Carters Creek Watershed Data Report

October 2016

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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 not 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 are 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 frequently, or monitor at all. 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 (TSSWCB) 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.

Watershed Location and Physical Description

Location and Physical Description

The Carters Creek Watershed (Segments 1209C, 1209D, and 1209L) is located in Brazos County, Texas, and originates in Bryan/College Station (TCEQ 2014). Carters Creek, a perennial stream, runs approximately 27 miles in total, and the watershed as a whole contains Carters Creek, Burton Creek, Country Club Branch, Fin Feather Lake, and Country Club Lake, and covers approximately 58 square miles (TCEQ 2014).

The watershed is located within the Southern Post Oak savannah ecoregion and has a subtropical humid climate with warm summers and dry winters (Office of Texas State Climatologist, 1983). Average annual precipitation within the watershed is 39.7 inches (Office of Texas State Climatologist, 1983).

Land Use and Impairments

Land use within the Carters Creek Watershed ranges from entirely urbanized on Burton Creek and Country Club Branch to half urbanized and half rural on Carters Creek (TCEQ 2012). Forest and rangeland are the primary uses of land in the rural (eastern) half of the Carters Creek Watershed (TCEQ 2012). Seven facilities regulated for point-source pollution lie within the watershed, with four treating and discharging domestic wastewater and three facilities discharging industrial wastewater (TCEQ 2012).

Geometric mean levels of *E. Coli* bacteria exceeding the 126 MPN/100 mL threshold consistently occur within Carters Creek, Burton Creek, and Country Club Branch, signifying a major impairment and preventing contact recreational uses such as swimming and wading (TCEQ 2012). Previous bacteria readings have included measurements of over 24,000 MPN/100 mL and geometric means as high as 757 MPN/100mL within Carter's Creek at Bird Pond Road (TCEQ 2012). Unregulated sources of the bacteria may include wildlife, agricultural activities and domesticated animals/pets, and failing septic lines and sewage facilities. Periods of low flow and/or droughts can also impact water quality on Carters Creek, as streamflow for portions of the watershed can be heavily influenced by municipal wastewater effluent from nearby treatment facilities (TCEQ 2014).

TMDL & Watershed Protection

The Texas Commission on Environmental Quality designated the Carters Creek Watershed as a TMDL project to better understand the sources of bacteria within the watershed (TCEQ 2014). The TMDL's stated goal is to reduce concentrations of bacteria within the affected streams, restore water quality to the area, and reduce health threats (TCEQ 2012, TCEQ 2014).

The Carters Creek Watershed TMDL is a wide-ranging project in conjunction with the Texas Water Resources Institute that includes activities such as reconnaissance sampling, routine and stormflow water quality monitoring for bacteria, developing quality assurance protection plans (QAPPs), watershed source survey and GIS mapping, stakeholder engagement through public meetings and data releases, and quarterly updates (Texas Water Resources Institute).

According to TCEQ, stakeholders had "positive reports" of the TMDL project's progress on improving water quality within the watershed (TCEQ 2014).

Endangered Species and Conservation Needs

Brazos County federal and state listed endangered or threatened species include:

Amphibians	Houston Toad
Birds	American Peregrine Falcon
	Bald Eagle
	Interior Least Tern
	Peregrine Falcon
	Red Knot
	Whooping Crane
	Wood Stork
Fishes	Blue Sucker
	Sharpnose Shiner
	Smalleye Shiner
Mammals	Louisiana Black Bear
	Red Wolf
Mollusks	Smooth Pimpleback
	Texas Fawnsfoot
Reptiles	Alligator Snapping Turtle
	Texas Horned Lizard
	Timber Rattlesnake
Plants	Navasota Ladies'-Tresses

Brazos County may also have several Species of Greatest Conservation Need (SGCN). These species are in decline or they are rare and are in need of attention in order to recover and prevent them from becoming listed species (Texas Parks & Wildlife 2016). The SGCN include:

Amphibians	Southern Crawfish Frog
Birds	Henslow's Sparrow
	Sprague's Pipit
Insects	Gulf Coast Clubtail
	Smoky Shadowfly
Mammals	Plains Spotted Skunk
Plants	Branched Gay-feather
	Bristle Nailwort
	Florida Pinkroot
	Small-headed Pipewort
	Texas Meadow-Rue
	Texas Sandmint
	Texas Sunnybell
	Texas Windmill-Grass
	Tree Dodder

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 may be used for general comparison purposes.

The DO concentrations may 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, everyone 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.

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.

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.

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 scientists 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 citizen scientist enters data electronically, the system will automatically flag data outside of the data limits and the citizen scientist 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 citizen scientist 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 ten percent 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 2014 Texas Surface Water Quality Standards report was used to calculate the exceedances for the Carters Creek Watershed, as seen below in Table 2.

Table 2: Summary of Surface Water Quality Standards for the Carters Creek Watershed

Parameter	Texas Surface Water Quality Standard 2014
Water Temperature (°C)	33.9
Total Dissolved Solids (mg/L)	600
Dissolved Oxygen (mg/L)	5.0
pH (su)	6.5-9.0
E.coli (CFU/100 mL)	126 (geomean during sampling period)

Methods of Analysis

All data collected from Carters Creek and its tributaries were exported from the Texas Stream Team database and were then grouped by site.

Once compiled, data was sorted and graphed in Microsoft Excel 2010 using standard methods. Trends over time were analyzed using a linear regression analysis in Minitab v 15. 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 citizen scientists, 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. Geomeans were calculated for *E. coli* data for trends and for each monitoring site.

Carters Creek Watershed Data Analysis

Data collected from Carters Creek by citizen scientists was part of an effort headed by the Texas Water Resources Institute (TWRI) at Texas A&M University. These citizen scientists collected data until February 2015, when TWRI discontinued sampling at sites #80908-80917 and shifted their focus to other sites within the city limits of College Station, TX.

Carters Creek 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 sites. For added reference points in all maps, layers showing monitoring sites, cities, counties, and major highways were included. All shapefiles were downloaded from reliable federal, state, and local agencies.

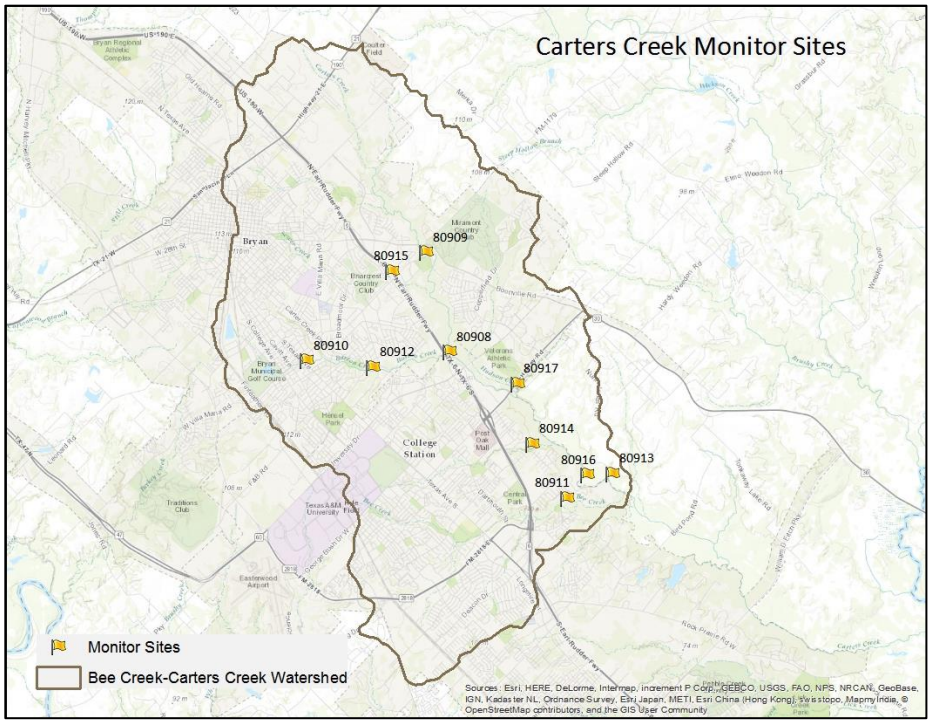

Figure 1: Map of the Carters Creek Watershed with Texas Stream Team Monitor Sites

Carters Creek Watershed Trends over Time

Sampling Trends over Time

Sampling in the Carters Creek Watershed began in February of 2013. A total of 217 monitoring events from 10 sites collected between February 2013 to February 2015 were analyzed. Monthly monitoring occurred on a consistent basis.

Table 3: Descriptive parameters for all sites in the Carters Creek Watershed

Carters Creek Watershed February 2013 – February 2015				
Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	237	523 ± 248	8.0	1255
Water Temperature (°C)	233	19.0 ± 7.4	1.2	31.1
Dissolved Oxygen (mg/L)	229	6.3 ± 3.1	0.5	14.6
pH	238	7.5 ± 0.6	6.1	9.5

There were a total of 238 sampling events between 2/26/2013 and 2/6/2015.

Trend Analysis over Time

Air and water temperature

A total of 233 water temperatures and 177 air temperatures were recorded in this watershed. The mean water temperature was 18.7 °C. The minimum water temperature was 1.2 °C and was recorded in January of 2014. The maximum water temperature of 31.1 °C was recorded in September of 2014. The air temperature ranged from a low of 2.7 °C in March of 2013 to a high of 35 °C in August of 2013.

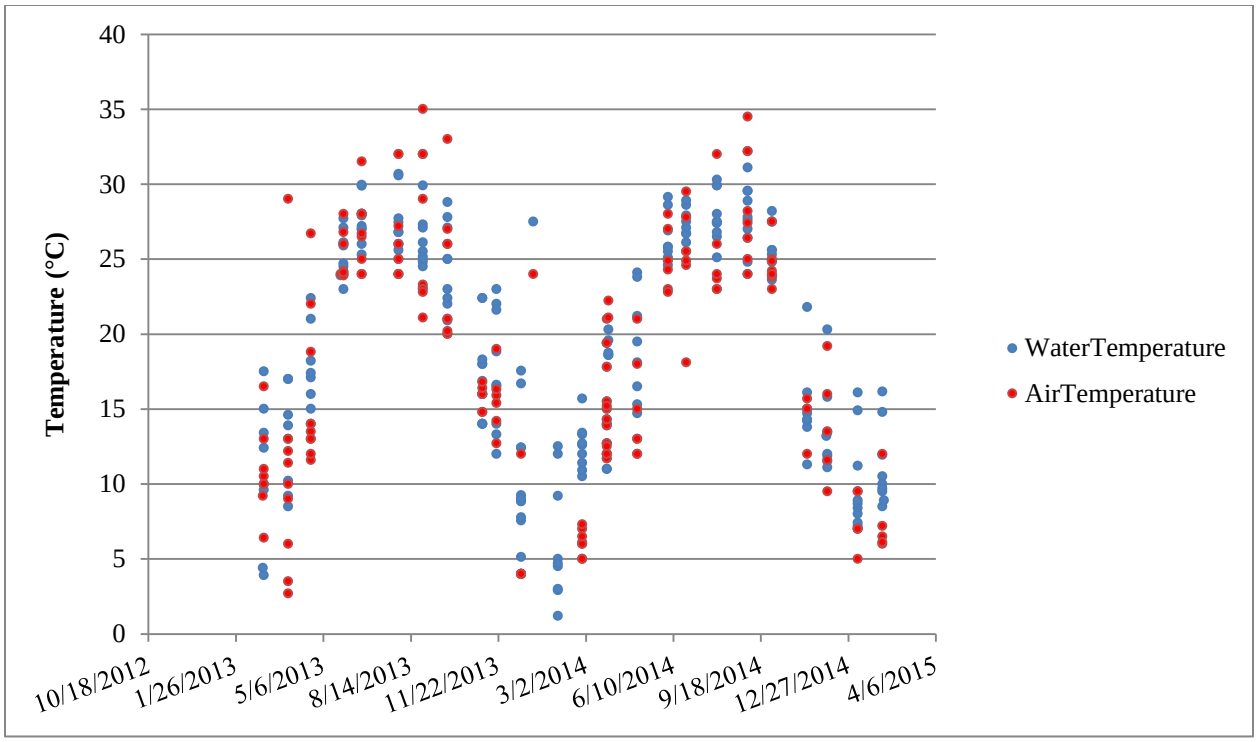

Figure 2: Air and water temperature over time at all sites within the Carters Creek Watershed

Total Dissolved Solids

Citizen scientists conducted a total of 237 total dissolved solids measurements in the watershed. The mean TDS concentration in the watershed was 523 mg/L and it ranged from a low of 8 mg/L in December of 2014 to a high of 1255 mg/L in July of 2013. There was no significant increase or decrease in TDS concentrations over time observed in the watershed.

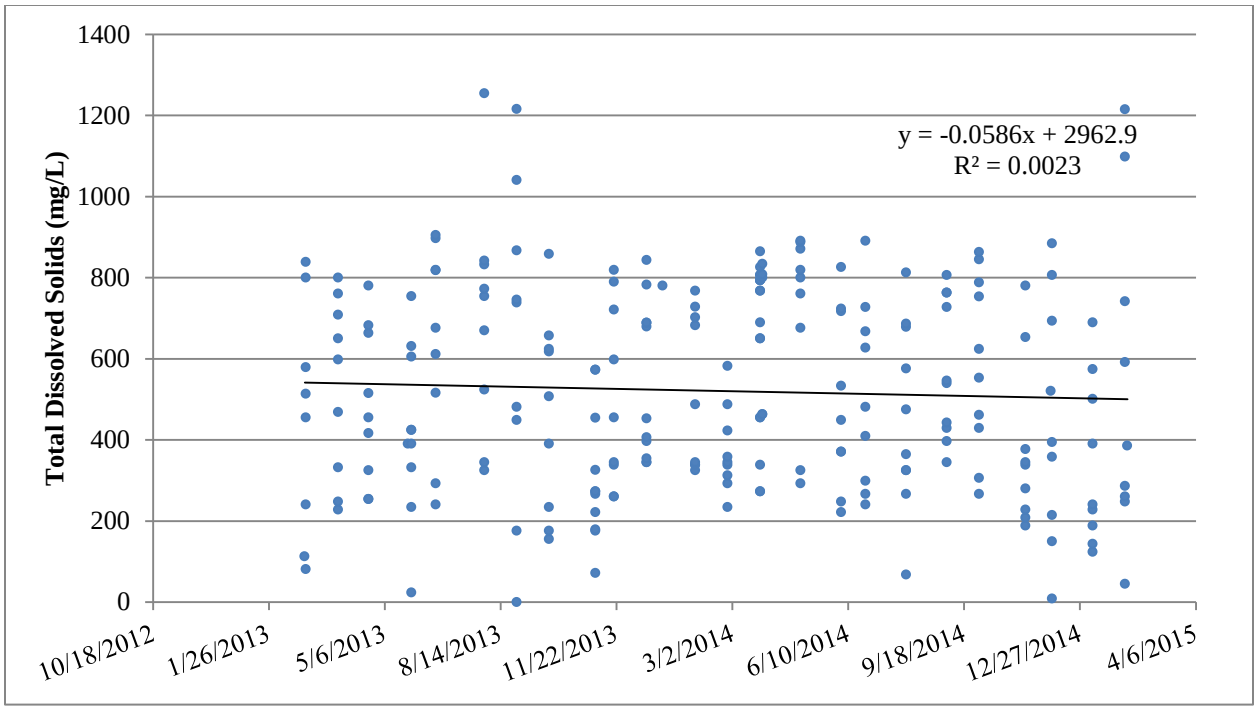

Figure 3: Total dissolved solids over time at all sites within the Carters Creek Watershed

Dissolved Oxygen

Citizen scientists collected a total of 229 dissolved oxygen samples in the watershed. The mean DO concentration was 6.3 mg/L and it ranged from a low of 0.5 mg/L in August 2013 to a high of 14.6 mg/L in March 2014.

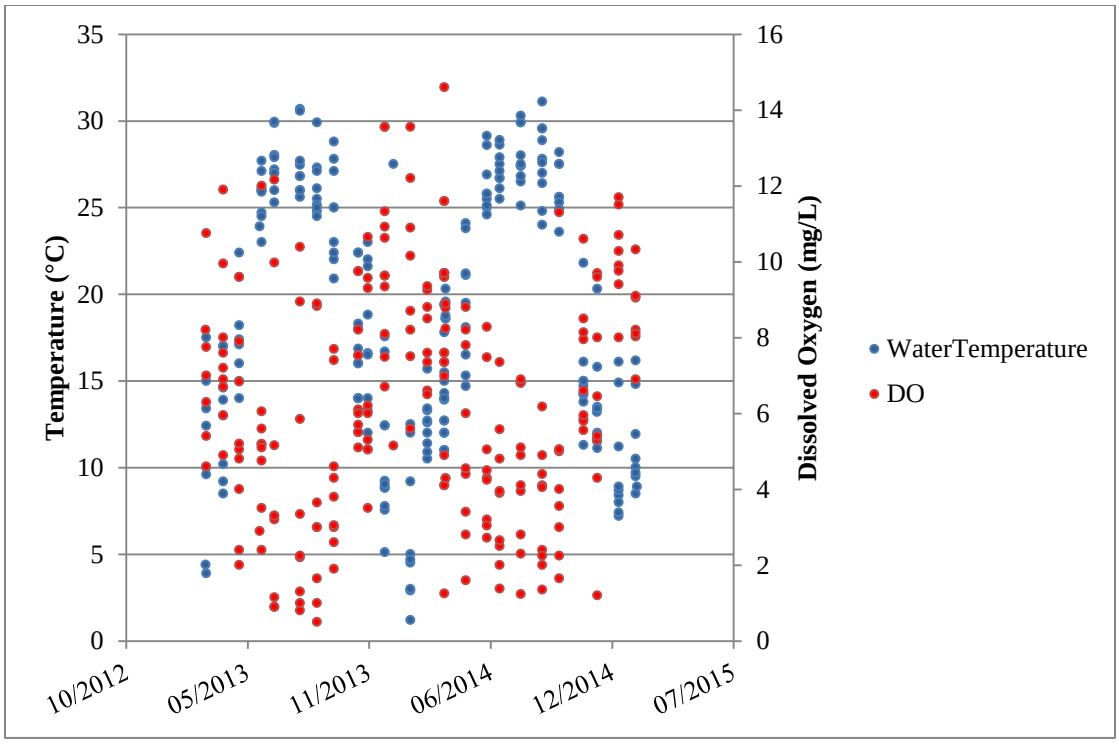

Figure 4: Water temperature and dissolved oxygen over time at all sites within the Carters Creek Watershed

pH

Citizen scientists took 238 pH measurements in the watershed. The mean pH was 7.5 and it ranged from a low of 6.1 in November 2014 to a high of 9.5 in July of 2013. There was a significant decrease in pH over time ($p = 0.006$), but the low R-squared value of 0.032 suggests the date of sampling has a minimal relationship with the overall variance of the data.

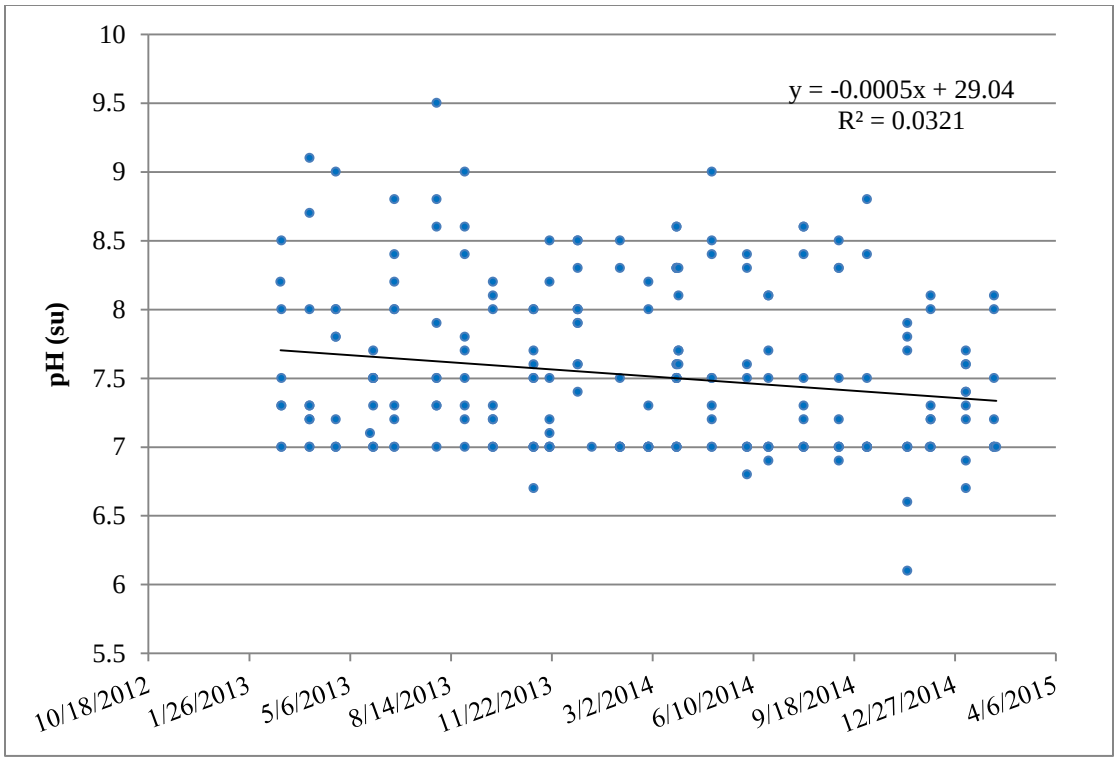

Figure 5: Measured pH over time within the Carters Creek Watershed

Carters Creek 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 4 on the following page, for a quick overview of the average results.

