Lake Tahoe Water Quality Investigations

Algal Bioassay • Phytoplankton • Atmospheric Nutrient Deposition • Periphyton

Annual Report

July 1, 2005 – June 30, 2006

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
University of California, Davis

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September 29, 2006

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Project Overview

The following document is our annual report for work completed during the second year (July 1, 2005 to June 30, 2006) 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 primary research and monitoring tasks addressed in this project include:

<u>Algal growth bioassay tests to assess nutrient limitation (Task 3)</u>. 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.

<u>Enumeration and identification of phytoplankton algae (Task 4)</u>. 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.

<u>Atmospheric deposition of nitrogen and phosphorus (Task 5).</u> 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, and TP.

<u>Monitoring of attached algae or periphyton along the shoreline (Task 6).</u> 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 AFDW and chlorophyll *a* biomass measurements, visual observations of filament length and % cover.

The additional tasks associated with this project include: Project management (Task 1), quality assurance (Task 2), and reporting of data (Task 3).

The summary of % work completed (based on a 3 year granting period) through the end of the second 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	67%
2 – Quality Assurance	67%
3 – Algal Growth Bioassays	67%
4 – Phytoplankton Analysis	67%
5 – Atmospheric Deposition of Nutrients	67%
6 – Periphyton	67%
7 - Reporting	67%

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 lake nutrient.

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 replicated in triplicate. 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.

Summary of Results 2005-2006

In this annual data summary we present the results for 6 separate bioassay experiments – three were conducted in 2005 (August, October, December) and three were conducted in 2006 (February, April, June). The results of each of the individual bioassays are presented in Table 1(a-f). The results for all bioassays done during the period 2002-2006 are summarized in Table 2.

During 2005-2006 patterns for nutrient limitation were similar to the 2004-2005 period for summer, fall and late winter/early spring periods, while patterns for early winter nutrient limitation were slightly different. N and P colimitation was prevalent in the summers of 2005 and 2006. In the bioassays done in Oct. of 2004 and 2005, slight P limitation was evident, however the combination of N and P added together caused the greatest growth response. In the winter and early spring (Feb. and April) bioassays done in both 2005 and 2006, P was found to be limiting.

The results of the bioassays done in early winter (December) were different for the two years however. In 2004 the phytoplankton appeared to be P limited. In the 2005 bioassays the phytoplankton appeared to respond to both the N(20) and P(10) alone treatments with slight growth. The N(20) treatment increased growth to 113% of control and the P(10) treatment increased growth to 108% of control. The lower level P treatment (P2) however, was not significantly stimulatory. The combination of N+P caused the greatest growth. The significant responses to N and P alone may be an indication that a portion of the phytoplankton assemblage (i.e. either certain species or phytoplankton derived from particular depths in the water column) were capable of responding with growth to additions of either N or P alone. The much stronger response to the combined N+P treatments seems to suggest that the phytoplankton community as a whole was predominantly co-limited by N and P during this period.

The data for all bioassays done during the period 2002-2006 is summarized in Table 2. P limitation was generally prevalent during winter and spring periods during 2002-2006. Patterns for late spring through fall have shown some variation. In the summers of 2002, 2004, 2005 and 2006 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. P was often found to be limiting in the fall, except for 2003 when colimitation was present. In all (100%) of the bioassay experi-ments a combination of N+P was stimulatory reinforcing the fact that Lake Tahoe phyto-plankton 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 8/15/05.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response ="*"
Control	0.312	0.002	3		
N(20)	0.327	0.009	3	105	
P(2)	0.340	0.020	3	109	
P(10)	0.328	0.019	3	105	
N(20)P(2)	0.553	0.004	3	177	*
N(20)P(10)	0.805	0.041	3	258	*

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

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response ="*"
Control	0.322	0.003	3		
N(20)	0.351	0.006	3	109	
P(2)	0.353	0.017	3	110	
P(10)	0.389	0.036	3	121	*
N(20)P(2)	0.460	0.011	3	143	*
N(20)P(10)	0.622	0.010	3	193	*

Table 1c. Bioassay done using 2,5,8,11,14,17,20m lake water collected 12/15/05.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response ="*"
Control	0.379	0.011	3		
N(20)	0.430	0.005	3	113	*
P(2)	0.388	0.007	3	102	
P(10)	0.410	0.027	3	108	*
N(20)P(2)	0.616	0.014	3	162	*
N(20)P(10)	0.722	0.020	3	190	*

Table 1d. Bioassay done using 2,5,8,11,14,17,20m lake water collected 2/21/06.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response =“*”
Control	0.268	0.006	3		
N(20)	0.262	0.005	3	98	
P(2)	0.485	0.038	3	181	*
P(10)	0.573	0.015	3	214	*
N(20)P(2)	0.522	0.010	3	195	*
N(20)P(10)	0.536	0.015	3	200	*

Table 1e. Bioassay done using 2,5,8,11,14,17,20m lake water collected 4/12/06.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response =“*”
Control	0.388	0.013	3		
N(20)	0.380	0.003	3	98	
P(2)	0.603	0.029	3	155	*
P(10)	0.628	0.027	3	162	*
N(20)P(2)	0.600	0.018	3	155	*
N(20)P(10)	0.624	0.014	3	161	*

Table 1f. Bioassay done using 2,5,8,11,14,17,20m lake water collected 6/19/06.

Treatment	Day 6 Mean Fluorescence	Std. Dev.	n	Day 6 Mean Fluorescence as % of Control	Statistically Signif. ($p \leq .05$) Response =“*”
Control	0.335	0.023	3		
N(20)	0.326	0.002	3	84	
P(2)	0.331	0.015	3	85	
P(10)	0.353	0.059	3	91	
N(20)P(2)	0.594	0.014	3	153	*
N(20)P(10)	0.982	0.061	3	253	*

Table 2. Summary of N and P bioassay treatment responses as % of control done in: (a) 2002, (b) 2003, (c) 2004, (d) 2005, (e) 2006. 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	8/15/05	10/20/05	12/15/05
Control	100	100	100	100	100	100
N20	99	97	109	105	109	113
P2	121	193	99	109	110	102
P10	122	233	105	105	121	108
N20P2	123	214	176	177	143	162
N20P10	127	241	239	258	193	190

(e) 2006 Bioassays

	2/21/06	4/12/06	6/19/06
Control	100	100	100
N20	98	98	84
P2	181	155	85
P10	214	162	91
N20P2	195	155	153
N20P10	200	161	253

Task 4. Enumeration and Identification of Phytoplankton

Phytoplankton, the microscopic, floating plant cells found in all lakes of the world are important components in the study of aquatic biology. These small cells are the primary producers and all life within the lake depends on them. Lake Tahoe has a community of phytoplankton that is fairly consistent from one year to the next. Alpine, oligotrophic lakes of the world have comparable phytoplankton species to those found in Lake Tahoe. However, what makes Lake Tahoe unique among lakes is its depth and volume of water. These physical features make Tahoe a very dynamic lake. A myriad of changes occur within the physical and chemical realms. These changes are reflected in the phytoplankton community, populations rise and fall, species change. There are predictable major events, like the spring diatom bloom. However, the intricacies of monthly community change are not predictable.

Phytoplankton are reactive to the ambient climate defined by depth, temperature and light. Many species have the ability to exploit favorable resources. Whereas other phytoplankton groups are so specialized that they can not compete under ordinary conditions. Population numbers can be mediated by sudden physical and chemical changes as well as predation. Generally, however, phytoplankton turnover of species occurs relatively slowly in Lake Tahoe. It is not certain how the slow turnover affects seasonal succession and selection within the community. It must have some influence since phytoplankton communities change so completely from one year to the next even though the physical and chemical parameters are fairly predictable.

This report includes results from ongoing monitoring in Lake Tahoe for July 2005 – June 2006. Phytoplankton counts are performed on composite samples from the Index Station every ten days. One composite is from the entire euphotic zone (0 – 105M). Another composite is collected from the surface waters, within the secchi visibility range (0-20M). Monthly sampling from the mid-lake station also provides a euphotic composite (0-100M) as well as a deep water composite (200- 450M). Six discrete depth samples are counted monthly. They are sampled from the Index station at 5, 20, 40, 60, 75, 90M. This regime of sampling has not changed for at least a decade. This reporting period includes a total of 148 samples counted.

The phytoplankton communities found at the Index Station and the Mid-Lake station are not significantly different from one another. This report focuses on the phytoplankton dynamics from the Index Station Full Composites (0- 105M). The secchi composite, deep water composite and the discrete depth samples assist in the over-all understanding of the euphotic zone community and will be mentioned as needed. The phytoplankton data are analyzed using two methods which are equally useful, cell abundance and cell bio-volume.

Cell abundance is the most obvious result from counting and identification of the samples. Abundance numbers reflect the actual visual representation in the counting chamber. Phytoplankton abundances are plotted in Figure 1. The most prominent groups, numerically, are diatoms, greens (Chlorophytes), Chrysophytes, and

Cryptomonads. The average cell abundance is 403,000 cells per liter. This is a higher average number than the previous year, Lahontan Annual Report 2004-2005 (348,000 cell/L).

The highest cell count is seen in September 2005 where numbers reach over 800,000 cells per liter. A large portion of that count is small, blue green algae named *Microcystis elachista*. The highest cell counts occur when the water column is stratified. During this six month period (May – October) most phytoplankton cells are located below the thermocline, peaking in abundance around 60M. The lowest cell count is seen in February 2006 (238,000 cells/L). Typically the lowest abundances are found in December and January samples, with cell counts as low as 150,000 cells/L. However, that trend was not seen, indeed, cell abundances from October 2005 – Jan 2006 were 2 times higher than usual. This can be attributed to one species of green algae (*Carteria sp*.) which bloomed during this period.

Using cell abundance as the sole method to describe phytoplankton community dynamics can be somewhat misleading because small numerous cells are given unwarranted weight in this analysis. Another complementary analysis is algal cell bio-volume. The metabolic potential of cellular function is linked to cell size. Additionally, the contribution of large, less abundant cells can be acknowledged. Bio-volume analysis is the most useful parameter for studies of primary productivity, nutrient recycling and algal resource limitations. The bio-volumes of algal groups are plotted in Figure 2. The average annual bio-volume (July – June) is 90 μm^3/L. This average is high compared to the same time frame in 2004-2005 (65 μm^3/L). Diatoms are the dominant algal group for eight months of the year. Indeed, in April through August the diatoms account for 60% or greater of the total phytoplankton bio-volume. During this period the diatom dominants are initially *Stephanodiscus alpina* and *Cyclotella ocellata*, two centric diatoms. As the spring bloom begins to gain momentum, the addition of a small pennate, *Achnanthes microcephala* brings the total community bio-volume to very high values. The highest bio-volume of the year is in late June 2006 (151 μm^3/L). This peak comes late in the season, probably the result of a cool spring which delayed runoff. Diatoms had a good year and are clearly the dominating algal group.

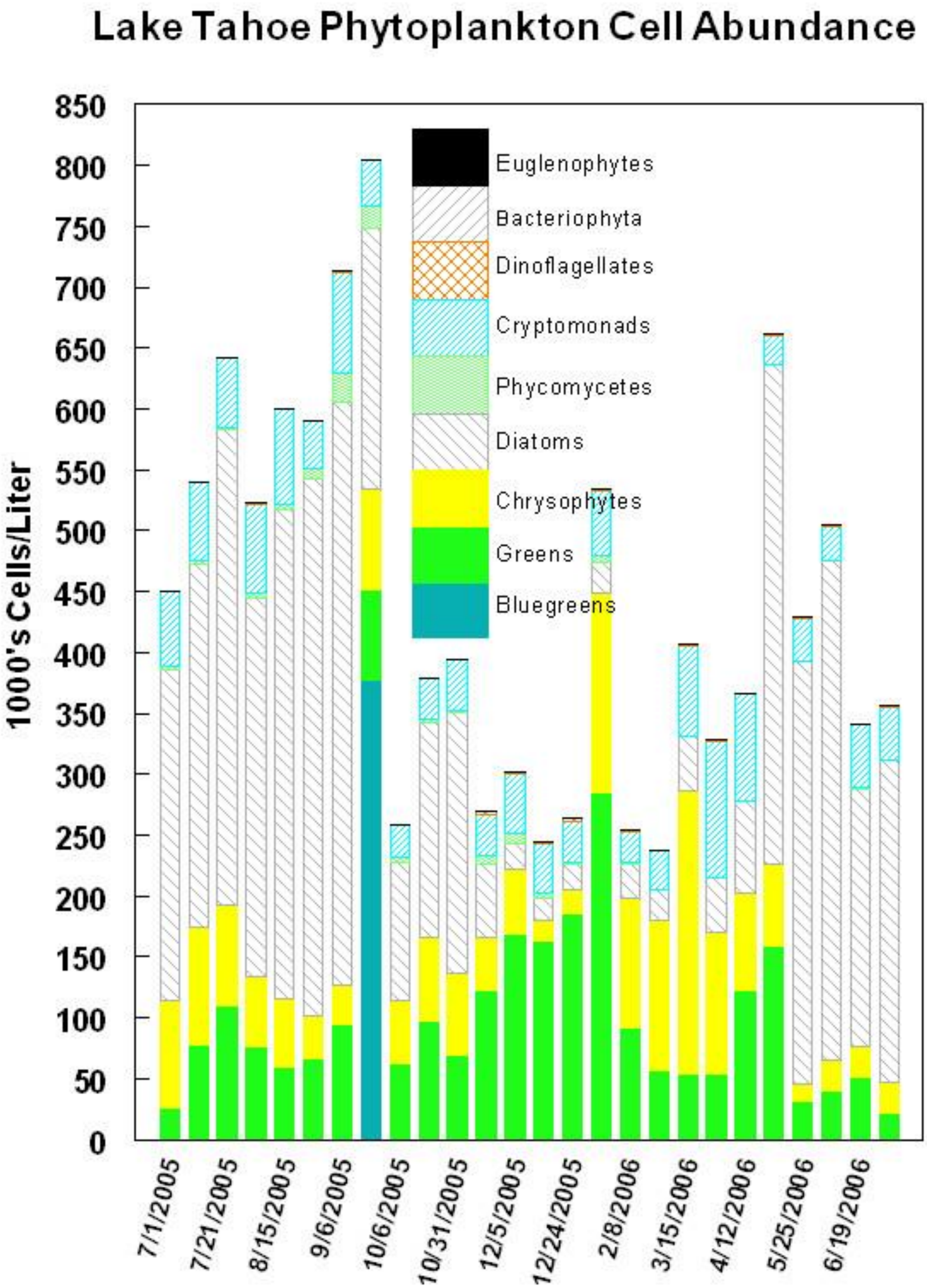
For the months when diatoms did not dominate, October – January, the phytoplankton community share dominance among three other algal groups. Surprisingly, the green algae (Chlorophytes) are dominant throughout this time. Cryptophytes and Dinoflagellates also perform well. The lowest bio-volume for the year is in early October (32 μm^3/L). This is also the time of highest species richness with 33 – 37 distinct species being identified.

In last year's annual report there is a discussion about the implications of increased abundances and total bio-volumes within the green algae. This year, again, the green algae are secondary dominants. However, I am less inclined to think that this is an indication of decreasing water quality. In 2004-2005 the species *Ankistrodesmus spiralis* was the green alga responsible for population increases. However, this year *Ankistrodesmus spiralis* is present but not abundant. The green alga, *Carteria sp*., has population increases that elevate the green algae's importance. When one species is so controlling, it is difficult to make a generalization about trophic changes in the lake. The average species richness within the green algae is 10 which is a decrease from the previous year where the average species richness is 12.

The one trend that makes the greatest impression on me is the growth patterns seen in the diatom community over the first eight months of the year. The population levels are low in January but as the light levels increase throughout spring, so too do the diatom numbers. From January to April, the populations gradually increase. In May there is explosive growth going on in the diatom community. The momentum continues into June, generally peaking during this month. The diatoms do not crash after this peak. The populations hold strong throughout the summer months. This generalized description has been repeated for several years. This pattern is different from the historical patterns seen in Tahoe.

In the past it was quite typical for diatoms to reach their peak abundance in April and early May, thereafter crashing, due to lack of nutrient resources. The diatoms would recover by summer with a different species assemblage. During the diatom crash other algal groups would exploit the void left by the diatoms. Chrysophytes, in particular, would grow and thrive during this time. Chrysophytes have efficient nutrient uptake and therefore they can survive when nutrient concentrations are very low. Dinoflagellates were another group that was common to the community during May and June. Dinoflagellates have a collection of strategies available for low nutrient situations, including ingestion of bacteria. Over the past five years there have been significant decreases in the Chrysophytes. Dinoflagellates have also decreased during the spring.

So the question remains as to what is fueling the diatom's spectacular crescendo? Is there a greater input of nutrients during spring runoff or a more even nutrient influx that maintains the diatom community? Are these similar trends between years the new norm? Could predation pressures be influencing the selection of phytoplankton species? The questions re-new an interest in the phytoplankton and how they interact within their environment. The answers are often complicated. Influences from chemical, physical and environmental factors make phytoplankton a key component for understanding the aquatic world.


Lake Tahoe Phytoplankton Cell Abundance
1000's Cells/Liter
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Euglenophytes
Bacteriophyta
Dinoflagellates
Cryptomonads
Phycomycetes
Diatoms
Chrysophytes
Greens
Bluegreens
7/1/2005
7/21/2005
8/15/2005
9/6/2005
10/6/2005
10/31/2005
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2/8/2006
3/15/2006
4/12/2006
5/25/2006
6/19/2006

Figure 1

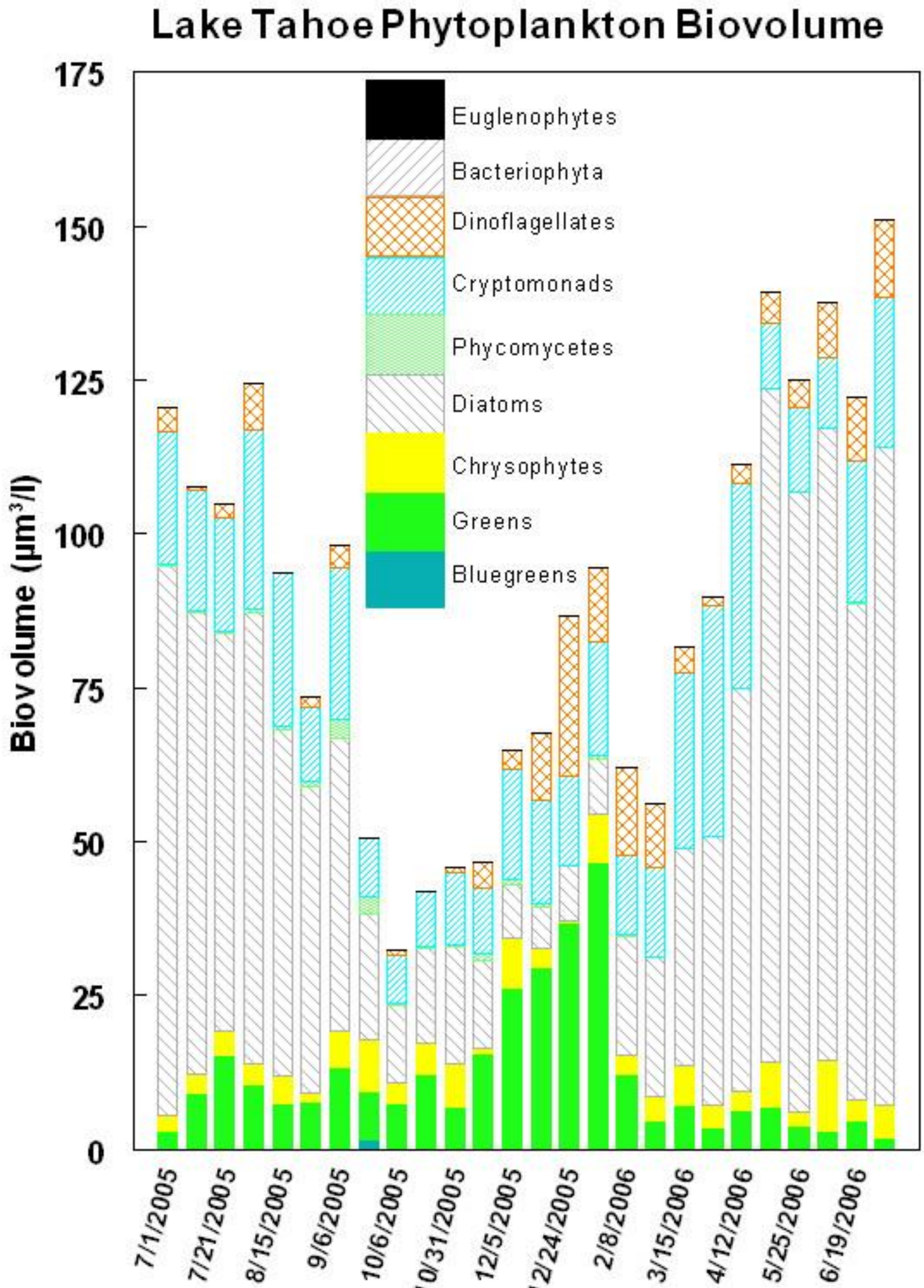

Lake Tahoe Phytoplankton Biovolume
Biovolume (µm³/l)
175
150
125
100
75
50
25
0
Euglenophytes
Bacteriophyta
Dinoflagellates
Cryptomonads
Phycomycetes
Diatoms
Chrysophytes
Greens
Bluegreens
7/1/2005
7/21/2005
8/15/2005
9/6/2005
10/6/2005
10/31/2005
12/5/2005
12/24/2005
2/8/2006
3/15/2006
4/12/2006
5/25/2006
6/19/2006

Figure 2

Task 5. Atmospheric Deposition of Nitrogen and Phosphorus

Monitoring of atmospheric deposition is crucial to an understanding of its role in degradation of the lake and for use in watershed management. Atmospheric deposition contributes nitrogen, phosphorus and fine particles which all impact lake clarity. Preliminary estimates in the nutrient and sediment budget for Lake Tahoe produced as part of the Tahoe TMDL project indicate that atmospheric deposition contributes about 52% of the nitrogen, 16% of the Total Phosphorus and 9% of the Total Fine particles to the lake. A significant portion of the nitrogen, phosphorus and fine particles in the atmospheric deposition (up to 90% of the nitrogen and more than half the phosphorus and particulates) is thought to originate in the basin. Control of air pollutants generated within the basin is therefore potentially a tool for watershed managers to reduce pollutants which impact the clarity of the lake. The atmospheric deposition monitoring program of TERC provides basic 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. Historical data collected as part of this monitoring program were utilized together with the results of the recent California Air Resource Board (CARB) atmospheric deposition study and research by Desert Research Institute (DRI) to come up with ultimate estimates of nutrient and fine particle contributions in atmospheric deposition to the lake. 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 collection is 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 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 electrically heated rain and snow gage and event data logger was not in service this past year, as power to the station and an Alpine Meadows building which supplied the power was removed. 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 used for analysis.

