Final Report

Oklahoma Conservation Commission
Grand Lake (Oklahoma) Watershed Implementation Project

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(FUNDED BY THE ENVIRONMENTAL PROTECTION AGENCY)

Contracted Agency: Oklahoma Water Resources Board, Oklahoma Water Watch

Demonstration Project **Task 5.6**: Develop and Implement Total Phosphorus, (Total Nitrogen) and Chlorophyll-a Monitoring Utilizing Volunteers from Grand Lake Association (Water Watch Chapter), Wyandotte Nation, and the Seneca-Cayuga Tribe of Oklahoma.

December 2008

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Introduction

Grand Lake O' The Cherokees is located in northeastern Oklahoma and was formed by the Grand River Dam Authority (GRDA) in 1940 through the construction of the Pensacola Dam on the Grand Neosho River. With its high recreational use and extensive waterfront development, Grand Lake is considered an invaluable resource to the state of Oklahoma. Due to concerns about nutrients and metals flowing into Grand Lake, a §314 Clean Lakes project was completed on Grand Lake with data collected 1989 – 1990. Average turbidity and chlorophyll-a trophic state index (TSI) value were 12 NTU and 55 TSI, respectively. The OWRB's 2001 Beneficial Use Monitoring Program's (BUMP) data showed an average lake turbidity and chlorophyll-a of 45 NTU and 59 TSI, respectively. According to the current Oklahoma Water Quality Standards (OWQS), Grand Lake is as not attaining its Fish and Wildlife Propagation (FWP) beneficial use due to low dissolved oxygen (D.O.) and excessive turbidity, and is listed on the state's §303(d) list of impaired waters for low dissolved oxygen. As part of the Comprehensive Grand Lake Watershed Study mandated by Senate Bill 408, the OWRB has been charged to perform an update of the original Clean Lakes study on Grand Lake to determine if water quality has degraded since the original study.

In addition to our focus on water quality studies and nutrient reduction efforts, the Oklahoma Water Resources Board coordinates an active statewide volunteer lake water quality monitoring program known as *Oklahoma Water Watch* (*OWW*).

The Grand Lake Association (GLA) Water Watch Chapter was initiated in 1992. Since then, over 100 volunteers have invested thousands of hours testing water quality throughout the Grand Lake basin. The GLA was the first OWW Chapter to be established and has served as a pilot project for many aspects of the program, including the use of electronic instruments for vertical profile monitoring and nutrient sampling (nitrogen ammonia, nitrate nitrogen, orthophosphate), collection of chlorophyll samples, bacteria monitoring, serving as Chapter training coordinators and managing their own data entry. In October of 2006, the Grand Lake Chapter received 501-C-3 status and became known as Grand Lake Water Watch, Inc. (GLWW). Throughout its history the Grand Lake Chapter has been successful in securing funding which has assisted them in the purchase of more sophisticated equipment and hiring staff for Chapter support. Therefore, when OWW has implemented a new procedure to the program, the GLWW Chapter has been the obvious program to pilot.

Table 1. Oklahoma Water Watch Water Quality Parameters.

Basic Water Quality Parameters		
Air Temperature Water Temperature	Dissolved Oxygen (mg/L) pH	Secchi Disk Depth
Nutrient Parameters		
Ammonia Nitrogen	Nitrate Nitrogen	Orthophosphate

PROJECT OBJECTIVES

This project has allowed OWW to further educate the established network of volunteers in the Grand Lake basin on watershed and land use impacts on water quality. It has also allowed for the research and development of protocols for implementing volunteer collected total phosphorus (TP), total nitrogen (TN) and chlorophyll-a monitoring at in-lake and shoreline sites. Total phosphorus and TN samples were to be collected and packaged by volunteers and sent for analysis to the state environmental laboratory, Oklahoma Department of Environmental Quality (ODEQ). Chlorophyll samples were collected, filtered, and packaged by volunteers, whereas OWRB staff extracted chlorophyll and the ODEQ analyzed the samples and reported the results. Volunteers were trained by OWRB field staff and Blue Thumb staff, further educating them on professional sampling techniques and quality assurance. They were educated on watershed impacts, with hopes that they could be instructed on the outcomes of the reported data to encourage them to do self-data interpretation.

Water samples for TP and TN were to be collected at the 15 in-lake sites at 4 discrete depths through the water column including the surface (0.1m), the thermocline, halfway between the thermocline and bottom, and at the bottom (0.5m off the bottom). The TP/TN samples were collected when the lake was stratified, or May through October of the sample year. In addition, a duplicate sample was collected at one site for each monthly sample event. The duplicate sample was labeled as Site I-88. Chlorophyll and turbidity samples are collected monthly from the in-lake sites at the surface (0.1m). Sample collection frequency was implemented ten out of twelve months per year to provide a consistent, large data set that could not conceivably be collected by State staff. The OWW QAPP was modified to include TP and TN sample collection and packaging. Chlorophyll-a sample collection is currently in the OWW QAPP, however it was updated to reflect the Grand Lake project. Turbidity samples were also measured using a HACH 2100P Turbidimeter.

OWW PROJECT TASKS

5.6. Develop and Implement Total Phosphorus and Chlorophyll-a monitoring utilizing volunteers from the Grand Lake Association, the Wyandotte Nation, and the Seneca-Cayuga Tribe.

TASK 5.6.1 Research and develop total phosphorus sample collection

Time frame: Originally written as October 2004 – September 2005, revised to August 2005 – December 2005.
Deliverables: OWW Handbook Addendum to include total phosphorus
Due: June, 2007

Research was done and protocols developed for sampling TP and TN that the volunteers could apply to their existing sampling regime. Revisions to the OWW Volunteer Monitoring Handbook in 2006, reflected the addition of sampling for TP and TN and provided detailed sample collection methods, containers, preservation methods and sample holding times. This separate chapter was submitted as an Addendum to the volunteer monitoring Handbook and can be viewed in Appendix 1, OWW Volunteer Water Quality Monitoring Handbook Addendum.

TASK 5.6.2 Modify Existing OWW QAPP to include total phosphorus sample collection

Time frame: Originally written as October 2004 – July 2005, revised to July 2006.
Deliverables: Modified OWW QAPP with Project Addendum
Due: July 2006

Information detailing sample collection for TP and TN was added to the OWW program QAPP later in 2006. This information detailed sample containers, preservatives and maximum holding times for samples. The Addendum detailed the sampling schedule and selected samples sites, and described responsibility for sample pick-ups and sample analysis. Signatures for the Addendum were obtained in the summer of 2006 and submitted to the Oklahoma Conservation Commission (OCC) September of 2006. The QAPP Addendum can be found in Appendix 2.

Other modifications to the OWW Program QAPP assisted the sampling protocols of this grant. The 2002 QAPP added sections on chlorophyll-a monitoring and turbidity. In 2003 the QAPP was more descriptive concerning chlorophyll-a and turbidity which specified samples must be collected using one liter polypropylene bottles from the surface and submitted with Chain of Custody and sample analysis forms.

The OWW Program also continues to do more research into how it can be more comparable with other state programs and has sought out more EPA-approved rather than EPA-recognized methodologies.

TASK 5.6.3 Train volunteers on new methodologies, including workshops on watershed and land use impacts and self-data interpretation

Time frame: Originally written as November 2005 – December 2006, revised to January 2006 – January 2008.
Deliverables: Revised training protocols including educational workshops
Due: December, 2008

As a part of the CLEAR GRAND (CLeaning Effort ARound Grand) initiative, two Oklahoma volunteer water quality monitoring and public education programs held a joint training for new volunteers on October 27-29, 2005. For the first time, the Blue Thumb (BT) program and Oklahoma Water Watch coordinated their water quality monitoring efforts as increased focus was placed on Grand Lake and incoming streams. The training allowed volunteers to learn about both stream and lake ecology and enabled these volunteers to monitor streams, the lake, or both. This training was scheduled for Thursday evening, 6 – 10 PM, and Friday and Saturday, 9AM to 4PM. Topics covered in the training were watersheds, stream and lake ecology, pollution sources, pollution prevention, stewardship, water testing, field collections, communications, and the CLEAR GRAND initiative. After the training, volunteer monitoring efforts would take place in small groups and typically run about 2-3 hours per month.

Demonstrations of lake sampling were done on October 27th, courtesy of Grand River Dam Authority - GRDA Lake Patrol. The parameters tested were: air and water temperature demonstrations, Secchi disk, how to collect sample bottles for Colorimeter, and Hydrolab usage.

Figure 1. GRDA Lake Patrol

Blue Thumb demonstrations were held at Honey Creek for bug and fish collections and how to conduct their water quality kit testing. Additional training for volunteers interested in only doing lake sampling was coordinated with the GLWW Chapter in Grove, OK.

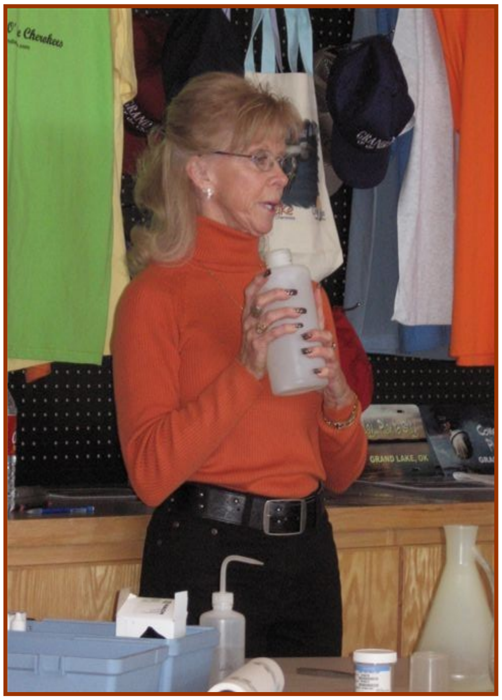
Figure 2: Training at Honey Creek

Figure 3: Joint training with Water Watch and Blue Thumb

Jim Mitchell, Training Coordinator for the GLWW Chapter, held eight regular Water Watch training sessions throughout the project period of July 2005 through December 2008. In 2005, two sessions were held, in 2006, 1 session, 2007, two sessions and in 2008, three training sessions were held. Eighteen individual volunteers were trained on Hydrolab use, chlorophyll and nutrient sampling.

The pre- and post-test for use with volunteers was completed in December of 2005. This test will also be used in the future with all monitoring groups statewide. The test was designed with input from other educational agencies and is broken up into 3 parts. Part one covers 6 multiple choice questions over watershed knowledge and limnology, Part two assesses program comprehension through 6 multiple choice questions over training and QCA procedures. Part three is given only after the monitor has been with the program for 6 months or more and measures environmental action. This section is broken up into narrative answers and also scaling questions where volunteers rate their own awareness about environmental issues and is intended to demonstrate changes in volunteer behavior and awareness over time. Since there was minimal volunteer involvement and the OWW and OWRB staff completed the project, these tests were not administered. The test is included in Appendix 3, OWW and BT Joint Training and Recruitment Efforts.

Two additional joint training sessions were also held; one on October 26th and 27th, 2006 and February 20th, 2007, in Grove, Oklahoma, at the Grand Lake Associations offices. On September 27th, 2006, a meeting was held between OWW, BT and CLEAR GRAND coordinator, Kevin Gustavson, to discuss and finalize the joint training between Blue Thumb and OWW for the October 26th and 27th, 2006, again as a part of the CLEAR GRAND initiative. OWRB sent out a press release on October 5th announcing the training. This training session was part of the ongoing effort to standardize sampling methodologies between volunteers and educate the volunteers on land use and watershed impacts. Approximately 15 people were in attendance over the two-day training.



On February 20, 2007, another joint training between Blue Thumb and OWW was held.
This joint training session with BT introduced volunteers from both groups to chlorophyll-a and Total Phosphorus/Total Nitrogen monitoring protocols. Many of the OWW Grand Lake volunteers were already familiar with the chlorophyll-a parameter. BT volunteers had not monitored for chlorophyll-a.

Sonja Raye of Grand Lake Water Watch Chapter demonstrated the method for chlorophyll-a extraction and grinding the sample to be sent to ODEQ for analysis. Sonja led the group through the chlorophyll-a procedure step by step. First, demonstrating how to get your sample, then how the sample is extracted, frozen, ground and finally sent to the DEQ lab for analysis. Sonja also instructed volunteers on the correct way to fill out all the log and chain of custody sheets and how to properly label the samples.

Figure 4. Chlorophyll-a extraction demo

Jean Lemmon and Lynda Williamson demonstrated the correct procedure for TP and TN collection.

There were two sessions held, one at 3:00pm and the other at 6:00pm. There were 9 people in attendance at the 3pm session (7 from OWW and 2 from BT) and 8 people in attendance at the 6pm session (2 from OWW and 6 from BT), including the Seneca-Cayuga tribe members.

During discussion about the sampling protocols, volunteers expressed their concern with the sampling effort involved for TP/ TN sampling and questions arose from these training sessions about how best to utilize the volunteers. The tribe members present were responsive and were contacted about sampling their sites at the upper end of Grand Lake.

Figure 5. Filter containing chlorophyll

Figure 6. Volunteers attending the 3:00pm session

On April 21, 2007, Sara Ivey and Lynda Williamson attended the Clear Grand Earth Day Celebration in Grove, Oklahoma – Cherokee Queen Location. The Clear Grand group hosted this event from 10:00 am until 3:00 pm on Saturday and invited OWW to attend. H2Olympics, a Project WET activity, and OWW monitoring kits were demonstrated. H2Olympics is an activity that demonstrates water's physical properties of cohesion, adhesion, surface tension and capillary action and the polarity of water. Community members saw water walk a tight rope, water falling down a piece of yarn at an angle from one cup to another, without "falling" off the yarn. They dropped pennies into a full glass of water to see how many they could get in before any water was displaced – the record for the day was 60. They let drops of water fall from an eye dropper on to a penny to see how many drops a single penny would hold – 20 was the record. They also carefully placed paperclips on the surface of the water using a fork to see how many they could get. OWW staff also went through an OWW kit with passers by and talked about the parameters that we sample for, and a brief demonstration of how some of the procedures, like Secchi are done.

TASK 5.6.4 Implement sample collection and quality control sessions for the implementation phase

Acquire monitoring equipment and supplies and implement volunteer monitor training for In-lake Monitoring Program. Initiate in-lake monitoring at the dam and/or BUMP sites depending on *flexibility of monitors. Additional volunteer monitors may be recruited throughout the year to aid in data collection activities conducted under this task.*

Time frame: January 2006 – December 2006, revised August 2006 – November 2007
Deliverables: Data summary/Results-included with final report
Due: December 2008

In order to fulfill the requirements of this federal grant, OWRB staff gathered all samples from all sites, when it was determined that the GLWW volunteers would not able to implemented the project. In April of 2007, a sampling schedule was set up utilizing personnel from the Lakes BUMP staff in Water Quality's Monitoring and Assessment section, and OWW staff. As indicated in the QAPP Addendum, sampling was to last 6-months and was scheduled to begin in May and end in October 2007. Sampling events were scheduled every five weeks until all field sampling was completed. This sampling schedule was modified and extended to November, 2007.

The OWW and OWRB Beneficial Use Monitoring Program (BUMP) staff worked out an internal sampling and delivery schedule with ODEQ that allowed the samples to be collected by BUMP, instead of the volunteers, through the May-November time frame, at 10 sites. The tribes' sites were the two most northern sites at the upper portion of the lake. During the June 2007 sampling dates, the members of the Wyandotte Nation and the Seneca-Cayuga tribes were contacted again in order to coordinate field sampling of their sites. Due to rainy weather on the second day of sampling, tribe members did not meet with OWRB staff and decided not to sample. It was then decided that OWRB staff would sample all sites (including the tribe sites) going forward.

OWW staff along with BUMP lakes staff utilized equipment that had been purchased by the Oklahoma Water Resources Board. Grand Lake Water Watch has been a successful Chapter and volunteers were able to secure equipment through grants. GLWW is the only monitoring Chapter in EPA Region 6 that produces data with the use of multi-parameter electronic probes and because of their meticulous calibration and field training, they have data that is on par with state water quality agencies.

The Quality Control Assessment Session (QCA Session) tests the volunteer monitor's precision and accuracy of performing the required parameters tested, verifies the proper working order of equipment, and determines whether the data quality objectives are being met. It serves as a coaching tool to maximize data quality. Volunteers are required to attend and successfully complete at least one of the sessions offered per year. The volunteers at GLWW were offered several QCA sessions during the scope of the §319 project time period between 2006 and 2007, though the volunteers consistently attend QCA Sessions as part of the ongoing OWW Volunteer Monitoring program. QCA Sessions were held at the GLA office on June 2nd & 3rd, 2006, June 8 and October 9th & 10th, 2007. Overall, the QCAS results were within the acceptable margins for accuracy and precision on all basic and advanced parameters. This demonstrated monitors understood all procedures and tests involved in monitoring. See Appendix 4, ODEQ Lab Analysis Sheets and QCA Session Reports

Data Summary

Data collection varied at each sampling event due to many occurrences; boat maintenance issues, communication with tribal members, various weather conditions, the lack of adequate boat ramps for usage due to flooding, early turnover of the lake (became mixed sooner than expected), and failure of field equipment. However, steps were taken to remedy the problems and sufficient data was collected.

Figure 7. Dock (left) and picnic area under water at boat ramp

The lake was sampled between May 2007 and November 2007 and field sampling events were scheduled for every five weeks. The August sampling trip had to be re-scheduled due to boat motor problems. Because of this setback, the monitoring schedule was extended in order to collect data for the grant time period and the August trip was made up the following week on September 4th. Samples were taken from 12 sites; 1, 2, 3, 4, 6, 7, 8, 11, 12, & 13, I-76 & I-77 (see Figure 9 Map below). The total amount of sampling sites was modified from 15 to 12 sites as the project got underway.

When it was realized the tribes would not be doing any sampling, the OWW/BUMP sampling team added those sites to their own. Further discussion with the ODEQ about what was needed for TMDL modeling determined that adequate sample coverage existed and sites, 5, 9 and 10 were dropped. All water samples were taken at four discrete depths; surface (0.1 meters), thermocline (located by observing a 1° temperature change), ½ way between the thermocline and bottom, and the bottom (approx. 0.5 meters off the bottom). Vertical profiling samples were taken at all sites with a MS5 Hydrolab®.

A maximum of five one-liter bottles were used per site. Four of the bottles were filled from the integrated samples and preserved with sulfuric acid. One bottle was filled for a chlorophyll-a sample and preserved on ice. An additional 125-milliliter bottle was filled and preserved on ice to prevent the neutralization of the one-liter samples. For July sampling, an ODEQ representative informed the team to take an additional 120cc sample at each site and each depth for testing. By collecting an extra sample, it enabled the ODEQ laboratory chemist to analyze the sample without having to neutralize the 1-liter samples preserved with sulfuric acid.

For reporting purposes, all data was not graphed or discussed. The chosen sites reported represent the limnological regions of the lake. Sites are also discussed using their Beneficial Use Monitoring (BUMP) site numbers. If there is not a BUMP site number, the OWW site number was used. The representative limnological regions of the lake are described for the following sites and can be seen on the lake map on page 15: Site 1 (the dam and deepest site of the lake - lacustrine), site 3 (lacustrine), site 8 (transitional), site 12 (I-66) (riverine), and site I-77 (northern most site – riverine). All data has been represented graphically but trend analysis was not done due to the limited amount of data collected for this purpose. All raw data is located on the OWRB/OWW database.

Figure 8. OWW staff sampling Grand Lake

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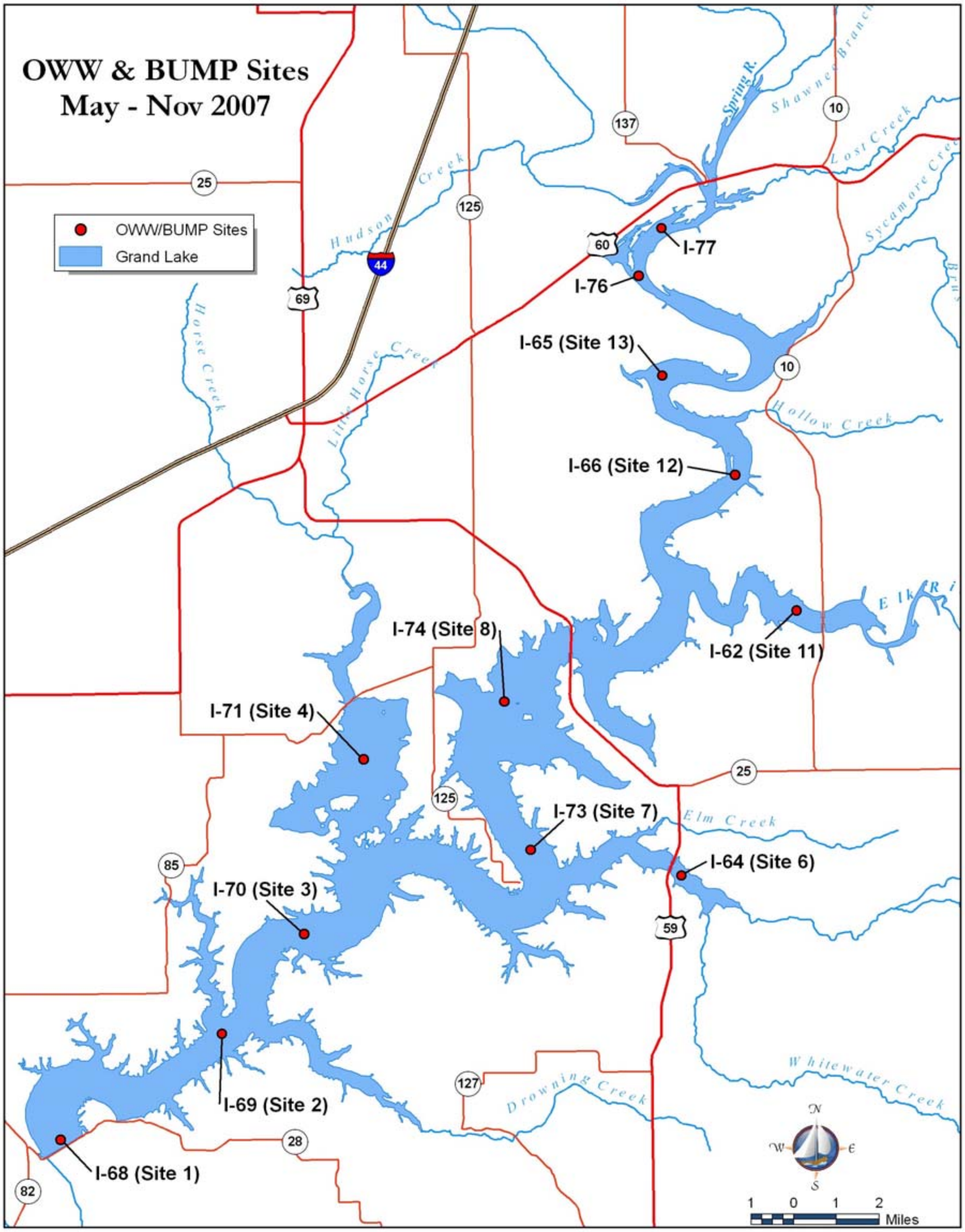

Figure 9. OWW and coordinating BUMP sample site locations at Grand Lake

Chlorophyll-a

Chlorophyll is the green pigment molecule that absorbs sunlight and uses its energy to synthesize carbohydrates from CO_2 and water in the process of photosynthesis. Chlorophyll is also used in determining a lakes' Trophic State Index (TSI).

Chlorophyll samples were taken at most sampling events and processed at the OWRB lab. The Oklahoma Department of Environmental Quality (ODEQ) Laboratory did analysis of the chlorophyll samples. When looking at the data, the month of September reported the highest amounts of chlorophyll-a present at site 12 (I-66) and site I-77, the more shallow, riverine sites. It is important to note that both of the sites that reported high levels of chlorophyll are located at the upper north region of the lake. The major rivers that enter the lake from the north are the Neosho River and Spring River.