As previously mentioned in the 'Water Quality Parameters' section, TDS 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 80914 had the highest overall average for TDS, with a result of 782 ± 327 mg/L. Site 80909 had the lowest average TDS, with a result of 270 ± 88 mg/L.

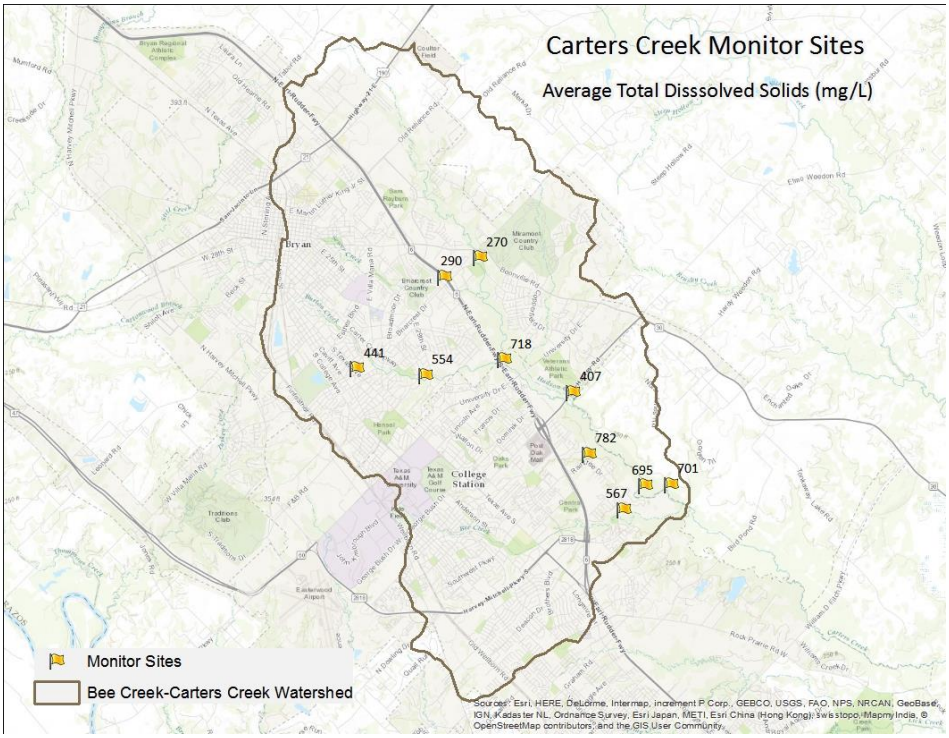

Figure 6: Map of the average total dissolved solids for sites in the Carters Creek Watershed

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 80910 had the lowest average DO reading, with a result of 4.1 ± 3.0 mg/L. Site 80916 had the highest average DO reading, with a result of 9.2 ± 2.5 mg/L.

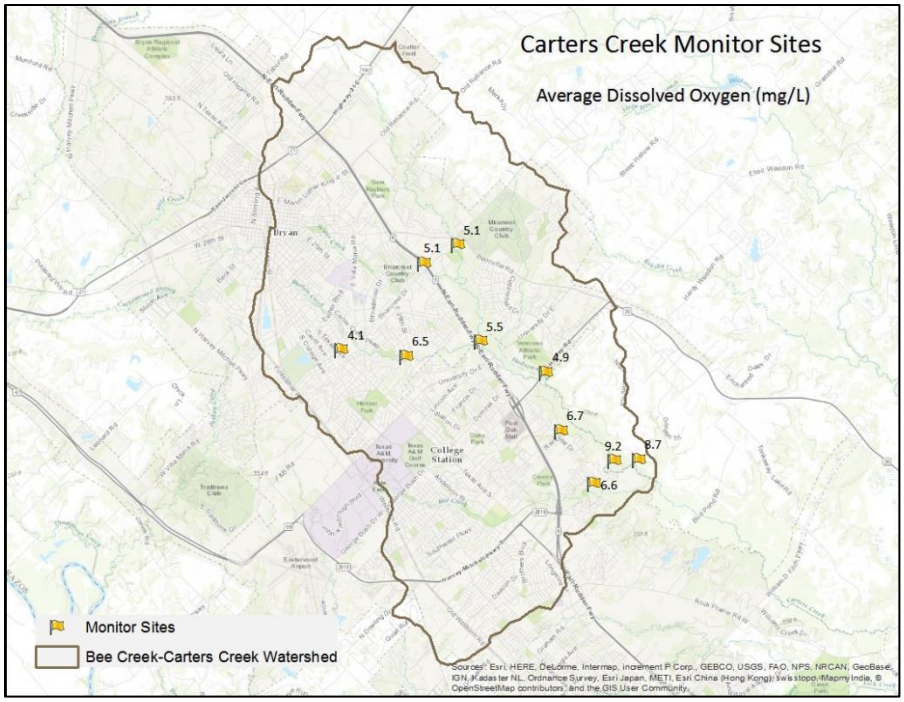

Figure 7: Map of the average dissolved oxygen for sites in the Carters Creek Watershed

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 80916 had the highest average pH level, with a result of 8.3 ± 0.4. Sites 80909 and 80910 had the lowest average pH level, with a result of 7.1.

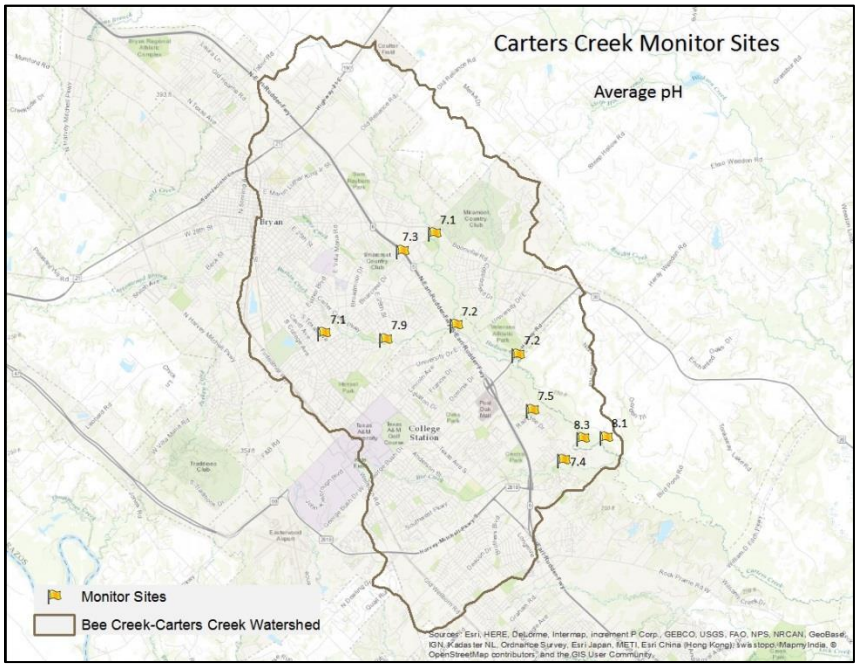

Figure 7: Map of the average pH for sites in the Carters Creek Watershed

Please see Table 4 for a summary of average results at all sites. Additionally, 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. Another aspect to consider is that citizen scientists are asked to conduct water quality testing within a two-hour timeframe each month. While this is a quick overview of the results, it is important to note the 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 4: Average Values for all sites

Site	TDS (mg/L)	DO (mg/L)	pH
80909	270 ± 88 (min)	5.1 ± 3.0	7.1 ± 0.3
80915	290 ± 209	5.1 ± 3.0	7.3 ± 0.4
80910	441 ± 174	4.1 ± 3.0	7.1 ± 0.3(min)
80912	554 ± 251	6.5 ± 2.4	7.9 ± 0.7
80908	718 ± 221 (max)	5.5 ± 1.7	7.2 ± 0.3 (min)
80917	407 ± 140	4.9 ± 3.1	7.2 ± 0.3 (min)
80914	782 ± 327	6.7 ± 2.1	7.5 ± 0.4
80916	695 ± 200	9.2 ± 2.5	8.3 ± 0.4 (max)
80913	701 ± 168	8.7 ± 1.4	8.1 ± 0.3
80911	567 ± 191	6.6 ± 2.5	7.4 ± 0.4

Site 80909 – Carters Creek at Briarcrest Drive

Site Description

This site is located in a heavily wooded area where Briarcrest Drive crosses Carters Creek. The wooded area abuts a small neighborhood and it is upstream of a shopping center.

Sampling Information

This site was sampled 24 times between February 2013 and February 2016. This site was sampled in the morning between 7:00 and 9:30.

Table 5: Descriptive parameters for Site 80909

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	24	270 ± 88	81	481
Water Temperature (°C)	22	17.6 ± 7.7	3.9	27
Dissolved Oxygen (mg/L)	24	5.1 ± 3.0	1.2	14.6
pH	24	7.1 ± 0.3	6.7	7.8

Site was sampled 24 times between 2/27/2013 and 2/4/2015.

Air and water temperature

There were 23 air and 22 water temperature measurements taken at this site. The mean water temperature was 17.6 °C. The minimum water temperature was 3.9 °C and was recorded in February 2013. The maximum water temperature was 27.0 °C and was recorded in June of 2013. The air temperature ranged from a low of 2.7°C to a high of 28.0 °C recorded in June 2013.

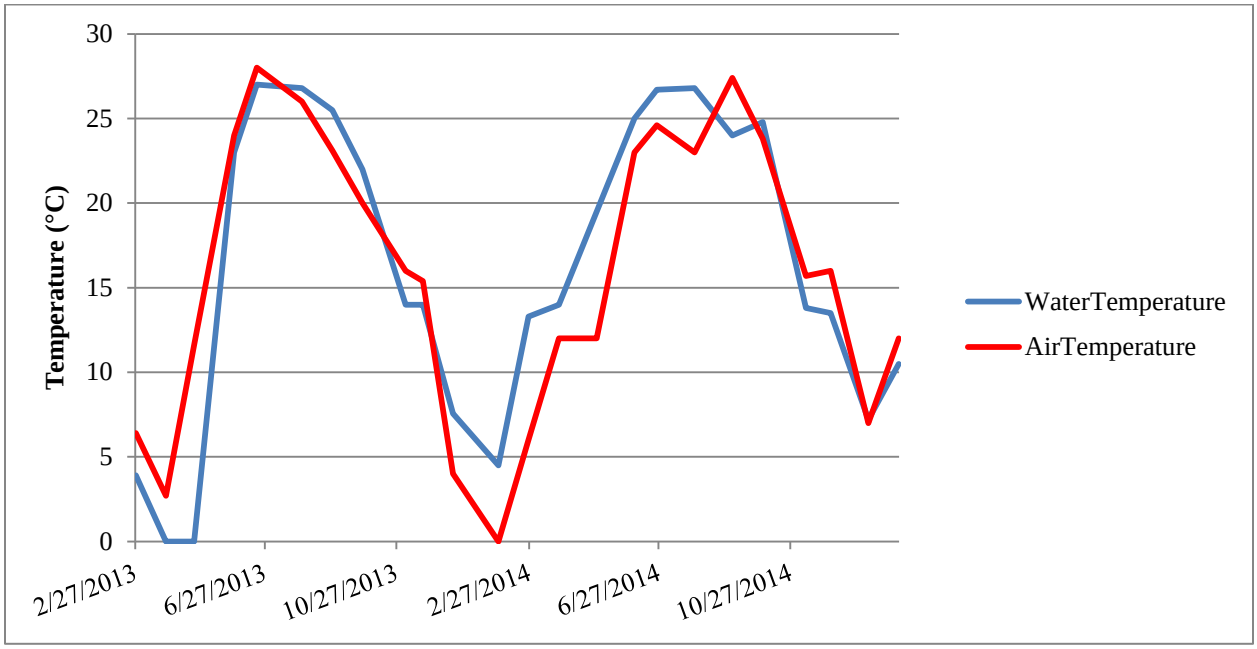

Figure 8: Air and water temperature at site 80909

Total Dissolved Solids

Citizen scientists collected 24 total dissolved solids measurements at this site. The mean TDS concentration was 270 mg/L. The minimum TDS measurement was recorded in February of 2013 and was 81 mg/L. The maximum TDS measurement was 481 mg/L and was recorded in August of 2013. There was no relationship between TDS concentrations and time observed at this site.

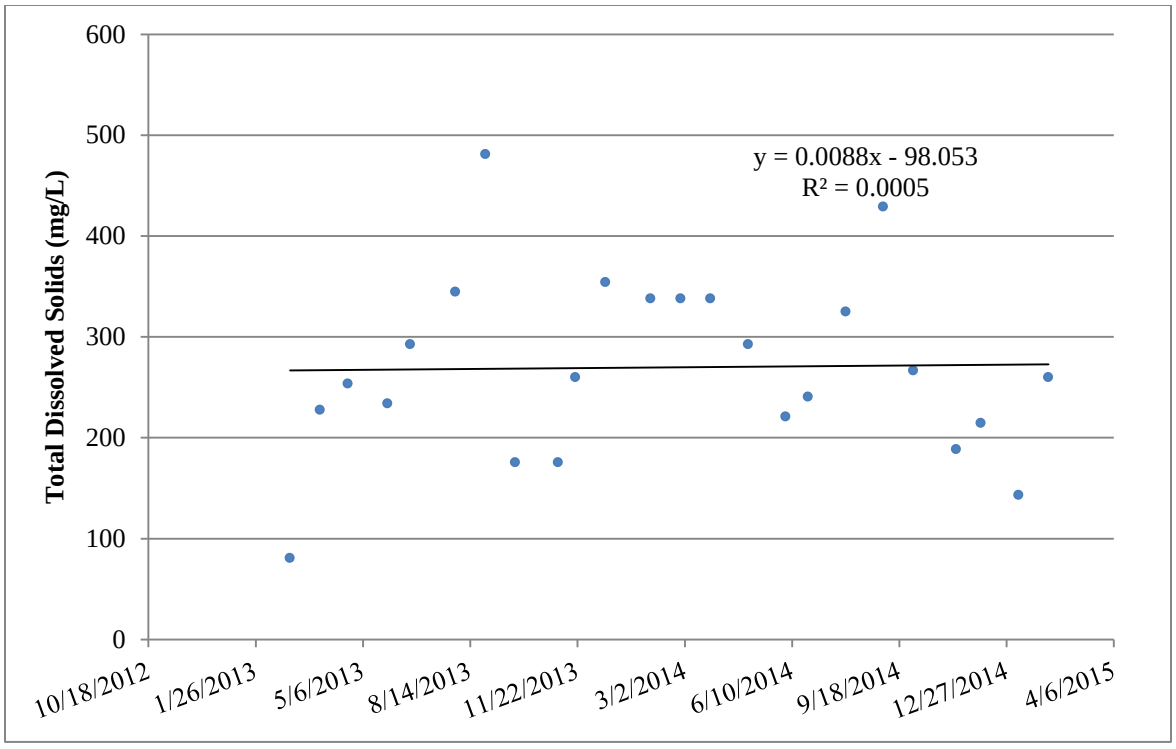

Figure 9: Total dissolved solids at site 80909

Dissolved Oxygen

Citizen scientists collected 24 dissolved oxygen samples at this site. The mean DO concentration was 5.1 mg/L and it ranged from a low of 1.2 mg/L in December 2014 to a high of 14.6 mg/L in March of 2014. There was no significant relationship between DO and time observed at this site.

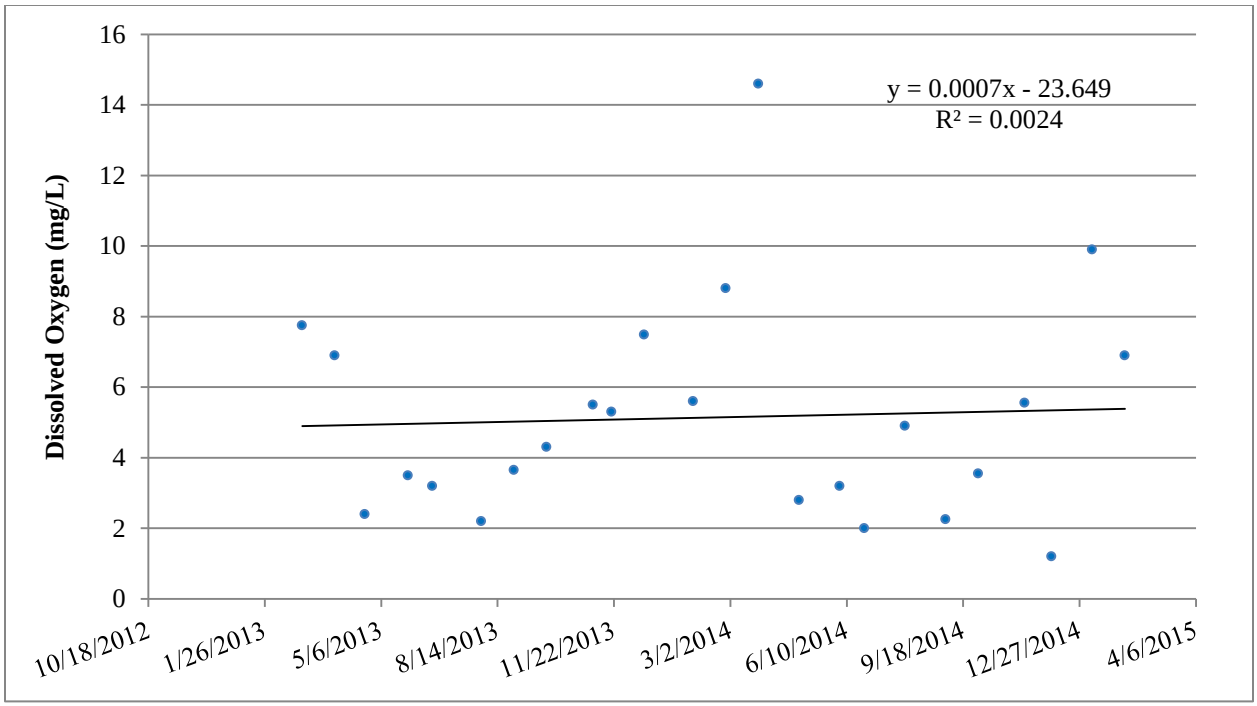

Figure 10: Dissolved oxygen at site 80909

pH

There were 24 pH samples taken at this site. The mean pH was 7.2 and it ranged from a low of 6.7 in November of 2013 to a high of 7.8 in August 2013. There was no significant relationship between pH and time observed at this site.

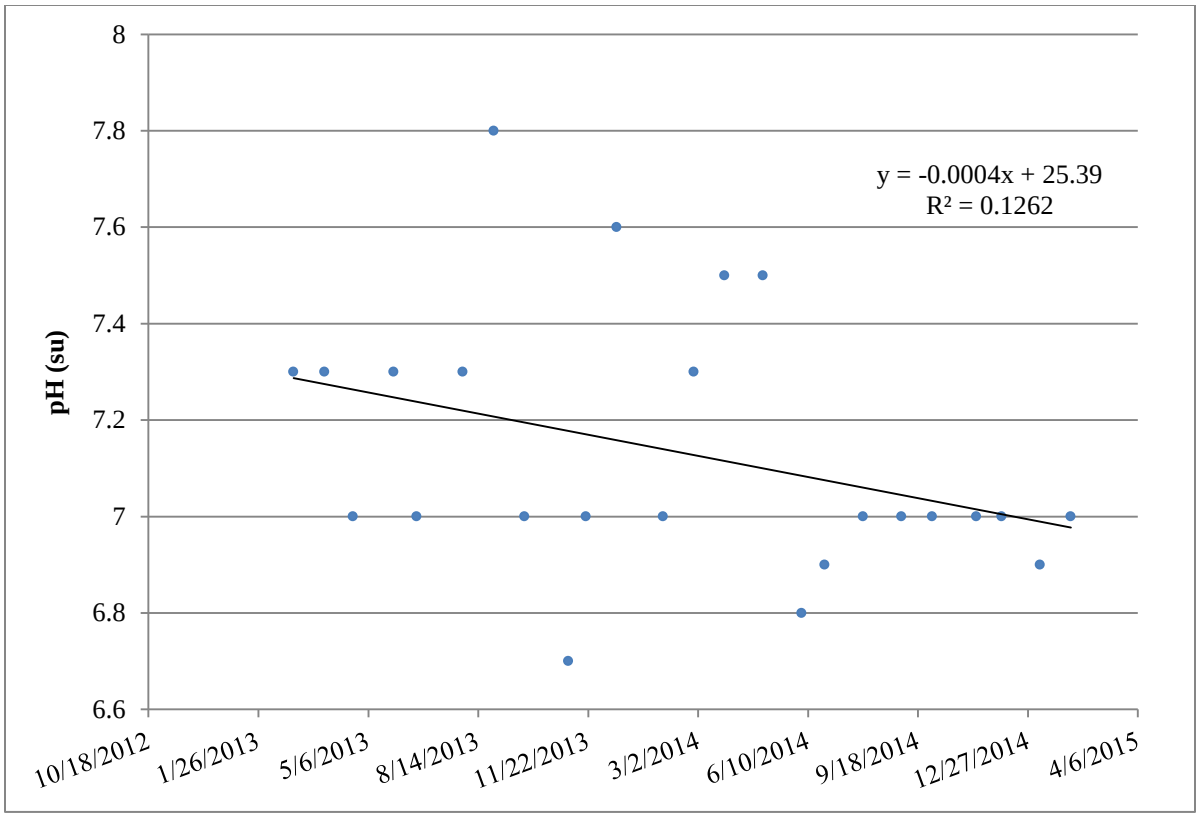

Figure 11: pH at site 80909

Field Observations

Flow at this site ranged from no flow to average flow. Algae was absent or rare except for instances of 26-50% estimated algae cover occurring in February and December 2014 and 51-75% estimated algae cover in March 2015. The water color was primarily greenish brown or tan, and the water clarity was usually cloudy or turbid.