Results

Data collected for this task include information on atmospheric deposition concentrations, nutrient loading, precipitation amounts and timing. Tables 3-8 present a summary of precipitation amounts, concentrations and nutrient loading from 7/1/05 through 6/30/06. A brief discussion of some of the more interesting features of the data during this year is also presented.

Table 3a. Precipitation amounts and N, P and H concentrations in bulk deposition at the Upper Ward Valley Station 7/1/05-6/30/06.

Tab. 3a 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	7/27/2005 13:15	0.00	DF	ST	NA	NA	41.70	460.58	1757.99	120.19	142.10	TBA	70
2	8/17/2005 10:15	0.12	R+DF	ST	4.70	19.95	201.60	777.66	NA	205.36	NA	NA	71
3	9/6/2005 16:15	0.00	DF	ST	NA	NA	24.68	28.54	118.53	5.91	10.02	NA	72
4	10/3/2005 11:45	0.51	R+DF	ST	4.71	19.50	246.77	424.33	1270.64	111.99	144.29	226.63	94
5	10/18/2005 17:10	0.30	R+S+DF	ST	NA	NA	211.03	222.84	413.58	18.86	19.41	48.79	
6	10/25/2005 16:15	0.38	R+DF	ST	4.65	22.39	145.82	157.26	274.30	4.12	11.21	23.88	
7	11/7/2005 11:45	4.34	R+S+DF	ST	5.10	7.94	68.14	104.02	154.22	0.46	3.43	14.27	
8	11/17/2005 16:50	0.92	R+DF	ST	5.10	7.94	48.67	43.26	141.98	1.14	3.78	4.05	95
9	11/28/2005 11:30	1.61	R+S+DF	ST	5.00	10.00	49.77	44.09	71.19	1.60	4.72	8.41	
10	11/30/2005 13:40	3.90	R+S+DF	ST	5.30	5.01	9.92	2.06	116.18	0.23	4.09	3.74	
11	12/6/2005 16:30	6.10	R+S+DF	ST	5.20	6.31	16.16	6.43	32.82	0.23	5.67	11.48	
12	12/15/2005 15:00	0.19	NA	ST	NA	NA	8.82	11.42	41.75	0.23	4.72	12.41	
13	12/23/2005 13:15	7.79	R+S+DF	ST	NA	NA	20.20	5.47	8.53	0.23	5.04	2.51	
14	1/4/2006 15:00	16.75+	R+S+DF	ST	5.50	3.16	6.80	4.35	10.42	0.23	4.41	2.67	96
15	1/17/2006 12:15	3.60	NA	ST	NA	NA	41.51	27.73	69.42	2.32	5.00	19.19	113
16	1/19/2006 14:00	2.92	S	ST	5.69	2.04	22.49	22.79	47.30	1.85	4.69	16.99	
17	2/3/2006 15:25	6.83	R+S	ST	5.02	9.55	34.21	32.90	50.38	2.32	5.00	21.40	
18	2/6/2006 14:45	0.85	R+S	ST	4.99	10.23	37.50	31.57	44.92	0.91	0.32	20.77	
19	2/24/2006 12:45	0.86	S	ST	4.80	15.85	139.45	167.30	154.84	4.10	3.80	24.23	114
20	3/1/2006 13:00	5.61	R+S	ST	5.40	3.98	13.65	16.12	36.73	1.37	3.77	18.88	
21	3/8/2006 11:50	4.57	S	ST	5.17	6.76	33.55	55.05	101.07	1.37	3.14	1.86	
22	3/13/2006 14:30	3.04	S	ST	5.01	9.77	52.80	45.16	74.28	1.37	3.77	1.24	
23	3/15/2006 16:30	1.77	S	ST	5.09	8.13	41.20	32.58	93.46	1.82	3.45	2.79	
24	3/27/2006 8:35	2.51	R+S	ST	5.19	6.46	51.48	53.76	96.80	2.51	3.77	3.10	
25	3/30/2006 11:15	1.17	S	ST	5.10	7.94	66.12	82.15	117.20	2.51	4.08	4.65	
26	4/6/2006 16:00	6.26	R+S	ST	4.89	12.88	32.81	39.49	49.55	1.39	6.55	1.24	

Tab. 3a	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
27	4/13/2006 14:30	3.28	R+S	ST	5.10	7.94	43.64	69.38	66.98	1.62	7.17	3.10	
28	4/17/2006 14:30	2.85+	S	ST	5.00	10.00	114.68	284.69	312.64	2.78	8.10	5.58	130
29	4/25/2006 10:20	0.99	R	ST	4.60	25.12	266.21	287.33	323.78	5.56	12.16	17.35	
30	5/1/2006 15:45	0.36	R	ST	4.62	23.99	176.87	227.99	243.10	5.10	13.72	16.30	
31	6/2/2006 11:40	1.87	R	ST	5.11	7.76	135.91	277.32	785.49	2.06	21.85	85.48	131
32	6/16/2006 16:40	0.48	R	ST	4.87	13.49	341.79	1209.64	1457	9.33	83.36	170.96	132
	Total	92.73											

Table 3b. Precipitation N, P and H loads in bulk deposition at the Upper Ward Valley Station 7/1/05-6/30/06.

Tab. 3b Samp. No.	Upper Ward V. Collection Date-Time	Snow Tube Precip. (in.)	Precip. Form	(Load) H+ (g/ha)	NO3-N (g/ha)	NH4-N (g/ha)	TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
1	7/27/2005 13:15	0.00	DF	NA	6.43	70.99	270.95	18.52	21.90	NA	70
2	8/17/2005 10:15	0.12	R+DF	3.08	31.07	119.86	NA	31.65	NA	NA	71
3	9/6/2005 16:15	0.00	DF	NA	3.80	4.40	18.27	0.91	1.54	NA	72
4	10/3/2005 11:45	0.51	R+DF	2.53	31.97	54.97	164.60	14.51	18.69	29.36	94
5	10/18/2005 17:10	0.30	R+S+DF	NA	16.08	16.98	31.51	1.44	1.48	3.72	
6	10/25/2005 16:15	0.38	R+DF	2.16	14.07	15.18	26.48	0.40	1.08	2.30	
7	11/7/2005 11:45	4.34	R+S+DF	8.76	75.11	114.67	170.01	0.51	3.78	15.73	
8	11/17/2005 16:50	0.92	R+DF	1.86	11.37	10.11	33.18	0.27	0.88	0.95	95
9	11/28/2005 11:30	1.61	R+S+DF	4.09	20.35	18.03	29.11	0.65	1.93	3.44	
10	11/30/2005 13:40	3.90	R+S+DF	4.96	9.83	2.04	115.09	0.23	4.05	3.70	
11	12/6/2005 16:30	6.10	R+S+DF	9.78	25.04	9.96	50.85	0.36	8.79	17.79	
12	12/15/2005 15:00	0.19	NA	NA	1.36	1.76	6.43	0.04	0.73	1.91	
13	12/23/2005 13:15	7.79	R+S+DF	NA	39.97	10.82	16.88	0.46	9.97	9.97*	
14	1/4/2006 15:00	16.75+	R+S+DF	13.45	28.93	18.51	44.33	0.98	18.76	18.76*	96
15	1/17/2006 12:15	3.60	NA	NA	37.96	25.36	63.48	2.12	4.57	17.55	113
	1/19/2006 14:00	2.92	S	1.51	16.68	16.90	35.08	1.37	3.48	12.60	
17	2/3/2006 15:25	6.83	R+S	16.57	59.35	57.08	87.40	4.02	8.67	37.13	
18	2/6/2006 14:45	0.85	R+S	2.21	8.10	6.82	9.70	0.20	0.07	4.48	
19	2/24/2006 12:45	0.86	S	3.46	30.46	36.55	36.55*	0.90	0.83	5.29	114
20	3/1/2006 13:00	5.61	R+S	5.67	19.45	22.97	52.34	1.95	5.37	26.90	
21	3/8/2006 11:50	4.57	S	7.85	38.94	63.90	117.32	1.59	3.64	3.64*	
22	3/13/2006 14:30	3.04	S	7.55	40.77	34.87	57.36	1.06	2.91	2.91*	
23	3/15/2006 16:30	1.77	S	3.65	18.52	14.65	42.02	0.82	1.55	1.25	
24	3/27/2006 8:35	2.51	R+S	4.12	32.82	34.27	61.71	1.60	2.40	1.98	
25	3/30/2006 11:15	1.17	S	2.36	19.65	24.41	34.83	0.75	1.21	1.38	
26	4/6/2006 16:00	6.26	R+S	20.48	52.17	62.79	78.79	2.21	10.41	10.41*	

Tab. 3b 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
27	4/13/2006 14:30	3.28	R+S	6.62	36.36	57.80	57.80*	1.35	5.97	5.97*	
28	4/17/2006 14:30	2.85+	S	7.24	83.02	206.09	226.32	2.01	5.86	5.86*	130
29	4/25/2006 10:20	0.99	R	6.32	66.94	72.25	81.42	1.40	3.06	4.36	
30	5/1/2006 15:45	0.36	R	2.19	16.17	20.85	22.23	0.47	1.25	1.49	
31	6/2/2006 11:40	1.87	R	3.69	64.55	131.72	373.09	0.98	10.38	40.60	131
32	6/16/2006 16:40	0.48	R	1.64	41.67	147.48	177.64	1.14	10.16	20.84	132

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table 4a. Precipitation amounts and N, P and H concentrations in wet deposition at the Ward Valley Lake Level Station 7/1/05-6/30/06.

Tab. 4a Samp. No.	Ward V. Lake Level Collection Date-Time	Wet Precip. (in)	Precip. Form	Collector Type	Wet Bkt Amt. (in)	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	7/27/2005 13:45	0.004	R	WET	0.004	NA	NA	30.29	31.83	79.18	3.11	4.69	12.28	73
2	8/17/2005 10:45	0.53	R	WET	0.53	4.35	44.67	307.96	19.33	560.17	<MDL	32.55	150.67	
3	10/3/2005 12:15	0.22	R	WET	0.22	4.89	12.88	136.15	37.76	131.55	0.80	5.01	12.91	
4	10/18/2005 17:40	0.36	R+S	WET	0.36	4.89	12.88	114.45	59.68	99.31	7.72	11.27	17.00	
5	10/25/2005 16:40	0.66	R	WET	0.66	4.82	15.14	141.60	195.13	300.76	2.75	8.41	21.40	
6	11/7/2005 12:15	1.58	R+S	WET	1.58	5.83	1.48	34.44	1.44	246.84	1.37	2.80	31.33	97
7	11/10/2005 11:10	0.21	R	WET	0.21	5.22	6.03	47.38	2.48	62.14	1.83	7.48	7.79	
8	11/28/2005 12:00	1.29	R+S	WET	1.29	5.2	6.31	51.79	45.34	92.69	0.46	3.46	5.92	
9	11/30/2005 16:05	1.97	R+S	WET	1.97	5.3	5.01	10.84	1.85	27.87	1.37	4.72	7.64	
10	12/2/2005 18:00	5.72	R	WET	5.72	5	10.00	18.37	2.68	13.62	0.46	9.23	10.55	98
11	12/15/2005 15:35	0.07	R+S	WET	0.07	NA	NA	10.47	14.75	16.88	<MDL	4.41	10.55	99
12	12/23/2005 17:15	7.42	R	WET	7.42	NA	NA	18.00	3.90	10.59	0.92	4.41	4.24	
13	12/30/2005 17:10	6.42	R+S	WET	6.42	5.3	5.01	23.14	7.27	42.85	1.14	4.57	5.79	
14	1/1/2006 16:15	5.87	R+S+DF	WET	5.87	5.11	7.76	9.00	3.22	26.74	0.46	3.78	4.71	100
15	1/4/2006 17:00	2.90	R+S+DF	WET	2.90	5.49	3.24	13.04	6.37	14.19	0.69	3.15	4.40	100
16	1/13/2006 17:30	0.46	S	WET	0.46	NA	NA	68.63	18.15	86.21	3.71	6.88	15.63	
17	1/15/2006 11:45	1.38	S	WET	1.38	NA	NA	25.12	29.31	62.15	2.32	4.69	15.42	115
18	1/19/2006 14:40	1.84	S+DF	WET	1.84	NA	NA	18.02	15.59	36.09	2.09	4.85	15.42	116
19	2/3/2006 14:45	2.54	R+S	WET	2.54	4.89	12.88	31.31	22.94	40.64	1.60	1.58	17.62	
20	2/6/2006 15:15	0.60	R+S	WET	0.60	5	10.00	34.95	24.11	39.46	0.68	0.63	21.40	
21	2/24/2006 13:15	0.73	S	WET	0.73	5.2	6.31	NA	NA	NA	NA	NA	NA	
22	3/1/2006 13:30	5.05	R+S	WET	5.05	5.38	4.17	19.24	10.96	24.80	0.91	3.45	16.99	
23	3/3/2006 15:55	0.92	S	WET	0.92	5.23	5.89	30.43	54.19	98.12	1.14	3.46	20.45	117
24	3/8/2006 12:30	1.00	S	WET	1.00	4.91	12.30	38.16	43.22	72.54	1.37	4.08	11.96	
25	3/13/2006 15:00	1.25	S	WET	0.15	NA	NA	106.58	71.61	177.78	2.28	4.08	14.56	118

Tab. 4a Samp. No.	Ward V. Lake Level Collection Date-Time	Wet Precip. (in)	Precip. Form	Collector Type	Wet Bkt Amt. (in)	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
	3/15/2006 17:00	1.73	S	WET	T	NA	NA	NA	NA	NA	NA	NA	NA	119
26	3/20/2006 12:10	0.39	R+S+DF	DRY	0.39	NA	NA	103.78	106.08	194.52	2.96	4.08	32.54	120
27	3/24/2006 12:15	0.07		WET	0.07	NA	NA	98.52	85.37	NA	5.01	7.85	NA	
28	3/27/2006 9:15	2.03	R+S	WET	2.03	5.2	6.31	24.84	29.46	62.71	2.28	3.45	1.24	
29	3/30/2006 11:45	0.83	R+S	WET	0.83	5.17	6.76	60.03	69.67	101.98	3.64	5.34	4.96	
30	4/6/2006 14:45	4.30	R+S	WET	4.30	5.21	6.17	26.74	20.37	38.96	2.32	8.73	2.79	
31	4/13/2006 15:00	1.28	R+S	WET	1.28	5.19	6.46	138.15	65.20	59.82	2.32	8.73	3.41	
32	4/17/2006 15:00	3.11	S	WET	2.89	5.3	5.01	57.26	146.30	138.11	2.32	7.48	4.96	
33	4/25/2006 10:50	0.59	R	WET	0.59	4.8	15.85	275.72	288.65	274.02	3.94	9.35	13.33	
34	5/1/2006 16:15	0.29	R	WET	0.29	5.08	8.32	130.11	133.12	143.31	1.85	8.42	7.19	
35	5/26/2006 14:35	0.63	R	WET	0.63	NA	NA	193.78	499.30	518.45	0.23	8.74	11.60	
36	6/2/2006 12:10	0.19	S	WET	0.19	4.7	19.95	47.74	29.22	114.35	<MDL	9.99	9.19	
37	6/16/2006 17:10	0.14	R	WET	0.14	NA	NA	NA	634.03	924	1.14	10.30	NA	
38	6/30/2006 17:40	0.10	R	WET	0.10	NA	NA	656.19	790.00	NA	13.22	14.36	NA	
	Total	66.67												

Table 4b. Precipitation loads and N, P and H concentrations in wet deposition at the Ward Valley Lake Level Station 7/1/05-6/30/06.

Tab. 4b Samp. No.	Ward V. Lake Level Collection Date-Time	Wet Precip. (in)	Precip. Form	Collector Type	Precip. Amt. (in) used for Loading	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	7/27/2005 13:45	0.00	R	WET	0.00	NA	2.36	2.48	6.17	0.24	0.37	0.96	73
2	8/17/2005 10:45	0.53	R	WET	0.53	6.01	41.46	2.60	75.41	0.00	4.38	20.28	
3	10/3/2005 12:15	0.22	R	WET	0.22	0.72	7.61	2.11	7.35	0.04	0.28	0.72	
4	10/18/2005 17:40	0.36	R+S	WET	0.36	1.18	10.47	5.46	9.08	0.71	1.03	1.55	
5	10/25/2005 16:40	0.66	R	WET	0.66	2.54	23.74	32.71	50.42	0.46	1.41	3.59	
6	11/7/2005 12:15	1.58	R+S	WET	1.58	0.59	13.82	0.58	99.06	0.55	1.12	12.57	97
7	11/10/2005 11:10	0.21	R	WET	0.21	0.32	2.53	0.13	3.31	0.10	0.40	0.42	
8	11/28/2005 12:00	1.29	R+S	WET	1.29	2.07	16.97	14.86	30.37	0.15	1.13	1.94	
9	11/30/2005 16:05	1.97	R+S	WET	1.97	2.51	5.42	0.93	13.95	0.69	2.36	3.82	
10	12/2/2005 18:00	5.72	R	WET	5.72	14.53	26.69	3.89	19.79	0.67	13.41	15.33	98
11	12/15/2005 15:35	0.07	R+S	WET	0.07	NA	0.82	1.15	1.32	0.00	0.34	0.82	99
12	12/23/2005 17:15	7.42	R	WET	7.42	NA	33.92	7.35	19.96	1.73	8.31	7.99	
13	12/30/2005 17:10	6.42	R+S	WET	6.42	8.17	37.73	11.86	69.87	1.86	7.45	9.44	
14	1/1/2006 16:15	5.87	R+S+DF	WET	5.87	11.57	13.42	4.80	39.87	0.69	5.64	7.02	100
15	1/4/2006 17:00	2.90	R+S+DF	WET	2.90	2.38	9.61	4.69	10.45	0.51	2.32	3.24	100
16	1/13/2006 17:30	0.46	S	WET	0.46	NA	8.02	2.12	10.07	0.43	0.80	1.83	
17	1/15/2006 11:45	1.38	S	WET	1.38	NA	8.81	10.27	21.78	0.81	1.64	5.41	115
18	1/19/2006 14:40	1.84	S+DF	WET	1.84	NA	8.42	7.29	16.87	0.98	2.27	7.21	116
19	2/3/2006 14:45	2.54	R+S	WET	2.54	8.31	20.20	14.80	26.22	1.03	1.02	11.37	
20	2/6/2006 15:15	0.60	R+S	WET	0.60	1.52	5.33	3.67	6.01	0.10	0.10	3.26	
21	2/24/2006 13:15	0.73	S	WET	0.73	1.17	NA	NA	NA	NA	NA	NA	
22	3/1/2006 13:30	5.05	R+S	WET	5.05	5.35	24.68	14.06	31.81	1.17	4.43	21.79	
23	3/3/2006 15:55	0.92	S	WET	0.92	1.38	7.11	12.66	22.93	0.27	0.81	4.78	117
24	3/8/2006 12:30	1.00	S	WET	1.00	3.12	9.69	10.98	18.43	0.35	1.04	3.04	
25	3/13/2006 15:00	1.25	S	WET	0.15	NA	4.06	2.73	6.77	0.09	0.16	0.55	118

Tab. 4b	Ward V. Lake Level	Wet			Precip. Amt. (in)			(Load)					
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
	3/15/2006 17:00	1.73	S	WET	T	NA	NA	NA	NA	NA	NA	NA	119
26	3/20/2006 12:10	0.39		DRY	0.39	NA	10.28	10.51	19.27	0.29	0.40	3.22	120
27	3/24/2006 12:15	0.07		WET	0.07	NA	1.75	1.52	NA	0.09	0.14	NA	
28	3/27/2006 9:15	2.03	R+S	WET	2.03	3.25	12.81	15.19	32.33	1.18	1.78	1.78*	
29	3/30/2006 11:45	0.83	R+S	WET	0.83	1.43	12.66	14.69	21.50	0.77	1.13	1.13*	
30	4/6/2006 14:45	4.30	R+S	WET	4.30	6.73	29.21	22.25	42.55	2.53	9.53	9.53*	
31	4/13/2006 15:00	1.28	R+S	WET	1.28	2.10	44.92	21.20	21.20*	0.75	2.84	2.84*	
32	4/17/2006 15:00	3.11	S	WET	2.89	3.96	45.23	115.57	115.57*	1.83	5.91	5.91*	
33	4/25/2006 10:50	0.59	R	WET	0.59	2.38	41.32	43.26	43.26*	0.59	1.40	2.00	
34	5/1/2006 16:15	0.29	R	WET	0.29	0.61	9.58	9.81	10.56	0.14	0.62	0.53	
35	5/26/2006 14:35	0.63	R	WET	0.63	NA	31.01	79.90	82.96	0.04	1.40	1.86	
36	6/2/2006 12:10	0.19	S	WET	0.19	0.96	2.30	1.41	5.52	0.00	0.48	0.44	
37	6/16/2006 17:10	0.14	R	WET	0.14	NA	NA	22.55	32.86	0.04	0.37	NA	
38	6/30/2006 17:40	0.10	R	WET	0.10	NA	16.67	20.07	NA	0.34	0.36	NA	

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table 5a. N and P concentrations in dry deposition at the Ward Valley Lake Level Station 7/1/05-6/30/06.

