San Bernard River 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.

San Bernard River Watershed Characterization

Location and Climate

The San Bernard River is approximately 120 miles long, originating just south of New Ulm, Texas and ending in the Gulf of Mexico. The San Bernard is classified as brackish water because of freshwater and saltwater mixing at the confluence with the Gulf of Mexico (Friends of the River San Bernard). The river passes through the following counties: Austin, Colorado, Wharton, Fort Bend, and Brazoria (Houston-Galveston Area Council (H-GAC)). The upper portion of the watershed is located on Bay Prairieland and the lower portion of the watershed is located on the Gulf Coast Prairies and Marshes Ecoregion (H-GAC). The major tributaries of the San Bernard are East Bernard, West Bernard, Middle Bernard, Peach, Mound, Coushatta, and Bell creeks, the Little San Bernard River, and McNeal and Redfish bayous (Texas State Historical Association). The terrain is mostly level with elevations ranging from 0" to 400"; it is slow draining and receives between 40" to 54" of average annual rainfall (Native Prairies Association of Texas, H-GAC). Soil types along the river are varied and consist of sand, gravels, sandy clay, silt with local sand, mud, and other fluvial deposits (H-GAC).

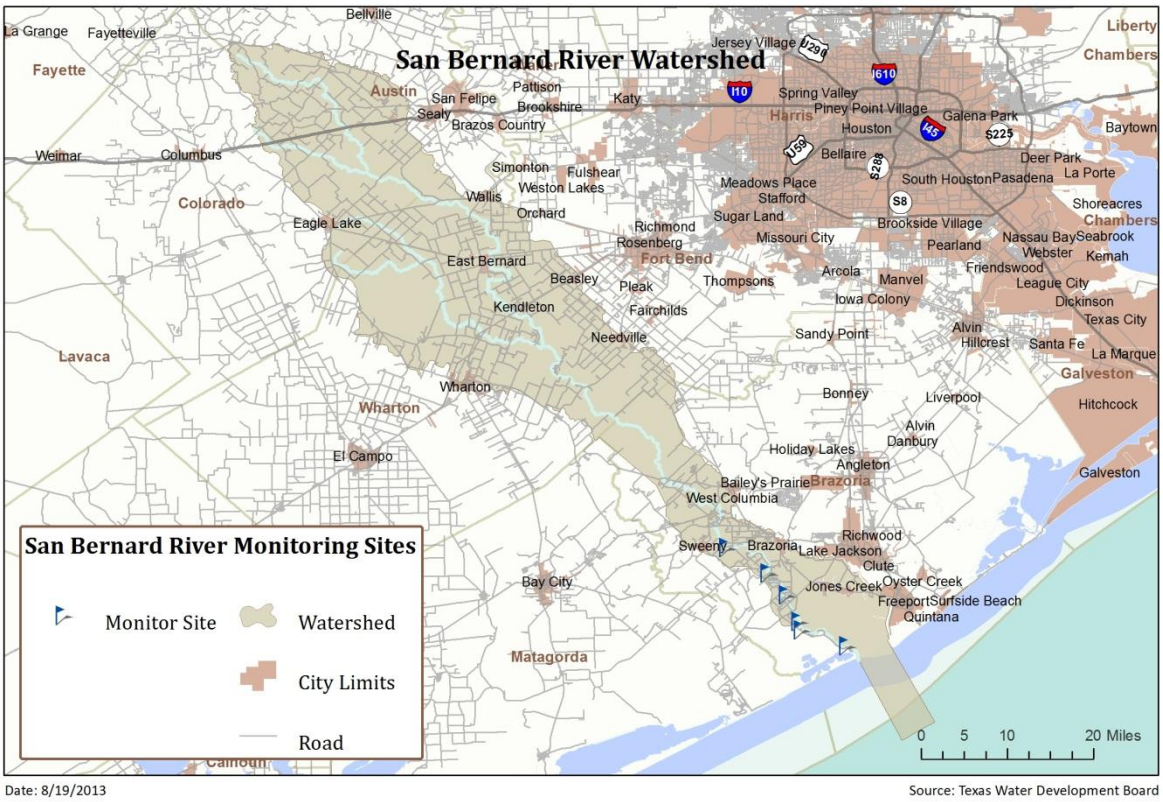

Figure 1: San Bernard River Watershed with Texas Stream Team Monitor Sites

Physical Description and Land Use

Due to the flat terrain and soil types, the land surrounding the San Bernard River is well suited for agriculture and cattle grazing (H-GAC). The majority of the land in the watershed is used for agriculture, with some small towns interspersed throughout the region (H-GAC). The river itself is primarily used for boating and fishing (H-GAC). Oil, gas, sulfur, and salt are abundant in this area; as a result, petrochemical industries in the area use barges to transport natural resources in the lower portion of the river (H-GAC).

Wildlife and Wildlife Refuges

The San Bernard Watershed contains three wildlife and habitat areas: the San Bernard National Wildlife Refuge, the Justin Hurst Wildlife Management Area, and the Attwater Prairie Chicken National Wildlife Refuge (H-GAC). The Gulf Coast Prairies and Marshes Ecoregion, where the refuges are located, is one of the most diverse ecosystems and is home to many birds, mammals, reptiles and fish (The Nature Conservancy). The San Bernard National Wildlife Refuge, created in 1968 as a sanctuary and habitat for winter waterfowl and marine species, lies on the coast just south of Sweeny and Brazoria, Texas (H-GAC). The Justin Hurst Wildlife Management area, established between 1985 and 1988, is located in Brazoria, Texas and is found in the southern most region of the San Bernard watershed (H-GAC). The Attwater Prairie Chicken National Wildlife Refuge is near Eagle Lake and was founded in 1983 (H-GAC). Green ash, water hickory, and water oak trees are the predominant species along the San Bernard (H-GAC). The wildlife found in the San Bernard watershed includes: Ring-billed Gulls, Caspian Tern, Willet shorebird, Red-Tailed Hawk, Bald Eagle, Great Blue Heron, Double-crested Cormorant, Snow Goose, Redfish, Speckled trout, White-tailed deer, Feral Hog, Water Moccasin, Oysters, Crabs, and many more (H-GAC).

History

Owing to level ground and slow draining soils, the San Bernard River is prone to flooding, particularly on its eastern edge near Wharton County (Scheibe 2010). Dating back to 1913, the river has experienced major flooding with a record flood in 1998 when 22” of rain fell over the course of two days (Scheibe 2010, Friends of the River San Bernard). In addition to flooding, the San Bernard also experiences a lot of shoreline changes. According to a recent geospatial analysis, the mouth of the San Bernard River has moved west by 2233 meters from 1974 to 2002 (Chen and Buzan). Several factors are likely to have contributed to this movement including: diversion of the Brazos River for construction of the port of Freeport and dredging of the Gulf Intracoastal Waterway West (GIWW) (H-GAC). The diversion of the Brazos River increased the transportation of sediment to the San Bernard area (H-GAC). While construction of the GIWW reduced the flow of the San Bernard River lower than is necessary to keep the mouth of the river open and flowing (H-GAC). In addition to the Brazos River diversion, there is another river diversion on Wharton county line for the New Gulf Reservoir, which was constructed in 1929 (Texas State Historical Association). Recent droughts, retention ponds, and over vegetation along the banks of the river have also decreased the San Bernard’s flow and contributed to changes in its shoreline in the past few decades (H-GAC).

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. 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.

Salinity

Salinity is the total of all salts dissolved in water, usually expressed in parts per thousand (ppt). Salinity is a term that usually refers to waters receiving marine inflow such as bays and estuaries. In an estuary, the low of fresh water from streams and rivers mixes with salty ocean water, producing a range of salinity from 0 to 35 ppt. The salt content of water affects the distribution of animal and plant species according to the amount of salinity they can tolerate. Salt pollution can be caused by natural conditions intensified by drought, irrigation return flows, wastewater discharges that may be high in salts, brine waters from oil production activities, or the spreading of road salt during icy conditions. Salt pollution is a problem because it can cause the salt levels of drinking water supplies to rise above recommended levels for human consumption. In some areas, it can cause rivers or streams to become unsuitable for agricultural irrigation or industrial use. Increasing levels might also impair aquatic life in ways that are difficult to determine. Fresh water and drinking water contain low salt concentrations and usually have a salinity of less than 0.5 ppt, while the salinity of seawater averages about 35 ppt.

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.

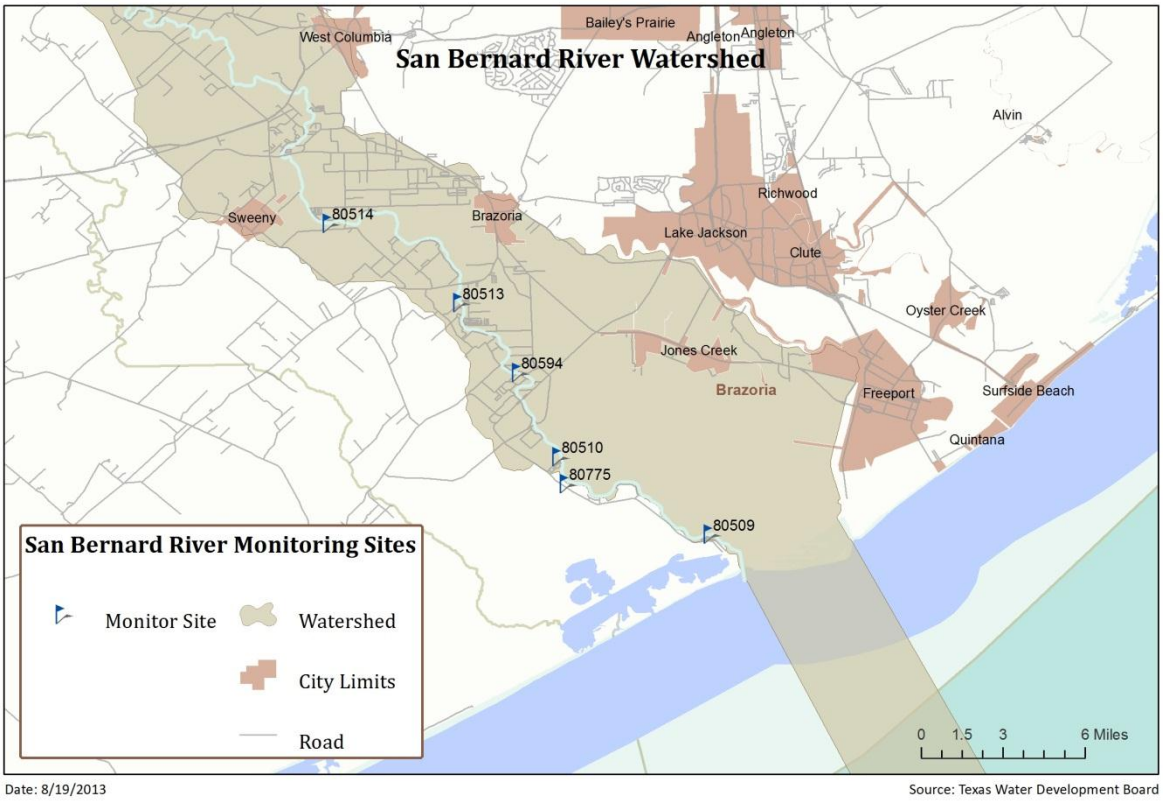

Figure 2: Monitor Sites on the San Bernard River

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 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 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. 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 San Bernard River Watershed, as seen below in Table 2.