Site 80915 – Briar Creek at State Highway 6

Site Description

This site is at the crossing of the Highway 6 Frontage Rd over Carters Creek. This site is upstream of a neighborhood that surrounds a golf course and straddles both sides of the creek. The riparian areas near the road are mowed and there is a large concrete stormwater culvert that drains from the highway into the creek.

Sampling Information

This site was sampled 25 times between February 2013 and February 2015. The sampling took place in the morning between 7:00 and 10:00.

Table 6: Descriptive parameters for Site 80915

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	25	290 ± 209	8	1216
Water Temperature (°C)	25	18.5 ± 7.1	5.0	27.6
Dissolved Oxygen (mg/L)	25	5.1 ± 3.0	0.5	12.0
pH	25	7.3 ± 0.4	6.6	8.7

Site was sampled 20 times between 2/27/2013 and 2/4/2015

Air and water temperature

There were 23 air and 25 water temperature samples collected at this site. The mean water temperature was 18.5 °C and it ranged from a low of 5.0 °C in January of 2014 to a high of 27.6 °C in September 2014. The air temperature ranged between 4.0 °C in December of 2013 to a high of 26.5 °C in June of 2013.

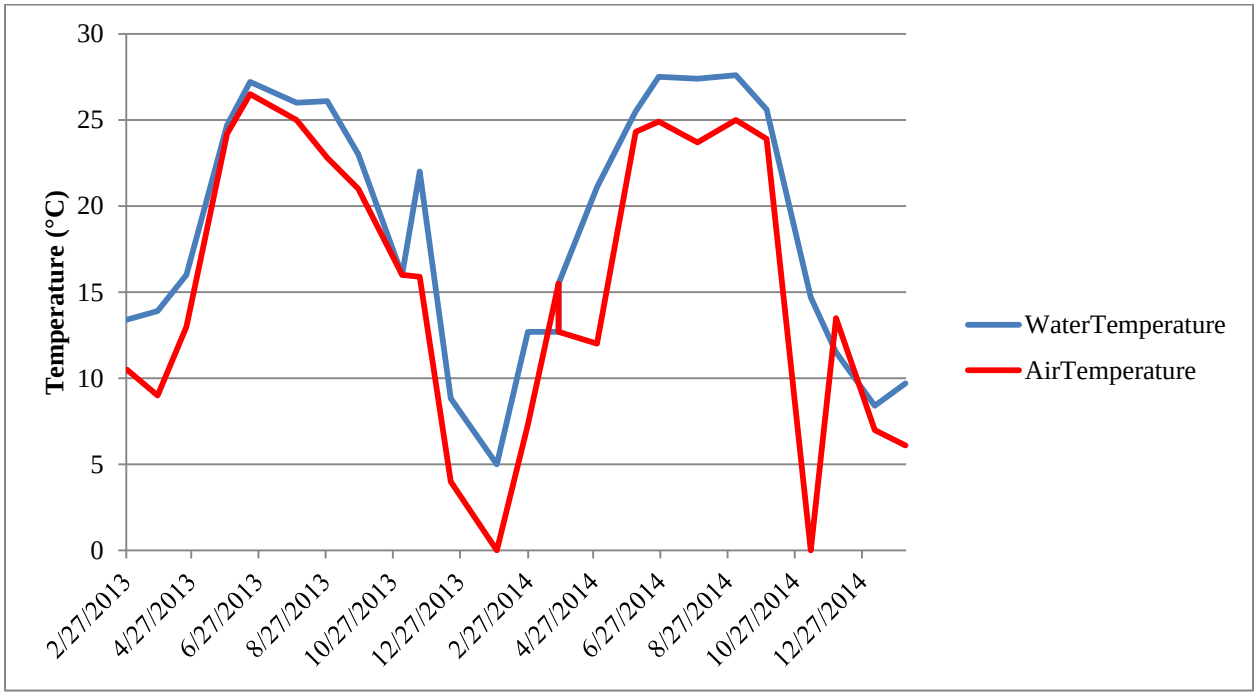

Figure 12: Air and water temperature at site 80915

Total Dissolved Solids

Citizen scientists collected 25 total dissolved solids measurements from this site. The mean TDS concentration was 290 mg/L and it ranged from a low of 8 mg/L in December of 2014 to a high of 1216 mg/L in August 2013. There was no significant increase or decrease in TDS concentrations over time observed at this site.

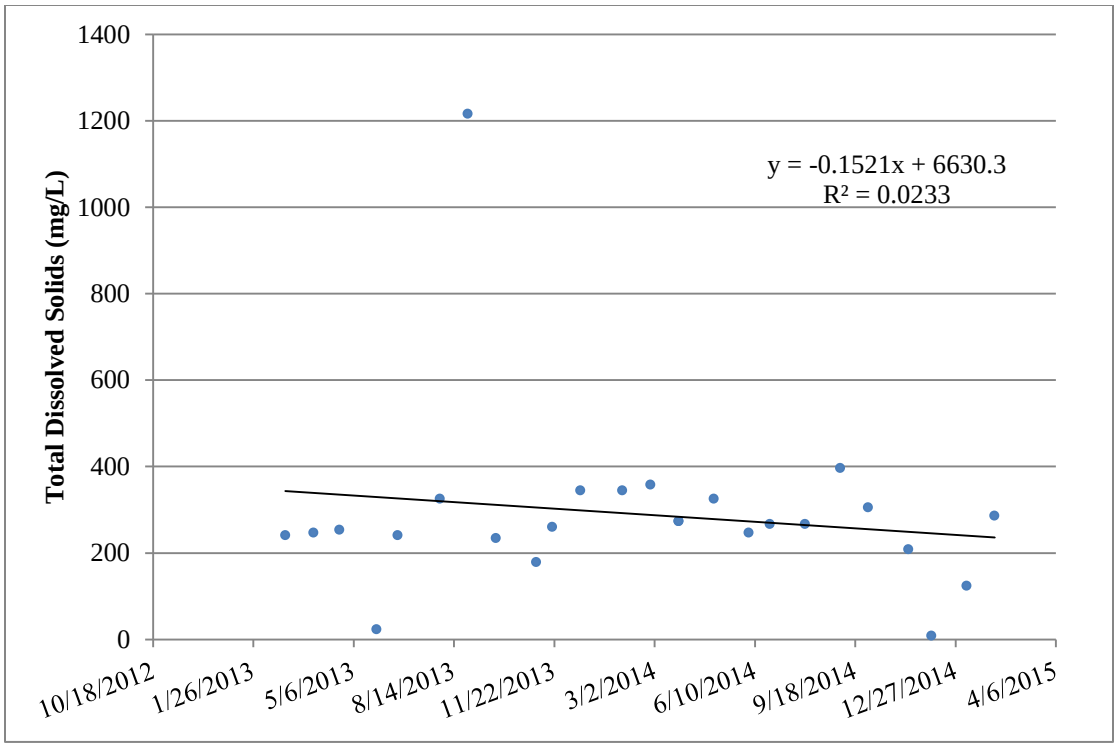

Figure 13: Total dissolved solids at site 80915

Dissolved Oxygen

There were 25 dissolved oxygen samples collected at this site. The mean DO concentration was 5.1 mg/L and it ranged from a low of 0.5 mg/L in August 2013 to a high of 12.0 mg/L. There was no significant relationship between DO concentration and time observed at this site.

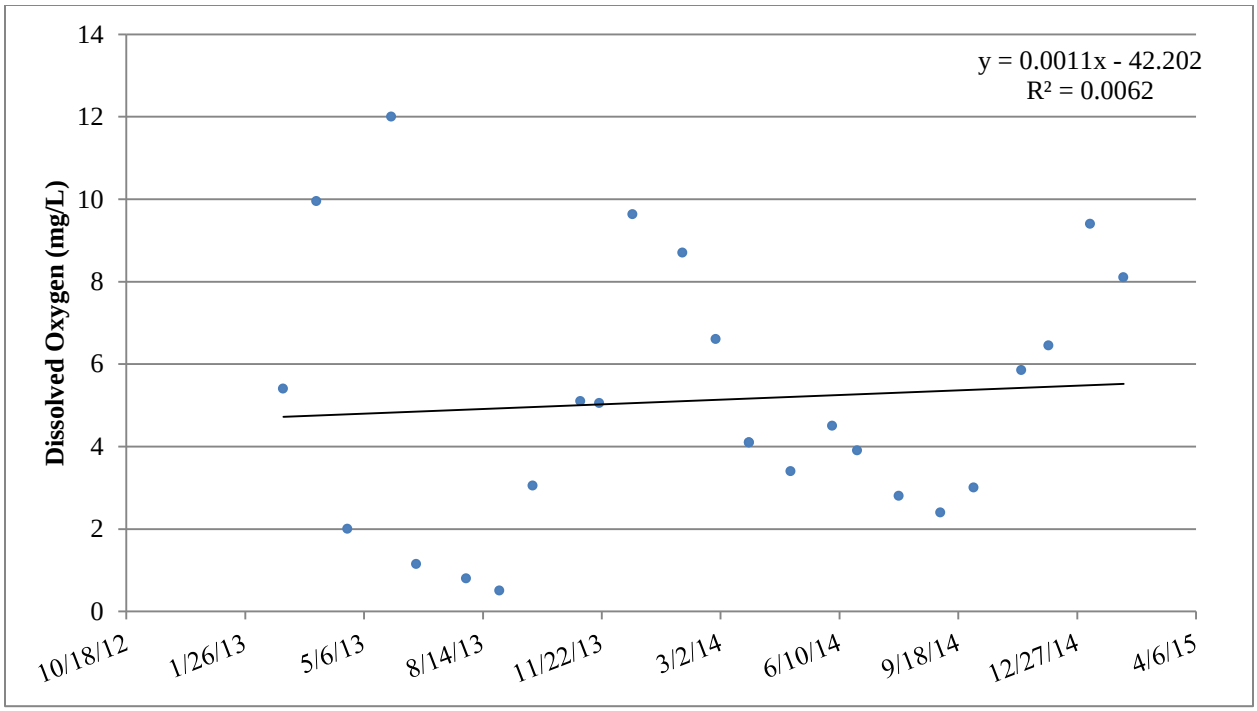

Figure 14: Dissolved oxygen at site 80915

pH

Citizen scientists collected 20 pH samples at this site. The mean pH was 7.3 and it ranged from a low of 7.0, recorded multiple times, to a high of 8.7 in March of 2013. There was a significant decrease in pH observed over time at this site ($p = 0.034$). The R^2 value of 0.18 indicates the sampling dates of these data account for about 18% of the variation within the data set.

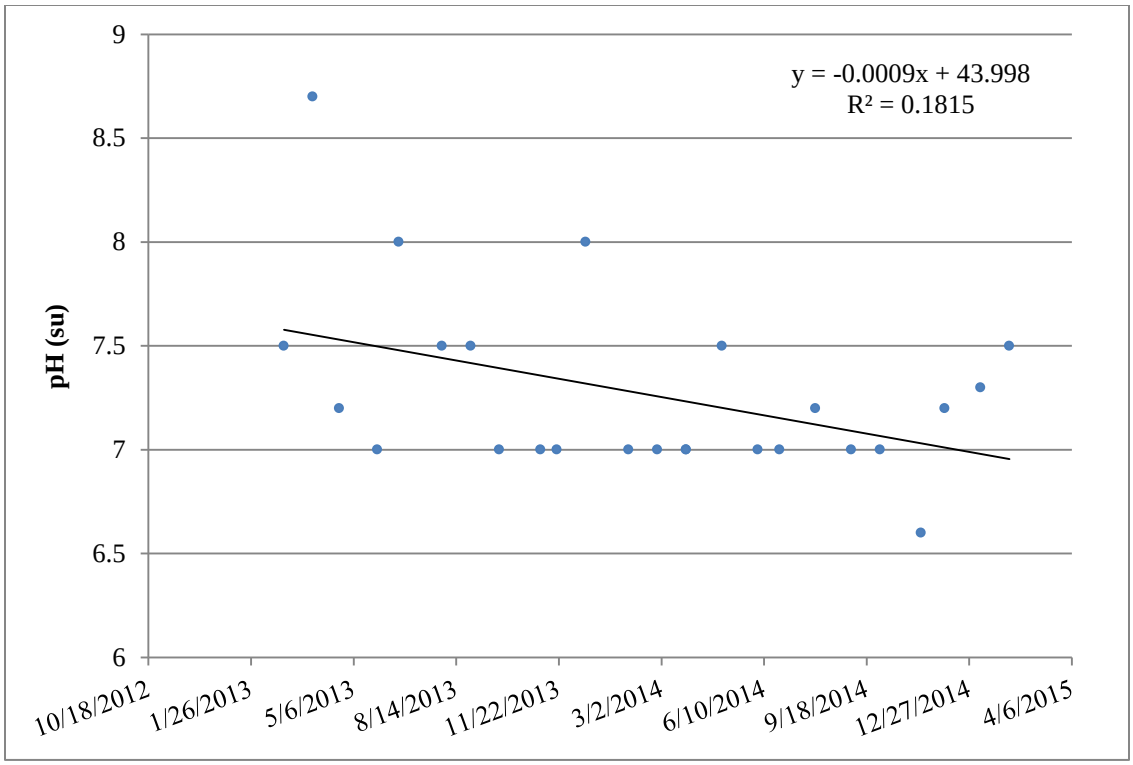

Figure 15: pH at site 80915

Field Observations

The flow at this site was recorded as average, low, or no flow. There was a broad range of algae coverage recorded at this site from absent to dominant, with more absent recordings being made from February 2014 to February 2015. The water color was tan or green/brown. The water clarity was recorded as cloudy or turbid.

Site 80910 – Unnamed Tributary of Burton Creek at Maloney Avenue

Site Description

This site is at a road bridge crossing a small tributary to Burton Creek. The north side of this creek is a commercial area and the south side of the creek abuts a neighborhood. There are 3 road crossings of this creek within several hundred yards of each other. The grass along the banks of the creek is mowed and there are a few trees in the riparian area.

Sampling Information

This site was sampled 23 times between February 2013 and February 2015. The site was most often sampled in the morning hours between 7:00 and 10:00.

Table 7: Descriptive parameters for Site 80910

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	23	441 ± 174	189	761
Water Temperature (°C)	23	17.1 ± 7.5	2.9	27.9
Dissolved Oxygen (mg/L)	22	4.1 ± 3.0	0.9	11.5
pH	23	7.1 ± 0.3	6.1	7.7

Site was sampled 15 times between 2/27/2013 and 2/4/2015

Air and water temperature

There were 19 air and 23 water temperature samples taken at this site. The mean water temperature was 17.1 °C and it ranged from a low of 2.9 °C in January of 2014 to 27.9 °C in June of 2014.

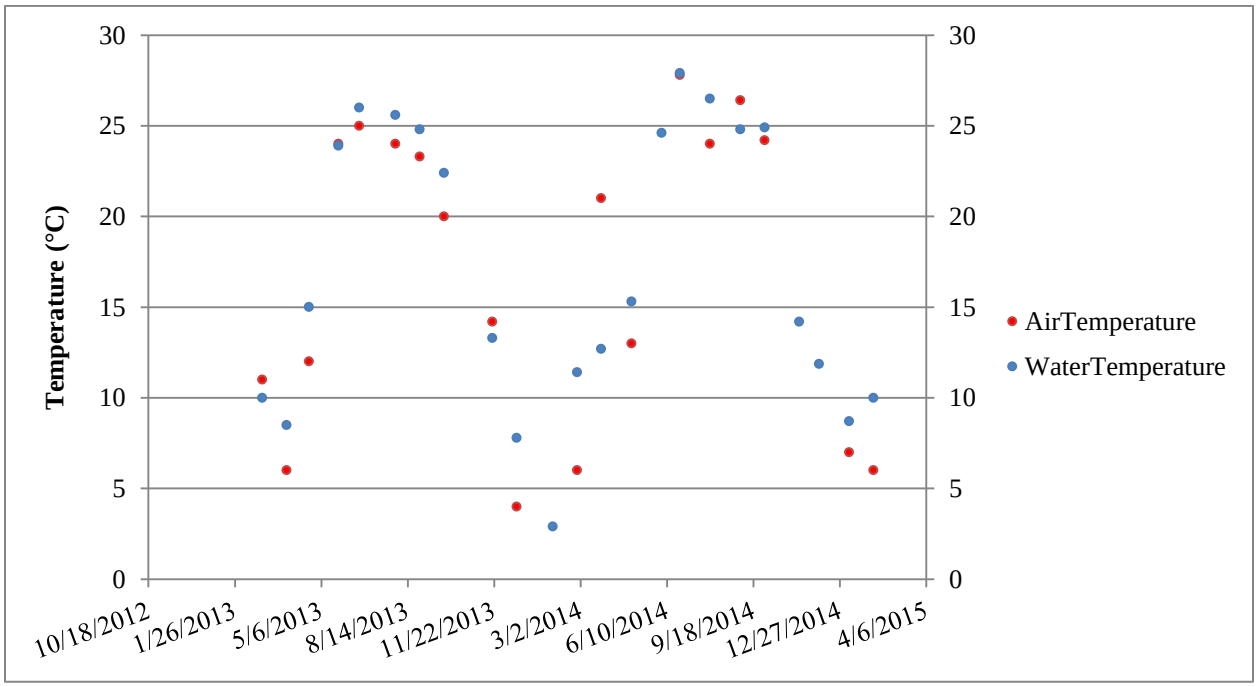

Figure 16: Air and water temperature at site 80910

Total Dissolved Solids

Citizen scientists recorded 23 total dissolved solids measurements at this site. The mean TDS concentration was 441 mg/L and it ranged from a low of 189 mg/L in January of 2015 to a high of 761 mg/L in April of 2014. There was a significant decrease in TDS over time at this site, and the R-squared value of 0.1798 conveys the sampling date accounts for approximately 18% of the variance in the dataset.

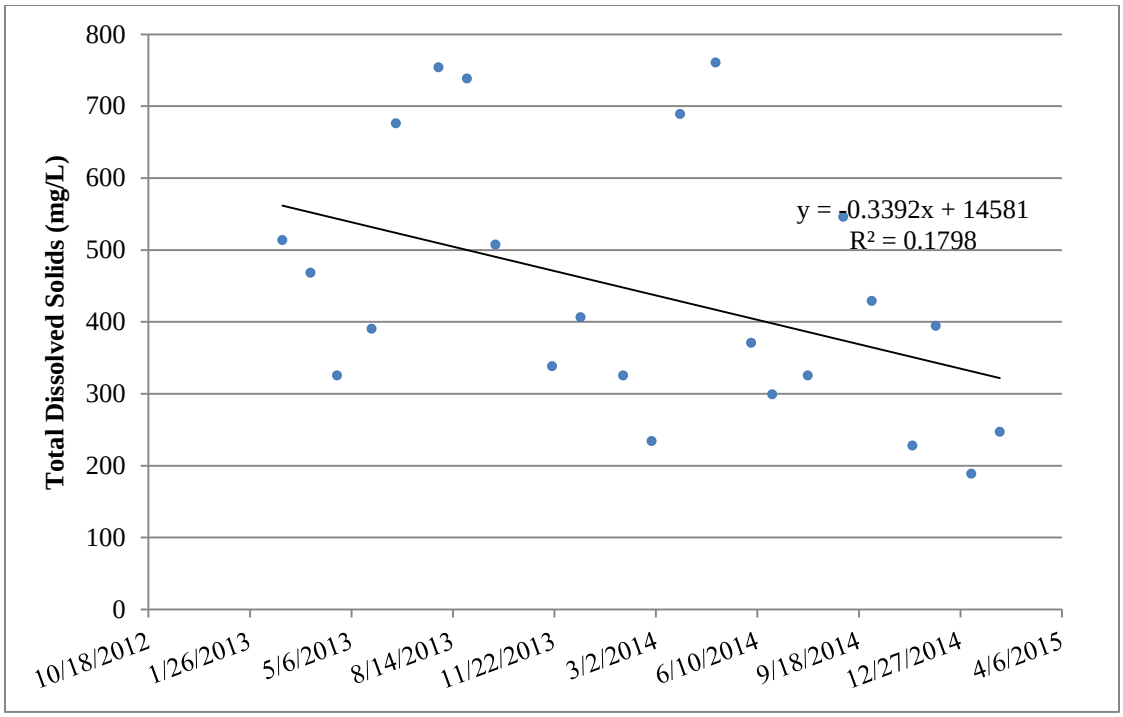

Figure 17: Total dissolved solids at site 80910

Dissolved Oxygen

Citizen scientists collected 22 dissolved oxygen samples from this site. The mean DO concentration was 4.1 mg/L. The minimum DO concentration was 0.9 mg/L and was recorded in June of 2013. The maximum DO concentration recorded was 11.5 in January of 2015. There was no significant correlation between DO concentrations and time observed at this site.

