White Rock Lake Watershed Data Report

July 2013

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Introduction

Texas Stream Team is a volunteer-based citizen water quality monitoring program. Citizen scientists collect surface water quality data that may be used in the decision-making process to promote and protect a healthy and safe environment for people and aquatic inhabitants. Citizen scientist water quality monitoring occurs at predetermined monitoring sites, at roughly the same time of day each month. Citizen scientist water quality monitoring data provides a valuable resource of information by supplementing professional data collection efforts where resources are limited. The data may be used by professionals to identify water quality trends, target additional data collection needs, identify potential pollution events and sources of pollution, and to test the effectiveness of water quality management measures.

Texas Stream Team citizen scientist data are not used by the state to assess whether water bodies are meeting the designated surface water quality standards. Texas Stream Team citizen scientists use different methods than the professional water quality monitoring community. These methods are utilized by Texas Stream Team due to higher equipment costs, training requirements, and stringent laboratory procedures that are required of the professional community. As a result, Texas Stream Team data do not have the same accuracy or precision as professional data, and is not directly comparable. However, the data collected by Texas Stream Team provides valuable records, often collected in portions of a water body that professionals are not able to monitor at all, or monitor as frequently. This long-term data set is available, and may be considered by the surface water quality professional community to facilitate management and protection of Texas water resources. For additional information about water quality monitoring methods and procedures, including the differences between professional and volunteer monitoring, please refer to the following sources:

- Texas Stream Volunteer Water Quality Monitoring Manual
- Texas Commission on Environmental Quality (TCEQ) Surface Water Quality Monitoring Procedures

The information that Texas Stream Team citizen scientists collect is covered under a TCEQ approved Quality Assurance Project Plan (QAPP) to ensure that a standard set of methods are used. All data used in watershed data reports are screened by the Texas Stream Team for completeness, precision, and accuracy, in addition to being scrutinized for data quality objectives and with data validation techniques.

The purpose of this report is to provide analysis of data collected by Texas Stream Team citizen scientists. The data presented in this report should be considered in conjunction with other relevant water quality reports in order to provide a holistic view of water quality in this water body. Such sources include, but are not limited to, the following potential resources:

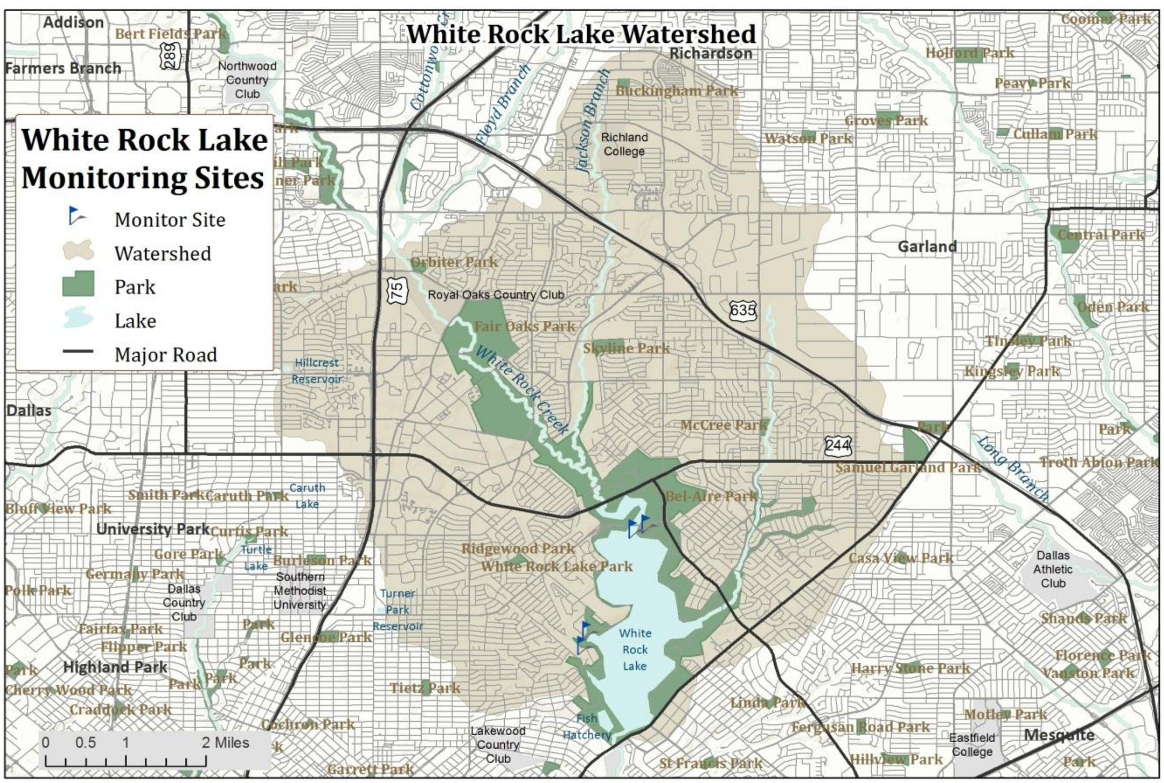
- Texas Surface Water Quality Standards
- Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)
- Texas Clean Rivers Program partner reports, such as Basin Summary Reports and Highlight Reports
- TCEQ Total Maximum Daily Load reports
- TCEQ and Texas State Soil and Water Conservation Board Nonpoint Source Program funded reports, including Watershed Protection Plans

Questions regarding this watershed data report should be directed to the Texas Stream Team at (512) 245-1346.

White Rock Lake Watershed Characterization

Location and Climate

White Rock Lake is located in downtown Dallas and impounds White Rock Creek, which is a tributary of the Elm Fork portion of the Trinity River (Texas Parks and Wildlife "White Rock Lake"). White Rock Creek, and subsequently White Rock Lake, is likely named because of its path across the white Austin Chalk Formation (Bradbury and Van Metre 1997). This watershed is located in the Northern Blackland Prairies Eco region of Texas (Trinity River Authority). The Blackland Prairies region is mostly level and has rapid surface drainage (Native Prairies Association of Texas). This region consists of a lower layer of white chalky limestone, shale, and marlstone that is covered by a dark alkaline clay soil interspersed with sandy loam (Texas Parks and Wildlife "Blackland Prairie Ecological Region"). This type of soil is also called cracking clay due to its tendency to form deep cracks during dry weather conditions, which can damage foundations, highways and other structures (Texas State Historical Association). Water erosion also presents another issue for management of the Blackland Prairies region (Texas State Historical Association).



Date: 8/19/2013 Source: Texas Water Development Board

Figure 1: White Rock Lake Watershed with Texas Stream Team Monitor Sites

Physical Description and Land Use

White Rock Lake has a maximum depth of 20 ft. and a conservation pool elevation of 458 feet above mean sea level (ft. msl) (Texas Parks and Wildlife "White Rock Lake"). White Rock Lake is surrounded by White Rock Park, which hosts several recreational activities including running trails, picnic areas, sailboat marinas, and a dog park (City of Dallas Park and Recreation Department). The park surrounding the lake sees a lot of heavy recreational use of these facilities (City of Dallas Park and Recreation Department). The vegetation in the park and around the lake includes pecan, oak, sweet gum, and cottonwood trees (White Rock Lake Museum). The lake is also home to many different mammals, reptiles, amphibians, birds, and fish. Some of these animals include squirrels, rabbits, possums, salamanders, toads, frogs, turtles, lizards, swans, pelicans, ducks, as well as several types of fish (White Rock Lake Museum). The main species of fish caught in the lake include channel catfish, largemouth bass, and white crappie (Texas Parks and Wildlife "White Rock Lake"). The majority of the area surrounding the lake and park is urban and residential, with some crops and pastures in the northern section (Trinity River Authority).

History

White Rock Lake was constructed in 1911 as a water source for a growing Dallas area. It was constructed with a 12-meter (m) dam that crosses White Rock Creek (Bradbury and Van Metre 1997). The lake was completely filled in 1914 (White Rock Lake Conservancy). By 1929, White Rock Lake was no longer needed as a water source for Dallas and it was transferred over to Dallas Parks and Recreation for management (White Rock Lake Conservancy). The lake is 1,119 acres and is primarily used for recreation and flood control (Texas Commission on Environmental Quality). It also supplies water to cool condensers at a steam-electric generating plant (Texas Water Development Board). Due to the prevalence of soil erosion in the Blackland Prairies region, White Rock Lake is prone to soil erosion and sediment accumulation (Bradbury and Van Metre 1997). Poor agricultural practices in the past, and home and road construction more recently have also contributed to soil erosion and sediment accumulation (Bradbury and Van Metre 1997). In the first 25 years after construction these erosion forces reduced the original area of the lake at a rate of 1% per year (Bradbury and Van Metre 1997). Due to these issues with soil erosion and sediment accumulation, White Rock Lake has been dredged five times in its history (Hungerford and Brock 2004). Most recently it was dredged in 1998 to increase the depth of the upper portion of the lake to 5 feet (Hungerford and Brock 2004).

Water Quality Parameters

Water Temperature

Water temperature influences the physiological processes of aquatic organisms and each species has an optimum temperature for survival. High water temperatures increase oxygen-demand for aquatic communities and can become stressful for fish and aquatic insects. Water temperature variations are most detrimental when they occur rapidly; leaving the aquatic community no time to adjust. Additionally, the ability of water to hold oxygen in solution (solubility) decreases as temperature increases.

Natural sources of warm water are seasonal, as water temperatures tend to increase during summer and decrease in winter in the Northern Hemisphere. Daily (diurnal) water temperature changes occur during normal heating and cooling patterns. Man-made sources of warm water include power plant effluent after it has been used for cooling or hydroelectric plants that release warmer water. Citizen scientist monitoring may not identify fluctuating patterns due to diurnal changes or events such as power plant releases. While citizen scientist data does not show diurnal temperature fluctuations, it may demonstrate the fluctuations over seasons and years.

Dissolved Oxygen

Oxygen is necessary for the survival of organisms like fish and aquatic insects. The amount of oxygen needed for survival and reproduction of aquatic communities varies according to species composition and adaptations to watershed characteristics like stream gradient, habitat, and available stream flow. The TCEQ Water Quality Standards document lists daily minimum Dissolved Oxygen (DO) criteria for specific water bodies and presumes criteria according to flow status (perennial, intermittent with perennial pools, and intermittent), aquatic life attributes, and habitat. These criteria are protective of aquatic life and can be used for general comparison purposes.