Table 2: Summary of Surface Water Quality Standards for Tidal segment of San Bernard River Watershed

Parameter	2010 Texas Surface Water Quality Standards for the San Bernard River
Water Temperature (°C) (Tidal)	35 (Maximum)
Total Dissolved Solids (mg/L)	N/A
Dissolved Oxygen (mg/L) (Tidal)	4.0 (Minimum)
pH	6.5-9.0 (Range)

Methods of Analysis

All data collected from the San Bernard River and its tributaries was exported from the database and 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. Upstream to downstream trends and 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 increases.

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

San Bernard River Watershed Data Analysis

San Bernard River 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 monitoring sites. For added reference, cities, counties, and major highways were included. All shapefiles were downloaded from reliable federal, state, and local agencies.

San Bernard River Watershed Trends over Time

Sampling Trends over Time

Sampling along the San Bernard River began in May 2008 and 95% of the sampling events occurred from 2009 to 2012. Sampling occurred throughout the year, with no significant difference in the amount of sampling by month. A majority of the sampling events took place in mid-morning, with few, to no samplings occurring in the dark hours. Samples were collected by members from the Friends of the San Bernard group. Monitors completed 8559 minutes of sampling and traveled 88.07 miles to collect the data for this report. The average sampling event took 77.8 minutes and took 0.82 miles of travel to complete.

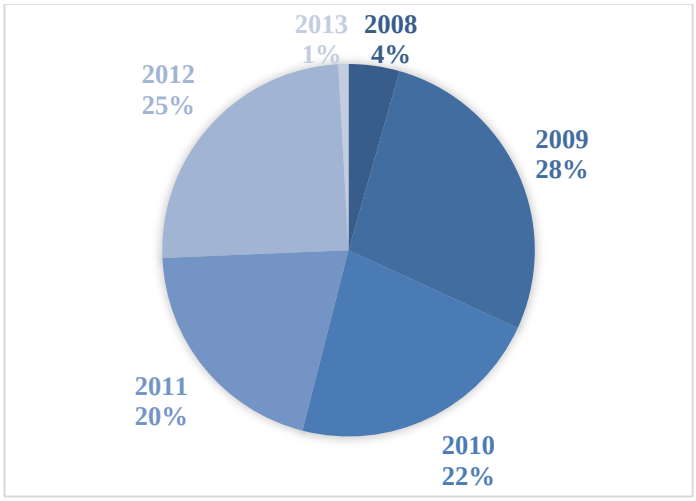

Figure 3: Samples by Year along the San Bernard River

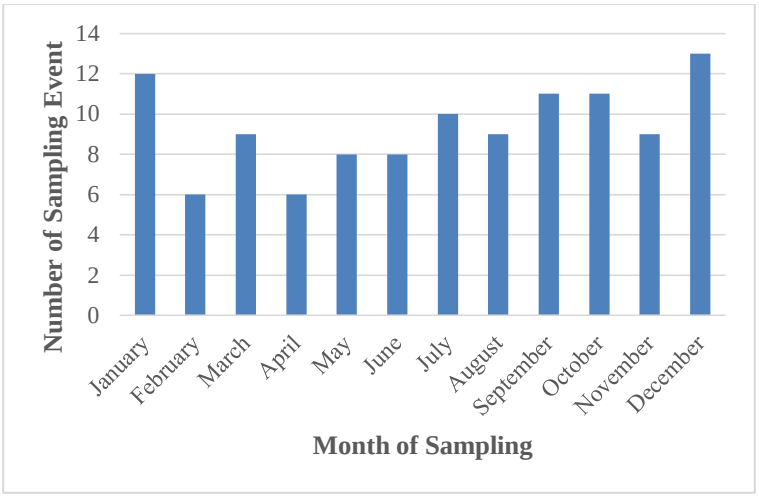

Figure 4: Breakdown of Sampling by Month

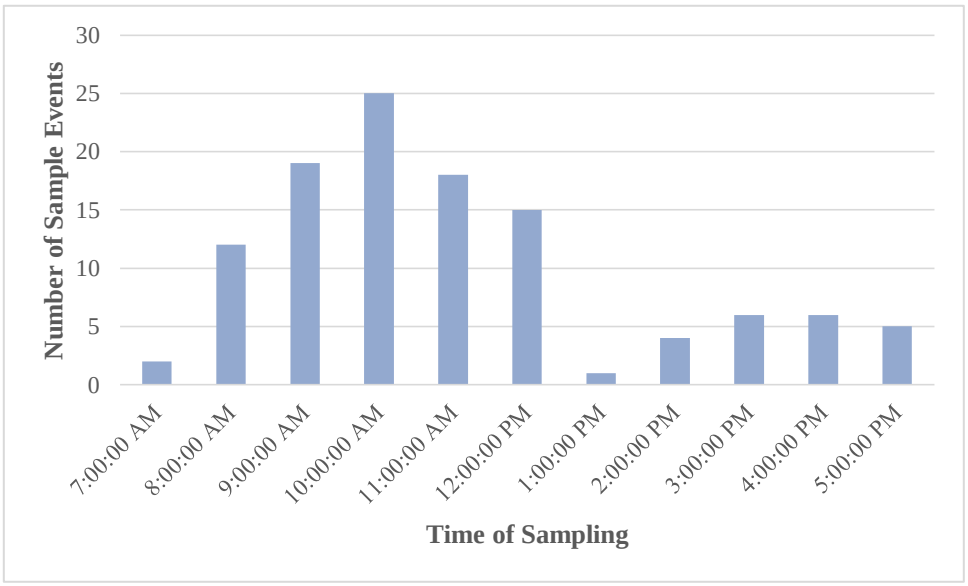

Figure 5: Breakdown of Time of Sampling on the San Bernard River

Descriptive Parameters over Time

Table 3: Descriptive parameters for all sites in the San Bernard River Watershed

San Bernard River Watershed May 2008 – Jan 2013				
Parameter	**% Complete**	**Mean ± Standard Deviation**	**Max.**	**Min.**
Total Dissolved Solids (mg/L)	37%	3700.88 ± 3999.73	12805	130
Water Temperature (°C)	100%	23.02 ± 6.70	33	8
Dissolved Oxygen (mg/L)	99%	6.51 ± 1.87	11.7	1.9
pH	100%	7.60 ± 0.36	8.6	6.9
Secchi disk transparency (m)	99%	0.34 ± 0.23	1.5	0.01
Depth (m)	98%	0.68 ± 0.36	2.4	0.0
Salinity (ppt)	40%	21.94 ± 6.06	41	0

*There were a total of 113 sampling events from May 2008 to January 2013. Mean, calculated in Microsoft Excel, is listed for all parameters.

Trend Analysis over Time

Air and water temperature

A total of 113 air temperature values and 113 water temperature values were collected within the San Bernard River Watershed between 2008 and 2013. Air temperature reached a high of 34ºC in August 2009. Regression analysis (p=0.193, F=1.72) showed that variation in water temperature was not significantly correlated with time.

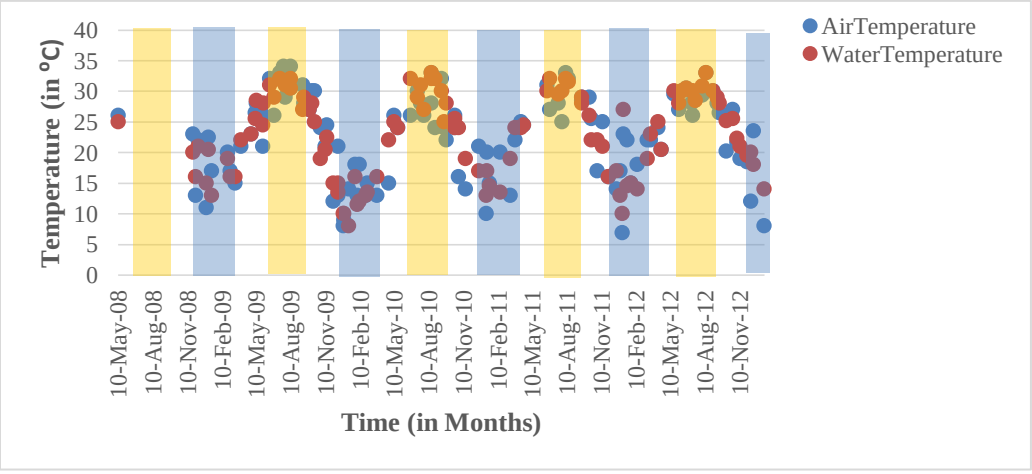

Figure 6: Air and water temperature over time at all sites within the San Bernard River Watershed

Total Dissolved Solids

Citizen scientists collected 42 TDS measurements within the watershed. Since most of these sites were near the Gulf of Mexico, salinity levels were too high for TDS to be accurately measured and TDS was only measured for 37% of the sampling events. During the other sampling events salinity was measured. Salinity and TDS were greatly affected either by plant outflow (see Site 80514 write up) or by the tides at a number of these sites. Given this, it is not surprising that TDS did not significantly correlate to time, as indicated with a regression analysis p-value of 0.842. When measured, TDS did appear to be affected by flow/water condition; TDS values were highest with low or normal flow (average = 3024.44 mg/L) and lowest during high or flood stage flow (average = 154.38 mg/L), as supported by previous studies.

