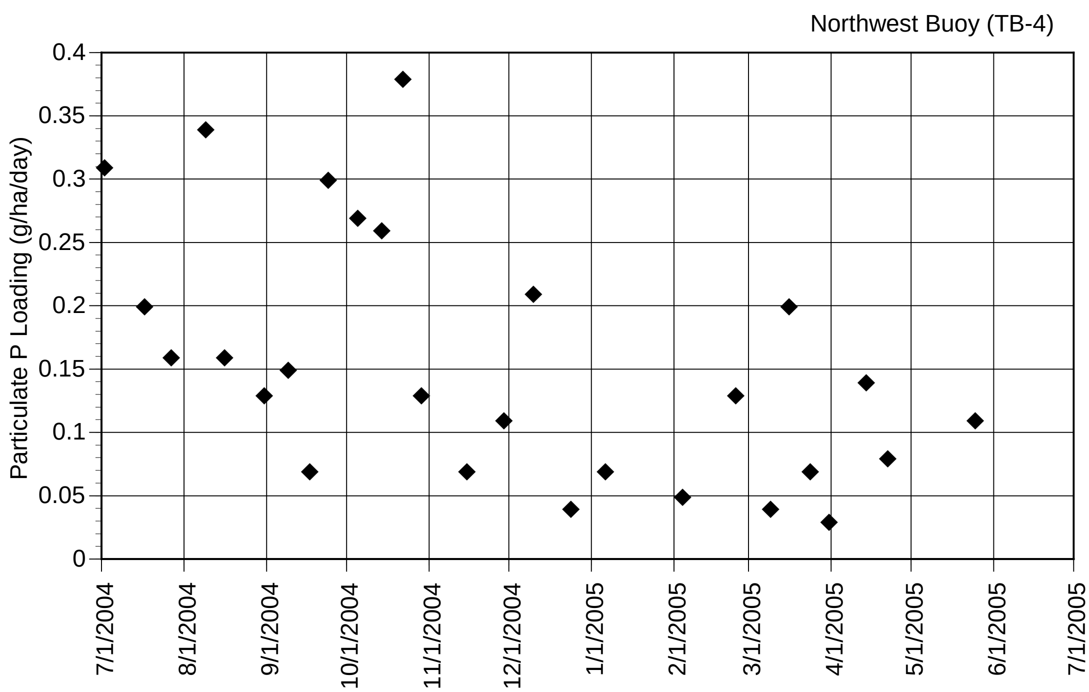


Figure 5b. Particulate phosphorus loading (TP-DP) (SRP) loading (g/ha/day) in Dry-Bulk samples collected at the TB-4 buoy 7/1/04-6/30/05.

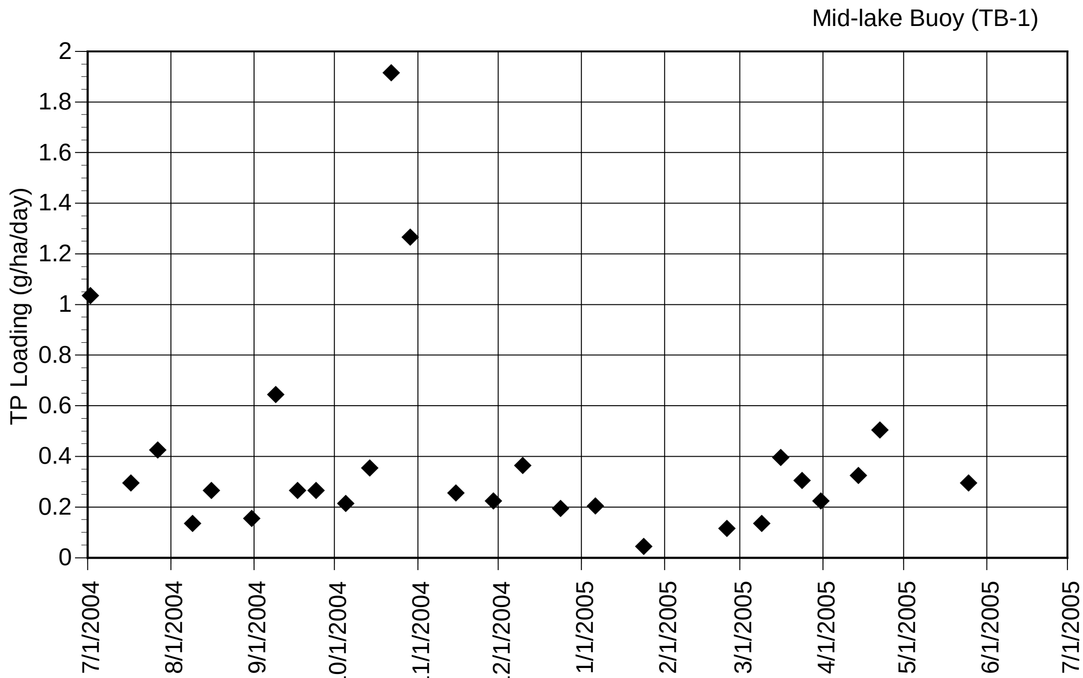


Figure 6a. Total phosphorus loading (g/ha/day) in Dry-Bulk samples collected at the Mid-lake buoy station (TB-1) 7/1/04-6/30/05.

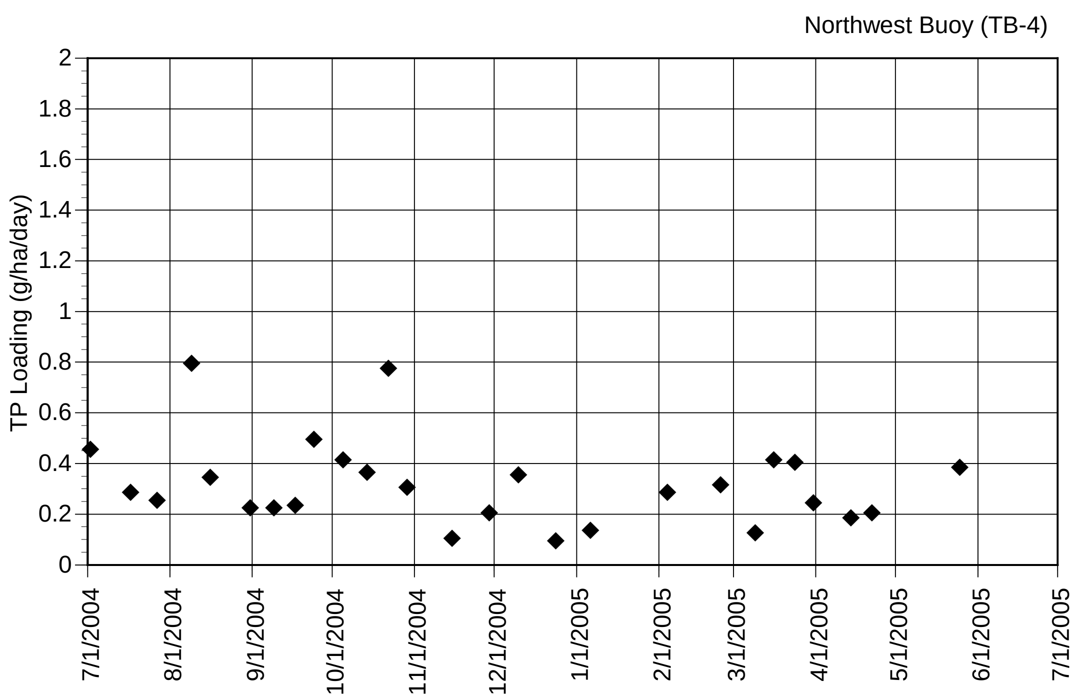


Figure 6b. Total phosphorus loading (g/ha/day) in Dry-Bulk samples collected at the TB-4 buoy 7/1/04-6/30/05.

