Center for Watershed Science and Education

University of Wisconsin-Stevens Point and University of Wisconsin Extension

University of Wisconsin-Stevens Point
College of Natural Resources
800 Reserve Street • Stevens Point, WI USA 54481

Lazy Lake Watershed Water Quality Summary Report

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Christopher Arnold, Charles Boettcher, and Nancy Turyk, Center for Watershed Science and Education

University of Wisconsin Stevens Point

Watershed Description:

The Lazy Lake Watershed is located primarily in the south eastern portion of Columbia County, and also encompasses portions of Dane and Dodge County. The watershed covers approximately 162 square miles and has 2,950 miles of streams (Figure 1).

Lake Description:

Lazy Lake is approximately 200 acres and is an impoundment of the North Branch of the Crawfish River with maximum depth of about 8 feet and a mean depth of 4 feet (WDNR 2005). This impoundment is considered eutrophic and has extensive aquatic plant and algal growth.

Background and Water Quality Results:

The water quality monitoring project as stated in the following grant was designed to add to the previous Lazy Lake watershed inventory to provide quantifiable data allowing for sound watershed management. By quantifying the in lake and tributary water quality and combining it with watershed/land use data, watershed management can be focused on areas that are in need of best management practices. This grant, conducted water quality monitoring over two years providing quantifiable surface water data for the Lazy Lake watershed, while allowing for future load analysis and lake modeling projects to be added increasing the quality of data over time for the watershed and lake. This approach reduces cost and ultimately increases the probabilities for success and efficiency for managing Lazy Lake and the watershed.

This grant addresses the first two years of this effort. In what is being called **Phase I** (water quality monitoring), by design will be incorporated into the future phases, they include **Phase 2** (Data Modeling, Compilation and a phosphorous budget) and **Phase 3** (TMDL Development). These three phases for addressing water quality will ideally be accompanied An assessment of the aquatic plant community, especially *Potomogeton crispus* will help us to understand the role that aquatic plants are playing in the Lazy Lake phosphorus budget.

In the summer of 2009 Columbia County began collecting and compiling water quality and discharge data in portions of the Lazy Lake watershed. Samples and measurements were taken about every two weeks at the sites noted above and were taken between the dates of 7/21/2009 and 11/15/2010 at five tributaries sites in the Lazy Lake watershed (Table 1). Site two proved to be a poor monitoring location and was discontinued.

The Total Phosphorus or TP median concentrations were all above the proposed DNR phosphorus standard of 75 µg/l for wadeable streams with the exception of site 1 (74 µg/l). TP concentrations ranged from 38-255 µg/l at site 1, 56-287µg/l at site 3, 50-221µg/l at site 4, and 42-212µg/l at site 5 (Figure2). Generally, the Soluble Reactive Phosphorus (SRP) increased with an increase in TP at all sites (Figure 3).

Nitrate (NO_3+NO_2-N) accounted for a majority of nitrogen concentrations at all sites. NO_3+NO_2-N concentrations ranged from detection levels to 5.3 mg/l with the higher concentrations measured in samples collected at sites 4 and 5 (Figure 4). The source appears to be attributed to ground water inputs with the exception of site 1 (Figure). Ammonia concentrations were all below .07 mg/l, with sites 1, 3, and 5 averaging 0.05 mg/l, see appendix for additional figures and information (Figure 21).

Total Suspended Solids or TSS concentration medians at all sites were below 10 mg/l (Figure 3).

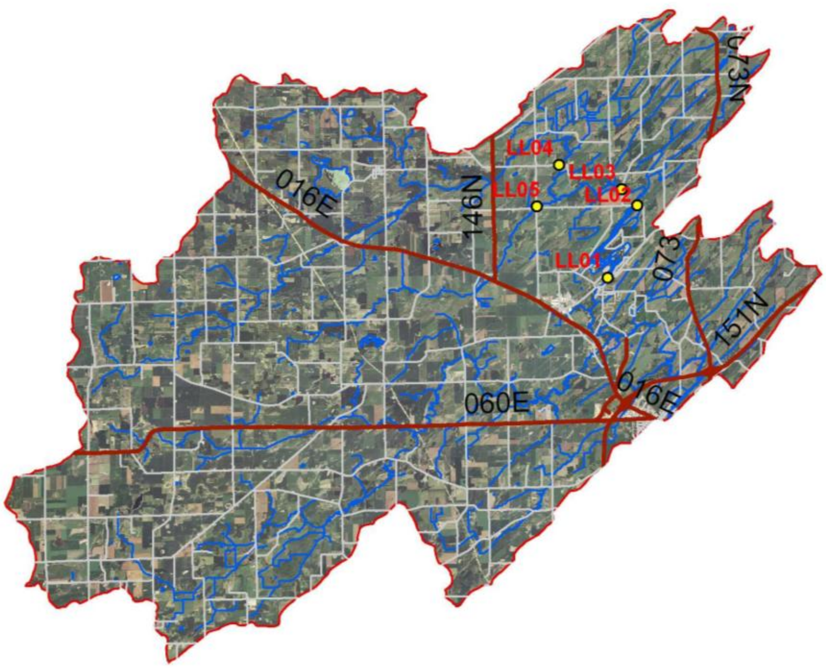

Figure 1: Map of Lazy Lake Watershed and tributary sampling sites.

Table 1: Table of Sampling Site Locations in the Lazy Lake Watershed

Site	Tributary Name	Adjacent Roadway
LL01	North Branch Crawfish River	County Road D/Main St.
LL02	North Branch Crawfish River	County Road DG
LL03	North Branch Crawfish River	County Road DG
LL04	North Branch Crawfish River	County Road Z
LL05	Unnamed	County Road Cd

The chloride concentrations measured at all sites exceeded the regional background concentrations of 10 mg/l. Sites 1, 3 and 4 had similar median concentrations (18.90 mg/l, 19.4 mg/l and 18.95 mg/l respectively.) with more variability at site 4 (7.3 mg/l to 25.5 mg/l)(Figure 4). These sites also experienced a noticeable increase in concentrations from summer to fall 2010 (Figure 5). Due to the small sample size it is unclear whether this is a seasonal trend and/or related to low flows or precipitation events. Samples collected at site 5 had the highest concentrations of chloride with a median concentration of 24.75 mg/l, ranging from 16.8 mg/l to 26.8 mg/l (Figure 4).

The specific conductance (SpC) measurements were particularly high at sites 3, 4, and 5. The median values were 620 µmho for 3, 610 µmho for 4 and 690 µmho for 5 (Figure 6).

The pH measured at the sites ranged from 7.7 to 8.9. The median values for sites 3, 4 and 5 were 8.35, 8.3 and 8.2 respectively. LL01 the outflow from the dam was higher as expected and had a median value of 8.5 (Figure 7).

Dissolved oxygen concentrations were measured during each sampling period. The lowest recorded value 6.13 mg/l (Figure 8).

Discharge Data Results:

Discharge and staff gauge measures were collected beginning in the summer of 2009 through October of 2010. In total, 15-18 of these measures have been taken for each site.

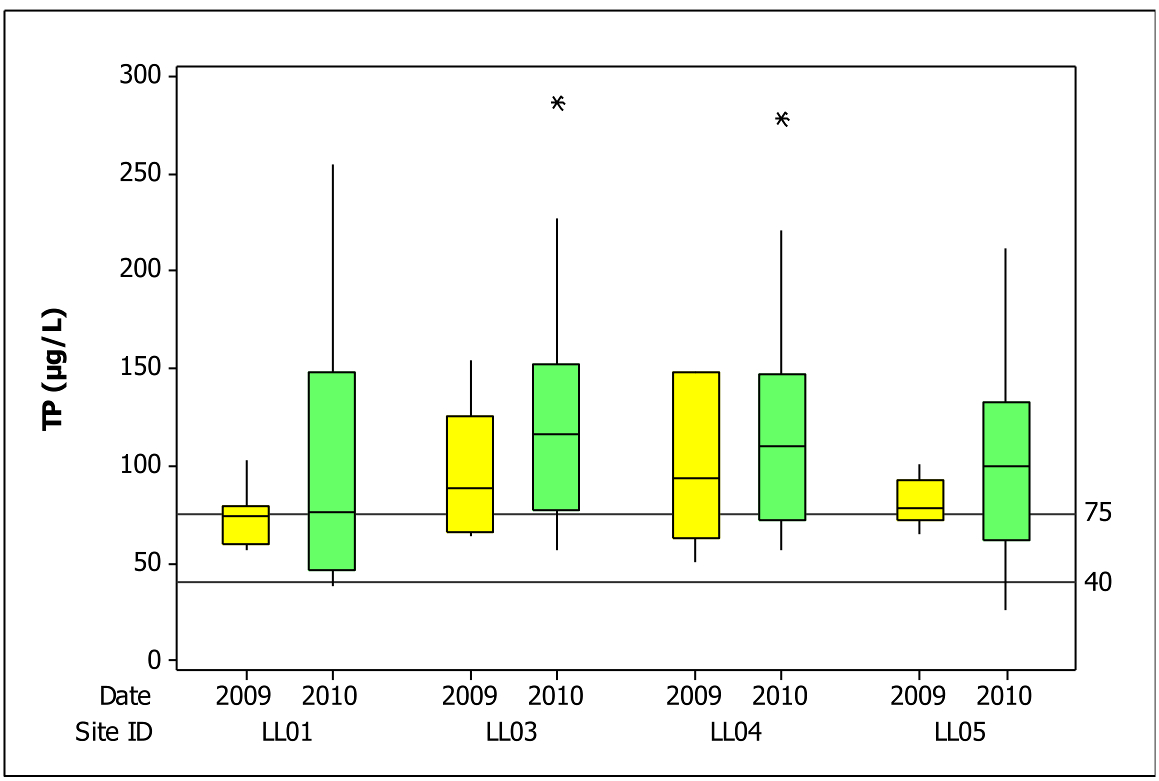

Figure 2: A Box plot of Total Phosphorus Concentrations in µg/l Measured at Each Site. The horizontal line represents the reference standard of 75 ug/l for wadable streams and 40 ug/l for impoundments.

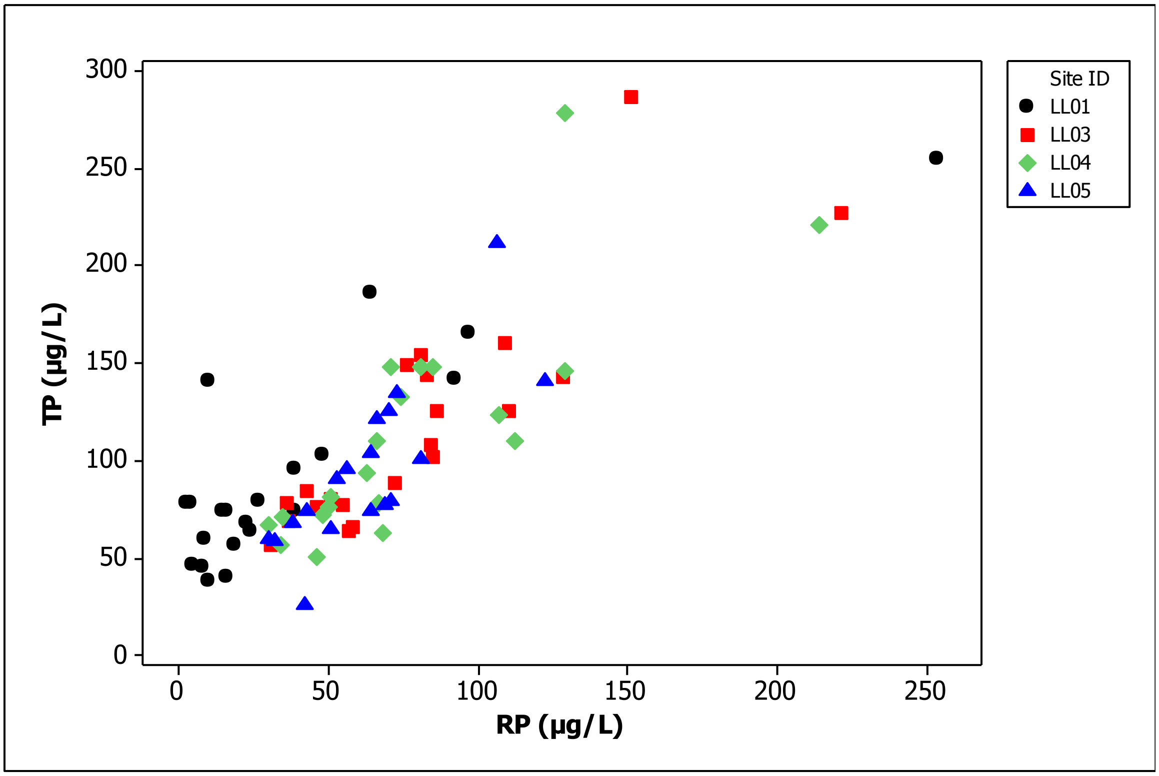

Figure 3: A Scatter plot of Total Phosphorus Concentrations vs. Soluble Reactive Phosphorus Measured at Each Site.