Tab. 5a Samp. No.	Ward. V. Lake Level Start Date-Time	Dry Collection Date-Time	Vol. Liters	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	6/20/2005 13:25	7/1/2005 15:00	2.065	DF	DRY	NA	NA	16.68	17.12	462.01	8.08	14.40	14.16	74
2	7/1/2005 15:00	7/15/2005 14:30	1.534	DF	DRY	NA	NA	9.53	19.75	1314.54	19.11	59.31	NA	
3	7/15/2005 14:30	7/27/2005 13:45	1.852	DF	DRY	NA	NA	13.27	6.57	647.65	12.66	15.34	6.60	
4	7/27/2005 13:45	8/5/2005 17:15	2.332	DF	DRY	NA	NA	12.08	29.84	599.52	5.76	8.14	NA	
5	8/5/2005 17:15	8/17/2005 10:45	2.255	DF	DRY	NA	NA	7.98	9.67	364.78	4.84	8.14	16.26	
6	8/17/2005 10:45	8/26/2005 17:40	2.282	DF	DRY	NA	NA	12.76	41.90	381.26	2.76	9.08	14.07	
7	8/26/2005 17:40	9/6/2005 16:45	2.23	DF	DRY	NA	NA	66.88	4.84	355.70	9.31	18.78	37.46	
8	9/6/2005 16:45	9/15/2005 13:30	3.092	DF	DRY	NA	NA	12.25	21.07	475.76	1.14	5.01	NA	
9	9/15/2005 13:30	9/28/2005 18:15	2.88	DF	DRY	NA	NA	C	C	C	C	C	C	
10	9/28/2005 18:15	10/6/2005 15:20	3.38	DF	DRY	NA	NA	9.53	13.39	188.79	2.95	5.32	12.91	
11	10/6/2005 15:20	10/20/2005 12:30	3.138	DF	DRY	NA	NA	C	C	C	C	C	C	101
12	10/20/2005 12:30	11/10/2005 11:10	3.623	DF	DRY	NA	NA	C	C	C	C	C	C	102
13	11/10/2005 11:10	11/18/2005 18:00	3.077	DF	DRY	NA	NA	7.16	3.52	NA	0.23	3.15	NA	
14	11/18/2005 18:00	12/6/2005 17:00	1.753	DF	DRY	NA	NA	18.00	27.06	154.91	17.75	27.72	41.73	
15	12/6/2005 17:00	12/15/2005 15:35	3.409	DF	DRY	NA	NA	9.73	12.46	25.45	0.23	4.41	14.89	
16	12/15/2005 15:35	12/23/2005 17:15	3.083	DF	DRY	NA	NA	11.20	3.00	20.92	0.23	5.35	6.60	
17	12/23/2005 17:15	1/4/2006 17:00	3.663	DF	DRY	NA	NA	9.92	8.62	14.57	1.60	C	5.03	100
18	1/4/2006 17:00	1/19/2006 14:40	3.316	DF	DRY	NA	NA	12.56	7.49	58.21	2.09	5.63	27.06	121
19	1/19/2006 14:40	2/6/2006 15:15	4.092	DF	DRY	NA	NA	19.84	10.69	33.32	3.87	4.75	20.77	122
20	2/6/2006 15:15	2/17/2006 15:15	2.4	DF	DRY	NA	NA	31.22	26.67	70.50	3.24	2.22	43.74	123
21	2/17/2006 15:15	2/24/2006 13:15	3.515	DF	DRY	NA	NA	13.65	23.90	22.52	3.24	1.27	21.40	
	2/24/2006 13:15	3/1/2006 13:30		DF	DRY	NA	NA	136.67	122.58	179.98	1.59	6.28	25.17	
22	3/1/2006 13:30	3/8/2006 12:30	3.045	DF	DRY	NA	NA	20.72	20.11	161.56	1.14	3.45	19.19	
23	3/8/2006 12:30	3/15/2006 17:00	6.881	DF+S	DRY-BULK	NA	NA	28.29	21.29	56.93	1.37	4.08	1.55	124
	3/15/2006 17:00	3/20/2006 12:10	0.63	DF+S	DRY-BULK									138
24	3/20/2006 12:10	3/27/2006 9:15	0.5	DF+R+S	DRY-BULK	5.19	6.46	50.33	41.29	138.20	2.51	4.40	40.90	129

Tab. 5a	Ward. V. 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
25	3/27/2006 9:15	4/6/2006 14:45	3.082	DF	DRY	NA	NA	21.99	20.81	52.36	0.93	8.88	4.96	
26	4/6/2006 14:45	4/25/2006 10:50	1.736	DF	DRY	NA	NA	110.58	106.08	183.04	1.62	8.73	10.54	
27	4/25/2006 10:50	5/5/2006 15:30	1.98	DF	DRY	NA	NA	4.05	7.21	90.21	2.76	4.76	20.38	133
28	5/5/2006 15:30	5/15/2006 12:10	1.701	DF	DRY	NA	NA	3.40	2.80	161.51	1.84	6.04	32.48	
29	5/15/2006 12:10	5/26/2006 14:35	2.781	DF	DRY	NA	NA	24.86	46.87	363.16	10.96	34.97	111.83	
30	5/26/2006 14:35	6/12/2006 14:50	1.689	DF	DRY	NA	NA	18.00	29.20	1655.31	18.89	76.49	169.42	132
31	6/12/2006 14:50	6/23/2006 15:00	2.315	DF	DRY	NA	NA	6.62	18.00	560.61	10.49	36.22	62.81	134
	6/23/2006 15:00	6/23/2006 18:25												
32	6/23/2006 18:25	6/30/2006 17:40	3.044	DF	DRY	NA	NA	5.09	8.00	597.51	0.46	13.11	46.11	135
	6/30/2006 17:40	7/11/2006 16:45	1.618	DF	DRY	NA	NA	12.05	23.00	428	10.26	27.16	NA	

Table 5b. N and P loads in dry deposition at the Ward Valley Lake Level Station 7/1/05-6/30/06.

Tab. 5b Samp. No.	Ward. V. Lake Level Start Date-Time	Dry Collection Date-Time	Vol. Liters	Precip. Form	Collector Type	H+ (g/ha)	NO3-N (g/ha)	NH4-N (g/ha)	(Load) TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
1	6/20/2005 13:25	7/1/2005 15:00	2.065	DF	DRY	NA	6.80	6.98	188.28	3.29	5.87	5.87*	74
2	7/1/2005 15:00	7/15/2005 14:30	1.534	DF	DRY	NA	2.89	5.98	397.96	5.79	17.96	NA	
3	7/15/2005 14:30	7/27/2005 13:45	1.852	DF	DRY	NA	4.85	2.40	236.71	4.63	5.61	2.41	
4	7/27/2005 13:45	8/5/2005 17:15	2.332	DF	DRY	NA	5.56	13.73	275.92	2.65	3.75	NA	
5	8/5/2005 17:15	8/17/2005 10:45	2.255	DF	DRY	NA	3.55	4.30	162.34	2.15	3.62	7.24	
6	8/17/2005 10:45	8/26/2005 17:40	2.282	DF	DRY	NA	5.75	18.87	171.70	1.24	4.09	6.34	
7	8/26/2005 17:40	9/6/2005 16:45	2.230	DF	DRY	NA	29.43	2.13	156.54	4.10	8.27	16.49	
8	9/6/2005 16:45	9/15/2005 13:30	3.092	DF	DRY	NA	7.48	12.86	290.32	0.70	3.06	NA	
9	9/15/2005 13:30	9/28/2005 18:15	2.880	DF	DRY	NA	C	C	C	C	C	C	
10	9/28/2005 18:15	10/6/2005 15:20	3.380	DF	DRY	NA	6.36	8.93	125.93	1.97	3.55	8.61	
11	10/6/2005 15:20	10/20/2005 12:30	3.138	DF	DRY	NA	C	C	C	C	C	C	101
12	10/20/2005 12:30	11/10/2005 11:10	3.623	DF	DRY	NA	C	C	C	C	C	C	102
13	11/10/2005 11:10	11/18/2005 18:00	3.077	DF	DRY	NA	4.35	2.14	NA	0.14	1.91	NA	
14	11/18/2005 18:00	12/6/2005 17:00	1.753	DF	DRY	NA	6.23	9.36	53.59	6.14	9.59	14.44	
15	12/6/2005 17:00	12/15/2005 15:35	3.409	DF	DRY	NA	6.55	8.38	17.12	0.15	2.97	10.02	
16	12/15/2005 15:35	12/23/2005 17:15	3.083	DF	DRY	NA	6.81	1.83	12.73	0.14	3.26	4.02	
17	12/23/2005 17:15	1/4/2006 17:00	3.663	DF	DRY	NA	7.17	6.23	10.53	1.16	NA	3.64	100
18	1/4/2006 17:00	1/19/2006 14:40	3.316	DF	DRY	NA	8.22	4.90	38.09	1.37	3.68	17.71	121
19	1/19/2006 14:40	2/6/2006 15:15	4.092	DF	DRY	NA	16.02	8.63	26.91	3.13	3.84	16.77	122
20	2/6/2006 15:15	2/17/2006 15:15	2.400	DF	DRY	NA	14.79	12.63	33.39	1.53	1.05	20.72	123
21	2/17/2006 15:15	2/24/2006 13:15	3.515	DF	DRY	NA	9.47	16.58	16.58*	2.25	0.88	14.85	
	2/24/2006 13:15	3/1/2006 13:30		DF	DRY	NA	NA	NA	NA	NA	NA	NA	
22	3/1/2006 13:30	3/8/2006 12:30	3.045	DF	DRY	NA	12.45	12.08	97.09	0.69	2.07	11.53	
23	3/8/2006 12:30	3/15/2006 17:00	6.881	DF+S	DRY-BULK	NA	38.42	28.91	77.31	1.86	5.54	5.54*	124
	3/15/2006 17:00	3/20/2006 12:10	0.630	DF+S	DRY-BULK								138
24	3/20/2006 12:10	3/27/2006 9:15	0.500	DF+R+S	DRY-BULK	NA	3.97	3.26	10.91	0.20	0.35	3.23	129

Tab. 5b	Ward. V. Lake Level	Dry						(Load)					
Samp. No.	Start Date-Time	Collection Date-Time	Vol. Liters	Precip. Form	Collector Type	H+ (g/ha)	NO3-N (g/ha)	NH4-N (g/ha)	TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
25	3/27/2006 9:15	4/6/2006 14:45	3.082	DF	DRY	NA	13.38	12.66	31.85	0.57	5.40	5.40*	
26	4/6/2006 14:45	4/25/2006 10:50	1.736	DF	DRY	NA	37.89	36.34	62.71	0.56	2.99	3.61	
27	4/25/2006 10:50	5/5/2006 15:30	1.980	DF	DRY	NA	1.58	2.82	35.25	1.08	1.86	7.96	133
28	5/5/2006 15:30	5/15/2006 12:10	1.701	DF	DRY	NA	1.14	0.94	54.22	0.62	2.03	10.90	
29	5/15/2006 12:10	5/26/2006 14:35	2.781	DF	DRY	NA	13.64	25.72	199.32	6.02	19.19	61.38	
30	5/26/2006 14:35	6/12/2006 14:50	1.689	DF	DRY	NA	6.00	9.73	551.76	6.30	25.50	56.47	132
31	6/12/2006 14:50	6/23/2006 15:00	2.315	DF	DRY	NA	3.02	8.22	256.13	4.79	16.55	28.70	134
	6/23/2006 15:00	6/23/2006 18:25											
32	6/23/2006 18:25	6/30/2006 17:40	3.044	DF	DRY	NA	3.06	4.81	358.95	0.28	7.88	27.70	
	6/30/2006 17:40	7/11/2006 16:45	1.618	DF	DRY	NA	3.85	7.34	136.67	3.28	8.67	NA	

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table 6a. Precipitation amounts, pH, N and P concentrations in bulk deposition collected in Snow Tube collector at the Mid-Lake Buoy (TB-1) Station 7/1/05 to 6/30/06.

Tab. 6a Samp. No.	Mid-lake Start Date-Time	Snow Tube Collection Date-Time	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	6/29/2005 10:50	7/13/2005 12:49	0.00	DF	ST	NA	NA	20.42	47.23	304.00	17.27	20.03	60.91	
	7/13/2005 12:49	7/27/2005 8:55	0.00	DF	ST	NA	NA	C	C	C	C	C	C	92
2	7/27/2005 8:55	8/6/2005 10:50	0.01	R+DF	ST	NA	NA	NA	NA	NA	NA	NA	NA	75
3	8/6/2005 10:50	8/18/2005 7:28	NA	R+DF	ST	NA	NA	80.84	114.12	437.95	44.21	48.83	NA	90
4	8/18/2005 7:28	8/26/2005 13:46	0.00	DF	ST	NA	NA	28.93	80.13	120.04	6.22	6.89	11.57	91
	8/26/2005 13:46	9/6/2005 12:35	0.00	DF	ST	NA	NA	NA	NA	NA	NA	NA	NA	93
5	9/6/2005 12:35	9/15/2005 15:32	0.00	DF	ST	NA	NA	25.53	71.35	280.85	2.73	6.89	NA	72
6	9/15/2005 15:32	9/27/2005 12:05	0.11	R+S+DF	ST	NA	NA	C	C	C	C	C	C	76
7	9/27/2005 12:05	10/6/2005 13:00	0.00	DF	ST	NA	NA	16.17	62.58	62.59	1.82	5.01	10.39	103
8	10/6/2005 13:00	10/20/2005 13:15	0.15	R+S+DF	ST	5.30	5.01	C	C	C	C	C	C	104
	10/20/2005 13:15	11/10/2005 12:55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
	11/10/2005 12:55	11/18/2005 10:05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	106
	11/18/2005 10:05	12/6/2005 13:02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	107
	12/6/2005 13:02	12/23/2005 12:30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
	12/23/2005 12:30	1/4/2006 12:47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
9	1/4/2006 12:47	1/24/2006 12:35	0.37	S+DF	ST	5.20	6.31	526.32	100.40	336.31	3.19	10.63	44.37	
10	1/24/2006 12:35	2/6/2006 13:25	0.59+	R+S+DF	ST	NA	NA	147.82	68.43	131.89	1.37	0.95	26.12	125
11	2/6/2006 13:25	2/23/2006 9:50	0.12	S+DF	ST	NA	NA	68.63	75.46	92.67	2.55	0.32	5.27	126
12	2/23/2006 9:50	3/8/2006 12:15	1.66	R+S+DF	ST	4.90	12.59	128.95	77.48	180.83	3.42	5.65	19.51	
13	3/8/2006 12:15	4/6/2006 10:45	0.06+	R+S+DF	ST	NA	NA	8.04	9.38	27.78	1.39	6.86	3.72	127
14	4/6/2006 10:45	4/21/2006 10:15	0.18	R+S+DF	ST	NA	NA	581.99	783.90	NA	11.13	18.70	NA	
15	4/21/2006 10:15	5/5/2006 12:55	0.53	R+DF	ST	4.29	51.29	NA	557.32	586.96	18.97	28.91	47.02	
16	5/5/2006 12:55	6/14/2006 9:45	0.20	R+DF	ST	NA	NA	493.91	589.89	843.46	15.62	33.72	59.74	136
17	6/14/2006 9:45	6/23/2006 12:25	0.00	DF	ST	NA	NA	7.30	24.00	283.27	15.16	33.41	55.15	137
	6/23/2006 12:25	6/29/2006 10:05	0.00	DF	ST	NA	NA	NA	NA	NA	NA	NA	NA	

Table 6b. Precipitation amounts, pH, N and P loads in bulk deposition collected in Snow Tube collector at the Mid-Lake Buoy (TB-1) Station 7/1/05 to 6/30/06.

Tab. 6b	Mid-lake	Snow Tube					(Load)						
Samp. No.	Start Date-Time	Collection Date-Time	Precip (in.)	Precip. Form	Collector Type	H+ (g/ha)	NO3-N (g/ha)	NH4-N (g/ha)	TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
1	6/29/2005 10:50	7/13/2005 12:49	0.00	DF	ST	NA	3.15	7.28	46.85	2.66	3.09	9.39	
	7/13/2005 12:49	7/27/2005 8:55	0.00	DF	ST	C	C	C	C	C	C	C	92
2	7/27/2005 8:55	8/6/2005 10:50	0.01	R+DF	ST	NA	NA	NA	NA	NA	NA	NA	75
3	8/6/2005 10:50	8/18/2005 7:28		R+DF	ST	NA	12.46	17.59	67.50	6.81	7.53	NA	90
4	8/18/2005 7:28	8/26/2005 13:46	0.00	DF	ST	NA	4.46	12.35	18.50	0.96	1.06	1.78	91
	8/26/2005 13:46	9/6/2005 12:35	0.00	DF	ST	NA	NA	NA	NA	NA	NA	NA	93
5	9/6/2005 12:35	9/15/2005 15:32	0.00	DF	ST	NA	3.93	11.00	43.29	0.42	1.06	NA	72
6	9/15/2005 15:32	9/27/2005 12:05	0.11	R+S+DF	ST	NA	C	C	C	C	C	C	76
7	9/27/2005 12:05	10/6/2005 13:00	0.00	DF	ST	NA	2.49	9.65	9.65	0.28	0.77	1.60	103
8	10/6/2005 13:00	10/20/2005 13:15	0.15	R+S+DF	ST	0.77	C	C	C	C	C	C	104
	10/20/2005 13:15	11/10/2005 12:55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
	11/10/2005 12:55	11/18/2005 10:05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	106
	11/18/2005 10:05	12/6/2005 13:02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	107
	12/6/2005 13:02	12/23/2005 12:30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
	12/23/2005 12:30	1/4/2006 12:47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
9	1/4/2006 12:47	1/24/2006 12:35	0.37	S+DF	ST	0.59	49.46	9.44	31.61	0.30	1.00	4.17	
10	1/24/2006 12:35	2/6/2006 13:25	0.59+	R+S+DF	ST	NA	22.15	10.25	19.77	0.21	0.14	3.91	125
11	2/6/2006 13:25	2/23/2006 9:50	0.12	S+DF	ST	NA	10.58	11.63	14.28	0.39	0.05	0.81	126
12	2/23/2006 9:50	3/8/2006 12:15	1.66	R+S+DF	ST	5.31	54.37	32.67	76.25	1.44	2.38	8.23	
13	3/8/2006 12:15	4/6/2006 10:45	0.06+	R+S+DF	ST	NA	1.24	1.45	4.28	0.21	1.06	1.06*	127
14	4/6/2006 10:45	4/21/2006 10:15	0.18	R+S+DF	ST	NA	26.61	35.84	NA	0.51	0.85	NA	
15	4/21/2006 10:15	5/5/2006 12:55	0.53	R+DF	ST	6.90	NA	75.03	79.02	2.55	3.89	6.33	
16	5/5/2006 12:55	6/14/2006 9:45	0.20	R+DF	ST	NA	76.74	91.65	131.05	2.43	5.24	9.28	136
17	6/14/2006 9:45	6/23/2006 12:25	0.00	DF	ST	NA	1.13	3.70	43.66	2.34	5.15	8.50	137
	6/23/2006 12:25	6/29/2006 10:05	0.00	DF	ST	NA	NA	NA	NA	NA	NA	NA	

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table 6c. Precipitation amounts, pH, N and P load per day in bulk deposition to Snow Tube collector at the Mid-Lake Buoy (TB-1) Station 7/1/05 to 6/30/06.

Tab. 6c Samp. No.	Mid-lake Start Date-Time	Snow Tube Collection Date-Time	Precip. (in.)	Precip. Form	Collector Type	H+ (g/ha/d)	(Load) NO3-N (g/ha/d)	NH4-N (g/ha/d)	TKN (g/ha/d)	SRP (g/ha/d)	DP (g/ha/d)	TP (g/ha/d)	Notes
1	6/29/2005 10:50	7/13/2005 12:49	0.00	DF	ST	NA	0.22	0.52	3.33	0.19	0.22	0.67	
	7/13/2005 12:49	7/27/2005 8:55	0.00	DF	ST	C	C	C	C	C	C	C	92
2	7/27/2005 8:55	8/6/2005 10:50	0.01	R+DF	ST	NA	NA	NA	NA	NA	NA	NA	75
3	8/6/2005 10:50	8/18/2005 7:28		R+DF	ST	NA	1.05	1.48	5.69	0.57	0.63	NA	90
4	8/18/2005 7:28	8/26/2005 13:46	0.00	DF	ST	NA	0.54	1.49	2.24	0.12	0.13	0.22	91
	8/26/2005 13:46	9/6/2005 12:35	0.00	DF	ST	NA	NA	NA	NA	NA	NA	NA	93
5	9/6/2005 12:35	9/15/2005 15:32	0.00	DF	ST	NA	0.43	1.21	4.74	0.05	0.12	NA	72
6	9/15/2005 15:32	9/27/2005 12:05	0.11	R+S+DF	ST	NA	C	C	C	C	C	C	76
7	9/27/2005 12:05	10/6/2005 13:00	0.00	DF	ST	NA	0.28	1.07	1.07	0.03	0.09	0.18	103
8	10/6/2005 13:00	10/20/2005 13:15	0.15	R+S+DF	ST	0.06	C	C	C	C	C	C	104
	10/20/2005 13:15	11/10/2005 12:55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
	11/10/2005 12:55	11/18/2005 10:05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	106
	11/18/2005 10:05	12/6/2005 13:02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	107
	12/6/2005 13:02	12/23/2005 12:30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
	12/23/2005 12:30	1/4/2006 12:47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105
9	1/4/2006 12:47	1/24/2006 12:35	0.37	S+DF	ST	0.03	2.47	0.47	1.58	0.01	0.05	0.21	
10	1/24/2006 12:35	2/6/2006 13:25	0.59+	R+S+DF	ST	NA	1.70	0.79	1.52	0.02	0.01	0.30	125
11	2/6/2006 13:25	2/23/2006 9:50	0.12	S+DF	ST	NA	0.63	0.69	0.85	0.02	0.00	0.05	126
12	2/23/2006 9:50	3/8/2006 12:15	1.66	R+S+DF	ST	0.41	4.15	2.49	5.82	0.11	0.18	0.63	
13	3/8/2006 12:15	4/6/2006 10:45	0.06+	R+S+DF	ST	NA	0.04	0.05	0.15	0.01	0.04	0.04*	127
14	4/6/2006 10:45	4/21/2006 10:15	0.18	R+S+DF	ST	NA	1.78	2.39	NA	0.03	0.06	NA	
15	4/21/2006 10:15	5/5/2006 12:55	0.53	R+DF	ST	0.49	NA	5.32	5.60	0.18	0.28	0.45	
16	5/5/2006 12:55	6/14/2006 9:45	0.20	R+DF	ST	NA	1.92	2.30	3.29	0.06	0.13	0.23	136
17	6/14/2006 9:45	6/23/2006 12:25	0.00	DF	ST	NA	0.12	0.41	4.79	0.26	0.57	0.93	137
	6/23/2006 12:25	6/29/2006 10:05	0.00	DF	ST	NA	NA	NA	NA	NA	NA	NA	

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table 7a. N, P, and H concentrations in dry-bulk deposition (buoy bucket collector) at the Mid-Lake Buoy (TB-1) Station 7/1/05-6/30/06.