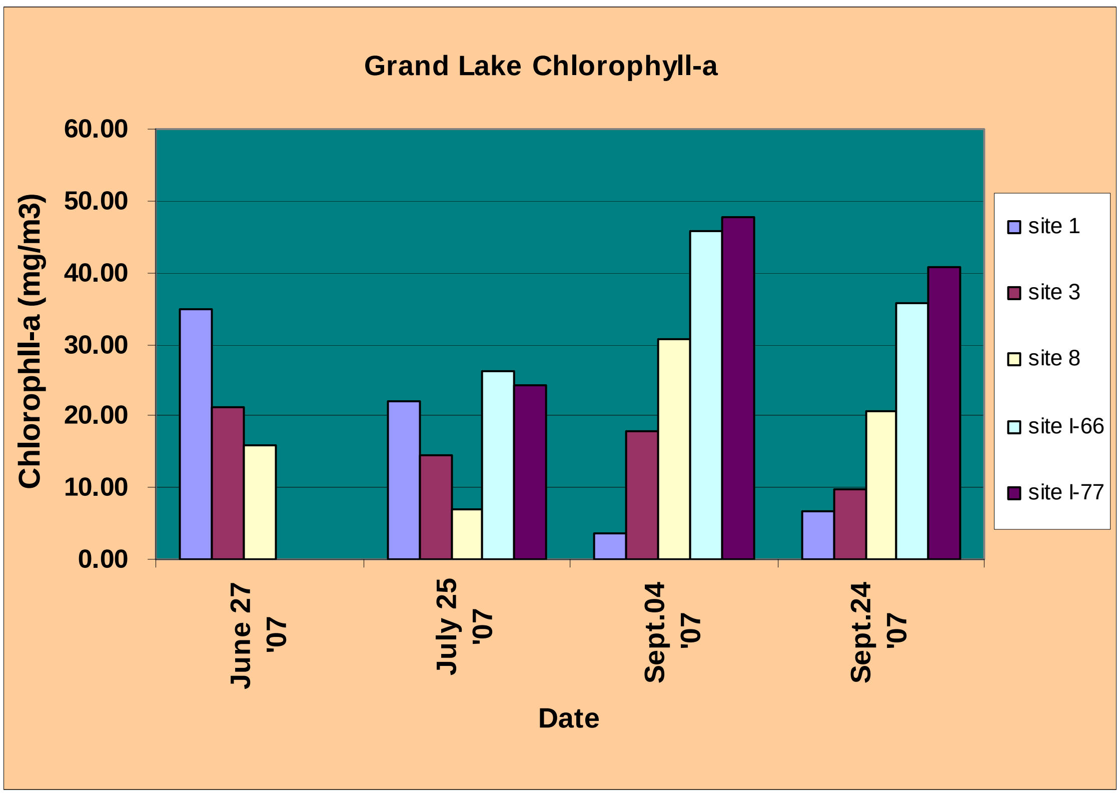

Figure 10. Chlorophyll-a data for June, July, and September 2007

Turbidity

Turbidity is the cloudiness or haziness of a fluid caused by individual suspended or dissolved solids that are generally invisible; the greater the turbidity, the greater the number of solids. The measurement of turbidity is a very important test in water quality. Water Quality Standards (WQS) state that turbidity measurements shall be restricted to not exceed 25 Nephlometric Turbidity Unit (NTU) for lakes. Turbidity measurements can be increased due to various reasons such as: phytoplankton, sediments from erosion, resuspended sediments, waste discharge, algae growth and urban runoff. Therefore, the elevated turbidity measurements that were recorded were expected due to the continuous days of excessive rain.

Turbidity samples were taken and read by OWRB staff. Turbidity measurements ranged from 2 NTU to 31 NTU. At each sampling event, site 1 had the lowest turbidity measurement. The highest turbidity measurement was at site 8 for the month of May and site I-77 for the month of July.

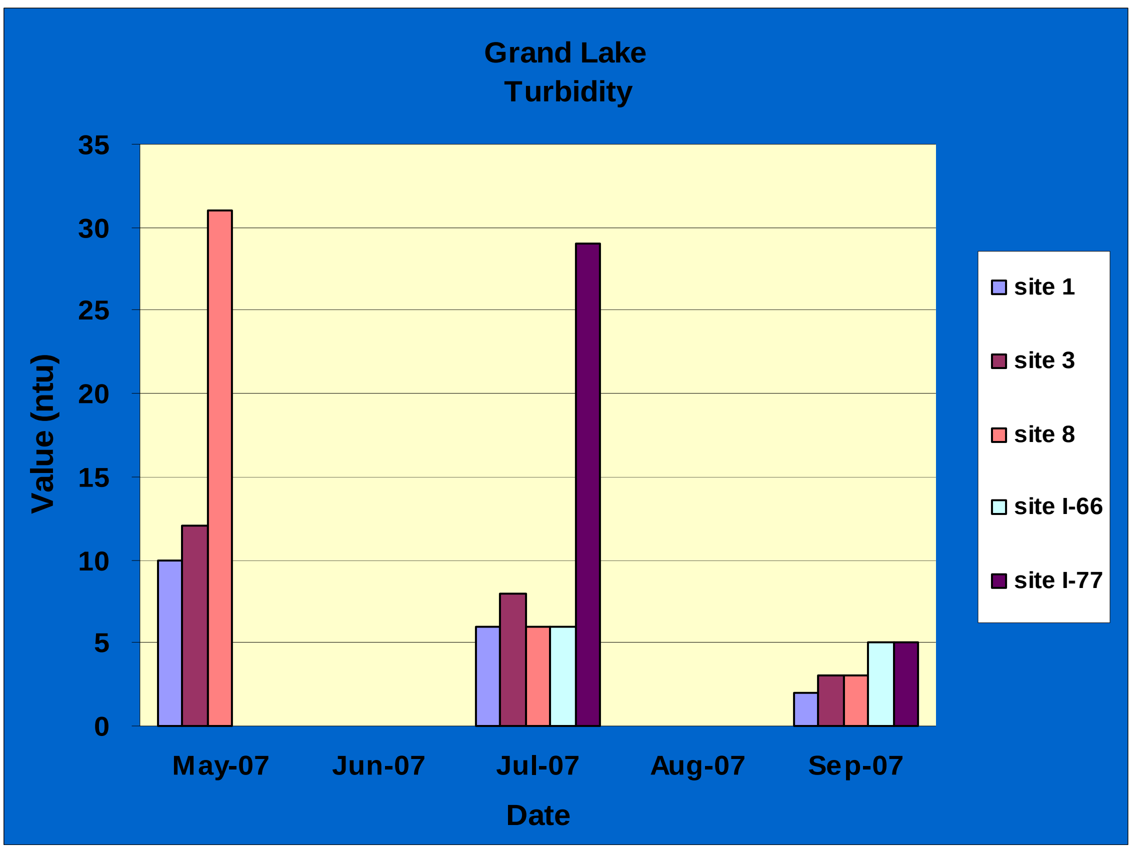

Figure 11. Turbidity measurements from May 2007 – September 2007

Bacteria

Bacteria are single celled prokaryotic microscopic organisms. There are many species of bacteria, however, GLWW only analyzes *E. coli*, Enterococci and total coliforms. For recreation purpose, WQS standards examine fecal coliforms, *E.coli* and Enterococci. Therefore, for this report, only *E. coli* and Enterococci were graphed. GLWW monitors for bacteria during the recreation season of May through September. Through grant monies, GLWW was able to purchase an IDEXX bacteria machine to analyze their bacteria samples.

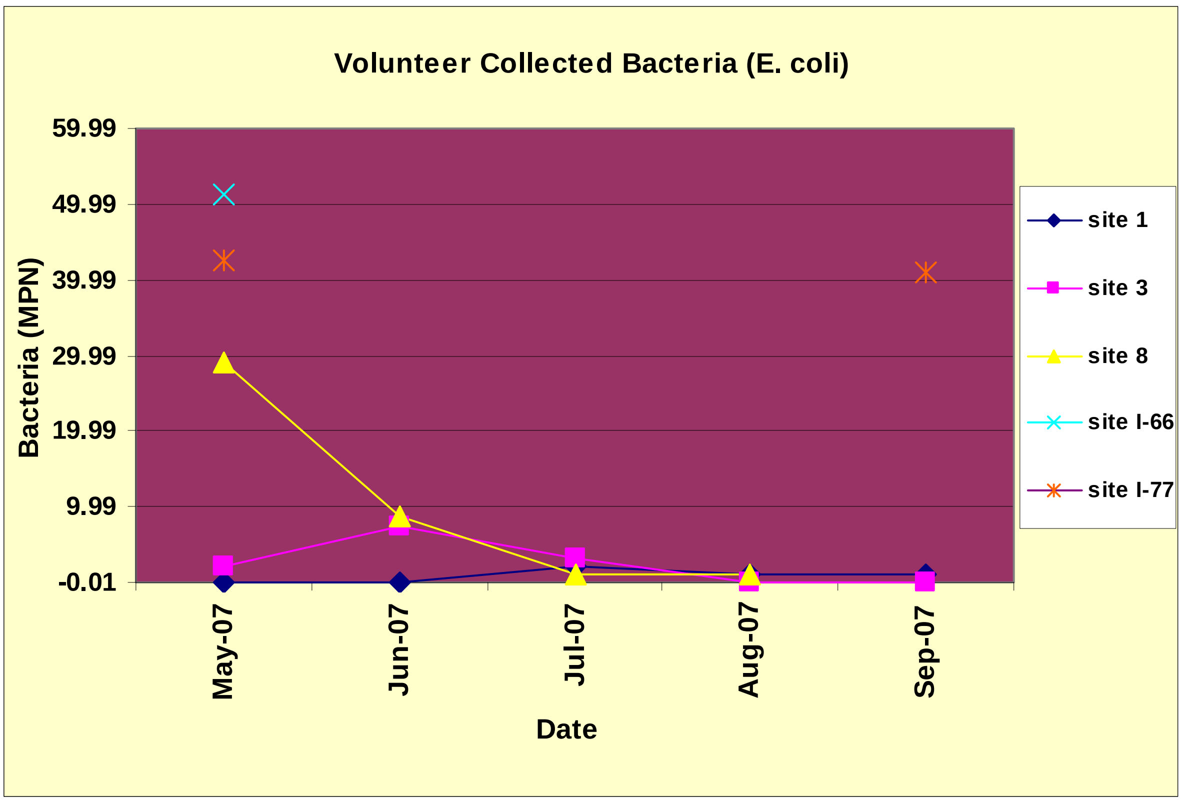

Figure 12. E. Coli data from May 2007 – September 2007

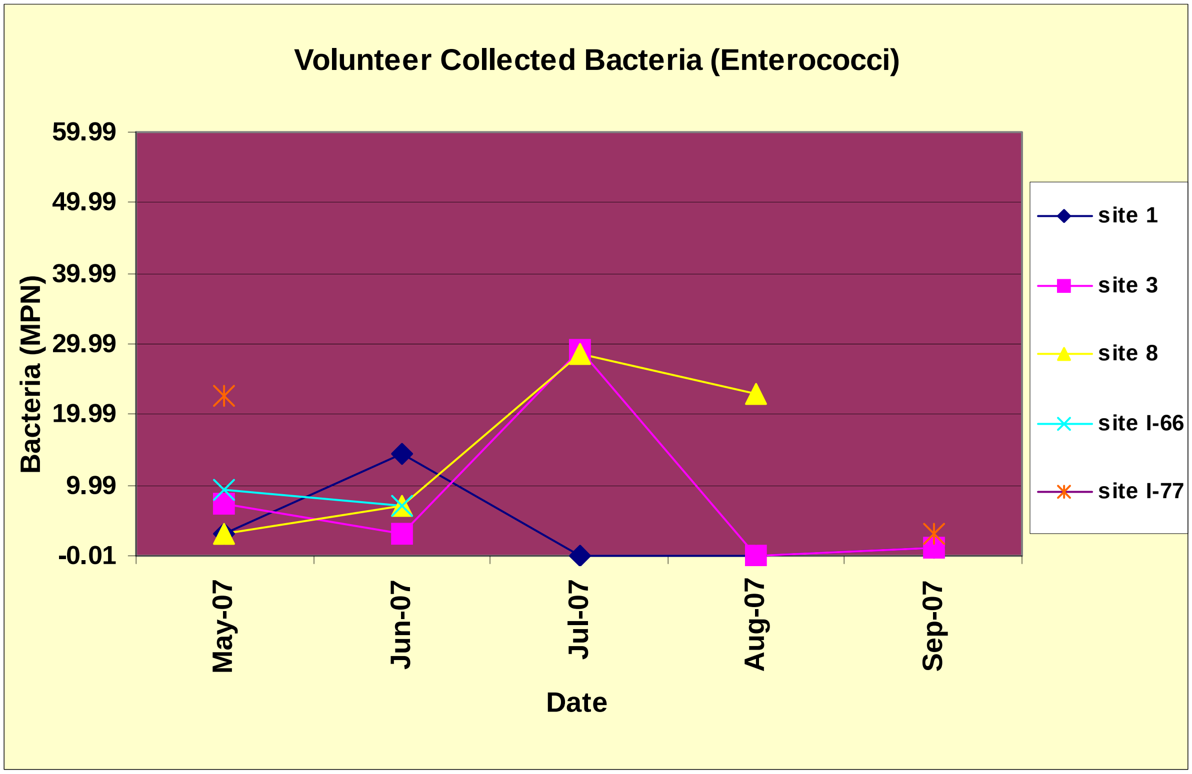

Figure 13. Enterococci data from May 2007 – September 2007

The Oklahoma WQS have established criteria for acceptable levels of bacteria for waterbodies in the state of Oklahoma to determine if a particular waterbody is fully supporting its beneficial uses. Separate WQS Implementation rules 785:46, establish rules for when waterbodies are deemed impaired due to bacteria levels. E. coli is deemed to be fully supported if the geometric mean of 126 colonies per 100 ml is met. Enterococci are deemed to be fully supported if the geometric mean of 33 colonies per 100 ml is met, or the sample concentrations from that waterbody taken during the season do not exceed the screening levels. The highest recorded value for E. coli occurred in May. Site I-66 had a reading of 51.2 MPN. The highest recorded value for Enterococci was in July at site 3, which had a reading of 29.1 MPN. Recorded values for E. coli and Enterococci are lower than the WQS and are deemed to be fully supporting.

Dissolved Oxygen and Temperature

Dissolved oxygen is the amount of gaseous oxygen dissolved in an aqueous solution. There are several means by which oxygen gets into water, such as: aeration, a waste product from photosynthesis and diffusion from the surrounding air.

Vertical profile readings for dissolved oxygen and temperature were taken at every meter throughout the water column at 12 sites. Oklahoma Water Quality Standards Implementation Rules OAC 785:46-15-5 (b)(3) states:

> (C) The Fish and Wildlife Propagation beneficial use designated for a lake or reservoir or portion thereof shall be deemed to be not supported with respect to the DO criterion if more than 50% of the water column at any given sample site has D.O. concentrations less than the screening level prescribed in (b)(2)(A) of this section due to other than naturally occurring conditions.

The screening levels described in *(b)(2)(A)* for DO for the water column of a lake shall be 2.0 mg/L, while the screening level for surface DO in a lake or arm of a lake shall be 4.0 mg/L from June 16 through October 15 each year and 5.0 mg/L for the remainder of the year.

As the surface of a lake begins to get warm in the spring, stratification begins. Thermal stratification is the formation of horizontal layers of different densities caused by changes in temperature. Cool water is more dense than warm water, therefore it tends to descend to the bottom of the lake. The less dense water forms over a more dense layer. The thermocline is the area where there is a large temperature and density change of the water by depth. Due to the differences, there is a thermal resistance to mixing between the epilimnion and the hypolimnion. Dissolved oxygen may be consumed and depleted. As expected, there was an inverse correlation between DO and water temperature, and oxygen concentration changed seasonally.

However, prior to lake stratification, the lake has isothermal conditions throughout the water column. Lake stratification may have a significant effect on water quality by “capturing” nutrients or chemicals in areas of reduced exchange and water interaction.

Three dimensional isopleth graphs can be used to illustrate physical lake data. These graphs show variation in physical parameters over depth and time. Each line on the graph represents a specific temperature or DO value. Vertical lines represent a mixed water column. When lines run horizontally, some degree of thermal stratification is present. The x-axis lists the date and the y-axis lists the depth in meters. Dissolved Oxygen values are colored red and blue. Higher DO readings are colored blue and gradually turn red as dissolved oxygen decreases. The measurements that were above 2 mg/L are blue, indicating higher DO in the water column. However, the measurements below 2 mg/l are red, indicating lower DO in the water column. Water temperatures are colored white and red. Warm water temperatures are colored white graduating to red as temperature decreases.

During the sampling period, site 1 experienced the least amount of dissolved oxygen, with measurements below 2 mg/L at approximately 5 meters. Also at 5 meters the temperature of the water began to decrease.

