Stormwater Control Measures in Austin, TX: Data Report

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Introduction

The City began monitoring the performance of stormwater control measures (SCMs) with respect to water quality in the early 1980s in cooperation with the U.S. Geological Survey. The City continued this monitoring through the 1980s and those data were used to create initial design guidelines for the COA Environmental Criteria Manual (ECM). The City, through Stormwater Quality Evaluation (SQE), has continued to collect performance data on additional SCMs and those data have also informed decisions on the types and designs of SCMs allowed in the City.

This report presents performance summaries for thirty-four SCMs at twenty-two different sites monitored by the City of Austin (COA) Watershed Protection Department (WPD) Stormwater Quality Evaluation (SQE) section. Data in this report were collected between 1981 and 2011. This report is the most comprehensive report of its type on the performance of SCMs monitored by the City, and uses techniques recommended by the International BMP Database (IBMPDB) project (Geosyntec and Wright Water, 2009). Additional analyses were also conduced to allow the user of these data to compare data with other reports such as older COA reports or data from other localities that did not follow IBMPDB recommendations.

Influent and effluent event mean concentrations (EMCs) were typically analyzed for seventeen parameters: total suspended solids (TSS), volatile suspended solids (VSS), chemical oxygen demand (COD), total organic carbon (TOC), 5-day bio-chemical oxygen demand (BOD), nitrate+nitrite (NO_3+NO_2), total Kjeldahl nitrogen (TKN), ammonia (NH_3), total phosphorus (TP), dissolved phosphorus (DP), fecal coliform (FCOL), E. coli (EC), fecal streptococci (FSTR), lead (Pb), zinc (Zn), copper (Cu), and cadmium (Cd). Total nitrogen (TN) was computed as the sum of NO_3+NO_2 plus TKN. This parameter list was not consistent through the period covered in this report; Cd was added in the early 1990s while bacteria (FCOL, EC, FSTR) and BOD were not measured after 2001 due to concerns with holding times for the effluent.

Refer to Figure 1 for a location map of the various monitoring sites covered in this report and Table 1 for a list of the SCMs and monitoring stations.

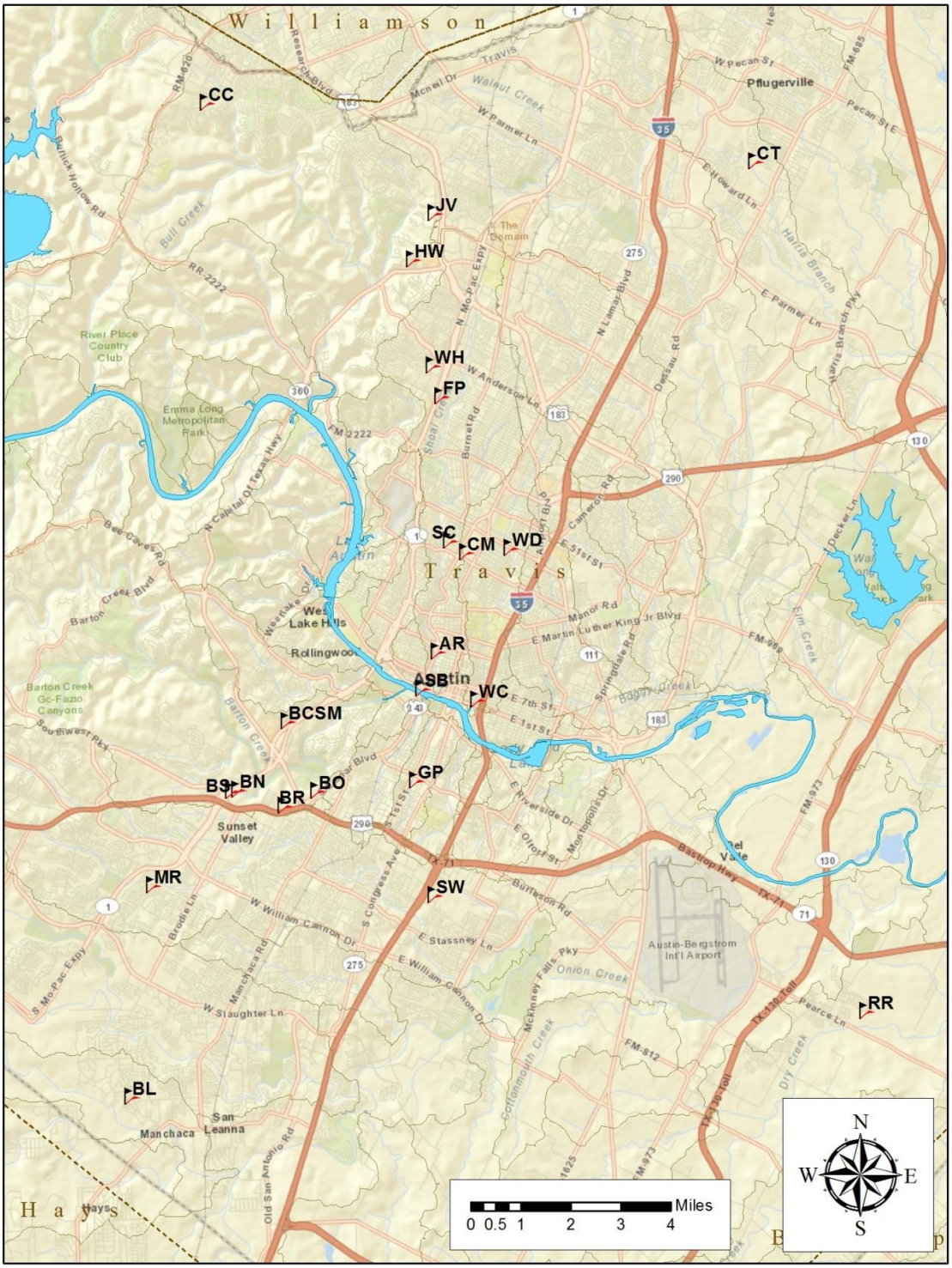

Figure 1. Map of SCMs in this report.

Table 1. Stormwater control measures monitored by the City of Austin.

Site	Stormwater Control Measure	Influent-Effluent
AR	Austin Rec Center O/G Chamber	ARA-ARE
BCSM	Barton Creek Square Mall Sand Filter	SI-SE
BL	Brodie Lane Swale, upper reach	BLI-BLM
	Brodie Lane Swale, lower reach	BLM-BLE
	Brodie Lane Swale	BLI-BLE
BN	MoPac BMP #6	BNI-BNE
BO	Brodie Oaks Sand Filter	BM-BE
	Brodie Oaks Water Quality Pond	BI-BE
	Brodie Oaks Retention Irrigation	BI-BM
BR	Barton Ridge Sedimentation Basin	BRI-BRM
	Barton Ridge Sand Filter	BRM-BRE
	Barton Ridge Sed-Fil Pond	BRI-BRE
BS	MoPac BMP #5	BSI-BSE
CC	Canyon Creek Sand Filter	CCI-CCS
	Canyon Creek Biofiltration	CCI-CCN
CM	Central Market Wet Pond	CMI-CME
CT	Ceylon Tea Wet Pond	CTI-CTE
FP	Far West Sedimentation Basin	FPI-FPS
	Far West Wetland	FPS-FPE
	Far West Water Quality Pond	FPI-FPE
GP	Gillis Park O/G Chamber	GPI-GPE
HW	Highwood Sand Filter	HI-HE
JV	Jollyville Road Sand Filter	JVI-JVE
MR	Maple Run Sedimentation Basin	MI-ME
RR	Ross Road Wet Pond	RRI-RRE
SB	Sand Beach Biofiltration	SBI-SBE
SC	Rosedale StormCeptor	SCI-SCE
SW	St. Elmo Wet Pond	SWI-SWE
WC	Convention Center O/G Chamber	WCI-WCE
	Convention Center Wet Pond	WCE-WCP
	Convention Center Wet Pond System	WCI-WCP
WD	45th Street O/G Chamber	WDI-WDE
WH	Woodhollow Wet Pond	HLA-WH

For a comparison of how the performance of different classes of SCMs compare to each other, refer to the companion SQE report (COA, 2013a).

Statistical Analyses

This section documents the various analytical and statistical techniques that were used to produce this report. These techniques were used to analyze EMCs only, not discrete samples. For a detailed explanation of the SQE methodology to compute EMCs and the quality control procedures, refer to the SQE small watershed report (COA, 2009). Data presented in this report are for the influent and treated effluent of the system; where applicable, any runoff bypassing the SCM would need to be considered when evaluating the overall performance or loading analyses.

SQE typically computes all of the following statistics and allows the user to decide on the appropriate set to use for a particular analysis. In general, non-parametric analyses will be valid; arithmetic analyses may be valid if the normality is not rejected and lognormality is rejected; lognormal analyses may be valid if the lognormality is not rejected and normality is rejected; bootstrapping may be valid if the data distributions are indeterminate.

Site Descriptive Statistics

Several analyses were conducted to compute descriptive statistics for each site in this report. These statistical parameters are used to describe the conditions at the site but are not used to compare the sites directly to one another. The parameters are most easily divided into four categories based on assumptions used in later analyses; non-parametric, arithmetic (normal), log transformed (lognormal) and bootstrap.

<u>Non-parametric</u>

Non-parametric tests assume no underlying data distribution and as such may be very robust because they make fewer assumptions about the data. But in cases where parametric analyses would be appropriate, they tend to have less power. This is often the case with small sample

sizes. Non-parametric descriptive statistics include: number of samples, maximum, minimum, median (50th percentile), upper quartile (75th percentile), and lower quartile (25th percentile).

Arithmetic

Arithmetic descriptive statistics assume a normal distribution of the data. The computation of these parameters is familiar to most users of data. The most common of these is the mean and standard deviation. The upper and lower confidence limits of the mean are computed using the following test:

$$\bar{x} \pm t_{1-\alpha,n-1} \frac{s}{\sqrt{n}} \qquad [1]$$

where,

$\bar{x}$ = is the sample mean,

$t_{1-\alpha,n-1}$ = is the student-t value for a give confidence interval (1- α) and *n* samples,

s = is the sample standard deviation, and

n = the number of samples.

If *n* is sufficiently large the $Z_{1-\alpha}$ test value may be used instead of $t_{1-\alpha,n-1}$.

The final descriptive statistic tests the assumption of normality using the *W* test developed by Shapiro and Wilk in 1965 (denoted as "Wilk (p-value)" in data summaries). While other tests are available, the *W* test is considered one of the most powerful tests for detecting departure from normal or lognormal distributions for small (n<50) datasets (Gilbert, 1987). The test is computed by:

$$W = \frac{\left(\sum_1^k a_i \left(x_{n-i+1} - x_i\right)\right)^2}{\sum_1^n \left(x_i - \bar{x}\right)^2} \qquad [2]$$

where k=n/2 if n is even and k=(n-1)/2 if n is odd and a_i are coefficients developed by Shapiro and Wilk (1965). Normality is rejected if the value of W is less than a value associated with n and the desired significance level, α. If normality is rejected, arithmetic descriptive statistics should not be used.

It is often difficult to reject normality in favor of a lognormal distribution with small sample sizes (Motulsky, 2007). In these cases, SQE assumes a lognormal distribution of EMCs without compelling evidence to the contrary, based on prior studies indicating environmental data are typically lognormally distributed. Bootstrap methods may also be used.

Log Transformed

Log transformed descriptive statistics assume the data follow a lognormal distribution. Descriptive statistics assuming a normal distribution were developed between 1920 and 1950 and have been well investigated. This is not the case with lognormal-based methods, which have received less scrutiny (Singh, et al., 1997). Further, with the advent of more powerful computers, older methods that may have been simpler should be replaced with more robust methods.

There are two primary methods to estimate the mean, μ, and the variance, σ^2, for lognormally distributed data. (Note: it is tempting to estimate μ of a lognormal distribution using the geometric mean; however, the geometric mean is a bias estimator of the true mean of the data [Gilbert, 1987]). A simplified method to estimate μ and σ^2 for lognormally distributed data that has long been used and was accepted by EPA as part of the NURP report and the BMP database project (EPA, 1983; Geosyntec and Wright Water, 2009) is defined as follows:

$$\hat{\mu} = e^{\left(\bar{y} + \frac{s_y^2}{2}\right)} \qquad [3]$$

and

$$\hat{\sigma}^2 = \hat{\mu}^2\left(e^{s_y^2} - 1\right) \qquad [4]$$

where,

$\hat{\mu}$ = the estimate of the mean of data from a lognormal distribution,

$\hat{\sigma}^2$ = the estimate of the variance of data from a lognormal distribution,

$\bar{y}$ = the arithmetic sample mean of the log transformed data, and

s_y^2 = the sample variance of the log transformed data.

This method has been used by SQE in the past but it does have some drawbacks, mainly a positive bias. Kendall and Stuart (1961) found that the bias approaches zero as *n* becomes large. One advantage of this method is that it is simple to compute; however, with current computing capacities this is not an issue. While this method has been widely used in the past to compute the mean of lognormally distributed data, the bias should be considered for small, highly variable datasets (Gilbert, 1987). The bias on the mean of Eqn. 3 may be estimated by:

$$\left(1 - \frac{\hat{\sigma}^2}{n}\right)^{-(n-1)/2} \exp\left(-\frac{n-1}{2n}\hat{\sigma}^2\right) \qquad [5]$$

Finney (1941) and Sichel (1952, 1966) independently developed the minimum variance unbiased (MVE) method to compute the mean for lognormally distributed data. This method has been recommended by USEPA for computing the mean of lognormally distributed data (Singh, et al, 1997). This method is defined as follows:

$$\hat{\mu} = \left(e^{\bar{y}}\right)\Psi_n\left(\frac{s_y^2}{2}\right) \qquad [6]$$

and

$$\hat{\sigma}^2 = \left(e^{(2\bar{y})}\right)\left[\Psi_n\left(2s_y^2\right) - \Psi_n\left(\frac{s_y^2(n-2)}{n-1}\right)\right] \qquad [7]$$

This report used Eqns. 6 and 7 means and variances of lognormal distributed data. (Note: the Psi function in Eqns. 6 and 7 is the log derivative of the Gamma function, also known as the digamma function.)

As with the mean and variance, there has been much confusion related to computing the confidence limits on the mean for lognormal distributed data. Using Eqn. 1 for lognormal data will produce biased results, since the right hand tail of the lognormal data is much longer unless the data set is very large (Gilbert, 1987) assuming $\bar{x}$ and s are computed using Eqn. 6 and 7. However, no guidance is provided as to how large n needs to be.

Cox and modified Cox methods (Olsson, 2005) are similar procedures: the Cox method uses $Z_{1-\alpha}$ and the modified Cox method uses $t_{1-\alpha,n-1}$. As such they will be discussed together. The general form of the Cox equation is

$$\exp\left(\bar{y} + \frac{s^2}{2} \pm Z_{1-\alpha}\sqrt{\frac{s^2}{n} + \frac{s^4}{2(n-1)}}\right) \qquad [8]$$

Both methods produced reasonable results, but the modified Cox method produced slightly better results for smaller samples sizes. It should be noted that the estimation of the mean in the Cox method is based on the biased estimator in Eqn. 3, as seen in the first term.

In 1971, Land proposed a generalized method to compute the confidence intervals for lineal functions of the normal mean and variance. This method will work for many distributions given the correct coefficients and is the preferred method if the underlying distribution is lognormal (Gilbert, 1987). The upper and lower limits are expressed as:

$$UL_{1-\alpha} = \exp\left(\bar{y} + \frac{s_y^2}{2} + \frac{s_y H_{1-\alpha}}{\sqrt{n-1}} \right) \qquad [9]$$

and

$$LL_{\alpha} = \exp\left(\bar{y} + \frac{s_y^2}{2} + \frac{s_y H_{\alpha}}{\sqrt{n-1}} \right) \qquad [10]$$

The difficulty of using this approach had been computing the coefficient *H*, which is dependent on α, *n* and s_y. Land (1975) provided tables with values for *H*, but looking up values and interpolating for different values of *n* and s_y was tedious. Lyon and Land (1999) developed a computer program to compute values of *H* for a given set of variables or to create detailed tables for various values of α, *n* and s_y. SQE has computed upper and lower limit values for *H* for α at 0.90, 0.95 and 0.975, *n* ranging between 6 and 51, and s_y between 0.10 and 4.00 (incremented by 0.01). These tables may be used as lookup tables to compute upper and lower limits on the means. While this method theoretically has the optimum properties when the data are lognormally distributed, field investigations (Hardin and Gilbert, 1993 and Singh, et al., 1997) found that it may overestimate the upper confidence limit if the data come from a mixed distribution or are poorly defined with a small dataset.

To overcome the shortcomings of all of these methods, SQE further revised the modified Cox approach to take advantage of the more robust estimate of the mean and used the following equations:

$$LCL = \frac{\hat{\mu}}{\exp\left(t_{\alpha,n-1} \sqrt{\frac{s^2}{n} + \frac{s^4}{2(n-1)}} \right)} \qquad [11]$$

$$UCL = \hat{\mu} \bullet \exp\left(t_{1-\alpha,n-1} \sqrt{\frac{s^2}{n} + \frac{s^4}{2(n-1)}} \right) \quad [12]$$

where $\hat{\mu}$ is computed based on Eqn. 6.

The last descriptive statistic in the lognormal class is the *W* test. The same W test described in Eqn. 2 is used, but on the log transformed data. This is used to determine if the data fit the lognormal distribution. If not, the parameters in the section should be ignored.

<u>Bootstrap</u>

Bootstrapping refers to a resampling technique used to compute descriptive statistics. The tests are useful if the underlying data distribution is unknown or if the sample size is too small to make statistical inferences. However, if the underlying assumption is known with a degree certainty to <u>not</u> be normal, it may produce misleading results based on the assumption of the computations.

Bootstrapping is accomplished by creating multiple synthetic datasets from the given data. A bootstrap dataset is created by selecting *n* random samples, with replacement from the given dataset, where *n* is the number of samples in the given dataset. Basic statistics are computed from this synthetic dataset using the assumption of normality. For example, the mean would be $\bar{x}_1$. A second synthetic dataset is created in the same manner resulting in $\bar{x}_2$. This is repeated a large number of times (for this report 1,000 synthetic datasets were used). The bootstrap statistic is created as follows:

$$\bar{x} = \frac{\sum_{n=1}^{1000} \bar{x}_n}{1000} \quad [13]$$

This technique was used to estimate the mean, standard deviation, and upper and lower confidence limits of the mean. The bootstrap statistics were used in cases where the *W* test either rejected both normal and lognormal distributions or accepted both distributions.

Comparative Statistics

While the descriptive statistics are common to other SQE reports, SCM analyses require comparative analyses to evaluate performance. Traditionally, the only comparative statistic used for SCM evaluation was the efficiency ratio or percent removal. However, this may produce misleading results and does not indicate if the difference between the influent and effluent is statistically significant. This section will outline the various comparative statistics and when they may be appropriate.

Efficiency Ratio

The efficiency ratio compares the fractional change in the concentration at the influent and effluent of the SCM and is computed as follows:

$$ER = 1 - \frac{MC_{out}}{MC_{in}} \qquad [14]$$

where,

MC_{out} = is the mean or median concentration at the effluent,

MC_{out} = is the mean or median concentration at the influent.

The efficiency ratio may be computed using the median, as is the case with non-parametric results, or the mean computed in any of the manner described above. While this method has been used historically to evaluate SCM performance, there are several shortcomings. The obvious example of this is where heavily sediment-laden influent is filtered to achieve high removal efficiency while still having high pollutant concentrations in the effluent, while less-polluted influents may show low removal efficiencies even when treated to background concentrations. First, the efficiency ratio is based on the influent concentration. Two properly functioning SCMs with similar effluent concentrations may have very different efficiency ratios if the influent concentrations are different. Second, a SCM may have a good percent removal but

still have an unacceptable effluent concentration. Further, there is no indication whether the difference is statistically significant. For these and other reasons, the International SCM Database project does not recommend using efficiency ratios to evaluate performance as a stand-alone parameter. Additional analyses are required to fully evaluate SCM performance.

Non-Parametric Tests

Non-parametric tests were used to compare influent and effluent concentrations. The Mann-Whitney U test (also known as the Wilcoxon rank-sum test) was used to compare the influent and effluent as two independent data sets. This test examines the rank order of the two data sets and infers whether they came from the same population (Gilbert, 1987). The Wilcoxon signed-rank test was used to test the difference between paired influent and effluent. Both of these tests are appropriate regardless of any underlying data distribution. The Wilcoxon signed-rank test, as with other paired tests, may indicate subtle differences in the influent and effluent concentrations that are masked by normal variability when using unpaired tests. However, the SQE monitoring plan was not initially designed to collect paired samples, resulting in fewer paired samples and a less powerful test. For some SCMs, a paired test may not be appropriated if the influent and effluent concentrations are not related to the same runoff event, as is the case with wet ponds.

Parametric Tests

The same parametric comparative statistics were computed using the assumptions of normal and lognormal distributions. For the assumption of a lognormal distribution, these tests were conducted using log transformed data. This does introduce an anomaly. Rather than comparing the means from lognormal data computed using Eqn. 6, the comparison is on the geometric means. Levels of significance should still be valid.

The primary parametric test used for comparison is the Student's t-test with several variations to account for underlying assumptions. The basic equation for the t-test assuming two independent data sets is:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S_{X_1X_2} \cdot \sqrt{\frac{2}{n}}} \qquad [15]$$

where,

$$S_{X_1X_2} = \sqrt{\frac{1}{2}(S_{X_1}^2 + S_{X_2}^2)} \qquad [16]$$

This form of the t-test assumes equal sample sizes, which is often not the case. To account for unequal sample sizes, Eqn. 15 and 16 are modified to be:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S_{X_1X_2} \cdot \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \qquad [17]$$

where,

$$S_{X_1X_2} = \sqrt{\frac{(n_1 - 1)S_{X_1}^2 + (n_2 - 1)S_{X_2}^2}{n_1 + n_2 - 2}} \qquad [18]$$

A further assumption of the t-test that must be accounted for is homoscedasticity, or equal variance. If the variances are not equal, the t-test must be further modified to:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S_{\bar{X}_1 - \bar{X}_2}} \qquad [19]$$

where,

$$S_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}} \qquad [20]$$

SQE computes t-test statistics using both Eqn. 17 and 19 and conducts a Levene to determine if the variances are equal. If the Levene test is significant and homoscedasticity is rejected, the test results using the assumption of equal variance should not be used.

As with the non-parametric analyses, SQE conducts a paired t-test on the paired data using the following:

$$t = \frac{\bar{x}_D - \mu_0}{s_D/\sqrt{n}} \qquad [21]$$

The same caveats apply to the paired t-test as to the Wilcoxon signed rank test with respect to power and applicability.

Data Plots

SQE generated four data plots to assist in comparing the influent and effluent concentrations and to help interpret the results. The first plot is a lognormal probability plot with the concentration of the influent and effluent on the x-axis with a log scale and the probability that the concentration is less than that value on the y-axis using a probability scale. The slope of the line is a representation of the variance and the data cross 0.5 on the y-axis at the median. If the data are parallel and the effluent is separate and to the left of the influent across the range of data, the SCM is removing that pollutant; one must be careful not to assume that aligned points are paired influent and effluent for an event. The influent and effluent data may converge and lower concentration, which may indicate the maximum treatment level for that SCM.

The second plot is a time series of the influent and effluent concentrations. This may be helpful to determine if the influent or effluent concentrations change over time, affecting the performance. This may indicate the need for maintenance if performance is decreasing, or the 'ripening' of the SCM if it is performing better over time, which may be case with SCMs requiring biological activity like wet ponds, bio-filtration or rain gardens. This plot may also be useful to compare paired results versus unpaired results.

The third graph is box-and-whisker plot on a log scale. This may be used in a manner similar to the probability plot for evaluating overall performance.

The final plot is a scatter plot of paired influent v. effluent concentrations. This will help determine if the influent and effluent are correlated and if so, if the effluent may be predicted from the influent. The same caveats apply as with the other paired analyses. The ability to predict effluent concentrations from influent concentrations may be limited if the data are poorly correlated and it would apply only to that SCM, not necessarily to a class of SCMs, given the variability in influent concentrations. Some have proposed that the slope of the regression represent the efficiency of the SCM; however, assumptions for regression are rarely valid.

Description of Stormwater Control Measures

Sedimentation

Sedimentation basins, also referred to as extended detention, are detention basins with increased runoff residence times sufficient to remove some settleable pollutants. Because the primary mechanism at work in a sedimentation basin is subsidence and deposition, a sedimentation basin usually has only moderate treatment efficiencies for some pollutants and is often used as pretreatment in an SCM system, such as sedimentation/filtration system. The sedimentation basin reduces the amount of sediment that reaches the sand filter, extending the life of the filtration basin. Details of sedimentation basins used in this manner can be found in City of Austin Environmental Criteria Manual (COA, 2013b). However, since sedimentation basins are not allowed as stand-alone treatment devices, no design criteria area are presented for that case.

Factors that may affect performance are residence time and surface area. Longer residence times allow for more settling while larger surface areas result in shorter settling distances for a given volume. Sedimentation basins are typically off-line systems. Data presented in this report are for the treated effluent of the system; any bypass would need to be considered when evaluating overall performance.

Results for individual sedimentation SCMs are found in Appendix A.

Sand Filtration

Sand filters are structural SCMs that capture and temporarily store stormwater runoff and filter the runoff through a bed of sand. There are many sand filter designs; the typical Austin sand filter has two basic components: the pretreatment sedimentation basin and the sand filter basin. The sedimentation basin reduces the amount of sediment that reaches the filtration basin and can clog the sand filter. In some cases it can help to ensure that stormwater reaches the sand filter as distributed flow. The sand filter traps the finer sediment and sediment-bound pollutants and may provide media for microbial removal of bacteria. The filtered runoff is collected by an underdrain and discharged to a creek or storm sewer. The rate of discharge is often regulated, either at the sedimentation basin or the discharge of the underdrain, depending on the design, to meet a specified drawdown rate.

The objective of sand filters is to remove sediment and the pollutants from the first flush of pavement and impervious area runoff. Sand filters have been demonstrated to be effective in removing many of the common pollutants found in urban stormwater runoff, especially those found in particulate form. They have been shown to have at least a moderate level of bacterial removal, but have not been effective at removing dissolved pollutants such as total dissolved solids and nitrate-nitrogen. The details of sand filters can be found in City of Austin Environmental Criteria Manual (COA, 2013b). As with sedimentation basins, these are off-line systems and bypass flows need to be taken into account.

Results for sand filter SCMs are found in Appendix B

Wet Ponds

A wet pond is a constructed stormwater basin that retains a permanent pool of water. Runoff from individual events is detained in the basin by displacing a corresponding volume of water in the permanent pool. The primary pollutant removal mechanisms in a wet pond are sedimentation and biological conversion. Significant loads of suspended pollutants, such as metals, nutrients,

sediments, and organics, may be removed by sedimentation, but wet ponds have longer resident times than sedimentation basins. Dissolved contaminants are removed by a combination of processes: physical adsorption to bottom sediments and suspended fine sediments, natural chemical flocculation, bacterial decomposition, and uptake by aquatic plants and algae.

Wet ponds have a moderate to high capacity for removing most urban pollutants, depending on how large the volume of the permanent pool is in relation to the runoff from the surrounding watershed. Soil conditions are important for the proper functioning of the wet pond. The pond is a permanent pool, and thus must be constructed such that the water must not be allowed to exfiltrate from the permanent portion of the pool. Unlike other SCMs, wet ponds typically treat all runoff from the contributing drainage area, as they are usually designed without a bypass. Wet ponds may offer flood-control benefits.

A well-designed and landscaped wet pond can be an aesthetic feature on a development site when it is planned and located properly. However, if the wet pond is not properly maintained or if the pond becomes stagnant, floating debris, scum, algal blooms, unpleasant odors, and insects may appear. In an arid climate, wet ponds must also be designed with sufficient drainage area to replace evaporative losses on a frequent basis. Sediment removal from the main portion of the pond is usually necessary after the pond has been functional for about 20 years. The details of wet ponds can be found in City of Austin Environmental Criteria Manual (COA, 2013b).

Results for wet pond SCMs are found in Appendix C

Biofiltration

Biofiltration basins are SCMs that use the chemical, biological, and physical properties of plants, microbes, and soils for removal of pollutants from stormwater runoff. The COA design of a biofiltration system is similar to that of a sand filter except the filtration media are biologically active and can support plant growth. The primary difference between sand filters and biofiltration is the presence of a biological community of plants and microorganism in a biofiltration system that can theoretically provide more treatment of runoff, especially nitrates,

which are problematic in sand filters. Another benefit of having a plant community is that the permeability of the biofiltration media may be sustained for longer periods without maintenance. The effluent concentrations from a biofiltration basin, however, are influenced by the filtration media used. High levels of compost may result in an export of nutrients. The details of biofiltration can be found in City of Austin Environmental Criteria Manual (COA, 2013b). As with sedimentation basins, these are off-line systems and bypass flows need to be taken into account.

Results for biofiltration SCMs are found in Appendix D.

Vaults and Oil/Grit Separators

Vaults are on-line underground facilities used for the storage of stormwater. They are typically constructed from reinforced concrete. A vault has both temporary and permanent water pools and may also have a constructed outlet that causes a temporary rise of the water level during each storm.

Vaults cannot provide the equivalent level of treatment accomplished by wet ponds and constructed wetlands because neither biological uptake nor vegetative filtration are available as pollutant removal mechanisms in vaults. Gravity settling of suspended solids is the primary removal mechanism, but vaults are unlikely to be as effective as open ponds in removing particulates because little or no soil layer exists in which to permanently stabilize trapped sediments.

Oil/grit separators are chambers designed to remove sediment and hydrocarbons from urban runoff; they are also effective for removing floating trash from runoff. They are normally used close to the source before pollutants are conveyed to storm sewers or as pre-treatment for other SCMs. Oil/grit separators are typically used in areas with heavy traffic or high potential for petroleum spills such as parking lots, gas stations, roads, and loading areas.

Oil/grit separators may have multiple chambers that water passes through. In the first chamber, the water is slowed and grit is deposited on the bottom while the water continues through to the second chamber. Here oil and grease as well as floatables are trapped on top of the water while the water is pushed into a final chamber through the bottom of the chamber wall. The third chamber allows for additional settlement of fine particles before discharging the water into either the storm sewer system or a retention or detention basin.

Runoff is detained only briefly in conventional oil-grit separators, so only moderate removal of coarse sediments, oil, and grease can be expected. Even more limited removal is likely for fine-grained sediment and pollutants attached to the sediment, such as trace metals and nutrients. Soluble pollutants will most likely pass through oil-grit separators.

The use of an oil-grit separator to pre-treat flows of stormwater runoff ahead of structural SCMs, e.g. as a forebay, can provide economic and environmental benefits. The structures are easily accessible and can be located underground, minimizing valuable space. However, the structures have limited pollutant removal capability and require frequent cleanout.

Results for vaults and oil/grit separator SCMs are found in Appendix E.

Other Control Measures

SQE has monitored several unique SCMs during the period of its existence. These SCMs do not fit neatly in to other categories and their results are presented in Appendix F. The following briefly describes these SCMs.

Stormceptor is a precast, modular, vertical cylindrical tank that is divided into an upper bypass chamber and a lower storage/separation chamber. Under normal design flow operating conditions, flow enters the structure through the upper chamber and is diverted by a U-shaped weir through a downpipe and into the lower separation/holding, or treatment, chamber. The downward flow is redirected horizontally around the circular walls of the separation chamber by a tee-fitting on the downpipe outlet. This circular flow, as well as gravitational settling, traps

sediments and other particulate pollutants (as well as any pollutants that adsorb to the particulates) at the bottom of the chamber.

Retention/irrigation refers to the capture of stormwater runoff in a holding pond, followed by use of the captured water quality volume for irrigation of appropriate landscape areas. The goal of retention/irrigation systems is to roughly simulate the natural (undeveloped) hydrologic regime in which the large majority of rainfall is ultimately infiltrated and/or lost to evapotranspiration. Pollutant removal effectiveness is high, accomplished through physical filtration of solids in the soil profile and uptake of nutrients by vegetation. The primary drawback of this approach is the potentially high maintenance requirements for the irrigation system, which must remain operational if this SCM is to function effectively. SQE has monitored other retention/irrigation systems but only one is presented here due to its combination with sand filtration. Due to the design requirement that discharge not occur from the irrigation fields evaluation differs significantly from typical flow-through systems. A more comprehensive evaluation of retention/irrigation systems will be provided in a later report.

Stormwater wetlands are constructed shallow marsh systems that are designed to treat urban stormwater and control runoff volumes. Stormwater wetlands provide physical, chemical, and biological water quality treatment of stormwater runoff. Physical treatment occurs as a result of decreasing flow velocities in the wetland, and is present in the form of evaporation, sedimentation, adsorption, and/or filtration. Chemical processes include chelation, precipitation, and chemical adsorption. Biological processes include decomposition, plant uptake, and removal of nutrients, plus biological transformation and degradation.

Enhanced grassed swales are broad, shallow channels designed to slow runoff, promote infiltration, and filter pollutants and sediments in the process of conveying runoff. The various pollutant removal mechanisms of a swale include: sedimentary filtering by the swale vegetation (both on side slopes and on bottom), filtering through a subsoil matrix, and/or infiltration into the underlying soils with the full array of infiltration-oriented pollutant removal mechanisms. Enhanced grassed swales are sized to allow the entire runoff volume to be filtered through the

vegetation or infiltrated through the filter media at the bottom of the swale. Because they are dry most of the time, they are often a preferred water quality control option in residential settings.

Vertical filter systems consist of a single large, concrete-lined chamber that serves as storage and settling area. To one side of the chamber is a permeable wall, frequently constructed of sand layered between filter fabric and then sandwiched between sets of gabions. The vertical filter concept has attracted interest because the design could provide filtration of stormwater in a facility that is smaller than the typical horizontal bed sand filter. The smaller facility footprint is obtained because the vertical filter can serve as one of the vertical walls of the chamber that stores captured stormwater.

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Appendix A Sedimentation

Maple Run Sedimentation Basin (MI-ME)

This SCM was designed to isolate and treat the first one -half inch of runoff from the northwest section of the subdivision (See the COA report on small watershed quantity and quality (COA, 2009) for a detailed description of the contributing watershed). Any additional runoff bypasses the pond via an overflow spillway. Effluent was discharged through a 12 inch perforated standpipe. This was initially covered with non-woven geotextile cloth, which clogged rapidly and was removed.

The monitoring was conducted but the initial City monitoring program. Due to technical limitations at the time, flow could not be accurately measured at the inflow station. Influent EMCs were computed as the arithmetic mean of the discrete aliquot concentrations due to these limitations.

The City collected runoff and water quality data at the Maple Run sedimentation basin (MI-ME) from 1984 to 1986. During this time 25 and 15 valid EMCs were collected at the influent (MI) and effluent (ME) respectively, of which 11 were paired.

Performance Summary

Overall, the Maple Run sedimentation basin had a minimal impact on water quality for the pollutants measured during this study. TSS was reduced by 53% and was only significant if a paired comparison is used. TDS was reduced by 48% and was not significant in any case, paired or not paired.

COD and TOC concentrations were reduced by 23% and 26% respectively, and were not significant in all cases. BOD concentration was increased by 25% and was not significant in any case.

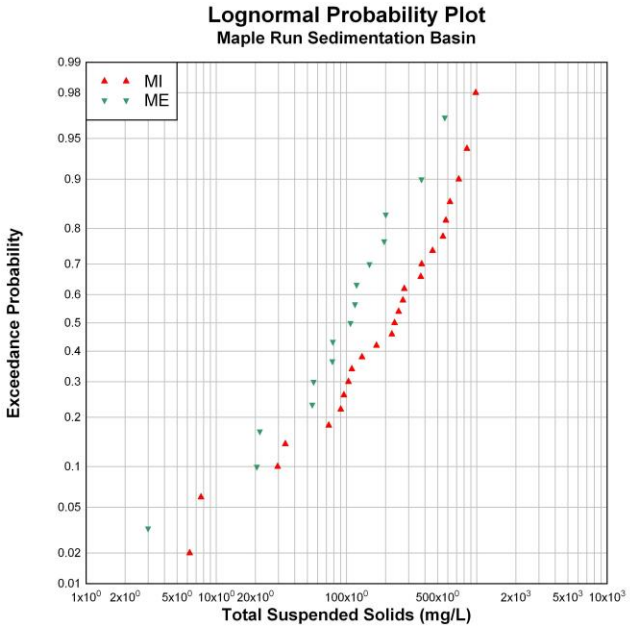
Total nitrogen and nitrate + nitrite concentrations were reduced by 43% and 43% respectively, and were significant in any case. Total Kjeldahl nitrogen concentration was reduced by 42% and was not significant in any case. Ammonia concentration was reduced by 30% and was only significant if data are paired.

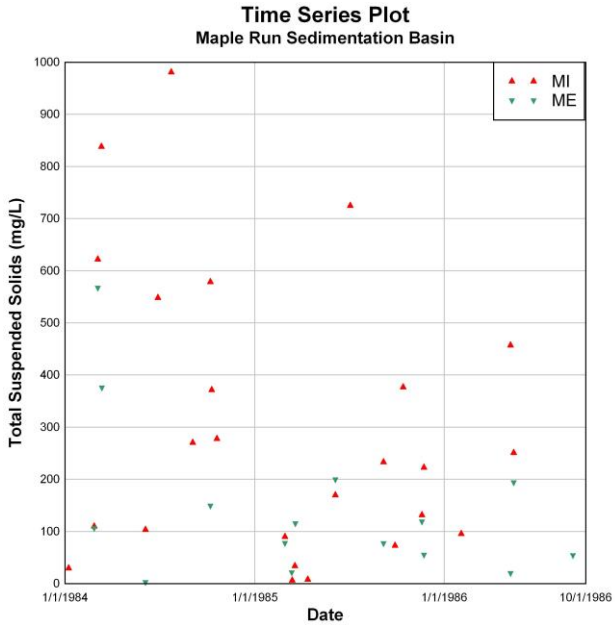
TP concentration was reduced by 17% and was not significant in any case.

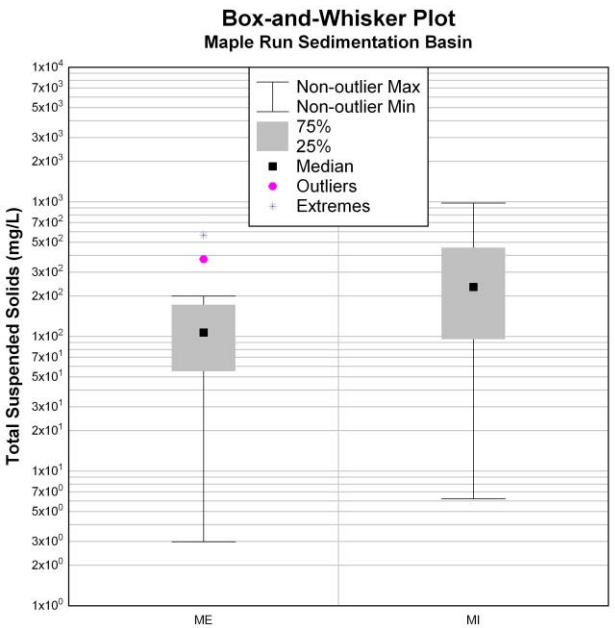
The reduction of bacteria was significant in any case for FCOL (69%), and was not significant in any case for FSTR (36%).

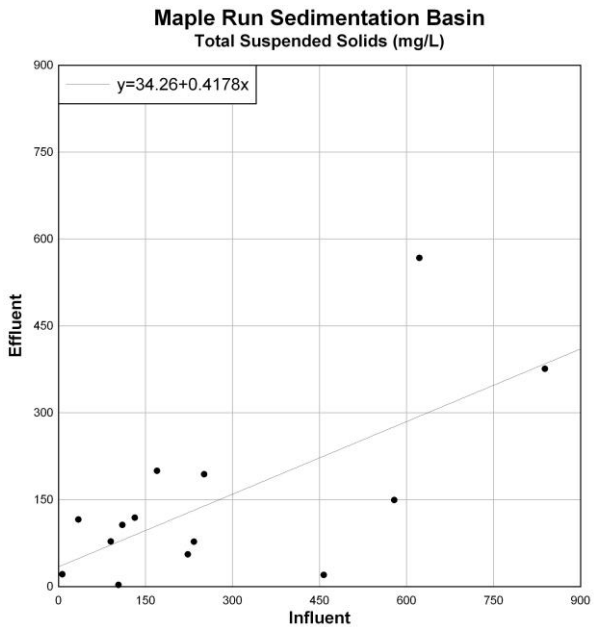
Lead concentration was reduced by 22% and was not significant in all case. Zinc and copper concentrations were increased by 6% and 26% respectively, and were not significant in all cases.

Maple Run Sedimentation Basin - Total Suspended Solids (mg/L)



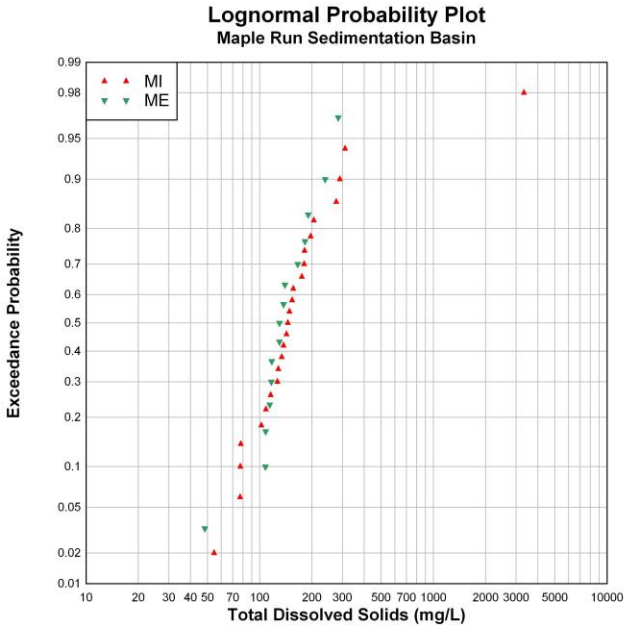


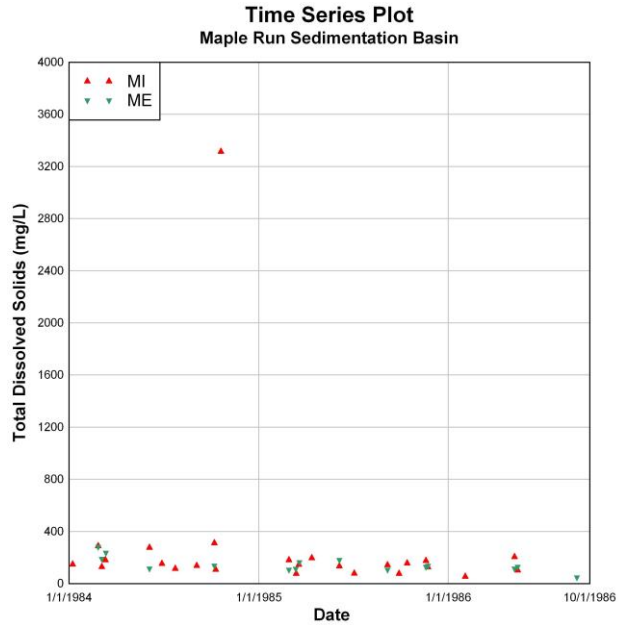


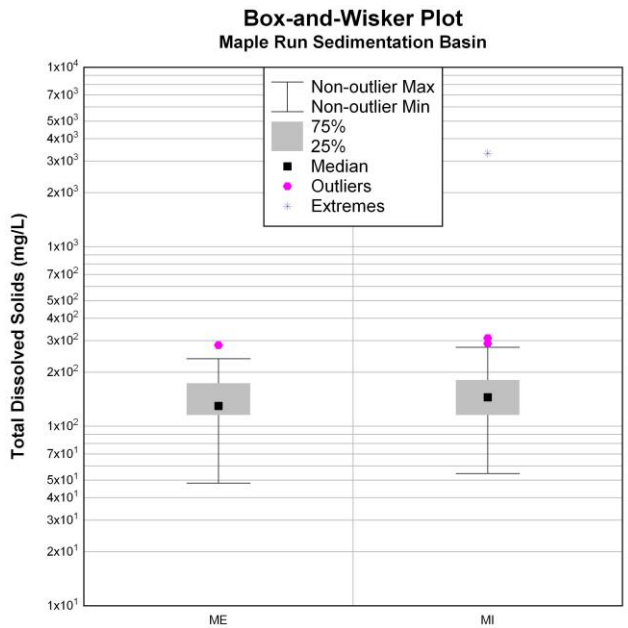


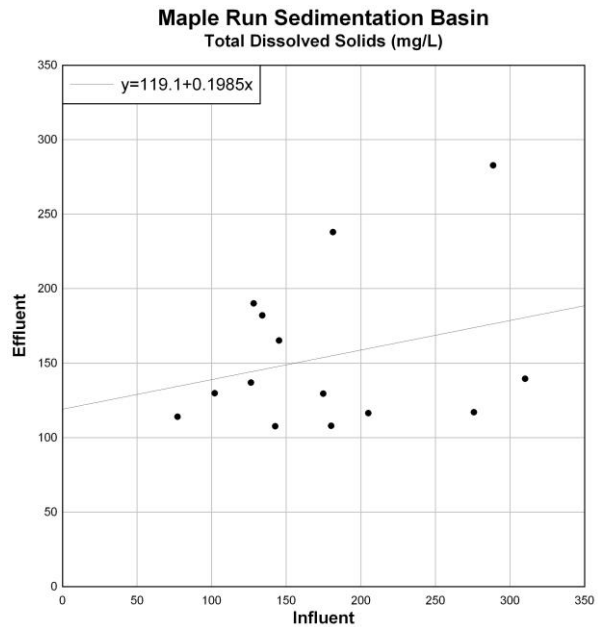
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	15
	Pairs Count	11	11
Non-Parametric	Maximum	981.0	567.7
	Upper Quartile	457.0	194.3
	Median	233.1	106.8
	Lower Quartile	95.5	54.5
	Minimum	6.3	3.0
	Efficiency	54.18%	
	Mann-Whitney	0.0577 *	
	Wilcoxon (paired)	0.0068 **	
Arithmetic	UCL	417.1	226.0
	Mean	304.1	142.8
	LCL	191.0	59.5
	Std. Dev.	273.9	150.4
	Wilk (p-value)	0.0110 **	0.0021 **
	Efficiency	53.05%	
	t-Test (equal var.)	0.0431 **	
	t-Test (unequal var.)	0.0213 **	
	t-test (paired)	0.0277 **	
	Levene Test	0.0778 *	
Log Transformed	UCL	854.5	456.0
	Mean	394.0	170.8
	LCL	181.6	64.0
	Std. Dev.	716.4	266.9
	Wilk (p-value)	0.0344 **	0.2479
	Efficiency	56.65%	
	t-Test (equal var.)	0.0973 *	
	t-Test (unequal var.)	0.0958 *	
	t-Test (paired)	0.0278 **	
	Levene Test	0.8385	
Bootstrap	UCL	405.7	216.1
	Mean	297.9	140.8
	LCL	190.2	65.6
	Std. Dev.	261.0	135.9
	Efficiency	52.73%	

Maple Run Sedimentation Basin - Total Dissolved Solids (mg/L)



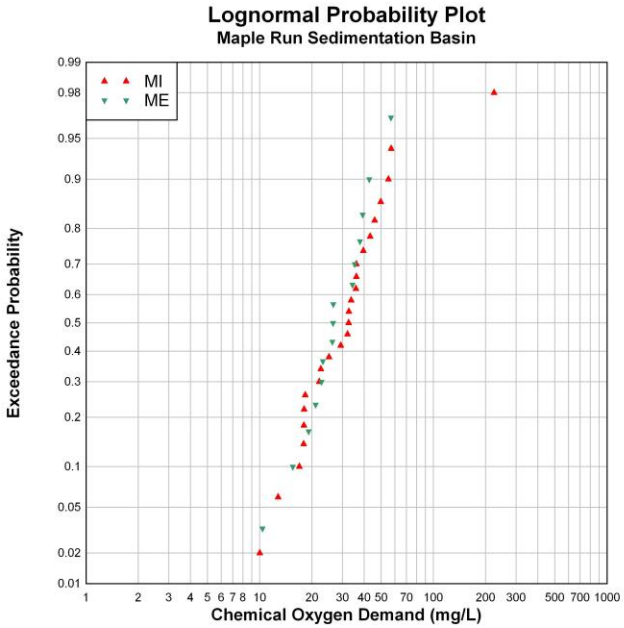


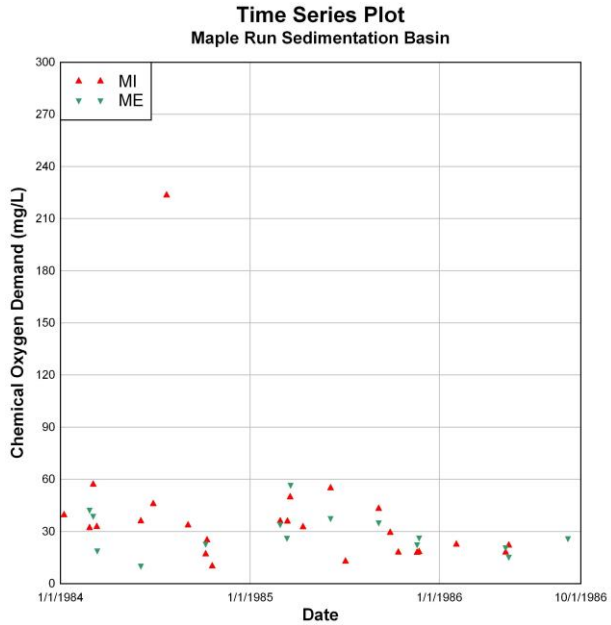


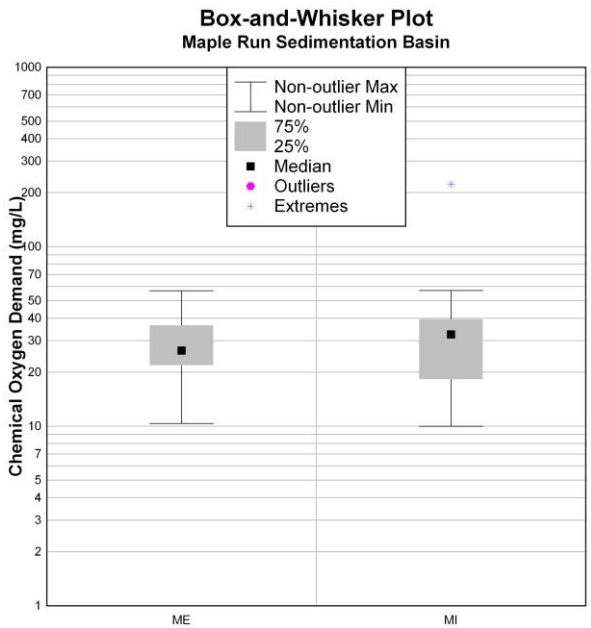


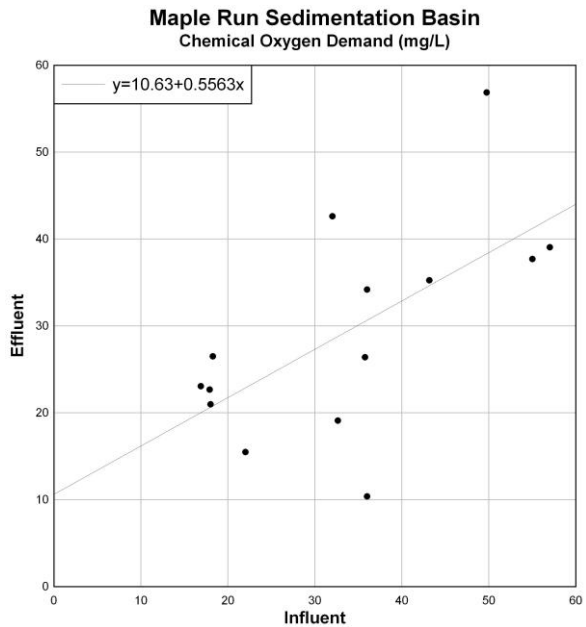
	PARAMETER	TDS (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	15
	Pairs Count	11	11
Non-Parametric	Maximum	3313.75	282.89
	Upper Quartile	181.25	182.16
	Median	145.00	129.81
	Lower Quartile	115.33	114.07
	Minimum	54.50	48.20
	Efficiency	10.48%	
	Mann-Whitney	0.5608	
	Wilcoxon (paired)	0.2061	
Arithmetic	UCL	542.52	179.07
	Mean	280.29	147.09
	LCL	18.06	115.11
	Std. Dev.	635.25	57.75
	Wilk (p-value)	0.0001 **	0.1386
	Efficiency	47.52%	
	t-Test (equal var.)	0.4253	
	t-Test (unequal var.)	0.3079	
	t-test (paired)	0.1313	
	Levene Test	0.4251	
Log Transformed	UCL	300.83	187.27
	Mean	210.53	147.76
	LCL	147.33	116.58
	Std. Dev.	176.33	61.89
	Wilk (p-value)	0.0001 **	0.1704
	Efficiency	29.82%	
	t-Test (equal var.)	0.4606	
	t-Test (unequal var.)	0.3961	
	t-Test (paired)	0.1475	
	Levene Test	0.4106	
Bootstrap	UCL	500.91	176.71
	Mean	283.65	146.32
	LCL	66.38	115.94
	Std. Dev.	526.35	54.87
	Efficiency	48.41%	

Maple Run Sedimentation Basin - Chemical Oxygen Demand (mg/L)



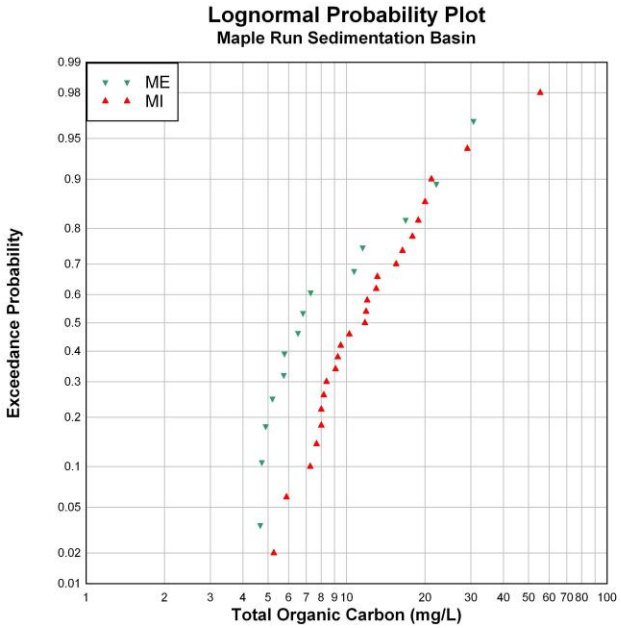


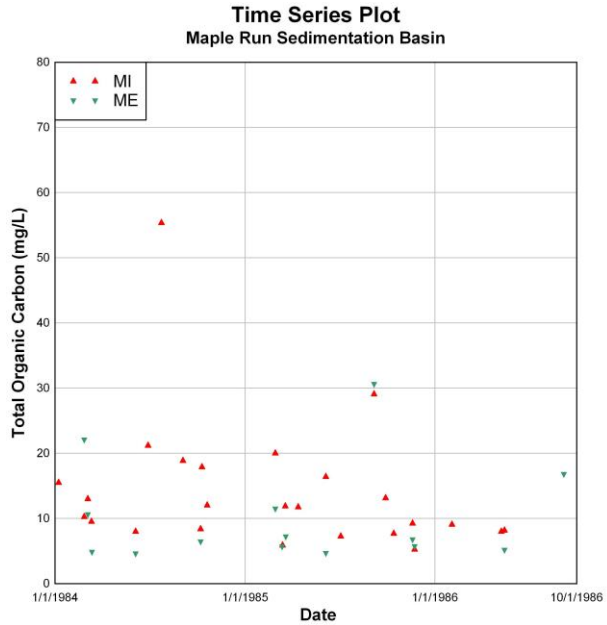


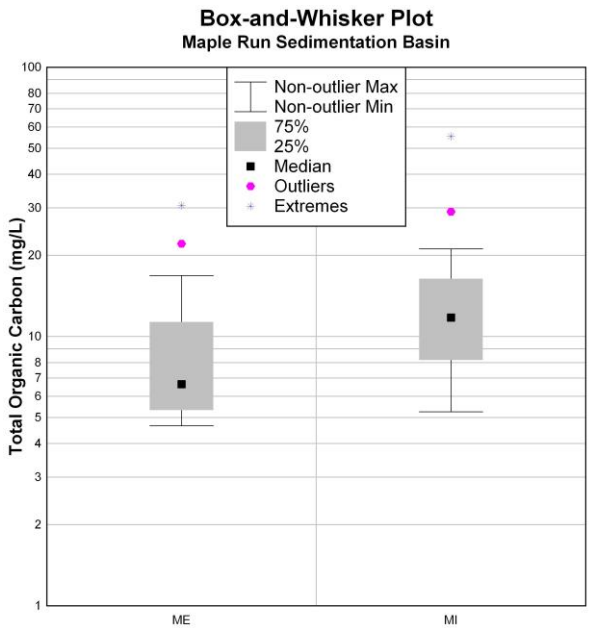


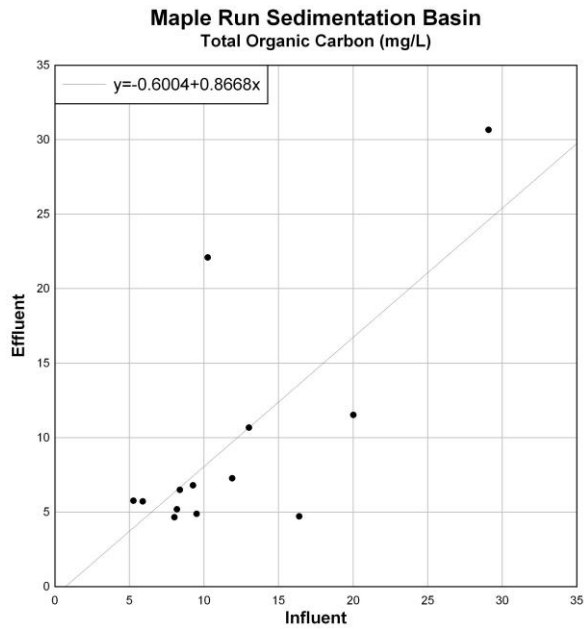
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	15
	Pairs Count	11	11
Non-Parametric	Maximum	223.50	56.87
	Upper Quartile	39.50	37.71
	Median	32.50	26.40
	Lower Quartile	18.25	20.99
	Minimum	10.00	10.38
	Efficiency	18.78%	
	Mann-Whitney	0.6978	
	Wilcoxon (paired)	0.4648	
Arithmetic	UCL	55.28	35.71
	Mean	38.50	29.11
	LCL	21.73	22.50
	Std. Dev.	40.63	11.93
	Wilk (p-value)	0.0001 **	0.6851
	Efficiency	24.41%	
	t-Test (equal var.)	0.3899	
	t-Test (unequal var.)	0.2880	
	t-test (paired)	0.2961	
	Levene Test	0.4162	
Log Transformed	UCL	48.11	37.54
	Mean	36.42	29.23
	LCL	27.58	22.76
	Std. Dev.	23.95	12.90
	Wilk (p-value)	0.0351 **	0.9457
	Efficiency	19.75%	
	t-Test (equal var.)	0.4932	
	t-Test (unequal var.)	0.4547	
	t-Test (paired)	0.4501	
	Levene Test	0.3786	
Bootstrap	UCL	51.42	35.32
	Mean	37.72	29.14
	LCL	24.01	22.97
	Std. Dev.	33.19	11.15
	Efficiency	22.74%	

Maple Run Sedimentation Basin - Total Organic Carbon (mg/L)



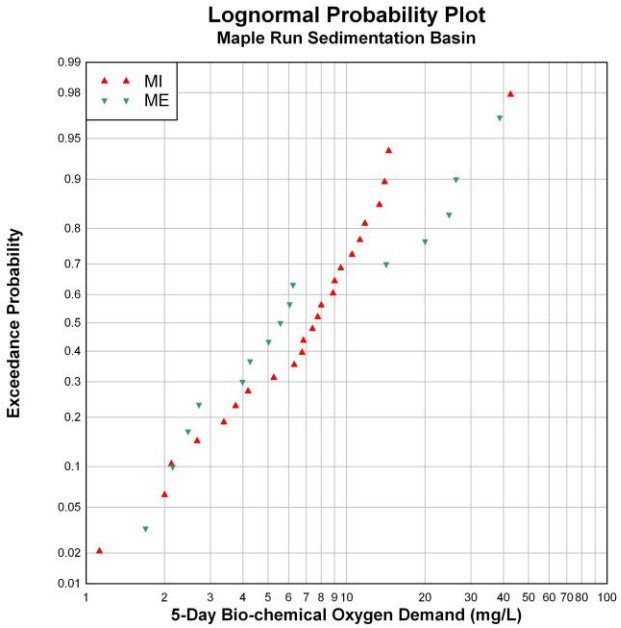


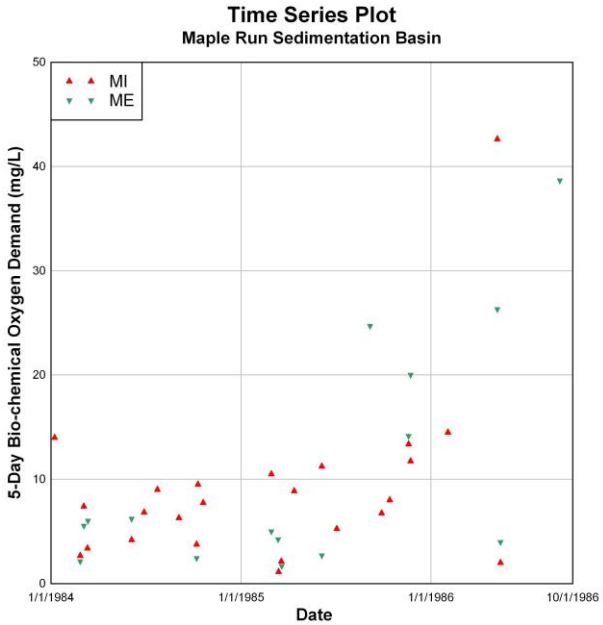


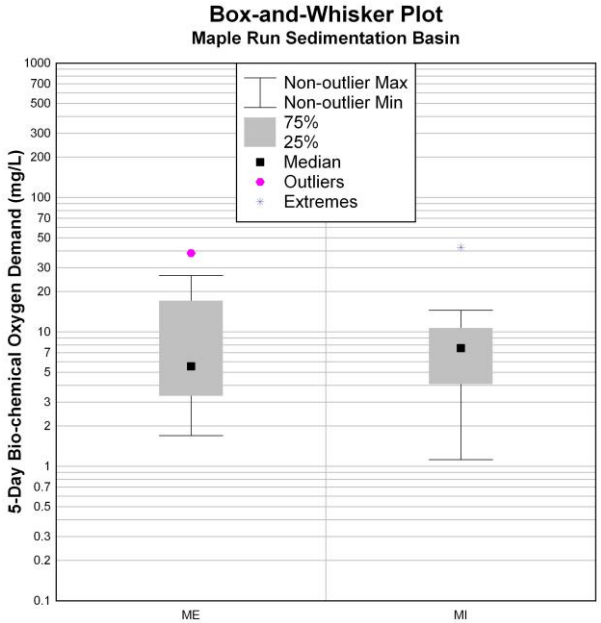


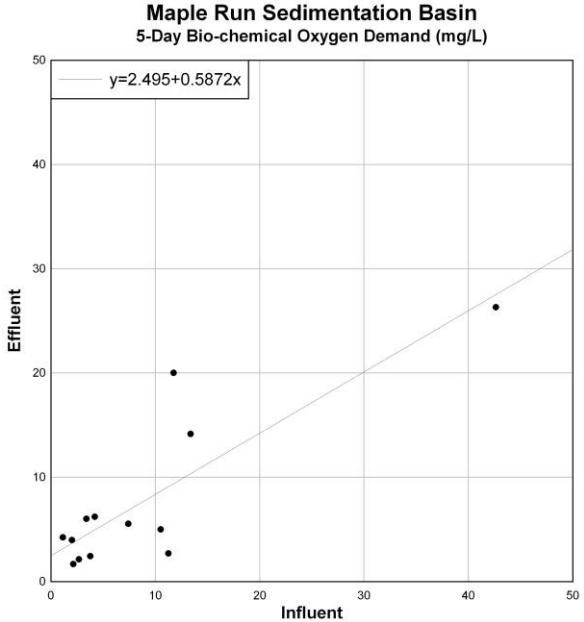
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	14
	Pairs Count	10	10
Non-Parametric	Maximum	55.33	30.67
	Upper Quartile	16.38	11.53
	Median	11.75	6.65
	Lower Quartile	8.17	5.19
	Minimum	5.25	4.66
	Efficiency	43.39%	
	Mann-Whitney	0.0332 **	
	Wilcoxon (paired)	0.1602	
Arithmetic	UCL	18.34	14.75
	Mean	14.10	10.24
	LCL	9.86	5.73
	Std. Dev.	10.27	7.82
	Wilk (p-value)	0.0001 **	0.0010 **
	Efficiency	27.39%	
	t-Test (equal var.)	0.2301	
	t-Test (unequal var.)	0.1964	
	t-test (paired)	0.3580	
	Levene Test	0.6344	
Log Transformed	UCL	17.38	14.66
	Mean	13.75	9.95
	LCL	10.89	6.75
	Std. Dev.	7.64	6.37
	Wilk (p-value)	0.1525	0.0279 **
	Efficiency	27.67%	
	t-Test (equal var.)	0.0602 *	
	t-Test (unequal var.)	0.0755 *	
	t-Test (paired)	0.1464	
	Levene Test	0.6149	
Bootstrap	UCL	17.70	14.46
	Mean	13.93	10.28
	LCL	10.16	6.10
	Std. Dev.	9.13	7.23
	Efficiency	26.19%	

Maple Run Sedimentation Basin - 5-Day Bio-chemical Oxygen Demand (mg/L)



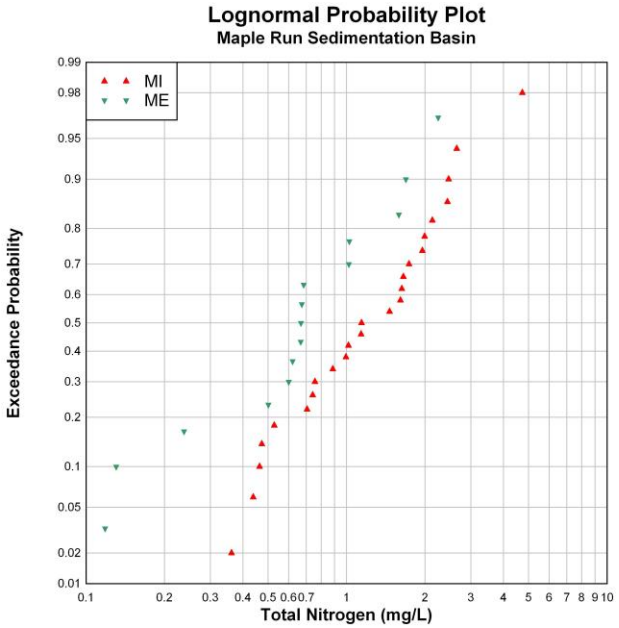


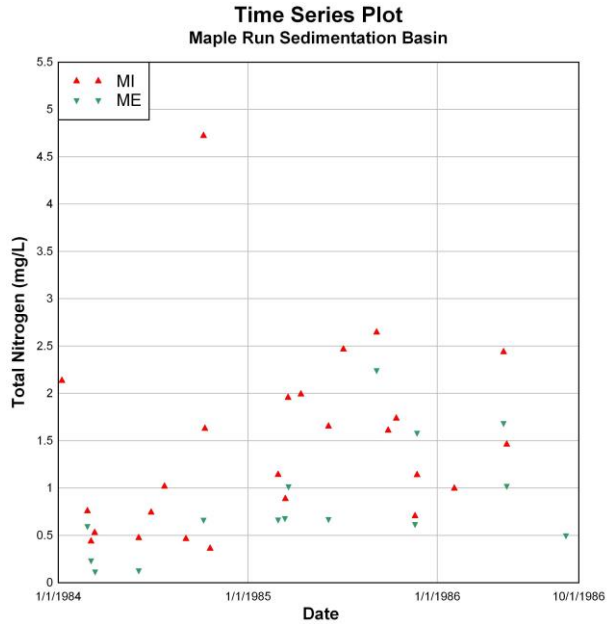


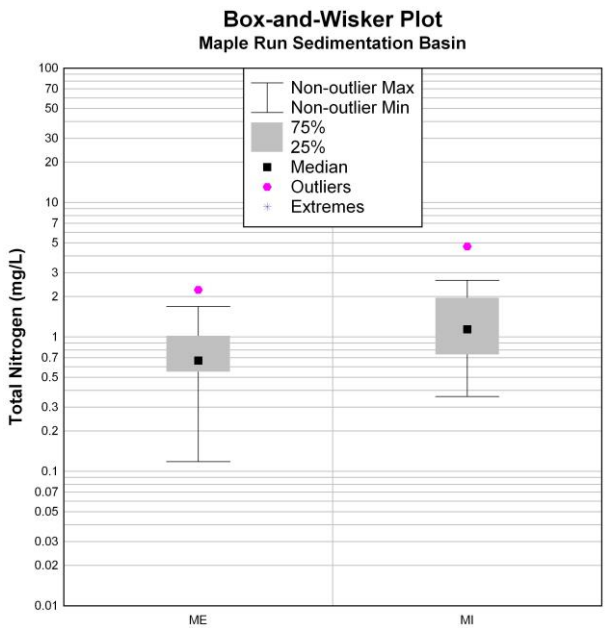


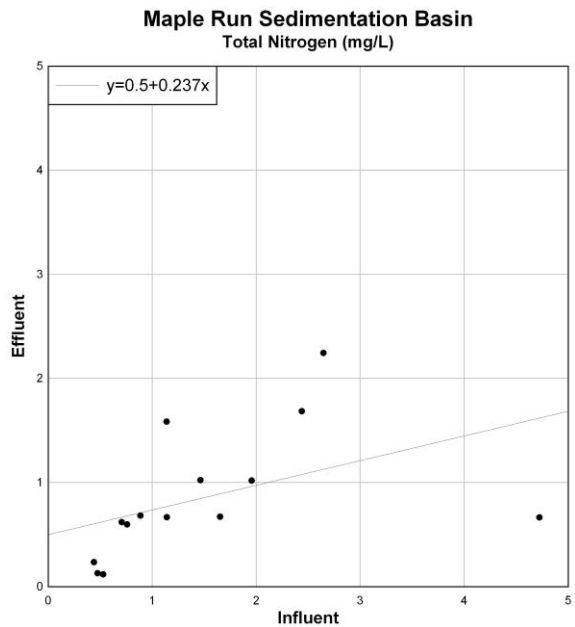
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	24	15
	Pairs Count	10	10
Non-Parametric	Maximum	42.63	38.68
	Upper Quartile	10.88	20.03
	Median	7.58	5.56
	Lower Quartile	3.97	2.71
	Minimum	1.13	1.69
	Efficiency	26.57%	
	Mann-Whitney	0.7635	
	Wilcoxon (paired)	0.5566	
Arithmetic	UCL	12.32	17.21
	Mean	8.87	10.94
	LCL	5.42	4.66
	Std. Dev.	8.17	11.32
	Wilk (p-value)	0.0001 **	0.0021 **
	Efficiency	-23.29%	
	t-Test (equal var.)	0.5125	
	t-Test (unequal var.)	0.5455	
	t-test (paired)	0.3526	
	Levene Test	0.4384	
Log Transformed	UCL	13.01	21.31
	Mean	8.90	10.72
	LCL	6.09	5.39
	Std. Dev.	7.72	12.11
	Wilk (p-value)	0.5399	0.2387
	Efficiency	-20.46%	
	t-Test (equal var.)	0.9407	
	t-Test (unequal var.)	0.9441	
	t-Test (paired)	0.3745	
	Levene Test	0.2543	
Bootstrap	UCL	12.06	17.16
	Mean	8.90	11.14
	LCL	5.73	5.13
	Std. Dev.	7.50	10.86
	Efficiency	-25.24%	

Maple Run Sedimentation Basin - Total Nitrogen (mg/L)



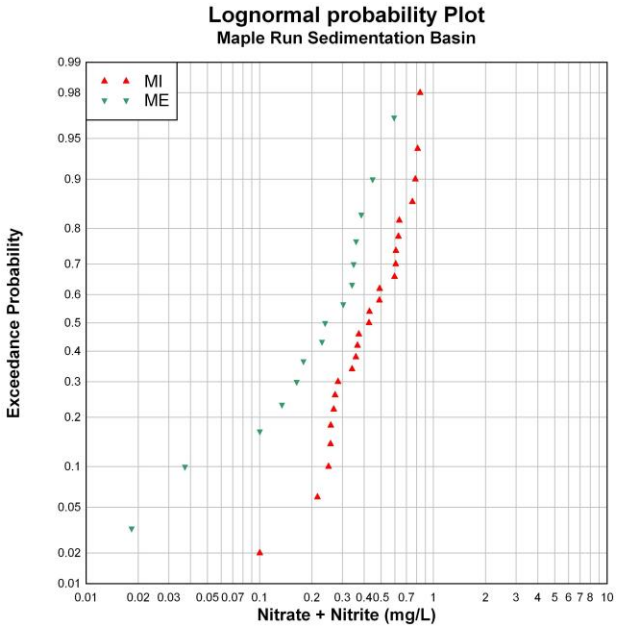


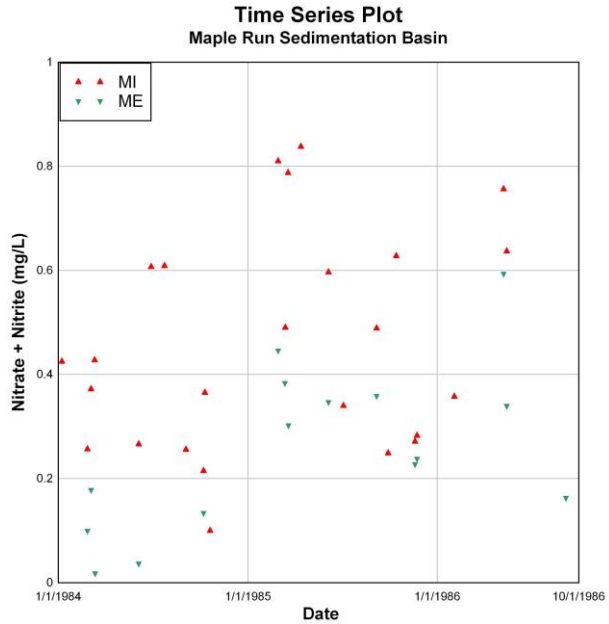


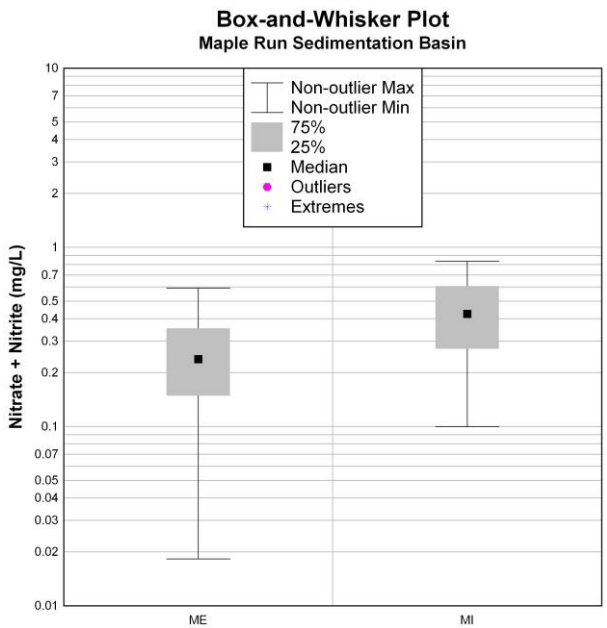


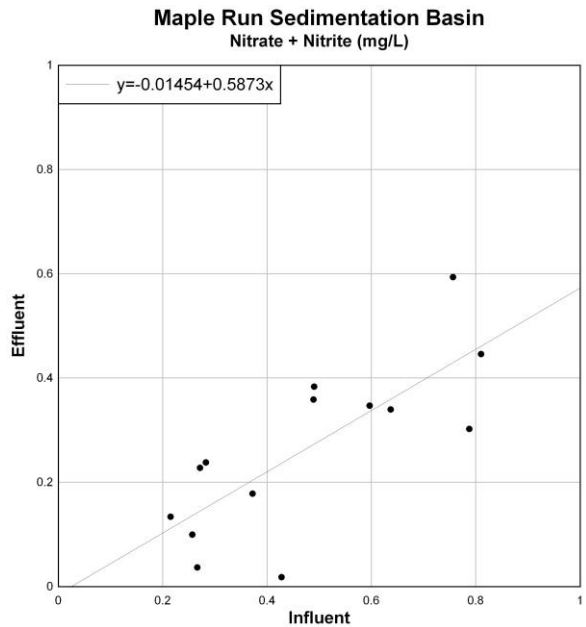
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	15
	Pairs Count	11	11
Non-Parametric	Maximum	4.721	2.247
	Upper Quartile	1.955	1.025
	Median	1.140	0.668
	Lower Quartile	0.742	0.501
	Minimum	0.361	0.118
	Efficiency	41.43%	
	Mann-Whitney	0.0333 **	
	Wilcoxon (paired)	0.0186 **	
Arithmetic	UCL	1.845	1.163
	Mean	1.443	0.831
	LCL	1.041	0.499
	Std. Dev.	0.974	0.600
	Wilk (p-value)	0.0029 **	0.0509 *
	Efficiency	42.42%	
	t-Test (equal var.)	0.0346 **	
	t-Test (unequal var.)	0.0186 **	
	t-test (paired)	0.0868 *	
	Levene Test	0.3053	
Log Transformed	UCL	1.966	1.525
	Mean	1.451	0.873
	LCL	1.070	0.500
	Std. Dev.	1.040	0.816
	Wilk (p-value)	0.6441	0.1451
	Efficiency	39.82%	
	t-Test (equal var.)	0.0128 **	
	t-Test (unequal var.)	0.0218 **	
	t-Test (paired)	0.0137 **	
	Levene Test	0.2559	
Bootstrap	UCL	1.840	1.147
	Mean	1.455	0.835
	LCL	1.070	0.524
	Std. Dev.	0.933	0.562
	Efficiency	42.58%	

Maple Run Sedimentation Basin - Nitrate + Nitrite (mg/L)



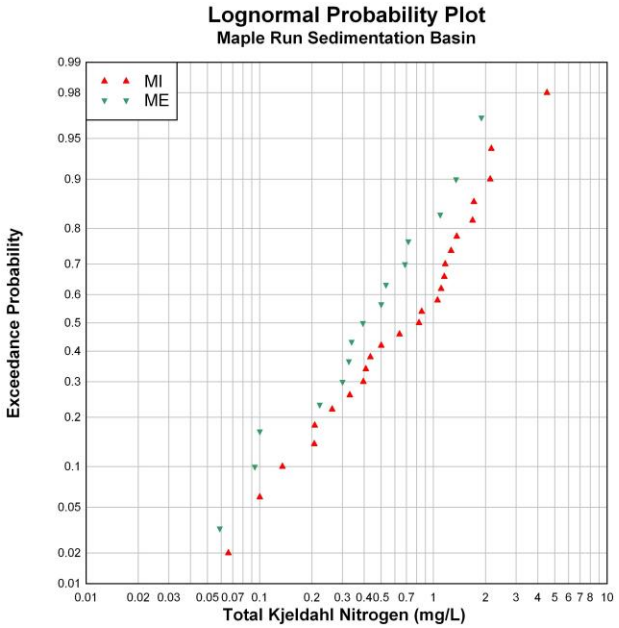


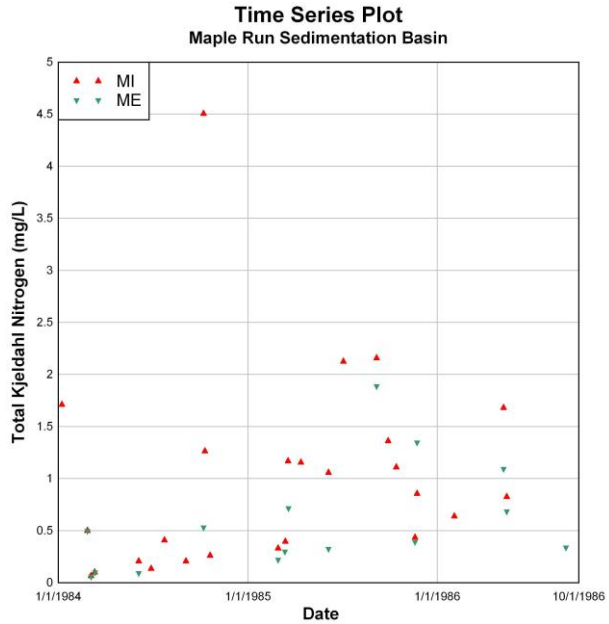


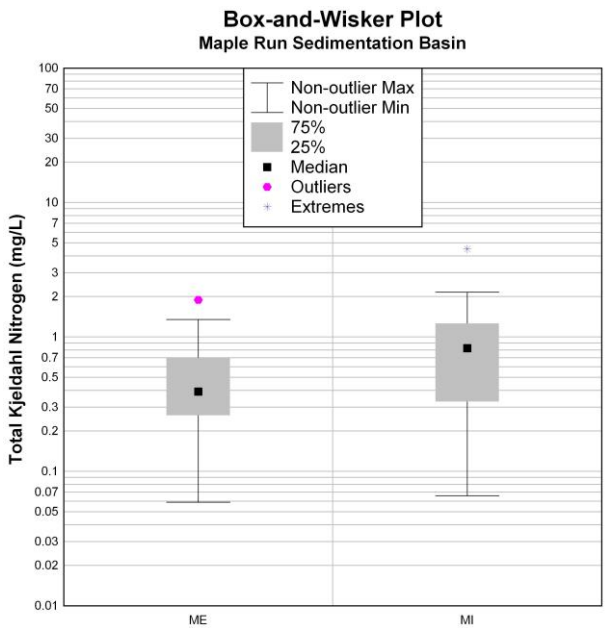


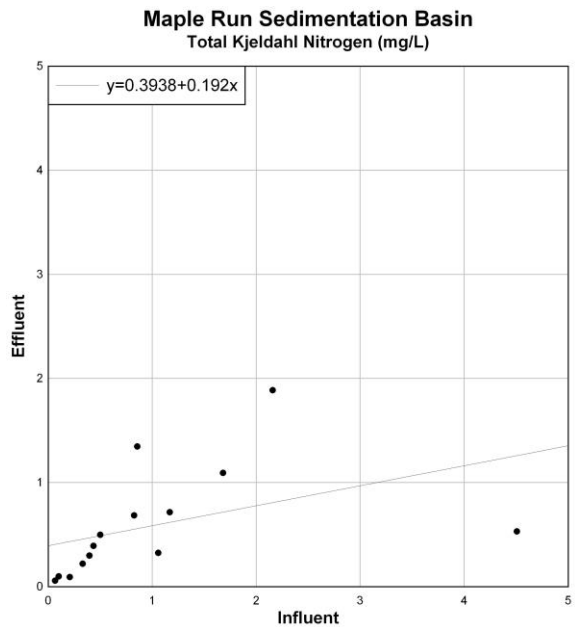
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	15
	Pairs Count	11	11
Non-Parametric	Maximum	0.838	0.594
	Upper Quartile	0.608	0.359
	Median	0.425	0.238
	Lower Quartile	0.271	0.134
	Minimum	0.100	0.018
	Efficiency	43.95%	
	Mann-Whitney	0.0065 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	0.543	0.346
	Mean	0.457	0.258
	LCL	0.371	0.170
	Std. Dev.	0.209	0.159
	Wilk (p-value)	0.1527	0.9070
	Efficiency	43.57%	
	t-Test (equal var.)	0.0030 **	
	t-Test (unequal var.)	0.0017 **	
	t-test (paired)	0.0002 **	
	Levene Test	0.1553	
Log Transformed	UCL	0.580	0.552
	Mean	0.463	0.291
	LCL	0.369	0.153
	Std. Dev.	0.249	0.308
	Wilk (p-value)	0.1444	0.0289 **
	Efficiency	37.20%	
	t-Test (equal var.)	0.0024 **	
	t-Test (unequal var.)	0.0109 **	
	t-Test (paired)	0.0025 **	
	Levene Test	0.0645 *	
Bootstrap	UCL	0.543	0.344
	Mean	0.458	0.260
	LCL	0.374	0.177
	Std. Dev.	0.205	0.151
	Efficiency	43.20%	

Maple Run Sedimentation Basin - Total Kjeldahl Nitrogen (mg/L)



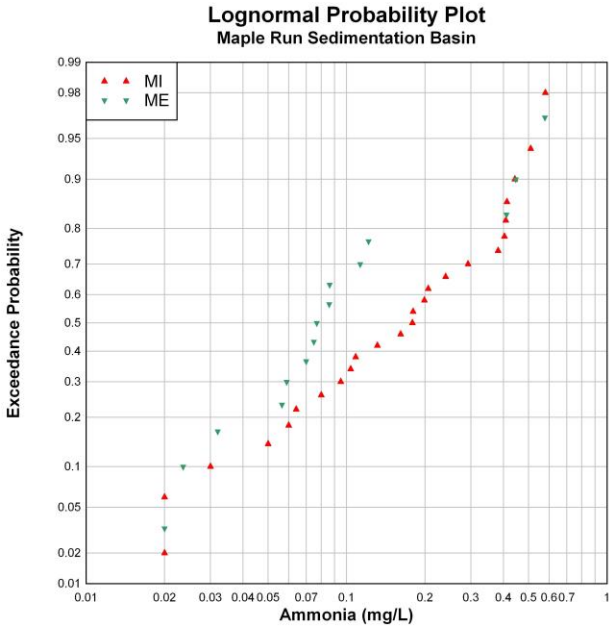


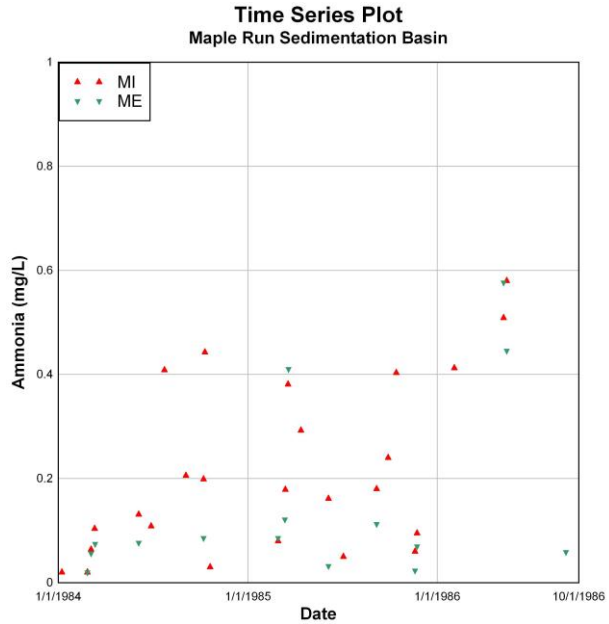


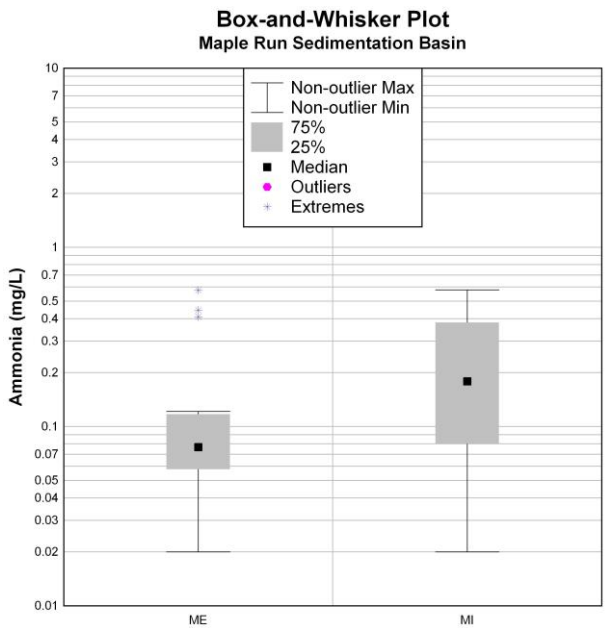


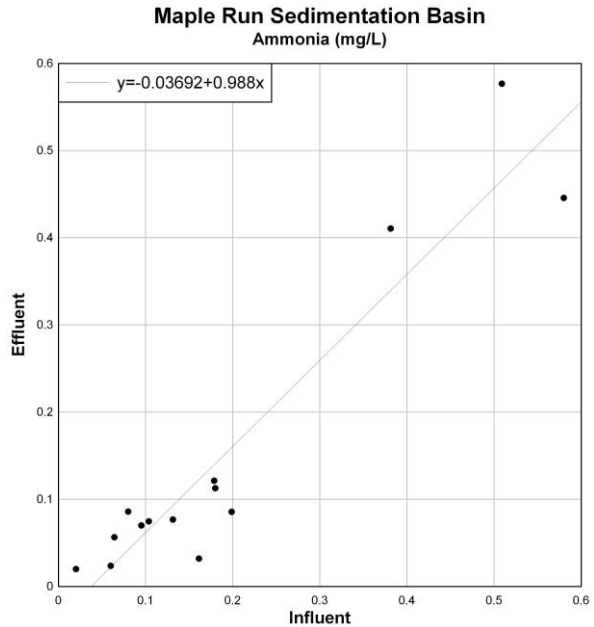
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	15
	Pairs Count	11	11
Non-Parametric	Maximum	4.506	1.887
	Upper Quartile	1.263	0.717
	Median	0.825	0.392
	Lower Quartile	0.330	0.221
	Minimum	0.066	0.059
	Efficiency	52.44%	
	Mann-Whitney	0.1505	
	Wilcoxon (paired)	0.0371 **	
Arithmetic	UCL	1.384	0.858
	Mean	0.986	0.573
	LCL	0.588	0.288
	Std. Dev.	0.963	0.514
	Wilk (p-value)	0.0002 **	0.0174 **
	Efficiency	41.89%	
	t-Test (equal var.)	0.1345	
	t-Test (unequal var.)	0.0857 *	
	t-test (paired)	0.1974	
	Levene Test	0.3173	
Log Transformed	UCL	1.816	1.187
	Mean	1.054	0.601
	LCL	0.611	0.304
	Std. Dev.	1.336	0.673
	Wilk (p-value)	0.7077	0.8022
	Efficiency	42.95%	
	t-Test (equal var.)	0.1537	
	t-Test (unequal var.)	0.1499	
	t-Test (paired)	0.0566 *	
	Levene Test	0.7342	
Bootstrap	UCL	1.373	0.841
	Mean	0.997	0.575
	LCL	0.620	0.309
	Std. Dev.	0.913	0.480
	Efficiency	42.30%	

Maple Run Sedimentation Basin - Ammonia (mg/L)



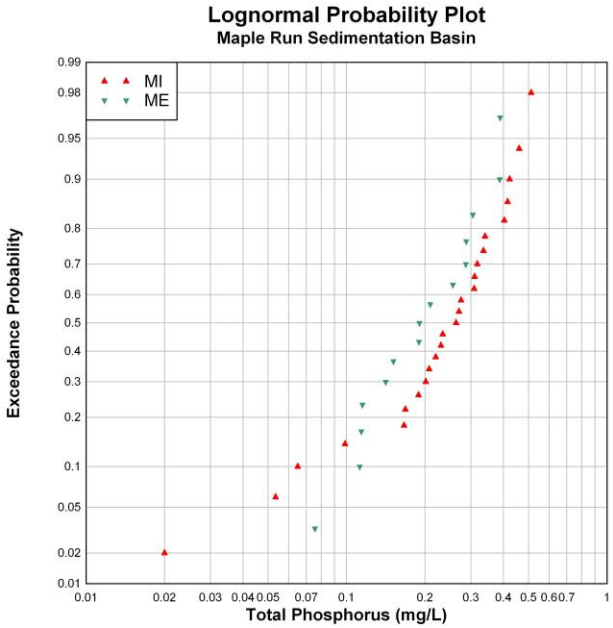


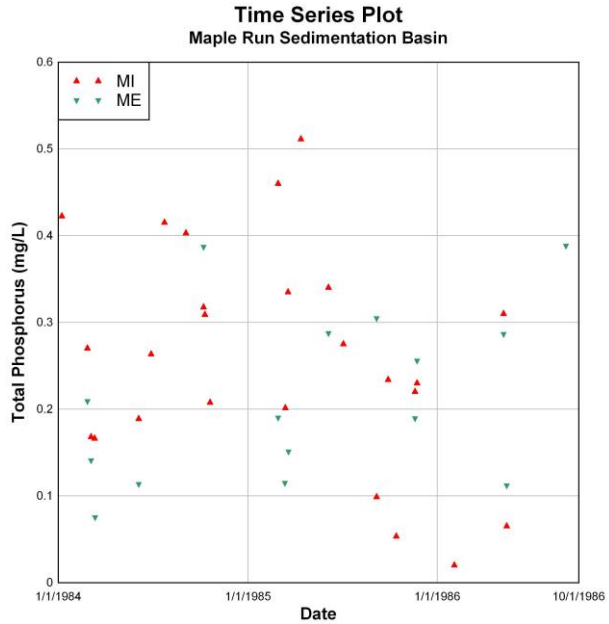


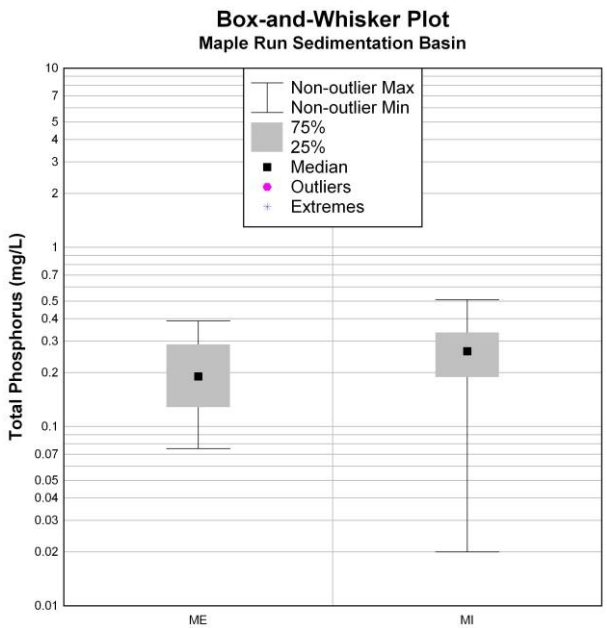


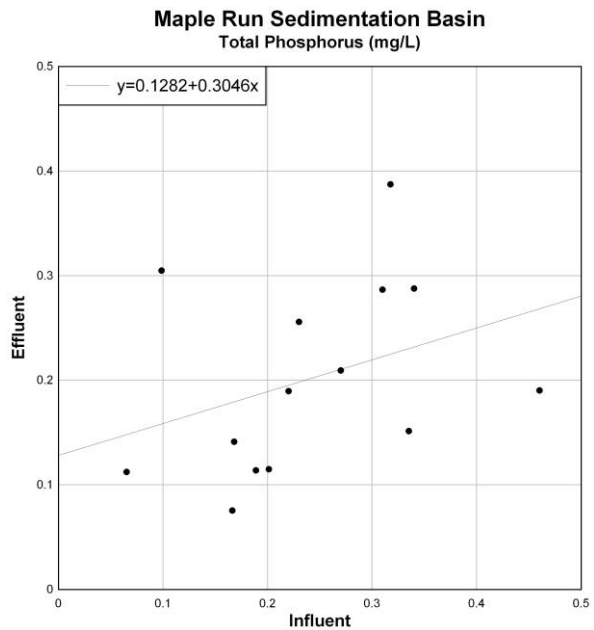
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	15
	Pairs Count	11	11
Non-Parametric	Maximum	0.580	0.577
	Upper Quartile	0.381	0.121
	Median	0.179	0.077
	Lower Quartile	0.080	0.056
	Minimum	0.020	0.020
	Efficiency	57.03%	
	Mann-Whitney	0.1467	
	Wilcoxon (paired)	0.0488 **	
Arithmetic	UCL	0.283	0.247
	Mean	0.214	0.150
	LCL	0.145	0.053
	Std. Dev.	0.167	0.175
	Wilk (p-value)	0.0202 **	0.0002 **
	Efficiency	29.93%	
	t-Test (equal var.)	0.2558	
	t-Test (unequal var.)	0.2638	
	t-test (paired)	0.0397 **	
	Levene Test	0.8874	
Log Transformed	UCL	0.384	0.284
	Mean	0.232	0.143
	LCL	0.140	0.072
	Std. Dev.	0.272	0.162
	Wilk (p-value)	0.1522	0.1696
	Efficiency	38.61%	
	t-Test (equal var.)	0.1473	
	t-Test (unequal var.)	0.1510	
	t-Test (paired)	0.0180 **	
	Levene Test	0.9916	
Bootstrap	UCL	0.282	0.240
	Mean	0.215	0.150
	LCL	0.147	0.059
	Std. Dev.	0.164	0.164
	Efficiency	30.22%	

Maple Run Sedimentation Basin - Total Phosphorus (mg/L)



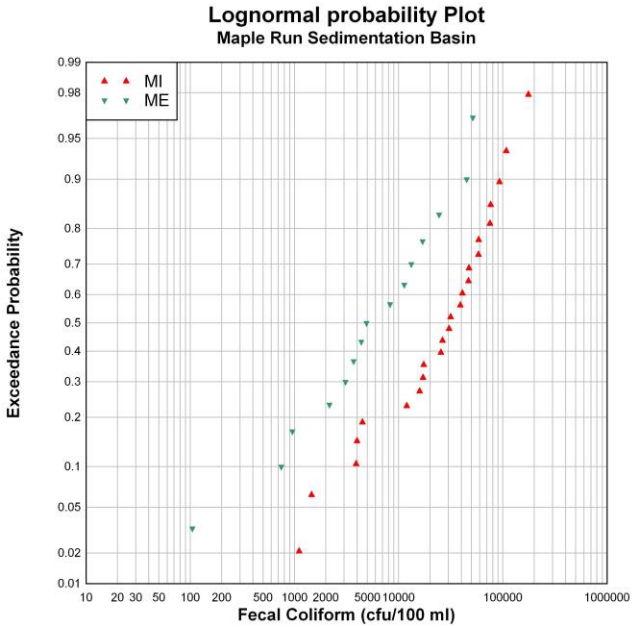


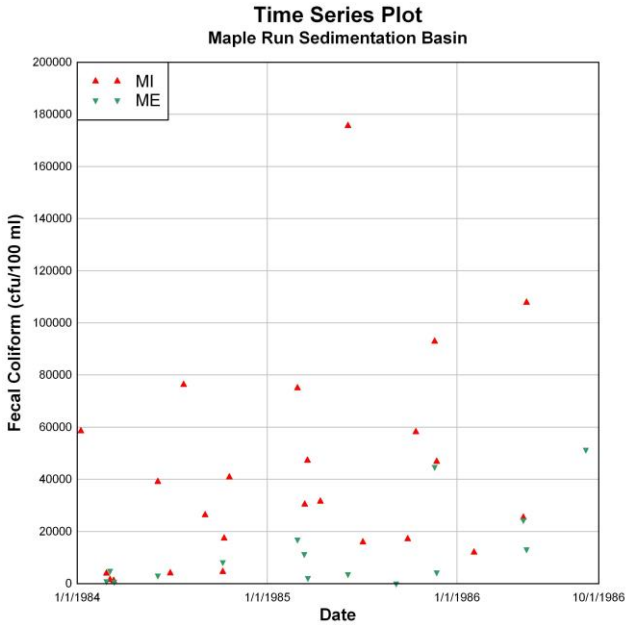


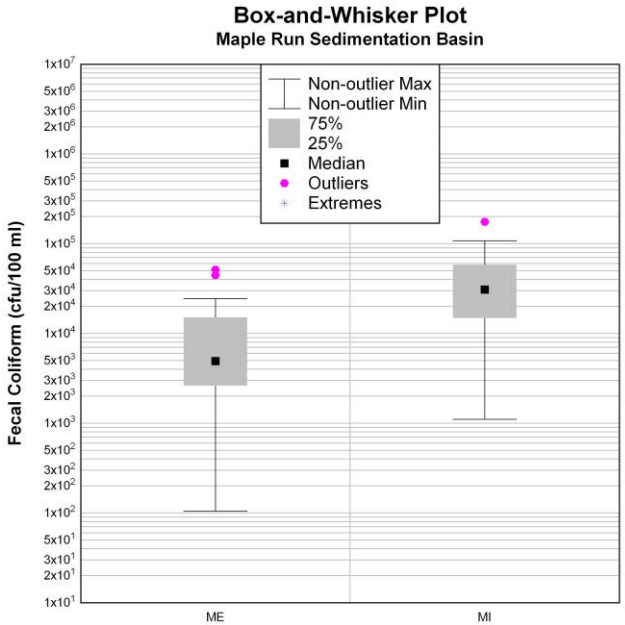


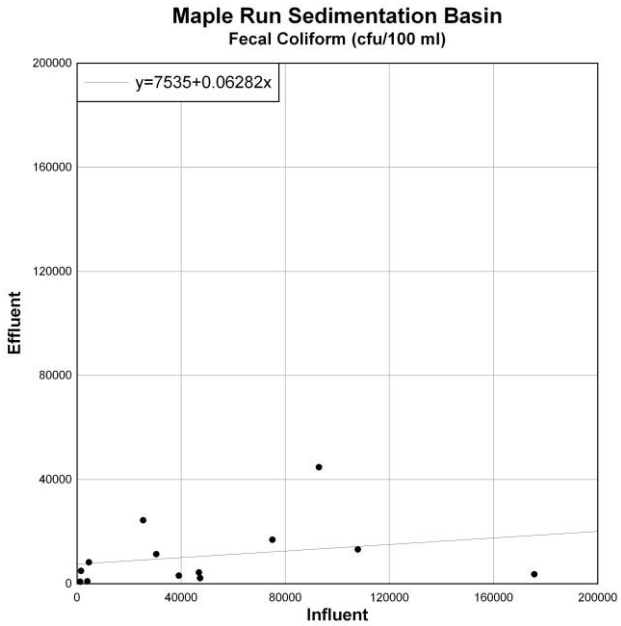
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	25	15
	Pairs Count	11	11
Non-Parametric	Maximum	0.511	0.388
	Upper Quartile	0.335	0.288
	Median	0.263	0.190
	Lower Quartile	0.189	0.115
	Minimum	0.020	0.076
	Efficiency	27.69%	
	Mann-Whitney	0.2263	
	Wilcoxon (paired)	0.5195	
Arithmetic	UCL	0.312	0.270
	Mean	0.259	0.214
	LCL	0.207	0.158
	Std. Dev.	0.128	0.100
	Wilk (p-value)	0.9341	0.2685
	Efficiency	17.49%	
	t-Test (equal var.)	0.2476	
	t-Test (unequal var.)	0.2205	
	t-test (paired)	0.6340	
	Levene Test	0.2489	
Log Transformed	UCL	0.397	0.288
	Mean	0.280	0.215
	LCL	0.197	0.160
	Std. Dev.	0.230	0.110
	Wilk (p-value)	0.0010 **	0.5844
	Efficiency	23.19%	
	t-Test (equal var.)	0.6042	
	t-Test (unequal var.)	0.5673	
	t-Test (paired)	0.8995	
	Levene Test	0.3253	
Bootstrap	UCL	0.310	0.269
	Mean	0.258	0.216
	LCL	0.207	0.162
	Std. Dev.	0.124	0.096
	Efficiency	16.62%	

Maple Run Sedimentation Basin - Fecal Coliform (cfu/100 ml)



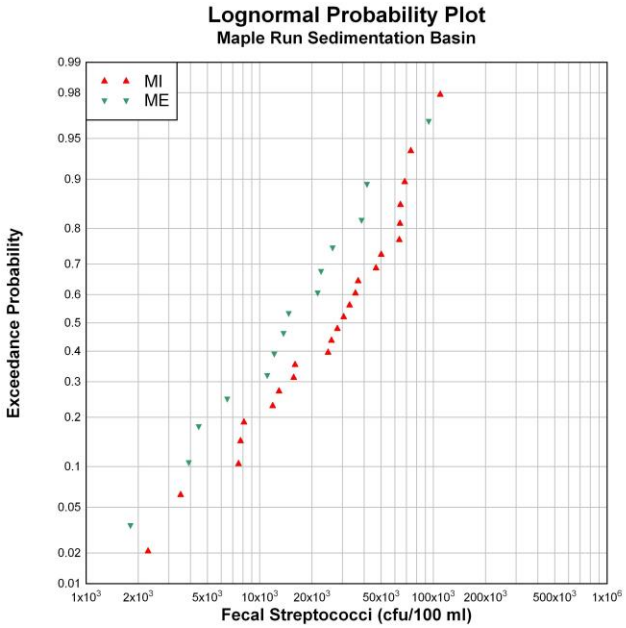


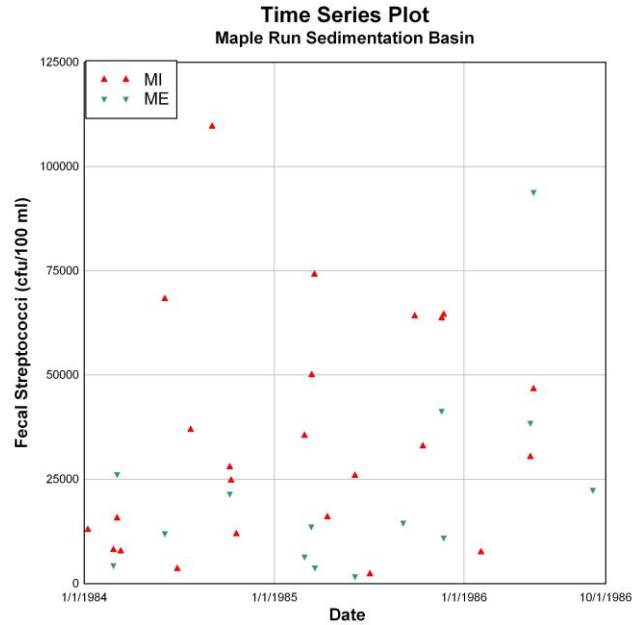


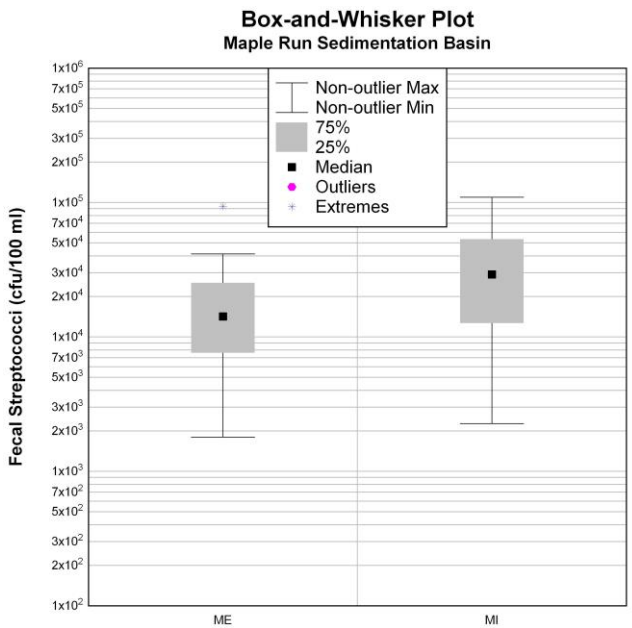


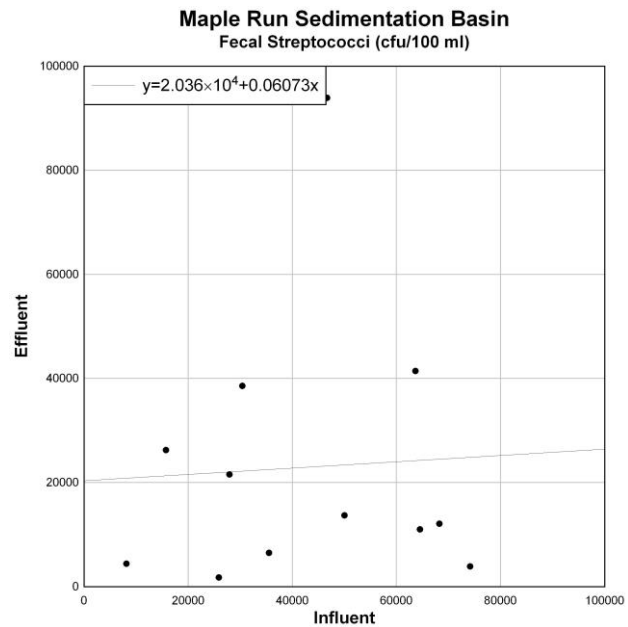
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	24	15
	Pairs Count	10	10
Non-Parametric	Maximum	175,625	51,420
	Upper Quartile	58,330	16,949
	Median	30,938	4,914
	Lower Quartile	13,904	2,161
	Minimum	1,109	105
	Efficiency	84.12%	
	Mann-Whitney	0.0062 **	
	Wilcoxon (paired)	0.0371 **	
Arithmetic	UCL	59,395	21,524
	Mean	42,040	12,692
	LCL	24,684	3,860
	Std. Dev.	41,094	15,947
	Wilk (p-value)	0.0017 **	0.0010 **
	Efficiency	69.81%	
	t-Test (equal var.)	0.0123 **	
	t-Test (unequal var.)	0.0036 **	
	t-test (paired)	0.0301 **	
	Levene Test	0.1492	
Log Transformed	UCL	116,377	71,817
	Mean	52,944	16,974
	LCL	24,086	4,012
	Std. Dev.	95,022	37,850
	Wilk (p-value)	0.0758 *	0.6284
	Efficiency	67.94%	
	t-Test (equal var.)	0.0037 **	
	t-Test (unequal var.)	0.0067 **	
	t-Test (paired)	0.0296 **	
	Levene Test	0.4069	
Bootstrap	UCL	59,072	21,552
	Mean	42,484	13,107
	LCL	25,895	4,662
	Std. Dev.	39,284	15,249
	Efficiency	69.15%	

Maple Run Sedimentation Basin - Fecal Streptococci (cfu/100 ml)



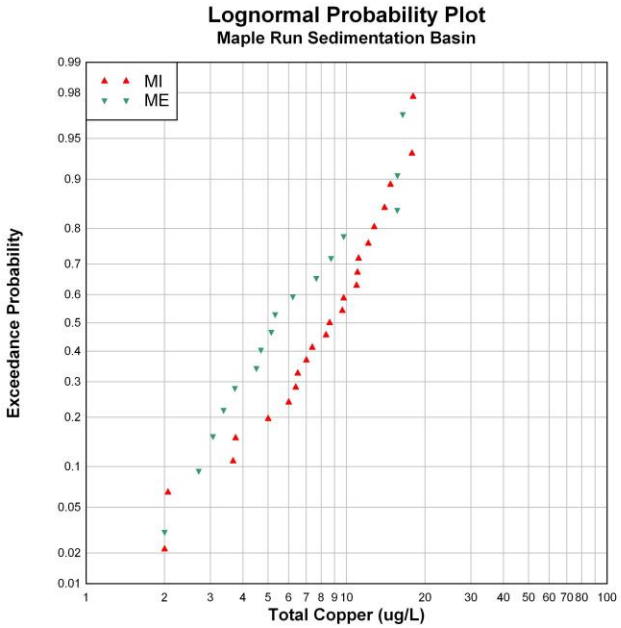


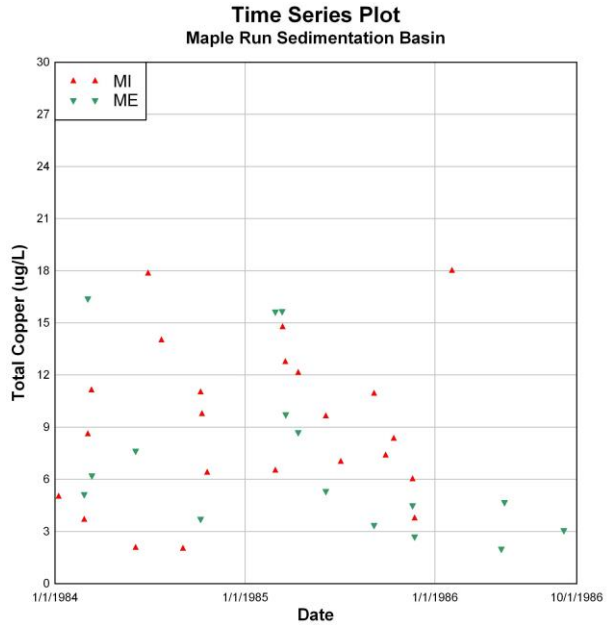


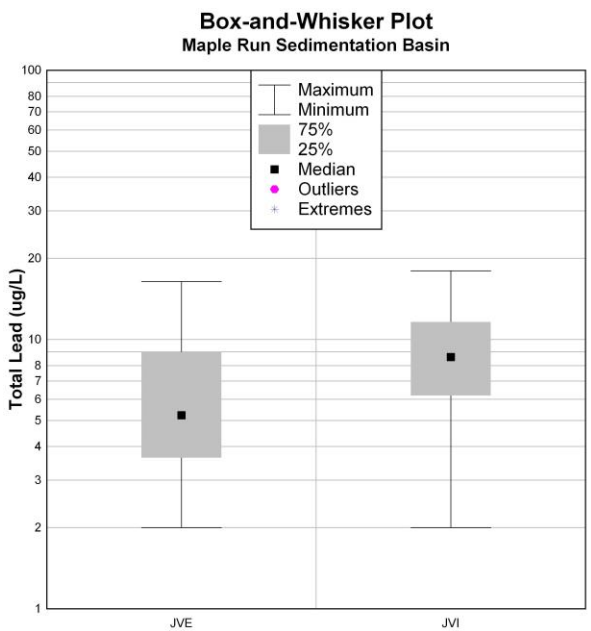


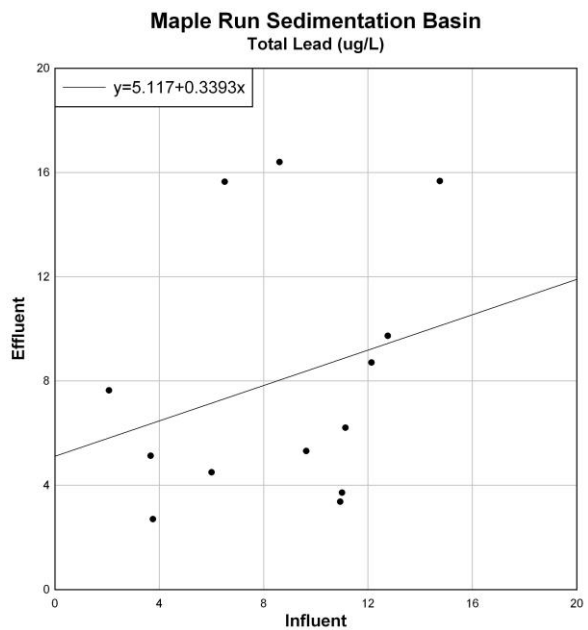
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	24	14
	Pairs Count	10	10
Non-Parametric	Maximum	109,571	93,929
	Upper Quartile	56,813	26,255
	Median	29,150	14,194
	Lower Quartile	12,381	6,491
	Minimum	2,273	1,800
	Efficiency	51.31%	
	Mann-Whitney	0.1206	
	Wilcoxon (paired)	0.2324	
Arithmetic	UCL	46,647	36,156
	Mean	35,029	22,319
	LCL	23,411	8,482
	Std. Dev.	27,509	23,969
	Wilk (p-value)	0.0350 **	0.0013 **
	Efficiency	36.28%	
	t-Test (equal var.)	0.1591	
	t-Test (unequal var.)	0.1460	
	t-test (paired)	0.2232	
	Levene Test	0.6369	
Log Transformed	UCL	65,081	49,642
	Mean	38,451	22,982
	LCL	22,717	10,640
	Std. Dev.	45,886	27,467
	Wilk (p-value)	0.2328	0.9954
	Efficiency	40.23%	
	t-Test (equal var.)	0.1276	
	t-Test (unequal var.)	0.1355	
	t-Test (paired)	0.0608 *	
	Levene Test	0.8912	
Bootstrap	UCL	46,087	35,096
	Mean	34,977	22,462
	LCL	23,868	9,828
	Std. Dev.	26,309	21,882
	Efficiency	35.78%	

Maple Run Sedimentation Basin - Total Lead (ug/L)



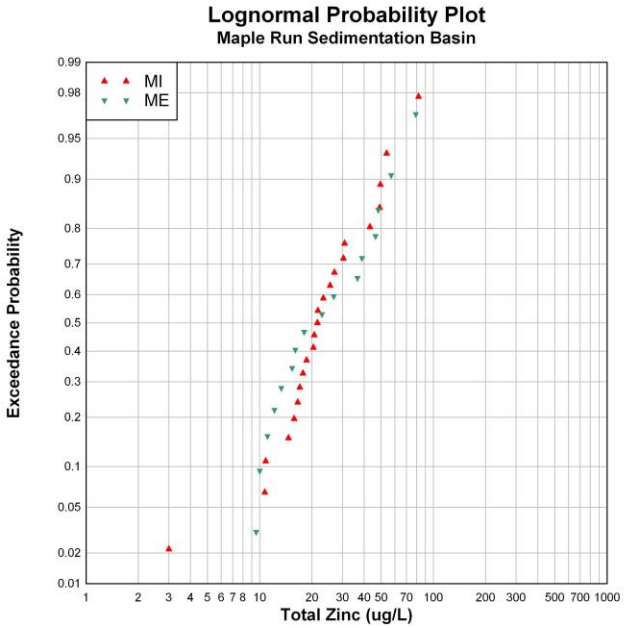


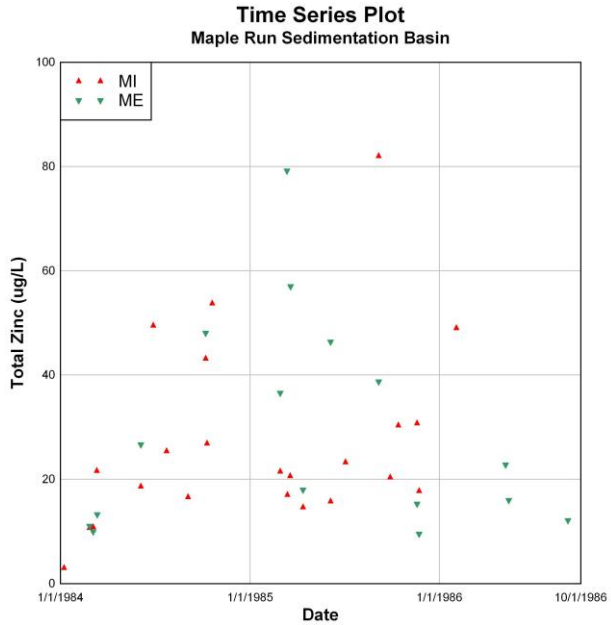


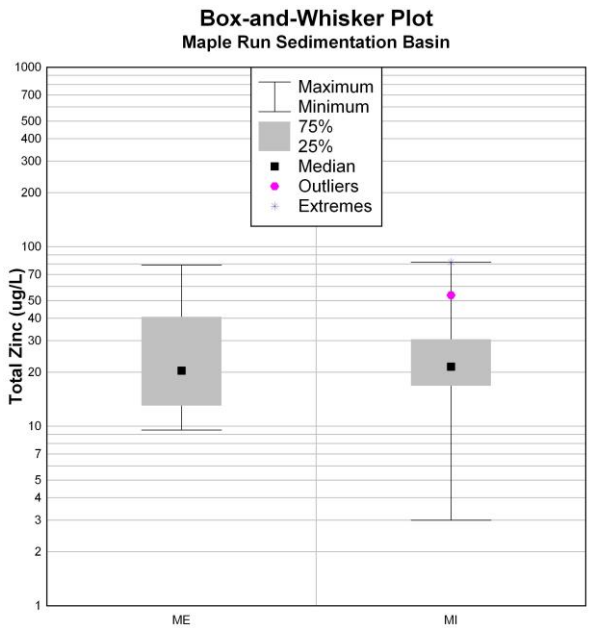


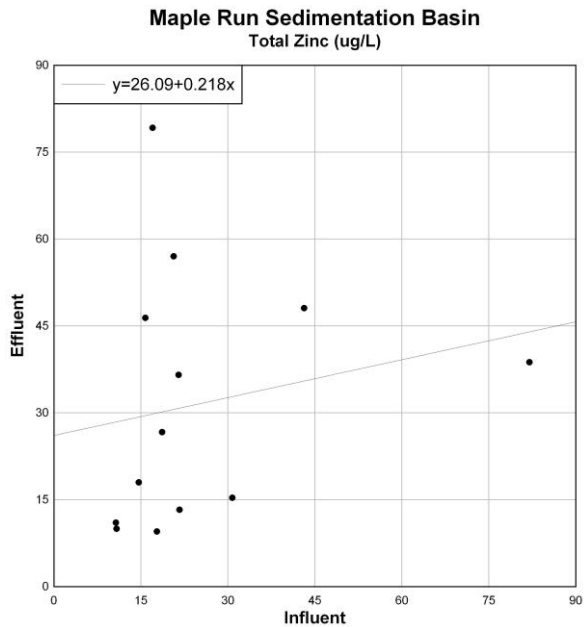
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	23	16
	Pairs Count	10	10
Non-Parametric	Maximum	18.0	16.4
	Upper Quartile	12.1	9.2
	Median	8.6	5.2
	Lower Quartile	6.0	3.6
	Minimum	2.0	2.0
	Efficiency	39.16%	
	Mann-Whitney	0.1459	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	11.0	9.7
	Mean	9.1	7.2
	LCL	7.1	4.6
	Std. Dev.	4.5	4.8
	Wilk (p-value)	0.6515	0.0079 **
	Efficiency	21.02%	
	t-Test (equal var.)	0.2166	
	t-Test (unequal var.)	0.2234	
	t-test (paired)	0.9563	
	Levene Test	0.7923	
Log Transformed	UCL	12.4	10.4
	Mean	9.3	7.1
	LCL	7.0	4.9
	Std. Dev.	6.0	4.9
	Wilk (p-value)	0.1076	0.5346
	Efficiency	23.37%	
	t-Test (equal var.)	0.1680	
	t-Test (unequal var.)	0.1746	
	t-Test (paired)	0.8183	
	Levene Test	0.7908	
Bootstrap	UCL	11.0	9.5
	Mean	9.1	7.1
	LCL	7.2	4.7
	Std. Dev.	4.4	4.6
	Efficiency	21.68%	

Maple Run Sedimentation Basin - Total Zinc (ug/L)



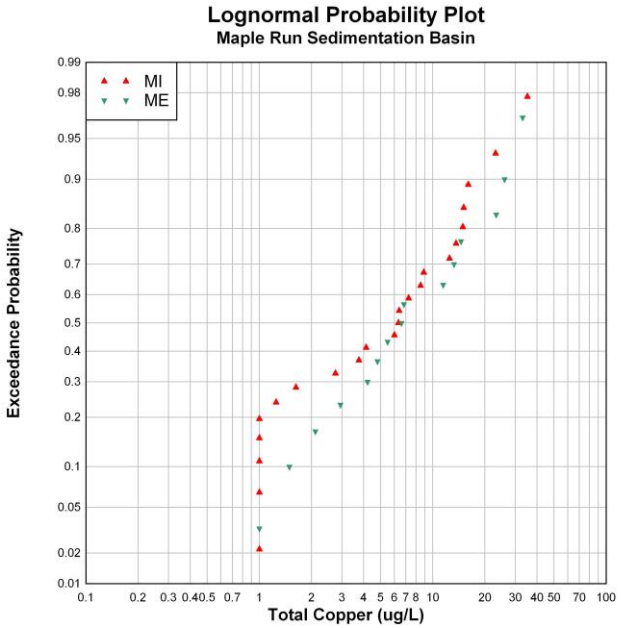


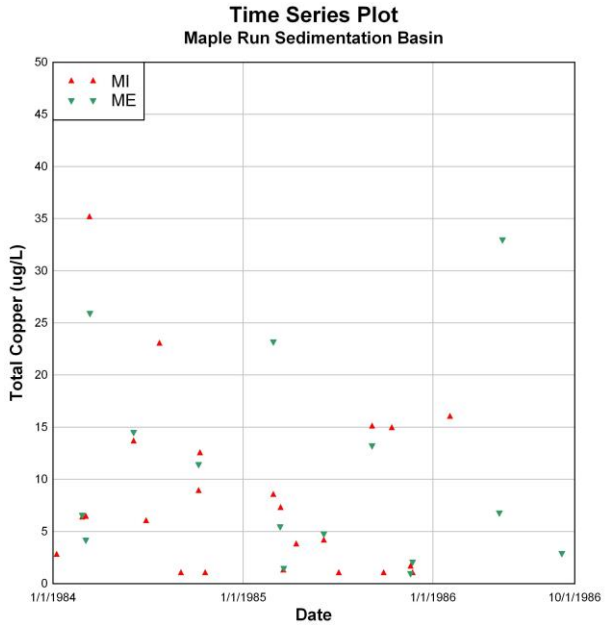


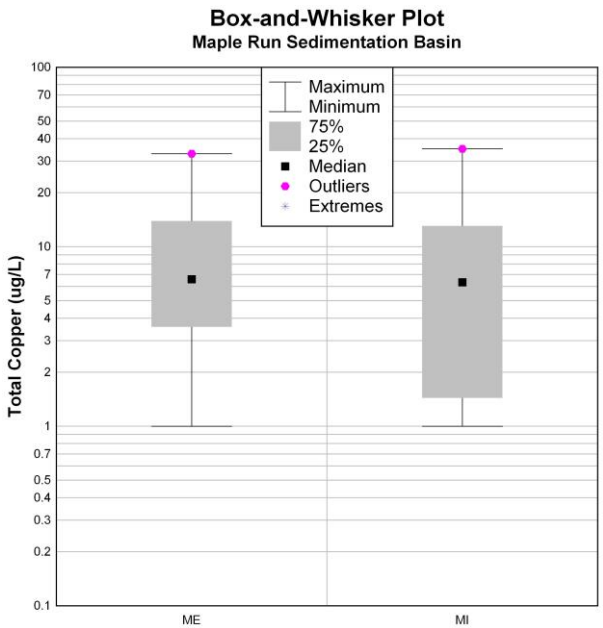


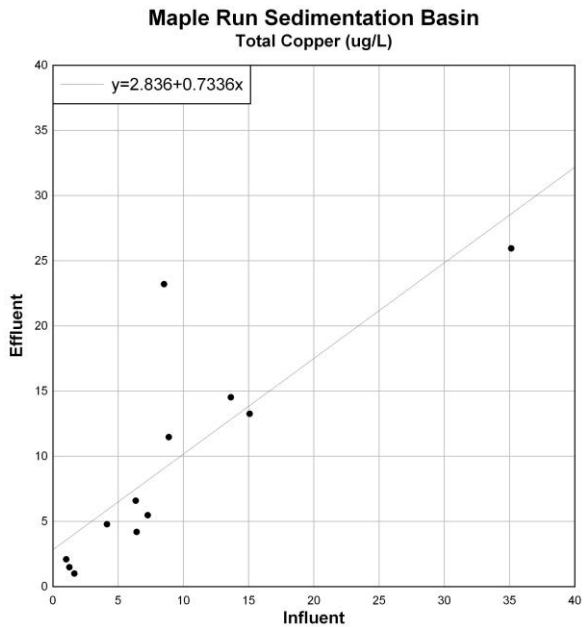
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	23	16
	Pairs Count	10	10
Non-Parametric	Maximum	82.0	79.2
	Upper Quartile	30.8	42.6
	Median	21.5	20.4
	Lower Quartile	16.6	12.7
	Minimum	3.0	9.5
	Efficiency	5.05%	
	Mann-Whitney	0.7877	
	Wilcoxon (paired)	0.9219	
Arithmetic	UCL	34.8	39.7
	Mean	27.1	28.8
	LCL	19.4	17.9
	Std. Dev.	17.7	20.4
	Wilk (p-value)	0.0026 **	0.0189 **
	Efficiency	-6.39%	
	t-Test (equal var.)	0.7796	
	t-Test (unequal var.)	0.7854	
	t-test (paired)	0.9358	
	Levene Test	0.6610	
Log Transformed	UCL	38.3	43.0
	Mean	27.7	28.6
	LCL	20.0	19.1
	Std. Dev.	20.2	20.8
	Wilk (p-value)	0.1272	0.2796
	Efficiency	-3.55%	
	t-Test (equal var.)	0.8686	
	t-Test (unequal var.)	0.8689	
	t-Test (paired)	0.9235	
	Levene Test	0.9924	
Bootstrap	UCL	34.5	39.2
	Mean	27.2	28.8
	LCL	19.9	18.5
	Std. Dev.	16.9	19.4
	Efficiency	-6.04%	

Maple Run Sedimentation Basin - Total Copper (ug/L)









	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: MI**	**EFF: ME**
	Site Count	23	15
	Pairs Count	9	9
Non-Parametric	Maximum	35.1	33.0
	Upper Quartile	13.6	14.5
	Median	6.3	6.6
	Lower Quartile	1.3	2.9
	Minimum	1.0	1.0
	Efficiency	-4.17%	
	Mann-Whitney	0.4864	
	Wilcoxon (paired)	0.4258	
Arithmetic	UCL	12.0	15.9
	Mean	8.4	10.5
	LCL	4.7	5.0
	Std. Dev.	8.5	9.8
	Wilk (p-value)	0.0008 **	0.0153 **
	Efficiency	-25.21%	
	t-Test (equal var.)	0.4865	
	t-Test (unequal var.)	0.5020	
	t-test (paired)	0.3358	
	Levene Test	0.6437	
Log Transformed	UCL	17.2	22.8
	Mean	9.0	10.9
	LCL	4.7	5.2
	Std. Dev.	12.8	13.1
	Wilk (p-value)	0.0447 **	0.8836
	Efficiency	-21.44%	
	t-Test (equal var.)	0.4056	
	t-Test (unequal var.)	0.3972	
	t-Test (paired)	0.4271	
	Levene Test	0.5293	
Bootstrap	UCL	11.7	15.5
	Mean	8.3	10.4
	LCL	4.8	5.2
	Std. Dev.	7.9	9.3
	Efficiency	-25.61%	

Barton Ridge Sedimentation Basin (BRI-BRM)

The Barton Ridge sedimentation basin is a pretreatment portion of a sedimentation/sand filtration SCM. For details on the overall system (BRI-BRE) or the filtration basin (BRM-BRE) refer to the Sand Filter section of this report. The half-inch plus water quality volume of runoff from a commercial shopping center (see the COA report on small watershed quantity and quality (COA, 2009) for a detailed description of the contributing watershed) was captured in the sedimentation basin, additional runoff bypassed the control via a splitter box. The effluent of the basin was a perforated riser pipe. The rate of drawdown could be adjusted by means of a gate valve on the end of the riser pipe.

WQM collected runoff and water quality data at The Barton Ridge Plaza sedimentation basin (BRI-BRM) between 1993 and 1997; the influent was reactivated for another study in 2007 for another study and only TSS samples were collected. During this time 29 and 13 valid EMCs were collected at the influent (BRI) and effluent (BRM) respectively, of which 9 were paired.

Performance Summary

The sedimentation basin had the best performance with the reductions of the concentrations of TSS (58%) and VSS (63%) and these are significant in all cases, paired or not paired.

COD, TOC and BOD concentrations were increased by 4%, 172% and 22% respectively, and were not significant in all cases.

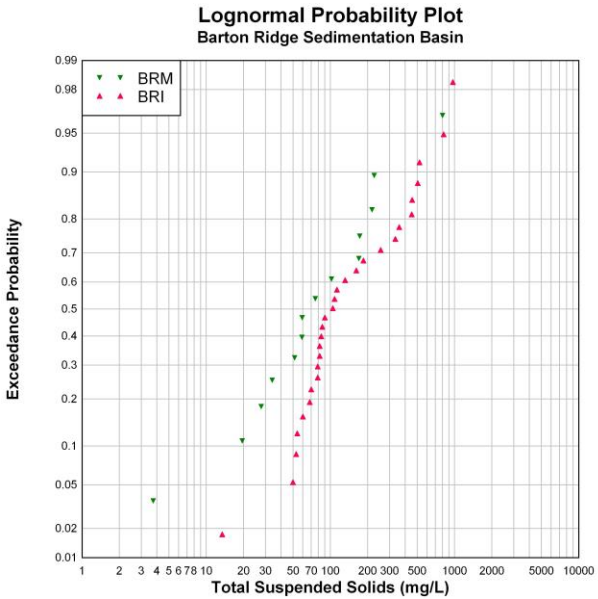
Total nitrogen concentration was reduced by 1% and only significant if data are paired. The reduction of concentration in nitrate + nitrite (2%) was not significant in any case. Total Kjeldahl nitrogen and ammonia concentrations were increased by 2% and 12% respectively and were not significant in any case.

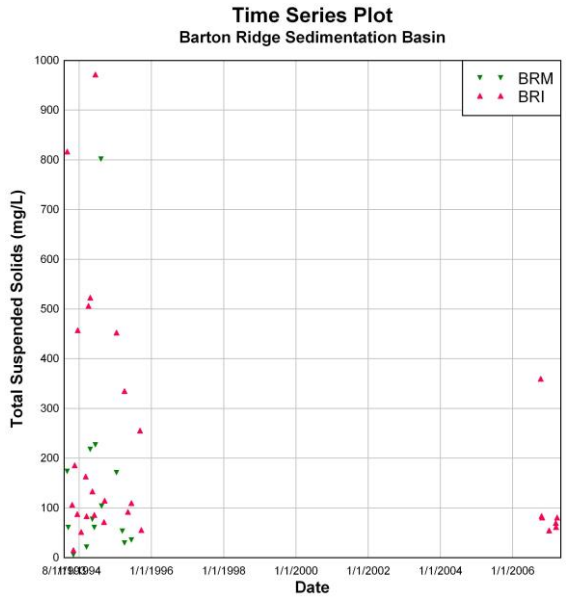
TP concentration was reduced by 23% and was only significant if data are paired. DP concentration was increased by 6% and was not significant in any case.

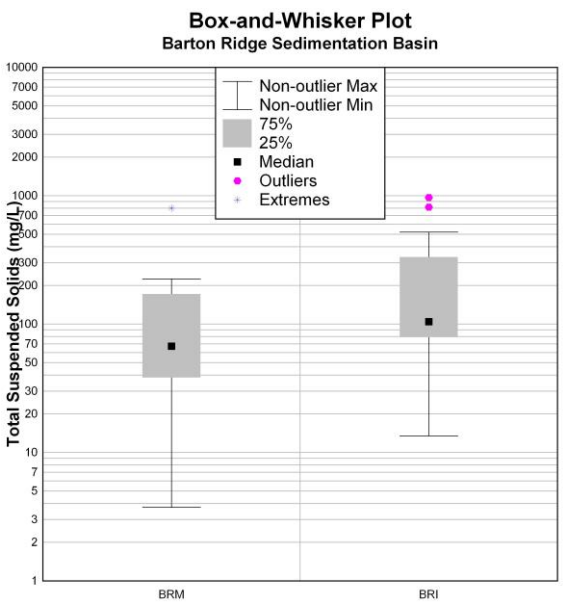
The reduction of bacteria was not significant in any case for both FCOL (27%) and FSTR (13%).

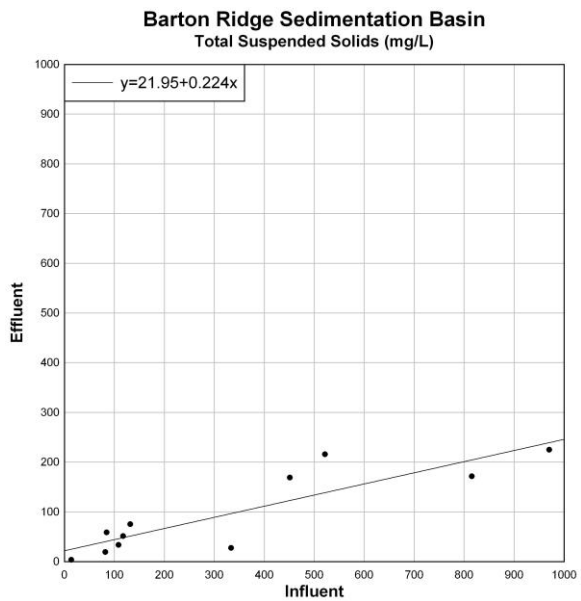
Lead, zinc, copper and cadmium concentrations were increased by 1%, 19%, 39% and 26% respectively, and were not significant in all cases.

Barton Ridge Sedimentation Basin - Total Suspended Solids (mg/L)



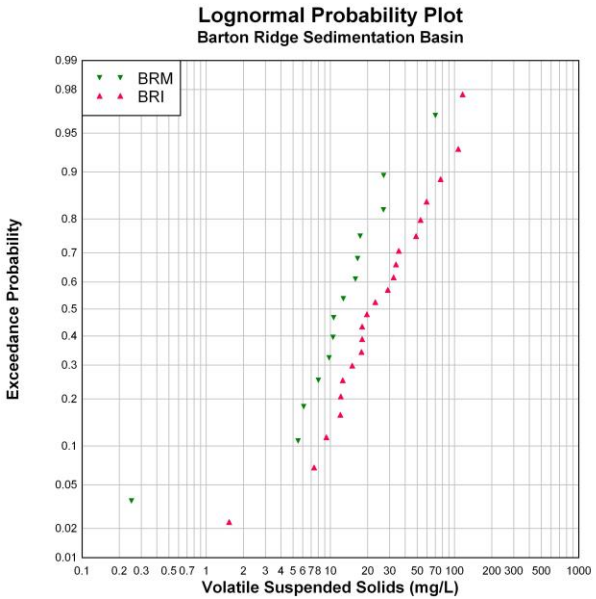


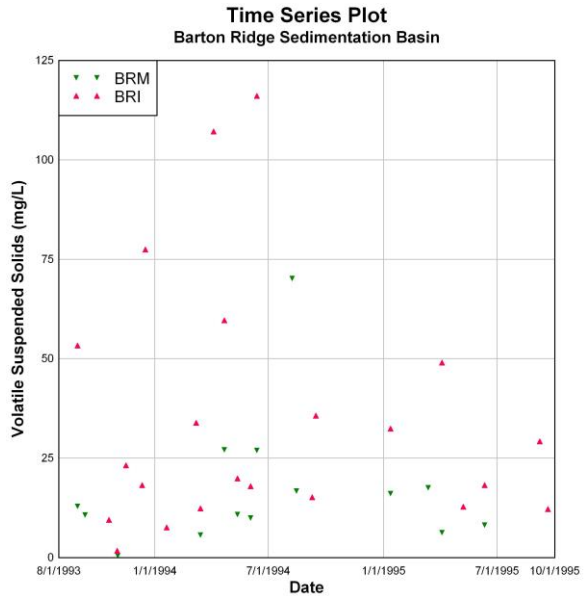


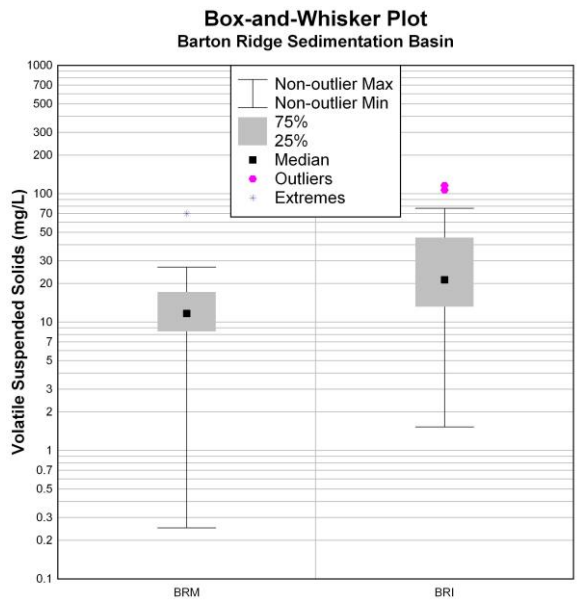


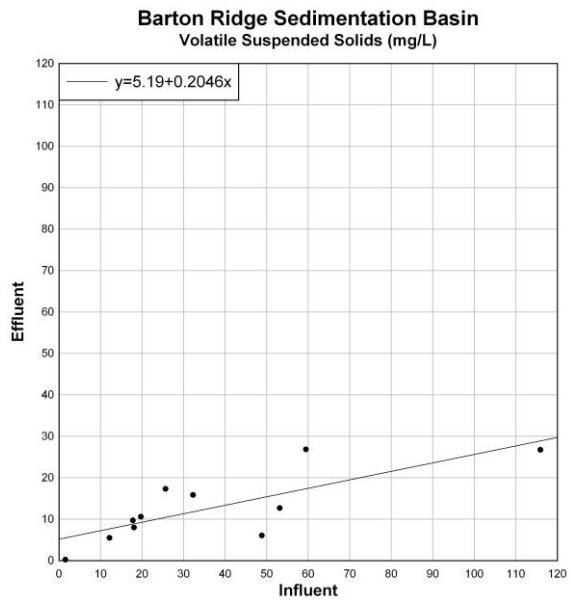
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	29	13
	Pairs Count	9	9
Non-Parametric	Maximum	970.0	225.3
	Upper Quartile	333.3	169.4
	Median	104.6	59.2
	Lower Quartile	79.0	34.0
	Minimum	13.4	3.7
	Efficiency	43.40%	
	Mann-Whitney	0.0450 **	
	Wilcoxon (paired)	0.0039 **	
Arithmetic	UCL	312.5	139.7
	Mean	221.3	93.5
	LCL	130.1	47.2
	Std. Dev.	239.8	76.5
	Wilk (p-value)	0.0001 **	0.0683 *
	Efficiency	57.76%	
	t-Test (equal var.)	0.0690 *	
	t-Test (unequal var.)	0.0135 **	
	t-test (paired)	0.0133 **	
	Levene Test	0.1313	
Log Transformed	UCL	345.9	267.8
	Mean	218.2	107.9
	LCL	137.7	43.5
	Std. Dev.	257.3	141.8
	Wilk (p-value)	0.0872 *	0.1956
	Efficiency	50.53%	
	t-Test (equal var.)	0.0221 **	
	t-Test (unequal var.)	0.0361 **	
	t-Test (paired)	0.0004 **	
	Levene Test	0.5931	
Bootstrap	UCL	312.1	138.2
	Mean	223.1	94.2
	LCL	134.1	50.3
	Std. Dev.	233.9	72.7
	Efficiency	57.76%	

Barton Ridge Sedimentation Basin - Volatile Suspended Solids (mg/L)



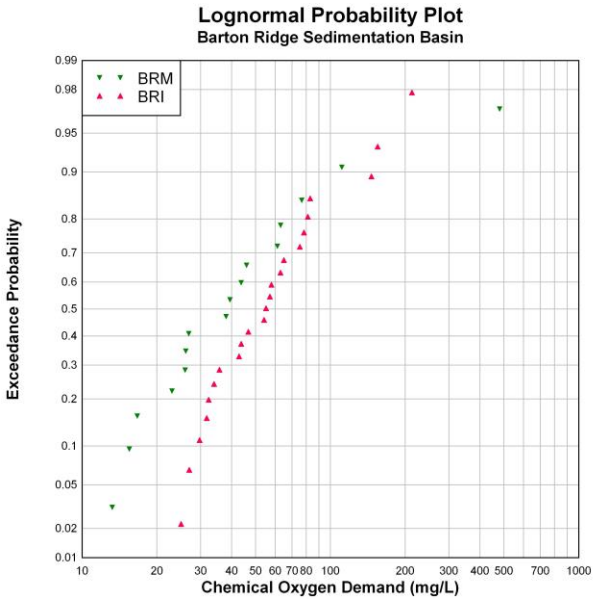


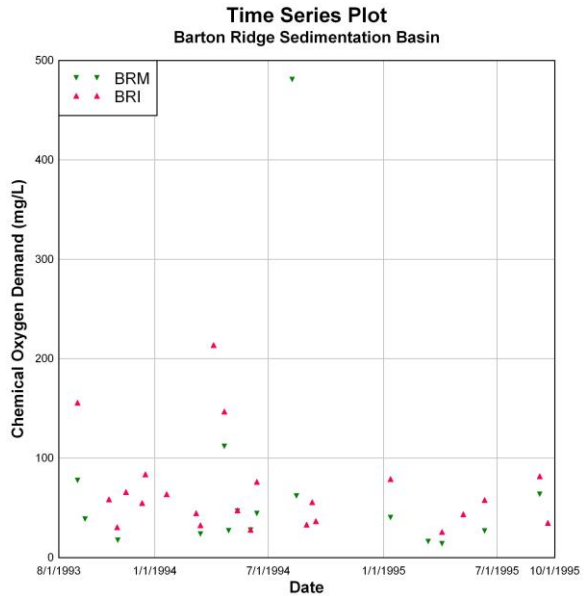


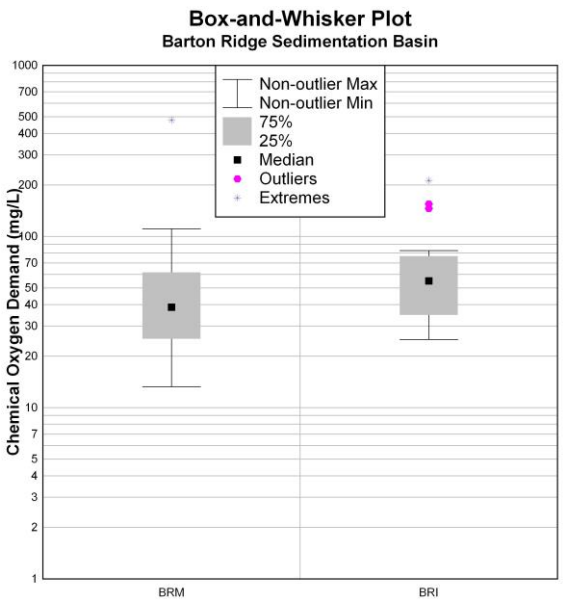


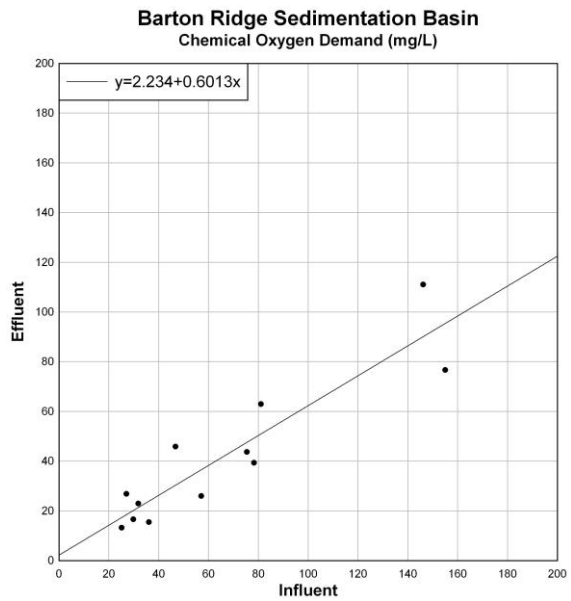
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	22	13
	Pairs Count	9	9
Non-Parametric	Maximum	115.9	26.9
	Upper Quartile	48.8	16.5
	Median	21.3	10.6
	Lower Quartile	12.6	8.0
	Minimum	1.5	.3
	Efficiency	50.22%	
	Mann-Whitney	0.0113 **	
	Wilcoxon (paired)	0.0039 **	
Arithmetic	UCL	48.3	17.6
	Mean	34.5	12.8
	LCL	20.6	8.1
	Std. Dev.	31.2	7.8
	Wilk (p-value)	0.0009 **	0.4689
	Efficiency	62.76%	
	t-Test (equal var.)	0.0201 **	
	t-Test (unequal var.)	0.0048 **	
	t-test (paired)	0.0135 **	
	Levene Test	0.0734 *	
Log Transformed	UCL	62.3	44.2
	Mean	36.6	17.0
	LCL	21.5	6.6
	Std. Dev.	41.8	23.3
	Wilk (p-value)	0.3605	0.0007 **
	Efficiency	53.44%	
	t-Test (equal var.)	0.0164 **	
	t-Test (unequal var.)	0.0252 **	
	t-Test (paired)	0.0003 **	
	Levene Test	0.6605	
Bootstrap	UCL	48.1	17.4
	Mean	34.7	12.9
	LCL	21.4	8.5
	Std. Dev.	30.0	7.4
	Efficiency	62.76%	

Barton Ridge Sedimentation Basin - Chemical Oxygen Demand (mg/L)



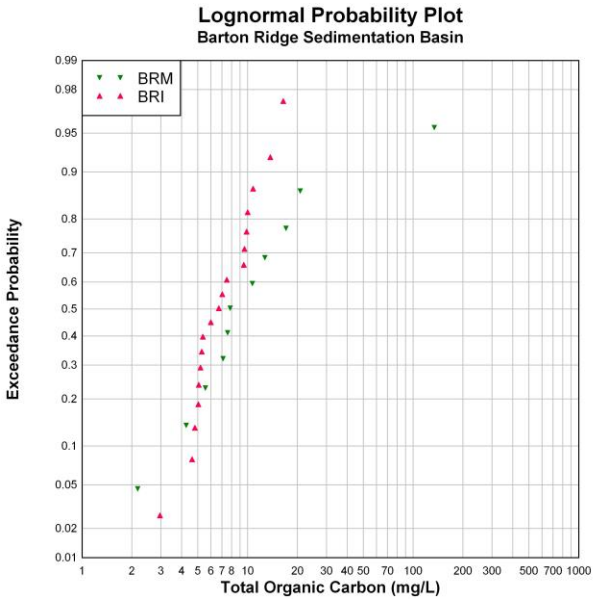


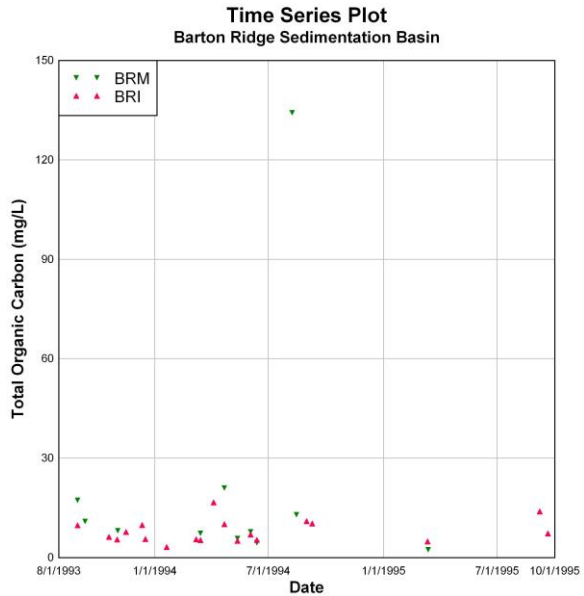


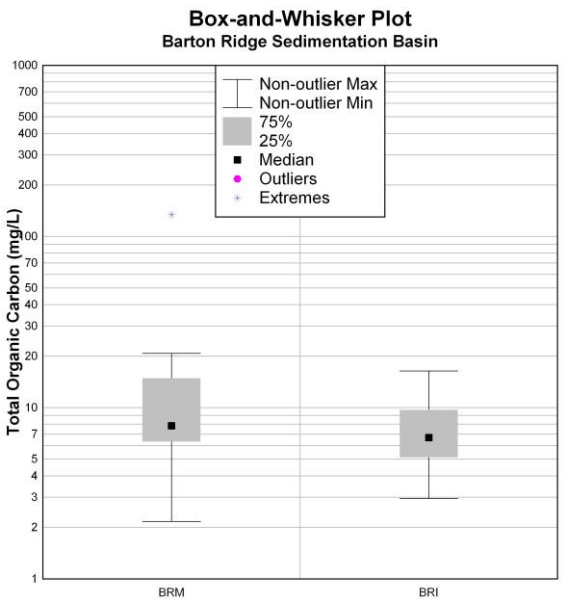


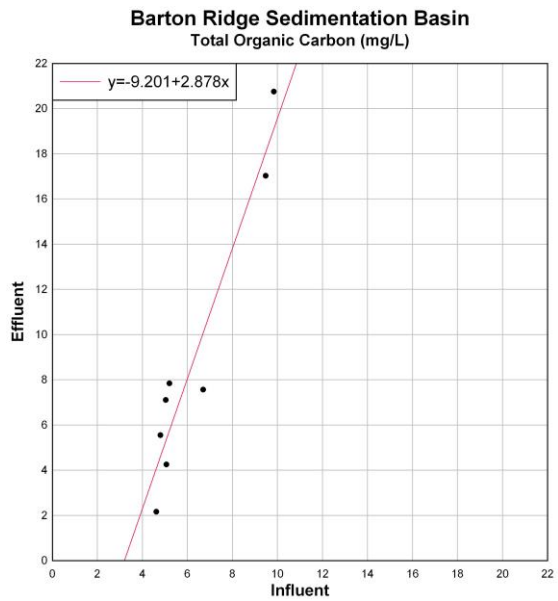
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	23	16
	Pairs Count	10	10
Non-Parametric	Maximum	212.91	480.00
	Upper Quartile	78.21	62.08
	Median	55.00	38.70
	Lower Quartile	34.00	24.50
	Minimum	25.04	13.24
	Efficiency	29.63%	
	Mann-Whitney	0.0922 *	
	Wilcoxon (paired)	0.0020 **	
Arithmetic	UCL	86.65	129.14
	Mean	66.61	69.16
	LCL	46.57	9.18
	Std. Dev.	46.33	112.59
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-3.83%	
	t-Test (equal var.)	0.9227	
	t-Test (unequal var.)	0.9327	
	t-test (paired)	0.0073 **	
	Levene Test	0.2687	
Log Transformed	UCL	85.23	103.51
	Mean	65.37	59.02
	LCL	50.14	33.65
	Std. Dev.	39.15	57.87
	Wilk (p-value)	0.2000	0.0803 *
	Efficiency	9.71%	
	t-Test (equal var.)	0.1915	
	t-Test (unequal var.)	0.2303	
	t-Test (paired)	0.0012 **	
	Levene Test	0.1947	
Bootstrap	UCL	86.36	121.00
	Mean	67.04	70.01
	LCL	47.71	19.02
	Std. Dev.	44.70	95.69
	Efficiency	-4.44%	

Barton Ridge Sedimentation Basin - Total Organic Carbon (mg/L)



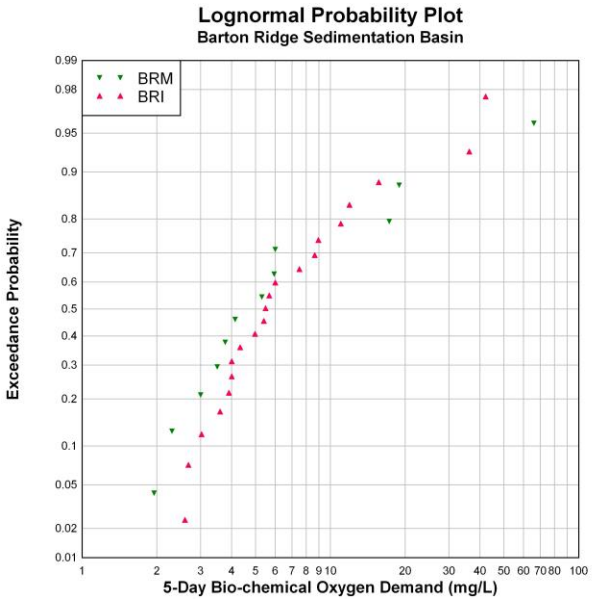


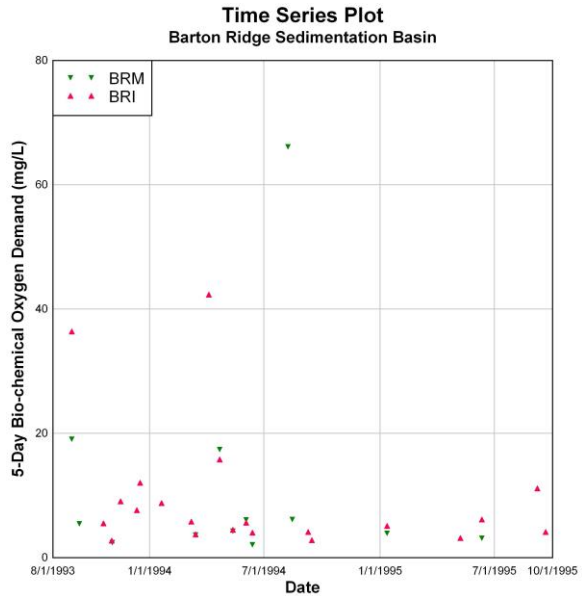


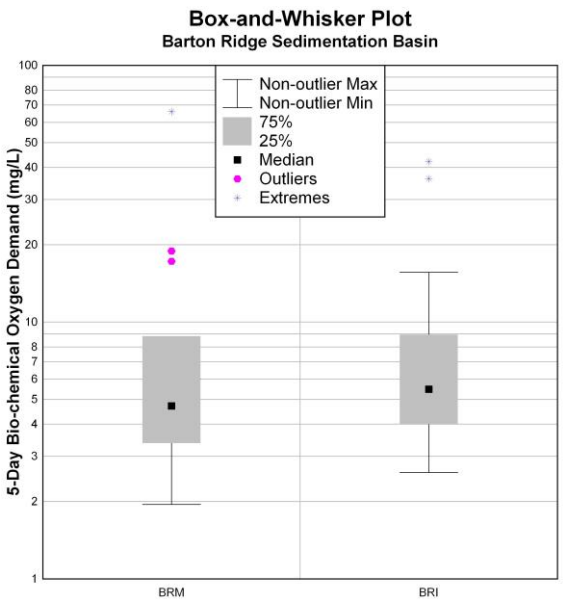


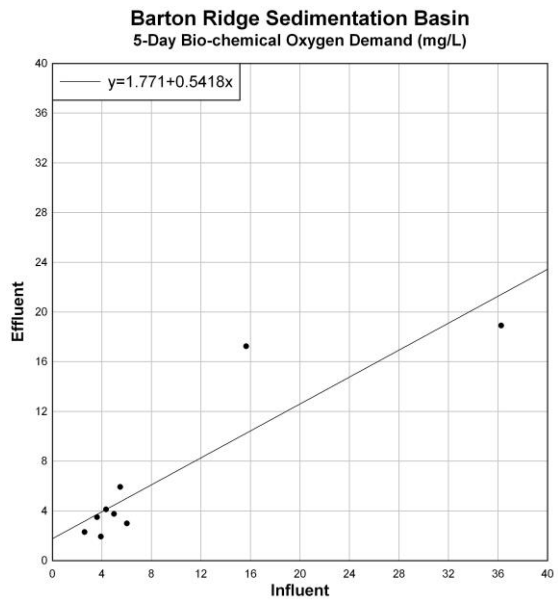
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	19	11
	Pairs Count	6	6
Non-Parametric	Maximum	16.38	134.00
	Upper Quartile	9.84	17.03
	Median	6.69	7.85
	Lower Quartile	5.06	5.56
	Minimum	2.95	2.17
	Efficiency	-17.19%	
	Mann-Whitney	0.2220	
	Wilcoxon (paired)	0.0938 *	
Arithmetic	UCL	9.30	46.36
	Mean	7.64	20.88
	LCL	5.98	-4.59
	Std. Dev.	3.45	37.92
	Wilk (p-value)	0.0401 **	0.0001 **
	Efficiency	-173.30%	
	t-Test (equal var.)	0.1370	
	t-Test (unequal var.)	0.2745	
	t-test (paired)	0.1167	
	Levene Test	0.1444	
Log Transformed	UCL	9.48	41.79
	Mean	7.63	16.86
	LCL	6.14	6.81
	Std. Dev.	3.38	19.64
	Wilk (p-value)	0.5818	0.2184
	Efficiency	-121.08%	
	t-Test (equal var.)	0.1665	
	t-Test (unequal var.)	0.2686	
	t-Test (paired)	0.0824 *	
	Levene Test	0.0701 *	
Bootstrap	UCL	9.23	41.38
	Mean	7.65	20.77
	LCL	6.06	0.16
	Std. Dev.	3.29	30.68
	Efficiency	-171.64%	

Barton Ridge Sedimentation Basin - 5-Day Bio-chemical Oxygen Demand (mg/L)



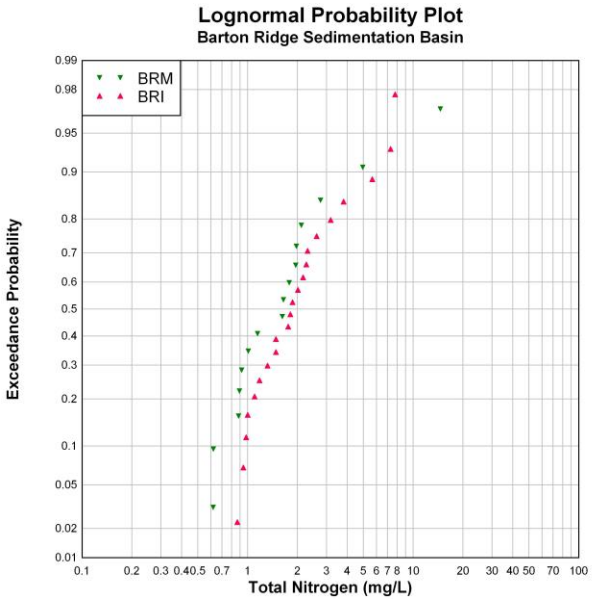


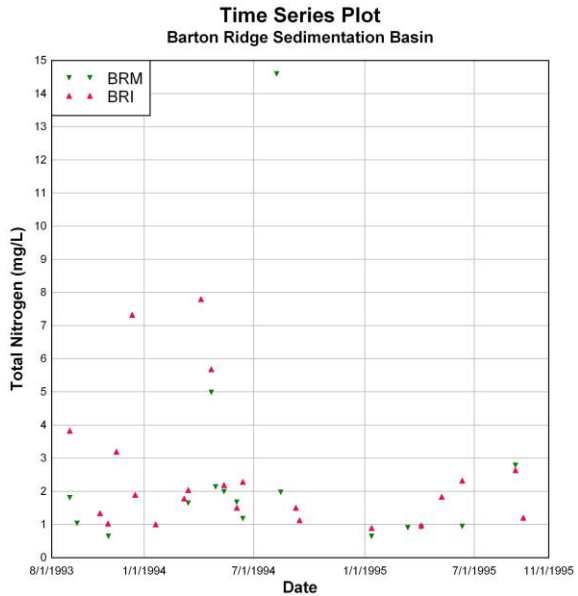


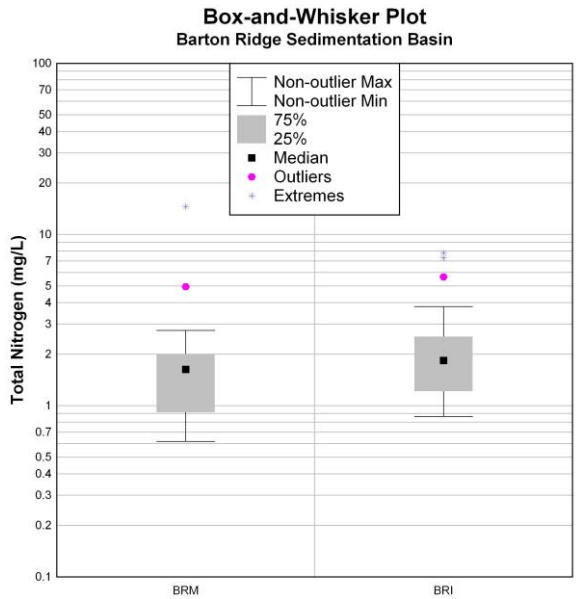


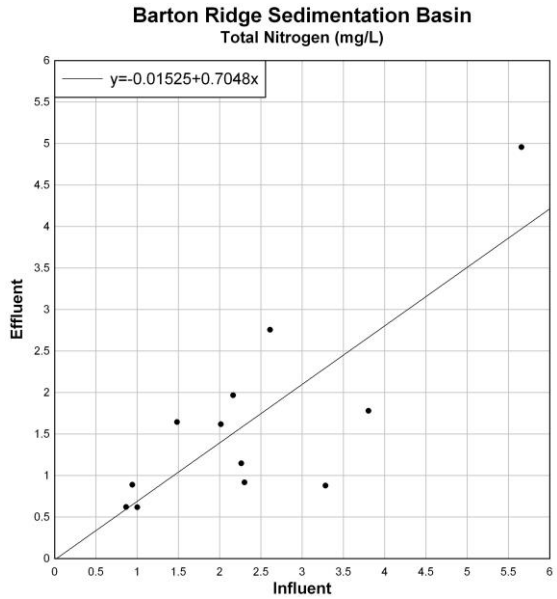
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	21	12
	Pairs Count	8	8
Non-Parametric	Maximum	42.20	65.98
	Upper Quartile	8.93	11.63
	Median	5.47	4.72
	Lower Quartile	4.00	3.25
	Minimum	2.59	1.95
	Efficiency	13.85%	
	Mann-Whitney	0.5172	
	Wilcoxon (paired)	0.1953	
Arithmetic	UCL	14.20	22.97
	Mean	9.42	11.50
	LCL	4.63	0.04
	Std. Dev.	10.50	18.05
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-22.18%	
	t-Test (equal var.)	0.6756	
	t-Test (unequal var.)	0.7186	
	t-test (paired)	0.2473	
	Levene Test	0.3349	
Log Transformed	UCL	13.01	22.09
	Mean	8.74	9.79
	LCL	5.87	4.34
	Std. Dev.	7.33	11.04
	Wilk (p-value)	0.0287 **	0.0783 *
	Efficiency	-11.94%	
	t-Test (equal var.)	0.8116	
	t-Test (unequal var.)	0.8268	
	t-Test (paired)	0.0627 *	
	Levene Test	0.3527	
Bootstrap	UCL	14.00	21.32
	Mean	9.48	11.58
	LCL	4.97	1.84
	Std. Dev.	9.92	15.33
	Efficiency	-22.12%	

Barton Ridge Sedimentation Basin - Total Nitrogen (mg/L)



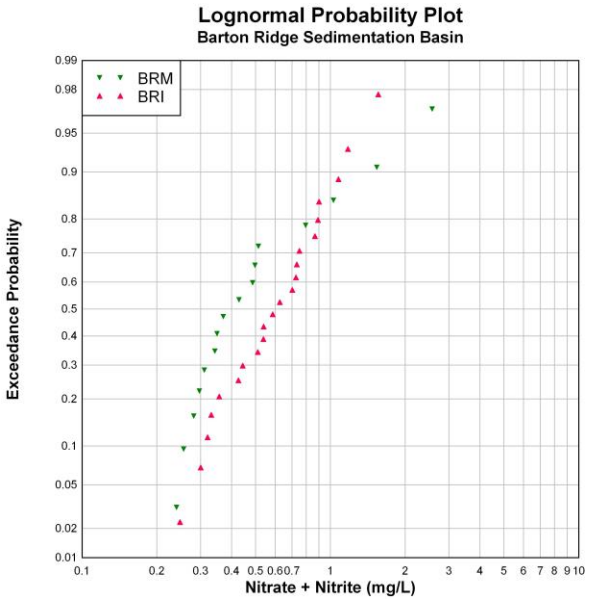


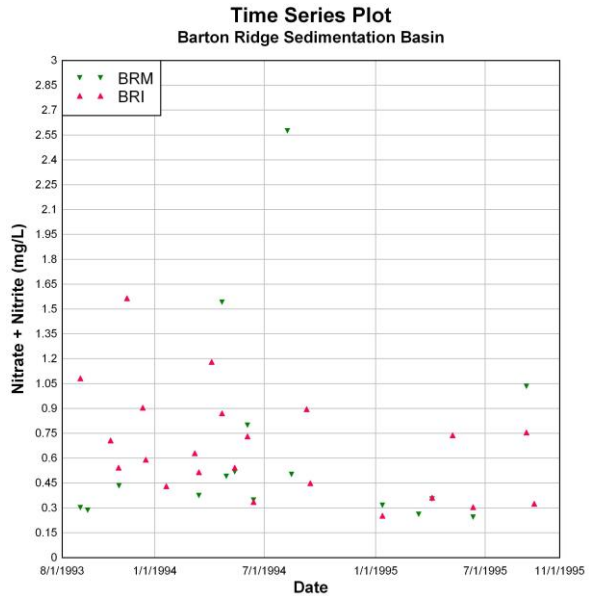


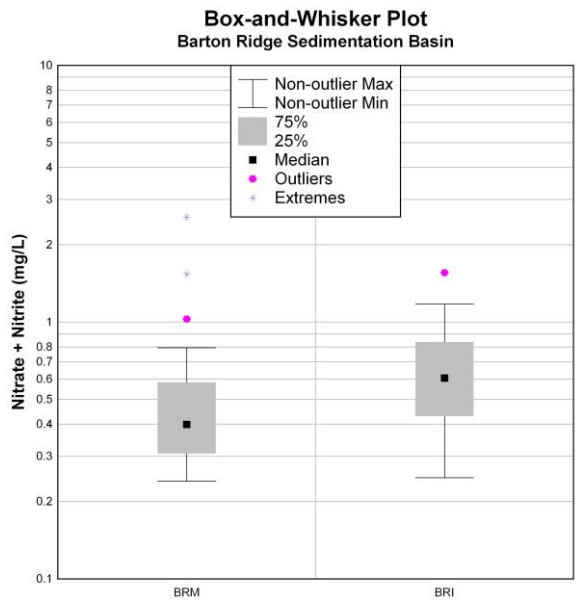


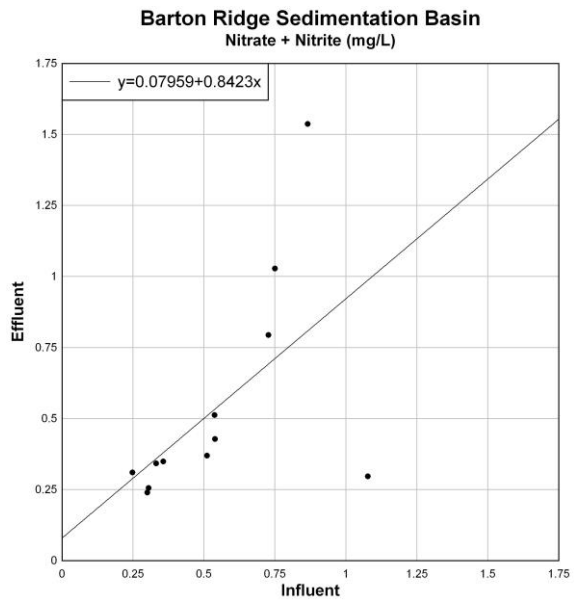
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	22	16
	Pairs Count	10	10
Non-Parametric	Maximum	7.772	14.570
	Upper Quartile	2.610	2.037
	Median	1.839	1.633
	Lower Quartile	1.180	0.906
	Minimum	0.866	0.619
	Efficiency	11.21%	
	Mann-Whitney	0.2388	
	Wilcoxon (paired)	0.0195 **	
Arithmetic	UCL	3.366	4.277
	Mean	2.492	2.466
	LCL	1.617	0.654
	Std. Dev.	1.972	3.400
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	1.06%	
	t-Test (equal var.)	0.9761	
	t-Test (unequal var.)	0.9781	
	t-test (paired)	0.0319 **	
	Levene Test	0.3734	
Log Transformed	UCL	3.316	3.617
	Mean	2.425	2.198
	LCL	1.773	1.335
	Std. Dev.	1.661	1.929
	Wilk (p-value)	0.0876 *	0.0479 **
	Efficiency	9.37%	
	t-Test (equal var.)	0.3916	
	t-Test (unequal var.)	0.4104	
	t-Test (paired)	0.0261 **	
	Levene Test	0.4477	
Bootstrap	UCL	3.346	4.062
	Mean	2.505	2.487
	LCL	1.664	0.912
	Std. Dev.	1.897	2.956
	Efficiency	0.72%	

Barton Ridge Sedimentation Basin - Nitrate + Nitrite (mg/L)



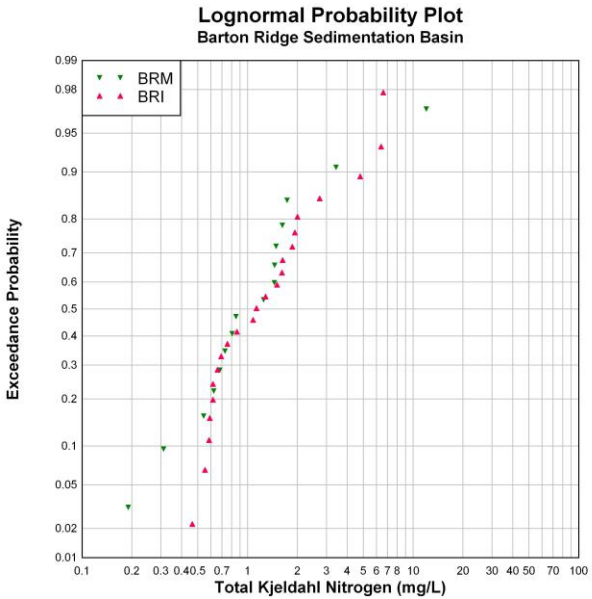


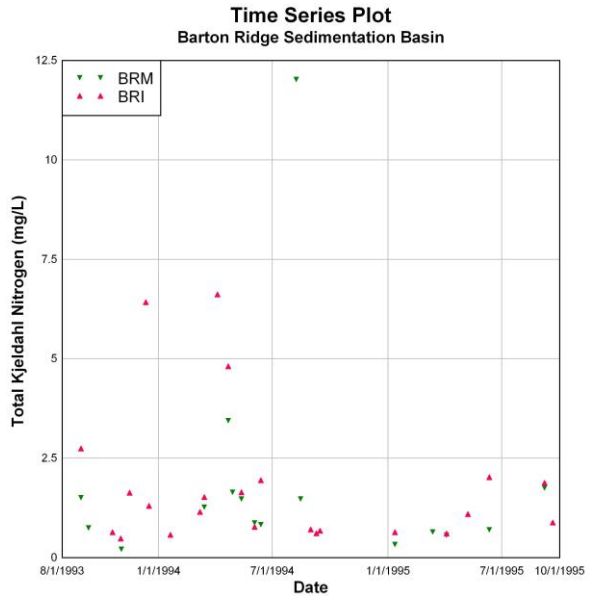


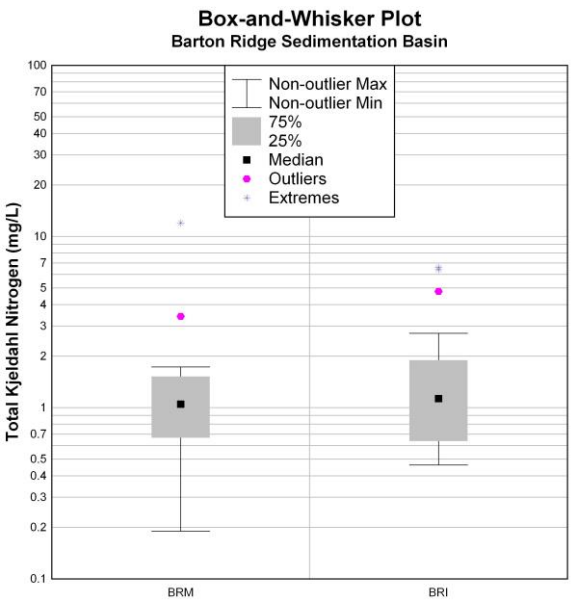


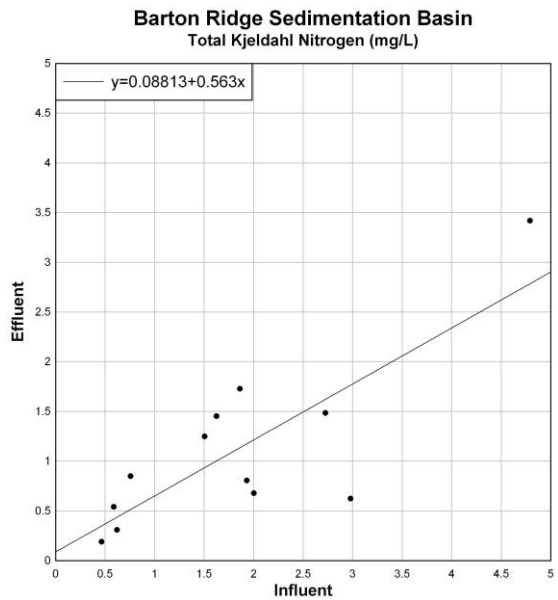
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	22	16
	Pairs Count	10	10
Non-Parametric	Maximum	1.560	2.570
	Upper Quartile	0.865	0.654
	Median	0.605	0.399
	Lower Quartile	0.426	0.304
	Minimum	0.248	0.240
	Efficiency	34.05%	
	Mann-Whitney	0.1364	
	Wilcoxon (paired)	0.8457	
Arithmetic	UCL	0.807	0.973
	Mean	0.664	0.644
	LCL	0.520	0.315
	Std. Dev.	0.324	0.617
	Wilk (p-value)	0.0913 *	0.0001 **
	Efficiency	2.97%	
	t-Test (equal var.)	0.8988	
	t-Test (unequal var.)	0.9082	
	t-test (paired)	0.9447	
	Levene Test	0.2026	
Log Transformed	UCL	0.832	0.911
	Mean	0.664	0.609
	LCL	0.530	0.408
	Std. Dev.	0.332	0.438
	Wilk (p-value)	0.9617	0.0227 **
	Efficiency	8.25%	
	t-Test (equal var.)	0.3218	
	t-Test (unequal var.)	0.3499	
	t-Test (paired)	0.6880	
	Levene Test	0.2011	
Bootstrap	UCL	0.798	0.951
	Mean	0.661	0.649
	LCL	0.524	0.347
	Std. Dev.	0.310	0.567
	Efficiency	1.84%	

Barton Ridge Sedimentation Basin - Total Kjeldahl Nitrogen (mg/L)



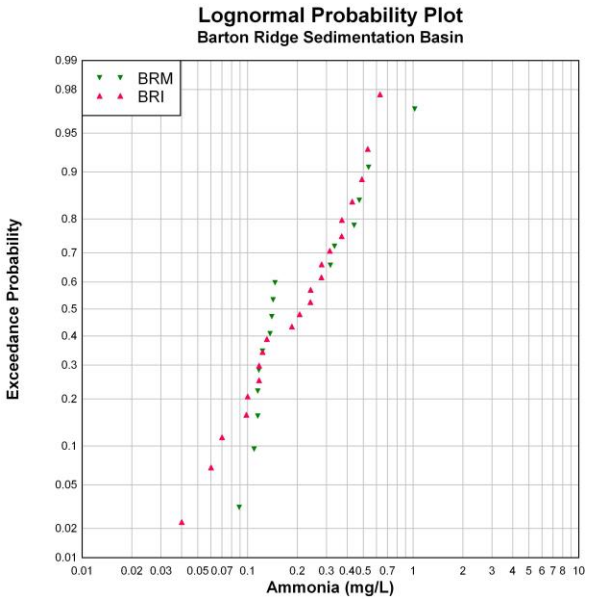


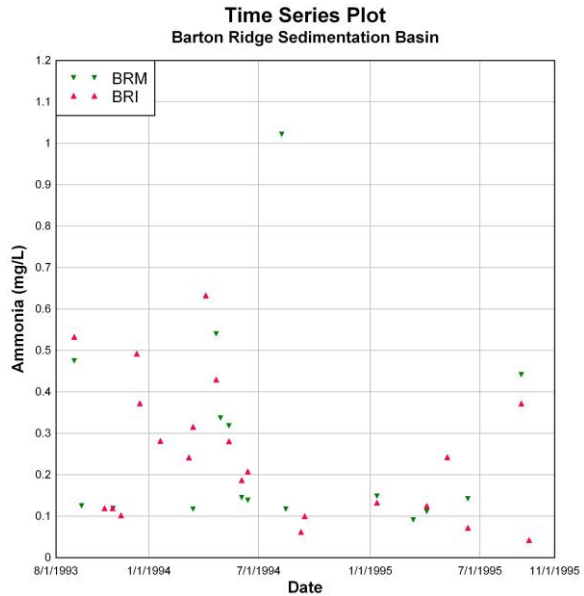


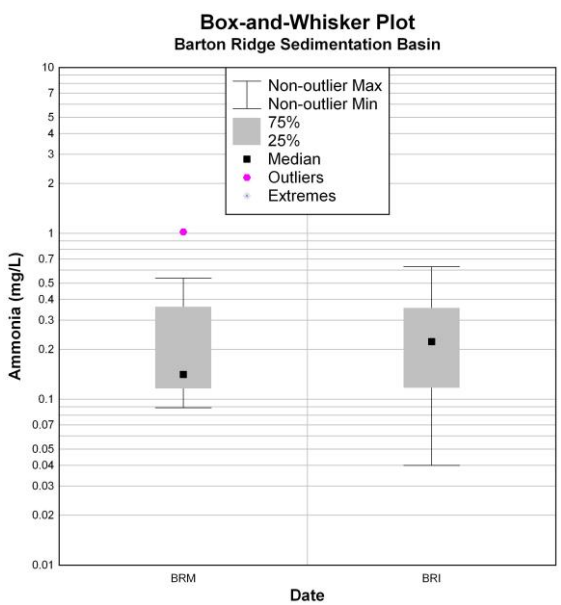


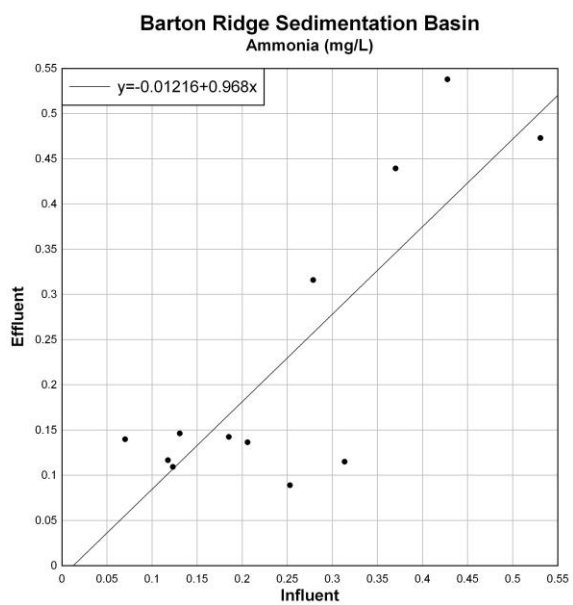
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	23	16
	Pairs Count	10	10
Non-Parametric	Maximum	6.597	12.000
	Upper Quartile	1.929	1.553
	Median	1.131	1.050
	Lower Quartile	0.618	0.652
	Minimum	0.462	0.190
	Efficiency	7.12%	
	Mann-Whitney	0.6004	
	Wilcoxon (paired)	0.0059 **	
Arithmetic	UCL	2.545	3.325
	Mean	1.779	1.822
	LCL	1.013	0.319
	Std. Dev.	1.771	2.821
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-2.41%	
	t-Test (equal var.)	0.9538	
	t-Test (unequal var.)	0.9575	
	t-test (paired)	0.0125 **	
	Levene Test	0.4266	
Log Transformed	UCL	2.509	3.025
	Mean	1.698	1.628
	LCL	1.149	0.876
	Std. Dev.	1.476	1.747
	Wilk (p-value)	0.0346 **	0.3712
	Efficiency	4.15%	
	t-Test (equal var.)	0.5507	
	t-Test (unequal var.)	0.5657	
	t-Test (paired)	0.0126 **	
	Levene Test	0.4837	
Bootstrap	UCL	2.526	3.132
	Mean	1.794	1.838
	LCL	1.061	0.545
	Std. Dev.	1.694	2.428
	Efficiency	-2.49%	

Barton Ridge Sedimentation Basin - Ammonia (mg/L)



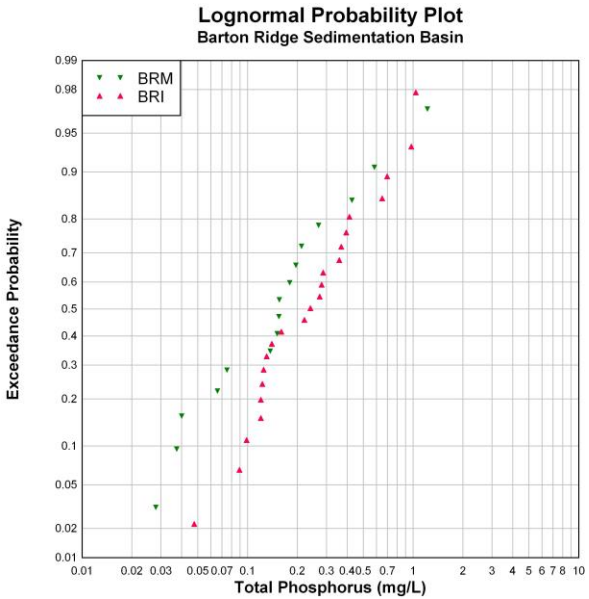


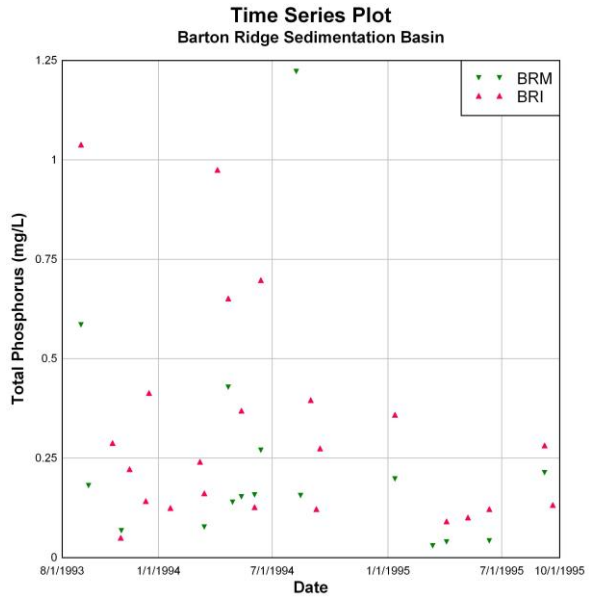


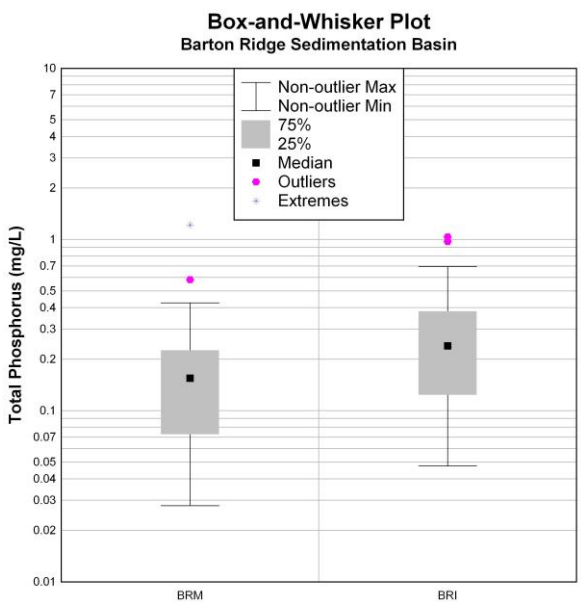


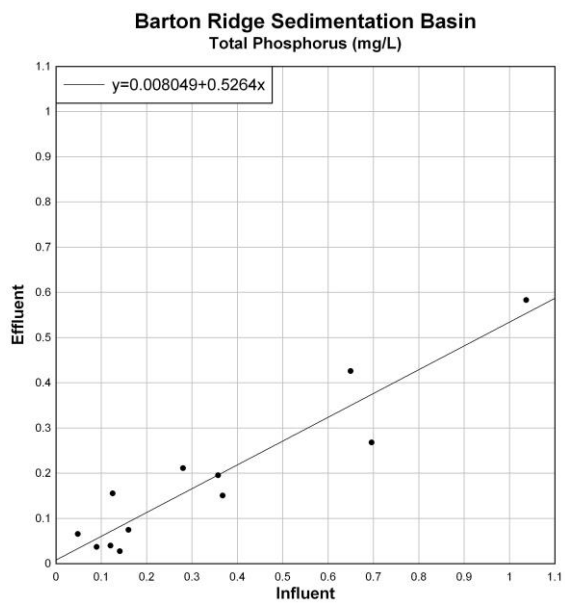
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	22	16
	Pairs Count	10	10
Non-Parametric	Maximum	0.631	1.020
	Upper Quartile	0.370	0.387
	Median	0.223	0.141
	Lower Quartile	0.117	0.116
	Minimum	0.040	0.089
	Efficiency	36.53%	
	Mann-Whitney	0.9181	
	Wilcoxon (paired)	0.9219	
Arithmetic	UCL	0.320	0.405
	Mean	0.246	0.272
	LCL	0.173	0.140
	Std. Dev.	0.166	0.249
	Wilk (p-value)	0.0848 *	0.0003 **
	Efficiency	-10.55%	
	t-Test (equal var.)	0.7014	
	t-Test (unequal var.)	0.7197	
	t-test (paired)	0.7901	
	Levene Test	0.2930	
Log Transformed	UCL	0.370	0.408
	Mean	0.252	0.262
	LCL	0.172	0.168
	Std. Dev.	0.209	0.207
	Wilk (p-value)	0.6604	0.0137 **
	Efficiency	-3.69%	
	t-Test (equal var.)	0.8208	
	t-Test (unequal var.)	0.8201	
	t-Test (paired)	0.6990	
	Levene Test	0.8478	
Bootstrap	UCL	0.318	0.398
	Mean	0.246	0.275
	LCL	0.174	0.151
	Std. Dev.	0.162	0.232
	Efficiency	-11.52%	

Barton Ridge Sedimentation Basin - Total Phosphorus (mg/L)



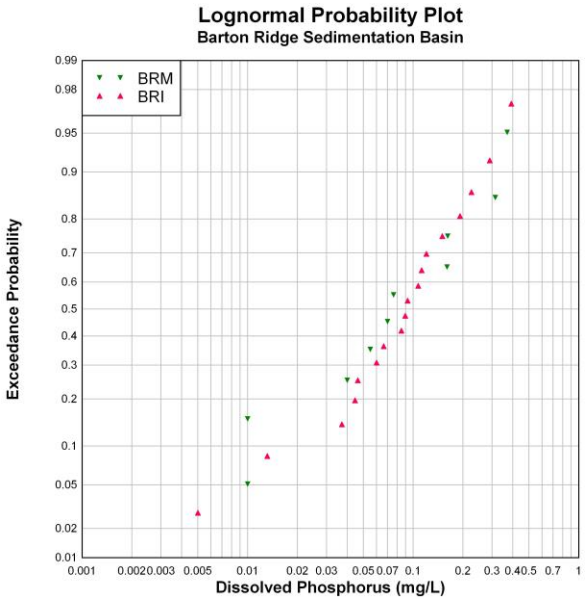


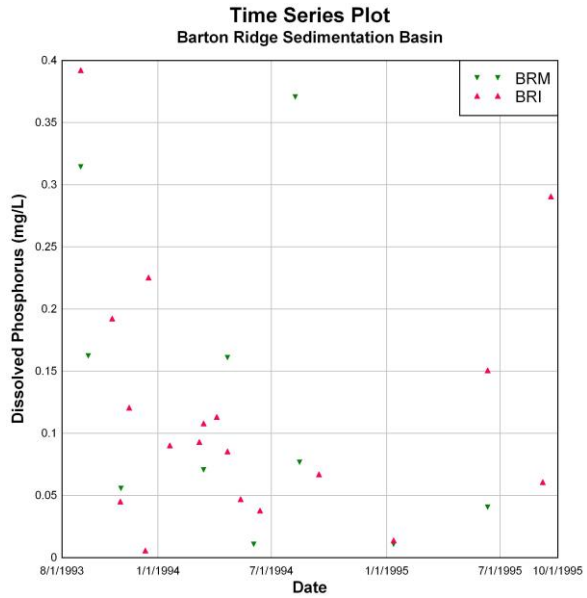


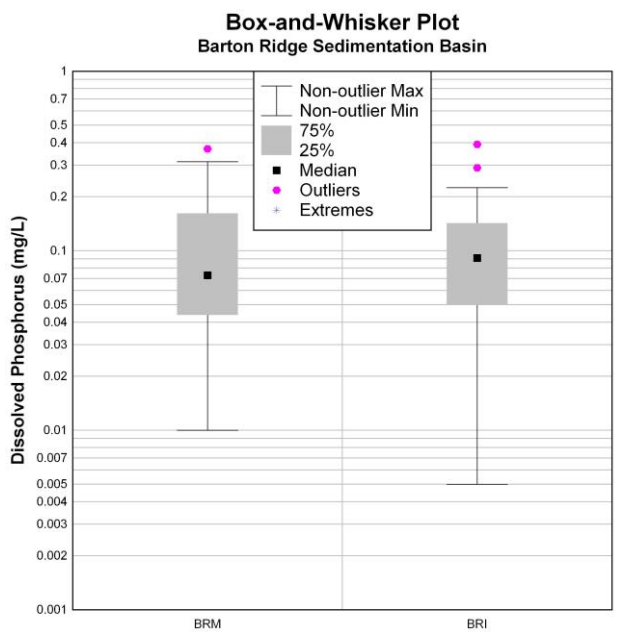


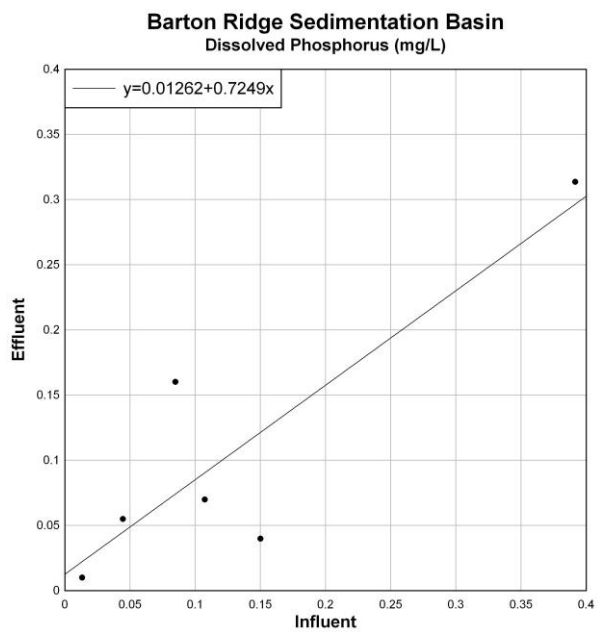
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	23	16
	Pairs Count	10	10
Non-Parametric	Maximum	1.036	1.220
	Upper Quartile	0.394	0.240
	Median	0.239	0.155
	Lower Quartile	0.122	0.070
	Minimum	0.048	0.028
	Efficiency	35.19%	
	Mann-Whitney	0.2218	
	Wilcoxon (paired)	0.0039 **	
Arithmetic	UCL	0.437	0.405
	Mean	0.319	0.246
	LCL	0.200	0.086
	Std. Dev.	0.274	0.298
	Wilk (p-value)	0.0004 **	0.0001 **
	Efficiency	23.00%	
	t-Test (equal var.)	0.4334	
	t-Test (unequal var.)	0.4415	
	t-test (paired)	0.0076 **	
	Levene Test	0.8448	
Log Transformed	UCL	0.474	0.472
	Mean	0.317	0.240
	LCL	0.212	0.122
	Std. Dev.	0.284	0.279
	Wilk (p-value)	0.5934	0.7861
	Efficiency	24.31%	
	t-Test (equal var.)	0.1347	
	t-Test (unequal var.)	0.1543	
	t-Test (paired)	0.0007 **	
	Levene Test	0.2777	
Bootstrap	UCL	0.437	0.392
	Mean	0.322	0.247
	LCL	0.207	0.103
	Std. Dev.	0.265	0.272
	Efficiency	23.12%	

Barton Ridge Sedimentation Basin - Dissolved Phosphorus (mg/L)



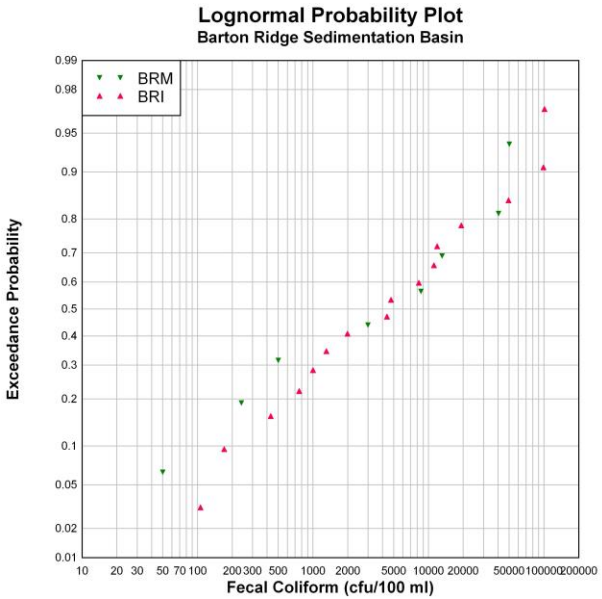


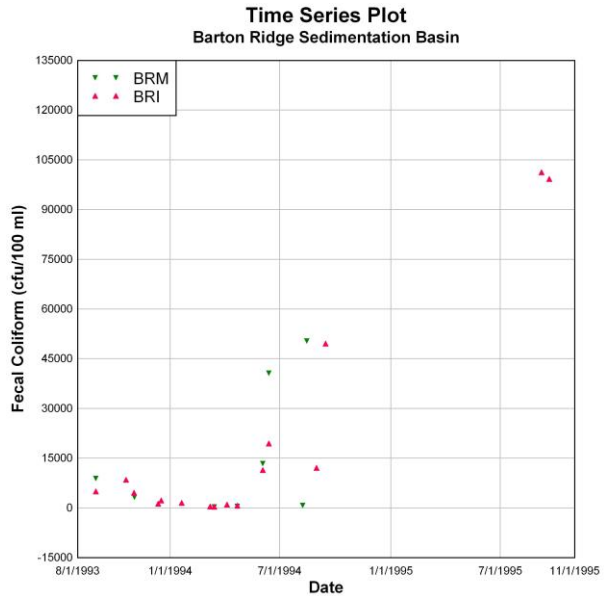


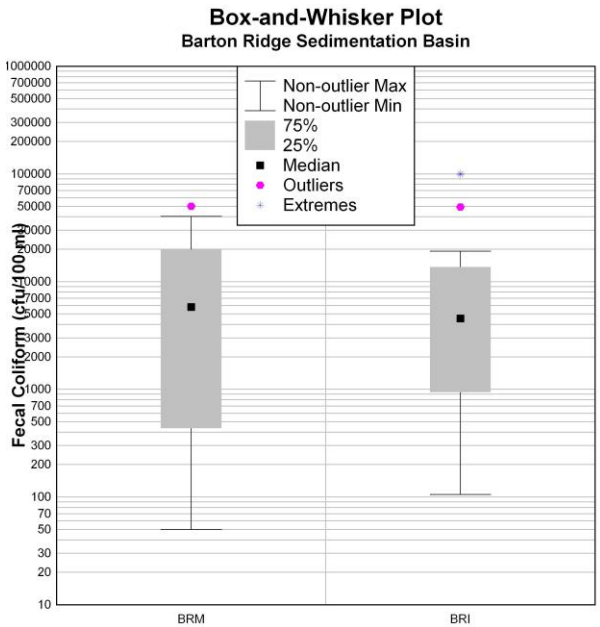


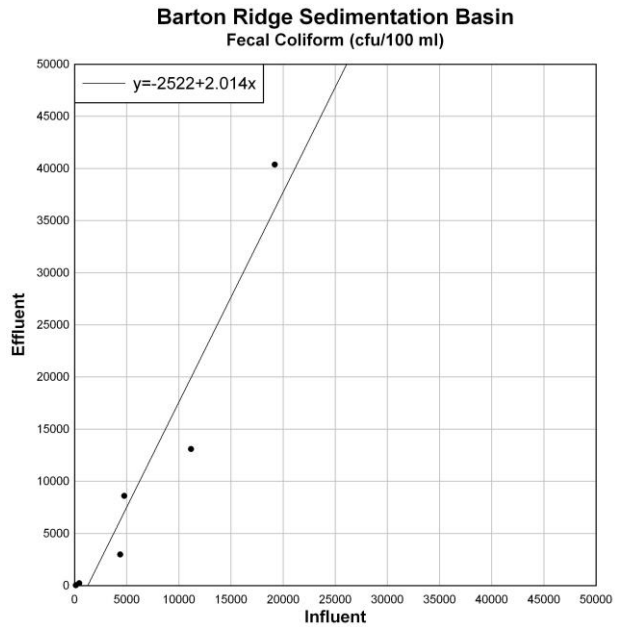
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	18	10
	Pairs Count	5	5
Non-Parametric	Maximum	0.391	0.370
	Upper Quartile	0.150	0.162
	Median	0.091	0.073
	Lower Quartile	0.046	0.040
	Minimum	0.005	0.010
	Efficiency	19.72%	
	Mann-Whitney	0.8680	
	Wilcoxon (paired)	0.3125	
Arithmetic	UCL	0.168	0.217
	Mean	0.118	0.127
	LCL	0.068	0.037
	Std. Dev.	0.101	0.126
	Wilk (p-value)	0.0142 **	0.0448 **
	Efficiency	-7.23%	
	t-Test (equal var.)	0.8453	
	t-Test (unequal var.)	0.8559	
	t-test (paired)	0.3959	
	Levene Test	0.5195	
Log Transformed	UCL	0.258	0.487
	Mean	0.133	0.141
	LCL	0.068	0.041
	Std. Dev.	0.165	0.198
	Wilk (p-value)	0.2060	0.3785
	Efficiency	-6.10%	
	t-Test (equal var.)	0.8241	
	t-Test (unequal var.)	0.8338	
	t-Test (paired)	0.3620	
	Levene Test	0.5998	
Bootstrap	UCL	0.167	0.209
	Mean	0.119	0.126
	LCL	0.071	0.043
	Std. Dev.	0.096	0.116
	Efficiency	-6.05%	

Barton Ridge Sedimentation Basin - Fecal Coliform (cfu/100 ml)



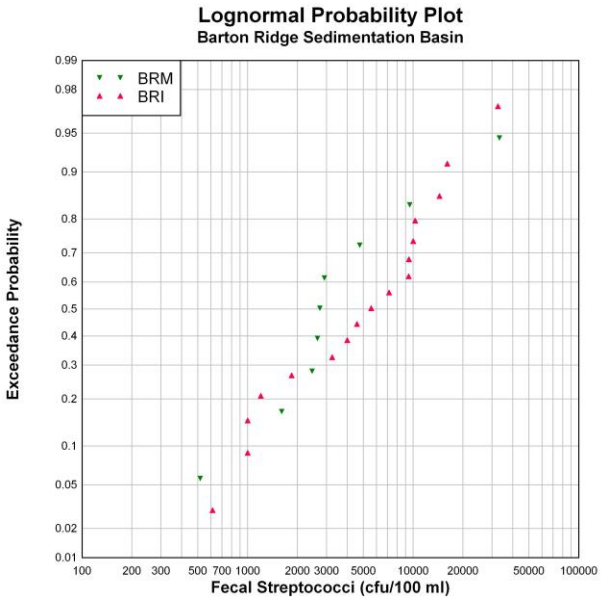


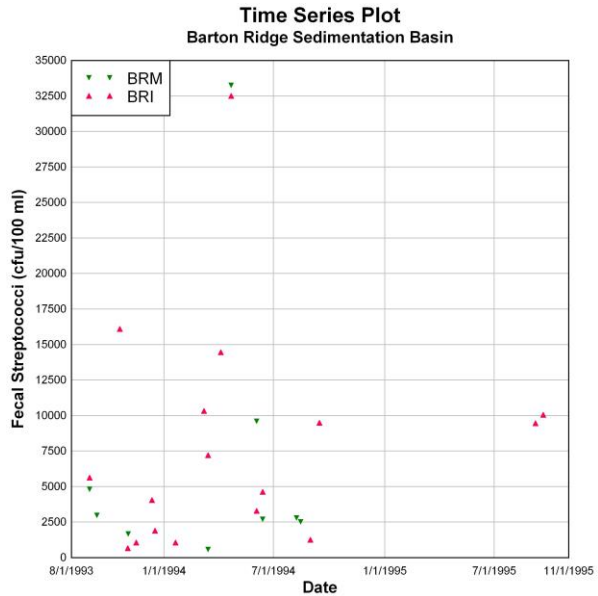


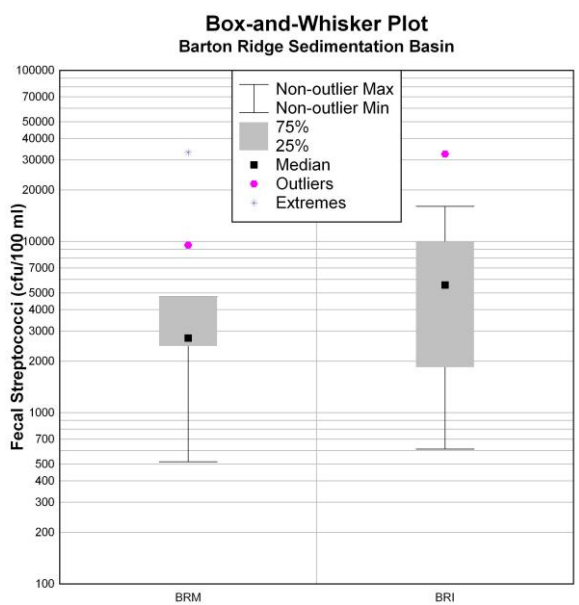


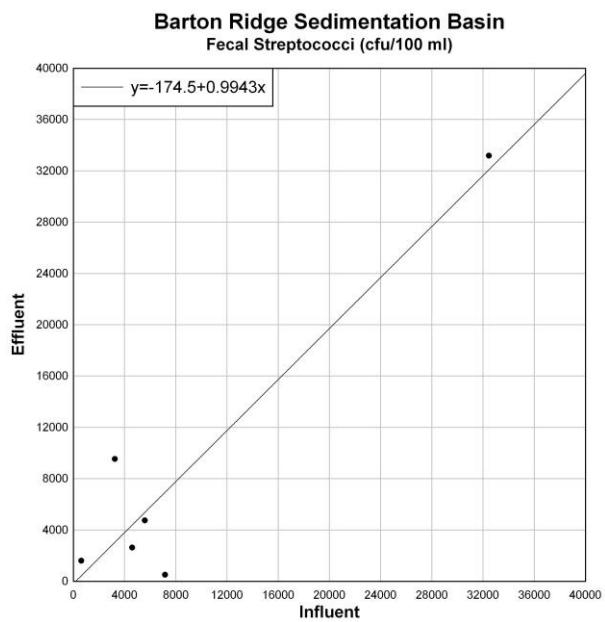
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	16	8
	Pairs Count	5	5
Non-Parametric	Maximum	101,000	50,084
	Upper Quartile	15,520	26,750
	Median	4,554	5,805
	Lower Quartile	880	370
	Minimum	106	50
	Efficiency	-27.48%	
	Mann-Whitney	0.8797	
	Wilcoxon (paired)	0.3125	
Arithmetic	UCL	37,597	30,962
	Mean	19,663	14,498
	LCL	1,730	-1,966
	Std. Dev.	33,662	19,690
	Wilk (p-value)	0.0001 **	0.0113 **
	Efficiency	26.27%	
	t-Test (equal var.)	0.6941	
	t-Test (unequal var.)	0.6411	
	t-test (paired)	0.2547	
	Levene Test	0.3539	
Log Transformed	UCL	204,882	2,431,783
	Mean	25,945	26,479
	LCL	3,286	288
	Std. Dev.	87,964	77,008
	Wilk (p-value)	0.8100	0.5566
	Efficiency	-2.06%	
	t-Test (equal var.)	0.7384	
	t-Test (unequal var.)	0.7557	
	t-Test (paired)	0.9186	
	Levene Test	0.5106	
Bootstrap	UCL	37,333	29,650
	Mean	20,306	14,763
	LCL	3,278	-125
	Std. Dev.	31,955	17,808
	Efficiency	27.30%	

Barton Ridge Sedimentation Basin - Fecal Streptococci (cfu/100 ml)



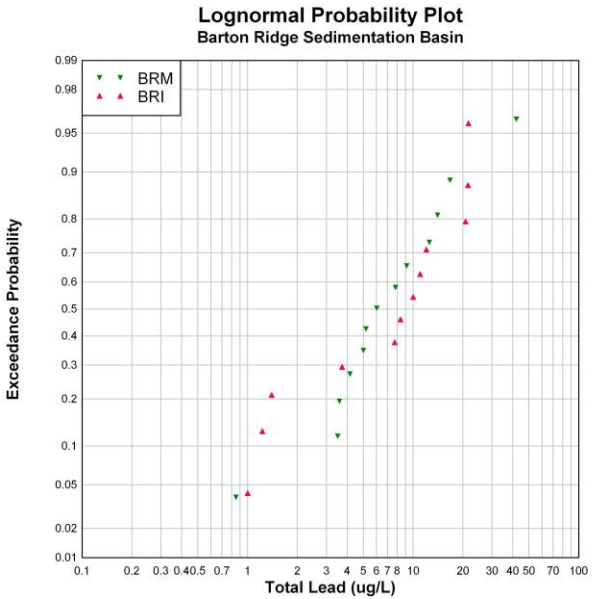


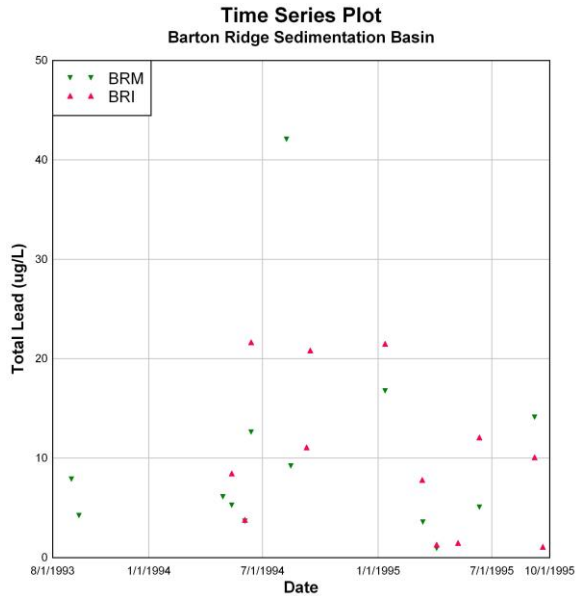


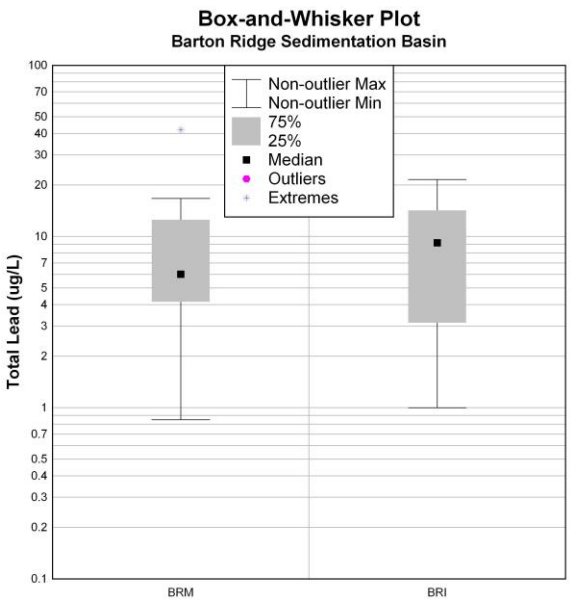


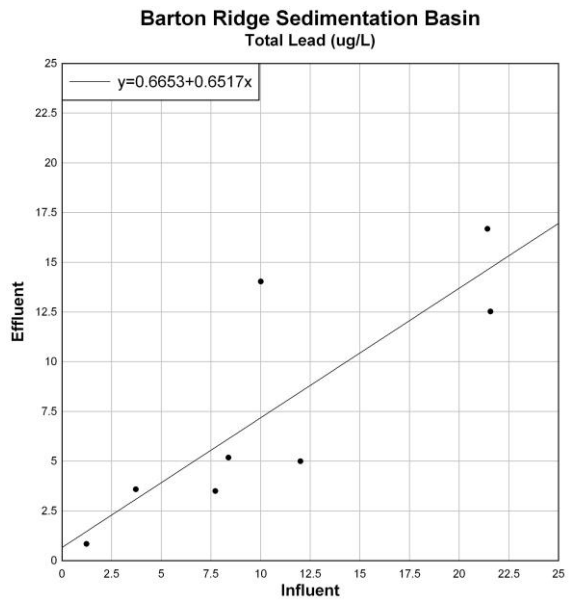
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	17	9
	Pairs Count	5	5
Non-Parametric	Maximum	32,450	33,186
	Upper Quartile	10,000	4,757
	Median	5,575	2,727
	Lower Quartile	1,845	2,454
	Minimum	613	517
	Efficiency	51.09%	
	Mann-Whitney	0.4265	
	Wilcoxon (paired)	0.6250	
Arithmetic	UCL	11,860	14,591
	Mean	7,776	6,704
	LCL	3,691	-1,182
	Std. Dev.	7,943	10,260
	Wilk (p-value)	0.0018 **	0.0001 **
	Efficiency	13.77%	
	t-Test (equal var.)	0.7699	
	t-Test (unequal var.)	0.7892	
	t-test (paired)	0.8338	
	Levene Test	0.6419	
Log Transformed	UCL	17,897	19,548
	Mean	8,375	6,016
	LCL	3,919	1,851
	Std. Dev.	11,297	7,487
	Wilk (p-value)	0.4916	0.5423
	Efficiency	28.17%	
	t-Test (equal var.)	0.5229	
	t-Test (unequal var.)	0.5282	
	t-Test (paired)	0.5038	
	Levene Test	0.9675	
Bootstrap	UCL	11,606	13,344
	Mean	7,815	6,781
	LCL	4,025	217
	Std. Dev.	7,373	8,539
	Efficiency	13.24%	

Barton Ridge Sedimentation Basin - Total Lead (ug/L)



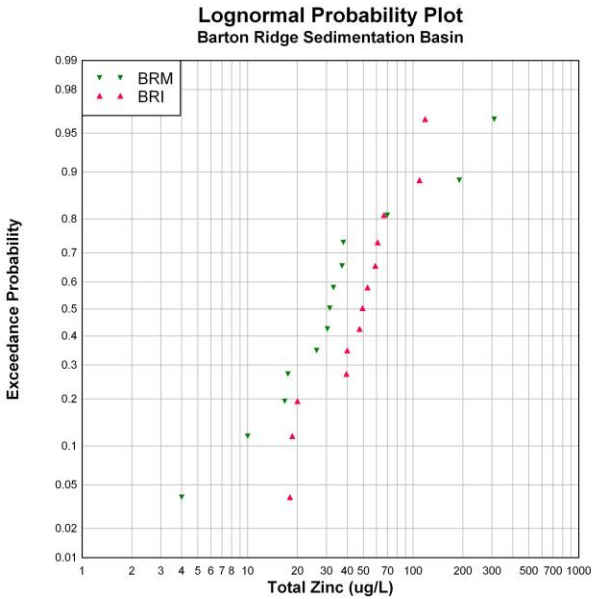


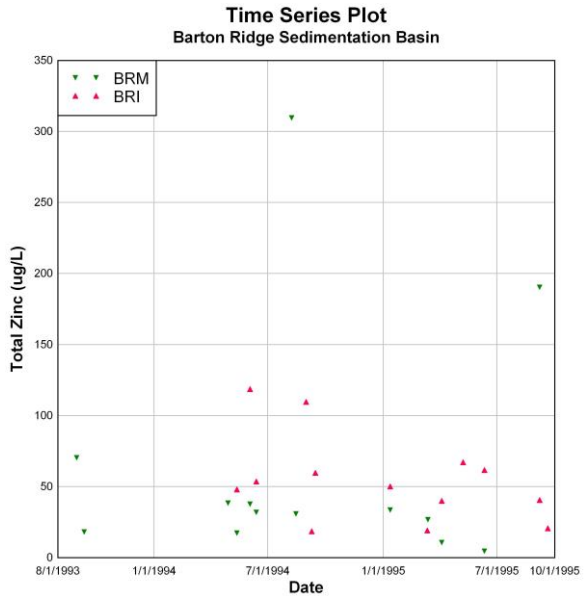


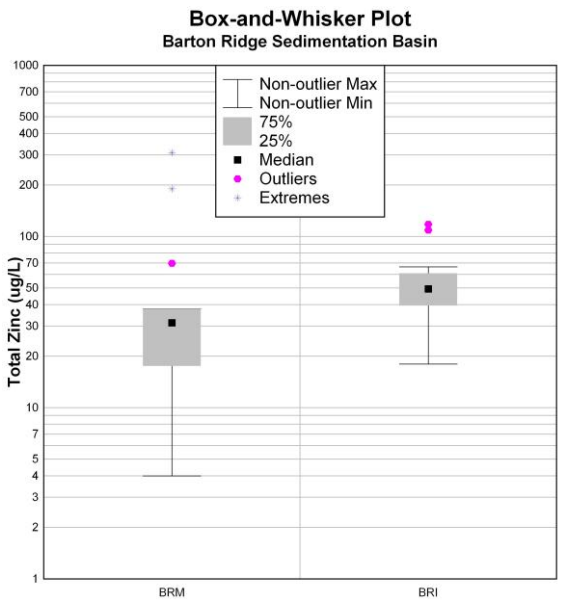


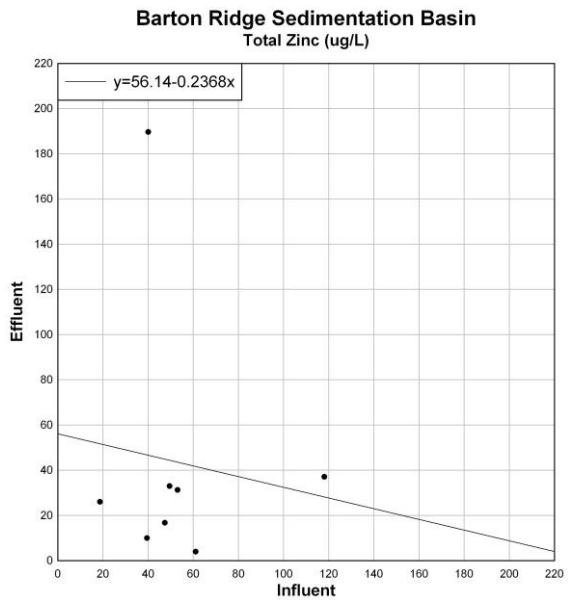
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	12	13
	Pairs Count	7	7
Non-Parametric	Maximum	21.6	42.0
	Upper Quartile	16.4	12.5
	Median	9.2	6.0
	Lower Quartile	2.6	4.2
	Minimum	1.0	0.8
	Efficiency	34.35%	
	Mann-Whitney	0.7674	
	Wilcoxon (paired)	0.1094	
Arithmetic	UCL	15.0	16.5
	Mean	10.0	10.0
	LCL	5.1	3.6
	Std. Dev.	7.8	10.7
	Wilk (p-value)	0.0893 *	0.0006 **
	Efficiency	-0.27%	
	t-Test (equal var.)	0.9944	
	t-Test (unequal var.)	0.9943	
	t-test (paired)	0.1352	
	Levene Test	0.5490	
Log Transformed	UCL	29.0	20.2
	Mean	11.3	10.1
	LCL	4.4	5.0
	Std. Dev.	14.5	10.5
	Wilk (p-value)	0.0540 *	0.8091
	Efficiency	10.99%	
	t-Test (equal var.)	0.9122	
	t-Test (unequal var.)	0.9129	
	t-Test (paired)	0.0753 *	
	Levene Test	0.4983	
Bootstrap	UCL	14.6	15.7
	Mean	9.9	10.0
	LCL	5.2	4.4
	Std. Dev.	7.3	9.4
	Efficiency	-1.47%	

Barton Ridge Sedimentation Basin - Total Zinc (ug/L)



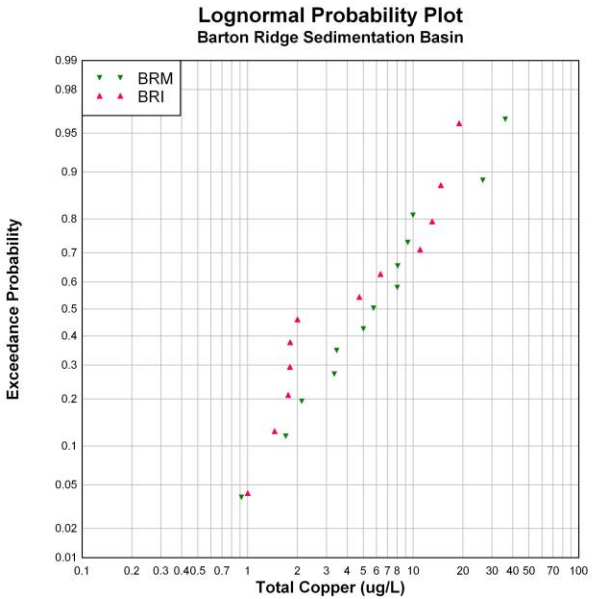


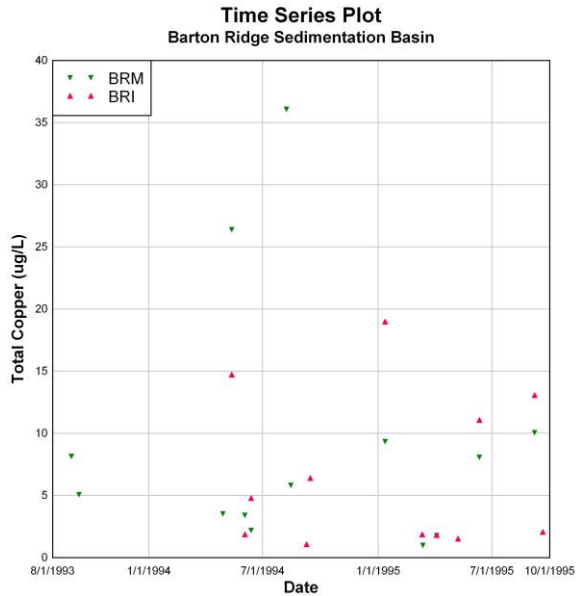


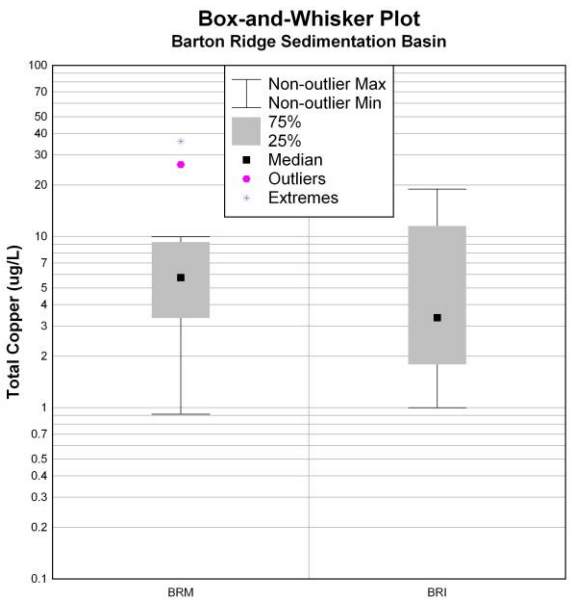


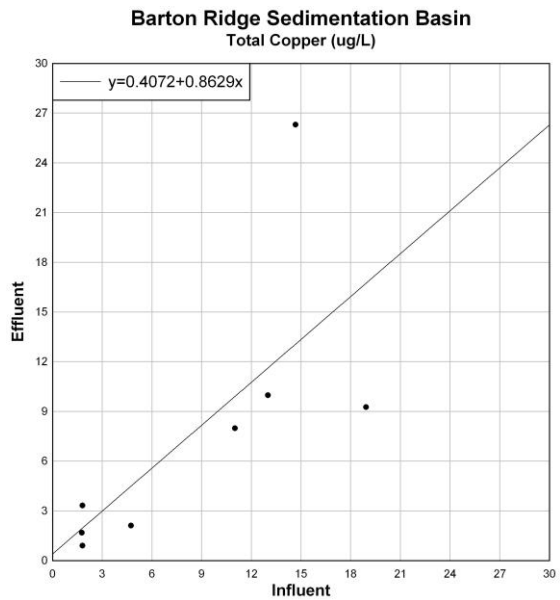
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	13	13
	Pairs Count	7	7
Non-Parametric	Maximum	118.0	309.0
	Upper Quartile	61.0	37.8
	Median	49.4	31.3
	Lower Quartile	39.4	17.5
	Minimum	18.0	4.0
	Efficiency	36.63%	
	Mann-Whitney	0.1495	
	Wilcoxon (paired)	0.2969	
Arithmetic	UCL	72.5	115.6
	Mean	53.8	62.5
	LCL	35.1	9.4
	Std. Dev.	31.0	87.9
	Wilk (p-value)	0.0799 *	0.0001 **
	Efficiency	-16.15%	
	t-Test (equal var.)	0.7398	
	t-Test (unequal var.)	0.7415	
	t-test (paired)	0.6784	
	Levene Test	0.1899	
Log Transformed	UCL	80.9	142.9
	Mean	54.2	58.5
	LCL	36.4	23.9
	Std. Dev.	34.1	75.7
	Wilk (p-value)	0.2717	0.5573
	Efficiency	-7.78%	
	t-Test (equal var.)	0.3633	
	t-Test (unequal var.)	0.3661	
	t-Test (paired)	0.1482	
	Levene Test	0.1067	
Bootstrap	UCL	70.4	110.8
	Mean	53.0	63.1
	LCL	35.6	15.5
	Std. Dev.	28.8	78.9
	Efficiency	-19.04%	

Barton Ridge Sedimentation Basin - Total Copper (ug/L)



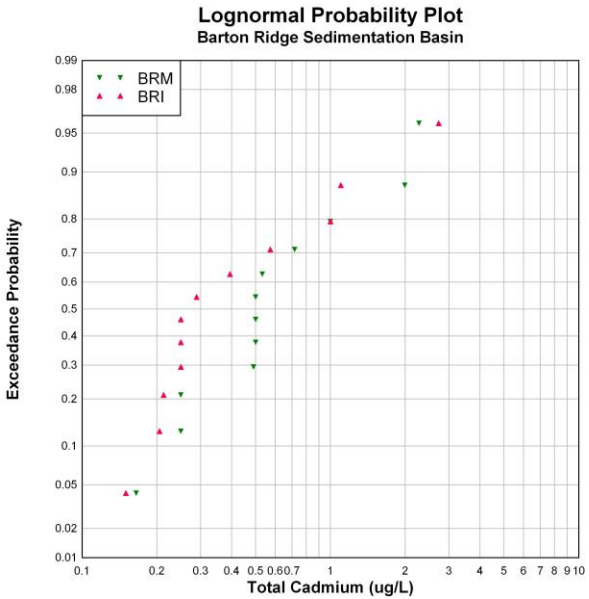


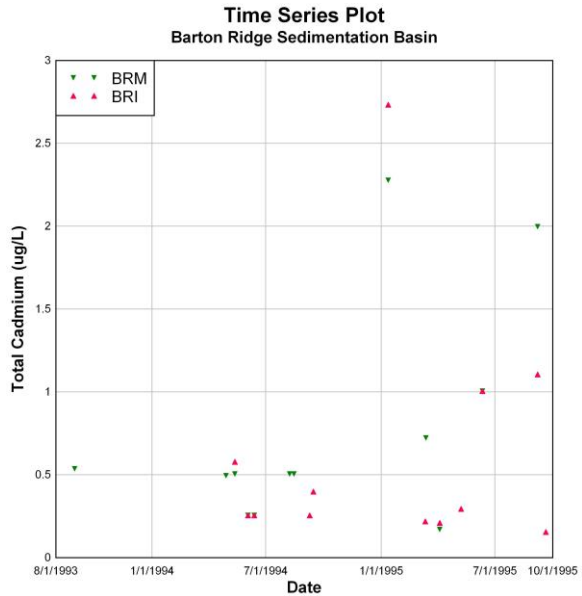


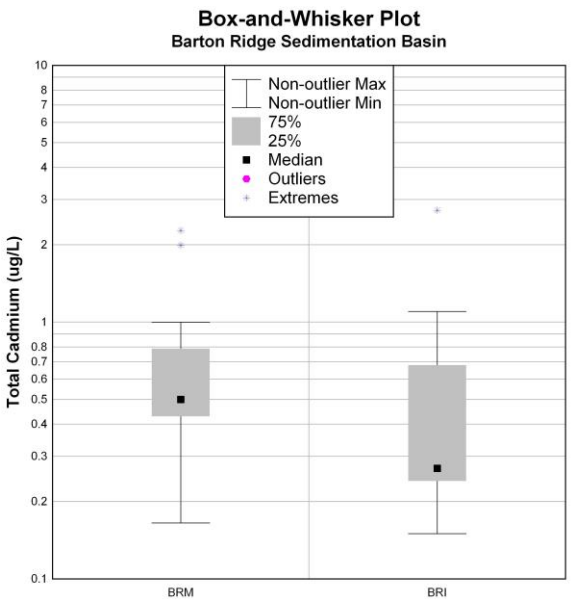


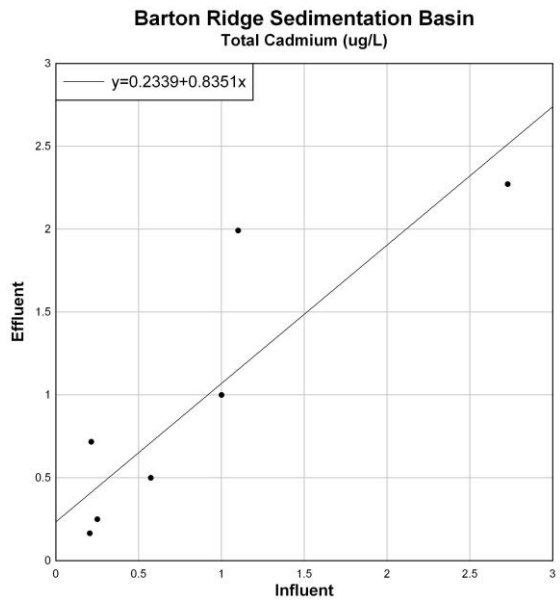
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	12	13
	Pairs Count	7	7
Non-Parametric	Maximum	18.9	36.0
	Upper Quartile	12.0	9.3
	Median	3.4	5.8
	Lower Quartile	1.8	3.3
	Minimum	1.0	0.9
	Efficiency	-71.22%	
	Mann-Whitney	0.5375	
	Wilcoxon (paired)	0.4688	
Arithmetic	UCL	10.5	15.5
	Mean	6.5	9.2
	LCL	2.6	3.0
	Std. Dev.	6.2	10.4
	Wilk (p-value)	0.0177 **	0.0010 **
	Efficiency	-41.08%	
	t-Test (equal var.)	0.4452	
	t-Test (unequal var.)	0.4377	
	t-test (paired)	0.7749	
	Levene Test	0.2970	
Log Transformed	UCL	15.4	20.1
	Mean	6.6	9.1
	LCL	2.8	4.2
	Std. Dev.	7.7	10.6
	Wilk (p-value)	0.1036	0.9621
	Efficiency	-38.53%	
	t-Test (equal var.)	0.4310	
	t-Test (unequal var.)	0.4313	
	t-Test (paired)	0.5571	
	Levene Test	0.9600	
Bootstrap	UCL	10.3	14.7
	Mean	6.5	9.1
	LCL	2.8	3.5
	Std. Dev.	5.9	9.3
	Efficiency	-39.28%	

Barton Ridge Sedimentation Basin - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRM**
	Site Count	12	12
	Pairs Count	7	7
Non-Parametric	Maximum	2.7	2.3
	Upper Quartile	0.8	0.9
	Median	0.3	0.5
	Lower Quartile	0.2	0.4
	Minimum	0.2	0.2
	Efficiency	-85.53%	
	Mann-Whitney	0.2600	
	Wilcoxon (paired)	0.6875	
Arithmetic	UCL	1.1	1.2
	Mean	0.6	0.8
	LCL	0.1	0.3
	Std. Dev.	0.7	0.7
	Wilk (p-value)	0.0003 **	0.0026 **
	Efficiency	-23.88%	
	t-Test (equal var.)	0.6153	
	t-Test (unequal var.)	0.6153	
	t-test (paired)	0.7734	
	Levene Test	0.8611	
Log Transformed	UCL	1.1	1.3
	Mean	0.6	0.7
	LCL	0.3	0.4
	Std. Dev.	0.5	0.6
	Wilk (p-value)	0.0768 *	0.3700
	Efficiency	-31.83%	
	t-Test (equal var.)	0.3348	
	t-Test (unequal var.)	0.3349	
	t-Test (paired)	0.9369	
	Levene Test	0.7386	
Bootstrap	UCL	1.0	1.2
	Mean	0.6	0.8
	LCL	0.2	0.4
	Std. Dev.	0.6	0.6
	Efficiency	-26.43%	

Far West Sedimentation Basin (FPI-FPS)

Far West sedimentation basin is the pretreatment for a wetland SCM. The overall system was constructed as a retrofit of a detention basin in northwest Austin (see the COA report on small watershed quantity and quality (COA, 2009) for a detailed description of the contributing watershed). For performance summaries of the overall system (FPI-FPE) or the wetland portion (FPS-FPE), see the Other SCM section of this report.

The sedimentation basin was constructed with compacted soil with rock gabions for support. During the monitoring period it was noted that flows entering the system were not being dissipated by the gabions and the soil sides of the basin were being undermined and failing. This created two problems from a monitoring standpoint; first, there was unmeasured flow entering the system and second, a higher sediment load was probably entering the basin that was being measured at the influent station.

The City collected runoff and water quality data at the Far West sedimentation basin (FPI-FPS) from 1997 to 1998. During this time 12 and 10 valid EMCs were collected at the influent (FPI) and effluent (FPS) respectively, of which 8 were paired.

Performance Summary (FPI-FPS)

Overall, the Far West sedimentation basin had a minimal impact on water quality for the pollutants measured during this study. TSS and VSS were reduced by 31% and 31% respectively; this is significant if a paired comparison is used but is not if the data are not paired.

COD concentration was reduced by 9% and was only significant if data are paired. The increase (43%) in TOC concentration was not significant in any case. BOD concentration was reduced by 35% and was not significant in all cases.

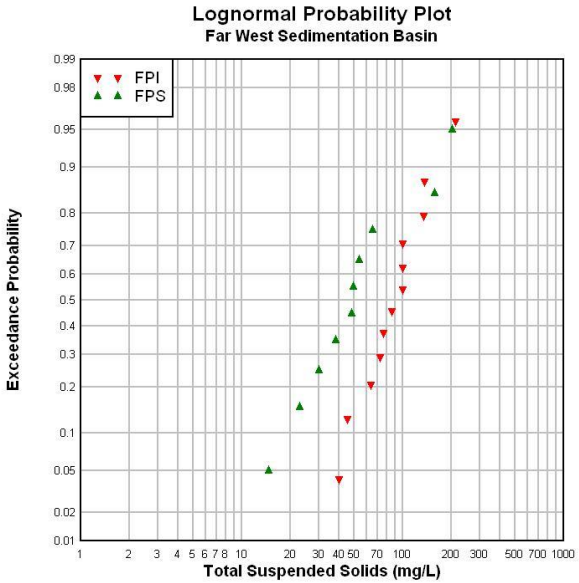
Total nitrogen and total Kjeldahl nitrogen concentrations were reduced by 11% and 19% respectively, and were not significant in any case. The increase of concentration in nitrate + nitrite (4%) was not significant in any case. Ammonia concentration was reduced by 47% and was only significant if data were paired.

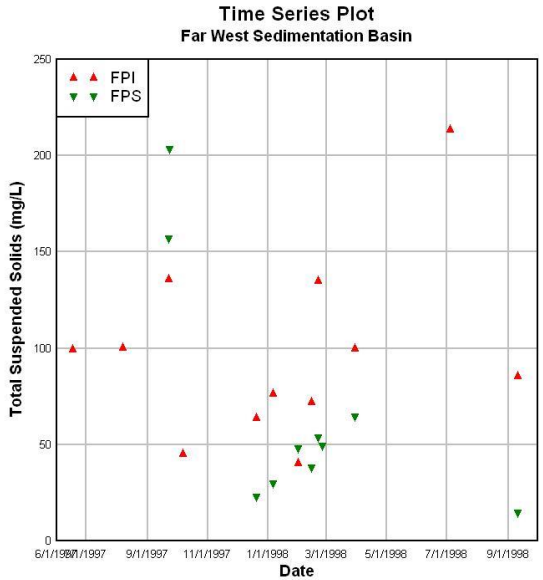
TP and DP concentrations were increased by 10% and 10% respectively, and were not significant in any case.

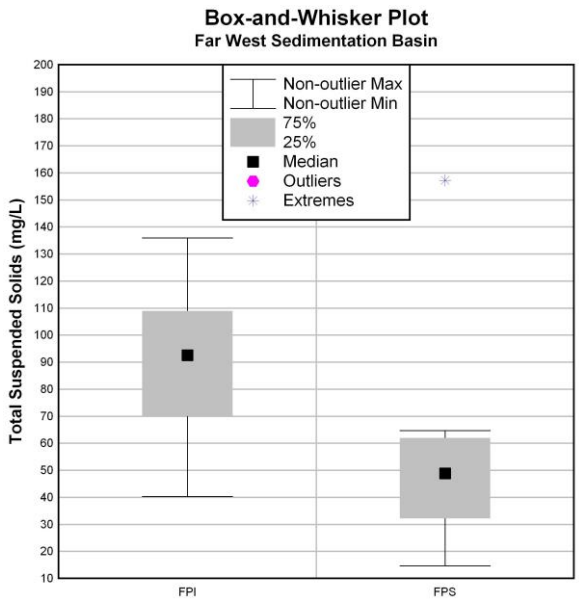
The reduction of FCOL (6%) was not significant in any case, and the reduction of FSTR (44%) was only significant if the data are not paired.

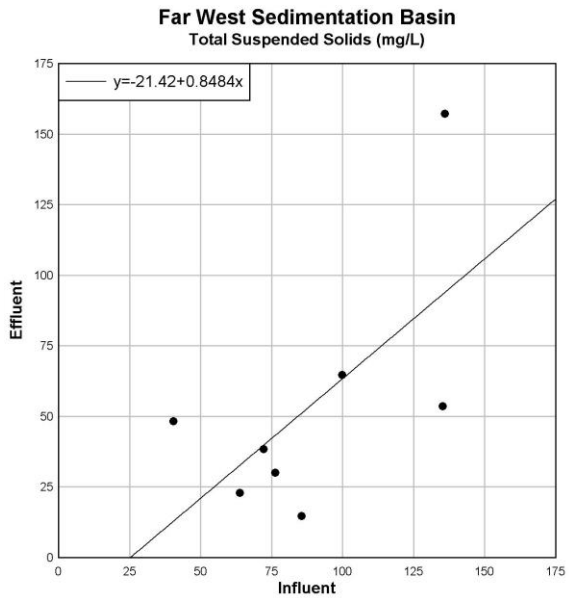
Lead and zinc concentrations were reduced by 21% and 21% respectively, and were only significant if the data are paired. Copper concentration was reduced by 11% and was not significant in all case. Cadmium concentration was increased by 16% and was not significant in all case.

Far West Sedimentation Basin - Total Suspended Solids (mg/L)



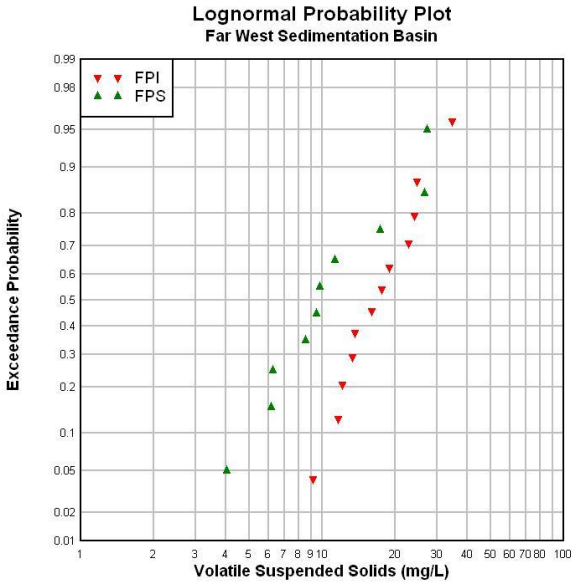


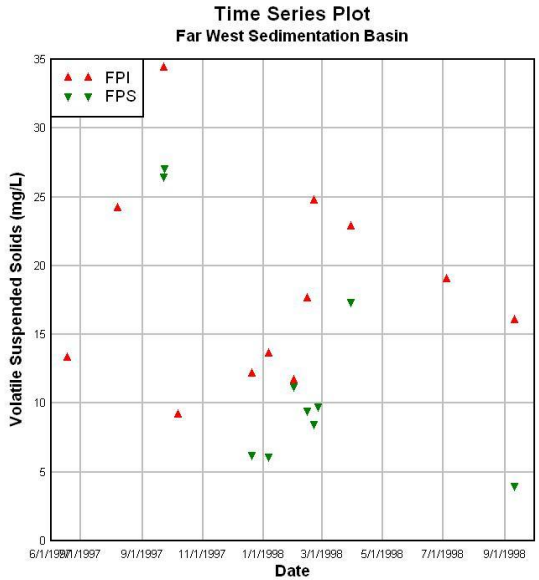


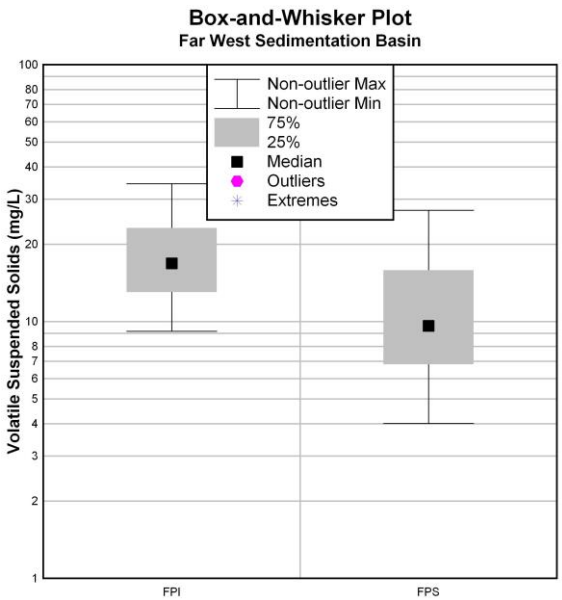


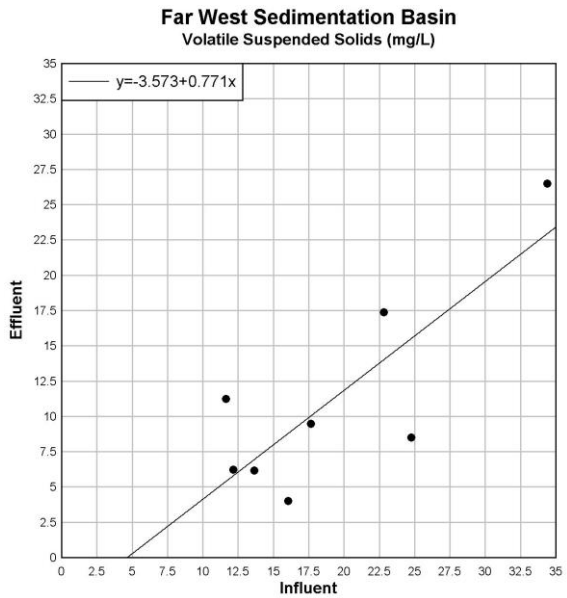
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	213.3	203.6
	Upper Quartile	117.6	64.7
	Median	92.6	48.8
	Lower Quartile	67.9	30.2
	Minimum	40.3	14.7
	Efficiency	47.27%	
	Mann-Whitney	0.0742 *	
	Wilcoxon (paired)	0.0391 **	
Arithmetic	UCL	127.4	112.6
	Mean	97.3	68.3
	LCL	67.1	24.0
	Std. Dev.	47.4	61.9
	Wilk (p-value)	0.1349	0.0047 **
	Efficiency	29.78%	
	t-Test (equal var.)	0.2281	
	t-Test (unequal var.)	0.2421	
	t-test (paired)	0.0262 **	
	Levene Test	0.5011	
Log Transformed	UCL	133.2	130.2
	Mean	97.2	66.7
	LCL	70.9	34.2
	Std. Dev.	46.6	56.1
	Wilk (p-value)	0.9469	0.6873
	Efficiency	31.38%	
	t-Test (equal var.)	0.0551 *	
	t-Test (unequal var.)	0.0724 *	
	t-Test (paired)	0.0212 **	
	Levene Test	0.1137	
Bootstrap	UCL	124.9	106.6
	Mean	97.2	67.3
	LCL	69.5	28.0
	Std. Dev.	43.7	54.9
	Efficiency	30.73%	

Far West Sedimentation Basin - Volatile Suspended Solids (mg/L)



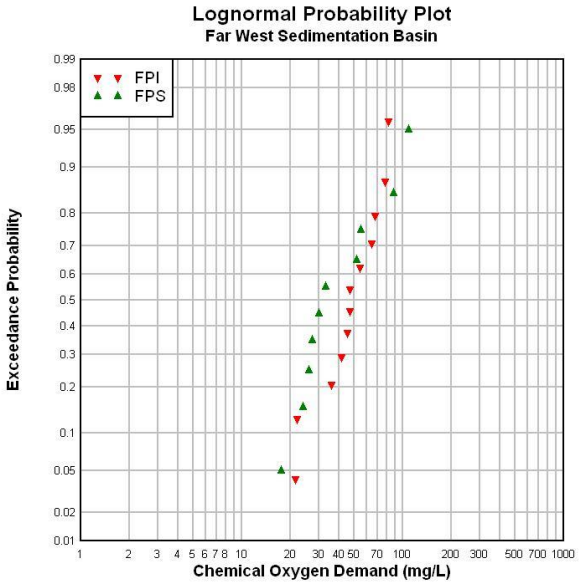


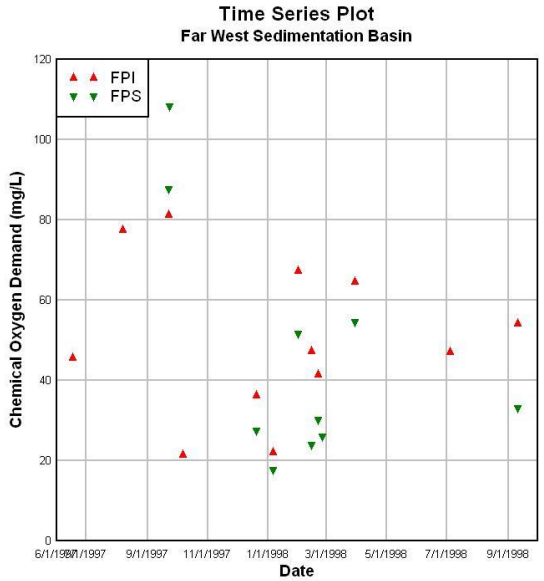


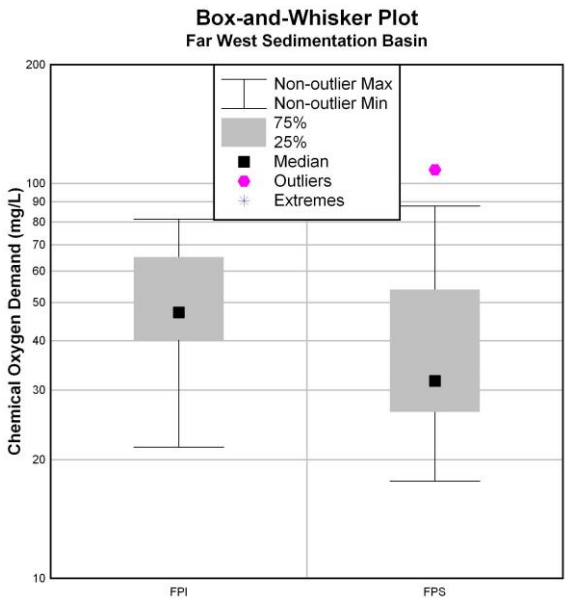


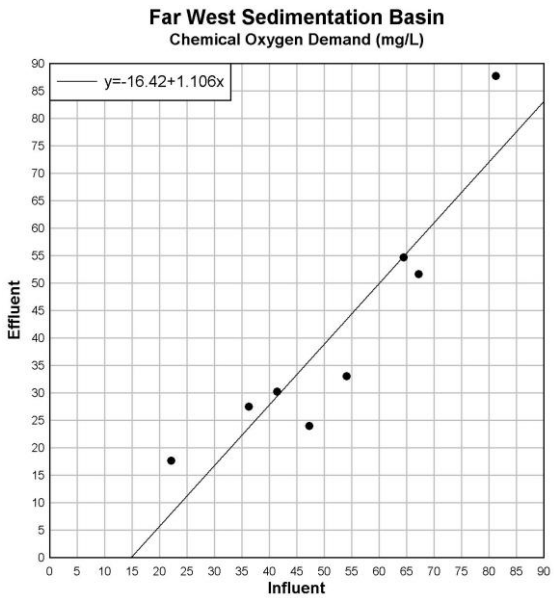
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	34.4	27.1
	Upper Quartile	23.5	17.4
	Median	16.8	9.6
	Lower Quartile	12.7	6.2
	Minimum	9.2	4.0
	Efficiency	42.82%	
	Mann-Whitney	0.0742 *	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	22.8	18.6
	Mean	18.2	12.6
	LCL	13.6	6.7
	Std. Dev.	7.2	8.3
	Wilk (p-value)	0.3355	0.0352 **
	Efficiency	30.68%	
	t-Test (equal var.)	0.1062	
	t-Test (unequal var.)	0.1121	
	t-test (paired)	0.0020 **	
	Levene Test	0.6599	
Log Transformed	UCL	23.4	20.6
	Mean	18.2	12.6
	LCL	14.1	7.6
	Std. Dev.	7.1	8.1
	Wilk (p-value)	0.9722	0.5910
	Efficiency	31.00%	
	t-Test (equal var.)	0.0395 **	
	t-Test (unequal var.)	0.0532 *	
	t-Test (paired)	0.0050 **	
	Levene Test	0.0827 *	
Bootstrap	UCL	22.4	17.9
	Mean	18.1	12.5
	LCL	13.9	7.1
	Std. Dev.	6.6	7.5
	Efficiency	31.07%	

Far West Sedimentation Basin -Chemical Oxygen Demand (mg/L)



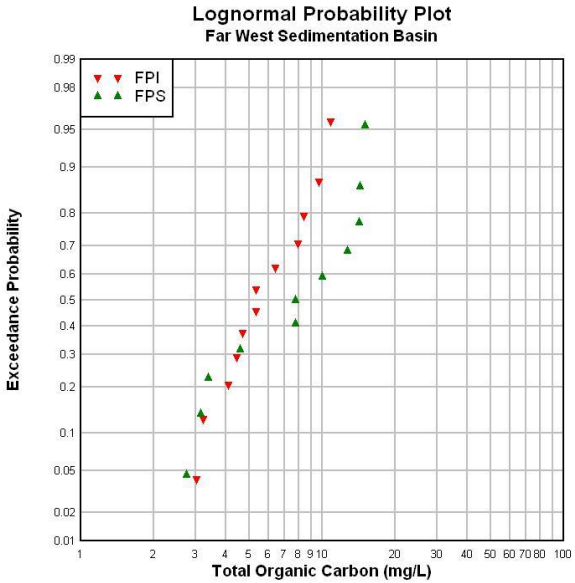


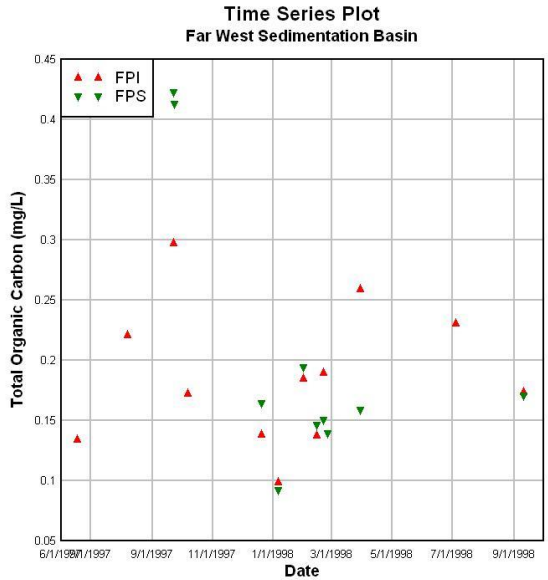


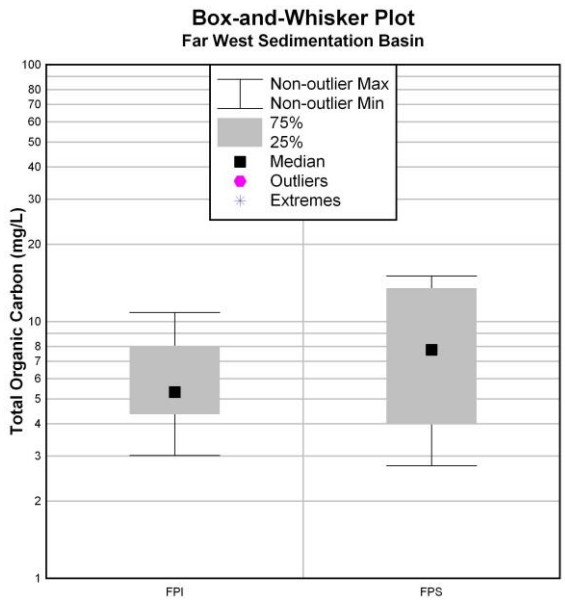


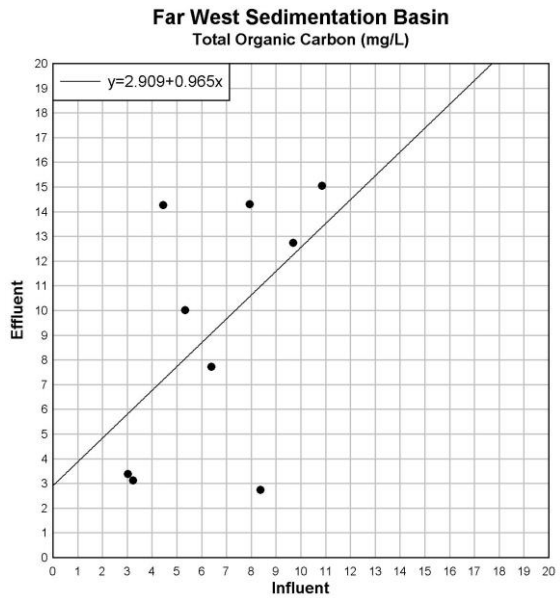
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	81.23	108.33
	Upper Quartile	65.84	54.68
	Median	47.17	31.62
	Lower Quartile	38.85	26.00
	Minimum	21.50	17.64
	Efficiency	32.95%	
	Mann-Whitney	0.4963	
	Wilcoxon (paired)	0.0234 **	
Arithmetic	UCL	62.79	67.64
	Mean	50.47	46.08
	LCL	38.15	24.51
	Std. Dev.	19.39	30.15
	Wilk (p-value)	0.6941	0.0304 **
	Efficiency	8.70%	
	t-Test (equal var.)	0.6839	
	t-Test (unequal var.)	0.6970	
	t-test (paired)	0.0137 **	
	Levene Test	0.2031	
Log Transformed	UCL	67.83	72.21
	Mean	50.82	45.51
	LCL	38.08	28.69
	Std. Dev.	22.42	27.61
	Wilk (p-value)	0.2716	0.4460
	Efficiency	10.45%	
	t-Test (equal var.)	0.4198	
	t-Test (unequal var.)	0.4351	
	t-Test (paired)	0.0076 **	
	Levene Test	0.2494	
Bootstrap	UCL	61.71	65.19
	Mean	50.25	45.75
	LCL	38.79	26.31
	Std. Dev.	18.03	27.18
	Efficiency	8.96%	

Far West Sedimentation Basin - Total Organic Carbon (mg/L)



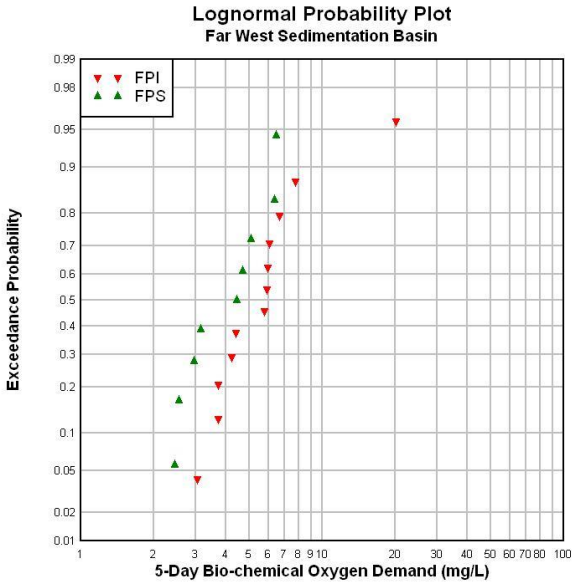


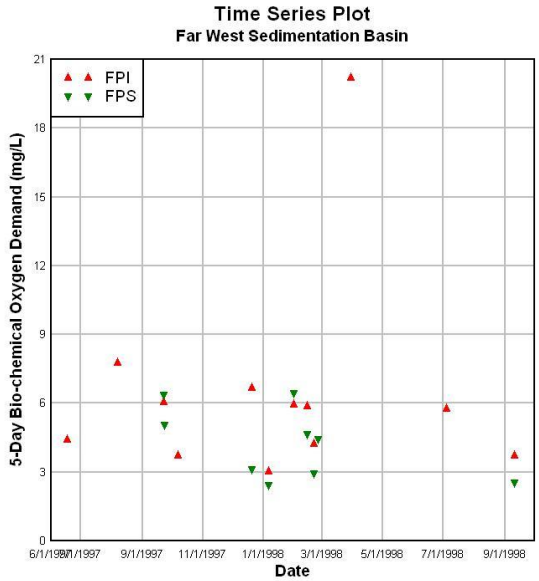


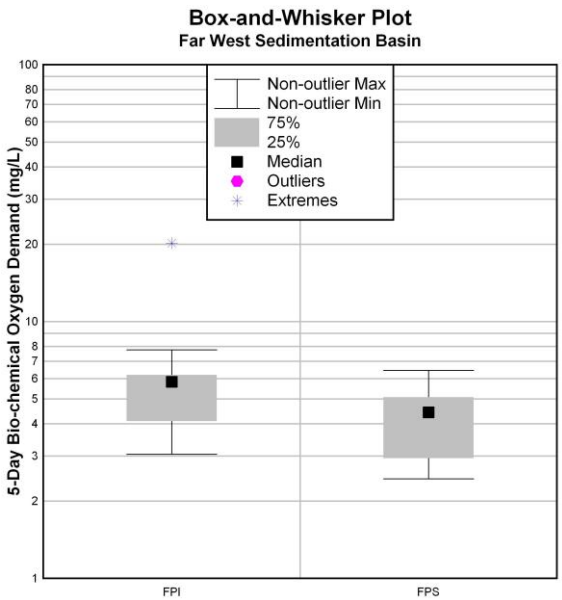


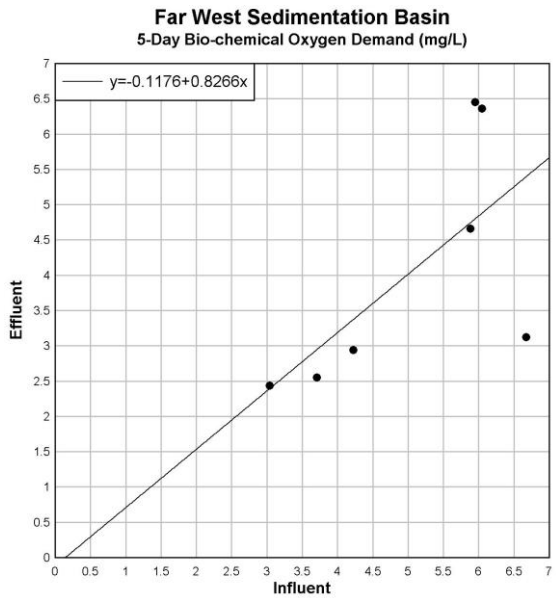
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	11
	Pairs Count	9	9
Non-Parametric	Maximum	10.85	15.05
	Upper Quartile	8.15	14.26
	Median	5.32	7.77
	Lower Quartile	4.27	3.38
	Minimum	3.01	2.75
	Efficiency	-46.07%	
	Mann-Whitney	0.3505	
	Wilcoxon (paired)	0.0977 *	
Arithmetic	UCL	7.73	11.95
	Mean	6.11	8.70
	LCL	4.49	5.45
	Std. Dev.	2.56	4.84
	Wilk (p-value)	0.3404	0.1127
	Efficiency	-42.34%	
	t-Test (equal var.)	0.1194	
	t-Test (unequal var.)	0.1346	
	t-test (paired)	0.1052	
	Levene Test	0.0035 **	
Log Transformed	UCL	8.06	14.47
	Mean	6.11	8.85
	LCL	4.63	5.42
	Std. Dev.	2.60	6.05
	Wilk (p-value)	0.7847	0.0922 *
	Efficiency	-44.91%	
	t-Test (equal var.)	0.2717	
	t-Test (unequal var.)	0.2839	
	t-Test (paired)	0.2804	
	Levene Test	0.0278 **	
Bootstrap	UCL	7.61	11.75
	Mean	6.08	8.70
	LCL	4.56	5.65
	Std. Dev.	2.40	4.54
	Efficiency	-43.06%	

Far West Sedimentation Basin – 5-Day BioChemical Oxygen Demand



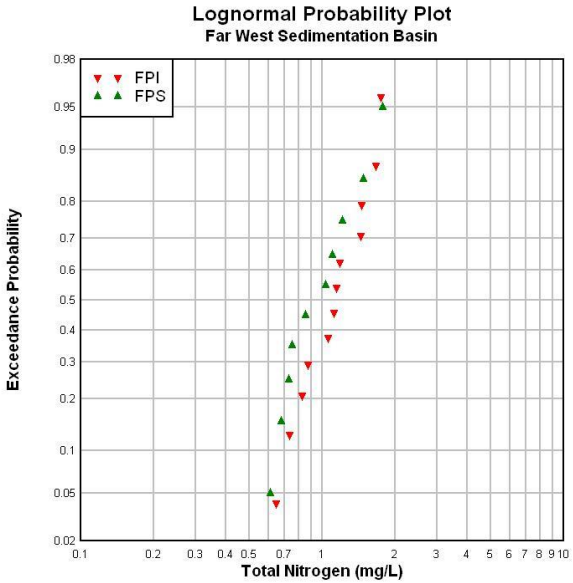


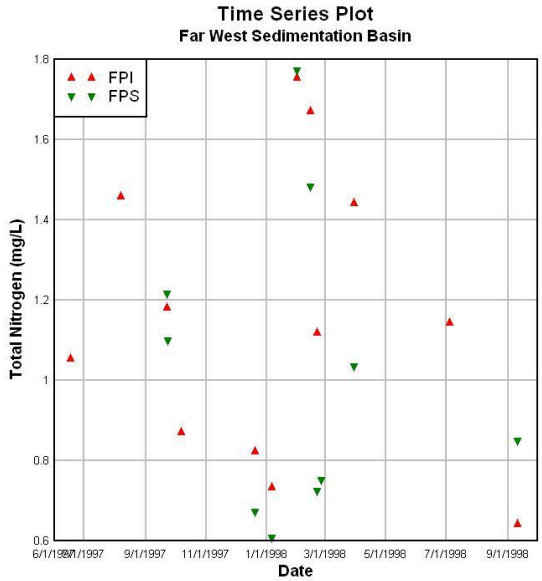


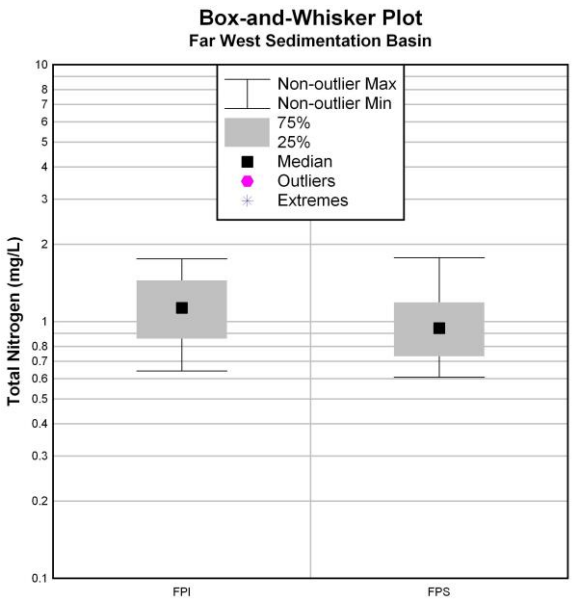


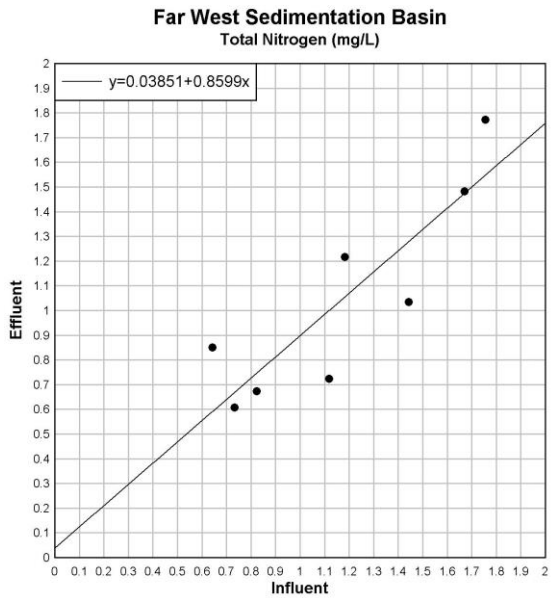
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	9
	Pairs Count	7	7
Non-Parametric	Maximum	20.20	6.45
	Upper Quartile	6.36	5.08
	Median	5.83	4.43
	Lower Quartile	3.97	2.94
	Minimum	3.04	2.44
	Efficiency	23.92%	
	Mann-Whitney	0.1811	
	Wilcoxon (paired)	0.0781 *	
Arithmetic	UCL	9.34	5.42
	Mean	6.45	4.23
	LCL	3.56	3.03
	Std. Dev.	4.55	1.55
	Wilk (p-value)	0.0002 **	0.2414
	Efficiency	34.43%	
	t-Test (equal var.)	0.1789	
	t-Test (unequal var.)	0.1380	
	t-test (paired)	0.0967 *	
	Levene Test	0.3620	
Log Transformed	UCL	8.73	5.72
	Mean	6.27	4.23
	LCL	4.50	3.13
	Std. Dev.	3.15	1.61
	Wilk (p-value)	0.0445 **	0.2921
	Efficiency	32.53%	
	t-Test (equal var.)	0.0941 *	
	t-Test (unequal var.)	0.0827 *	
	t-Test (paired)	0.0529 *	
	Levene Test	0.5536	
Bootstrap	UCL	8.92	5.32
	Mean	6.45	4.21
	LCL	3.97	3.11
	Std. Dev.	3.89	1.44
	Efficiency	34.67%	

Far West Sedimentation Basin - Total Nitrogen (mg/L)



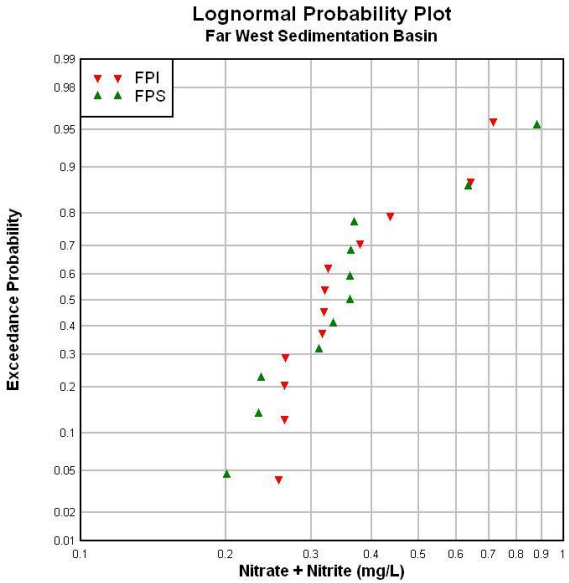


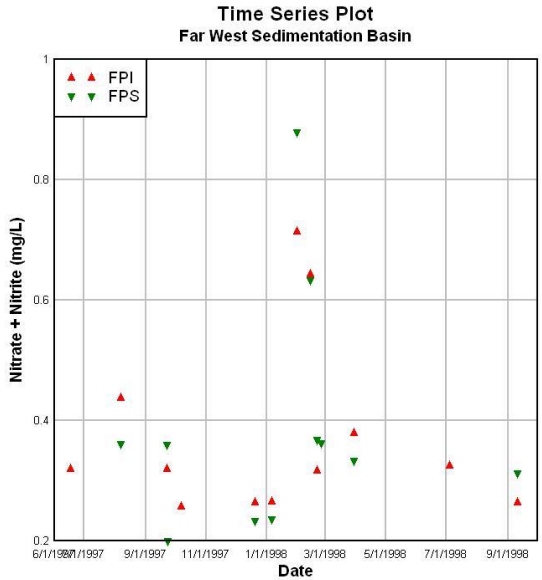


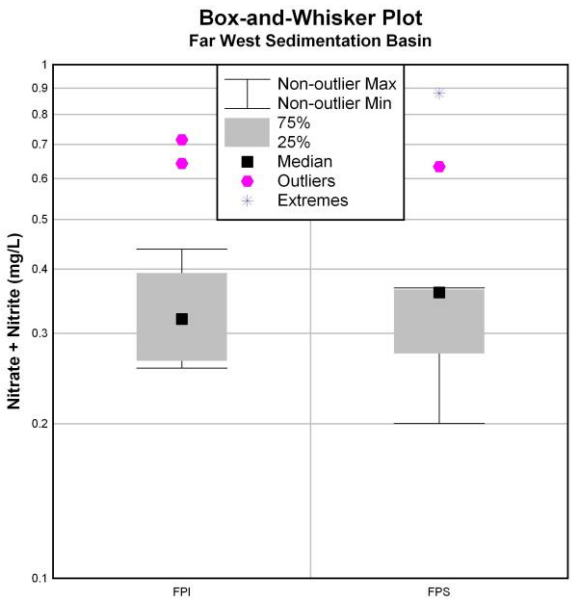


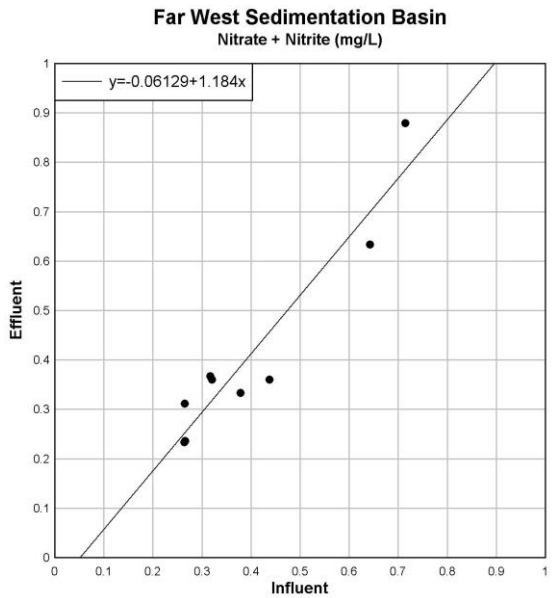
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	1.755	1.772
	Upper Quartile	1.451	1.216
	Median	1.131	0.943
	Lower Quartile	0.847	0.725
	Minimum	0.642	0.607
	Efficiency	16.63%	
	Mann-Whitney	0.3835	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	1.388	1.293
	Mean	1.158	1.021
	LCL	0.927	0.749
	Std. Dev.	0.363	0.381
	Wilk (p-value)	0.6794	0.2912
	Efficiency	11.79%	
	t-Test (equal var.)	0.4001	
	t-Test (unequal var.)	0.4028	
	t-test (paired)	0.1373	
	Levene Test	0.8738	
Log Transformed	UCL	1.431	1.325
	Mean	1.159	1.019
	LCL	0.938	0.784
	Std. Dev.	0.379	0.366
	Wilk (p-value)	0.7920	0.7066
	Efficiency	12.05%	
	t-Test (equal var.)	0.3543	
	t-Test (unequal var.)	0.3594	
	t-Test (paired)	0.1774	
	Levene Test	0.6984	
Bootstrap	UCL	1.372	1.273
	Mean	1.153	1.022
	LCL	0.934	0.770
	Std. Dev.	0.345	0.352
	Efficiency	11.43%	

Far West Sedimentation Basin-Nitrate + Nitrite (mg/L)



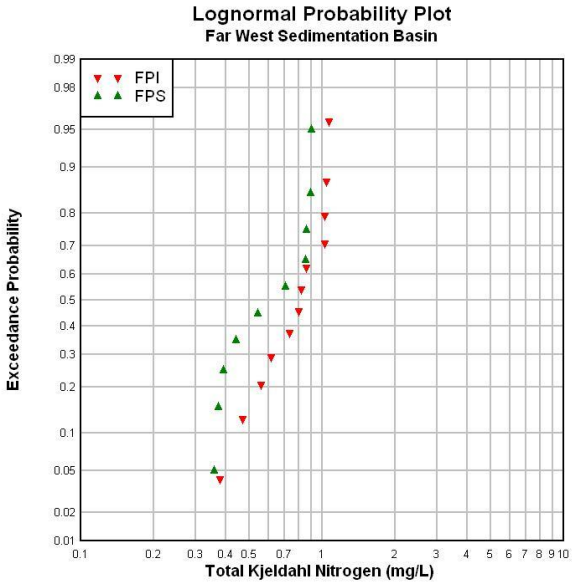


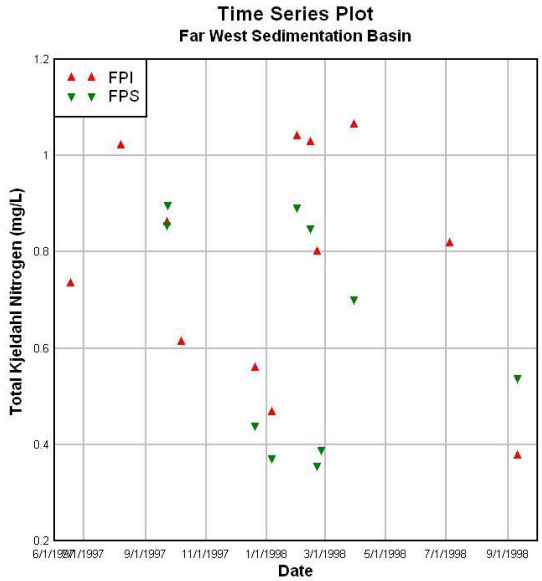


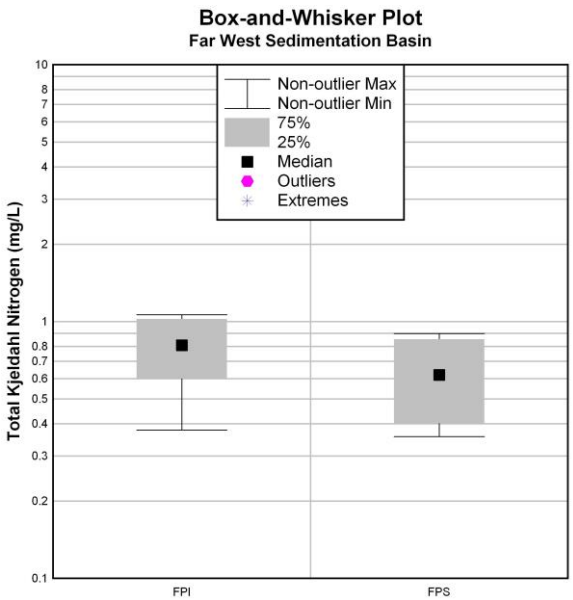


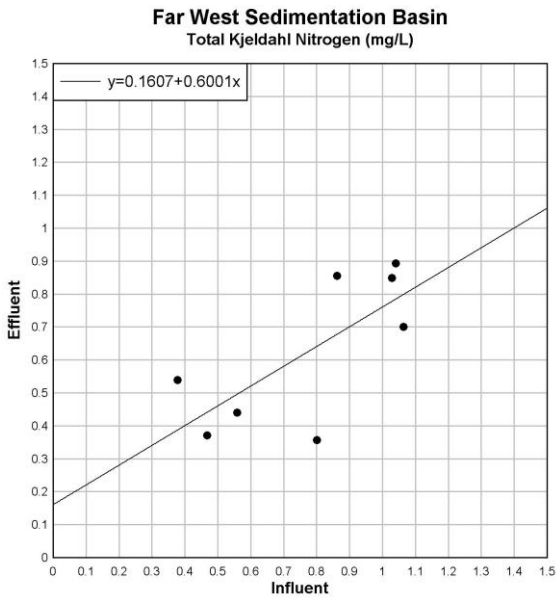
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	11
	Pairs Count	9	9
Non-Parametric	Maximum	0.715	0.880
	Upper Quartile	0.408	0.368
	Median	0.320	0.360
	Lower Quartile	0.265	0.236
	Minimum	0.257	0.200
	Efficiency	-12.71%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	0.7344	
Arithmetic	UCL	0.472	0.523
	Mean	0.375	0.389
	LCL	0.279	0.255
	Std. Dev.	0.152	0.199
	Wilk (p-value)	0.0027 **	0.0038 **
	Efficiency	-3.62%	
	t-Test (equal var.)	0.8547	
	t-Test (unequal var.)	0.8567	
	t-test (paired)	0.6187	
	Levene Test	0.5245	
Log Transformed	UCL	0.467	0.522
	Mean	0.373	0.385
	LCL	0.298	0.284
	Std. Dev.	0.130	0.169
	Wilk (p-value)	0.0179 **	0.1578
	Efficiency	-3.28%	
	t-Test (equal var.)	0.9878	
	t-Test (unequal var.)	0.9879	
	t-Test (paired)	0.8901	
	Levene Test	0.4965	
Bootstrap	UCL	0.463	0.510
	Mean	0.375	0.390
	LCL	0.287	0.270
	Std. Dev.	0.139	0.178
	Efficiency	-4.06%	

Far West Sedimentation Basin -Total Kjeldahl Nitrogen (mg/L)



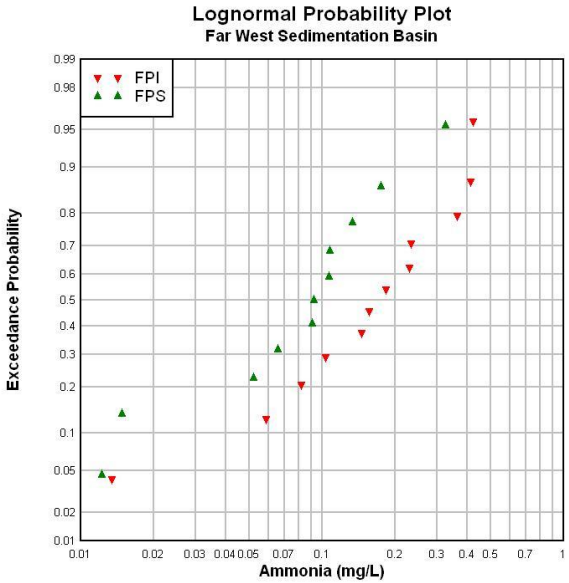


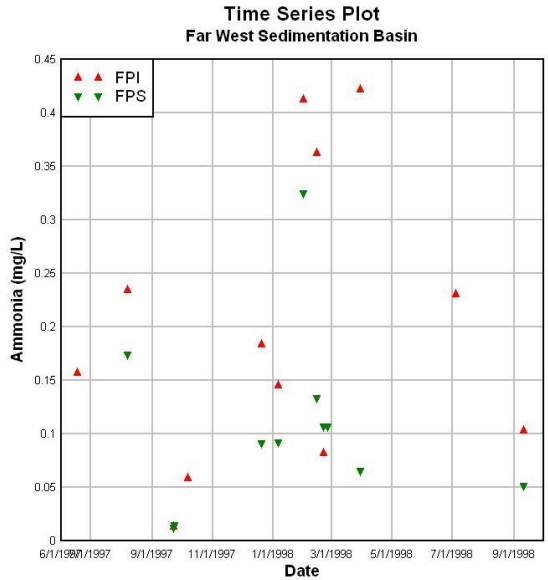


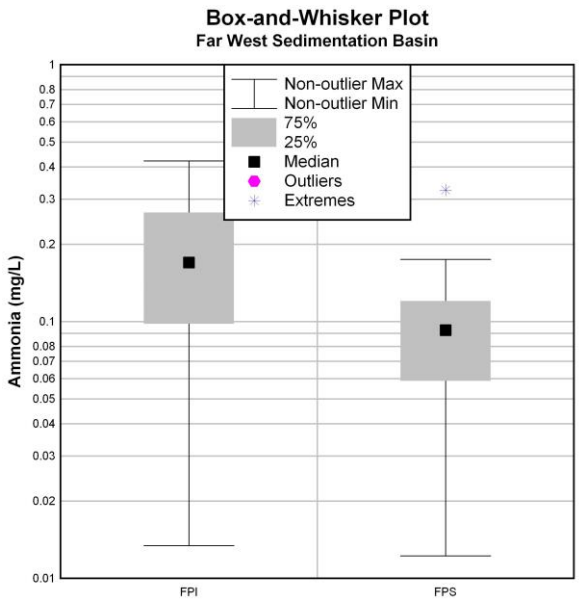


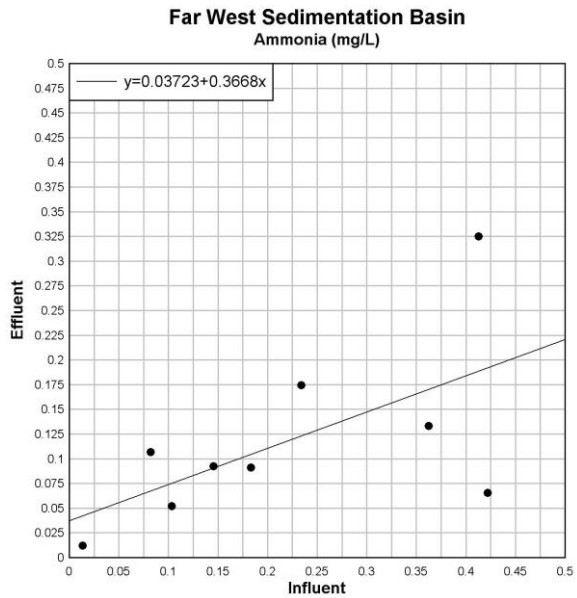
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	1.064	0.899
	Upper Quartile	1.025	0.856
	Median	0.810	0.620
	Lower Quartile	0.586	0.389
	Minimum	0.378	0.357
	Efficiency	23.43%	
	Mann-Whitney	0.1710	
	Wilcoxon (paired)	0.0781 *	
Arithmetic	UCL	0.933	0.796
	Mean	0.782	0.629
	LCL	0.632	0.462
	Std. Dev.	0.236	0.233
	Wilk (p-value)	0.3085	0.0380 **
	Efficiency	19.56%	
	t-Test (equal var.)	0.1442	
	t-Test (unequal var.)	0.1442	
	t-test (paired)	0.0623 *	
	Levene Test	0.8951	
Log Transformed	UCL	0.982	0.845
	Mean	0.785	0.631
	LCL	0.628	0.471
	Std. Dev.	0.271	0.250
	Wilk (p-value)	0.1629	0.0444 **
	Efficiency	19.73%	
	t-Test (equal var.)	0.1471	
	t-Test (unequal var.)	0.1540	
	t-Test (paired)	0.1137	
	Levene Test	0.4961	
Bootstrap	UCL	0.922	0.784
	Mean	0.779	0.628
	LCL	0.635	0.472
	Std. Dev.	0.226	0.218
	Efficiency	19.31%	

Far West Sedimentation Basin -Ammonia (mg/L)



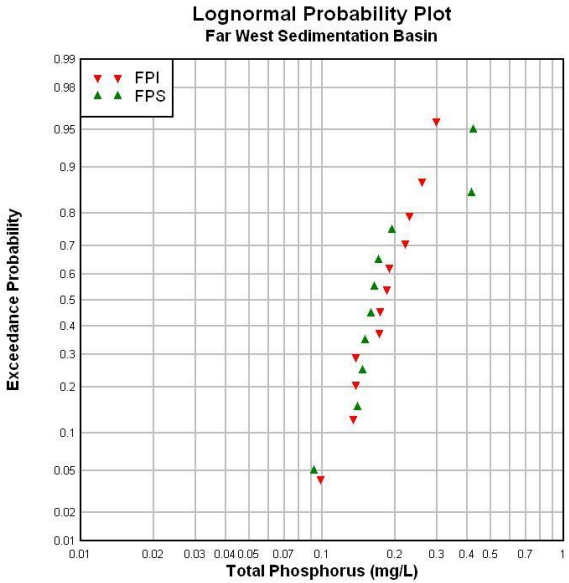


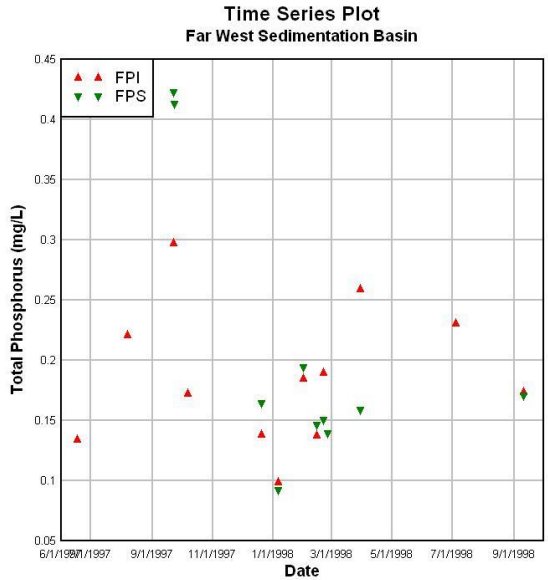


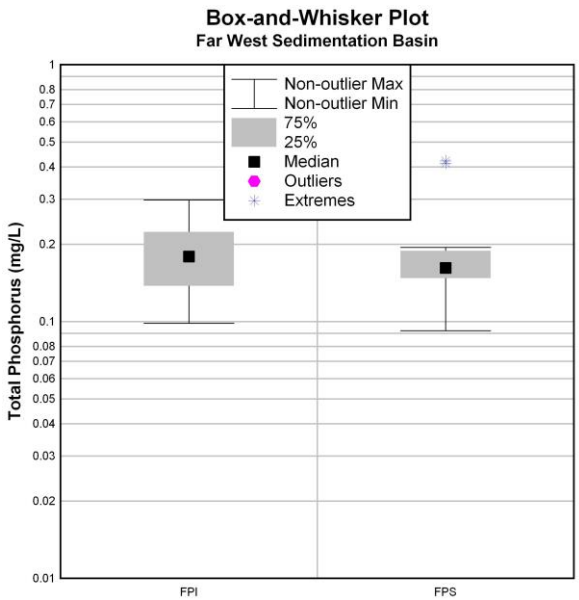


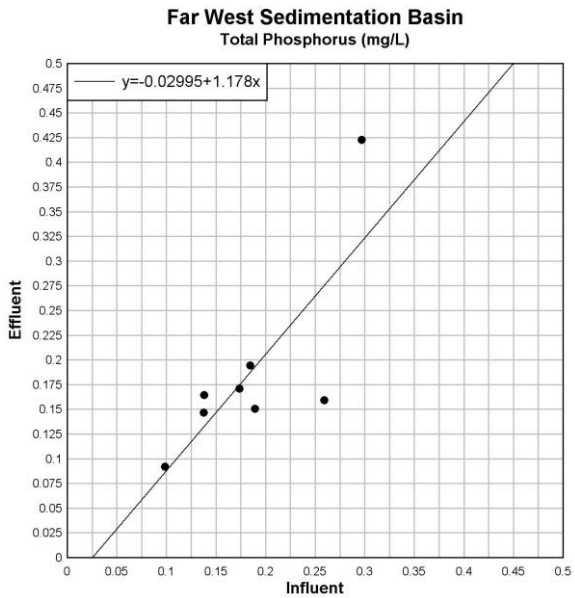
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	11
	Pairs Count	9	9
Non-Parametric	Maximum	0.422	0.325
	Upper Quartile	0.298	0.133
	Median	0.170	0.093
	Lower Quartile	0.093	0.052
	Minimum	0.013	0.012
	Efficiency	45.58%	
	Mann-Whitney	0.0933 *	
	Wilcoxon (paired)	0.0117 **	
Arithmetic	UCL	0.287	0.165
	Mean	0.200	0.107
	LCL	0.113	0.048
	Std. Dev.	0.137	0.087
	Wilk (p-value)	0.3271	0.0449 **
	Efficiency	46.67%	
	t-Test (equal var.)	0.0667 *	
	t-Test (unequal var.)	0.0635 *	
	t-test (paired)	0.0356 **	
	Levene Test	0.1403	
Log Transformed	UCL	0.480	0.260
	Mean	0.223	0.115
	LCL	0.104	0.051
	Std. Dev.	0.239	0.122
	Wilk (p-value)	0.1289	0.2164
	Efficiency	48.47%	
	t-Test (equal var.)	0.1205	
	t-Test (unequal var.)	0.1207	
	t-Test (paired)	0.0251 **	
	Levene Test	0.9975	
Bootstrap	UCL	0.283	0.159
	Mean	0.201	0.107
	LCL	0.120	0.055
	Std. Dev.	0.128	0.078
	Efficiency	46.80%	

Far West Sedimentation Basin - Total Phosphorus (mg/L)



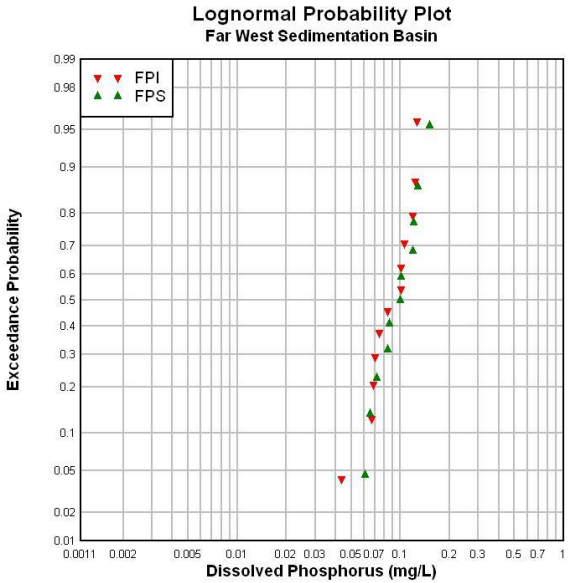


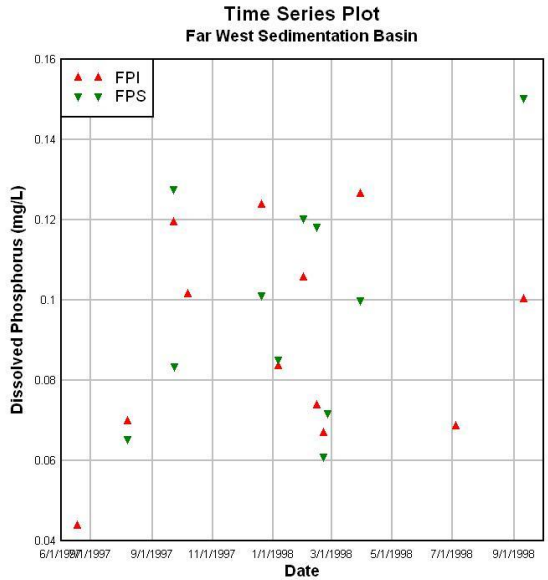


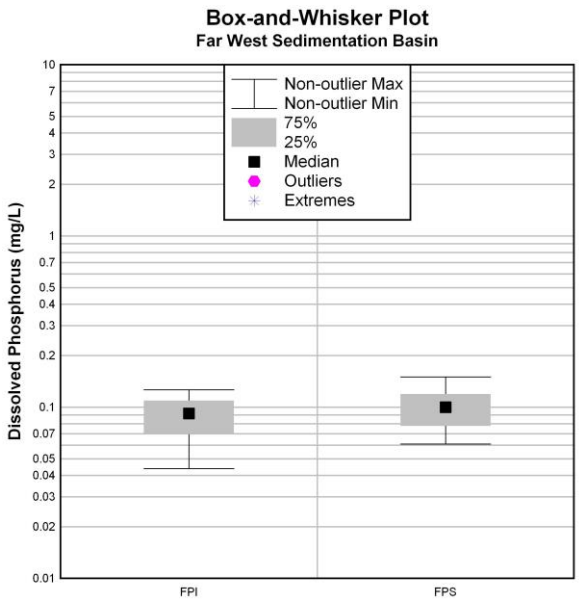


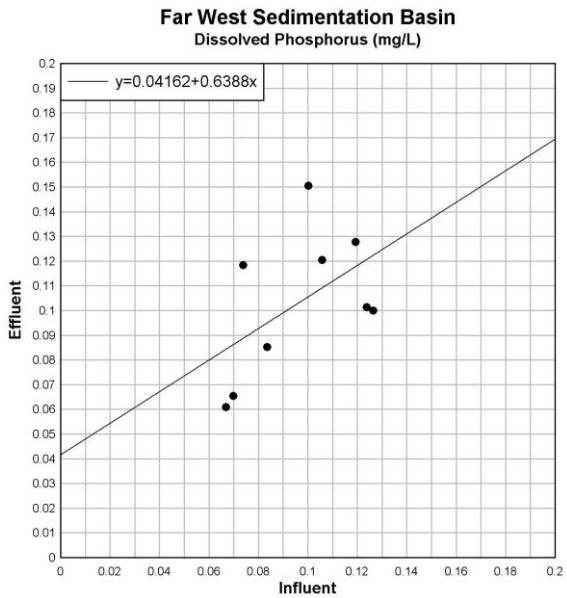
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	0.297	0.423
	Upper Quartile	0.226	0.195
	Median	0.179	0.162
	Lower Quartile	0.138	0.147
	Minimum	0.099	0.092
	Efficiency	9.63%	
	Mann-Whitney	0.8197	
	Wilcoxon (paired)	0.8438	
Arithmetic	UCL	0.223	0.288
	Mean	0.186	0.205
	LCL	0.150	0.123
	Std. Dev.	0.057	0.115
	Wilk (p-value)	0.8676	0.0015 **
	Efficiency	-10.27%	
	t-Test (equal var.)	0.6176	
	t-Test (unequal var.)	0.6403	
	t-test (paired)	0.8989	
	Levene Test	0.1075	
Log Transformed	UCL	0.229	0.291
	Mean	0.186	0.203
	LCL	0.152	0.141
	Std. Dev.	0.059	0.098
	Wilk (p-value)	0.9680	0.0458 **
	Efficiency	-8.86%	
	t-Test (equal var.)	0.8650	
	t-Test (unequal var.)	0.8705	
	t-Test (paired)	0.8390	
	Levene Test	0.2213	
Bootstrap	UCL	0.220	0.277
	Mean	0.186	0.204
	LCL	0.152	0.131
	Std. Dev.	0.054	0.102
	Efficiency	-9.74%	

Far West Sedimentation Basin – Dissolved Phosphorus (ug/L)



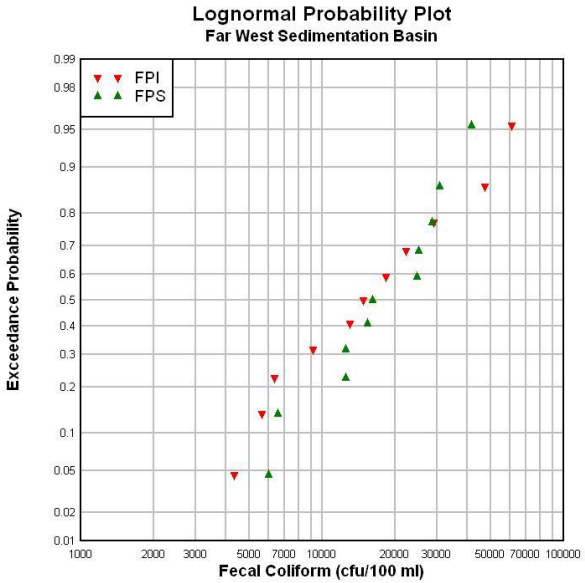


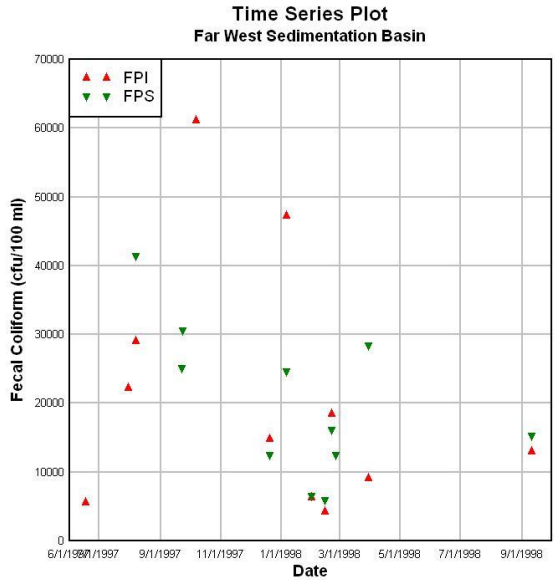


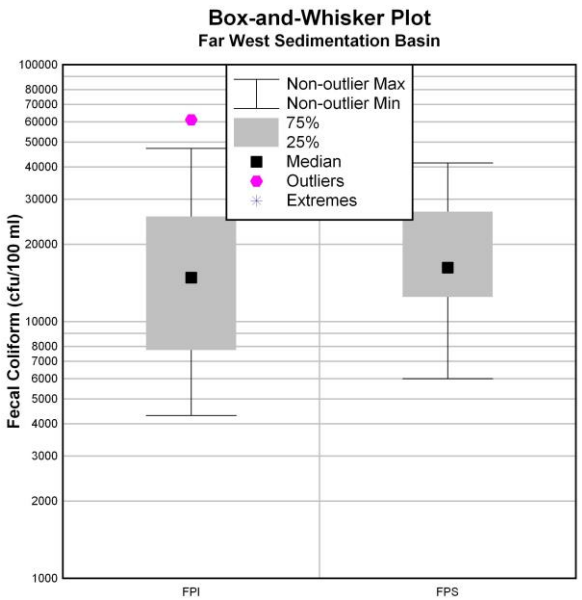


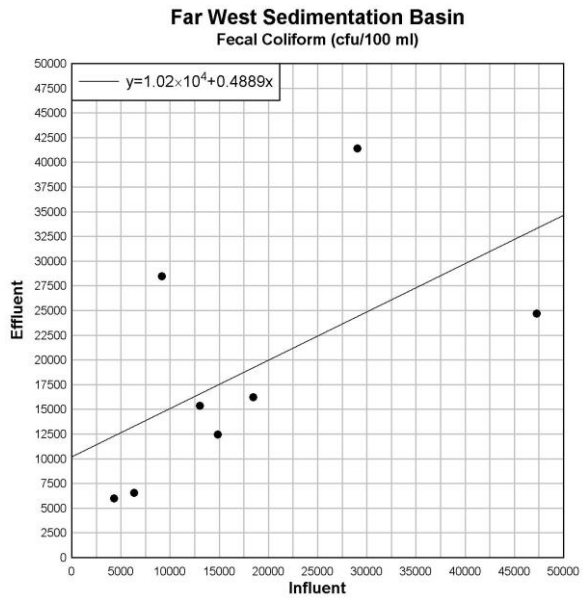
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	11
	Pairs Count	9	9
Non-Parametric	Maximum	0.126	0.150
	Upper Quartile	0.112	0.120
	Median	0.092	0.100
	Lower Quartile	0.069	0.072
	Minimum	0.044	0.061
	Efficiency	-8.84%	
	Mann-Whitney	0.6489	
	Wilcoxon (paired)	0.6523	
Arithmetic	UCL	0.107	0.118
	Mean	0.090	0.099
	LCL	0.074	0.080
	Std. Dev.	0.026	0.028
	Wilk (p-value)	0.5101	0.7552
	Efficiency	-9.32%	
	t-Test (equal var.)	0.4693	
	t-Test (unequal var.)	0.4709	
	t-test (paired)	0.4693	
	Levene Test	0.7518	
Log Transformed	UCL	0.111	0.121
	Mean	0.091	0.099
	LCL	0.074	0.081
	Std. Dev.	0.029	0.029
	Wilk (p-value)	0.3074	0.8155
	Efficiency	-9.06%	
	t-Test (equal var.)	0.4680	
	t-Test (unequal var.)	0.4662	
	t-Test (paired)	0.5145	
	Levene Test	0.7201	
Bootstrap	UCL	0.106	0.117
	Mean	0.090	0.099
	LCL	0.075	0.081
	Std. Dev.	0.025	0.027
	Efficiency	-9.87%	

Far West Sedimentation Basin -Fecal Coliform (cfu/100L)



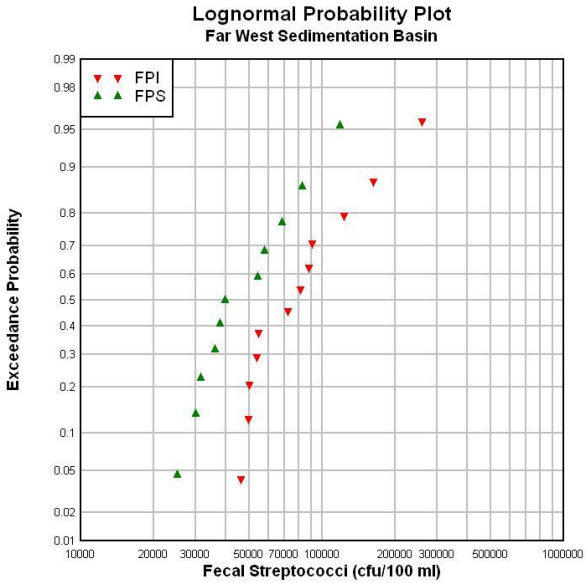


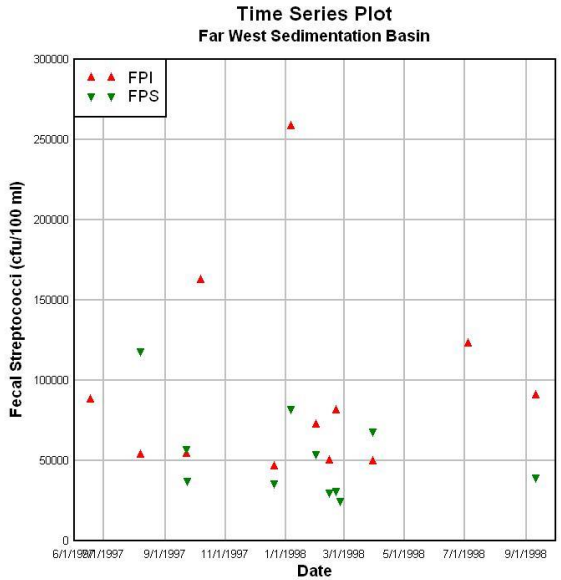


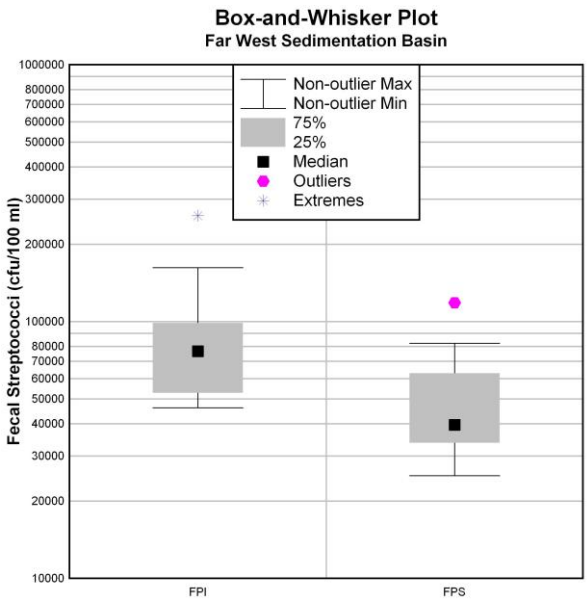


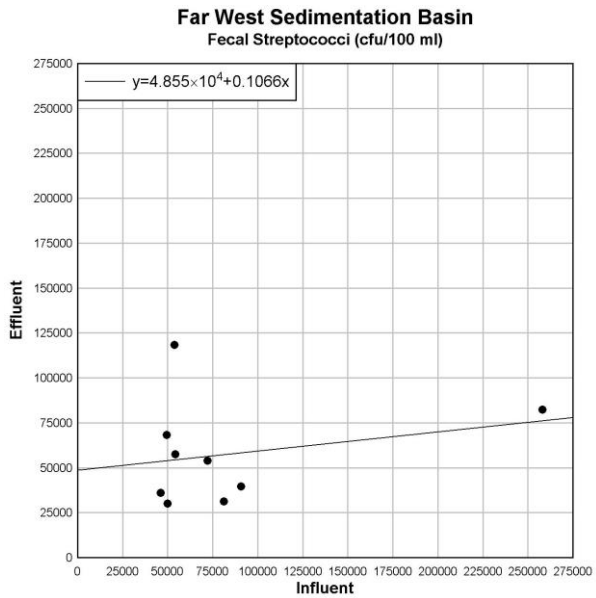
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	11	11
	Pairs Count	8	8
Non-Parametric	Maximum	61,090	41,424
	Upper Quartile	29,043	28,451
	Median	14,843	16,215
	Lower Quartile	6,319	12,467
	Minimum	4,312	6,000
	Efficiency	-9.25%	
	Mann-Whitney	0.6976	
	Wilcoxon (paired)	0.8438	
Arithmetic	UCL	33,310	27,359
	Mean	21,028	19,946
	LCL	8,747	12,534
	Std. Dev.	18,282	11,034
	Wilk (p-value)	0.0317 **	0.5628
	Efficiency	5.15%	
	t-Test (equal var.)	0.8682	
	t-Test (unequal var.)	0.8686	
	t-test (paired)	0.8064	
	Levene Test	0.2075	
Log Transformed	UCL	41,812	32,109
	Mean	20,998	20,234
	LCL	10,545	12,750
	Std. Dev.	19,332	13,073
	Wilk (p-value)	0.8713	0.5188
	Efficiency	3.64%	
	t-Test (equal var.)	0.7163	
	t-Test (unequal var.)	0.7166	
	t-Test (paired)	0.4883	
	Levene Test	0.1888	
Bootstrap	UCL	32,230	26,616
	Mean	20,914	19,720
	LCL	9,598	12,824
	Std. Dev.	16,844	10,265
	Efficiency	5.71%	

Far West Sedimentation Basin -Fecal Streptococci (cfu/100L)



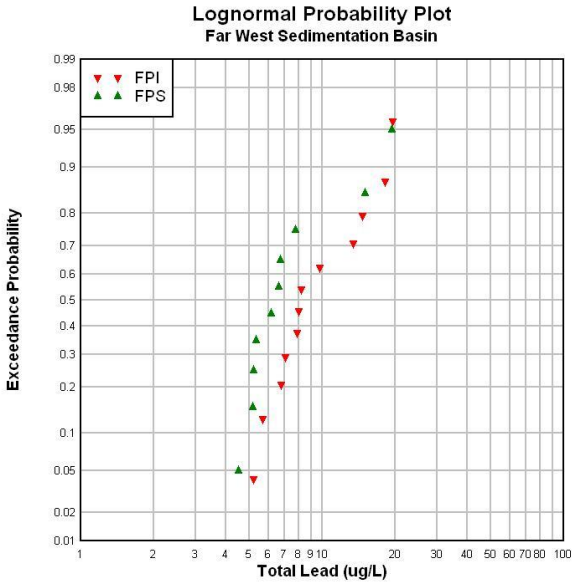


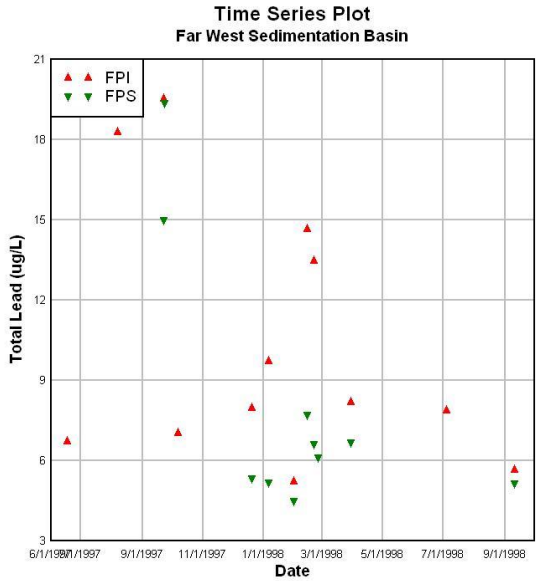


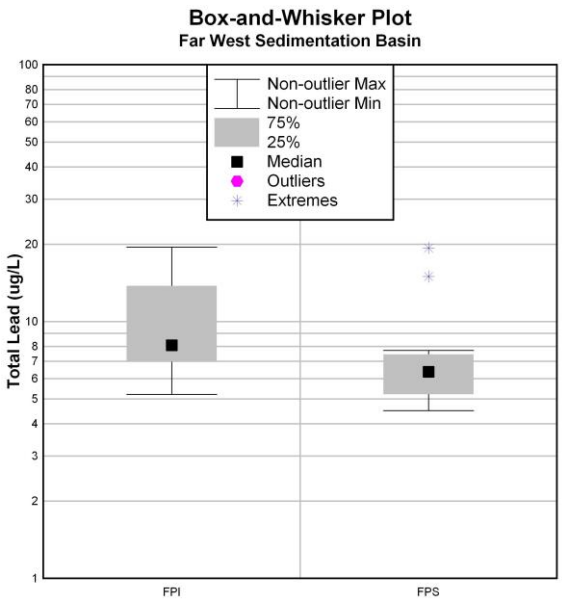


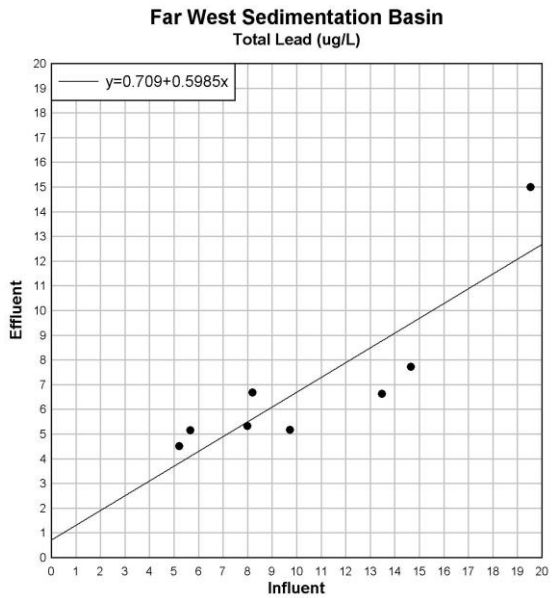
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	11
	Pairs Count	9	9
Non-Parametric	Maximum	258,127	118,351
	Upper Quartile	106,763	68,322
	Median	76,706	39,656
	Lower Quartile	51,852	31,319
	Minimum	46,130	25,110
	Efficiency	48.30%	
	Mann-Whitney	0.0398 **	
	Wilcoxon (paired)	0.3008	
Arithmetic	UCL	133,579	71,592
	Mean	94,059	52,755
	LCL	54,540	33,918
	Std. Dev.	62,199	28,041
	Wilk (p-value)	0.0035 **	0.0541 *
	Efficiency	43.91%	
	t-Test (equal var.)	0.0564 *	
	t-Test (unequal var.)	0.0543 *	
	t-test (paired)	0.2649	
	Levene Test	0.2290	
Log Transformed	UCL	133,057	73,545
	Mean	92,268	52,360
	LCL	63,983	37,277
	Std. Dev.	50,904	25,493
	Wilk (p-value)	0.1359	0.6664
	Efficiency	43.25%	
	t-Test (equal var.)	0.0191 **	
	t-Test (unequal var.)	0.0186 **	
	t-Test (paired)	0.1767	
	Levene Test	0.6737	
Bootstrap	UCL	129,735	69,535
	Mean	94,001	52,414
	LCL	58,266	35,293
	Std. Dev.	56,242	25,485
	Efficiency	44.24%	

Far West Sedimentation Basin -Total Lead (ug/L)



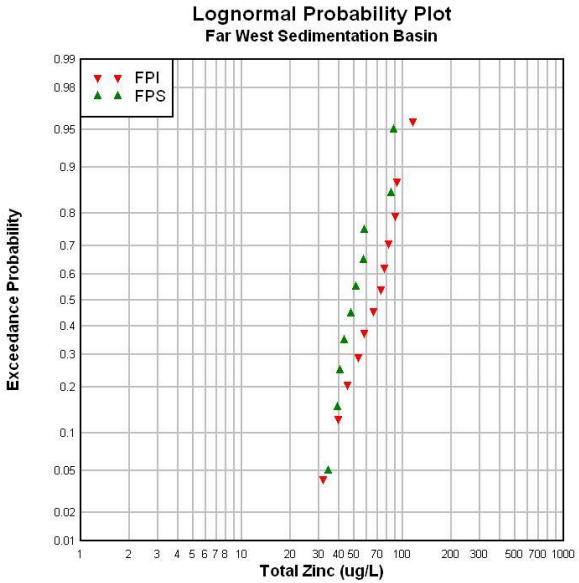


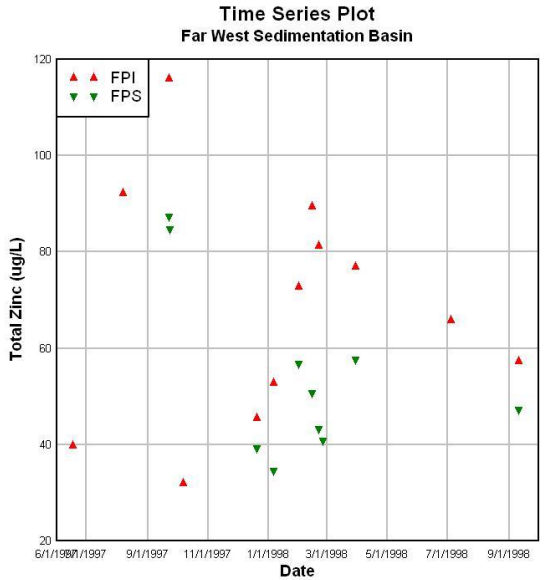


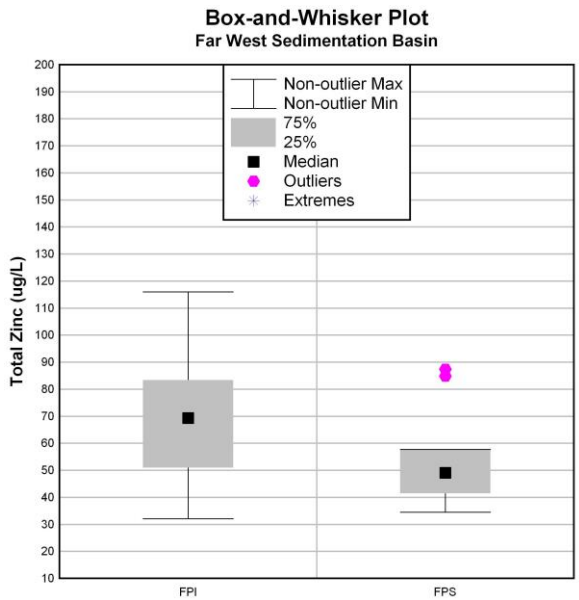


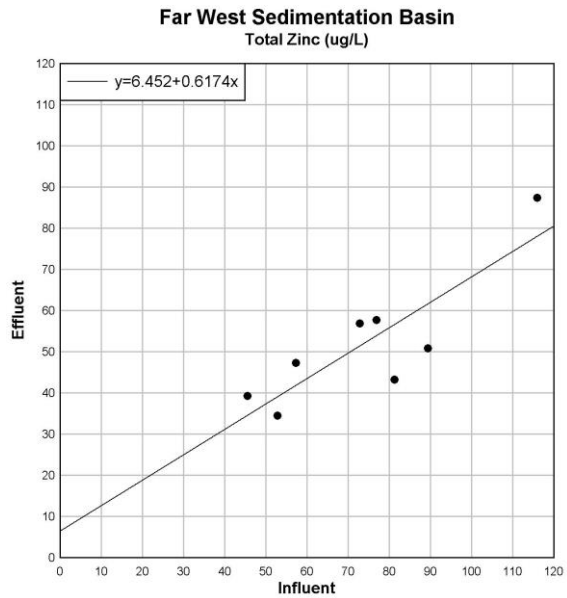
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	19.5	19.4
	Upper Quartile	14.1	7.7
	Median	8.1	6.4
	Lower Quartile	6.9	5.2
	Minimum	5.2	4.5
	Efficiency	21.16%	
	Mann-Whitney	0.0841 *	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	13.5	11.7
	Mean	10.4	8.2
	LCL	7.2	4.6
	Std. Dev.	4.9	5.0
	Wilk (p-value)	0.0503 *	0.0011 **
	Efficiency	21.15%	
	t-Test (equal var.)	0.3110	
	t-Test (unequal var.)	0.3119	
	t-test (paired)	0.0062 **	
	Levene Test	0.9994	
Log Transformed	UCL	13.9	11.6
	Mean	10.3	8.0
	LCL	7.7	5.6
	Std. Dev.	4.7	3.9
	Wilk (p-value)	0.3115	0.0213 **
	Efficiency	22.28%	
	t-Test (equal var.)	0.1951	
	t-Test (unequal var.)	0.1994	
	t-Test (paired)	0.0030 **	
	Levene Test	0.7993	
Bootstrap	UCL	13.1	11.2
	Mean	10.3	8.1
	LCL	7.4	5.0
	Std. Dev.	4.5	4.4
	Efficiency	21.11%	

Far West Sedimentation Basin - Total Zinc (ug/L)



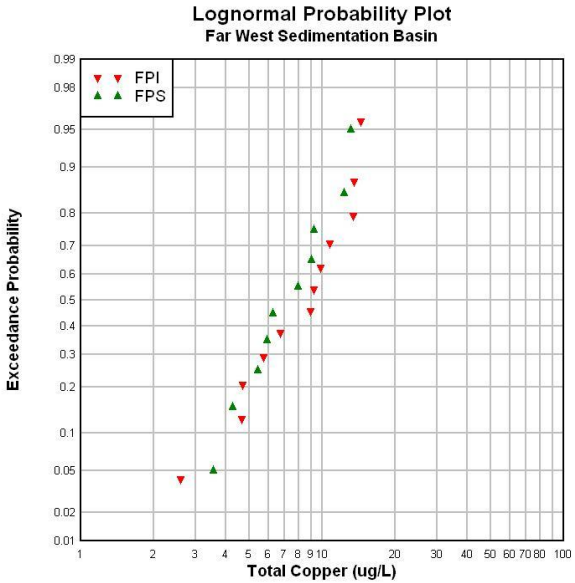


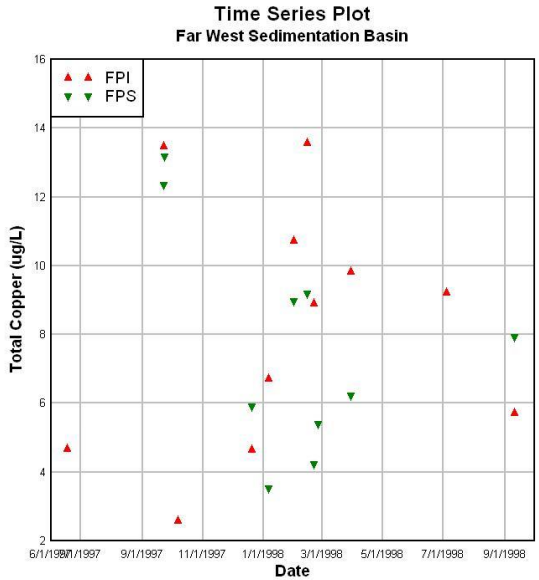


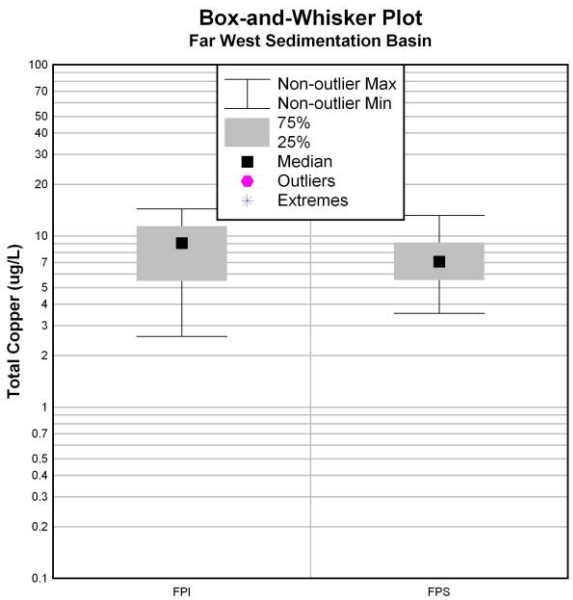


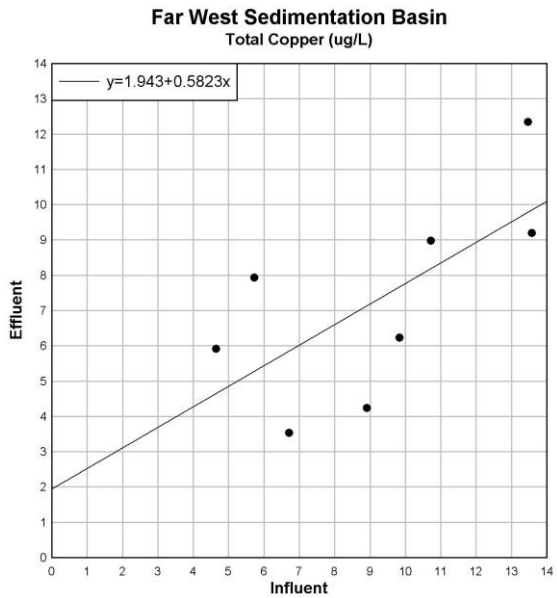
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	116.0	87.4
	Upper Quartile	85.3	57.7
	Median	69.4	49.0
	Lower Quartile	49.1	40.8
	Minimum	32.1	34.5
	Efficiency	29.31%	
	Mann-Whitney	0.1908	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	84.0	67.4
	Mean	68.5	54.3
	LCL	53.0	41.1
	Std. Dev.	24.4	18.3
	Wilk (p-value)	0.9835	0.0595 *
	Efficiency	20.77%	
	t-Test (equal var.)	0.1449	
	t-Test (unequal var.)	0.1350	
	t-test (paired)	0.0014 **	
	Levene Test	0.3186	
Log Transformed	UCL	88.2	68.1
	Mean	68.7	54.1
	LCL	53.5	43.0
	Std. Dev.	26.4	17.0
	Wilk (p-value)	0.9658	0.3385
	Efficiency	21.18%	
	t-Test (equal var.)	0.1644	
	t-Test (unequal var.)	0.1572	
	t-Test (paired)	0.0008 **	
	Levene Test	0.4464	
Bootstrap	UCL	82.6	65.9
	Mean	68.2	54.1
	LCL	53.8	42.2
	Std. Dev.	22.7	16.5
	Efficiency	20.71%	

Far West Sedimentation Basin -Total Copper (ug/L)



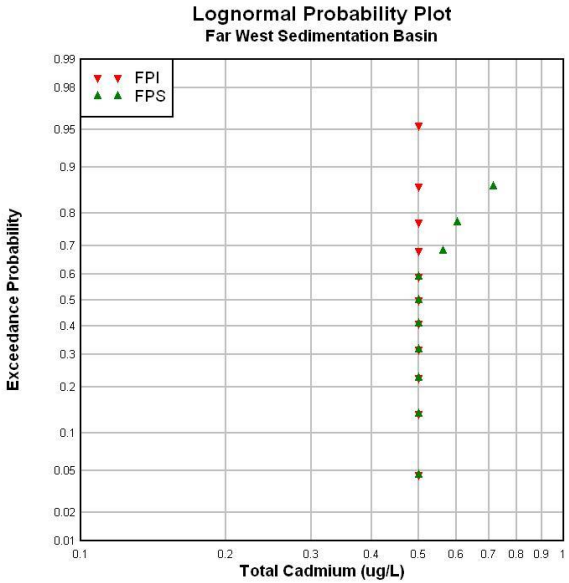


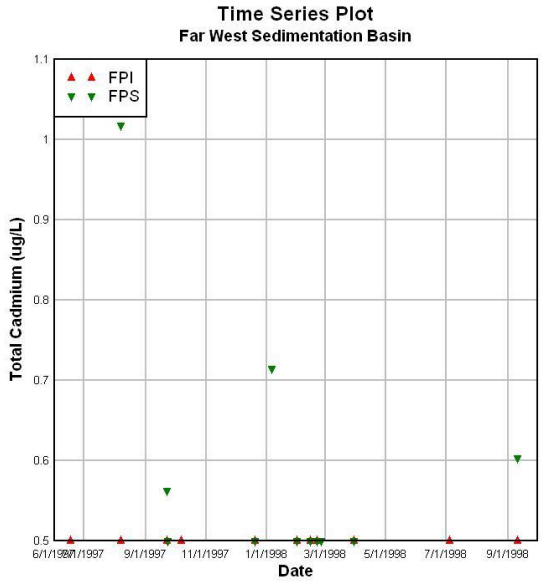


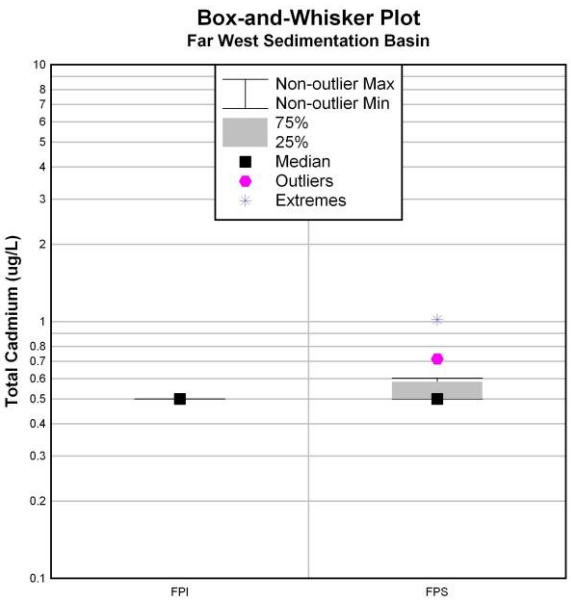


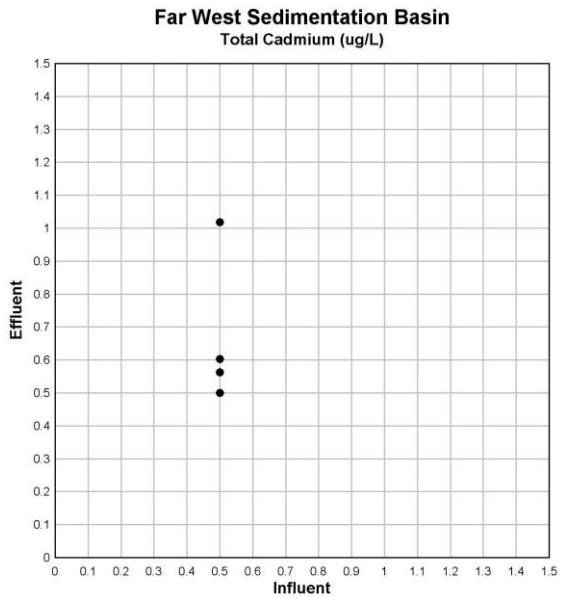
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	12	10
	Pairs Count	8	8
Non-Parametric	Maximum	14.4	13.2
	Upper Quartile	12.1	9.2
	Median	9.1	7.1
	Lower Quartile	5.2	5.4
	Minimum	2.6	3.5
	Efficiency	21.95%	
	Mann-Whitney	0.4567	
	Wilcoxon (paired)	0.1094	
Arithmetic	UCL	11.2	10.0
	Mean	8.7	7.7
	LCL	6.2	5.4
	Std. Dev.	3.9	3.3
	Wilk (p-value)	0.5850	0.5171
	Efficiency	11.60%	
	t-Test (equal var.)	0.5228	
	t-Test (unequal var.)	0.5157	
	t-test (paired)	0.0742 *	
	Levene Test	0.3929	
Log Transformed	UCL	12.6	10.7
	Mean	8.8	7.7
	LCL	6.2	5.6
	Std. Dev.	4.8	3.4
	Wilk (p-value)	0.3431	0.8514
	Efficiency	12.65%	
	t-Test (equal var.)	0.6580	
	t-Test (unequal var.)	0.6522	
	t-Test (paired)	0.1247	
	Levene Test	0.4751	
Bootstrap	UCL	11.0	9.8
	Mean	8.7	7.7
	LCL	6.3	5.5
	Std. Dev.	3.7	3.0
	Efficiency	11.42%	

Far West Sedimentation Basin – Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPS**
	Site Count	11	11
	Pairs Count	8	8
Non-Parametric	Maximum	0.5	1.0
	Upper Quartile	0.5	0.6
	Median	0.5	0.5
	Lower Quartile	0.5	0.5
	Minimum	0.5	0.5
	Efficiency	0.00%	
	Mann-Whitney	0.0482 **	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	0.5	0.7
	Mean	0.5	0.6
	LCL	0.5	0.5
	Std. Dev.	0.0	0.2
	Wilk (p-value)	NA	0.0001 **
	Efficiency	-16.33%	
	t-Test (equal var.)	0.1058	
	t-Test (unequal var.)	0.1212	
	t-test (paired)	0.2193	
	Levene Test	0.1812	
Log Transformed	UCL	0.5	0.7
	Mean	0.5	0.6
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Wilk (p-value)	NA	0.0001 **
	Efficiency	-15.95%	
	t-Test (equal var.)	0.0819 *	
	t-Test (unequal var.)	0.0968 *	
	t-Test (paired)	0.1885	
	Levene Test	0.1374	
Bootstrap	UCL	0.5	0.7
	Mean	0.5	0.6
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Efficiency	-16.22%	

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Appendix B Sand Filters

Highwood Sand Filter (HE-HI)

The Highwood sand filter was monitored as part of the City of Austin's original monitoring program. Filtration is accomplished by a filter trench system approximately 122 feet long, three feet wide and 1.25 feet deep composed of a layer of sodded soil overlying a sand bed. Large flows overflowed via a standpipe but a splitter box was not used, creating some issues with the effluent concentrations. This is an on-line pond where all storm flows pass through the pond. The City collected runoff and water quality data at The Highwood sand filter (HI-HE) from 1985 to 1987. During this time 20 and 21 valid EMCs were collected at the influent (HI) and effluent (HE) respectively, of which 15 were paired. See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed.