Task 6. Periphyton

The purpose of the periphyton monitoring task is to assess the levels of nearshore attached algae (periphyton) growth around the lake. As for phytoplankton, nutrient availability plays a large role in promoting periphyton growth. The amount of periphyton growth can be an indicator of local nutrient loading and long-term environmental changes. Monitoring trends in periphyton growth can be valuable for assessing local and lake-wide nutrient loading trends, and may be used as a secondary indicator of the success of nutrient load reductions arising from environmental projects and future maximum clarity load (TMDL) implementation.

Periphyton grows in the littoral (shore) zone of Lake Tahoe, which may be divided into the eulittoral zone and the sublittoral zone, each with distinct periphyton communities. The eulittoral zone is the shallow area between the low and high lake level (0 to 2 m) and is significantly affected by wave activity. This zone represents only a very small (<1%) of the total littoral area. Substrata within this region desiccate as the lake level declines, and periphyton must recolonize this area when lake level rises. The sublittoral zone extends from the bottom of the eulittoral to the maximum depth of the photoautotrophic growth. The sublittoral zone remains constantly submerged and represents the largest littoral benthic region of Lake Tahoe.

The eulittoral zone community is typically made up of filamentous green algae i.e. *Ulothrix zonata* and filamentous diatom species i.e. *Gomphoneis herculeana*. The attached algae in the eulittoral zone display significant growth allowing for rapid colonization. These algae are able to take advantage of localized soluble nutrients, and can establish a thick coverage over the substrate within a matter of months. Similarly, as nutrient concentrations diminish and shallow nearshore water temperatures warm with the onset of summer, this community rapidly dies back. The algae can slough from the substrate and disperse into the open water, as well as be washed ashore. In areas where biomass is high the slimy coating over rocks and sloughed material accumulated along shore can be a nuisance. The eulittoral zone periphyton plays an important roll in the aesthetic, beneficial use of the shorezone. It is the rapid growth ability of the eulittoral periphyton in response to nutrient inputs that lend particular value to monitoring this community as an indicator of localized differences in nutrient loading.

The sublittoral zone is made up of differing algal communities down through the euphotic zone. Cyanophycean (blue-green) algal communities make up a significant portion of the uppermost sublittoral zone. These communities are slower growing and more stable than the filamentous and diatom species in the eulittoral zone.

<u>Stations and Methods</u>

Ten routine stations were monitored during July 2004-August 2005 (Rubicon Pt., Sugar Pine Pt., Pineland, Tahoe City, Dollar Pt., Zephyr Pt., Deadman Pt., Sand Pt., Incline Condominium, Incline West). A detailed description most of the sample collection and analysis procedures is given in Hackley et al. (2004). Note, we have also added measurements average filament length, % algal coverage, and a visual score to our field observations. The visual score is a subjective ranking (1-5) of the level of algal growth (viewed underwater) where 1 is least offensive appearing (usually natural rock surface with little or no growth) and 5 is the most offensive condition with very heavy growth.

Results

Monitoring at routine sites

In this report we will present data collected from July 2004-August 2005. Sampling delays due to difficult weather and lake conditions during the a portion of the spring resulted in only 7 full sampling circuits of routine sites being completed during the period July 2004 to June 2005. An eighth sampling circuit of routine sites was completed in August 2005 and is included with this report.

Table 1 presents the results for chlorophyll a, AFDW and field observations of visual score, avg. filament length and percent algal coverage at the ten routine periphyton sites for the period July 2004-August 2005. The results for chlorophyll a and AFDW biomass are also presented graphically in Figures 1a-1j.

Table 1. Summary of eulittoral periphyton chlorophyll a, Ash Free Dry Weight (AFDW), visual score, avg. filament length and % algal coverage for routine periphyton monitoring sites during July 2004-August 2005. Visual score is a subjective ranking of the aesthetic appearance of algal growth (viewed underwater) where 1 is the least offensive and 5 is the most offensive.

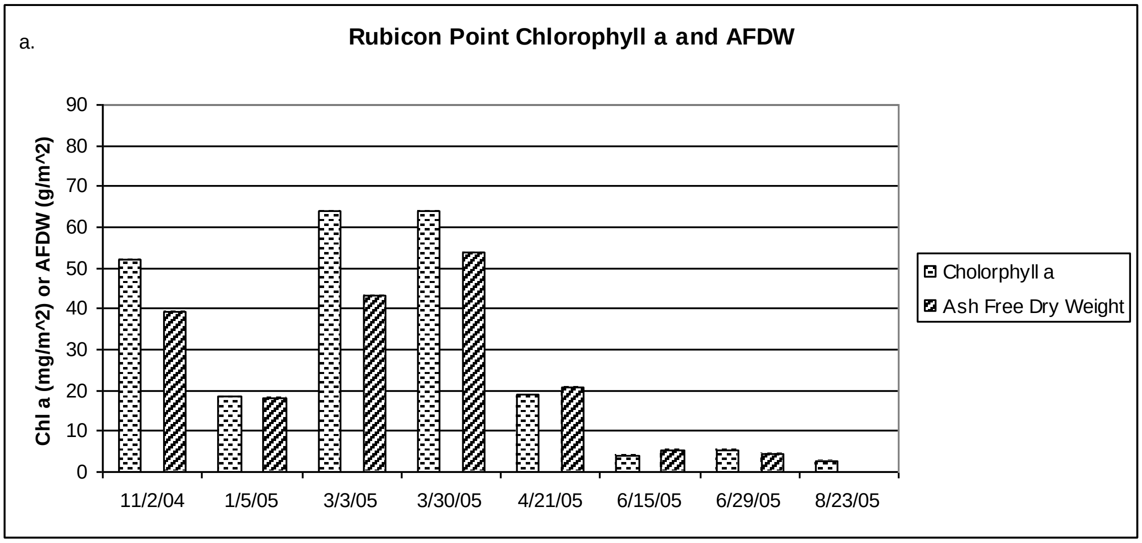
Table 1. Site	**Date**	**Depth (m)**	**Chlor. a (mg/m^2)**	**Std Dev (mg/m^2)**	**AFDW (g/m^2)**	**Std Dev (g/m^2)**	**Visual Score**	**Fil. Length (cm)**	**Algal Coverage (%)**
Rubicon Pt.	11/2/04	0.5m	52.20	13.41	39.23	6.97	na	na	na
	1/5/05	0.5m	18.49	8.32	18.22	7.55	na	na	na
	3/3/05	0.5m	64.10	1.93	43.07	3.61	na	na	na
	3/30/05	0.5m	64.18	6.39	53.89	0.19	na	na	na
	4/21/05	0.5m	19.03	0.90	20.89	1.82	3	1.5	80
	6/15/05	0.5m	3.87	1.59	5.24	1.45	2	1	50
	6/15/05	0.8m	na	na	na	na	3	1.75	70
	6/29/05	0.5m	5.40	na	4.56	1.39	2	0.7	40
	8/23/05	0.5m	2.68	na	na	na	1	0	0
Sugar Pine Pt.	11/2/04	0.5m	17.73	1.87	14.82	1.01	na	na	na
	1/5/05	0.5m	14.11	4.39	14.24	3.68	na	na	na
	3/3/05	0.5m	35.51	9.06	31.94	9.00	na	na	na
	3/30/05	0.5m	11.20	2.95	11.43	3.32	na	na	na
	4/21/05	0.5m	5.79	2.94	10.93	na	2	0.4	50
	6/15/05	0.5m	2.41	0.48	na	na	2	0.3	60
	6/15/05	0.8m	na	na	na	na	3	0.8	70
	6/29/05	0.5m	na	na	na	na	2	0.2	20
	8/23/05	0.5m	na	na	0.75	na	1	0	0