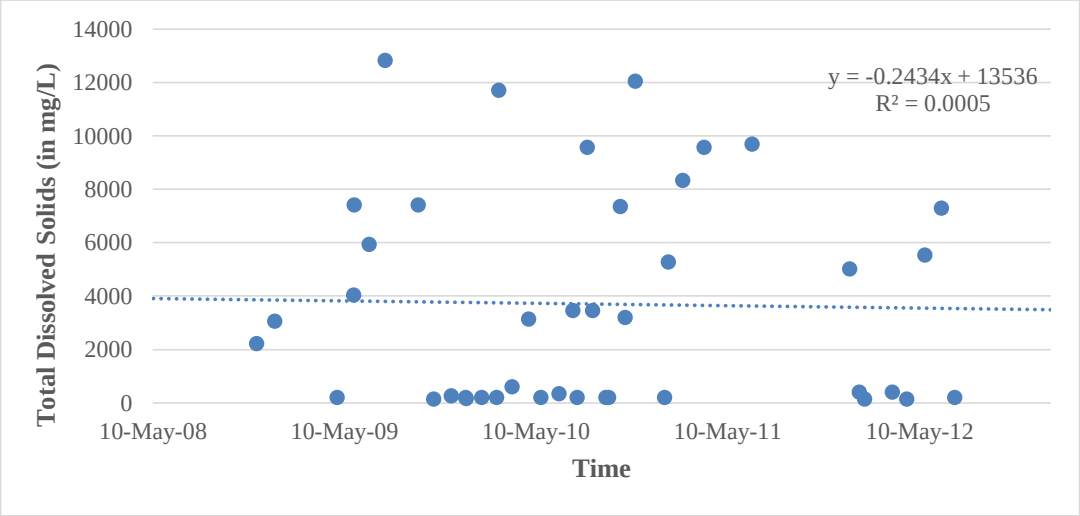

Figure 7: Total Dissolved Solids over time at all sites within the San Bernard River Watershed

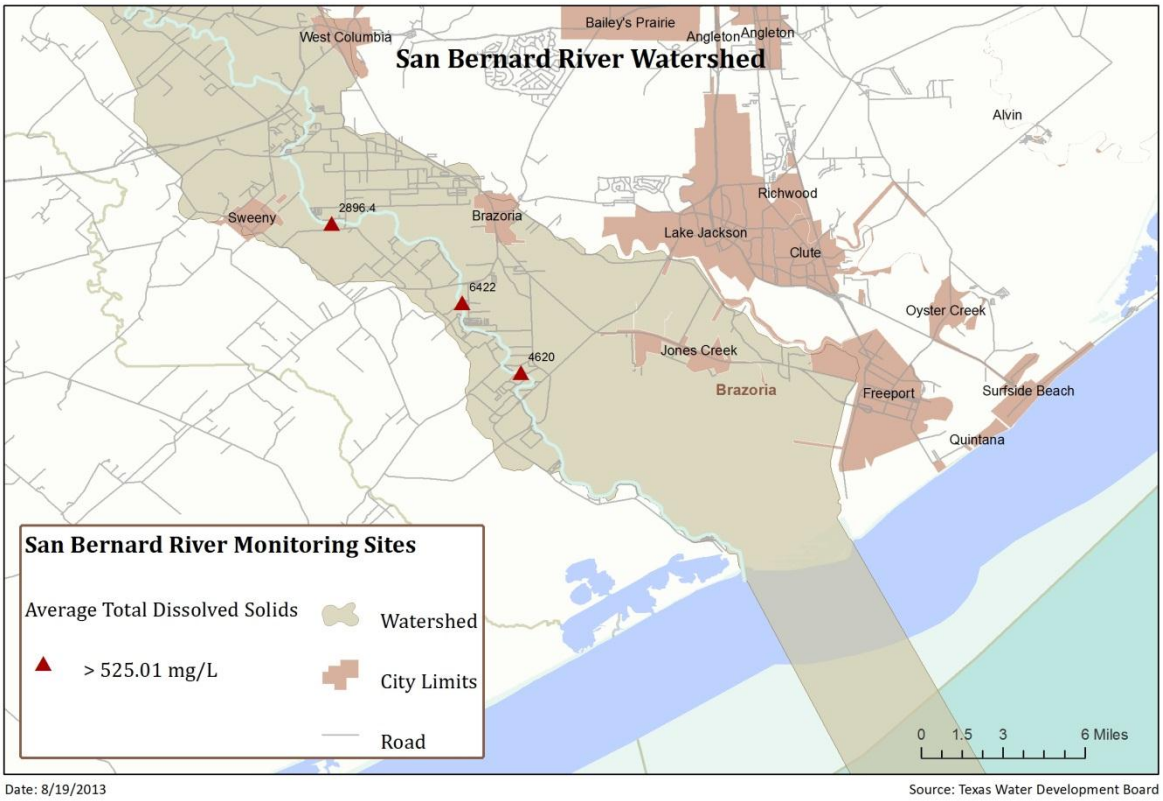

Figure 8: Average Total Dissolved Solids

Table 4: Average Total Dissolved Solids (mg/L) by flow level in the San Bernard River Watershed

Flow Level	Average	Standard Deviation
No Flow	390	0
Low Flow	1083.33	1237.8
Normal Flow	4965.55	4103.24
Flood	169	35.60

Dissolved Oxygen

Citizen scientist monitors collected a total of 112 DO samples within the San Bernard River Watershed. The DO values were not significantly related to time (p=0.986, F=0.000). Additionally, DO is naturally affected by water temperature, rate of flow, season, and time of day that sampling occurred. As flow increases and the waters are mixed DO levels rise; however, that pattern was not seen at these sites, possibly because of the salinity levels. The DO was affected by water temperature, as shown in Figure 6. Cold water holds more oxygen than warm water; thus, DO was highest in the winter months. Additionally, plants and algae add a substantial amount of DO via photosynthesis, resulting in the natural diurnal pattern of high DO levels observed during the daylight hours, peaking in the late afternoon, and decreasing after dark. This pattern is vaguely shown in Table 6.