The DO concentrations can be influenced by other water quality parameters such as nutrients and temperature. High concentrations of nutrients can lead to excessive surface vegetation growth and algae, which may starve subsurface vegetation of sunlight, and therefore limit the amount of DO in a water body due to reduced photosynthesis. This process, known as eutrophication, is enhanced when the subsurface vegetation and algae die and oxygen is consumed by bacteria during decomposition. Low DO levels may also result from high groundwater inflows due to minimal groundwater aeration, high temperatures that reduce oxygen solubility, or water releases from deeper portions of dams where DO stratification occurs. Supersaturation typically only occurs underneath waterfalls or dams with water flowing over the top.

Specific Conductivity and Total Dissolved Solids

Specific conductivity is a measure of the ability of a body of water to conduct electricity. It is measured in micro Siemens per cubic centimeter ($\mu S/cm^3$). A body of water is more conductive if it has more dissolved solids such as nutrients and salts, which indicates poor water quality if they are overly abundant. High concentrations of nutrients can lower the level of DO, leading to eutrophication. High concentrations of salt can inhibit water absorption and limit root growth for vegetation, leading to an abundance of more drought tolerant plants, and can cause dehydration of fish and amphibians. Sources of Total Dissolved Solids (TDS) can include agricultural runoff, domestic runoff, or discharges from wastewater treatment plants. For this report, specific conductivity values have been converted to TDS using a conversion factor of 0.65 and are reported as mg/L.

pH

The pH scale measures the concentration of hydrogen ions on a range of 0 to 14 and is reported in standard units (su). The pH of water can provide useful information regarding acidity or alkalinity. The range is logarithmic; therefore, every 1 unit change is representative of a 10-fold increase or decrease in acidity. Acidic sources, indicated by a low pH level, can include acid rain and runoff from acid-laden soils. Acid rain is mostly caused by coal power plants with minimal contributions from the burning of other fossil fuels and other natural processes, such as volcanic emissions. Soil-acidity can be caused by excessive rainfall leaching alkaline materials out of soils, acidic parent material, crop decomposition creating hydrogen ions, or high-yielding fields that have drained the soil of all alkalinity. Sources of high pH (alkaline) include geologic composition, as in the case of limestone increasing alkalinity and the dissolving of carbon dioxide in water. Carbon dioxide is water soluble, and, as it dissolves it forms carbonic acid. The most suitable pH range for healthy organisms is between 6.5 and 9.

Secchi disk and total depth

The Secchi disk is used to determine the clarity of the water, a condition known as turbidity. The disk is lowered into the water until it is no longer visible, and the depth is recorded. Highly turbid waters pose a risk to wildlife by clogging the gills of fish, reducing visibility, and carrying contaminants. Reduced visibility can harm predatory fish or birds that depend on good visibility to find their prey. Turbid waters allow very little light to penetrate deep into the water, which in turn decreases the density of phytoplankton, algae, and other aquatic plants. This reduces the DO in the water due to reduced photosynthesis. Contaminants are most commonly transported in sediment rather than in the water. Turbid waters can results from sediment washing away from construction sites, erosion of farms, or mining operations. Average Secchi disk transparency (a.k.a. Secchi depth) readings that are less than the total depth readings indicate turbid water. Readings that are equal to total depth indicate clear water. Low total depth observations have a potential to concentrate contaminants.

Texas Surface Water Quality Standards

The Texas Surface Water Quality Standards establish explicit goals for the quality of streams, rivers, lakes, and bays throughout the state. The standards are developed to maintain the quality of surface waters in Texas so that it supports public health and protects aquatic life, consistent with the sustainable economic development of the state.

Water quality standards identify appropriate uses for the state's surface waters, including aquatic life, recreation, and sources of public water supply (or drinking water). The criteria for evaluating support of those uses include DO, temperature, pH, TDS, toxic substances, and bacteria.

The Texas Surface Water Quality Standards also contain narrative criteria (verbal descriptions) that apply to all waters of the state and are used to evaluate support of applicable uses. Narrative criteria include general descriptions, such as the existence of excessive aquatic plant growth, foaming of surface waters, taste- and odor producing substances, sediment build-up, and toxic materials. Narrative criteria are evaluated by using screening levels, if they are available, as well as other information, including water quality studies, existence of fish kills or contaminant spills, photographic evidence, and local knowledge. Screening levels serve as a reference point to indicate when water quality parameters may be approaching levels of concern.

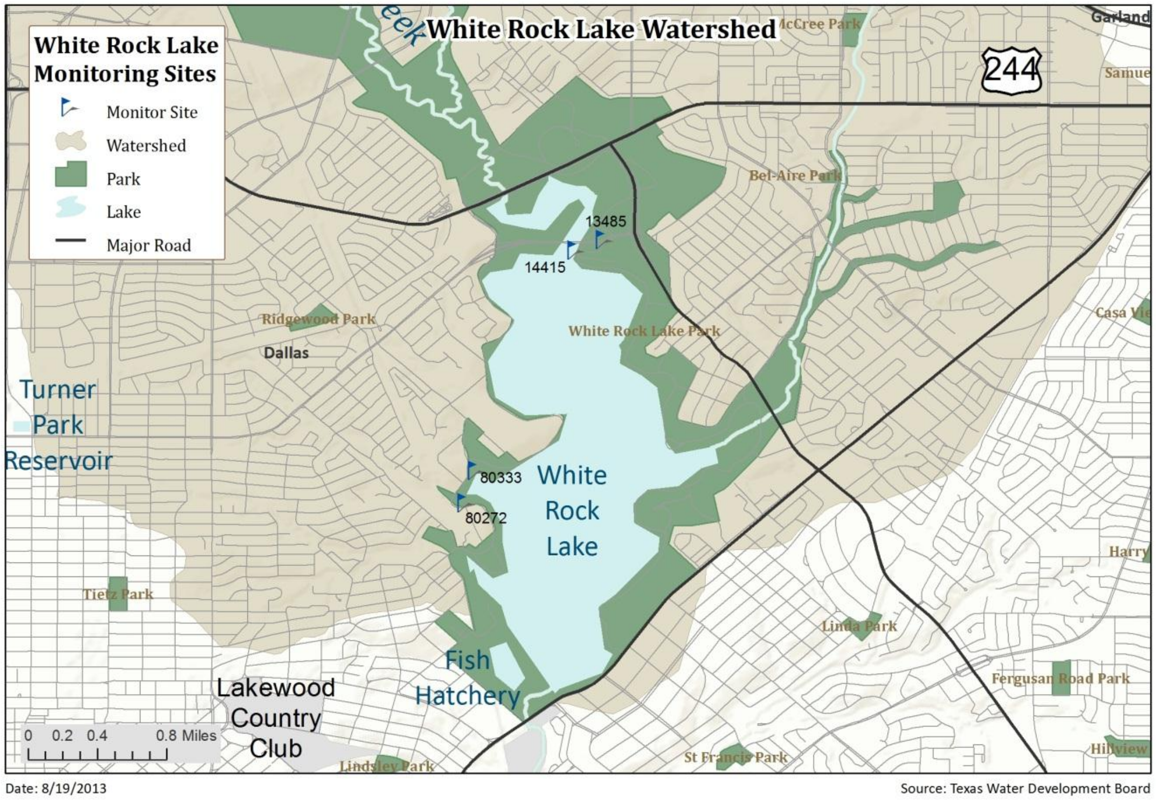


Figure 2: White Rock Lake Monitor Sites

Data Analysis Methodologies

Data Collection

The field sampling procedures are documented in Texas Stream Team Water Quality Monitoring Manual and its appendices, or the TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1 (August 2012). Additionally, all data collection adheres to Texas Stream Team's approved Quality Assurance Project Plan (QAPP).

Table 1: Sample Storage, Preservation, and Handling Requirements

Parameter	Matrix	Container	Sample Volume	Preservation	Holding Time
E. coli	Water	Sterile Polystyrene (SPS)	100	Refrigerate at 4ºC*	6 hours
Nitrate/Nitrogen	Water	Plastic Test Tube	10 mL	Refrigerate at 4ºC*	48 hours
Orthophosphate/Phosphorous	Water	Glass Mixing Bottle	25 mL	Refrigerate at 4ºC*	48 hours
Chemical Turbidity	water	Plastic Turbidity Column	50 mL	Refrigerate at 4ºC*	48 hours

*Preservation performed within 15 minutes of collection.

Processes to Prevent Contamination

Procedures documented in Texas Stream Team Water Quality Monitoring Manual and its appendices, or the TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1 (August 2012) outline the necessary steps to prevent contamination of samples, including direct collection into sample containers, when possible. Field Quality Control (QC) samples are collected to verify that contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on the field data sheet. For all field sampling events the following items are recorded: station ID, location, sampling time, date, and depth, sample collector's name/signature, group identification number, conductivity meter calibration information, and reagent expiration dates are checked and recorded if expired.

For all *E. coli* sampling events, station ID, location, sampling time, date, depth, sample collector's name/signature, group identification number, incubation temperature, incubation duration, *E. coli* colony counts, dilution aliquot, field blanks, and media expiration dates are checked and recorded if expired. Values for all measured parameters are recorded. If reagents or media are expired, it is noted and communicated to Texas Stream Team.

Sampling is still encouraged with expired reagents and bacteria media; however, the corresponding values will be flagged in the database. Detailed observational data are recorded, including water appearance, weather, field observations (biological activity and stream uses), algae cover, unusual odors, days since last significant rainfall, and flow severity.

Comments related to field measurements, number of participants, total time spent sampling, and total round-trip distance traveled to the sampling site are also recorded for grant and administrative purposes.

Data Entry and Quality Assurance

Data Entry

The citizen monitors collect field data and report the measurement results on Texas Stream Team approved physical or electronic datasheet. The physical data sheet is submitted to the Texas Stream Team and local partner, if applicable. The electronic datasheet is accessible in the online DataViewer and, upon submission and verification, is uploaded directly to the Texas Stream Team Database.

Quality Assurance & Quality Control

All data are reviewed to ensure that they are representative of the samples analyzed and locations where measurements were made, and that the data and associated quality control data conform to specified monitoring procedures and project specifications. The respective field, data management, and Quality Assurance Officer (QAO) data verification responsibilities are listed by task in the Section D1 of the QAPP, available on the Texas Stream Team website.

Data review and verification is performed using a data management checklist and self-assessments, as appropriate to the project task, followed by automated database functions that will validate data as the information is entered into the database. The data are verified and evaluated against project specifications and are checked for errors, especially errors in transcription, calculations, and data input. Potential errors are identified by examination of documentation and by manual and computer-assisted examination of corollary or unreasonable data. Issues that can be corrected are corrected and documented. If there are errors in the calibration log, expired reagents used to generate the sampling data, or any other deviations from the field or *E. coli* data review checklists, the corresponding data is flagged in the database.