Tab.7a Samp. No.	Mid-lake Station Start Date-Time	Dry-Bulk Collection Date-Time	Vol. Liters	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	6/29/2005 10:50	7/13/2005 12:49	0.500	DF	DRY-BULK	NA	NA	276.55	246.79	884.84	13.59	22.85	NA	77
2	7/13/2005 12:49	7/27/2005 8:55	0.500	DF	DRY-BULK	NA	NA	C	C	C	C	C	C	78
3	7/27/2005 8:55	8/6/2005 10:50	0.500	DF	DRY-BULK	5.18	6.61	C	C	C	C	C	C	79
4	8/6/2005 10:50	8/18/2005 7:28	0.500	R+DF	DRY-BULK	4.52	30.20	619.47	322.45	743.90	6.68	8.76	NA	80
5	8/18/2005 7:28	8/26/2005 13:46	0.435	DF	DRY-BULK	4.51	30.90	497.79	779.69	NA	37.99	46.64	50.02	81
6	8/26/2005 13:46	9/6/2005 12:35	0.500	DF	DRY-BULK	NA	NA	19.57	420.04	750.77	2.95	8.45	NA	82
7	9/6/2005 12:35	9/15/2005 15:32	0.699	DF	DRY-BULK	4.49	32.36	321.65	613.02	847.03	8.18	17.21	NA	88
8	9/15/2005 15:32	9/27/2005 12:05	0.500	DF	DRY-BULK	NA	NA	554.80	602.06	922.65	8.18	11.58	NA	83
9	9/27/2005 12:05	10/6/2005 13:00	0.678	DF	DRY-BULK	4.37	42.66	298.67	363.23	562.07	6.36	9.08	18.57	
10	10/6/2005 13:00	10/20/2005 13:15	0.290	R+S+DF	DRY-BULK	5.09	8.13	943.67	1549.94	1938.12	5.49	24.41	92.74	108
11	10/20/2005 13:15	11/10/2005 12:55	0.190	R+S+DF	DRY-BULK	4.51	30.90	851.97	950.69	1177.40	7.33	11.53	34.27	109
12	11/10/2005 12:55	11/18/2005 10:05	1.835	DF	DRY-BULK	5.00	10.00	57.85	32.23	74.75	0.92	3.46	4.36	108
13	11/18/2005 10:05	12/6/2005 13:02	2.325	R+S+DF	DRY-BULK	4.98	10.47	47.20	14.54	159.51	1.14	6.61	20.79	110
14	12/6/2005 13:02	12/23/2005 12:30	3.121	R+S+DF	DRY-BULK	NA	NA	51.42	13.12	37.71	2.29	5.04	3.46	110
15	12/23/2005 12:30	1/4/2006 13:25	2.514	R+S+DF	DRY-BULK	5.11	7.76	26.45	10.42	16.08	0.69	3.78	5.66	110
16	1/4/2006 13:25	1/24/2006 12:35	0.500	S+DF	DRY-BULK	<5.6	>2.51	374.18	128.74	329.34	1.14	5.63	36.19	128
17	1/24/2006 12:35	2/6/2006 13:25	1.136	R+S+DF	DRY-BULK	5.06	8.71	79.92	107.64	133.94	1.14	0.32	64.51	
18	2/6/2006 13:25	2/23/2006 9:50	1.065	S+DF	DRY-BULK	4.90	12.59	155.65	123.83	140.42	4.63	3.17	22.82	
19	2/23/2006 9:50	3/8/2006 12:15	1.796	R+S+DF	DRY-BULK	4.91	12.30	67.76	41.93	131.55	2.28	4.08	11.33	
20	3/8/2006 12:15	4/6/2006 10:45	1.105	R+S+DF	DRY-BULK	4.79	16.22	153.73	150.48	177.32	5.10	11.22	12.71	
21	4/6/2006 10:45	4/21/2006 10:15	0.524	R+S+DF	DRY-BULK	4.61	24.55	187.69	304.04	427.09	6.72	14.34	12.71	
22	4/21/2006 10:15	5/5/2006 12:55	1.102	R+DF	DRY-BULK	NA	NA	380.98	295.02	507.91	23.45	29.86	57.60	
23	5/5/2006 12:55	6/14/2006 9:45	0.500	R+DF	DRY-BULK	NA	NA	344.02	387.21	1152.85	35.91	65.56	117.65	
24	6/14/2006 9:45	6/23/2006 12:25	0.500	DF	DRY-BULK	NA	NA	63.33	64.00	603.74	7.93	26.85	75.98	138
25	6/23/2006 12:25	6/29/2006 10:05	1.879	DF	DRY-BULK	NA	NA	110.53	121.00	224.08	0.46	11.86	18.08	

Table 7b. N, P, and H loads in dry-bulk deposition (buoy bucket collector) at the Mid-Lake Buoy (TB-1) Station 7/1/05-6/30/06.

Tab.7b Samp. No.	Mid-lake Station Start Date-Time	Dry-Bulk Collection Date-Time	Vol. Liters	Precip. Form	Collector Type	H+ (g/ha)	(Load) NO3-N (g/ha)	NH4-N (g/ha)	TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
1	6/29/2005 10:50	7/13/2005 12:49	0.500	DF	DRY-BULK	NA	27.29	24.35	87.31	1.34	2.25	NA	77
2	7/13/2005 12:49	7/27/2005 8:55	0.500	DF	DRY-BULK	NA	C	C	C	C	C	C	78
3	7/27/2005 8:55	8/6/2005 10:50	0.500	DF	DRY-BULK	0.65	C	C	C	C	C	C	79
4	8/6/2005 10:50	8/18/2005 7:28	0.500	R+DF	DRY-BULK	3.13	64.30	33.47	77.22	0.69	0.91	NA	80
5	8/18/2005 7:28	8/26/2005 13:46	0.435	DF	DRY-BULK	2.65	42.73	66.94	NA	3.26	4.00	4.29	81
6	8/26/2005 13:46	9/6/2005 12:35	0.500	DF	DRY-BULK	NA	2.03	43.60	77.93	0.31	0.88	NA	82
7	9/6/2005 12:35	9/15/2005 15:32	0.699	DF	DRY-BULK	4.46	44.37	84.57	116.85	1.13	2.37	NA	88
8	9/15/2005 15:32	9/27/2005 12:05	0.500	DF	DRY-BULK	NA	57.59	62.49	95.77	0.85	1.20	NA	83
9	9/27/2005 12:05	10/6/2005 13:00	0.678	DF	DRY-BULK	6.00	42.04	51.13	79.11	0.90	1.28	2.61	
10	10/6/2005 13:00	10/20/2005 13:15	0.290	R+S+DF	DRY-BULK	0.47	54.01	88.71	110.92	0.31	1.40	5.31	108
11	10/20/2005 13:15	11/10/2005 12:55	0.190	R+S+DF	DRY-BULK	1.16	31.95	35.65	44.15	0.27	0.43	1.29	109
12	11/10/2005 12:55	11/18/2005 10:05	1.835	DF	DRY-BULK	3.62	20.95	11.67	27.07	0.33	1.25	1.58	108
13	11/18/2005 10:05	12/6/2005 13:02	2.325	R+S+DF	DRY-BULK	4.80	21.66	6.67	73.19	0.52	3.03	9.54	110
14	12/6/2005 13:02	12/23/2005 12:30	3.121	R+S+DF	DRY-BULK	NA	31.67	8.08	23.23	1.41	3.10	3.10	110
15	12/23/2005 12:30	1/4/2006 13:25	2.514	R+S+DF	DRY-BULK	3.85	13.12	5.17	7.98	0.34	1.88	2.81	110
16	1/4/2006 13:25	1/24/2006 12:35	0.500	S+DF	DRY-BULK	>0.02	36.92	12.70	32.50	0.11	0.56	3.57	128
17	1/24/2006 12:35	2/6/2006 13:25	1.136	R+S+DF	DRY-BULK	2.05	18.85	25.39	31.59	0.27	0.08	15.21	
18	2/6/2006 13:25	2/23/2006 9:50	1.065	S+DF	DRY-BULK	2.65	32.71	26.03	29.51	0.97	0.67	4.80	
19	2/23/2006 9:50	3/8/2006 12:15	1.796	R+S+DF	DRY-BULK	4.36	24.02	14.86	46.63	0.81	1.45	4.02	
20	3/8/2006 12:15	4/6/2006 10:45	1.105	R+S+DF	DRY-BULK	3.54	33.52	32.82	38.67	1.11	2.45	2.77	
21	4/6/2006 10:45	4/21/2006 10:15	0.524	R+S+DF	DRY-BULK	2.67	20.42	33.07	46.46	0.73	1.56	1.56*	
22	4/21/2006 10:15	5/5/2006 12:55	1.102	R+DF	DRY-BULK	NA	82.86	64.16	110.46	5.10	6.49	12.53	
23	5/5/2006 12:55	6/14/2006 9:45	0.500	R+DF	DRY-BULK	NA	35.71	40.19	119.67	3.73	6.81	12.21	
24	6/14/2006 9:45	6/23/2006 12:25	0.500	DF	DRY-BULK	NA	6.25	6.32	59.57	0.78	2.65	7.50	138
25	6/23/2006 12:25	6/29/2006 10:05	1.879	DF	DRY-BULK	NA	40.99	44.87	83.09	0.17	4.40	6.70	

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table 7c. N, P, and H loading per day in dry-bulk deposition (buoy bucket collector) at the Mid-Lake Buoy (TB-1) Station 7/1/05-6/30/06.

Tab.7c Samp. No.	Mid-lake Station Start Date-Time	Dry-Bulk Collection Date-Time	Vol. Liters	Precip. Form	Collector Type	(Load) H+ (g/ha/d)	NO3-N (g/ha/d)	NH4-N (g/ha/d)	TKN (g/ha/d)	SRP (g/ha/d)	DP (g/ha/d)	TP (g/ha/d)	Notes
1	6/29/2005 10:50	7/13/2005 12:49	0.5	DF	DRY-BULK	NA	1.94	1.73	6.20	0.10	0.16	NA	77
2	7/13/2005 12:49	7/27/2005 8:55	0.5	DF	DRY-BULK	NA	C	C	C	C	C	C	78
3	7/27/2005 8:55	8/6/2005 10:50	0.5	DF	DRY-BULK	0.06	C	C	C	C	C	C	79
4	8/6/2005 10:50	8/18/2005 7:28	0.5	R+DF	DRY-BULK	0.26	5.42	2.82	6.51	0.06	0.08	NA	80
5	8/18/2005 7:28	8/26/2005 13:46	0.435	DF	DRY-BULK	0.32	5.17	8.10	NA	0.39	0.48	0.52	81
6	8/26/2005 13:46	9/6/2005 12:35	0.5	DF	DRY-BULK	NA	0.19	3.98	7.12	0.03	0.08	NA	82
7	9/6/2005 12:35	9/15/2005 15:32	0.699	DF	DRY-BULK	0.49	4.86	9.27	12.81	0.12	0.26	NA	88
8	9/15/2005 15:32	9/27/2005 12:05	0.5	DF	DRY-BULK	NA	4.86	5.27	8.08	0.07	0.10	NA	83
9	9/27/2005 12:05	10/6/2005 13:00	0.678	DF	DRY-BULK	0.66	4.65	5.66	8.75	0.10	0.14	0.29	
10	10/6/2005 13:00	10/20/2005 13:15	0.29	R+S+DF	DRY-BULK	0.03	3.85	6.33	7.92	0.02	0.10	0.38	108
11	10/20/2005 13:15	11/10/2005 12:55	0.19	R+S+DF	DRY-BULK	0.06	1.52	1.70	2.10	0.01	0.02	0.06	109
12	11/10/2005 12:55	11/18/2005 10:05	1.835	DF	DRY-BULK	0.46	2.66	1.48	3.43	0.04	0.16	0.20	108
13	11/18/2005 10:05	12/6/2005 13:02	2.325	R+S+DF	DRY-BULK	0.27	1.20	0.37	4.04	0.03	0.17	0.53	110
14	12/6/2005 13:02	12/23/2005 12:30	3.121	R+S+DF	DRY-BULK	NA	1.87	0.48	1.37	0.08	0.18	0.18	110
15	12/23/2005 12:30	1/4/2006 13:25	2.514	R+S+DF	DRY-BULK	0.32	1.09	0.43	0.66	0.03	0.16	0.23	110
16	1/4/2006 13:25	1/24/2006 12:35	0.5	S+DF	DRY-BULK	NA	1.85	0.64	1.63	0.01	0.03	0.18	128
17	1/24/2006 12:35	2/6/2006 13:25	1.136	R+S+DF	DRY-BULK	0.16	1.45	1.95	2.42	0.02	0.01	1.17	
18	2/6/2006 13:25	2/23/2006 9:50	1.065	S+DF	DRY-BULK	0.16	1.94	1.54	1.75	0.06	0.04	0.28	
19	2/23/2006 9:50	3/8/2006 12:15	1.796	R+S+DF	DRY-BULK	0.33	1.83	1.13	3.56	0.06	0.11	0.31	
20	3/8/2006 12:15	4/6/2006 10:45	1.105	R+S+DF	DRY-BULK	0.12	1.16	1.13	1.34	0.04	0.08	0.10	
21	4/6/2006 10:45	4/21/2006 10:15	0.524	R+S+DF	DRY-BULK	0.18	1.36	2.21	3.10	0.05	0.10	0.10*	
22	4/21/2006 10:15	5/5/2006 12:55	1.102	R+DF	DRY-BULK	NA	5.87	4.55	7.83	0.36	0.46	0.89	
23	5/5/2006 12:55	6/14/2006 9:45	0.5	R+DF	DRY-BULK	NA	0.90	1.01	3.00	0.09	0.17	0.31	
24	6/14/2006 9:45	6/23/2006 12:25	0.5	DF	DRY-BULK	NA	0.69	0.69	6.54	0.09	0.29	0.82	138
25	6/23/2006 12:25	6/29/2006 10:05	1.879	DF	DRY-BULK	NA	6.94	7.60	14.08	0.03	0.75	1.14	

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table 8a. N, P, and H concentrations in dry-bulk deposition (buoy bucket collector) at the Northwest Buoy (TB-4) Station 7/1/05-6/30/06.

Tab.8a Samp. No.	Buoy TB-4 Start Date-Time	Dry-Bulk Collection Date-Time	Vol. Liters	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	6/29/2005 10:30	7/13/2005 12:26	0.500	DF	DRY-BULK	NA	NA	171.89	134.95	565.14	7.37	14.08	NA	82
2	7/13/2005 12:26	7/27/2005 8:35	0.500	DF	DRY-BULK	NA	NA	368.45	193.06	833.28	10.13	15.34	NA	82
3	7/27/2005 8:35	8/6/2005 10:32	0.500	DF	DRY-BULK	4.70	19.95	453.54	619.60	1013.75	6.45	10.64	NA	84
4	8/6/2005 10:32	8/18/2005 7:13	0.426	R+DF	DRY-BULK	4.40	39.81	1045.78	1039.56	3934.00	130.32	195.62	NA	85
5	8/18/2005 7:13	8/26/2005 13:25	0.500	DF	DRY-BULK	4.80	15.85	427.59	617.41	834.36	5.07	8.61	12.19	86
6	8/26/2005 13:25	9/6/2005 12:03	0.500	DF	DRY-BULK	NA	NA	NA	369.60	651.08	4.32	10.95	NA	87
7	9/6/2005 12:03	9/15/2005 15:10	0.763	DF	DRY-BULK	4.60	25.12	244.21	520.92	740.46	10.22	14.40	NA	88
8	9/15/2005 15:10	9/27/2005 11:40	0.500	DF	DRY-BULK	NA	NA	513.96	586.71	1015.47	4.54	8.45	NA	89
9	9/27/2005 11:40	10/6/2005 12:24	0.565	DF	DRY-BULK	4.34	45.71	350.58	460.61	641.62	5.91	8.45	28.01	
10	10/6/2005 12:24	10/20/2005 13:50	0.098	R+S+DF	DRY-BULK	4.89	12.88	559.90	909.75	1072.77	3.66	12.21	37.84	112
11	10/20/2005 13:50	11/10/2005 13:30	0.385	R+S+DF	DRY-BULK	4.41	38.90	111.07	1547.66	1511.64	8.01	6.85	21.81	
12	11/10/2005 13:30	11/18/2005 9:50	1.815	DF	DRY-BULK	5.10	7.94	54.91	33.06	81.22	0.46	9.23	3.43	
13	11/18/2005 9:50	12/6/2005 13:45	2.276	R+S+DF	DRY-BULK	5.09	8.13	37.28	15.17	32.72	0.23	8.31	12.10	110
14	12/6/2005 13:45	12/23/2005 12:05	2.892	R+S+DF	DRY-BULK	NA	NA	52.16	11.09	42.56	1.83	6.30	4.40	110
15	12/23/2005 12:05	1/4/2006 12:47	3.735	R+S+DF	DRY-BULK	5.15	7.08	9.00	10.42	7.41	1.14	3.46	3.46	110
16	1/4/2006 12:47	1/24/2006 11:45	0.225	S+DF	DRY-BULK	<5.6	>2.51	364.31	146.63	313.58	0.91	5.79	28.01	
17	1/24/2006 11:45	2/6/2006 12:51	1.570	R+S+DF	DRY-BULK	4.92	12.02	56.07	55.65	68.11	0.91	0.80	11.33	
18	2/6/2006 12:51	2/23/2006 9:35	0.996	S+DF	DRY-BULK	4.90	12.59	182.24	118.51	144.17	4.63	1.90	26.12	
19	2/23/2006 9:35	3/8/2006 12:58	1.509	R+S+DF	DRY-BULK	5.02	9.55	52.63	38.92	88.23	2.28	3.45	11.96	
20	3/8/2006 12:58	4/6/2006 12:54	1.969	R+S+DF	DRY-BULK	4.88	13.18	96.31	107.40	141.87	2.78	9.66	7.29	
21	4/6/2006 12:54	4/21/2006 9:35	0.714	R+S+DF	DRY-BULK	4.70	19.95	230.90	343.60	420.08	6.26	12.78	24.48	
22	4/21/2006 9:35	5/5/2006 16:40	0.830	R+DF	DRY-BULK	4.41	38.90	561.12	494.22	755.80	22.99	29.54	55.76	
23	5/5/2006 16:40	6/14/2006 9:25	1.955	R+DF	DRY-BULK	NA	NA	115.79	105.80	341.97	8.98	23.73	39.83	
24	6/14/2006 9:45	6/23/2006 12:25	0.500	DF	DRY-BULK	NA	NA	93.38	127.00	392.08	7.23	24.35	37.99	137
25	6/23/2006 12:25	6/29/2006 10:05	1.872	DF	DRY-BULK	NA	NA	103.06	140.00	189.95	0.23	12.18	10.42	

Table 8b. N, P, and H loading in dry-bulk deposition (buoy bucket collector) at the Northwest Buoy (TB-4) Station 7/1/05-6/30/06