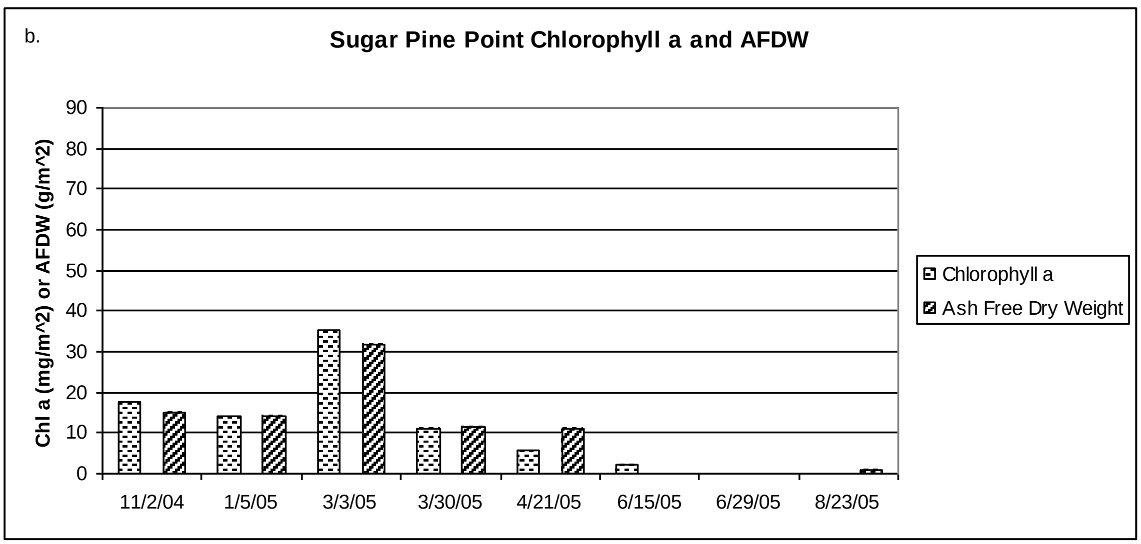
Table 1.

Site	Date	Depth (m)	Chlor. a (mg/m^2)	Std Dev (mg/m^2)	AFDW (g/m^2)	Std Dev (g/m^2)	Visual Score	Fil. Length (cm)	Algal Coverage (%)
Pineland	11/2/04	0.5m	33.54	6.18	32.39	1.82	na	na	na
	1/5/05	0.5m	26.44	9.95	19.64	5.37	na	na	na
	3/3/05	0.5m	42.09	5.53	29.04	9.92	na	na	na
	3/30/05	0.5m	79.06	1.06	59.47	7.43	na	na	na
	4/21/05	0.5m	87.46	55.19	33.80	23.69	4	2	90
	6/15/05	0.5m	9.37	1.50	14.01	0.46	3	0.8	75
	6/15/05	0.8m	24.30	3.90	39.64	1.48	4	2.8	90
	6/29/05	0.5m	1.66	0.29	3.55	1.47	3	0.3	40
	8/23/05	0.5m	3.15	na	1.52	1.61	2	0.2	50
Tahoe City	11/2/04	0.5m	8.41	5.84	11.10	9.36	na	na	na
	1/5/05	0.5m	18.95	1.56	23.07	1.63	na	na	na
	3/4/05	0.5m	33.36	2.45	34.78	0.82	na	na	na
	3/31/05	0.5m	132.25	25.04	75.17	11.65	na	na	na
	4/21/05	0.5m	48.81	5.51	38.39	9.14	4	2.1	90
	6/13/05	0.5m	17.58	4.10	29.94	4.69	3	0.7	60
	6/13/05	0.77m	na	na	na	na	na	1.35	60
	7/5/05	0.5m	8.10	0.07	13.77	0.54	3	0.6	30
	8/23/05	0.5m	na	na	0.49	0.69	2	0.2	50
Dollar Pt.	11/2/04	0.5m	39.70	4.46	25.39	5.58	na	na	na
	1/5/05	0.5m	63.40	8.86	36.29	9.40	na	na	na
	3/3/05	0.5m	101.79	24.44	47.14	8.98	na	na	na
	3/30/05	0.5m	21.96	5.29	20.80	2.68	na	na	na
	4/21/05	0.5m	23.97	15.01	19.07	10.68	4	1.3	90
	6/13/05	0.5m	5.98	2.87	na	na	2	0.7	50
	6/13/05	0.7m	na	na	na	na	3	1.35	50
	7/5/05	0.5m	11.41	3.78	13.12	4.84	2	0.8	25
	8/23/05	0.5m	8.47	1.67	6.65	na	2	0.1	70
Incline West	10/22/04	0.5m	33.46	7.11	44.19	8.88	na	na	na
	1/20/05	0.5m	51.77	25.00	55.53	23.12	na	na	na
	3/3/05	0.5m	40.67	4.10	48.03	9.14	na	na	na
	3/30/05	0.5m	38.79	17.44	46.63	23.07	na	na	na
	4/29/05	0.5m	40.12	0.88	53.43	2.45	3	0.5	70
	6/13/05	0.5m	7.41	0.66	9.64	2.08	3	0.8	80
	6/13/05	0.77m	na	na	na	na	3	1.75	80
	6/29/05	0.5m	3.64	1.16	3.82	1.31	2	0.5	70
	8/23/05	0.5m	TBA	TBA	6.85	0.29	2	0.2	40
Incline Condo	10/22/04	0.5m	10.60	0.51	10.24	1.75	na	na	na
	1/20/05	0.5m	67.94	24.95	68.96	21.80	na	na	na
	3/3/05	0.5m	27.64	4.30	33.95	7.24	na	na	na
	3/30/05	0.5m	32.53	4.80	36.69	4.82	na	na	na
	4/29/05	0.5m	22.61	0.42	31.74	2.76	3	1.2	90
	6/13/05	0.5m	6.96	1.46	7.86	0.39	3	1	80