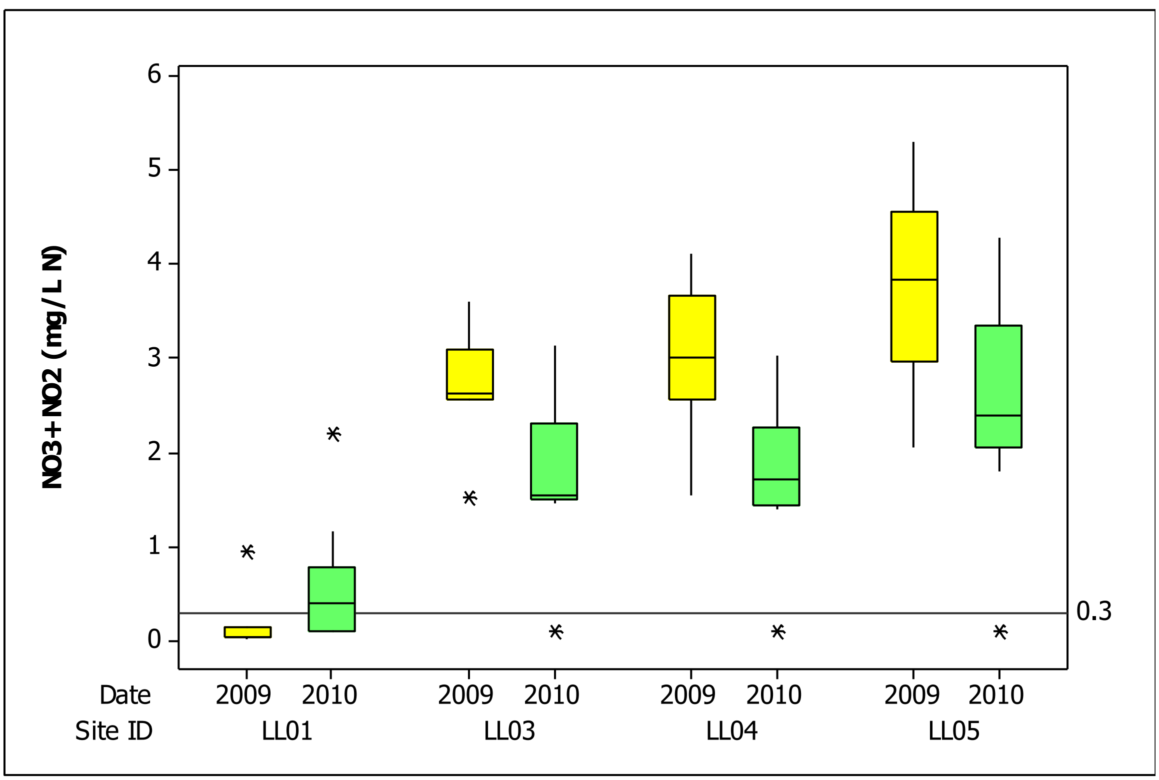

Figure 4: A Box plot of NO_3+NO_2-N Concentrations Measured at Each Site. The horizontal line represents the reference standard for algal blooms in lakes of 0.3 mg/l.

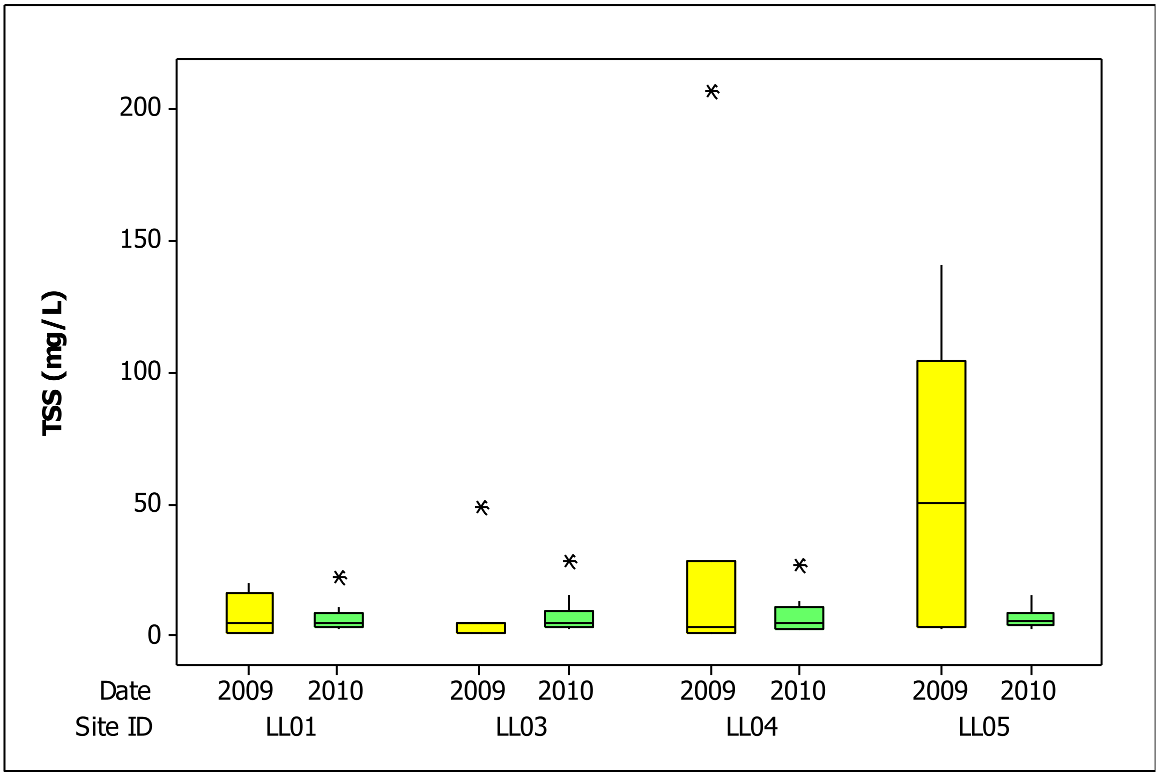

Figure 3: A Box plot of Total Suspended Solids Concentrations Measured at Each Site

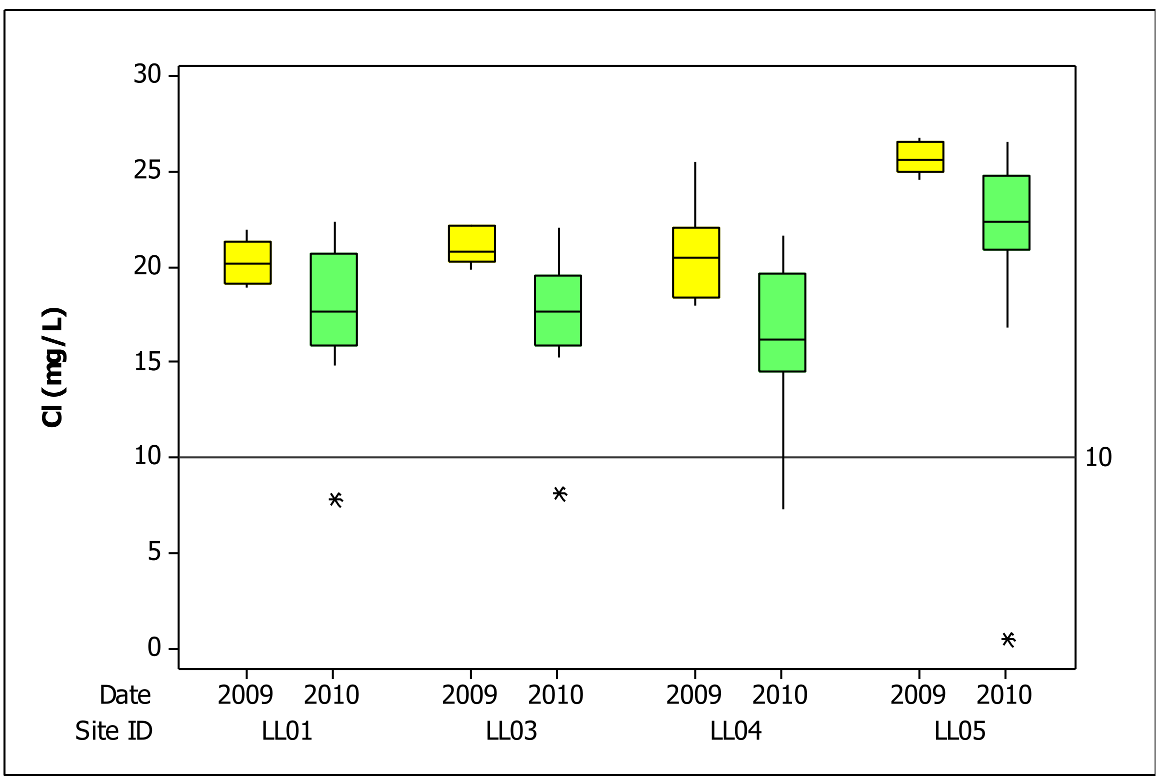

Figure 4: A Box plot of Dissolved Chloride Concentrations Measured at Each Site. The horizontal line represents the regional average of 10 mg/l.

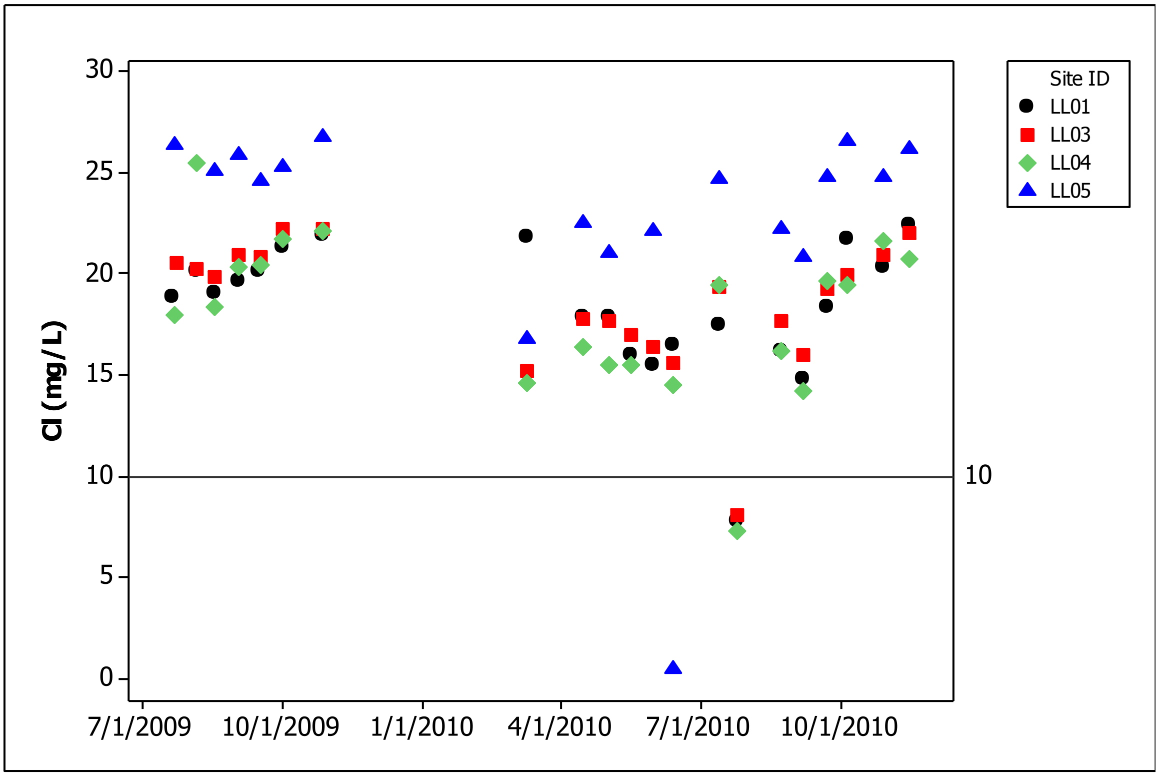

Figure 5: A Scatter plot of Dissolved Chloride Concentrations Measured in at Each Site by Date. The horizontal line represents the regional average of 10 mg/l.