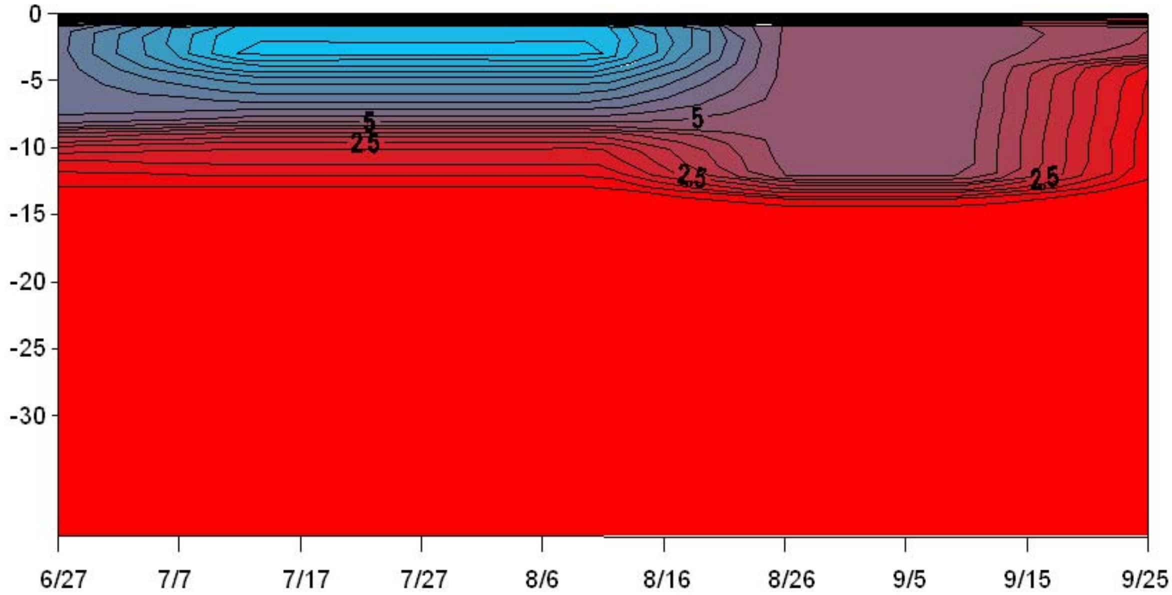

Figure 14. Site 1 DO

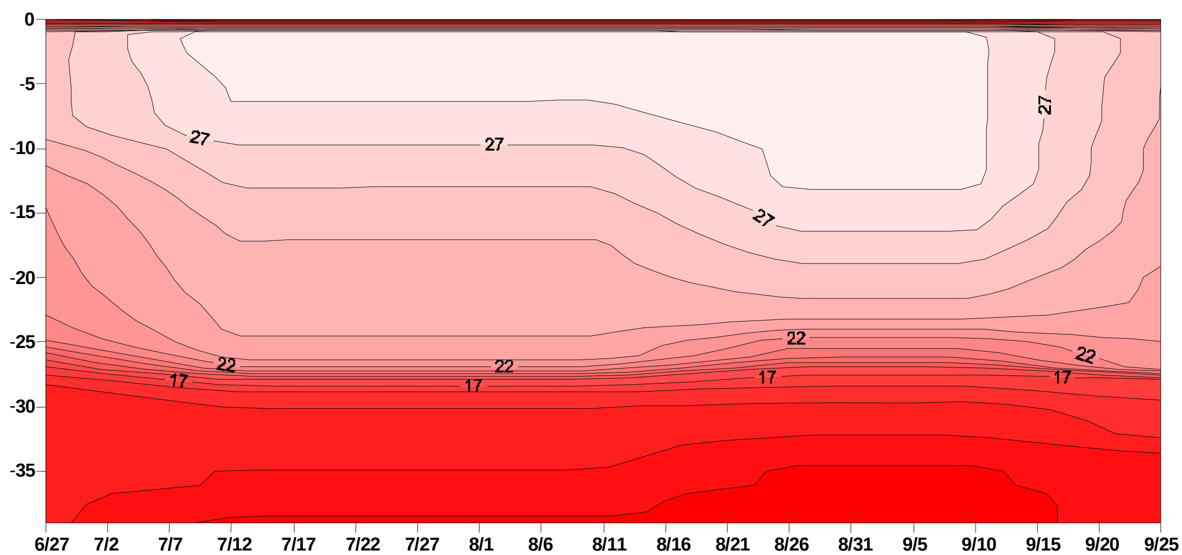

Figure 15. Site 1 corresponding temperature

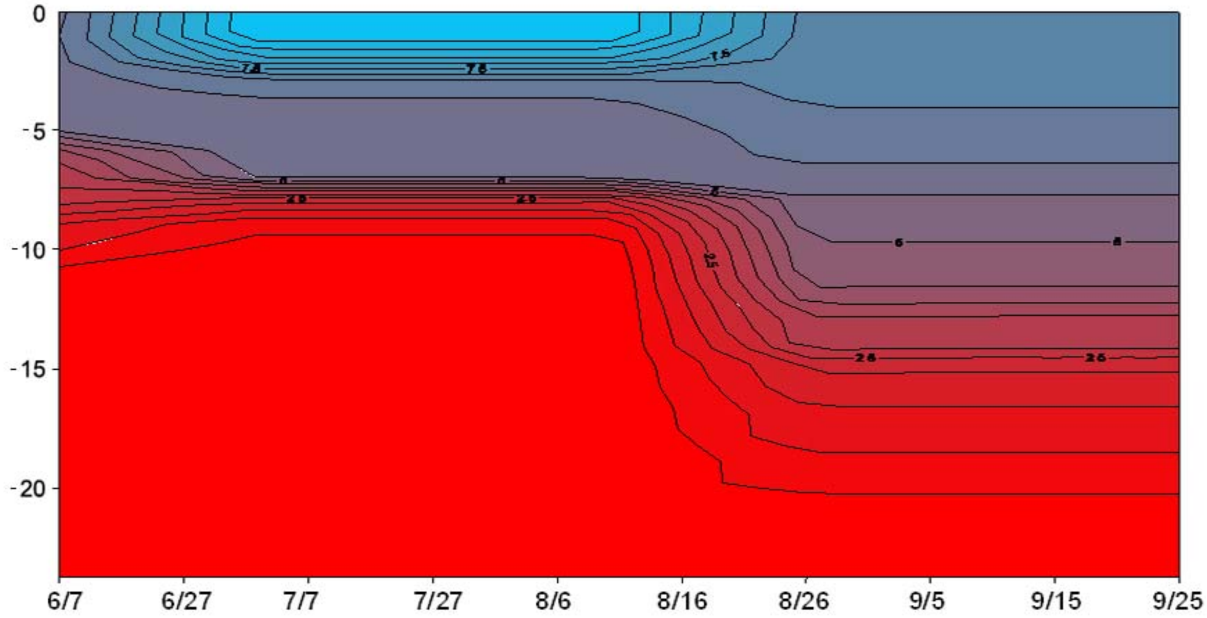

Figure 16. Site 3 DO

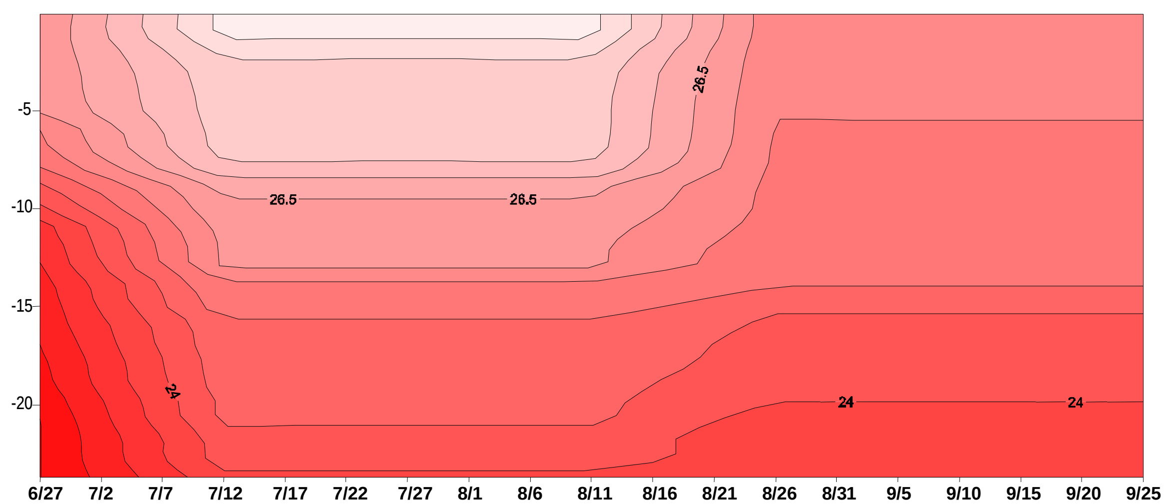

Figure 17. Site 3 corresponding temperature

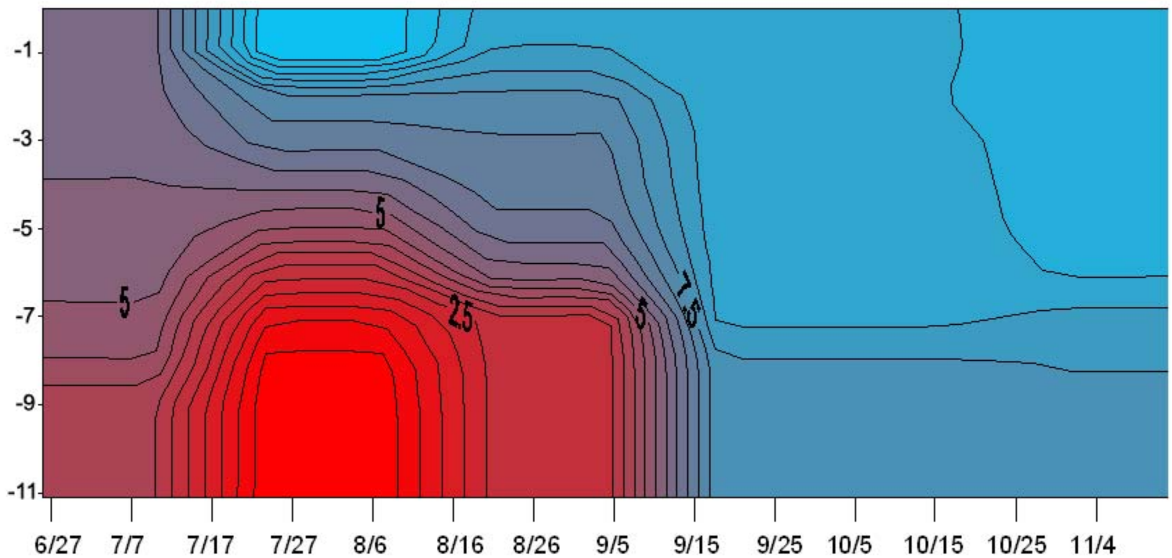

Figure 18. Site 8 DO

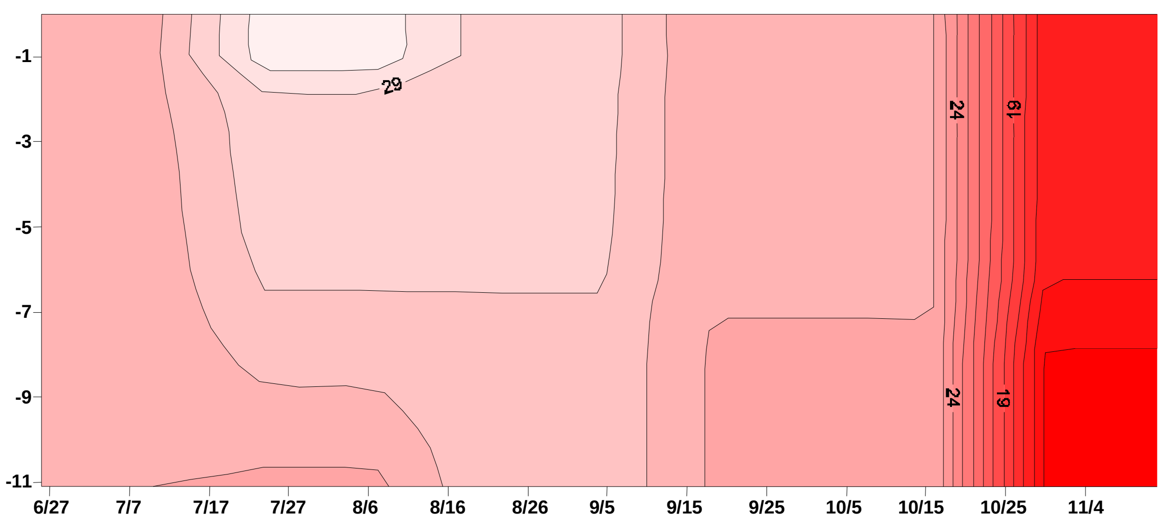

Figure 19. Site 8 corresponding temperature

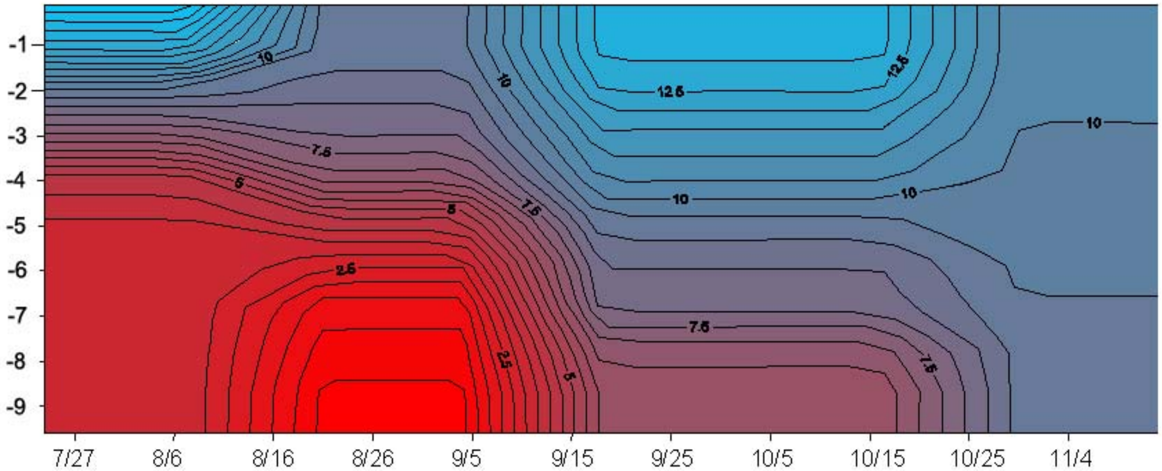

Figure 20. Site 12 (I-66) DO

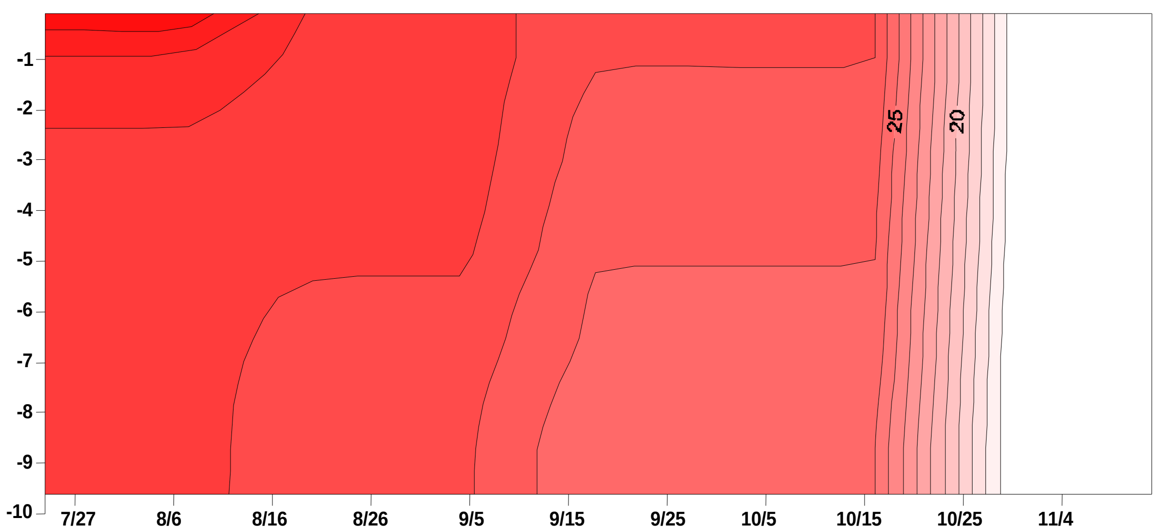

Figure 21. Site 12 (I-66) corresponding temperature

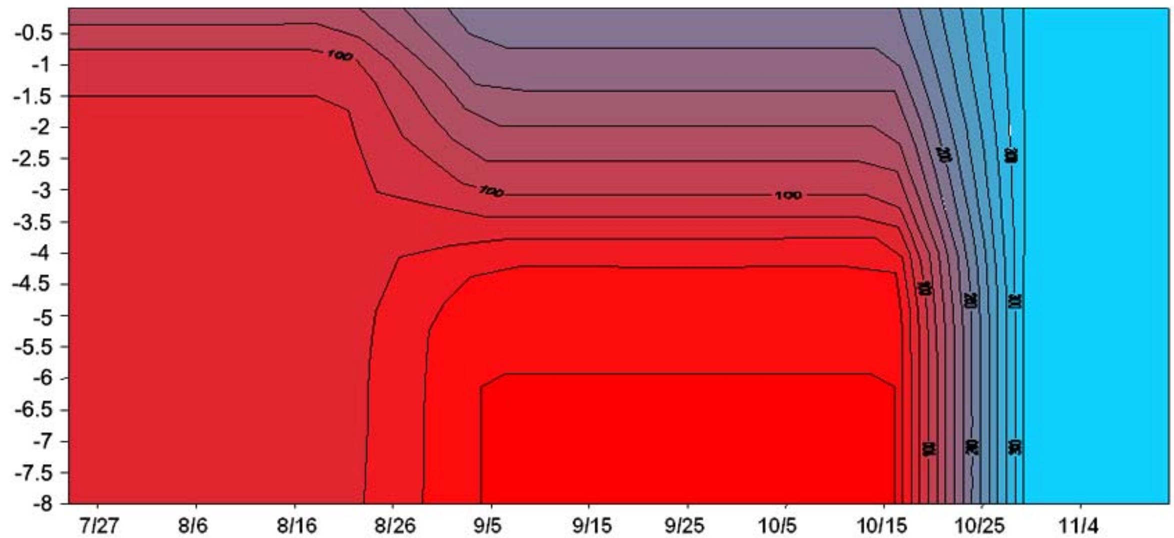

Figure 22. Site I-77 DO

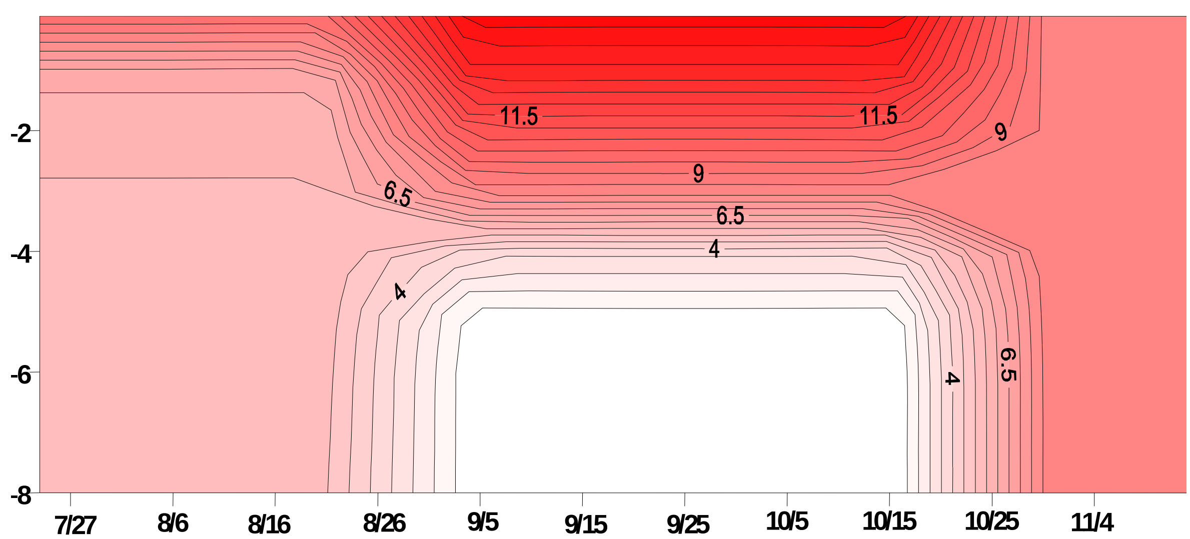

Figure 23 Site I-77 corresponding temperature

Nutrients

Nutrients promote algal growth of in a lake system. The main nutrients of concern are nitrogen and phosphorus. These elements are measured in several forms. Phosphorus and nitrogen can be measured as total phosphorus (TP) and total nitrogen (TN) or in their soluble reactive forms, which are more biologically available. The dissolved form of phosphorus is ortho-phosphorus, whereas the dissolved forms of nitrogen are ammonia, nitrate and nitrite. Phosphorus and nitrogen can originate from many different sources including: human and animal waste, fertilizer, detergents, septic systems, sewage and runoff.

The ODEQ lab, however, analyzed dissolved and total forms of nitrogen. But only the total form of phosphorus was reported for this project. For this report, only the total forms of nitrogen and phosphorus were graphed.

Nutrient samples for total phosphorus and total nitrogen were collected during the 2007 summer sampling season. Samples were taken in May, June, July and September. During the sampling season, the sampling team was faced with many challenges including, inclement weather. There were many days of rainfall resulting in flooding. In addition, boat maintenance, and conflict of scheduling with BUMP-Lakes staff caused the sampling schedule to be modified. Samples were not collected at every depth at all sampling events. For sites 12 (I-66) and I-77 samples were only submitted in July and September. On the September 04 sampling trip, heavy rainfall was encountered and there was not a collection between the thermocline and bottom on September 4th. The data also reflected a spike in nutrients on this sample date. In all probability, this was due to non-point source runoff from the rain event.

Nutrients samples were taken at four discrete depths in the water column: surface, thermocline, between the thermocline and bottom, and bottom. The thermocline was detected by using a Hydrolab®. If the thermocline was not detected, the sample was taken half-way between the surface and bottom to allow for a mid column sample.

Chemical nutrient limitations can be calculated using the TN:TP ratio. Generally, reservoirs that are nitrogen limited had water column TN:TP ratios <18. Sites and depths were randomly selected to calculate the TN:TP ratio, and all fell below 18 molar.