Tab.8b Samp. No.	Buoy TB-4 Start Date-Time	Dry-Bulk Collection Date-Time	Vol. Liters	Precip. Form	Collector Type	H+ (g/ha)	(Load) NO3-N (g/ha)	NH4-N (g/ha)	TKN (g/ha)	SRP (g/ha)	DP (g/ha)	TP (g/ha)	Notes
1	6/29/2005 10:30	7/13/2005 12:26	0.500	DF	DRY-BULK	NA	16.96	13.32	55.77	0.73	1.39	NA	82
2	7/13/2005 12:26	7/27/2005 8:35	0.500	DF	DRY-BULK	NA	36.36	19.05	82.23	1.00	1.51	NA	82
3	7/27/2005 8:35	8/6/2005 10:32	0.500	DF	DRY-BULK	1.97	44.75	61.14	100.03	0.64	1.05	NA	84
4	8/6/2005 10:32	8/18/2005 7:13	0.426	R+DF	DRY-BULK	3.35	87.92	87.40	330.74	10.96	16.45	NA	85
5	8/18/2005 7:13	8/26/2005 13:25	0.500	DF	DRY-BULK	1.56	42.19	60.92	82.33	0.50	0.85	1.20	86
6	8/26/2005 13:25	9/6/2005 12:03	0.500	DF	DRY-BULK	NA	NA	36.47	64.25	0.43	1.08	NA	87
7	9/6/2005 12:03	9/15/2005 15:10	0.763	DF	DRY-BULK	3.98	38.68	82.51	117.29	1.62	2.28	NA	88
8	9/15/2005 15:10	9/27/2005 11:40	0.500	DF	DRY-BULK	NA	50.72	57.89	100.20	0.45	0.83	NA	89
9	9/27/2005 11:40	10/6/2005 12:24	0.565	DF	DRY-BULK	5.10	39.09	51.36	71.54	0.66	0.94	3.12	
10	10/6/2005 12:24	10/20/2005 13:50	0.098	R+S+DF	DRY-BULK	0.25	10.83	17.60	20.75	0.07	0.24	0.73	112
11	10/20/2005 13:50	11/10/2005 13:30	0.385	R+S+DF	DRY-BULK	3.11	8.88	123.70	123.70*	0.64	0.55	1.74	
12	11/10/2005 13:30	11/18/2005 9:50	1.815	DF	DRY-BULK	2.85	19.67	11.84	29.09	0.16	3.31	3.31	
13	11/18/2005 9:50	12/6/2005 13:45	2.276	R+S+DF	DRY-BULK	3.65	16.75	6.81	14.70	0.10	3.73	5.44	110
14	12/6/2005 13:45	12/23/2005 12:05	2.892	R+S+DF	DRY-BULK	NA	29.77	6.33	24.29	1.04	3.60	3.60	110
15	12/23/2005 12:05	1/4/2006 12:47	3.735	R+S+DF	DRY-BULK	5.49	6.98	8.08	8.08	0.88	2.68	2.68	110
16	1/4/2006 12:47	1/24/2006 11:45	0.225	S+DF	DRY-BULK	>0.02	16.18	6.51	13.92	0.04	0.26	1.24	
17	1/24/2006 11:45	2/6/2006 12:51	1.570	R+S+DF	DRY-BULK	3.92	18.28	18.14	22.20	0.30	0.26	3.69	
18	2/6/2006 12:51	2/23/2006 9:35	0.996	S+DF	DRY-BULK	2.47	35.82	23.29	28.34	0.91	0.37	5.13	
19	2/23/2006 9:35	3/8/2006 12:58	1.509	R+S+DF	DRY-BULK	2.99	16.49	12.19	27.64	0.71	1.08	3.75	
20	3/8/2006 12:58	4/6/2006 12:54	1.969	R+S+DF	DRY-BULK	5.12	37.42	41.73	55.13	1.08	3.75	3.75	
21	4/6/2006 12:54	4/21/2006 9:35	0.714	R+S+DF	DRY-BULK	2.81	32.54	48.42	59.19	0.88	1.80	3.45	
22	4/21/2006 9:35	5/5/2006 16:40	0.830	R+DF	DRY-BULK	6.37	91.91	80.95	123.80	3.77	4.84	9.13	
23	5/5/2006 16:40	6/14/2006 9:25	1.955	R+DF	DRY-BULK	NA	44.67	40.82	131.94	3.46	9.16	15.37	
24	6/14/2006 9:45	6/23/2006 12:25	0.500	DF	DRY-BULK	NA	9.21	12.53	38.69	0.71	2.40	3.75	137
25	6/23/2006 12:25	6/29/2006 10:05	1.872	DF	DRY-BULK	NA	40.05	54.41	73.82	0.09	4.73	4.73	

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table 8c. N, P, and H loading per day in dry-bulk deposition (buoy bucket collector) at the Northwest Buoy (TB-4) Station 7/1/05-6/30/06

Tab.8c Samp. No.	Buoy TB-4 Start Date-Time	Dry-Bulk Collection Date-Time	Vol. Liters	Precip. Form	Collector Type	H+ (g/ha/d)	NO3-N (g/ha/d)	NH4-N (g/ha/d)	TKN (g/ha/d)	SRP (g/ha/d)	DP (g/ha/d)	TP (g/ha/d)	Notes
1	6/29/2005 10:30	7/13/2005 12:26	0.500	DF	DRY-BULK	NA	1.20	0.95	3.96	0.05	0.10	NA	82
2	7/13/2005 12:26	7/27/2005 8:35	0.500	DF	DRY-BULK	NA	2.63	1.38	5.94	0.07	0.11	NA	82
3	7/27/2005 8:35	8/6/2005 10:32	0.500	DF	DRY-BULK	0.20	4.44	6.06	9.92	0.06	0.10	NA	84
4	8/6/2005 10:32	8/18/2005 7:13	0.426	R+DF	DRY-BULK	0.28	7.41	7.37	27.88	0.92	1.39	NA	85
5	8/18/2005 7:13	8/26/2005 13:25	0.500	DF	DRY-BULK	0.19	5.11	7.38	9.97	0.06	0.10	0.15	86
6	8/26/2005 13:25	9/6/2005 12:03	0.500	DF	DRY-BULK	NA	NA	3.33	5.87	0.04	0.10	NA	87
7	9/6/2005 12:03	9/15/2005 15:10	0.763	DF	DRY-BULK	0.44	4.24	9.04	12.85	0.18	0.25	NA	88
8	9/15/2005 15:10	9/27/2005 11:40	0.500	DF	DRY-BULK	NA	4.28	4.88	8.45	0.04	0.07	NA	89
9	9/27/2005 11:40	10/6/2005 12:24	0.565	DF	DRY-BULK	0.56	4.33	5.69	7.92	0.07	0.10	0.35	
10	10/6/2005 12:24	10/20/2005 13:50	0.098	R+S+DF	DRY-BULK	0.02	0.77	1.25	1.48	0.01	0.02	0.05	112
11	10/20/2005 13:50	11/10/2005 13:30	0.385	R+S+DF	DRY-BULK	0.15	0.42	5.89	5.89*	0.03	0.03	0.08	
12	11/10/2005 13:30	11/18/2005 9:50	1.815	DF	DRY-BULK	0.36	2.51	1.51	3.71	0.02	0.42	0.42*	
13	11/18/2005 9:50	12/6/2005 13:45	2.276	R+S+DF	DRY-BULK	0.20	0.92	0.38	0.81	0.01	0.21	0.30	110
14	12/6/2005 13:45	12/23/2005 12:05	2.892	R+S+DF	DRY-BULK	NA	1.76	0.37	1.43	0.06	0.21	0.21*	110
15	12/23/2005 12:05	1/4/2006 12:47	3.735	R+S+DF	DRY-BULK	0.46	0.58	0.67	0.67*	0.07	0.22	0.22	110
16	1/4/2006 12:47	1/24/2006 11:45	0.225	S+DF	DRY-BULK	NA	0.81	0.33	0.70	0.00	0.01	0.06	
17	1/24/2006 11:45	2/6/2006 12:51	1.570	R+S+DF	DRY-BULK	0.30	1.40	1.39	1.70	0.02	0.02	0.28	
18	2/6/2006 12:51	2/23/2006 9:35	0.996	S+DF	DRY-BULK	0.15	2.12	1.38	1.68	0.05	0.02	0.30	
19	2/23/2006 9:35	3/8/2006 12:58	1.509	R+S+DF	DRY-BULK	0.23	1.25	0.93	2.10	0.05	0.08	0.29	
20	3/8/2006 12:58	4/6/2006 12:54	1.969	R+S+DF	DRY-BULK	0.18	1.29	1.44	1.90	0.04	0.13	0.13*	
21	4/6/2006 12:54	4/21/2006 9:35	0.714	R+S+DF	DRY-BULK	0.19	2.19	3.26	3.98	0.06	0.12	0.23	
22	4/21/2006 9:35	5/5/2006 16:40	0.830	R+DF	DRY-BULK	0.45	6.43	5.66	8.66	0.26	0.34	0.64	
23	5/5/2006 16:40	6/14/2006 9:25	1.955	R+DF	DRY-BULK	NA	1.13	1.03	3.32	0.09	0.23	0.39	
24	6/14/2006 9:45	6/23/2006 12:25	0.500	DF	DRY-BULK	NA	1.01	1.38	4.25	0.08	0.26	0.41	137
25	6/23/2006 12:25	6/29/2006 10:05	1.872	DF	DRY-BULK	NA	6.79	9.22	12.51	0.02	0.80	0.80*	

Note- * = Indicates either TKN or TP concentration was less than NH4-N or DP concentration respectively, therefore, used higher dissolved fraction to calculate load.

Table Legend and Notes:

Table Legend:

Precipitation Form: (S=snow; R=rain; DF= dry fall (Dry deposition); H=hail; G=graupel; 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:

(70) ST dry added 500 ml deionized H2O to process; (71) ST had 100ml of precipitation, added 400ml deionized H2O to process, many bugs in sample; (72) ST dry, added 500ml DIW to process, used non-precombusted filter to filter; (73) 7 ml of sample, added 493ml DIW to process; (74) much pollen in sample; (75) ST had 12ml precip added 488ml DIW to process; (76) ST had 90ml precip added 410ml DIW to process; (77) bucket dry, added 500ml DIW to process, much pollen; (78) bucket dry, added 500ml DIW to process, dead bee and many small bugs in bucket; (79) bucket had 1 bug and suds, maybe not enough DIW rinses last time washed; (80) 10ml precip in bucket, added 490ml DIW to process; (81) many plastic flakes; (82) bucket dry, added 500ml DIW to process; (83) 129ml sample in bucket, added 371ml DIW to process; (84) 70ml sample in bucket added 430ml DIW to process; (85) many bugs, pollen, some suds in sample, filter very dirty; (86) 145 ml sample, added 355ml DIW to process; (87) bucket dry, added 500ml DIW to process; (88) deionized water used suspect these samples, cartridges bad; (89) 145ml sample added 365ml DIW; (90) Trace amount of precip + 500ml DIW; (91) added 500ml DIW to process; (92) bird dung and many small bugs in ST, discarded; (93) ST dry, not processed; (94) 120 V AC power no longer supplied to station, Alpine Meadows is replacing chairlift, power no longer supplied to old blockhouse; (95) sample not collected for 1 week after storm; (96) ST had approximately 19 inches of frozen water with some snow in it at top; (97) 3 aspen leaves in wet bucket; (98) precipitation rain from system which had tropical moisture associated with it; (99) added 391ml DIW to 109 ml sample for processing; (100) power outage along west shore and Tahoe City 1/31/05-1/2/06, Aerochem Metrics lid stuck over dry bucket, wet bucket caught some dry deposition, dry bucket missed some dry deposition; (101) 10+ aspen leaves in dry bucket, hazy, smokey from controlled burns in basin; (102) many aspen leaves in dry bucket; (103) ST dry, added 500ml DIW to process; (104) ST water cloudy, filter brown with silt, also one small bug in sample, 120ml of sample, added 380ml of DIW to process; (105) no sample ST had leak; (106) ST cap plastic torn, ST cap returned to lab for repair, no sample; (107) no ST in place, ST cap in lab for repairs; (108) many plastic flakes in sample; (109) 190ml of sample + added 310ml DIW to process; (110) gusty winds this period, may have impacted bucket if caused some sample to spill; (strong winds and significant rain this period may have impacted sample); (112) 98 ml of sample + 402ml DIW added to process; (113) pH high, suspect; (114) small leak in bottom of tube; (115) Aerochem Metrics lid loose and plastic underneath ripped, poor seal over buckets, snow 4 inches above rim compacted; (116) Aerochem Metrics lid frozen over dry bucket, snow accumulated 10 inches above wet bucket rim; (117) snow 4-5 inches above bucket rim, compacted; (118) dry bucket caught majority of precipitation this storm, amount from TBG=1.25 inches, amount in wet bucket=0.15 inches; (119) nearly all snow caught by dry bucket again, left wet bucket out, changed dry bucket, replaced with a dry bucket without deionized water; (120) Aerochem Metrics sampler dry bucket caught all precipitation, replaced precipitation sensor with sensor from CARB Aerochem Metrics sampler; (121) Aerochem Metrics lid frozen over dry bucket during portion of the period; (122) added 1 liter of deionized water to dry 2/3/06; (123) ice on surface of sampler during portion of the period; (124) dry bucket caught nearly all snow this storm; (125) leak in corner of ST portion of sample lost; (126) 102ml of precipitation, added 398ml of deionized water to process; (127) ST had leak, 50 ml of sample left in ST, added 450ml of deionized water to process; (128) 140ml of sample, added 360ml of deionized water; (129) Dry bucket had 10ml of precipitation, added 490ml of deionized water to process, this was old-style dry bucket with no deionized water at start; (130) snow tube appears to have bridged, did not catch all precipitation; (131) sample sat out at site for approximately 12 days at station before collection; (132) much pollen; (133) heater plug briefly contacted sample water when moving; (134) trimmed aspen trees adjacent to station; (135) placed new bucket out after trimming trees; (136) added 341ml deionized water to 163ml sample to process; (137) ST dry, added 500ml deionized water to process; (138) bucket dry, added 500ml deionized water to process; (138) Dry bucket caught most of precipitation, load included with wet;

During July 1, 2005-June 30, 2006, 137 samples were collected from the 3 primary stations (32 dry bucket and 38 wet bucket samples from the Ward Lake Level station, 25 dry-bulk samples from each of the lake buoy stations and 17 Mid-lake snow tube samples). 32 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 can be characterized as a particularly "wet" one. Over 92.73 inches of precipitation fell at the Upper Ward Valley station and over 66.67 inches at the lower Ward Valley station during July 1, 2005-June 20, 2006. Total precipitation for Water Year 2006 (Oct. 1, 2005 – Sept. 30, 2006) was one of the highest precipitation years during LTIMP monitoring. Water Year 2006 total precipitation was 92.12 inches at the Upper Ward Valley station and 65.97 inches at the Lower Ward station. Since 1981 at the Lower Ward station, only WY 1995 had higher precipitation at 73.29 inches, while WY 1983 was slightly less than 2006 at 65.46 inches.

The outstanding precipitation features of this past year were the rain storms at the end of November 2005, the series of drenching rainstorms that occurred near the end of December 2005 and the steady progression of storms which occurred throughout March and the first half of April 2006 which contributed to a large spring snow pack. Figure 3

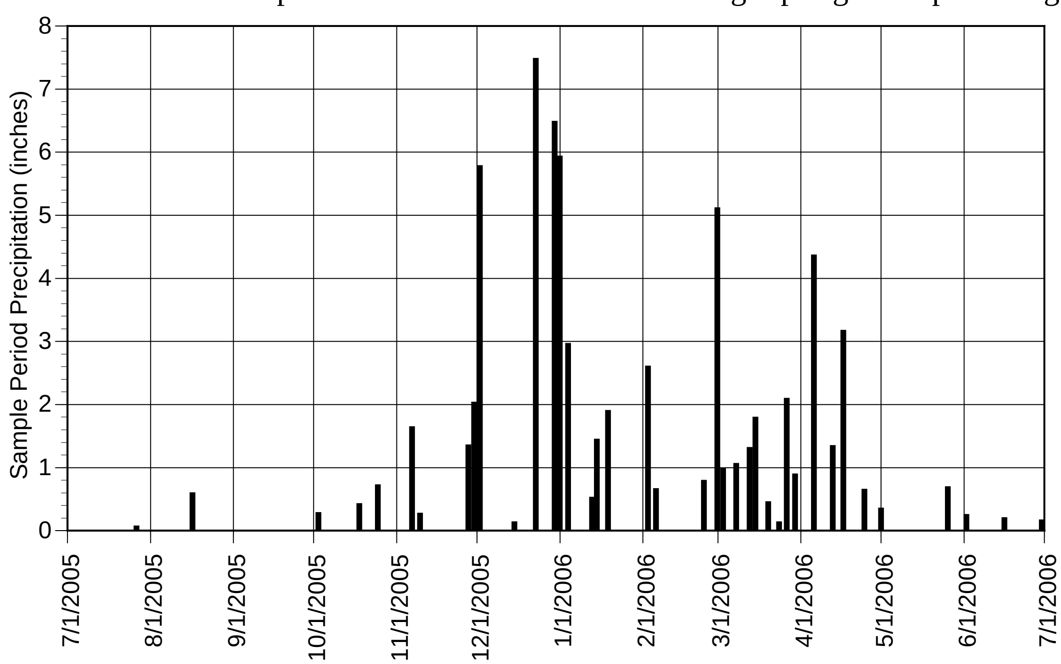


Figure 3. Chart showing precipitation amounts occurring at the Ward Valley Lake Level station during sample collection periods 7/1/05-6/30/06. Each vertical bar corresponds to the total amount of precipitation which occurred during a particular collection period, in some cases two or more wet buckets were combined in a collection period, (the date under each bar is the final collection date of the sample(s)).

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).

The first strong storm events for 2005-06 occurred at the end of November 2005. From 11/25/05 to 11/30/05 a couple of storms dropped a total of 5.51 inches of rain and snow at the upper Ward station and 3.26 inches of rain and some snow at the lower Ward station. This was followed on 12/1/05 by a strong storm with much tropical moisture associated with it which dropped 5.72 inches of rain at the lower Ward station and over 6 inches of rain and snow at the upper Ward station. Significant rises in west shore streams were observed as a result of this storm.

A memorable series of rainstorms occurred in the basin at the end of December, 2005. The first storm on 12/21-12/22/06 dropped 7.42 inches of rain at the Lower Ward station and 7.79 inches of rain and snow at the Upper Ward station. Significant peaks in stream flows resulted from this storm. A second storm which arrived on 12/27/05, brought moderate-to-heavy rain on 12/27 then a rain and snow mix at lake level on 12/28/05. The third and most significant storm arrived around mid-day on 12/30/05. Steady drenching moderate-to-heavy rain occurred late in the afternoon on 12/30/05, with moderate-to-heavy rain occurring all night and during the early morning on 12/31/05 finally changing to snow in late morning. Stream flows along the west shore of the lake on 12/31/05 were the highest since the 1997 floods and some flooding was observed on Blackwood and General Creeks along the west shore. During the period 12/21/05 to 1/4/06 an incredible 22.61 inches of precipitation, much of it rain, occurred at the Lower Ward Valley station and 24.54 inches occurred at the Upper Ward Valley station as both rain and snow.

The precipitation pattern settled down a bit in January and February then became very active again in March into April. In March, the frequency of storms moving through the basin was the striking feature, as precipitation occurred on about 25 days of the month. During the first half of March, much of the precipitation fell as snow. The second half of March saw a mix of rain and snow storms at the lower Ward station with primarily snow at the Upper Ward station with some rain. A large snow pack accumulated at the Upper Ward site at the end of March. By mid-April an additional 12.38 inches of precipitation had fallen at the Upper Ward Valley station and 8.68 inches at the lower Ward station as a mix of rain, snow and sleet at different times. The precipitation finally tapered off substantially after this.

There were some significant hydrological impacts associated with the heavy precipitation in 2005-06. These included significant peaks in LTIMP stream flows and likely significant nutrient and sediment loading, and stream channel erosion associated with the December storms. The lake also rose extremely rapidly in December as a result of all the runoff. This had an impact on the periphyton monitoring (see Periphyton Section of this report). The large accumulated snow pack from storms during 2005-06 resulted in a very significant spring runoff. Stream flows were very high throughout most of May and much of June. This runoff resulted in a continuous rise in lake level which ultimately filled the lake to maximum reservoir capacity. The frequency of storms also resulted in many days with cloud cover, frequent precipitation to the lake-surface and usually wind associated with the storms.

One of the main objectives of the atmospheric deposition monitoring is to provide data on loads of N and P contributed from atmospheric deposition. Table 9 presents preliminary estimates of daily loading rates for Bulk precipitation at the Upper Ward site, Wet and Dry precipitation at the lower Ward site and Dry-bulk deposition at the two buoy sites. Data from the previous year (2004-05) is shown for comparison.

Table 9. Comparisons 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 during 2004-05 and 2005-06. For dry loading rate, the load for analyzed samples was 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**
Upper Ward ST (Wet/Bulk) 2004-05	78.32	2.92	4.13	9.06	0.13	0.42	0.83
Upper Ward ST (Wet/Bulk) 2005-06	92.73+	2.74	4.12	7.11	0.27	0.48	0.86
Lower Ward (Wet) 2004-05	48.73	1.70	1.85	3.32	0.09	0.19	0.28
Lower Ward (Wet) 2005-06	66.67	1.71	1.57	2.98	0.06	0.25	0.51
Lower Ward (Dry) 2004-05		0.73	0.90	10.20	0.19	0.51	0.94
Lower Ward (Dry) 2005-06		0..91	0.93	12.64	0.20	0.57	1.37
Lower Ward (Wet+Dry) 2004-05		2.43	2.75	13.52	0.28	0.70	1.22
Lower Ward (Wet+Dry) 2005-06		2.62	2.50	15.52	0.26	0.82	1.88
TB-4 (Dry-Bulk) 2004-05		3.16	2.94	5.07	0.08	0.17	0.31
TB-4 (Dry-Bulk) 2005-06		2.24	2.70	4.93	0.09	0.19	0.27
Mid-lake TB-1 (Dry-Bulk) 2004-05	7.92+	3.22	3.11	5.82	0.11	0.17	0.33
Mid-lake TB-1 (Dry-Bulk) 2005-06	NA*	2.31	2.42	4.25	0.07	0.15	0.36

+ Note- precipitation was underestimated at mid-lake due to snow tube problems on several dates.

* - There were not enough successful snow tube measurements during 2005-06 to estimate mid-lake precipitation.

Loading of nitrogen in Wet deposition was fairly similar in 2004-05 and 2005-06 even though significantly more precipitation fell in 2005-06. This pattern was true for NO3-N and NH4-N in precipitation collected in Wet buckets at Ward Lake Level. A similar pattern was seen for Wet-bulk precipitation collected in snow tubes at the Upper Ward Valley station. TKN loading was also relatively similar in both periods for Wet precipitation at the lower Ward Valley station and showed a slight decline in 2005-06 at the Upper Ward station. The occurrence of similar N loading in wet deposition between years despite significantly different WY total precipitation has been seen before in the historical data. In an 2004 analysis of the 1981-2003 Wet deposition at Ward Lake Level we did for the atmospheric portion of the Tahoe TMDL project, only a very slight positive association was found between NO3-N and DIN loading and WY precipitation and several Water Years with significantly different precipitation amounts had very similar nitrogen loads.

The absence of any significant increase in nitrogen loading associated with the increased precipitation in 2005-06 may have been the consequence of a precipitation "wash-out" effect during the several very large rainstorms which occurred. These large rainstorms produced large amounts of precipitation in which much of the NO3-N and NH4-N may have been "washed" from the atmosphere earlier in the storm with small additional amounts contributed during the prolonged rains. Examination of the Ward Lake Level precipitation data for Wet precipitation for the large storms at the end of December shows that concentrations of NO3-N and NH4-N were in fact very low in samples collected. Concentrations of NO3-N ranged between 9-23 µg/l and NH4-N ranged between 3-6 µg/l in the four wet deposition samples collected between 12/23/05 and 1/4//06.