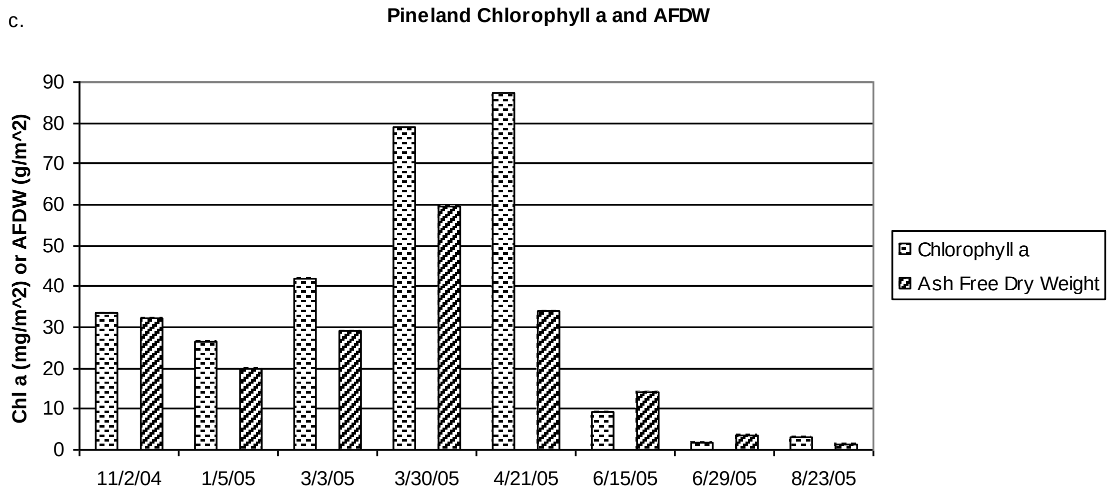
Table 1. Site	Date	Depth (m)	Chlor. a (mg/m^2)	Std Dev (mg/m^2)	AFDW (g/m^2)	Std Dev (g/m^2)	Visual Score	Fil. Length (cm)	Algal Coverage (%)
Incline Condo	6/13/05	0.77m	na	na	na	na	3	1.5	30
Cont'd.	6/29/05	0.5m	3.78	0.10	3.91	0.80	3	0.7	90
	8/23/05	0.5m	TBA	TBA	7.01	1.16	2	0.2	80
Sand Point	10/22/04	0.5m	29.91	6.16	34.11	5.52	na	na	na
	1/20/04	0.5m	55.80	3.57	67.84	2.94	na	na	na
	3/3/05	0.5m	47.89	8.63	59.84	6.04	na	na	na
	3/30/05	0.5m	30.50	8.80	43.27	7.84	na	na	na
	4/29/05	0.5m	38.97	3.94	66.47	19.52	3	0.4	80
	6/13/05	0.5m	1.82	0.89	na	na	2	0.1	25
	6/13/05	0.77m	62.81	12.21	71.27	na	4	0.8	80
	6/29/05	0.5m	7.85	4.59	4.93	0.71	2	0.3	60
	8/23/05	0.5m	6.08	1.06	4.13	1.89	2	0.1	30
Deadman Pt.	10/22/04	0.5m	47.21	12.38	59.02	3.69	na	na	na
	1/20/05	0.5m	66.92	6.49	69.50	0.47	na	na	na
	3/3/05	0.5m	47.61	5.57	57.80	3.08	na	na	na
	3/30/05	0.5m	49.33	22.52	49.67	20.72	na	na	na
	4/29/05	0.5m	46.23	10.76	65.22	13.07	3	0.5	60
	5/31/05	0.5m	na	na	na	na	1	0.1	40
	5/31/05	0.77m	85.43	39.85	102.21	1.28	3	1.7	80
	6/29/05	0.5m	2.06	2.15	na	na	1	0	0
	8/23/05	0.5m	na	na	0.57	na	1	0	0
Zephyr Pt.	10/22/04	0.5m	10.86	1.44	12.64	0.06	na	na	na
	1/20/05	0.5m	28.10	8.61	28.95	4.34	na	na	na
	3/3/05	0.5m	28.77	12.59	22.93	6.63	na	na	na
	3/30/05	0.5m	29.38	4.01	34.53	1.02	na	na	na
	4/29/05	0.5m	35.22	4.36	47.24	0.94	3	0.8	75
	5/31/05	0.5m	18.23	0.54	15.75	1.36	3	0.6	95
	5/31/05	0.7m	na	na	na	na	4	2.3	na
	6/29/05	0.5m	16.55	3.05	17.11	5.71	3	1.5	70
	8/23/05	0.5m	9.07	2.97	7.30	1.08	2	0.1	60

Figure 1. Periphyton chlorophyll a and Ash Free Dry Weight (AFDW) biomass at the ten routine monitoring sites July 2004 – August 2005.



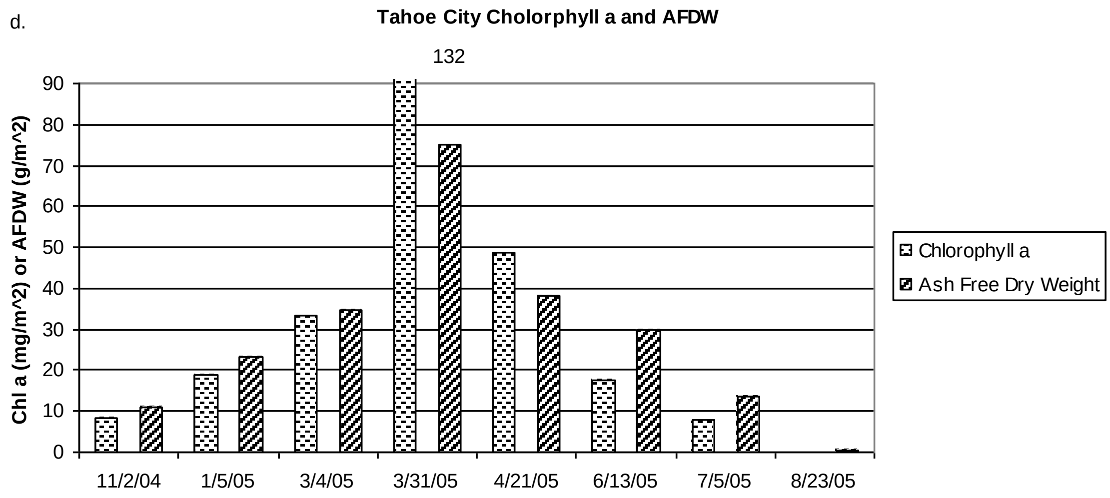


c.