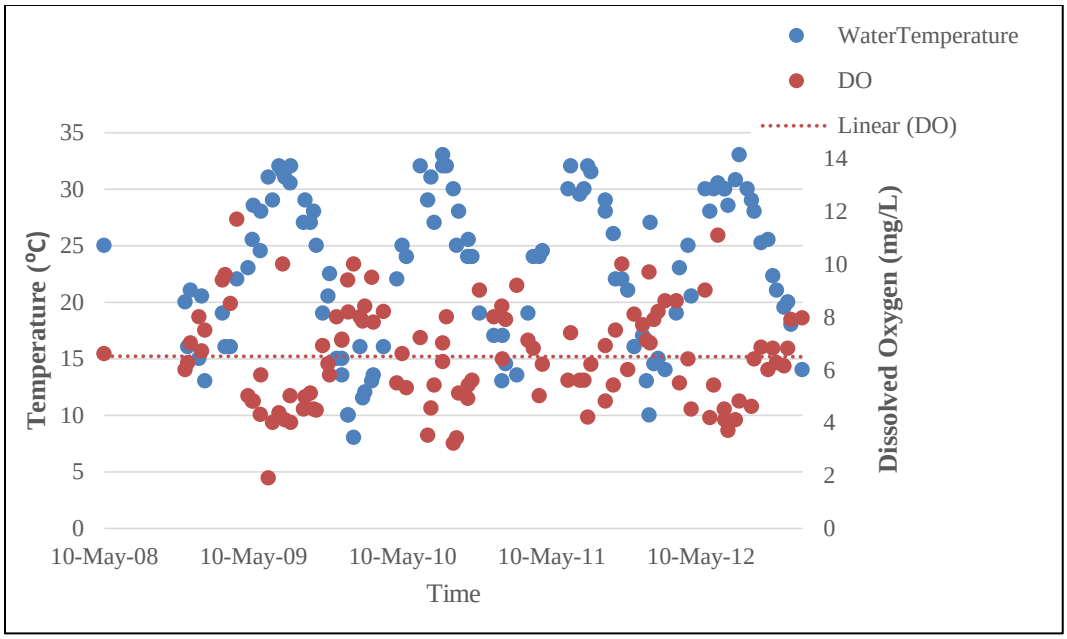

Figure 9: Dissolved Oxygen at all sites within the San Bernard River Watershed

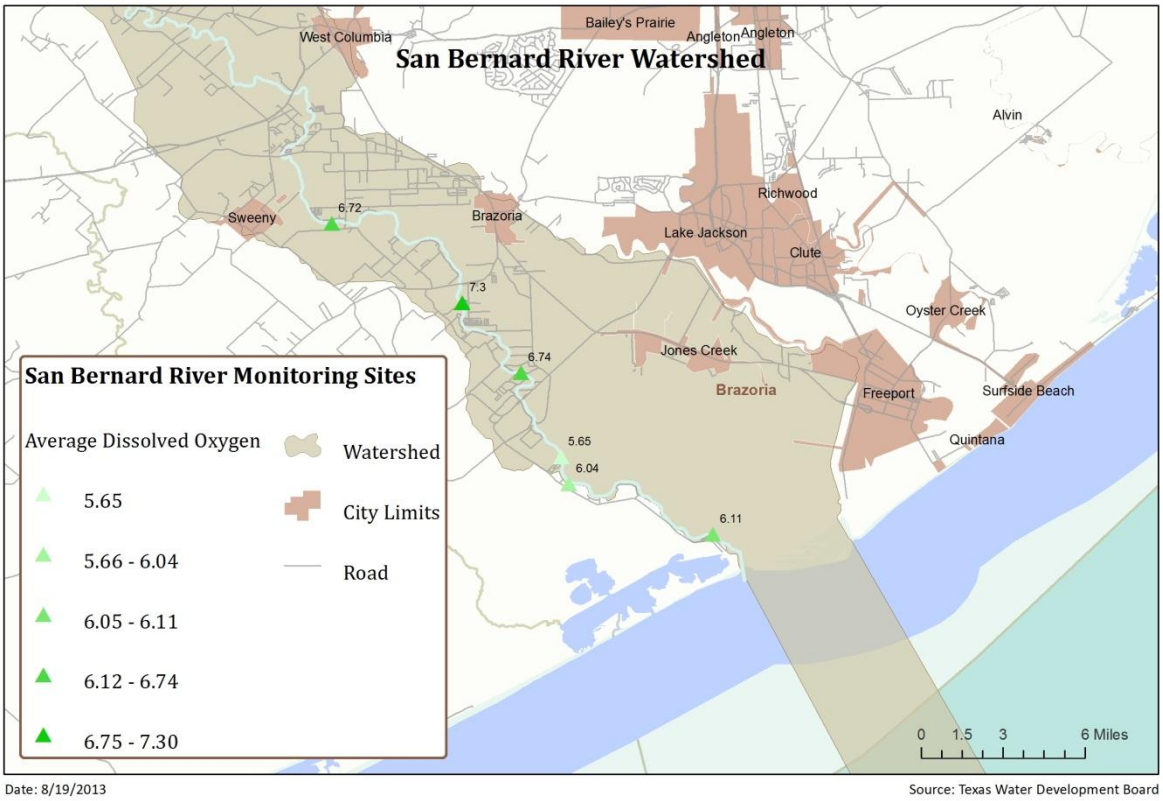

Figure 10: Average Dissolved Oxygen

Table 5: Average Dissolved Oxygen at five different flow levels along the San Bernard River

Flow Level	Average DO (mg/L)	Standard Deviation
No Flow	7.48	2.07
Low Flow	6.86	1.78
Normal Flow	6.29	1.92
High	5.36	1.21
Flood	5.45	0.81

Table 6: Average Dissolved Oxygen values by Sampling Time within the San Bernard River Watershed

Time	Average DO (mg/L)	Standard Deviation
7:00	5.00	0.71
8:00	5.97	1.82
9:00	6.42	1.56
10:00	6.35	1.71
11:00	6.70	1.81
12:00	6.13	1.91
13:00	9.00	NA
14:00	5.00	2.36
15:00	6.43	1.23
16:00	9.33	1.68
17:00-22:00	7.36	2.09

pH

The pH mean was 7.61. The pH was sampled 113 times, with no individual values exceeding the range of between 6.5 and 9, which is the optimal pH range for aquatic life. Regression analysis showed that pH was not significantly correlated with time (p=0.069, F=3.38).

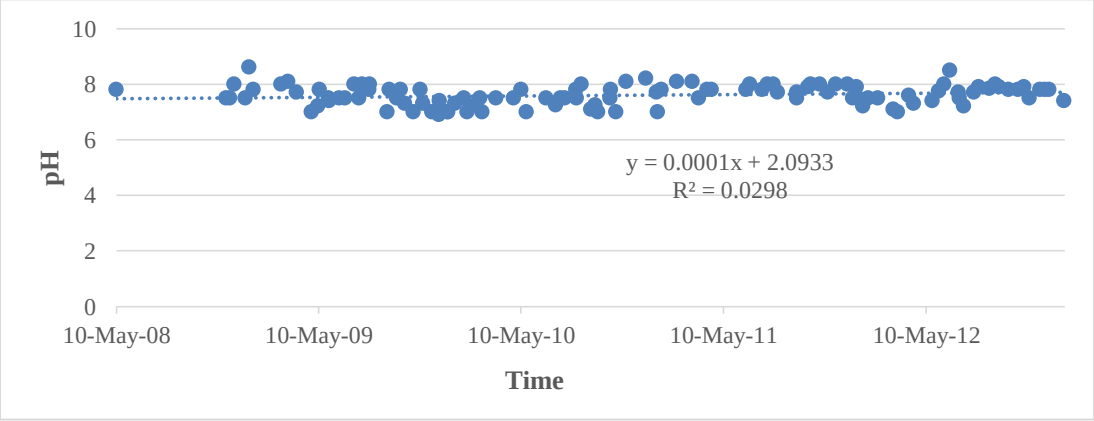

Figure 11: Changes in pH over time at all sites within the San Bernard River Watershed

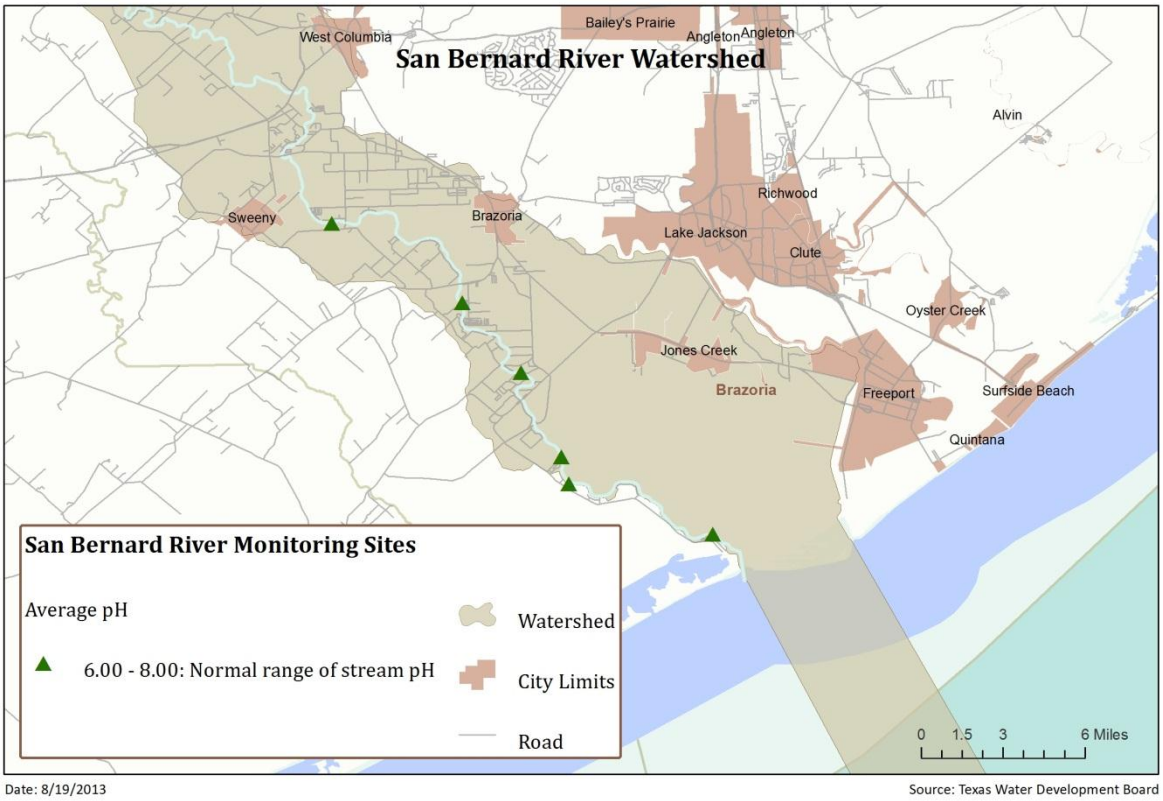

Figure 12: Average pH

Secchi disk and total depth

Total depth was measured 111 times and Secchi disk values were collected 112 times within the watershed during the sampling period. Both Secchi disk ($p=0.437$) and total depth ($p=0.986$) were not significantly correlated with time. Secchi disk depth values were consistently below total depth over time, suggesting that water clarity was limited. However, during each winter, water clarity was slightly higher than during the summer.

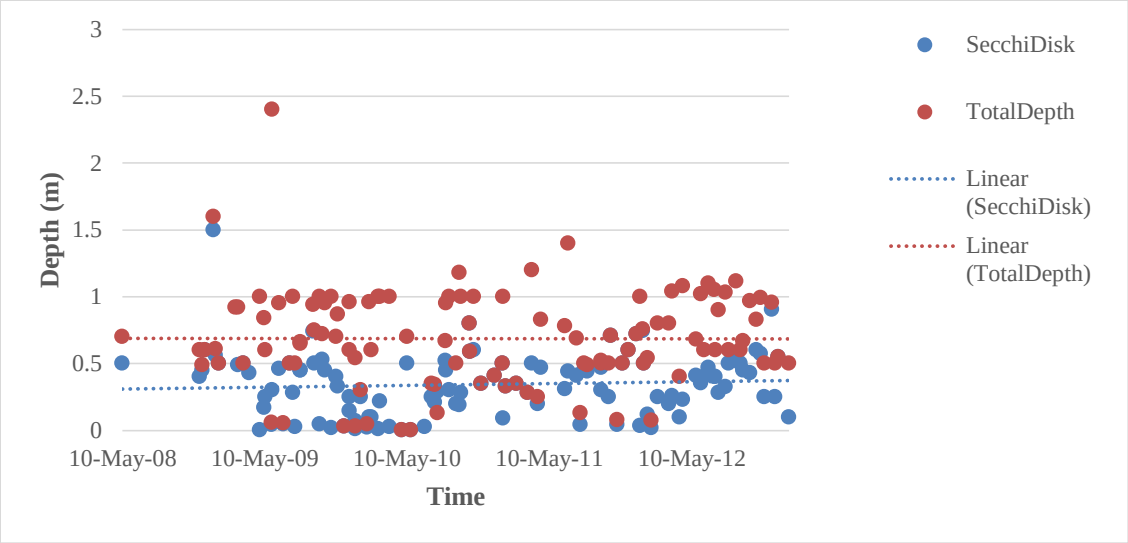

Figure 13: Total depth and Secchi disk over time within the San Bernard River

Field Observations

All sites on the lower San Bernard had no algae present, had no water odor, and had a clear water surface at all monitoring events. Flow was primarily normal 60% of the time, but was noted as to be low 28% of the time. The water was observed to be clear during 53% of the sampling events and cloudy 36% of the time at all sites. Water conditions were rippled at 54% of the sampling events and calm during 38% of the sampling at all sites along the lower San Bernard River. Water color was reported to be light green for 27% of the time and green/tan for 49% of the sampling events; however, most of the light green observations were noted early in the sampling period. Weather was mainly cloudy (50%) or overcast (28%) during the sampling events, although monitors noted clear conditions 19% of the time and rain at 4% of the sampling events.