When the QAO receives the physical data sheets, they are validated using the data validation checklist, and then entered into the online database. Any errors are noted in an error log and the errors are flagged in the Texas Stream Team database. When a monitor enters data electronically, the system will automatically flag data outside of the data limits and the monitor will be prompted to correct the mistake or the error will be logged in the database records. The certified QAO will further review any flagged errors before selecting to validate the data. After validation the data will be formally entered into the database. Once entered, the data can be accessible through the online DataViewer.

Errors, which may compromise the program's ability to fulfill the completeness criteria prescribed in the QAPP, will be reported to the Texas Stream Team Program Manager. If repeated errors occur, the monitor and/or the group leader will be notified via e-mail or telephone.

Data Analysis Methods

Data are compared to state standards and screening levels, as defined in the Surface Water Quality Monitoring Procedures, to provide readers with a reference point for amounts/levels of parameters that may be of concern. The assessment performed by TCEQ and/or designation of impairment involves more complicated monitoring methods and oversight than used by volunteers and staff in this report. The citizen water quality monitoring data are not used in the assessments mentioned above, but are intended to inform stakeholders about general characteristics and assist professionals in identifying areas of potential concern.

Standards & Exceedances

The TCEQ determines a water body to be impaired if more than 10% of samples, provided by professional monitoring, from the last seven years, exceed the standard for each parameter, except for *E. coli* bacteria. When the observed sample value does not meet the standard, it is referred to as an exceedance. At least ten samples from the last seven years must be collected over at least two years with the same reasonable amount of time between samples for a data set to be considered adequate. The 2010 Texas Surface Water Quality Standards report was used to calculate the exceedances for the White Rock Lake Watershed, as seen below in Table 2.

Table 2: Summary of Surface Water Quality Standards for White Rock Lake Watershed

Parameter	2010 Texas Surface Water Quality Standards for White Rock Lake	
Water Temperature (°C)	32.7° C (Maximum)	
Total Dissolved Solids (mg/L)	400 mg/L (Maximum)	
Dissolved Oxygen (mg/L)	5 mg/L (Minimum)	
pH	6.5-9.0 (Range)	
E. coli (CFU)	399 CFU/100mL	Single Sample
	126 CFU/100mL	Geometric Mean

Methods of Analysis

All data collected from White Rock Lake and its tributaries were exported from the Texas Stream Team database and were then grouped by site. Data was reviewed and, for the sake of data analysis, only one sampling event per month, per site was selected for the entire study duration. If more than one sampling event occurred per month, per site, the most complete, correct, and representative sampling event was selected.

Once compiled, data was sorted and graphed in Microsoft Excel 2010 using standard methods. Statistically significant trends were added to Excel to be graphed. The cut off for statistical significance was set to a p-value of ≤ 0.05. A p-value of ≤ 0.05 means that the probability that the observed data matches the actual conditions found in nature is 95%. As the p-value decreases, the confidence that it matches actual conditions in nature increases.

For this report, specific conductivity measurements, gathered by volunteers, were converted to TDS using the TCEQ-recommended conversion formula of specific conductivity 0.65. This conversion was made so that volunteer gathered data could be more readily compared to state gathered data.

White Rock Lake Watershed Data Analysis

White Rock Lake Watershed Maps

Numerous maps were prepared to show spatial variation of the parameters. The parameters mapped include DO, pH, and TDS. There is also a reference map showing the locations of all active. For added reference, cities and major highways were included. All shapefiles were downloaded from reliable federal, state, and local agencies.

White Rock Lake Watershed Trends over Time

Sampling Trends over Time

Sampling along the White Rock Lake began in February 1993 and 95% of the sampling events occurred during the years 2005-2013. The highest percent of samples (11%) were collected in 2005 and 2012. Sampling occurred throughout the year, with a greater number of sampling occurring in February and March and a lower number of sampling occurring in August and September. A majority of the sampling events took place in morning (08:00 – 09:00), with no samplings occurring in after 17:00. Samples were collected by from local groups: For the Love of the Lake and Aquatic Alliance. Monitors completed 19,884 minutes of sampling and traveled 2,878.9 miles to collect the data for this report. The average sampling event required 83.45 minutes and took 11.90 miles of travel to complete.