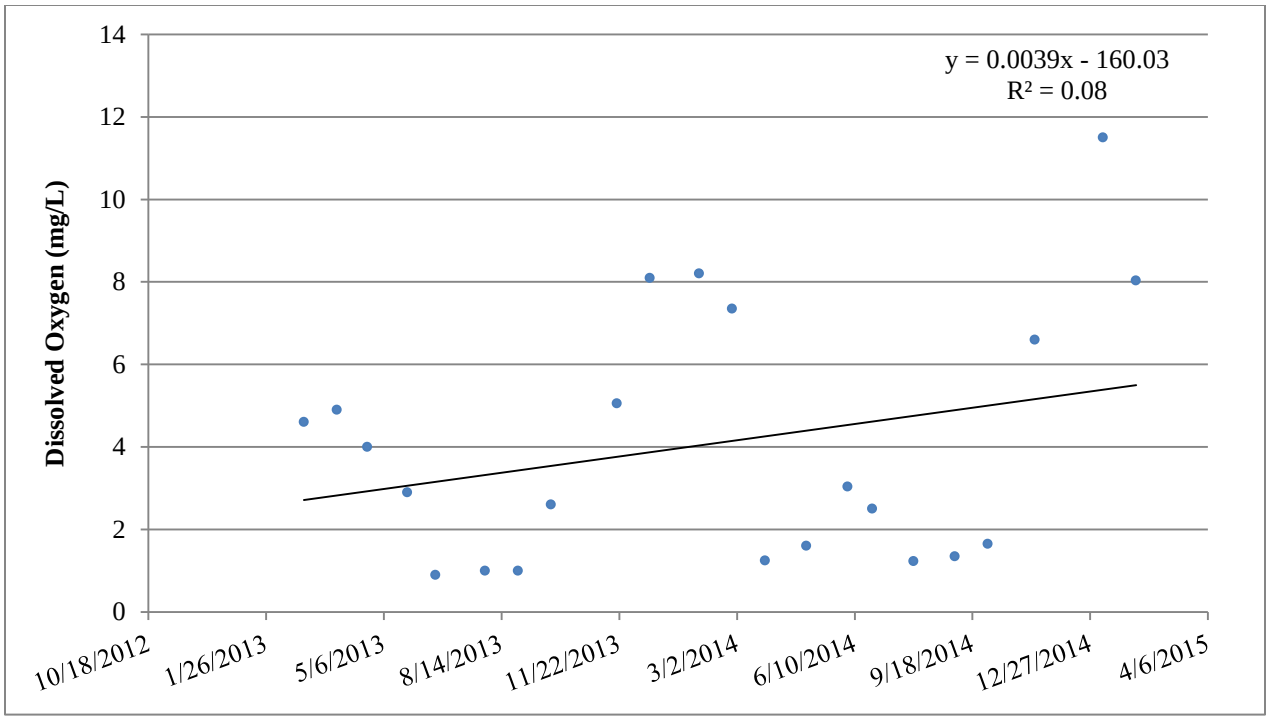

Figure 18: Dissolved oxygen at site 80910

pH

Citizen scientists took 23 pH measurements from this site. The mean pH was 7.1 and it ranged from a low of 6.1, recorded on November 2014, to a high of 7.7 in August of 2013. There was no significant relationship between pH and time observed at this site.

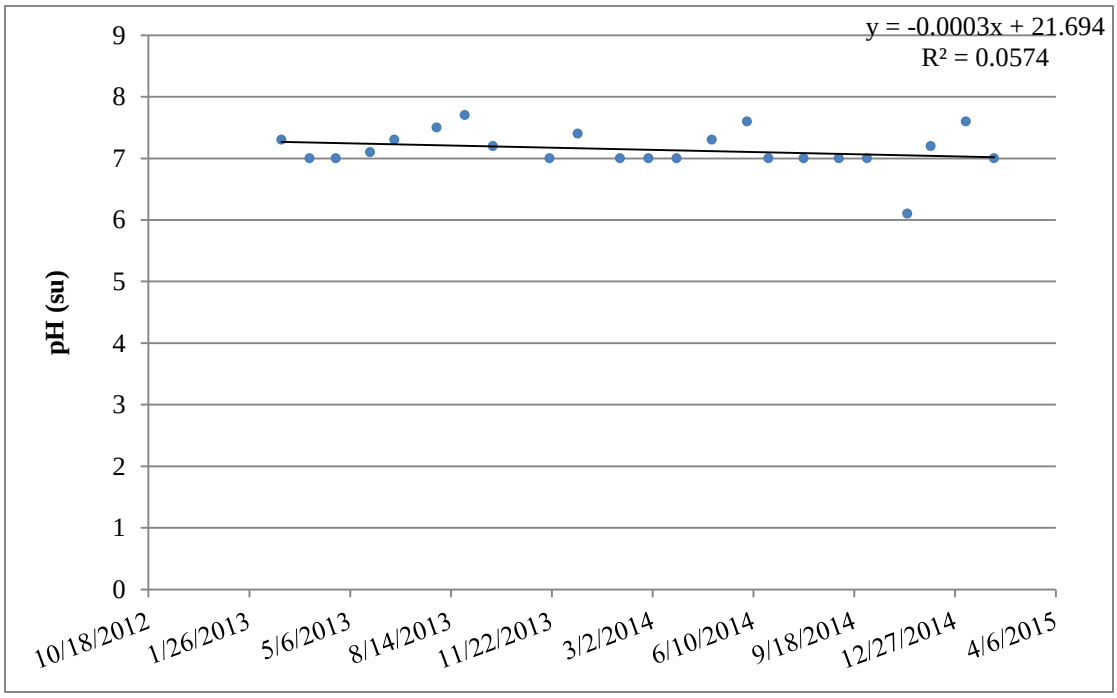

Figure 19: Observed pH values at site 80910

Field Observations

The flow at this site ranged from no flow, to low, to normal, with one instance of high flow recorded. The algae cover varied from absent to dominant. The water color was primarily tan, but it was also recorded as green/brown. Water clarity was usually clear with a few instances where it was recorded as cloudy.

Site 80912 – Burton Creek Downstream of Tanglewood Drive

Site Description

This site is located on the Burton Creek tributary to Carters Creek. It is in a residential neighborhood and downstream of the Tanglewood Drive bridge. The site is in a wooded area. The creek is shallow and the banks are concreted.

Sampling Information

This site was sampled 25 times between February 2013 and February 2015. The site was sampled in the morning between 7:00 and 9:00.

Table 8: Descriptive parameters for Site 80912

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	25	554 ± 251	150	1255
Water Temperature (°C)	25	16.3 ± 7.8	1.2	26.8
Dissolved Oxygen (mg/L)	21	6.5 ± 2.4	2.3	11.3
pH	25	7.9 ± 0.7	6.7	9.5

Site was sampled 21 times between 2/27/2013 and 2/6/2015.

Air and water temperature

There were 20 air and 25 water temperature measurements taken from this site. The mean water temperature was 16.3 °C. The water temperature ranged from a low of 1.2 °C in January 2014 to a high of 26.8 °C in July of 2013. The air temperature ranged from a low of 4.0 °C in December of 2013 to a high of 27.0 in June of 2014.

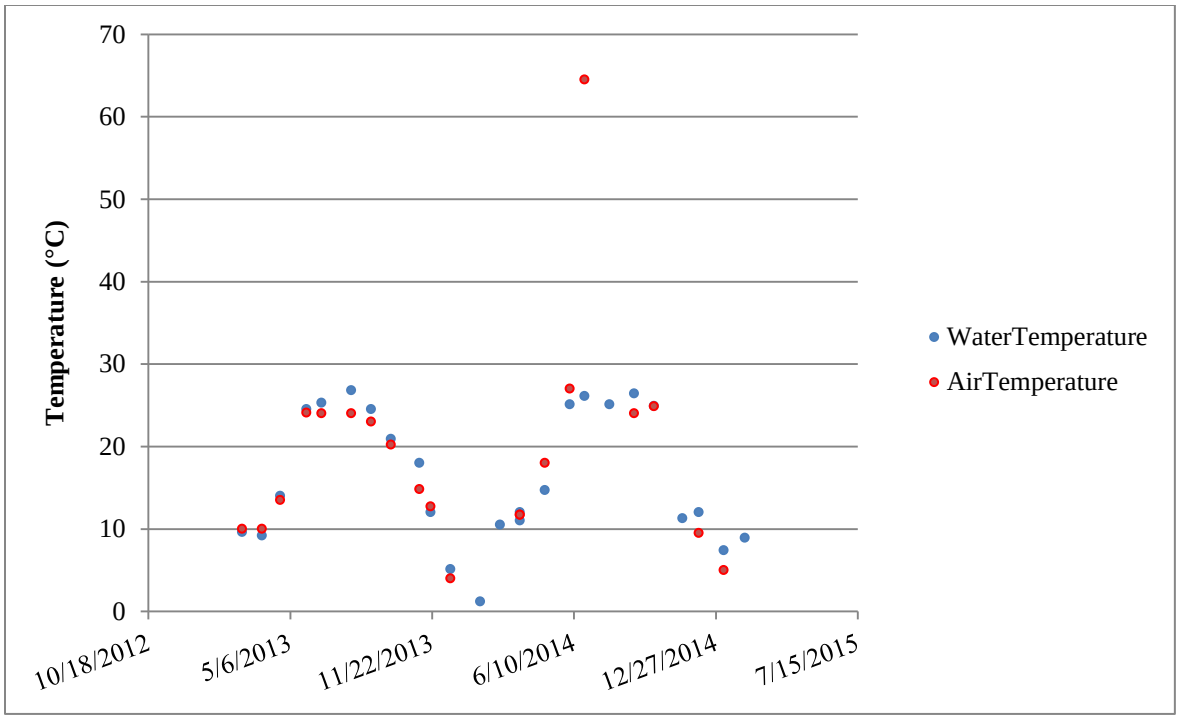

Figure 20: Air and water temperature at site 80912

Total Dissolved Solids

Citizen scientists recorded 25 total dissolved solids measurements at this site. The mean TDS concentration was 554 mg/L and it ranged from a low of 150 mg/L in December of 2014 to a high of 1255 in July of 2013. There was a significant decrease in TDS values over time (p=.025), and the R-squared value of 0.201 conveys the sampling date explains about 20% of the variance within the dataset.

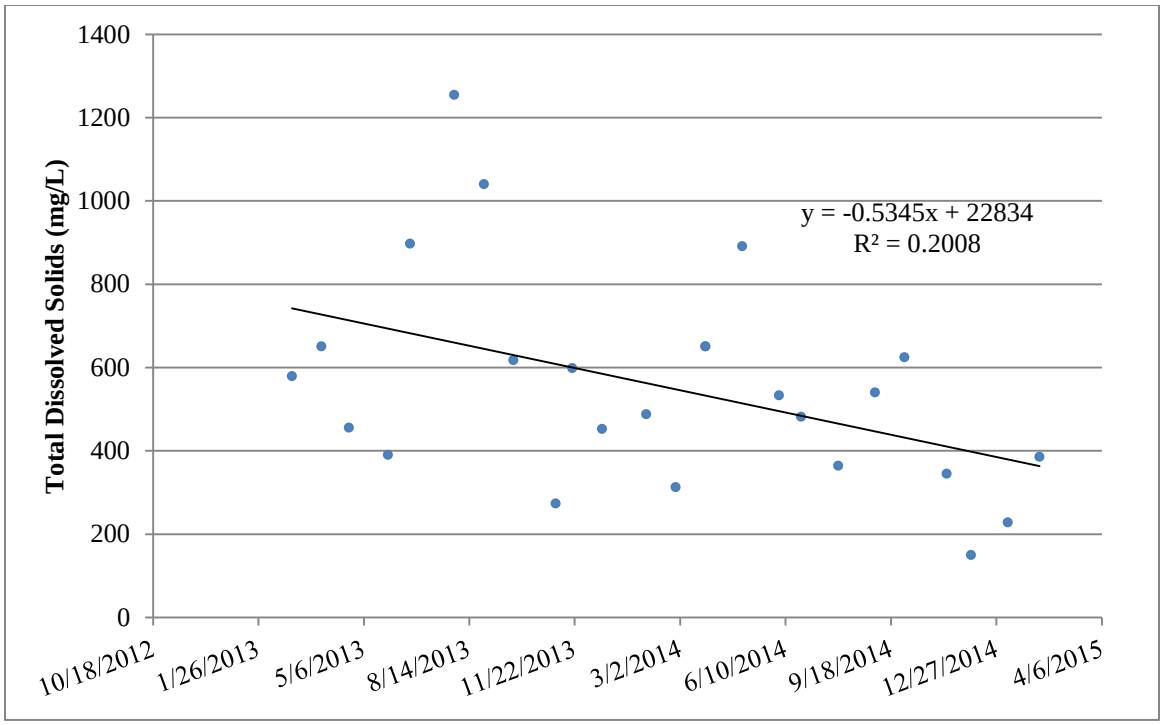

Figure 21: Total dissolved solids at site 80912

Dissolved Oxygen

Citizen scientists collected 21 dissolved oxygen samples at this site. The mean DO concentration was 6.5 mg/L and it ranged from a low of 2.3 mg/L in July of 2013 to a high of 11.3 mg/L in December of 2013. There was no significant relationship between DO concentrations and time observed at this site.

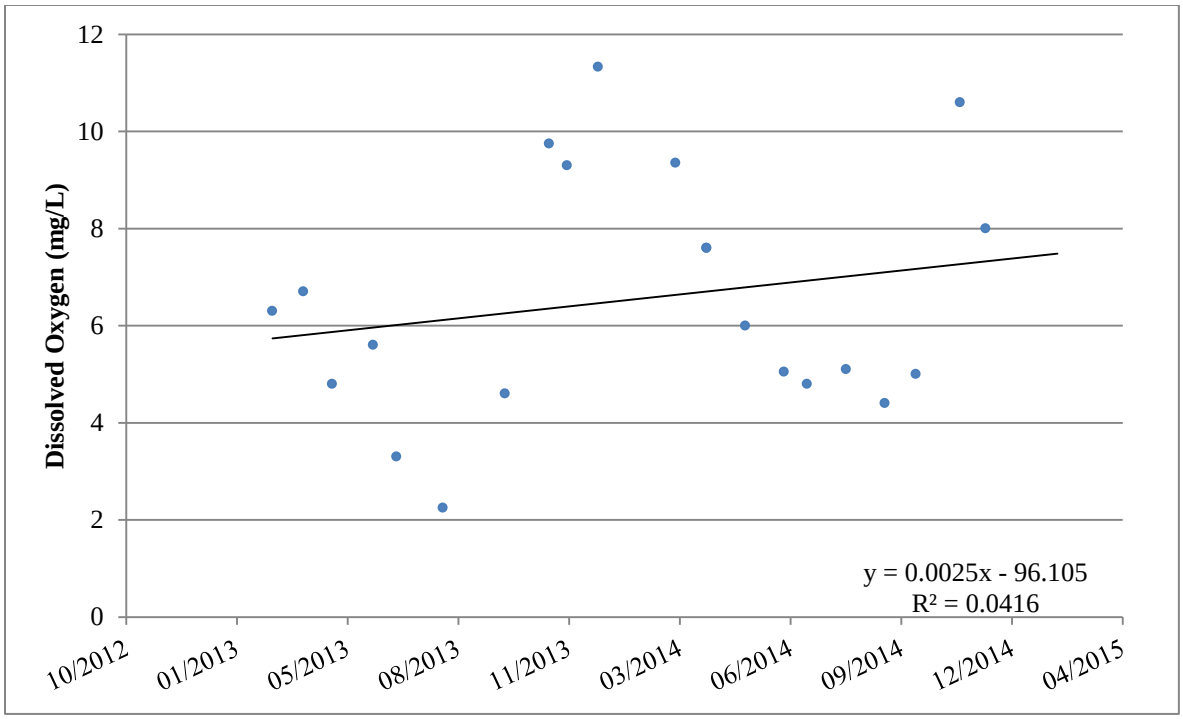

Figure 22: Dissolved Oxygen at site 80912

pH

Citizen scientists recorded 25 pH measurements at this site. The mean pH was 8.0 and it ranged from a low of 7.0 in February of 2014 to a high of 9.5 in July of 2013. There was a significant decrease in pH over time observed at this site ($p = 0.000$ and the high R^2 of 0.49 indicates a strong relationship between the two variables.

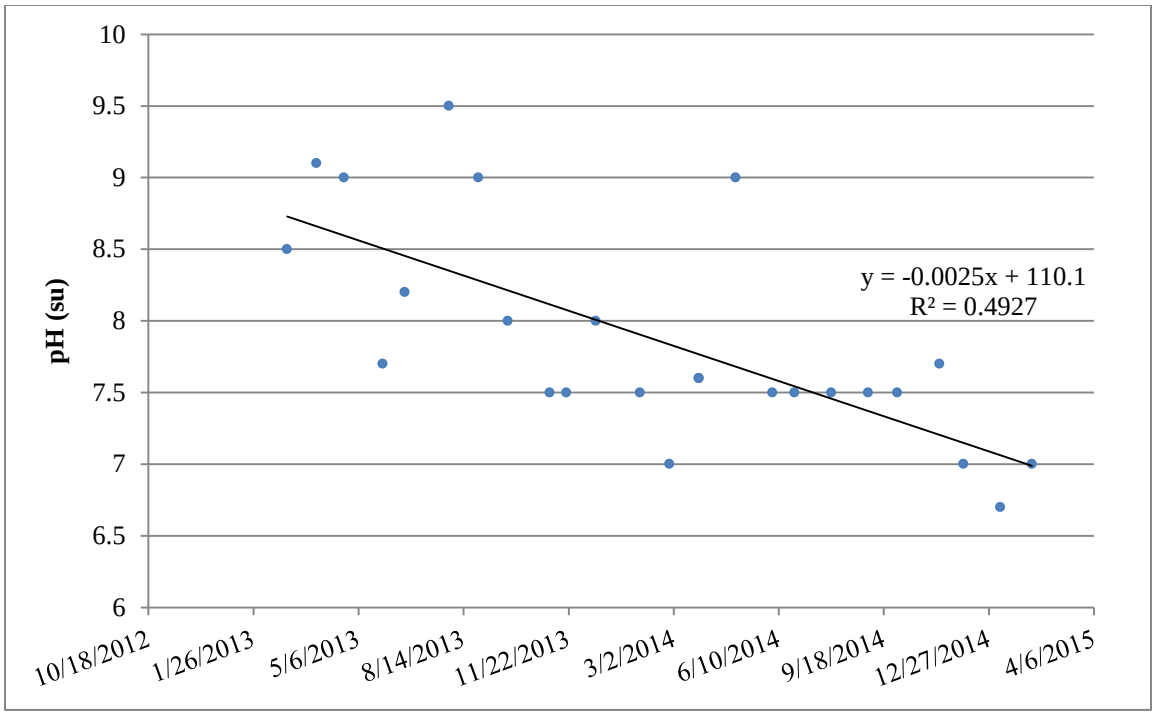

Figure 24: pH at site 80912

Field Observations

Flow was usually recorded as no flow, low, or average. There was one instance where flow was recorded as high. Algae was usually recorded as rare, but varied between common, abundant, and dominant on several occasions. Water color was recorded as tan or green/brown, and the water clarity was usually clear.

Site 80908 – Burton Creek at State Highway 6

Site Description

This site is located on the Burton Creek tributary to Carters Creek. The site is at the Highway 6 Bridge crossing the creek. The banks of the creek on both sides are concrete to support the bridge, but the site is downstream of an undeveloped wooded area. There is also a large shopping center to the south of the creek. A wastewater treatment plant effluent is located several hundred yards upstream of the site.

Sampling Information

This site was sampled 26 times between February 2013 and February 2015. The site was sampled in the morning between 7:00 and 9:00.

Table 9: Descriptive parameters for Site 80908

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	26	718 ± 221	72	891
Water Temperature (°C)	26	19.8 ± 6.5	8.8	28.9
Dissolved Oxygen (mg/L)	23	5.5 ± 1.7	3.0	9.6
pH	26	7.2 ± 0.3	7.0	8.0

Site was sampled 20 times between 2/27/2013 and 2/4/2015.

Air and water temperature

There were 21 air and 26 water temperature samples recorded at this site. The mean water temperature was 19.8 °C and ranged from a low of 8.8 °C in December 2013 to a high of 28.9 in September of 2014. The air temperature ranged from a low of 3.5 in March 2013 to a high of 28.2 °C in September 2014.