Total Nitrogen graphs

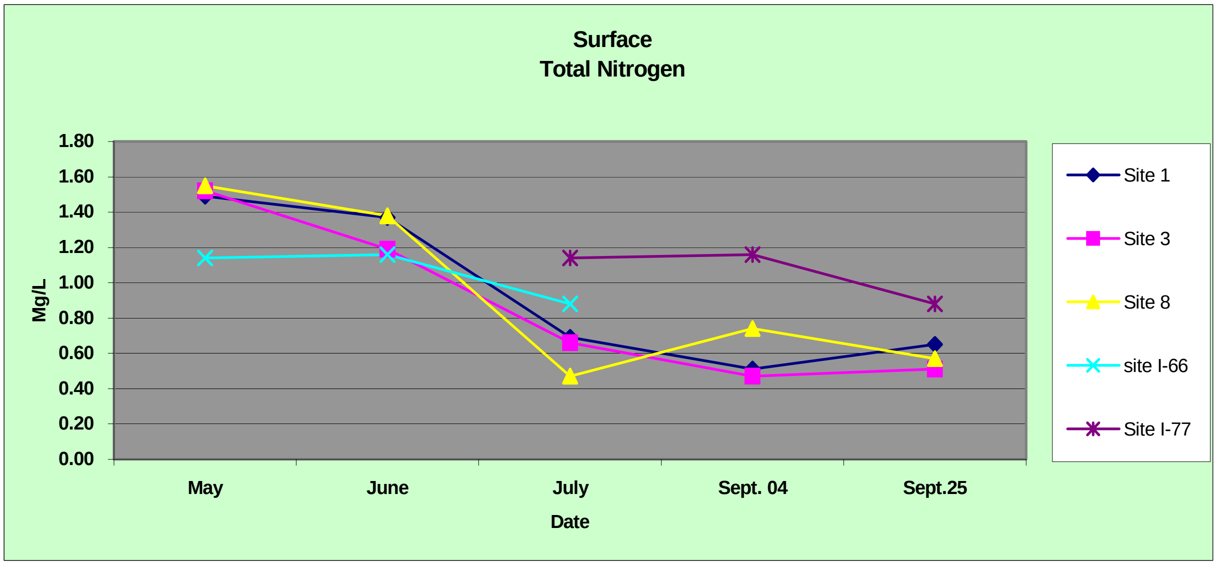

Figure 24. Surface Total Nitrogen Measurements

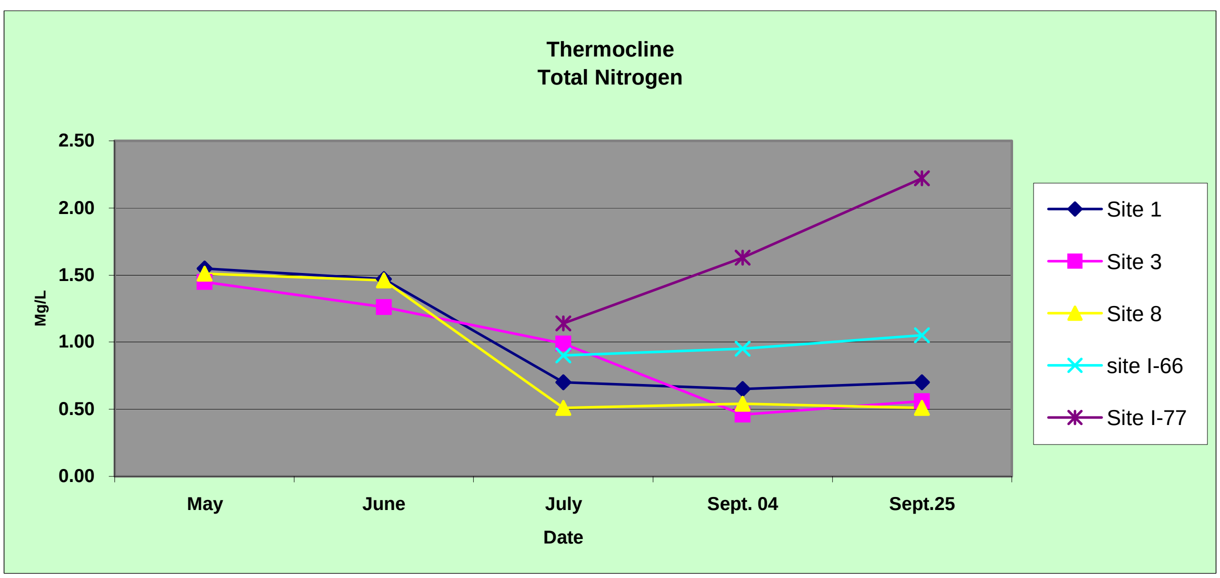

Figure 25. Thermocline Total Nitrogen Measurements

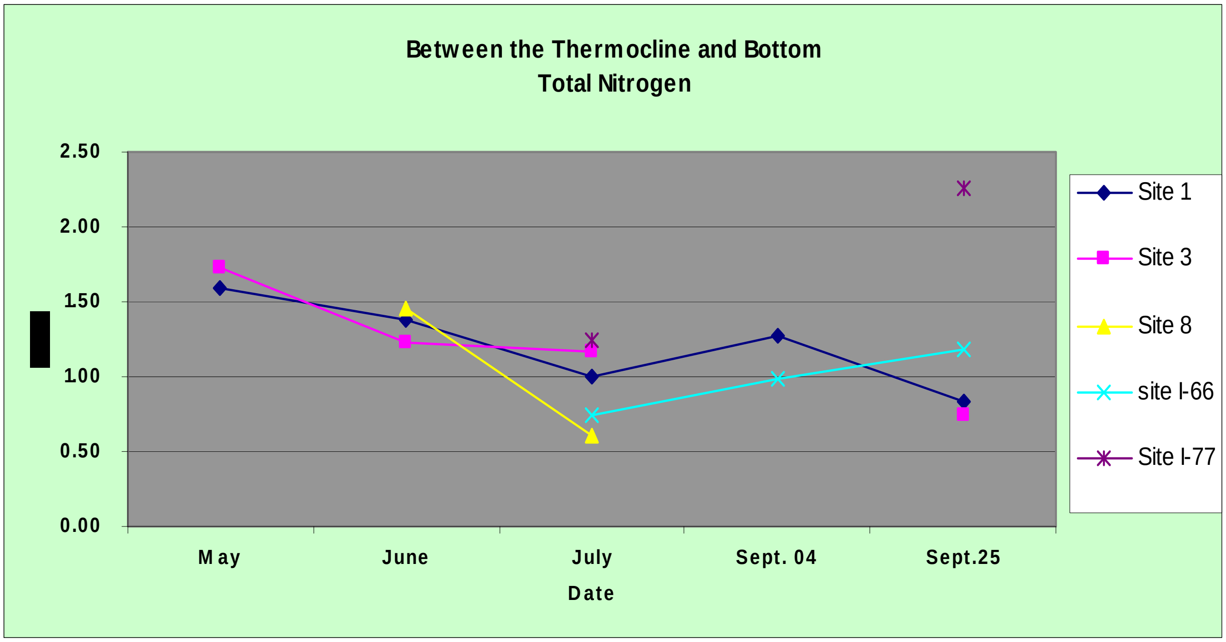

Figure 26. **Between Thermocline and Bottom TN Measurements**

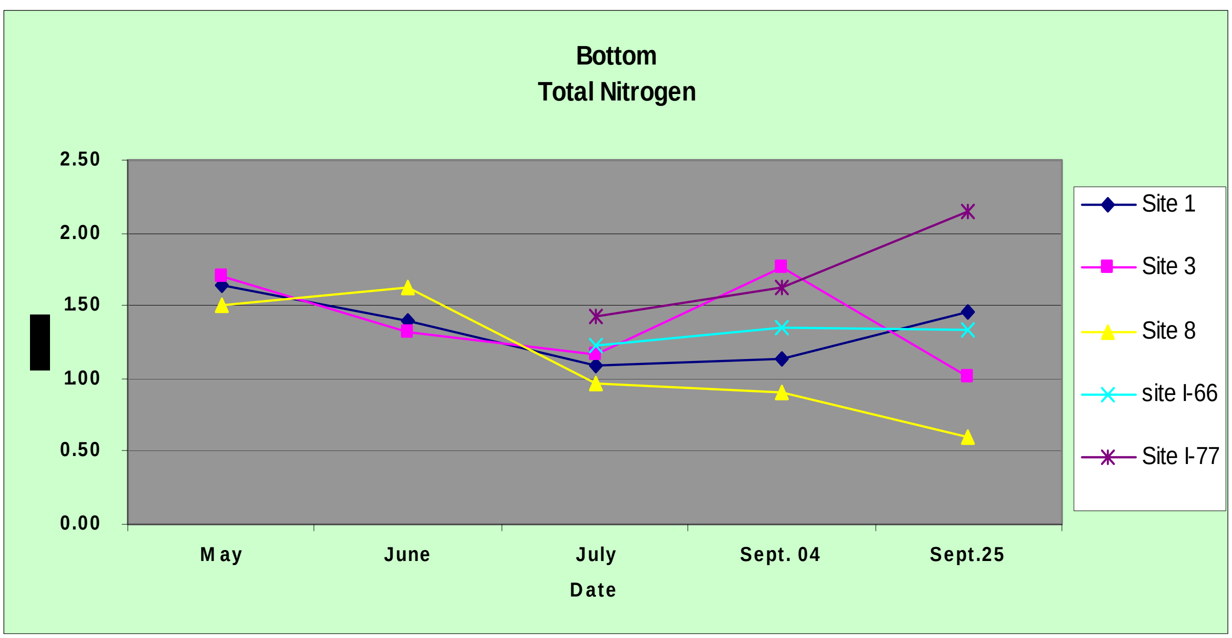

Figure 27. Bottom Total Nitrogen Measurements

Total Phosphorus graphs

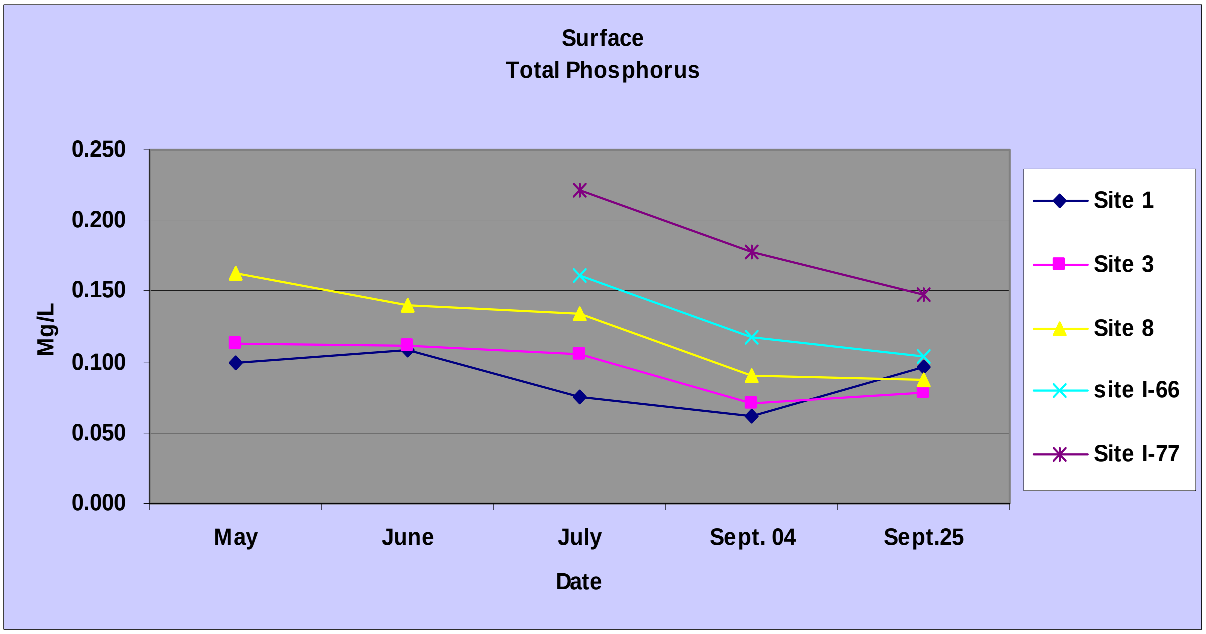

Figure 28. Surface Total Phosphorus Measurements

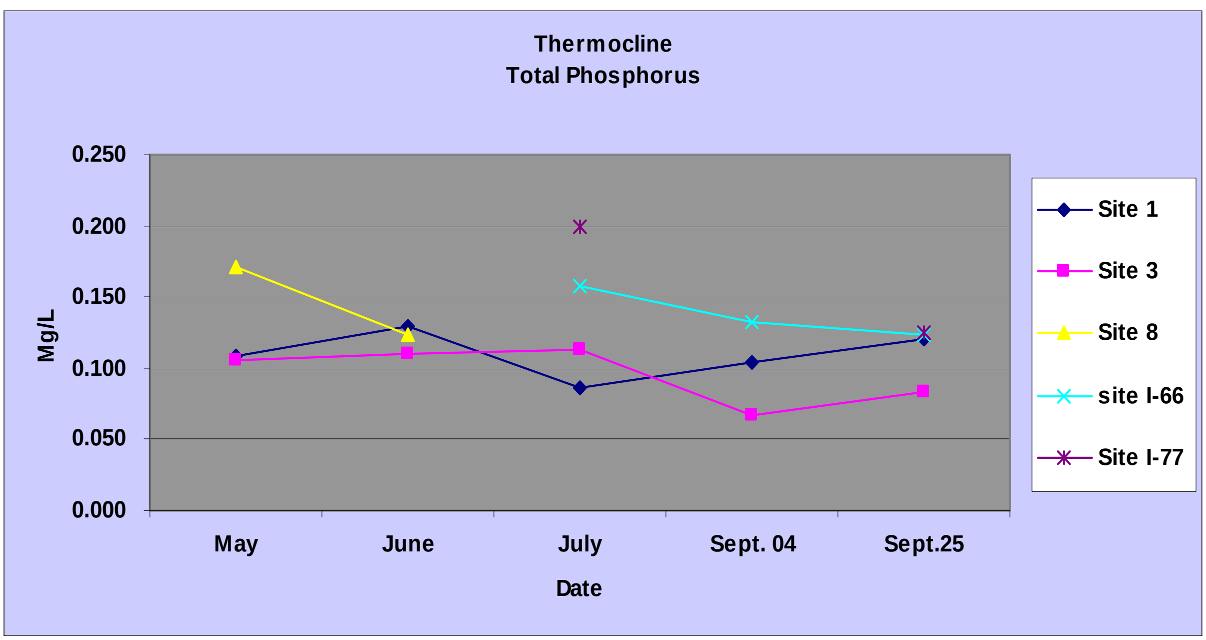

Figure 29. Thermocline Total Phosphorus Measurements

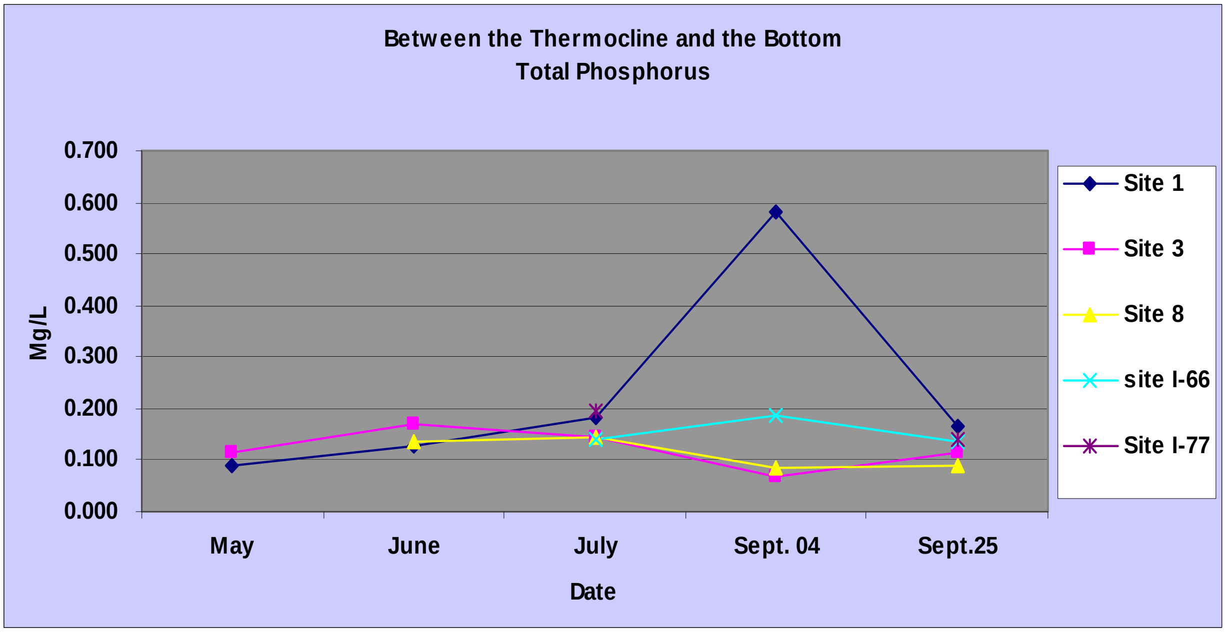

Figure 30.. Between Thermocline and Bottom TP Measurements

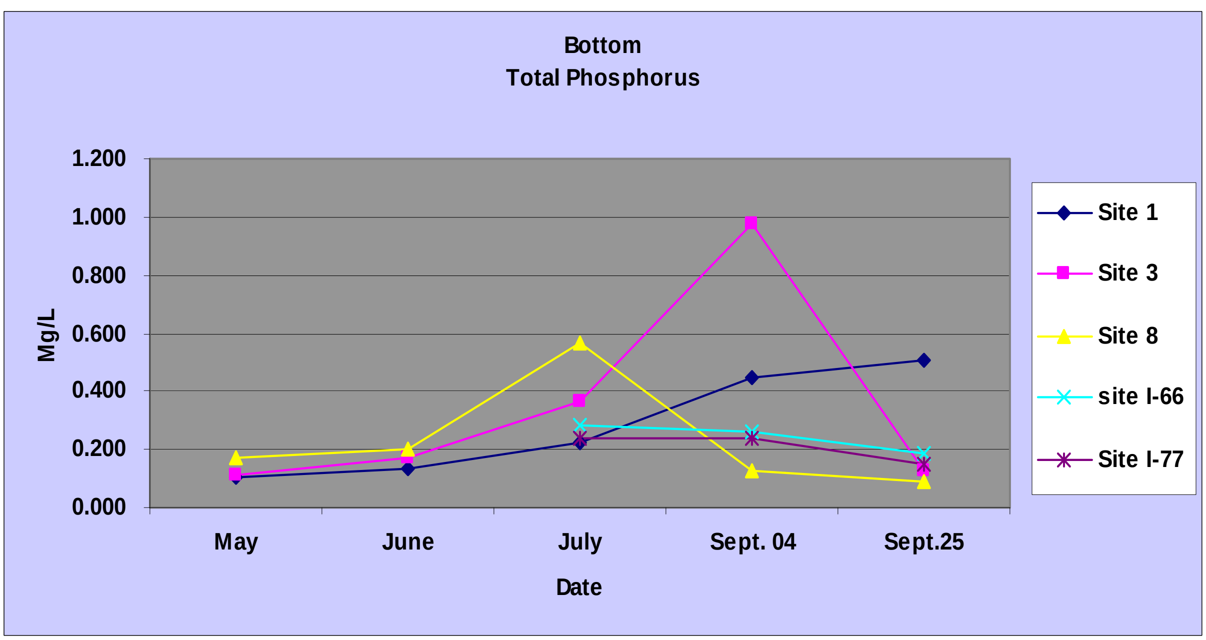

Figure 31. Bottom Total Phosphorus Measurements

TASK 5.6.5 Semi-annual progress reports and draft Final Report

Reporting will be coordinated with Blue Thumb Program *(Task 5.7) to document volunteer monitoring efforts completed as part of this effort.* Final report will also include documentation of the time and associated match contributed to the task efforts by volunteers.

Time frame: October 2004 – March 2007, revised to October 2008,
Deliverables: Semi-annual reports/ Final Report
Due: Semi-annuals - April and October, Final - December 2008

The GLWW Chapter began sampling for chlorophyll-a in April 2000, not as part of this grant. Chlorophyll samples were collected during the project period as part of GLWW's routine sampling schedule. Samples were collected monthly, weather permitting, at 13 of the 15 in-lake sites. (See the lake map in the QAPP Addendum in Appendix 2 for existing sites.) Sites I-71, Horse and Little Horse tributaries and I-62, Elk River arm, were not and are not routinely sampled for chlorophyll.

Seven volunteers and members of the Seneca-Cayuga Tribe sampled these in-lake sites for chlorophyll. Some of these sites were consistently sampled by the same volunteers over the last 8 years; other sites have been split up and sampled between these seven volunteers.

I-68, I-69 & I-70 – Bill Castles
I-72 – Larry Conner, Bill Castles
I-73 – Sam Grasso, Larry Conner
I-63,I-64 & I-67 – John McDonald, Gary Herrington
I-74 – Garry Herrington, Bill Castles, R & H
I-66, I-65, I-76, & I-77 – Seneca-Cayuga Tribe

GLWW recorded 257 samples were submitted for analysis by these volunteers; thirty-five in 2005, 85 in 2006, 75 in 2007 and 61 in 2008. Sample time was approximately 1.25 hrs for collection to render a total of 321.25 man hours.

All Semi- Annual reports were submitted in a timely manner as required. The Final Report was submitted for review to the Oklahoma Conservation Committee in December of 2008.

PROBLEMS ENCOUNTERED AND RESOLUTIONS

Change of Oklahoma Water Watch (OWW) personnel

Problem: OWW experienced substantial changes in personnel between January 2006 and February 2007. The original Program Coordinator was replaced in January 2006. The Training Coordinator vacated her position in December of 2006 and was replaced in January 2007. The Quality Assurance Officer resigned her position in February 2007 and was not replaced until April 2007. Change in OWW staff contributed to lapses in coordination of volunteer recruitment and also caused communication breakdown. It is important to note that *none* of the original OWW employees that initiated the grant proposal remained with the program to the end of the project. Despite the constant change in program staff, the grant requirements were fulfilled and the project was finished on time.

Utilization of Volunteers at every sampling event

Problem: Numerous meetings were held in 2006 and 2007 as the new Program Coordinator took her position. During presentation of the §319 grant to the newly accredited 501C3 GLWW Chapter, utilization of the volunteers was discussed with the Chapter Coordinator in hopes of encouraging the volunteers to add TP and TN to their sampling schedule. Additional discussion was then held with those in attendance at the various joint trainings between Blue Thumb, OWW and tribal members. Volunteers expressed their concern with the sampling effort involved and were reluctant to commit to adding additional parameters to their already defined schedules. After discussions, it seemed too difficult for the volunteers to coordinate sample delivery within the maximum sample holding times and they felt this might be too difficult for most of the retired volunteers to perform, especially those who had sites with the greatest depths and no equipment to pull depth samples through the water column. Tribal members showed interest in sampling their sites and meeting with OWW staff to deliver their samples. However, during the sampling events, tribal members were contacted numerous times to participate, but did not respond.

Solution: In developing the monitoring activities, the OWW and OWRB Beneficial Use Monitoring Program (BUMP) took on the responsibility for sampling of the lake and worked out an internal sampling and sample delivery schedule with ODEQ, that would allow the samples to be collected by BUMP. Some volunteers had expressed an interest in helping out in some way with the sampling so volunteers were still contacted to assist with the monitoring efforts at various times throughout the project. Because of the liability involved with volunteers using OWRB boats, OWW staff contacted those interested volunteers and worked out a sampling schedule using their own boats for some of the sampling trips. GPS readings of their sites were double checked on these trips.

Volunteer Larry Love did accompany the OWW staff on a sampling event. Demonstrations on professional use of equipment were presented at this time. There continues to be training, workshops, and information given to the volunteers on total phosphorous and the impact it may have on their waterbody.

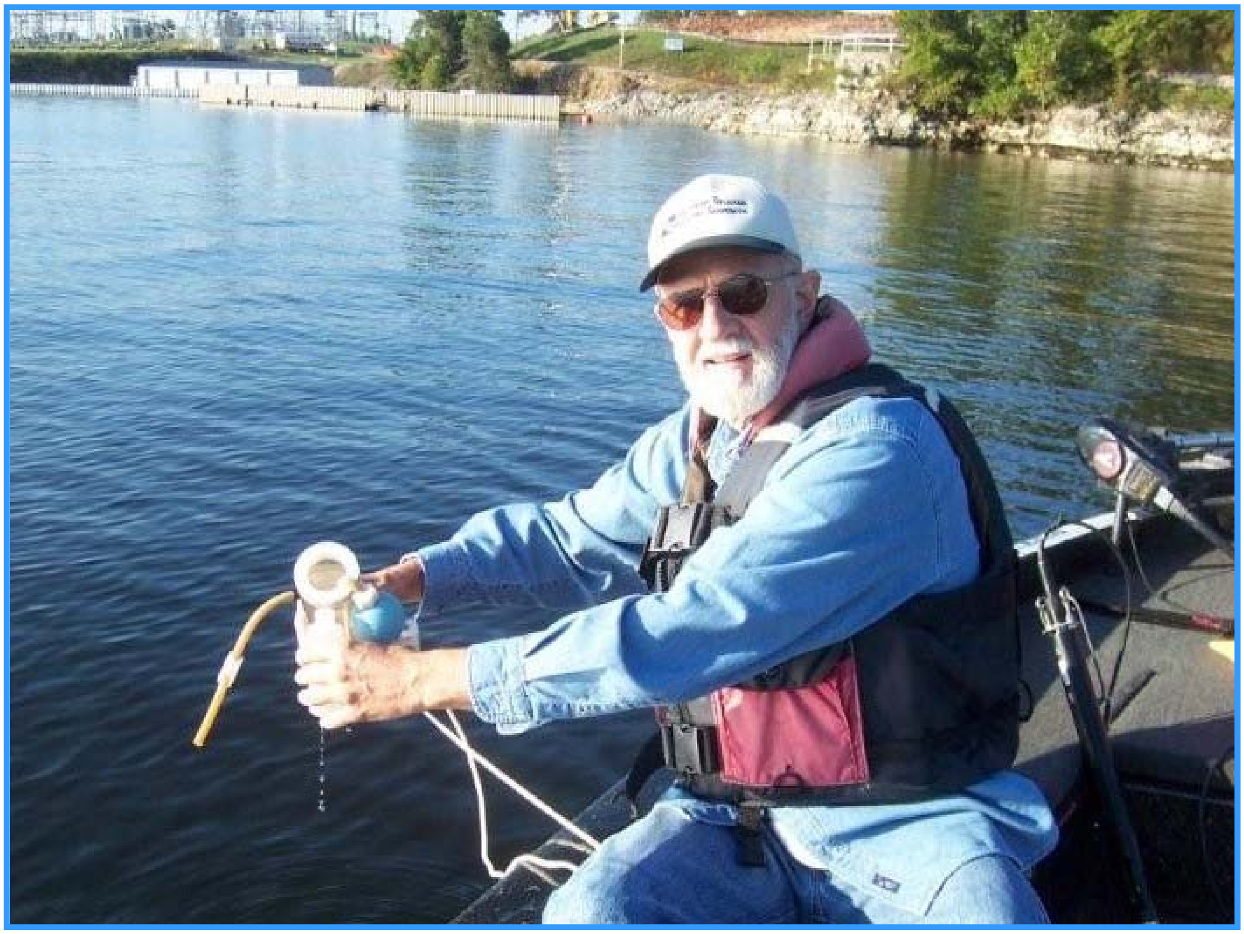

Figure 32. Larry Love, GLWW volunteer, sampling for the Grand Lake 319 project

Perhaps the most important thing that was learned through this grant was that a long-term monitoring plan must be devised from the beginning, involving all major parties, keeping the volunteer level of effort required in mind. All stakeholders within the watershed must come together during the initial stage to reach consensus on what they can contribute and when. A volunteer's time is very valuable. Even with a very organized and dedicated Chapter such as the GLWW, the volunteers must be able to see the value of their work and how their data will be used before they will commit their time and effort to a project.

As the second OWW Coordinator to the program during this grant period, it is difficult to know exactly what went on in the very beginning of the project. However, as soon as I became aware of the project, in January 2006, I personally set up several meetings and went to the Grand Lake WW Chapter explaining the project and the importance of their role in it and our wish for their involvement. I also spoke with the Tribes, asking for their help and then sent detailed instructions via e-mail seeking their involvement as well. They committed to helping OWRB with their sites at the upper end of the lake, but later were unable to provide that help. The Seneca-Cayuga Tribe did collect chlorophyll during the project period as part of their routine sampling. The sampling schedule for the Addendum to the OWW QAPP was developed around the volunteers' existing schedules and had been designed before 2006. It was the intention of this project to utilize their existing sampling schedule so as not to add an additional burden.

Various weather variables caused numerous issues

Problem: During the 2007 sampling season, the OWW team experienced heavy rain and extremely high winds. Because Oklahoma experienced one of its wettest years in 2007, many issues arose. During the sampling season, OWW staff was faced with extremely high lake levels, resulting in several closed boat ramps. Also, due to the excessive amount of rain and high winds, much of the upper sites of the lake contained a lot of debris which made it difficult to sample.

Solution: Even though OWW staff was faced with many challenges, monitoring efforts continued, and either complete or partial sampling occurred for the duration of this grant. The team had to battle the high winds and locate functioning boat ramps to conclude this project. Samples were taken May through November, as scheduled, at most sites. Sampling dates were rearranged in a timely manner to ensure that data would still meet the Data Quality Objectives.

Boat Maintenance

Problem: The Oklahoma Water Resources Board boats were under repair at various times during this grant and boat scheduling between the BUMP staff sampling trips had to be reorganized. This delayed sampling and prolonged the end date of the established sampling schedule for the grant.

Solution: At the first sampling event, contact was made to utilize a boat operated by Grand River Dam Authority (GRDA) personnel. On this particular day, the wind was too strong to sample in the pontoon boat that was provided by GRDA. We rescheduled the sampling event for a later date. GRDA Lake Patrol again agreed to assist OWW with the sampling and drove their boat. However, time constraints encountered on the lower portion of the lake limited our sampling that day and we were not able to sample the upper end sites. We were also informed that due to heavy rains, the upper end of the lake was full of debris and difficult to sample.

In June OWRB boats were repaired and functioning and we were able to sample the lake. However, due to the excessive rain, debris was heavy throughout the upper sites and samples were not taken.

In September, OWW staff sampled the upper portion of the lake. We were not able to sample the entire lake due to debris that was lodged in the motor. Therefore, this sampling event was rescheduled.

SUMMARY

Timeline of Events

July 21, 2005:	GLWW Training Session
October 2005:	Press release detailing project
October 2005:	Joint three day training with Blue Thumb
November 29, 2005:	GLWW training session
June 2006:	GLWW QCA Session
October 23, 2006:	GLWW Training Session
October 2006:	Second Press release
October 2006:	Joint two day training with Blue Thumb
November 2006:	GRAND LAKE WW and OWRB OWW Meeting
February 2007:	Joint training with OWW/BT volunteers at Grand Lake for Chlorophyll-a, TP, and TN.
April 2007:	Earth Day Celebration at Grand Lake
April 24, 2007:	GLWW Training Session
May 2007:	Sampling began at Grand Lake
June 2007:	GLWW QCA Session
June 11, 2007:	Update letter of 319 Project to OCC regarding role of GLWW volunteers in project
July 19, 2007:	GLWW Training Session
October 2007:	GLWW QCA Session
March 25, 2008:	GLWW QCA Session
August 20, 2008:	GLWW QCA Session
November 14, 2008:	GLWW QCA Session

CONCLUSIONS AND OUTCOMES

The Future of OWW program at Grand Lake

The monies from this grant allowed the Oklahoma Water Watch program to hold multiple trainings for chlorophyll-a, Total Nitrogen, and Total Phosphorus trainings at Grand Lake. It also allowed for the monitoring of these parameters to collect data in order to aide in TMDL modeling. GLWW volunteers received important field monitoring experience and became educated on the intra-workings of their watershed. Some of the volunteers also gained data interpretation experience. However, GLWW volunteers did have many concerns about actually monitoring the lake and coordinating with a carrier service to get the samples to ODEQ in a timely manner. As with any volunteer program, volunteers can change over time as do their interests. There were several GLWW volunteers that had shown an interest in sampling with OWRB staff and were allowed to sample along side the professionals. This allowed the volunteers to see how OWRB professionals collected data and also gave them an opportunity to use additional professional equipment.

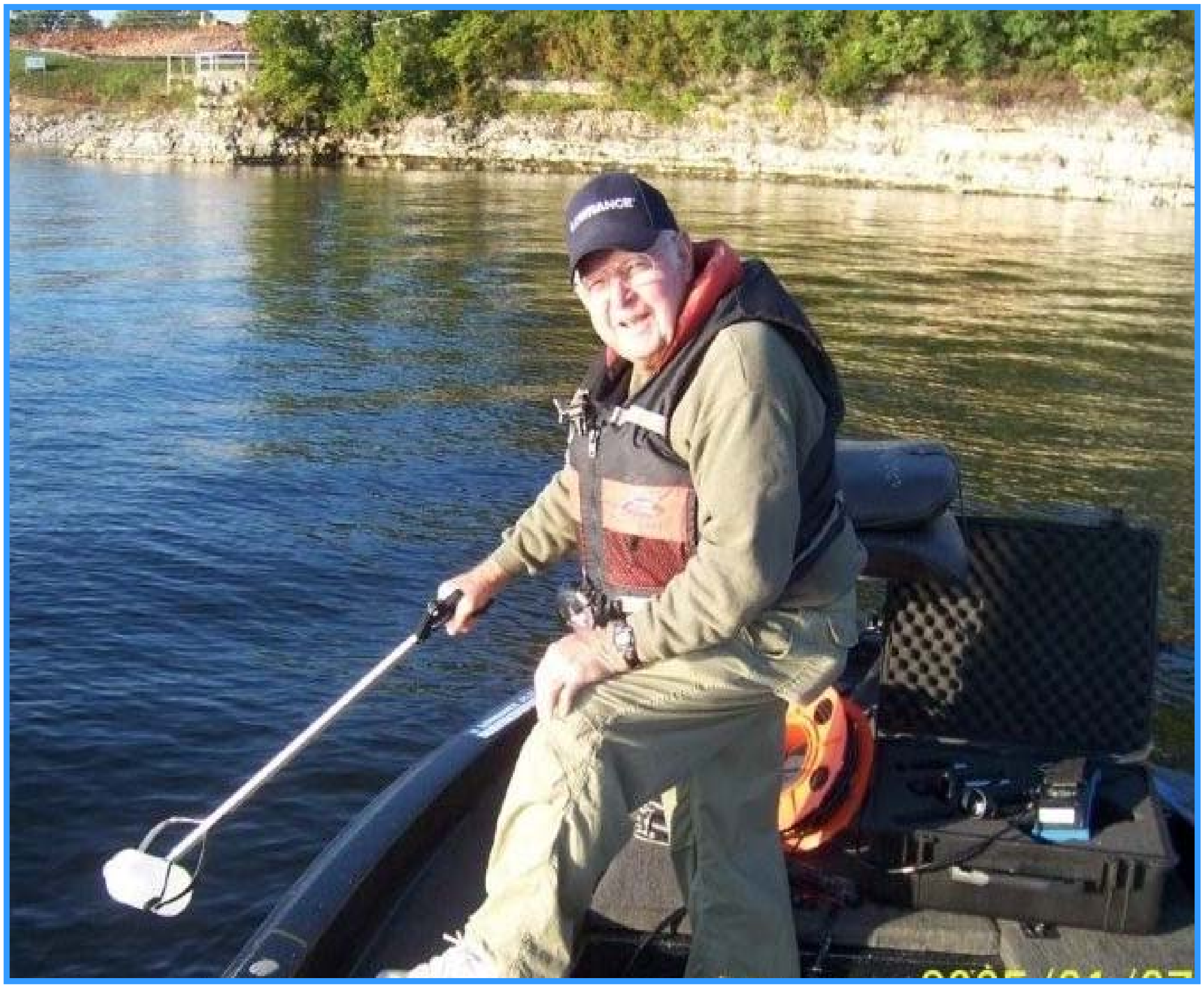

Figure 33. GLWW volunteer, Bill Castles assisting in sampling efforts

Through this grant OWW staff learned much about the promises and pitfalls of trying to involve volunteer groups in state projects. Volunteers must be involved from the initial onset of a project and encouraged about the importance of their contribution. Their dedication and commitment must not be assumed but fostered. Grand Lake Water Watch continues to be an important volunteer monitoring group that submits consistent usable data. Recruitment will be ongoing and relationships will continue to be built with GLWW. Data will continue to be entered into the OWW's online database and can be queried for reports or at public request.

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APPENDICES

Appendix 1: Addendum to the OWW Volunteer Water Quality Monitoring Handbook
Chapter 13: Total Phosphorus & Total Nitrogen Sampling Procedures

CHAPTER 13:

TOTAL PHOSPHOROUS AND TOTAL NITROGEN

Chapter 13 - Table of Contents

Chapter 13 – Table of Figures

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Chapter 13 Total Phosphorus and Total Nitrogen

Introduction

Nutrients are essential to the health and diversity of surface waters. Excessive nutrient amounts however, cause eutrophication or hypereutrophication, resulting in overgrowth of plant life, decline of the biological community and can also result in human health risks, such as the growth of harmful algal blooms that has become more prevalent in Oklahoma lakes in the past few years. If there is chronic nutrient overenrichment of a waterbody the following consequences may occur: algal blooms, low dissolved oxygen, fish kills, overabundance of macrophytes, likely increased sedimentation and species shifts of both flora and fauna.

Most people want their lakes to have clear water with a slight blue color. Deviation from this standard causes people to question the lakes water quality. And in most cases, it is the algae population that decreases clarity and changes the color of the water. Parameters that measure the algal condition depict it's trophic state. These indices allow for a quantitative means to describe the level of lake aging or nutritional state of a lake or reservoir (euthrophication).

Total Phosphorus is an essential plant nutrient that stimulates the growth of algae in many lakes (the more phosphorus in the lake, the more algae). By measuring phosphorus concentration we can get an indication of water fertility. Nitrogen is another nutrient essential to the growth and survival of aquatic plants and algae. Too much nitrogen can cause environmental degradation. Nitrogen is very common and found in many forms in the environment. In excess this nutrient can also cause cultural (human-induced) eutrophication. This results in stimulated growth of plants and algae, a decrease in water clarity, depletion of dissolved oxygen in deep waters and even death of fish may occur. Unlike phosphorus, nitrogen sources are more difficult to pinpoint because nitrogen is easily absorbed by organisms directly from the atmosphere.