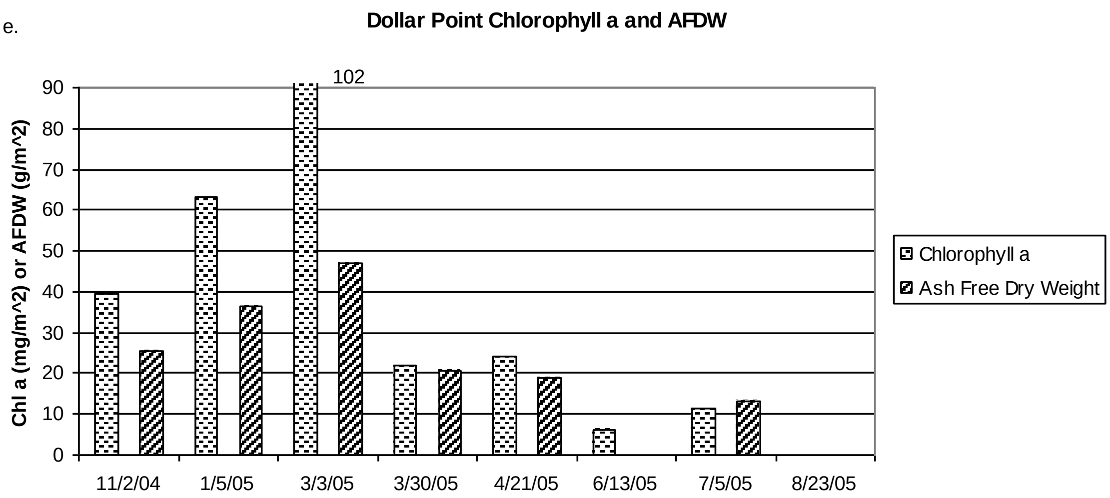
Pineland Chlorophyll a and AFDW
Chl a (mg/m^2) or AFDW (g/m^2)
0
10
20
30
40
50
60
70
80
90
11/2/04
1/5/05
3/3/05
3/30/05
4/21/05
6/15/05
6/29/05
8/23/05
Chlorophyll a
Ash Free Dry Weight

d.

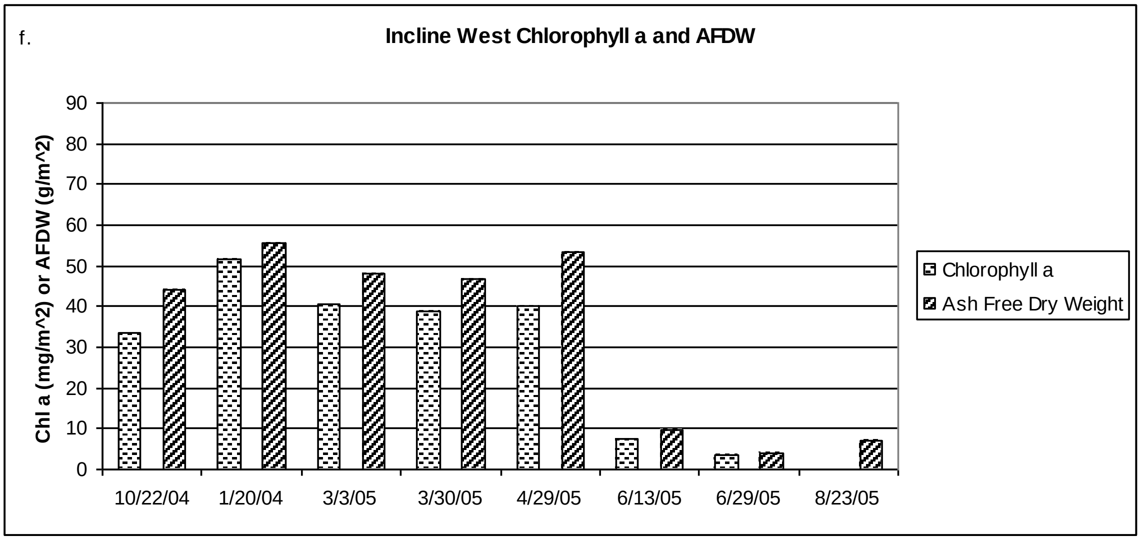


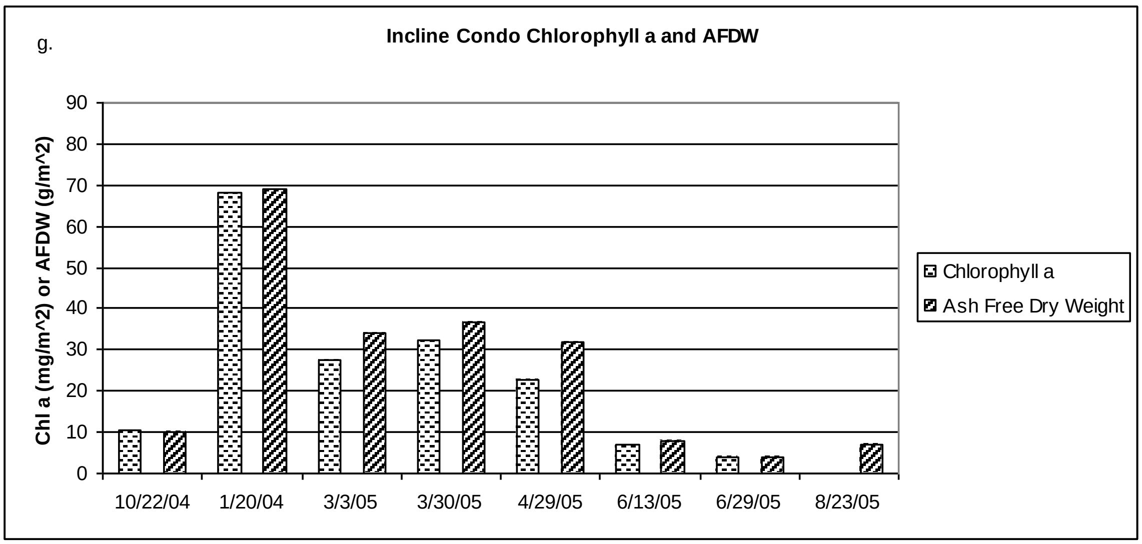
Tahoe City Cholorphyll a and AFDW
132
Chl a (mg/m^2) or AFDW (g/m^2)
0
10
20
30
40
50
60
70
80
90
11/2/04
1/5/05
3/4/05
3/31/05
4/21/05
6/13/05
7/5/05
8/23/05
Chlorophyll a
Ash Free Dry Weight