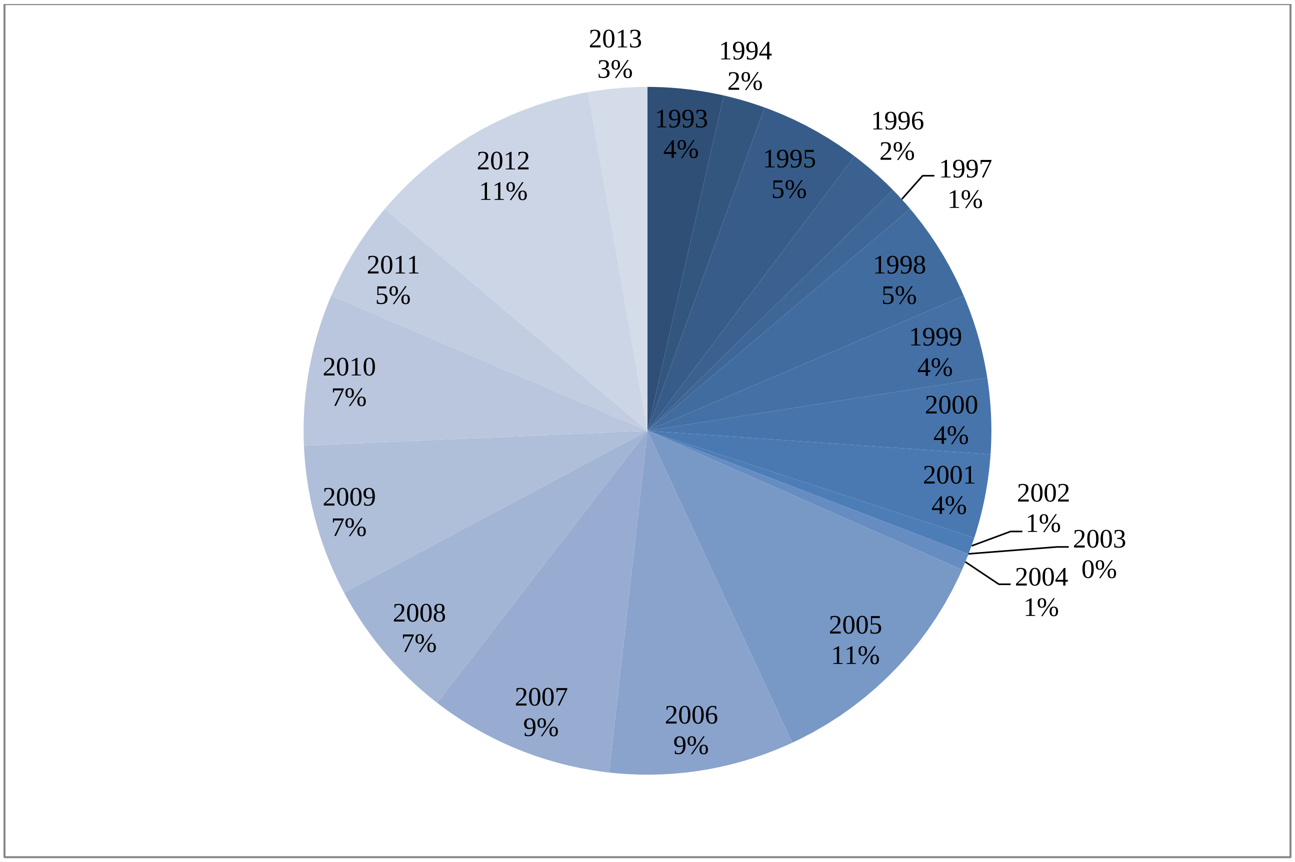


Figure 3: Samples by Year along the White Rock Lake

Descriptive Parameters over Time

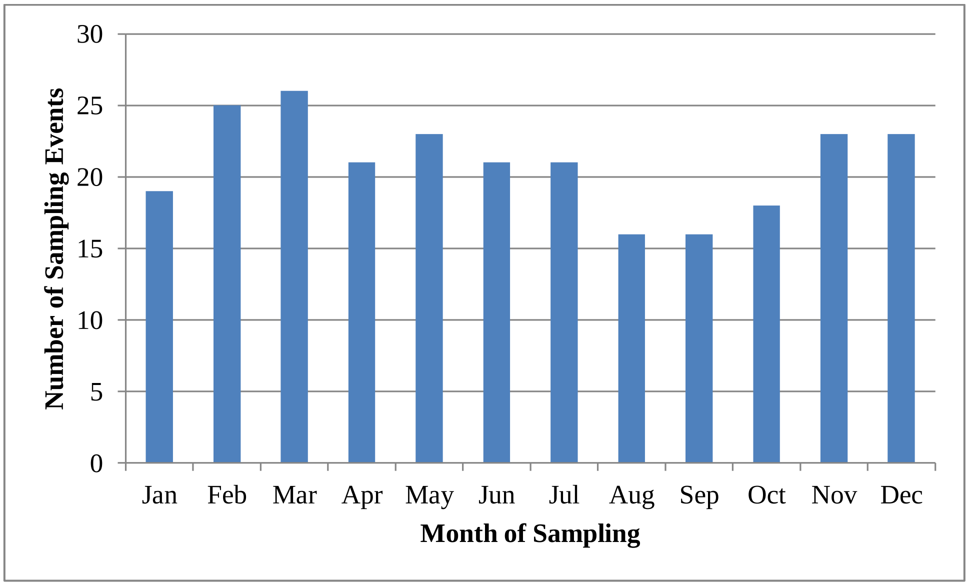


Figure 4: Breakdown of Sampling by Month for White Rock Lake

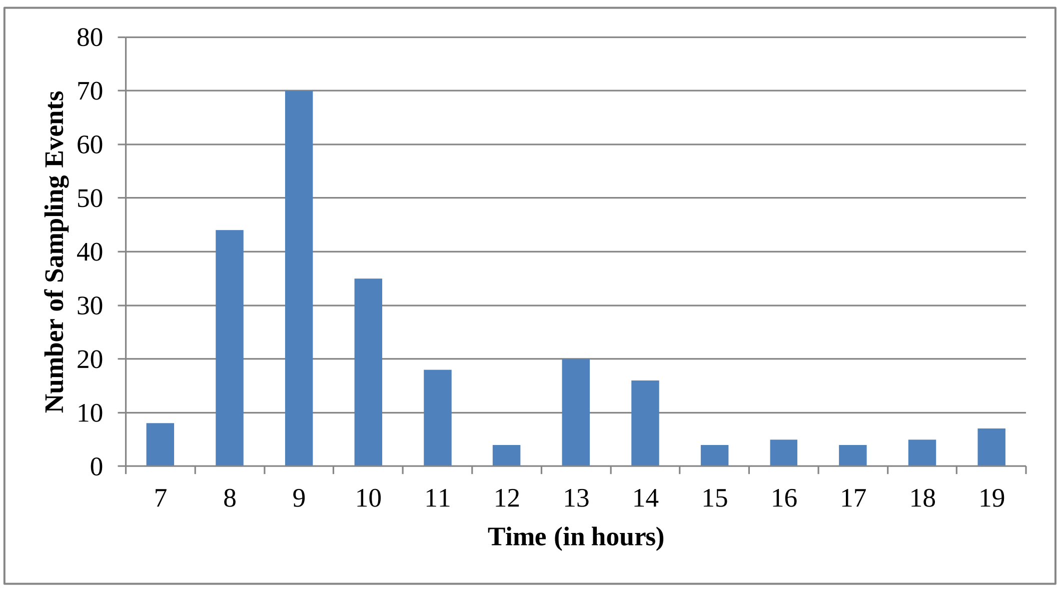


Figure 5: Breakdown of Time of Sampling on White Rock Lake

Table 3: Descriptive parameters for all sites in the White Rock Lake Watershed

White Rock Lake Watershed Feb 1993 – Apr 2013				
Parameter	**% Complete**	**Mean ± Standard Deviation**	**Max.**	**Min.**
Total Dissolved Solids (mg/L)	95%	320.11 ± 100.35	585	97.5
Water Temperature (°C)	97%	18.31 ± 7.63	34.2	2.5
Dissolved Oxygen (mg/L)	85%	7.06 ± 2.51	12.3	1.8
pH	97%	7.44 ± 0.49	9	4.5
Secchi disk transparency (m)	42%	0.15 ± 0.36	3	0
Depth (m)	90%	0.48 ± 0.57	3	0

*There were a total of 237 sampling events from Feb 1993 – April 2013. Mean calculated in Microsoft Excel.

Trend Analysis over Time

Air and water temperature

A total of 237 air temperatures values and 231 water temperature values were collected within the White Rock Lake Watershed between 1993 and 2013. Water temperature readings never exceeded the TCEQ water suggested optimal temperature of 32.2°C during the summer months of 1998, 1999, 2000, or 2001. Air temperature reached a high of 36ºC in May 2005. Regression analysis (p=0.530) shows that variation in water temperature was not significantly affected by time, with water temperature showing no change over time.

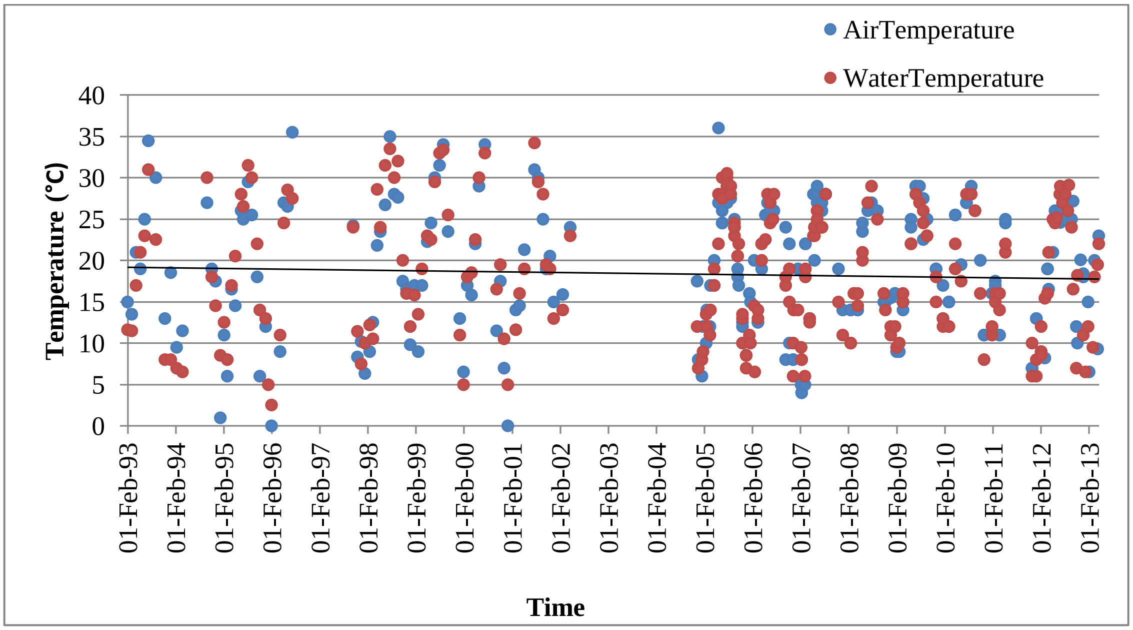


Figure 6: Air and water temperature over time at all sites within the White Rock Lake Watershed

Total Dissolved Solids

Citizen scientists collected 226 TDS measurements within the watershed. The TDS was measured at 95% of the site. The TDS results were significantly correlated to time, indicated with a regression analysis p-value of 0.000 and an F-value of 15.74. While the results showed a significant increase in TDS over time, the low F-value and low R^2 value (0.06) suggest that a large degree of variation exists and a linear regression may not be the best fit for this data and analysis. Total Dissolved Solids values are typically highest with low or normal flow; however, in this case TDS were lower at low flow (average = 288.51 mg/L) than normal flow (average = 357.19mg/L) and lowest during high or flood stage flow (average = 237.478 mg/L).

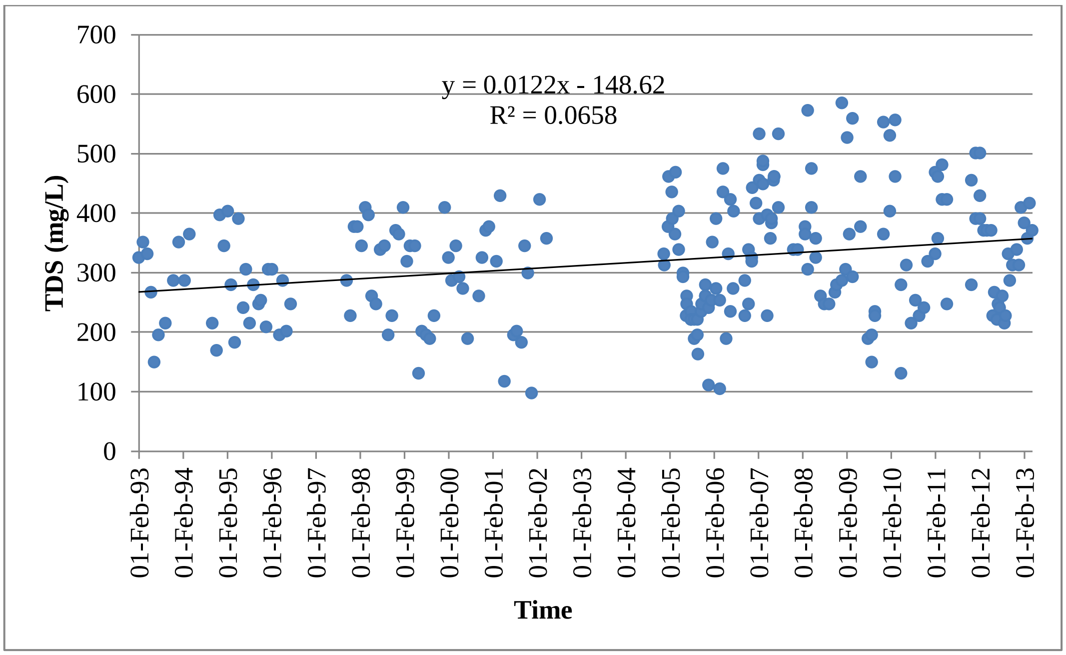


Figure 7: Total Dissolved Solids over time at all sites within the White Rock Lake Watershed

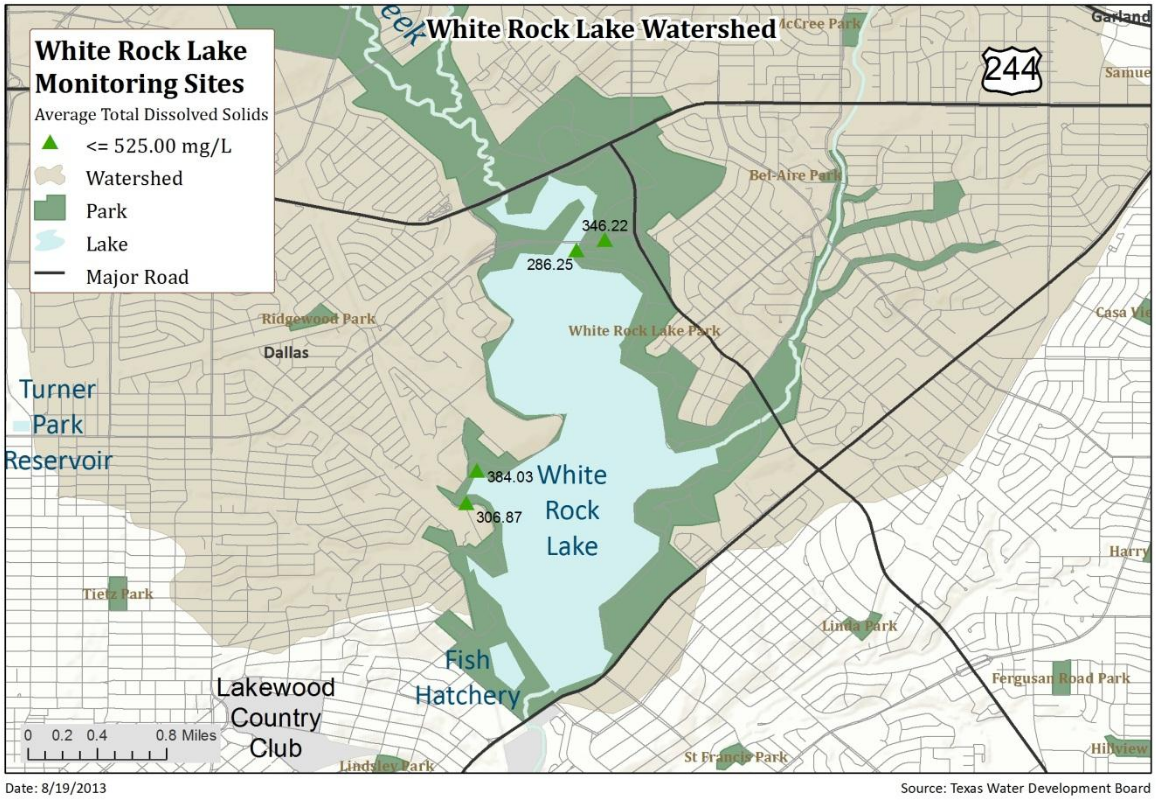


Figure 8: Average Total Dissolved Solids

Table 4: Average Total Dissolved Solids (mg/L) by flow level in the White Rock Lake Watershed

Flow Level	Average	Standard Deviation
No Flow	288.51	78.58
Low Flow	317.35	94.46
Normal Flow	357.19	97.54
High Flow or Flood	237.47	130.99

Dissolved Oxygen

Citizen scientist monitors collected a total of 202 DO samples within the White Rock Lake Watershed. The DO values were significantly related to time (p=0.000; F=48.10; r^2=0.19). As a reminder, DO is normally affected by water temperature, rate of flow, season, and time of day that sampling occurred. As flow increased and waters were mixed, DO levels rose. The DO was also affected by water temperature, which produces seasonal DO patterns, which are visible in the Site by Site DO figures. Cold water holds more oxygen than warm water; as a result, it was not surprising that DO was highest in the winter months. Additionally, plants and algae add a substantial amount of DO via photosynthesis, resulting in the diurnal trends of high DO levels observed during the daylight hours, peaking in the late afternoon, and decreasing after dark. This pattern is shown in Table 7.