Salinity

Regression analysis (p = 0.013, F=6.51, r^2=0.098) of citizen scientists data suggests downward correlation between salinity levels and time for the duration of this study. However, the low F and r^2 values suggest that a high level of variation is present in the results and that linear regression is not the best model to represent the relationship seen below. A total of 62 samples were collected.

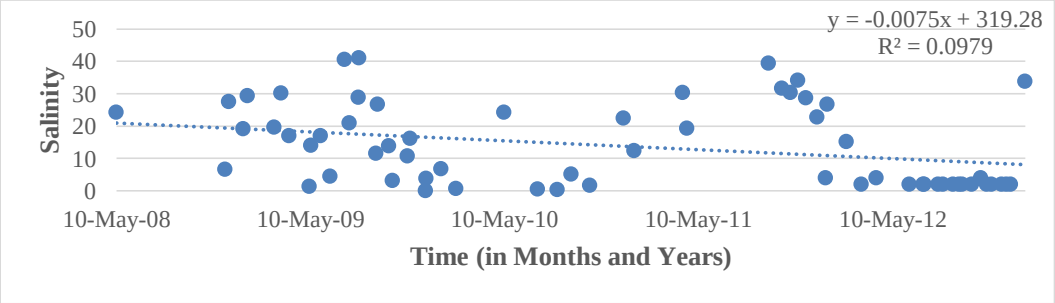

Figure 14: Salinity over time within the San Bernard River

San Bernard River Watershed Upstream and Downstream Trends

Air and water temperature

Water temperature is not significantly correlated (p=0.0.379) with distance along the San Bernard River in this study, although, water temperature showed a slight increase as distance from headwaters increased. Air temperature was not reviewed with a regression analysis.

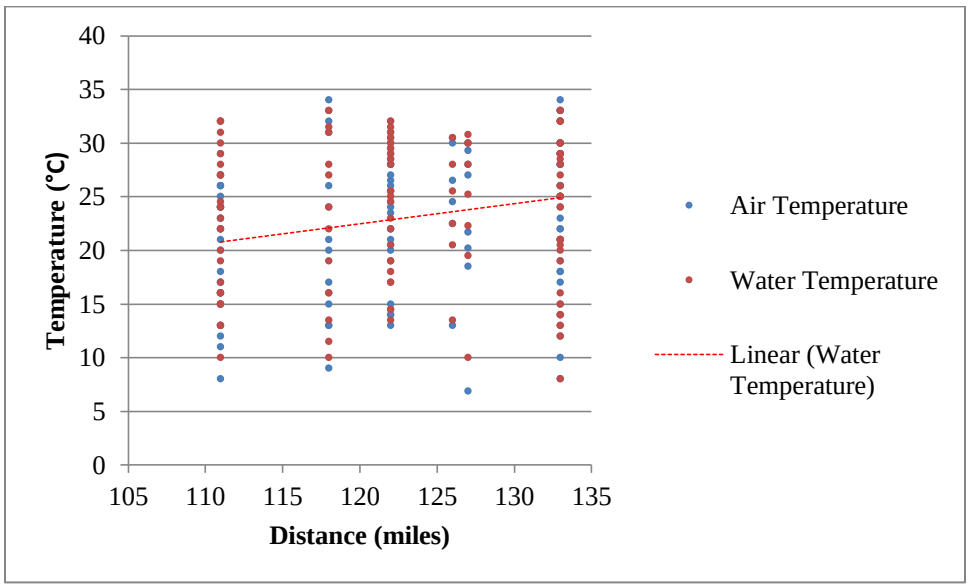

Figure 15: Air and water temperature over distance from headwaters at all sites within the San Bernard River Watershed

Total Dissolved Solids

The TDS concentration was only collected at the upstream sites. As the river nears the Gulf of Mexico, salinity was measured instead of TDS. Although the linear regression line on Figure 14 suggests that TDS increased with distance from headwaters, this relationship was not found to be statistically significant (p=0.151), partly due to the limited number of sample events and the low r^2 value (r^2=0.052).

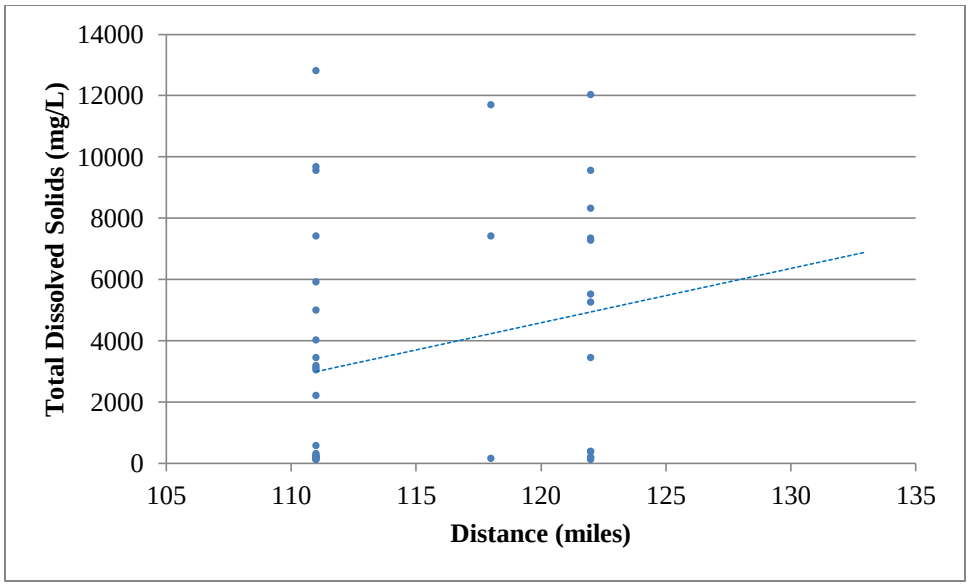

Figure 16: Total Dissolved Solids over distance from headwaters at all sites within the San Bernard River Watershed

Dissolved Oxygen

Distance from headwaters was not a significant predictor (p=0.081) of DO along the San Bernard River during this study, although a slight decrease in DO was noted with distance downstream.

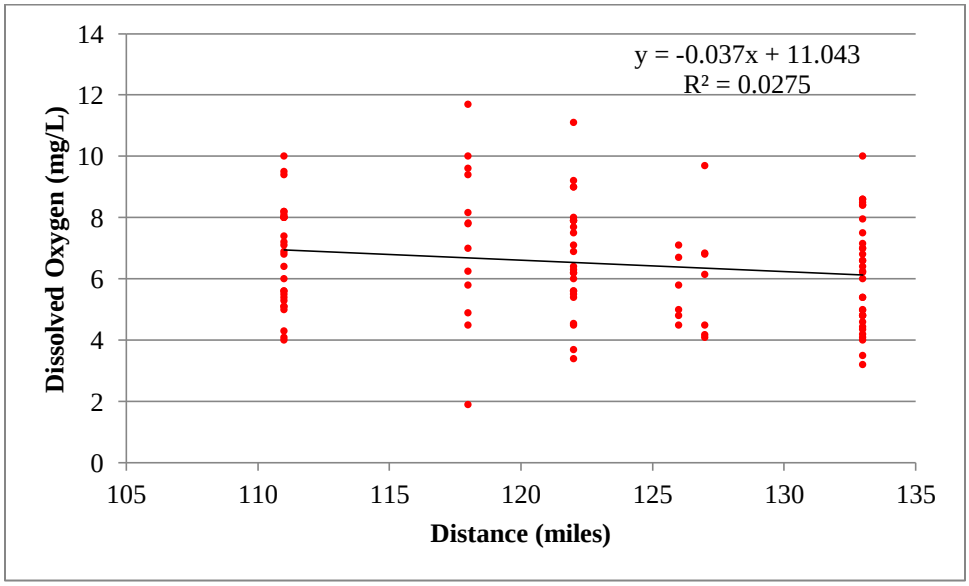

Figure 17: Dissolved Oxygen over distance from headwaters at all sites within the San Bernard River Watershed

pH

Distance from headwaters was not a statistically significant predictor (p=0.09, F=7.08) of pH along the San Bernard River.

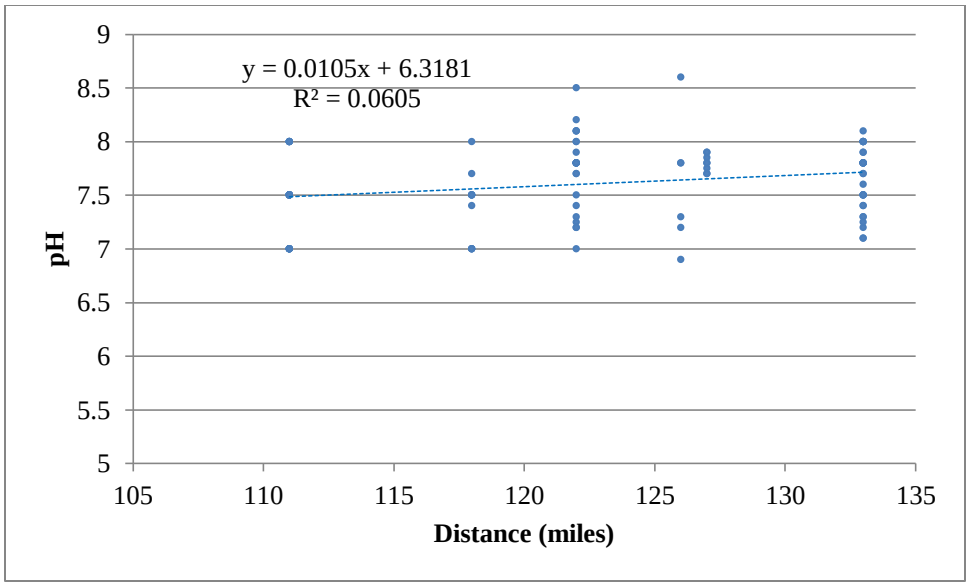

Figure 18: The pH over distance from headwaters at all sites within the San Bernard River Watershed

Secchi disk and total depth

Secchi disk and total depth values did not indicate a significant increase with distance from headwaters (p=0.06 and p = 0.48 respectively).