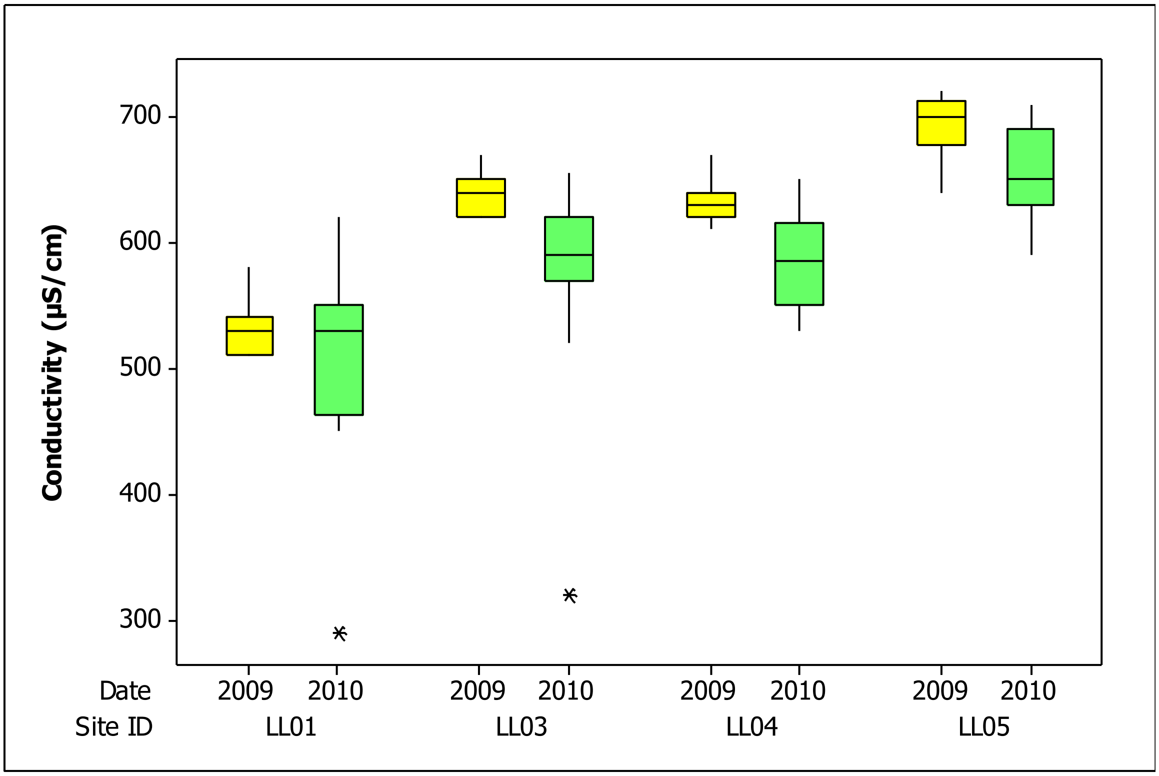

Figure 6: A Box plot of Specific Conductance Levels Measured at Each Site.

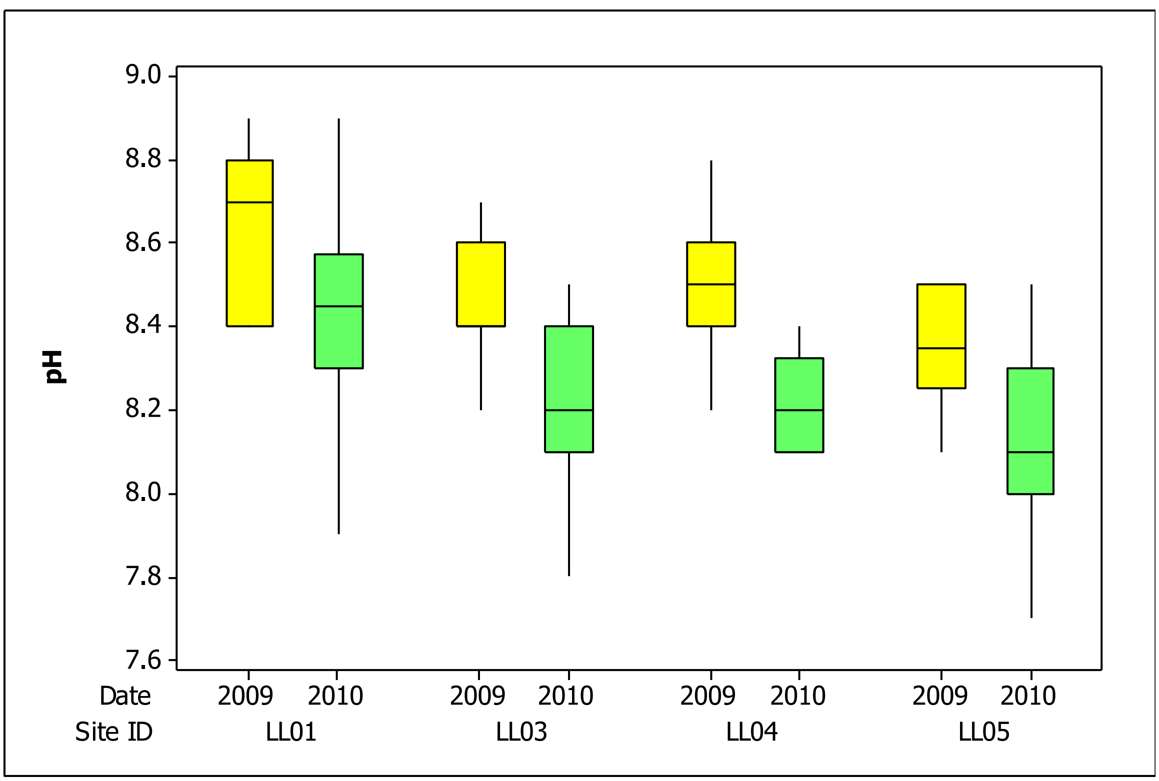

Figure 7: A Box plot of pH Levels Measured at Each Site.

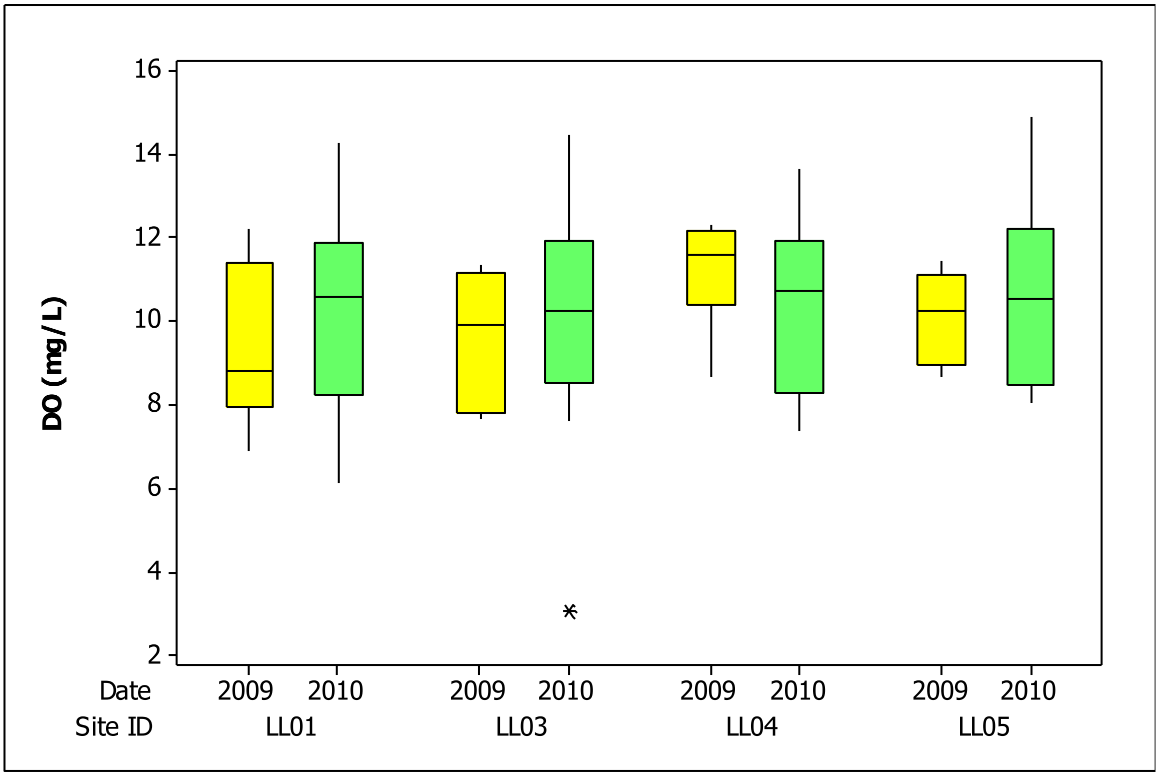

Figure 8: A Box plot of Dissolved Oxygen Measured at Each Site.