Loading of phosphorus showed slight increases in 2005-06 for most P fractions in Ward Valley Wet precipitation. Slight increases in DP and TP loading in Wet deposition at Lake Level and Wet-bulk deposition at the Upper Ward station were observed in 2005-06 compared to the previous year. SRP similarly increased in 2005-06 Wet-bulk deposition at the Upper Ward Valley station, however, it showed a slight decrease in Lower Ward Wet deposition. In the 2004 analysis of the 1981-2003 Wet deposition at Ward Lake Level we did for the atmospheric portion of the Tahoe TMDL project, we found a general trend of increased P loading with increased WY precipitation, however, again there were years which had significantly different total precipitation yet similar P loads.

Some patterns were also observed in Dry Deposition loading at the Ward Lake Level station. Dry deposition loading rates were very similar among the two years for NH4-N, SRP and DP with slight increases in the NO3-N, TKN and TP loading in 2005-06. The slight increases in the particulate-associated TKN and TP fractions might have been a consequence of increased particle deposition during windy periods associated with or following storms.

Some patterns were also discernable for the Dry-bulk loading data collected from the buoys near the middle portion of the lake. Comparing data from buoy TB-1 with TB-4, Dry-bulk (Wet + Dry) N and P loading rates were very close to each other in 2004-05 and rates from the two stations were also similar to each other in 2005-06. Overall, loading rates for phosphorus were very close in both years at both stations. Loading of nitrogen appeared to be less in 2005-06 at the mid-lake station compared to the previous year and slightly less at the TB-4 station. It is also interesting the note that the loading of NO3-N + NH4-N in Dry-bulk deposition collected from buoys near the middle of the lake is relatively close the combined Wet + Dry loading of NO3-N and NH4-N collected at the Ward Lake Level station.

Ultimately the loading and concentration data will be assimilated into the long-term data set to allow comparisons of loading at the stations from Water Year to Water Year and assessment for trends. The long-term data-set was recently updated for the Ward Lake Level Wet Deposition data through WY 2005. Figures 4 and 5 present the WY 1981-2005 data for Dissolved Inorganic Nitrogen (DIN) and Soluble Reactive Phosphorus respectively in Wet precipitation.

A couple of patterns in the 1981-2005 historical DIN and SRP data are notable. First, there appears to be a general negative association between WY precipitation and DIN concentration, e.g. in a “dry” year with little precipitation the average annual DIN concentration is relatively high, while in a wet year, the average annual DIN concentration tends to be low. Interestingly as mentioned earlier there appears to be only a very slight positive association between DIN loading and WY precipitation. From Figure 4, the DIN load does not always vary consistently with WY precipitation. Second, for SRP there appears to be a relationship between WY precipitation and SRP loading in wet deposition. Higher annual SRP loads are typically associated with higher WY precipitation. This might seem logical since average annual SRP concentrations are fairly consistent year to year, within a range of about 3-5 ppb. With similar concentrations year to year, more precipitation would typically equate to more SRP. Again, there are some years which are exceptions in which precipitation is relatively high yet SRP loads are not similarly high. A more thorough assessment of all the historical atmospheric deposition data is planned by TERC in the near future.

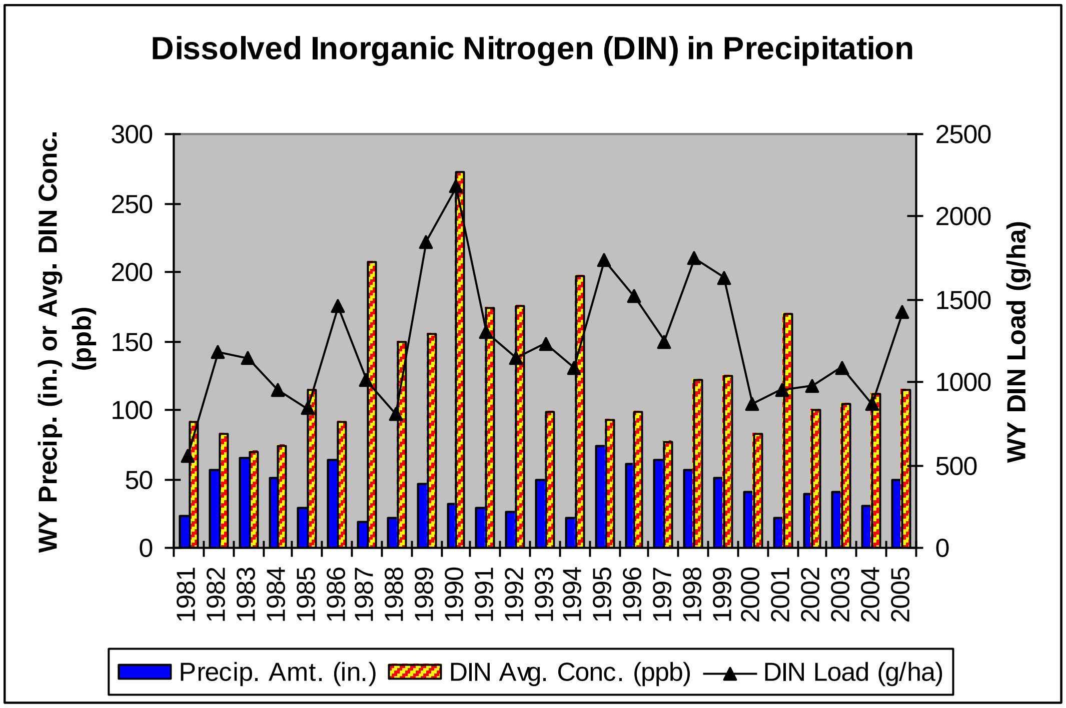


Figure 4. Summary plot of Water Year (WY) total precipitation (inches), average Dissolved Inorganic Nitrogen (DIN) concentration (ppb), and extrapolated annual DIN load (g/ha/yr) in Wet Deposition at the Ward Valley Lake Level station for WY 1981-2005. A Water Year begins Oct. 1 and ends Sept. 30 (i.e. WY 1981 ended Sept. 30, 1981).

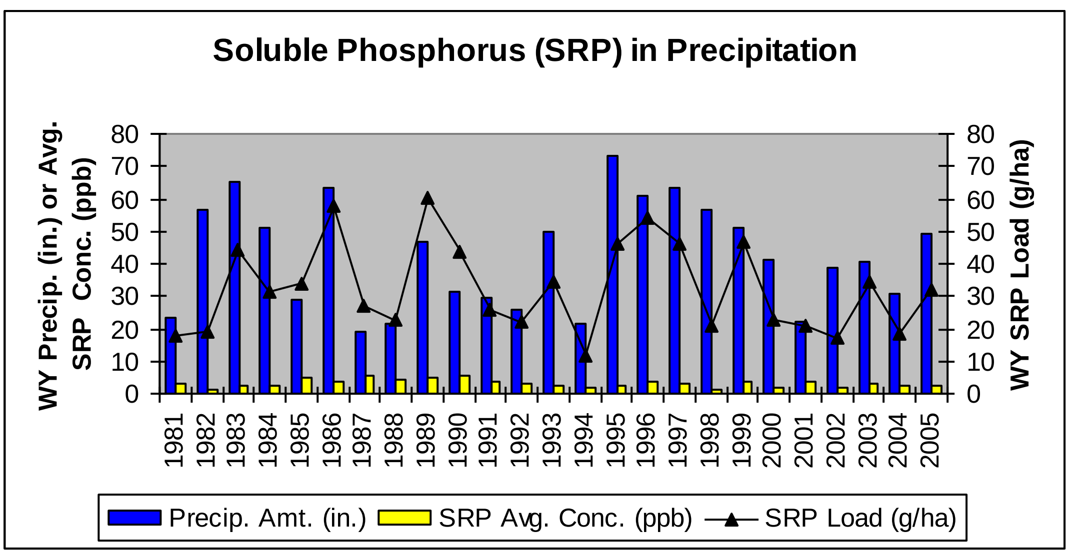


Figure 5. Summary plot of Water Year (WY) total precipitation (inches), average Soluble Reactive Phosphorus (SRP) concentration (ppb), and extrapolated annual SRP load (g/ha/yr) in Wet Deposition at the Ward Valley Lake Level station for WY 1981-2005.

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 have potential use 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.

Stations and Methods

Ten routine stations were monitored during July 2005-August 2006 (Rubicon Pt., Sugar Pine Pt., Pineland, Tahoe City, Dollar Pt., Zephyr Pt., Deadman Pt., Sand Pt., Incline Condominium, Incline West). These ten sites are located around the lake (Table 10) and represent a range of backshore disturbance levels from relatively undisturbed land (Rubicon Point and Deadman Point) to a developed urban center (Tahoe City).

Table 10. Locations of Routine Periphyton Monitoring Stations

SITE NAME	LOCATION
Rubicon	N38 59.52; W120 05.60
Sugar Pine Point	N39 02.88; W120 06.62
Pineland	N39 08.14; W120 09.10
Tahoe City	N39 10.24; W120 08.42
Dollar Point	N39 11.15; W120 05.52
Zephyr Point	N39 00.10; W119 57.66
Deadman Point	N39 06.38; W11957.68
Sand Point	N39 10.59; W119 55.70
Incline Condominiums	N39 14.90; W119 59.63
Incline West	N39 14.83; W119 59.75

A detailed description of the sample collection and analysis procedures is given in Hackley et al. (2004). Briefly, the method entails collection while snorkeling of duplicate samples of attached algae from a known area of natural rock substrate at a depth of 0.5m, using a syringe and toothbrush sampler. These samples are transported to the laboratory where the samples processed and split, with one portion of the sample analyzed for Ash Free Dry Weight (AFDW) and the other portion frozen for later analysis of Chlorophyll *a* concentration (both AFDW and chlorophyll *a* are used as measures of algal biomass). We also measure average filament length, % algal coverage, and estimate the visual score in 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 present data collected from July 2005-August 2006. During this period, the ten routine sampling sites were sampled approximately monthly from November through the end of June. In March, difficult weather and rough lake conditions pushed back the monthly sampling a bit and caused postponement of the east shore sampling until early April. The result was that a second sampling of the routine sites was done later in April at the same time an intensive synoptic sampling of 40 additional sites was carried out. A total of 61 routine site sample were analyzed for chlorophyll a and 51 routine samples were analyzed for AFDW. An additional 79 samples collected during the synoptic sampling were analyzed for chlorophyll *a* and 78 additional samples for AFDW.

Table 11 presents the results for chlorophyll *a*, AFDW and field observations of visual score, average filament length and percent algal coverage at the ten routine periphyton sites for the period July 2005-June 2006. Figures 6a-1j present the results for chlorophyll a and AFDW biomass graphically.

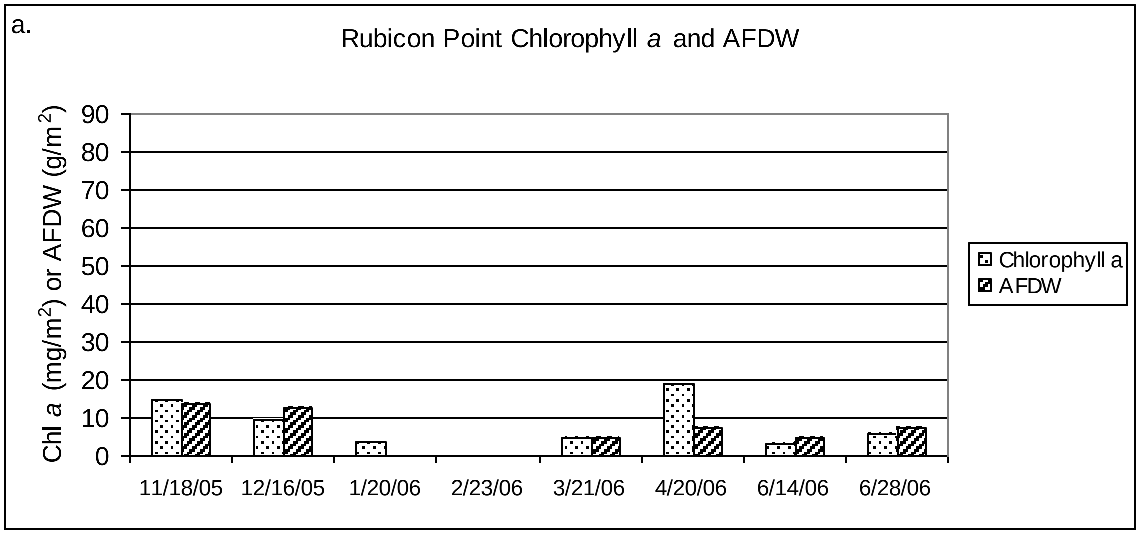
Table 11. Summary of eulittoral periphyton chlorophyll a, Ash Free Dry Weight (AFDW), visual score, average filament length and % algal coverage for routine periphyton monitoring sites during July 2005-June 2006. Visual score is a subjective ranking of the aesthetic appearance of algal growth (viewed underwater) where 1 is the least offensive and 5 is the most offensive.

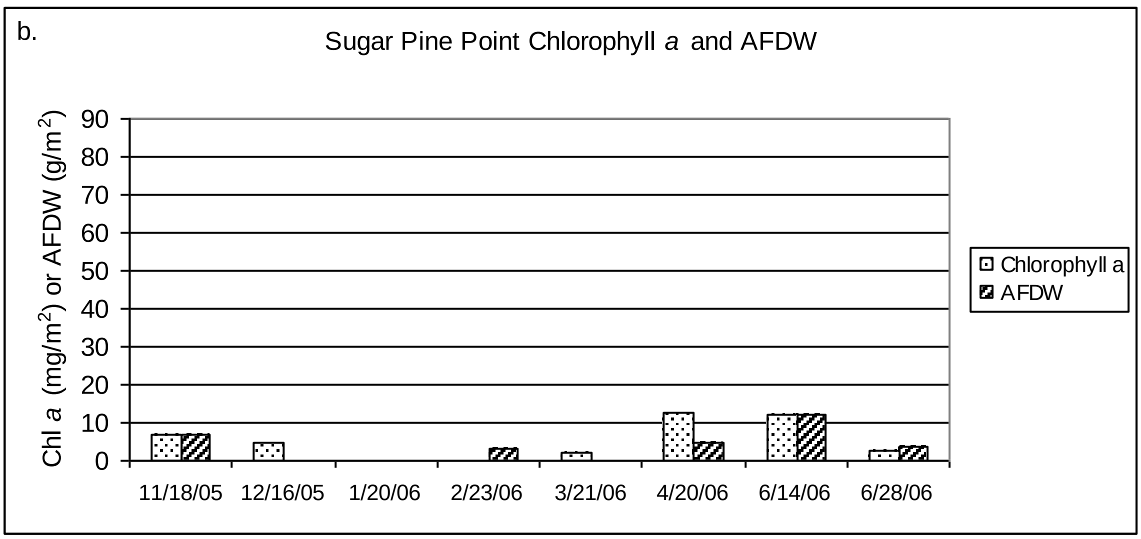
Table 11. Site	Date	Depth (m)	Chlor. A (mg/m^2)	Std Dev (mg/m^2)	AFDW (g/m^2)	Std Dev (g/m^2)	Visual Score	Fil. Length (cm)	Algal Coverage (%)
Rubicon Pt.	11/18/2005	0.5	14.80	0.36	13.70	3.67	3	0.8	60%
	12/16/2005	0.5	9.62	0.86	12.47	1.32	3	1.1	60%
	1/20/2006	0.5	3.90	1.02	na	na	2	0.1	80%
	2/23/2006	0.5	na	na	0.18	0.26	2	0.2	60%
	3/21/2006	0.5	4.98	1.14	4.90	2.39	3	1.5	40%
	4/20/2006	0.5	19.11	1.55	7.29	2.12	4	1.6	80%
	6/14/2006	0.5	3.31	0.77	4.65	na	2	0.7	50%
	6/28/2006	0.5	5.91	0.05	7.18	0.04	3	0.6	60%
Sugar Pine Pt.	11/18/2005	0.5	6.96	5.19	7.05	na	2	0.1	80%
	12/16/2005	0.5	4.65	1.07	na	na	2	0.1	80%
	1/20/2006	0.5	na	na	na	na	1	0.0	0%
	2/23/2006	0.5	na	na	3.02	na	2	0.1	50%
	3/21/2006	0.5	1.92	0.40	na	na	2	0.5	80%
	4/20/2006	0.5	12.54	na	4.63	na	2	0.7	70%
	6/14/2006	0.5	11.93	8.43	12.21	7.49	3	1.0	80%
	6/28/2006	0.5	2.88	1.10	3.84	0.25	3	0.4	50%
Pineland	11/18/2005	0.5	53.18	19.81	43.87	3.94	2	0.5	70%
	12/16/2005	0.5	36.98	3.71	28.19	3.51	3	0.4	50%
	1/20/2006	0.5	7.98	na	4.11	3.34	3	0.6	70%
	2/23/2006	0.5	31.26	10.78	24.95	6.45	4	2.5	80%
	3/21/2006	0.5	47.80	27.82	34.92	9.97	5	2.6	90%
	4/19/2006	0.5	6.65	0.21	6.62	0.65	2	0.3	60%
	5/31/2006	0.5	17.58	3.52	22.08	6.55	3	0.5	70%
	6/28/2006	0.5	2.60	0.49	4.26	0.55	2	<0.1	30%
Tahoe City	11/18/2005	0.5	12.72	6.79	2.16	na	2	0.1	50%
	12/16/2005	0.5	5.24	0.34	8.82	1.41	na	0.2	50%
	1/25/2006	0.5	19.46	0.62	37.68	8.98	2	0.3	70%
	2/23/2006	0.5	39.85	17.33	76.67	21.63	3	0.7	90%
	3/21/2006	0.5	111.48	30.31	203.86	37.54	5	2.3	90%
	4/21/2006	0.5	86.98	0.61	124.01	2.37	na	na	na
	5/31/2006	0.5	10.42	2.43	19.16	5.13	2	0.1	70%
	6/28/2006	0.5	5.74	1.94	5.87	1.45	2	<0.1	70%
Dollar Pt.	11/18/2005	0.5	12.50	8.68	15.60	9.94	2	0.1	50%
	12/16/2005	0.5	3.52	1.46	4.33	1.55	2	0.1	80%
	1/20/2006	0.5	6.83	0.81	5.00	0.04	2	0.2	80%
	2/23/2006	0.5	19.84	0.37	21.02	6.13	3	1.4	90%
	3/21/2006	0.5	30.97	na	24.54	na	4	1.1	100%

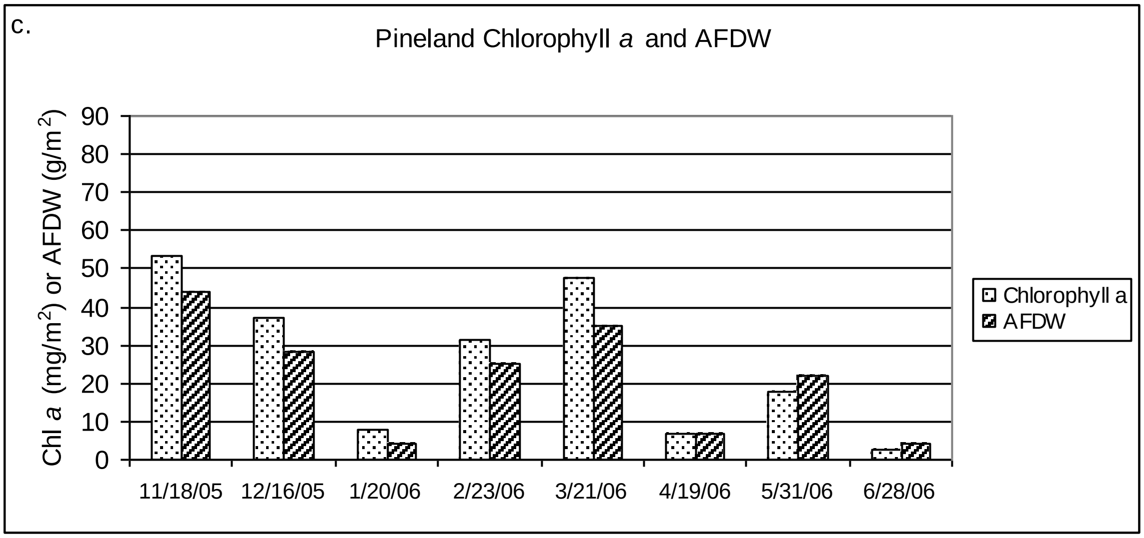
Table 11.