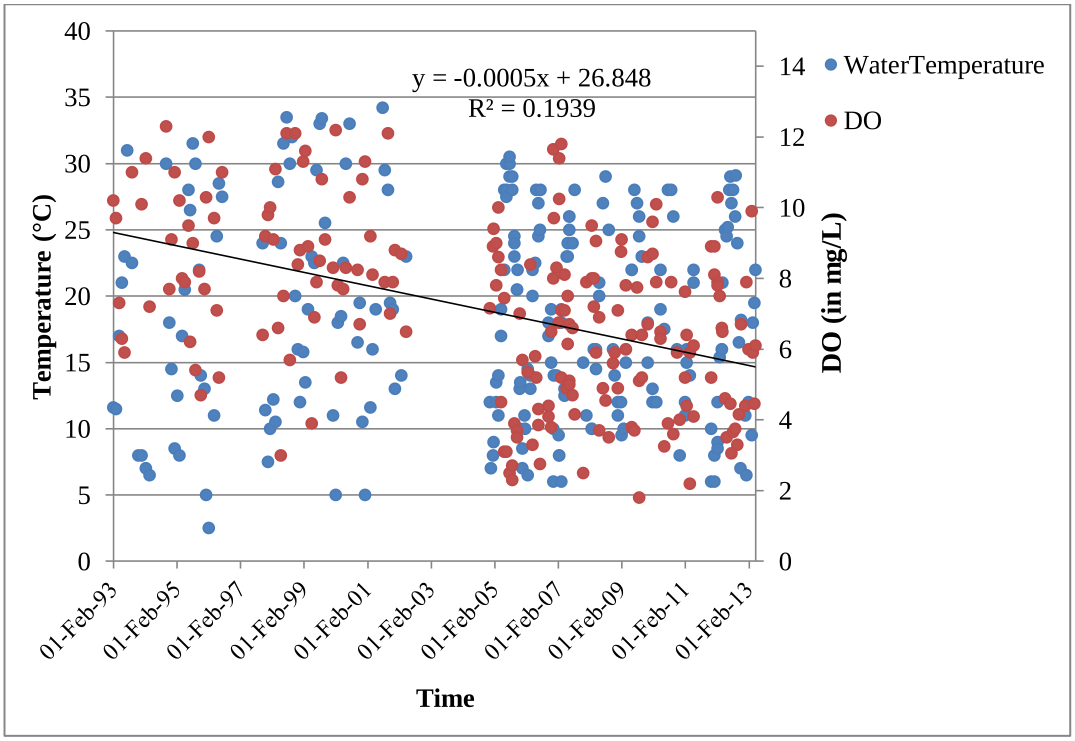


Figure 9: Dissolved Oxygen at all sites within the White Rock Lake Watershed

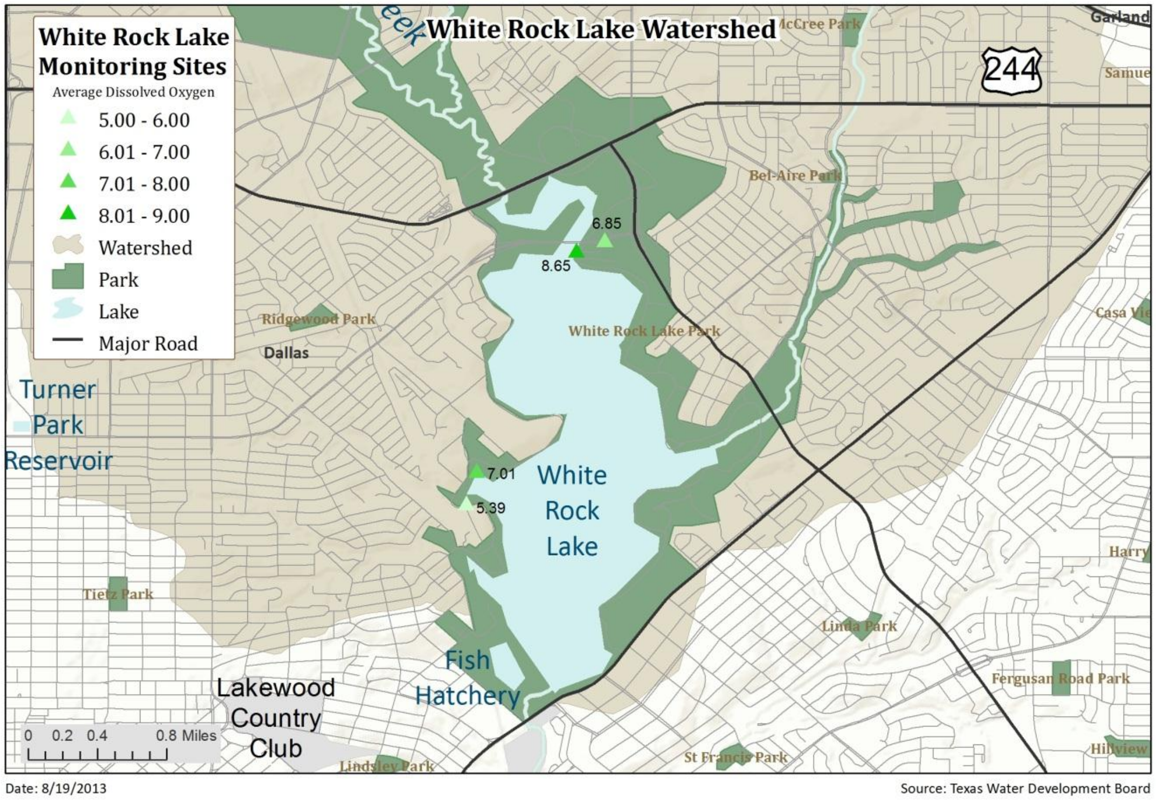


Figure 10: Average Dissolved Oxygen

Table 5: Average Dissolved Oxygen at five different flow levels along the White Rock Lake

Flow Level	Average DO	Standard Deviation
No Flow	5.93	2.74
Low Flow	7.30	2.64
Normal Flow	7.49	2.25
High	7.49	1.47
Flood	8.21	1.10

Table 6: Average Dissolved Oxygen values by Sampling Time within the White Rock Lake Watershed

Time	Average DO	Standard Deviation
7:00	7.15	2.49
8:00	5.67	1.96
9:00	6.05	2.26
10:00	4.73	2.02
11:00	8.19	1.94
12:00	8.00	2.64
13:00	8.91	1.58
14:00	8.23	2.51
15:00	7.34	3.47
16:00	9.2	1.73
17:00-22:00	7.88	2.18

pH

The mean pH was 7.44. The pH was sampled 231 times for White Rock Lake, with some individual values exceeding the range of 6.5 to 9, which is the optimal range for aquatic life; the range was exceeded in winter of 2005 and spring of 2008. Regression analysis (p=0.000) showed that pH was significantly affected by time, with pH decreasing over time at White Rock Lake. Additionally, a high F-value (109.86) and a reasonable r^2 value (0.32) suggest that there is only limited variation in the results and that this linear model explains the relationship well.

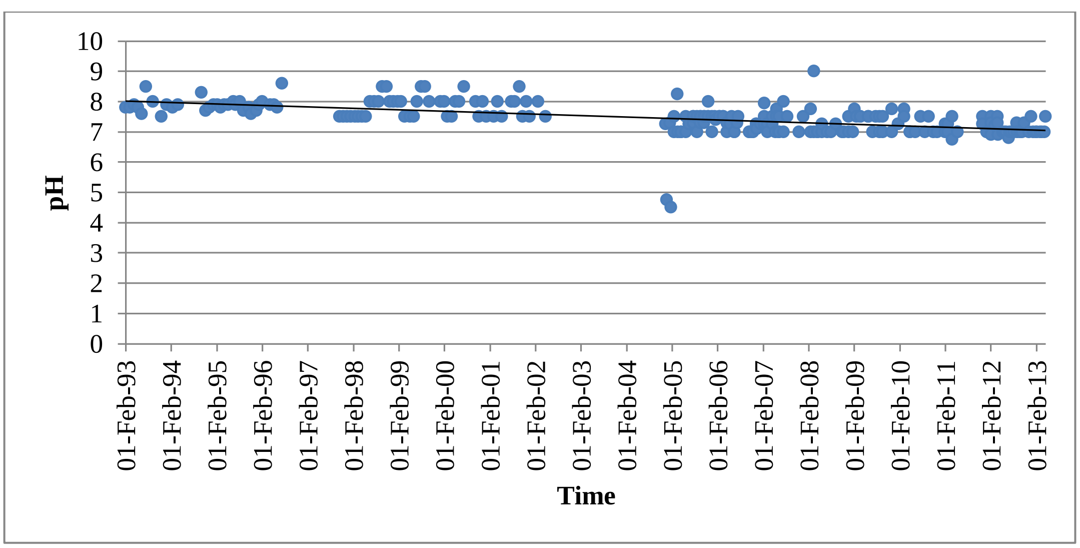


Figure 11: Changes in pH over time at all sites within the White Rock Lake Watershed