Performance Summary

The Highwood sand filter had the best performance with the reduction of the concentrations of TSS and some metals. TSS was reduced by 84% and was significant if a paired comparison is used or if the data are not paired. VSS was increased by 82% and was significant in all cases, paired or not paired.

COD, TOC and BOD concentrations were reduced by 42%, 33% and 37% respectively, and were only significant for BOD if data are not paired.

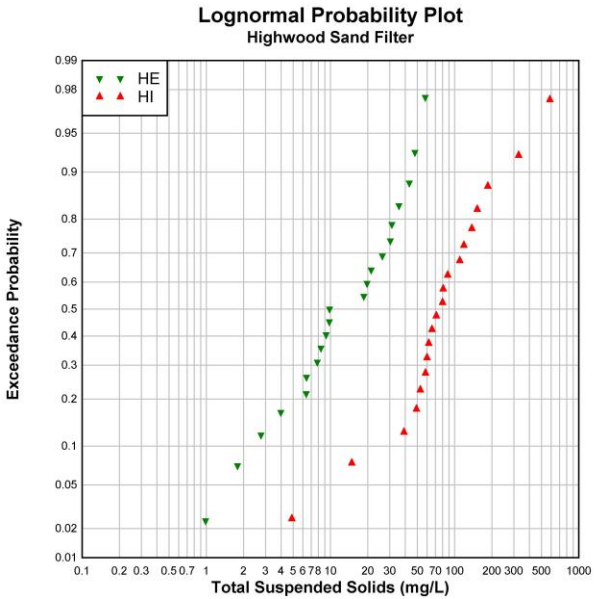
Total nitrogen and total Kjeldahl nitrogen concentration were reduced by 20% and 38% respectively, and were not significant in all case. The increase of concentration in nitrate + nitrite (21%) was significant in all case. Ammonia concentration was reduced by 43% and was only significant if data are paired.

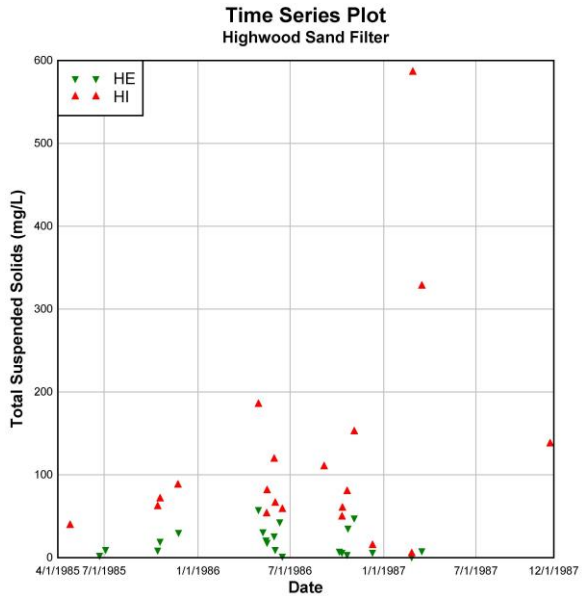
TP concentration was reduced by 19% and was not significant in all case.

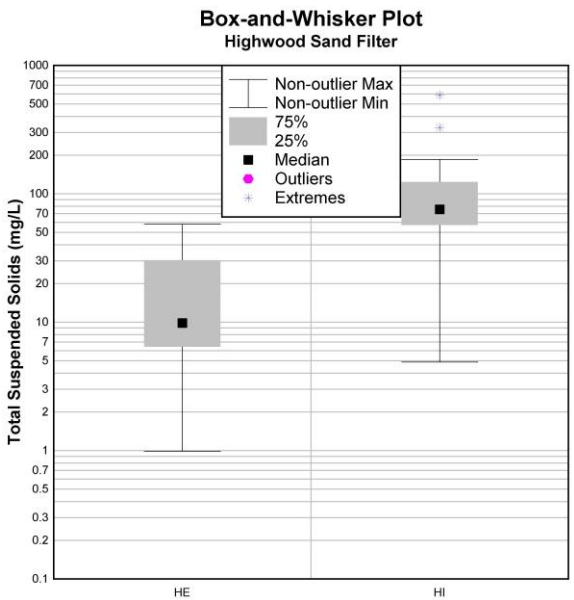
The reductions of bacteria were not significant in all case for FCOL (18%) and for FSTR (7%).

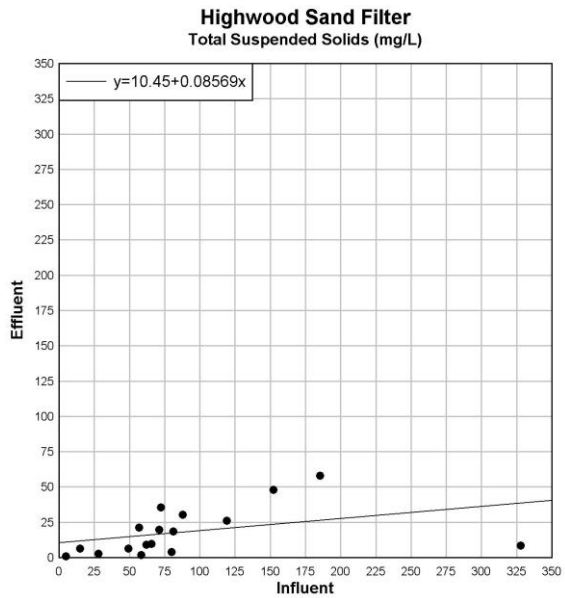
Lead and zinc concentrations were reduced by 73% and 52% respectively, and were significant in all cases. Copper concentration was reduced by 9% and was not significant in all case

Highwood Sand Filter - Total Suspended Solids (mg/L)



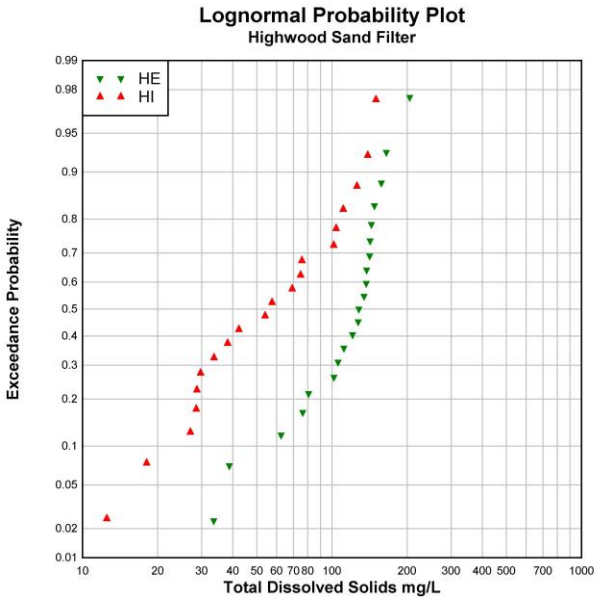


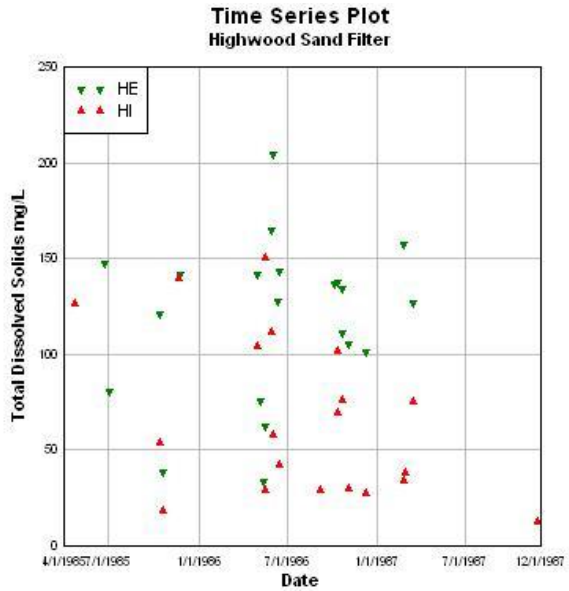


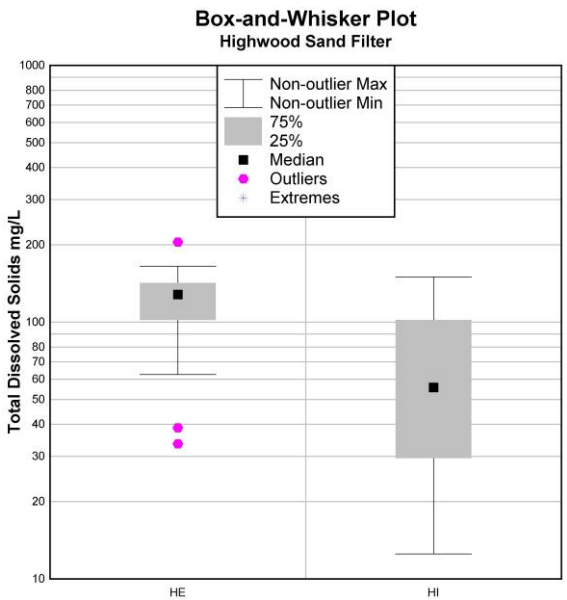


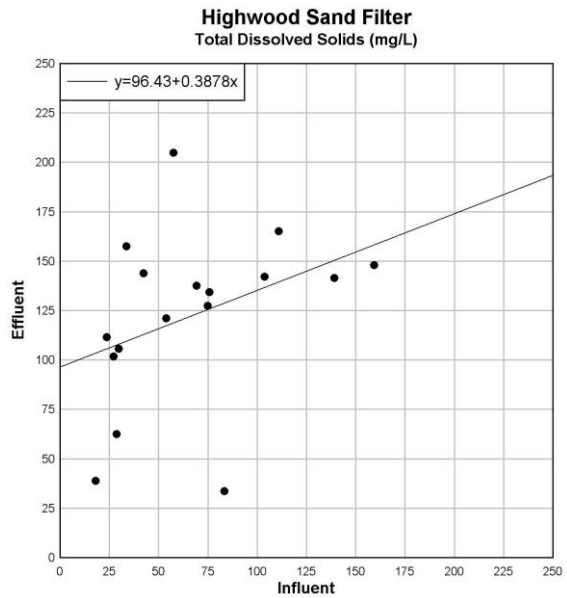
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	585.9	58.1
	Upper Quartile	128.3	30.4
	Median	75.5	9.8
	Lower Quartile	55.6	6.4
	Minimum	4.9	1.0
	Efficiency	86.98%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	178.6	26.6
	Mean	117.2	19.0
	LCL	55.9	11.5
	Std. Dev.	131.1	16.6
	Wilk (p-value)	0.0001 **	0.0197 **
	Efficiency	83.76%	
	t-Test (equal var.)	0.0015 **	
	t-Test (unequal var.)	0.0035 **	
	t-test (paired)	0.0019 **	
	Levene Test	0.1396	
Log Transformed	UCL	220.1	40.7
	Mean	122.3	21.2
	LCL	68.0	11.0
	Std. Dev.	144.4	28.6
	Wilk (p-value)	0.1376	0.3826
	Efficiency	82.67%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.6934	
Bootstrap	UCL	173.0	25.9
	Mean	117.2	18.7
	LCL	61.4	11.6
	Std. Dev.	119.2	15.8
	Efficiency	84.00%	

Highwood Sand Filter -Total Dissolved Solids (mg/L)



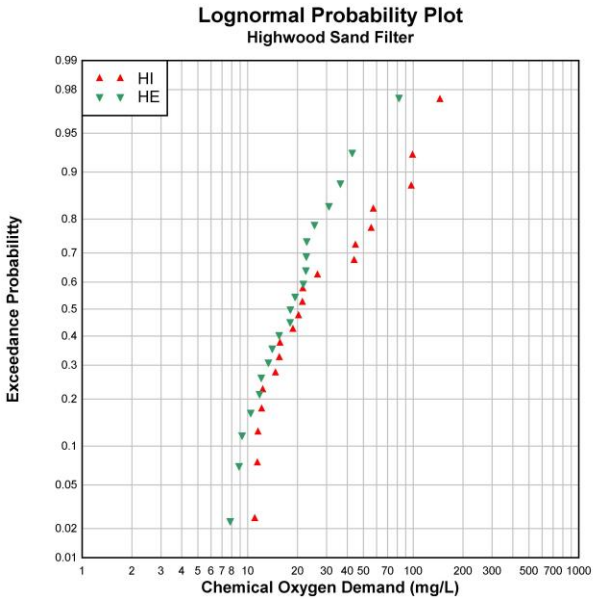


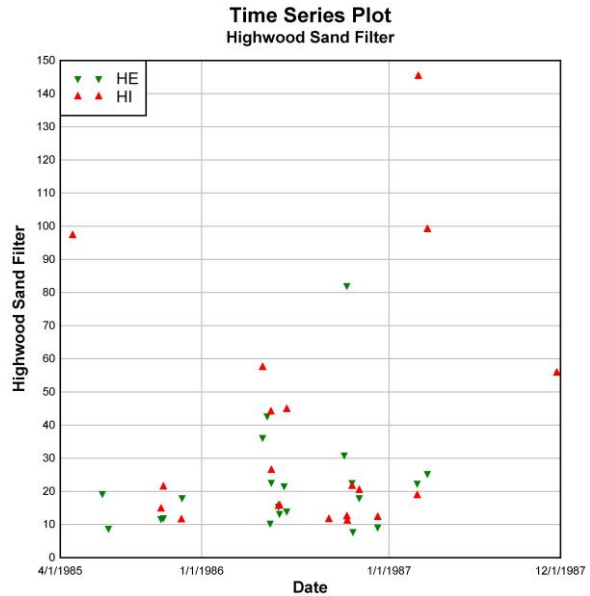


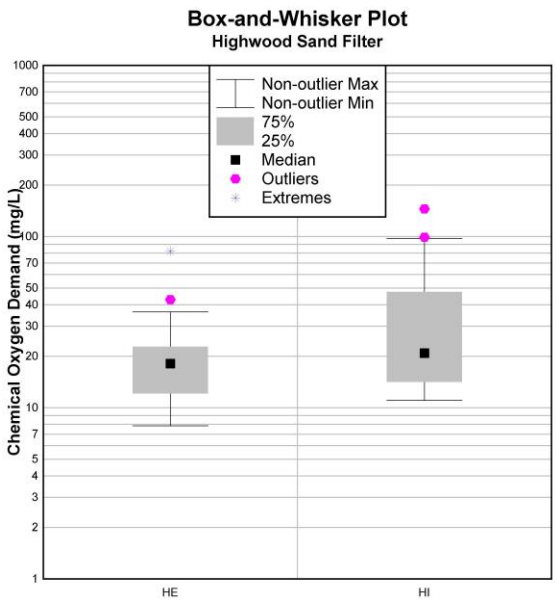


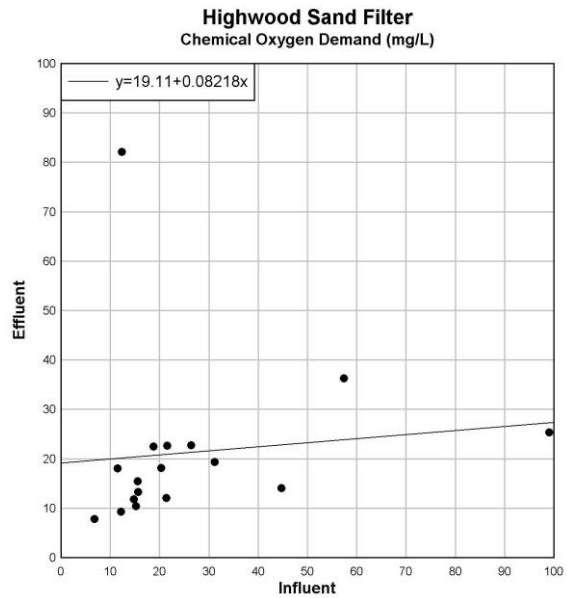
	PARAMETER	TDS (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	150.00	204.94
	Upper Quartile	102.66	142.23
	Median	55.68	128.24
	Lower Quartile	29.23	101.87
	Minimum	12.51	33.60
	Efficiency	-130.31%	
	Mann-Whitney	0.0012 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	85.95	138.19
	Mean	66.07	119.05
	LCL	46.19	99.92
	Std. Dev.	42.48	42.04
	Wilk (p-value)	0.0696 *	0.3474
	Efficiency	-80.18%	
	t-Test (equal var.)	0.0003 **	
	t-Test (unequal var.)	0.0003 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.9627	
Log Transformed	UCL	97.94	151.01
	Mean	67.27	121.16
	LCL	46.20	97.20
	Std. Dev.	51.88	57.55
	Wilk (p-value)	0.4971	0.0032 **
	Efficiency	-80.11%	
	t-Test (equal var.)	0.0004 **	
	t-Test (unequal var.)	0.0005 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0479 **	
Bootstrap	UCL	84.68	137.69
	Mean	65.53	119.32
	LCL	46.39	100.96
	Std. Dev.	40.91	40.34
	Efficiency	-82.08%	

Highwood Sand Filter -Chemical Oxygen Demand (mg/L)



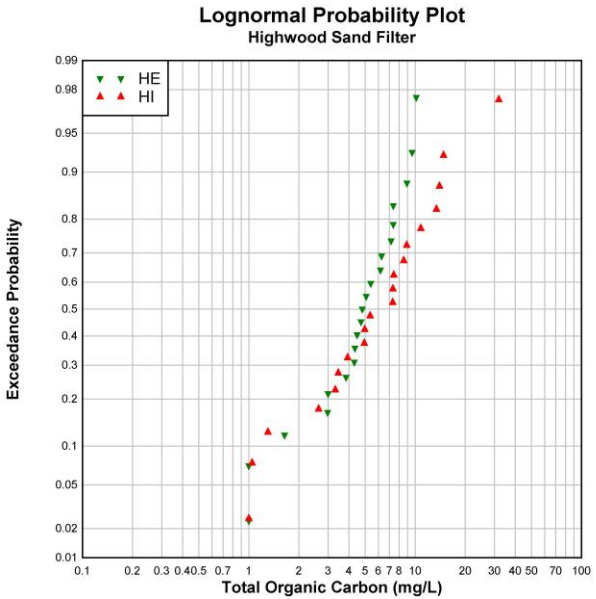


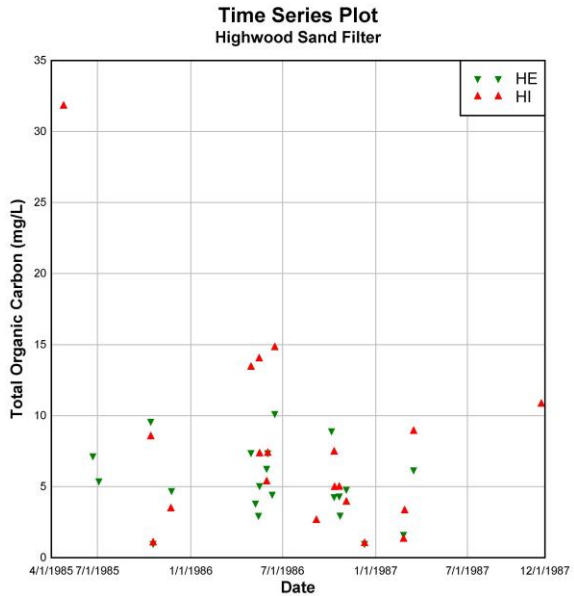


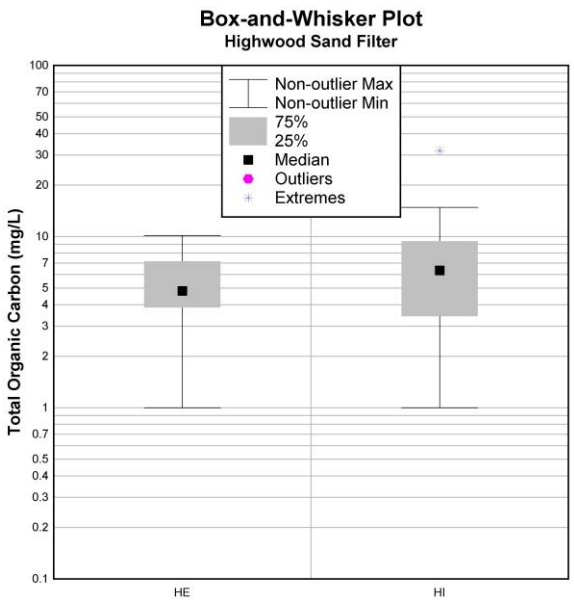


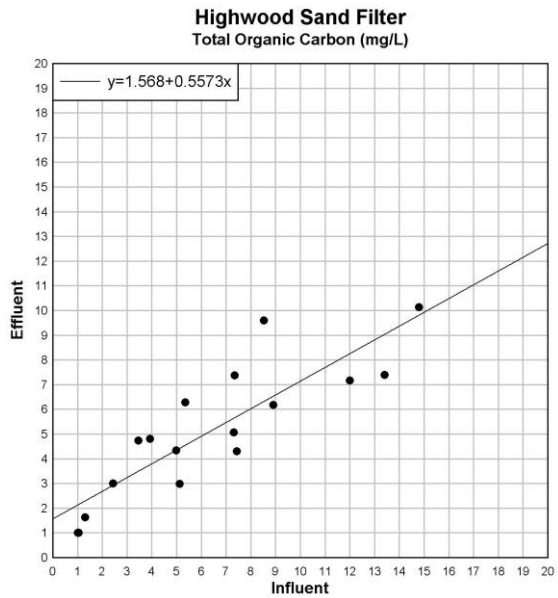
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	145.22	82.08
	Upper Quartile	50.22	22.73
	Median	20.83	18.10
	Lower Quartile	13.53	12.06
	Minimum	11.04	7.85
	Efficiency	13.12%	
	Mann-Whitney	0.2323	
	Wilcoxon (paired)	0.0730 *	
Arithmetic	UCL	55.08	29.67
	Mean	37.81	22.17
	LCL	20.54	14.68
	Std. Dev.	36.90	16.47
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	41.35%	
	t-Test (equal var.)	0.0852 *	
	t-Test (unequal var.)	0.0942 *	
	t-test (paired)	0.4554	
	Levene Test	0.0902 *	
Log Transformed	UCL	56.38	28.78
	Mean	36.26	21.69
	LCL	23.32	16.35
	Std. Dev.	32.59	13.11
	Wilk (p-value)	0.0232 **	0.4926
	Efficiency	40.18%	
	t-Test (equal var.)	0.1077	
	t-Test (unequal var.)	0.1117	
	t-Test (paired)	0.3536	
	Levene Test	0.1075	
Bootstrap	UCL	54.33	29.10
	Mean	37.98	22.16
	LCL	21.62	15.23
	Std. Dev.	34.94	15.24
	Efficiency	41.63%	

Highwood Sand Filter - Total Organic Carbon (mg/L)



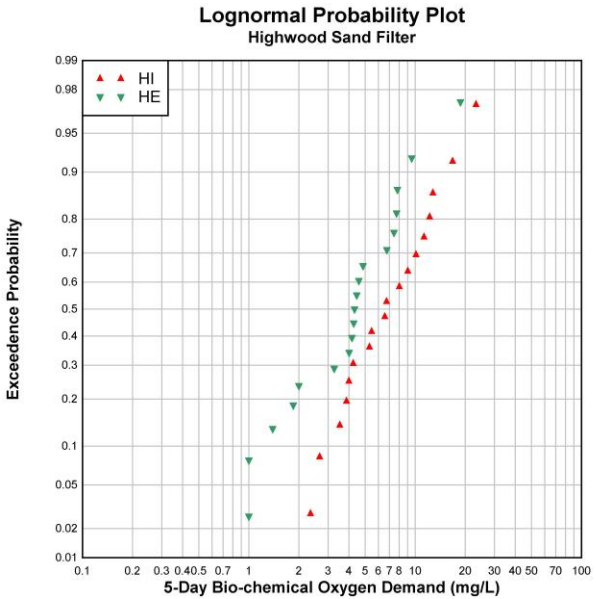


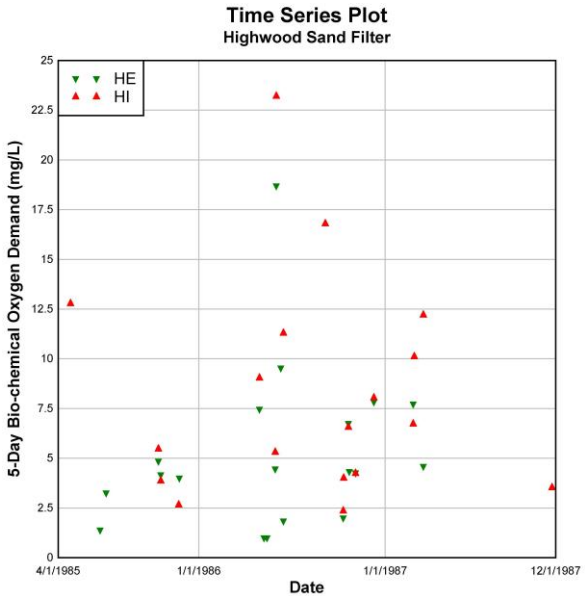


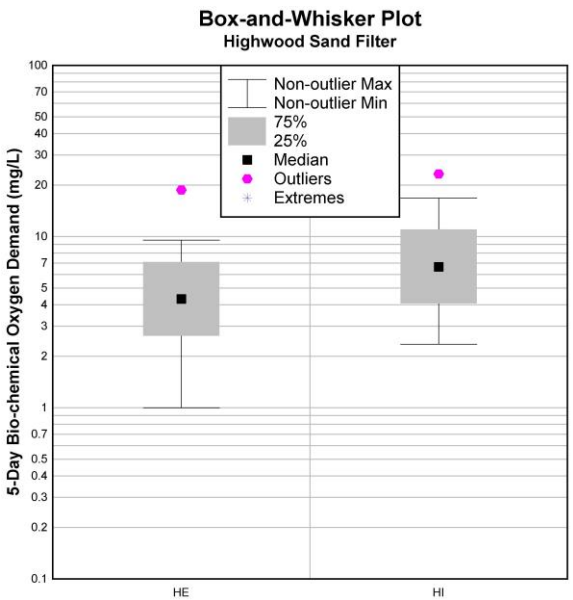


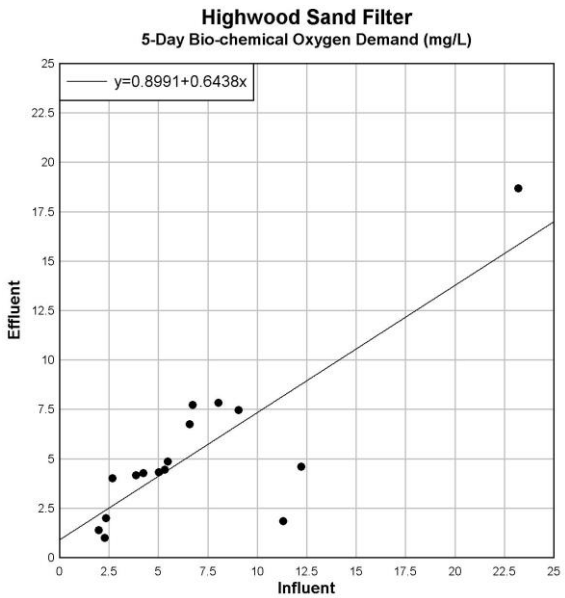
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	31.79	10.14
	Upper Quartile	9.86	7.17
	Median	6.33	4.82
	Lower Quartile	3.38	3.84
	Minimum	1.00	1.00
	Efficiency	23.97%	
	Mann-Whitney	0.3091	
	Wilcoxon (paired)	0.1688	
Arithmetic	UCL	11.11	6.41
	Mean	7.81	5.22
	LCL	4.52	4.04
	Std. Dev.	7.04	2.60
	Wilk (p-value)	0.0006 **	0.6802
	Efficiency	33.15%	
	t-Test (equal var.)	0.1229	
	t-Test (unequal var.)	0.1350	
	t-test (paired)	0.0435 **	
	Levene Test	0.1457	
Log Transformed	UCL	13.46	7.56
	Mean	8.08	5.43
	LCL	4.85	3.91
	Std. Dev.	8.34	3.81
	Wilk (p-value)	0.5680	0.0159 **
	Efficiency	32.74%	
	t-Test (equal var.)	0.3949	
	t-Test (unequal var.)	0.3993	
	t-Test (paired)	0.1032	
	Levene Test	0.1683	
Bootstrap	UCL	10.91	6.36
	Mean	7.82	5.22
	LCL	4.72	4.08
	Std. Dev.	6.61	2.50
	Efficiency	33.28%	

Highwood Sand Filter – 5-Day BioChemical Oxygen Demand



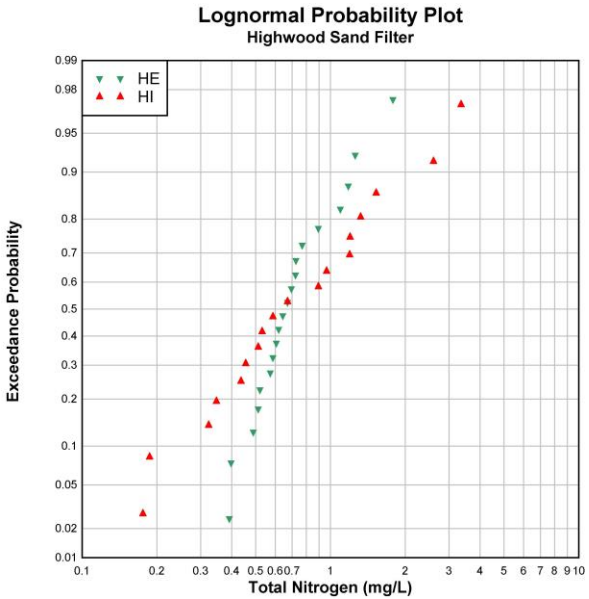


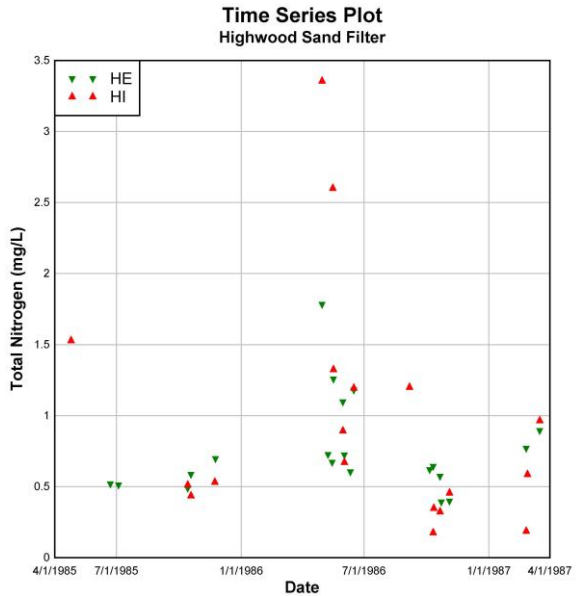


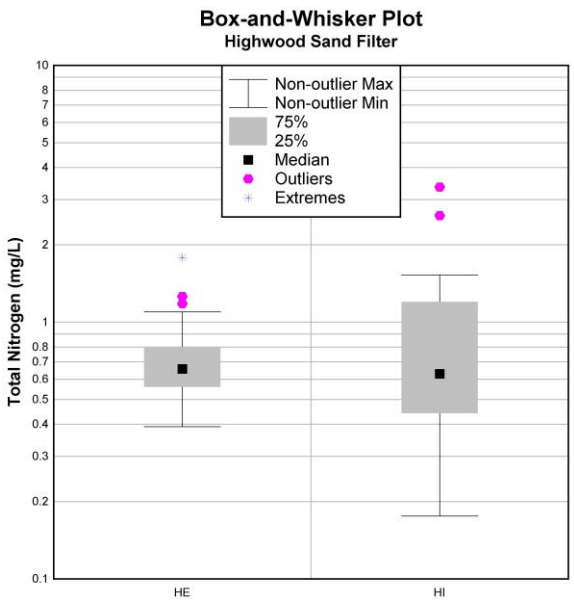


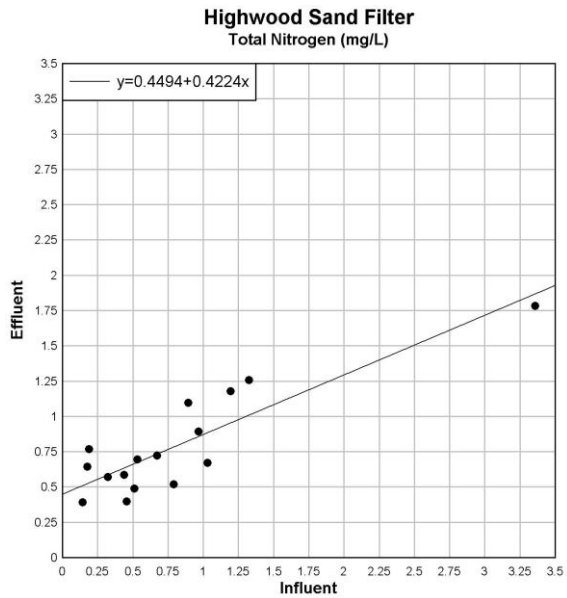
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	18	19
	Pairs Count	14	14
Non-Parametric	Maximum	23.21	18.69
	Upper Quartile	11.30	7.46
	Median	6.65	4.33
	Lower Quartile	4.00	2.00
	Minimum	2.35	1.00
	Efficiency	34.94%	
	Mann-Whitney	0.0790 *	
	Wilcoxon (paired)	0.0245 **	
Arithmetic	UCL	10.96	7.19
	Mean	8.23	5.22
	LCL	5.51	3.25
	Std. Dev.	5.48	4.10
	Wilk (p-value)	0.0236 **	0.0013 **
	Efficiency	36.61%	
	t-Test (equal var.)	0.0653 *	
	t-Test (unequal var.)	0.0683 *	
	t-test (paired)	0.0542 *	
	Levene Test	0.4213	
Log Transformed	UCL	11.68	8.15
	Mean	8.22	5.30
	LCL	5.79	3.45
	Std. Dev.	5.58	4.50
	Wilk (p-value)	0.9554	0.3810
	Efficiency	35.49%	
	t-Test (equal var.)	0.0307 **	
	t-Test (unequal var.)	0.0300 **	
	t-Test (paired)	0.0628 *	
	Levene Test	0.3655	
Bootstrap	UCL	10.87	7.04
	Mean	8.27	5.21
	LCL	5.67	3.37
	Std. Dev.	5.23	3.81
	Efficiency	37.08%	

Highwood Sand Filter - Total Nitrogen (mg/L)



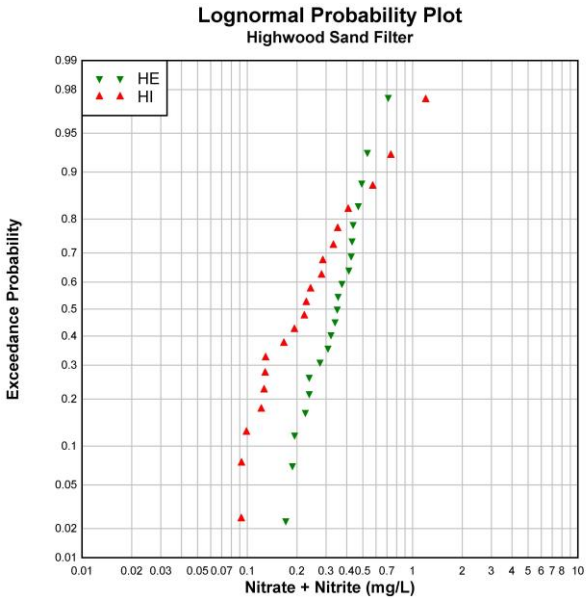


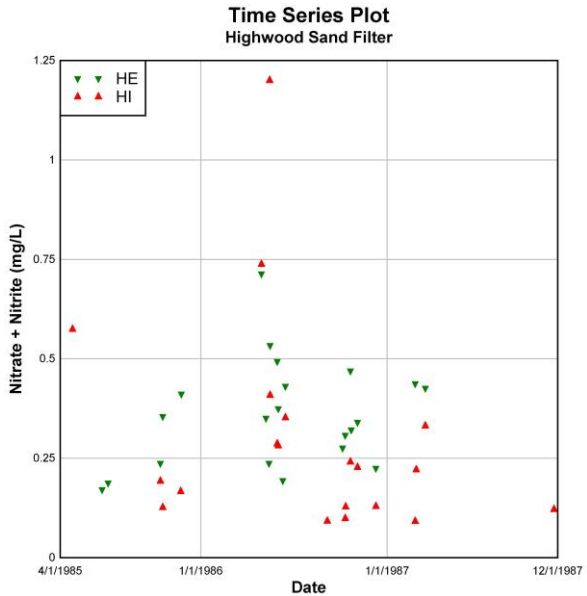


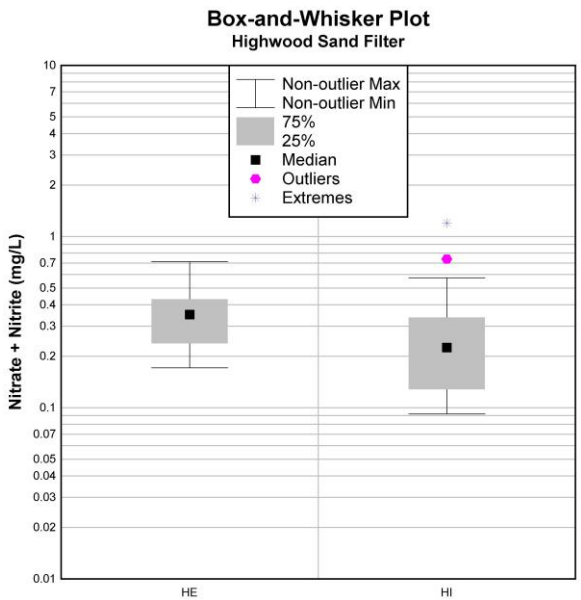


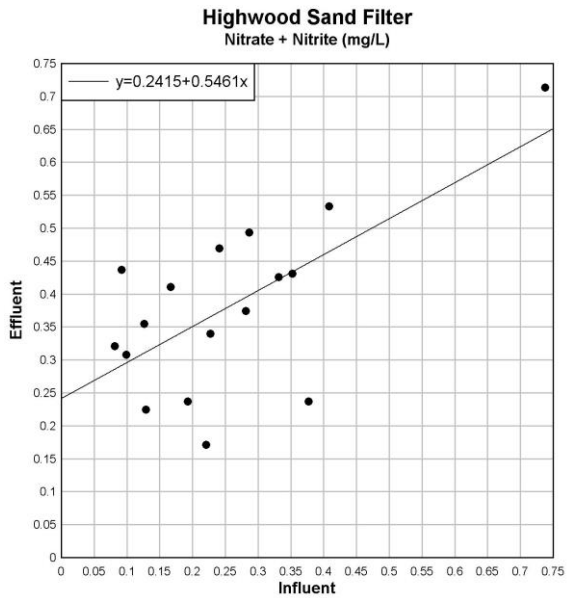
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	18	20
	Pairs Count	14	14
Non-Parametric	Maximum	3.356	1.784
	Upper Quartile	1.200	0.832
	Median	0.629	0.657
	Lower Quartile	0.436	0.546
	Minimum	0.176	0.392
	Efficiency	-4.55%	
	Mann-Whitney	0.8503	
	Wilcoxon (paired)	0.5830	
Arithmetic	UCL	1.380	0.916
	Mean	0.960	0.757
	LCL	0.540	0.598
	Std. Dev.	0.845	0.340
	Wilk (p-value)	0.0014 **	0.0024 **
	Efficiency	21.18%	
	t-Test (equal var.)	0.3279	
	t-Test (unequal var.)	0.3505	
	t-test (paired)	0.9515	
	Levene Test	0.0844 *	
Log Transformed	UCL	1.531	0.908
	Mean	0.956	0.752
	LCL	0.597	0.623
	Std. Dev.	0.856	0.298
	Wilk (p-value)	0.9246	0.3144
	Efficiency	21.30%	
	t-Test (equal var.)	0.9919	
	t-Test (unequal var.)	0.9922	
	t-Test (paired)	0.1509	
	Levene Test	0.0101 **	
Bootstrap	UCL	1.339	0.906
	Mean	0.951	0.757
	LCL	0.563	0.607
	Std. Dev.	0.781	0.319
	Efficiency	20.41%	

Highwood Sand Filter -Nitrate + Nitrite (mg/L)



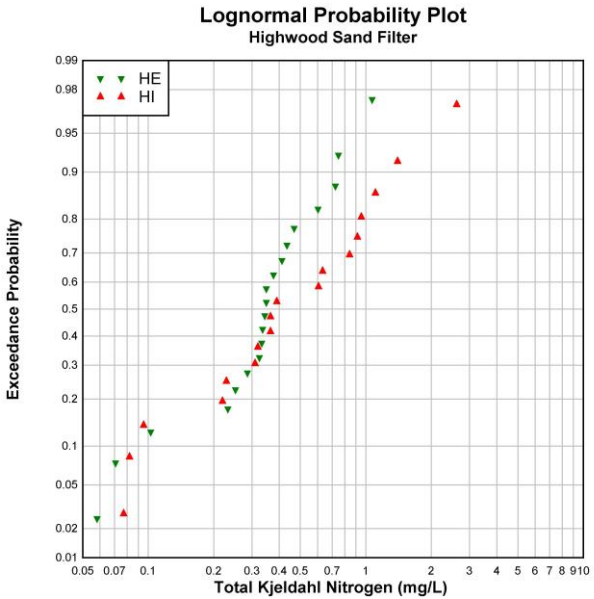


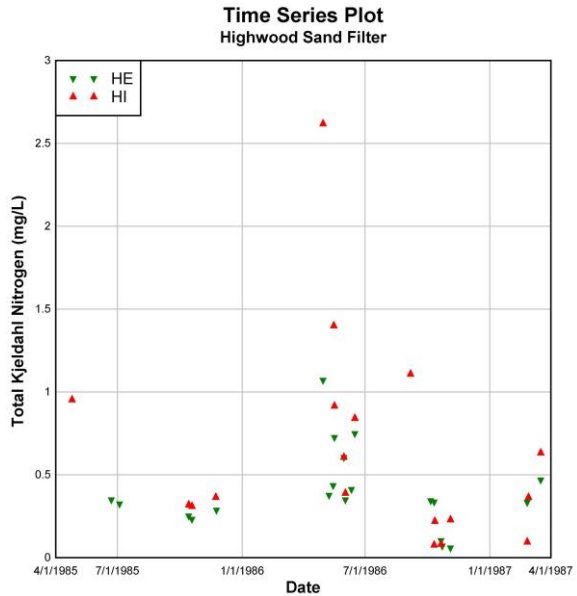


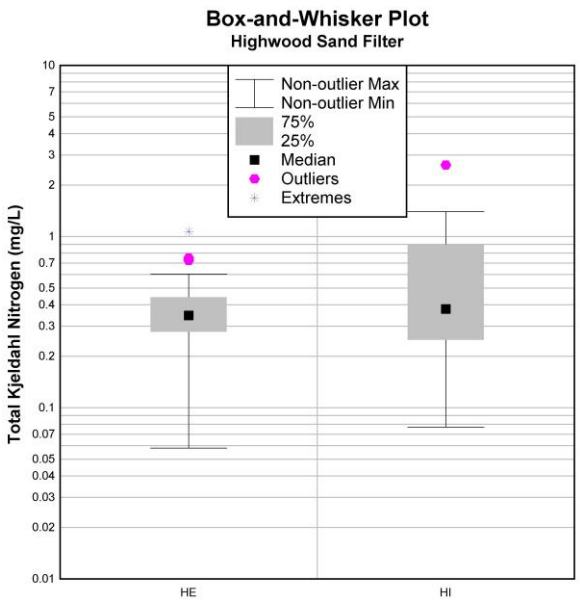


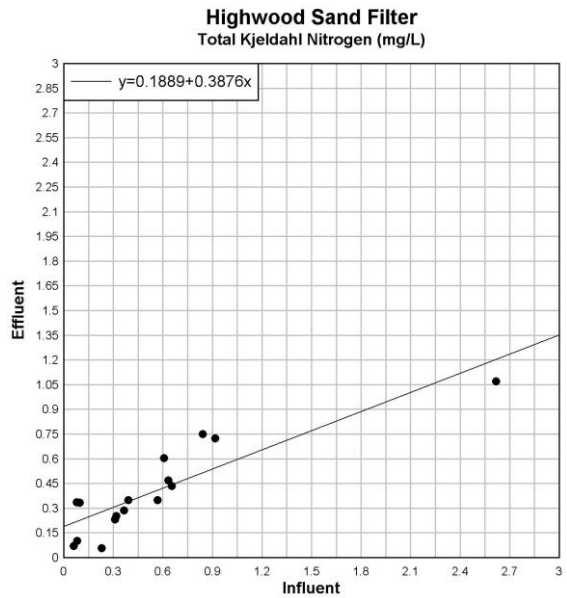
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	1.200	0.714
	Upper Quartile	0.342	0.431
	Median	0.224	0.350
	Lower Quartile	0.127	0.237
	Minimum	0.092	0.171
	Efficiency	-56.02%	
	Mann-Whitney	0.0314 **	
	Wilcoxon (paired)	0.0004 **	
Arithmetic	UCL	0.427	0.417
	Mean	0.300	0.357
	LCL	0.174	0.296
	Std. Dev.	0.270	0.133
	Wilk (p-value)	0.0001 **	0.2988
	Efficiency	-18.68%	
	t-Test (equal var.)	0.4003	
	t-Test (unequal var.)	0.4096	
	t-test (paired)	0.0002 **	
	Levene Test	0.1941	
Log Transformed	UCL	0.423	0.426
	Mean	0.291	0.357
	LCL	0.200	0.299
	Std. Dev.	0.224	0.138
	Wilk (p-value)	0.2889	0.8199
	Efficiency	-22.67%	
	t-Test (equal var.)	0.0401 **	
	t-Test (unequal var.)	0.0452 **	
	t-Test (paired)	0.0011 **	
	Levene Test	0.0226 **	
Bootstrap	UCL	0.410	0.414
	Mean	0.296	0.356
	LCL	0.181	0.299
	Std. Dev.	0.245	0.127
	Efficiency	-20.51%	

Highwood Sand Filter - Total Kjeldahl Nitrogen (mg/L)



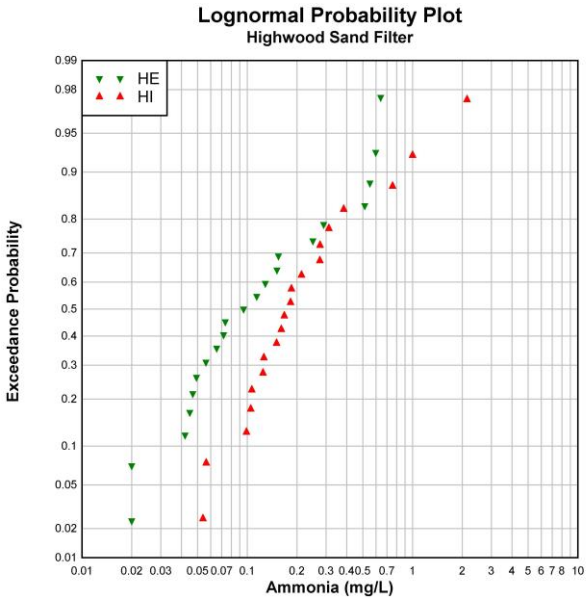


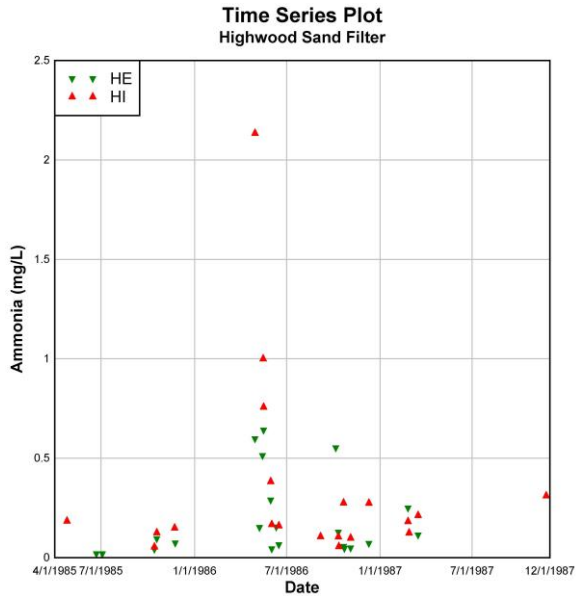


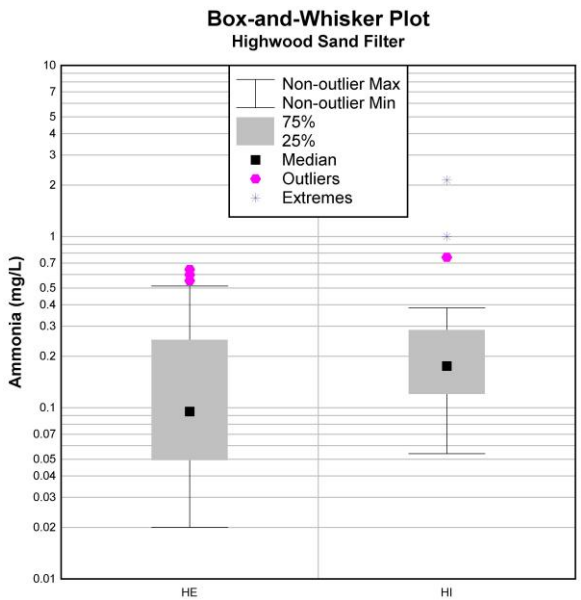


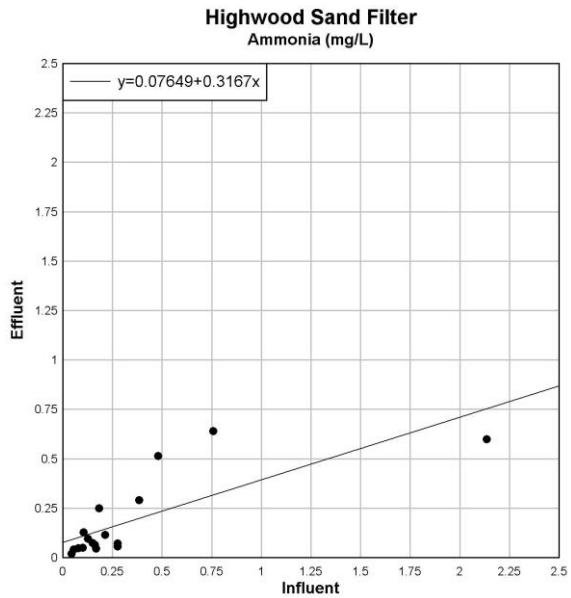
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	18	20
	Pairs Count	14	14
Non-Parametric	Maximum	2.618	1.070
	Upper Quartile	0.916	0.451
	Median	0.377	0.346
	Lower Quartile	0.229	0.269
	Minimum	0.077	0.058
	Efficiency	8.17%	
	Mann-Whitney	0.3631	
	Wilcoxon (paired)	0.1726	
Arithmetic	UCL	0.951	0.508
	Mean	0.640	0.394
	LCL	0.330	0.280
	Std. Dev.	0.624	0.243
	Wilk (p-value)	0.0011 **	0.0333 **
	Efficiency	38.51%	
	t-Test (equal var.)	0.1105	
	t-Test (unequal var.)	0.1305	
	t-test (paired)	0.2235	
	Levene Test	0.1307	
Log Transformed	UCL	1.209	0.607
	Mean	0.661	0.411
	LCL	0.361	0.278
	Std. Dev.	0.748	0.328
	Wilk (p-value)	0.6605	0.0355 **
	Efficiency	37.82%	
	t-Test (equal var.)	0.3264	
	t-Test (unequal var.)	0.3348	
	t-Test (paired)	0.7393	
	Levene Test	0.2049	
Bootstrap	UCL	0.917	0.501
	Mean	0.633	0.393
	LCL	0.350	0.286
	Std. Dev.	0.570	0.230
	Efficiency	37.85%	

Highwood Sand Filter -Ammonia (mg/L)



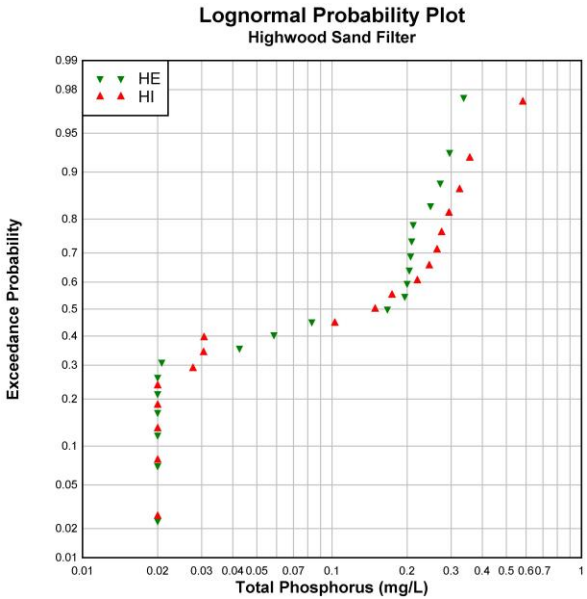


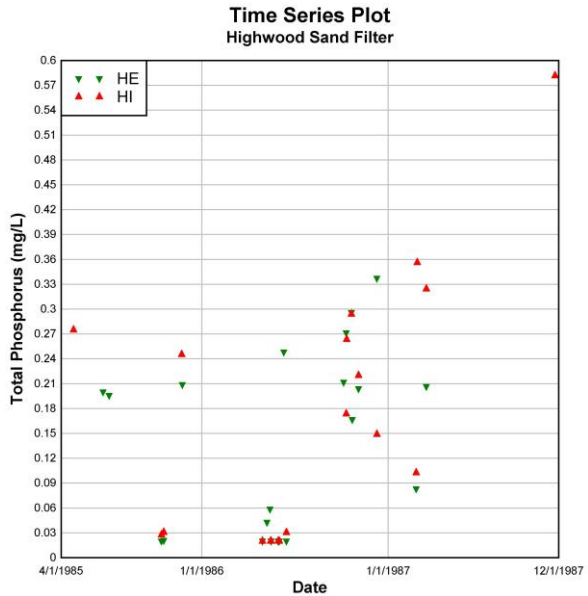


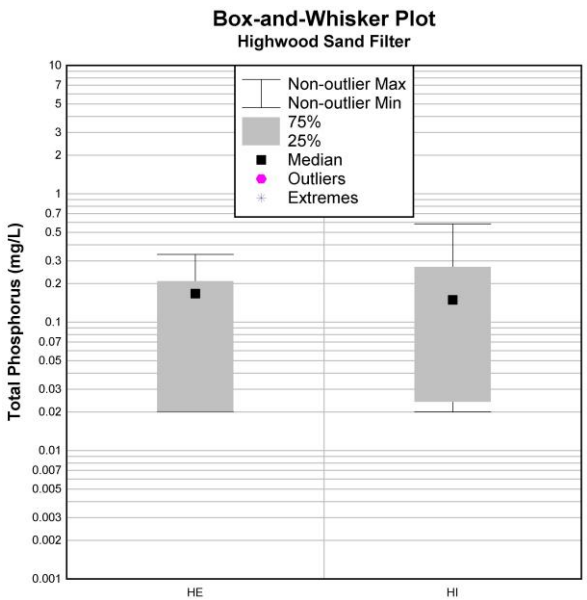


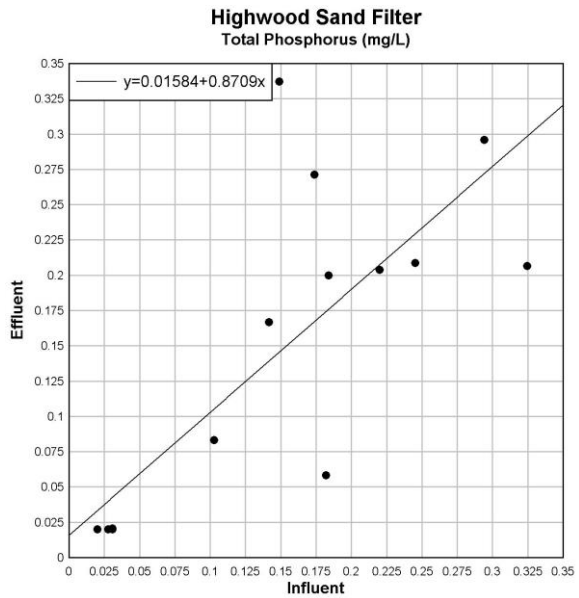
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	2.134	0.641
	Upper Quartile	0.293	0.250
	Median	0.175	0.095
	Lower Quartile	0.116	0.049
	Minimum	0.054	0.020
	Efficiency	45.76%	
	Mann-Whitney	0.0528 *	
	Wilcoxon (paired)	0.0026 **	
Arithmetic	UCL	0.569	0.283
	Mean	0.343	0.189
	LCL	0.117	0.096
	Std. Dev.	0.483	0.205
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	44.81%	
	t-Test (equal var.)	0.1881	
	t-Test (unequal var.)	0.1997	
	t-test (paired)	0.1114	
	Levene Test	0.2503	
Log Transformed	UCL	0.516	0.348
	Mean	0.308	0.188
	LCL	0.184	0.102
	Std. Dev.	0.321	0.240
	Wilk (p-value)	0.1422	0.2324
	Efficiency	38.76%	
	t-Test (equal var.)	0.0509 *	
	t-Test (unequal var.)	0.0502 *	
	t-Test (paired)	0.0008 **	
	Levene Test	0.4630	
Bootstrap	UCL	0.526	0.278
	Mean	0.332	0.189
	LCL	0.138	0.099
	Std. Dev.	0.415	0.196
	Efficiency	43.19%	

Highwood Sand Filter - Total Phosphorus (mg/L)



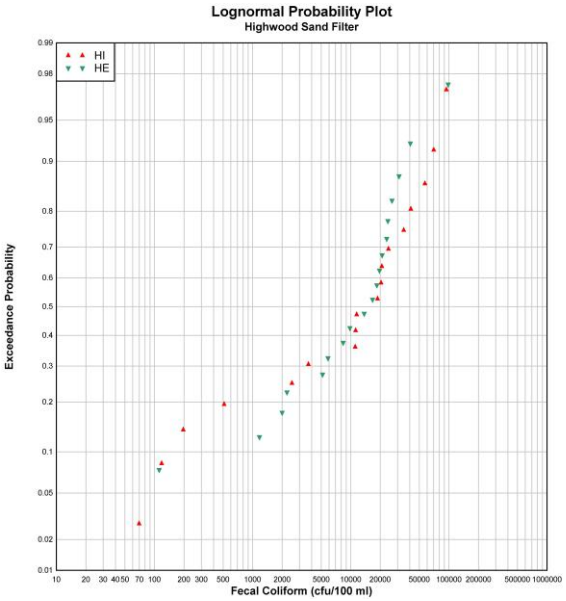


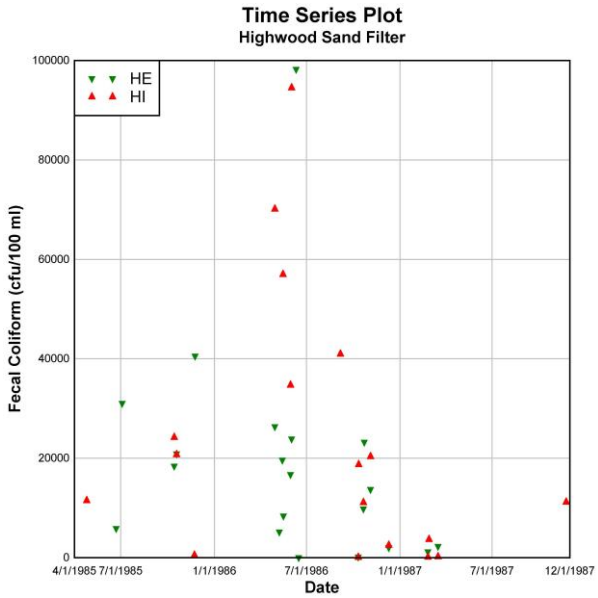


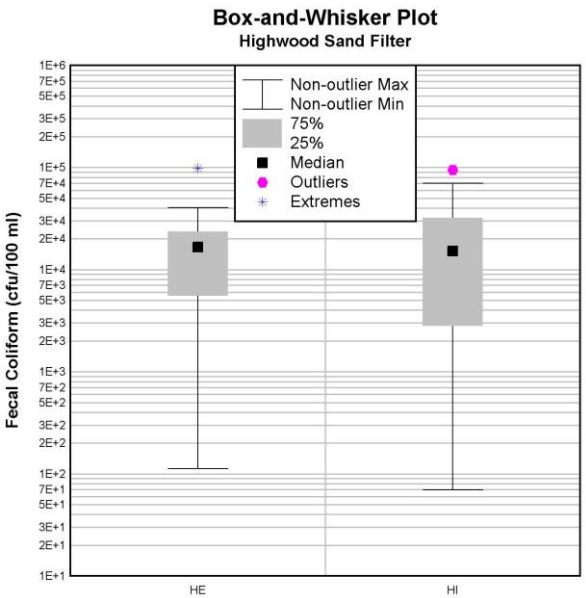


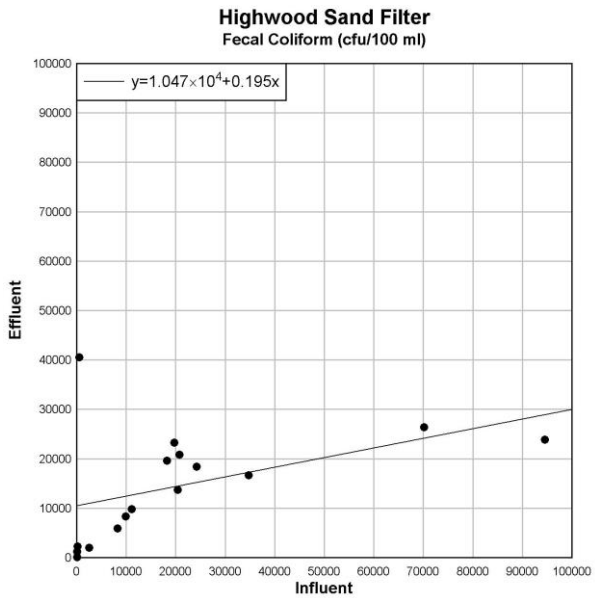
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	19	21
	Pairs Count	15	15
Non-Parametric	Maximum	0.582	0.337
	Upper Quartile	0.275	0.209
	Median	0.149	0.167
	Lower Quartile	0.020	0.020
	Minimum	0.020	0.020
	Efficiency	-11.87%	
	Mann-Whitney	0.5516	
	Wilcoxon (paired)	0.8984	
Arithmetic	UCL	0.243	0.186
	Mean	0.167	0.137
	LCL	0.091	0.087
	Std. Dev.	0.158	0.109
	Wilk (p-value)	0.0080 **	0.0054 **
	Efficiency	18.17%	
	t-Test (equal var.)	0.4797	
	t-Test (unequal var.)	0.4884	
	t-test (paired)	0.5684	
	Levene Test	0.1509	
Log Transformed	UCL	0.425	0.301
	Mean	0.187	0.153
	LCL	0.083	0.078
	Std. Dev.	0.294	0.214
	Wilk (p-value)	0.0039 **	0.0006 **
	Efficiency	18.23%	
	t-Test (equal var.)	0.8183	
	t-Test (unequal var.)	0.8192	
	t-Test (paired)	0.7842	
	Levene Test	0.3304	
Bootstrap	UCL	0.244	0.186
	Mean	0.171	0.138
	LCL	0.097	0.089
	Std. Dev.	0.153	0.106
	Efficiency	19.22%	

Highwood Sand Filter -Fecal Coliform (cfu/100L)



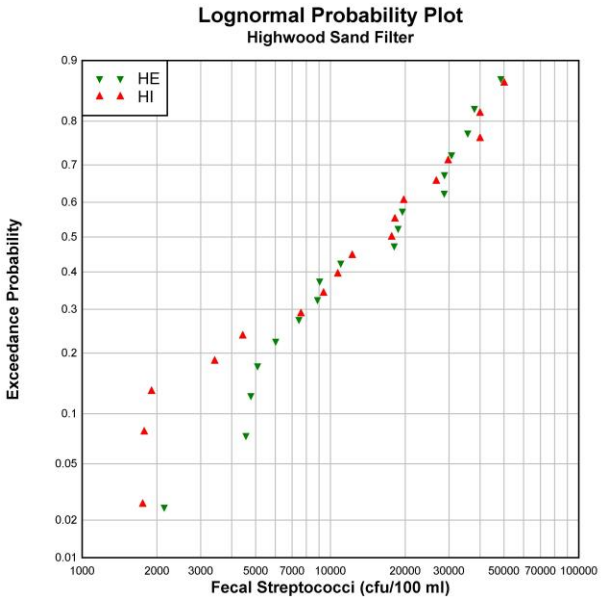


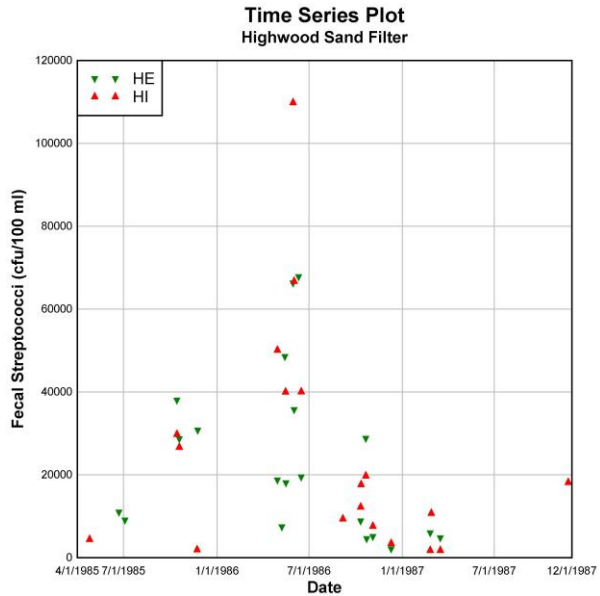


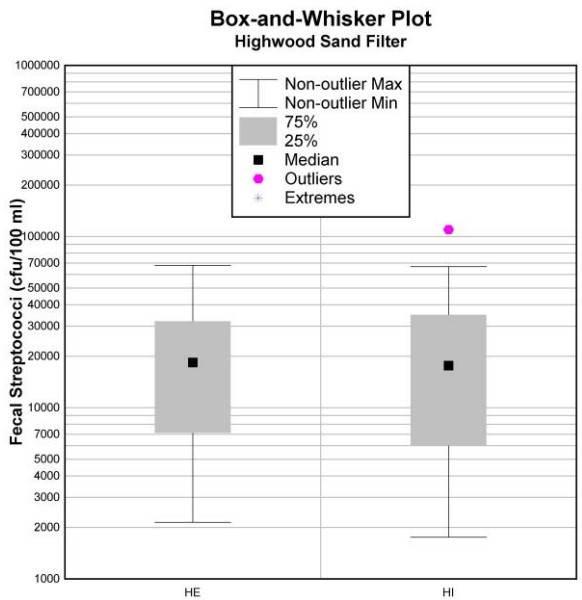


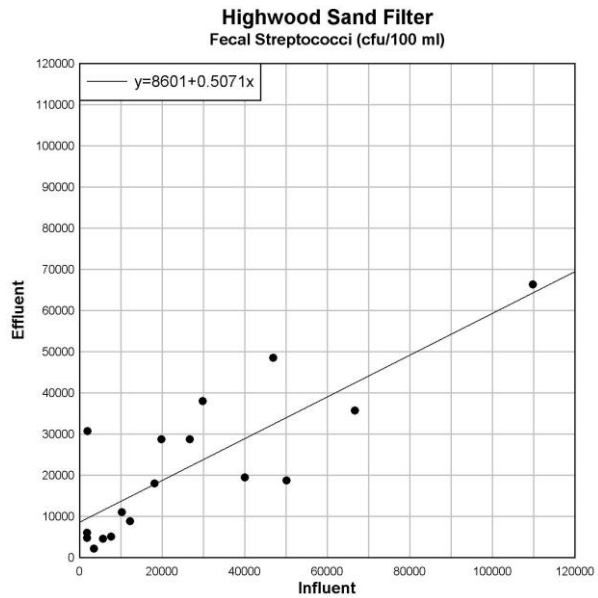
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	18	19
	Pairs Count	14	14
Non-Parametric	Maximum	94,523	98,224
	Upper Quartile	34,719	23,866
	Median	15,122	16,693
	Lower Quartile	2,518	5,158
	Minimum	70	112
	Efficiency	-10.39%	
	Mann-Whitney	0.9399	
	Wilcoxon (paired)	0.0676 *	
Arithmetic	UCL	36,820	30,002
	Mean	23,464	19,331
	LCL	10,108	8,659
	Std. Dev.	26,855	22,140
	Wilk (p-value)	0.0035 **	0.0001 **
	Efficiency	17.62%	
	t-Test (equal var.)	0.6119	
	t-Test (unequal var.)	0.6139	
	t-test (paired)	0.0935 *	
	Levene Test	0.6186	
Log Transformed	UCL	519,764	85,910
	Mean	60,032	28,065
	LCL	6,934	9,168
	Std. Dev.	245,284	60,006
	Wilk (p-value)	0.0159 **	0.0303 **
	Efficiency	53.25%	
	t-Test (equal var.)	0.6002	
	t-Test (unequal var.)	0.6044	
	t-Test (paired)	0.8555	
	Levene Test	0.1535	
Bootstrap	UCL	35,987	28,814
	Mean	23,304	19,040
	LCL	10,620	9,267
	Std. Dev.	25,505	20,278
	Efficiency	18.30%	

Highwood Sand Filter -Fecal Streptococci (cfu/100L)



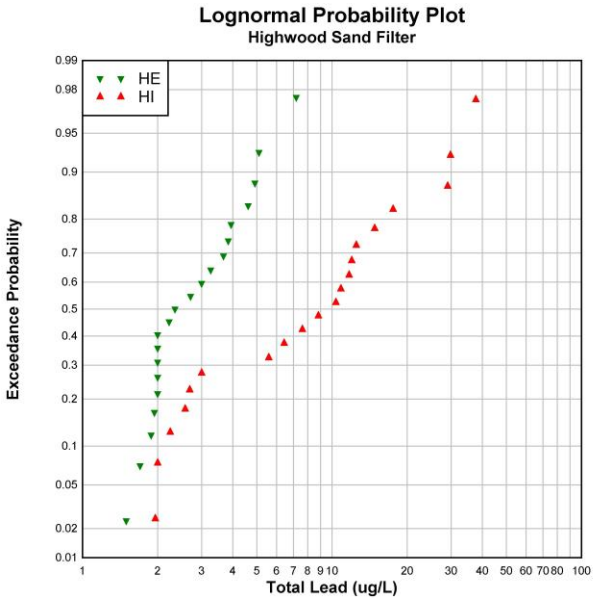


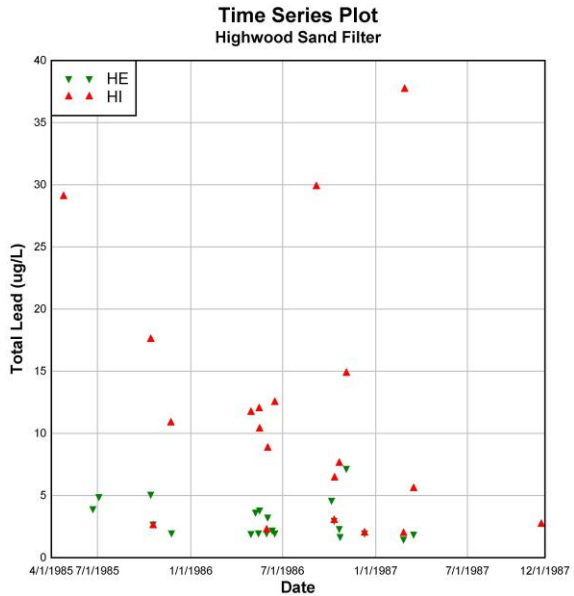


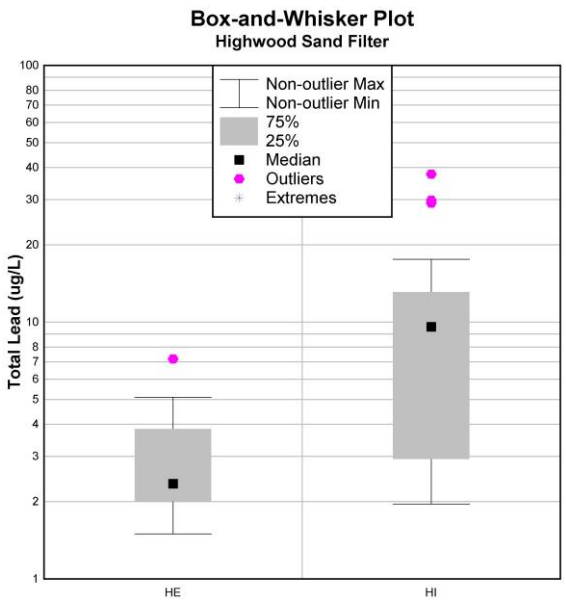


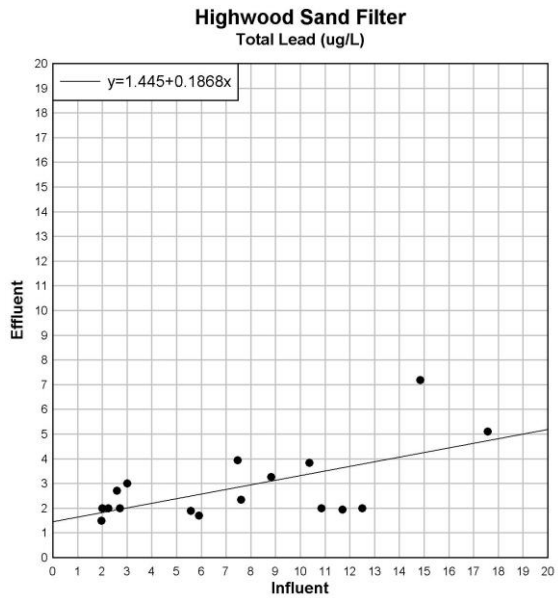
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	19	20
	Pairs Count	15	15
Non-Parametric	Maximum	109,826	67,829
	Upper Quartile	40,000	33,253
	Median	17,643	18,396
	Lower Quartile	4,430	6,738
	Minimum	1,753	2,139
	Efficiency	-4.26%	
	Mann-Whitney	0.8125	
	Wilcoxon (paired)	0.3894	
Arithmetic	UCL	38,081	32,361
	Mean	24,838	22,999
	LCL	11,596	13,638
	Std. Dev.	27,474	20,003
	Wilk (p-value)	0.0009 **	0.0083 **
	Efficiency	7.40%	
	t-Test (equal var.)	0.8117	
	t-Test (unequal var.)	0.8134	
	t-test (paired)	0.1100	
	Levene Test	0.3898	
Log Transformed	UCL	61,864	42,587
	Mean	27,371	24,073
	LCL	12,110	13,608
	Std. Dev.	42,771	27,627
	Wilk (p-value)	0.4620	0.5084
	Efficiency	12.05%	
	t-Test (equal var.)	0.7149	
	t-Test (unequal var.)	0.7167	
	t-Test (paired)	0.6082	
	Levene Test	0.1890	
Bootstrap	UCL	37,112	31,969
	Mean	24,664	22,926
	LCL	12,216	13,883
	Std. Dev.	25,827	19,322
	Efficiency	7.05%	

Highwood Sand Filter -Total Lead (ug/L)



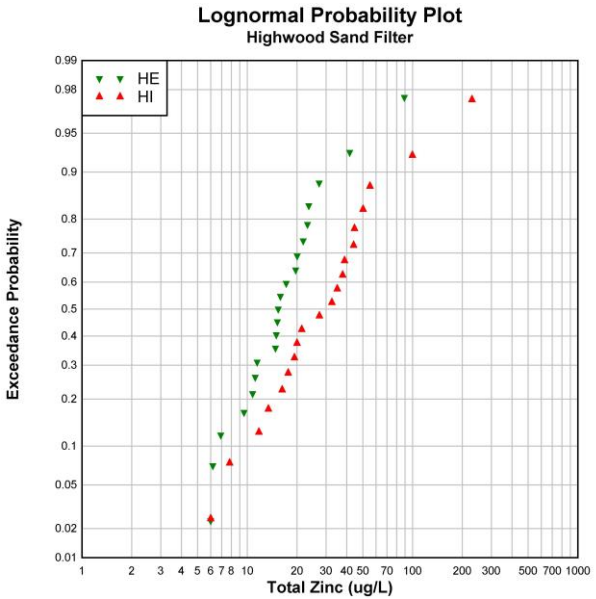


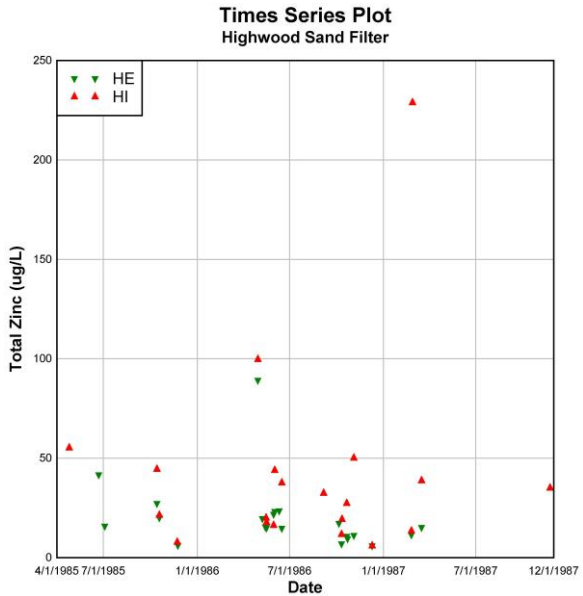


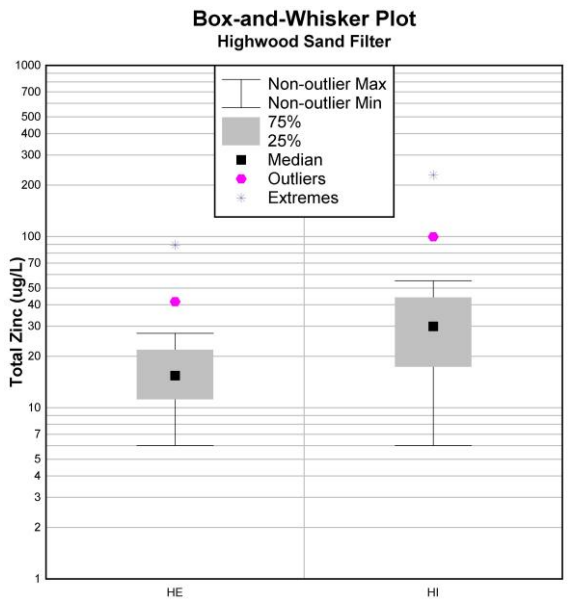


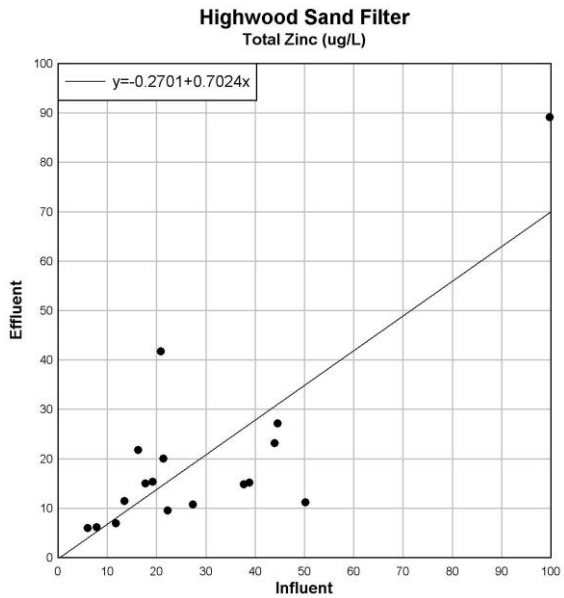
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	37.7	7.2
	Upper Quartile	13.7	3.8
	Median	9.6	2.3
	Lower Quartile	2.8	2.0
	Minimum	2.0	1.5
	Efficiency	75.53%	
	Mann-Whitney	0.0011 **	
	Wilcoxon (paired)	0.0009 **	
Arithmetic	UCL	16.2	3.7
	Mean	11.5	3.0
	LCL	6.7	2.4
	Std. Dev.	10.2	1.5
	Wilk (p-value)	0.0025 **	0.0037 **
	Efficiency	73.49%	
	t-Test (equal var.)	0.0006 **	
	t-Test (unequal var.)	0.0015 **	
	t-test (paired)	0.0007 **	
	Levene Test	0.0123 **	
Log Transformed	UCL	19.9	3.7
	Mean	11.8	3.0
	LCL	6.9	2.5
	Std. Dev.	12.5	1.3
	Wilk (p-value)	0.1969	0.0899 *
	Efficiency	74.30%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0002 **	
	Levene Test	0.0009 **	
Bootstrap	UCL	16.0	3.7
	Mean	11.4	3.0
	LCL	6.9	2.4
	Std. Dev.	9.7	1.4
	Efficiency	73.39%	

Highwood Sand Filter - Total Zinc (ug/L)



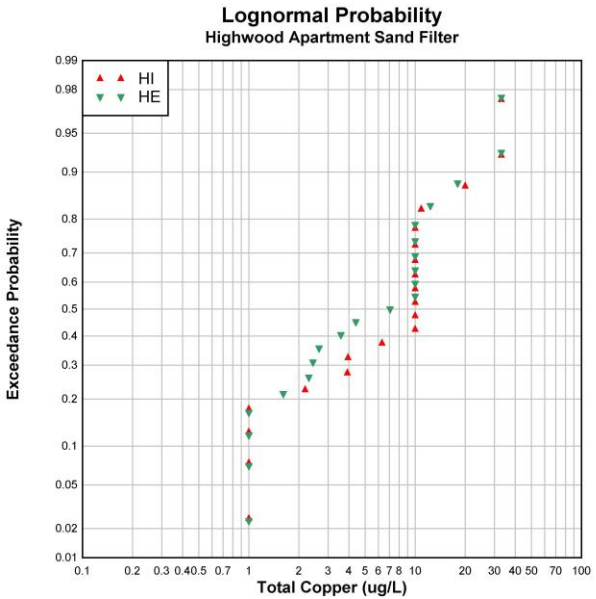


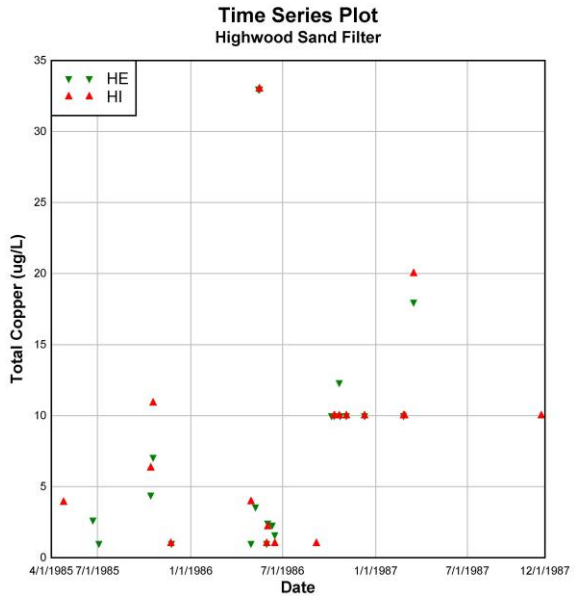


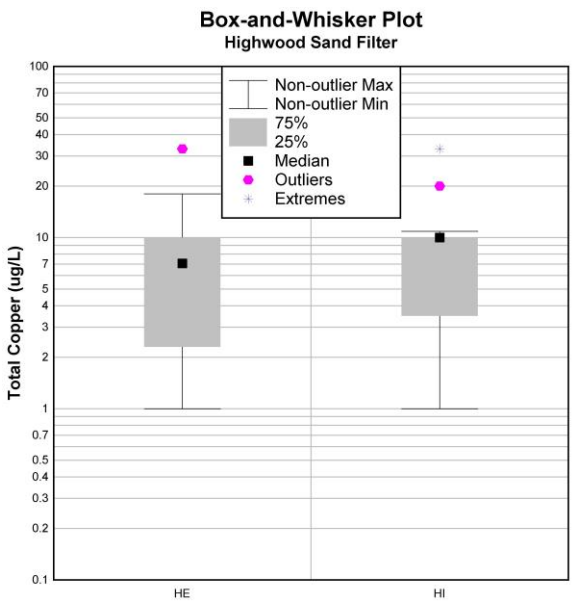


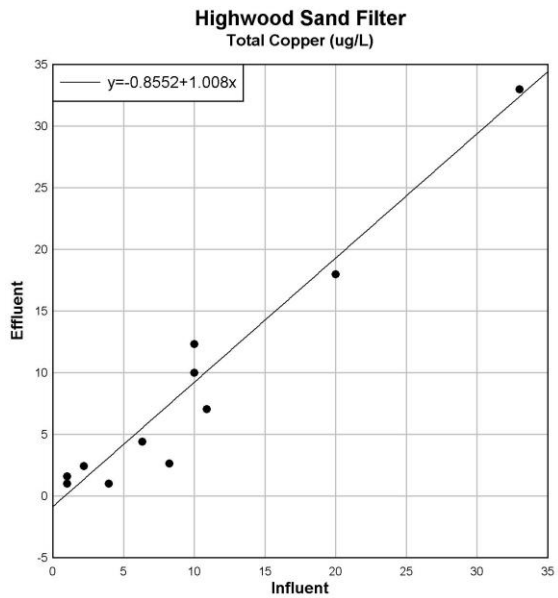
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	228.9	89.1
	Upper Quartile	44.2	21.8
	Median	29.9	15.4
	Lower Quartile	17.0	11.2
	Minimum	6.0	6.0
	Efficiency	48.44%	
	Mann-Whitney	0.0232 **	
	Wilcoxon (paired)	0.0181 **	
Arithmetic	UCL	64.3	28.2
	Mean	41.4	20.1
	LCL	18.4	12.0
	Std. Dev.	49.1	17.8
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	51.43%	
	t-Test (equal var.)	0.0701 *	
	t-Test (unequal var.)	0.0803 *	
	t-test (paired)	0.0195 **	
	Levene Test	0.2531	
Log Transformed	UCL	62.7	26.6
	Mean	39.4	19.4
	LCL	24.7	14.2
	Std. Dev.	37.2	13.0
	Wilk (p-value)	0.8254	0.2495
	Efficiency	50.69%	
	t-Test (equal var.)	0.0212 **	
	t-Test (unequal var.)	0.0227 **	
	t-Test (paired)	0.0121 **	
	Levene Test	0.2798	
Bootstrap	UCL	61.3	26.8
	Mean	41.1	19.7
	LCL	20.9	12.7
	Std. Dev.	43.2	15.4
	Efficiency	51.95%	

Highwood Sand Filter -Total Copper (ug/L)









	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: HI**	**EFF: HE**
	Site Count	20	21
	Pairs Count	15	15
Non-Parametric	Maximum	33.0	33.0
	Upper Quartile	10.0	10.0
	Median	10.0	7.1
	Lower Quartile	3.0	2.3
	Minimum	1.0	1.0
	Efficiency	29.36%	
	Mann-Whitney	0.6227	
	Wilcoxon (paired)	0.2474	
Arithmetic	UCL	14.2	13.0
	Mean	9.9	8.8
	LCL	5.5	4.5
	Std. Dev.	9.3	9.3
	Wilk (p-value)	0.0003 **	0.0001 **
	Efficiency	10.99%	
	t-Test (equal var.)	0.7111	
	t-Test (unequal var.)	0.7110	
	t-test (paired)	0.1147	
	Levene Test	0.9780	
Log Transformed	UCL	21.5	18.1
	Mean	10.9	9.2
	LCL	5.5	4.7
	Std. Dev.	14.8	12.8
	Wilk (p-value)	0.0101 **	0.0743 *
	Efficiency	15.36%	
	t-Test (equal var.)	0.6041	
	t-Test (unequal var.)	0.6040	
	t-Test (paired)	0.1878	
	Levene Test	0.9273	
Bootstrap	UCL	13.9	13.0
	Mean	9.8	8.9
	LCL	5.7	4.9
	Std. Dev.	8.7	8.9
	Efficiency	8.66%	

Barton Creek Square Mall Sand Filter (SI-SE)

This site was initially monitored by the USGS them by the initial COA monitoring program. This control treats runoff from Barton Creek Square Mall influent. See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed. The pond is considered on-line, once the 3.5 acre-feet capacity was exceeded, runoff entered a standpipe and was combined with the effluent, a splitter box was not incorporated.

The filter bed was originally designed with eighteen inches of fine sand overlying twelve inches of coarse sand with gravel /PVC pipe under drain system. The sand media was changed several times during the monitoring period so it is doubtful that the sand composition remained the same.

WQM collected runoff and water quality data at the Barton Creek Square Mall sand filter (SI-SE) from 1985 to 1987. During this time 24 and 20 valid EMCs were collected at the influent (SI) and effluent (SE) respectively, of which 15 were paired.

Performance Summary

The Barton Creek Square Mall sand filter had the best performance with the reduction of the concentrations of TSS and some metals. TSS was reduced by 50% and was significant in all cases, paired or not paired. TDS was increased by 69% and was significant in any case.

COD and TOC concentrations were reduced by 33% and 16% respectively, and were only significant if data are paired. BOD was reduced by 36% and was not significant in any case.

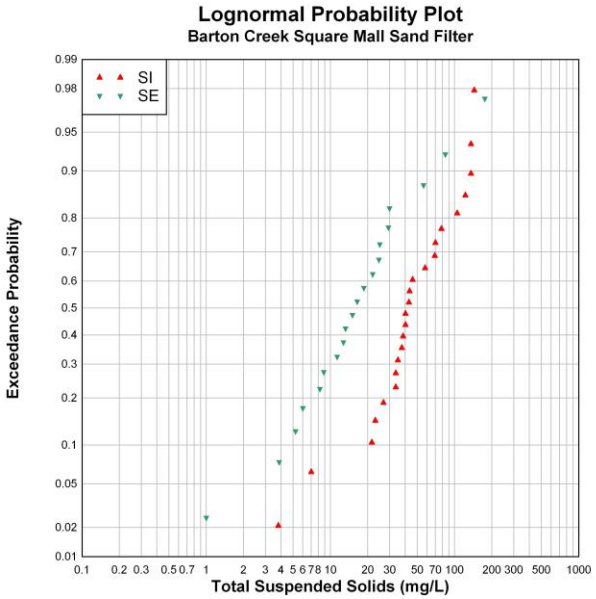
Total nitrogen concentration was increased by 8% and was not significant in any case. The increase of concentration in nitrate + nitrite (122%) was significant in any case. Total Kjeldahl nitrogen concentration was reduced by 46% and was only significant if data are paired. Ammonia concentration was reduced by 44% and was only significant if data are not paired.

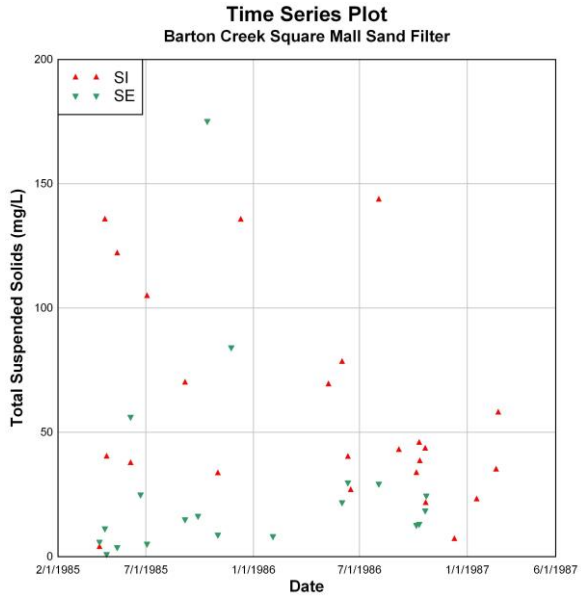
TP concentration was reduced by 38% and was only significant if data are paired.

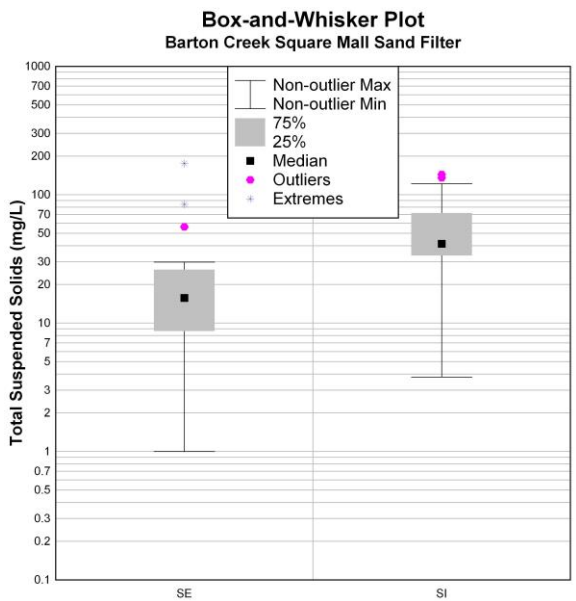
The reduction of bacteria was not significant in any case for FCOL (20%), and was only significant if data are paired for FSTR (17%).

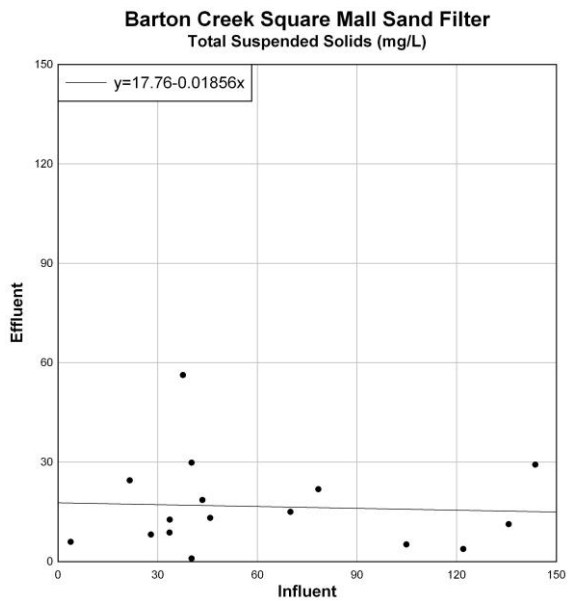
Lead and zinc concentrations were reduced by 85% and 77% respectively, and were significant in all cases. Copper concentration was reduced by 28% and was not significant in all case.

Barton Creek Square Mall Sand Filter - Total Suspended Solids (mg/L)



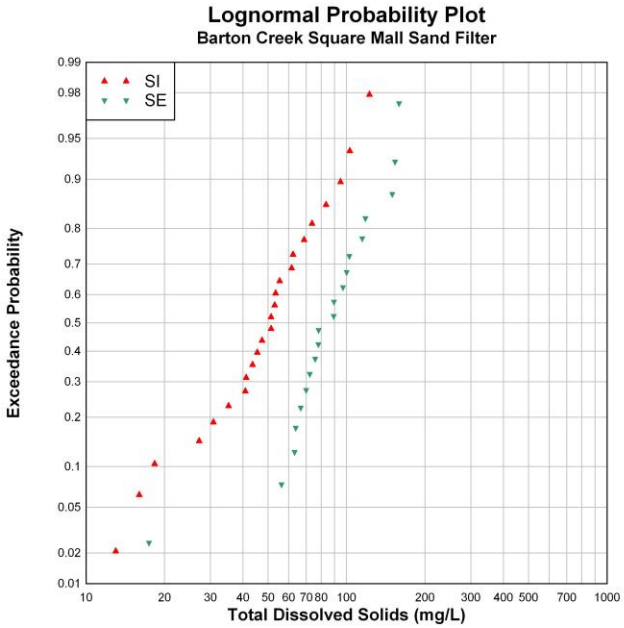


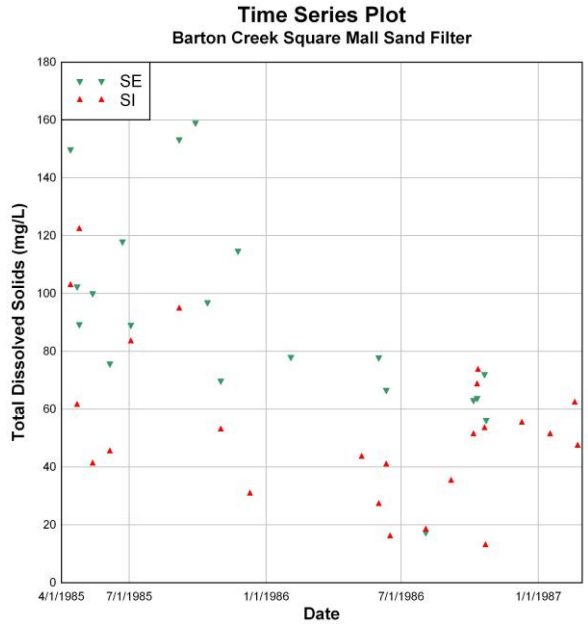


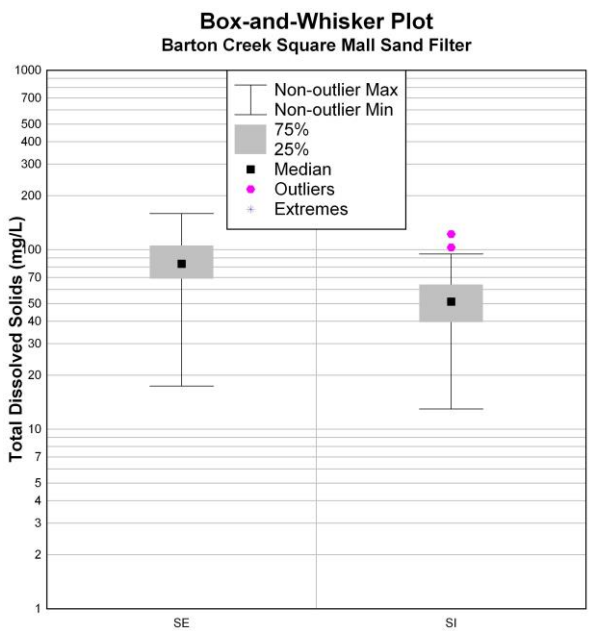


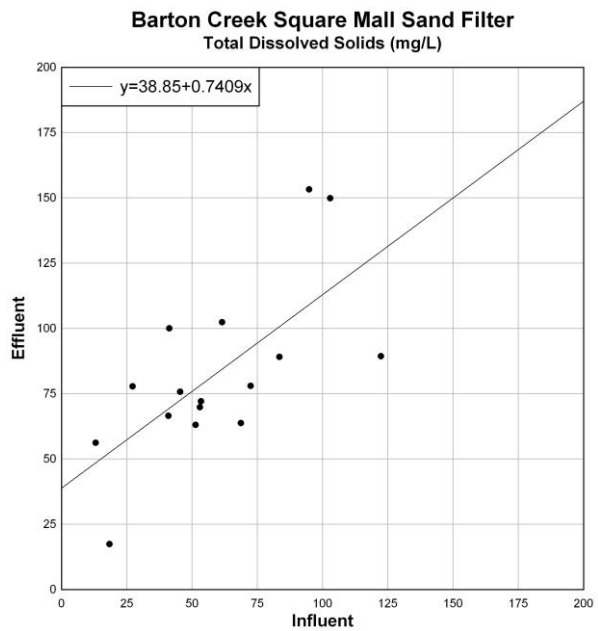
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	143.6	175.3
	Upper Quartile	74.1	27.2
	Median	41.5	15.7
	Lower Quartile	33.6	8.5
	Minimum	3.8	1.0
	Efficiency	62.13%	
	Mann-Whitney	0.0018 **	
	Wilcoxon (paired)	0.0004 **	
Arithmetic	UCL	75.3	46.9
	Mean	57.9	28.3
	LCL	40.5	9.8
	Std. Dev.	41.2	39.7
	Wilk (p-value)	0.0042 **	0.0001 **
	Efficiency	51.04%	
	t-Test (equal var.)	0.0205 **	
	t-Test (unequal var.)	0.0202 **	
	t-test (paired)	0.0012 **	
	Levene Test	0.9013	
Log Transformed	UCL	95.7	55.8
	Mean	62.1	28.2
	LCL	40.2	14.2
	Std. Dev.	61.2	38.5
	Wilk (p-value)	0.0248 **	0.8769
	Efficiency	54.58%	
	t-Test (equal var.)	0.0015 **	
	t-Test (unequal var.)	0.0021 **	
	t-Test (paired)	0.0004 **	
	Levene Test	0.3464	
Bootstrap	UCL	74.2	45.4
	Mean	57.4	28.5
	LCL	40.6	11.6
	Std. Dev.	39.7	36.1
	Efficiency	50.39%	

Barton Creek Square Mall Sand Filter - Total Dissolved Solids (mg/L)



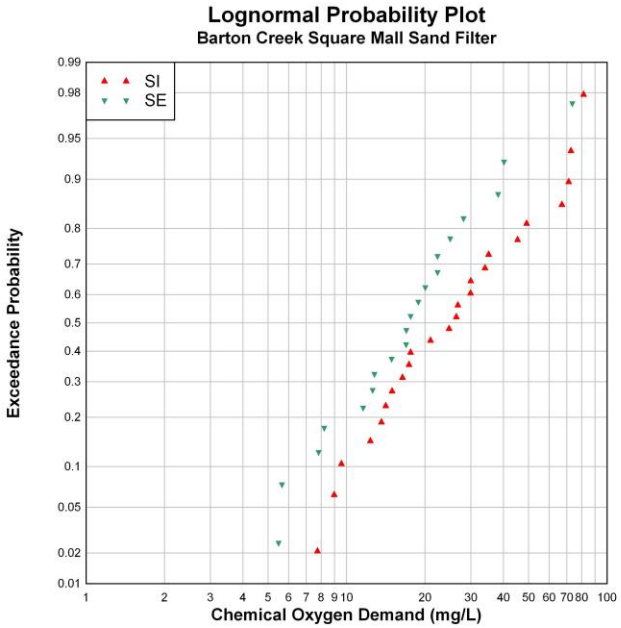


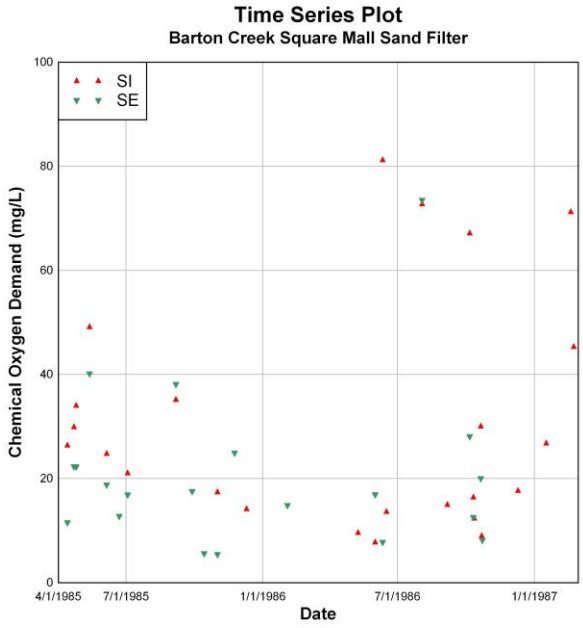


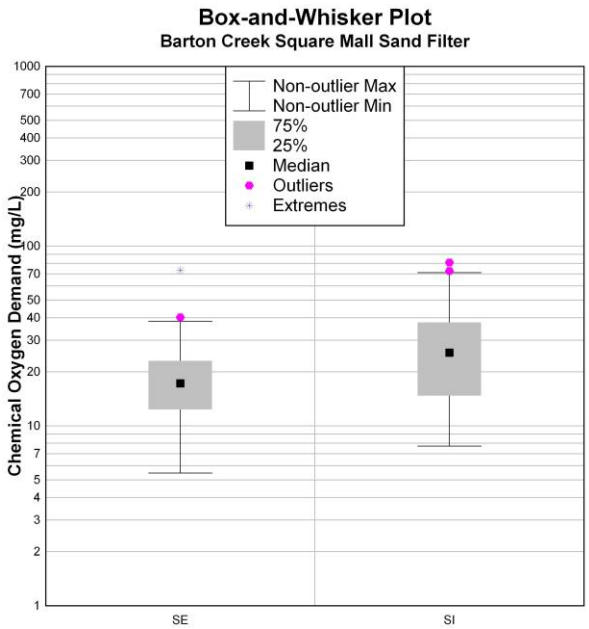


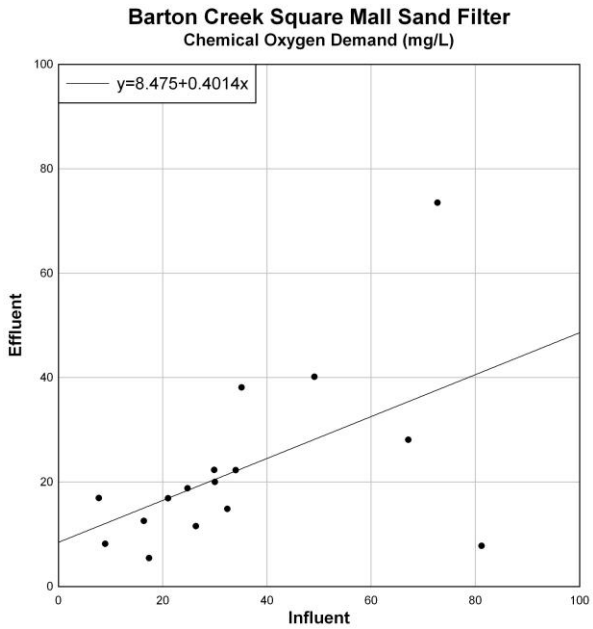
	PARAMETER	TDS (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	122.30	159.08
	Upper Quartile	65.46	108.59
	Median	51.33	83.58
	Lower Quartile	38.06	68.24
	Minimum	12.98	17.43
	Efficiency	-62.84%	
	Mann-Whitney	0.0007 **	
	Wilcoxon (paired)	0.0054 **	
Arithmetic	UCL	65.31	107.19
	Mean	53.86	90.69
	LCL	42.42	74.19
	Std. Dev.	27.11	35.26
	Wilk (p-value)	0.2626	0.2595
	Efficiency	-68.37%	
	t-Test (equal var.)	0.0003 **	
	t-Test (unequal var.)	0.0005 **	
	t-test (paired)	0.0054 **	
	Levene Test	0.2645	
Log Transformed	UCL	70.60	117.09
	Mean	54.68	92.42
	LCL	42.36	72.95
	Std. Dev.	32.35	45.75
	Wilk (p-value)	0.3417	0.0053 **
	Efficiency	-69.01%	
	t-Test (equal var.)	0.0009 **	
	t-Test (unequal var.)	0.0008 **	
	t-Test (paired)	0.0040 **	
	Levene Test	0.5702	
Bootstrap	UCL	64.51	106.60
	Mean	53.49	90.59
	LCL	42.47	74.59
	Std. Dev.	26.09	34.19
	Efficiency	-69.36%	

Barton Creek Square Mall Sand Filter - Chemical Oxygen Demand (mg/L)



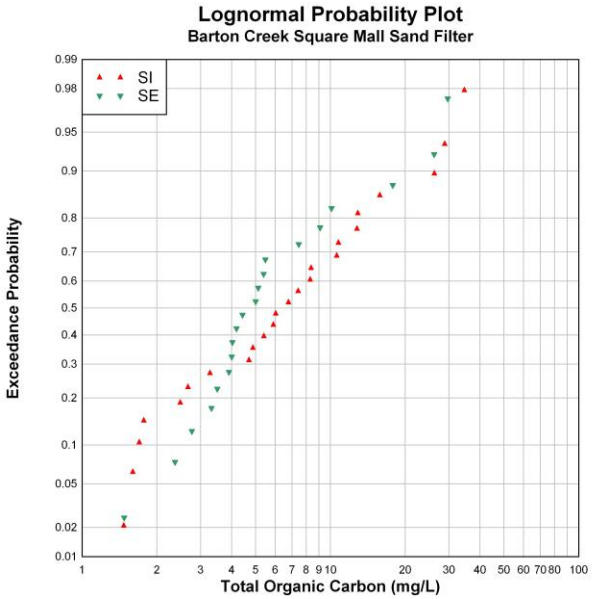


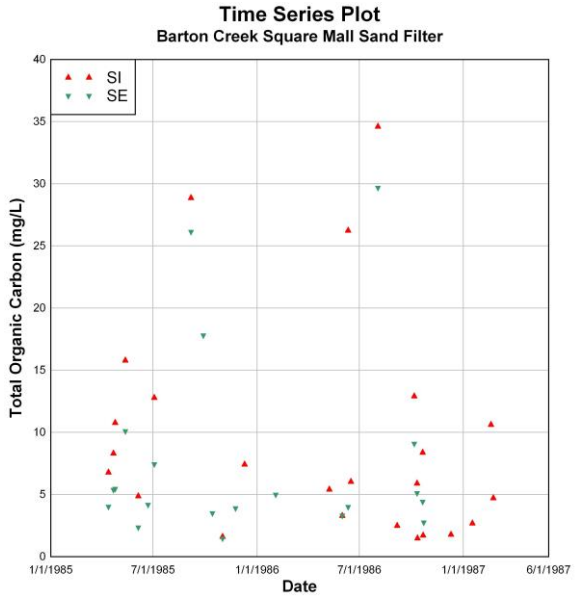


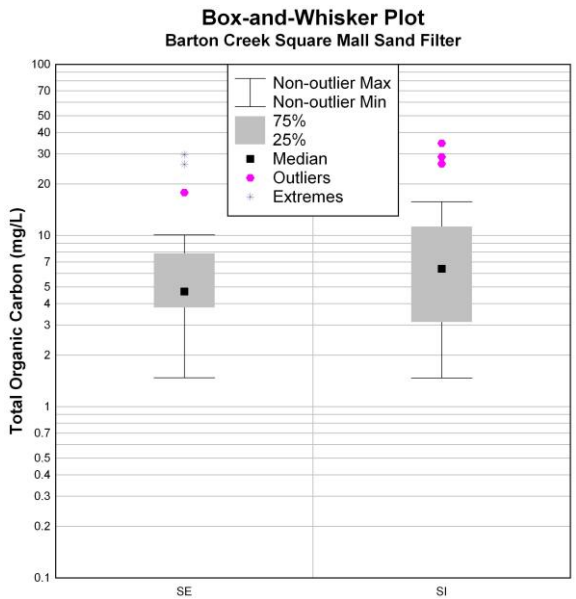


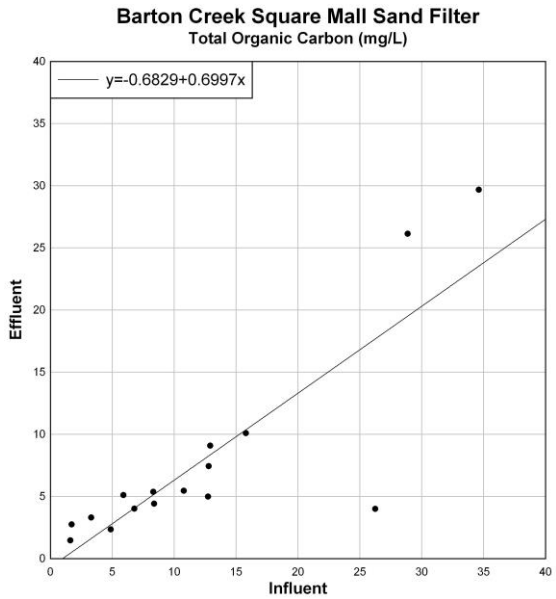
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	81.17	73.53
	Upper Quartile	40.20	23.66
	Median	25.54	17.28
	Lower Quartile	14.53	12.07
	Minimum	7.73	5.48
	Efficiency	32.35%	
	Mann-Whitney	0.1137	
	Wilcoxon (paired)	0.0034 **	
Arithmetic	UCL	40.43	28.24
	Mean	31.12	20.95
	LCL	21.81	13.65
	Std. Dev.	22.04	15.59
	Wilk (p-value)	0.0022 **	0.0005 **
	Efficiency	32.69%	
	t-Test (equal var.)	0.0905 *	
	t-Test (unequal var.)	0.0813 *	
	t-test (paired)	0.0241 **	
	Levene Test	0.2265	
Log Transformed	UCL	43.05	29.15
	Mean	31.07	20.79
	LCL	22.43	14.83
	Std. Dev.	23.27	14.50
	Wilk (p-value)	0.4876	0.8836
	Efficiency	33.09%	
	t-Test (equal var.)	0.0724 *	
	t-Test (unequal var.)	0.0711 *	
	t-Test (paired)	0.0185 **	
	Levene Test	0.7427	
Bootstrap	UCL	40.08	27.71
	Mean	31.04	20.89
	LCL	22.00	14.07
	Std. Dev.	21.40	14.57
	Efficiency	32.71%	

Barton Creek Square Mall Sand Filter - Total Organic Carbon (mg/L)



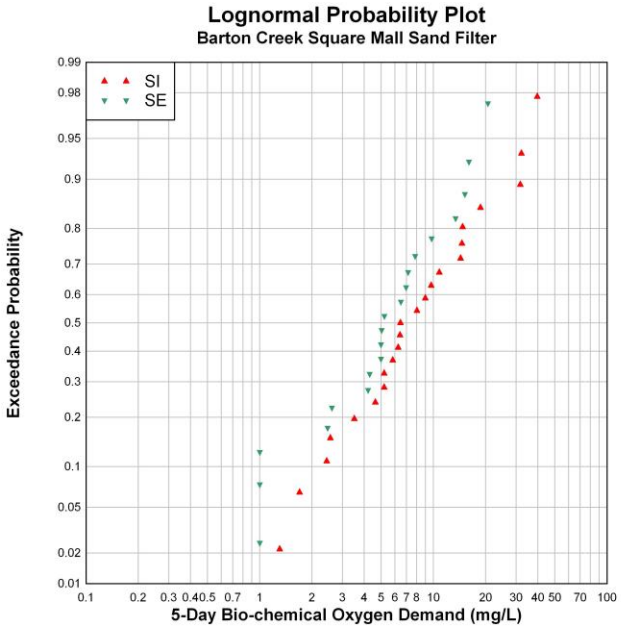


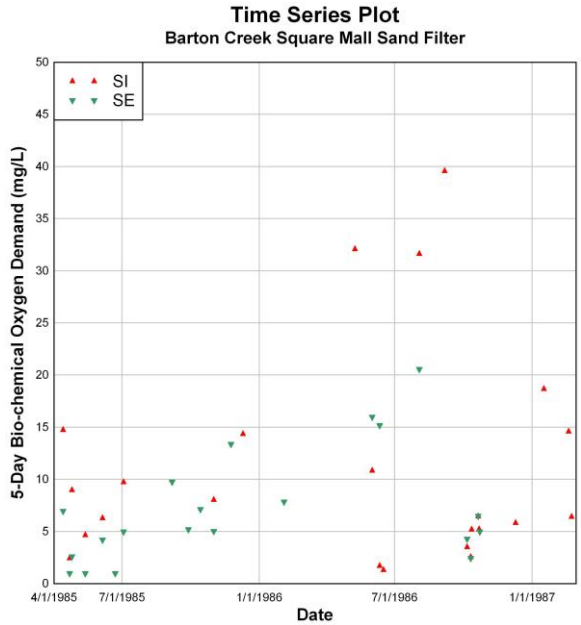


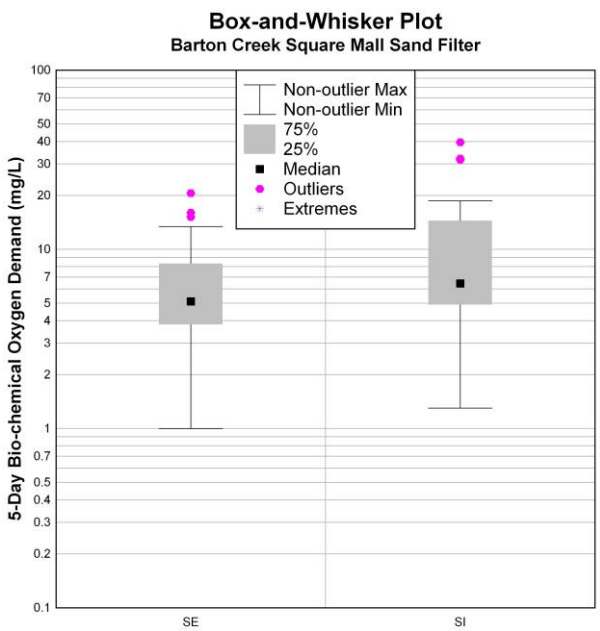


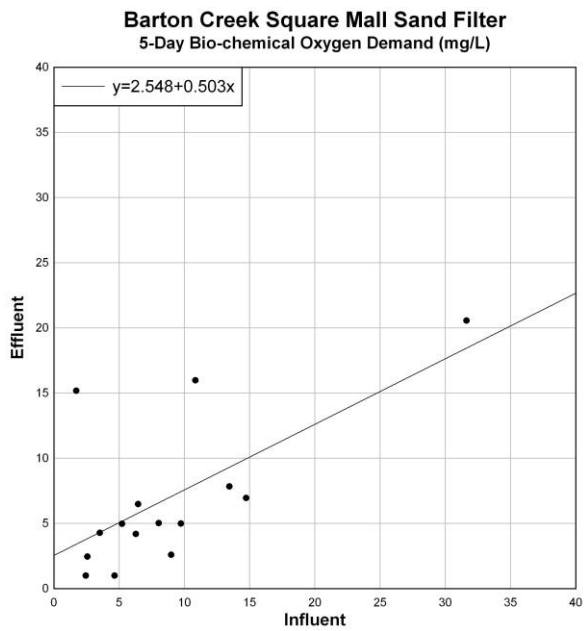
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	34.61	29.68
	Upper Quartile	11.77	8.27
	Median	6.40	4.71
	Lower Quartile	2.97	3.70
	Minimum	1.47	1.48
	Efficiency	26.34%	
	Mann-Whitney	0.4618	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	13.15	11.40
	Mean	9.38	7.76
	LCL	5.61	4.12
	Std. Dev.	8.93	7.78
	Wilk (p-value)	0.0002 **	0.0001 **
	Efficiency	17.30%	
	t-Test (equal var.)	0.5281	
	t-Test (unequal var.)	0.5228	
	t-test (paired)	0.0040 **	
	Levene Test	0.6562	
Log Transformed	UCL	15.04	11.14
	Mean	9.44	7.38
	LCL	5.93	4.89
	Std. Dev.	9.99	6.20
	Wilk (p-value)	0.5087	0.1077
	Efficiency	21.83%	
	t-Test (equal var.)	0.6318	
	t-Test (unequal var.)	0.6262	
	t-Test (paired)	0.0009 **	
	Levene Test	0.3511	
Bootstrap	UCL	12.81	11.21
	Mean	9.25	7.78
	LCL	5.68	4.35
	Std. Dev.	8.44	7.33
	Efficiency	15.83%	

Barton Creek Square Mall Sand Filter - 5-Day Bio-chemical Oxygen Demand (mg/L)



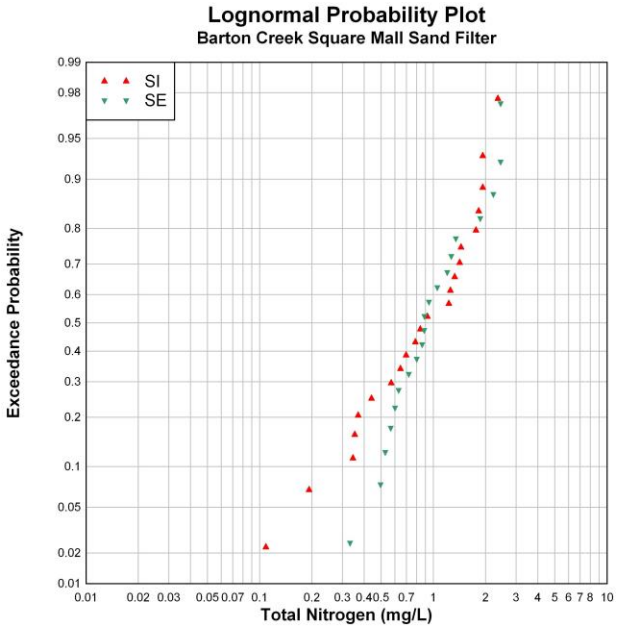


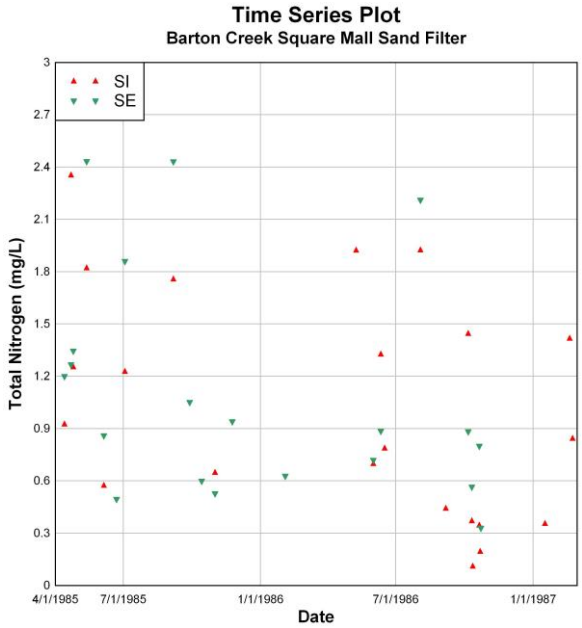


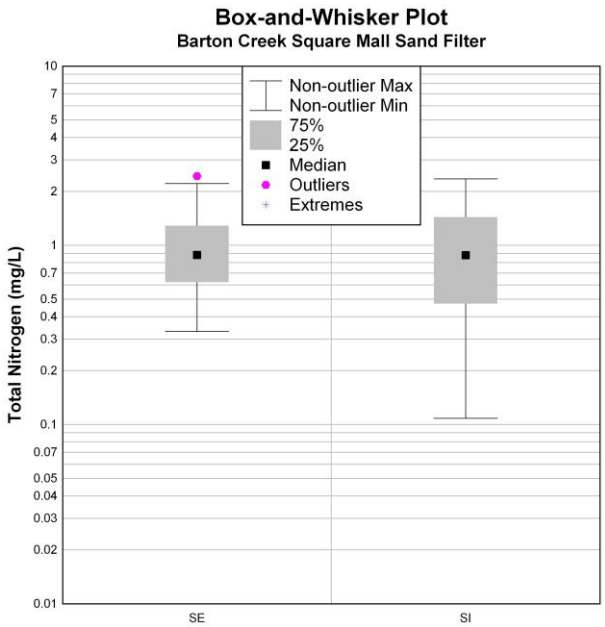


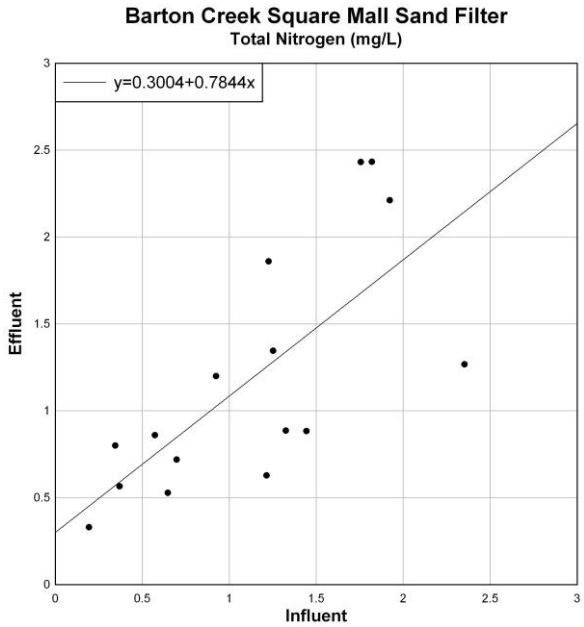
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	23	20
	Pairs Count	14	14
Non-Parametric	Maximum	39.55	20.58
	Upper Quartile	14.58	8.80
	Median	6.45	5.12
	Lower Quartile	4.63	3.40
	Minimum	1.30	1.00
	Efficiency	20.50%	
	Mann-Whitney	0.2348	
	Wilcoxon (paired)	0.1189	
Arithmetic	UCL	15.56	9.55
	Mean	11.07	7.01
	LCL	6.57	4.47
	Std. Dev.	10.39	5.43
	Wilk (p-value)	0.0003 **	0.0169 **
	Efficiency	36.68%	
	t-Test (equal var.)	0.1243	
	t-Test (unequal var.)	0.1114	
	t-test (paired)	0.2628	
	Levene Test	0.0972 *	
Log Transformed	UCL	17.90	12.16
	Mean	11.17	7.37
	LCL	6.97	4.47
	Std. Dev.	11.66	7.47
	Wilk (p-value)	0.8787	0.1457
	Efficiency	33.96%	
	t-Test (equal var.)	0.1564	
	t-Test (unequal var.)	0.1561	
	t-Test (paired)	0.2349	
	Levene Test	0.9181	
Bootstrap	UCL	15.38	9.48
	Mean	11.07	7.05
	LCL	6.76	4.63
	Std. Dev.	9.97	5.19
	Efficiency	36.26%	

Barton Creek Square Mall Sand Filter - Total Nitrogen (mg/L)



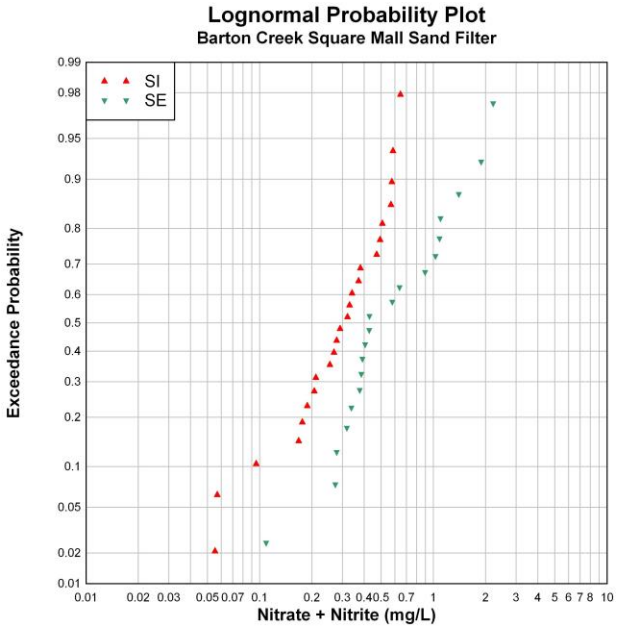


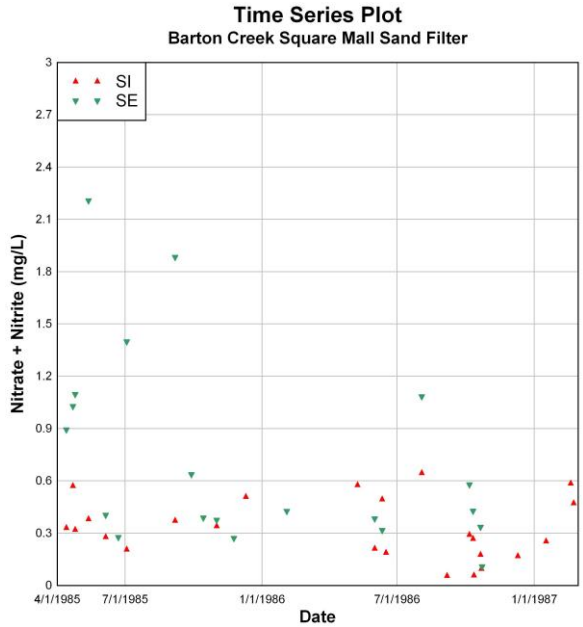


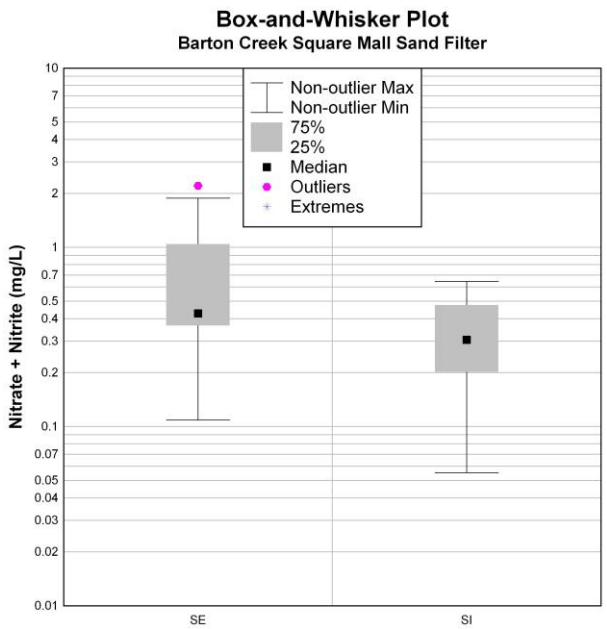


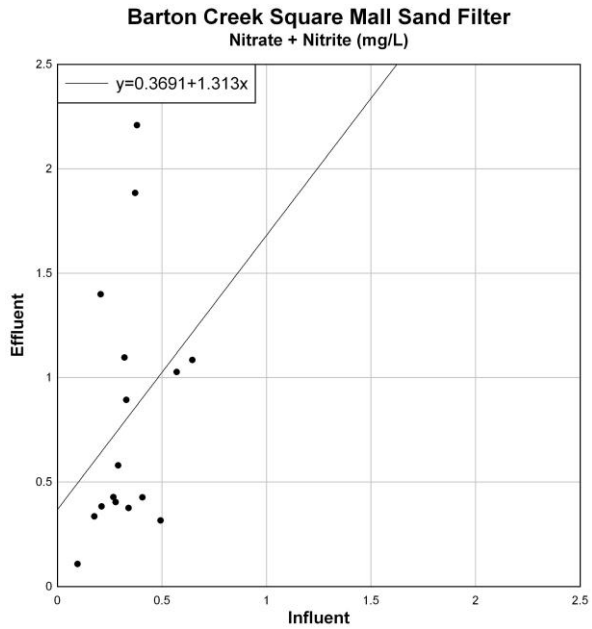
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	22	20
	Pairs Count	15	15
Non-Parametric	Maximum	2.352	2.434
	Upper Quartile	1.443	1.307
	Median	0.882	0.885
	Lower Quartile	0.440	0.615
	Minimum	0.109	0.331
	Efficiency	-0.36%	
	Mann-Whitney	0.7169	
	Wilcoxon (paired)	0.4887	
Arithmetic	UCL	1.319	1.405
	Mean	1.032	1.103
	LCL	0.744	0.800
	Std. Dev.	0.648	0.646
	Wilk (p-value)	0.2692	0.0061 **
	Efficiency	-6.88%	
	t-Test (equal var.)	0.7245	
	t-Test (unequal var.)	0.7245	
	t-test (paired)	0.7031	
	Levene Test	0.9733	
Log Transformed	UCL	1.658	1.454
	Mean	1.092	1.099
	LCL	0.719	0.830
	Std. Dev.	0.987	0.640
	Wilk (p-value)	0.1444	0.6038
	Efficiency	-0.62%	
	t-Test (equal var.)	0.4335	
	t-Test (unequal var.)	0.4257	
	t-Test (paired)	0.6200	
	Levene Test	0.1189	
Bootstrap	UCL	1.293	1.388
	Mean	1.016	1.098
	LCL	0.740	0.808
	Std. Dev.	0.623	0.620
	Efficiency	-8.05%	

Barton Creek Square Mall Sand Filter - Nitrate + Nitrite (mg/L)



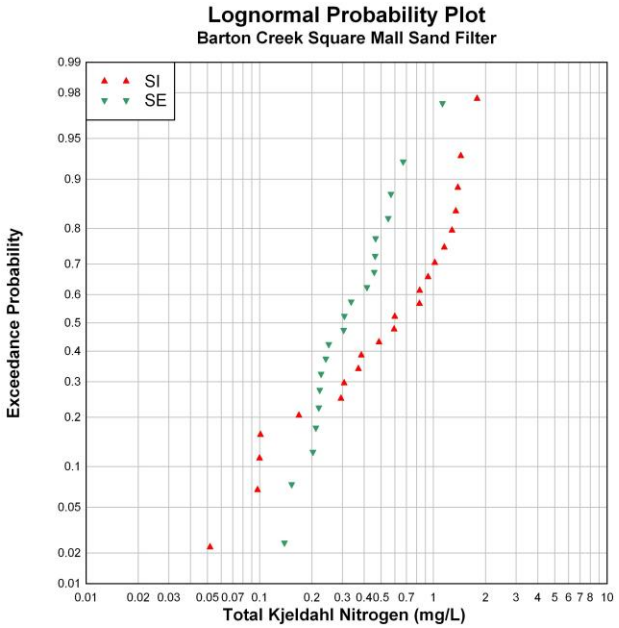


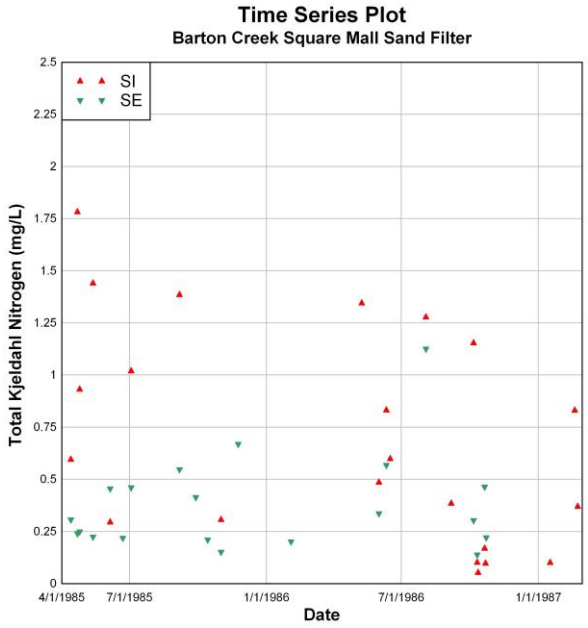


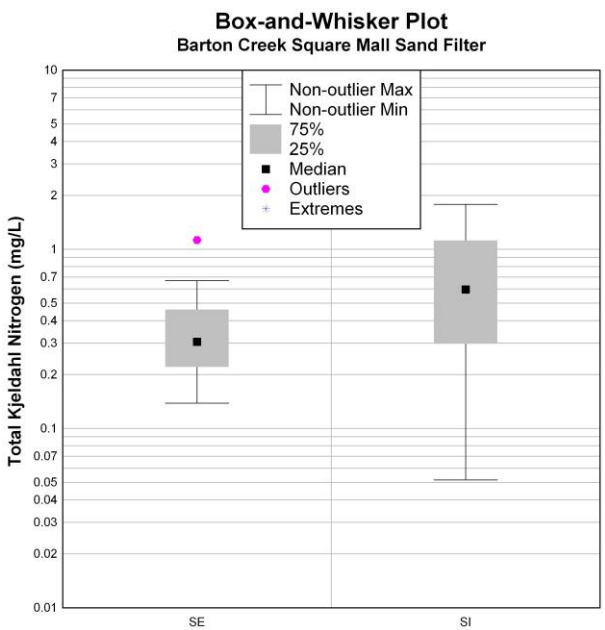


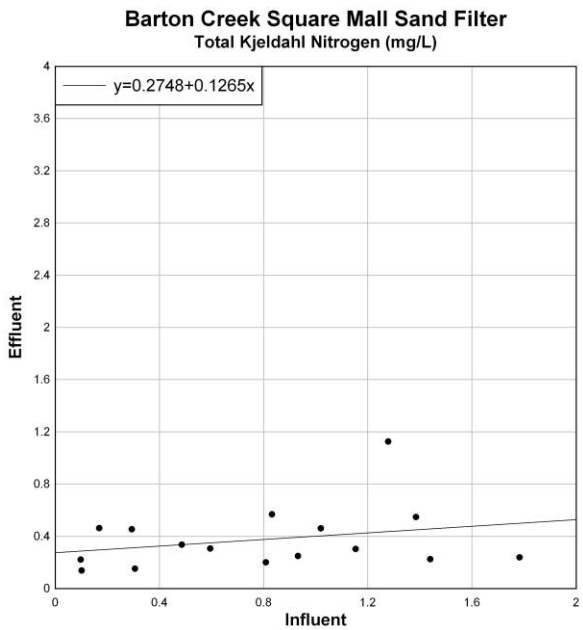
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	0.645	2.209
	Upper Quartile	0.482	1.057
	Median	0.305	0.428
	Lower Quartile	0.197	0.356
	Minimum	0.055	0.109
	Efficiency	-40.38%	
	Mann-Whitney	0.0061 **	
	Wilcoxon (paired)	0.0012 **	
Arithmetic	UCL	0.399	0.993
	Mean	0.326	0.727
	LCL	0.253	0.461
	Std. Dev.	0.172	0.569
	Wilk (p-value)	0.3776	0.0021 **
	Efficiency	-122.84%	
	t-Test (equal var.)	0.0021 **	
	t-Test (unequal var.)	0.0061 **	
	t-test (paired)	0.0048 **	
	Levene Test	0.0134 **	
Log Transformed	UCL	0.467	1.082
	Mean	0.340	0.726
	LCL	0.247	0.487
	Std. Dev.	0.249	0.593
	Wilk (p-value)	0.0270 **	0.4290
	Efficiency	-113.86%	
	t-Test (equal var.)	0.0018 **	
	t-Test (unequal var.)	0.0021 **	
	t-Test (paired)	0.0006 **	
	Levene Test	0.6701	
Bootstrap	UCL	0.397	0.977
	Mean	0.326	0.723
	LCL	0.255	0.469
	Std. Dev.	0.168	0.542
	Efficiency	-122.04%	

Barton Creek Square Mall Sand Filter - Total Kjeldahl Nitrogen (mg/L)



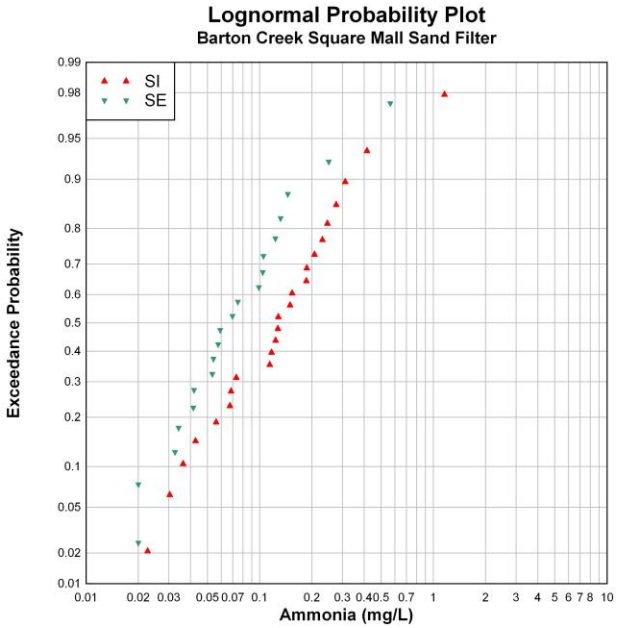


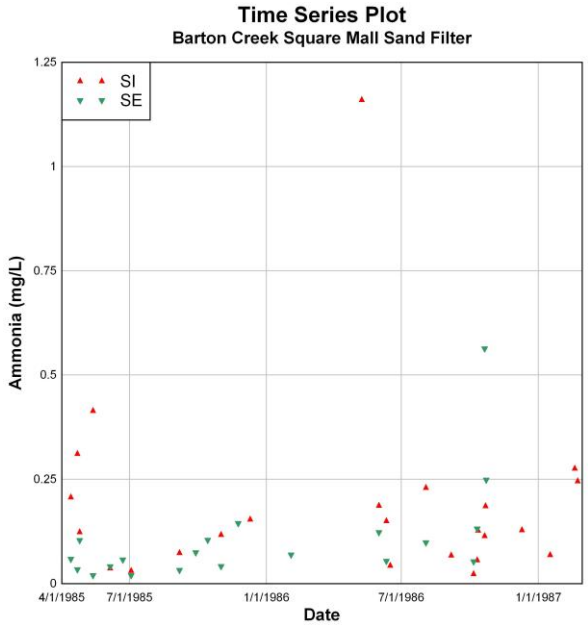


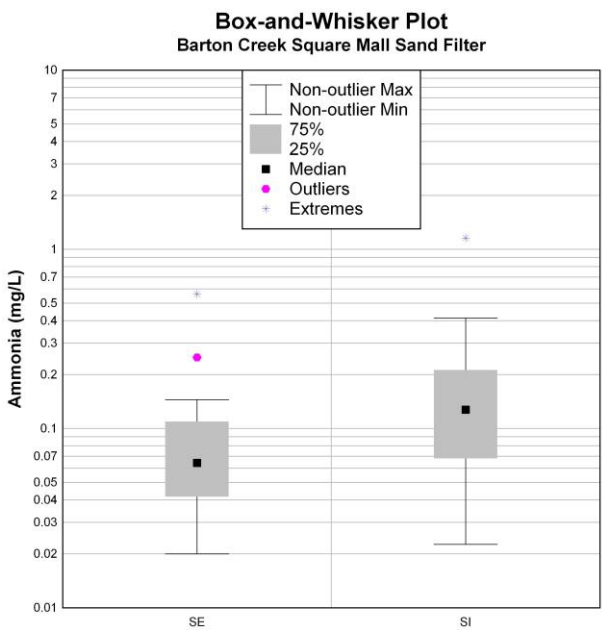


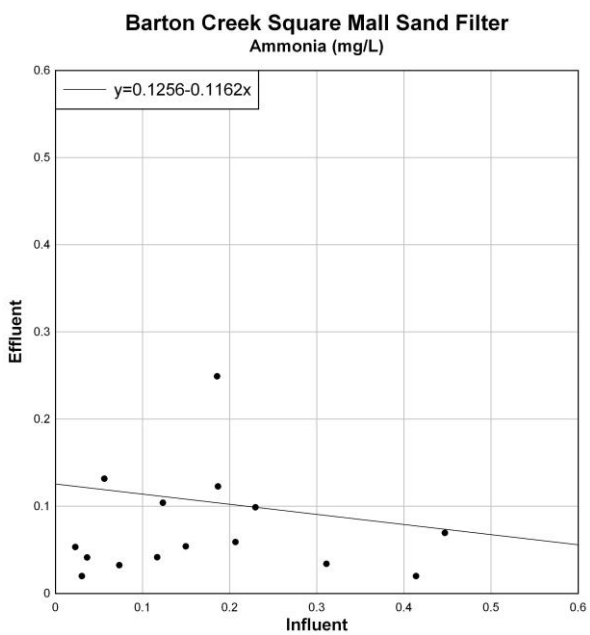
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	22	20
	Pairs Count	15	15
Non-Parametric	Maximum	1.782	1.126
	Upper Quartile	1.153	0.463
	Median	0.596	0.305
	Lower Quartile	0.294	0.220
	Minimum	0.052	0.139
	Efficiency	48.80%	
	Mann-Whitney	0.0752 *	
	Wilcoxon (paired)	0.0067 **	
Arithmetic	UCL	0.938	0.484
	Mean	0.706	0.376
	LCL	0.475	0.267
	Std. Dev.	0.522	0.232
	Wilk (p-value)	0.1150	0.0014 **
	Efficiency	46.82%	
	t-Test (equal var.)	0.0127 **	
	t-Test (unequal var.)	0.0114 **	
	t-test (paired)	0.0041 **	
	Levene Test	0.0023 **	
Log Transformed	UCL	1.404	0.486
	Mean	0.790	0.372
	LCL	0.444	0.285
	Std. Dev.	0.973	0.207
	Wilk (p-value)	0.0537 *	0.5987
	Efficiency	52.91%	
	t-Test (equal var.)	0.1454	
	t-Test (unequal var.)	0.1364	
	t-Test (paired)	0.0086 **	
	Levene Test	0.0094 **	
Bootstrap	UCL	0.914	0.477
	Mean	0.692	0.375
	LCL	0.470	0.273
	Std. Dev.	0.501	0.217
	Efficiency	45.79%	

Barton Creek Square Mall Sand Filter - Ammonia (mg/L)



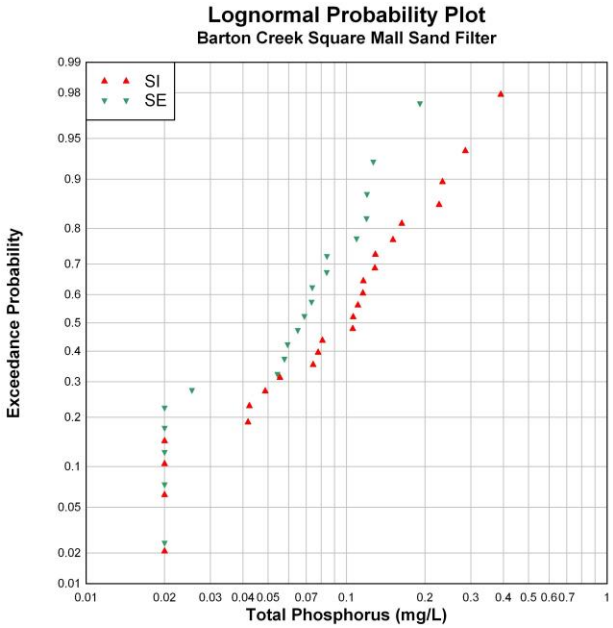


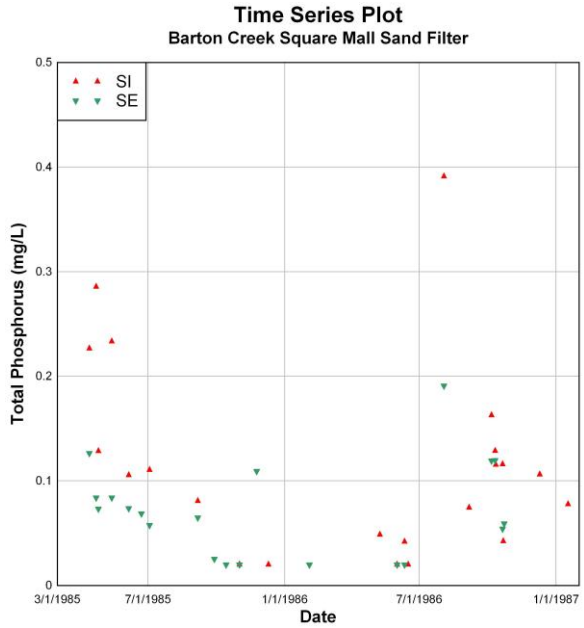


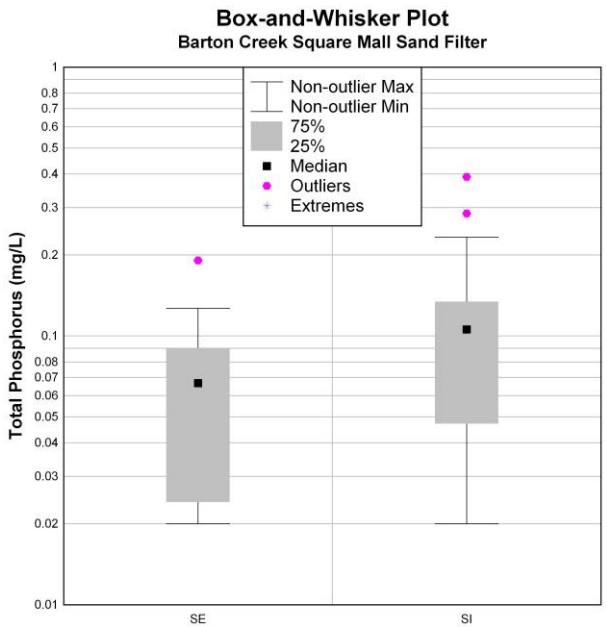


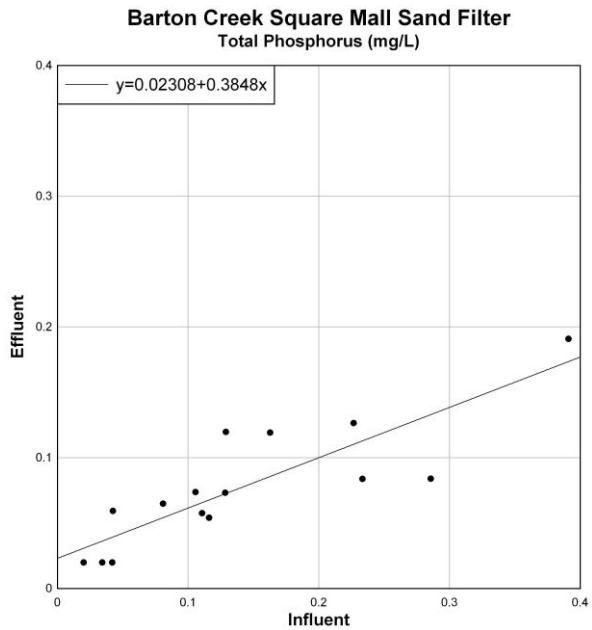
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	1.160	0.564
	Upper Quartile	0.218	0.114
	Median	0.127	0.064
	Lower Quartile	0.068	0.042
	Minimum	0.023	0.020
	Efficiency	49.54%	
	Mann-Whitney	0.0329 **	
	Wilcoxon (paired)	0.0730 *	
Arithmetic	UCL	0.285	0.161
	Mean	0.188	0.104
	LCL	0.092	0.047
	Std. Dev.	0.229	0.121
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	44.85%	
	t-Test (equal var.)	0.1448	
	t-Test (unequal var.)	0.1262	
	t-test (paired)	0.1914	
	Levene Test	0.4122	
Log Transformed	UCL	0.288	0.153
	Mean	0.183	0.098
	LCL	0.116	0.063
	Std. Dev.	0.189	0.089
	Wilk (p-value)	0.8661	0.5888
	Efficiency	46.28%	
	t-Test (equal var.)	0.0412 **	
	t-Test (unequal var.)	0.0395 **	
	t-Test (paired)	0.0612 *	
	Levene Test	0.6636	
Bootstrap	UCL	0.276	0.157
	Mean	0.189	0.106
	LCL	0.102	0.054
	Std. Dev.	0.206	0.110
	Efficiency	43.99%	

Barton Creek Square Mall Sand Filter - Total Phosphorus (mg/L)



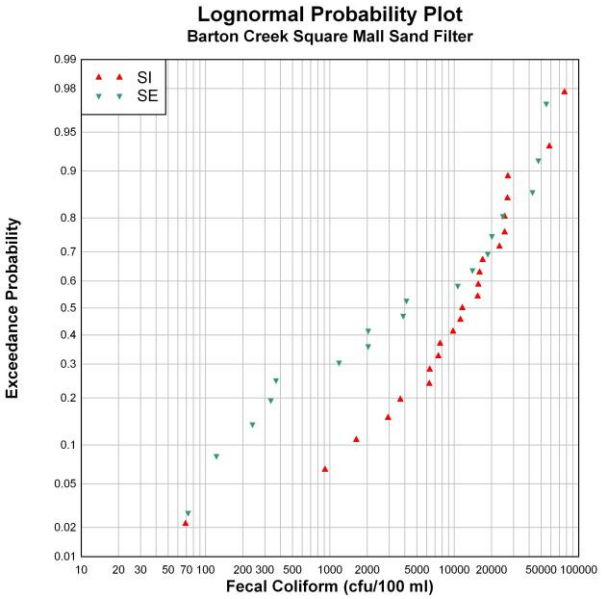


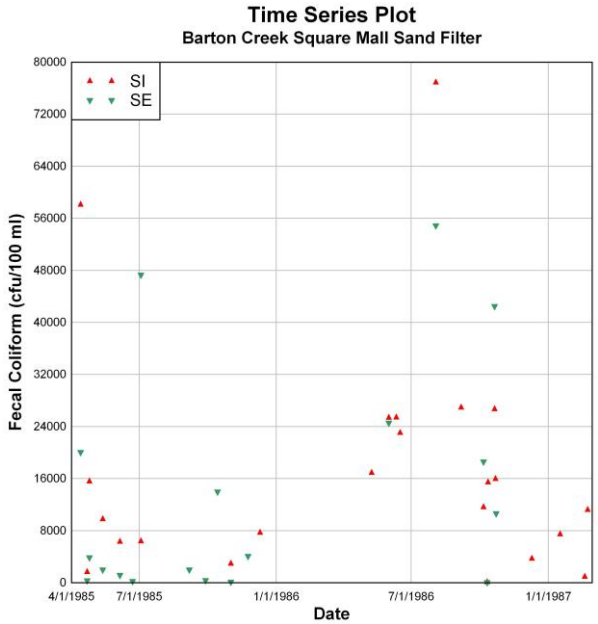


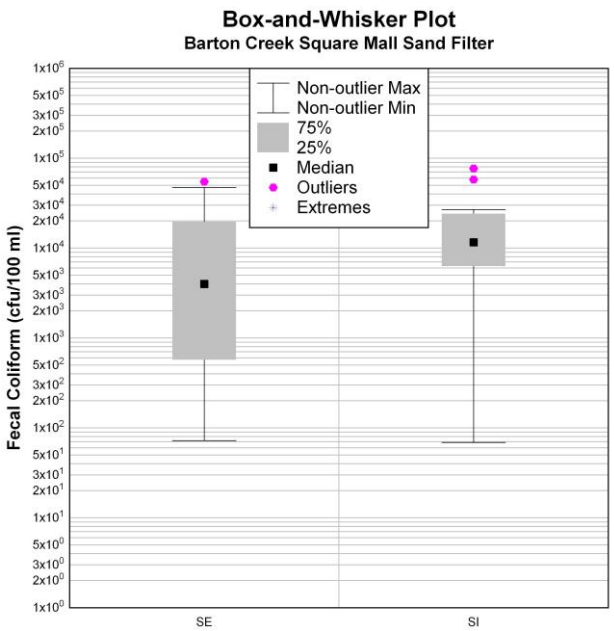


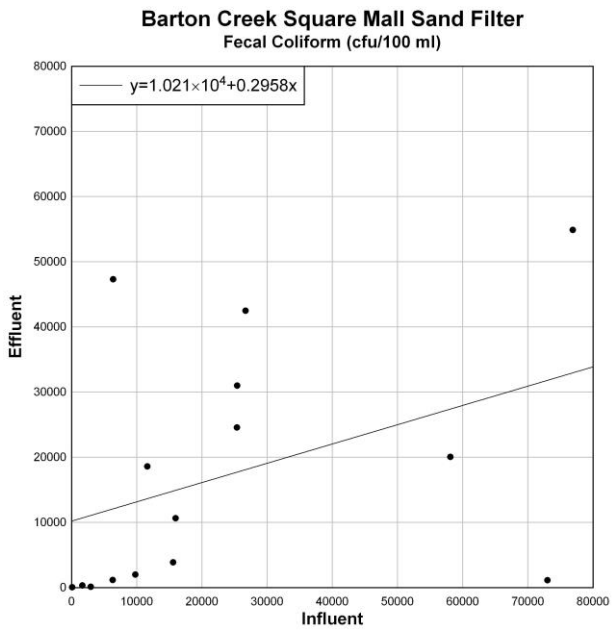
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	0.391	0.191
	Upper Quartile	0.140	0.097
	Median	0.106	0.067
	Lower Quartile	0.046	0.023
	Minimum	0.020	0.020
	Efficiency	36.80%	
	Mann-Whitney	0.1174	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	0.154	0.092
	Mean	0.115	0.071
	LCL	0.076	0.049
	Std. Dev.	0.092	0.046
	Wilk (p-value)	0.0035 **	0.0419 **
	Efficiency	38.67%	
	t-Test (equal var.)	0.0558 *	
	t-Test (unequal var.)	0.0449 **	
	t-test (paired)	0.0028 **	
	Levene Test	0.0987 *	
Log Transformed	UCL	0.183	0.107
	Mean	0.119	0.072
	LCL	0.077	0.049
	Std. Dev.	0.116	0.058
	Wilk (p-value)	0.1937	0.0215 **
	Efficiency	39.23%	
	t-Test (equal var.)	0.1094	
	t-Test (unequal var.)	0.1044	
	t-Test (paired)	0.0001 **	
	Levene Test	0.3421	
Bootstrap	UCL	0.151	0.091
	Mean	0.114	0.070
	LCL	0.077	0.050
	Std. Dev.	0.088	0.044
	Efficiency	38.32%	

Barton Creek Square Mall Sand Filter - Fecal Coliform (cfu/100 ml)



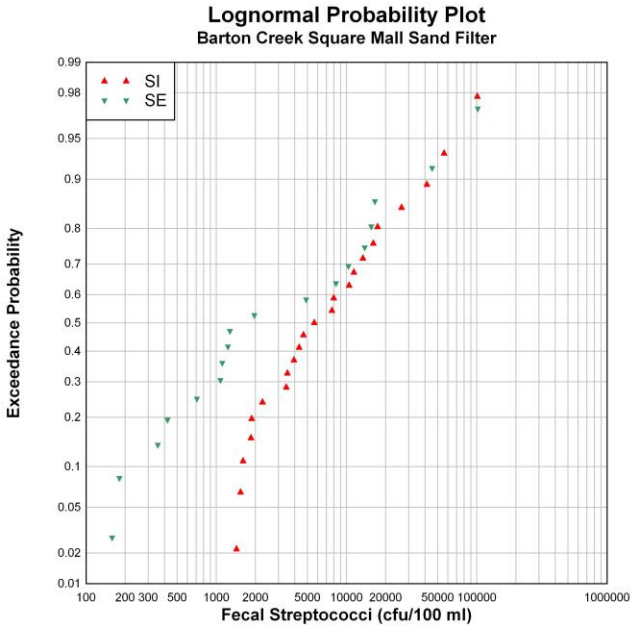


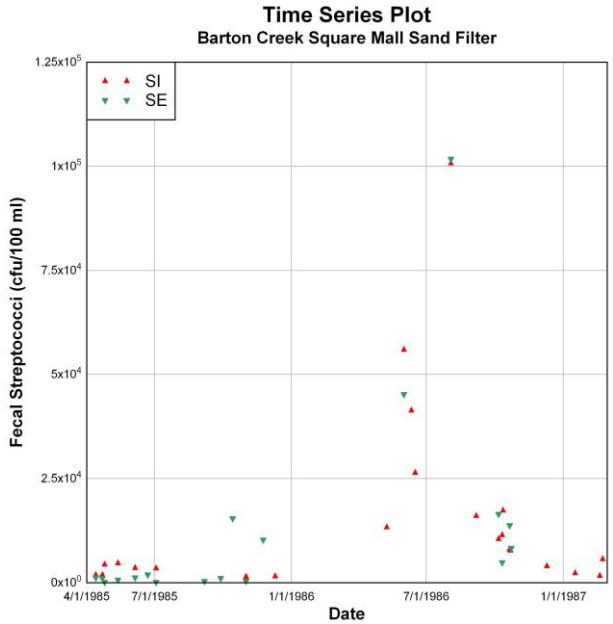


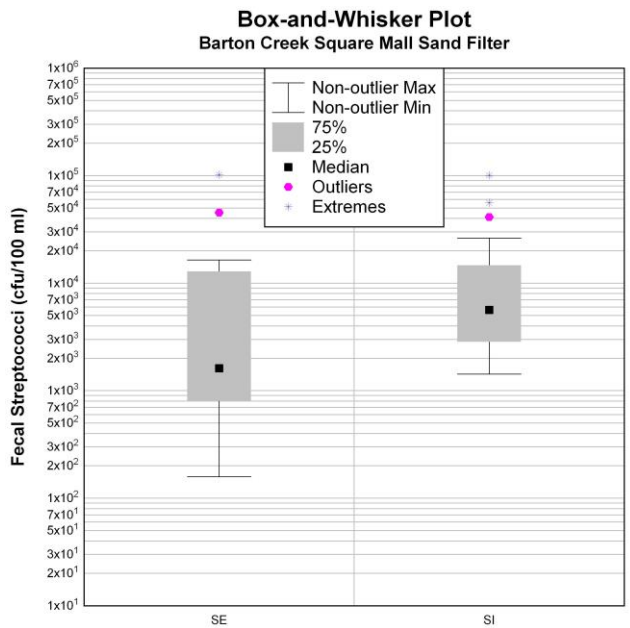


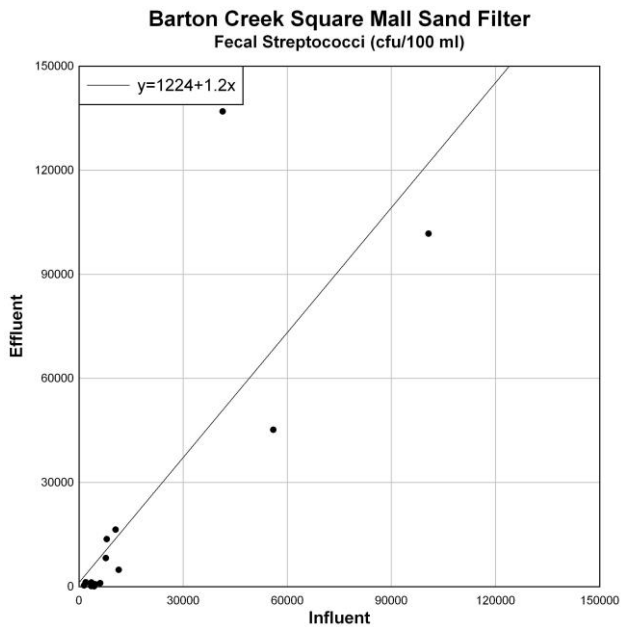
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	23	18
	Pairs Count	14	14
Non-Parametric	Maximum	76,868	54,903
	Upper Quartile	25,339	20,061
	Median	11,600	3,998
	Lower Quartile	6,292	368
	Minimum	69	72
	Efficiency	65.54%	
	Mann-Whitney	0.2009	
	Wilcoxon (paired)	0.3575	
Arithmetic	UCL	25,092	22,565
	Mean	17,202	13,722
	LCL	9,311	4,878
	Std. Dev.	18,246	17,782
	Wilk (p-value)	0.0001 **	0.0007 **
	Efficiency	20.23%	
	t-Test (equal var.)	0.5436	
	t-Test (unequal var.)	0.5425	
	t-test (paired)	0.3609	
	Levene Test	0.9245	
Log Transformed	UCL	65,339	183,824
	Mean	25,219	24,858
	LCL	9,733	3,362
	Std. Dev.	53,486	93,288
	Wilk (p-value)	0.0063 **	0.1860
	Efficiency	1.43%	
	t-Test (equal var.)	0.0913 *	
	t-Test (unequal var.)	0.1084	
	t-Test (paired)	0.0694 *	
	Levene Test	0.1243	
Bootstrap	UCL	24,788	22,392
	Mean	17,345	13,933
	LCL	9,902	5,474
	Std. Dev.	17,213	17,011
	Efficiency	19.67%	

Barton Creek Square Mall Sand Filter - Fecal Streptococci (cfu/100 ml)



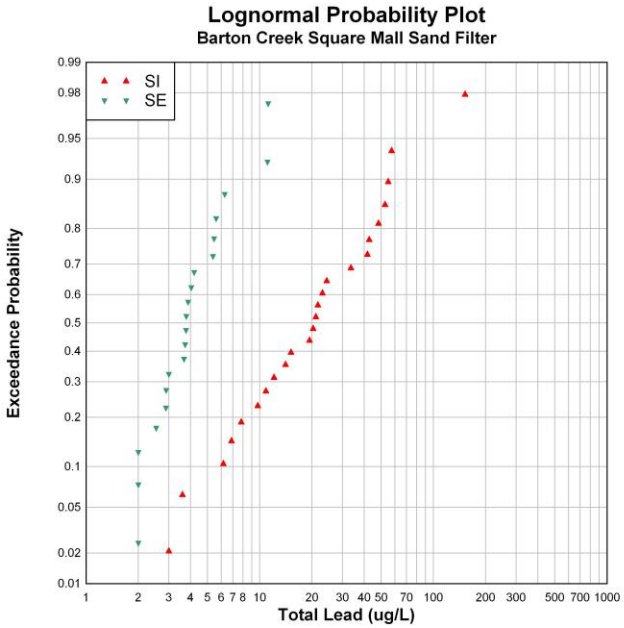


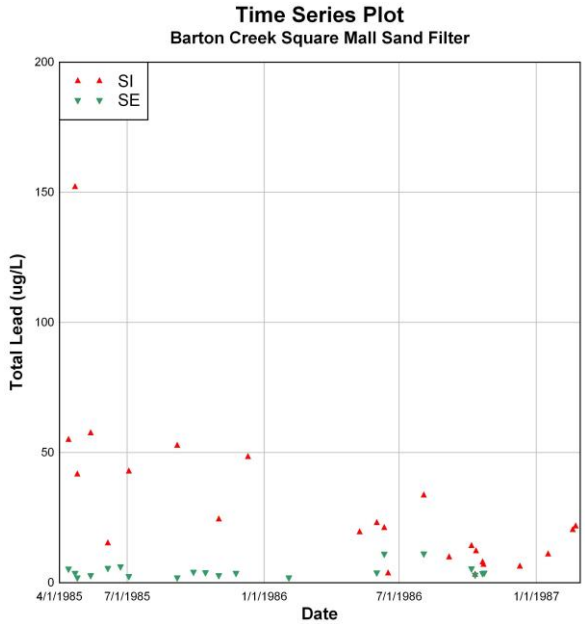


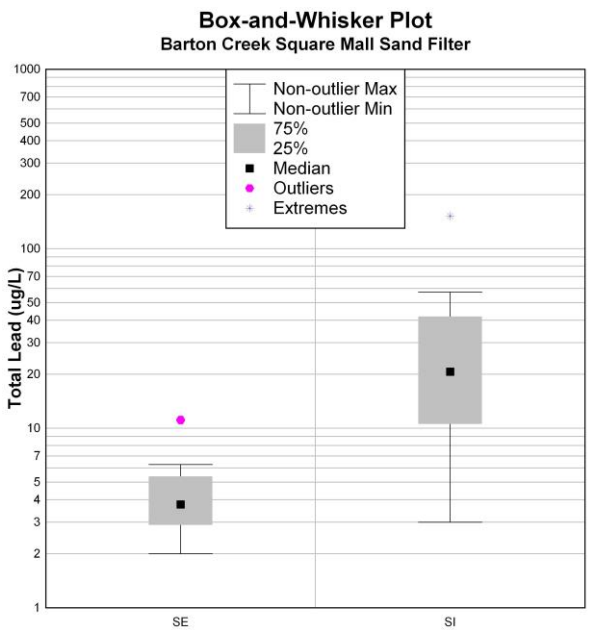


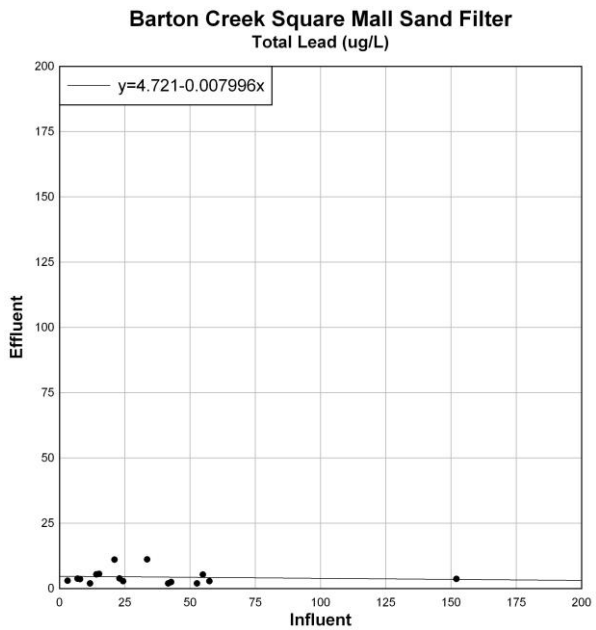
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	23	18
	Pairs Count	14	14
Non-Parametric	Maximum	100,672	101,766
	Upper Quartile	16,012	13,755
	Median	5,648	1,615
	Lower Quartile	2,256	708
	Minimum	1,426	158
	Efficiency	71.40%	
	Mann-Whitney	0.0883 *	
	Wilcoxon (paired)	0.4263	
Arithmetic	UCL	24,964	24,848
	Mean	14,977	12,482
	LCL	4,989	116
	Std. Dev.	23,095	24,864
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	16.66%	
	t-Test (equal var.)	0.7417	
	t-Test (unequal var.)	0.7442	
	t-test (paired)	0.4896	
	Levene Test	0.8900	
Log Transformed	UCL	27,625	65,829
	Mean	13,772	13,189
	LCL	6,866	2,643
	Std. Dev.	21,107	39,042
	Wilk (p-value)	0.2594	0.5558
	Efficiency	4.23%	
	t-Test (equal var.)	0.0626 *	
	t-Test (unequal var.)	0.0799 *	
	t-Test (paired)	0.0285 **	
	Levene Test	0.0221 **	
Bootstrap	UCL	24,484	23,617
	Mean	15,181	12,618
	LCL	5,878	1,618
	Std. Dev.	21,513	22,119
	Efficiency	16.89%	

Barton Creek Square Mall Sand Filter - Total Lead (ug/L)



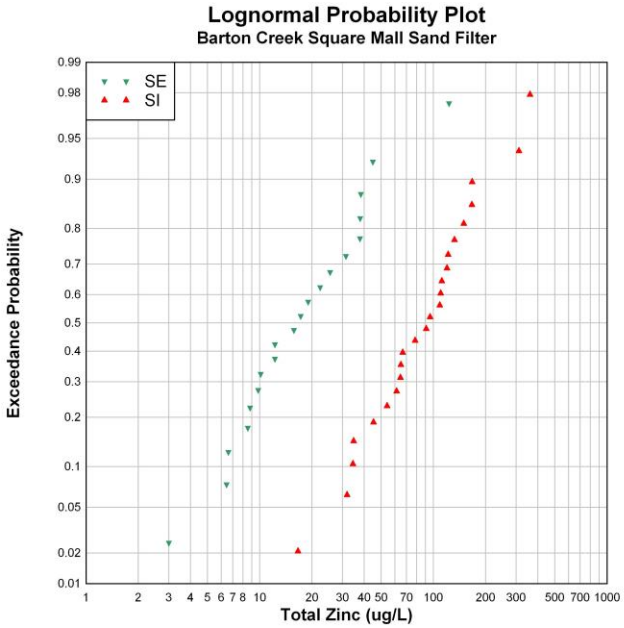


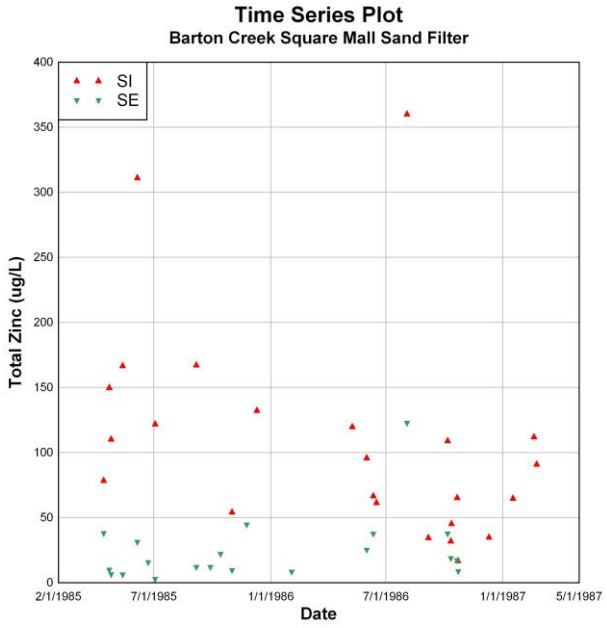


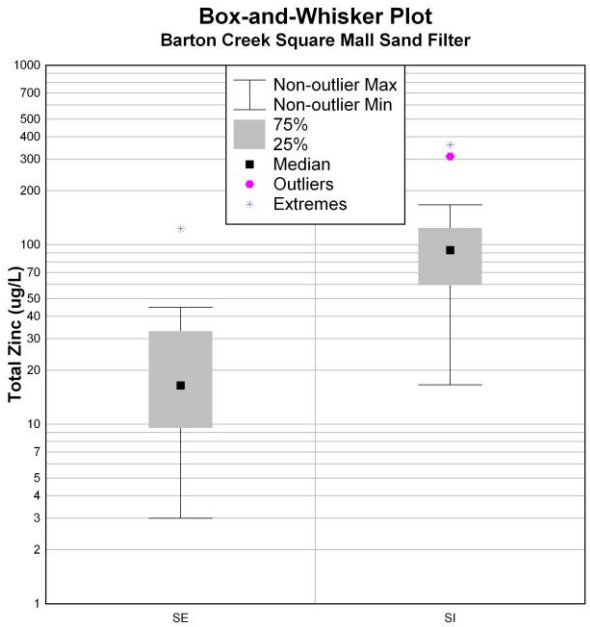


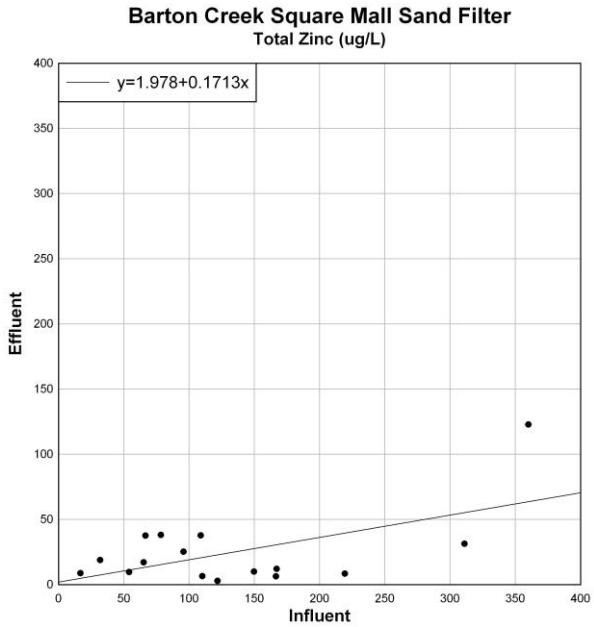
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	152.0	11.2
	Upper Quartile	42.2	5.4
	Median	20.6	3.8
	Lower Quartile	10.3	2.9
	Minimum	3.0	2.0
	Efficiency	81.74%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	42.4	5.7
	Mean	29.2	4.5
	LCL	16.0	3.3
	Std. Dev.	31.2	2.6
	Wilk (p-value)	0.0001 **	0.0004 **
	Efficiency	84.73%	
	t-Test (equal var.)	0.0010 **	
	t-Test (unequal var.)	0.0008 **	
	t-test (paired)	0.0042 **	
	Levene Test	0.1775	
Log Transformed	UCL	47.8	5.6
	Mean	29.4	4.4
	LCL	18.1	3.5
	Std. Dev.	32.4	2.2
	Wilk (p-value)	0.9399	0.1374
	Efficiency	85.00%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0201 **	
Bootstrap	UCL	40.9	5.6
	Mean	28.8	4.5
	LCL	16.7	3.3
	Std. Dev.	28.6	2.4
	Efficiency	84.54%	

Barton Creek Square Mall Sand Filter - Total Zinc (ug/L)



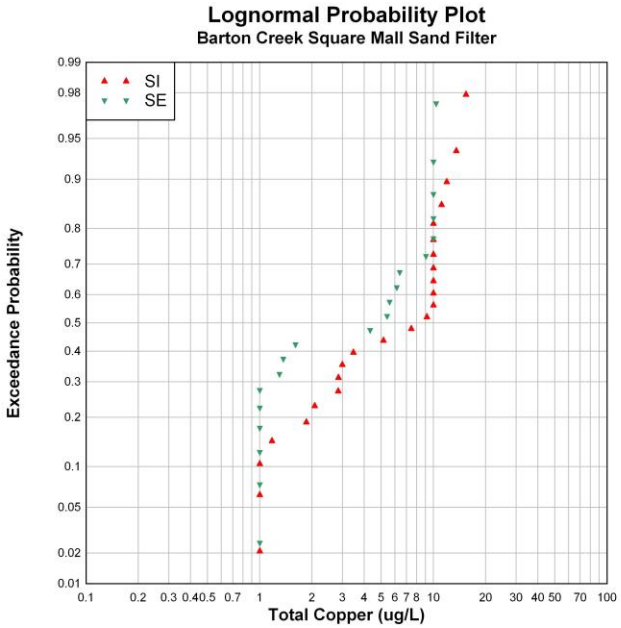


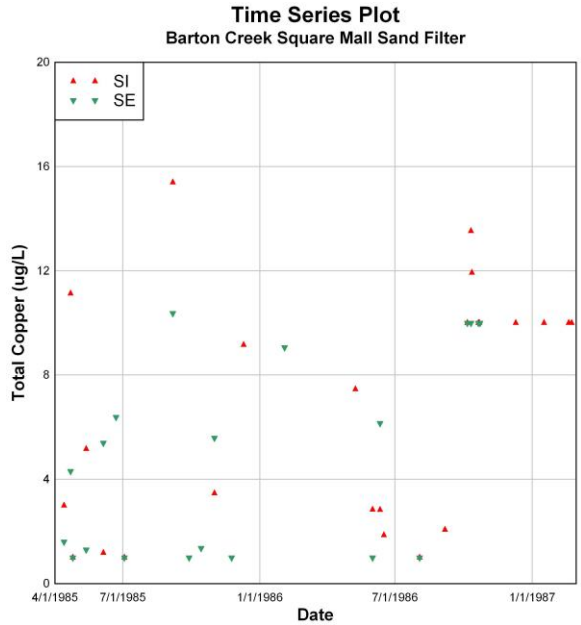


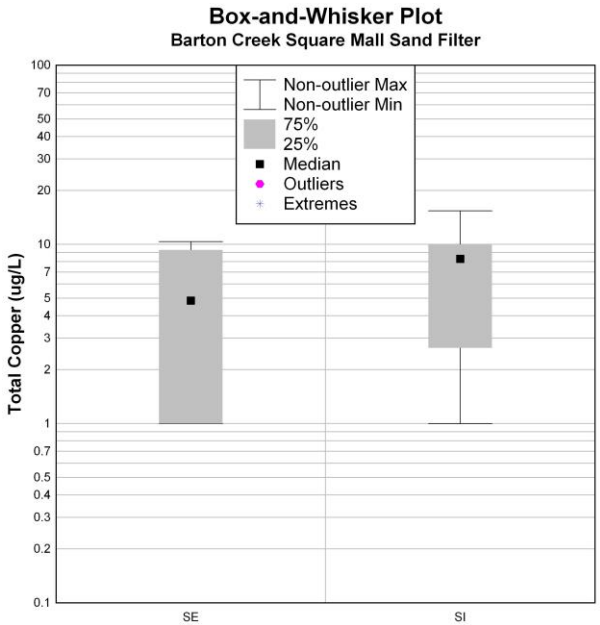


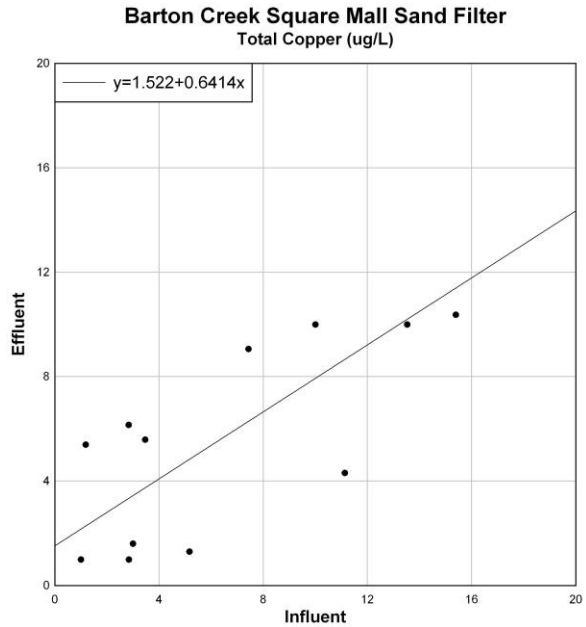
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	360.0	122.8
	Upper Quartile	126.9	34.6
	Median	93.2	16.5
	Lower Quartile	57.7	9.3
	Minimum	16.6	3.0
	Efficiency	82.33%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	142.9	36.8
	Mean	108.2	24.5
	LCL	73.6	12.2
	Std. Dev.	82.1	26.3
	Wilk (p-value)	0.0004 **	0.0001 **
	Efficiency	77.36%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0001 **	
	Levene Test	0.0871 *	
Log Transformed	UCL	153.0	38.3
	Mean	108.8	23.9
	LCL	77.4	14.9
	Std. Dev.	85.1	22.9
	Wilk (p-value)	0.9138	0.9306
	Efficiency	78.02%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.4328	
Bootstrap	UCL	139.8	35.7
	Mean	107.1	24.5
	LCL	74.4	13.3
	Std. Dev.	77.4	23.9
	Efficiency	77.09%	

Barton Creek Square Mall Sand Filter - Total Copper (ug/L)









	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: SI**	**EFF: SE**
	Site Count	24	20
	Pairs Count	15	15
Non-Parametric	Maximum	15.4	10.4
	Upper Quartile	10.0	9.5
	Median	8.3	4.9
	Lower Quartile	2.4	1.0
	Minimum	1.0	1.0
	Efficiency	41.52%	
	Mann-Whitney	0.1199	
	Wilcoxon (paired)	0.4316	
Arithmetic	UCL	8.8	6.7
	Mean	6.8	4.9
	LCL	4.9	3.1
	Std. Dev.	4.6	3.9
	Wilk (p-value)	0.0100 **	0.0012 **
	Efficiency	28.60%	
	t-Test (equal var.)	0.1379	
	t-Test (unequal var.)	0.1320	
	t-test (paired)	0.3656	
	Levene Test	0.1615	
Log Transformed	UCL	12.0	9.3
	Mean	7.4	5.2
	LCL	4.6	2.9
	Std. Dev.	8.0	6.1
	Wilk (p-value)	0.0025 **	0.0007 **
	Efficiency	30.39%	
	t-Test (equal var.)	0.1585	
	t-Test (unequal var.)	0.1618	
	t-Test (paired)	0.5569	
	Levene Test	0.5240	
Bootstrap	UCL	8.7	6.7
	Mean	6.8	4.9
	LCL	5.0	3.1
	Std. Dev.	4.4	3.8
	Efficiency	28.42%	

Brodie Oaks Sand Filter (BM-BE)

The basin is the second section of an overall system. Runoff from the Brodie Oaks Shopping center (see the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed) initially enters a retention basin that is used for irrigation. Overflow from that basin enters the sand filter section. For details on the performance of the retention basin, see the section on other stormwater controls. This site was monitored during the initial COA monitoring program.

The filter bed is composed of eighteen inches of fine sand overlaying twelve inches of coarse sand. Underlying the sand is a gravel layer with perforated PVC collection pipes. The sand was never replaced during the monitoring period. Percent reductions may be reduced due to the retention pre-treatment.

The City collected runoff and water quality data at the Brodie Oaks sand filtration bond (BM-BE) from 1984 to 1988. During this time 7 and 8 valid EMCs were collected at the influent (BM) and effluent (BE) respectively, of which 6 were paired.

Performance Summary

Overall, the Brodie Oaks sand filtration pond had a minimal impact on water quality for the pollutants measured during this study. TSS was reduced by 55% and significant in all cases. TDS was increased by 91% and not significant in all cases.

COD concentration was reduced by 40% and significant only when data are not paired. The reduction (30%) in TOC concentration was not significant in any case. The increase (14%) in BOD concentration was significant only when data are paired.

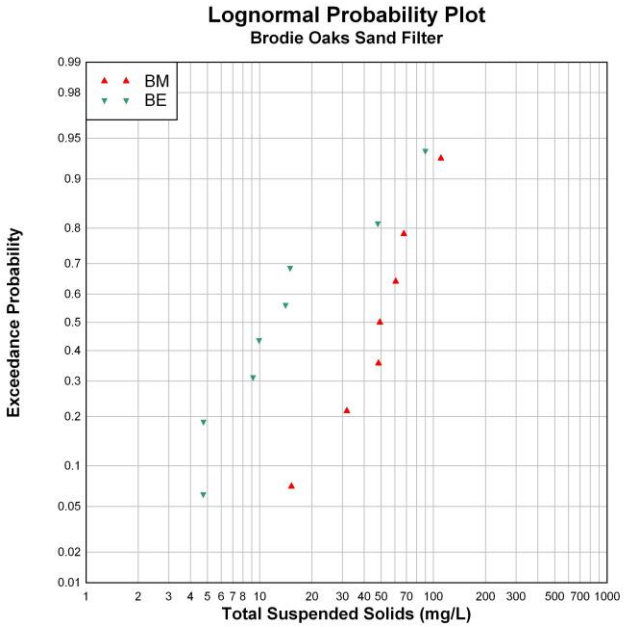
There was no significant reduction in total nitrogen (0%) in any case, paired or not paired. Nitrate + nitrite concentration was increased (88%) and was significant in any case. Total Kjeldahl nitrogen was reduced (43%) significantly only if data are paired. The reduction of ammonia concentration (55%) was only significant if data are paired.

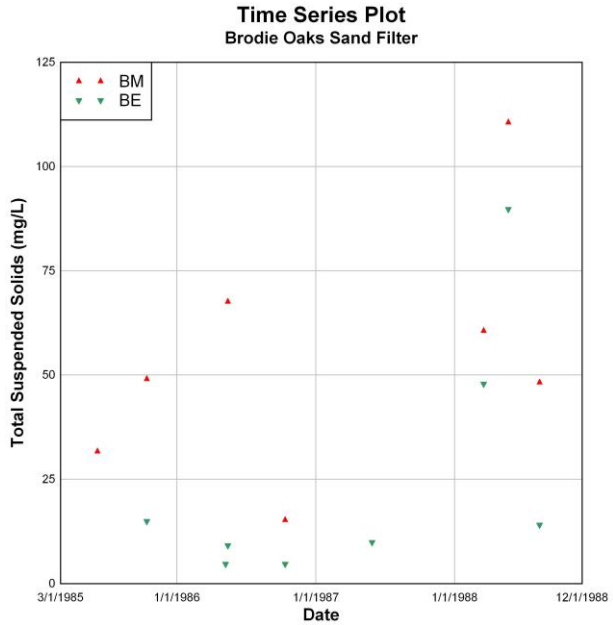
Total P concentration was reduced by 32% but this was not significant in any case.

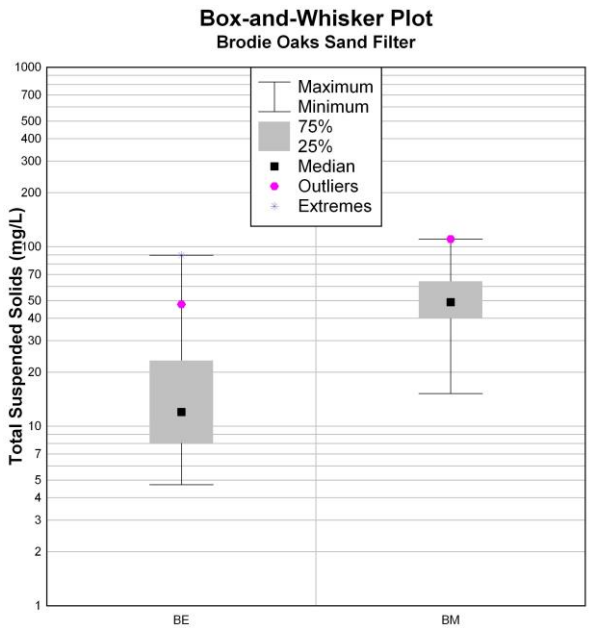
The reduction of bacteria was not significant in any case for both FCOL (85%) and FSTR (67%).

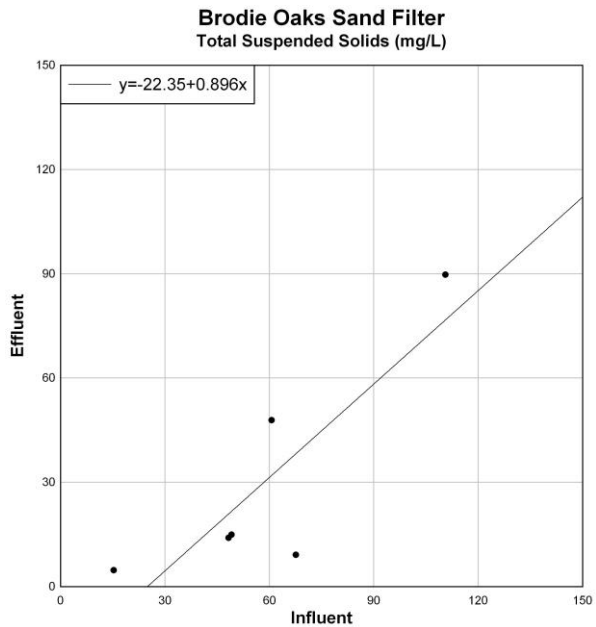
Lead and zinc were reduced by 48 and 35% respectively, and copper was increased by 1%. The reduction in lead concentration was significant in all cases, and the reduction in zinc concentration and the increase in copper concentration were not significant in all cases.

Brodie Oaks Sand Filter - Total Suspended Solids (mg/L)



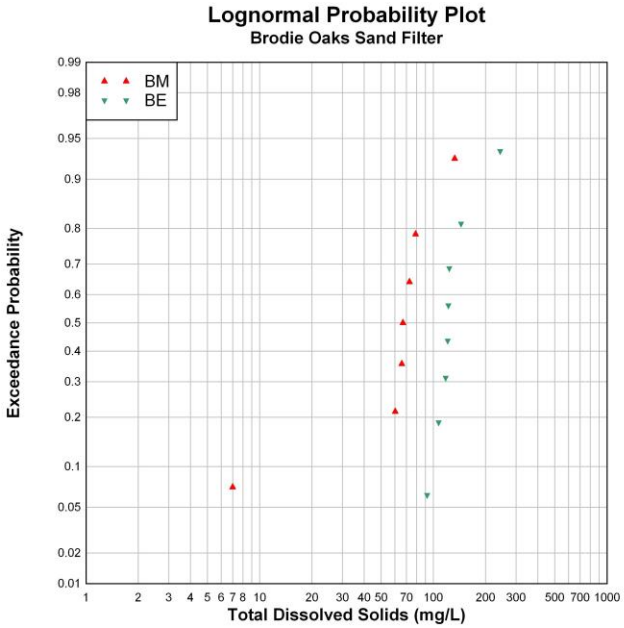


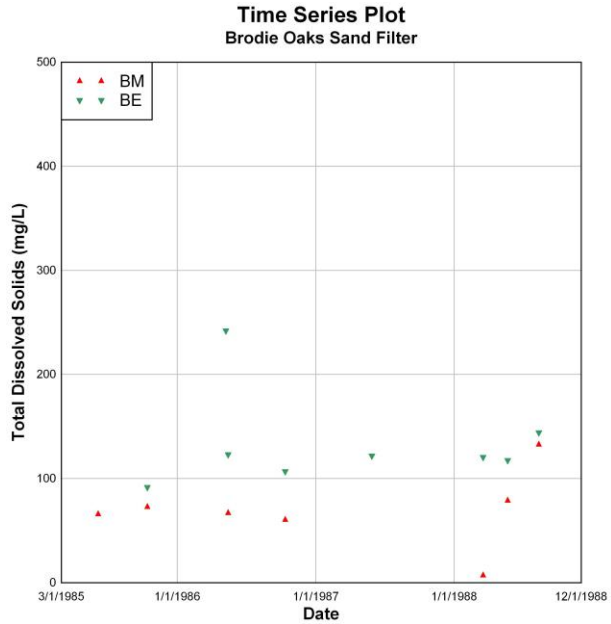


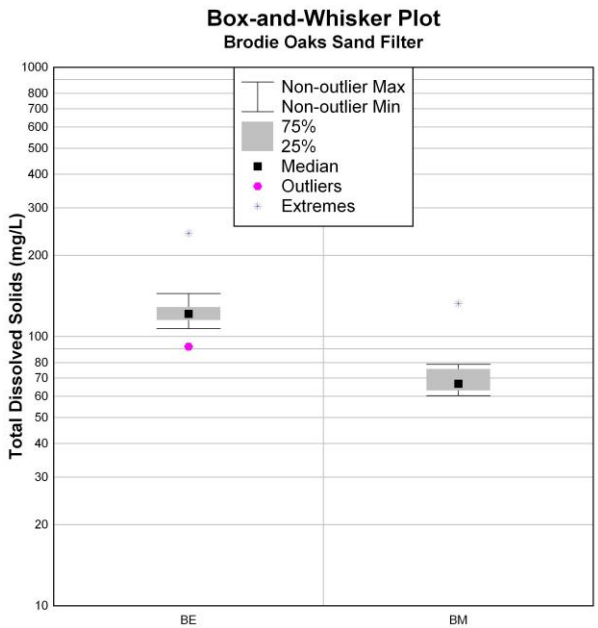


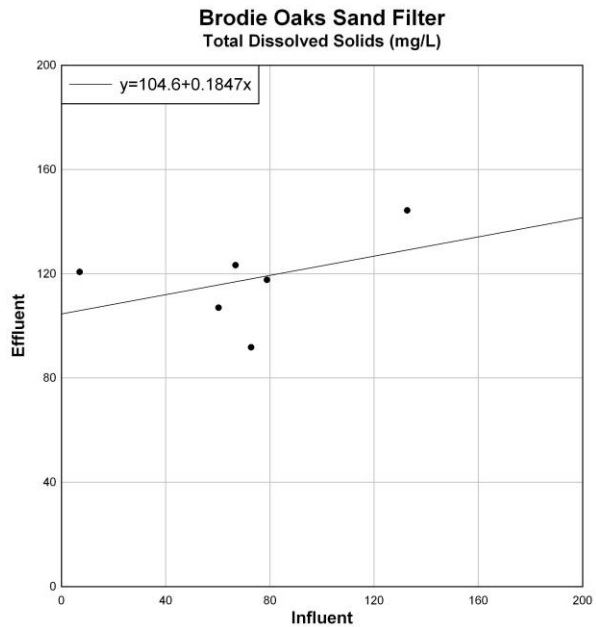
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	110.5	89.8
	Upper Quartile	67.6	31.4
	Median	49.1	12.0
	Lower Quartile	31.7	6.9
	Minimum	15.2	4.7
	Efficiency	75.54%	
	Mann-Whitney	0.0405 **	
	Wilcoxon (paired)	0.0313 **	
Arithmetic	UCL	82.7	49.4
	Mean	54.7	24.4
	LCL	26.8	-.6
	Std. Dev.	30.2	29.9
	Wilk (p-value)	0.6961	0.0026 **
	Efficiency	55.38%	
	t-Test (equal var.)	0.0731 *	
	t-Test (unequal var.)	0.0739 *	
	t-test (paired)	0.0114 **	
	Levene Test	0.9962	
Log Transformed	UCL	105.7	68.8
	Mean	55.6	22.7
	LCL	29.2	7.5
	Std. Dev.	35.2	24.7
	Wilk (p-value)	0.7390	0.2914
	Efficiency	59.25%	
	t-Test (equal var.)	0.0213 **	
	t-Test (unequal var.)	0.0195 **	
	t-Test (paired)	0.0154 **	
	Levene Test	0.2109	
Bootstrap	UCL	79.4	46.1
	Mean	54.9	24.6
	LCL	30.4	3.1
	Std. Dev.	26.5	25.7
	Efficiency	55.18%	

Brodie Oaks Sand Filter - Total Dissolved Solids (mg/L)



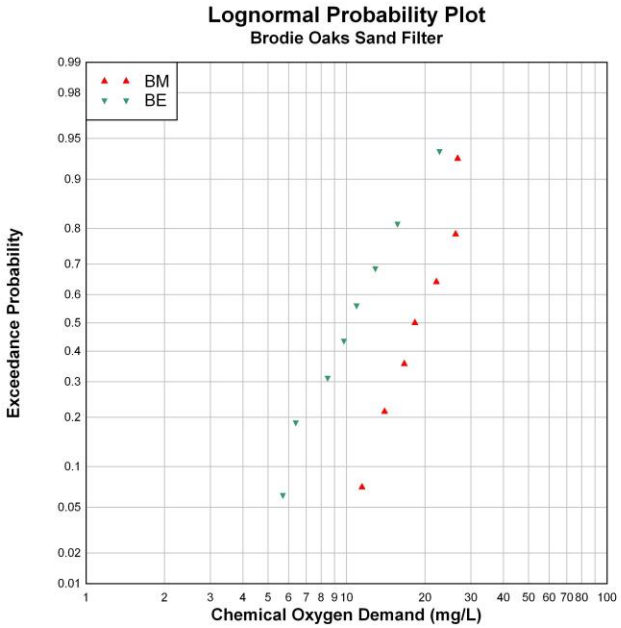


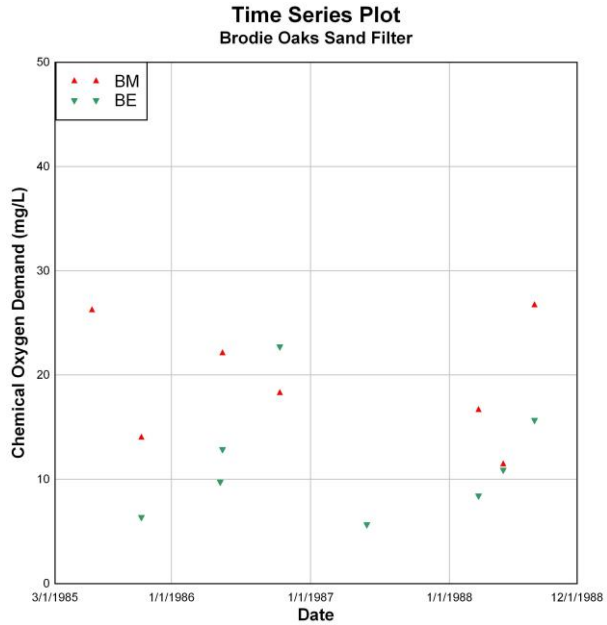


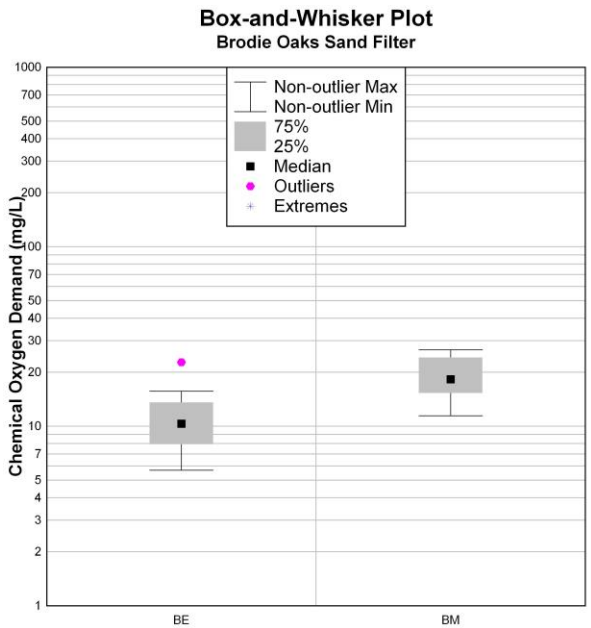


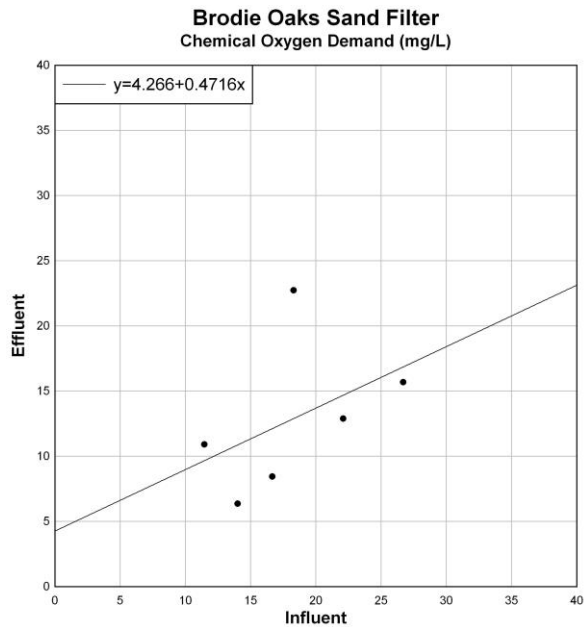
	PARAMETER	TDS (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	132.65	242.15
	Upper Quartile	78.83	133.84
	Median	66.76	121.34
	Lower Quartile	60.26	112.37
	Minimum	6.99	91.85
	Efficiency	-81.74%	
	Mann-Whitney	0.0261 **	
	Wilcoxon (paired)	0.0313 **	
Arithmetic	UCL	103.11	172.35
	Mean	69.13	133.63
	LCL	35.14	94.92
	Std. Dev.	36.74	46.30
	Wilk (p-value)	0.2770	0.0036 **
	Efficiency	-93.32%	
	t-Test (equal var.)	0.0111 **	
	t-Test (unequal var.)	0.0102 **	
	t-test (paired)	0.0236 **	
	Levene Test	0.6747	
Log Transformed	UCL	228.44	170.04
	Mean	78.19	133.00
	LCL	26.76	104.02
	Std. Dev.	74.94	38.34
	Wilk (p-value)	0.0038 **	0.0522 *
	Efficiency	-70.10%	
	t-Test (equal var.)	0.0285 **	
	t-Test (unequal var.)	0.0535 *	
	t-Test (paired)	0.1174	
	Levene Test	0.2304	
Bootstrap	UCL	99.42	164.16
	Mean	69.40	132.89
	LCL	39.37	101.62
	Std. Dev.	32.47	37.40
	Efficiency	-91.48%	

Brodie Oaks Sand Filter - Chemical Oxygen Demand (mg/L)



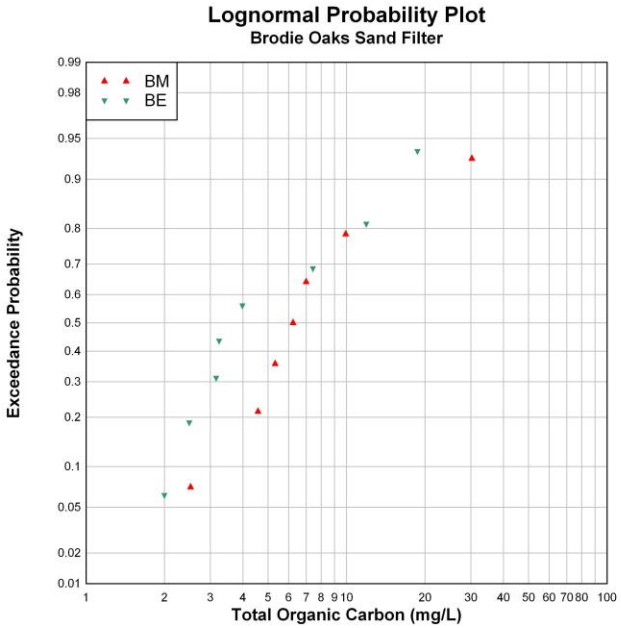


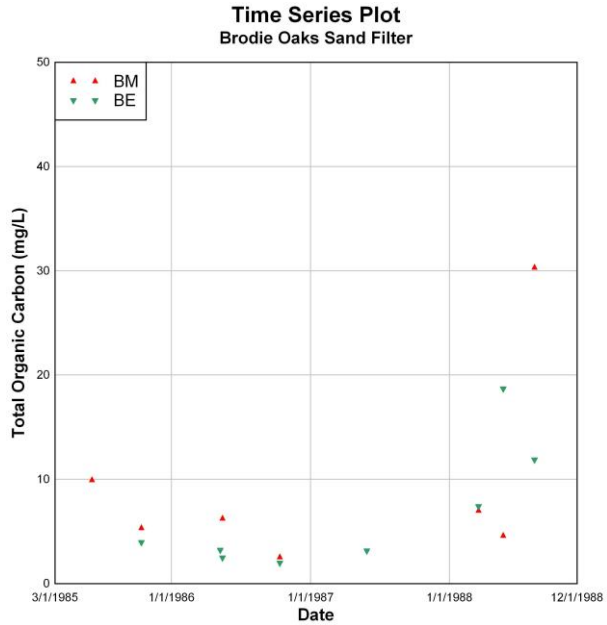


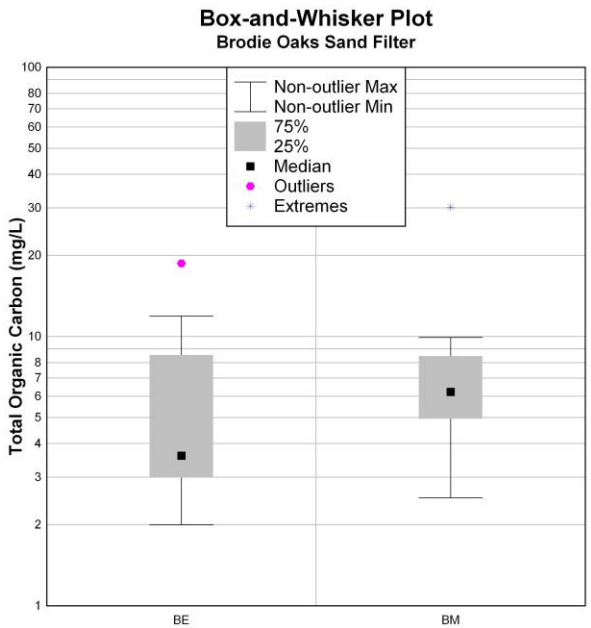


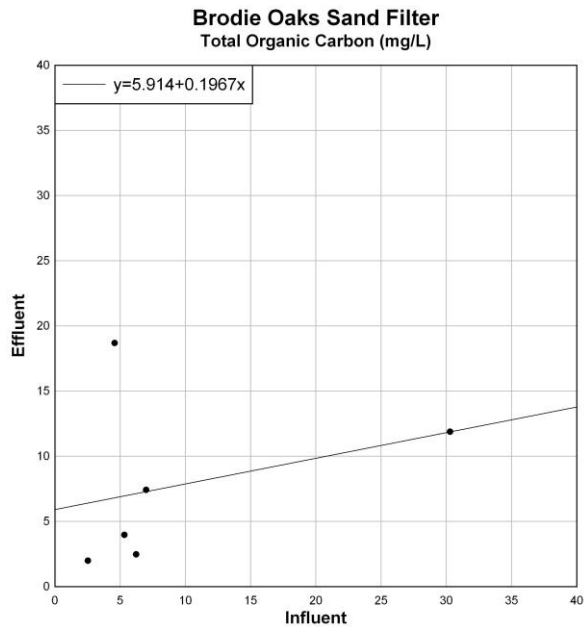
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	26.69	22.74
	Upper Quartile	26.22	14.29
	Median	18.27	10.34
	Lower Quartile	13.99	7.41
	Minimum	11.45	5.69
	Efficiency	43.39%	
	Mann-Whitney	0.0405 **	
	Wilcoxon (paired)	0.0938 *	
Arithmetic	UCL	24.79	16.24
	Mean	19.34	11.57
	LCL	13.89	6.89
	Std. Dev.	5.89	5.59
	Wilk (p-value)	0.6161	0.3595
	Efficiency	40.19%	
	t-Test (equal var.)	0.0212 **	
	t-Test (unequal var.)	0.0221 **	
	t-test (paired)	0.0807 *	
	Levene Test	0.8939	
Log Transformed	UCL	26.21	17.32
	Mean	19.36	11.53
	LCL	14.30	7.68
	Std. Dev.	6.18	5.35
	Wilk (p-value)	0.6903	0.9591
	Efficiency	40.43%	
	t-Test (equal var.)	0.0171 **	
	t-Test (unequal var.)	0.0156 **	
	t-Test (paired)	0.0574 *	
	Levene Test	0.2723	
Bootstrap	UCL	24.38	15.79
	Mean	19.41	11.62
	LCL	14.45	7.45
	Std. Dev.	5.37	4.98
	Efficiency	40.15%	

Brodie Oaks Sand Filter - Total Organic Carbon (mg/L)



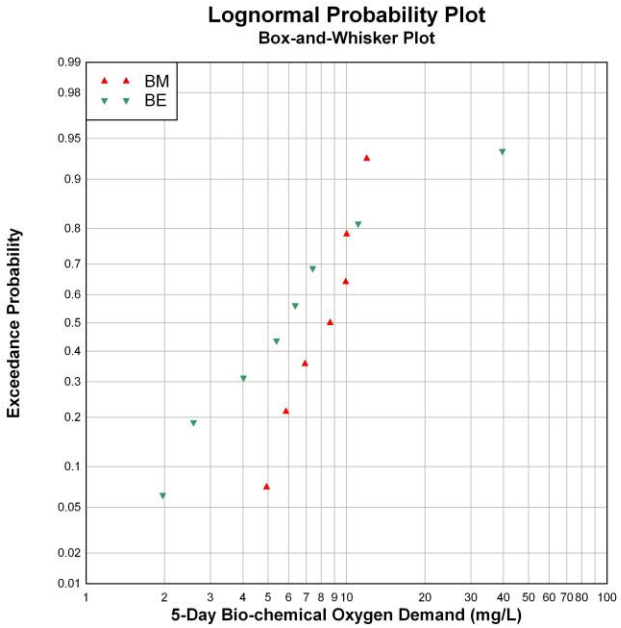


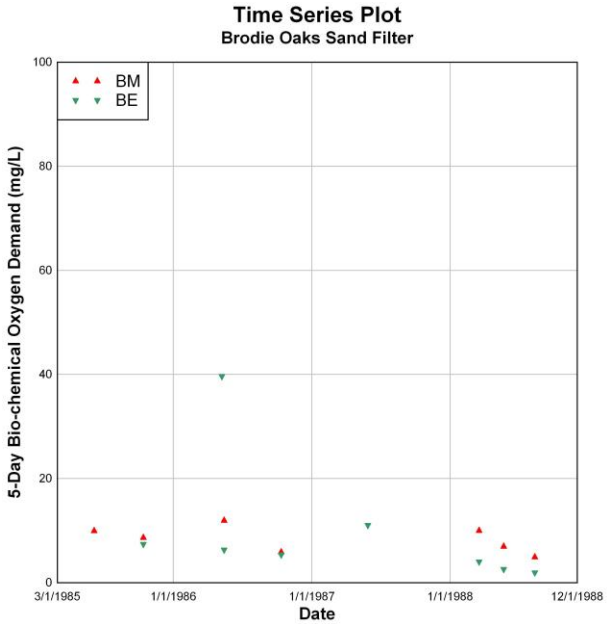


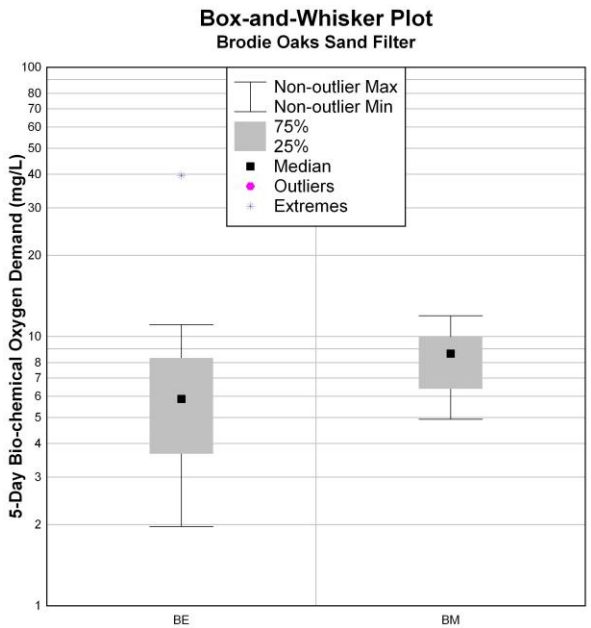


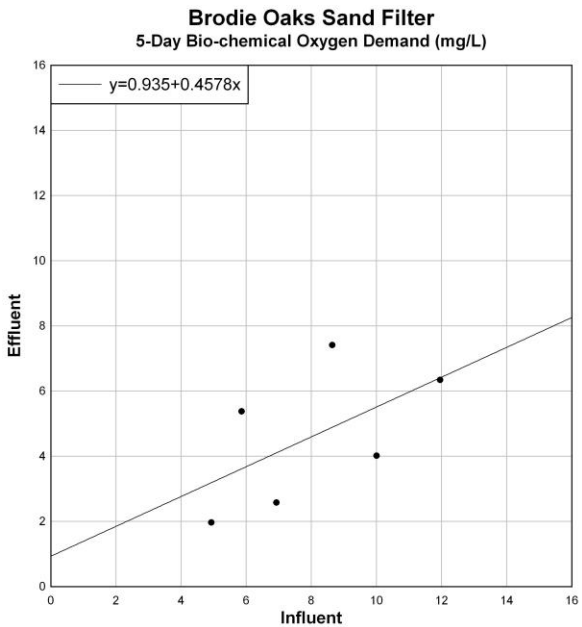
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	30.29	18.70
	Upper Quartile	9.92	9.66
	Median	6.22	3.61
	Lower Quartile	4.57	2.82
	Minimum	2.52	2.00
	Efficiency	42.01%	
	Mann-Whitney	0.4001	
	Wilcoxon (paired)	0.4375	
Arithmetic	UCL	18.18	11.54
	Mean	9.40	6.61
	LCL	0.63	1.68
	Std. Dev.	9.48	5.89
	Wilk (p-value)	0.0022 **	0.0229 **
	Efficiency	29.71%	
	t-Test (equal var.)	0.4989	
	t-Test (unequal var.)	0.5161	
	t-test (paired)	0.7263	
	Levene Test	0.4408	
Log Transformed	UCL	20.49	13.93
	Mean	8.94	6.41
	LCL	3.90	2.95
	Std. Dev.	7.00	5.24
	Wilk (p-value)	0.5297	0.3715
	Efficiency	28.22%	
	t-Test (equal var.)	0.4021	
	t-Test (unequal var.)	0.4013	
	t-Test (paired)	0.6863	
	Levene Test	0.9108	
Bootstrap	UCL	16.88	11.09
	Mean	9.59	6.69
	LCL	2.30	2.29
	Std. Dev.	7.88	5.26
	Efficiency	30.27%	

Brodie Oaks Sand Filter - 5-Day Bio-chemical Oxygen Demand (mg/L)



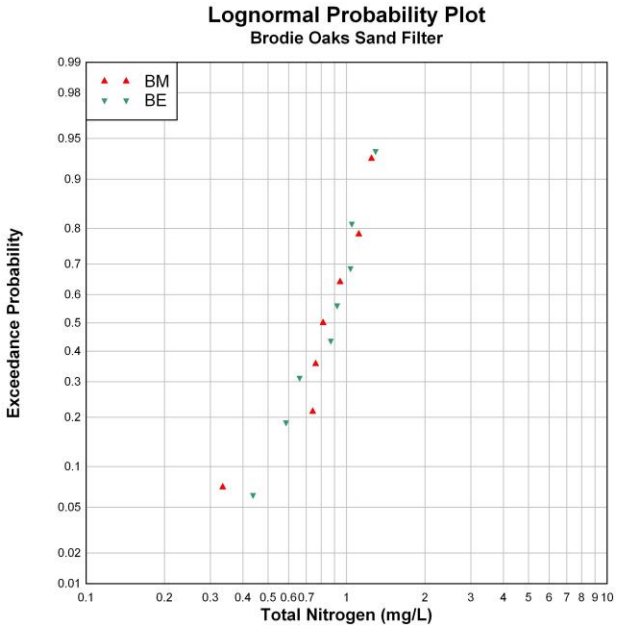


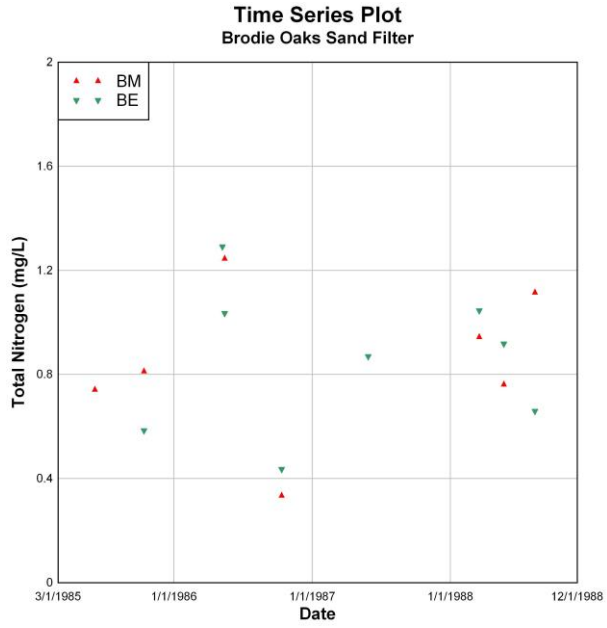


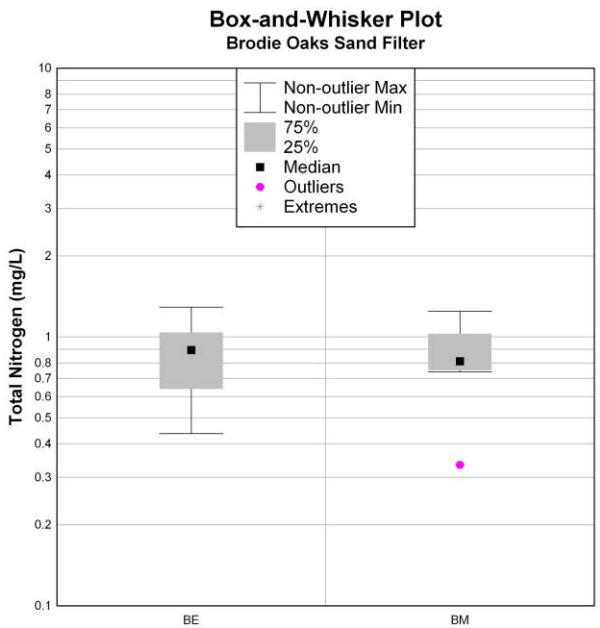


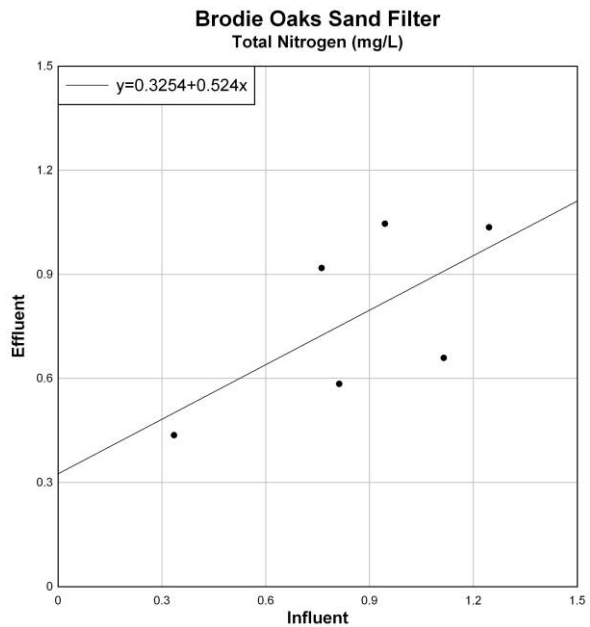
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	11.95	39.65
	Upper Quartile	10.00	9.24
	Median	8.64	5.86
	Lower Quartile	5.86	3.30
	Minimum	4.92	1.97
	Efficiency	32.12%	
	Mann-Whitney	0.3420	
	Wilcoxon (paired)	0.0313 **	
Arithmetic	UCL	10.65	20.17
	Mean	8.32	9.80
	LCL	5.98	-0.56
	Std. Dev.	2.52	12.40
	Wilk (p-value)	0.8177	0.0004 **
	Efficiency	-17.88%	
	t-Test (equal var.)	0.7613	
	t-Test (unequal var.)	0.7493	
	t-test (paired)	0.0141 **	
	Levene Test	0.2873	
Log Transformed	UCL	11.30	23.36
	Mean	8.33	8.99
	LCL	6.14	3.46
	Std. Dev.	2.68	8.69
	Wilk (p-value)	0.7289	0.6006
	Efficiency	-7.92%	
	t-Test (equal var.)	0.5195	
	t-Test (unequal var.)	0.5017	
	t-Test (paired)	0.0135 **	
	Levene Test	0.1540	
Bootstrap	UCL	10.42	17.65
	Mean	8.31	9.50
	LCL	6.20	1.35
	Std. Dev.	2.29	9.75
	Efficiency	-14.32%	

Brodie Oaks Sand Filter - Total Nitrogen (mg/L)



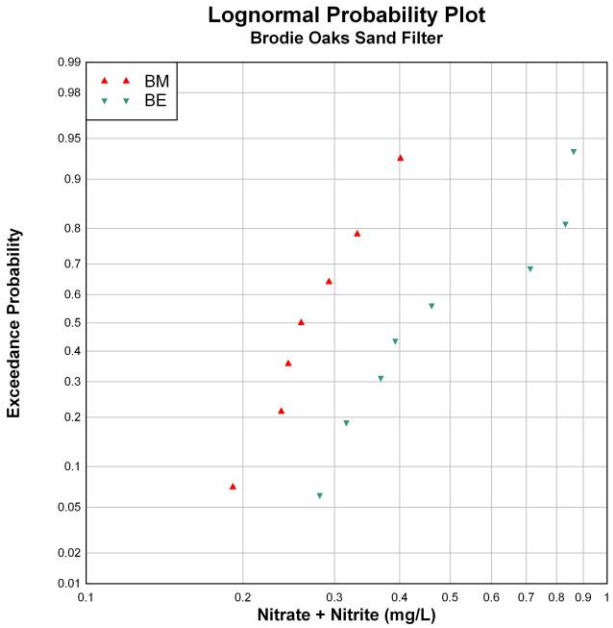


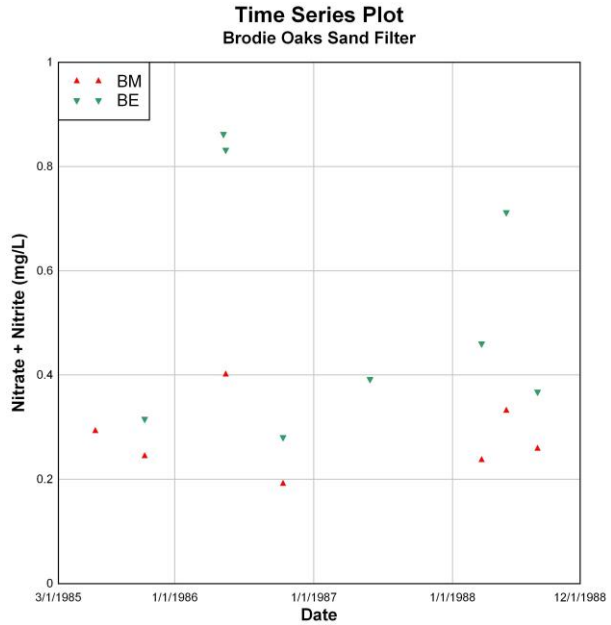


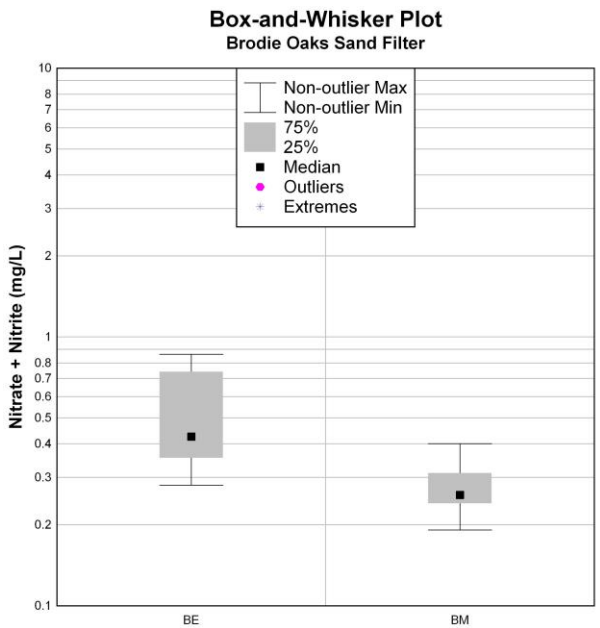


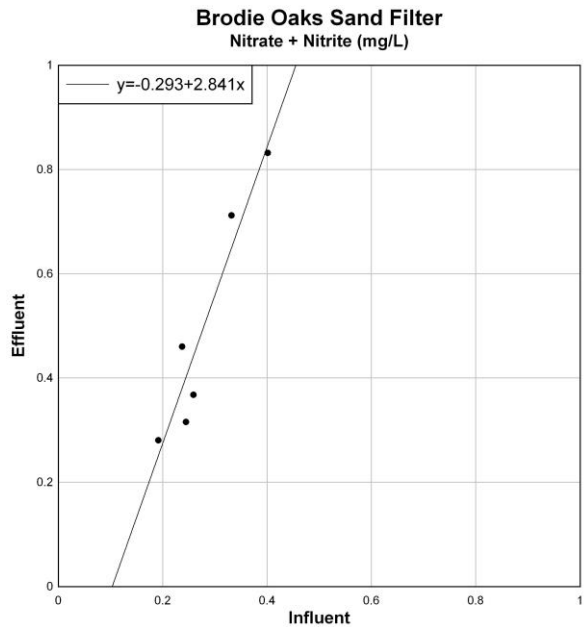
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	1.245	1.292
	Upper Quartile	1.114	1.041
	Median	0.812	0.895
	Lower Quartile	0.742	0.622
	Minimum	0.334	0.437
	Efficiency	-10.21%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	0.4375	
Arithmetic	UCL	1.123	1.090
	Mean	0.850	0.856
	LCL	0.578	0.621
	Std. Dev.	0.295	0.280
	Wilk (p-value)	0.7817	0.9221
	Efficiency	-0.63%	
	t-Test (equal var.)	0.9720	
	t-Test (unequal var.)	0.9721	
	t-test (paired)	0.4204	
	Levene Test	0.9014	
Log Transformed	UCL	1.304	1.169
	Mean	0.859	0.858
	LCL	0.566	0.630
	Std. Dev.	0.370	0.308
	Wilk (p-value)	0.1480	0.7192
	Efficiency	0.13%	
	t-Test (equal var.)	0.9186	
	t-Test (unequal var.)	0.9198	
	t-Test (paired)	0.5638	
	Levene Test	0.6771	
Bootstrap	UCL	1.096	1.063
	Mean	0.855	0.852
	LCL	0.614	0.641
	Std. Dev.	0.261	0.252
	Efficiency	0.39%	

Brodie Oaks Sand Filter - Nitrate + Nitrite (mg/L)



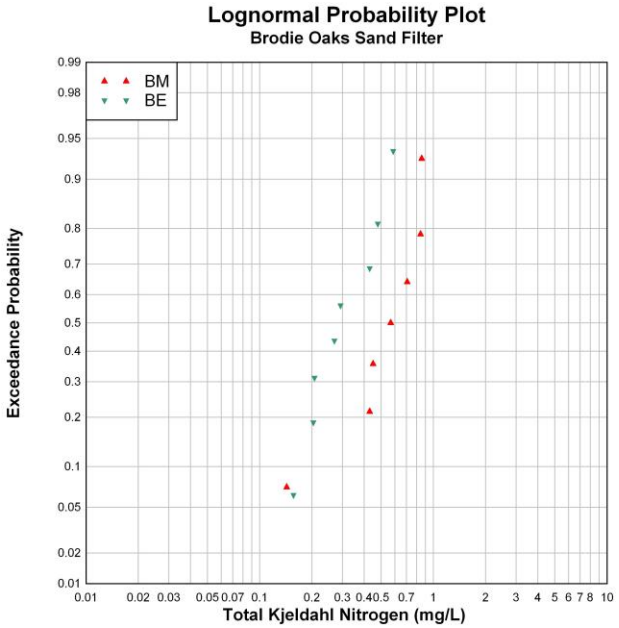


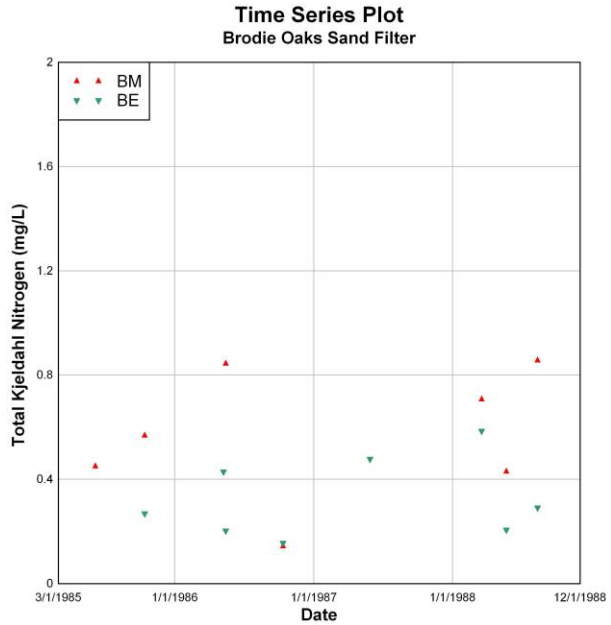


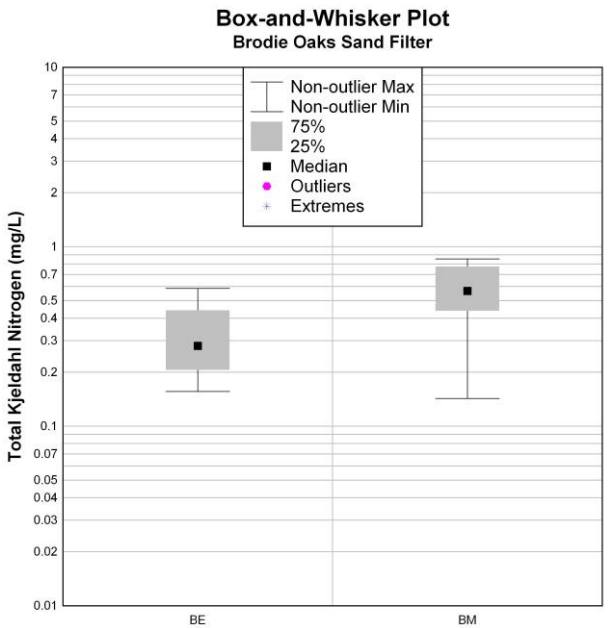


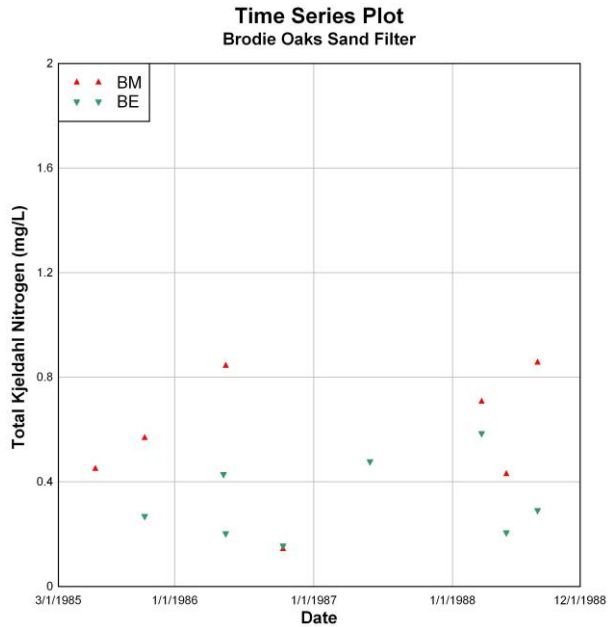
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	0.401	0.862
	Upper Quartile	0.331	0.772
	Median	0.259	0.426
	Lower Quartile	0.237	0.342
	Minimum	0.191	0.281
	Efficiency	-64.82%	
	Mann-Whitney	0.0325 **	
	Wilcoxon (paired)	0.0313 **	
Arithmetic	UCL	0.344	0.726
	Mean	0.279	0.528
	LCL	0.215	0.330
	Std. Dev.	0.069	0.237
	Wilk (p-value)	0.7721	0.1047
	Efficiency	-88.92%	
	t-Test (equal var.)	0.0194 **	
	t-Test (unequal var.)	0.0212 **	
	t-test (paired)	0.0189 **	
	Levene Test	0.0076 **	
Log Transformed	UCL	0.351	0.779
	Mean	0.279	0.527
	LCL	0.222	0.356
	Std. Dev.	0.068	0.236
	Wilk (p-value)	0.9736	0.2594
	Efficiency	-88.67%	
	t-Test (equal var.)	0.0094 **	
	t-Test (unequal var.)	0.0089 **	
	t-Test (paired)	0.0020 **	
	Levene Test	0.0372 **	
Bootstrap	UCL	0.336	0.707
	Mean	0.280	0.526
	LCL	0.223	0.346
	Std. Dev.	0.061	0.216
	Efficiency	-88.00%	

Brodie Oaks Sand Filter - Total Kjeldahl Nitrogen (mg/L)



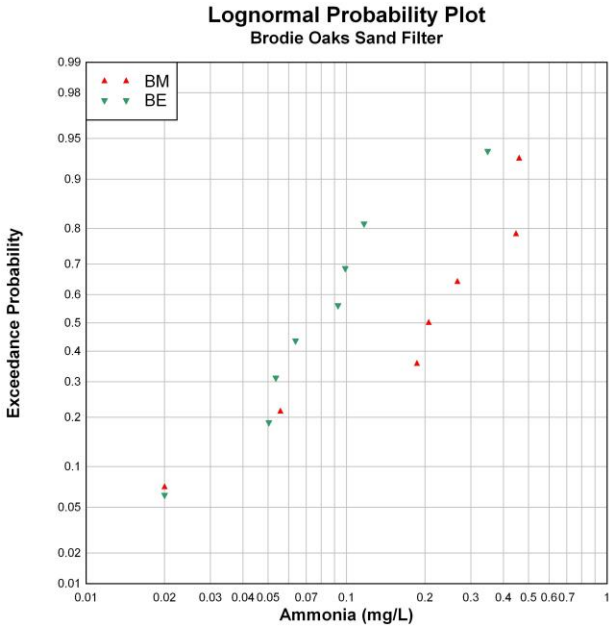


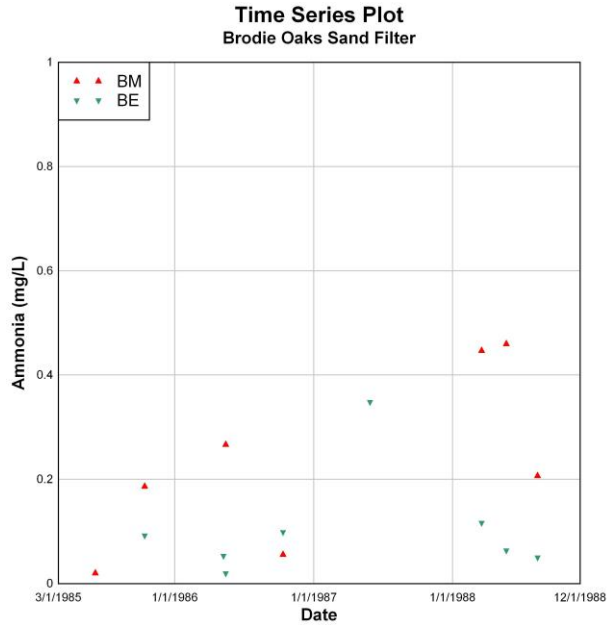


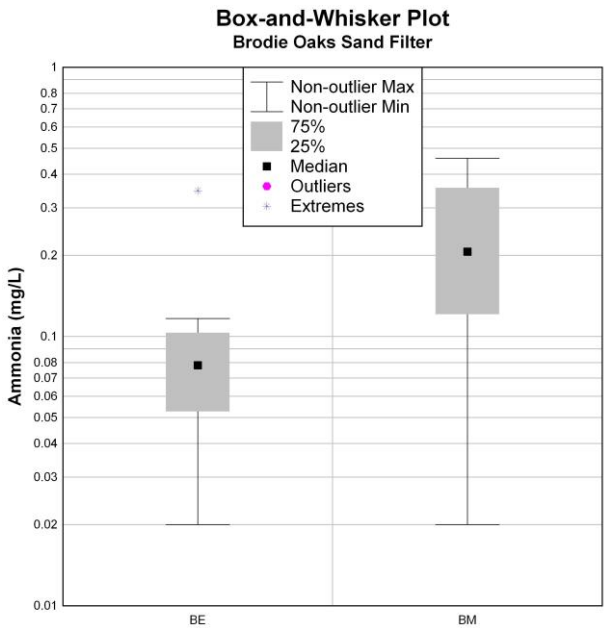


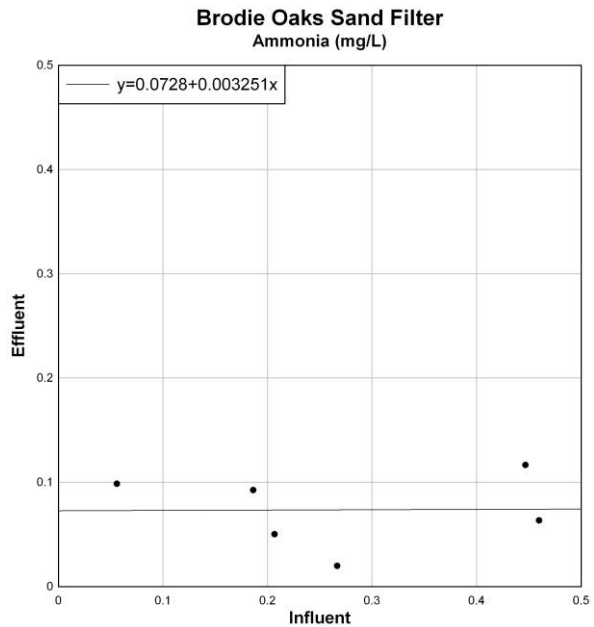
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	0.856	0.586
	Upper Quartile	0.844	0.454
	Median	0.567	0.280
	Lower Quartile	0.430	0.205
	Minimum	0.143	0.156
	Efficiency	50.59%	
	Mann-Whitney	0.1405	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	0.807	0.455
	Mean	0.571	0.328
	LCL	0.334	0.200
	Std. Dev.	0.256	0.153
	Wilk (p-value)	0.6095	0.3871
	Efficiency	42.61%	
	t-Test (equal var.)	0.0407 **	
	t-Test (unequal var.)	0.0540 *	
	t-test (paired)	0.0318 **	
	Levene Test	0.1610	
Log Transformed	UCL	1.110	0.495
	Mean	0.589	0.327
	LCL	0.313	0.216
	Std. Dev.	0.368	0.154
	Wilk (p-value)	0.0835 *	0.7163
	Efficiency	44.45%	
	t-Test (equal var.)	0.0861 *	
	t-Test (unequal var.)	0.0958 *	
	t-Test (paired)	0.0304 **	
	Levene Test	0.5170	
Bootstrap	UCL	0.787	0.442
	Mean	0.576	0.326
	LCL	0.364	0.210
	Std. Dev.	0.228	0.139
	Efficiency	43.37%	

Brodie Oaks Sand Filter - Ammonia (mg/L)



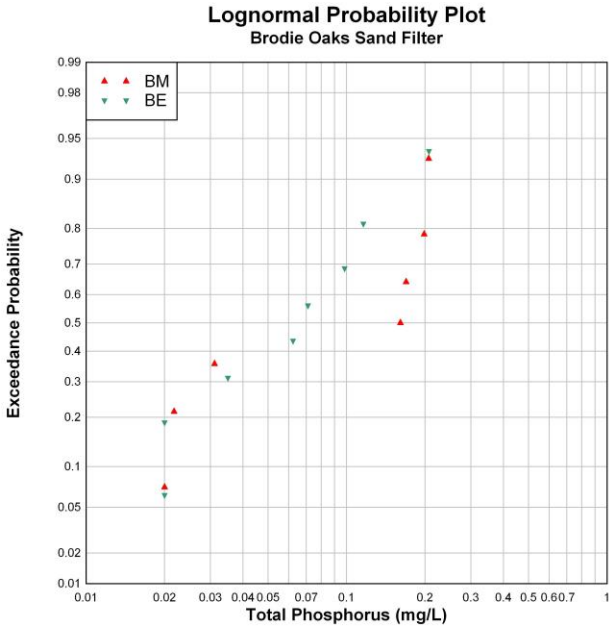


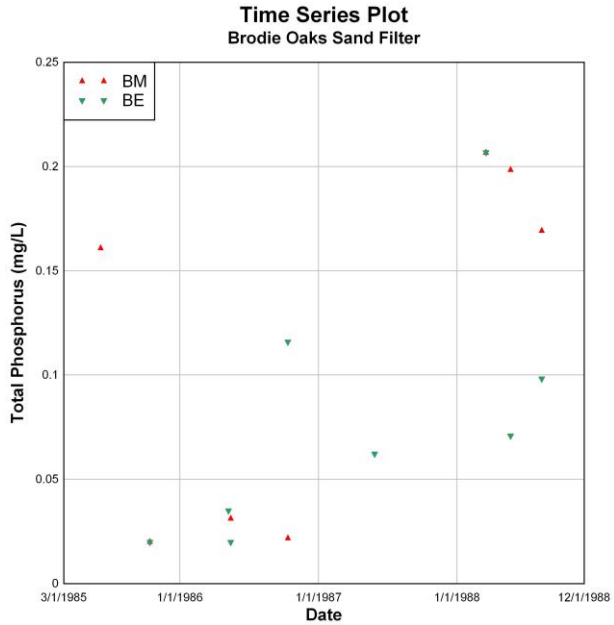


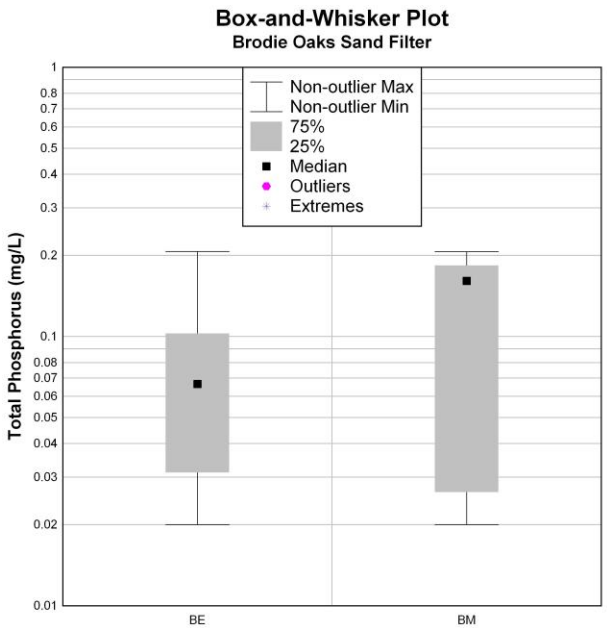


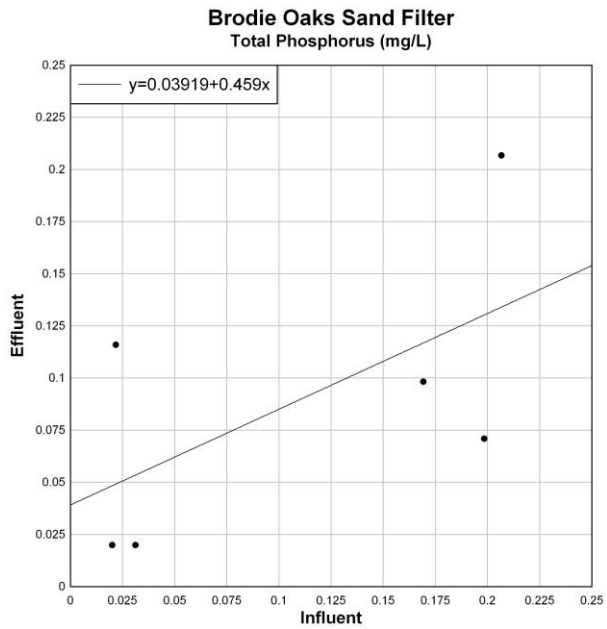
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	0.460	0.348
	Upper Quartile	0.447	0.108
	Median	0.207	0.078
	Lower Quartile	0.056	0.052
	Minimum	0.020	0.020
	Efficiency	62.16%	
	Mann-Whitney	0.1862	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	0.394	0.192
	Mean	0.234	0.105
	LCL	0.075	0.019
	Std. Dev.	0.172	0.103
	Wilk (p-value)	0.4440	0.0028 **
	Efficiency	55.01%	
	t-Test (equal var.)	0.0968 *	
	t-Test (unequal var.)	0.1158	
	t-test (paired)	0.0305 **	
	Levene Test	0.1734	
Log Transformed	UCL	1.103	0.231
	Mean	0.267	0.103
	LCL	0.065	0.046
	Std. Dev.	0.315	0.087
	Wilk (p-value)	0.1976	0.7779
	Efficiency	61.53%	
	t-Test (equal var.)	0.1890	
	t-Test (unequal var.)	0.2036	
	t-Test (paired)	0.0390 **	
	Levene Test	0.3927	
Bootstrap	UCL	0.380	0.176
	Mean	0.236	0.105
	LCL	0.092	0.034
	Std. Dev.	0.155	0.085
	Efficiency	55.45%	

Brodie Oaks Sand Filter - Total Phosphorus (mg/L)



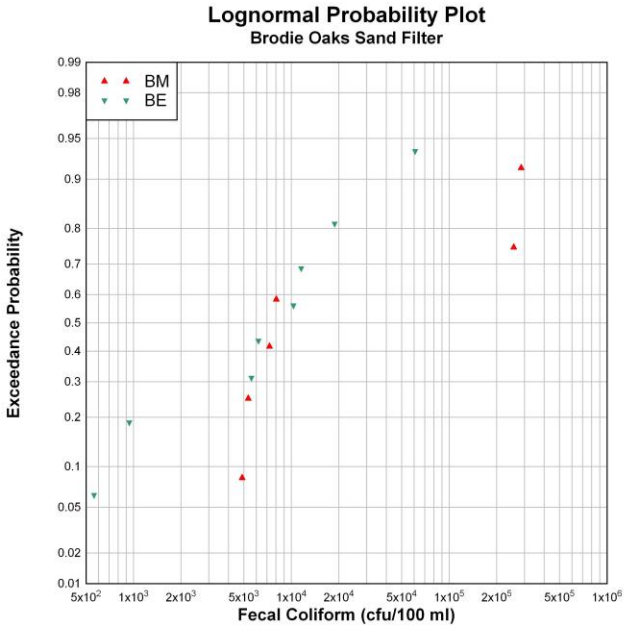


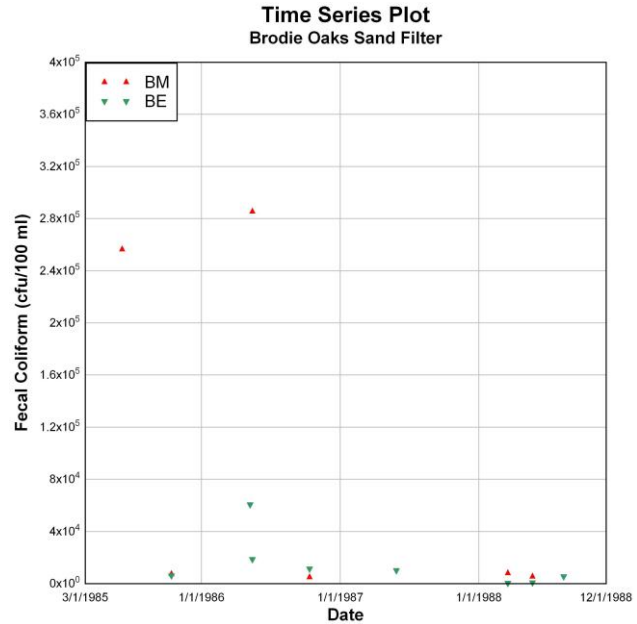


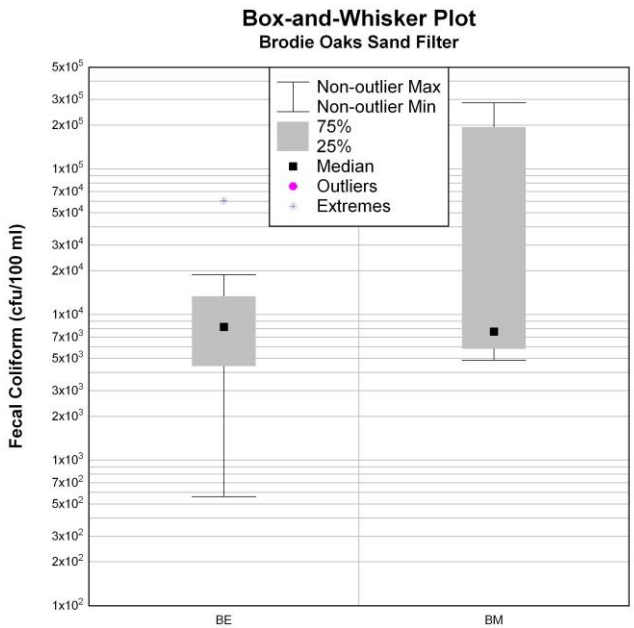


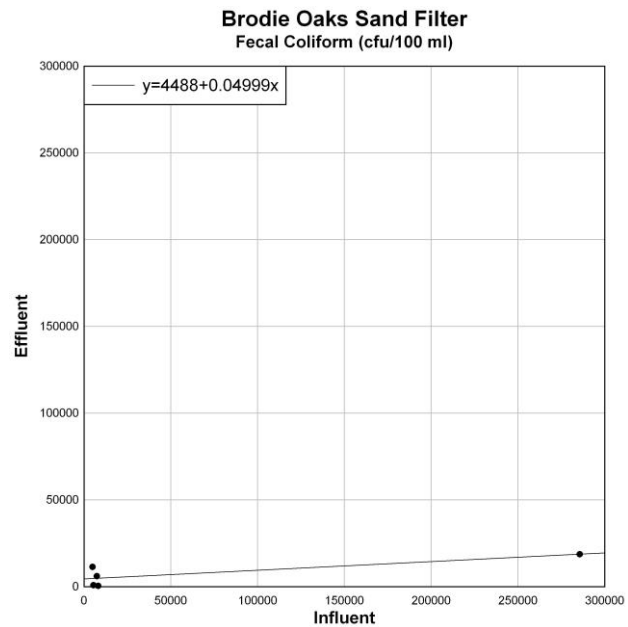
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	0.207	0.207
	Upper Quartile	0.198	0.107
	Median	0.161	0.067
	Lower Quartile	0.022	0.028
	Minimum	0.020	0.020
	Efficiency	58.55%	
	Mann-Whitney	0.6094	
	Wilcoxon (paired)	0.6250	
Arithmetic	UCL	0.196	0.131
	Mean	0.115	0.079
	LCL	0.035	0.026
	Std. Dev.	0.087	0.062
	Wilk (p-value)	0.0356 **	0.1849
	Efficiency	31.82%	
	t-Test (equal var.)	0.3592	
	t-Test (unequal var.)	0.3732	
	t-test (paired)	0.5587	
	Levene Test	0.2082	
Log Transformed	UCL	0.471	0.183
	Mean	0.125	0.079
	LCL	0.033	0.035
	Std. Dev.	0.140	0.069
	Wilk (p-value)	0.0199 **	0.6332
	Efficiency	36.15%	
	t-Test (equal var.)	0.6153	
	t-Test (unequal var.)	0.6233	
	t-Test (paired)	0.8881	
	Levene Test	0.1590	
Bootstrap	UCL	0.190	0.125
	Mean	0.117	0.079
	LCL	0.044	0.033
	Std. Dev.	0.079	0.055
	Efficiency	32.30%	

Brodie Oaks Sand Filter - Fecal Coliform (cfu/100 ml)



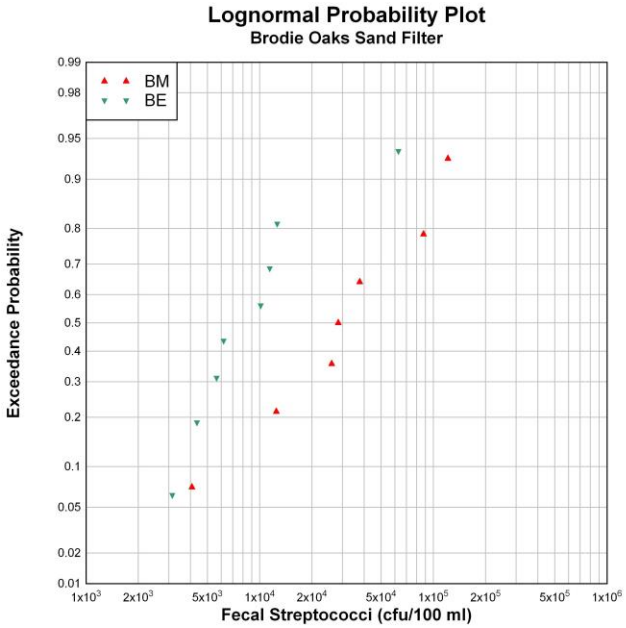


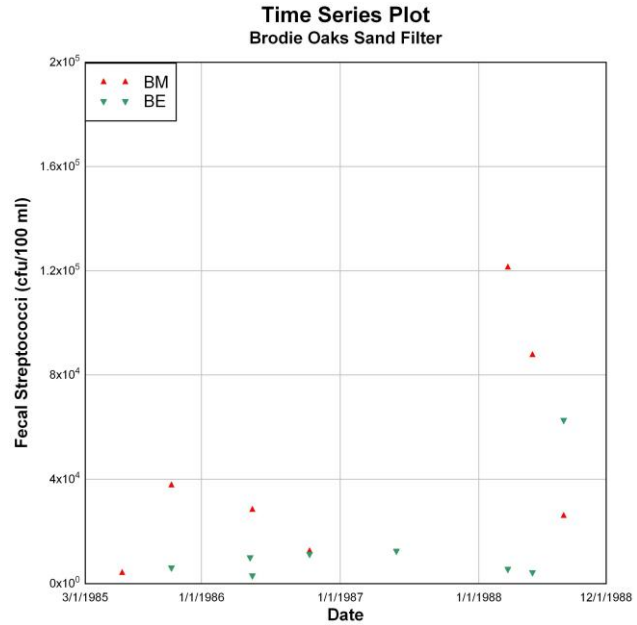


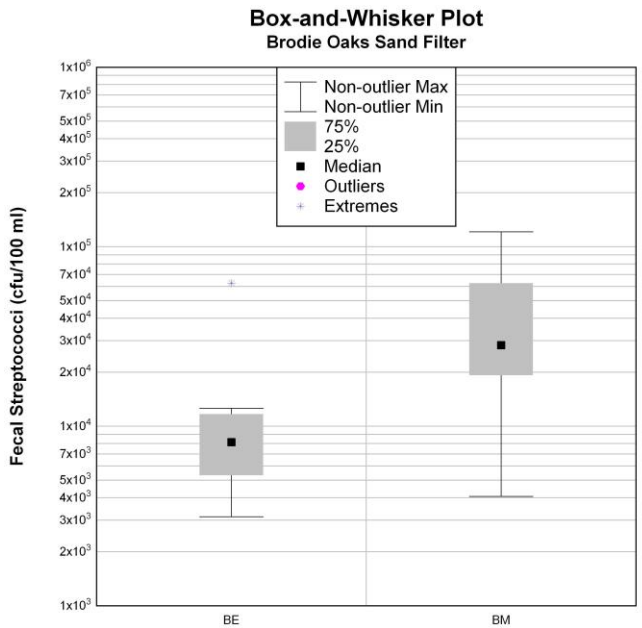


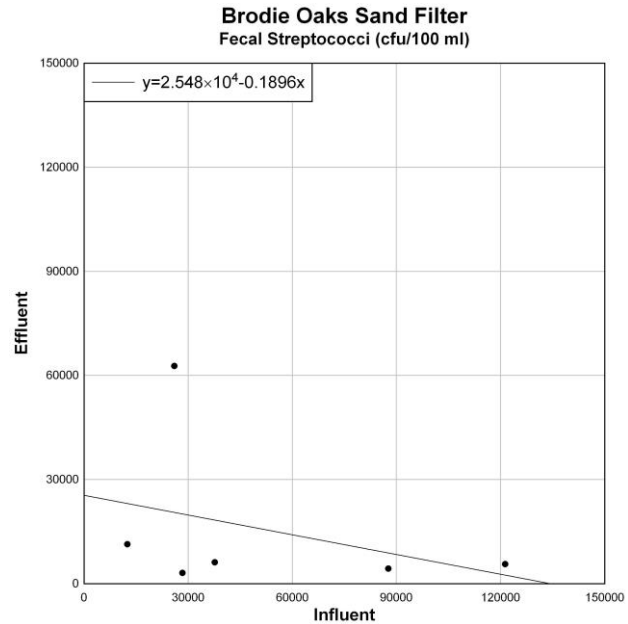
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	6	8
	Pairs Count	5	5
Non-Parametric	Maximum	285,491	60,768
	Upper Quartile	256,345	15,156
	Median	7,637	8,232
	Lower Quartile	5,332	3,255
	Minimum	4,864	561
	Efficiency	-7.79%	
	Mann-Whitney	0.6588	
	Wilcoxon (paired)	0.3125	
Arithmetic	UCL	238,272	30,788
	Mean	94,551	14,327
	LCL	-49,170	-2,134
	Std. Dev.	136,929	19,686
	Wilk (p-value)	0.0031 **	0.0019 **
	Efficiency	84.85%	
	t-Test (equal var.)	0.1234	
	t-Test (unequal var.)	0.2120	
	t-test (paired)	0.3618	
	Levene Test	0.0046 **	
Log Transformed	UCL	3,485,091	113,426
	Mean	83,800	15,975
	LCL	2,015	2,250
	Std. Dev.	159,657	26,422
	Wilk (p-value)	0.0102 **	0.6541
	Efficiency	80.94%	
	t-Test (equal var.)	0.2044	
	t-Test (unequal var.)	0.2273	
	t-Test (paired)	0.1440	
	Levene Test	0.4084	
Bootstrap	UCL	220,324	27,147
	Mean	95,254	13,912
	LCL	-29,816	677
	Std. Dev.	119,178	15,831
	Efficiency	85.39%	

Brodie Oaks Sand Filter - Fecal Streptococci (cfu/100 ml)



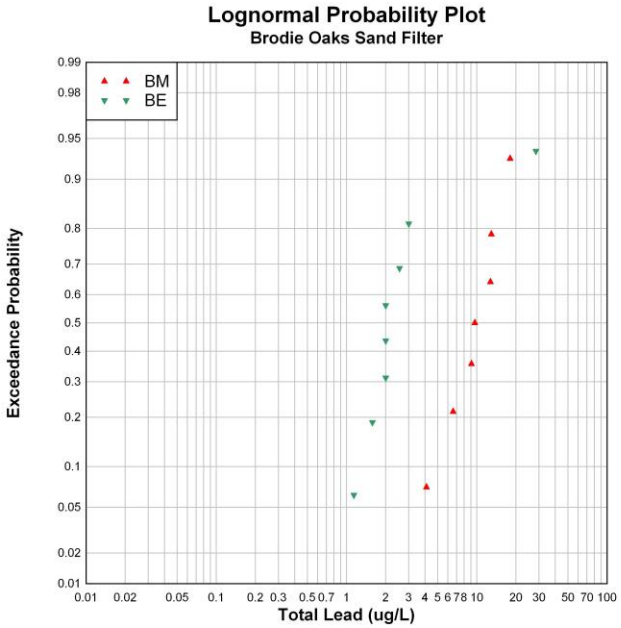


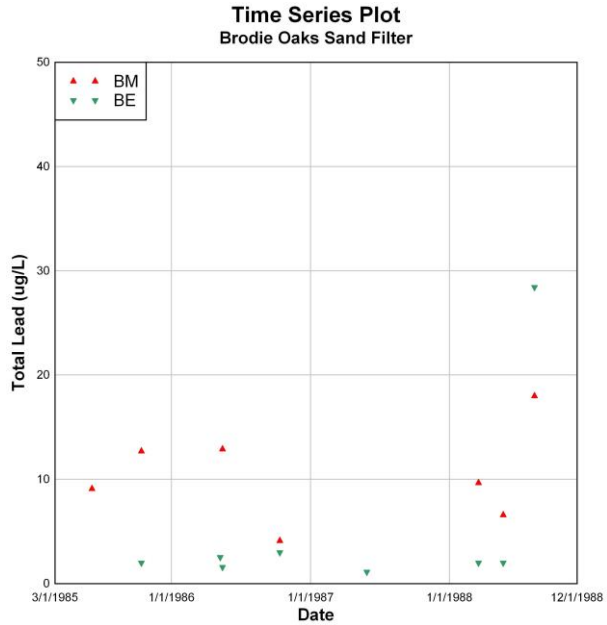


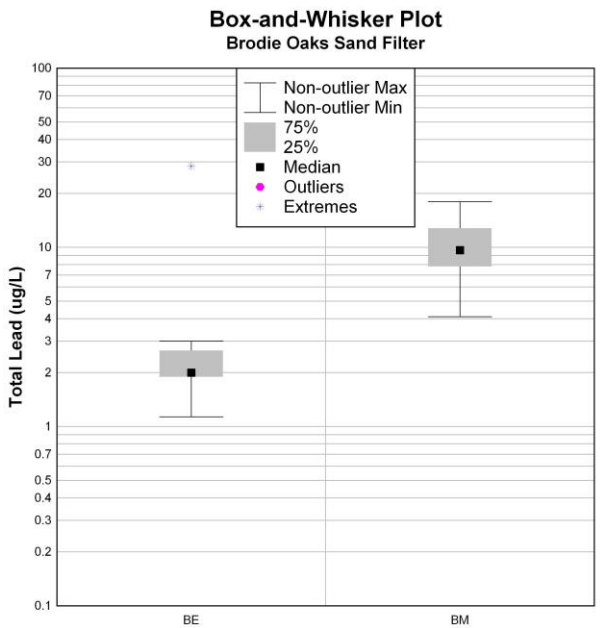


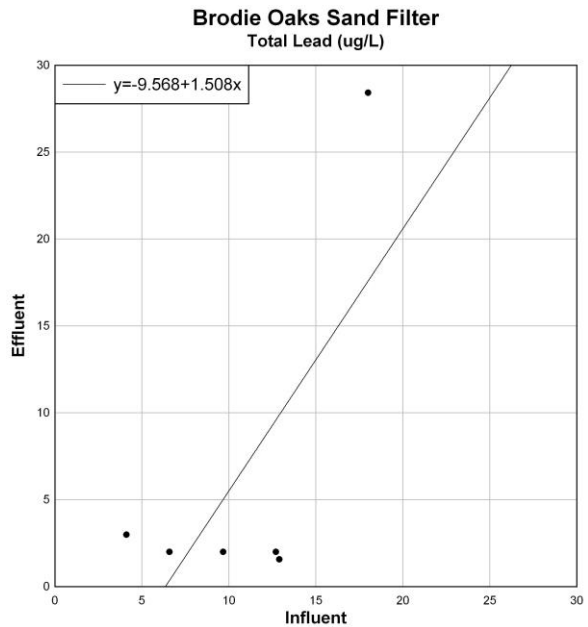
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	121,282	62,760
	Upper Quartile	87,638	11,998
	Median	28,299	8,147
	Lower Quartile	12,448	4,996
	Minimum	4,071	3,137
	Efficiency	71.21%	
	Mann-Whitney	0.0945 *	
	Wilcoxon (paired)	0.2188	
Arithmetic	UCL	85,058	31,069
	Mean	45,339	14,522
	LCL	5,621	-2,025
	Std. Dev.	42,945	19,789
	Wilk (p-value)	0.1467	0.0001 **
	Efficiency	67.97%	
	t-Test (equal var.)	0.0907 *	
	t-Test (unequal var.)	0.1185	
	t-test (paired)	0.1649	
	Levene Test	0.1257	
Log Transformed	UCL	198,469	32,986
	Mean	48,288	12,885
	LCL	11,749	5,033
	Std. Dev.	56,834	12,303
	Wilk (p-value)	0.8283	0.2277
	Efficiency	73.32%	
	t-Test (equal var.)	0.0511 *	
	t-Test (unequal var.)	0.0569 *	
	t-Test (paired)	0.0652 *	
	Levene Test	0.5850	
Bootstrap	UCL	80,926	28,532
	Mean	45,630	14,843
	LCL	10,335	1,154
	Std. Dev.	38,163	16,374
	Efficiency	67.47%	

Brodie Oaks Sand Filter - Total Lead (ug/L)



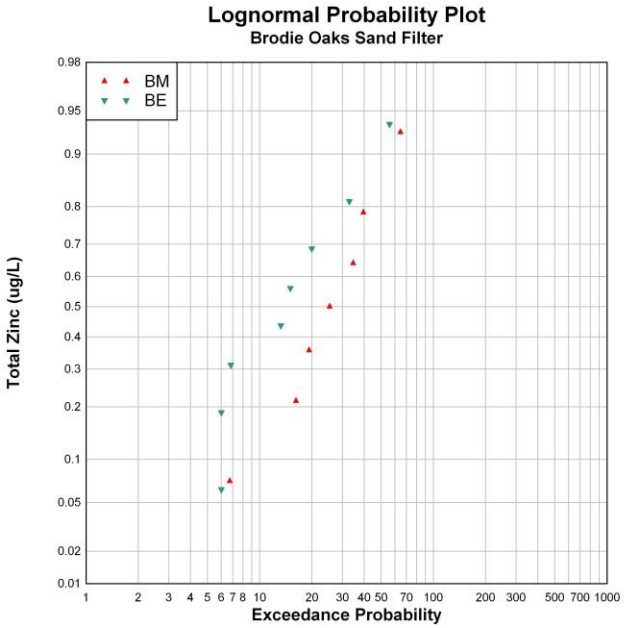


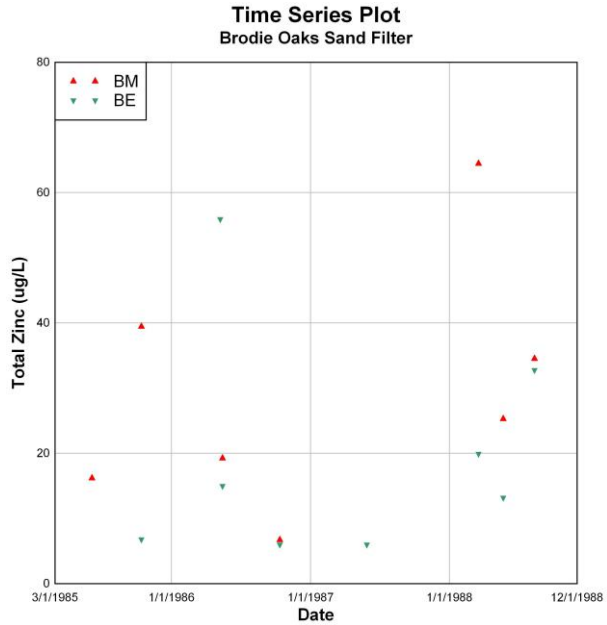


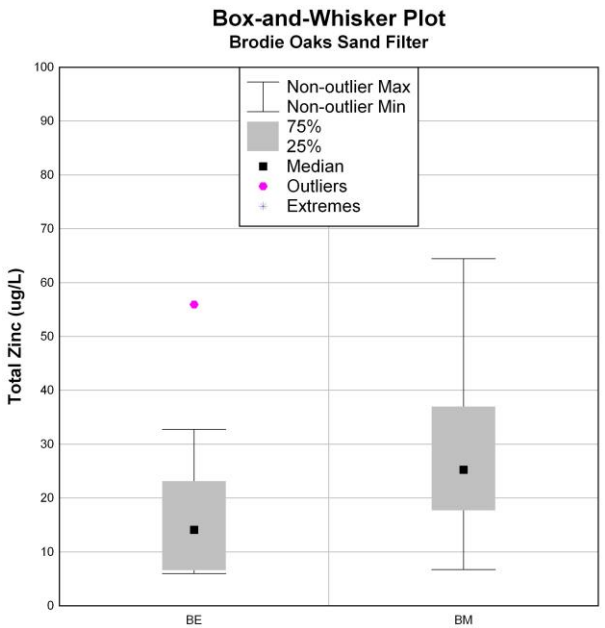


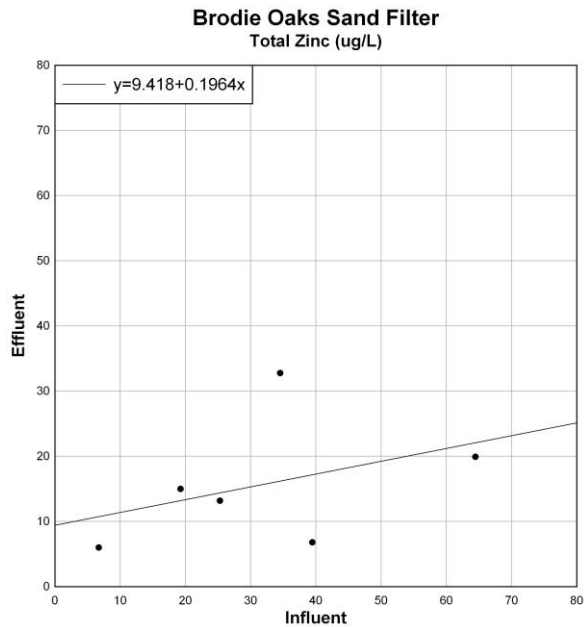
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	18.0	28.4
	Upper Quartile	12.9	2.8
	Median	9.7	2.0
	Lower Quartile	6.6	1.8
	Minimum	4.1	1.1
	Efficiency	79.29%	
	Mann-Whitney	0.0320 **	
	Wilcoxon (paired)	0.2188	
Arithmetic	UCL	14.7	13.2
	Mean	10.4	5.3
	LCL	6.2	-2.5
	Std. Dev.	4.6	9.3
	Wilk (p-value)	0.9409	0.0001 **
	Efficiency	48.85%	
	t-Test (equal var.)	0.2138	
	t-Test (unequal var.)	0.2007	
	t-test (paired)	0.2649	
	Levene Test	0.4221	
Log Transformed	UCL	17.0	11.6
	Mean	10.5	4.1
	LCL	6.5	1.5
	Std. Dev.	5.2	4.2
	Wilk (p-value)	0.8412	0.0023 **
	Efficiency	60.79%	
	t-Test (equal var.)	0.0100 **	
	t-Test (unequal var.)	0.0098 **	
	t-Test (paired)	0.0415 **	
	Levene Test	0.3818	
Bootstrap	UCL	14.3	11.7
	Mean	10.5	5.5
	LCL	6.7	-0.7
	Std. Dev.	4.1	7.4
	Efficiency	47.62%	

Brodie Oaks Sand Filter - Total Zinc (ug/L)



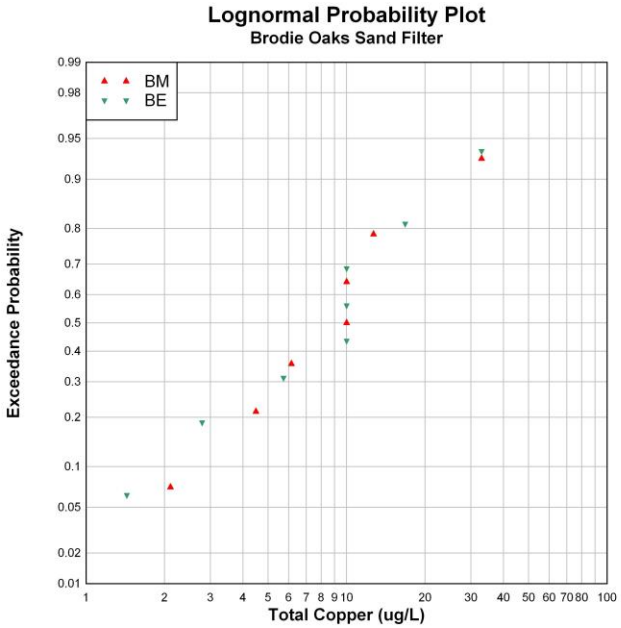


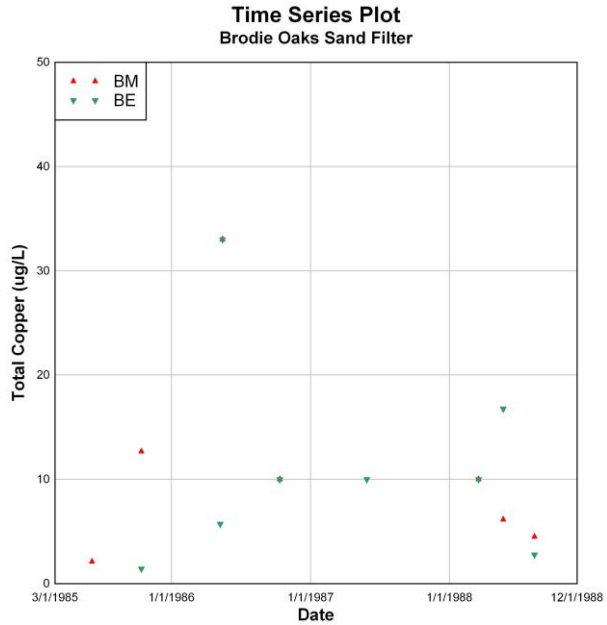


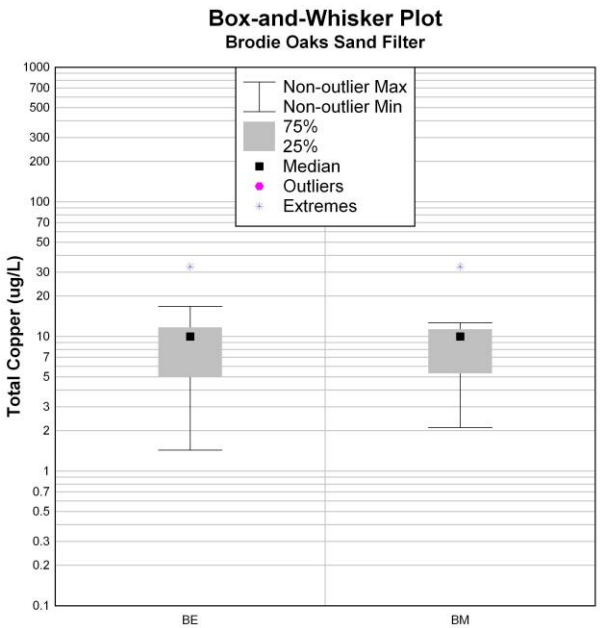


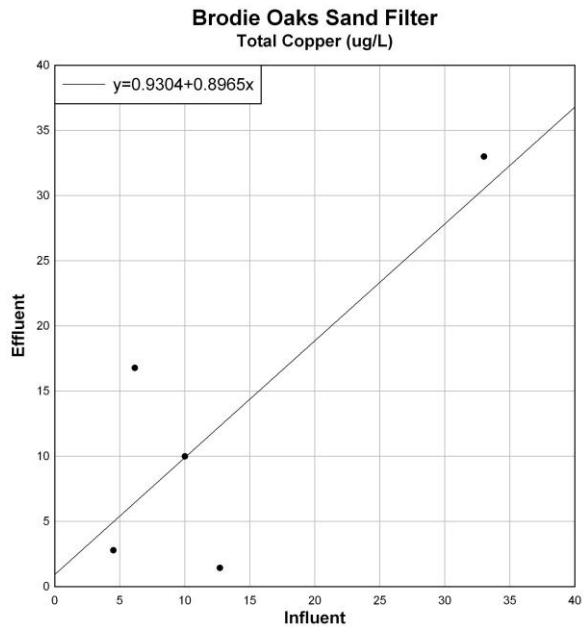
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	64.5	55.9
	Upper Quartile	39.4	26.4
	Median	25.3	14.1
	Lower Quartile	16.2	6.4
	Minimum	6.7	6.0
	Efficiency	44.21%	
	Mann-Whitney	0.2045	
	Wilcoxon (paired)	0.0313 **	
Arithmetic	UCL	47.0	33.9
	Mean	29.4	19.5
	LCL	11.8	5.0
	Std. Dev.	19.0	17.3
	Wilk (p-value)	0.6645	0.0347 **
	Efficiency	33.81%	
	t-Test (equal var.)	0.3077	
	t-Test (unequal var.)	0.3119	
	t-test (paired)	0.0858 *	
	Levene Test	0.8352	
Log Transformed	UCL	64.9	42.8
	Mean	30.0	19.1
	LCL	13.9	8.5
	Std. Dev.	22.1	16.1
	Wilk (p-value)	0.9301	0.4175
	Efficiency	36.38%	
	t-Test (equal var.)	0.2227	
	t-Test (unequal var.)	0.2190	
	t-Test (paired)	0.0616 *	
	Levene Test	0.6757	
Bootstrap	UCL	45.2	31.7
	Mean	29.6	19.3
	LCL	14.0	6.9
	Std. Dev.	16.8	14.8
	Efficiency	34.89%	

Brodie Oaks Sand Filter - Total Copper (ug/L)









	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BM**	**EFF: BE**
	Site Count	7	8
	Pairs Count	6	6
Non-Parametric	Maximum	33.0	33.0
	Upper Quartile	12.7	13.4
	Median	10.0	10.0
	Lower Quartile	4.5	4.3
	Minimum	2.1	1.4
	Efficiency	0.00%	
	Mann-Whitney	0.9542	
	Wilcoxon (paired)	0.8750	
Arithmetic	UCL	20.7	19.6
	Mean	11.2	11.2
	LCL	1.7	2.8
	Std. Dev.	10.3	10.0
	Wilk (p-value)	0.0278 **	0.0648 *
	Efficiency	-0.11%	
	t-Test (equal var.)	0.9982	
	t-Test (unequal var.)	0.9982	
	t-test (paired)	0.8973	
	Levene Test	0.9803	
Log Transformed	UCL	29.1	32.8
	Mean	11.1	11.7
	LCL	4.3	4.1
	Std. Dev.	9.8	12.0
	Wilk (p-value)	0.9484	0.7662
	Efficiency	-4.63%	
	t-Test (equal var.)	0.9091	
	t-Test (unequal var.)	0.9082	
	t-Test (paired)	0.5498	
	Levene Test	0.6763	
Bootstrap	UCL	19.1	18.7
	Mean	11.2	11.3
	LCL	3.3	3.9
	Std. Dev.	8.6	8.9
	Efficiency	-0.97%	

Brodie Oaks Water Quality Pond (BI-BE)

This unique SCM was monitored by COA during its initial monitoring program. Runoff was routed into a retention basin that was used to irrigate landscape. Any overflow from this basin was routed to a sand filter. The retention basin acted as an oversized sedimentation basin and captured most of the smaller runoff events. See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed.