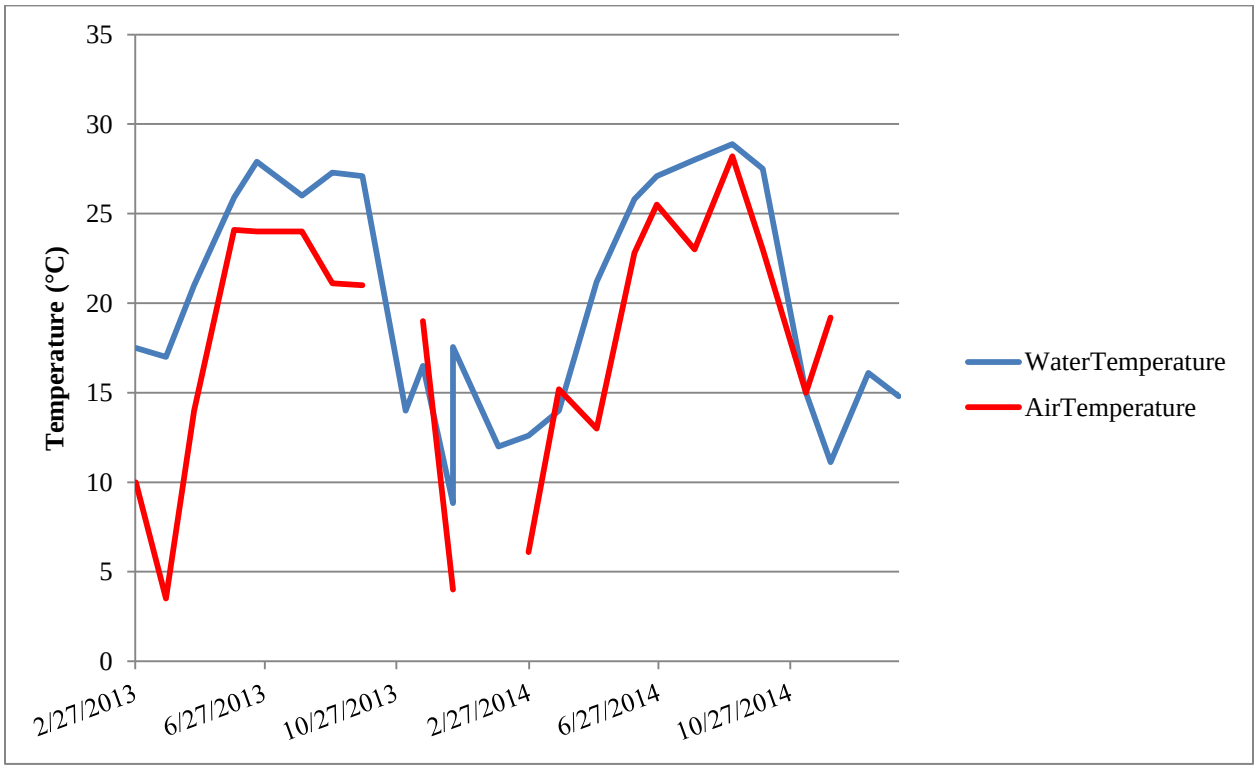

Figure 23: Air and water temperature at site 80908

Total Dissolved Solids

Citizen scientists collected 26 total dissolved solids measurements at this site. The mean TDS concentration was 718 mg/L and it ranged from a low of 72 mg/L in November of 2013 to a high of 891 mg/L in June of 2015. There was no significant increase or decrease in TDS concentrations over time observed at this site.

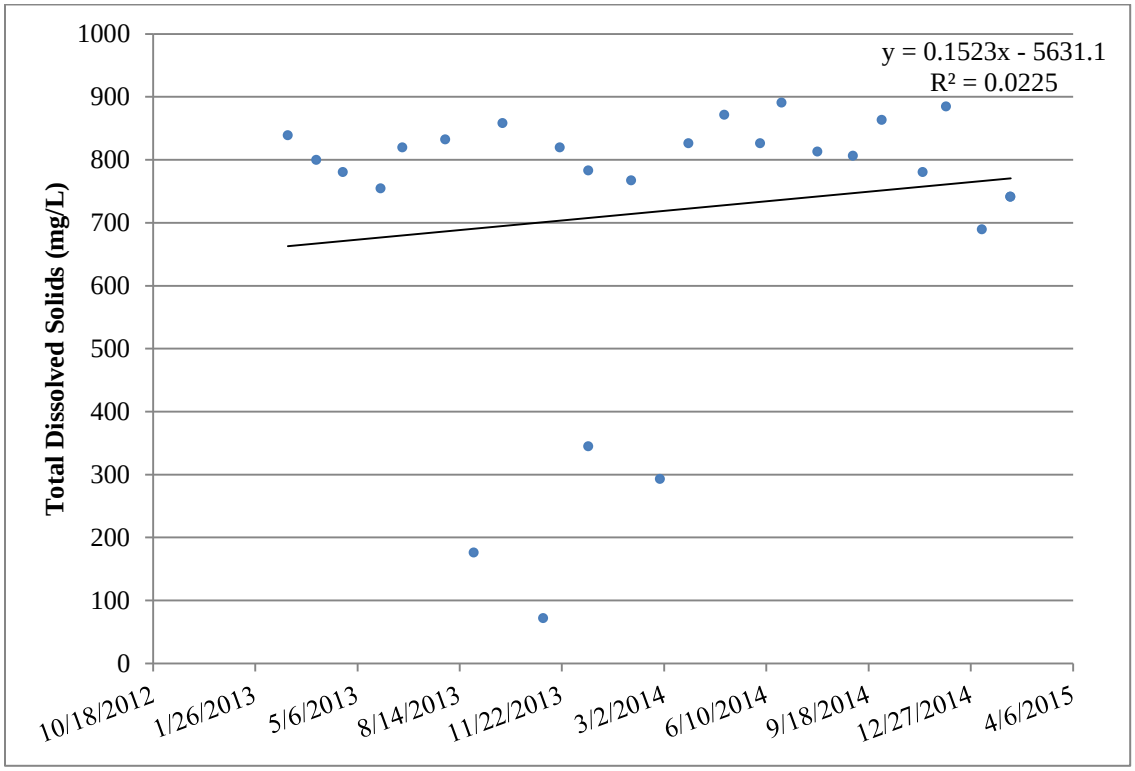

Figure 24: Total dissolved solids at site 80908

Dissolved Oxygen

Citizen scientists took 23 dissolved oxygen samples at this site. The mean DO concentration was 5.5 mg/L and it ranged from a low of 3.0 mg/L in August of 2013 to a high of 9.6 in December of 2013. There was no significant increase or decrease in dissolved oxygen over time observed at this site.

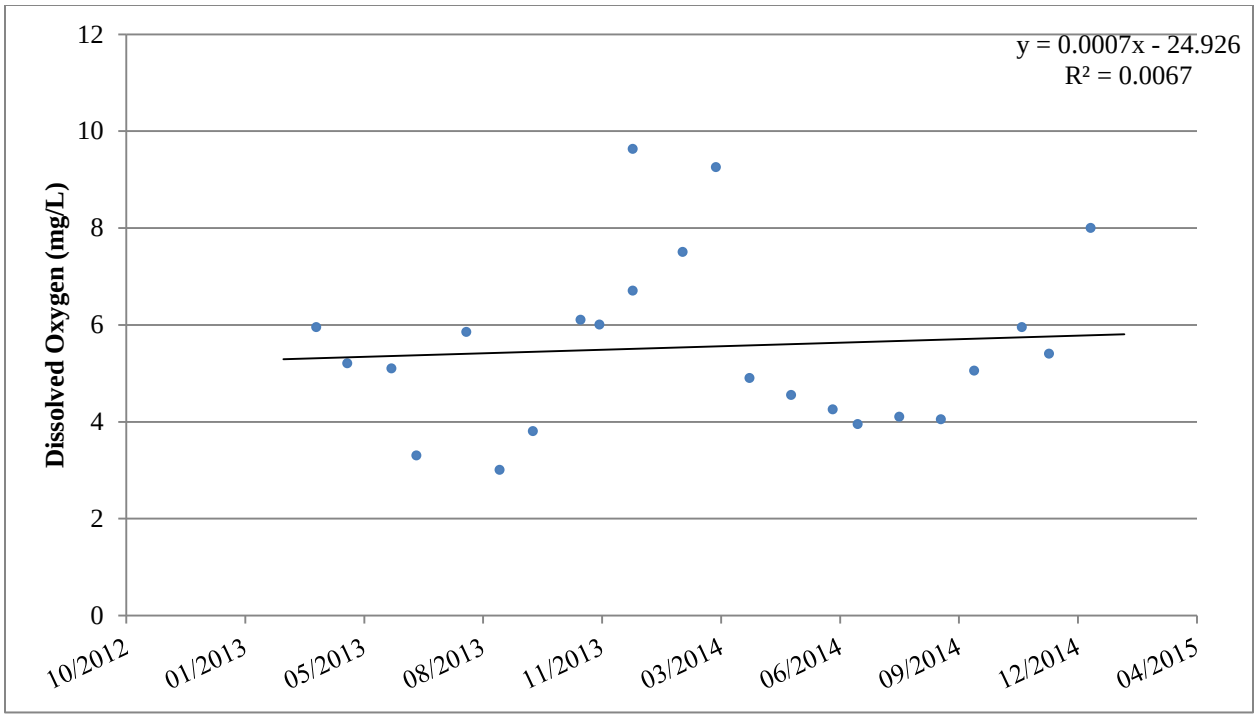

Figure 25: Dissolved oxygen at site 80908

pH

Citizen scientists took 26 pH measurements at this site. The mean pH was 7.2 and it ranged from a low of 7.0, recorded multiple times, to a high of 8.0 in December of 2013. There was no significant increase or decrease in pH over time observed at this site.

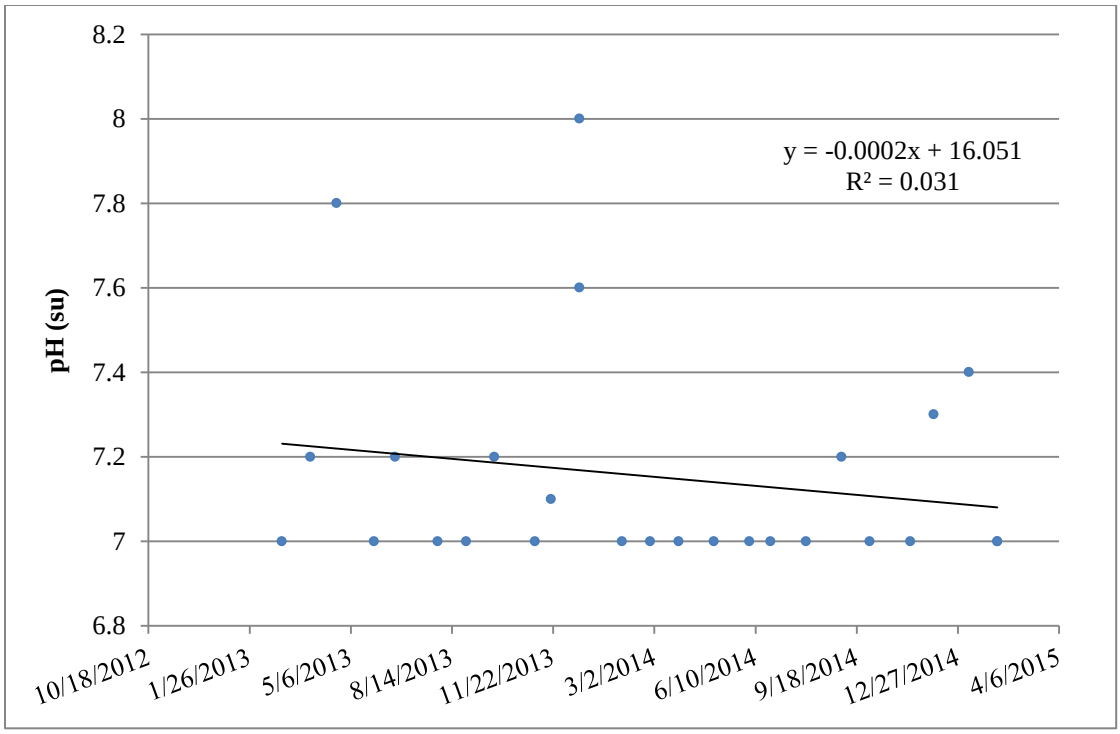

Figure 26: pH at site 80908

Field Observations

Flow was recorded as low or normal, except for one event when it was recorded as high. Algae cover was absent or rare. Water color recorded as having no color or a light green color. Water clarity was almost always clear.

Site 80917 – Hudson Creek at State Highway 30 and Harvey Road

Site Description

This site is on the Hudson Creek tributary to Carters Creek. The site is at the Harvey Road Bridge just north of Highway 30. There is a large shopping center on the south side of the creek upstream of the monitoring site, but this location is in a wooded, undeveloped area. There is a park with soccer fields on the north side of the creek, downstream of the monitoring site.

Sampling Information

This site was sampled 26 times between March 2013 and February 2015. Sampling at this site took place in the morning between 9:00 and 11:00.

Table 10: Descriptive parameters for Site 80917

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	25	407 ± 140	45	676
Water Temperature (°C)	26	18.3 ± 7.2	3.0	27.7
Dissolved Oxygen (mg/L)	25	4.9 ± 3.1	0.9	13.6
pH	26	7.2 ± 0.3	7.0	7.9

Site was sampled 21 times between 3/27/2013 and 2/4/2015.

Air and water temperature

There were 22 air and 26 water temperature samples collected at this site. The mean water temperature was 18.3 °C and it ranged from a low of 3.0 °C in January 2014 to a high of 27.7 °C in July 2013. The air temperature ranged from a low of 6.5 °C in February of 2015 to a high of 34.5 °C in September 2014.

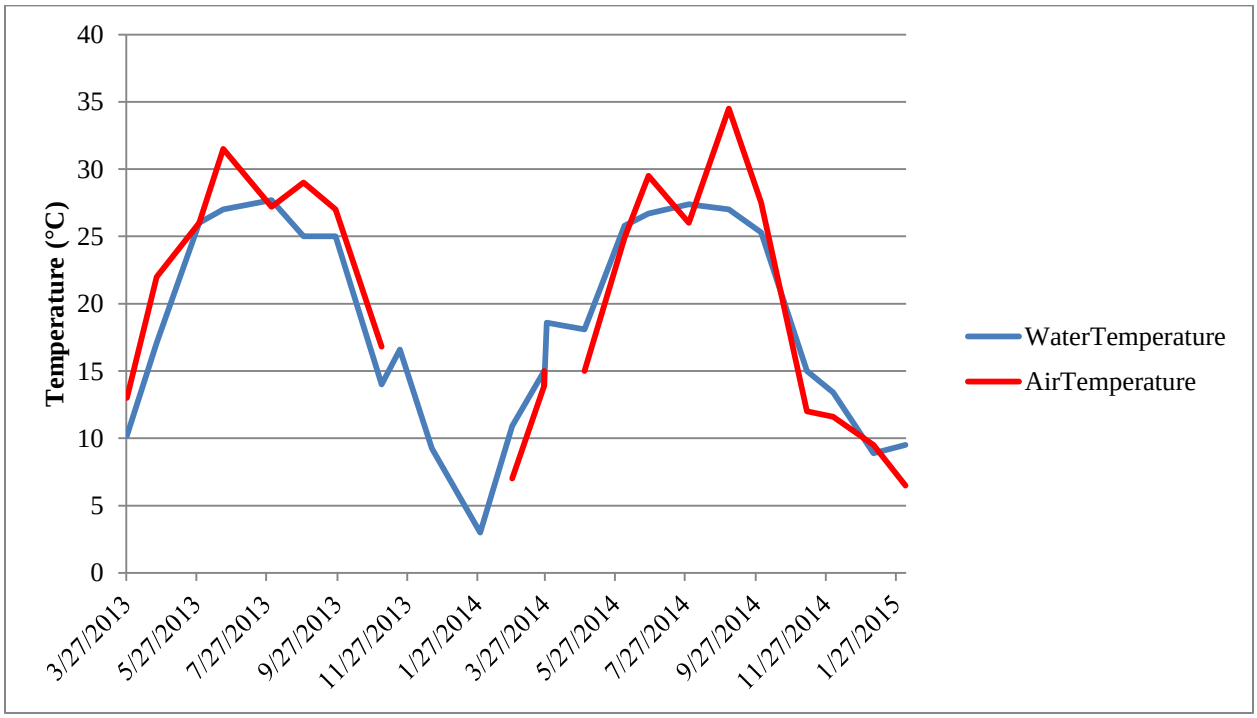

Figure 27: Air and water temperature at site 80917

Total Dissolved Solids

Citizen scientists collected 25 total dissolved solids measurements at this site. The mean TDS concentration was 407 mg/L and it ranged from a low of 45 mg/L in February of 2015 to a high of 676 mg/L in April of 2014. There was no significant relationship between TDS concentrations and time observed at this site.

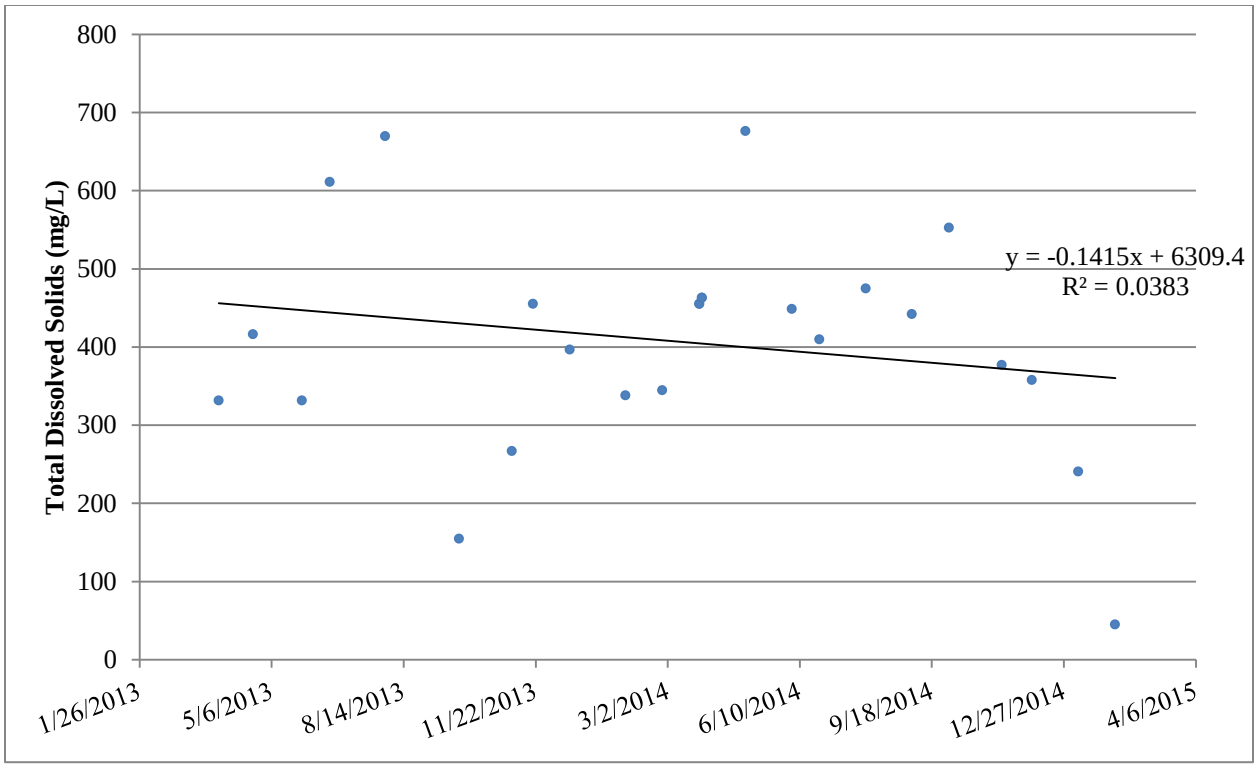

Figure 28: Total dissolved solids at site 80917

Dissolved Oxygen

Citizen scientists collected 25 dissolved oxygen samples at this site. The mean DO concentration was 4.9 mg/L and it ranged from a low of 0.9 mg/L in June of 2013 to a high of 13.6 mg/L in January of 2014. There was no significant increase or decrease in DO concentrations over time observed at this site.