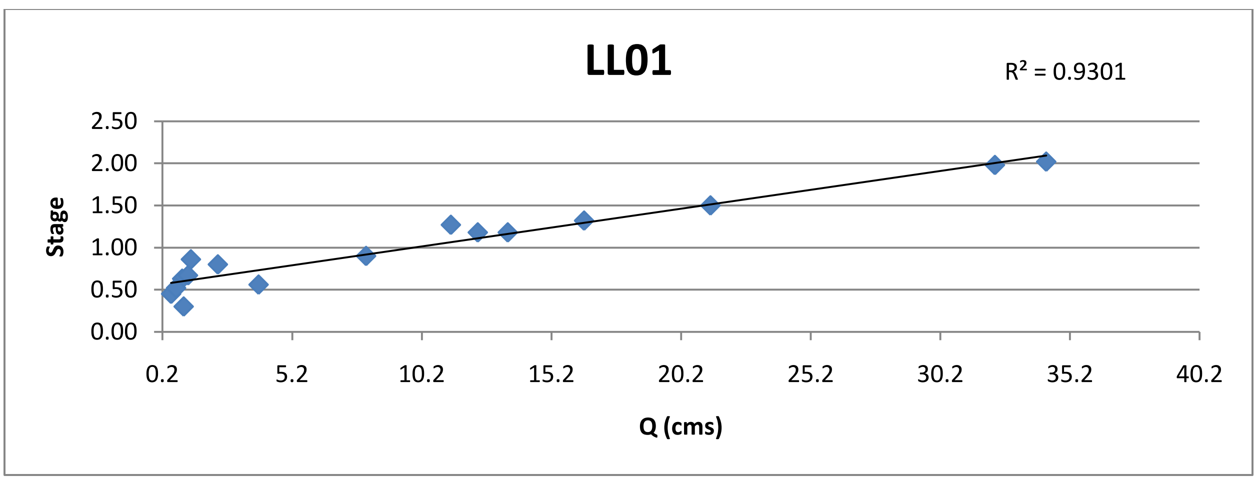

Figure 9: The Rating Curve for LL01

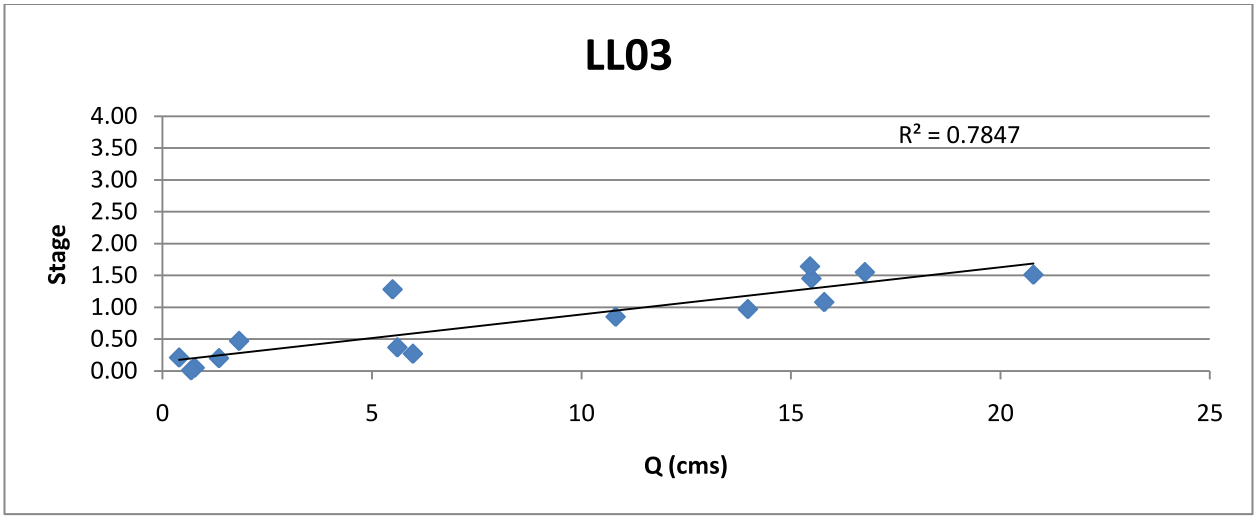

Figure 10: The Rating Curve for LL03

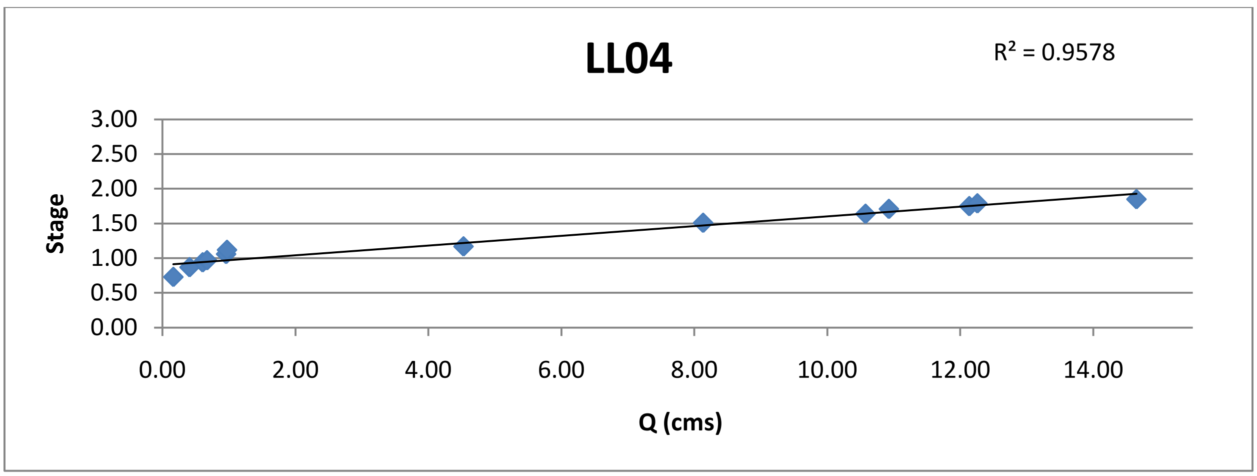

Figure 11: The Rating Curve for LL04

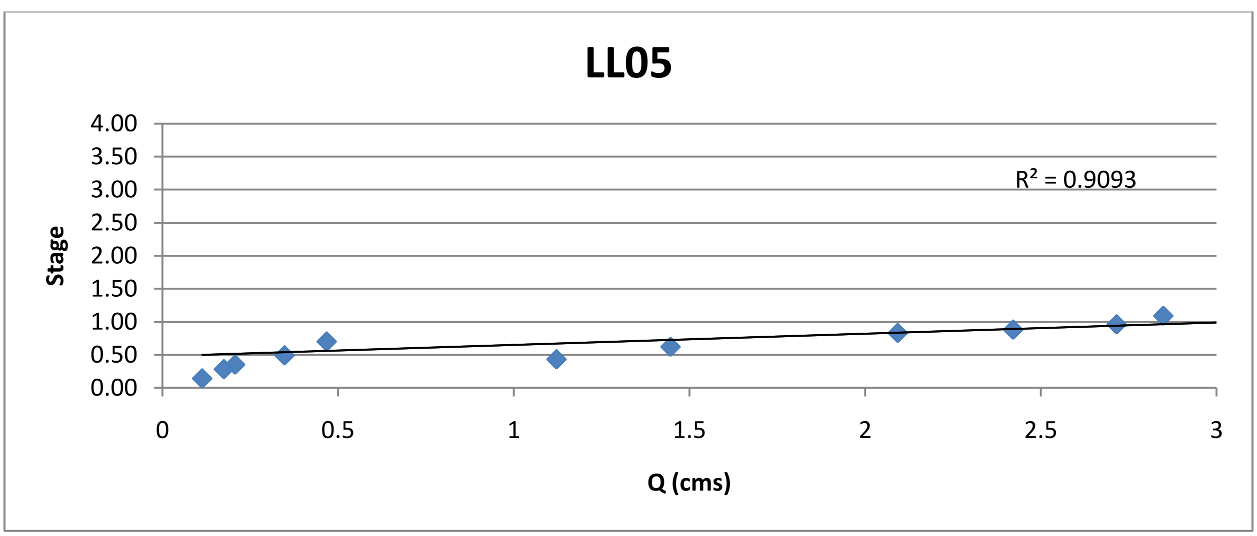

Figure 12: The Rating Curve for LL05

Appendix:

Watershed Sampling Methods: To understand how the watershed influences water quality in Lazy Lake, water monitoring was performed at 5 tributaries (LL01-LL05). Tributary nutrient concentrations and water flow rates were measured. Stream flow was measured with pressure transducers, staff gauges, and stream flow measurements. Water samples were collected for lab analysis throughout the year and during a variety of flow conditions. Samples were collected during low flow (base flow) using the grab method and during high flow using siphon samplers. The siphon samplers were set at varying depths in each tributary to collect samples during different points in a storm or snow melt event. The arrangement of siphon samplers was intended to explore if and how nutrient concentrations varied with stream flow intensity related to precipitation and runoff. These samples allowed us to evaluate how land use changes from the upper to lower reaches of sub-watersheds affected water quality in the streams. Samples were shipped on ice to the state-certified Water and Environmental Analysis Lab on the UWSP campus for lab analysis of NO_2+NO_3-N, NH_4, TKN, SRP, Total P, Cl, and TSS. Dissolved oxygen, pH, specific conductance, and temperature were recorded using a Hydrolab during base flow sampling. During synoptic sampling water samples were also analyzed for various ions including: arsenic, calcium, copper, iron, sulfates, potassium, magnesium, manganese, sodium, phosphorus, lead, and zinc.

Lake Sampling Methods: The Columbia County Land and Water Conservation Department conducted in-lake water quality monitoring during the spring through the fall of 2009 and 2010. Lake water quality data was collected at the deep point of the basin. Profiles of temperature (Figure 13),DO (Figure 14), pH, specific conductance, and water clarity were collected 6 times on 4/19/2010, 7/6/2010,7/28/2010, 8/17/2010, 9/14/2010, and 11/1/2010. Dissolved oxygen, pH, specific conductance, and temperature were recorded using a Hydrolab, and a Secchi disk was used to determine water clarity. During the year water quality samples were collected 6 times were analyzed for total phosphorus and chlorophyll a (an indicator of algae) and is recorded (Table 2). The phosphorus samples were preserved using H_2SO_4 and the chlorophyll a samples were field filtered with 934-AH filters and stored in whirl packs covered in aluminum foil. The samples were collected using a 4 foot integrative sampler. In addition a fall and overturn sample was collected 1 foot into the water column on 10/15/2009 and 4/19/2010, respectively, and was analyzed for nitrates, total nitrogen and organic nitrogen, chlorides, pH, specific conductance, alkalinity, total and calcium hardness, ammonium, total and reactive phosphorus, sulfates, potassium, sodium, turbidity and color and is recorded (Table3). All water quality samples were kept on ice during transport to the lab. Water chemistry analysis was performed at the state certified UWSP Water and Environmental Analysis Lab.

Table 2: Total Phosphorus and Chlorophyll a readings on Lazy Lake for 2009 and 2010

Date	TP (µg/L)	Chlorophyll A

8/19/2009	234.00	37.00
7/6/2010	126.00	46.00
9/14/2010	74.00	15.00
7/28/2010	211.00	10.00
11/1/2010	126.00	8.00

Table 3: Overturn water quality data collected for Lazy Lake on 10/15/2009 and 4/19/2010

Date	10/15/2009	4/19/2010
NO3+NO2 (N) (mg/l)	3.82	0.70
Cl (mg/l)	30.30	19.60
NH4 (mg/l)	0.02	0.01
TKN (mg/l)	1.09	1.07
TP (ug/l)	81.00	24.00
RP (ug/l)	44.00	3.00
conductivity (umhos)	732.00	463.00
pH	8.36	8.63
Alk (g CaC03)	308.00	228.00
T Hard (mg/l)	388.00	265.00
Ca Hard (mg/l)	172.00	137.00
SO4 (mg/l)	54.83	15.81
K (mg/l)	4.20	2.50
Na (mg/l)	11.70	6.40
Turb (NTU)	3.00	4.10
Color (CU)	21.00	28.00

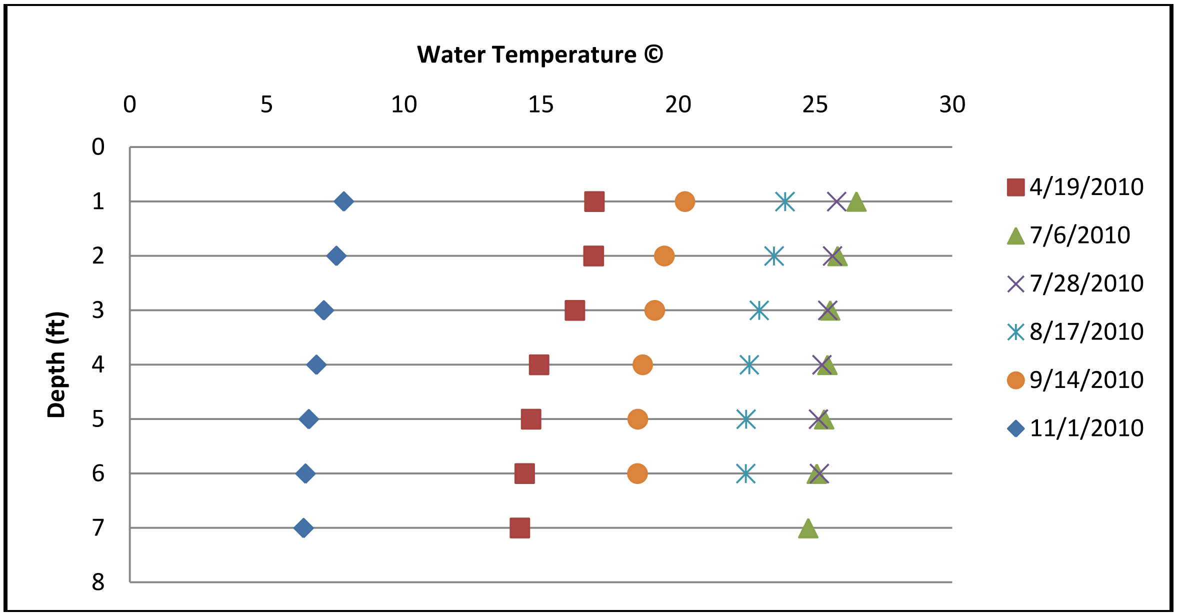

Figure 13: The temperature profile measured on Lazy Lake by date

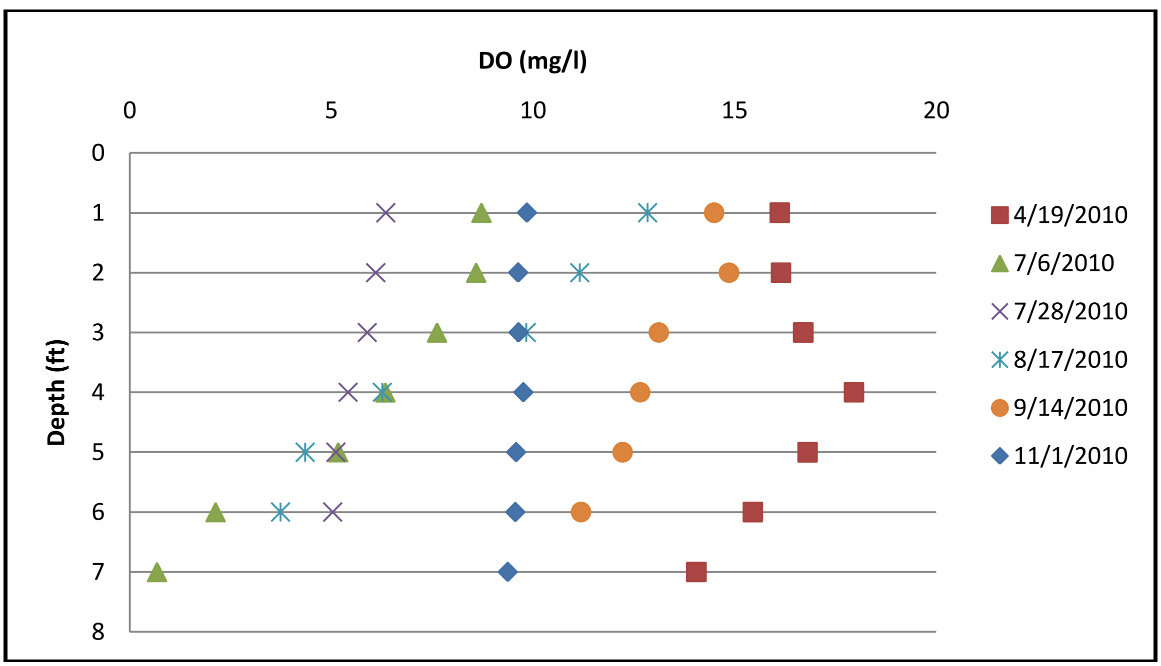

Figure 14: The temperature profile measured on Lazy Lake by date.