Total Phosphorus

Phosphorus is one of several essential nutrients that algae and other aquatic plants need to grow and reproduce. Phosphorus is sometimes considered the limiting nutrient in a lake. The amount of phosphorus in a lake often determines the amount of algae and aquatic plant growth that can occur. Combined with other parameters such as chlorophyll-*a* and Secchi disk readings, phosphorus is used to measure the algal conditions of a lake and to provide information on the relationship between water fertility and algal growth. The presence of phosphorus in a lake also enables plants to use other nutrients in the lake more efficiently, nitrogen for example, and further increases productivity.

Phosphorus is found in lakes in several forms. Algae most readily consume a form of phosphorus known as orthophosphate, the simplest form found in natural waters. As it is taken in by the algae it becomes organically bound to the cells. When the cells die the phosphorus, still bound, settles to the bottom of the lake and becomes attached to aluminum, iron and other ions. Anoxic or deficient oxygen conditions cause chemical reactions that can release phosphorus from the sediments into the water. There are several forms of phosphorus that can be measured. Total Phosphorus (TP) is the measurement of all the forms of phosphorus (orthophosphate, polyphosphate, and organic phosphate) found in a water sample. (Figure 1)

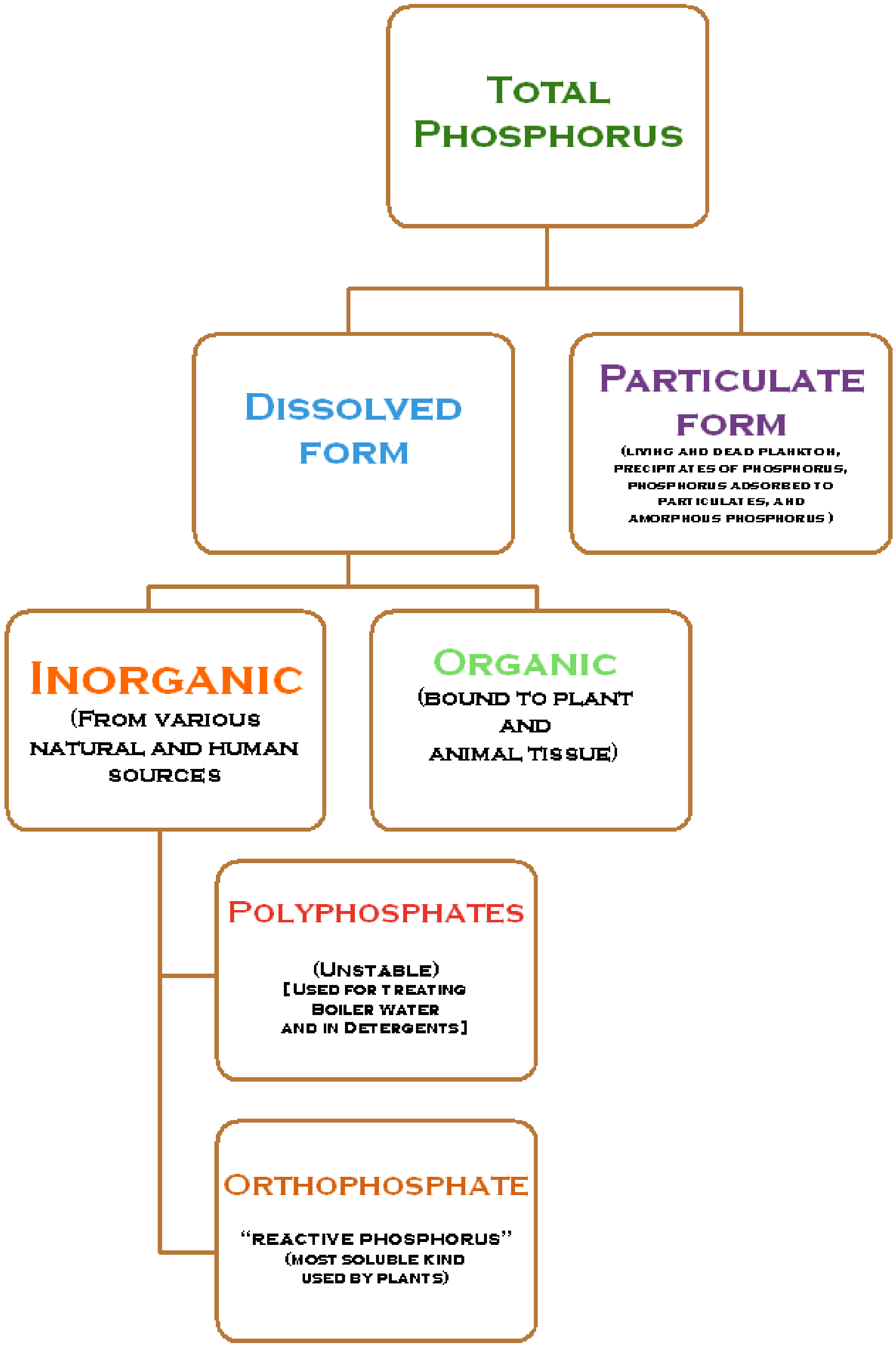

Figure 1: Total Phosphorus tree diagram

Phosphorus transfers to waterbodies from very few natural sources. But humans use and discard phosphorus daily. Phosphorus is found in many common household items such as laundry detergent, foods, and fertilizers. Watersheds that lie in developed areas often receive some of this human-generated phosphorus from various point and non-point sources including:

- *Wastewater treatment plants*
- *Runoff from lawns and croplands that are fertilized*
- *Septic leachate*
- *Runoff from animal manure storage areas*
- *Runoff from land area that has been disturbed or developed*
- *Runoff from wetlands that have been drained*
- *Waste from waterfowl or pets*

Phosphorus enters a water body from various sources as illustrated in Figure 2 below.

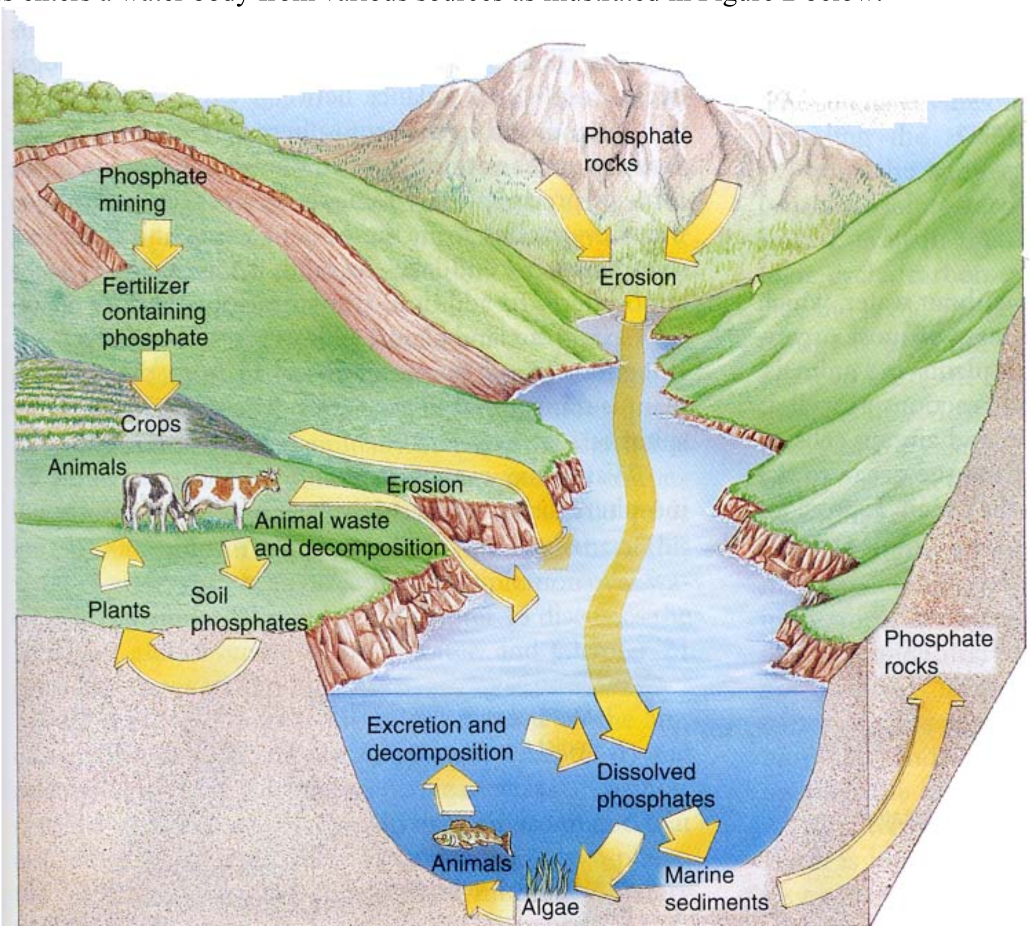

Figure 2: Various Sources of Phosphorus

Phosphorus is not often in great supply in most fresh waters. But under the right conditions, even a small increase of phosphorus can lead to many undesirable results.

Total Nitrogen

Nitrogen exists in the environment in many forms as well however, most organisms cannot use nitrogen (N_2) directly. In fact, in order for plants and animals to be able to use nitrogen, N_2 gas must first be converted to a more chemically available form such as ammonium (NH_4^+), nitrate (NO_3^-), or organic nitrogen (e.g. urea - $(NH_3)_2CO$), which can directly stimulate plant growth. Total Nitrogen (TN) is the collective measurement of all the forms of nitrogen found in a water sample. The Total Nitrogen in water is comprised of dissolved inorganic (nitrites, nitrates and ammonia) and organic nitrogen and particulate organic and inorganic nitrogen, minus N_2 gas. Figure 3 depicts the nitrogen cycle.

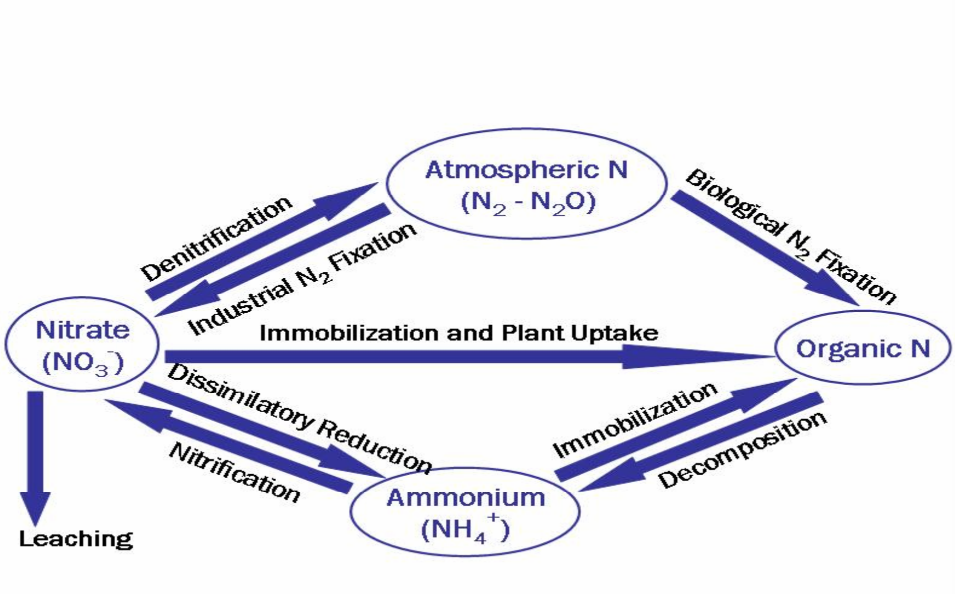

Figure 3: Nitrogen Cycle

Organic forms of nitrogen can rapidly be changed into inorganic forms through biological processes which occur during respiration or decay. Decomposition of aquatic life adds both dissolved organic and particulate organic nitrogen to water; while sewage runoff and erosion in the watershed increases particulate inorganic nitrogen levels in water. Nitrate and ammonium are converted to organic nitrogen through plant uptake and immobilization. Ammonium readily adheres to soils and sediments or can be volatilized as ammonia gas (NH_3) into the earths atmosphere. Nitrate is the most common and abundant form of inorganic N in lakes and does not generally bind to soils and sediment so it is likely to leach into groundwater. Phytoplankton and bacteria contribute to the amount of dissolved inorganic nitrogen content.

Knowing the amount and form of nitrogen at any location helps to identify its source and potential impact to a water body, to help in making management decisions.

Total Nitrogen in a waterbody can come from many sources, both man-made and natural. These include:

- *Air (can be absorbed directly from the atmosphere)*
- *Fertilizer runoff from homes or farms*

- *Runoff from storm water including developed areas, or undeveloped areas where nitrogen occurs naturally in the soil*

- *Animal and human wastes (wastewater treatment, septic tanks, landfills, dairies, feedlots, etc.)*

- *Automobile exhaust emissions (contains oxides of nitrogen which are dissolved by rain and can then enter water systems)*

Increased nitrogen and phosphorous levels combined with other favorable conditions can result in an algal bloom. Algal blooms are dangerous because they can choke out other aquatic plants by blocking sunlight and decreasing the amount of oxygen available for other aquatic life. Other effects of increased phosphorus and nitrogen levels speed up plant growth, and lower dissolved oxygen levels. This can lead to death for certain fish, invertebrates and other aquatic animals.

Different levels of aquatic plant and algae growth are favorable for different lake uses. For example, a fisherman might hope for more aquatic plant growth as a source of food and cover for fish. However, too much growth can have the choke out effect mentioned above. A swimmer or boater might prefer less aquatic plant and algae growth to prevent tangling of legs or motors. Nutrient levels are often managed to accommodate for different lake uses.

There are simple things you can do to help limit the amount of Phosphorus and Nitrogen input into our precious water resources:

- *Create a riparian buffer. If you live along a water body, maintaining a healthy buffer consisting of native plants between your property and the water will allow the excess phosphorous and nitrogen to be absorbed by the plants before they can enter the lake.*

- *Clean up after your pet. Pet waste contains phosphorous and nitrogen. Even if you're miles from a lake, the storm water that washes over your dog's waste is going somewhere!*

- *Be a responsible water user. Use public restrooms.*

- *Maintain your septic system. Have it inspected every year or two, and have it pumped regularly.*

- *Don’t pour chemicals down the drain. Pesticides, disinfectants, medicines, acids, paint thinner, and fertilizers can contaminate your septic system and groundwater.*

- *Manage your use of lawn and garden fertilizer. Have your soil tested to determine how much, and what kind of fertilizer your lawns and gardens need. Avoid fertilizing just before a heavy rain, to reduce runoff. Store fertilizers in a location with a concrete floor.*

- *Use phosphorus free detergents. Check the labels, most liquid detergents do not contain phosphorus, but some powder detergents and dishwasher detergents still do.*

- *Don't feed wild animals at riverside locations! Waterfowl become habituated to receiving handouts from humans at certain spots and frequent these areas. As a result, feces collect in high concentrations.*

****NOTE:** Total Phosphorous/Total Nitrogen monitoring are only two components of water quality monitoring. TP/TN data results alone do not indicate the environmental health of the water body. However, these results are useful in assessing the overall health of a waterbody when combined with other relevant data.**

What Happens to the Data?

Although volunteer data results are not intended to be used for enforcement purposes, the volunteer data collected utilizes some parameters and methods that are directly comparable to that collected by OWRB professionals (Hydrolab data, samples collected for analysis by contract laboratory, etc.) . It. is anticipated that your data may supplement and further support or validate data collected by OWRB's Beneficial Use Monitoring Program (BUMP). For lakes, the BUMP program has a rotating schedule of sampling all of Oklahoma's public lakes greater than 100 surface acres in size quarterly, every three years. This allows for seasonal variation in productivity to be taken into account. Your ability to regularly visit a site and collect monthly samples offers a more representative picture of water quality than our field staff alone can collect. It more accurately represents long-term reservoir conditions and minimizes any bias associated with just using growing season numbers.

The *OWW* program is a cooperative effort between volunteer citizens and the OWRB with the express purpose of collecting baseline water quality data to be used in determining water quality trends and to assist the state in identifying areas of concern or potential impairment. Because this data must meet data quality objectives (DQOs) for precision, accuracy, representativeness, comparability and completeness, specific lab analysis methods should be performed on certain parameters such as TP and TN in order to better achieve these objectives.

****NOTE:** Your consistency as a monitor is crucial to the success of the OWW program. Chapters receive a five (5) year trend analysis report. This time period allows for enough data to confidently conduct water quality statistics on data results. Remember: the more samples you collect, the better picture of the waterbody you are depicting! **

At the time of this reporting, all your Total Phosphorus and Total Nitrogen data are not compared to Use Support Assessment Protocols (USAP) to determine beneficial use support. OWRB is just beginning to pursue nutrient criteria for most waters in the state. Water Quality Standards (WQS) are continuing to be developed that address nutrient criteria by USAP to determine whether certain beneficial uses of waters of the state are being supported. First consideration has been given to Oklahoma's scenic rivers where there has been T P criteria set and for high profile waters such as Eucha and Spavinaw lakes. Other waters, such as designated sensitive water supplies, then general purpose waters are to follow as this process expands. Unless samples are being collected for laboratory analysis volunteer data will be used as a screening tool. Other volunteer-collected data associated with the site is compiled and analyzed along with T P / TN results (i.e.: Secchi disk depth, chlorophyll-a, surface nutrients, etc.) thus allowing us to see the 'bigger picture.'

While there are various methods for analyzing TP and TN the most accurate method for these tests can be very complex, involving very expensive equipment that is very accurate and precise. The TP state environmental laboratory test measures both immediately and potentially bioavailable forms of phosphorous in the sample. All forms of phosphorus in the collected sample are converted to orthophosphate by 'cooking' or digesting the sample in suitable reagents in order to measure TP. The sample is then neutralized and the orthophosphate is measured by a standard ascorbic acid method. Because there is a need for a heat source, it is more convenient and accurate to do this procedure in a laboratory. As stated earlier, even small changes in low phosphorus concentrations (0.01-0.02 mg/L) can have a significant effect on the ecosystem and existing field equipment can't detect phosphate at concentrations below 0.02 mg/L. In this case, there is nothing gained from monitoring if concentrations are consistently lower than the detection limit of your equipment.

The State Environmental Laboratory Quality Assurance Plan outlines the procedures for the determination of Total Nitrogen which involves the use of a calculation: Organic Nitrogen + Inorganic Nitrogen = Total Nitrogen; ON + ION = TN. But in order to get the needed numbers for the calculation, the organics and inorganics must be separated. This is achieved through the following: Total Nitrogen = Total Kjeldahl Nitrogen (TKN) + Nitrite + Nitrate; TKN + NO_2 + NO_3 = TN. "TKN" is defined as total organic nitrogen and ammonia nitrogen; Organic N + NH_4 = TKN. The organically bound nitrogen, TKN, must be released from the organic matter by a process of digestion prior to analysis. The level of organic nitrogen is then determined by subtraction after first determining the ammonia component. The final process looks like this: TKN (ON+NH_4) +NO_2+NO_3 = TN. However, this method is very time consuming and requires a distillation and an apparatus to trap the organic nitrogen that is converted to gaseous ammonia. As you can see, these procedures are not achievable or practical in a general field setting.

Federally funded grant projects such as the 319 Nonpoint Source demonstration projects for Grand Lake and Eucha/Spavinaw provide our program the funds to collect additional samples and have certain parameters such as TP/TN analyzed by a contract laboratory that would otherwise not be tested for as part of the "base" program. With federal funds, the OWRB can afford professional analysis by the state environmental laboratory that the existing volunteer program cannot easily afford. Any samples taken to the ODEQ environmental lab are then directly comparable to OWRB data. To get the highest quality data needed for many of the federally funded projects, commercial laboratory analyses are recommended for these parameters that meet the Beneficial Use Monitoring Program DQOs and that follow Standard Operating Procedures (SOP) used by OWRB water quality professionals. In order for *OWW* to be comparable with this professionally collected data, these methods of analysis just described with their current EPA methods listed below, were selected.

Levels of Total Phosphorus and Total Nitrogen are determined at the ODEQ laboratory by using method 365.3/CAL, Phosphorus, Colorimetric, Two Reagent and Spectrophotometric Determination and 353.2/ Nitrate/Nitrite and 351.2/Nitrogen, Kjeldhal and Nitrogen,Total/CAL (U.S. Environmental Protection Agency, April 2003 revised edition. Index to EPA Test Methods. Publication EPA 901/3-88-001;available online at http://www.epa.gov/region1/info/testmethods/pdfs/testmeth.pdf

MATERIALS & METHODS

What you need to sample for TP and TN:

- *Plastic 1 L sample containers (1 for each site and each depth that is collected), plus 1 blank and 1 replicate per lake. For example if you were sampling 1 lake with five sites, where you were sampling 2 depths at each site you would take 10 bottles to collect samples with, 1 bottles for blank DI water, and 1 bottles for replicates. This would total 12 bottles).*
- *Plastic Gloves*
- *Protective Eyeware*
- *Cooler to ice all samples*
- *Acid Vials (1 per sample bottle)*
- *Sharps container for Acid Vials*
- *Van Dorn Sampler with Rope*
- *Data Sheets, Lake Map with sites marked, Chain-of-Custody Sheets*
- *Life Jackets*
- *Sunscreen*

STANDARD OPERATING PROCEDURES for:
LAKES AND STREAMS

After each sampling site is approved for safety and accessibility by Oklahoma Water Watch staff, Chapters can collect Total Phosphorous and Total Nitrogen samples monthly throughout the year in order to collect a full amount of seasonal data or during the recreational season, May through October. TP/TN samples are collected with a one-liter sample bottle at elbow depth (0.5 M) below the surface of the water and 0.5 M from the bottom using a Van Dorn sampler. They must be representative of the waterbody they are being collected from and must be taken away from potential disturbances to ensure water quality (i.e.: away from direct influence of shoreline activity, obvious nonpoint source contributions, etc.).

> ****NOTE:** Remember to clearly mark *each* sample bottle with the site number and use it exclusively at that site in order to avoid cross contamination of samples.**

All TP/TN samples must have a laboratory Chain of Custody (Appendix 1: Total Phosphorus / Total Nitrogen Chain-of-Custody Form) and Sample Analysis Request form submitted with the samples when they are delivered to the Oklahoma Department of Environmental Quality (ODEQ) State Environmental Laboratory for analysis.

The ODEQ laboratory reports Total Phosphorous and Total Nitrogen results directly to the OWRB. OWW staff then verifies sample identification information from the chain-of-custody forms, and enters the information into the appropriate record in the database. These data are also reviewed by OWW staff every time a report is due.

Sample Collection — Point or Grab Sampling

Water samples will be collected at designated sites, preferably at 2 depths: 0.5 M from the surface and 0.5 M from the bottom. The one-half meter surface depth is representative of photic zone conditions for chlorophyll-a and total phosphorus. The photic zone is where free-floating algae grow and reproduce and constitutes the upper portion of the water column where sunlight penetrates and stimulates photosynthesis in algal cells.

It is important to **prime each sample bottle** by rinsing the containers out with a small amount of sample water before filling. Discard this water.

To begin:

A. You will take a surface sample. Surface samples are collected by completely immersing the sample containers to 0.5 M, approximately at elbow length below the surface, and then filling them. Try to avoid letting bubbles come into the bottle. It is important to completely fill the container leaving no room for air.

B. Sub-samples, 0.5 M from the bottom will be collected using a Van Dorn sampler. Before this sample can be taken you must determine the lake depth at this point. You can do this using either a vertical column profiler such as a Hydolab or Scout or by using the depth finder on a boat. It is important to collect your sample just above the bottom so that you do not introduce sediment.

Figure 4: Van Dorn Sampler

Using a Van Dorn at each site:

1) Anchor your boat.
2) Open both ends of the sampler and secure them onto the top.
3) Rinse the Van Dorn thoroughly, twice with DI water.
4) Prime the Van Dorn with sample water.
5) Hold the sampler horizontally and carefully lower it overboard to the 0.5M from the bottom depth.
6) Send the messenger down the cord which will trigger both ends of the tube to close.
7) Carefully retrieve the sampler.
8) Discharge the first several centimeters from the tube using the rubber hose.
9) Prime and then completely fill the appropriately labeled plastic 1L bottle, while being cautious to not let the sample bottle touch the discharge hose.
10) Add one vial of acid to the sample bottle to preserve the sample for analysis.
11) Place all bottles on ice and store in the ice chest as samples are collected.

STANDARD OPERATING PROCEDURES for STRATIFIED LAKES (as used for the Grand Lake FY 04 319(h) Project)

As stated earlier, phosphorus can be released from bottom sediments when anaerobic or anoxic conditions occur. Summer stratification (temperature gradients throughout the water column) can break down and phosphorus can reach the surface waters, causing algal blooms. A change in quantity and species of algae can change throughout the year. But most often algal density increases in the spring and early summer as water temperatures increase and nutrients become available in the surface as a result of spring turnover. Then as summer arrives and the lake stratifies, the algal populations may change as the supply of orthophosphate in the upper layer becomes depleted and /or microscopic animals (zooplankton) graze on the algae. During fall turnover fresh nutrients can be brought to the surface and stimulate increased algal growth.

Spring overturn (when wind action circulates the entire volume of water), can produce algal blooms as a result of increased nutrient availability and warming water temperatures. The summer growing season corresponds with the recreational season, which is usually the time that increased algal growth is most objectionable because it interferes with recreational activities such as swimming, water-skiing and fishing. The fall overturn can also be another time when the water circulates and algal blooms typically occur but may not be conceived as a problem because it comes at the end of the recreational season.