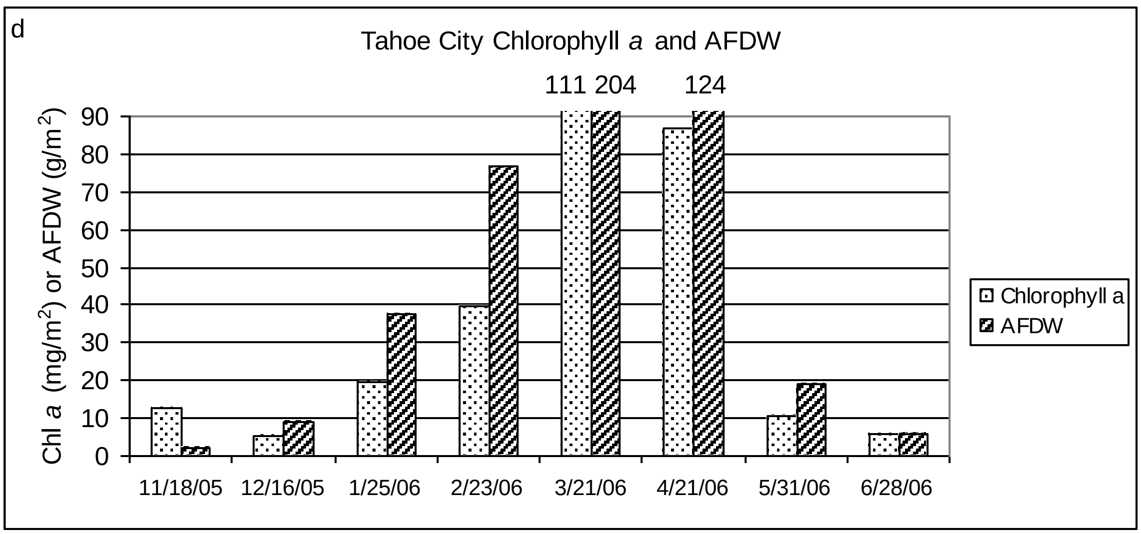
Site	Date	Depth (m)	Chlor. A (mg/m^2)	Std Dev (mg/m^2)	AFDW (g/m^2)	Std Dev (g/m^2)	Visual Score	Fil. Length (cm)	Algal Coverage (%)
Dollar Pt.	4/19/2006	0.5	43.65	25.09	32.30	11.35	4	1.1	100%
	5/31/2006	0.5	27.35	5.29	30.86	2.44	3	0.6	80%
	6/29/2006	0.5	10.54	1.78	14.71	1.91	3	0.4	70%
Incline West	11/18/2005	0.5	21.55	3.10	77.36	12.20	3	0.3	90%
	12/16/2005	0.5	38.82	5.50	42.91	6.19	3	0.5	90%
	1/25/2006	0.5	11.77	4.31	7.44	2.47	3	0.7	90%
	2/23/2006	0.5	4.67	0.02	2.46	0.12	3	0.9	90%
	4/7/2006	0.5	10.89	4.76	6.08	1.20	4	1.7	70%
	4/28/2006	0.5	19.84	1.30	12.68	0.38	4	1.6	80%
	5/31/2006	0.5	6.47	1.32	4.50	2.02	3	0.9	70%
	6/29/2006	0.5	4.12	0.18	5.33	0.39	2	0.8	50%
Incline Condo	11/18/2005	0.5	5.73	1.81	41.31	14.76	2	0.2	65%
	12/16/2005	0.5	40.03	15.67	70.70	16.46	2	0.5	80%
	1/25/2006	0.5	6.34	na	3.12	na	3	0.6	80%
	2/23/2006	0.5	20.86	5.21	11.82	0.53	3	1.2	70%
	4/7/2006	0.5	27.29	5.52	16.22	1.90	4	1.5	100%
	4/28/2006	0.5	31.90	0.12	17.25	1.01	5	2.6	100%
	5/31/2006	0.5	11.36	1.92	16.29	5.30	3	0.9	70%
	6/29/2006	0.5	8.42	2.15	11.35	2.99	3	1.4	80%
Sand Point	11/18/2005	0.5	17.67	0.87	31.68	2.40	3	0.4	60%
	12/16/2005	0.5	36.39	23.75	46.97	17.09	2	0.9	50%
	1/25/2006	0.5	2.42	2.03	na	na	1	0.0	0%
	2/23/2006	0.5	na	na	1.02	1.45	2	0.5	80%
	4/7/2006	0.5	1.45	0.17	na	na	3	0.2	100%
	4/28/2006	0.5	2.72	0.20	0.80	0.05	3	1.1	90%
	6/14/2006	0.5	5.13	1.06	4.22	0.70	3	0.7	60%
	6/29/2006	0.5	11.19	na	8.16	4.28	3	1.1	90%
Deadman Pt.	11/18/2005	0.5	11.79	na	29.15	14.44	3	0.3	65%
	12/16/2005	0.5	17.56	5.20	32.28	0.75	2	0.4	40%
	1/25/2006	0.5	nes	na	na	na	1	0.0	0%
	2/23/2006	0.5	nes	na	bld	na	1	0.0	10%
	4/7/2006	0.5	2.01	0.43	na	na	2	0.1	70%
	4/28/2006	0.5	1.94	0.72	na	na	2	0.2	60%
	6/14/2006	0.5	1.92	0.04	na	na	2	0.2	40%
	6/29/2006	0.5	4.01	0.13	2.74	0.34	2	0.4	60%
Zephyr Point	11/18/2005	0.5	15.92	3.63	26.60	11.35	2	0.1	70%
	12/16/2005	0.5	10.75	4.48	13.87	3.64	2	0.1	40%
	1/25/2006	0.5	6.66	2.41	na	na	2	0.1	50%
	2/23/2006	0.5	3.81	na	2.52	0.41	2	<0.5	na
	4/7/2006	0.5	19.63	3.51	10.19	2.56	3	1.3	80%
	4/28/2006	0.5	19.05	4.56	11.78	1.13	3	1.0	90%
	6/14/2006	0.5	9.65	1.66	8.18	0.73	3	0.7	na
	6/29/2006	0.5	3.63	0.15	4.22	0.37	2	1.0	30%

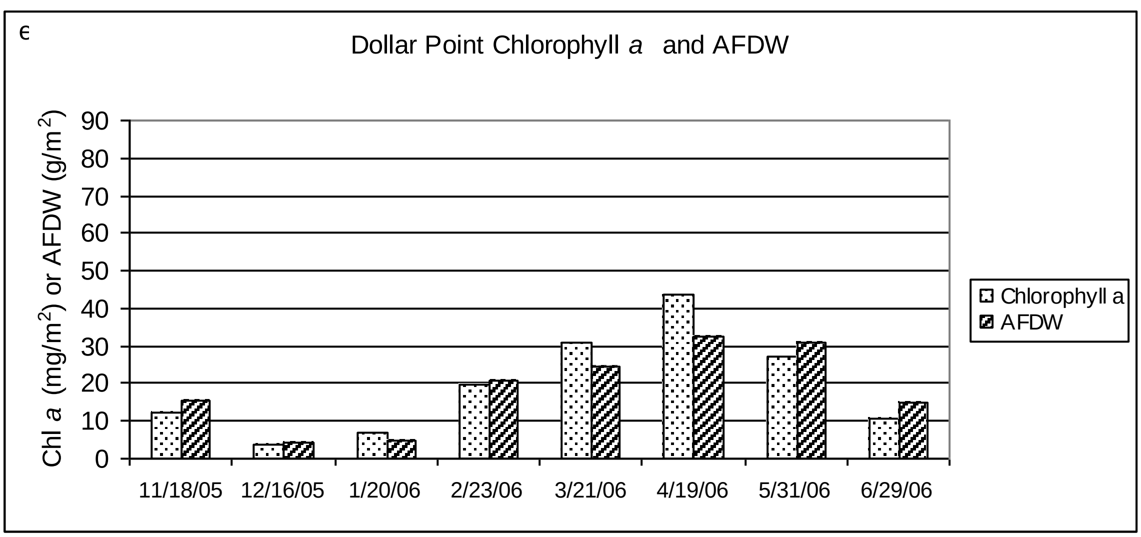
Figure 6. Periphyton chlorophyll a and Ash Free Dry Weight (AFDW) biomass at the ten routine monitoring sites July 2005 – August 2006.



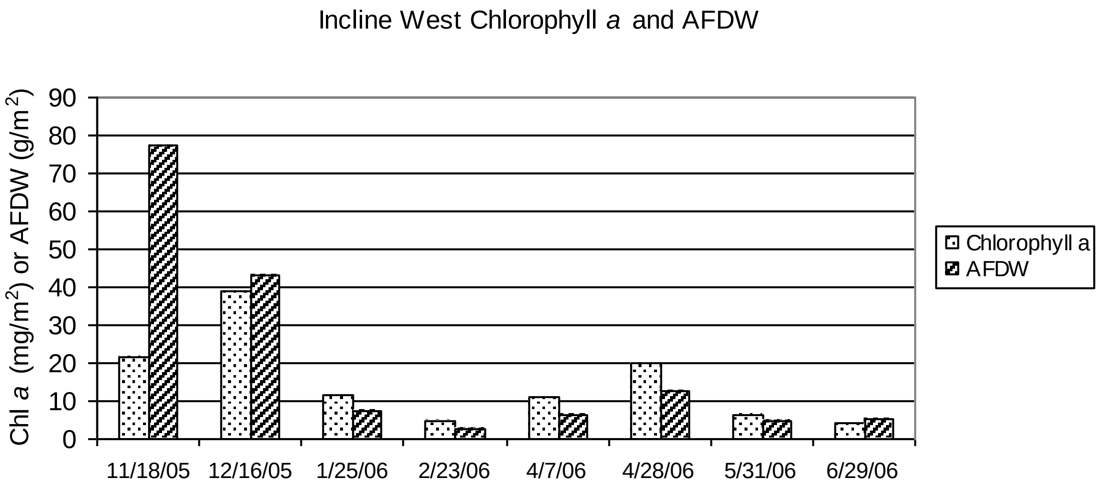



c.
Pineland Chlorophyll a and AFDW
Chl a (mg/m2) or AFDW (g/m2)
90
80
70
60
50
40
30
20
10
0
11/18/05
12/16/05
1/20/06
2/23/06
3/21/06
4/19/06
5/31/06
6/28/06
Chlorophyll a
AFDW


d
Tahoe City Chlorophyll a and AFDW
111 204
124
Chl a (mg/m2) or AFDW (g/m2)
90
80
70
60
50
40
30
20
10
0
11/18/05
12/16/05
1/25/06
2/23/06
3/21/06
4/21/06
5/31/06
6/28/06
Chlorophyll a
AFDW

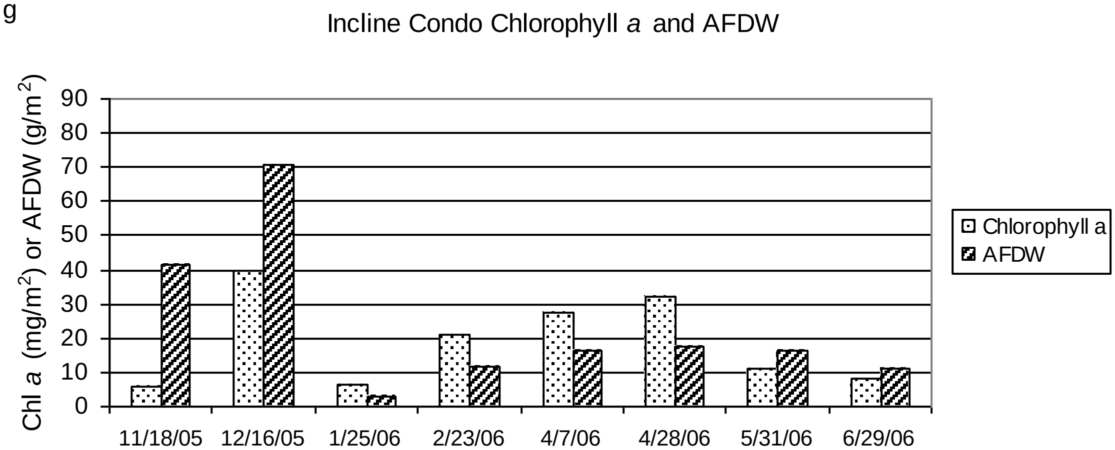

ϵ
Dollar Point Chlorophyll a and AFDW
Chl a (mg/m2) or AFDW (g/m2)
90
80
70
60
50
40
30
20
10
0
11/18/05
12/16/05
1/20/06
2/23/06
3/21/06
4/19/06
5/31/06
6/29/06
Chlorophyll a
AFDW

f.



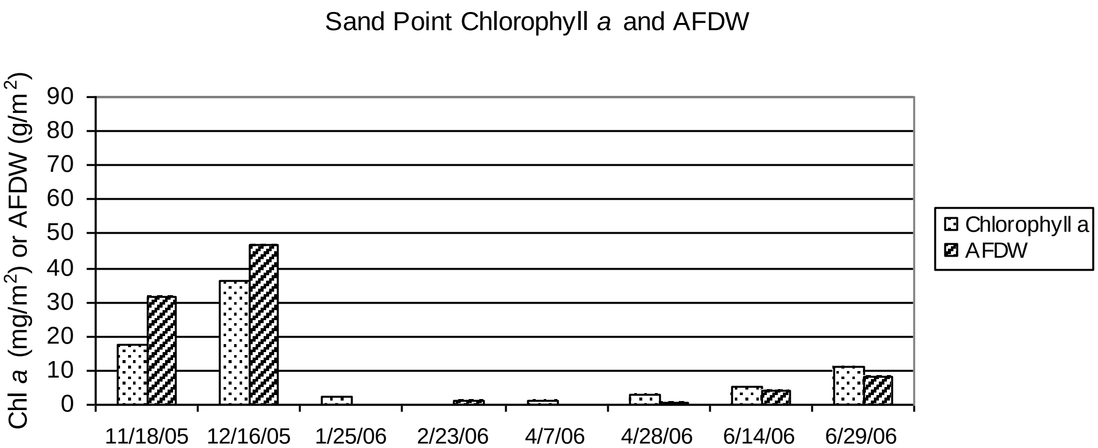
Incline West Chlorophyll *a* and AFDW
Chl *a* (mg/m^2) or AFDW (g/m^2)
90
80
70
60
50
40
30
20
10
0
11/18/05
12/16/05
1/25/06
2/23/06
4/7/06
4/28/06
5/31/06
6/29/06
Chlorophyll a
AFDW

g

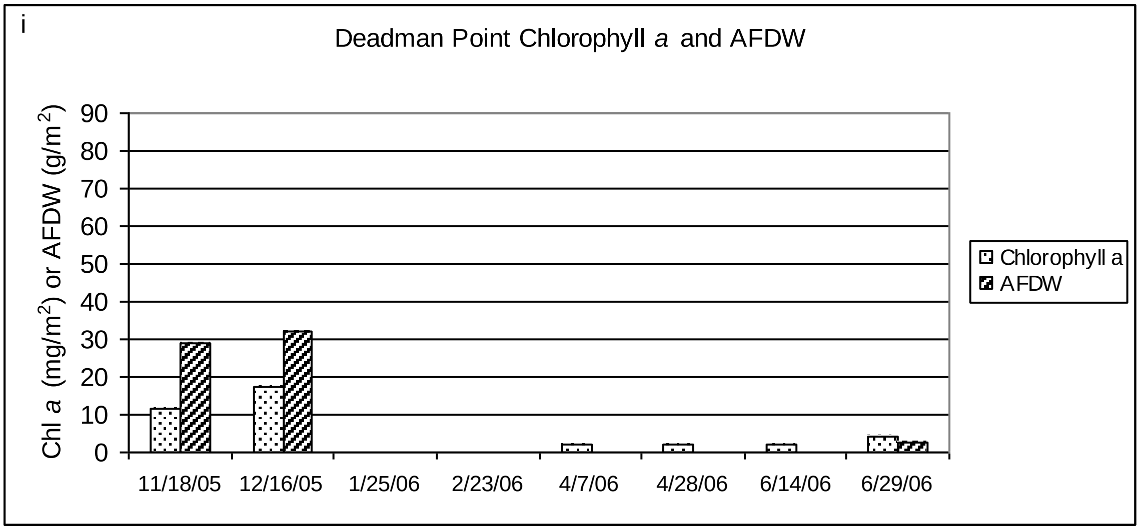


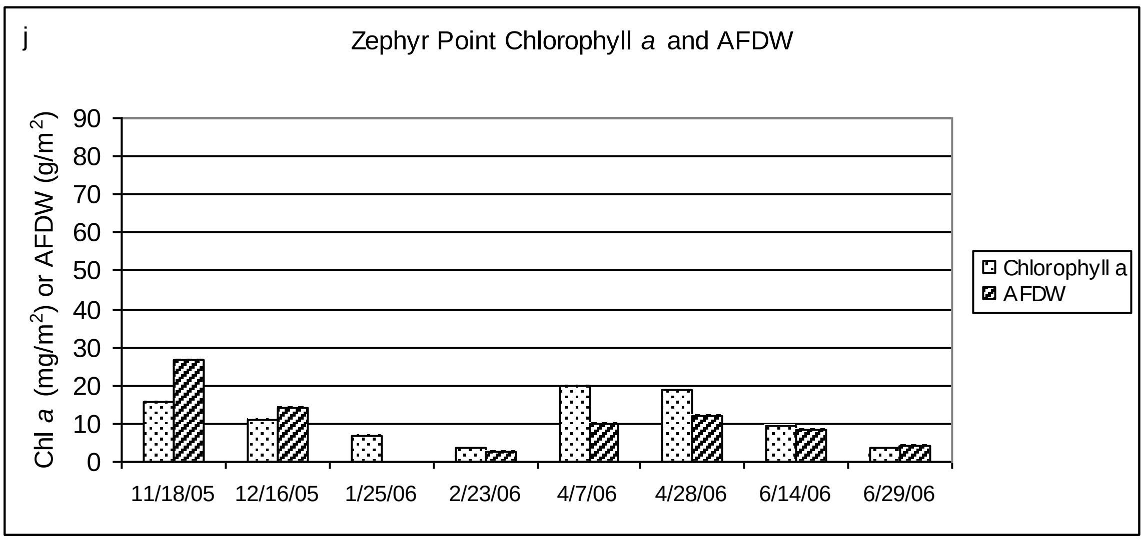
Incline Condo Chlorophyll *a* and AFDW
Chl *a* (mg/m^2) or AFDW (g/m^2)
90
80
70
60
50
40
30
20
10
0
11/18/05
12/16/05
1/25/06
2/23/06
4/7/06
4/28/06
5/31/06
6/29/06
Chlorophyll a
AFDW

h



Sand Point Chlorophyll *a* and AFDW
Chl *a* (mg/m^2) or AFDW (g/m^2)
90
80
70
60
50
40
30
20
10
0
11/18/05
12/16/05
1/25/06
2/23/06
4/7/06
4/28/06
6/14/06
6/29/06
Chlorophyll a
AFDW

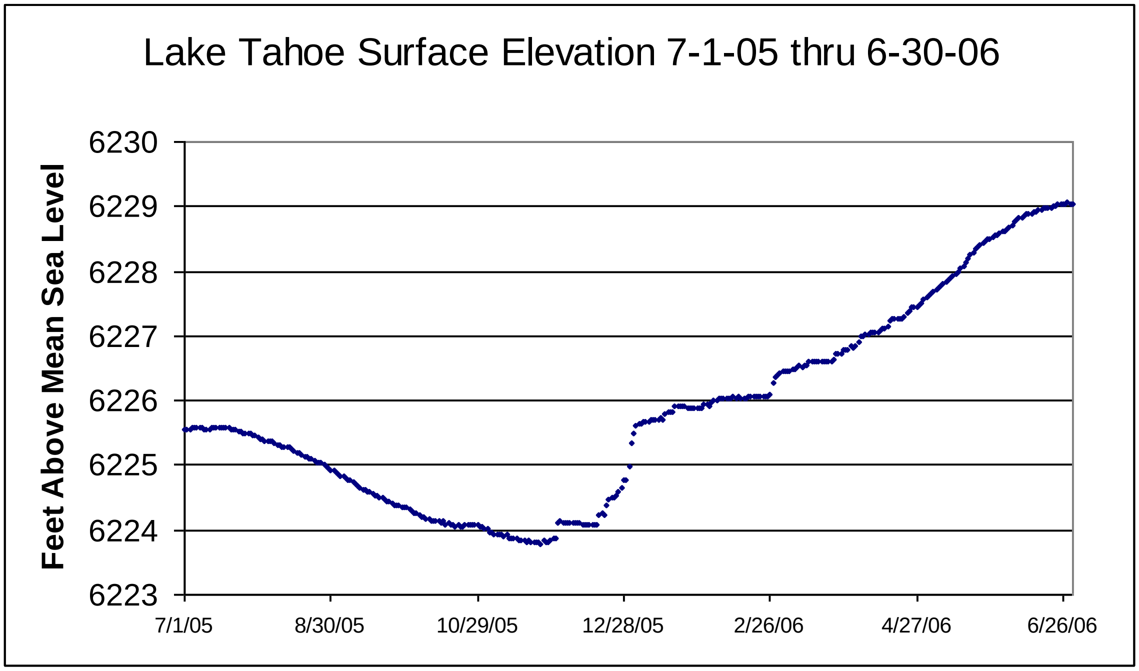




Patterns of biomass during 2005-06 show that it was elevated at the majority of sites both during November-December 2005 and during the spring period 2006. Chlorophyll a and AFDW biomass were elevated in Nov. and Dec. at all sites at 0.5m then was markedly reduced in January. Tahoe City was an exception as biomass increased steadily from a low in November and December to a peak in March 2006. In Nov. - Dec. 2005 levels of chlorophyll *a* at 0.5m were actually the highest measured for the year at Pineland, Incline West, Incline Condo, Sand Pt. and Deadman Pt.. All sites except Deadman Pt. showed a second peak in spring 2006.

Different factors were at play in producing the early winter 2005 versus the spring 2006 peaks in growth. In the early winter 2005, a very low lake level was the cause of the high biomass measured. By mid-November the lake had dropped to an elevation of 6223.8' (Figure 7), and as a result samples collected from 0.5m were below the natural rim of the lake and included elevated biomass associated with blue green algae. The elevated

Figure 7. Lake Tahoe water surface elevations July 1, 2005 to June 30, 2006.



biomass during this early winter therefore was not indicative of a peak in growth of eulittoral algae associated which might be associated with nutrient loading.

In contrast, biomass in the spring was dominated by the new growth of the stalked diatom Gomphoneis over newly submerged substrate. At the end of December a series of strong rain events caused the lake level to rise rapidly, submerging shore zone substrate that had been previously been exposed (Figure 7). As a result, the January sampling at 0.5m occurred on newly submerged substrate that had had little opportunity for periphyton colonization and biomass levels were very low at all sites (except Tahoe City). Lake level rose only slightly in January and February which provided time for Gomphoneis to colonize and grow on the newly submerged substrate at 0.5m. As the spring progressed, significant storms occurred in March and early April which resulted in additional lake level increases and shifted the 0.5m sampling sites “upwards” on recently submerged rock surfaces continually throughout the spring. The periphyton biomass measured between January and June consisted predominantly of the rapid colonizer Gomphoneis at the sites and differences in levels of biomass at many sites may largely reflect differences in nutrient availability from various sources.