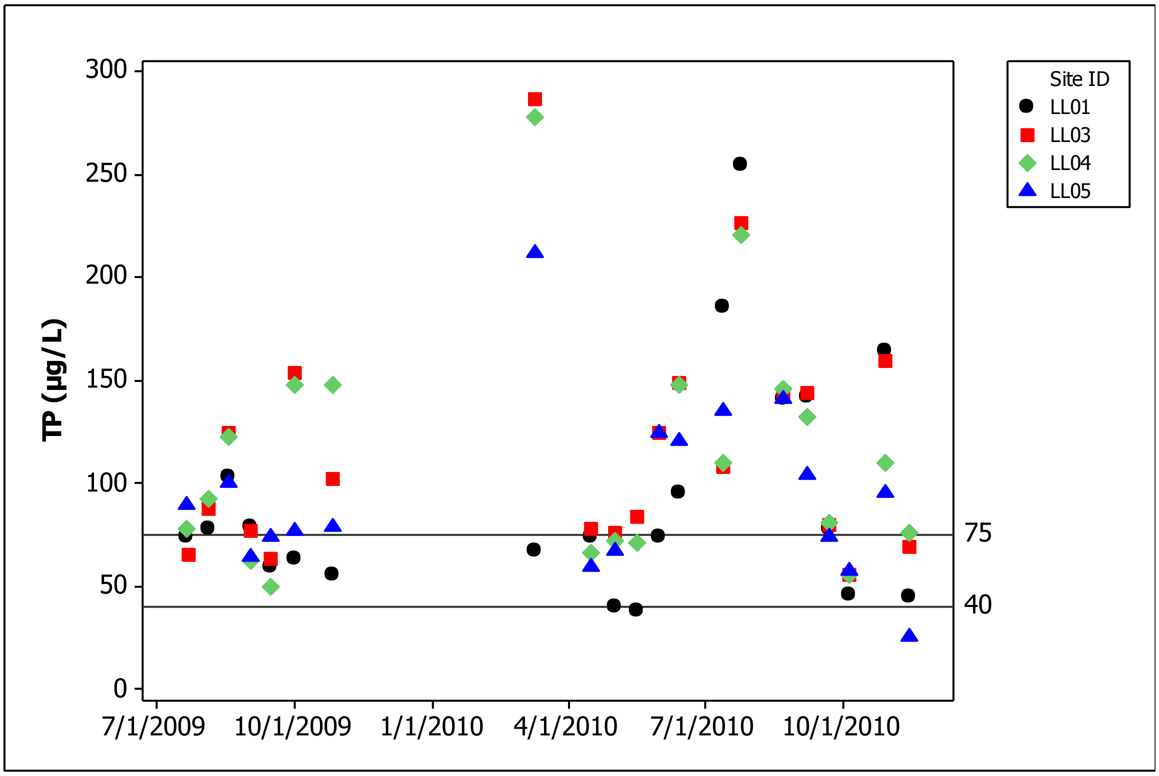

Figure 15: A Scatter plot of Total Phosphorus Concentrations Measured at Each Site by Date. The horizontal line represents the reference standard of 75 ug/l for wadable streams and 40 ug/l for impoundments.

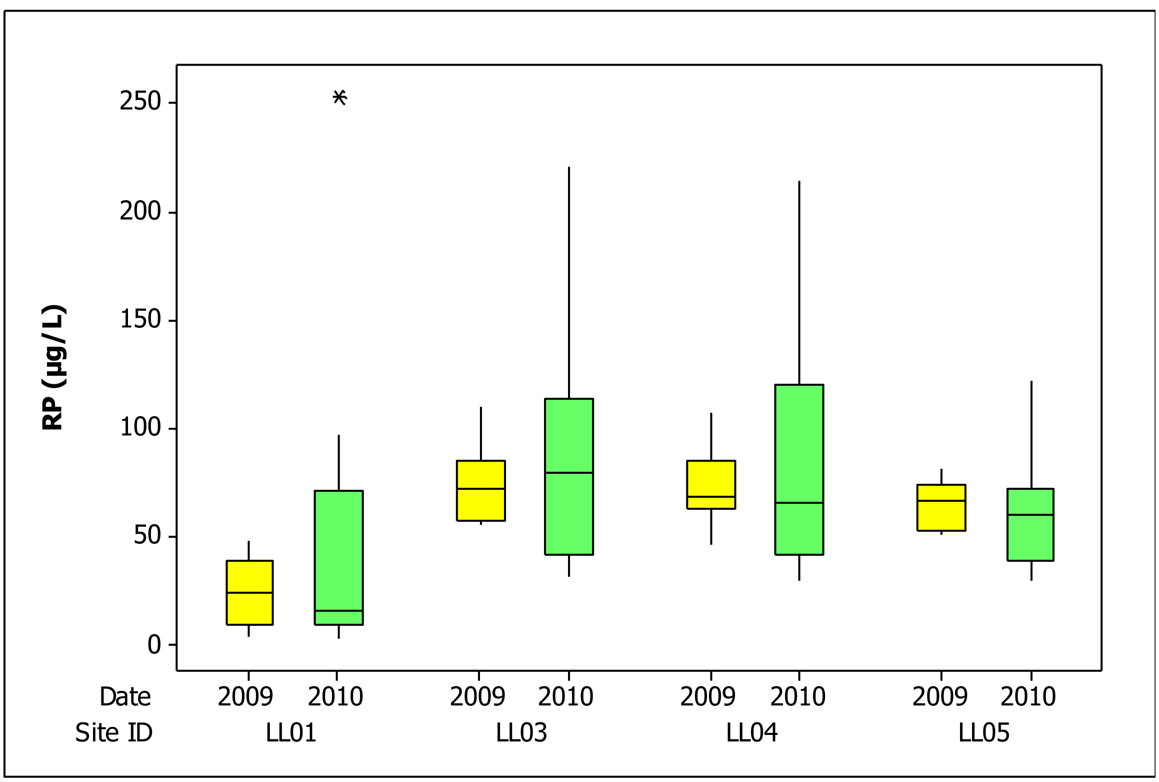

Figure 16: A Box plot of Soluble Reactive Phosphorus Concentrations Measured at Each Site.

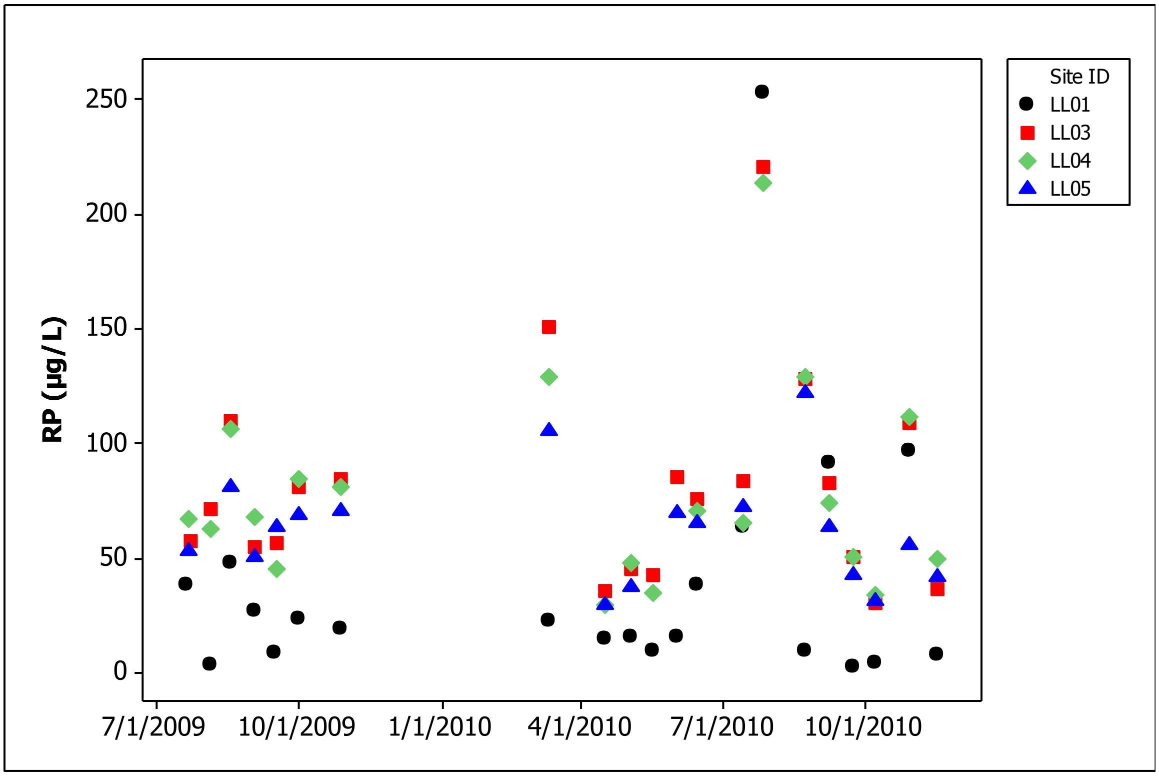

Figure 17: A Scatter Plot of Soluble Reactive Phosphorus Concentrations Measured at Each Site by Date.

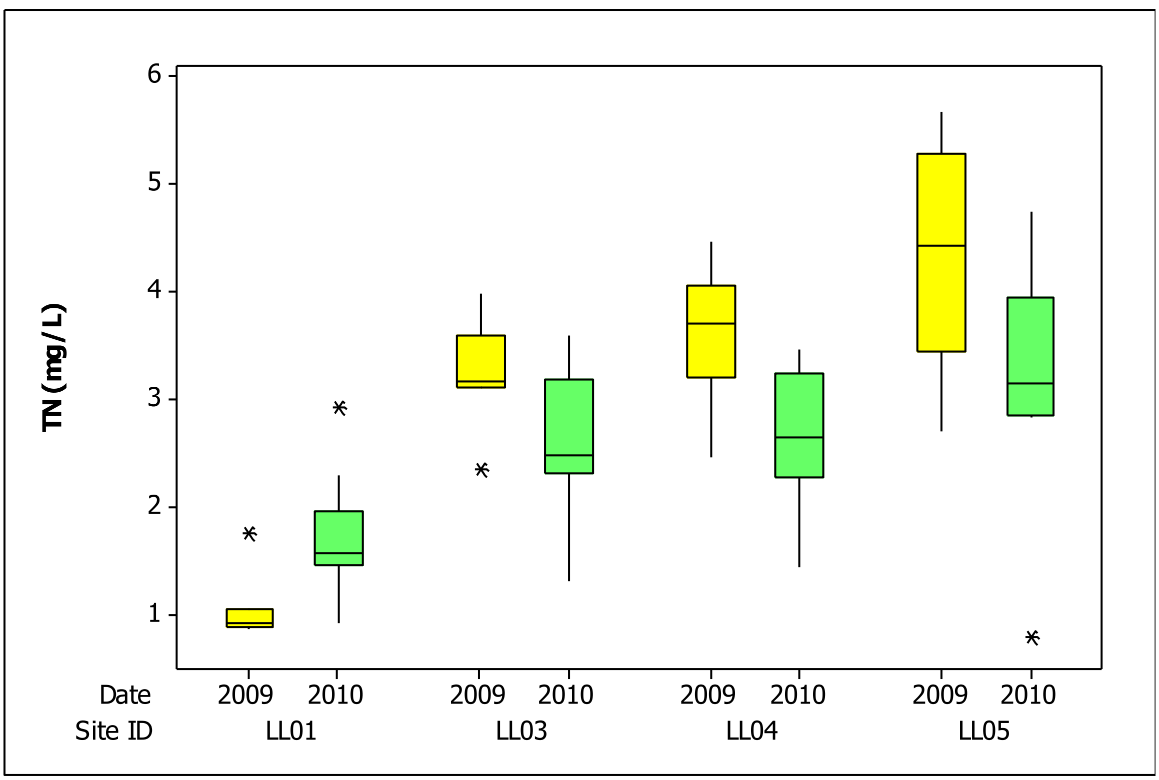

Figure 18: A Box plot of Total Nitrogen Concentrations Measured at Each Site.