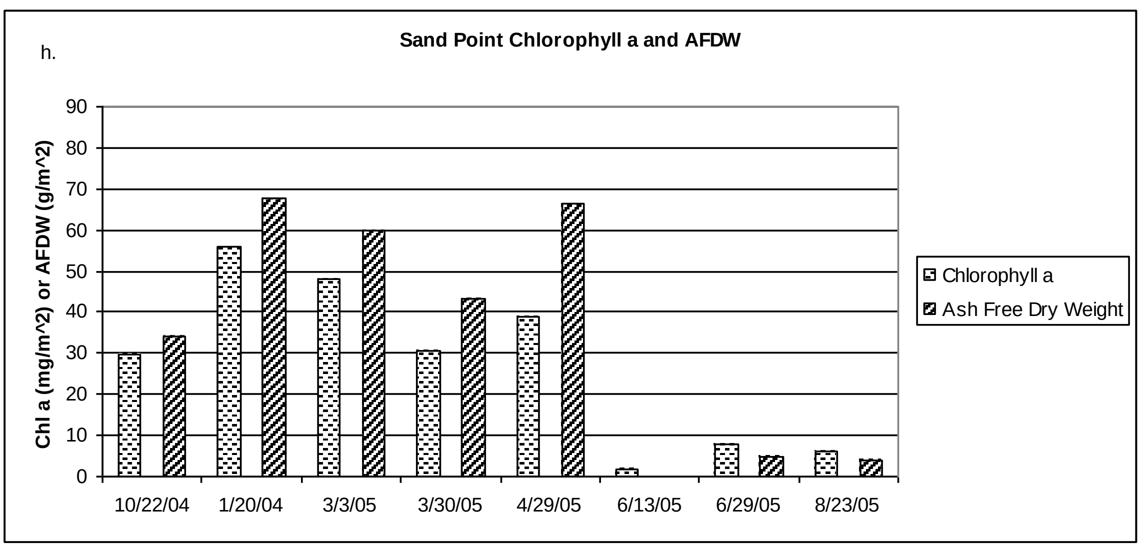
e.

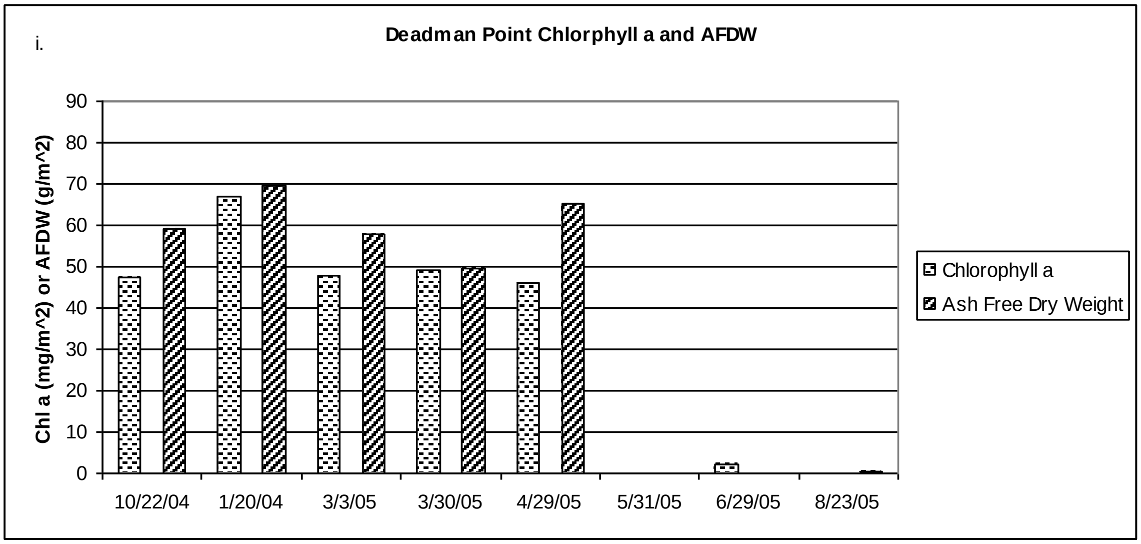


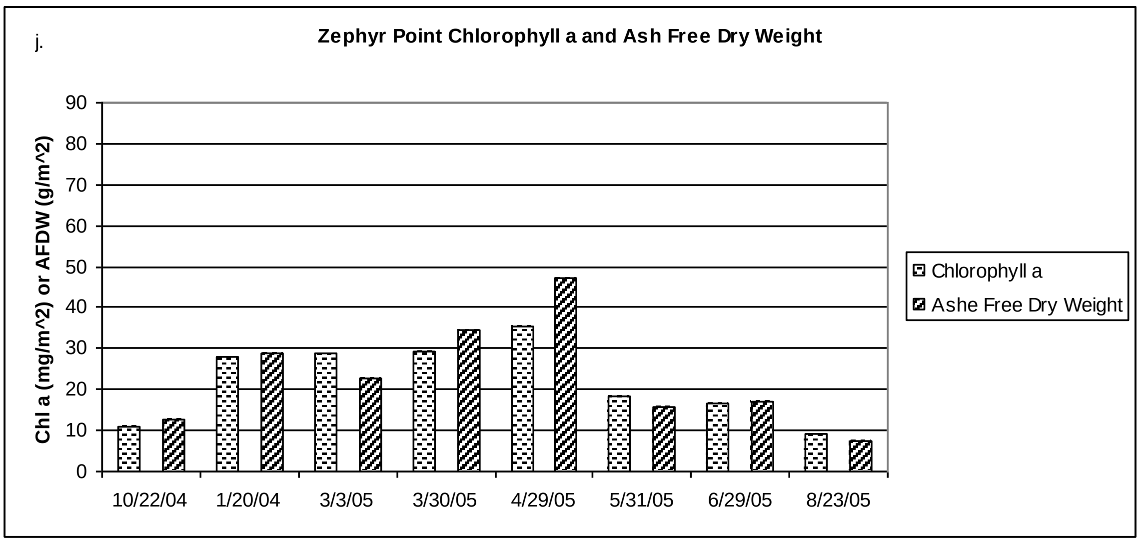
Dollar Point Chlorophyll a and AFDW
102
Chl a (mg/m^2) or AFDW (g/m^2)
0
10
20
30
40
50
60
70
80
90
11/2/04
1/5/05
3/3/05
3/30/05
4/21/05
6/13/05
7/5/05
8/23/05
Chlorophyll a
Ash Free Dry Weight


f.
Incline West Chlorophyll a and AFDW
Chl a (mg/m^2) or AFDW (g/m^2)
0
10
20
30
40
50
60
70
80
90
10/22/04
1/20/04
3/3/05
3/30/05
4/29/05
6/13/05
6/29/05
8/23/05
Chlorophyll a
Ash Free Dry Weight


g.
Incline Condo Chlorophyll a and AFDW
Chl a (mg/m^2) or AFDW (g/m^2)
0
10
20
30
40
50
60
70
80
90
10/22/04
1/20/04
3/3/05
3/30/05
4/29/05
6/13/05
6/29/05
8/23/05
Chlorophyll a
Ash Free Dry Weight


h.
Sand Point Chlorophyll a and AFDW
Chl a (mg/m^2) or AFDW (g/m^2)
0
10
20
30
40
50
60
70
80
90
10/22/04
1/20/04
3/3/05
3/30/05
4/29/05
6/13/05
6/29/05
8/23/05
Chlorophyll a
Ash Free Dry Weight