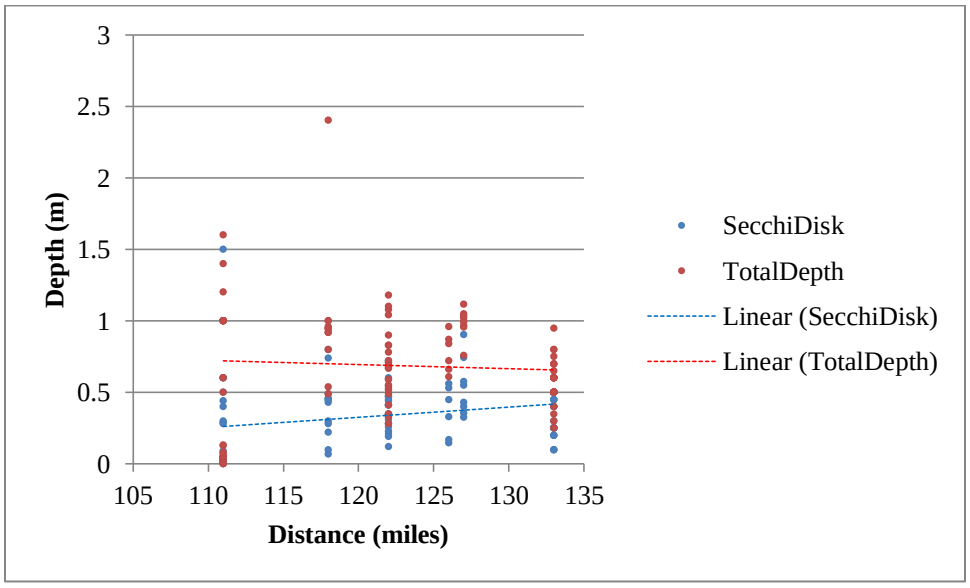

Figure 19: Secchi disk and total depth over distance from headwaters at all sites within the San Bernard River Watershed

Salinity

Salinity was only collected at sites near the Gulf of Mexico. Regression analysis indicates no significant trend in salinity with distance from the headwaters (p = 0.859).

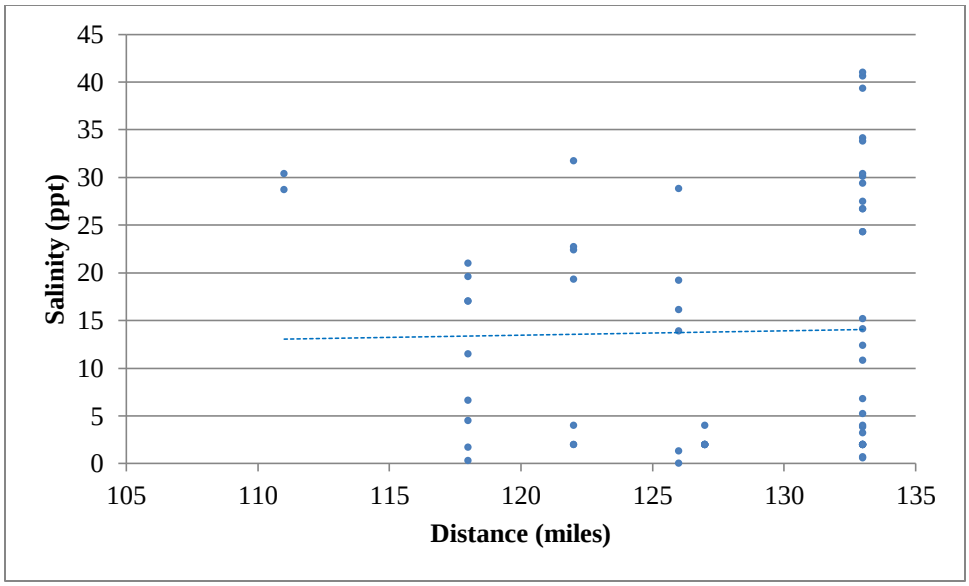

Figure 20: Salinity over distance from headwaters at all sites within the San Bernard River

San Bernard River 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 will be presented. These values are reported in order to provide a quick overview of the watershed. The salinity, 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.

Salinity in an estuarine environment can be an important indicator of instream flow. Organisms in this type of environment are adapted to living in a certain salinity range, and salinities can increase in cases of drought and/or diversion of freshwater from the river. Site 80514 – San Bernard River at CR961 had the highest overall average for salinity, with a result of 29.55 ± 1.2 ppt. Site 80775 – San Bernard River at Cox's Reef had the lowest average salinity, with a result of 2.28 ± 0.756 ppt.

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 algal growth, which then die, and causes an increase in Biological Oxygen Demand and lowers the DO when bacteria begin to consume the dead algae. 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 80510 – San Bernard River at 2649 County Road 496 had the lowest average DO reading, with a result of 5.65 ± 1.067 mg/L. Site 80775 – San Bernard River at Cox's Reef had the highest average DO reading, with a result of 10.25 ± 12.08 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 80594- San Bernard River at 2649 County Road 496

had the highest average pH level, with a result of 7.742 ± 0.36. Site 80513– San Bernard River at CR415A had the lowest average pH level, with a result of 6.84 ± 1.98.

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 sites

Site Number	Salinity (ppt)	DO (mg/L)	pH
Site 80514	29.55 ± 1.2 (max.)	6.72 ± 1.68	7.46 ± 0.39
Site 80513	11.02 ± 7.97	7.29 ± 2.64	6.84 ± 1.98 (min.)
Site 80594	14.87 ± 12.043	6.74 ± 1.83	7.742 ± 0.36 (max.)
Site 80775	2.28 ± 0.756 (min.)	10.25 ± 12.08 (max.)	7.66 ± 0.29
Site 80510	13.21 ± 10.99	5.65 ± 1.067 (min.)	7.6 ± 0.603

Site 80514 – San Bernard River at CR961

Site Description

This site is located east of the town of Sweeny. The site is located on a monitor's dock along a residential area on the San Bernard River. This site is surrounded by open farm land and suburban areas with little to no riparian zone observed.

Sampling Information

This is an inactive site sampled 28 times from 11/24/2008 to 01/27/2012 by Jackie and Bill Benson of the group Friends of the San Bernard. Sampling has occurred on average eight times a year, typically during the latter part of the month and throughout day with no set sampling time. Since 11/24/2008, monitors spent a total of 35 hours and 20 minutes and traveled 9.2 miles while sampling this site, with an average of 79.71 minutes spent and 0.32 miles traveled during each sampling event.

Table 8: Descriptive parameters for Site 80514 -San Bernard River at CR961

Parameter	% Complete	Mean ± Standard Deviation	Max.	Min.
Total Dissolved Solids (mg/L)	89.29%	2896.4 ± 3636.27	12805	130
Water Temperature (°C)	100%	22.02 ± 6.66	32	10
Dissolved Oxygen (mg/L)	100%	6.72 ± 1.68	10	4
pH	100%	7.46 ± 0.39	8	7
Secchi disk transparency (m)	100%	0.19 ± 0.32	1.5	0.0023
Depth (m)	96.43%	0.61 ± 0.51	1.6	0.00102
Salinity (ppt)	7.14%	29.55 ± 1.2	30.4	28.7

*Site was sampled 28 times between 11/24/2008 and 1/27/2012.

Air and water temperature

Water and air temperatures were sampled 28 times at Site 80514. Temperatures fluctuated in an expected seasonal pattern, with maximum temperatures in the summer of 2012. Water temperature remained above air temperature, except during September 2009 and during the winter months between 2008 and 2012. Water never reached temperatures above the 2010 Texas Surface Water Quality Standard of 35ºC.

Total Dissolved Solids

Citizen scientists sampled TDS at this site 25 times and noted that the TDS values where highly variable, as shown with such a large standard deviation value, and may be due to tidal influxes or freshwater inputs from rain events. In fact, the average TDS after sampling events with rain events of 0.5 in. or more in the three days prior was 1191.67 mg/L versus an average TDS of 4470 mg/L on sampling dates with no recorded rain in the three days prior.

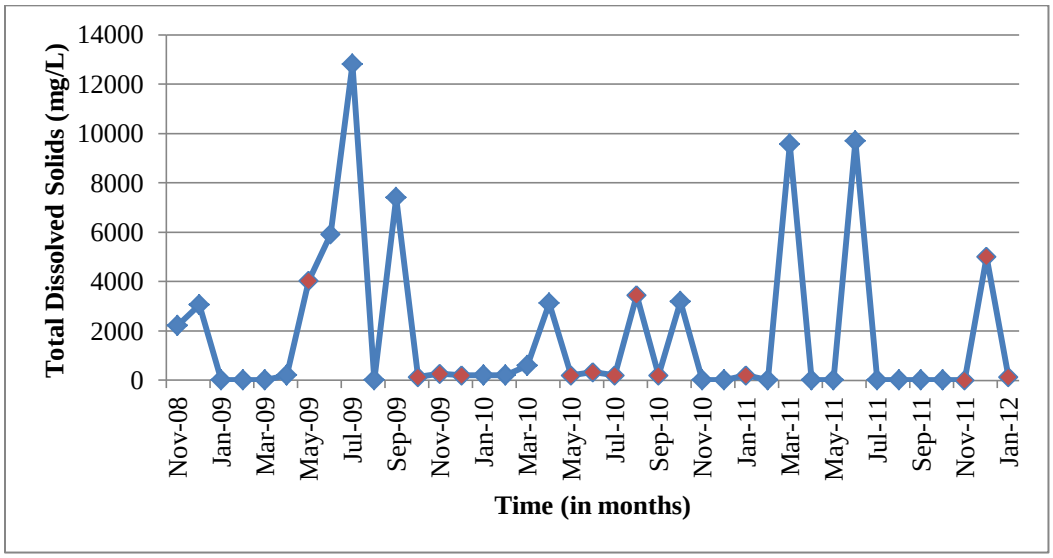

Figure 21: Total Dissolved Solids at Site 80514. Red data points signify sampling events with 0.5 inches of rain occurring within three days of the sampling event.