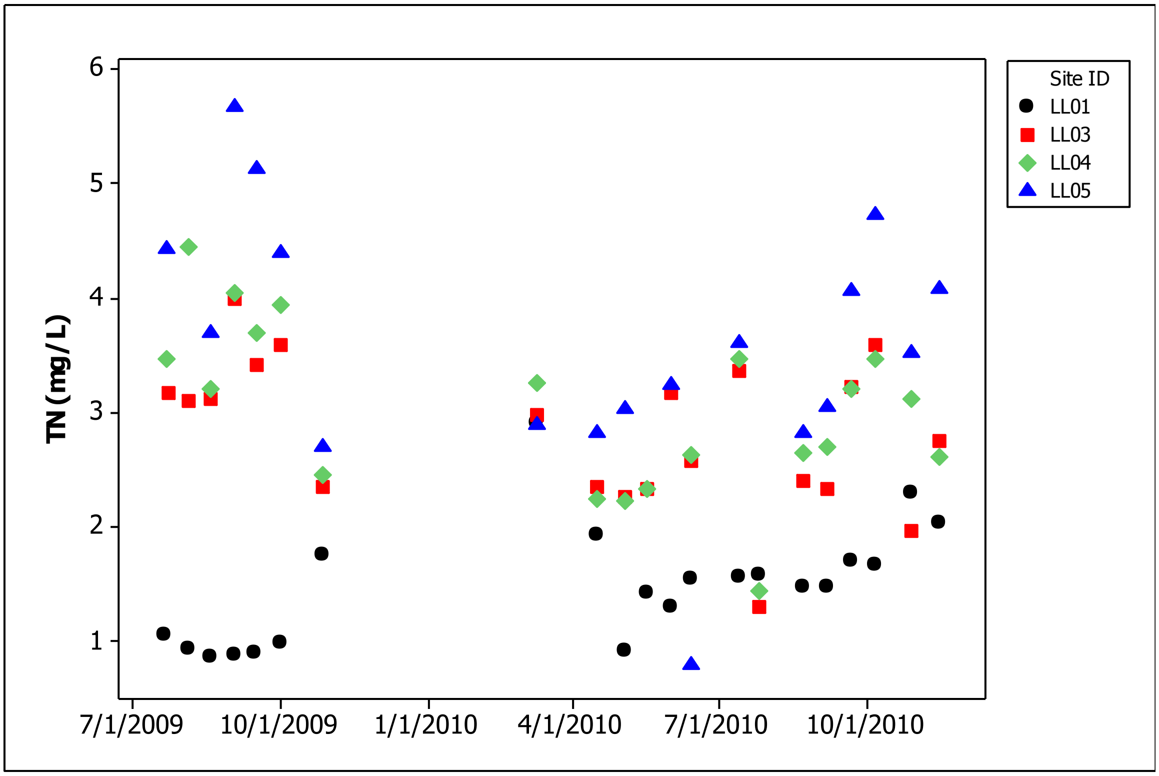

Figure 19: A Scatter plot of Total Nitrogen Concentrations Measured at Each Site by Date.

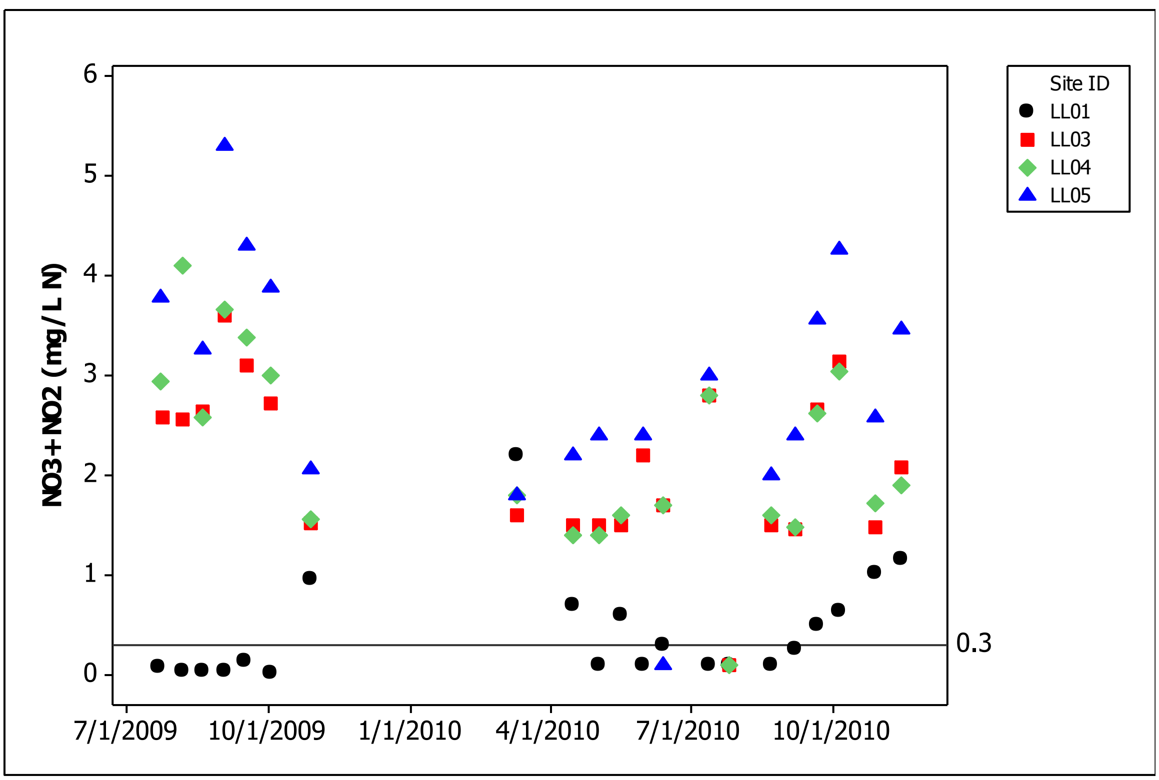

Figure 20: A Scatter plot of NO_3+NO_2-N Concentrations Measured at Each Site by Date. The horizontal line represents the reference standard for algal blooms in lakes of 0.3 mg/l.

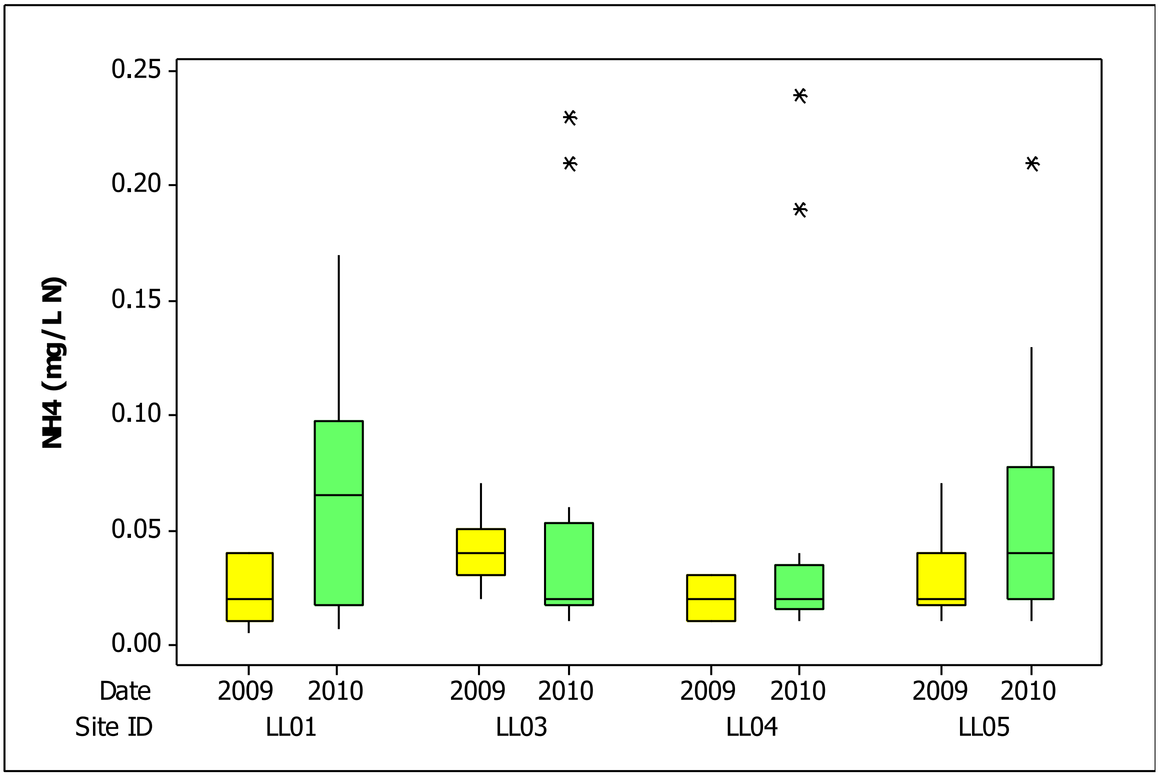

Figure 21: A Box plot of Ammonium Concentrations measured at Each Site.

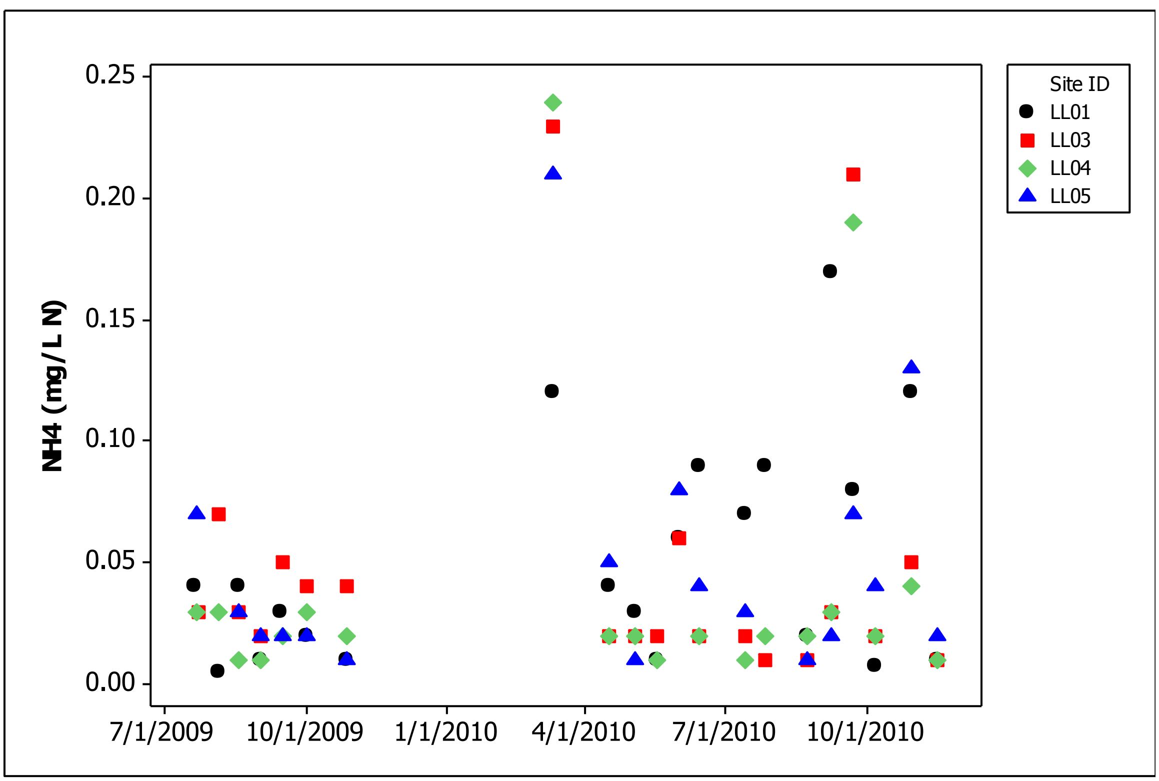

Figure 22: A Scatter plot of Ammonium Concentrations Measured at Each Site by Date.

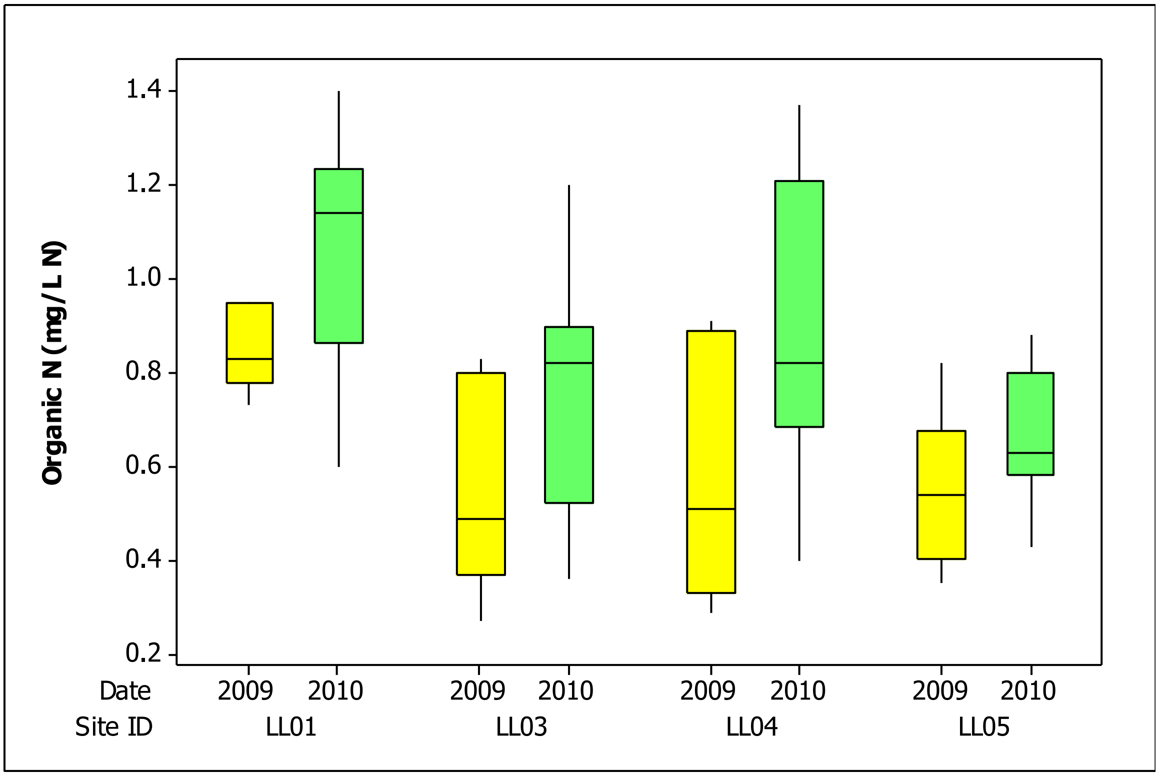

Figure 23: A Box plot of Organic Nitrogen Concentrations Measured at Each Site.