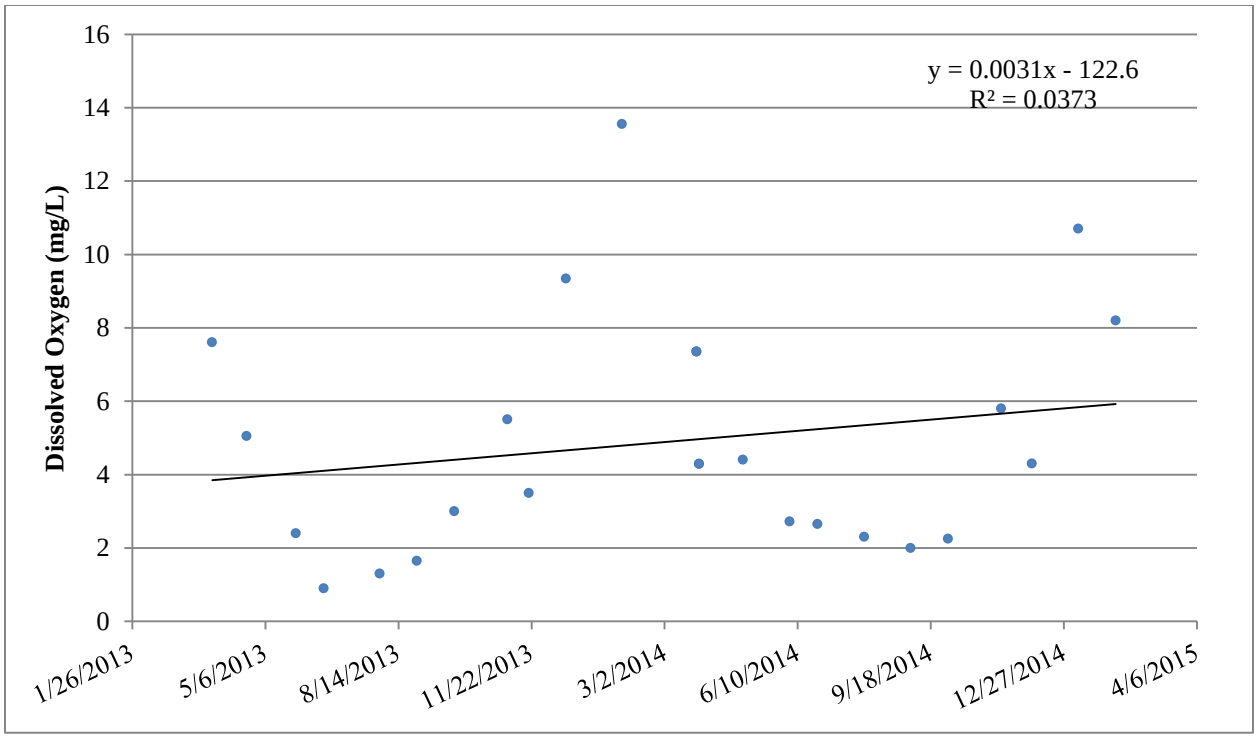

Figure 29: Dissolved oxygen at site 80917

pH

There were 26 pH samples taken at this site. The mean pH was 7.2 and it ranged from a low of 7.0, recorded many times, to a high of 7.9 in December of 2013. There was no significant increase or decrease in pH over time observed at this site.

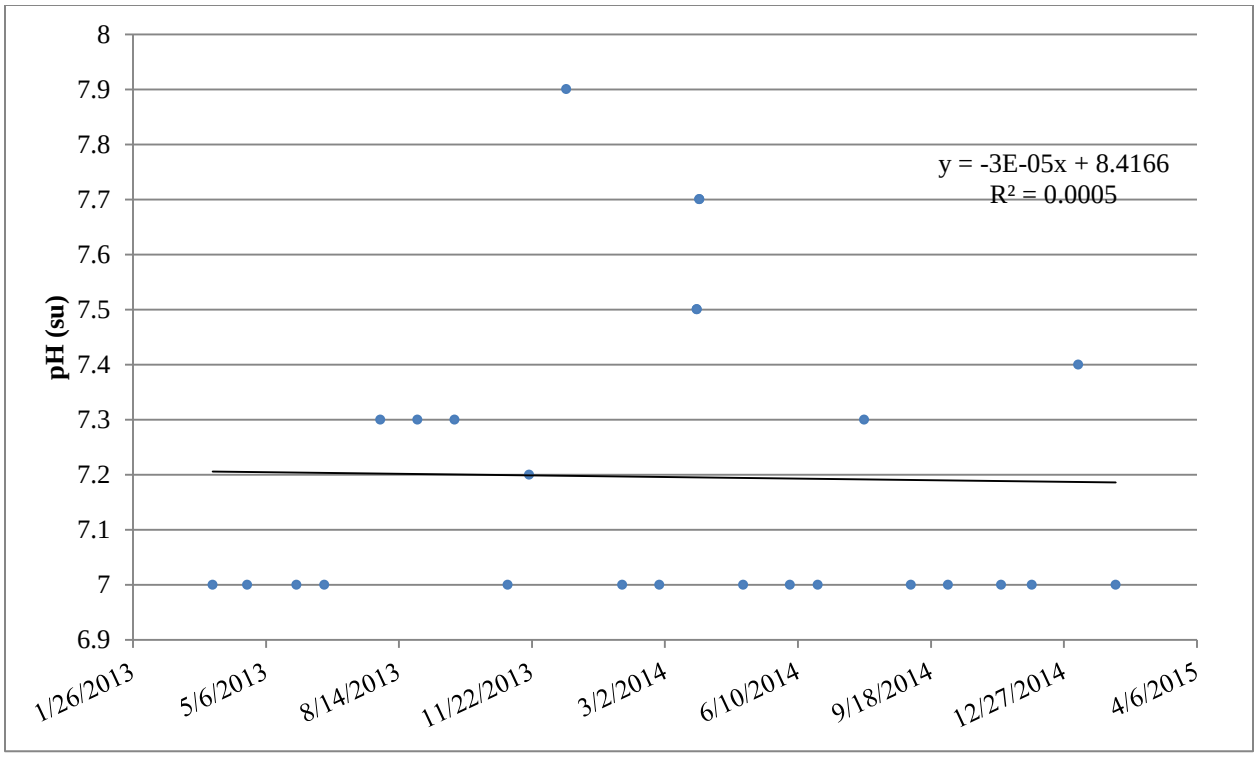

Figure 30: pH at site 80917

Field Observations

Flow at this site was recorded as low or normal. Algae cover was absent or rare. The water color was green/brown or tan. The water color ranged from clear, to cloudy, to turbid.

Site 80914 – Wolfpen Creek at Raintree Park

Site Description

This site was on the Wolfpen Creek tributary to Carters Creek. It is located in a small wooded park that lies between a residential neighborhood off of Raintree Dr. to the south, and a field for grazing to the north.

Sampling Information

This site was sampled 27 times between February 2013 and February of 2015. The site was sampled in the morning between the hours of 9:00 and 10:00.

Table 11: Descriptive parameters for Site 80914

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	26	782 ± 327	10	1755
Water Temperature (°C)	26	17.5 ± 7.8	1.5	27.5
Dissolved Oxygen (mg/L)	27	6.7 ± 2.1	3.4	11.8
pH	27	7.5 ± 0.4	6.9	8.4

Site was sampled 22 times between 3/27/2013 and 2/4/2015.

Air and water temperature

There were 22 air and 26 water temperature samples taken at this site. The mean water temperature was 18.3 °C and it ranged from a low of 1.5 °C in December of 2014 to a high of 27.5 °C in September of 2014. The air temperature ranged from a low of 7.0 °C in February of 2014 to a high of 30.0 °C in June of 2013 and July of 2014.

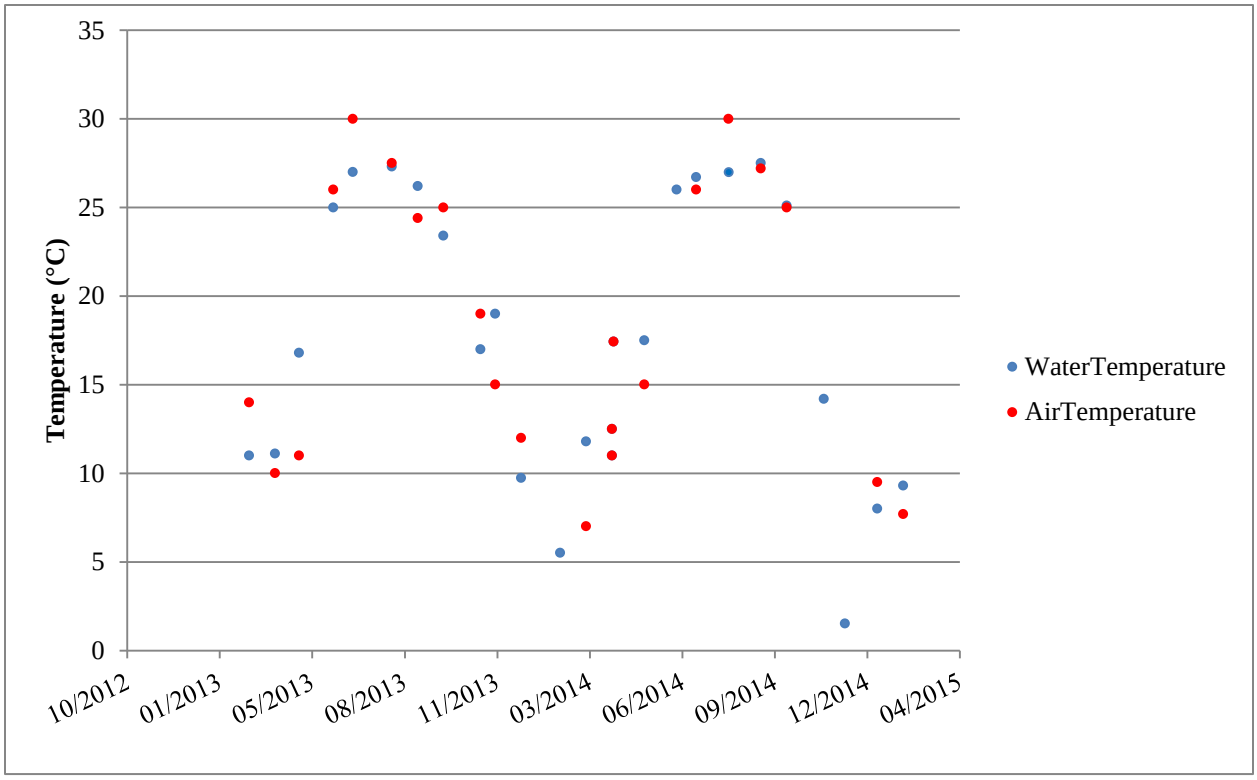

Figure 31: Air and water temperature at site 80914

Total Dissolved Solids

Citizen scientists collected 26 total dissolved solids measurements at this site. The mean TDS concentration was 782 mg/L and it ranged from a low of 10 mg/L in April of 2014 to a high of 1755 in June of 2013. There was no significant increase or decrease in TDS concentrations over time observed at this site.

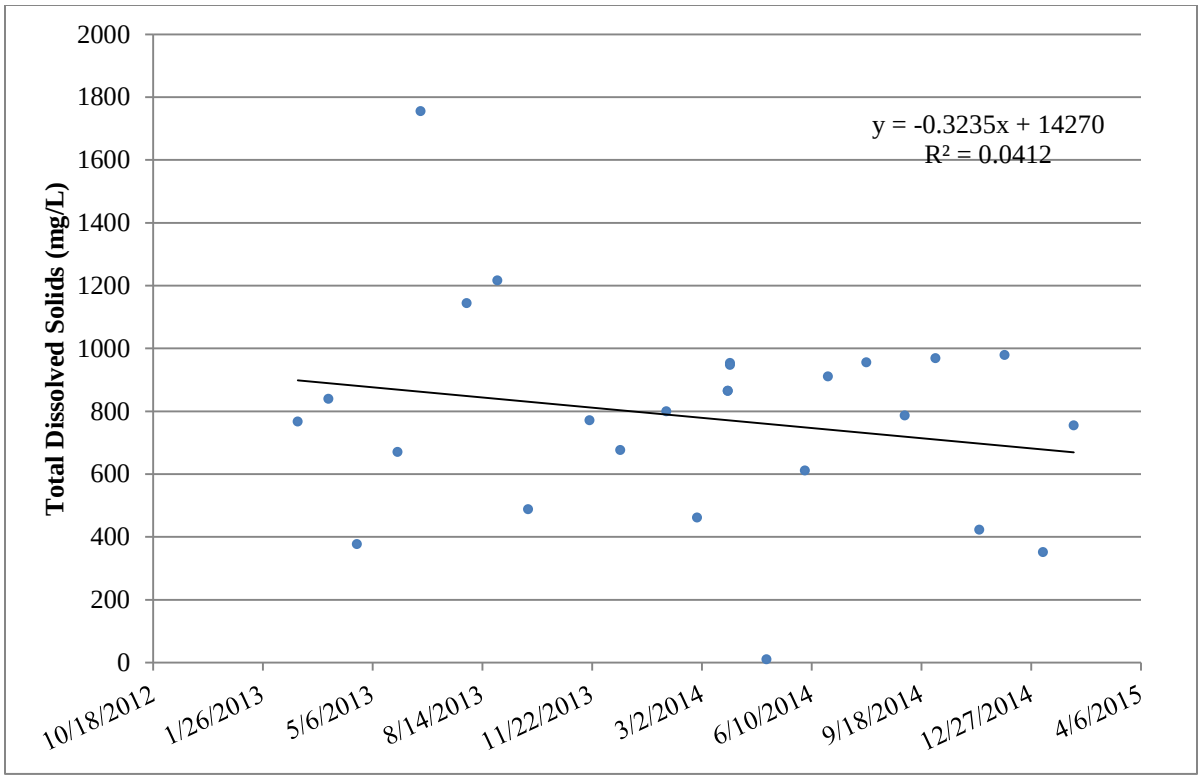

Figure 32: Total dissolved solids at site 80914

Dissolved Oxygen

Citizen scientists collected 27 dissolved oxygen samples from this site. The mean DO concentration was 6.7 mg/L and it ranged from a low of 3.4 mg/L in July of 2014 to a high of 11.8 mg/L in January of 2014. There was no significant increase or decrease in DO concentrations observed at this site.

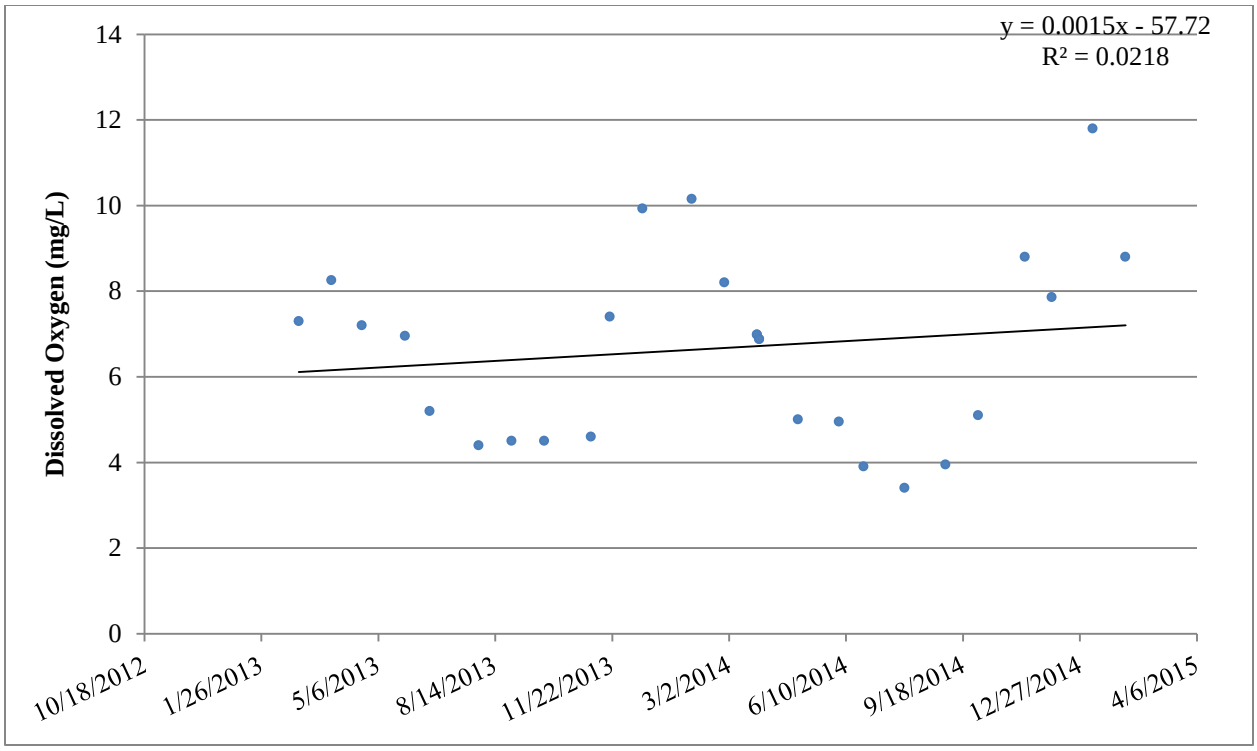

Figure 33: Dissolved oxygen at site 80914

pH

Citizen scientists collected a total of 27 pH measurements at this site. The mean pH was 7.5. The minimum pH was 6.9 and was recorded in June of 2013. The maximum pH was 8.4 and was recorded in December of 2013. There was no significant increase or decrease in pH over time observed at this site.

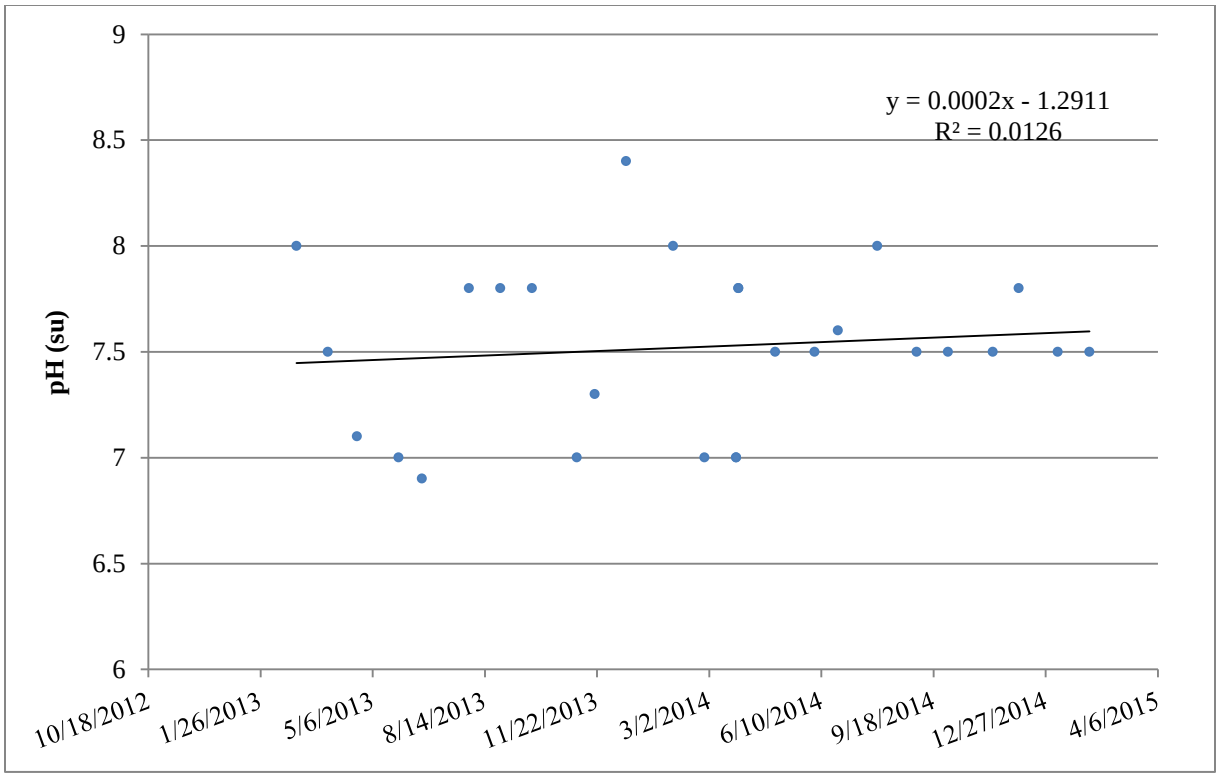

Figure 36: pH at site 80914

Field Observations

Flow was usually recorded as normal, but it was recorded as low for a few instances. Algae cover was recorded as absent or rare. Water color was usually tan or brown/green, and water clarity was usually clear or cloudy.

Site 80916 – Carters Creek above CCWWTF

Site Description

This site is located on a sand bar along the banks of Carters Creek and is located immediately upstream of a waste water treatment plant effluent. The area surrounding this site is undeveloped and is a mixture of trees and grassland.

Sampling Information

This site was sampled 28 times between February 2013 and February 2015. The sampling time was usually in the morning to early afternoon from 10:00 to 13:00.

Table 12: Descriptive parameters for Site 80916

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	28	695 ± 200	68	1098
Water Temperature (°C)	27	20.9 ± 7.1	9.2	30.6
Dissolved Oxygen (mg/L)	28	9.2 ± 2.5	4.1	13.6
pH	28	8.3 ± 0.4	7.5	8.8

Site was sampled 21 times between 2/27/2013 and 2/4/2015.

Air and water temperature

There were 11 air and 27 water temperature samples taken at this site. The mean water temperature was 20.9 °C and ranged from a low of 9.2 °C to a high of 30.6 °C in July of 2013. The air temperature ranged from 5.0 °C in February of 2014 to a high of 32.2 °C in September of 2014.