Performance summaries for the retention basin (BI-BM) or the sand filter (BM-BE) refer to the Other Controls and Sand Filters sections respectively.

The Brodie Oaks water quality pond (BI-BE) is a combination of a retention/irrigation pond (BI-BM) and a sand filtration (BM-BE). WQM collected runoff and water quality data at the Brodie Oaks water quality pond (BI-BE) from 1984 to 1988. During this time 12 and 8 valid EMCs were collected at the influent (BI) and effluent (BE) respectively, of which 5 were paired.

Performance Summary

Overall, the Brodie Oaks Water Quality Pond had a minimal impact on water quality for the pollutants measured during this study. The BMP had the best performance with the reduction of the concentrations of TSS and some metals. TSS was reduced by 61% and TDS was increased by 40%; these were significant only if a paired comparison is used.

COD concentration was reduced by 56% and significant only when data are not paired. The reduction (45%) in TOC concentration was not significant in any case. The increase (32%) in BOD concentration was not significant in any case.

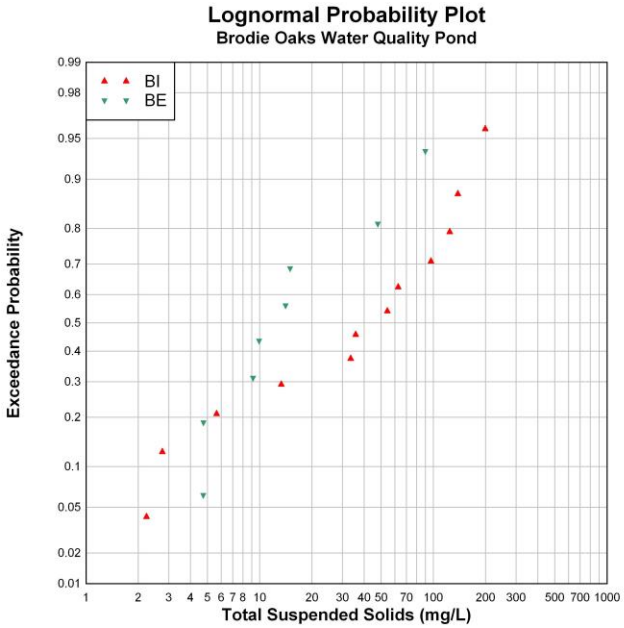
There was no significant reduction in total nitrogen (9%) in any case, paired or not paired. Nitrate + nitrite concentration was increased (90%) and only significant if data are not paired. Total Kjeldahl nitrogen was reduced (51%) significantly only if data are not paired. The reduction of ammonia concentration (58%) was only significant if data are paired.

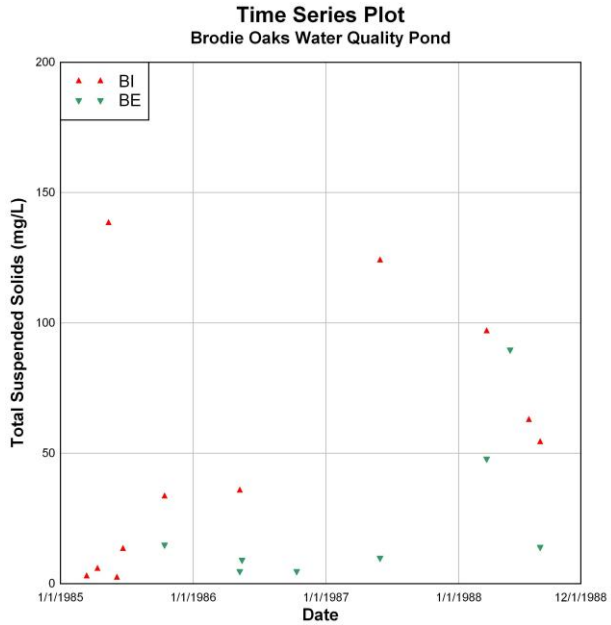
TP concentration was reduced by 26% but this was not significant in any case.

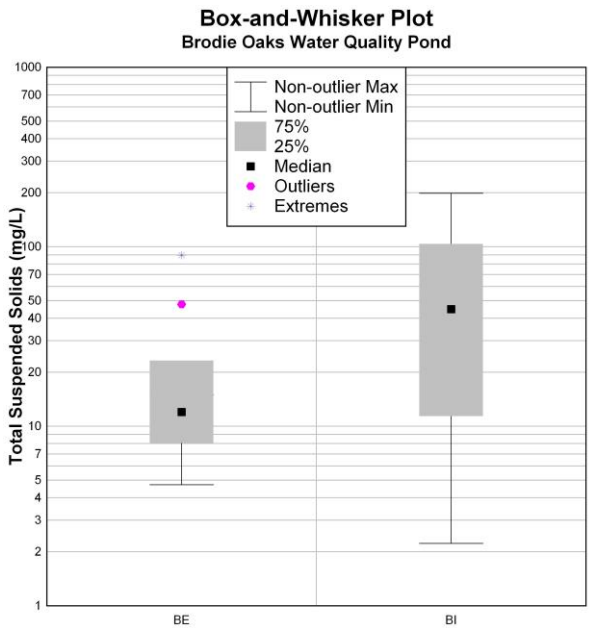
The reduction of bacteria was not significant in any case for both FCOL (43%) and FSTR (16%).

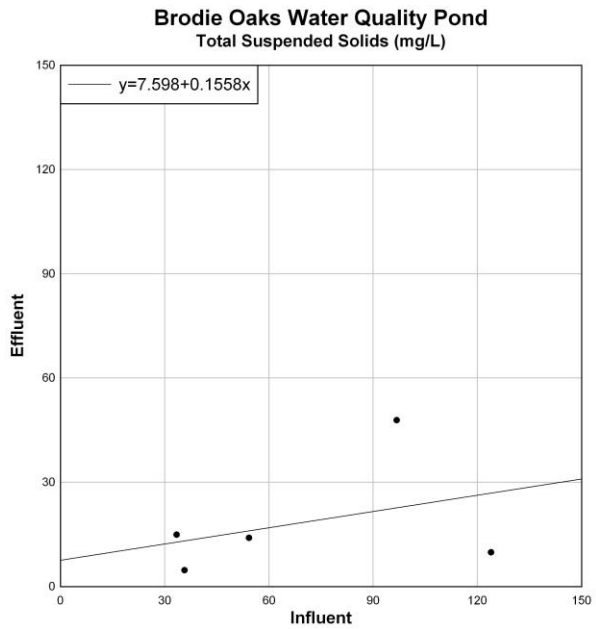
Lead and zinc were reduced by 78 and 66% respectively, and copper was increased by 88%. The reduction in lead concentration was significant in all cases, and reduction in zinc concentrations was significant only if not paired. The increase in copper concentration was not significant in all cases.

Brodie Oaks Water Quality Pond - Total Suspended Solids (mg/L)



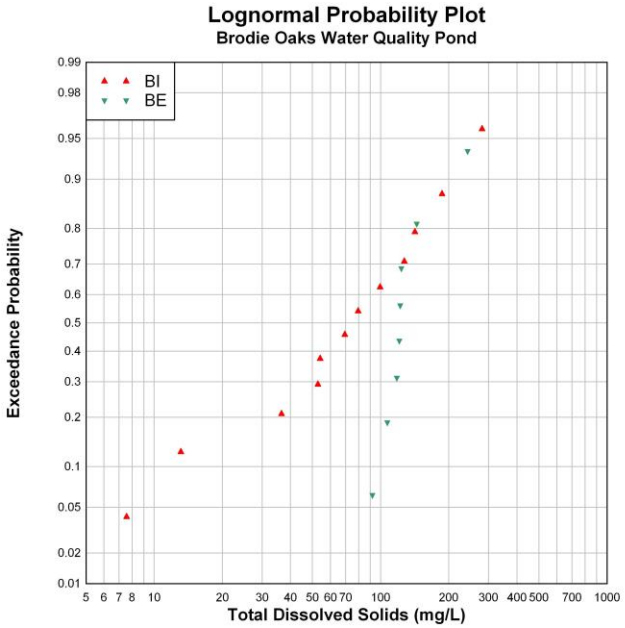


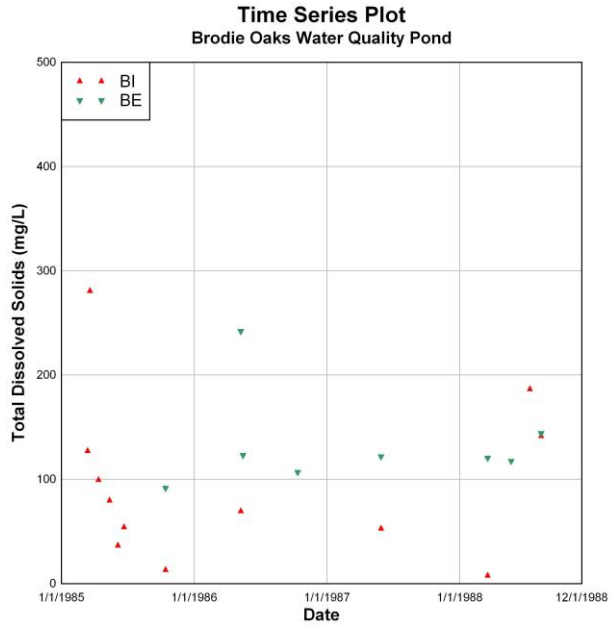


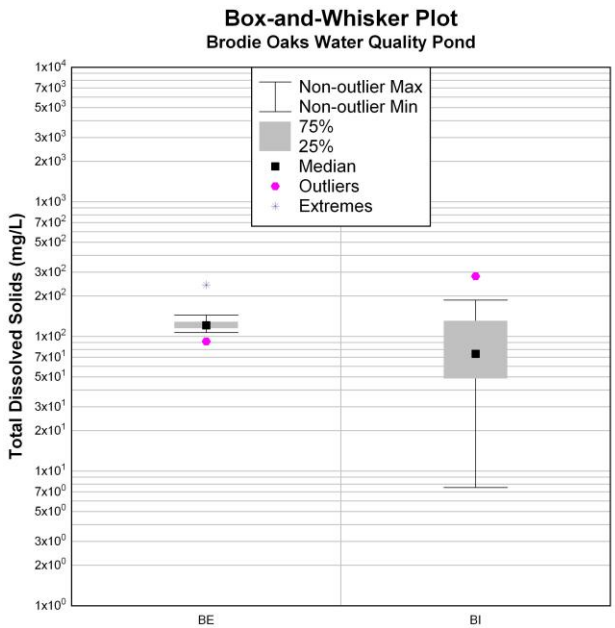


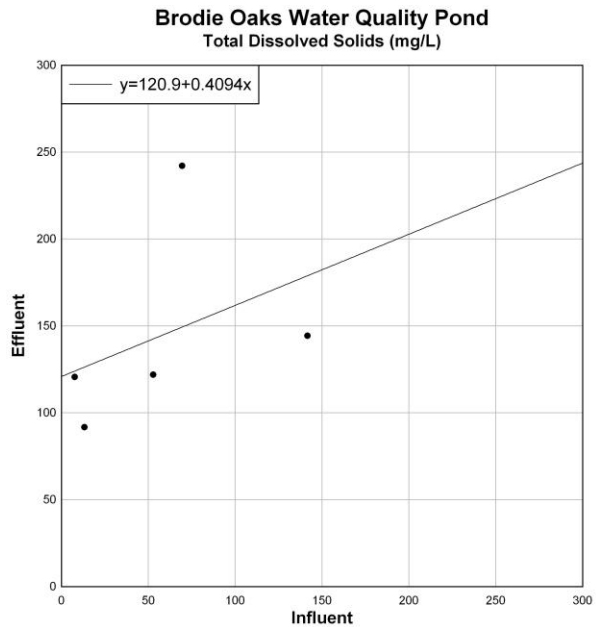
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	198.6	89.8
	Upper Quartile	110.3	31.4
	Median	45.0	12.0
	Lower Quartile	9.5	6.9
	Minimum	2.2	4.7
	Efficiency	73.30%	
	Mann-Whitney	0.2465	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	104.0	49.4
	Mean	64.0	24.4
	LCL	23.9	-.6
	Std. Dev.	63.0	29.9
	Wilk (p-value)	0.1084	0.0026 **
	Efficiency	61.84%	
	t-Test (equal var.)	0.1172	
	t-Test (unequal var.)	0.0776 *	
	t-test (paired)	0.0388 **	
	Levene Test	0.1272	
Log Transformed	UCL	369.2	68.8
	Mean	83.6	22.7
	LCL	18.9	7.5
	Std. Dev.	157.5	24.7
	Wilk (p-value)	0.1985	0.2914
	Efficiency	72.90%	
	t-Test (equal var.)	0.2485	
	t-Test (unequal var.)	0.2134	
	t-Test (paired)	0.0135 **	
	Levene Test	0.1717	
Bootstrap	UCL	100.5	46.1
	Mean	63.5	24.6
	LCL	26.5	3.1
	Std. Dev.	58.3	25.7
	Efficiency	61.25%	

Brodie Oaks Water Quality Pond - Total Dissolved Solids (mg/L)



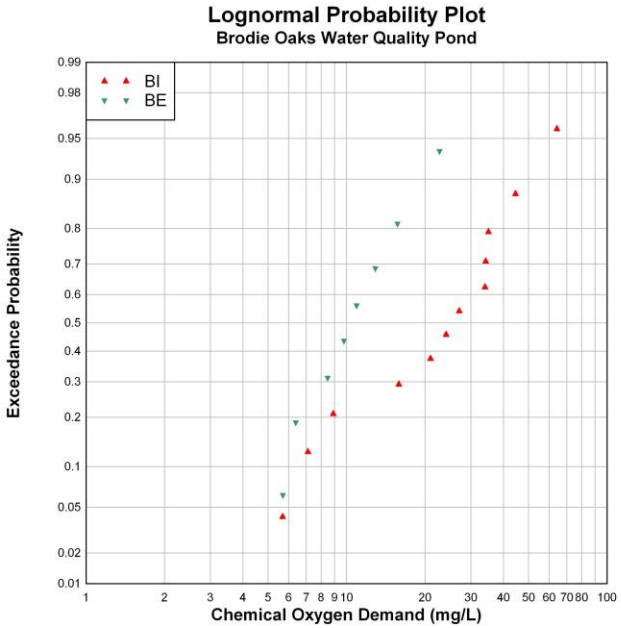


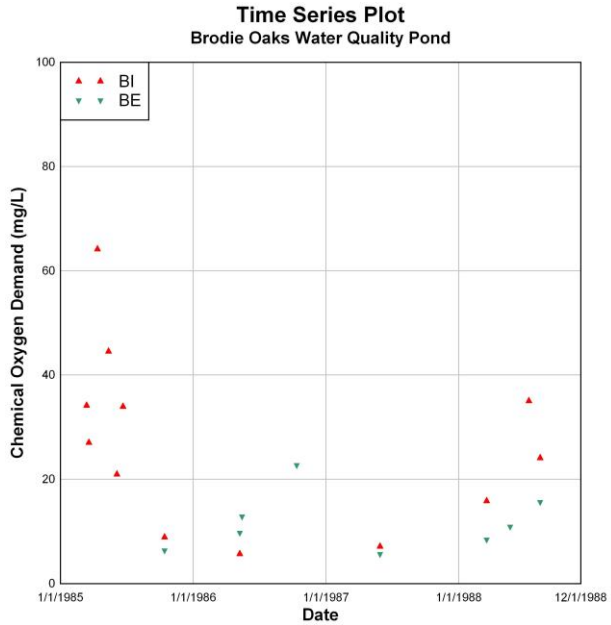


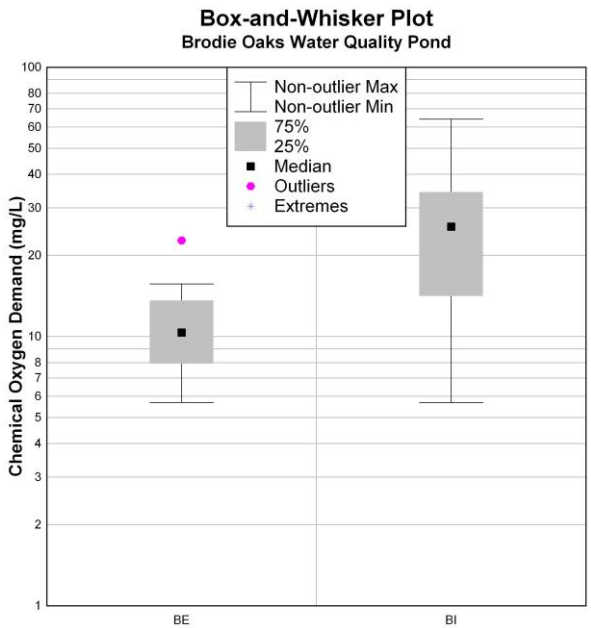


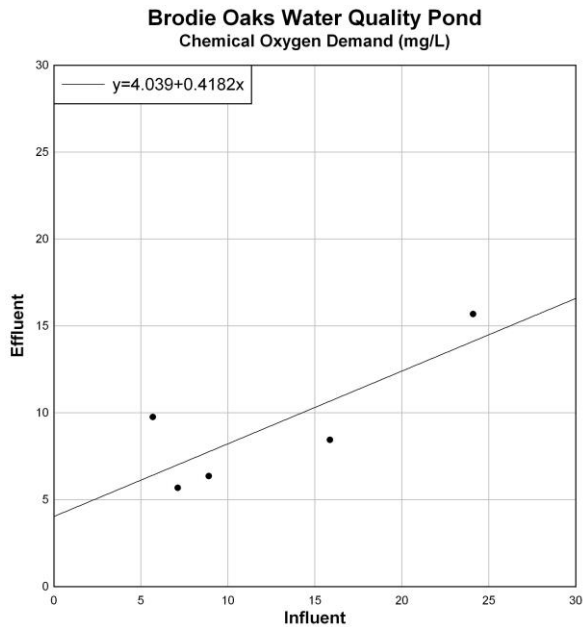
	PARAMETER	TDS (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	280.66	242.15
	Upper Quartile	134.29	133.84
	Median	74.48	121.34
	Lower Quartile	44.61	112.37
	Minimum	7.55	91.85
	Efficiency	-62.90%	
	Mann-Whitney	0.1489	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	145.68	172.35
	Mean	95.66	133.63
	LCL	45.64	94.92
	Std. Dev.	78.72	46.30
	Wilk (p-value)	0.1727	0.0036 **
	Efficiency	-39.70%	
	t-Test (equal var.)	0.2368	
	t-Test (unequal var.)	0.1921	
	t-test (paired)	0.0349 **	
	Levene Test	0.2998	
Log Transformed	UCL	244.96	170.04
	Mean	105.25	133.00
	LCL	45.22	104.02
	Std. Dev.	122.61	38.34
	Wilk (p-value)	0.5150	0.0522 *
	Efficiency	-26.36%	
	t-Test (equal var.)	0.0907 *	
	t-Test (unequal var.)	0.0510 *	
	t-Test (paired)	0.0439 **	
	Levene Test	0.0804 *	
Bootstrap	UCL	140.76	164.16
	Mean	94.99	132.89
	LCL	49.22	101.62
	Std. Dev.	72.04	37.40
	Efficiency	-39.90%	

Brodie Oaks Water Quality Pond - Chemical Oxygen Demand (mg/L)



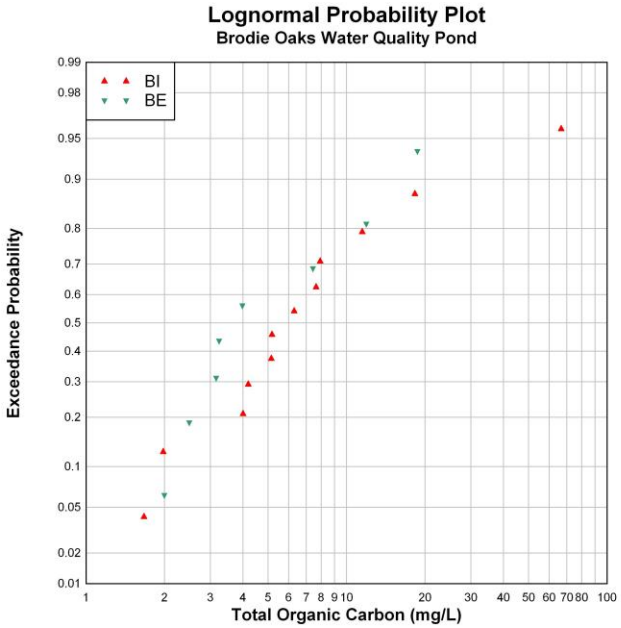


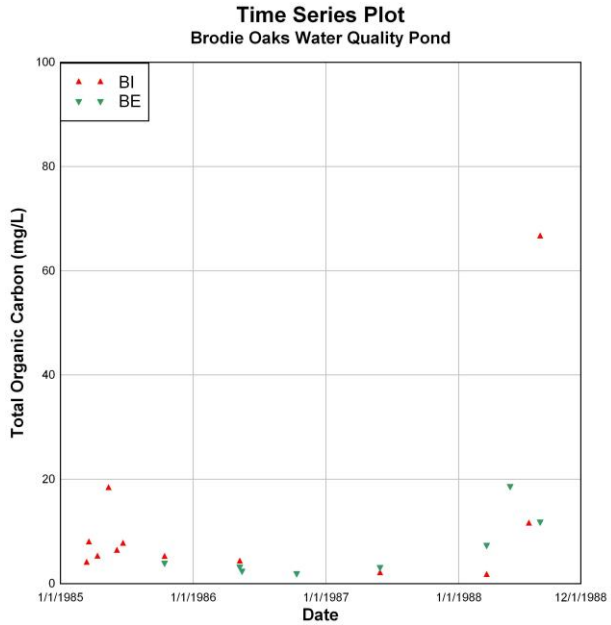


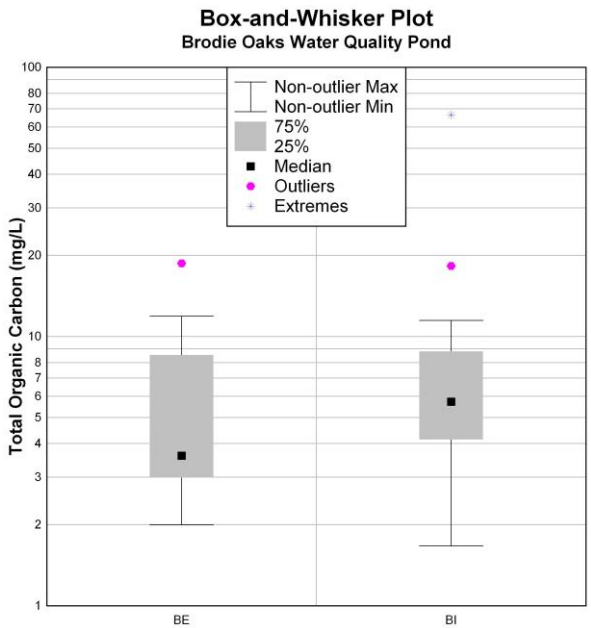


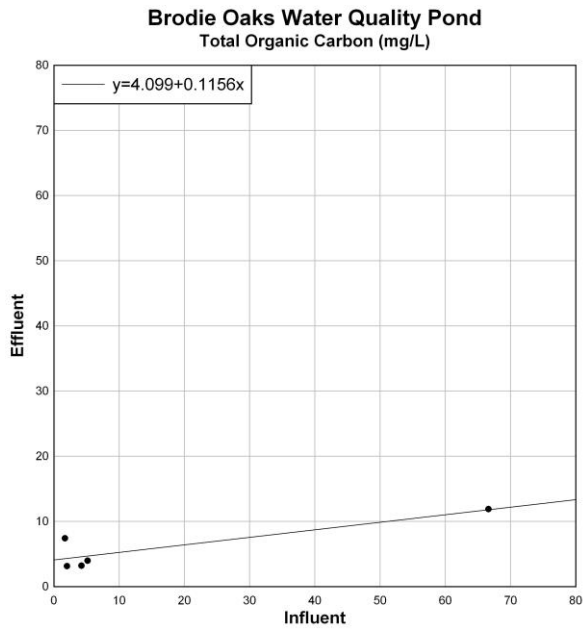
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	64.17	22.74
	Upper Quartile	34.60	14.29
	Median	25.57	10.34
	Lower Quartile	12.38	7.41
	Minimum	5.68	5.69
	Efficiency	59.55%	
	Mann-Whitney	0.0550 *	
	Wilcoxon (paired)	0.3125	
Arithmetic	UCL	37.63	16.24
	Mean	26.79	11.57
	LCL	15.96	6.89
	Std. Dev.	17.06	5.59
	Wilk (p-value)	0.4774	0.3595
	Efficiency	56.83%	
	t-Test (equal var.)	0.0263 **	
	t-Test (unequal var.)	0.0122 **	
	t-test (paired)	0.2369	
	Levene Test	0.1038	
Log Transformed	UCL	48.05	17.32
	Mean	27.66	11.53
	LCL	15.93	7.68
	Std. Dev.	22.20	5.35
	Wilk (p-value)	0.4169	0.9591
	Efficiency	58.31%	
	t-Test (equal var.)	0.0300 **	
	t-Test (unequal var.)	0.0182 **	
	t-Test (paired)	0.3458	
	Levene Test	0.1313	
Bootstrap	UCL	36.42	15.79
	Mean	26.45	11.62
	LCL	16.48	7.45
	Std. Dev.	15.69	4.98
	Efficiency	56.08%	

Brodie Oaks Water Quality Pond - Total Organic Carbon (mg/L)



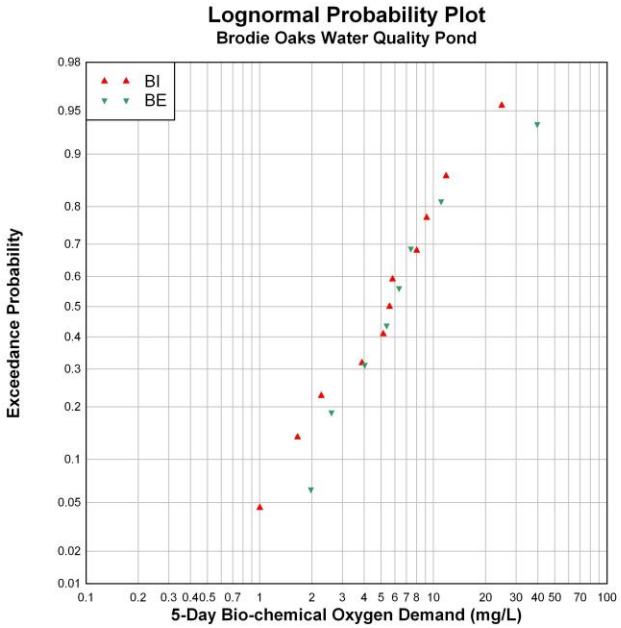


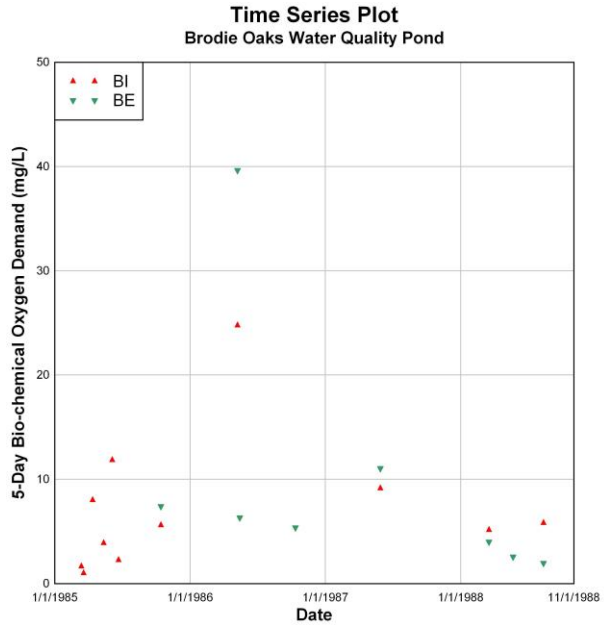


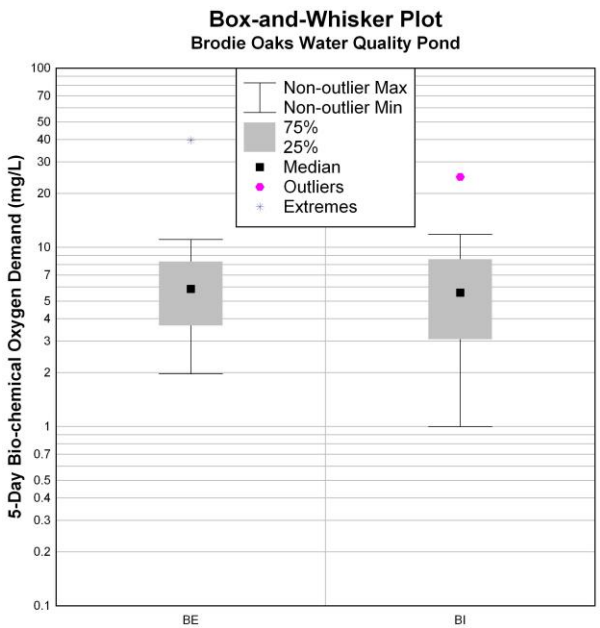


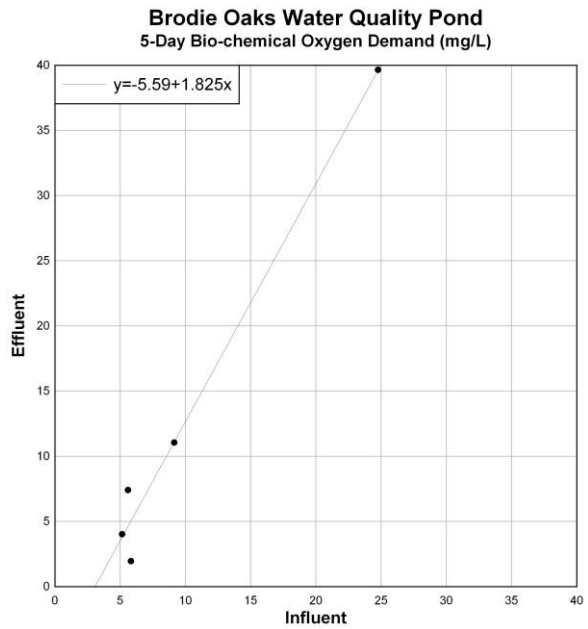
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	66.59	18.70
	Upper Quartile	9.70	9.66
	Median	5.73	3.61
	Lower Quartile	4.10	2.82
	Minimum	1.67	2.00
	Efficiency	37.02%	
	Mann-Whitney	0.4725	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	23.05	11.54
	Mean	11.70	6.61
	LCL	0.34	1.68
	Std. Dev.	17.87	5.89
	Wilk (p-value)	0.0001 **	0.0229 **
	Efficiency	43.49%	
	t-Test (equal var.)	0.4504	
	t-Test (unequal var.)	0.3757	
	t-test (paired)	0.4254	
	Levene Test	0.4028	
Log Transformed	UCL	22.25	13.93
	Mean	10.27	6.41
	LCL	4.74	2.95
	Std. Dev.	11.08	5.24
	Wilk (p-value)	0.3758	0.3715
	Efficiency	37.52%	
	t-Test (equal var.)	0.4700	
	t-Test (unequal var.)	0.4508	
	t-Test (paired)	0.9216	
	Levene Test	0.5622	
Bootstrap	UCL	22.07	11.09
	Mean	12.13	6.69
	LCL	2.18	2.29
	Std. Dev.	15.66	5.26
	Efficiency	44.82%	

Brodie Oaks Water Quality Pond - 5-Day Bio-chemical Oxygen Demand (mg/L)



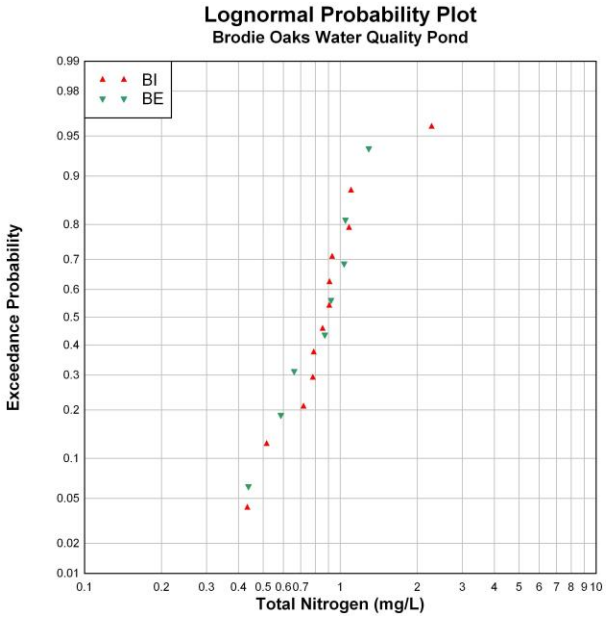


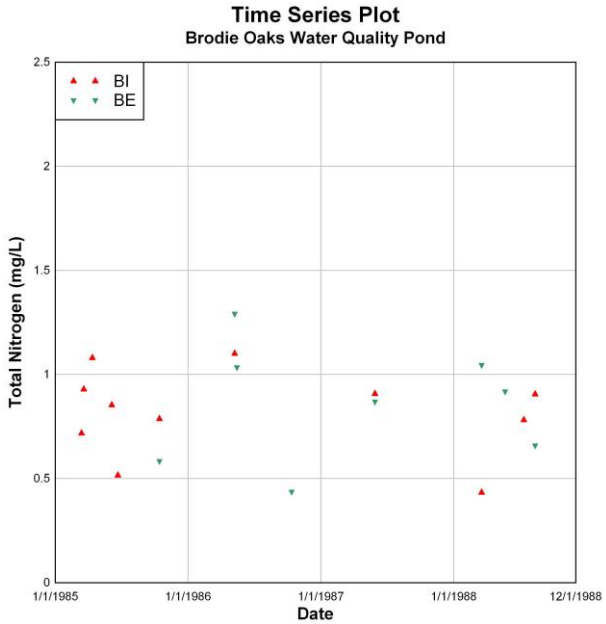


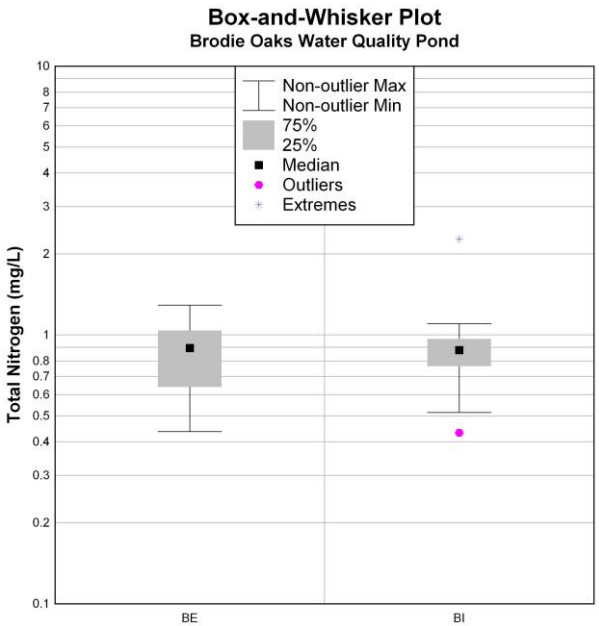


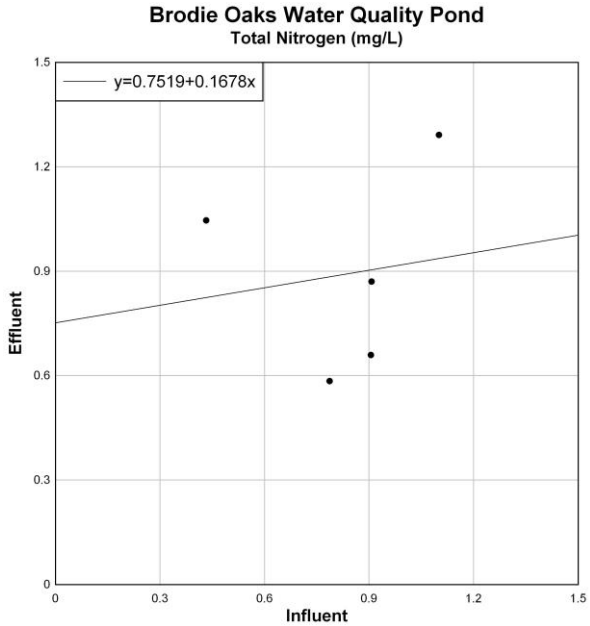
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	11	8
	Pairs Count	5	5
Non-Parametric	Maximum	24.76	39.65
	Upper Quartile	9.13	9.24
	Median	5.59	5.86
	Lower Quartile	2.26	3.30
	Minimum	1.00	1.97
	Efficiency	-4.82%	
	Mann-Whitney	0.7759	
	Wilcoxon (paired)	0.6250	
Arithmetic	UCL	11.68	20.17
	Mean	7.19	9.80
	LCL	2.70	-0.56
	Std. Dev.	6.69	12.40
	Wilk (p-value)	0.0083 **	0.0004 **
	Efficiency	-36.36%	
	t-Test (equal var.)	0.5602	
	t-Test (unequal var.)	0.5999	
	t-test (paired)	0.4433	
	Levene Test	0.3457	
Log Transformed	UCL	15.39	23.36
	Mean	7.29	8.99
	LCL	3.46	3.46
	Std. Dev.	7.20	8.69
	Wilk (p-value)	0.9770	0.6006
	Efficiency	-23.24%	
	t-Test (equal var.)	0.6238	
	t-Test (unequal var.)	0.6255	
	t-Test (paired)	0.7962	
	Levene Test	0.9926	
Bootstrap	UCL	11.21	17.65
	Mean	7.20	9.50
	LCL	3.20	1.35
	Std. Dev.	5.96	9.75
	Efficiency	-31.86%	

Brodie Oaks Water Quality Pond - Total Nitrogen (mg/L)



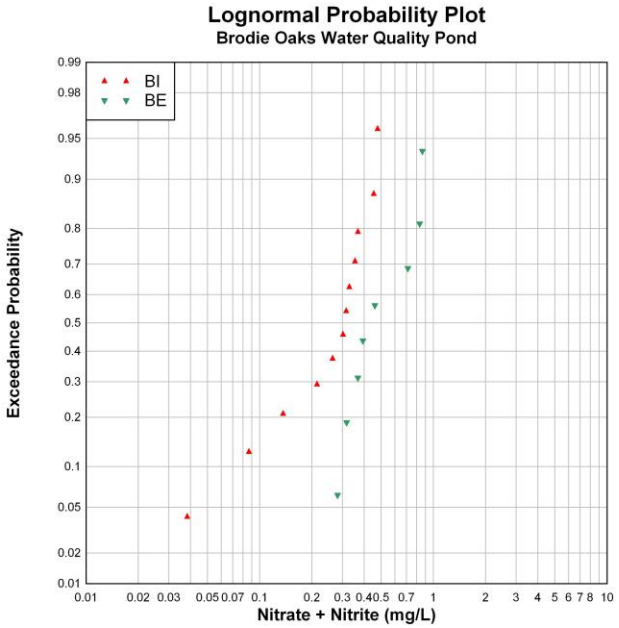


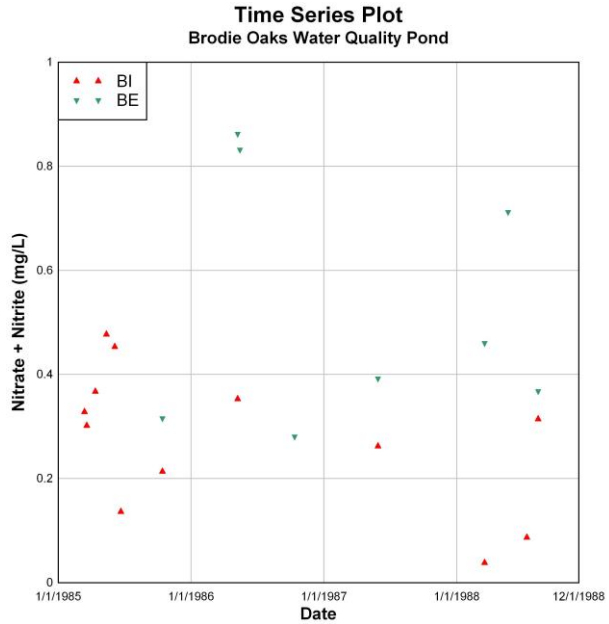


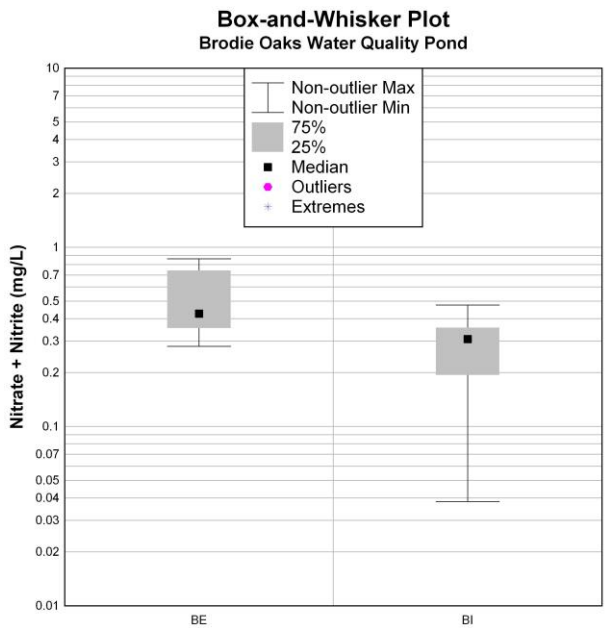


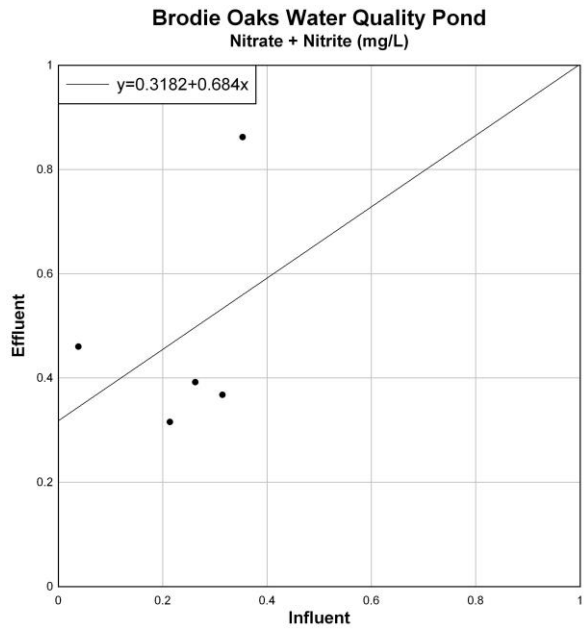
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	2.275	1.292
	Upper Quartile	1.004	1.041
	Median	0.879	0.895
	Lower Quartile	0.749	0.622
	Minimum	0.432	0.437
	Efficiency	-1.81%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	1.235	1.090
	Mean	0.940	0.856
	LCL	0.645	0.621
	Std. Dev.	0.464	0.280
	Wilk (p-value)	0.0021 **	0.9221
	Efficiency	8.98%	
	t-Test (equal var.)	0.6517	
	t-Test (unequal var.)	0.6188	
	t-test (paired)	0.7032	
	Levene Test	0.4864	
Log Transformed	UCL	1.225	1.169
	Mean	0.933	0.858
	LCL	0.710	0.630
	Std. Dev.	0.390	0.308
	Wilk (p-value)	0.2165	0.7192
	Efficiency	7.98%	
	t-Test (equal var.)	0.7326	
	t-Test (unequal var.)	0.7254	
	t-Test (paired)	0.7401	
	Levene Test	0.6971	
Bootstrap	UCL	1.194	1.063
	Mean	0.936	0.852
	LCL	0.678	0.641
	Std. Dev.	0.407	0.252
	Efficiency	8.96%	

Brodie Oaks Water Quality Pond - Nitrate + Nitrite (mg/L)



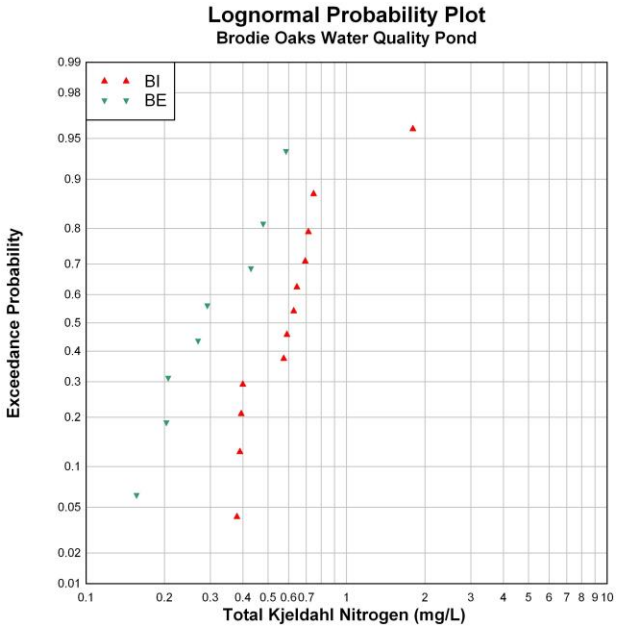


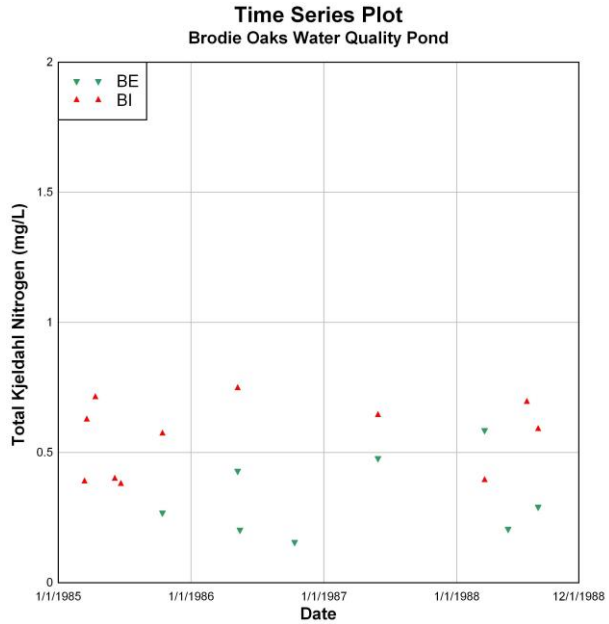


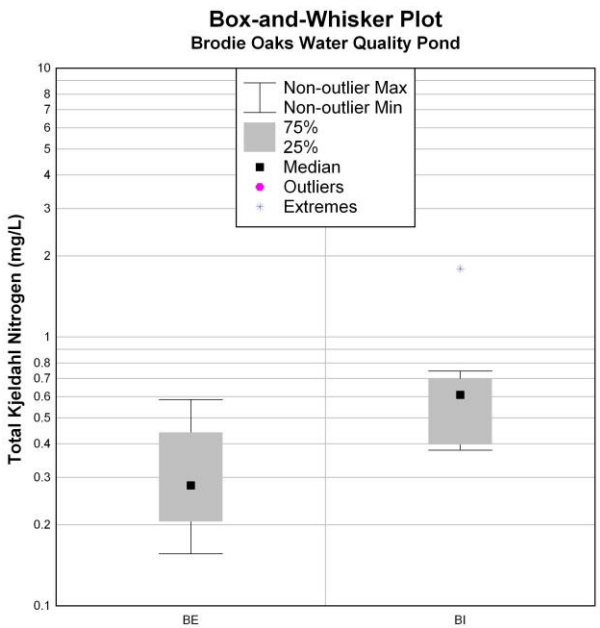


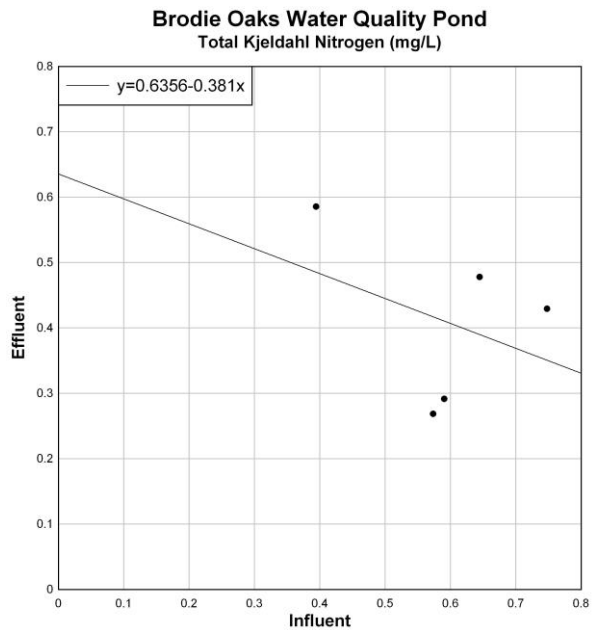
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	0.477	0.862
	Upper Quartile	0.360	0.772
	Median	0.308	0.426
	Lower Quartile	0.175	0.342
	Minimum	0.038	0.281
	Efficiency	-38.44%	
	Mann-Whitney	0.0295 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	0.365	0.726
	Mean	0.278	0.528
	LCL	0.190	0.330
	Std. Dev.	0.137	0.237
	Wilk (p-value)	0.7377	0.1047
	Efficiency	-90.21%	
	t-Test (equal var.)	0.0076 **	
	t-Test (unequal var.)	0.0219 **	
	t-test (paired)	0.0582 *	
	Levene Test	0.0212 **	
Log Transformed	UCL	0.510	0.779
	Mean	0.296	0.527
	LCL	0.172	0.356
	Std. Dev.	0.234	0.236
	Wilk (p-value)	0.0230 **	0.2594
	Efficiency	-78.06%	
	t-Test (equal var.)	0.0215 **	
	t-Test (unequal var.)	0.0123 **	
	t-Test (paired)	0.1098	
	Levene Test	0.3021	
Bootstrap	UCL	0.359	0.707
	Mean	0.277	0.526
	LCL	0.195	0.346
	Std. Dev.	0.129	0.216
	Efficiency	-90.08%	

Brodie Oaks Water Quality Pond - Total Kjeldahl Nitrogen (mg/L)



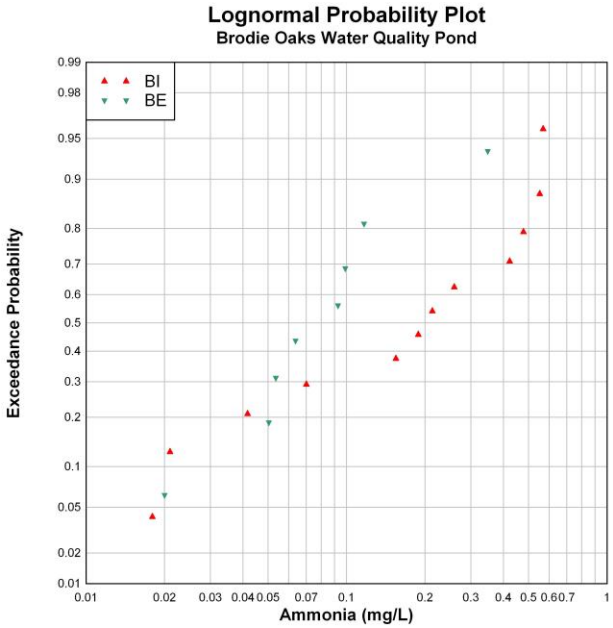


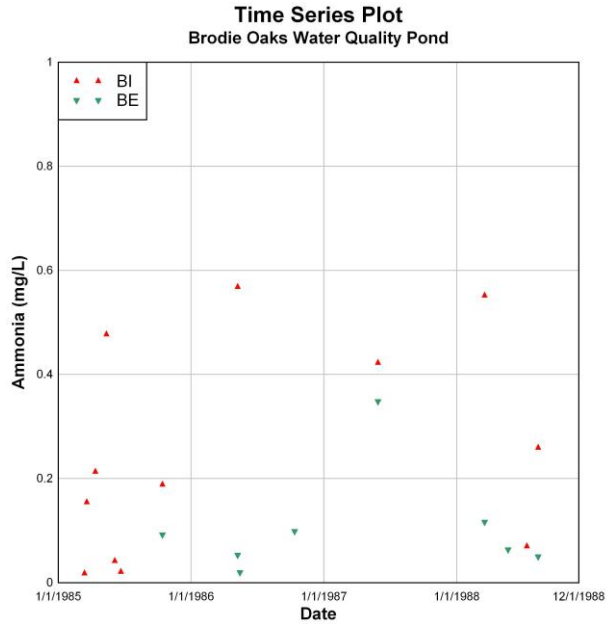


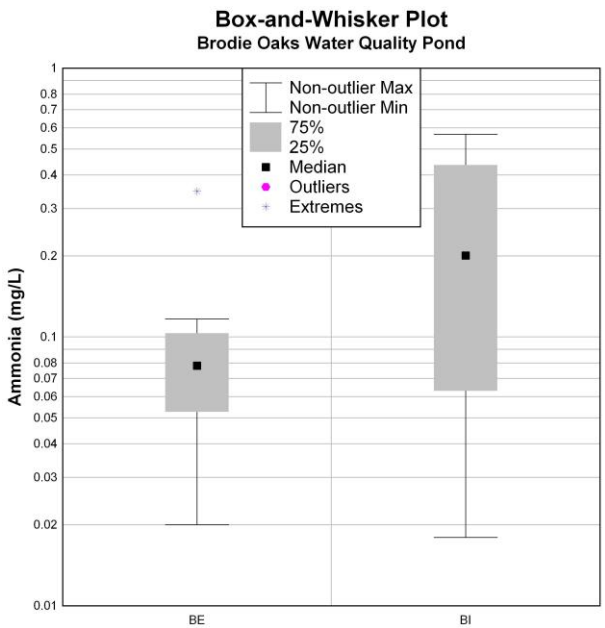


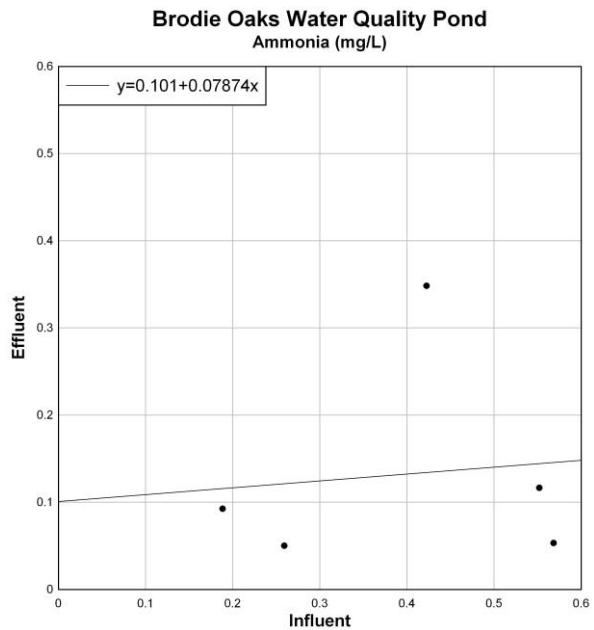
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	1.798	0.586
	Upper Quartile	0.703	0.454
	Median	0.609	0.280
	Lower Quartile	0.397	0.205
	Minimum	0.379	0.156
	Efficiency	53.95%	
	Mann-Whitney	0.0154 **	
	Wilcoxon (paired)	0.1875	
Arithmetic	UCL	0.906	0.455
	Mean	0.662	0.328
	LCL	0.419	0.200
	Std. Dev.	0.383	0.153
	Wilk (p-value)	0.0003 **	0.3871
	Efficiency	50.55%	
	t-Test (equal var.)	0.0312 **	
	t-Test (unequal var.)	0.0154 **	
	t-test (paired)	0.1374	
	Levene Test	0.3948	
Log Transformed	UCL	0.869	0.495
	Mean	0.652	0.327
	LCL	0.488	0.216
	Std. Dev.	0.287	0.154
	Wilk (p-value)	0.0234 **	0.7163
	Efficiency	49.77%	
	t-Test (equal var.)	0.0030 **	
	t-Test (unequal var.)	0.0044 **	
	t-Test (paired)	0.1425	
	Levene Test	0.8845	
Bootstrap	UCL	0.869	0.442
	Mean	0.659	0.326
	LCL	0.450	0.210
	Std. Dev.	0.330	0.139
	Efficiency	50.54%	

Brodie Oaks Water Quality Pond - Ammonia (mg/L)



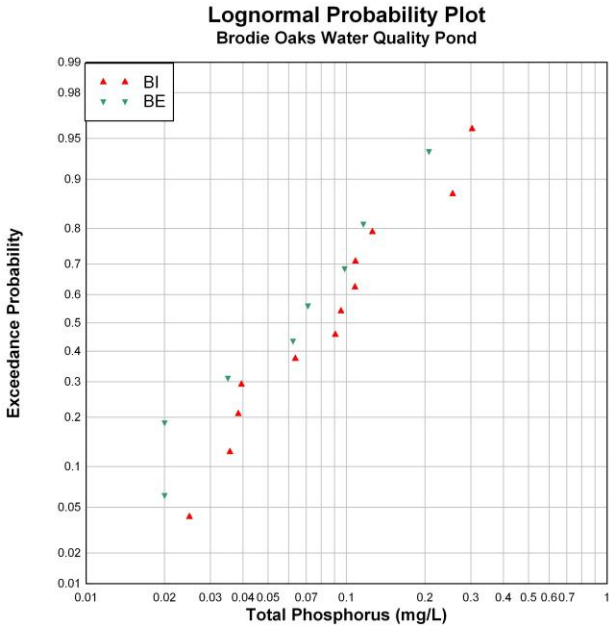


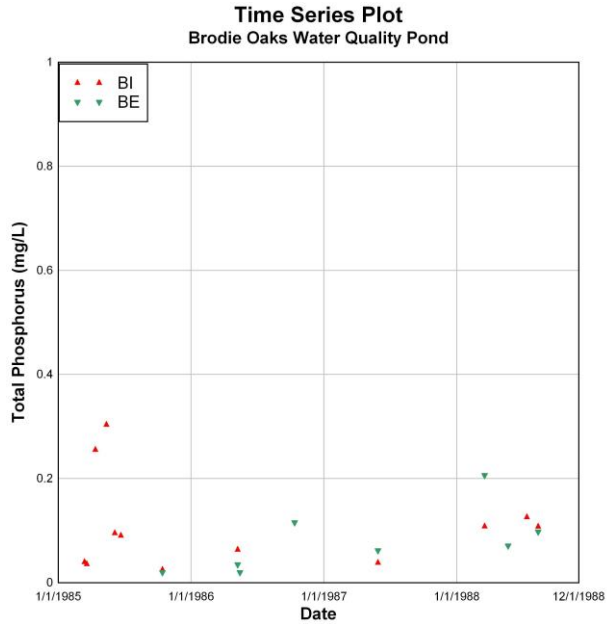


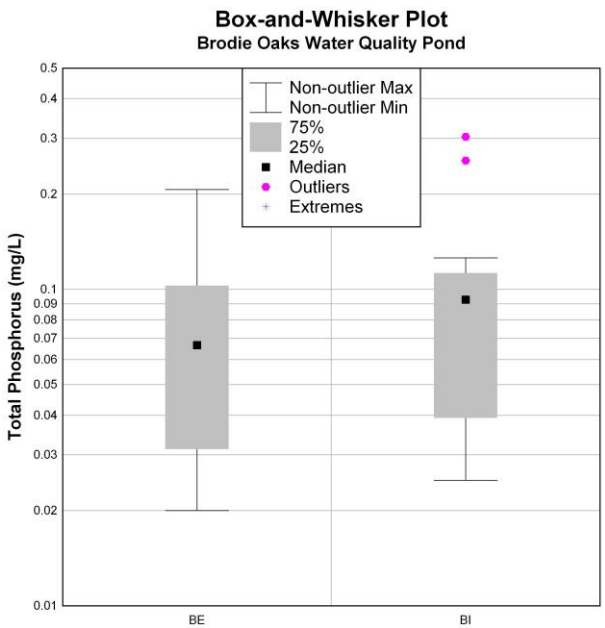


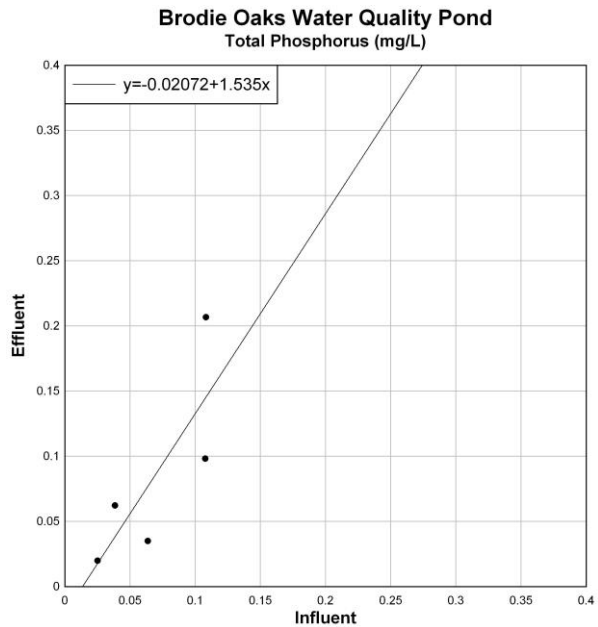
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	0.568	0.348
	Upper Quartile	0.450	0.108
	Median	0.201	0.078
	Lower Quartile	0.056	0.052
	Minimum	0.018	0.020
	Efficiency	61.09%	
	Mann-Whitney	0.1928	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	0.380	0.192
	Mean	0.249	0.105
	LCL	0.117	0.019
	Std. Dev.	0.207	0.103
	Wilk (p-value)	0.1131	0.0028 **
	Efficiency	57.60%	
	t-Test (equal var.)	0.0877 *	
	t-Test (unequal var.)	0.0560 *	
	t-test (paired)	0.0409 **	
	Levene Test	0.0380 **	
Log Transformed	UCL	0.846	0.231
	Mean	0.290	0.103
	LCL	0.100	0.046
	Std. Dev.	0.414	0.087
	Wilk (p-value)	0.1233	0.7779
	Efficiency	64.55%	
	t-Test (equal var.)	0.2100	
	t-Test (unequal var.)	0.1751	
	t-Test (paired)	0.0272 **	
	Levene Test	0.1700	
Bootstrap	UCL	0.375	0.176
	Mean	0.250	0.105
	LCL	0.125	0.034
	Std. Dev.	0.196	0.085
	Efficiency	57.95%	

Brodie Oaks Water Quality Pond - Total Phosphorus (mg/L)



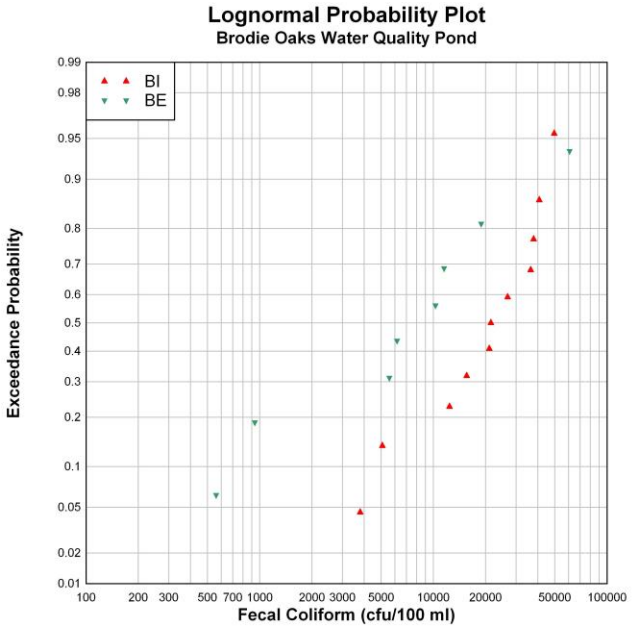


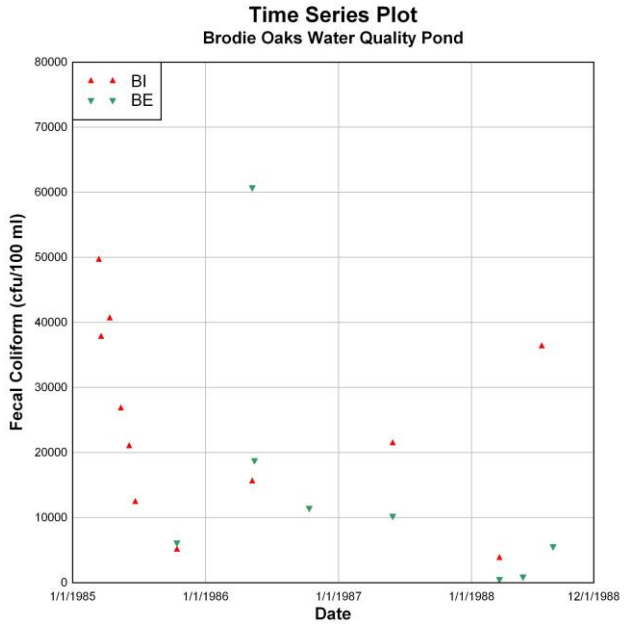


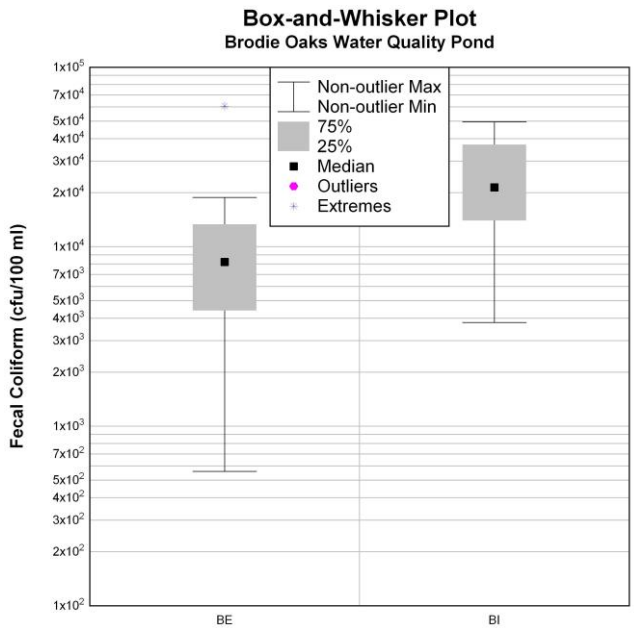


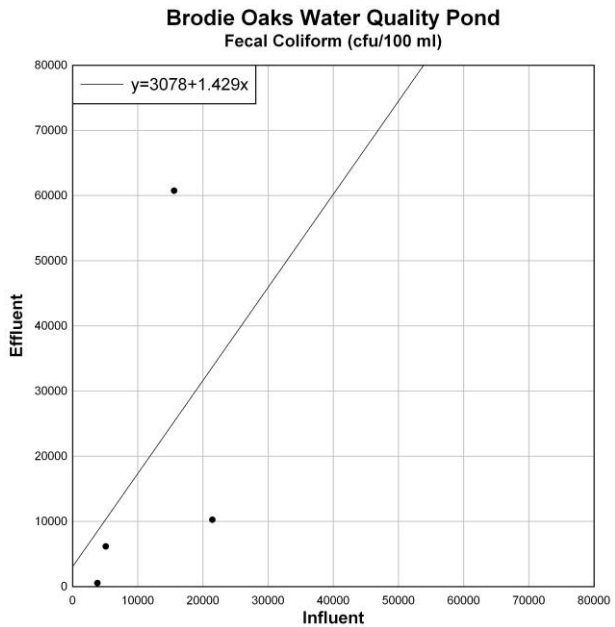
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	0.303	0.207
	Upper Quartile	0.117	0.107
	Median	0.093	0.067
	Lower Quartile	0.039	0.028
	Minimum	0.025	0.020
	Efficiency	28.17%	
	Mann-Whitney	0.3859	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	0.163	0.131
	Mean	0.107	0.079
	LCL	0.052	0.026
	Std. Dev.	0.088	0.062
	Wilk (p-value)	0.0117 **	0.1849
	Efficiency	26.69%	
	t-Test (equal var.)	0.4358	
	t-Test (unequal var.)	0.4046	
	t-test (paired)	0.5147	
	Levene Test	0.4250	
Log Transformed	UCL	0.189	0.183
	Mean	0.107	0.079
	LCL	0.060	0.035
	Std. Dev.	0.088	0.069
	Wilk (p-value)	0.6084	0.6332
	Efficiency	25.48%	
	t-Test (equal var.)	0.3915	
	t-Test (unequal var.)	0.4020	
	t-Test (paired)	0.8549	
	Levene Test	0.8209	
Bootstrap	UCL	0.157	0.125
	Mean	0.106	0.079
	LCL	0.056	0.033
	Std. Dev.	0.079	0.055
	Efficiency	25.74%	

Brodie Oaks Water Quality Pond - Fecal Coliform (cfu/100 ml)



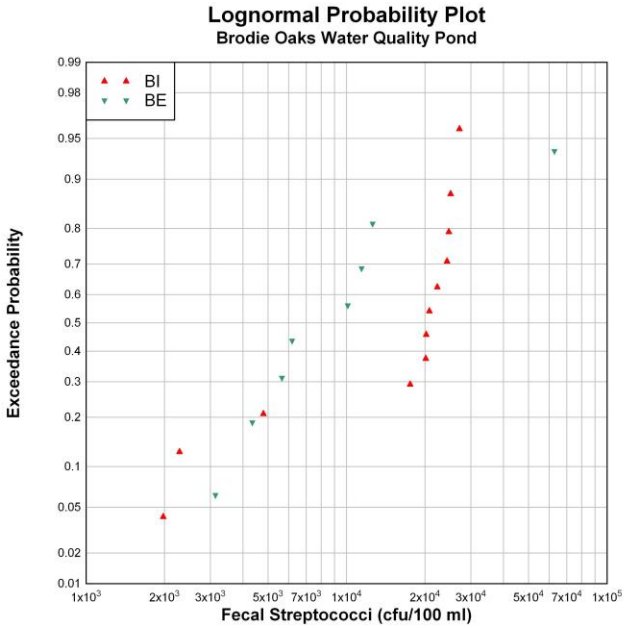


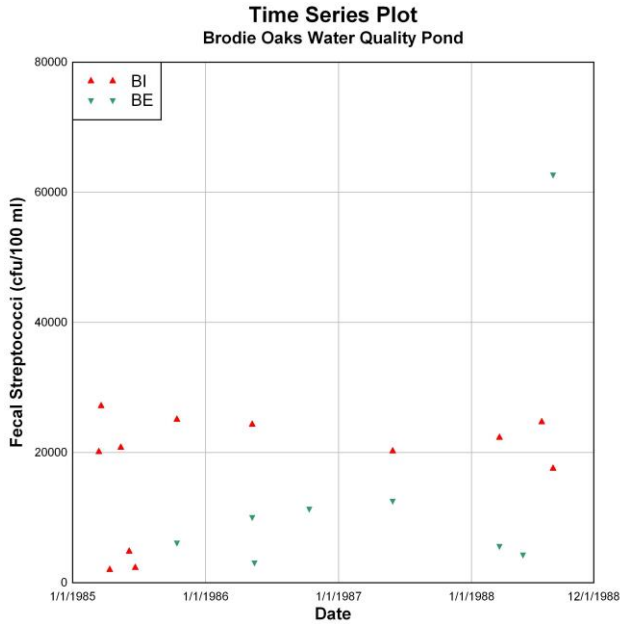


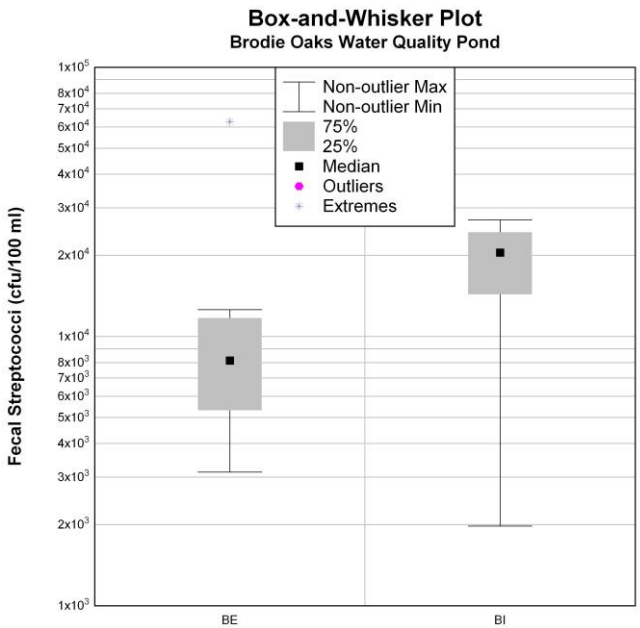


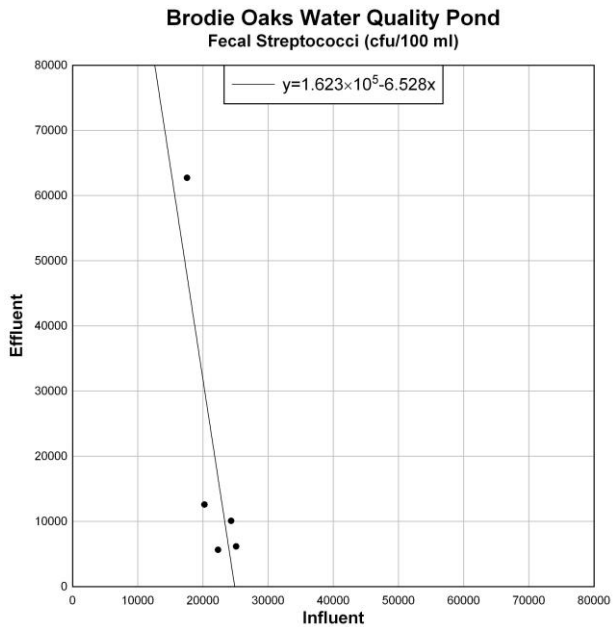
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	11	8
	Pairs Count	4	4
Non-Parametric	Maximum	49,634	60,768
	Upper Quartile	37,784	15,156
	Median	21,412	8,232
	Lower Quartile	12,384	3,255
	Minimum	3,780	561
	Efficiency	61.55%	
	Mann-Whitney	0.1077	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	34,692	30,788
	Mean	24,575	14,327
	LCL	14,458	-2,134
	Std. Dev.	15,060	19,686
	Wilk (p-value)	0.7295	0.0019 **
	Efficiency	41.70%	
	t-Test (equal var.)	0.2149	
	t-Test (unequal var.)	0.2400	
	t-test (paired)	0.5728	
	Levene Test	0.5731	
Log Transformed	UCL	50,997	113,426
	Mean	26,158	15,975
	LCL	13,417	2,250
	Std. Dev.	23,440	26,422
	Wilk (p-value)	0.1618	0.6541
	Efficiency	38.93%	
	t-Test (equal var.)	0.0582 *	
	t-Test (unequal var.)	0.0929 *	
	t-Test (paired)	0.7224	
	Levene Test	0.0908 *	
Bootstrap	UCL	33,935	27,147
	Mean	24,463	13,912
	LCL	14,991	677
	Std. Dev.	14,100	15,831
	Efficiency	43.13%	

Brodie Oaks Water Quality Pond - Fecal Streptococci (cfu/100 ml)



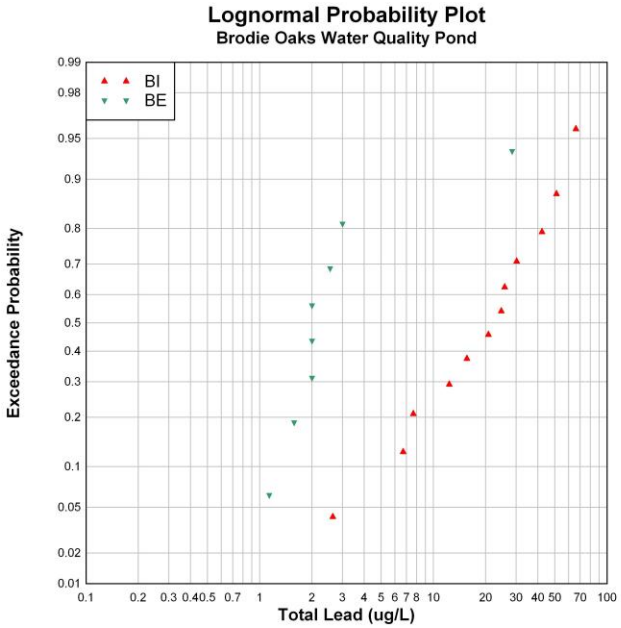


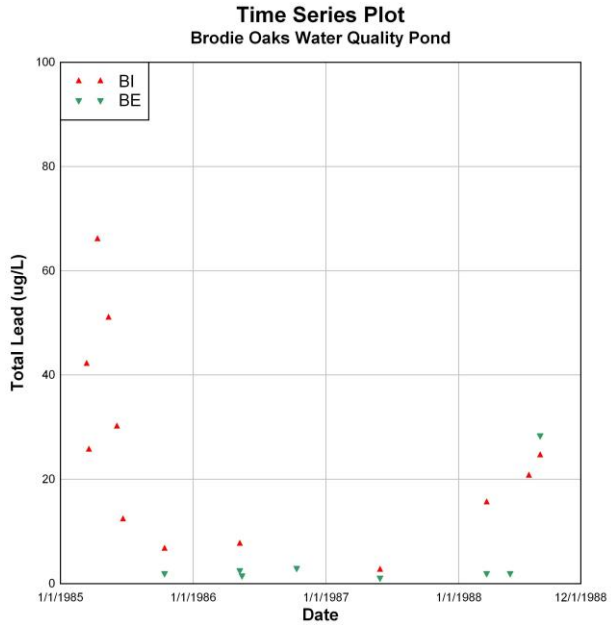


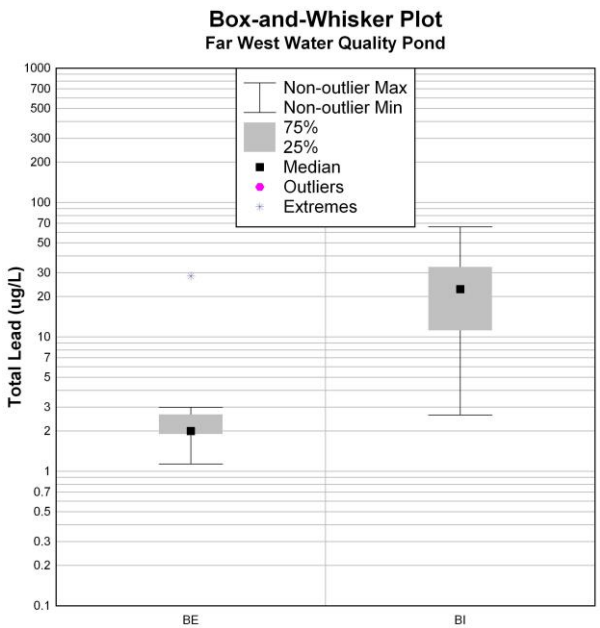


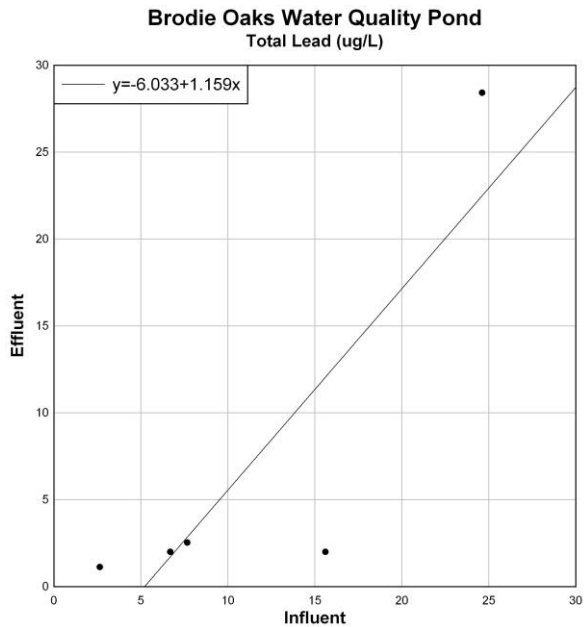
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	27,139	62,760
	Upper Quartile	24,500	11,998
	Median	20,493	8,147
	Lower Quartile	11,156	4,996
	Minimum	1,976	3,137
	Efficiency	60.25%	
	Mann-Whitney	0.2184	
	Wilcoxon (paired)	0.6250	
Arithmetic	UCL	23,439	31,069
	Mean	17,597	14,522
	LCL	11,755	-2,025
	Std. Dev.	9,195	19,789
	Wilk (p-value)	0.0100 **	0.0001 **
	Efficiency	17.47%	
	t-Test (equal var.)	0.6428	
	t-Test (unequal var.)	0.6907	
	t-test (paired)	0.8508	
	Levene Test	0.2655	
Log Transformed	UCL	42,843	32,986
	Mean	20,096	12,885
	LCL	9,427	5,033
	Std. Dev.	21,293	12,303
	Wilk (p-value)	0.0007 **	0.2277
	Efficiency	35.88%	
	t-Test (equal var.)	0.3864	
	t-Test (unequal var.)	0.3832	
	t-Test (paired)	0.3117	
	Levene Test	0.8377	
Bootstrap	UCL	23,035	28,532
	Mean	17,634	14,843
	LCL	12,232	1,154
	Std. Dev.	8,502	16,374
	Efficiency	15.83%	

Brodie Oaks Water Quality Pond - Total Lead (ug/L)



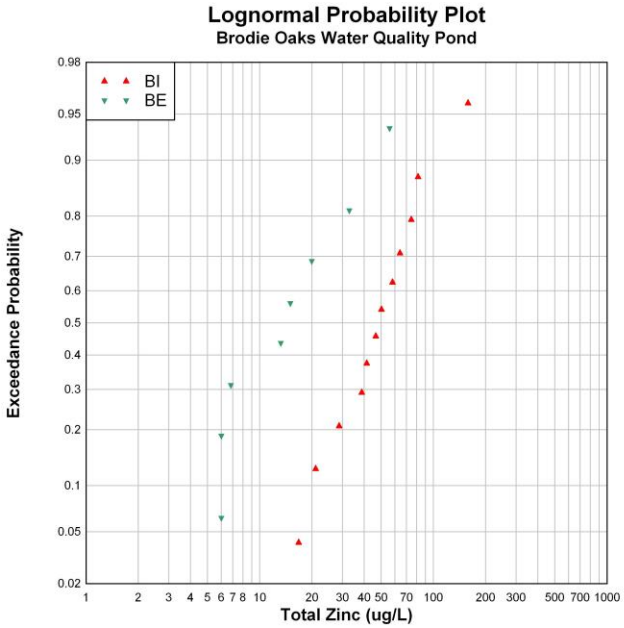


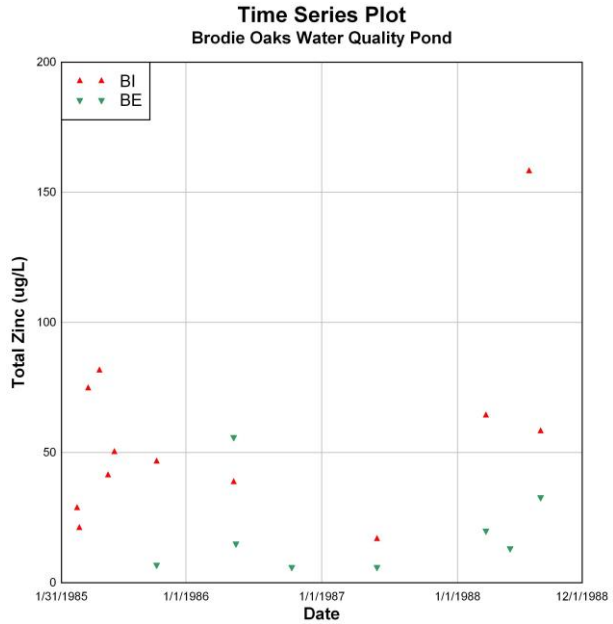


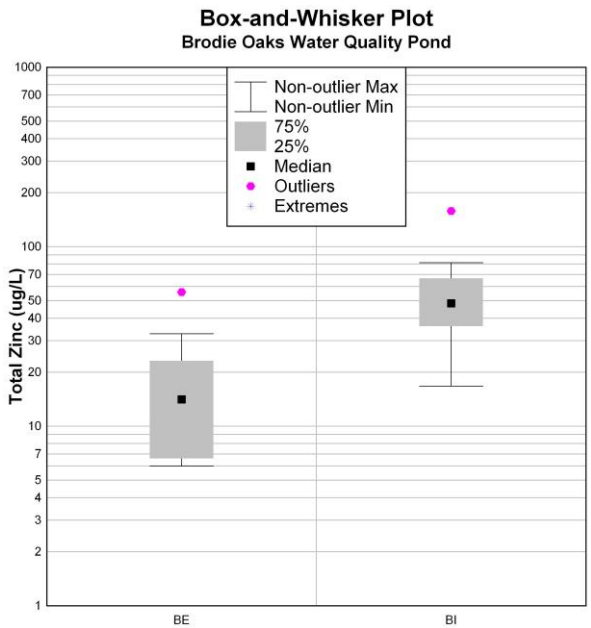


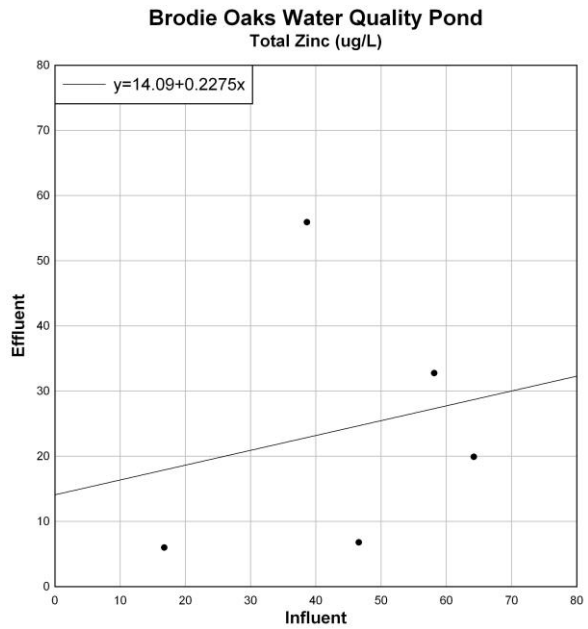
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	66.1	28.4
	Upper Quartile	36.1	2.8
	Median	22.6	2.0
	Lower Quartile	10.0	1.8
	Minimum	2.6	1.1
	Efficiency	91.17%	
	Mann-Whitney	0.0078 **	
	Wilcoxon (paired)	0.1875	
Arithmetic	UCL	37.7	13.2
	Mean	25.4	5.3
	LCL	13.2	-2.5
	Std. Dev.	19.3	9.3
	Wilk (p-value)	0.3187	0.0001 **
	Efficiency	79.03%	
	t-Test (equal var.)	0.0139 **	
	t-Test (unequal var.)	0.0065 **	
	t-test (paired)	0.2115	
	Levene Test	0.1464	
Log Transformed	UCL	55.5	11.6
	Mean	27.0	4.1
	LCL	13.2	1.5
	Std. Dev.	27.4	4.2
	Wilk (p-value)	0.7981	0.0023 **
	Efficiency	84.76%	
	t-Test (equal var.)	0.0004 **	
	t-Test (unequal var.)	0.0007 **	
	t-Test (paired)	0.0457 **	
	Levene Test	0.9280	
Bootstrap	UCL	36.3	11.7
	Mean	25.1	5.5
	LCL	13.8	-0.7
	Std. Dev.	17.7	7.4
	Efficiency	78.07%	

Brodie Oaks Water Quality Pond - Total Zinc (ug/L)



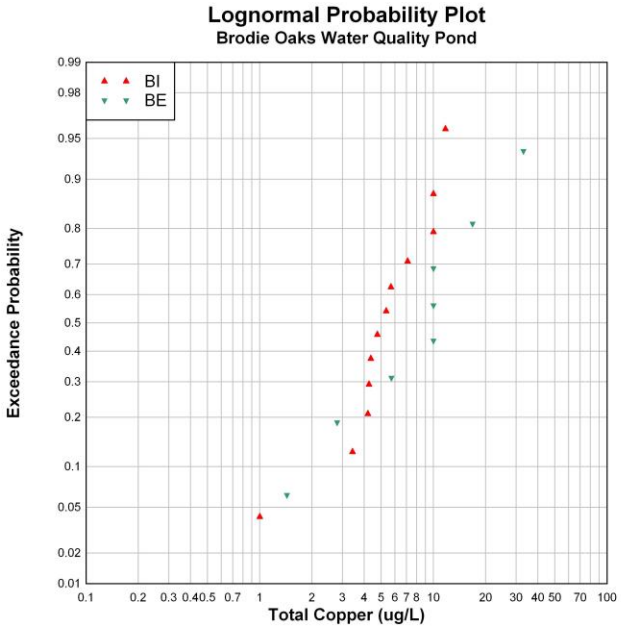


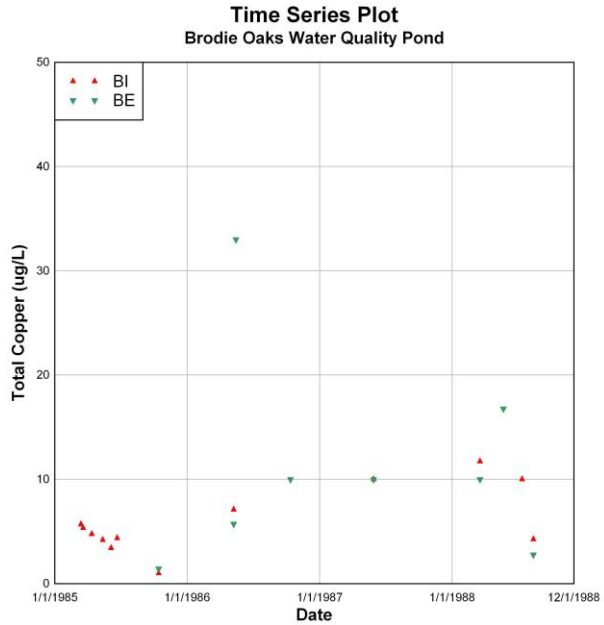


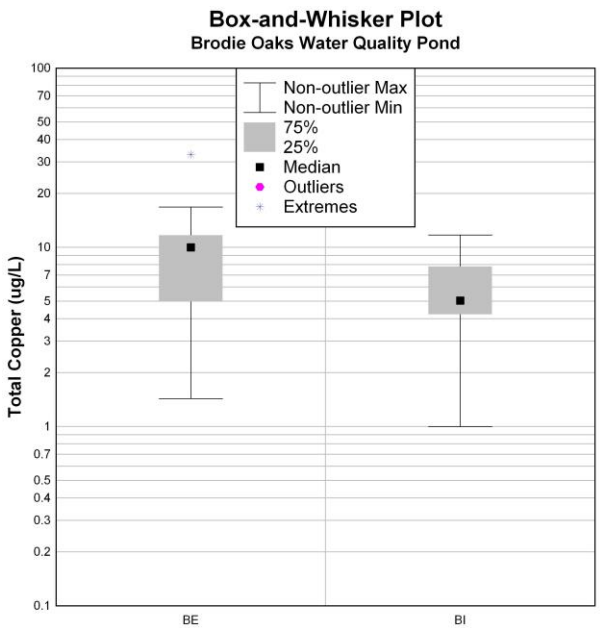


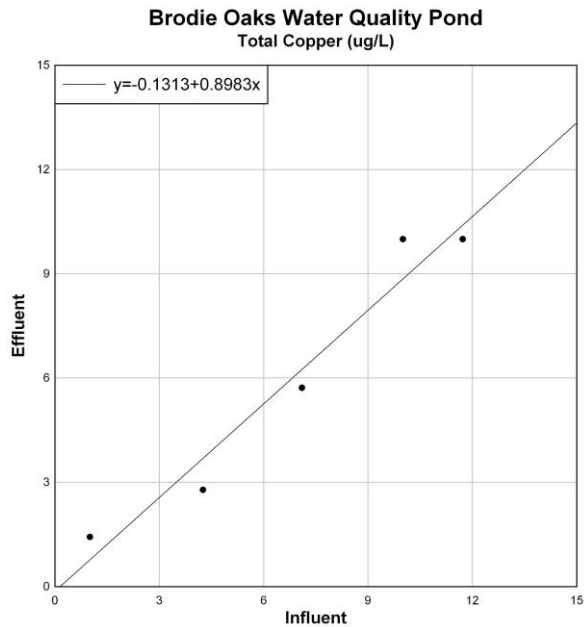
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	158.1	55.9
	Upper Quartile	69.4	26.4
	Median	48.4	14.1
	Lower Quartile	33.6	6.4
	Minimum	16.7	6.0
	Efficiency	70.83%	
	Mann-Whitney	0.0110 **	
	Wilcoxon (paired)	0.1875	
Arithmetic	UCL	80.6	33.9
	Mean	56.6	19.5
	LCL	32.7	5.0
	Std. Dev.	37.7	17.3
	Wilk (p-value)	0.0215 **	0.0347 **
	Efficiency	65.62%	
	t-Test (equal var.)	0.0183 **	
	t-Test (unequal var.)	0.0087 **	
	t-test (paired)	0.1391	
	Levene Test	0.3266	
Log Transformed	UCL	86.6	42.8
	Mean	56.4	19.1
	LCL	36.8	8.5
	Std. Dev.	36.0	16.1
	Wilk (p-value)	0.9928	0.4175
	Efficiency	66.18%	
	t-Test (equal var.)	0.0015 **	
	t-Test (unequal var.)	0.0041 **	
	t-Test (paired)	0.0840 *	
	Levene Test	0.3262	
Bootstrap	UCL	78.3	31.7
	Mean	56.7	19.3
	LCL	35.2	6.9
	Std. Dev.	33.9	14.8
	Efficiency	66.02%	

Brodie Oaks Water Quality Pond - Total Copper (ug/L)









	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BE**
	Site Count	12	8
	Pairs Count	5	5
Non-Parametric	Maximum	11.7	33.0
	Upper Quartile	8.5	13.4
	Median	5.0	10.0
	Lower Quartile	4.2	4.3
	Minimum	1.0	1.4
	Efficiency	-98.18%	
	Mann-Whitney	0.2430	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	8.0	19.6
	Mean	6.0	11.2
	LCL	4.0	2.8
	Std. Dev.	3.1	10.0
	Wilk (p-value)	0.3067	0.0648 *
	Efficiency	-87.40%	
	t-Test (equal var.)	0.1059	
	t-Test (unequal var.)	0.1919	
	t-test (paired)	0.1305	
	Levene Test	0.0995 *	
Log Transformed	UCL	9.8	32.8
	Mean	6.2	11.7
	LCL	3.9	4.1
	Std. Dev.	4.2	12.0
	Wilk (p-value)	0.0828 *	0.7662
	Efficiency	-88.38%	
	t-Test (equal var.)	0.2732	
	t-Test (unequal var.)	0.3214	
	t-Test (paired)	0.5413	
	Levene Test	0.2595	
Bootstrap	UCL	7.9	18.7
	Mean	6.0	11.3
	LCL	4.1	3.9
	Std. Dev.	3.0	8.9
	Efficiency	-88.18%	

Jollyville Road (JVI-JVE)

The Jollyville sand filter was initially monitored the first COA monitoring program (1988-90); monitoring was restarted by the current program in 1994 for further study. It was the first SCM monitored that incorporated a splitter box but it does not conform to current design standards. It was designed to treat runoff from Jollyville Road. See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed.

Runoff comes from the influent to a sand filter water quality control basin. The pond was designed to isolate and filter the first half- inch of rain fall runoff. Additional runoff bypasses the pond via an overflow spillway. The filter bed was designed with eighteen inches of sand overlaying twelve inches of coarse sand with gravel/ PVC pipe under drain system. The sand media was not changed during the monitoring period.

WQM collected runoff and water quality data at the Jollyville Road sand filter (JVI-JVE) from 1988 to 2002. During this time 32 and 34 valid EMCs were collected at the influent (JVI) and effluent (JVE) respectively, of which 29 were paired.

Performance Summary

The Jollyville Road sand filter had good performance with the reductions of the concentrations of almost all pollutant parameters. TSS and VSS concentrations were reduced by 94% and 96% respectively, and were significant in all cases, paired or not paired. TDS concentration was reduced by 14% and was not significant in all cases.

COD, TOC and BOD concentrations were reduced by 56%, 39% and 63% respectively, and were significant in all cases.

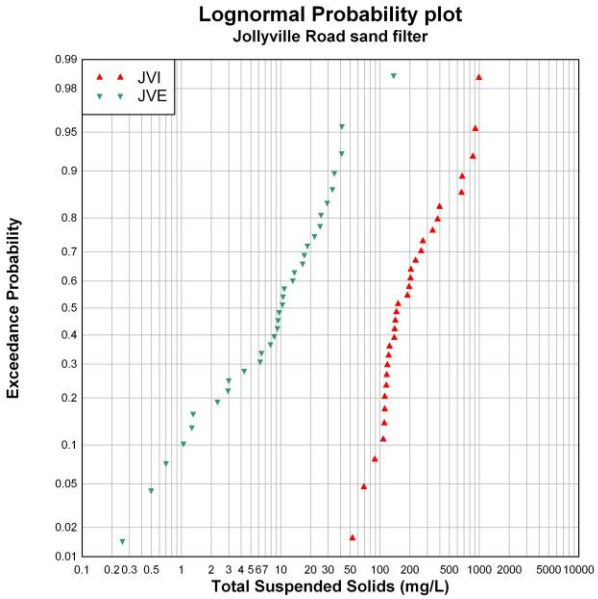
Total nitrogen concentration was reduced by 13% and was not significant in any case. The increase of concentration in nitrate + nitrite (90%) was significant in any case. Total Kjeldahl nitrogen and ammonia concentrations were reduced by 53% and 73% respectively, and were significant in any case.

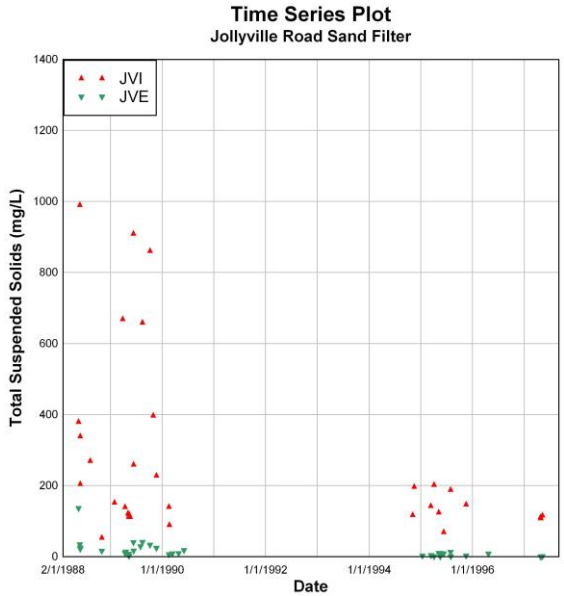
TP concentration was reduced by 61% and was significant in any case. DP concentration was reduced by 40% and was not significant in any case.

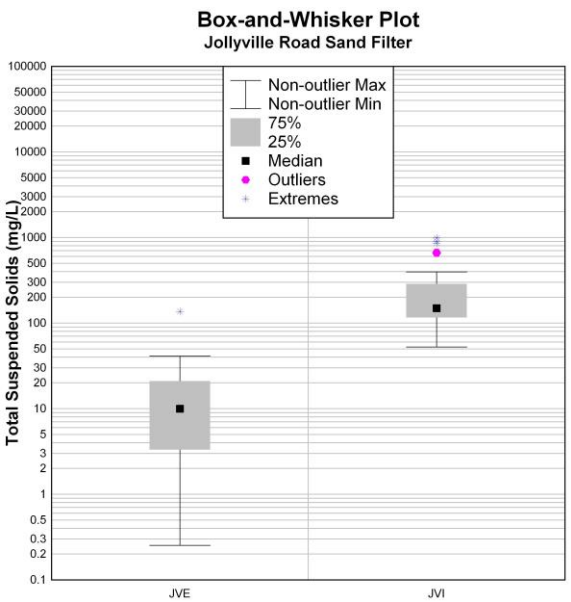
The reduction of bacteria was not significant in any case for FCOL (36%), and was significant in any case for FSTR (31%).

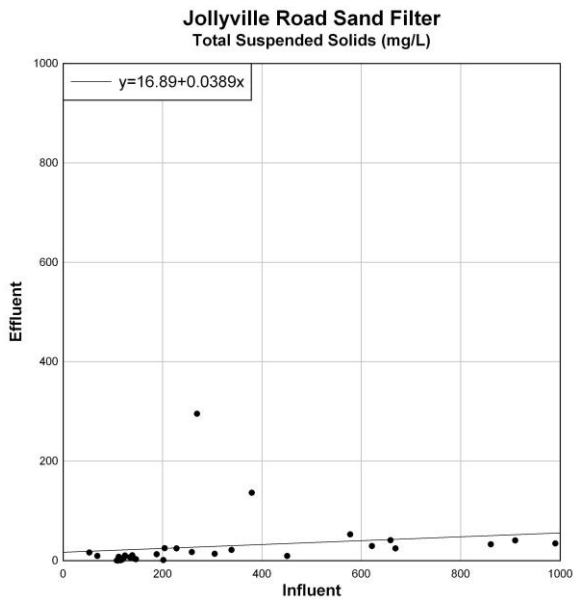
Lead, zinc and copper concentrations were reduced by 79%, 84% and 63% respectively, and were significant in all cases. Cadmium concentration was reduced by 43% and was only significant if data are not paired.

Jollyville Road Sand Filter - Total Suspended Solids (mg/L)



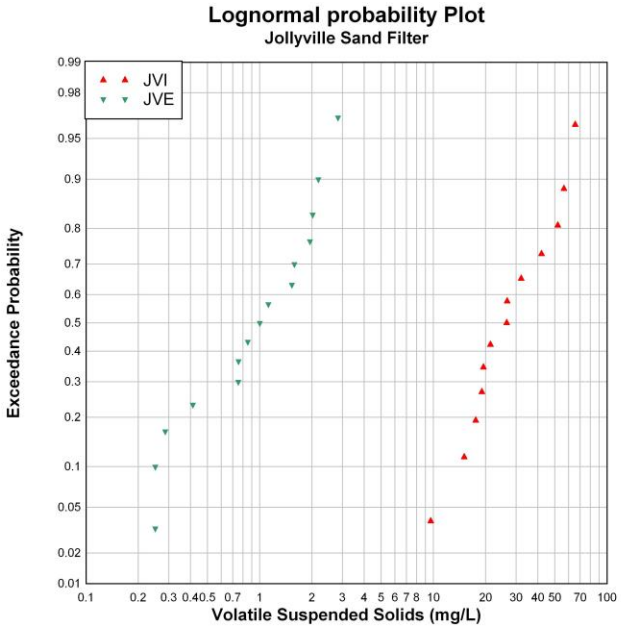


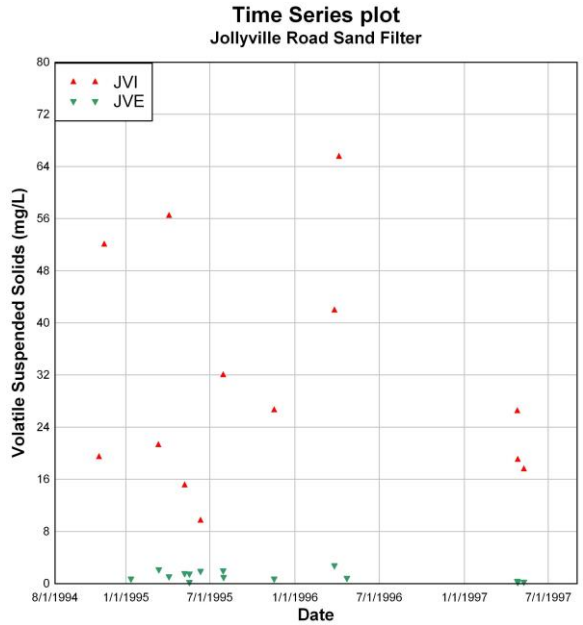


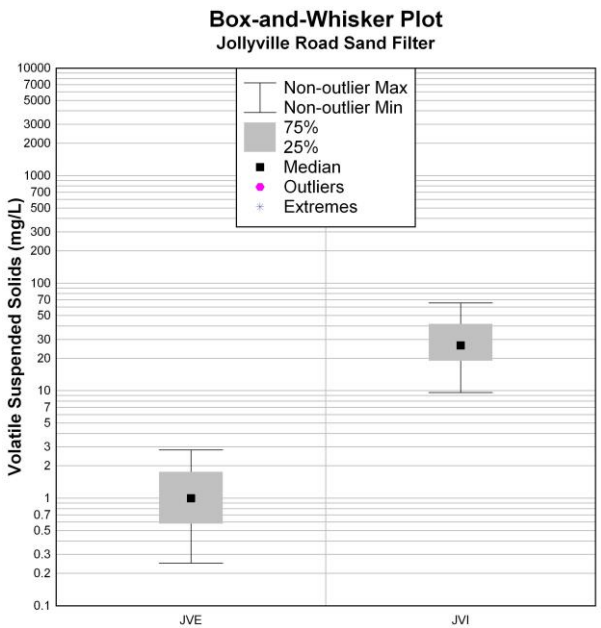


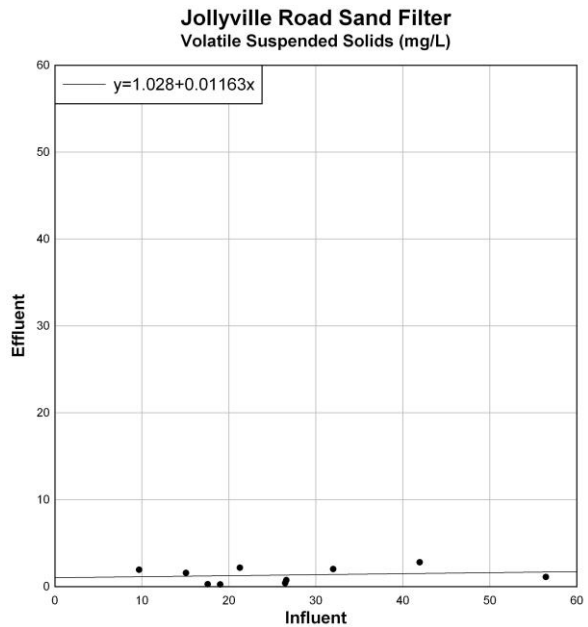
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	32	34
	Pairs Count	29	29
Non-Parametric	Maximum	990.1	136.9
	Upper Quartile	303.8	21.8
	Median	149.0	10.0
	Lower Quartile	116.0	3.0
	Minimum	52.7	.3
	Efficiency	93.28%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	365.1	25.4
	Mean	272.2	16.9
	LCL	179.4	8.4
	Std. Dev.	257.6	24.3
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	93.80%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0039 **	
Log Transformed	UCL	358.0	41.2
	Mean	261.5	20.4
	LCL	191.0	10.1
	Std. Dev.	223.1	42.2
	Wilk (p-value)	0.0181 **	0.1923
	Efficiency	92.20%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0078 **	
Bootstrap	UCL	363.2	24.3
	Mean	272.9	16.7
	LCL	182.5	9.0
	Std. Dev.	250.5	22.0
	Efficiency	93.89%	

Jollyville Road Sand Filter - Volatile Suspended Solids (mg/L)



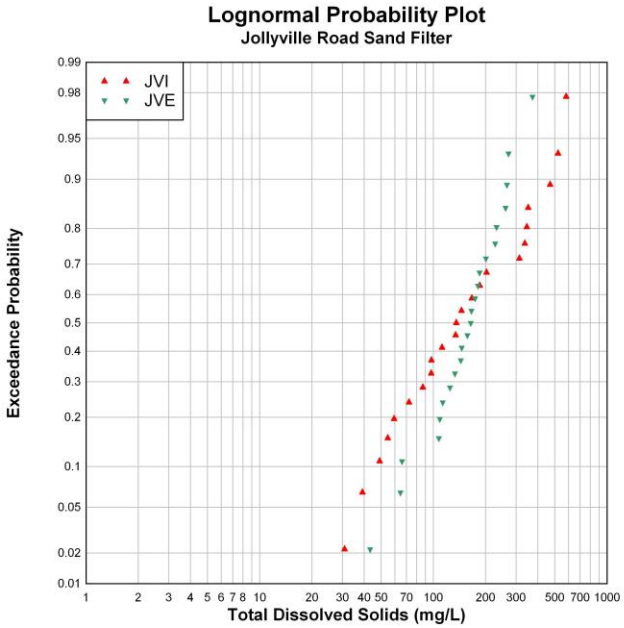


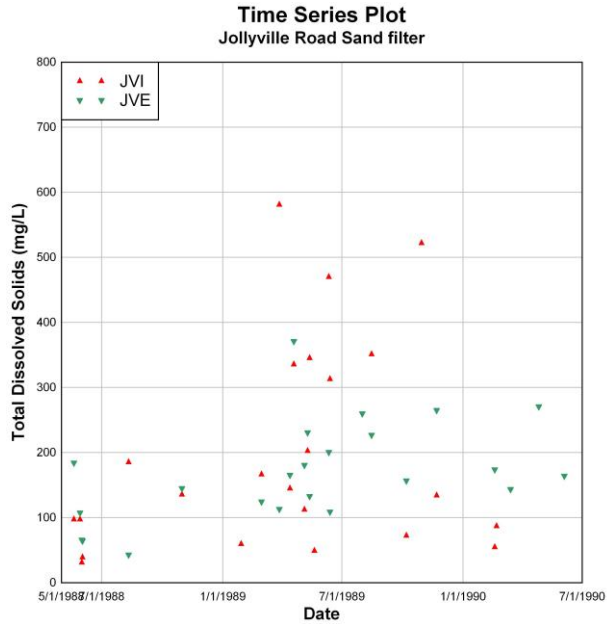


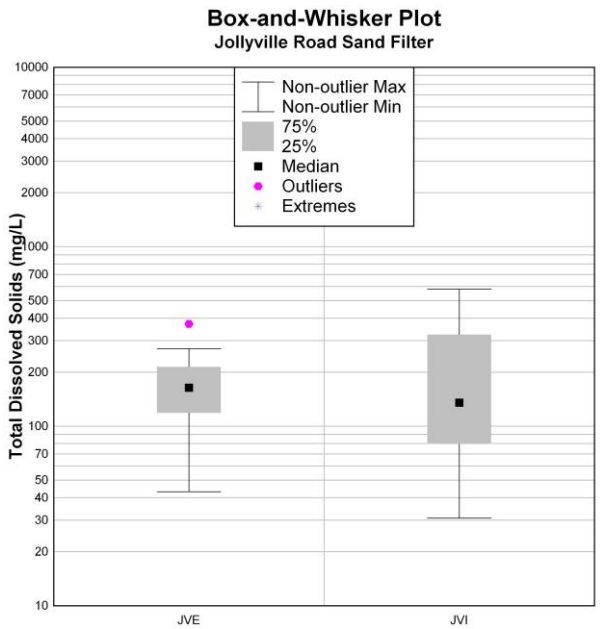


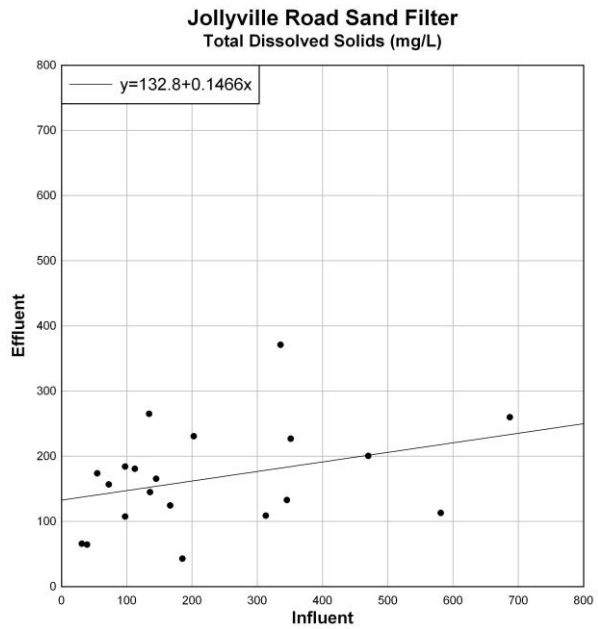
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	13	15
	Pairs Count	9	9
Non-Parametric	Maximum	65.5	2.8
	Upper Quartile	41.9	1.9
	Median	26.5	1.0
	Lower Quartile	19.0	.4
	Minimum	9.6	.3
	Efficiency	96.22%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0039 **	
Arithmetic	UCL	41.6	1.6
	Mean	31.0	1.2
	LCL	20.4	.7
	Std. Dev.	17.6	.8
	Wilk (p-value)	0.1152	0.2669
	Efficiency	96.18%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0007 **	
	Levene Test	0.0028 **	
Log Transformed	UCL	44.9	2.1
	Mean	31.0	1.2
	LCL	21.4	.7
	Std. Dev.	18.2	1.1
	Wilk (p-value)	0.8393	0.1833
	Efficiency	96.04%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1004	
Bootstrap	UCL	40.8	1.6
	Mean	30.8	1.2
	LCL	20.7	.8
	Std. Dev.	16.6	.8
	Efficiency	96.17%	

Jollyville Road Sand Filter - Total Dissolved Solids (mg/L)



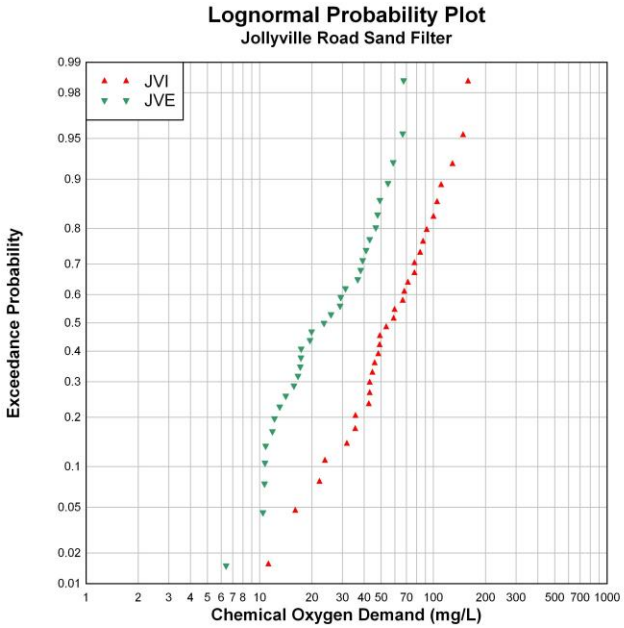


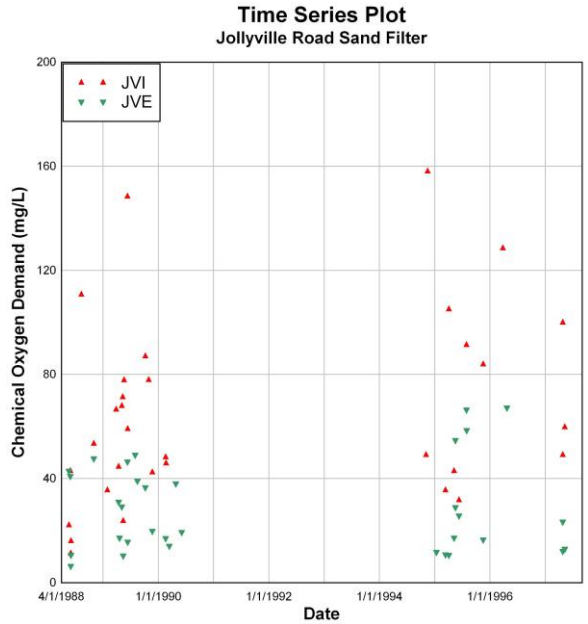


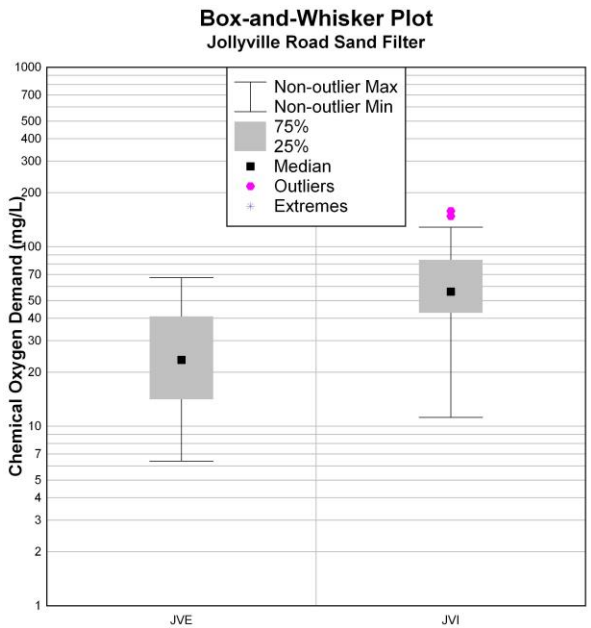


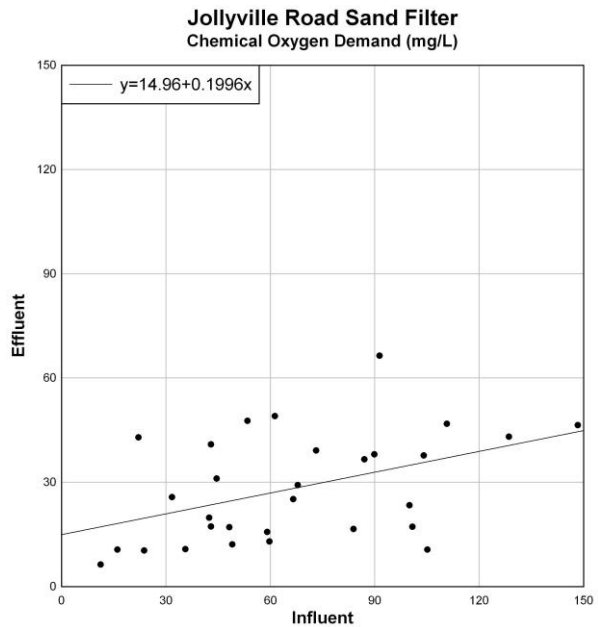
	PARAMETER	TDS (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	23	23
	Pairs Count	20	20
Non-Parametric	Maximum	580.91	371.30
	Upper Quartile	335.53	227.00
	Median	135.41	164.21
	Lower Quartile	72.37	113.04
	Minimum	30.78	43.19
	Efficiency	-21.27%	
	Mann-Whitney	0.7268	
	Wilcoxon (paired)	0.4524	
Arithmetic	UCL	269.83	202.87
	Mean	199.28	169.64
	LCL	128.72	136.40
	Std. Dev.	163.15	76.86
	Wilk (p-value)	0.0035 **	0.5371
	Efficiency	14.87%	
	t-Test (equal var.)	0.4348	
	t-Test (unequal var.)	0.4365	
	t-test (paired)	0.1309	
	Levene Test	0.0125 **	
Log Transformed	UCL	312.78	216.78
	Mean	202.24	171.70
	LCL	130.76	136.00
	Std. Dev.	195.64	90.73
	Wilk (p-value)	0.6006	0.3905
	Efficiency	15.10%	
	t-Test (equal var.)	0.7710	
	t-Test (unequal var.)	0.7713	
	t-Test (paired)	0.5674	
	Levene Test	0.0090 **	
Bootstrap	UCL	268.36	203.38
	Mean	200.12	171.28
	LCL	131.88	139.18
	Std. Dev.	157.80	74.22
	Efficiency	14.41%	

Jollyville Road Sand Filter - Chemical Oxygen Demand (mg/L)



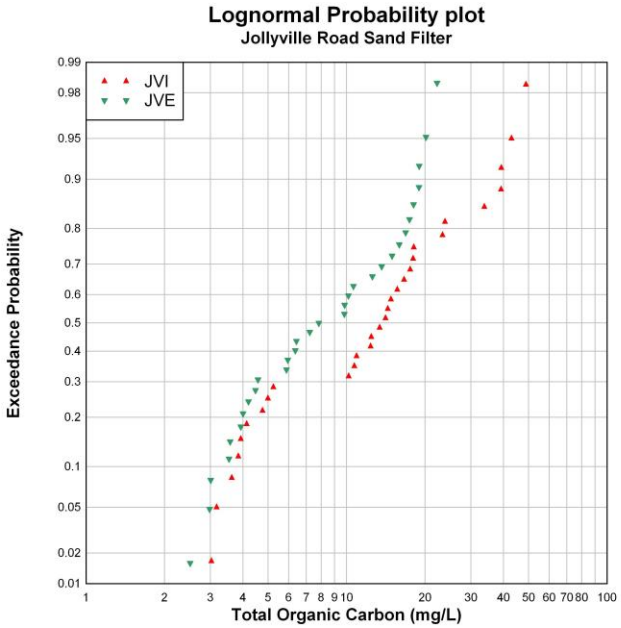


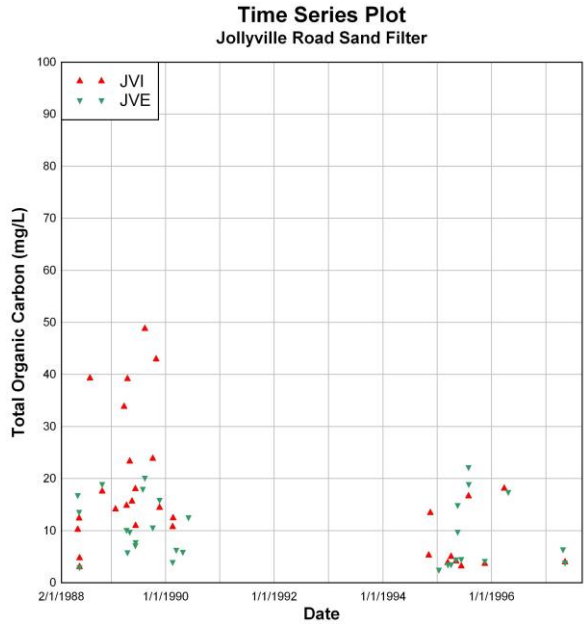


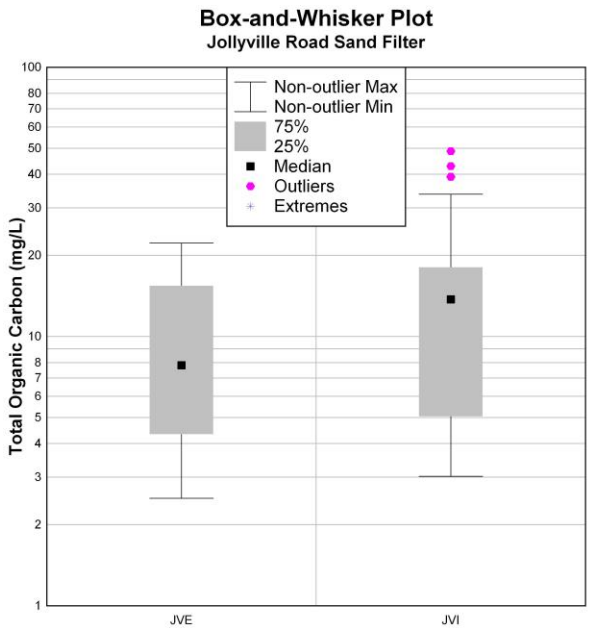


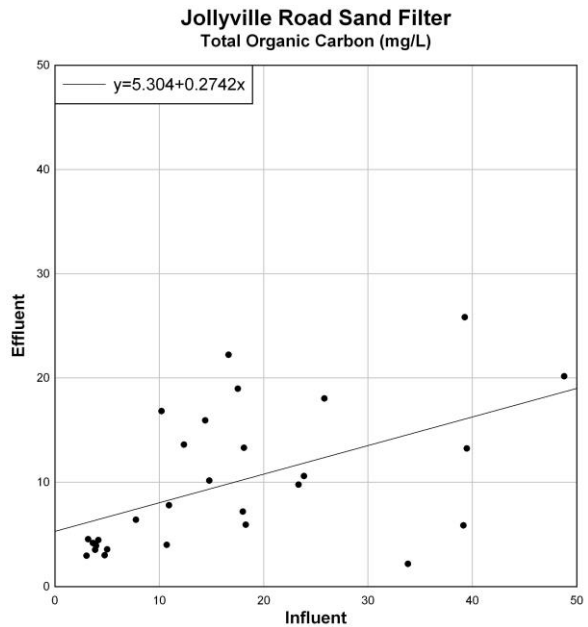
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	32	33
	Pairs Count	28	28
Non-Parametric	Maximum	158.00	67.28
	Upper Quartile	85.43	40.98
	Median	56.22	23.41
	Lower Quartile	42.63	14.11
	Minimum	11.21	6.39
	Efficiency	58.36%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	78.39	35.04
	Mean	65.21	28.80
	LCL	52.03	22.55
	Std. Dev.	36.54	17.62
	Wilk (p-value)	0.0566 *	0.0066 **
	Efficiency	55.84%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0056 **	
Log Transformed	UCL	84.58	37.26
	Mean	66.37	29.01
	LCL	52.08	22.59
	Std. Dev.	43.85	20.12
	Wilk (p-value)	0.5548	0.1889
	Efficiency	56.29%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7854	
Bootstrap	UCL	78.09	35.07
	Mean	65.27	28.93
	LCL	52.46	22.80
	Std. Dev.	35.54	17.30
	Efficiency	55.67%	

Jollyville Road Sand Filter - Total Organic Carbon (mg/L)



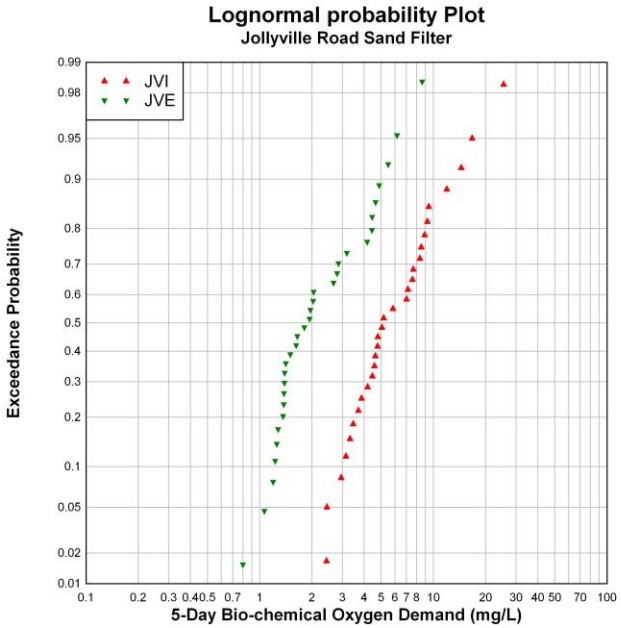


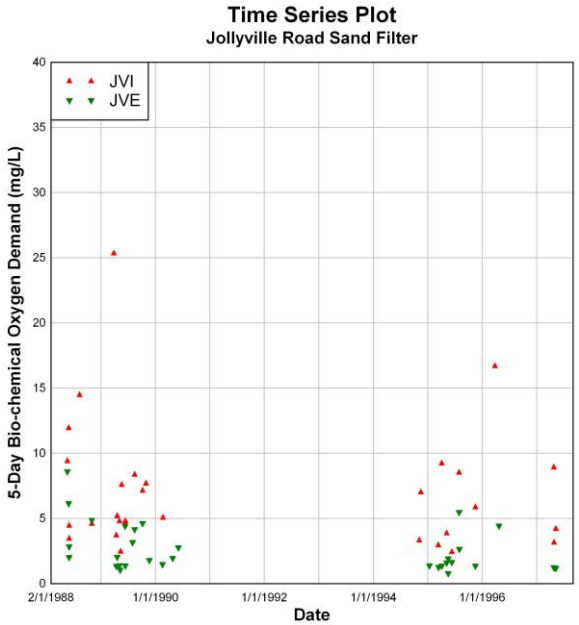


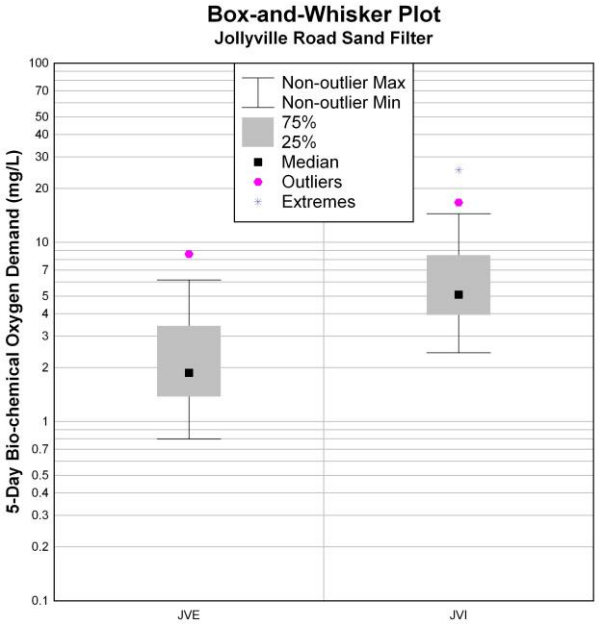


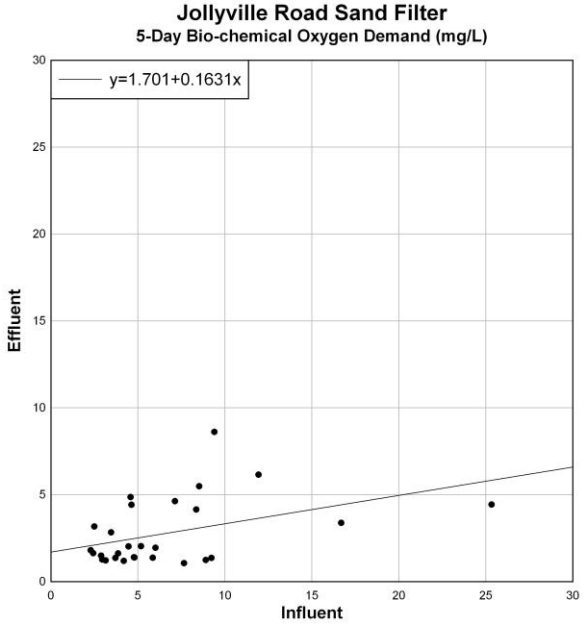
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	30	31
	Pairs Count	26	26
Non-Parametric	Maximum	48.79	22.24
	Upper Quartile	18.10	15.94
	Median	13.74	7.82
	Lower Quartile	4.99	4.20
	Minimum	3.02	2.51
	Efficiency	43.14%	
	Mann-Whitney	0.0823 *	
	Wilcoxon (paired)	0.0044 **	
Arithmetic	UCL	21.00	12.15
	Mean	16.23	9.89
	LCL	11.46	7.63
	Std. Dev.	12.77	6.16
	Wilk (p-value)	0.0007 **	0.0060 **
	Efficiency	39.07%	
	t-Test (equal var.)	0.0159 **	
	t-Test (unequal var.)	0.0183 **	
	t-test (paired)	0.0040 **	
	Levene Test	0.0086 **	
Log Transformed	UCL	23.91	13.19
	Mean	16.61	10.01
	LCL	11.53	7.59
	Std. Dev.	15.82	7.38
	Wilk (p-value)	0.0690 *	0.0546 *
	Efficiency	39.74%	
	t-Test (equal var.)	0.0485 **	
	t-Test (unequal var.)	0.0495 **	
	t-Test (paired)	0.0049 **	
	Levene Test	0.0978 *	
Bootstrap	UCL	20.74	12.07
	Mean	16.12	9.86
	LCL	11.50	7.66
	Std. Dev.	12.36	6.02
	Efficiency	38.80%	

Jollyville Road Sand Filter - 5-Day Bio-chemical Oxygen Demand (mg/L)



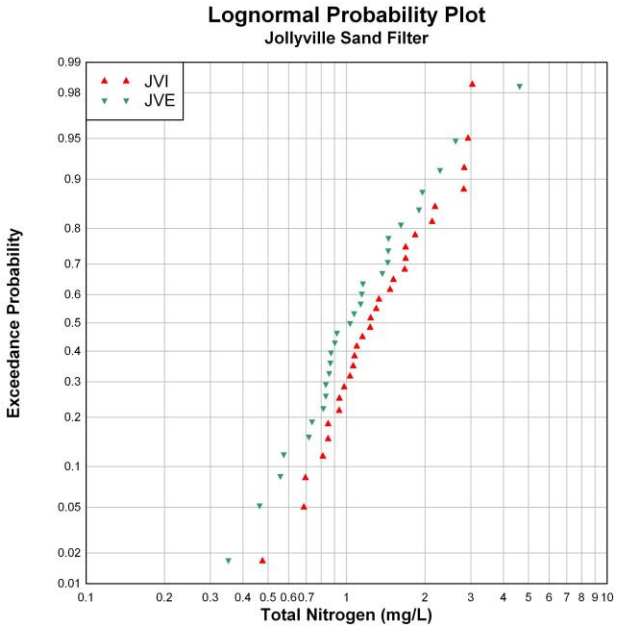


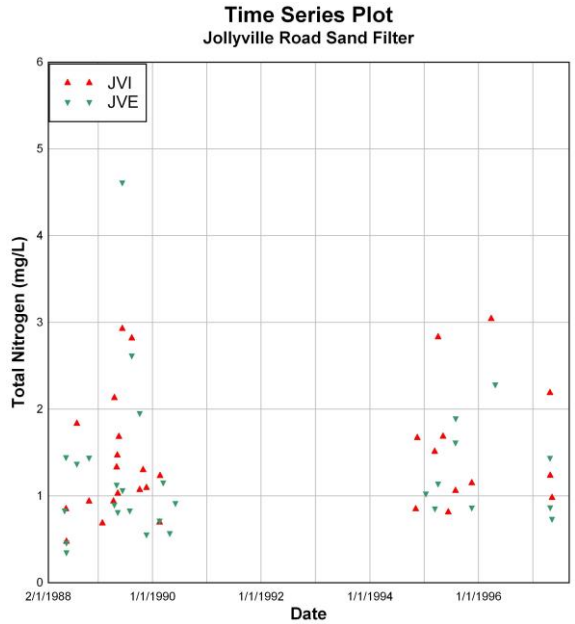


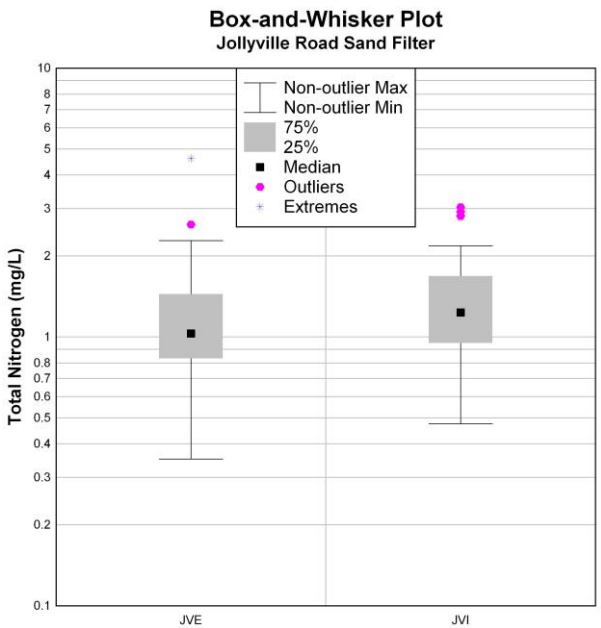


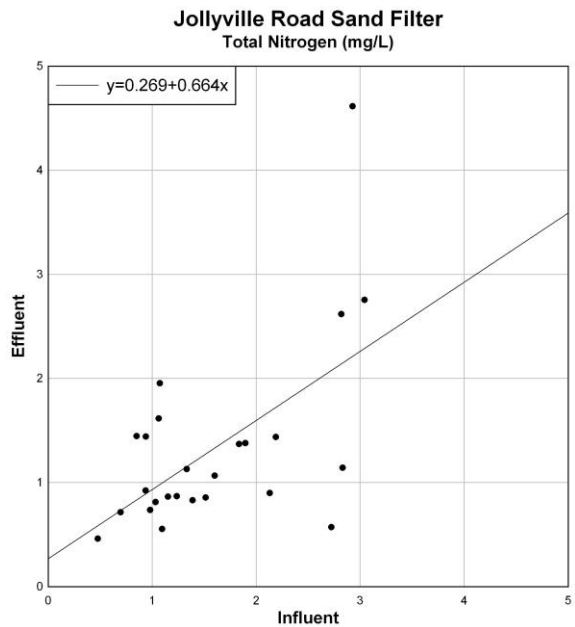
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	30	32
	Pairs Count	26	26
Non-Parametric	Maximum	25.33	8.61
	Upper Quartile	8.51	3.67
	Median	5.11	1.87
	Lower Quartile	3.86	1.38
	Minimum	2.42	0.80
	Efficiency	63.42%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	8.85	3.28
	Mean	7.03	2.62
	LCL	5.20	1.96
	Std. Dev.	4.89	1.82
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	62.69%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0002 **	
	Levene Test	0.0752 *	
Log Transformed	UCL	8.71	3.27
	Mean	6.91	2.58
	LCL	5.49	2.04
	Std. Dev.	4.20	1.66
	Wilk (p-value)	0.4149	0.0310 **
	Efficiency	62.69%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7500	
Bootstrap	UCL	8.72	3.25
	Mean	7.00	2.62
	LCL	5.29	1.98
	Std. Dev.	4.60	1.77
	Efficiency	62.65%	

Jollyville Road Sand Filter - Total Nitrogen (mg/L)



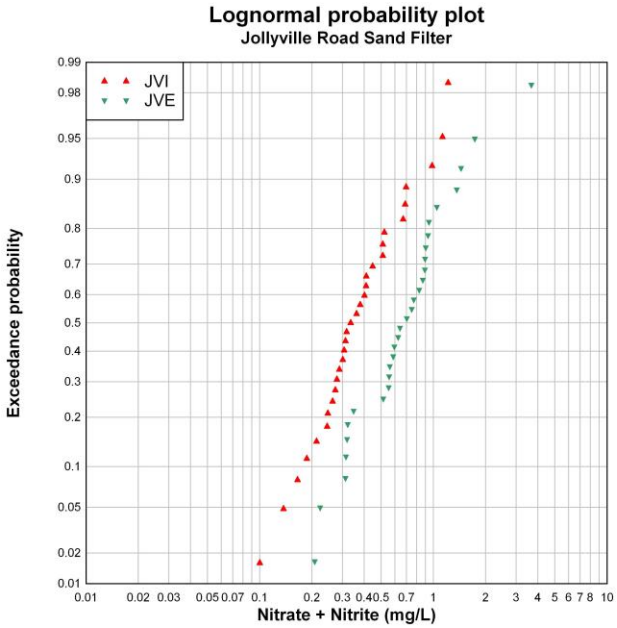


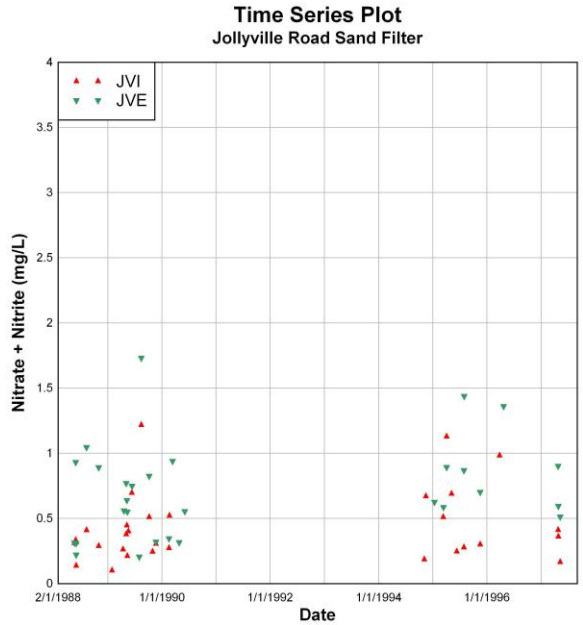


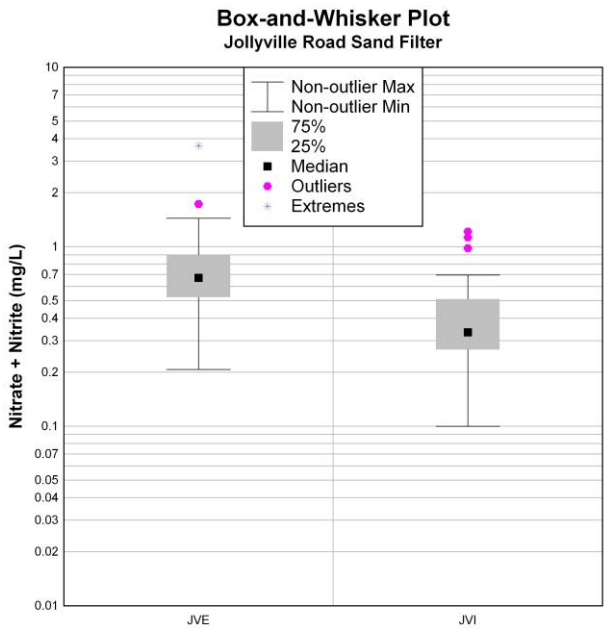


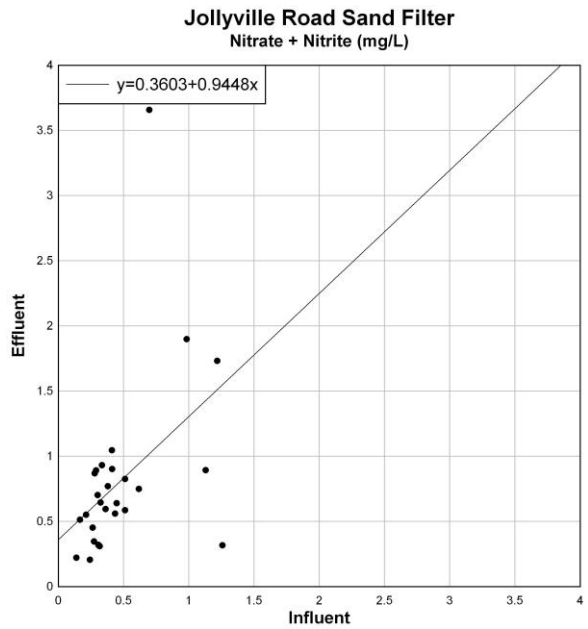
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	30	29
	Pairs Count	23	23
Non-Parametric	Maximum	3.041	4.615
	Upper Quartile	1.686	1.444
	Median	1.233	1.030
	Lower Quartile	0.938	0.832
	Minimum	0.475	0.351
	Efficiency	16.50%	
	Mann-Whitney	0.1256	
	Wilcoxon (paired)	0.1764	
Arithmetic	UCL	1.715	1.578
	Mean	1.450	1.259
	LCL	1.185	0.940
	Std. Dev.	0.710	0.839
	Wilk (p-value)	0.0032 **	0.0001 **
	Efficiency	13.19%	
	t-Test (equal var.)	0.3478	
	t-Test (unequal var.)	0.3493	
	t-test (paired)	0.2652	
	Levene Test	0.6325	
Log Transformed	UCL	1.740	1.549
	Mean	1.447	1.242
	LCL	1.204	0.997
	Std. Dev.	0.704	0.708
	Wilk (p-value)	0.5737	0.7367
	Efficiency	14.17%	
	t-Test (equal var.)	0.1581	
	t-Test (unequal var.)	0.1593	
	t-Test (paired)	0.1030	
	Levene Test	0.4689	
Bootstrap	UCL	1.709	1.555
	Mean	1.450	1.258
	LCL	1.191	0.961
	Std. Dev.	0.694	0.781
	Efficiency	13.24%	

Jollyville Road Sand Filter - Nitrate + Nitrite (mg/L)



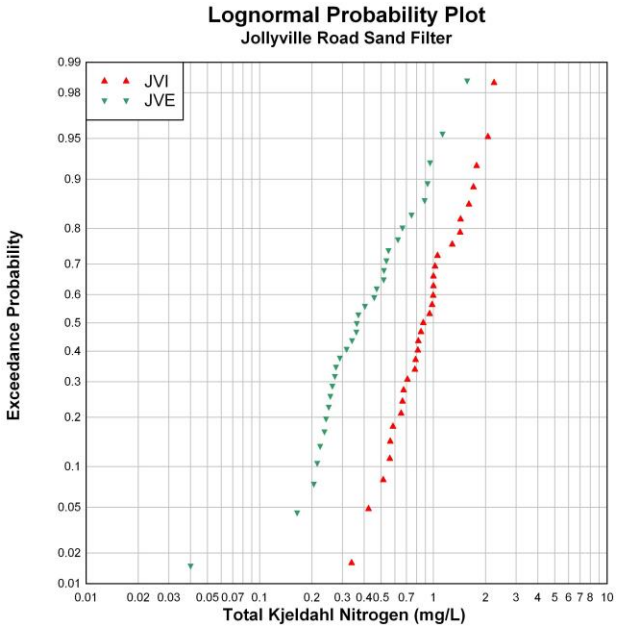


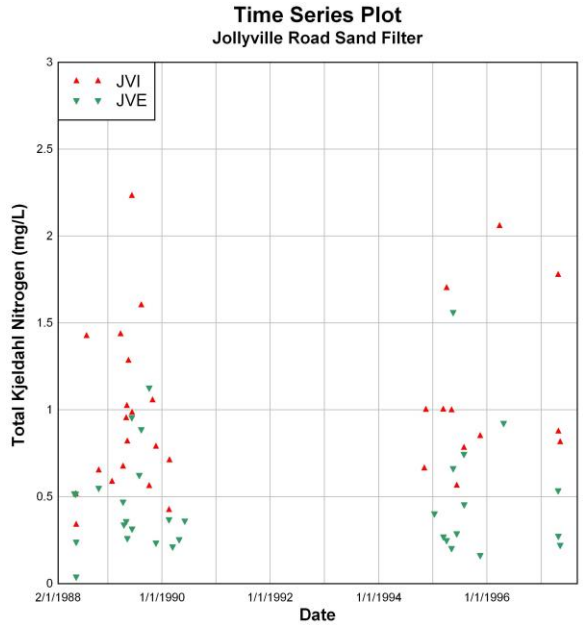


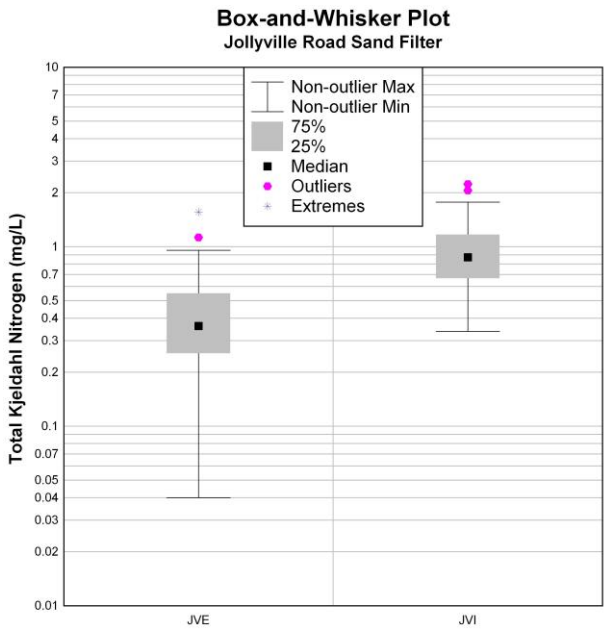


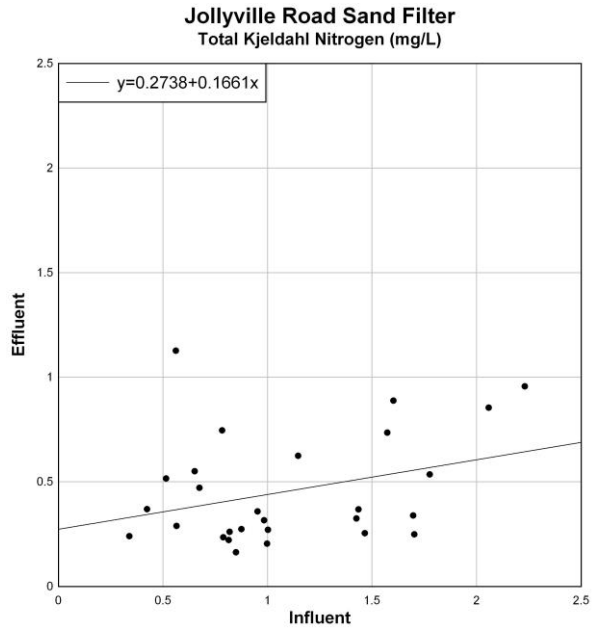
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	31	30
	Pairs Count	26	26
Non-Parametric	Maximum	1.217	3.658
	Upper Quartile	0.511	0.903
	Median	0.334	0.672
	Lower Quartile	0.263	0.514
	Minimum	0.100	0.207
	Efficiency	-101.39%	
	Mann-Whitney	0.0006 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.529	1.055
	Mean	0.429	0.813
	LCL	0.328	0.572
	Std. Dev.	0.273	0.647
	Wilk (p-value)	0.0002 **	0.0001 **
	Efficiency	-89.62%	
	t-Test (equal var.)	0.0035 **	
	t-Test (unequal var.)	0.0046 **	
	t-test (paired)	0.0021 **	
	Levene Test	0.2137	
Log Transformed	UCL	0.537	1.031
	Mean	0.427	0.800
	LCL	0.339	0.620
	Std. Dev.	0.264	0.534
	Wilk (p-value)	0.8248	0.3532
	Efficiency	-87.46%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0002 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7319	
Bootstrap	UCL	0.530	1.047
	Mean	0.432	0.820
	LCL	0.334	0.593
	Std. Dev.	0.267	0.608
	Efficiency	-89.88%	

Jollyville Road Sand Filter - Total Kjeldahl Nitrogen (mg/L)



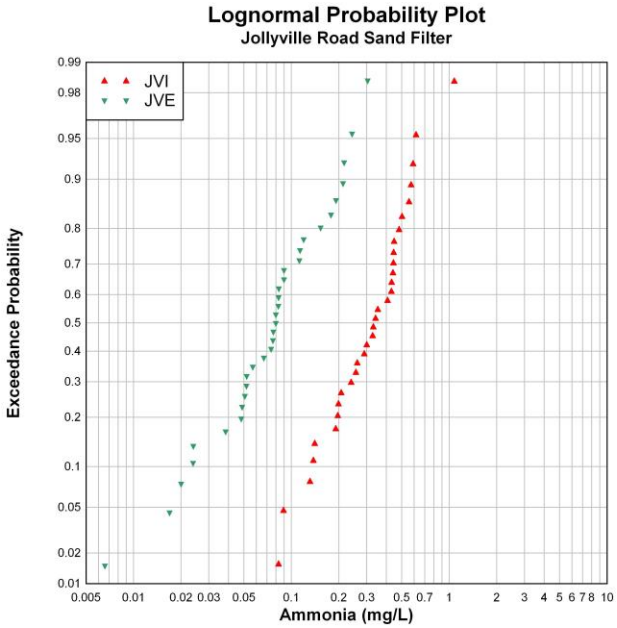


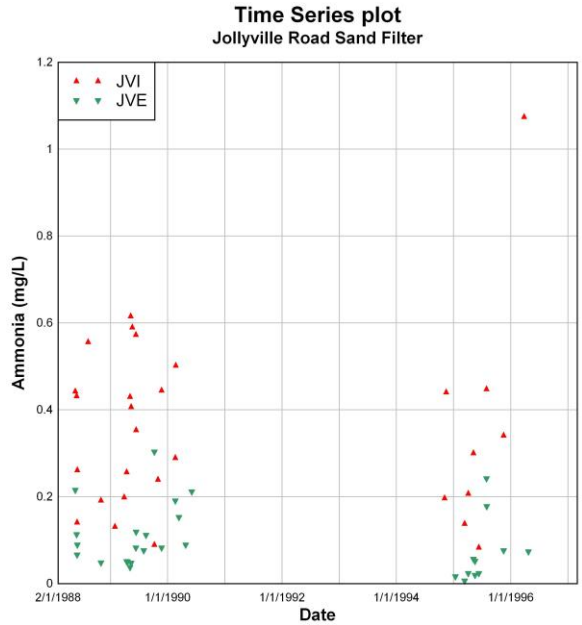


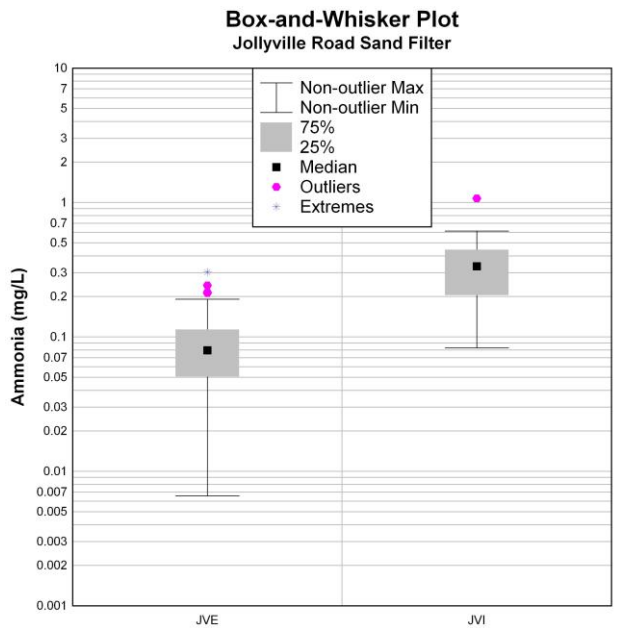


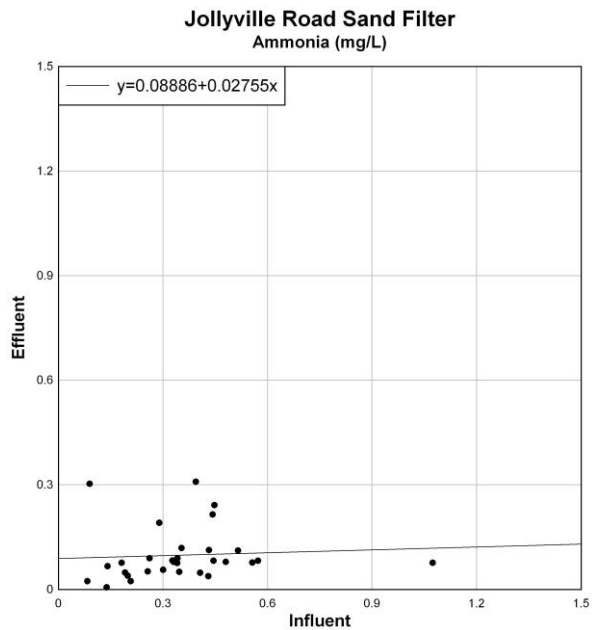
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	31	33
	Pairs Count	26	26
Non-Parametric	Maximum	2.230	1.563
	Upper Quartile	1.283	0.551
	Median	0.875	0.362
	Lower Quartile	0.663	0.255
	Minimum	0.338	0.040
	Efficiency	58.59%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	1.178	0.587
	Mean	1.004	0.473
	LCL	0.830	0.359
	Std. Dev.	0.474	0.322
	Wilk (p-value)	0.0101 **	0.0003 **
	Efficiency	52.85%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0992 *	
Log Transformed	UCL	1.196	0.633
	Mean	1.003	0.483
	LCL	0.842	0.368
	Std. Dev.	0.475	0.363
	Wilk (p-value)	0.8934	0.0712 *
	Efficiency	51.89%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1419	
Bootstrap	UCL	1.175	0.586
	Mean	1.005	0.476
	LCL	0.836	0.365
	Std. Dev.	0.461	0.312
	Efficiency	52.70%	

Jollyville Road Sand Filter - Ammonia (mg/L)



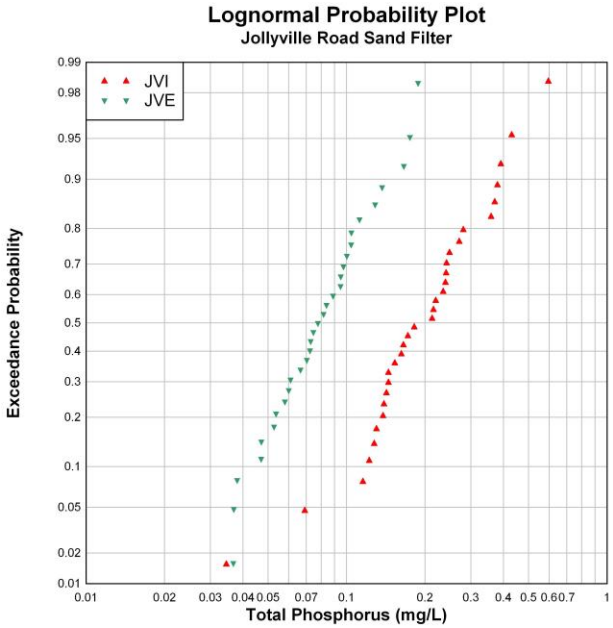


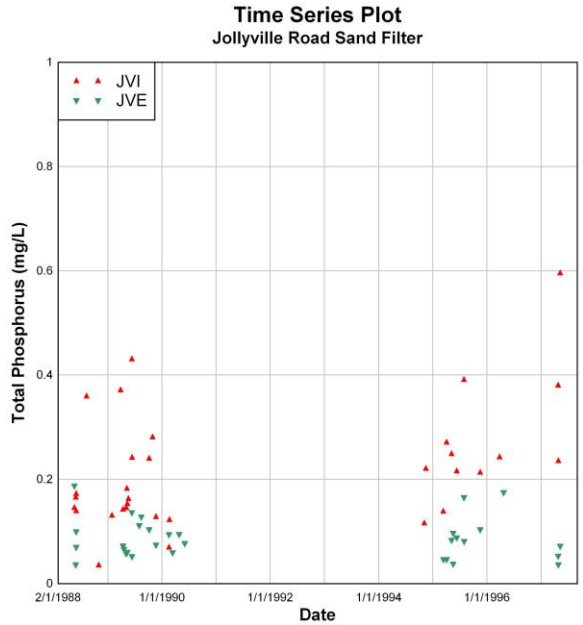


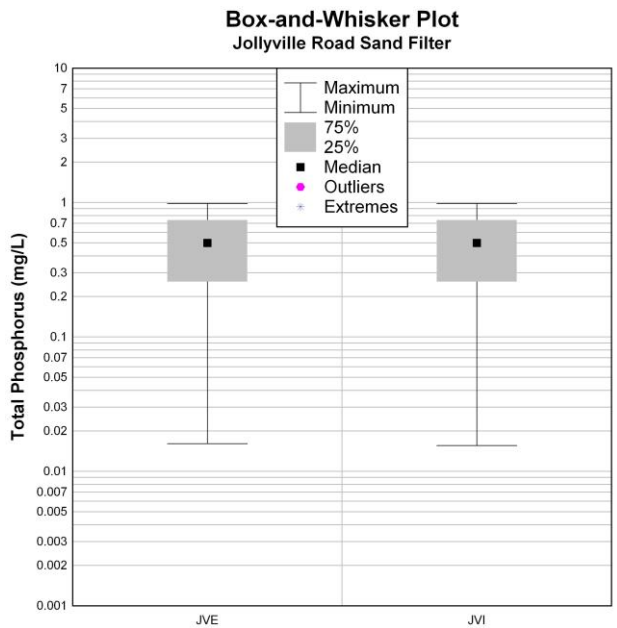


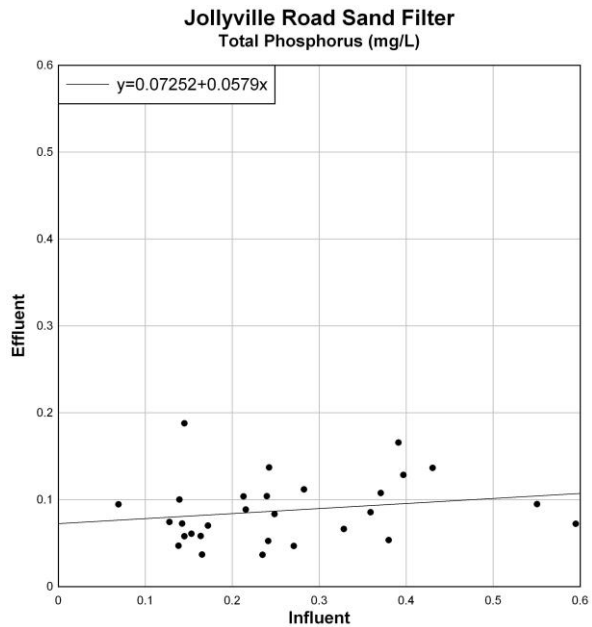
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	32	33
	Pairs Count	28	28
Non-Parametric	Maximum	1.074	0.303
	Upper Quartile	0.446	0.114
	Median	0.335	0.080
	Lower Quartile	0.202	0.051
	Minimum	0.083	0.007
	Efficiency	76.28%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.431	0.121
	Mean	0.359	0.096
	LCL	0.287	0.071
	Std. Dev.	0.200	0.071
	Wilk (p-value)	0.0057 **	0.0011 **
	Efficiency	73.36%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0340 **	
Log Transformed	UCL	0.458	0.141
	Mean	0.364	0.100
	LCL	0.289	0.071
	Std. Dev.	0.228	0.095
	Wilk (p-value)	0.3378	0.1811
	Efficiency	72.43%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1180	
Bootstrap	UCL	0.429	0.121
	Mean	0.359	0.096
	LCL	0.290	0.072
	Std. Dev.	0.193	0.070
	Efficiency	73.17%	

Jollyville Road Sand Filter - Total Phosphorus (mg/L)



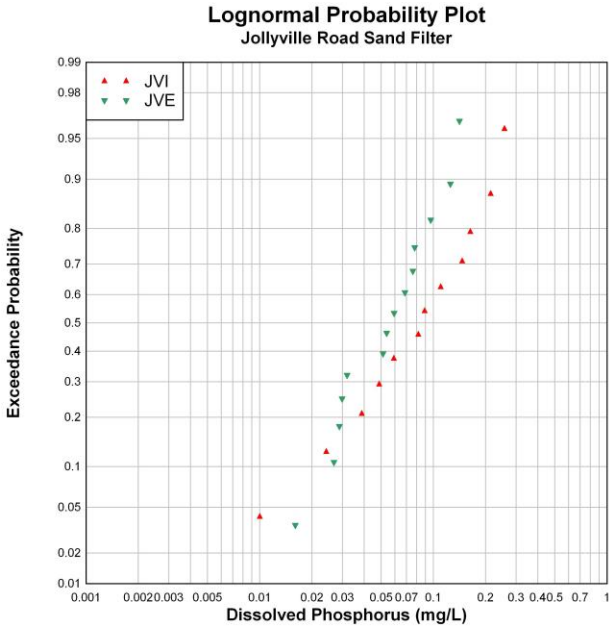


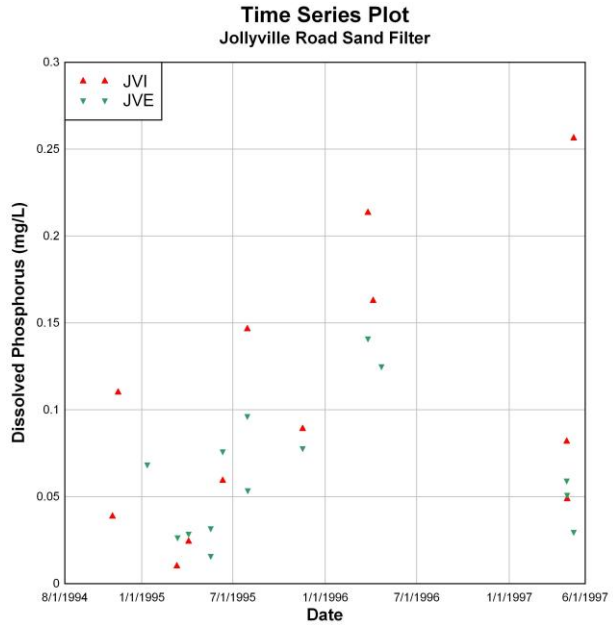


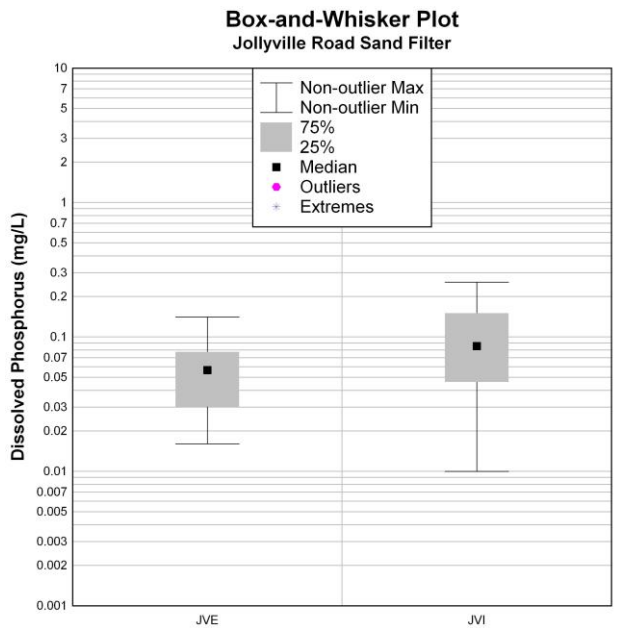


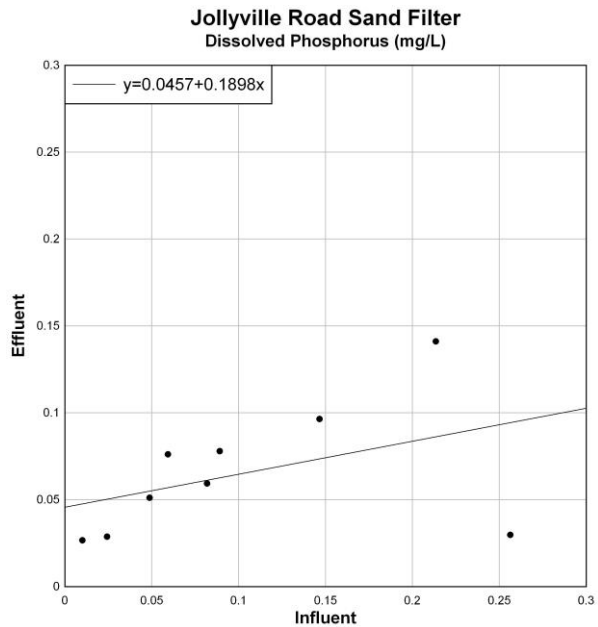
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	32	31
	Pairs Count	27	27
Non-Parametric	Maximum	0.595	0.188
	Upper Quartile	0.260	0.104
	Median	0.197	0.078
	Lower Quartile	0.141	0.058
	Minimum	0.035	0.037
	Efficiency	60.68%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.263	0.101
	Mean	0.221	0.086
	LCL	0.179	0.072
	Std. Dev.	0.118	0.039
	Wilk (p-value)	0.0069 **	0.0114 **
	Efficiency	60.87%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0125 **	
Log Transformed	UCL	0.278	0.102
	Mean	0.224	0.086
	LCL	0.180	0.073
	Std. Dev.	0.132	0.039
	Wilk (p-value)	0.1396	0.7283
	Efficiency	61.39%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.3016	
Bootstrap	UCL	0.264	0.100
	Mean	0.222	0.086
	LCL	0.181	0.072
	Std. Dev.	0.116	0.038
	Efficiency	61.16%	

Jollyville Road Sand Filter - Dissolved Phosphorus (mg/L)



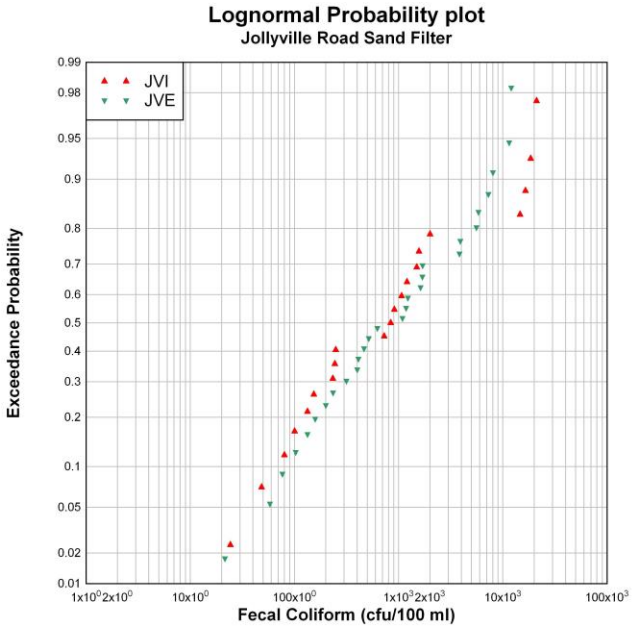


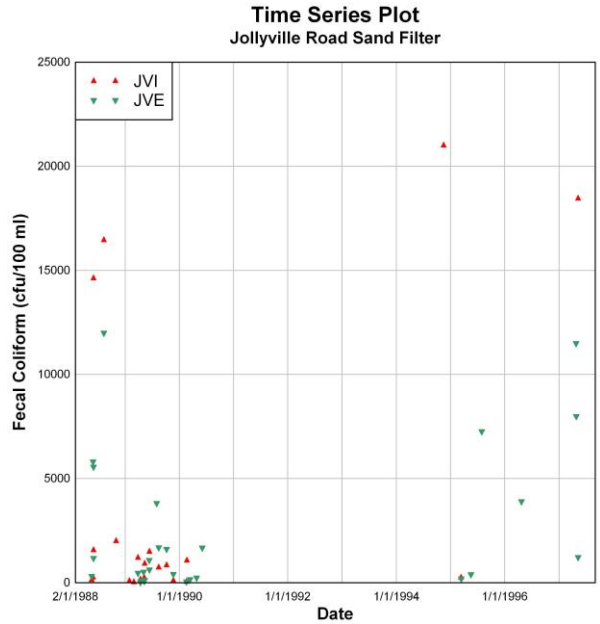


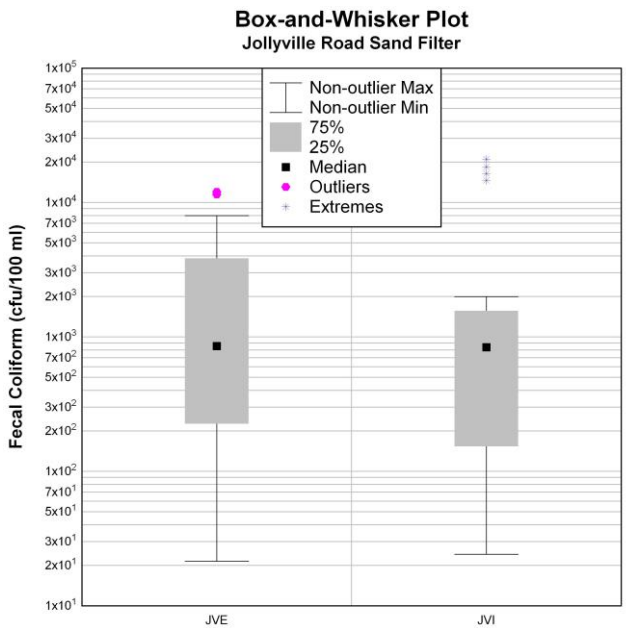


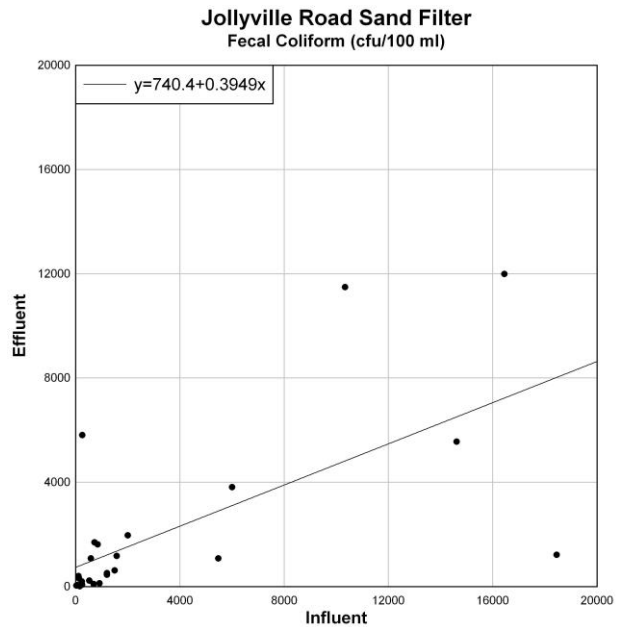
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	12	14
	Pairs Count	8	8
Non-Parametric	Maximum	0.256	0.141
	Upper Quartile	0.155	0.078
	Median	0.085	0.057
	Lower Quartile	0.044	0.030
	Minimum	0.010	0.016
	Efficiency	33.69%	
	Mann-Whitney	0.2381	
	Wilcoxon (paired)	0.1484	
Arithmetic	UCL	0.152	0.085
	Mean	0.103	0.063
	LCL	0.054	0.041
	Std. Dev.	0.077	0.038
	Wilk (p-value)	0.3887	0.2268
	Efficiency	38.99%	
	t-Test (equal var.)	0.0966 *	
	t-Test (unequal var.)	0.1200	
	t-test (paired)	0.1539	
	Levene Test	0.0347 **	
Log Transformed	UCL	0.231	0.096
	Mean	0.111	0.064
	LCL	0.053	0.042
	Std. Dev.	0.114	0.043
	Wilk (p-value)	0.7447	0.8001
	Efficiency	42.44%	
	t-Test (equal var.)	0.2871	
	t-Test (unequal var.)	0.3042	
	t-Test (paired)	0.2135	
	Levene Test	0.1837	
Bootstrap	UCL	0.152	0.084
	Mean	0.105	0.063
	LCL	0.059	0.043
	Std. Dev.	0.074	0.035
	Efficiency	39.96%	

Jollyville Road Sand Filter - Fecal Coliform (cfu/100 ml)



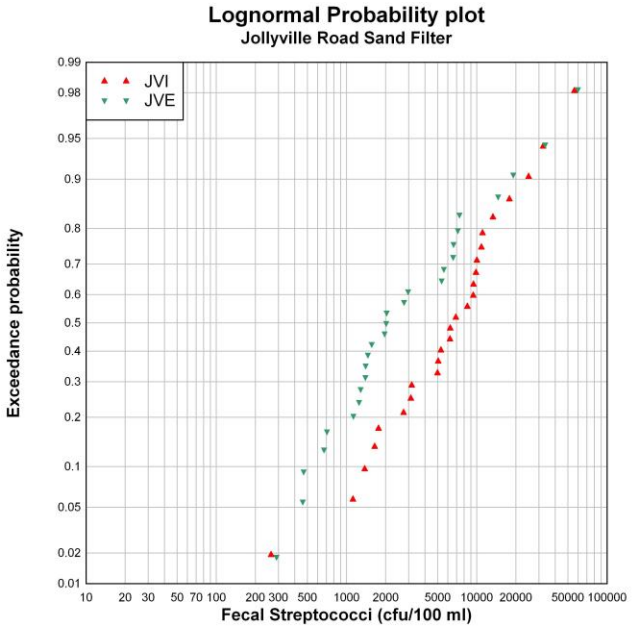


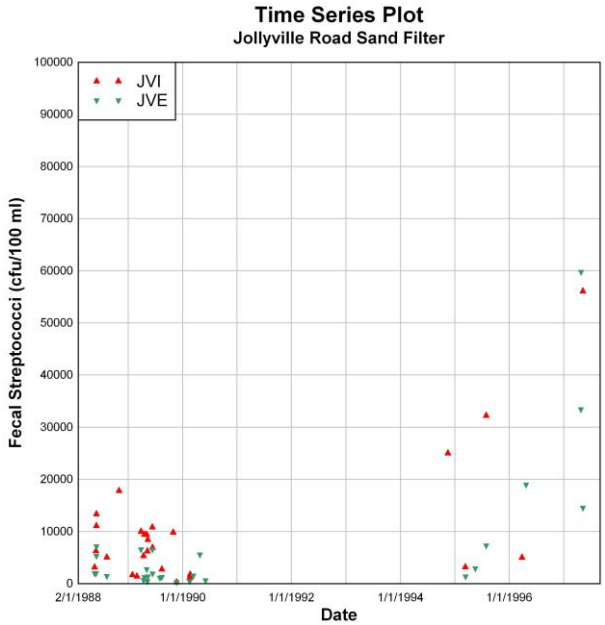


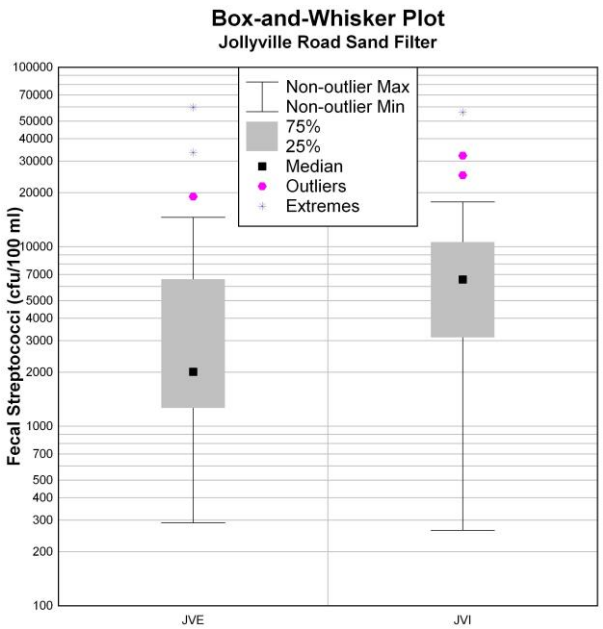


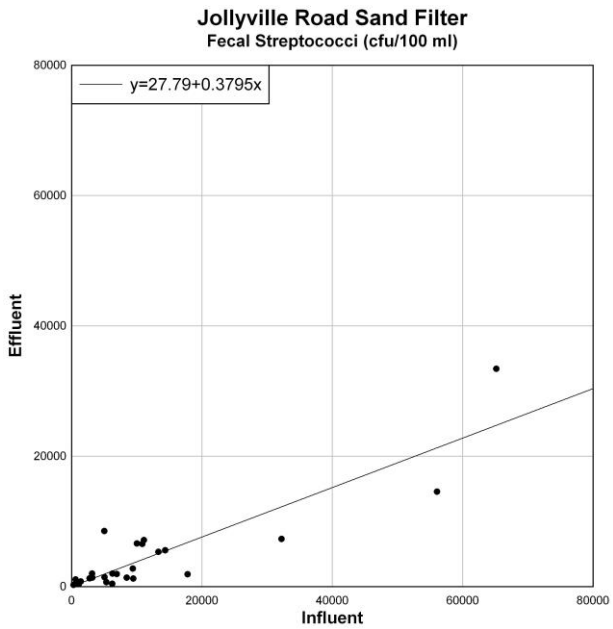
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	21	28
	Pairs Count	23	23
Non-Parametric	Maximum	21,000	12,000
	Upper Quartile	1,567	3,863
	Median	839	856
	Lower Quartile	154	217
	Minimum	24	21
	Efficiency	-1.98%	
	Mann-Whitney	0.7708	
	Wilcoxon (paired)	0.1764	
Arithmetic	UCL	7,041	3,851
	Mean	3,884	2,503
	LCL	727	1,155
	Std. Dev.	6,936	3,475
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	35.56%	
	t-Test (equal var.)	0.3654	
	t-Test (unequal var.)	0.4097	
	t-test (paired)	0.1371	
	Levene Test	0.0352 **	
Log Transformed	UCL	20,566	9,261
	Mean	4,157	3,177
	LCL	840	1,090
	Std. Dev.	14,413	9,166
	Wilk (p-value)	0.2372	0.5731
	Efficiency	23.57%	
	t-Test (equal var.)	0.8265	
	t-Test (unequal var.)	0.8302	
	t-Test (paired)	0.2441	
	Levene Test	0.3853	
Bootstrap	UCL	6,968	3,799
	Mean	3,927	2,504
	LCL	886	1,209
	Std. Dev.	6,681	3,340
	Efficiency	36.24%	

Jollyville Road Sand Filter - Fecal Streptococci (cfu/100 ml)



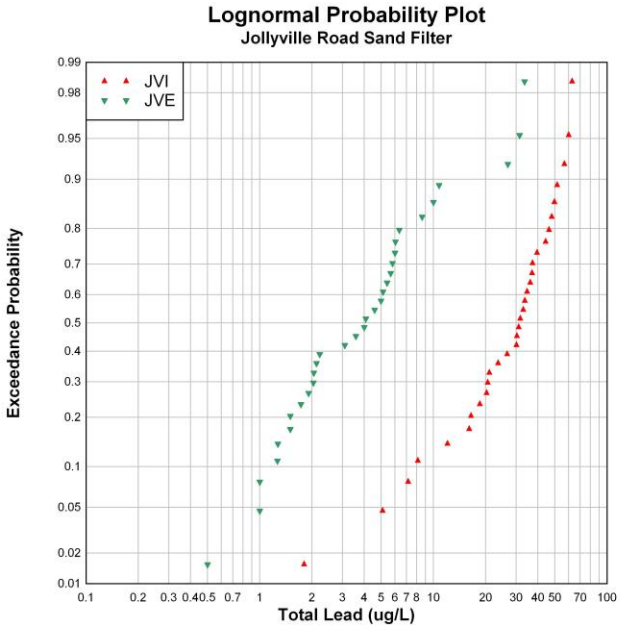


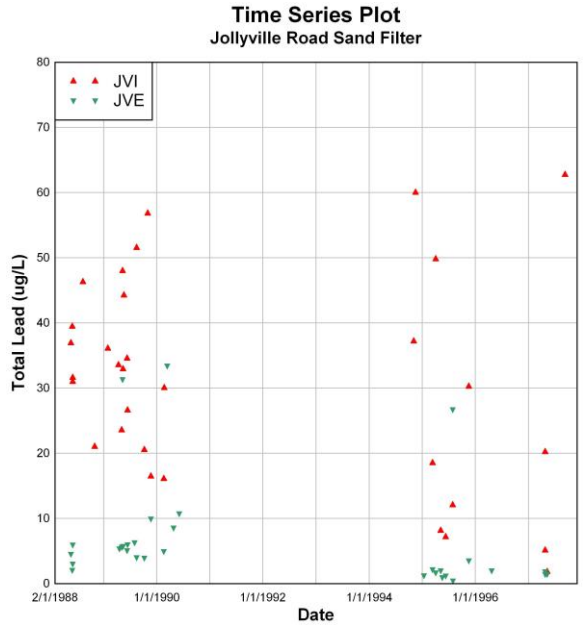


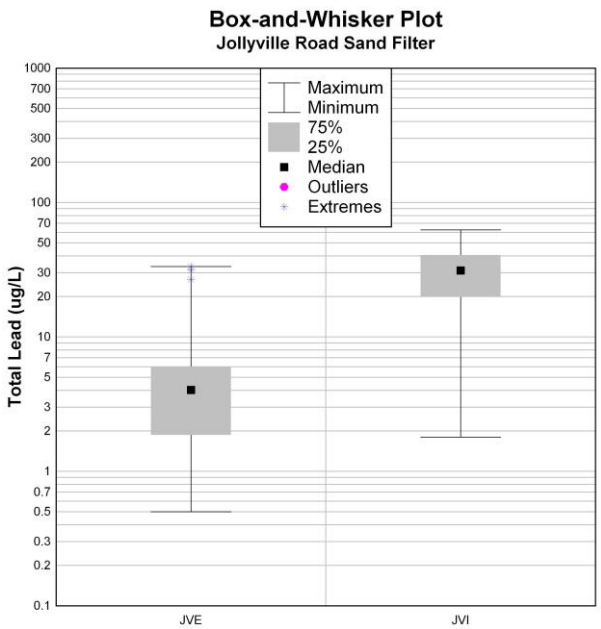


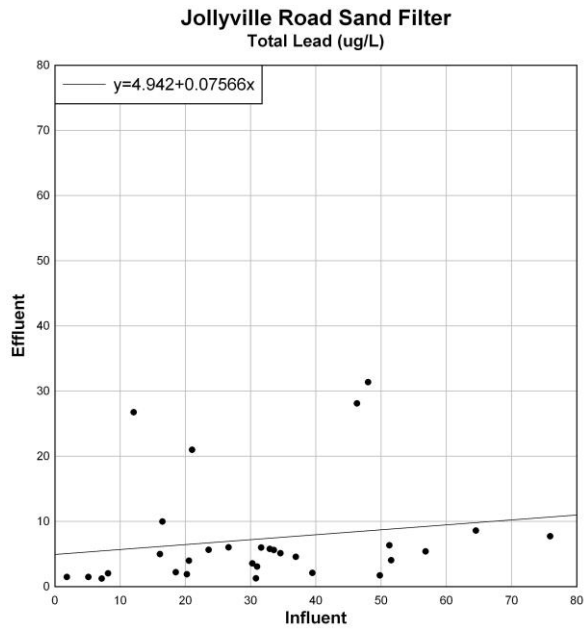
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	26	27
	Pairs Count	23	23
Non-Parametric	Maximum	56,058	59,810
	Upper Quartile	10,827	6,616
	Median	6,573	2,013
	Lower Quartile	3,115	1,248
	Minimum	263	289
	Efficiency	69.38%	
	Mann-Whitney	0.0263 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	14,942	12,061
	Mean	10,123	7,009
	LCL	5,303	1,957
	Std. Dev.	11,929	12,767
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	30.76%	
	t-Test (equal var.)	0.3637	
	t-Test (unequal var.)	0.3631	
	t-test (paired)	0.0025 **	
	Levene Test	0.8802	
Log Transformed	UCL	19,972	12,861
	Mean	10,941	6,219
	LCL	5,994	3,007
	Std. Dev.	15,749	11,200
	Wilk (p-value)	0.5925	0.4325
	Efficiency	43.16%	
	t-Test (equal var.)	0.0284 **	
	t-Test (unequal var.)	0.0280 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.4765	
Bootstrap	UCL	14,959	11,778
	Mean	10,322	7,109
	LCL	5,684	2,439
	Std. Dev.	11,481	11,804
	Efficiency	31.13%	

Jollyville Road Sand Filter - Total Lead (ug/L)



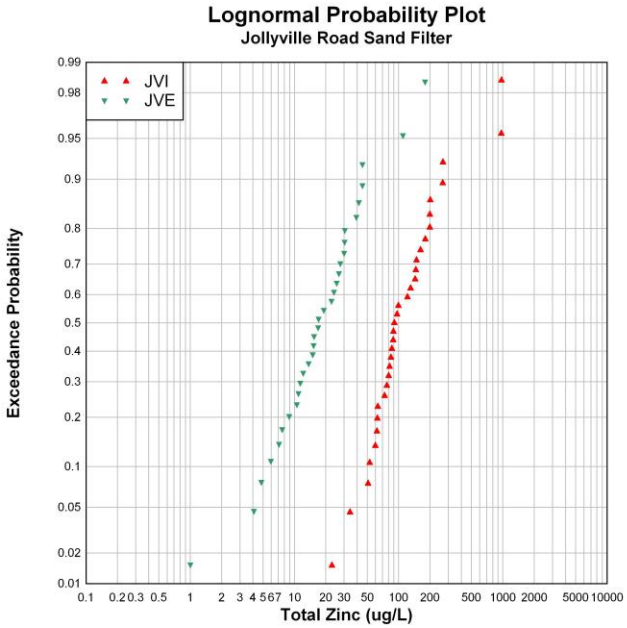


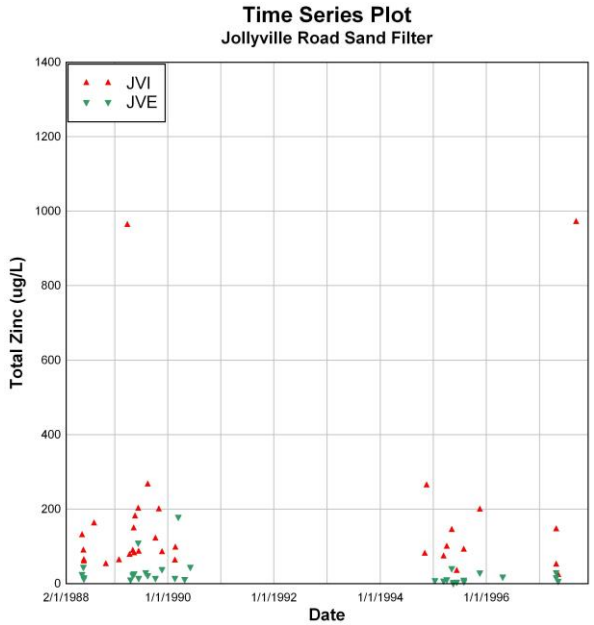


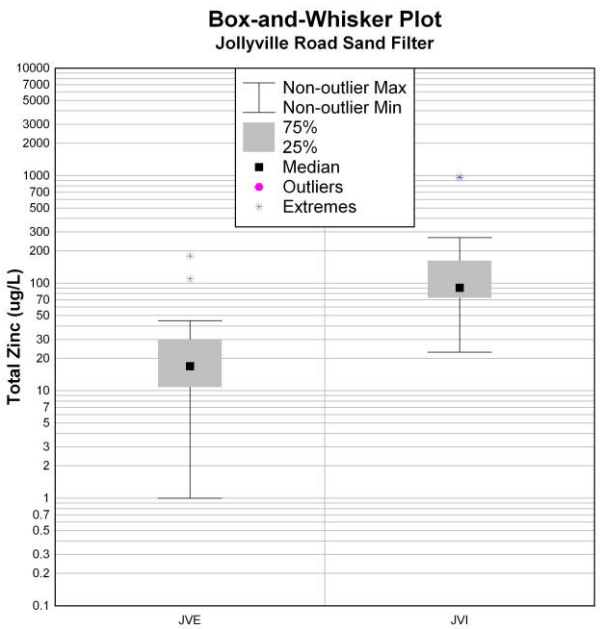


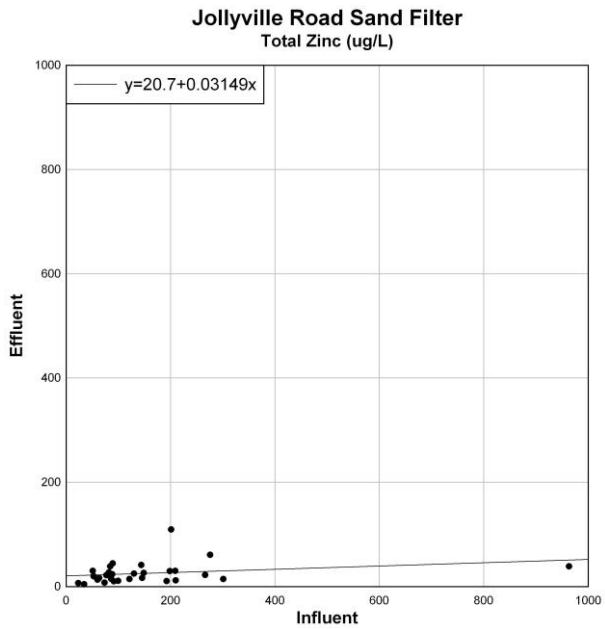
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	32	32
	Pairs Count	28	28
Non-Parametric	Maximum	62.8	33.5
	Upper Quartile	41.8	6.0
	Median	31.3	4.0
	Lower Quartile	19.4	1.8
	Minimum	1.8	0.5
	Efficiency	87.10%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	36.8	9.4
	Mean	30.9	6.4
	LCL	25.1	3.4
	Std. Dev.	16.2	8.3
	Wilk (p-value)	0.7867	0.0001 **
	Efficiency	79.21%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0028 **	
Log Transformed	UCL	46.4	9.6
	Mean	33.6	6.1
	LCL	24.3	3.9
	Std. Dev.	29.5	7.4
	Wilk (p-value)	0.0007 **	0.3313
	Efficiency	81.84%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2419	
Bootstrap	UCL	36.7	9.3
	Mean	30.9	6.4
	LCL	25.2	3.5
	Std. Dev.	16.0	7.9
	Efficiency	79.33%	

Jollyville Road Sand Filter - Total Zinc (ug/L)



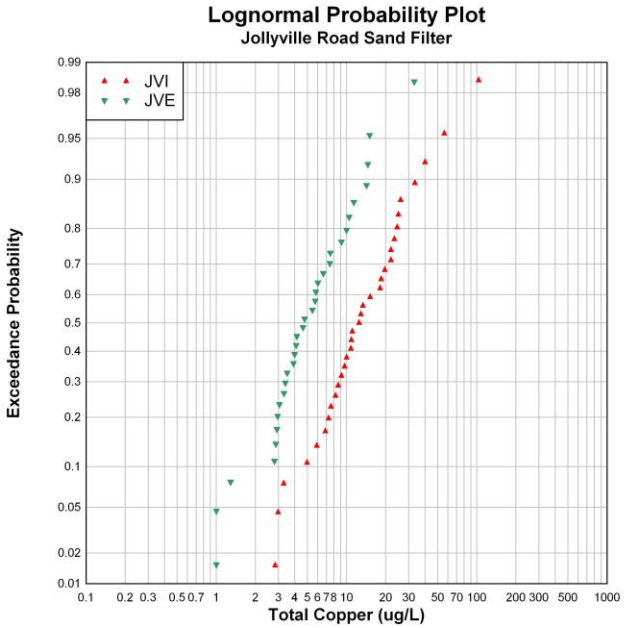


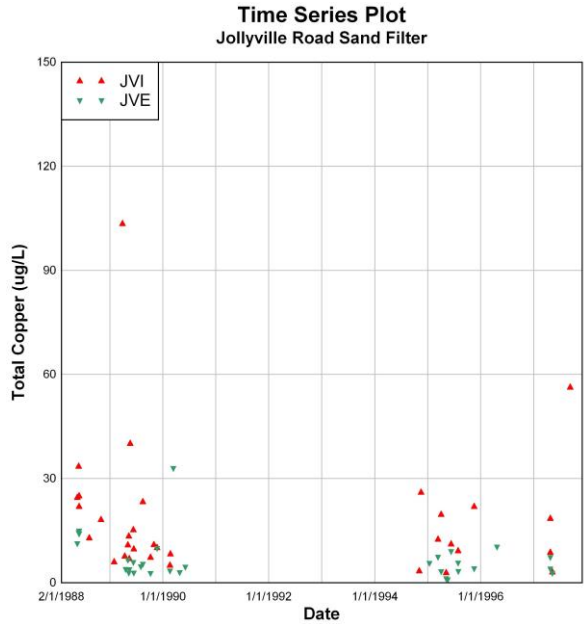


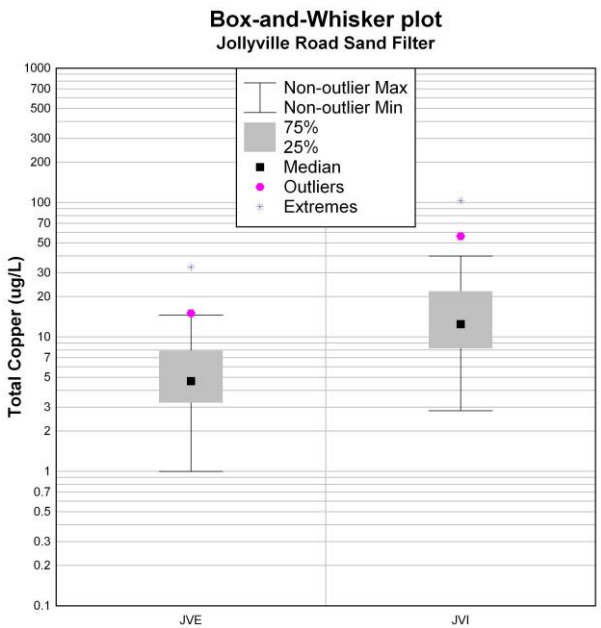


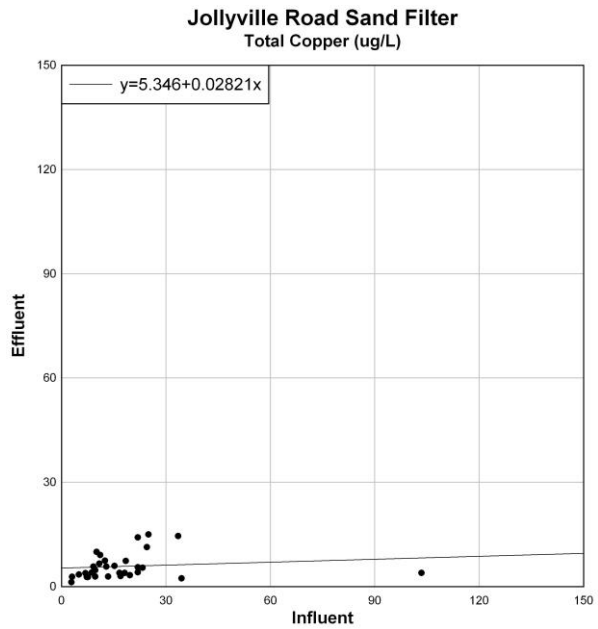
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	33	32
	Pairs Count	28	28
Non-Parametric	Maximum	971.2	179.3
	Upper Quartile	161.6	30.0
	Median	91.0	17.0
	Lower Quartile	73.2	10.7
	Minimum	22.8	1.0
	Efficiency	81.35%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	241.6	39.6
	Mean	165.0	27.3
	LCL	88.5	14.9
	Std. Dev.	215.8	34.2
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	83.48%	
	t-Test (equal var.)	0.0007 **	
	t-Test (unequal var.)	0.0010 **	
	t-test (paired)	0.0005 **	
	Levene Test	0.1120	
Log Transformed	UCL	207.6	42.0
	Mean	150.7	27.3
	LCL	109.4	17.7
	Std. Dev.	133.5	31.9
	Wilk (p-value)	0.0207 **	0.4113
	Efficiency	81.89%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.3769	
Bootstrap	UCL	239.6	38.2
	Mean	167.0	27.0
	LCL	94.5	15.7
	Std. Dev.	204.7	31.3
	Efficiency	83.85%	

Jollyville Road Sand Filter - Total Copper (ug/L)



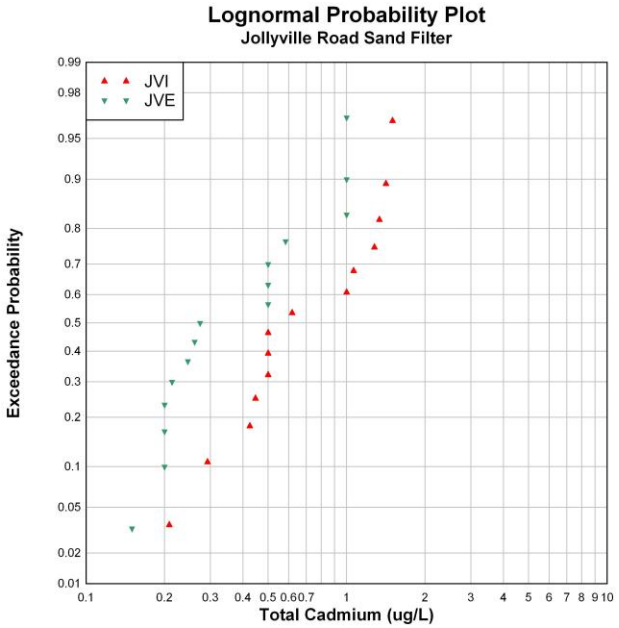


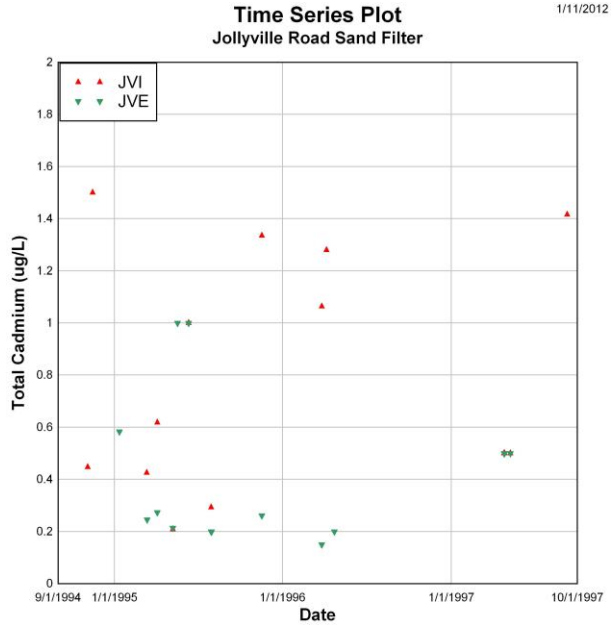


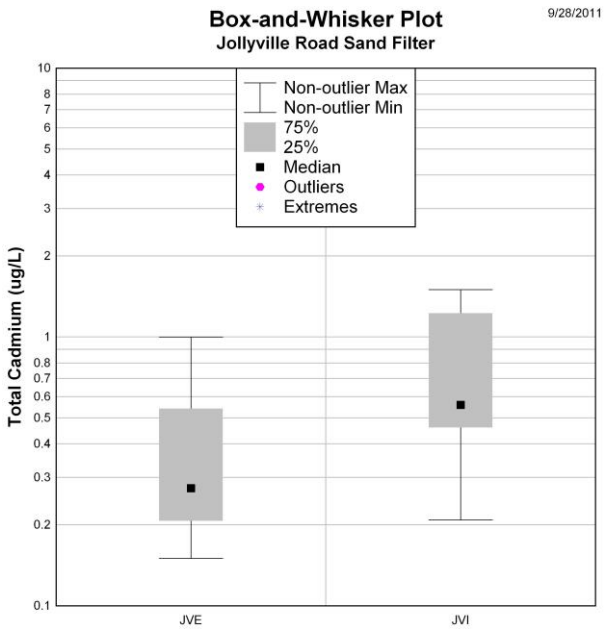


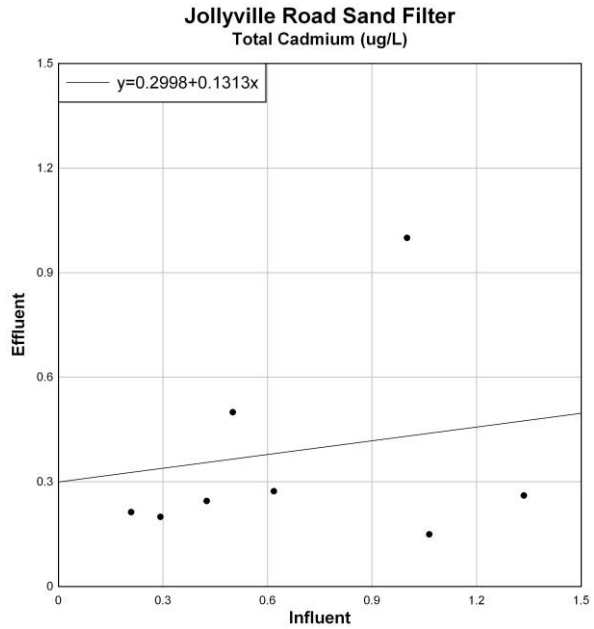
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	33	32
	Pairs Count	29	29
Non-Parametric	Maximum	103.4	33.1
	Upper Quartile	21.9	8.3
	Median	12.5	4.7
	Lower Quartile	8.2	3.2
	Minimum	2.8	1.0
	Efficiency	62.32%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	25.1	9.0
	Mean	18.4	6.7
	LCL	11.6	4.5
	Std. Dev.	19.1	6.2
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	63.22%	
	t-Test (equal var.)	0.0017 **	
	t-Test (unequal var.)	0.0020 **	
	t-test (paired)	0.0012 **	
	Levene Test	0.1623	
Log Transformed	UCL	25.0	9.3
	Mean	17.9	6.7
	LCL	12.9	4.9
	Std. Dev.	16.4	5.8
	Wilk (p-value)	0.8473	0.4941
	Efficiency	62.54%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.8242	
Bootstrap	UCL	24.7	8.8
	Mean	18.4	6.7
	LCL	12.1	4.6
	Std. Dev.	17.9	5.8
	Efficiency	63.44%	

Jollyville Road Sand Filter - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: JVI**	**EFF: JVE**
	Site Count	14	15
	Pairs Count	9	9
Non-Parametric	Maximum	1.5	1.0
	Upper Quartile	1.3	0.6
	Median	0.6	0.3
	Lower Quartile	0.4	0.2
	Minimum	0.2	0.2
	Efficiency	51.05%	
	Mann-Whitney	0.0309 **	
	Wilcoxon (paired)	0.1172	
Arithmetic	UCL	1.1	0.6
	Mean	0.8	0.5
	LCL	0.5	0.3
	Std. Dev.	0.5	0.3
	Wilk (p-value)	0.0606 *	0.0032 **
	Efficiency	42.52%	
	t-Test (equal var.)	0.0269 **	
	t-Test (unequal var.)	0.0301 **	
	t-test (paired)	0.0963 *	
	Levene Test	0.0476 **	
Log Transformed	UCL	1.2	0.7
	Mean	0.8	0.5
	LCL	0.5	0.3
	Std. Dev.	0.5	0.3
	Wilk (p-value)	0.2237	0.0540 *
	Efficiency	43.59%	
	t-Test (equal var.)	0.0205 **	
	t-Test (unequal var.)	0.0203 **	
	t-Test (paired)	0.0745 *	
	Levene Test	0.7879	
Bootstrap	UCL	1.0	0.6
	Mean	0.8	0.5
	LCL	0.5	0.3
	Std. Dev.	0.4	0.3
	Efficiency	42.60%	

Barton Ridge Sed/Fil System (BRI-BRE)

The Barton Ridge sedimentation/filtration system was the first SCM monitored by the City built to specifications in the Environmental Criteria Manual. It has a sedimentation basin designed to capture the water quality volume. A splitter-box is incorporated to divert runoff when the basin is full. Water from the sedimentation basin is routed to a separated sand filter through a 12”valve. The drawdown rate was variable because the valve could be adjusted. During monitoring, it was noted that runoff was entering the filtration basin directly; this was corrected using treated lumber. Runoff is from a shopping center; see the City’s report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed.

This summary is for the complete sedimentation/filtration system. For summaries of the sedimentation basin (BRI-BRM) and the sand filter (BRM-BRE) individually, see summaries in the Sedimentation and Sand Filter sections respectively.

WQM collected runoff and water quality data at The Barton Ridge Plaza pond (BRI-BRE) from 1993 to 2002. During this time 29 and 15 valid EMCs were collected at the influent (BRI) and effluent (BRE) respectively, of which 11 were paired.

Performance Summary

The system had the best performance with the reductions of the concentrations of TSS (90%) and VSS (89%) and these are significant in all cases, paired or not paired.

COD and BOD concentrations were reduced by 68% and 66% respectively, and were significant in all cases. The reduction (16%) in TOC concentration was not significant in any case.

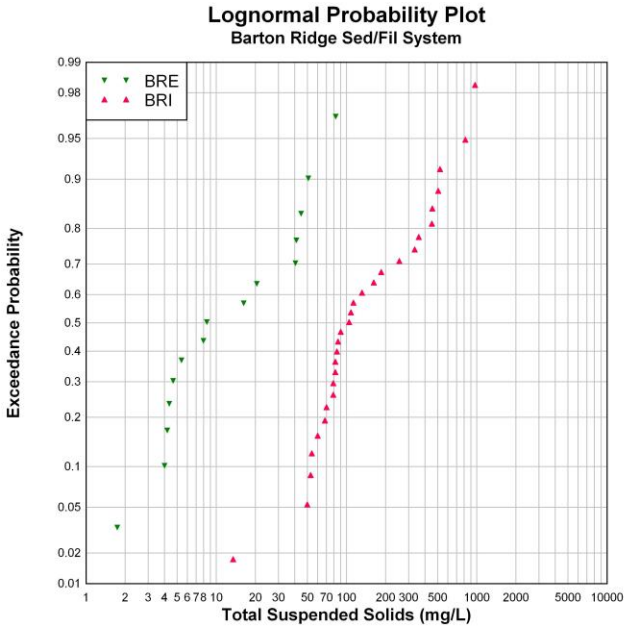
The reductions of concentrations in total nitrogen (47%), total Kjeldahl nitrogen (63%) and ammonia (52%) were significant in any case. Nitrate + nitrite concentration was reduced by 2% and only significant if data are paired.

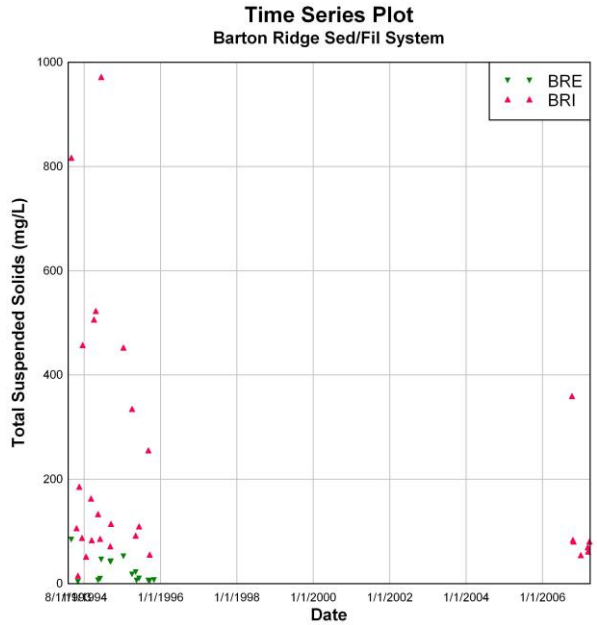
TP concentration was reduced by 66% and was significant in any case. DP concentration was reduced by 35% but this was not significant in any case.

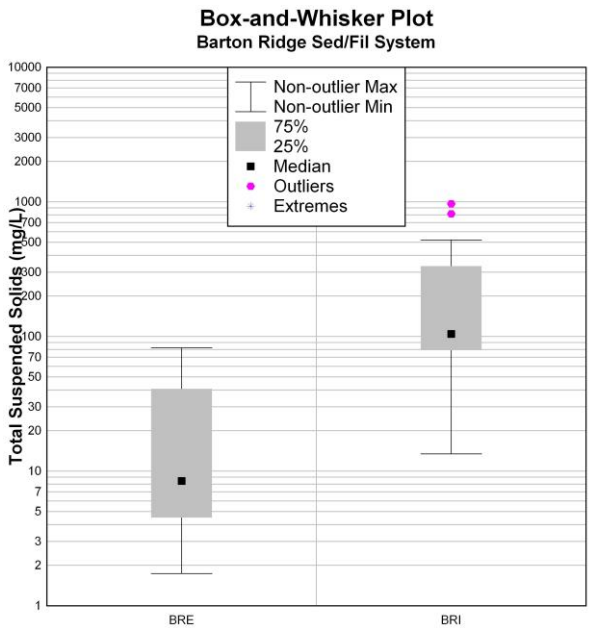
The reduction of bacteria was not significant in any case for FCOL (19%), and only significant if data are not paired for FSTR (76%).

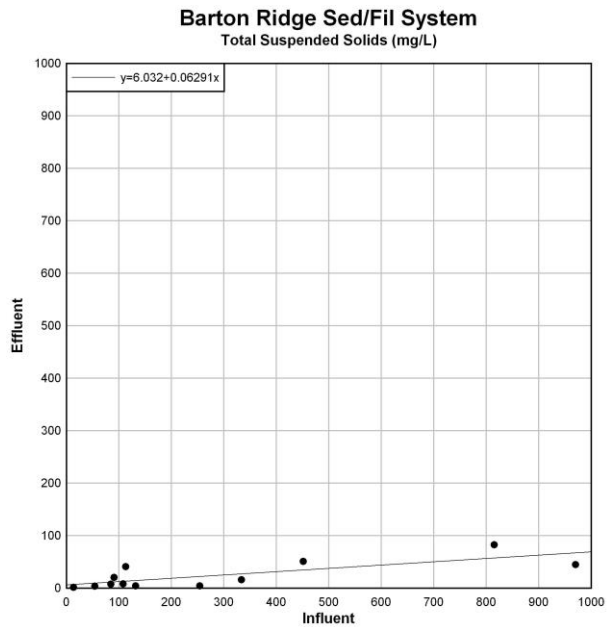
Lead and zinc concentrations were reduced by 71% and 37% respectively, and were significant in all cases. Copper and cadmium concentrations were reduced by 25% and 0% respectively, and were not significant in all case.

Barton Ridge Sed/Fil System - Total Suspended Solids (mg/L)



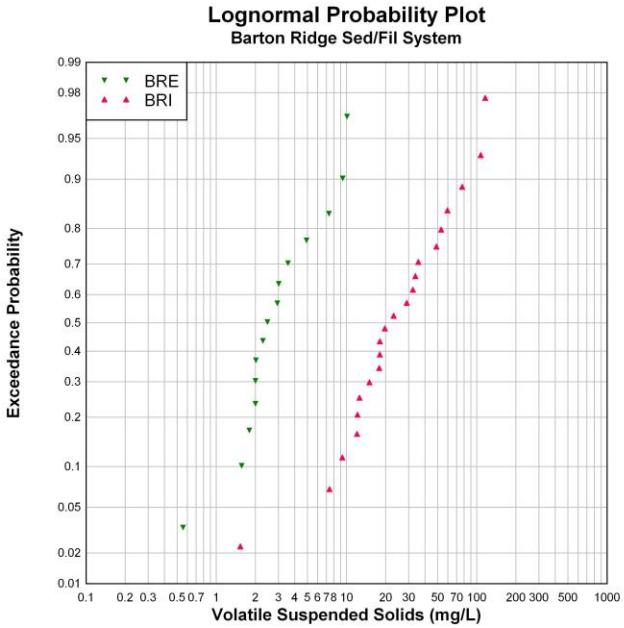


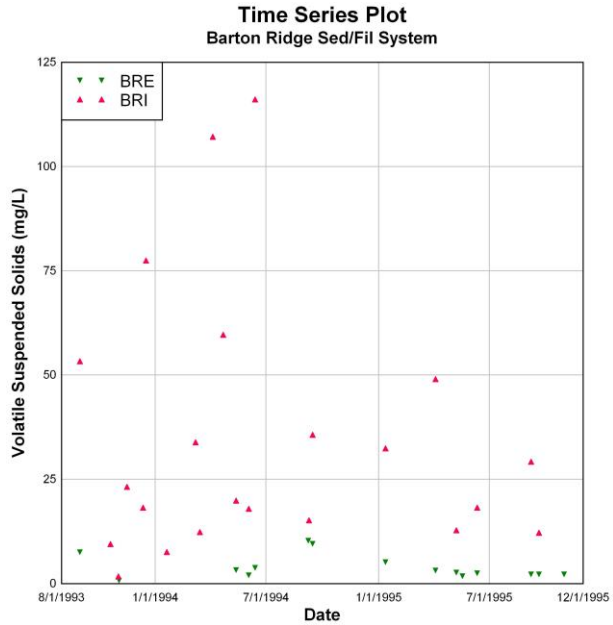


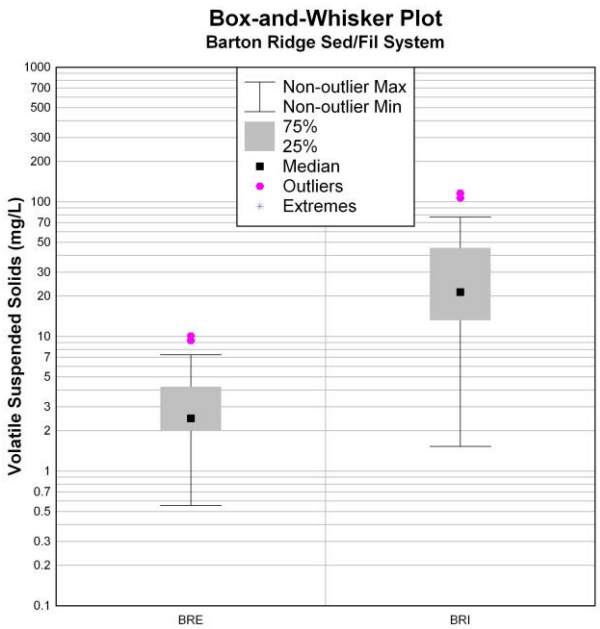


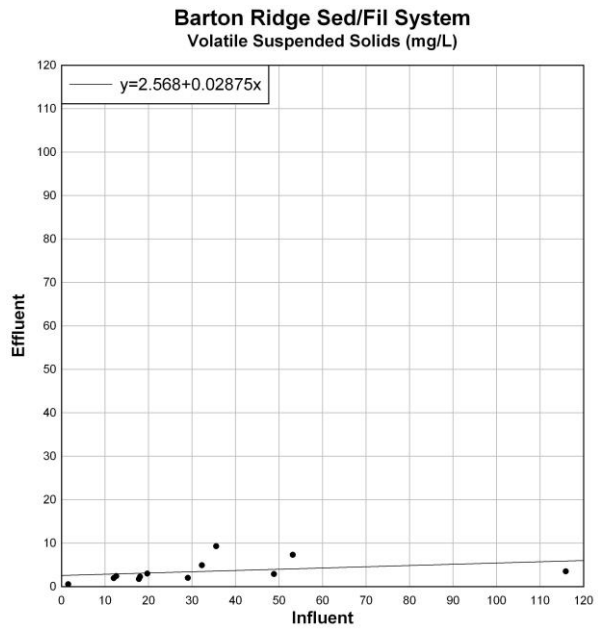
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	29	15
	Pairs Count	11	11
Non-Parametric	Maximum	970.0	82.7
	Upper Quartile	333.3	41.2
	Median	104.6	8.5
	Lower Quartile	79.0	4.4
	Minimum	13.4	1.7
	Efficiency	91.91%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	312.5	35.8
	Mean	221.3	22.5
	LCL	130.1	9.2
	Std. Dev.	239.8	24.1
	Wilk (p-value)	0.0001 **	0.0043 **
	Efficiency	89.83%	
	t-Test (equal var.)	0.0027 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0099 **	
	Levene Test	0.0761 *	
Log Transformed	UCL	345.9	55.7
	Mean	218.2	23.2
	LCL	137.7	9.7
	Std. Dev.	257.3	32.6
	Wilk (p-value)	0.0872 *	0.2407
	Efficiency	89.35%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.3323	
Bootstrap	UCL	312.1	35.1
	Mean	223.1	22.5
	LCL	134.1	9.9
	Std. Dev.	233.9	22.7
	Efficiency	89.93%	

Barton Ridge Sed/Fil System - Volatile Suspended Solids (mg/L)



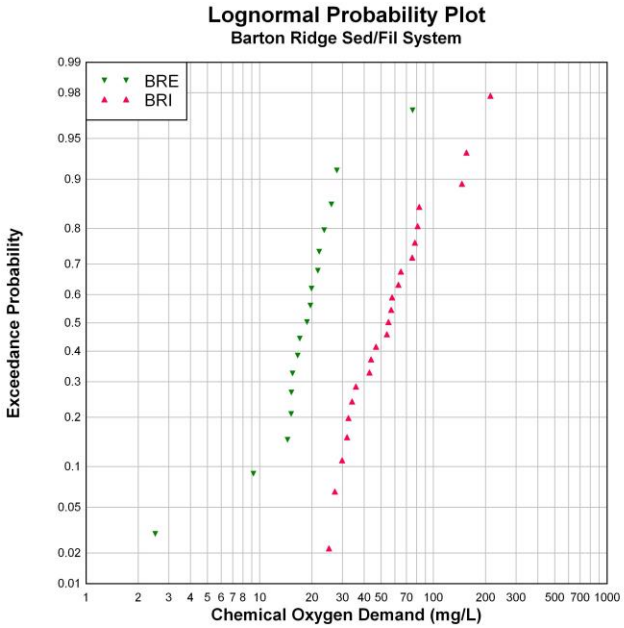


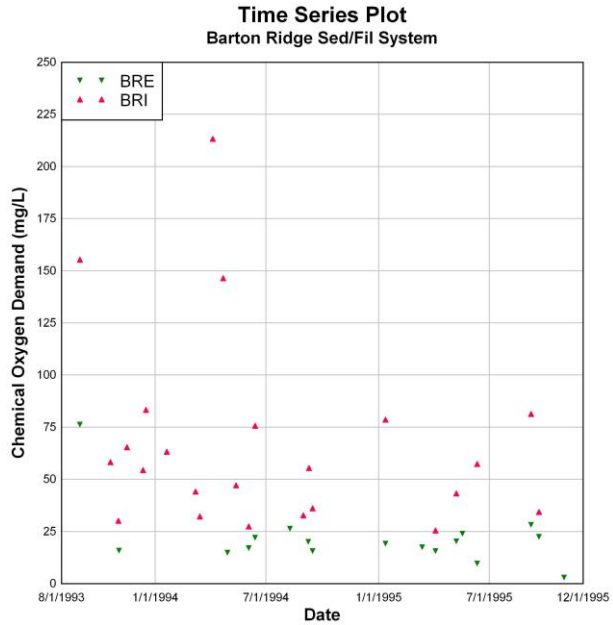


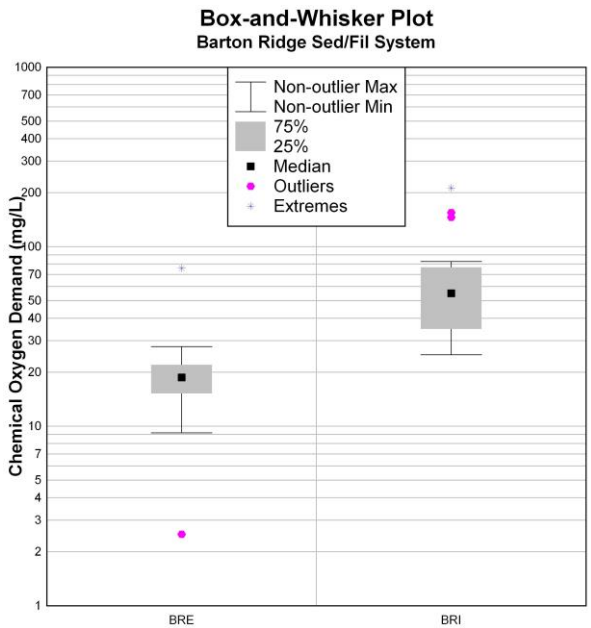


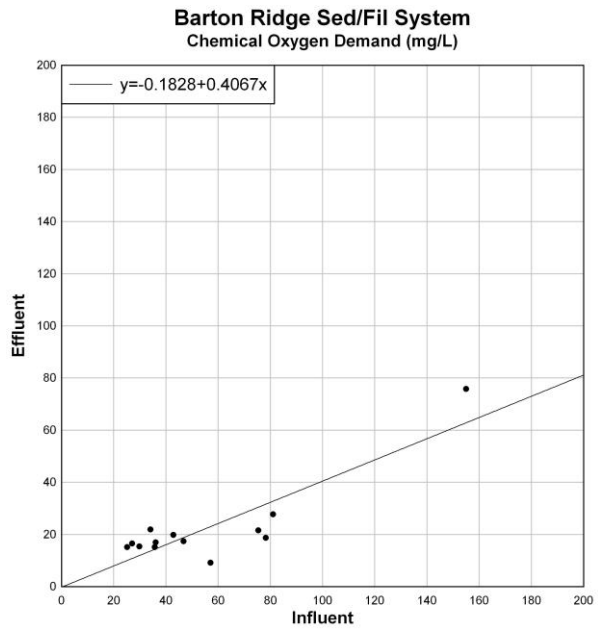
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	22	15
	Pairs Count	11	11
Non-Parametric	Maximum	115.9	10.1
	Upper Quartile	48.8	4.9
	Median	21.3	2.5
	Lower Quartile	12.6	2.0
	Minimum	1.5	.6
	Efficiency	88.44%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	48.3	5.3
	Mean	34.5	3.7
	LCL	20.6	2.1
	Std. Dev.	31.2	2.9
	Wilk (p-value)	0.0009 **	0.0036 **
	Efficiency	89.19%	
	t-Test (equal var.)	0.0006 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0047 **	
	Levene Test	0.0428 **	
Log Transformed	UCL	62.3	6.0
	Mean	36.6	3.7
	LCL	21.5	2.3
	Std. Dev.	41.8	3.0
	Wilk (p-value)	0.3605	0.3532
	Efficiency	89.80%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.3981	
Bootstrap	UCL	48.1	5.3
	Mean	34.7	3.7
	LCL	21.4	2.2
	Std. Dev.	30.0	2.8
	Efficiency	89.22%	

Barton Ridge Sed/Fil System - Chemical Oxygen Demand (mg/L)



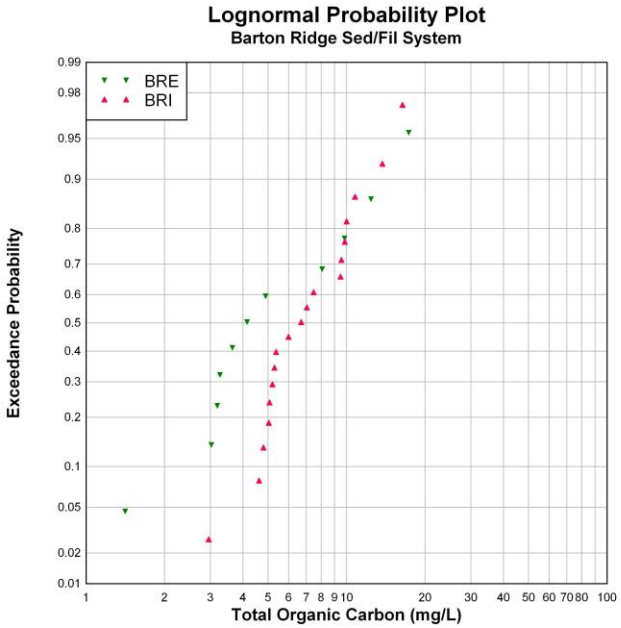


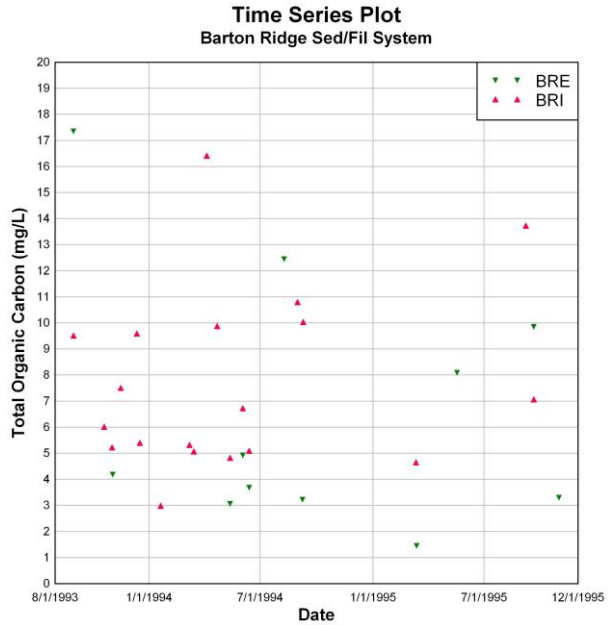


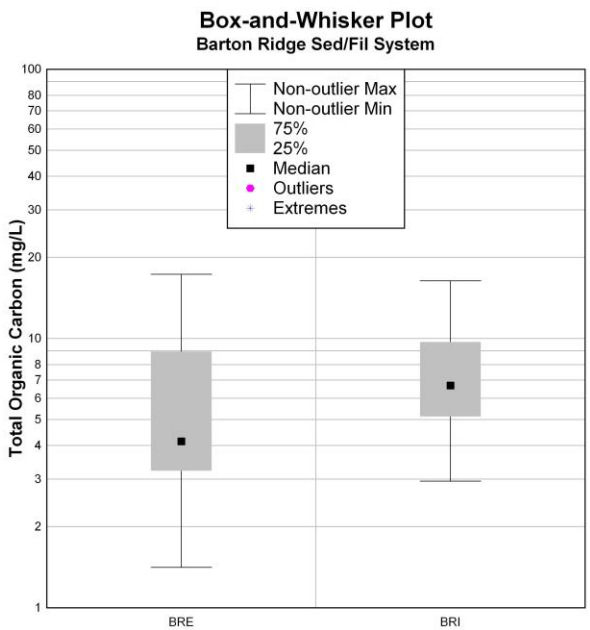


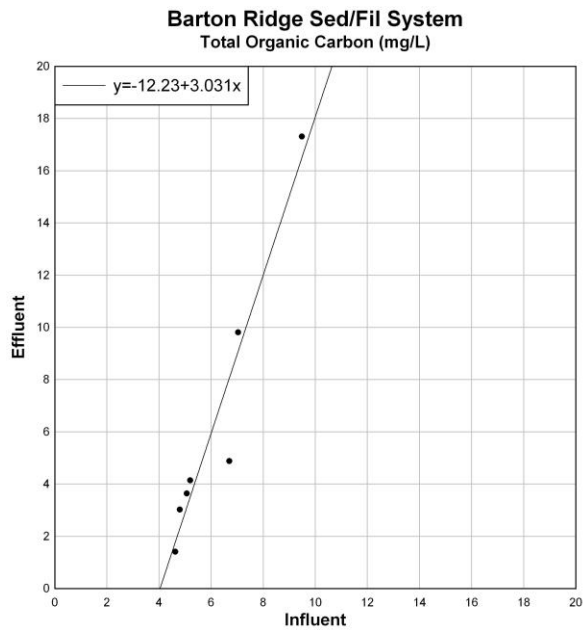
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	23	17
	Pairs Count	11	11
Non-Parametric	Maximum	212.91	75.89
	Upper Quartile	78.21	22.00
	Median	55.00	18.72
	Lower Quartile	34.00	15.23
	Minimum	25.04	2.50
	Efficiency	65.96%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	86.65	29.08
	Mean	66.61	21.20
	LCL	46.57	13.32
	Std. Dev.	46.33	15.32
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	68.17%	
	t-Test (equal var.)	0.0004 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0005 **	
	Levene Test	0.1164	
Log Transformed	UCL	85.23	31.53
	Mean	65.37	21.59
	LCL	50.14	14.78
	Std. Dev.	39.15	15.22
	Wilk (p-value)	0.2000	0.0041 **
	Efficiency	66.97%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.6554	
Bootstrap	UCL	86.36	28.15
	Mean	67.04	21.19
	LCL	47.71	14.24
	Std. Dev.	44.70	13.52
	Efficiency	68.39%	

Barton Ridge Sed/Fil System - Total Organic Carbon (mg/L)



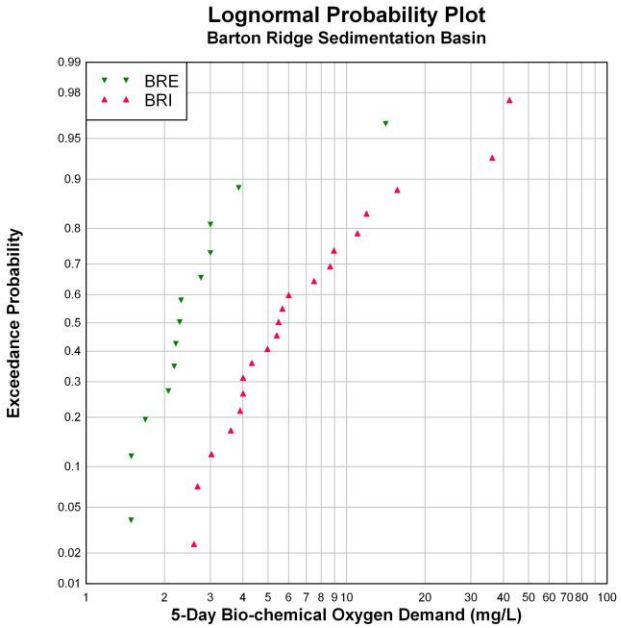


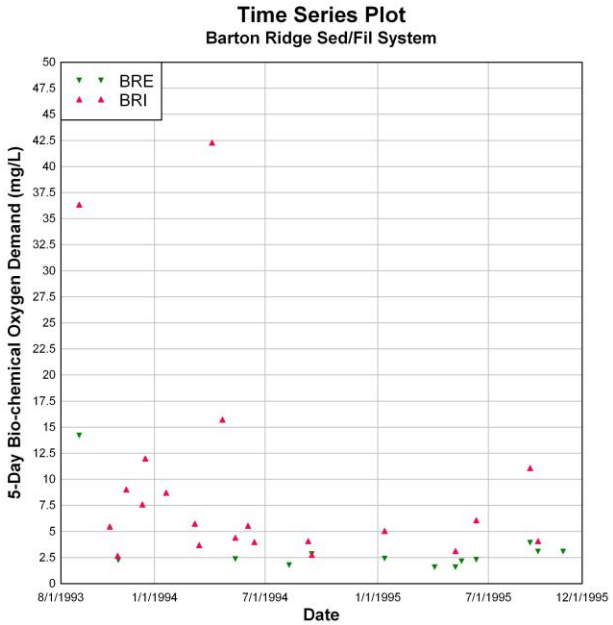


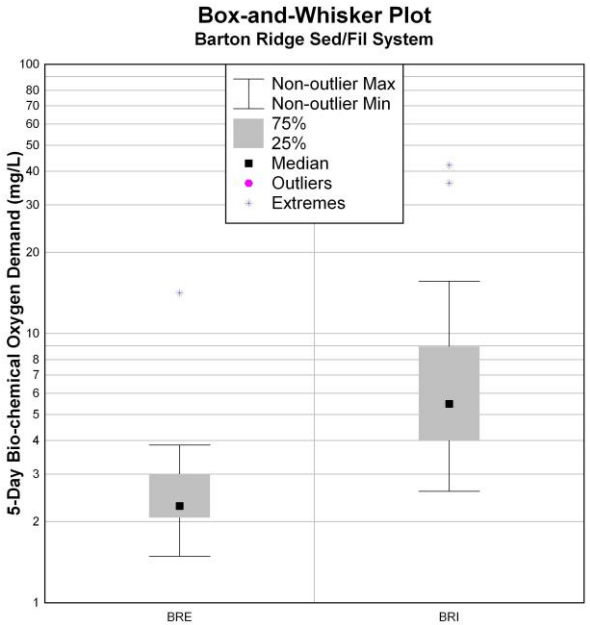


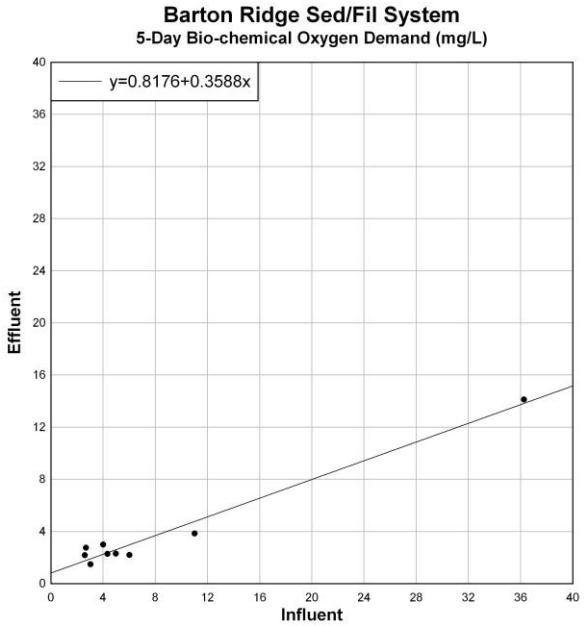
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	19	11
	Pairs Count	5	5
Non-Parametric	Maximum	16.38	17.32
	Upper Quartile	9.84	9.82
	Median	6.69	4.15
	Lower Quartile	5.06	3.19
	Minimum	2.95	1.41
	Efficiency	38.03%	
	Mann-Whitney	0.1542	
	Wilcoxon (paired)	0.8125	
Arithmetic	UCL	9.30	9.77
	Mean	7.64	6.47
	LCL	5.98	3.17
	Std. Dev.	3.45	4.91
	Wilk (p-value)	0.0401 **	0.0392 **
	Efficiency	15.30%	
	t-Test (equal var.)	0.4503	
	t-Test (unequal var.)	0.4961	
	t-test (paired)	0.5815	
	Levene Test	0.2608	
Log Transformed	UCL	9.48	11.32
	Mean	7.63	6.45
	LCL	6.14	3.67
	Std. Dev.	3.38	4.98
	Wilk (p-value)	0.5818	0.7116
	Efficiency	15.49%	
	t-Test (equal var.)	0.1394	
	t-Test (unequal var.)	0.2057	
	t-Test (paired)	0.8845	
	Levene Test	0.0393 **	
Bootstrap	UCL	9.23	9.45
	Mean	7.65	6.43
	LCL	6.06	3.41
	Std. Dev.	3.29	4.49
	Efficiency	15.94%	

Barton Ridge Sed/Fil System - 5-Day Bio-chemical Oxygen Demand (mg/L)



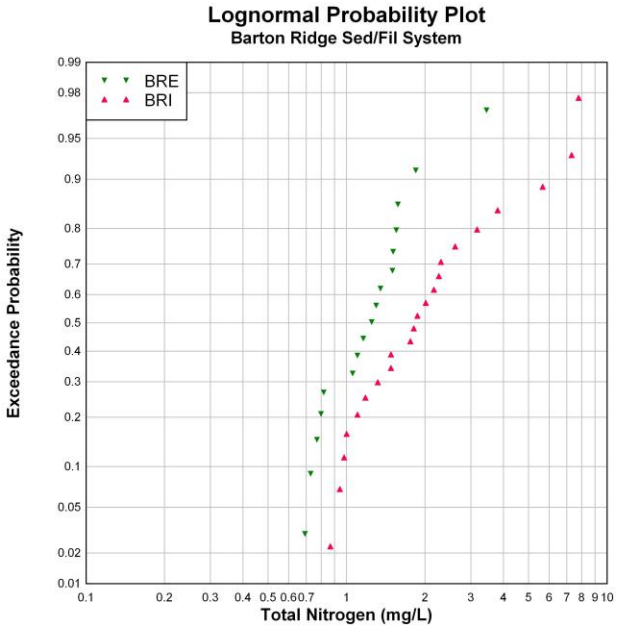


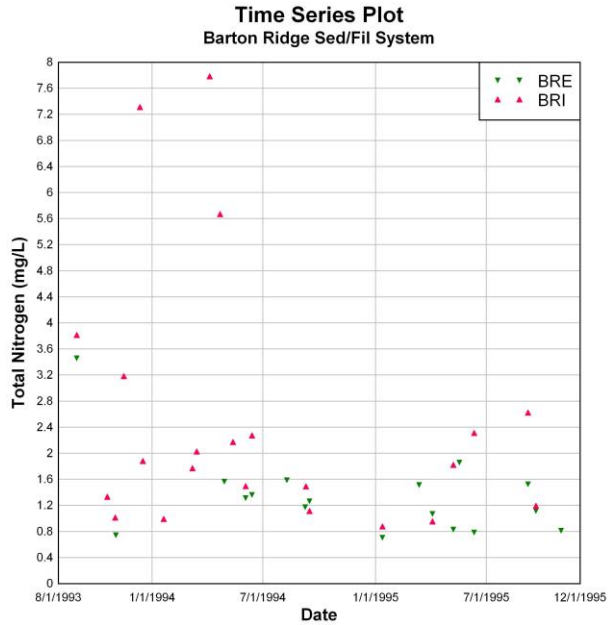


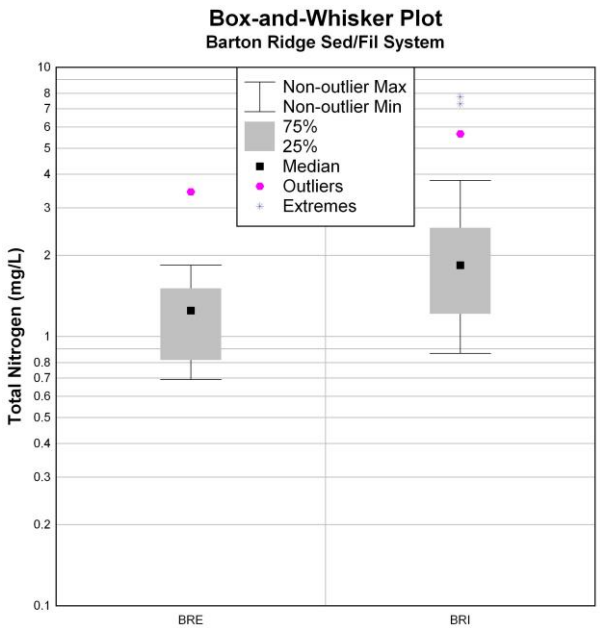


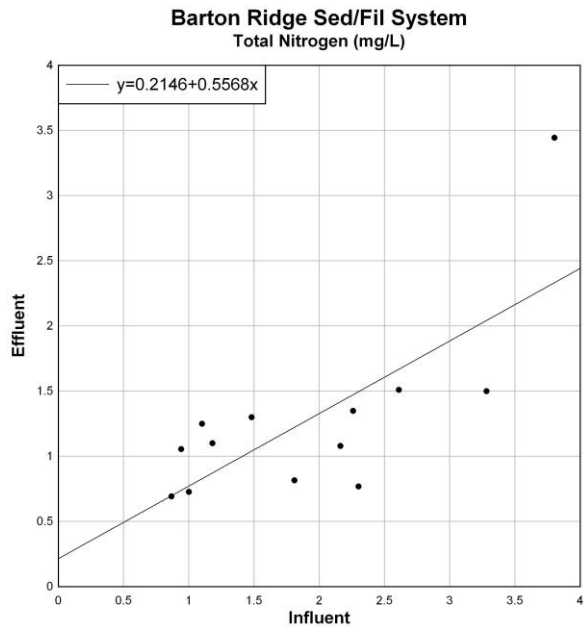
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	21	13
	Pairs Count	8	8
Non-Parametric	Maximum	42.20	14.13
	Upper Quartile	8.93	3.00
	Median	5.47	2.29
	Lower Quartile	4.00	2.07
	Minimum	2.59	1.49
	Efficiency	58.25%	
	Mann-Whitney	0.0005 **	
	Wilcoxon (paired)	0.0156 **	
Arithmetic	UCL	14.20	5.28
	Mean	9.42	3.27
	LCL	4.63	1.25
	Std. Dev.	10.50	3.33
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	65.31%	
	t-Test (equal var.)	0.0499 **	
	t-Test (unequal var.)	0.0196 **	
	t-test (paired)	0.0905 *	
	Levene Test	0.2188	
Log Transformed	UCL	13.01	4.45
	Mean	8.74	3.05
	LCL	5.87	2.08
	Std. Dev.	7.33	1.83
	Wilk (p-value)	0.0287 **	0.0027 **
	Efficiency	65.16%	
	t-Test (equal var.)	0.0007 **	
	t-Test (unequal var.)	0.0003 **	
	t-Test (paired)	0.0014 **	
	Levene Test	0.4192	
Bootstrap	UCL	14.00	4.91
	Mean	9.48	3.26
	LCL	4.97	1.61
	Std. Dev.	9.92	2.73
	Efficiency	65.59%	

Barton Ridge Sed/Fil System - Total Nitrogen (mg/L)



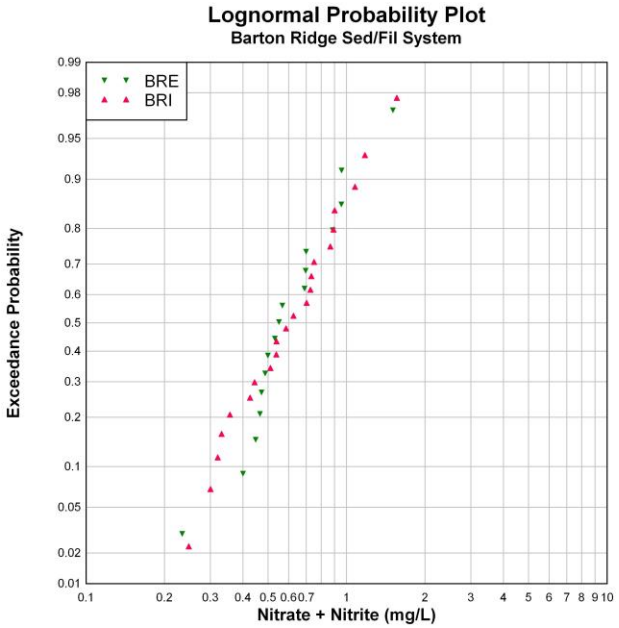


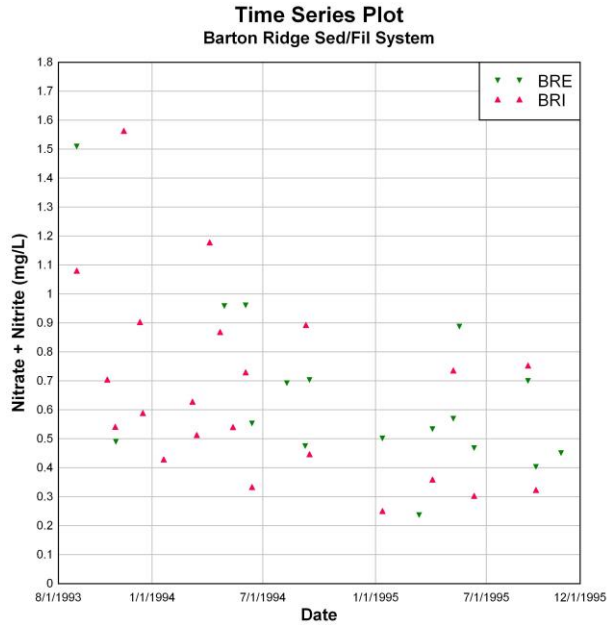


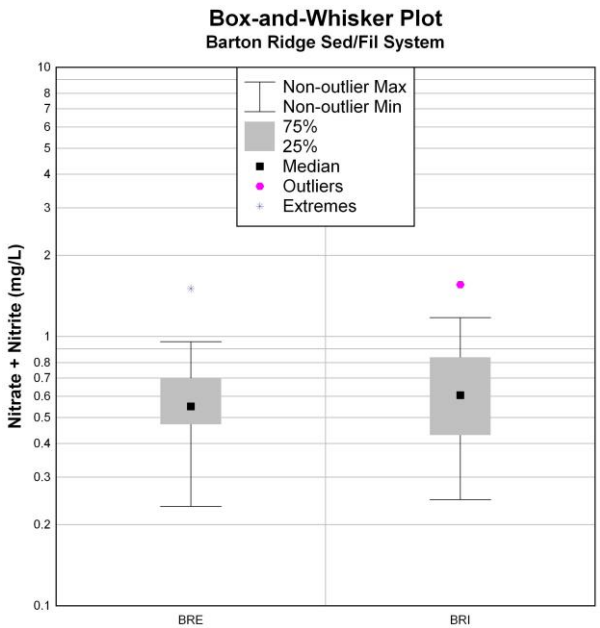


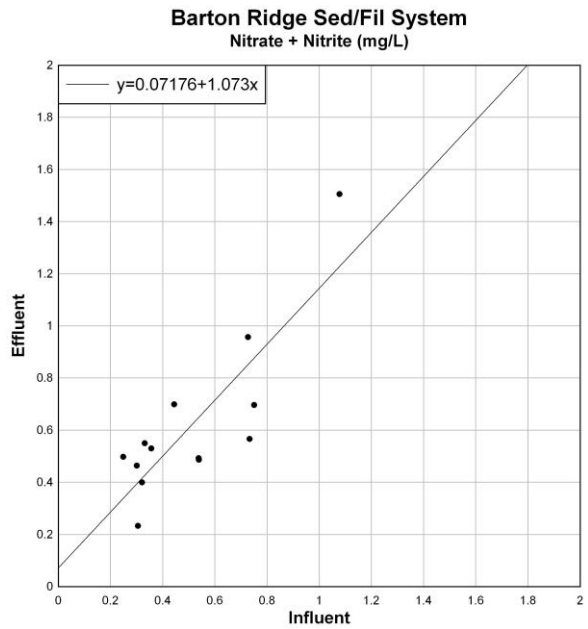
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	22	17
	Pairs Count	11	11
Non-Parametric	Maximum	7.772	3.445
	Upper Quartile	2.610	1.511
	Median	1.839	1.249
	Lower Quartile	1.180	0.817
	Minimum	0.866	0.692
	Efficiency	32.05%	
	Mann-Whitney	0.0155 **	
	Wilcoxon (paired)	0.0098 **	
Arithmetic	UCL	3.366	1.653
	Mean	2.492	1.320
	LCL	1.617	0.987
	Std. Dev.	1.972	0.647
	Wilk (p-value)	0.0001 **	0.0007 **
	Efficiency	47.03%	
	t-Test (equal var.)	0.0243 **	
	t-Test (unequal var.)	0.0146 **	
	t-test (paired)	0.0094 **	
	Levene Test	0.0751 *	
Log Transformed	UCL	3.316	1.629
	Mean	2.425	1.309
	LCL	1.773	1.053
	Std. Dev.	1.661	0.545
	Wilk (p-value)	0.0876 *	0.1923
	Efficiency	46.01%	
	t-Test (equal var.)	0.0080 **	
	t-Test (unequal var.)	0.0053 **	
	t-Test (paired)	0.0139 **	
	Levene Test	0.0988 *	
Bootstrap	UCL	3.346	1.624
	Mean	2.505	1.320
	LCL	1.664	1.016
	Std. Dev.	1.897	0.592
	Efficiency	47.30%	

Barton Ridge Sed/Fil System - Nitrate + Nitrite (mg/L)



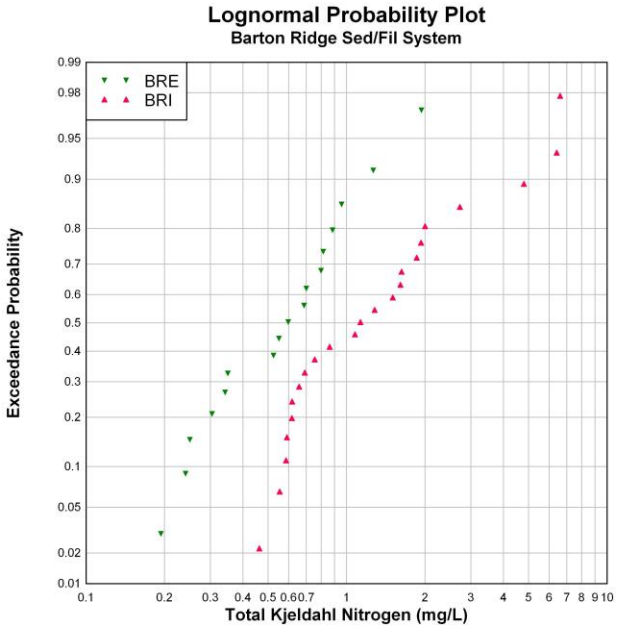


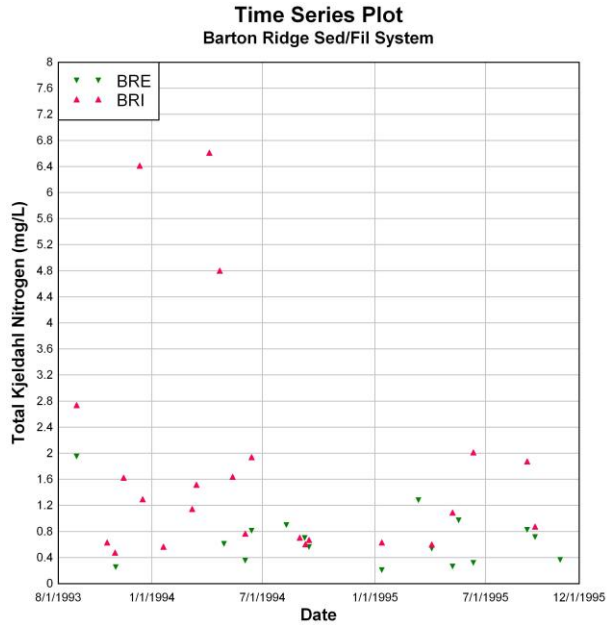


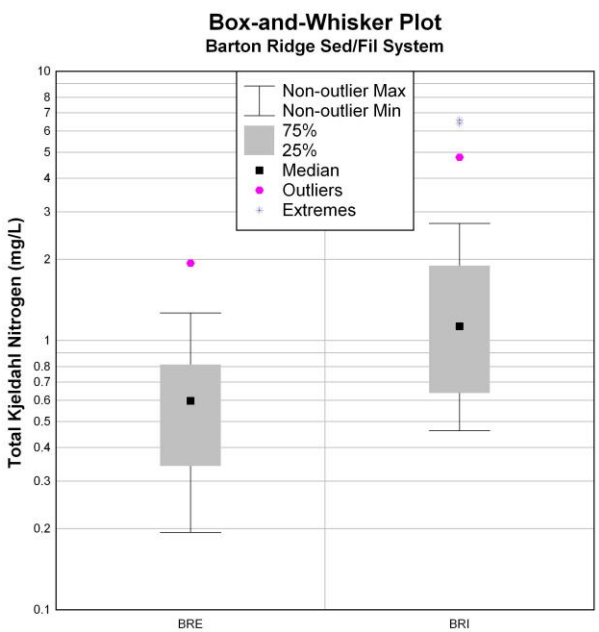


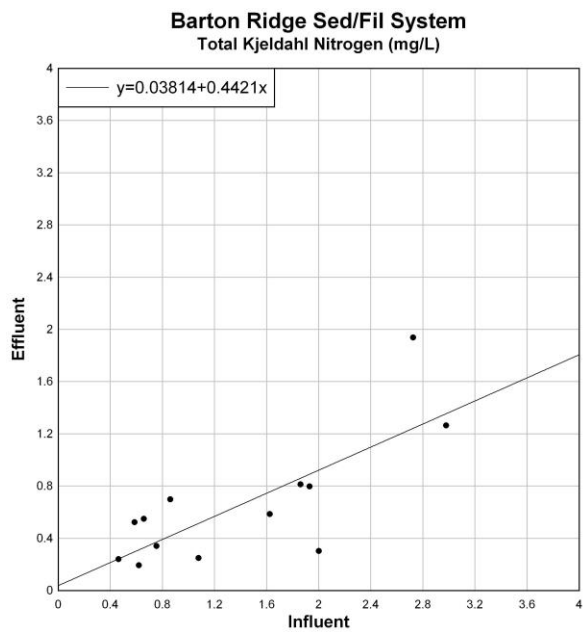
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	22	17
	Pairs Count	11	11
Non-Parametric	Maximum	1.560	1.506
	Upper Quartile	0.865	0.700
	Median	0.605	0.550
	Lower Quartile	0.426	0.472
	Minimum	0.248	0.234
	Efficiency	9.14%	
	Mann-Whitney	0.8549	
	Wilcoxon (paired)	0.0244 **	
Arithmetic	UCL	0.807	0.802
	Mean	0.664	0.649
	LCL	0.520	0.497
	Std. Dev.	0.324	0.296
	Wilk (p-value)	0.0913 *	0.0158 **
	Efficiency	2.14%	
	t-Test (equal var.)	0.8890	
	t-Test (unequal var.)	0.8877	
	t-test (paired)	0.0219 **	
	Levene Test	0.7596	
Log Transformed	UCL	0.832	0.814
	Mean	0.664	0.648
	LCL	0.530	0.516
	Std. Dev.	0.332	0.281
	Wilk (p-value)	0.9617	0.6197
	Efficiency	2.42%	
	t-Test (equal var.)	0.9918	
	t-Test (unequal var.)	0.9917	
	t-Test (paired)	0.0129 **	
	Levene Test	0.5432	
Bootstrap	UCL	0.798	0.792
	Mean	0.661	0.649
	LCL	0.524	0.506
	Std. Dev.	0.310	0.278
	Efficiency	1.81%	

Barton Ridge Sed/Fil System - Total Kjeldahl Nitrogen (mg/L)



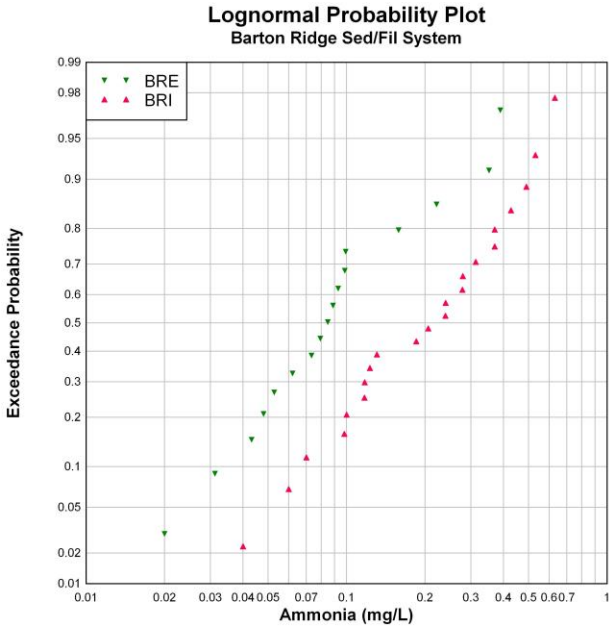


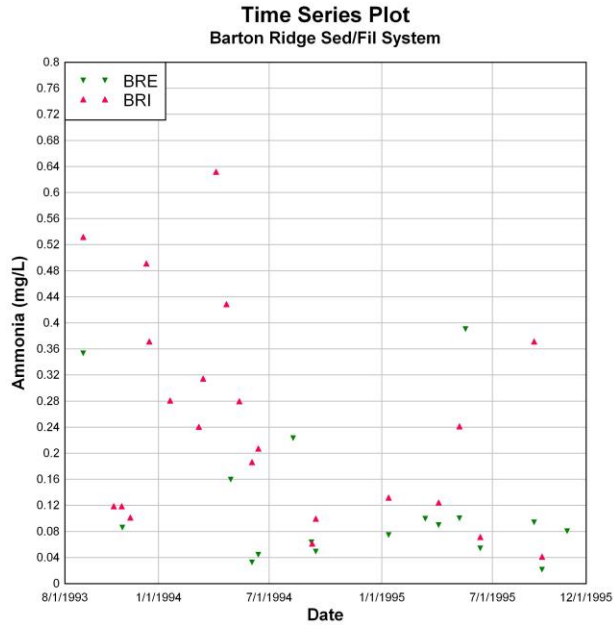


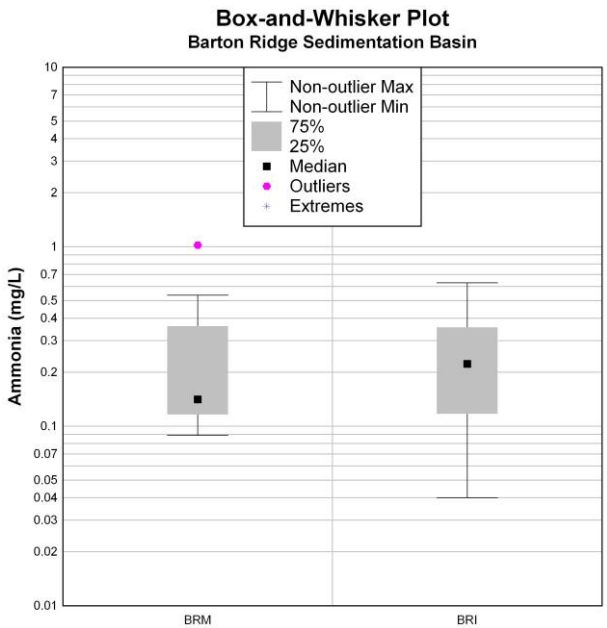


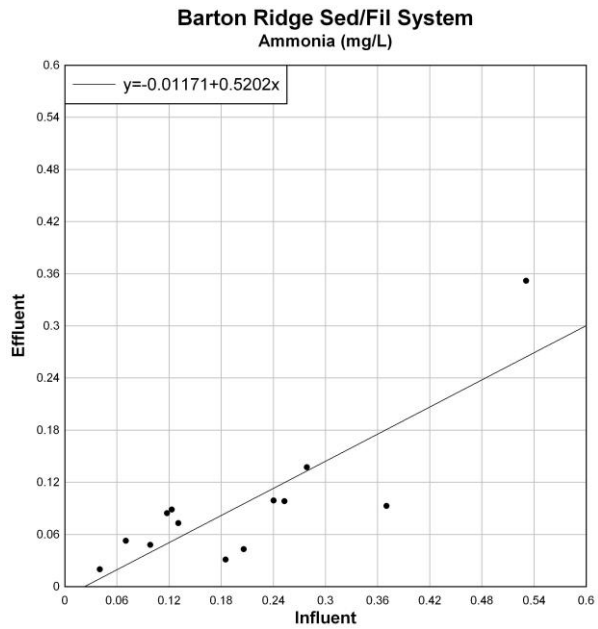
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	23	17
	Pairs Count	11	11
Non-Parametric	Maximum	6.597	1.938
	Upper Quartile	1.929	0.814
	Median	1.131	0.597
	Lower Quartile	0.618	0.342
	Minimum	0.462	0.194
	Efficiency	47.24%	
	Mann-Whitney	0.0061 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	2.545	0.897
	Mean	1.779	0.670
	LCL	1.013	0.444
	Std. Dev.	1.771	0.440
	Wilk (p-value)	0.0001 **	0.0171 **
	Efficiency	62.31%	
	t-Test (equal var.)	0.0162 **	
	t-Test (unequal var.)	0.0079 **	
	t-test (paired)	0.0011 **	
	Levene Test	0.0768 *	
Log Transformed	UCL	2.509	0.959
	Mean	1.698	0.671
	LCL	1.149	0.469
	Std. Dev.	1.476	0.448
	Wilk (p-value)	0.0346 **	0.8517
	Efficiency	60.50%	
	t-Test (equal var.)	0.0010 **	
	t-Test (unequal var.)	0.0007 **	
	t-Test (paired)	0.0008 **	
	Levene Test	0.3102	
Bootstrap	UCL	2.526	0.883
	Mean	1.794	0.671
	LCL	1.061	0.459
	Std. Dev.	1.694	0.412
	Efficiency	62.59%	

Barton Ridge Sed/Fil System - Ammonia (mg/L)



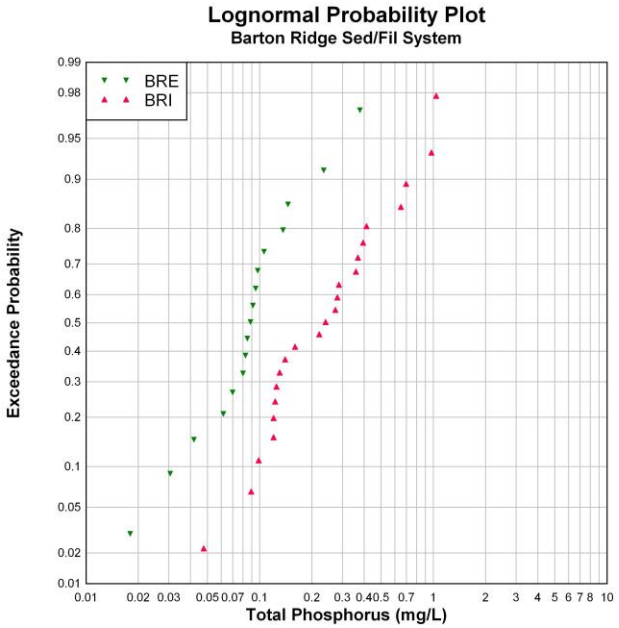


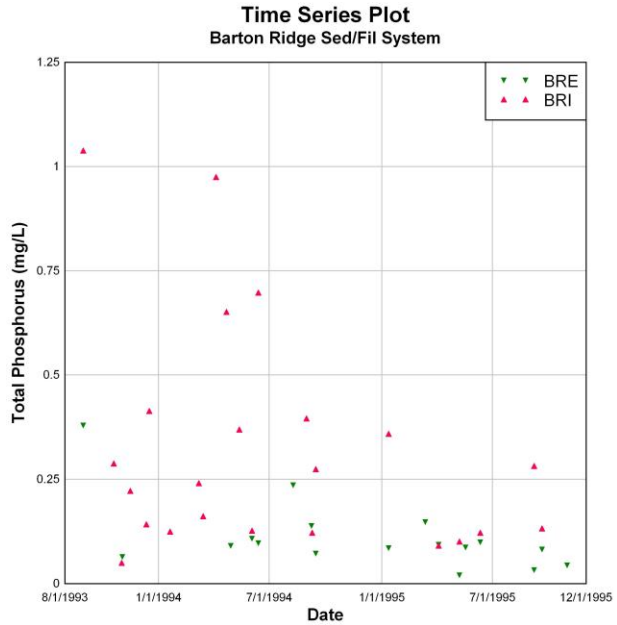


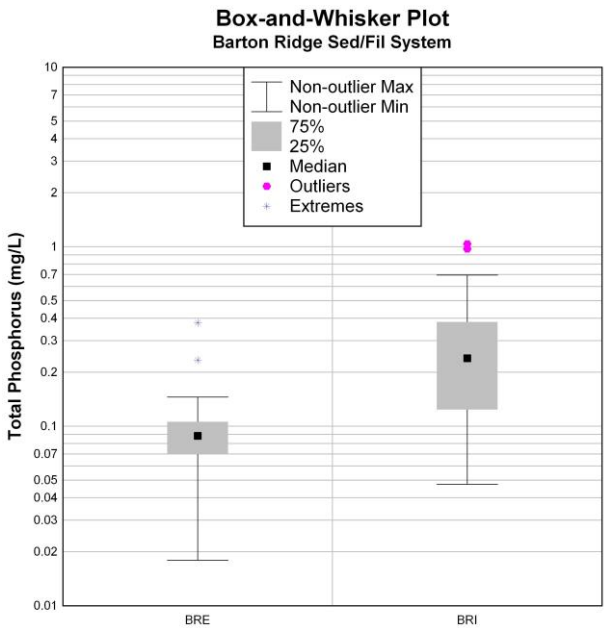


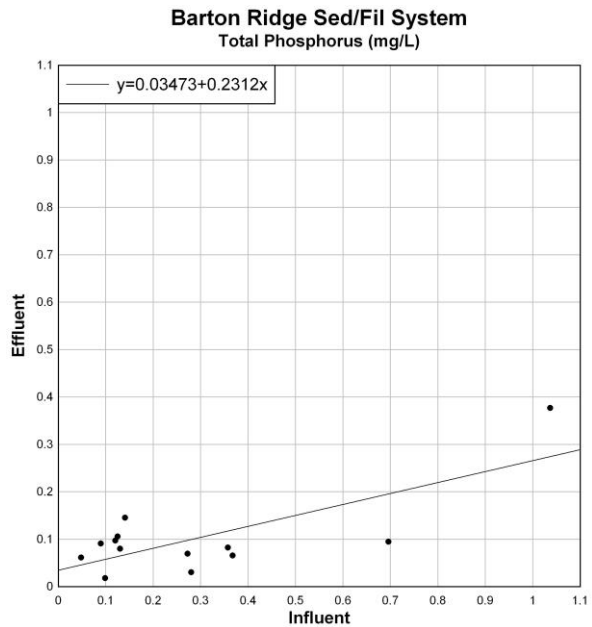
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	22	17
	Pairs Count	11	11
Non-Parametric	Maximum	0.631	0.389
	Upper Quartile	0.370	0.099
	Median	0.223	0.085
	Lower Quartile	0.117	0.053
	Minimum	0.040	0.020
	Efficiency	61.92%	
	Mann-Whitney	0.0053 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	0.320	0.172
	Mean	0.246	0.117
	LCL	0.173	0.062
	Std. Dev.	0.166	0.107
	Wilk (p-value)	0.0848 *	0.0004 **
	Efficiency	52.33%	
	t-Test (equal var.)	0.0084 **	
	t-Test (unequal var.)	0.0057 **	
	t-test (paired)	0.0011 **	
	Levene Test	0.1066	
Log Transformed	UCL	0.370	0.183
	Mean	0.252	0.115
	LCL	0.172	0.072
	Std. Dev.	0.209	0.099
	Wilk (p-value)	0.6604	0.6515
	Efficiency	54.45%	
	t-Test (equal var.)	0.0026 **	
	t-Test (unequal var.)	0.0028 **	
	t-Test (paired)	0.0002 **	
	Levene Test	0.8644	
Bootstrap	UCL	0.318	0.170
	Mean	0.246	0.118
	LCL	0.174	0.066
	Std. Dev.	0.162	0.101
	Efficiency	52.07%	

Barton Ridge Sed/Fil System - Total Phosphorus (mg/L)



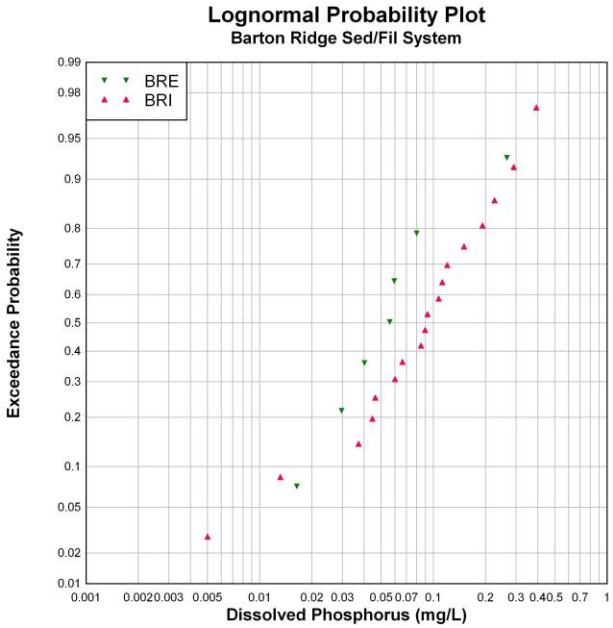


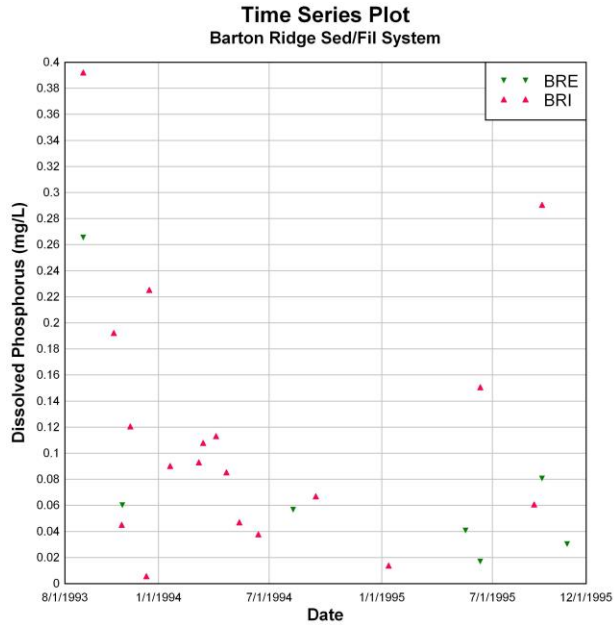


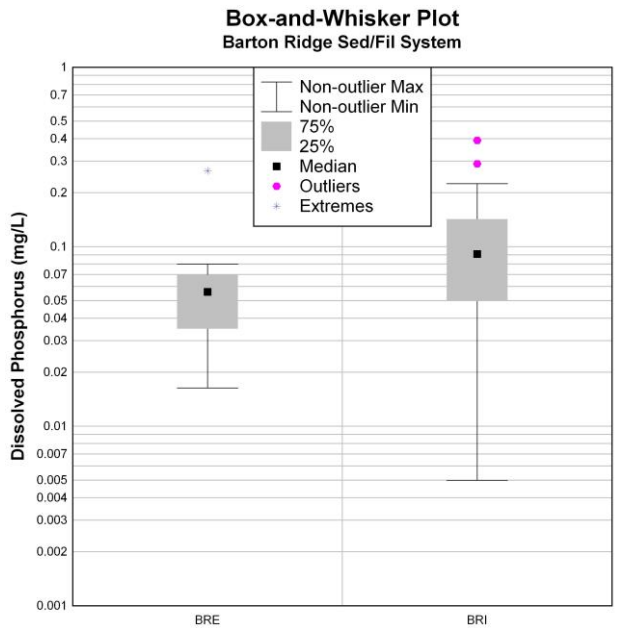


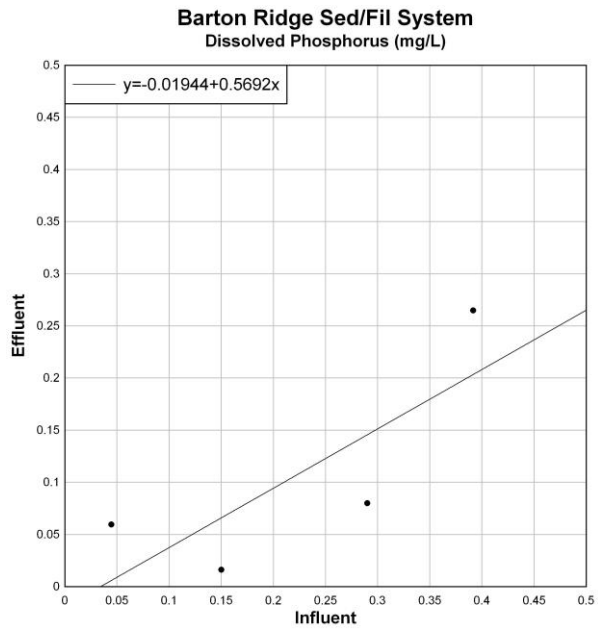
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	23	17
	Pairs Count	11	11
Non-Parametric	Maximum	1.036	0.377
	Upper Quartile	0.394	0.106
	Median	0.239	0.089
	Lower Quartile	0.122	0.070
	Minimum	0.048	0.018
	Efficiency	62.95%	
	Mann-Whitney	0.0007 **	
	Wilcoxon (paired)	0.0020 **	
Arithmetic	UCL	0.437	0.152
	Mean	0.319	0.108
	LCL	0.200	0.065
	Std. Dev.	0.274	0.085
	Wilk (p-value)	0.0004 **	0.0005 **
	Efficiency	66.07%	
	t-Test (equal var.)	0.0042 **	
	t-Test (unequal var.)	0.0018 **	
	t-test (paired)	0.0090 **	
	Levene Test	0.0500 *	
Log Transformed	UCL	0.474	0.163
	Mean	0.317	0.108
	LCL	0.212	0.072
	Std. Dev.	0.284	0.082
	Wilk (p-value)	0.5934	0.4788
	Efficiency	65.84%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0002 **	
	t-Test (paired)	0.0009 **	
	Levene Test	0.5341	
Bootstrap	UCL	0.437	0.148
	Mean	0.322	0.108
	LCL	0.207	0.068
	Std. Dev.	0.265	0.078
	Efficiency	66.49%	

Barton Ridge Sed/Fil System - Dissolved Phosphorus (mg/L)



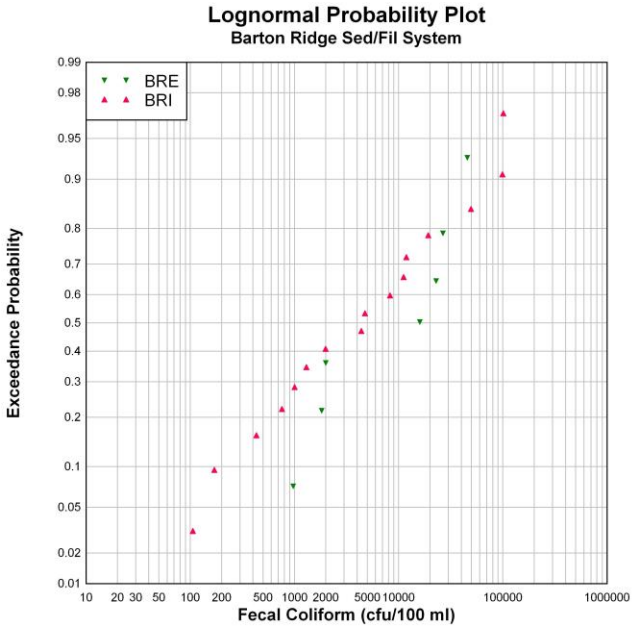


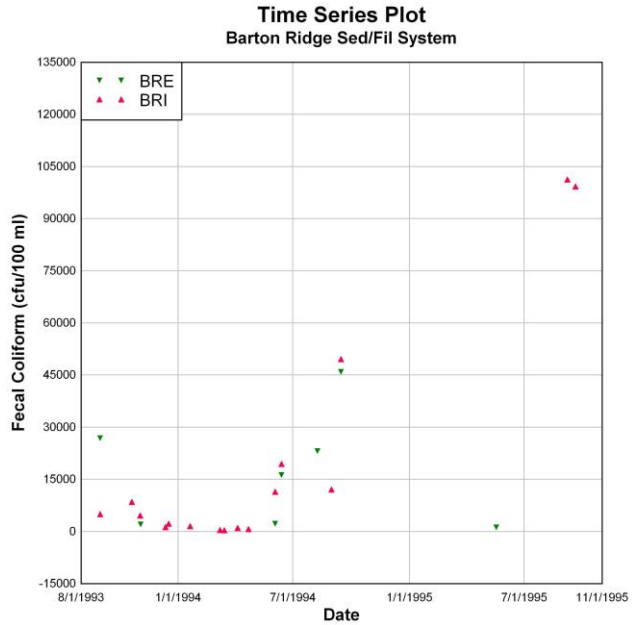


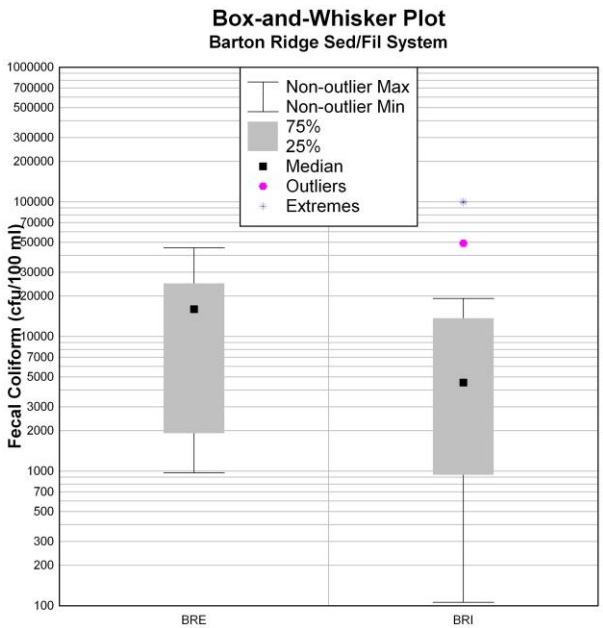


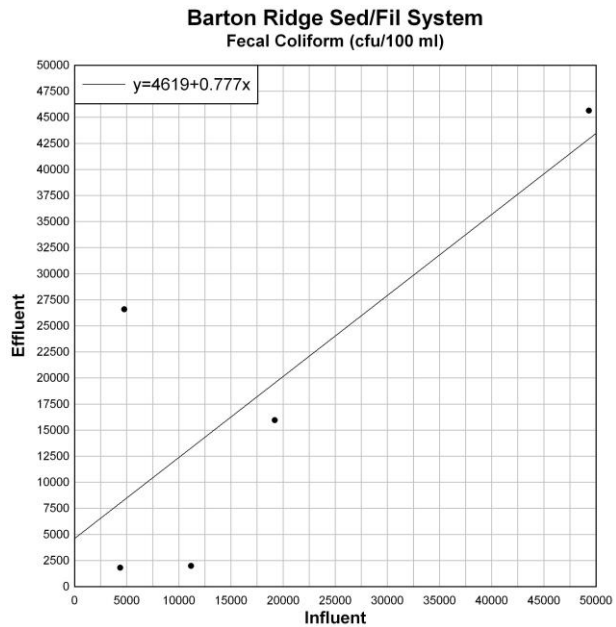
		PARAMETER	DP (mg/L)
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	18	7
	Pairs Count	3	3
Non-Parametric	Maximum	0.391	0.265
	Upper Quartile	0.150	0.080
	Median	0.091	0.056
	Lower Quartile	0.046	0.030
	Minimum	0.005	0.016
	Efficiency	38.44%	
	Mann-Whitney	0.1859	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	0.168	0.157
	Mean	0.118	0.078
	LCL	0.068	0.000
	Std. Dev.	0.101	0.085
	Wilk (p-value)	0.0142 **	0.0029 **
	Efficiency	33.91%	
	t-Test (equal var.)	0.3620	
	t-Test (unequal var.)	0.3338	
	t-test (paired)	0.0278 **	
	Levene Test	0.6543	
Log Transformed	UCL	0.258	0.196
	Mean	0.133	0.074
	LCL	0.068	0.028
	Std. Dev.	0.165	0.066
	Wilk (p-value)	0.2060	0.7981
	Efficiency	44.09%	
	t-Test (equal var.)	0.4112	
	t-Test (unequal var.)	0.3767	
	t-Test (paired)	0.1327	
	Levene Test	0.5920	
Bootstrap	UCL	0.167	0.141
	Mean	0.119	0.078
	LCL	0.071	0.014
	Std. Dev.	0.096	0.069
	Efficiency	34.77%	

Barton Ridge Sed/Fil System - Fecal Coliform (cfu/100 ml)



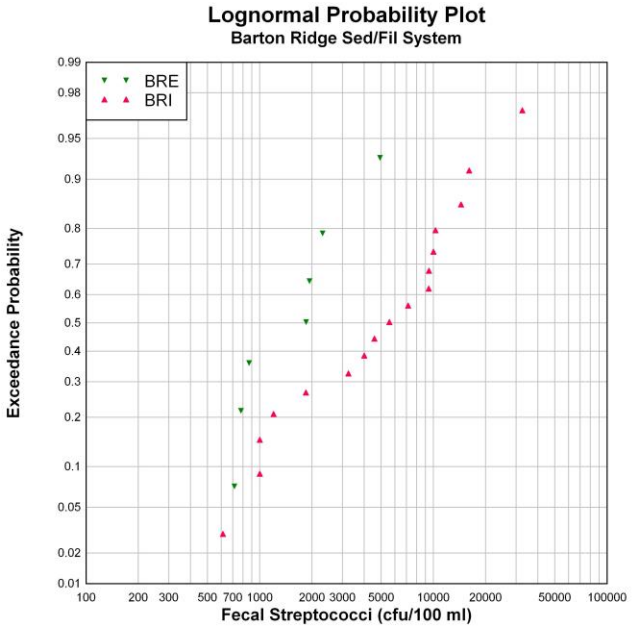


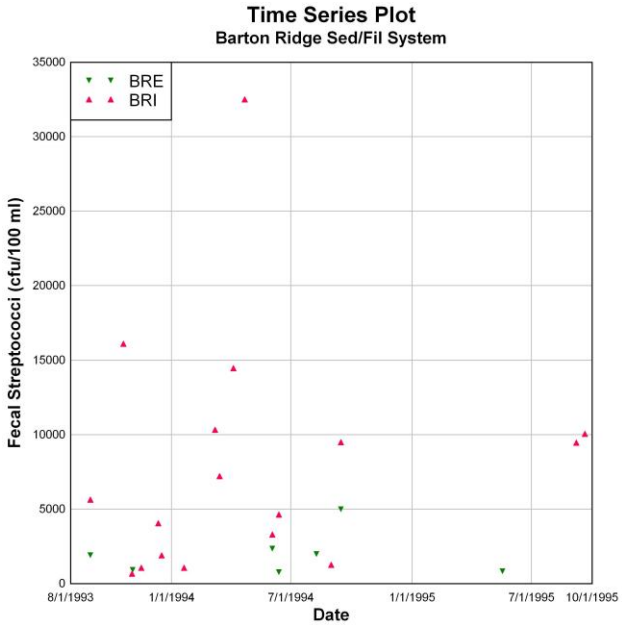


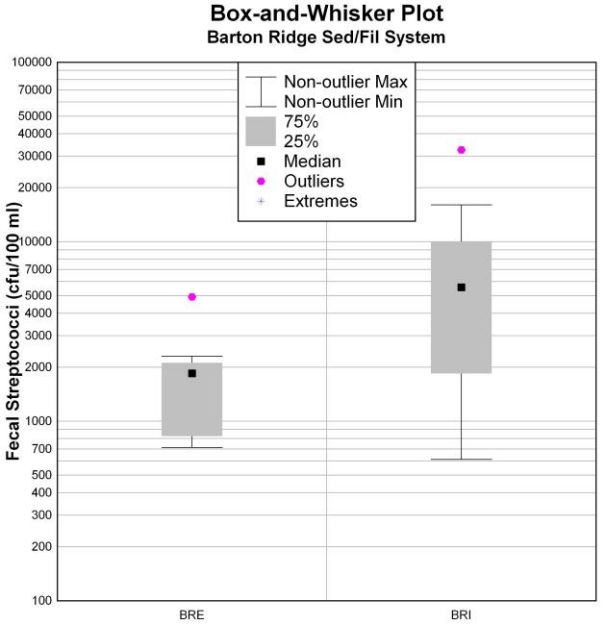


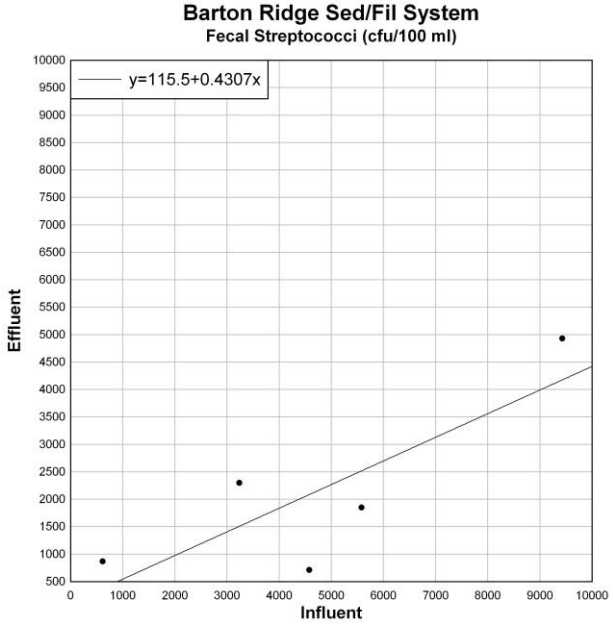
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	16	7
	Pairs Count	4	4
Non-Parametric	Maximum	101,000	45,657
	Upper Quartile	15,520	26,609
	Median	4,554	15,969
	Lower Quartile	880	1,827
	Minimum	106	973
	Efficiency	-250.68%	
	Mann-Whitney	0.4504	
	Wilcoxon (paired)	0.8750	
Arithmetic	UCL	37,597	31,951
	Mean	19,663	16,565
	LCL	1,730	1,180
	Std. Dev.	33,662	16,635
	Wilk (p-value)	0.0001 **	0.2432
	Efficiency	15.76%	
	t-Test (equal var.)	0.8208	
	t-Test (unequal var.)	0.7710	
	t-test (paired)	0.8467	
	Levene Test	0.3218	
Log Transformed	UCL	204,882	184,361
	Mean	25,945	19,568
	LCL	3,286	2,077
	Std. Dev.	87,964	31,615
	Wilk (p-value)	0.8100	0.1694
	Efficiency	24.58%	
	t-Test (equal var.)	0.4609	
	t-Test (unequal var.)	0.4097	
	t-Test (paired)	0.9338	
	Levene Test	0.2384	
Bootstrap	UCL	37,333	30,234
	Mean	20,306	16,507
	LCL	3,278	2,779
	Std. Dev.	31,955	14,843
	Efficiency	18.71%	

Barton Ridge Sed/Fil System - Fecal Streptococci (cfu/100 ml)



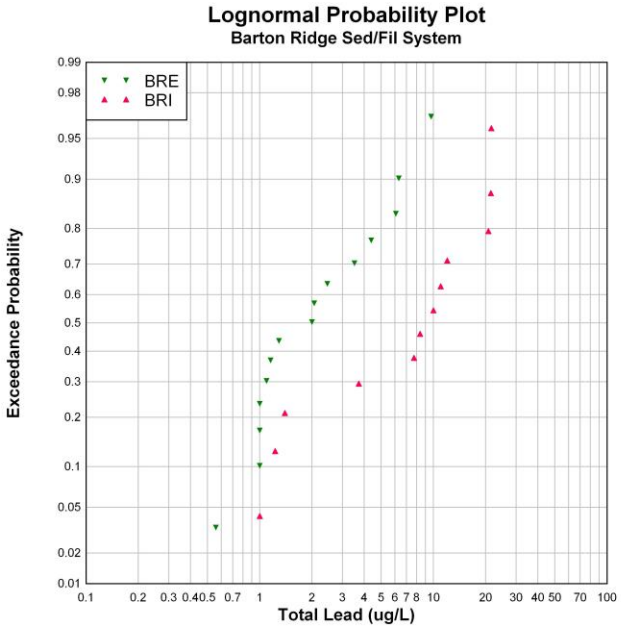


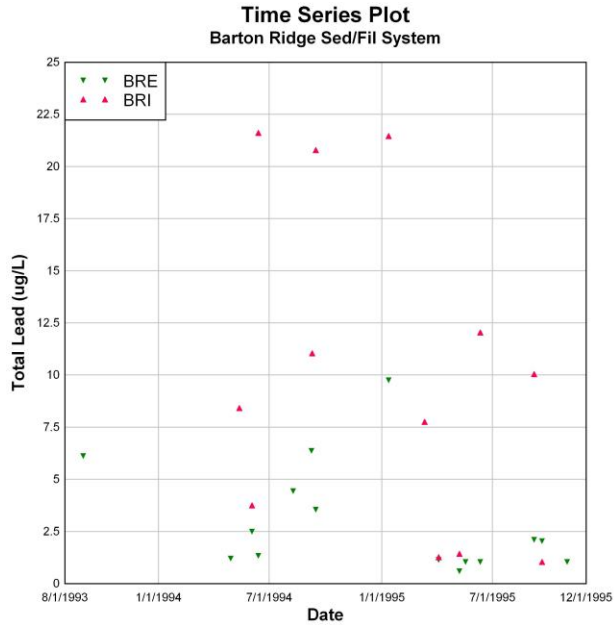


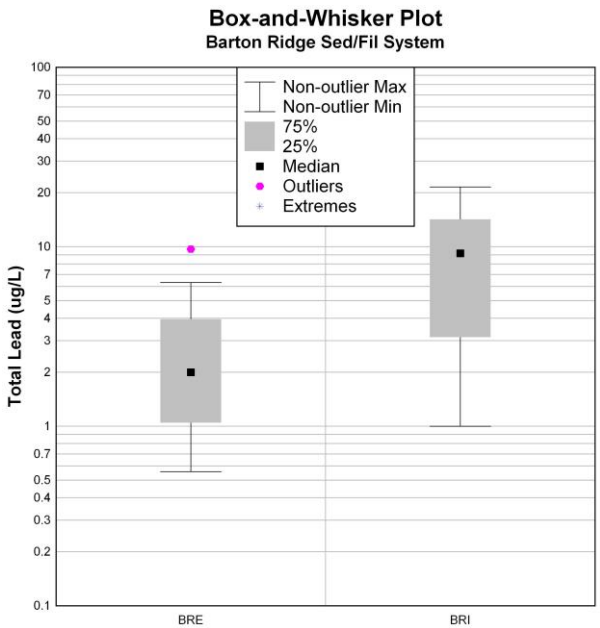


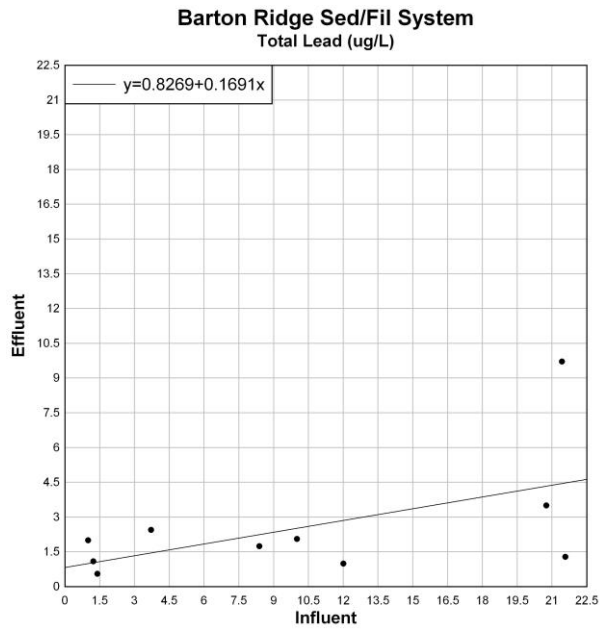
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	17	7
	Pairs Count	4	4
Non-Parametric	Maximum	32,450	4,932
	Upper Quartile	10,000	2,301
	Median	5,575	1,851
	Lower Quartile	1,845	781
	Minimum	613	714
	Efficiency	66.79%	
	Mann-Whitney	0.0473 **	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	11,860	3,277
	Mean	7,776	1,912
	LCL	3,691	546
	Std. Dev.	7,943	1,476
	Wilk (p-value)	0.0018 **	0.0431 **
	Efficiency	75.41%	
	t-Test (equal var.)	0.0686 *	
	t-Test (unequal var.)	0.0089 **	
	t-test (paired)	0.0260 **	
	Levene Test	0.3058	
Log Transformed	UCL	17,897	3,949
	Mean	8,375	1,884
	LCL	3,919	898
	Std. Dev.	11,297	1,343
	Wilk (p-value)	0.4916	0.3784
	Efficiency	77.51%	
	t-Test (equal var.)	0.0262 **	
	t-Test (unequal var.)	0.0096 **	
	t-Test (paired)	0.0579 *	
	Levene Test	0.1308	
Bootstrap	UCL	11,606	3,084
	Mean	7,815	1,913
	LCL	4,025	742
	Std. Dev.	7,373	1,266
	Efficiency	75.52%	

Barton Ridge Sed/Fil System - Total Lead (ug/L)



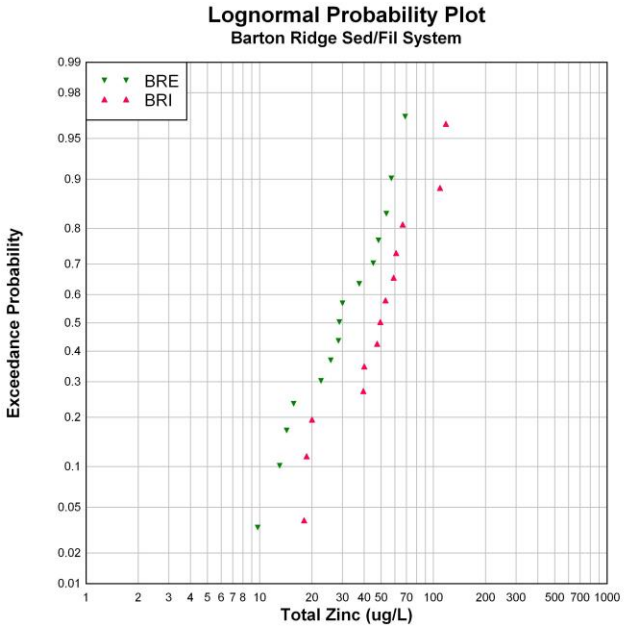


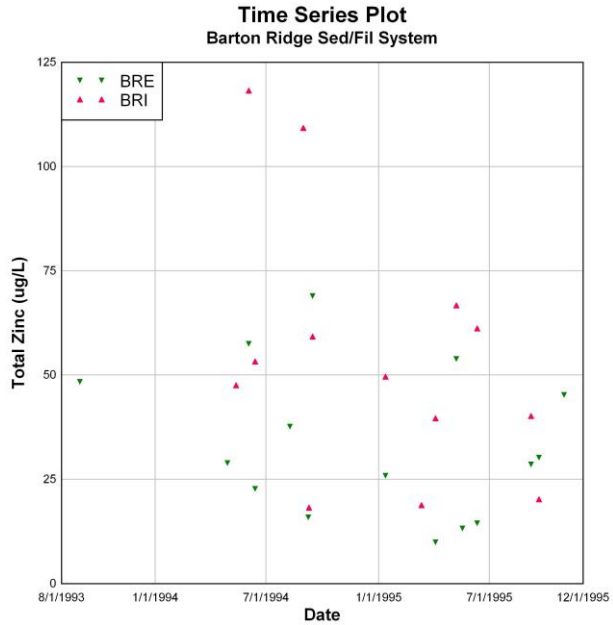


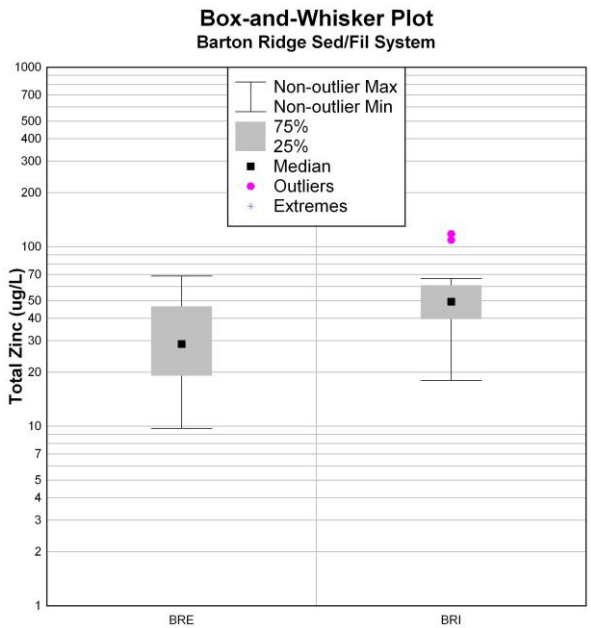


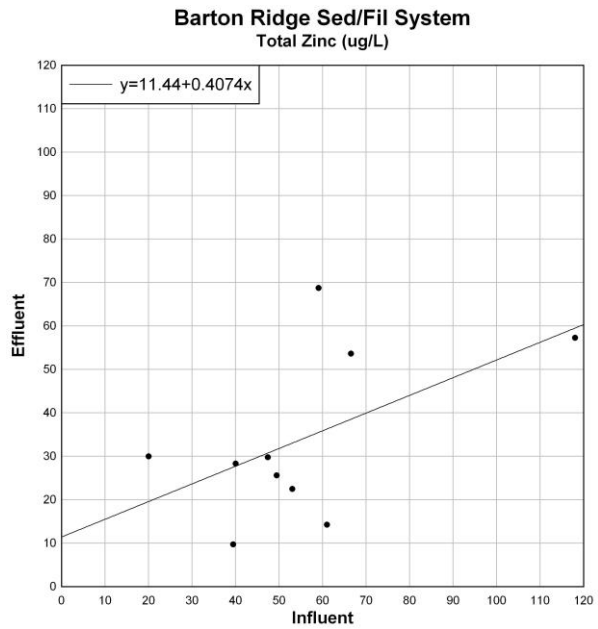
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	12	15
	Pairs Count	10	10
Non-Parametric	Maximum	21.6	9.7
	Upper Quartile	16.4	4.4
	Median	9.2	2.0
	Lower Quartile	2.6	1.0
	Minimum	1.0	0.6
	Efficiency	78.23%	
	Mann-Whitney	0.0156 **	
	Wilcoxon (paired)	0.0098 **	
Arithmetic	UCL	15.0	4.4
	Mean	10.0	2.9
	LCL	5.1	1.4
	Std. Dev.	7.8	2.6
	Wilk (p-value)	0.0893 *	0.0039 **
	Efficiency	70.96%	
	t-Test (equal var.)	0.0027 **	
	t-Test (unequal var.)	0.0096 **	
	t-test (paired)	0.0103 **	
	Levene Test	0.0019 **	
Log Transformed	UCL	29.0	4.9
	Mean	11.3	2.9
	LCL	4.4	1.7
	Std. Dev.	14.5	2.6
	Wilk (p-value)	0.0540 *	0.3482
	Efficiency	74.80%	
	t-Test (equal var.)	0.0061 **	
	t-Test (unequal var.)	0.0089 **	
	t-Test (paired)	0.0073 **	
	Levene Test	0.1664	
Bootstrap	UCL	14.6	4.3
	Mean	9.9	2.9
	LCL	5.2	1.5
	Std. Dev.	7.3	2.5
	Efficiency	70.79%	

Barton Ridge Sed/Fil System - Total Zinc (ug/L)



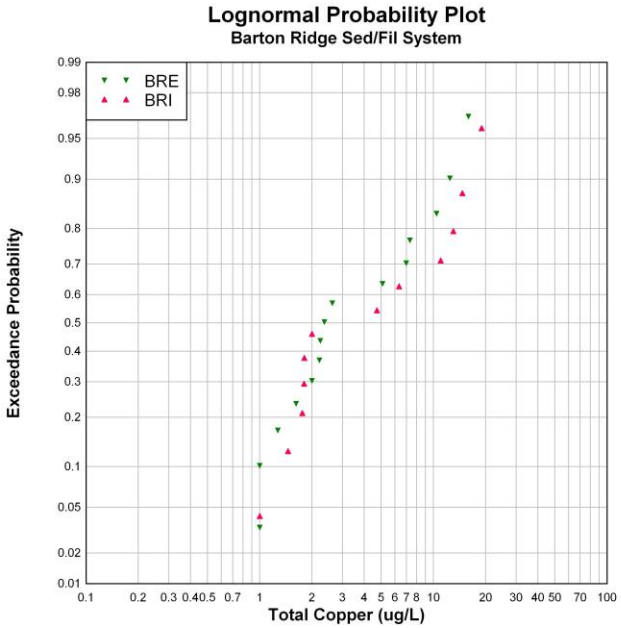


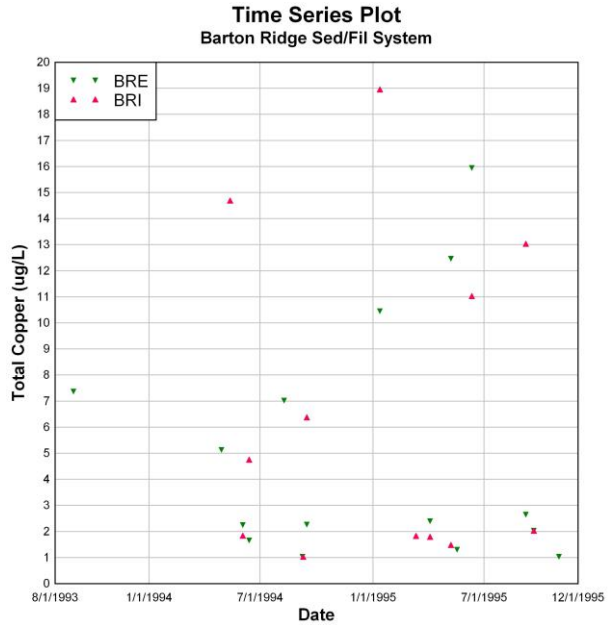


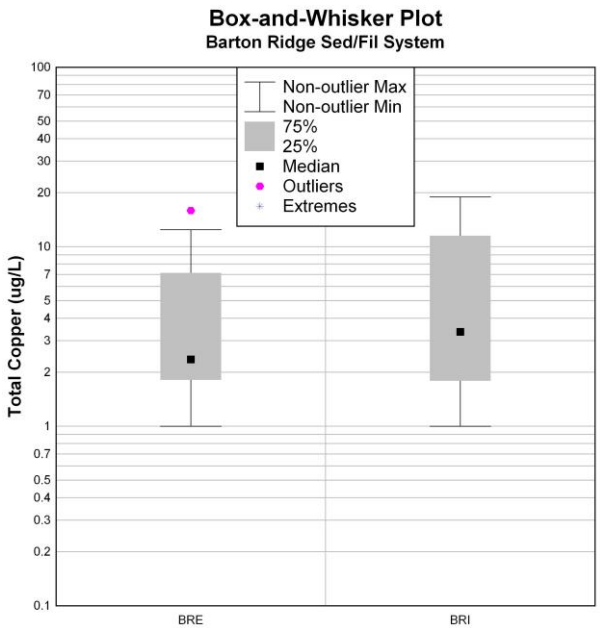


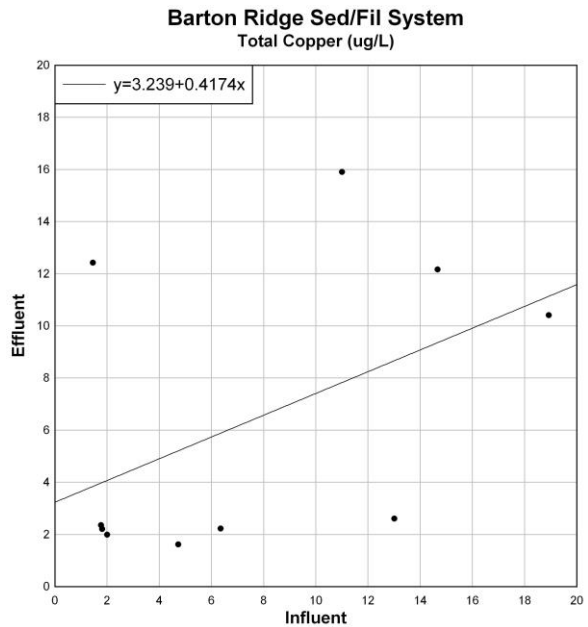
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	13	15
	Pairs Count	10	10
Non-Parametric	Maximum	118.0	68.8
	Upper Quartile	61.0	48.2
	Median	49.4	28.7
	Lower Quartile	39.4	15.7
	Minimum	18.0	9.7
	Efficiency	41.96%	
	Mann-Whitney	0.0697 *	
	Wilcoxon (paired)	0.0098 **	
Arithmetic	UCL	72.5	43.1
	Mean	53.8	33.2
	LCL	35.1	23.3
	Std. Dev.	31.0	17.9
	Wilk (p-value)	0.0799 *	0.4313
	Efficiency	38.26%	
	t-Test (equal var.)	0.0378 **	
	t-Test (unequal var.)	0.0488 **	
	t-test (paired)	0.0142 **	
	Levene Test	0.1051	
Log Transformed	UCL	80.9	48.0
	Mean	54.2	33.6
	LCL	36.4	23.5
	Std. Dev.	34.1	20.8
	Wilk (p-value)	0.2717	0.6871
	Efficiency	38.10%	
	t-Test (equal var.)	0.0456 **	
	t-Test (unequal var.)	0.0462 **	
	t-Test (paired)	0.0168 **	
	Levene Test	0.9422	
Bootstrap	UCL	70.4	42.8
	Mean	53.0	33.2
	LCL	35.6	23.6
	Std. Dev.	28.8	17.3
	Efficiency	37.41%	

Barton Ridge Sed/Fil System - Total Copper (ug/L)



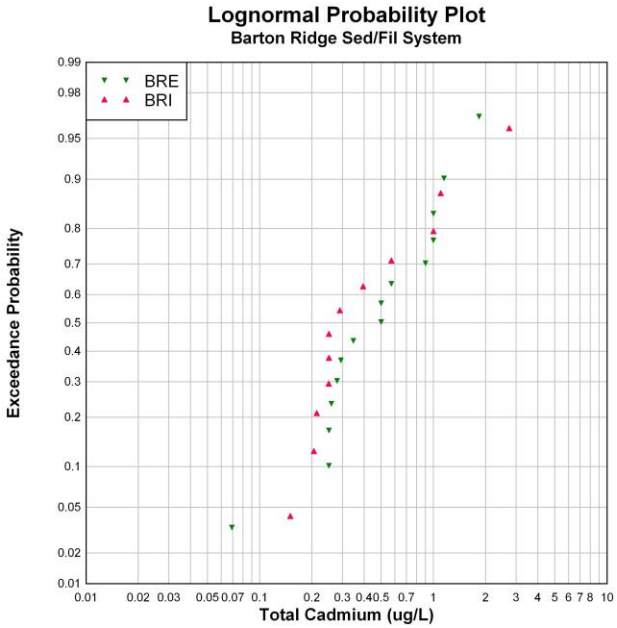


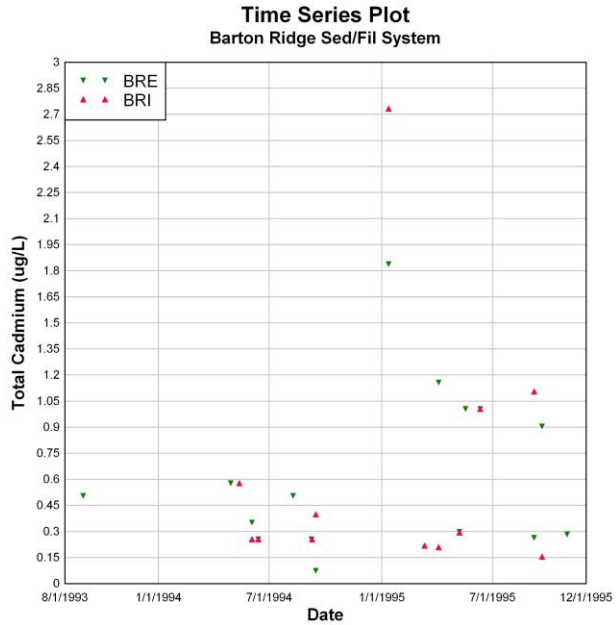


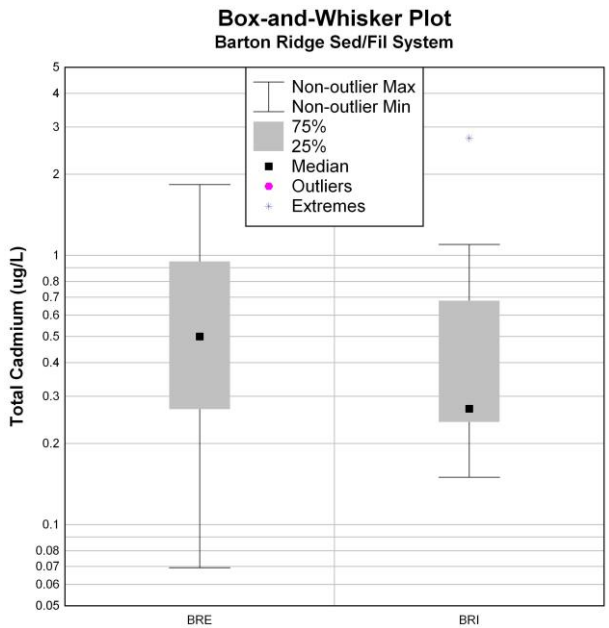


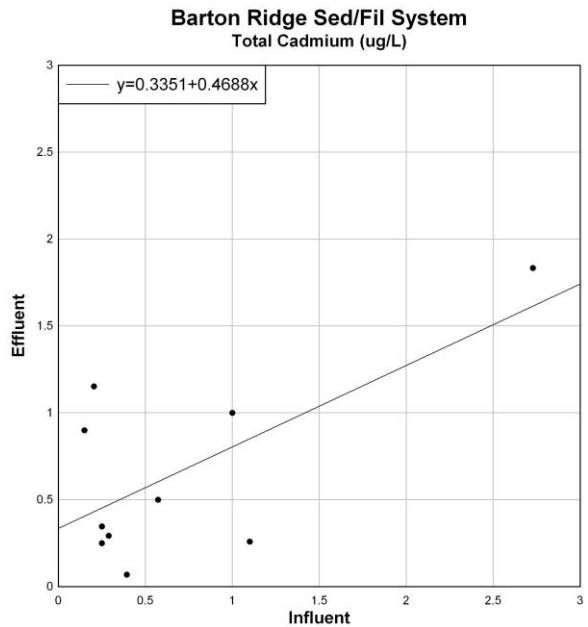
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	12	15
	Pairs Count	10	10
Non-Parametric	Maximum	18.9	15.9
	Upper Quartile	12.0	7.3
	Median	3.4	2.4
	Lower Quartile	1.8	1.6
	Minimum	1.0	1.0
	Efficiency	29.77%	
	Mann-Whitney	0.7536	
	Wilcoxon (paired)	0.6250	
Arithmetic	UCL	10.5	7.6
	Mean	6.5	5.0
	LCL	2.6	2.4
	Std. Dev.	6.2	4.7
	Wilk (p-value)	0.0177 **	0.0046 **
	Efficiency	24.06%	
	t-Test (equal var.)	0.4613	
	t-Test (unequal var.)	0.4772	
	t-test (paired)	0.5646	
	Levene Test	0.2766	
Log Transformed	UCL	15.4	9.1
	Mean	6.6	4.9
	LCL	2.8	2.6
	Std. Dev.	7.7	5.0
	Wilk (p-value)	0.1036	0.1995
	Efficiency	25.66%	
	t-Test (equal var.)	0.6069	
	t-Test (unequal var.)	0.6127	
	t-Test (paired)	0.6634	
	Levene Test	0.4484	
Bootstrap	UCL	10.3	7.4
	Mean	6.5	4.9
	LCL	2.8	2.5
	Std. Dev.	5.9	4.4
	Efficiency	24.59%	

Barton Ridge Sed/Fil System - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: BRI**	**EFF: BRE**
	Site Count	12	15
	Pairs Count	10	10
Non-Parametric	Maximum	2.7	1.8
	Upper Quartile	0.8	1.0
	Median	0.3	0.5
	Lower Quartile	0.2	0.3
	Minimum	0.2	0.1
	Efficiency	-85.53%	
	Mann-Whitney	0.3377	
	Wilcoxon (paired)	0.9102	
Arithmetic	UCL	1.1	0.9
	Mean	0.6	0.6
	LCL	0.1	0.4
	Std. Dev.	0.7	0.5
	Wilk (p-value)	0.0003 **	0.0244 **
	Efficiency	0.50%	
	t-Test (equal var.)	0.9896	
	t-Test (unequal var.)	0.9901	
	t-test (paired)	0.8604	
	Levene Test	0.4063	
Log Transformed	UCL	1.1	1.1
	Mean	0.6	0.6
	LCL	0.3	0.4
	Std. Dev.	0.5	0.6
	Wilk (p-value)	0.0768 *	0.4776
	Efficiency	-11.11%	
	t-Test (equal var.)	0.7078	
	t-Test (unequal var.)	0.7094	
	t-Test (paired)	0.9695	
	Levene Test	0.9096	
Bootstrap	UCL	1.0	0.9
	Mean	0.6	0.6
	LCL	0.2	0.4
	Std. Dev.	0.6	0.4
	Efficiency	0.30%	

Barton Ridge Sand Filter (BRM-BRE)

The Barton Ridge sand filter is a portion of the Barton Ridge sedimentation/filtration system. Runoff entered the sand filter after pretreatment in a sedimentation basin.