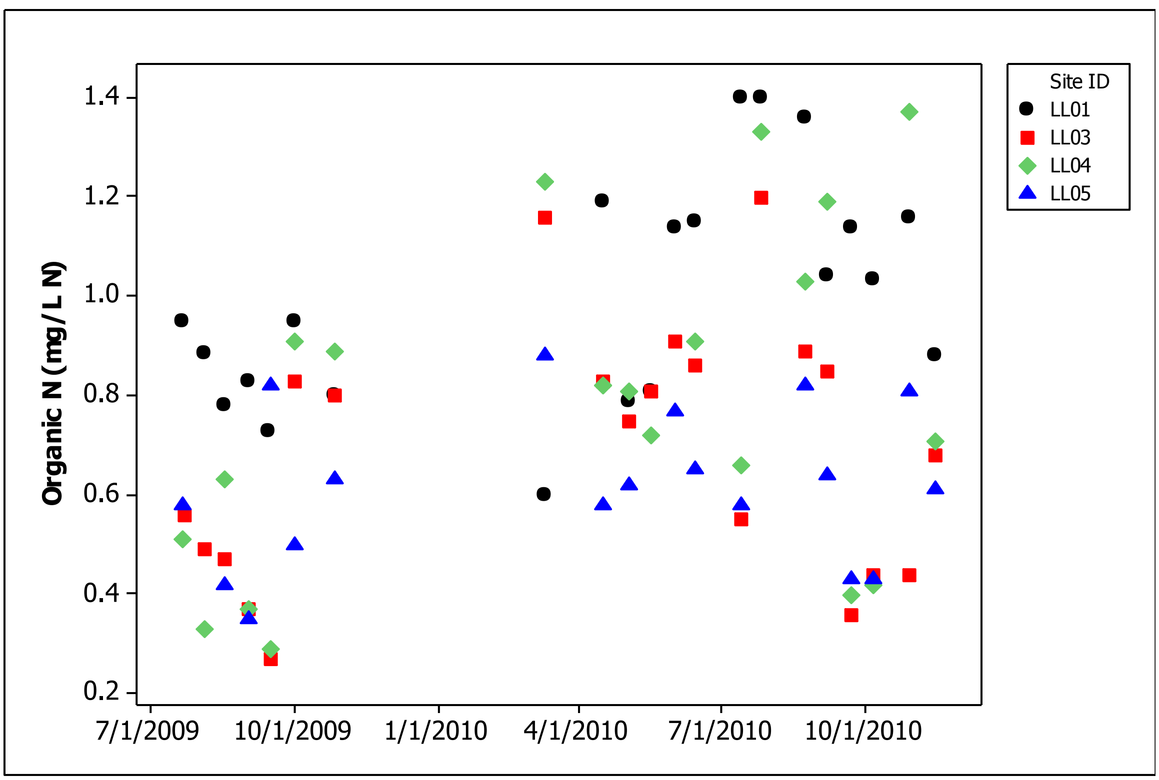

Figure 24: A Scatter plot of Organic Nitrogen Concentrations Measured at Each Site by Date.

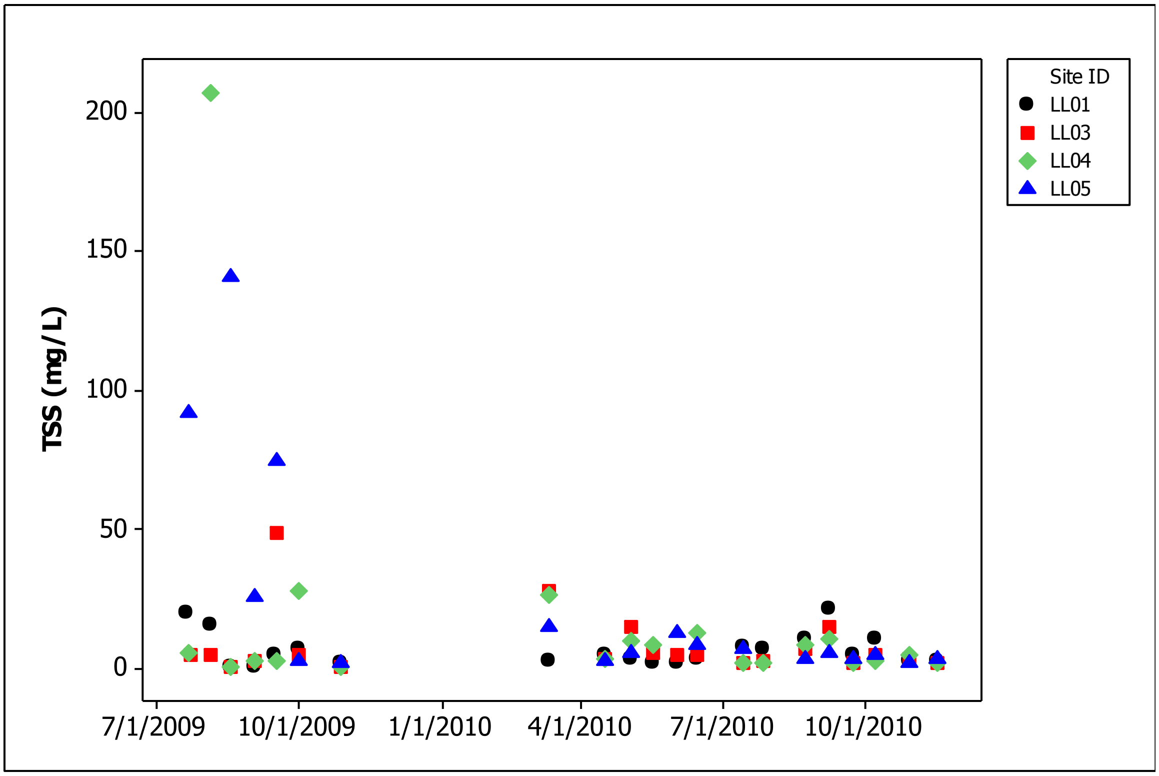

Figure 27: A Scatter plot of Total Suspended Solid Concentrations Measured at Each Site by Date.

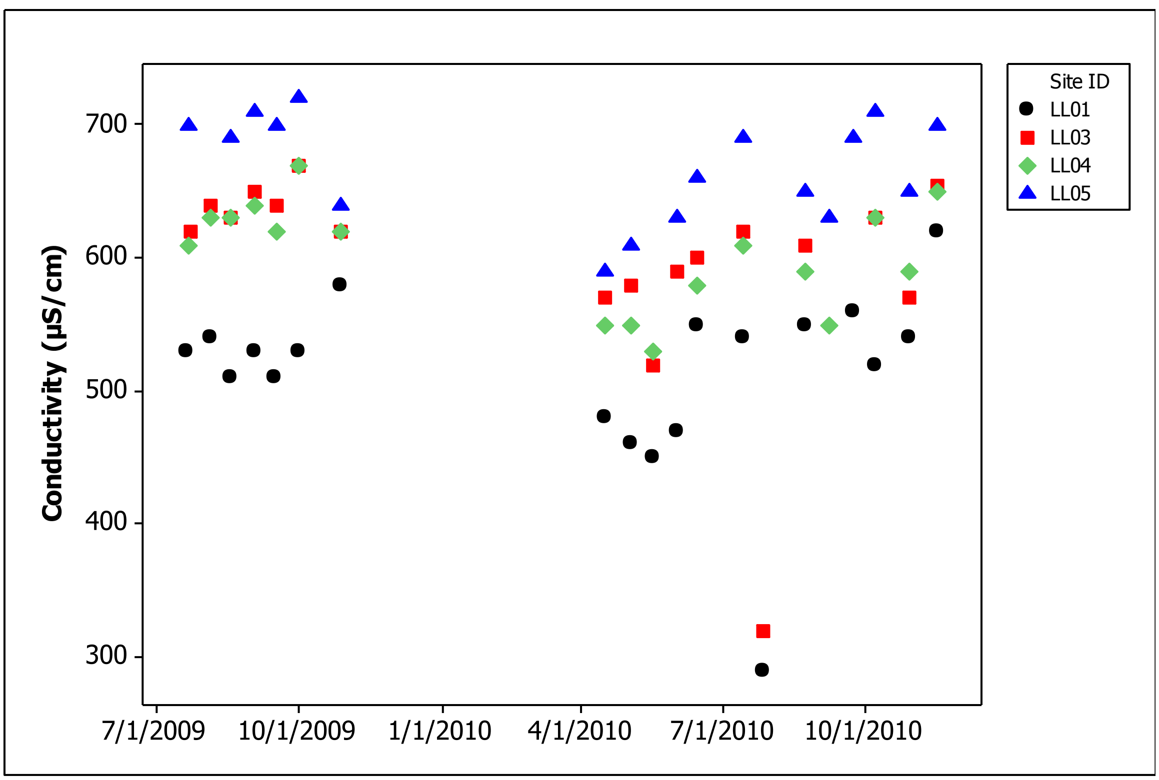

Figure28: A Scatter plot of Specific Conductance Levels Measured at Each Site by Date.

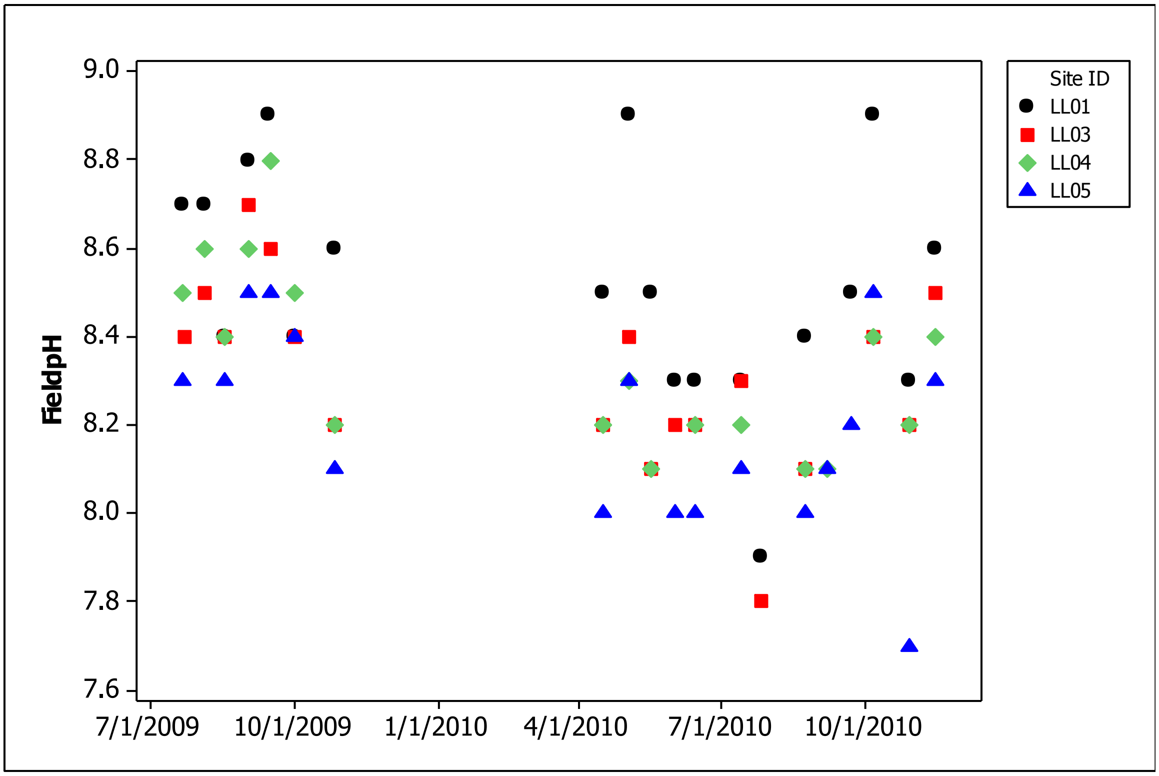

Figure 29: A Scatter plot of pH Levels Measured at Each Site by Date.