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. Individual DO sampling event readings show that DO never dropped below 4.0 mg/L. The DO also showed a slight increase over time at this site; however, this trend could not be supported statistically. The average result for DO was 6.72 ± 1.68 mg/L for this site.

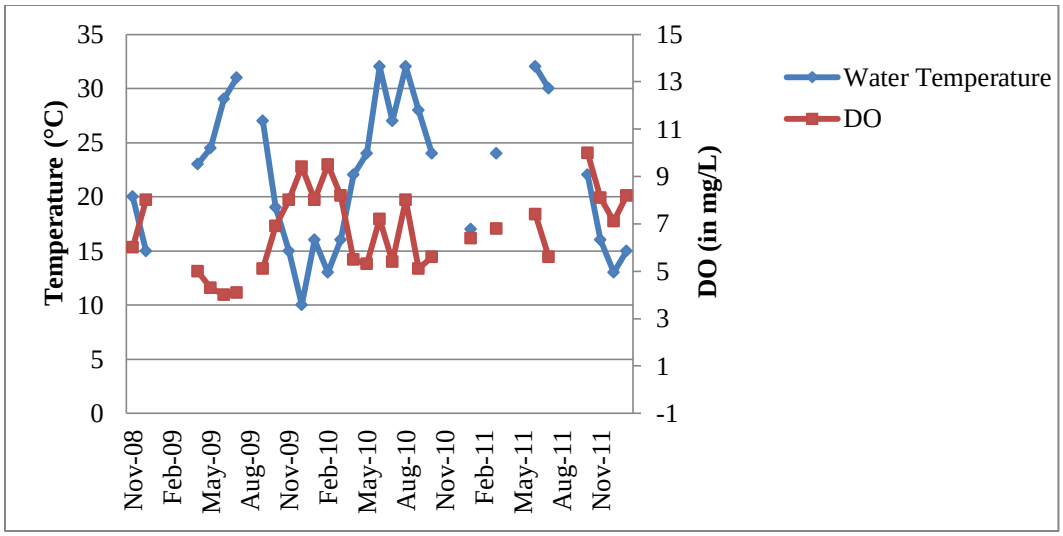

Figure 22: Dissolved Oxygen at Site 80514

pH

The pH values at Site 80514 showed an average result of 7.46 ± 0.39 and demonstrated a slight trend upwards with time, but this result was not statistically significant.

Secchi disk and total depth

Secchi disk depth and total depth were directly related during the sampling events, meaning that as depth increased, so did Secchi disk depth. However, Secchi disk was always significantly lower than depth, suggesting that the water has limited clarity.

Field Observations

At Site 80514, field observations recorded during sampling events indicated that water had no algae, a clear water surface, no odor, and was either clear (61%) or slightly cloudy (39%) during all of the sampling events. Water color was either light green or green/tan (43% and 46% respectively) and was either calm or ripples (46% and 54% respectively). Weather was noted to be clear during 25% of the sampling events, cloudy during 32% of the sampling events, overcast during 39% of the sampling events, and raining during 4% of the sampling events. Rainfall events of 8.25 inches occurred near sampling in the winter months of 2011 and 18 inches of rain during July of 2010.

Site 80513 – San Bernard River at CR415A

Site Description

This site is located south west of the town of Brazoria. The site is located on a monitor's dock along a residential area on the San Bernard River. This site is surrounded by open farm land and suburban areas, with a slight riparian zone observed.

Sampling Information

This is an inactive site sampled sporadically from 12/01/2008 to 10/18/2010 by Larry Vacek of Friends of the San Bernard. Sampling has occurred on average six times a year, with no set time during the month or during the day. Since 12/01/2008, monitors have spent a total of 25 hours and 40 minutes sampling and have traveled 4.25 miles while sampling this site, with an average of 118.46 minutes spent sampling and 0.38 miles traveled during each sampling event.

Table 9: Descriptive parameters for Site 80513– San Bernard River at CR415A

Parameter	% Complete	Mean ± Standard Deviation	Max.	Min.
Total Dissolved Solids (mg/L)	23.79%	6422 ± 5835.1	11700	156
Water Temperature (°C)	100%	21.73 ± 7.98	33	10
Dissolved Oxygen (mg/L)	100%	7.29 ± 2.64	11.7	1.9
pH	100%	6.84 ± 1.98	8	0.3
Secchi Disk Transparency (m)	100%	1.13 ± 2.67	10	0.07
Depth (m)	100%	0.98 ± 0.47	2.4	0.49
Salinity	69.23%	11.02 ± 7.97	21	0.3

*Site was sampled 13 times between 12/1/2008 and 10/18/2010.

Air and water temperature

Water and air temperatures were sampled 13 times at Site 80513. Temperatures fluctuated in an expected seasonal pattern, with maximum temperatures occurring in the summer of 2009. No other pattern could be determined with water temperature due to the low and inconsistent number of samples. Water temperature remained below air temperature at except during May 2009 and Dec 2009. Water never reached temperatures above the Texas Surface Water Quality Standard of 35°C.

Total Dissolved Solids

Citizen scientists sampled TDS at this site three times and noted that the TDS values where highly variable, as evidenced by the large standard deviation value. All other sampling events recorded salinity in place of TDS.

Salinity

Salinity was measured during nine sampling events at Site 80513; the average value was 11.02 ± 7.97 ppt. Salinity reached a maximum level in February and July of 2009.

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 limited and inconsistent to yield results or patterns. The average recorded result for DO at this site was 7.29 ± 2.64 mg/L.

pH

The pH values at Site 80513 show an average of 6.84 ± 1.98 and remained consistently near that average. This was the minimum recorded average pH value for all sites sampled.

Secchi disk and total depth

Secchi disk was always significantly lower than depth, suggesting that the water had limited clarity.

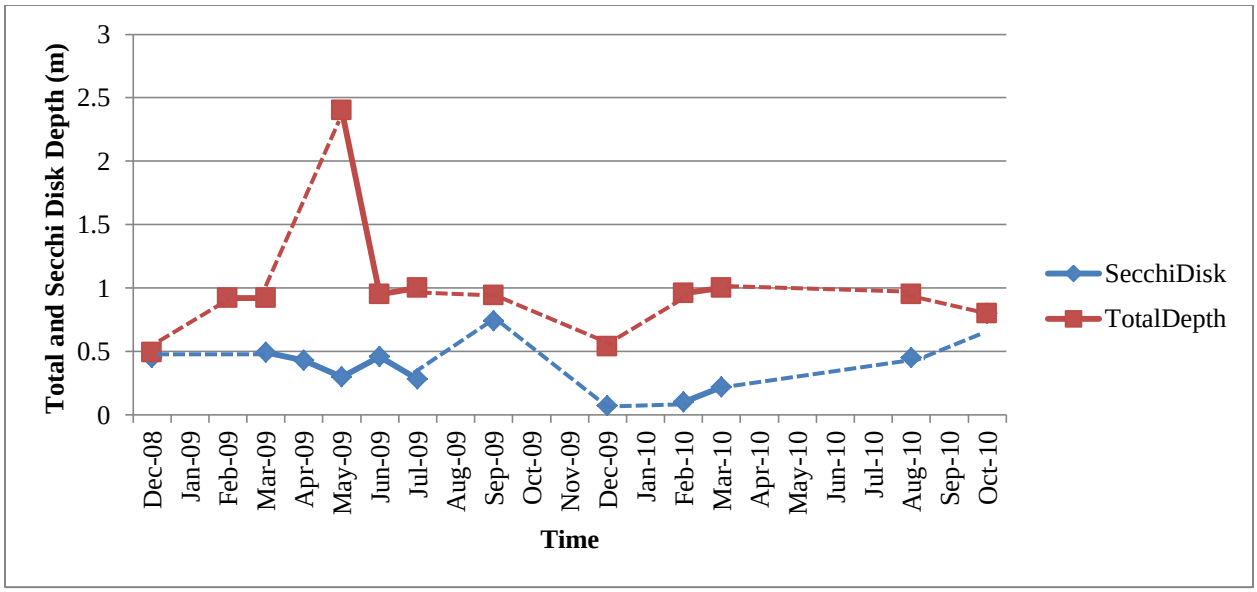

Figure 23: Dissolved Oxygen at Site 80513

Field Observations

At Site 80514, field observations recorded during sampling events indicated that water had no algae, a clear water surface, no odor, and was either clear (39%) or slightly cloudy (61%) during all of the sampling events. Water color was green/tan, light green, or colorless (46%, 23%, and 23% respectively), was either calm or had ripples (46% and 54% respectively), and had predominately normal flow. Weather was noted to be clear during 8% of the sampling events, cloudy during 85% of the sampling events, and overcast during 23% of the sampling. The largest rainfall event within three days of a sampling event was two inches in September 2009.

Site 80594 – San Bernard River at 2649 County Road 496

Site Description

This site is located south of the town of Brazoria. The site is located on a monitor's dock along a residential area on the San Bernard River. This site is surrounded by open farm land and suburban areas with a slight riparian zone observed.

Sampling Information

This is an active site sampled sporadically from 07/10/2010 to 12/18/2012 by Valroy Maudlin of Friends of the San Bernard. Sampling has occurred on average 8.7 times a year, with most sampling events occurring during the middle part of the month and in the middle to late morning. Since 07/10/2010, monitors have spent a total of 24 hours and 30 minutes sampling and traveled 65 miles while sampling this site, with an average of 61.25 minutes spent sampling and 2.82 miles traveled during each sampling event.