For a performance summary of the Barton Ridge sedimentation/filtration system (BRI-BRE), see the summary elsewhere in the Sand Filter section.

Performance Summary

The Barton Ridge Plaza sand filter had the best performance with the reductions of the concentrations of TSS (76%) and VSS (71%) and these are significant in all cases, paired or not paired.

COD and BOD concentrations were reduced by 70% and 72% respectively, and were significant in all cases. The reduction (69%) in TOC concentration was only significant if data are paired.

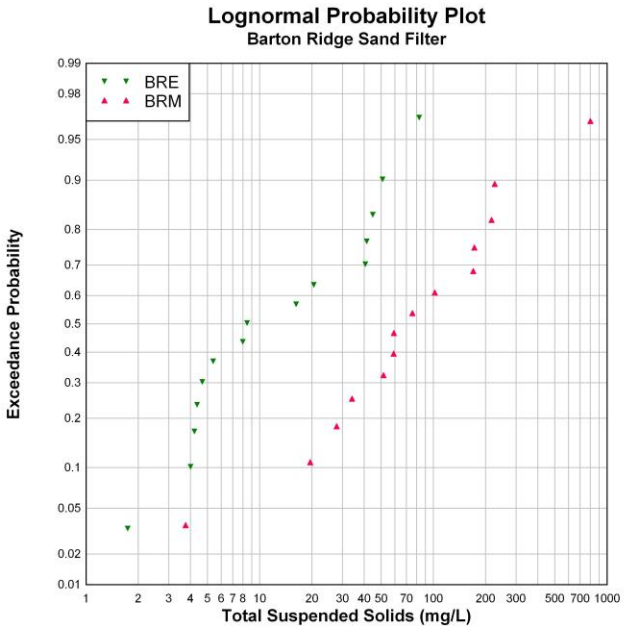
The reduction of concentration in total nitrogen (47%) was not significant in any case. Nitrate + nitrite concentration was increased by 0% and only significant if data are paired. The reduction of concentration in total Kjeldahl nitrogen (63%) was only significant if data are not paired and the reduction of concentration in ammonia (57%) was significant in any case.

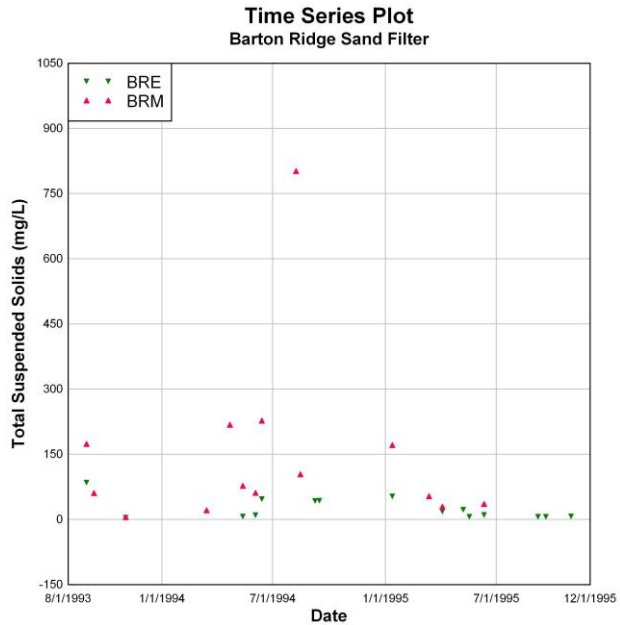
TP and DP concentrations were reduced by 56% and 38% respectively and were not significant in any case.

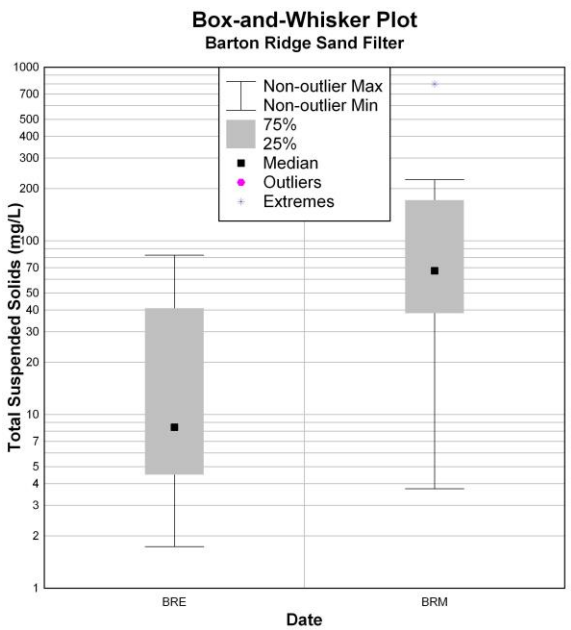
The increase of FCOL (12%) concentration was not significant in any case. The reduction of concentration in FSTR (72%) was only significant if data are paired.

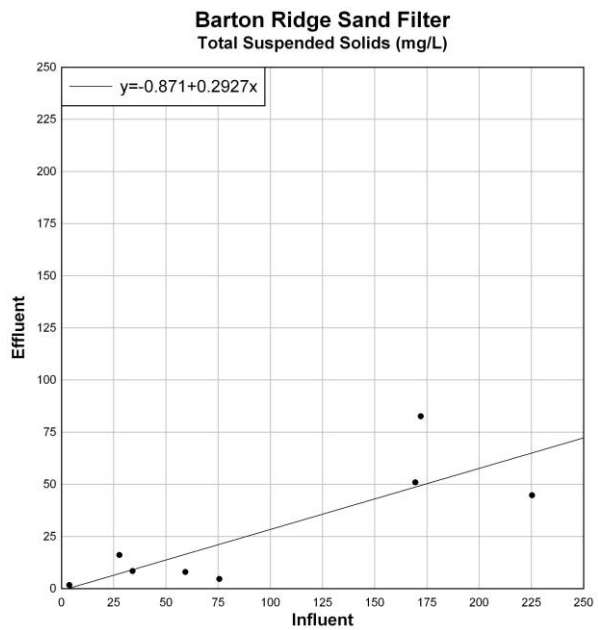
Lead concentration was reduced by 71 and was significant in all cases. Zinc, copper and cadmium concentrations were reduced by 47%, 46% and 21% respectively, and were not significant in all case.

Barton Ridge Sand Filter - Total Suspended Solids (mg/L)



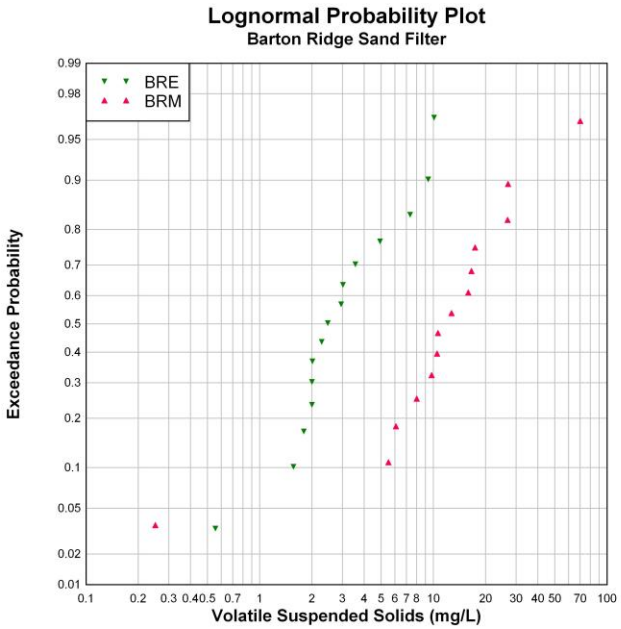


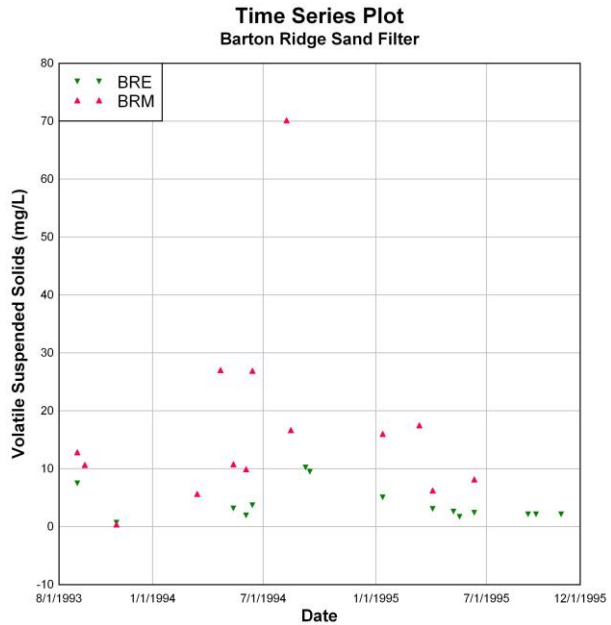


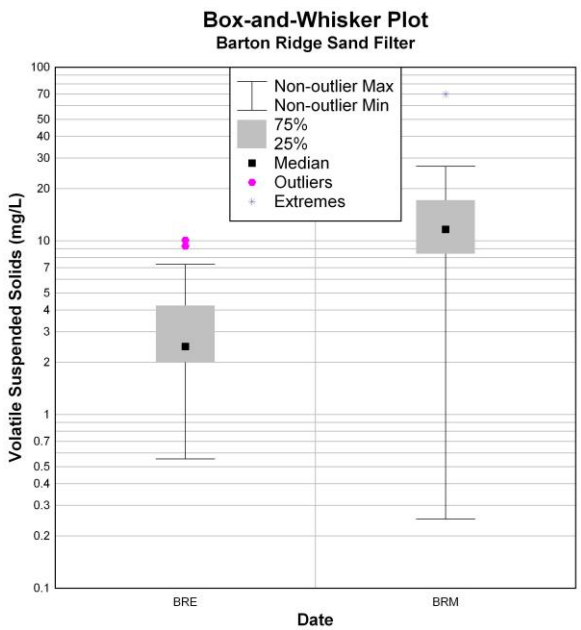


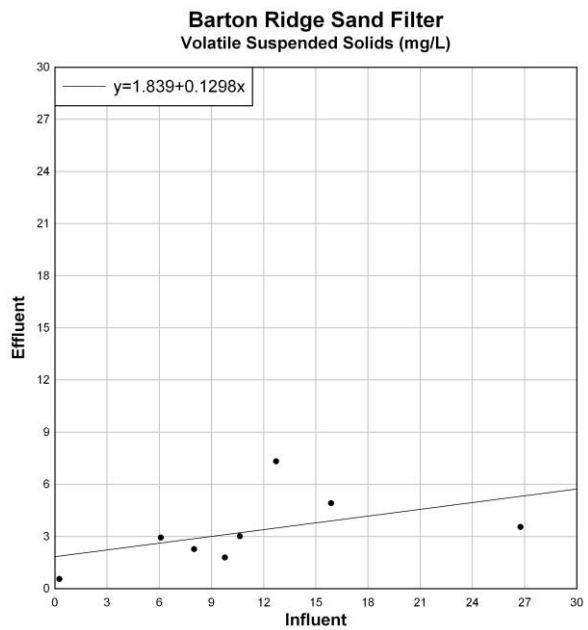
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	13	15
	Pairs Count	8	8
Non-Parametric	Maximum	225.3	82.7
	Upper Quartile	169.4	41.2
	Median	59.2	8.5
	Lower Quartile	34.0	4.4
	Minimum	3.7	1.7
	Efficiency	85.71%	
	Mann-Whitney	0.0073 **	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	139.7	35.8
	Mean	93.5	22.5
	LCL	47.2	9.2
	Std. Dev.	76.5	24.1
	Wilk (p-value)	0.0683 *	0.0043 **
	Efficiency	75.92%	
	t-Test (equal var.)	0.0021 **	
	t-Test (unequal var.)	0.0063 **	
	t-test (paired)	0.0144 **	
	Levene Test	0.0020 **	
Log Transformed	UCL	267.8	55.7
	Mean	107.9	23.2
	LCL	43.5	9.7
	Std. Dev.	141.8	32.6
	Wilk (p-value)	0.1956	0.2407
	Efficiency	78.47%	
	t-Test (equal var.)	0.0014 **	
	t-Test (unequal var.)	0.0014 **	
	t-Test (paired)	0.0013 **	
	Levene Test	0.8685	
Bootstrap	UCL	138.2	35.1
	Mean	94.2	22.5
	LCL	50.3	9.9
	Std. Dev.	72.7	22.7
	Efficiency	76.15%	

Barton Ridge Sand Filter - Volatile Suspended Solids (mg/L)



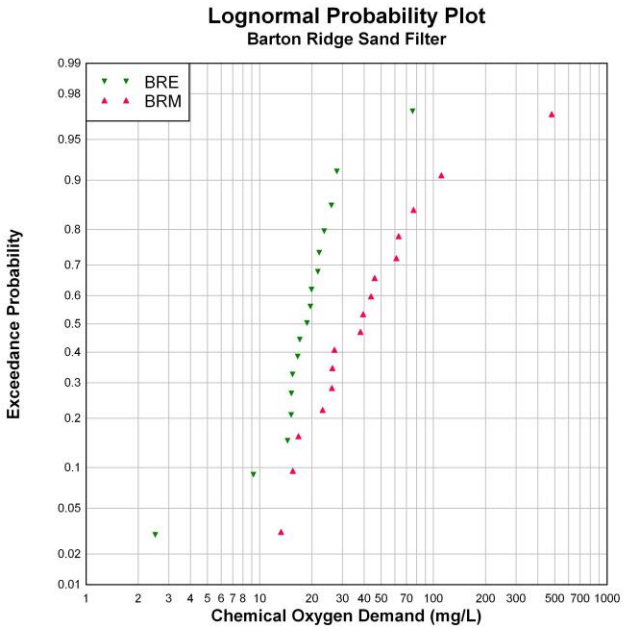


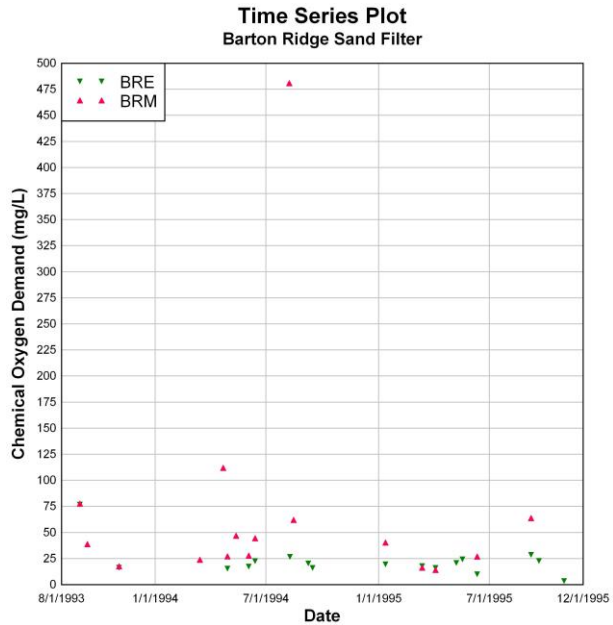


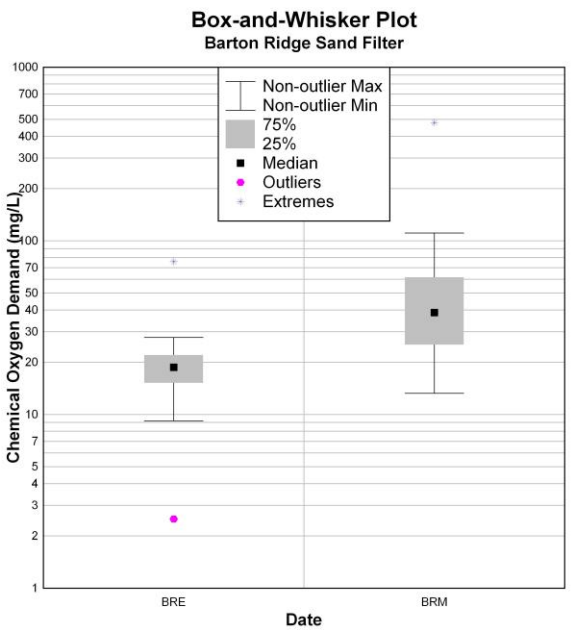


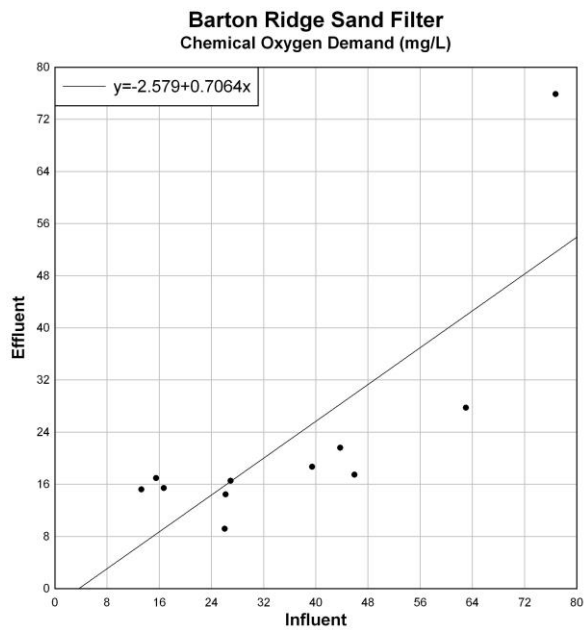
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	13	15
	Pairs Count	8	8
Non-Parametric	Maximum	26.9	10.1
	Upper Quartile	16.5	4.9
	Median	10.6	2.5
	Lower Quartile	8.0	2.0
	Minimum	.3	.6
	Efficiency	76.77%	
	Mann-Whitney	0.0023 **	
	Wilcoxon (paired)	0.0156 **	
Arithmetic	UCL	17.6	5.3
	Mean	12.8	3.7
	LCL	8.1	2.1
	Std. Dev.	7.8	2.9
	Wilk (p-value)	0.4689	0.0036 **
	Efficiency	70.98%	
	t-Test (equal var.)	0.0003 **	
	t-Test (unequal var.)	0.0013 **	
	t-test (paired)	0.0149 **	
	Levene Test	0.0189 **	
Log Transformed	UCL	44.2	6.0
	Mean	17.0	3.7
	LCL	6.6	2.3
	Std. Dev.	23.3	3.0
	Wilk (p-value)	0.0007 **	0.3532
	Efficiency	78.09%	
	t-Test (equal var.)	0.0044 **	
	t-Test (unequal var.)	0.0068 **	
	t-Test (paired)	0.0144 **	
	Levene Test	0.4143	
Bootstrap	UCL	17.4	5.3
	Mean	12.9	3.7
	LCL	8.5	2.2
	Std. Dev.	7.4	2.8
	Efficiency	71.05%	

Barton Ridge Sand Filter - Chemical Oxygen Demand (mg/L)



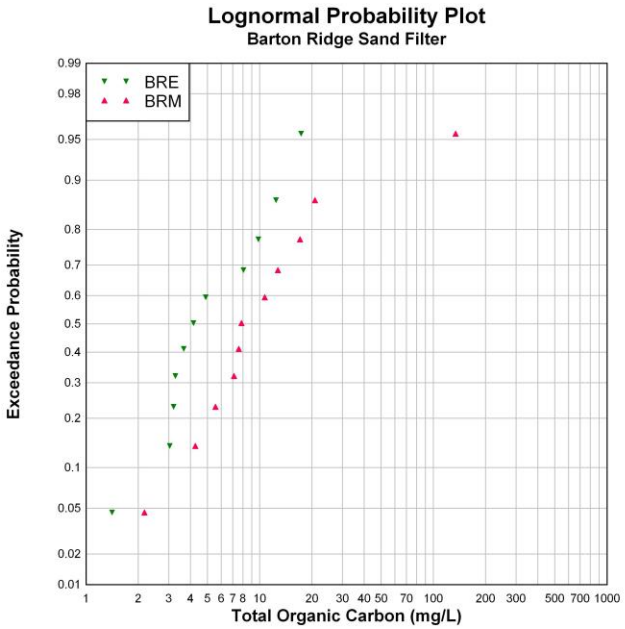


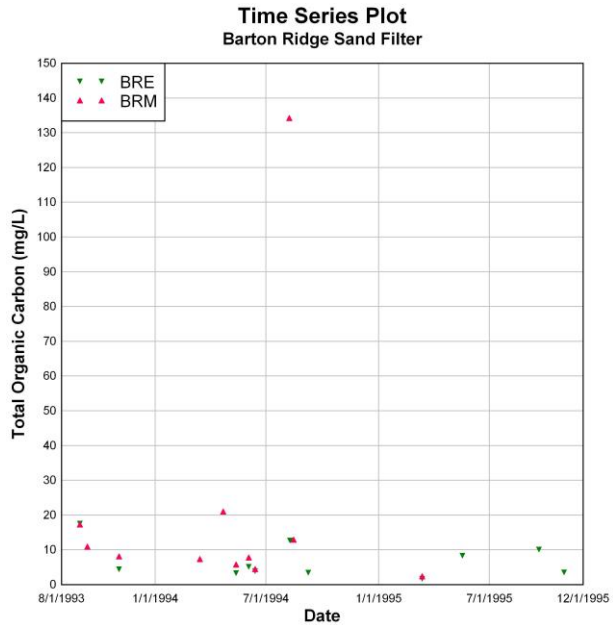


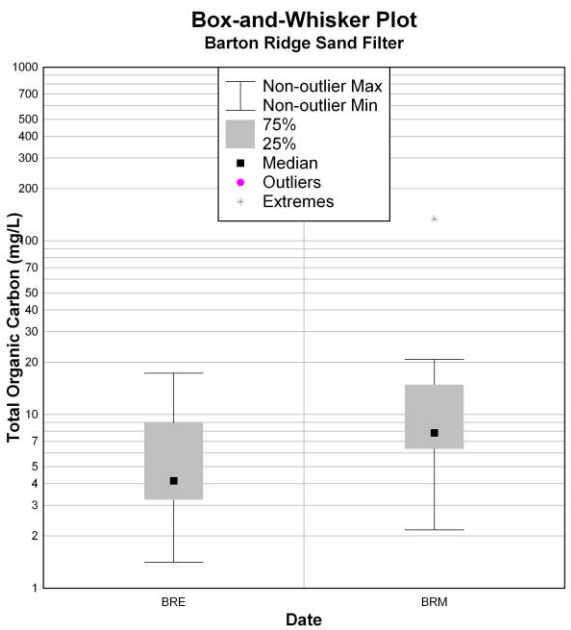


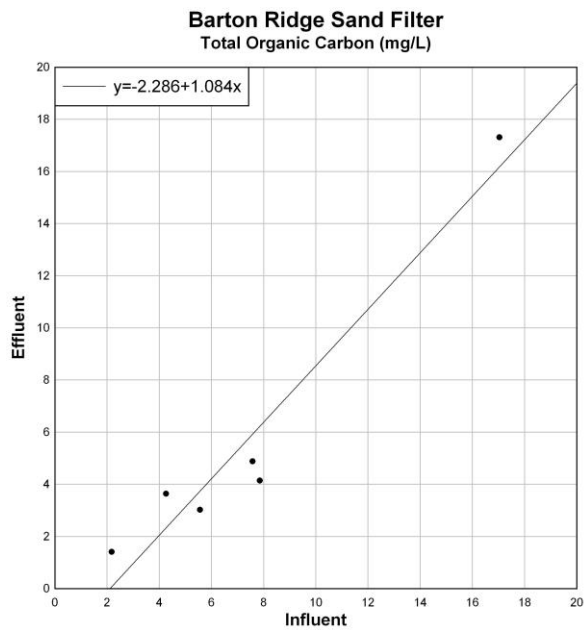
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	16	17
	Pairs Count	11	11
Non-Parametric	Maximum	480.00	75.89
	Upper Quartile	62.08	22.00
	Median	38.70	18.72
	Lower Quartile	24.50	15.23
	Minimum	13.24	2.50
	Efficiency	51.63%	
	Mann-Whitney	0.0051 **	
	Wilcoxon (paired)	0.0186 **	
Arithmetic	UCL	129.14	29.08
	Mean	69.16	21.20
	LCL	9.18	13.32
	Std. Dev.	112.59	15.32
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	69.34%	
	t-Test (equal var.)	0.0916 *	
	t-Test (unequal var.)	0.1112	
	t-test (paired)	0.0066 **	
	Levene Test	0.2590	
Log Transformed	UCL	103.51	31.53
	Mean	59.02	21.59
	LCL	33.65	14.78
	Std. Dev.	57.87	15.22
	Wilk (p-value)	0.0803 *	0.0041 **
	Efficiency	63.42%	
	t-Test (equal var.)	0.0037 **	
	t-Test (unequal var.)	0.0043 **	
	t-Test (paired)	0.0048 **	
	Levene Test	0.4677	
Bootstrap	UCL	121.00	28.15
	Mean	70.01	21.19
	LCL	19.02	14.24
	Std. Dev.	95.69	13.52
	Efficiency	69.73%	

Barton Ridge Sand Filter - Total Organic Carbon (mg/L)



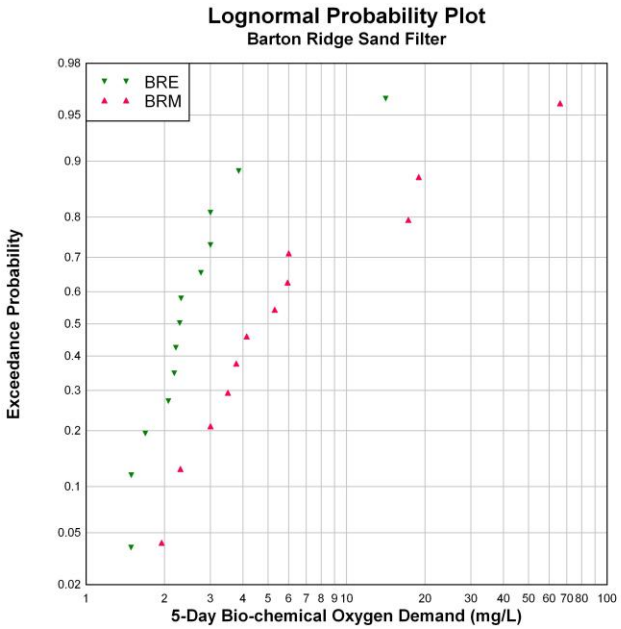


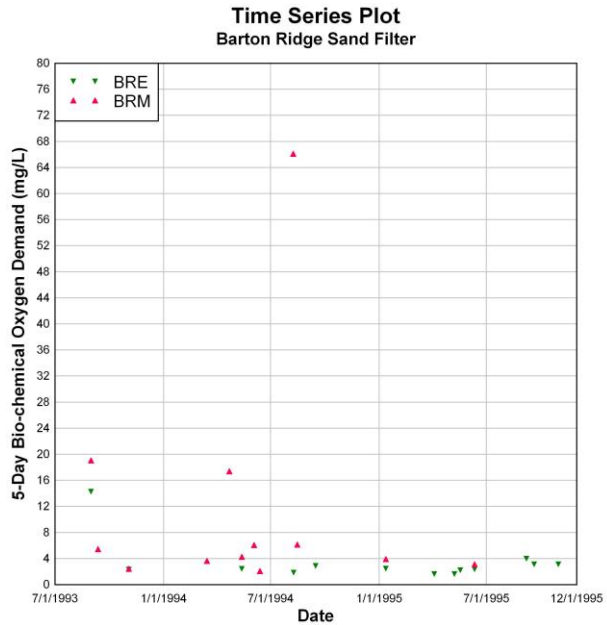


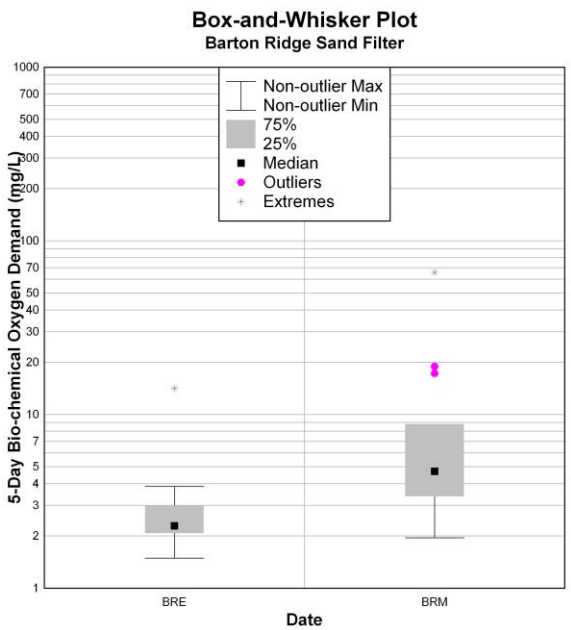


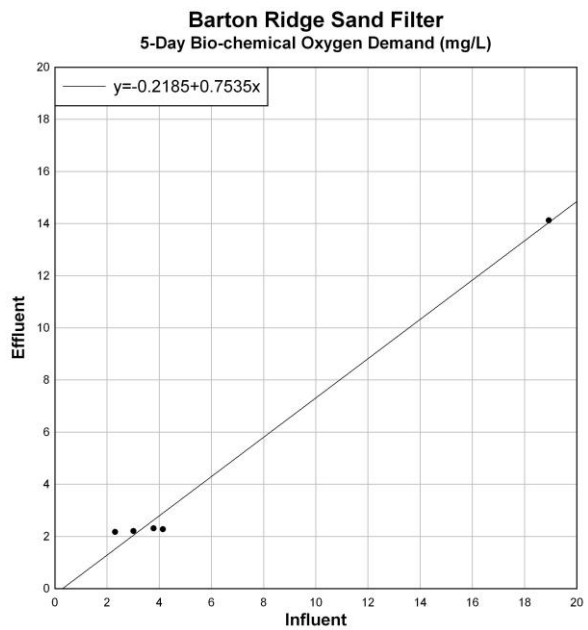
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	11	11
	Pairs Count	6	6
Non-Parametric	Maximum	134.00	17.32
	Upper Quartile	17.03	9.82
	Median	7.85	4.15
	Lower Quartile	5.56	3.19
	Minimum	2.17	1.41
	Efficiency	47.12%	
	Mann-Whitney	0.1156	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	46.36	9.77
	Mean	20.88	6.47
	LCL	-4.59	3.17
	Std. Dev.	37.92	4.91
	Wilk (p-value)	0.0001 **	0.0392 **
	Efficiency	69.01%	
	t-Test (equal var.)	0.2257	
	t-Test (unequal var.)	0.2388	
	t-test (paired)	0.0442 **	
	Levene Test	0.2767	
Log Transformed	UCL	41.79	11.32
	Mean	16.86	6.45
	LCL	6.81	3.67
	Std. Dev.	19.64	4.98
	Wilk (p-value)	0.2184	0.7116
	Efficiency	61.77%	
	t-Test (equal var.)	0.0829 *	
	t-Test (unequal var.)	0.0847 *	
	t-Test (paired)	0.0161 **	
	Levene Test	0.4001	
Bootstrap	UCL	41.38	9.45
	Mean	20.77	6.43
	LCL	0.16	3.41
	Std. Dev.	30.68	4.49
	Efficiency	69.06%	

Barton Ridge Sand Filter - 5-Day Bio-chemical Oxygen Demand (mg/L)



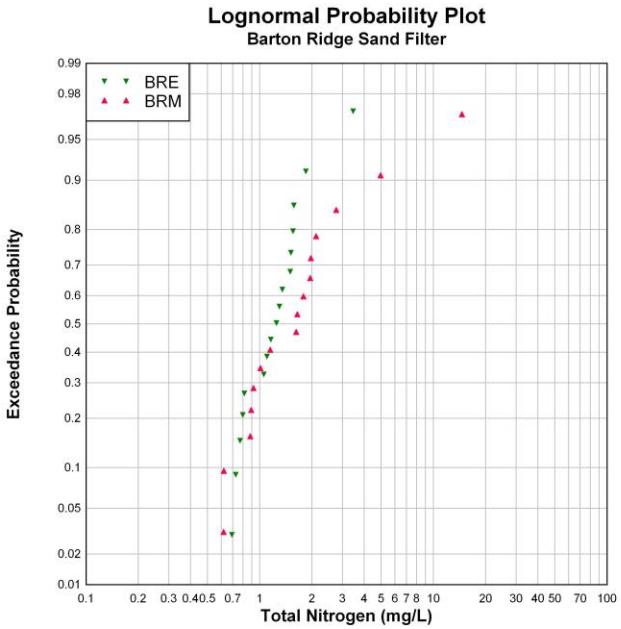


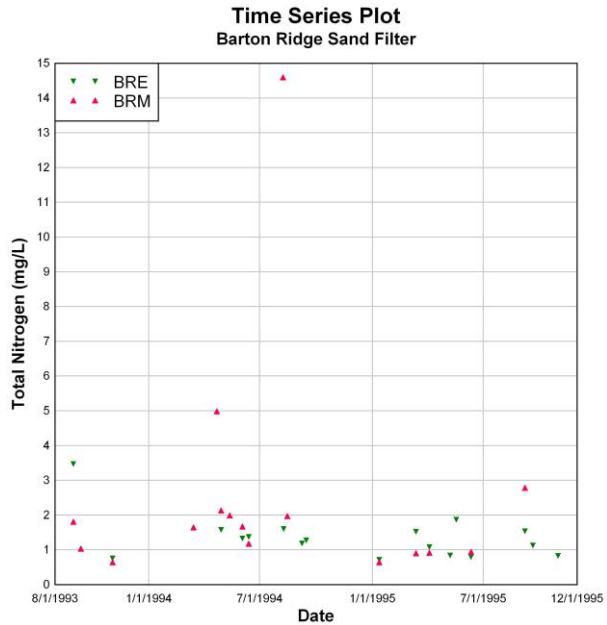


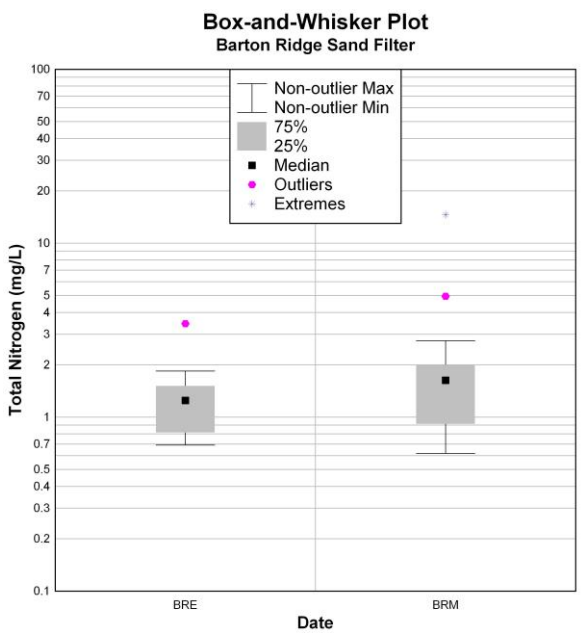


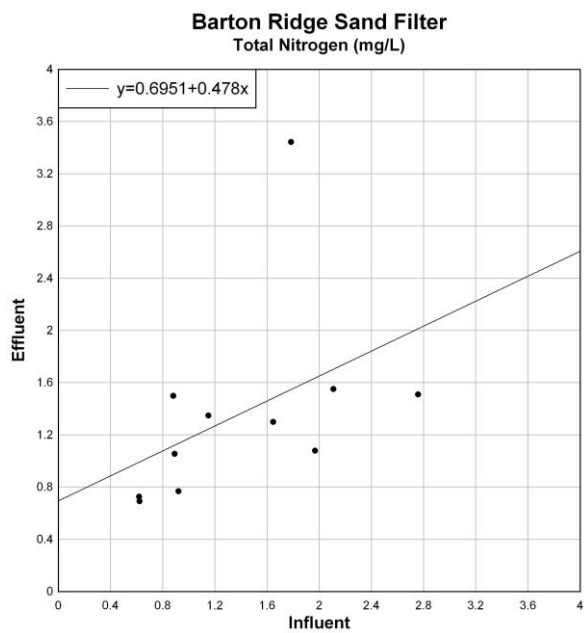
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	12	13
	Pairs Count	5	5
Non-Parametric	Maximum	65.98	14.13
	Upper Quartile	11.63	3.00
	Median	4.72	2.29
	Lower Quartile	3.25	2.07
	Minimum	1.95	1.49
	Efficiency	51.53%	
	Mann-Whitney	0.0105 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	22.97	5.28
	Mean	11.50	3.27
	LCL	0.04	1.25
	Std. Dev.	18.05	3.33
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	71.61%	
	t-Test (equal var.)	0.1191	
	t-Test (unequal var.)	0.1461	
	t-test (paired)	0.0885 *	
	Levene Test	0.2284	
Log Transformed	UCL	22.09	4.45
	Mean	9.79	3.05
	LCL	4.34	2.08
	Std. Dev.	11.04	1.83
	Wilk (p-value)	0.0783 *	0.0027 **
	Efficiency	68.88%	
	t-Test (equal var.)	0.0158 **	
	t-Test (unequal var.)	0.0206 **	
	t-Test (paired)	0.0199 **	
	Levene Test	0.1923	
Bootstrap	UCL	21.32	4.91
	Mean	11.58	3.26
	LCL	1.84	1.61
	Std. Dev.	15.33	2.73
	Efficiency	71.82%	

Barton Ridge Sand Filter - Total Nitrogen (mg/L)



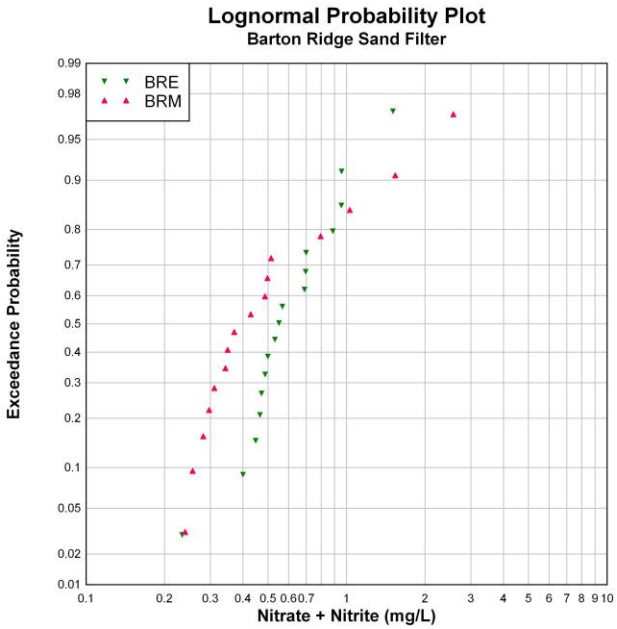


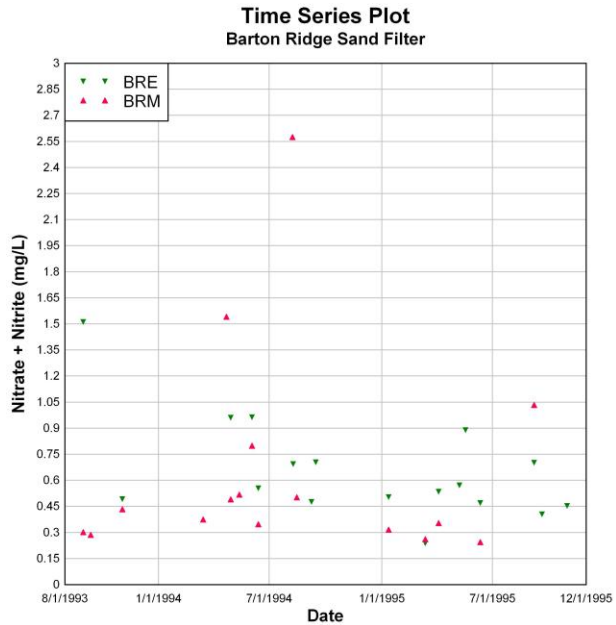


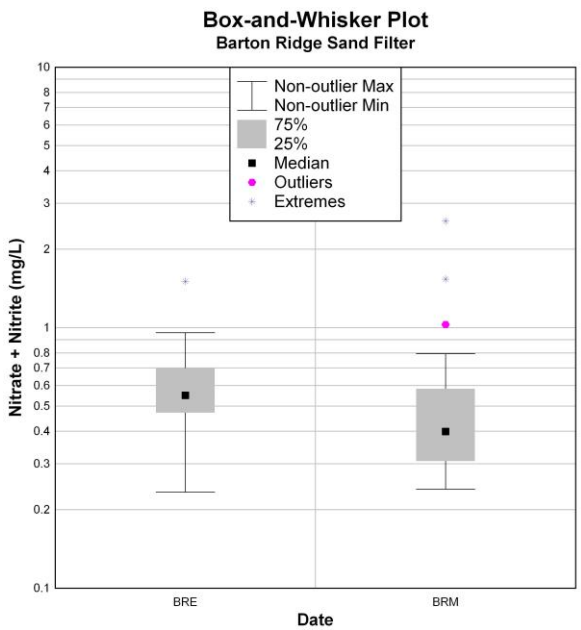


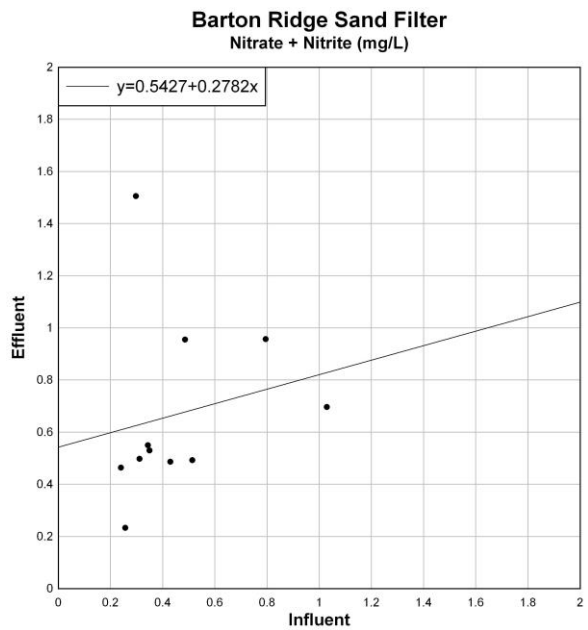
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	16	17
	Pairs Count	11	11
Non-Parametric	Maximum	14.570	3.445
	Upper Quartile	2.037	1.511
	Median	1.633	1.249
	Lower Quartile	0.906	0.817
	Minimum	0.619	0.692
	Efficiency	23.47%	
	Mann-Whitney	0.2364	
	Wilcoxon (paired)	0.8984	
Arithmetic	UCL	4.277	1.653
	Mean	2.466	1.320
	LCL	0.654	0.987
	Std. Dev.	3.400	0.647
	Wilk (p-value)	0.0001 **	0.0007 **
	Efficiency	46.47%	
	t-Test (equal var.)	0.1821	
	t-Test (unequal var.)	0.2036	
	t-test (paired)	0.8909	
	Levene Test	0.2434	
Log Transformed	UCL	3.617	1.629
	Mean	2.198	1.309
	LCL	1.335	1.053
	Std. Dev.	1.929	0.545
	Wilk (p-value)	0.0479 **	0.1923
	Efficiency	40.42%	
	t-Test (equal var.)	0.1884	
	t-Test (unequal var.)	0.2004	
	t-Test (paired)	0.9251	
	Levene Test	0.1326	
Bootstrap	UCL	4.062	1.624
	Mean	2.487	1.320
	LCL	0.912	1.016
	Std. Dev.	2.956	0.592
	Efficiency	46.92%	

Barton Ridge Sand Filter - Nitrate + Nitrite (mg/L)



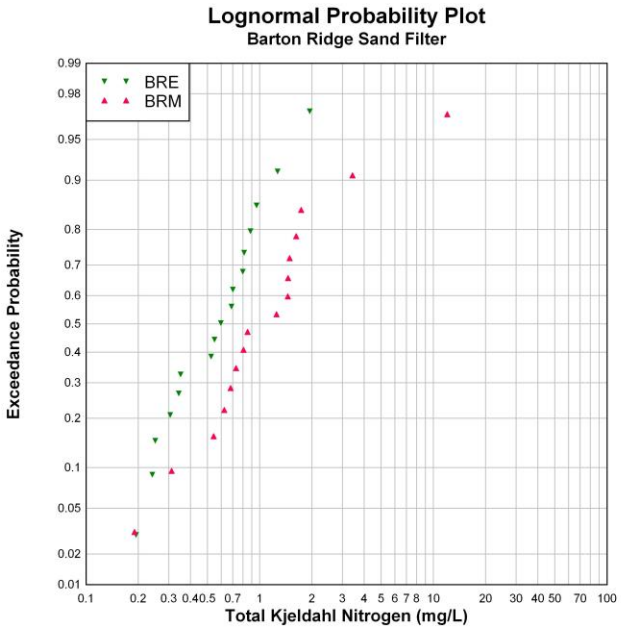


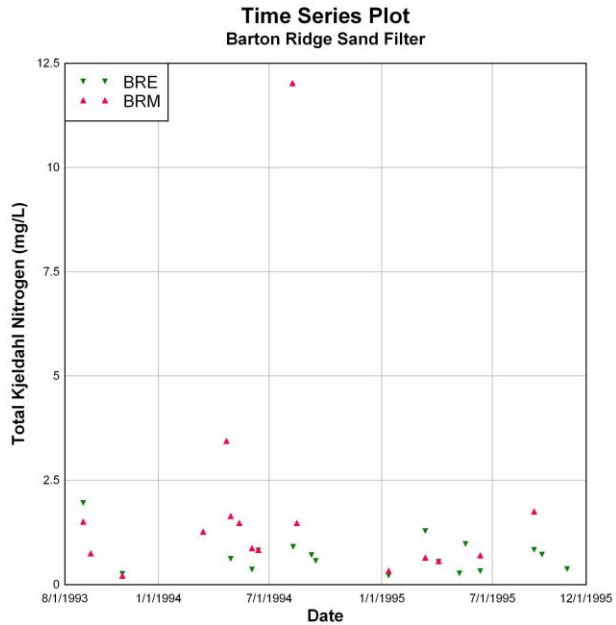


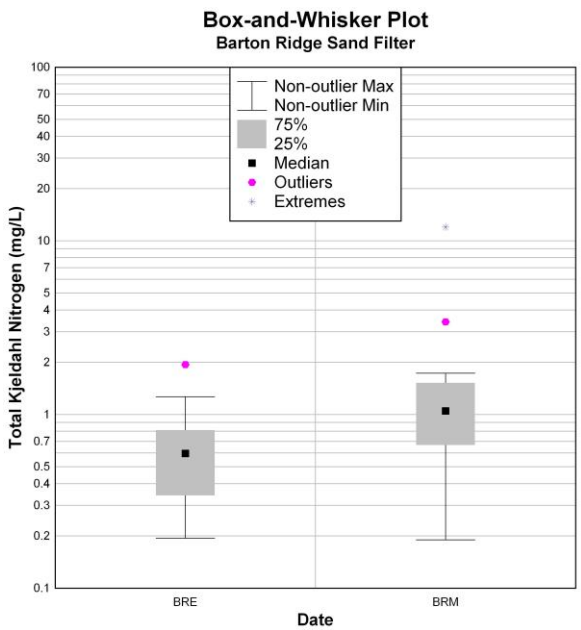


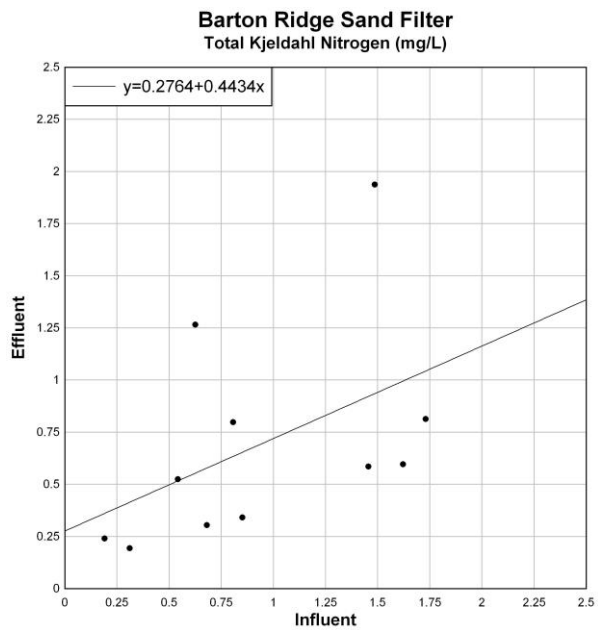
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	16	17
	Pairs Count	11	11
Non-Parametric	Maximum	2.570	1.506
	Upper Quartile	0.654	0.700
	Median	0.399	0.550
	Lower Quartile	0.304	0.472
	Minimum	0.240	0.234
	Efficiency	-37.77%	
	Mann-Whitney	0.1188	
	Wilcoxon (paired)	0.0674 *	
Arithmetic	UCL	0.973	0.802
	Mean	0.644	0.649
	LCL	0.315	0.497
	Std. Dev.	0.617	0.296
	Wilk (p-value)	0.0001 **	0.0158 **
	Efficiency	-0.86%	
	t-Test (equal var.)	0.9736	
	t-Test (unequal var.)	0.9742	
	t-test (paired)	0.0994 *	
	Levene Test	0.2323	
Log Transformed	UCL	0.911	0.814
	Mean	0.609	0.648
	LCL	0.408	0.516
	Std. Dev.	0.438	0.281
	Wilk (p-value)	0.0227 **	0.6197
	Efficiency	-6.36%	
	t-Test (equal var.)	0.3381	
	t-Test (unequal var.)	0.3464	
	t-Test (paired)	0.0416 **	
	Levene Test	0.1598	
Bootstrap	UCL	0.951	0.792
	Mean	0.649	0.649
	LCL	0.347	0.506
	Std. Dev.	0.567	0.278
	Efficiency	-0.04%	

Barton Ridge Sand Filter - Total Kjeldahl Nitrogen (mg/L)



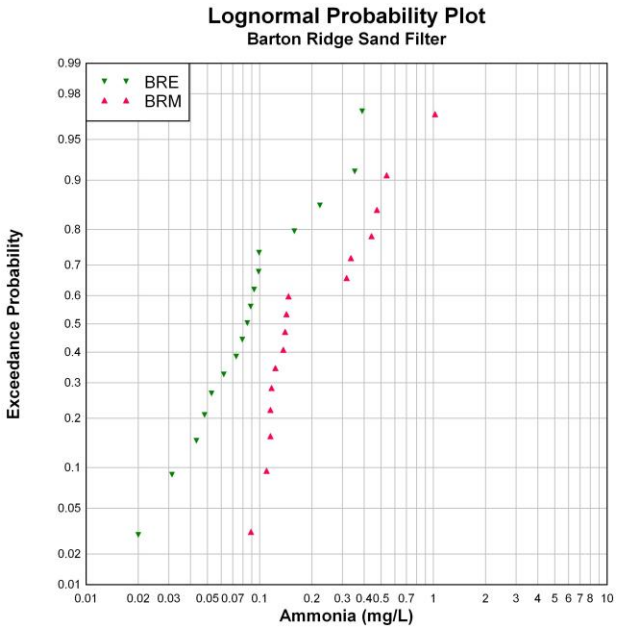


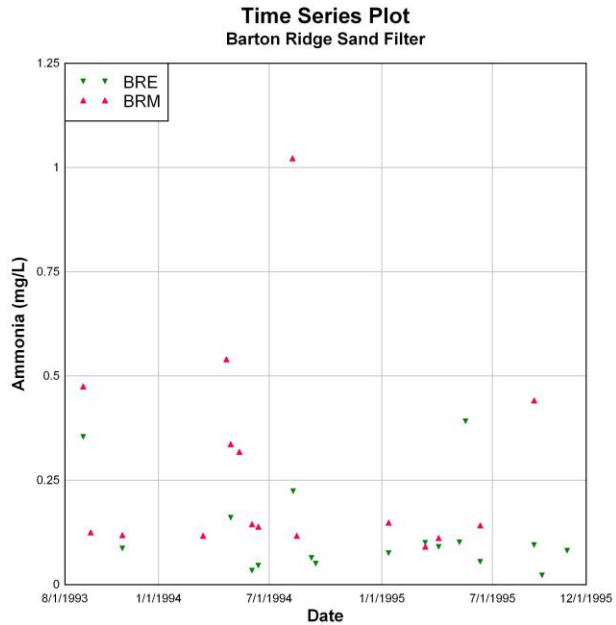


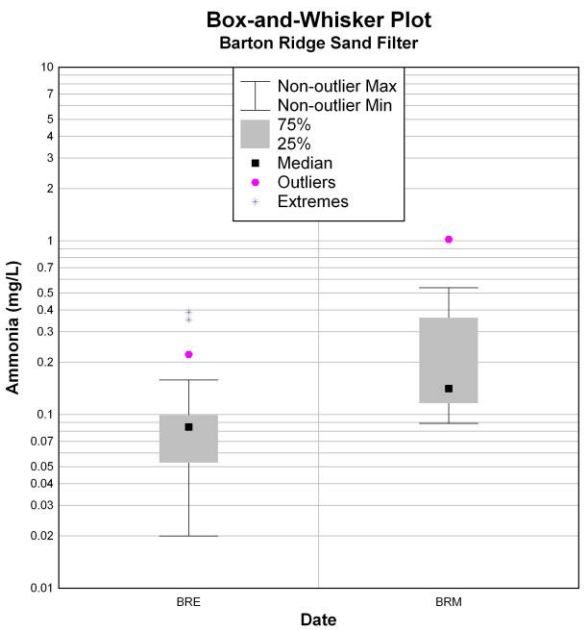


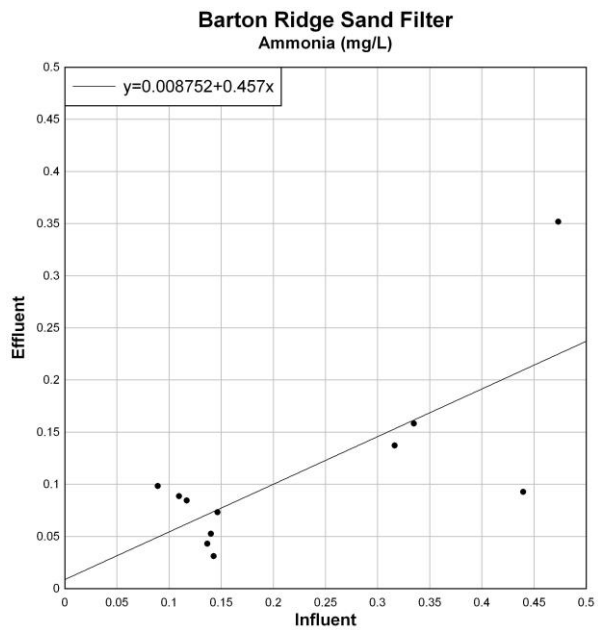
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	16	17
	Pairs Count	11	11
Non-Parametric	Maximum	12.000	1.938
	Upper Quartile	1.553	0.814
	Median	1.050	0.597
	Lower Quartile	0.652	0.342
	Minimum	0.190	0.194
	Efficiency	43.19%	
	Mann-Whitney	0.0465 **	
	Wilcoxon (paired)	0.1748	
Arithmetic	UCL	3.325	0.897
	Mean	1.822	0.670
	LCL	0.319	0.444
	Std. Dev.	2.821	0.440
	Wilk (p-value)	0.0001 **	0.0171 **
	Efficiency	63.20%	
	t-Test (equal var.)	0.1065	
	t-Test (unequal var.)	0.1265	
	t-test (paired)	0.1706	
	Levene Test	0.2504	
Log Transformed	UCL	3.025	0.959
	Mean	1.628	0.671
	LCL	0.876	0.469
	Std. Dev.	1.747	0.448
	Wilk (p-value)	0.3712	0.8517
	Efficiency	58.79%	
	t-Test (equal var.)	0.0259 **	
	t-Test (unequal var.)	0.0291 **	
	t-Test (paired)	0.0895 *	
	Levene Test	0.2298	
Bootstrap	UCL	3.132	0.883
	Mean	1.838	0.671
	LCL	0.545	0.459
	Std. Dev.	2.428	0.412
	Efficiency	63.49%	

Barton Ridge Sand Filter - Ammonia (mg/L)



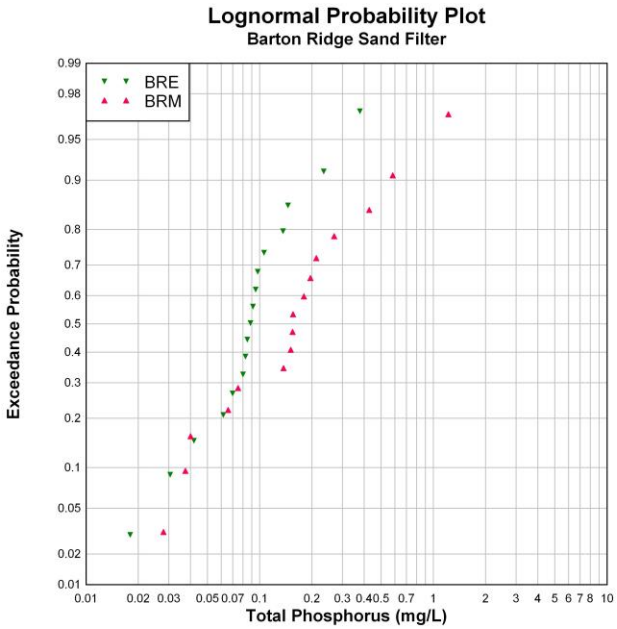


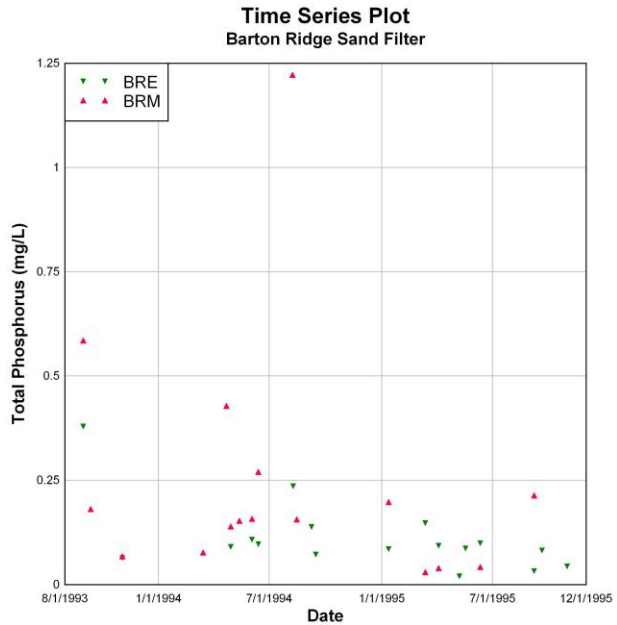


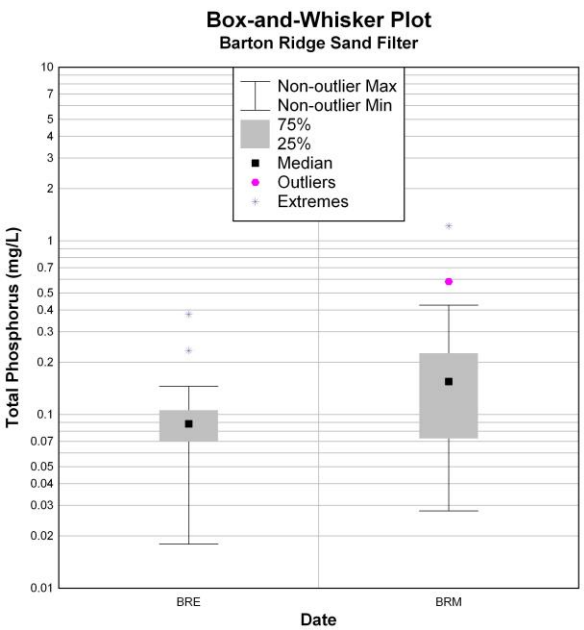


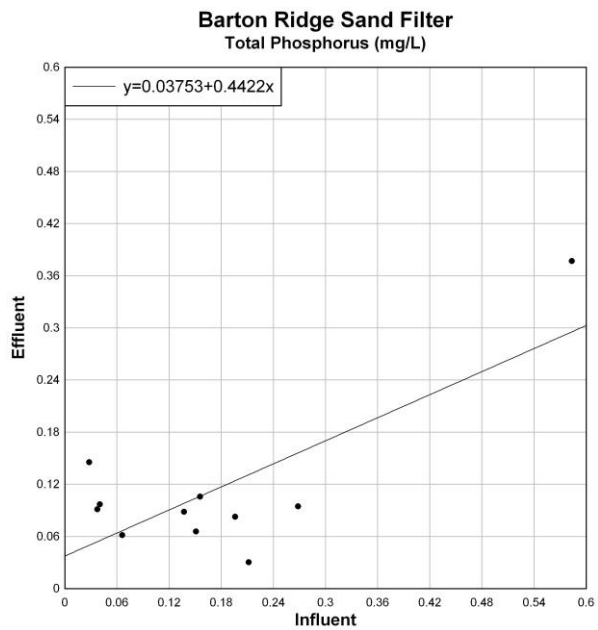
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	16	17
	Pairs Count	11	11
Non-Parametric	Maximum	1.020	0.389
	Upper Quartile	0.387	0.099
	Median	0.141	0.085
	Lower Quartile	0.116	0.053
	Minimum	0.089	0.020
	Efficiency	40.01%	
	Mann-Whitney	0.0032 **	
	Wilcoxon (paired)	0.0020 **	
Arithmetic	UCL	0.405	0.172
	Mean	0.272	0.117
	LCL	0.140	0.062
	Std. Dev.	0.249	0.107
	Wilk (p-value)	0.0003 **	0.0004 **
	Efficiency	56.88%	
	t-Test (equal var.)	0.0254 **	
	t-Test (unequal var.)	0.0324 **	
	t-test (paired)	0.0035 **	
	Levene Test	0.1621	
Log Transformed	UCL	0.408	0.183
	Mean	0.262	0.115
	LCL	0.168	0.072
	Std. Dev.	0.207	0.099
	Wilk (p-value)	0.0137 **	0.6515
	Efficiency	56.07%	
	t-Test (equal var.)	0.0029 **	
	t-Test (unequal var.)	0.0028 **	
	t-Test (paired)	0.0010 **	
	Levene Test	0.7581	
Bootstrap	UCL	0.398	0.170
	Mean	0.275	0.118
	LCL	0.151	0.066
	Std. Dev.	0.232	0.101
	Efficiency	57.02%	

Barton Ridge Sand Filter - Total Phosphorus (mg/L)



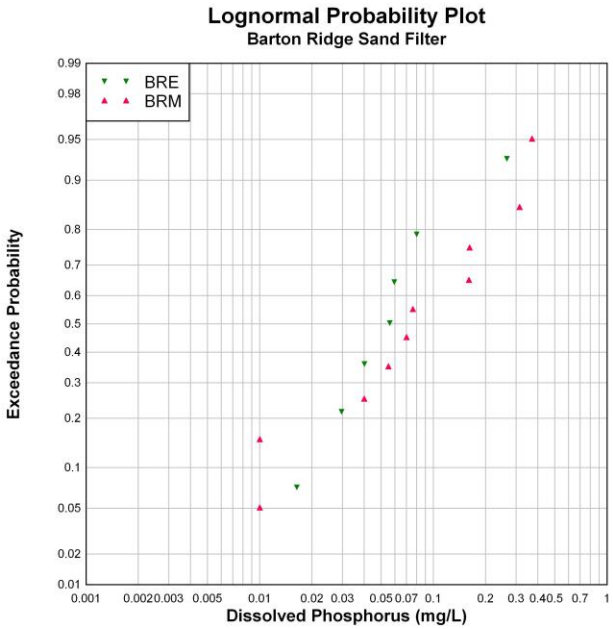


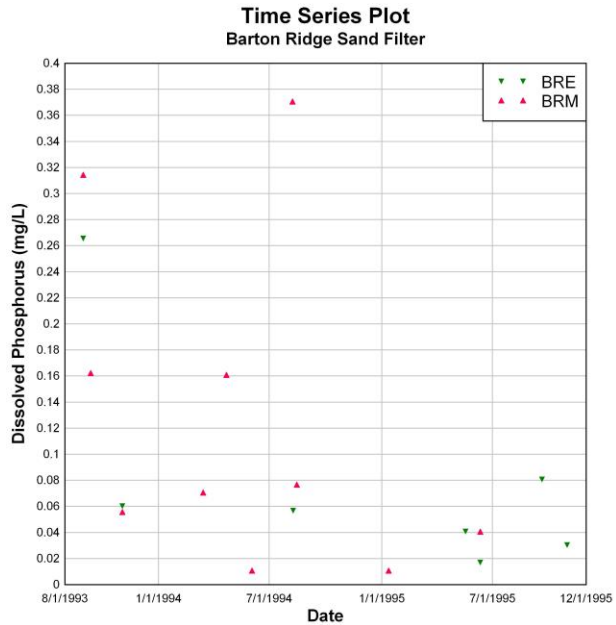


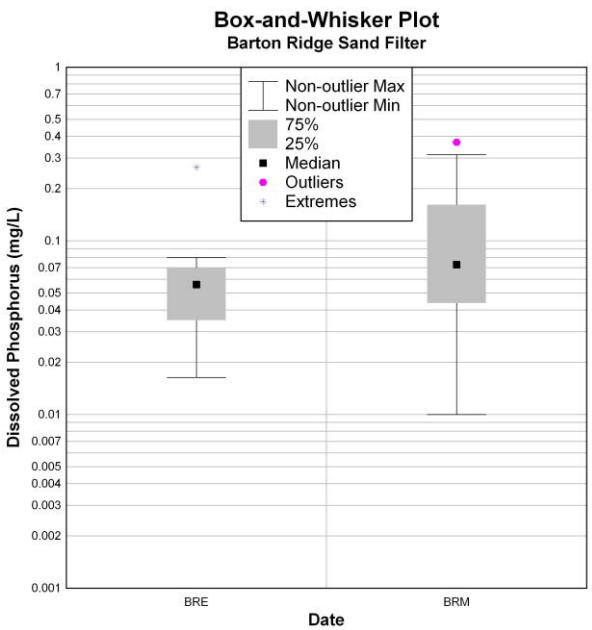


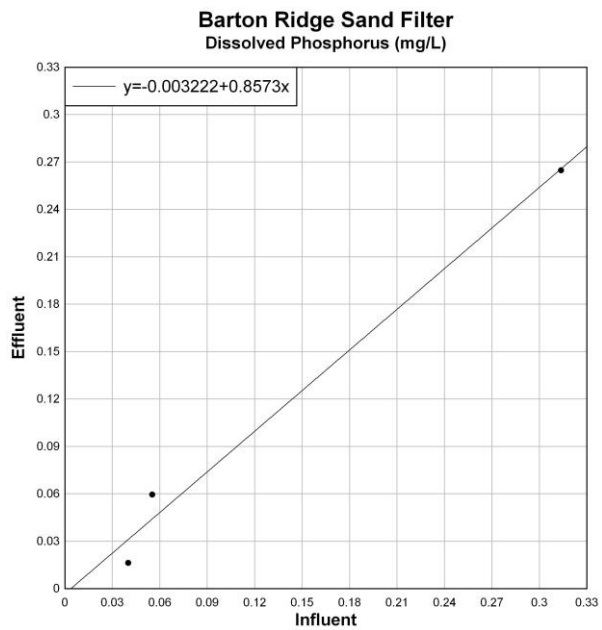
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	16	17
	Pairs Count	11	11
Non-Parametric	Maximum	1.220	0.377
	Upper Quartile	0.240	0.106
	Median	0.155	0.089
	Lower Quartile	0.070	0.070
	Minimum	0.028	0.018
	Efficiency	42.84%	
	Mann-Whitney	0.0902 *	
	Wilcoxon (paired)	0.1748	
Arithmetic	UCL	0.405	0.152
	Mean	0.246	0.108
	LCL	0.086	0.065
	Std. Dev.	0.298	0.085
	Wilk (p-value)	0.0001 **	0.0005 **
	Efficiency	55.93%	
	t-Test (equal var.)	0.0782 *	
	t-Test (unequal var.)	0.0937 *	
	t-test (paired)	0.1045	
	Levene Test	0.1846	
Log Transformed	UCL	0.472	0.163
	Mean	0.240	0.108
	LCL	0.122	0.072
	Std. Dev.	0.279	0.082
	Wilk (p-value)	0.7861	0.4788
	Efficiency	54.87%	
	t-Test (equal var.)	0.0782 *	
	t-Test (unequal var.)	0.0830 *	
	t-Test (paired)	0.4708	
	Levene Test	0.1759	
Bootstrap	UCL	0.392	0.148
	Mean	0.247	0.108
	LCL	0.103	0.068
	Std. Dev.	0.272	0.078
	Efficiency	56.41%	

Barton Ridge Sand Filter - Dissolved Phosphorus (mg/L)



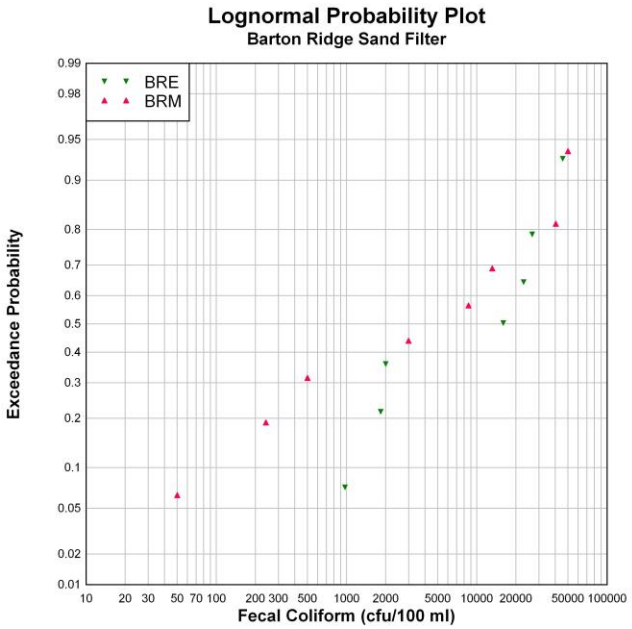


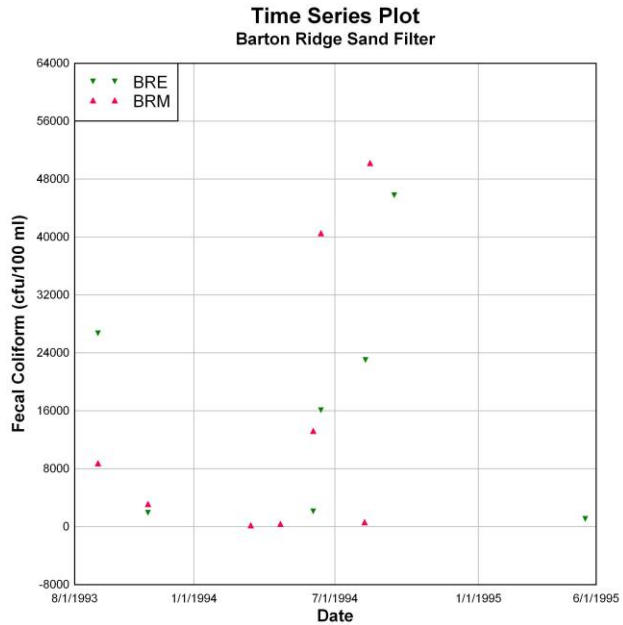


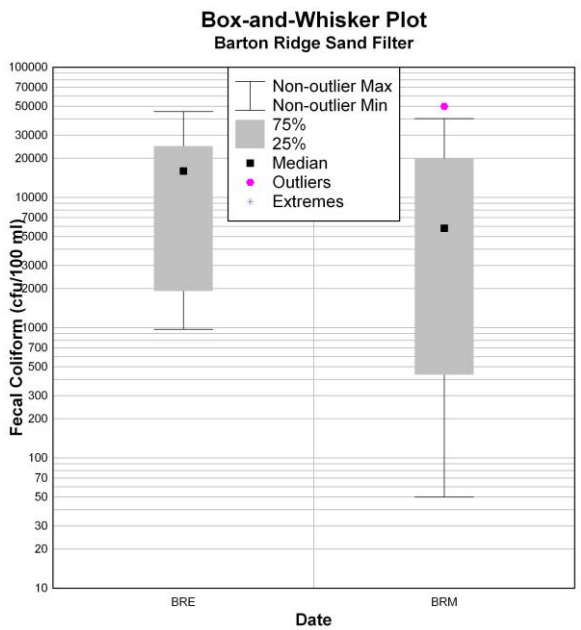


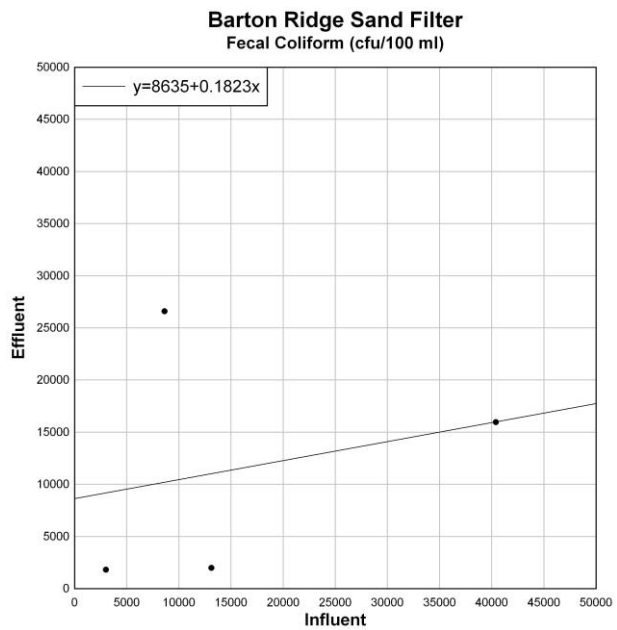
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	10	7
	Pairs Count	3	3
Non-Parametric	Maximum	0.370	0.265
	Upper Quartile	0.162	0.080
	Median	0.073	0.056
	Lower Quartile	0.040	0.030
	Minimum	0.010	0.016
	Efficiency	23.31%	
	Mann-Whitney	0.5986	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	0.217	0.157
	Mean	0.127	0.078
	LCL	0.037	0.000
	Std. Dev.	0.126	0.085
	Wilk (p-value)	0.0448 **	0.0029 **
	Efficiency	38.36%	
	t-Test (equal var.)	0.3891	
	t-Test (unequal var.)	0.3566	
	t-test (paired)	0.2788	
	Levene Test	0.3429	
Log Transformed	UCL	0.487	0.196
	Mean	0.141	0.074
	LCL	0.041	0.028
	Std. Dev.	0.198	0.066
	Wilk (p-value)	0.3785	0.7981
	Efficiency	47.31%	
	t-Test (equal var.)	0.6229	
	t-Test (unequal var.)	0.5995	
	t-Test (paired)	0.3770	
	Levene Test	0.2630	
Bootstrap	UCL	0.209	0.141
	Mean	0.126	0.078
	LCL	0.043	0.014
	Std. Dev.	0.116	0.069
	Efficiency	38.49%	

Barton Ridge Sand Filter - Fecal Coliform (cfu/100 ml)



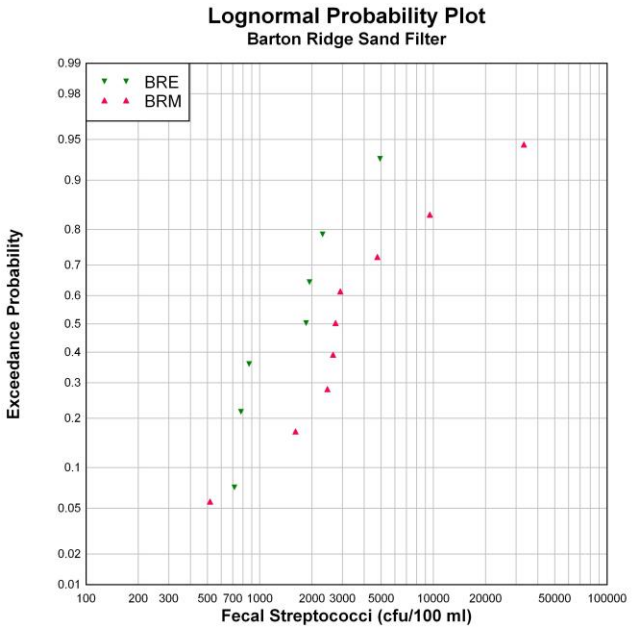


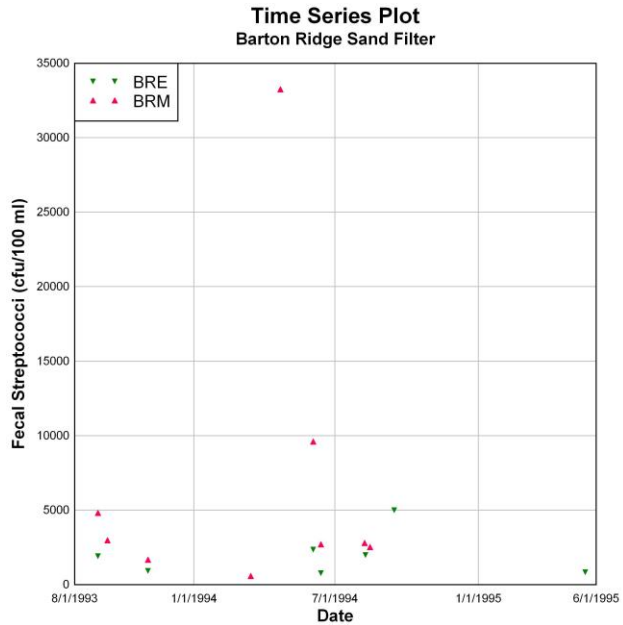


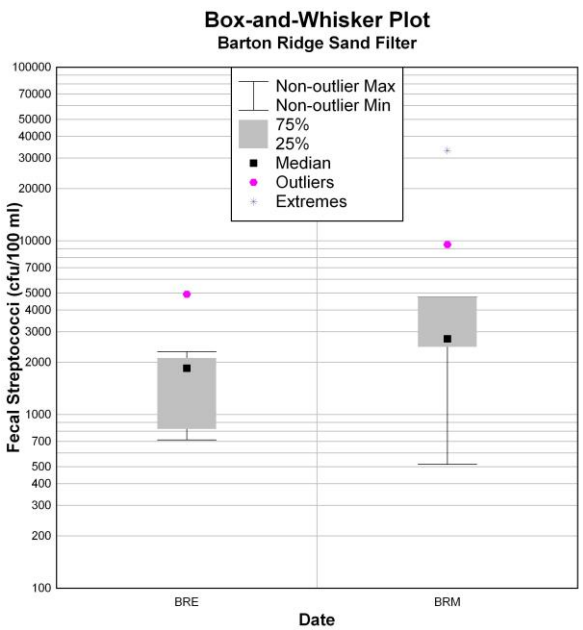


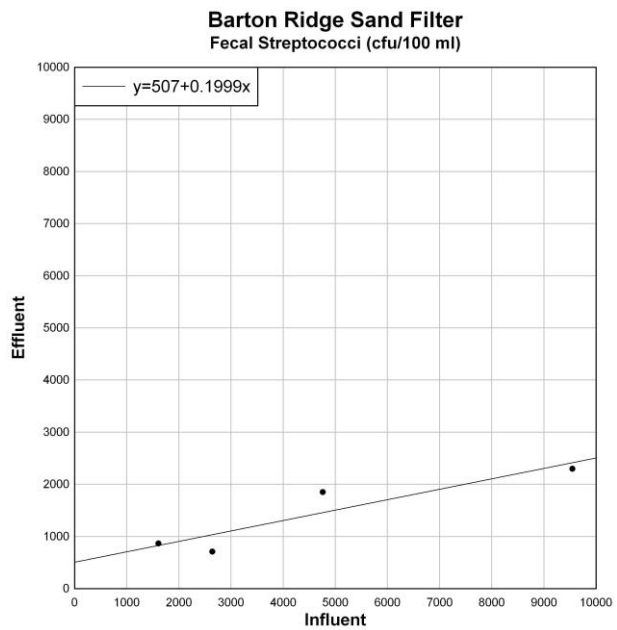
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	8	7
	Pairs Count	4	4
Non-Parametric	Maximum	50,084	45,657
	Upper Quartile	26,750	26,609
	Median	5,805	15,969
	Lower Quartile	370	1,827
	Minimum	50	973
	Efficiency	-175.09%	
	Mann-Whitney	0.5347	
	Wilcoxon (paired)	0.6250	
Arithmetic	UCL	30,962	31,951
	Mean	14,498	16,565
	LCL	-1,966	1,180
	Std. Dev.	19,690	16,635
	Wilk (p-value)	0.0113 **	0.2432
	Efficiency	-14.26%	
	t-Test (equal var.)	0.8310	
	t-Test (unequal var.)	0.8290	
	t-test (paired)	0.6369	
	Levene Test	0.6011	
Log Transformed	UCL	2,431,783	184,361
	Mean	26,479	19,568
	LCL	288	2,077
	Std. Dev.	77,008	31,615
	Wilk (p-value)	0.5566	0.1694
	Efficiency	26.10%	
	t-Test (equal var.)	0.3808	
	t-Test (unequal var.)	0.3676	
	t-Test (paired)	0.4503	
	Levene Test	0.1133	
Bootstrap	UCL	29,650	30,234
	Mean	14,763	16,507
	LCL	-125	2,779
	Std. Dev.	17,808	14,843
	Efficiency	-11.81%	

Barton Ridge Sand Filter - Fecal Streptococci (cfu/100 ml)



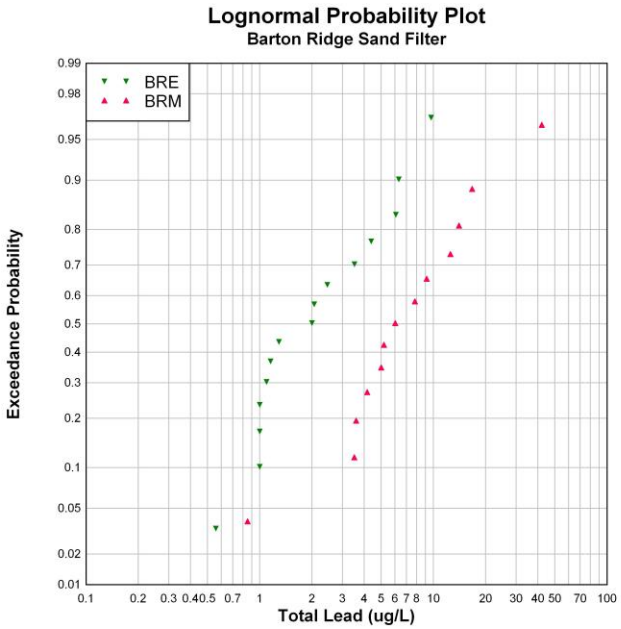


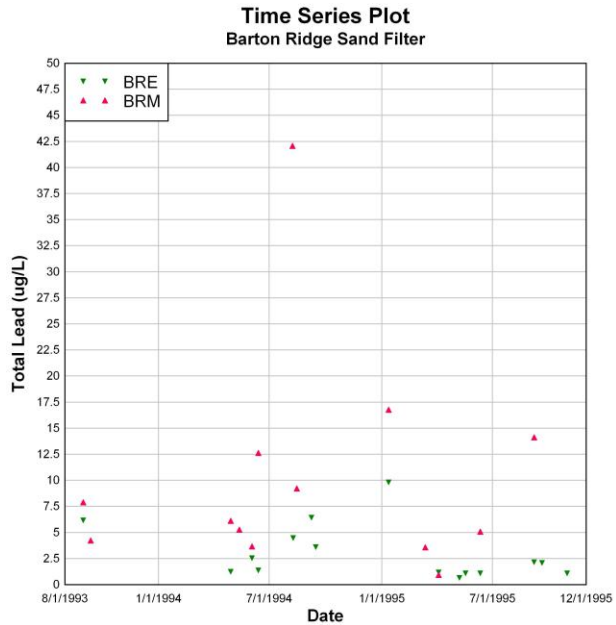


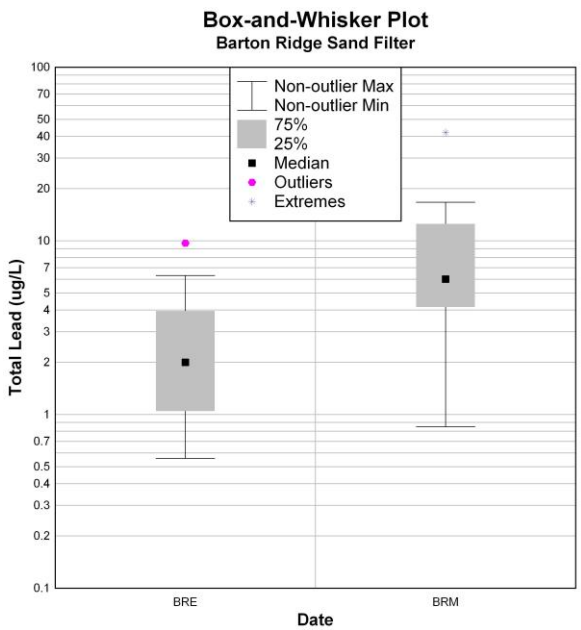


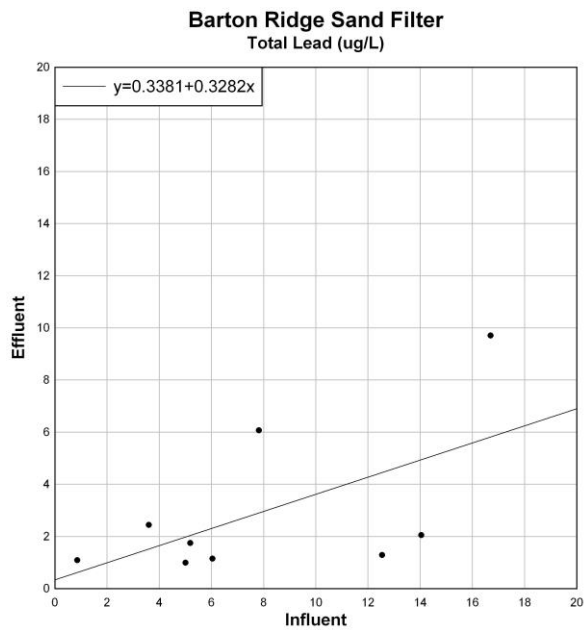
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	9	7
	Pairs Count	4	4
Non-Parametric	Maximum	33,186	4,932
	Upper Quartile	4,757	2,301
	Median	2,727	1,851
	Lower Quartile	2,454	781
	Minimum	517	714
	Efficiency	32.11%	
	Mann-Whitney	0.1332	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	14,591	3,277
	Mean	6,704	1,912
	LCL	-1,182	546
	Std. Dev.	10,260	1,476
	Wilk (p-value)	0.0001 **	0.0431 **
	Efficiency	71.49%	
	t-Test (equal var.)	0.2438	
	t-Test (unequal var.)	0.2022	
	t-test (paired)	0.1091	
	Levene Test	0.3091	
Log Transformed	UCL	19,548	3,949
	Mean	6,016	1,884
	LCL	1,851	898
	Std. Dev.	7,487	1,343
	Wilk (p-value)	0.5423	0.3784
	Efficiency	68.69%	
	t-Test (equal var.)	0.1289	
	t-Test (unequal var.)	0.1093	
	t-Test (paired)	0.0100 **	
	Levene Test	0.3121	
Bootstrap	UCL	13,344	3,084
	Mean	6,781	1,913
	LCL	217	742
	Std. Dev.	8,539	1,266
	Efficiency	71.79%	

Barton Ridge Sand Filter - Total Lead (ug/L)



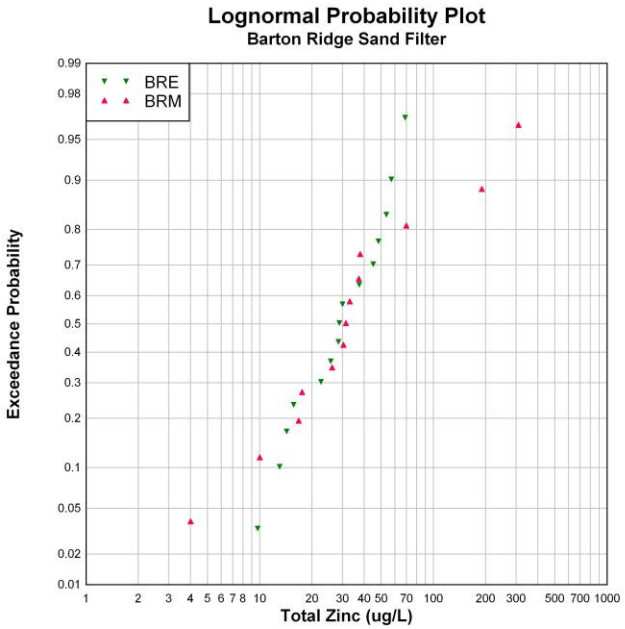


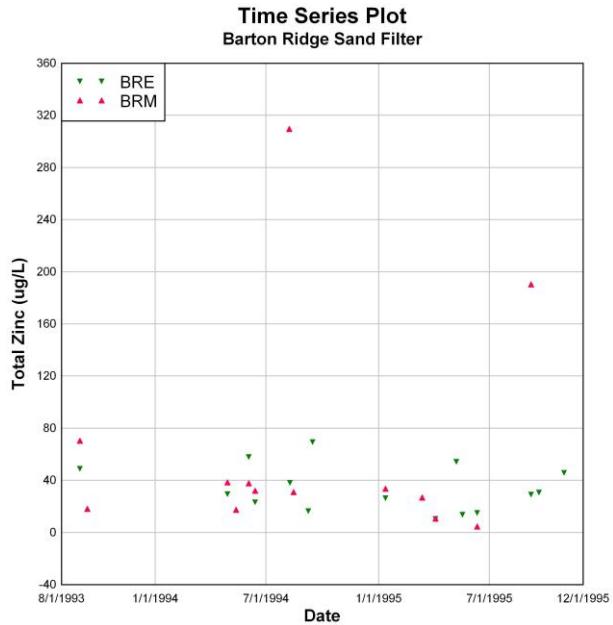


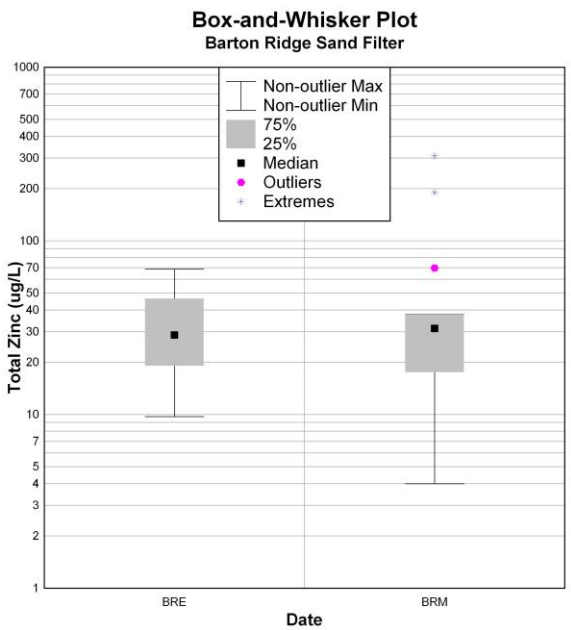


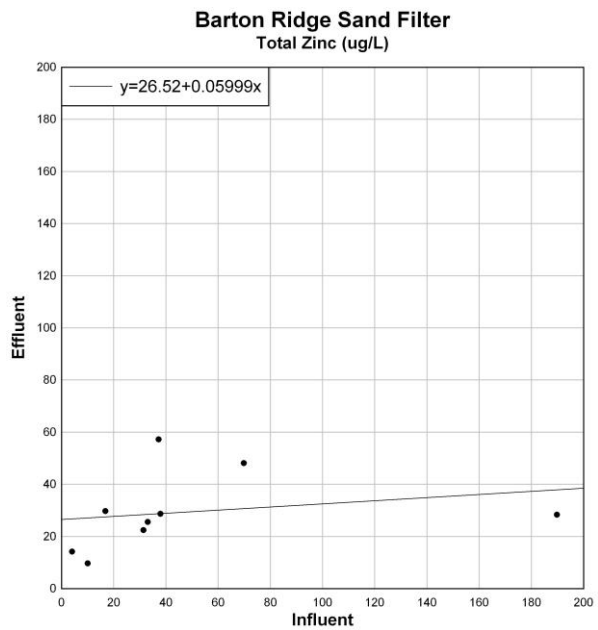
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	13	15
	Pairs Count	9	9
Non-Parametric	Maximum	42.0	9.7
	Upper Quartile	12.5	4.4
	Median	6.0	2.0
	Lower Quartile	4.2	1.0
	Minimum	0.8	0.6
	Efficiency	66.85%	
	Mann-Whitney	0.0113 **	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	16.5	4.4
	Mean	10.0	2.9
	LCL	3.6	1.4
	Std. Dev.	10.7	2.6
	Wilk (p-value)	0.0006 **	0.0039 **
	Efficiency	71.04%	
	t-Test (equal var.)	0.0185 **	
	t-Test (unequal var.)	0.0347 **	
	t-test (paired)	0.0081 **	
	Levene Test	0.1793	
Log Transformed	UCL	20.2	4.9
	Mean	10.1	2.9
	LCL	5.0	1.7
	Std. Dev.	10.5	2.6
	Wilk (p-value)	0.8091	0.3482
	Efficiency	71.69%	
	t-Test (equal var.)	0.0017 **	
	t-Test (unequal var.)	0.0019 **	
	t-Test (paired)	0.0065 **	
	Levene Test	0.6881	
Bootstrap	UCL	15.7	4.3
	Mean	10.0	2.9
	LCL	4.4	1.5
	Std. Dev.	9.4	2.5
	Efficiency	71.21%	

Barton Ridge Sand Filter - Total Zinc (ug/L)



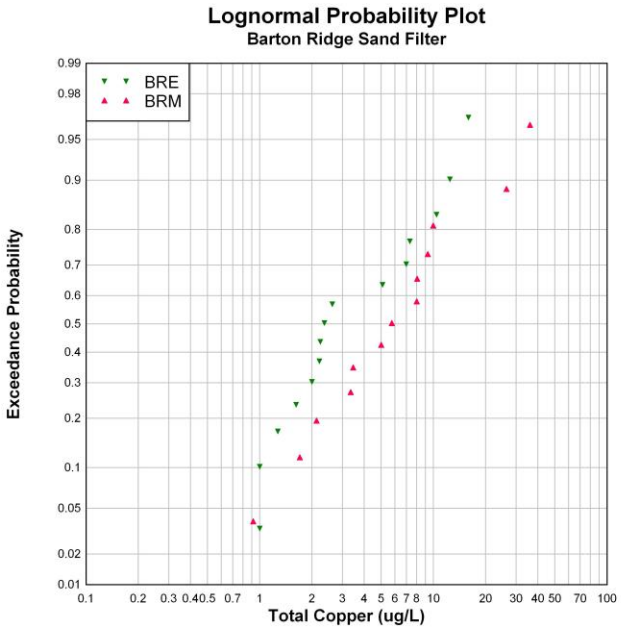


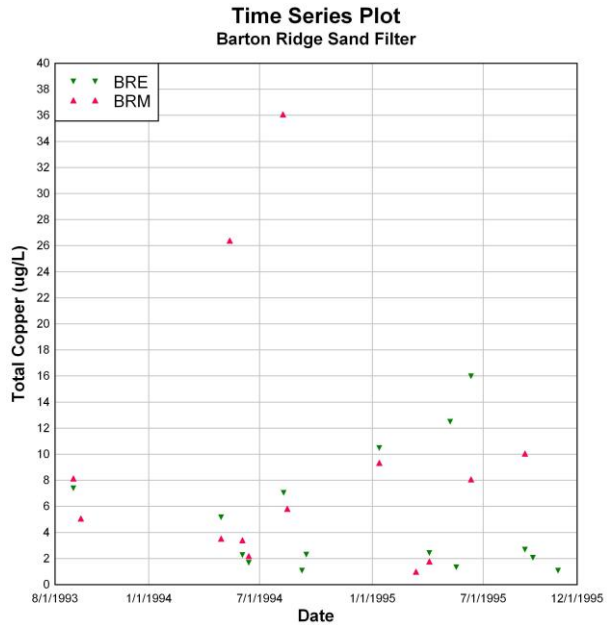


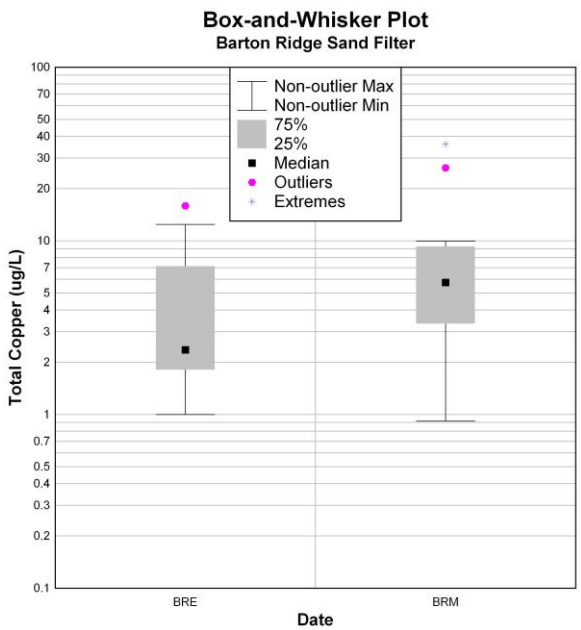


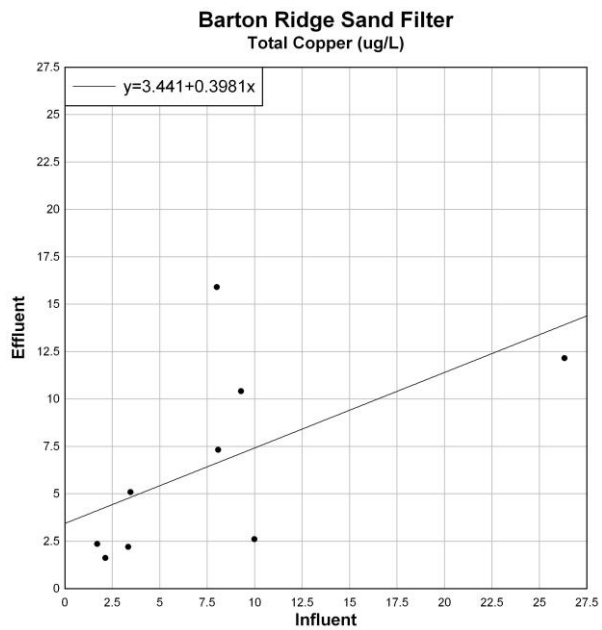
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	13	15
	Pairs Count	9	9
Non-Parametric	Maximum	309.0	68.8
	Upper Quartile	37.8	48.2
	Median	31.3	28.7
	Lower Quartile	17.5	15.7
	Minimum	4.0	9.7
	Efficiency	8.42%	
	Mann-Whitney	0.7154	
	Wilcoxon (paired)	0.6523	
Arithmetic	UCL	115.6	43.1
	Mean	62.5	33.2
	LCL	9.4	23.3
	Std. Dev.	87.9	17.9
	Wilk (p-value)	0.0001 **	0.4313
	Efficiency	46.85%	
	t-Test (equal var.)	0.2177	
	t-Test (unequal var.)	0.2595	
	t-test (paired)	0.3479	
	Levene Test	0.1229	
Log Transformed	UCL	142.9	48.0
	Mean	58.5	33.6
	LCL	23.9	23.5
	Std. Dev.	75.7	20.8
	Wilk (p-value)	0.5573	0.6871
	Efficiency	42.57%	
	t-Test (equal var.)	0.6699	
	t-Test (unequal var.)	0.6845	
	t-Test (paired)	0.7454	
	Levene Test	0.0784 *	
Bootstrap	UCL	110.8	42.8
	Mean	63.1	33.2
	LCL	15.5	23.6
	Std. Dev.	78.9	17.3
	Efficiency	47.42%	

Barton Ridge Sand Filter - Total Copper (ug/L)



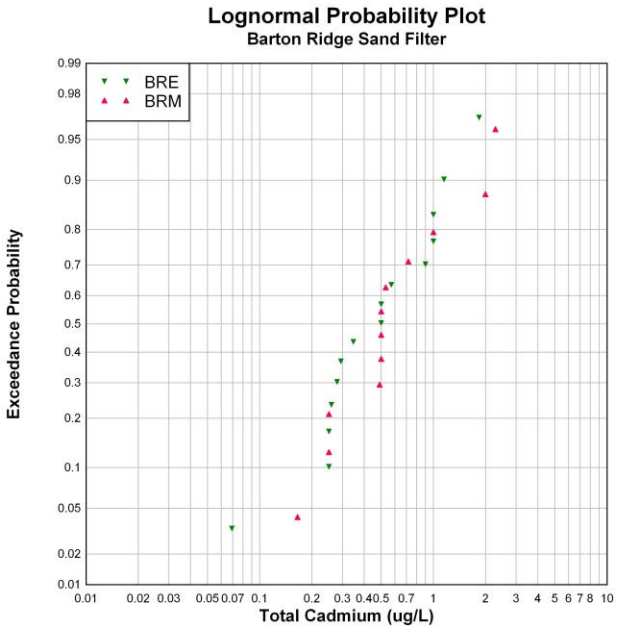


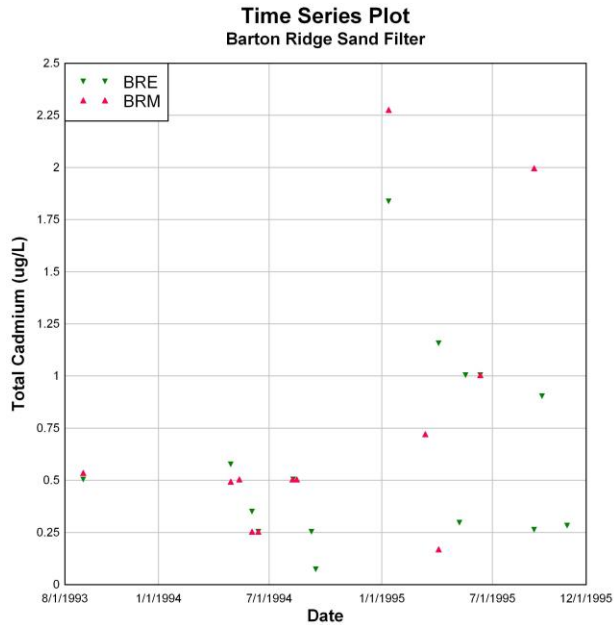


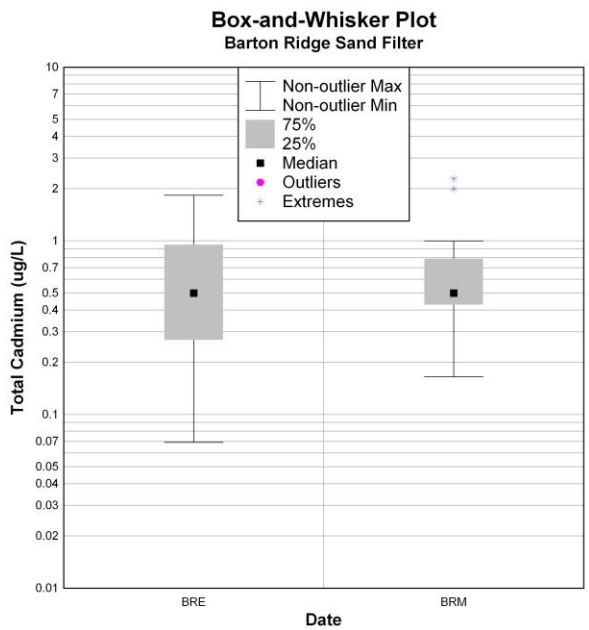


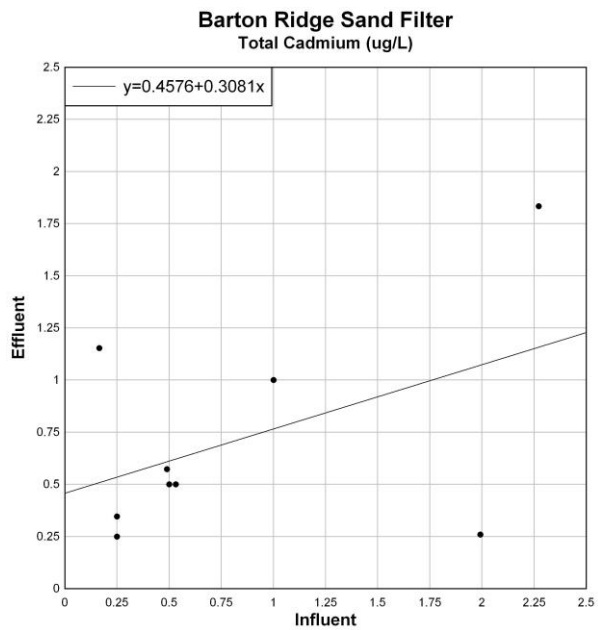
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	13	15
	Pairs Count	9	9
Non-Parametric	Maximum	36.0	15.9
	Upper Quartile	9.3	7.3
	Median	5.8	2.4
	Lower Quartile	3.3	1.6
	Minimum	0.9	1.0
	Efficiency	58.98%	
	Mann-Whitney	0.2414	
	Wilcoxon (paired)	0.9102	
Arithmetic	UCL	15.5	7.6
	Mean	9.2	5.0
	LCL	3.0	2.4
	Std. Dev.	10.4	4.7
	Wilk (p-value)	0.0010 **	0.0046 **
	Efficiency	46.17%	
	t-Test (equal var.)	0.1631	
	t-Test (unequal var.)	0.1904	
	t-test (paired)	0.5191	
	Levene Test	0.1468	
Log Transformed	UCL	20.1	9.1
	Mean	9.1	4.9
	LCL	4.2	2.6
	Std. Dev.	10.6	5.0
	Wilk (p-value)	0.9621	0.1995
	Efficiency	46.34%	
	t-Test (equal var.)	0.1622	
	t-Test (unequal var.)	0.1664	
	t-Test (paired)	0.4912	
	Levene Test	0.6160	
Bootstrap	UCL	14.7	7.4
	Mean	9.1	4.9
	LCL	3.5	2.5
	Std. Dev.	9.3	4.4
	Efficiency	45.86%	

Barton Ridge Sand Filter - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: BRM**	**EFF: BRE**
	Site Count	12	15
	Pairs Count	9	9
Non-Parametric	Maximum	2.3	1.8
	Upper Quartile	0.9	1.0
	Median	0.5	0.5
	Lower Quartile	0.4	0.3
	Minimum	0.2	0.1
	Efficiency	0.00%	
	Mann-Whitney	0.7720	
	Wilcoxon (paired)	0.9453	
Arithmetic	UCL	1.2	0.9
	Mean	0.8	0.6
	LCL	0.3	0.4
	Std. Dev.	0.7	0.5
	Wilk (p-value)	0.0026 **	0.0244 **
	Efficiency	19.68%	
	t-Test (equal var.)	0.5048	
	t-Test (unequal var.)	0.5232	
	t-test (paired)	0.6409	
	Levene Test	0.3264	
Log Transformed	UCL	1.3	1.1
	Mean	0.7	0.6
	LCL	0.4	0.4
	Std. Dev.	0.6	0.6
	Wilk (p-value)	0.3700	0.4776
	Efficiency	15.72%	
	t-Test (equal var.)	0.5128	
	t-Test (unequal var.)	0.5103	
	t-Test (paired)	0.9721	
	Levene Test	0.8187	
Bootstrap	UCL	1.2	0.9
	Mean	0.8	0.6
	LCL	0.4	0.4
	Std. Dev.	0.6	0.4
	Efficiency	21.14%	

Canyon Creek Sand Filter (CCI-CCS)

The Canyon Creek water quality pond was designed to be able to test different filtration media with a sand filter control. Water flows into a standard sedimentation basin sized using City of Austin guidelines. There are two riser pipes which control the flow into the two filtration bed. Water quality leaving the sedimentation bed is designated as CCI, effluent from the sand filter is designated as CCS. The performance of the sedimentation basin is not measured at this facility, thus the removal efficiencies die CCS may be lower than otherwise expected.

CCS is a chamber in the Canyon Creek complex which receives stormwater from CCI. The flow of water into CCS is controlled by an orifice in a PVC cap which regulates how fast CCI is drained. The water drains into a concrete trough which helps to spread the water evenly throughout the treatment area. The stormwater is then treated in CCS with a sand filtration media. Once treated the water flows into sub-surface pipes and then out of the system into a chamber where samples are collected. Flow is measured as it leaves this chamber with a 90 degree V-notch weir.

The City collected 19 samples at CCI and 21 samples at CCS in 2009 and 2010, 16 of which were paired. The City monitored this site in 1996-8 but those samples were not included in these analyses because the controls were rebuilt in 2008.

Performance Summary

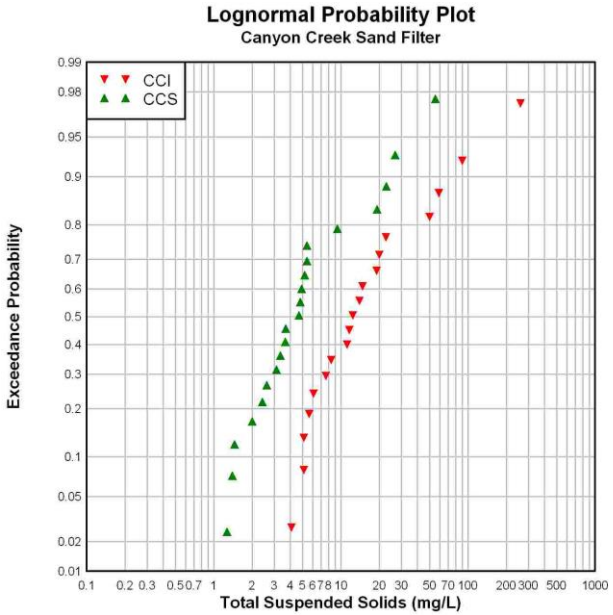
The performance of the sand filter is typical of other similar systems. There are significant reductions of TSS, VSS, COD and TOC; although the removal efficiencies for TSS and VSS appear lower than other systems. This is likely due to measuring the influent after sedimentation has occurred. The mean effluent concentrations are similar to other systems.

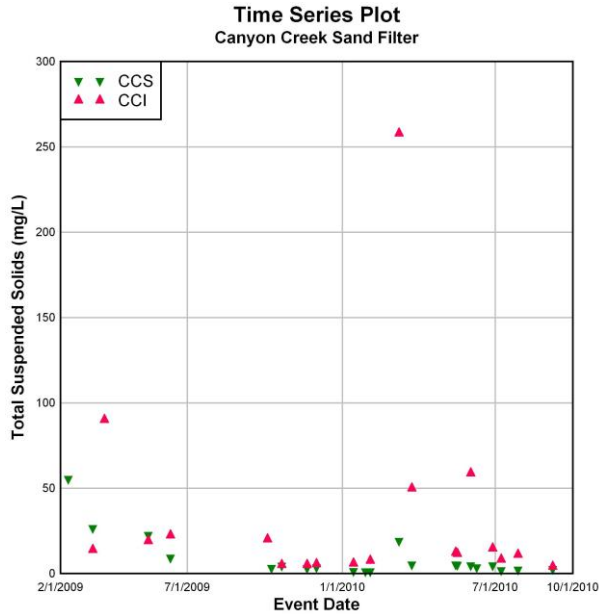
There was a moderate but not significant reduction of total nitrogen. Nitrate concentrations were significantly higher in the effluent while there were slight and significant reductions in ammonia and TKN. Total P was significantly reduced by approximately 50% while dissolved P was reduced by ~10% but the results were not significant.

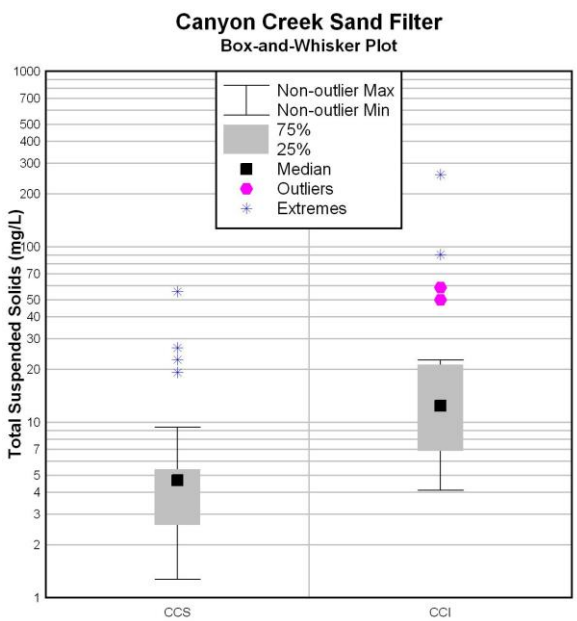
Fecal Coliform and E. Coli concentrations at the effluent were both significantly lower, ~90% reductions.

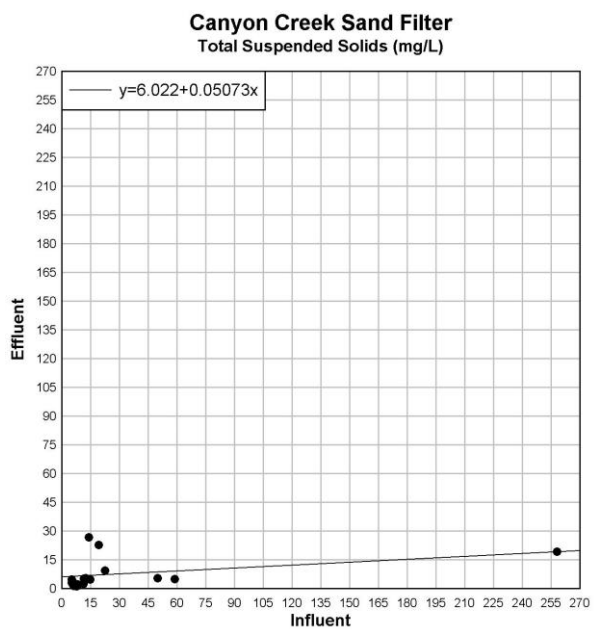
Total and dissolved metals were measured at the Canyon Creek pond. Effluent concentrations of total Pb, Zn and Cu and dissolved Pb and Zn were significantly lower than the influent in all statistical tests. Paired samples of dissolved Cu were significantly different but the difference did not carry over to the pooled tests. There were no significant trends for Cd.

Canyon Creek Sand Filter -- Total Suspended Solids (mg/L)



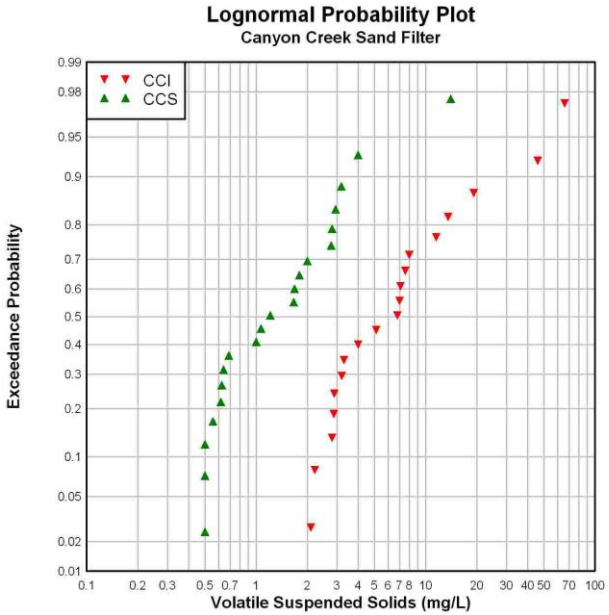


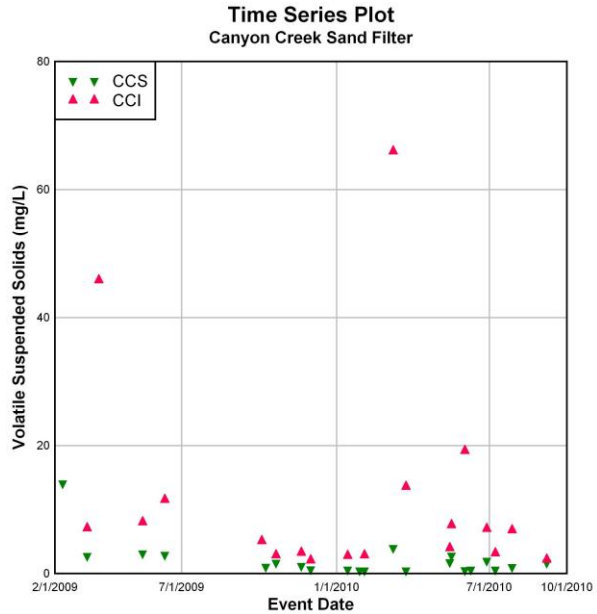


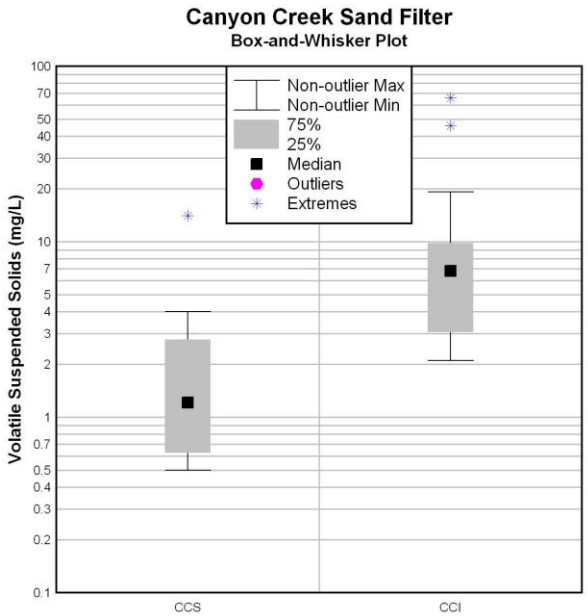


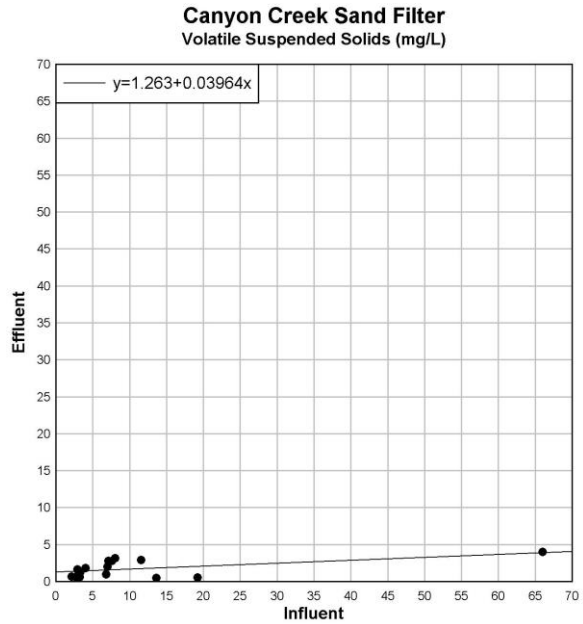
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	258.0	55.5
	Upper Quartile	22.5	5.4
	Median	12.4	4.7
	Lower Quartile	6.1	2.6
	Minimum	4.1	1.3
	Efficiency	62.28%	
	Mann-Whitney	0.0022 **	
	Wilcoxon (paired)	0.0052 **	
Arithmetic	UCL	61.3	14.8
	Mean	32.9	9.0
	LCL	4.5	3.1
	Std. Dev.	58.9	12.8
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	72.66%	
	t-Test (equal var.)	0.0776 *	
	t-Test (unequal var.)	0.0992 *	
	t-test (paired)	0.1241	
	Levene Test	0.2193	
Log Transformed	UCL	53.4	14.3
	Mean	27.2	8.0
	LCL	13.8	4.5
	Std. Dev.	35.5	9.6
	Wilk (p-value)	0.0630 *	0.0732 *
	Efficiency	70.37%	
	t-Test (equal var.)	0.0015 **	
	t-Test (unequal var.)	0.0016 **	
	t-Test (paired)	0.0003 **	
	Levene Test	0.7517	
Bootstrap	UCL	57.3	14.3
	Mean	32.4	8.9
	LCL	7.5	3.5
	Std. Dev.	51.6	11.8
	Efficiency	72.44%	

Canyon Creek Sand Filter -- Volatile Suspended Solids (mg/L)



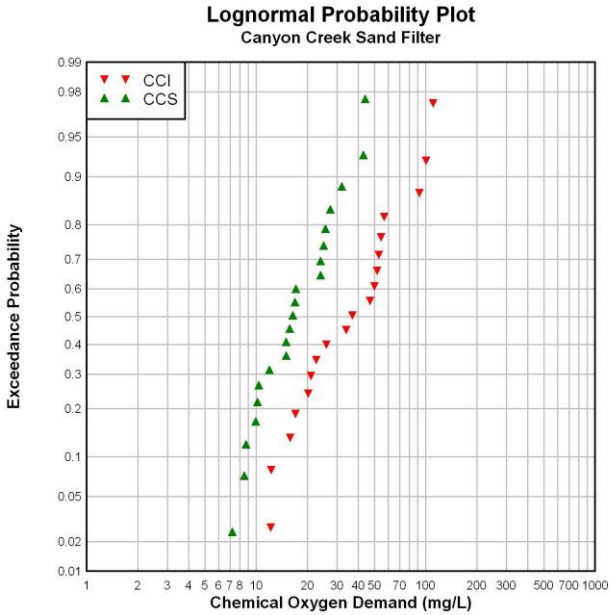


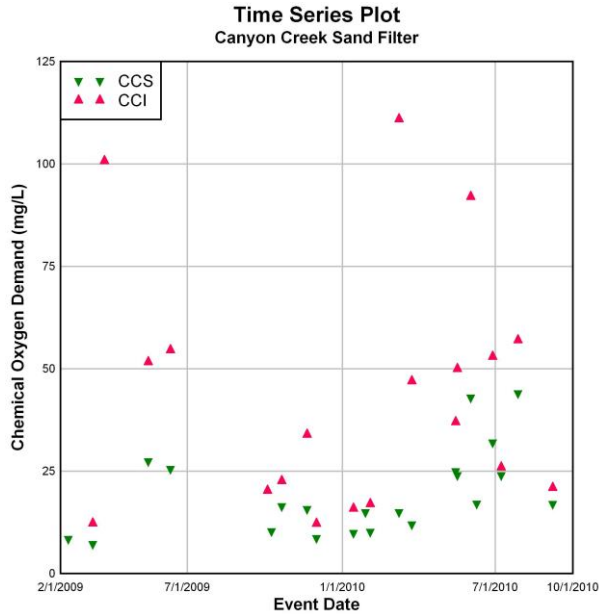


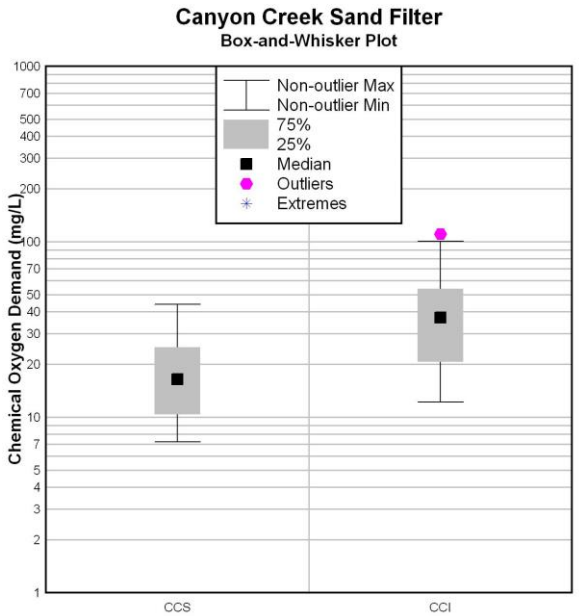


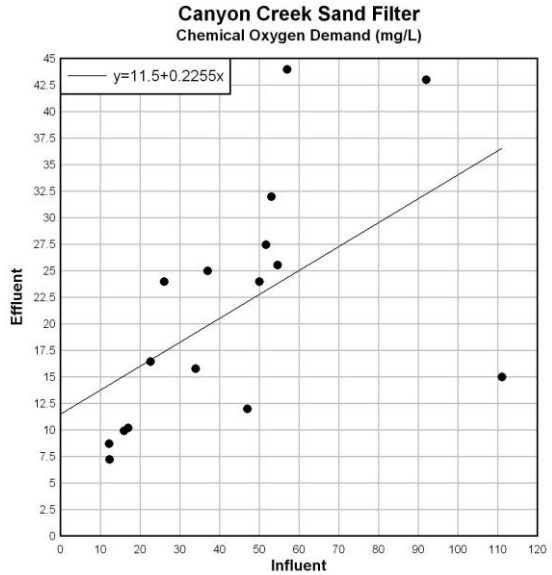
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	66.0	14.1
	Upper Quartile	11.6	2.8
	Median	6.8	1.2
	Lower Quartile	2.9	.6
	Minimum	2.1	.5
	Efficiency	82.22%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	19.6	3.5
	Mean	11.6	2.1
	LCL	3.7	.8
	Std. Dev.	16.6	2.9
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	81.68%	
	t-Test (equal var.)	0.0135 **	
	t-Test (unequal var.)	0.0232 **	
	t-test (paired)	0.0320 **	
	Levene Test	0.1087	
Log Transformed	UCL	18.3	3.1
	Mean	10.3	2.0
	LCL	5.8	1.2
	Std. Dev.	11.5	1.9
	Wilk (p-value)	0.0498 **	0.0487 **
	Efficiency	81.08%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.6926	
Bootstrap	UCL	18.7	3.3
	Mean	11.5	2.1
	LCL	4.2	1.0
	Std. Dev.	15.0	2.6
	Efficiency	81.37%	

Canyon Creek Sand Filter -- Chemical Oxygen Demand (mg/L)



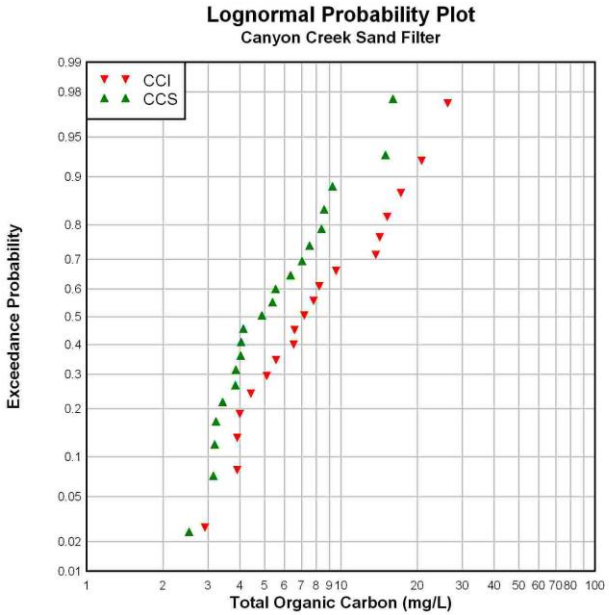


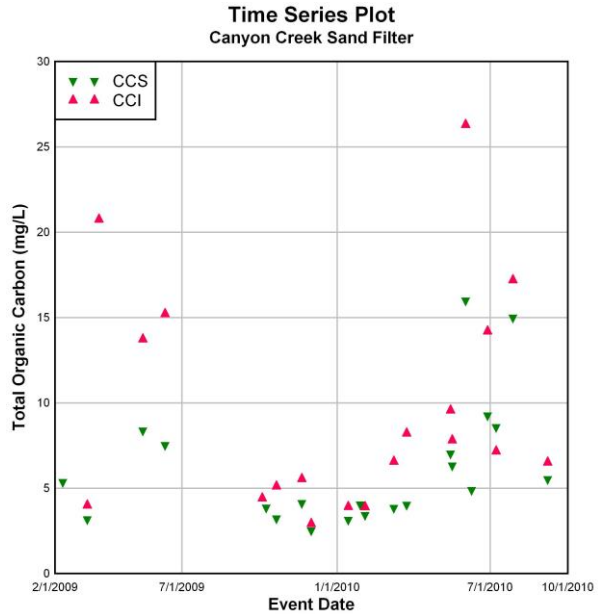


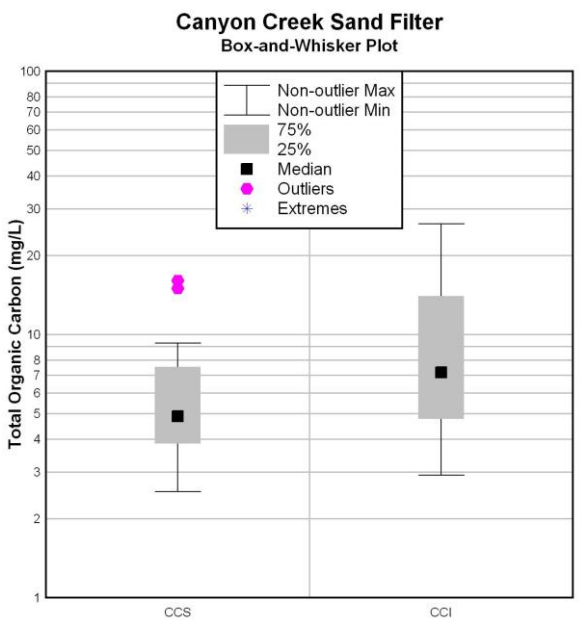


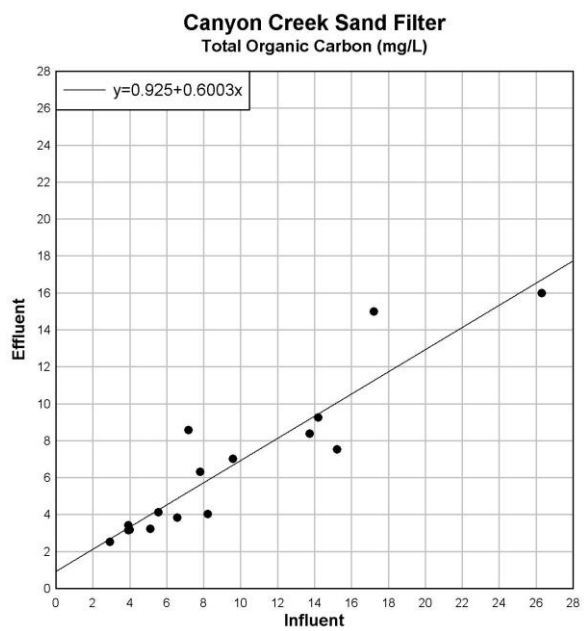
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	111.00	44.00
	Upper Quartile	54.60	25.00
	Median	37.00	16.43
	Lower Quartile	20.28	10.34
	Minimum	12.19	7.21
	Efficiency	55.60%	
	Mann-Whitney	0.0026 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	58.35	24.28
	Mean	43.97	19.44
	LCL	29.58	14.60
	Std. Dev.	29.85	10.63
	Wilk (p-value)	0.0142 **	0.0162 **
	Efficiency	55.79%	
	t-Test (equal var.)	0.0011 **	
	t-Test (unequal var.)	0.0026 **	
	t-test (paired)	0.0020 **	
	Levene Test	0.0089 **	
Log Transformed	UCL	64.04	25.09
	Mean	44.17	19.40
	LCL	30.46	15.00
	Std. Dev.	32.69	10.70
	Wilk (p-value)	0.3728	0.5008
	Efficiency	56.07%	
	t-Test (equal var.)	0.0005 **	
	t-Test (unequal var.)	0.0007 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1186	
Bootstrap	UCL	57.40	24.20
	Mean	43.67	19.52
	LCL	29.93	14.84
	Std. Dev.	28.50	10.29
	Efficiency	55.30%	

Canyon Creek Sand Filter -- Total Organic Carbon (mg/L)



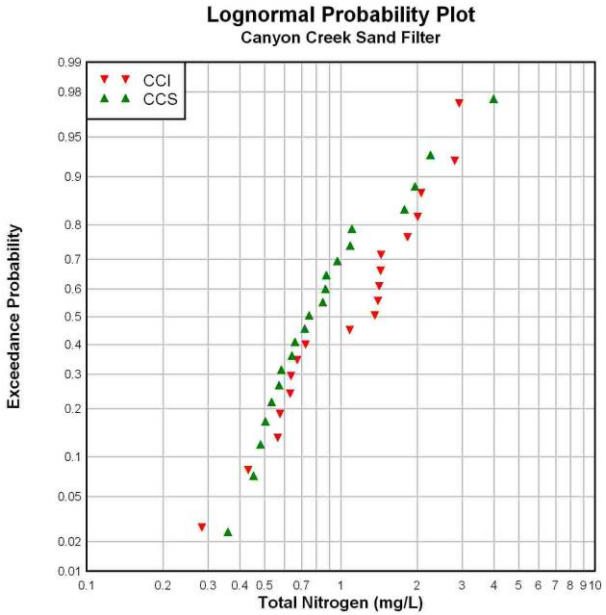


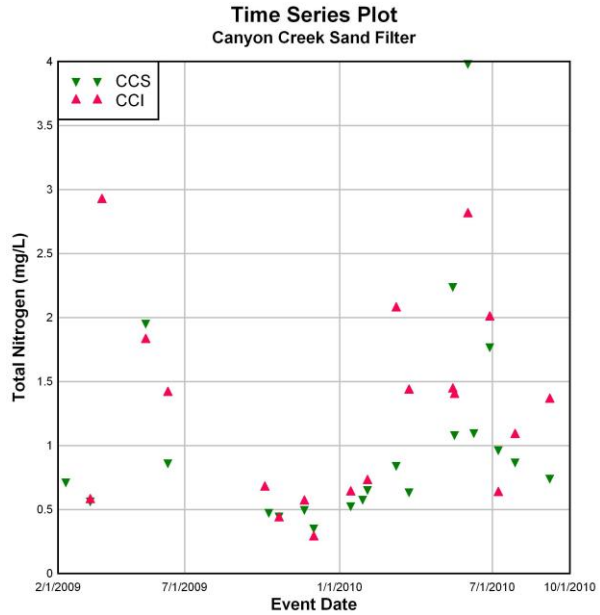


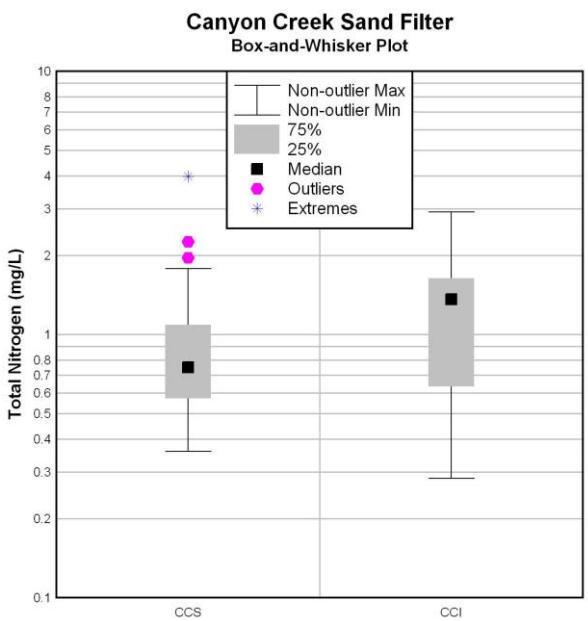


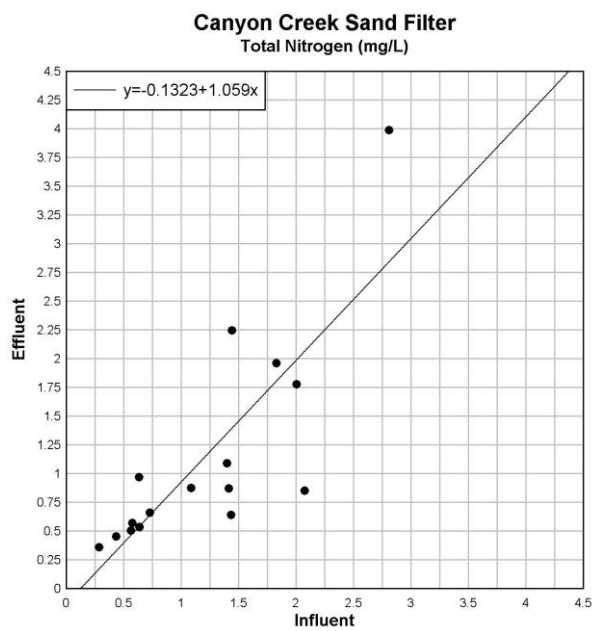
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	26.30	16.00
	Upper Quartile	14.20	7.53
	Median	7.17	4.89
	Lower Quartile	4.42	3.85
	Minimum	2.91	2.53
	Efficiency	31.73%	
	Mann-Whitney	0.0618 *	
	Wilcoxon (paired)	0.0003 **	
Arithmetic	UCL	12.77	7.84
	Mean	9.63	6.16
	LCL	6.49	4.48
	Std. Dev.	6.52	3.68
	Wilk (p-value)	0.0091 **	0.0007 **
	Efficiency	36.04%	
	t-Test (equal var.)	0.0424 **	
	t-Test (unequal var.)	0.0504 *	
	t-test (paired)	0.0017 **	
	Levene Test	0.0779 *	
Log Transformed	UCL	13.41	7.80
	Mean	9.57	6.09
	LCL	6.82	4.75
	Std. Dev.	6.47	3.24
	Wilk (p-value)	0.5044	0.1771
	Efficiency	36.38%	
	t-Test (equal var.)	0.0401 **	
	t-Test (unequal var.)	0.0429 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2404	
Bootstrap	UCL	12.57	7.80
	Mean	9.58	6.20
	LCL	6.60	4.60
	Std. Dev.	6.19	3.52
	Efficiency	35.32%	

Canyon Creek Sand Filter -- Total Nitrogen (mg/L)



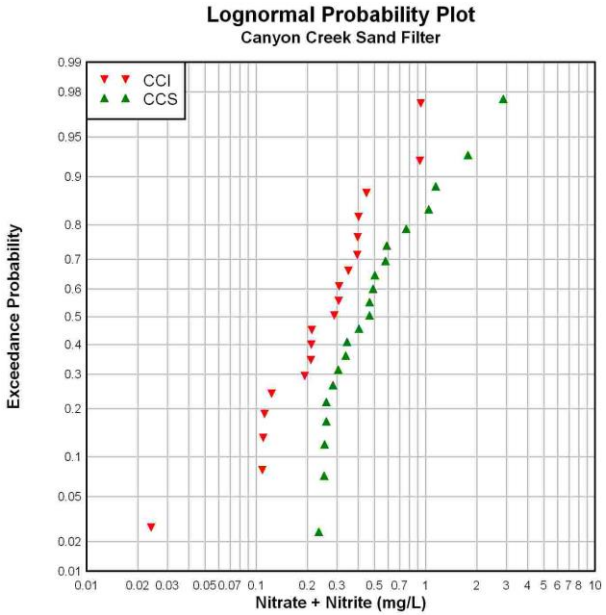


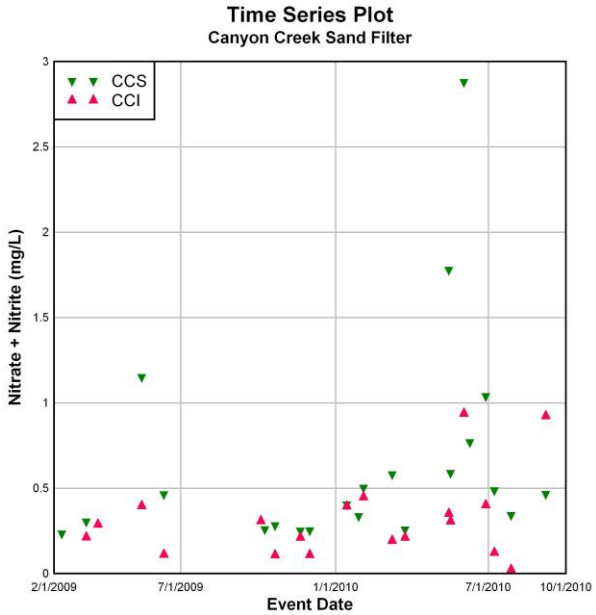


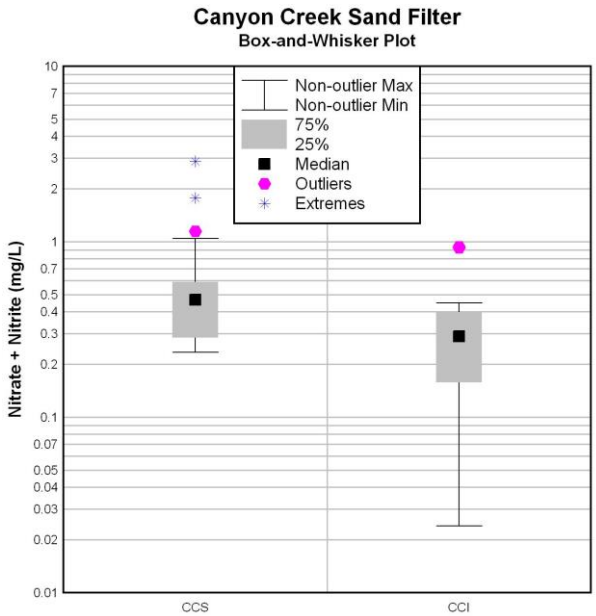


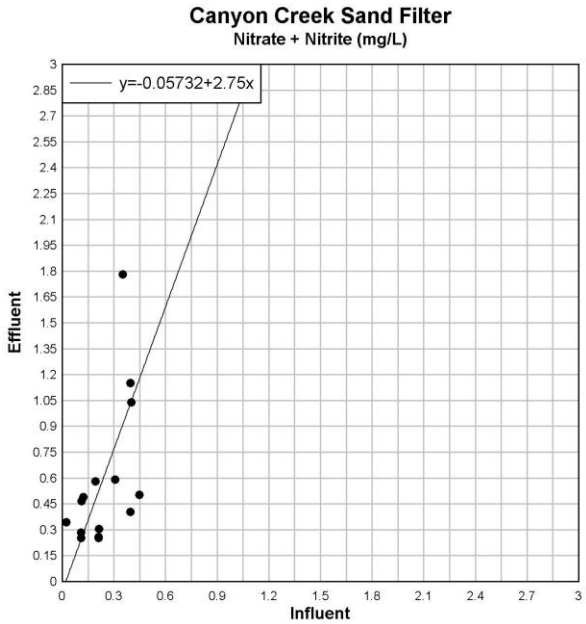
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	2.920	3.990
	Upper Quartile	1.827	1.088
	Median	1.361	0.750
	Lower Quartile	0.632	0.570
	Minimum	0.284	0.359
	Efficiency	44.89%	
	Mann-Whitney	0.2736	
	Wilcoxon (paired)	0.4954	
Arithmetic	UCL	1.652	1.431
	Mean	1.278	1.047
	LCL	0.904	0.663
	Std. Dev.	0.776	0.843
	Wilk (p-value)	0.0691 *	0.0001 **
	Efficiency	18.06%	
	t-Test (equal var.)	0.3751	
	t-Test (unequal var.)	0.3731	
	t-test (paired)	0.6707	
	Levene Test	0.8150	
Log Transformed	UCL	1.835	1.364
	Mean	1.294	1.013
	LCL	0.912	0.753
	Std. Dev.	0.904	0.642
	Wilk (p-value)	0.4400	0.1039
	Efficiency	21.67%	
	t-Test (equal var.)	0.2909	
	t-Test (unequal var.)	0.2934	
	t-Test (paired)	0.3266	
	Levene Test	0.6772	
Bootstrap	UCL	1.631	1.409
	Mean	1.274	1.052
	LCL	0.918	0.696
	Std. Dev.	0.740	0.783
	Efficiency	17.42%	

Canyon Creek Sand Filter -- Nitrate + Nitrite (mg/L)



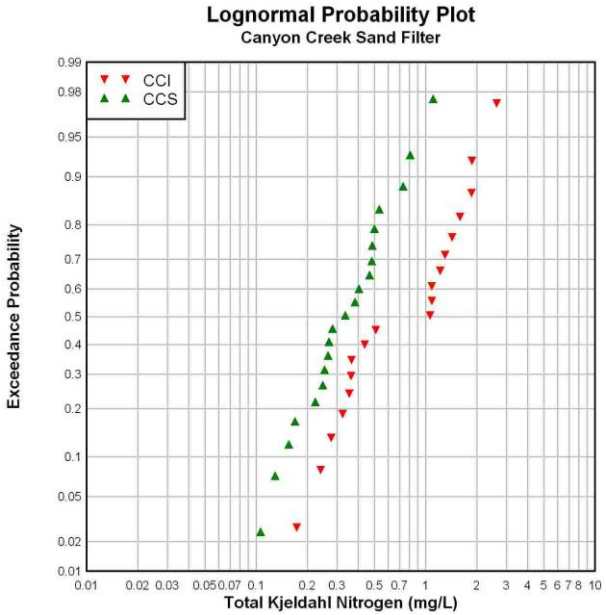


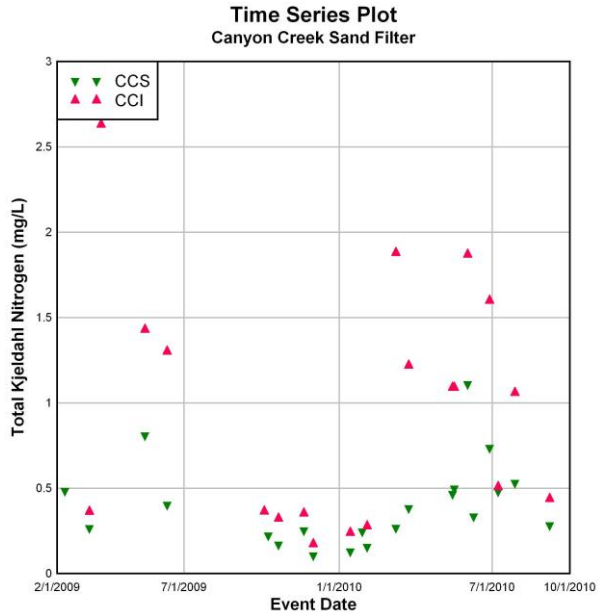


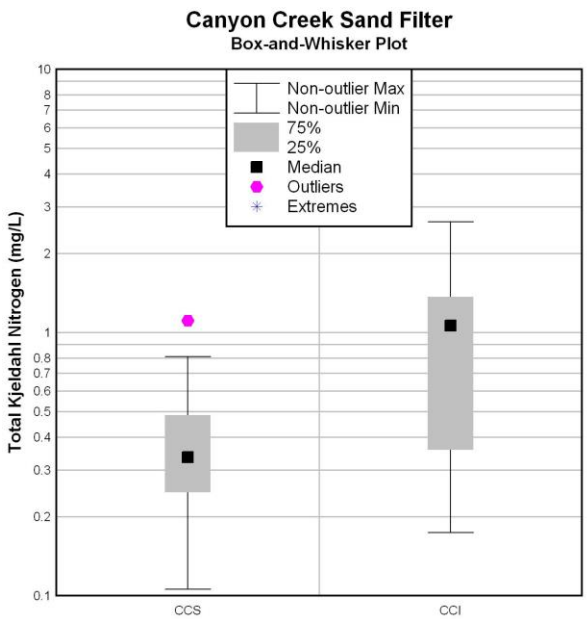


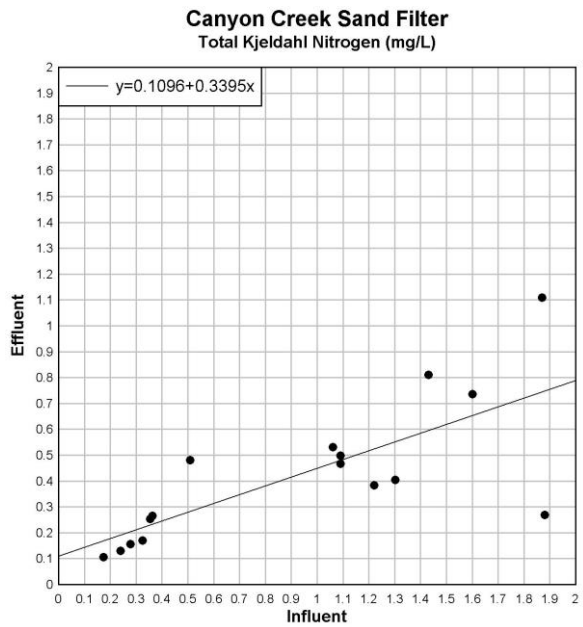
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	0.938	2.880
	Upper Quartile	0.397	0.590
	Median	0.289	0.466
	Lower Quartile	0.123	0.284
	Minimum	0.024	0.235
	Efficiency	-61.01%	
	Mann-Whitney	0.0107 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.438	0.939
	Mean	0.319	0.650
	LCL	0.201	0.360
	Std. Dev.	0.246	0.636
	Wilk (p-value)	0.0017 **	0.0001 **
	Efficiency	-103.55%	
	t-Test (equal var.)	0.0402 **	
	t-Test (unequal var.)	0.0363 **	
	t-test (paired)	0.0052 **	
	Levene Test	0.1983	
Log Transformed	UCL	0.539	0.873
	Mean	0.335	0.615
	LCL	0.208	0.434
	Std. Dev.	0.313	0.455
	Wilk (p-value)	0.1454	0.0177 **
	Efficiency	-83.93%	
	t-Test (equal var.)	0.0052 **	
	t-Test (unequal var.)	0.0059 **	
	t-Test (paired)	0.0001 **	
	Levene Test	0.4849	
Bootstrap	UCL	0.436	0.920
	Mean	0.322	0.653
	LCL	0.209	0.386
	Std. Dev.	0.235	0.587
	Efficiency	-102.69%	

Canyon Creek Sand Filter -- Total Kjeldahl Nitrogen (mg/L)



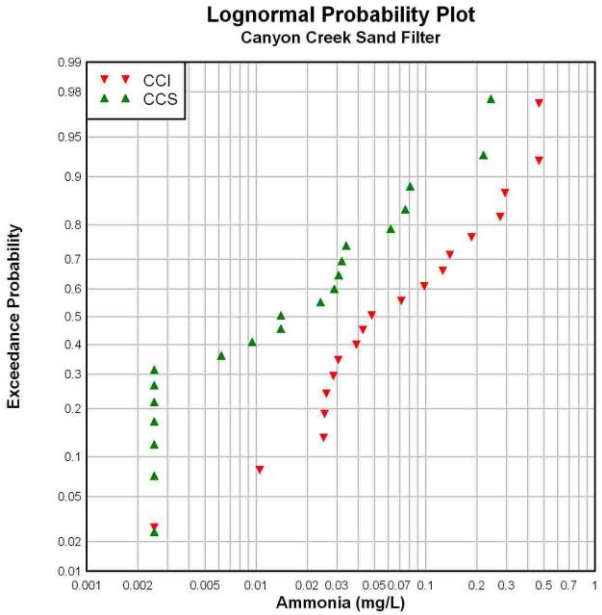


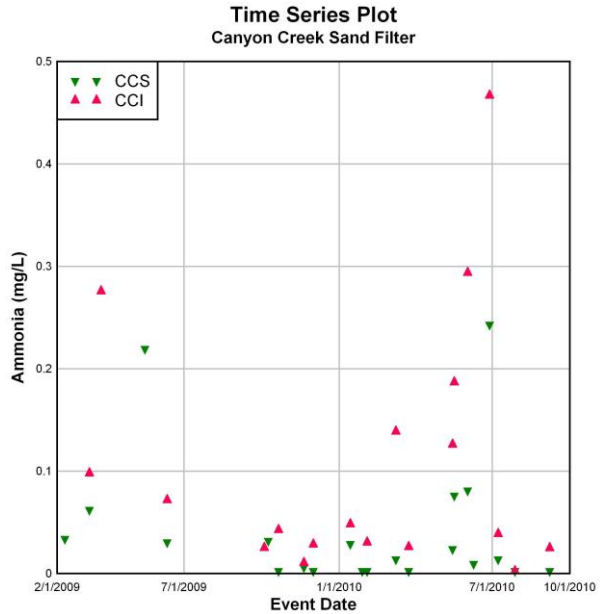


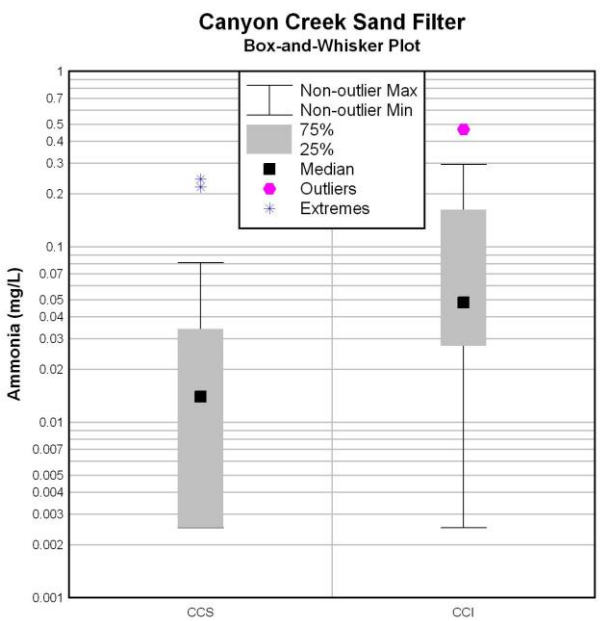


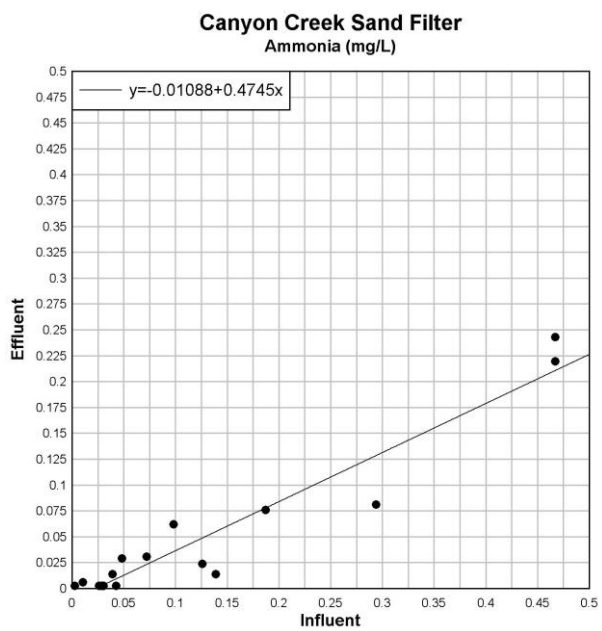
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	2.631	1.110
	Upper Quartile	1.430	0.485
	Median	1.060	0.335
	Lower Quartile	0.353	0.247
	Minimum	0.174	0.106
	Efficiency	68.36%	
	Mann-Whitney	0.0114 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	1.297	0.510
	Mean	0.959	0.397
	LCL	0.620	0.284
	Std. Dev.	0.703	0.248
	Wilk (p-value)	0.0345 **	0.0146 **
	Efficiency	58.55%	
	t-Test (equal var.)	0.0014 **	
	t-Test (unequal var.)	0.0032 **	
	t-test (paired)	0.0004 **	
	Levene Test	0.0049 **	
Log Transformed	UCL	1.564	0.538
	Mean	0.982	0.398
	LCL	0.617	0.294
	Std. Dev.	0.899	0.256
	Wilk (p-value)	0.1288	0.9740
	Efficiency	59.48%	
	t-Test (equal var.)	0.0020 **	
	t-Test (unequal var.)	0.0025 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0565 *	
Bootstrap	UCL	1.275	0.507
	Mean	0.952	0.399
	LCL	0.629	0.291
	Std. Dev.	0.670	0.237
	Efficiency	58.07%	

Canyon Creek Sand Filter -- Ammonia (mg/L)



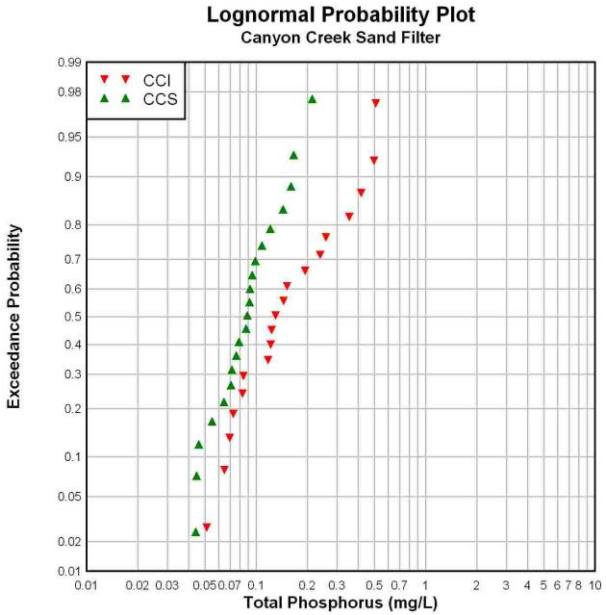


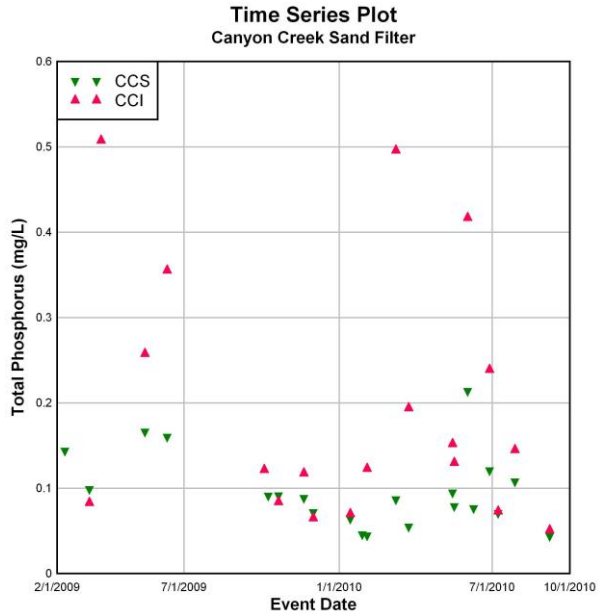


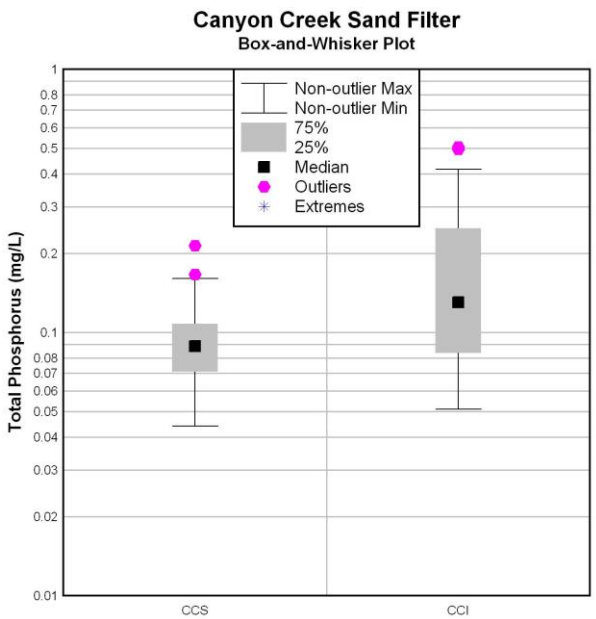


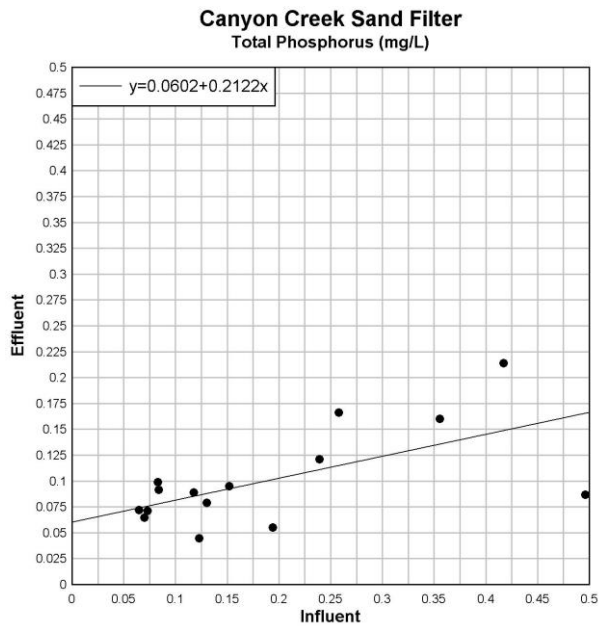
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	0.467	0.243
	Upper Quartile	0.187	0.034
	Median	0.048	0.014
	Lower Quartile	0.026	0.003
	Minimum	0.003	0.003
	Efficiency	70.97%	
	Mann-Whitney	0.0108 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	0.197	0.073
	Mean	0.127	0.042
	LCL	0.056	0.012
	Std. Dev.	0.147	0.067
	Wilk (p-value)	0.0004 **	0.0001 **
	Efficiency	66.42%	
	t-Test (equal var.)	0.0234 **	
	t-Test (unequal var.)	0.0312 **	
	t-test (paired)	0.0017 **	
	Levene Test	0.0471 **	
Log Transformed	UCL	0.355	0.128
	Mean	0.143	0.044
	LCL	0.057	0.015
	Std. Dev.	0.248	0.098
	Wilk (p-value)	0.4731	0.0249 **
	Efficiency	69.11%	
	t-Test (equal var.)	0.0035 **	
	t-Test (unequal var.)	0.0033 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.4376	
Bootstrap	UCL	0.193	0.071
	Mean	0.126	0.043
	LCL	0.059	0.014
	Std. Dev.	0.140	0.063
	Efficiency	66.25%	

Canyon Creek Sand Filter--Total Phosphorus (mg/L)



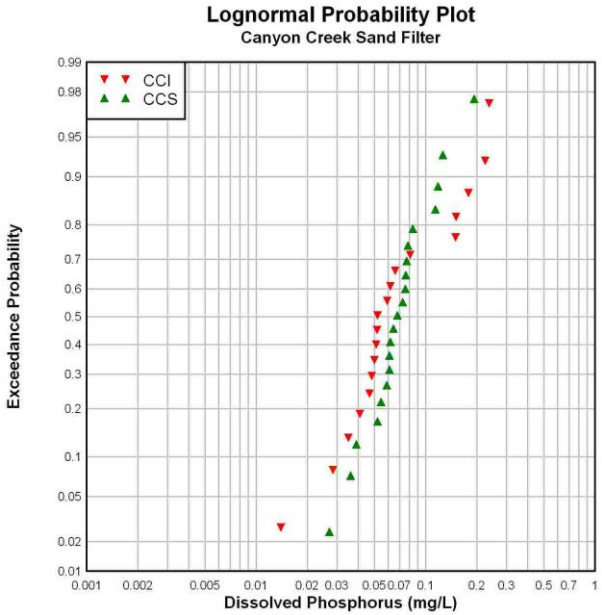


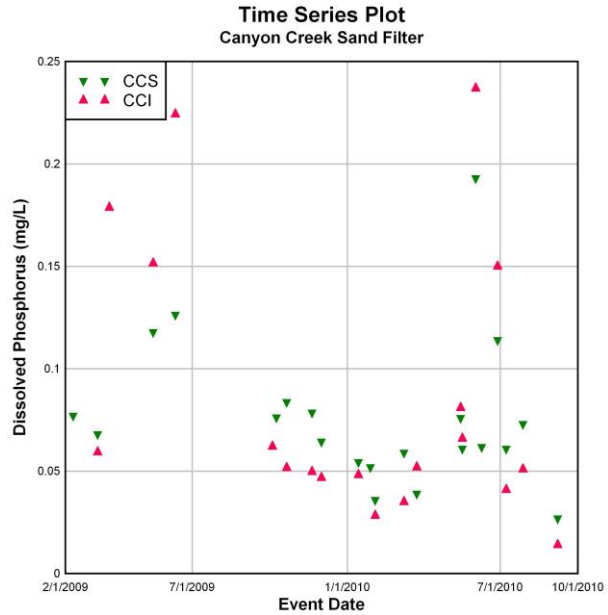


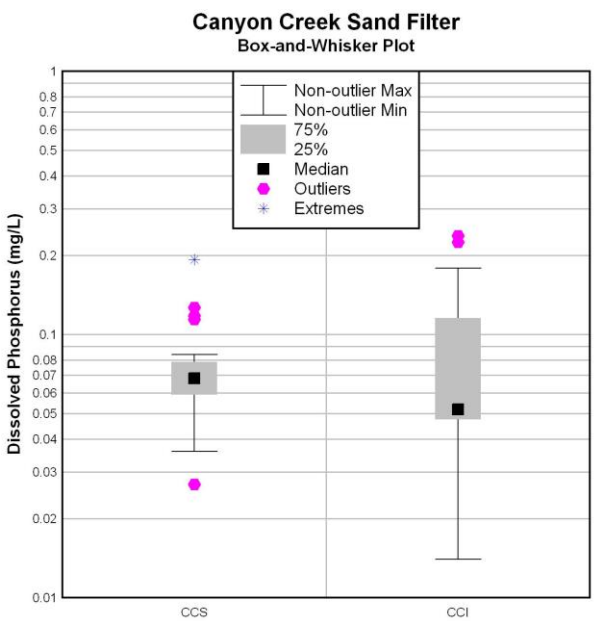


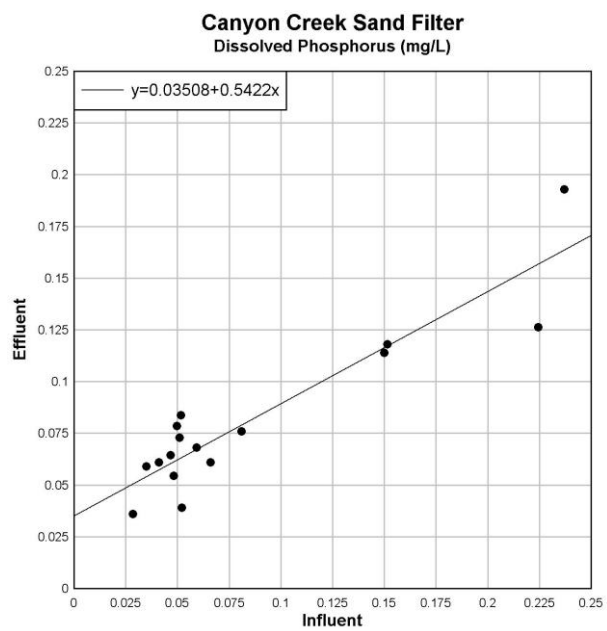
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	15	15
Non-Parametric	Maximum	0.508	0.214
	Upper Quartile	0.258	0.108
	Median	0.130	0.089
	Lower Quartile	0.083	0.071
	Minimum	0.051	0.044
	Efficiency	31.70%	
	Mann-Whitney	0.0236 **	
	Wilcoxon (paired)	0.0043 **	
Arithmetic	UCL	0.264	0.116
	Mean	0.194	0.096
	LCL	0.123	0.076
	Std. Dev.	0.147	0.044
	Wilk (p-value)	0.0023 **	0.0310 **
	Efficiency	50.38%	
	t-Test (equal var.)	0.0060 **	
	t-Test (unequal var.)	0.0110 **	
	t-test (paired)	0.0084 **	
	Levene Test	0.0055 **	
Log Transformed	UCL	0.282	0.118
	Mean	0.192	0.096
	LCL	0.130	0.078
	Std. Dev.	0.147	0.043
	Wilk (p-value)	0.2988	0.6827
	Efficiency	49.97%	
	t-Test (equal var.)	0.0053 **	
	t-Test (unequal var.)	0.0072 **	
	t-Test (paired)	0.0029 **	
	Levene Test	0.0154 **	
Bootstrap	UCL	0.259	0.115
	Mean	0.191	0.096
	LCL	0.124	0.076
	Std. Dev.	0.140	0.042
	Efficiency	49.98%	

Canyon Creek Sand Filter -- Dissolved Phosphorus (mg/L)



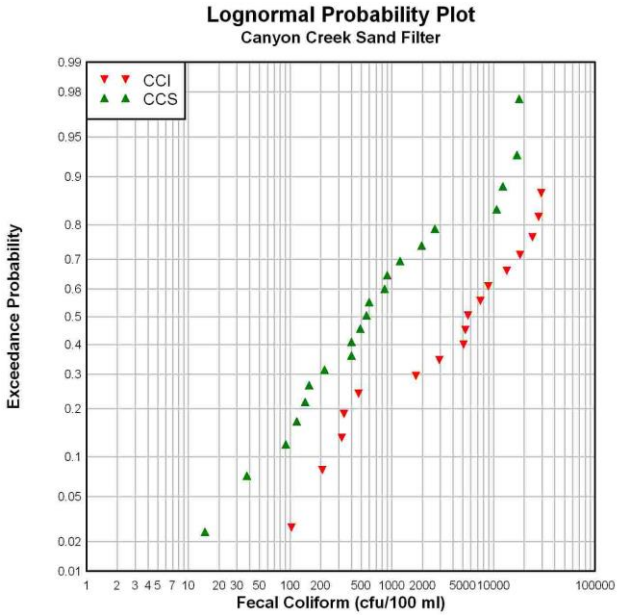


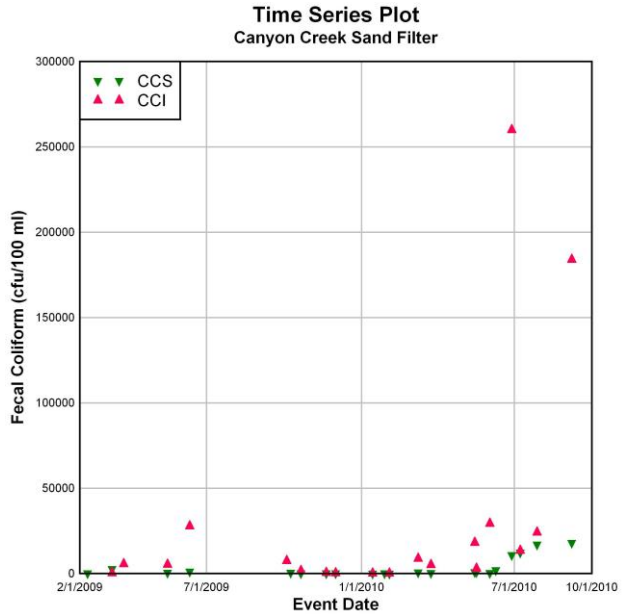


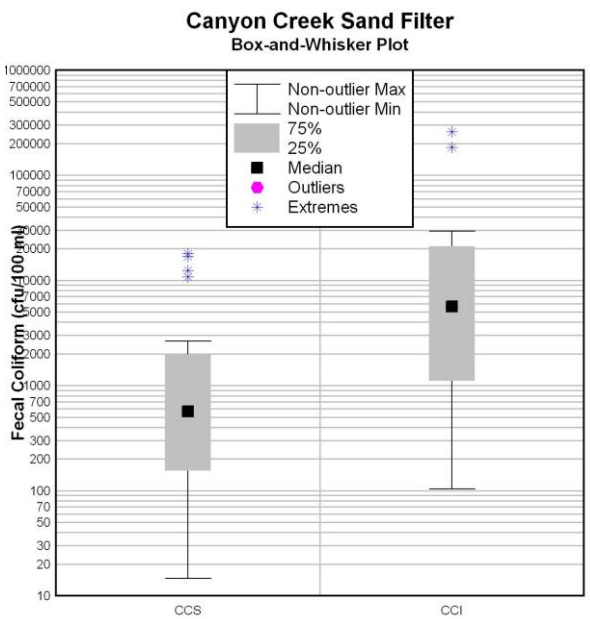


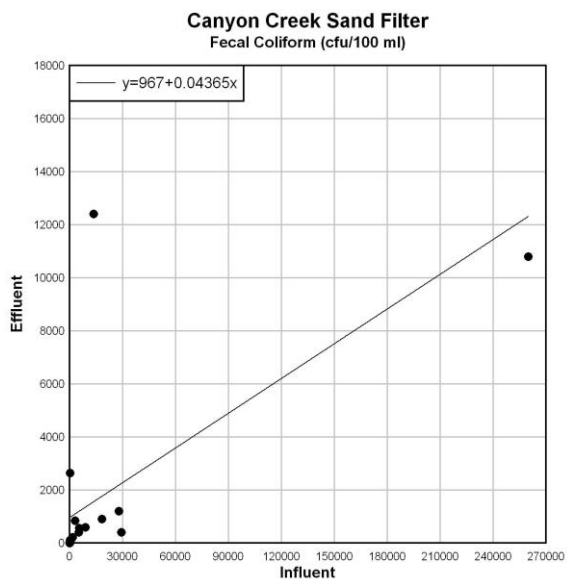
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	0.237	0.193
	Upper Quartile	0.150	0.079
	Median	0.052	0.068
	Lower Quartile	0.047	0.059
	Minimum	0.014	0.027
	Efficiency	-30.97%	
	Mann-Whitney	0.3841	
	Wilcoxon (paired)	0.9699	
Arithmetic	UCL	0.118	0.093
	Mean	0.086	0.076
	LCL	0.053	0.059
	Std. Dev.	0.067	0.037
	Wilk (p-value)	0.0008 **	0.0036 **
	Efficiency	11.07%	
	t-Test (equal var.)	0.5787	
	t-Test (unequal var.)	0.5903	
	t-test (paired)	0.6318	
	Levene Test	0.0567 *	
Log Transformed	UCL	0.127	0.094
	Mean	0.085	0.076
	LCL	0.057	0.062
	Std. Dev.	0.068	0.035
	Wilk (p-value)	0.1738	0.6404
	Efficiency	10.69%	
	t-Test (equal var.)	0.7989	
	t-Test (unequal var.)	0.8041	
	t-Test (paired)	0.3470	
	Levene Test	0.0508 *	
Bootstrap	UCL	0.116	0.092
	Mean	0.085	0.076
	LCL	0.054	0.060
	Std. Dev.	0.064	0.035
	Efficiency	10.47%	

Canyon Creek Sand Filter -- Fecal Coliform (cfu/100 ml)



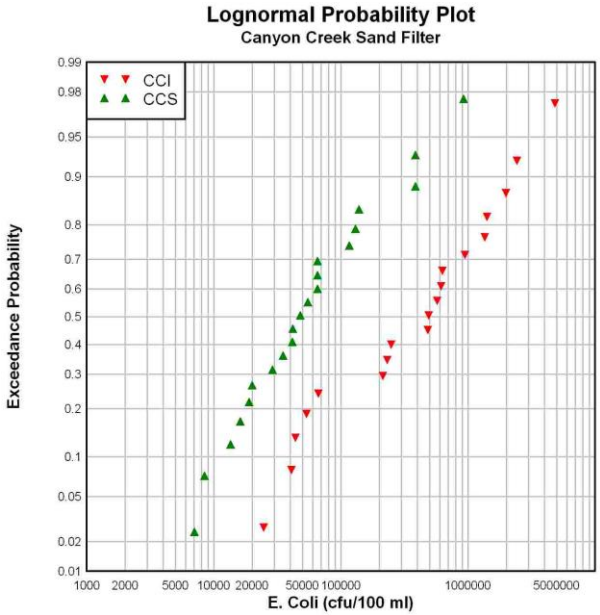


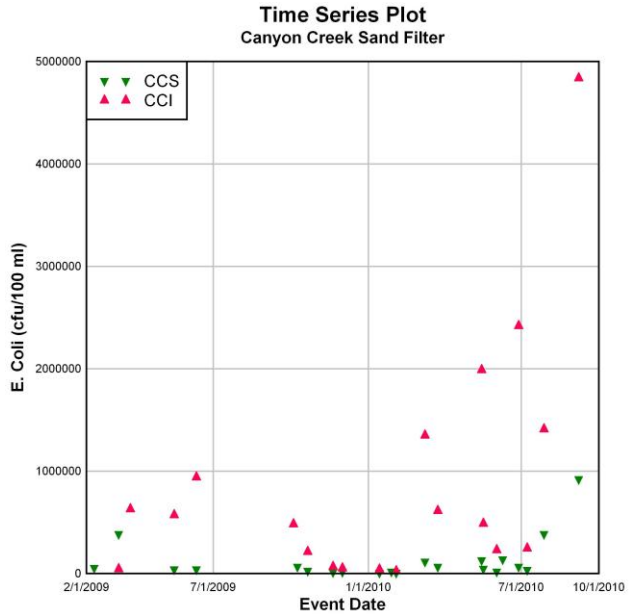


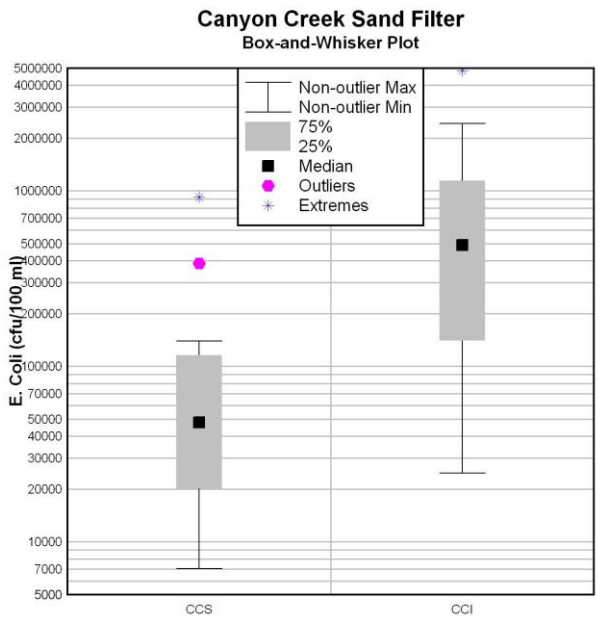


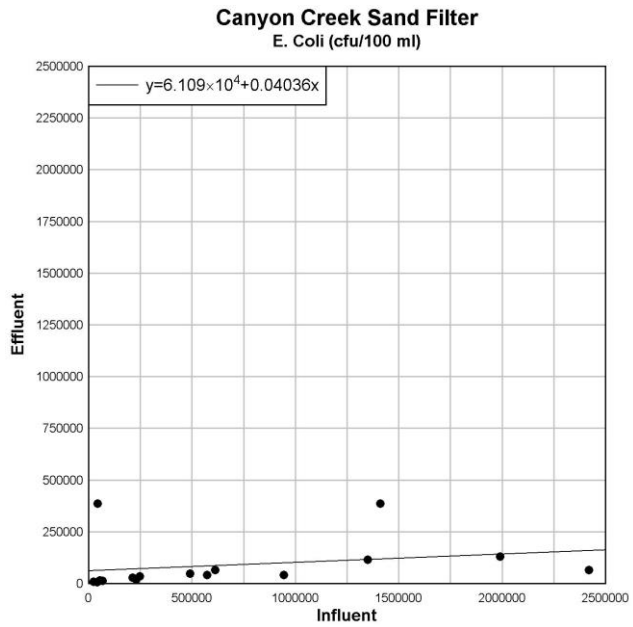
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	260,000	18,000
	Upper Quartile	24,200	1,969
	Median	5,642	567
	Lower Quartile	469	154
	Minimum	104	15
	Efficiency	89.94%	
	Mann-Whitney	0.0150 **	
	Wilcoxon (paired)	0.0008 **	
Arithmetic	UCL	64,616	5,924
	Mean	31,347	3,286
	LCL	-1,923	647
	Std. Dev.	69,023	5,796
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	89.52%	
	t-Test (equal var.)	0.0709 *	
	t-Test (unequal var.)	0.0941 *	
	t-test (paired)	0.1740	
	Levene Test	0.1133	
Log Transformed	UCL	292,225	17,437
	Mean	39,497	3,655
	LCL	5,338	766
	Std. Dev.	158,204	12,340
	Wilk (p-value)	0.5784	0.5599
	Efficiency	90.74%	
	t-Test (equal var.)	0.0042 **	
	t-Test (unequal var.)	0.0045 **	
	t-Test (paired)	0.0002 **	
	Levene Test	0.5663	
Bootstrap	UCL	63,772	5,960
	Mean	32,785	3,399
	LCL	1,797	839
	Std. Dev.	64,292	5,626
	Efficiency	89.63%	

Canyon Creek Sand Filter -- E. Coli. (cfu/100 ml)



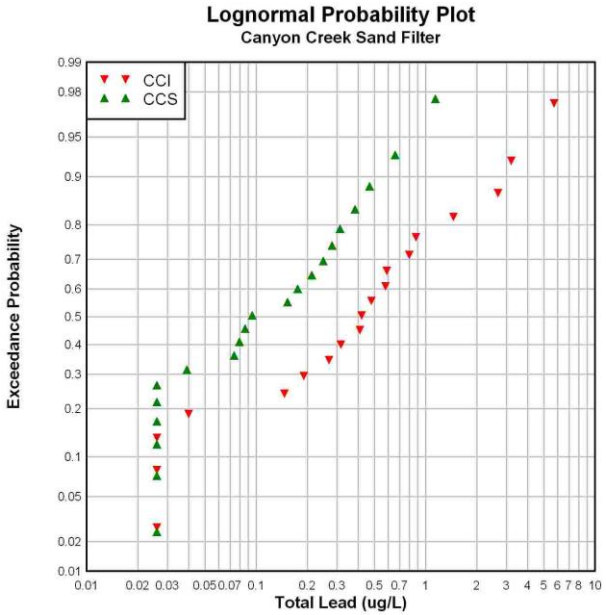


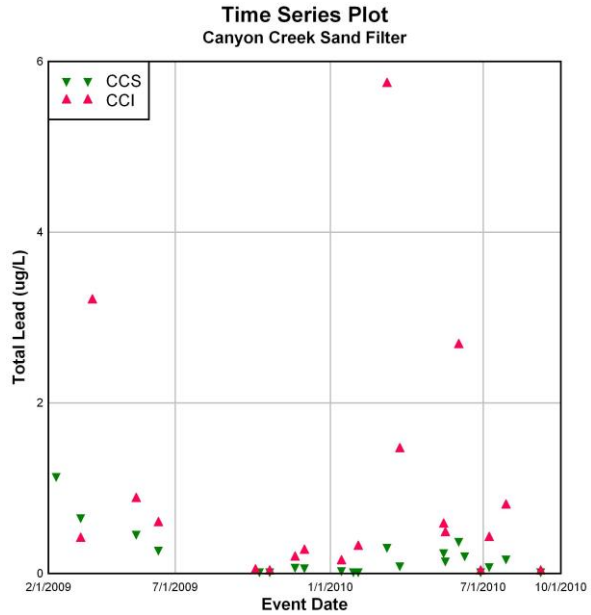


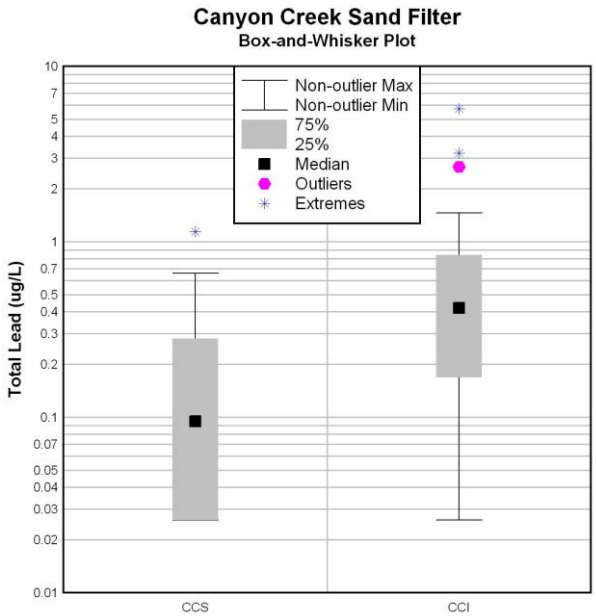


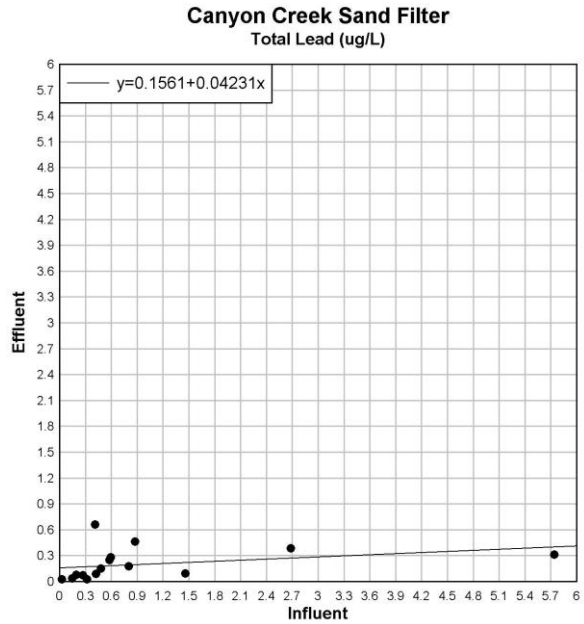
	PARAMETER	E. Coli (cfu/100ml)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	4,839,200	922,000
	Upper Quartile	1,350,000	116,000
	Median	490,000	48,000
	Lower Quartile	66,480	20,100
	Minimum	24,627	7,019
	Efficiency	90.20%	
	Mann-Whitney	0.0011 **	
	Wilcoxon (paired)	0.0008 **	
Arithmetic	UCL	1,445,782	220,865
	Mean	876,970	124,358
	LCL	308,157	27,852
	Std. Dev.	1,180,102	212,008
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	85.82%	
	t-Test (equal var.)	0.0066 **	
	t-Test (unequal var.)	0.0130 **	
	t-test (paired)	0.0062 **	
	Levene Test	0.1051	
Log Transformed	UCL	3,155,796	243,016
	Mean	1,044,118	111,409
	LCL	345,454	51,075
	Std. Dev.	2,206,700	179,263
	Wilk (p-value)	0.4241	0.6376
	Efficiency	89.33%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.3158	
Bootstrap	UCL	1,444,478	218,384
	Mean	902,001	127,533
	LCL	359,523	36,682
	Std. Dev.	1,125,508	199,586
	Efficiency	85.86%	

Canyon Creek Sand Filter -- Total Lead (ug/L)



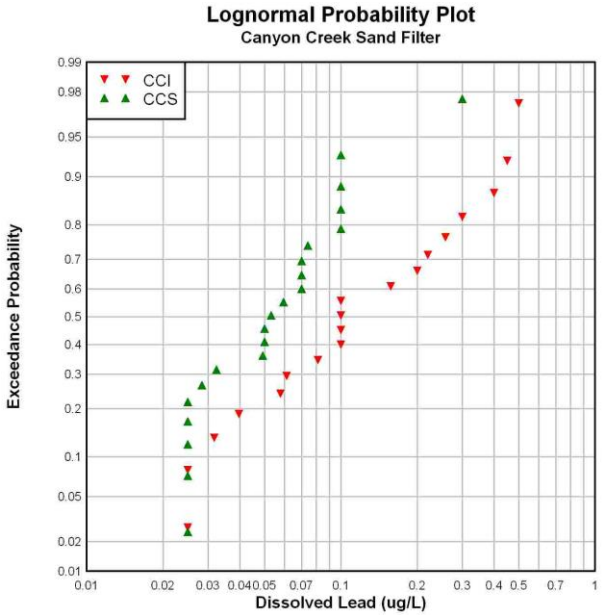


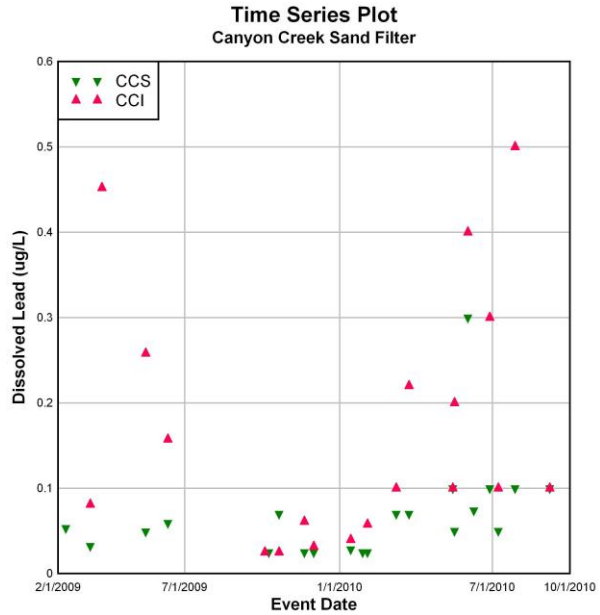


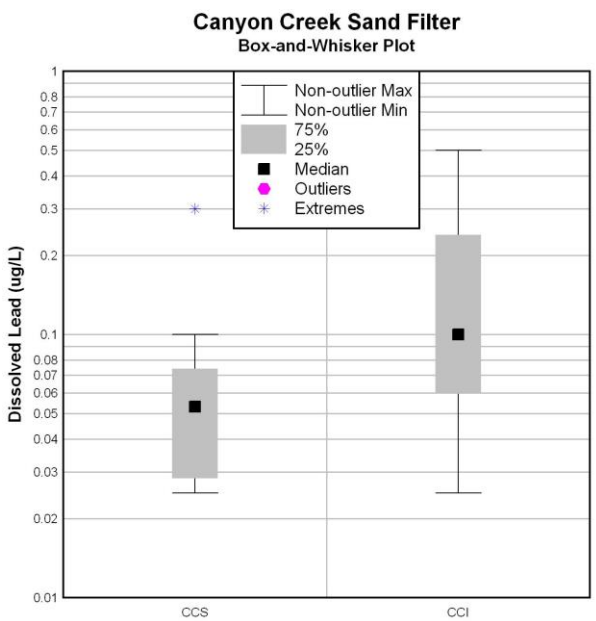


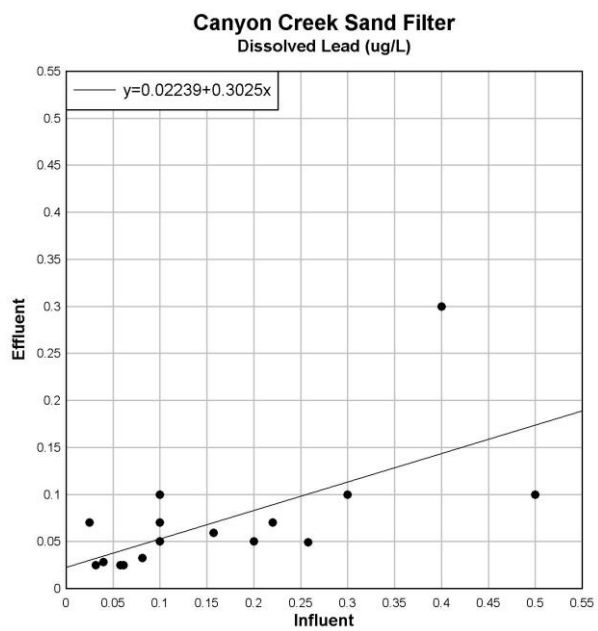
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	5.7	1.1
	Upper Quartile	0.9	0.3
	Median	0.4	0.1
	Lower Quartile	0.1	0.0
	Minimum	0.0	0.0
	Efficiency	77.38%	
	Mann-Whitney	0.0227 **	
	Wilcoxon (paired)	0.0006 **	
Arithmetic	UCL	1.7	0.3
	Mean	1.0	0.2
	LCL	0.3	0.1
	Std. Dev.	1.4	0.3
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	77.39%	
	t-Test (equal var.)	0.0263 **	
	t-Test (unequal var.)	0.0400 **	
	t-test (paired)	0.0495 **	
	Levene Test	0.0977 *	
Log Transformed	UCL	3.8	0.5
	Mean	1.1	0.2
	LCL	0.3	0.1
	Std. Dev.	2.6	0.3
	Wilk (p-value)	0.2618	0.0656 *
	Efficiency	80.62%	
	t-Test (equal var.)	0.0150 **	
	t-Test (unequal var.)	0.0170 **	
	t-Test (paired)	0.0002 **	
	Levene Test	0.1311	
Bootstrap	UCL	1.6	0.3
	Mean	0.9	0.2
	LCL	0.3	0.1
	Std. Dev.	1.3	0.3
	Efficiency	77.16%	

Canyon Creek Sand Filter--- Dissolved Lead (ug/L)



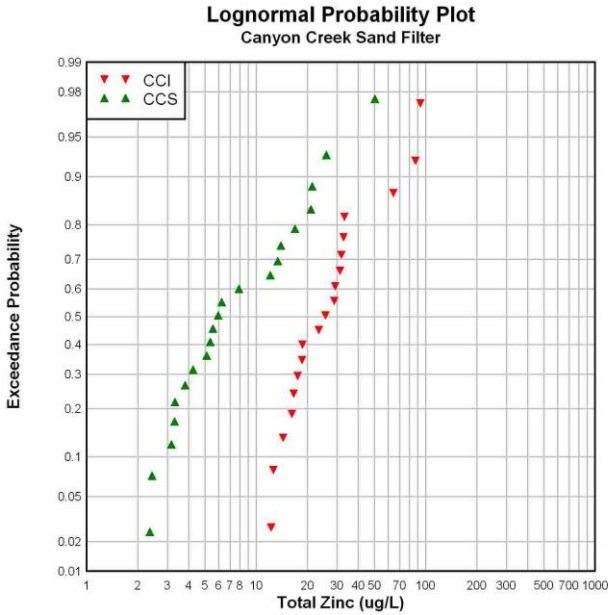


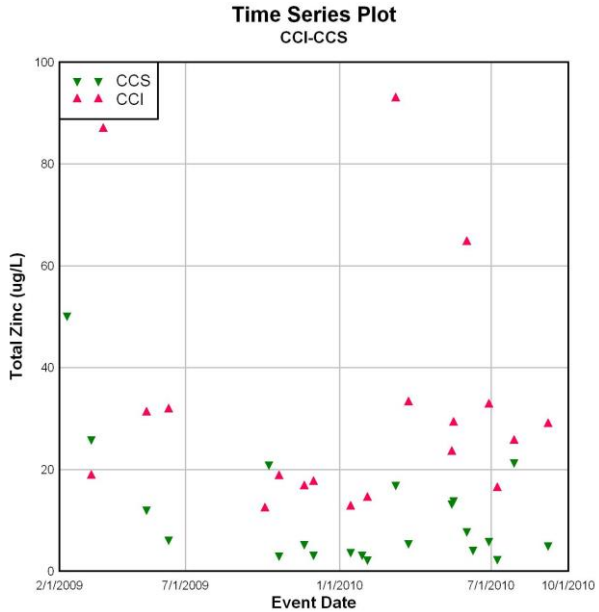


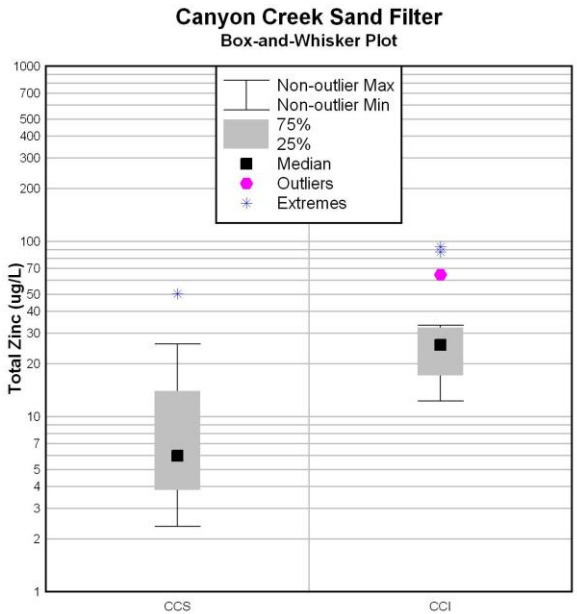


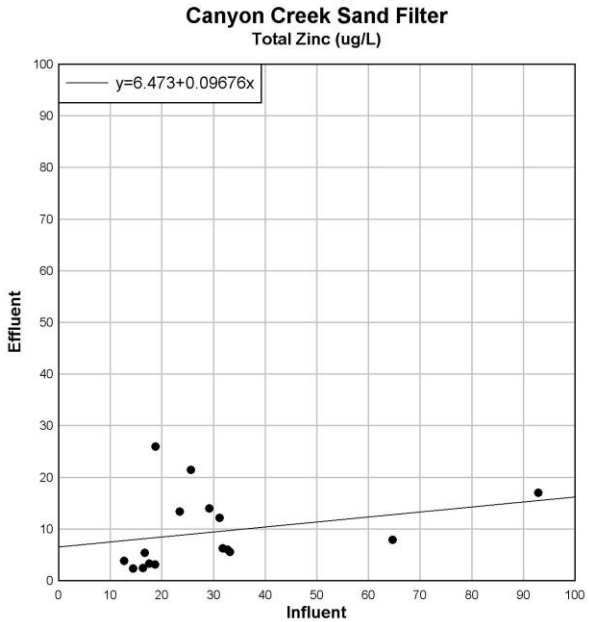
	PARAMETER	Lead, Dissolved (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	0.5	0.3
	Upper Quartile	0.3	0.1
	Median	0.1	0.1
	Lower Quartile	0.1	0.0
	Minimum	0.0	0.0
	Efficiency	46.72%	
	Mann-Whitney	0.0207 **	
	Wilcoxon (paired)	0.0006 **	
Arithmetic	UCL	0.2	0.1
	Mean	0.2	0.1
	LCL	0.1	0.0
	Std. Dev.	0.1	0.1
	Wilk (p-value)	0.0061 **	0.0001 **
	Efficiency	59.62%	
	t-Test (equal var.)	0.0069 **	
	t-Test (unequal var.)	0.0113 **	
	t-test (paired)	0.0044 **	
	Levene Test	0.0143 **	
Log Transformed	UCL	0.3	0.1
	Mean	0.2	0.1
	LCL	0.1	0.0
	Std. Dev.	0.2	0.0
	Wilk (p-value)	0.4101	0.0349 **
	Efficiency	61.83%	
	t-Test (equal var.)	0.0066 **	
	t-Test (unequal var.)	0.0083 **	
	t-Test (paired)	0.0007 **	
	Levene Test	0.0535 *	
Bootstrap	UCL	0.2	0.1
	Mean	0.2	0.1
	LCL	0.1	0.0
	Std. Dev.	0.1	0.1
	Efficiency	59.30%	

Canyon Creek Sand Filter -- Total Zinc (ug/L)



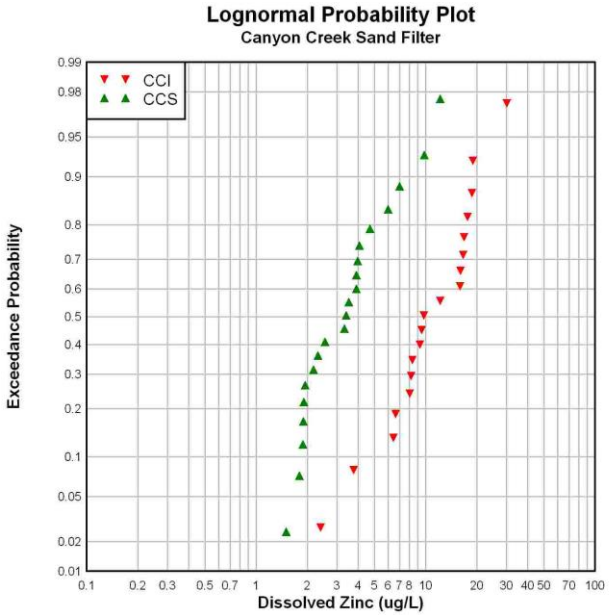


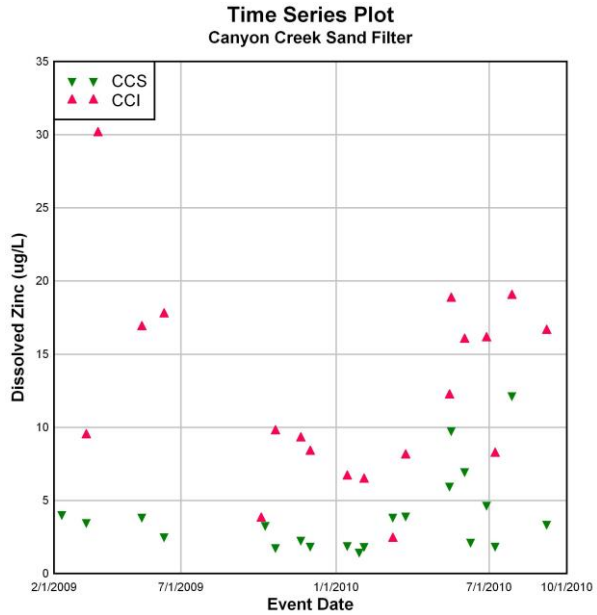


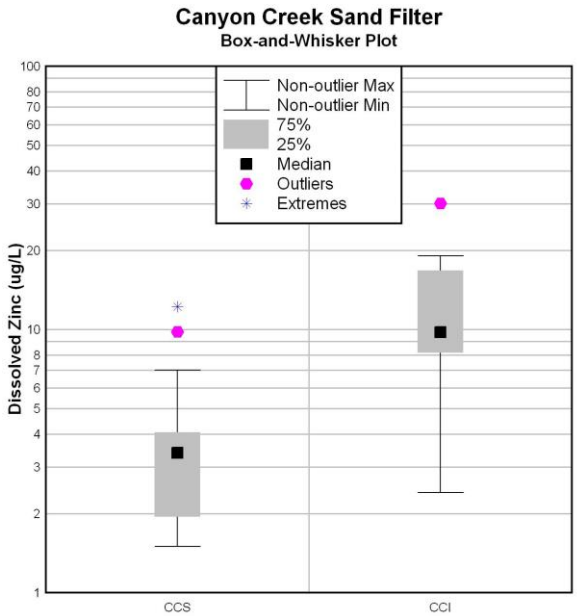


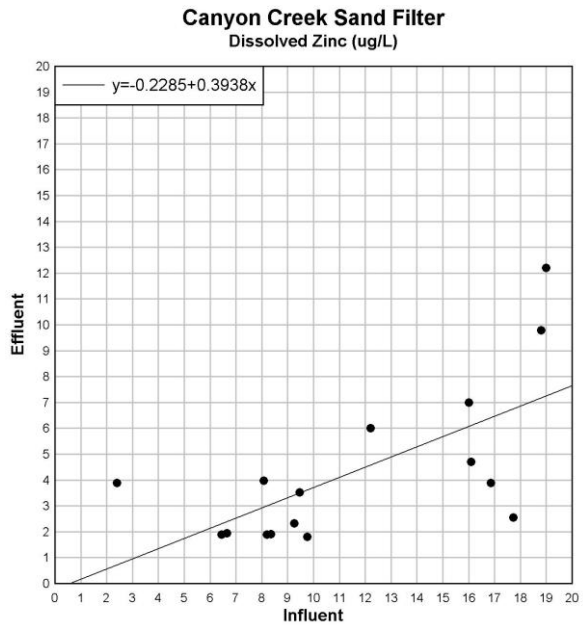
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	92.9	50.3
	Upper Quartile	32.7	14.0
	Median	25.6	6.0
	Lower Quartile	16.7	3.8
	Minimum	12.3	2.4
	Efficiency	76.72%	
	Mann-Whitney	0.0003 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	43.4	16.3
	Mean	32.0	11.1
	LCL	20.6	5.9
	Std. Dev.	23.6	11.4
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	65.18%	
	t-Test (equal var.)	0.0009 **	
	t-Test (unequal var.)	0.0018 **	
	t-test (paired)	0.0010 **	
	Levene Test	0.0972 *	
Log Transformed	UCL	42.6	17.1
	Mean	31.2	10.8
	LCL	22.9	6.8
	Std. Dev.	19.5	10.4
	Wilk (p-value)	0.0567 *	0.2437
	Efficiency	65.45%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0839 *	
Bootstrap	UCL	42.4	16.0
	Mean	31.8	11.1
	LCL	21.1	6.2
	Std. Dev.	22.1	10.7
	Efficiency	65.04%	

Canyon Creek Sand Filter -- Dissolved Zinc (ug/L)



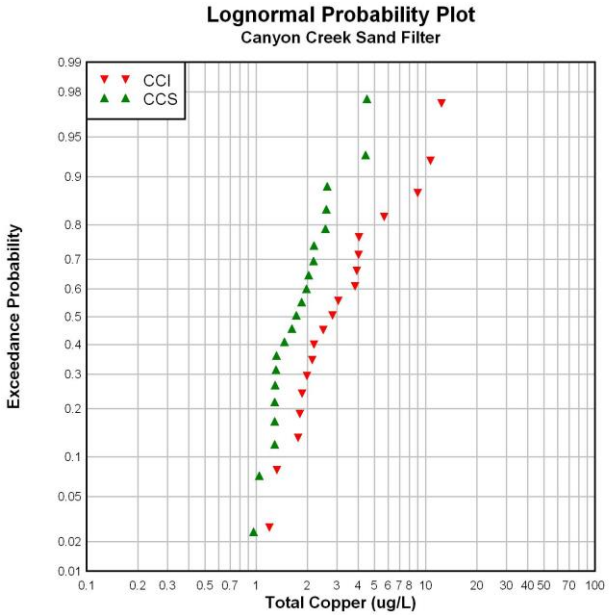


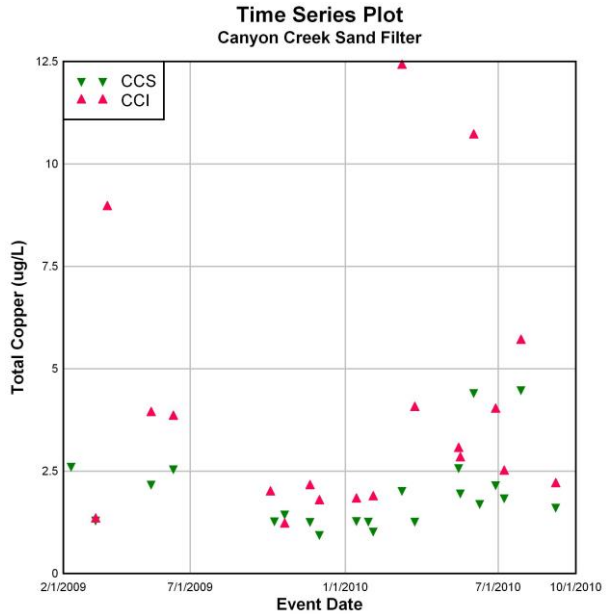


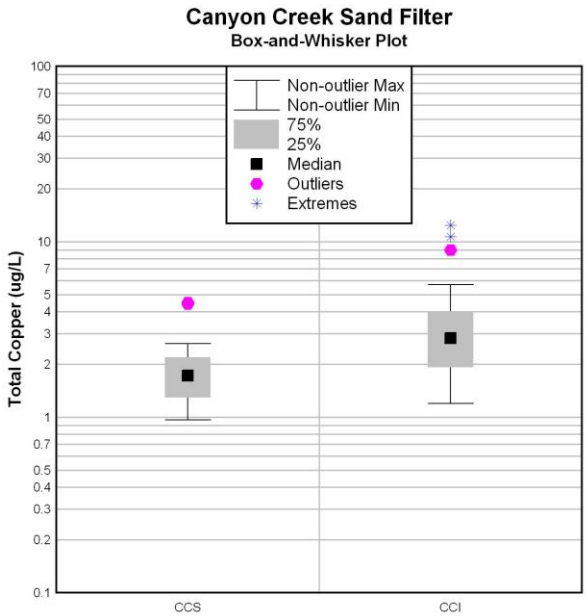


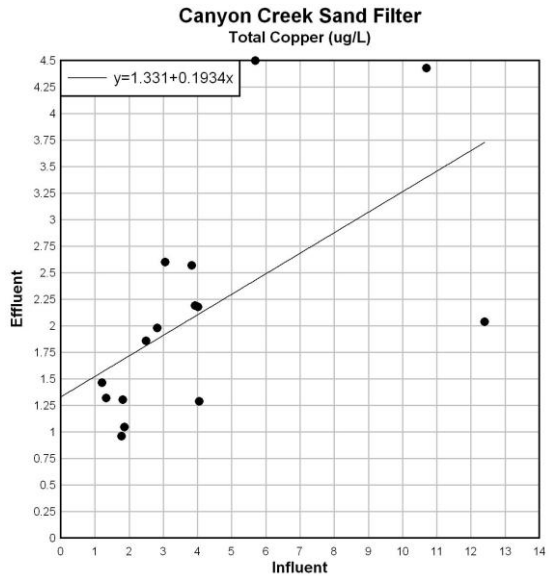
	PARAMETER	Zinc, Dissolved (µg/L)	
Type	Statistic	INF: CCI	EFF: CCS
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	30.1	12.2
	Upper Quartile	16.9	4.1
	Median	9.7	3.4
	Lower Quartile	8.1	1.9
	Minimum	2.4	1.5
	Efficiency	65.13%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	15.6	5.2
	Mean	12.4	4.0
	LCL	9.2	2.7
	Std. Dev.	6.7	2.8
	Wilk (p-value)	0.1440	0.0003 **
	Efficiency	67.85%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0291 **	
Log Transformed	UCL	17.5	5.2
	Mean	12.7	3.9
	LCL	9.2	3.0
	Std. Dev.	8.2	2.4
	Wilk (p-value)	0.2938	0.1494
	Efficiency	69.05%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7858	
Bootstrap	UCL	15.5	5.2
	Mean	12.4	4.0
	LCL	9.3	2.8
	Std. Dev.	6.4	2.6
	Efficiency	67.66%	

Canyon Creek Sand Filter -- Total Copper (ug/L)



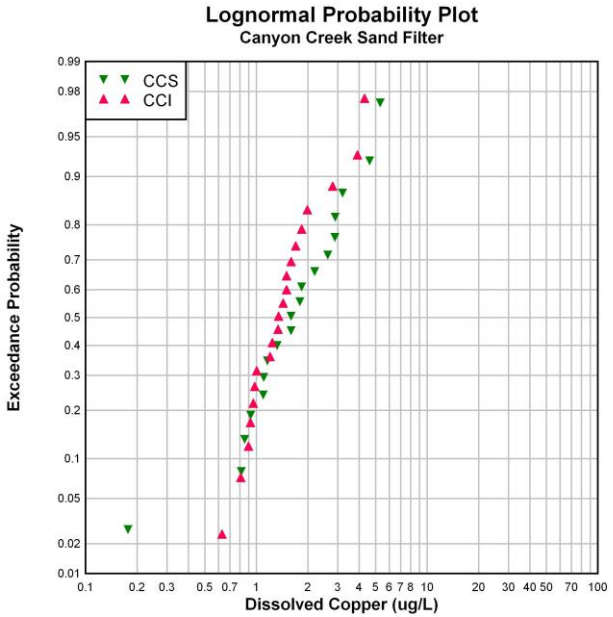


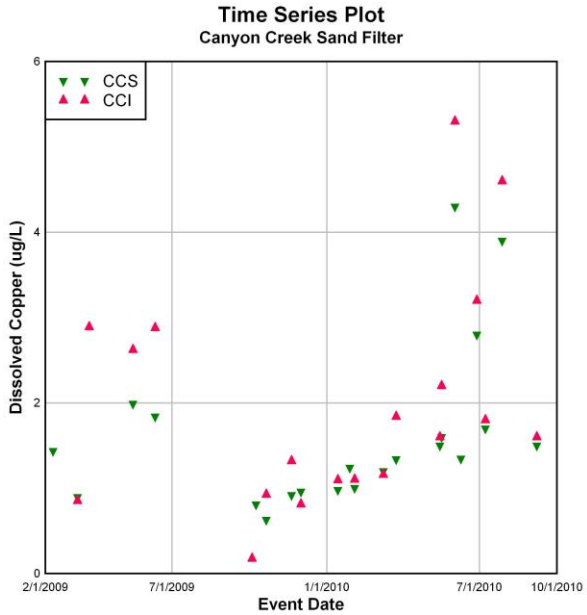


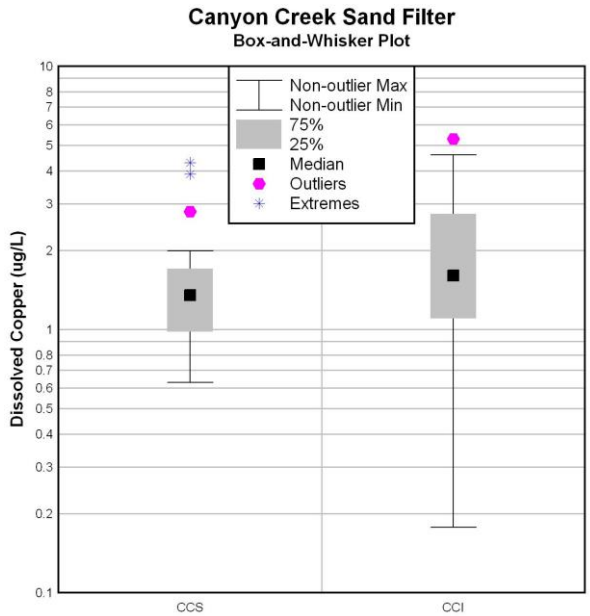


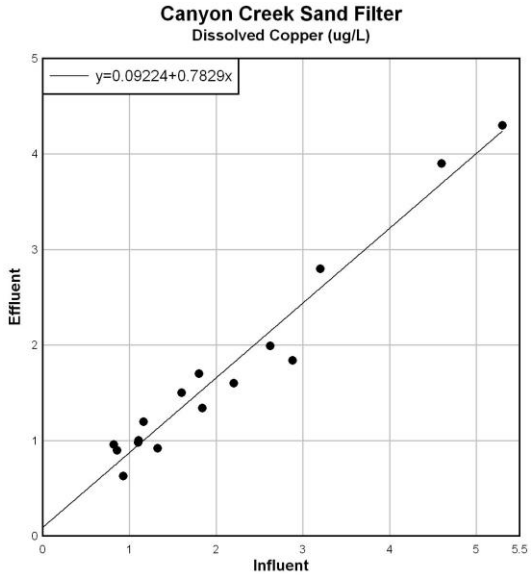
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	15	15
Non-Parametric	Maximum	12.4	4.5
	Upper Quartile	4.1	2.2
	Median	2.8	1.7
	Lower Quartile	1.9	1.3
	Minimum	1.2	1.0
	Efficiency	38.86%	
	Mann-Whitney	0.0100 **	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	5.6	2.4
	Mean	4.0	2.0
	LCL	2.5	1.5
	Std. Dev.	3.2	1.0
	Wilk (p-value)	0.0003 **	0.0007 **
	Efficiency	50.60%	
	t-Test (equal var.)	0.0090 **	
	t-Test (unequal var.)	0.0155 **	
	t-test (paired)	0.0175 **	
	Levene Test	0.0299 **	
Log Transformed	UCL	5.6	2.4
	Mean	3.9	2.0
	LCL	2.7	1.6
	Std. Dev.	2.8	0.9
	Wilk (p-value)	0.1960	0.1268
	Efficiency	49.73%	
	t-Test (equal var.)	0.0029 **	
	t-Test (unequal var.)	0.0041 **	
	t-Test (paired)	0.0010 **	
	Levene Test	0.0517 *	
Bootstrap	UCL	5.5	2.4
	Mean	4.0	2.0
	LCL	2.5	1.6
	Std. Dev.	3.1	0.9
	Efficiency	50.09%	

Canyon Creek Sand Filter -- Dissolved Copper (ug/L)



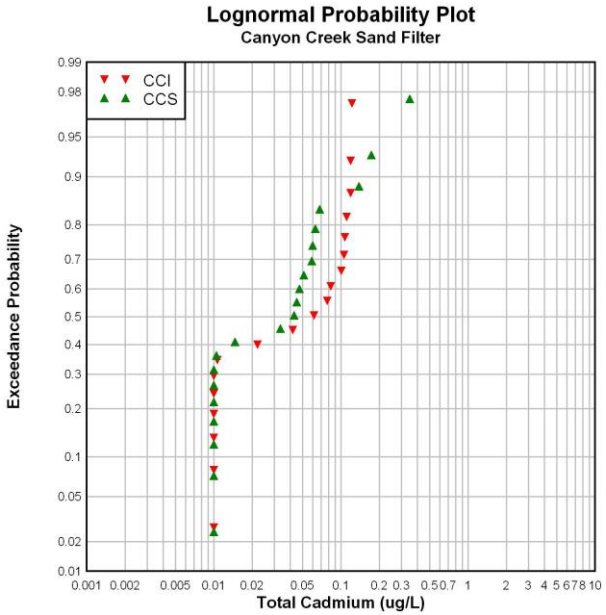


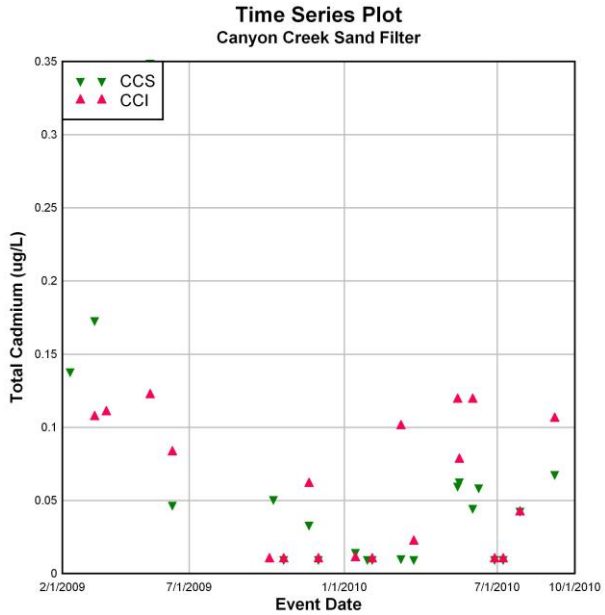


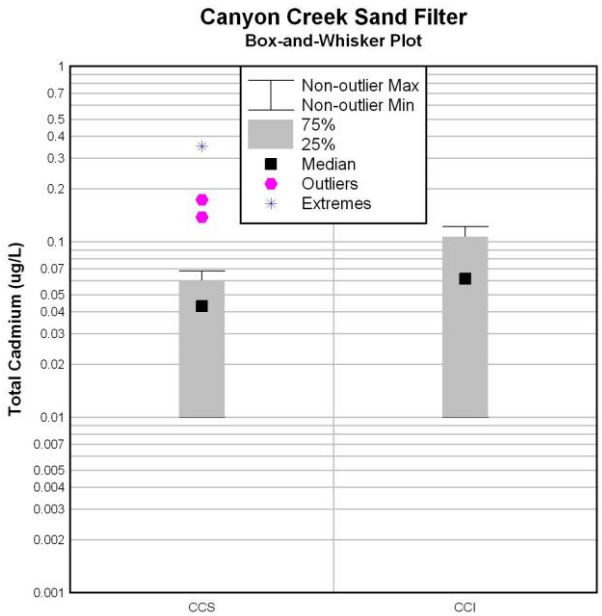


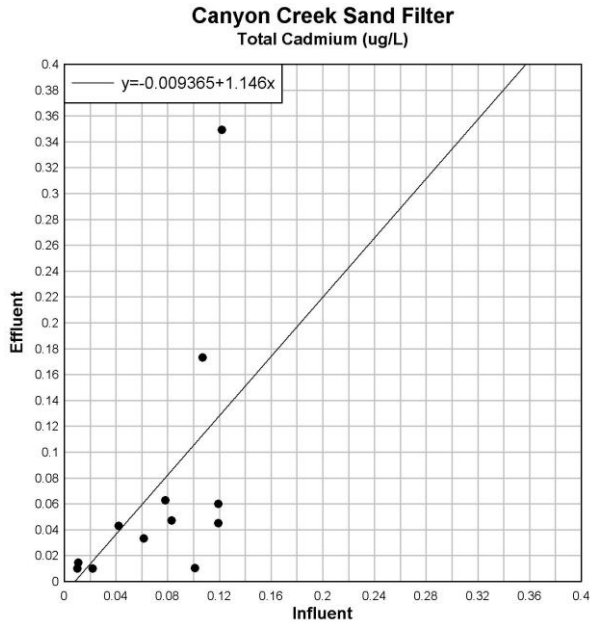
	PARAMETER	Copper, Dissolved (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	5.3	4.3
	Upper Quartile	2.9	1.7
	Median	1.6	1.3
	Lower Quartile	1.1	1.0
	Minimum	0.2	0.6
	Efficiency	15.73%	
	Mann-Whitney	0.3627	
	Wilcoxon (paired)	0.0013 **	
Arithmetic	UCL	2.6	2.1
	Mean	2.0	1.6
	LCL	1.4	1.2
	Std. Dev.	1.3	1.0
	Wilk (p-value)	0.0436 **	0.0003 **
	Efficiency	19.27%	
	t-Test (equal var.)	0.2945	
	t-Test (unequal var.)	0.3032	
	t-test (paired)	0.0012 **	
	Levene Test	0.2917	
Log Transformed	UCL	3.2	2.0
	Mean	2.1	1.6
	LCL	1.4	1.3
	Std. Dev.	1.7	0.8
	Wilk (p-value)	0.1361	0.2216
	Efficiency	23.81%	
	t-Test (equal var.)	0.5794	
	t-Test (unequal var.)	0.5883	
	t-Test (paired)	0.0014 **	
	Levene Test	0.2051	
Bootstrap	UCL	2.6	2.0
	Mean	2.0	1.6
	LCL	1.4	1.2
	Std. Dev.	1.3	0.9
	Efficiency	18.75%	

Canyon Creek Sand Filter -- Total Cadmium (ug/L)



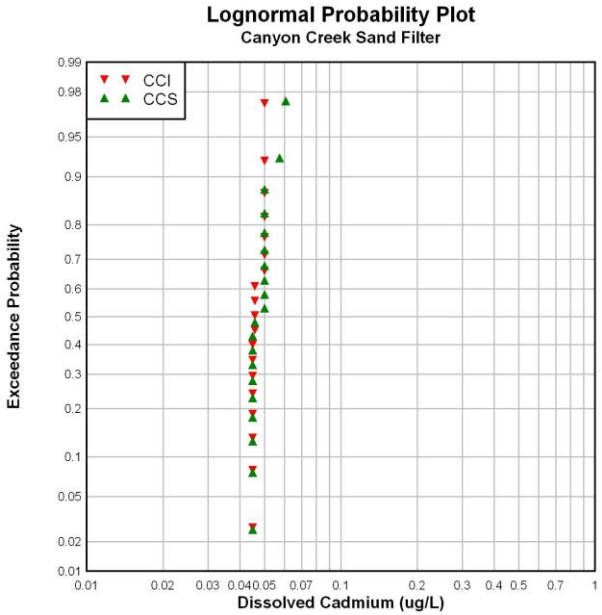


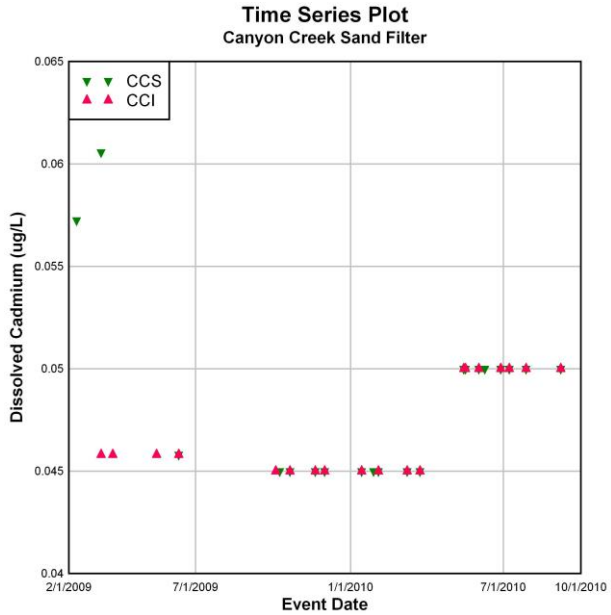


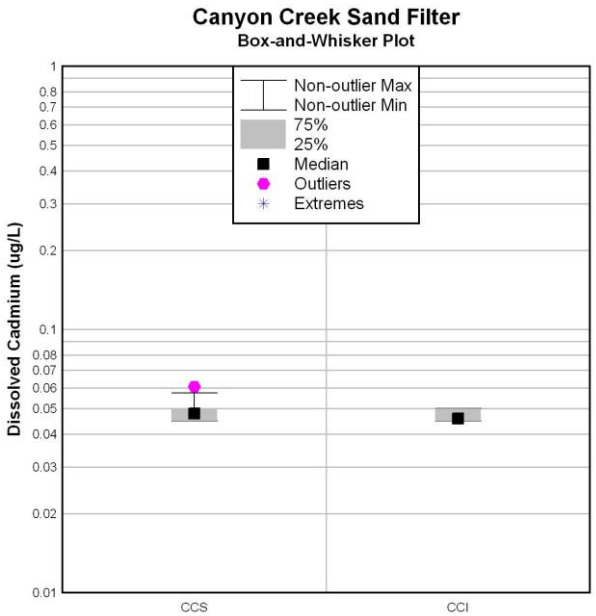


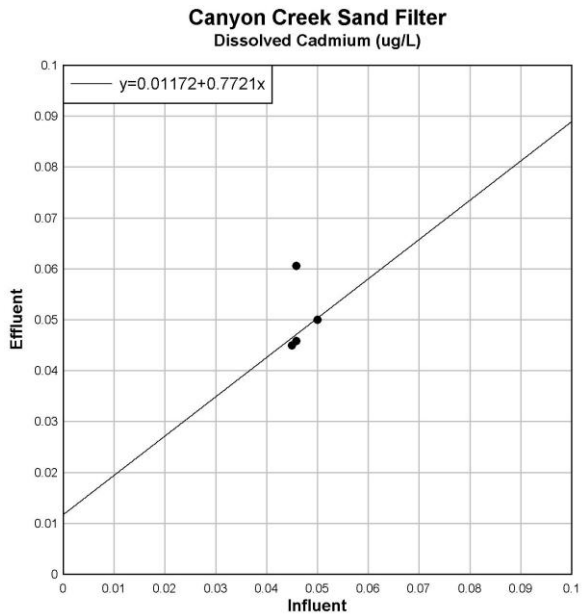
	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCS**
	Site Count	19	21
	Pairs Count	16	16
Non-Parametric	Maximum	0.1	0.3
	Upper Quartile	0.1	0.1
	Median	0.1	0.0
	Lower Quartile	0.0	0.0
	Minimum	0.0	0.0
	Efficiency	30.02%	
	Mann-Whitney	0.3482	
	Wilcoxon (paired)	0.3095	
Arithmetic	UCL	0.1	0.1
	Mean	0.1	0.1
	LCL	0.0	0.0
	Std. Dev.	0.0	0.1
	Wilk (p-value)	0.0018 **	0.0001 **
	Efficiency	2.90%	
	t-Test (equal var.)	0.9340	
	t-Test (unequal var.)	0.9324	
	t-test (paired)	0.9555	
	Levene Test	0.3554	
Log Transformed	UCL	0.1	0.1
	Mean	0.1	0.1
	LCL	0.0	0.0
	Std. Dev.	0.1	0.1
	Wilk (p-value)	0.0004 **	0.0084 **
	Efficiency	16.20%	
	t-Test (equal var.)	0.6192	
	t-Test (unequal var.)	0.6193	
	t-Test (paired)	0.1747	
	Levene Test	0.9870	
Bootstrap	UCL	0.1	0.1
	Mean	0.1	0.1
	LCL	0.0	0.0
	Std. Dev.	0.0	0.1
	Efficiency	3.88%	

Canyon Creek Sand Filter -- Dissolved Cadmium (ug/L)









	PARAMETER	Cadmium, Dissolved (µg/L)	
Type	Statistic	INF: CCI	EFF: CCS
	Site Count	19	20
	Pairs Count	15	15
Non-Parametric	Maximum	0.1	0.1
	Upper Quartile	0.0	0.0
	Median	0.0	0.0
	Lower Quartile	0.0	0.0
	Minimum	0.0	0.0
	Efficiency	-4.58%	
	Mann-Whitney	0.6729	
	Wilcoxon (paired)	0.9102	
Arithmetic	UCL	0.0	0.1
	Mean	0.0	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-3.02%	
	t-Test (equal var.)	0.2156	
	t-Test (unequal var.)	0.2112	
	t-test (paired)	0.3343	
	Levene Test	0.1227	
Log Transformed	UCL	0.0	0.1
	Mean	0.0	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0002 **
	Efficiency	-3.01%	
	t-Test (equal var.)	0.2307	
	t-Test (unequal var.)	0.2263	
	t-Test (paired)	0.3343	
	Levene Test	0.1146	
Bootstrap	UCL	0.0	0.1
	Mean	0.0	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Efficiency	-2.94%	

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Appendix C Wet Ponds

Wood Hollow Wet Pond (HLA-WH)

The watershed discharges through the Wood Hollow stormwater retention/detention basin. A permanent pool of the Wood Hollow detention pond was detained by closing a gate at the outlet so the wet pond acted like a dam. This SCM originally designed to be a flood detention, but later on retrofitted to be a wet pond without proper reform. It is built with steep sides without sediment forebay and vegetation. Both of these may be explained due to flaws in the original design and installation of the system. Maintenance at this site faced many difficulties due to its unique design. Multiple monitoring stations have been established above and below the basin in order to obtain more adequate data. Flow from this SCM eventually discharges to Shoal Creek.

See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed.

The City collected runoff and water quality data at the Wood Hollow wet pond (HLA-WH) from April 1985 to June 1987 and again from September 1995 to June 1996. During this time 22 and 16 valid EMCs were collected at the influent (HLA) and effluent (WH), respectively, of which 13 were paired.

Performance Summary

The Wood Hollow wet pond had the best performance with the reduction of the concentrations of TSS and metals. TSS concentration was reduced by 48% and was only significant if data are paired. TDS concentration was increased by 84% and was significant in all cases.

COD, TOC and BOD concentrations were reduced by 32%, 11% and 28%, respectively, and were not significant in all cases.

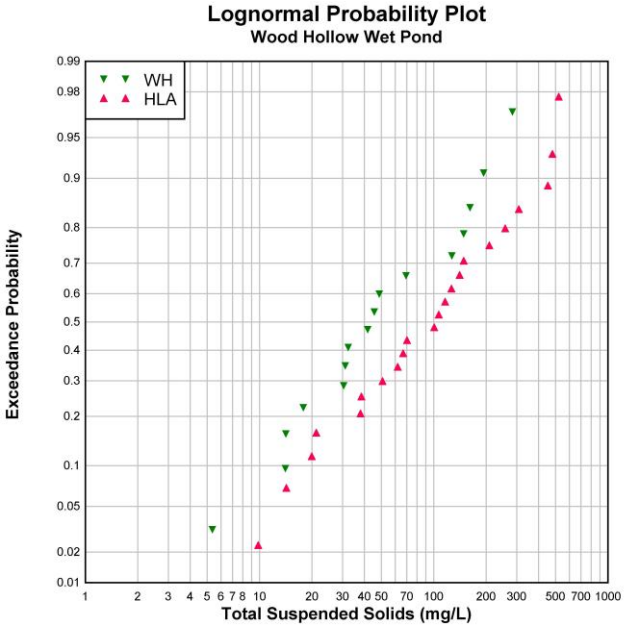
Total nitrogen concentration was increased by 1% and was not significant in any case. The increase of concentration in nitrate + nitrite (5%) was not significant in any case. Total Kjeldahl nitrogen and ammonia concentrations were reduced by 4% and 19%, respectively, and were not significant in any case.

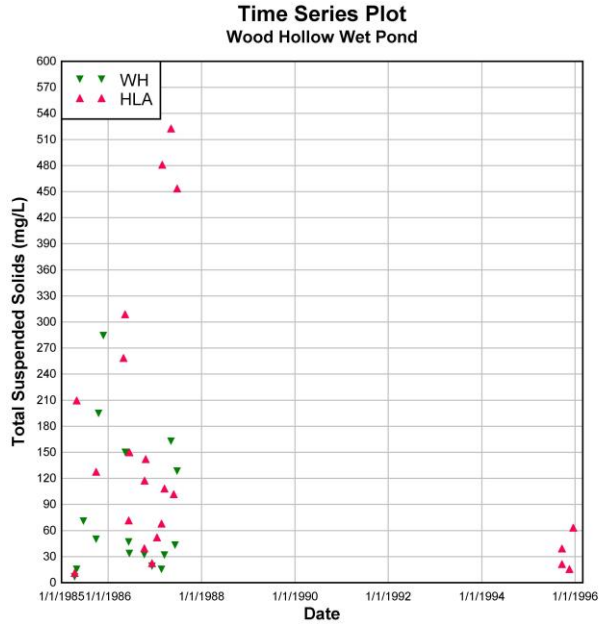
TP concentration was reduced by 44% and was significant in any case.

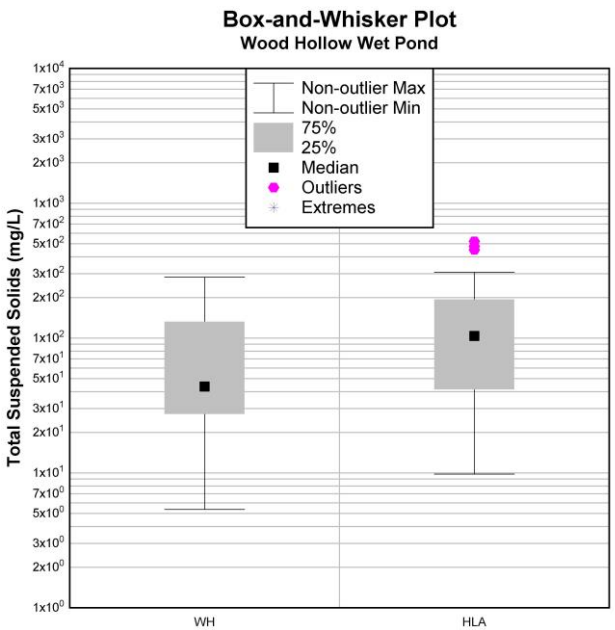
The increase of FCOL (27%) was not significant in any case, and the reduction of FSTR (28%) was only significant if data are paired.

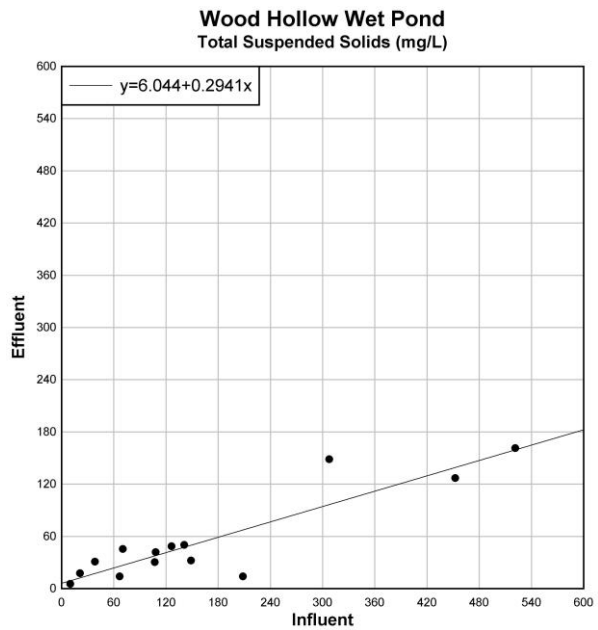
Lead, zinc and copper concentrations were reduced by 64%, 64% and 46%, respectively, and were significant in all cases.

Wood Hollow Wet Pond - Total Suspended Solids (mg/L)



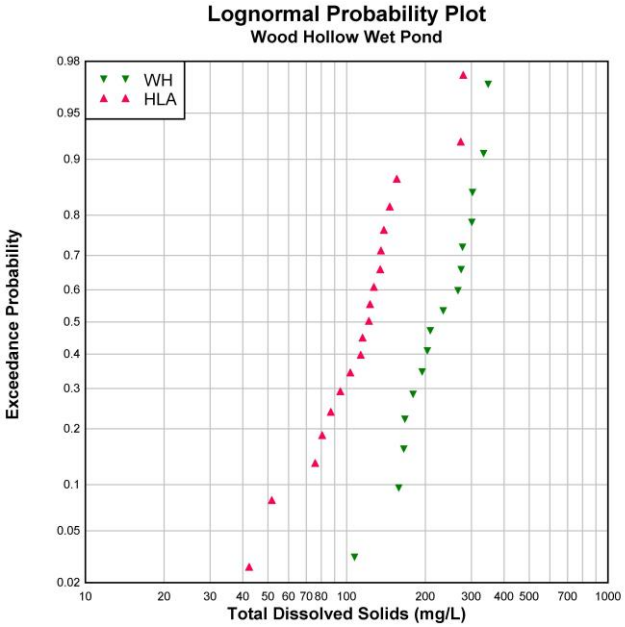


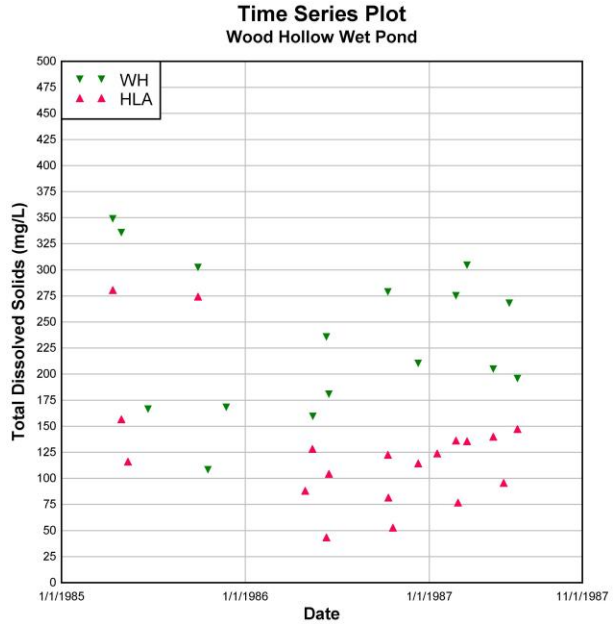


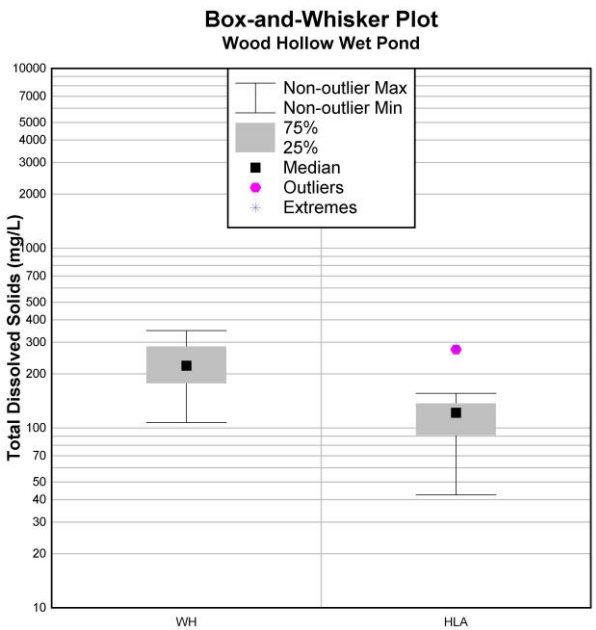


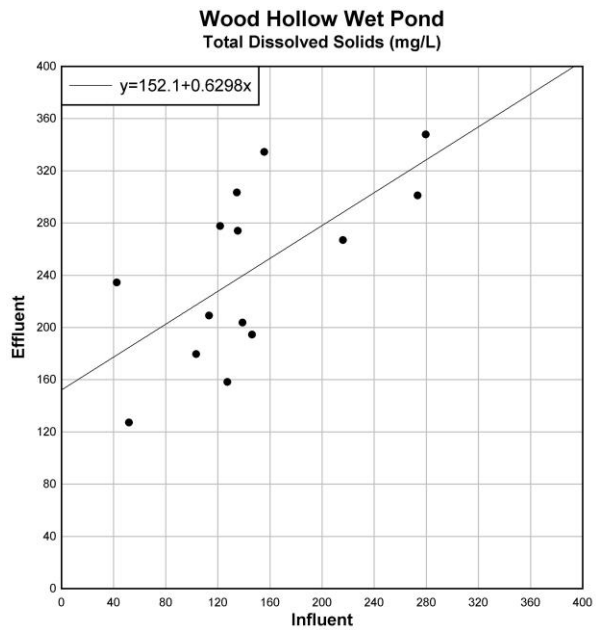
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	22	16
	Pairs Count	13	13
Non-Parametric	Maximum	521.3	283.1
	Upper Quartile	208.3	137.9
	Median	103.7	43.7
	Lower Quartile	38.4	24.1
	Minimum	9.8	5.4
	Efficiency	57.87%	
	Mann-Whitney	0.1291	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	221.8	121.8
	Mean	152.6	79.0
	LCL	83.4	36.3
	Std. Dev.	156.0	80.3
	Wilk (p-value)	0.0006 **	0.0045 **
	Efficiency	48.21%	
	t-Test (equal var.)	0.0935 *	
	t-Test (unequal var.)	0.0671 *	
	t-test (paired)	0.0061 **	
	Levene Test	0.0799 *	
Log Transformed	UCL	313.4	175.0
	Mean	162.9	82.2
	LCL	84.6	38.6
	Std. Dev.	227.6	105.9
	Wilk (p-value)	0.7088	0.8019
	Efficiency	49.50%	
	t-Test (equal var.)	0.0954 *	
	t-Test (unequal var.)	0.0945 *	
	t-Test (paired)	0.0001 **	
	Levene Test	0.8302	
Bootstrap	UCL	219.4	119.3
	Mean	152.4	79.0
	LCL	85.4	38.7
	Std. Dev.	151.1	75.7
	Efficiency	48.16%	

Wood Hollow Wet Pond - Total Dissolved Solids (mg/L)



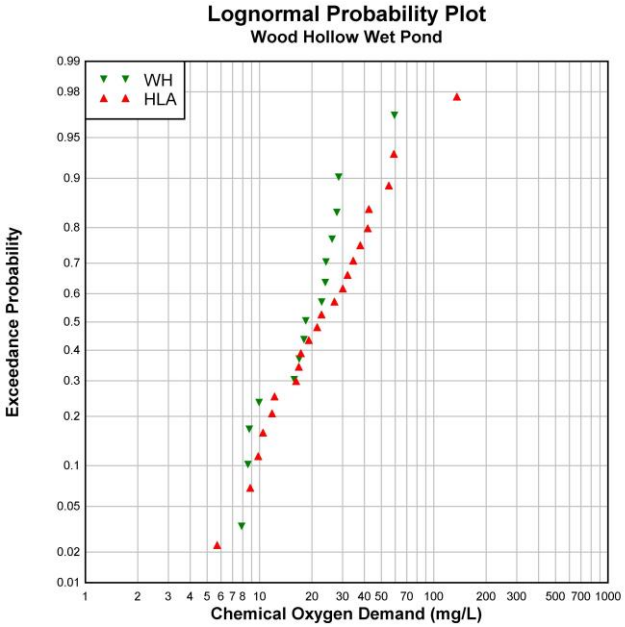


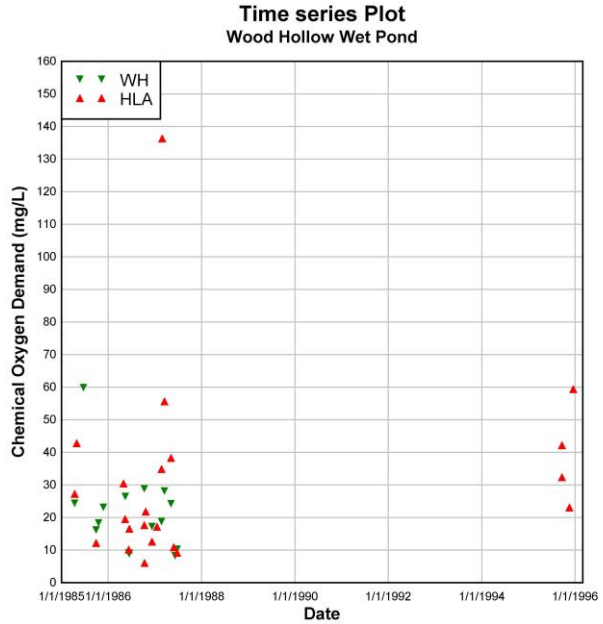


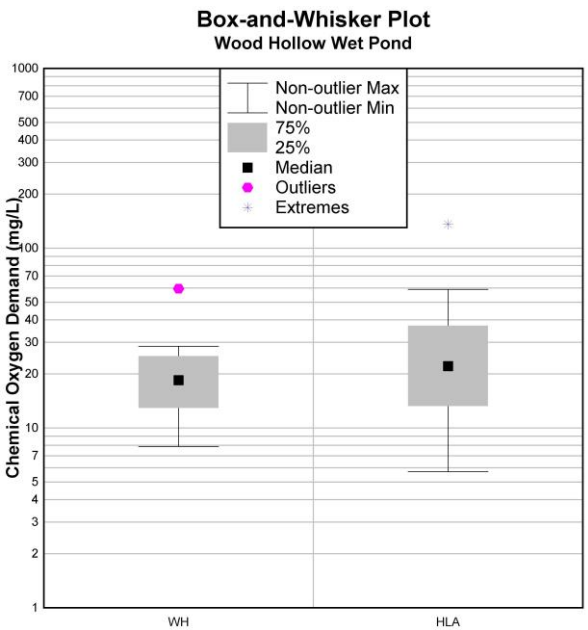


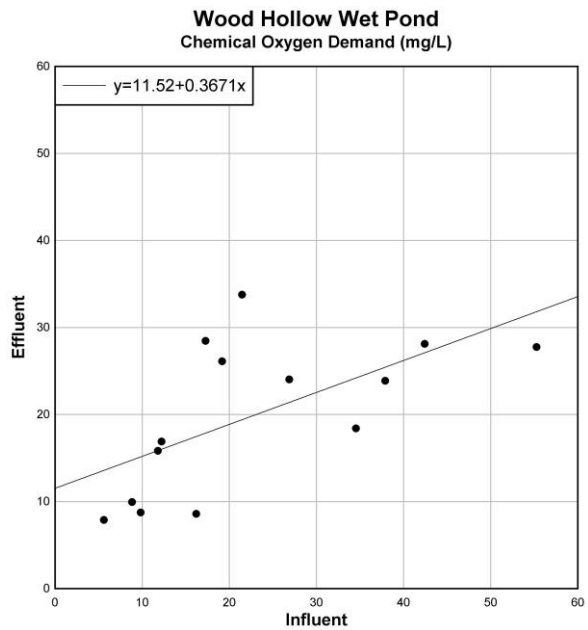
	PARAMETER	TDS (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	19	16
	Pairs Count	13	13
Non-Parametric	Maximum	279.56	347.84
	Upper Quartile	138.91	289.43
	Median	121.62	221.85
	Lower Quartile	86.98	173.38
	Minimum	42.38	107.22
	Efficiency	-82.42%	
	Mann-Whitney	0.0004 **	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	155.71	270.28
	Mean	126.23	232.86
	LCL	96.75	195.44
	Std. Dev.	61.16	70.23
	Wilk (p-value)	0.0042 **	0.7044
	Efficiency	-84.47%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.6010	
Log Transformed	UCL	159.77	278.79
	Mean	126.26	233.45
	LCL	99.78	195.49
	Std. Dev.	60.37	76.77
	Wilk (p-value)	0.3238	0.4973
	Efficiency	-84.89%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0002 **	
	Levene Test	0.2328	
Bootstrap	UCL	154.35	268.38
	Mean	126.41	232.65
	LCL	98.47	196.93
	Std. Dev.	57.96	67.04
	Efficiency	-84.04%	

Wood Hollow Wet Pond - Chemical Oxygen Demand (mg/L)



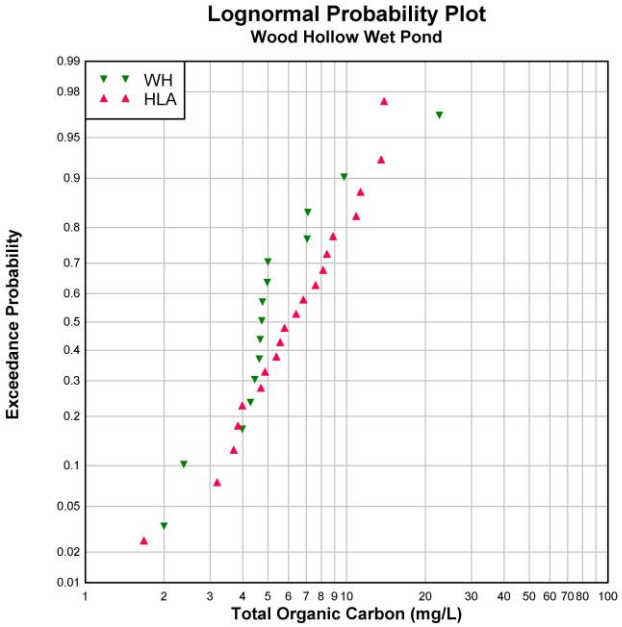


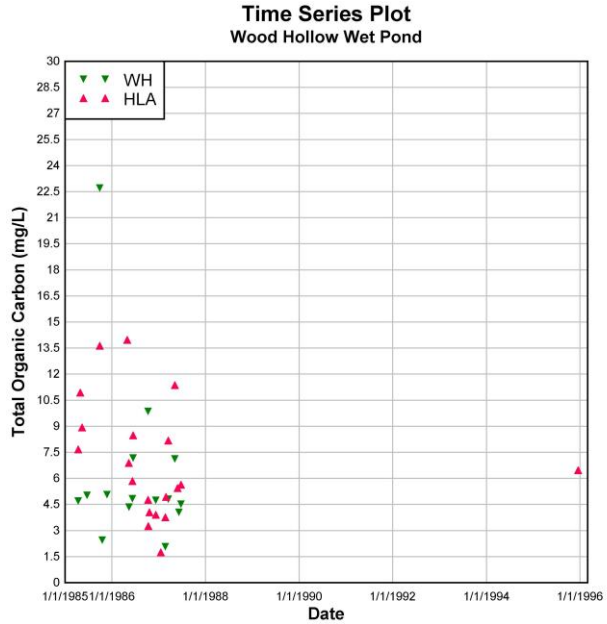


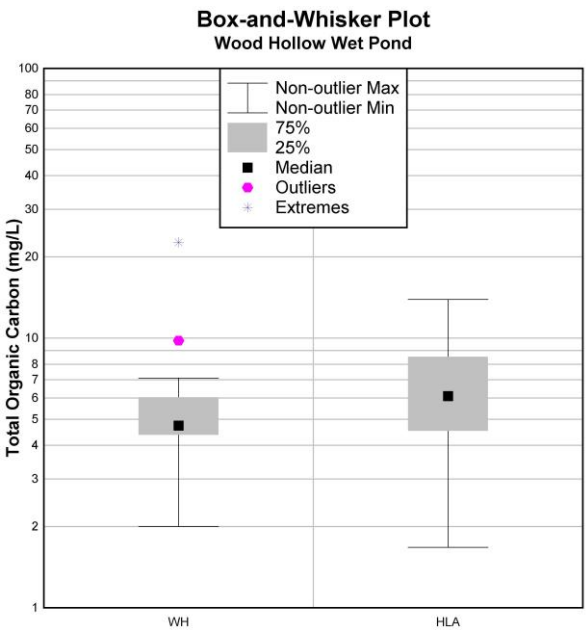


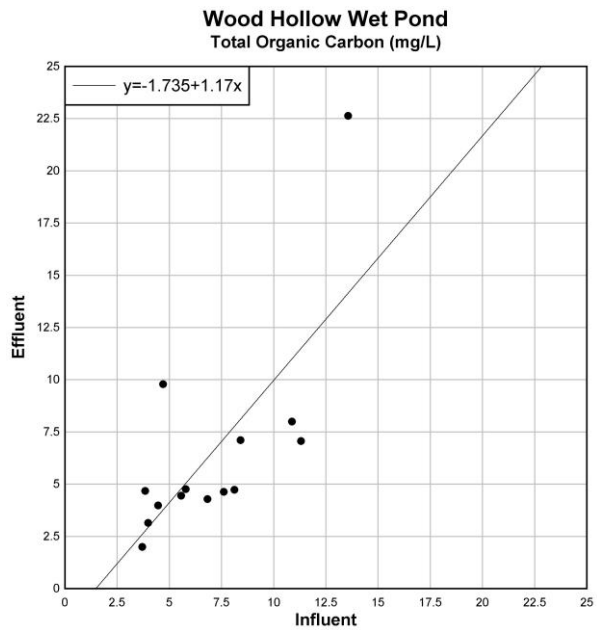
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	22	15
	Pairs Count	13	13
Non-Parametric	Maximum	135.94	59.50
	Upper Quartile	37.89	26.13
	Median	22.06	18.42
	Lower Quartile	12.20	9.95
	Minimum	5.71	7.90
	Efficiency	16.50%	
	Mann-Whitney	0.3363	
	Wilcoxon (paired)	0.4143	
Arithmetic	UCL	42.75	28.21
	Mean	30.38	21.13
	LCL	18.01	14.05
	Std. Dev.	27.89	12.78
	Wilk (p-value)	0.0001 **	0.0040 **
	Efficiency	30.45%	
	t-Test (equal var.)	0.2393	
	t-Test (unequal var.)	0.1836	
	t-test (paired)	0.2783	
	Levene Test	0.3403	
Log Transformed	UCL	43.24	29.33
	Mean	29.77	21.06
	LCL	20.49	15.12
	Std. Dev.	24.15	12.14
	Wilk (p-value)	0.9766	0.2968
	Efficiency	29.26%	
	t-Test (equal var.)	0.3180	
	t-Test (unequal var.)	0.2918	
	t-Test (paired)	0.5406	
	Levene Test	0.2611	
Bootstrap	UCL	42.10	27.34
	Mean	30.62	20.96
	LCL	19.14	14.58
	Std. Dev.	25.90	11.52
	Efficiency	31.54%	

Wood Hollow Wet Pond - Total Organic Carbon (mg/L)



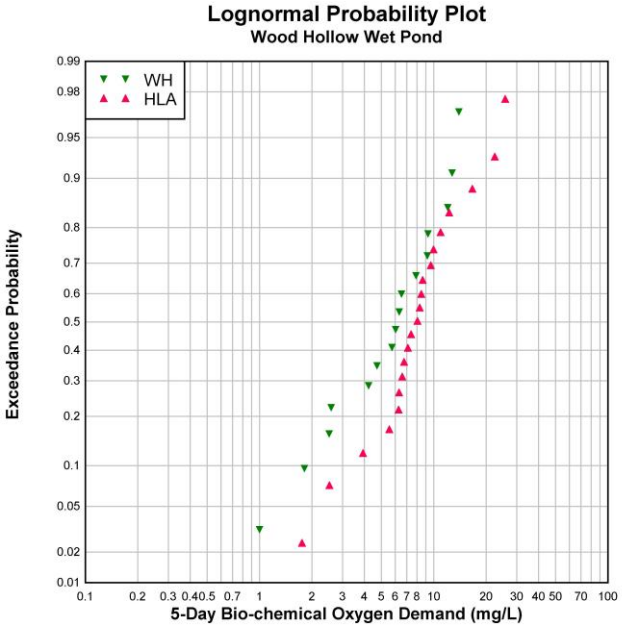


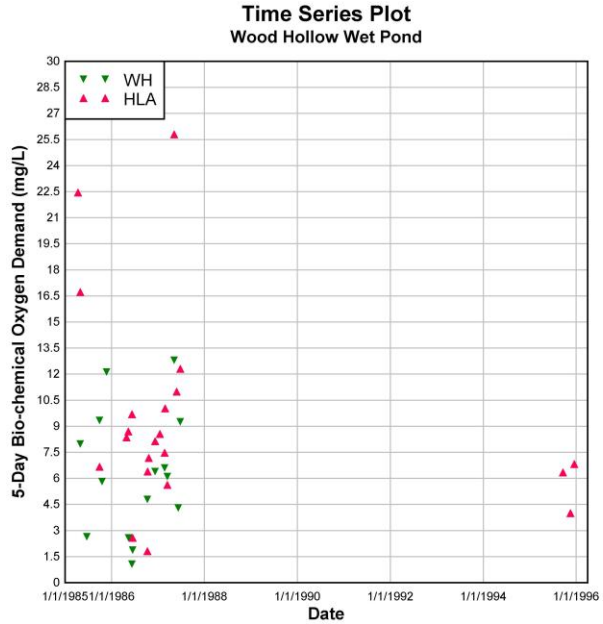


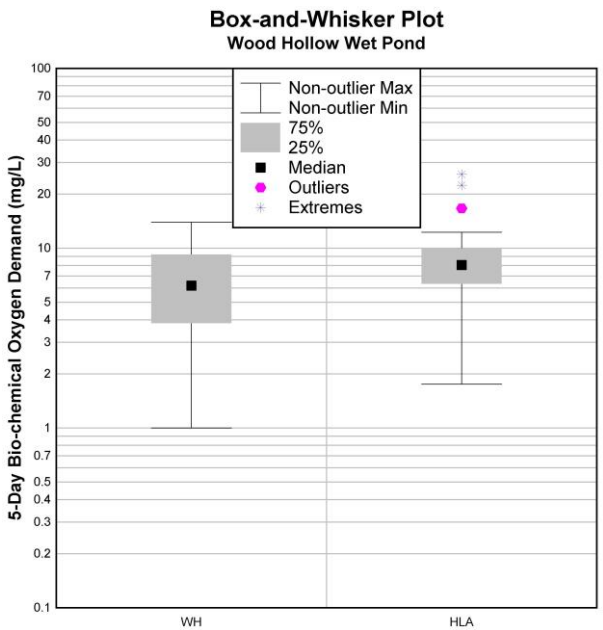


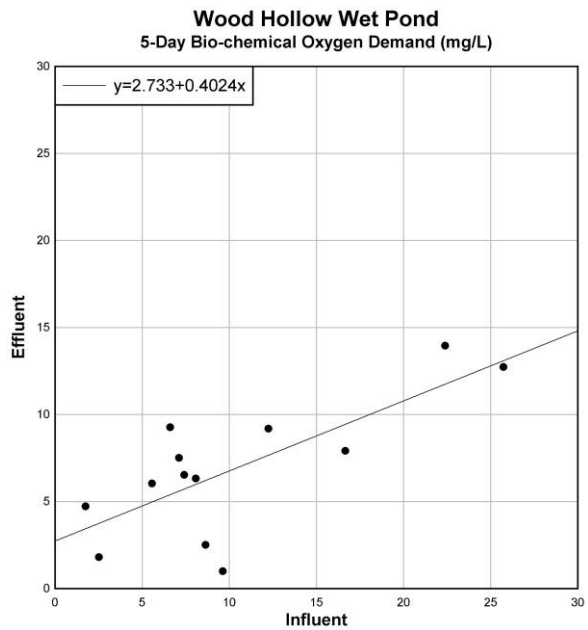
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	20	15
	Pairs Count	13	13
Non-Parametric	Maximum	13.91	22.64
	Upper Quartile	8.64	7.06
	Median	6.10	4.74
	Lower Quartile	4.34	4.29
	Minimum	1.68	2.00
	Efficiency	22.32%	
	Mann-Whitney	0.2198	
	Wilcoxon (paired)	0.2439	
Arithmetic	UCL	8.52	8.90
	Mean	6.93	6.16
	LCL	5.33	3.43
	Std. Dev.	3.41	4.93
	Wilk (p-value)	0.2531	0.0001 **
	Efficiency	11.04%	
	t-Test (equal var.)	0.5907	
	t-Test (unequal var.)	0.6110	
	t-test (paired)	0.7160	
	Levene Test	0.4649	
Log Transformed	UCL	9.11	8.38
	Mean	6.99	5.98
	LCL	5.37	4.26
	Std. Dev.	3.86	3.51
	Wilk (p-value)	0.7785	0.0445 **
	Efficiency	14.53%	
	t-Test (equal var.)	0.3598	
	t-Test (unequal var.)	0.3653	
	t-Test (paired)	0.2136	
	Levene Test	0.8483	
Bootstrap	UCL	8.39	8.49
	Mean	6.87	6.14
	LCL	5.35	3.78
	Std. Dev.	3.25	4.25
	Efficiency	10.65%	

Wood Hollow Wet Pond - 5-Day Bio-chemical Oxygen Demand (mg/L)



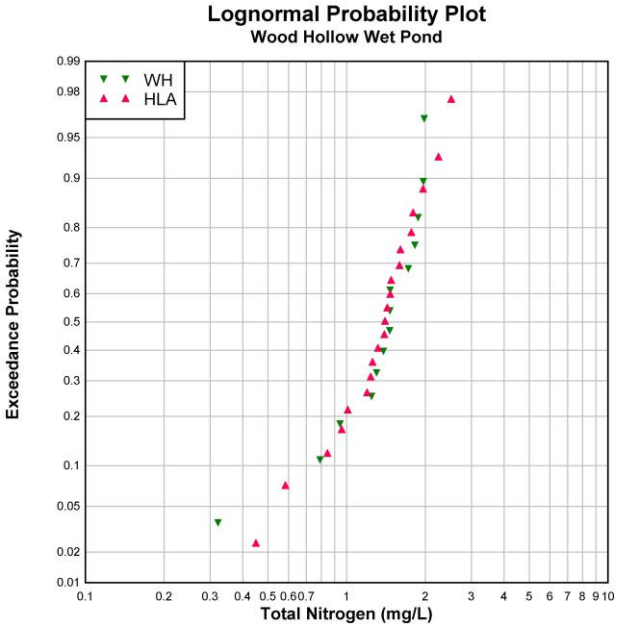


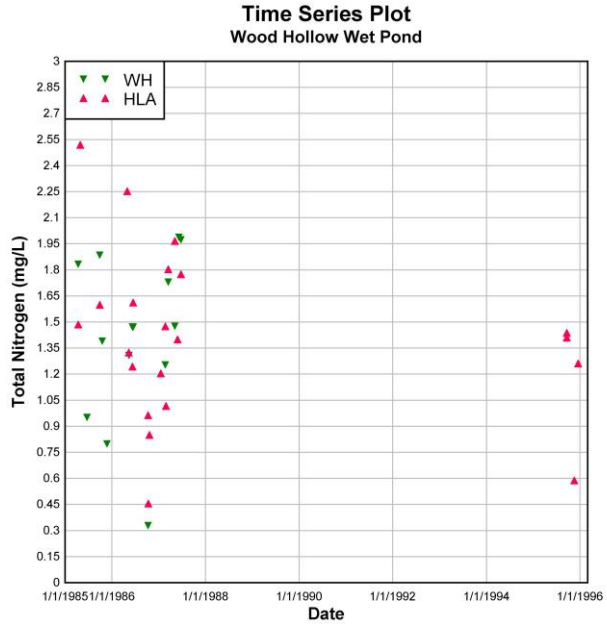


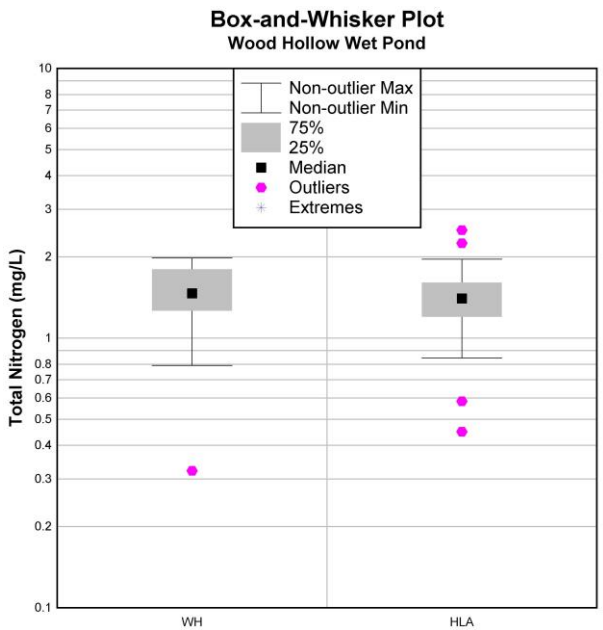


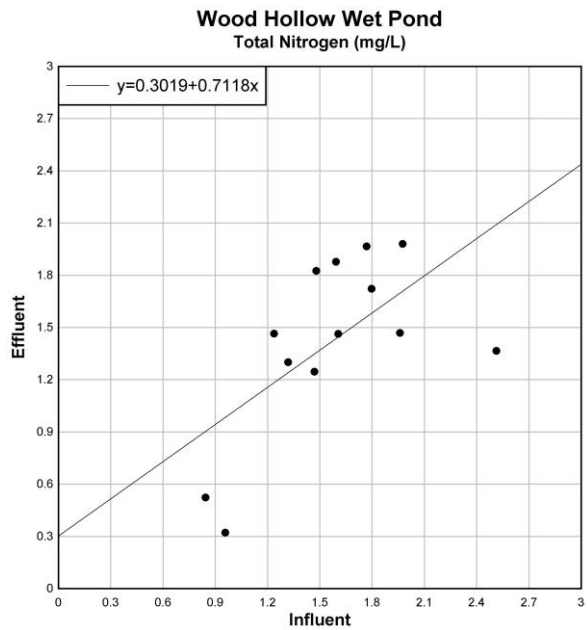
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	21	16
	Pairs Count	12	12
Non-Parametric	Maximum	25.72	13.96
	Upper Quartile	9.97	9.23
	Median	8.07	6.19
	Lower Quartile	6.32	3.41
	Minimum	1.75	1.00
	Efficiency	23.30%	
	Mann-Whitney	0.1626	
	Wilcoxon (paired)	0.0771 *	
Arithmetic	UCL	11.98	8.77
	Mean	9.30	6.67
	LCL	6.61	4.56
	Std. Dev.	5.90	3.95
	Wilk (p-value)	0.0021 **	0.5197
	Efficiency	28.28%	
	t-Test (equal var.)	0.1335	
	t-Test (unequal var.)	0.1145	
	t-test (paired)	0.0551 *	
	Levene Test	0.2858	
Log Transformed	UCL	12.81	10.92
	Mean	9.38	6.95
	LCL	6.86	4.42
	Std. Dev.	6.23	5.57
	Wilk (p-value)	0.3053	0.2903
	Efficiency	25.87%	
	t-Test (equal var.)	0.1080	
	t-Test (unequal var.)	0.1182	
	t-Test (paired)	0.1976	
	Levene Test	0.5012	
Bootstrap	UCL	11.85	8.66
	Mean	9.29	6.65
	LCL	6.73	4.64
	Std. Dev.	5.63	3.78
	Efficiency	28.41%	

Wood Hollow Wet Pond - Total Nitrogen (mg/L)



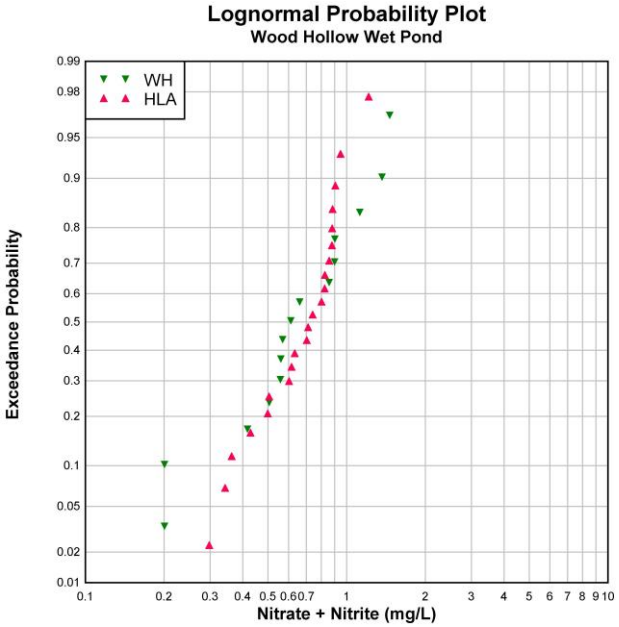


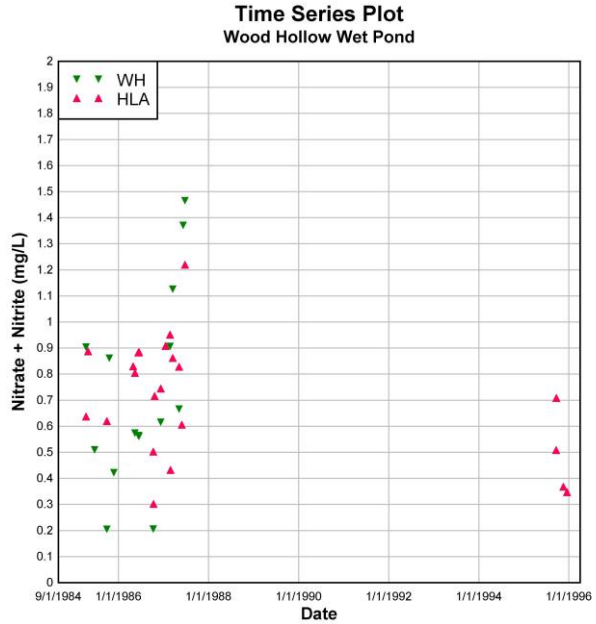


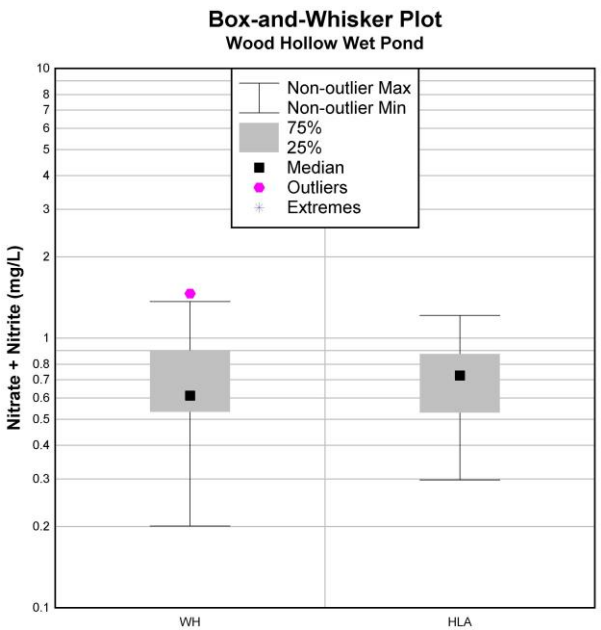


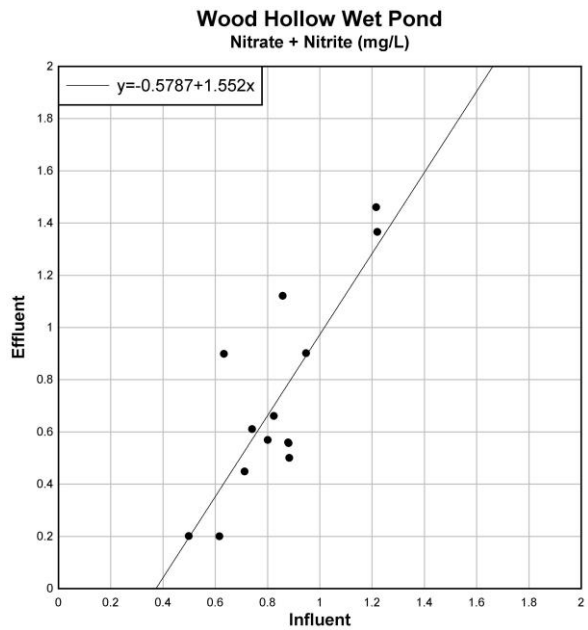
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	21	14
	Pairs Count	12	12
Non-Parametric	Maximum	2.513	1.980
	Upper Quartile	1.606	1.825
	Median	1.403	1.464
	Lower Quartile	1.198	1.246
	Minimum	0.449	0.322
	Efficiency	-4.33%	
	Mann-Whitney	0.8021	
	Wilcoxon (paired)	0.3804	
Arithmetic	UCL	1.632	1.686
	Mean	1.405	1.411
	LCL	1.178	1.136
	Std. Dev.	0.499	0.477
	Wilk (p-value)	0.9334	0.2535
	Efficiency	-0.42%	
	t-Test (equal var.)	0.9725	
	t-Test (unequal var.)	0.9722	
	t-test (paired)	0.2199	
	Levene Test	0.8231	
Log Transformed	UCL	1.723	1.943
	Mean	1.418	1.446
	LCL	1.167	1.076
	Std. Dev.	0.598	0.718
	Wilk (p-value)	0.1212	0.0026 **
	Efficiency	-1.99%	
	t-Test (equal var.)	0.9601	
	t-Test (unequal var.)	0.9615	
	t-Test (paired)	0.1434	
	Levene Test	0.6770	
Bootstrap	UCL	1.615	1.675
	Mean	1.397	1.413
	LCL	1.179	1.151
	Std. Dev.	0.479	0.453
	Efficiency	-1.12%	

Wood Hollow Wet Pond - Nitrate + Nitrite (mg/L)



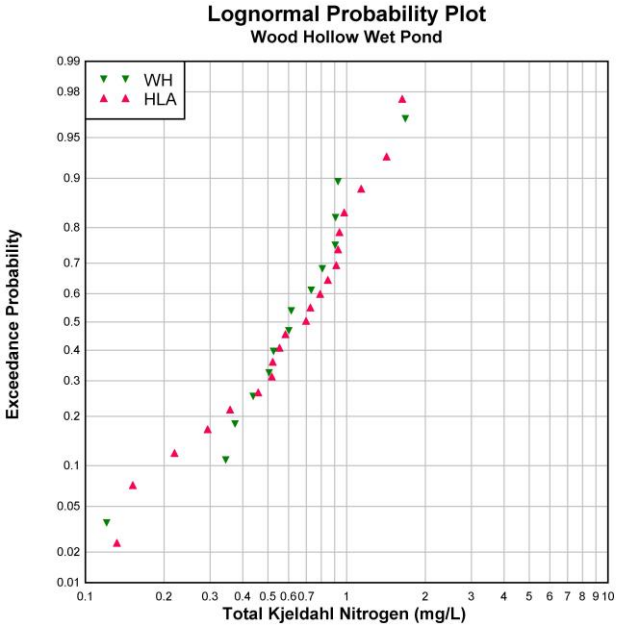


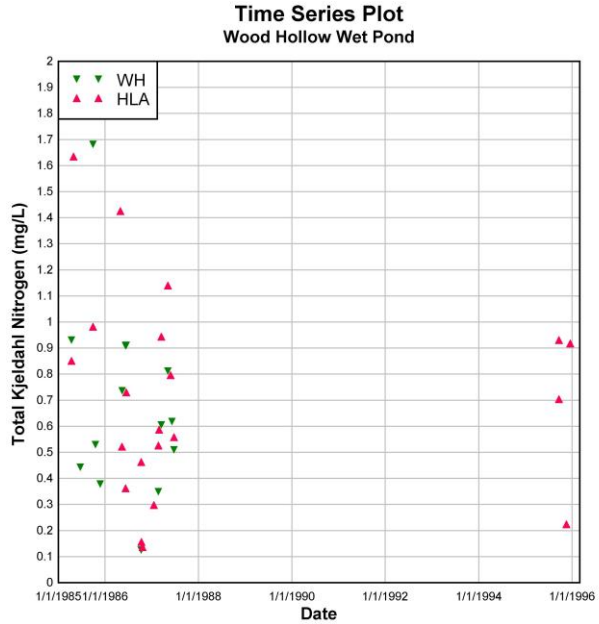


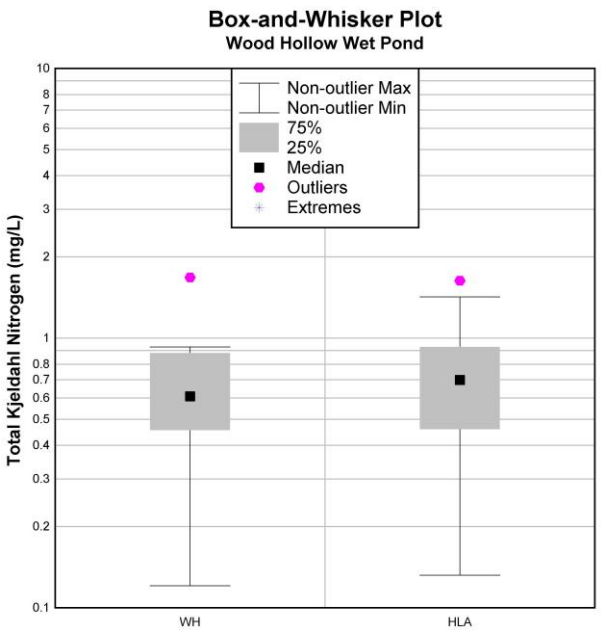


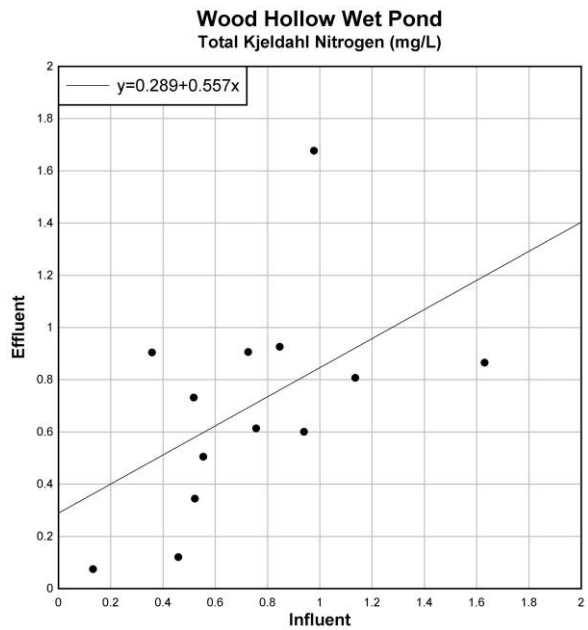
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	22	15
	Pairs Count	13	13
Non-Parametric	Maximum	1.215	1.461
	Upper Quartile	0.878	0.902
	Median	0.726	0.611
	Lower Quartile	0.505	0.505
	Minimum	0.298	0.201
	Efficiency	15.81%	
	Mann-Whitney	0.9144	
	Wilcoxon (paired)	0.1272	
Arithmetic	UCL	0.805	0.934
	Mean	0.703	0.726
	LCL	0.601	0.518
	Std. Dev.	0.230	0.376
	Wilk (p-value)	0.4870	0.3379
	Efficiency	-3.35%	
	t-Test (equal var.)	0.8143	
	t-Test (unequal var.)	0.8306	
	t-test (paired)	0.1540	
	Levene Test	0.0454 **	
Log Transformed	UCL	0.837	1.053
	Mean	0.706	0.738
	LCL	0.596	0.518
	Std. Dev.	0.266	0.455
	Wilk (p-value)	0.0900 *	0.2237
	Efficiency	-4.53%	
	t-Test (equal var.)	0.7456	
	t-Test (unequal var.)	0.7669	
	t-Test (paired)	0.0507 *	
	Levene Test	0.0736 *	
Bootstrap	UCL	0.798	0.933
	Mean	0.699	0.732
	LCL	0.600	0.531
	Std. Dev.	0.224	0.363
	Efficiency	-4.69%	

Wood Hollow Wet Pond - Total Kjeldahl Nitrogen (mg/L)



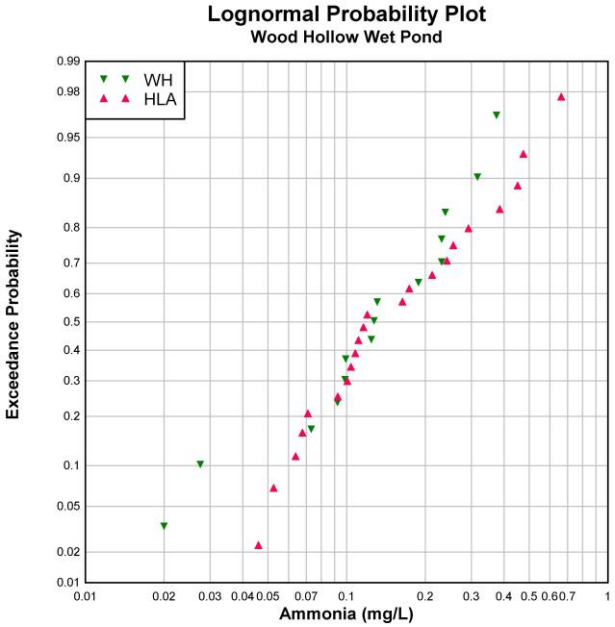


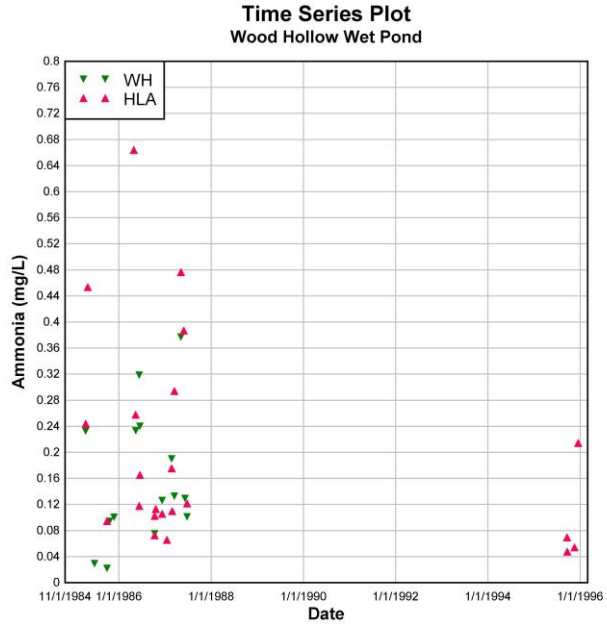


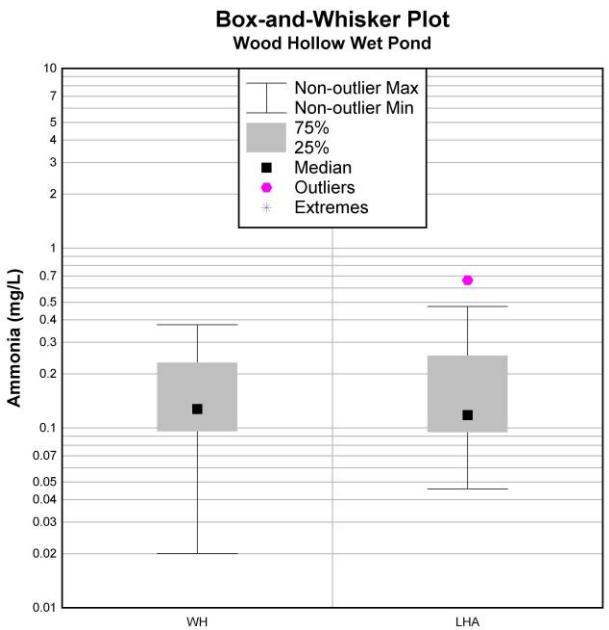


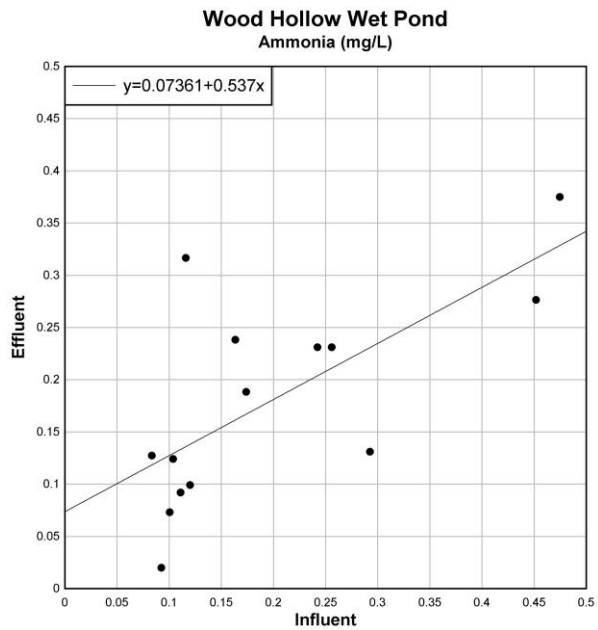
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	21	14
	Pairs Count	12	12
Non-Parametric	Maximum	1.631	1.677
	Upper Quartile	0.926	0.904
	Median	0.699	0.607
	Lower Quartile	0.459	0.439
	Minimum	0.132	0.121
	Efficiency	13.14%	
	Mann-Whitney	0.7510	
	Wilcoxon (paired)	0.5186	
Arithmetic	UCL	0.885	0.893
	Mean	0.705	0.677
	LCL	0.524	0.461
	Std. Dev.	0.396	0.374
	Wilk (p-value)	0.4999	0.1069
	Efficiency	3.93%	
	t-Test (equal var.)	0.8372	
	t-Test (unequal var.)	0.8355	
	t-test (paired)	0.6295	
	Levene Test	0.8109	
Log Transformed	UCL	1.029	1.023
	Mean	0.728	0.692
	LCL	0.515	0.468
	Std. Dev.	0.534	0.447
	Wilk (p-value)	0.1879	0.2713
	Efficiency	4.93%	
	t-Test (equal var.)	0.9784	
	t-Test (unequal var.)	0.9780	
	t-Test (paired)	0.2922	
	Levene Test	0.6879	
Bootstrap	UCL	0.874	0.869
	Mean	0.702	0.672
	LCL	0.529	0.475
	Std. Dev.	0.379	0.341
	Efficiency	4.21%	

Wood Hollow Wet Pond - Ammonia (mg/L)



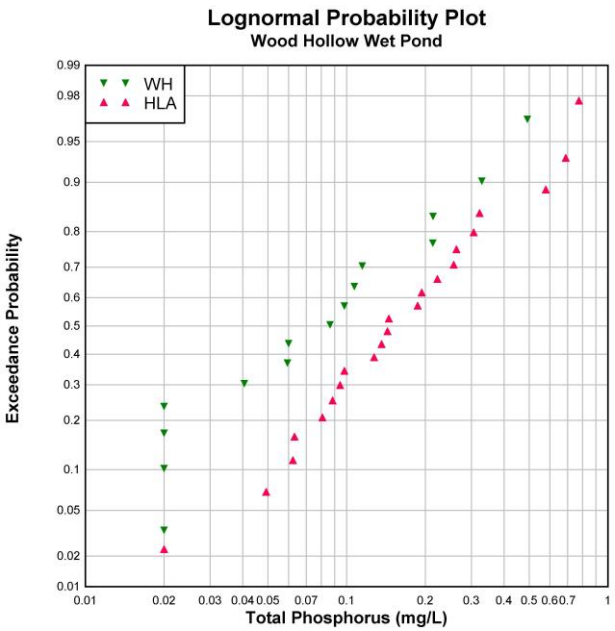


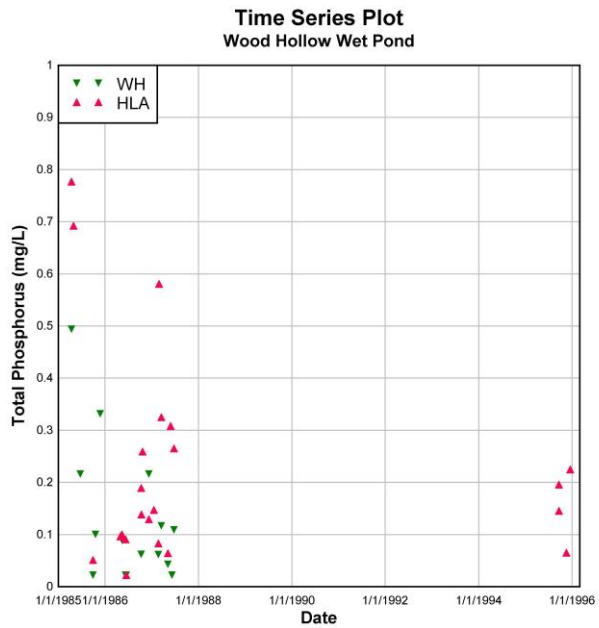


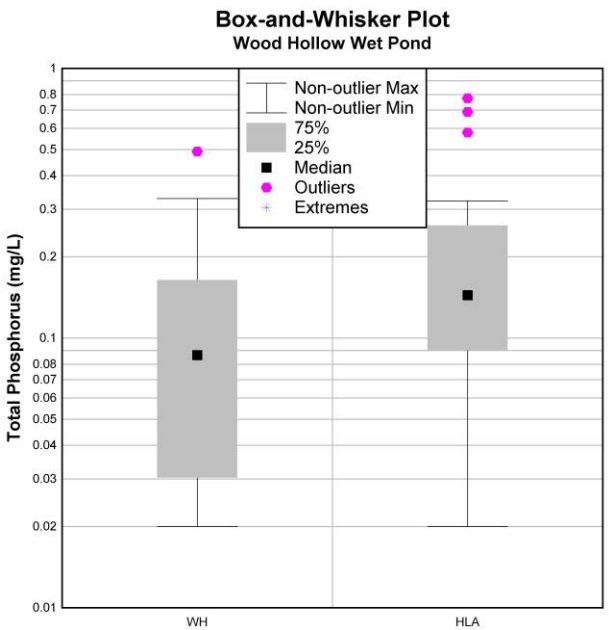


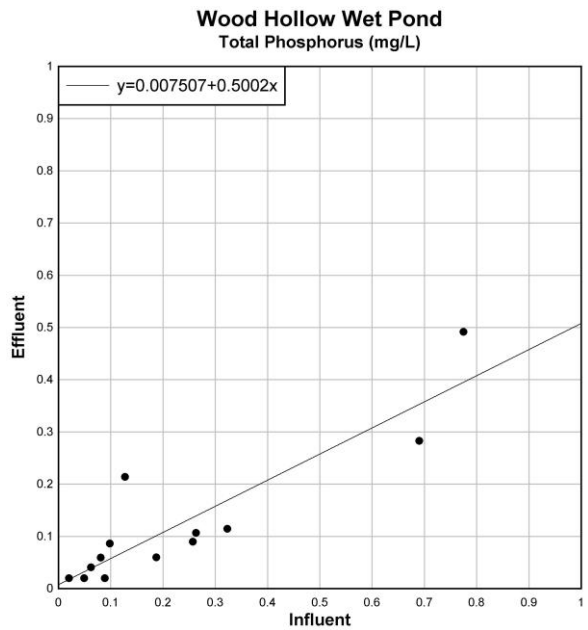
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	22	15
	Pairs Count	13	13
Non-Parametric	Maximum	0.662	0.375
	Upper Quartile	0.256	0.231
	Median	0.118	0.127
	Lower Quartile	0.093	0.092
	Minimum	0.046	0.020
	Efficiency	-8.00%	
	Mann-Whitney	0.7241	
	Wilcoxon (paired)	0.4973	
Arithmetic	UCL	0.271	0.215
	Mean	0.198	0.158
	LCL	0.126	0.101
	Std. Dev.	0.163	0.103
	Wilk (p-value)	0.0010 **	0.3343
	Efficiency	20.26%	
	t-Test (equal var.)	0.4046	
	t-Test (unequal var.)	0.3649	
	t-test (paired)	0.5282	
	Levene Test	0.2142	
Log Transformed	UCL	0.287	0.286
	Mean	0.196	0.168
	LCL	0.134	0.098
	Std. Dev.	0.163	0.151
	Wilk (p-value)	0.4914	0.1736
	Efficiency	14.49%	
	t-Test (equal var.)	0.4550	
	t-Test (unequal var.)	0.4637	
	t-Test (paired)	0.4518	
	Levene Test	0.7249	
Bootstrap	UCL	0.266	0.213
	Mean	0.197	0.159
	LCL	0.128	0.105
	Std. Dev.	0.155	0.098
	Efficiency	19.06%	

Wood Hollow Wet Pond - Total Phosphorus (mg/L)



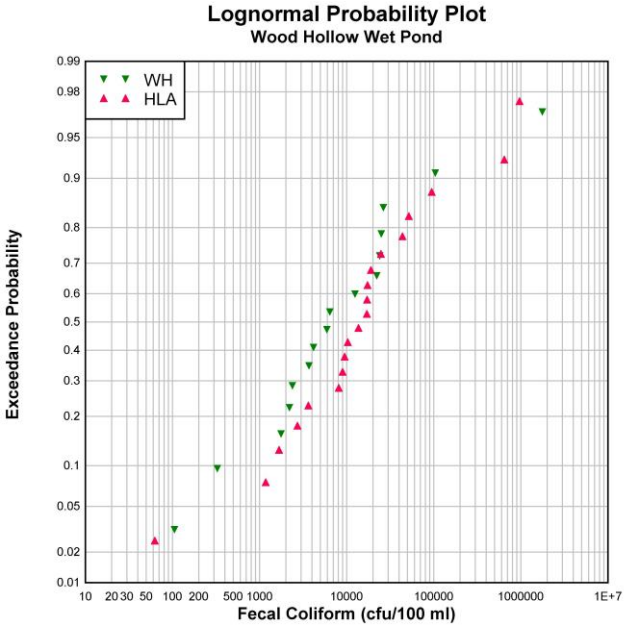


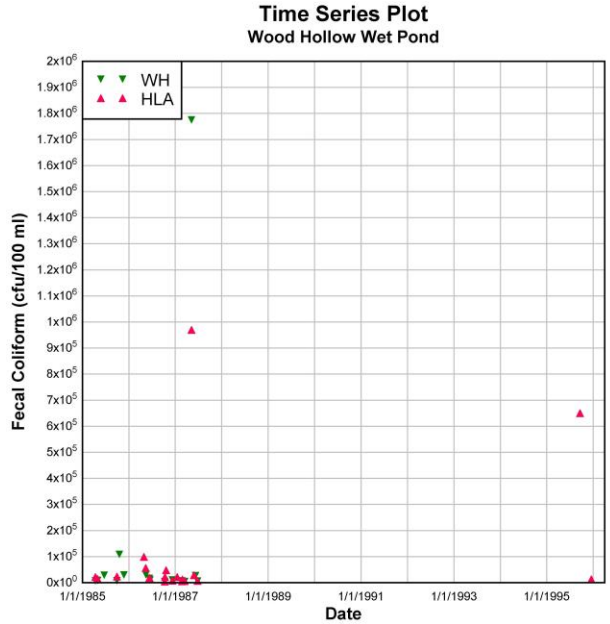


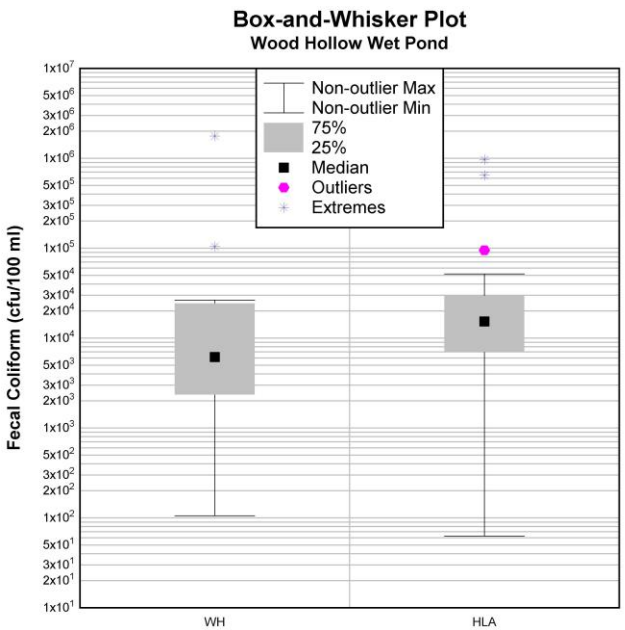


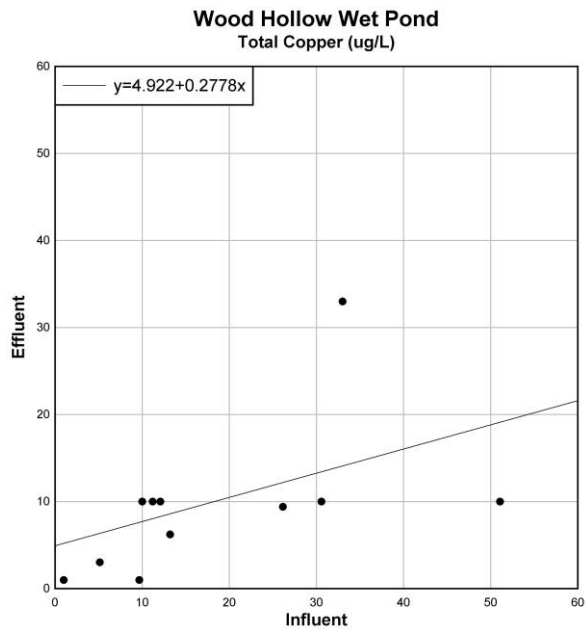
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	22	15
	Pairs Count	13	13
Non-Parametric	Maximum	0.775	0.492
	Upper Quartile	0.263	0.214
	Median	0.144	0.086
	Lower Quartile	0.088	0.020
	Minimum	0.020	0.020
	Efficiency	40.10%	
	Mann-Whitney	0.0570 *	
	Wilcoxon (paired)	0.0098 **	
Arithmetic	UCL	0.314	0.201
	Mean	0.223	0.126
	LCL	0.131	0.052
	Std. Dev.	0.206	0.135
	Wilk (p-value)	0.0003 **	0.0021 **
	Efficiency	43.32%	
	t-Test (equal var.)	0.1202	
	t-Test (unequal var.)	0.0939 *	
	t-test (paired)	0.0140 **	
	Levene Test	0.2745	
Log Transformed	UCL	0.361	0.268
	Mean	0.225	0.127
	LCL	0.141	0.060
	Std. Dev.	0.228	0.155
	Wilk (p-value)	0.9345	0.2464
	Efficiency	43.47%	
	t-Test (equal var.)	0.0353 **	
	t-Test (unequal var.)	0.0437 **	
	t-Test (paired)	0.0019 **	
	Levene Test	0.4137	
Bootstrap	UCL	0.311	0.195
	Mean	0.224	0.125
	LCL	0.137	0.056
	Std. Dev.	0.196	0.125
	Efficiency	44.01%	

Wood Hollow Wet Pond - Fecal Coliform (cfu/100 ml)



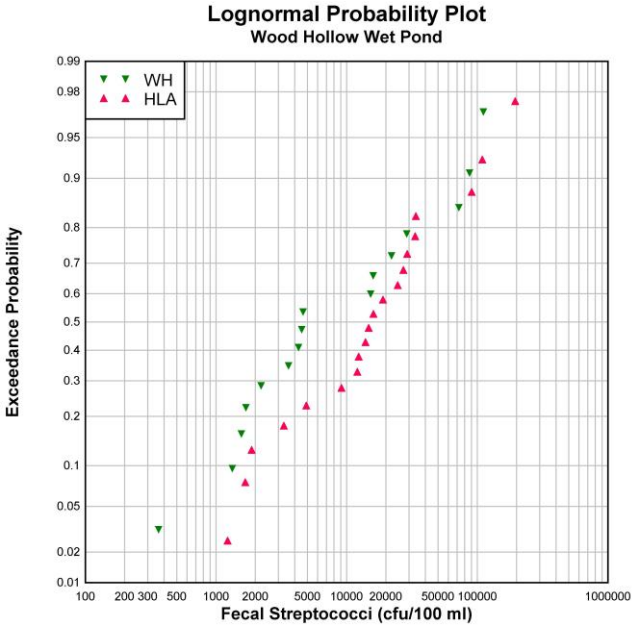


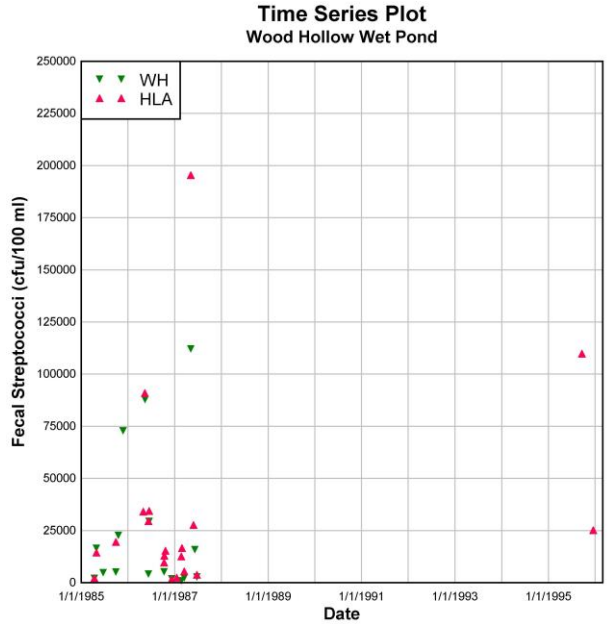


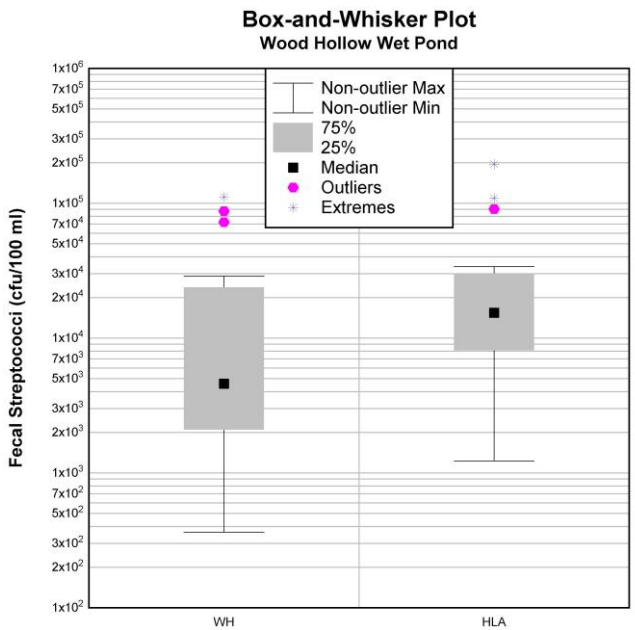


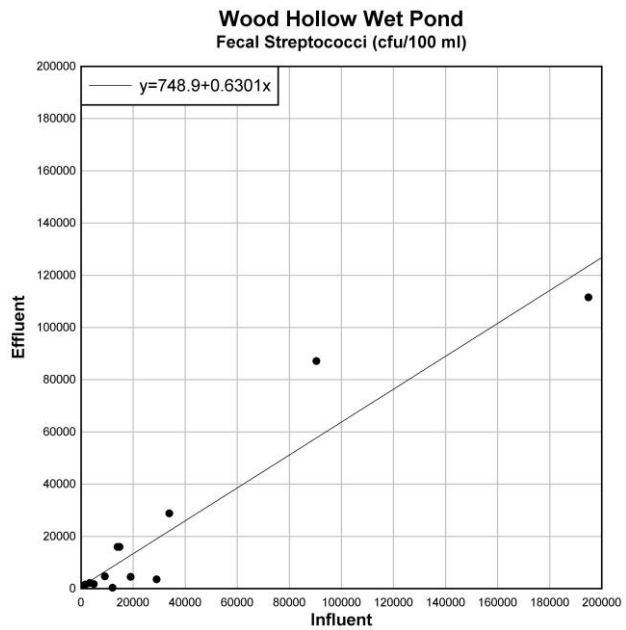
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	20	16
	Pairs Count	12	12
Non-Parametric	Maximum	964,860	1,770,741
	Upper Quartile	34,243	24,505
	Median	15,338	6,167
	Lower Quartile	5,873	2,293
	Minimum	63	106
	Efficiency	59.79%	
	Mann-Whitney	0.4594	
	Wilcoxon (paired)	0.2334	
Arithmetic	UCL	214,072	359,834
	Mean	97,801	125,746
	LCL	-18,470	-108,343
	Std. Dev.	248,438	439,397
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-28.57%	
	t-Test (equal var.)	0.8111	
	t-Test (unequal var.)	0.8225	
	t-test (paired)	0.3760	
	Levene Test	0.4393	
Log Transformed	UCL	577,787	658,498
	Mean	94,416	64,861
	LCL	15,429	6,389
	Std. Dev.	358,194	247,889
	Wilk (p-value)	0.2810	0.6004
	Efficiency	31.30%	
	t-Test (equal var.)	0.4501	
	t-Test (unequal var.)	0.4539	
	t-Test (paired)	0.1332	
	Levene Test	0.8430	
Bootstrap	UCL	203,641	306,329
	Mean	99,005	125,419
	LCL	-5,632	-55,491
	Std. Dev.	223,575	339,506
	Efficiency	-26.68%	

Wood Hollow Wet Pond - Fecal Streptococci (cfu/100 ml)



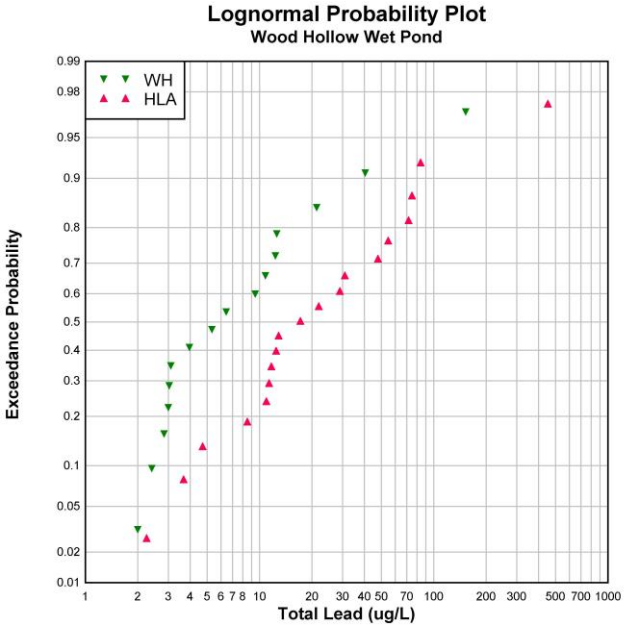


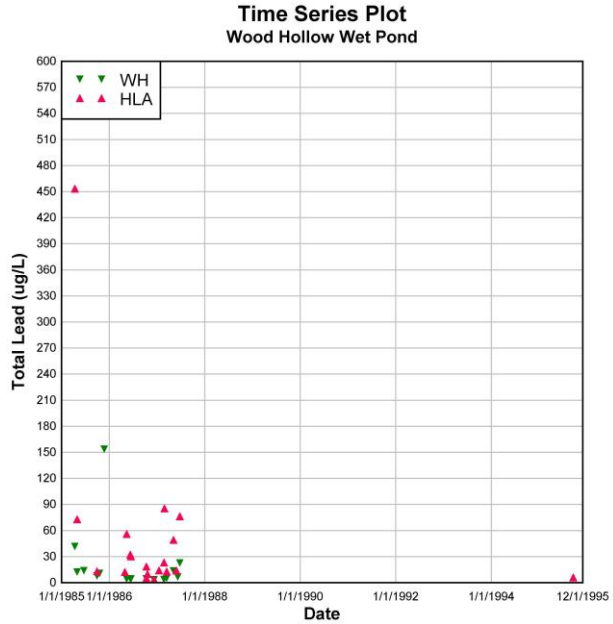


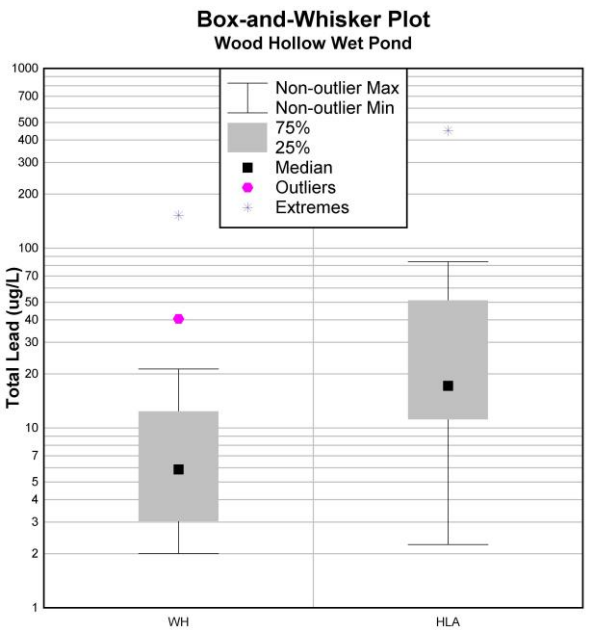


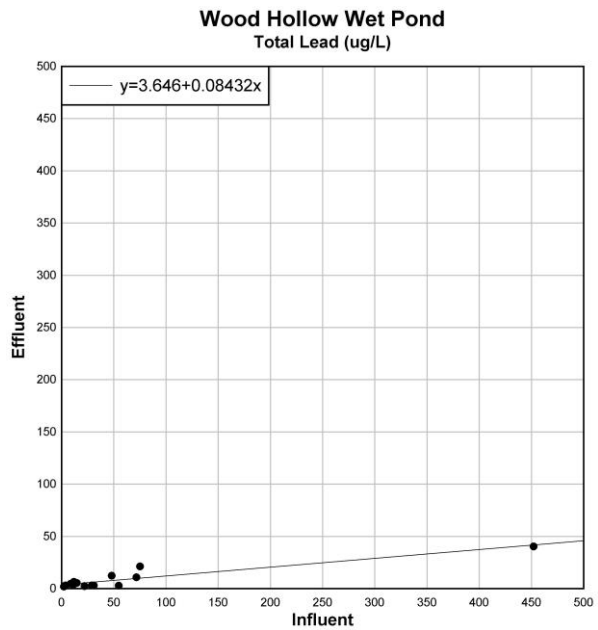
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	20	16
	Pairs Count	12	12
Non-Parametric	Maximum	194,882	111,527
	Upper Quartile	31,250	25,477
	Median	15,386	4,593
	Lower Quartile	7,020	1,954
	Minimum	1,228	364
	Efficiency	70.15%	
	Mann-Whitney	0.2406	
	Wilcoxon (paired)	0.0210 **	
Arithmetic	UCL	54,827	42,178
	Mean	32,646	23,592
	LCL	10,465	5,006
	Std. Dev.	47,395	34,887
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	27.73%	
	t-Test (equal var.)	0.5280	
	t-Test (unequal var.)	0.5139	
	t-test (paired)	0.1057	
	Levene Test	0.5229	
Log Transformed	UCL	84,709	105,326
	Mean	34,464	25,678
	LCL	14,022	6,260
	Std. Dev.	61,636	59,471
	Wilk (p-value)	0.6278	0.5802
	Efficiency	25.49%	
	t-Test (equal var.)	0.1928	
	t-Test (unequal var.)	0.2045	
	t-Test (paired)	0.0267 **	
	Levene Test	0.3094	
Bootstrap	UCL	52,874	40,947
	Mean	32,476	23,523
	LCL	12,078	6,099
	Std. Dev.	43,585	32,699
	Efficiency	27.57%	

Wood Hollow Wet Pond - Total Lead (ug/L)



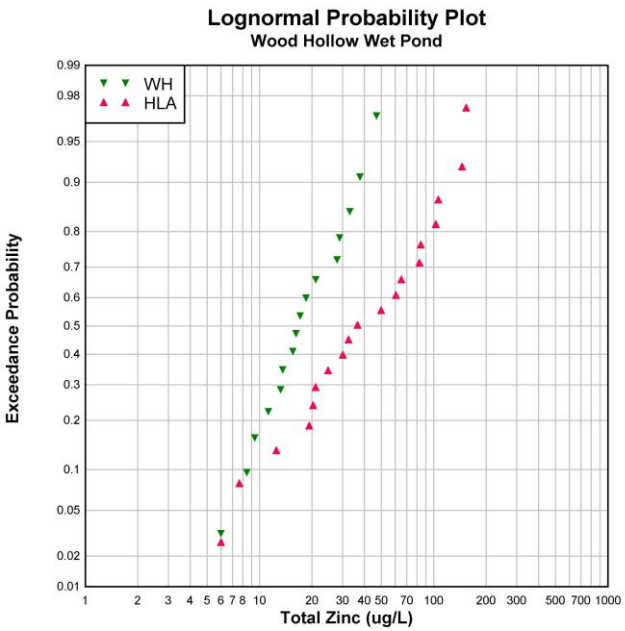


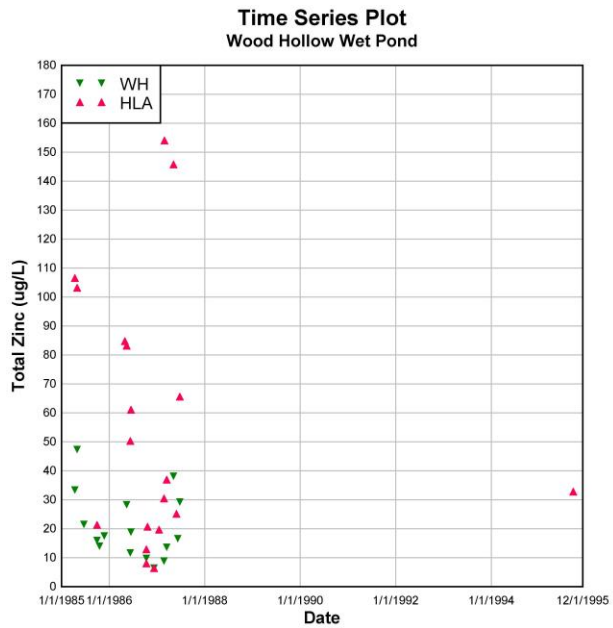


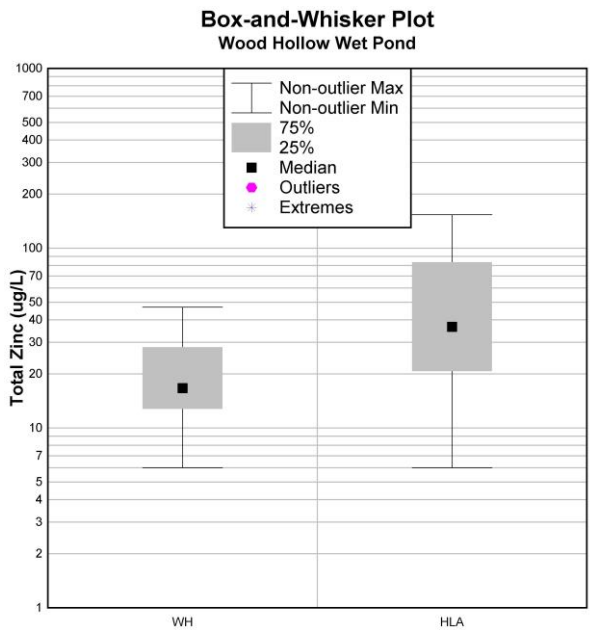


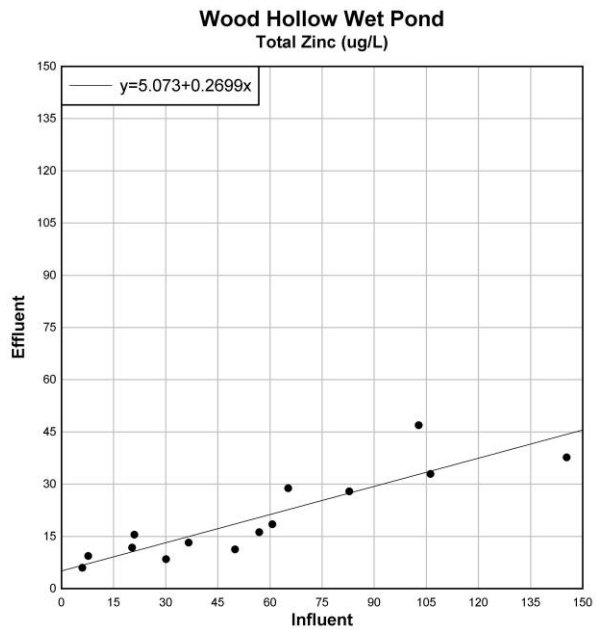
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	19	16
	Pairs Count	13	13
Non-Parametric	Maximum	452.1	152.4
	Upper Quartile	54.7	12.4
	Median	17.2	5.9
	Lower Quartile	10.9	3.0
	Minimum	2.2	2.0
	Efficiency	65.75%	
	Mann-Whitney	0.0188 **	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	99.1	38.0
	Mean	50.7	18.2
	LCL	2.2	-1.6
	Std. Dev.	100.6	37.1
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	64.06%	
	t-Test (equal var.)	0.2309	
	t-Test (unequal var.)	0.2044	
	t-test (paired)	0.1216	
	Levene Test	0.3767	
Log Transformed	UCL	101.5	32.0
	Mean	44.1	14.1
	LCL	19.1	6.2
	Std. Dev.	70.4	19.6
	Wilk (p-value)	0.7843	0.0557 *
	Efficiency	68.11%	
	t-Test (equal var.)	0.0191 **	
	t-Test (unequal var.)	0.0184 **	
	t-Test (paired)	0.0001 **	
	Levene Test	0.7547	
Bootstrap	UCL	93.0	34.7
	Mean	51.2	18.2
	LCL	9.4	1.7
	Std. Dev.	86.7	31.0
	Efficiency	64.48%	

Wood Hollow Wet Pond - Total Zinc (ug/L)



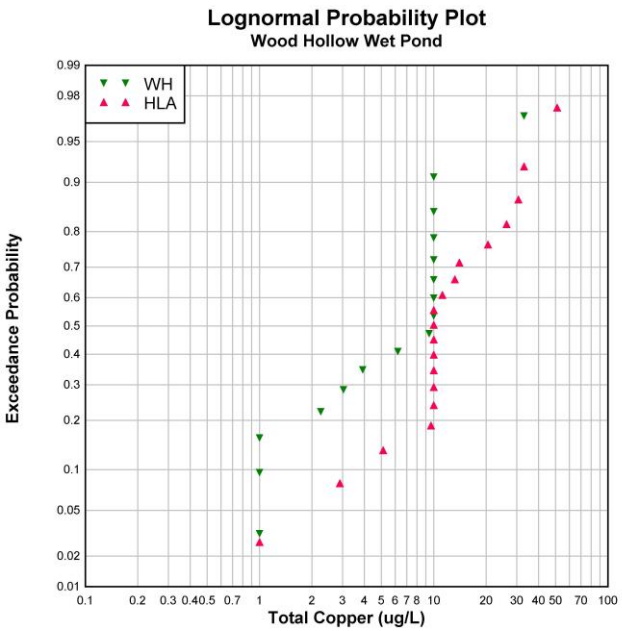


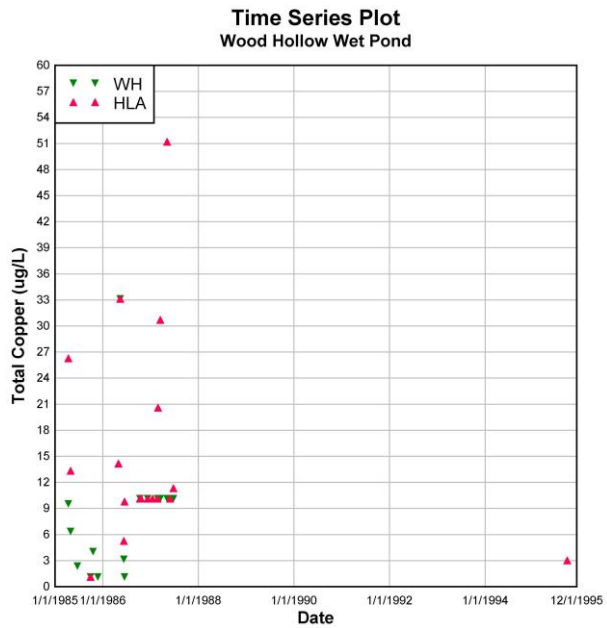


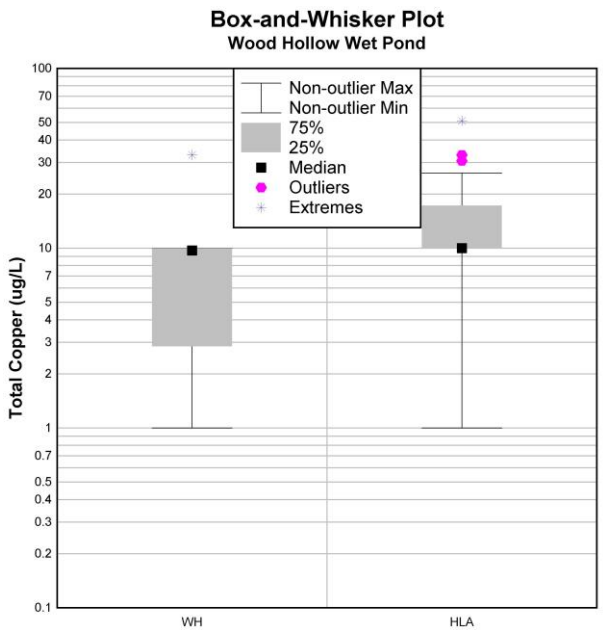


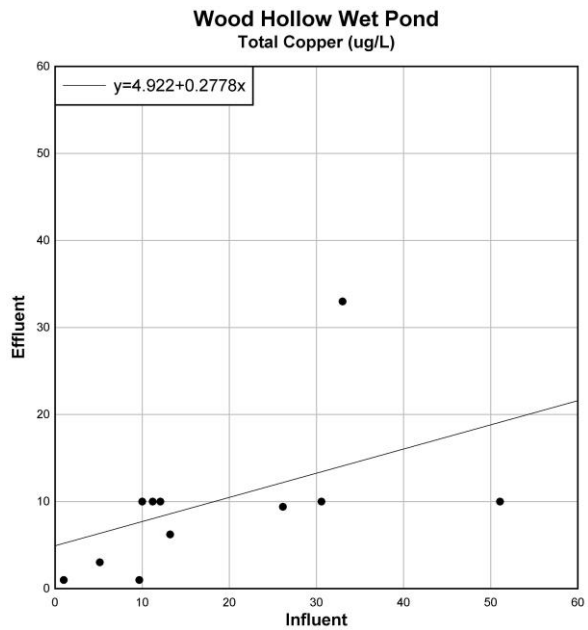
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	19	16
	Pairs Count	13	13
Non-Parametric	Maximum	153.7	47.0
	Upper Quartile	84.4	28.4
	Median	36.6	16.6
	Lower Quartile	20.3	12.2
	Minimum	6.0	6.0
	Efficiency	54.47%	
	Mann-Whitney	0.0143 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	77.7	26.4
	Mean	55.9	20.3
	LCL	34.0	14.1
	Std. Dev.	45.4	11.5
	Wilk (p-value)	0.0278 **	0.1358
	Efficiency	63.69%	
	t-Test (equal var.)	0.0045 **	
	t-Test (unequal var.)	0.0035 **	
	t-test (paired)	0.0017 **	
	Levene Test	0.0076 **	
Log Transformed	UCL	102.7	28.3
	Mean	58.8	20.3
	LCL	33.6	14.6
	Std. Dev.	63.9	12.1
	Wilk (p-value)	0.5885	0.9910
	Efficiency	65.41%	
	t-Test (equal var.)	0.0063 **	
	t-Test (unequal var.)	0.0049 **	
	t-Test (paired)	0.0001 **	
	Levene Test	0.0368 **	
Bootstrap	UCL	77.2	26.0
	Mean	56.0	20.2
	LCL	34.7	14.4
	Std. Dev.	44.1	10.9
	Efficiency	63.91%	

Wood Hollow Wet Pond - Total Copper (ug/L)









	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: HLA**	**EFF: WH**
	Site Count	19	16
	Pairs Count	13	13
Non-Parametric	Maximum	51.1	33.0
	Upper Quartile	20.5	10.0
	Median	10.0	9.7
	Lower Quartile	10.0	2.6
	Minimum	1.0	1.0
	Efficiency	2.98%	
	Mann-Whitney	0.0240 **	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	21.1	12.3
	Mean	15.2	8.2
	LCL	9.3	4.1
	Std. Dev.	12.2	7.7
	Wilk (p-value)	0.0011 **	0.0002 **
	Efficiency	46.14%	
	t-Test (equal var.)	0.0554 *	
	t-Test (unequal var.)	0.0475 **	
	t-test (paired)	0.0422 **	
	Levene Test	0.2936	
Log Transformed	UCL	26.6	17.5
	Mean	16.1	8.8
	LCL	9.7	4.4
	Std. Dev.	15.9	10.4
	Wilk (p-value)	0.0321 **	0.0145 **
	Efficiency	45.36%	
	t-Test (equal var.)	0.0313 **	
	t-Test (unequal var.)	0.0343 **	
	t-Test (paired)	0.0142 **	
	Levene Test	0.5594	
Bootstrap	UCL	20.8	12.0
	Mean	15.2	8.3
	LCL	9.6	4.6
	Std. Dev.	11.6	6.9
	Efficiency	45.61%	

Convention Center Wet Pond (WCE-WCP)

This wet pond SCM treats an area of downtown Austin. See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed. WCP is the effluent measuring point of the wet pond and also for the whole Convention Center combined system. For a description and analysis summary of the combined system please refer to Convention Center Wet Pond System (WCI-WCP).