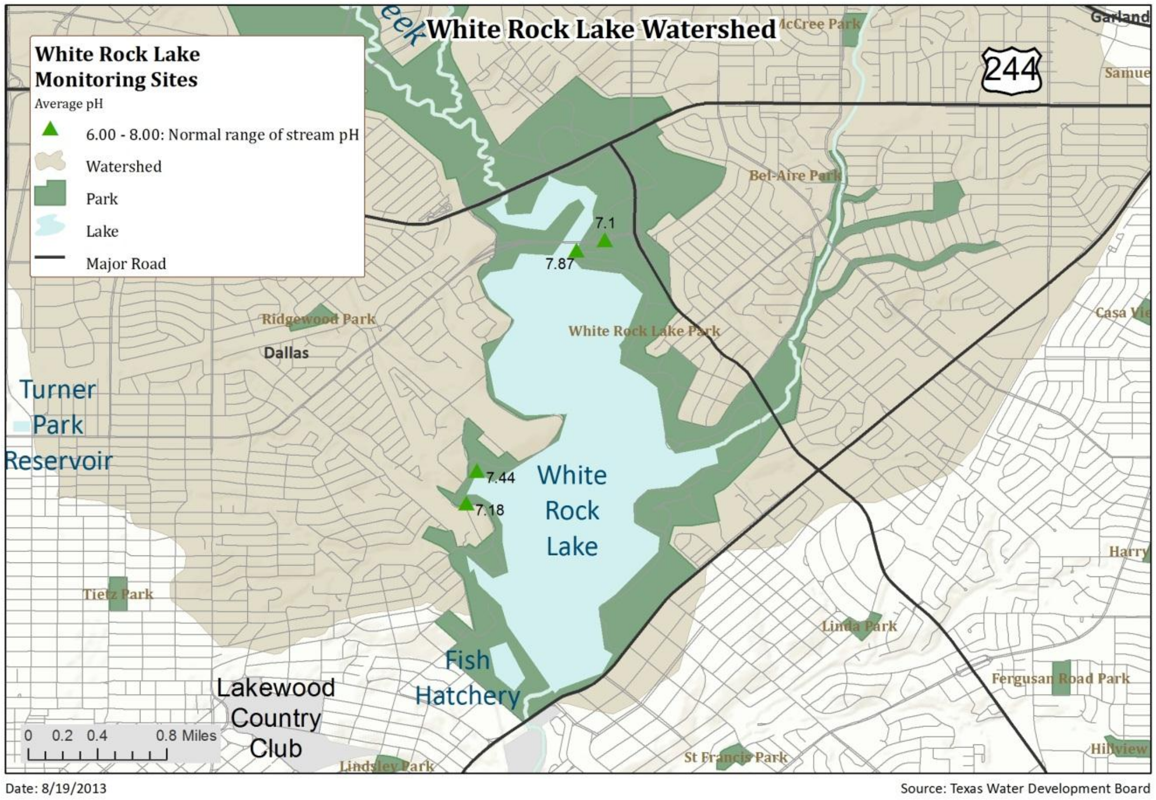


Figure 12: Average pH

Secchi disk and total depth

Total depth was measured 213 times and Secchi disk values were collected 100 times within the watershed during the sampling period. Secchi disk values (p=0.567) were not significantly affected by time. Secchi disk values were consistently below total depth over time, suggesting that water clarity was limited; however, limited Secchi disk sampling made the any accurate analysis difficult.

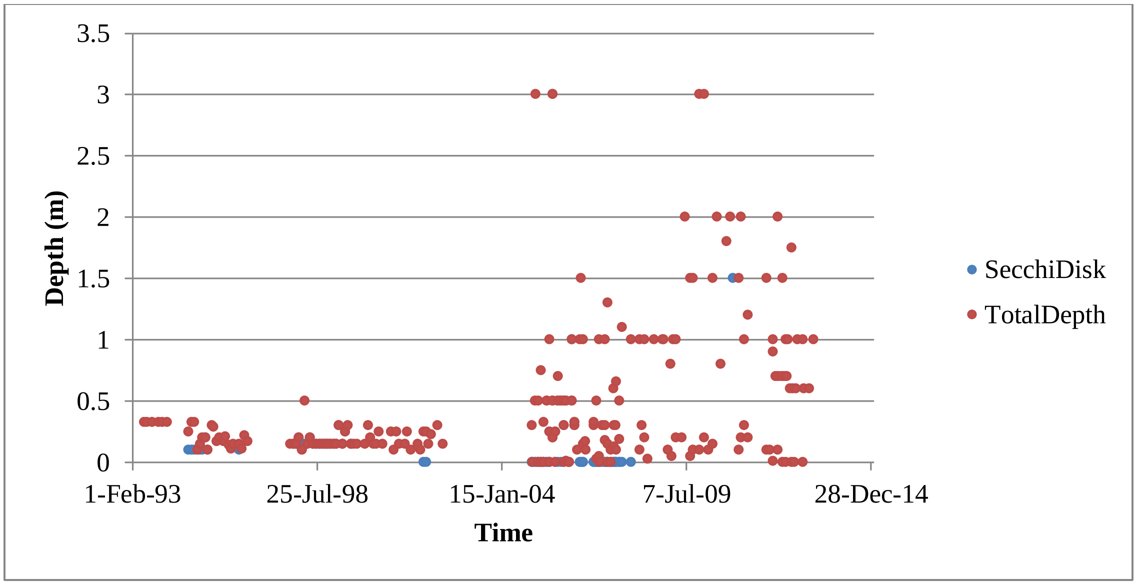


Figure 13: Total depth and Secchi disk over time within the White Rock Lake

Field Observations

Because of the length of time that sampling has been occurring in this watershed, some parameters were only collected in the later years. Weather and flow conditions were collected the whole sampling period, while algae cover, water clarity, and water surface observations were not required or collected until 1998. Percentages were calculated from the total number of observations collected for each parameter.

At sites on the around White Rock Lake, monitors noted that for the majority of sampling events no algae was present (71%), the water had no water odor (82%), a clear water surface was reported (88%), and the water was clear in color (64%). Flow was noted to be no flow for 28% of the sampling events, low flow for 29% of sampling events, and normal flow for 35% of the sampling events. Water conditions were noted to be calm during 51% of the sampling events and rippled during 41% of the sampling events. Weather was clear during 53% of the sampling events and cloudy for 27% of the sampling events, although monitors noted overcast conditions 18% of the time and rain 2% time.

White Rock Lake Watershed Site by Site Analysis

The following sections will provide a brief summarization of analysis, by site. The average minimum and maximum values recorded in the watershed. These values are reported in order to provide a quick overview of the watershed. The TDS, DO, and pH values are presented as an average, plus or minus the standard deviation from the average. Please see Table 7, on the following page, for a quick overview of the average results.

Total Dissolved Solids is an important indicator of turbidity and specific conductivity. The higher the TDS measurement, the more conductive the water is. A high TDS result can indicate increased nutrients present in the water. Site 80333, Rush Creek at Fisher/Branchfield, had the highest overall average for TDS, with a result of 384.03 ± 142.92 mg/L. Site 14415, White Rock Lake at Mockingbird Lane, had the lowest average TDS, with a result of 286.25 ± 80.65 mg/L.

The DO measurement can help to understand the overall health of the aquatic community. If there is a large influx of nutrients into the water body than there will be an increase in surface vegetation growth, which can then reduce photosynthesis in the subsurface, thus decreasing the level of DO. Low DO can be dangerous for aquatic inhabitants, which rely upon the dissolved oxygen to breathe. The DO levels can also be impacted by temperature; a high temperature can limit the amount of oxygen solubility, which can also lead to a low DO measurement. Site 80272, Williamson Creek at W, Lawther Bridge, had the lowest average DO reading, with a result of 5.41 ± 1.98 mg/L. Site 14415, White Rock Lake at Mockingbird Lane, had the highest average DO reading, with a result of 8.65 ± 2.14 mg/L.

The pH levels are an important indicator for the overall health of the watershed as well. Aquatic inhabitants typically require a pH range between 6.5 and 9 for the most optimum environment. Anything below 6.5 or above 9 can negatively impact reproduction or can result in fish kills. There were no reported pH levels outside of this widely accepted range. Site 14415, White Rock Lake at Mockingbird Lane, had the highest average pH level, with a result of 7.87 ± 0.30. Site 13485, Mockingbird Lake at White Rock Lake, had the lowest average pH level, with a result of 7.09 ± 0.66.

Please see Table 7 for a summary of average results at all sites. It is important to note that there was variation in the number of times each site was tested, the time of day at which each site was tested, and the time of month the sampling occurred. While this is a quick overview of the results, it is important to keep in mind that there is natural diurnal and seasonal variation in these water quality parameters. Texas Stream Team citizen scientist data is not used by the state to assess whether water bodies are meeting the designated surface water quality standards.

Table 7: Average Values for all White Rock Lake Sites

Site Number	TDS (mg/L)	DO (mg/L)	pH
14415	286.25 ± 80.65 (min.)	8.65 ± 2.14 (max.)	7.87 ± 0.30 (max.)
13485	348.19 ± 89.27	6.91 ± 2.19	7.09 ± 0.66 (min.)
80333	384.03 ± 142.92 (max.)	7.01 ± 2.37	7.44 ± 0.37
80272	309.0 ± 79.78	5.41 ± 1.98 (min.)	7.1 ± 0.23

Site 14415 – White Rock Lake at Mockingbird Lane near the West Bank on South Side of Road

Site Description

This site is located on the far northern section of the lake, where White Rock Creek first enters the lake. The site is located on the White Rock Creek Trail, where it passes next to the Mockingbird Lane overpass and is surrounded a treed riparian zone near a dog park. This site is surrounded by city of Dallas suburban area and the White Rock Creek Greenbelt to the north. This site had the highest average DO and pH readings and the lowest TDS, suggesting relatively high water quality.

Sampling Information

This is an inactive site, sampled sporadically from 02/01/1993 to 04/21/2002 by James and Rosemary Costello and Norman Sears, of For the Love of the Lake. Sampling has occurred on average 7.8 times a year, typically with no set sampling time during the month or day. Since 2/1/1993, monitors spent a total of 39 hours and 58 minutes and traveled 122.4 miles while sampling this site, with an average of 36.33 minutes spent sampling and an average of 1.75 miles traveled during each sampling event.

Table 8: Descriptive parameters for Site 14415

Parameter	% Complete	Mean ± Standard Deviation	Max.	Min.
Total Dissolved Solids (mg/L)	100%	286.25 ± 80.65	429	97.5
Water Temperature (°C)	100%	19.16 ± 8.65	34.2	2.5
Dissolved Oxygen (mg/L)	92.3%	8.65 ± 2.14	12.3	3
pH	100%	7.87 ± 0.30	8.6	7.5
Secchi Disk Transparency (m)	39.7%	0.14 ± 0.06	0.3	0.0
Depth (m)	94.6%	0.20 ± 0.07	0.5	0.10

*Site was sampled 78 times between 2/1/1993 and 4/21/2002.