After each sampling site is approved for safety and accessibility by Oklahoma Water Watch staff, Chapters can choose to collect Total Phosphorous and Total Nitrogen samples monthly throughout the year. This will improve the odds of measuring a short-term event such as an algal bloom or a sudden phosphorus input from storm runoff or sewage plant bypass. Or samples can be taken during the recreational season, May through October.

TP/TN samples are collected with a one-liter sample bottle at 4 discrete depths through the water column where the lake is stratified, including the surface (0.1 M), the thermocline, halfway between the thermocline, and at the bottom (0.5 M off the bottom) using a Van Dorn sampler for the latter 3 depths. They must be representative of the waterbody they are being collected from and must be taken away from potential disturbances to ensure water quality (i.e.: away from direct influence of shoreline activity, obvious nonpoint source contributions, etc.).

> ****NOTE:** Remember to clearly mark *each* sample bottle with the site number and use it exclusively at that site in order to avoid cross contamination of samples.**

All TP/TN samples must have a laboratory Chain of Custody (Appendix 1: Total Phosphorus / Total Nitrogen Chain-of-Custody Form) and Sample Analysis Request form submitted with the samples when they are delivered to the Oklahoma Department of Environmental Quality (ODEQ) State Environmental Laboratory for analysis.

The ODEQ laboratory reports Total Phosphorous and Total Nitrogen results directly to the OWRB. OWW staff then verifies sample identification information from the chain-of-custody forms, and enters the information into the appropriate record in the database. OWW staff also reviews this data every time a report is due.

Sample Collection — Water Column Sampling

The internal loading of phosphorus is important when analyzing the algal condition of productive lakes. For this reason, volunteers should try to collect throughout the water column. TP/TN samples should be collected when the lake is stratified, or May through October of the recreational season of the sample year.

Water samples for TP and TN can be collected at the same sites that are already being monitored in your Chapter, but will be collected at 4 discrete depths through the water column including the surface (0.1 M), the thermocline, halfway between the thermocline and the bottom, and at the bottom (0.5 M off the bottom). All sub-samples, will be collected using a Van Dorn sampler All sampling procedures will follow the same protocols as described above under Point or Grab Sampling.

In addition, a duplicate sample will be collected at one site for each monthly sample event. The duplicate sample will be labeled as Site I-88.

In-lake samples to be sent to the ODEQ Lab will be collected within a 48-hour timeframe. The Chapter Coordinator will be responsible for coordinating sample collection with the volunteers. Once all samples have been received , samples will be delivered to the lab via OWRB staff, ODEQ staff, or a professional courier service. Samples will be delivered to ODEQ within 72 hours of collection.

Forms

OWW employs the following forms:

OWW Total Phosphorous / Total Nitrogen Chain-of-Custody Form

All bottles, including blanks and replicates, should be labeled using a Sharpie waterproof marker with the Lake name, your group name, your name, the site number, the date of collection, and the preservative used, which in this case is acid. They are also considered a data sheet and should be treated as such. Carefully check your bottles at each site to be sure that you are using the proper one.

Data Storage

All completed paper copies of forms and data sheets are maintained in a notebook; organized chronologically by site number. The data from the field notes and laboratory data sheets are entered into the OWW Online Data Entry Application (Figure 5). This applies for Total Phosphorus samples taken at surface and bottom depths only.

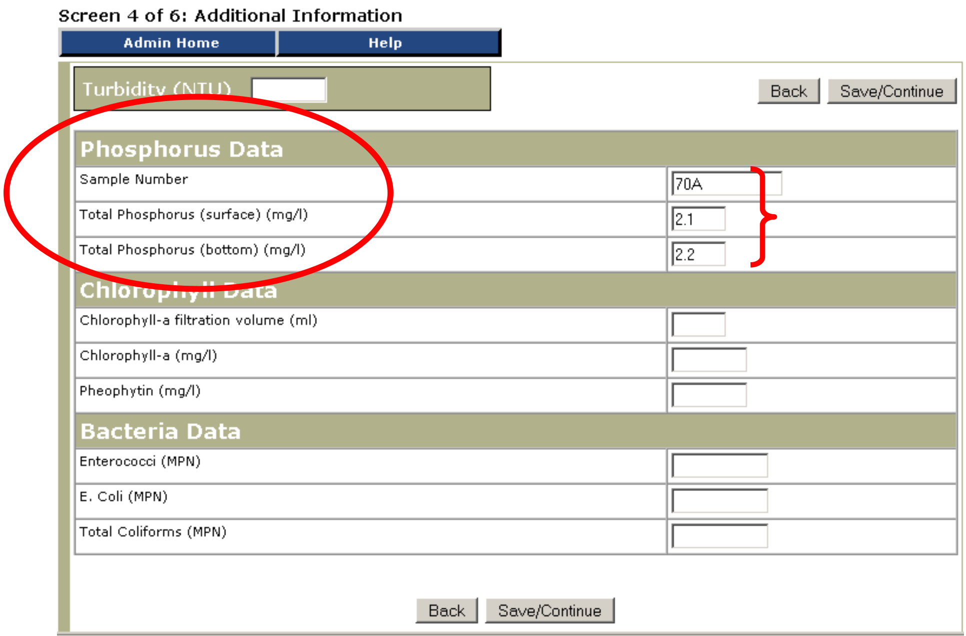

Figure 5. Total Phosphorus Data Fields in the Data Entry Application

After all fields are completed, the application then auto generates a visual representation of the Monthly Data Sheet Form (Figure 6) where volunteers can double check their entries for errors before submitting their data. Additional information pertaining to Total Phosphorus monitoring that wouldn't normally fit in a pre-existing field in the database can be can be entered under the comments section as shown in (Figure 6). Finally, each sample is maintained electronically in the database under a unique sample number.

Comments:	
WATER WATCH NOTES:	
Certified Monitor's Signature:	Date:

TOTAL PHOSPHORUS SURFACE	2.1
TOTAL PHOSPHORUS BOTTOM	2.2
CHLOROPHYLL FILTRATION VOL	N/A
CHLOROPHYLL	N/A
PHEOPHYTIN	N/A
ENTEROCOCCI	N/A
ECOLI	N/A
TOTAL COLIFORMS	N/A

Figure 6.Total Phosphorous Section of the Auto-Populated Form

Sample Storage and Transport

Sample Storage:

- All samples must immediately be placed on ice and out of sunlight. Samples shall be maintained on ice until acceptance at the laboratory.
- Samples should be held in a secure location.

Sample Preservation:

- Samples shall be maintained on ice until acceptance by the laboratory.
- When you finish your sampling day line up all of your sample bottles and put on your gloves and goggles. Carefully add one vial of concentrated Sulfuric acid H_2SO_4 to each bottle, making sure to add the whole vial. Dispose of the waste in the sharps box provided.

Sample Holding Time limits:

- Preserved samples: Must be delivered to ODEQ lab within 72 hours of collection.

- All samples must be collected within a 48-hour time frame each month. Once all samples have been received at the designated Chapter location, samples will be delivered to the lab via OWRB staff, ODEQ staff, or a professional courier service. Samples will be delivered to ODEQ within 72 hours of collection.

Sample Chain Of Custody (CoC):

- Fill out a Chain-of-Custody form (see Appendix 1). This form allows for a written record of possession and handling of sample from collection in the field to delivery of data to the investigator. The Chain-of-Custody should be placed in a sealed zip lock bag and attached to the sample cooler.

- Chain-of-Custody should be signed and dated by all personnel when relinquishing or taking possession of the samples.

- The original Chain-of-Custody (CoC) sheet shall accompany the samples to the laboratory. The final signature on the CoC should be from the laboratory.

Post Monitoring Clean-Up & Storage

1) Rinse Van Dorn with deionized water.

2) Dry all equipment and store until next sampling event.

QUALITY ASSURANCE/QUALITY CONTROL:

TP/TN must be analyzed in a laboratory. OWW employs the following measures to insure quality of data:

- Field duplicates: A field duplicate is an internal QC measure to assess the reproducibility of the monitor and the lab method. A duplicate is done by simply taking a second water sample at the same time as another sample. Duplicates help to ensure that samples are properly processed. Monitors are asked to collect field duplicates for no less than 10% of the samples. The acceptance criterion of the results is within 30% relative percent difference (RPD). More information on duplicates can be found in the program's QAPP (2007).

- Field Blanks: Deionized water treated as a sample. It is used to identify errors or contamination in sample collection and analysis. Blanks are another internal QC measure. Monitors are asked to run blanks once per sample batch. The acceptance criterion is the same as for duplicates.

- A no greater than 30% difference relative percent difference (RPD) criteria will be used to screen results taken during QC Checks (3 months following training).

- Lab Blanks: Deionized water treated as a sample. They are used to identify errors or contamination in sample collection and analysis. Blanks are another internal QC measure. Monitors are asked to run one blank once a year at their annual QCA Session. The acceptance criterion is the same as for duplicates. At the QCA Session, monitors are graded on their technique for sample collection, filtration preparation, performance, and processing; and finally the sample shipping preparation.

- Results from QCA Sessions and QC Checks must meet pre-set Data Quality Objectives outlined in the QAPP. Deficiencies will be addressed and corrective actions taken such as re-training the monitor and scheduling a Sample-Along Day.

Works Cited

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U.S. EPA. *Nutrient Criteria Guidance Manual: Lakes and Reservoirs,* 2000 (Doc. No. EPA EPA-822-B00-001), Section 5.B.1-5.B.2

U.S. EPA. *Volunteer Stream Monitoring: A Methods Manual,* 1997 (Doc. No. EPA 841-B-97-003), Section 5.6

U.S. EPA. *Volunteer Lake Monitoring: A Methods Manual,* 1991 (Doc. No. EPA 440-4-91-002), Section 3.A

Environment Waikato**.** Waikato Regional Council. New Zealand. *Water Quality Glossary.* 2007.

http://www.fws.gov/midwest/ashland/mtan/mtan61/images/Total-Phos.jpg

http://vincejtremante.tripod.com/images/phosphorus.jpg

Appendices

Appendix 1: Total Phosphorus / Total Nitrogen Chain-of-Custody Form

OKLAHOMA WATER RESOURCES BOARD - ODEQ CHAIN OF CUSTODY RECORD

PROJECT: Oklahoma Water Watch Program

SAMPLERS: (Signature)

SITE #	DATE	TIME	SITE LOCATION DESCRIPTION	# OF CONTAINERS	Nitrogen Series: Total Nitrogen (TN)	Phosphorus Series: Total Phosphorus (TP)	REMARKS
1	05/15/07		Grand Lake				
2	05/15/07		Grand Lake				
3	05/15/07		Grand Lake				

RELINQUISHED BY: (Volunteer Monitor Signature)	**DATE & TIME**	**RECEIVED FOR COURIER SERVICE BY: (Signature)**	**DATE: & TIME**
REMARKS:			
RELINQUISHED BY COURIER: (Signature)	**DATE & TIME**	**RECEIVED FOR LABORATORY BY: (Signature)**	**DATE: & TIME**
REMARKS:			

S:\Monitoring\OWW\FORMS\ODEQ Lab\OWW COC 319 Grand TP-TN

Appendix 2: OWW QAPP Addendum

ADDENDUM TO THE Generic Oklahoma Water Watch QAPP 2006

FY 04 319(h) Project 5 Grand Lake Workplan, Task 5.6 Developing and Implementing Total Phosphorus and Chlorophyll-a Monitoring Utilizing Volunteers from the Grand Lake Association, Wyandotte Nation, and the Seneca-Cayuga Tribe.

GRANT CA# C9-996100-12 Project 5 (Project #04-123)

OKLAHOMA WATER RESOURCES BOARD APPROVAL

____

Derek Smithee, Division Chief

____

Jeff Everett, QA Officer

____

Lynda Williamson, Project Manager

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

____

Mark Derichsweiler, Engineering Manager

OFFICE OF SECRETARY OF THE ENVIRONMENT APPROVAL

____

Jennifer Wasinger, Environmental Programs Administrator

OKLAHOMA CONSERVATION COMMISSION

____

Greg Kloxin, Quality Assurance Officer/Senior Technical Writer

EPA APPROVAL

____

Nikole Witt, Region VI Project Officer

____

EPA approval official

ADDENDUM TO THE Generic Oklahoma Water Watch QAPP 2006

FY 04 319(h) Project 5 Grand Lake Workplan, Task 6 Developing and Implementing Total Phosphorus and Chlorophyll-a Monitoring Utilizing Volunteers from the Grand Lake Association, Wyandotte Nation, and the Seneca-Cayuga Tribe.

GRANT CA# C9-996100-12 Project 5 (Project #04-123)

OKLAHOMA WATER RESOURCES BOARD APPROVAL

7/10/06

Derek Smithee, Division Chief

7/11/06

Jeff Everett, QA Officer

Lynda S Williamson 7/11/06

Lynda Williamson, Project Manager

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Jennifer Wasinger, Environmental Programs ~~Administrator~~ Manager

OKLAHOMA CONSERVATION COMMISSION

Greg A. Kloxin 7/10/06

Greg Kloxin, Quality Assurance Officer/Senior Technical Writer

EPA APPROVAL

10-10-06

Nikole Witt, Region VI Project Officer

Donna R. Miller 10/16/06

EPA approval official

Project Objective

The Grand Lake Association (GLA) Oklahoma Water Watch Chapter was initiated in 1992. Since then, over 100 volunteers have invested thousands of hours testing water quality throughout the Grand Lake basin. The Grand Lake Water Watch Chapter was the first Chapter for Oklahoma Water Watch (OWW) and has served as a pilot project for many aspects of the program, including the use of electronic instruments for vertical profile monitoring and nutrients (nitrogen ammonia, nitrate nitrogen, orthophosphate), collection of chlorophyll samples, bacteria monitoring, serving as Chapter training coordinators and managing their own data entry. The GLA OWW Chapter has been successful in securing funding which has assisted them in the purchase of more sophisticated equipment and hiring staff for Chapter support. Therefore, when OWW is implementing a new procedure to the program the Grand Lake Chapter will be the obvious program to pilot.

OWW has been operating under an EPA approved QAPP since 1992. A major revision to the QAPP occurred in 2003 and has been re-certified annually (QTRAK #04-089). With the FY04 Grand Lake §319 project the QAPP has again been revised to include new parameters and methods. (The §319 project QAPP was submitted prior to this addendum and was re-certified in May of 2006, QTRAK #06-250). Data collection activities of the Grand Lake Water Watch Chapter have been ongoing since the programs inception. It is anticipated that routine-monitoring activities will be maintained throughout the submission of these documents, however total phosphorus monitoring will not begin, and other funded monitoring activities will not be billed to the project until approval of this QAPP. Data collected since 2000 will be used in the reporting for the final output of this project.

Parameters and Frequency

Over the years, monitors have been testing for pH, dissolved oxygen, Secchi disk depth, ammonia nitrogen, nitrate nitrogen, orthophosphate, water color, and other characteristics such as water and air temperature, amount of precipitation, and aquatic macrophytes. This has been ongoing at 80 different sites throughout the basin. Currently, the GLA OWW Chapter has 45 active sites. Fifteen are in-lake and thirteen of them correspond with sites being monitored by the OWRB's Beneficial Use Monitoring Program, which collects at these sites quarterly, every other year. The usefulness of volunteer collected data at the same location and within the basin, on a consistent basis, is extremely beneficial for the OWRB, the State of Oklahoma, and local lake managers, by providing data that can be used to fill in gaps and develop baseline trends. The Grand Lake 319 project is intended to add sample collection for total phosphorus and total nitrogen analysis to the suite of parameters collected. Analysis will be performed by the Oklahoma Department of Environmental Quality (ODEQ) Laboratory.

Routine monitoring includes basic and advanced parameters. Basic parameters include water temperature, pH, dissolved oxygen, specific conductance and Secchi disk depth. A Hydrolab® instrument, either a Minisonde or a Quanta is used to collect data for these parameters. Depending on which specific unit is checked out additional parameters including oxidative-reduction potential (ORP) and total dissolved solids (TDS) may be available. Advanced parameters include nitrate-nitrogen, ammonia nitrogen and orthophosphate. The use of the HACH Colorimeter was implemented in May of 2005, thus data collected since then was collected with the instrument. Prior to that date, data was collected using the color wheels from HACH. At the in-lake sites surface and bottom samples may be collected for nutrients. Samples are also collected for turbidity and chlorophyll at the in-lake sites. Additionally, with this project, samples will be collected for total phosphorus (TP) and total nitrogen (TN) as stated above.

Water samples for TP and TN will be collected at the 15 in-lake sites at 4 discrete depths through the water column including the surface (0.1m), the thermocline, halfway between the thermocline and bottom, and at the bottom (0.5m off the bottom). TP/TN samples will be collected when the lake is stratified, or May through October of the sample year. A duplicate sample will be collected at one site for each monthly sample event. The duplicate sample will be labeled as Site I-88. Chlorophyll and turbidity samples are collected monthly from the in-lake sites at the surface (0.1m). Sample log sheets and chain of custodies can be found in Appendix 1 of this document. Table 1 lists the sites, frequency, and parameters monitored for shoreline Sites. Table 2 lists the sites, frequency, and descriptive location for in-lake sites. Figure 1 shows the location of all sites in Grand Lake.

In-lake samples to be sent to the ODEQ Lab will be collected within a 48- hour timeframe. The Grand Lake Chapter Coordinator is currently coordination sample collection with the volunteers. Once all samples have been received at the Grand Lake Water Watch Chapter office, samples will be delivered to the lab via OWRB staff, ODEQ staff, or a professional courier service. Samples will be delivered to ODEQ Lab within 72 hours of collection.

Table 1. Shoreline Sites at Grand Lake.

Site #	Test Day & Time	Parameters
3	1st Fri; 10:00:00 AM	Basic, Advanced
6	21st; 9:00 AM	Basic, Advanced
18	1st Wed. 11 am	Basic, Advanced, Bacteria
22	25th; 11:30 AM	Basic, Advanced
23		Basic, Advanced
24	15th; 10:00 AM	Basic, Advanced
32	3rd Thur; 10:00 AM	Basic, Advanced
41	2nd Wed; 10:00 AM	Basic, Advanced, Bacteria
50	2nd Tues; 9:00 AM	Basic, Advanced
72	25th; 11:00 AM	Basic, Advanced
73	27th; 10:00 AM	Basic, Advanced
74	3rd; 11:00 AM	Basic, Advanced
76	15th; 10:00 AM	Basic, Advanced, Bacteria
77	15th; 11:00 AM	Basic, Advanced, Bacteria
78	15th; 12:00 PM	Basic, Advanced, Bacteria
79		Basic, Advanced, Bacteria
80	1st Sat; 12:30 PM	Basic, Advanced, Bacteria
81	2nd Thur; 10:00 AM	Basic, Advanced, Bacteria
90	1st Mon; 1:00 PM	Basic, Advanced
93	3rd Sat	Basic, Advanced
93	3rd Sat	Basic, Advanced
97	2nd Thurs.	Bacteria only
98	2nd Sun	Basic, Advanced, Bacteria
99	2nd Sat; 10:00 AM	Basic, Advanced
101		Basic, Advanced, Bacteria
102	last Fri; 10:00 AM	Basic, Advanced
103	3rd Tues; 10:00 AM	Basic, Advanced, Bacteria
104	2nd Sunday 4 p.m.	Basic, Advanced, Bacteria
105	Last Fri. Noon	Basic, Advanced
106	2nd Mon. 9 a.m.	Basic, Advanced
107	1st Wed 9 am	Basic, Advanced
108	2nd Sun 10:00am	Basic, Advanced

Table 2. In-lake Sites at Grand Lake.

Site #	Test Frequency	Current Parameters	Proposed Parameters	BUMP Site/ Location
I-62	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 11/ Elk River
I-63	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 9/ East of Sailboat Bridge
I-64	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 6/ Honey Creek
I-65	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 13/ Upper end, below Sycamore Creek
I-66	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 12/ Upper end, below Site 13
I-67	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 10/ Main Body at Elk River
I-68	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 1/ Dam
I-69	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 2/ Main Body at Duck Creek
I-70	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 3/ Main Body, above Site 2
I-71	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 4/ Horse Creek
I-72	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 5/ Main Body, Monkey Island
I-73	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	NA/ Main Body, Governor's Island
I-74	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	Site 8/ West of Sailboat Bridge
I-76	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	NA/ Upper end, above Site 13 (I-65)
I-77	Monthly	Basic (vertical profile), Advanced, Bacteria, chlorophyll, turbidity	Total Phosphorus and Total Nitrogen	NA/ Upper end, above I-76, near Twin Bridges

The intent of task schedule 5.6 is to: 1) develop new methodologies to improve the existing Volunteer Monitoring activities resulting in better data generated and more educated lake citizens. Once methodologies have been developed and implemented, it is the intent for OWW and the Grand Lake Water Watch Chapter to continue implementation beyond budget and project period at no additional cost to the federal government, and 2) collect data that will be useful for the upcoming TMDL scheduled for Grand Lake.

Because TMDL data requirements can be quite specific regarding time, location, and parameters for sample collection, ODEQ will be included as a signatory to the QAPP and will participate throughout its development.

Grand Lake Water Watch Sites

January 2006

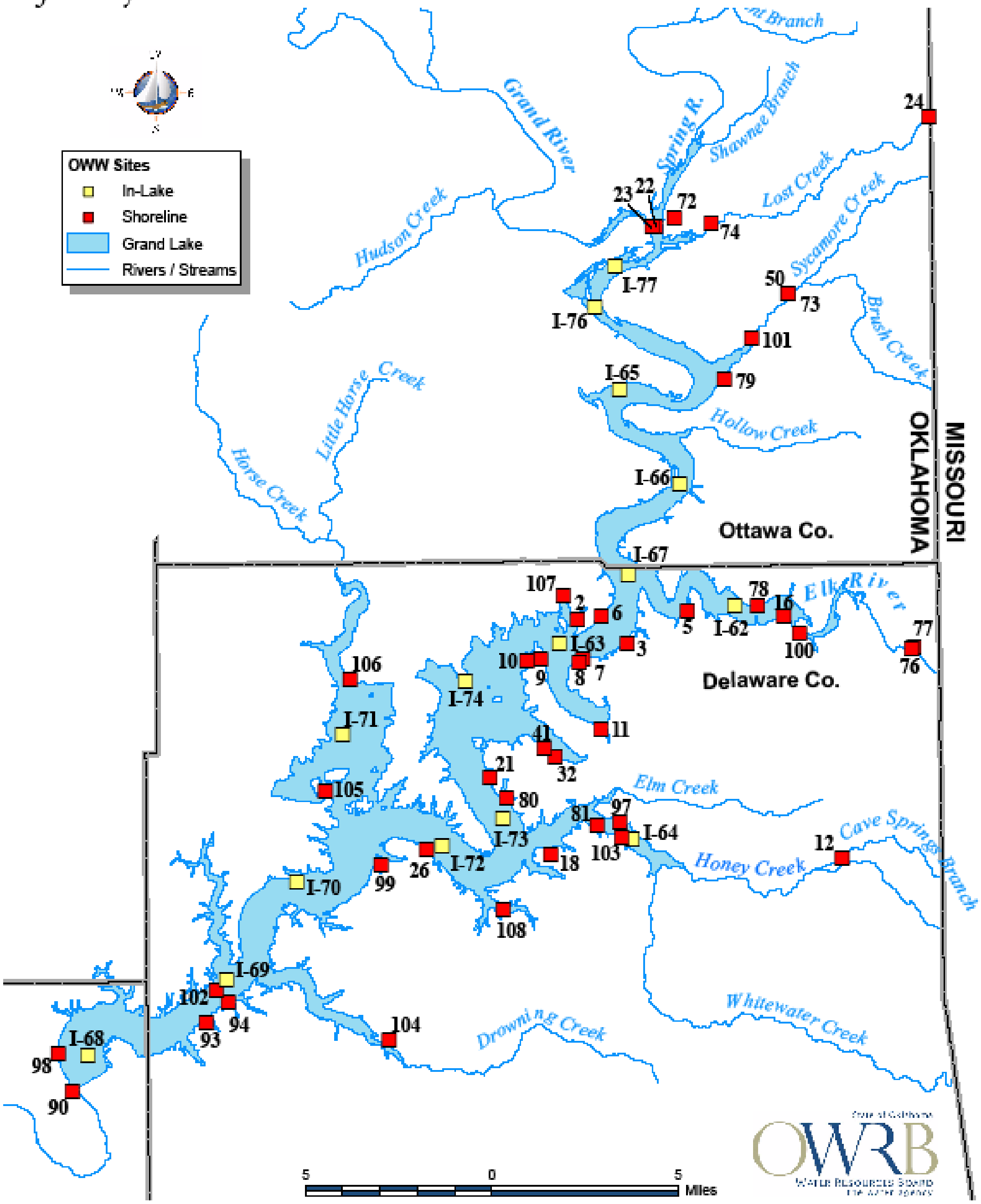

Figure 1. OWW Monitoring Sites, January 2006.

Appendix 1.

File Path:
S:/ monitoring/oww/forms/odeqlab/ GLWW 319 Chl-a lab, GLWW 319 Chl-a log, GLWW 319 DEQ COC

Appendix 3: OWW and BT Joint Training and Volunteer Recruitment Efforts

October 7, 2005

FOR IMMEDIATE RELEASE

CLEAR GRAND Initiative Offers Joint Blue Thumb and Oklahoma Water Watch Volunteer Training.

Northeastern Oklahoma citizens who want to help protect local lakes, streams, ponds, and wetlands will soon have their chance. As a part of the CLEAR GRAND (CLeaning Effort ARound the Grand) initiative, two Oklahoma volunteer water quality monitoring and public education programs will be holding a joint training for new volunteers on October 27-29. For the first time, the Blue Thumb program and Oklahoma Water Watch will coordinate their water quality monitoring efforts as they increase their focus on Grand Lake and incoming streams.