The July 1, 2004 to June 30, 2005 period was characterized by unusually low lake levels early in the year and then a significant increase in lake level in later in the year. These fluctuations in lake level played a significant role in the biomass patterns observed. In early winter the lake surface elevation was drawn down below the natural rim of Lake Tahoe. As a consequence the algae communities sampled at 0.5m were more characteristic of the sublittoral zone with a large blue-green algae component. The growth of these blue-greens was particularly luxuriant at Incline West, Sand Pt. and Deadman Pt which is reflected in the moderately high biomass levels seen at these sites through April. Rubicon Pt. also had a significant amount of blue-green algae on rock surfaces at 0.5m. The level of blue-green algal growth appeared to be less at other sites but still comprised a significant part of the algal community. A rapid increase in lake level in May caused rock substrata that had been desiccated above water earlier in the year to be submerged below the 0.5m sampling depth. The result of this was that samples collected from 0.5m from late May on, contained only low amounts of biomass associated with newly colonized algae.

The typical seasonal pattern of a peak in periphyton growth in the spring was observed at the five sites along the west shore of the lake. The growth of periphyton at 0.5m peaked in either March or April at Rubicon Pt., Sugar Pine Pt., Pineland, Tahoe City, and Dollar Pt. The peak biomass values measured were: Rubicon Pt. (Chl a and AFDW respectively) 64 mg/m^2 and 53.9 g/m^2, Sugar Pine Pt. 35.5 mg/m^2 and 31.9 g/m^2, Pineland 87.5 mg/m^2 and 59.5 g/m^2, Sugar Tahoe City 132.3 mg/m^2 and 75.2 g/m^2, Dollar Pt. 101.8 mg/m^2 and 47.1 g/m^2. Patterns of biomass for these sites were similar to those seen in past monitoring. The peak biomass was highest at the Tahoe City site, and was also high at Pineland and Dollar Pt. Lowest growth was at Sugar Pine Pt. Rubicon Pt. growth was moderately high. The spring peaks in biomass for west shore sites resulted from increased growth of green filamentous species and/or Gomphoneis over blue-green algae species.

In contrast, at Incline West, Sand Point, and Deadman Pt. a distinct peak in biomass was not apparent. Rather biomass levels remained relatively consistent and moderately high during much of the early winter and spring at these sites. Chlorophyll a and AFDW ranges respectively through April were: Incline West 33.5 to 51.8 mg/m^2 and 19.1 to 47.1 g/m^2; at Sand Pt. 29.9 to 55.8 mg/m^2 and 34.1 to 67.8 g/m^2; at Deadman Pt 47.2 to 66.9 mg/m^2 and 49.7 to 69.5 g/m^2. Zephyr Pt. showed a pattern similar to the other east shore sites except biomass levels were less: (Chl a) 10.9 to 35.2 mg/m^2 and (AFDW) 12.6 to 47.2 g/m^2. At Incline Condo, a significant peak occurred early in the year in January (Chl a) 67.9 mg/m^2 and (AFDW) 69.0 g/m^2. The relatively consistent biomass levels for these east and north shore sites is likely a consequence of the stable blue-green algal community. The absence of a significant peak in green filamentous species or diatoms over the blue-greens may be an indication that nutrient loading was less for these sites during the period than that occurring along the west shore.

There is a need to better understand patterns of blue-green algae growth as well as patterns for green filamentous and diatom growth relative to nutrient loading in such low lake level years such as just occurred. Such information is particularly important for evaluating long-term trends in growth. Periphyton monitoring data is available for previous low water years i.e. early 1990s and analysis of that data together with the 2004/05 data may help provide this needed information.

<u>Expanded Monitoring</u>

During the spring and early summer of 2005 we monitored the level of growth at 40 additional sites around the lake. These names and locations of these sites are given in Table 2. This monitoring was initially planned to coincide with the peak biomass conditions in each area of the lake and provide a more detailed picture of levels of biomass around the lake at peak growth. However, it was difficult to predict when the peak growth would occur in the different areas of the lake. Sites from Cascade Cr to TCPUD boat ramp were sampled on 4/22/05 which was near the peak for Pineland. Sites from S. Dollar Pt. to Agatam boat launch on the northwest shore were not sampled until

5/17/05 due to a series of weather delays. The data from these two dates do correspond to periods of elevated growth and do provide information that shows differences in growth. Due to difficulties associated with weather delays we were not able to continue expanded monitoring until late May 2005 along the east shore. By this time the rapidly rising lake level had created a band of previously desiccated fresh rock substrate from the surface to about 0.8m. We decided to continue expanded sampling of 0.5m depths at the east and north shore sites during June. The data do not represent maximum biomass levels, but instead represent levels of newly colonized algal growth. The data do show some site to site differences also which might be attributable to nutrient loading.

The results of the expanded monitoring are presented in Table 3. Chlorophyll a data is available for 19 sites and AFDW available for 15. We also made measures of visual score, filament length and algal % coverage at each site, along with documenting the level of growth with underwater photos.

The chlorophyll a data indicate a broad area of elevated algal biomass along the west and northwest shores from site H (South Fleur du Lac) to site P (Cedar Flat). The results of monitoring at routine sites also showed highest levels of growth within this area at the Pineland, Tahoe City, and Dollar Pt sites. The expanded monitoring appears to show that the area of heavy growth extends south of Pineland to near Blackwood Cr. and north of Dollar Pt. to near Cedar Flat. Chlorophyll a levels for sites in this region included site H 92.53 mg/m^2, site L (Tavern Pt.) 58.04 mg/m^2, site TCT (Tahoe City Tributary) 113.8 mg/m^2, Site M (TCPUD Boat Ramp) 44.95 mg/m^2, site P 69.4 mg/m^2 . Several potential nutrient sources exist in this region including: tributary inflow from Blackwood and Ward Creeks; direct runoff and urban runoff; ground water; and development present in the Sunnyside, Tahoe City and Dollar Pt. areas. These factors and a shallow shelf off of Tahoe City may all interact to create high nutrient availability for periphyton in this area. The highest chlorophyll a value of 113 mg/m^2 was observed near the mouth of a tributary which passes through Tahoe City site TCT. The high level of biomass seen here likely is a result of nutrient loading from this tributary.