Air and water temperature

Water and air temperatures were sampled 78 times at Site 14415. Temperatures fluctuated in an expected seasonal pattern, with maximum temperatures in the summer of 1996 and 1998. Water temperature increased over time; however, this increase was not statistically significant (p=0.146). Water reached temperatures above the Texas Surface Water Quality suggested temperature of 32.2ºC during each summer in the sampling period.

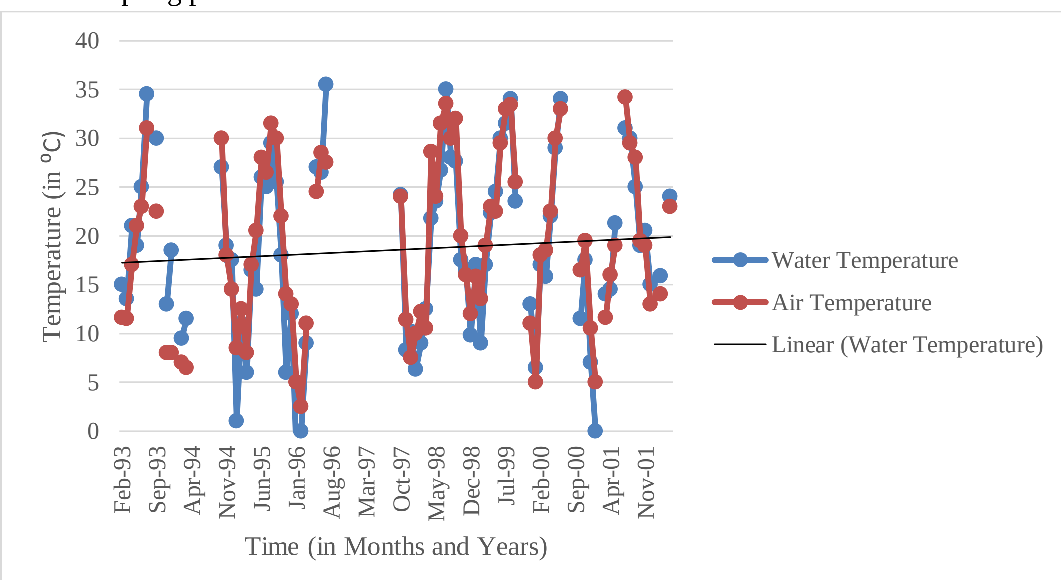


Figure 14: Water and Air Temperature at Site 14415

Total Dissolved Solids

Citizen scientists sampled TDS at this site 78 times and noted that the TDS values ranged between 150 mg/L and 450 mg/L. The TDS variation was not explained by any noticeable pattern and did not appear to change over time at this site. This site had the lowest average TDS of all the sites, with a result of 286.25 ± 80.65 mg/L.

Dissolved Oxygen

Dissolved oxygen followed a normal seasonal trend, rising in the winter when the water temperature was low and decreasing in the summer when the water temperature was high. However, DO results remained near the average of 8.65 mg/L. This site had the highest average DO of all the sites, with a result of 8.65 ± 2.14 mg/L.

pH

The pH values at Site 14415 show an average of 7.86 and no statistically significant trend was seen over time. This site was also noted to have the highest average pH reading of all the sites, with a slightly alkaline result of 7.87 ± 0.30.

Secchi disk and total depth

Secchi disk depth and total depth were directly related during the sampling events, except during October – May 1995 and October 2001. These results suggest that, other than the expectations seasonal changes, the water had a high level of clarity over time at this site.

Field Observations

At Site 14415, field observations recorded during sampling events indicated that water primarily had a clear water surface (85%) with ripples (67%), was clear (79%), and colorless (68%) during all of the sampling events. Water levels were noted to be either normal (45%) or low (32%), and either had no odor (49%) or a fishy smell (49%) of the time during sampling events. Algae cover at the site during sampling events was noted to be either common (36%), absent (28%) or rare (36%). Weather was noted to be clear during 50% of the sampling events, cloudy during 23% of the sampling events, overcast during 19% of the sampling events and raining during 5% of the sampling events. Rainfall events of 8.3 inches occurred near sampling in the January 1998 and 5 inches of rain during June of 1995. Monitors commented seeing the following birds: pigeons, coot, ducks, geese, white egrets, mallards, black swan, cormorants, pelicans, seagulls, crows, Canadian geese, and ruddy ducks. Kayakers/canoers, fisherman and bikers were also regularly noted at the site.

Site 13485 – Mockingbird Lake at White Rock Lake

Site Description

This site is located on the far northern part of the lake, where White Rock Creek first enters the lake. The site is located on the east bank of the lake near the White Rock Paddling Co. dock parking lot. The area has little natural riparian zone and is part of a manicured park.

Sampling Information

This is an active site, sampled sporadically from 12/18/2004 to 04/08/2013 by G. Edward Snyder, Jim Shouse, Shelley Kofler, Mike Swope, Janet Smith, Frank Korman, Ursula Barhill, and Maria Richards of For the Love of the Lake. Sampling has occurred on average 6.8 times a year, with no set time during the month or day. No samples were taken from February 2008 to January 2012. Since 12/18/2004, monitors have spent a total of 62 hours and 40 minutes sampling and have traveled 300 miles to sample this site, with an average of 96.41 minutes spent sampling and 7.69 miles traveled during each sampling event.

Table 9: Descriptive parameters for Site 13485

Parameter	% Complete	Mean ± Standard Deviation	Max.	Min.
Total Dissolved Solids (mg/L)	95%	348.19 ± 89.27	533	214.5
Water Temperature (°C)	95%	19.11 ± 7.6	30.5	6
Dissolved Oxygen (mg/L)	67%	6.91 ± 2.19	11.8	3.65
pH	100%	7.09 ± 0.66	8.25	4.5
Secchi Disk Transparency (m)	56%	0.13 ± 0.64	3	0
Depth (m)	90%	0.58 ± 0.76	3	0

*Site was sampled 39 times between 12/18/2004 and 4/8/2013.

Air and water temperature

Water and air temperatures were sampled 37 times at site 13485. Temperatures fluctuated in an expected seasonal pattern, with maximum water temperatures in June 2005 and maximum air temperature in May 2005. No other pattern could be determined with water temperature. Water never reached temperatures above the Texas Surface Water Quality suggested temperature of 32.2ºC.

Total Dissolved Solids

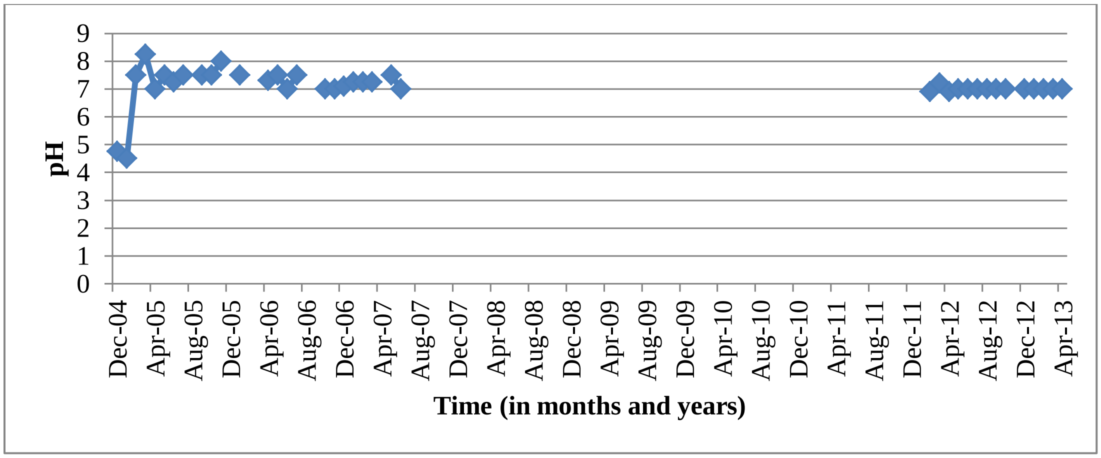
Citizen scientists sampled TDS at this site 37 times and noted that the TDS values varied between 200 mg/L and 550 mg/L, with a reasonable standard deviation value for this test. The variation in TDS was not explained by any pattern noted and did not appear to change over time at this site. The average TDS at this site was 348.19 ± 89.27 mg/L.

Dissolved Oxygen

Dissolved oxygen appeared to follow a normal seasonal trend, rising in the winter when the water temperature was low and decreasing in the summer when the water temperature was high. However sampling was too inconsistent to yield results or patterns. The average DO was 6.91 ± 2.19 mg/L.

pH

The pH values at Site 13485 show an average of 7.09 and remained consistently near that average, except during the first three samples taken. The average pH for this site was 7.09 ± 0.66, which was the lowest pH average value recorded for all the sites.



Transparency Tube and Total Depth

Transparency Tube readings were only recorded in 2012 and 2013 at this site. When completed, the transparency tube depth was lower than total depth, suggesting that the water had limited clarity. Water depth was highest (3 meters) in January and June of 2005, although no records of high levels of rainfall were mentioned.

Field Observations

At Site 13485, field observations recorded during sampling events indicated that water primarily had a clear water surface (87%), clear water (84%), rippled surface (59%), a normal water level (65%) and no odor (92%) during all of the sampling events. Water color was either colorless or light green (51% and 46% respectively) and had either no (57%) or rare (24%) algae cover. Weather was noted to be clear during 41% of the sampling events, cloudy during 38% of the sampling events, overcast during 22% of the sampling. The largest rainfall event within three days of a sampling event was 1.5 inches in Sept 2005. Monitors noted presence of birds but did not record species present.

Site 80333 – Rush Creek at Fisher/Branchfield near White Rock Lake

Site Description

This site is on the west bank of the lake, near the parking area on W. Lawther Dr. The site is located in a city park and is surrounded by suburban areas with a limited tree riparian zone observed.

Sampling Information

This is an inactive site sampled sporadically from 06/18/2005 to 12/27/2012 by Maria Richards, Barbara Maimbourg, Lisa Eresl, and Lacretia Dickerson of For the Love of the Lake. Sampling has occurred on average 7.38 times a year, with most sampling events occurring during the middle part of the month and in the middle to late morning. Since 06/18/2005, monitors have spent a total of 77 hours and 22 minutes sampling and traveled 1,044.5 total miles while sampling this site, with an average of 82.89 minutes spent sampling and 18.65 miles traveling during each sampling event.