The CLEAR GRAND initiative is a long term project aimed at reducing pollution that enters Grand Lake and local streams from the surrounding landscape. CLEAR GRAND coordinator, Kevin Gustavson, says, "The Water Watch and Blue Thumb monitoring efforts will help our project tremendously. With monitoring data, we can document improvements in stream and lake water quality resulting from our efforts to reduce pollution washing off of the landscape."

The Blue Thumb volunteers will monitor streams by testing water samples, collecting stream insects and fish, and will educate the public about pollution prevention.

The Oklahoma Water Watch Program already has volunteers established on Grand Lake, and they test water samples and measure lake temperature and turbidity.

The upcoming training will allow volunteers to learn about both stream and lake ecology and enable these volunteers to monitor streams, the lake, or both. This training is scheduled for a Thursday evening, 6 – 10 PM, and Friday and Saturday, 9AM to 4PM. Topics covered in the training will include watersheds, stream and lake ecology, pollution sources, pollution prevention, stewardship, water testing, field collections, communications, and the CLEAR GRAND initiative. After the training, volunteer monitoring efforts take place in small groups and typically take about 2-3 hours per month.

Blue Thumb Director Cheryl Cheadle said "This training prepares our volunteers to monitor local streams and lakes and provide pollution prevention information to the public." Cheadle said that the training is open to people ages middle school through retirement. Cheadle reported that on average, a Blue Thumb training will consist of approximately 20 people, some retired, some active in their profession, many teachers and students, 4-H leaders, Scouts and Scout Leaders, etc. Both the Blue Thumb and Water Watch Programs are excited about expanding their programs in the area and for holding their first ever joint training as a part of the CLEAR GRAND initiative.

For more information about Oklahoma Water Watch and Blue Thumb and the upcoming training, call Cheryl Cheadle at 918-280-1598. Citizens are asked to be at all three days of training in order to become a monitoring volunteer.

Blue Thumb &
Oklahoma Water Watch
Training for
New Volunteers

Sponsored by
Grand Lake Water Quality Project

Protect Grand Lake and Area Streams!

October 27, 28, & 29, 2005
Grand Lake Association
Grove, OK

Volunteers attend all three days. Hours are Thursday, 6:00—10:00 p.m. and on Friday and Saturday, 9:00 a.m.—4:00 p.m.

More information is available by calling Kevin Gustavson at 918-801-2150.

Blue Thumb volunteers record stream habitat information before beginning a fish collection.

Come to the new volunteer training and learn about

⇒ stream & lake ecology
⇒ pollutants
⇒ water testing
⇒ watersheds
⇒ field collections
⇒ brand new Grand Lake Project

Become a Grand Lake Project volunteer and protect our lakes and rivers!!

Who Can Volunteer?

⇒ teachers & students
⇒ 4-H members & leaders
⇒ retired folks
⇒ professionals
⇒ farmers & ranchers
⇒ college students
⇒ anyone with an interest in clean water

Blue Thumb Volunteer Training
GROVE, OK

Thursday, October 27

6:00 p.m. Welcome/Introductions

6:30 Oklahoma Water Watch and Blue Thumb Program

7:15 Watersheds
Project WET

8:00 Break

8:15 Stream Ecology/Pollutants

8:45 Lake Ecology/Pollutants

9:15 EnviroScape Watershed Model

9:30 Overview of Monitoring
chemical
habitat
biota

9:45 Volunteer Responsibilities

Friday, October 28

9:00 a.m. Data Sheet

10:15 Test Kits

Learning about and using the test kits will take place all morning. Breaks will be as needed, and lunch will be taken at a good stopping place.

1:30 Cleaning and Storing the Test Kit

3:00 Quality Assurance and Safety Information for the Field

4:00 Oklahoma Water Watch in Lake Monitoring Demo*

Saturday, October 29

9:00 a.m. We will meet and then proceed to stream site.

All volunteers will be introduced to:
a) seining and fish
b) macroinvertebrates and habitat

11:30 Site Activities for Water Quality Monitoring

12:30 Lunch (on your own)

1:30 Blue Thumb Test Kit Practice

4:00 What's Next

Attire:
Dress for comfort. Day one and day two are primarily inside. Air conditioning, heaters, or the lack of these can be an issue. Day three, morning is outside. Dress to get wet, or bring waders. You may want to bring a change of clothes so that you will be comfortable while you perform testing. A change of shoes is a good plan. Hats, sunscreen, drinking water, rain gear may all have a place on Saturday.

*If boat is available, this will be an "on lake" field trip.

October 6, 2006

FOR IMMEDIATE RELEASE

CLEAR GRAND Initiative Offers Joint Blue Thumb and Oklahoma Water Watch Volunteer Training.

Northeastern Oklahoma citizens who want to help protect local lakes, streams, ponds, and wetlands will again have an opportunity to get involved. As a part of the CLEAR GRAND initiative, two Oklahoma volunteer water quality monitoring and public education programs will be holding a joint training for new volunteers on October 26-27. The Blue Thumb program and Oklahoma Water Watch will coordinate their water quality monitoring efforts as they increase their focus on Grand Lake and incoming streams.

The CLEAR GRAND initiative is a long term project aimed at reducing pollution that enters Grand Lake and local streams from the surrounding landscape and is looking for new volunteers who are interested in protecting Oklahoma's valuable water resources! CLEAR GRAND coordinator, Kevin Gustavson, says, "The Water Watch and Blue Thumb monitoring efforts will help our project tremendously. With monitoring data, we can document improvements in stream and lake water quality resulting from our efforts to reduce pollution washing off of the landscape."

The Blue Thumb volunteers will monitor streams by testing water samples, collecting stream insects and fish, and will educate the public about pollution prevention. The Oklahoma Water Watch Program already has volunteers established on Grand Lake, and they test water samples for basic parameters such as temperature, dissolved oxygen, pH and turbidity to nutrients that include ammonia nitrogen, nitrate nitrogen and orthophosphate. They also have a bacteria testing program and collect samples for chlorophyll analysis.

The upcoming training will allow volunteers to learn about both stream and lake ecology and enable these volunteers to monitor streams, the lake, or both. This training is scheduled for Thursday, 8:30AM – 5 PM, and Friday, 8AM to 4PM. Topics covered in the training will include watersheds, stream and lake ecology, pollution sources, pollution prevention, stewardship, water testing, field collections, communications, and in-the-field lake and stream monitoring demonstrations. After the training, volunteer monitoring efforts take place in small groups and typically take about 2-3 hours per month.

Blue Thumb Director Cheryl Cheadle said "This training prepares our volunteers to monitor local streams and lakes and provide pollution prevention information to the public." Cheadle said that the training is open to people ages middle school through retirement. Cheadle reported that on average, a Blue Thumb training will consist of approximately 20 people, some retired, some active in their profession, many teachers and students, 4-H leaders, Scouts and Scout Leaders, etc. Both the Blue Thumb and Water Watch Programs are excited that their programs are expanding in the area as a result of these joint trainings.

For more information about Oklahoma Water Watch and Blue Thumb and the upcoming training, call Cheryl Cheadle at 918-280-1598. Citizens must attend both days of training in order to become a monitoring volunteer.

From: Vance, Brian
Sent: Thursday, October 05, 2006 4:36 PM
To: 'L.Hahn@waterstrategist.com'; 'lcnt@cwis.net'; 'news@adaeveningnews.com'; 'editor@altustimes.com'; 'alvareview@aol.com'; 'john.bridwell@ardmoreite.com'; 'editor@examiner-enterprise.com'; 'editor@chickashanews.com'; 'editor@claremoreprogress.com'; 'cdnews@swbell.net'; 'editor@durantdemocrat.com'; 'news@edmondsun.com'; 'enidnews@enidnews.com'; 'holdenvillenews@itlnet.net'; 'hugonews@sbcglobal.net'; 'paper@mccurtain.com'; 'paper@sirinet.net'; 'news@normantranscript.com'; 'rcariker@newsok.com'; 'drtimes@rapfire.net'; 'pveditor@swbell.net'; 'news@poncacitynews.com'; 'publisher@poteaudailynews.com'; 'news@seminoleproducer.com'; 'karen.green@news-star.com'; 'news@stwnewspress.com'; 'wdn@wdnonline.com'; 'editor@woodwardnews.net'; 'gcheatham@odot.org'; 'kurklin3@flash.net'; 'mike@gwpc.org'; 'markh@okcc.state.ok.us'; 'news@ofumic.com'; 'actatoka@atoka.net'; 'elkcitydailynews@itlnet.net'; 'pregister@earthlink.net'; 'jcjohn@sulphurtimes.com'; 'editor@grovesun.com'; 'valeader@valliant.net'; 'news.staff@miaminewsrecord.com'; 'capital_democrat@yahoo.com'; 'rnelson@neighbor-newspapers.com'; 'angel.riggs@tulsaworld.com'; 'aburckhalter@oipa.com'; 'bbolton@odwc.state.ok.us'; Fogerty, Barry; 'dbsecrest@aol.com'; 'news@grcnet.net'; 'bcpub@pldi.net'; 'news@cushingdaily.com'; 'wythe@lsb.state.ok.us'; Whitley, Darla; Couch, Dean; 'dcpub@pldi.net'; Smith, Duane; 'osrc@fullnet.net'; 'fdrummond@sbcglobal.net'; 'fgtimes@intellex.com'; 'jharrington@acogok.org'; 'GENECEORWA@aol.com'; 'gnlnews@yahoo.com'; Strong, J.D.; 'drann@wilnet1.com'; Beougher, JaNeal; 'publisher@okpubtoday.com'; 'jeff.packham@journalrecord.com'; 'jennifer.smalley@journalrecord.com'; 'JJBlack1@aol.com'; Freeman, Joe; 'okcnews@metronetworks.com'; 'newsman@mcalesterradio.com'; 'cknowles@pldi.net'; 'lonnie-farmer@sbcglobal.net'; 'markn@swoi.net'; 'mshafer@ou.edu'; 'marlapeek@okfb.org'; Schooley, Mary; 'mmungle@ofumic.com'; 'Mick.Hinton@tulsaworld.com'; Mathis, Mike; Melton, Mike; 'rlepper@muskogeephoenix.com'; 'editor@swdtimes.com'; 'gloria@perrydailyjournal.com'; 'raycarter@okhouse.gov'; 'oaks@leakecar.com'; 'rmoore7858@aol.com'; 'HerrmannR@aol.com'; 'scottklm@yahoo.com'; 'stilwell_democrat_journal@hotmail.com'; 'press@intellex.com'; 'athornton@oklahoman.com'; 'tct@cachetimes.com'; 'ccagle@neighbor-newspapers.com'; 'Wayne.Greene@tulsaworld.com'
Cc: WaterQuality
Subject: CLEAR GRAND Initiative Offers Joint Blue Thumb and Oklahoma Water Watch Volunteer Training October 26-27

Contacts: Water Strategist; Latimer County News-Tribune; Ada Evening News; Altus Times; Alva Review Courier; Ardmore - Daily Ardmoreite; Bartlesville Examiner-Enterprise; Chickasha Express-Star; Claremore Daily Progress; Clinton Daily News; Durant Daily Democrat; Edmond Evening Sun; Enid News Eagle; Holdenville News; Hugo Daily News; Idabel McCurtain Daily Gazette; Lawton Constitution; Norman Transcript; Oklahoma City, Daily Oklahoman; Okmulgee Daily Times; Pauls Valley Daily Democrat; Ponca City News; Poteau Daily News; Seminole Producer; Shawnee News-Star; Stillwater News-Press; Weatherford Daily News; Woodward News; Arkansas Basin Development Association; Clean Lakes Association; Groundwater Protection Council; Oklahoma Association of Conservation Districts; Oklahoma Farmers Union; Atoka County Times; Elk City Daily News; Purcell Register; Sulphur Times-Democrat; Grove Daily Sun; Valliant Leader; Miami News-Record; Tishomingo - Johnson County Capital-Democrat; Broken Arrow Daily Ledger; Angel Riggs; Angie Burckhalter; Barry Bolton; Barry Fogerty; Bill Secrest; Blackwell Journal-Tribune; Canton Times; Cushing Daily Citizen; Dale Wythe; Darla Whitley; Dean Couch; Dewey County Record; Duane A. Smith; Ed Fite; F. Ford Drummond; Fort Gibson Times; Garber-Wellington Association; Gene Whatley; Guthrie News Leader; J.D. Strong; Jack W. Keeley; JaNeal

Beougher; Jason; Jeff Packham; Jennifer Smalley; Jerry Black; Joe Freeman; Joe Mitchell; John Yates; Kenneth K. Knowles; Lonnie Farmer; Mark Nichols; Mark Shafer; Marla Peek; Mary Schooley; Mason Mungle; Mick Hinton; Mike Mathis; Mike Melton; Muskogee Daily Phoenix & Times Democrat; Nancy Kletecka; Perry Daily Journal; Ray Carter; Richard Sevenoaks; Rick Moore; Rudy Herrmann; Scott Karnik; Stilwell Democrat Journal; Tahlequah Daily Press; Tony Thornton; Venius Matthys; Wagoner Tribune; Wayne Green

October 6, 2006

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#

Blue Thumb/OK Water Watch
Volunteer Training
GROVE, OK, 2006

Thursday, October 26

8:30a.m. Welcome/Introductions

8:50 Grand Lake Project

9:00 Oklahoma Water Watch and Blue Thumb Program

9:45 Stream Ecology

10:15 Break

10:30 Lake Ecology

11:00 Overview of Monitoring

11:20 Lunch

12:30 EnviroScape Watershed Model

12:45 Project WET Watershed Activity

1:30 Data Sheets
Blue Thumb
OWW

2:30 Quality Assurance and Safety

3:30 Volunteer Responsibilities

4:00 Preparing for the Field

Friday, October 27

8:00 a.m. OWW: On Lake Monitoring Demonstration

9:15 a.m. to 10:15 – All volunteers will be introduced to:
a) seining and fish
b) macroinvertebrates and habitat

10:15 On-site Activities

Lunch will be when on-site activities are complete. In the afternoon, two different test kit training sessions will take place. Volunteers planning to participate in lake monitoring will train in one room, stream monitors will train in another. Volunteers must choose.

12:45 Test Kits

3:15 Cleaning and Storing the Test Kit

4:00 What's Next?

BT/OWW Training – What you need to know.....

To be a monitoring volunteer, you must attend this entire training. Important information will be covered in each topic, and we have worked to make this training event concise.

Dress for comfort. The first evening is inside. Air conditioning, heating, or the lack of these can be an issue.

Friday is our field day. We will begin in a boat on the lake. Then we go to the creek to collect insects and study fish, so there is the likelihood you will be totally wet. Please wear old sneakers, water shoes, or boots. Feel free to bring waders. Sometimes rocks get in shoes.

You may want to have a change of clothes with you. The afternoon will be spent inside working on testing water and learning about safety, quality assurance, and test kit storage.

Bring with you the things that add to your comfort – sunscreen, hat, bug repellant, drinking water, rain gear, tic-tacs, etc.

Oklahoma Water Watch Training Summary

Group: Grand Lake Water Watch
Date: 10-26 &27-06
Location: GLA building, Honey Creek and on Lake
Attendees: Julia Matthews, January Haskin, Gina Manders, Todd Cumpton, Mike Wood, Julie Shannon, Adele Register, Julie Shannon
OWW Staff Member: Hannah Harder, Sarah Davis
Parameters/Equipment: Intro to Hydrolab
Sites: with GRDA in Lake at a small marina

Summary: Joint Blue Thumb/ OWW Training

On Thursday OWW and BT alternated with demonstrations and power points about our programs, our QA, what parameters we offer, and also watershed education on stream ecology and limnology. We had 7 people attend on Thursday and 8 on Friday.
Friday began out on the lake, compliments of an escort by the GRDA Lake Patrol. It was very cold and windy and we were somewhat pressed for time there. We did air and water temperature demonstrations, Secchi disk, how to collect sample bottles for Colorimeter, and Hydrolab demonstration. Then all went to a Honey Creek site for Blue Thumb demonstrations on bug and fish collections and how to conduct their water quality kit testing. Of the people in attendance, 6 were interested in doing both OWW and BT. Originally we were going to have a split afternoon training where volunteers pick one or the other, but because of the large interest in both it was decided that it would be in the best interest of everyone to do a BT training only in the afternoon and hook the OWW interested people up with our Grand trainers to complete their training.

Comments: Kevin Gustavson, Jeanne Lemmon, and I had an extensive discussion Friday afternoon about what worked and what didn't. All liked the way that the Thursday agenda ran. One suggestion to improve this day was to put the watershed presentations together and to invite existing volunteers so that they could get a better comprehension of both groups, and the big picture in agreement with the current 319 project. We felt like the training was successful- especially in that so many were interested in volunteering for both. With the complete switch to Colorimeter and digital equipment by Grand Lake volunteers there is now a more distinct difference between the 2 groups.

All liked having the opportunity to have the demo on the lake and the stream because we felt like this was the swaying factor in getting them to participate with both groups. However, it was suggested that an improvement would be to allow Friday afternoon to be one or the other program (BT for example) and then those interested would attend a third half day of training for the other program (OWW) at everyone's convenience.

AGENDA

GRAND LAKE WW and OWRB OWW
Meeting
November 8th, 2006 in Grove, OK

- Evolving role of GLWW – New Contract

- 319 Grand Lake FY 04 CA # C9-996102-12 Project 5 Grand Lake Watershed Implementation Project
  - Role of the GLWW monitors – how will samples be taken, who will take them?
  - Role of OWW

- Future trainings for volunteers and development of joint materials

Who: Oklahoma Water Watch Volunteers
What: Training Session
When: Tuesday, February 20, 2007
3:00 p.m. or 6:00 p.m.
Where: Grand Lake Association Building

Oklahoma Water Watch volunteers, you are invited to a joint training session hosted by Oklahoma Water Watch and Blue Thumb. Volunteers can attend one of two available sessions on Tuesday February 20, 2007. This training will cover:
Total Phosphorus, Total Nitrogen and Chlorophyll-a
Sample collection/ Preservation/ Labeling/ Shipping/ Etc.

Grand Lake Water Watchers will soon begin sampling for these parameters to gather data that will help the Oklahoma Department of Environmental Quality with their "total maximum daily load" planning for Grand Lake. Please ~ try to attend this training session and demonstration, and learn how you can do more to help gain valuable data within the Grand Lake Watershed. For more information, call Sara Ivey, Oklahoma Water Watch Training Coordinator at 405-530-8800.

Bring your test kit!

Tuesday, February 20, 2007
3:00 p.m. or 6:00 p.m.
Two sessions from which to choose
Grand Lake Association Building

Blue Thumb volunteers can attend either session, and in addition to completing your Blue Thumb quality assurance responsibilities, you will learn about ***Total Phosphorus and Chlorophyll-a testing ~ sample collection/preservation/ labeling/shipping/etc.***

Blue Thumb in the Grand Lake Watershed is moving ahead to gain information that will help the Oklahoma Department of Environmental Quality with their "total maximum daily load" planning for Grand Lake. Please ~ come to your QA session, plan to stay for this valuable workshop and demonstration, and learn how you can do more to help gain valuable data within the Grand Lake Watershed. For more information, call Jean, 918-521-9535.

Bring your test kit!

Oklahoma Water Watch Training Summary

Group: Grand Lake Water Watch / Blue Thumb Volunteers
Date: February 20, 2007
Location: Grand Lake Association Office, Grove OK
Attendees: Grand Lake Water Watchers, Blue Thumb Volunteers
OWW Staff Members: Lynda Williamson, Sara Ivey (& BT Jean Lemmon)
Parameters/Equipment: Chlorophyll-a and Total Phosphorus/Total Nitrogen
Sites: 15 In-lake sites: I-77, I-76, I-65, I-66, I-67, I-62, I-63, I-74, I-73, I-64, I-71, I-72, I-70, I-69, I-68 on Grand Lake. (8 BT sites on Rivers/Streams)

Summary:

This was a joint training session with Blue Thumb to introduce volunteers from both groups to Chlorophyll-a and Total Phosphorus/Total Nitrogen monitoring. Many of the OWW Grand Lake volunteers were already familiar with the Chlorophyll-a parameter. BT volunteers have not monitored for Chlorophyll-a. Sonja Raye of the Grand Lake Water Watch Chapter led the group through the Chlorophyll-a procedure step by step. First demonstrating how to get your sample, then how the sample is extracted, frozen, ground and finally sent to the DEQ lab for analysis. Sonja also instructed volunteers the correct way to fill out all the log and chain of custody sheets and how to properly label the samples.
Jean Lemmon and Lynda Williamson demonstrated the correct procedure for Total Phosphorus and Total Nitrogen collection.
There were two sessions held one at 3:00pm and the other at 6:00pm. There were 9 people in attendance at the 3pm session (7 from OWW and 2 from BT) and 8 people in attendance at the 6pm session (2 from OWW and 6 from BT)

Comments:

Volunteers voiced concerns about the Total P/ Total N sampling and the following questions arose from these training sessions:

1. What is the hold time for Total N?
2. Do all 15 in-lake sites have to be done on the same day?
   - If not, what is the window? (All Collected within 48 hours? or each site taken on the normal volunteer sample day?)
3. Do all the in-lake and stream sites need to be done on the same day? (Do we have to sample on the same dates as Blue Thumb?)
4. Is there flexibility of the date for the collection? How to deal with weather issues, boat issues, etc.
5. How much time has to elapse between samples if the schedule gets off for some reason? Could we go back to “normal” schedule for the next month or not?
6. Would the themocline have to be determined at each individual site, or could we determine the thermocline of the lake on that day and use that at all sites
7. At sites with less depth, how many samples need to be taken?
   - If the lake is not stratified, just top and bottom?
   - If the depth is very low would we just take a sample in the middle of the water column?
8. How do we get a code at the DEQ lab for this project?
9. Will the DEQ lab be able to process 61 samples all at the same time?
   - Will the lab need to be notified ahead of time to expect this many?
   - What day must they be to DEQ by to ensure completion before busting?

Comments continued:

10. Can the Total P and Total N samples be taken from the same sample bottle? (same preservation method?)
    - What is the volume of sample that is needed to be able to get both Total P and Total N from the same bottle?
11. Can Chlorophyll-a be collected on the volunteers normal sample schedule, or does it have to be collected at the same time as the Total P/Total N?
12. Is Total N being done at the in-lake and stream sites, or just the in-lake sites?
13. Could they be done on the normal sample day and just be to the lab within the normal the holding time?
14. Can we have multiple shipments to DEQ? Will this skew the data?
15. Estimated time per site to do TP/TN and Chlorophyll-a is 3.5 hours. This is too much to be piggybacked on to their existing monitoring trip, and be done in a timely fashion. Is there a way to reduce the amount of time at each site?
    - To get all 15 sites done in 24 hours, they would need 5-6 monitors minimum to make separate trips to accomplish this feat.
    - Volunteers would need to be compensated for the extra gas required to make these additional trips.
16. To determine the thermocline, volunteers would need to use a hydrolab. Would this have to be done at each site? Or, if several sites are all done on the same day, could one person determine the depth of the thermocline and tell all the other sites and they would all use the same depths? If days vary, this would need to be done on each particular day that sampling is performed?
17. What happens to the bottles once they go to the lab? Is there a possibility of getting those back, or do they need a new bottle each time?
18. Coolers – how would they get back to the volunteers?
19. Is there a weight limit that velocity will accept?
    - Health concerns for some of the volunteers who would be pulling up the weight of the Van Dorn, that many times, from those depths, so often.
20. Can we have the Senacas do sites 65,66,76,77?
    - They would have less navigational issues
    - Coordination with them could be an issue depending on time requirements
    - (This may also be an issue if we have Senacas doing their sites and OWRB staff doing others)
21. What days must sampling be done to ensure that samples get to DEQ on days that the office is open and able to process them in time?
22. Can we rotate the duplicate/blank assignment monthly so that one person is not always stuck with it?

CLEAR GRAND Grand Lake Earth Day Celebration!

Saturday, April 21 - 10am to 3pm

Headquarters: Grand Lake Visitor Center (9630 Hwy 59N, Grove)

See area Rain Gardens

Nature Tours of Bernice State Park

Learn about local Environmental projects

Painting with OK soils

Experience Oklahoma Soil

Make Your Own Bracelets

Prizes

Food Available

Fun for the Whole Family

Tours of Lendonwood Gardens

See Local Science Fair Projects

Learn about healthy lawn practices

Board the Cherokee Queen

Enviroscape at Walmart

Events & Times

grandlakefun.com/cleargrand/EarthDay.htm

CLEAR GRAND is a collaborative effort to keep Grand Lake clean as well as the streams and rivers that feed it. The project is funded by EPA through Section 319(h) of the Clean Water Act, with matching funds from the State of Oklahoma and other sources, and headed by the Oklahoma Conservation Commission, Water Quality Division, with manypartners including OSU Extension, local conservation districts, Department of Environmental Quality, Grand Lake Association, Oklahoma Water Watch, Statewide Blue Thumb, Grand River Dam Authority, and many more.

Oklahoma Water Watch Education Summary

Event: Clear Grand Earth Day Celebration
Date: April 21, 2007
Location: Grove, Oklahoma – Cherokee Queen Location
Attendees: Grove Community
OWW Staff Members: Lynda Williamson and Sara Ivey
Activity: Project WET's H2Olympics and OWW Monitoring Equipment

Summary:

This event was in Grove Oklahoma on Grand Lake. The Clear Grand group hosted this event and invited OWW to attend. We did H2Olympics and demonstrated OWW monitoring kits. H2Olympics is an activity that demonstrates waters physical properties of cohesion, adhesion, surface tension and capillary action and the polarity of water. Community members saw water walk a tight rope, water falling down a piece of yarn at an angle from one cup to another, without "falling" off the yarn. They dropped pennies into a full glass of water to see how many they could get in before any water was displaced – the record for the day was 60. They let drops of water fall from an eye dropper on to a penny to see how many drops a single penny would hold – 20 was the record. They also carefully placed paperclips on the surface of the water using a fork to see how many they could get.
OWW staff also went though a OWW kit with passers by and talked about the parameters that we sample for, and a brief demonstration of how some of the procedures, like Secchi are done. The event was from 10:00 am until 3:00 pm on Saturday April 21, 2007.