This report characterizes the after treatment for the wet pond with respect the pretreatment effluent at station WCE. For a description and analysis summary of the oil-grit separator please refer to Convention Center O/G Chamber (WCI-WCE).

The Convention Center Wet Pond was undergoing maintenance during monitoring period in winter of 1997, so the water level was lower than operational norm during that time. Average residence time in this pond was shorter than a regularly designed wet pond. The Convention Center Wet Pond has a smaller forebay compared to other ponds due to the densely developed urban area.

The City collected runoff and water quality data at the Convention Center wet pond (WCE-WCP) from January 1995 to December 1998. During this time 5 and 34 valid EMCs were collected at the influent (WCE) and effluent (WCP), respectively, of which 4 were paired.

Performance Summary

The Convention Center wet pond did not have good performance for reductions of the concentrations for almost all pollutant parameters. TSS concentration was reduced by 60% and was significant in all cases, paired or not paired. VSS concentration was reduced by 41% and was only significant if data are paired.

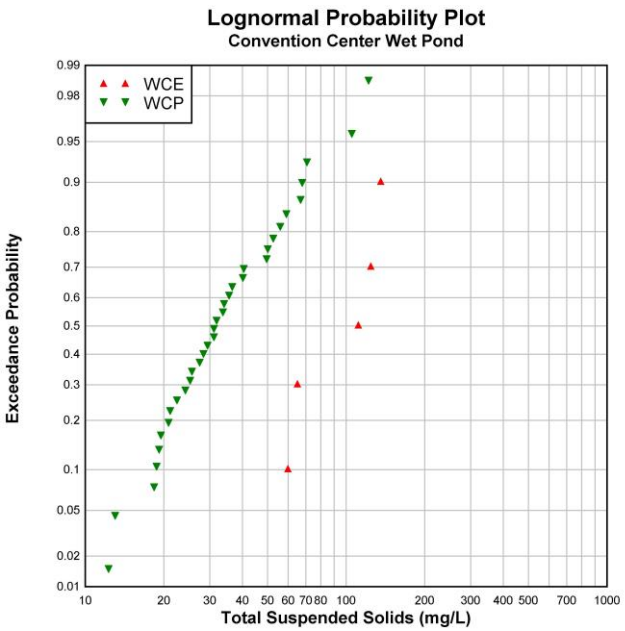
COD concentration was reduced by 40% and was only significant if data are not paired. TOC concentration was reduced by 8% and was not significant in any case. BOD concentration was increased by 10% and was not significant in any case.

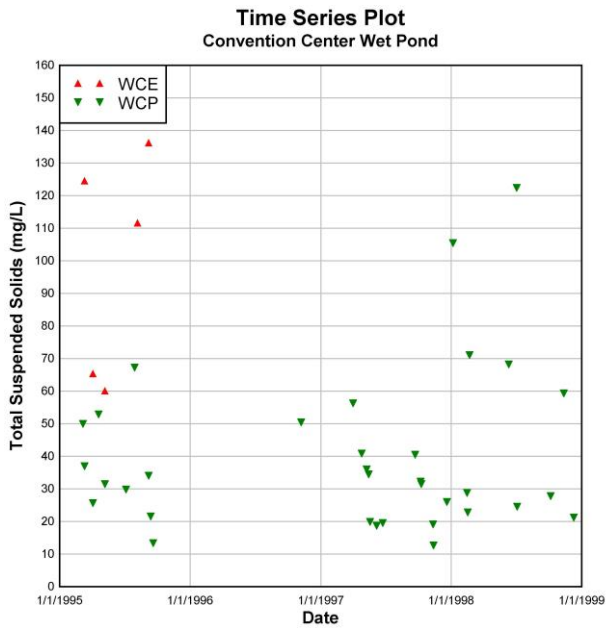
Total nitrogen, Total Kjeldahl nitrogen and ammonia concentrations were reduced by 37%, 37% and 27%, respectively, and were not significant in any case. The reduction of concentration in nitrate + nitrite (37%) was only significant if data are paired.

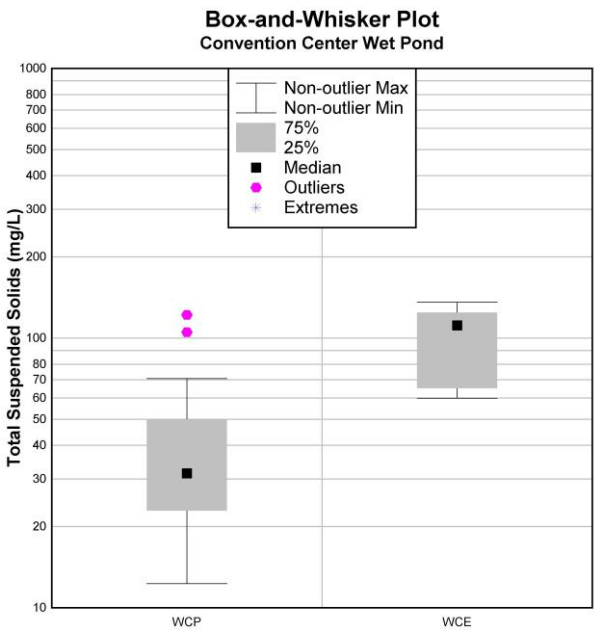
TP concentration was reduced by 15% and was not significant in any case.

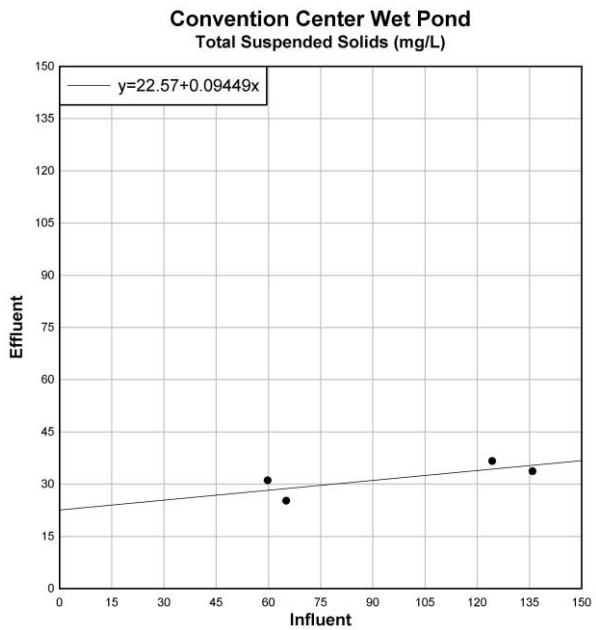
Lead, zinc and copper concentrations were reduced by 44%, 28% and 7%, respectively, and were not significant in all cases. Cadmium concentration was reduced by 35% and was only significant if data are paired.

Convention Center Wet Pond - Total Suspended Solids (mg/L)



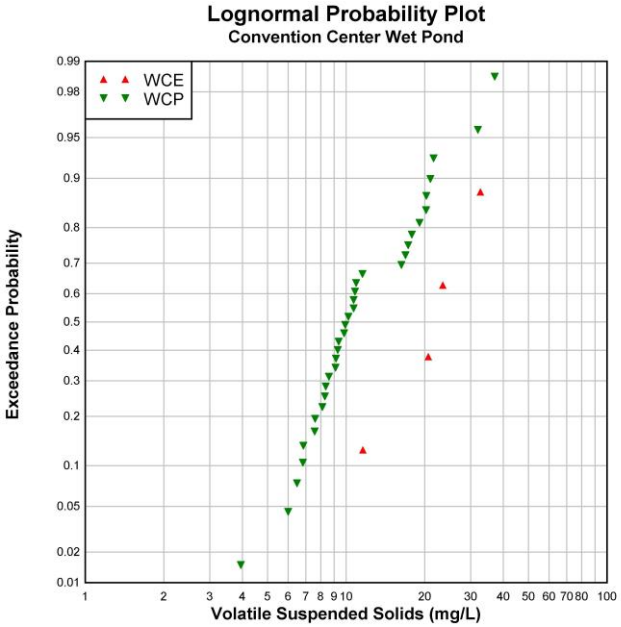


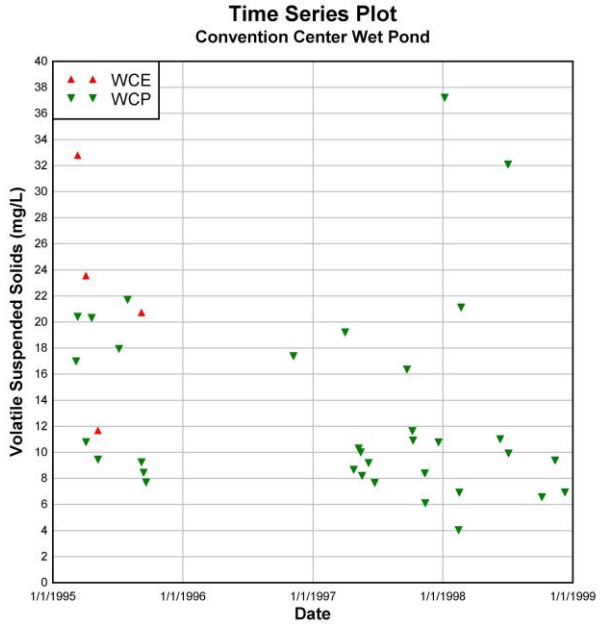


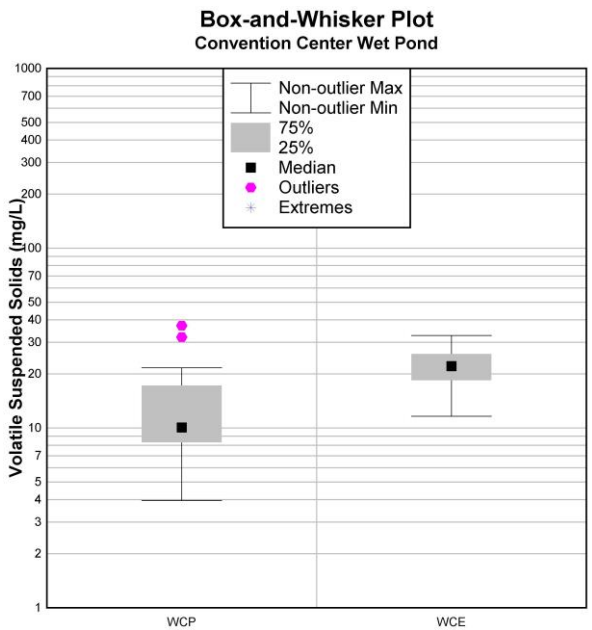


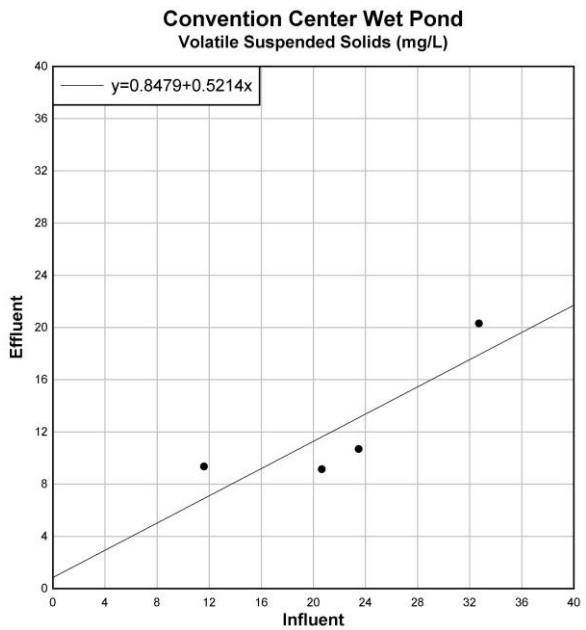
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	5	34
	Pairs Count	4	4
Non-Parametric	Maximum	135.9	122.0
	Upper Quartile	124.3	50.1
	Median	111.3	31.5
	Lower Quartile	65.1	22.4
	Minimum	59.8	12.3
	Efficiency	71.69%	
	Mann-Whitney	0.0038 **	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	142.4	48.0
	Mean	99.3	39.4
	LCL	56.1	30.8
	Std. Dev.	34.8	24.7
	Wilk (p-value)	0.2651	0.0001 **
	Efficiency	60.29%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0160 **	
	t-test (paired)	0.0366 **	
	Levene Test	0.5371	
Log Transformed	UCL	163.2	47.9
	Mean	99.5	39.1
	LCL	60.7	31.8
	Std. Dev.	37.8	22.6
	Wilk (p-value)	0.1823	0.6848
	Efficiency	60.75%	
	t-Test (equal var.)	0.0003 **	
	t-Test (unequal var.)	0.0014 **	
	t-Test (paired)	0.0074 **	
	Levene Test	0.3331	
Bootstrap	UCL	136.2	47.8
	Mean	99.2	39.5
	LCL	62.1	31.1
	Std. Dev.	29.9	23.9
	Efficiency	60.21%	

Convention Center Wet Pond - Volatile Suspended Solids (mg/L)



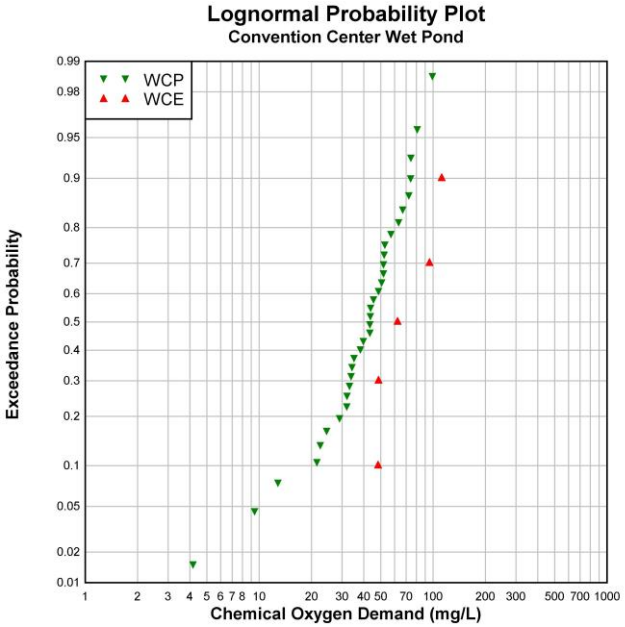


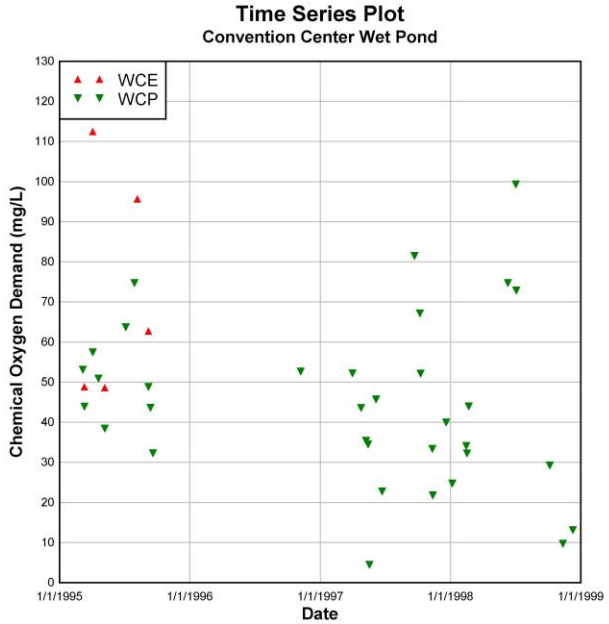


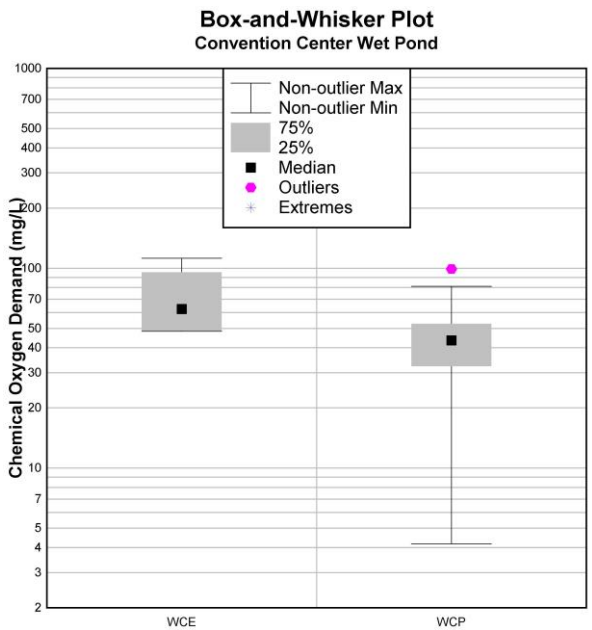


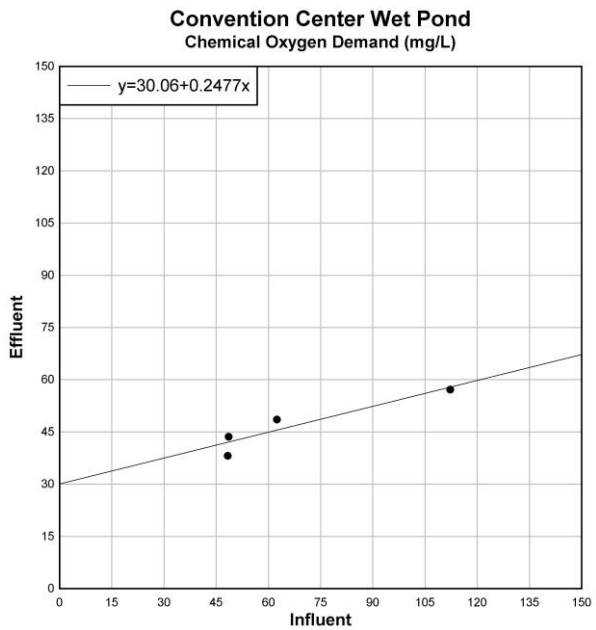
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	4	34
	Pairs Count	4	4
Non-Parametric	Maximum	32.7	37.1
	Upper Quartile	28.1	17.3
	Median	22.1	10.1
	Lower Quartile	16.1	8.3
	Minimum	11.6	3.9
	Efficiency	54.38%	
	Mann-Whitney	0.0240 **	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	35.9	15.5
	Mean	22.1	12.9
	LCL	8.3	10.4
	Std. Dev.	8.7	7.4
	Wilk (p-value)	0.9525	0.0001 **
	Efficiency	41.49%	
	t-Test (equal var.)	0.0264 **	
	t-Test (unequal var.)	0.1221	
	t-test (paired)	0.0304 **	
	Levene Test	0.9460	
Log Transformed	UCL	46.0	15.4
	Mean	22.2	12.8
	LCL	10.7	10.7
	Std. Dev.	9.5	6.7
	Wilk (p-value)	0.7827	0.1436
	Efficiency	42.20%	
	t-Test (equal var.)	0.0274 **	
	t-Test (unequal var.)	0.0614 *	
	t-Test (paired)	0.0272 **	
	Levene Test	0.5561	
Bootstrap	UCL	33.0	15.4
	Mean	22.1	12.9
	LCL	11.1	10.4
	Std. Dev.	6.9	7.2
	Efficiency	41.46%	

Convention Center Wet Pond - Chemical Oxygen Demand (mg/L)



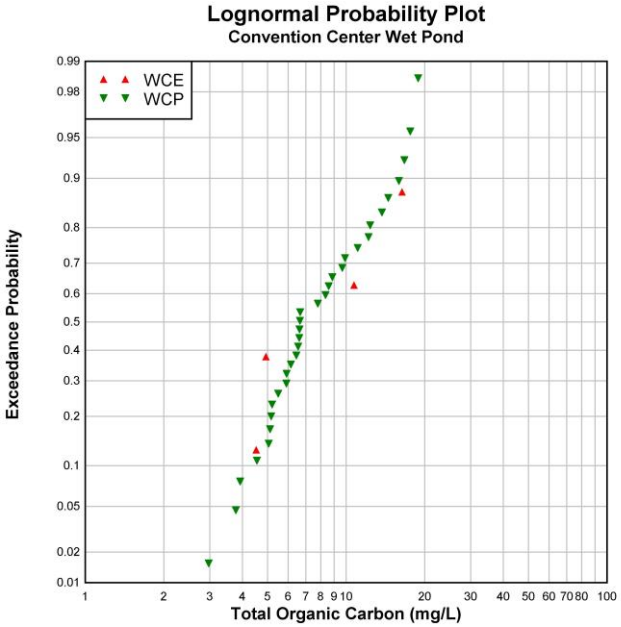


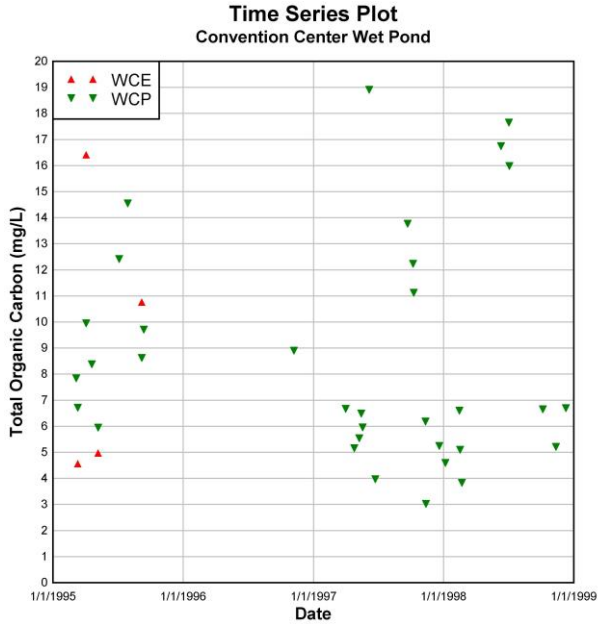


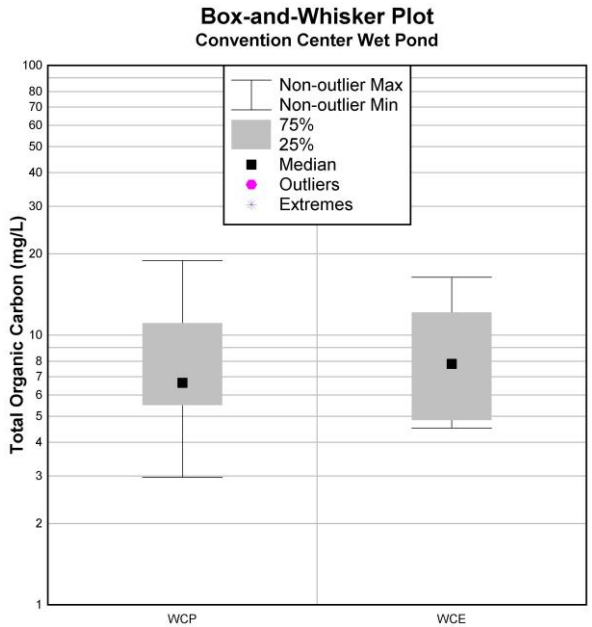


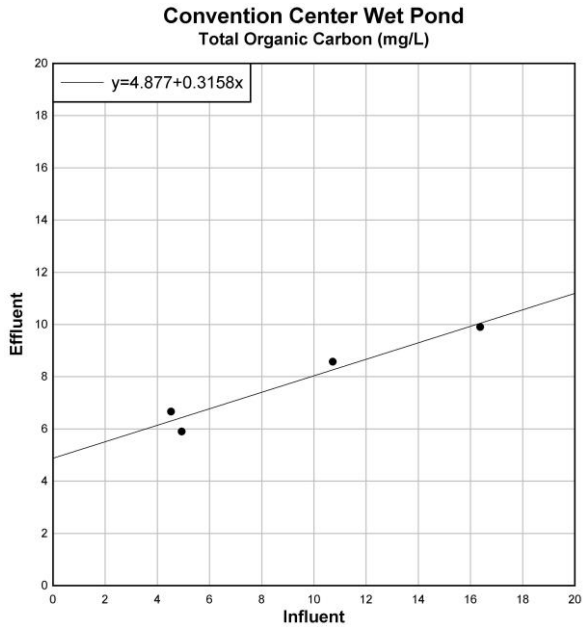
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	5	34
	Pairs Count	4	4
Non-Parametric	Maximum	112.22	99.00
	Upper Quartile	95.38	52.82
	Median	62.45	43.49
	Lower Quartile	48.59	31.97
	Minimum	48.33	4.17
	Efficiency	30.35%	
	Mann-Whitney	0.0444 **	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	109.34	51.98
	Mean	73.39	44.65
	LCL	37.44	37.32
	Std. Dev.	28.96	21.00
	Wilk (p-value)	0.2339	0.7825
	Efficiency	39.17%	
	t-Test (equal var.)	0.0097 **	
	t-Test (unequal var.)	0.0898 *	
	t-test (paired)	0.1647	
	Levene Test	0.4155	
Log Transformed	UCL	121.23	59.55
	Mean	73.28	46.74
	LCL	44.30	36.68
	Std. Dev.	28.27	31.94
	Wilk (p-value)	0.2619	0.0009 **
	Efficiency	36.23%	
	t-Test (equal var.)	0.0535 *	
	t-Test (unequal var.)	0.0226 **	
	t-Test (paired)	0.0820 *	
	Levene Test	0.5153	
Bootstrap	UCL	104.36	51.62
	Mean	73.68	44.39
	LCL	43.01	37.15
	Std. Dev.	24.70	20.73
	Efficiency	39.76%	

Convention Center Wet Pond - Total Organic Carbon (mg/L)



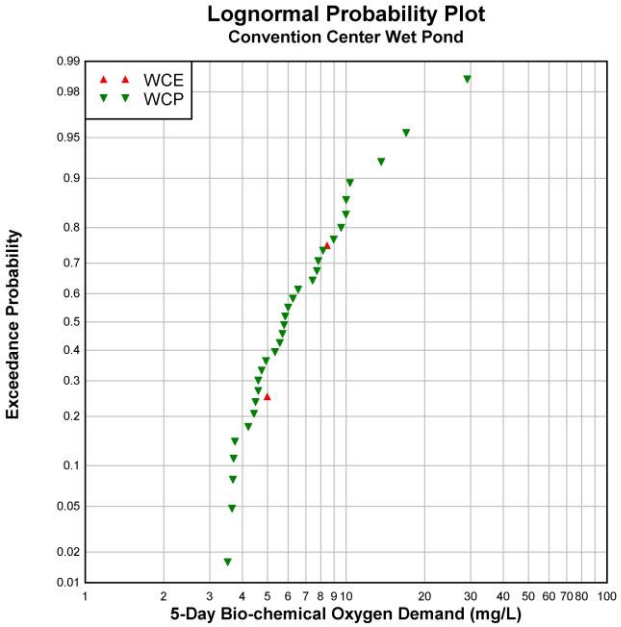


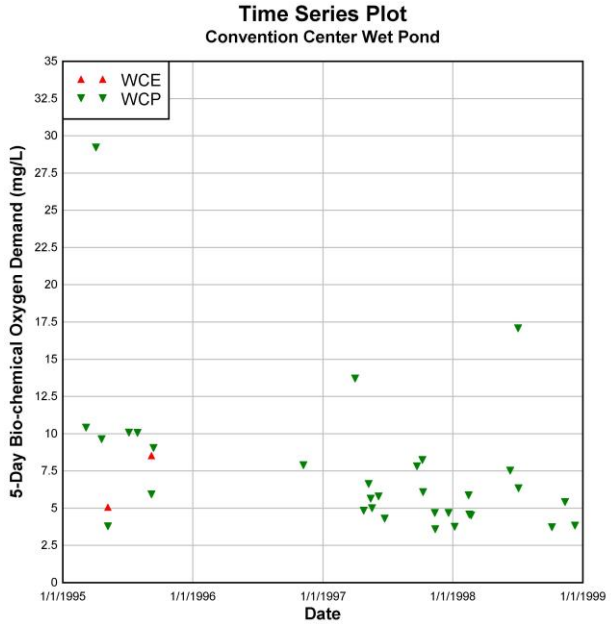


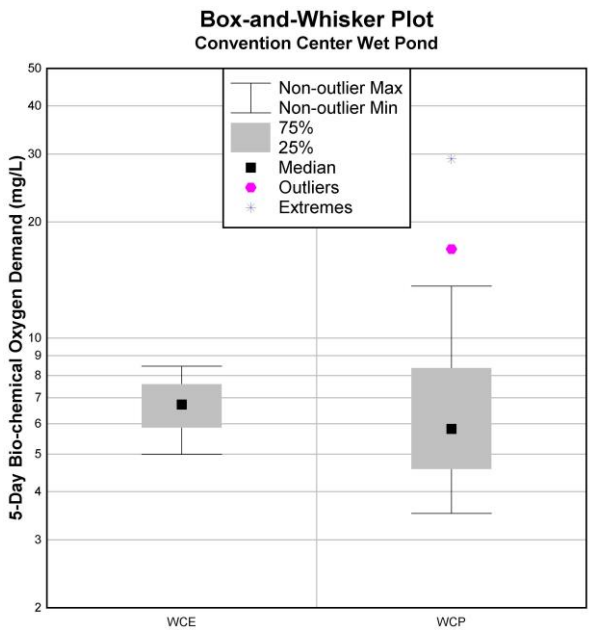


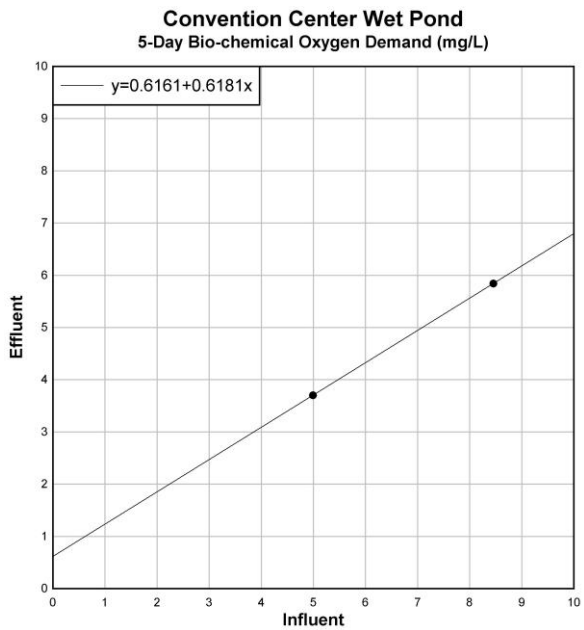
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	4	33
	Pairs Count	4	4
Non-Parametric	Maximum	16.38	18.86
	Upper Quartile	13.55	11.07
	Median	7.83	6.65
	Lower Quartile	4.73	5.49
	Minimum	4.52	2.97
	Efficiency	15.06%	
	Mann-Whitney	0.8270	
	Wilcoxon (paired)	0.8750	
Arithmetic	UCL	18.04	10.17
	Mean	9.14	8.63
	LCL	0.24	7.10
	Std. Dev.	5.59	4.33
	Wilk (p-value)	0.3550	0.0025 **
	Efficiency	5.54%	
	t-Test (equal var.)	0.8310	
	t-Test (unequal var.)	0.8709	
	t-test (paired)	0.5265	
	Levene Test	0.6821	
Log Transformed	UCL	27.57	10.30
	Mean	9.11	8.61
	LCL	3.01	7.20
	Std. Dev.	5.50	4.30
	Wilk (p-value)	0.3704	0.3711
	Efficiency	5.45%	
	t-Test (equal var.)	0.9210	
	t-Test (unequal var.)	0.9400	
	t-Test (paired)	0.8554	
	Levene Test	0.6082	
Bootstrap	UCL	16.70	10.14
	Mean	9.37	8.63
	LCL	2.03	7.12
	Std. Dev.	4.61	4.26
	Efficiency	7.88%	

Convention Center Wet Pond - 5-Day Bio-chemical Oxygen Demand (mg/L)



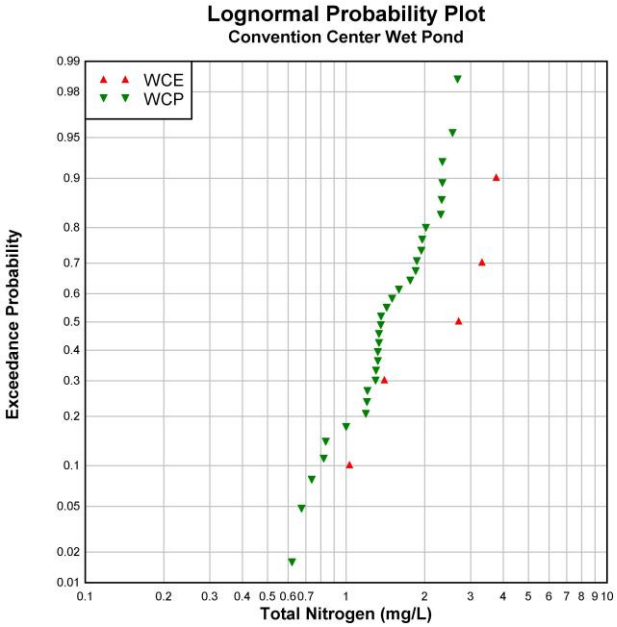


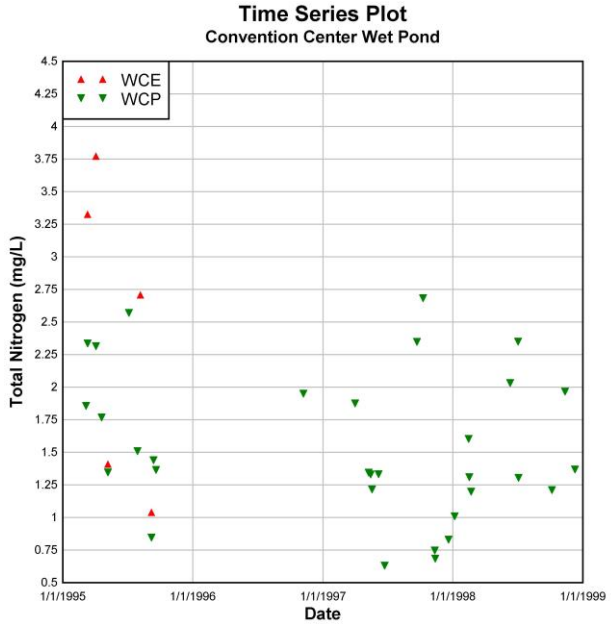


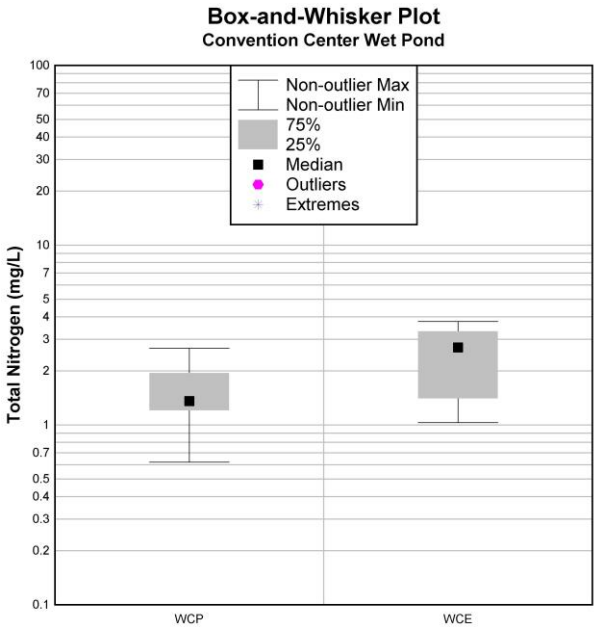


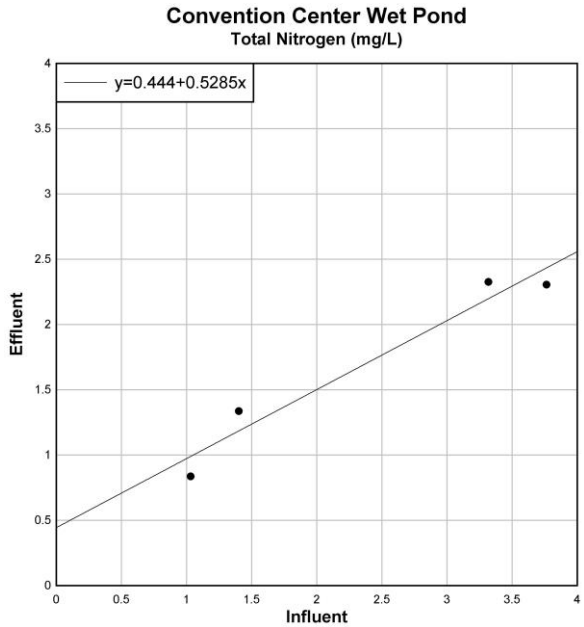
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	2	32
	Pairs Count	2	2
Non-Parametric	Maximum	8.46	29.14
	Upper Quartile	8.46	8.56
	Median	6.72	5.82
	Lower Quartile	4.99	4.55
	Minimum	4.99	3.51
	Efficiency	13.51%	
	Mann-Whitney	0.7994	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	28.73	9.22
	Mean	6.72	7.41
	LCL	-15.28	5.60
	Std. Dev.	2.45	5.01
	Wilk (p-value)	1.0000	0.0001 **
	Efficiency	-10.20%	
	t-Test (equal var.)	0.8506	
	t-Test (unequal var.)	0.7656	
	t-test (paired)	0.2080	
	Levene Test	NA	
Log Transformed	UCL	239.46	8.72
	Mean	6.72	7.24
	LCL	0.19	6.01
	Std. Dev.	2.45	3.69
	Wilk (p-value)	1.0000	0.0141 **
	Efficiency	-7.69%	
	t-Test (equal var.)	0.9866	
	t-Test (unequal var.)	0.9858	
	t-Test (paired)	0.0670 *	
	Levene Test	NA	
Bootstrap	UCL	17.88	9.07
	Mean	6.72	7.37
	LCL	-4.43	5.68
	Std. Dev.	1.24	4.69
	Efficiency	-9.69%	

Convention Center Wet Pond - Total Nitrogen (mg/L)



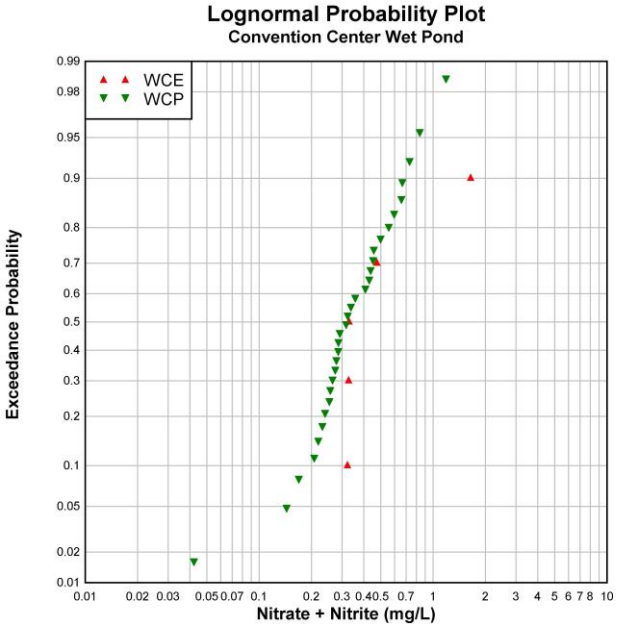


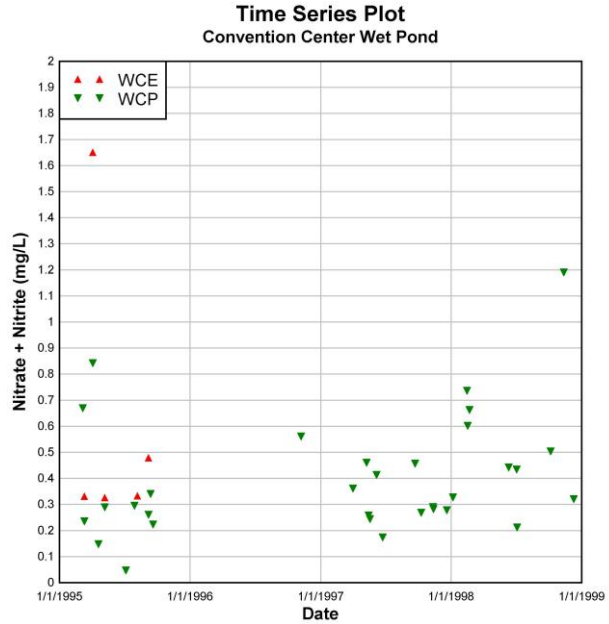


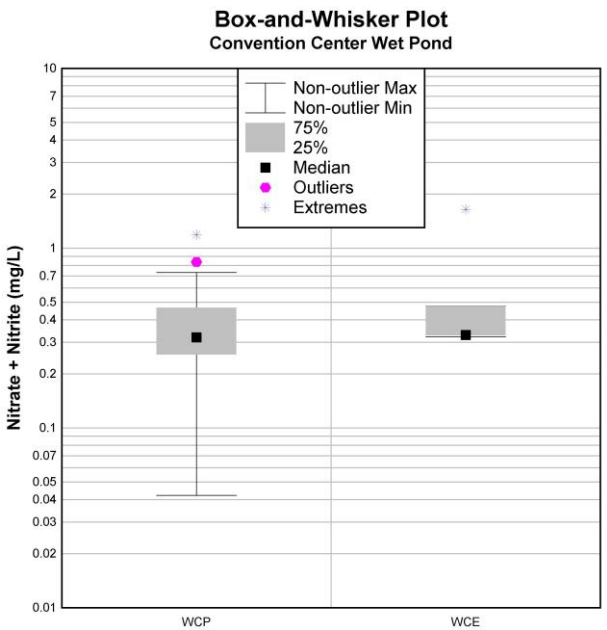


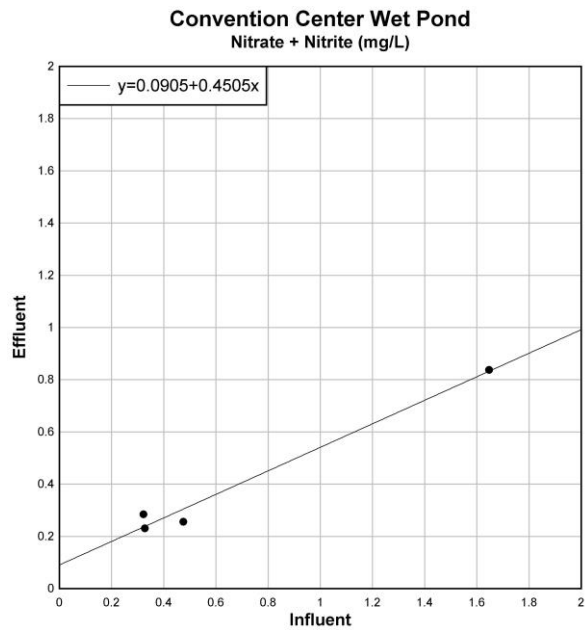
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	5	32
	Pairs Count	4	4
Non-Parametric	Maximum	3.764	2.673
	Upper Quartile	3.317	1.949
	Median	2.700	1.358
	Lower Quartile	1.402	1.204
	Minimum	1.031	0.621
	Efficiency	49.69%	
	Mann-Whitney	0.0958 *	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	3.918	1.747
	Mean	2.443	1.543
	LCL	0.967	1.339
	Std. Dev.	1.189	0.565
	Wilk (p-value)	0.5208	0.1666
	Efficiency	36.83%	
	t-Test (equal var.)	0.0081 **	
	t-Test (unequal var.)	0.1669	
	t-test (paired)	0.1335	
	Levene Test	0.0002 **	
Log Transformed	UCL	5.313	1.794
	Mean	2.465	1.549
	LCL	1.144	1.338
	Std. Dev.	1.378	0.624
	Wilk (p-value)	0.3826	0.1636
	Efficiency	37.15%	
	t-Test (equal var.)	0.0456 **	
	t-Test (unequal var.)	0.1801	
	t-Test (paired)	0.0630 *	
	Levene Test	0.2360	
Bootstrap	UCL	3.707	1.741
	Mean	2.430	1.542
	LCL	1.154	1.343
	Std. Dev.	1.028	0.552
	Efficiency	36.56%	

Convention Center Wet Pond - Nitrate + Nitrite (mg/L)



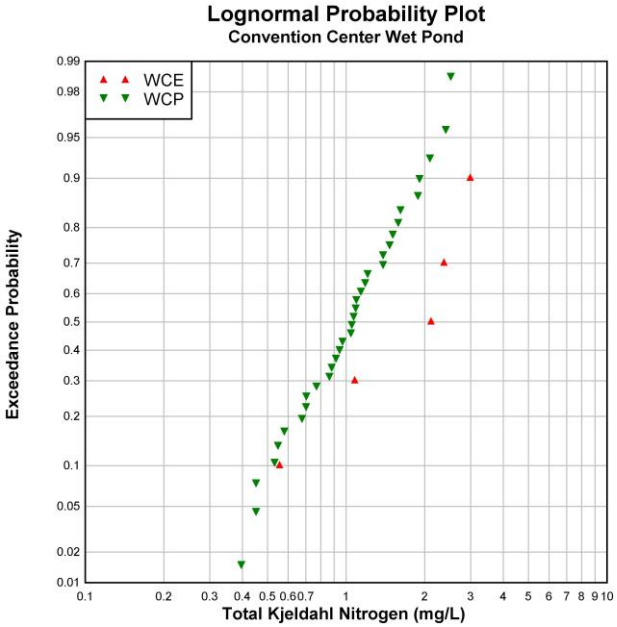


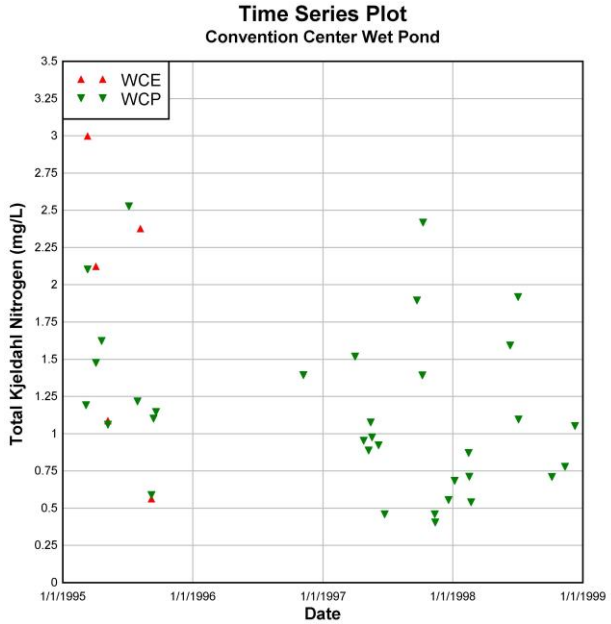


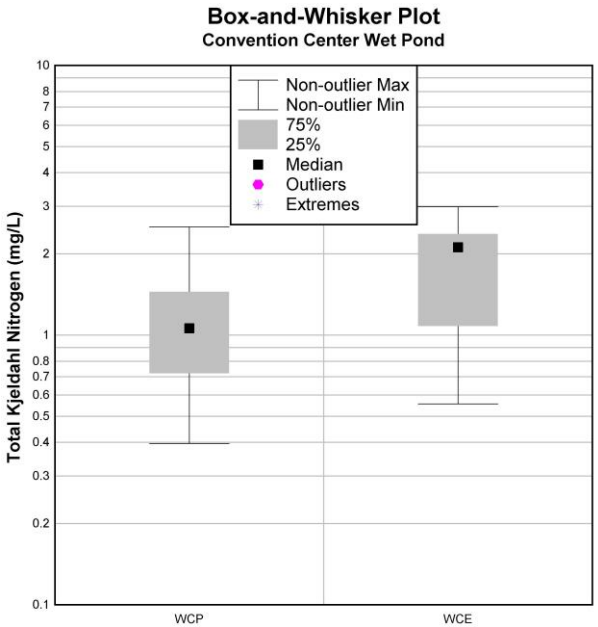


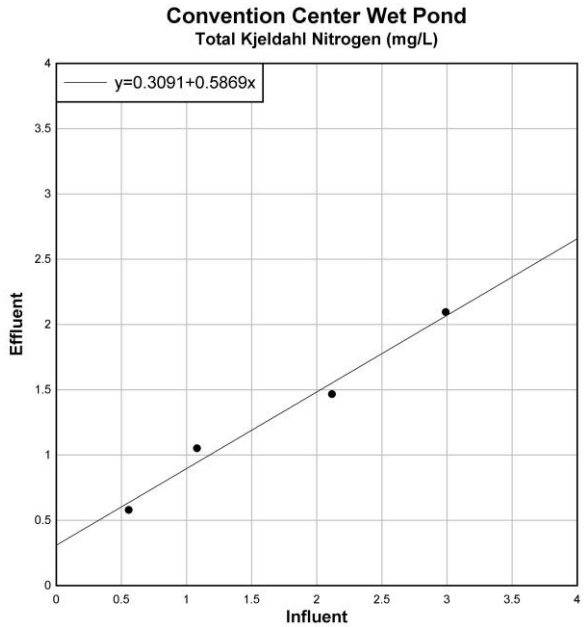
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	5	32
	Pairs Count	4	4
Non-Parametric	Maximum	1.647	1.186
	Upper Quartile	0.475	0.478
	Median	0.329	0.319
	Lower Quartile	0.327	0.255
	Minimum	0.322	0.042
	Efficiency	3.00%	
	Mann-Whitney	0.2648	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	1.337	0.480
	Mean	0.620	0.396
	LCL	-0.097	0.313
	Std. Dev.	0.578	0.231
	Wilk (p-value)	0.0015 **	0.0017 **
	Efficiency	36.06%	
	t-Test (equal var.)	0.1207	
	t-Test (unequal var.)	0.4386	
	t-test (paired)	0.1997	
	Levene Test	0.0196 **	
Log Transformed	UCL	1.592	0.514
	Mean	0.588	0.404
	LCL	0.217	0.318
	Std. Dev.	0.406	0.265
	Wilk (p-value)	0.0098 **	0.0437 **
	Efficiency	31.27%	
	t-Test (equal var.)	0.2315	
	t-Test (unequal var.)	0.3222	
	t-Test (paired)	0.0410 **	
	Levene Test	0.9332	
Bootstrap	UCL	1.168	0.477
	Mean	0.627	0.396
	LCL	0.086	0.315
	Std. Dev.	0.436	0.224
	Efficiency	36.80%	

Convention Center Wet Pond - Total Kjeldahl Nitrogen (mg/L)



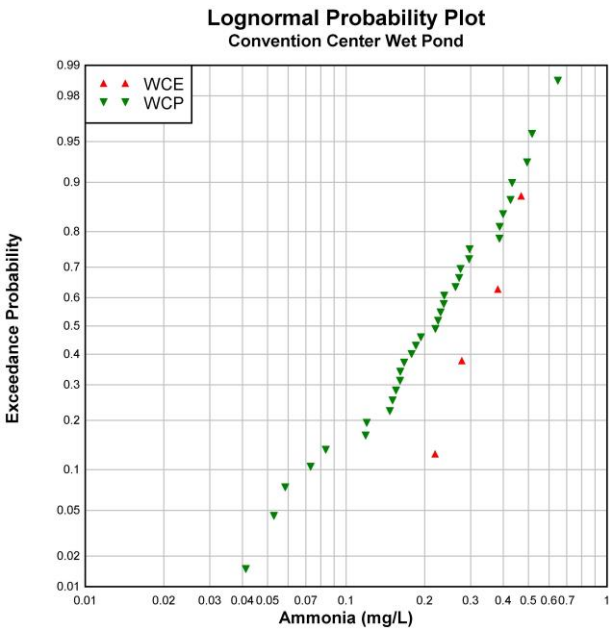


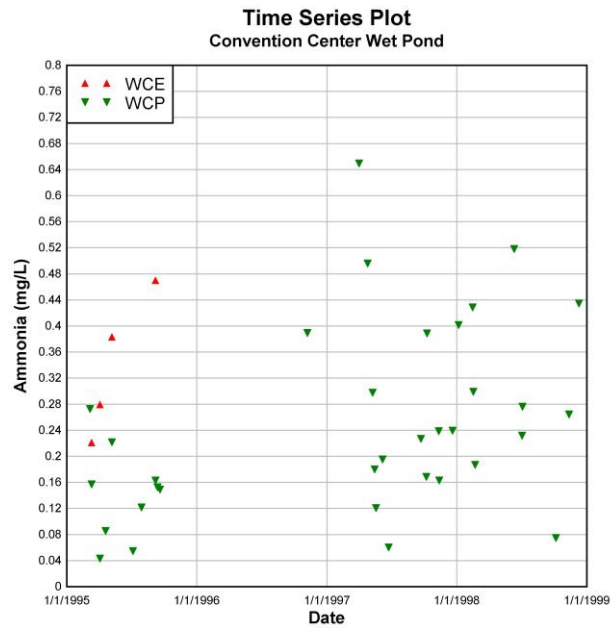


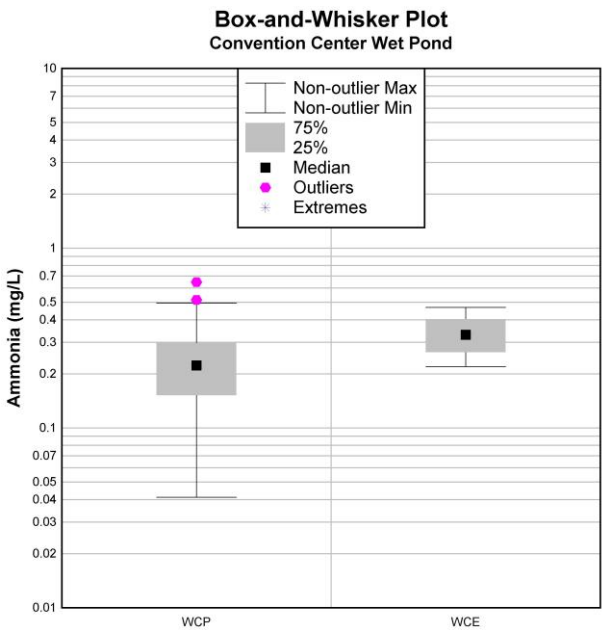


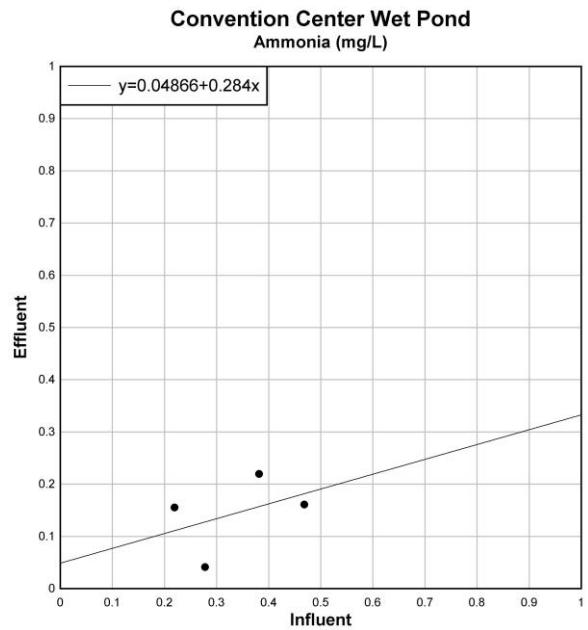
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	5	34
	Pairs Count	4	4
Non-Parametric	Maximum	2.990	2.518
	Upper Quartile	2.370	1.467
	Median	2.117	1.060
	Lower Quartile	1.080	0.704
	Minimum	0.556	0.397
	Efficiency	49.91%	
	Mann-Whitney	0.1441	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	3.050	1.339
	Mean	1.823	1.148
	LCL	0.596	0.956
	Std. Dev.	0.988	0.548
	Wilk (p-value)	0.7588	0.0389 **
	Efficiency	37.03%	
	t-Test (equal var.)	0.0269 **	
	t-Test (unequal var.)	0.2037	
	t-test (paired)	0.1886	
	Levene Test	0.0325 **	
Log Transformed	UCL	4.929	1.377
	Mean	1.865	1.151
	LCL	0.705	0.962
	Std. Dev.	1.263	0.584
	Wilk (p-value)	0.4356	0.7835
	Efficiency	38.27%	
	t-Test (equal var.)	0.1001	
	t-Test (unequal var.)	0.2568	
	t-Test (paired)	0.1995	
	Levene Test	0.2755	
Bootstrap	UCL	2.860	1.331
	Mean	1.803	1.144
	LCL	0.747	0.957
	Std. Dev.	0.851	0.535
	Efficiency	36.57%	

Convention Center Wet Pond - Ammonia (mg/L)



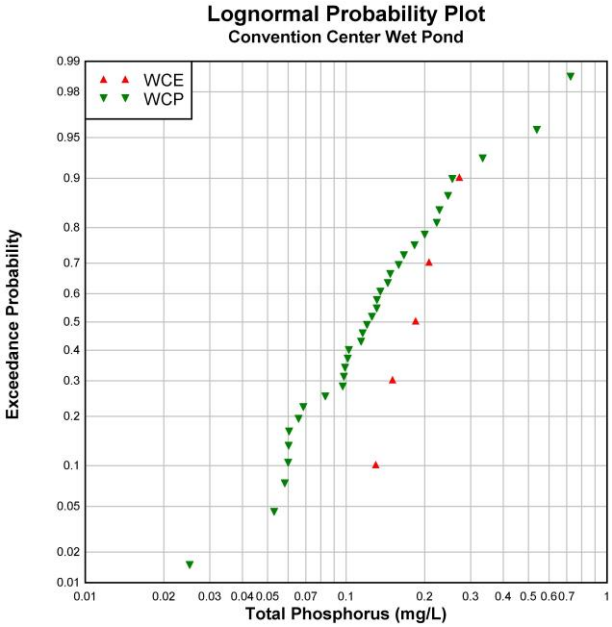


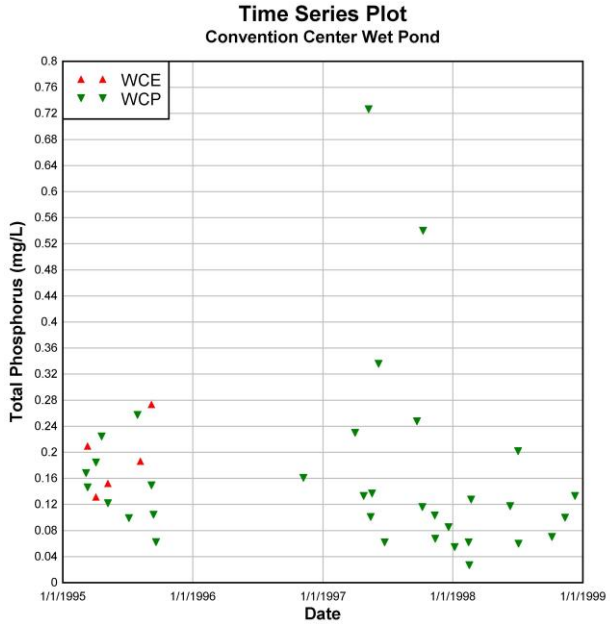


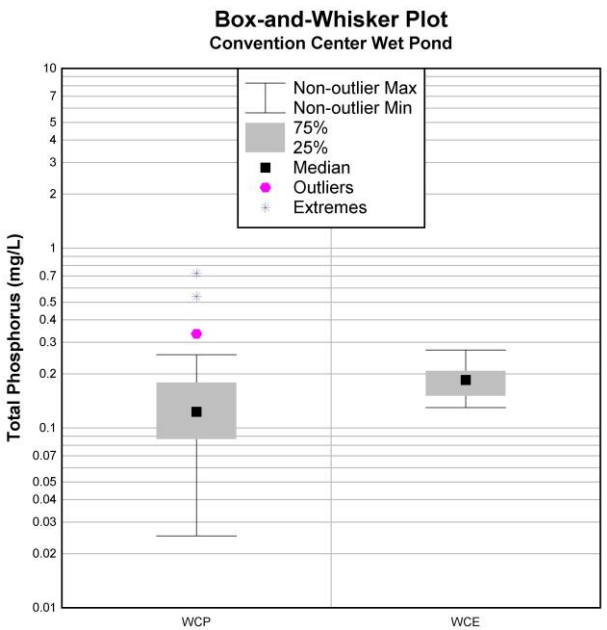


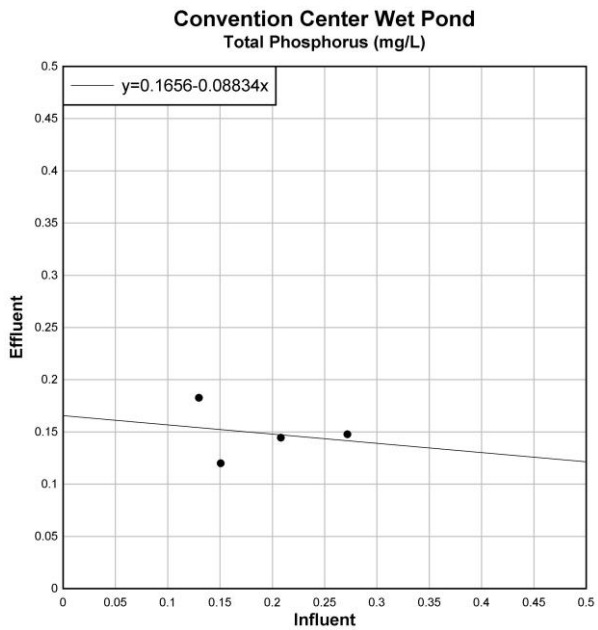
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	4	34
	Pairs Count	4	4
Non-Parametric	Maximum	0.468	0.648
	Upper Quartile	0.425	0.297
	Median	0.330	0.222
	Lower Quartile	0.248	0.151
	Minimum	0.219	0.041
	Efficiency	32.55%	
	Mann-Whitney	0.1834	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	0.513	0.294
	Mean	0.337	0.244
	LCL	0.161	0.193
	Std. Dev.	0.111	0.145
	Wilk (p-value)	0.8404	0.0407 **
	Efficiency	27.63%	
	t-Test (equal var.)	0.2255	
	t-Test (unequal var.)	0.1943	
	t-test (paired)	0.0344 **	
	Levene Test	0.4792	
Log Transformed	UCL	0.587	0.323
	Mean	0.337	0.250
	LCL	0.193	0.193
	Std. Dev.	0.112	0.182
	Wilk (p-value)	0.8662	0.3159
	Efficiency	25.89%	
	t-Test (equal var.)	0.1753	
	t-Test (unequal var.)	0.0567 *	
	t-Test (paired)	0.0688 *	
	Levene Test	0.2574	
Bootstrap	UCL	0.479	0.294
	Mean	0.337	0.244
	LCL	0.194	0.195
	Std. Dev.	0.090	0.142
	Efficiency	27.45%	

Convention Center Wet Pond - Total Phosphorus (mg/L)



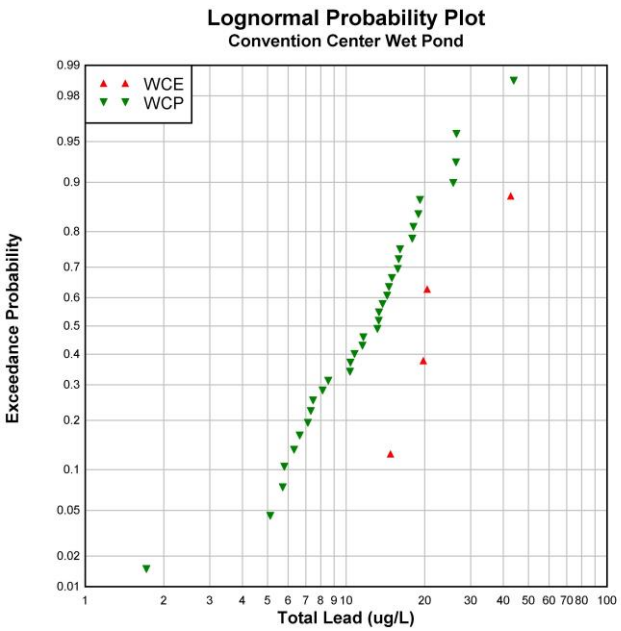


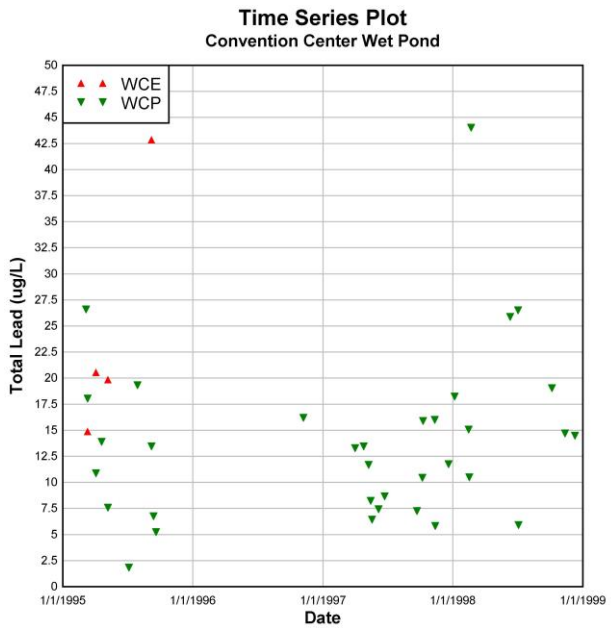


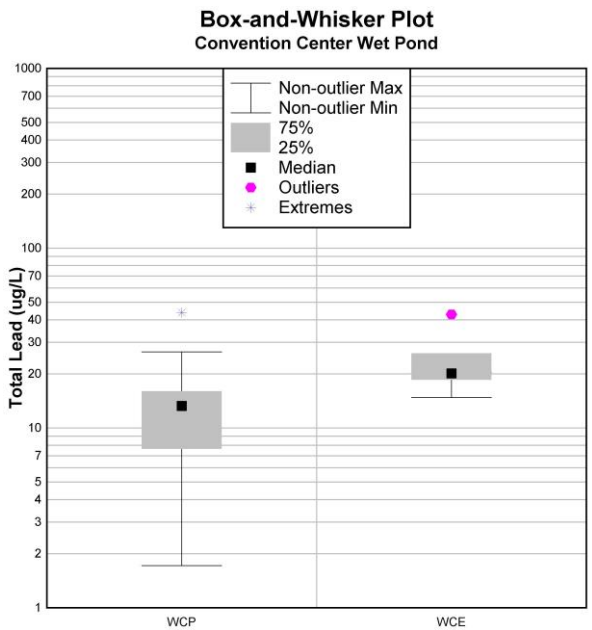


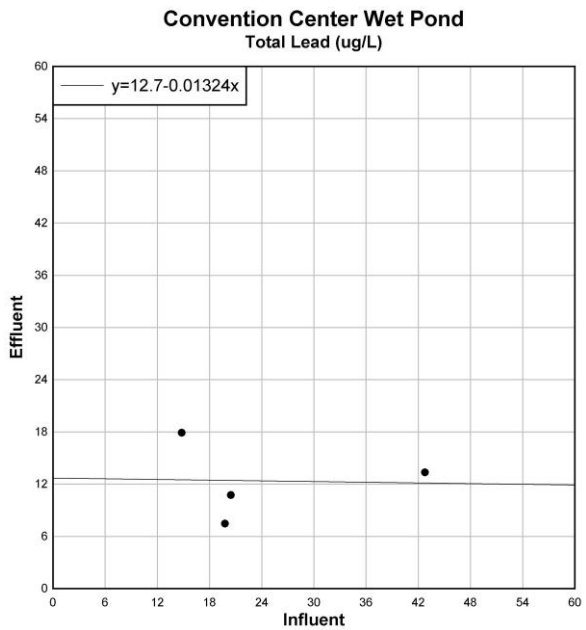
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	5	34
	Pairs Count	4	4
Non-Parametric	Maximum	0.272	0.725
	Upper Quartile	0.208	0.183
	Median	0.185	0.123
	Lower Quartile	0.151	0.083
	Minimum	0.130	0.025
	Efficiency	33.54%	
	Mann-Whitney	0.1053	
	Wilcoxon (paired)	0.3750	
Arithmetic	UCL	0.258	0.209
	Mean	0.189	0.160
	LCL	0.120	0.112
	Std. Dev.	0.055	0.139
	Wilk (p-value)	0.8016	0.0001 **
	Efficiency	15.13%	
	t-Test (equal var.)	0.6556	
	t-Test (unequal var.)	0.4197	
	t-test (paired)	0.3446	
	Levene Test	0.5376	
Log Transformed	UCL	0.272	0.204
	Mean	0.189	0.157
	LCL	0.131	0.121
	Std. Dev.	0.054	0.116
	Wilk (p-value)	0.9584	0.5607
	Efficiency	16.93%	
	t-Test (equal var.)	0.2348	
	t-Test (unequal var.)	0.0511 *	
	t-Test (paired)	0.3654	
	Levene Test	0.2598	
Bootstrap	UCL	0.248	0.206
	Mean	0.189	0.160
	LCL	0.131	0.114
	Std. Dev.	0.047	0.132
	Efficiency	15.32%	

Convention Center Wet Pond - Total Lead (ug/L)



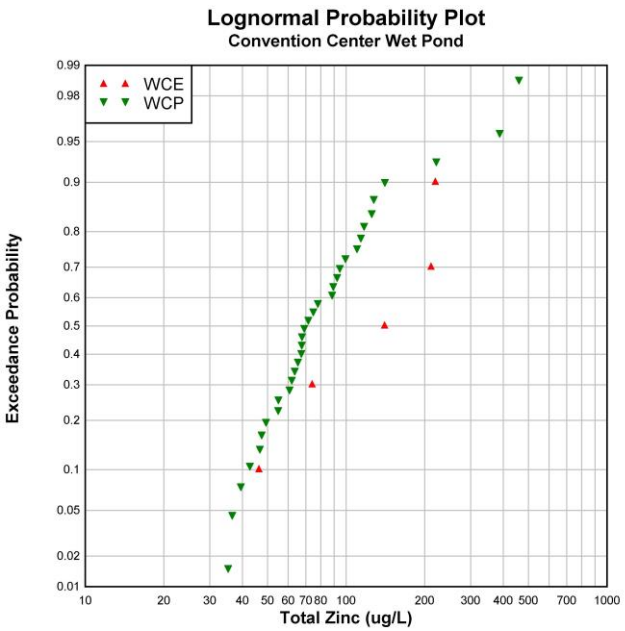


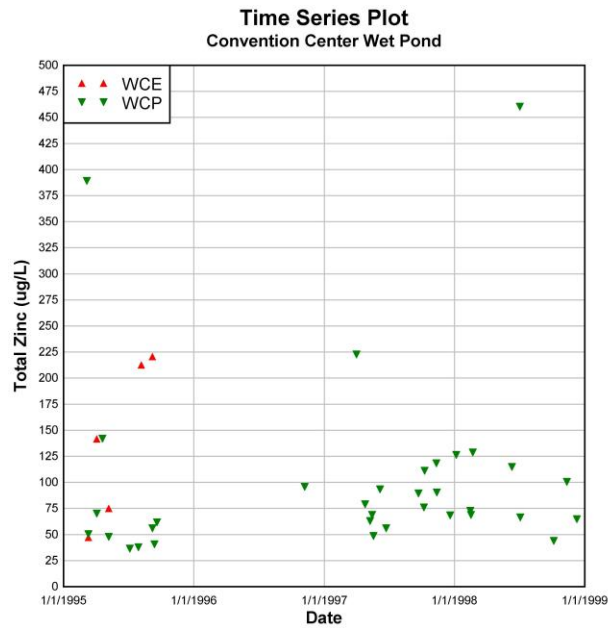


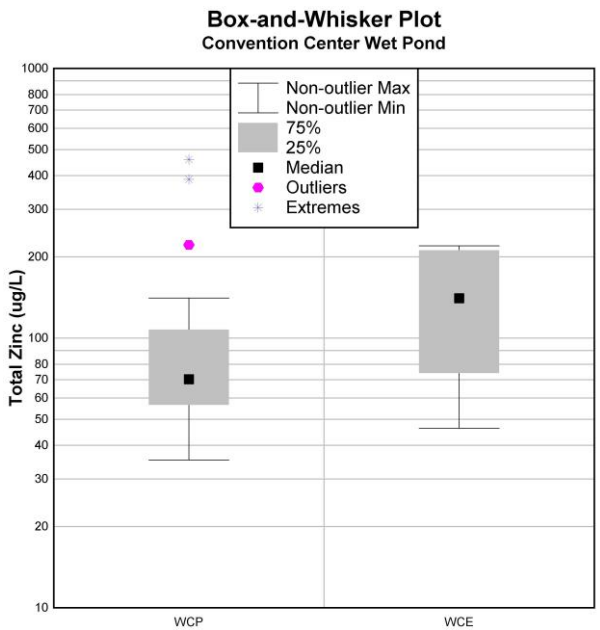


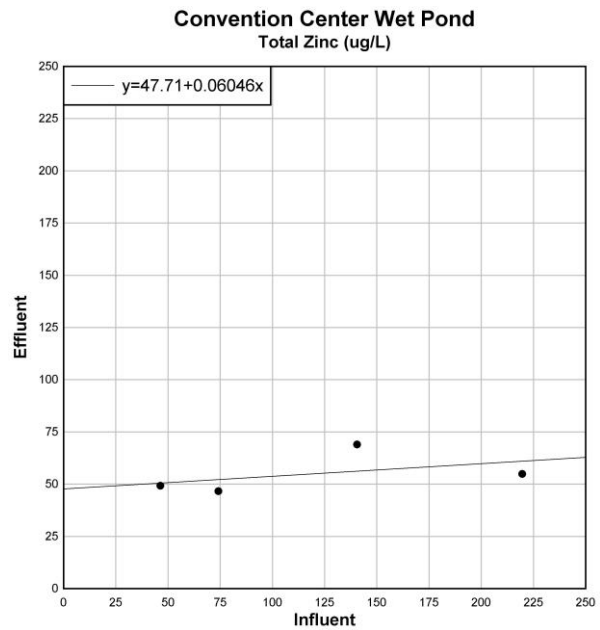
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	4	34
	Pairs Count	4	4
Non-Parametric	Maximum	42.8	43.9
	Upper Quartile	31.6	16.1
	Median	20.1	13.3
	Lower Quartile	17.3	7.5
	Minimum	14.8	1.7
	Efficiency	34.03%	
	Mann-Whitney	0.0332 **	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	44.3	16.5
	Mean	24.4	13.7
	LCL	4.6	10.9
	Std. Dev.	12.5	8.1
	Wilk (p-value)	0.1046	0.0007 **
	Efficiency	43.84%	
	t-Test (equal var.)	0.0232 **	
	t-Test (unequal var.)	0.1837	
	t-test (paired)	0.1693	
	Levene Test	0.5256	
Log Transformed	UCL	52.2	17.5
	Mean	24.2	13.9
	LCL	11.3	11.1
	Std. Dev.	10.8	9.0
	Wilk (p-value)	0.3388	0.1908
	Efficiency	42.53%	
	t-Test (equal var.)	0.0441 **	
	t-Test (unequal var.)	0.0531 *	
	t-Test (paired)	0.1198	
	Levene Test	0.5627	
Bootstrap	UCL	39.5	16.5
	Mean	24.5	13.8
	LCL	9.4	11.1
	Std. Dev.	9.5	7.8
	Efficiency	43.71%	

Convention Center Wet Pond - Total Zinc (ug/L)



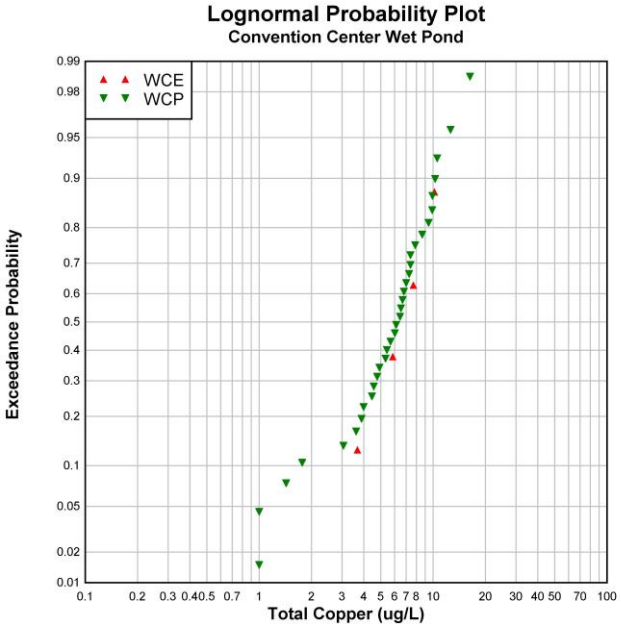


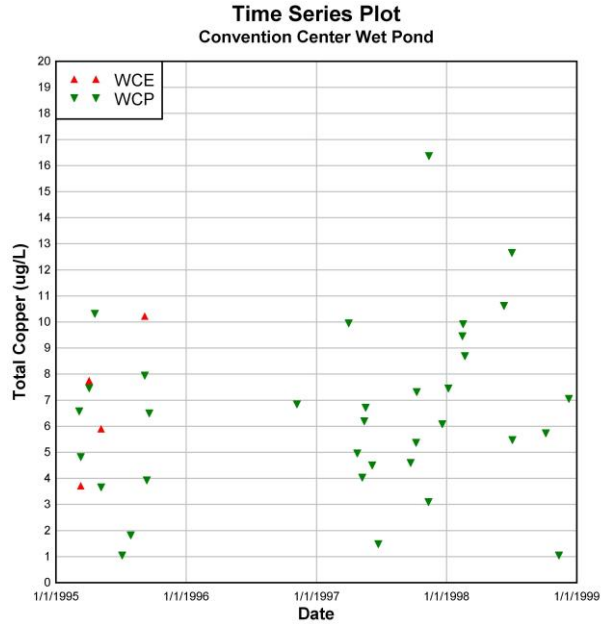


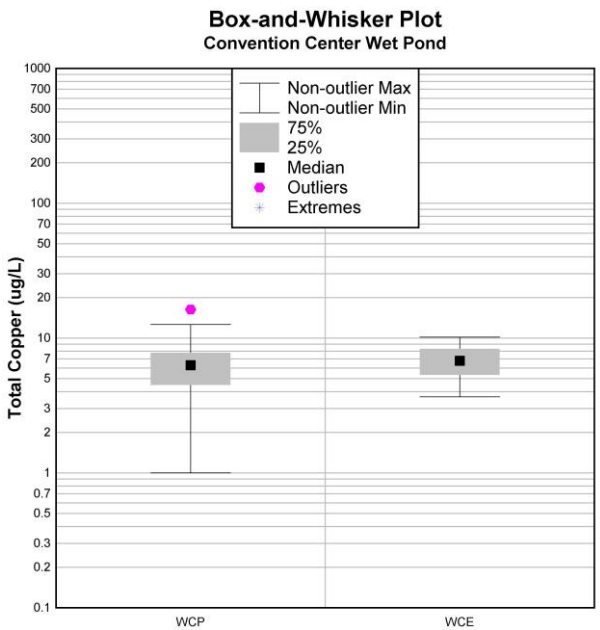


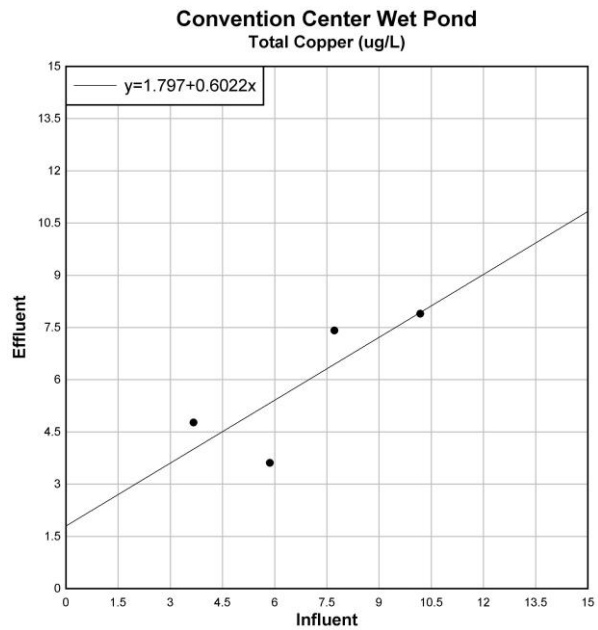
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	5	34
	Pairs Count	4	4
Non-Parametric	Maximum	219.6	459.2
	Upper Quartile	211.6	110.0
	Median	140.6	70.4
	Lower Quartile	74.1	55.0
	Minimum	46.3	35.3
	Efficiency	49.95%	
	Mann-Whitney	0.2386	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	235.7	132.2
	Mean	138.4	100.7
	LCL	41.1	69.1
	Std. Dev.	78.4	90.4
	Wilk (p-value)	0.3874	0.0001 **
	Efficiency	27.28%	
	t-Test (equal var.)	0.3824	
	t-Test (unequal var.)	0.3645	
	t-test (paired)	0.1725	
	Levene Test	0.7954	
Log Transformed	UCL	366.5	120.1
	Mean	140.6	96.1
	LCL	53.9	76.9
	Std. Dev.	94.1	60.5
	Wilk (p-value)	0.3935	0.0053 **
	Efficiency	31.64%	
	t-Test (equal var.)	0.2075	
	t-Test (unequal var.)	0.3034	
	t-Test (paired)	0.1296	
	Levene Test	0.9103	
Bootstrap	UCL	223.4	130.3
	Mean	139.8	100.6
	LCL	56.2	71.0
	Std. Dev.	67.3	84.9
	Efficiency	28.01%	

Convention Center Wet Pond - Total Copper (ug/L)



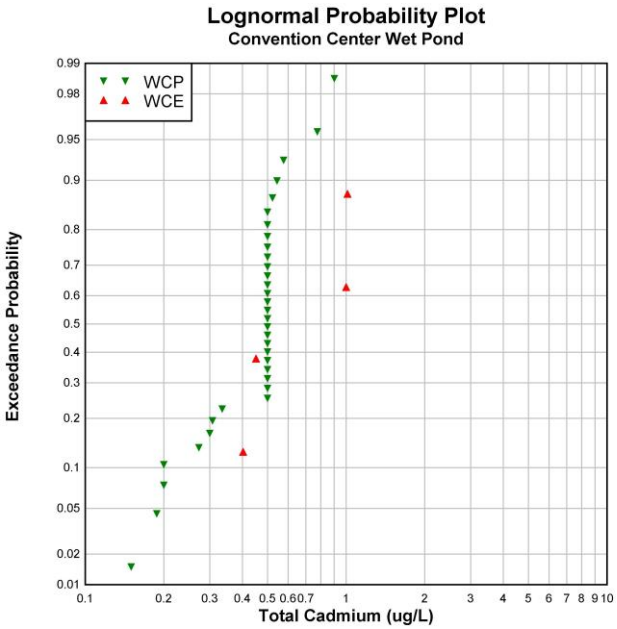


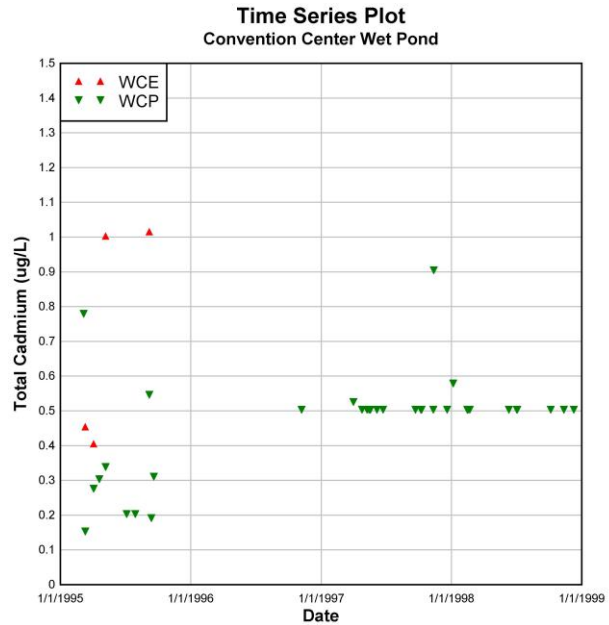


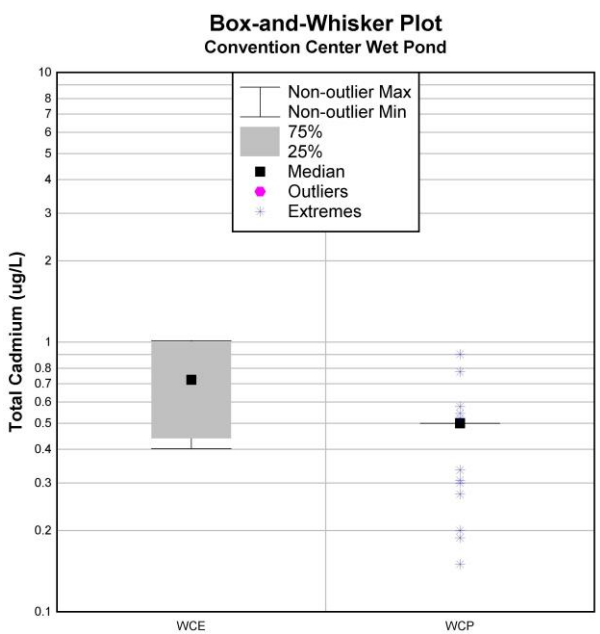


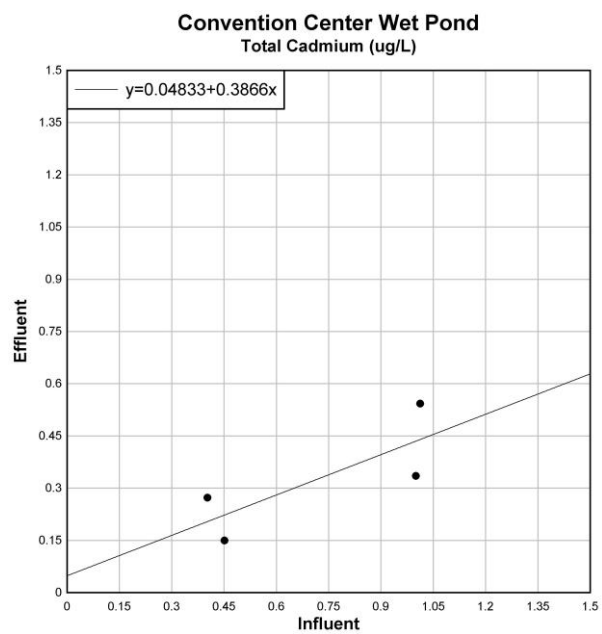
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	4	34
	Pairs Count	4	4
Non-Parametric	Maximum	10.2	16.3
	Upper Quartile	8.9	7.9
	Median	6.8	6.3
	Lower Quartile	4.8	4.4
	Minimum	3.7	1.0
	Efficiency	7.22%	
	Mann-Whitney	0.7233	
	Wilcoxon (paired)	0.3750	
Arithmetic	UCL	11.3	7.6
	Mean	6.9	6.4
	LCL	2.5	5.3
	Std. Dev.	2.8	3.3
	Wilk (p-value)	0.9920	0.2491
	Efficiency	6.43%	
	t-Test (equal var.)	0.8005	
	t-Test (unequal var.)	0.7824	
	t-test (paired)	0.3400	
	Levene Test	0.5996	
Log Transformed	UCL	14.3	8.6
	Mean	6.9	6.7
	LCL	3.3	5.2
	Std. Dev.	2.9	4.8
	Wilk (p-value)	0.9215	0.0036 **
	Efficiency	2.80%	
	t-Test (equal var.)	0.6261	
	t-Test (unequal var.)	0.5278	
	t-Test (paired)	0.4785	
	Levene Test	0.4653	
Bootstrap	UCL	10.5	7.5
	Mean	6.9	6.4
	LCL	3.4	5.3
	Std. Dev.	2.2	3.2
	Efficiency	7.12%	

Convention Center Wet Pond - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: WCE**	**EFF: WCP**
	Site Count	4	34
	Pairs Count	4	4
Non-Parametric	Maximum	1.0	0.9
	Upper Quartile	1.0	0.5
	Median	0.7	0.5
	Lower Quartile	0.4	0.5
	Minimum	0.4	0.2
	Efficiency	31.09%	
	Mann-Whitney	0.4357	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	1.2	0.5
	Mean	0.7	0.5
	LCL	0.2	0.4
	Std. Dev.	0.3	0.2
	Wilk (p-value)	0.0624 *	0.0001 **
	Efficiency	35.26%	
	t-Test (equal var.)	0.0094 **	
	t-Test (unequal var.)	0.2290	
	t-test (paired)	0.0420 **	
	Levene Test	0.0059 **	
Log Transformed	UCL	1.7	0.5
	Mean	0.7	0.5
	LCL	0.3	0.4
	Std. Dev.	0.4	0.2
	Wilk (p-value)	0.0833 *	0.0001 **
	Efficiency	34.70%	
	t-Test (equal var.)	0.0614 *	
	t-Test (unequal var.)	0.1998	
	t-Test (paired)	0.0202 **	
	Levene Test	0.7730	
Bootstrap	UCL	1.1	0.5
	Mean	0.7	0.5
	LCL	0.3	0.4
	Std. Dev.	0.3	0.1
	Efficiency	34.61%	

Convention Center Wet Pond System (WCI-WCP)

This combined system SCM treats an area of downtown Austin. See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed. Stormwater runoff monitored at the influent station WCI passed through a pre-treatment oil-grit separator. Effluent from the separator was monitored at station WCE before entering the wet pond WCP. For a description and analysis summary of the oil-grit separator please refer to Convention Center O/G Chamber (WCI-WCE). For a description and analysis summary of the wet pond please refer to Convention Center Wet Pond (WCE-WCP).

Beside the difficulties of access and maintenance, this combined SCM worked well during the monitoring period. This pond is a great public attraction and houses large variety of wetland flora, dense emergent vegetation on its shelves, and a variety of wildlife. The pond is a photo icon for the city of Austin and its visitors.

The City collected runoff and water quality data at the Convention Center Wet Pond System (WCI-WCP) from January 1995 to December 1998. During this time 34 and 34 valid EMCs were collected at the influent (WCI) and effluent (WCP), respectively, of which 25 were paired.

Performance Summary

The Convention Center Wet Pond System had good performance with the reductions of the concentrations for almost all pollutant parameters. TSS and VSS concentrations were reduced by 70% and 58%, respectively, and were significant in all cases, paired or not paired.

COD and TOC concentrations were reduced by 68% and 83%, respectively, and were significant in all cases. BOD concentration was reduced by 55% and was only significant if data are not paired.

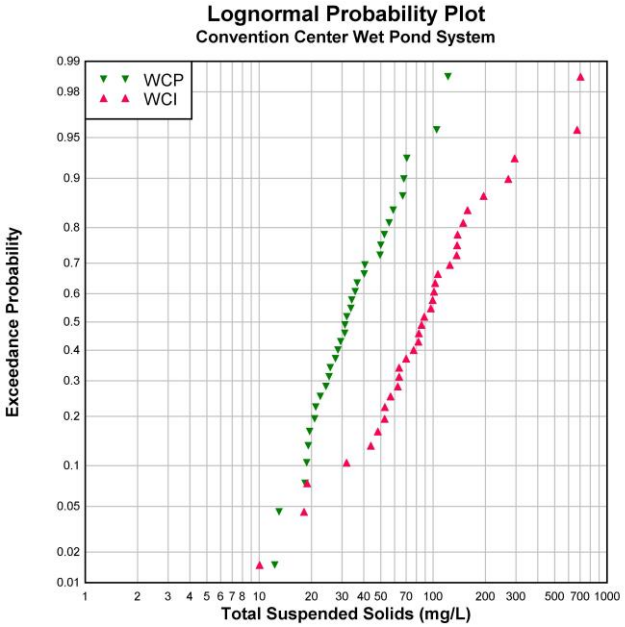
Total nitrogen concentration and nitrate + nitrite were reduced by 59% and 63%, respectively, and were significant in any case. Total Kjeldahl nitrogen was reduced by 58% and was only significant if data are not paired. Ammonia concentration was reduced by 77% and significant in any case.

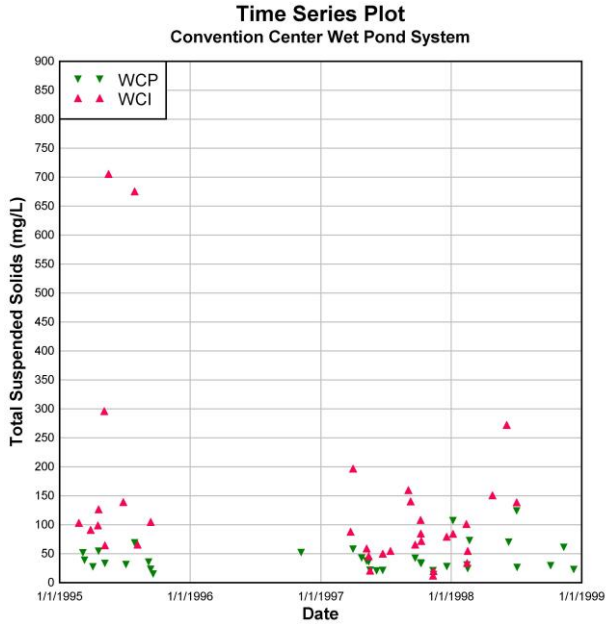
TP and DP concentrations were reduced by 72% and 71%, respectively, and were significant in all cases.

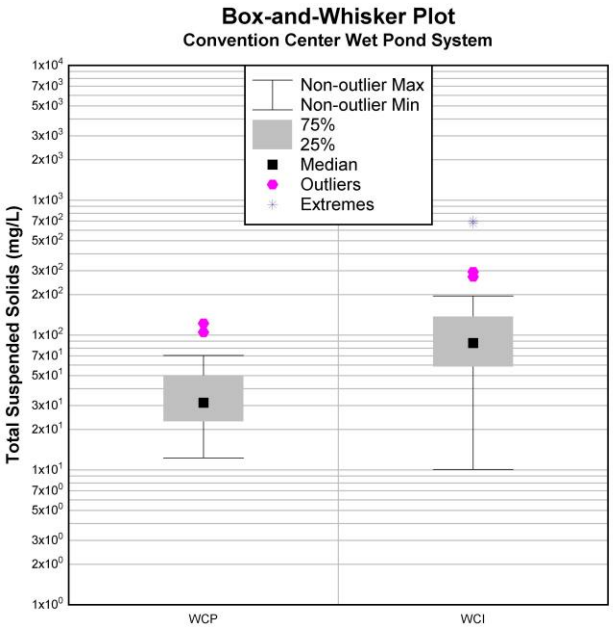
The reduction of bacteria was significant in any case for FCOL (70%), and was significant in any case for FSTR (63%).

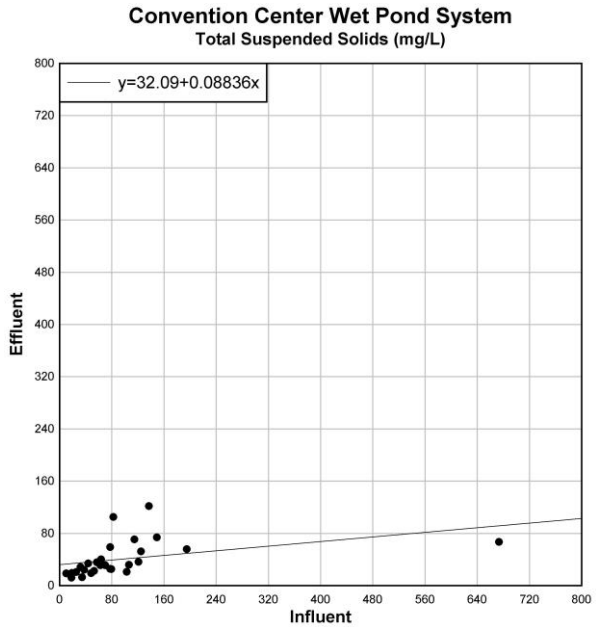
Lead, zinc, copper and cadmium concentrations were reduced by 71%, 69%, 74% and 34%, respectively, and were significant in all cases.

Convention Center Wet Pond System - Total Suspended Solids (mg/L)



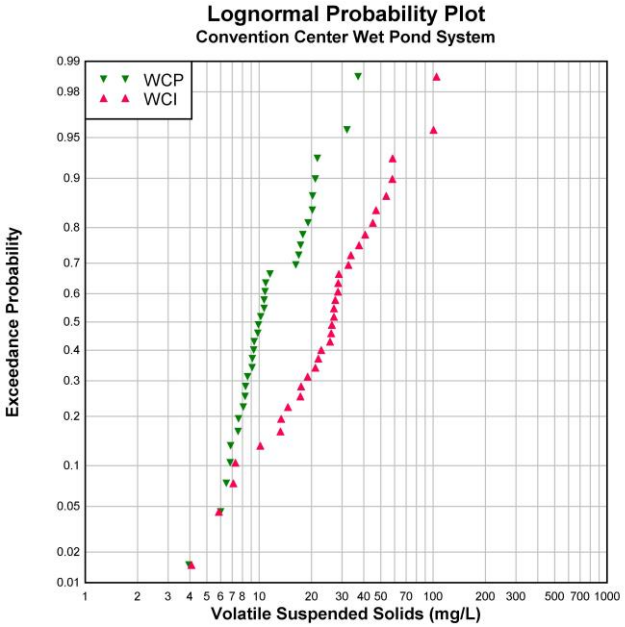


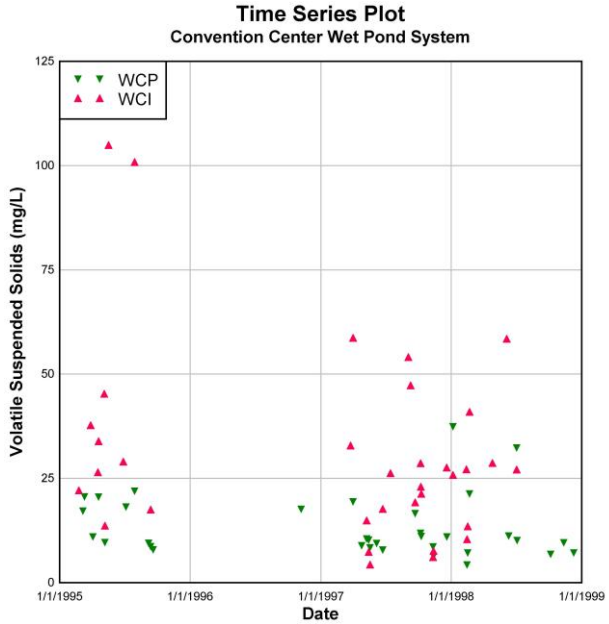


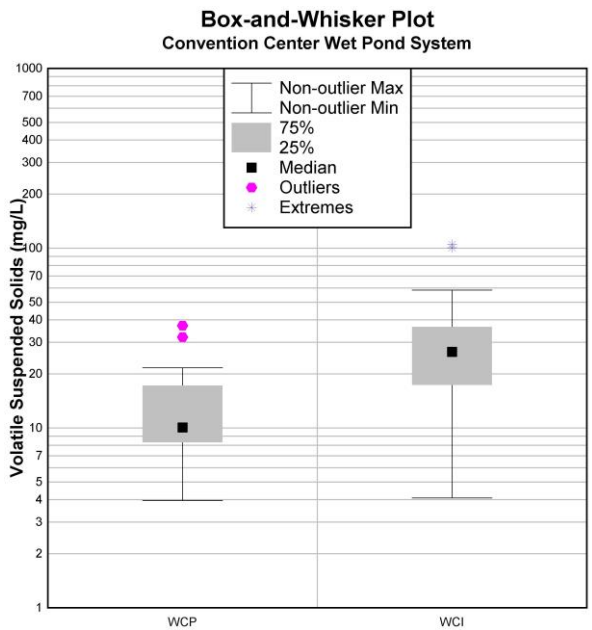


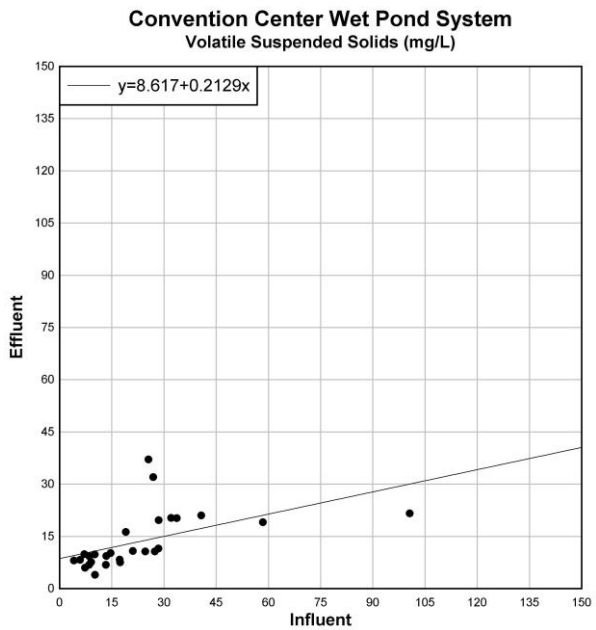
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	34	34
	Pairs Count	25	25
Non-Parametric	Maximum	703.6	122.0
	Upper Quartile	137.3	50.1
	Median	87.4	31.5
	Lower Quartile	57.0	22.4
	Minimum	10.1	12.3
	Efficiency	63.93%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	186.2	48.0
	Mean	132.3	39.4
	LCL	78.3	30.8
	Std. Dev.	154.6	24.7
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	70.20%	
	t-Test (equal var.)	0.0010 **	
	t-Test (unequal var.)	0.0015 **	
	t-test (paired)	0.0225 **	
	Levene Test	0.0758 *	
Log Transformed	UCL	185.7	47.9
	Mean	128.8	39.1
	LCL	89.4	31.8
	Std. Dev.	132.5	22.6
	Wilk (p-value)	0.2476	0.6848
	Efficiency	69.69%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0485 **	
Bootstrap	UCL	181.0	47.8
	Mean	130.9	39.5
	LCL	80.8	31.1
	Std. Dev.	143.6	23.9
	Efficiency	69.86%	

Convention Center Wet Pond System - Volatile Suspended Solids (mg/L)



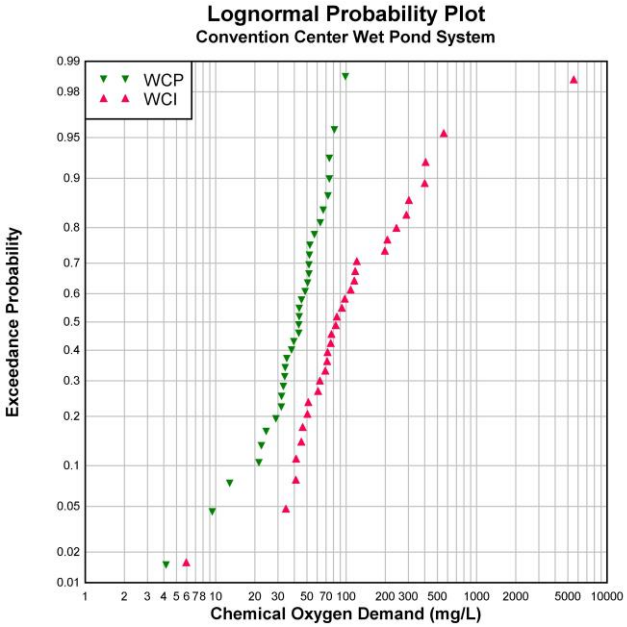


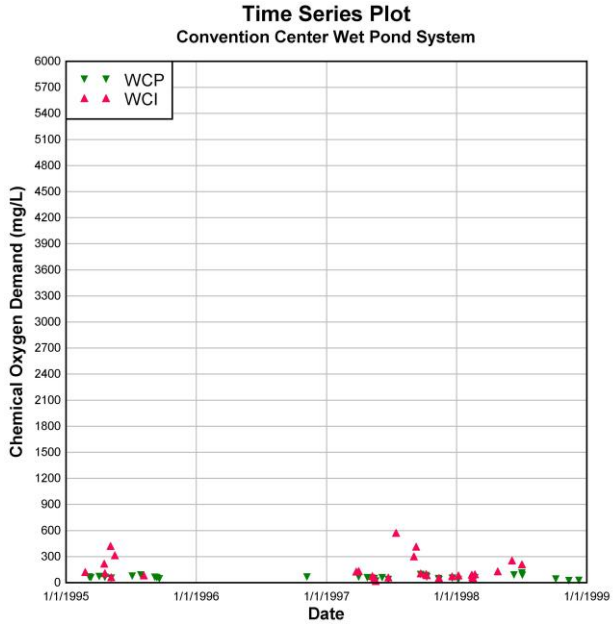


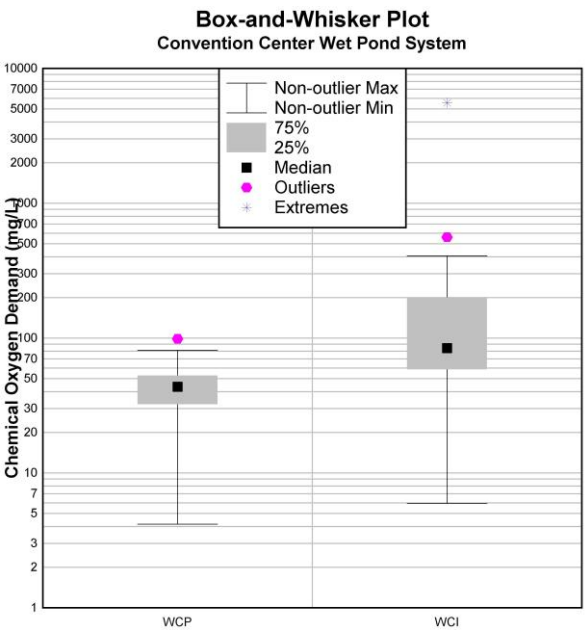


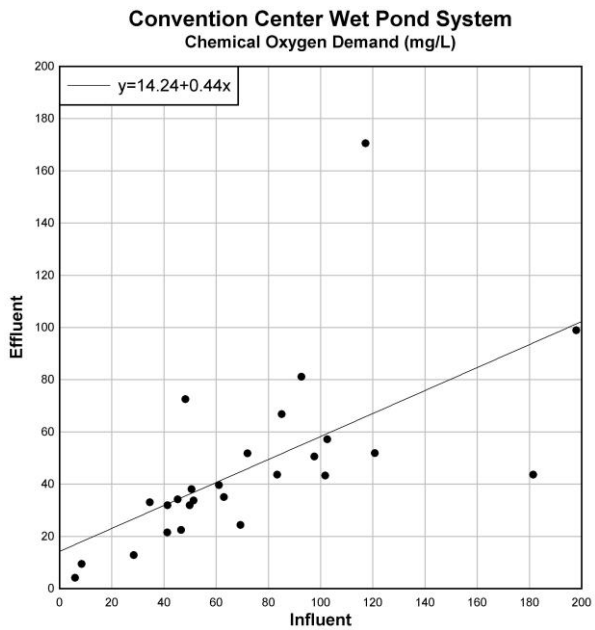
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	34	34
	Pairs Count	25	25
Non-Parametric	Maximum	104.7	37.1
	Upper Quartile	37.5	17.3
	Median	26.5	10.1
	Lower Quartile	17.3	8.3
	Minimum	4.1	3.9
	Efficiency	62.05%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0012 **	
Arithmetic	UCL	39.0	15.5
	Mean	30.9	12.9
	LCL	22.9	10.4
	Std. Dev.	23.1	7.4
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	58.18%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0149 **	
	Levene Test	0.0279 **	
Log Transformed	UCL	42.2	15.4
	Mean	31.5	12.8
	LCL	23.5	10.7
	Std. Dev.	26.0	6.7
	Wilk (p-value)	0.5006	0.1436
	Efficiency	59.26%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0015 **	
	Levene Test	0.0497 **	
Bootstrap	UCL	38.6	15.4
	Mean	30.8	12.9
	LCL	23.1	10.4
	Std. Dev.	22.1	7.2
	Efficiency	58.12%	

Convention Center Wet Pond System - Chemical Oxygen Demand (mg/L)



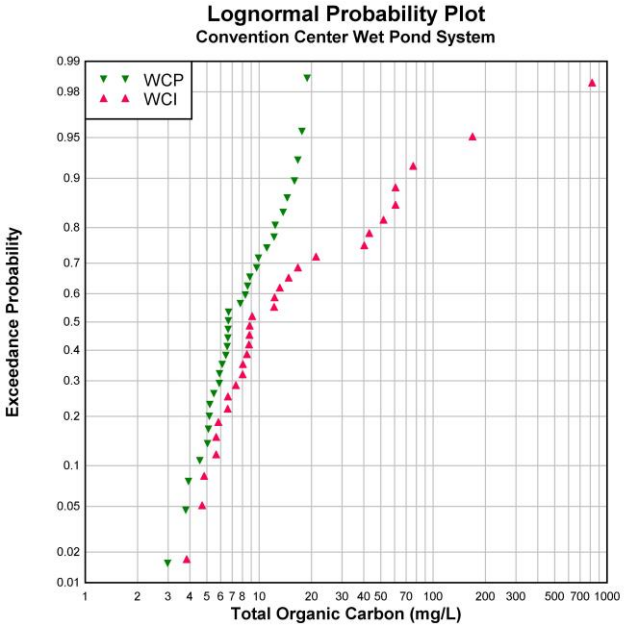


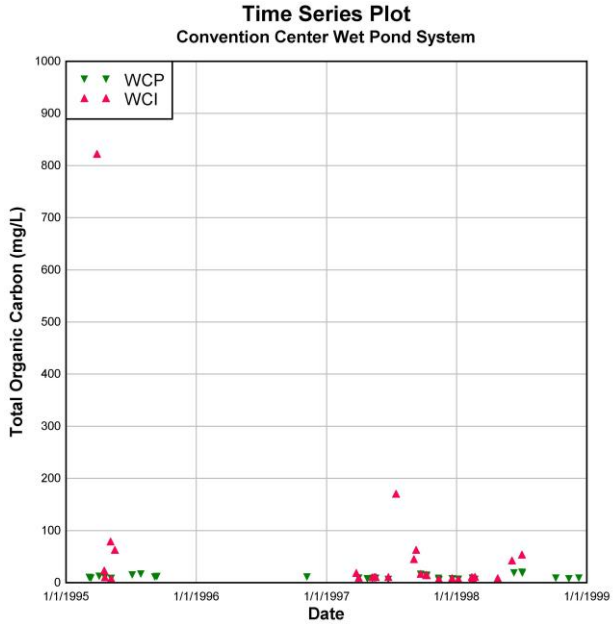


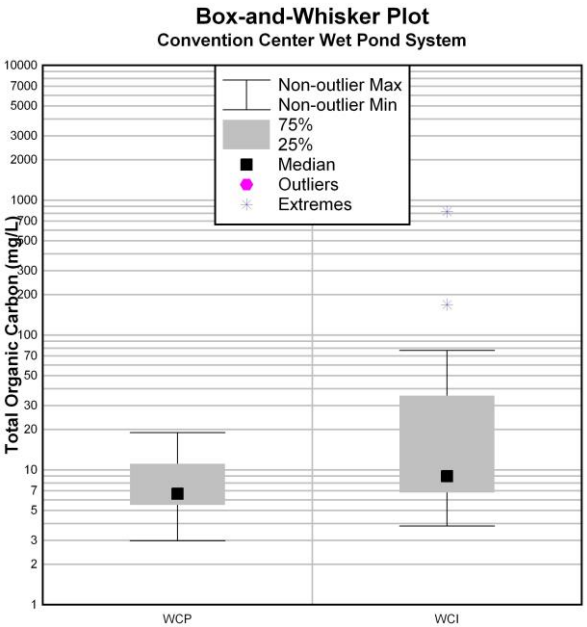


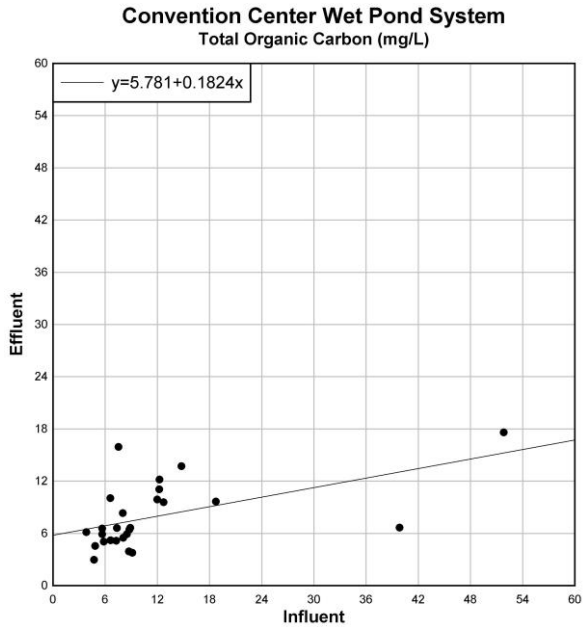
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	31	34
	Pairs Count	24	24
Non-Parametric	Maximum	559.41	99.00
	Upper Quartile	197.95	52.82
	Median	83.30	43.49
	Lower Quartile	51.33	31.97
	Minimum	5.94	4.17
	Efficiency	47.79%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	184.51	51.98
	Mean	136.60	44.65
	LCL	88.69	37.32
	Std. Dev.	130.63	21.00
	Wilk (p-value)	0.0001 **	0.7825
	Efficiency	67.32%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0005 **	
	t-test (paired)	0.0020 **	
	Levene Test	0.0089 **	
Log Transformed	UCL	207.36	59.55
	Mean	139.25	46.74
	LCL	93.51	36.68
	Std. Dev.	147.73	31.94
	Wilk (p-value)	0.0713 *	0.0009 **
	Efficiency	66.44%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1756	
Bootstrap	UCL	185.05	51.62
	Mean	138.35	44.39
	LCL	91.65	37.15
	Std. Dev.	127.32	20.73
	Efficiency	67.92%	

Convention Center Wet Pond System - Total Organic Carbon (mg/L)



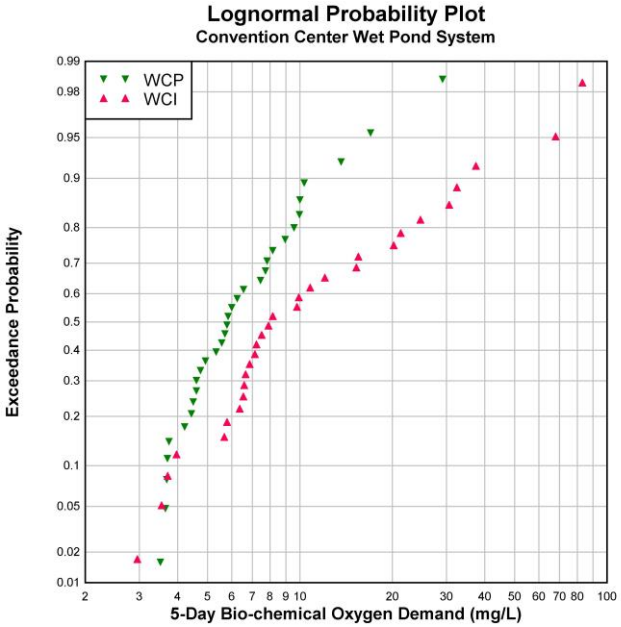


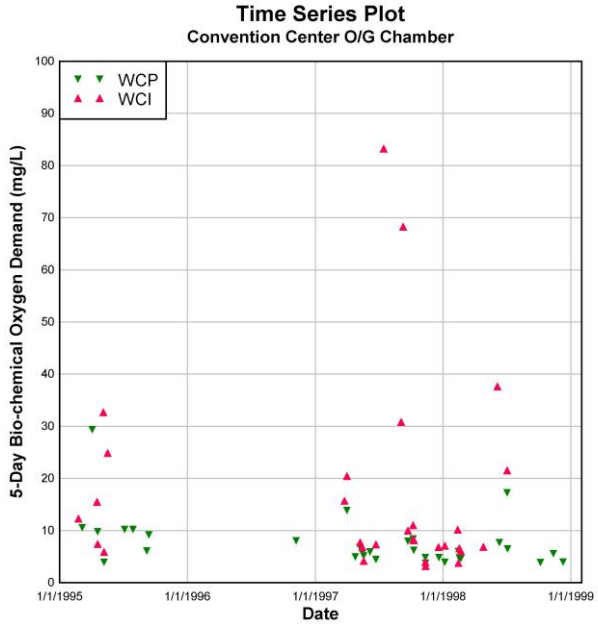


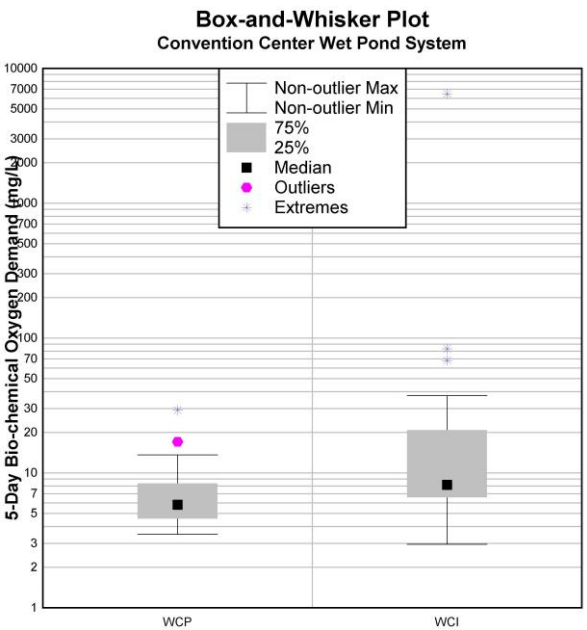


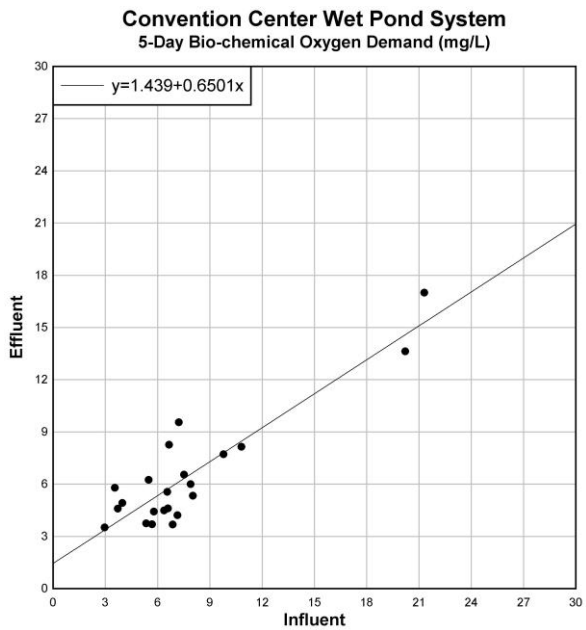
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	30	33
	Pairs Count	24	24
Non-Parametric	Maximum	820.51	18.86
	Upper Quartile	40.23	11.07
	Median	8.97	6.65
	Lower Quartile	6.61	5.49
	Minimum	3.84	2.97
	Efficiency	25.93%	
	Mann-Whitney	0.0245 **	
	Wilcoxon (paired)	0.0117 **	
Arithmetic	UCL	106.50	10.17
	Mean	50.78	8.63
	LCL	-4.94	7.10
	Std. Dev.	149.23	4.33
	Wilk (p-value)	0.0001 **	0.0025 **
	Efficiency	83.00%	
	t-Test (equal var.)	0.1097	
	t-Test (unequal var.)	0.1328	
	t-test (paired)	0.0681 *	
	Levene Test	0.2560	
Log Transformed	UCL	58.48	10.30
	Mean	31.77	8.61
	LCL	17.26	7.20
	Std. Dev.	51.27	4.30
	Wilk (p-value)	0.0005 **	0.3711
	Efficiency	72.90%	
	t-Test (equal var.)	0.0033 **	
	t-Test (unequal var.)	0.0054 **	
	t-Test (paired)	0.0270 **	
	Levene Test	0.0184 **	
Bootstrap	UCL	98.10	10.14
	Mean	51.18	8.63
	LCL	4.26	7.12
	Std. Dev.	125.65	4.26
	Efficiency	83.14%	

Convention Center Wet Pond System - 5-Day Bio-chemical Oxygen Demand (mg/L)



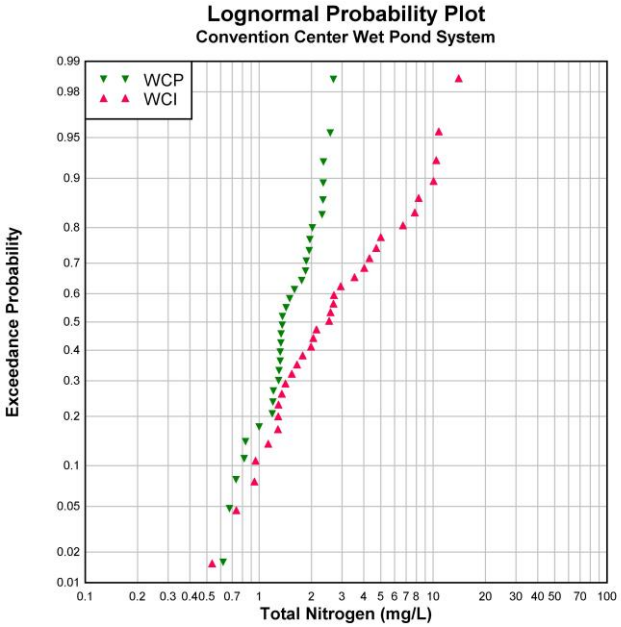


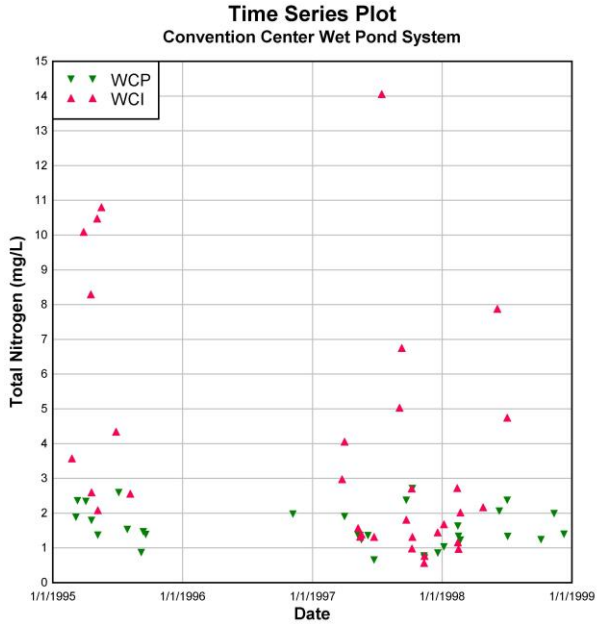


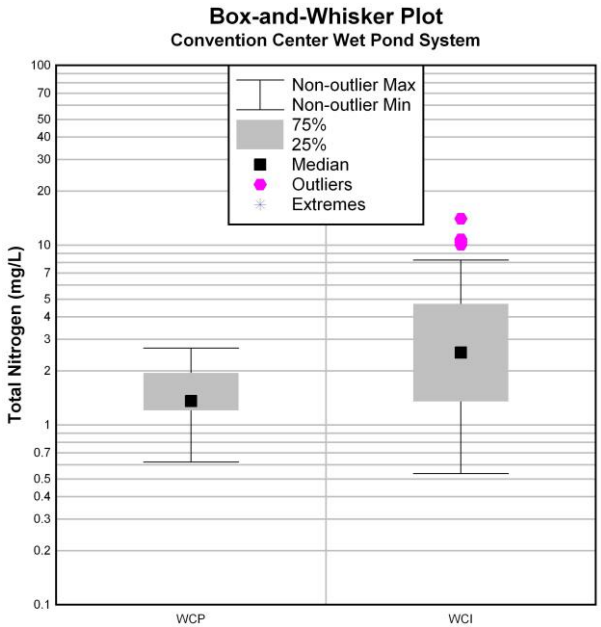


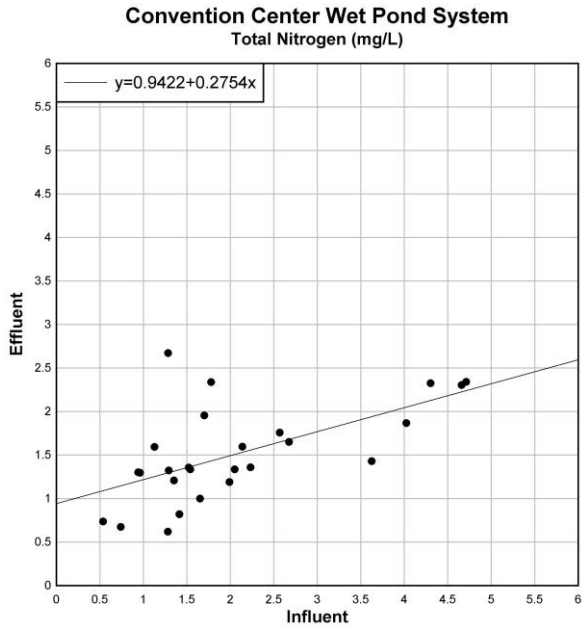
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	30	32
	Pairs Count	20	20
Non-Parametric	Maximum	83.04	29.14
	Upper Quartile	20.21	8.56
	Median	8.03	5.82
	Lower Quartile	6.55	4.55
	Minimum	2.95	3.51
	Efficiency	27.55%	
	Mann-Whitney	0.0105 **	
	Wilcoxon (paired)	0.0240 **	
Arithmetic	UCL	23.19	9.22
	Mean	16.26	7.41
	LCL	9.32	5.60
	Std. Dev.	18.58	5.01
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	54.42%	
	t-Test (equal var.)	0.0119 **	
	t-Test (unequal var.)	0.0167 **	
	t-test (paired)	0.0306 **	
	Levene Test	0.0615 *	
Log Transformed	UCL	22.15	8.72
	Mean	15.27	7.24
	LCL	10.53	6.01
	Std. Dev.	14.83	3.69
	Wilk (p-value)	0.0621 *	0.0141 **
	Efficiency	52.60%	
	t-Test (equal var.)	0.0044 **	
	t-Test (unequal var.)	0.0056 **	
	t-Test (paired)	0.0789 *	
	Levene Test	0.0155 **	
Bootstrap	UCL	23.15	9.07
	Mean	16.45	7.37
	LCL	9.76	5.68
	Std. Dev.	17.92	4.69
	Efficiency	55.18%	

Convention Center Wet Pond System - Total Nitrogen (mg/L)



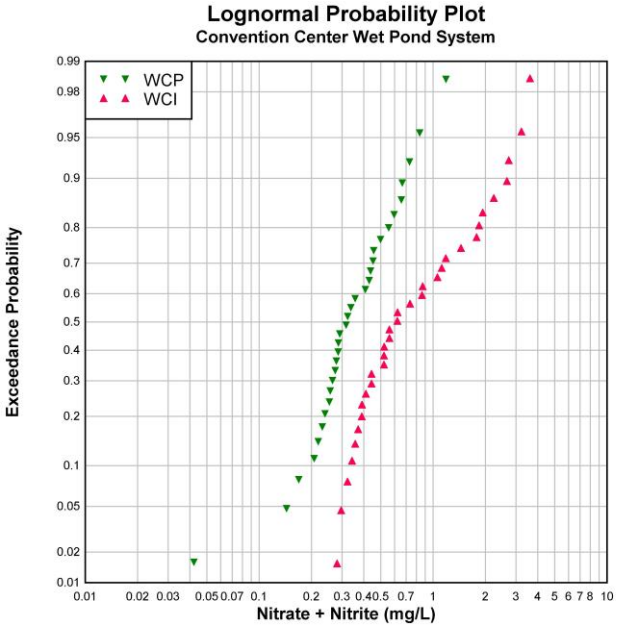


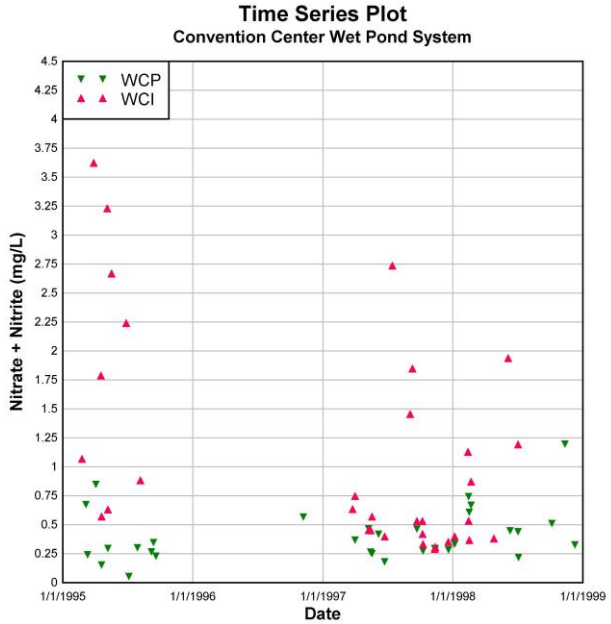


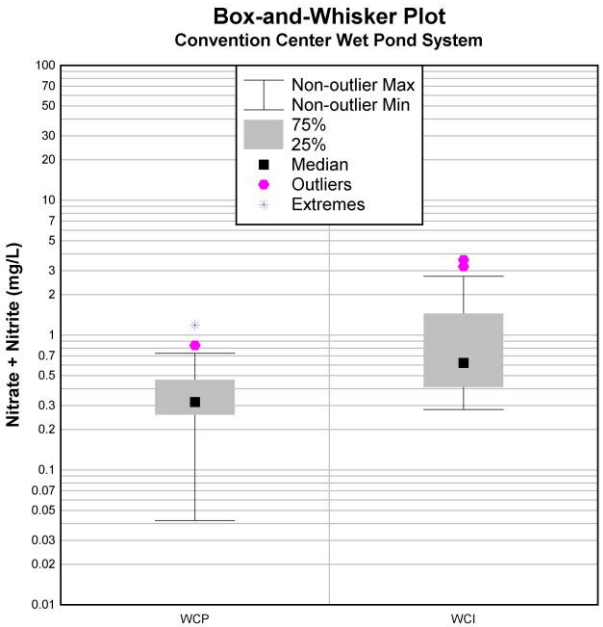


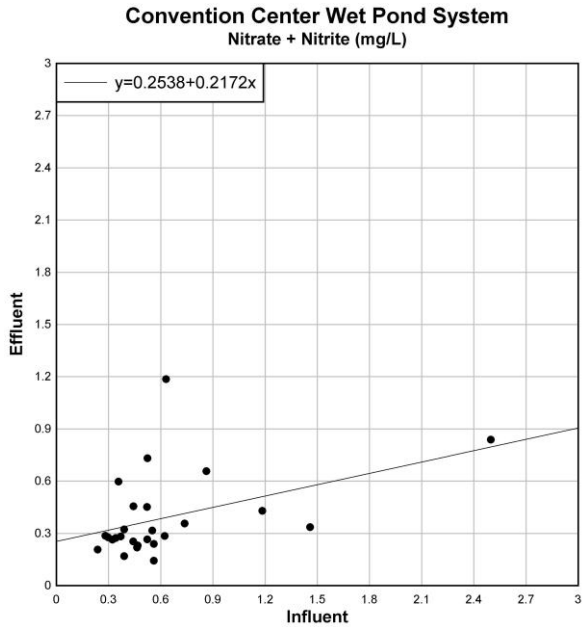
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	33	32
	Pairs Count	24	24
Non-Parametric	Maximum	14.022	2.673
	Upper Quartile	4.711	1.949
	Median	2.529	1.358
	Lower Quartile	1.351	1.204
	Minimum	0.536	0.621
	Efficiency	46.30%	
	Mann-Whitney	0.0040 **	
	Wilcoxon (paired)	0.0205 **	
Arithmetic	UCL	5.026	1.747
	Mean	3.793	1.543
	LCL	2.559	1.339
	Std. Dev.	3.478	0.565
	Wilk (p-value)	0.0001 **	0.1666
	Efficiency	59.32%	
	t-Test (equal var.)	0.0006 **	
	t-Test (unequal var.)	0.0008 **	
	t-test (paired)	0.0148 **	
	Levene Test	0.0027 **	
Log Transformed	UCL	5.352	1.794
	Mean	3.753	1.549
	LCL	2.631	1.338
	Std. Dev.	3.682	0.624
	Wilk (p-value)	0.3882	0.1636
	Efficiency	58.72%	
	t-Test (equal var.)	0.0005 **	
	t-Test (unequal var.)	0.0006 **	
	t-Test (paired)	0.0300 **	
	Levene Test	0.0002 **	
Bootstrap	UCL	5.009	1.741
	Mean	3.802	1.542
	LCL	2.595	1.343
	Std. Dev.	3.404	0.552
	Efficiency	59.45%	

Convention Center Wet Pond System - Nitrate + Nitrite (mg/L)



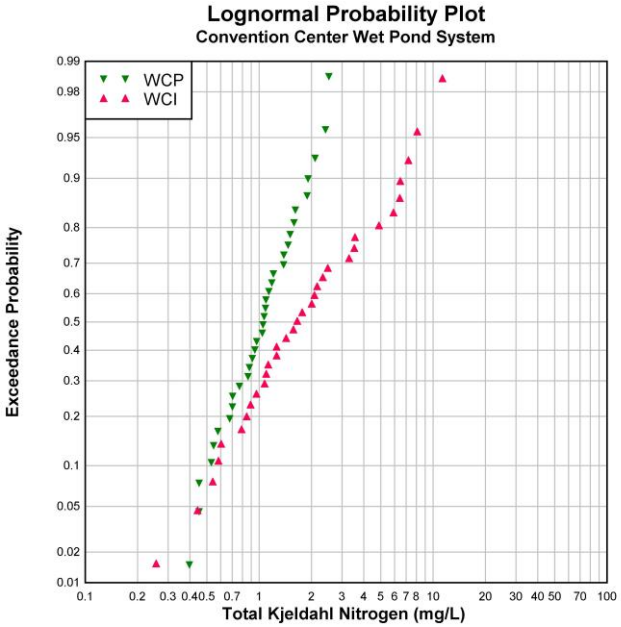


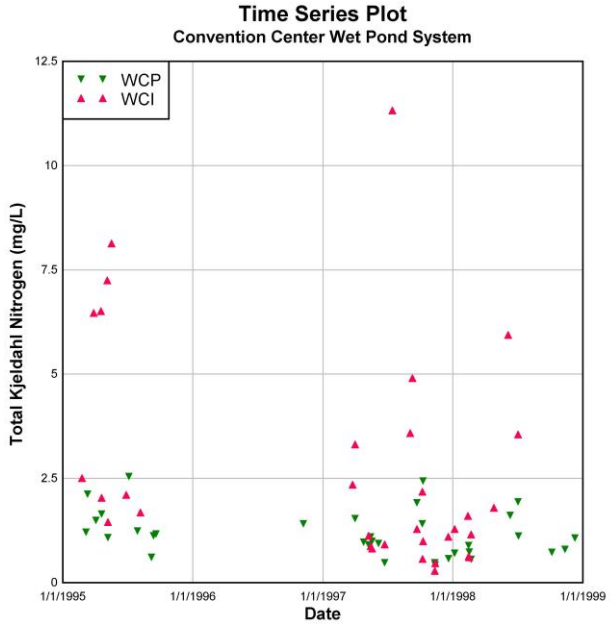


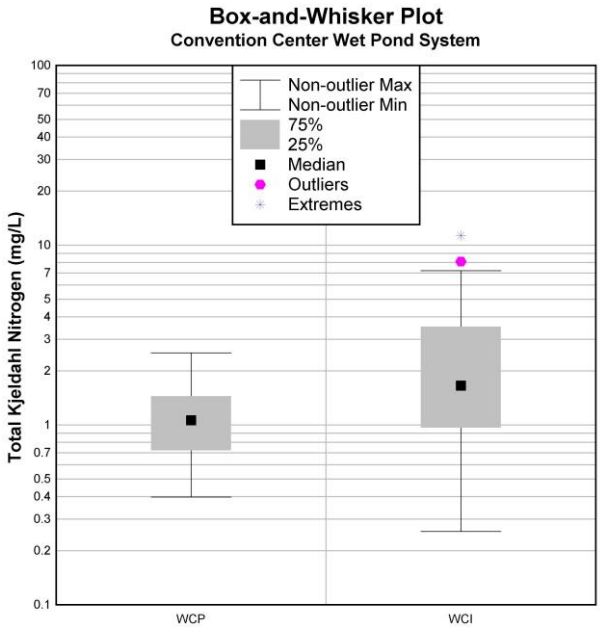


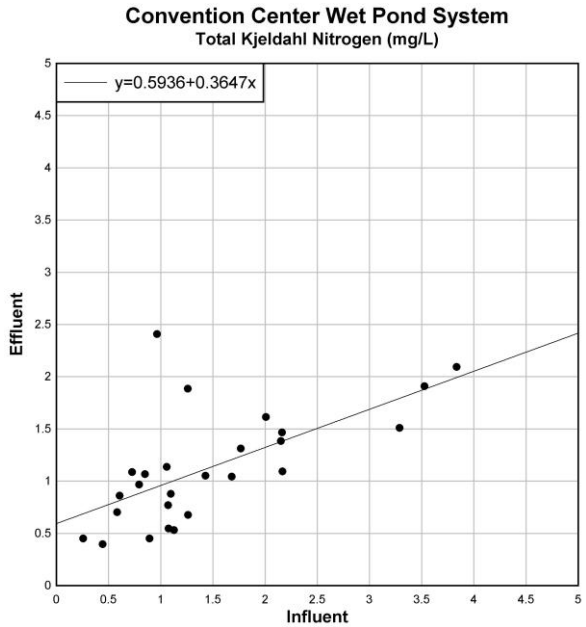
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	33	32
	Pairs Count	24	24
Non-Parametric	Maximum	3.613	1.186
	Upper Quartile	1.445	0.478
	Median	0.622	0.319
	Lower Quartile	0.411	0.255
	Minimum	0.281	0.042
	Efficiency	48.64%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0019 **	
Arithmetic	UCL	1.395	0.480
	Mean	1.068	0.396
	LCL	0.741	0.313
	Std. Dev.	0.921	0.231
	Wilk (p-value)	0.0001 **	0.0017 **
	Efficiency	62.89%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0003 **	
	t-test (paired)	0.0160 **	
	Levene Test	0.0026 **	
Log Transformed	UCL	1.428	0.514
	Mean	1.045	0.404
	LCL	0.764	0.318
	Std. Dev.	0.902	0.265
	Wilk (p-value)	0.0170 **	0.0437 **
	Efficiency	61.30%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0007 **	
	Levene Test	0.2200	
Bootstrap	UCL	1.388	0.477
	Mean	1.070	0.396
	LCL	0.751	0.315
	Std. Dev.	0.898	0.224
	Efficiency	62.98%	

Convention Center Wet Pond System - Total Kjeldahl Nitrogen (mg/L)



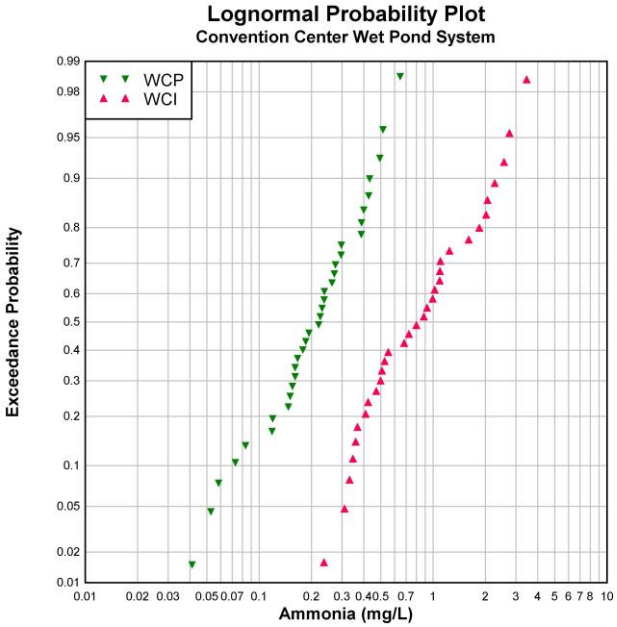


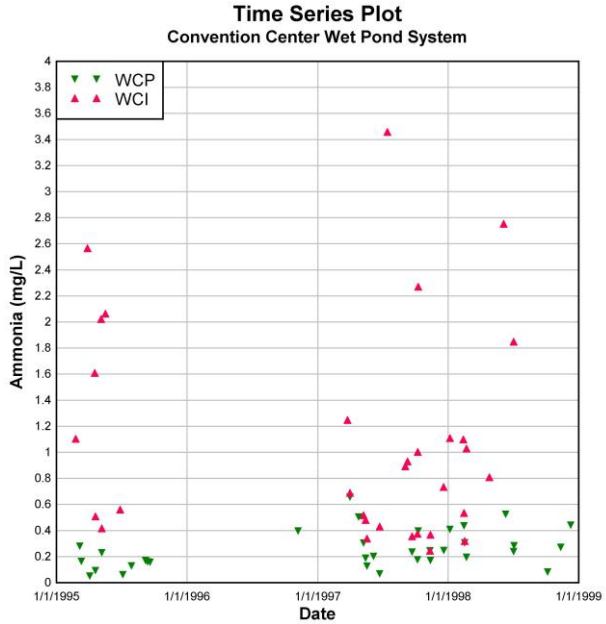


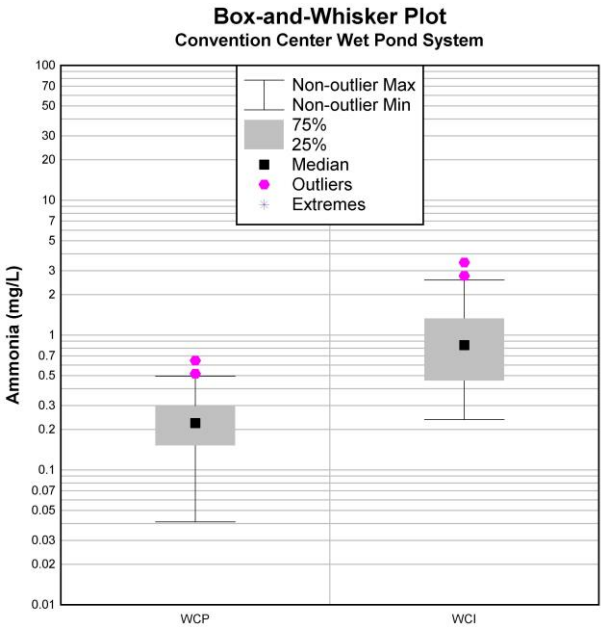


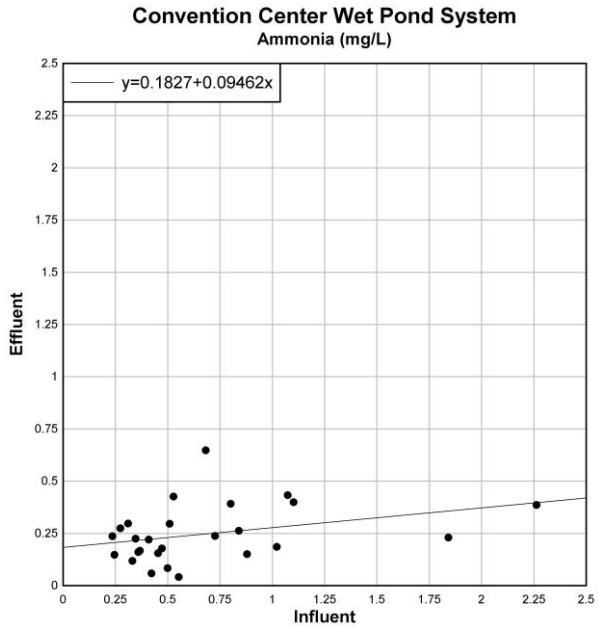
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	33	34
	Pairs Count	24	24
Non-Parametric	Maximum	11.296	2.518
	Upper Quartile	3.527	1.467
	Median	1.657	1.060
	Lower Quartile	0.963	0.704
	Minimum	0.255	0.397
	Efficiency	36.00%	
	Mann-Whitney	0.0090 **	
	Wilcoxon (paired)	0.0338 **	
Arithmetic	UCL	3.664	1.339
	Mean	2.725	1.148
	LCL	1.785	0.956
	Std. Dev.	2.650	0.548
	Wilk (p-value)	0.0001 **	0.0389 **
	Efficiency	57.88%	
	t-Test (equal var.)	0.0012 **	
	t-Test (unequal var.)	0.0020 **	
	t-test (paired)	0.0508 *	
	Levene Test	0.0065 **	
Log Transformed	UCL	4.058	1.377
	Mean	2.730	1.151
	LCL	1.837	0.962
	Std. Dev.	2.993	0.584
	Wilk (p-value)	0.8156	0.7835
	Efficiency	57.84%	
	t-Test (equal var.)	0.0027 **	
	t-Test (unequal var.)	0.0033 **	
	t-Test (paired)	0.1252	
	Levene Test	0.0009 **	
Bootstrap	UCL	3.650	1.331
	Mean	2.732	1.144
	LCL	1.814	0.957
	Std. Dev.	2.589	0.535
	Efficiency	58.13%	

Convention Center Wet Pond System - Ammonia (mg/L)



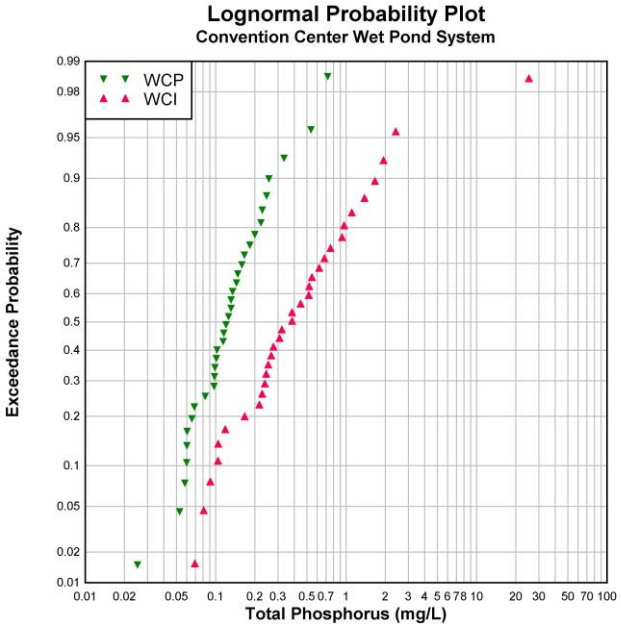


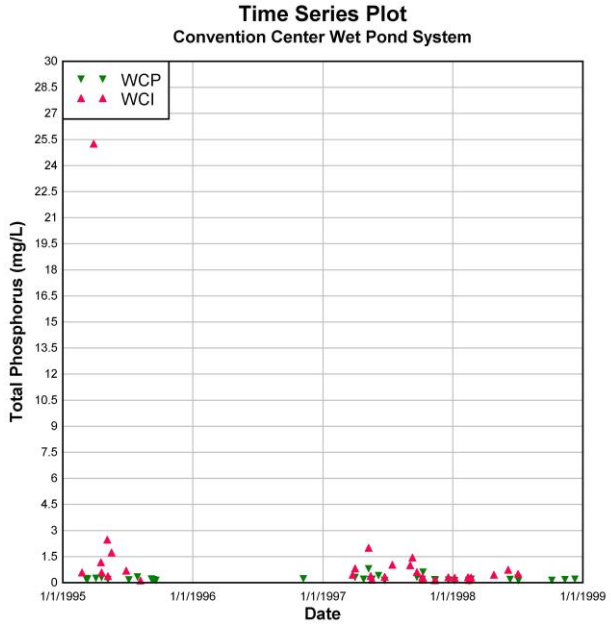


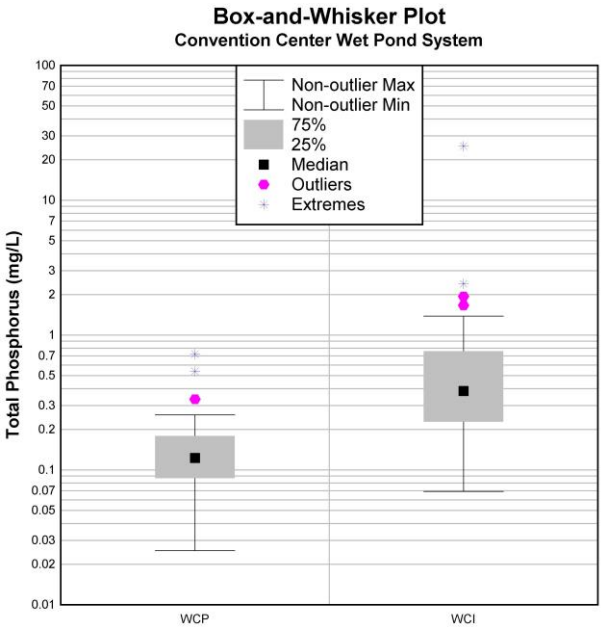


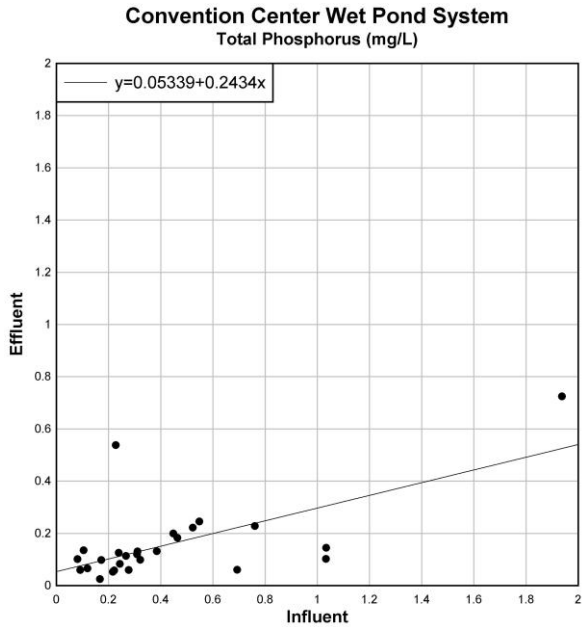
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	32	34
	Pairs Count	24	24
Non-Parametric	Maximum	3.450	0.648
	Upper Quartile	1.420	0.297
	Median	0.843	0.222
	Lower Quartile	0.447	0.151
	Minimum	0.236	0.041
	Efficiency	73.61%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	1.373	0.294
	Mean	1.076	0.244
	LCL	0.779	0.193
	Std. Dev.	0.824	0.145
	Wilk (p-value)	0.0004 **	0.0407 **
	Efficiency	77.34%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0003 **	
	Levene Test	0.0013 **	
Log Transformed	UCL	1.444	0.323
	Mean	1.071	0.250
	LCL	0.795	0.193
	Std. Dev.	0.869	0.182
	Wilk (p-value)	0.3029	0.3159
	Efficiency	76.70%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.5424	
Bootstrap	UCL	1.374	0.294
	Mean	1.082	0.244
	LCL	0.790	0.195
	Std. Dev.	0.811	0.142
	Efficiency	77.43%	

Convention Center Wet Pond System - Total Phosphorus (mg/L)



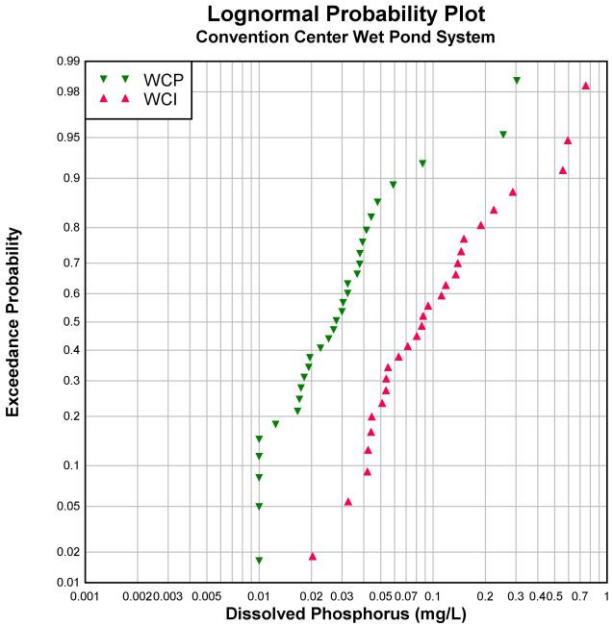


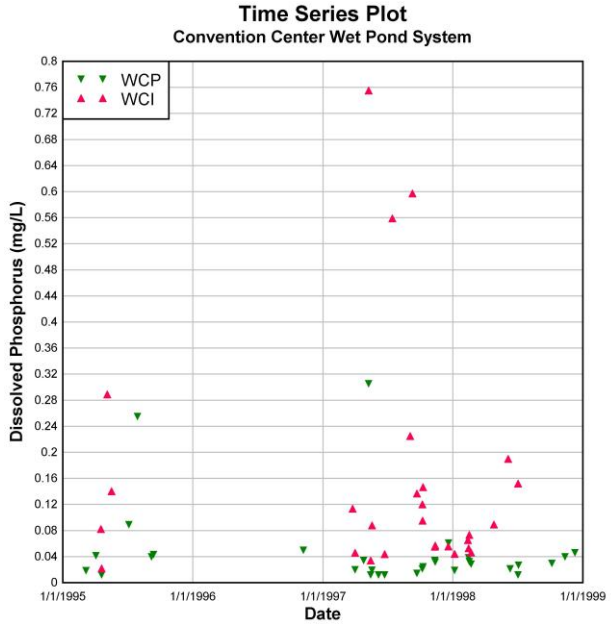


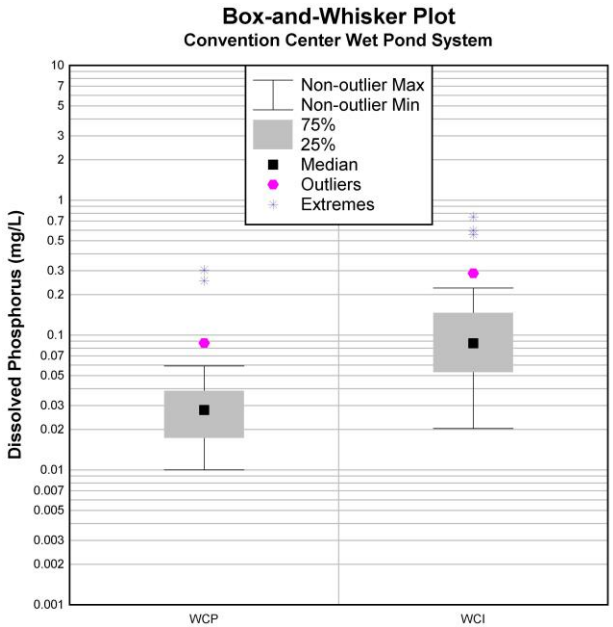


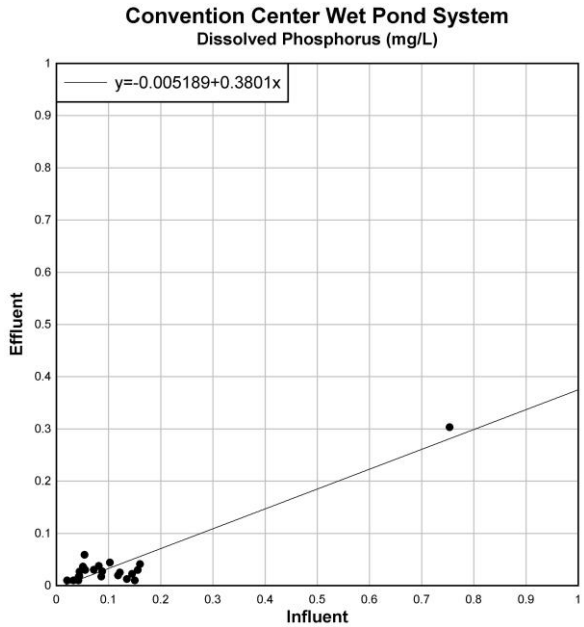
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	32	34
	Pairs Count	24	24
Non-Parametric	Maximum	2.404	0.725
	Upper Quartile	0.721	0.183
	Median	0.352	0.123
	Lower Quartile	0.222	0.083
	Minimum	0.069	0.025
	Efficiency	65.15%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.780	0.209
	Mean	0.573	0.160
	LCL	0.367	0.112
	Std. Dev.	0.573	0.139
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	72.02%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0004 **	
	t-test (paired)	0.0005 **	
	Levene Test	0.0114 **	
Log Transformed	UCL	0.876	0.204
	Mean	0.577	0.157
	LCL	0.380	0.121
	Std. Dev.	0.655	0.116
	Wilk (p-value)	0.6987	0.5607
	Efficiency	72.80%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0446 **	
Bootstrap	UCL	0.774	0.206
	Mean	0.574	0.160
	LCL	0.375	0.114
	Std. Dev.	0.553	0.132
	Efficiency	72.10%	

Convention Center Wet Pond System - Dissolved Phosphorus (mg/L)



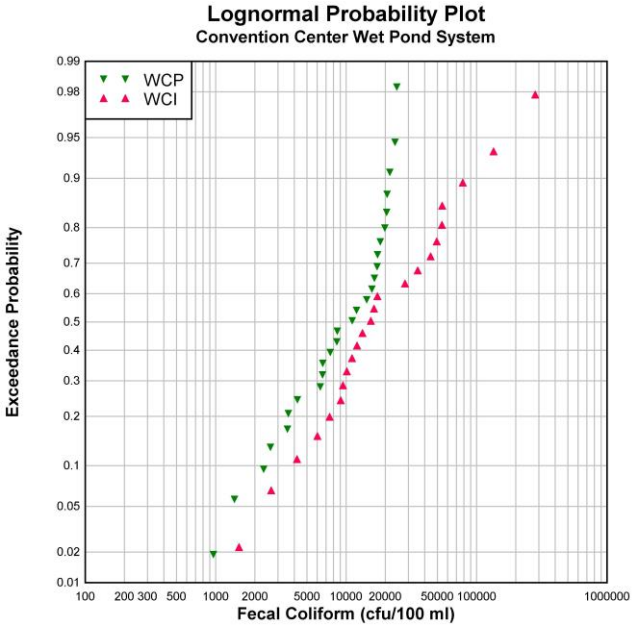


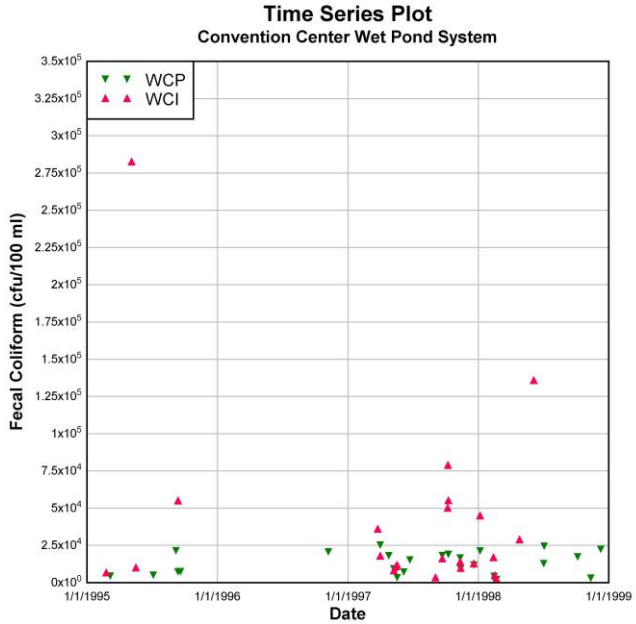


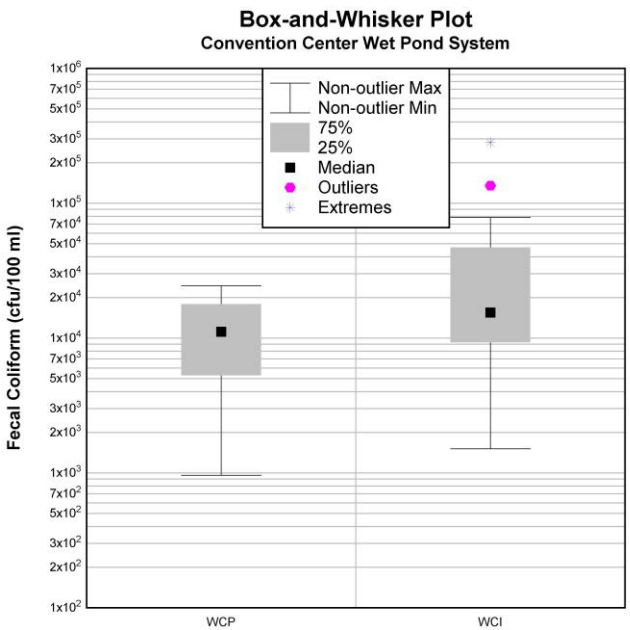


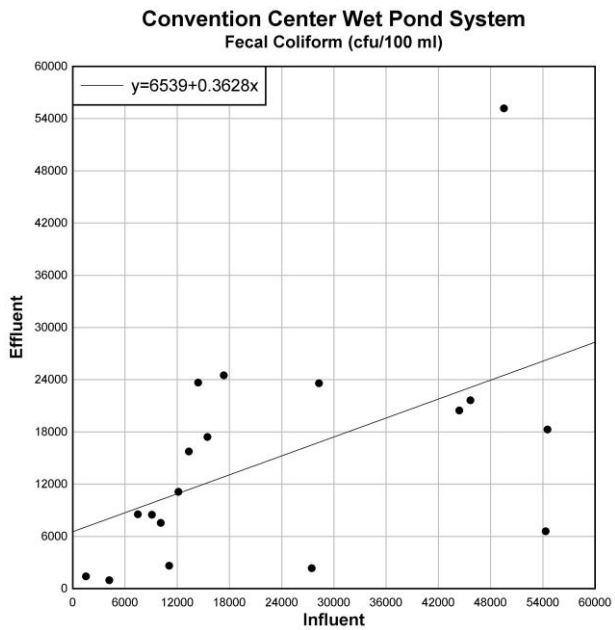
		PARAMETER	DP (mg/L)
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	28	31
	Pairs Count	21	21
Non-Parametric	Maximum	0.754	0.304
	Upper Quartile	0.148	0.039
	Median	0.087	0.028
	Lower Quartile	0.052	0.017
	Minimum	0.020	0.010
	Efficiency	67.99%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.225	0.068
	Mean	0.154	0.045
	LCL	0.084	0.021
	Std. Dev.	0.183	0.065
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	71.06%	
	t-Test (equal var.)	0.0027 **	
	t-Test (unequal var.)	0.0049 **	
	t-test (paired)	0.0010 **	
	Levene Test	0.0549 *	
Log Transformed	UCL	0.219	0.056
	Mean	0.145	0.040
	LCL	0.096	0.028
	Std. Dev.	0.149	0.037
	Wilk (p-value)	0.1684	0.0044 **
	Efficiency	72.67%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7414	
Bootstrap	UCL	0.221	0.067
	Mean	0.154	0.045
	LCL	0.087	0.023
	Std. Dev.	0.173	0.060
	Efficiency	71.04%	

Convention Center Wet Pond System - Fecal Coliform (cfu/100 ml)



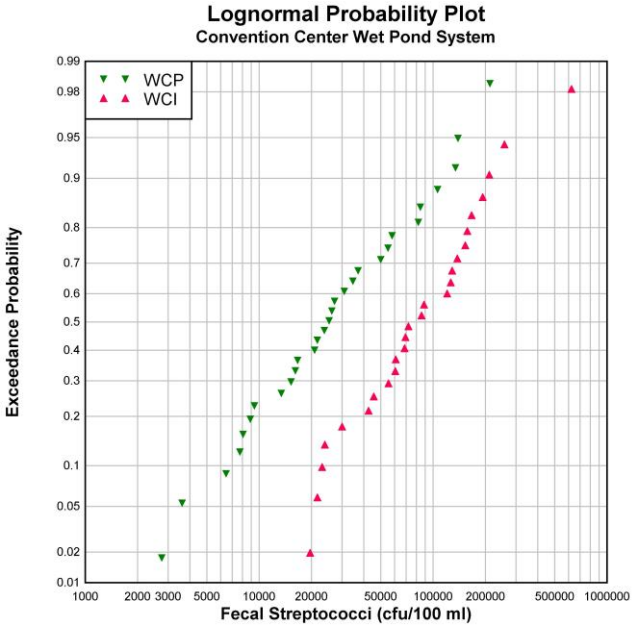


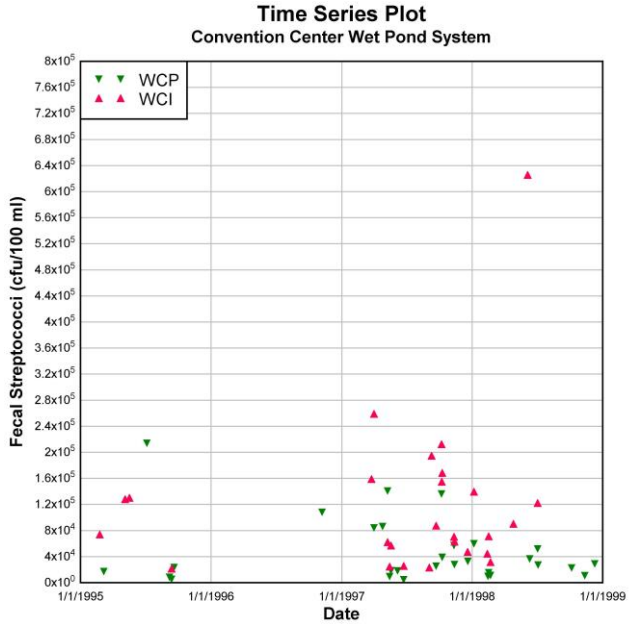


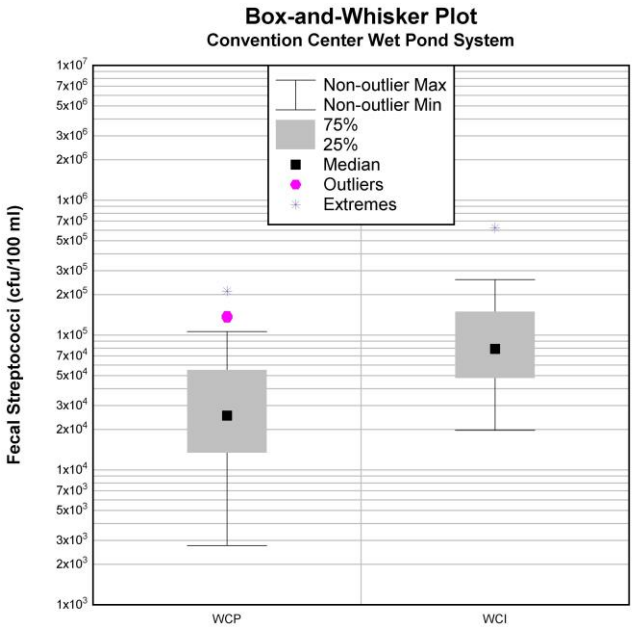


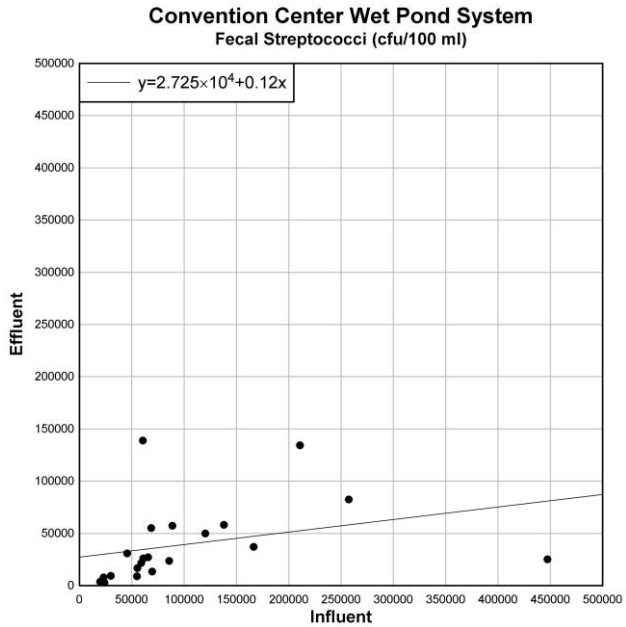
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	23	27
	Pairs Count	16	16
Non-Parametric	Maximum	282,019	24,505
	Upper Quartile	49,527	18,291
	Median	15,456	11,130
	Lower Quartile	9,096	4,229
	Minimum	1,509	962
	Efficiency	27.99%	
	Mann-Whitney	0.0705 *	
	Wilcoxon (paired)	0.2114	
Arithmetic	UCL	65,593	14,704
	Mean	39,045	11,718
	LCL	12,497	8,733
	Std. Dev.	61,388	7,546
	Wilk (p-value)	0.0001 **	0.0617 *
	Efficiency	69.99%	
	t-Test (equal var.)	0.0260 **	
	t-Test (unequal var.)	0.0451 **	
	t-test (paired)	0.0783 *	
	Levene Test	0.1371	
Log Transformed	UCL	78,045	19,665
	Mean	37,669	12,796
	LCL	18,181	8,327
	Std. Dev.	60,452	13,457
	Wilk (p-value)	0.9794	0.0153 **
	Efficiency	66.03%	
	t-Test (equal var.)	0.0185 **	
	t-Test (unequal var.)	0.0223 **	
	t-Test (paired)	0.0326 **	
	Levene Test	0.1246	
Bootstrap	UCL	63,395	14,661
	Mean	39,201	11,739
	LCL	15,008	8,817
	Std. Dev.	55,947	7,386
	Efficiency	70.06%	

Convention Center Wet Pond System - Fecal Streptococci (cfu/100 ml)



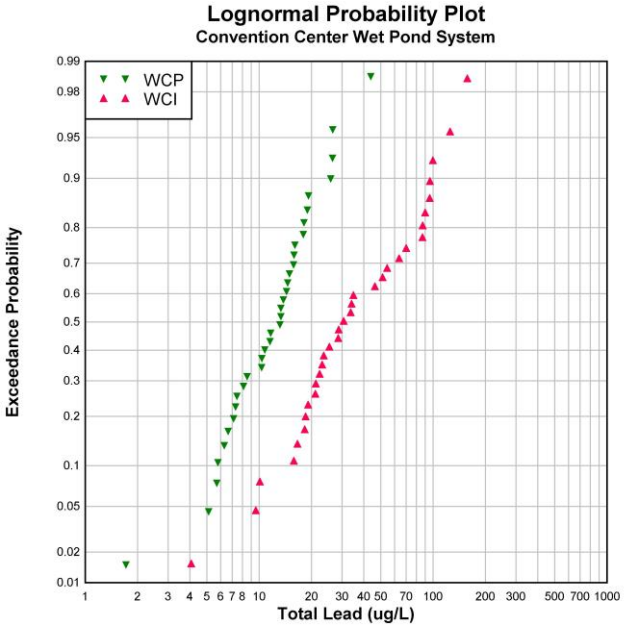


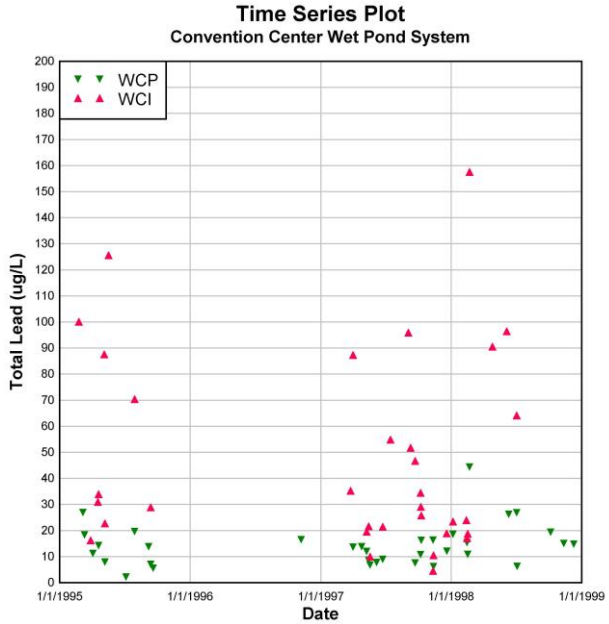


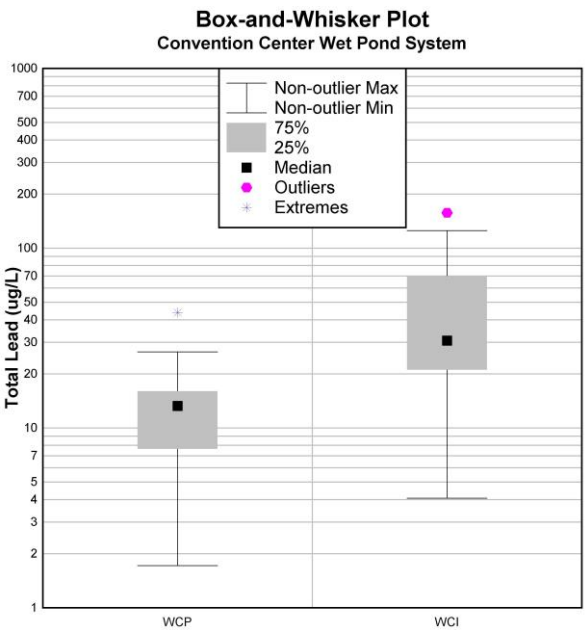


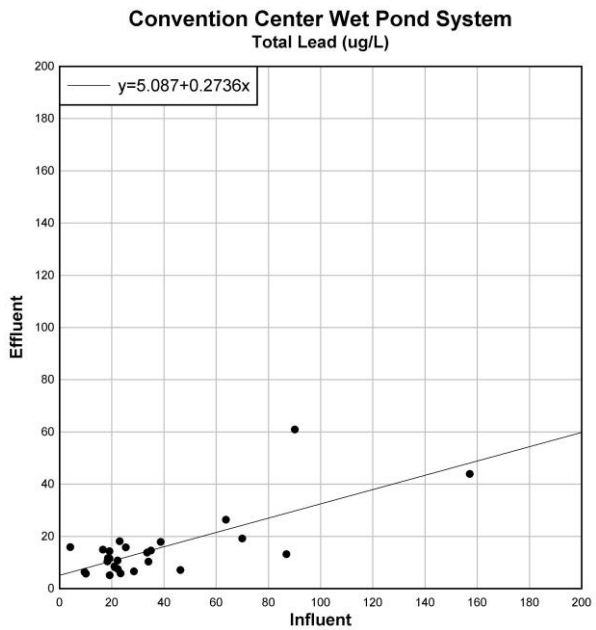
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	26	29
	Pairs Count	19	19
Non-Parametric	Maximum	624,125	212,047
	Upper Quartile	153,260	55,061
	Median	78,933	25,230
	Lower Quartile	45,529	13,403
	Minimum	19,652	2,753
	Efficiency	68.04%	
	Mann-Whitney	0.0005 **	
	Wilcoxon (paired)	0.0005 **	
Arithmetic	UCL	166,209	62,855
	Mean	117,039	44,041
	LCL	67,868	25,227
	Std. Dev.	121,709	49,470
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	62.37%	
	t-Test (equal var.)	0.0045 **	
	t-Test (unequal var.)	0.0075 **	
	t-test (paired)	0.0094 **	
	Levene Test	0.2064	
Log Transformed	UCL	173,669	76,731
	Mean	115,634	45,136
	LCL	76,993	26,551
	Std. Dev.	112,583	61,471
	Wilk (p-value)	0.6290	0.9584
	Efficiency	60.97%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1685	
Bootstrap	UCL	163,092	61,842
	Mean	117,622	43,811
	LCL	72,152	25,779
	Std. Dev.	112,575	47,405
	Efficiency	62.75%	

Convention Center Wet Pond System - Total Lead (ug/L)



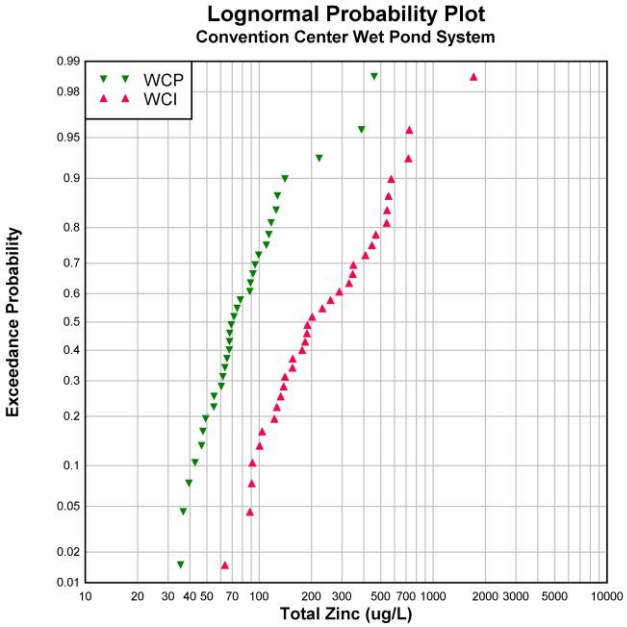


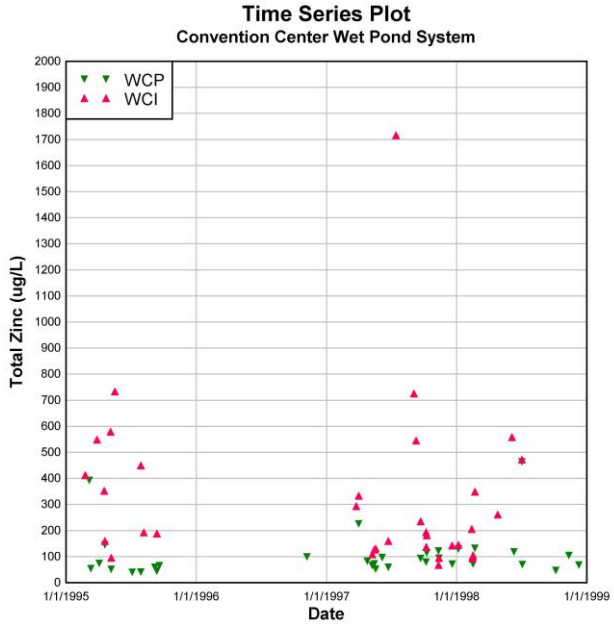


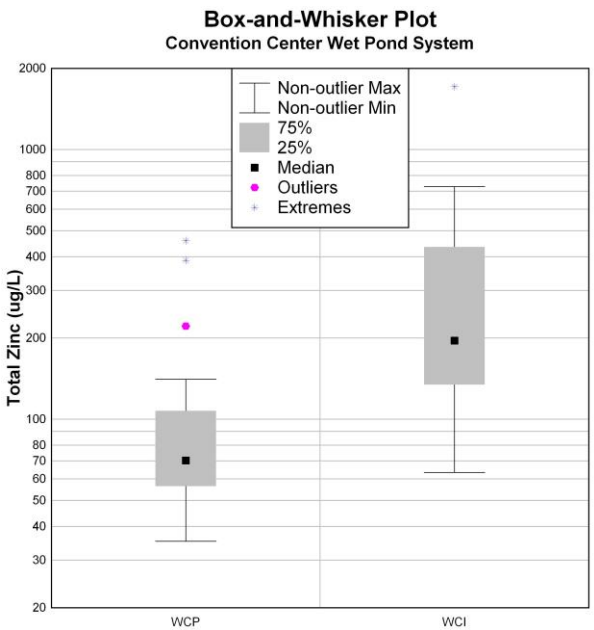


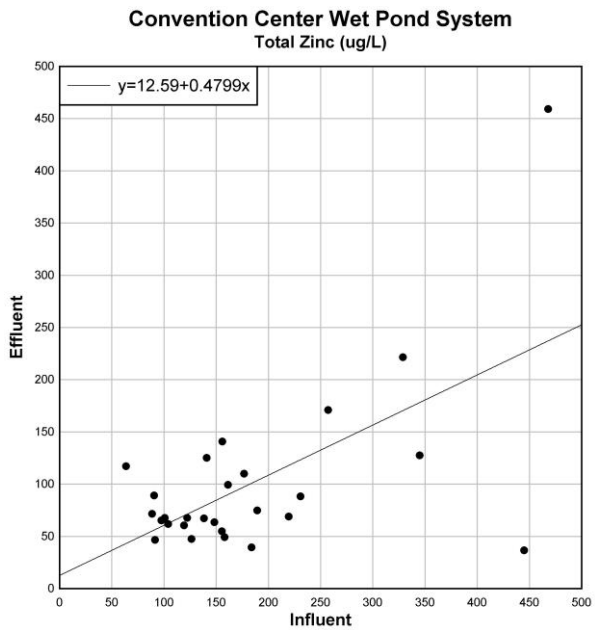
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	33	34
	Pairs Count	25	25
Non-Parametric	Maximum	157.1	43.9
	Upper Quartile	69.9	16.1
	Median	30.6	13.3
	Lower Quartile	21.0	7.5
	Minimum	4.1	1.7
	Efficiency	56.66%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	60.7	16.5
	Mean	47.3	13.7
	LCL	33.9	10.9
	Std. Dev.	37.8	8.1
	Wilk (p-value)	0.0004 **	0.0007 **
	Efficiency	71.00%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0002 **	
	Levene Test	0.0011 **	
Log Transformed	UCL	68.4	17.5
	Mean	48.4	13.9
	LCL	34.3	11.1
	Std. Dev.	46.2	9.0
	Wilk (p-value)	0.3922	0.1908
	Efficiency	71.21%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1057	
Bootstrap	UCL	60.5	16.5
	Mean	47.4	13.8
	LCL	34.3	11.1
	Std. Dev.	36.9	7.8
	Efficiency	70.95%	

Convention Center Wet Pond System - Total Zinc (ug/L)



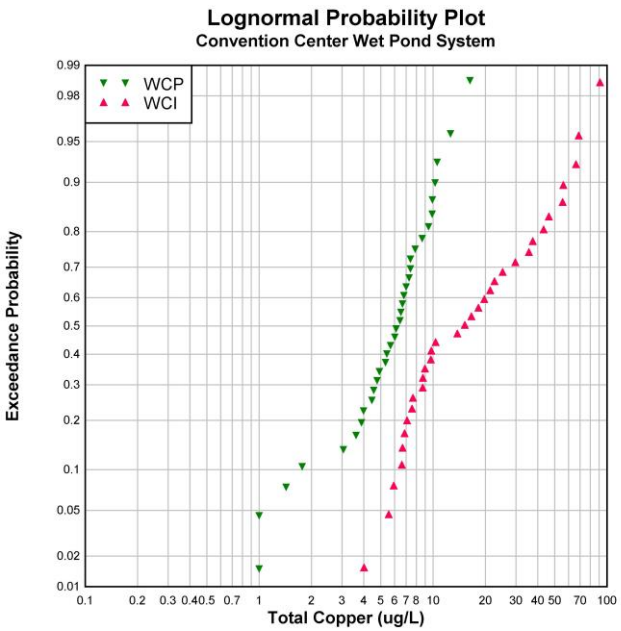


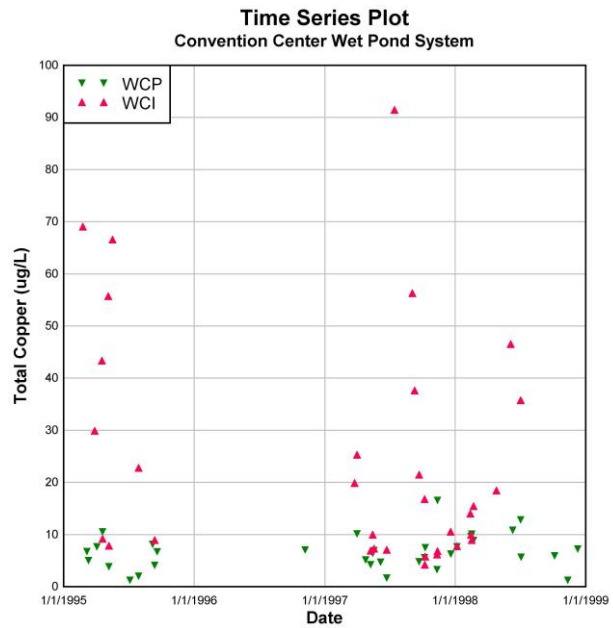


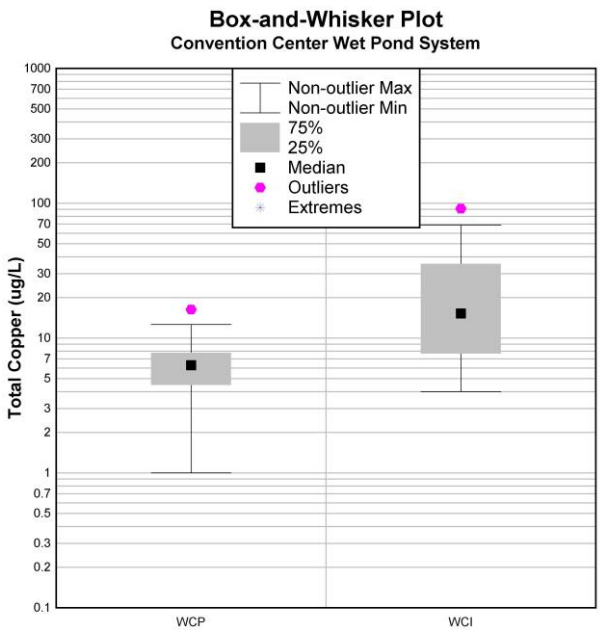


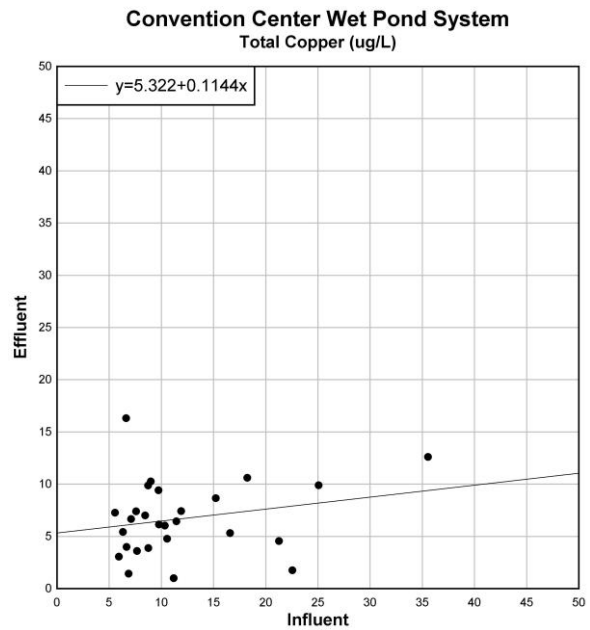
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	34	34
	Pairs Count	25	25
Non-Parametric	Maximum	1711.4	459.2
	Upper Quartile	444.9	110.0
	Median	195.5	70.4
	Lower Quartile	132.9	55.0
	Minimum	63.5	35.3
	Efficiency	64.02%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	430.2	132.2
	Mean	321.9	100.7
	LCL	213.6	69.1
	Std. Dev.	310.4	90.4
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	68.73%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0003 **	
	t-test (paired)	0.0001 **	
	Levene Test	0.1326	
Log Transformed	UCL	424.3	120.1
	Mean	313.3	96.1
	LCL	231.3	76.9
	Std. Dev.	267.4	60.5
	Wilk (p-value)	0.3408	0.0053 **
	Efficiency	69.32%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1768	
Bootstrap	UCL	425.8	130.3
	Mean	323.5	100.6
	LCL	221.1	71.0
	Std. Dev.	293.4	84.9
	Efficiency	68.89%	

Convention Center Wet Pond System - Total Copper (ug/L)



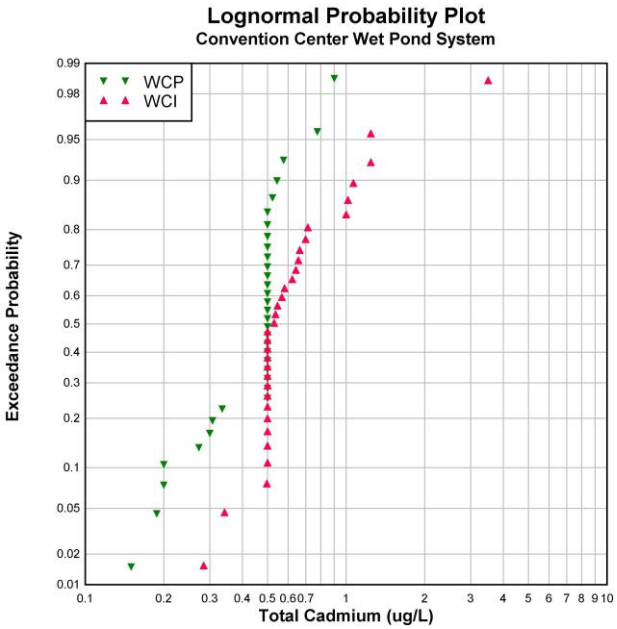


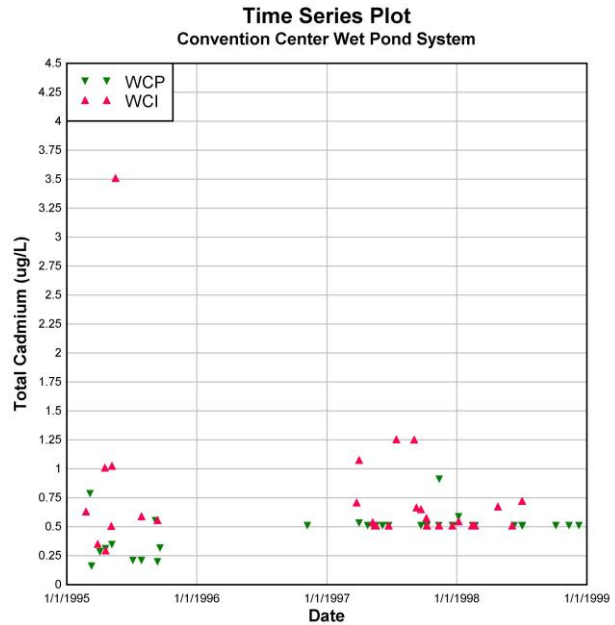


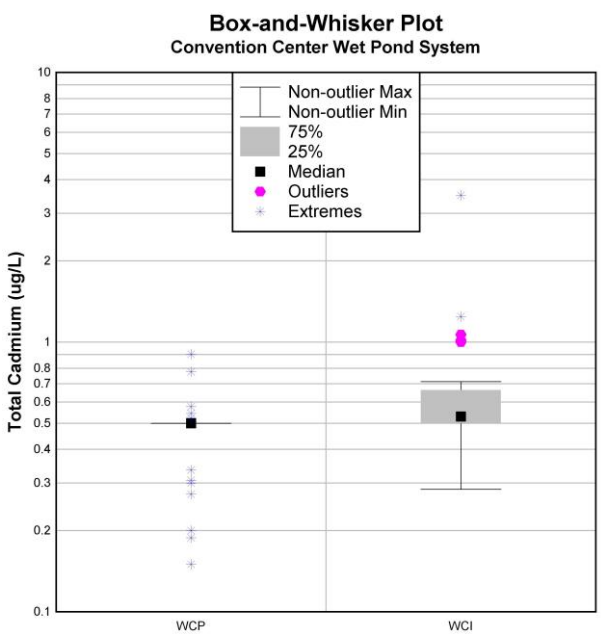


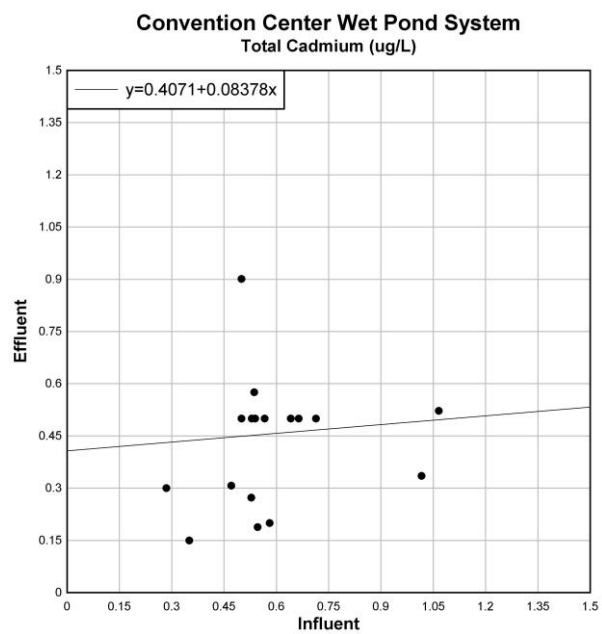
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	33	34
	Pairs Count	25	25
Non-Parametric	Maximum	91.2	16.3
	Upper Quartile	35.5	7.9
	Median	15.2	6.3
	Lower Quartile	7.7	4.4
	Minimum	4.0	1.0
	Efficiency	58.62%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	32.0	7.6
	Mean	24.1	6.4
	LCL	16.2	5.3
	Std. Dev.	22.3	3.3
	Wilk (p-value)	0.0001 **	0.2491
	Efficiency	73.43%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0011 **	
	Levene Test	0.0020 **	
Log Transformed	UCL	34.4	8.6
	Mean	23.9	6.7
	LCL	16.6	5.2
	Std. Dev.	24.1	4.8
	Wilk (p-value)	0.0715 *	0.0036 **
	Efficiency	72.01%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0004 **	
	Levene Test	0.0747 *	
Bootstrap	UCL	32.0	7.5
	Mean	24.2	6.4
	LCL	16.5	5.3
	Std. Dev.	21.8	3.2
	Efficiency	73.50%	

Convention Center Wet Pond System - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCP**
	Site Count	33	34
	Pairs Count	25	25
Non-Parametric	Maximum	3.5	0.9
	Upper Quartile	0.7	0.5
	Median	0.5	0.5
	Lower Quartile	0.5	0.5
	Minimum	0.3	0.2
	Efficiency	5.54%	
	Mann-Whitney	0.0030 **	
	Wilcoxon (paired)	0.0094 **	
Arithmetic	UCL	0.9	0.5
	Mean	0.7	0.5
	LCL	0.5	0.4
	Std. Dev.	0.6	0.2
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	34.71%	
	t-Test (equal var.)	0.0145 **	
	t-Test (unequal var.)	0.0179 **	
	t-test (paired)	0.0165 **	
	Levene Test	0.2416	
Log Transformed	UCL	0.8	0.5
	Mean	0.7	0.5
	LCL	0.6	0.4
	Std. Dev.	0.3	0.2
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	31.63%	
	t-Test (equal var.)	0.0009 **	
	t-Test (unequal var.)	0.0010 **	
	t-Test (paired)	0.0069 **	
	Levene Test	0.6363	
Bootstrap	UCL	0.9	0.5
	Mean	0.7	0.5
	LCL	0.5	0.4
	Std. Dev.	0.5	0.1
	Efficiency	34.43%	

St. Elmo Wet Pond (SWI-SWE)

Watershed runoff enters from St. Elmo two influent monitoring stations (SWI & SWJ). For purposes of data analysis the influents have been combined and are referred to collectively as SWI. See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed.

All flow from the two influents is diverted to the wet pond. Wet pond size is about 1.5 acres, four feet deep and can retain up to 250,000 cubic feet of water. A vegetated buffer was preserved around the pond to protect the banks from erosion and provide some pollutant removal. Exceeded runoff was monitored by the effluent station (SWE).

The City collected runoff and water quality data at the St. Elmo wet pond (SWI-SWE) from April 1995 to September 1996. During this time 26 and 8 valid EMCs were collected at the influent (SWI) and effluent (SWE), respectively, of which only 1 were paired.

Performance Summary

The St. Elmo wet pond had good performance with the reductions of the concentrations for almost all pollutant parameters. TSS and VSS concentrations were reduced by 96% and 87%, respectively, and were significant if data are not paired.

COD, TOC and BOD concentrations were reduced by 62%, 44% and 71%, respectively, and were significant if data are not paired.

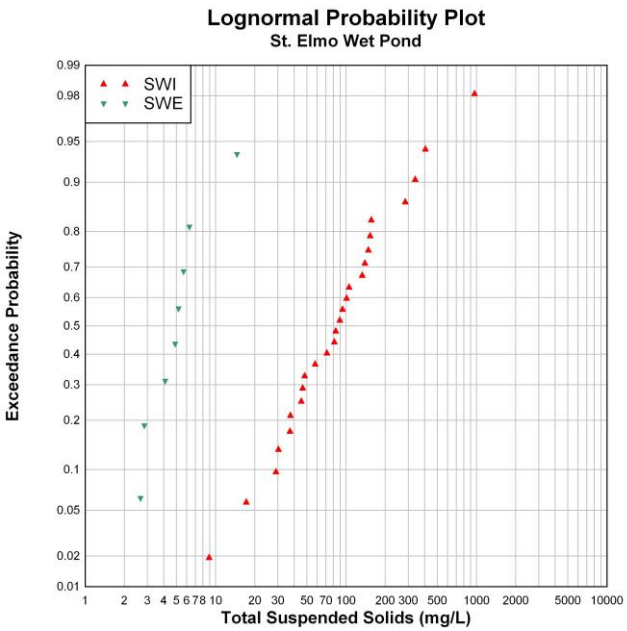
Total nitrogen, nitrate + nitrite, total Kjeldahl nitrogen and ammonia concentrations were reduced by 51%, 48%, 58% and 86%, respectively, and were significant if data are not paired.

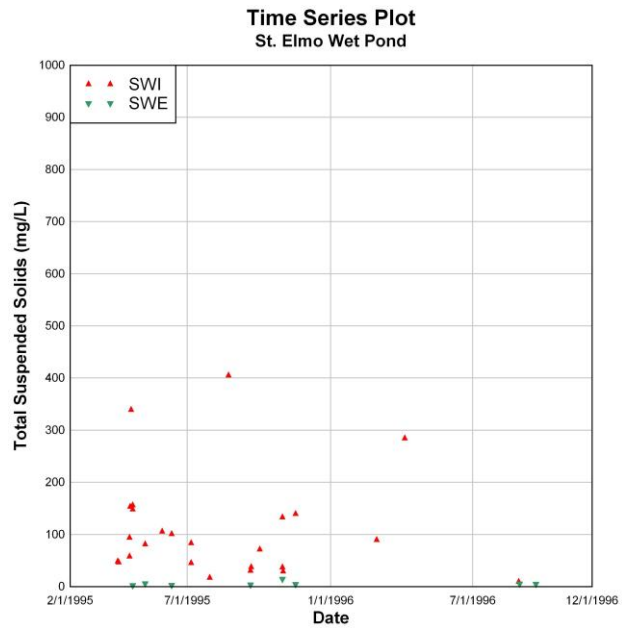
TP concentration was reduced by 76% and was significant if data are not paired. DP concentration was reduced by 41% and was not significant if data are not paired.

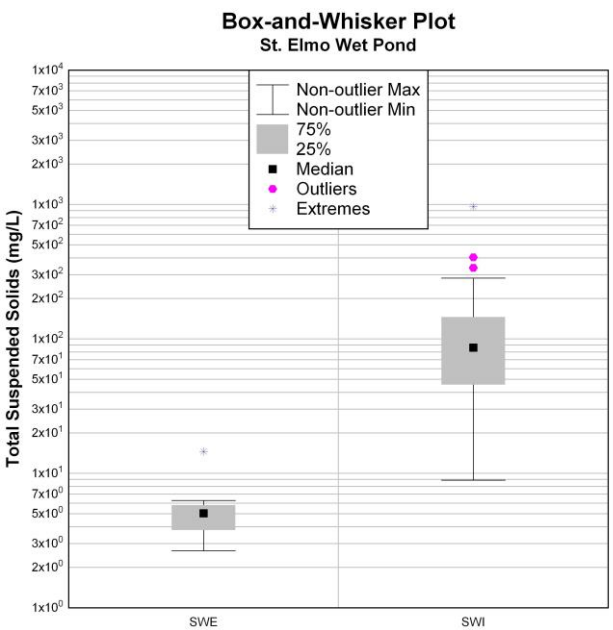
The reduction of bacteria was significant if data are not paired for FCOL (96%), and was not significant if data are not paired for FSTR (91%).

Lead, zinc and copper concentrations were reduced by 73%, 84% and 81%, respectively, and were significant if data are not paired. Cadmium concentration was reduced by 8% and was not significant if data are not paired.

St. Elmo Wet Pond - Total Suspended Solids (mg/L)



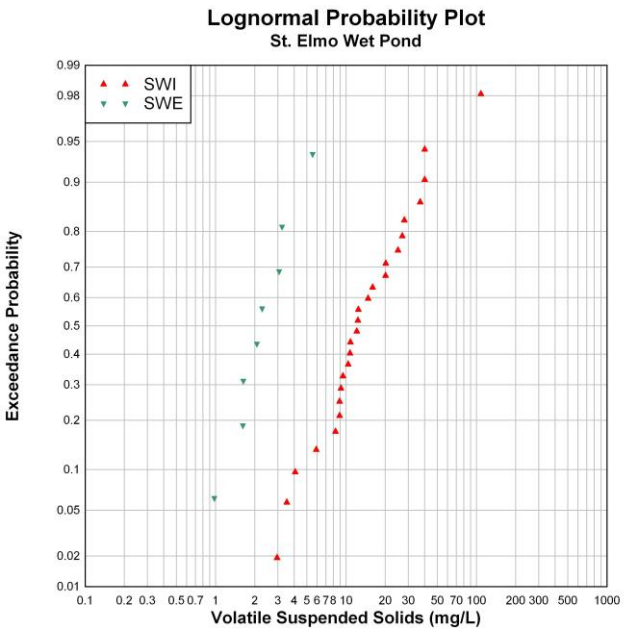


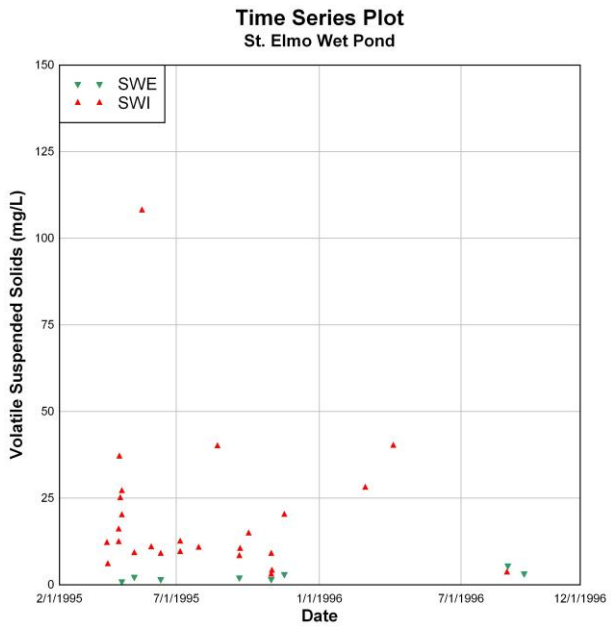


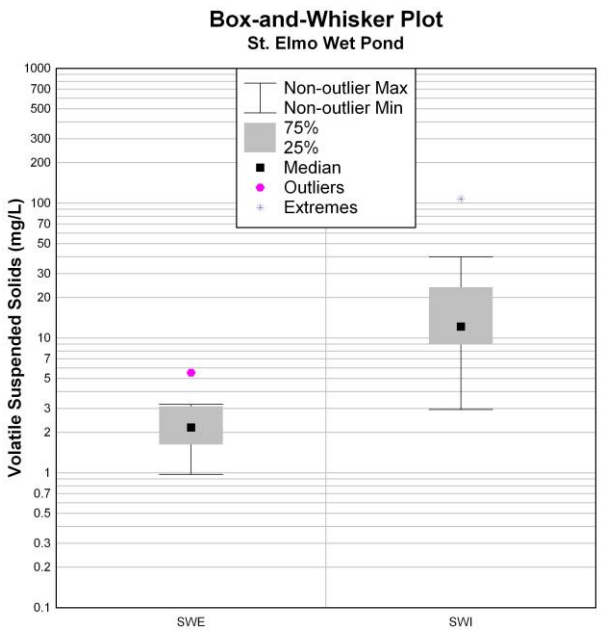
Analysis Plot Removed

	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	964.0	14.6
	Upper Quartile	147.9	6.0
	Median	86.3	5.0
	Lower Quartile	45.4	3.5
	Minimum	8.9	2.7
	Efficiency	94.16%	
	Mann-Whitney	0.0002 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	220.8	8.9
	Mean	142.4	5.8
	LCL	64.1	2.6
	Std. Dev.	193.9	3.8
	Wilk (p-value)	0.0001 **	0.0061 **
	Efficiency	95.95%	
	t-Test (equal var.)	0.0572 *	
	t-Test (unequal var.)	0.0014 **	
	t-test (paired)	NA	
	Levene Test	0.4464	
Log Transformed	UCL	227.8	9.2
	Mean	137.0	5.7
	LCL	82.4	3.5
	Std. Dev.	166.3	3.1
	Wilk (p-value)	0.9718	0.3659
	Efficiency	95.86%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	NA	
	Levene Test	0.1845	
Bootstrap	UCL	216.4	8.4
	Mean	143.5	5.8
	LCL	70.6	3.1
	Std. Dev.	180.5	3.2
	Efficiency	95.98%	

St. Elmo Wet Pond - Volatile Suspended Solids (mg/L)



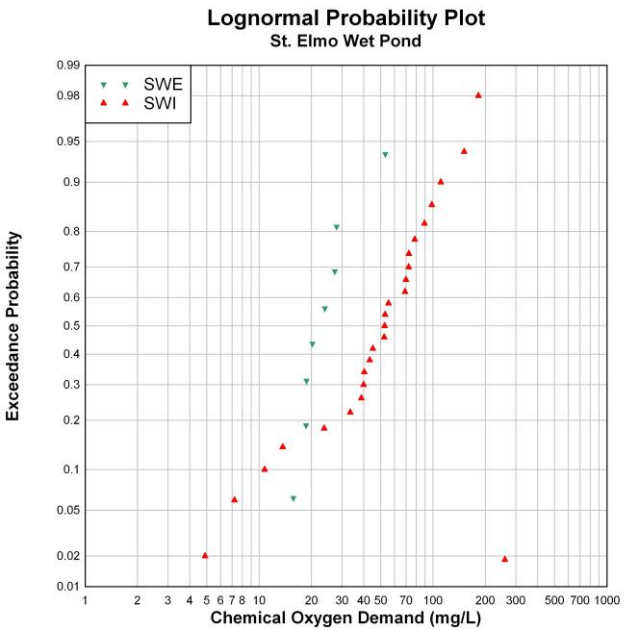


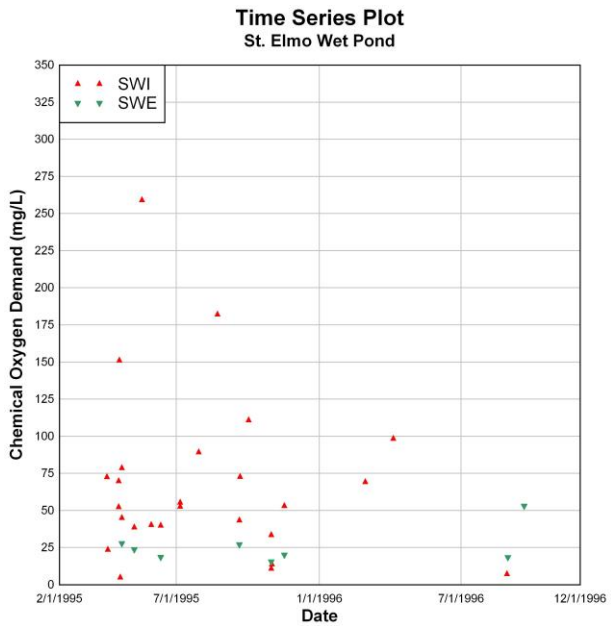


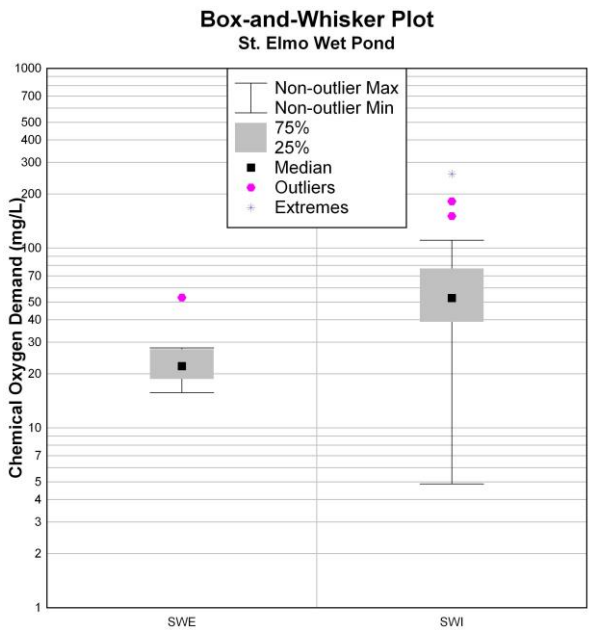
Analysis Plot Removed

	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	108.0	5.5
	Upper Quartile	25.0	3.1
	Median	12.2	2.2
	Lower Quartile	8.9	1.6
	Minimum	3.0	1.0
	Efficiency	82.19%	
	Mann-Whitney	0.0003 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	28.0	3.7
	Mean	19.4	2.5
	LCL	10.9	1.4
	Std. Dev.	21.1	1.4
	Wilk (p-value)	0.0001 **	0.1944
	Efficiency	86.89%	
	t-Test (equal var.)	0.0318 **	
	t-Test (unequal var.)	0.0004 **	
	t-test (paired)	NA	
	Levene Test	0.4394	
Log Transformed	UCL	27.7	4.1
	Mean	18.8	2.5
	LCL	12.8	1.6
	Std. Dev.	17.3	1.4
	Wilk (p-value)	0.6530	0.9673
	Efficiency	86.51%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	NA	
	Levene Test	0.2638	
Bootstrap	UCL	27.5	3.6
	Mean	19.6	2.6
	LCL	11.6	1.5
	Std. Dev.	19.7	1.3
	Efficiency	86.91%	

St. Elmo Wet Pond - Chemical Oxygen Demand (mg/L)



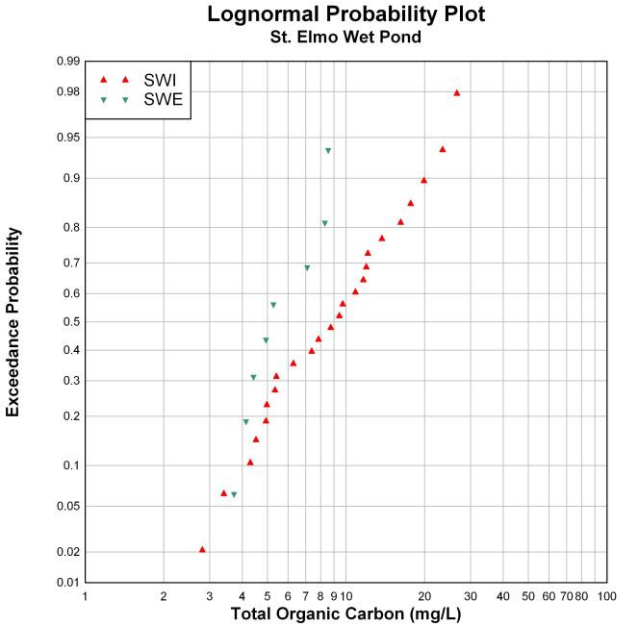


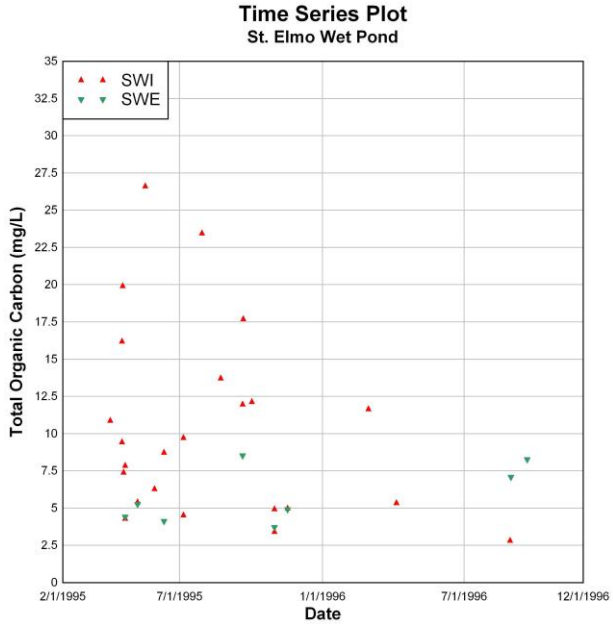


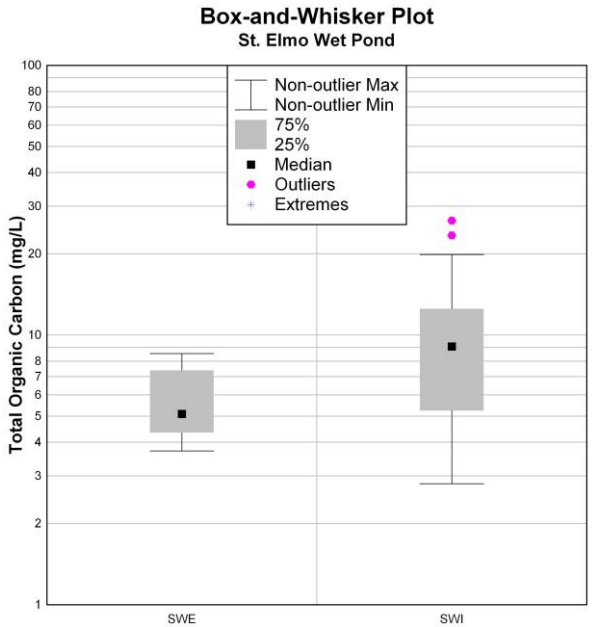
Analysis Plot Removed

	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	259.00	53.16
	Upper Quartile	78.54	27.57
	Median	52.81	22.05
	Lower Quartile	38.63	18.66
	Minimum	4.88	15.71
	Efficiency	58.25%	
	Mann-Whitney	0.0235 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	90.96	35.64
	Mean	67.93	25.68
	LCL	44.90	15.72
	Std. Dev.	57.00	11.91
	Wilk (p-value)	0.0004 **	0.0082 **
	Efficiency	62.20%	
	t-Test (equal var.)	0.0474 **	
	t-Test (unequal var.)	0.0013 **	
	t-test (paired)	NA	
	Levene Test	0.2631	
Log Transformed	UCL	114.66	35.39
	Mean	72.73	25.45
	LCL	46.14	18.30
	Std. Dev.	79.11	9.71
	Wilk (p-value)	0.1469	0.1863
	Efficiency	65.01%	
	t-Test (equal var.)	0.0489 **	
	t-Test (unequal var.)	0.0045 **	
	t-Test (paired)	NA	
	Levene Test	0.1425	
Bootstrap	UCL	90.11	34.51
	Mean	67.93	25.84
	LCL	45.74	17.17
	Std. Dev.	54.93	10.37
	Efficiency	61.96%	

St. Elmo Wet Pond - Total Organic Carbon (mg/L)



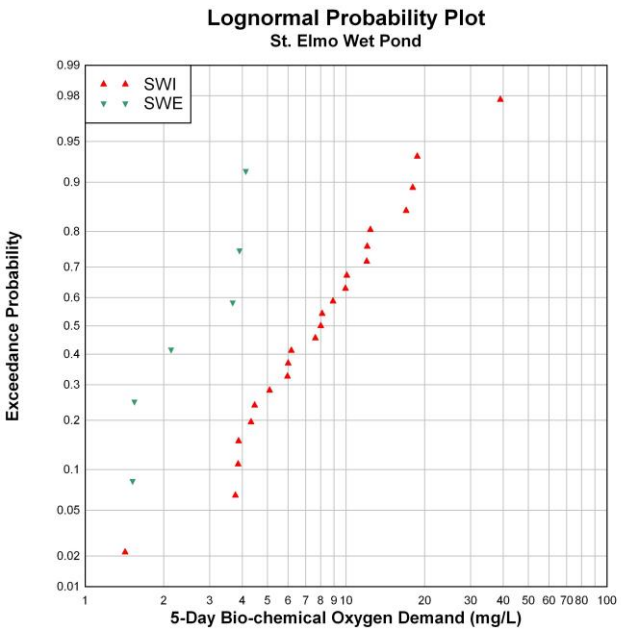


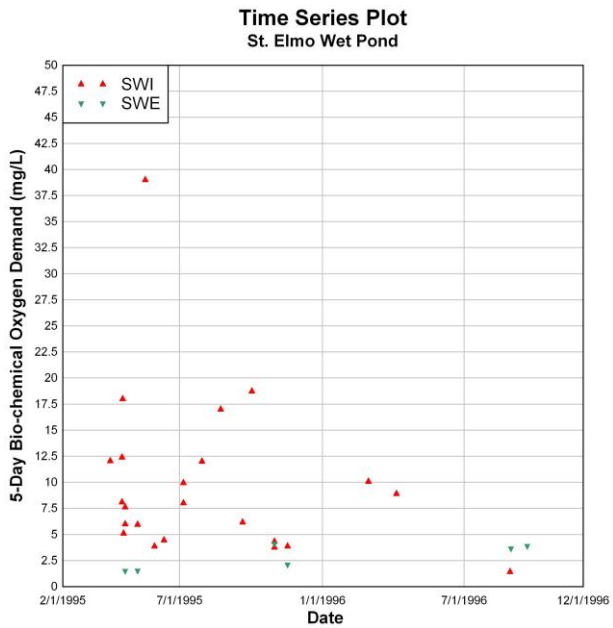


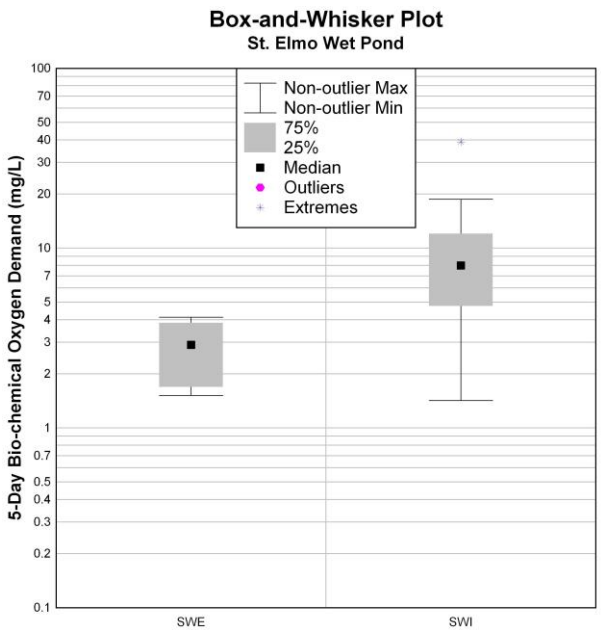
Analysis Plot Removed

	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	24	8
	Pairs Count	1	1
Non-Parametric	Maximum	26.60	8.54
	Upper Quartile	12.91	7.69
	Median	9.07	5.09
	Lower Quartile	5.15	4.27
	Minimum	2.81	3.72
	Efficiency	43.83%	
	Mann-Whitney	0.0472 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	13.10	7.39
	Mean	10.38	5.80
	LCL	7.66	4.20
	Std. Dev.	6.44	1.91
	Wilk (p-value)	0.0186 **	0.1707
	Efficiency	44.14%	
	t-Test (equal var.)	0.0588 *	
	t-Test (unequal var.)	0.0042 **	
	t-test (paired)	NA	
	Levene Test	0.1023	
Log Transformed	UCL	13.82	7.63
	Mean	10.40	5.79
	LCL	7.82	4.39
	Std. Dev.	6.82	1.87
	Wilk (p-value)	0.8604	0.3344
	Efficiency	44.30%	
	t-Test (equal var.)	0.0587 *	
	t-Test (unequal var.)	0.0139 **	
	t-Test (paired)	NA	
	Levene Test	0.0603 *	
Bootstrap	UCL	12.96	7.29
	Mean	10.33	5.82
	LCL	7.70	4.35
	Std. Dev.	6.23	1.76
	Efficiency	43.67%	

St. Elmo Wet Pond - 5-Day Bio-chemical Oxygen Demand (mg/L)



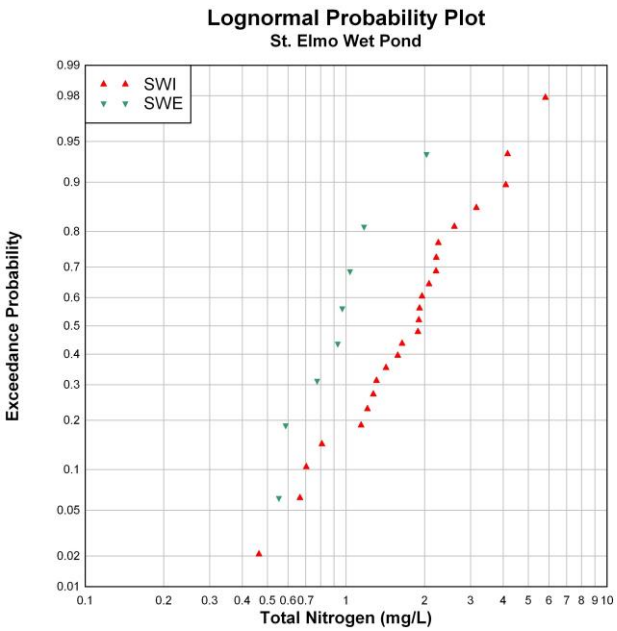


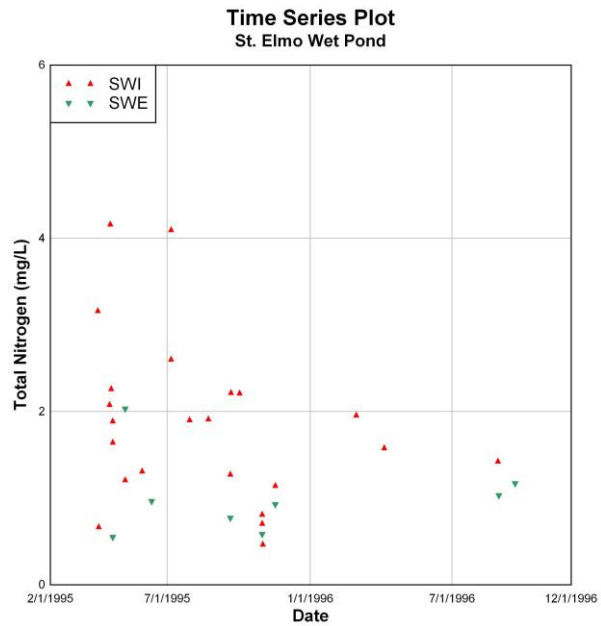


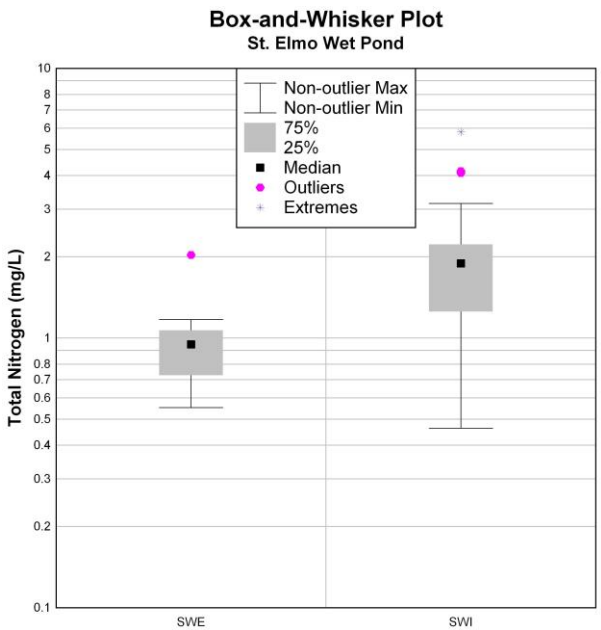
Analysis Plot Removed

	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	23	6
	Pairs Count	1	1
Non-Parametric	Maximum	39.00	4.13
	Upper Quartile	12.05	3.90
	Median	8.00	2.90
	Lower Quartile	4.46	1.54
	Minimum	1.42	1.52
	Efficiency	63.73%	
	Mann-Whitney	0.0051 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	13.28	4.09
	Mean	9.86	2.82
	LCL	6.43	1.54
	Std. Dev.	7.92	1.22
	Wilk (p-value)	0.0001 **	0.1031
	Efficiency	71.43%	
	t-Test (equal var.)	0.0414 **	
	t-Test (unequal var.)	0.0004 **	
	t-test (paired)	NA	
	Levene Test	0.4208	
Log Transformed	UCL	13.80	4.77
	Mean	9.82	2.82
	LCL	6.98	1.67
	Std. Dev.	7.49	1.32
	Wilk (p-value)	0.8573	0.0961 *
	Efficiency	71.23%	
	t-Test (equal var.)	0.0012 **	
	t-Test (unequal var.)	0.0007 **	
	t-Test (paired)	NA	
	Levene Test	0.3651	
Bootstrap	UCL	13.12	3.99
	Mean	9.89	2.85
	LCL	6.65	1.71
	Std. Dev.	7.49	1.09
	Efficiency	71.18%	

St. Elmo Wet Pond - Total Nitrogen (mg/L)



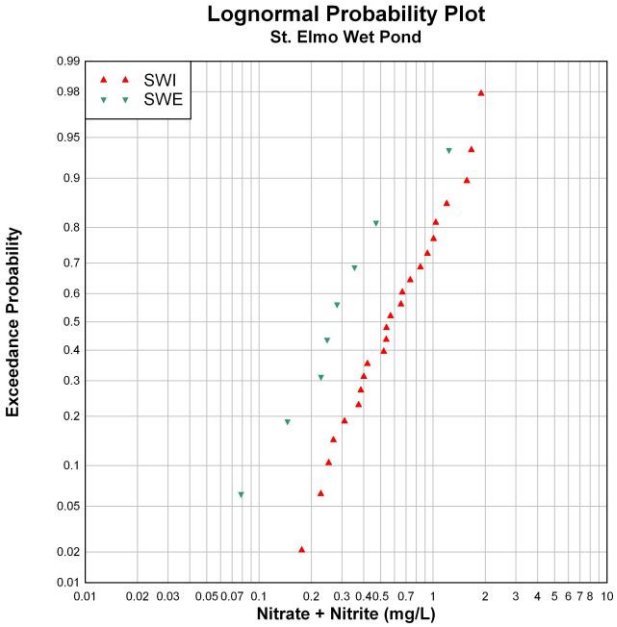


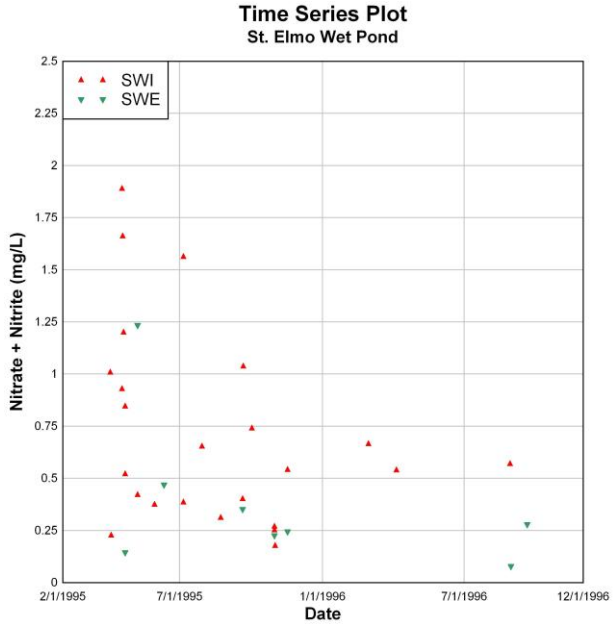


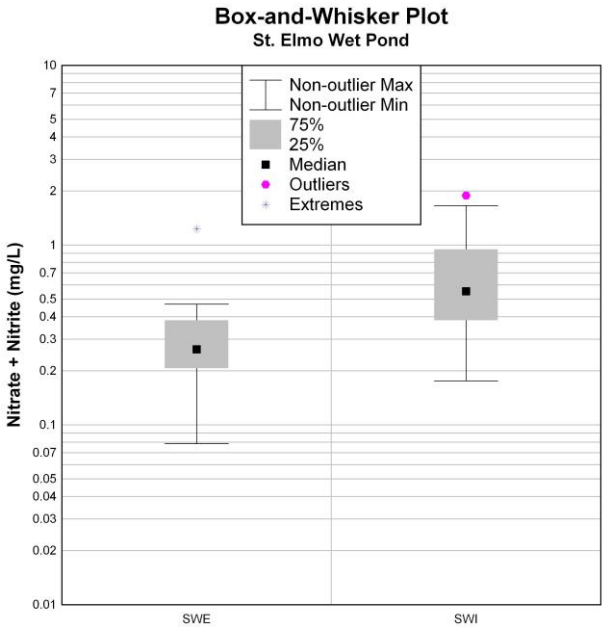
Analysis Plot Removed

	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	24	8
	Pairs Count	1	1
Non-Parametric	Maximum	5.801	2.033
	Upper Quartile	2.236	1.102
	Median	1.893	0.948
	Lower Quartile	1.238	0.681
	Minimum	0.464	0.552
	Efficiency	49.92%	
	Mann-Whitney	0.0161 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	2.543	1.396
	Mean	2.018	1.006
	LCL	1.492	0.616
	Std. Dev.	1.245	0.467
	Wilk (p-value)	0.0046 **	0.0660 *
	Efficiency	50.14%	
	t-Test (equal var.)	0.0337 **	
	t-Test (unequal var.)	0.0023 **	
	t-test (paired)	NA	
	Levene Test	0.2404	
Log Transformed	UCL	2.673	1.437
	Mean	2.026	1.000
	LCL	1.536	0.697
	Std. Dev.	1.297	0.417
	Wilk (p-value)	0.8887	0.6146
	Efficiency	50.62%	
	t-Test (equal var.)	0.0130 **	
	t-Test (unequal var.)	0.0052 **	
	t-Test (paired)	NA	
	Levene Test	0.2768	
Bootstrap	UCL	2.527	1.330
	Mean	2.021	1.000
	LCL	1.516	0.670
	Std. Dev.	1.197	0.395
	Efficiency	50.53%	

St. Elmo Wet Pond - Nitrate + Nitrite (mg/L)



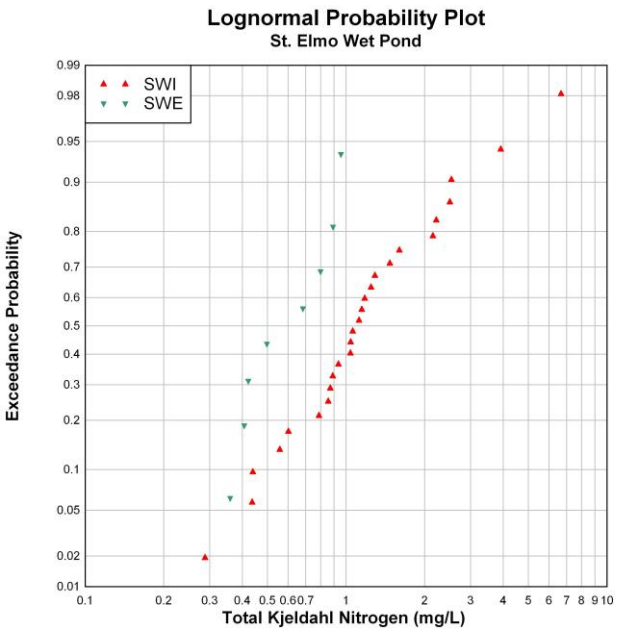


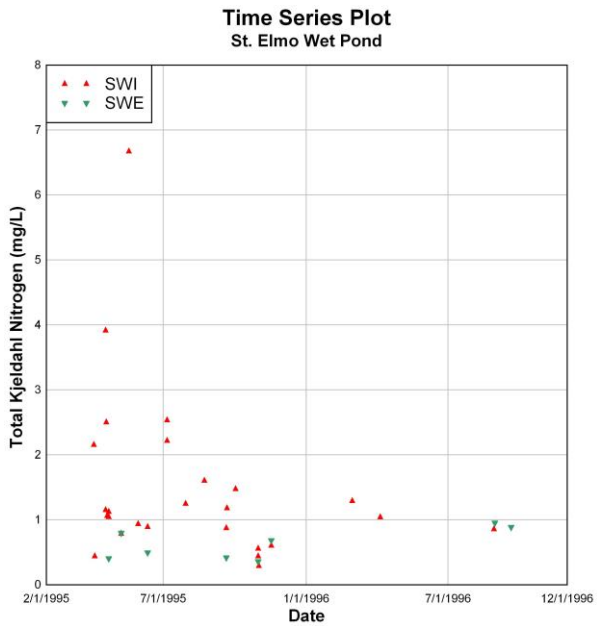


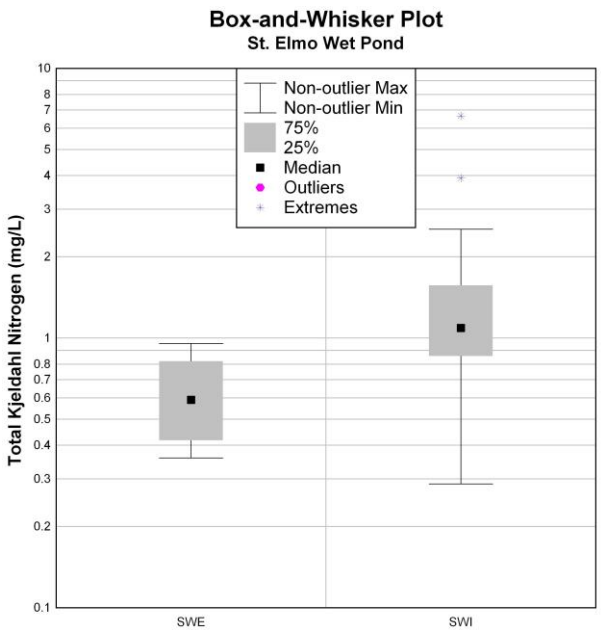
Analysis Plot Removed

	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	24	8
	Pairs Count	1	1
Non-Parametric	Maximum	1.888	1.235
	Upper Quartile	0.967	0.412
	Median	0.554	0.263
	Lower Quartile	0.379	0.186
	Minimum	0.176	0.079
	Efficiency	52.56%	
	Mann-Whitney	0.0293 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	0.914	0.685
	Mean	0.715	0.379
	LCL	0.516	0.073
	Std. Dev.	0.472	0.366
	Wilk (p-value)	0.0087 **	0.0047 **
	Efficiency	46.91%	
	t-Test (equal var.)	0.0775 *	
	t-Test (unequal var.)	0.0546 *	
	t-test (paired)	NA	
	Levene Test	0.4567	
Log Transformed	UCL	0.970	0.820
	Mean	0.716	0.369
	LCL	0.529	0.166
	Std. Dev.	0.501	0.309
	Wilk (p-value)	0.9068	0.9224
	Efficiency	48.42%	
	t-Test (equal var.)	0.0135 **	
	t-Test (unequal var.)	0.0409 **	
	t-Test (paired)	NA	
	Levene Test	0.4624	
Bootstrap	UCL	0.911	0.620
	Mean	0.718	0.372
	LCL	0.525	0.124
	Std. Dev.	0.457	0.297
	Efficiency	48.15%	

St. Elmo Wet Pond - Total Kjeldahl Nitrogen (mg/L)



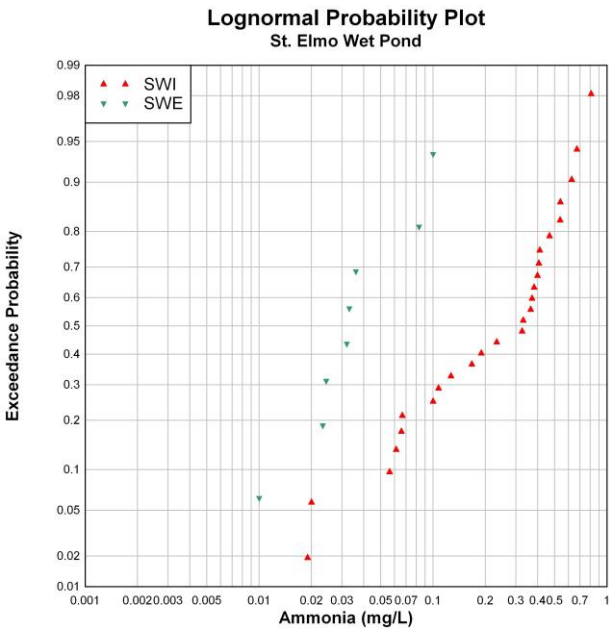


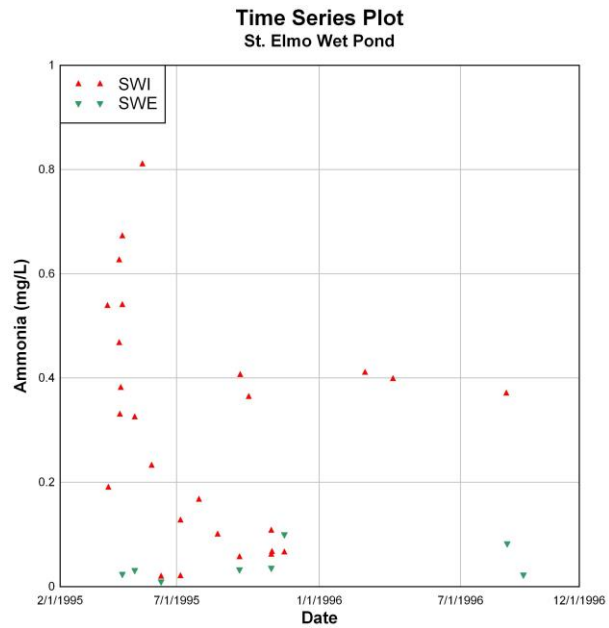


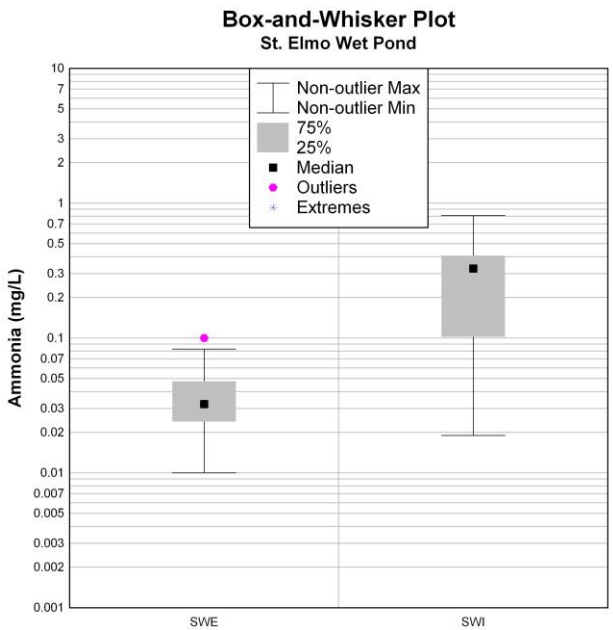
Analysis Plot Removed

	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	6.670	0.956
	Upper Quartile	1.600	0.844
	Median	1.090	0.590
	Lower Quartile	0.853	0.414
	Minimum	0.288	0.360
	Efficiency	45.88%	
	Mann-Whitney	0.0098 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	2.030	0.824
	Mean	1.493	0.626
	LCL	0.957	0.429
	Std. Dev.	1.328	0.236
	Wilk (p-value)	0.0001 **	0.2592
	Efficiency	58.05%	
	t-Test (equal var.)	0.0784 *	
	t-Test (unequal var.)	0.0036 **	
	t-test (paired)	NA	
	Levene Test	0.3858	
Log Transformed	UCL	1.992	0.877
	Mean	1.457	0.627
	LCL	1.065	0.448
	Std. Dev.	1.099	0.243
	Wilk (p-value)	0.6906	0.3001
	Efficiency	56.98%	
	t-Test (equal var.)	0.0130 **	
	t-Test (unequal var.)	0.0019 **	
	t-Test (paired)	NA	
	Levene Test	0.2110	
Bootstrap	UCL	2.004	0.810
	Mean	1.497	0.628
	LCL	0.989	0.445
	Std. Dev.	1.256	0.218
	Efficiency	58.06%	

St. Elmo Wet Pond - Ammonia (mg/L)



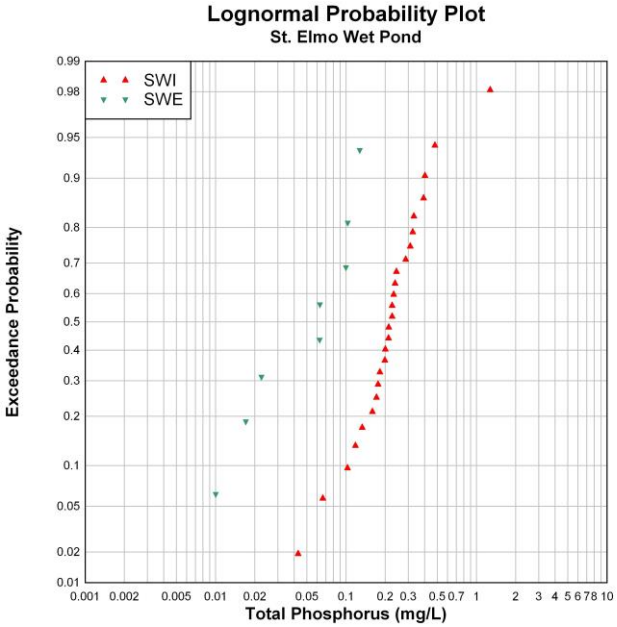


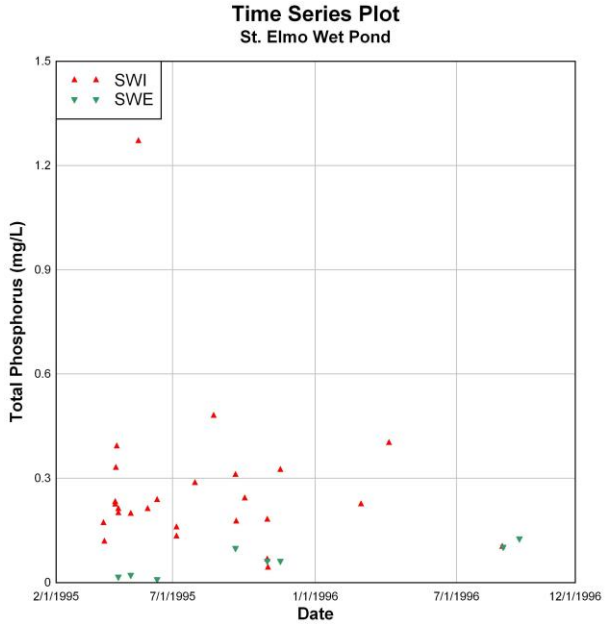


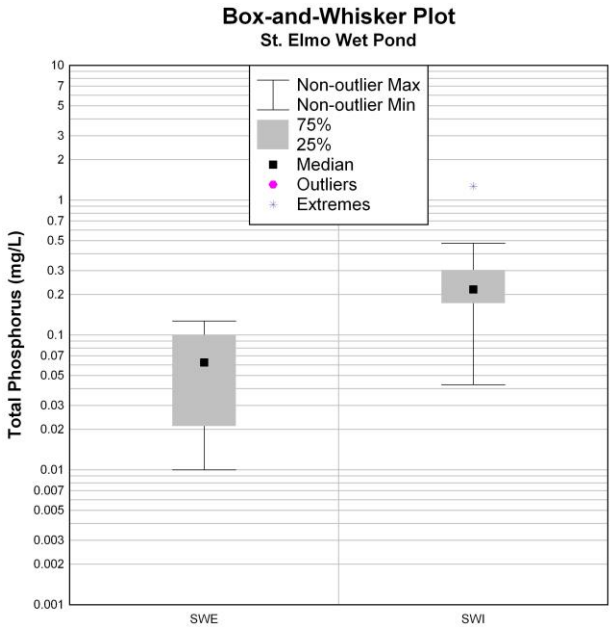
Analysis Plot Removed

	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	0.810	0.100
	Upper Quartile	0.410	0.059
	Median	0.327	0.032
	Lower Quartile	0.100	0.024
	Minimum	0.019	0.010
	Efficiency	90.10%	
	Mann-Whitney	0.0025 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	0.391	0.069
	Mean	0.302	0.043
	LCL	0.213	0.016
	Std. Dev.	0.221	0.032
	Wilk (p-value)	0.0983 *	0.0459 **
	Efficiency	85.87%	
	t-Test (equal var.)	0.0026 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	NA	
	Levene Test	0.0265 **	
Log Transformed	UCL	0.588	0.086
	Mean	0.344	0.043
	LCL	0.201	0.021
	Std. Dev.	0.441	0.032
	Wilk (p-value)	0.0195 **	0.5698
	Efficiency	87.60%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	NA	
	Levene Test	0.2450	
Bootstrap	UCL	0.391	0.066
	Mean	0.304	0.043
	LCL	0.217	0.019
	Std. Dev.	0.216	0.028
	Efficiency	85.96%	

St. Elmo Wet Pond - Total Phosphorus (mg/L)



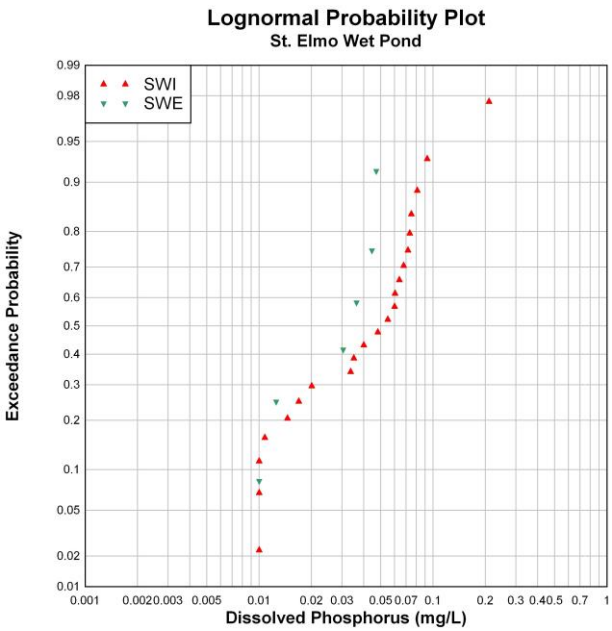


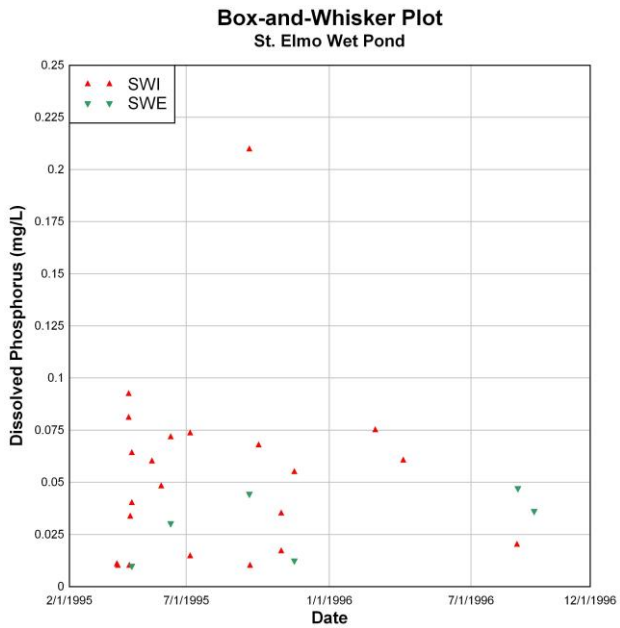


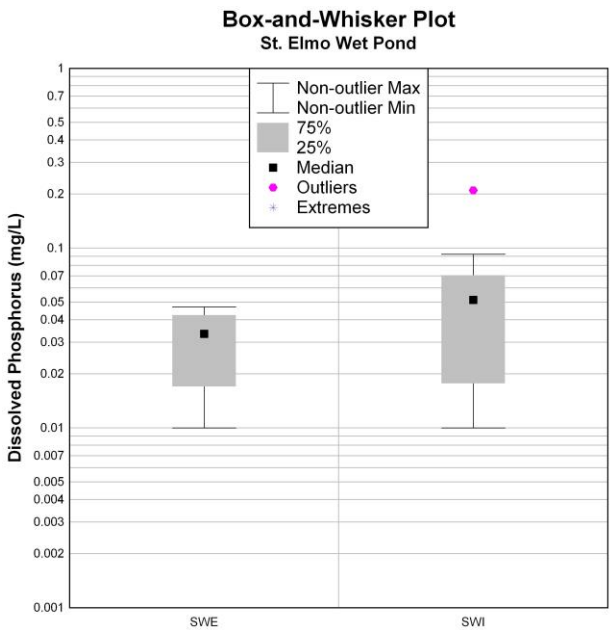
Analysis Plot Removed

	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	1.270	0.127
	Upper Quartile	0.310	0.101
	Median	0.218	0.063
	Lower Quartile	0.171	0.020
	Minimum	0.043	0.010
	Efficiency	71.30%	
	Mann-Whitney	0.0007 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	0.359	0.100
	Mean	0.266	0.063
	LCL	0.174	0.026
	Std. Dev.	0.229	0.044
	Wilk (p-value)	0.0001 **	0.3839
	Efficiency	76.32%	
	t-Test (equal var.)	0.0189 **	
	t-Test (unequal var.)	0.0002 **	
	t-test (paired)	NA	
	Levene Test	0.4911	
Log Transformed	UCL	0.350	0.178
	Mean	0.263	0.067
	LCL	0.197	0.025
	Std. Dev.	0.183	0.066
	Wilk (p-value)	0.1964	0.2359
	Efficiency	74.50%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0019 **	
	t-Test (paired)	NA	
	Levene Test	0.2287	
Bootstrap	UCL	0.352	0.098
	Mean	0.267	0.064
	LCL	0.182	0.030
	Std. Dev.	0.211	0.041
	Efficiency	76.10%	

St. Elmo Wet Pond - Dissolved Phosphorus (mg/L)



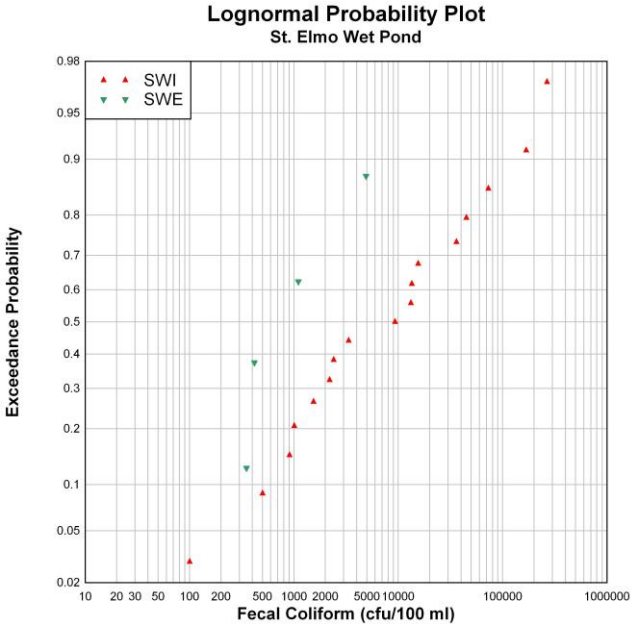


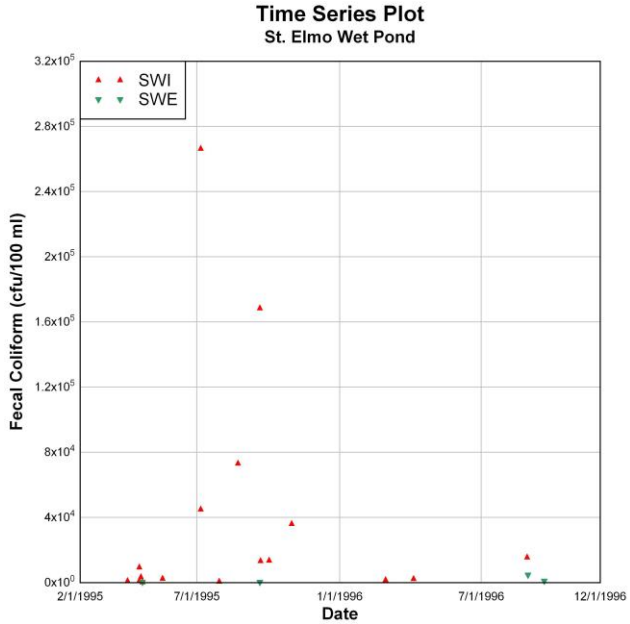


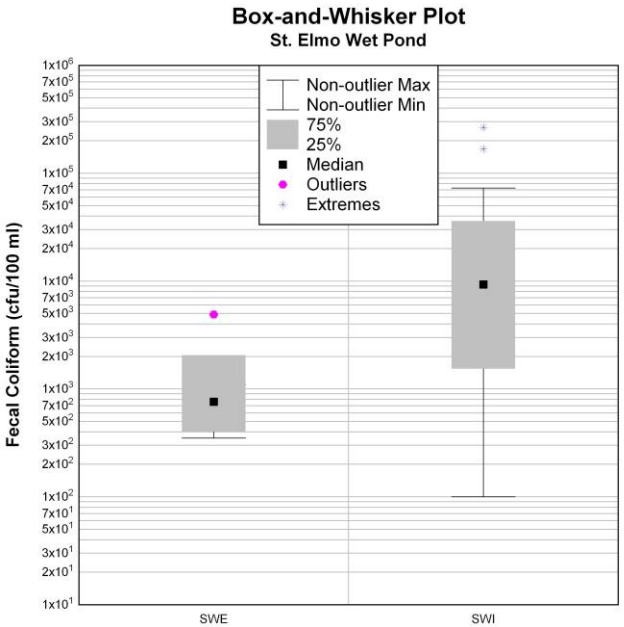
Analysis Plot Removed

	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	22	6
	Pairs Count	1	1
Non-Parametric	Maximum	0.210	0.047
	Upper Quartile	0.072	0.045
	Median	0.051	0.033
	Lower Quartile	0.017	0.013
	Minimum	0.010	0.010
	Efficiency	35.26%	
	Mann-Whitney	0.1896	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	0.072	0.047
	Mean	0.053	0.030
	LCL	0.033	0.014
	Std. Dev.	0.044	0.016
	Wilk (p-value)	0.0003 **	0.3283
	Efficiency	42.78%	
	t-Test (equal var.)	0.2337	
	t-Test (unequal var.)	0.0596 *	
	t-test (paired)	NA	
	Levene Test	0.4474	
Log Transformed	UCL	0.085	0.068
	Mean	0.054	0.031
	LCL	0.035	0.014
	Std. Dev.	0.053	0.021
	Wilk (p-value)	0.0516 *	0.1353
	Efficiency	43.28%	
	t-Test (equal var.)	0.3110	
	t-Test (unequal var.)	0.2566	
	t-Test (paired)	NA	
	Levene Test	0.3017	
Bootstrap	UCL	0.070	0.045
	Mean	0.052	0.031
	LCL	0.034	0.016
	Std. Dev.	0.040	0.014
	Efficiency	41.00%	

St. Elmo Wet Pond - Fecal Coliform (cfu/100 ml)



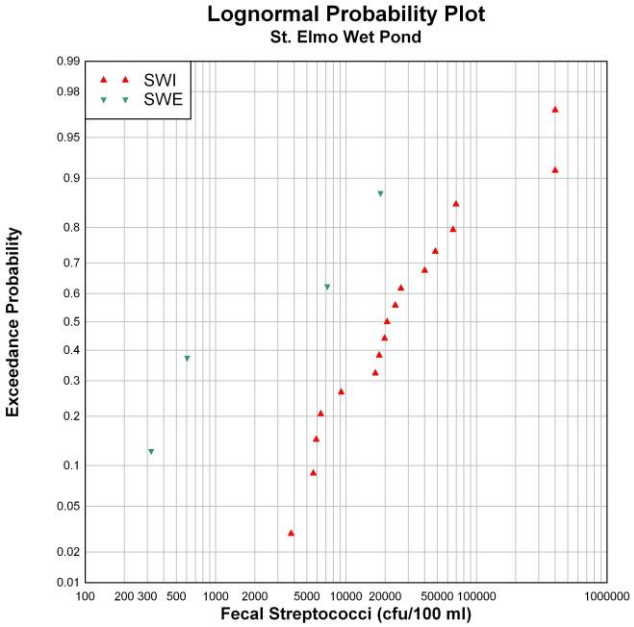


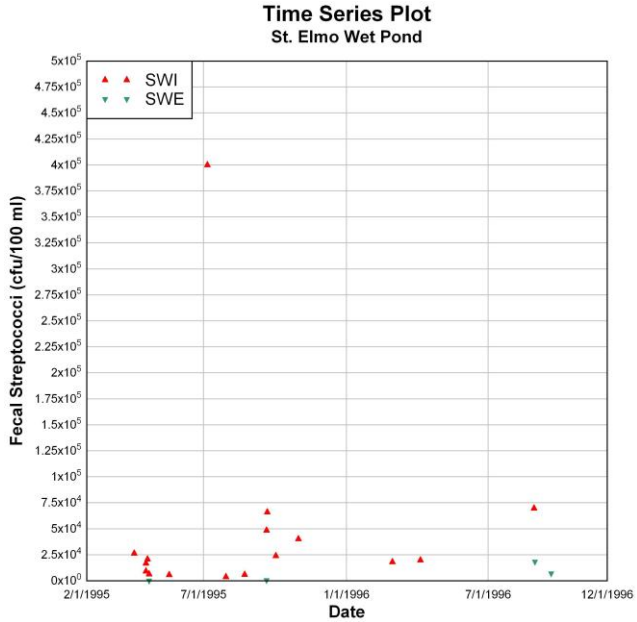


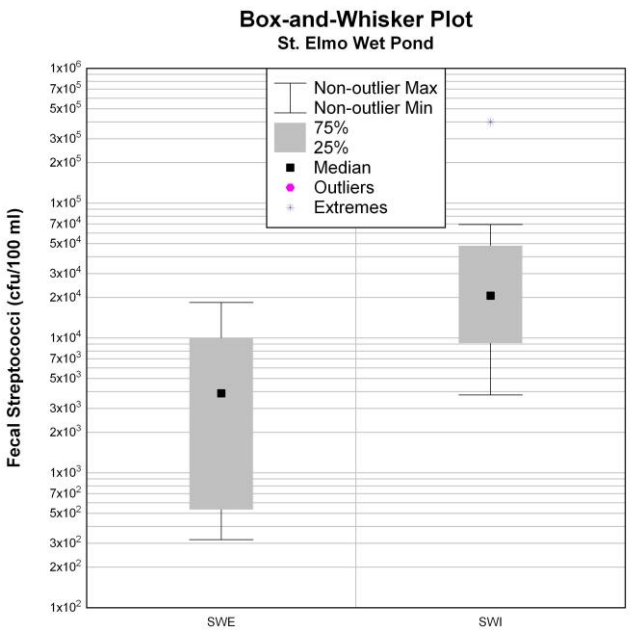
No Data Available

	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	17	4
	Pairs Count	0	0
Non-Parametric	Maximum	266,184	4,918
	Upper Quartile	36,000	3,010
	Median	9,297	760
	Lower Quartile	1,543	384
	Minimum	100	351
	Efficiency	91.82%	
	Mann-Whitney	0.0961 *	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	75,504	5,156
	Mean	38,348	1,697
	LCL	1,193	-1,761
	Std. Dev.	72,262	2,174
	Wilk (p-value)	0.0001 **	0.0356 **
	Efficiency	95.57%	
	t-Test (equal var.)	0.3325	
	t-Test (unequal var.)	0.0531 *	
	t-test (paired)	NA	
	Levene Test	0.4582	
Log Transformed	UCL	399,519	23,270
	Mean	50,175	1,555
	LCL	6,301	104
	Std. Dev.	183,174	1,710
	Wilk (p-value)	0.9605	0.3771
	Efficiency	96.90%	
	t-Test (equal var.)	0.0964 *	
	t-Test (unequal var.)	0.0371 **	
	t-Test (paired)	NA	
	Levene Test	0.2196	
Bootstrap	UCL	72,204	4,225
	Mean	38,338	1,670
	LCL	4,472	-885
	Std. Dev.	65,867	1,606
	Efficiency	95.64%	

St. Elmo Wet Pond - Fecal Streptococci (cfu/100 ml)



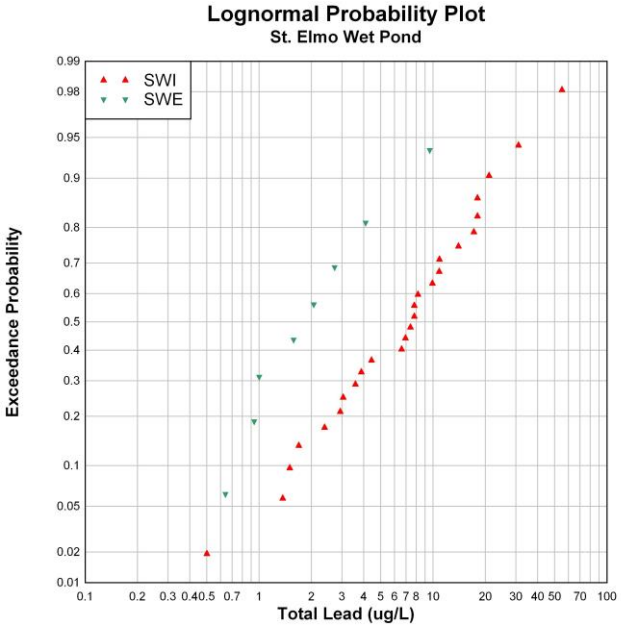


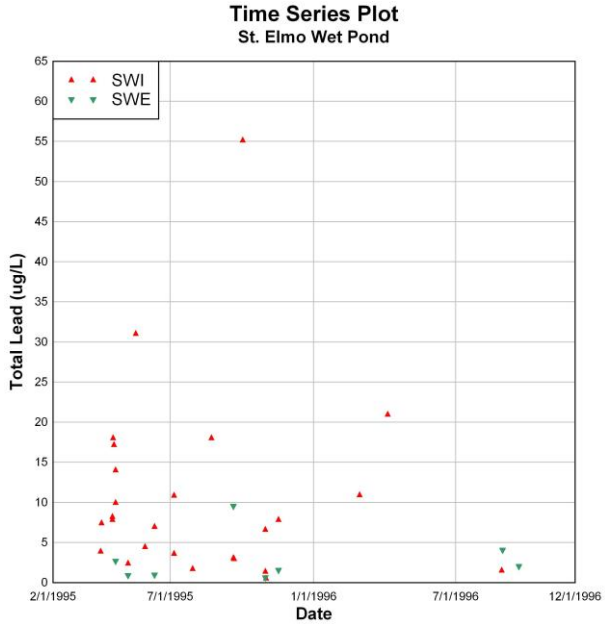


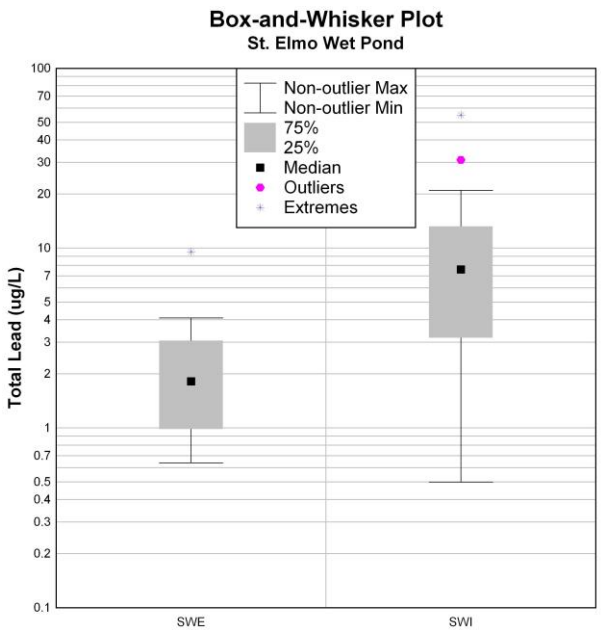
No Data Available

	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	17	4
	Pairs Count	0	0
Non-Parametric	Maximum	400,000	18,364
	Upper Quartile	48,404	12,776
	Median	20,642	3,897
	Lower Quartile	9,175	463
	Minimum	3,789	320
	Efficiency	81.12%	
	Mann-Whitney	0.0575 *	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	134,221	20,060
	Mean	69,424	6,619
	LCL	4,626	-6,821
	Std. Dev.	126,023	8,448
	Wilk (p-value)	0.0001 **	0.2284
	Efficiency	90.47%	
	t-Test (equal var.)	0.3409	
	t-Test (unequal var.)	0.0581 *	
	t-test (paired)	NA	
	Levene Test	0.4213	
Log Transformed	UCL	153,112	2,283,708
	Mean	57,861	7,067
	LCL	21,865	22
	Std. Dev.	98,605	11,159
	Wilk (p-value)	0.1708	0.4538
	Efficiency	87.79%	
	t-Test (equal var.)	0.0074 **	
	t-Test (unequal var.)	0.0817 *	
	t-Test (paired)	NA	
	Levene Test	0.4002	
Bootstrap	UCL	128,715	16,999
	Mean	69,633	6,507
	LCL	10,550	-3,986
	Std. Dev.	114,912	6,594
	Efficiency	90.66%	

St. Elmo Wet Pond - Total Lead (ug/L)



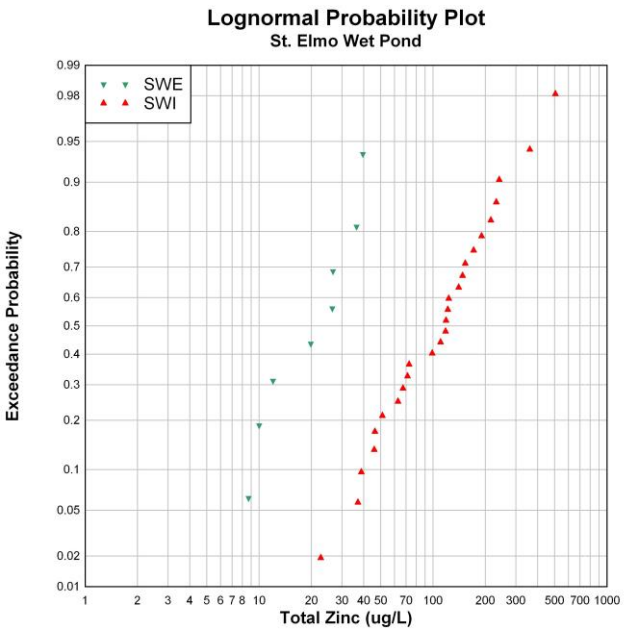


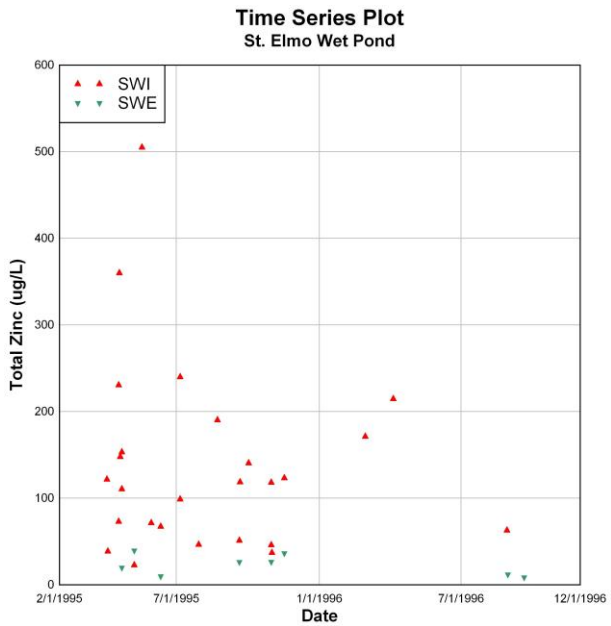


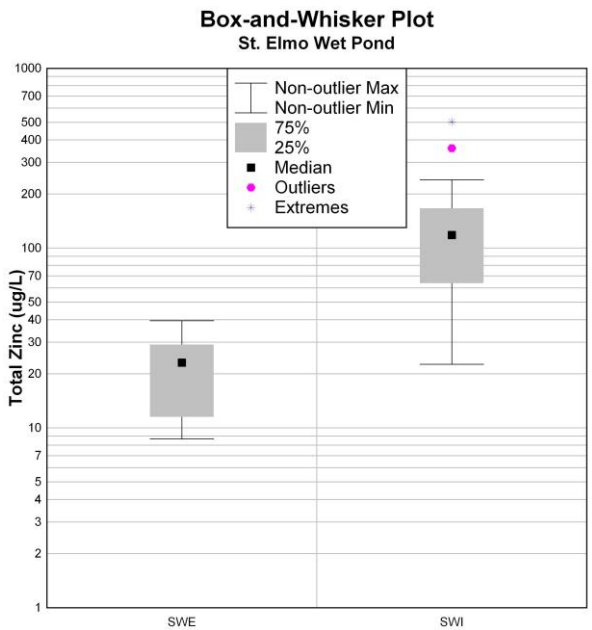
Analysis Plot Removed

		PARAMETER	Lead (µg/L)
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	55.1	9.6
	Upper Quartile	14.0	3.4
	Median	7.6	1.8
	Lower Quartile	3.0	1.0
	Minimum	0.5	0.6
	Efficiency	76.09%	
	Mann-Whitney	0.0146 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	15.3	5.3
	Mean	10.6	2.8
	LCL	5.9	0.4
	Std. Dev.	11.7	3.0
	Wilk (p-value)	0.0001 **	0.0068 **
	Efficiency	73.39%	
	t-Test (equal var.)	0.0732 *	
	t-Test (unequal var.)	0.0041 **	
	t-test (paired)	NA	
	Levene Test	0.3791	
Log Transformed	UCL	19.3	6.6
	Mean	11.1	2.7
	LCL	6.4	1.1
	Std. Dev.	14.6	2.5
	Wilk (p-value)	0.9627	0.8348
	Efficiency	75.71%	
	t-Test (equal var.)	0.0072 **	
	t-Test (unequal var.)	0.0066 **	
	t-Test (paired)	NA	
	Levene Test	0.4643	
Bootstrap	UCL	15.0	4.9
	Mean	10.6	2.8
	LCL	6.2	0.7
	Std. Dev.	10.9	2.5
	Efficiency	73.36%	

St. Elmo Wet Pond - Total Zinc (ug/L)



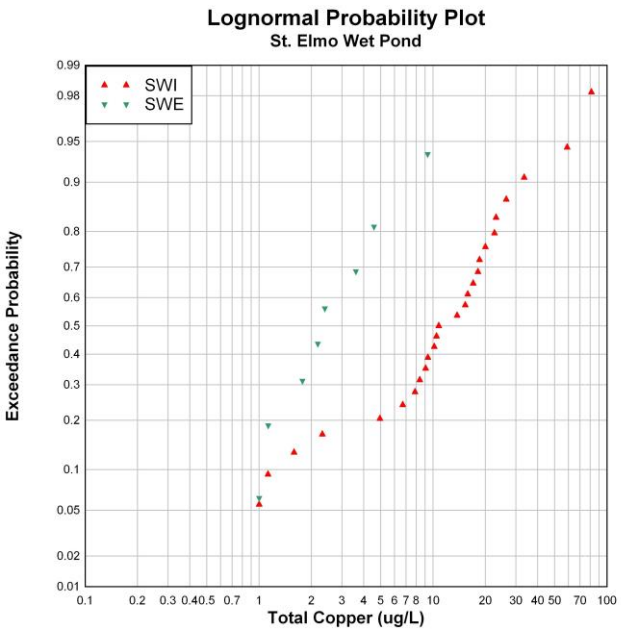


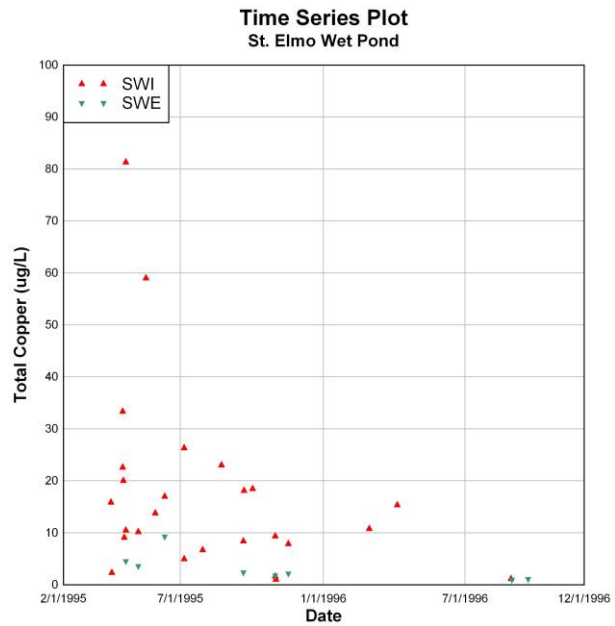


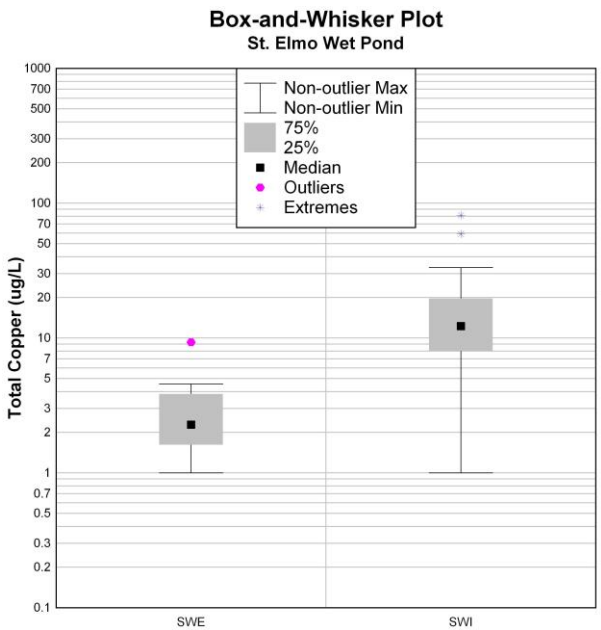
Analysis Plot Removed

	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	505.0	39.5
	Upper Quartile	171.0	31.5
	Median	118.3	23.1
	Lower Quartile	62.8	11.0
	Minimum	22.6	8.7
	Efficiency	80.49%	
	Mann-Whitney	0.0004 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	180.6	32.3
	Mean	136.8	22.4
	LCL	93.1	12.5
	Std. Dev.	108.4	11.8
	Wilk (p-value)	0.0004 **	0.3970
	Efficiency	83.62%	
	t-Test (equal var.)	0.0059 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	NA	
	Levene Test	0.2578	
Log Transformed	UCL	193.2	38.6
	Mean	137.3	22.6
	LCL	97.5	13.2
	Std. Dev.	112.7	13.5
	Wilk (p-value)	0.9812	0.3549
	Efficiency	83.53%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	NA	
	Levene Test	0.3492	
Bootstrap	UCL	179.9	31.2
	Mean	137.7	22.1
	LCL	95.6	13.1
	Std. Dev.	104.3	10.8
	Efficiency	83.93%	

St. Elmo Wet Pond - Total Copper (ug/L)



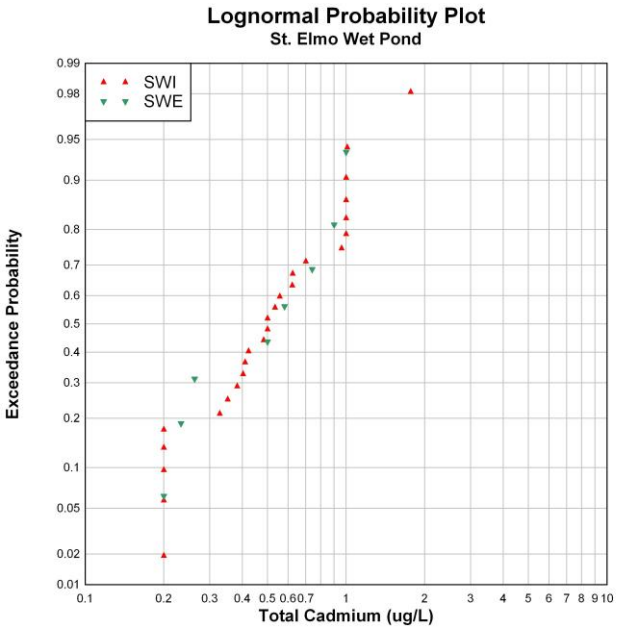


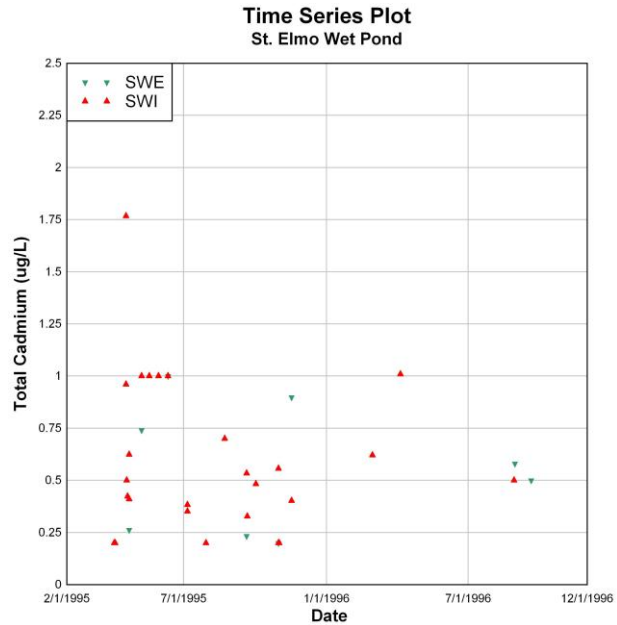


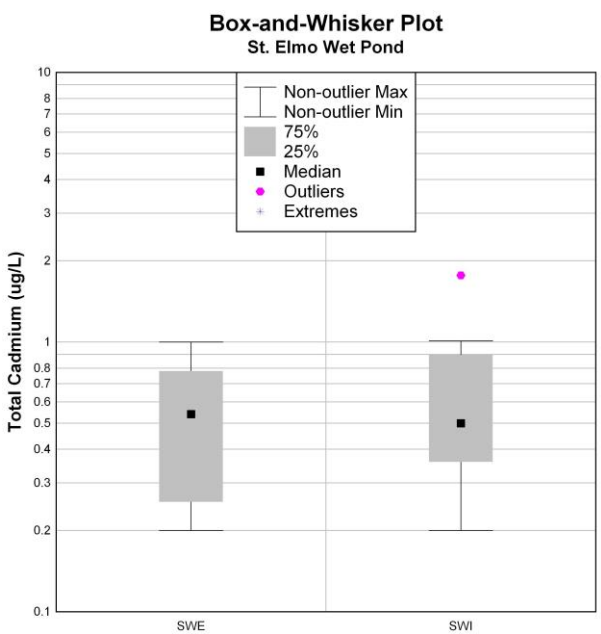
Analysis Plot Removed

	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	81.3	9.3
	Upper Quartile	20.0	4.1
	Median	12.3	2.3
	Lower Quartile	7.9	1.5
	Minimum	1.0	1.0
	Efficiency	81.40%	
	Mann-Whitney	0.0050 **	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	24.4	5.5
	Mean	17.2	3.2
	LCL	10.0	1.0
	Std. Dev.	17.9	2.7
	Wilk (p-value)	0.0001 **	0.0262 **
	Efficiency	81.16%	
	t-Test (equal var.)	0.0365 **	
	t-Test (unequal var.)	0.0006 **	
	t-test (paired)	NA	
	Levene Test	0.3282	
Log Transformed	UCL	32.8	6.5
	Mean	18.8	3.2
	LCL	10.8	1.6
	Std. Dev.	25.1	2.4
	Wilk (p-value)	0.1154	0.8315
	Efficiency	83.12%	
	t-Test (equal var.)	0.0013 **	
	t-Test (unequal var.)	0.0005 **	
	t-Test (paired)	NA	
	Levene Test	0.2975	
Bootstrap	UCL	24.1	5.2
	Mean	17.3	3.2
	LCL	10.5	1.2
	Std. Dev.	16.9	2.4
	Efficiency	81.27%	

St. Elmo Wet Pond - Total Cadmium (ug/L)







Analysis Plot Removed

	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: SWI**	**EFF: SWE**
	Site Count	26	8
	Pairs Count	1	1
Non-Parametric	Maximum	1.8	1.0
	Upper Quartile	1.0	0.8
	Median	0.5	0.5
	Lower Quartile	0.4	0.2
	Minimum	0.2	0.2
	Efficiency	-8.05%	
	Mann-Whitney	0.9678	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	0.7	0.8
	Mean	0.6	0.6
	LCL	0.4	0.3
	Std. Dev.	0.4	0.3
	Wilk (p-value)	0.0021 **	0.3937
	Efficiency	7.72%	
	t-Test (equal var.)	0.7522	
	t-Test (unequal var.)	0.7306	
	t-test (paired)	NA	
	Levene Test	0.6094	
Log Transformed	UCL	0.8	1.0
	Mean	0.6	0.6
	LCL	0.5	0.3
	Std. Dev.	0.4	0.4
	Wilk (p-value)	0.1109	0.2978
	Efficiency	7.02%	
	t-Test (equal var.)	0.7917	
	t-Test (unequal var.)	0.7986	
	t-Test (paired)	NA	
	Levene Test	0.9559	
Bootstrap	UCL	0.7	0.8
	Mean	0.6	0.6
	LCL	0.5	0.3
	Std. Dev.	0.4	0.3
	Efficiency	7.67%	

Central Market Wet Pond (CMI-CME)

This report summarizes water quality performance of the wet pond by comparing influent station (CMI) to the effluent station (CME). See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed.