Table 10: Descriptive parameters for Site 80333

Parameter	% Complete	Mean ± Standard Deviation	Max.	Min.
Total Dissolved Solids (mg/L)	76%	384.03 ± 142.92	585	104
Water Temperature (°C)	80%	16.54 ± 6.88	30	6
Dissolved Oxygen (mg/L)	78%	7.01 ± 2.37	11.65	1.8
pH	78%	7.44 ± 0.37	9	7
Secchi Disk Transparency (m)	35%	0.24 ± 0.29	1	0
Depth (m)	88%	0.18 ± 0.19	1	0

*Site was sampled 48 times between 6/18/2005 and 12/27/2012.

Air and water temperature

Water and air temperatures were sampled 37 times at Site 80333. Temperatures fluctuated in an expected seasonal pattern, with maximum air temperatures of 30°C in June 2005 and maximum water temperatures in August 2005, June 2006, and July 2007. Water temperature does appear to decrease over time at this site, however sampling was too inconsistent and varied to be significant (r^2=0.11). Water temperature was below air temperature, except during September 2005, March 2009, and August 2009. Water never reached temperatures above the Texas Surface Water Quality suggested level of 32.2ºC.

Total Dissolved Solids and Salinity

Citizen scientists sampled TDS at this site 37 times and TDS increase over time (p=0.003). The average TDS for this site was 384.03 ± 142.92 mg/l, which was the highest average TDS of all the sampled sites.

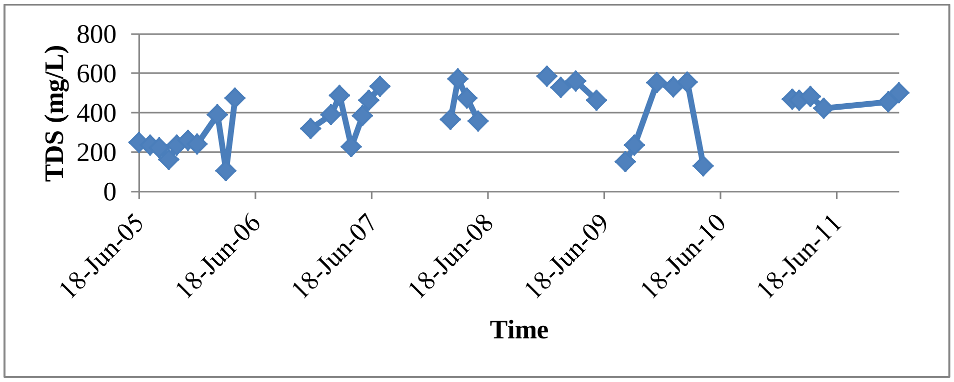


Figure 15: Total Dissolved Solids at Site 80333

Dissolved Oxygen

Dissolved oxygen appeared to follow a normal seasonal trend, rising in the winter when the water temperature was low and decreasing in the summer when the water temperature was high. The DO results at this site showed a slight but insignificant increase over time. The average DO for this site was 7.01 ± 2.37 mg/L.

pH

The pH values at Site 80333 show an average of 7.44 and remained consistently near that average, with no change over time (7.44 ± 0.37).

Secchi disk and total depth

Secchi disk values were only recorded in 2005, and the ranged from 0.25 m to 1 m. When measured, the Secchi disk and total depth measurements were the same, suggesting a high level of clarity.

Field Observations

At Site 80333, field observations recorded during sampling events indicated that water had no algae cover during 98% of the sampling events. Monitors also noted a clear water surface for 76% of the sampling events, clear coloring 87% of the time, and no odor for 98% of sampling events. The water surface was calm 62% of the time and had ripples 38% of the time. The water was also reported to have no flow 37% of the time and normal flow for 37% of the time. Weather was noted to be clear during 71% of the sampling events, cloudy during 28% of the sampling events, and overcast during 11% of the sampling. The largest rainfall event within three days of a sampling event was 1.58 inches in August of 2005.

Site 80272 – Williamson Creek at W. Lawther Bridge on White Rock Lake

Site Description

This site is located on the west side of the lake where a small tributary, Williamson Creek, passes through Lakewood Park and flows into the White Rock Lake. The site is located on the tributary close to where it enters that lake. This site is surrounded by suburban areas and the Lakewood Park, with a treed riparian zone observed along the tributary.

Sampling Information

This is an active site sampled from 12/11/2004 to 04/17/2013 by Larcetia Dickerson White, Maria Richards, Douglas Frazier, and Barbara Maimbourg of For the Love of the Lake and Aquatic Alliance. Sampling has occurred 9.13 times a year, with no set time during the month but usually during the mid to late morning time of the day. Since 12/11/2004, monitors spent a total of 151 hours and 26 minutes sampling and have traveled 1,412 miles while sampling this site, with an average of 117.97 minutes spent sampling and 18.34 miles spent travelling during each sampling event.

Table 11: Descriptive parameters for Site 80272

Parameter	% Complete	Mean ± Standard Deviation	Max.	Min.
Total Dissolved Solids (mg/L)	96%	309.0 ± 79.78	481	110.5
Water Temperature (°C)	99%	18.12 ± 6.79	29	7
Dissolved Oxygen (mg/L)	86%	5.41 ± 1.98	10.25	2.2
pH	100%	7.1 ± 0.23	7.5	6.75
Secchi Disk Transparency (m)	39%	0.137 ± 0.32	1.5	0
Depth (m)	82%	1.06 ± 1.01	7	0

*Site was sampled 77 times between 12/11/2004 and 4/17/2013.

Air and water temperature

Water and air temperatures were sampled 77 times at Site 80272. Temperatures fluctuated in an expected seasonal pattern; maximum air temperatures were in June 2009 and August 2010, while maximum water temperatures were in July of 2005 and 2008. No other trend could be determined and water temperature did not change significantly over time. Water temperature never reached temperatures above the Texas Surface Water Quality suggested standard of 32.2ºC.

Total Dissolved Solids

The TDS values ranged from as low as 110 mg/L in December 2005 and as high as 455 mg/L in March 2007. The TDS does not change significantly over time at this site and the average TDS at this site was 309.0 ± 79.78 mg/L.

Dissolved Oxygen

Dissolved oxygen appeared to follow a normal seasonal trend, rising in the winter when the water temperature was low and decreasing in the summer when the water temperature was high. The DO did not change significantly over time this site. The DO at this site had the lowest average DO of all the sites, with a result of 5.41 ± 1.98 mg/L.

pH

The pH values at Site 80272 held steady between 7.0 and 7.5 for the year sampled, except for two sampling events, when it fell below 7 in March 2011 and June 2012. The average pH for this site was 7.1 ± 0.23.

Secchi disk and total depth

Secchi disk was usually significantly lower than depth when sampled, suggesting that the water had limited clarity. However, total depth did increase over time at this site, with a high depth reading of 3 meters in November 2009.

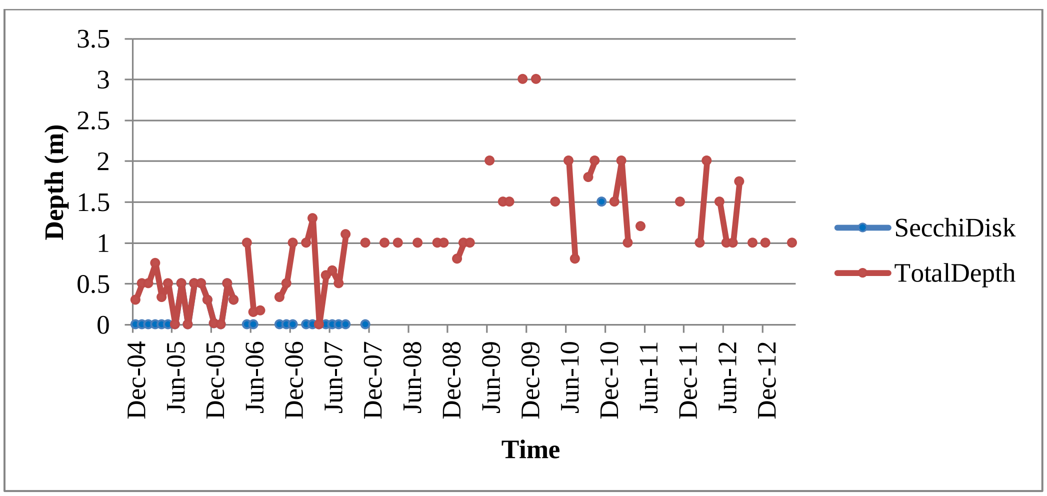


Figure 16: Secchi disk and total depth for Site 80272

Field Observations

Field observations recorded during sampling events indicated that water had no algae during 84% of the sampling events. Monitors also reported a clear water surface 73% of the time and no odor 100% of the time. The water was reported to be clear 95% of the time and had normal flow 90% of all of the sampling events. Water color was noted to be clear 55% of the time and green or tan 35% of the time, while water levels were noted to have no flow for 49% of sampling occasions and to have low flow during 40% of the sampling events. Weather was noted to be clear during 57% of the sampling events, cloudy during 23% of the sampling, and overcast during 19% of the sampling events. Rainfall events equal to or more than 1.5 inches were noted in September and October of 2005.

Get Involved with Texas Stream Team!

Once trained, citizen monitors can directly participate in monitoring by communicating their data to various stakeholders. Some options include: participating in the Clean Rivers Program (CRP) Steering Committee Process, providing information during "public comment" periods, attending city council and advisory panel meetings, developing relations with local Texas Commission on Environmental Quality (TCEQ) and river authority water specialists, and, if necessary, filing complaints with environmental agencies, contacting elected representatives and media, or starting organized local efforts to address areas of concern.

The Texas Clean Rivers Act established a way for the citizens of Texas to participate in building the foundation for effective statewide watershed planning activities. Each CRP partner agency has established a steering committee to set priorities within its basin. These committees bring together the diverse stakeholder interests in each basin and watershed. Steering committee participants include representatives from the public, government, industry, business, agriculture, and environmental groups. The steering committee is designed to allow local concerns to be addressed and regional solutions to be formulated. For more information about participating in these steering committee meetings, please contact the appropriate CRP partner agency for your river basin at:
http://www.tceq.state.tx.us/compliance/monitoring/crp/partners.html.

Currently, Texas Stream Team is working with various public and private organizations to facilitate data and information sharing. One component of this process includes interacting with watershed stakeholders at CRP steering committee meetings. A major function of these meetings is to discuss water quality issues and to obtain input from the general public. While participation in this process may not bring about instantaneous results, it is a great place to begin making institutional connections and to learn how to become involved in the assessment and protection system that Texas agencies use to keep water resources healthy and sustainable.

Appendix A- List of Maps, Tables, and Figures

Tables

Figures