Spring peaks in biomass were observed in March and April at most of the sites and heaviest growth was again in the northwest portion of the lake near Tahoe City. Peak levels of chlorophyll measured during March and April were: Tahoe City (111.48 mg/m2), Pineland (47.80 mg/m2), Dollar Pt. (43.65 mg/m2), Incline Condo (31.90 mg/m2), Incline West (19.84 mg/m2), Rubicon Pt. (19.11 mg/m2) and Sugar Pine Pt. (12.54 mg/m2). Sand Pt. and Deadman Pt. biomass remained very low throughout most of the spring and was only slightly elevated by the end of June (Sand Pt. peak was 11.19 mg/m2 and Deadman Pt. peak was 4.01 mg/m2).

Periphyton growth during the winter and spring appeared to show a general association with the level of development and disturbance in the backshore at many sites. Sites with limited human impacts (Sugar Pine Point, Sand Point, and Deadman Point) displayed low peak biomass with spring peak chlorophyll a concentrations well below 20 mg/m^2. Sites with an urban back shore (Pineland, Tahoe City, Dollar Point and Incline Condo) had higher peak periphyton biomass reflected by chlorophyll a concentrations significantly greater than 20 mg/m^2. Peak levels of chlorophyll a biomass at Rubicon Pt., Incline West and Zephyr Pt. were all moderately high near 20 mg/m2. These sites are adjacent to areas with different levels of development near them. Rubicon Pt. is very pristine and is located in Bliss St. Park, Incline West is located near the Incline Condo developed area but not directly adjacent to it, and Zephyr Pt is near a moderately developed area in the backshore. Factors controlling periphyton growth in the lake are complex. Nutrient availability appears to play a major role, but other factors also likely play a role in determining the levels of growth. A better understanding of all factors controlling periphyton growth is needed to better understand patterns of growth around the lake.

Expanded Monitoring

While the ten routine sampling sites provide data from many different regions around the lake with differing levels of backshore development and disturbance, the limited number of these sites does not provide enough resolution to determine periphyton biomass on a whole-lake scale. For this reason a synoptic sampling was done in which 40 additional sites (Table 12) along with the 10 routine sites were sampled for chlorophyll a and AFDW. This synoptic event was timed as much as possible to correspond to peak periphyton growth in each region of the lake, and was done in a concentrated period of two weeks between 19 April and 2 May. For the first time we were able to sample biomass at all 50 sites as well as make measurements of visual score, filament length and % coverage. This data provided much more “resolution” of spatial patterns of periphyton growth during the 2006 maximum spring growth period.

Table 13 presents the results for this intensive synoptic sampling and Figures 8 and 9 present the data on maps which also show bar graphs of the of the concentrations of chlorophyll a and AFDW at each site. The individual chlorophyll a data (presented in Figure 8) was ultimately used to prepare a map which estimates the whole-lake distribution of chlorophyll a biomass during the 2006 spring peak (Figure 9). To estimate regional distribution of biomass between discreet sampling points individual site values for chlorophyll *a* were extrapolated to occur along shore half the distance to the next site on either side. This was done for all ten regular sites combined with the synoptic sampling locations. With the exception of the South Lake Tahoe shoreline, where substrate limits sampling locations, the synoptic survey provides appropriate spatial resolution to characterize whole lake periphyton biomass.

Table 12. Periphyton expanded monitoring locations 2005-2006.

SITE DESIGNATION	SITE NAME	LOCATION
	WEST SHORE	
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	
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	
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	
S1	Tahoe Keys Entrance	N38 56.398; W120 00.390
S2	Kiva Point	N38 56.555; W120 03.203

Table 13. 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 April 19, 2006- May 2, 2006. 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	4/20/2006	33.16	0.67	14.05	0.61	4	1.8	100%
B	4/20/2006	20.19	0.97	9.52	1.37	4	1.2	90%
C	4/20/2006	49.02	3.41	24.20	4.69	5	3.8	100%
D	4/20/2006	426.74	103.69	134.87	47.08	5	3.5	100%
E	4/20/2006	14.66	7.16	9.68	5.04	4	2.2	80%
F	4/20/2006	85.73	19.80	32.06	6.85	3.5	1.8	80%
G	4/20/2006	8.81	2.73	6.35	1.31	3	1.0	60%
H	4/19/2006	45.80	2.72	37.98	10.47	4	1.7	90%
I	4/19/2006	5.25	0.20	na	na	3	0.3	60%
J	4/19/2006	11.54	1.81	5.78	1.65	3	0.5	50%
K	4/19/2006	2.54	1.59	1.10	na	2	0.1	40%
L	4/19/2006	37.77	3.89	42.96	3.54	4	1.4	100%
TCT	4/21/2006	191.64	13.22	192.67	53.23	5	3.9	100%
M	4/19/2006	206.91	148.93	242.45	137.38	5	3.5	100%
N	4/19/2006	11.09	1.00	15.44	6.38	2	0.6	50%
O	4/19/2006	114.37	40.53	43.92	15.44	5	2.4	100%
P	4/19/2006	28.59	2.47	17.97	1.92	3	0.9	100%
Q	4/19/2006	117.98	48.71	71.29	26.19	4	1.7	80%
R	4/27/2006	40.69	9.66	20.78	8.80	3	1.2	90%
S	4/27/2006	63.59	17.68	25.65	8.02	4	2.2	100%
T	4/27/2006	5.19	0.98	na	na	2	0.2	40%
E1	5/2/2006	49.44	19.69	23.50	8.78	4	2.1	80%
E2	5/2/2006	11.73	na	7.01	na	2	0.3	70%
E3	5/2/2006	105.65	41.72	54.45	6.47	4	2.6	60%
E4	5/2/2006	11.24	7.38	8.12	5.04	3	0.8	80%
E5	5/2/2006	8.88	0.36	5.95	0.97	3	1.0	80%
E6	5/2/2006	19.11	8.08	9.68	3.41	4	1.5	100%
E7	5/2/2006	4.54	1.02	3.08	1.90	3	0.6	90%
E8	4/28/2006	8.55	2.98	5.62	na	na	na	na
E9	4/28/2006	4.34	1.04	4.83	na	2	0.6	80%
E10	4/28/2006	11.84	1.73	5.66	0.72	3	0.5	90%
E11	4/28/2006	2.34	0.14	na	na	2	0.5	100%
E12	4/28/2006	3.29	1.44	na	na	3	0.4	95%
E13	4/28/2006	16.88	2.25	9.72	0.48	3	0.8	75%
E14	4/28/2006	2.85	2.69	3.28	na	3	1.3	80%
E15	4/28/2006	8.90	0.12	5.21	1.11	4	0.7	90%
E16	4/27/2006	47.67	3.53	27.70	1.31	4	1.5	100%
E17	4/27/2006	64.88	2.47	97.86	31.12	4	1.9	100%
S1	4/20/2006	35.58	5.26	na	3.87	4.5	1.6	80%
S2	4/20/2006	23.07	5.13	32.73	3.69	4	1.0	80%

Periphyton Biomass (Chlorophyll a)
at 0.5m depth Spring 2006

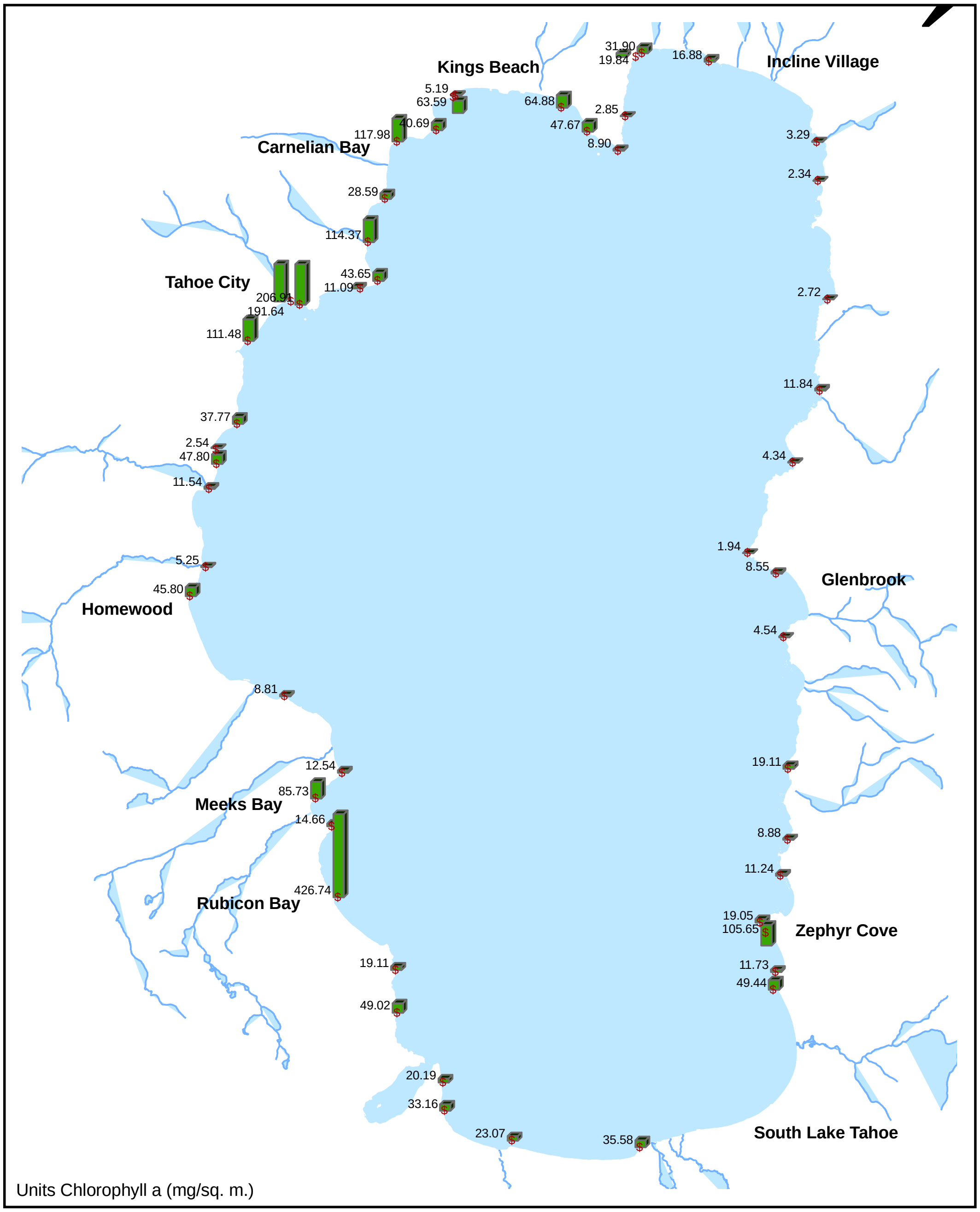


Figure 8. Levels of periphyton biomass as chlorophyll a at synoptic and routine sampling sites during the peak growth period, Spring 2006. Note the data for the majority of sites was collected during 19 April -2 May, 2006 while data for Tahoe City and Pineland were collected during the spring peak at these sites in late March.

Periphyton Biomass (Ash Free Dry Weight) at 0.5m depth Spring 2006

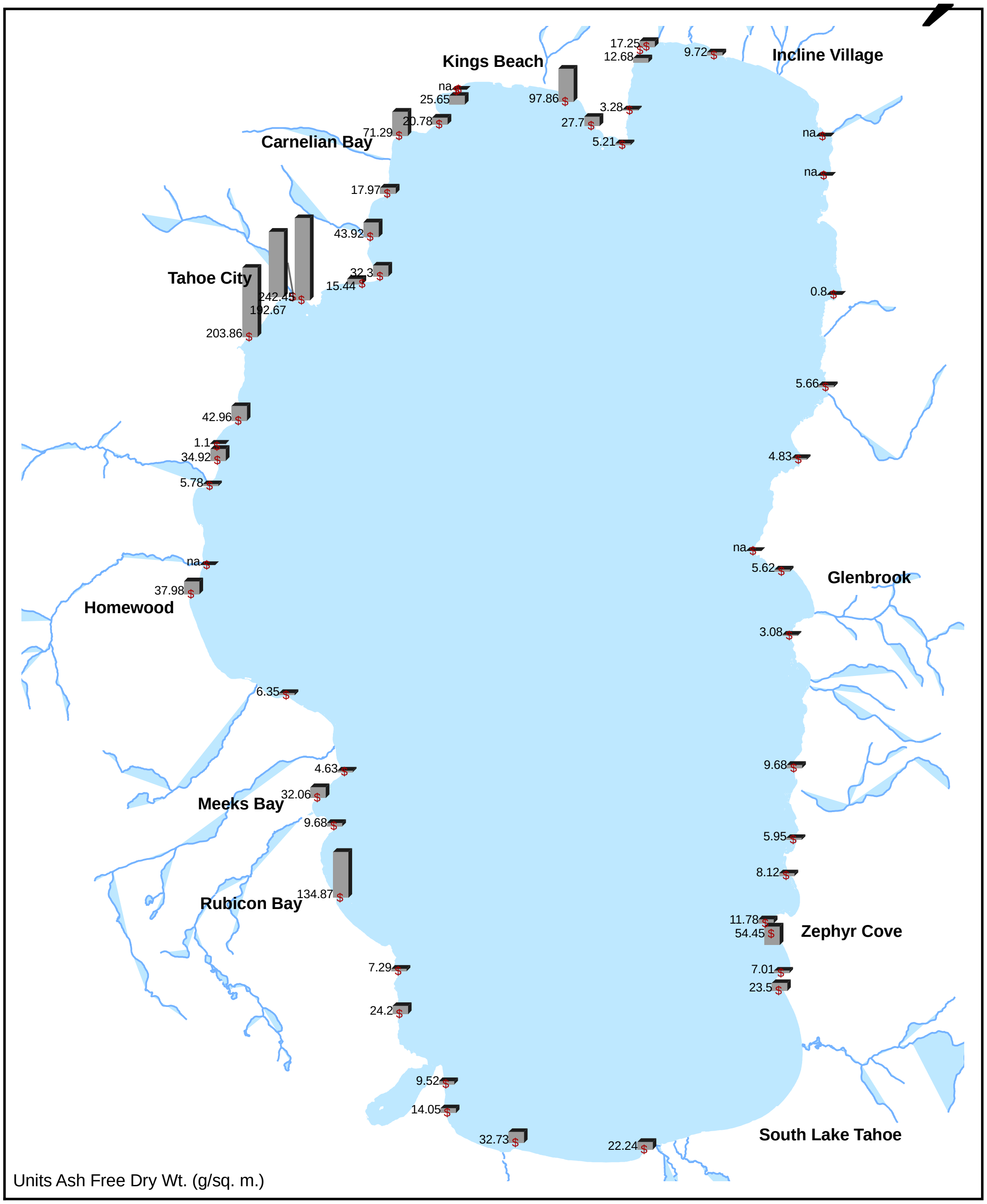


Figure 9. Levels of periphyton biomass as Ash Free Dry Weight (AFDW) at synoptic and routine sampling sites during the peak growth period, Spring 2006. Note the data for the majority of sites was collected during 19 April -2 May, 2006 while data for Tahoe City and Pineland were collected during the spring peak at these sites in late March.

Distribution of Periphyton Biomass (Chl. a)
at 0.5m depth Spring 2006

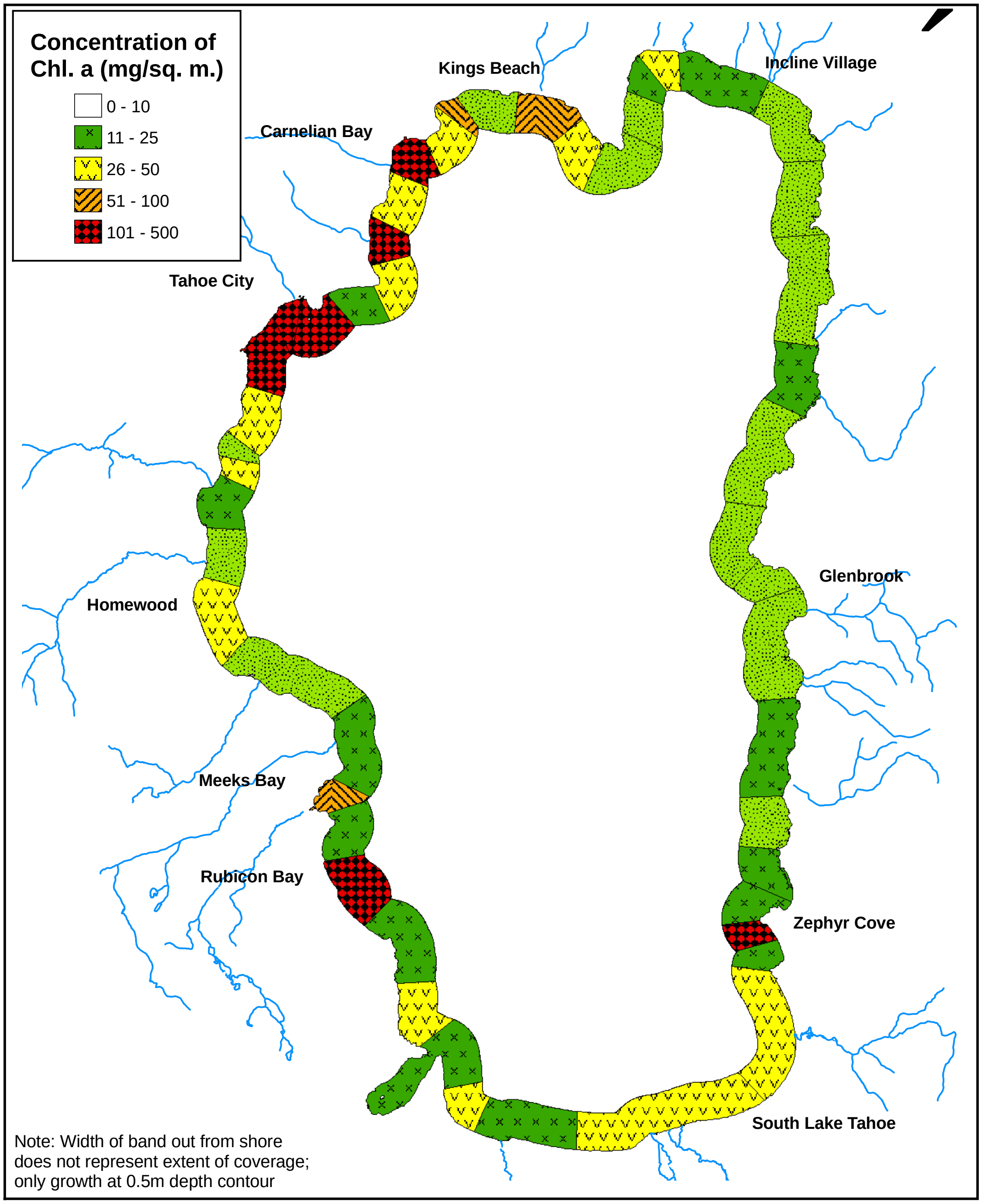


Figure 10. Extrapolated regional distribution of periphyton biomass as Chlorophyll *a* at 0.5m during the 2006 Spring peak growth period.

Quite a range of chlorophyll a biomass was observed along the shoreline at 0.5m with particularly high level observed in the northwest portion of the lake and in localized sites along the southwest and southeast shoreline. Along the east shore from Incline Village to Zephyr Cove peak periphyton biomass, as measured by chlorophyll a, was low (<12 mg/m^2) with only one site nearing 20 mg/m^2 (Cave Rock). There is little development along this stretch of shoreline as most of the land is managed by Nevada State Parks. From Zephyr Cove around the south end of the lake to D.L. Bliss State Park, slightly higher biomass was recorded with chlorophyll a concentrations between 20 and 50 mg/m^2. One site with very high chlorophyll a was found in this section, the South Side of Zephyr Pt. had a chlorophyll level of 105.65 mg/m^2. The south shore region of the lake has a greater degree of development, but broad statements about the regional distribution of periphyton growth in this area are difficult to make as much of the submerged substrate is sand, limiting available sampling locations. From D.L. Bliss State Park up the west shore to North Sunnyside, peak periphyton biomass was highly variable. Measured values ranged from a low of 2 mg/m^2 at North Sunnyside to an incredibly high 426 mg/m^2 at Gold Coast. It is unclear what caused the exceptionally high biomass at Gold Coast as this site is not adjacent to a large urban area or stream. Periphyton growth in this area occurred on isolated boulders surrounded largely by sandy substrate. It is possible substrate characteristics and natural lake dynamics (this area is near an area that might be favorable for upwelling of nutrients) favor periphyton growth at this location, or an unknown source of soluble nutrients is affecting localized conditions.

Interestingly low growth was observed at the time of the synoptic in much of the area between Sugar Pine Pt. to North Sunnyside, with an exception being an area south of Fleur Du Lac (45.80 mg/m^2). Pineland chlorophyll a biomass at the time of the synoptic was 6.65 mg/m^2 and Tahoe City 86.98 mg/m^2. Based on the high level of growth observed earlier in March at Pineland, we feel it is likely peak growth had already occurred in much of this region earlier in March, and had partially sloughed associated with storms and wave activity later in March. Therefore in the mapping of spring growth Figs 8-10, we included the higher values from late March at Pineland (47.80 mg/m^2) and Tahoe City (111.48) as representative of peak spring biomass values. We feel this gives a more representative whole-lake picture of spring peak growth.

Significant growth was found between Tavern Pt and up along most of the northwest shoreline to near Stateline. Moderate to very heavy chlorophyll a biomass was observed between Tavern Pt (37.77 mg/m^2) and the Tahoe City PUD Boat ramp (206.91 mg/m^2). Significant biomass extended along much of the rest of the northwest shoreline up to Brockway Springs. Two areas with particularly high growth in this stretch were South Dollar Cr. (114.37 mg/m^2) and Garwoods (117.98 mg/m^2) where runoff from a small drainage was entering the lake. The northeast section of the lake from North Stateline to the east shore had low to moderate growth.

The intensive synoptic done provides essentially a “snapshot view” of the periphyton distribution during the spring peak period. We hope to further examine this data as well as that obtained in last year’s synoptic for information which may help further identify factors potentially impacting growth in various regions. It is clear factors controlling the growth of periphyton in any one area or region can be complex. A better understanding of all factors controlling periphyton growth is needed to better understand patterns of growth around the lake.

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.