Expanded sampling along the east shore and north shores indicated generally low levels < 6 $mg/m^2$of new growth at most sites. Many of the samples were collected late in June and may reflect low nutrient availability. Exceptions were Logan Shoals which was collected at the end of May and had a slightly elevated chlorophyll a of 18.3 mg/m^2 and Chimney Beach collected 6/23/05 which had a slightly elevated chlorophyll a value of 9.2 mg/m^2. A small tributary enters near the Chimney Beach site which may contribute some nutrient loading here. Most of the visual scores were low (1 or 2) for the east and north shore sites and are consistent with the low biomass results.

Table 2. Periphyton expanded monitoring locations 2004-2005.

SITE DESIGNATION	SITE NAME	LOCATION
	WEST SHORE APRIL-MAY 2005	
A	Cascade Creek	N38 57.130; W120 04.615
B	S. of Eagle Point	N38 57.607; W120 04.660
C	E.Bay/Rubicon	N38 58.821; W120 05.606
D	Gold Coast	N39 00.789; W120 06.796
E	S. Meeks Point	N39 01.980; W120 06.882
F	N. Meeks Bay	N39 02.475; W120 07.194
G	Tahoma	N39 04.199; W120 07.771
H	S. Fleur Du Lac	N39 05.957; W120 09.774
I	Blackwood Creek	N39 06.411; W120 09.424
J	Ward Creek	N39 07.719; W120 09.304
K	N. Sunnyside	N39 08.385; W120 09.135
L	Tavern Point	N39 08.806; W120 08.628
TCT	Tahoe City Tributary	(adjacent to T.C. Marina)
M	TCPUD Boat Ramp	N39 10.819; W120 07.177
N	S. Dollar Point	N39 11.016; W120 05.888
O	S. Dollar Creek	N39 11.794; W120 05.699
P	Cedar Flat	N39 12.567; W120 05.285
Q	Garwood's	N39 13.486; W120 04.974
R	Flick Point	N39 13.650; W120 04.155
S	Stag Avenue	N39 14.212; W120 03.710
T	Agatam Boat Launch	N39 14.250; W120 03.710
	EAST SHORE MAY-JUNE 2005	
E1	South side of Elk Point	N38 58.965; W119 57.399
E2	North Side of Elk Point	N38 59.284; W119 57.341
E3	South Side of Zephyr Point	N38 59.956; W119 57.566
E4	North Zephyr Cove	N39 00.920; W119 57.193
E5	Logan Shoals	N39 01.525; W119 56.997
E6	Cave Rock Ramp	N39 02.696; W119 56.935
E7	South Glenbrook Bay	N39 04.896;W119 56.955
E8	South Deadman Point	N39 05.998; W119 57.087
E9	Skunk Harbor	N39 07.856; W119 56.597
E10	Chimney Beach	N39 09.044; W119 56.008
E11	Observation Point	N39 12.580; W119 55.861
	NORTH SHORE JUNE 2005	
E12	Hidden Beach	N39 13.263; W119 55.832
E13	Burnt Cedar Beach	N39 14.680; W119 58.132
E14	Stillwater Cove	N39 13.789; W120 00.020
E15*	North Stateline Point	N39 13.237; W120 00.193
E16*	Brockway Springs	N39 13.560; W120 00.829
E17	Kings Beach Ramp Area	N39 14.009; W120 01.401
	SOUTH SHORE JULY 2005	
S1	Tahoe Keys Entrance	N38 56.398; W120 00.390
S2	Kiva Point	N38 56.555; W120 03.203

Table 3. Summary of 0.5m periphyton chlorophyll a, Ash Free Dry Weight (AFDW), visual score, avg. filament length and % algal coverage for expanded periphyton monitoring sites during April – July 2005. Visual score is a subjective ranking of the aesthetic appearance of algal growth (viewed underwater) where 1 is the least offensive and 5 is the most offensive.

Site	Date	Chl a (mg/m^2)	Std Dev (mg/m^2)	AFDW (g/m^2)	Std.Dev (g/m^2)	Visual Score	Fil. Length (cm)	Algal Coverage %
A	4/22/2005					2	0.6	40
B	4/22/2005	14.14	3.97	16.77	0.64	3	0.6	70
C	4/22/2005					4	1.1	90
D	4/22/2005					4	1.3	80
E	4/22/2005	34.47	10.87	35.68	12.83	4	1.3	90
F	4/22/2005					3	1.5	90
G	4/22/2005					2	0.2	70
H	4/22/2005	92.53	53.95	74.44	56.03	4	1.8	90
I	4/22/2005					3	1.2	60
J	4/22/2005					5	4.2	40
K	4/22/2005					4	1.9	70
L	4/22/2005	58.04	7.52	55.51	15.38	3	1.7	50
TCT	4/21/2005	113.77	19.21	63.47	6.12	5	2.6	100
M	4/22/2005	44.95	15.04	56.68	13.89	4	1.1	80
N	5/17/2005					4	1.8	90
O	5/17/2005					4	1.8	80
P	5/17/2005	69.4	0.77	65.8	9.07	3	1	80
Q	5/17/2005					3	0.7	70
R	5/17/2005	21.15	4.63	29.63	4.98	3	1	60
S	5/17/2005					3	0.8	60
T	5/17/2005	9.2	3.11	15.31	3.33	4	1.2	70
E1	6/29/2005	5.62	0.64	4.59	0.22	3	0.4	50
E2	6/29/2005					3	0.8	40
E3	5/31/2005					3	1	75
E4	5/31/2005					2	0.2	90
E5	5/31/2005	18.27	11.23	15.69	1.98	3	0.6	70
E6	5/31/2005					2	0.3	70
E7	5/31/2005	4.38	0.07	7.19	1.77	2	0.2	70
E8	5/31/2005					2	0.7	70
E9	5/31/2005					2	0.5	50
E10	6/23/2005	9.21	1.8	7.37	1.72	3	0.7	60
E11	6/23/2005	2.99	3.94			1	0	0
E12	6/29/2005					2	0.3	40
E13	6/23/2005	3.3	0.56			2	0.2	30
E14	6/29/2005					2	1	50
E15	6/23/2005	3.52	0.64			2	0.2	30
E16	6/23/2005					2	0.8	50
E17	6/23/2005	3.98	3.54	7.96	6.69	3	0.3	35
S1	7/6/2005	1.75	0.22			2	0.2	40
S2	7/6/2005	1.24	0.73	1.77	1.48	2	0.1	50

References

Hackley, S. H., Allen, B.C., Hunter, D.A., and J.E. Reuter. 2004. Lake Tahoe water quality investigations: algal bioassay, phytoplankton, atmospheric nutrient deposition, periphyton. Final report submitted to State Water Resources Control Board, Lahontan Regional Water Quality Control Board. Tahoe Research Group, University of California, Davis.