Monitoring began in 1996, but was halted for two years (1997-1998) due to new hospital construction. Even though main inflow at CMI was measured in a 42” inch diameter storm sewer pipe, other influents were not monitored. This SCM has gone through different stages of retrofit since its construction.

Wetland plants serve as a natural filter for the nutrients and other pollutants found in urban stormwater runoff. Additionally, the pond provides habitat for a variety of birds and animals that many people find appealing. Central Park Wet Pond is a joint public/private enterprise between the State of Texas and City of Austin.

The City collected runoff and water quality from April 1997 to November 2001. Unpaired influent and effluent EMCs totaled 24 and 32, respectively. There were 22 paired EMCs available for analysis.

Performance Summary

Solids measured by TSS and VSS were both found to be highly significant in all cases, paired and unpaired, with 86.8% and 87.9% removal efficiencies reported, respectively. TDS analysis was invalidated since there were only four unpaired EMCs for the influent.

Oxygen demand parameter COD was highly significant in all cases, paired and unpaired, with 67.2% removal efficiency. Analysis of TOC indicated a highly significant difference only for the unpaired arithmetic case with 54.3% removal efficiency. Parameter BOD was also highly significant only for unpaired data. BOD was highly significant in all unpaired cases with removal efficiency of 75.3%.

Nutrient parameters TN, NO2+NO3, TKN, NH3 and TP were highly significant in all cases, paired and unpaired. Analysis for nutrient DP was not significant in any case, paired or unpaired. The best performing nutrient was NO2+NO3 with 78.1% removal efficiency. Decreasing performance following NO2+NO3 was reported for NH3 with 59.9%, TN with 58.2%, TKN with 54.7% and finally TP with 43.4%.

The number of influent EMCs available for bacteria analysis was less than half of other parameters. Bacteria removal as demonstrated by F. Strep. was highly significant in all cases, paired and unpaired, with 74.5% efficiency. F. coliform was highly significant in all unpaired cases and the log-transformed case for paired analysis having 82.5% removal efficiency. Other cases of paired F. Coliform analysis were merely significant.

Metals PB, ZN, and CU demonstrated highly significant removal efficiencies in all cases, paired and unpaired. In order of decreasing efficiency PB had 88.1% removal followed by CU with 81.5% and ZN with 73.6%. Analysis of EMCs for CD at both the influent and effluent was affected by detection limits and should be invalidated

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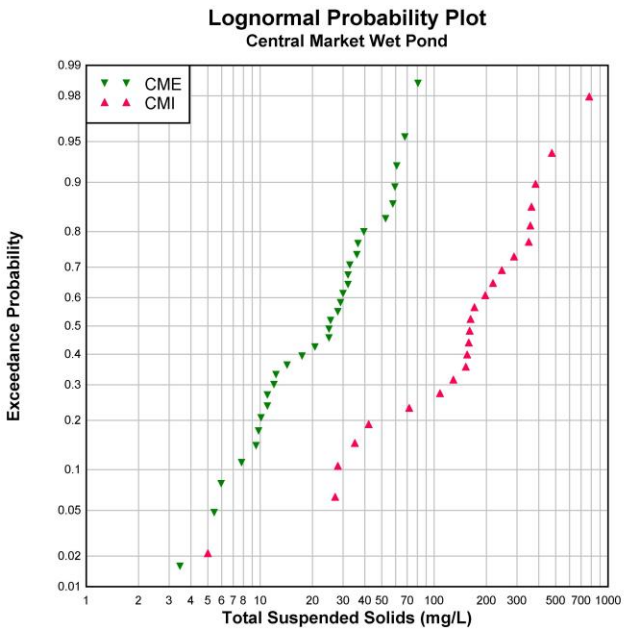
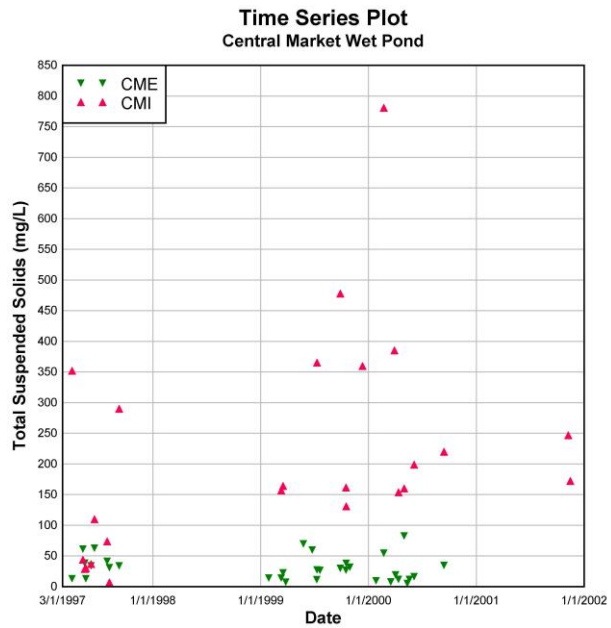
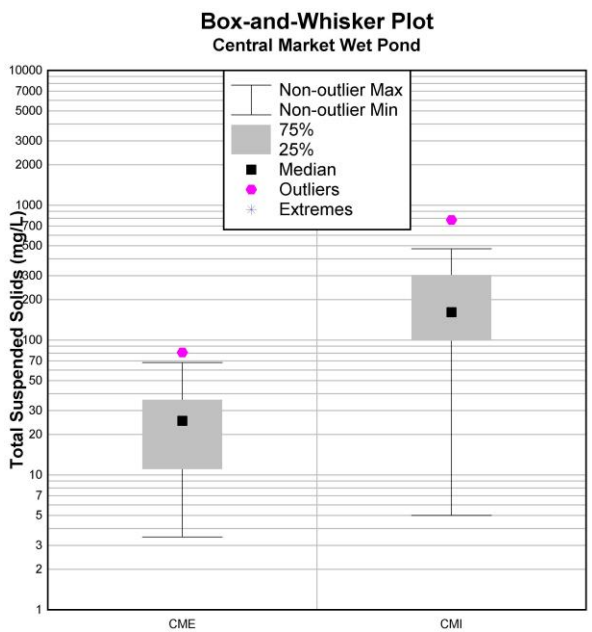
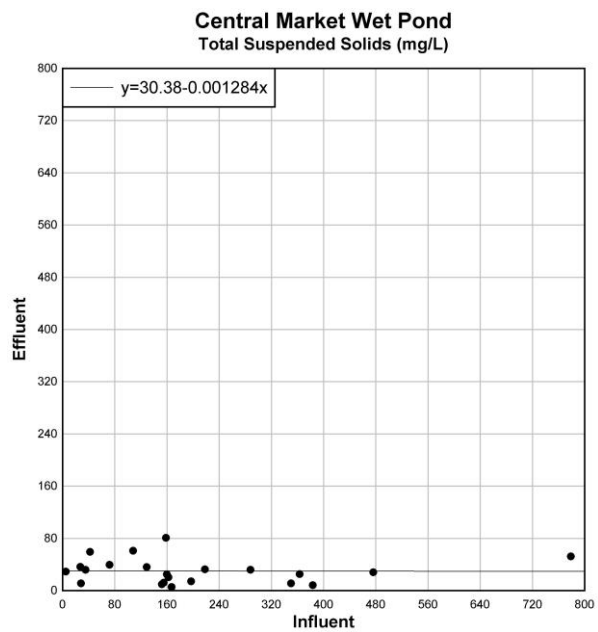
Central Market Wet Pond - Total Suspended Solids (mg/L)



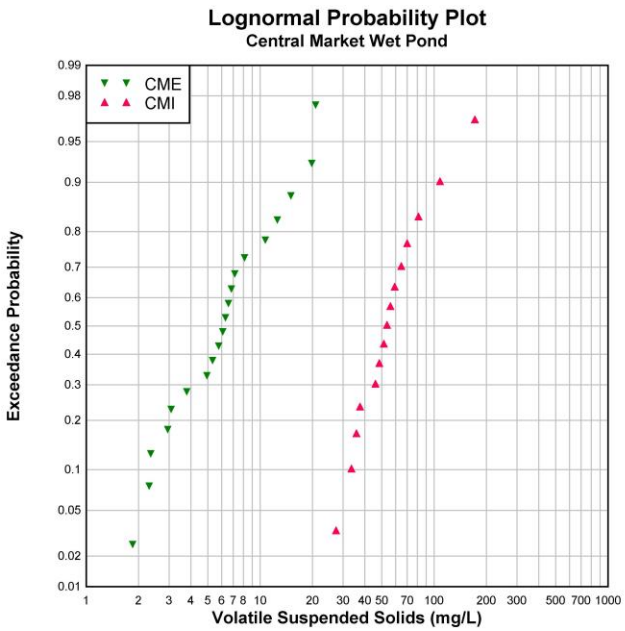


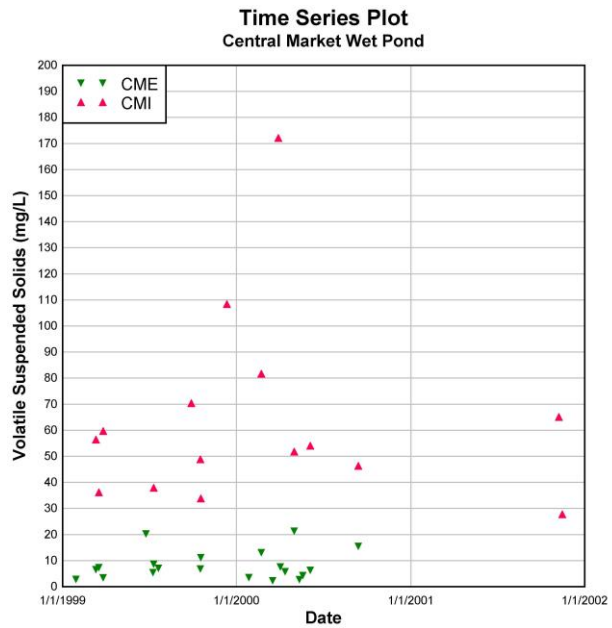


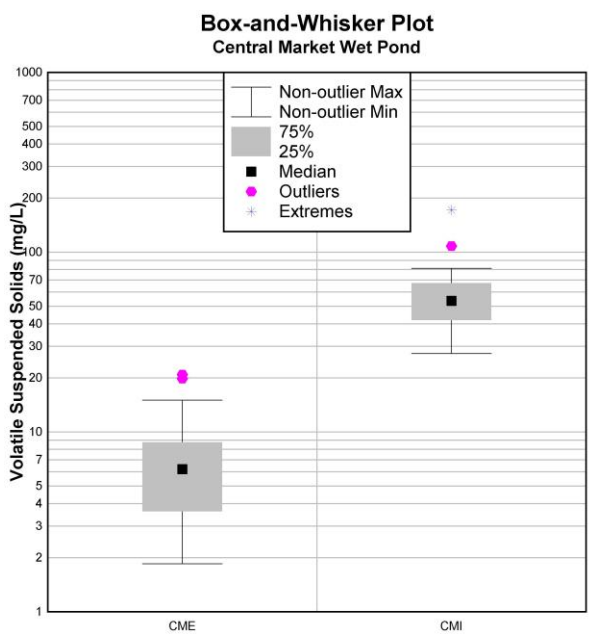


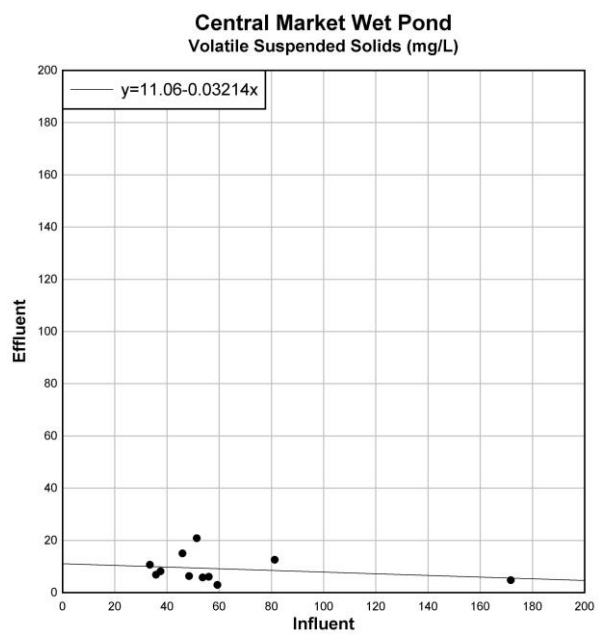
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	24	32
	Pairs Count	22	22
Non-Parametric	Maximum	778.8	80.9
	Upper Quartile	319.0	36.2
	Median	161.1	25.1
	Lower Quartile	90.0	11.0
	Minimum	5.0	3.5
	Efficiency	84.39%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	285.4	35.5
	Mean	210.9	28.2
	LCL	136.4	20.9
	Std. Dev.	176.4	20.3
	Wilk (p-value)	0.0050 **	0.0068 **
	Efficiency	86.64%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0002 **	
	Levene Test	0.0126 **	
Log Transformed	UCL	464.0	40.7
	Mean	249.7	29.1
	LCL	134.4	20.8
	Std. Dev.	350.6	26.6
	Wilk (p-value)	0.0294 **	0.3911
	Efficiency	88.35%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1627	
Bootstrap	UCL	285.0	35.4
	Mean	213.8	28.2
	LCL	142.7	21.0
	Std. Dev.	168.6	19.9
	Efficiency	86.81%	

Central Market Wet Pond - Volatile Suspended Solids (mg/L)



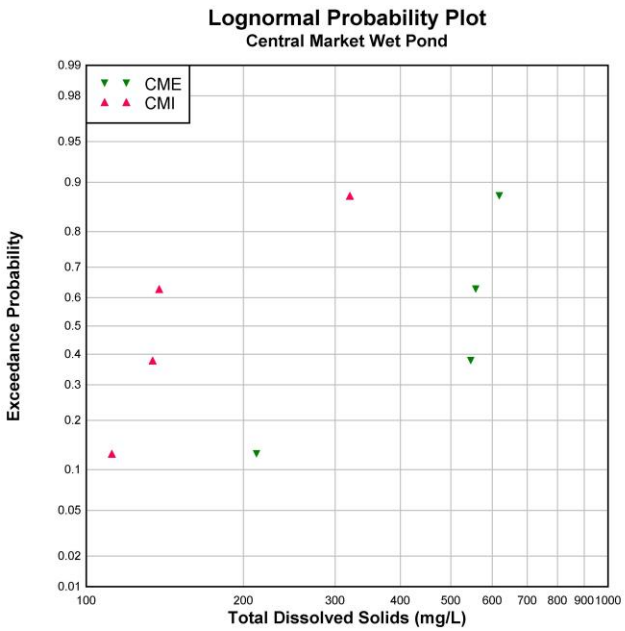


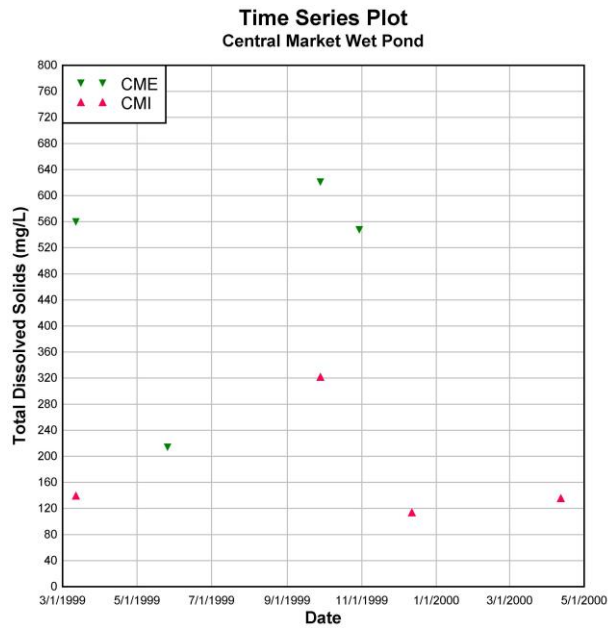


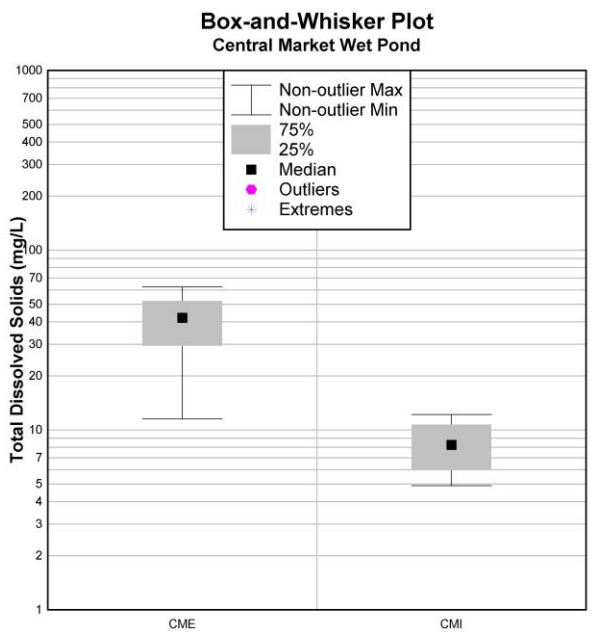


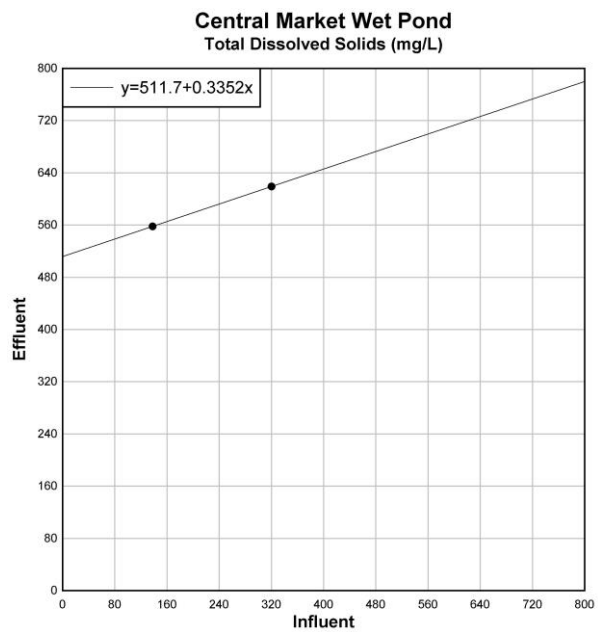
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	15	20
	Pairs Count	11	11
Non-Parametric	Maximum	171.7	20.8
	Upper Quartile	70.0	9.4
	Median	53.7	6.2
	Lower Quartile	37.5	3.4
	Minimum	27.3	1.8
	Efficiency	88.43%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	83.1	10.2
	Mean	63.0	7.6
	LCL	42.8	5.0
	Std. Dev.	36.4	5.5
	Wilk (p-value)	0.0020 **	0.0038 **
	Efficiency	87.90%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0016 **	
	Levene Test	0.0779 *	
Log Transformed	UCL	81.9	11.0
	Mean	62.2	7.6
	LCL	47.2	5.3
	Std. Dev.	30.2	5.7
	Wilk (p-value)	0.6136	0.6668
	Efficiency	87.76%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1104	
Bootstrap	UCL	81.1	10.0
	Mean	62.8	7.6
	LCL	44.5	5.1
	Std. Dev.	33.0	5.2
	Efficiency	87.92%	

Central Market Wet Pond - Total Dissolved Solids (mg/L)



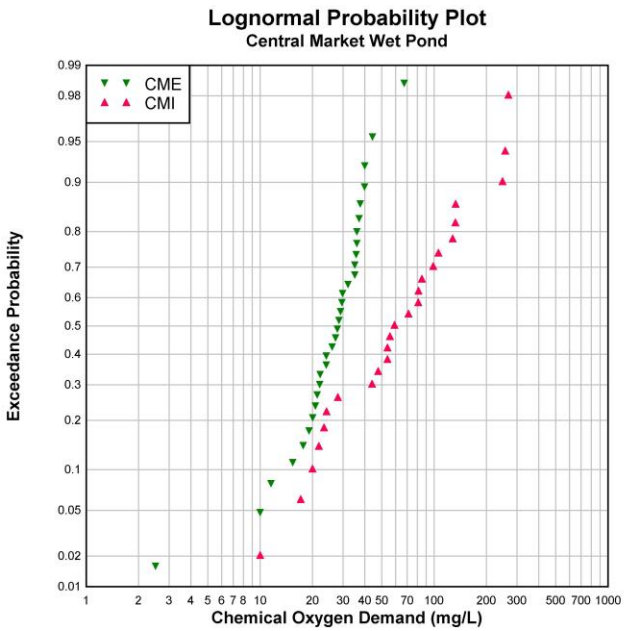


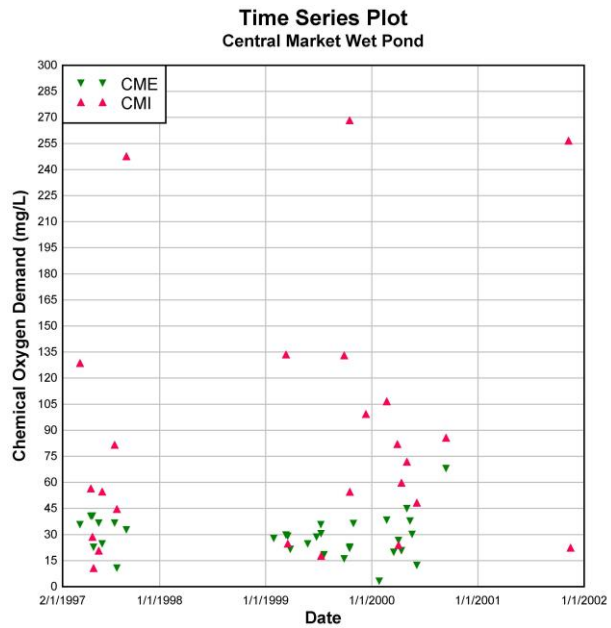


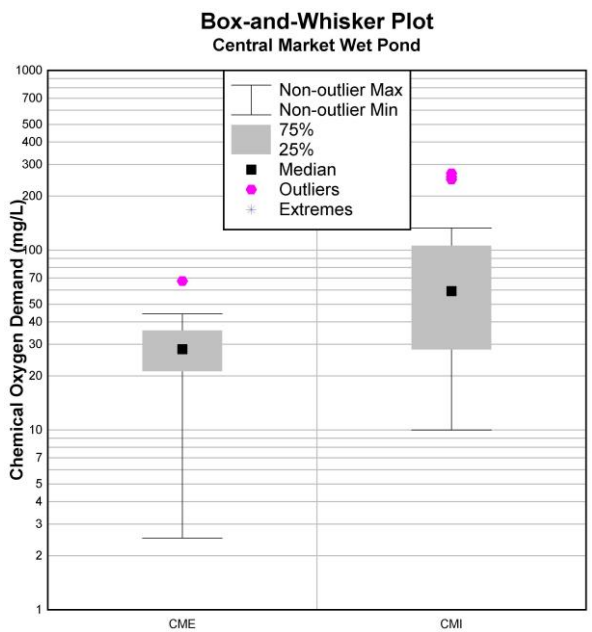


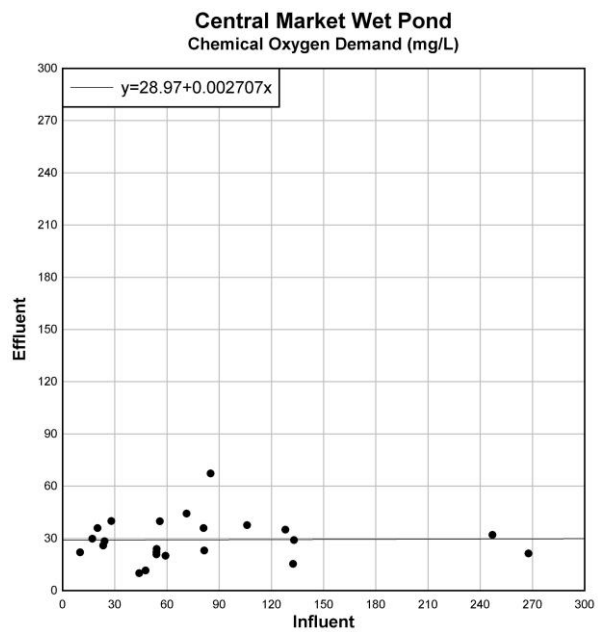
	PARAMETER	TDS (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	4	4
	Pairs Count	2	2
Non-Parametric	Maximum	320.00	619.00
	Upper Quartile	229.00	588.50
	Median	136.00	552.00
	Lower Quartile	123.00	379.00
	Minimum	112.00	212.00
	Efficiency	-305.88%	
	Mann-Whitney	0.1027	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	329.81	776.44
	Mean	176.00	483.75
	LCL	22.19	191.06
	Std. Dev.	96.68	183.96
	Wilk (p-value)	0.0280 **	0.0732 *
	Efficiency	-174.86%	
	t-Test (equal var.)	0.0252 **	
	t-Test (unequal var.)	0.0354 **	
	t-test (paired)	0.1061	
	Levene Test	0.3241	
Log Transformed	UCL	387.24	1159.22
	Mean	174.04	490.38
	LCL	78.22	207.44
	Std. Dev.	80.38	241.01
	Wilk (p-value)	0.0992 *	0.0238 **
	Efficiency	-181.76%	
	t-Test (equal var.)	0.0244 **	
	t-Test (unequal var.)	0.0245 **	
	t-Test (paired)	0.2191	
	Levene Test	0.8942	
Bootstrap	UCL	299.42	707.10
	Mean	179.85	476.40
	LCL	60.28	245.69
	Std. Dev.	75.14	144.98
	Efficiency	-164.89%	

Central Market Wet Pond - Chemical Oxygen Demand (mg/L)



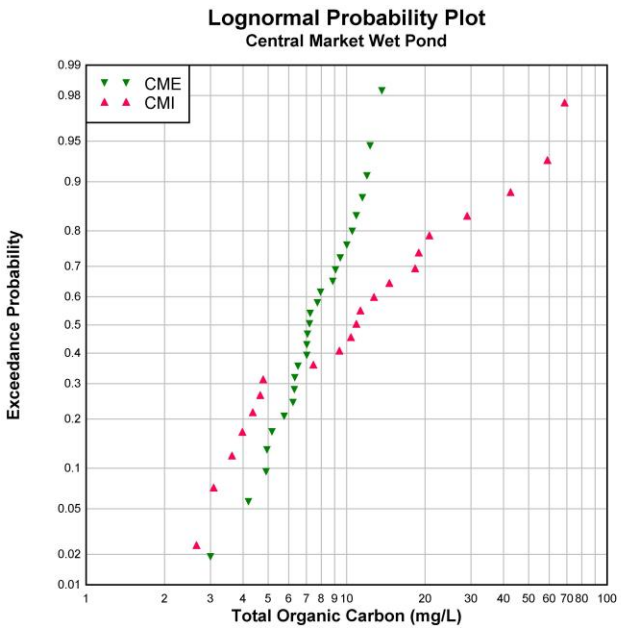


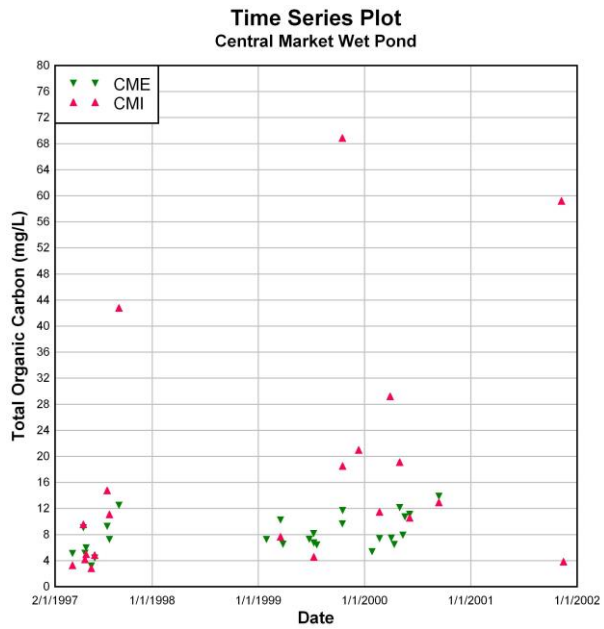


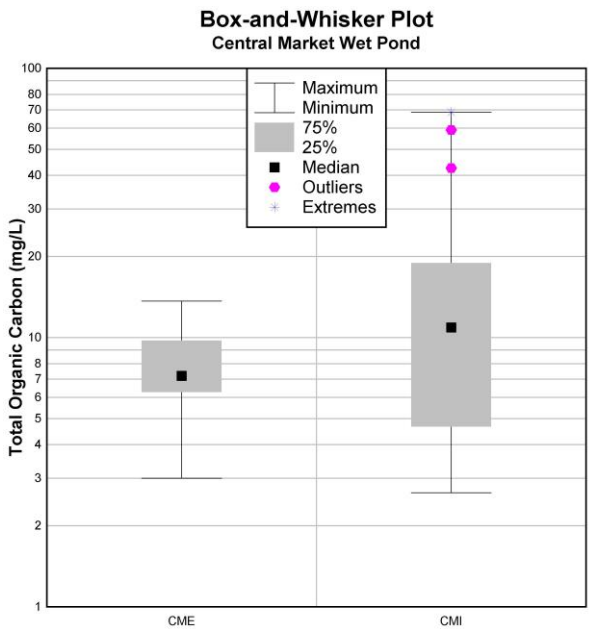


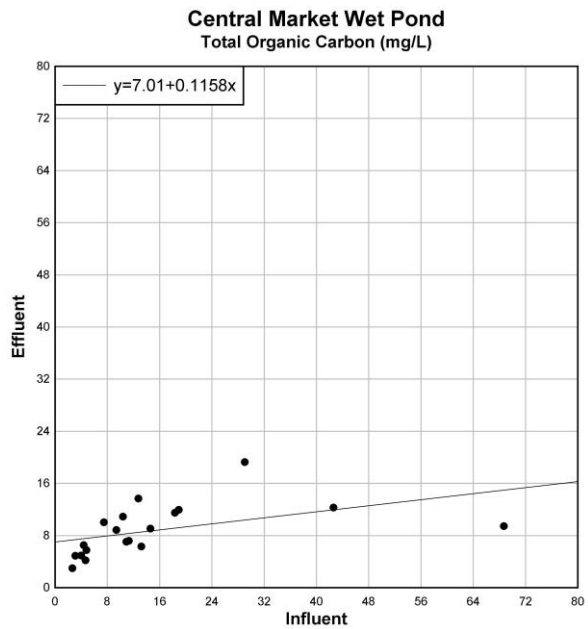
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	25	32
	Pairs Count	23	23
Non-Parametric	Maximum	267.73	67.38
	Upper Quartile	105.96	35.85
	Median	59.10	28.11
	Lower Quartile	28.00	21.04
	Minimum	10.00	2.50
	Efficiency	52.43%	
	Mann-Whitney	0.0005 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	116.45	32.56
	Mean	85.85	28.25
	LCL	55.25	23.93
	Std. Dev.	74.12	11.96
	Wilk (p-value)	0.0004 **	0.1207
	Efficiency	67.10%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0007 **	
	t-test (paired)	0.0019 **	
	Levene Test	0.0027 **	
Log Transformed	UCL	134.62	36.80
	Mean	87.54	29.43
	LCL	56.92	23.54
	Std. Dev.	87.97	17.94
	Wilk (p-value)	0.6564	0.0001 **
	Efficiency	66.38%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0005 **	
	Levene Test	0.0859 *	
Bootstrap	UCL	115.98	32.51
	Mean	86.24	28.26
	LCL	56.50	24.02
	Std. Dev.	72.05	11.78
	Efficiency	67.23%	

Central Market Wet Pond - Total Organic Carbon (mg/L)



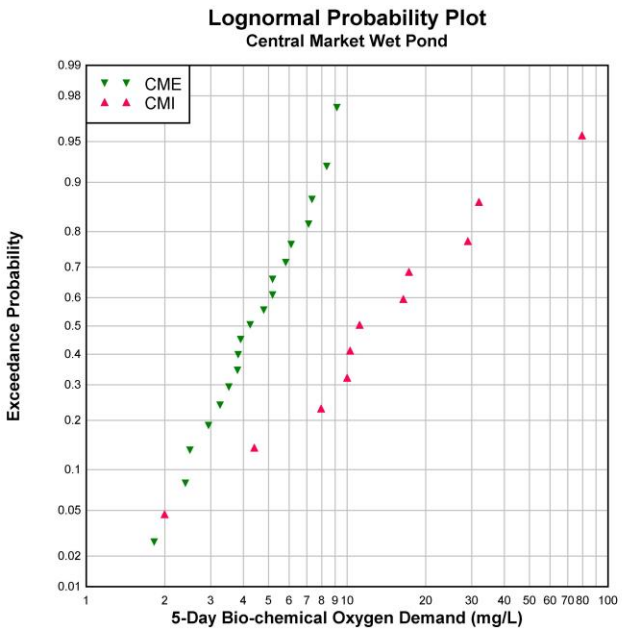


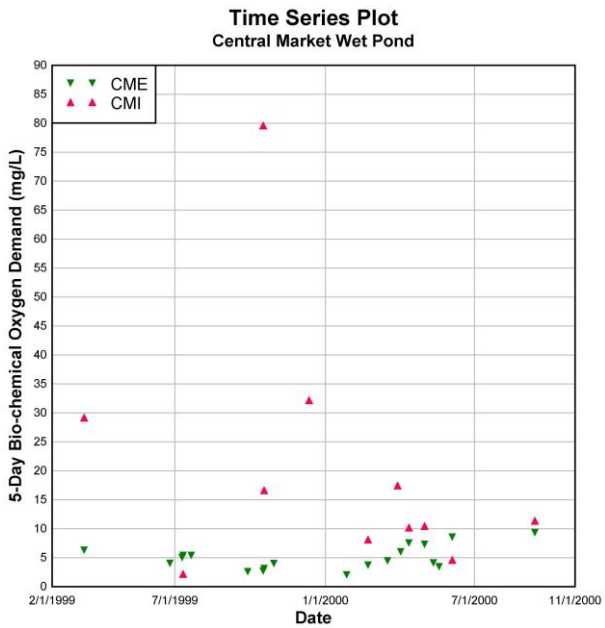


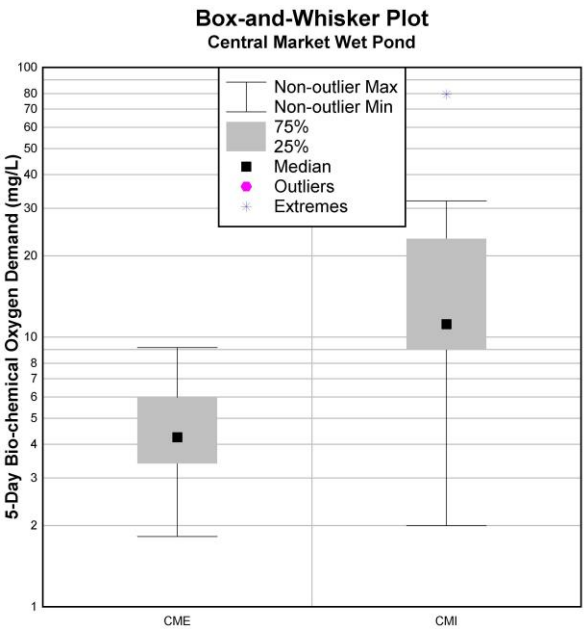


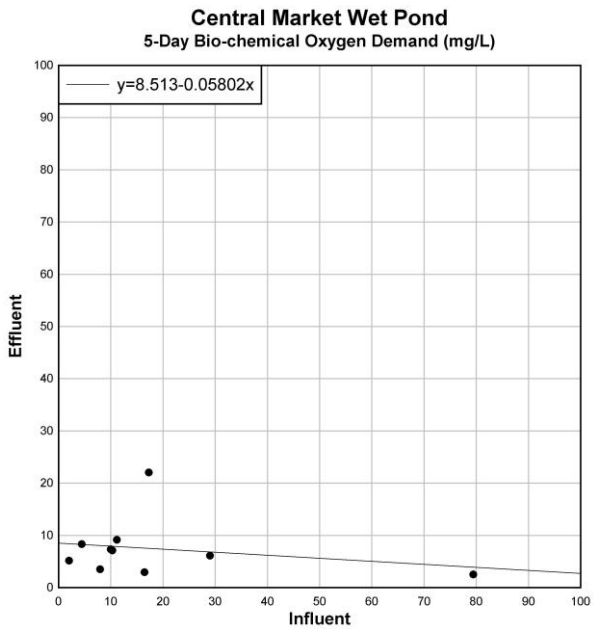
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	21	27
	Pairs Count	19	19
Non-Parametric	Maximum	68.69	13.67
	Upper Quartile	18.92	10.02
	Median	10.90	7.20
	Lower Quartile	4.66	6.23
	Minimum	2.65	3.00
	Efficiency	33.94%	
	Mann-Whitney	0.1703	
	Wilcoxon (paired)	0.0663 *	
Arithmetic	UCL	25.57	8.95
	Mean	17.20	7.88
	LCL	8.84	6.82
	Std. Dev.	18.37	2.68
	Wilk (p-value)	0.0001 **	0.5819
	Efficiency	54.18%	
	t-Test (equal var.)	0.0122 **	
	t-Test (unequal var.)	0.0316 **	
	t-test (paired)	0.0700 *	
	Levene Test	0.0160 **	
Log Transformed	UCL	28.66	9.15
	Mean	16.84	7.90
	LCL	9.90	6.83
	Std. Dev.	18.63	2.89
	Wilk (p-value)	0.4261	0.7486
	Efficiency	53.07%	
	t-Test (equal var.)	0.0580 *	
	t-Test (unequal var.)	0.0902 *	
	t-Test (paired)	0.0715 *	
	Levene Test	0.0003 **	
Bootstrap	UCL	25.22	8.93
	Mean	17.28	7.89
	LCL	9.35	6.85
	Std. Dev.	17.43	2.62
	Efficiency	54.34%	

Central Market Wet Pond - 5-Day Bio-chemical Oxygen Demand (mg/L)



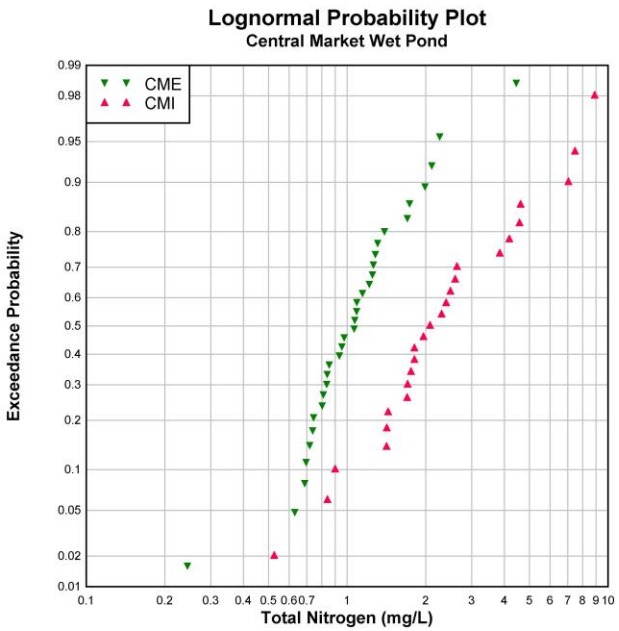


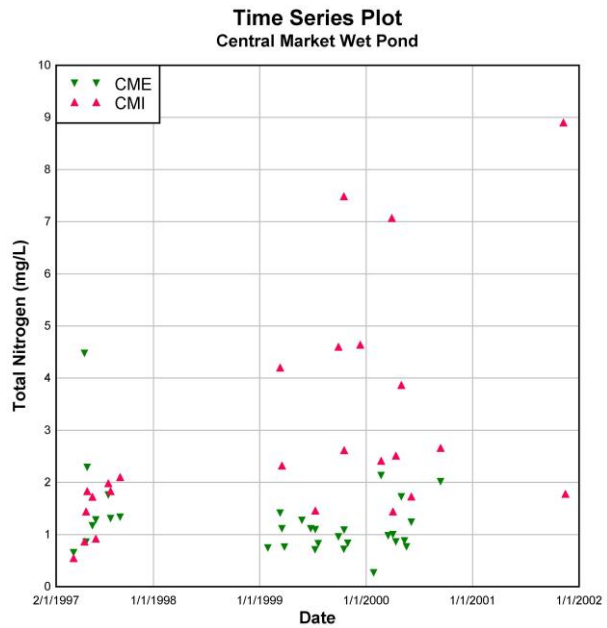


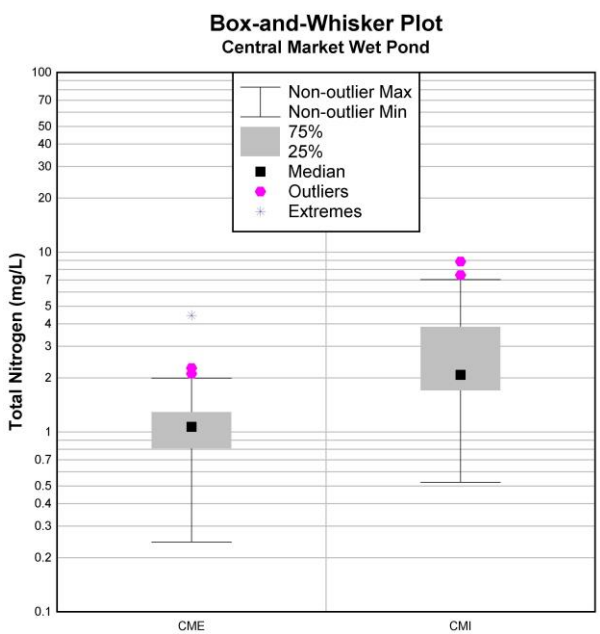


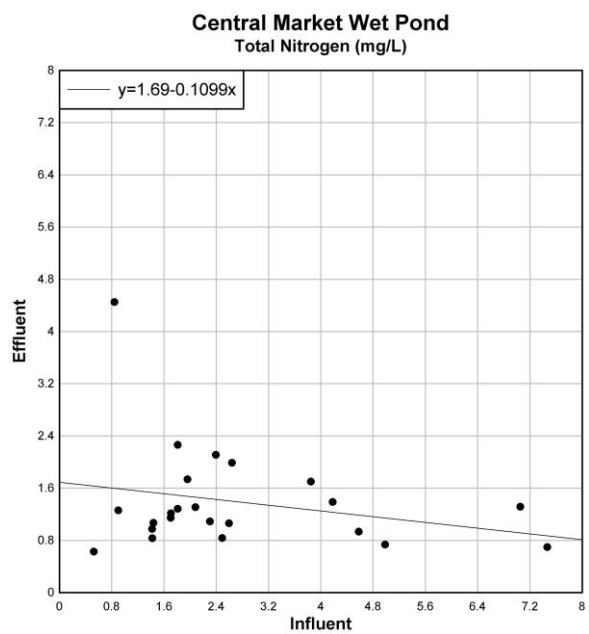
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	11	19
	Pairs Count	10	10
Non-Parametric	Maximum	79.42	9.15
	Upper Quartile	29.00	6.10
	Median	11.17	4.25
	Lower Quartile	7.94	3.26
	Minimum	2.00	1.82
	Efficiency	61.94%	
	Mann-Whitney	0.0031 **	
	Wilcoxon (paired)	0.2754	
Arithmetic	UCL	34.65	5.80
	Mean	19.99	4.80
	LCL	5.33	3.81
	Std. Dev.	21.82	2.07
	Wilk (p-value)	0.0010 **	0.3997
	Efficiency	75.97%	
	t-Test (equal var.)	0.0050 **	
	t-Test (unequal var.)	0.0438 **	
	t-test (paired)	0.1770	
	Levene Test	0.0771 *	
Log Transformed	UCL	45.96	6.02
	Mean	19.98	4.81
	LCL	8.69	3.85
	Std. Dev.	21.65	2.19
	Wilk (p-value)	0.9764	0.9705
	Efficiency	75.91%	
	t-Test (equal var.)	0.0003 **	
	t-Test (unequal var.)	0.0051 **	
	t-Test (paired)	0.1447	
	Levene Test	0.0230 **	
Bootstrap	UCL	32.19	5.81
	Mean	19.61	4.84
	LCL	7.03	3.87
	Std. Dev.	18.72	2.01
	Efficiency	75.33%	

Central Market Wet Pond - Total Nitrogen (mg/L)



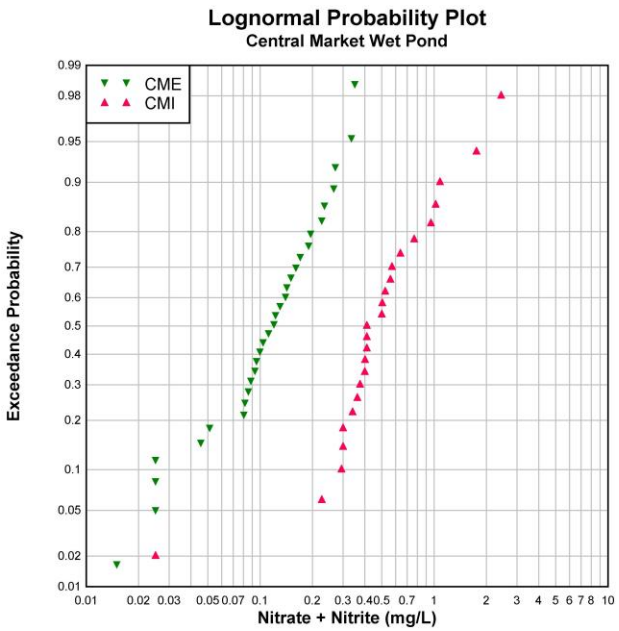


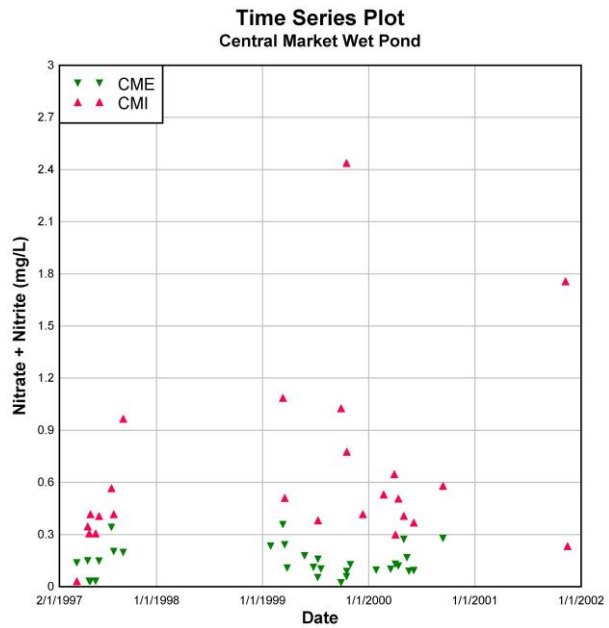


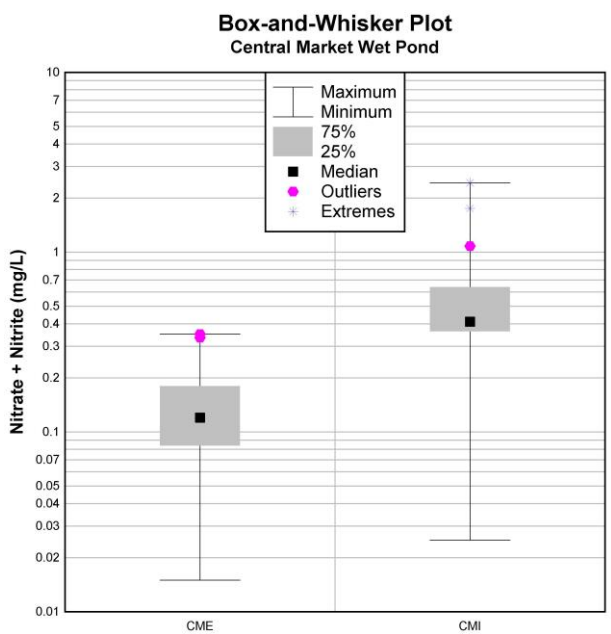


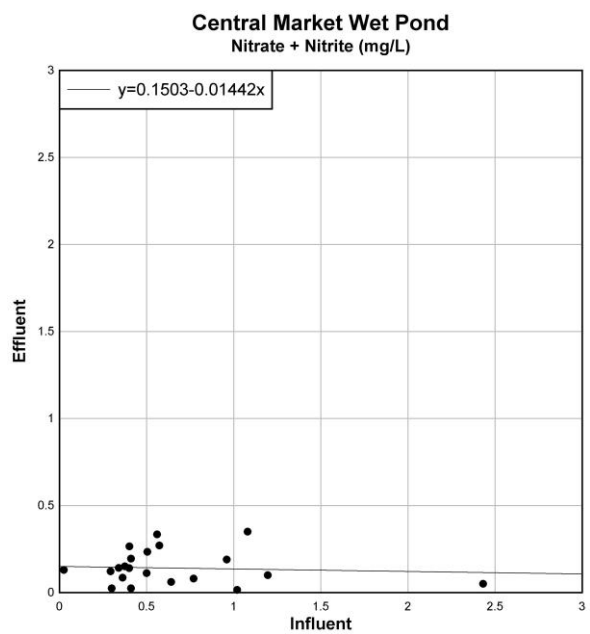
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	25	32
	Pairs Count	23	23
Non-Parametric	Maximum	8.882	4.453
	Upper Quartile	3.846	1.298
	Median	2.080	1.067
	Lower Quartile	1.700	0.806
	Minimum	0.525	0.244
	Efficiency	48.72%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0003 **	
Arithmetic	UCL	3.786	1.483
	Mean	2.896	1.215
	LCL	2.006	0.947
	Std. Dev.	2.157	0.743
	Wilk (p-value)	0.0004 **	0.0001 **
	Efficiency	58.04%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0008 **	
	t-test (paired)	0.0091 **	
	Levene Test	0.0113 **	
Log Transformed	UCL	3.950	1.461
	Mean	2.882	1.206
	LCL	2.102	0.996
	Std. Dev.	2.140	0.633
	Wilk (p-value)	0.6024	0.0526 *
	Efficiency	58.14%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0041 **	
	Levene Test	0.1687	
Bootstrap	UCL	3.778	1.472
	Mean	2.913	1.219
	LCL	2.049	0.966
	Std. Dev.	2.095	0.702
	Efficiency	58.16%	

Central Market Wet Pond - Nitrate + Nitrite (mg/L)



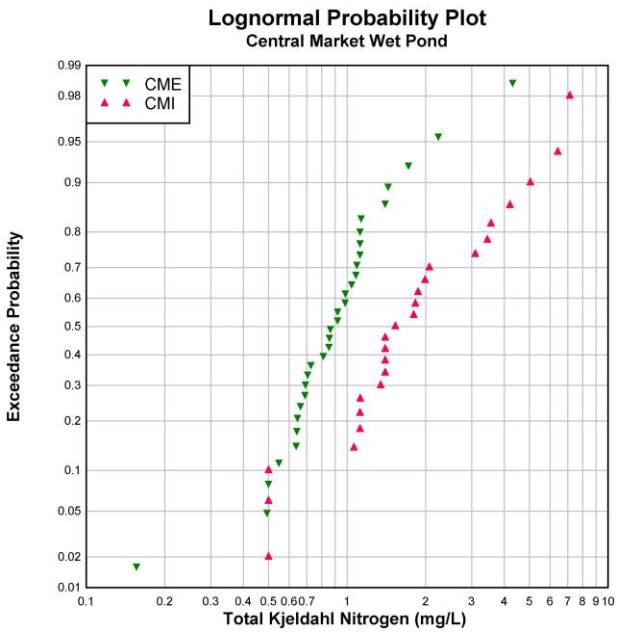


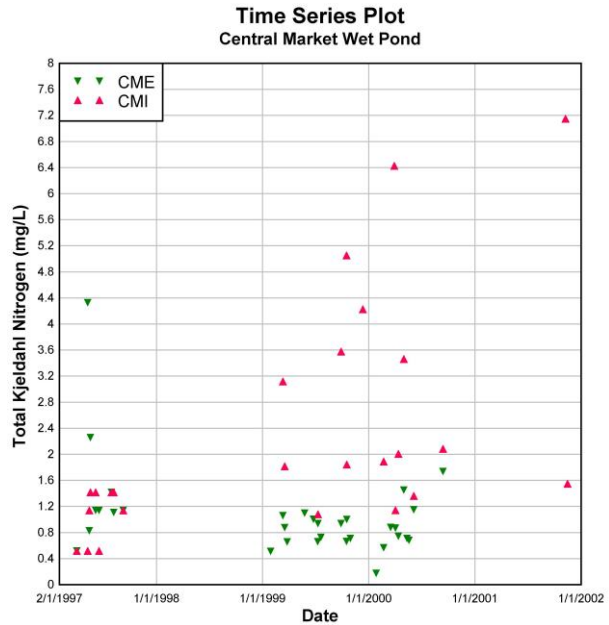


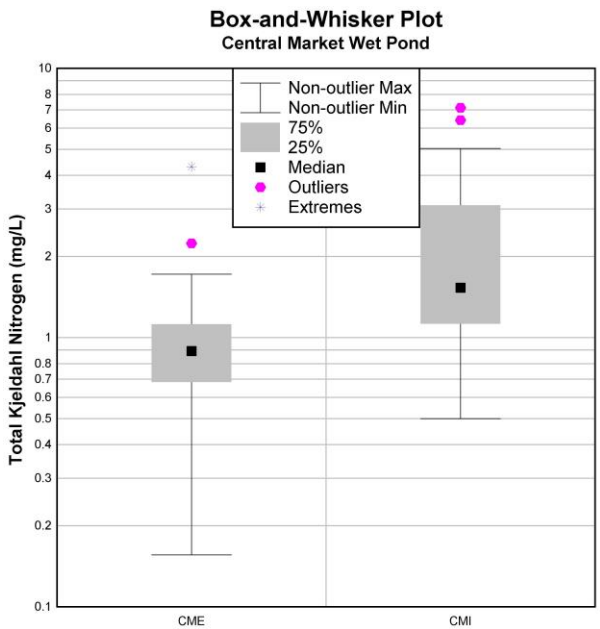


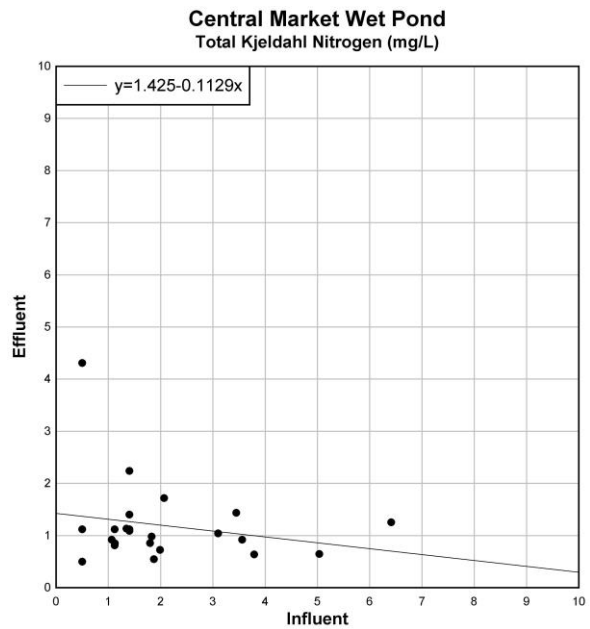
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	25	31
	Pairs Count	22	22
Non-Parametric	Maximum	2.431	0.350
	Upper Quartile	0.640	0.190
	Median	0.410	0.120
	Lower Quartile	0.362	0.082
	Minimum	0.025	0.015
	Efficiency	70.73%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.835	0.169
	Mean	0.623	0.136
	LCL	0.410	0.104
	Std. Dev.	0.515	0.088
	Wilk (p-value)	0.0001 **	0.0501 *
	Efficiency	78.08%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0002 **	
	Levene Test	0.0465 **	
Log Transformed	UCL	0.984	0.201
	Mean	0.657	0.144
	LCL	0.439	0.103
	Std. Dev.	0.619	0.128
	Wilk (p-value)	0.0015 **	0.0505 *
	Efficiency	78.12%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.8563	
Bootstrap	UCL	0.826	0.168
	Mean	0.624	0.136
	LCL	0.422	0.105
	Std. Dev.	0.490	0.085
	Efficiency	78.12%	

Central Market Wet Pond - Total Kjeldahl Nitrogen (mg/L)



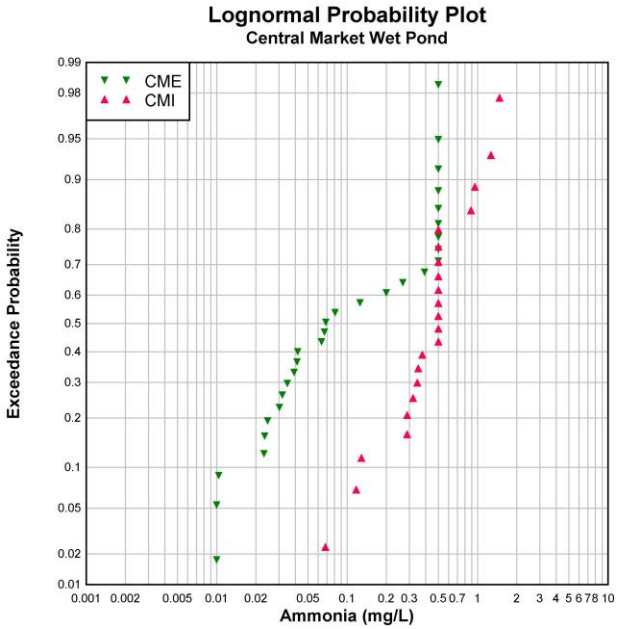


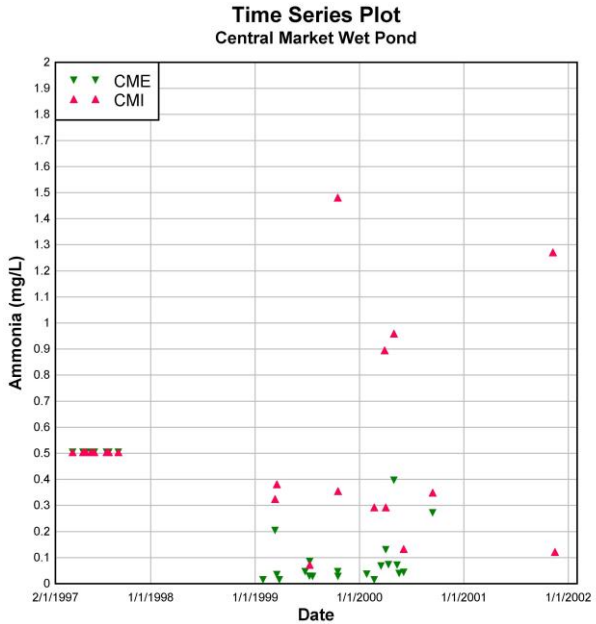


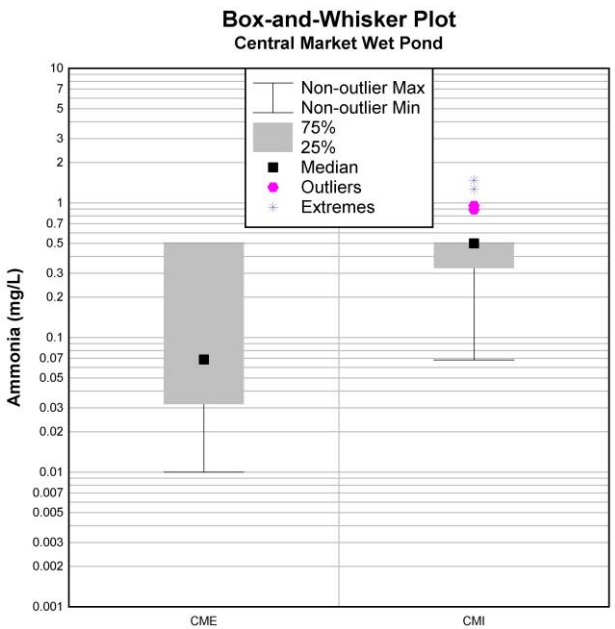


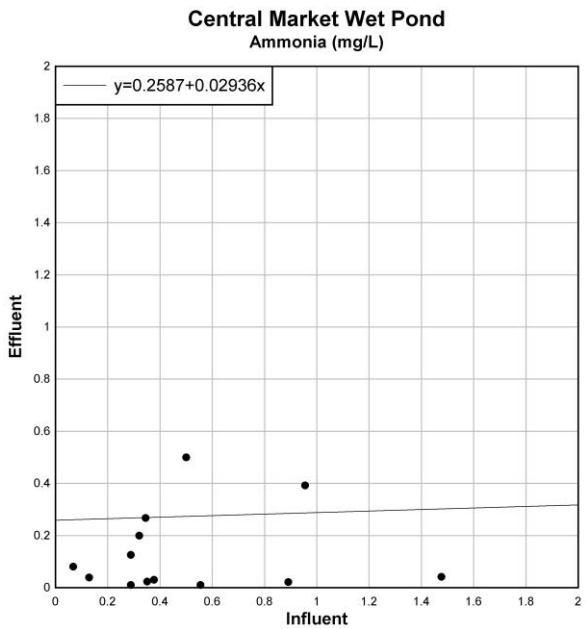
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	25	32
	Pairs Count	23	23
Non-Parametric	Maximum	7.132	4.310
	Upper Quartile	3.100	1.120
	Median	1.532	0.891
	Lower Quartile	1.124	0.676
	Minimum	0.500	0.156
	Efficiency	41.85%	
	Mann-Whitney	0.0003 **	
	Wilcoxon (paired)	0.0073 **	
Arithmetic	UCL	3.008	1.291
	Mean	2.274	1.034
	LCL	1.540	0.777
	Std. Dev.	1.778	0.714
	Wilk (p-value)	0.0003 **	0.0001 **
	Efficiency	54.52%	
	t-Test (equal var.)	0.0007 **	
	t-Test (unequal var.)	0.0026 **	
	t-test (paired)	0.0303 **	
	Levene Test	0.0187 **	
Log Transformed	UCL	3.180	1.267
	Mean	2.265	1.027
	LCL	1.613	0.832
	Std. Dev.	1.807	0.590
	Wilk (p-value)	0.2263	0.0091 **
	Efficiency	54.67%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0003 **	
	t-Test (paired)	0.0252 **	
	Levene Test	0.2143	
Bootstrap	UCL	3.002	1.276
	Mean	2.290	1.037
	LCL	1.577	0.797
	Std. Dev.	1.727	0.664
	Efficiency	54.72%	

Central Market Wet Pond - Ammonia (mg/L)



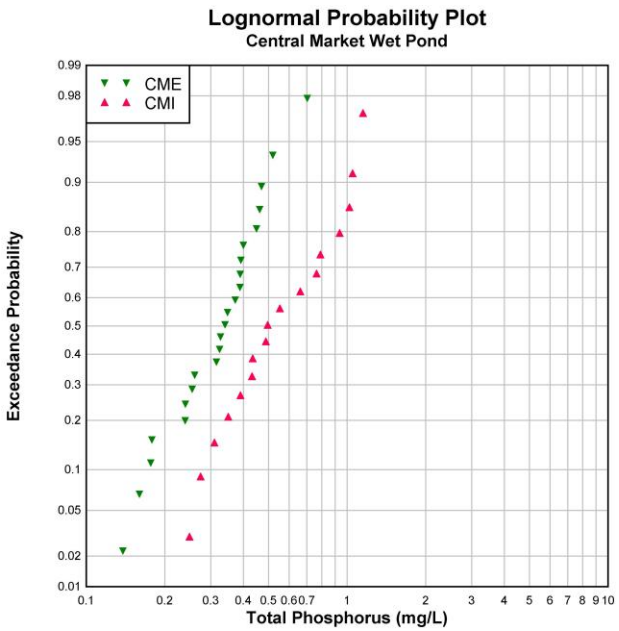


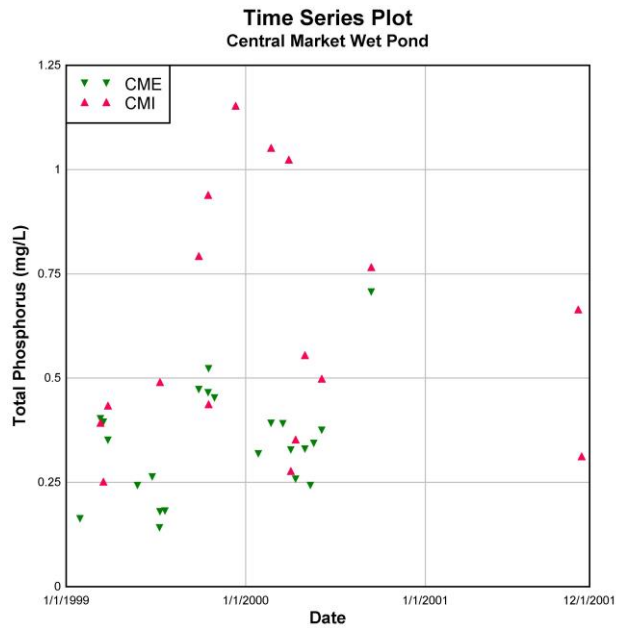


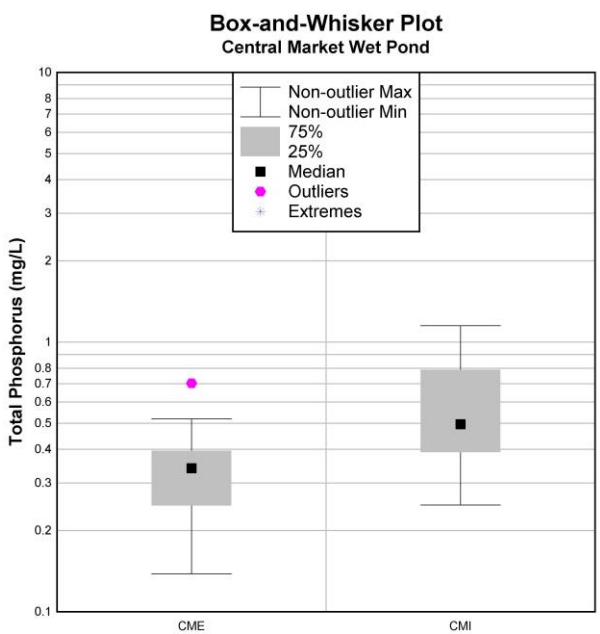


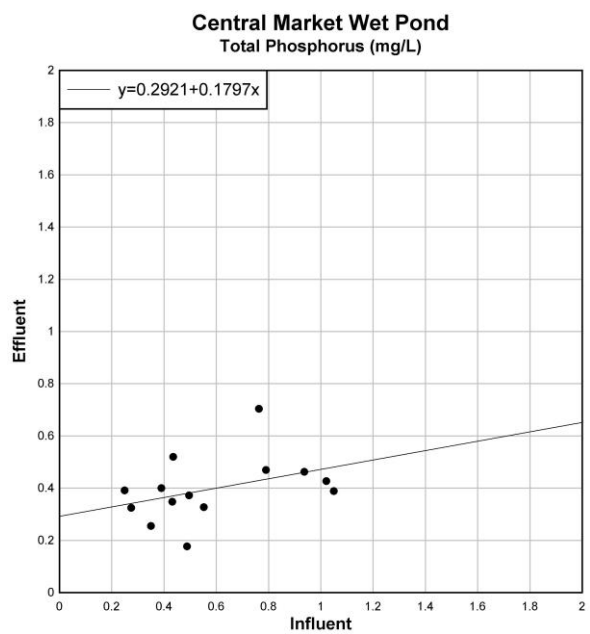
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	22	29
	Pairs Count	21	21
Non-Parametric	Maximum	1.476	0.500
	Upper Quartile	0.500	0.500
	Median	0.500	0.069
	Lower Quartile	0.320	0.032
	Minimum	0.068	0.010
	Efficiency	86.25%	
	Mann-Whitney	0.0011 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	0.671	0.291
	Mean	0.517	0.210
	LCL	0.362	0.128
	Std. Dev.	0.348	0.214
	Wilk (p-value)	0.0014 **	0.0001 **
	Efficiency	59.40%	
	t-Test (equal var.)	0.0003 **	
	t-Test (unequal var.)	0.0009 **	
	t-test (paired)	0.0098 **	
	Levene Test	0.0893 *	
Log Transformed	UCL	0.766	0.524
	Mean	0.532	0.245
	LCL	0.370	0.114
	Std. Dev.	0.421	0.490
	Wilk (p-value)	0.0439 **	0.0020 **
	Efficiency	54.03%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0028 **	
	Levene Test	0.0002 **	
Bootstrap	UCL	0.662	0.285
	Mean	0.514	0.206
	LCL	0.366	0.127
	Std. Dev.	0.333	0.208
	Efficiency	59.86%	

Central Market Wet Pond - Total Phosphorus (mg/L)



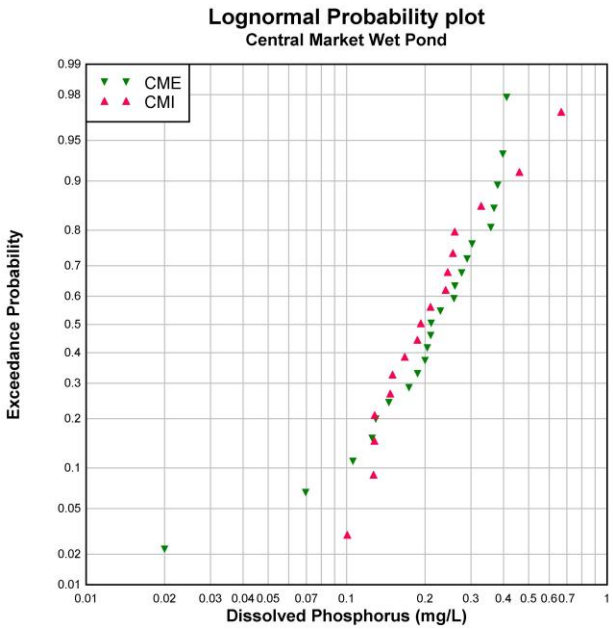


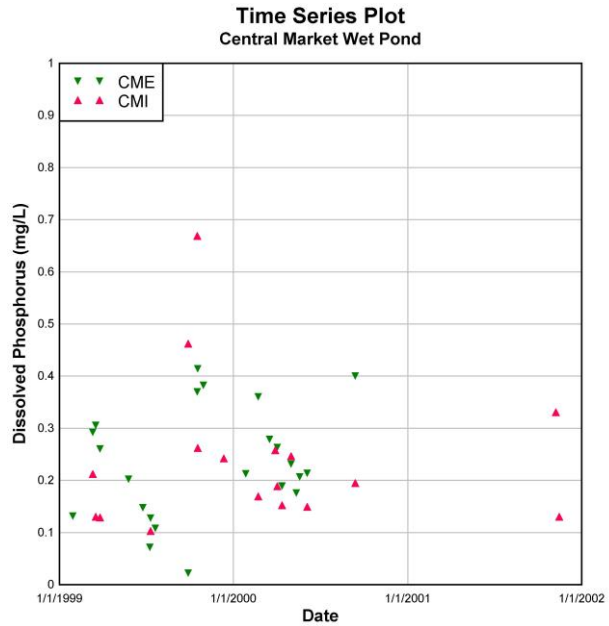


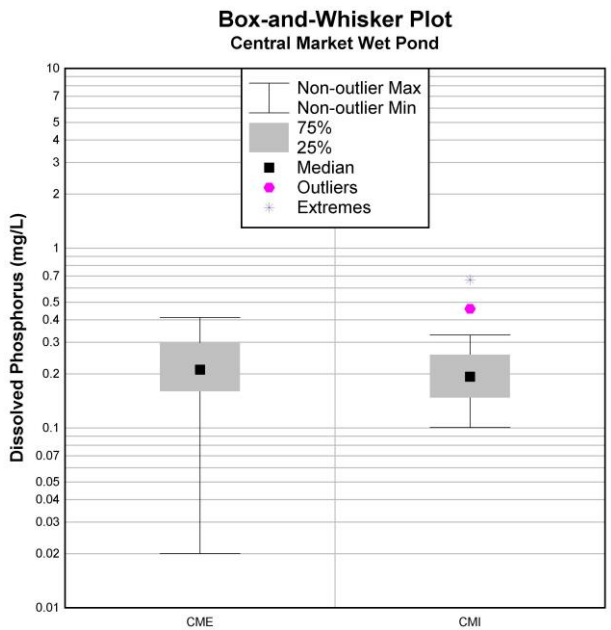


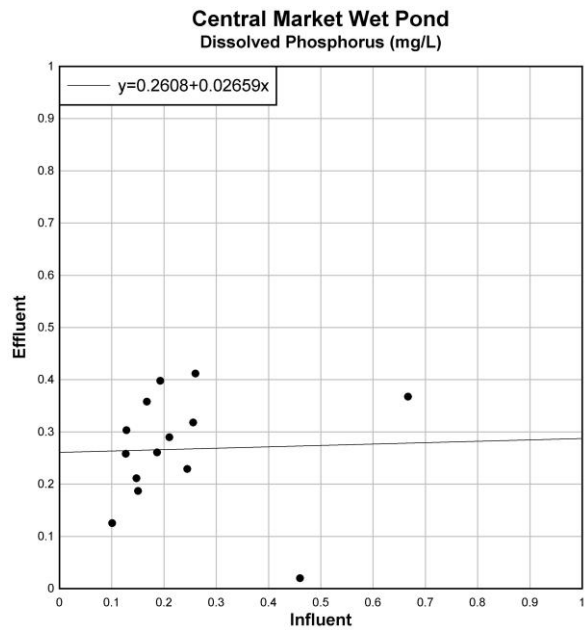
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	17	23
	Pairs Count	14	14
Non-Parametric	Maximum	1.150	0.704
	Upper Quartile	0.790	0.400
	Median	0.496	0.341
	Lower Quartile	0.390	0.240
	Minimum	0.249	0.138
	Efficiency	31.27%	
	Mann-Whitney	0.0032 **	
	Wilcoxon (paired)	0.0203 **	
Arithmetic	UCL	0.759	0.398
	Mean	0.609	0.341
	LCL	0.459	0.284
	Std. Dev.	0.292	0.132
	Wilk (p-value)	0.1119	0.3326
	Efficiency	43.92%	
	t-Test (equal var.)	0.0004 **	
	t-Test (unequal var.)	0.0020 **	
	t-test (paired)	0.0144 **	
	Levene Test	0.0011 **	
Log Transformed	UCL	0.795	0.411
	Mean	0.609	0.343
	LCL	0.467	0.286
	Std. Dev.	0.307	0.142
	Wilk (p-value)	0.5055	0.5501
	Efficiency	43.78%	
	t-Test (equal var.)	0.0004 **	
	t-Test (unequal var.)	0.0008 **	
	t-Test (paired)	0.0169 **	
	Levene Test	0.3091	
Bootstrap	UCL	0.753	0.400
	Mean	0.608	0.344
	LCL	0.463	0.288
	Std. Dev.	0.282	0.129
	Efficiency	43.38%	

Central Market Wet Pond - Dissolved Phosphorus (mg/L)



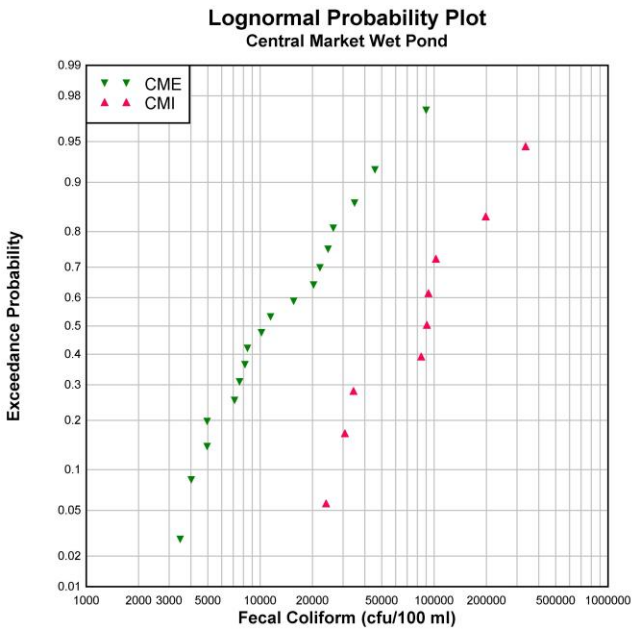


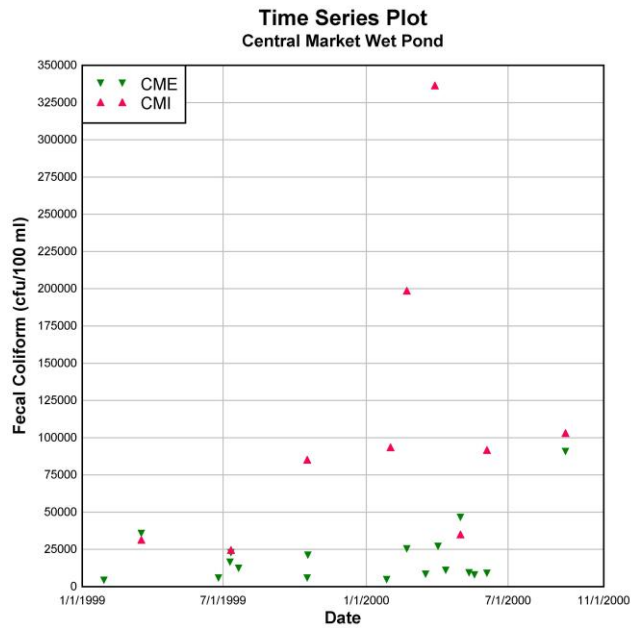


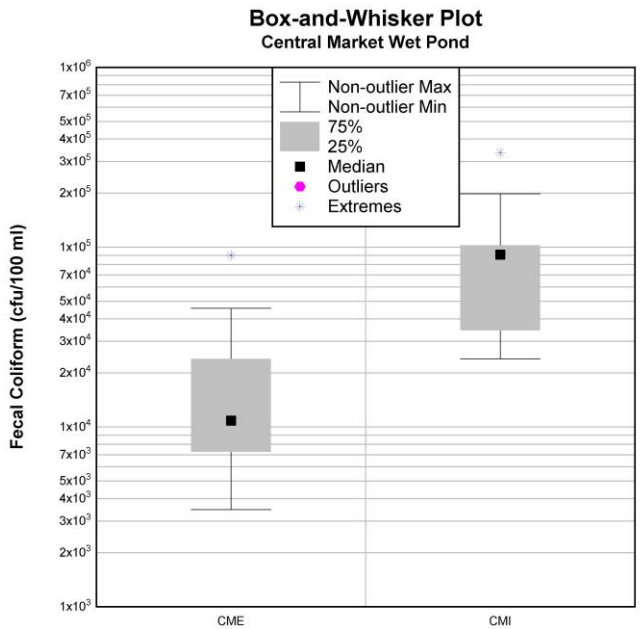


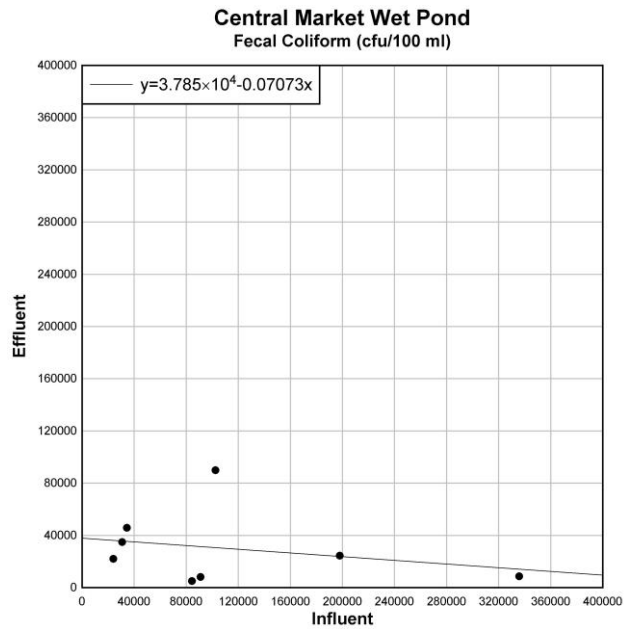
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	17	23
	Pairs Count	14	14
Non-Parametric	Maximum	0.667	0.412
	Upper Quartile	0.256	0.303
	Median	0.193	0.211
	Lower Quartile	0.147	0.145
	Minimum	0.101	0.020
	Efficiency	-9.62%	
	Mann-Whitney	0.5689	
	Wilcoxon (paired)	0.1353	
Arithmetic	UCL	0.308	0.277
	Mean	0.235	0.231
	LCL	0.162	0.185
	Std. Dev.	0.142	0.107
	Wilk (p-value)	0.0009 **	0.8116
	Efficiency	1.60%	
	t-Test (equal var.)	0.9244	
	t-Test (unequal var.)	0.9277	
	t-test (paired)	0.5317	
	Levene Test	0.4150	
Log Transformed	UCL	0.303	0.340
	Mean	0.231	0.245
	LCL	0.177	0.177
	Std. Dev.	0.118	0.179
	Wilk (p-value)	0.3587	0.0015 **
	Efficiency	-5.97%	
	t-Test (equal var.)	0.8160	
	t-Test (unequal var.)	0.8073	
	t-Test (paired)	0.7148	
	Levene Test	0.4473	
Bootstrap	UCL	0.301	0.278
	Mean	0.234	0.232
	LCL	0.167	0.187
	Std. Dev.	0.131	0.105
	Efficiency	0.77%	

Central Market Wet Pond - Fecal Coliform (cfu/100 ml)



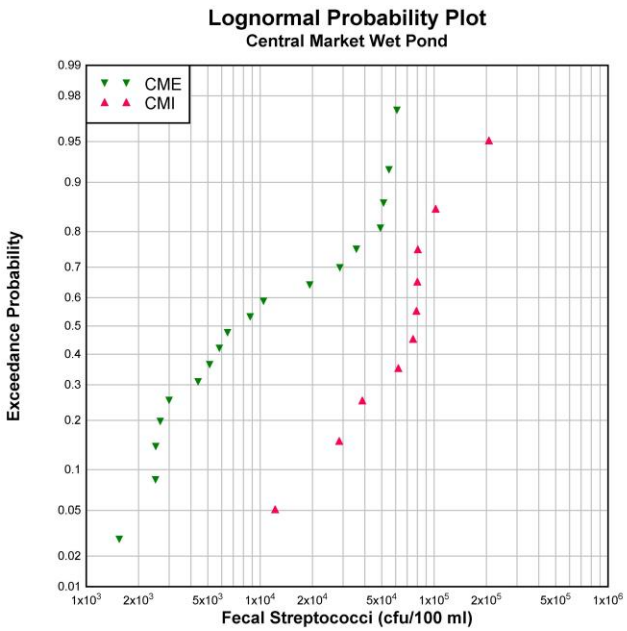


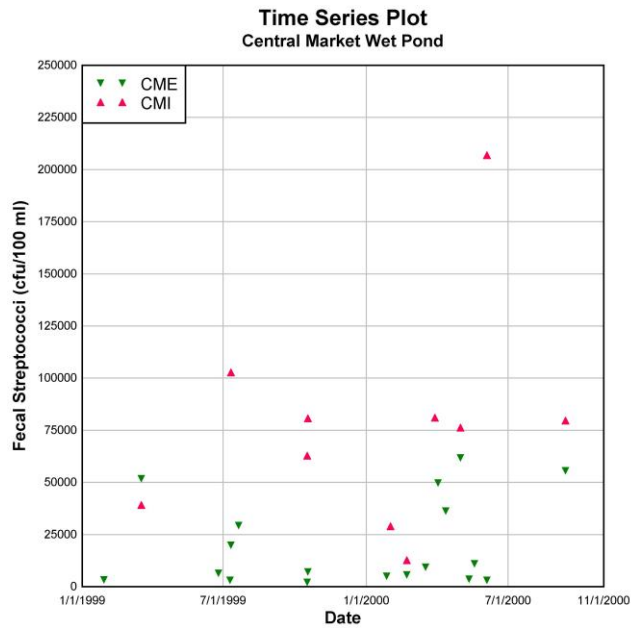


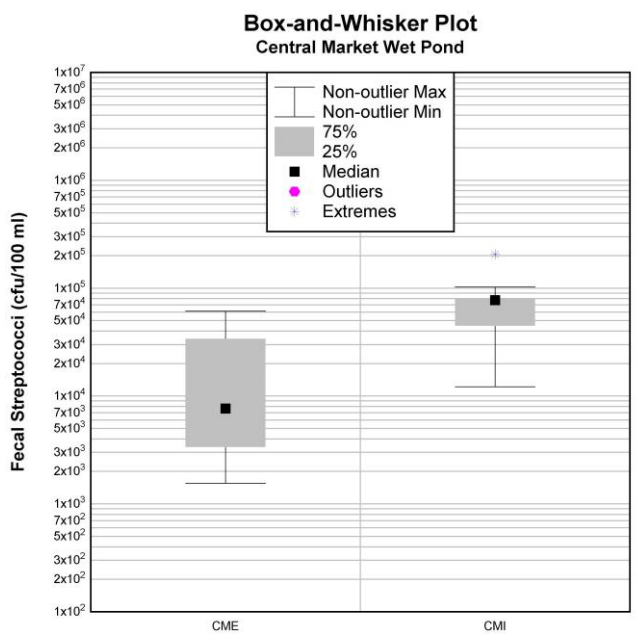


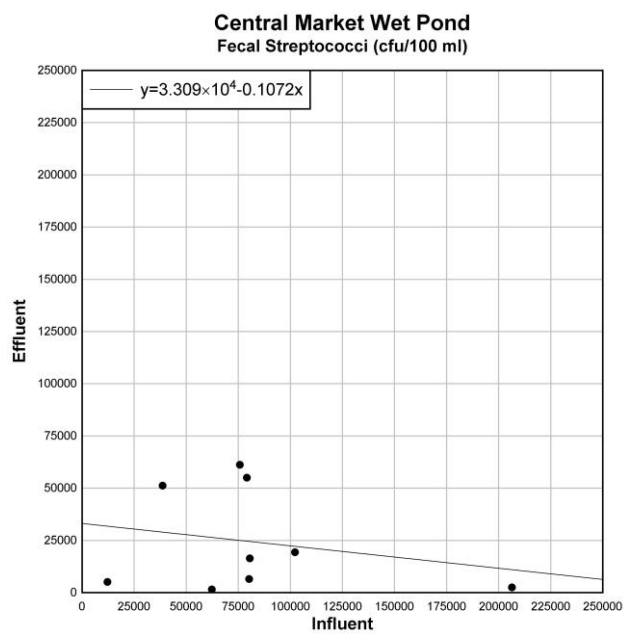
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	9	18
	Pairs Count	8	8
Non-Parametric	Maximum	335,678	90,000
	Upper Quartile	102,402	24,551
	Median	90,948	10,842
	Lower Quartile	34,385	7,132
	Minimum	23,897	3,473
	Efficiency	88.08%	
	Mann-Whitney	0.0016 **	
	Wilcoxon (paired)	0.0781 *	
Arithmetic	UCL	186,953	29,965
	Mean	110,350	19,443
	LCL	33,747	8,922
	Std. Dev.	99,657	21,156
	Wilk (p-value)	0.0202 **	0.0001 **
	Efficiency	82.38%	
	t-Test (equal var.)	0.0009 **	
	t-Test (unequal var.)	0.0258 **	
	t-test (paired)	0.0859 *	
	Levene Test	0.0333 **	
Log Transformed	UCL	244,256	32,133
	Mean	109,760	18,795
	LCL	49,322	10,994
	Std. Dev.	99,971	19,017
	Wilk (p-value)	0.5539	0.6868
	Efficiency	82.88%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0452 **	
	Levene Test	0.7949	
Bootstrap	UCL	180,282	29,518
	Mean	111,920	19,611
	LCL	43,558	9,703
	Std. Dev.	88,936	19,923
	Efficiency	82.48%	

Central Market Wet Pond - Fecal Streptococci (cfu/100 ml)



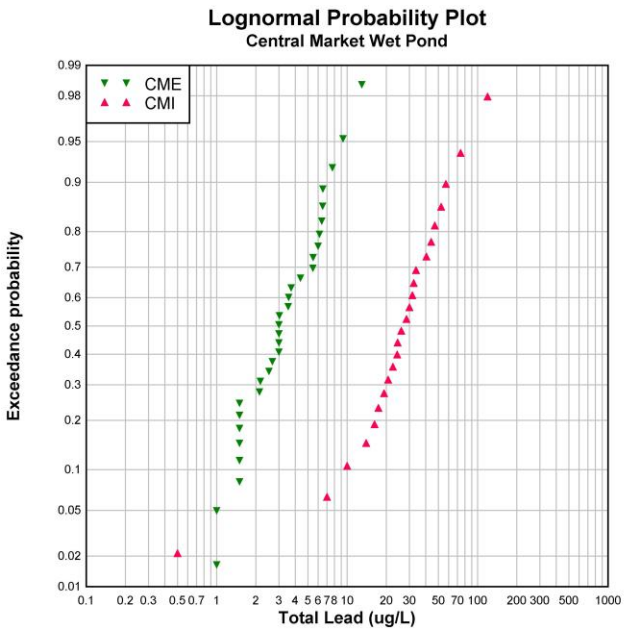


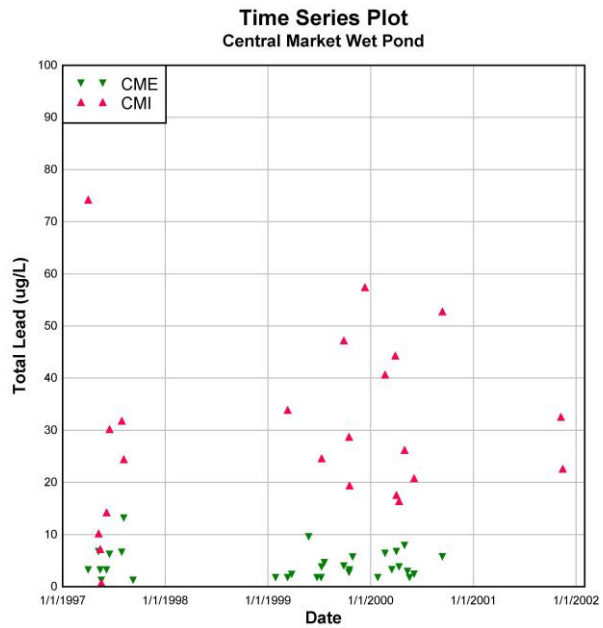


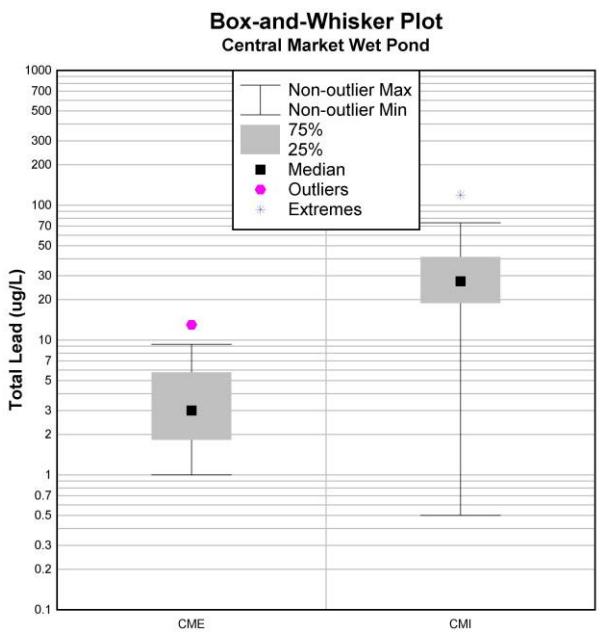


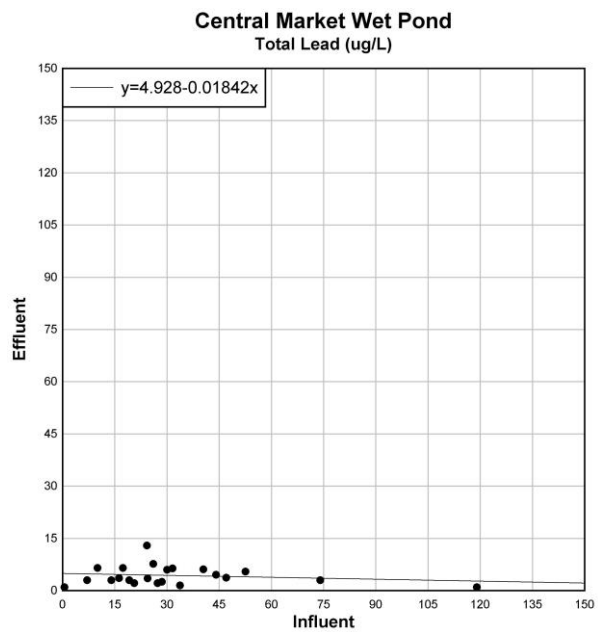
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	10	18
	Pairs Count	9	9
Non-Parametric	Maximum	206,410	61,230
	Upper Quartile	80,508	35,716
	Median	77,384	7,634
	Lower Quartile	38,618	2,994
	Minimum	12,202	1,550
	Efficiency	90.13%	
	Mann-Whitney	0.0017 **	
	Wilcoxon (paired)	0.0117 **	
Arithmetic	UCL	114,753	30,219
	Mean	76,565	19,649
	LCL	38,377	9,078
	Std. Dev.	53,387	21,254
	Wilk (p-value)	0.0469 **	0.0009 **
	Efficiency	74.34%	
	t-Test (equal var.)	0.0004 **	
	t-Test (unequal var.)	0.0083 **	
	t-test (paired)	0.0272 **	
	Levene Test	0.0905 *	
Log Transformed	UCL	149,827	47,555
	Mean	79,033	20,464
	LCL	41,690	8,806
	Std. Dev.	64,015	31,746
	Wilk (p-value)	0.3915	0.0820 *
	Efficiency	74.11%	
	t-Test (equal var.)	0.0003 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0142 **	
	Levene Test	0.0323 **	
Bootstrap	UCL	111,162	29,817
	Mean	77,029	19,616
	LCL	42,895	9,416
	Std. Dev.	47,715	20,512
	Efficiency	74.53%	

Central Market Wet Pond - Total Lead (ug/L)



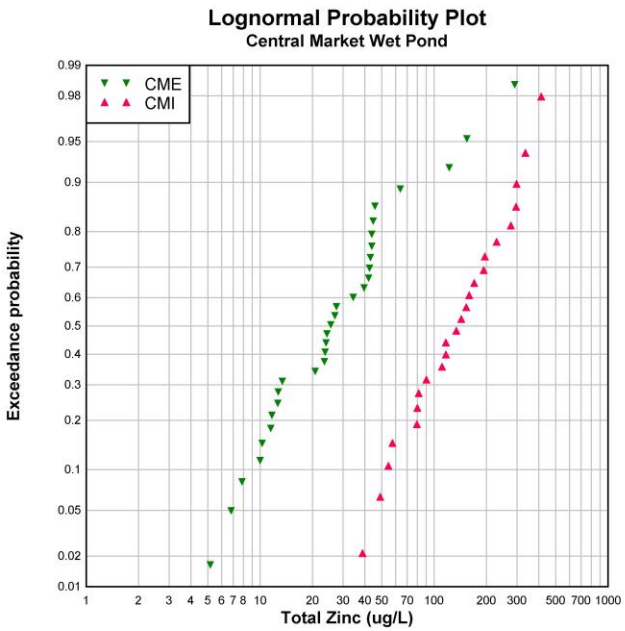


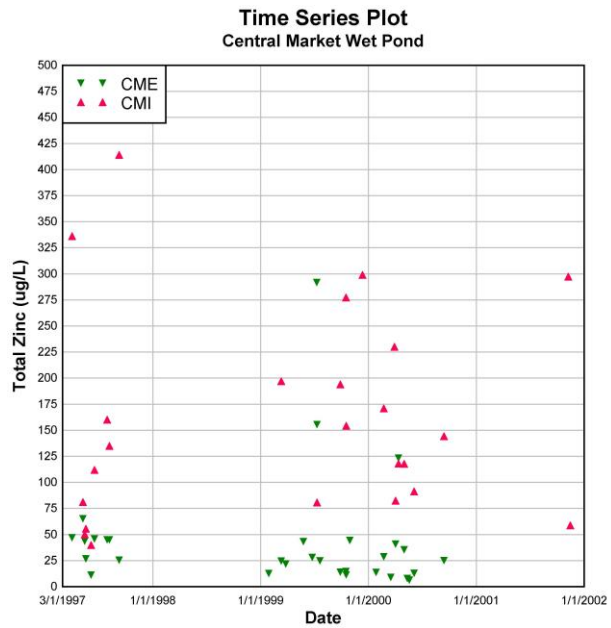


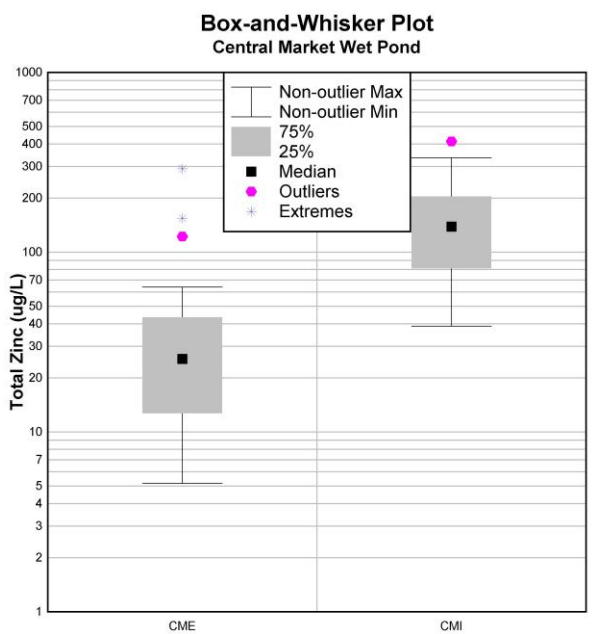


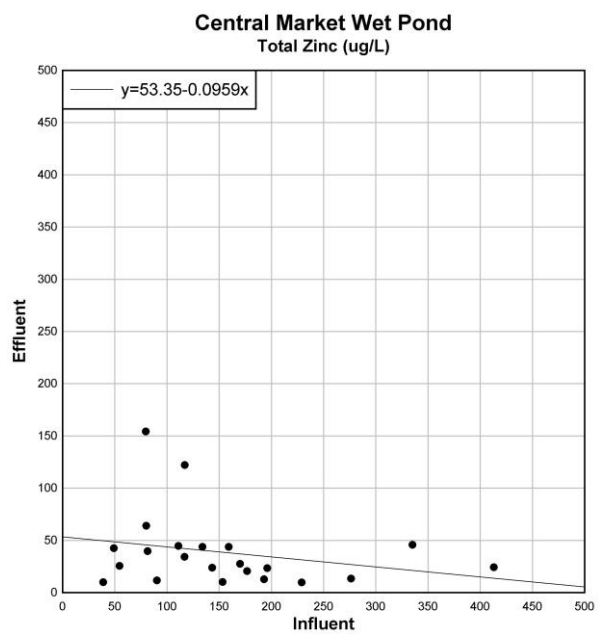
		PARAMETER	Lead (µg/L)
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	24	31
	Pairs Count	22	22
Non-Parametric	Maximum	119.0	13.0
	Upper Quartile	42.3	6.0
	Median	27.3	3.0
	Lower Quartile	18.3	1.5
	Minimum	0.5	1.0
	Efficiency	89.00%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	43.5	5.0
	Mean	33.0	4.0
	LCL	22.5	3.0
	Std. Dev.	24.9	2.7
	Wilk (p-value)	0.0013 **	0.0010 **
	Efficiency	87.96%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0001 **	
	Levene Test	0.0334 **	
Log Transformed	UCL	68.1	5.2
	Mean	39.5	4.0
	LCL	22.9	3.0
	Std. Dev.	48.8	2.9
	Wilk (p-value)	0.0003 **	0.3600
	Efficiency	89.92%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2908	
Bootstrap	UCL	43.2	4.9
	Mean	33.3	4.0
	LCL	23.3	3.0
	Std. Dev.	23.6	2.6
	Efficiency	88.09%	

Central Market Wet Pond - Total Zinc (ug/L)



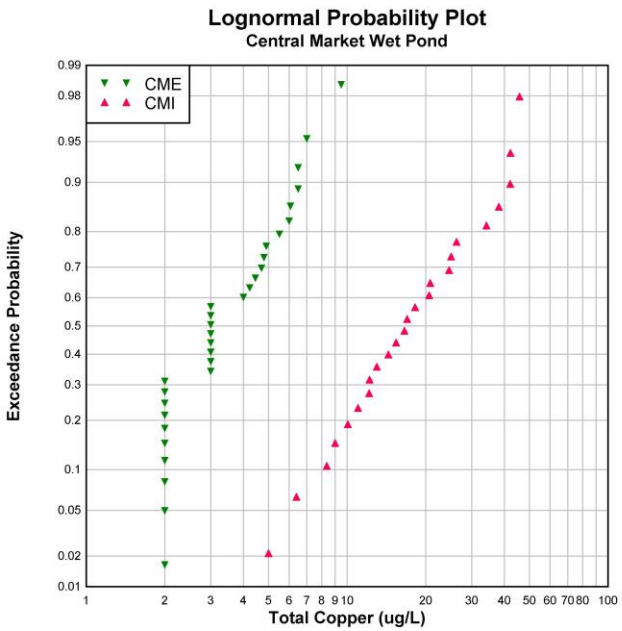


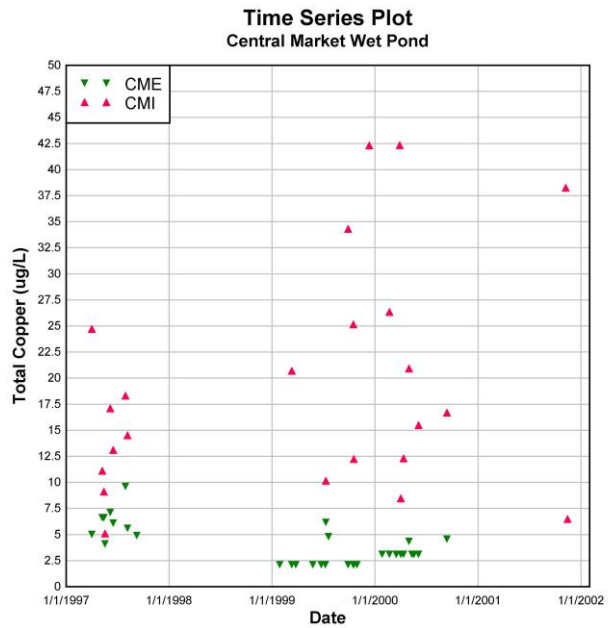


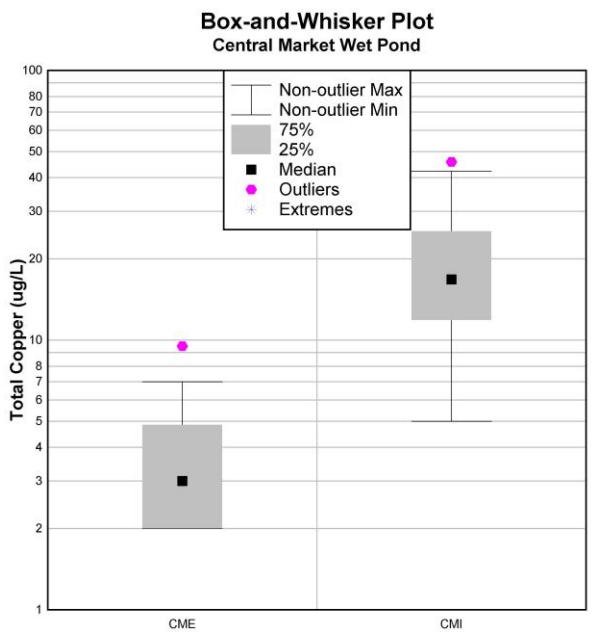


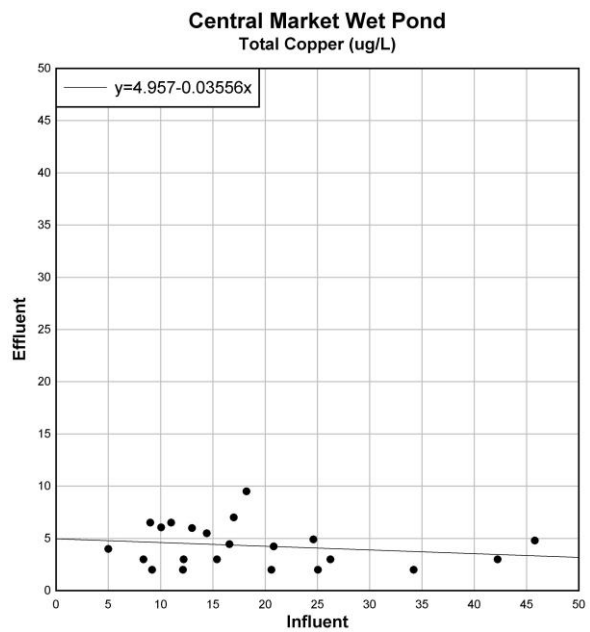
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	24	31
	Pairs Count	22	22
Non-Parametric	Maximum	413.0	290.6
	Upper Quartile	212.5	43.8
	Median	138.6	25.5
	Lower Quartile	80.7	12.6
	Minimum	38.8	5.2
	Efficiency	81.61%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	203.8	62.7
	Mean	161.3	42.2
	LCL	118.8	21.7
	Std. Dev.	100.6	56.0
	Wilk (p-value)	0.0407 **	0.0001 **
	Efficiency	73.84%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0001 **	
	Levene Test	0.0525 *	
Log Transformed	UCL	220.1	58.8
	Mean	162.7	39.5
	LCL	120.3	26.5
	Std. Dev.	113.2	41.9
	Wilk (p-value)	0.8406	0.2661
	Efficiency	75.73%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1365	
Bootstrap	UCL	203.5	62.2
	Mean	162.1	42.8
	LCL	120.7	23.4
	Std. Dev.	98.0	52.9
	Efficiency	73.63%	

Central Market Wet Pond - Total Copper (ug/L)



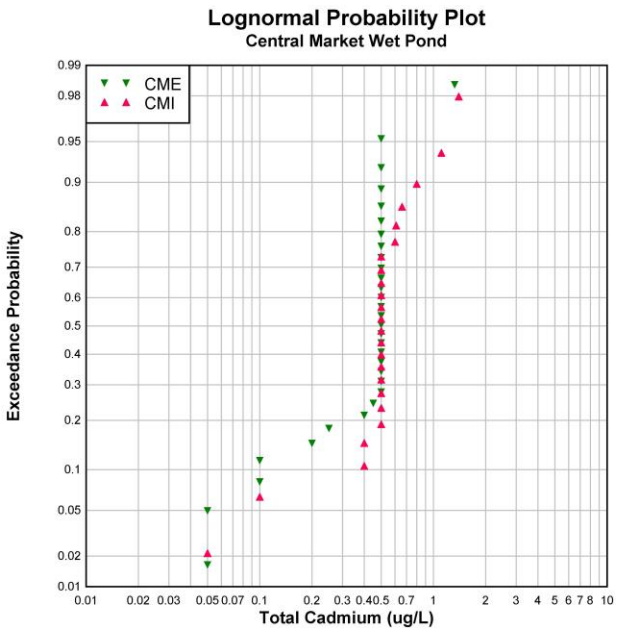


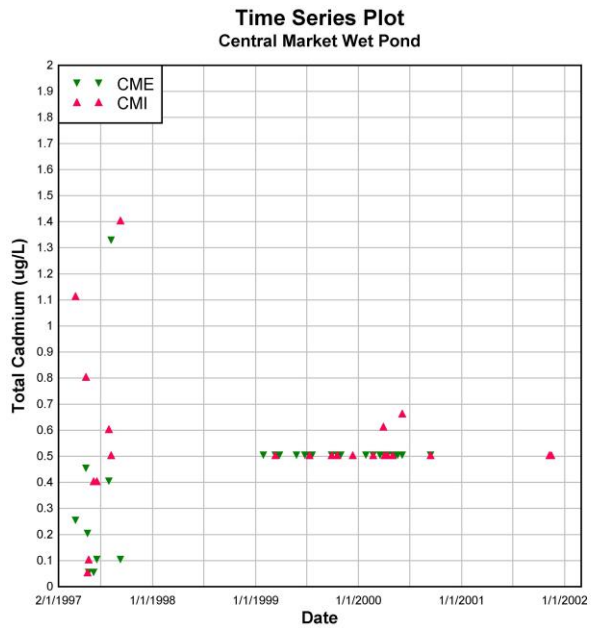


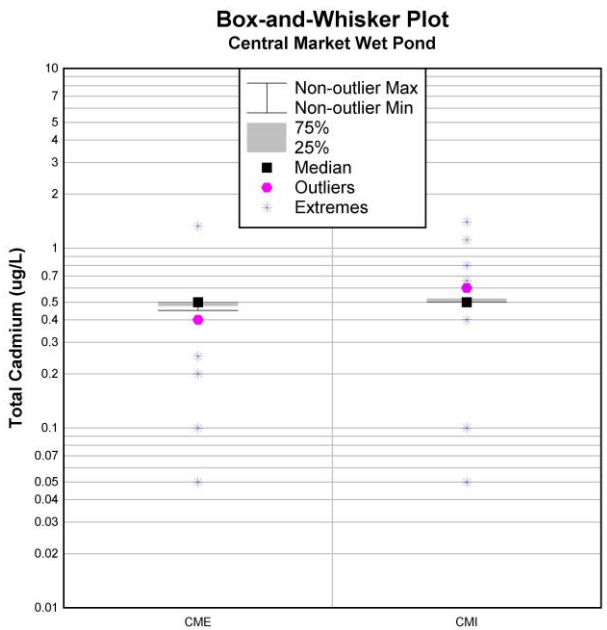


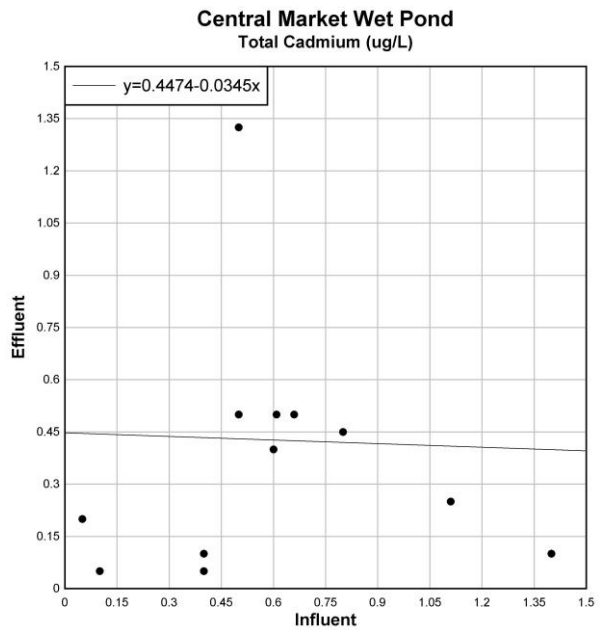
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	24	31
	Pairs Count	22	22
Non-Parametric	Maximum	45.8	9.5
	Upper Quartile	25.6	4.9
	Median	16.8	3.0
	Lower Quartile	11.6	2.0
	Minimum	5.0	2.0
	Efficiency	82.13%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	25.5	4.5
	Mean	20.4	3.8
	LCL	15.3	3.1
	Std. Dev.	12.1	1.9
	Wilk (p-value)	0.0178 **	0.0006 **
	Efficiency	81.28%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0001 **	
Log Transformed	UCL	27.1	4.6
	Mean	20.5	3.8
	LCL	15.5	3.2
	Std. Dev.	13.2	1.9
	Wilk (p-value)	0.7887	0.0040 **
	Efficiency	81.45%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1148	
Bootstrap	UCL	25.4	4.5
	Mean	20.5	3.8
	LCL	15.5	3.1
	Std. Dev.	11.8	1.9
	Efficiency	81.46%	

Central Market Wet Pond – Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: CMI**	**EFF: CME**
	Site Count	24	31
	Pairs Count	22	22
Non-Parametric	Maximum	1.4	1.3
	Upper Quartile	0.6	0.5
	Median	0.5	0.5
	Lower Quartile	0.5	0.4
	Minimum	0.0	0.0
	Efficiency	0.00%	
	Mann-Whitney	0.1186	
	Wilcoxon (paired)	0.0640 *	
Arithmetic	UCL	0.7	0.5
	Mean	0.5	0.4
	LCL	0.4	0.4
	Std. Dev.	0.3	0.2
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	17.88%	
	t-Test (equal var.)	0.1453	
	t-Test (unequal var.)	0.1558	
	t-test (paired)	0.1556	
	Levene Test	0.6201	
Log Transformed	UCL	0.8	0.7
	Mean	0.6	0.5
	LCL	0.4	0.4
	Std. Dev.	0.4	0.4
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	16.56%	
	t-Test (equal var.)	0.2392	
	t-Test (unequal var.)	0.2339	
	t-Test (paired)	0.0941 *	
	Levene Test	0.7675	
Bootstrap	UCL	0.7	0.5
	Mean	0.5	0.4
	LCL	0.4	0.4
	Std. Dev.	0.3	0.2
	Efficiency	18.30%	

Ross Road Wet Pond (RRI-RRE)

This wet pond was constructed to COA design standards found in the ECM however there were several issues that impacted the performance of the control. The contributing watershed was a single-family subdivision (See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed) that was not built-out when pond went into operation. Sedimentation controls did not work adequately during construction the construction phase, resulting in sediment deposits in the storm sewers and at inlet of the pond. This sediment became re-suspended during storm events, elevating the effluent concentrations. Due to submergence in the storm sewers, the influent station was located upstream of the sediment deposits resulting in lower influent concentrations with respect to what was actually entering the pond.

The main lesson learned was to not allow wet ponds to be used as construction phase sediment control without requiring the developer to pay for initial clean out of the wet pond.

The City collected runoff and water quality data at the Ross Road Wet Pond (RRI-RRE) from August 2003 to March 2007. During this time 32 and 27 valid EMCs were collected at the influent (RRI) and effluent (RRE), respectively, out of which 16 were paired.

Performance Summary

The Ross Road Wet Pond had good performance with the reductions of the concentrations for most pollutant parameters. TSS and VSS concentrations were reduced by 75% and 65%, respectively, and were significant in all cases, paired or not paired.

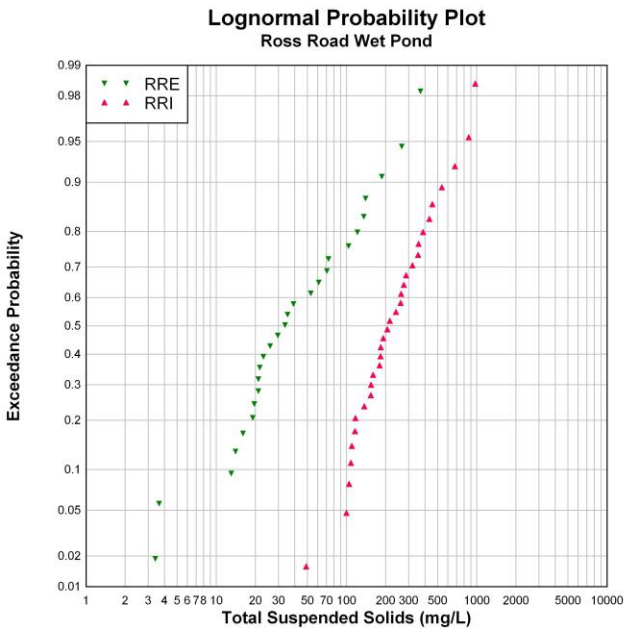
COD and TOC concentrations were reduced by 68% and 46%, respectively, and were significant in all cases.

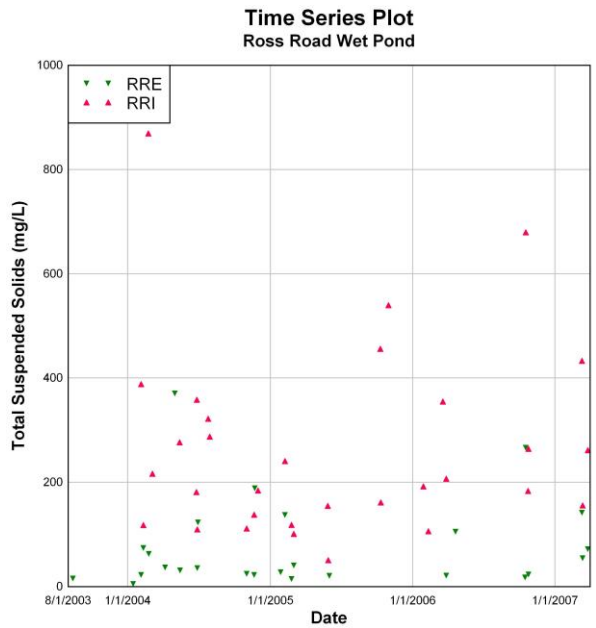
Total nitrogen concentration and nitrate + nitrite were reduced by 54% and 82%, respectively, and were significant in any case. Total Kjeldahl nitrogen was reduced by 38% and was only significant if data are not paired. Ammonia concentration was reduced by 45% and was only significant if data are paired.

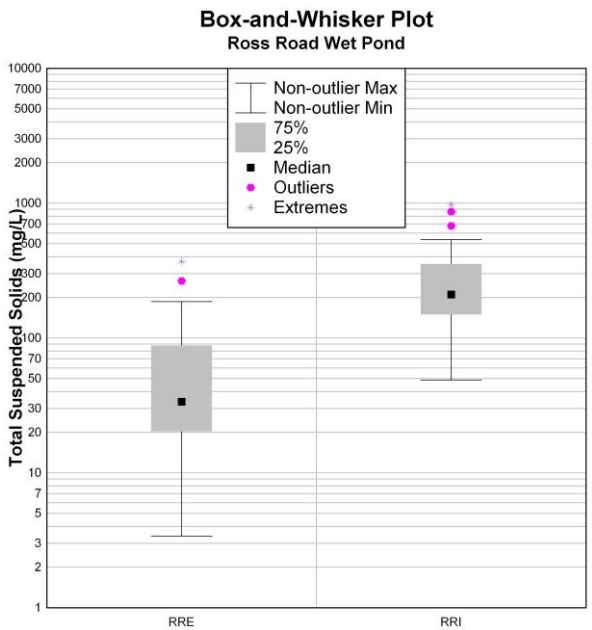
TP and DP concentrations were reduced by 56% and 43%, respectively, and were significant in any case.

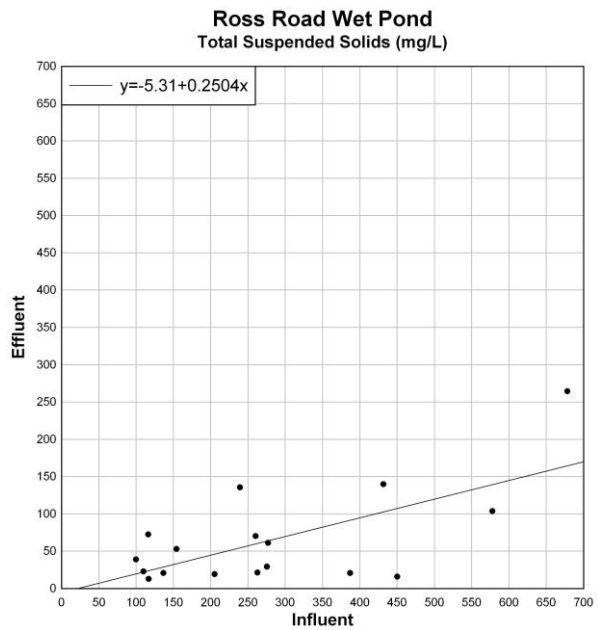
Lead, zinc and copper concentrations were reduced by 27%, 73% and 68%, respectively, and were significant in all cases. Cadmium concentration was reduced by 16% and was only significant if data are paired.

Ross Road Wet Pond - Total Suspended Solids (mg/L)



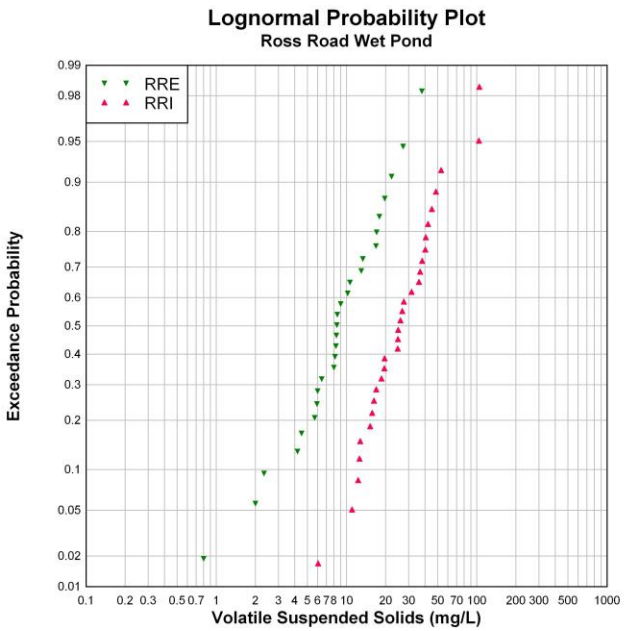


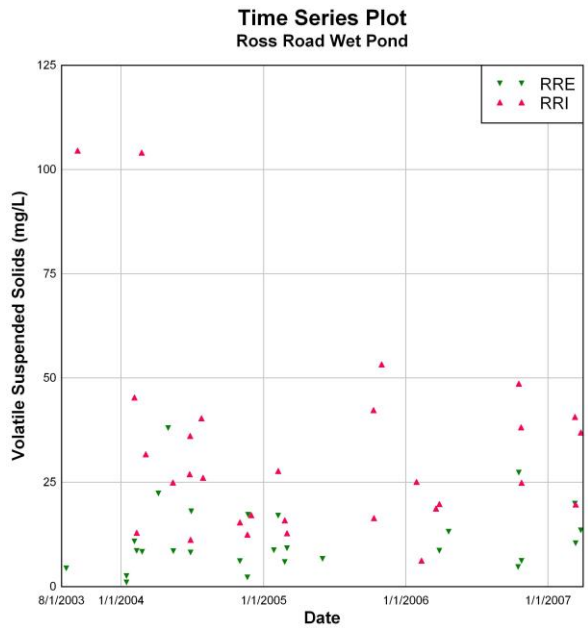


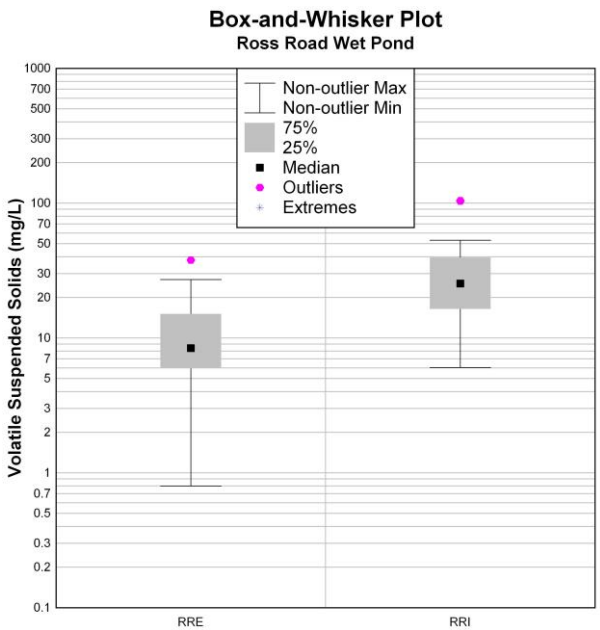


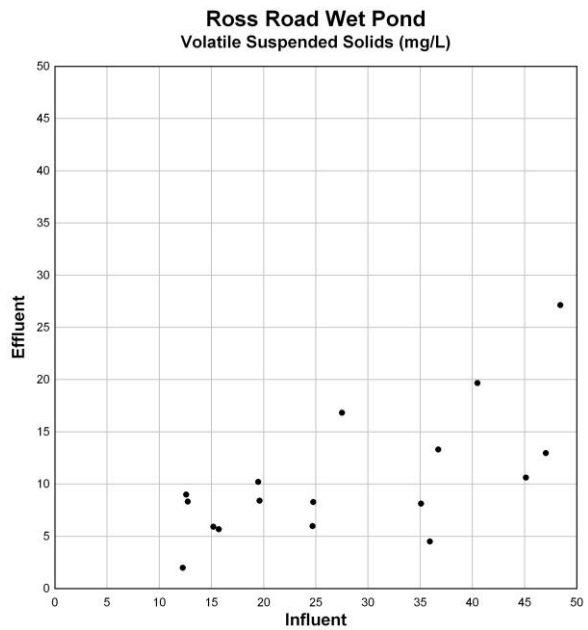
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	32	27
	Pairs Count	16	16
Non-Parametric	Maximum	970.9	369.1
	Upper Quartile	355.1	103.8
	Median	210.1	33.7
	Lower Quartile	144.9	19.6
	Minimum	48.8	3.4
	Efficiency	83.97%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	364.2	105.2
	Mean	285.7	71.0
	LCL	207.2	36.8
	Std. Dev.	217.7	86.4
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	75.14%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0513 *	
Log Transformed	UCL	371.4	132.6
	Mean	283.2	72.9
	LCL	215.9	40.1
	Std. Dev.	208.9	107.0
	Wilk (p-value)	0.8432	0.5610
	Efficiency	74.24%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0124 **	
Bootstrap	UCL	361.7	102.4
	Mean	285.9	70.3
	LCL	210.0	38.2
	Std. Dev.	210.3	81.1
	Efficiency	75.40%	

Ross Road Wet Pond - Volatile Suspended Solids (mg/L)



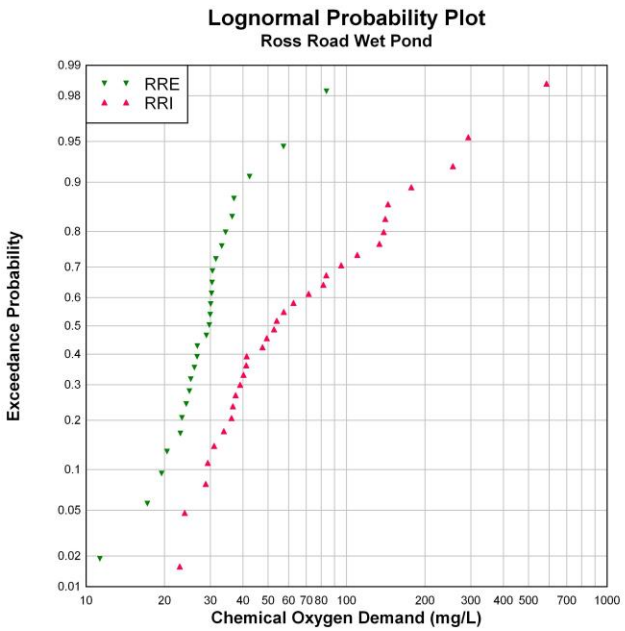


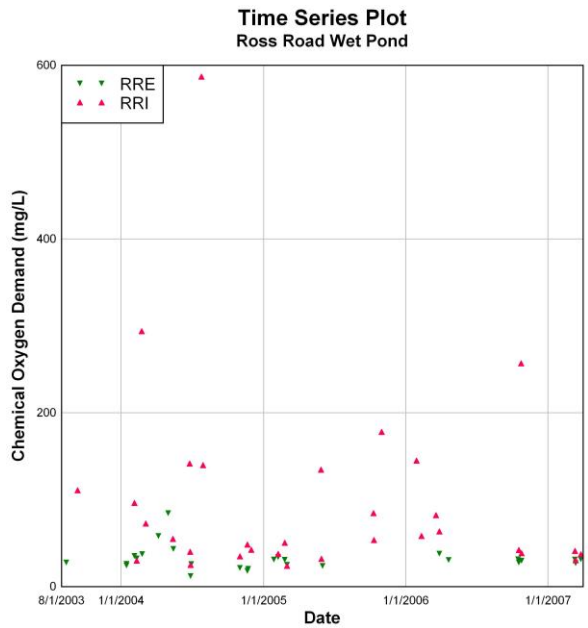


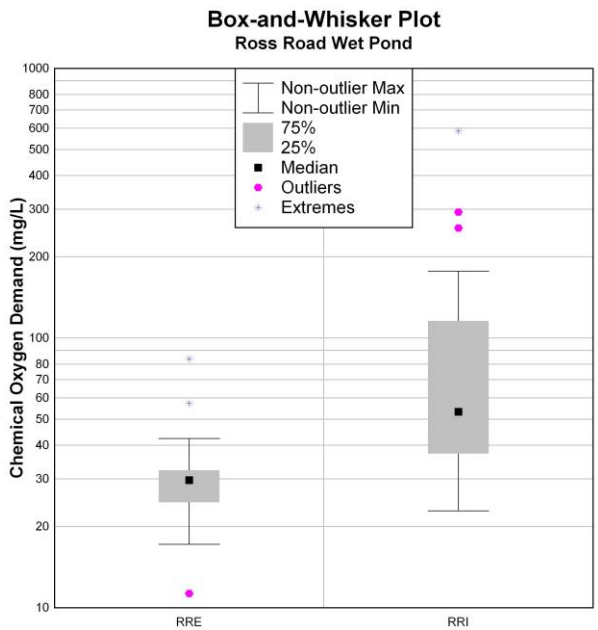


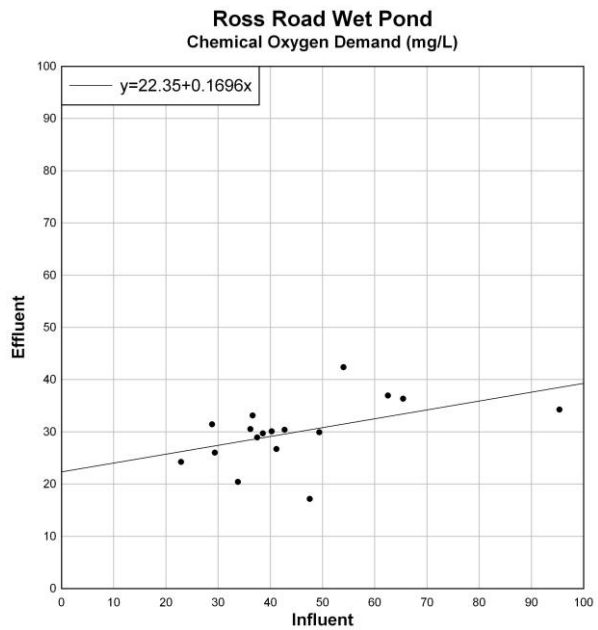
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	30	27
	Pairs Count	16	16
Non-Parametric	Maximum	104.3	37.8
	Upper Quartile	40.1	16.8
	Median	25.4	8.4
	Lower Quartile	16.2	5.9
	Minimum	6.0	.8
	Efficiency	66.83%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	40.3	14.5
	Mean	31.7	11.2
	LCL	23.0	7.9
	Std. Dev.	23.2	8.3
	Wilk (p-value)	0.0001 **	0.0027 **
	Efficiency	64.65%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0759 *	
Log Transformed	UCL	40.8	17.3
	Mean	31.4	11.8
	LCL	24.2	8.0
	Std. Dev.	21.6	11.0
	Wilk (p-value)	0.7369	0.2325
	Efficiency	62.55%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2663	
Bootstrap	UCL	40.0	14.2
	Mean	31.7	11.1
	LCL	23.4	8.0
	Std. Dev.	22.2	7.9
	Efficiency	65.00%	

Ross Road Wet Pond - Chemical Oxygen Demand (mg/L)



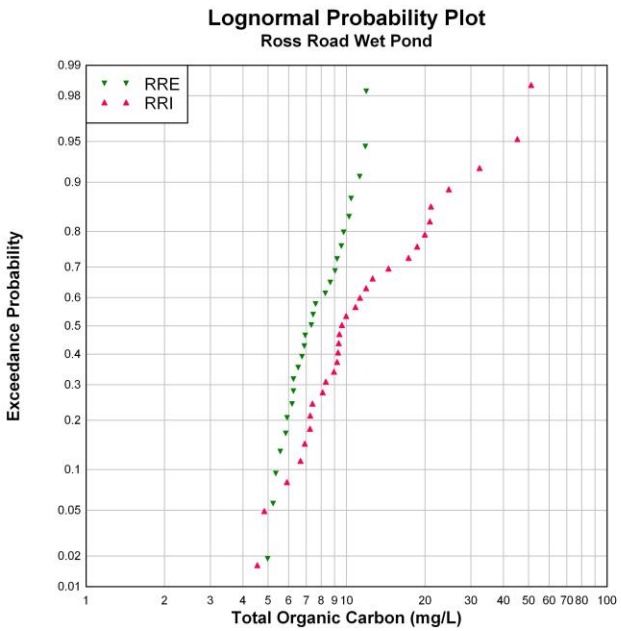


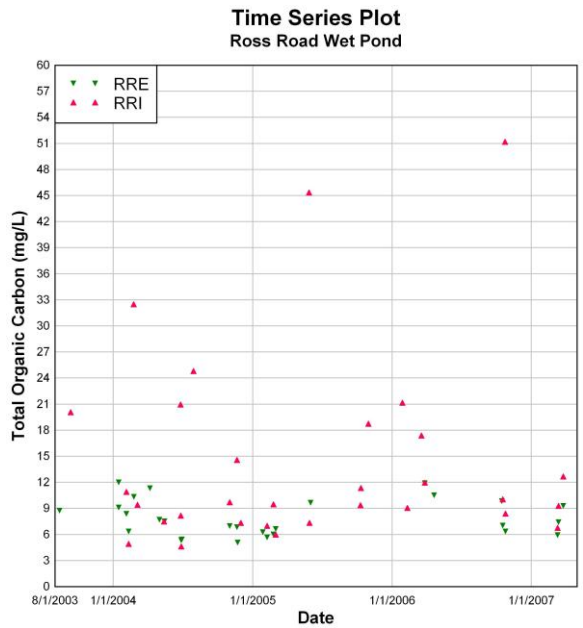


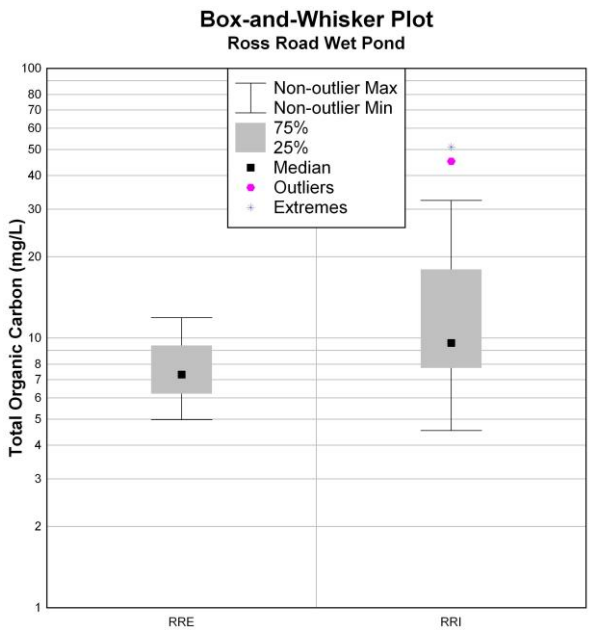


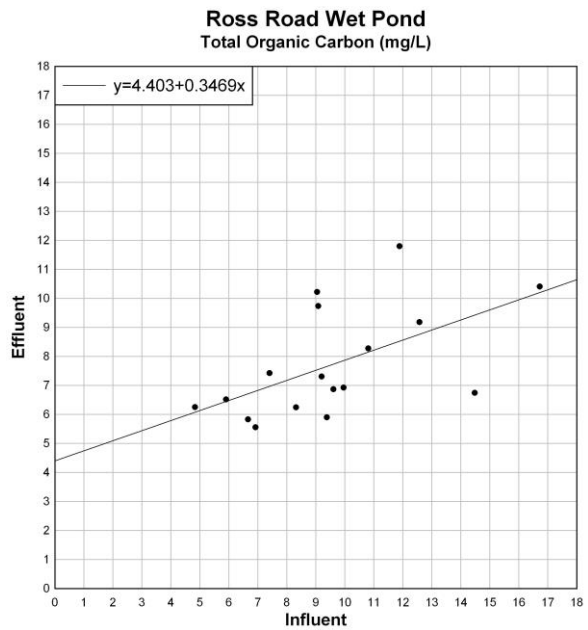
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	32	27
	Pairs Count	16	16
Non-Parametric	Maximum	585.86	83.70
	Upper Quartile	121.73	33.17
	Median	53.33	29.74
	Lower Quartile	37.04	24.24
	Minimum	22.87	11.30
	Efficiency	44.24%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	136.08	36.28
	Mean	96.10	30.90
	LCL	56.13	25.52
	Std. Dev.	110.84	13.59
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	67.85%	
	t-Test (equal var.)	0.0036 **	
	t-Test (unequal var.)	0.0024 **	
	t-test (paired)	0.0017 **	
	Levene Test	0.1557	
Log Transformed	UCL	124.75	35.76
	Mean	89.90	30.74
	LCL	64.79	26.43
	Std. Dev.	79.95	11.63
	Wilk (p-value)	0.0312 **	0.0592 *
	Efficiency	65.80%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0003 **	
	Levene Test	0.0115 **	
Bootstrap	UCL	131.50	35.56
	Mean	94.92	30.62
	LCL	58.34	25.68
	Std. Dev.	101.46	12.49
	Efficiency	67.74%	

Ross Road Wet Pond - Total Organic Carbon (mg/L)



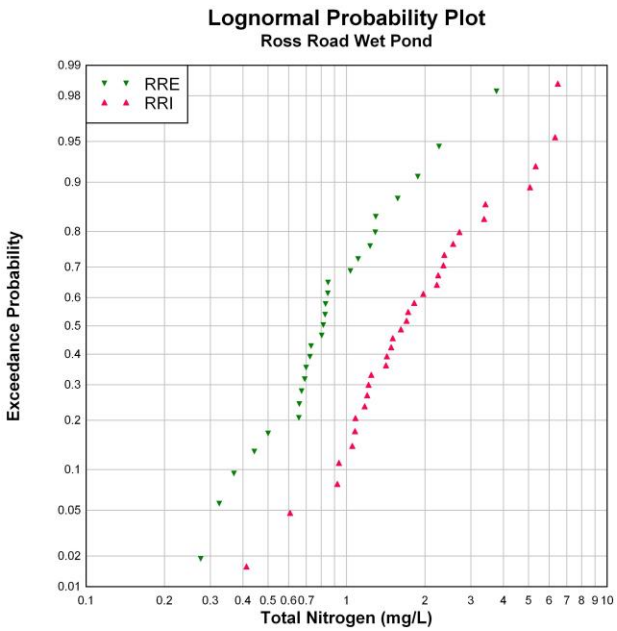


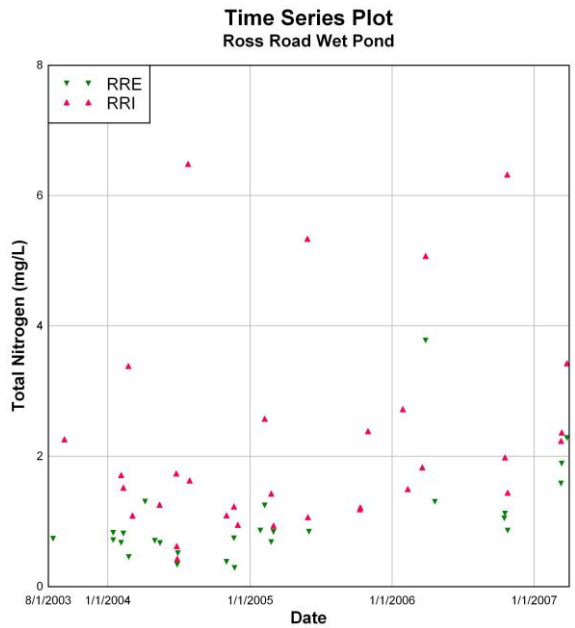


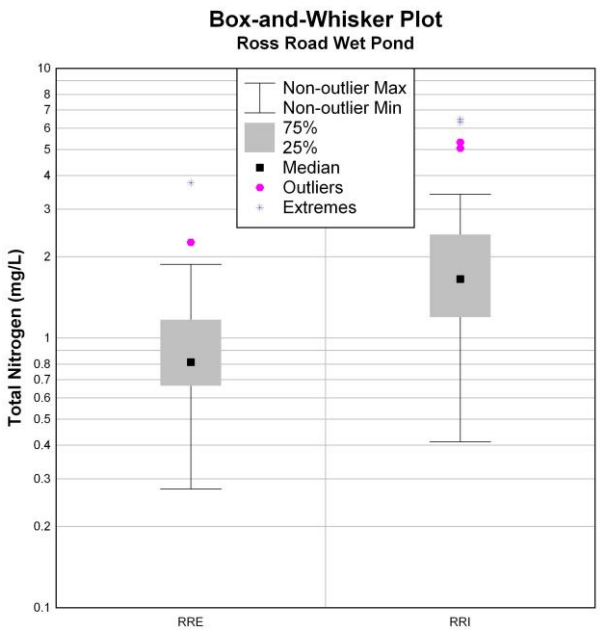


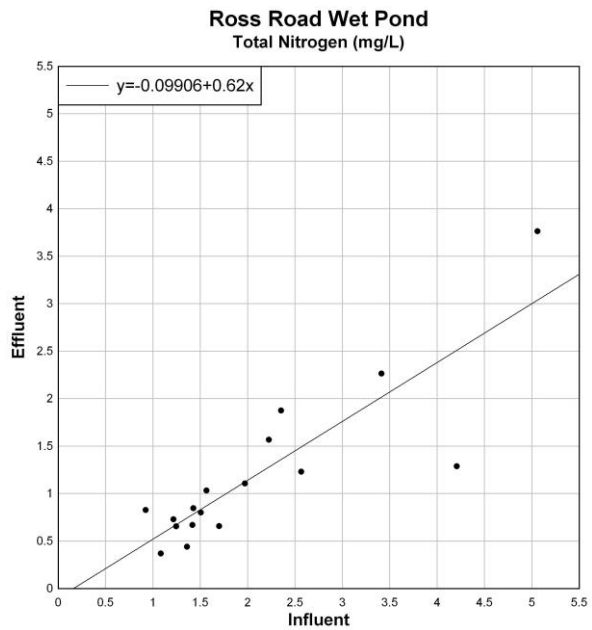
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	31	27
	Pairs Count	16	16
Non-Parametric	Maximum	51.10	11.89
	Upper Quartile	18.65	9.55
	Median	9.60	7.32
	Lower Quartile	7.40	6.18
	Minimum	4.54	4.97
	Efficiency	23.78%	
	Mann-Whitney	0.0037 **	
	Wilcoxon (paired)	0.0063 **	
Arithmetic	UCL	18.42	8.64
	Mean	14.36	7.81
	LCL	10.29	6.99
	Std. Dev.	11.09	2.09
	Wilk (p-value)	0.0001 **	0.0675 *
	Efficiency	45.58%	
	t-Test (equal var.)	0.0038 **	
	t-Test (unequal var.)	0.0029 **	
	t-test (paired)	0.0079 **	
	Levene Test	0.0423 **	
Log Transformed	UCL	17.81	8.68
	Mean	13.98	7.81
	LCL	10.97	7.03
	Std. Dev.	9.08	2.07
	Wilk (p-value)	0.0639 *	0.2632
	Efficiency	44.14%	
	t-Test (equal var.)	0.0010 **	
	t-Test (unequal var.)	0.0007 **	
	t-Test (paired)	0.0072 **	
	Levene Test	0.0053 **	
Bootstrap	UCL	18.24	8.60
	Mean	14.35	7.80
	LCL	10.46	7.00
	Std. Dev.	10.60	2.03
	Efficiency	45.64%	

Ross Road Wet Pond -Ross Road Wet Pond - Total Nitrogen (mg/L)



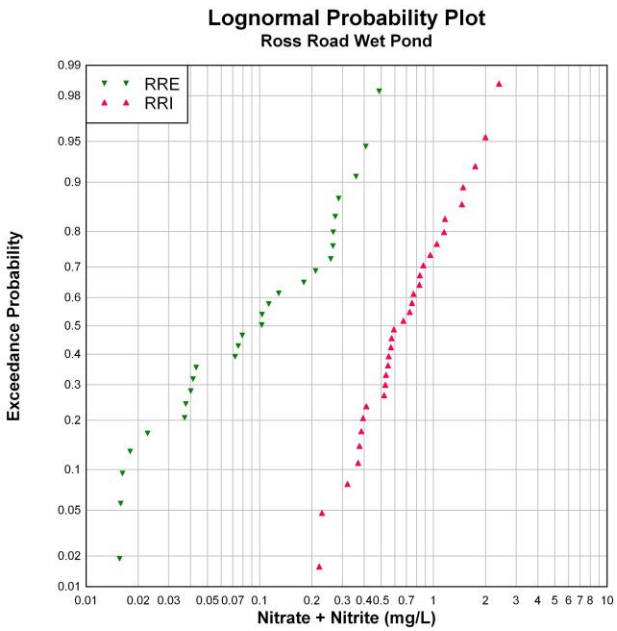


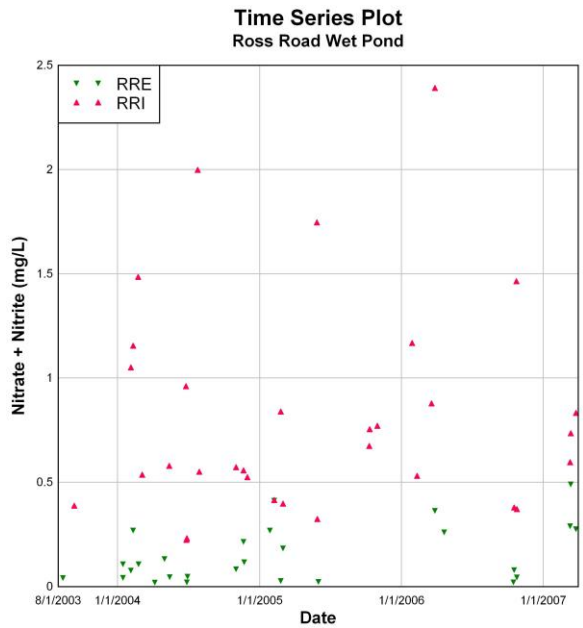


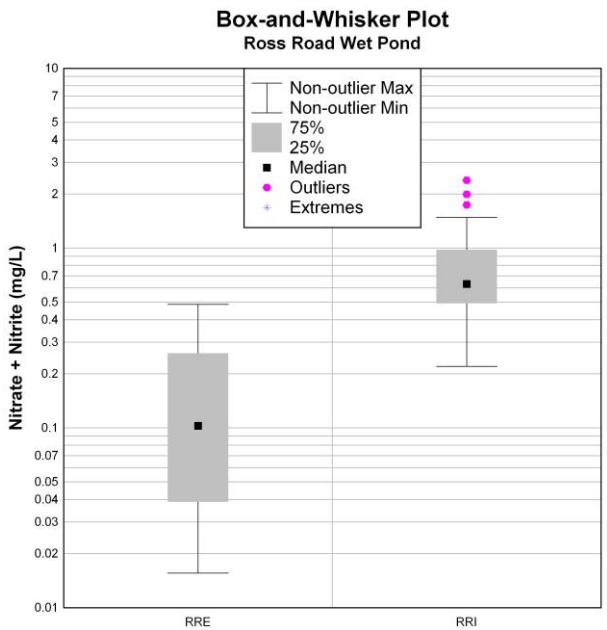


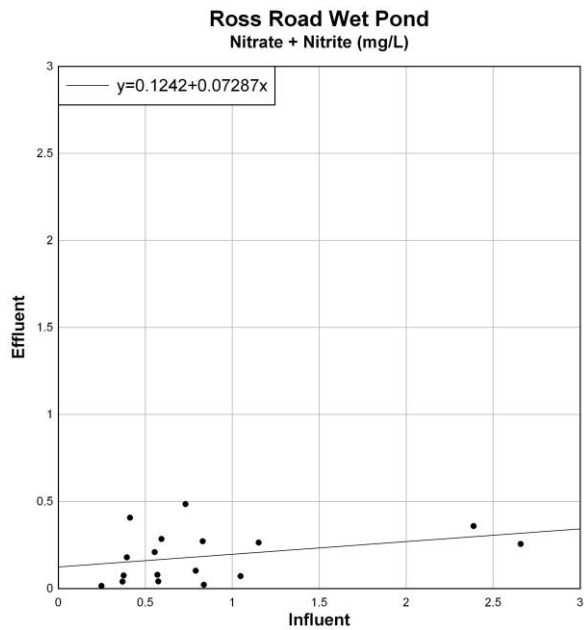
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	32	27
	Pairs Count	16	16
Non-Parametric	Maximum	6.473	3.765
	Upper Quartile	2.467	1.231
	Median	1.656	0.814
	Lower Quartile	1.187	0.658
	Minimum	0.413	0.276
	Efficiency	50.85%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	2.753	1.289
	Mean	2.187	1.005
	LCL	1.621	0.722
	Std. Dev.	1.569	0.717
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	54.03%	
	t-Test (equal var.)	0.0007 **	
	t-Test (unequal var.)	0.0004 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0436 **	
Log Transformed	UCL	2.794	1.269
	Mean	2.168	0.991
	LCL	1.682	0.773
	Std. Dev.	1.498	0.608
	Wilk (p-value)	0.4855	0.4993
	Efficiency	54.30%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.6049	
Bootstrap	UCL	2.736	1.280
	Mean	2.192	1.011
	LCL	1.649	0.742
	Std. Dev.	1.507	0.680
	Efficiency	53.90%	

Ross Road Wet Pond - Nitrate + Nitrite (mg/L)



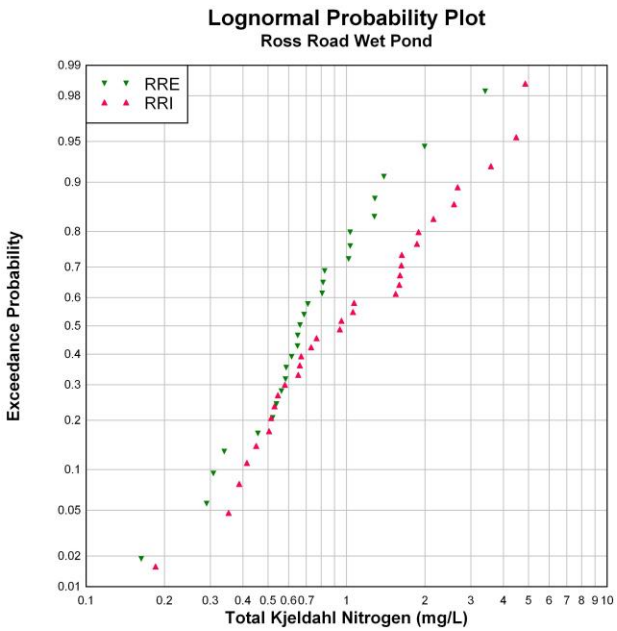


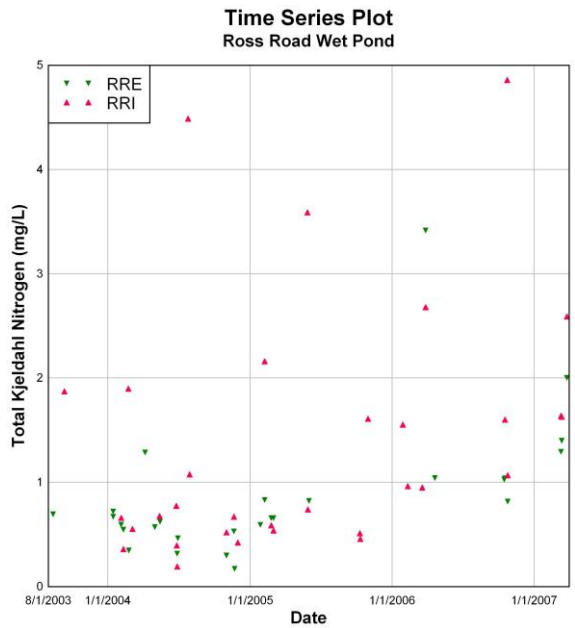


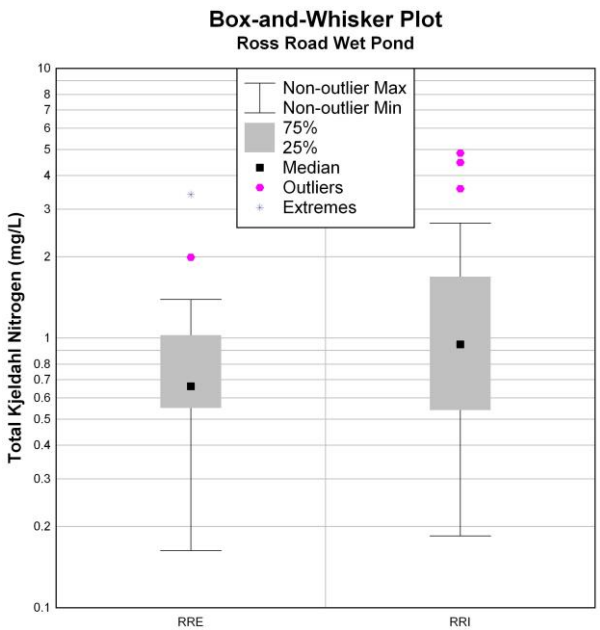


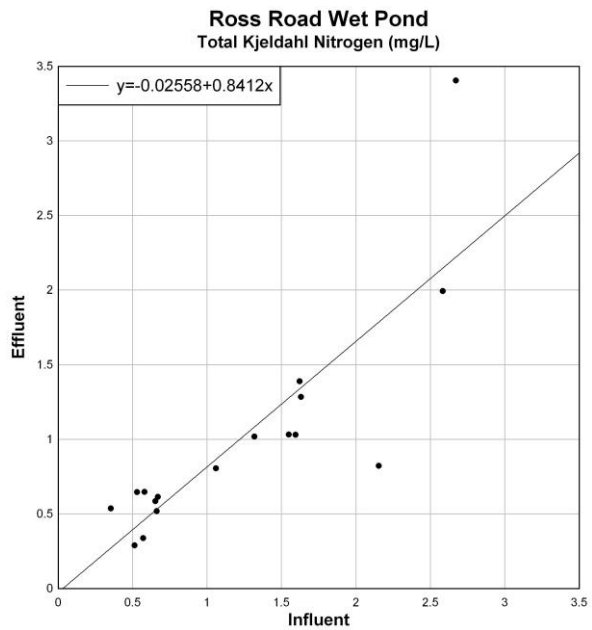
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	32	27
	Pairs Count	16	16
Non-Parametric	Maximum	2.387	0.486
	Upper Quartile	1.002	0.265
	Median	0.631	0.103
	Lower Quartile	0.466	0.037
	Minimum	0.220	0.016
	Efficiency	83.73%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.998	0.199
	Mean	0.811	0.146
	LCL	0.624	0.093
	Std. Dev.	0.519	0.134
	Wilk (p-value)	0.0006 **	0.0019 **
	Efficiency	81.99%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0010 **	
	Levene Test	0.0135 **	
Log Transformed	UCL	1.019	0.273
	Mean	0.808	0.157
	LCL	0.641	0.090
	Std. Dev.	0.511	0.213
	Wilk (p-value)	0.8542	0.0847 *
	Efficiency	80.57%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0001 **	
Bootstrap	UCL	0.992	0.199
	Mean	0.810	0.147
	LCL	0.629	0.095
	Std. Dev.	0.502	0.131
	Efficiency	81.83%	

Ross Road Wet Pond - Total Kjeldahl Nitrogen (mg/L)



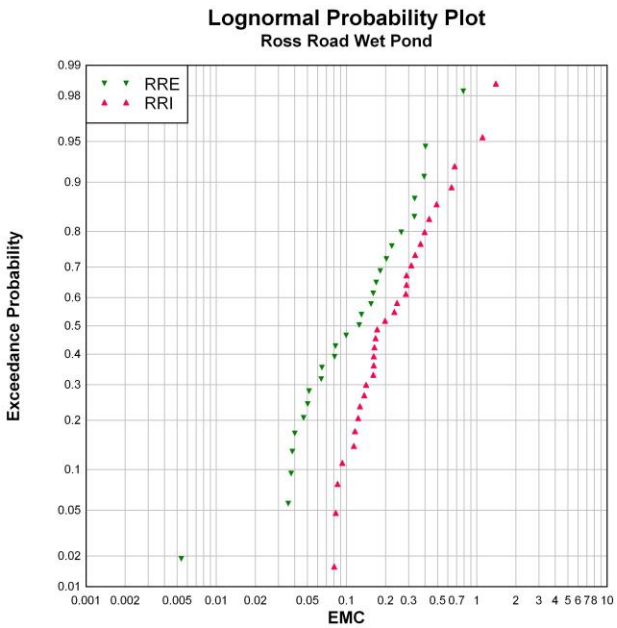


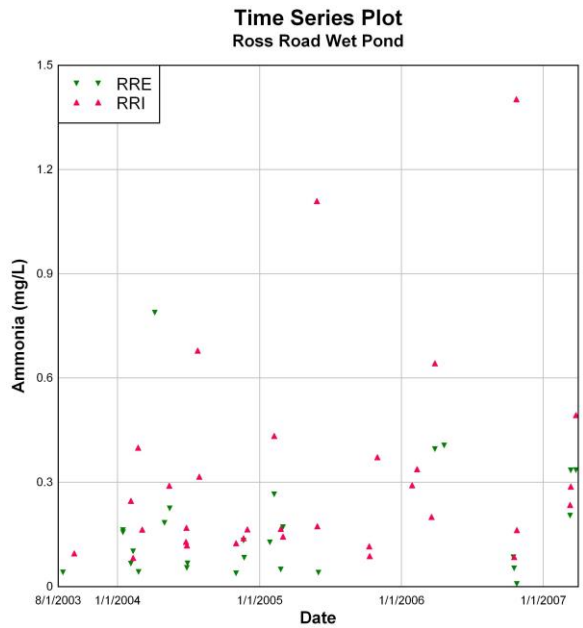


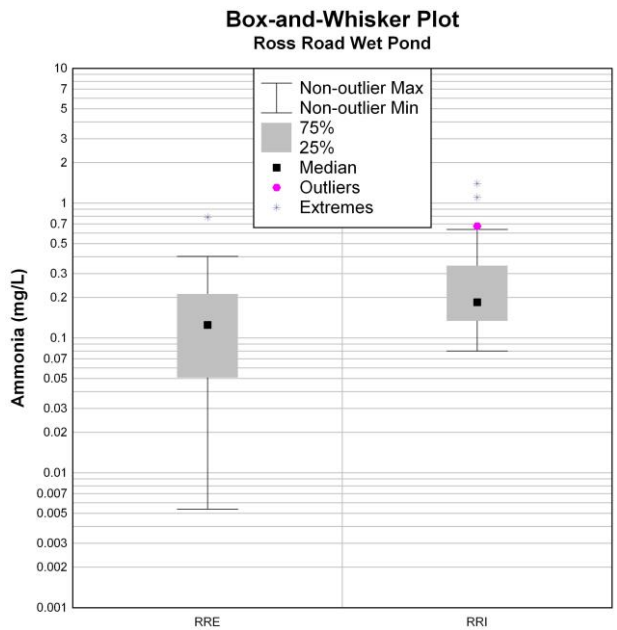


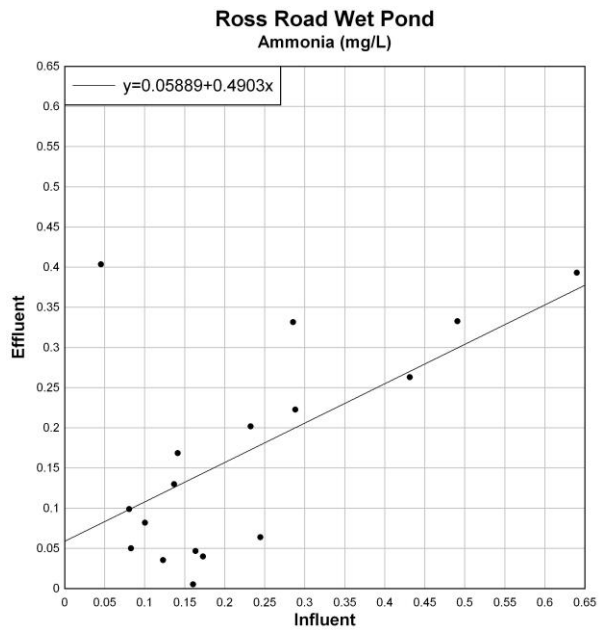
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	32	27
	Pairs Count	16	16
Non-Parametric	Maximum	4.850	3.407
	Upper Quartile	1.746	1.032
	Median	0.948	0.662
	Lower Quartile	0.536	0.538
	Minimum	0.185	0.163
	Efficiency	30.15%	
	Mann-Whitney	0.1208	
	Wilcoxon (paired)	0.0250 **	
Arithmetic	UCL	1.799	1.114
	Mean	1.375	0.859
	LCL	0.952	0.605
	Std. Dev.	1.174	0.643
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	37.54%	
	t-Test (equal var.)	0.0460 **	
	t-Test (unequal var.)	0.0376 **	
	t-test (paired)	0.0546 *	
	Levene Test	0.0989 *	
Log Transformed	UCL	1.907	1.111
	Mean	1.370	0.850
	LCL	0.984	0.651
	Std. Dev.	1.230	0.561
	Wilk (p-value)	0.6113	0.6600
	Efficiency	37.94%	
	t-Test (equal var.)	0.0646 *	
	t-Test (unequal var.)	0.0592 *	
	t-Test (paired)	0.0253 **	
	Levene Test	0.1707	
Bootstrap	UCL	1.788	1.104
	Mean	1.382	0.864
	LCL	0.976	0.624
	Std. Dev.	1.125	0.607
	Efficiency	37.52%	

Ross Road Wet Pond - Ammonia (mg/L)



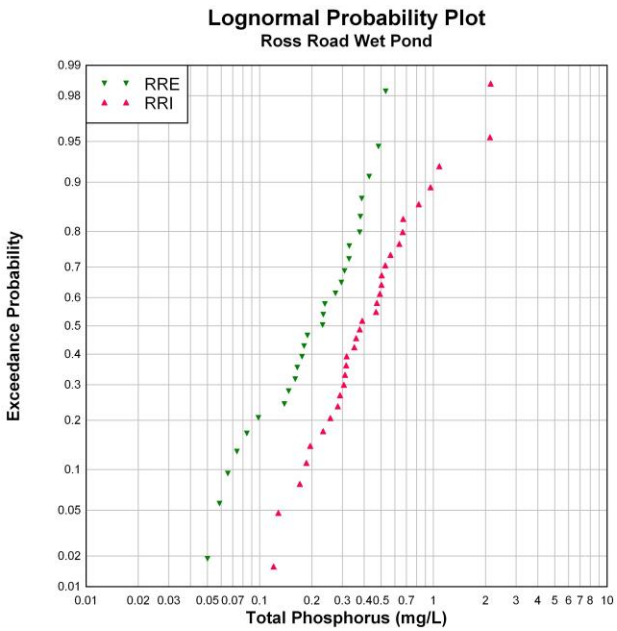


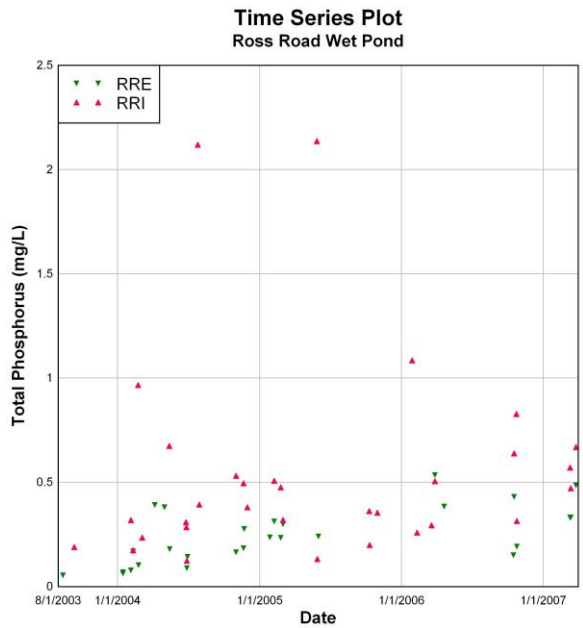


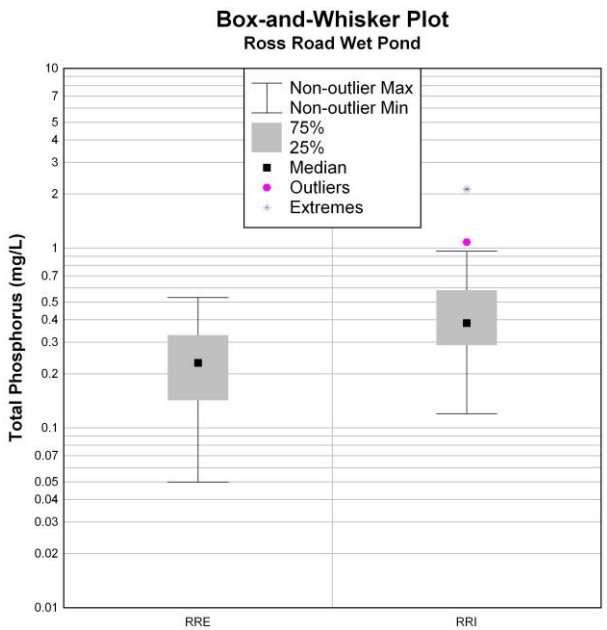


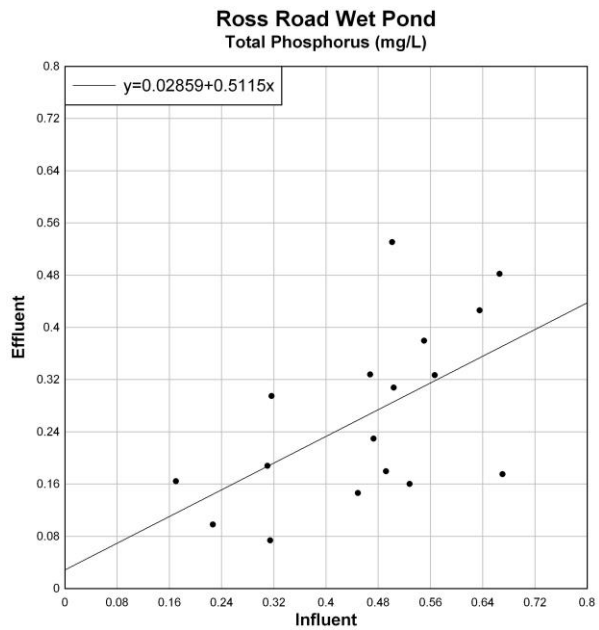
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	32	27
	Pairs Count	16	16
Non-Parametric	Maximum	1.400	0.786
	Upper Quartile	0.352	0.223
	Median	0.185	0.125
	Lower Quartile	0.131	0.050
	Minimum	0.080	0.005
	Efficiency	32.11%	
	Mann-Whitney	0.0087 **	
	Wilcoxon (paired)	0.0507 *	
Arithmetic	UCL	0.412	0.235
	Mean	0.306	0.169
	LCL	0.199	0.102
	Std. Dev.	0.294	0.168
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	44.83%	
	t-Test (equal var.)	0.0366 **	
	t-Test (unequal var.)	0.0298 **	
	t-test (paired)	0.1381	
	Levene Test	0.2295	
Log Transformed	UCL	0.396	0.302
	Mean	0.294	0.180
	LCL	0.218	0.107
	Std. Dev.	0.239	0.228
	Wilk (p-value)	0.1258	0.3337
	Efficiency	38.63%	
	t-Test (equal var.)	0.0022 **	
	t-Test (unequal var.)	0.0032 **	
	t-Test (paired)	0.0976 *	
	Levene Test	0.1323	
Bootstrap	UCL	0.407	0.230
	Mean	0.307	0.167
	LCL	0.206	0.105
	Std. Dev.	0.278	0.158
	Efficiency	45.41%	

Ross Road Wet Pond - Total Phosphorus (mg/L)



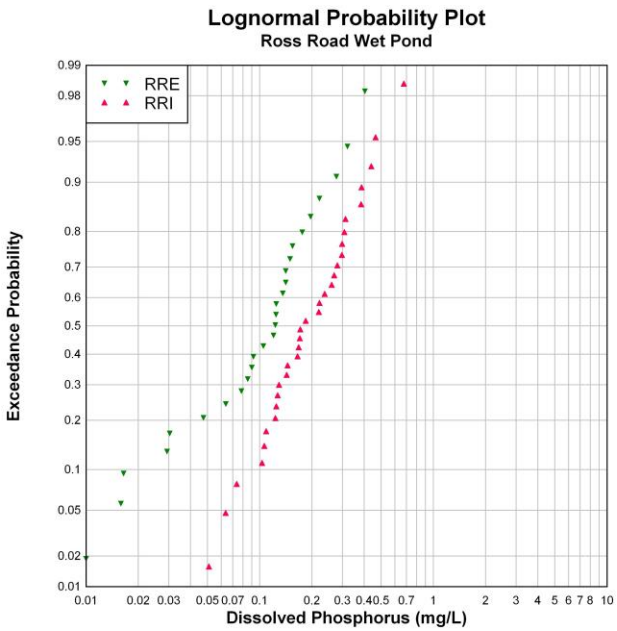


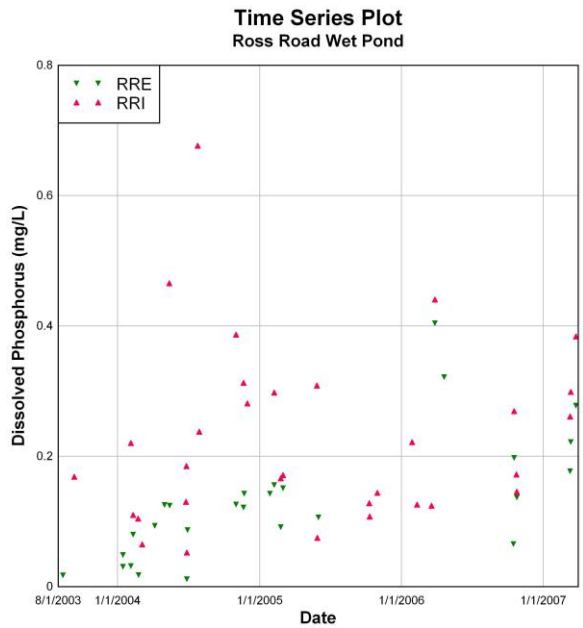


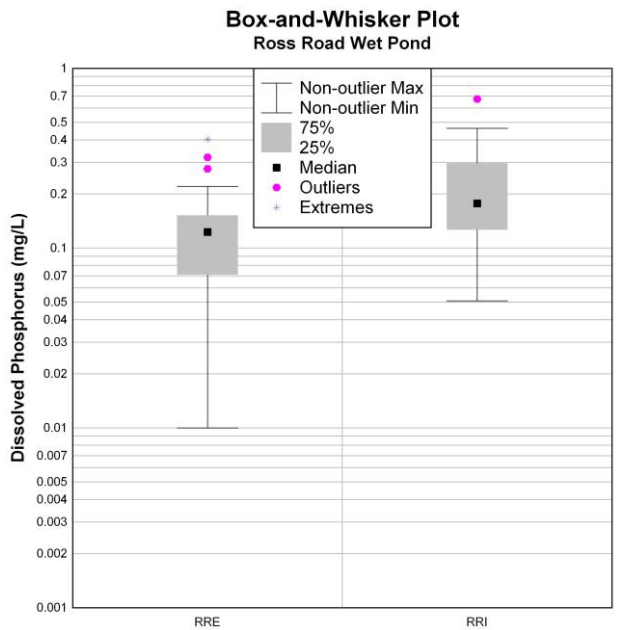


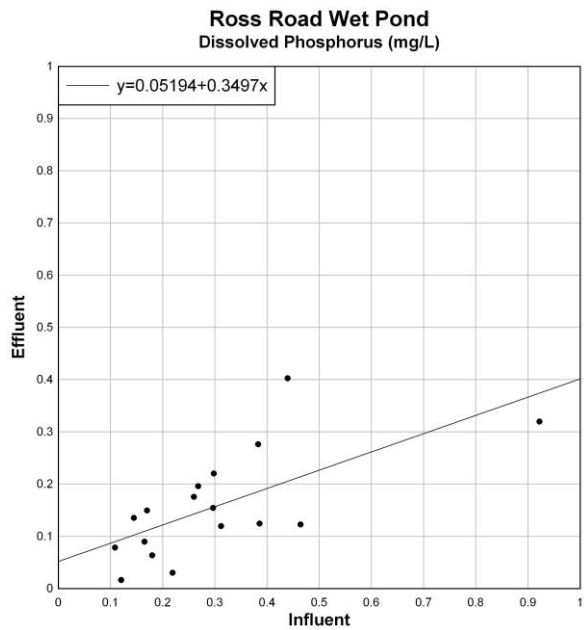
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	32	27
	Pairs Count	16	16
Non-Parametric	Maximum	2.133	0.531
	Upper Quartile	0.601	0.328
	Median	0.383	0.230
	Lower Quartile	0.286	0.138
	Minimum	0.120	0.050
	Efficiency	39.97%	
	Mann-Whitney	0.0006 **	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	0.708	0.290
	Mean	0.537	0.237
	LCL	0.366	0.183
	Std. Dev.	0.475	0.135
	Wilk (p-value)	0.0001 **	0.2590
	Efficiency	55.90%	
	t-Test (equal var.)	0.0024 **	
	t-Test (unequal var.)	0.0016 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0916 *	
Log Transformed	UCL	0.688	0.327
	Mean	0.523	0.243
	LCL	0.397	0.181
	Std. Dev.	0.391	0.178
	Wilk (p-value)	0.4064	0.1584
	Efficiency	53.46%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0001 **	
	Levene Test	0.9144	
Bootstrap	UCL	0.701	0.290
	Mean	0.539	0.238
	LCL	0.377	0.186
	Std. Dev.	0.449	0.132
	Efficiency	55.88%	

Ross Road Wet Pond - Dissolved Phosphorus (mg/L)



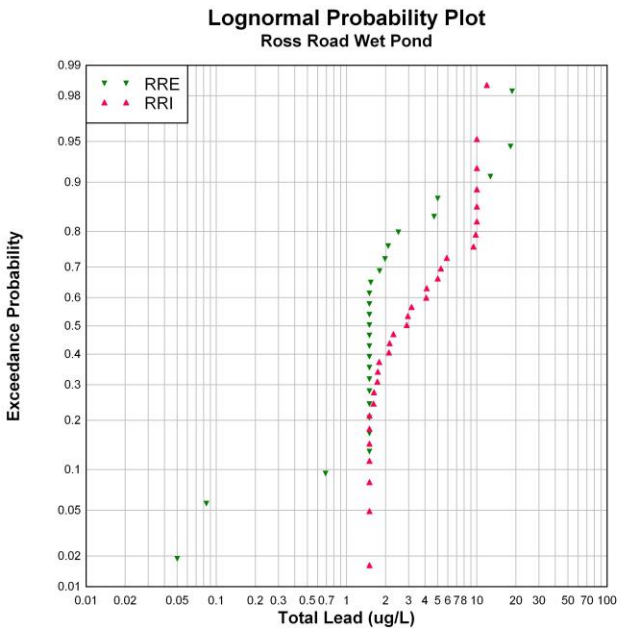


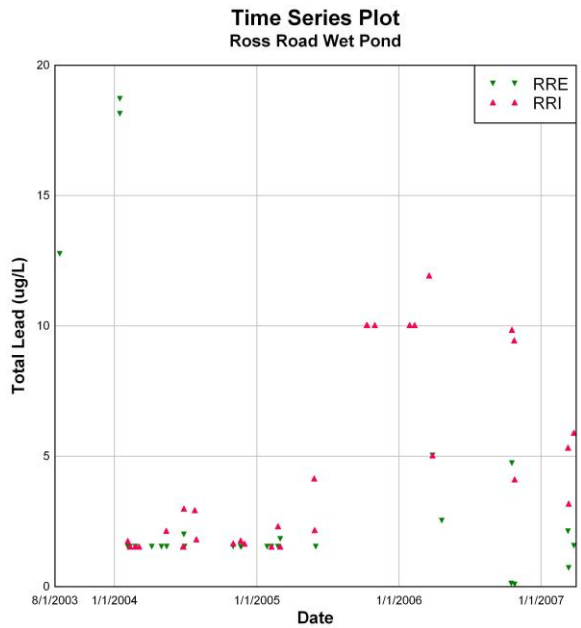


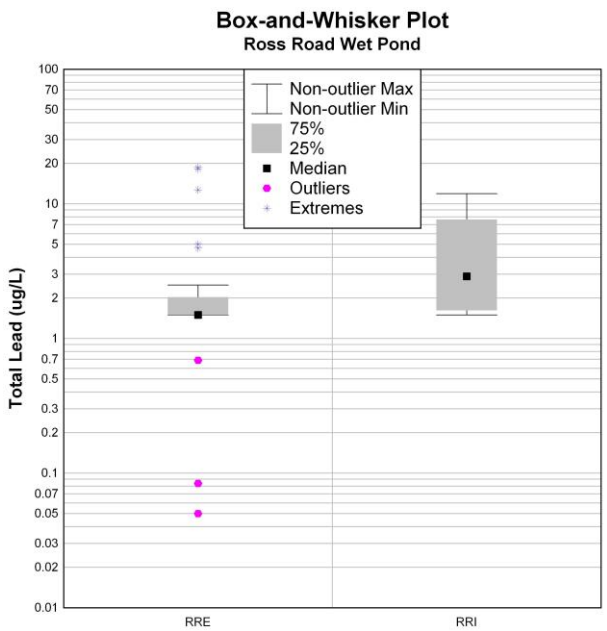


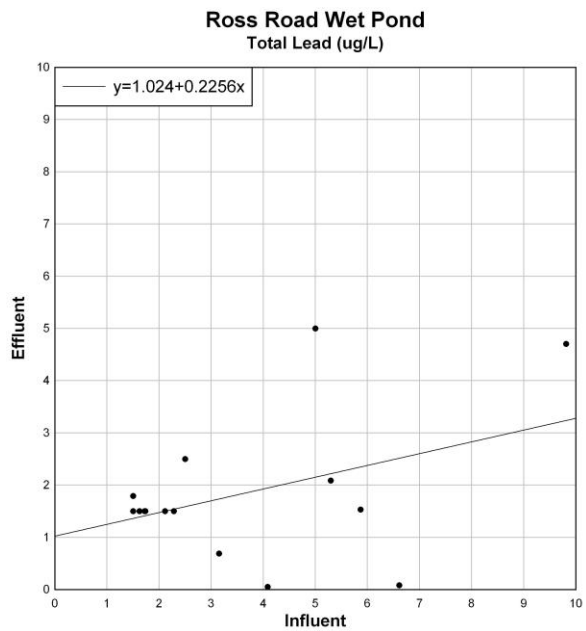
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	32	27
	Pairs Count	16	16
Non-Parametric	Maximum	0.675	0.403
	Upper Quartile	0.297	0.155
	Median	0.177	0.123
	Lower Quartile	0.126	0.064
	Minimum	0.051	0.010
	Efficiency	30.74%	
	Mann-Whitney	0.0030 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.274	0.166
	Mean	0.225	0.128
	LCL	0.176	0.091
	Std. Dev.	0.136	0.094
	Wilk (p-value)	0.0042 **	0.0144 **
	Efficiency	42.87%	
	t-Test (equal var.)	0.0030 **	
	t-Test (unequal var.)	0.0023 **	
	t-test (paired)	0.0021 **	
	Levene Test	0.2090	
Log Transformed	UCL	0.286	0.217
	Mean	0.226	0.140
	LCL	0.179	0.090
	Std. Dev.	0.145	0.151
	Wilk (p-value)	0.9731	0.0405 **
	Efficiency	38.04%	
	t-Test (equal var.)	0.0008 **	
	t-Test (unequal var.)	0.0013 **	
	t-Test (paired)	0.0003 **	
	Levene Test	0.0463 **	
Bootstrap	UCL	0.273	0.165
	Mean	0.226	0.129
	LCL	0.179	0.094
	Std. Dev.	0.131	0.091
	Efficiency	42.76%	

Ross Road Wet Pond - Total Lead (ug/L)



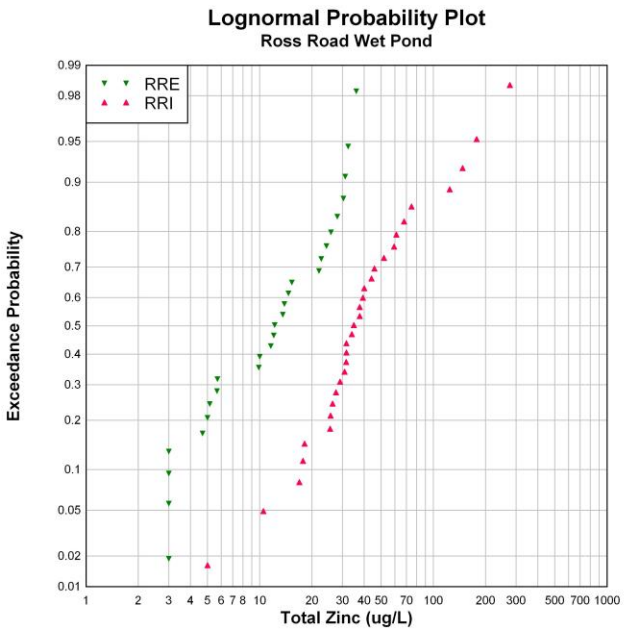


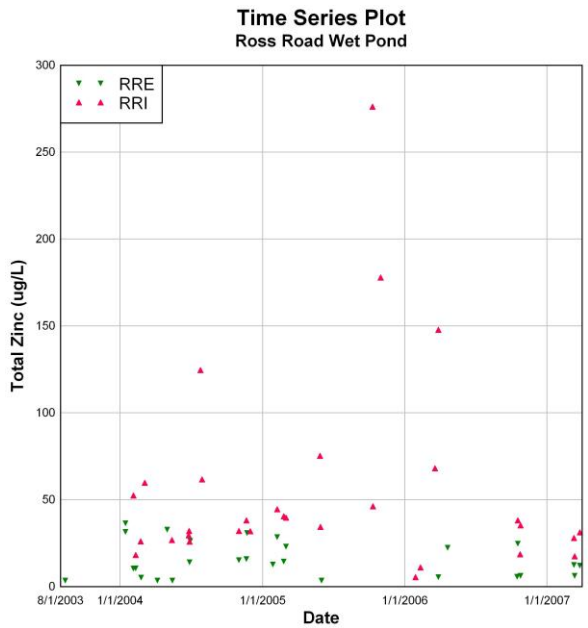


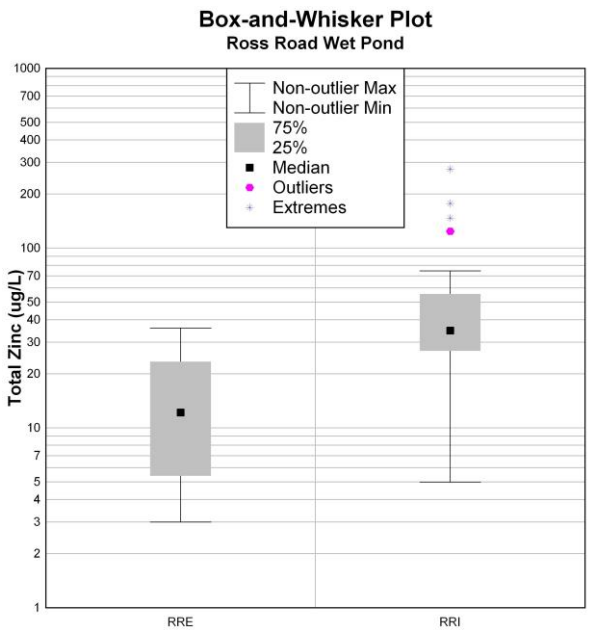


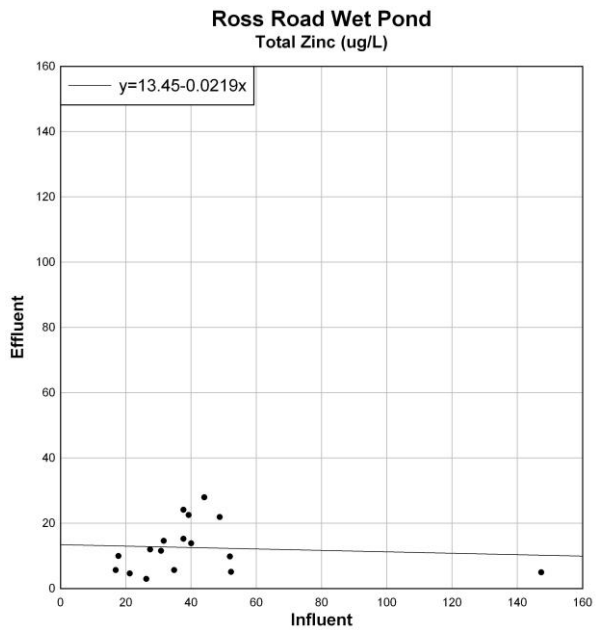
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	31	27
	Pairs Count	16	16
Non-Parametric	Maximum	11.9	18.7
	Upper Quartile	9.4	2.1
	Median	2.9	1.5
	Lower Quartile	1.6	1.5
	Minimum	1.5	0.0
	Efficiency	48.31%	
	Mann-Whitney	0.0106 **	
	Wilcoxon (paired)	0.0071 **	
Arithmetic	UCL	5.8	5.3
	Mean	4.5	3.4
	LCL	3.2	1.4
	Std. Dev.	3.6	4.9
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	25.42%	
	t-Test (equal var.)	0.3110	
	t-Test (unequal var.)	0.3221	
	t-test (paired)	0.0096 **	
	Levene Test	0.3317	
Log Transformed	UCL	6.2	6.9
	Mean	4.5	3.6
	LCL	3.2	1.8
	Std. Dev.	3.9	5.8
	Wilk (p-value)	0.0003 **	0.0001 **
	Efficiency	20.12%	
	t-Test (equal var.)	0.0165 **	
	t-Test (unequal var.)	0.0210 **	
	t-Test (paired)	0.0314 **	
	Levene Test	0.1189	
Bootstrap	UCL	5.8	5.1
	Mean	4.5	3.3
	LCL	3.2	1.5
	Std. Dev.	3.5	4.6
	Efficiency	26.69%	

Ross Road Wet Pond - Total Zinc (ug/L)



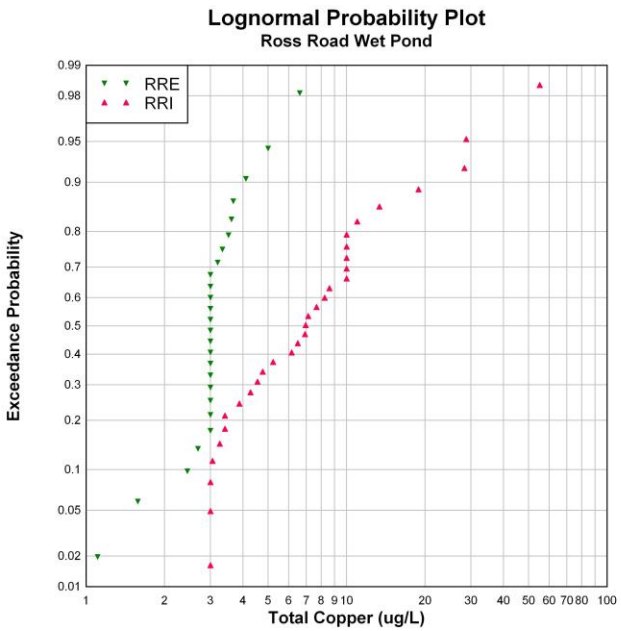


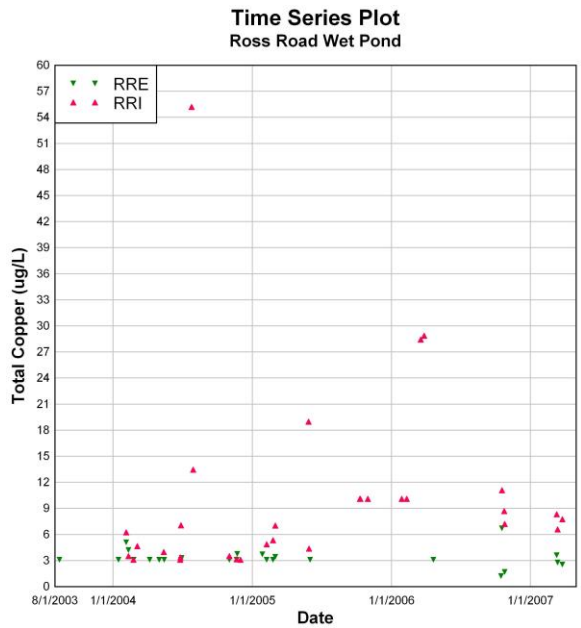


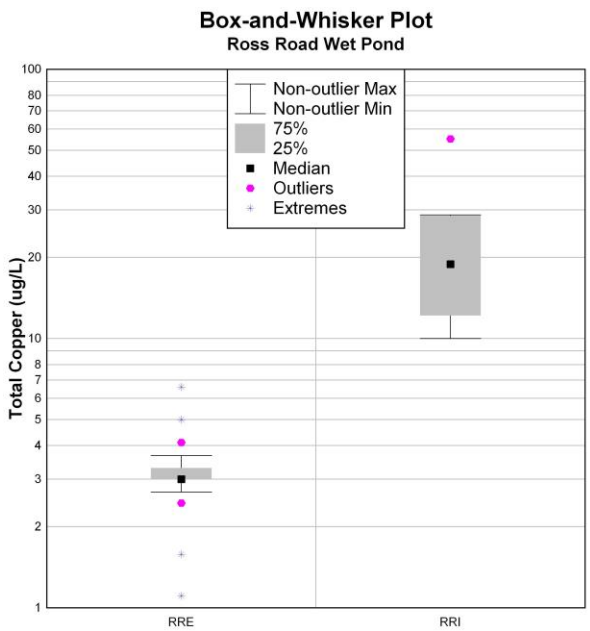


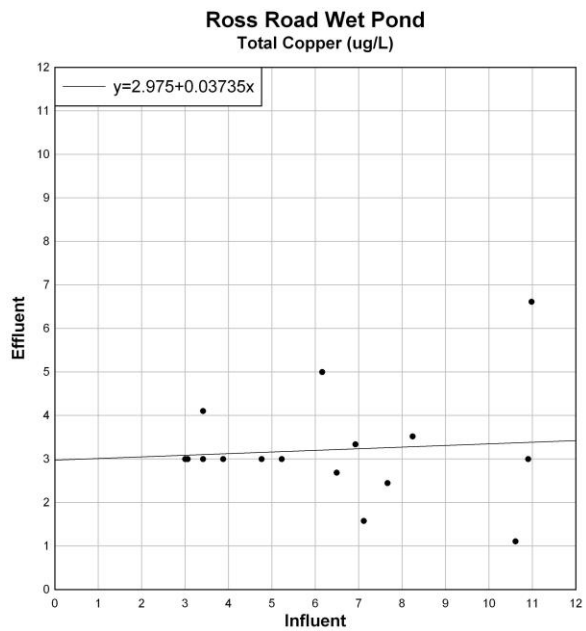
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	31	27
	Pairs Count	16	16
Non-Parametric	Maximum	275.7	35.9
	Upper Quartile	59.3	24.2
	Median	34.8	12.2
	Lower Quartile	26.2	5.2
	Minimum	5.0	3.0
	Efficiency	64.94%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	74.8	19.1
	Mean	54.2	14.9
	LCL	33.6	10.8
	Std. Dev.	56.2	10.4
	Wilk (p-value)	0.0001 **	0.0137 **
	Efficiency	72.42%	
	t-Test (equal var.)	0.0007 **	
	t-Test (unequal var.)	0.0006 **	
	t-test (paired)	0.0023 **	
	Levene Test	0.0973 *	
Log Transformed	UCL	73.9	22.7
	Mean	52.6	15.5
	LCL	37.5	10.6
	Std. Dev.	47.6	14.4
	Wilk (p-value)	0.1904	0.0341 **
	Efficiency	70.57%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.8796	
Bootstrap	UCL	73.5	18.8
	Mean	54.0	14.8
	LCL	34.5	10.8
	Std. Dev.	53.2	10.1
	Efficiency	72.51%	

Ross Road Wet Pond - Total Copper (ug/L)



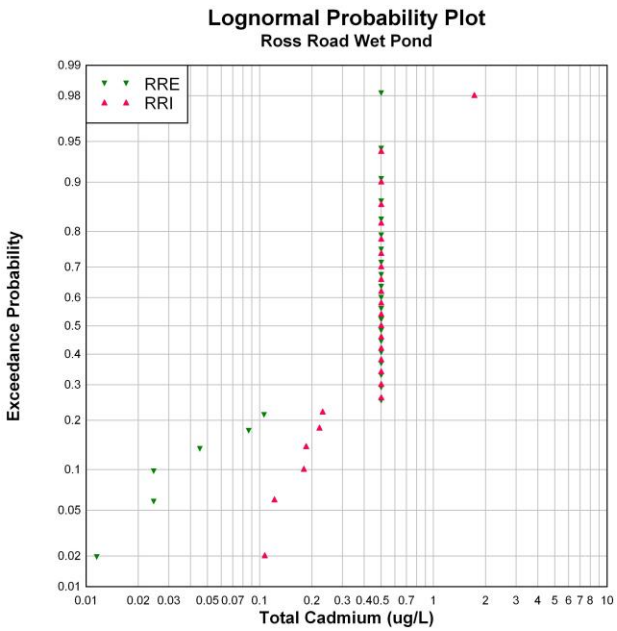


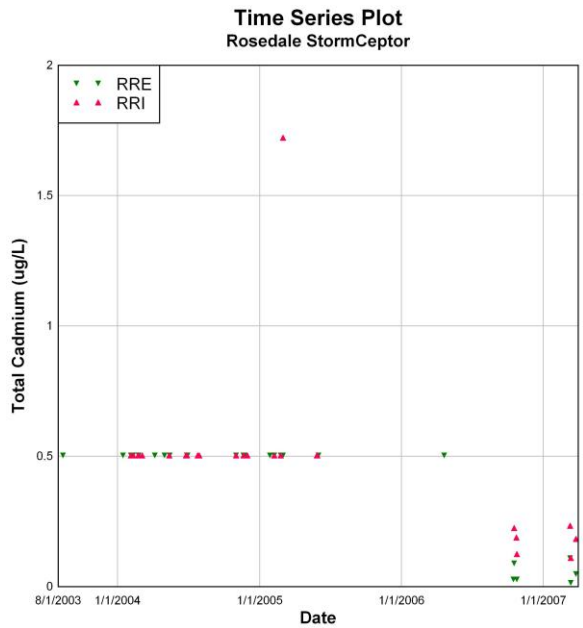


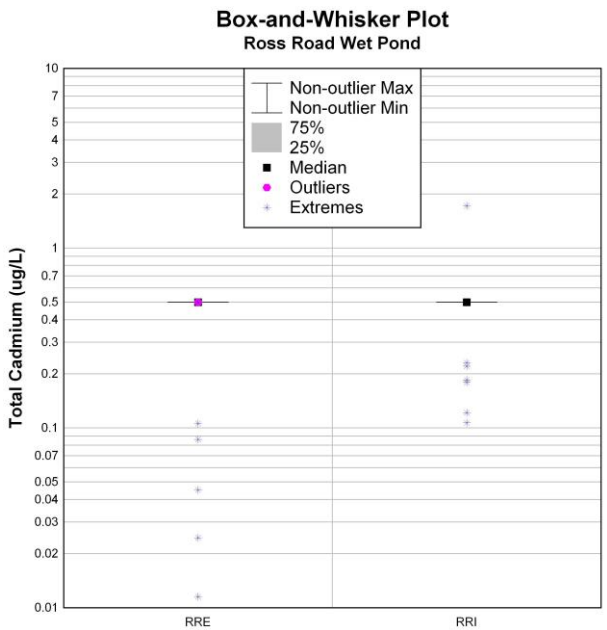


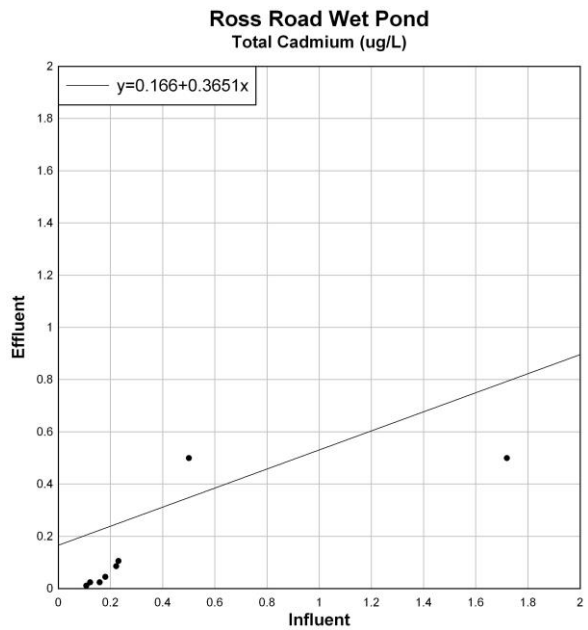
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	31	26
	Pairs Count	15	15
Non-Parametric	Maximum	55.1	6.6
	Upper Quartile	10.0	3.3
	Median	7.0	3.0
	Lower Quartile	3.9	3.0
	Minimum	3.0	1.1
	Efficiency	56.92%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0006 **	
Arithmetic	UCL	13.8	3.6
	Mean	9.9	3.2
	LCL	6.1	2.8
	Std. Dev.	10.6	1.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	67.95%	
	t-Test (equal var.)	0.0020 **	
	t-Test (unequal var.)	0.0013 **	
	t-test (paired)	0.0008 **	
	Levene Test	0.1432	
Log Transformed	UCL	12.7	3.7
	Mean	9.4	3.2
	LCL	7.0	2.8
	Std. Dev.	7.6	1.0
	Wilk (p-value)	0.0216 **	0.0001 **
	Efficiency	66.00%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0012 **	
	Levene Test	0.0158 **	
Bootstrap	UCL	13.4	3.6
	Mean	9.9	3.2
	LCL	6.3	2.8
	Std. Dev.	9.7	0.9
	Efficiency	67.72%	

Ross Road Wet Pond - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: RRI**	**EFF: RRE**
	Site Count	25	26
	Pairs Count	15	15
Non-Parametric	Maximum	1.7	0.5
	Upper Quartile	0.5	0.5
	Median	0.5	0.5
	Lower Quartile	0.5	0.5
	Minimum	0.1	0.0
	Efficiency	0.00%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	0.0137 **	
Arithmetic	UCL	0.6	0.5
	Mean	0.5	0.4
	LCL	0.3	0.3
	Std. Dev.	0.3	0.2
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	15.82%	
	t-Test (equal var.)	0.2925	
	t-Test (unequal var.)	0.2973	
	t-test (paired)	0.1258	
	Levene Test	0.4362	
Log Transformed	UCL	0.6	1.0
	Mean	0.5	0.5
	LCL	0.4	0.3
	Std. Dev.	0.3	0.8
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-10.84%	
	t-Test (equal var.)	0.1480	
	t-Test (unequal var.)	0.1453	
	t-Test (paired)	0.0066 **	
	Levene Test	0.0453 **	
Bootstrap	UCL	0.6	0.5
	Mean	0.5	0.4
	LCL	0.4	0.3
	Std. Dev.	0.3	0.2
	Efficiency	15.92%	

Ceylon Tea Wet Pond (CTI-CTE)

Ceylon Tea wet pond consists of three influents (CTI, CTJ, CTK) and an effluent (CTE). For purposes of data analysis the influents have been combined and are referred to as CTI collectively. Each influent has a separate station with two flow meters and a sampler. See the City's report on small watershed quality and quantity (COA, 2009) for a detailed description of the contributing watershed.

The effluent is a PVC pipe that regulates outflow from the pond at a rate which allows for treatment by the wet pond. At elevated levels there is an overflow which allows runoff to leave the pond so flooding does not occur.

The wet pond has aquatic vegetation planted throughout to help with treatment of stormwater. A very common problem with this particular pond was excessive growth of the vegetation which would clog the effluent and severely inhibit proper drainage.

The City monitored Ceylon Tea wet pond from July 2005 to May 2007. Unpaired influent and effluent EMCs totaled 64 and 11 respectively. There were only five paired EMCs available for analysis.

Performance Summary

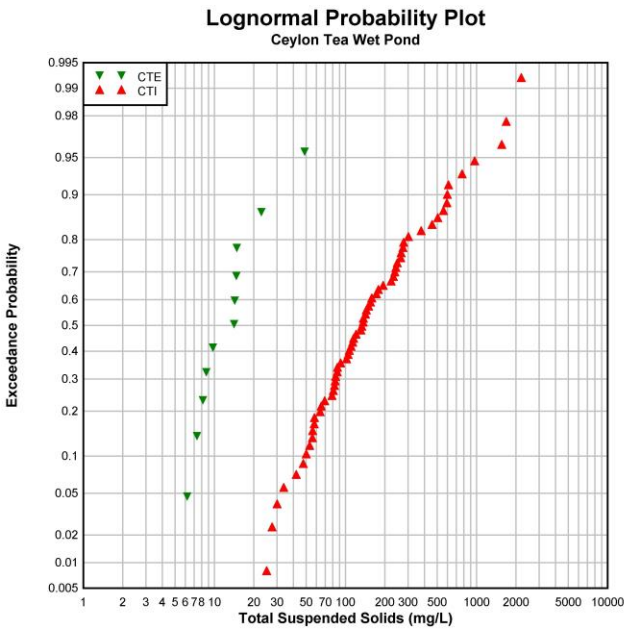
Solids measured by parameters TSS and VSS were both found to be highly significant in all unpaired cases with 94.2% removal efficiency reported. TSS and VSS paired results were both found to be highly significant only for arithmetic and log-transformed cases with 81.2% efficiency reported. TDS was not analyzed at this site.

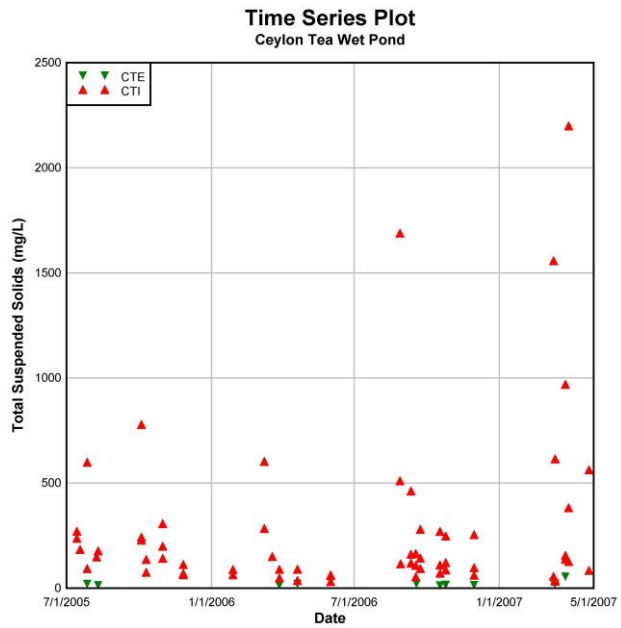
Oxygen demand parameter COD was highly significant in all unpaired cases with 64.3% removal efficiency. For paired data only the log-transformed case was highly significant with 63.5% removal efficiency. Parameter TOC was not found to be significant in any case, paired and unpaired. BOD was not analyzed at this site.

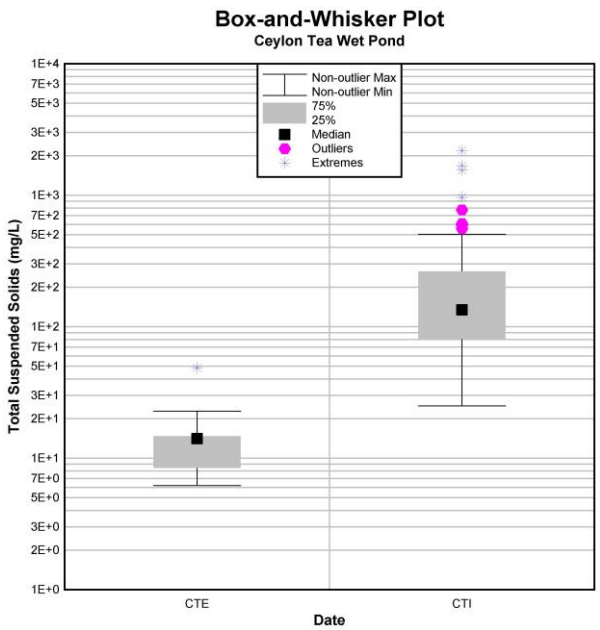
Nutrient parameters TN, NO2+NO3, NH3, TP and DP were highly significant in all unpaired cases. Unpaired nutrient analysis for TKN was not highly significant in any case. With respect to paired data DP was the only parameter found to be highly significant in arithmetic and log-transformed cases. Parameters TN, NO2+NO3, TKN, and TP were highly significant in only the log-transformed case for paired data. Paired analyses for NH3 were not significant in any case. The best performing nutrient was TP with 64.3 % removal efficiency. Decreasing performance following TP was reported for DP with 54.5%, NH3 with 53.7%, NO2+NO3 with 53.2%, TN with 37.7% and finally TKN with 30.0%.

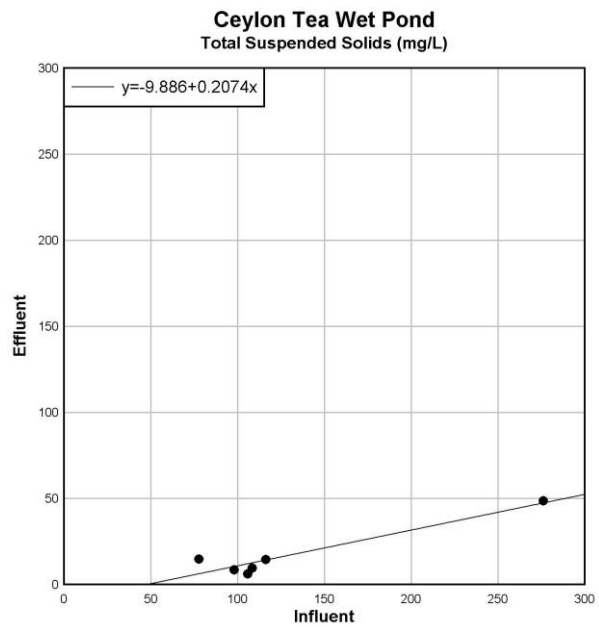
Metal parameters PB, ZN, and CU analyses demonstrated highly significant removal efficiencies in all unpaired cases. CD was an exception due to detection limit interference during the beginning of monitoring. With respect to paired data analyses PB, ZN, CU and CD were all highly significant in arithmetic and log-transformed cases and merely significant in the non-parametric case. Removal efficiency was highest for ZN and PB with 88.5% and 86.1%, respectively. Next in order of decreasing efficiency was CU with 64.4%. Finally, CD with only 35.6% removal efficiency was probably the result of a known detection limit problem.

Ceylon Tea Wet Pond – Total Suspended Solids (mg/L)



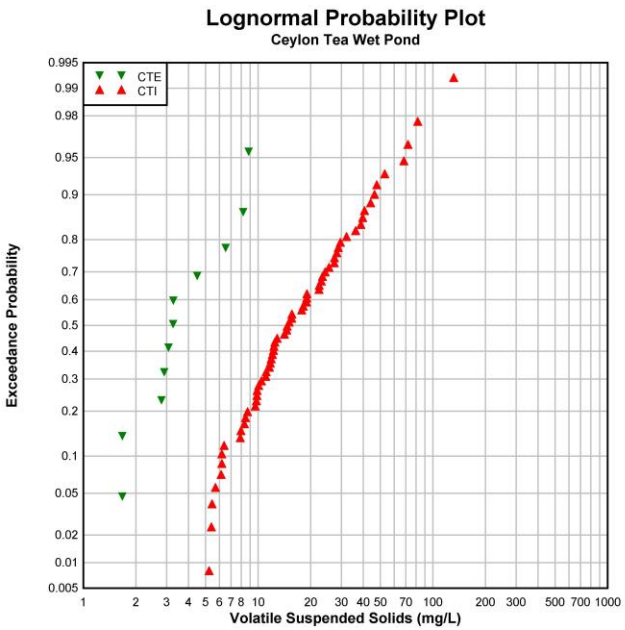


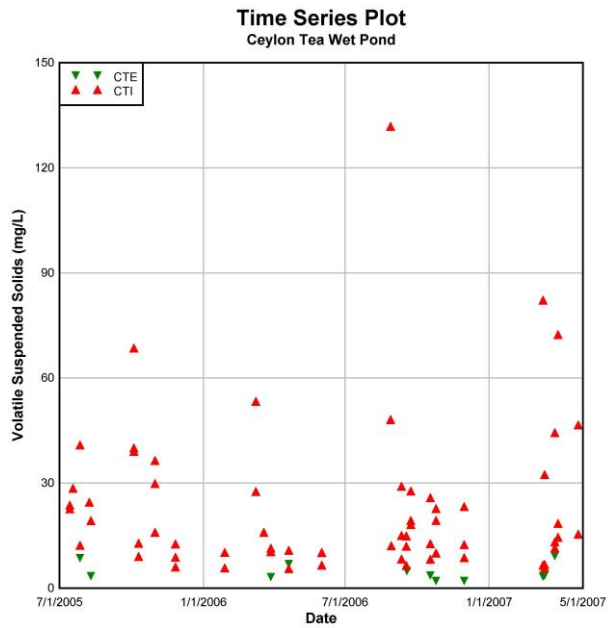


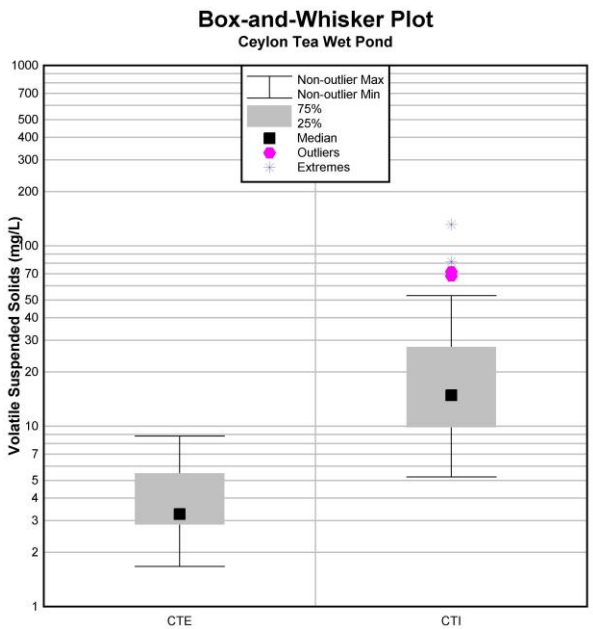


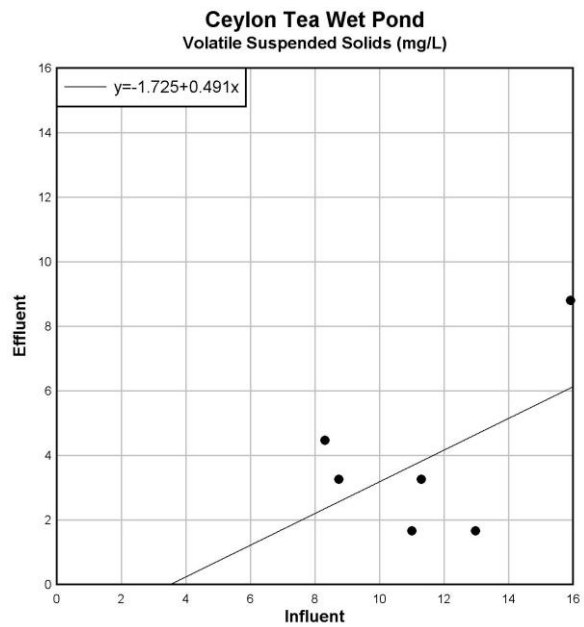
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	2,193.1	48.7
	Upper Quartile	264.1	14.8
	Median	134.2	14.1
	Lower Quartile	79.6	8.2
	Minimum	25.0	6.2
	Efficiency	89.48%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	371.5	23.5
	Mean	272.2	15.4
	LCL	173.0	7.3
	Std. Dev.	397.3	12.0
	Wilk (p-value)	0.0001 **	0.0004 **
	Efficiency	94.34%	
	t-Test (equal var.)	0.0364 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0092 **	
	Levene Test	0.3553	
Log Transformed	UCL	340.1	23.0
	Mean	249.4	14.9
	LCL	182.9	9.7
	Std. Dev.	316.6	9.1
	Wilk (p-value)	0.0781 *	0.2221
	Efficiency	94.01%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0002 **	
	Levene Test	0.1244	
Bootstrap	UCL	364.7	23.1
	Mean	269.7	15.8
	LCL	174.7	8.4
	Std. Dev.	380.3	11.0
	Efficiency	94.16%	

Ceylon Tea Wet Pond – Volatile Suspended Solids (mg/L)



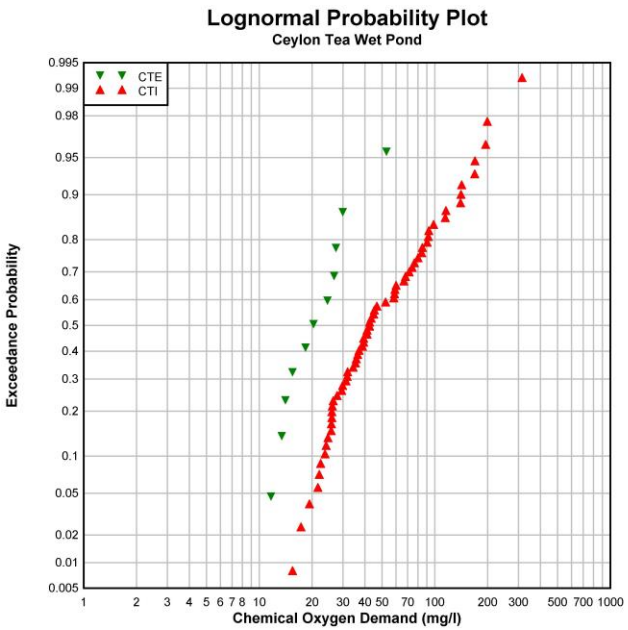


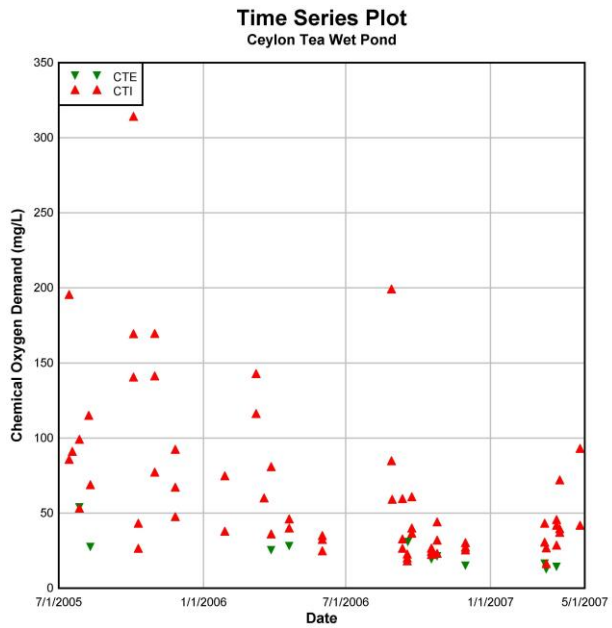


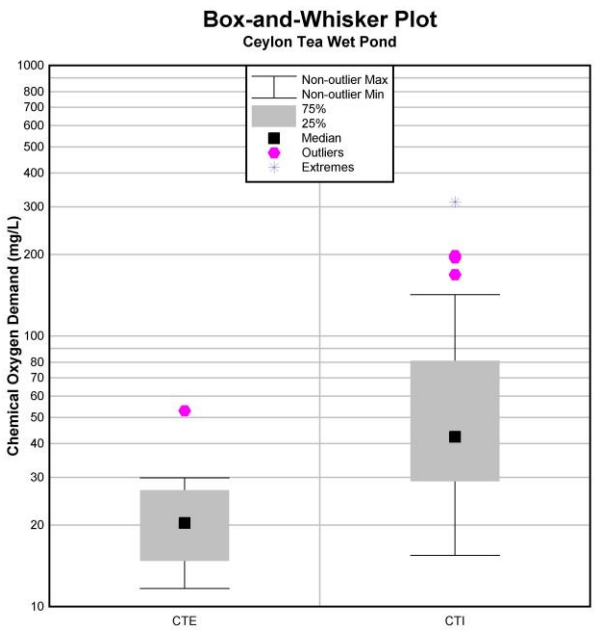


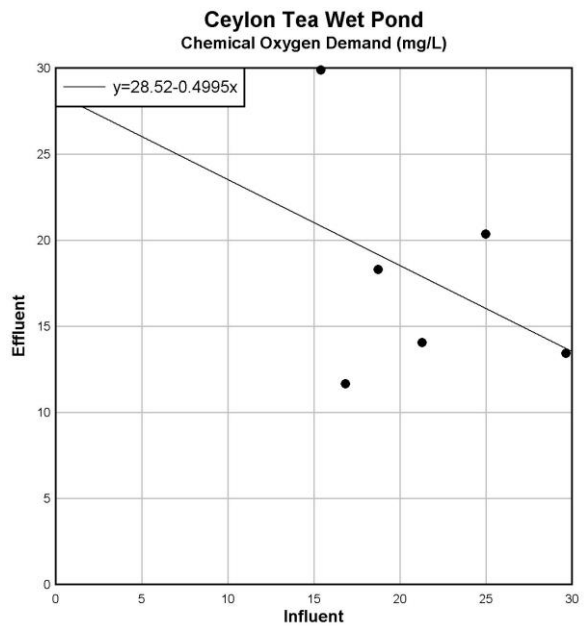
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	131.4	8.8
	Upper Quartile	27.7	6.5
	Median	14.8	3.3
	Lower Quartile	9.8	2.8
	Minimum	5.2	1.7
	Efficiency	78.06%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	28.2	5.9
	Mean	22.8	4.2
	LCL	17.4	2.6
	Std. Dev.	21.7	2.5
	Wilk (p-value)	0.0001 **	0.0355 **
	Efficiency	81.44%	
	t-Test (equal var.)	0.0060 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0011 **	
	Levene Test	0.3339	
Log Transformed	UCL	27.4	6.4
	Mean	22.2	4.2
	LCL	18.0	2.8
	Std. Dev.	18.7	2.5
	Wilk (p-value)	0.0934 *	0.3006
	Efficiency	80.96%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0078 **	
	Levene Test	0.2548	
Bootstrap	UCL	27.9	5.9
	Mean	22.7	4.3
	LCL	17.5	2.7
	Std. Dev.	20.9	2.4
	Efficiency	81.16%	

Ceylon Tea Wet Pond – Chemical Oxygen Demand (mg/L)



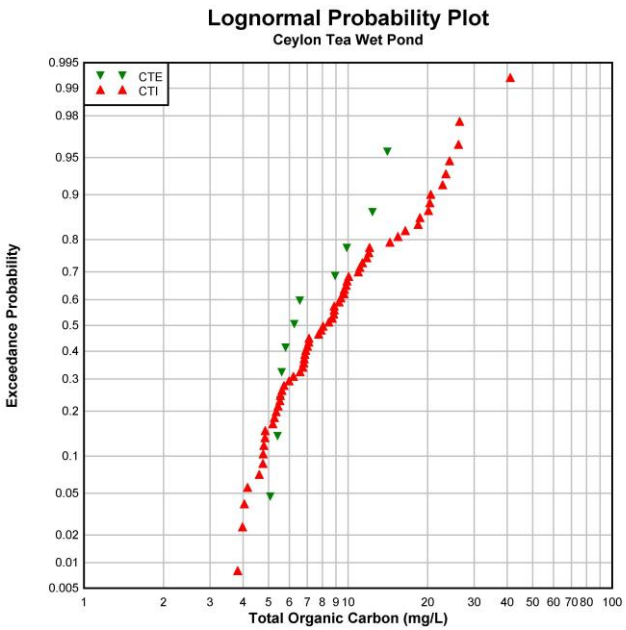


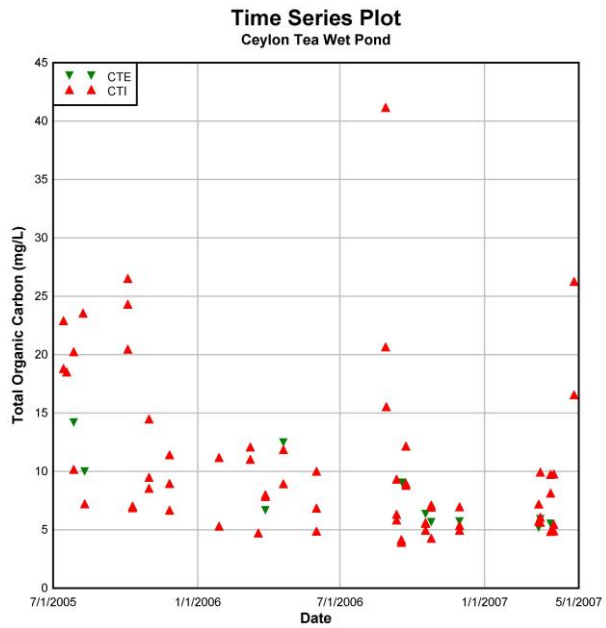


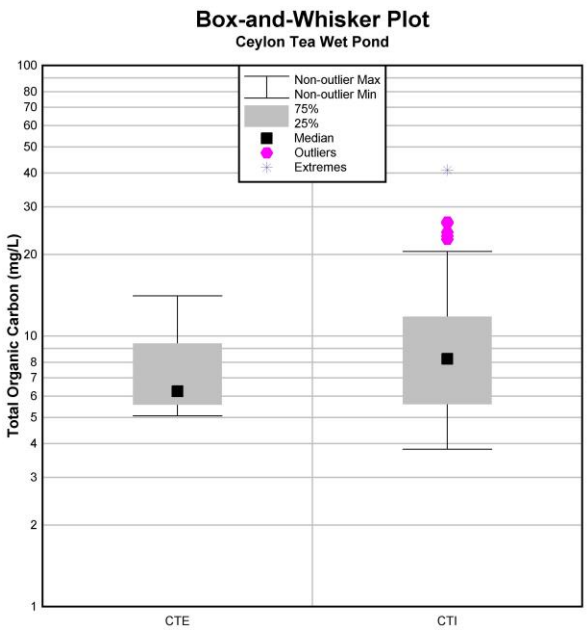


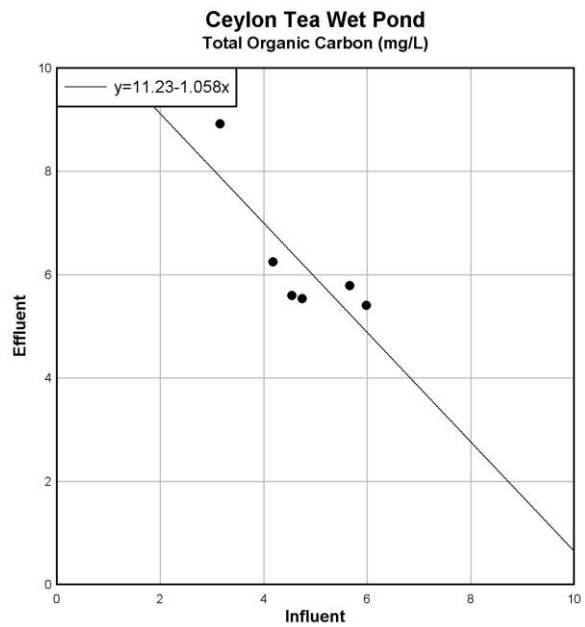
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	313.34	52.96
	Upper Quartile	82.05	27.26
	Median	42.45	20.35
	Lower Quartile	28.60	14.07
	Minimum	15.47	11.67
	Efficiency	52.05%	
	Mann-Whitney	0.0003 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	78.22	30.98
	Mean	64.56	23.13
	LCL	50.89	15.29
	Std. Dev.	54.72	11.68
	Wilk (p-value)	0.0001 **	0.0215 **
	Efficiency	64.17%	
	t-Test (equal var.)	0.0151 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0621 *	
	Levene Test	0.2632	
Log Transformed	UCL	76.23	31.37
	Mean	62.94	22.97
	LCL	51.97	16.81
	Std. Dev.	48.16	10.32
	Wilk (p-value)	0.0263 **	0.6395
	Efficiency	63.51%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0483 **	
	Levene Test	0.1159	
Bootstrap	UCL	77.61	30.01
	Mean	64.31	22.97
	LCL	51.00	15.93
	Std. Dev.	53.26	10.48
	Efficiency	64.28%	

Ceylon Tea Wet Pond – Total Organic Carbon (mg/L)



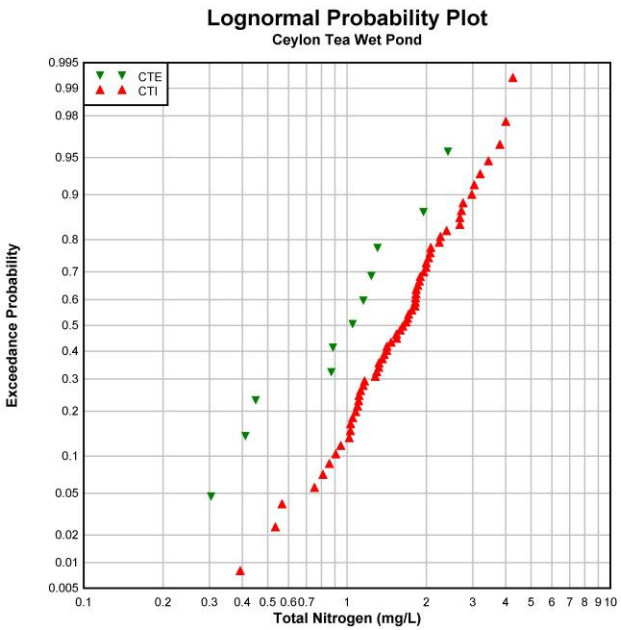


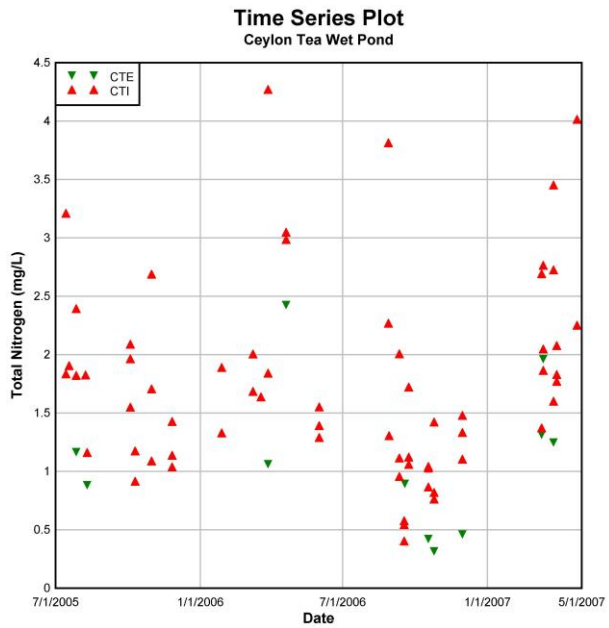


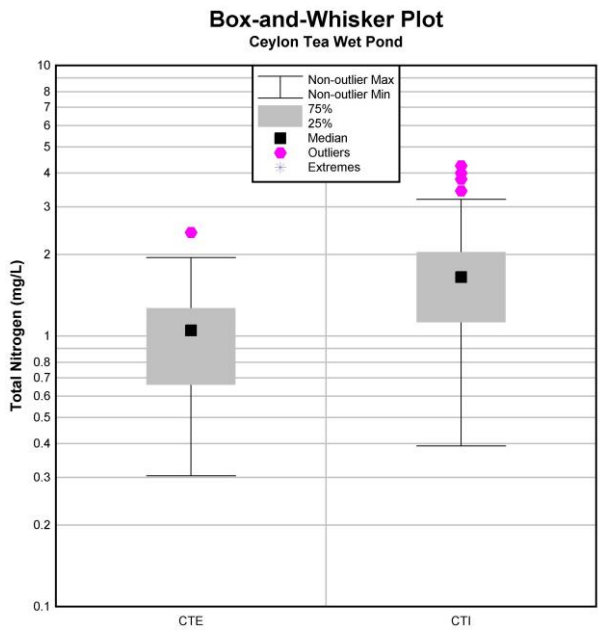


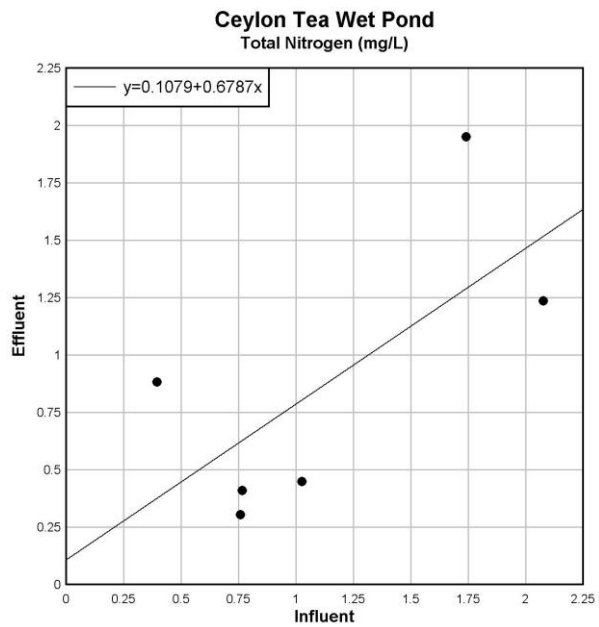
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	41.05	14.08
	Upper Quartile	11.86	9.88
	Median	8.23	6.25
	Lower Quartile	5.57	5.54
	Minimum	3.82	5.07
	Efficiency	24.06%	
	Mann-Whitney	0.3758	
	Wilcoxon (paired)	0.1875	
Arithmetic	UCL	12.32	9.86
	Mean	10.54	7.77
	LCL	8.76	5.68
	Std. Dev.	7.14	3.11
	Wilk (p-value)	0.0001 **	0.0128 **
	Efficiency	26.31%	
	t-Test (equal var.)	0.2108	
	t-Test (unequal var.)	0.0399 **	
	t-test (paired)	0.1931	
	Levene Test	0.2765	
Log Transformed	UCL	12.05	9.93
	Mean	10.37	7.73
	LCL	8.91	6.02
	Std. Dev.	6.23	2.82
	Wilk (p-value)	0.0064 **	0.0454 **
	Efficiency	25.40%	
	t-Test (equal var.)	0.2638	
	t-Test (unequal var.)	0.1425	
	t-Test (paired)	0.1820	
	Levene Test	0.1252	
Bootstrap	UCL	12.25	9.67
	Mean	10.51	7.73
	LCL	8.76	5.79
	Std. Dev.	6.98	2.89
	Efficiency	26.39%	

Ceylon Tea Wet Pond – Total Nitrogen (mg/L)



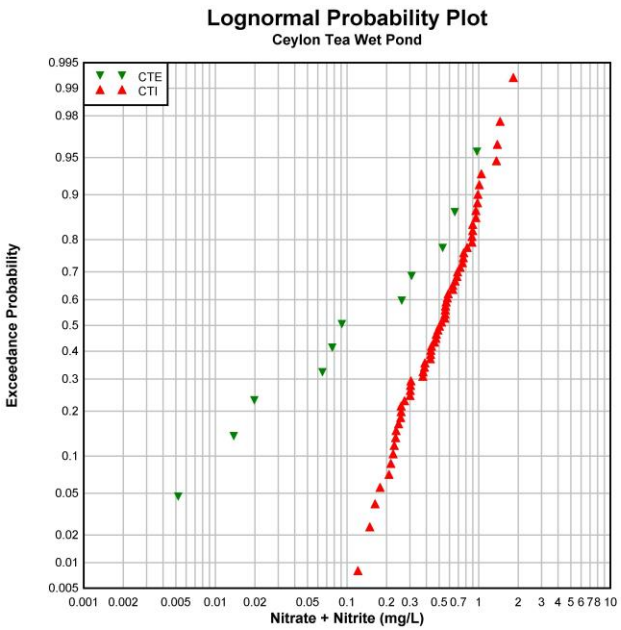


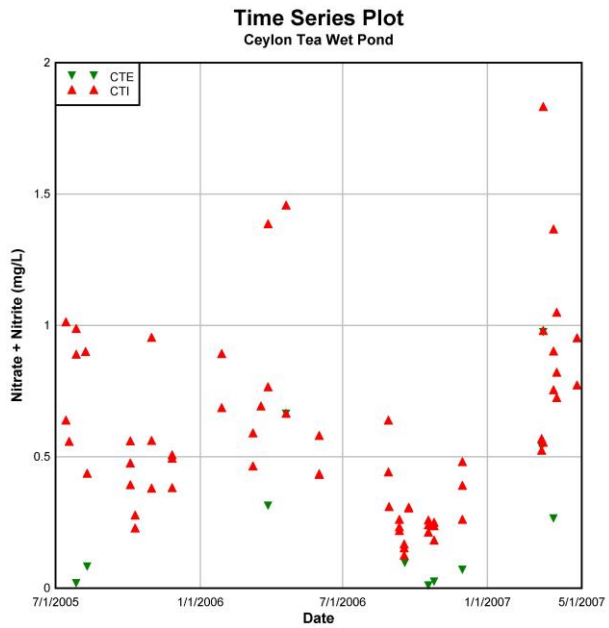


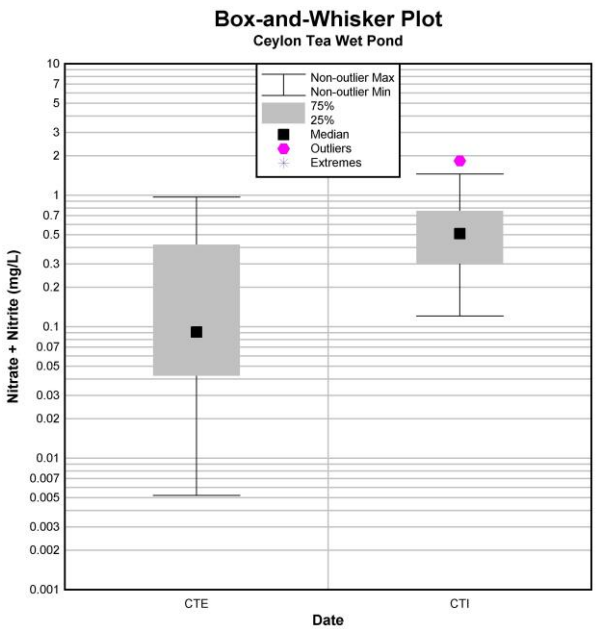


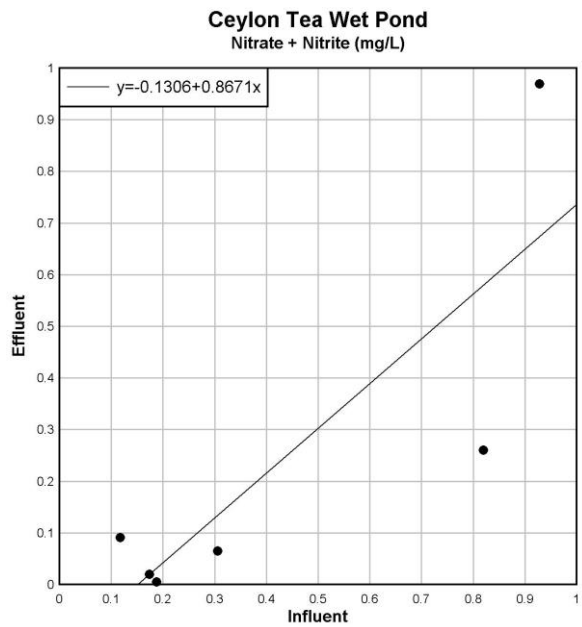
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	4.259	2.414
	Upper Quartile	2.052	1.304
	Median	1.650	1.050
	Lower Quartile	1.118	0.449
	Minimum	0.392	0.305
	Efficiency	36.36%	
	Mann-Whitney	0.0127 **	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	1.964	1.526
	Mean	1.756	1.093
	LCL	1.547	0.661
	Std. Dev.	0.835	0.644
	Wilk (p-value)	0.0008 **	0.3436
	Efficiency	37.73%	
	t-Test (equal var.)	0.0146 **	
	t-Test (unequal var.)	0.0082 **	
	t-test (paired)	0.0812 *	
	Levene Test	0.3939	
Log Transformed	UCL	2.003	1.791
	Mean	1.764	1.108
	LCL	1.553	0.685
	Std. Dev.	0.895	0.742
	Wilk (p-value)	0.6312	0.6027
	Efficiency	37.20%	
	t-Test (equal var.)	0.0018 **	
	t-Test (unequal var.)	0.0216 **	
	t-Test (paired)	0.0378 **	
	Levene Test	0.2060	
Bootstrap	UCL	1.960	1.495
	Mean	1.755	1.094
	LCL	1.549	0.692
	Std. Dev.	0.822	0.598
	Efficiency	37.68%	

Ceylon Tea Wet Pond – Nitrate + Nitrite (mg/L)



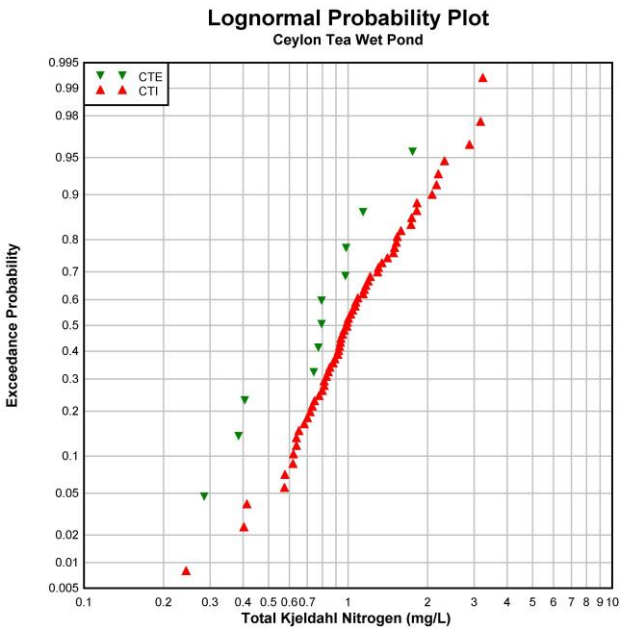


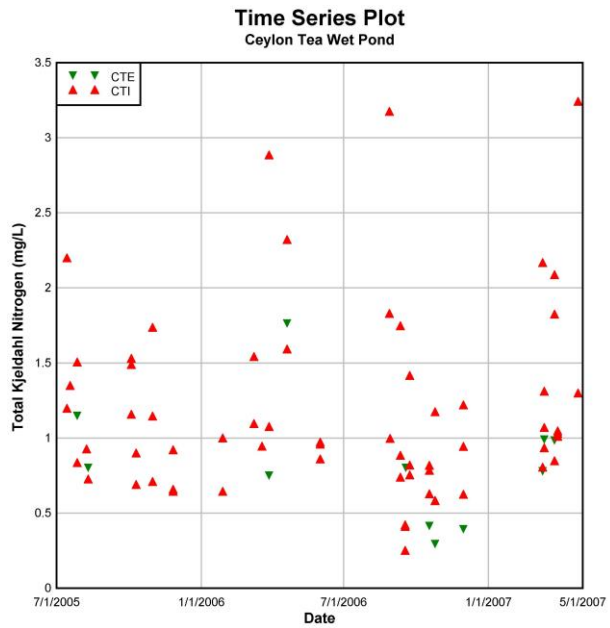


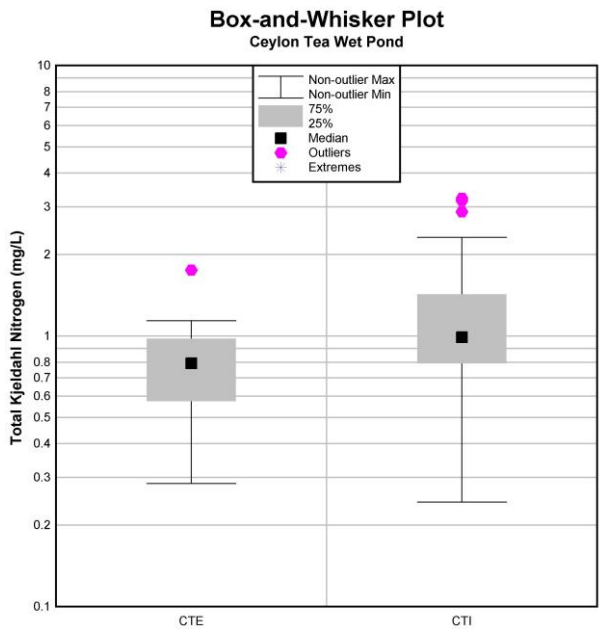


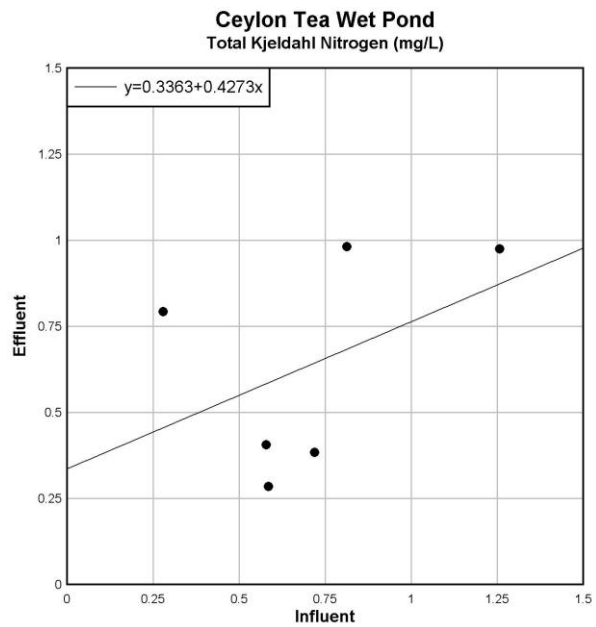
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	1.828	0.970
	Upper Quartile	0.765	0.533
	Median	0.511	0.091
	Lower Quartile	0.301	0.020
	Minimum	0.120	0.005
	Efficiency	82.19%	
	Mann-Whitney	0.0064 **	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	0.669	0.488
	Mean	0.581	0.273
	LCL	0.493	0.058
	Std. Dev.	0.352	0.319
	Wilk (p-value)	0.0001 **	0.0200 **
	Efficiency	53.04%	
	t-Test (equal var.)	0.0082 **	
	t-Test (unequal var.)	0.0111 **	
	t-test (paired)	0.0883 *	
	Levene Test	0.6892	
Log Transformed	UCL	0.692	2.255
	Mean	0.586	0.353
	LCL	0.496	0.055
	Std. Dev.	0.390	0.741
	Wilk (p-value)	0.6345	0.6104
	Efficiency	39.70%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0142 **	
	t-Test (paired)	0.0481 **	
	Levene Test	0.0000 **	
Bootstrap	UCL	0.669	0.470
	Mean	0.583	0.273
	LCL	0.496	0.076
	Std. Dev.	0.347	0.293
	Efficiency	53.19%	

Ceylon Tea Wet Pond – Total Kjeldahl Nitrogen (mg/L)



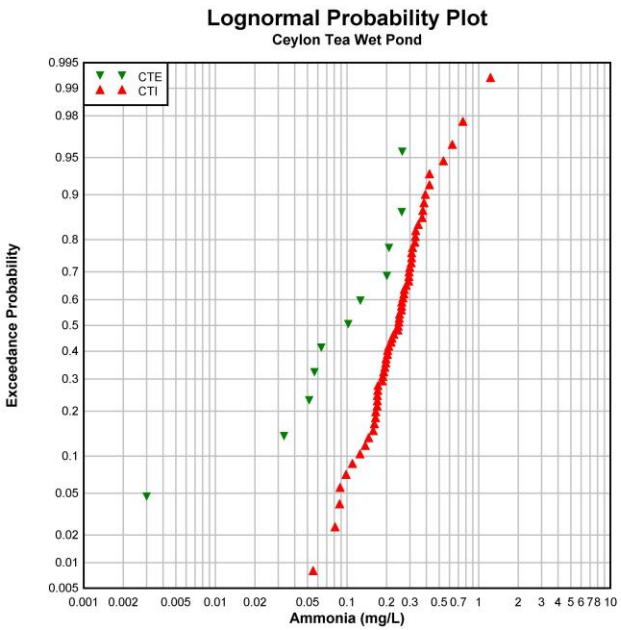


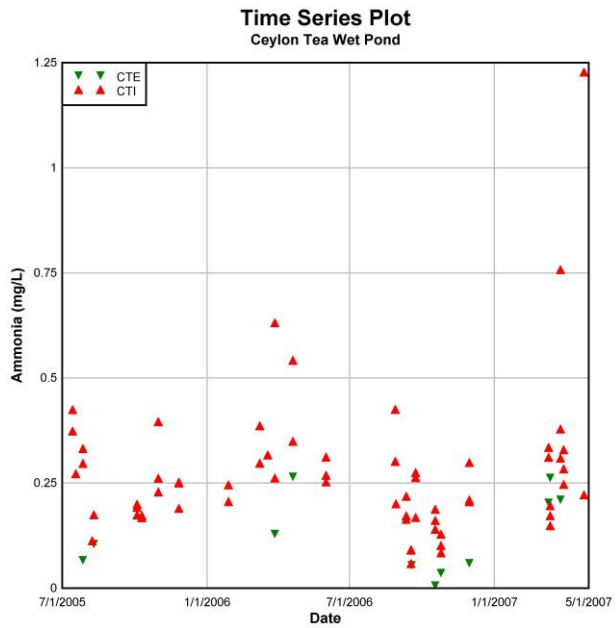


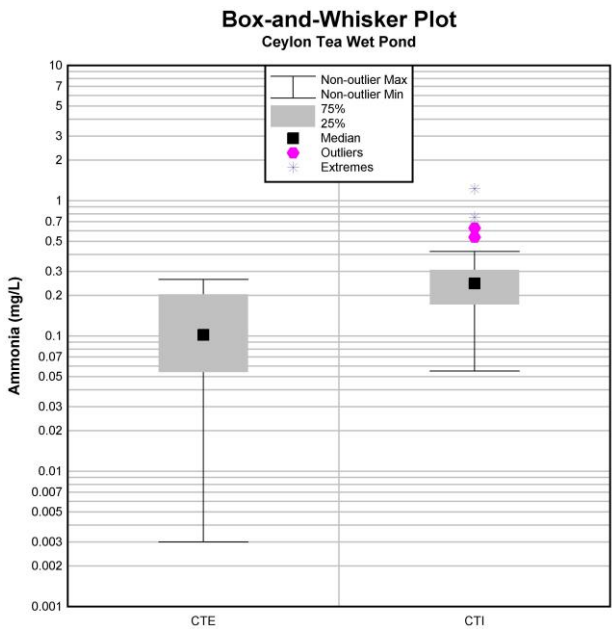


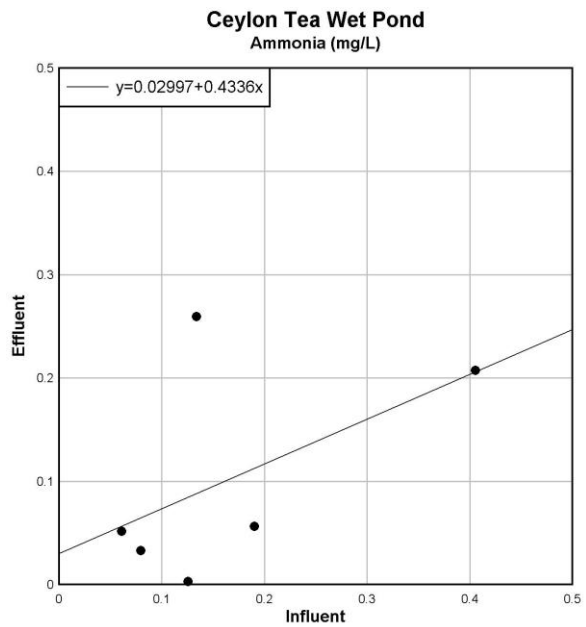
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	3.235	1.755
	Upper Quartile	1.445	0.982
	Median	0.990	0.792
	Lower Quartile	0.787	0.406
	Minimum	0.243	0.285
	Efficiency	20.00%	
	Mann-Whitney	0.0563 *	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	1.330	1.096
	Mean	1.175	0.820
	LCL	1.019	0.545
	Std. Dev.	0.622	0.411
	Wilk (p-value)	0.0001 **	0.2528
	Efficiency	30.16%	
	t-Test (equal var.)	0.0733 *	
	t-Test (unequal var.)	0.0255 **	
	t-test (paired)	0.1171	
	Levene Test	0.3560	
Log Transformed	UCL	1.335	1.210
	Mean	1.173	0.826
	LCL	1.030	0.564
	Std. Dev.	0.604	0.448
	Wilk (p-value)	0.3973	0.4909
	Efficiency	29.56%	
	t-Test (equal var.)	0.0292 **	
	t-Test (unequal var.)	0.0555 *	
	t-Test (paired)	0.0922 *	
	Levene Test	0.8744	
Bootstrap	UCL	1.324	1.075
	Mean	1.172	0.821
	LCL	1.020	0.566
	Std. Dev.	0.610	0.379
	Efficiency	29.97%	

Ceylon Tea Wet Pond – Ammonia (mg/L)



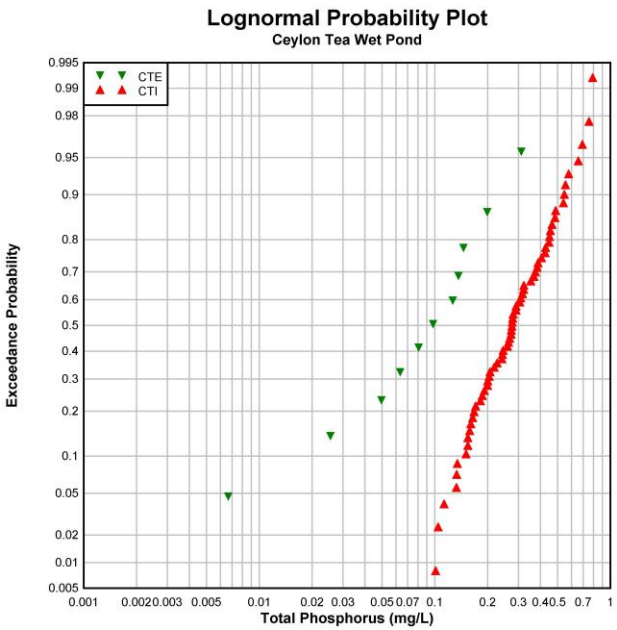


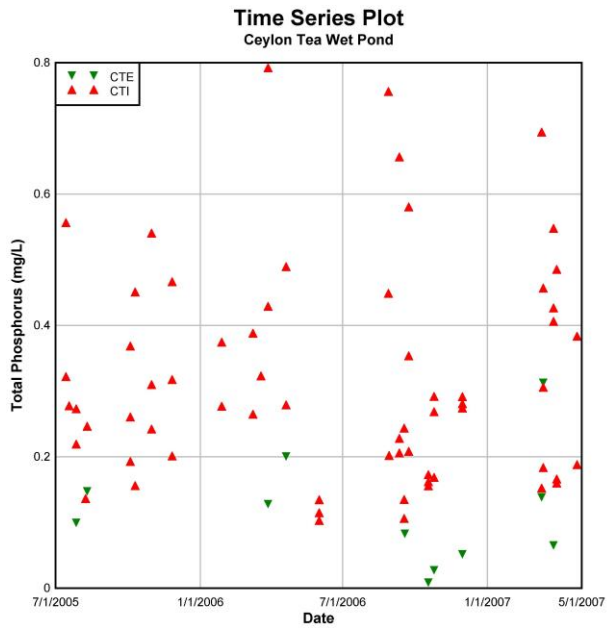


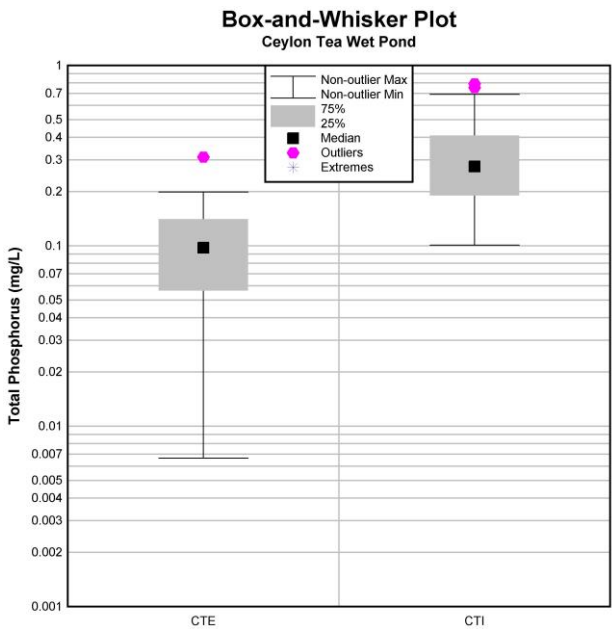


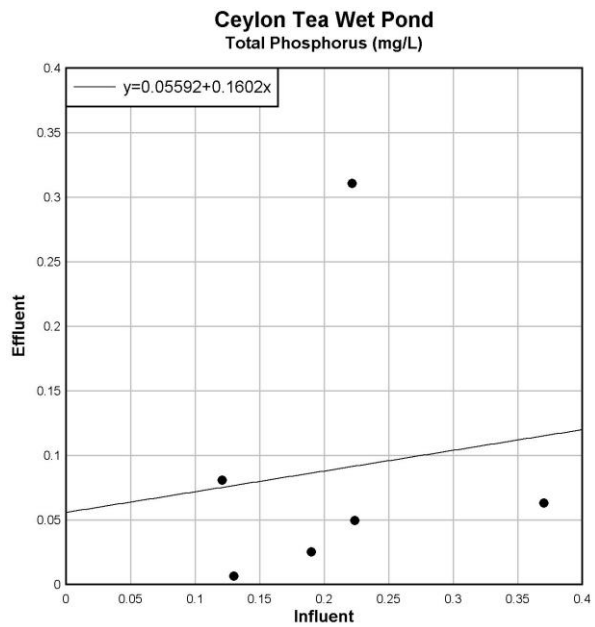
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	1.225	0.262
	Upper Quartile	0.308	0.207
	Median	0.245	0.102
	Lower Quartile	0.170	0.052
	Minimum	0.055	0.003
	Efficiency	58.41%	
	Mann-Whitney	0.0022 **	
	Wilcoxon (paired)	0.3125	
Arithmetic	UCL	0.312	0.187
	Mean	0.269	0.124
	LCL	0.226	0.061
	Std. Dev.	0.173	0.093
	Wilk (p-value)	0.0001 **	0.1974
	Efficiency	53.84%	
	t-Test (equal var.)	0.0086 **	
	t-Test (unequal var.)	0.0004 **	
	t-test (paired)	0.2503	
	Levene Test	0.5477	
Log Transformed	UCL	0.307	0.534
	Mean	0.267	0.160
	LCL	0.232	0.048
	Std. Dev.	0.149	0.236
	Wilk (p-value)	0.1787	0.0244 **
	Efficiency	39.95%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0190 **	
	t-Test (paired)	0.1794	
	Levene Test	0.0025 **	
Bootstrap	UCL	0.311	0.184
	Mean	0.269	0.125
	LCL	0.228	0.065
	Std. Dev.	0.166	0.088
	Efficiency	53.67%	

Ceylon Tea Wet Pond – Total Phosphorus (mg/L)



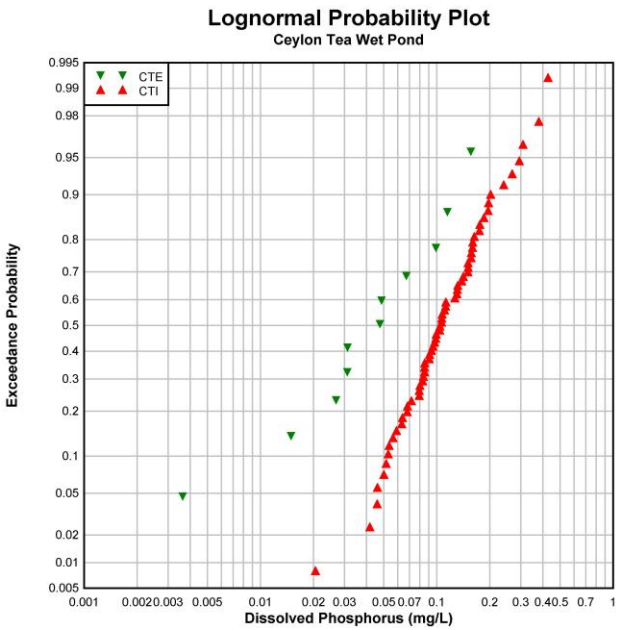


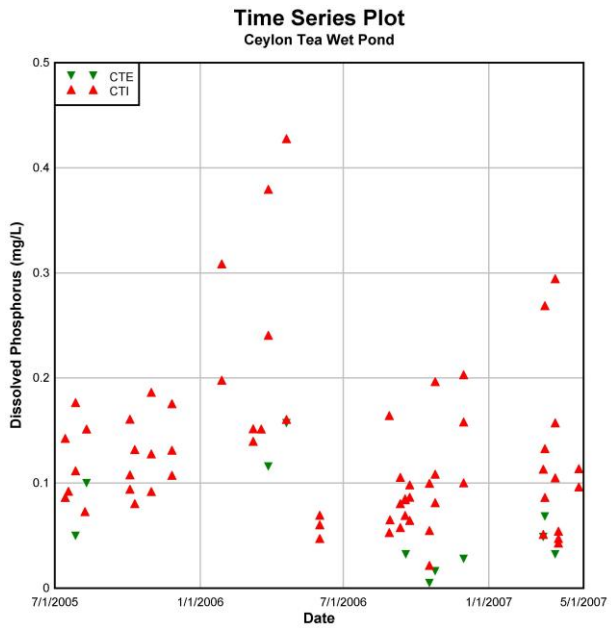


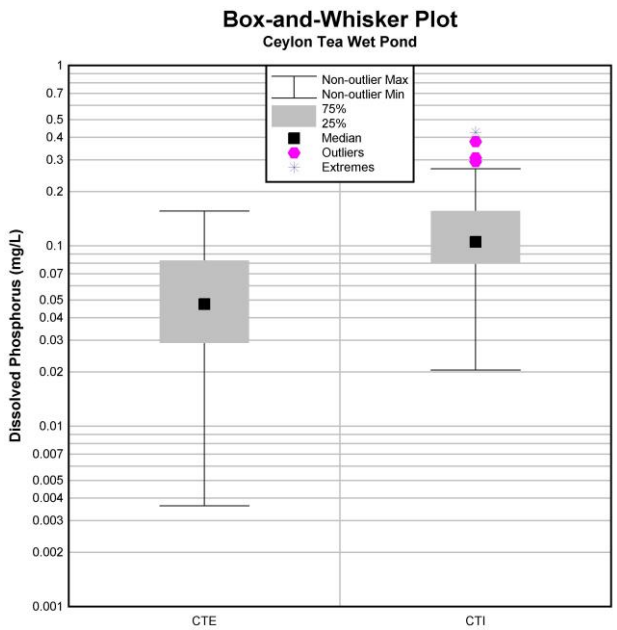


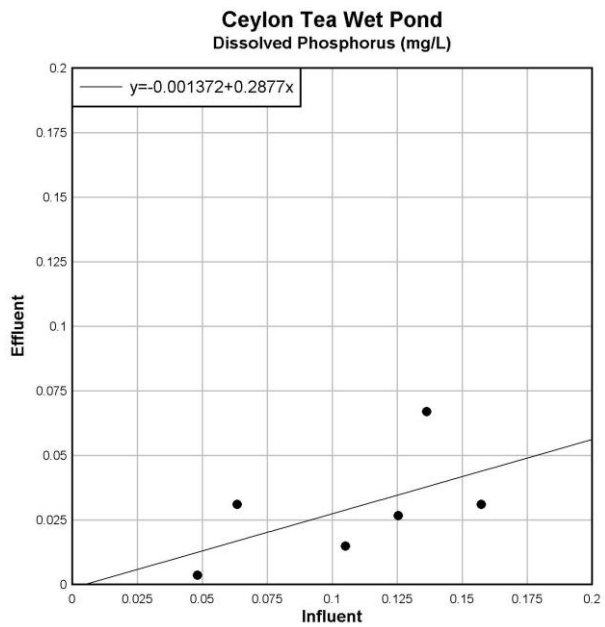
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	0.790	0.311
	Upper Quartile	0.414	0.145
	Median	0.275	0.098
	Lower Quartile	0.189	0.050
	Minimum	0.101	0.007
	Efficiency	64.58%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	0.355	0.171
	Mean	0.315	0.113
	LCL	0.274	0.055
	Std. Dev.	0.163	0.087
	Wilk (p-value)	0.0003 **	0.3440
	Efficiency	64.13%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.1017	
	Levene Test	0.1378	
Log Transformed	UCL	0.360	0.318
	Mean	0.315	0.128
	LCL	0.275	0.051
	Std. Dev.	0.168	0.150
	Wilk (p-value)	0.6389	0.2710
	Efficiency	59.34%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0027 **	
	t-Test (paired)	0.0429 **	
	Levene Test	0.0012 **	
Bootstrap	UCL	0.354	0.165
	Mean	0.314	0.112
	LCL	0.274	0.059
	Std. Dev.	0.160	0.079
	Efficiency	64.34%	

Ceylon Tea Wet Pond – Dissolved Phosphorus (mg/L)



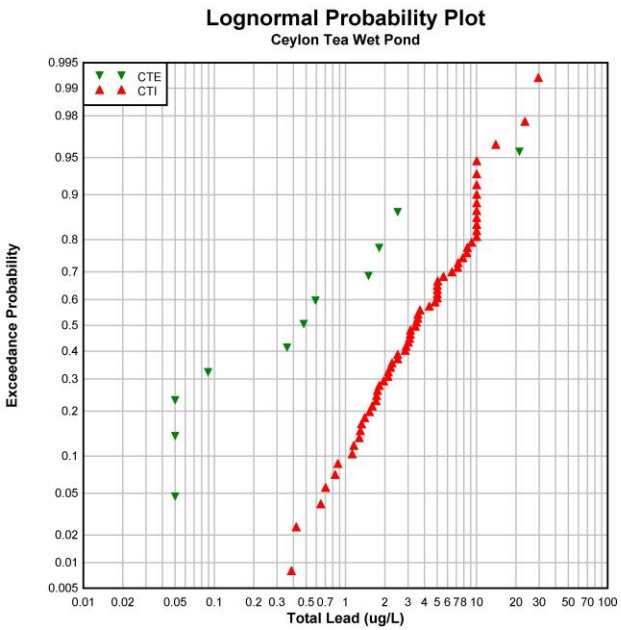


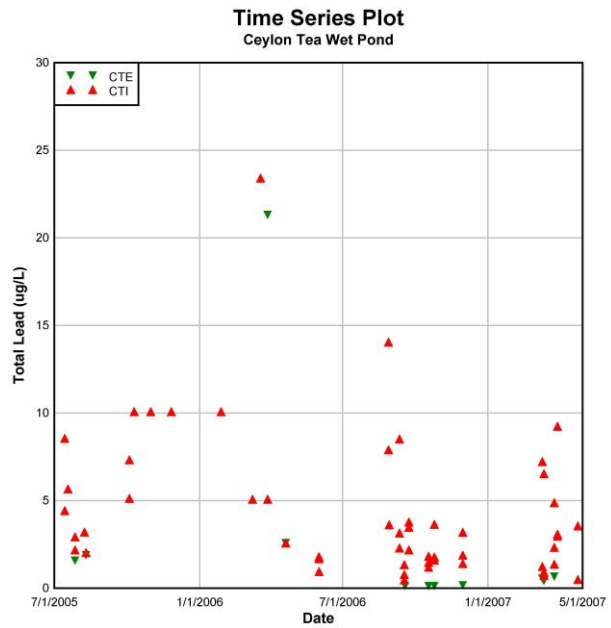


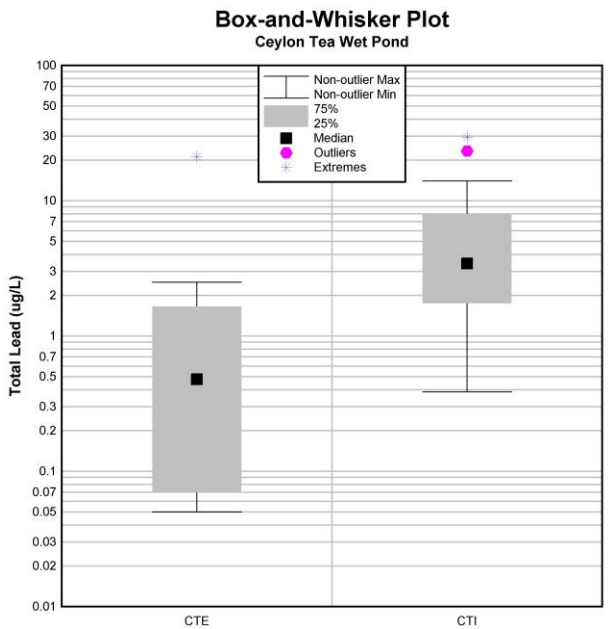


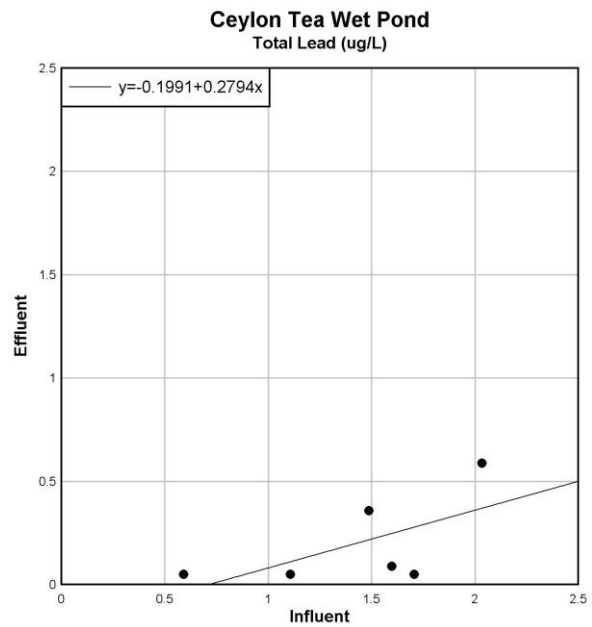
		PARAMETER	DP (mg/L)
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	11
	Pairs Count	5	5
Non-Parametric	Maximum	0.427	0.156
	Upper Quartile	0.156	0.099
	Median	0.105	0.048
	Lower Quartile	0.079	0.027
	Minimum	0.020	0.004
	Efficiency	54.78%	
	Mann-Whitney	0.0019 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	0.146	0.090
	Mean	0.126	0.058
	LCL	0.107	0.027
	Std. Dev.	0.078	0.047
	Wilk (p-value)	0.0001 **	0.2110
	Efficiency	53.94%	
	t-Test (equal var.)	0.0065 **	
	t-Test (unequal var.)	0.0007 **	
	t-test (paired)	0.0034 **	
	Levene Test	0.3614	
Log Transformed	UCL	0.147	0.159
	Mean	0.126	0.065
	LCL	0.108	0.026
	Std. Dev.	0.077	0.075
	Wilk (p-value)	0.8509	0.4144
	Efficiency	48.83%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0107 **	
	t-Test (paired)	0.0053 **	
	Levene Test	0.0068 **	
Bootstrap	UCL	0.146	0.087
	Mean	0.127	0.058
	LCL	0.107	0.028
	Std. Dev.	0.077	0.043
	Efficiency	54.54%	

Ceylon Tea Wet Pond – Total Lead (ug/L)



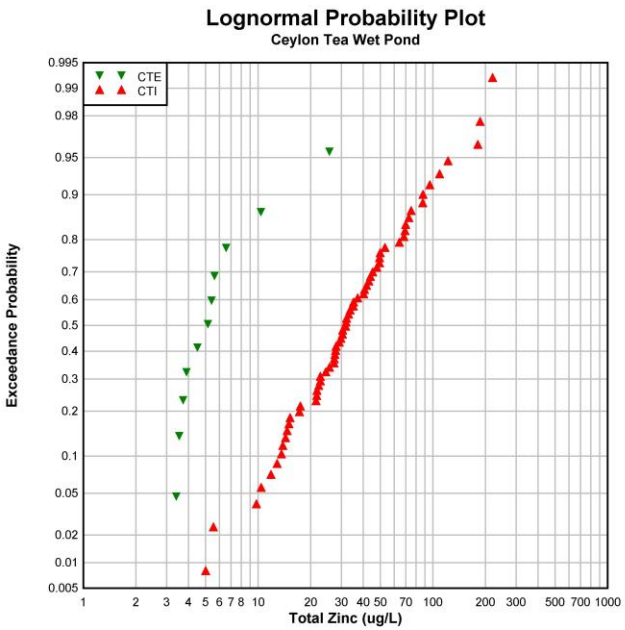


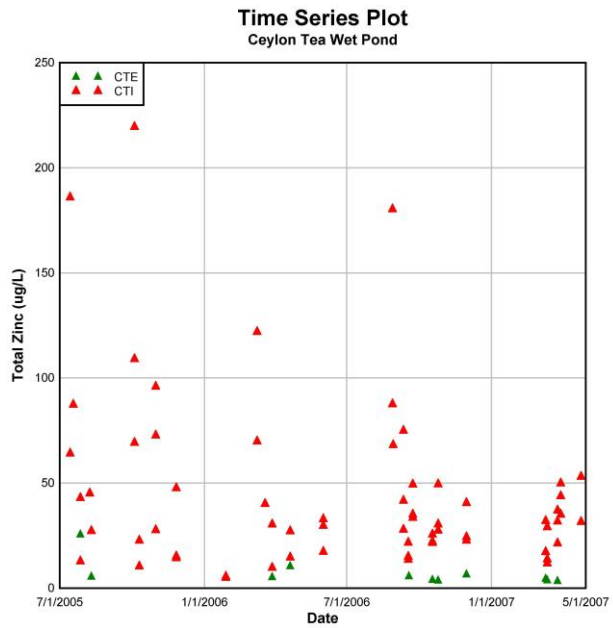


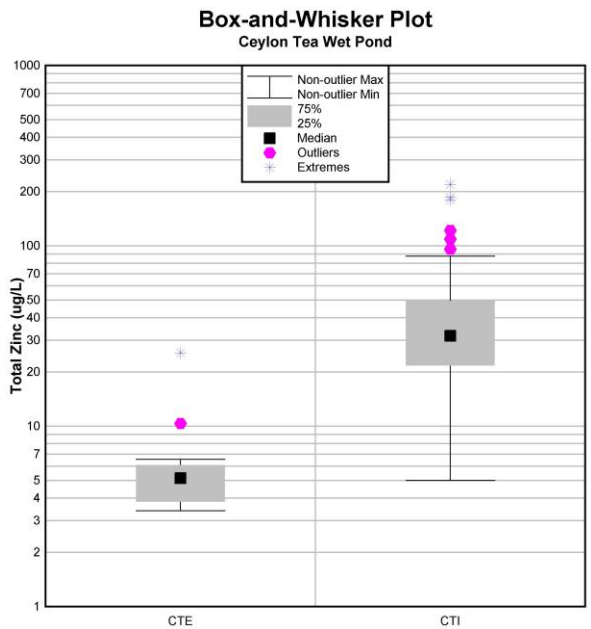


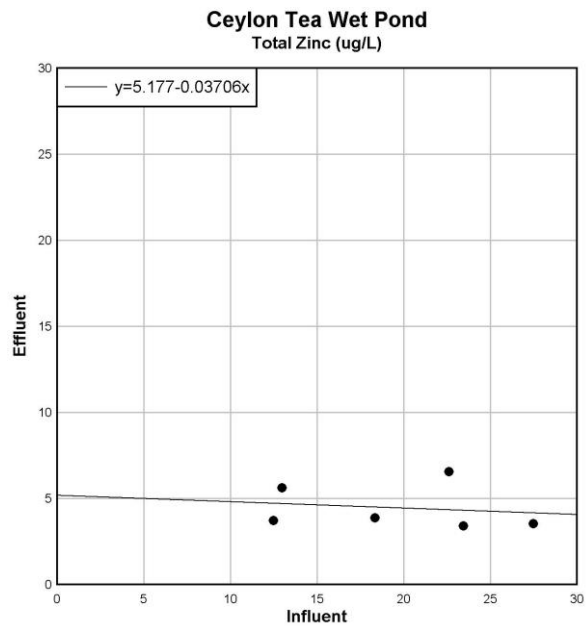
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	10
	Pairs Count	5	5
Non-Parametric	Maximum	29.5	2.5
	Upper Quartile	8.1	1.5
	Median	3.4	0.4
	Lower Quartile	1.7	0.1
	Minimum	0.4	0.0
	Efficiency	87.81%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	6.5	1.4
	Mean	5.2	0.7
	LCL	3.9	0.1
	Std. Dev.	5.2	0.9
	Wilk (p-value)	0.0001 **	0.0179 **
	Efficiency	85.69%	
	t-Test (equal var.)	0.0082 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0003 **	
	Levene Test	0.3336	
Log Transformed	UCL	7.1	4.8
	Mean	5.4	0.8
	LCL	4.0	0.2
	Std. Dev.	6.2	1.5
	Wilk (p-value)	0.3864	0.1129
	Efficiency	84.20%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0008 **	
	t-Test (paired)	0.0063 **	
	Levene Test	0.0014 **	
Bootstrap	UCL	6.5	1.3
	Mean	5.2	0.7
	LCL	4.0	0.2
	Std. Dev.	5.0	0.8
	Efficiency	86.07%	

Ceylon Tea Wet Pond – Total Zinc (ug/L)



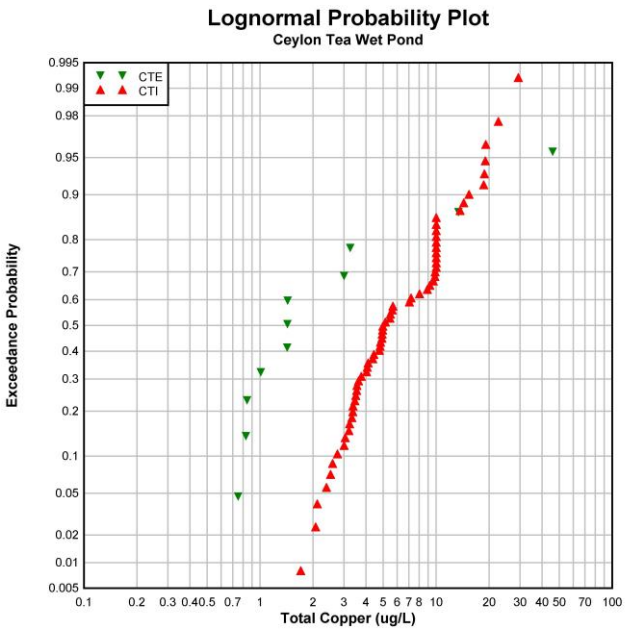


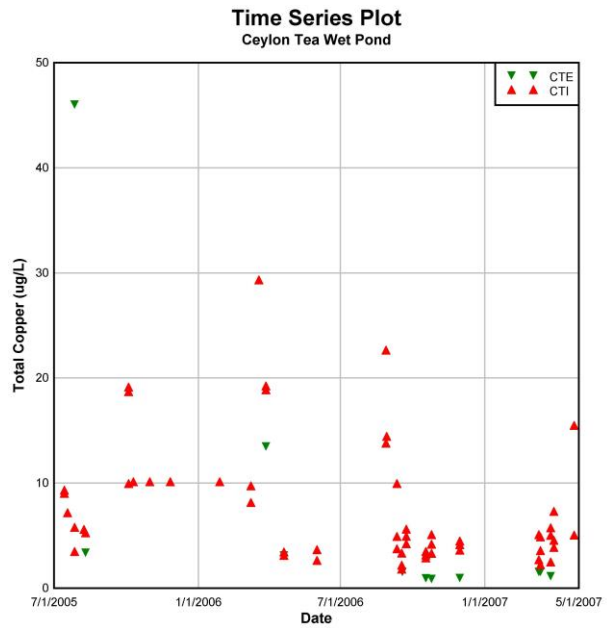


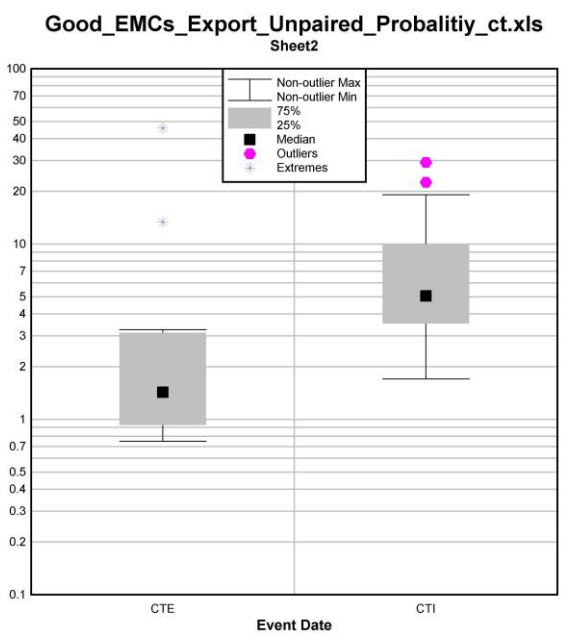


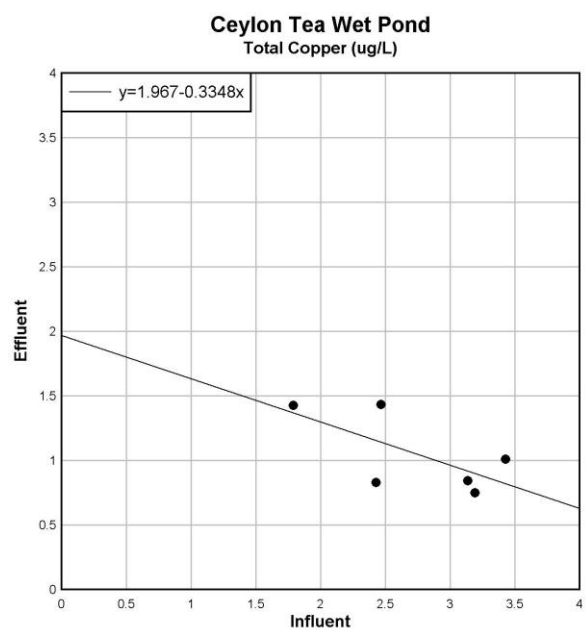
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	10
	Pairs Count	5	5
Non-Parametric	Maximum	219.5	10.4
	Upper Quartile	49.7	5.6
	Median	31.7	4.8
	Lower Quartile	21.7	3.7
	Minimum	5.0	3.4
	Efficiency	84.81%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	55.7	6.7
	Mean	45.2	5.2
	LCL	34.7	3.7
	Std. Dev.	42.0	2.1
	Wilk (p-value)	0.0001 **	0.0159 **
	Efficiency	88.47%	
	t-Test (equal var.)	0.0038 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0029 **	
	Levene Test	0.2743	
Log Transformed	UCL	55.8	6.7
	Mean	44.7	5.2
	LCL	35.8	4.0
	Std. Dev.	39.8	1.8
	Wilk (p-value)	0.7155	0.2518
	Efficiency	88.40%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0008 **	
	Levene Test	0.0880 *	
Bootstrap	UCL	55.2	6.5
	Mean	45.0	5.2
	LCL	34.8	3.9
	Std. Dev.	40.8	1.8
	Efficiency	88.51%	

Ceylon Tea Wet Pond – Total Copper (ug/L)



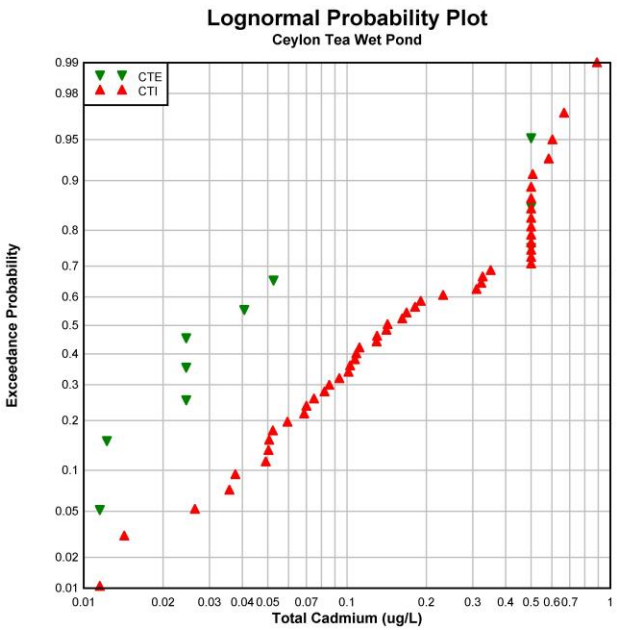


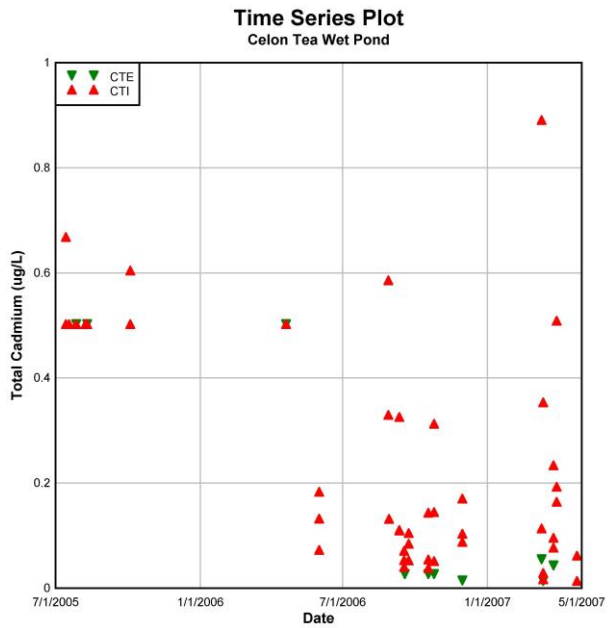


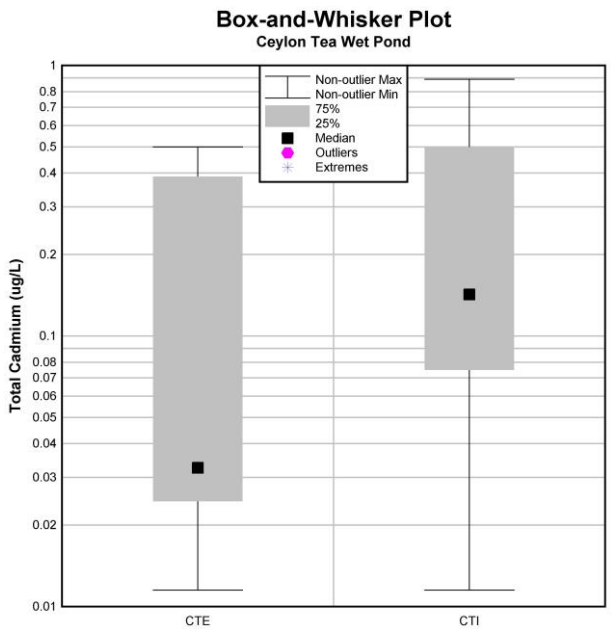


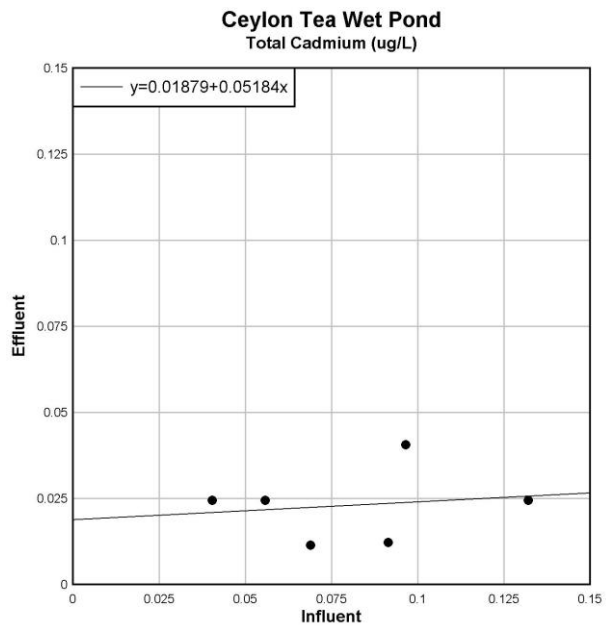
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	64	10
	Pairs Count	5	5
Non-Parametric	Maximum	29.2	13.4
	Upper Quartile	10.0	3.0
	Median	5.1	1.4
	Lower Quartile	3.5	0.8
	Minimum	1.7	0.8
	Efficiency	71.82%	
	Mann-Whitney	0.0002 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	8.9	5.5
	Mean	7.5	2.7
	LCL	6.1	0.0
	Std. Dev.	5.6	3.8
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	63.76%	
	t-Test (equal var.)	0.0110 **	
	t-Test (unequal var.)	0.0035 **	
	t-test (paired)	0.0022 **	
	Levene Test	0.4270	
Log Transformed	UCL	9.0	5.1
	Mean	7.5	2.4
	LCL	6.2	1.1
	Std. Dev.	5.5	2.2
	Wilk (p-value)	0.0456 **	0.0338 **
	Efficiency	67.97%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0013 **	
	t-Test (paired)	0.0020 **	
	Levene Test	0.2266	
Bootstrap	UCL	8.9	4.9
	Mean	7.5	2.7
	LCL	6.2	0.4
	Std. Dev.	5.5	3.1
	Efficiency	64.40%	

Ceylon Tea Wet Pond - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: CTI**	**EFF: CTE**
	Site Count	49	10
	Pairs Count	5	5
Non-Parametric	Maximum	0.9	0.5
	Upper Quartile	0.5	0.5
	Median	0.1	0.0
	Lower Quartile	0.1	0.0
	Minimum	0.0	0.0
	Efficiency	77.14%	
	Mann-Whitney	0.0355 **	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	0.3	0.3
	Mean	0.3	0.2
	LCL	0.2	0.0
	Std. Dev.	0.2	0.2
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	33.34%	
	t-Test (equal var.)	0.2767	
	t-Test (unequal var.)	0.3038	
	t-test (paired)	0.0067 **	
	Levene Test	0.9777	
Log Transformed	UCL	0.4	0.8
	Mean	0.3	0.2
	LCL	0.2	0.0
	Std. Dev.	0.4	0.3
	Wilk (p-value)	0.0190 **	0.0171 **
	Efficiency	42.97%	
	t-Test (equal var.)	0.0183 **	
	t-Test (unequal var.)	0.0815 *	
	t-Test (paired)	0.0044 **	
	Levene Test	0.0509 *	
Bootstrap	UCL	0.3	0.3
	Mean	0.3	0.2
	LCL	0.2	0.0
	Std. Dev.	0.2	0.2
	Efficiency	35.61%	

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Appendix D Biofiltration

Sand Beach Biofiltration (SBI-SBE)

The Sand Beach biofiltration SCM is the first biofiltration basin monitored by the City. The design is similar to a partial sedimentation/filtration basin except the media is designed to promote plant growth. The media for this SMC incorporated compost. After the preliminary results of this monitoring indicated an export of P, compost was eliminated from the approved biofiltration media mix.

The City collected runoff and water quality data at the Sand Beach Biofiltration basin from 2009 to 2010. During this time 19 and 21 valid EMCs were collected at the influent (SBI) and effluent (SBE) respectively, of which 17 were paired.

Performance Summary

Overall, Sand Beach Biofiltration basin had a good impact on water quality for the pollutants measured during this study. The BMP had the best performance with the reduction of the concentrations of solids and metals. TSS and VSS were reduced by 81% and 71% respectively; the differences were significant in all cases and were significant if a paired comparison is used or if the data are not paired.

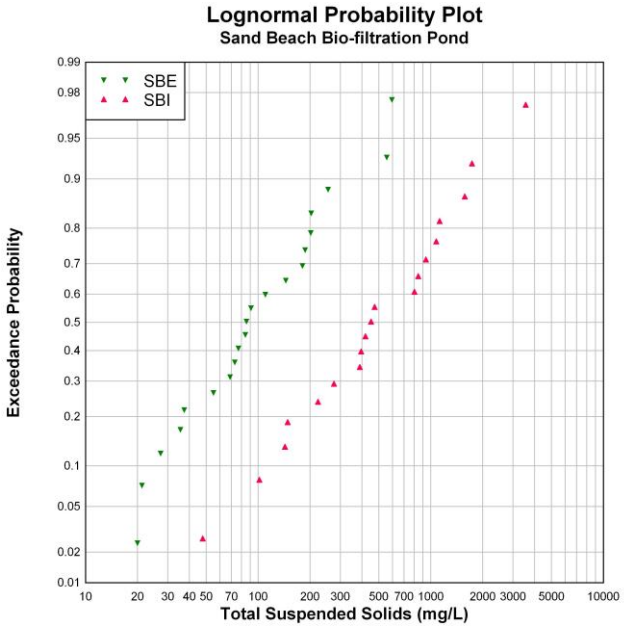
There were significant reductions in COD but TOC was not affected by treatment.

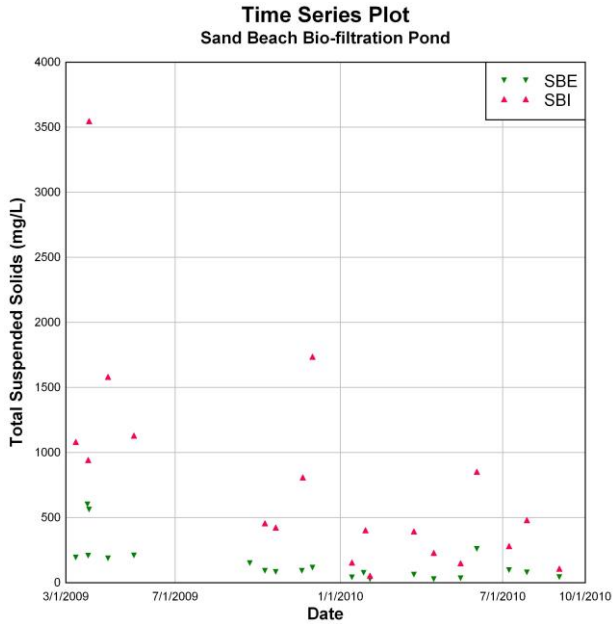
There were significant reductions in total N, TKN and ammonia (30. 50 and 80% respectively) but also a significant increase in nitrate plus nitrite (-50%), typical of other filtration systems. As with sand filtration, it is expected that the increase in nitrates it related to the conversion of ammonia but may also be influenced by the filtration media. There was a slight but insignificant reduction in the concentration of total P (35%) but a large and significant increase in dissolved P (-95%) that is likely due to the used of compost in the filtration media.

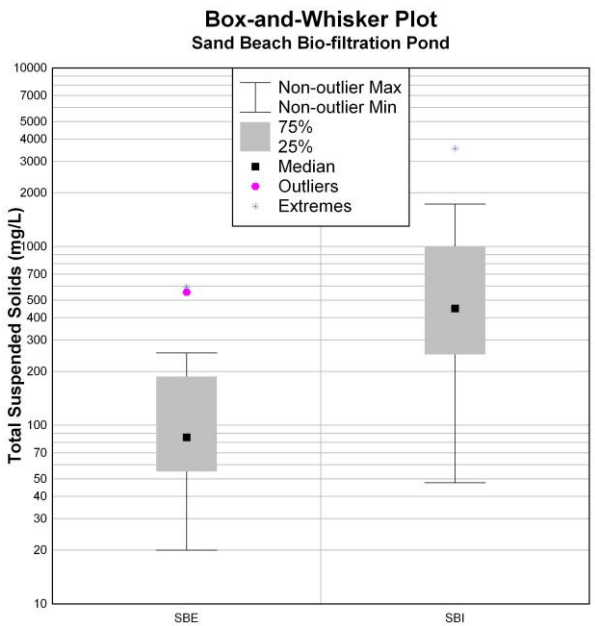
There were significant decreases in the concentrations of all metals when considering the total phase but there were insignificant changes for the dissolved phase.

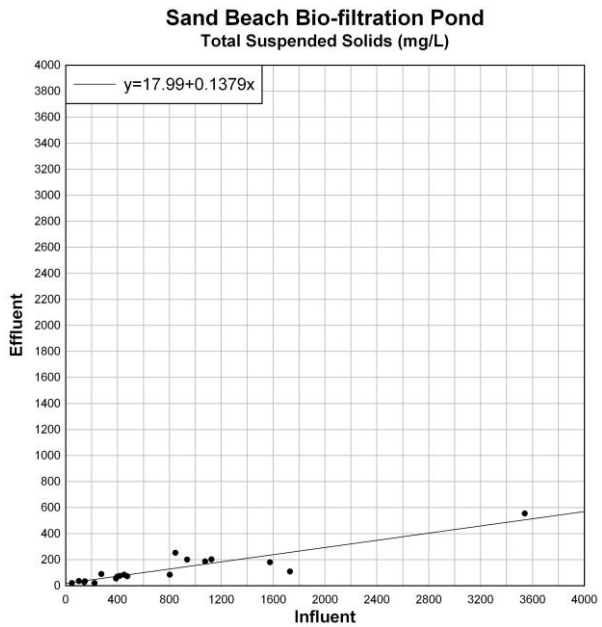
There were no significant changes for bacteria.