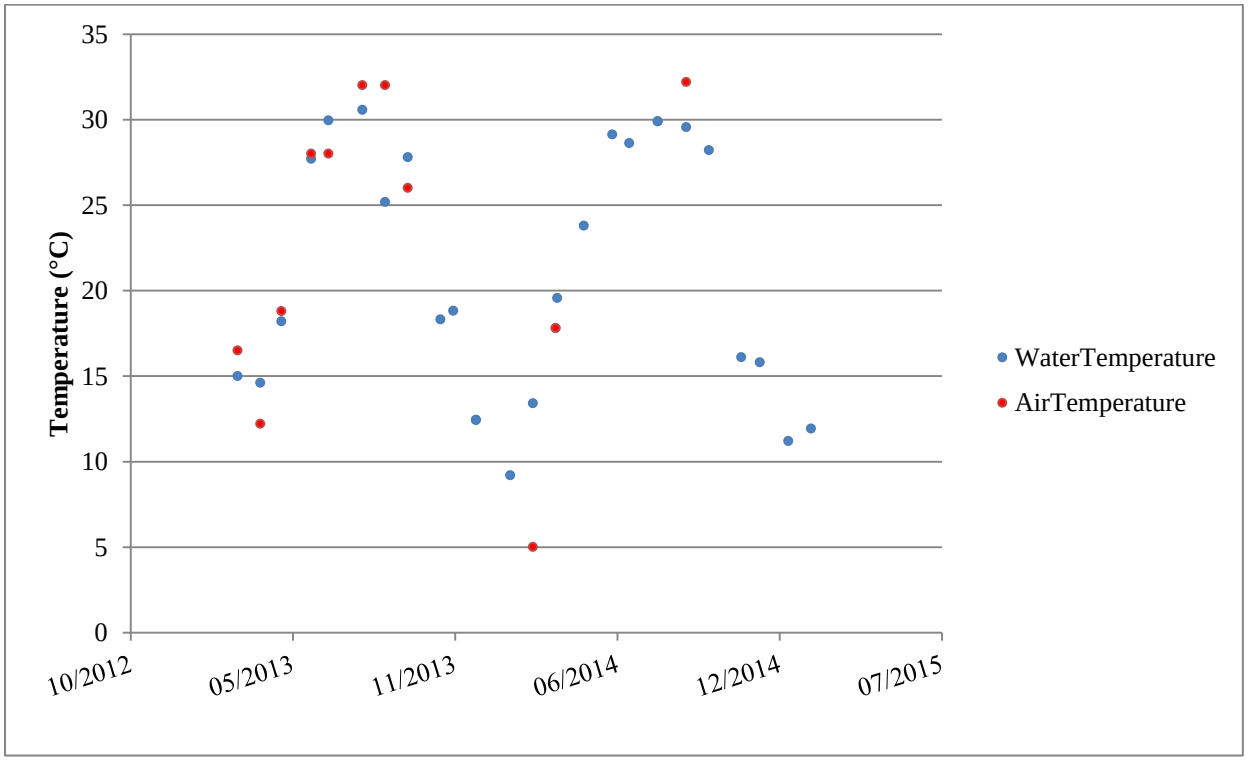

Figure 34: Air and water temperature at site 80916

Total Dissolved Solids

There were 28 total dissolved solids measurements taken at this site. The mean TDS concentration was 695 mg/L at this site and it ranged from a low of 68 mg/L in July 2014 to a high of 1098 mg/L in February of 2015. There was no significant increase or decrease in TDS concentrations over time observed at this site.

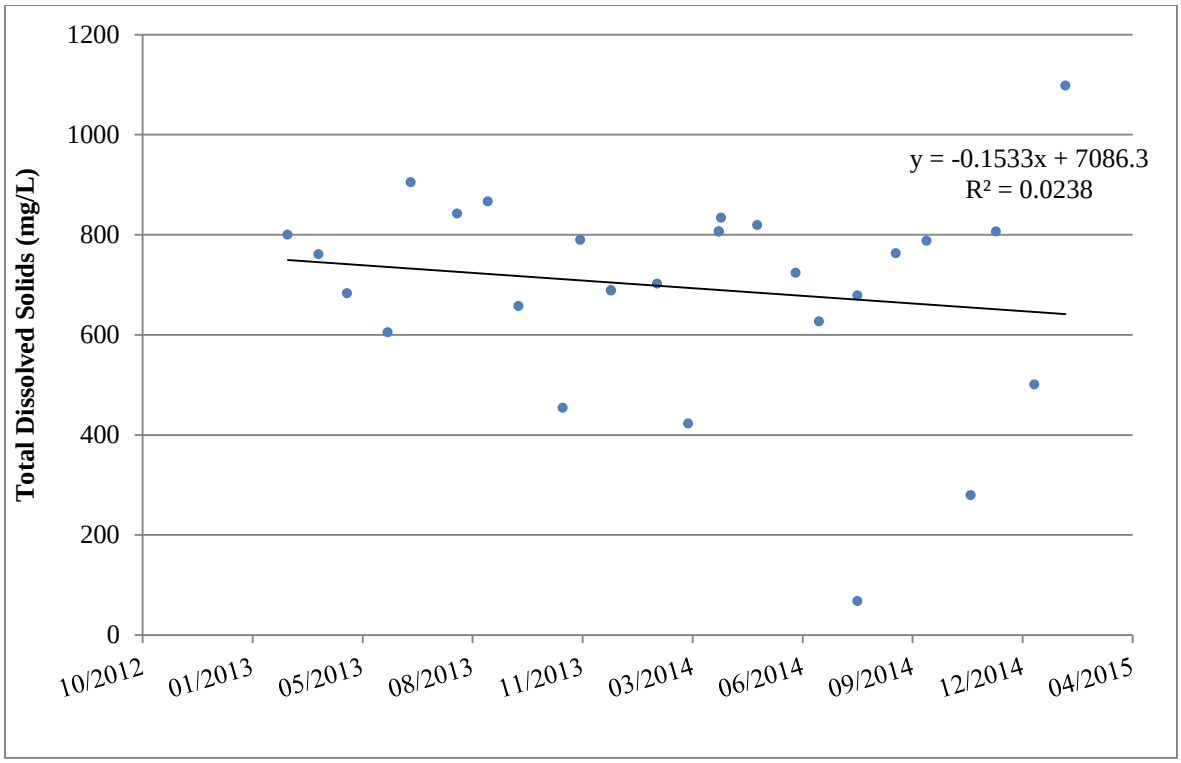

Figure 38: Total dissolved solids at site 80916

Dissolved Oxygen

Citizen scientists collected 28 dissolved oxygen samples at this site. The mean DO concentration was 9.2 mg/L and it ranged from a low of 4.1 mg/L in May of 2013 to a high of 13.6 in December of 2013. There was no significant increase or decrease in DO concentrations observed over time at this site.

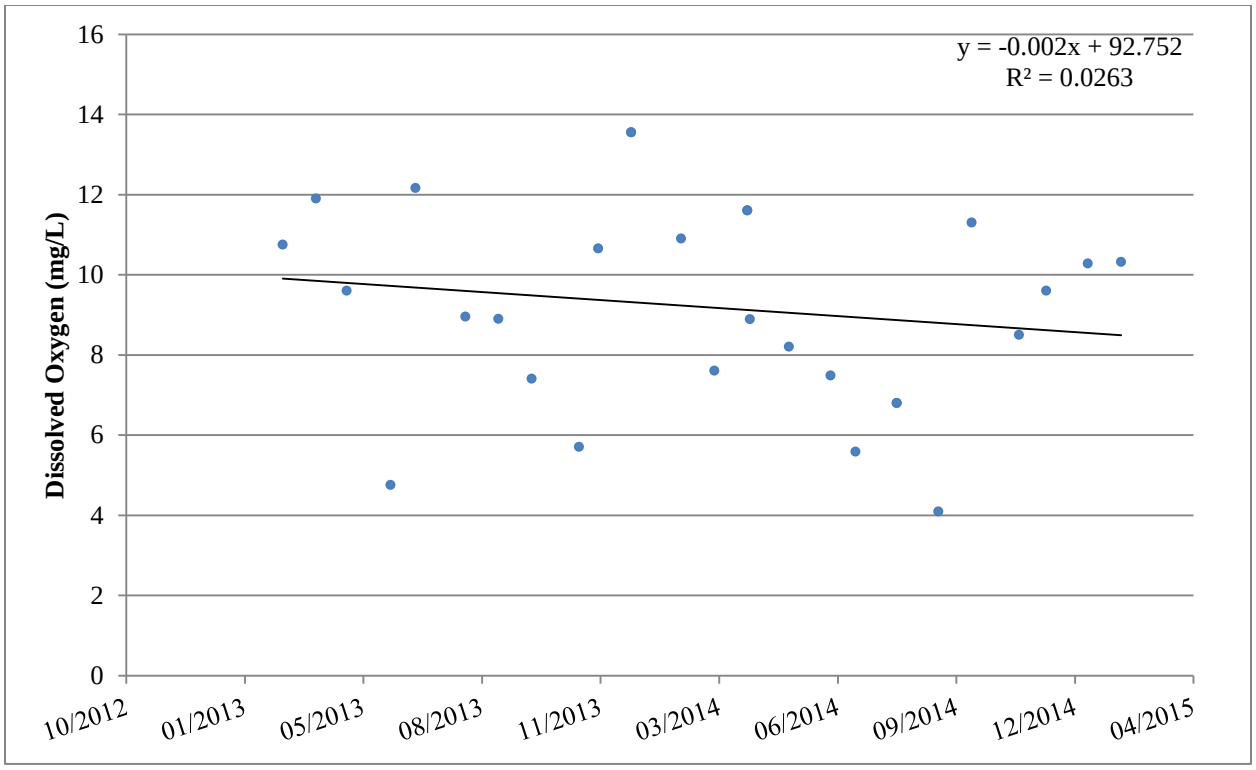

Figure 35: Dissolved oxygen at site 80916

pH

Citizen scientists took 28 pH measurements at this site. The mean pH was 8.3 and it ranged from a low of 7.5 in May of 2013 to a high of 8.8 in June and July of 2013. There was no significant increase or decrease in pH values observed over time at this site.

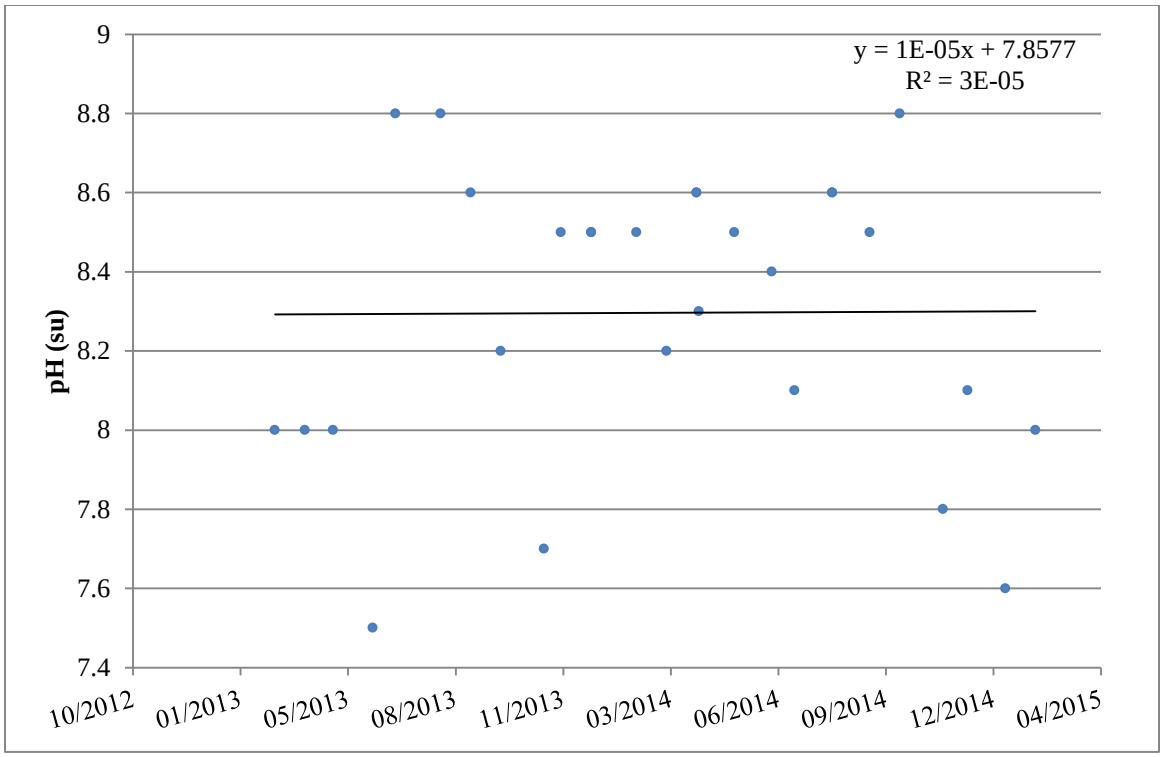

Figure 36: pH at site 80916

Field Observations

Flow was recorded as low or normal at this site. There was one instance where it was recorded as high, and one instance where it was recorded as no flow. Algae cover was mostly absent at this site. The water color was described as tan or green/brown. The water clarity was clear or cloudy.

Site 80913 – Carters Creek below CCWWTF

Site Description

This site is located in the same stretch of undeveloped land as site 80916, but it is several hundred yards downstream of the wastewater effluent. The north bank of the creek is heavily wooded while the south side of the creek is cleared pastureland for grazing. Both sides of the creek have a strip of riparian trees and grasses.

Sampling Information

This site was sampled 26 times between February 2013 and February of 2015. The site was usually sampled in the morning between the hours of 10:00 and 12:00.

Table 13: Descriptive parameters for Site 80913

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	26	701 ± 168	112	1215
Water Temperature (°C)	25	22.2 ± 6.7	4.4	31.1
Dissolved Oxygen (mg/L)	25	8.7 ± 1.4	6.1	12.2
pH	26	8.1 ± 0.3	7.2	8.6

Site was sampled 21 times between 2/26/2013 and 2/4/2015.

Air and water temperature

There were 11 air and 25 water temperature samples taken at this site. The mean water temperature was 22.2 °C and it ranged from a low of 4.4 °C in February 2013 to a high of 31.1 °C in September of 2014. The air temperature ranged from a low of 5.0 °C in February 2014 to a high of 32.0 °C in July and August of 2013.

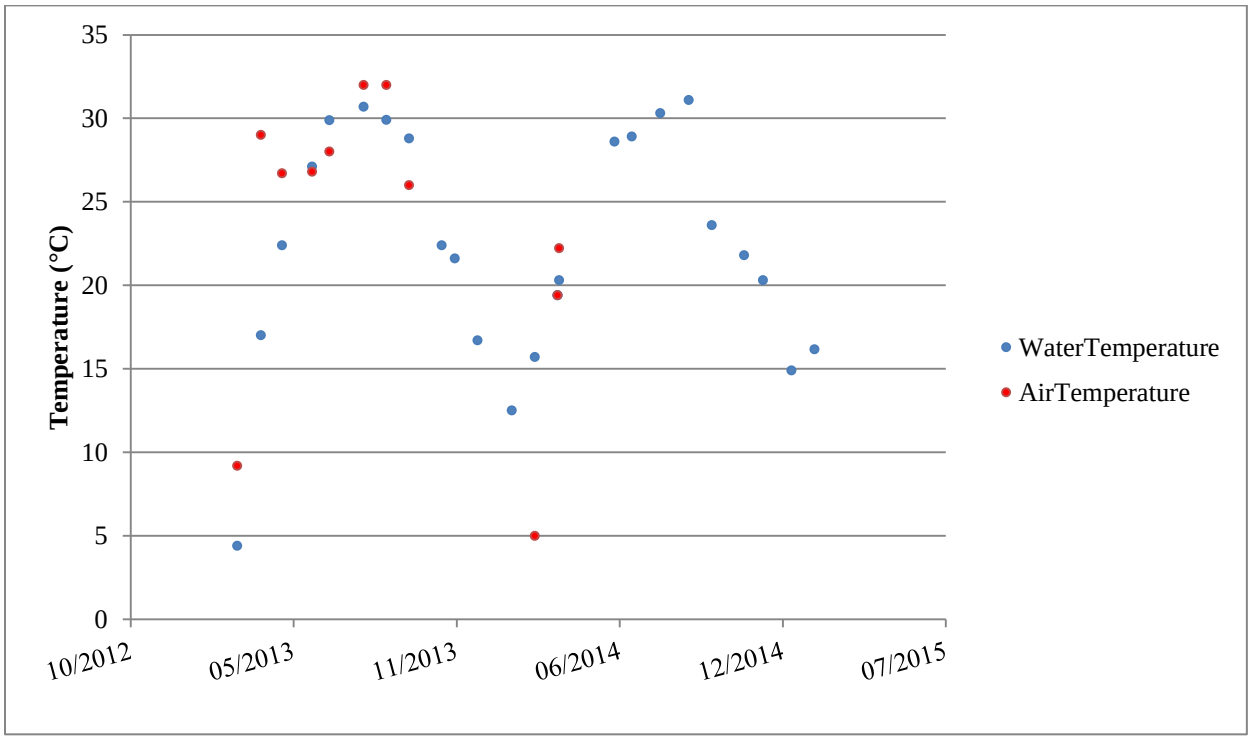

Figure 37: Air and water temperature at site 80913

Total Dissolved Solids

There were 26 total dissolved solids measurements taken at this site. The mean TDS concentration was 701 mg/L and it ranged from a low of 112 mg/L in February 2013 to a high of 1215 mg/L in February of 2015. There was a significant increase in TDS values observed over time at this site (p=.04). The R-squared value of 0.16 suggests the sampling date accounts for about 16% of the variance within the dataset.

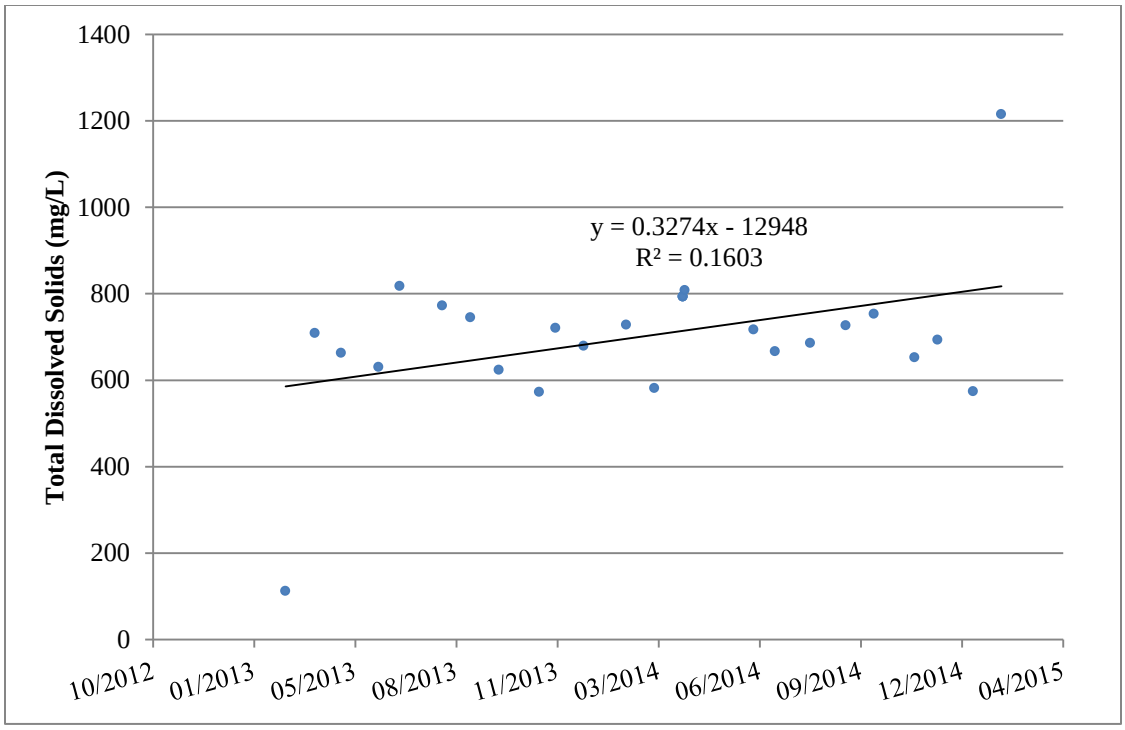

Figure 42: Total dissolved solids at site 80913

Dissolved Oxygen

Citizen scientists collected 25 dissolved oxygen measurements at this site. The mean DO concentration was 8.7 and it ranged from a low of 6.1 mg/L in May of 2013 to a high of 12.2 mg/L in January of 2014. There was no significant increase or decrease in dissolved oxygen over time observed at this site.