Comments:

There were not very many people that attended the event. I did not get an exact count of how many people came by our location, but it was less than 20 people. Due to the location of this event, and the long drive time, I would suggest not attending this event next year. There were many great things offered at the event, but the population of Grove did not attend. We had one other H2Olympic event that did not "work" correctly. The soap boat was not working due to the cardboard that I brought. The cardboard needs to be changed and tested again before doing this activity at another event.

June 11, 2007

Ms. Shanon Philips
Water Quality Division
Oklahoma Conservation Commission
Will Rogers Building
2401 N. Lincoln Blvd., Room 224
OKC OK 73105

Dear Shanon,

RE: FY 04 319(h) Project 5 Grand Lake Workplan, Task 6: Developing and Implementing total Phosphorus and Chlorophyll-a Monitoring Utilizing Volunteers from the Grand Lake Association (now Grand Lake Water Watch), Wyandotte Nation, and the Seneca-Cayuga Tribes.

In presenting the 319 grant to the newly accredited 501C3 Grand Lake Water Watch (GLWW) Chapter it was discovered that they were reluctant to commit the time and were concerned about the level of physical exertion required for collecting the samples. As originally submitted, the Addendum to the OWW QAPP calls for profile sampling; pulling samples from 4 discrete depths when the lake is stratified, at 15 sites. The volunteers felt this might be too difficult for most of the retired volunteers to perform, especially those who had sites with the greatest depths and do not have equipment to pull depth samples.

After this, you may recall, discussions were held during several meetings with you and it was my understanding that it was determined that the requested level of involvement from the volunteers would be too burdensome. I contacted Mark Derichsweiler of ODEQ concerning his requirements of TMDL data with these concerns. He and other engineers said that the number of sites could be reduced from 15 in-lake sites and samples could still be collected that would provide them with adequate data needed for the TMDL study.

The OWW and OWRB Beneficial Use Monitoring Program (BUMP) have worked out an internal schedule and sample delivery schedule with ODEQ that would allow the samples to be collected by BUMP, instead of the volunteers, through the May-October time frame at 8 sites. The Tribes have the most northerly sites. Since these are the most shallow and might not be stratified at these shallow depths it is hoped that one surface sample could be pulled from two of their sites unless stratification is the determining factor. The same parameters as selected in the Addendum; nutrients, Total Phosphorus, Total Nitrogen, turbidity and chlorophyll-a, will be sampled and analyzed.

Some volunteer have expressed an interest in helping out with some of the sampling. Since there is liability with volunteers using OWRB boats, we are in the process of contacting some volunteers to work out a possible schedule of sampling from their boats on some of the sampling trips.

If a new Addendum is required, please advise and it will be submitted. If you have any questions you may contact me at (405) 530-8923.

Sincerely,

Lynda Williamson, OWW Coordinator
Oklahoma Water Resources Board

OKLAHOMA WATER WATCH

Name____________
Date_____________
Group_____________

OKLAHOMA WATER WATCH

Pre-test given before Phase I p.1 of 3

Watershed Quiz

1. What is a watershed?
   a. a building that stores water
   b. all of the land area that drains down a slope to the lowest waterbody
   c. an environmental term referring to all the groundwater in a location
   d. a place of drinking water storage

2. Non-point source pollution is______
   a. not something that I directly contribute to
   b. caused by factories and industries only
   c. pollution that comes from many non-distinguishable sources which may include agriculture, construction, fertilizer, and pesticides
   d. from a discharge pipe

3. The number one pollutant to waterbodies in Oklahoma and the U.S. is________.
   a. sediment
   b. Phosphorous
   c. acid rain
   d. litter

4. The best way to reduce sedimentation is to_______
   a. dredge out sediment from the affected area
   b. maintain a large vegetation buffer zone around the water
   c. use Rocks and rip-rap to maintain the stream bank.
   d. cut down surrounding trees

5. Water Transparency can be affected by which of the following
   a. algae growth
   b. sediment
   c. local geology
   d. all of the above

6. An increase in sediment does **NOT** cause which of the following water quality problems:
   a. Decrease in oxygen levels
   b. Increase in temperature
   c. Overpopulation of fish species
   d. Taste and odor problems

OKLAHOMA WATER WATCH

Name____________
Date____________
Group____________

Training/QC

1. To maintain your certification you must
   a. monitor all parameters
   b. Train two other people
   c. agree with everything the Water Board says
   d. submit data 9 months out of the year and attend 2 QCA sessions

2. Which parameter must be divided by 50 in order to obtain the answer?
   a. Orthophosphate
   b. Nitrogen
   c. PH
   d. Ammonia

3. Which parameter has it's own waste container?
   a. oxygen
   b. orthophosphate
   c. Ammonia
   d. Nitrogen

4. Precision is the measure of
   a. how close a reading is to the true or known value
   b. the degree volunteer data can be compared to other studies with similar conditions.
   c. volunteer accuracy
   d. reproducibility between multiple test repetitions

5. Volunteer data is **<u>NOT</u>** used for which of the following:
   a. Legal court proceedings
   b. To assess trends over time
   c. To look for improvements or degradations in water quality
   d. To supplement BUMP data

6. Filling out your data sheet completely in the field is important because
   a. Omitting certain fields will not allow you to enter your data in the database
   b. Your memory may fail you later
   c. It gives the most accurate portrayal of environmental conditions on that day
   d. All of the above

OKLAHOMA WATER WATCH

Name____________
Date_____________
Group____________

OKLAHOMA WATER WATCH

Pre-test given at Phase III p.3 of 3

Environmental Actions

1) Participating in the OWW program has affected me in the following ways….

2) In my opinion, the biggest problem confronting Oklahoma's Water is….

3) OWW allows me to do the following for my community…..

Strongly agree Strongly Disagree

1) I have a strong understanding about Oklahoma's water systems and water pollution issues.

1 2 3 4 5

2) I would consider myself aware of the happenings of my local environment and watershed.

1 2 3 4 5

3) I desire to be involved in the politics of local water decisions.

1 2 3 4 5

4) I understand the roles of different state and federal agencies in maintaining and protecting Oklahoma's Water.

1 2 3 4 5

5) I have a role in managing Oklahoma's water.

1 2 3 4 5

6) I work to actively reduce my own contributions to water pollution

1 2 3 4 5

OKLAHOMA WATER WATCH

Name____________
Date____________
Group____________

OKLAHOMA WATER WATCH

Post-test p.1 of 3 (administered at QC after 1 year of monitoring)

Watershed Quiz

1. What is a watershed?
   a. a building that stores water
   b. all of the land area that drains down a slope to the lowest waterbody
   c. an environmental term referring to all the groundwater in a location
   d. a place of drinking water storage

2. Non-point source pollution is______
   a. not something that I directly contribute to
   b. caused by factories and industries only
   c. pollution that comes from many non-distinguishable sources which may include agriculture, construction, fertilizer, and pesticides
   d. from a discharge pipe

3. The number one pollutant to waterbodies in Oklahoma and the U.S. is________.
   a. sediment
   b. Phosphorous
   c. acid rain
   d. litter

4. The best way to reduce sedimentation is to_______
   a. dredge out sediment from the affected area
   b. maintain a large vegetation buffer zone around the water
   c. use Rocks and rip-rap to maintain the stream bank.
   d. cut down surrounding trees

5. Water Transparency can be affected by which of the following
   a. algae growth
   b. sediment
   c. local geology
   d. all of the above

6. An increase in sediment does **NOT** cause which of the following water quality problems:
   a. Decrease in oxygen levels
   b. Increase in temperature
   c. Overpopulation of fish species
   d. Taste and odor problems

OKLAHOMA WATER WATCH

Name____________
Date_____________
Group____________

OKLAHOMA WATER WATCH

Post-test p.2 of 3

Training/QC

1. To maintain your certification you must
   a. monitor all parameters
   b. Train two other people
   c. agree with everything the Water Board says
   d. submit data 9 months out of the year and attend 2 QCA sessions

2. Which parameter must be divided by 50 in order to obtain the answer?
   a. Orthophosphate
   b. Nitrogen
   c. PH
   d. Ammonia

3. Which parameter has it's own waste container?
   a. oxygen
   b. orthophosphate
   c. Ammonia
   d. Nitrogen

4. Precision is the measure of
   a. how close a reading is to the true or known value
   b. the degree volunteer data can be compared to other studies with similar conditions.
   c. volunteer accuracy
   d. reproducibility between multiple test repetitions

5. Volunteer data is **NOT** used for which of the following:
   a. Legal court proceedings
   b. To assess trends over time
   c. To look for improvements or degradations in water quality
   d. To supplement BUMP data

6. Filing out your data sheet completely in the field is important because
   a. Omitting certain fields will not allow you to enter your data in the database
   b. Your memory may fail you later
   c. It gives the most accurate portrayal of environmental conditions on that day
   d. All of the above

OKLAHOMA WATER WATCH

Name____________
Date____________
Group____________

OKLAHOMA WATER WATCH

Post-test p.3 of 3

Environmental Actions

1) Participating in the OWW program has affected me in the following ways….

2) In my opinion, the biggest problem confronting Oklahoma's Water is….

3) OWW allows me to do the following for my community…..

Strongly agree Strongly Disagree

1) I have a strong understanding about Oklahoma's water systems and water pollution issues.

1 2 3 4 5

2) I would consider myself aware of the happenings of my local environment and watershed.

1 2 3 4 5

3) I desire to be involved in the politics of local water decisions.

1 2 3 4 5

4) I understand the roles of different state and federal agencies in maintaining and protecting Oklahoma's Water.

1 2 3 4 5

5) I have a role in managing Oklahoma's water.

1 2 3 4 5

6) I work to actively reduce my own contributions to water pollution

1 2 3 4 5

Appendix 4: ODEQ Lab Analysis Sheets and QCA Session Reports

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY LOG-IN SHEET
OKLAHOMA WATER RESOURCES BOARD – OK.Water Watch Grand Lake 319 Project

FOR LAB USE ONLY

PROJECT CODE: GL-319

SELS SAMPLE NUMBER:_______________

____

Collector's Initials:_______ Source: Grand Lake

Date Collected: ___________ Time: ____:___ QA Code: 10

SITE NUMBER: 4 (I-71) STATION ID: 121600030030-04

Comments:____

LABORATORY PARAMETERS

☐ Nitrogen as Ammonia	☑ Phosphorus, Total	☐ Total Solids, Suspended
☐ Nitrogen as Nitrite	☐ Phosphorus, Ortho	☐ Total Solids, Dissolved
☐ Nitrogen as Nitrate	☐ Chlorophyll-a	☐ Total Solids, Settleable
☑ Nitrogen, Total	☐ Alkalinity	☐ Color, True
☑ Nitrogen, Kjeldahl	☐ Chloride	☐ Hardness
☑ Nitrogen, Nitrate/Nitrite	☐ Metals	☐ Sulfate

FIELD PARAMETERS

☐ Fecal Streptococci	☑ Air Temperature	☑ Specific Conductivity
☐ E. Coli	☑ Water Temperature	☑ Salinity
☐ Enterococci	☑ Dissolved Oxygen	☑ Oxidation/Reduction Potential
☐ Fecal Coliform	☑ D.O. % Saturation	☑ Total Dissolved Solids
☑ Turbidity	☑ Secchi Disk Depth	
☑ Depth	☑ pH	

RETURN TO: OWRB/LYNDA WILLIAMSON
3800 N. CLASSEN BOULEVARD
OKLAHOMA CITY, OK. 73118

FILE COPY

FOR LAB USE ONLY:

PROJECT CODE: GL-319

SELS SAMPLE NO.

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
STATE ENVIRONMENTAL LABORATORY
707 N. ROBINSON
OKLAHOMA CITY, OK 73102
(405) 702-1113
OKLAHOMA WATER RESOURCES BOARD
CHLOROPHYLL LOGIN FORM

Collector: TW/SI Lake: Grand Lake

Date Collected: 05/16/07 Time Collected: ________

Site #: 6 Site ID#: 520700020290-06

Extraction Date: 5/16/07 Extractor's Initials: TW

Volume Filtered: 400 ml. Date Filtered: ________

QA Code: 20

Comments: ________

Corrected Chlorophyll A (32210) Pheophytin A (32218)

Return To: Lynda Williamson
OWRB WQ Division
3800 N. Classen Blvd.
Oklahoma City, OK 73118

Copy: File Copy

Attention Volunteers!!

Grand Lake Water Watch Inc.,

QCA Session and QA Presentation

WHAT? Quality Control Assessment Session and QA Presentation

WHEN? Friday 06/02/06 from 9:00 AM to 3:00 PM **AND**
Sat 06/03/06 from 9:00 AM till noon.

WHERE? Grand Lake Association 9630 Hwy 59 N
Grove, OK 74345-1147

PLEASE BRING your monitoring equipment, handbooks, laminated field guide, calculator, and anything you may need for testing.

PLEASE NOTE: The QA Presentation will start promptly at 9:15 AM

See You Then!

Questions? Contact Karina at 405-530-8937 or email KRivasCareaga@owrb.state.ok.us

3800 N Classen Blvd.
Oklahoma City, OK 73118

Grand Lake Water Watch Inc., QCA Session & QA Presentation

Fri 06/02/2006 from 9:00 AM to 3:00 PM
Saturday 06/03/06 from 9:00 AM till noon
Grand Lake Association
9630 Hwy 59 N
Grove, OK 74345-1147

Meeting called by:	OWW	**Type of meeting:**	QCA Session
Facilitators:	KRC – LW – JM - CY		
Attendees:	Could I get a list of confirmed monitors attending this?		
Please Bring:	Handbooks, laminated field guides, calculators, all your monitoring equipment.		

---- Agenda Topics ---- DAY ONE

Welcome	Lynda Williamson	5
Quality Assurance: "Out with the Old, In with the New"	Karina Rivas-Careaga	15
Questions & Answers on Presentation	Karina Rivas-Careaga	5-10
BREAK		10
QCA Session • Colorimeters • Hydrolab (checking logs) • Chlorophyll • Bacteria	KRC – JM - CY	180 (3 to 4 hours)

----- Agenda Topics ---- DAY TWO

QCA Session • Colorimeters • Hydrolab (checking logs) • Chlorophyll • Bacteria	KRC – JM - CY	9:00 AM till noon

Other Information

Resource persons:	
Special notes:	Anything else?

Water Watch QCA Session Coming Up!

WHAT?
Annual Quality Control Assessment (QCA) Session.

WHY?
Retain your Certification as an OWW monitor by attending this class.

WHEN?
June 8, 2007. You MUST schedule a 30-minute period between 9:30 a.m. and 3:00 p.m. by calling Sonja Raye at 918-786-2292.

WHERE?
Grand Lake Association, 9630 Hwy 59 North, Grove, OK 74345

WEAR?
Clothes that you don't mind getting a little dirty.

State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

RSVP to Sonja Raye, 918-786-2292

Questions toTamara Williams, QA/QC Officer, 405-530-8937 or you can email questions to *trwilliams@owrb.ok.gov*

OKLAHOMA WATER WATCH

OKLAHOMA WATER WATCH

Duane Smith
Executive Director

Derek Smithee, Chief
Water Quality

Bill Cauthron
Water Quality
Monitoring Programs
Coordinator

Lynda Williamson
OWW Program
Coordinator

Tamara Williams
OWW Quality
Assurance Officer

Sara Ivey
OWW Training
Coordinator

Protecting Oklahoma's Water Resources

Oklahoma Water Watch
Oklahoma Water Resources Board
3800 N. Classen Blvd.
Oklahoma City, OK 73118
Phone: 405-530-8800
Fax: 405-530-8900

Memorandum

Date: December 21, 2007

To: Cliff Younger, GLWW Coordinator

From: Tamara Williams, OWW Quality Assurance Officer

Subject: Quality Control Assessment Session Results

Enclosed you will find a report detailing the recent Quality Control Assessment (QCA) session conducted with Grand Lake Water Watch Chapter. Please review the report in full, and if you have any questions, feel free to contact me at (405) 530-8937.

The data spreadsheet is coded for volunteers. I have included a copy of the volunteer monitor code, which lists each volunteer monitor and their corresponding code number. Each volunteer who participated in the session will receive a copy of the report minus the volunteer monitor code sheet. To maintain volunteer confidentiality, please do not distribute the volunteer monitor code sheet.

The graphs depict the results, indicating that most advanced parameters were within the acceptable limits for accuracy and precision. These results guarantee the reliability of the data collected by the volunteers who attended the QCA session and their data will be accepted for inclusion in the OWW database.

OWW greatly appreciates your efforts in collecting quality data for the program! Your continued efforts are invaluable to building historical databases for the waters of Oklahoma and in identifying long term trends.

Thank you and Happy Sampling!

Grand Lake
Water Watch Chapter

OKLAHOMA WATER WATCH

QUALITY CONTROL ASSESSMENT SESSION
LABORATORY REPORT
CONDUCTED: June 08, 2007 and October 10, 2007
REPORTED: December 17, 2007

Summary:

Volunteer monitors are required to successfully complete an annual Quality Control Assessment Session (QCAS) to validate their data for that year. Volunteer monitors perform four (4) or two (2) repetitions on a known concentration for each test. The QCAS, serves as a tool for volunteers to show their proficiency with the parameters tested by measuring the their accuracy and precision. Another factor in determining volunteer data is completeness. This is a comparison of the total amount of data collected to the amount of data needed to establish a complete data set. For an OWW chapter to receive a rating of 100% completeness, six data sheets per site must be submitted to and accepted by OWW annually. Of the six or more data sheets submitted, at least 85% (5 data sheets) must be accepted as complete, accurate, and precise for the given calendar year, with properly filled out information. For the 2007 sampling period, the Grand Lake Water Watch Chapter received a rating of 100% completeness. The group performed test on both advanced and basic parameters consistently on a monthly basis.

On June 08, 2007 and October 10, 2007, a total of twenty-nine (29) volunteer monitors with the Grand Lake Water Watch (GLWW) Chapter participated in a Quality Control Assessment Session (QCAS) at the Grand Lake Association building, in Grove, Oklahoma.

During this QCA session, volunteer monitors proved their ability to conduct tests for: Orthophosphate, Nitrate-Nitrogen, and Ammonia Nitrogen. Each volunteer monitor tested samples with known values performing two repetitions on each spike sample. The following table lays out the ranges for acceptable precision and accuracy

Table 1. Summary table of volunteer measured water quality variables and their associated range of values, precision and accuracy.

Variable	Range	Precision	Accuracy
Nitrate Nitrogen	0 – 0.50 mg/l (low-range)	±0.05 mg/l	± 0.20 mg/l
	0 - 30.0 mg/l (high-range)	±0.4 mg/l	± 1.0 mg/l
Orthophosphate	0 – 2.50 mg/l (low-range)	±0.04 mg/l	± 0.1 mg/l
	0 - 5.0 mg/l (mid-range)	±0.2 mg/l	±0.5 mg/l
	0 - 50.0 mg/l (high-range)	±2.0 mg/l	±5.0 mg/l
Ammonia Nitrogen	0 – 0.50 mg/l	±0.10 mg/l	± 0.20 mg/l

OWW sets rigorous margins for accuracy and precision to ensure that volunteer collected data is reliable and valid. Accuracy is based upon the exactness of the test itself. For all three advanced parameters, ammonia nitrogen, nitrate nitrogen, and orthophosphate, there is an accuracy range of ±10%.

Apart from the limitations of the kit itself, there are several factors that can adversely affect the nitrate nitrogen test result. False negative readings are common mistakes resulting from transferring black specs from the Nitri Ver 6 into the second test tube. The black particles will have a negative effect on the test since the cadmium metal is reactive enough to destroy or reduce some of the final color being formed. In other words, it will show lower results. Also, floating particles from the unoxidized cadmium particles can interfere with visual test. Hence the importance of making sure all the cadmium metal remains in the first tube. The time elapsed is another crucial factor determining reliable results. Samples should be kept at 4°C (39.2°F) and analyzed within 24 hours. However, samples should be warmed to room temperature prior to performing the test. Orthophosphate is one of the most cleanliness-sensitive tests. The glassware must be kept extremely clean at all times. In no case should commercial detergent containing phosphate be used to wash the glassware as this would interfere with the true spike value. Occasionally rinsing glass ware in the dishwasher (not using any soap) will also decrease the chance for cross contamination of samples since the exposure to heat will remove residue particles adhered to the glassware.

Included with this report is the graphical representation of the data obtained during the June and October 2007 QCAS (please refer to them as needed). Line graphs are used to show the relationship between allowable deviation and the monitors' deviation. Monitors were randomly grouped and assigned a spike of known value for analysis.

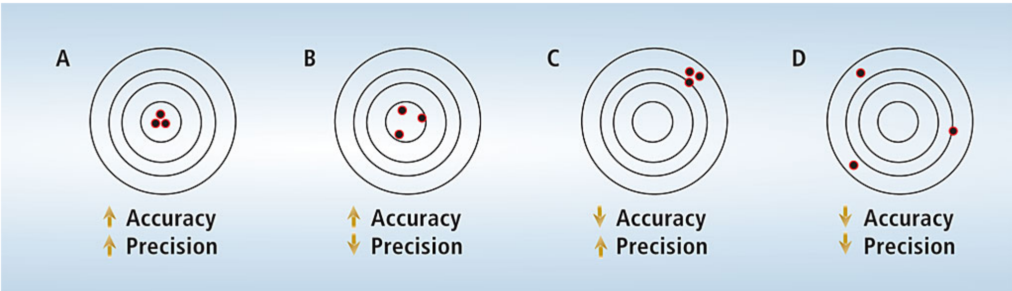
These values are unknown to the volunteers. Each parameter (with its corresponding lot number) was graphed separately in a line graph. The solid red lines represent the upper and lower limits of the test. The dotted blue line in the middle indicates the matrix or spike value. Similarly, the black squares scattered on the graph stand for the average value obtained per monitor. These points indicate the monitor's demonstrated precision and accuracy. As long as the black squares fall within the two solid red lines, the monitor is within range of acceptable precision and accuracy. Squares positioned exactly on the dotted blue line indicate that the monitor obtained a perfect accuracy or precision value.

Results:

In reporting the results of the QCAS, results are compared to the known concentrations by calculating the mean (AVE.), standard deviation (STD) and the relative deviation (RSD). Individual averages are calculated and the STD and RSD account for any random or uncontrollable error. Relative Percent Difference (RPD) and the deviation (DEV) are also calculated. The smaller the RPD, the more accurate and precise the results. Volunteer data must be within the accuracy and precision limits as outlined in Table 1 to be valid for the year. Below you will find the group information for the parameter tested.

Accuracy vs. Precision

Accuracy can be defined as the agreement of a measured value, to its exact (true) value. Precision can be defined as the degree to which the measured values demonstrate the same or similar results, repeatedly. The diagrams below further explain these concepts.



1. Orthophosphate

Of the eighty-seven (87) average (AVE.) measurements recorded (see data charts), 96.6 % demonstrated acceptable accuracy and acceptable precision for the Orthophosphate test, which received the highest rating. At the June 06, 2007 QCAS, all volunteers were within the acceptable range for accuracy and precision. However, at the October 10, 2007 QCA, one monitor's results are not within the limits for accuracy nor precision. The code for this monitor is GLWW 18. Rep 1 was high, thus resulting in a high AVE (refer to graph).

2. Nitrate Nitrogen

Measurements of nitrate nitrogen showed that 82.8 % demonstrated precision and accuracy rating that were within the acceptable limits (see data charts). Seventeen percent (or five monitors) unfortunately recorded readings that were not within acceptable limits for accuracy nor precision. The number code for these monitors is as follows: GLWW-09, GLWW-10, GLWW-11, GLWW-12, AND GLWW-17.

3. Ammonia Nitrogen

At the June 06, 2007 QCA session first samples values for the ammonia nitrogen test are inclusive. The spike sample was not at room temperature, therefore allowing for error. However, testing methods and techniques were observed. All of these monitors demonstrated proficiency with testing. These monitors are: GLWW-01, GLWW-02, GLWW-03, GLWW-04, GLWW-05, GLWW-06, GLWW-07, GLWW-08, GLWW-09, and GLWW-10. The remaining volunteer measurements show that 78.9% demonstrated precision and accuracy ratings that were within the acceptable limits (see data charts). Unfortunately two monitors recorded readings that were not within the acceptable accuracy and precision limits. The number code for the monitors that did not pass is: GLWW-16 and GLWW-17. The ammonia –nitrogen test exhibited the lowest accuracy and precision of the entire assessment with the most squares positioned outside of the solid red lines.

Conclusion:

Overall, the QCAS results were within the acceptable margins for accuracy and precision on all basic and advanced parameters. This demonstrates monitors understand all procedures and tests involved in monitoring. I am more than confident that its chapter's members are proficient in water quality monitoring and that there data is valid and usable. The Grand Lake Water Watch Chapter continues to be a productive and dependable group providing the OWRB with valuable data on the Grand Lake basin. Should you have any questions about this report, please do not hesitate to contact Tamara Williams at (405) 530-8937 or at trwilliams@owrb.ok.gov.

Thanks and Happy Sampling!

Tamara Williams
OWW QA Officer