Sand Beach Biofiltration Pond - Total Suspended Solids (mg/L)



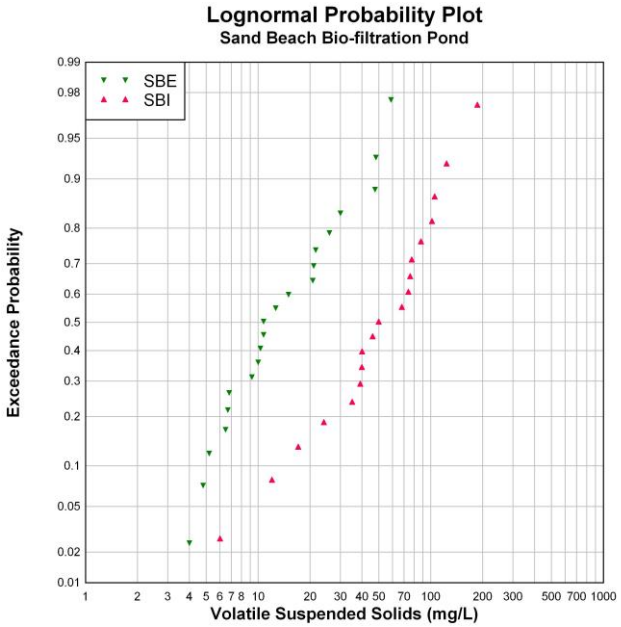


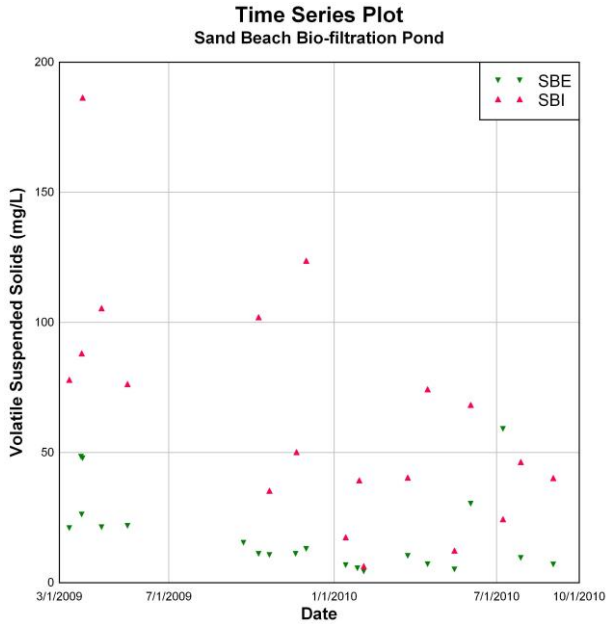


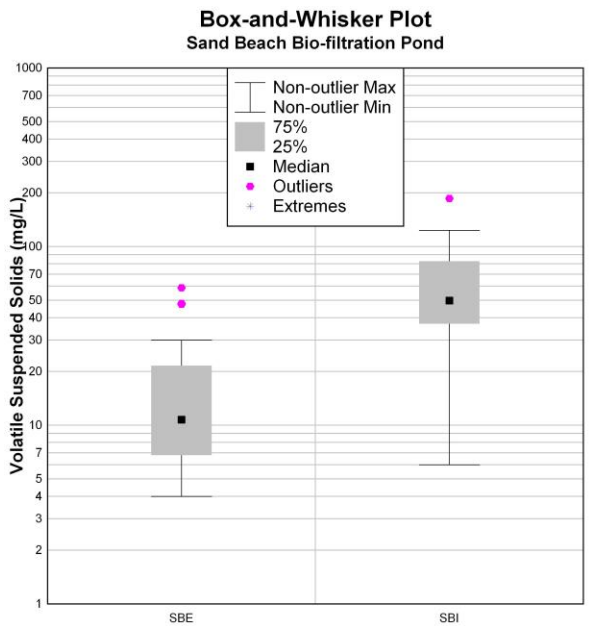


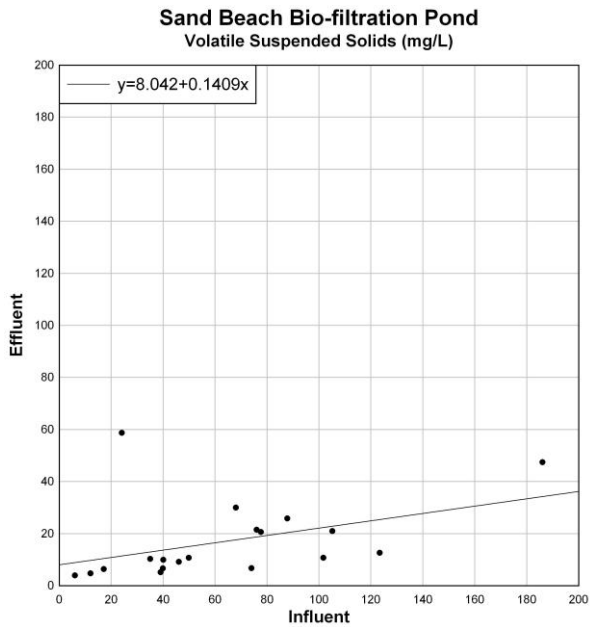
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	3,540.0	595.8
	Upper Quartile	1,073.8	187.0
	Median	450.0	85.6
	Lower Quartile	222.0	55.0
	Minimum	47.7	20.0
	Efficiency	80.98%	
	Mann-Whitney	0.0004 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	1,172.8	219.7
	Mean	772.9	148.0
	LCL	373.0	76.3
	Std. Dev.	829.6	157.6
	Wilk (p-value)	0.0003 **	0.0001 **
	Efficiency	80.85%	
	t-Test (equal var.)	0.0016 **	
	t-Test (unequal var.)	0.0044 **	
	t-test (paired)	0.0023 **	
	Levene Test	0.1008	
Log Transformed	UCL	1,569.7	249.1
	Mean	808.9	146.7
	LCL	416.9	86.3
	Std. Dev.	1,035.8	161.8
	Wilk (p-value)	0.9824	0.6636
	Efficiency	81.87%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.5530	
Bootstrap	UCL	1,130.7	211.3
	Mean	763.6	145.0
	LCL	396.6	78.7
	Std. Dev.	761.6	145.6
	Efficiency	81.01%	

Sand Beach Biofiltration Pond - Volatile Suspended Solids (mg/L)



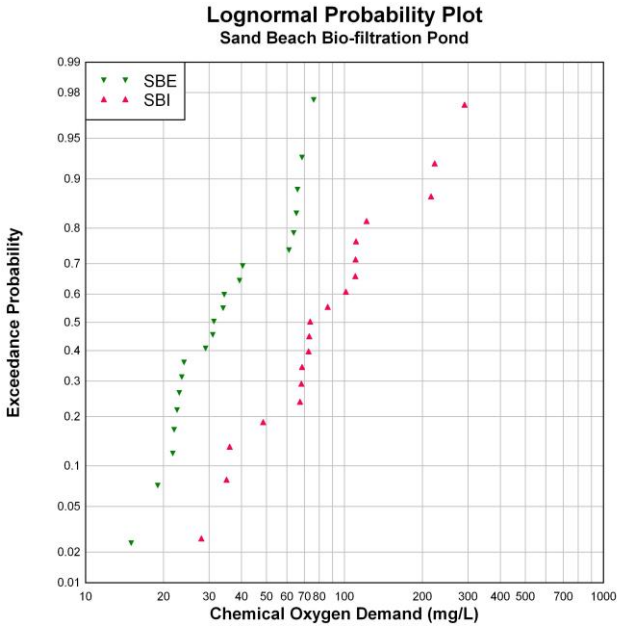


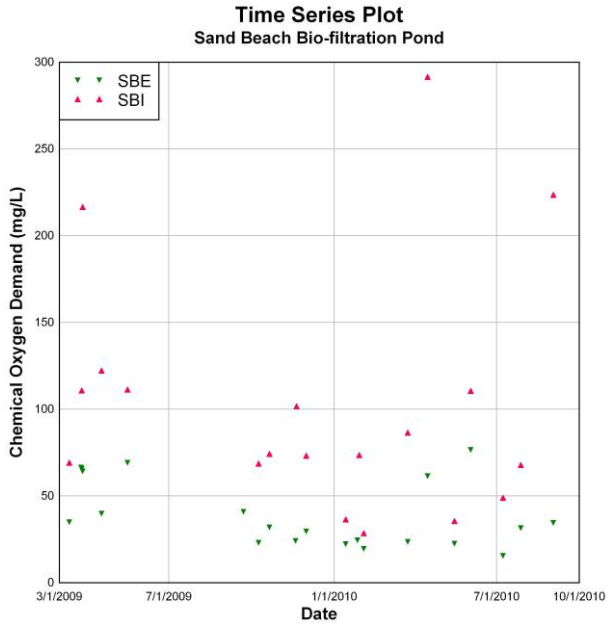


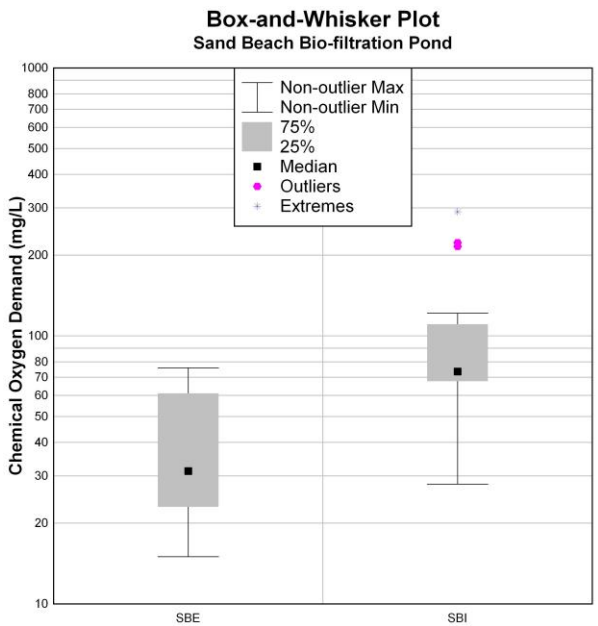


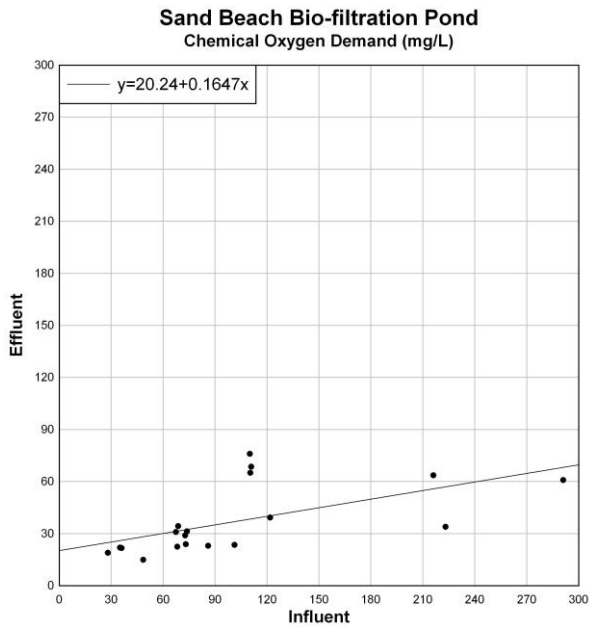
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	186.0	58.8
	Upper Quartile	87.8	21.5
	Median	49.8	10.8
	Lower Quartile	35.0	6.8
	Minimum	6.0	4.0
	Efficiency	78.41%	
	Mann-Whitney	0.0004 **	
	Wilcoxon (paired)	0.0003 **	
Arithmetic	UCL	85.0	25.5
	Mean	63.6	18.4
	LCL	42.2	11.2
	Std. Dev.	44.4	15.7
	Wilk (p-value)	0.1091	0.0007 **
	Efficiency	71.09%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0004 **	
	t-test (paired)	0.0003 **	
	Levene Test	0.0328 **	
Log Transformed	UCL	109.3	27.4
	Mean	67.5	18.1
	LCL	41.7	12.0
	Std. Dev.	63.9	15.8
	Wilk (p-value)	0.3699	0.4308
	Efficiency	73.11%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7315	
Bootstrap	UCL	83.4	25.0
	Mean	63.1	18.2
	LCL	42.8	11.4
	Std. Dev.	42.0	15.0
	Efficiency	71.16%	

Sand Beach Biofiltration Pond - Chemical Oxygen Demand (mg/L)



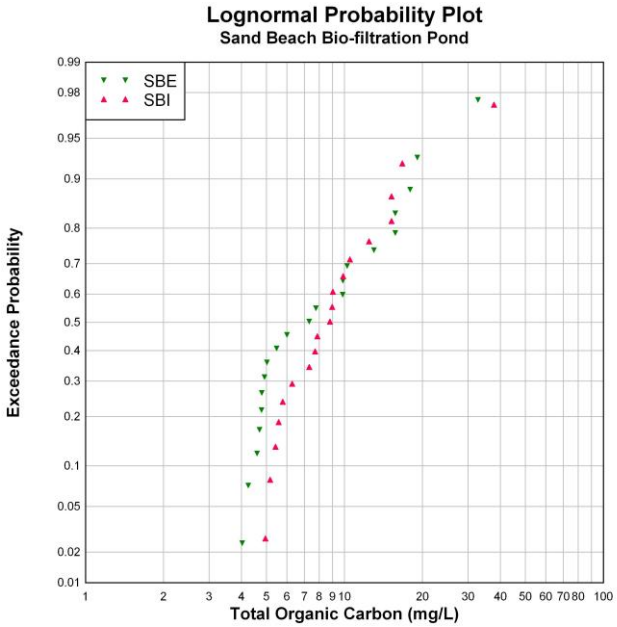


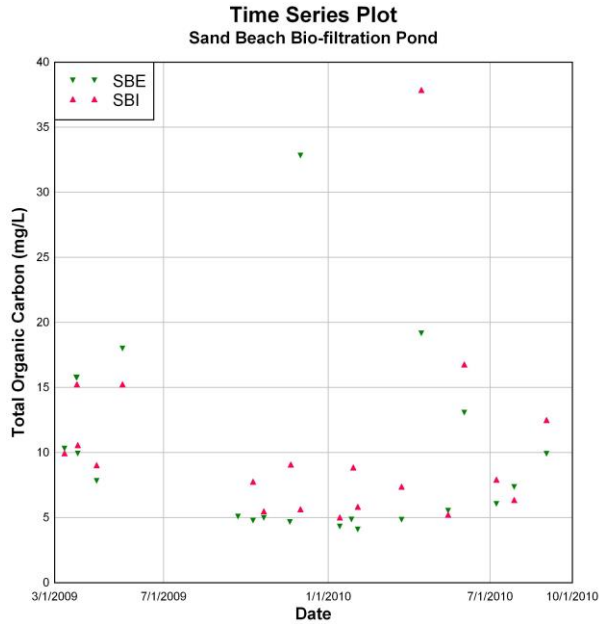


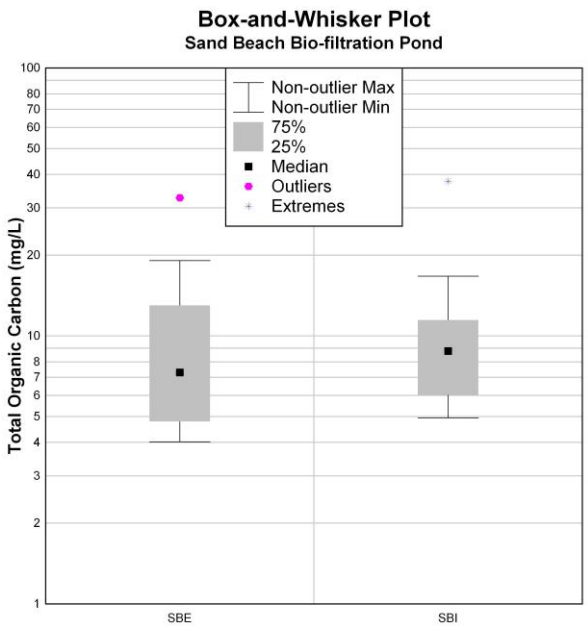


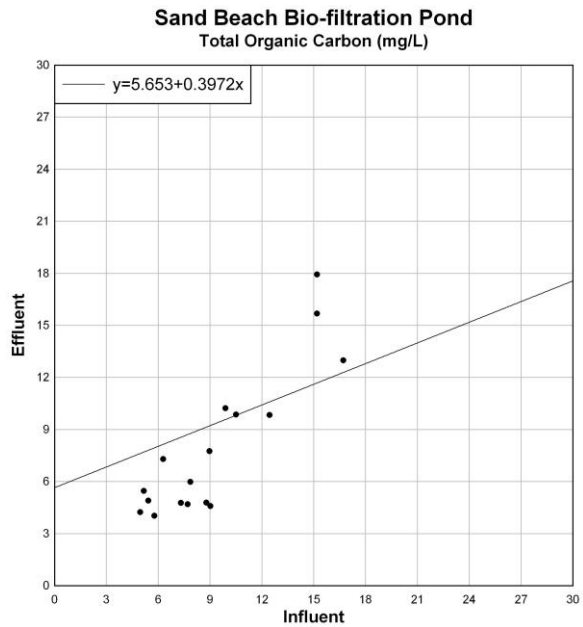
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	291.00	76.00
	Upper Quartile	110.76	61.00
	Median	73.68	31.32
	Lower Quartile	67.28	23.00
	Minimum	28.00	15.00
	Efficiency	57.49%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	135.73	47.45
	Mean	102.14	38.60
	LCL	68.56	29.75
	Std. Dev.	69.68	19.45
	Wilk (p-value)	0.0019 **	0.0053 **
	Efficiency	62.21%	
	t-Test (equal var.)	0.0003 **	
	t-Test (unequal var.)	0.0010 **	
	t-test (paired)	0.0006 **	
	Levene Test	0.0299 **	
Log Transformed	UCL	141.06	48.78
	Mean	101.49	38.50
	LCL	73.02	30.39
	Std. Dev.	66.95	19.60
	Wilk (p-value)	0.5390	0.0926 *
	Efficiency	62.06%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2404	
Bootstrap	UCL	134.95	46.79
	Mean	102.75	38.27
	LCL	70.56	29.76
	Std. Dev.	66.79	18.71
	Efficiency	62.75%	

Sand Beach Biofiltration Pond - Total Organic Carbon (mg/L)



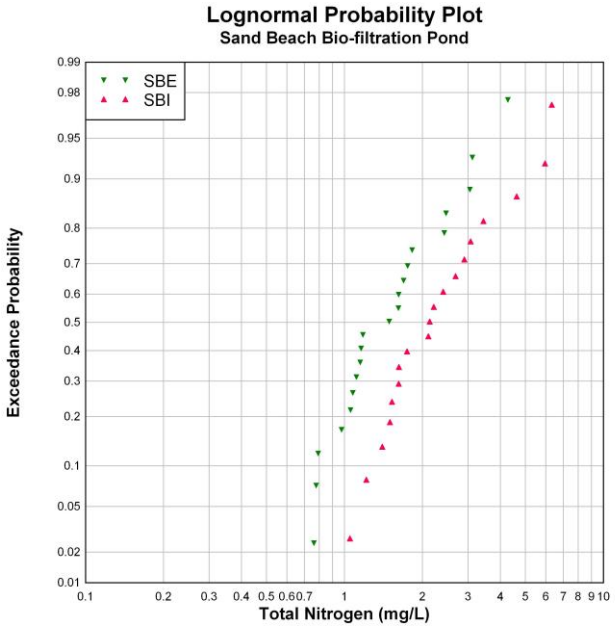


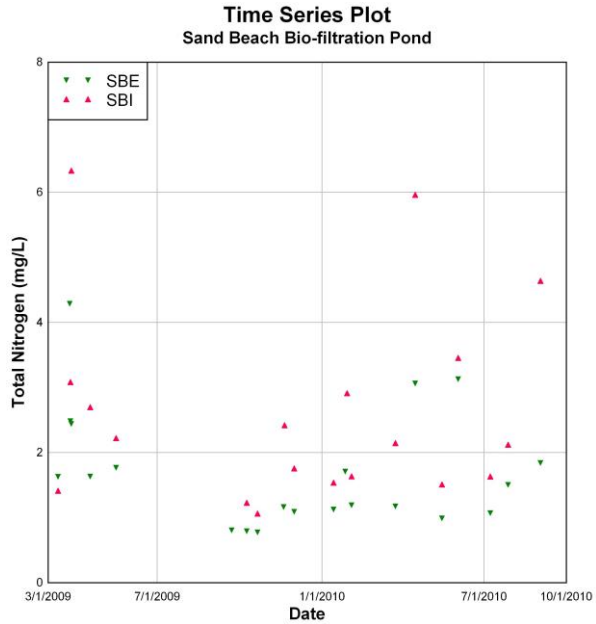


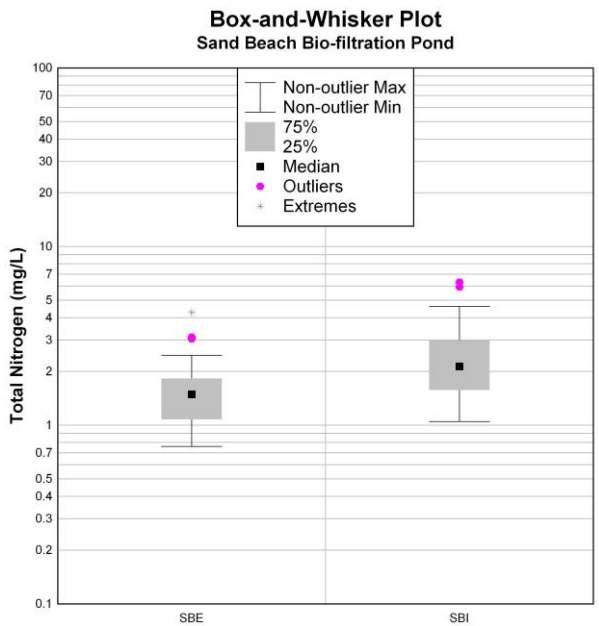


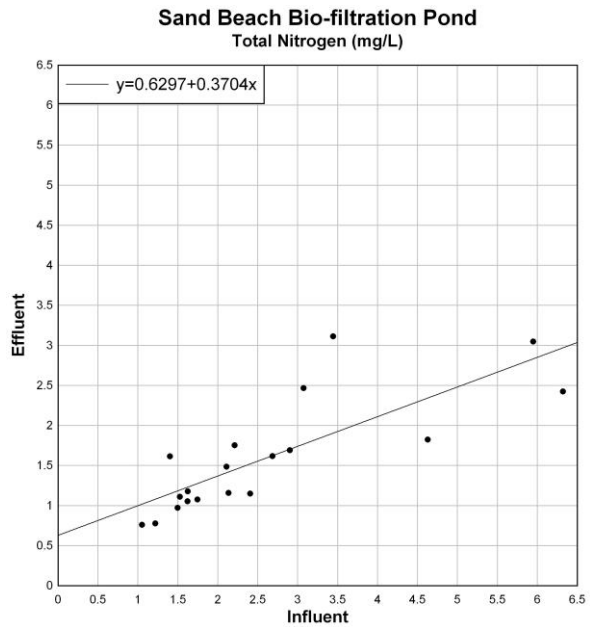
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	37.80	32.75
	Upper Quartile	12.43	13.00
	Median	8.78	7.30
	Lower Quartile	5.77	4.79
	Minimum	4.95	4.03
	Efficiency	16.86%	
	Mann-Whitney	0.3356	
	Wilcoxon (paired)	0.1324	
Arithmetic	UCL	14.17	13.14
	Mean	10.55	9.89
	LCL	6.93	6.64
	Std. Dev.	7.51	7.13
	Wilk (p-value)	0.0001 **	0.0003 **
	Efficiency	6.22%	
	t-Test (equal var.)	0.7783	
	t-Test (unequal var.)	0.7789	
	t-test (paired)	0.8875	
	Levene Test	0.9127	
Log Transformed	UCL	13.36	13.13
	Mean	10.28	9.71
	LCL	7.91	7.18
	Std. Dev.	5.46	6.25
	Wilk (p-value)	0.0591 *	0.0355 **
	Efficiency	5.58%	
	t-Test (equal var.)	0.5460	
	t-Test (unequal var.)	0.5425	
	t-Test (paired)	0.6652	
	Levene Test	0.4533	
Bootstrap	UCL	13.89	12.89
	Mean	10.58	9.84
	LCL	7.27	6.79
	Std. Dev.	6.87	6.70
	Efficiency	7.01%	

Sand Beach Biofiltration Pond - Total Nitrogen (mg/L)



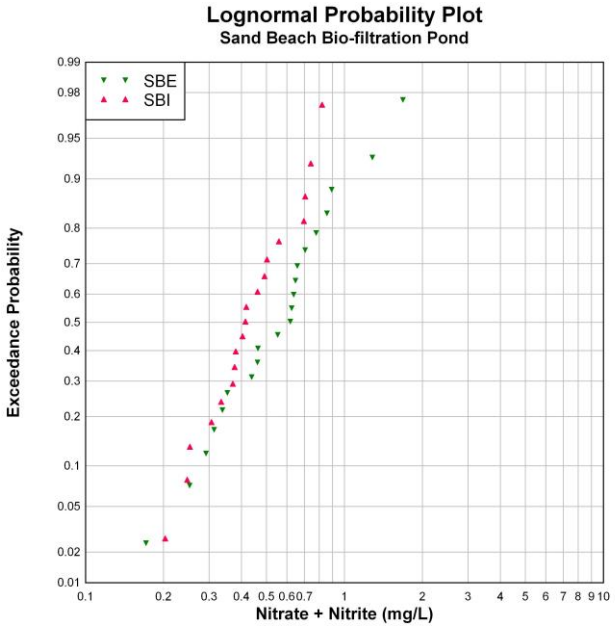


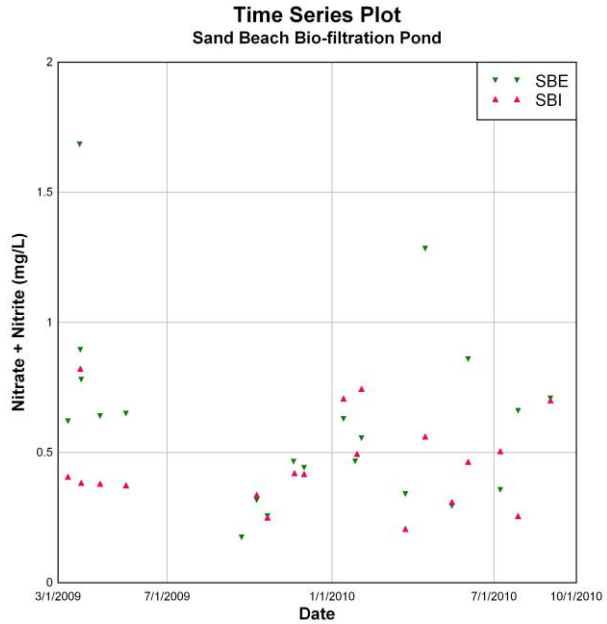


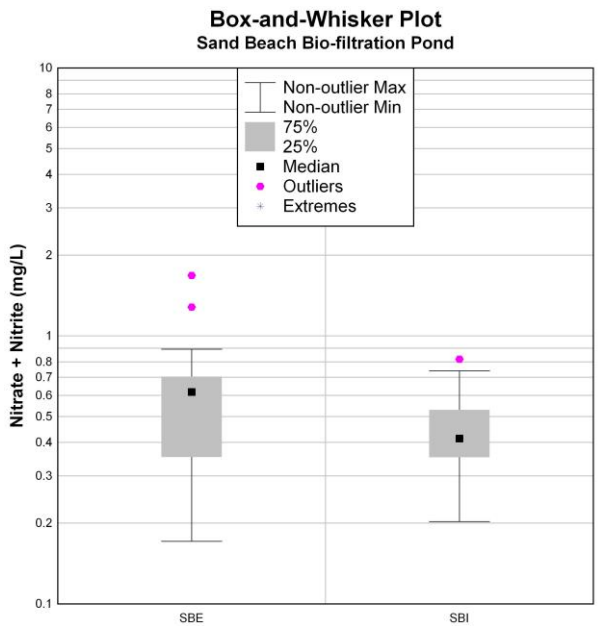


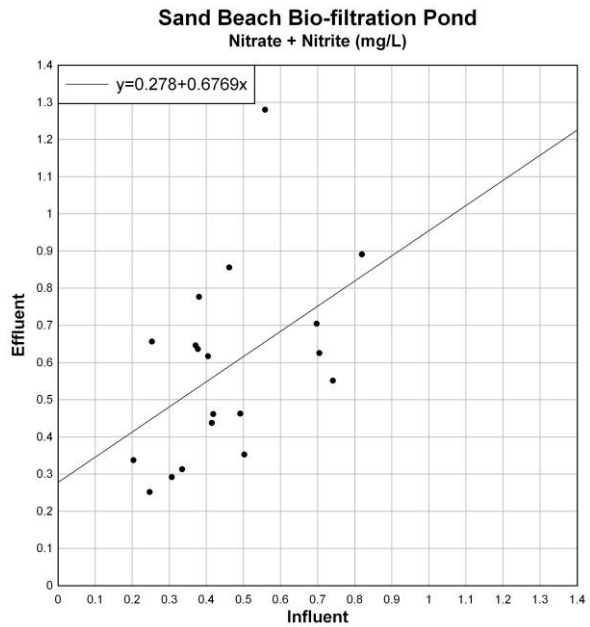
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	6.320	4.274
	Upper Quartile	3.071	1.825
	Median	2.133	1.488
	Lower Quartile	1.525	1.077
	Minimum	1.050	0.762
	Efficiency	30.24%	
	Mann-Whitney	0.0221 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	3.339	2.101
	Mean	2.606	1.684
	LCL	1.873	1.268
	Std. Dev.	1.521	0.915
	Wilk (p-value)	0.0024 **	0.0038 **
	Efficiency	35.37%	
	t-Test (equal var.)	0.0241 **	
	t-Test (unequal var.)	0.0293 **	
	t-test (paired)	0.0021 **	
	Levene Test	0.1263	
Log Transformed	UCL	3.354	2.112
	Mean	2.579	1.672
	LCL	1.983	1.323
	Std. Dev.	1.371	0.842
	Wilk (p-value)	0.3790	0.3035
	Efficiency	35.19%	
	t-Test (equal var.)	0.0108 **	
	t-Test (unequal var.)	0.0111 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.8018	
Bootstrap	UCL	3.315	2.073
	Mean	2.616	1.677
	LCL	1.916	1.282
	Std. Dev.	1.451	0.868
	Efficiency	35.87%	

Sand Beach Biofiltration Pond - Nitrate + Nitrite (mg/L)



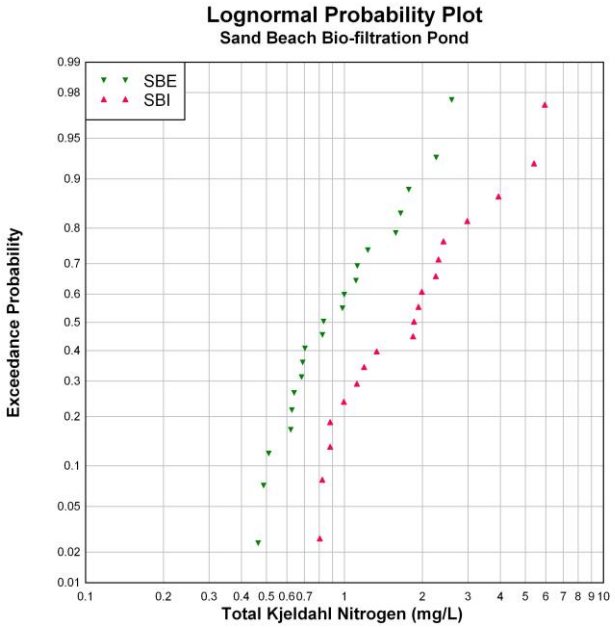


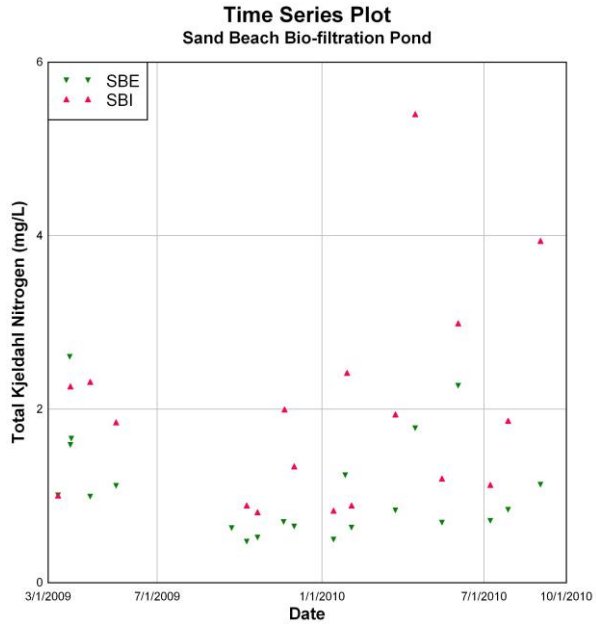


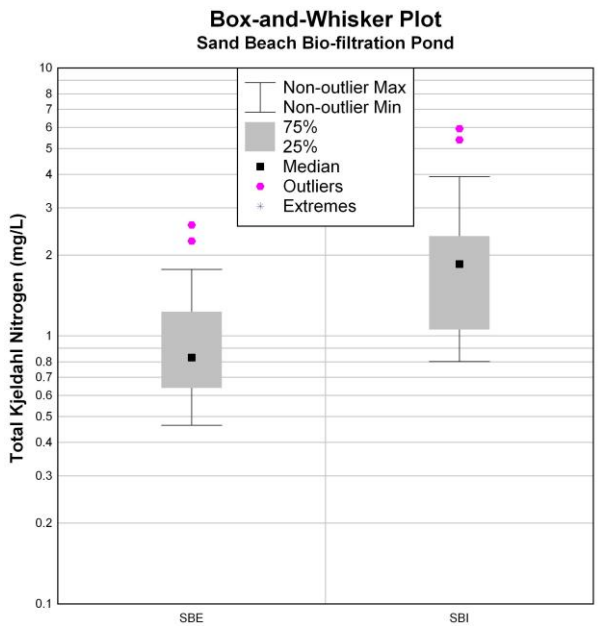


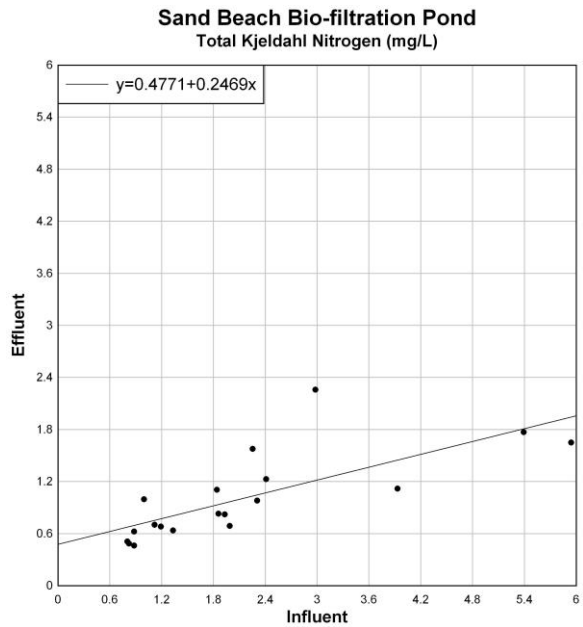
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	0.819	1.681
	Upper Quartile	0.558	0.705
	Median	0.414	0.617
	Lower Quartile	0.334	0.353
	Minimum	0.203	0.171
	Efficiency	-49.02%	
	Mann-Whitney	0.1516	
	Wilcoxon (paired)	0.0395 **	
Arithmetic	UCL	0.542	0.780
	Mean	0.457	0.620
	LCL	0.372	0.459
	Std. Dev.	0.176	0.354
	Wilk (p-value)	0.1910	0.0092 **
	Efficiency	-35.61%	
	t-Test (equal var.)	0.0781 *	
	t-Test (unequal var.)	0.0716 *	
	t-test (paired)	0.0242 **	
	Levene Test	0.1319	
Log Transformed	UCL	0.555	0.808
	Mean	0.457	0.620
	LCL	0.377	0.475
	Std. Dev.	0.181	0.353
	Wilk (p-value)	0.8037	0.9800
	Efficiency	-35.55%	
	t-Test (equal var.)	0.1269	
	t-Test (unequal var.)	0.1212	
	t-Test (paired)	0.0169 **	
	Levene Test	0.1603	
Bootstrap	UCL	0.539	0.768
	Mean	0.457	0.617
	LCL	0.376	0.466
	Std. Dev.	0.170	0.333
	Efficiency	-34.90%	

Sand Beach Biofiltration Pond - Total Kjeldahl Nitrogen (mg/L)



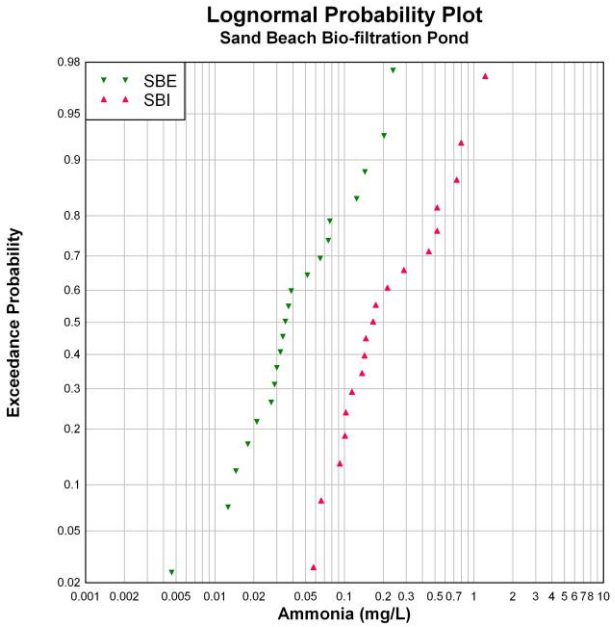


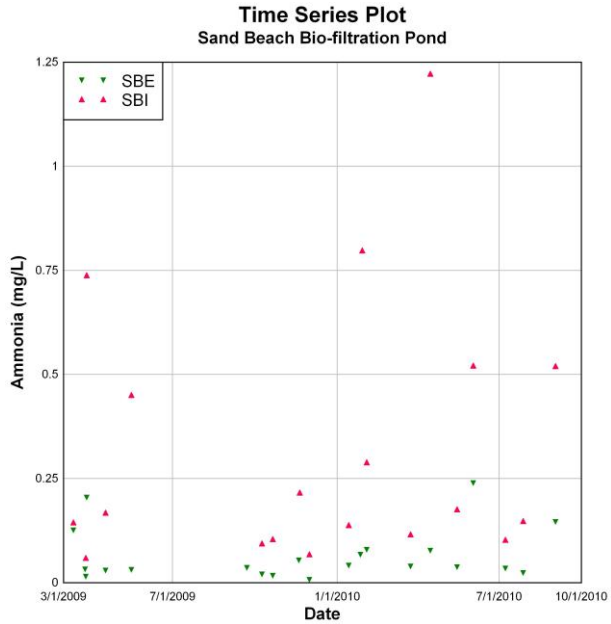


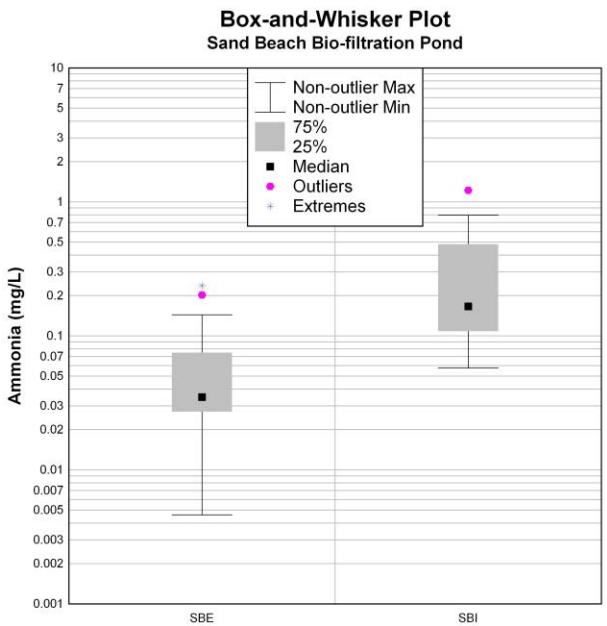


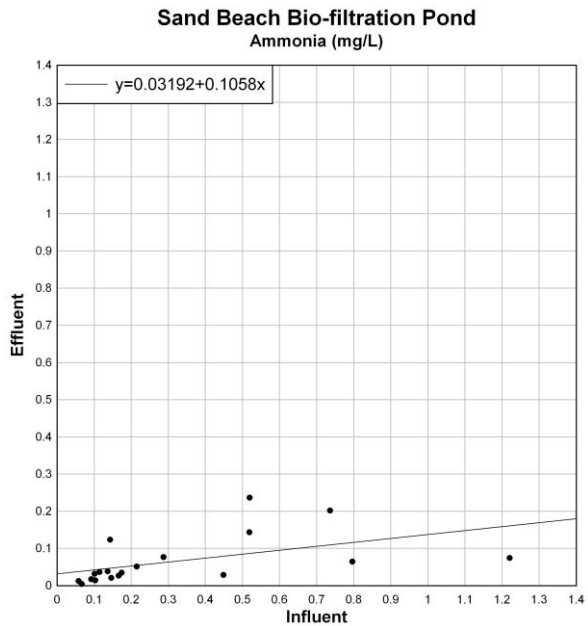
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	5.940	2.593
	Upper Quartile	2.410	1.230
	Median	1.856	0.831
	Lower Quartile	0.995	0.639
	Minimum	0.803	0.464
	Efficiency	55.22%	
	Mann-Whitney	0.0032 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	2.867	1.334
	Mean	2.149	1.065
	LCL	1.432	0.795
	Std. Dev.	1.488	0.592
	Wilk (p-value)	0.0016 **	0.0047 **
	Efficiency	50.46%	
	t-Test (equal var.)	0.0038 **	
	t-Test (unequal var.)	0.0068 **	
	t-test (paired)	0.0017 **	
	Levene Test	0.0416 **	
Log Transformed	UCL	2.940	1.347
	Mean	2.123	1.057
	LCL	1.533	0.829
	Std. Dev.	1.385	0.552
	Wilk (p-value)	0.2102	0.3017
	Efficiency	50.24%	
	t-Test (equal var.)	0.0009 **	
	t-Test (unequal var.)	0.0011 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2807	
Bootstrap	UCL	2.841	1.318
	Mean	2.158	1.060
	LCL	1.476	0.803
	Std. Dev.	1.416	0.565
	Efficiency	50.87%	

Sand Beach Biofiltration Pond - Ammonia (mg/L)



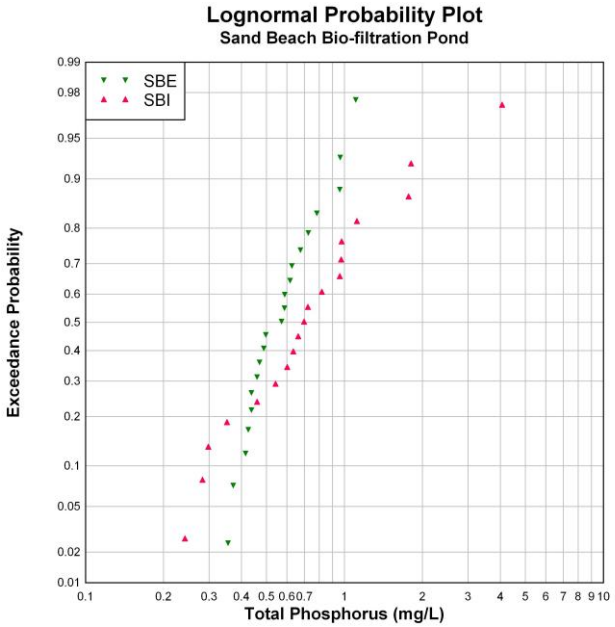


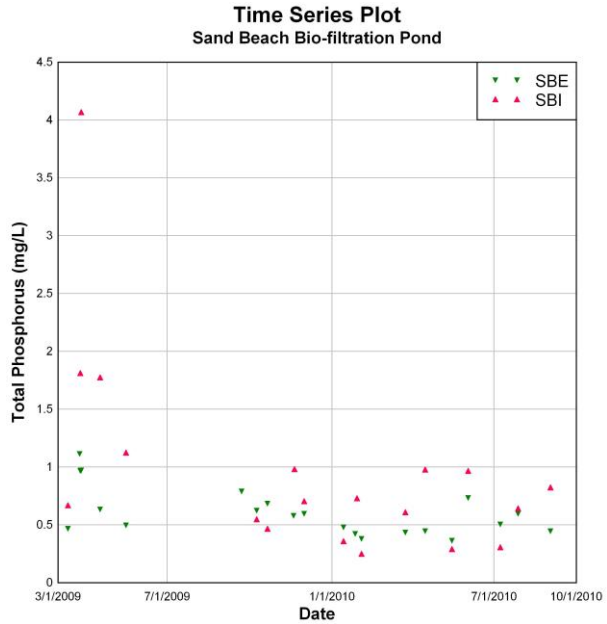


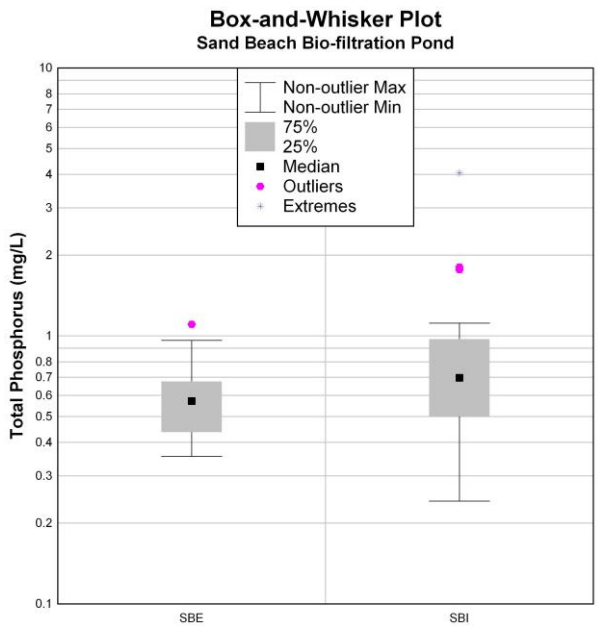


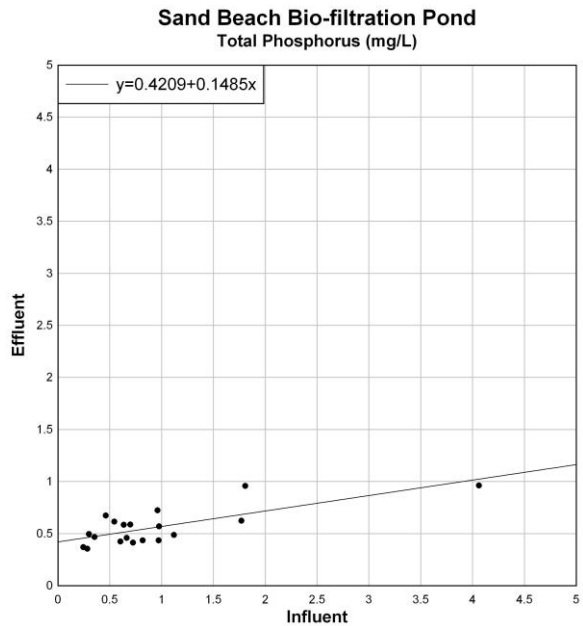
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	1.220	0.237
	Upper Quartile	0.518	0.075
	Median	0.166	0.035
	Lower Quartile	0.103	0.027
	Minimum	0.058	0.005
	Efficiency	78.93%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.469	0.091
	Mean	0.318	0.062
	LCL	0.166	0.034
	Std. Dev.	0.315	0.063
	Wilk (p-value)	0.0005 **	0.0002 **
	Efficiency	80.38%	
	t-Test (equal var.)	0.0008 **	
	t-Test (unequal var.)	0.0025 **	
	t-test (paired)	0.0036 **	
	Levene Test	0.0302 **	
Log Transformed	UCL	0.518	0.107
	Mean	0.310	0.063
	LCL	0.185	0.037
	Std. Dev.	0.312	0.069
	Wilk (p-value)	0.2600	0.8036
	Efficiency	79.78%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7325	
Bootstrap	UCL	0.464	0.090
	Mean	0.320	0.063
	LCL	0.175	0.036
	Std. Dev.	0.300	0.060
	Efficiency	80.31%	

Sand Beach Biofiltration Pond - Total Phosphorus (mg/L)



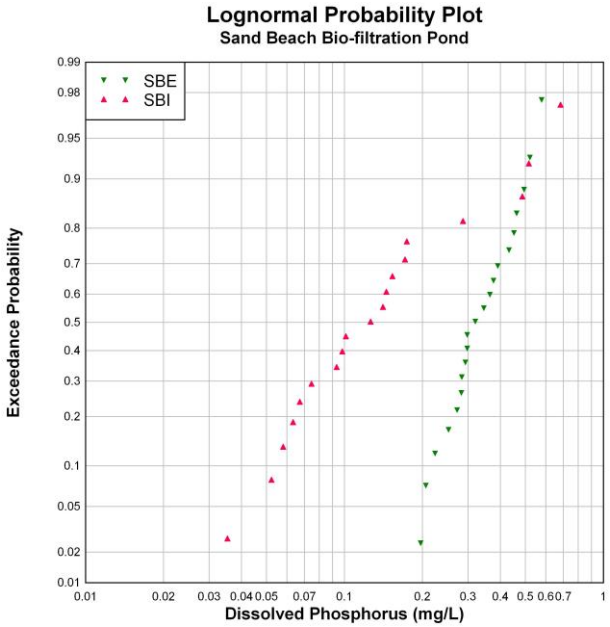


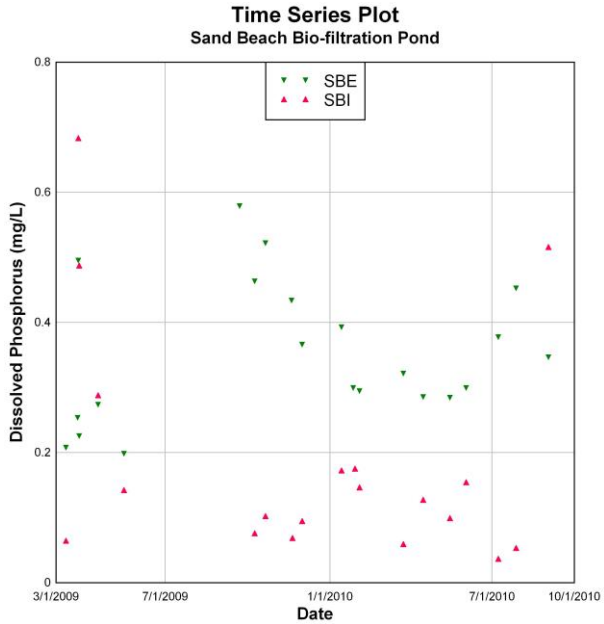


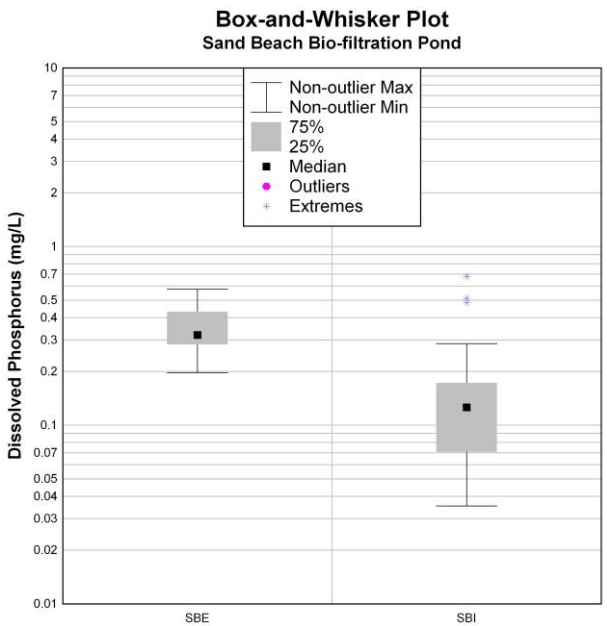


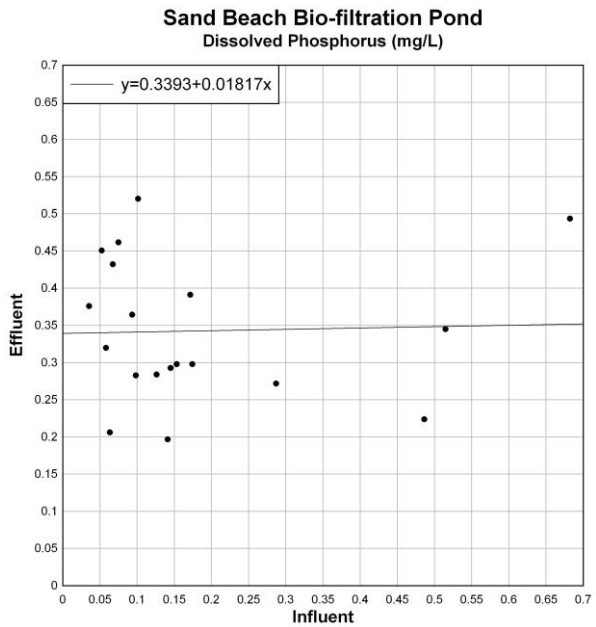
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	4.060	1.105
	Upper Quartile	0.974	0.675
	Median	0.697	0.571
	Lower Quartile	0.460	0.437
	Minimum	0.242	0.355
	Efficiency	18.10%	
	Mann-Whitney	0.1591	
	Wilcoxon (paired)	0.0448 **	
Arithmetic	UCL	1.366	0.692
	Mean	0.945	0.598
	LCL	0.525	0.503
	Std. Dev.	0.872	0.207
	Wilk (p-value)	0.0001 **	0.0176 **
	Efficiency	36.79%	
	t-Test (equal var.)	0.0837 *	
	t-Test (unequal var.)	0.1054	
	t-test (paired)	0.0620 *	
	Levene Test	0.1628	
Log Transformed	UCL	1.337	0.692
	Mean	0.916	0.596
	LCL	0.628	0.513
	Std. Dev.	0.689	0.194
	Wilk (p-value)	0.5727	0.3094
	Efficiency	34.93%	
	t-Test (equal var.)	0.1490	
	t-Test (unequal var.)	0.1669	
	t-Test (paired)	0.0643 *	
	Levene Test	0.0263 **	
Bootstrap	UCL	1.309	0.684
	Mean	0.935	0.594
	LCL	0.560	0.505
	Std. Dev.	0.777	0.197
	Efficiency	36.40%	

Sand Beach Biofiltration Pond - Dissolved Phosphorus (mg/L)



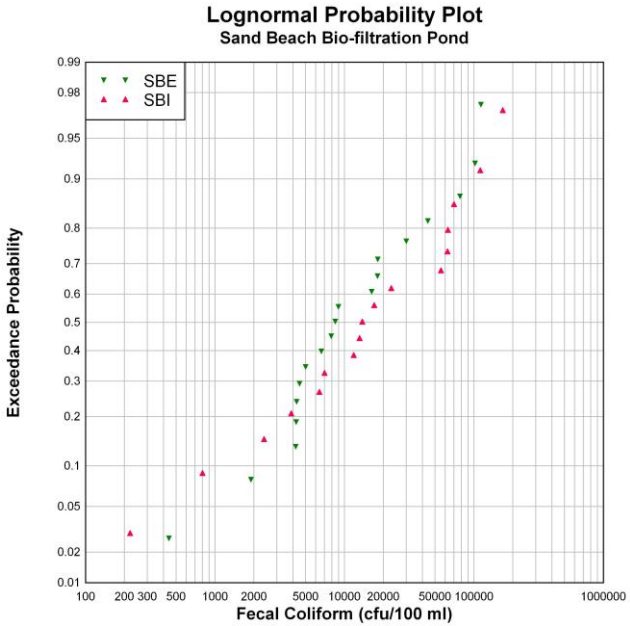


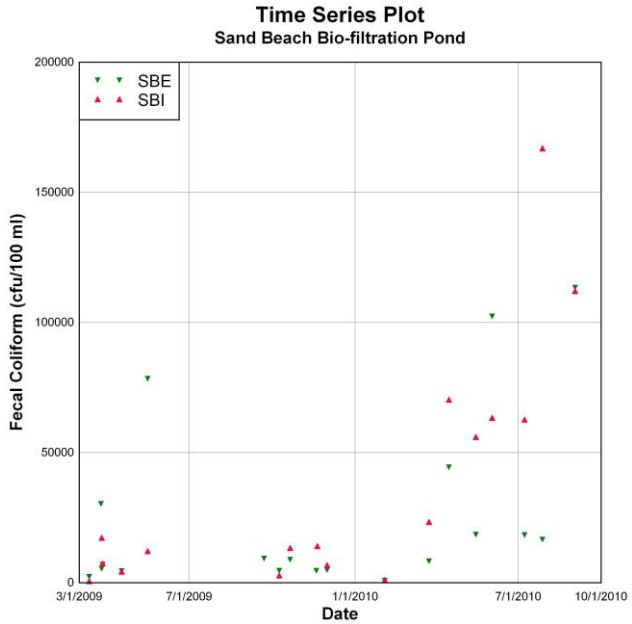


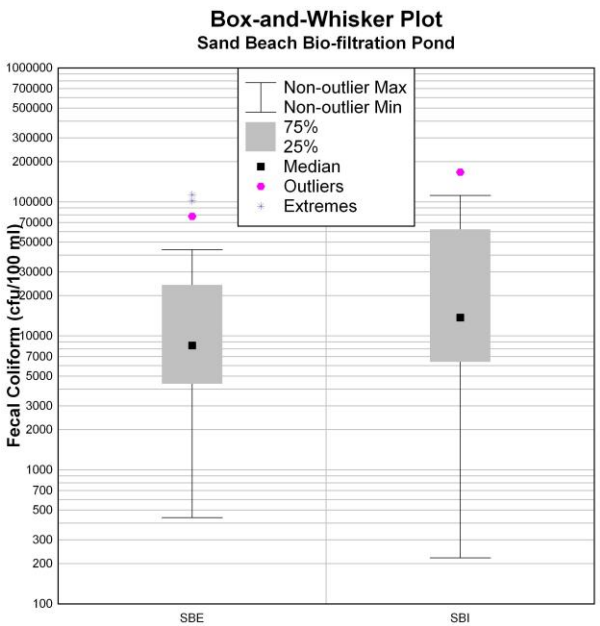


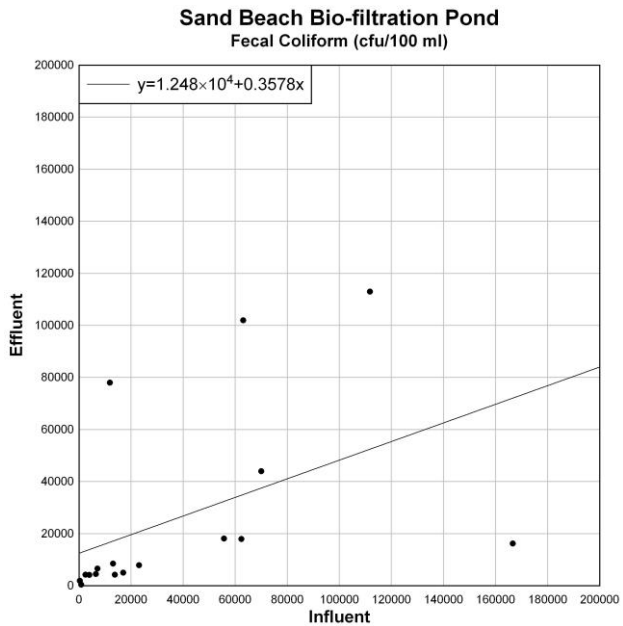
		PARAMETER	DP (mg/L)
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	0.682	0.577
	Upper Quartile	0.174	0.432
	Median	0.126	0.320
	Lower Quartile	0.067	0.283
	Minimum	0.035	0.197
	Efficiency	-153.98%	
	Mann-Whitney	0.0008 **	
	Wilcoxon (paired)	0.0232 **	
Arithmetic	UCL	0.272	0.398
	Mean	0.185	0.350
	LCL	0.098	0.301
	Std. Dev.	0.180	0.107
	Wilk (p-value)	0.0001 **	0.3813
	Efficiency	-88.54%	
	t-Test (equal var.)	0.0011 **	
	t-Test (unequal var.)	0.0017 **	
	t-test (paired)	0.0097 **	
	Levene Test	0.1443	
Log Transformed	UCL	0.282	0.403
	Mean	0.179	0.350
	LCL	0.113	0.303
	Std. Dev.	0.161	0.108
	Wilk (p-value)	0.3680	0.8166
	Efficiency	-95.34%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0010 **	
	Levene Test	0.0039 **	
Bootstrap	UCL	0.266	0.397
	Mean	0.184	0.350
	LCL	0.103	0.304
	Std. Dev.	0.170	0.102
	Efficiency	-90.06%	

Sand Beach Biofiltration Pond - Fecal Coliform (cfu/100 ml)



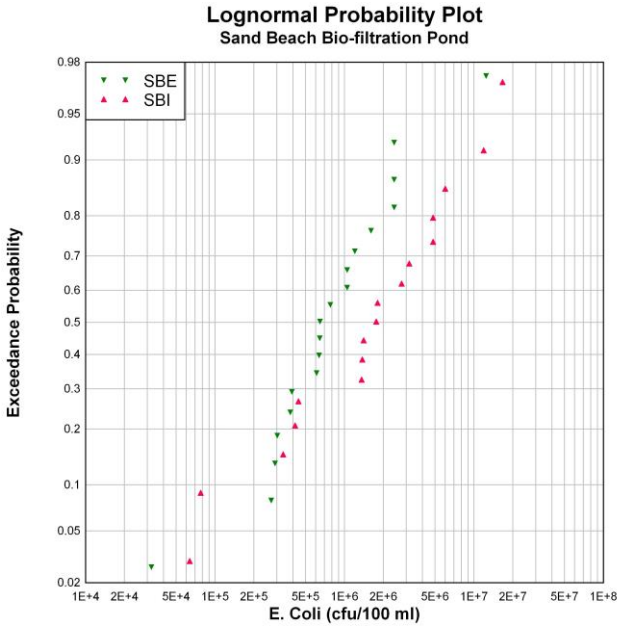


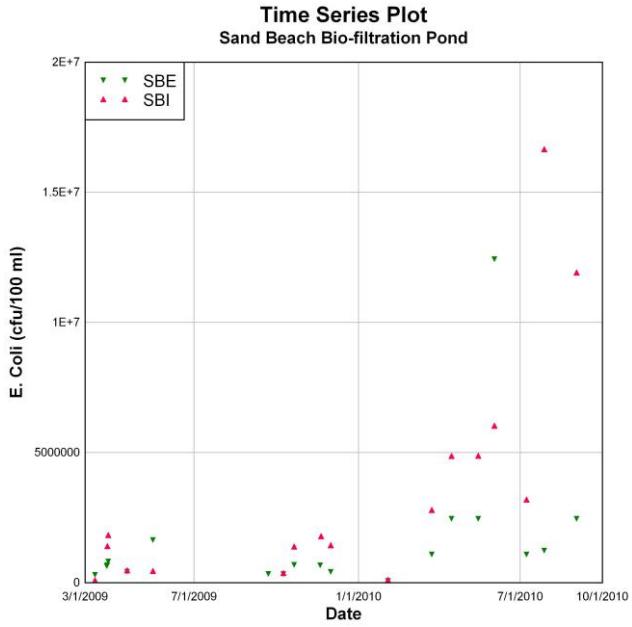


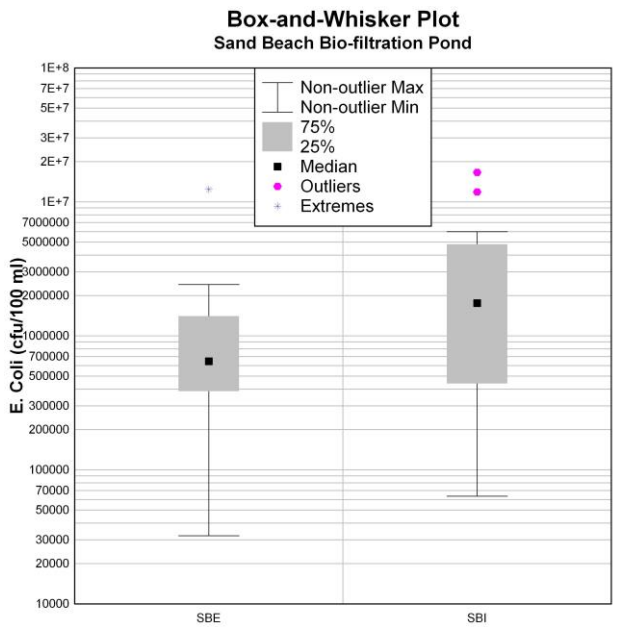


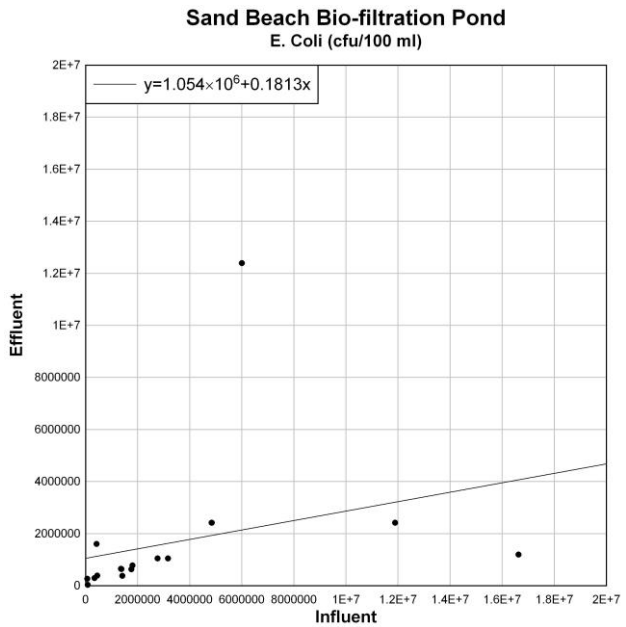
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	17	19
	Pairs Count	16	16
Non-Parametric	Maximum	166,611	113,000
	Upper Quartile	62,342	29,963
	Median	13,719	8,494
	Lower Quartile	6,382	4,262
	Minimum	221	440
	Efficiency	38.09%	
	Mann-Whitney	0.5721	
	Wilcoxon (paired)	0.2312	
Arithmetic	UCL	60,768	41,688
	Mean	36,968	25,046
	LCL	13,168	8,404
	Std. Dev.	46,288	34,528
	Wilk (p-value)	0.0009 **	0.0001 **
	Efficiency	32.25%	
	t-Test (equal var.)	0.3840	
	t-Test (unequal var.)	0.3926	
	t-test (paired)	0.3320	
	Levene Test	0.4042	
Log Transformed	UCL	246,361	69,915
	Mean	54,609	26,390
	LCL	12,105	9,961
	Std. Dev.	142,775	49,109
	Wilk (p-value)	0.4316	0.5297
	Efficiency	51.67%	
	t-Test (equal var.)	0.6615	
	t-Test (unequal var.)	0.6660	
	t-Test (paired)	0.4333	
	Levene Test	0.3480	
Bootstrap	UCL	60,826	41,630
	Mean	38,017	25,588
	LCL	15,208	9,545
	Std. Dev.	44,363	33,285
	Efficiency	32.69%	

Sand Beach Biofiltration Pond – E.Coli (cfu/100 ml)



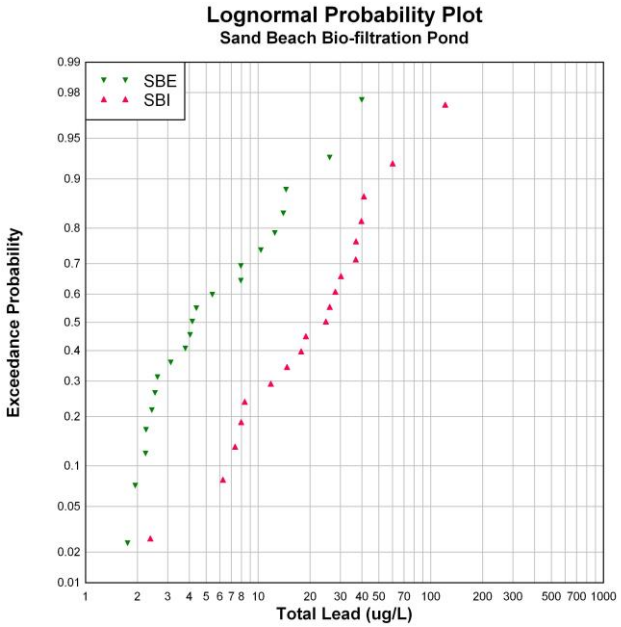


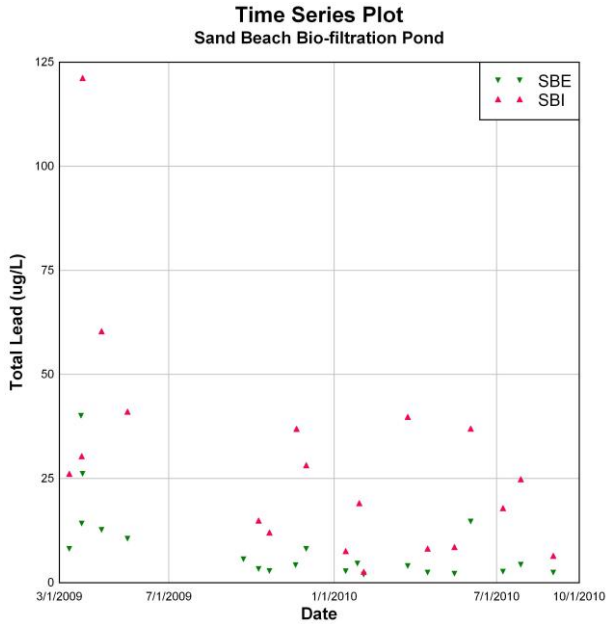


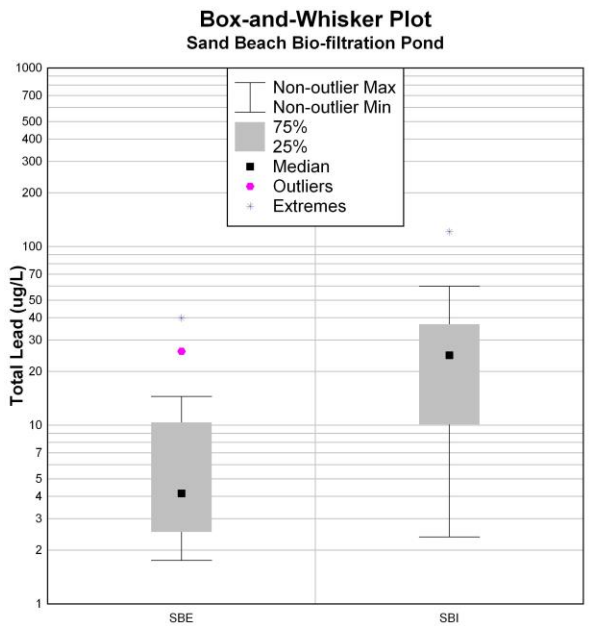


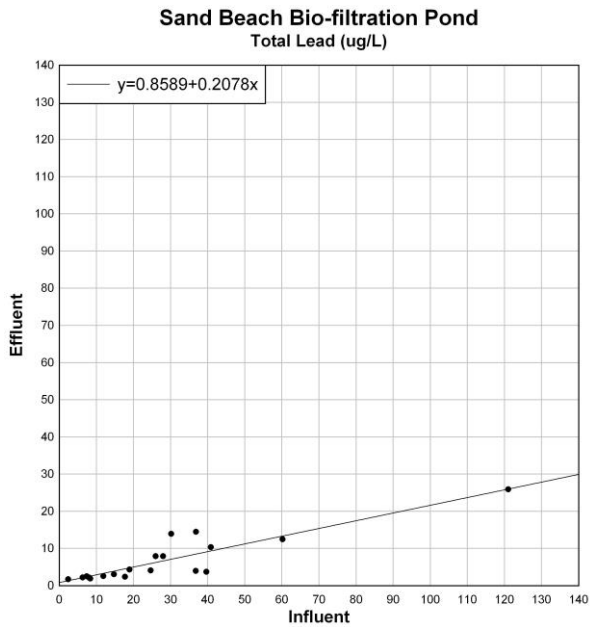
	PARAMETER	E. Coli (cfu/100ml)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	17	19
	Pairs Count	16	16
Non-Parametric	Maximum	16,621,001	12,400,000
	Upper Quartile	4,839,200	1,604,729
	Median	1,757,132	647,584
	Lower Quartile	440,868	382,059
	Minimum	63,756	32,300
	Efficiency	63.15%	
	Mann-Whitney	0.0901 *	
	Wilcoxon (paired)	0.0335 **	
Arithmetic	UCL	5,795,248	2,872,049
	Mean	3,478,471	1,555,183
	LCL	1,161,695	238,317
	Std. Dev.	4,505,808	2,732,073
	Wilk (p-value)	0.0003 **	0.0001 **
	Efficiency	55.29%	
	t-Test (equal var.)	0.1262	
	t-Test (unequal var.)	0.1390	
	t-test (paired)	0.1428	
	Levene Test	0.3133	
Log Transformed	UCL	15,192,774	3,275,736
	Mean	4,408,108	1,497,498
	LCL	1,278,990	684,580
	Std. Dev.	9,473,239	2,249,038
	Wilk (p-value)	0.4366	0.2557
	Efficiency	66.03%	
	t-Test (equal var.)	0.1717	
	t-Test (unequal var.)	0.1791	
	t-Test (paired)	0.0496 **	
	Levene Test	0.3325	
Bootstrap	UCL	5,787,334	2,748,961
	Mean	3,586,087	1,592,673
	LCL	1,384,840	436,386
	Std. Dev.	4,281,311	2,399,014
	Efficiency	55.59%	

Sand Beach Biofiltration Pond - Total Lead (ug/L)



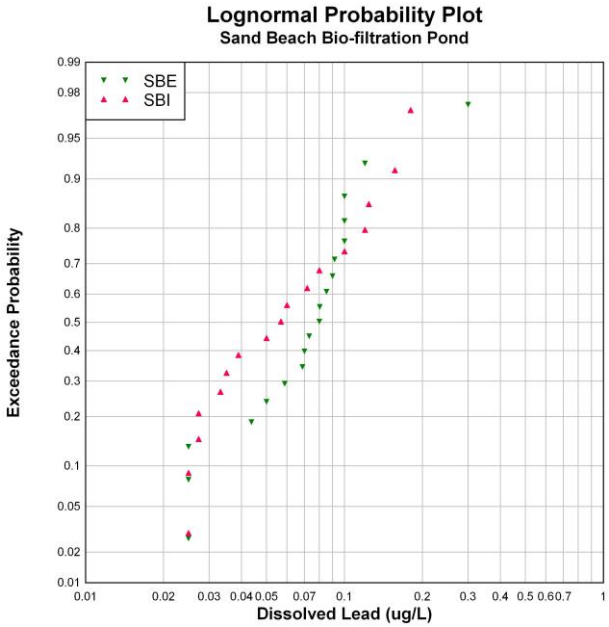


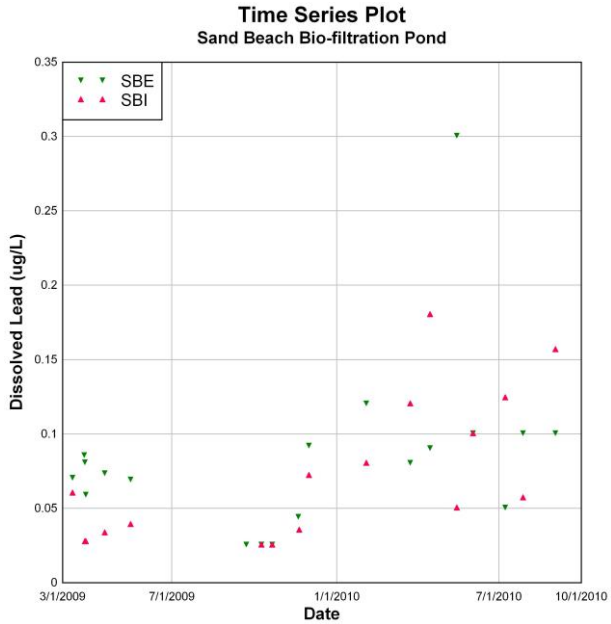


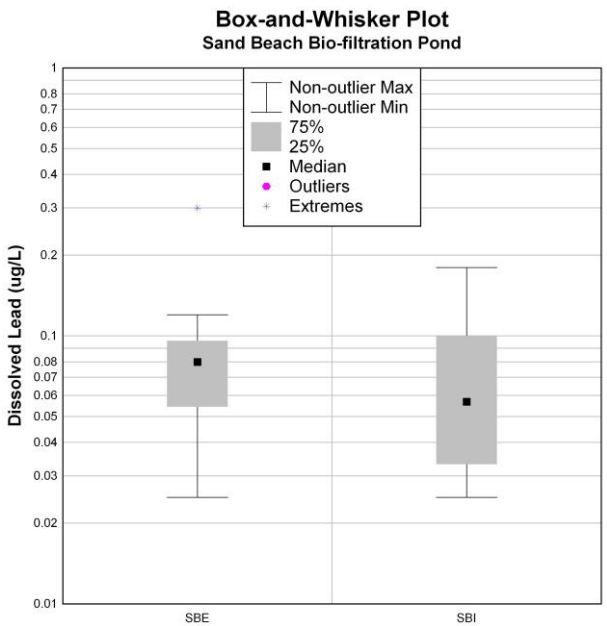


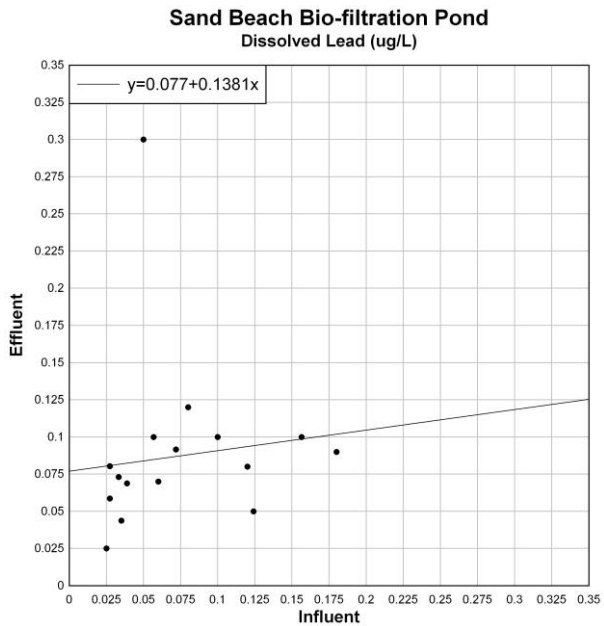
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	121.0	39.9
	Upper Quartile	36.8	10.4
	Median	24.6	4.1
	Lower Quartile	8.4	2.5
	Minimum	2.4	1.8
	Efficiency	83.15%	
	Mann-Whitney	0.0008 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	41.4	12.5
	Mean	28.4	8.3
	LCL	15.4	4.0
	Std. Dev.	27.0	9.4
	Wilk (p-value)	0.0003 **	0.0001 **
	Efficiency	70.86%	
	t-Test (equal var.)	0.0027 **	
	t-Test (unequal var.)	0.0055 **	
	t-test (paired)	0.0013 **	
	Levene Test	0.1599	
Log Transformed	UCL	50.1	12.7
	Mean	29.2	7.8
	LCL	17.1	4.8
	Std. Dev.	30.7	7.9
	Wilk (p-value)	0.8859	0.1038
	Efficiency	73.24%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.8789	
Bootstrap	UCL	39.9	12.0
	Mean	28.0	8.1
	LCL	16.2	4.2
	Std. Dev.	24.5	8.6
	Efficiency	71.14%	

Sand Beach Biofiltration Pond - Dissolved Lead (ug/L)



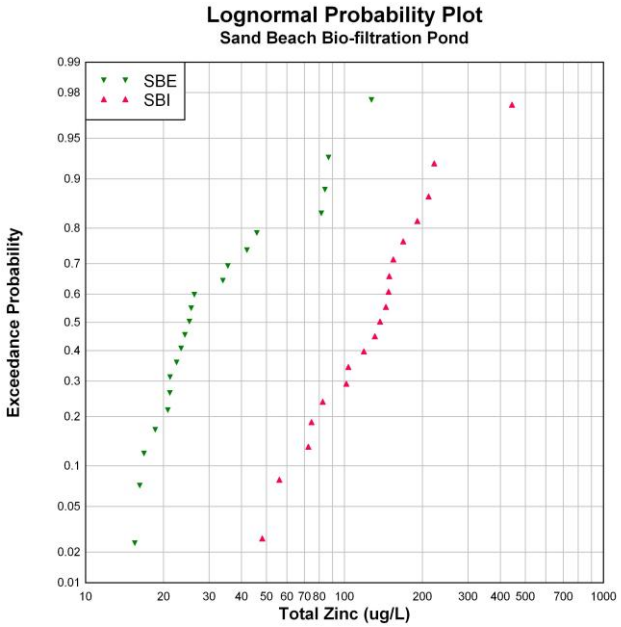


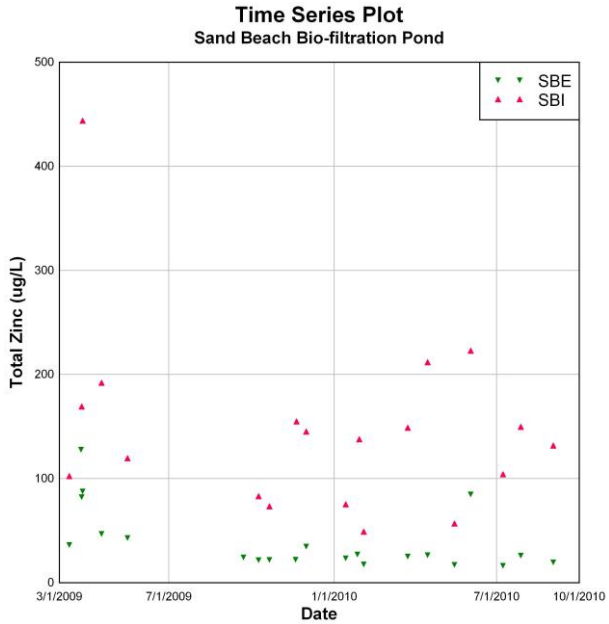


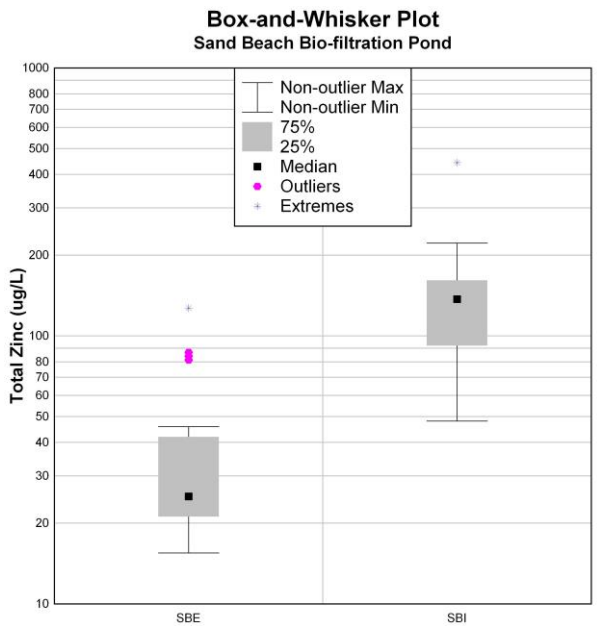


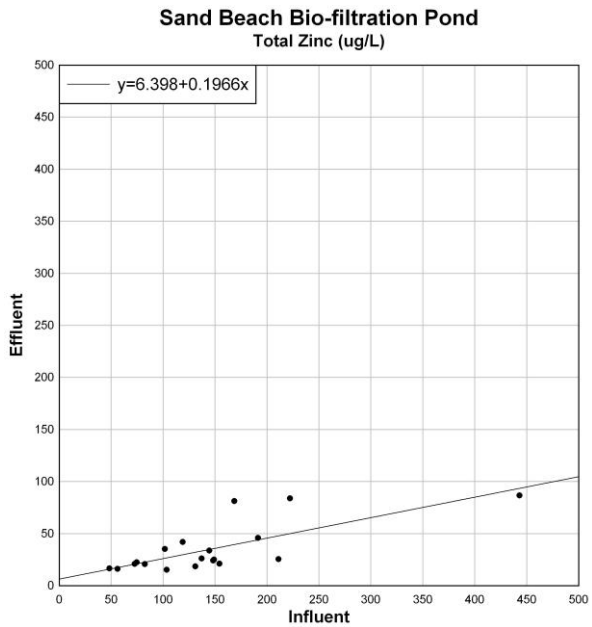
	PARAMETER	Lead, Dissolved (µg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	17	19
	Pairs Count	16	16
Non-Parametric	Maximum	0.2	0.3
	Upper Quartile	0.1	0.1
	Median	0.1	0.1
	Lower Quartile	0.0	0.0
	Minimum	0.0	0.0
	Efficiency	-40.80%	
	Mann-Whitney	0.4902	
	Wilcoxon (paired)	0.5708	
Arithmetic	UCL	0.1	0.1
	Mean	0.1	0.1
	LCL	0.0	0.1
	Std. Dev.	0.0	0.1
	Wilk (p-value)	0.0177 **	0.0001 **
	Efficiency	-17.22%	
	t-Test (equal var.)	0.5051	
	t-Test (unequal var.)	0.5004	
	t-test (paired)	0.4129	
	Levene Test	0.6828	
Log Transformed	UCL	0.1	0.1
	Mean	0.1	0.1
	LCL	0.0	0.1
	Std. Dev.	0.1	0.1
	Wilk (p-value)	0.2017	0.0646 *
	Efficiency	-17.09%	
	t-Test (equal var.)	0.3663	
	t-Test (unequal var.)	0.3693	
	t-Test (paired)	0.1788	
	Levene Test	0.6514	
Bootstrap	UCL	0.1	0.1
	Mean	0.1	0.1
	LCL	0.0	0.1
	Std. Dev.	0.0	0.1
	Efficiency	-15.63%	

Sand Beach Biofiltration Pond - Total Zinc (ug/L)



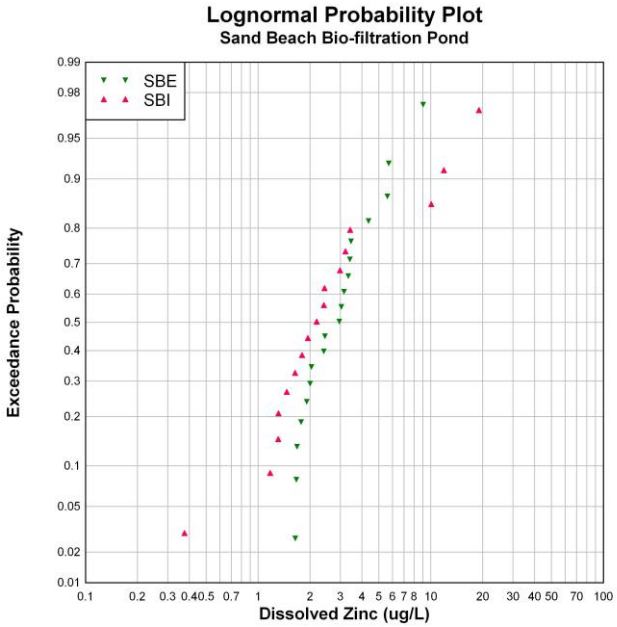


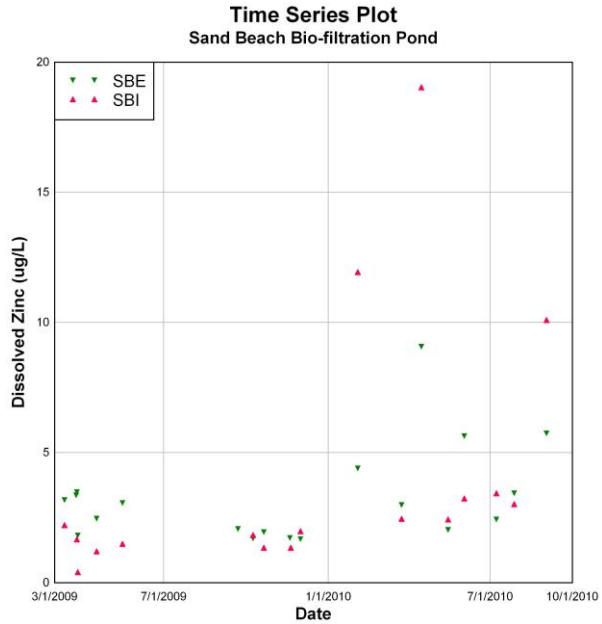


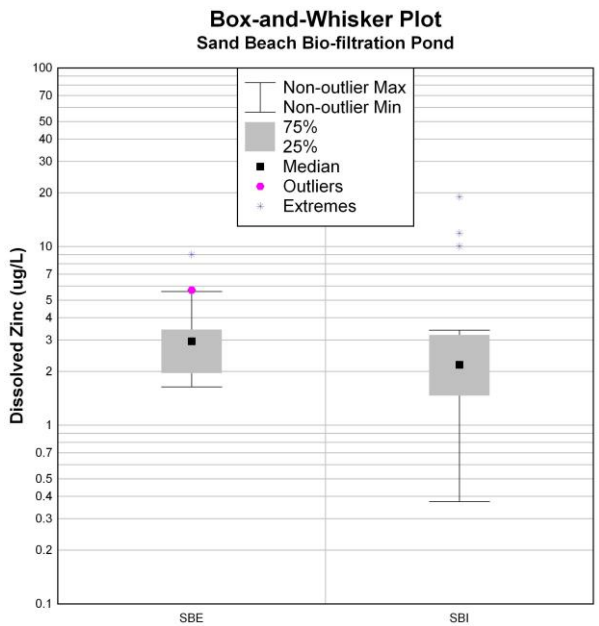


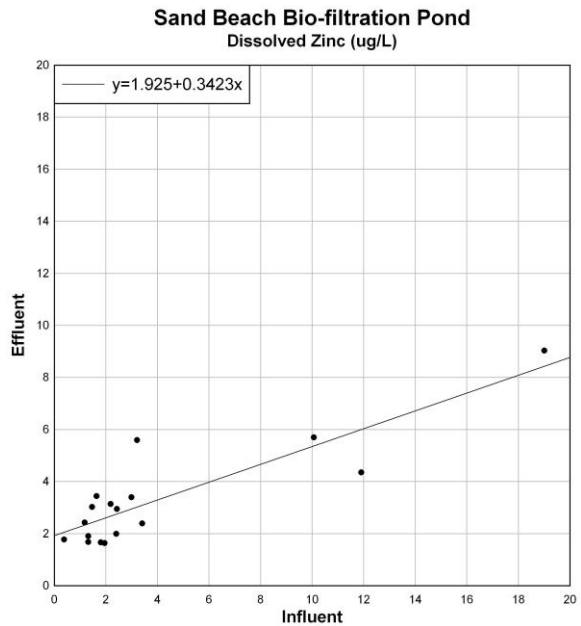
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	443.0	127.0
	Upper Quartile	168.4	42.0
	Median	137.0	25.2
	Lower Quartile	82.3	21.2
	Minimum	48.1	15.5
	Efficiency	81.61%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	187.2	52.5
	Mean	145.0	38.8
	LCL	102.9	25.0
	Std. Dev.	87.5	30.1
	Wilk (p-value)	0.0008 **	0.0001 **
	Efficiency	73.28%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.1513	
Log Transformed	UCL	189.1	51.1
	Mean	144.2	37.6
	LCL	109.9	27.6
	Std. Dev.	79.1	24.6
	Wilk (p-value)	0.8194	0.0095 **
	Efficiency	73.93%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.4893	
Bootstrap	UCL	183.3	51.1
	Mean	144.8	38.3
	LCL	106.3	25.4
	Std. Dev.	79.8	28.3
	Efficiency	73.58%	

Sand Beach Biofiltration Pond - Dissolved Zinc (ug/L)



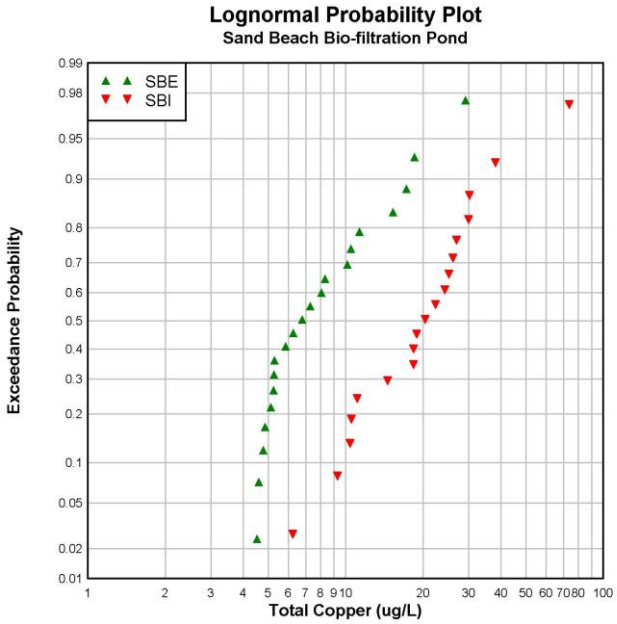


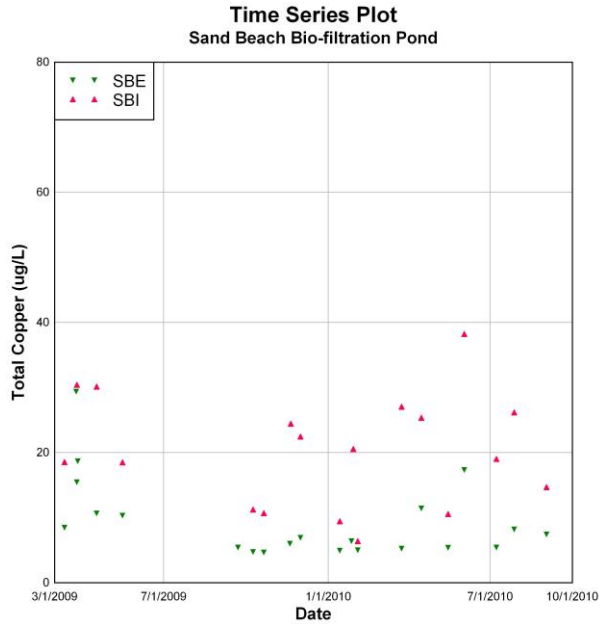


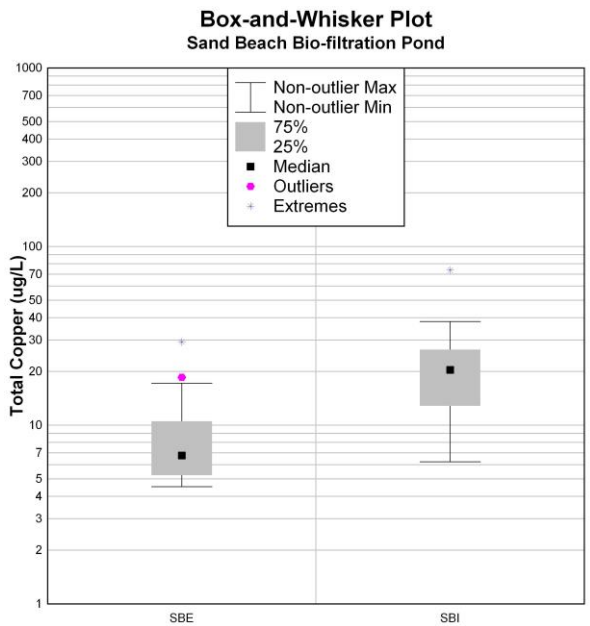


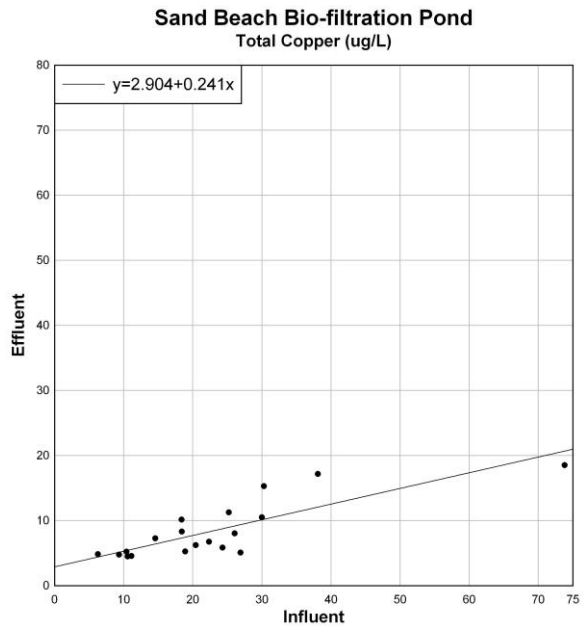
	PARAMETER	Zinc, Dissolved (µg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	17	19
	Pairs Count	16	16
Non-Parametric	Maximum	19.0	9.0
	Upper Quartile	3.2	3.4
	Median	2.2	3.0
	Lower Quartile	1.5	1.9
	Minimum	0.4	1.6
	Efficiency	-35.47%	
	Mann-Whitney	0.2617	
	Wilcoxon (paired)	0.6685	
Arithmetic	UCL	6.6	4.1
	Mean	4.0	3.2
	LCL	1.5	2.3
	Std. Dev.	4.9	1.9
	Wilk (p-value)	0.0001 **	0.0007 **
	Efficiency	19.67%	
	t-Test (equal var.)	0.5200	
	t-Test (unequal var.)	0.5405	
	t-test (paired)	0.3767	
	Levene Test	0.1245	
Log Transformed	UCL	6.8	4.1
	Mean	3.8	3.2
	LCL	2.1	2.5
	Std. Dev.	4.0	1.6
	Wilk (p-value)	0.1435	0.1195
	Efficiency	15.35%	
	t-Test (equal var.)	0.5764	
	t-Test (unequal var.)	0.5909	
	t-Test (paired)	0.3920	
	Levene Test	0.0530 *	
Bootstrap	UCL	6.5	4.1
	Mean	4.1	3.3
	LCL	1.7	2.4
	Std. Dev.	4.6	1.8
	Efficiency	20.30%	

Sand Beach Biofiltration Pond - Total Copper (ug/L)



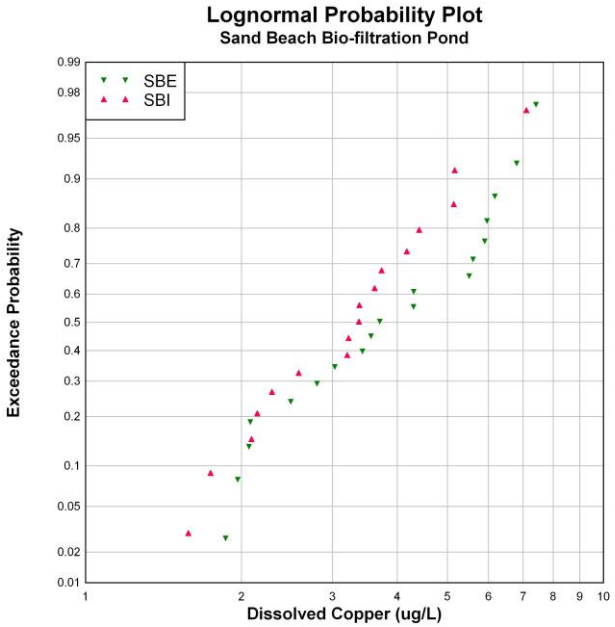


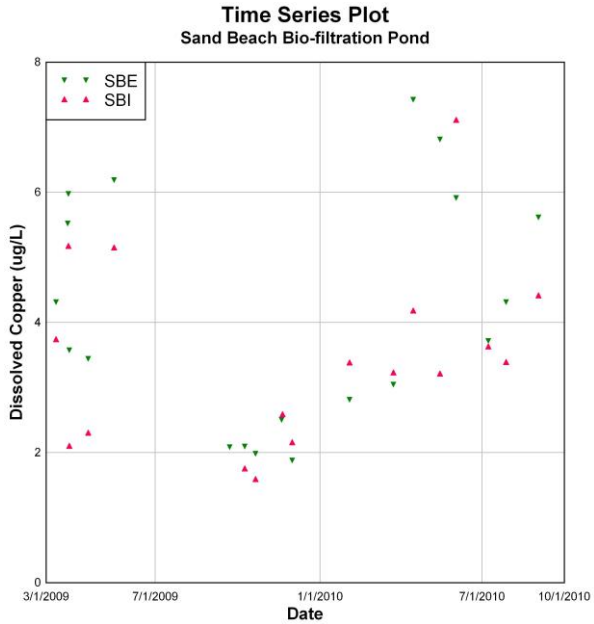


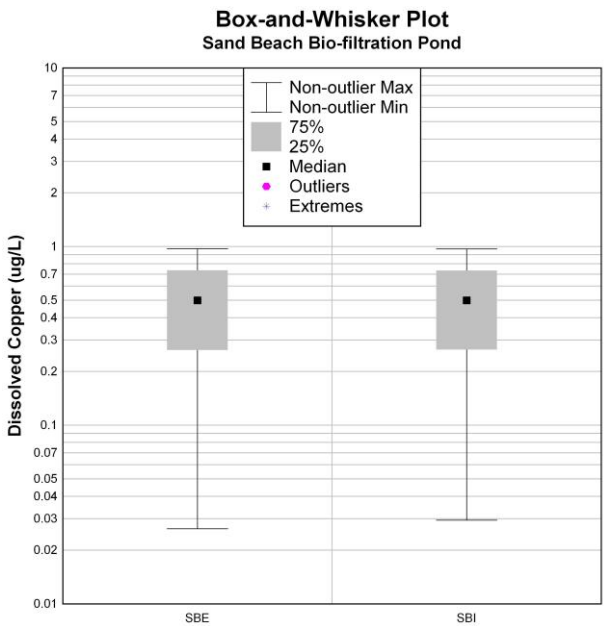


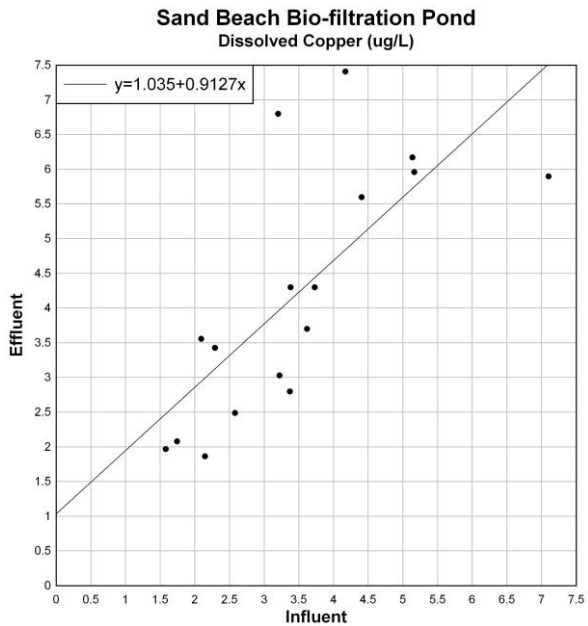
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	73.8	29.2
	Upper Quartile	26.9	10.5
	Median	20.4	6.8
	Lower Quartile	11.1	5.3
	Minimum	6.3	4.5
	Efficiency	66.80%	
	Mann-Whitney	0.0002 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	30.1	12.1
	Mean	22.9	9.3
	LCL	15.7	6.4
	Std. Dev.	14.9	6.2
	Wilk (p-value)	0.0007 **	0.0001 **
	Efficiency	59.55%	
	t-Test (equal var.)	0.0005 **	
	t-Test (unequal var.)	0.0011 **	
	t-test (paired)	0.0002 **	
	Levene Test	0.1839	
Log Transformed	UCL	30.8	11.8
	Mean	22.8	9.1
	LCL	16.9	7.0
	Std. Dev.	13.8	5.1
	Wilk (p-value)	0.7834	0.0174 **
	Efficiency	60.19%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7587	
Bootstrap	UCL	29.4	11.8
	Mean	22.8	9.2
	LCL	16.3	6.5
	Std. Dev.	13.6	5.8
	Efficiency	59.80%	

Sand Beach Biofiltration Pond - Dissolved Copper (ug/L)



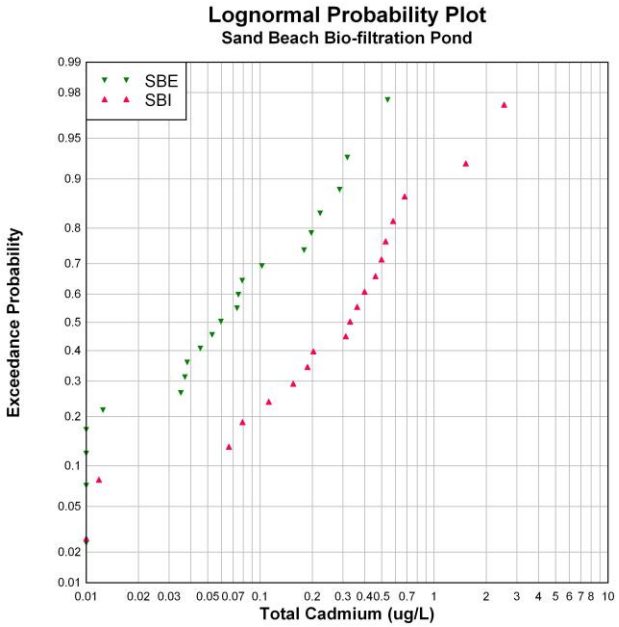


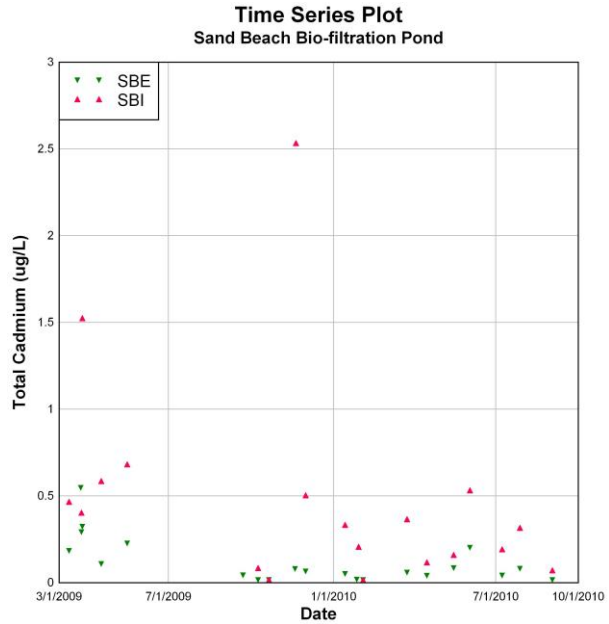


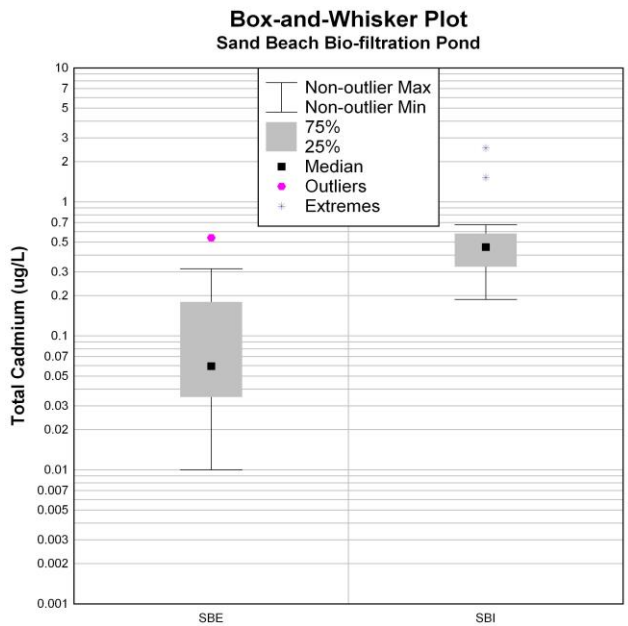


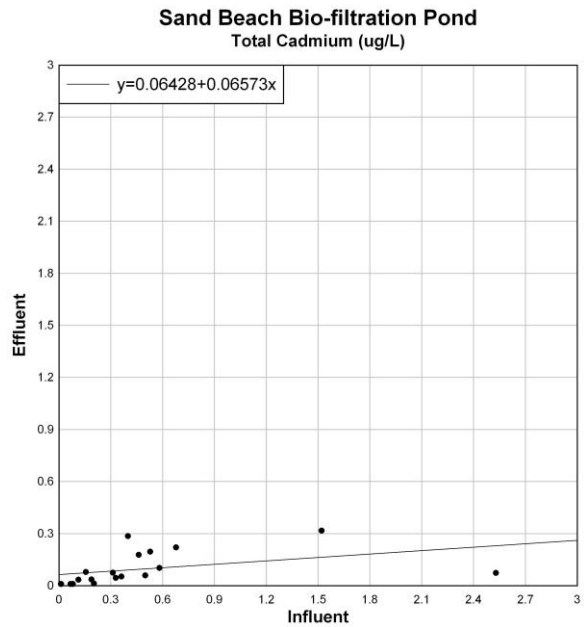
	PARAMETER	Copper, Dissolved (µg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	17	19
	Pairs Count	16	16
Non-Parametric	Maximum	7.1	7.4
	Upper Quartile	4.2	5.9
	Median	3.4	3.7
	Lower Quartile	2.3	2.5
	Minimum	1.6	1.9
	Efficiency	-9.79%	
	Mann-Whitney	0.3029	
	Wilcoxon (paired)	0.0214 **	
Arithmetic	UCL	4.2	5.0
	Mean	3.5	4.2
	LCL	2.7	3.3
	Std. Dev.	1.4	1.8
	Wilk (p-value)	0.2441	0.1436
	Efficiency	-19.88%	
	t-Test (equal var.)	0.2142	
	t-Test (unequal var.)	0.2088	
	t-test (paired)	0.0245 **	
	Levene Test	0.2682	
Log Transformed	UCL	4.3	5.3
	Mean	3.5	4.2
	LCL	2.8	3.3
	Std. Dev.	1.5	2.0
	Wilk (p-value)	0.9346	0.1689
	Efficiency	-20.28%	
	t-Test (equal var.)	0.2638	
	t-Test (unequal var.)	0.2608	
	t-Test (paired)	0.0134 **	
	Levene Test	0.5030	
Bootstrap	UCL	4.1	5.0
	Mean	3.5	4.2
	LCL	2.8	3.3
	Std. Dev.	1.3	1.7
	Efficiency	-20.36%	

Sand Beach Biofiltration Pond - Total Cadmium (ug/L)



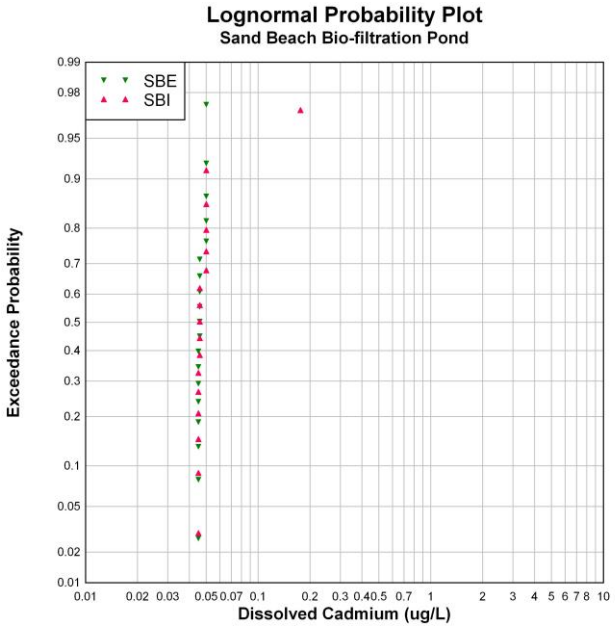


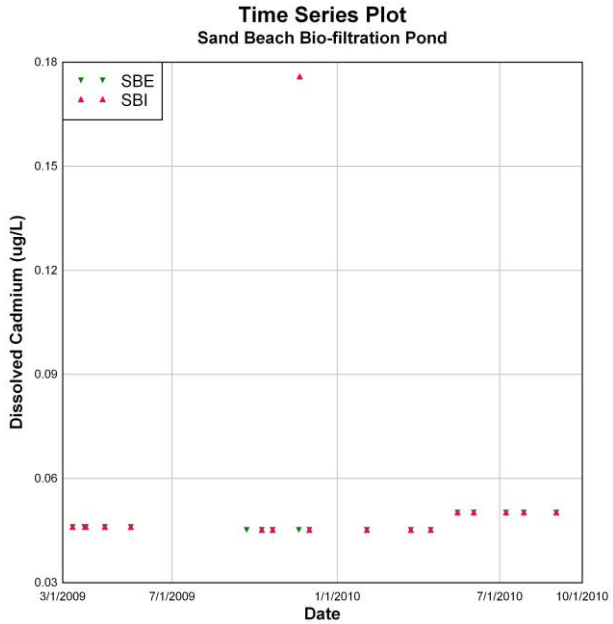


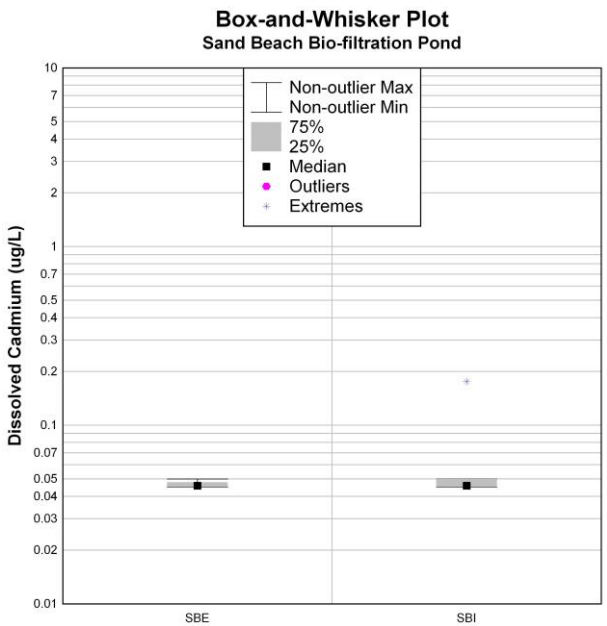


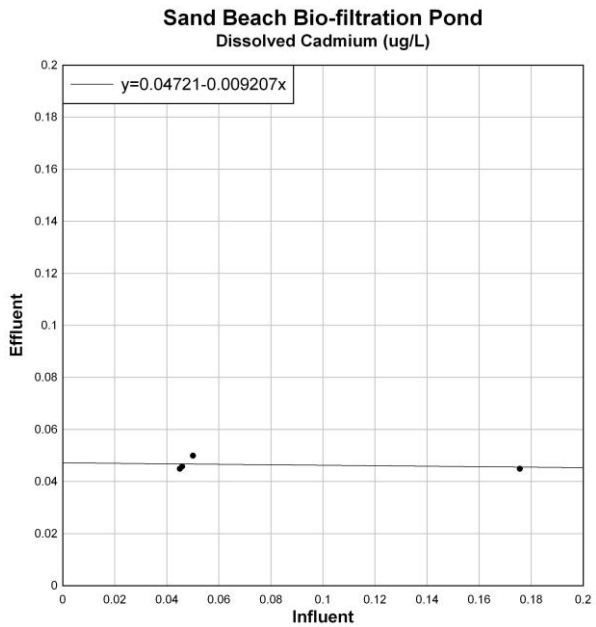
	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	19	21
	Pairs Count	17	17
Non-Parametric	Maximum	2.5	0.5
	Upper Quartile	0.5	0.2
	Median	0.3	0.1
	Lower Quartile	0.1	0.0
	Minimum	0.0	0.0
	Efficiency	81.85%	
	Mann-Whitney	0.0031 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.8	0.2
	Mean	0.5	0.1
	LCL	0.2	0.1
	Std. Dev.	0.6	0.1
	Wilk (p-value)	0.0001 **	0.0002 **
	Efficiency	75.98%	
	t-Test (equal var.)	0.0113 **	
	t-Test (unequal var.)	0.0195 **	
	t-test (paired)	0.0015 **	
	Levene Test	0.1280	
Log Transformed	UCL	1.5	0.3
	Mean	0.6	0.1
	LCL	0.2	0.1
	Std. Dev.	1.1	0.2
	Wilk (p-value)	0.1565	0.1832
	Efficiency	79.23%	
	t-Test (equal var.)	0.0022 **	
	t-Test (unequal var.)	0.0024 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.5781	
Bootstrap	UCL	0.7	0.2
	Mean	0.5	0.1
	LCL	0.2	0.1
	Std. Dev.	0.6	0.1
	Efficiency	76.39%	

Sand Beach Biofiltration Pond - Dissolved Cadmium (ug/L)









	PARAMETER	Cadmium, Dissolved (µg/L)	
Type	**Statistic**	**INF: SBI**	**EFF: SBE**
	Site Count	17	19
	Pairs Count	16	16
Non-Parametric	Maximum	0.2	0.1
	Upper Quartile	0.0	0.0
	Median	0.0	0.0
	Lower Quartile	0.0	0.0
	Minimum	0.0	0.0
	Efficiency	0.00%	
	Mann-Whitney	0.4307	
	Wilcoxon (paired)	0.5186	
Arithmetic	UCL	0.1	0.0
	Mean	0.1	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	14.38%	
	t-Test (equal var.)	0.2845	
	t-Test (unequal var.)	0.3194	
	t-test (paired)	0.5487	
	Levene Test	0.2663	
Log Transformed	UCL	0.1	0.0
	Mean	0.1	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	12.31%	
	t-Test (equal var.)	0.2767	
	t-Test (unequal var.)	0.3105	
	t-Test (paired)	0.5464	
	Levene Test	0.2657	
Bootstrap	UCL	0.1	0.0
	Mean	0.1	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Efficiency	14.64%	

Canyon Creek Biofiltration (CCI-CCN)

The Canyon Creek water quality pond was designed to be able to test different filtration media with a sand filter control. Water flows into a standard sedimentation basin sized using City of Austin guidelines. There are two riser pipes which control the flow into the two filtration bed. Water quality leaving the sedimentation bed is designated as CCI, effluent from the biofiltration is designated as CCN. The performance of the sedimentation basin is not measured at this facility, thus the removal efficiencies die CCN may be lower than otherwise expected. Refer to the Sand Filter section of this report for details on the sand filter portion of this SCM (CCI-CCS)

CCN is a chamber in the Canyon Creek complex which receives stormwater from CCI. The flow of water into CCN is controlled by an orifice in a PVC cap which regulates how fast CCI is drained. The water drains into a concrete trough which helps to spread the water evenly throughout the treatment area. The stormwater is then treated in CCN with biofiltration media. Once treated the water flows into sub-surface pipes and then out of the system into a chamber where samples are collected. The filtration media in this SCM used compost which is no longer allowed in Austin for biofiltration.

The City collected 19 samples at CCI and 23 samples at CCS in 2009 and 2010, 16 of which were paired. The City monitored this site in 1996-8 but those samples were not included in these analyses because the controls were rebuilt in 2008.

Performance Summary

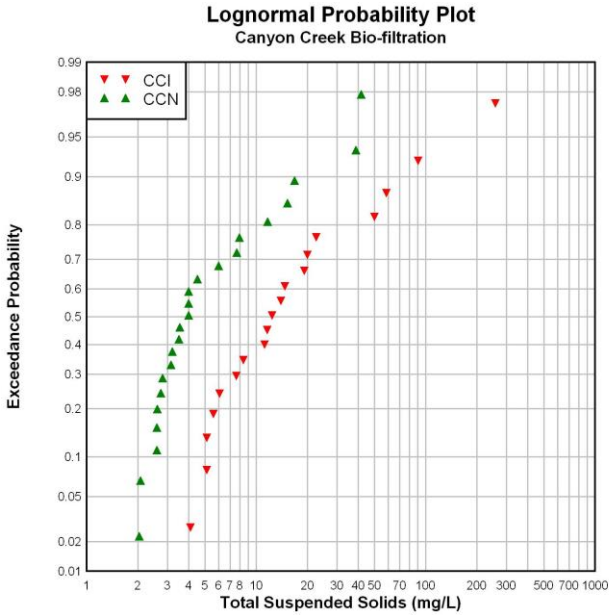
The performance of the Biofiltration media is similar to sand filtration in many respects. There are significant reductions of TSS, VSS and COD. TOC samples were significantly different with paired tests but not with pooled data. This varies slightly with the adjacent sand filter which had a significant reduction in TOC. This may be due to the organic matter in the Biofiltration media.

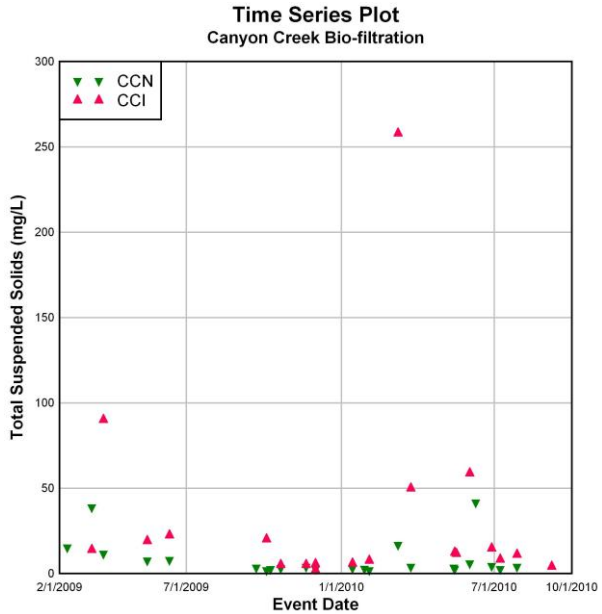
There was a slight but not significant export of total nitrogen. Nitrate concentrations were significantly higher in the effluent while there were slight and significant reductions in ammonia and TKN. Total and dissolved P concentrations were significantly higher in the effluent, 2 and 3 times respectively. The increases in nutrients is likely due to the compost added to the Biofiltration media, it has been hypothesized that the concentrations would decrease over time but that temporal trend was not observed in the data.

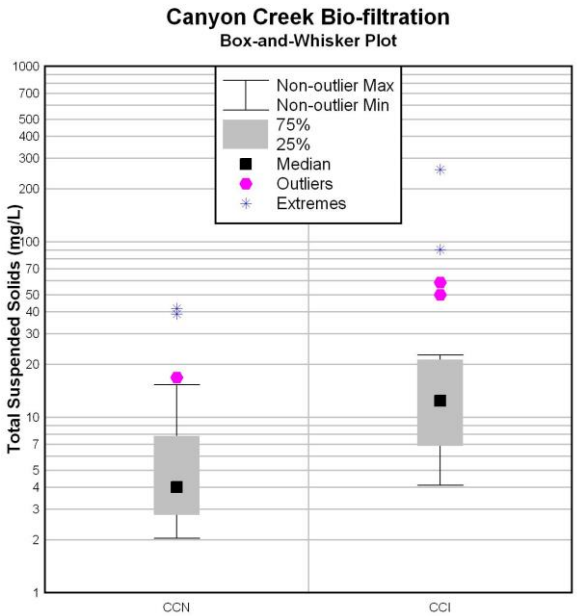
Fecal Coliform and E. Coli concentrations at the effluent were both significantly lower, ~90% reductions.

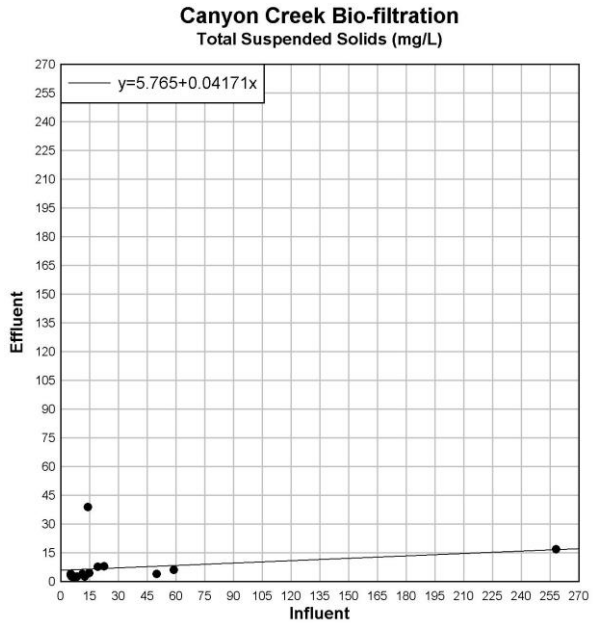
Total and dissolved metals were measured at the Canyon Creek pond. Effluent concentrations of total and dissolved Pb and Zn were significantly lower than the influent in all statistical tests. There was no significant difference for total Cu but dissolved Cu concentrations were significantly high than the effluent. This may be a result of the added compost. There were no significant trends for Cd.

Canyon Creek Bio-Filter -- Total Suspended Solids (mg/L)



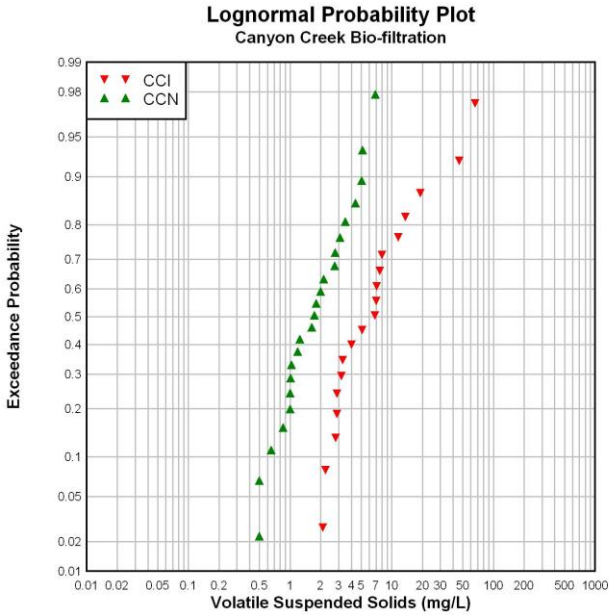


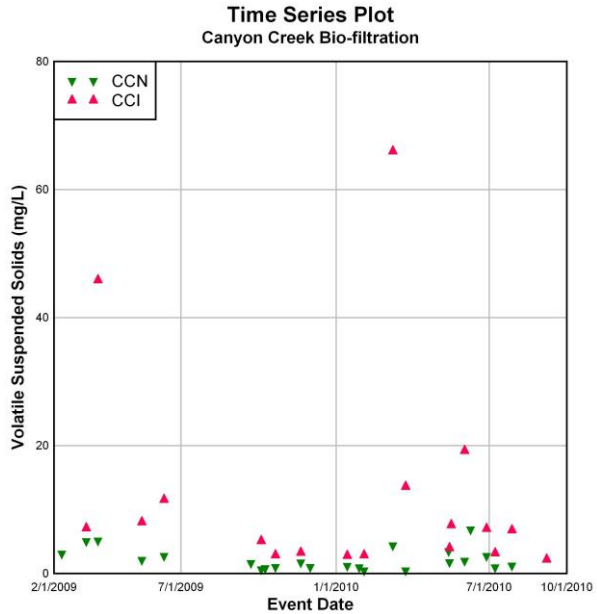


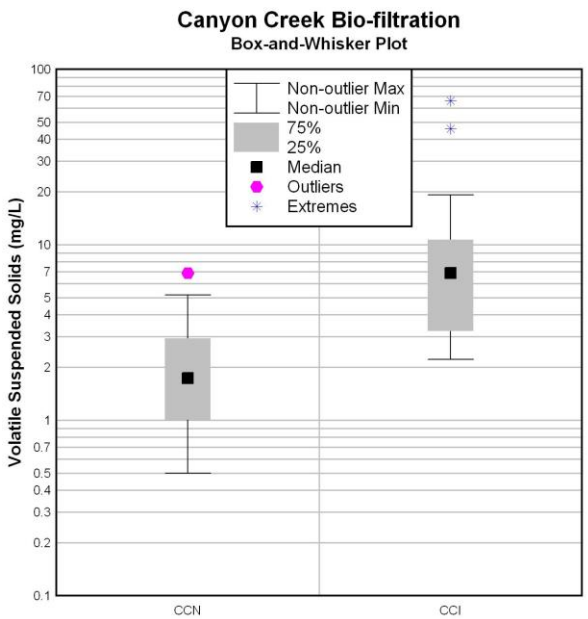


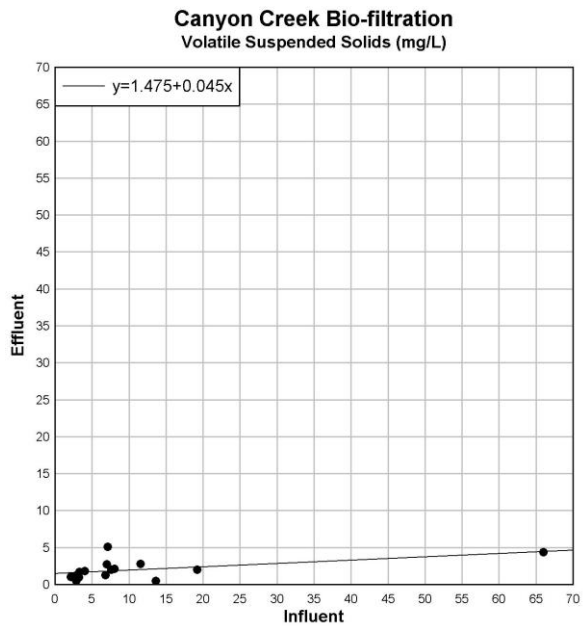
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	258.0	41.7
	Upper Quartile	22.5	7.9
	Median	12.4	4.0
	Lower Quartile	6.1	2.7
	Minimum	4.1	2.0
	Efficiency	67.86%	
	Mann-Whitney	0.0012 **	
	Wilcoxon (paired)	0.0027 **	
Arithmetic	UCL	61.3	13.1
	Mean	32.9	8.4
	LCL	4.5	3.7
	Std. Dev.	58.9	10.8
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	74.46%	
	t-Test (equal var.)	0.0572 *	
	t-Test (unequal var.)	0.0899 *	
	t-test (paired)	0.1208	
	Levene Test	0.1917	
Log Transformed	UCL	53.4	11.8
	Mean	27.2	7.5
	LCL	13.8	4.8
	Std. Dev.	35.5	7.5
	Wilk (p-value)	0.0630 *	0.0025 **
	Efficiency	72.27%	
	t-Test (equal var.)	0.0009 **	
	t-Test (unequal var.)	0.0013 **	
	t-Test (paired)	0.0002 **	
	Levene Test	0.3836	
Bootstrap	UCL	57.3	12.7
	Mean	32.4	8.4
	LCL	7.5	4.0
	Std. Dev.	51.6	10.1
	Efficiency	74.15%	

Canyon Creek Bio-Filter -- Volatile Suspended Solids (mg/L)



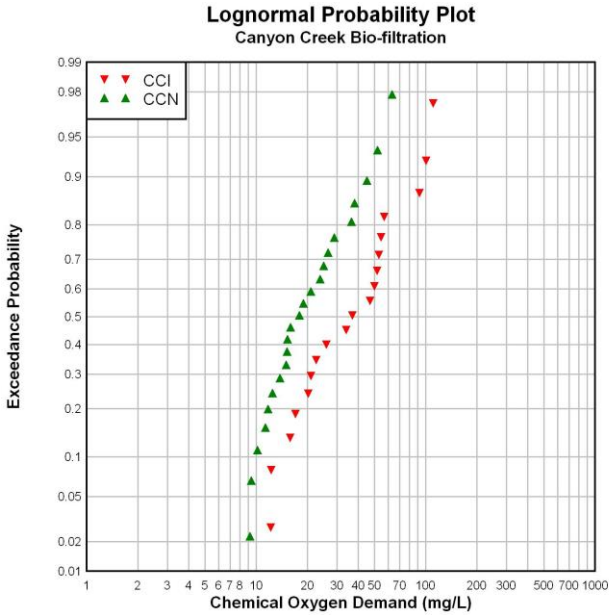


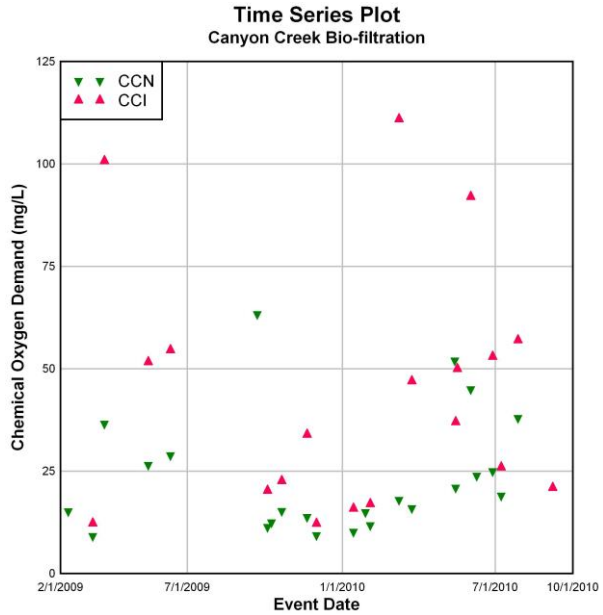


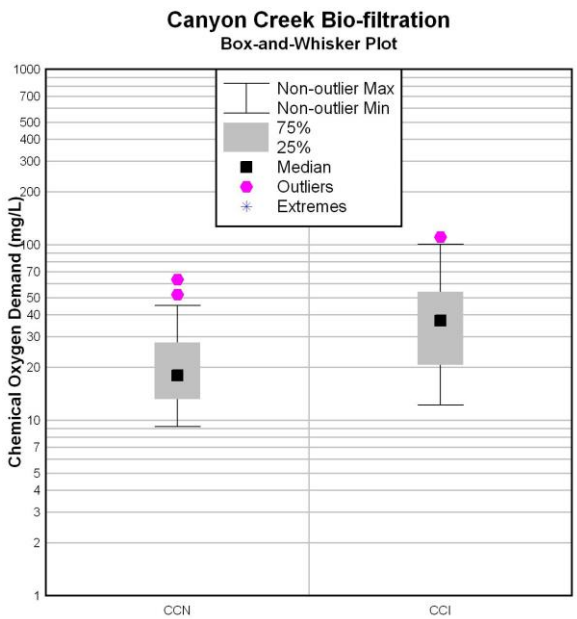


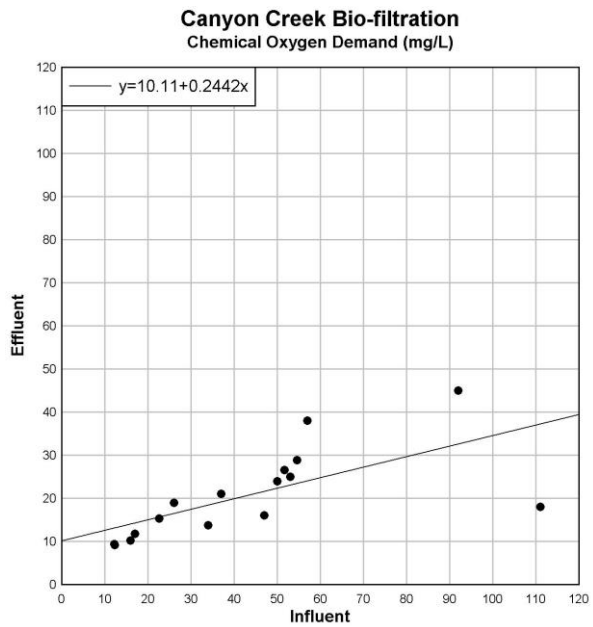
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	66.0	6.9
	Upper Quartile	11.6	3.1
	Median	6.8	1.7
	Lower Quartile	2.9	1.0
	Minimum	2.1	.5
	Efficiency	74.53%	
	Mann-Whitney	0.0001 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	19.6	3.0
	Mean	11.6	2.3
	LCL	3.7	1.5
	Std. Dev.	16.6	1.7
	Wilk (p-value)	0.0001 **	0.0040 **
	Efficiency	80.60%	
	t-Test (equal var.)	0.0099 **	
	t-Test (unequal var.)	0.0240 **	
	t-test (paired)	0.0360 **	
	Levene Test	0.0861 *	
Log Transformed	UCL	18.3	3.3
	Mean	10.3	2.3
	LCL	5.8	1.6
	Std. Dev.	11.5	1.9
	Wilk (p-value)	0.0498 **	0.6556
	Efficiency	78.09%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2583	
Bootstrap	UCL	18.7	3.0
	Mean	11.5	2.3
	LCL	4.2	1.5
	Std. Dev.	15.0	1.7
	Efficiency	80.33%	

Canyon Creek Bio-Filter -- Chemical Oxygen Demand (mg/L)



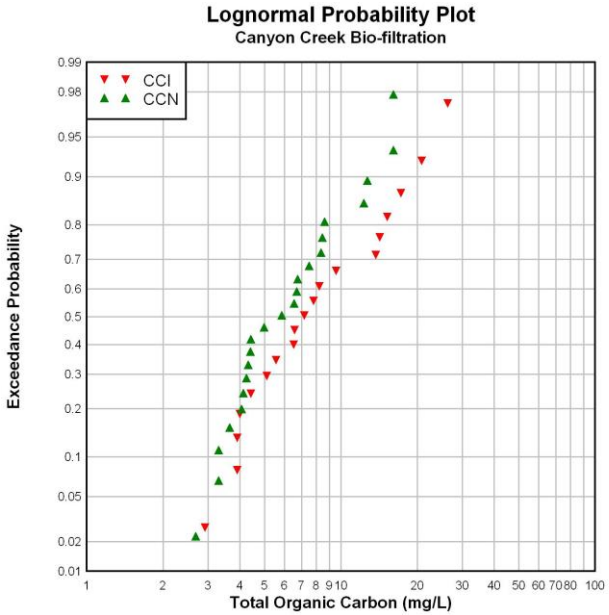


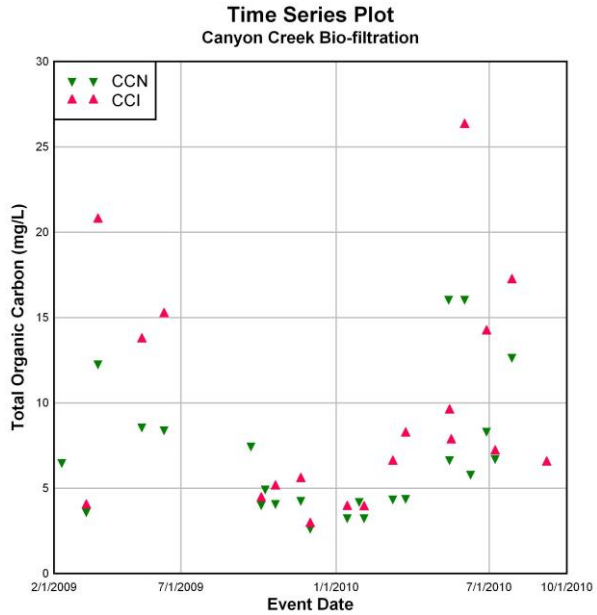


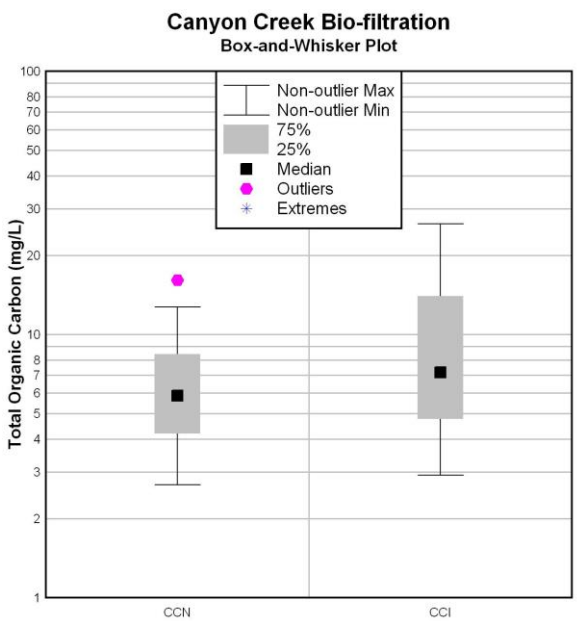


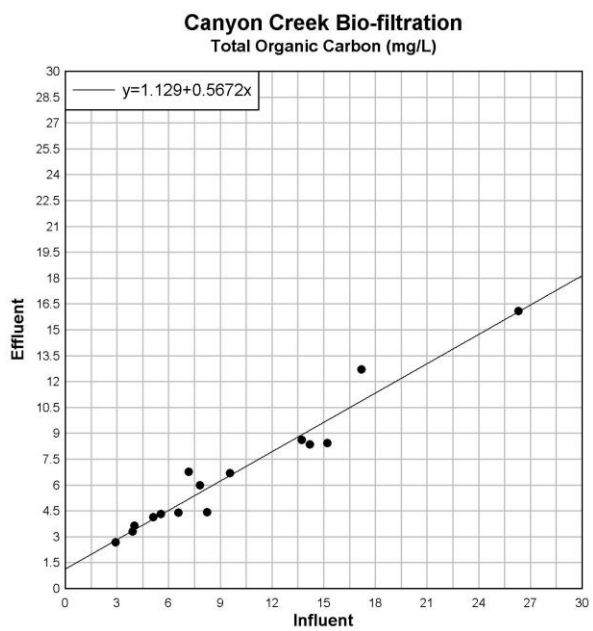
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	111.00	63.35
	Upper Quartile	54.60	28.91
	Median	37.00	18.00
	Lower Quartile	20.28	12.51
	Minimum	12.19	9.19
	Efficiency	51.35%	
	Mann-Whitney	0.0120 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	58.35	29.66
	Mean	43.97	23.35
	LCL	29.58	17.04
	Std. Dev.	29.85	14.60
	Wilk (p-value)	0.0142 **	0.0020 **
	Efficiency	46.90%	
	t-Test (equal var.)	0.0057 **	
	t-Test (unequal var.)	0.0109 **	
	t-test (paired)	0.0011 **	
	Levene Test	0.0205 **	
Log Transformed	UCL	64.04	29.98
	Mean	44.17	23.11
	LCL	30.46	17.81
	Std. Dev.	32.69	13.60
	Wilk (p-value)	0.3728	0.3105
	Efficiency	47.68%	
	t-Test (equal var.)	0.0049 **	
	t-Test (unequal var.)	0.0061 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2146	
Bootstrap	UCL	57.40	29.38
	Mean	43.67	23.33
	LCL	29.93	17.28
	Std. Dev.	28.50	13.99
	Efficiency	46.57%	

Canyon Creek Bio-Filter -- Total Organic Carbon (mg/L)



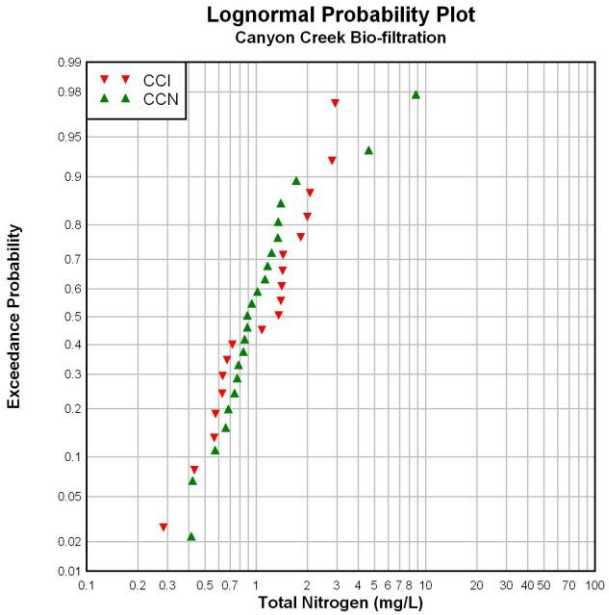


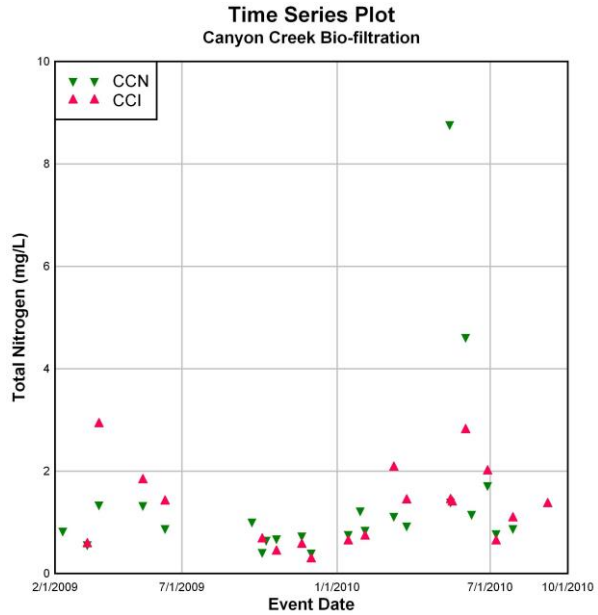


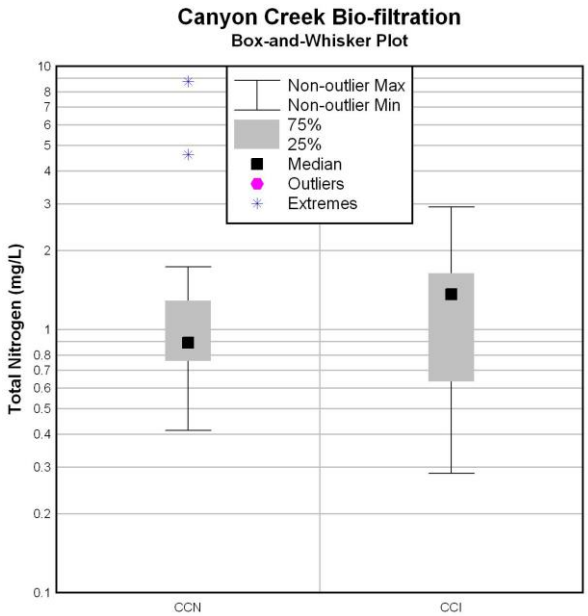


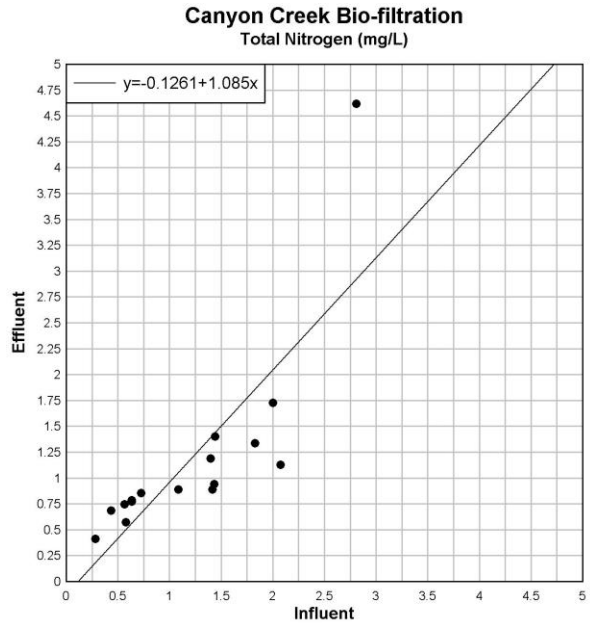
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	26.30	16.10
	Upper Quartile	14.20	8.44
	Median	7.17	5.85
	Lower Quartile	4.42	4.14
	Minimum	2.91	2.68
	Efficiency	18.36%	
	Mann-Whitney	0.2321	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	12.77	8.64
	Mean	9.63	6.94
	LCL	6.49	5.23
	Std. Dev.	6.52	3.94
	Wilk (p-value)	0.0091 **	0.0017 **
	Efficiency	28.00%	
	t-Test (equal var.)	0.1057	
	t-Test (unequal var.)	0.1249	
	t-test (paired)	0.0009 **	
	Levene Test	0.0838 *	
Log Transformed	UCL	13.41	8.72
	Mean	9.57	6.88
	LCL	6.82	5.43
	Std. Dev.	6.47	3.70
	Wilk (p-value)	0.5044	0.2173
	Efficiency	28.05%	
	t-Test (equal var.)	0.1430	
	t-Test (unequal var.)	0.1524	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2210	
Bootstrap	UCL	12.57	8.62
	Mean	9.58	6.96
	LCL	6.60	5.30
	Std. Dev.	6.19	3.84
	Efficiency	27.37%	

Canyon Creek Bio-Filter -- Total Nitrogen (mg/L)



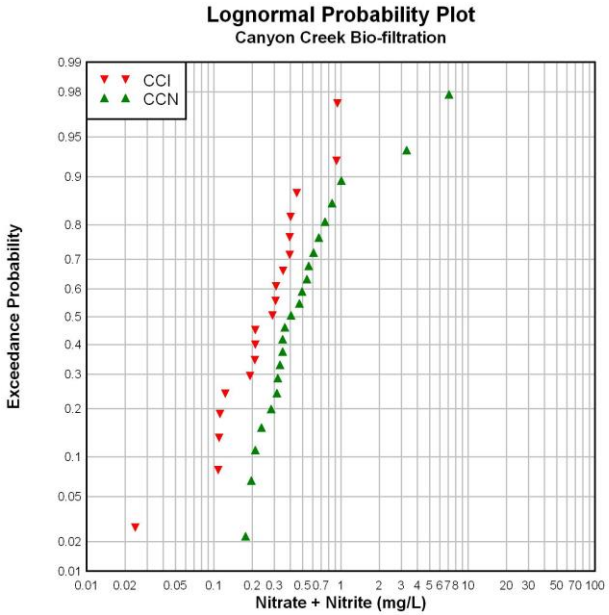


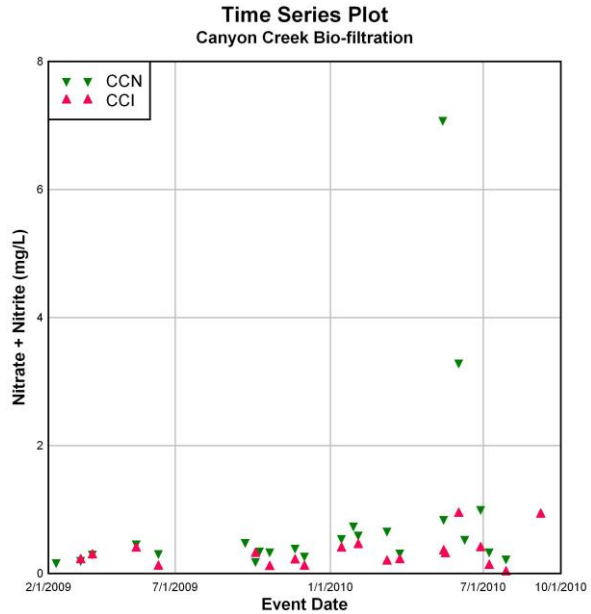


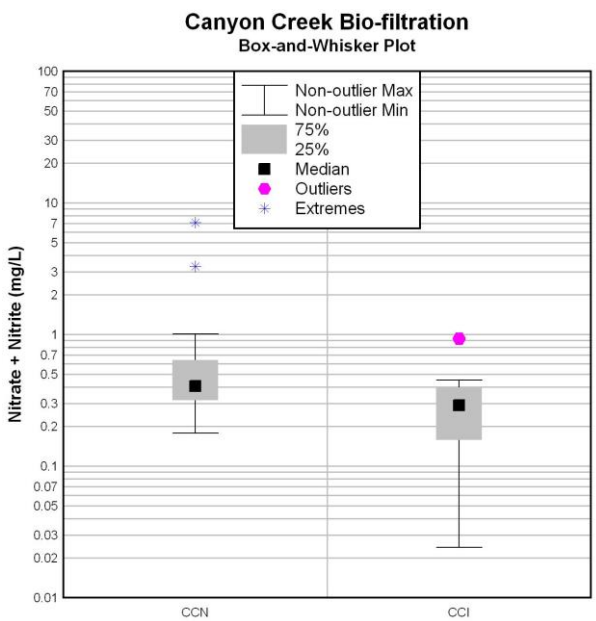


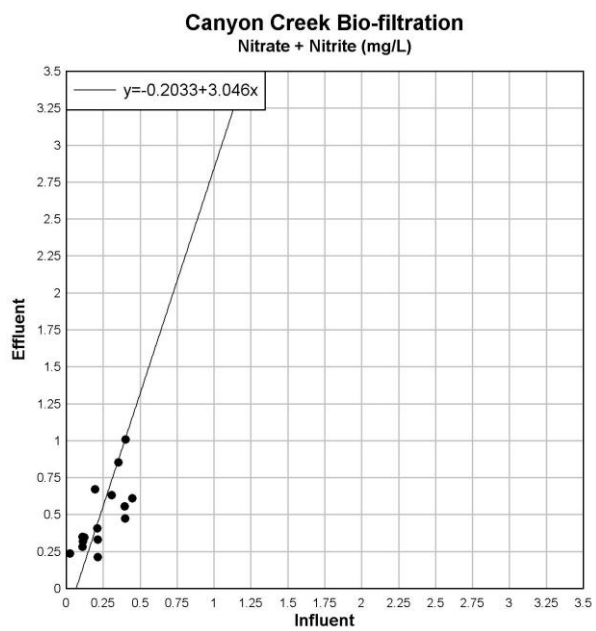
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	2.920	8.780
	Upper Quartile	1.827	1.339
	Median	1.361	0.889
	Lower Quartile	0.632	0.746
	Minimum	0.284	0.413
	Efficiency	34.65%	
	Mann-Whitney	0.6160	
	Wilcoxon (paired)	0.4037	
Arithmetic	UCL	1.652	2.225
	Mean	1.278	1.445
	LCL	0.904	0.666
	Std. Dev.	0.776	1.802
	Wilk (p-value)	0.0691 *	0.0001 **
	Efficiency	-13.10%	
	t-Test (equal var.)	0.7083	
	t-Test (unequal var.)	0.6898	
	t-test (paired)	0.8790	
	Levene Test	0.3334	
Log Transformed	UCL	1.835	1.814
	Mean	1.294	1.309
	LCL	0.912	0.944
	Std. Dev.	0.904	0.958
	Wilk (p-value)	0.4400	0.0017 **
	Efficiency	-1.15%	
	t-Test (equal var.)	0.9796	
	t-Test (unequal var.)	0.9795	
	t-Test (paired)	0.9162	
	Levene Test	0.8941	
Bootstrap	UCL	1.631	2.164
	Mean	1.274	1.459
	LCL	0.918	0.755
	Std. Dev.	0.740	1.628
	Efficiency	-14.55%	

Canyon Creek Bio-Filter -- Nitrate + Nitrite (mg/L)



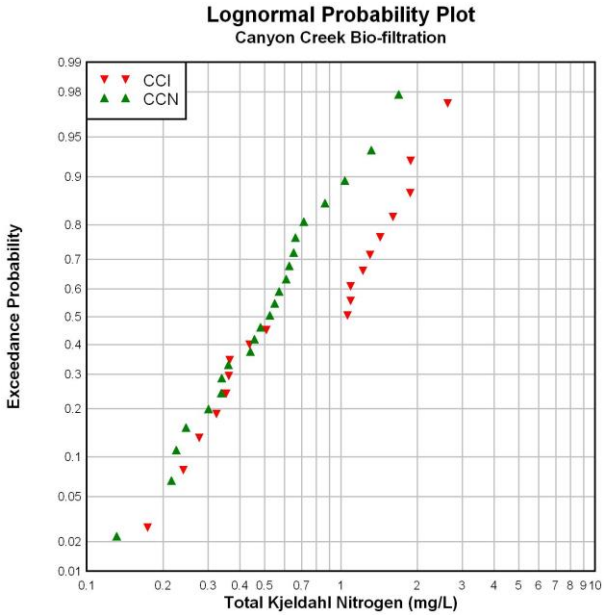


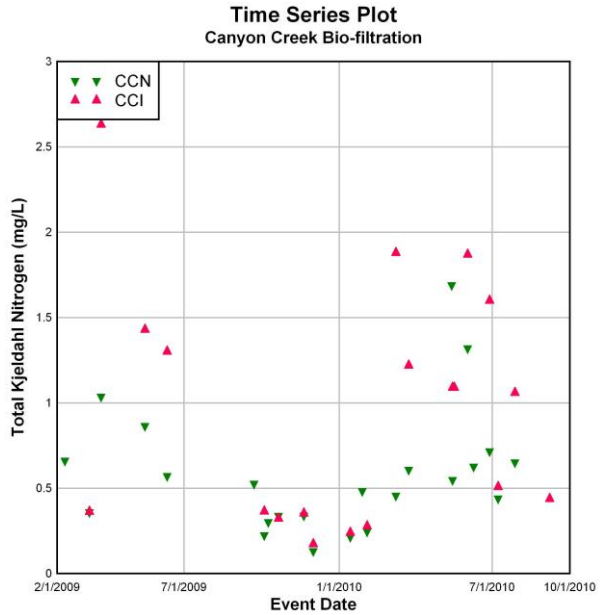


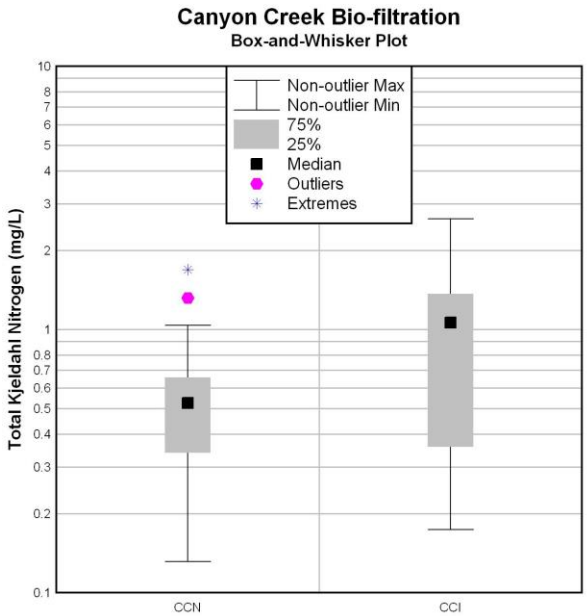


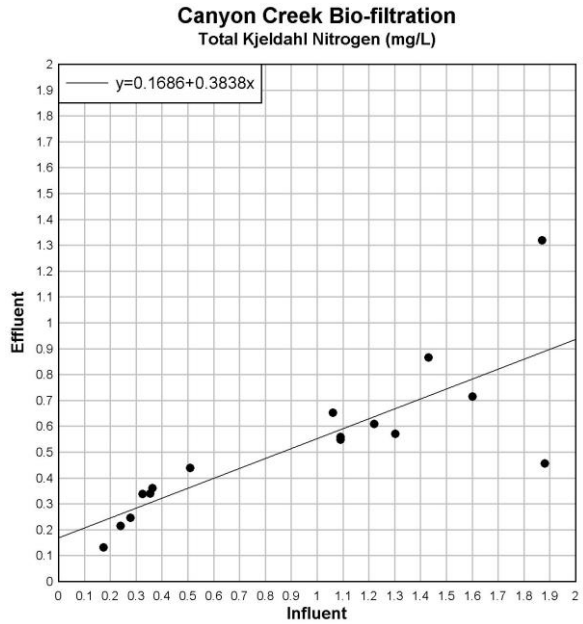
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	0.938	7.090
	Upper Quartile	0.397	0.671
	Median	0.289	0.406
	Lower Quartile	0.123	0.313
	Minimum	0.024	0.178
	Efficiency	-40.34%	
	Mann-Whitney	0.0155 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	0.438	1.512
	Mean	0.319	0.864
	LCL	0.201	0.217
	Std. Dev.	0.246	1.497
	Wilk (p-value)	0.0017 **	0.0001 **
	Efficiency	-170.78%	
	t-Test (equal var.)	0.1249	
	t-Test (unequal var.)	0.0987 *	
	t-test (paired)	0.0154 **	
	Levene Test	0.2680	
Log Transformed	UCL	0.539	1.100
	Mean	0.335	0.710
	LCL	0.208	0.459
	Std. Dev.	0.313	0.689
	Wilk (p-value)	0.1454	0.0020 **
	Efficiency	-112.27%	
	t-Test (equal var.)	0.0081 **	
	t-Test (unequal var.)	0.0081 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.9406	
Bootstrap	UCL	0.436	1.456
	Mean	0.322	0.877
	LCL	0.209	0.299
	Std. Dev.	0.235	1.338
	Efficiency	-172.35%	

Canyon Creek Bio-Filter -- Total Kjeldahl Nitrogen (mg/L)



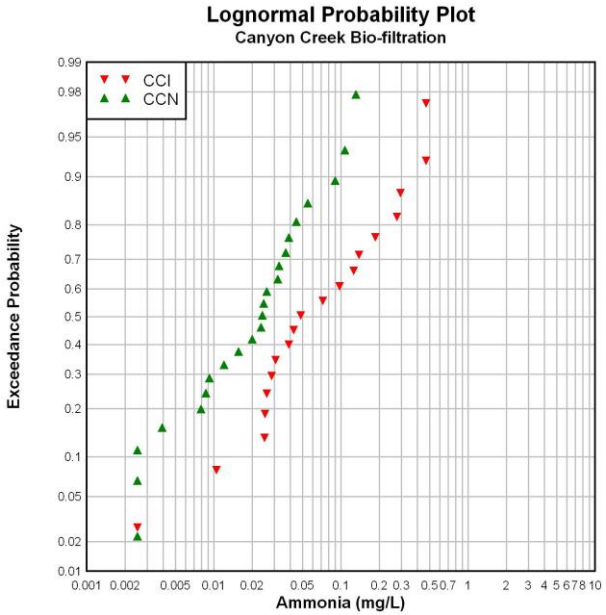


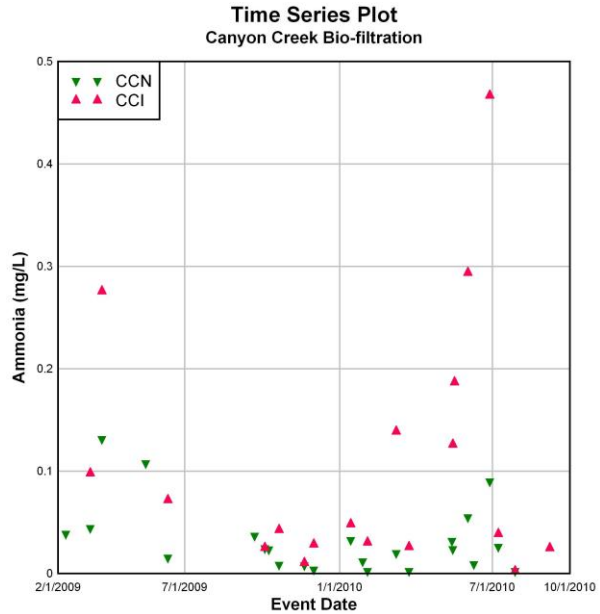


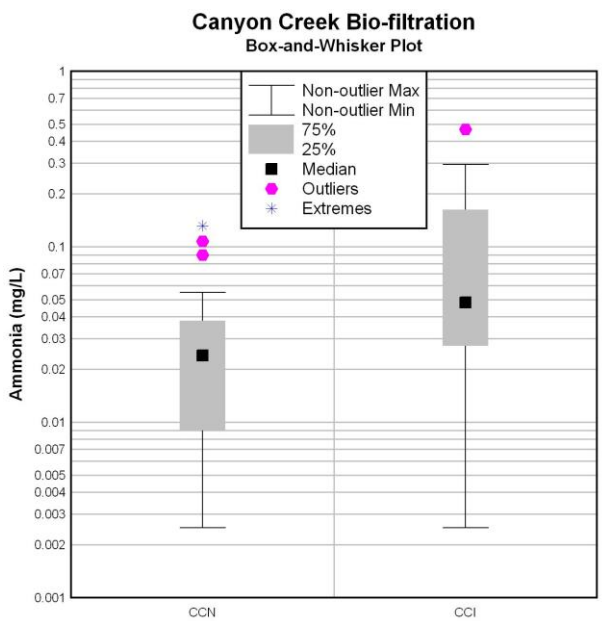


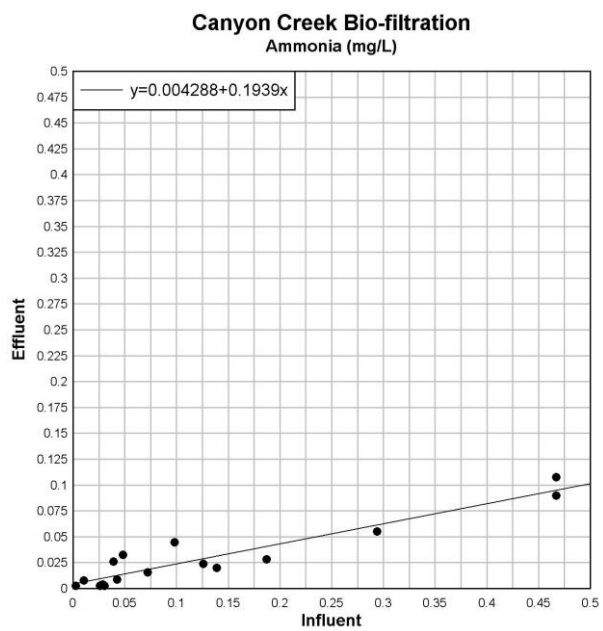
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	2.631	1.690
	Upper Quartile	1.430	0.661
	Median	1.060	0.526
	Lower Quartile	0.353	0.339
	Minimum	0.174	0.131
	Efficiency	50.38%	
	Mann-Whitney	0.1798	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	1.297	0.740
	Mean	0.959	0.581
	LCL	0.620	0.422
	Std. Dev.	0.703	0.367
	Wilk (p-value)	0.0345 **	0.0042 **
	Efficiency	39.40%	
	t-Test (equal var.)	0.0308 **	
	t-Test (unequal var.)	0.0440 **	
	t-test (paired)	0.0014 **	
	Levene Test	0.0221 **	
Log Transformed	UCL	1.564	0.773
	Mean	0.982	0.582
	LCL	0.617	0.438
	Std. Dev.	0.899	0.372
	Wilk (p-value)	0.1288	0.9934
	Efficiency	40.78%	
	t-Test (equal var.)	0.0957 *	
	t-Test (unequal var.)	0.1075	
	t-Test (paired)	0.0004 **	
	Levene Test	0.0599 *	
Bootstrap	UCL	1.275	0.735
	Mean	0.952	0.582
	LCL	0.629	0.429
	Std. Dev.	0.670	0.353
	Efficiency	38.85%	

Canyon Creek Bio-Filter -- Ammonia (mg/L)



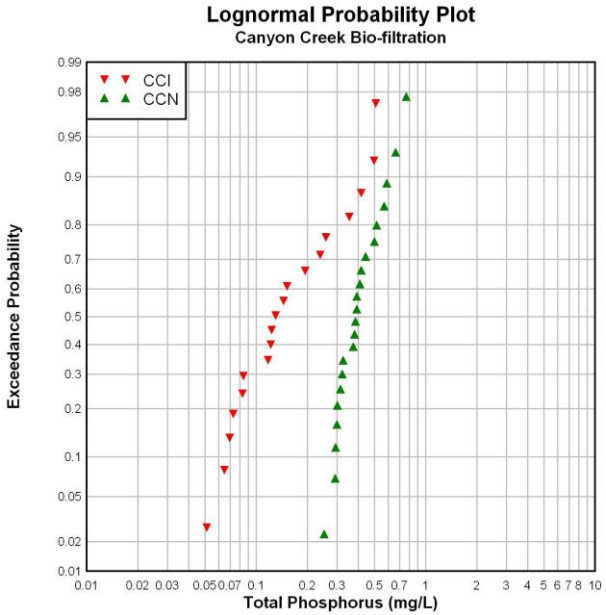


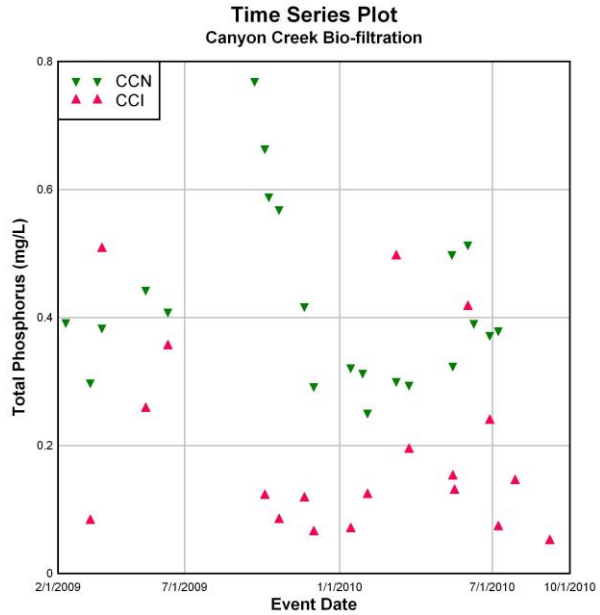


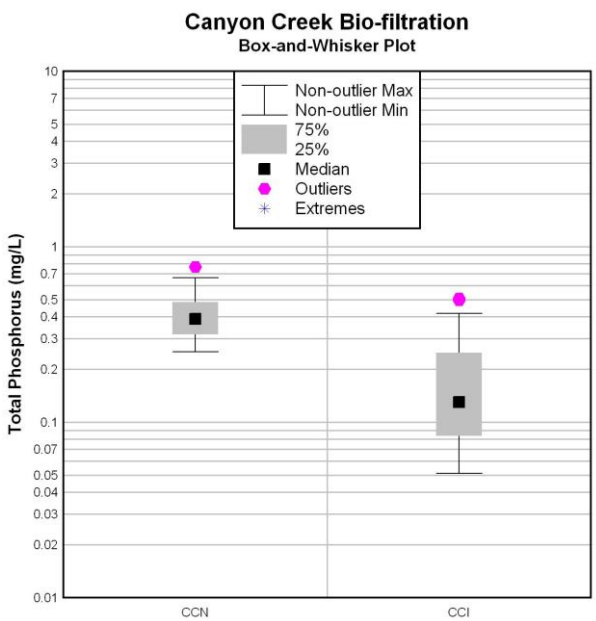


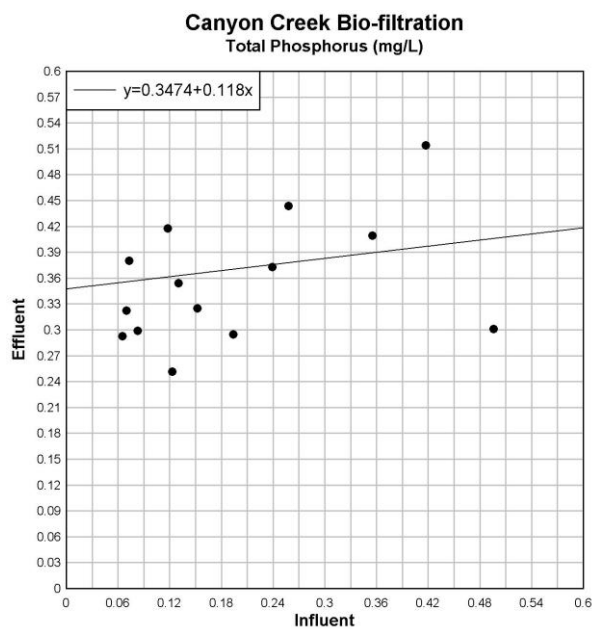
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	0.467	0.131
	Upper Quartile	0.187	0.039
	Median	0.048	0.024
	Lower Quartile	0.026	0.009
	Minimum	0.003	0.003
	Efficiency	50.23%	
	Mann-Whitney	0.0067 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	0.197	0.048
	Mean	0.127	0.033
	LCL	0.056	0.018
	Std. Dev.	0.147	0.034
	Wilk (p-value)	0.0004 **	0.0002 **
	Efficiency	74.16%	
	t-Test (equal var.)	0.0050 **	
	t-Test (unequal var.)	0.0133 **	
	t-test (paired)	0.0052 **	
	Levene Test	0.0101 **	
Log Transformed	UCL	0.355	0.069
	Mean	0.143	0.036
	LCL	0.057	0.018
	Std. Dev.	0.248	0.052
	Wilk (p-value)	0.4731	0.2642
	Efficiency	75.01%	
	t-Test (equal var.)	0.0039 **	
	t-Test (unequal var.)	0.0046 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.4904	
Bootstrap	UCL	0.193	0.046
	Mean	0.126	0.032
	LCL	0.059	0.018
	Std. Dev.	0.140	0.032
	Efficiency	74.44%	

Canyon Creek Bio-Filter --Total Phosphorus (mg/L)



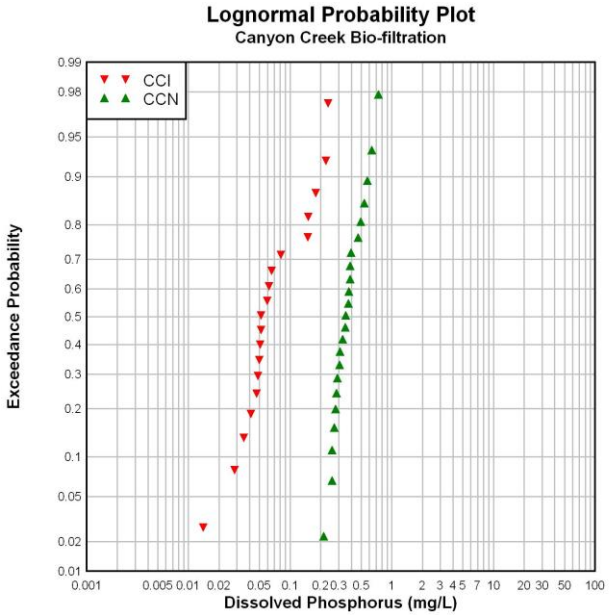


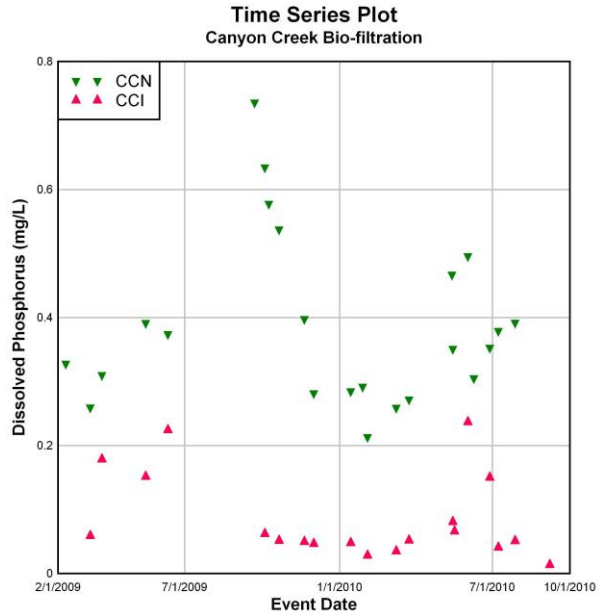


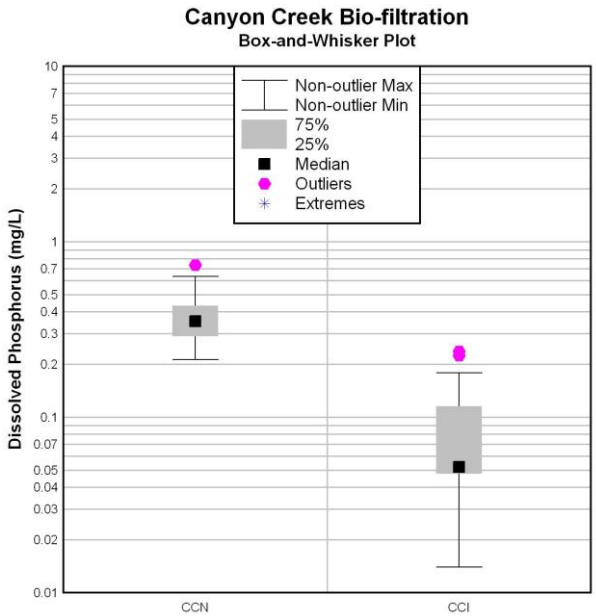


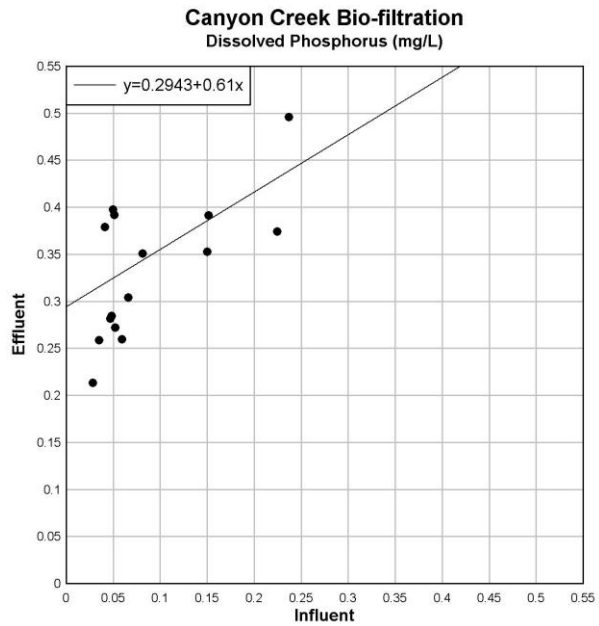
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	22
	Pairs Count	15	15
Non-Parametric	Maximum	0.508	0.770
	Upper Quartile	0.258	0.499
	Median	0.130	0.388
	Lower Quartile	0.083	0.314
	Minimum	0.051	0.252
	Efficiency	-198.49%	
	Mann-Whitney	0.0003 **	
	Wilcoxon (paired)	0.0015 **	
Arithmetic	UCL	0.264	0.477
	Mean	0.194	0.418
	LCL	0.123	0.359
	Std. Dev.	0.147	0.133
	Wilk (p-value)	0.0023 **	0.0203 **
	Efficiency	-115.78%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0004 **	
	Levene Test	0.7031	
Log Transformed	UCL	0.282	0.477
	Mean	0.192	0.417
	LCL	0.130	0.365
	Std. Dev.	0.147	0.124
	Wilk (p-value)	0.2988	0.3370
	Efficiency	-117.50%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0002 **	
	Levene Test	0.0006 **	
Bootstrap	UCL	0.259	0.472
	Mean	0.191	0.416
	LCL	0.124	0.360
	Std. Dev.	0.140	0.126
	Efficiency	-117.21%	

Canyon Creek Bio-Filter -- Dissolved Phosphorus (mg/L)



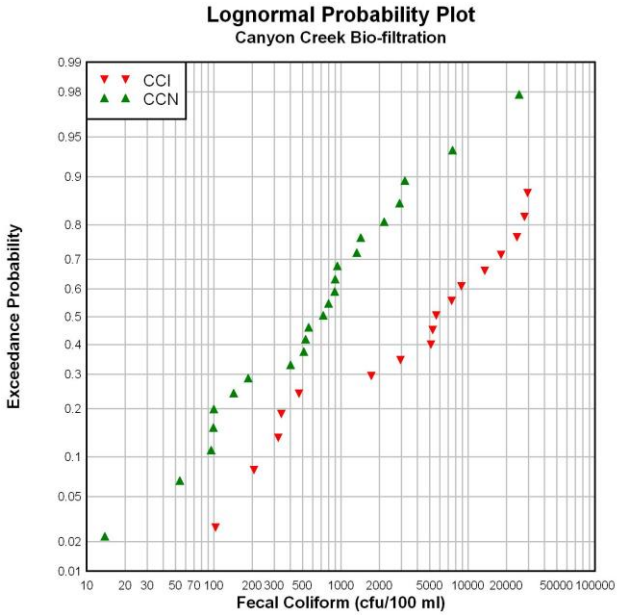


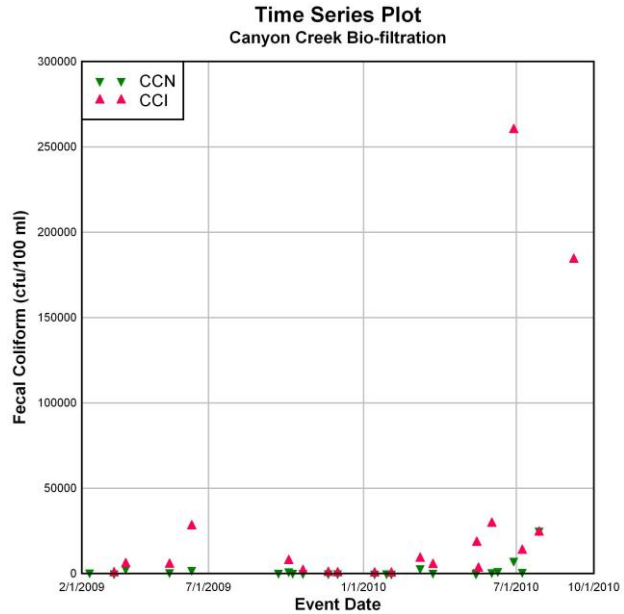


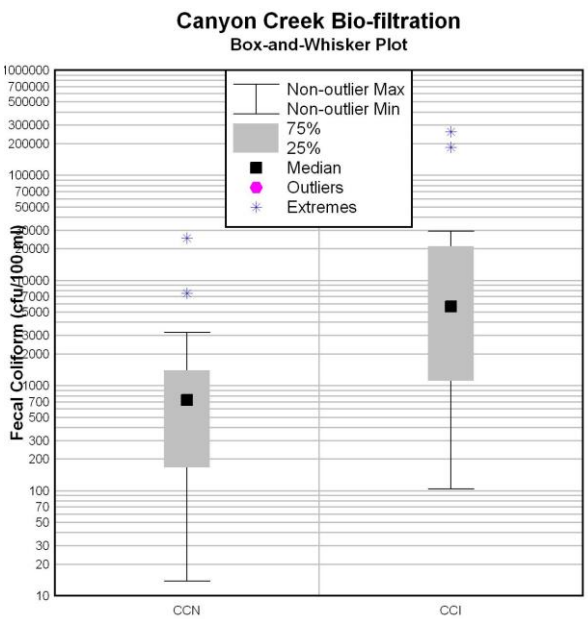


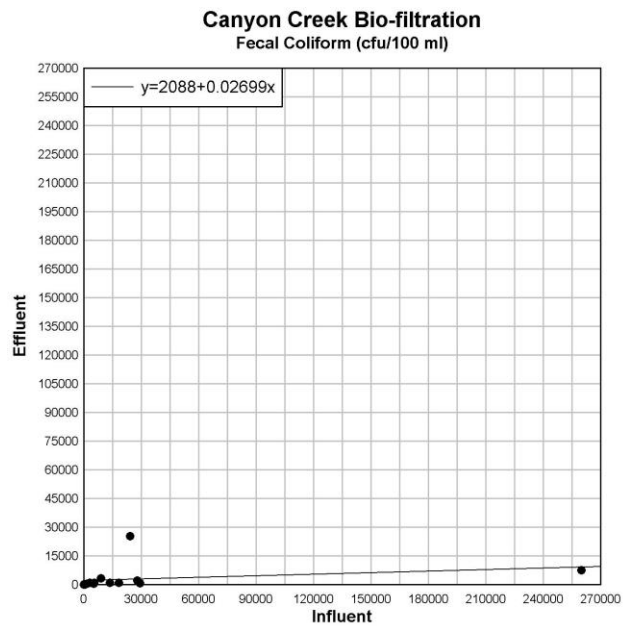
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	0.237	0.736
	Upper Quartile	0.150	0.467
	Median	0.052	0.353
	Lower Quartile	0.047	0.285
	Minimum	0.014	0.213
	Efficiency	-578.84%	
	Mann-Whitney	0.0000 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.118	0.444
	Mean	0.086	0.387
	LCL	0.053	0.329
	Std. Dev.	0.067	0.132
	Wilk (p-value)	0.0008 **	0.0202 **
	Efficiency	-351.33%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0576 *	
Log Transformed	UCL	0.127	0.444
	Mean	0.085	0.386
	LCL	0.057	0.335
	Std. Dev.	0.068	0.124
	Wilk (p-value)	0.1738	0.5218
	Efficiency	-353.39%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0060 **	
Bootstrap	UCL	0.116	0.439
	Mean	0.085	0.385
	LCL	0.054	0.331
	Std. Dev.	0.064	0.126
	Efficiency	-354.25%	

Canyon Creek Bio-Filter -- Fecal Coliform (cfu/100 ml)



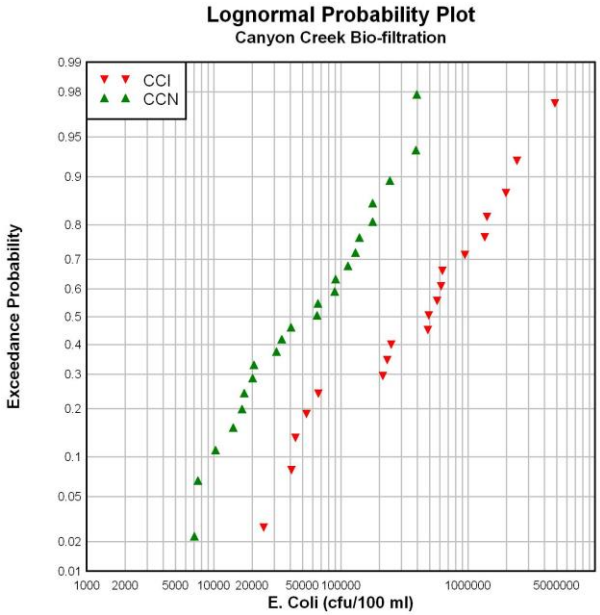


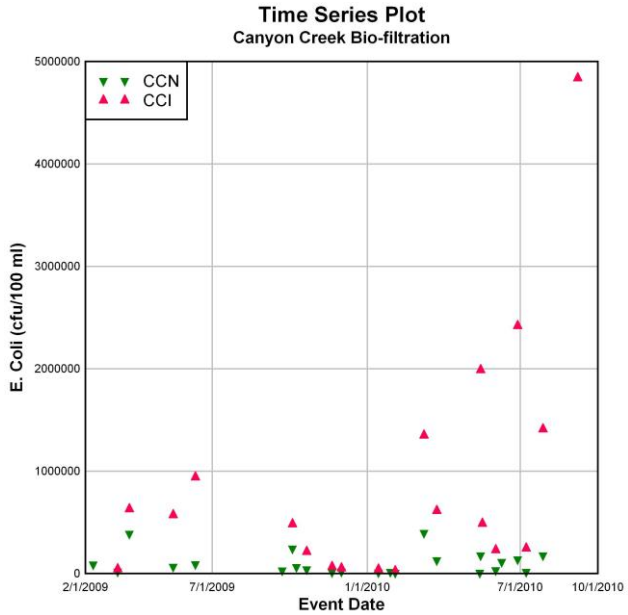


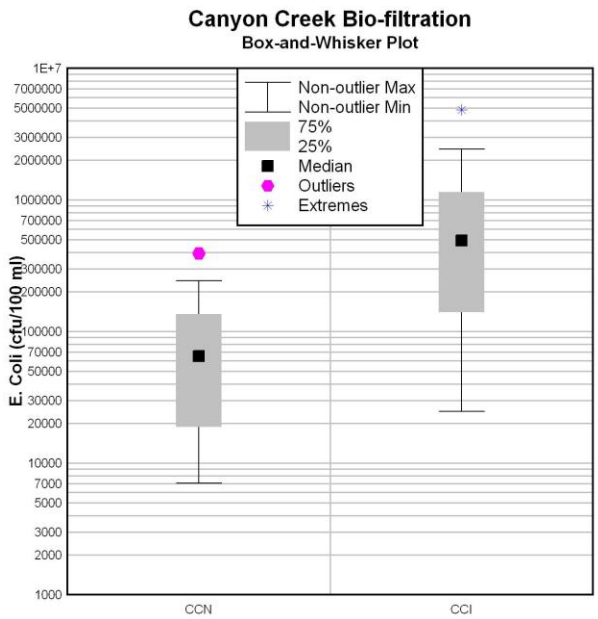


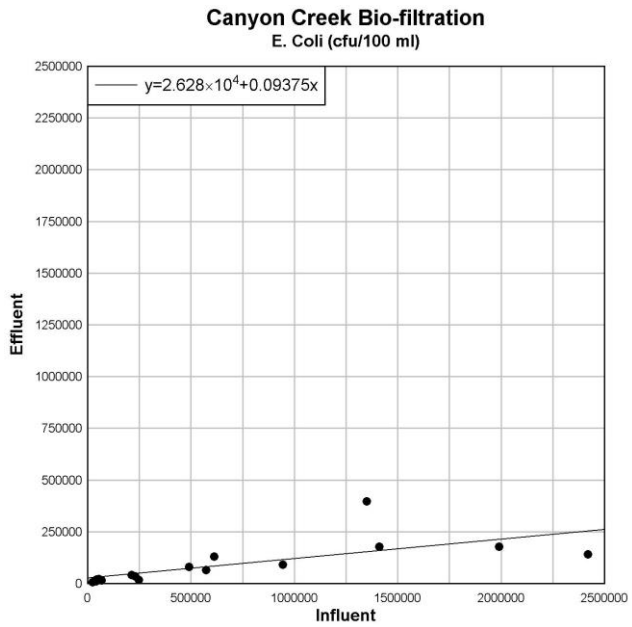
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	260,000	25,200
	Upper Quartile	24,200	1,436
	Median	5,642	727
	Lower Quartile	469	144
	Minimum	104	14
	Efficiency	87.11%	
	Mann-Whitney	0.0051 **	
	Wilcoxon (paired)	0.0004 **	
Arithmetic	UCL	64,616	4,491
	Mean	31,347	2,209
	LCL	-1,923	-73
	Std. Dev.	69,023	5,276
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	92.95%	
	t-Test (equal var.)	0.0498 **	
	t-Test (unequal var.)	0.0828 *	
	t-test (paired)	0.1743	
	Levene Test	0.0968 *	
Log Transformed	UCL	292,225	6,747
	Mean	39,497	2,127
	LCL	5,338	671
	Std. Dev.	158,204	5,572
	Wilk (p-value)	0.5784	0.9459
	Efficiency	94.61%	
	t-Test (equal var.)	0.0010 **	
	t-Test (unequal var.)	0.0015 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2049	
Bootstrap	UCL	63,772	4,368
	Mean	32,785	2,298
	LCL	1,797	228
	Std. Dev.	64,292	4,787
	Efficiency	92.99%	

Canyon Creek Bio-Filter -- E. Coli. (cfu/100 ml)



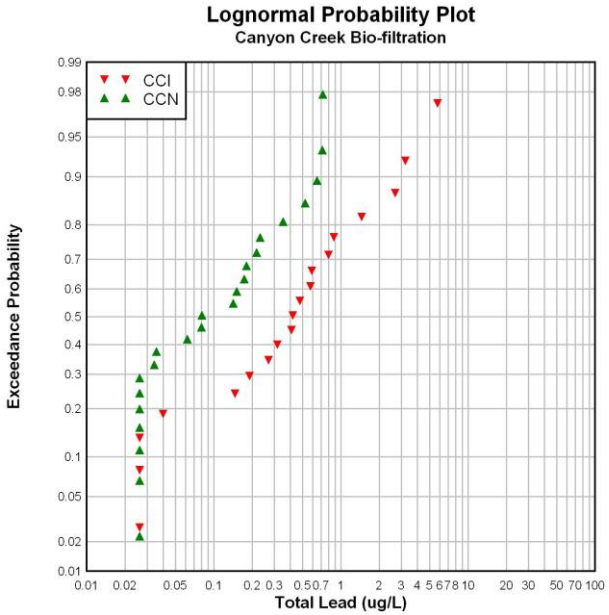


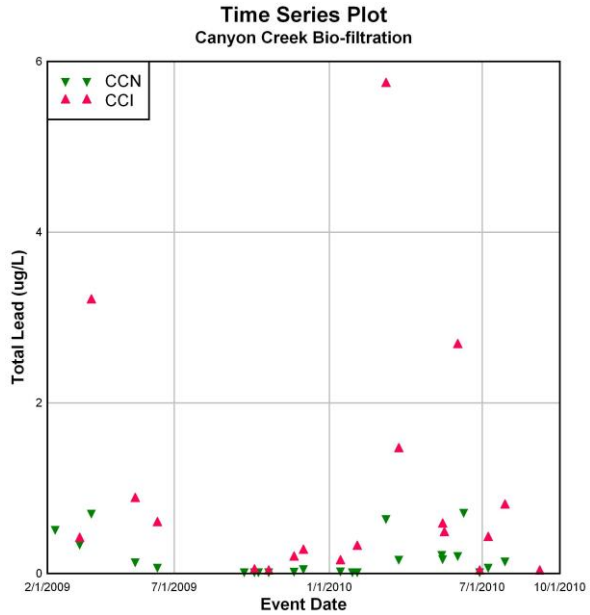


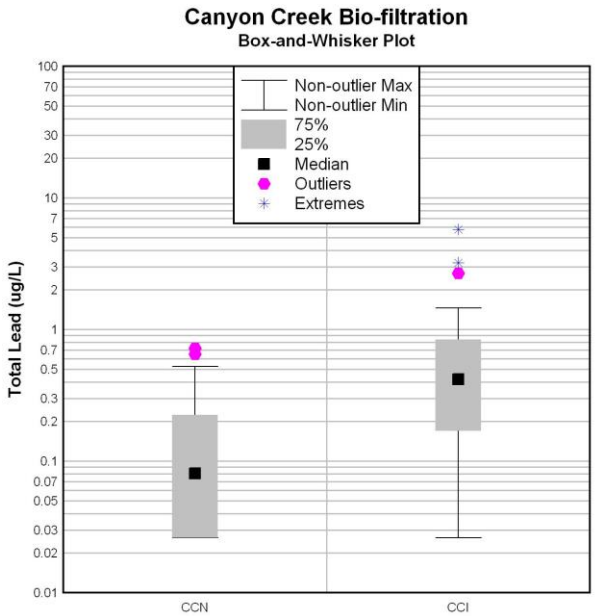


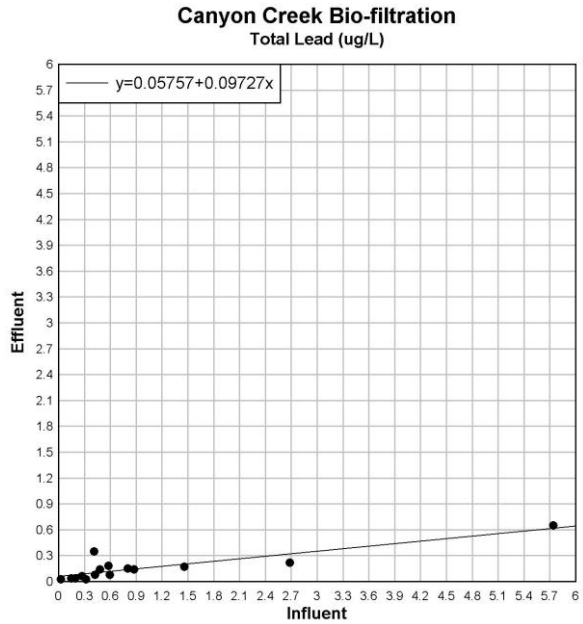
	PARAMETER	E. Coli (cfu/100ml)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	4,839,200	397,000
	Upper Quartile	1,350,000	140,000
	Median	490,000	64,856
	Lower Quartile	66,480	17,300
	Minimum	24,627	7,033
	Efficiency	86.76%	
	Mann-Whitney	0.0005 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	1,445,782	148,982
	Mean	876,970	100,039
	LCL	308,157	51,096
	Std. Dev.	1,180,102	113,174
	Wilk (p-value)	0.0001 **	0.0002 **
	Efficiency	88.59%	
	t-Test (equal var.)	0.0031 **	
	t-Test (unequal var.)	0.0103 **	
	t-test (paired)	0.0040 **	
	Levene Test	0.0822 *	
Log Transformed	UCL	3,155,796	217,626
	Mean	1,044,118	106,372
	LCL	345,454	51,993
	Std. Dev.	2,206,700	167,708
	Wilk (p-value)	0.4241	0.4006
	Efficiency	89.81%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1900	
Bootstrap	UCL	1,444,478	145,653
	Mean	902,001	99,092
	LCL	359,523	52,532
	Std. Dev.	1,125,508	107,671
	Efficiency	89.01%	

Canyon Creek Bio-Filter -- Total Lead (ug/L)



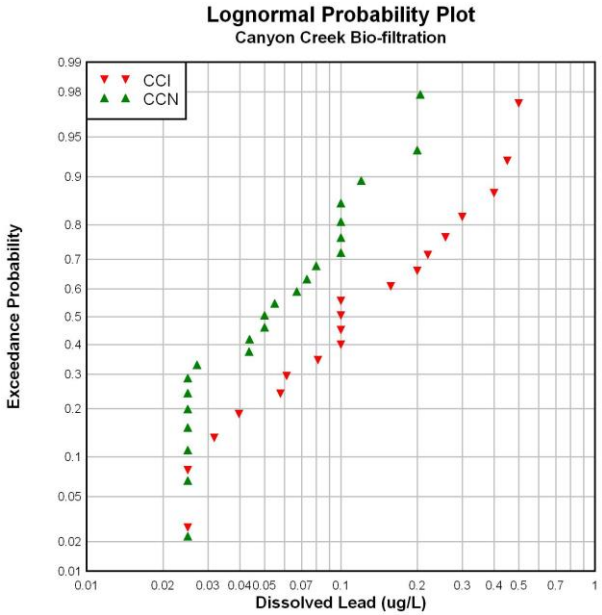


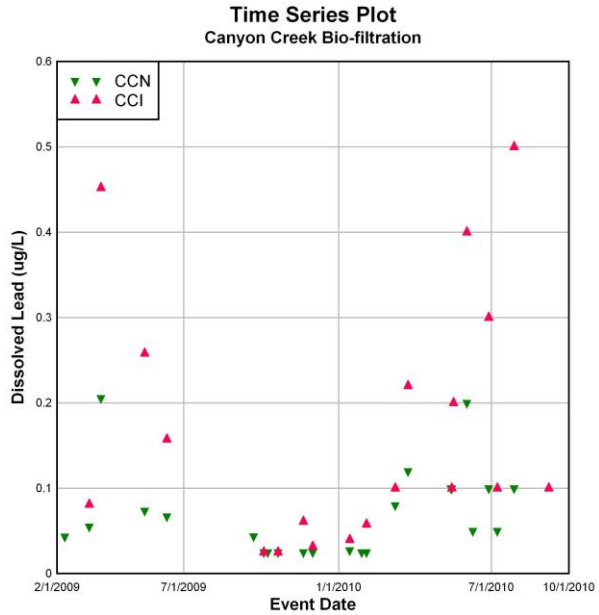


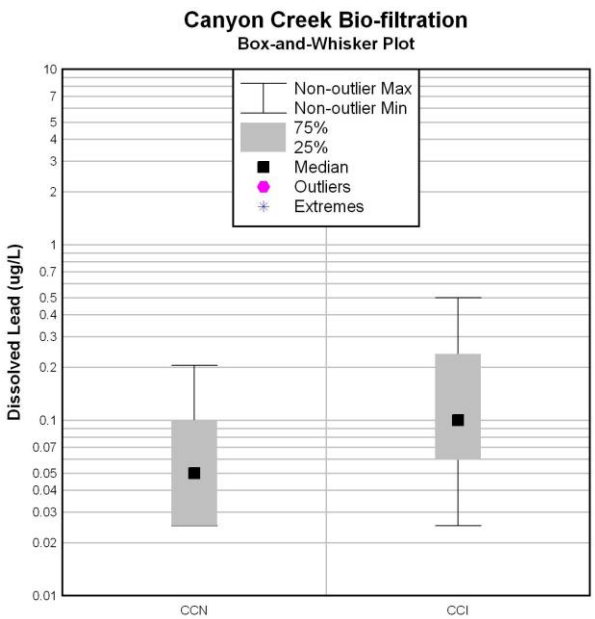


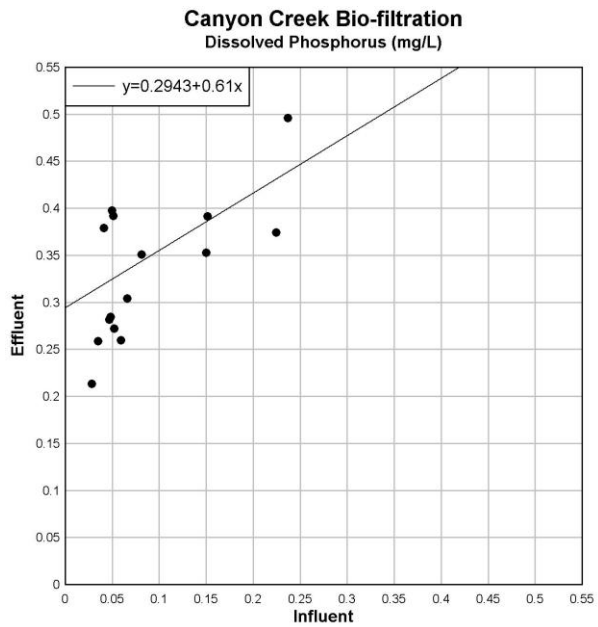
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	5.7	0.7
	Upper Quartile	0.9	0.2
	Median	0.4	0.1
	Lower Quartile	0.1	0.0
	Minimum	0.0	0.0
	Efficiency	80.79%	
	Mann-Whitney	0.0196 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	1.7	0.3
	Mean	1.0	0.2
	LCL	0.3	0.1
	Std. Dev.	1.4	0.2
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	79.52%	
	t-Test (equal var.)	0.0167 **	
	t-Test (unequal var.)	0.0348 **	
	t-test (paired)	0.0284 **	
	Levene Test	0.0798 *	
Log Transformed	UCL	3.8	0.4
	Mean	1.1	0.2
	LCL	0.3	0.1
	Std. Dev.	2.6	0.3
	Wilk (p-value)	0.2618	0.0073 **
	Efficiency	82.52%	
	t-Test (equal var.)	0.0063 **	
	t-Test (unequal var.)	0.0084 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1204	
Bootstrap	UCL	1.6	0.3
	Mean	0.9	0.2
	LCL	0.3	0.1
	Std. Dev.	1.3	0.2
	Efficiency	79.21%	

Canyon Creek Bio-Filter --- Dissolved Lead (ug/L)



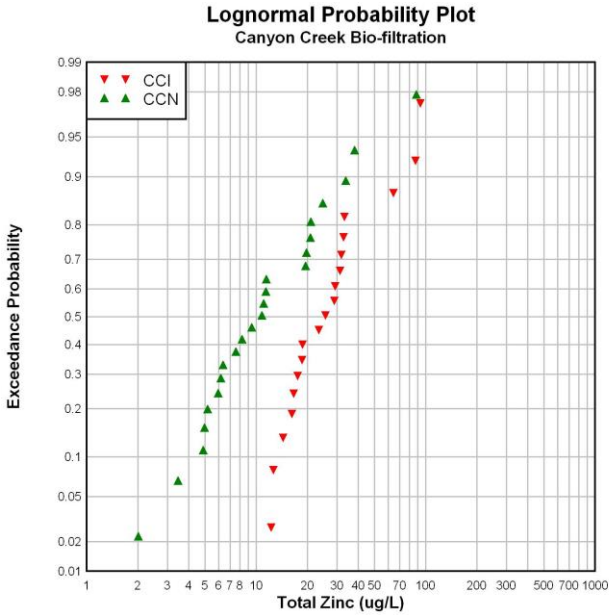


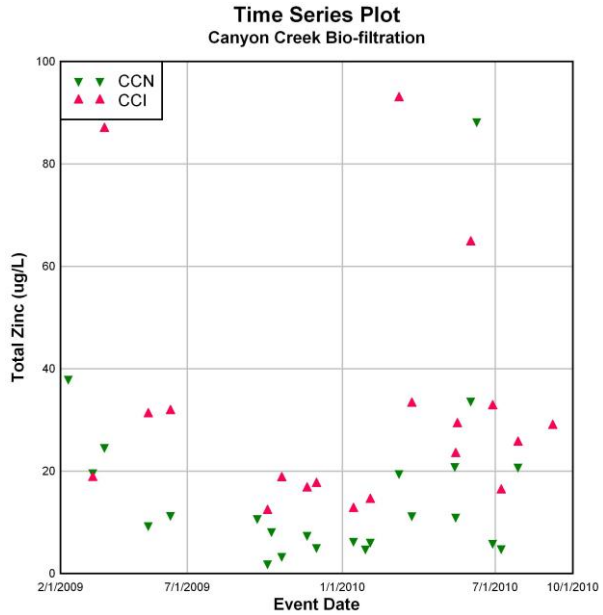


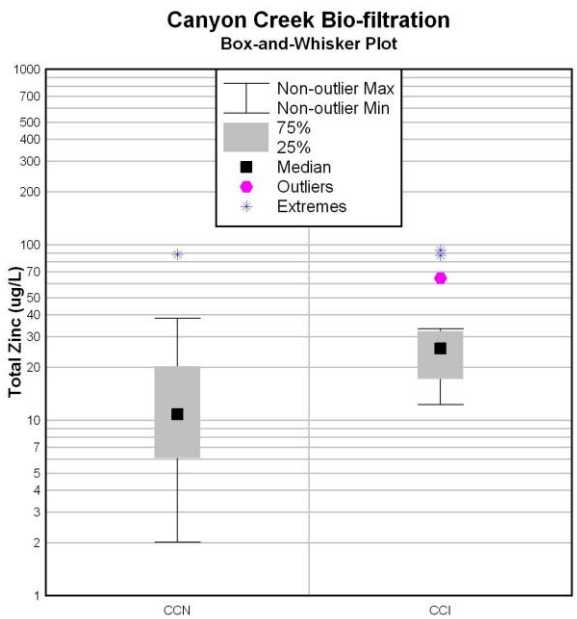


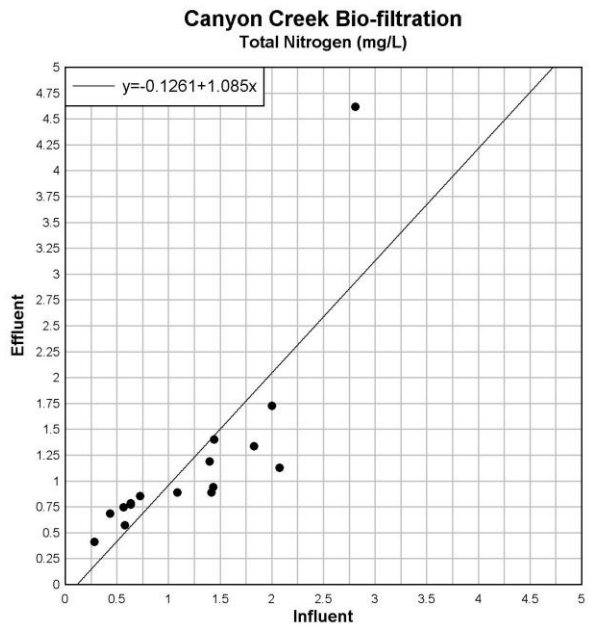
	PARAMETER	Lead, Dissolved (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	0.5	0.2
	Upper Quartile	0.3	0.1
	Median	0.1	0.1
	Lower Quartile	0.1	0.0
	Minimum	0.0	0.0
	Efficiency	50.00%	
	Mann-Whitney	0.0209 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.2	0.1
	Mean	0.2	0.1
	LCL	0.1	0.0
	Std. Dev.	0.1	0.1
	Wilk (p-value)	0.0061 **	0.0004 **
	Efficiency	59.05%	
	t-Test (equal var.)	0.0046 **	
	t-Test (unequal var.)	0.0110 **	
	t-test (paired)	0.0042 **	
	Levene Test	0.0046 **	
Log Transformed	UCL	0.3	0.1
	Mean	0.2	0.1
	LCL	0.1	0.0
	Std. Dev.	0.2	0.1
	Wilk (p-value)	0.4101	0.0168 **
	Efficiency	60.51%	
	t-Test (equal var.)	0.0065 **	
	t-Test (unequal var.)	0.0088 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.0580 *	
Bootstrap	UCL	0.2	0.1
	Mean	0.2	0.1
	LCL	0.1	0.0
	Std. Dev.	0.1	0.0
	Efficiency	59.02%	

Canyon Creek Bio-Filter -- Total Zinc (ug/L)



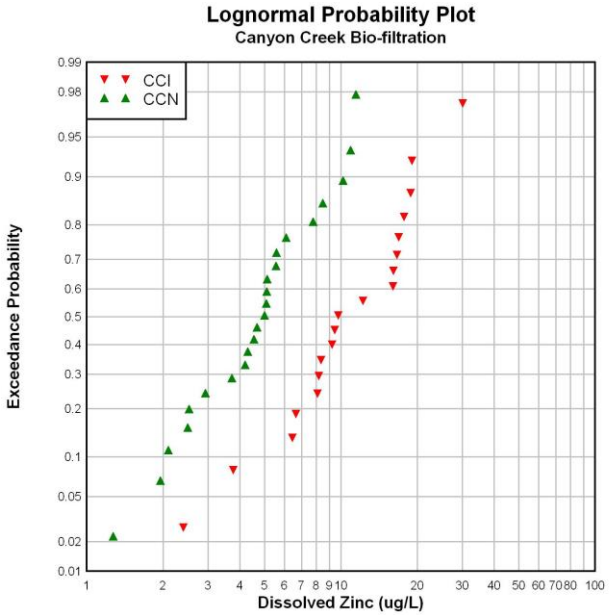


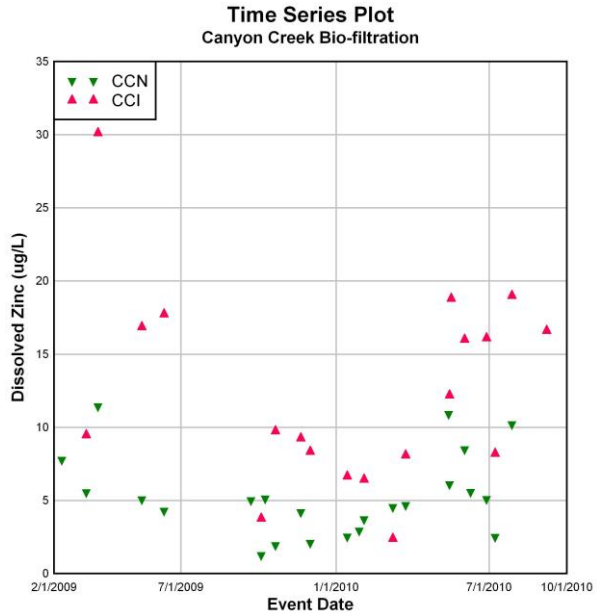


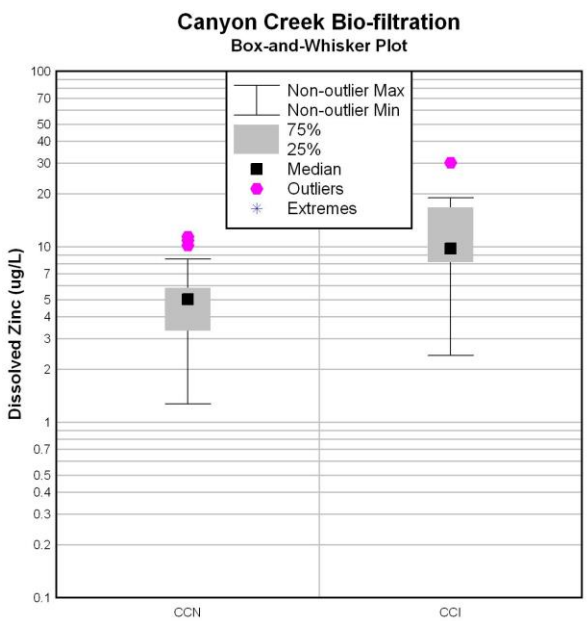


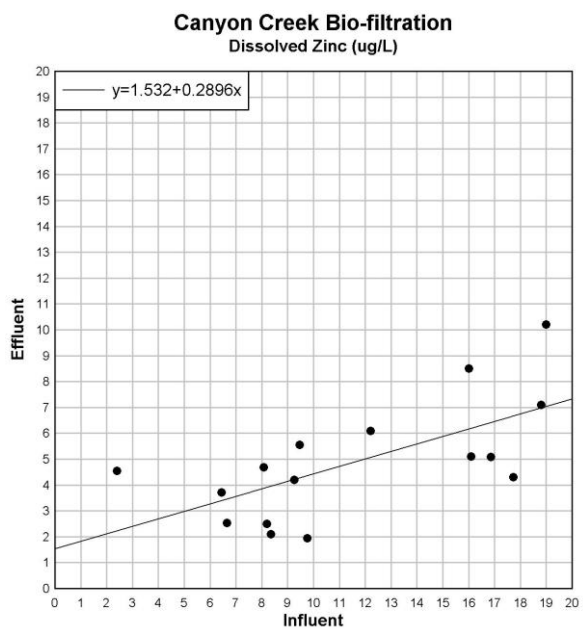
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	92.9	88.3
	Upper Quartile	32.7	20.9
	Median	25.6	10.8
	Lower Quartile	16.7	6.0
	Minimum	12.3	2.0
	Efficiency	57.74%	
	Mann-Whitney	0.0026 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	43.4	24.3
	Mean	32.0	16.3
	LCL	20.6	8.4
	Std. Dev.	23.6	18.4
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	48.99%	
	t-Test (equal var.)	0.0203 **	
	t-Test (unequal var.)	0.0242 **	
	t-test (paired)	0.0005 **	
	Levene Test	0.5347	
Log Transformed	UCL	42.6	24.5
	Mean	31.2	15.7
	LCL	22.9	10.1
	Std. Dev.	19.5	15.5
	Wilk (p-value)	0.0567 *	0.8717
	Efficiency	49.64%	
	t-Test (equal var.)	0.0006 **	
	t-Test (unequal var.)	0.0004 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.1364	
Bootstrap	UCL	42.4	23.7
	Mean	31.8	16.4
	LCL	21.1	9.1
	Std. Dev.	22.1	16.9
	Efficiency	48.35%	

Canyon Creek Bio-Filter -- Dissolved Zinc (ug/L)



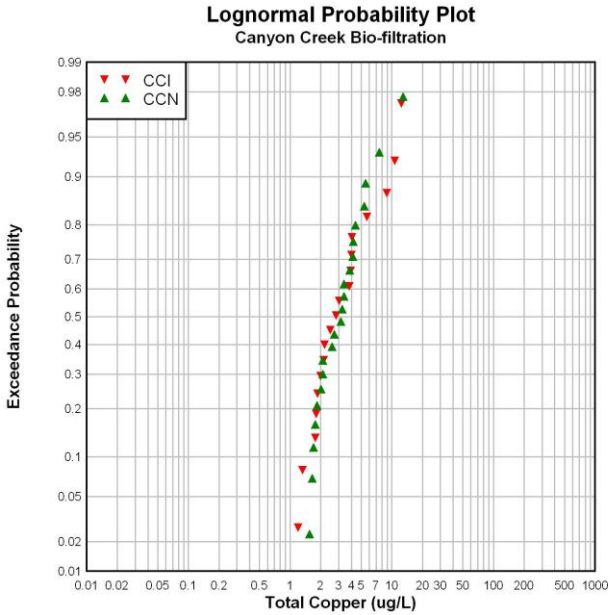


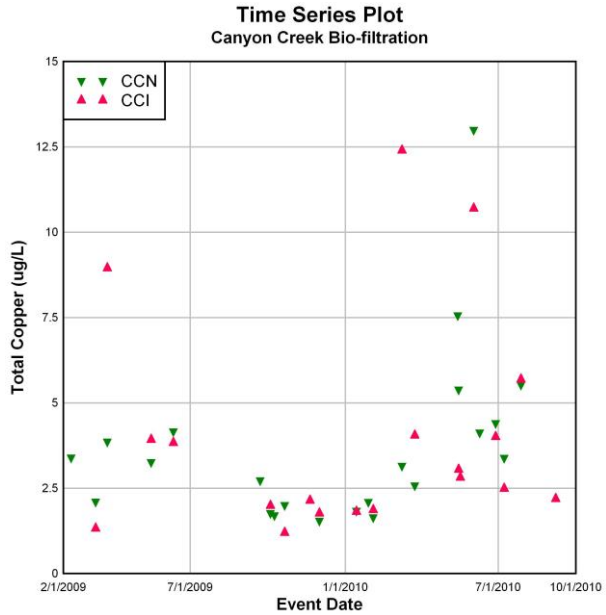


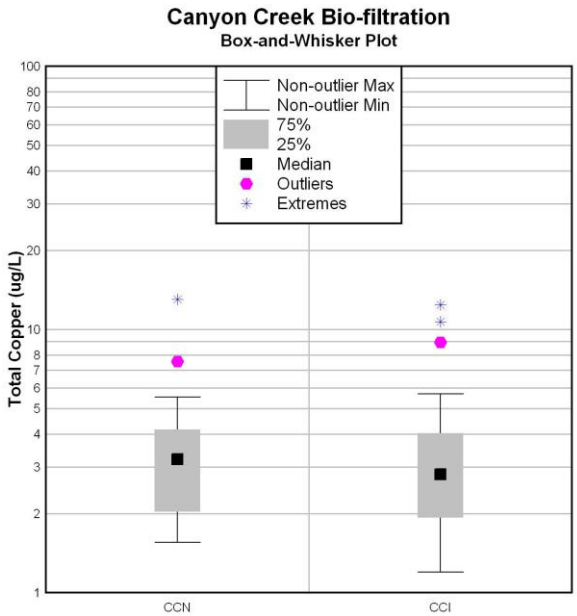


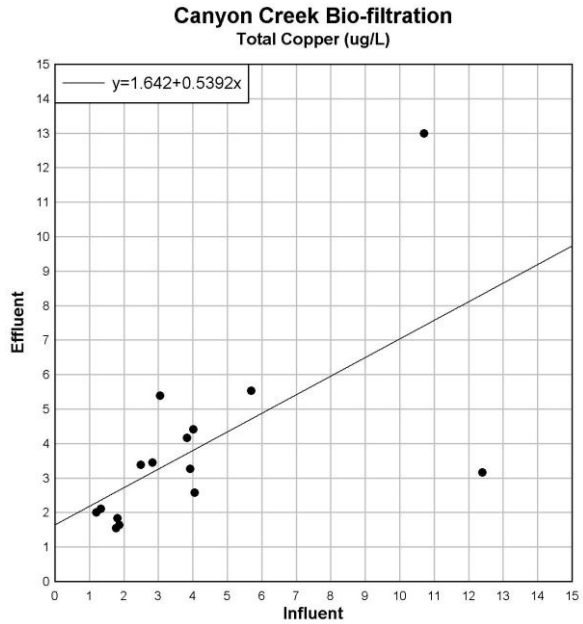
	PARAMETER	Zinc, Dissolved (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	30.1	11.4
	Upper Quartile	16.9	6.1
	Median	9.7	5.0
	Lower Quartile	8.1	2.9
	Minimum	2.4	1.3
	Efficiency	48.63%	
	Mann-Whitney	0.0004 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	15.6	6.5
	Mean	12.4	5.3
	LCL	9.2	4.0
	Std. Dev.	6.7	2.8
	Wilk (p-value)	0.1440	0.0442 **
	Efficiency	57.56%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0002 **	
	t-test (paired)	0.0000 **	
	Levene Test	0.0220 **	
Log Transformed	UCL	17.5	6.9
	Mean	12.7	5.3
	LCL	9.2	4.1
	Std. Dev.	8.2	3.2
	Wilk (p-value)	0.2938	0.5398
	Efficiency	58.02%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.7317	
Bootstrap	UCL	15.5	6.5
	Mean	12.4	5.3
	LCL	9.3	4.1
	Std. Dev.	6.4	2.7
	Efficiency	57.41%	

Canyon Creek Bio-Filter -- Total Copper (ug/L)



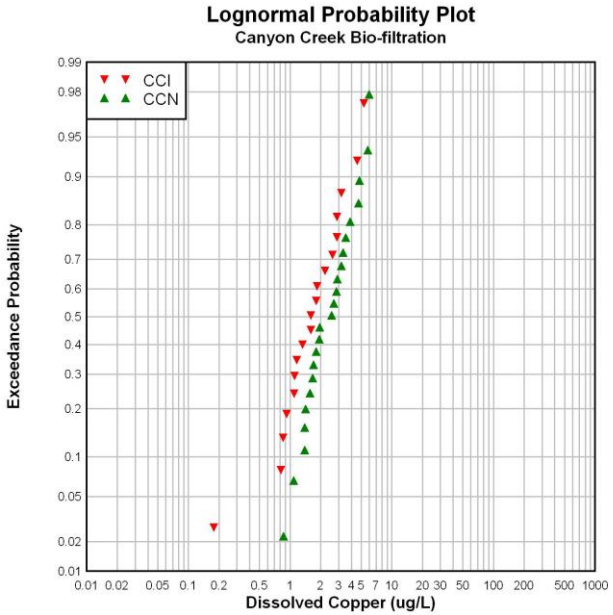


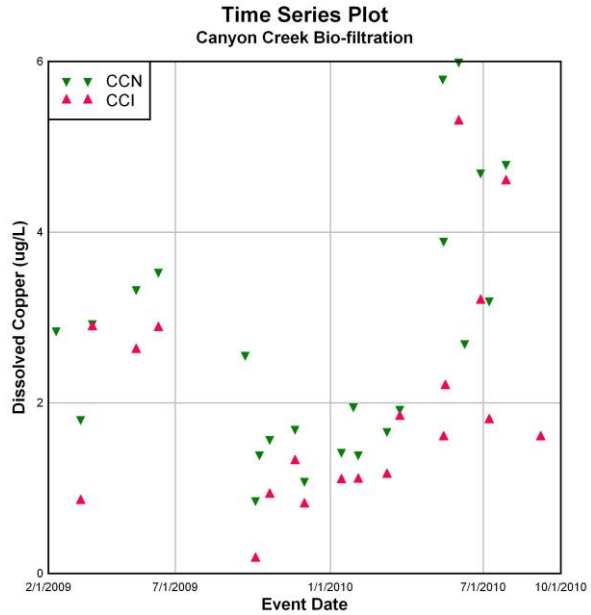


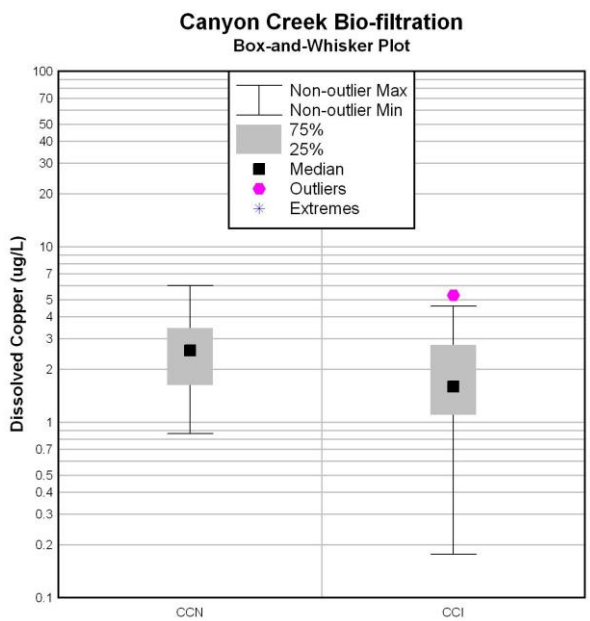


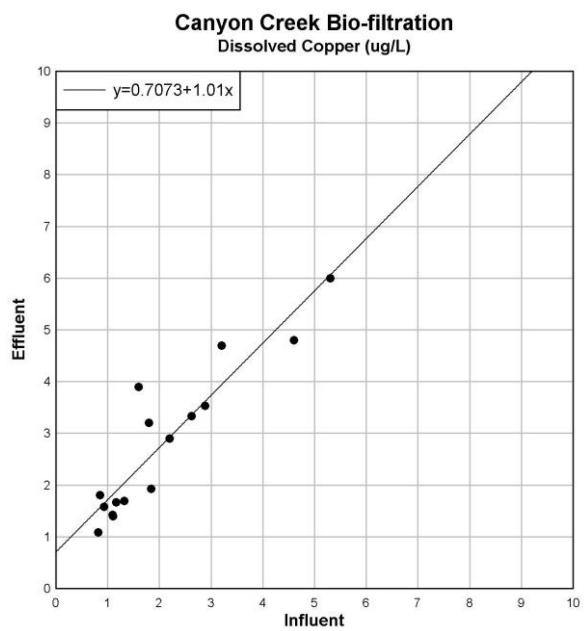
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	22
	Pairs Count	15	15
Non-Parametric	Maximum	12.4	13.0
	Upper Quartile	4.1	4.2
	Median	2.8	3.2
	Lower Quartile	1.9	2.0
	Minimum	1.2	1.5
	Efficiency	-13.92%	
	Mann-Whitney	0.8864	
	Wilcoxon (paired)	0.3894	
Arithmetic	UCL	5.6	4.8
	Mean	4.0	3.7
	LCL	2.5	2.6
	Std. Dev.	3.2	2.6
	Wilk (p-value)	0.0003 **	0.0001 **
	Efficiency	7.83%	
	t-Test (equal var.)	0.7308	
	t-Test (unequal var.)	0.7353	
	t-test (paired)	0.7452	
	Levene Test	0.5387	
Log Transformed	UCL	5.6	4.7
	Mean	3.9	3.6
	LCL	2.7	2.8
	Std. Dev.	2.8	2.1
	Wilk (p-value)	0.1960	0.1736
	Efficiency	7.35%	
	t-Test (equal var.)	0.9846	
	t-Test (unequal var.)	0.9848	
	t-Test (paired)	0.9323	
	Levene Test	0.3383	
Bootstrap	UCL	5.5	4.8
	Mean	4.0	3.7
	LCL	2.5	2.7
	Std. Dev.	3.1	2.4
	Efficiency	6.44%	

Canyon Creek Bio-Filter -- Dissolved Copper (ug/L)



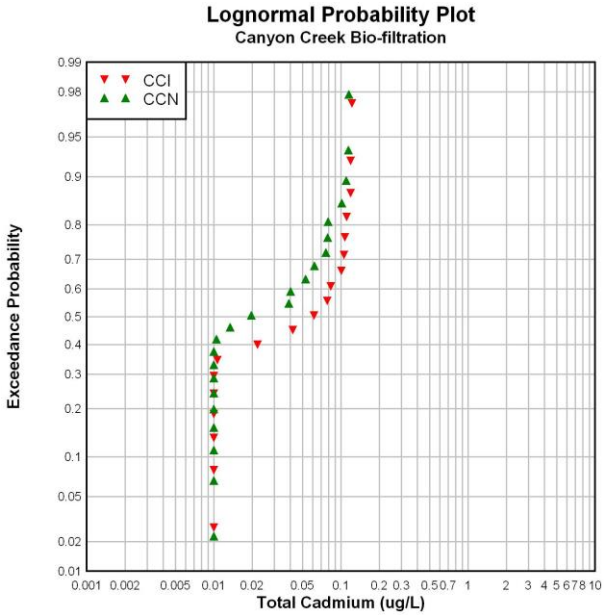


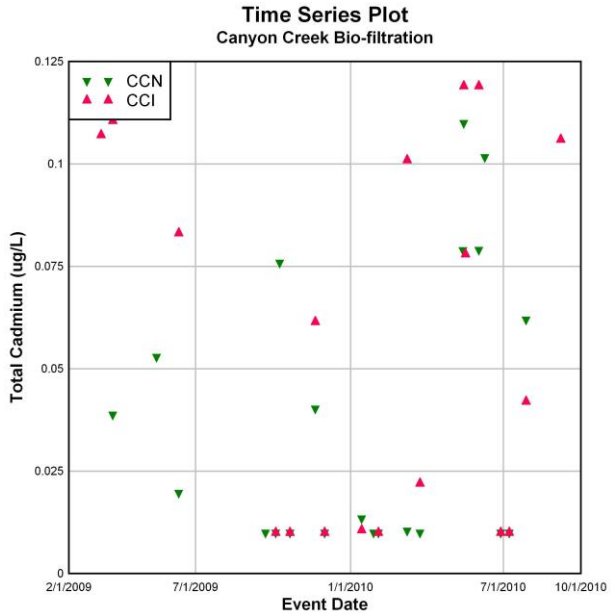


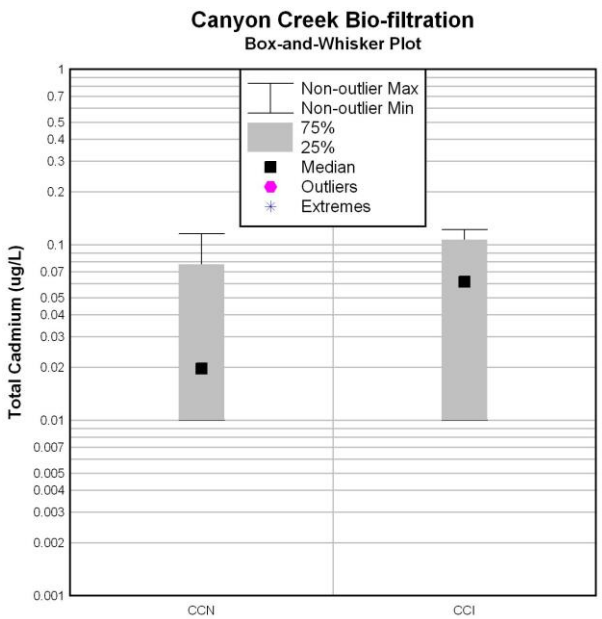


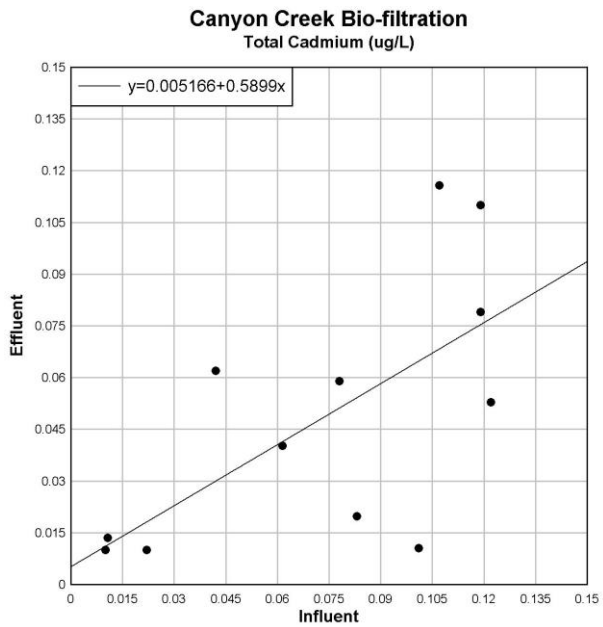
	PARAMETER	Copper, Dissolved (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	5.3	6.0
	Upper Quartile	2.9	3.5
	Median	1.6	2.6
	Lower Quartile	1.1	1.6
	Minimum	0.2	0.9
	Efficiency	-60.17%	
	Mann-Whitney	0.0686 *	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	2.6	3.4
	Mean	2.0	2.7
	LCL	1.4	2.1
	Std. Dev.	1.3	1.5
	Wilk (p-value)	0.0436 **	0.0347 **
	Efficiency	-37.26%	
	t-Test (equal var.)	0.0960 *	
	t-Test (unequal var.)	0.0926 *	
	t-test (paired)	0.0001 **	
	Levene Test	0.6153	
Log Transformed	UCL	3.2	3.5
	Mean	2.1	2.7
	LCL	1.4	2.1
	Std. Dev.	1.7	1.5
	Wilk (p-value)	0.1361	0.7076
	Efficiency	-31.47%	
	t-Test (equal var.)	0.0486 **	
	t-Test (unequal var.)	0.0580 *	
	t-Test (paired)	0.0000 **	
	Levene Test	0.2520	
Bootstrap	UCL	2.6	3.4
	Mean	2.0	2.8
	LCL	1.4	2.1
	Std. Dev.	1.3	1.4
	Efficiency	-37.74%	

Canyon Creek Bio-Filter -- Total Cadmium (ug/L)



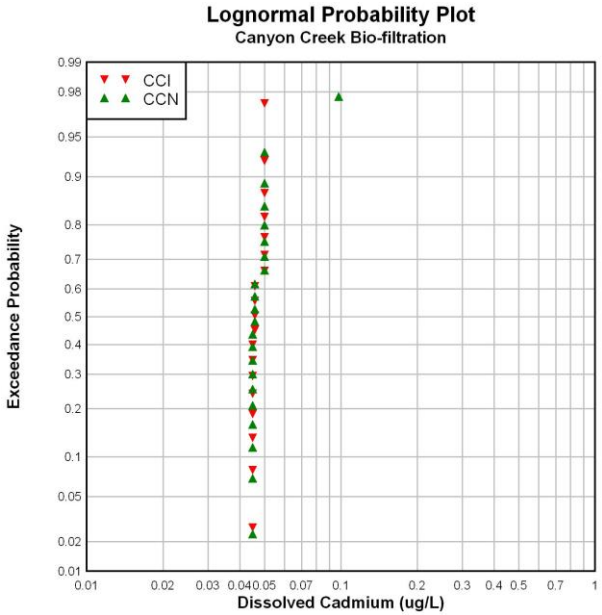


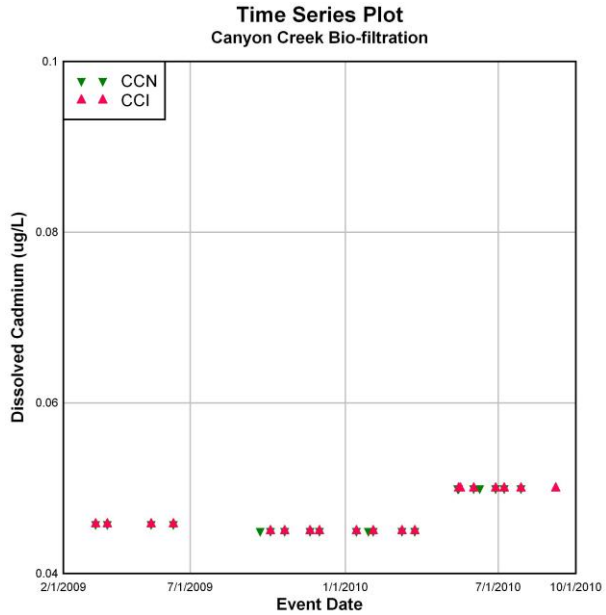


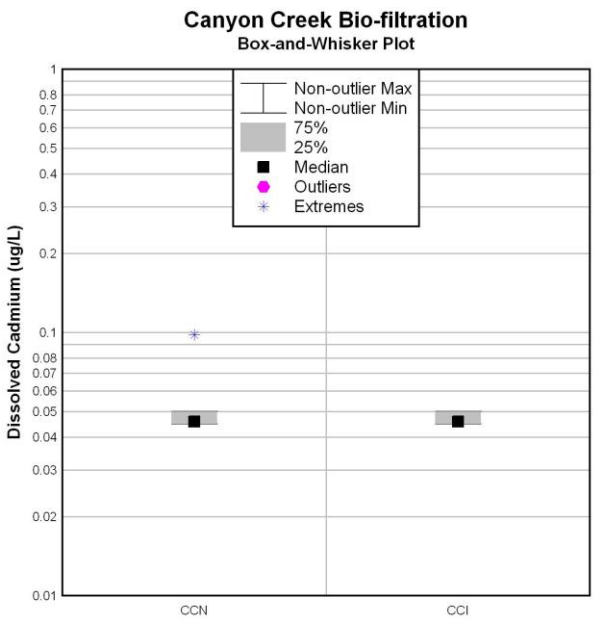


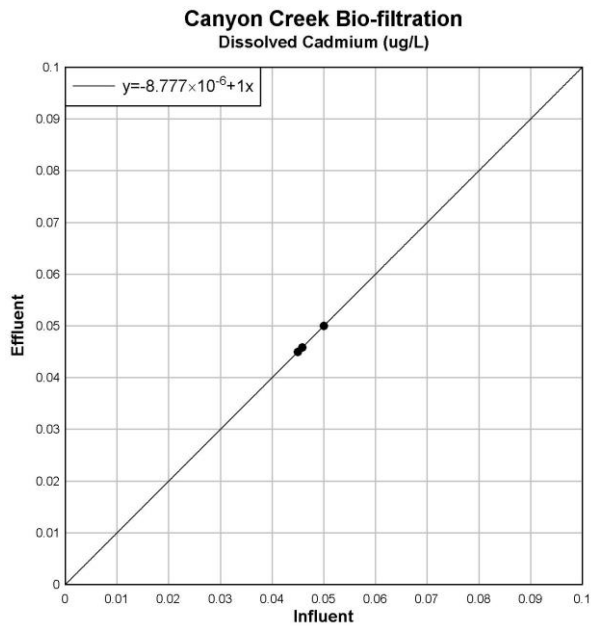
	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: CCI**	**EFF: CCN**
	Site Count	19	23
	Pairs Count	16	16
Non-Parametric	Maximum	0.1	0.1
	Upper Quartile	0.1	0.1
	Median	0.1	0.0
	Lower Quartile	0.0	0.0
	Minimum	0.0	0.0
	Efficiency	67.88%	
	Mann-Whitney	0.3608	
	Wilcoxon (paired)	0.0757 *	
Arithmetic	UCL	0.1	0.1
	Mean	0.1	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0018 **	0.0003 **
	Efficiency	27.37%	
	t-Test (equal var.)	0.2254	
	t-Test (unequal var.)	0.2335	
	t-test (paired)	0.0339 **	
	Levene Test	0.1811	
Log Transformed	UCL	0.1	0.1
	Mean	0.1	0.0
	LCL	0.0	0.0
	Std. Dev.	0.1	0.1
	Wilk (p-value)	0.0004 **	0.0003 **
	Efficiency	32.88%	
	t-Test (equal var.)	0.3326	
	t-Test (unequal var.)	0.3368	
	t-Test (paired)	0.0511 *	
	Levene Test	0.3619	
Bootstrap	UCL	0.1	0.1
	Mean	0.1	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Efficiency	27.32%	

Canyon Creek Bio-Filter -- Dissolved Cadmium (ug/L)









	PARAMETER	Cadmium, Dissolved (µg/L)	
Type	Statistic	INF: CCI	EFF: CCN
	Site Count	19	22
	Pairs Count	15	15
Non-Parametric	Maximum	0.1	0.1
	Upper Quartile	0.0	0.0
	Median	0.0	0.0
	Lower Quartile	0.0	0.0
	Minimum	0.0	0.0
	Efficiency	0.00%	
	Mann-Whitney	0.8447	
	Wilcoxon (paired)	0.9473	
Arithmetic	UCL	0.0	0.1
	Mean	0.0	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-4.53%	
	t-Test (equal var.)	0.4186	
	t-Test (unequal var.)	0.3902	
	t-test (paired)	0.5264	
	Levene Test	0.3367	
Log Transformed	UCL	0.0	0.1
	Mean	0.0	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-4.22%	
	t-Test (equal var.)	0.4567	
	t-Test (unequal var.)	0.4310	
	t-Test (paired)	0.5320	
	Levene Test	0.3374	
Bootstrap	UCL	0.0	0.1
	Mean	0.0	0.0
	LCL	0.0	0.0
	Std. Dev.	0.0	0.0
	Efficiency	-4.57%	

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Appendix E Vaults & Oil-Grit Separators

Austin Rec Center O/G Chamber (ARA-ARE)

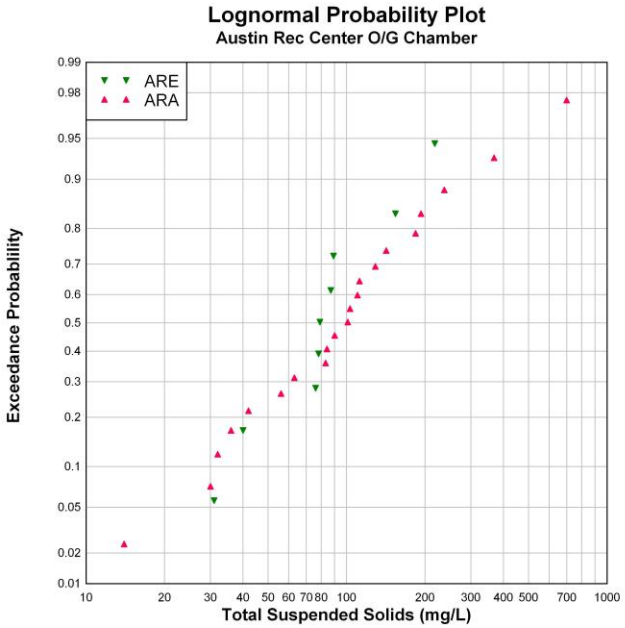
This oil and grit chamber was designed to capture low flows from a parking area (see ARA in the COA reports on small watershed quantity and quality (2009) for details in the drainage area); when the runoff rate exceeded the capacity of the chamber, flows bypassed the station and were not measured. During very large events flows in Shoal Creek backed up into the chamber and also impacted the monitoring. Grates allow vehicular and pedestrian traffic over the chamber. During the monitoring period metal sheets were placed under the grates to prevent evaporation of water and to slow entry of addition flow and debris into the chamber.

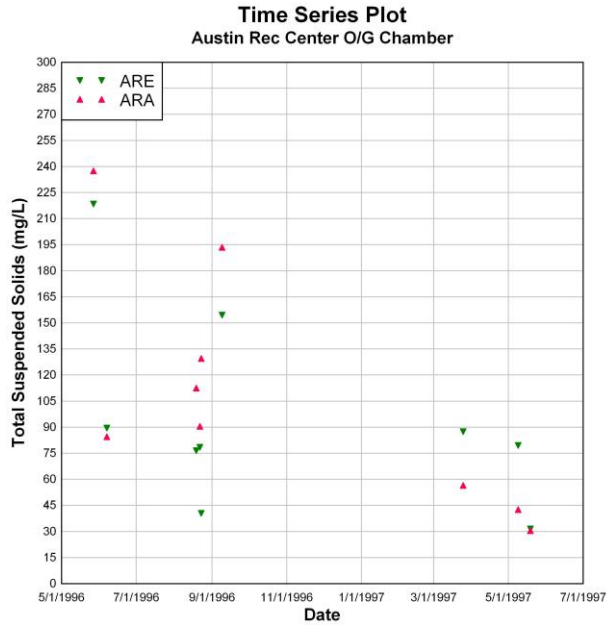
The City collected 9 influent EMCs and 9 effluent EMCs between 1996 and 1997. Of these 9 were paired. The influent station was reactivated in 2007 and additional TSS samples were collected there but not at the effluent. Phosphorus results are not presented in these analyses due to poor detection limits with the contract laboratory. Detection limits for NH_3 were also problematic.

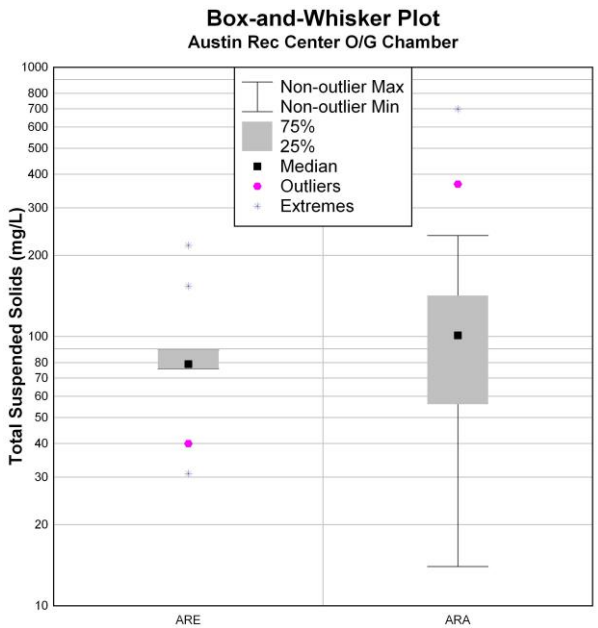
Performance Summary

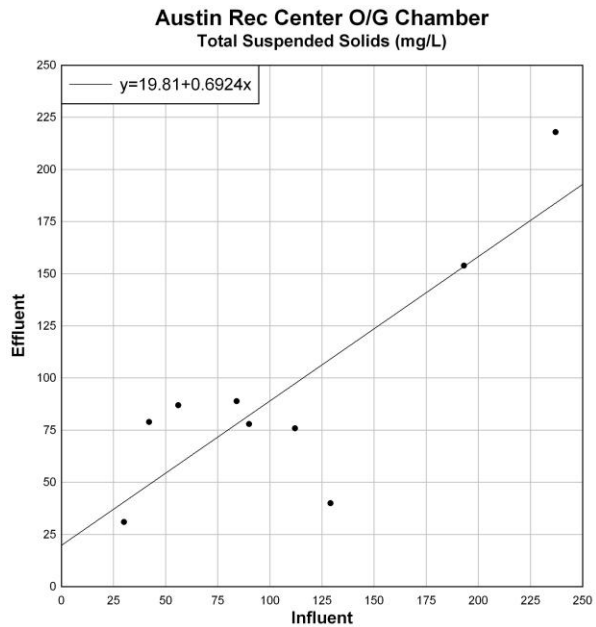
There was no significant difference in influent and effluent concentrations for and measured pollutant except Pb, Cu and Cd. These were only slightly different and only significant if paired analyses were used.

Austin Rec Center O/G Chamber - Total Suspended Solids (mg/L)



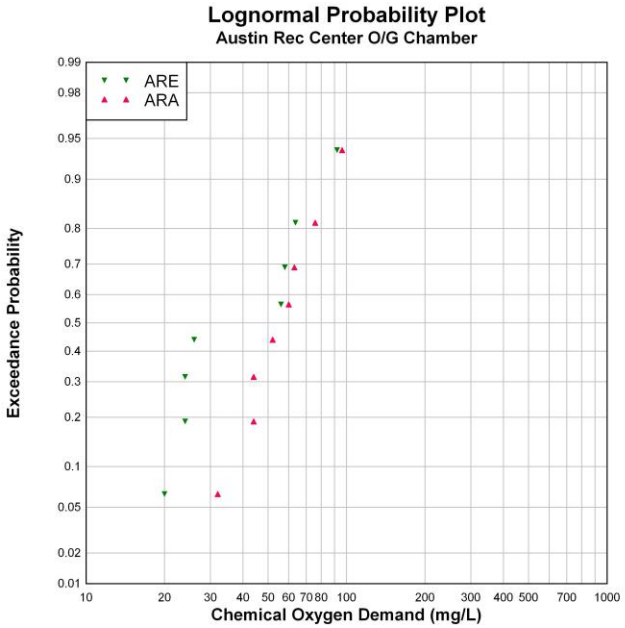


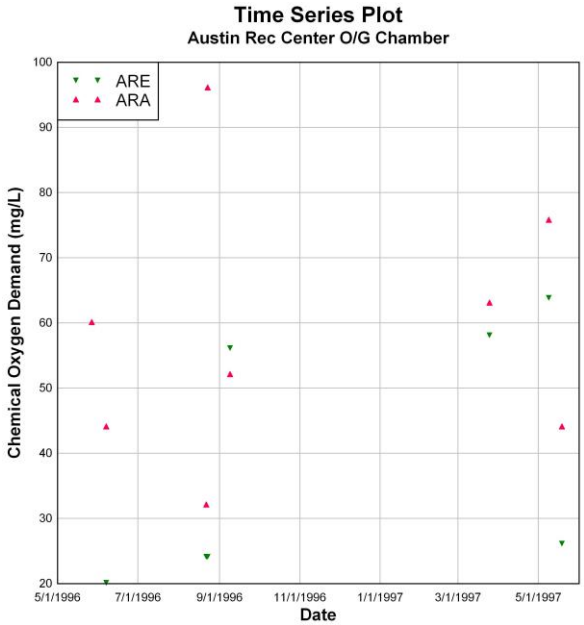


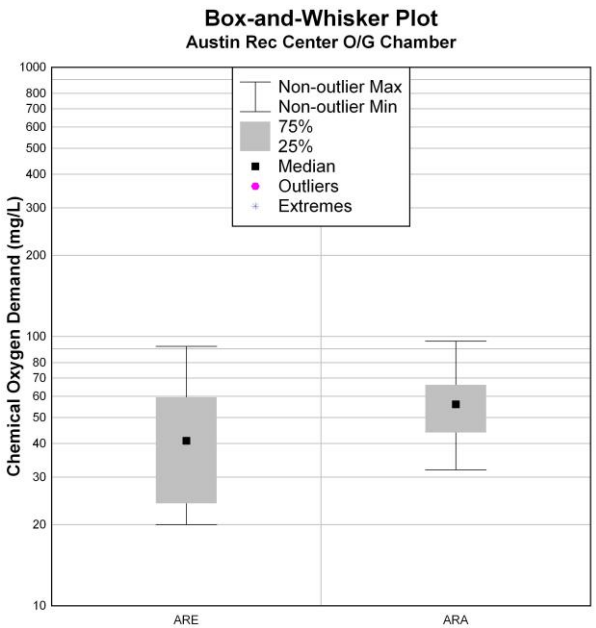


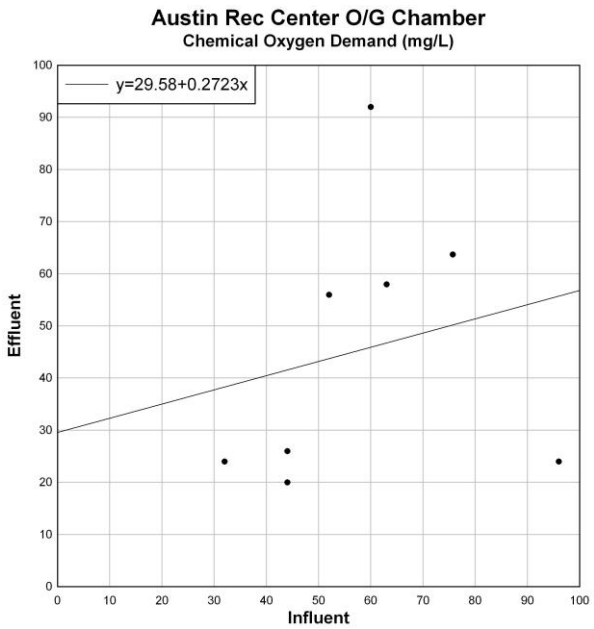
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	21	9
	Pairs Count	9	9
Non-Parametric	Maximum	699.0	218.0
	Upper Quartile	142.0	89.0
	Median	101.0	79.0
	Lower Quartile	56.0	76.0
	Minimum	14.0	31.0
	Efficiency	21.78%	
	Mann-Whitney	0.5026	
	Wilcoxon (paired)	0.4258	
Arithmetic	UCL	207.9	139.1
	Mean	138.5	94.7
	LCL	69.1	50.2
	Std. Dev.	152.5	57.8
	Wilk (p-value)	0.0001 **	0.0690 *
	Efficiency	31.64%	
	t-Test (equal var.)	0.4138	
	t-Test (unequal var.)	0.2643	
	t-test (paired)	0.3276	
	Levene Test	0.4088	
Log Transformed	UCL	221.8	156.2
	Mean	136.1	94.6
	LCL	83.5	57.3
	Std. Dev.	138.9	57.6
	Wilk (p-value)	0.9873	0.5233
	Efficiency	30.47%	
	t-Test (equal var.)	0.6734	
	t-Test (unequal var.)	0.6211	
	t-Test (paired)	0.5977	
	Levene Test	0.2580	
Bootstrap	UCL	203.1	133.5
	Mean	139.2	93.6
	LCL	75.3	53.7
	Std. Dev.	140.4	51.9
	Efficiency	32.76%	

Austin Rec Center O/G Chamber - Chemical Oxygen Demand (mg/L)



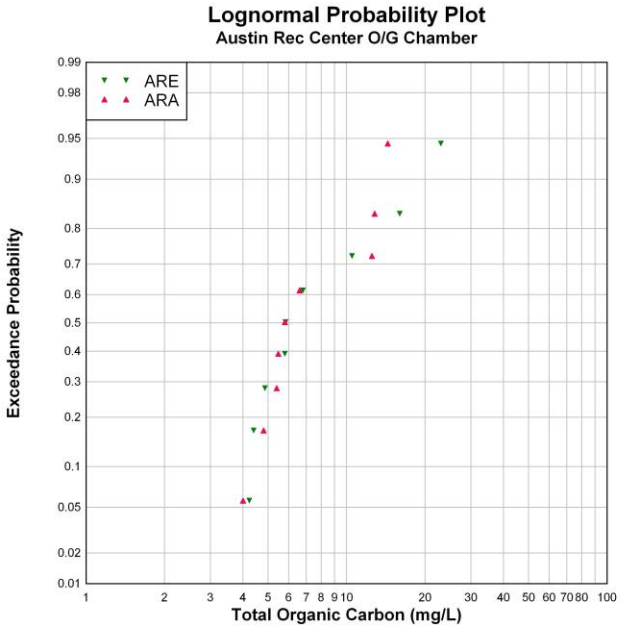


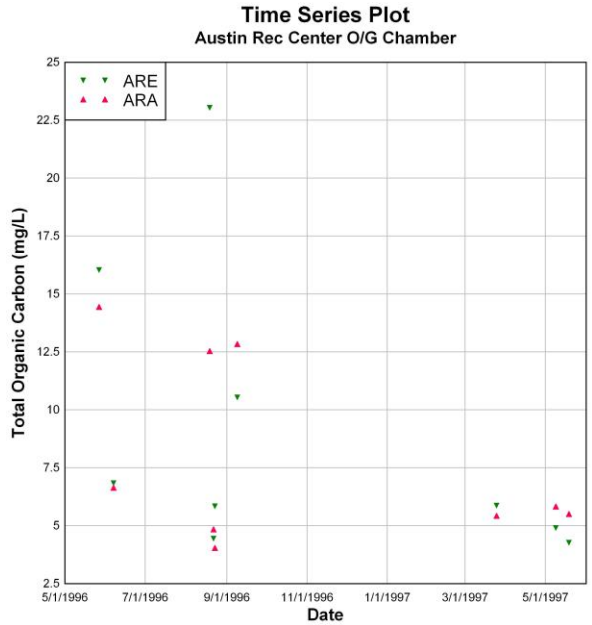


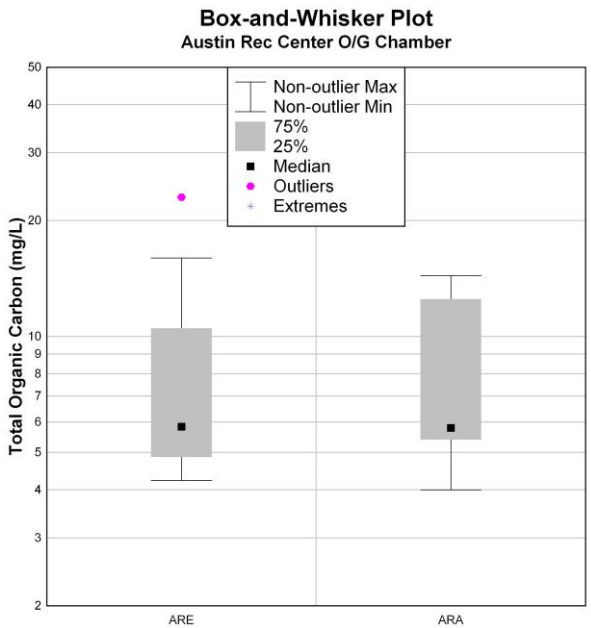


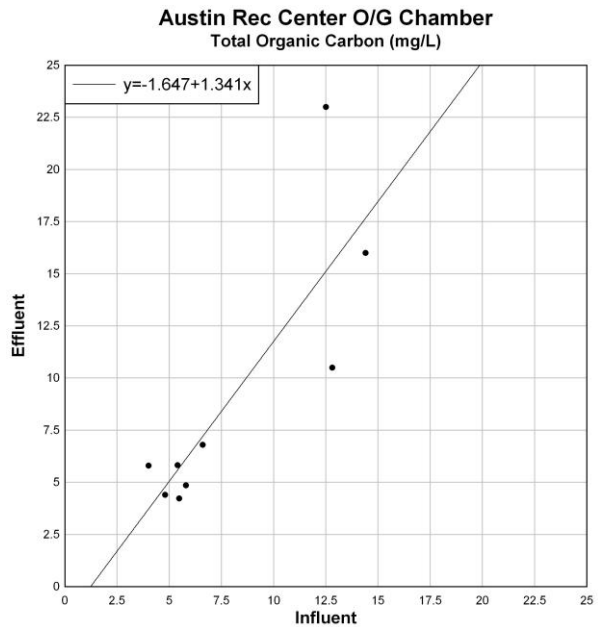
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	8	8
	Pairs Count	8	8
Non-Parametric	Maximum	96.00	92.00
	Upper Quartile	69.35	60.85
	Median	56.00	41.00
	Lower Quartile	44.00	24.00
	Minimum	32.00	20.00
	Efficiency	26.79%	
	Mann-Whitney	0.2875	
	Wilcoxon (paired)	0.1953	
Arithmetic	UCL	75.33	67.16
	Mean	58.34	45.46
	LCL	41.35	23.76
	Std. Dev.	20.32	25.95
	Wilk (p-value)	0.7614	0.1271
	Efficiency	22.07%	
	t-Test (equal var.)	0.2878	
	t-Test (unequal var.)	0.2889	
	t-test (paired)	0.2547	
	Levene Test	0.4428	
Log Transformed	UCL	78.60	77.04
	Mean	58.33	45.41
	LCL	43.28	26.77
	Std. Dev.	20.25	26.70
	Wilk (p-value)	0.9891	0.1550
	Efficiency	22.14%	
	t-Test (equal var.)	0.1723	
	t-Test (unequal var.)	0.1772	
	t-Test (paired)	0.1265	
	Levene Test	0.0407 **	
Bootstrap	UCL	73.63	65.04
	Mean	58.30	45.41
	LCL	42.97	25.78
	Std. Dev.	18.34	23.48
	Efficiency	22.11%	

Austin Rec Center O/G Chamber - Total Organic Carbon (mg/L)



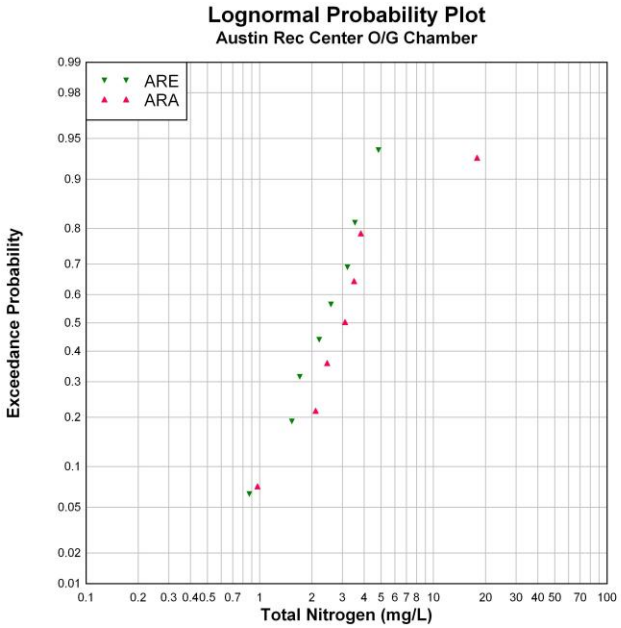


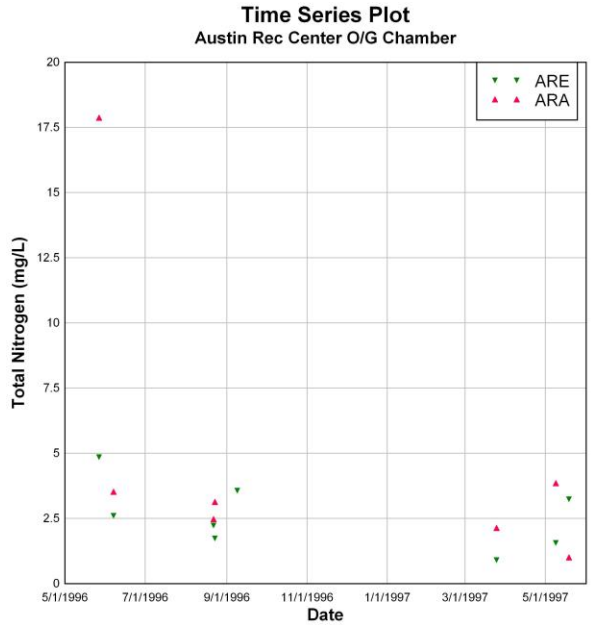


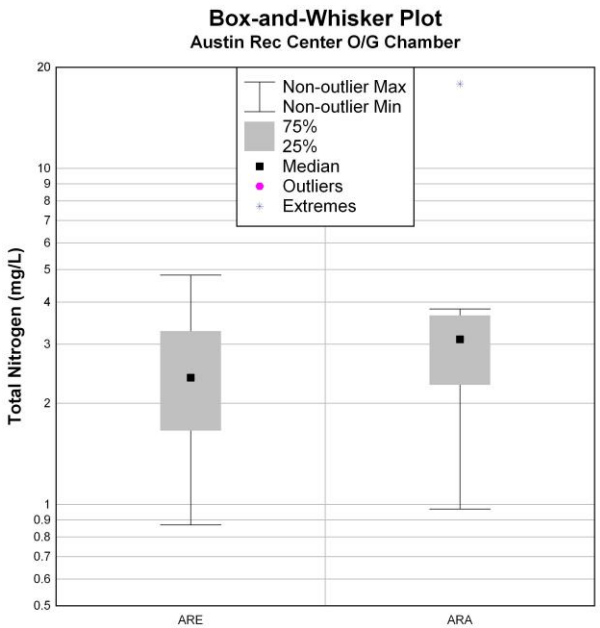


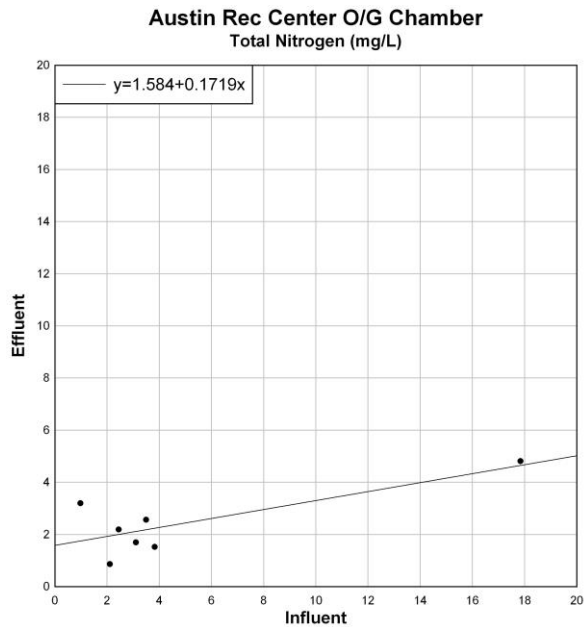
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	9	9
	Pairs Count	9	9
Non-Parametric	Maximum	14.40	23.00
	Upper Quartile	12.50	10.50
	Median	5.79	5.83
	Lower Quartile	5.39	4.86
	Minimum	4.00	4.23
	Efficiency	-0.69%	
	Mann-Whitney	0.7943	
	Wilcoxon (paired)	0.7344	
Arithmetic	UCL	11.08	14.01
	Mean	7.97	9.05
	LCL	4.87	4.08
	Std. Dev.	4.04	6.46
	Wilk (p-value)	0.0216 **	0.0093 **
	Efficiency	-13.48%	
	t-Test (equal var.)	0.6777	
	t-Test (unequal var.)	0.6788	
	t-test (paired)	0.4175	
	Levene Test	0.2911	
Log Transformed	UCL	11.73	14.67
	Mean	7.93	8.85
	LCL	5.36	5.33
	Std. Dev.	3.86	5.43
	Wilk (p-value)	0.0919 *	0.1219
	Efficiency	-11.58%	
	t-Test (equal var.)	0.8384	
	t-Test (unequal var.)	0.8385	
	t-Test (paired)	0.5906	
	Levene Test	0.4204	
Bootstrap	UCL	10.78	13.35
	Mean	7.91	8.93
	LCL	5.04	4.51
	Std. Dev.	3.74	5.75
	Efficiency	-12.88%	

Austin Rec Center O/G Chamber - Total Nitrogen (mg/L)



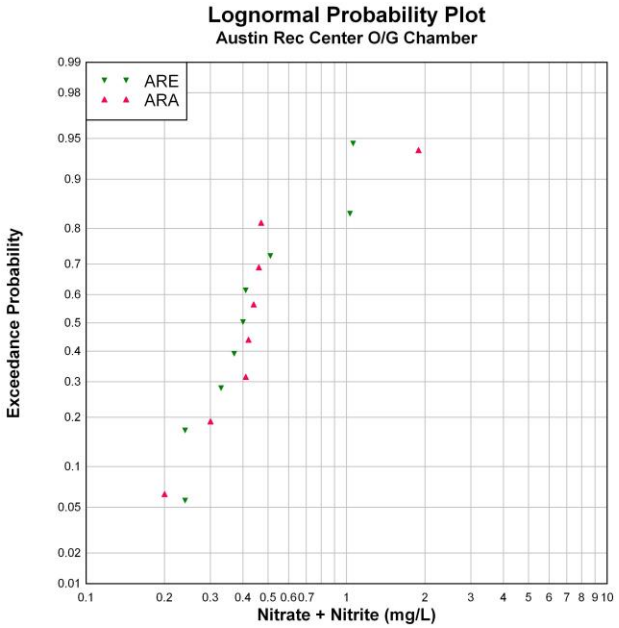


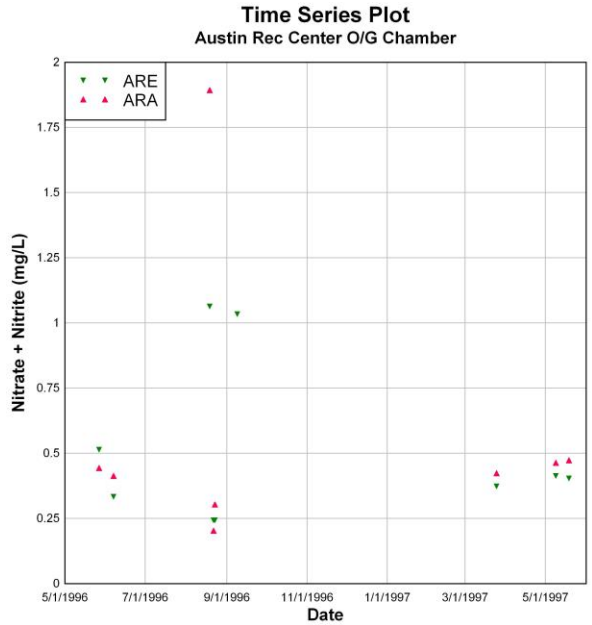


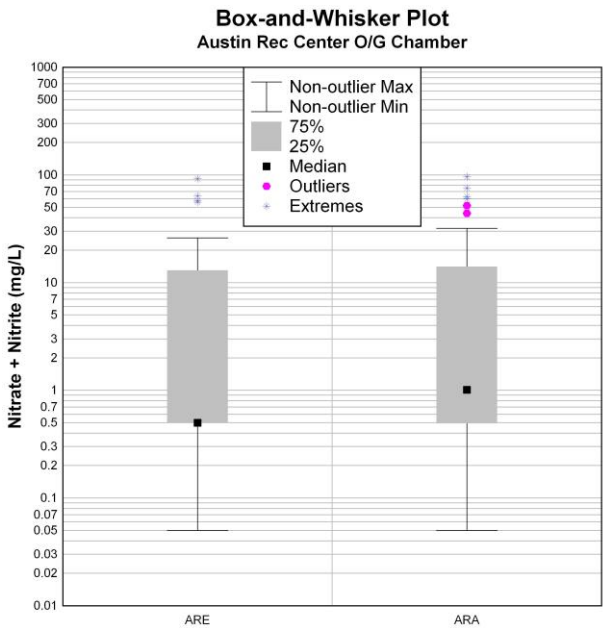


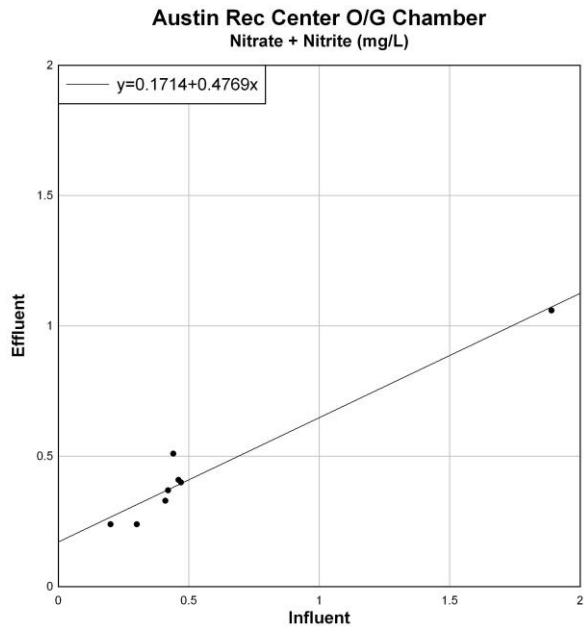
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	7	8
	Pairs Count	7	7
Non-Parametric	Maximum	17.840	4.820
	Upper Quartile	3.820	3.365
	Median	3.100	2.385
	Lower Quartile	2.100	1.615
	Minimum	0.970	0.870
	Efficiency	23.06%	
	Mann-Whitney	0.5347	
	Wilcoxon (paired)	0.1563	
Arithmetic	UCL	10.204	3.612
	Mean	4.823	2.553
	LCL	-0.559	1.493
	Std. Dev.	5.819	1.267
	Wilk (p-value)	0.0004 **	0.9143
	Efficiency	47.07%	
	t-Test (equal var.)	0.2997	
	t-Test (unequal var.)	0.3479	
	t-test (paired)	0.2400	
	Levene Test	0.2284	
Log Transformed	UCL	11.900	4.198
	Mean	4.450	2.573
	LCL	1.664	1.577
	Std. Dev.	3.990	1.413
	Wilk (p-value)	0.3136	0.9673
	Efficiency	42.19%	
	t-Test (equal var.)	0.3588	
	t-Test (unequal var.)	0.3794	
	t-Test (paired)	0.2248	
	Levene Test	0.3390	
Bootstrap	UCL	9.018	3.507
	Mean	4.780	2.549
	LCL	0.543	1.592
	Std. Dev.	4.582	1.146
	Efficiency	46.67%	

Austin Rec Center O/G Chamber - Nitrate + Nitrite (mg/L)



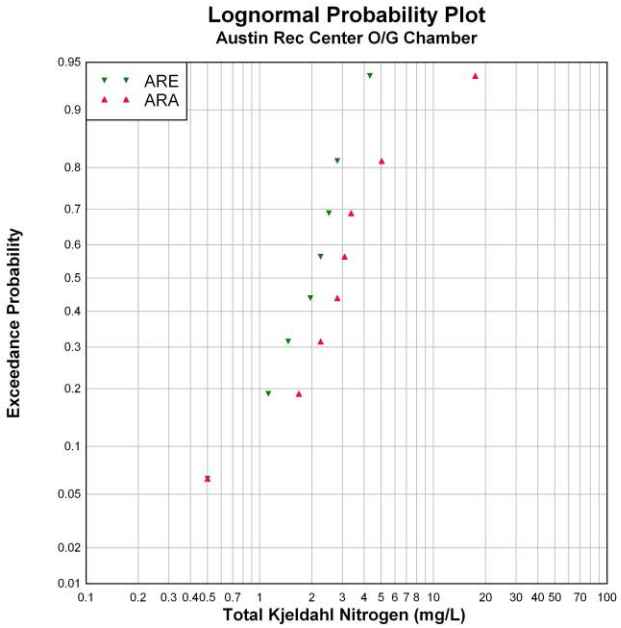


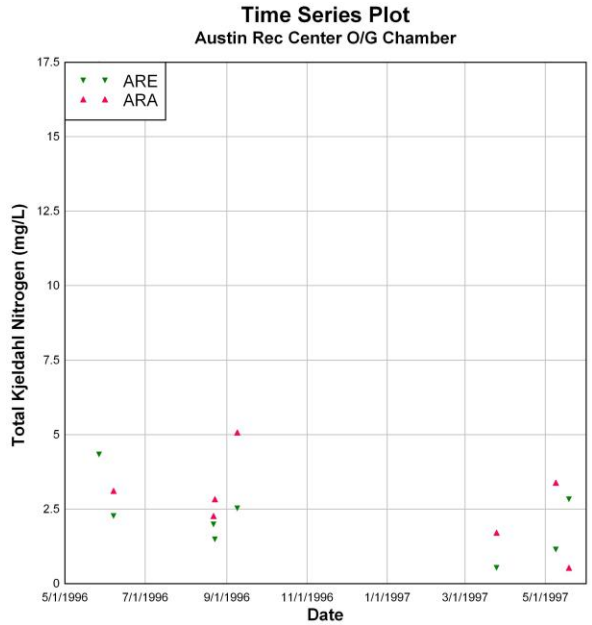


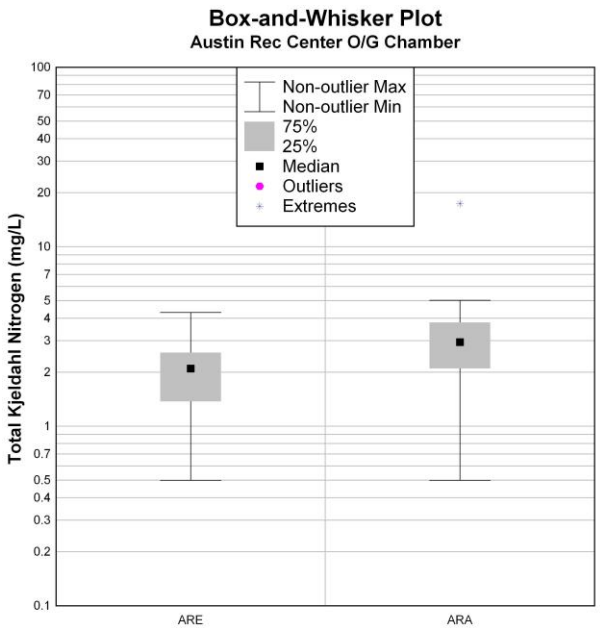


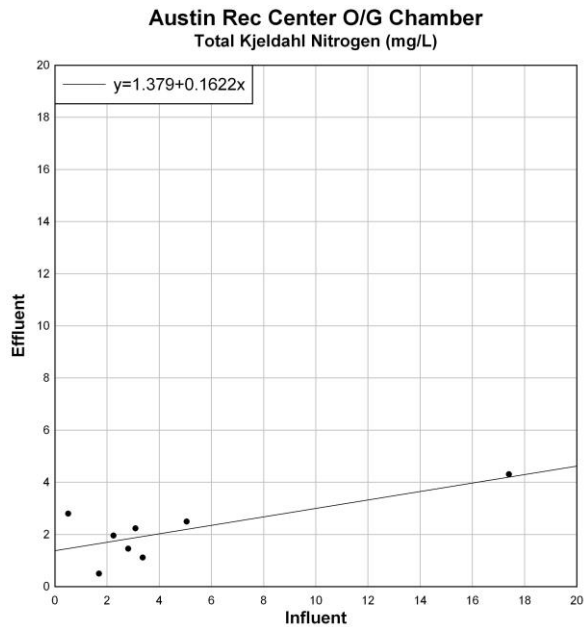
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	8	9
	Pairs Count	8	8
Non-Parametric	Maximum	1.890	1.060
	Upper Quartile	0.465	0.510
	Median	0.430	0.400
	Lower Quartile	0.355	0.330
	Minimum	0.200	0.240
	Efficiency	6.98%	
	Mann-Whitney	0.7050	
	Wilcoxon (paired)	0.1484	
Arithmetic	UCL	1.025	0.752
	Mean	0.574	0.510
	LCL	0.122	0.268
	Std. Dev.	0.540	0.315
	Wilk (p-value)	0.0001 **	0.0079 **
	Efficiency	11.11%	
	t-Test (equal var.)	0.7668	
	t-Test (unequal var.)	0.7752	
	t-test (paired)	0.2473	
	Levene Test	0.4239	
Log Transformed	UCL	0.990	0.792
	Mean	0.544	0.503
	LCL	0.299	0.320
	Std. Dev.	0.357	0.280
	Wilk (p-value)	0.0298 **	0.1381
	Efficiency	7.48%	
	t-Test (equal var.)	0.9167	
	t-Test (unequal var.)	0.9176	
	t-Test (paired)	0.1472	
	Levene Test	0.7125	
Bootstrap	UCL	0.943	0.728
	Mean	0.579	0.509
	LCL	0.214	0.289
	Std. Dev.	0.435	0.286
	Efficiency	12.07%	

Austin Rec Center O/G Chamber - Total Kjeldahl Nitrogen (mg/L)



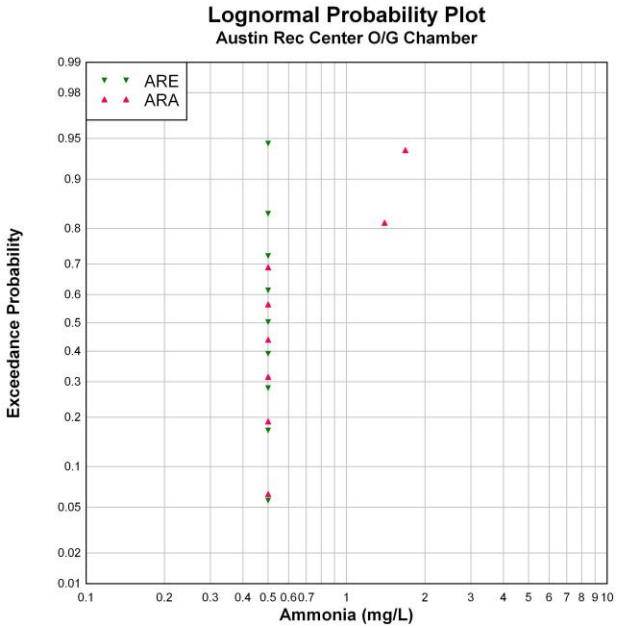


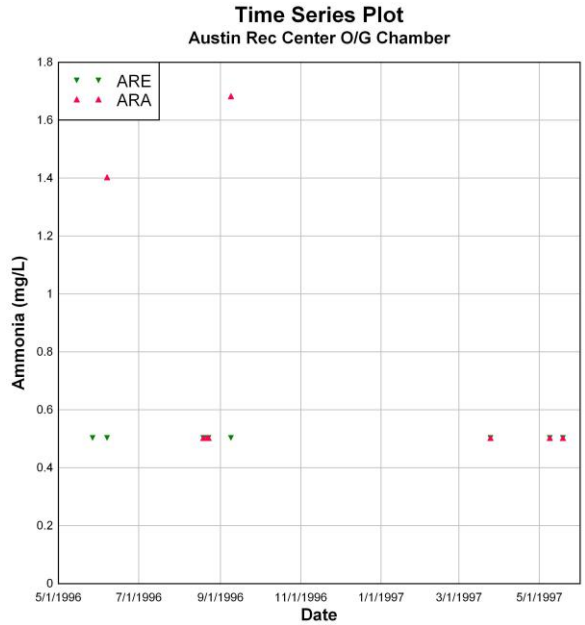


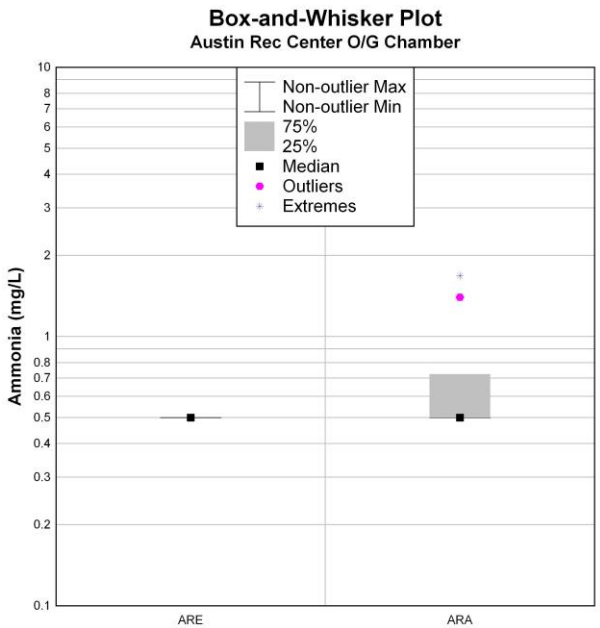


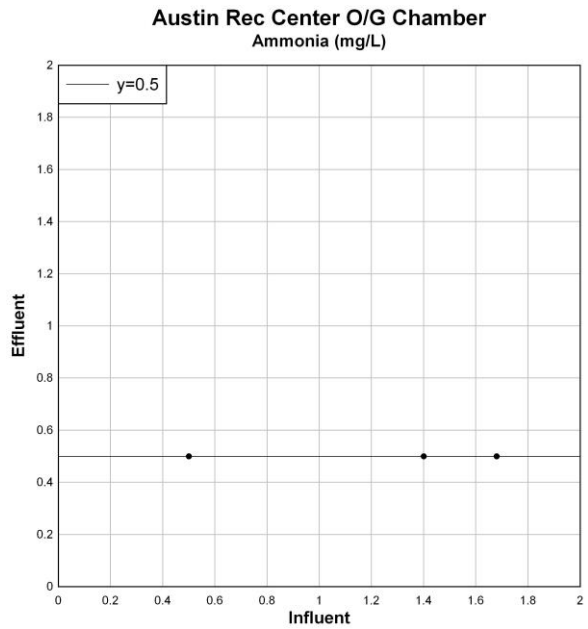
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	8	8
	Pairs Count	8	8
Non-Parametric	Maximum	17.400	4.310
	Upper Quartile	4.200	2.650
	Median	2.940	2.100
	Lower Quartile	1.960	1.290
	Minimum	0.500	0.500
	Efficiency	28.57%	
	Mann-Whitney	0.2259	
	Wilcoxon (paired)	0.1094	
Arithmetic	UCL	9.004	3.085
	Mean	4.513	2.111
	LCL	0.021	1.137
	Std. Dev.	5.371	1.165
	Wilk (p-value)	0.0007 **	0.8910
	Efficiency	53.21%	
	t-Test (equal var.)	0.2369	
	t-Test (unequal var.)	0.2531	
	t-test (paired)	0.1805	
	Levene Test	0.2537	
Log Transformed	UCL	12.491	3.997
	Mean	4.380	2.162
	LCL	1.536	1.170
	Std. Dev.	4.557	1.450
	Wilk (p-value)	0.6624	0.6910
	Efficiency	50.63%	
	t-Test (equal var.)	0.2820	
	t-Test (unequal var.)	0.2849	
	t-Test (paired)	0.2174	
	Levene Test	0.3715	
Bootstrap	UCL	8.136	2.982
	Mean	4.462	2.108
	LCL	0.788	1.235
	Std. Dev.	4.395	1.045
	Efficiency	52.75%	

Austin Rec Center O/G Chamber - Ammonia (mg/L)



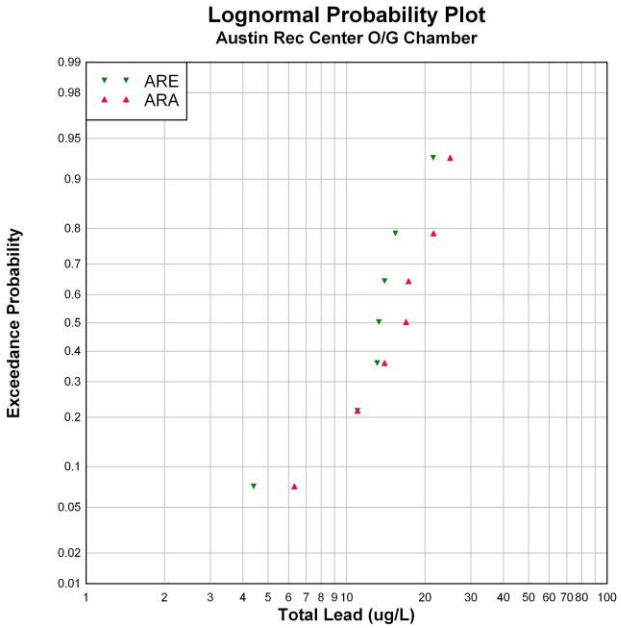


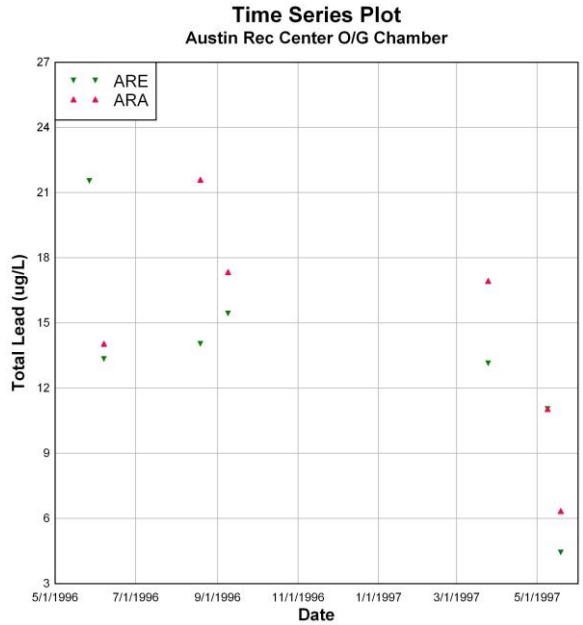


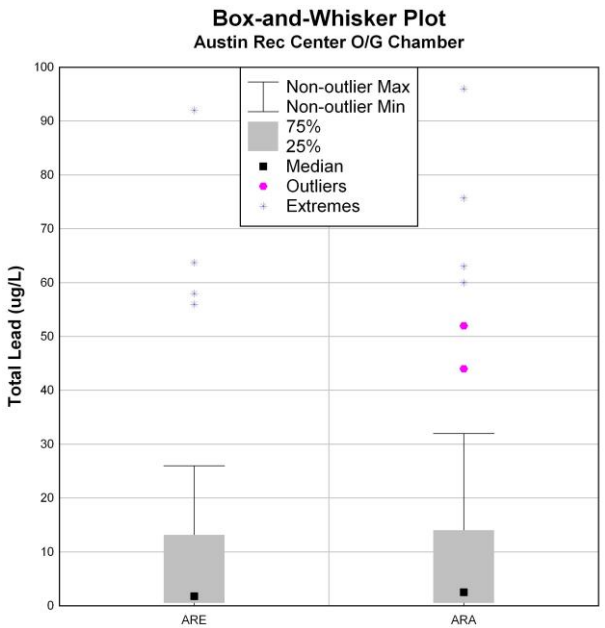


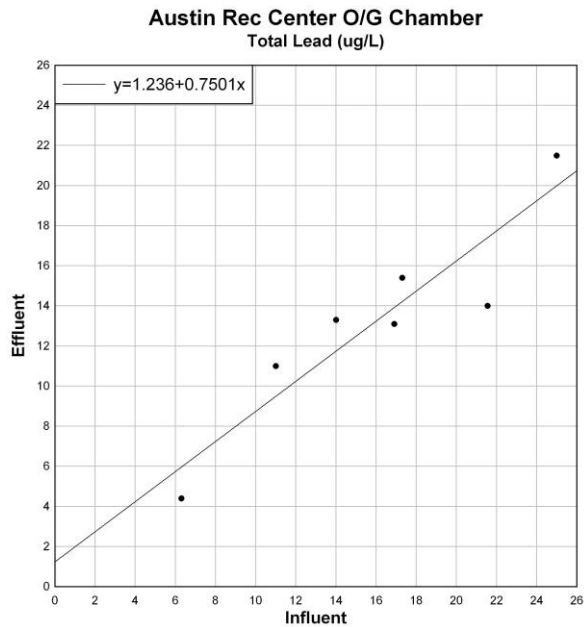
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	8	9
	Pairs Count	8	8
Non-Parametric	Maximum	1.680	0.500
	Upper Quartile	0.950	0.500
	Median	0.500	0.500
	Lower Quartile	0.500	0.500
	Minimum	0.500	0.500
	Efficiency	0.00%	
	Mann-Whitney	0.1636	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	1.167	0.500
	Mean	0.760	0.500
	LCL	0.353	0.500
	Std. Dev.	0.487	0.000
	Wilk (p-value)	0.0002 **	NA
	Efficiency	34.21%	
	t-Test (equal var.)	0.1287	
	t-Test (unequal var.)	0.1749	
	t-test (paired)	0.1749	
	Levene Test	0.0439 **	
Log Transformed	UCL	1.188	0.500
	Mean	0.744	0.500
	LCL	0.466	0.500
	Std. Dev.	0.393	0.000
	Wilk (p-value)	0.0001 **	NA
	Efficiency	32.80%	
	t-Test (equal var.)	0.1261	
	t-Test (unequal var.)	0.1721	
	t-Test (paired)	0.1721	
	Levene Test	0.0335 **	
Bootstrap	UCL	1.109	0.500
	Mean	0.758	0.500
	LCL	0.406	0.500
	Std. Dev.	0.420	0.000
	Efficiency	34.01%	

Austin Rec Center O/G Chamber - Total Lead (ug/L)



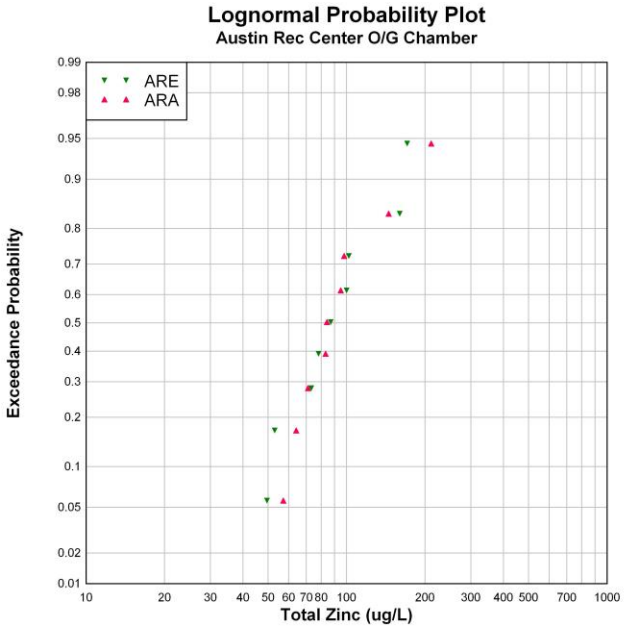


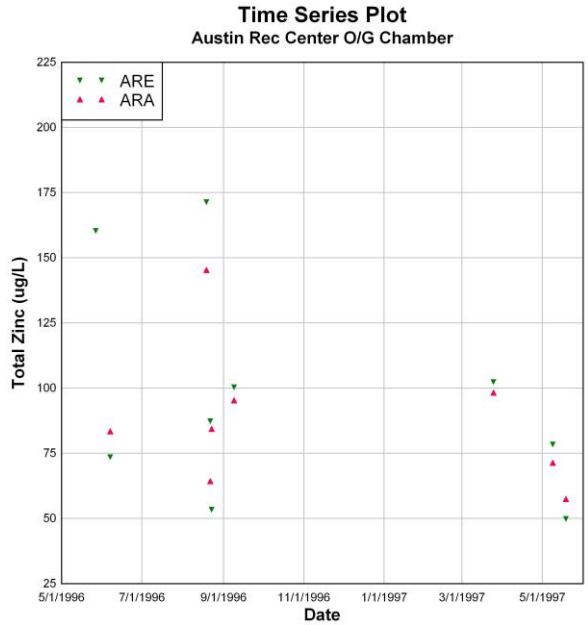


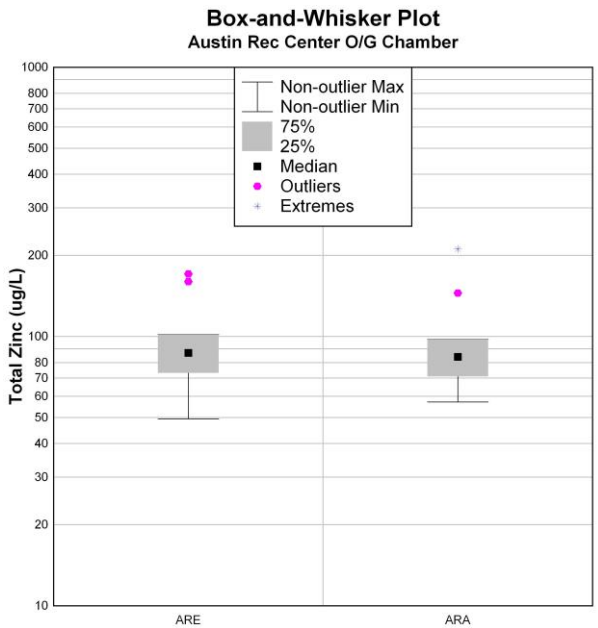


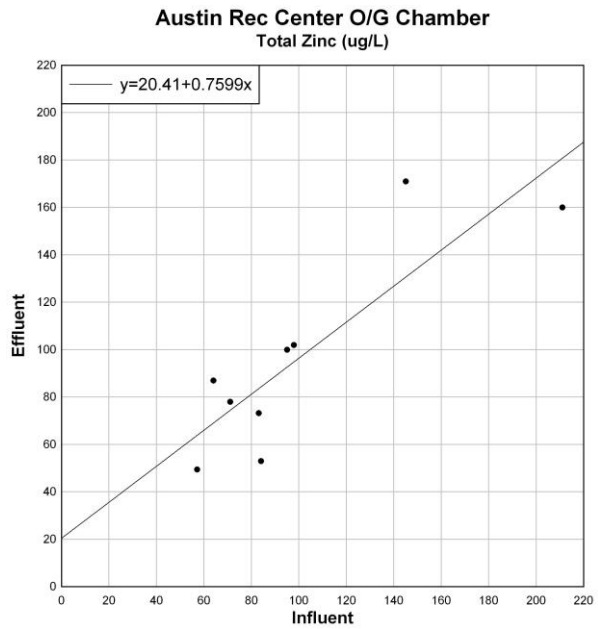
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	7	7
	Pairs Count	7	7
Non-Parametric	Maximum	25.0	21.5
	Upper Quartile	21.5	15.4
	Median	16.9	13.3
	Lower Quartile	11.0	11.0
	Minimum	6.3	4.4
	Efficiency	21.30%	
	Mann-Whitney	0.3549	
	Wilcoxon (paired)	0.0313 **	
Arithmetic	UCL	21.8	18.0
	Mean	16.0	13.2
	LCL	10.2	8.5
	Std. Dev.	6.3	5.1
	Wilk (p-value)	0.9889	0.6116
	Efficiency	17.27%	
	t-Test (equal var.)	0.3846	
	t-Test (unequal var.)	0.3853	
	t-test (paired)	0.0270 **	
	Levene Test	0.5687	
Log Transformed	UCL	25.4	21.9
	Mean	16.2	13.5
	LCL	10.3	8.3
	Std. Dev.	7.5	6.7
	Wilk (p-value)	0.5812	0.0801 *
	Efficiency	16.66%	
	t-Test (equal var.)	0.4601	
	t-Test (unequal var.)	0.4602	
	t-Test (paired)	0.0180 **	
	Levene Test	0.8856	
Bootstrap	UCL	21.2	17.4
	Mean	15.9	13.2
	LCL	10.7	9.0
	Std. Dev.	5.7	4.5
	Efficiency	17.45%	

Austin Rec Center O/G Chamber - Total Zinc (ug/L)



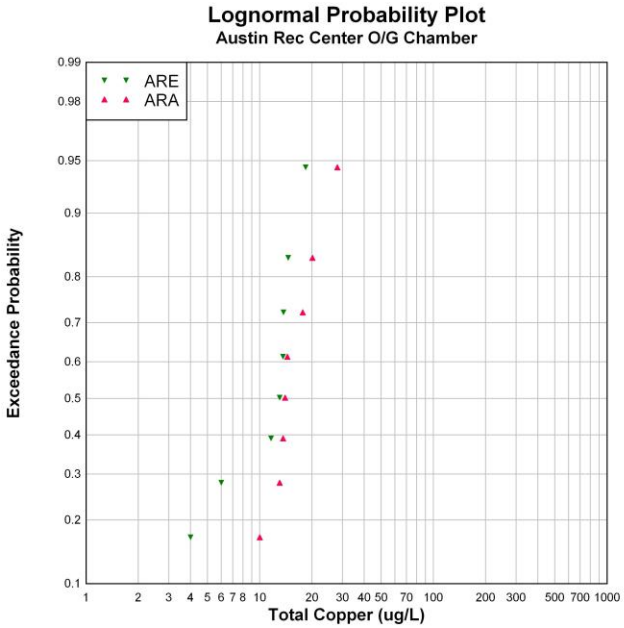


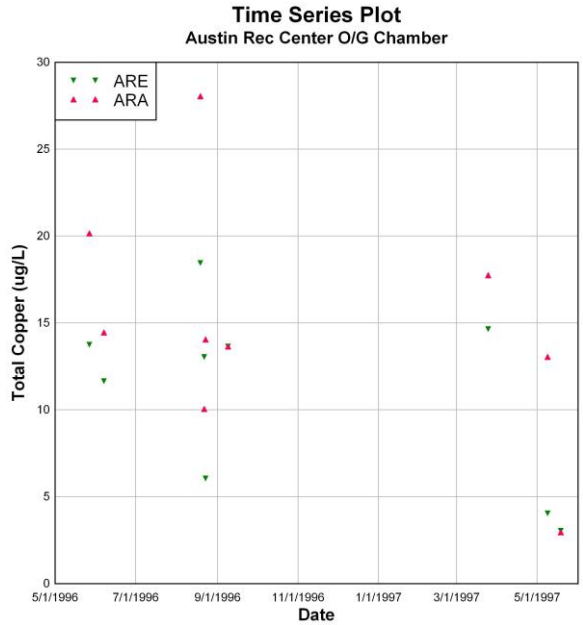


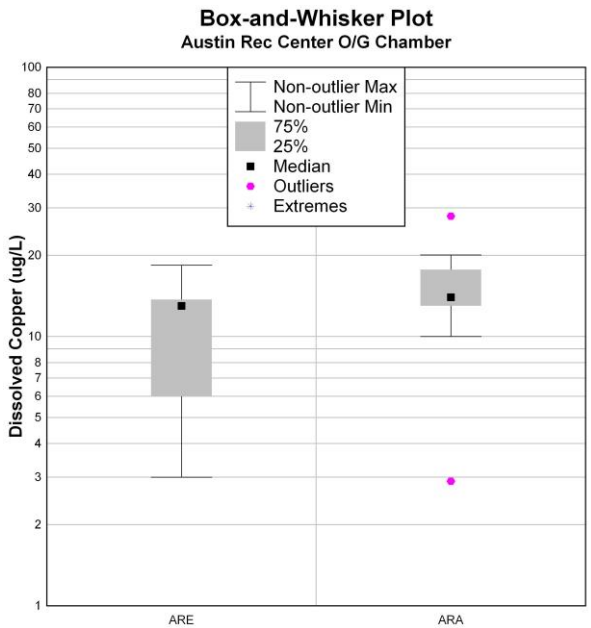


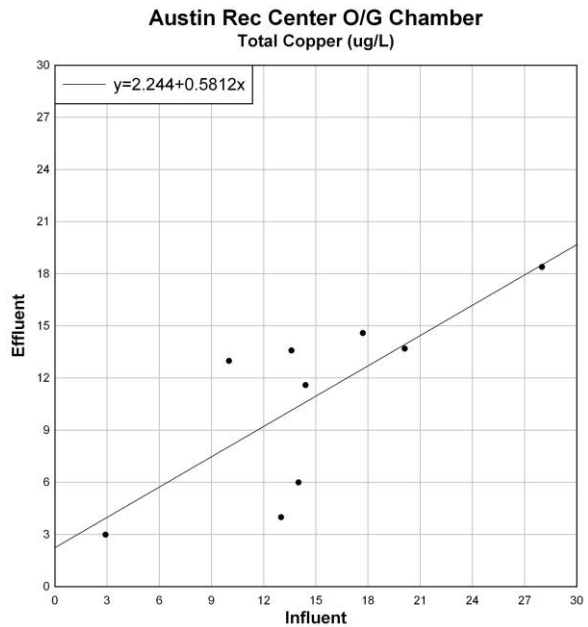
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	9	9
	Pairs Count	9	9
Non-Parametric	Maximum	211.0	171.0
	Upper Quartile	97.9	102.0
	Median	84.0	87.0
	Lower Quartile	71.0	73.2
	Minimum	57.1	49.5
	Efficiency	-3.57%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	0.7344	
Arithmetic	UCL	138.2	130.0
	Mean	100.9	97.1
	LCL	63.6	64.1
	Std. Dev.	48.6	42.9
	Wilk (p-value)	0.0234 **	0.1750
	Efficiency	3.79%	
	t-Test (equal var.)	0.8618	
	t-Test (unequal var.)	0.8618	
	t-test (paired)	0.6549	
	Levene Test	0.7501	
Log Transformed	UCL	139.1	137.0
	Mean	100.1	96.9
	LCL	71.9	68.6
	Std. Dev.	41.5	42.1
	Wilk (p-value)	0.3739	0.6049
	Efficiency	3.13%	
	t-Test (equal var.)	0.8472	
	t-Test (unequal var.)	0.8472	
	t-Test (paired)	0.6359	
	Levene Test	0.8818	
Bootstrap	UCL	132.5	126.1
	Mean	99.8	96.1
	LCL	67.1	66.1
	Std. Dev.	42.5	39.0
	Efficiency	3.68%	

Austin Rec Center O/G Chamber - Total Copper (ug/L)



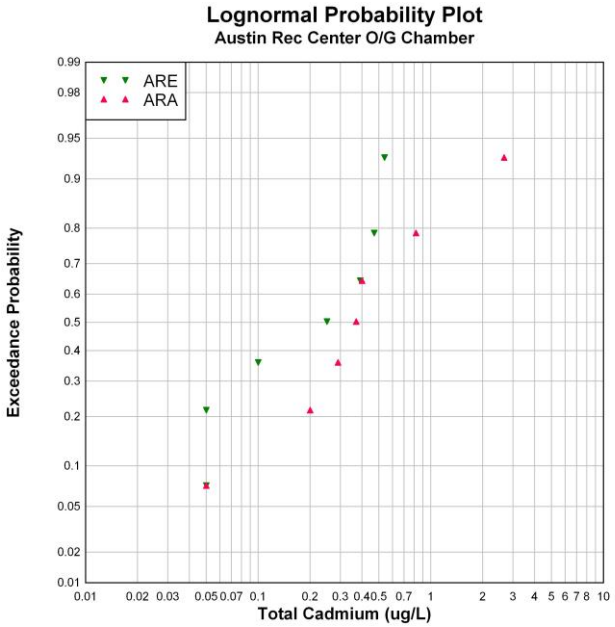


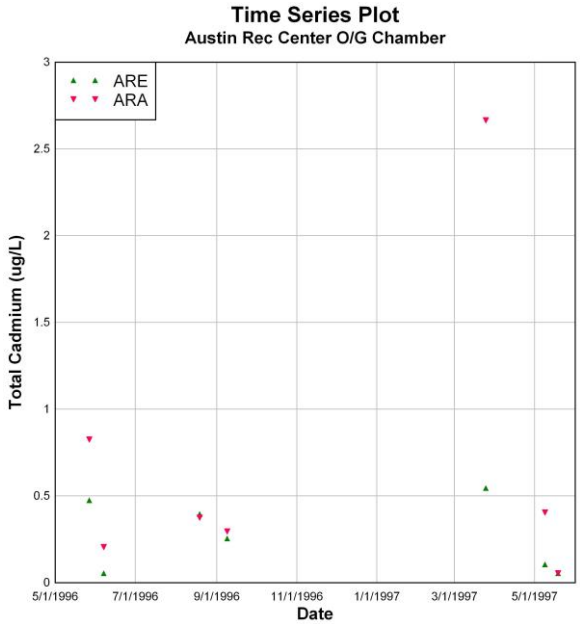


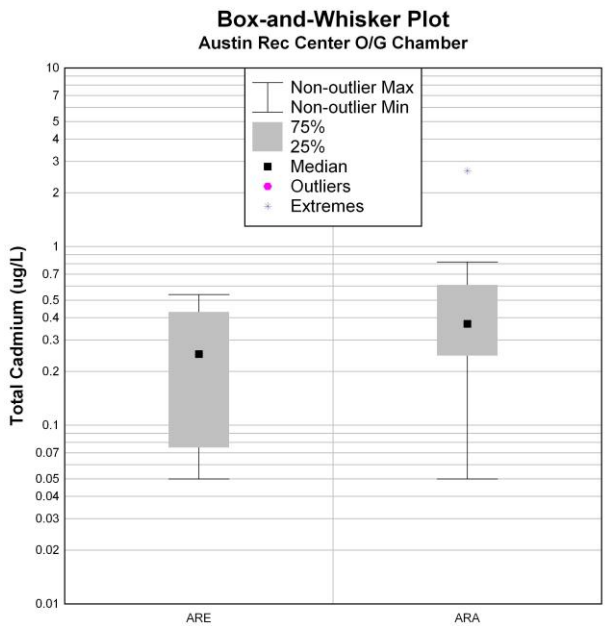


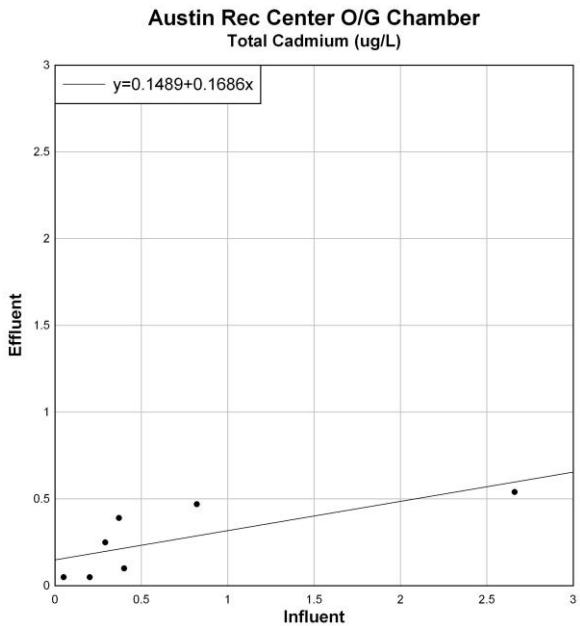
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	9	9
	Pairs Count	9	9
Non-Parametric	Maximum	28.0	18.4
	Upper Quartile	17.7	13.7
	Median	14.0	13.0
	Lower Quartile	13.0	6.0
	Minimum	2.9	3.0
	Efficiency	7.14%	
	Mann-Whitney	0.3450	
	Wilcoxon (paired)	0.0742 *	
Arithmetic	UCL	20.2	14.9
	Mean	14.9	10.9
	LCL	9.6	6.8
	Std. Dev.	6.9	5.3
	Wilk (p-value)	0.7308	0.2674
	Efficiency	26.78%	
	t-Test (equal var.)	0.1889	
	t-Test (unequal var.)	0.1901	
	t-test (paired)	0.0292 **	
	Levene Test	0.4713	
Log Transformed	UCL	26.5	19.4
	Mean	15.4	11.2
	LCL	9.0	6.5
	Std. Dev.	10.0	7.4
	Wilk (p-value)	0.0394 **	0.0567 *
	Efficiency	27.50%	
	t-Test (equal var.)	0.2935	
	t-Test (unequal var.)	0.2935	
	t-Test (paired)	0.0611 *	
	Levene Test	0.9696	
Bootstrap	UCL	19.5	14.5
	Mean	14.7	10.7
	LCL	9.9	7.0
	Std. Dev.	6.3	4.9
	Efficiency	26.88%	

Austin Rec Center O/G Chamber - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: ARA**	**EFF: ARE**
	Site Count	7	7
	Pairs Count	7	7
Non-Parametric	Maximum	2.7	0.5
	Upper Quartile	0.8	0.5
	Median	0.4	0.2
	Lower Quartile	0.2	0.1
	Minimum	0.0	0.0
	Efficiency	32.43%	
	Mann-Whitney	0.5340	
	Wilcoxon (paired)	0.0781 *	
Arithmetic	UCL	1.5	0.5
	Mean	0.7	0.3
	LCL	-0.2	0.1
	Std. Dev.	0.9	0.2
	Wilk (p-value)	0.0025 **	0.2527
	Efficiency	61.38%	
	t-Test (equal var.)	0.2534	
	t-Test (unequal var.)	0.2714	
	t-test (paired)	0.1957	
	Levene Test	0.2400	
Log Transformed	UCL	3.2	1.0
	Mean	0.7	0.3
	LCL	0.1	0.1
	Std. Dev.	0.8	0.3
	Wilk (p-value)	0.8927	0.1438
	Efficiency	58.37%	
	t-Test (equal var.)	0.2598	
	t-Test (unequal var.)	0.2604	
	t-Test (paired)	0.0391 **	
	Levene Test	0.6322	
Bootstrap	UCL	1.4	0.4
	Mean	0.7	0.3
	LCL	0.0	0.1
	Std. Dev.	0.7	0.2
	Efficiency	61.61%	

Gillis Park Oil and Grit Chamber (GPI-GPE)

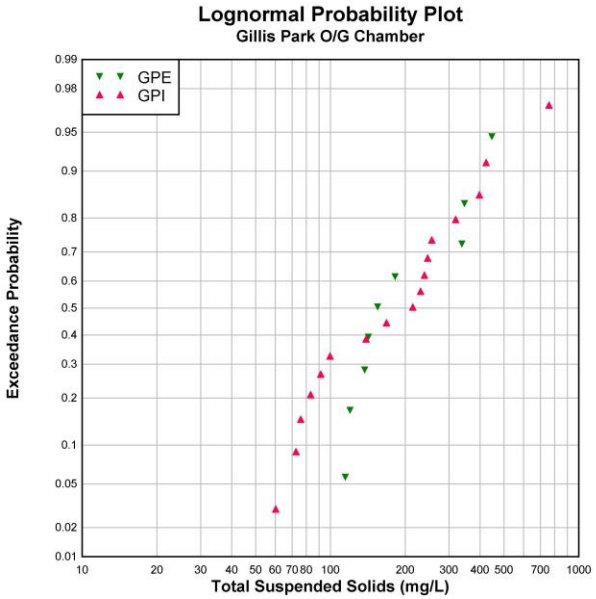
This SCM was installed to treat a mixed use area (see GPI in the COA reports on small watershed quantity and quality (2009) for details in the drainage area). Trash and debris often clogged the influent and effluent requiring excessive maintenance. The system has since been removed.