Table 10: Descriptive parameters for Site 80594 - San Bernard River at 2649 County Road 496

Parameter	% Complete	Mean ± Standard Deviation	Max.	Min.
Total Dissolved Solids (mg/L)	56%	4290.9 ± 4158.56	12025	12.285
Water Temperature (°C)	100%	23.94 ± 6.03	32	13.5
Dissolved Oxygen (mg/L)	100%	6.74 ± 1.83	11.1	3.4
pH	100%	7.742 ± 0.36	8.5	7
Secchi disk transparency (m)	100%	0.405 ± 0.156	0.72	0.12
Depth (m)	100%	0.665 ± 0.259	1.18	0.28
Salinity (ppt)	28%	14.87 ± 12.043	31.7	2

*Site was sampled 25 times between 07/10/2010 and 12/18/2012.

Air and water temperature

Water and air temperatures were sampled 25 times at Site 80594. Temperatures fluctuated in an expected seasonal pattern, with maximum temperatures in September of 2010 and 2011. No other pattern could be determined with water temperature. Water temperature remained above air temperature at except during the winter months from November to February during each year. Water never reached temperatures above the 2010 Texas Surface Water Quality Standard of 35ºC.

Total Dissolved Solids

Citizen scientists sampled TDS at this site 14 times and noted that the TDS values where highly variable, as evidenced by a large standard deviation value. The lowest TDS values all occurred during times of high levels of rainfall. All other sampling events recorded salinity.

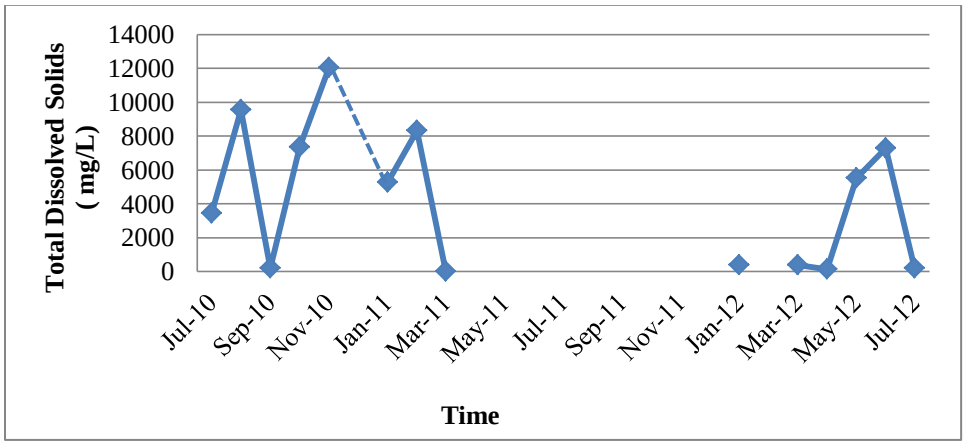

Figure 24: Total Dissolved Solids at Site 80594

Salinity

Salinity was measured seven times over the sampling period and showed no significant pattern according to season or rainfall. The average value was 14.87 ± 12.043 ppt.

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. No unusual patterns were noted. The average recorded DO for this site was 6.74 ± 1.83 mg/L.

pH

The pH values at Site 80513 showed an average of 7.742 ± 0.36 and remained consistently near that average. This site had the highest recorded average pH value out of all the sites sampled.

Secchi disk and total depth

Secchi disk depth was typically shallower than total depth, suggesting that the water had limited clarity; however, Secchi disk depth was nearly equal to total depth during the winter indicating greater water clarity during that time.

Field Observations

At Site 80514, field observations recorded during sampling events indicated that water had no algae, a clear water surface, had no odor, and primarily had normal flow (88%) during all of the sampling events. Water color was green/tan, dark green, or colorless (40%, 28%, or 20% respectively) and was either calm or had ripples (52% and 44% respectively). Weather was noted to be clear during 28% of the sampling events, cloudy during 48% of the sampling events, and overcast during 42% of the sampling. The largest rainfall event within three days of a sampling event was five inches in April of 2012.

Site 80775 – San Bernard River at Cox's Reef

Site Description

This site is located north of San Bernard National Wildlife. The site is located on a monitor's dock along a residential area on the San Bernard River. It is surrounded by open farm land and suburban areas with a treed riparian zone observed.

Sampling Information

This is an active site sampled from 01/05/2008 to 12/01/2012 by John Hellings of Friends of the San Bernard. Sampling has occurred eight times during 2012, with no set time during the month but usually during the mid to late morning. Since 01/05/2008, monitors have spent a total of 48 hours and 24 minutes sampling and have traveled 3.02 miles in order to sample this site, with an average of 90.75 minutes spent sampling and 0.09 miles traveled during each sampling event.

Table 11: Descriptive parameters for Site 80775– San Bernard River at Cox's Reef

Parameter	% Complete	Mean ± Standard Deviation	Max.	Min.
Total Dissolved Solids (mg/L)	0%	NA	NA	NA
Water Temperature (°C)	100%	24.475 ± 7.10	30.8	10
Dissolved Oxygen (mg/L)	100%	10.25 ± 12.08	10	3.2
pH	100%	7.66 ± 0.29	8.1	7.1
Secchi Disk Transparency (m)	100%	0.359 ± 0.14	0.6	0.1
Depth (m)	100%	0.56 ± 0.14	0.95	0.25
Salinity (ppt)	88%	2.28 ± 0.756	4	2

*Site was sampled 33 times between 05/10/2008 and 01/14/2013.

Air and water temperature

Water and air temperatures were sampled eight times at Site 80775. Temperatures fluctuated in an expected seasonal pattern, with maximum temperatures in August of 2012, when the water temperature never reached temperatures above the 2010 Texas Surface Water Quality Standard of 35ºC. No other pattern could be determined with water temperature due to the low number of samples. Water temperature was always above the air temperature.

Salinity

Salinity was measured seven times over the sampling period and showed no significant pattern according to season or rainfall. The average value was 2.28 ± 0.756 ppt; this was the lowest recorded average for salinity out of all the sampled sites.

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 limited and inconsistent to yield results or patterns. The average recorded value for DO at this site was 10.25 ± 12.08 mg/L; this was the highest recorded average for DO out of all the sampled sites.

pH

The pH values at Site 80509 held steady between 7.7 and 7.9 for the year sampled. The recorded average pH for this site was 7.66 ± 0.29.

Secchi disk and total depth

Secchi disk was usually significantly lower than depth, suggesting that the water had limited clarity. However during each winter the Secchi disk depth and total depth were similar, suggesting that the water was somewhat clear during the winter but turbid during the other seasons.

Field Observations

At Site 80775, field observations recorded during sampling events indicated that water had no algae, a clear water surface (75%), no odor, was primarily green/brown (63%) in color, had normal flow (88%), and was clear (75%) during all of the sampling events. Weather was noted to be clear during 75% of the sampling events, cloudy during 13% of the sampling, and overcast during 13% of the sampling events. Rainfall events over 2.68 inches were reported in December 2012.

Site 80510 – San Bernard River at 2649 County Road 496

Site Description

This site is located north of San Bernard National Wildlife. The site is located on a monitor's dock along a residential area on the San Bernard River and is surrounded by open farm land and suburban areas with a small treed riparian zone observed.

Sampling Information

This is an inactive site sampled sporadically from 01/04/2009 to 12/13/2009 by Darrell Powell of Friends of the San Bernard. Sampling has occurred six times in 2009, with most of the sampling events occurring

during the first part of the month and usually between the hours of 10:00 and 15:0L. Since 05/10/2008, monitors have spent a total of 7 hours and 35 minutes sampling and traveled 0.6 miles in order to sample this site, with an average of 75.83 minutes spent sampling and 0.1 miles traveled during each sampling event.

Table 12: Descriptive parameters for Site 80510– San Bernard River at 2649 County Road 496

Parameter	% Complete	Mean ± Standard Deviation	Max	Min
Total Dissolved Solids (mg/L)	0%	NA	NA	NA
Water Temperature (°C)	100%	23.41 ± 6.05	30.5	13.5
Dissolved Oxygen (mg/L)	100%	5.65 ± 1.067	7.1	4.5
pH	100%	7.6 ± 0.603	8.6	6.9
Secchi disk transparency (m)	100%	0.364 ± 0.18	0.56	0.146
Depth (m)	100%	0.77 ± 0.13	0.96	0.61
Salinity (ppt)	100%	13.21 ± 10.99	28.8	0

*Site was sampled 6 times between 01/04/2009 and 12/13/2009.

Air and water temperature

Water and air temperatures were sampled six times at Site 80510. Temperatures fluctuated in an expected seasonal pattern, with maximum temperatures in the August of 2009. No other pattern could be determined with water temperature due to the low number of samples. Water temperature remained near but below air temperature during the sampling period and never reached temperatures above the 2010 Texas Surface Water Quality Standard of 35ºC.

Total Dissolved Solids

Citizen scientists sampled TDS at this site three times and noted that the TDS values where highly variable, as evidenced by a large standard deviation value. All other sampling events recorded salinity. No pattern was noticed and readings varied greatly.

Salinity

Salinity was measured six times over the sampling period. The average value was 13.21 ± 10.99 ppt.

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 limited and inconsistent to yield results or patterns. The average recorded value for SO at this site was 5.65 ± 1.067 mg/L; this site had the lowest average recorded DO results out of all the sampled sites.

pH

The pH values at Site 80513 showed an average of 7.6 ± 0.603, but fluctuated between 7 and 9 over the course of the year sampled.

Secchi disk and total depth

Secchi disk was always significantly lower than depth, suggesting that the water had limited clarity. No other pattern was noticed.

Field Observations

At Site 80514, field observations recorded during sampling events indicated that water had no algae, a clear water surface, no odor, and was predominately tan/brown in color (83%) or slightly cloudy (67%) during all of the sampling events. Water was either calm or had ripples (33% and 50% respectively) and had predominately low flow (67%) during the sampling period. Weather was noted to be cloudy during 50% of the sampling events and overcast during 50% of the sampling. The largest rainfall event within three days of a sampling event was 0.9 inches in October 2009.

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