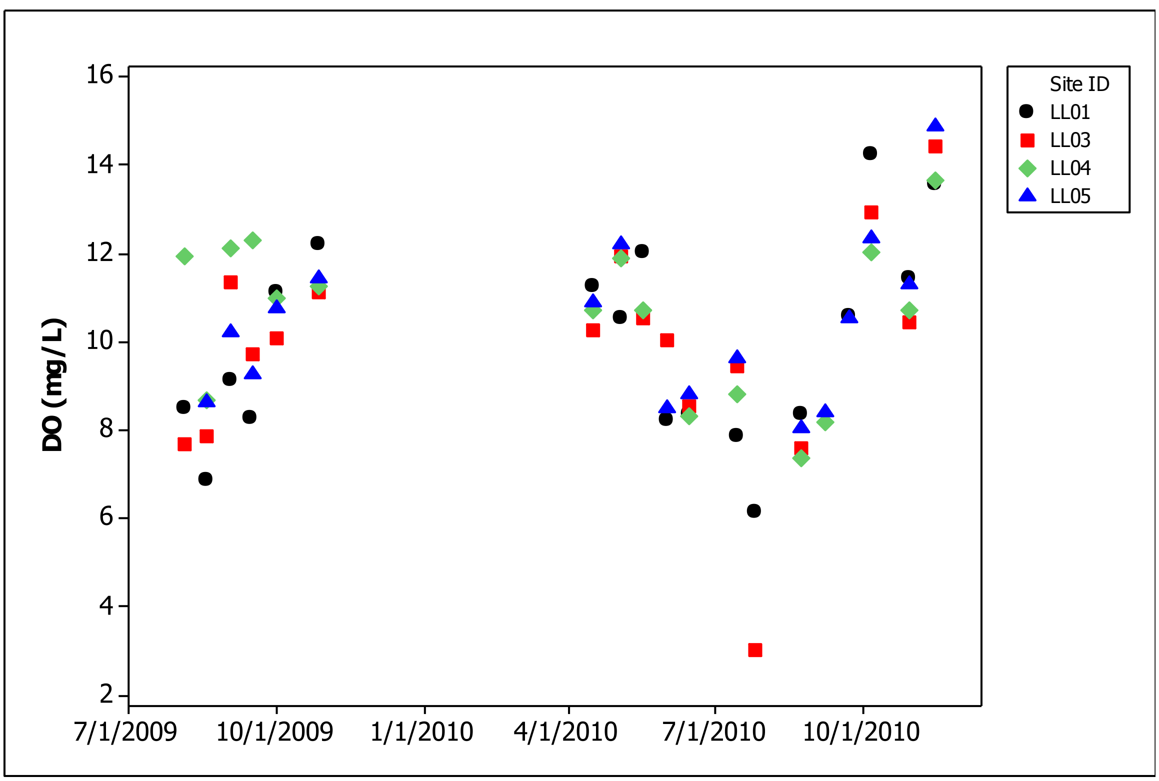

Figure 25: A Scatter plot of Dissolved Oxygen Concentrations Measured at Each Site by Date.

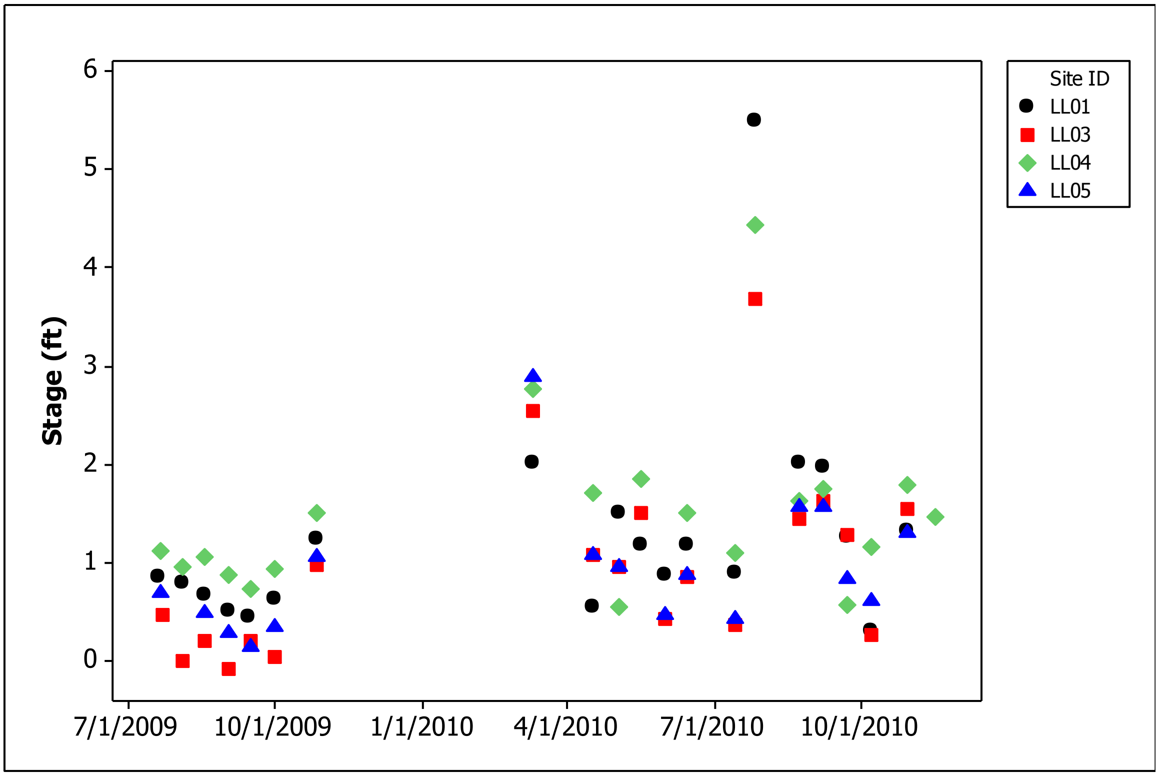

Figure 31: Scatter plot of Average Stage Height Measured at Each Site by Date.

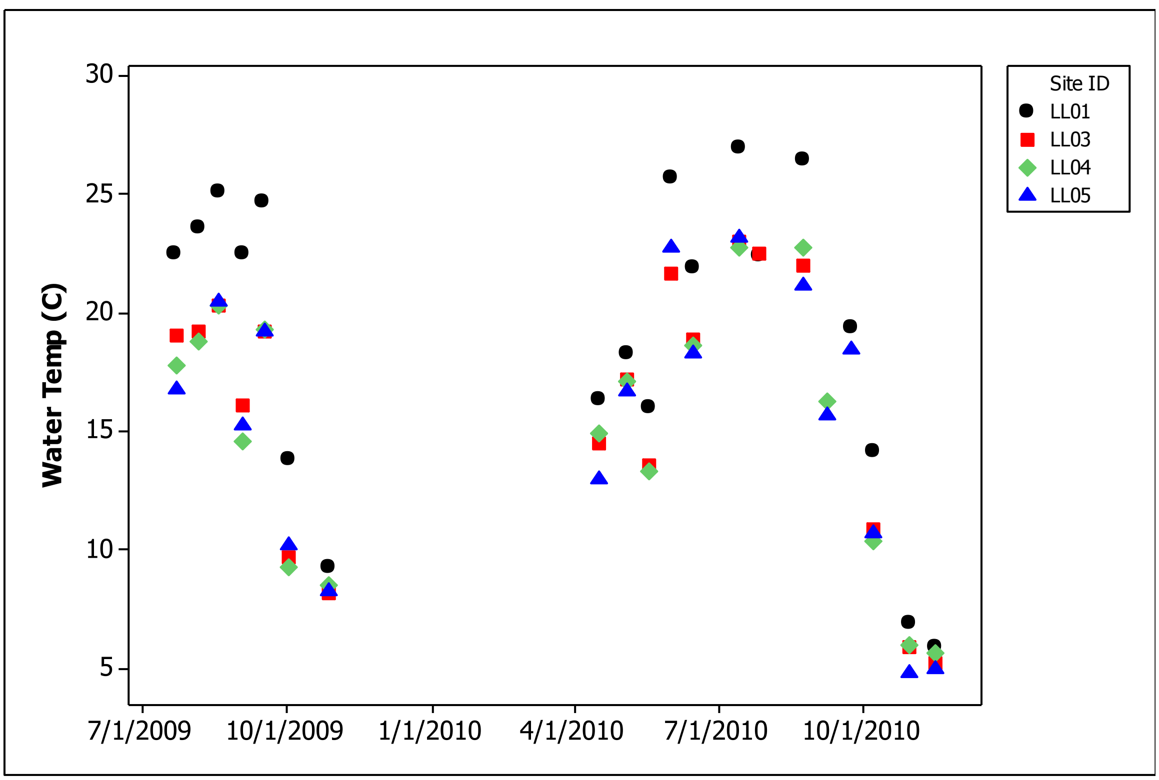

Figure 26 A Scatter plot of Water Temperatures Measured at Each Site by Date.

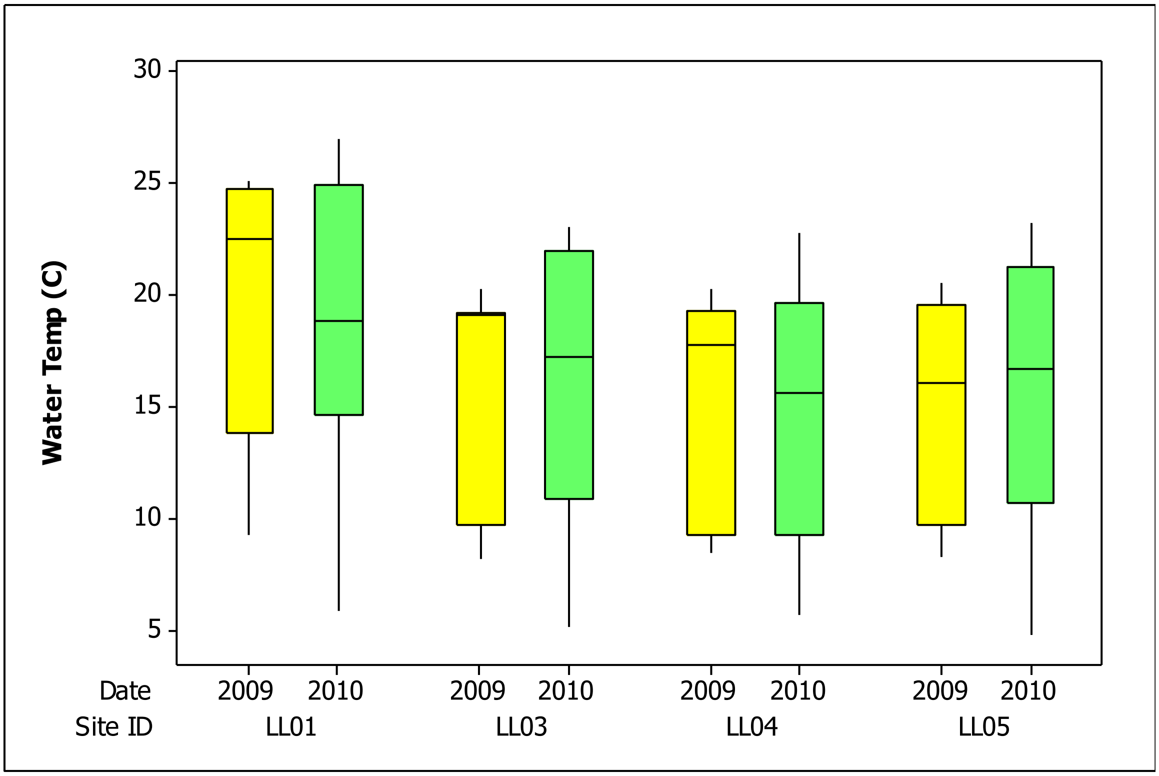

Figure 33: A Box plot of Water Temperatures Measured at Each Site.

Literature Cited:

Bureau of Fisheries and Habitat Management (2005) “Wisconsin Lakes” Wisconsin Department of Natural Resources Publication pp. 45.

“Proposed Phosphorus Water Quality Standards Criteria for Lakes and Streams” (2007) EPA Water Quality Report.