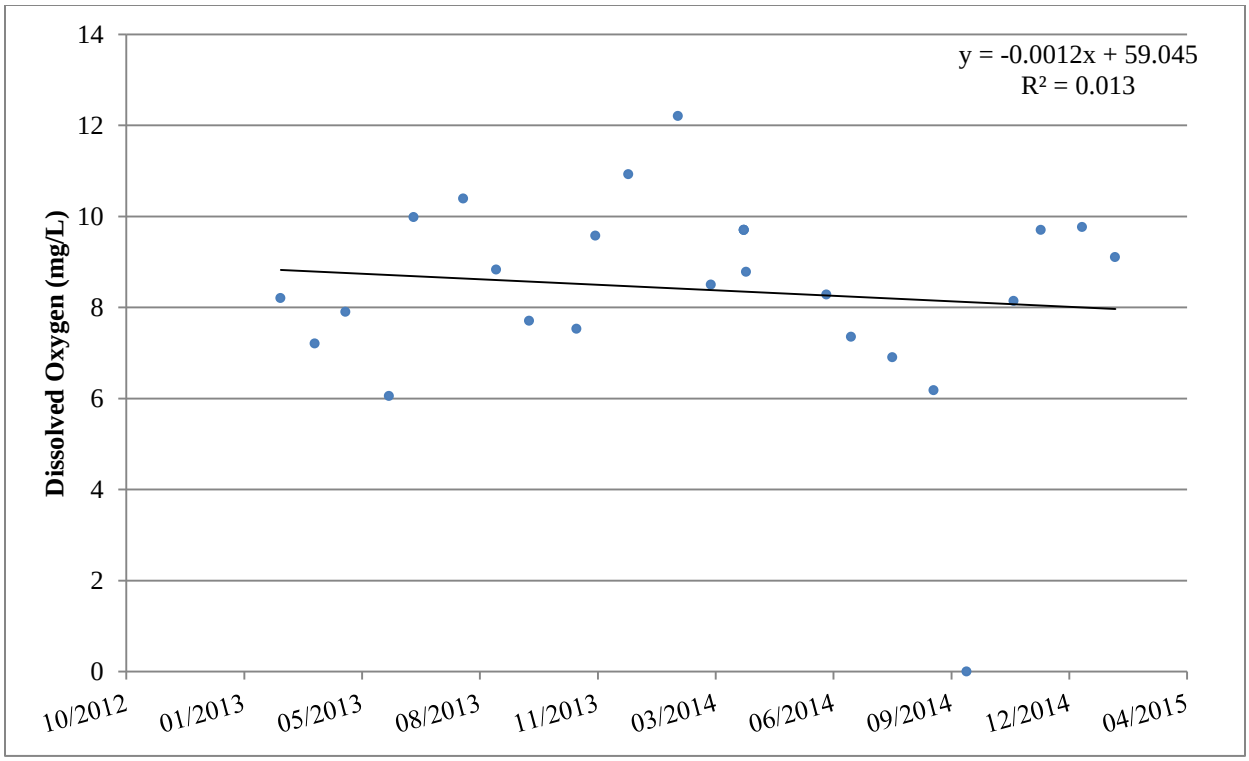

Figure 43: Dissolved oxygen at site 80913

pH

There were 26 pH measurements taken at this site. The mean pH was 8.1 and it ranged from a low of 7.2 in March 2013 to a high of 8.6 in July of 2013. There was no significant increase or decrease in pH over time observed at this site.

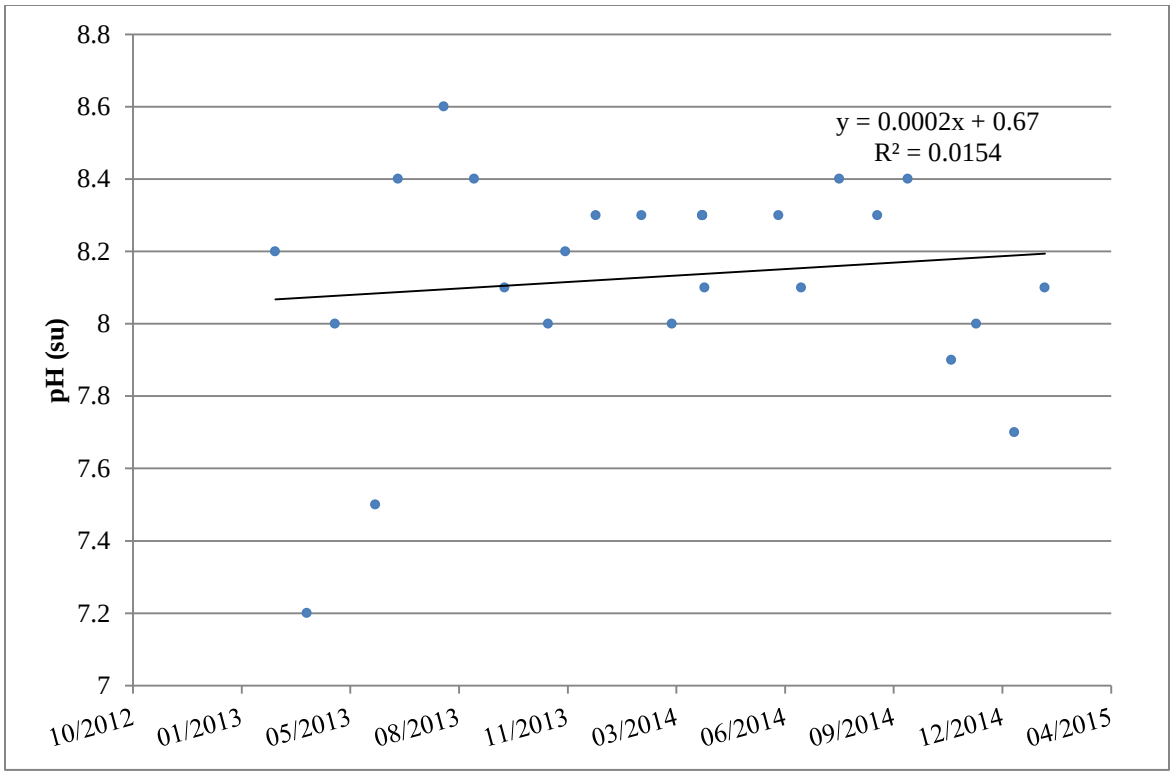

Figure 44: pH at site 80913

Field Observations

Flow was recorded as normal with a few instances where it was low. There were two recordings of high flow at this site. Algae cover was absent at this site. The water color was tan and the water was described as clear.

Site 80911 – Bee Creek at Appomattox

Site Description

This site is located on the Bee Creek tributary to Carters Creek at the Appomattox Street Bridge. There is a confluence of a drainage ditch with the creek just upstream of this site. The site is in a wooded area and abuts a residential neighborhood to the north. Emerald Forest Park is on the south side of the creek.

Sampling Information

This site was sampled 36 times between February 2013 and February 2015. Sampling usually took place in the morning hours between 7:00 and 12:00.

Table 14: Descriptive parameters for Site 80911

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	36	567 ± 191	221	887
Water Temperature (°C)	35	19.5 ± 7.2	4.7	29.6
Dissolved Oxygen (mg/L)	36	6.6 ± 2.5	1.4	11.7
pH	36	7.4 ± 0.4	6.9	8.4

Site was sampled 36 times between 2/27/2013 and 2/4/2015.

Air and water temperature

There were 27 air and 35 water temperature measurements taken at this site. The mean water temperature was 19.5 ℃ and it ranged from a low of 4.7 ℃ in January of 2014 to a high of 29.6 ℃ in September of 2014. The air temperature ranged from a low of 6.5 ℃ in February of 2014 to a high of 35 ℃ in August of 2013.

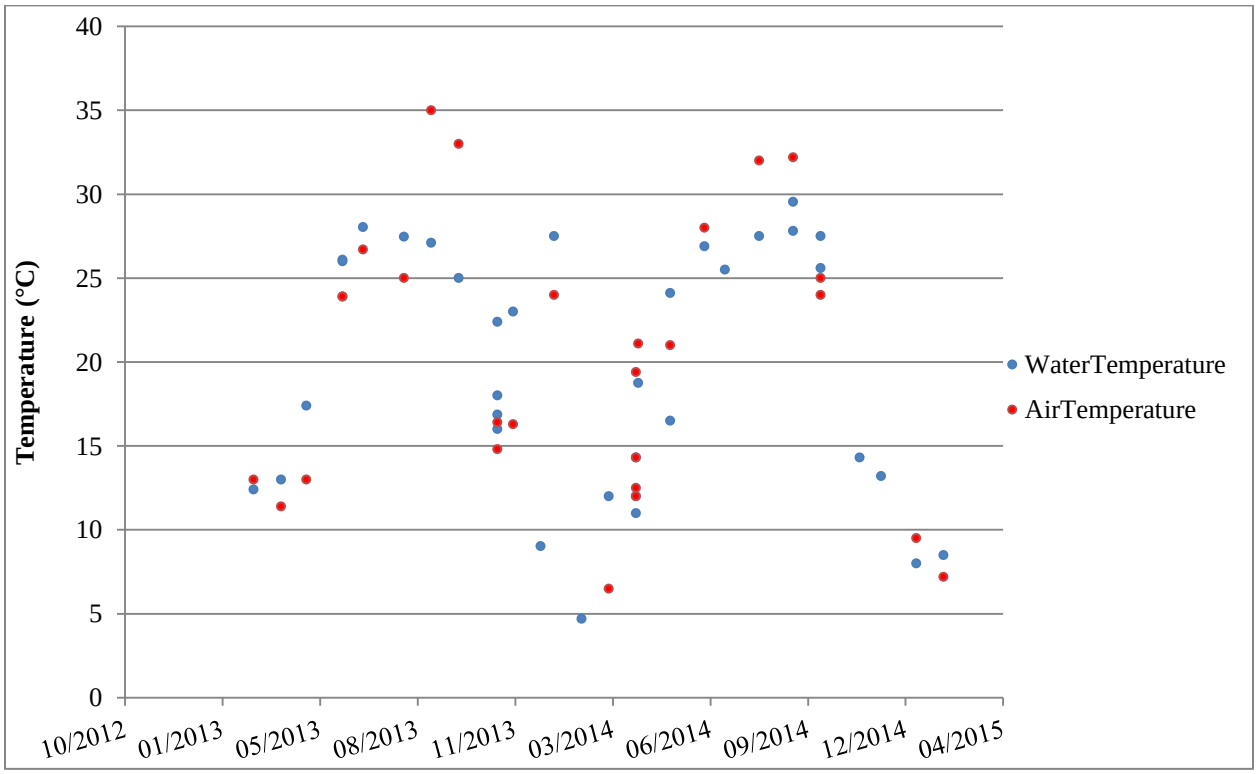

Figure 38: Air and water temperature at site 80911

Total Dissolved Solids

Citizen scientists took 36 total dissolved solids measurements at this site. The mean TDS concentration was 567 mg/L and it ranged from a low of 221 mg/L in November 2013 to a high of 887 mg/L in April of 2014. There was no significant increase or decrease in total dissolved solids over time observed at this site.

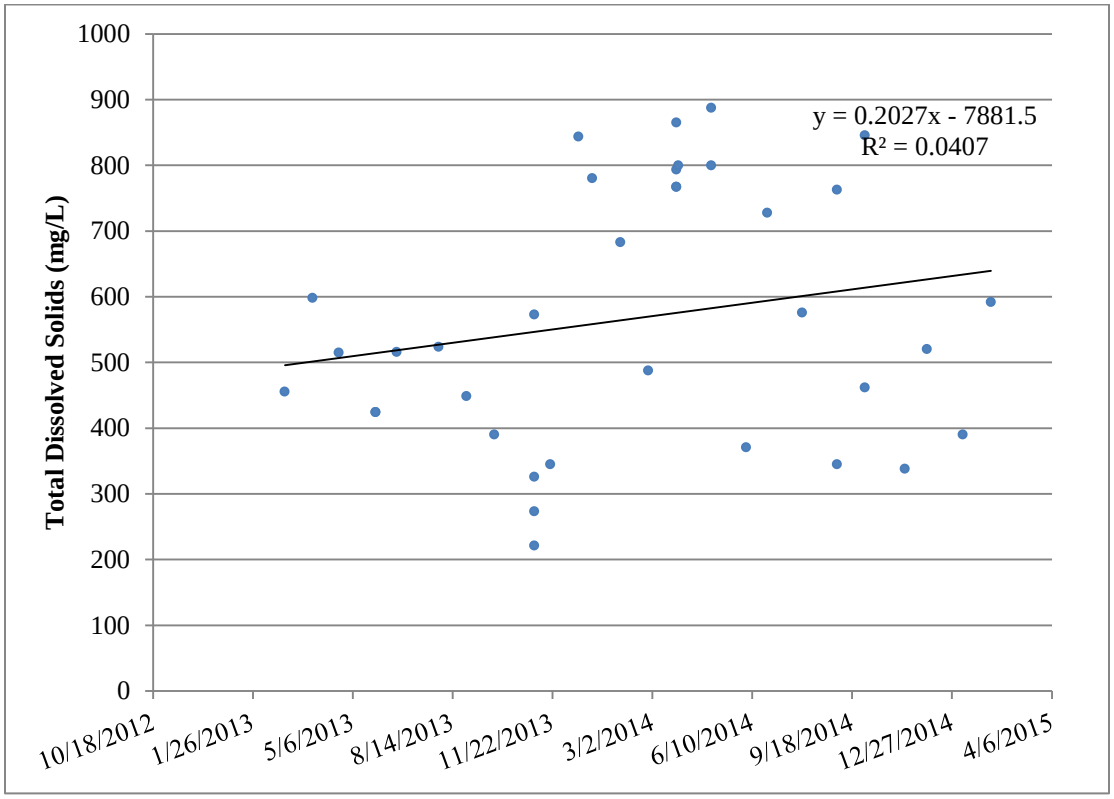

Figure 39: Total dissolved solids at site 80911

Dissolved Oxygen

Citizen scientists collected 36 dissolved oxygen samples at this site. The mean DO concentration was 6.6 mg/L and it ranged from a low of 1.4 mg/L in June of 2014 to a high of 11.7 mg/L in January of 2015. There was no significant increase or decrease in dissolved oxygen over time observed at this site.

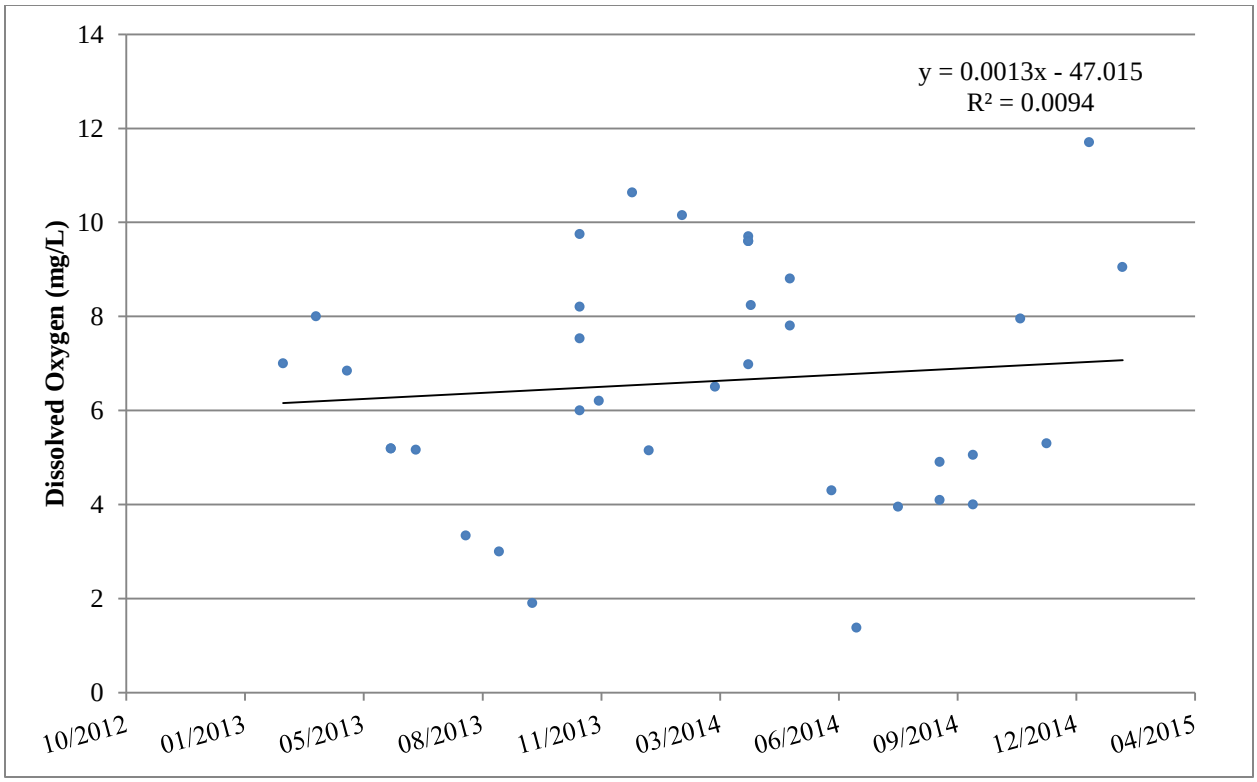

Figure 40: Dissolved oxygen at site 80911

pH

There were 36 pH measurements taken at this site. The mean pH was 7.4 and it ranged from a low of 6.9 in September of 2014 to a high of 8.4 in April of 2014. There was no significant increase or decrease in pH over time observed at this site.

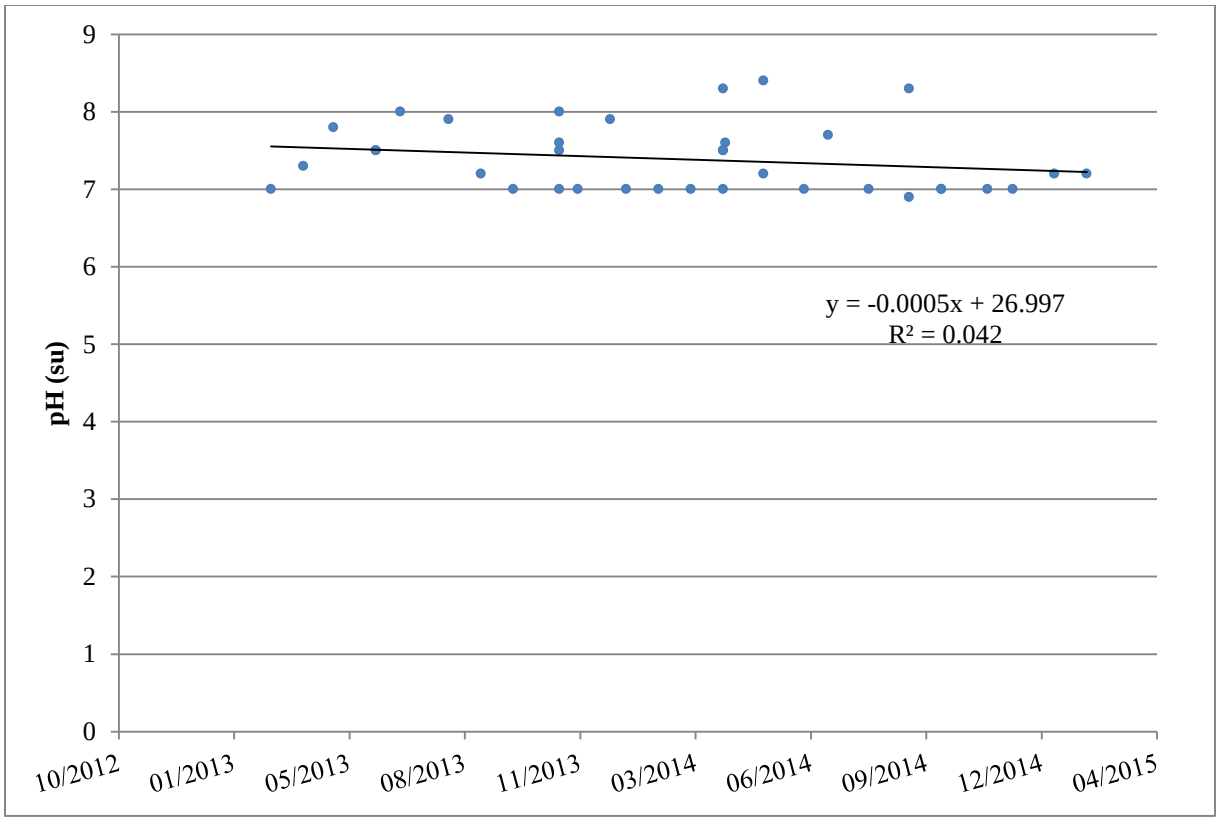

Figure 41: pH at site 80911

Field Observations

The flow was recorded as low or normal at this site with 3 instances where citizen scientists recorded the flow as high. Algae cover varied at this site from absent, to common, to dominant. The water color was tan and green/brown. The water clarity was clear or cloudy.

Watershed Summary

Elevated levels of E. coli occurred at multiple periods within the Carters Creek watershed. Sources of these bacteria may include agriculture, fertilizers, wildlife, domesticated pets/animals and possible failing septic systems. Implementation of a Total Maximum Daily Load (TMDL) by the Texas Commission on Environmental Quality (TCEQ) is ongoing in order to gain a better understanding of the bacteria sources found within the watershed. The TMDL's goal is to attempt to reduce the concentrations of the bacteria, restore water quality and to reduce health risks.

Texas Stream Team citizen scientists monitored several water quality parameters from 10 different sites from 2013 to 2015, including total dissolved solids (TDS), dissolved oxygen (DO), and pH levels. During the time observed, there was no significant increase or decrease in TDS concentration within the watershed as a whole, although TDS levels remained elevated at points along Burton Creek, Wolfpen Creek, and Carters Creek. Dissolved oxygen levels were low at points along Burton Creek and Briar Creek well within the College Station city limits, but there have been no statistically significant relationships between

a decrease in DO levels and time at individual sites. However, pH levels showed a significant decrease over time throughout the watershed despite staying within acceptable state standards.

Regional partners plan resumed citizen scientist monitoring at new Texas Stream Team sites along Bee and Wolfpen Creeks within the College Station city limits in September 2016.

Get Involved with Texas Stream Team!

Once trained, citizen scientists 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.

Sources

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Appendix A- List of Tables and Figures

Tables

Figures