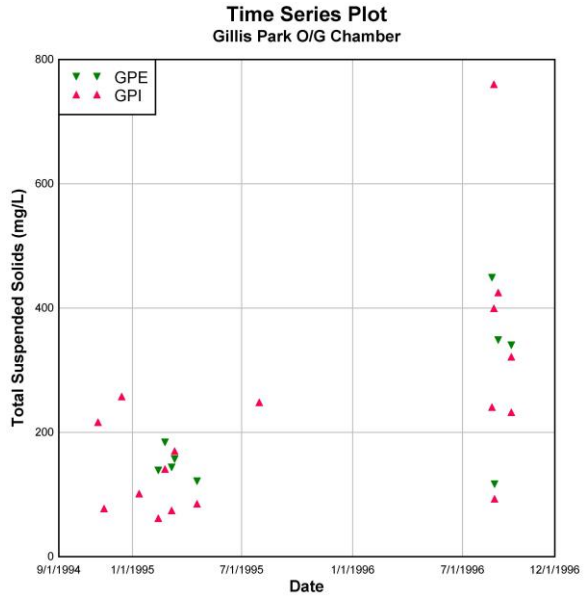
Between 1994 and 1996, the City collected 17 influent EMCs and 9 effluent EMCs. All 9 Effluent EMCs were paired with influent EMCs.

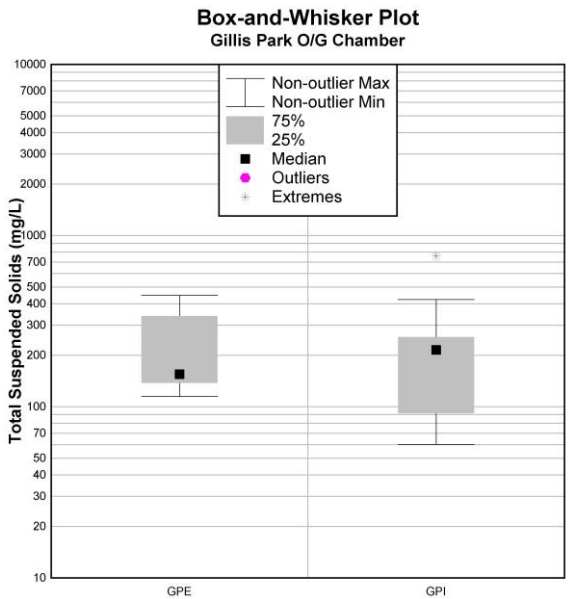
Performance Summary

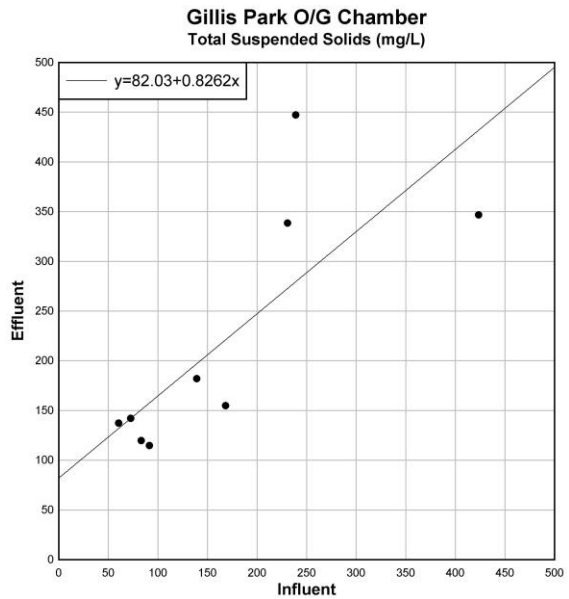
The overall performance of this system was poor. There was a slight reduction in TSS concentrations (3%) that was significant using paired analyses. The effluent concentrations were higher than the influent concentrations for all other parameters, however very few of the results were significant.

Gillis Park O/G Chamber - Total Suspended Solids (mg/L)



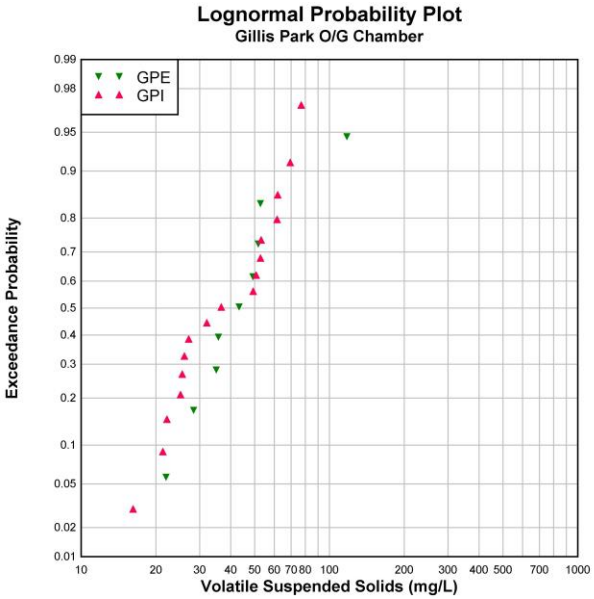


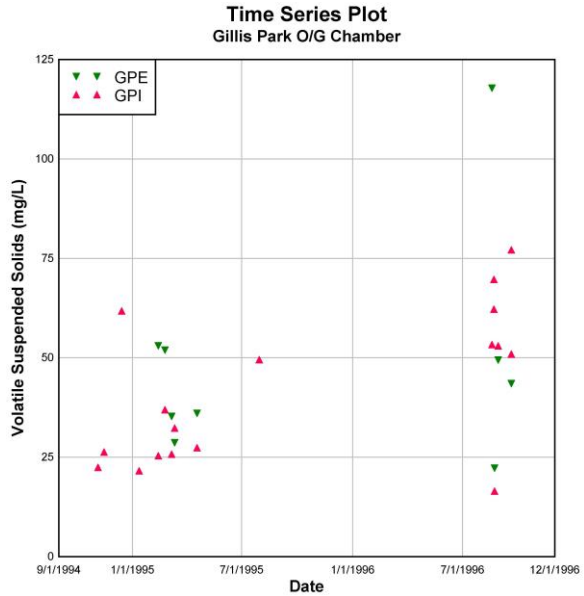


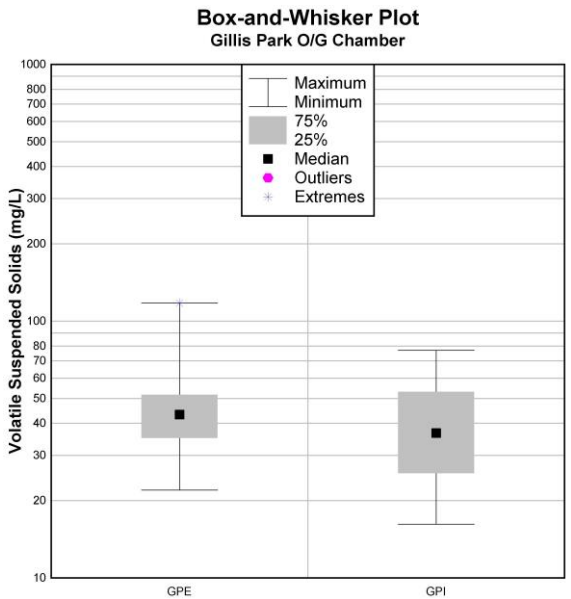


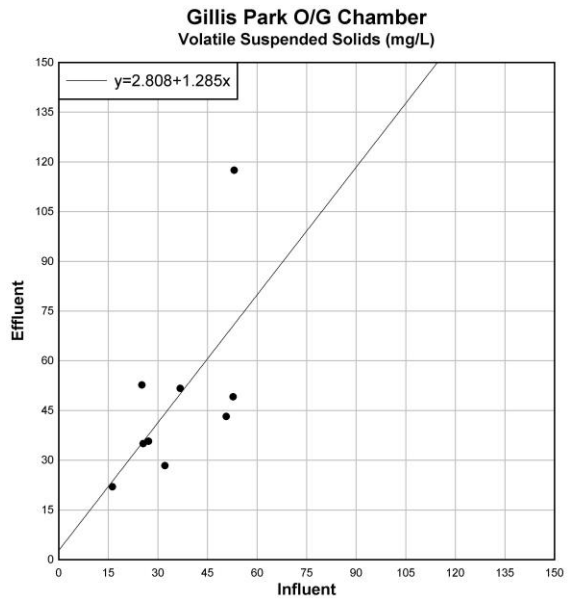
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	9
	Pairs Count	9	9
Non-Parametric	Maximum	758.3	447.3
	Upper Quartile	255.9	338.5
	Median	214.8	155.0
	Lower Quartile	91.3	137.3
	Minimum	60.2	114.8
	Efficiency	27.80%	
	Mann-Whitney	0.7092	
	Wilcoxon (paired)	0.0742 *	
Arithmetic	UCL	319.0	315.1
	Mean	228.0	220.4
	LCL	137.0	125.7
	Std. Dev.	177.0	123.2
	Wilk (p-value)	0.0039 **	0.0244 **
	Efficiency	3.33%	
	t-Test (equal var.)	0.9100	
	t-Test (unequal var.)	0.8996	
	t-test (paired)	0.0806 *	
	Levene Test	0.4841	
Log Transformed	UCL	345.9	334.1
	Mean	227.0	218.5
	LCL	149.0	143.0
	Std. Dev.	176.9	114.5
	Wilk (p-value)	0.5379	0.0854 *
	Efficiency	3.73%	
	t-Test (equal var.)	0.7468	
	t-Test (unequal var.)	0.7202	
	t-Test (paired)	0.0160 **	
	Levene Test	0.1808	
Bootstrap	UCL	317.0	310.2
	Mean	231.5	223.0
	LCL	146.0	135.7
	Std. Dev.	166.3	113.5
	Efficiency	3.70%	

Gillis Park O/G Chamber - Volatile Suspended Solids (mg/L)



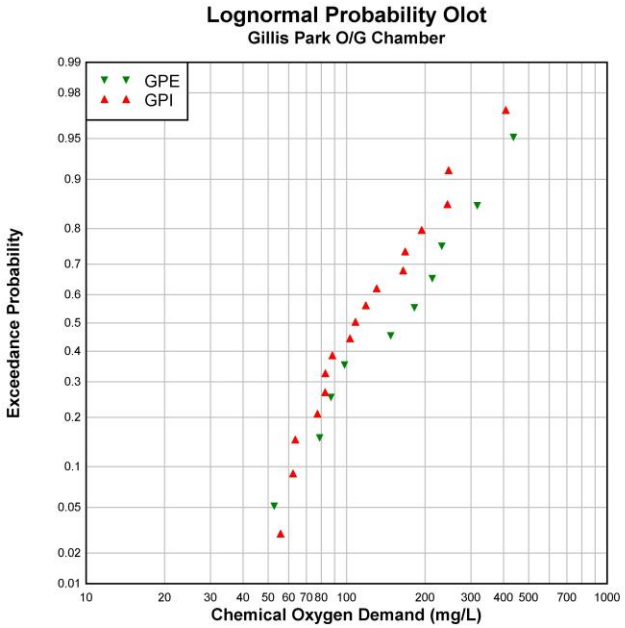


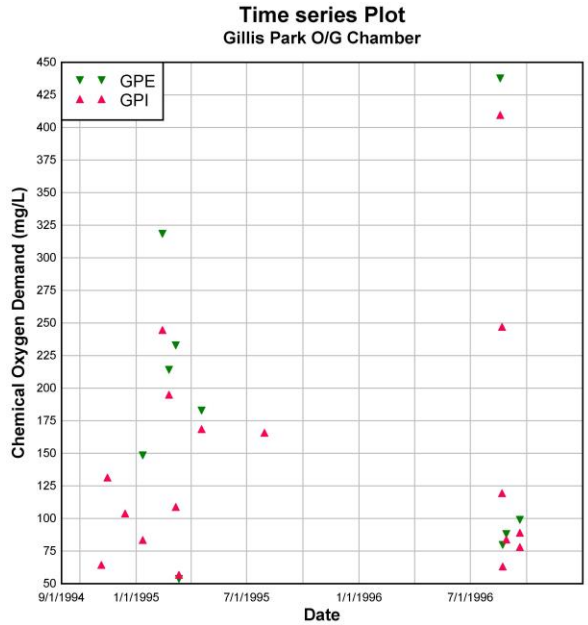


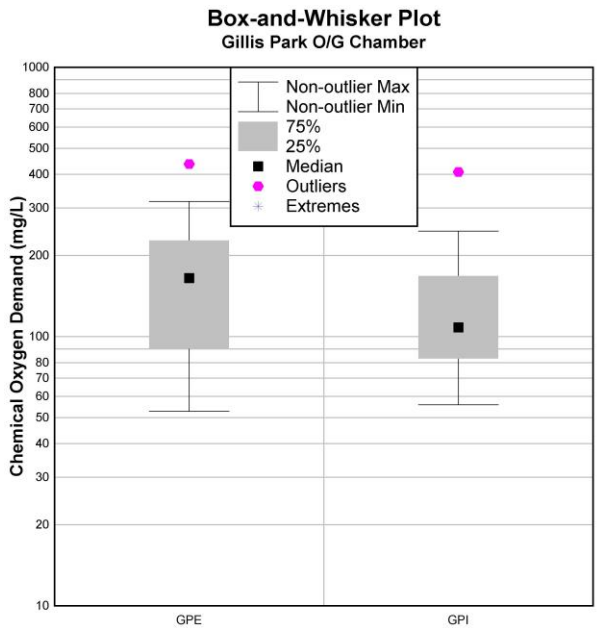


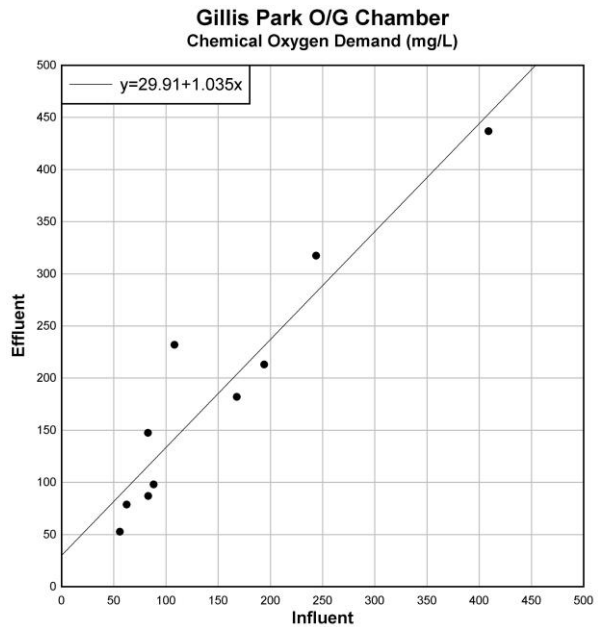
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	9
	Pairs Count	9	9
Non-Parametric	Maximum	76.9	117.5
	Upper Quartile	53.1	51.7
	Median	36.7	43.2
	Lower Quartile	25.5	35.0
	Minimum	16.2	22.0
	Efficiency	-17.84%	
	Mann-Whitney	0.7898	
	Wilcoxon (paired)	0.0742 *	
Arithmetic	UCL	51.4	69.9
	Mean	41.6	48.4
	LCL	31.9	26.9
	Std. Dev.	19.0	28.0
	Wilk (p-value)	0.1388	0.0058 **
	Efficiency	-16.18%	
	t-Test (equal var.)	0.4723	
	t-Test (unequal var.)	0.5294	
	t-test (paired)	0.1182	
	Levene Test	0.3592	
Log Transformed	UCL	54.2	70.4
	Mean	41.8	47.8
	LCL	32.2	32.4
	Std. Dev.	20.6	23.0
	Wilk (p-value)	0.2495	0.4849
	Efficiency	-14.36%	
	t-Test (equal var.)	0.4769	
	t-Test (unequal var.)	0.4790	
	t-Test (paired)	0.0479 **	
	Levene Test	0.8810	
Bootstrap	UCL	51.5	67.1
	Mean	42.1	48.5
	LCL	32.6	29.9
	Std. Dev.	18.4	24.2
	Efficiency	-15.21%	

Gillis Park O/G Chamber - Chemical Oxygen Demand (mg/L)



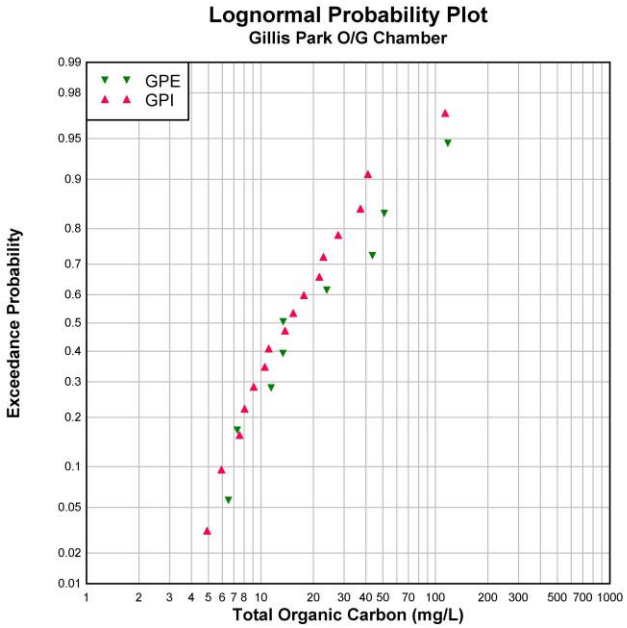


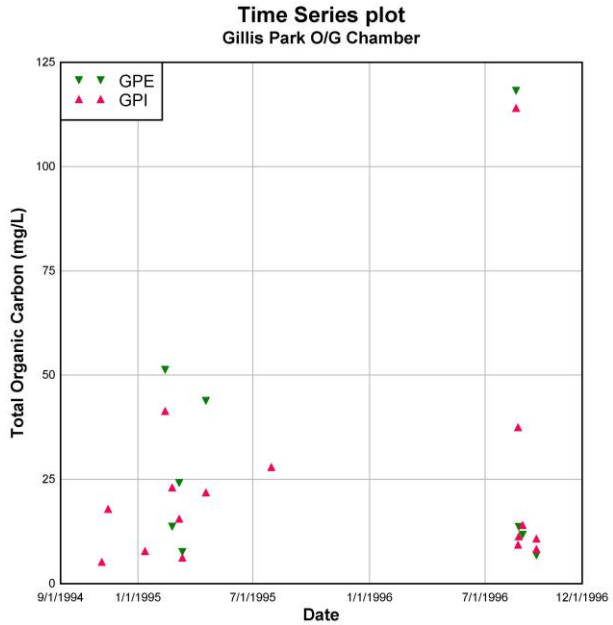


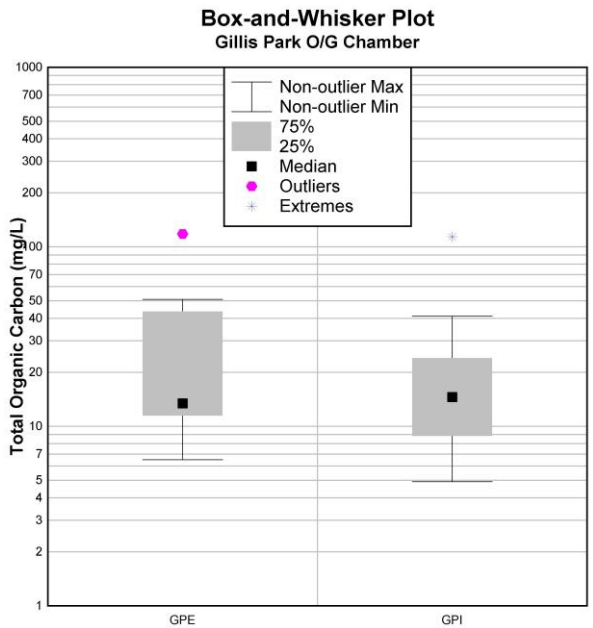


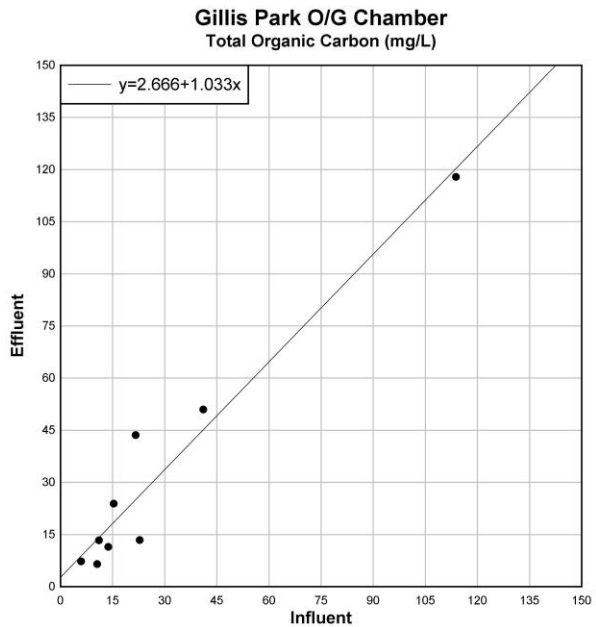
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	408.76	436.89
	Upper Quartile	167.70	232.01
	Median	108.00	164.78
	Lower Quartile	82.66	87.13
	Minimum	55.83	52.78
	Efficiency	-52.57%	
	Mann-Whitney	0.4150	
	Wilcoxon (paired)	0.0039 **	
Arithmetic	UCL	188.05	271.00
	Mean	141.06	184.60
	LCL	94.07	98.20
	Std. Dev.	91.39	120.78
	Wilk (p-value)	0.0033 **	0.2734
	Efficiency	-30.86%	
	t-Test (equal var.)	0.2987	
	t-Test (unequal var.)	0.3397	
	t-test (paired)	0.0214 **	
	Levene Test	0.4591	
Log Transformed	UCL	189.84	316.36
	Mean	139.24	185.24
	LCL	102.12	108.46
	Std. Dev.	81.25	128.35
	Wilk (p-value)	0.5043	0.9406
	Efficiency	-33.04%	
	t-Test (equal var.)	0.3401	
	t-Test (unequal var.)	0.3677	
	t-Test (paired)	0.0257 **	
	Levene Test	0.4782	
Bootstrap	UCL	184.95	264.72
	Mean	140.75	184.29
	LCL	96.56	103.87
	Std. Dev.	85.96	112.43
	Efficiency	-30.93%	

Gillis Park O/G Chamber - Total Organic Carbon (mg/L)



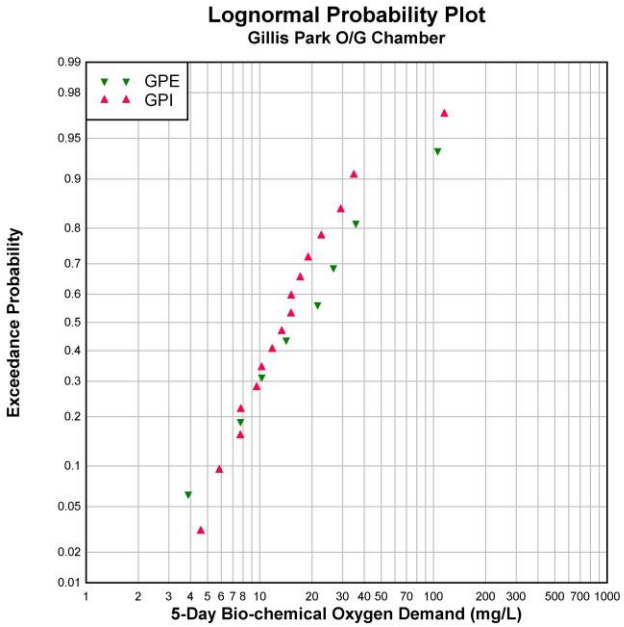


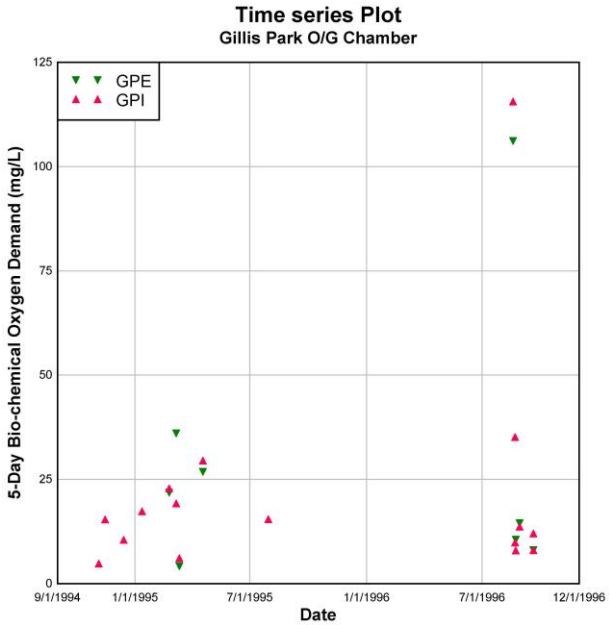


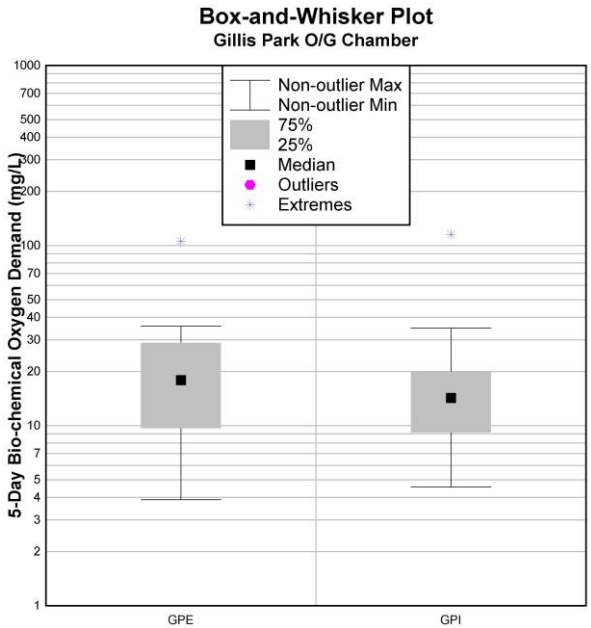


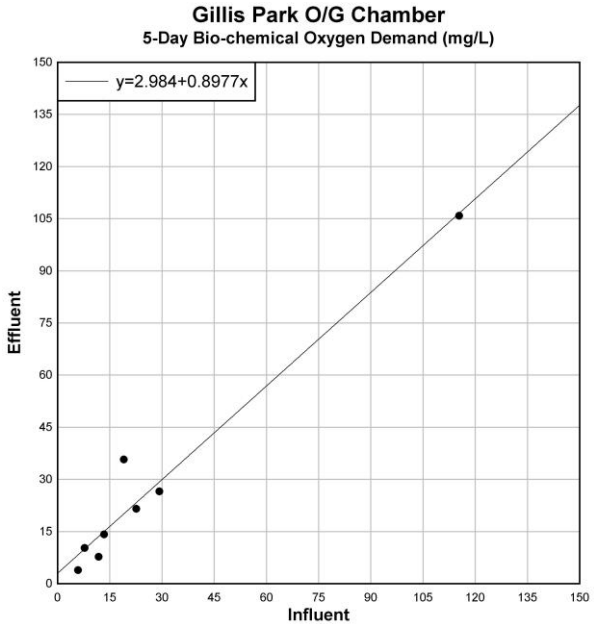
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	16	9
	Pairs Count	9	9
Non-Parametric	Maximum	113.77	117.87
	Upper Quartile	25.24	43.59
	Median	14.53	13.42
	Lower Quartile	8.57	11.45
	Minimum	4.91	6.51
	Efficiency	7.67%	
	Mann-Whitney	0.5578	
	Wilcoxon (paired)	0.3594	
Arithmetic	UCL	37.12	59.64
	Mean	23.00	32.04
	LCL	8.88	4.45
	Std. Dev.	26.51	35.90
	Wilk (p-value)	0.0001 **	0.0037 **
	Efficiency	-39.31%	
	t-Test (equal var.)	0.4783	
	t-Test (unequal var.)	0.5201	
	t-test (paired)	0.2705	
	Levene Test	0.5903	
Log Transformed	UCL	35.94	77.03
	Mean	21.63	30.55
	LCL	13.02	12.12
	Std. Dev.	19.32	31.35
	Wilk (p-value)	0.6276	0.5004
	Efficiency	-41.24%	
	t-Test (equal var.)	0.5001	
	t-Test (unequal var.)	0.5248	
	t-Test (paired)	0.6362	
	Levene Test	0.5972	
Bootstrap	UCL	35.59	56.42
	Mean	22.97	32.04
	LCL	10.35	7.66
	Std. Dev.	23.69	31.72
	Efficiency	-39.49%	

Gillis Park O/G Chamber - 5-Day Bio-chemical Oxygen Demand (mg/L)



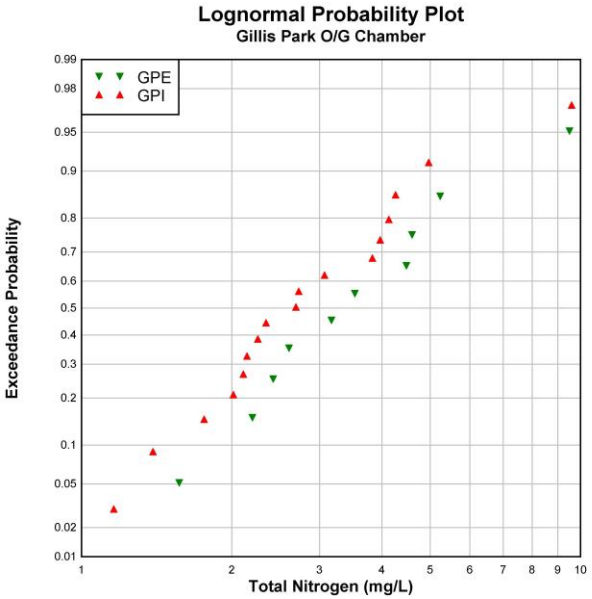


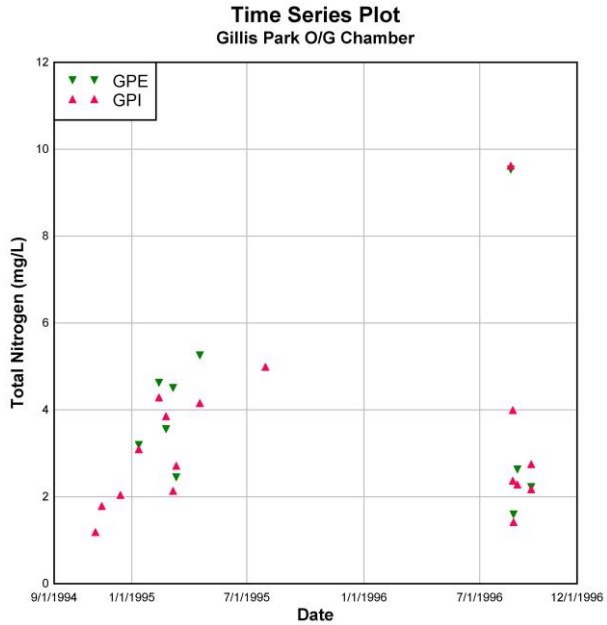


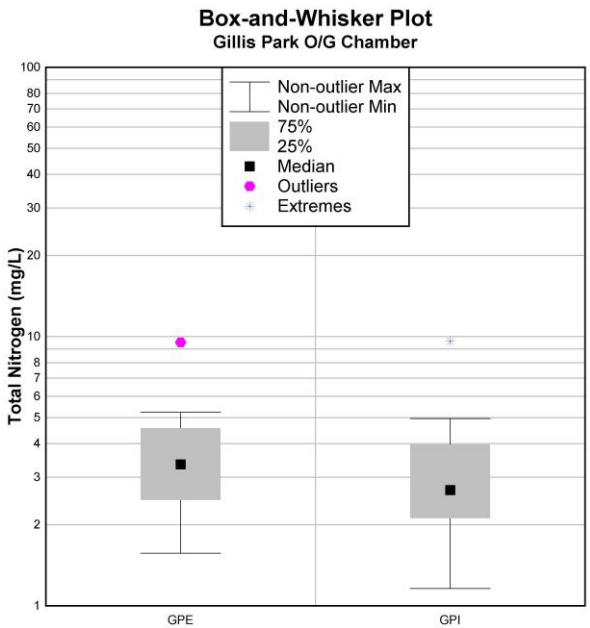


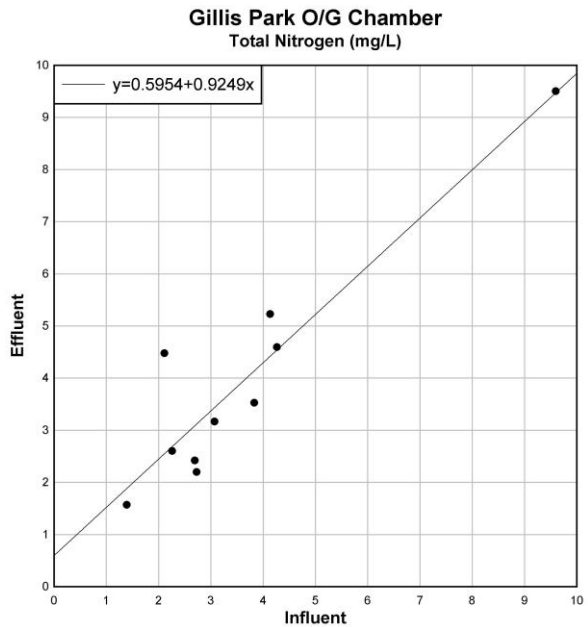
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	16	8
	Pairs Count	8	8
Non-Parametric	Maximum	115.34	105.83
	Upper Quartile	20.80	31.14
	Median	14.25	17.87
	Lower Quartile	8.68	9.02
	Minimum	4.57	3.88
	Efficiency	-25.37%	
	Mann-Whitney	0.6503	
	Wilcoxon (paired)	0.5469	
Arithmetic	UCL	35.30	55.87
	Mean	21.21	28.22
	LCL	7.12	0.56
	Std. Dev.	26.44	33.07
	Wilk (p-value)	0.0001 **	0.0030 **
	Efficiency	-33.05%	
	t-Test (equal var.)	0.5787	
	t-Test (unequal var.)	0.6116	
	t-test (paired)	0.9694	
	Levene Test	0.7488	
Log Transformed	UCL	31.50	79.33
	Mean	19.51	27.18
	LCL	12.09	9.32
	Std. Dev.	16.51	28.77
	Wilk (p-value)	0.3366	0.9941
	Efficiency	-39.31%	
	t-Test (equal var.)	0.6317	
	t-Test (unequal var.)	0.6653	
	t-Test (paired)	0.9354	
	Levene Test	0.4916	
Bootstrap	UCL	33.76	50.93
	Mean	21.41	27.93
	LCL	9.06	4.93
	Std. Dev.	23.18	27.51
	Efficiency	-30.46%	

Gillis Park O/G Chamber - Total Nitrogen (mg/L)



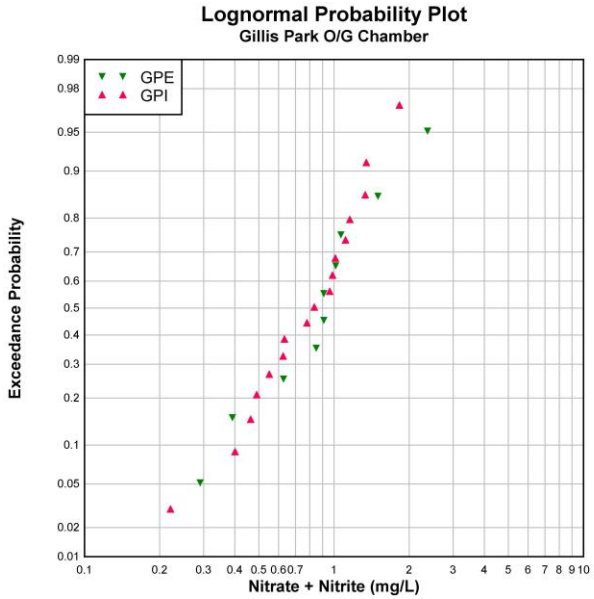


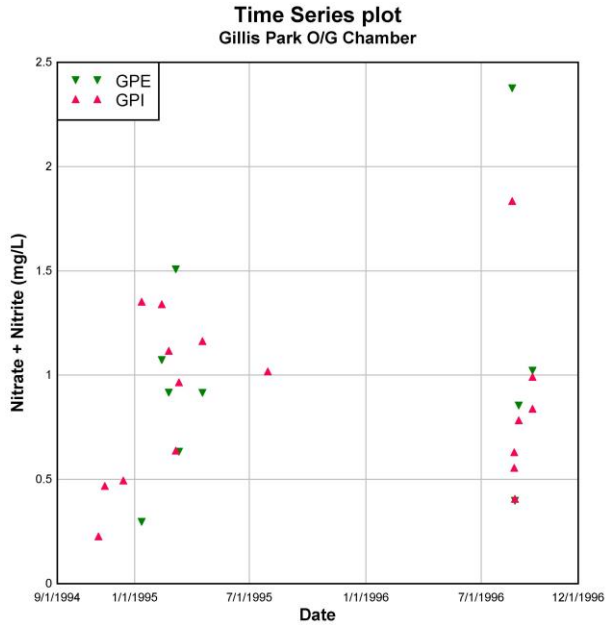


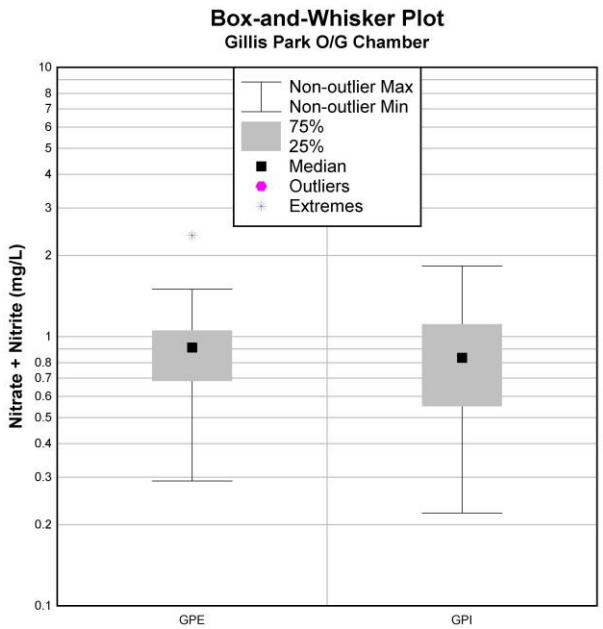


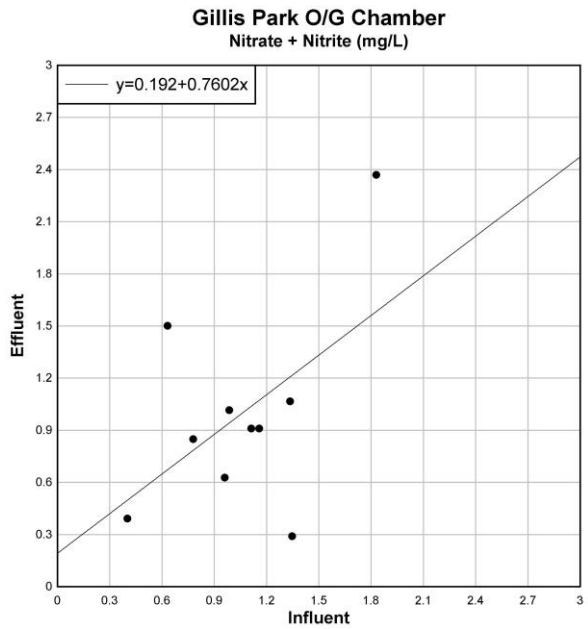
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	9.595	9.503
	Upper Quartile	3.969	4.596
	Median	2.689	3.349
	Lower Quartile	2.110	2.421
	Minimum	1.160	1.569
	Efficiency	-24.53%	
	Mann-Whitney	0.2689	
	Wilcoxon (paired)	0.3750	
Arithmetic	UCL	4.215	5.562
	Mean	3.201	3.930
	LCL	2.186	2.298
	Std. Dev.	1.974	2.281
	Wilk (p-value)	0.0010 **	0.0402 **
	Efficiency	-22.79%	
	t-Test (equal var.)	0.3894	
	t-Test (unequal var.)	0.4113	
	t-test (paired)	0.2575	
	Levene Test	0.7917	
Log Transformed	UCL	4.195	5.784
	Mean	3.164	3.898
	LCL	2.386	2.628
	Std. Dev.	1.687	2.049
	Wilk (p-value)	0.7826	0.9465
	Efficiency	-23.21%	
	t-Test (equal var.)	0.3062	
	t-Test (unequal var.)	0.3097	
	t-Test (paired)	0.2880	
	Levene Test	0.9472	
Bootstrap	UCL	4.140	5.419
	Mean	3.205	3.939
	LCL	2.270	2.459
	Std. Dev.	1.819	2.069
	Efficiency	-22.90%	

Gillis Park O/G Chamber - Nitrate+Nitrite (mg/L)



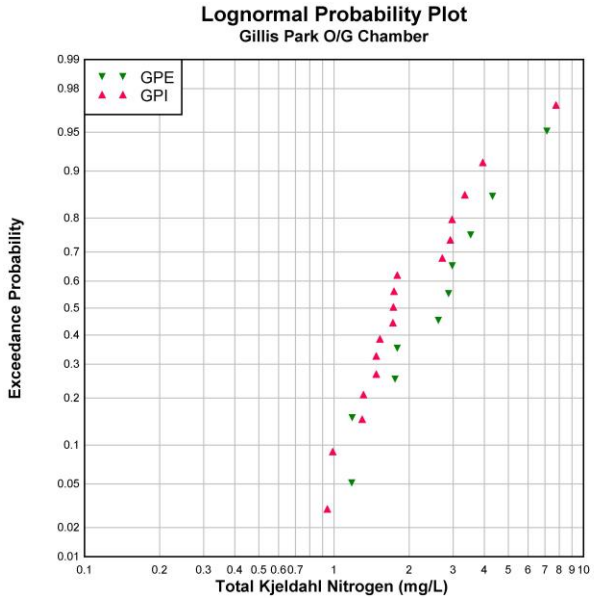


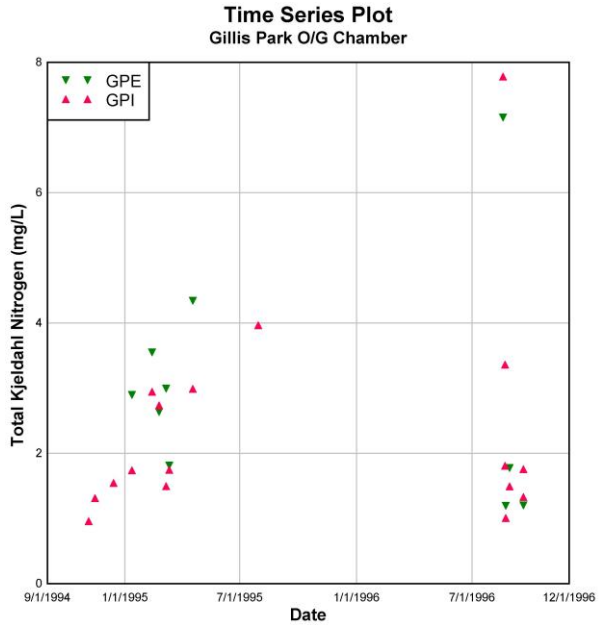


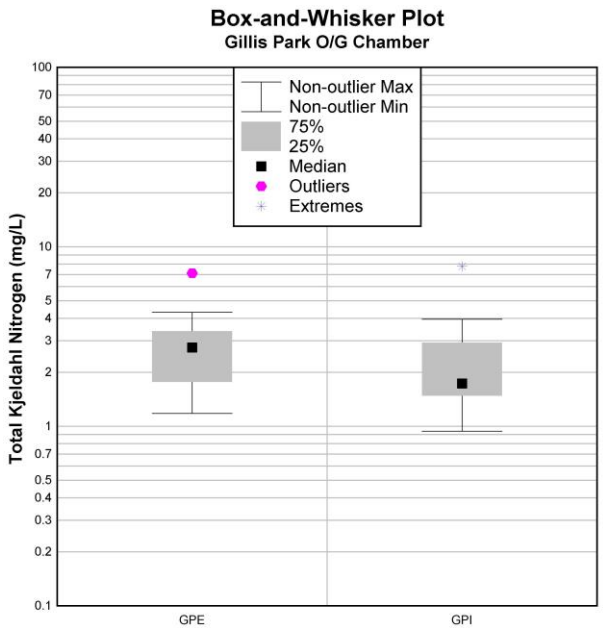


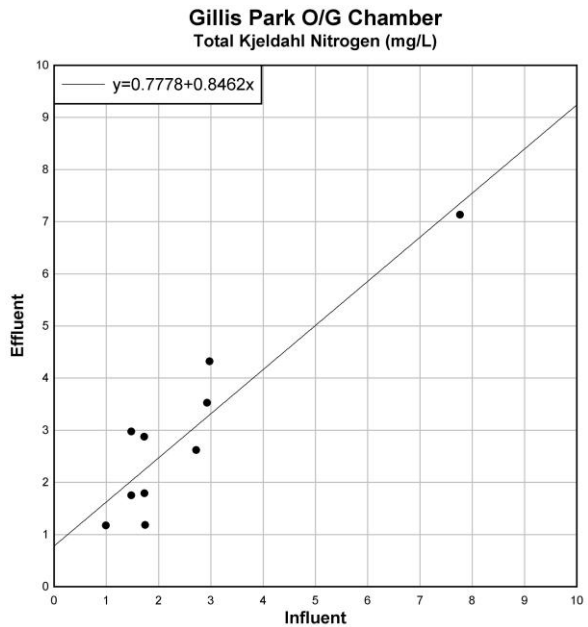
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	1.830	2.369
	Upper Quartile	1.111	1.066
	Median	0.834	0.910
	Lower Quartile	0.550	0.627
	Minimum	0.221	0.291
	Efficiency	-9.16%	
	Mann-Whitney	0.7468	
	Wilcoxon (paired)	0.6250	
Arithmetic	UCL	1.079	1.418
	Mean	0.867	0.993
	LCL	0.654	0.568
	Std. Dev.	0.413	0.595
	Wilk (p-value)	0.7552	0.1268
	Efficiency	-14.58%	
	t-Test (equal var.)	0.5202	
	t-Test (unequal var.)	0.5624	
	t-test (paired)	0.7193	
	Levene Test	0.3228	
Log Transformed	UCL	1.175	1.608
	Mean	0.877	0.999
	LCL	0.655	0.620
	Std. Dev.	0.484	0.624
	Wilk (p-value)	0.7805	0.7694
	Efficiency	-13.89%	
	t-Test (equal var.)	0.6631	
	t-Test (unequal var.)	0.6761	
	t-Test (paired)	0.4806	
	Levene Test	0.6851	
Bootstrap	UCL	1.068	1.389
	Mean	0.866	1.002
	LCL	0.664	0.616
	Std. Dev.	0.393	0.541
	Efficiency	-15.69%	

Gillis Park O/G Chamber - Total Kjeldahl Nitrogen (mg/L)



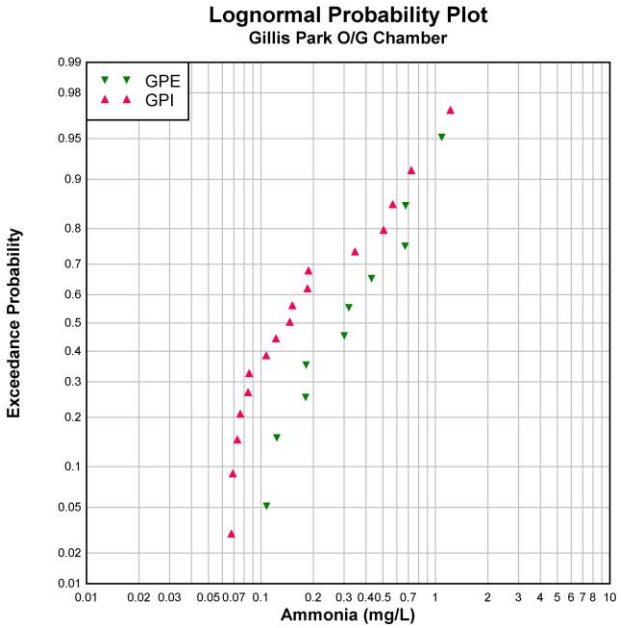


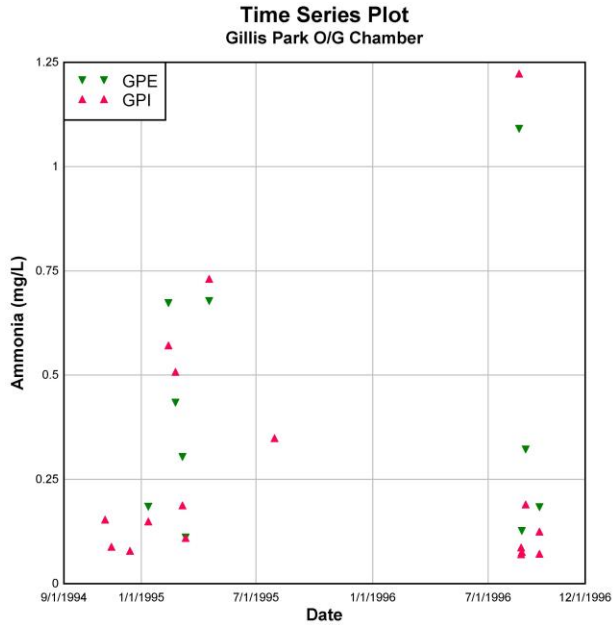


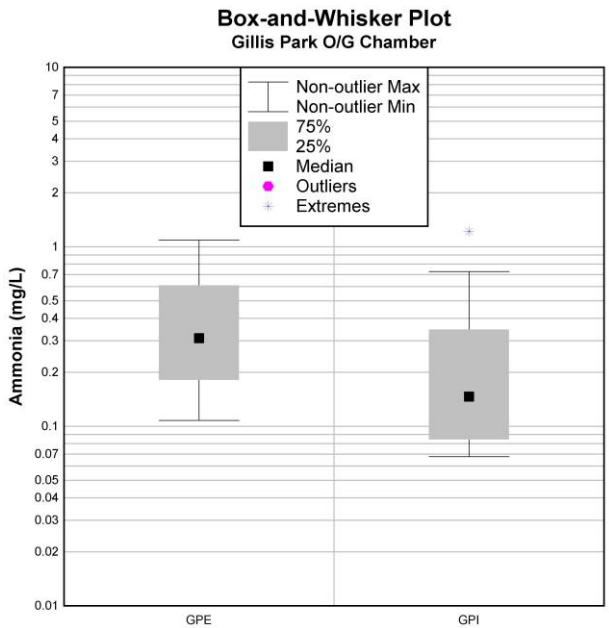


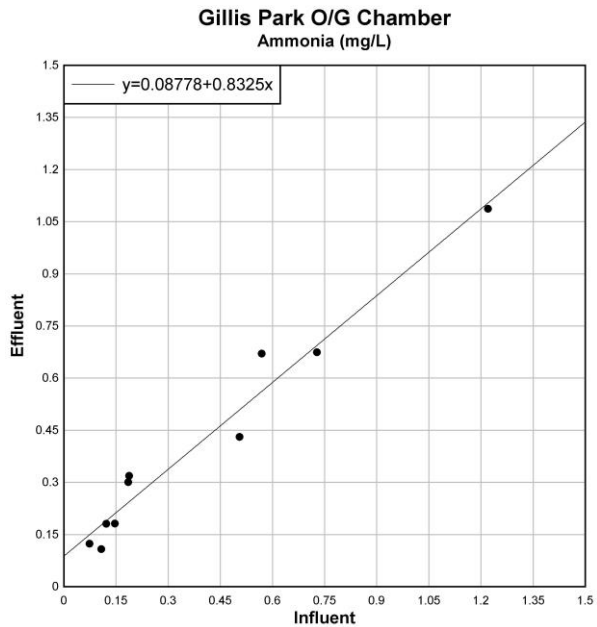
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	7.765	7.134
	Upper Quartile	2.926	3.530
	Median	1.729	2.749
	Lower Quartile	1.477	1.755
	Minimum	0.940	1.178
	Efficiency	-58.95%	
	Mann-Whitney	0.2487	
	Wilcoxon (paired)	0.1934	
Arithmetic	UCL	3.181	4.218
	Mean	2.334	2.937
	LCL	1.487	1.656
	Std. Dev.	1.647	1.791
	Wilk (p-value)	0.0002 **	0.0787 *
	Efficiency	-25.84%	
	t-Test (equal var.)	0.3819	
	t-Test (unequal var.)	0.3958	
	t-test (paired)	0.1404	
	Levene Test	0.8977	
Log Transformed	UCL	3.083	4.554
	Mean	2.282	2.923
	LCL	1.690	1.876
	Std. Dev.	1.293	1.710
	Wilk (p-value)	0.1708	0.7589
	Efficiency	-28.07%	
	t-Test (equal var.)	0.2854	
	t-Test (unequal var.)	0.2954	
	t-Test (paired)	0.1279	
	Levene Test	0.9279	
Bootstrap	UCL	3.116	4.112
	Mean	2.338	2.937
	LCL	1.560	1.762
	Std. Dev.	1.513	1.643
	Efficiency	-25.62%	

Gillis Park O/G Chamber - Ammonia (mg/L)



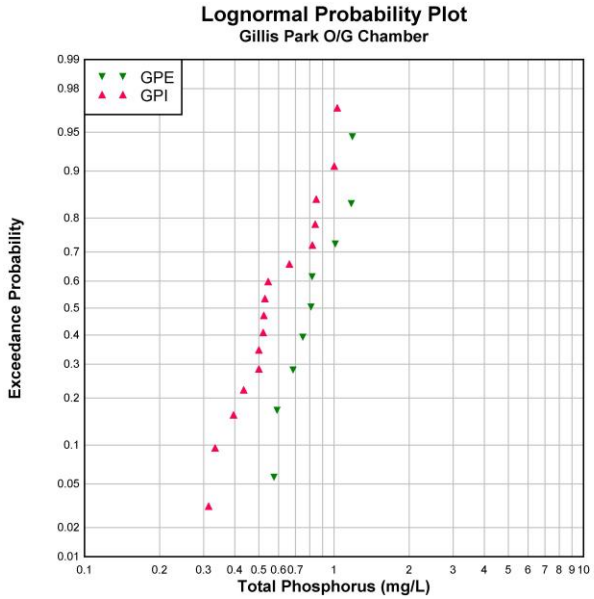


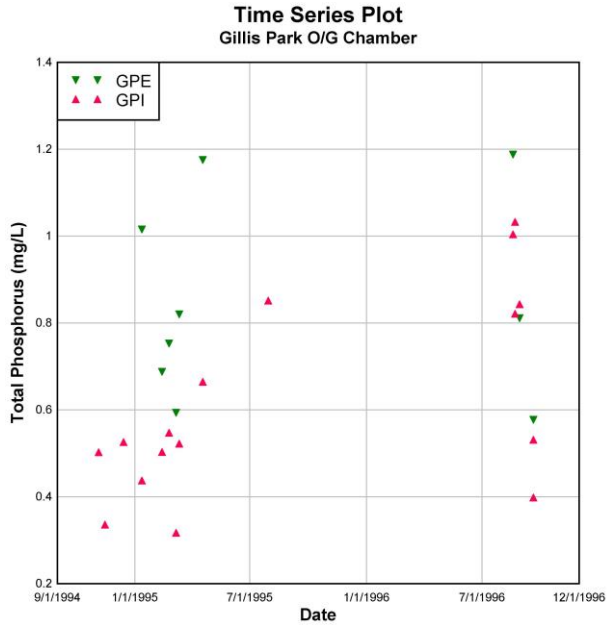


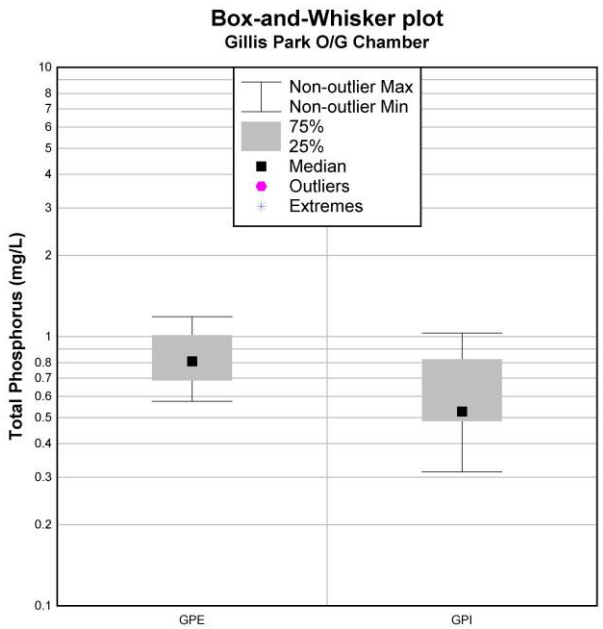


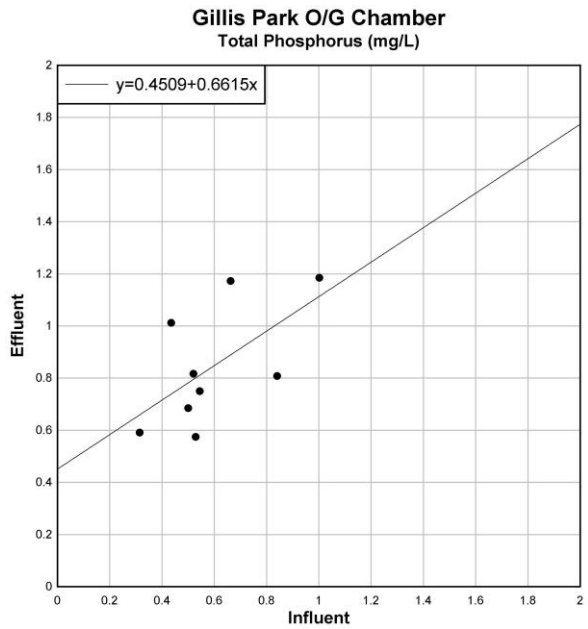
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	1.220	1.088
	Upper Quartile	0.346	0.670
	Median	0.146	0.310
	Lower Quartile	0.084	0.181
	Minimum	0.068	0.108
	Efficiency	-111.75%	
	Mann-Whitney	0.1148	
	Wilcoxon (paired)	0.4922	
Arithmetic	UCL	0.439	0.633
	Mean	0.278	0.408
	LCL	0.116	0.182
	Std. Dev.	0.314	0.315
	Wilk (p-value)	0.0001 **	0.0853 *
	Efficiency	-46.76%	
	t-Test (equal var.)	0.3102	
	t-Test (unequal var.)	0.3138	
	t-test (paired)	0.4189	
	Levene Test	0.9639	
Log Transformed	UCL	0.461	0.774
	Mean	0.261	0.407
	LCL	0.148	0.214
	Std. Dev.	0.269	0.331
	Wilk (p-value)	0.0387 **	0.7078
	Efficiency	-56.01%	
	t-Test (equal var.)	0.1137	
	t-Test (unequal var.)	0.1008	
	t-Test (paired)	0.0490 **	
	Levene Test	0.4428	
Bootstrap	UCL	0.428	0.617
	Mean	0.277	0.409
	LCL	0.125	0.200
	Std. Dev.	0.294	0.292
	Efficiency	-47.74%	

Gillis Park O/G Chamber - Total Phosphorus (mg/L)



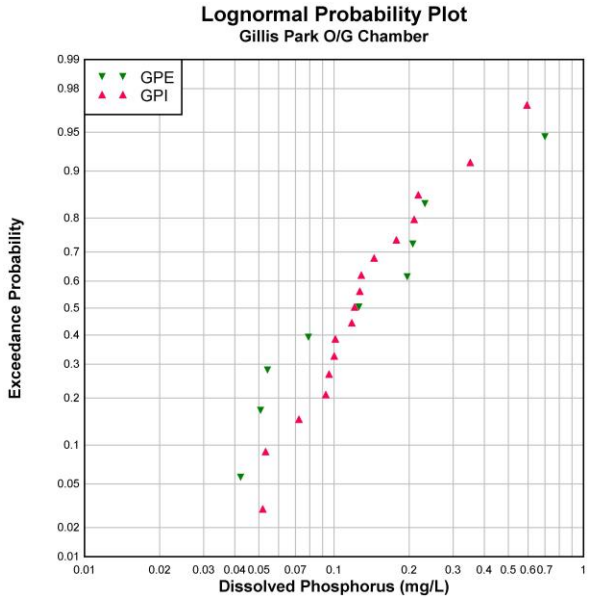


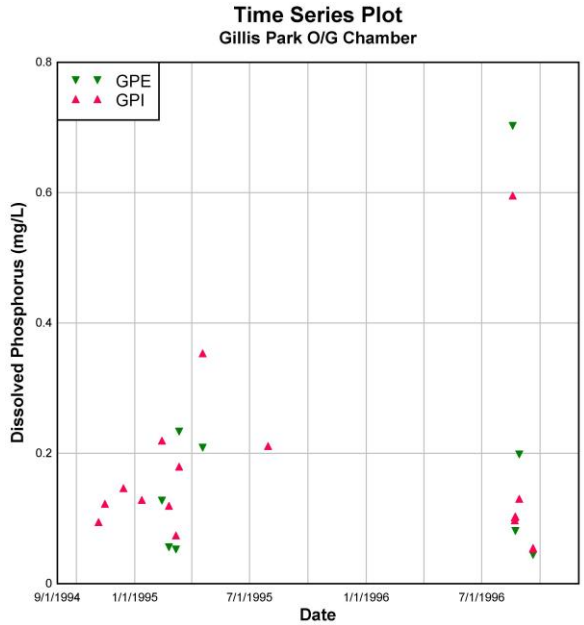


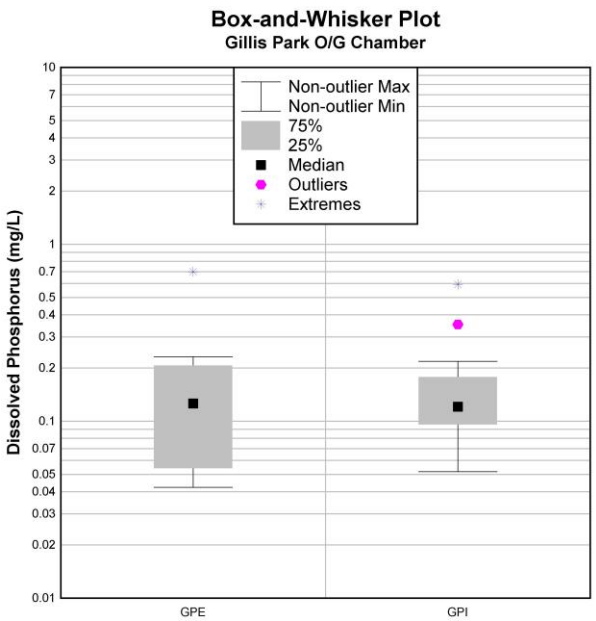


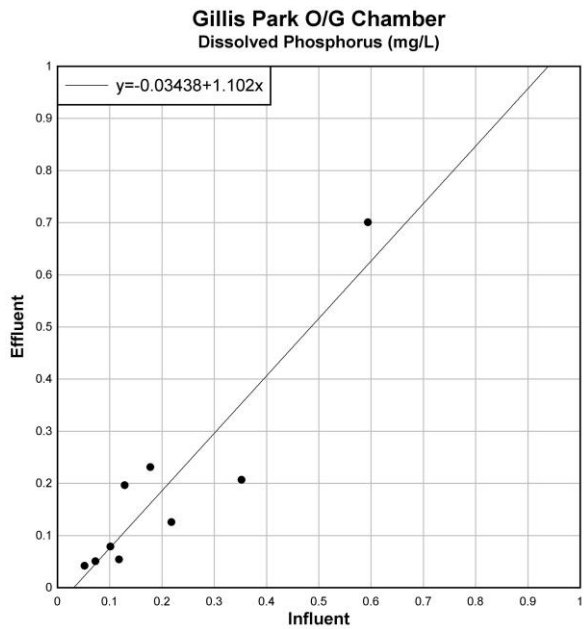
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	16	9
	Pairs Count	9	9
Non-Parametric	Maximum	1.030	1.185
	Upper Quartile	0.830	1.012
	Median	0.526	0.808
	Lower Quartile	0.467	0.685
	Minimum	0.315	0.575
	Efficiency	-53.64%	
	Mann-Whitney	0.0393 **	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	0.734	1.021
	Mean	0.612	0.844
	LCL	0.491	0.667
	Std. Dev.	0.228	0.231
	Wilk (p-value)	0.0952 *	0.2599
	Efficiency	-37.81%	
	t-Test (equal var.)	0.0233 **	
	t-Test (unequal var.)	0.0273 **	
	t-test (paired)	0.0052 **	
	Levene Test	0.9482	
Log Transformed	UCL	0.750	1.042
	Mean	0.612	0.844
	LCL	0.500	0.683
	Std. Dev.	0.230	0.229
	Wilk (p-value)	0.3722	0.4357
	Efficiency	-37.80%	
	t-Test (equal var.)	0.0199 **	
	t-Test (unequal var.)	0.0124 **	
	t-Test (paired)	0.0042 **	
	Levene Test	0.1921	
Bootstrap	UCL	0.731	1.007
	Mean	0.614	0.843
	LCL	0.498	0.678
	Std. Dev.	0.218	0.214
	Efficiency	-37.17%	

Gillis Park O/G Chamber - Dissolved Phosphorus (mg/L)



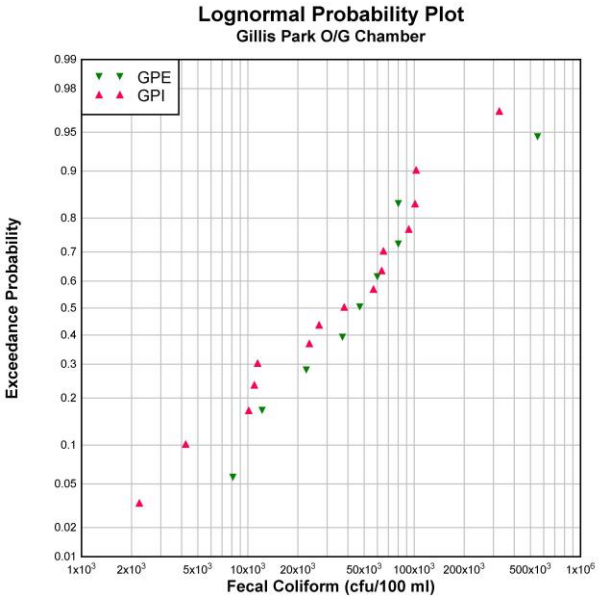


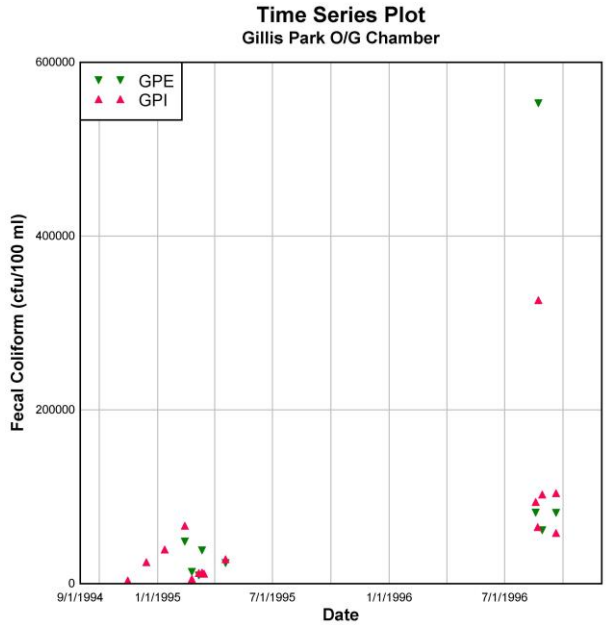


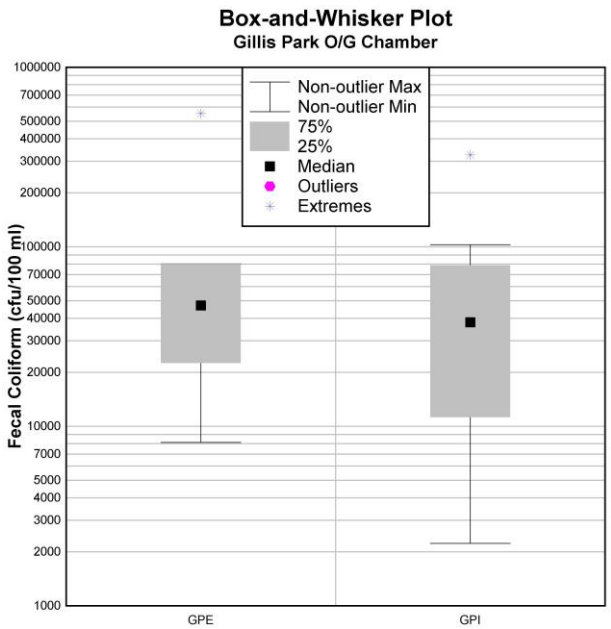


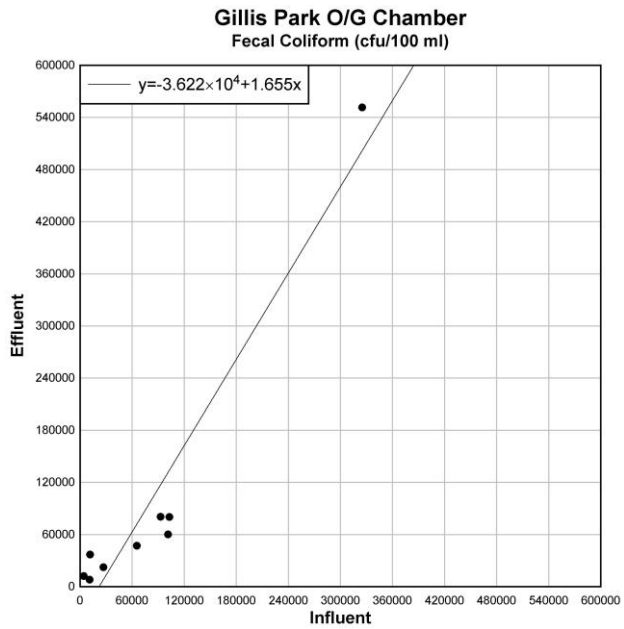
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	9
	Pairs Count	9	9
Non-Parametric	Maximum	0.594	0.701
	Upper Quartile	0.178	0.207
	Median	0.121	0.126
	Lower Quartile	0.096	0.054
	Minimum	0.052	0.042
	Efficiency	-4.13%	
	Mann-Whitney	0.8311	
	Wilcoxon (paired)	0.6523	
Arithmetic	UCL	0.231	0.346
	Mean	0.162	0.188
	LCL	0.094	0.029
	Std. Dev.	0.133	0.206
	Wilk (p-value)	0.0001 **	0.0015 **
	Efficiency	-15.66%	
	t-Test (equal var.)	0.7055	
	t-Test (unequal var.)	0.7438	
	t-test (paired)	0.6178	
	Levene Test	0.4124	
Log Transformed	UCL	0.224	0.422
	Mean	0.157	0.180
	LCL	0.111	0.076
	Std. Dev.	0.104	0.173
	Wilk (p-value)	0.3647	0.4796
	Efficiency	-14.06%	
	t-Test (equal var.)	0.8799	
	t-Test (unequal var.)	0.8942	
	t-Test (paired)	0.1773	
	Levene Test	0.2104	
Bootstrap	UCL	0.225	0.326
	Mean	0.162	0.189
	LCL	0.099	0.053
	Std. Dev.	0.123	0.178
	Efficiency	-17.07%	

Gillis Park O/G Chamber - Fecal Coliform (cfu/100 ml)



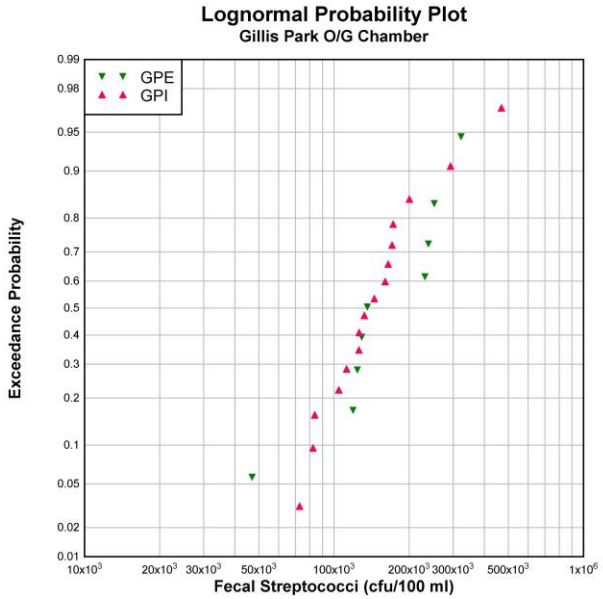


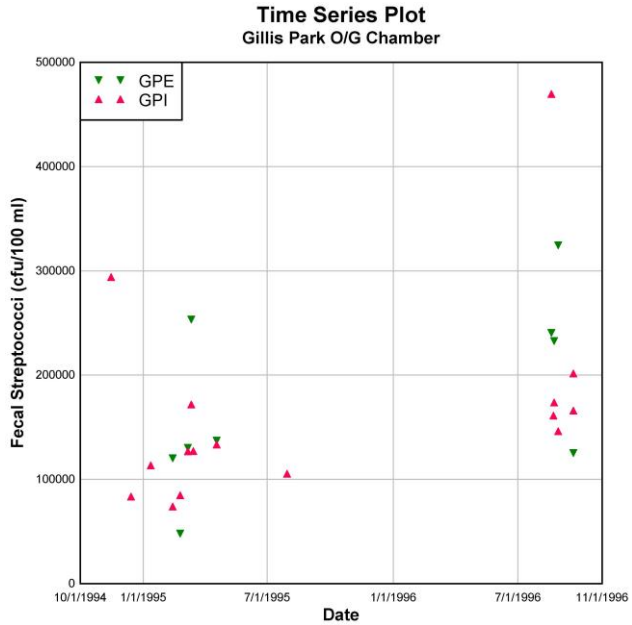


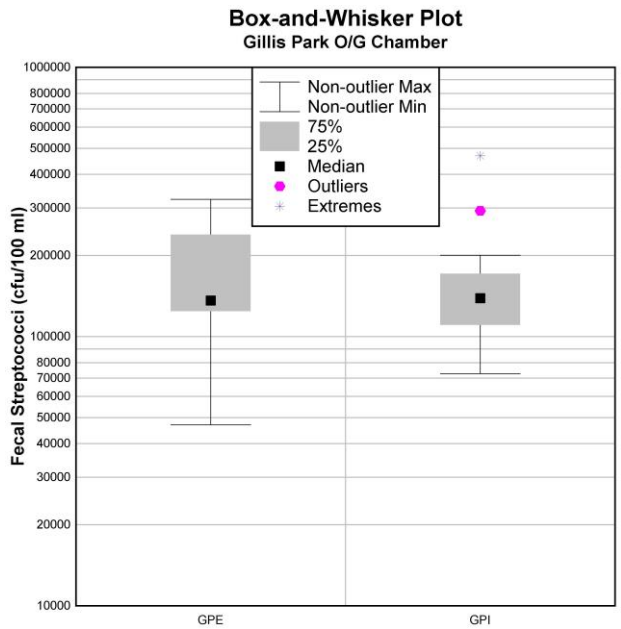


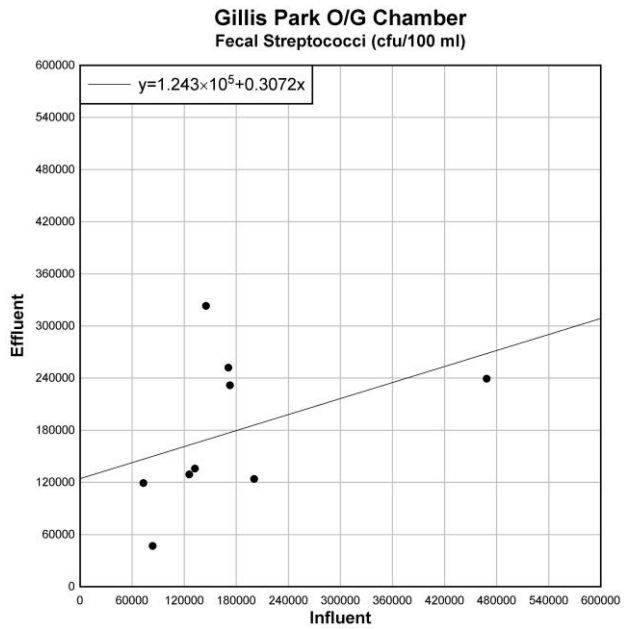
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	15	9
	Pairs Count	9	9
Non-Parametric	Maximum	324,893	551,557
	Upper Quartile	92,673	80,289
	Median	38,023	47,134
	Lower Quartile	10,946	22,449
	Minimum	2,224	8,129
	Efficiency	-23.96%	
	Mann-Whitney	0.7683	
	Wilcoxon (paired)	0.7344	
Arithmetic	UCL	107,076	231,718
	Mean	62,335	99,922
	LCL	17,594	-31,875
	Std. Dev.	80,784	171,462
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-60.30%	
	t-Test (equal var.)	0.4721	
	t-Test (unequal var.)	0.5503	
	t-test (paired)	0.5297	
	Levene Test	0.2764	
Log Transformed	UCL	196,455	313,426
	Mean	68,955	86,003
	LCL	24,203	23,599
	Std. Dev.	114,246	115,062
	Wilk (p-value)	0.8120	0.6262
	Efficiency	-24.72%	
	t-Test (equal var.)	0.4868	
	t-Test (unequal var.)	0.4785	
	t-Test (paired)	0.5975	
	Levene Test	0.7047	
Bootstrap	UCL	102,603	203,864
	Mean	62,834	100,233
	LCL	23,064	-3,398
	Std. Dev.	71,814	134,818
	Efficiency	-59.52%	

Gillis Park O/G Chamber - Fecal Streptococci (cfu/100 ml)



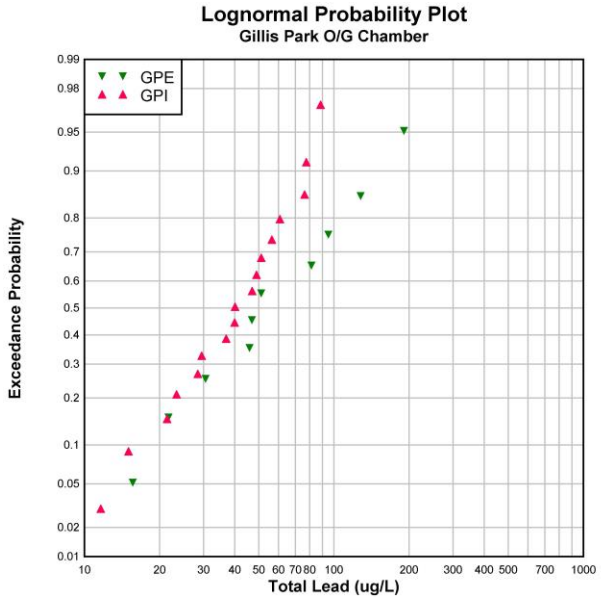


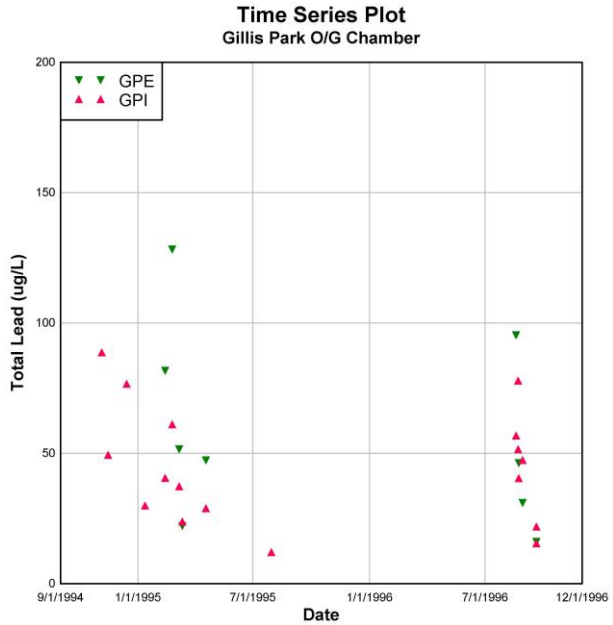


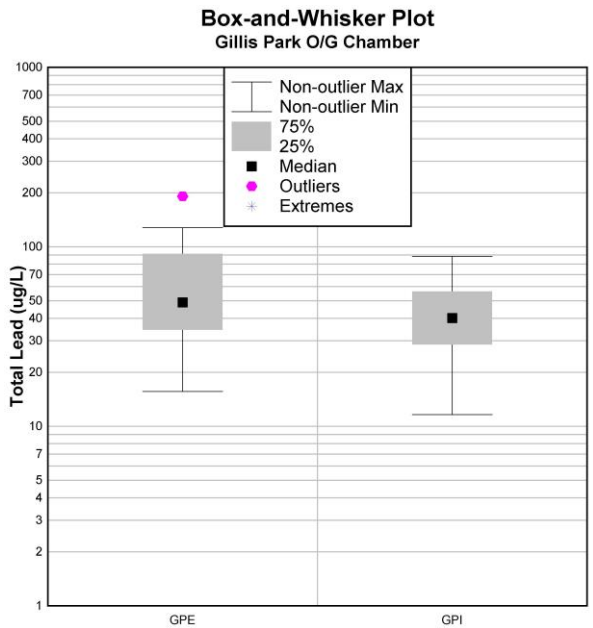


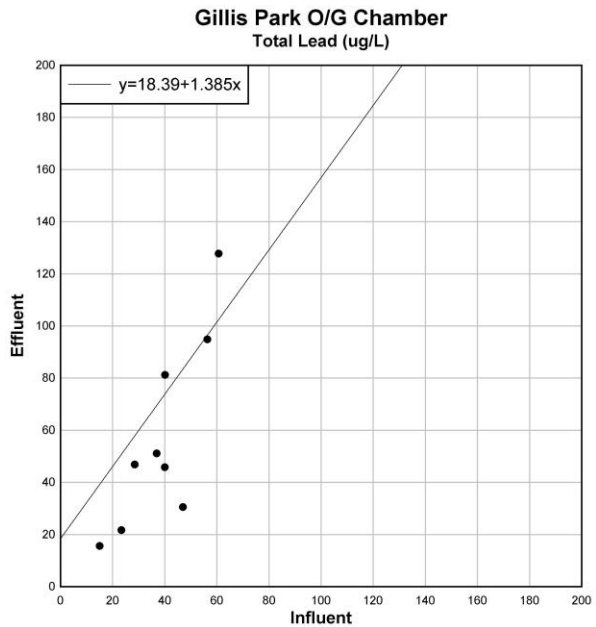
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	16	9
	Pairs Count	9	9
Non-Parametric	Maximum	468,455	323,276
	Upper Quartile	171,757	239,263
	Median	138,719	136,027
	Lower Quartile	108,402	124,081
	Minimum	72,823	46,941
	Efficiency	1.94%	
	Mann-Whitney	0.5956	
	Wilcoxon (paired)	0.6523	
Arithmetic	UCL	215,425	245,052
	Mean	163,468	177,973
	LCL	111,511	110,895
	Std. Dev.	97,526	87,267
	Wilk (p-value)	0.0006 **	0.5066
	Efficiency	-8.87%	
	t-Test (equal var.)	0.7148	
	t-Test (unequal var.)	0.7067	
	t-test (paired)	0.9333	
	Levene Test	0.7879	
Log Transformed	UCL	210,498	295,633
	Mean	161,102	181,215
	LCL	123,297	111,080
	Std. Dev.	78,782	107,991
	Wilk (p-value)	0.3344	0.2477
	Efficiency	-12.48%	
	t-Test (equal var.)	0.7352	
	t-Test (unequal var.)	0.7518	
	t-Test (paired)	0.8508	
	Levene Test	0.5805	
Bootstrap	UCL	211,279	241,308
	Mean	164,313	179,315
	LCL	117,347	117,323
	Std. Dev.	88,139	80,649
	Efficiency	-9.13%	

Gillis Park O/G Chamber - Total Lead (ug/L)



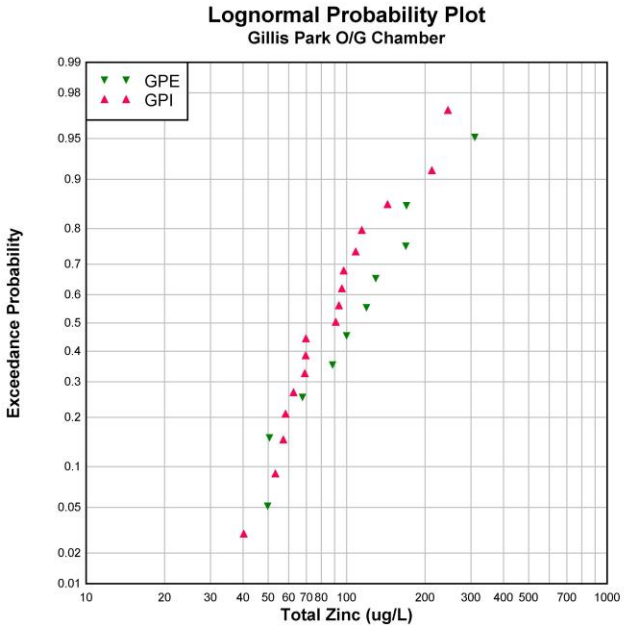


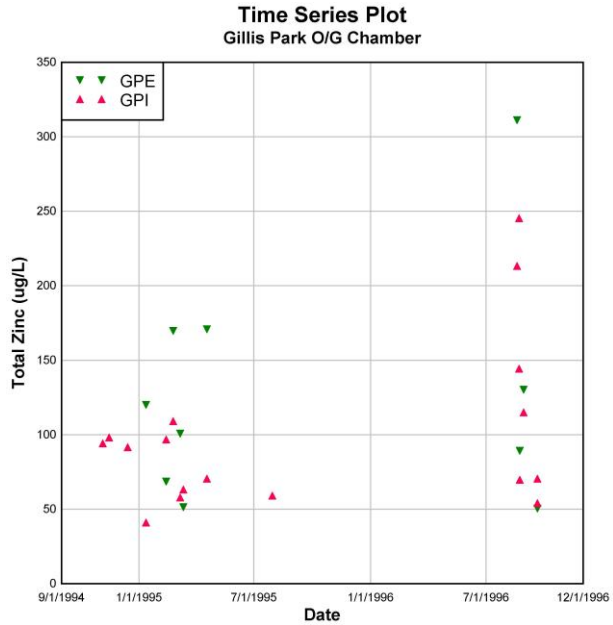


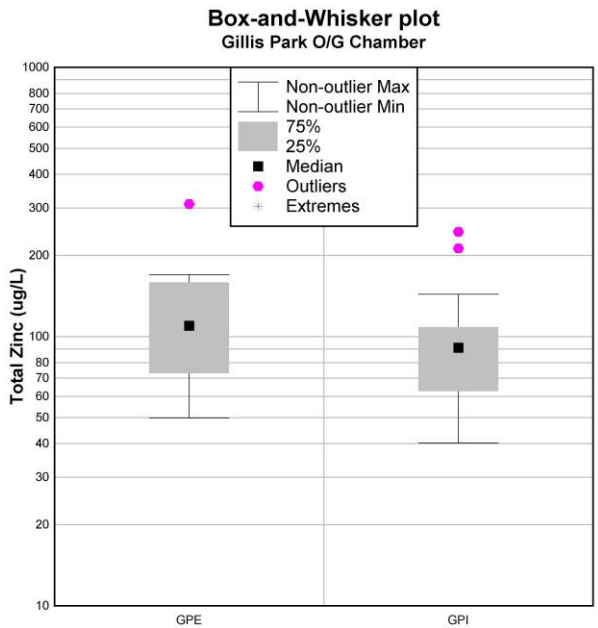


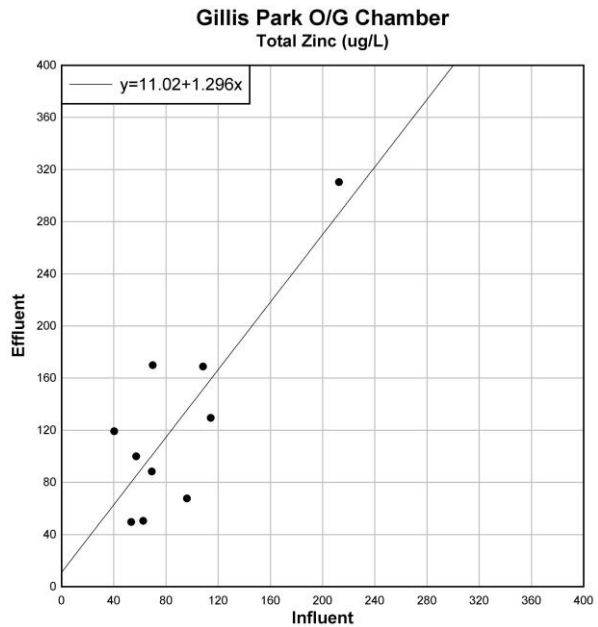
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	88.3	190.9
	Upper Quartile	56.4	94.9
	Median	40.1	49.0
	Lower Quartile	28.4	30.6
	Minimum	11.6	15.6
	Efficiency	-22.15%	
	Mann-Whitney	0.2903	
	Wilcoxon (paired)	0.0371 **	
Arithmetic	UCL	55.8	109.8
	Mean	44.3	70.7
	LCL	32.8	31.5
	Std. Dev.	22.4	54.8
	Wilk (p-value)	0.6516	0.1148
	Efficiency	-59.64%	
	t-Test (equal var.)	0.0888 *	
	t-Test (unequal var.)	0.1742	
	t-test (paired)	0.0732 *	
	Levene Test	0.0418 **	
Log Transformed	UCL	61.8	136.1
	Mean	44.9	71.0
	LCL	32.6	37.0
	Std. Dev.	27.0	58.4
	Wilk (p-value)	0.6573	0.9682
	Efficiency	-57.99%	
	t-Test (equal var.)	0.2073	
	t-Test (unequal var.)	0.2522	
	t-Test (paired)	0.0552 *	
	Levene Test	0.2075	
Bootstrap	UCL	55.2	104.5
	Mean	44.2	69.2
	LCL	33.1	33.9
	Std. Dev.	21.5	49.3
	Efficiency	-56.70%	

Gillis Park O/G Chamber - Total Zinc (ug/L)



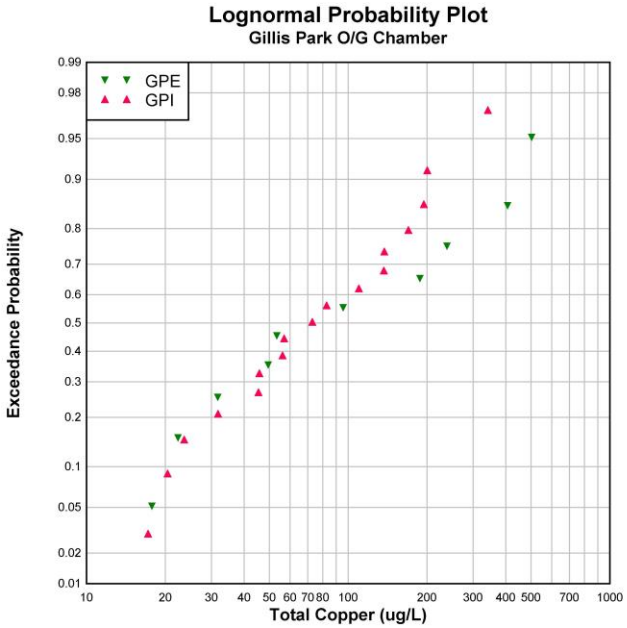


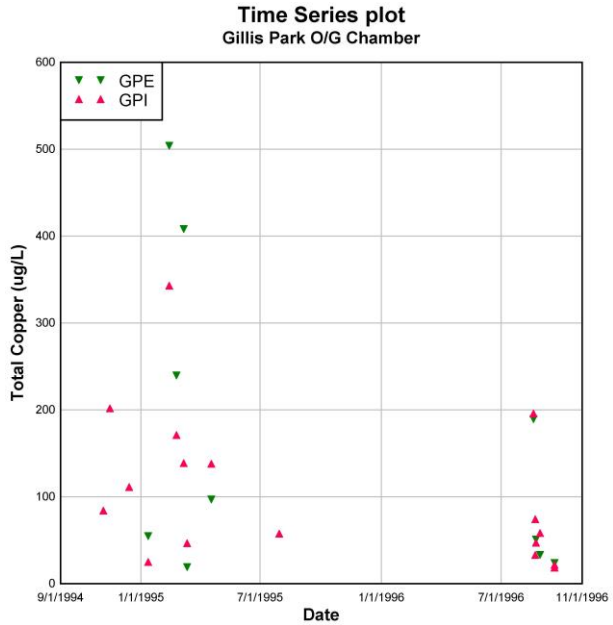


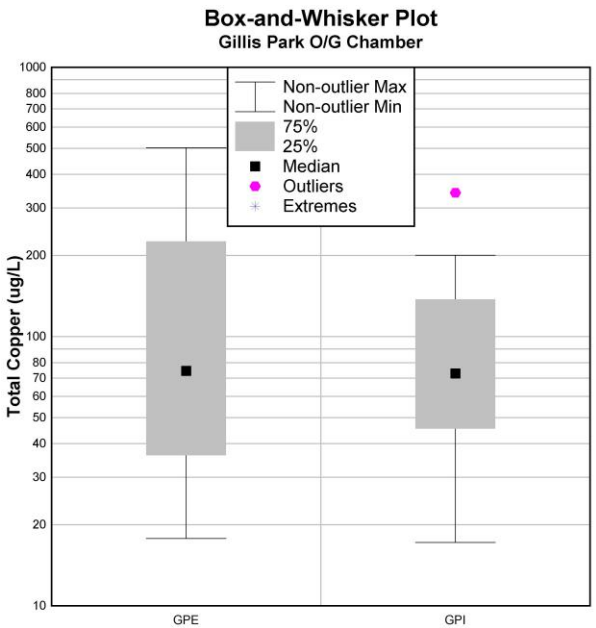


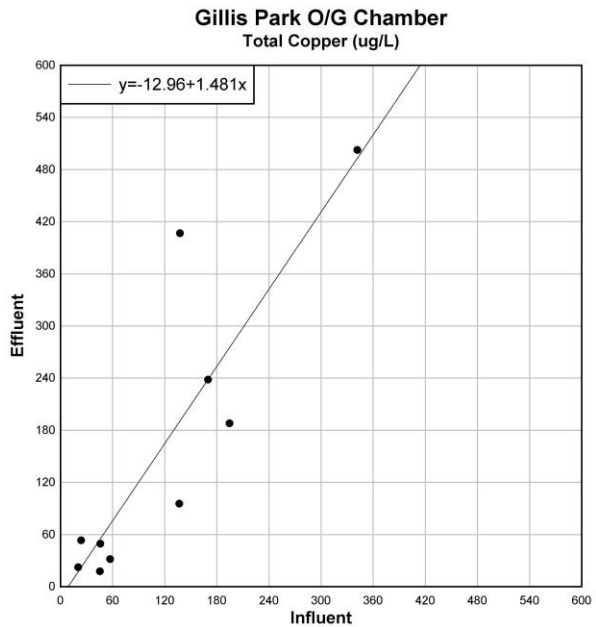
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	244.6	310.4
	Upper Quartile	108.4	169.0
	Median	90.9	109.6
	Lower Quartile	62.5	67.7
	Minimum	40.3	49.7
	Efficiency	-20.56%	
	Mann-Whitney	0.4150	
	Wilcoxon (paired)	0.0488 **	
Arithmetic	UCL	127.4	181.3
	Mean	98.9	125.4
	LCL	70.3	69.6
	Std. Dev.	55.6	78.1
	Wilk (p-value)	0.0025 **	0.0639 *
	Efficiency	-26.84%	
	t-Test (equal var.)	0.3122	
	t-Test (unequal var.)	0.3608	
	t-test (paired)	0.0314 **	
	Levene Test	0.4049	
Log Transformed	UCL	127.2	195.6
	Mean	97.9	124.7
	LCL	75.3	79.5
	Std. Dev.	48.6	74.0
	Wilk (p-value)	0.4244	0.7983
	Efficiency	-27.45%	
	t-Test (equal var.)	0.3361	
	t-Test (unequal var.)	0.3641	
	t-Test (paired)	0.0622 *	
	Levene Test	0.5287	
Bootstrap	UCL	126.4	176.3
	Mean	99.2	125.3
	LCL	72.1	74.3
	Std. Dev.	52.8	71.3
	Efficiency	-26.25%	

Gillis Park O/G Chamber - Total Copper (ug/L)



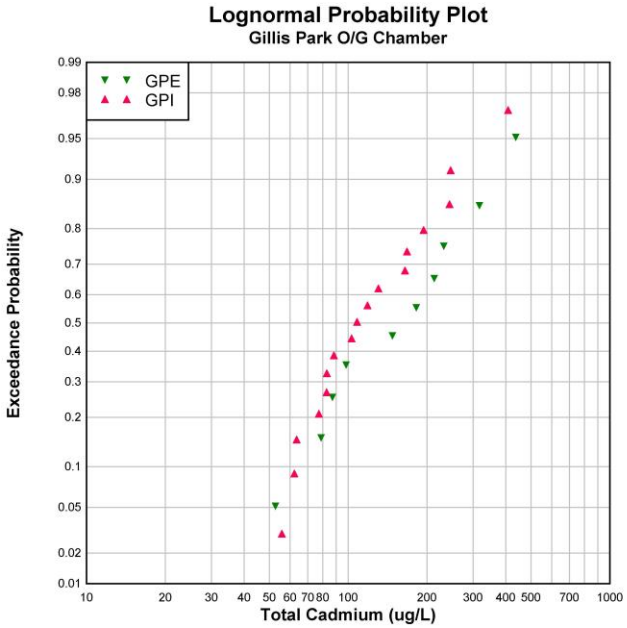


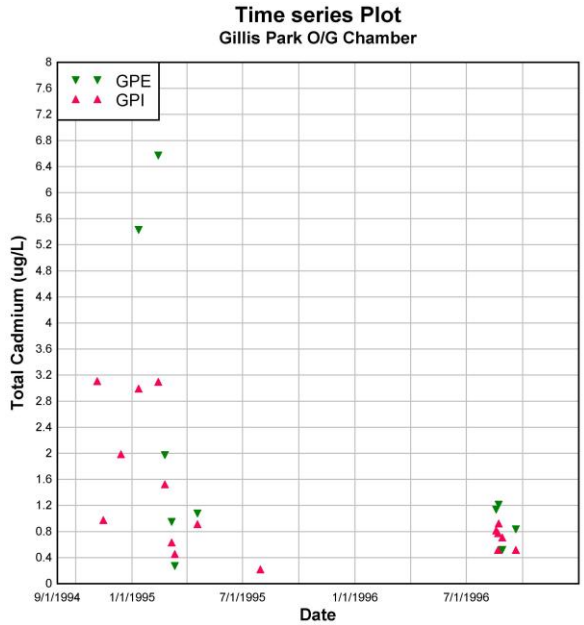


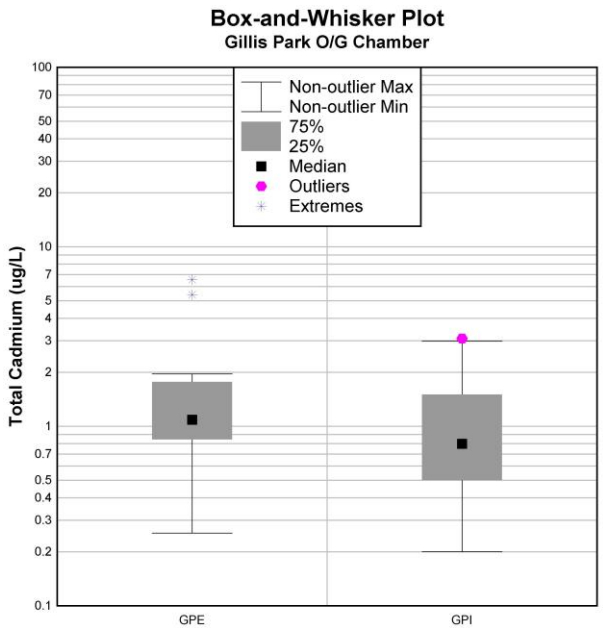


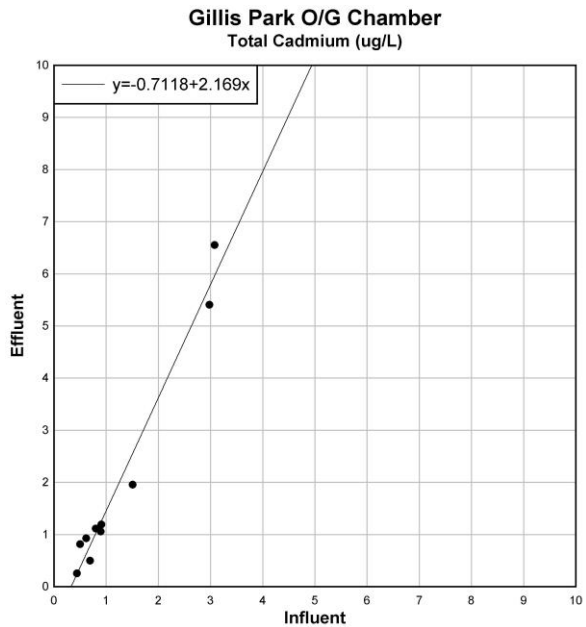
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	341.6	502.6
	Upper Quartile	137.5	238.3
	Median	72.9	74.5
	Lower Quartile	45.4	31.8
	Minimum	17.2	17.8
	Efficiency	-2.16%	
	Mann-Whitney	0.7468	
	Wilcoxon (paired)	0.4316	
Arithmetic	UCL	147.0	284.2
	Mean	102.6	160.6
	LCL	58.1	37.0
	Std. Dev.	86.4	172.7
	Wilk (p-value)	0.0136 **	0.0215 **
	Efficiency	-56.60%	
	t-Test (equal var.)	0.2534	
	t-Test (unequal var.)	0.3412	
	t-test (paired)	0.1996	
	Levene Test	0.0482 **	
Log Transformed	UCL	178.2	519.6
	Mean	104.4	163.8
	LCL	61.1	51.6
	Std. Dev.	101.6	217.0
	Wilk (p-value)	0.8044	0.5160
	Efficiency	-56.93%	
	t-Test (equal var.)	0.6410	
	t-Test (unequal var.)	0.6702	
	t-Test (paired)	0.6609	
	Levene Test	0.1108	
Bootstrap	UCL	141.6	272.0
	Mean	100.4	158.8
	LCL	59.2	45.5
	Std. Dev.	80.2	158.4
	Efficiency	-58.12%	

Gillis Park O/G Chamber - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: GPI**	**EFF: GPE**
	Site Count	17	10
	Pairs Count	10	10
Non-Parametric	Maximum	3.1	6.6
	Upper Quartile	1.5	2.0
	Median	0.8	1.1
	Lower Quartile	0.5	0.8
	Minimum	0.2	0.3
	Efficiency	-36.09%	
	Mann-Whitney	0.2787	
	Wilcoxon (paired)	0.0195 **	
Arithmetic	UCL	1.7	3.5
	Mean	1.2	2.0
	LCL	0.7	0.4
	Std. Dev.	1.0	2.2
	Wilk (p-value)	0.0010 **	0.0013 **
	Efficiency	-65.06%	
	t-Test (equal var.)	0.2096	
	t-Test (unequal var.)	0.3060	
	t-test (paired)	0.0862 *	
	Levene Test	0.0551 *	
Log Transformed	UCL	1.9	4.6
	Mean	1.2	1.9
	LCL	0.8	0.8
	Std. Dev.	1.0	2.0
	Wilk (p-value)	0.2522	0.5194
	Efficiency	-60.63%	
	t-Test (equal var.)	0.3496	
	t-Test (unequal var.)	0.3863	
	t-Test (paired)	0.0859 *	
	Levene Test	0.3638	
Bootstrap	UCL	1.6	3.3
	Mean	1.2	1.9
	LCL	0.7	0.6
	Std. Dev.	0.9	1.9
	Efficiency	-65.17%	

Convention Center O/G Chamber (WCI-WCE)

This device is a part of a more complete water quality control system. The inflow to the oil & grit chamber was designated WCI. See WCI in the COA reports on small watershed quantity and quality (2009) for details in the drainage area.

The chamber contained baffles and siphons and acted as a sedimentation basin for the wet pond portion of the system. Volume in the chamber was regulated by four 18 inch self-starting siphons. Measurement of flow out of the chamber was difficult because of the siphons. Water quality was measured as water entered back into the chamber from the wet pond. Because of sampling difficulties, WCE was only monitored during 1995 and only a limited number of valid samples were collected.

WQM collected runoff and water quality data at the Convention Center O/G chamber from 1995 to 1998. During this time 34 and 5 valid EMCs were collected at the influent (WCI) and effluent (WCE) respectively, of which 4 were paired.

Preliminary Performance Summary

The Convention Center O/G chamber had a mixed performance but it is difficult to draw conclusions based on the limited number of samples collected at WCE.

Influent and effluent concentrations for TSS, VSS, TOC, TN, TKN, Pb and Cd were not significantly different.

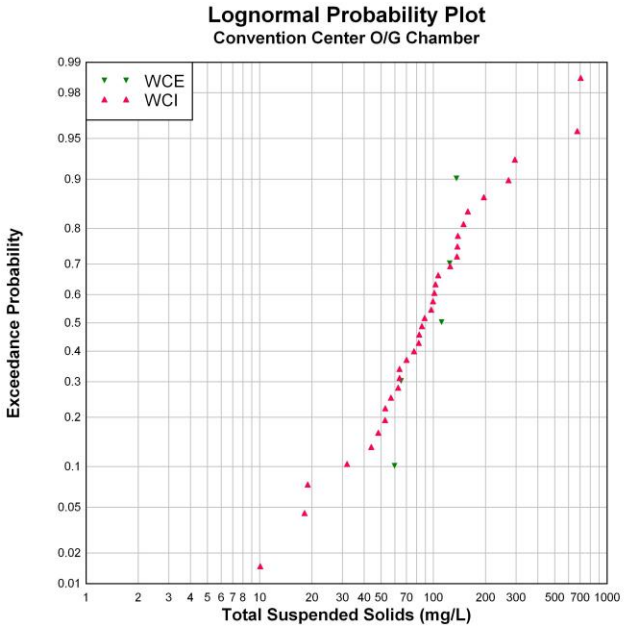
COD and BOD concentrations were reduced by 47% and 59% respectively but were not significant different.

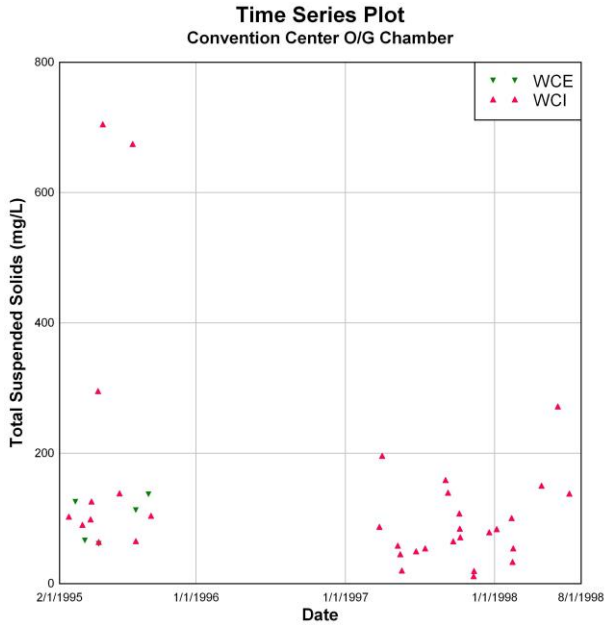
The reduction of concentration in nitrate + nitrite (~50%) was only significant if data are paired. Ammonia concentration was reduced by 69% and was only significant if data are not paired.

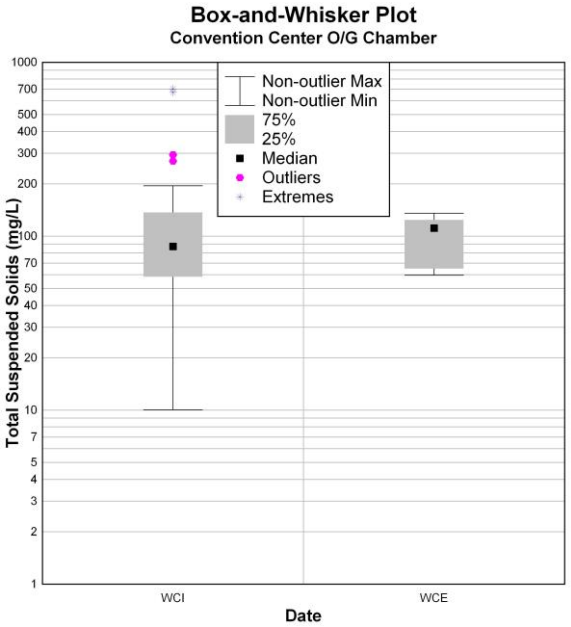
TP concentration was reduced significantly by 67%.

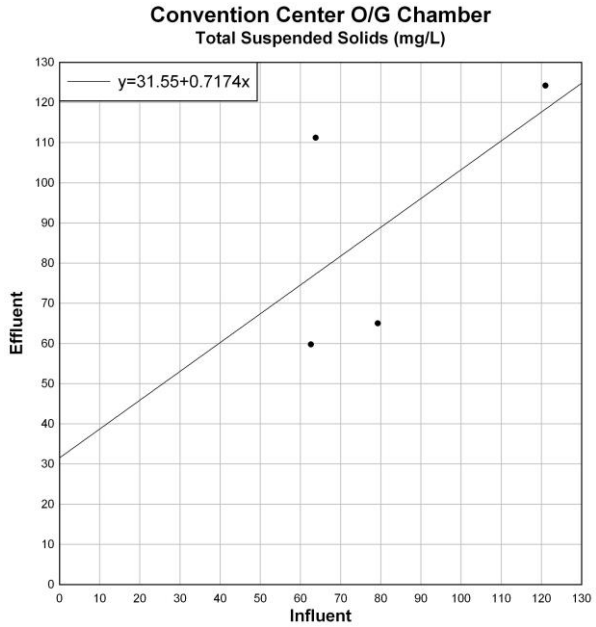
Zn and Cu concentrations were significantly reduced by 57% and 71% respectively.

Convention Center O/G Chamber - Total Suspended Solids (mg/L)



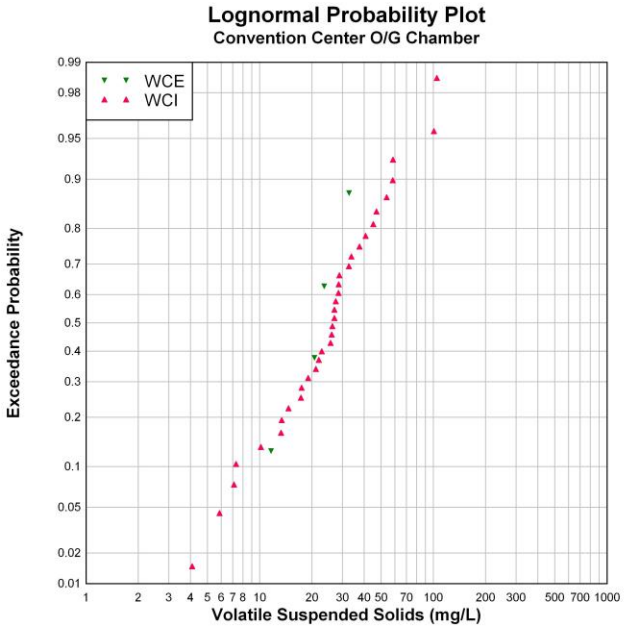


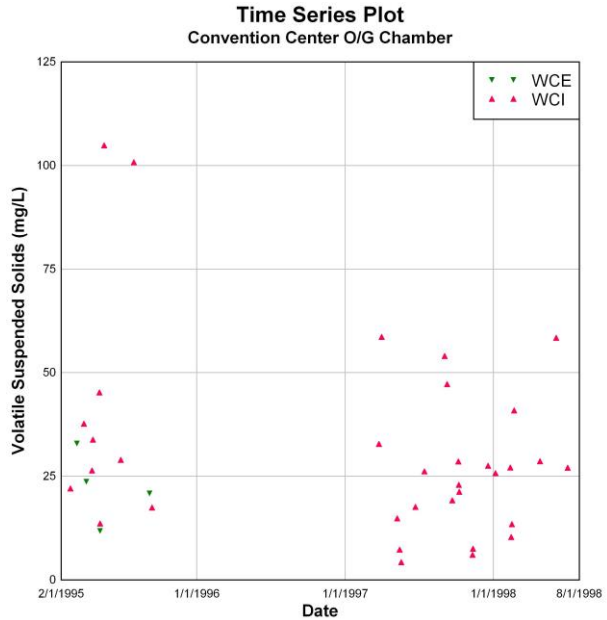


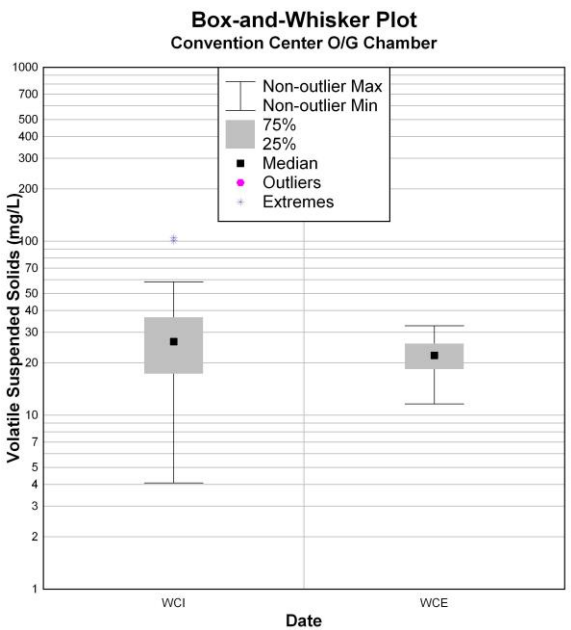


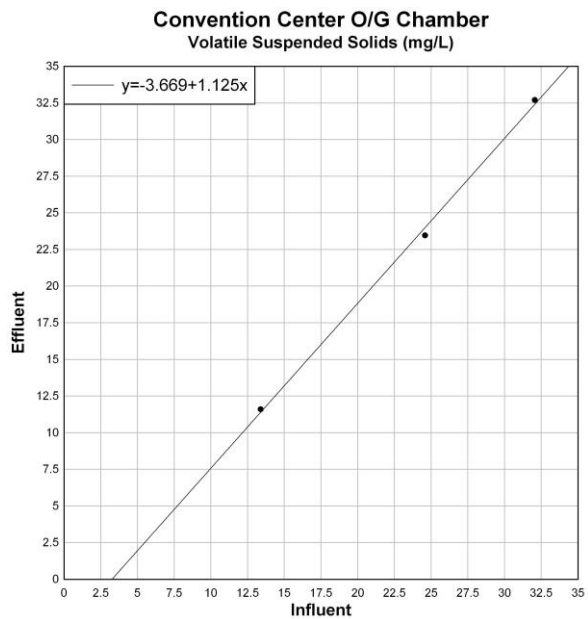
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	34	5
	Pairs Count	4	4
Non-Parametric	Maximum	703.6	135.9
	Upper Quartile	137.3	124.3
	Median	87.4	111.3
	Lower Quartile	57.0	65.1
	Minimum	10.1	59.8
	Efficiency	-27.37%	
	Mann-Whitney	0.8185	
	Wilcoxon (paired)	0.8750	
Arithmetic	UCL	186.2	142.4
	Mean	132.3	99.3
	LCL	78.3	56.1
	Std. Dev.	154.6	34.8
	Wilk (p-value)	0.0001 **	0.2651
	Efficiency	24.96%	
	t-Test (equal var.)	0.6406	
	t-Test (unequal var.)	0.2913	
	t-test (paired)	0.5745	
	Levene Test	0.5053	
Log Transformed	UCL	185.7	163.2
	Mean	128.8	99.5
	LCL	89.4	60.7
	Std. Dev.	132.5	37.8
	Wilk (p-value)	0.2476	0.1823
	Efficiency	22.76%	
	t-Test (equal var.)	0.8836	
	t-Test (unequal var.)	0.7984	
	t-Test (paired)	0.6378	
	Levene Test	0.2835	
Bootstrap	UCL	181.0	136.2
	Mean	130.9	99.2
	LCL	80.8	62.1
	Std. Dev.	143.6	29.9
	Efficiency	24.25%	

Convention Center O/G Chamber - Volatile Suspended Solids (mg/L)



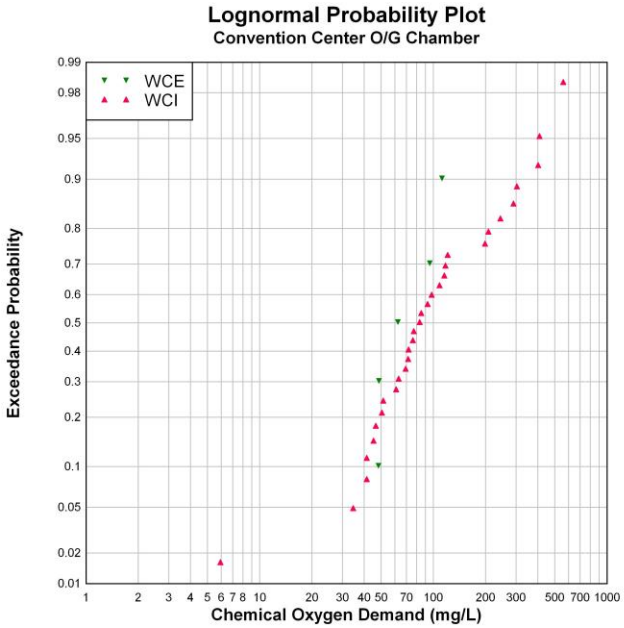


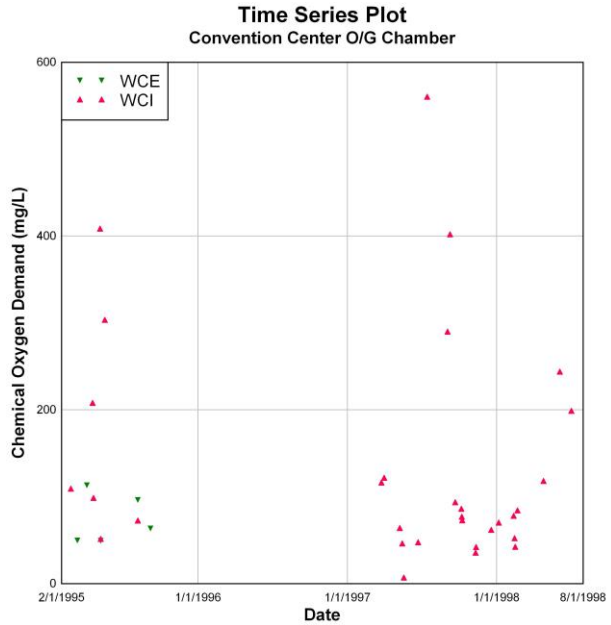


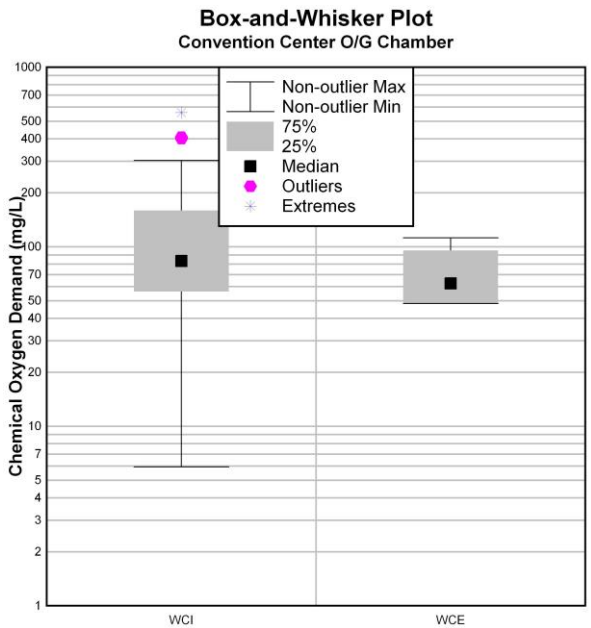


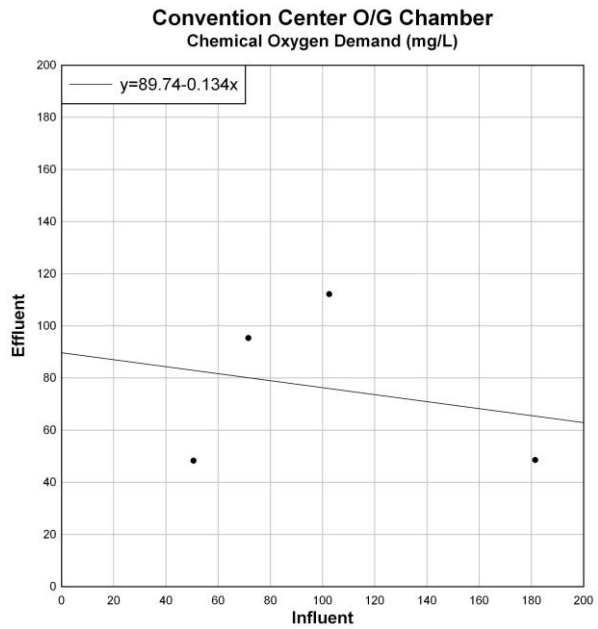
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	34	4
	Pairs Count	3	3
Non-Parametric	Maximum	104.7	32.7
	Upper Quartile	37.5	28.1
	Median	26.5	22.1
	Lower Quartile	17.3	16.1
	Minimum	4.1	11.6
	Efficiency	16.82%	
	Mann-Whitney	0.5247	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	39.0	35.9
	Mean	30.9	22.1
	LCL	22.9	8.3
	Std. Dev.	23.1	8.7
	Wilk (p-value)	0.0001 **	0.9525
	Efficiency	28.53%	
	t-Test (equal var.)	0.4582	
	t-Test (unequal var.)	0.1661	
	t-test (paired)	0.4149	
	Levene Test	0.4530	
Log Transformed	UCL	42.2	46.0
	Mean	31.5	22.2
	LCL	23.5	10.7
	Std. Dev.	26.0	9.5
	Wilk (p-value)	0.5006	0.7827
	Efficiency	29.52%	
	t-Test (equal var.)	0.6879	
	t-Test (unequal var.)	0.5635	
	t-Test (paired)	0.3575	
	Levene Test	0.3309	
Bootstrap	UCL	38.6	33.0
	Mean	30.8	22.1
	LCL	23.1	11.1
	Std. Dev.	22.1	6.9
	Efficiency	28.46%	

Convention Center O/G Chamber - Chemical Oxygen Demand (mg/L)



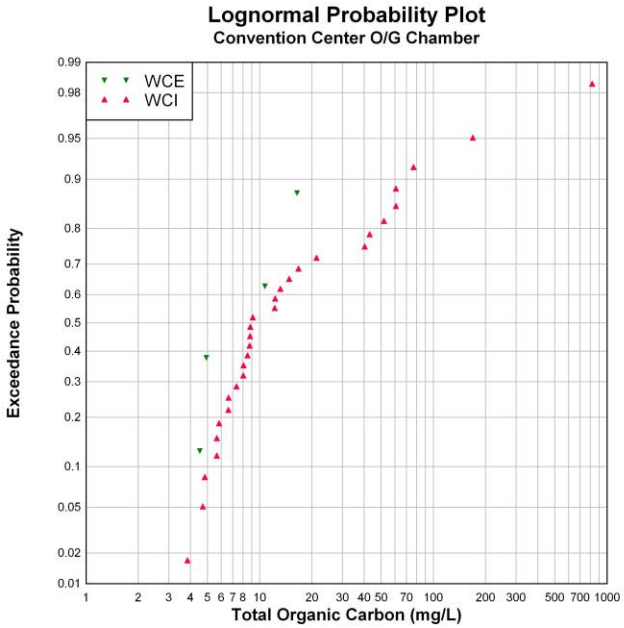


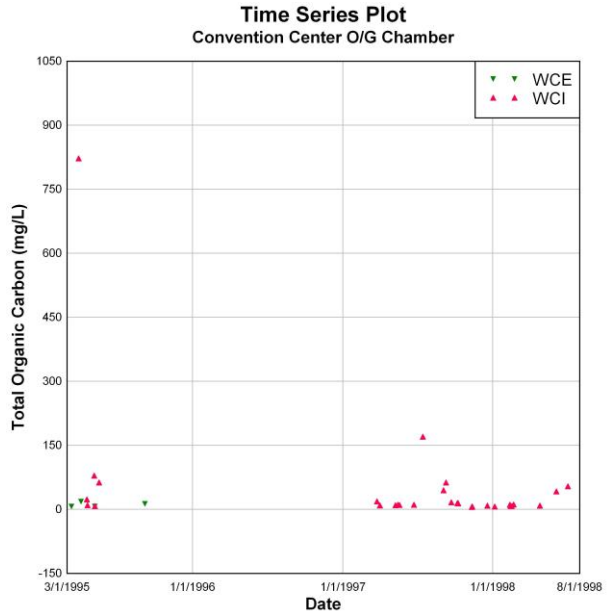


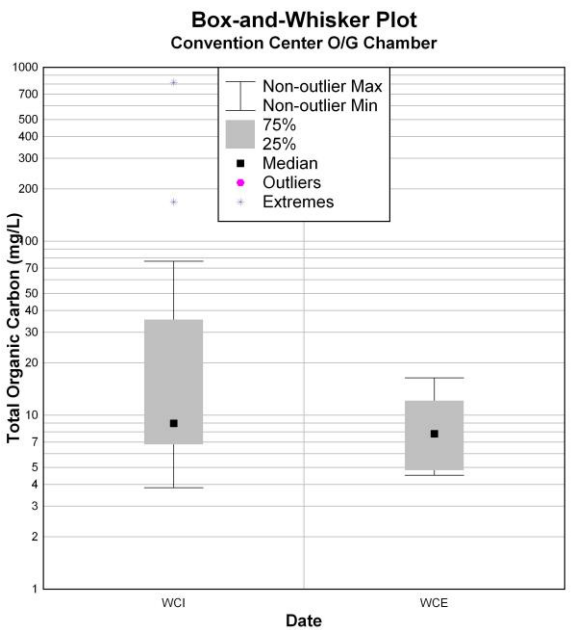


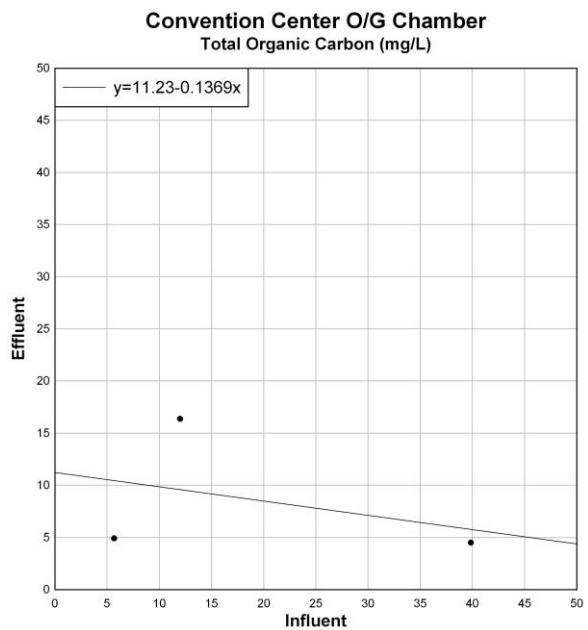
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	31	5
	Pairs Count	4	4
Non-Parametric	Maximum	559.41	112.22
	Upper Quartile	197.95	95.38
	Median	83.30	62.45
	Lower Quartile	51.33	48.59
	Minimum	5.94	48.33
	Efficiency	25.04%	
	Mann-Whitney	0.4159	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	184.51	109.34
	Mean	136.60	73.39
	LCL	88.69	37.44
	Std. Dev.	130.63	28.96
	Wilk (p-value)	0.0001 **	0.2339
	Efficiency	46.27%	
	t-Test (equal var.)	0.2942	
	t-Test (unequal var.)	0.0250 **	
	t-test (paired)	0.5339	
	Levene Test	0.3210	
Log Transformed	UCL	207.36	121.23
	Mean	139.25	73.28
	LCL	93.51	44.30
	Std. Dev.	147.73	28.27
	Wilk (p-value)	0.0713 *	0.2619
	Efficiency	47.37%	
	t-Test (equal var.)	0.4666	
	t-Test (unequal var.)	0.2206	
	t-Test (paired)	0.5470	
	Levene Test	0.3164	
Bootstrap	UCL	185.05	104.36
	Mean	138.35	73.68
	LCL	91.65	43.01
	Std. Dev.	127.32	24.70
	Efficiency	46.74%	

Convention Center O/G Chamber - Total Organic Carbon (mg/L)



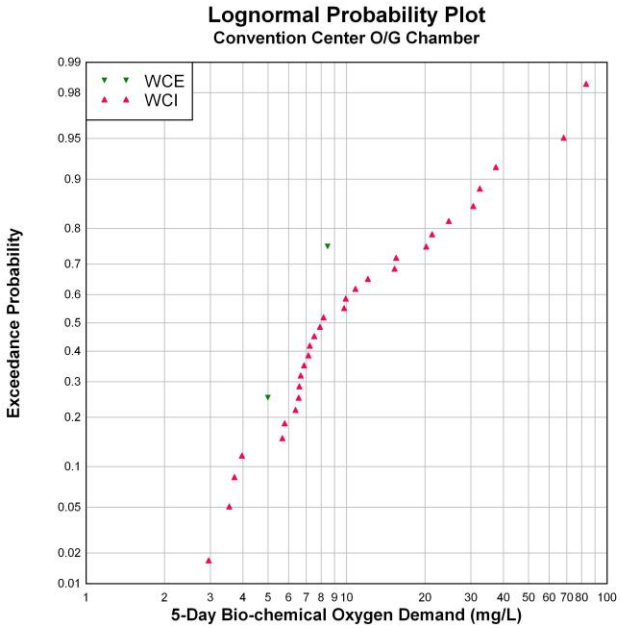


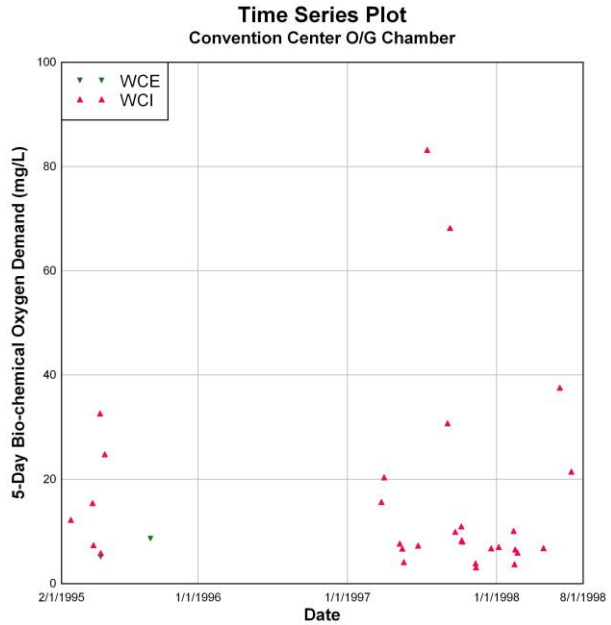


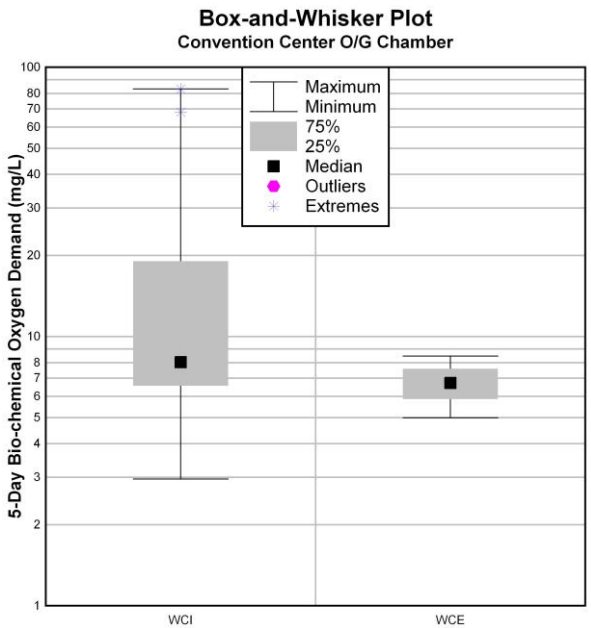


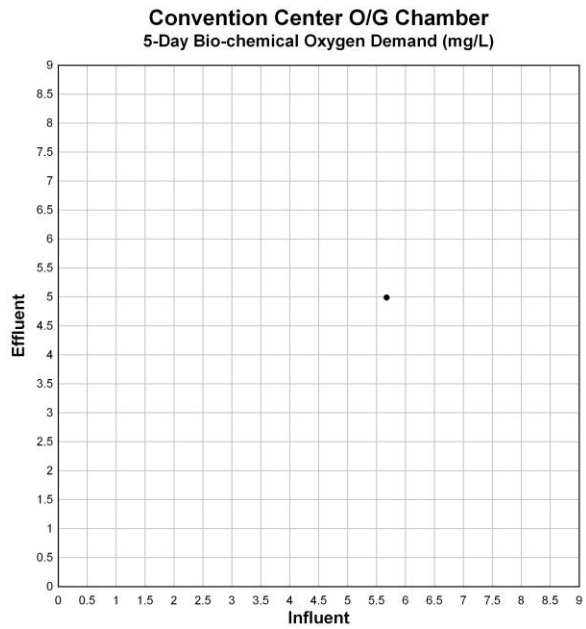
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	30	4
	Pairs Count	3	3
Non-Parametric	Maximum	820.51	16.38
	Upper Quartile	40.23	13.55
	Median	8.97	7.83
	Lower Quartile	6.61	4.73
	Minimum	3.84	4.52
	Efficiency	12.79%	
	Mann-Whitney	0.3048	
	Wilcoxon (paired)	0.7500	
Arithmetic	UCL	106.50	18.04
	Mean	50.78	9.14
	LCL	-4.94	0.24
	Std. Dev.	149.23	5.59
	Wilk (p-value)	0.0001 **	0.3550
	Efficiency	82.01%	
	t-Test (equal var.)	0.5857	
	t-Test (unequal var.)	0.1390	
	t-test (paired)	0.4868	
	Levene Test	0.6966	
Log Transformed	UCL	58.48	27.57
	Mean	31.77	9.11
	LCL	17.26	3.01
	Std. Dev.	51.27	5.50
	Wilk (p-value)	0.0005 **	0.3704
	Efficiency	71.34%	
	t-Test (equal var.)	0.2883	
	t-Test (unequal var.)	0.1207	
	t-Test (paired)	0.4757	
	Levene Test	0.4358	
Bootstrap	UCL	98.10	16.70
	Mean	51.18	9.37
	LCL	4.26	2.03
	Std. Dev.	125.65	4.61
	Efficiency	81.70%	

Convention Center O/G Chamber - 5-Day Bio-chemical Oxygen Demand (mg/L)



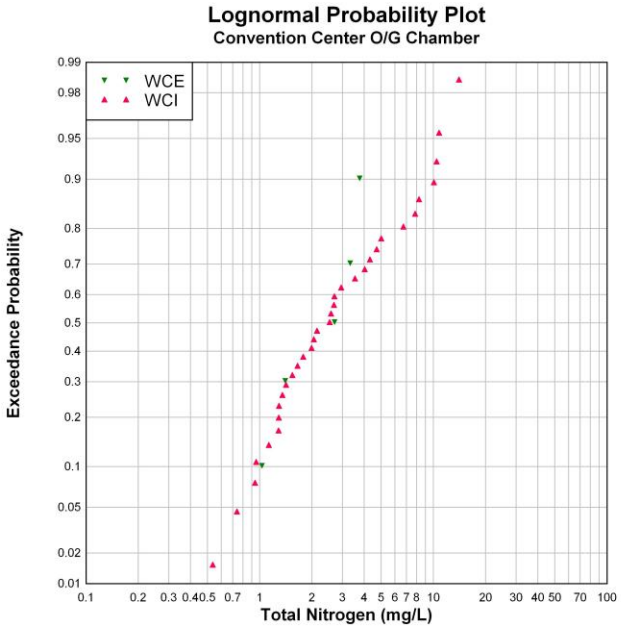


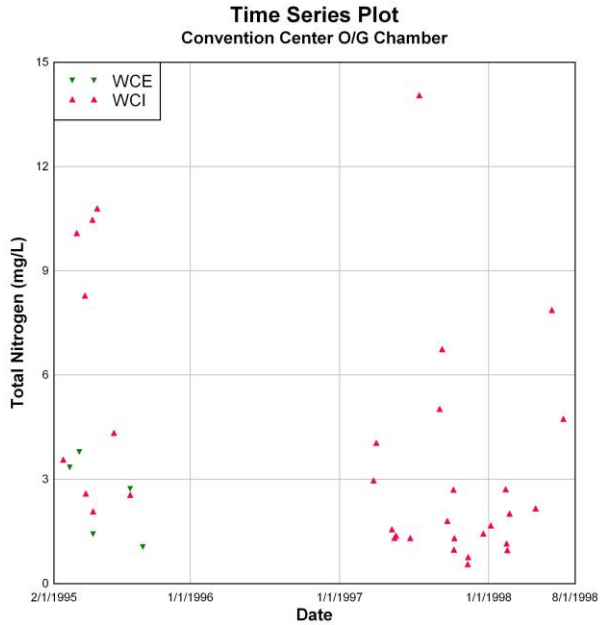


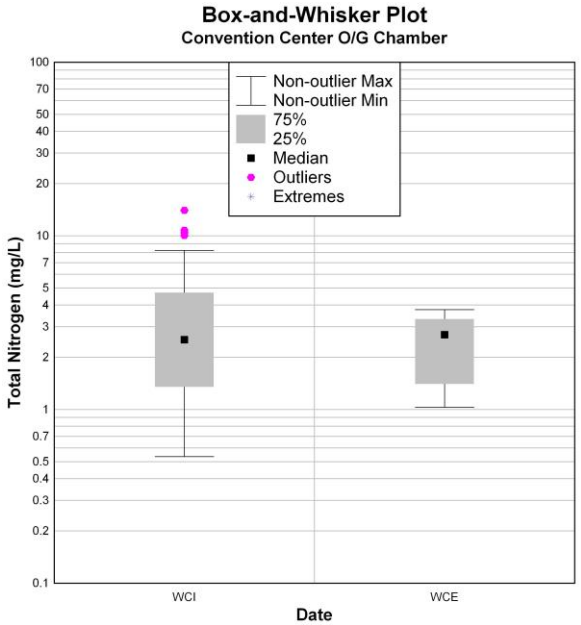


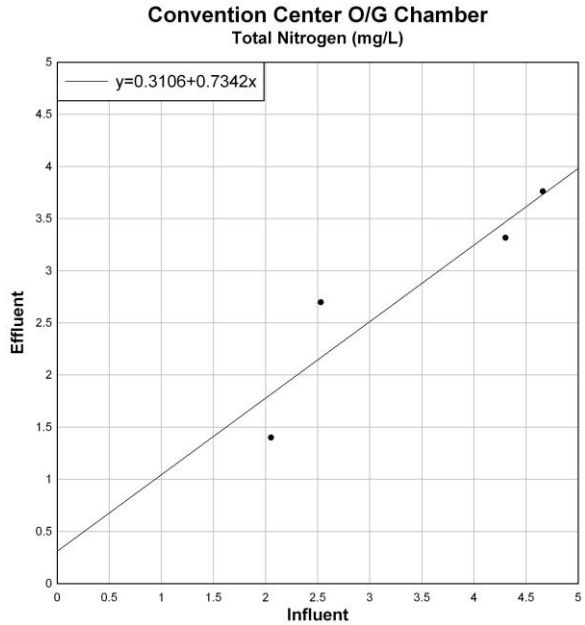
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	30	2
	Pairs Count	1	1
Non-Parametric	Maximum	83.04	8.46
	Upper Quartile	20.21	8.46
	Median	8.03	6.72
	Lower Quartile	6.55	4.99
	Minimum	2.95	4.99
	Efficiency	16.23%	
	Mann-Whitney	0.4651	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	23.19	28.73
	Mean	16.26	6.72
	LCL	9.32	-15.28
	Std. Dev.	18.58	2.45
	Wilk (p-value)	0.0001 **	1.0000
	Efficiency	58.64%	
	t-Test (equal var.)	0.4806	
	t-Test (unequal var.)	0.0239 **	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	22.15	239.46
	Mean	15.27	6.72
	LCL	10.53	0.19
	Std. Dev.	14.83	2.45
	Wilk (p-value)	0.0621 *	1.0000
	Efficiency	55.98%	
	t-Test (equal var.)	0.4114	
	t-Test (unequal var.)	0.2504	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	23.15	17.88
	Mean	16.45	6.72
	LCL	9.76	-4.43
	Std. Dev.	17.92	1.24
	Efficiency	59.14%	

Convention Center O/G Chamber - Total Nitrogen (mg/L)



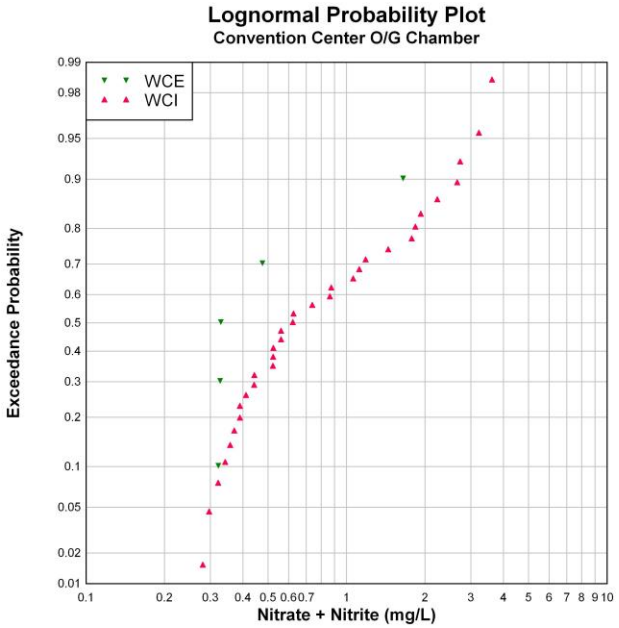


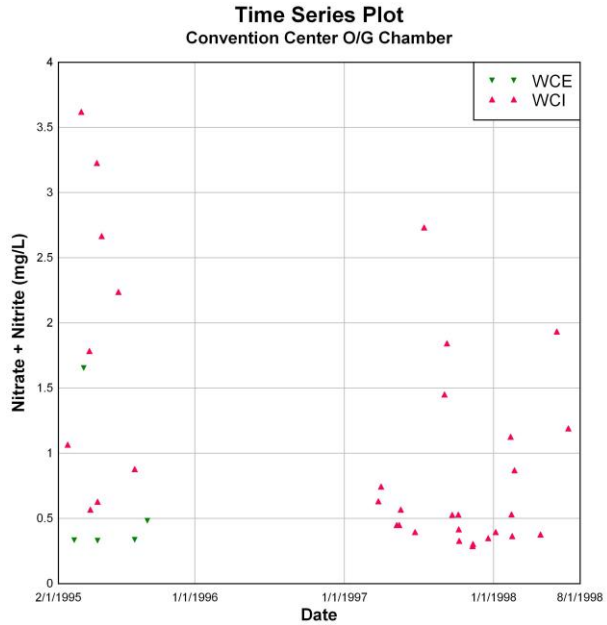


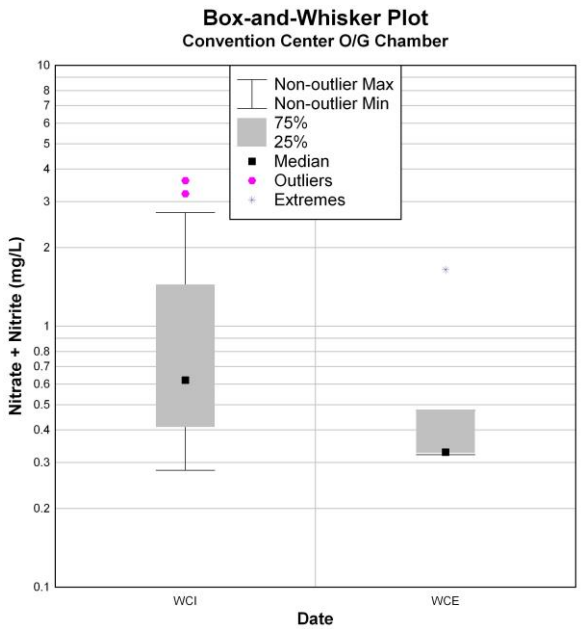


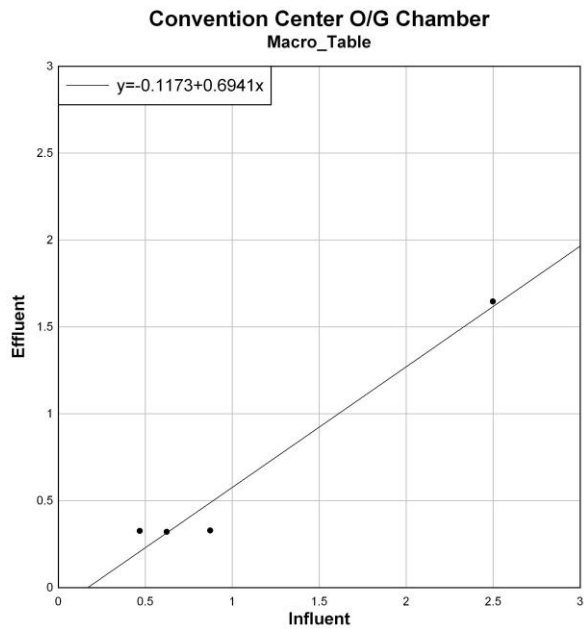
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	33	5
	Pairs Count	4	4
Non-Parametric	Maximum	14.022	3.764
	Upper Quartile	4.711	3.317
	Median	2.529	2.700
	Lower Quartile	1.351	1.402
	Minimum	0.536	1.031
	Efficiency	-6.74%	
	Mann-Whitney	0.7970	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	5.026	3.918
	Mean	3.793	2.443
	LCL	2.559	0.967
	Std. Dev.	3.478	1.189
	Wilk (p-value)	0.0001 **	0.5208
	Efficiency	35.60%	
	t-Test (equal var.)	0.3999	
	t-Test (unequal var.)	0.1116	
	t-test (paired)	0.1109	
	Levene Test	0.2647	
Log Transformed	UCL	5.352	5.313
	Mean	3.753	2.465
	LCL	2.631	1.144
	Std. Dev.	3.682	1.378
	Wilk (p-value)	0.3882	0.3826
	Efficiency	34.32%	
	t-Test (equal var.)	0.6246	
	t-Test (unequal var.)	0.5251	
	t-Test (paired)	0.1276	
	Levene Test	0.2097	
Bootstrap	UCL	5.009	3.707
	Mean	3.802	2.430
	LCL	2.595	1.154
	Std. Dev.	3.404	1.028
	Efficiency	36.08%	

Convention Center O/G Chamber - Nitrate + Nitrite (mg/L)



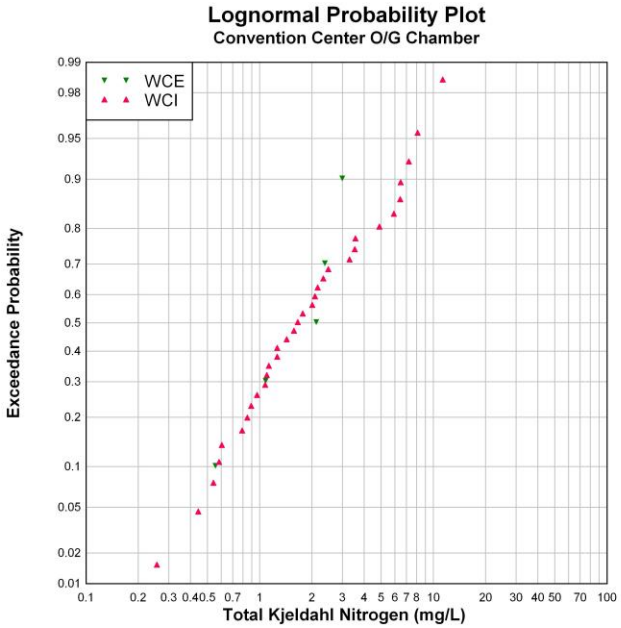


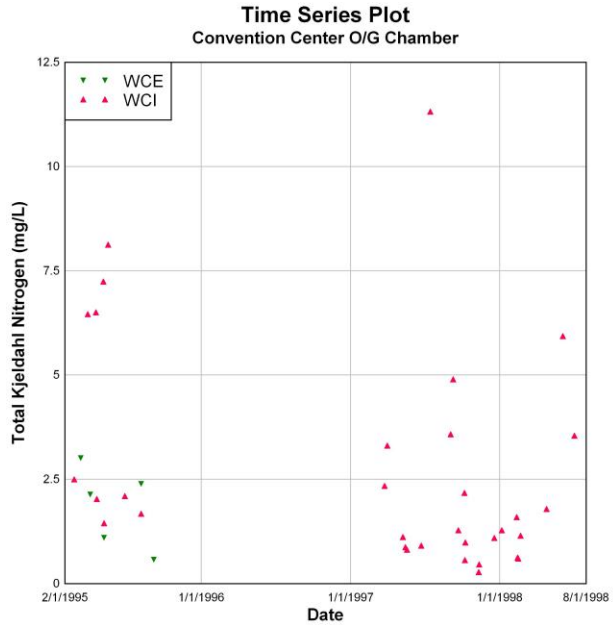


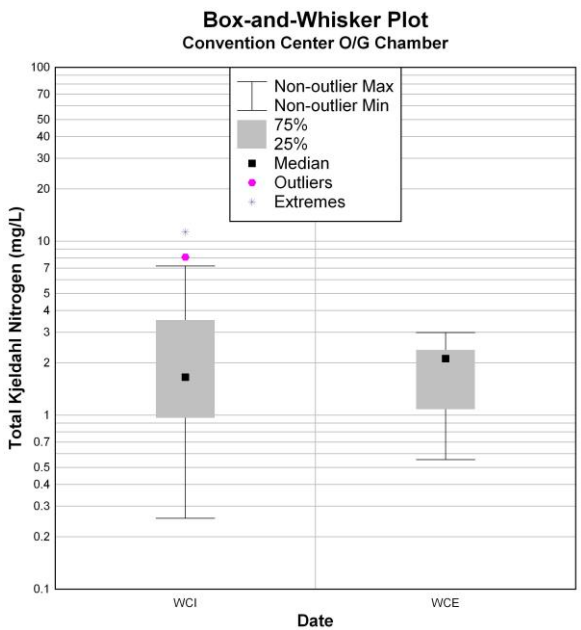


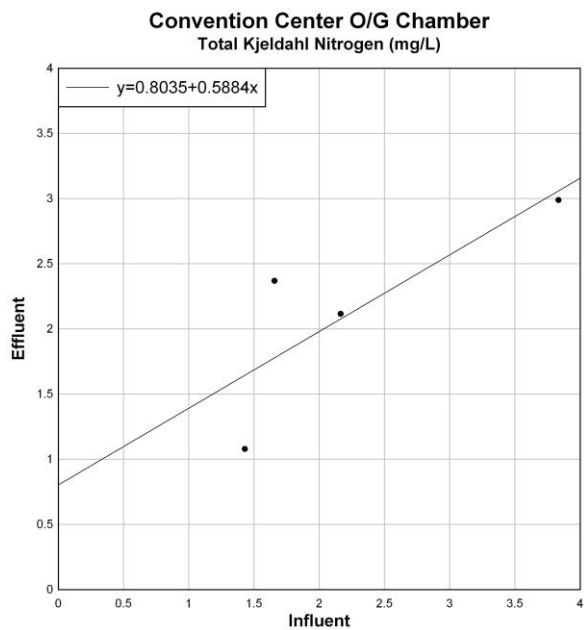
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	33	5
	Pairs Count	4	4
Non-Parametric	Maximum	3.613	1.647
	Upper Quartile	1.445	0.475
	Median	0.622	0.329
	Lower Quartile	0.411	0.327
	Minimum	0.281	0.322
	Efficiency	47.05%	
	Mann-Whitney	0.1186	
	Wilcoxon (paired)	0.1250	
Arithmetic	UCL	1.395	1.337
	Mean	1.068	0.620
	LCL	0.741	-0.097
	Std. Dev.	0.921	0.578
	Wilk (p-value)	0.0001 **	0.0015 **
	Efficiency	41.95%	
	t-Test (equal var.)	0.3009	
	t-Test (unequal var.)	0.1811	
	t-test (paired)	0.0594 *	
	Levene Test	0.3833	
Log Transformed	UCL	1.428	1.592
	Mean	1.045	0.588
	LCL	0.764	0.217
	Std. Dev.	0.902	0.406
	Wilk (p-value)	0.0170 **	0.0098 **
	Efficiency	43.69%	
	t-Test (equal var.)	0.1987	
	t-Test (unequal var.)	0.2130	
	t-Test (paired)	0.0233 **	
	Levene Test	0.5219	
Bootstrap	UCL	1.388	1.168
	Mean	1.070	0.627
	LCL	0.751	0.086
	Std. Dev.	0.898	0.436
	Efficiency	41.43%	

Convention Center O/G Chamber - Total Kjeldahl Nitrogen (mg/L)



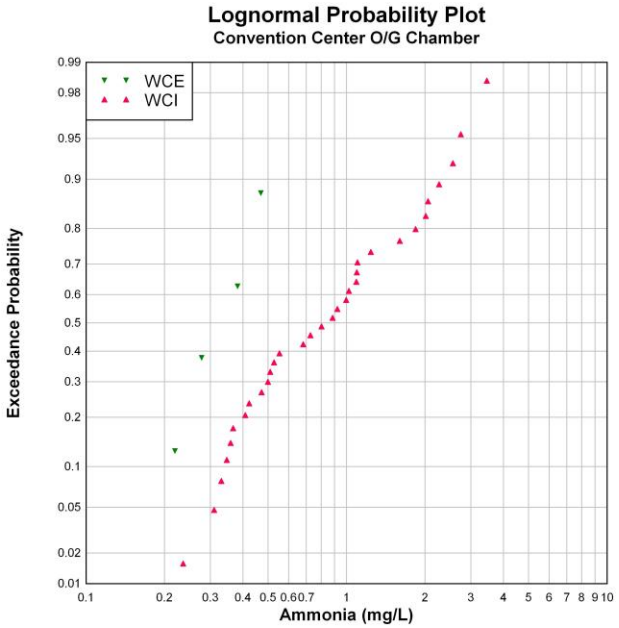


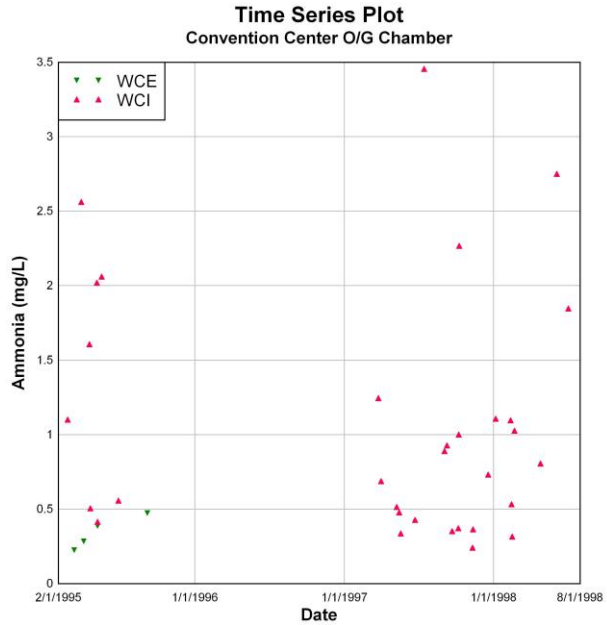


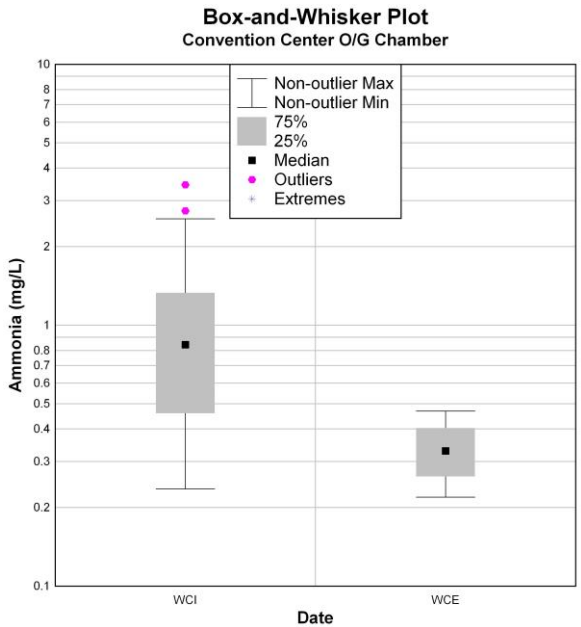


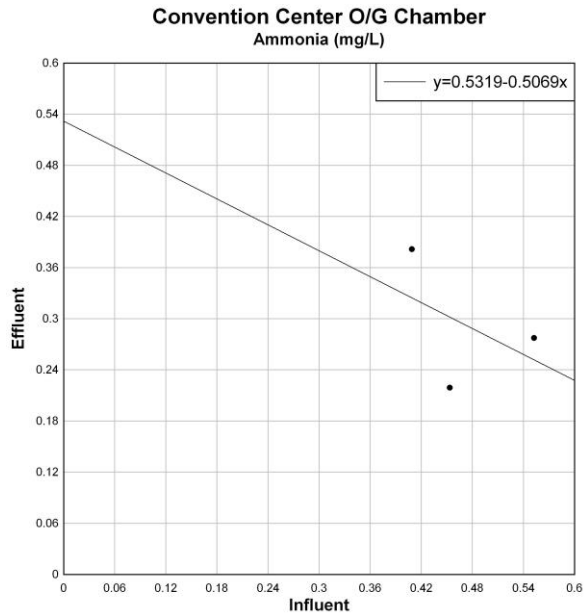
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	33	5
	Pairs Count	4	4
Non-Parametric	Maximum	11.296	2.990
	Upper Quartile	3.527	2.370
	Median	1.657	2.117
	Lower Quartile	0.963	1.080
	Minimum	0.255	0.556
	Efficiency	-27.76%	
	Mann-Whitney	0.8638	
	Wilcoxon (paired)	0.6250	
Arithmetic	UCL	3.664	3.050
	Mean	2.725	1.823
	LCL	1.785	0.596
	Std. Dev.	2.650	0.988
	Wilk (p-value)	0.0001 **	0.7588
	Efficiency	33.11%	
	t-Test (equal var.)	0.4606	
	t-Test (unequal var.)	0.1781	
	t-test (paired)	0.7147	
	Levene Test	0.3309	
Log Transformed	UCL	4.058	4.929
	Mean	2.730	1.865
	LCL	1.837	0.705
	Std. Dev.	2.993	1.263
	Wilk (p-value)	0.8156	0.4356
	Efficiency	31.70%	
	t-Test (equal var.)	0.7301	
	t-Test (unequal var.)	0.6778	
	t-Test (paired)	0.7663	
	Levene Test	0.3135	
Bootstrap	UCL	3.650	2.860
	Mean	2.732	1.803
	LCL	1.814	0.747
	Std. Dev.	2.589	0.851
	Efficiency	33.99%	

Convention Center O/G Chamber - Ammonia (mg/L)



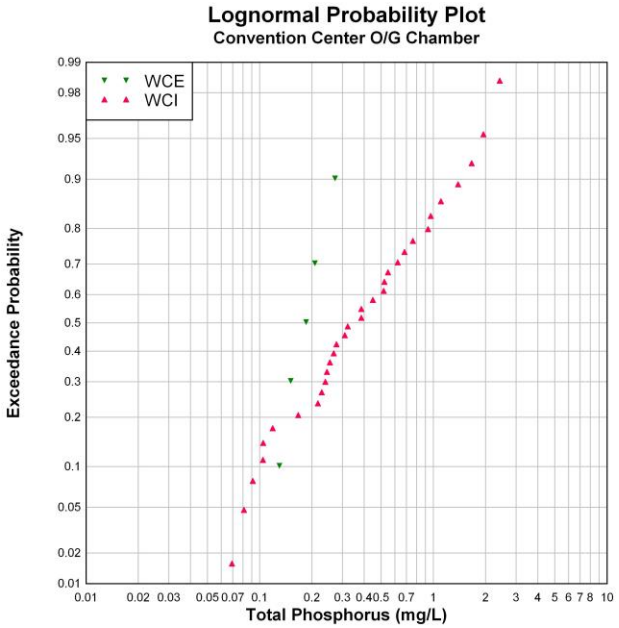


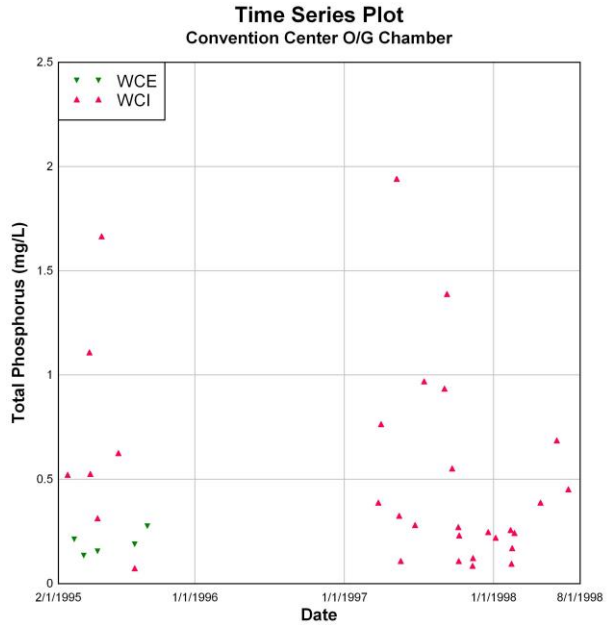


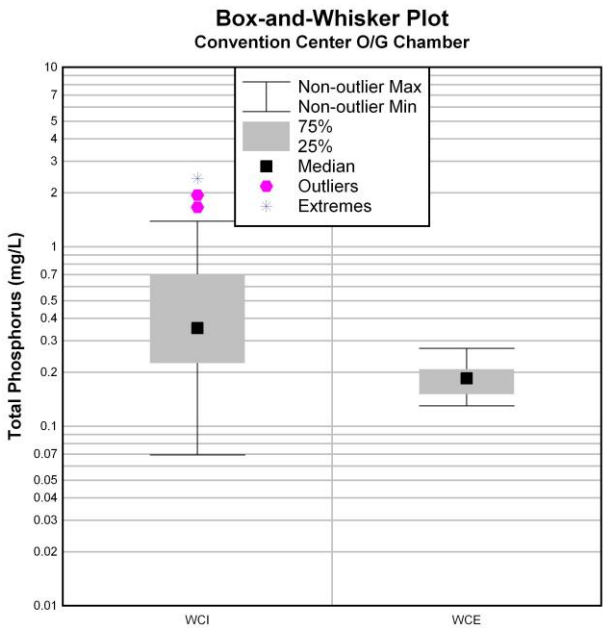


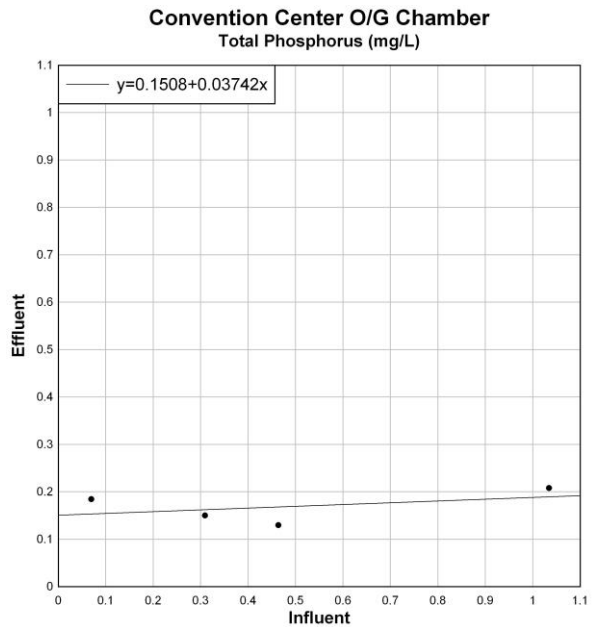
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	32	4
	Pairs Count	3	3
Non-Parametric	Maximum	3.450	0.468
	Upper Quartile	1.420	0.425
	Median	0.843	0.330
	Lower Quartile	0.447	0.248
	Minimum	0.236	0.219
	Efficiency	60.88%	
	Mann-Whitney	0.0198 **	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	1.373	0.513
	Mean	1.076	0.337
	LCL	0.779	0.161
	Std. Dev.	0.824	0.111
	Wilk (p-value)	0.0004 **	0.8404
	Efficiency	68.69%	
	t-Test (equal var.)	0.0858 *	
	t-Test (unequal var.)	0.0000 **	
	t-test (paired)	0.1452	
	Levene Test	0.2526	
Log Transformed	UCL	1.444	0.587
	Mean	1.071	0.337
	LCL	0.795	0.193
	Std. Dev.	0.869	0.112
	Wilk (p-value)	0.3029	0.8662
	Efficiency	68.56%	
	t-Test (equal var.)	0.0169 **	
	t-Test (unequal var.)	0.0027 **	
	t-Test (paired)	0.1463	
	Levene Test	0.1113	
Bootstrap	UCL	1.374	0.479
	Mean	1.082	0.337
	LCL	0.790	0.194
	Std. Dev.	0.811	0.090
	Efficiency	68.89%	

Convention Center O/G Chamber - Total Phosphorus (mg/L)



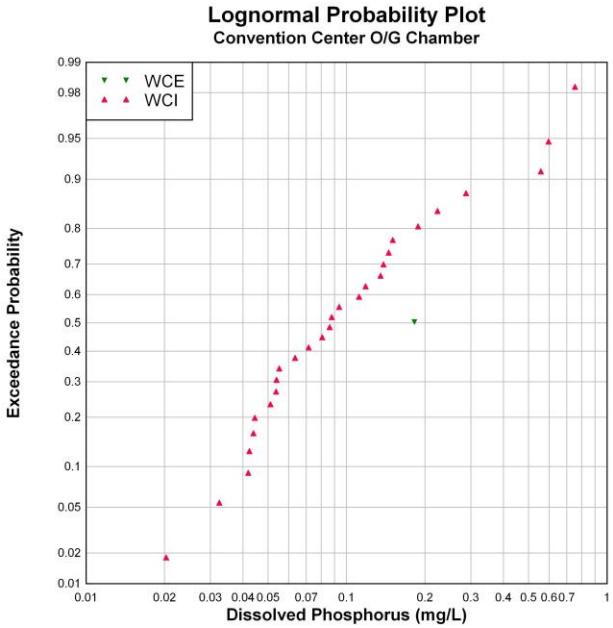


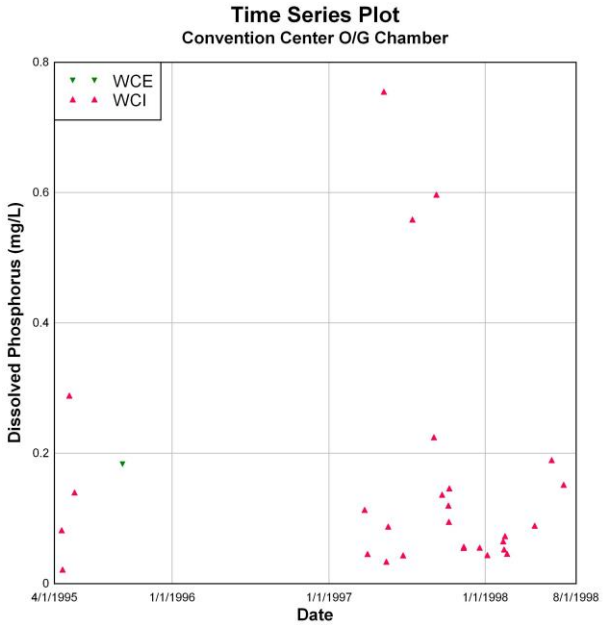


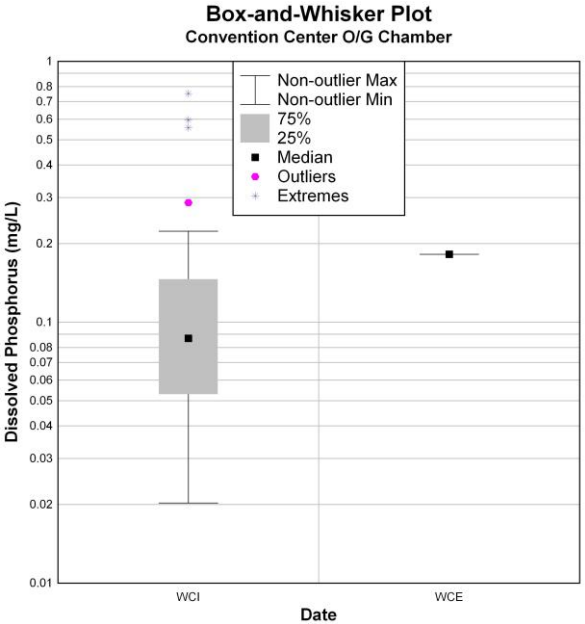


	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	32	5
	Pairs Count	4	4
Non-Parametric	Maximum	2.404	0.272
	Upper Quartile	0.721	0.208
	Median	0.352	0.185
	Lower Quartile	0.222	0.151
	Minimum	0.069	0.130
	Efficiency	47.57%	
	Mann-Whitney	0.0804 *	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	0.780	0.258
	Mean	0.573	0.189
	LCL	0.367	0.120
	Std. Dev.	0.573	0.055
	Wilk (p-value)	0.0001 **	0.8016
	Efficiency	67.03%	
	t-Test (equal var.)	0.1478	
	t-Test (unequal var.)	0.0008 **	
	t-test (paired)	0.2264	
	Levene Test	0.3034	
Log Transformed	UCL	0.876	0.272
	Mean	0.577	0.189
	LCL	0.380	0.131
	Std. Dev.	0.655	0.054
	Wilk (p-value)	0.6987	0.9584
	Efficiency	67.25%	
	t-Test (equal var.)	0.1103	
	t-Test (unequal var.)	0.0029 **	
	t-Test (paired)	0.3385	
	Levene Test	0.0786 *	
Bootstrap	UCL	0.774	0.248
	Mean	0.574	0.189
	LCL	0.375	0.131
	Std. Dev.	0.553	0.047
	Efficiency	67.05%	

Convention Center O/G Chamber - Dissolved Phosphorus (mg/L)

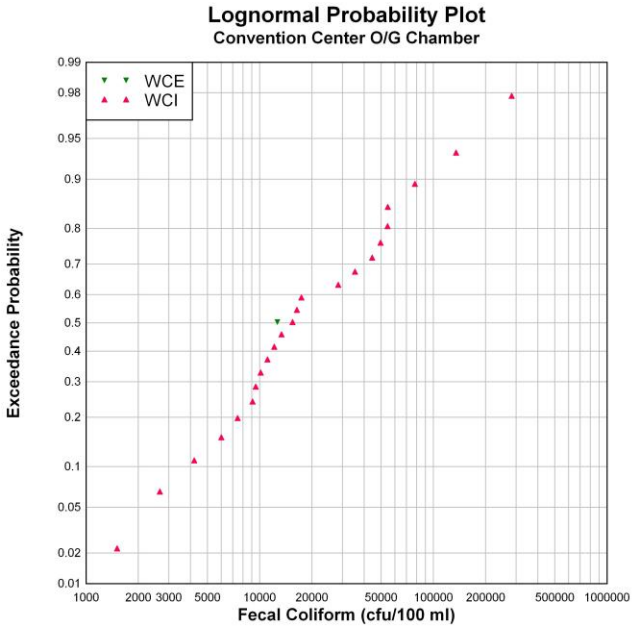


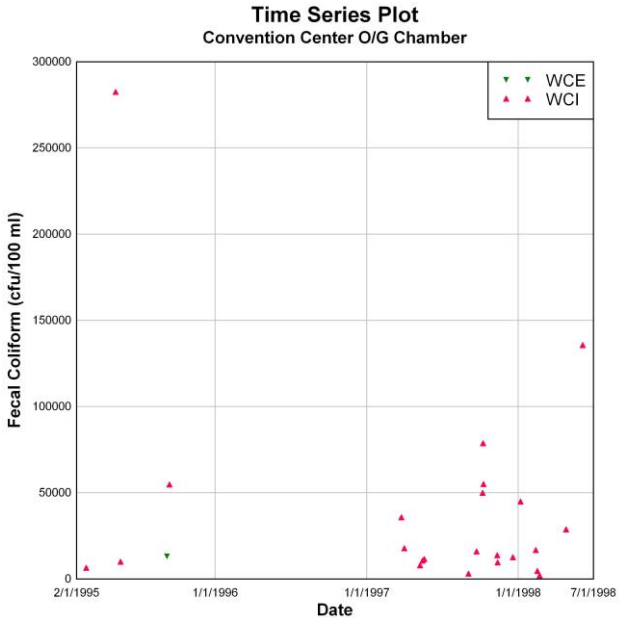


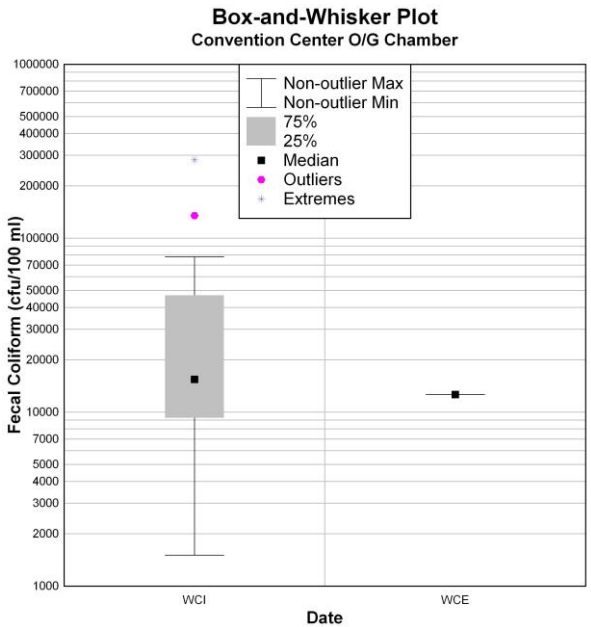


	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	28	0
	Pairs Count	0	0
Non-Parametric	Maximum	0.754	
	Upper Quartile	0.148	
	Median	0.087	
	Lower Quartile	0.052	
	Minimum	0.020	
	Efficiency	NA	
	Mann-Whitney	0.3777	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	0.225	
	Mean	0.154	
	LCL	0.084	
	Std. Dev.	0.183	
	Wilk (p-value)	0.0001 **	NA
	Efficiency	NA	
	t-Test (equal var.)	0.8833	
	t-Test (unequal var.)	NA	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	0.219	
	Mean	0.145	
	LCL	0.096	
	Std. Dev.	0.149	
	Wilk (p-value)	0.1684	NA
	Efficiency	NA	
	t-Test (equal var.)	0.5093	
	t-Test (unequal var.)	NA	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	0.221	
	Mean	0.154	
	LCL	0.087	
	Std. Dev.	0.173	
	Efficiency	NA	

Convention Center O/G Chamber - Fecal Coliform (cfu/100 ml)

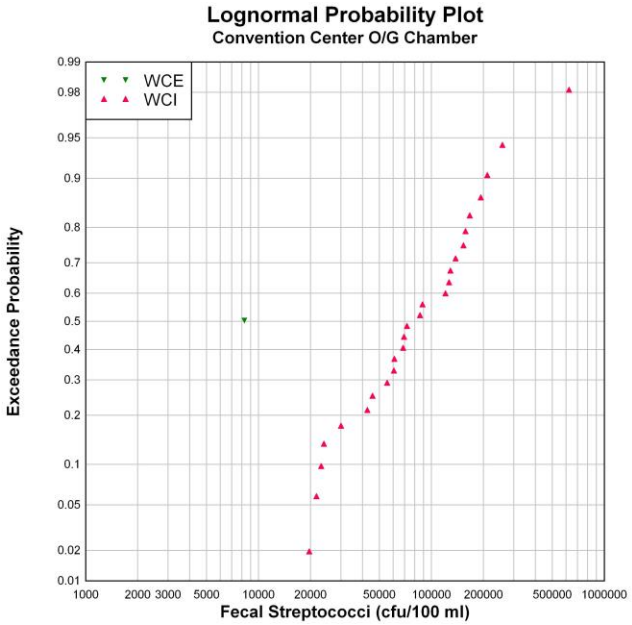


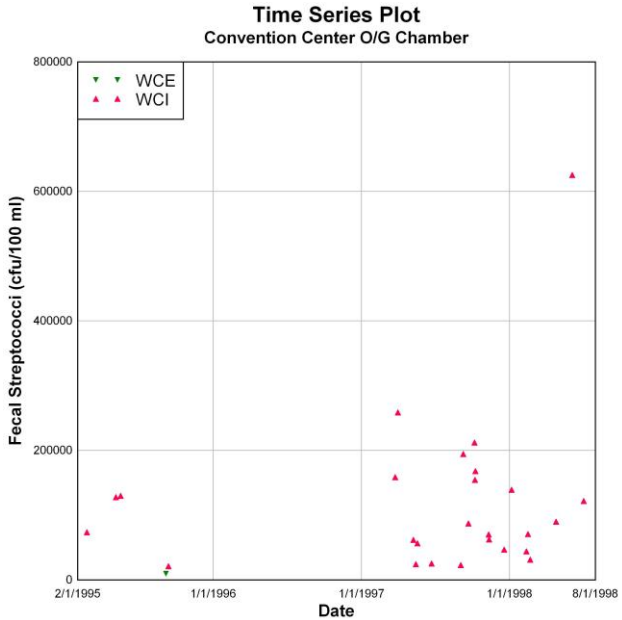


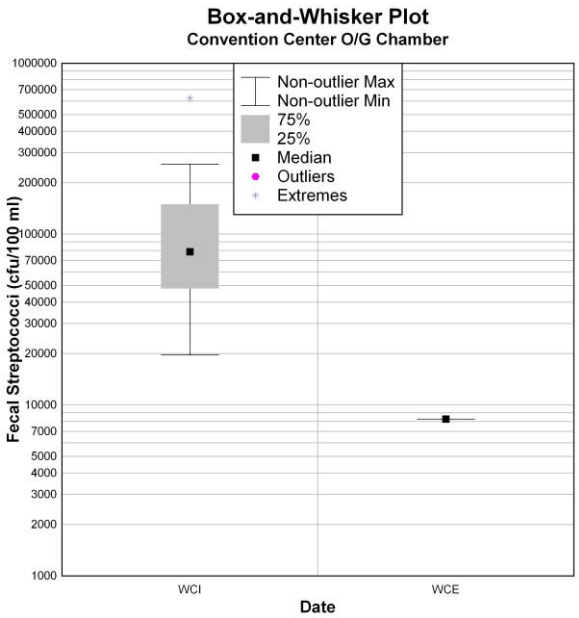


	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	23	0
	Pairs Count	0	0
Non-Parametric	Maximum	282,019	
	Upper Quartile	49,527	
	Median	15,456	
	Lower Quartile	9,096	
	Minimum	1,509	
	Efficiency	NA	
	Mann-Whitney	0.8864	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	65,593	
	Mean	39,045	
	LCL	12,497	
	Std. Dev.	61,388	
	Wilk (p-value)	0.0001 **	NA
	Efficiency	NA	
	t-Test (equal var.)	0.6776	
	t-Test (unequal var.)	NA	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	78,045	
	Mean	37,669	
	LCL	18,181	
	Std. Dev.	60,452	
	Wilk (p-value)	0.9794	NA
	Efficiency	NA	
	t-Test (equal var.)	0.7759	
	t-Test (unequal var.)	NA	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	63,395	
	Mean	39,201	
	LCL	15,008	
	Std. Dev.	55,947	
	Efficiency	NA	

Convention Center O/G Chamber - Fecal Streptococci (cfu/100 ml)

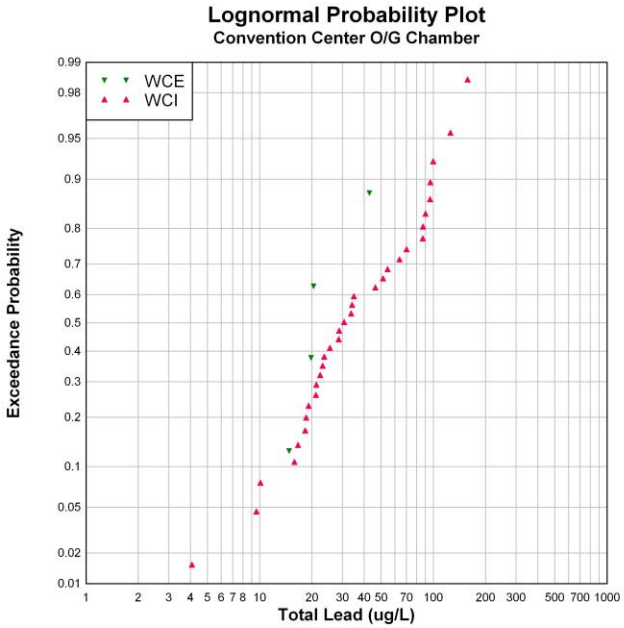


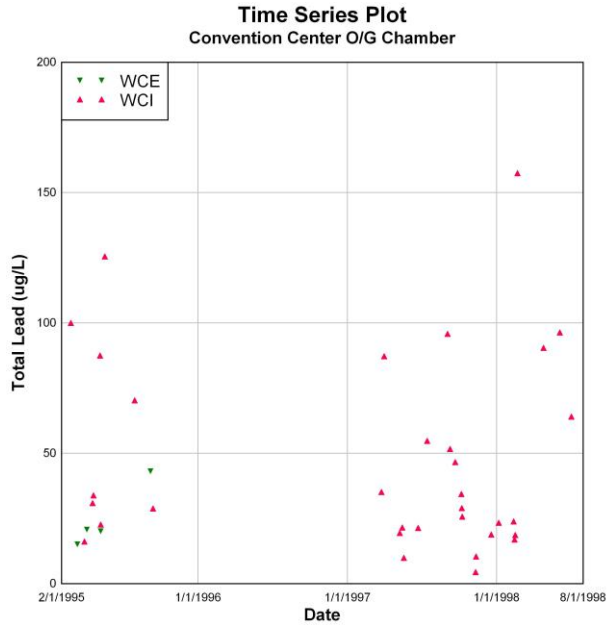


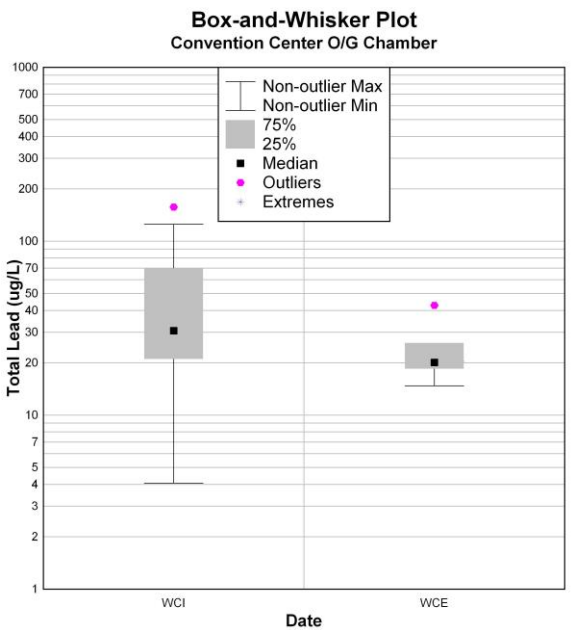


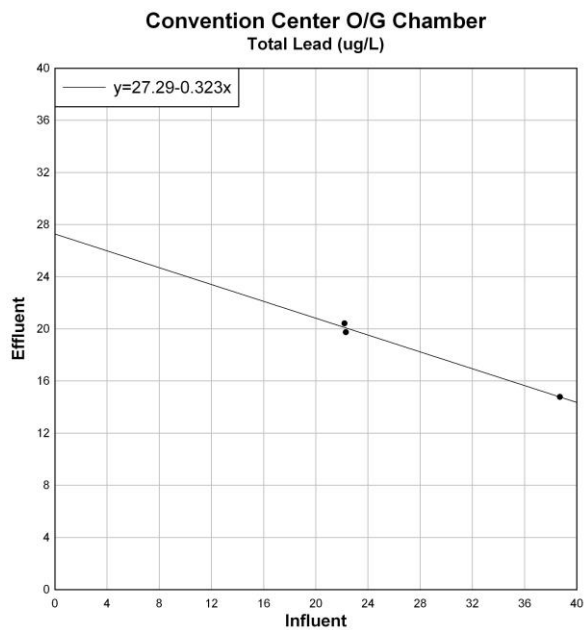
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	26	0
	Pairs Count	0	0
Non-Parametric	Maximum	624,125	
	Upper Quartile	153,260	
	Median	78,933	
	Lower Quartile	45,529	
	Minimum	19,652	
	Efficiency	NA	
	Mann-Whitney	0.1206	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	166,209	
	Mean	117,039	
	LCL	67,868	
	Std. Dev.	121,709	
	Wilk (p-value)	0.0001 **	NA
	Efficiency	NA	
	t-Test (equal var.)	0.3889	
	t-Test (unequal var.)	NA	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	173,669	
	Mean	115,634	
	LCL	76,993	
	Std. Dev.	112,583	
	Wilk (p-value)	0.6290	NA
	Efficiency	NA	
	t-Test (equal var.)	0.0147 **	
	t-Test (unequal var.)	NA	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	163,092	
	Mean	117,622	
	LCL	72,152	
	Std. Dev.	112,575	
	Efficiency	NA	

Convention Center O/G Chamber - Total Lead (ug/L)



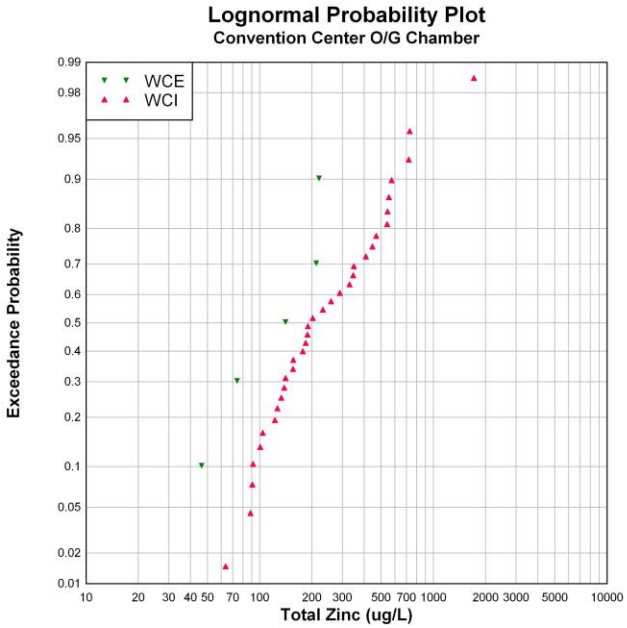


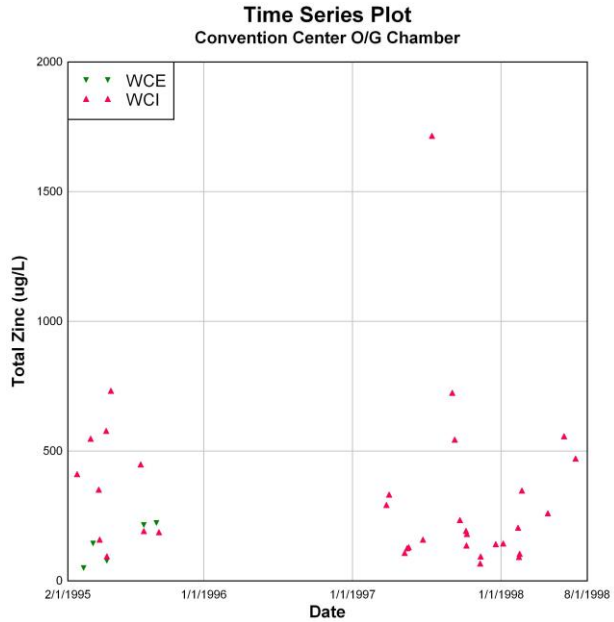


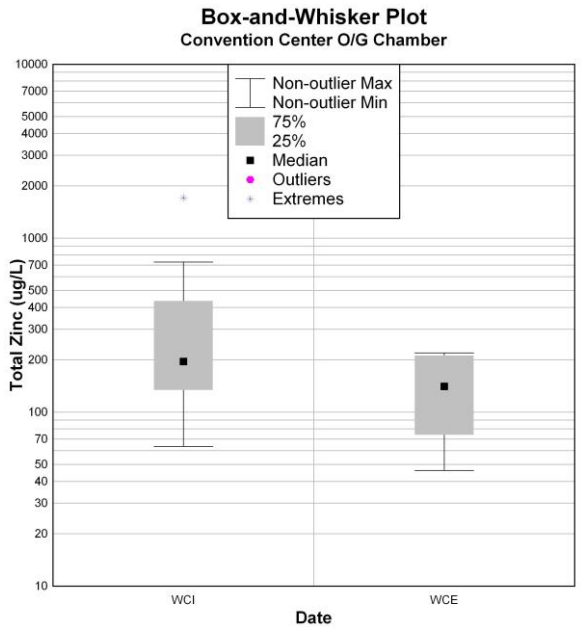


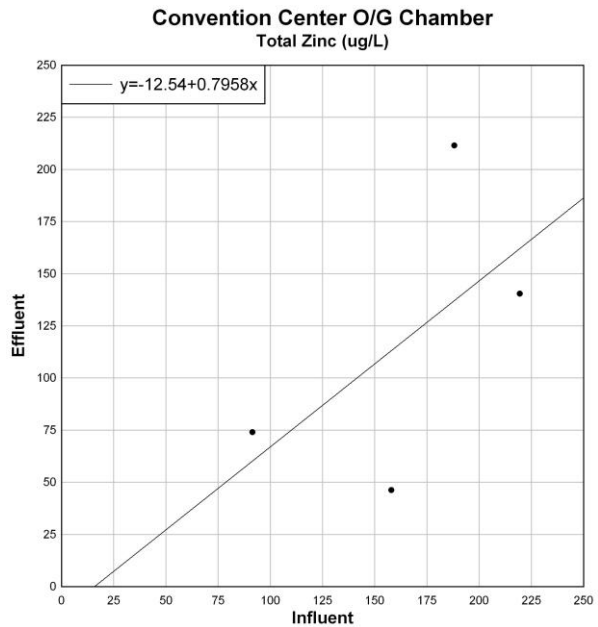
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	33	4
	Pairs Count	3	3
Non-Parametric	Maximum	157.1	42.8
	Upper Quartile	69.9	31.6
	Median	30.6	20.1
	Lower Quartile	21.0	17.3
	Minimum	4.1	14.8
	Efficiency	34.30%	
	Mann-Whitney	0.2032	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	60.7	44.3
	Mean	47.3	24.4
	LCL	33.9	4.6
	Std. Dev.	37.8	12.5
	Wilk (p-value)	0.0004 **	0.1046
	Efficiency	48.37%	
	t-Test (equal var.)	0.2415	
	t-Test (unequal var.)	0.0266 **	
	t-test (paired)	0.3245	
	Levene Test	0.2713	
Log Transformed	UCL	68.4	52.2
	Mean	48.4	24.2
	LCL	34.3	11.3
	Std. Dev.	46.2	10.8
	Wilk (p-value)	0.3922	0.3388
	Efficiency	49.91%	
	t-Test (equal var.)	0.3203	
	t-Test (unequal var.)	0.1602	
	t-Test (paired)	0.3085	
	Levene Test	0.2650	
Bootstrap	UCL	60.5	39.5
	Mean	47.4	24.5
	LCL	34.3	9.4
	Std. Dev.	36.9	9.5
	Efficiency	48.38%	

Convention Center O/G Chamber - Total Zinc (ug/L)



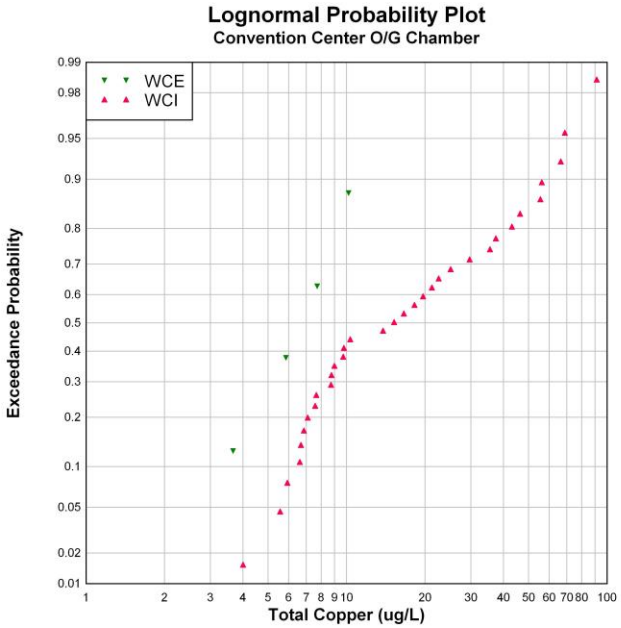


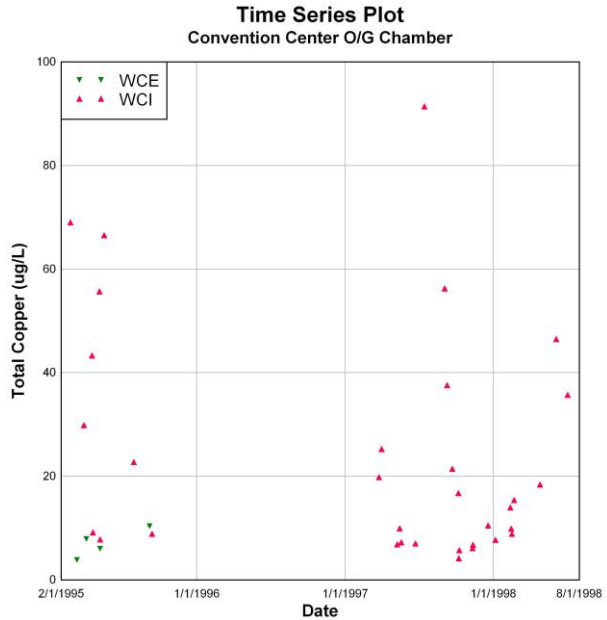


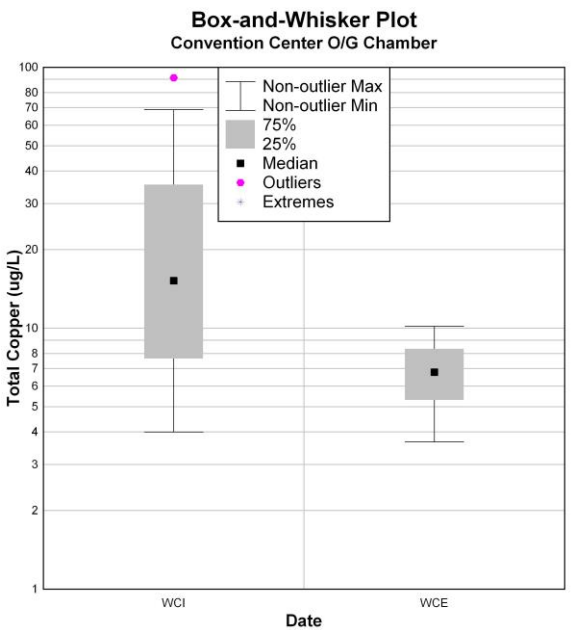


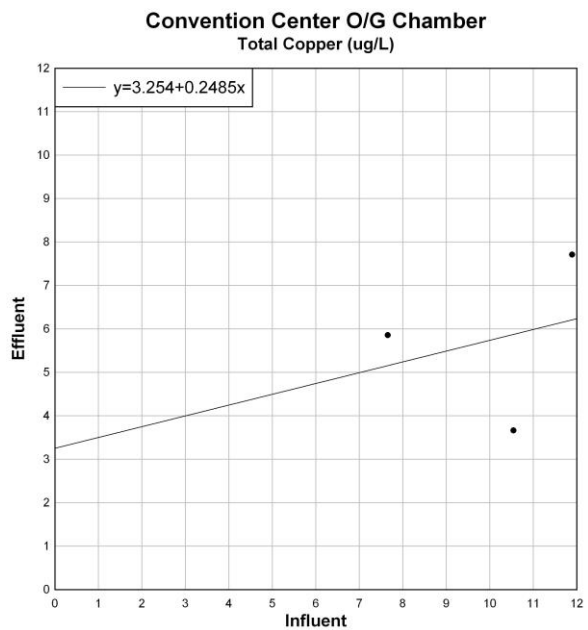
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	34	5
	Pairs Count	4	4
Non-Parametric	Maximum	1711.4	219.6
	Upper Quartile	444.9	211.6
	Median	195.5	140.6
	Lower Quartile	132.9	74.1
	Minimum	63.5	46.3
	Efficiency	28.12%	
	Mann-Whitney	0.1235	
	Wilcoxon (paired)	0.3750	
Arithmetic	UCL	430.2	235.7
	Mean	321.9	138.4
	LCL	213.6	41.1
	Std. Dev.	310.4	78.4
	Wilk (p-value)	0.0001 **	0.3874
	Efficiency	57.00%	
	t-Test (equal var.)	0.2011	
	t-Test (unequal var.)	0.0078 **	
	t-test (paired)	0.2260	
	Levene Test	0.5525	
Log Transformed	UCL	424.3	366.5
	Mean	313.3	140.6
	LCL	231.3	53.9
	Std. Dev.	267.4	94.1
	Wilk (p-value)	0.3408	0.3935
	Efficiency	55.12%	
	t-Test (equal var.)	0.0601 *	
	t-Test (unequal var.)	0.0820 *	
	t-Test (paired)	0.2209	
	Levene Test	0.5621	
Bootstrap	UCL	425.8	223.4
	Mean	323.5	139.8
	LCL	221.1	56.2
	Std. Dev.	293.4	67.3
	Efficiency	56.78%	

Convention Center O/G Chamber - Total Copper (ug/L)



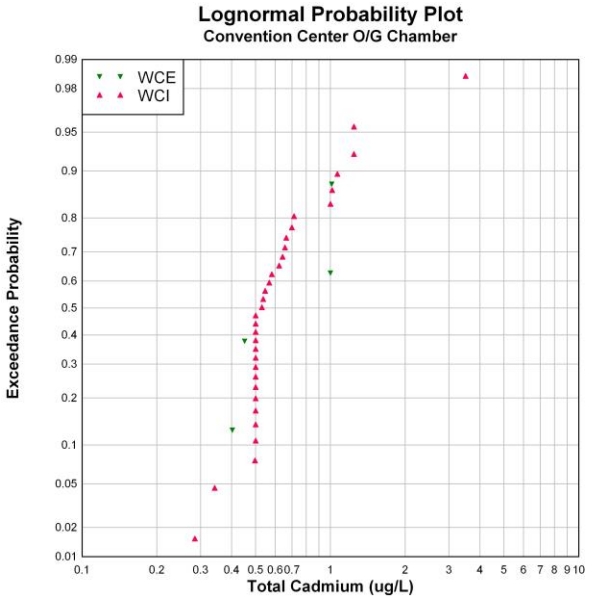


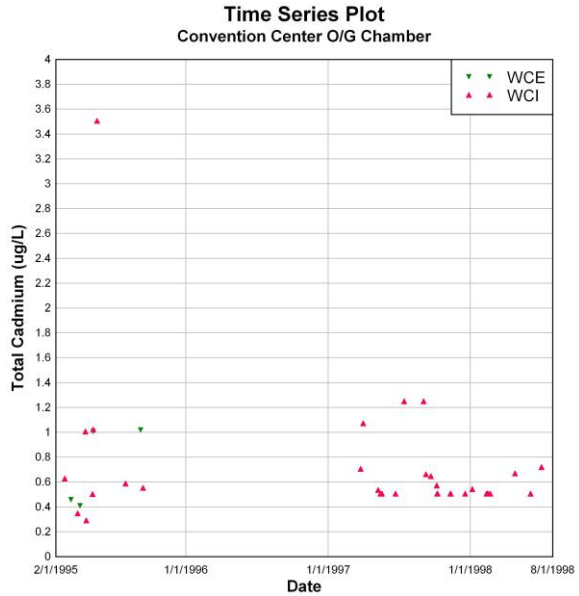


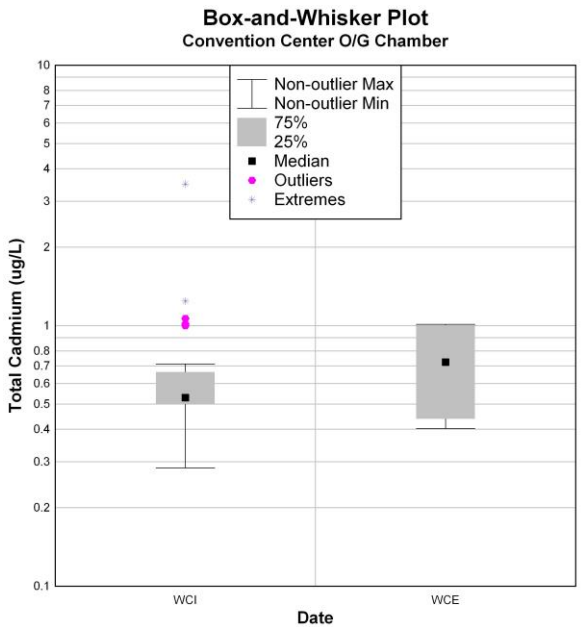


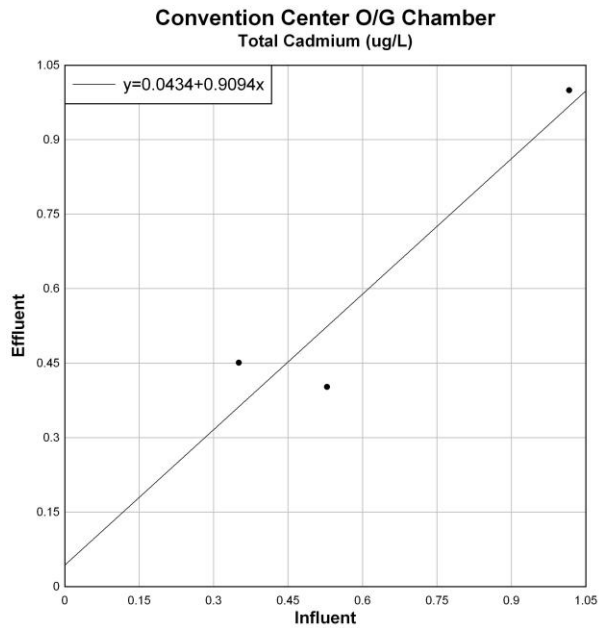
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	33	4
	Pairs Count	3	3
Non-Parametric	Maximum	91.2	10.2
	Upper Quartile	35.5	8.9
	Median	15.2	6.8
	Lower Quartile	7.7	4.8
	Minimum	4.0	3.7
	Efficiency	55.40%	
	Mann-Whitney	0.0553 *	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	32.0	11.3
	Mean	24.1	6.9
	LCL	16.2	2.5
	Std. Dev.	22.3	2.8
	Wilk (p-value)	0.0001 **	0.9920
	Efficiency	71.60%	
	t-Test (equal var.)	0.1351	
	t-Test (unequal var.)	0.0002 **	
	t-test (paired)	0.1001	
	Levene Test	0.2780	
Log Transformed	UCL	34.4	14.3
	Mean	23.9	6.9
	LCL	16.6	3.3
	Std. Dev.	24.1	2.9
	Wilk (p-value)	0.0715 *	0.9215
	Efficiency	71.21%	
	t-Test (equal var.)	0.0410 **	
	t-Test (unequal var.)	0.0102 **	
	t-Test (paired)	0.1350	
	Levene Test	0.1050	
Bootstrap	UCL	32.0	10.5
	Mean	24.2	6.9
	LCL	16.5	3.4
	Std. Dev.	21.8	2.2
	Efficiency	71.47%	

Convention Center O/G Chamber - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: WCI**	**EFF: WCE**
	Site Count	33	4
	Pairs Count	3	3
Non-Parametric	Maximum	3.5	1.0
	Upper Quartile	0.7	1.0
	Median	0.5	0.7
	Lower Quartile	0.5	0.4
	Minimum	0.3	0.4
	Efficiency	-37.07%	
	Mann-Whitney	0.7518	
	Wilcoxon (paired)	0.7500	
Arithmetic	UCL	0.9	1.2
	Mean	0.7	0.7
	LCL	0.5	0.2
	Std. Dev.	0.6	0.3
	Wilk (p-value)	0.0001 **	0.0624 *
	Efficiency	-0.85%	
	t-Test (equal var.)	0.9832	
	t-Test (unequal var.)	0.9763	
	t-test (paired)	0.8524	
	Levene Test	0.7589	
Log Transformed	UCL	0.8	1.7
	Mean	0.7	0.7
	LCL	0.6	0.3
	Std. Dev.	0.3	0.4
	Wilk (p-value)	0.0001 **	0.0833 *
	Efficiency	-4.71%	
	t-Test (equal var.)	0.8295	
	t-Test (unequal var.)	0.8526	
	t-Test (paired)	0.9445	
	Levene Test	0.9720	
Bootstrap	UCL	0.9	1.1
	Mean	0.7	0.7
	LCL	0.5	0.3
	Std. Dev.	0.5	0.3
	Efficiency	-0.27%	

45th Street O/G Chamber (WDI-WDE)

Watershed runoff enters from the influent monitoring station (WDI). See WDI in the COA reports on small watershed quantity and quality (2009) for details in the drainage area.

This oil and grit separator is a small Two-Chamber Separator installed in the parking lot of an auto repair facility. It has a capacity of less than 30cu.ft. Samples were taken before water leaves the chamber through a 4" PVC pipe to storm sewer inlet box (WDE).

The City collected 14 EMCs at the influent and effluent in 1995; only 13 EMCs were paired.

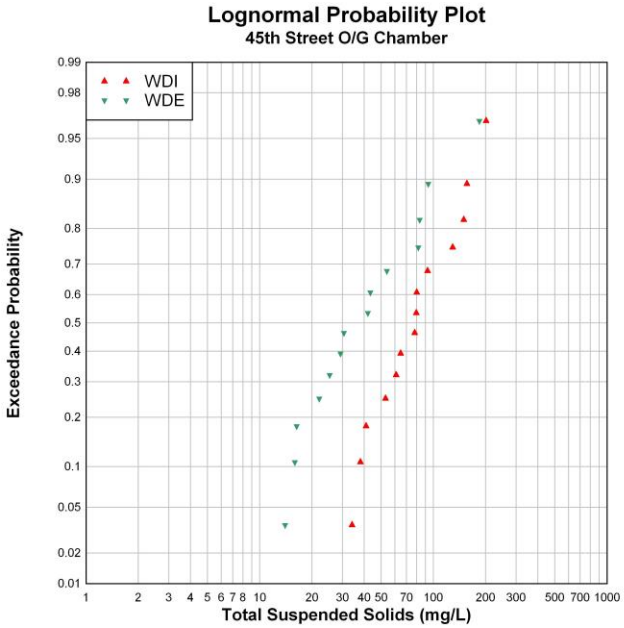
Performance Summary (WDI-WDE)

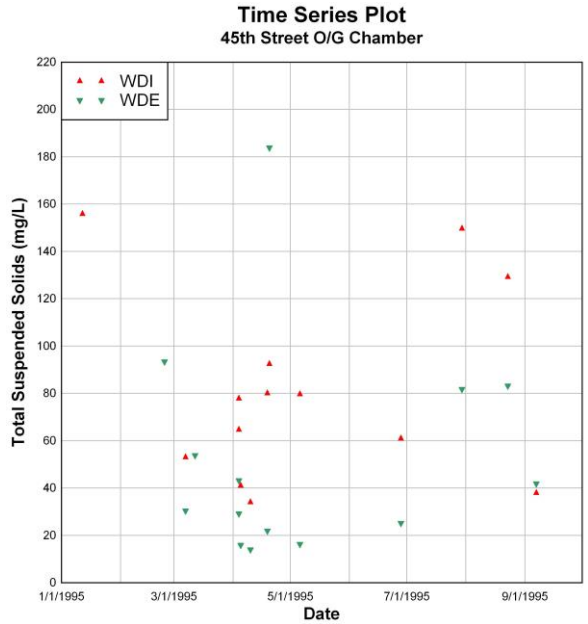
TSS (40%), VSS (56%), COD (32%), TN (20%) and TP (36%) concentrations were significantly reduced.

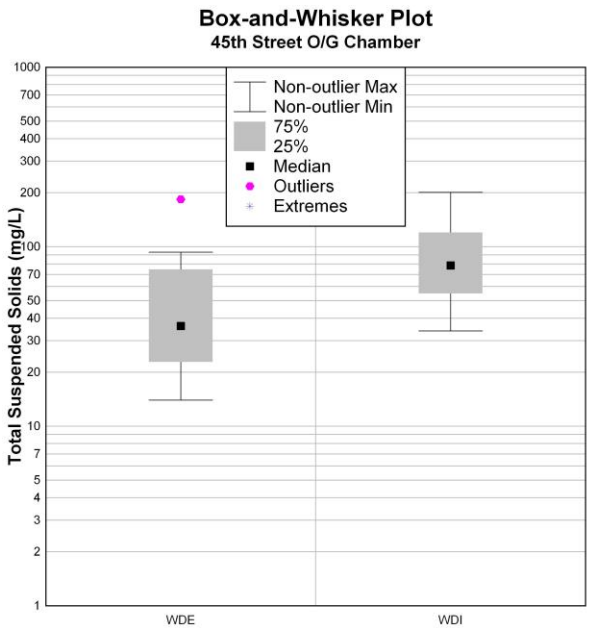
Nitrate + Nitrite was significantly reduced by 43%; however ammonia concentrations increased by 78%. It is assumed that the reduction of nitrate and the increase in ammonia are related and due to denitrification in the anaerobic conditions in the chamber.

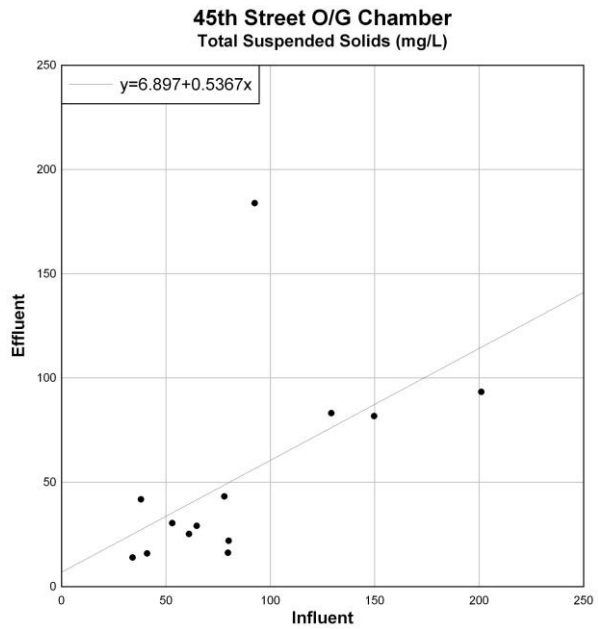
The influent and effluent concentrations for other parameters were not significantly different.

45th Street O/G Chamber - Total Suspended Solids (mg/L)



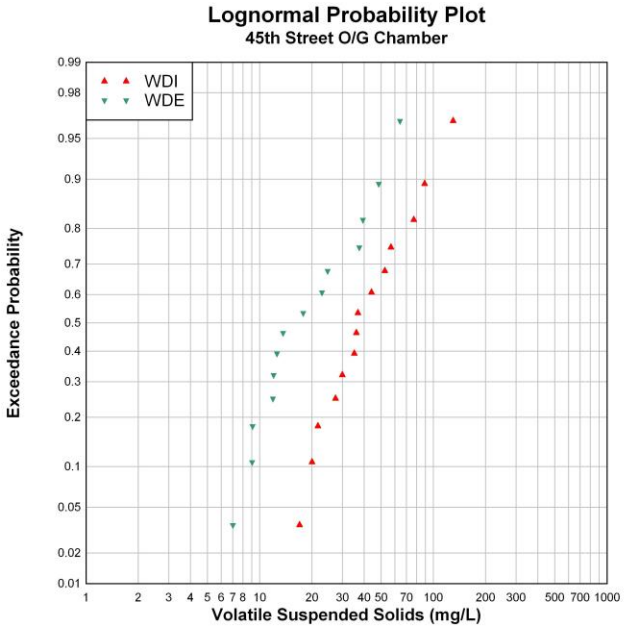


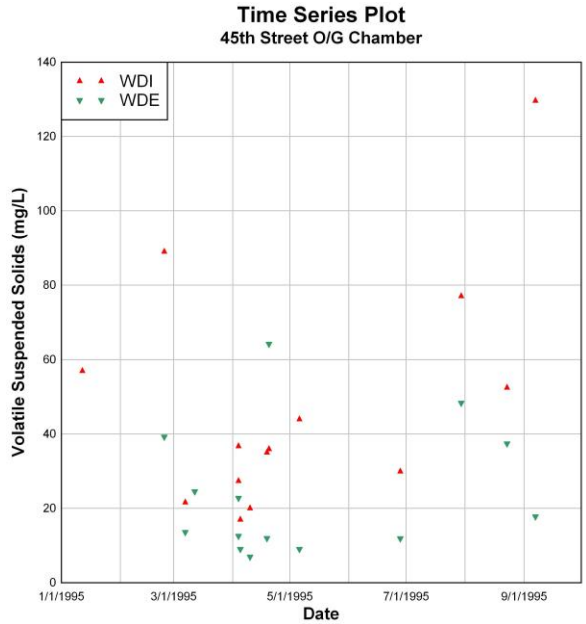


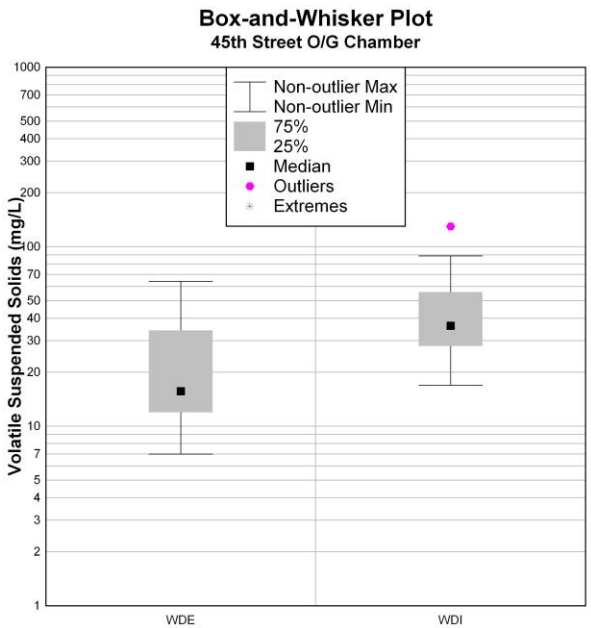


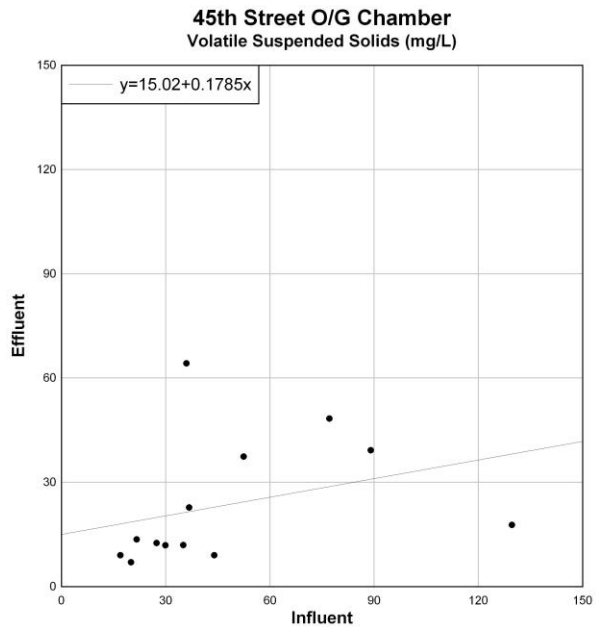
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	200.9	183.9
	Upper Quartile	129.2	81.8
	Median	78.8	36.2
	Lower Quartile	53.0	22.0
	Minimum	34.0	14.0
	Efficiency	54.06%	
	Mann-Whitney	0.0418 **	
	Wilcoxon (paired)	0.0215 **	
Arithmetic	UCL	119.0	79.2
	Mean	89.8	52.5
	LCL	60.6	25.8
	Std. Dev.	50.5	46.2
	Wilk (p-value)	0.0925 *	0.0027 **
	Efficiency	41.56%	
	t-Test (equal var.)	0.0518 *	
	t-Test (unequal var.)	0.0518 *	
	t-test (paired)	0.0269 **	
	Levene Test	0.7936	
Log Transformed	UCL	126.4	85.6
	Mean	89.7	51.4
	LCL	63.6	30.9
	Std. Dev.	51.3	42.4
	Wilk (p-value)	0.7307	0.6171
	Efficiency	42.69%	
	t-Test (equal var.)	0.0116 **	
	t-Test (unequal var.)	0.0122 **	
	t-Test (paired)	0.0014 **	
	Levene Test	0.1640	
Bootstrap	UCL	116.7	77.2
	Mean	89.3	52.7
	LCL	61.9	28.1
	Std. Dev.	47.5	42.6
	Efficiency	41.05%	

45th Street O/G Chamber - Volatile Suspended Solids (mg/L)



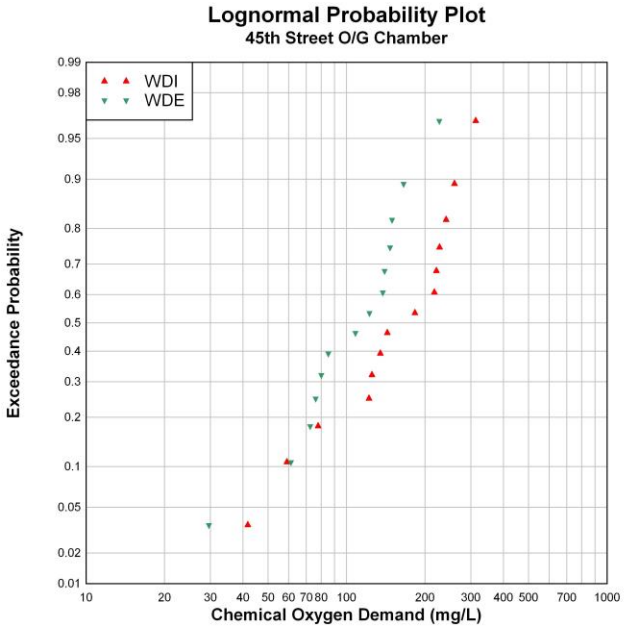


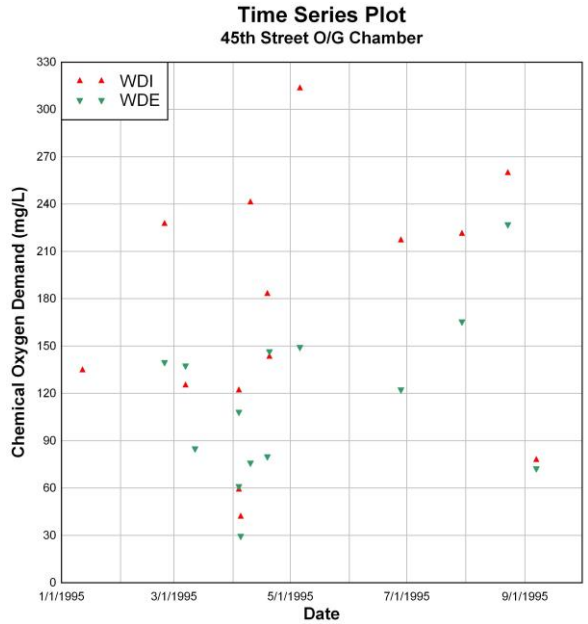


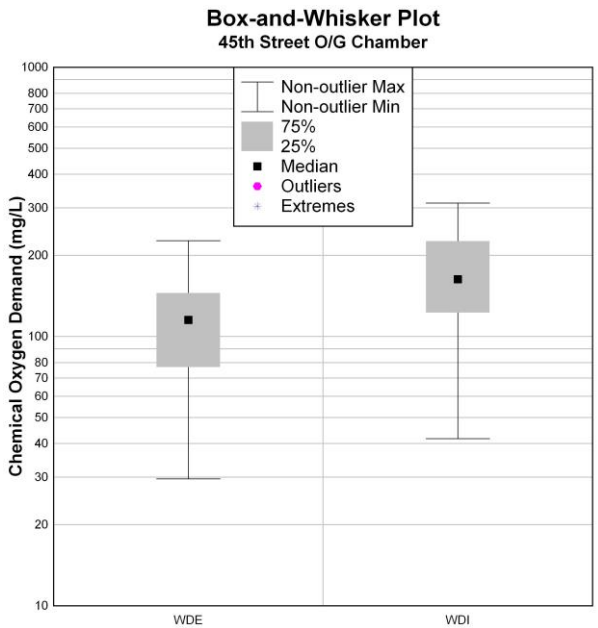


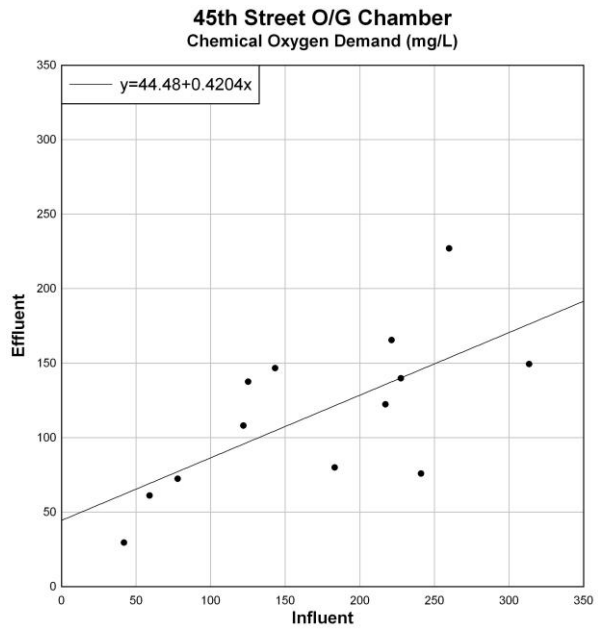
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	129.6	64.2
	Upper Quartile	57.0	37.5
	Median	36.3	15.7
	Lower Quartile	27.3	11.9
	Minimum	16.9	7.0
	Efficiency	56.79%	
	Mann-Whitney	0.0186 **	
	Wilcoxon (paired)	0.0081 **	
Arithmetic	UCL	66.3	33.6
	Mean	48.0	23.5
	LCL	29.8	13.5
	Std. Dev.	31.6	17.4
	Wilk (p-value)	0.0182 **	0.0176 **
	Efficiency	50.98%	
	t-Test (equal var.)	0.0173 **	
	t-Test (unequal var.)	0.0193 **	
	t-test (paired)	0.0193 **	
	Levene Test	0.1843	
Log Transformed	UCL	68.9	36.5
	Mean	47.5	23.3
	LCL	32.8	14.9
	Std. Dev.	29.2	17.1
	Wilk (p-value)	0.8940	0.4355
	Efficiency	51.00%	
	t-Test (equal var.)	0.0038 **	
	t-Test (unequal var.)	0.0039 **	
	t-Test (paired)	0.0008 **	
	Levene Test	0.4370	
Bootstrap	UCL	65.8	33.1
	Mean	48.5	23.6
	LCL	31.2	14.1
	Std. Dev.	29.9	16.4
	Efficiency	51.33%	

45th Street O/G Chamber - Chemical Oxygen Demand (mg/L)



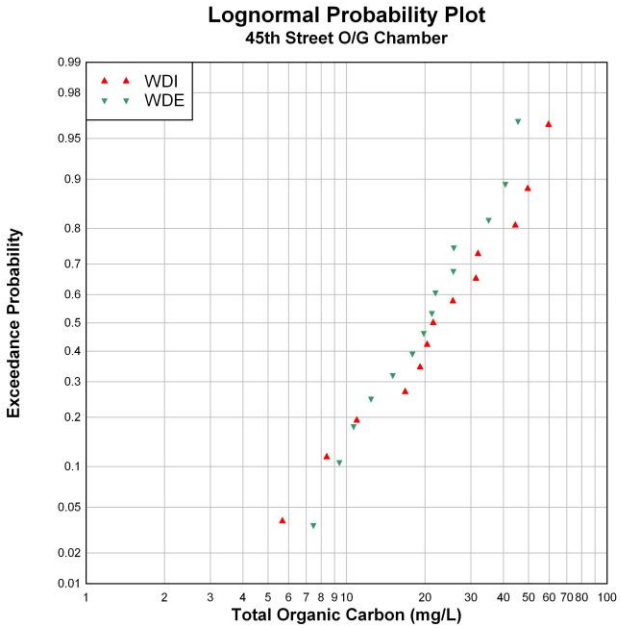


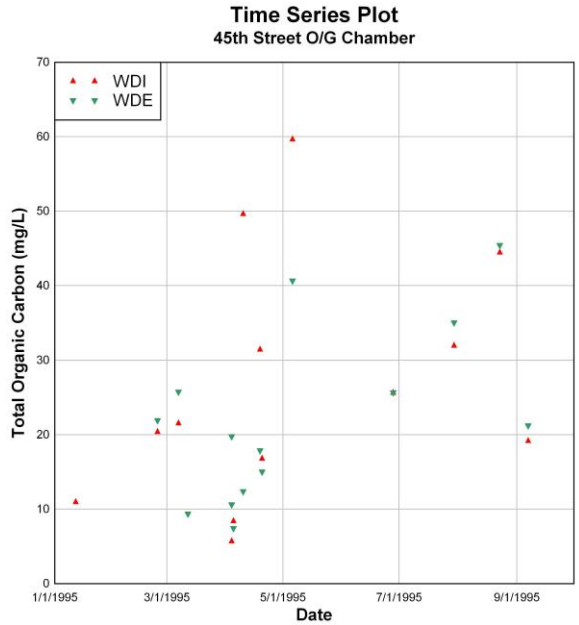


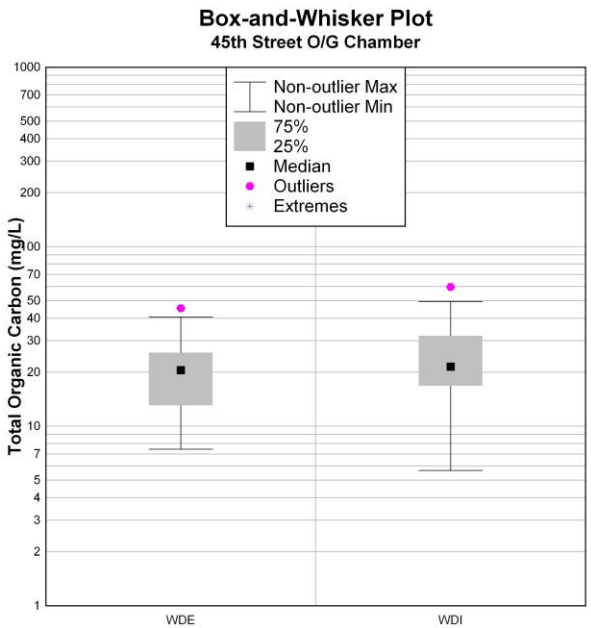


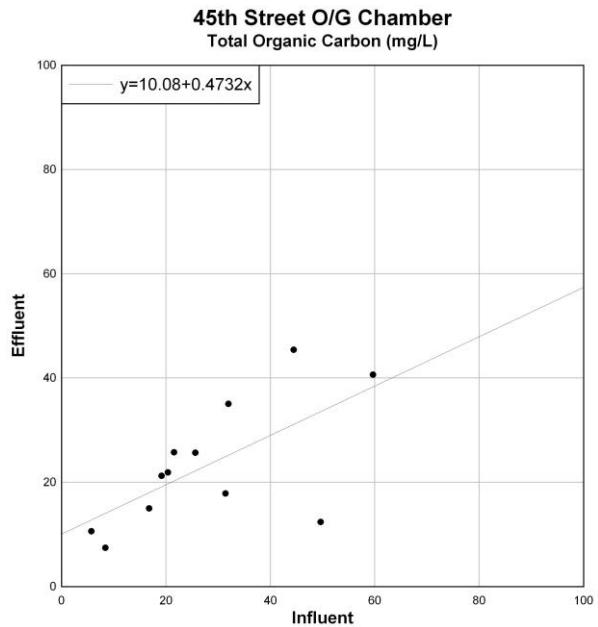
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	313.36	227.15
	Upper Quartile	227.48	146.73
	Median	163.08	115.35
	Lower Quartile	121.86	76.00
	Minimum	41.75	29.58
	Efficiency	29.27%	
	Mann-Whitney	0.1145	
	Wilcoxon (paired)	0.0061 **	
Arithmetic	UCL	215.82	143.98
	Mean	169.00	114.38
	LCL	122.18	84.77
	Std. Dev.	81.10	51.28
	Wilk (p-value)	0.8041	0.8012
	Efficiency	32.32%	
	t-Test (equal var.)	0.0428 **	
	t-Test (unequal var.)	0.0446 **	
	t-test (paired)	0.0079 **	
	Levene Test	0.0681 *	
Log Transformed	UCL	251.40	159.53
	Mean	172.92	115.98
	LCL	118.94	84.32
	Std. Dev.	107.18	61.86
	Wilk (p-value)	0.2005	0.4033
	Efficiency	32.93%	
	t-Test (equal var.)	0.0989 *	
	t-Test (unequal var.)	0.0992 *	
	t-Test (paired)	0.0062 **	
	Levene Test	0.6176	
Bootstrap	UCL	213.38	142.50
	Mean	168.89	114.32
	LCL	124.39	86.15
	Std. Dev.	77.06	48.80
	Efficiency	32.31%	

45th Street O/G Chamber - Total Organic Carbon (mg/L)



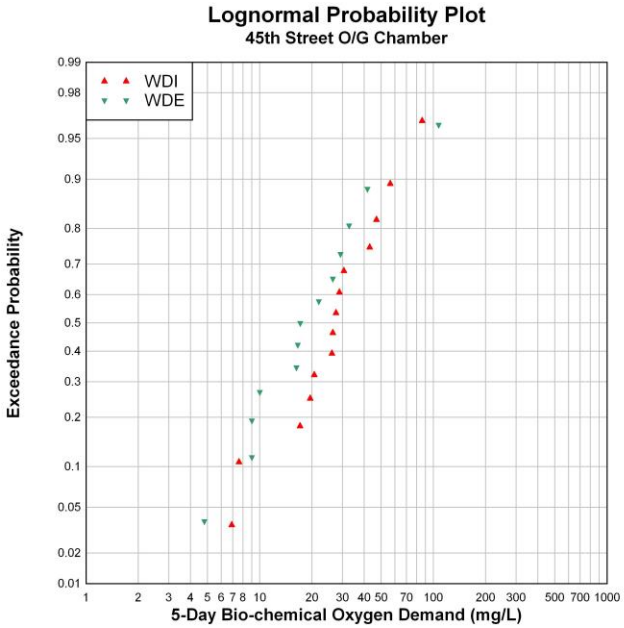


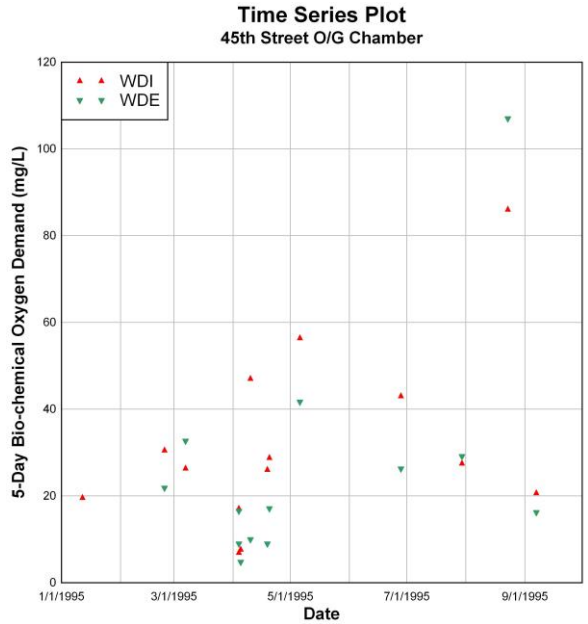


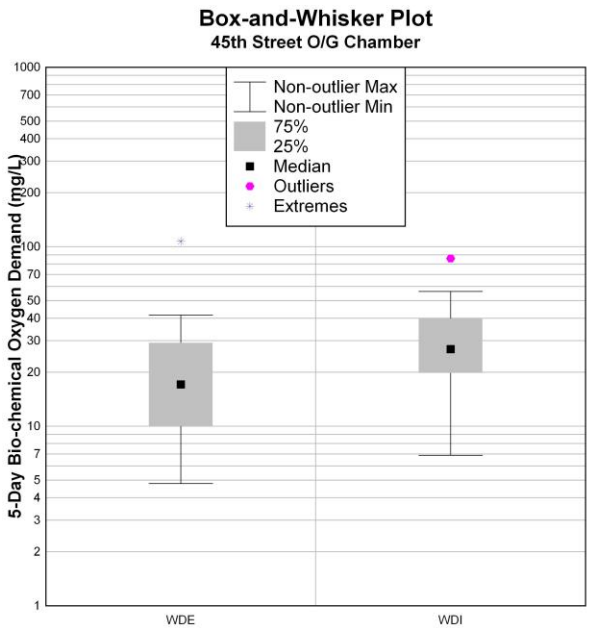


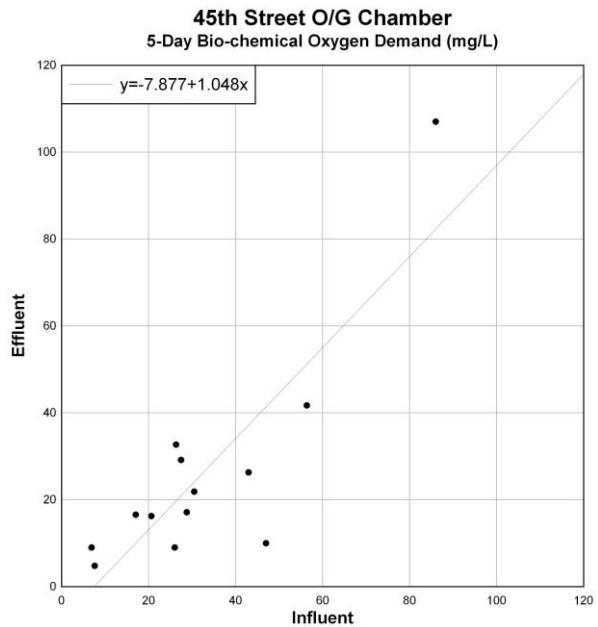
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	13	14
	Pairs Count	12	12
Non-Parametric	Maximum	59.65	45.46
	Upper Quartile	31.94	25.77
	Median	21.51	20.52
	Lower Quartile	16.77	12.40
	Minimum	5.67	7.45
	Efficiency	4.61%	
	Mann-Whitney	0.6147	
	Wilcoxon (paired)	0.9697	
Arithmetic	UCL	36.48	28.75
	Mean	26.57	22.03
	LCL	16.67	15.31
	Std. Dev.	16.39	11.64
	Wilk (p-value)	0.4038	0.2797
	Efficiency	17.09%	
	t-Test (equal var.)	0.4116	
	t-Test (unequal var.)	0.4187	
	t-test (paired)	0.2305	
	Levene Test	0.2049	
Log Transformed	UCL	43.45	31.08
	Mean	27.11	22.12
	LCL	16.92	15.75
	Std. Dev.	19.86	12.53
	Wilk (p-value)	0.8539	0.9214
	Efficiency	18.41%	
	t-Test (equal var.)	0.6164	
	t-Test (unequal var.)	0.6200	
	t-Test (paired)	0.4143	
	Levene Test	0.3242	
Bootstrap	UCL	36.02	28.51
	Mean	26.67	22.13
	LCL	17.32	15.76
	Std. Dev.	15.47	11.04
	Efficiency	17.02%	

45th Street O/G Chamber - 5-Day Bio-chemical Oxygen Demand (mg/L)



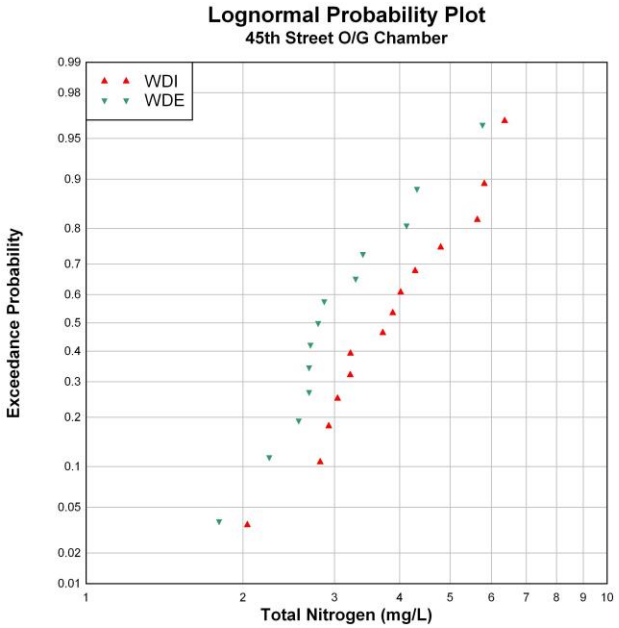


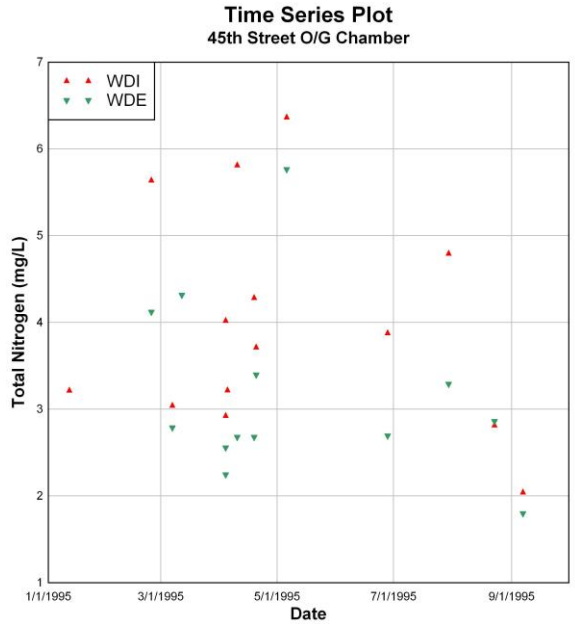


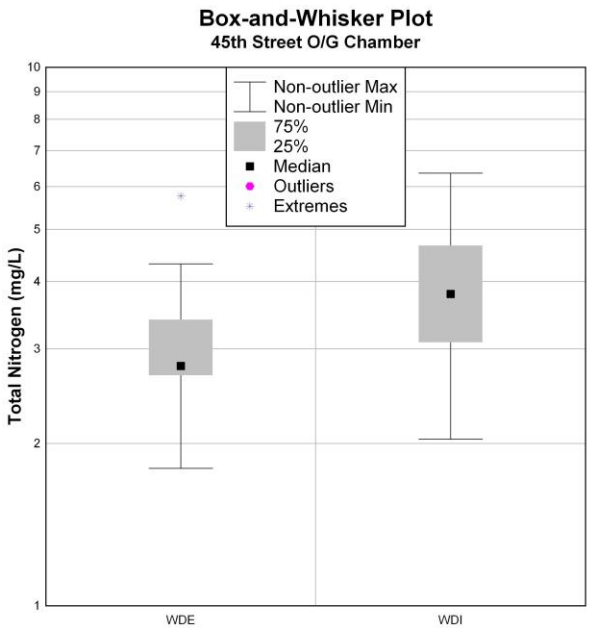


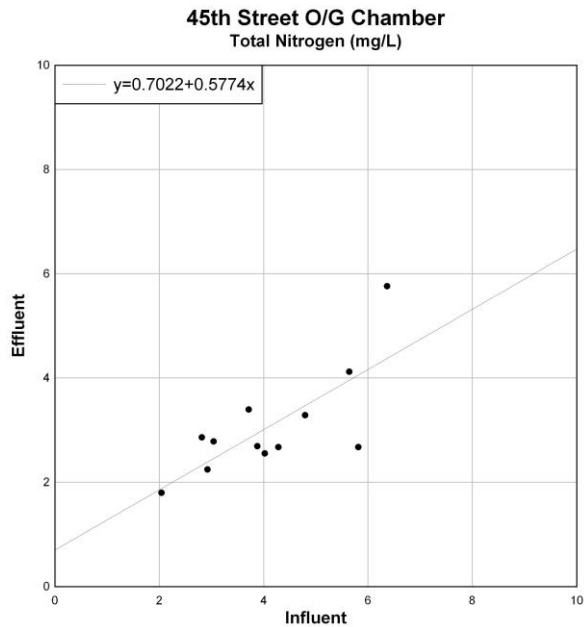
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	13
	Pairs Count	13	13
Non-Parametric	Maximum	86.00	107.01
	Upper Quartile	42.99	29.18
	Median	26.87	17.12
	Lower Quartile	19.53	10.00
	Minimum	6.90	4.80
	Efficiency	36.29%	
	Mann-Whitney	0.2849	
	Wilcoxon (paired)	0.1272	
Arithmetic	UCL	43.72	42.29
	Mean	31.64	26.27
	LCL	19.57	10.26
	Std. Dev.	20.92	26.50
	Wilk (p-value)	0.0578 *	0.0004 **
	Efficiency	16.97%	
	t-Test (equal var.)	0.5626	
	t-Test (unequal var.)	0.5666	
	t-test (paired)	0.1311	
	Levene Test	0.6448	
Log Transformed	UCL	50.41	44.64
	Mean	32.16	25.47
	LCL	20.52	14.53
	Std. Dev.	23.62	21.84
	Wilk (p-value)	0.5584	0.9305
	Efficiency	20.80%	
	t-Test (equal var.)	0.3030	
	t-Test (unequal var.)	0.3061	
	t-Test (paired)	0.0459 **	
	Levene Test	0.6265	
Bootstrap	UCL	43.02	40.10
	Mean	31.74	26.20
	LCL	20.46	12.29
	Std. Dev.	19.54	23.01
	Efficiency	17.45%	

45th Street O/G Chamber - Total Nitrogen (mg/L)



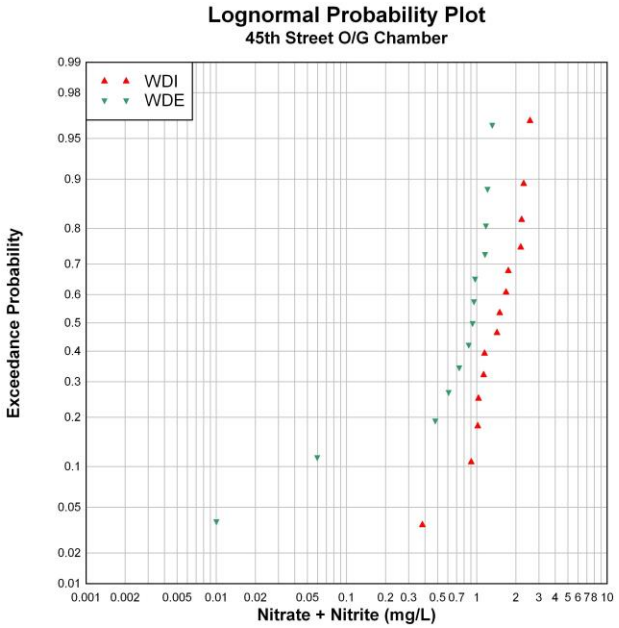


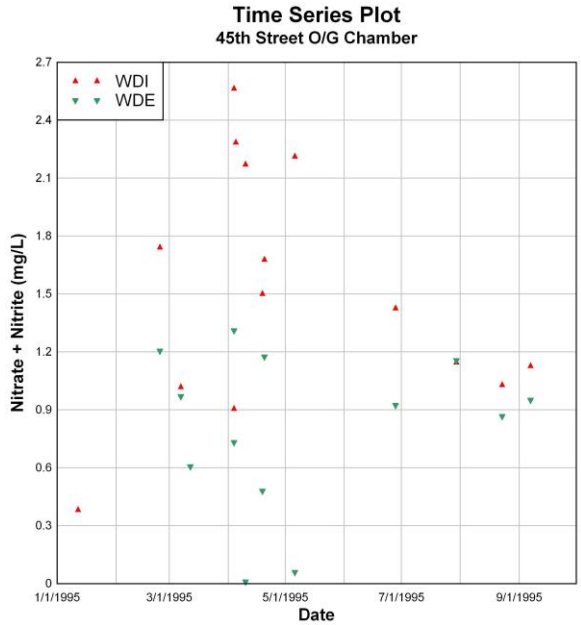


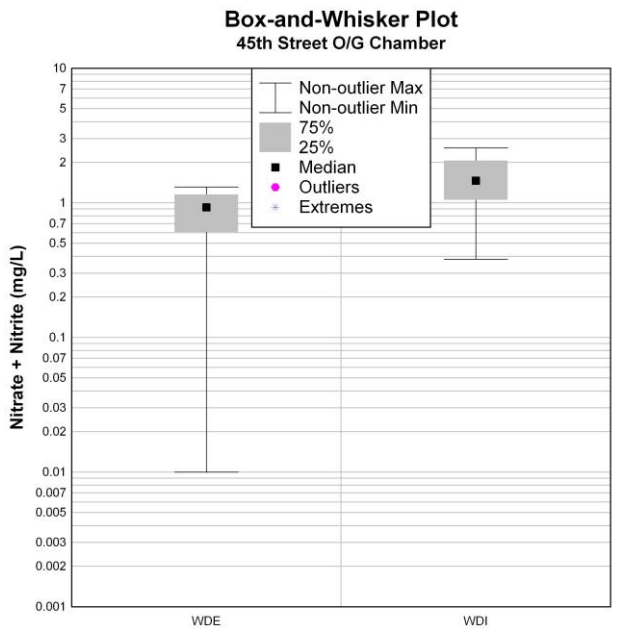


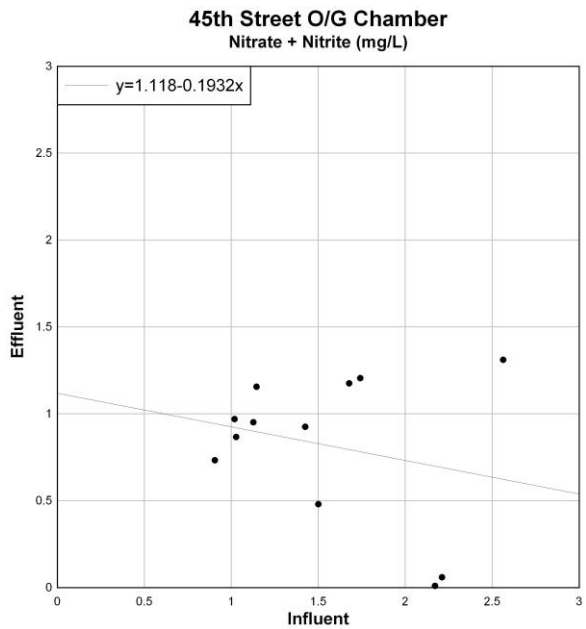
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	13
	Pairs Count	12	12
Non-Parametric	Maximum	6.361	5.765
	Upper Quartile	4.791	3.399
	Median	3.794	2.789
	Lower Quartile	3.040	2.680
	Minimum	2.040	1.800
	Efficiency	26.50%	
	Mann-Whitney	0.0663 *	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	4.712	3.800
	Mean	3.981	3.170
	LCL	3.249	2.539
	Std. Dev.	1.268	1.044
	Wilk (p-value)	0.4693	0.0683 *
	Efficiency	20.37%	
	t-Test (equal var.)	0.0829 *	
	t-Test (unequal var.)	0.0810 *	
	t-test (paired)	0.0019 **	
	Levene Test	0.4812	
Log Transformed	UCL	4.812	3.814
	Mean	3.982	3.163
	LCL	3.295	2.623
	Std. Dev.	1.287	0.966
	Wilk (p-value)	0.8837	0.6389
	Efficiency	20.56%	
	t-Test (equal var.)	0.0722 *	
	t-Test (unequal var.)	0.0716 *	
	t-Test (paired)	0.0011 **	
	Levene Test	0.8252	
Bootstrap	UCL	4.662	3.748
	Mean	3.965	3.158
	LCL	3.269	2.569
	Std. Dev.	1.206	0.976
	Efficiency	20.35%	

45th Street O/G Chamber - Nitrate + Nitrite (mg/L)



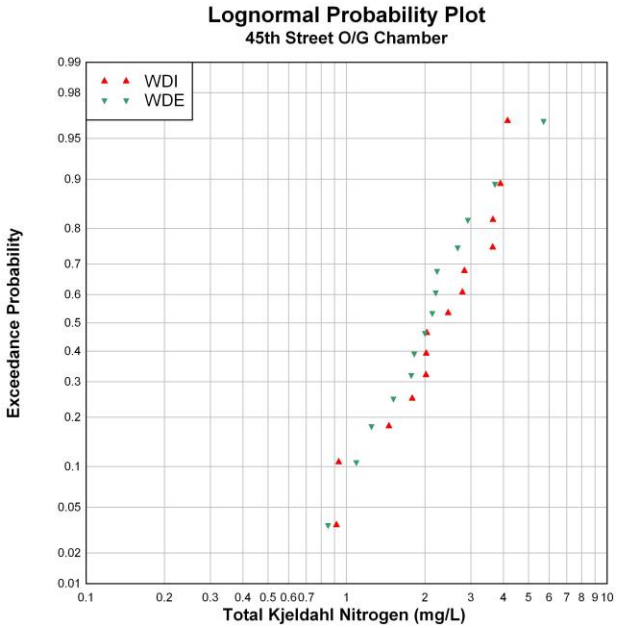


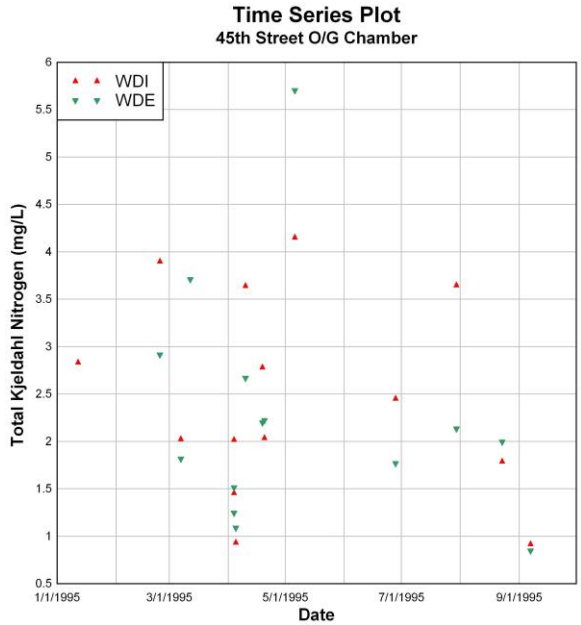


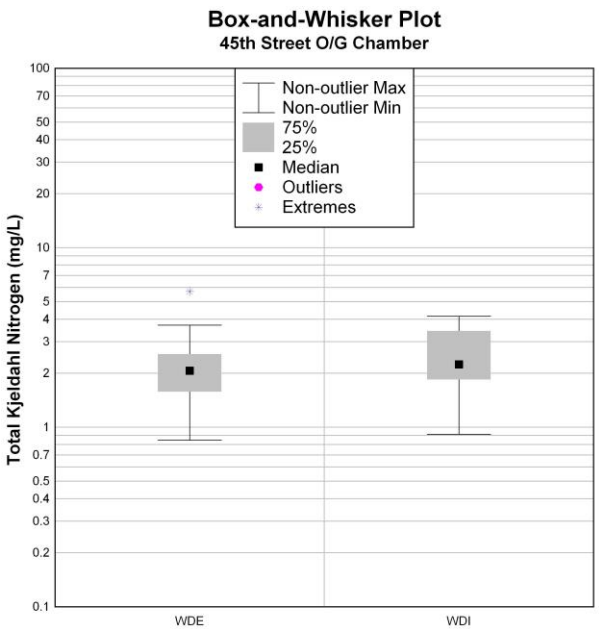


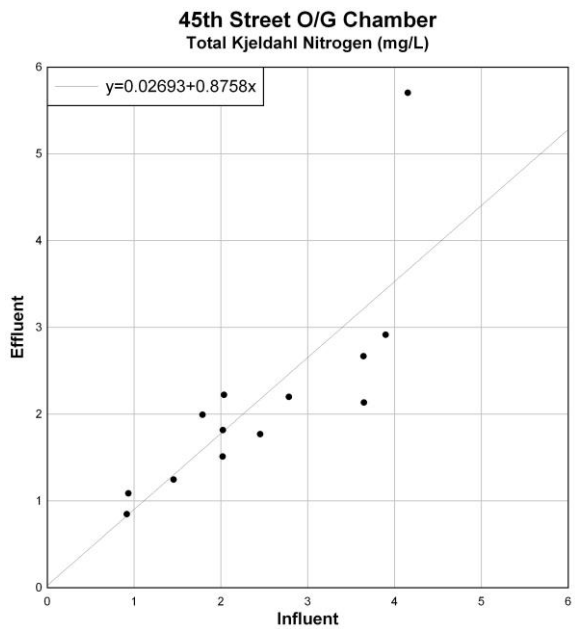
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	13
	Pairs Count	12	12
Non-Parametric	Maximum	2.563	1.311
	Upper Quartile	2.170	1.156
	Median	1.462	0.925
	Lower Quartile	1.027	0.607
	Minimum	0.381	0.010
	Efficiency	36.73%	
	Mann-Whitney	0.0109 **	
	Wilcoxon (paired)	0.0010 **	
Arithmetic	UCL	1.875	1.056
	Mean	1.512	0.804
	LCL	1.150	0.552
	Std. Dev.	0.628	0.417
	Wilk (p-value)	0.7567	0.1428
	Efficiency	46.83%	
	t-Test (equal var.)	0.0021 **	
	t-Test (unequal var.)	0.0021 **	
	t-test (paired)	0.0078 **	
	Levene Test	0.1084	
Log Transformed	UCL	2.090	4.475
	Mean	1.536	1.270
	LCL	1.130	0.360
	Std. Dev.	0.792	2.217
	Wilk (p-value)	0.1372	0.0001 **
	Efficiency	17.37%	
	t-Test (equal var.)	0.0253 **	
	t-Test (unequal var.)	0.0360 **	
	t-Test (paired)	0.0546 *	
	Levene Test	0.1608	
Bootstrap	UCL	1.858	1.044
	Mean	1.515	0.805
	LCL	1.171	0.567
	Std. Dev.	0.595	0.394
	Efficiency	46.83%	

45th Street O/G Chamber -Total Kjeldahl Nitrogen (mg/L)



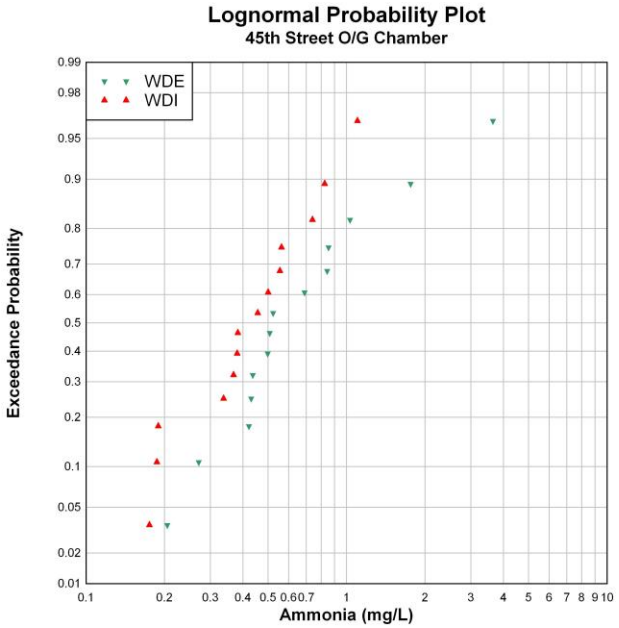


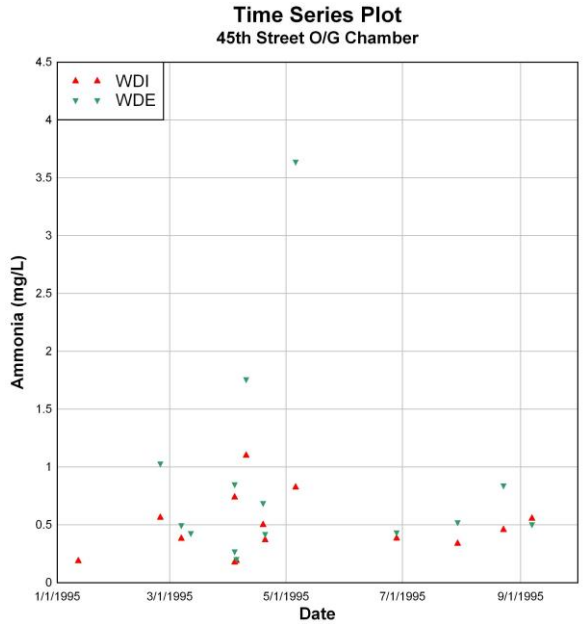


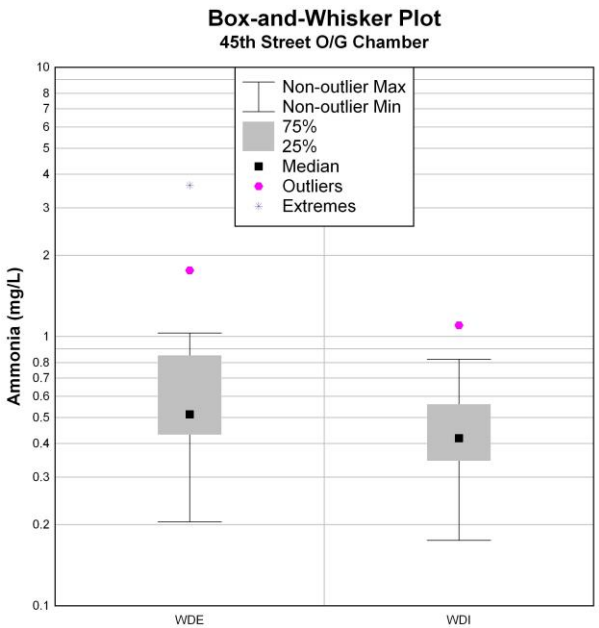


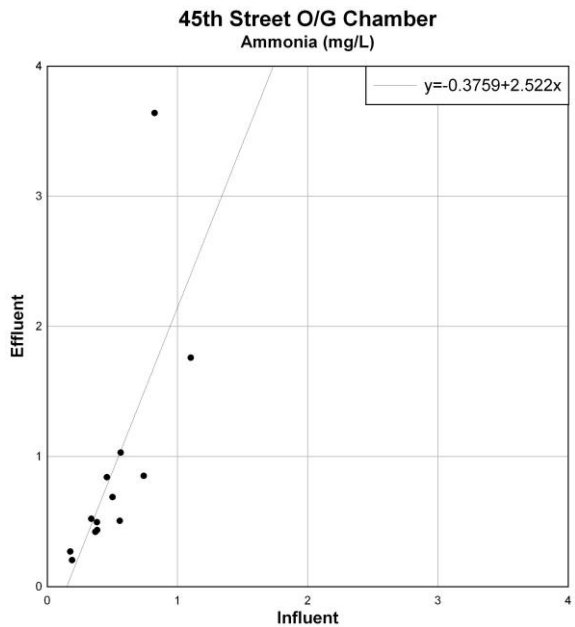
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	4.151	5.705
	Upper Quartile	3.640	2.670
	Median	2.243	2.065
	Lower Quartile	1.786	1.514
	Minimum	0.914	0.849
	Efficiency	7.93%	
	Mann-Whitney	0.5109	
	Wilcoxon (paired)	0.1465	
Arithmetic	UCL	3.083	2.991
	Mean	2.468	2.275
	LCL	1.854	1.558
	Std. Dev.	1.064	1.241
	Wilk (p-value)	0.4355	0.0218 **
	Efficiency	7.85%	
	t-Test (equal var.)	0.6611	
	t-Test (unequal var.)	0.6612	
	t-test (paired)	0.2124	
	Levene Test	0.6634	
Log Transformed	UCL	3.364	3.063
	Mean	2.492	2.263
	LCL	1.846	1.672
	Std. Dev.	1.255	1.148
	Wilk (p-value)	0.2326	0.9894
	Efficiency	9.18%	
	t-Test (equal var.)	0.6022	
	t-Test (unequal var.)	0.6022	
	t-Test (paired)	0.0819 *	
	Levene Test	0.9773	
Bootstrap	UCL	3.043	2.921
	Mean	2.457	2.261
	LCL	1.871	1.601
	Std. Dev.	1.015	1.143
	Efficiency	8.00%	

45th Street O/G Chamber - Ammonia (mg/L)



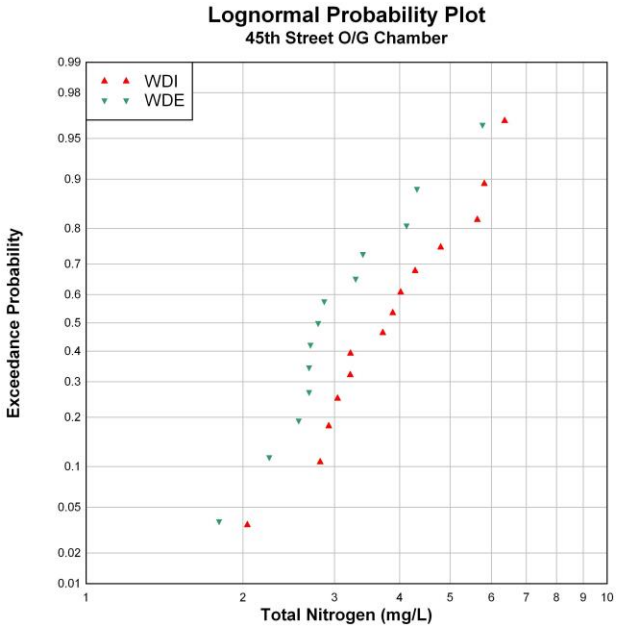


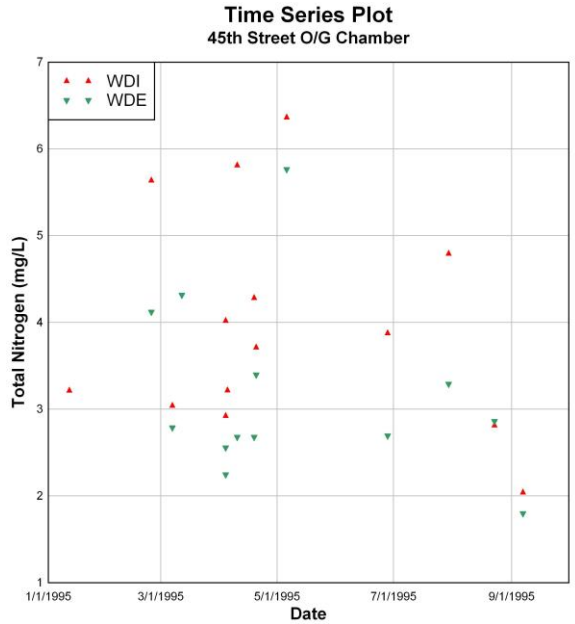


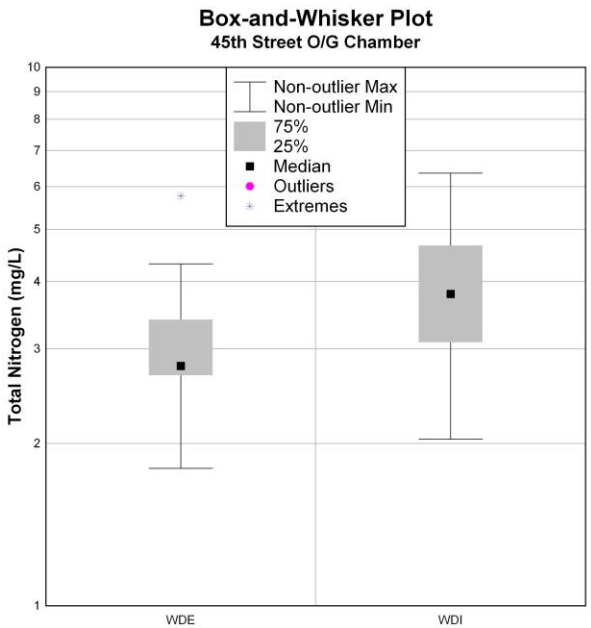


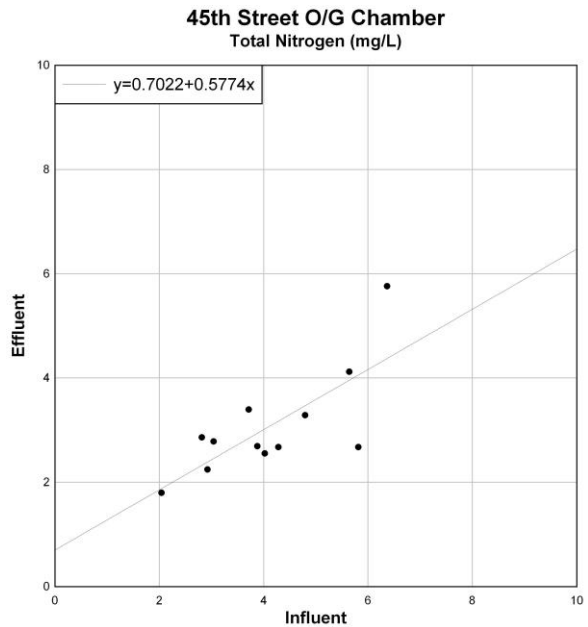
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	1.100	3.641
	Upper Quartile	0.562	0.852
	Median	0.419	0.514
	Lower Quartile	0.337	0.431
	Minimum	0.175	0.205
	Efficiency	-22.67%	
	Mann-Whitney	0.1470	
	Wilcoxon (paired)	0.0007 **	
Arithmetic	UCL	0.634	1.379
	Mean	0.483	0.865
	LCL	0.331	0.351
	Std. Dev.	0.263	0.890
	Wilk (p-value)	0.1794	0.0001 **
	Efficiency	-79.23%	
	t-Test (equal var.)	0.1355	
	t-Test (unequal var.)	0.1439	
	t-test (paired)	0.0853 *	
	Levene Test	0.2245	
Log Transformed	UCL	0.686	1.333
	Mean	0.485	0.820
	LCL	0.342	0.505
	Std. Dev.	0.280	0.647
	Wilk (p-value)	0.5551	0.3804
	Efficiency	-69.28%	
	t-Test (equal var.)	0.1021	
	t-Test (unequal var.)	0.1030	
	t-Test (paired)	0.0039 **	
	Levene Test	0.3675	
Bootstrap	UCL	0.626	1.317
	Mean	0.484	0.865
	LCL	0.341	0.412
	Std. Dev.	0.246	0.784
	Efficiency	-78.78%	

45th Street O/G Chamber - Total Phosphorus (mg/L)



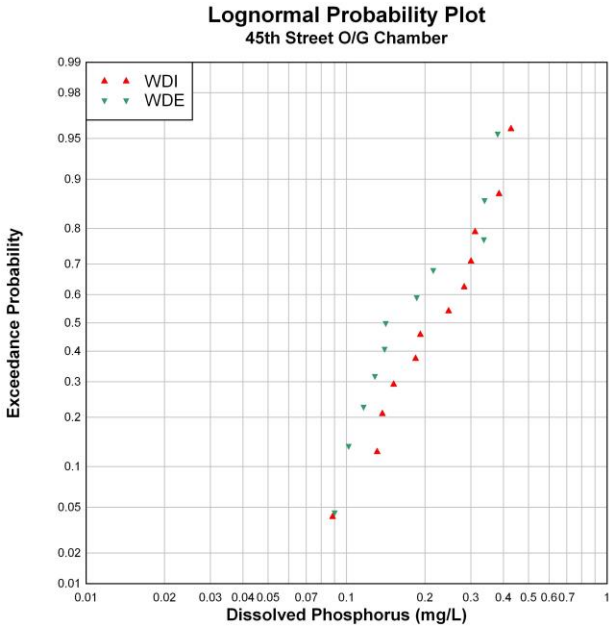


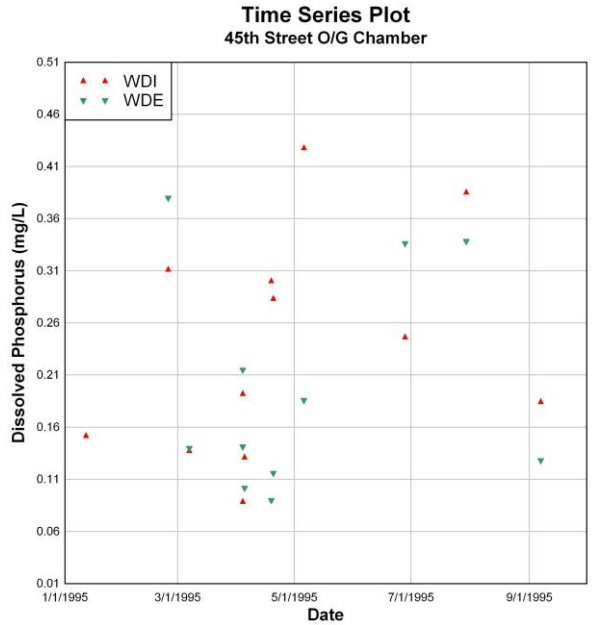


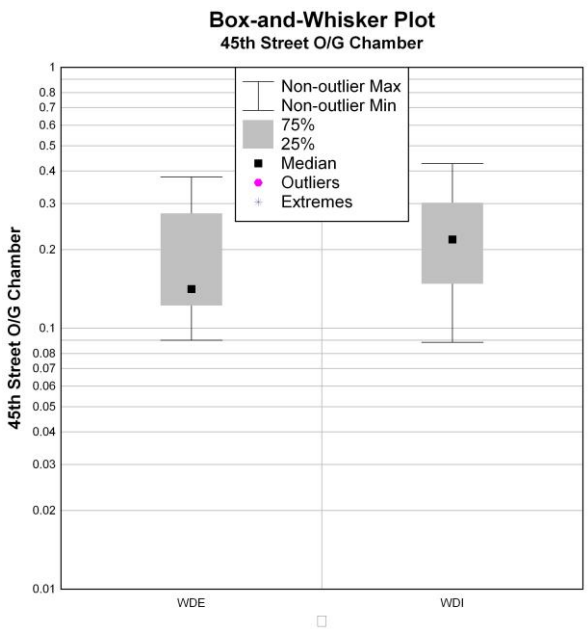


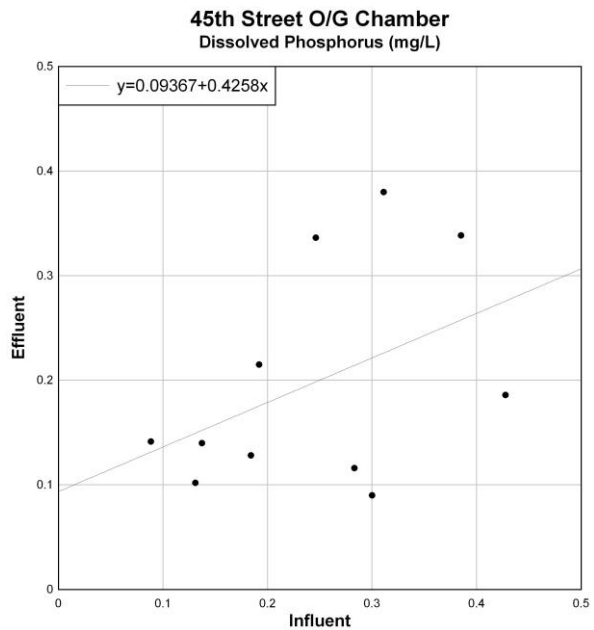
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	1.108	0.750
	Upper Quartile	0.913	0.542
	Median	0.692	0.418
	Lower Quartile	0.479	0.311
	Minimum	0.266	0.163
	Efficiency	39.63%	
	Mann-Whitney	0.0229 **	
	Wilcoxon (paired)	0.0046 **	
Arithmetic	UCL	0.854	0.536
	Mean	0.692	0.441
	LCL	0.530	0.345
	Std. Dev.	0.281	0.165
	Wilk (p-value)	0.5875	0.9453
	Efficiency	36.28%	
	t-Test (equal var.)	0.0078 **	
	t-Test (unequal var.)	0.0089 **	
	t-test (paired)	0.0050 **	
	Levene Test	0.0236 **	
Log Transformed	UCL	0.922	0.566
	Mean	0.697	0.443
	LCL	0.527	0.347
	Std. Dev.	0.328	0.184
	Wilk (p-value)	0.3468	0.8186
	Efficiency	36.47%	
	t-Test (equal var.)	0.0139 **	
	t-Test (unequal var.)	0.0140 **	
	t-Test (paired)	0.0022 **	
	Levene Test	0.6237	
Bootstrap	UCL	0.846	0.530
	Mean	0.692	0.440
	LCL	0.538	0.349
	Std. Dev.	0.267	0.157
	Efficiency	36.43%	

45th Street O/G Chamber - Dissolved Phosphorus (mg/L)



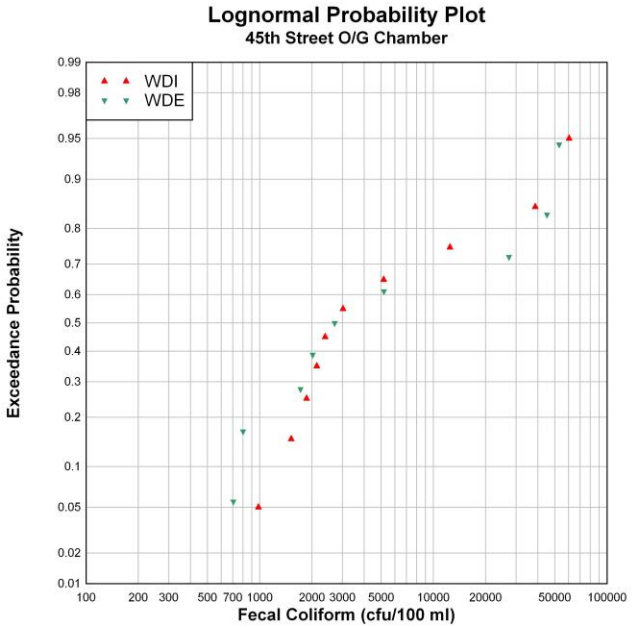


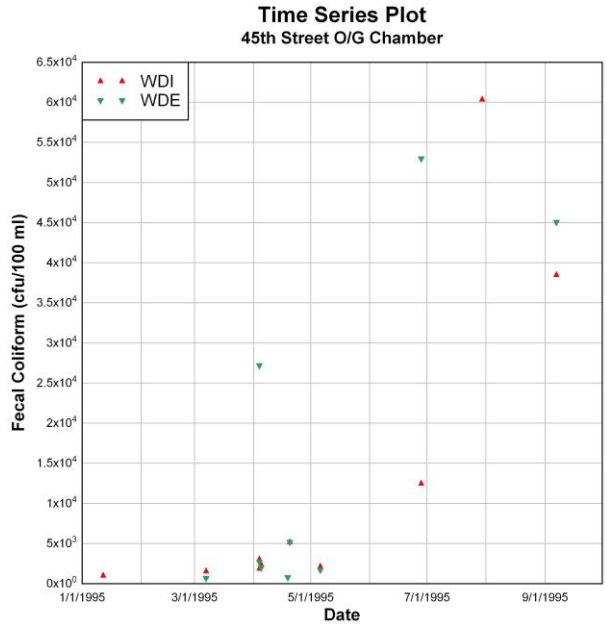


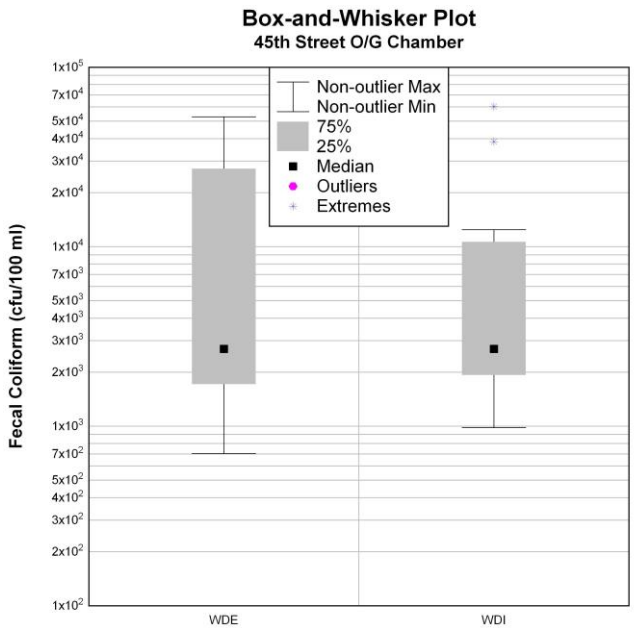


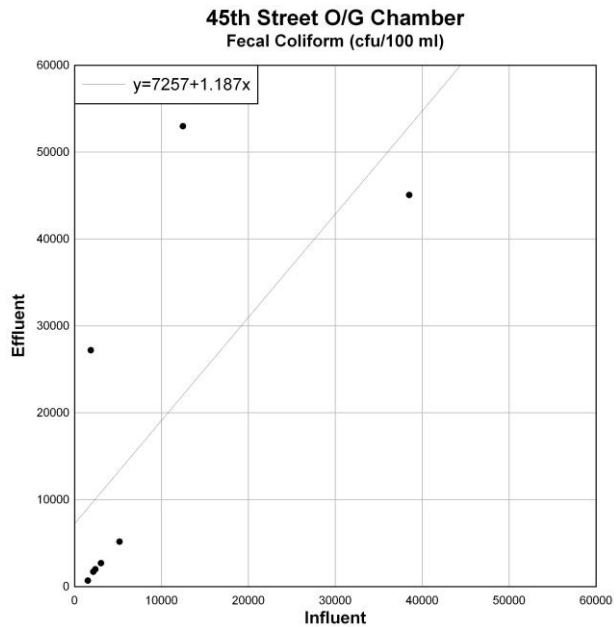
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	12	11
	Pairs Count	11	11
Non-Parametric	Maximum	0.428	0.380
	Upper Quartile	0.306	0.336
	Median	0.219	0.141
	Lower Quartile	0.144	0.116
	Minimum	0.088	0.090
	Efficiency	35.43%	
	Mann-Whitney	0.3818	
	Wilcoxon (paired)	0.4131	
Arithmetic	UCL	0.304	0.269
	Mean	0.236	0.198
	LCL	0.169	0.127
	Std. Dev.	0.107	0.106
	Wilk (p-value)	0.6626	0.0330 **
	Efficiency	16.40%	
	t-Test (equal var.)	0.3917	
	t-Test (unequal var.)	0.3916	
	t-test (paired)	0.2044	
	Levene Test	0.9441	
Log Transformed	UCL	0.329	0.284
	Mean	0.237	0.197
	LCL	0.172	0.136
	Std. Dev.	0.117	0.103
	Wilk (p-value)	0.8634	0.2398
	Efficiency	17.20%	
	t-Test (equal var.)	0.3437	
	t-Test (unequal var.)	0.3451	
	t-Test (paired)	0.1860	
	Levene Test	0.7966	
Bootstrap	UCL	0.301	0.263
	Mean	0.237	0.196
	LCL	0.173	0.130
	Std. Dev.	0.100	0.099
	Efficiency	17.15%	

45th Street O/G Chamber - Fecal Coliform (cfu/100 ml)



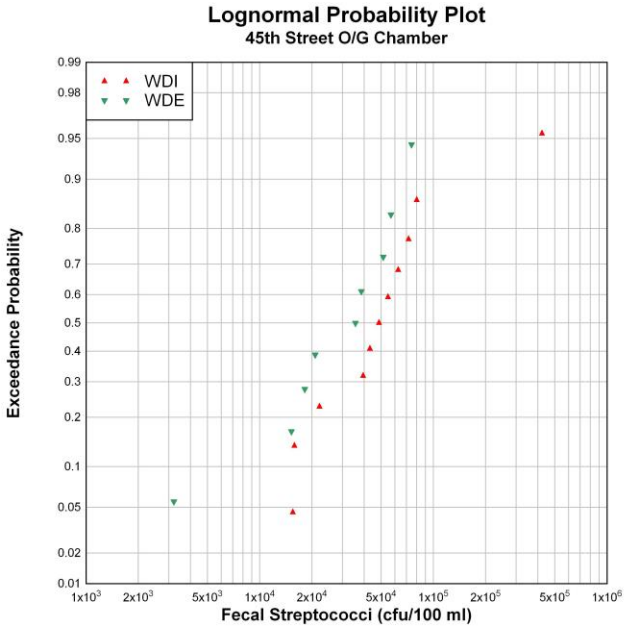


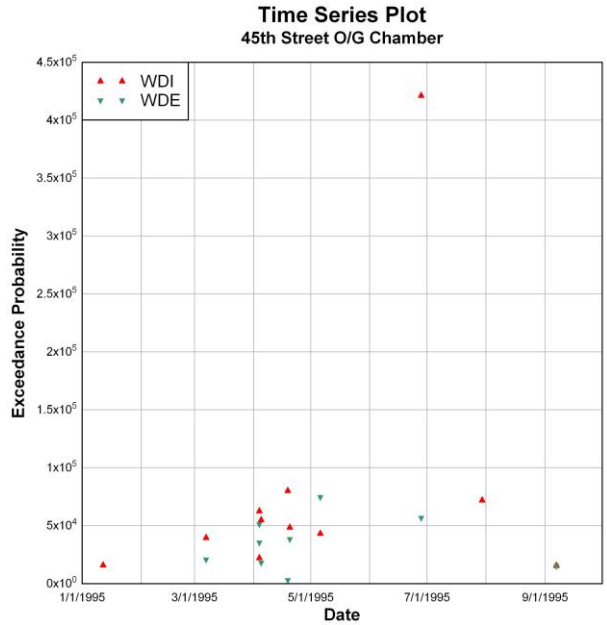


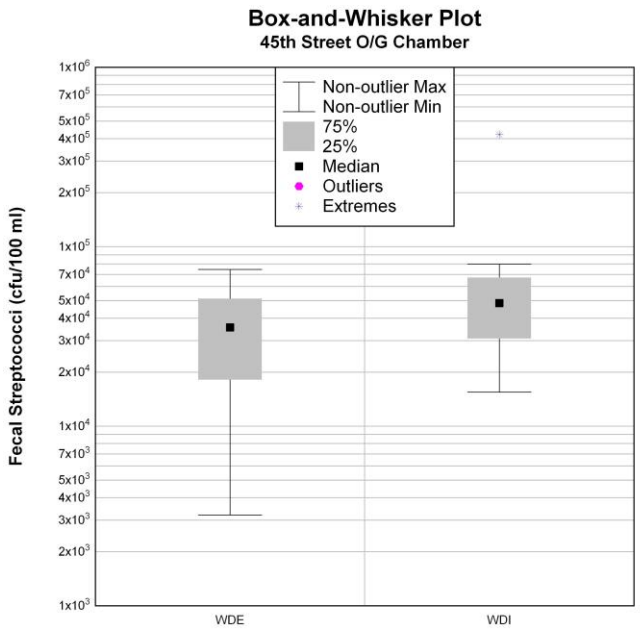


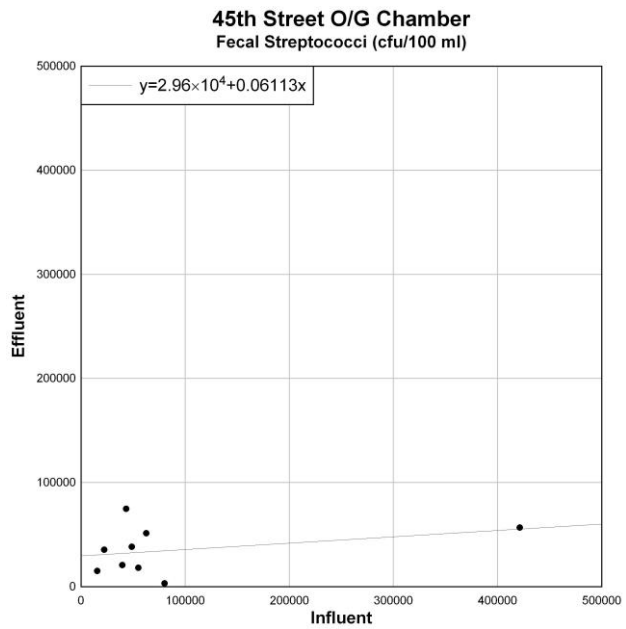
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	10	9
	Pairs Count	8	8
Non-Parametric	Maximum	60,350	53,000
	Upper Quartile	12,460	27,216
	Median	2,697	2,700
	Lower Quartile	1,862	1,715
	Minimum	982	704
	Efficiency	-0.10%	
	Mann-Whitney	0.9039	
	Wilcoxon (paired)	0.6406	
Arithmetic	UCL	27,307	31,449
	Mean	12,835	15,381
	LCL	-1,637	-688
	Std. Dev.	20,232	20,904
	Wilk (p-value)	0.0002 **	0.0031 **
	Efficiency	-19.84%	
	t-Test (equal var.)	0.7907	
	t-Test (unequal var.)	0.7911	
	t-test (paired)	0.1540	
	Levene Test	0.9418	
Log Transformed	UCL	46,932	125,964
	Mean	10,951	15,487
	LCL	2,555	1,904
	Std. Dev.	17,453	29,809
	Wilk (p-value)	0.1273	0.1666
	Efficiency	-41.42%	
	t-Test (equal var.)	0.9640	
	t-Test (unequal var.)	0.9644	
	t-Test (paired)	0.3720	
	Levene Test	0.4339	
Bootstrap	UCL	26,238	30,599
	Mean	13,241	15,794
	LCL	243	989
	Std. Dev.	18,169	19,261
	Efficiency	-19.28%	

45th Street O/G Chamber - Fecal Streptococci (cfu/100 ml)



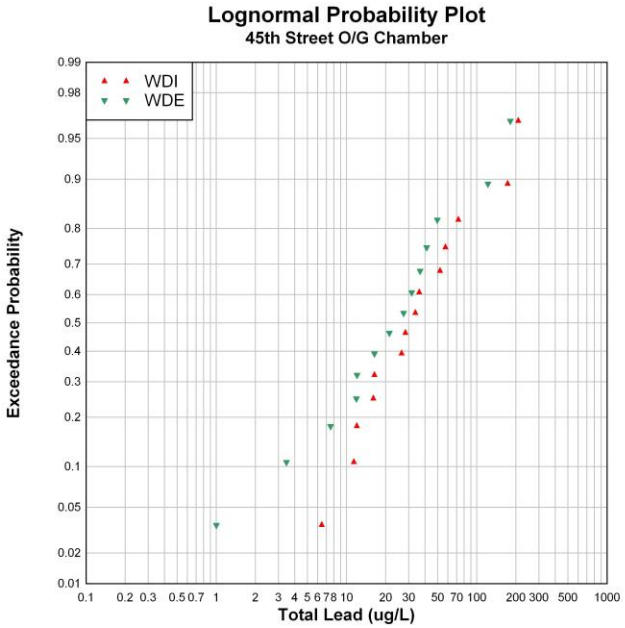


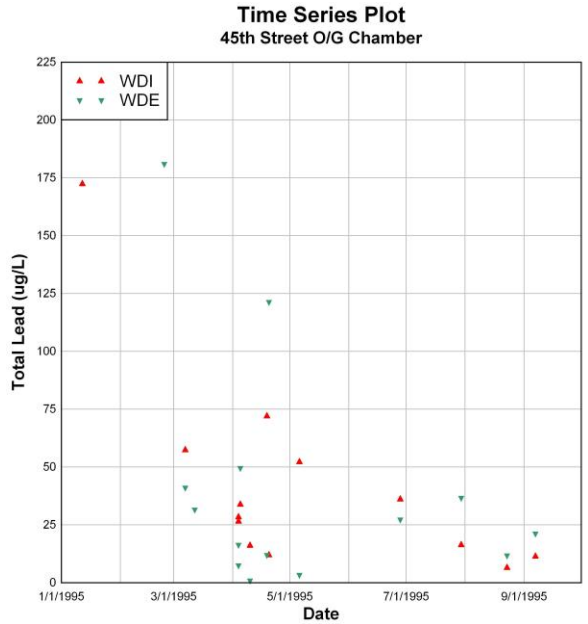


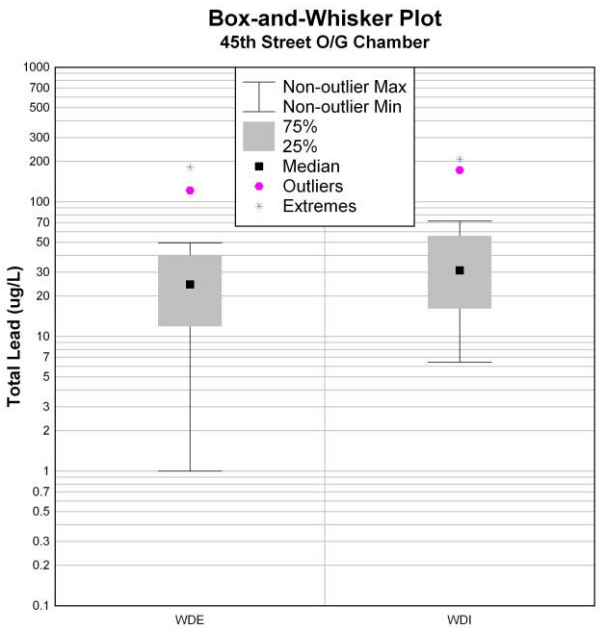


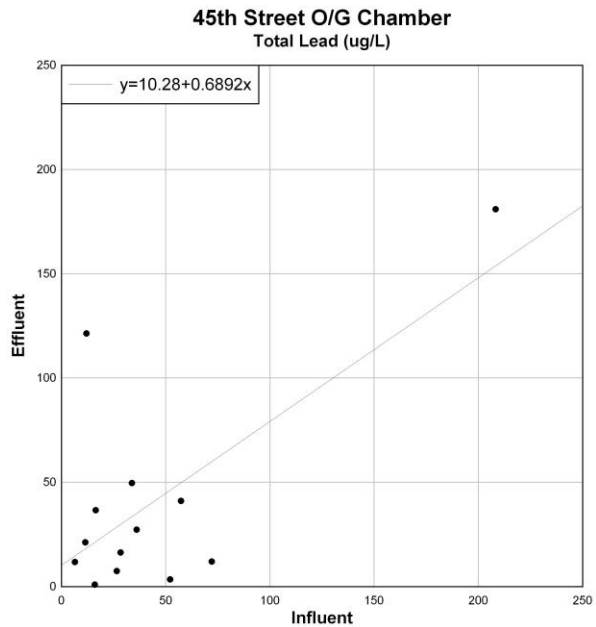
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	11	9
	Pairs Count	9	9
Non-Parametric	Maximum	421,189	74,823
	Upper Quartile	71,902	51,385
	Median	48,510	35,551
	Lower Quartile	22,083	18,145
	Minimum	15,496	3,200
	Efficiency	26.71%	
	Mann-Whitney	0.2120	
	Wilcoxon (paired)	0.1641	
Arithmetic	UCL	157,021	52,620
	Mean	79,535	34,944
	LCL	2,049	17,267
	Std. Dev.	115,346	22,996
	Wilk (p-value)	0.0001 **	0.8570
	Efficiency	56.07%	
	t-Test (equal var.)	0.2708	
	t-Test (unequal var.)	0.2366	
	t-test (paired)	0.2287	
	Levene Test	0.3311	
Log Transformed	UCL	148,564	94,920
	Mean	70,601	38,476
	LCL	33,551	15,596
	Std. Dev.	69,466	38,718
	Wilk (p-value)	0.1496	0.1952
	Efficiency	45.50%	
	t-Test (equal var.)	0.1524	
	t-Test (unequal var.)	0.1552	
	t-Test (paired)	0.1218	
	Levene Test	0.9395	
Bootstrap	UCL	142,841	51,153
	Mean	79,120	34,815
	LCL	15,398	18,476
	Std. Dev.	94,851	21,255
	Efficiency	56.00%	

45th Street O/G Chamber - Total Lead (ug/L)



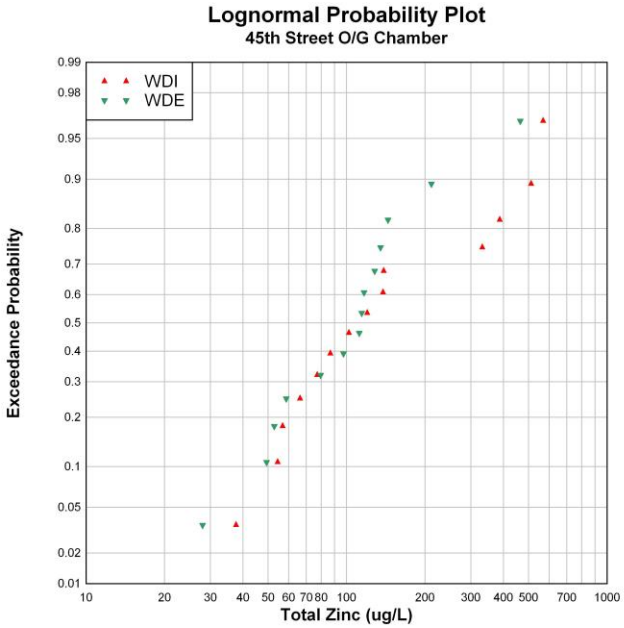


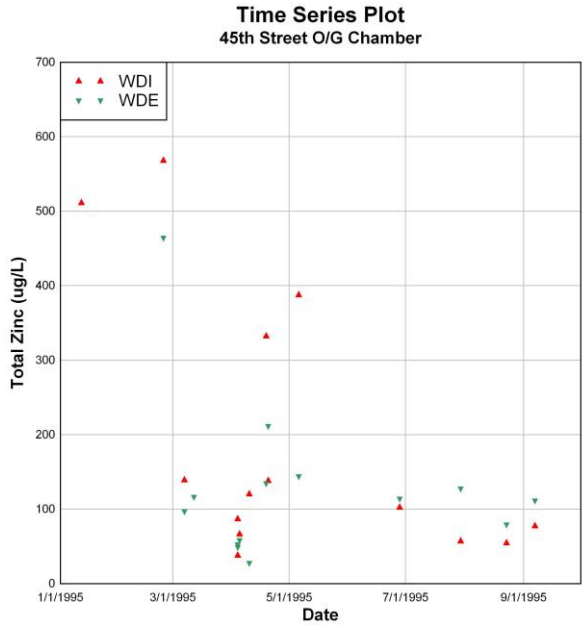


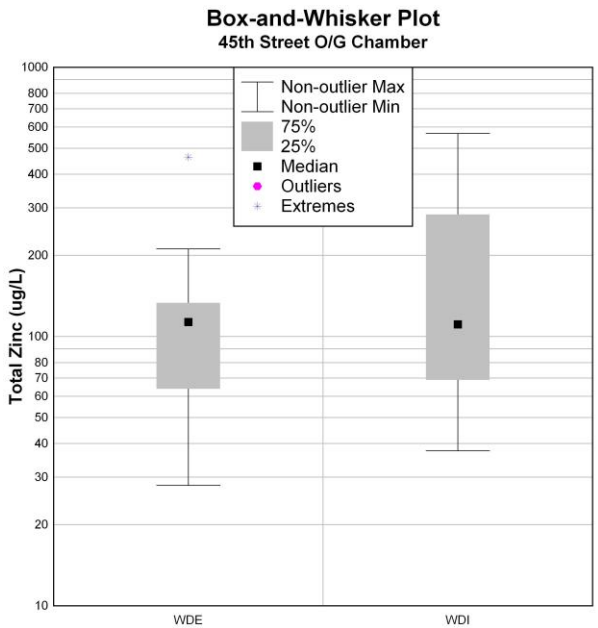


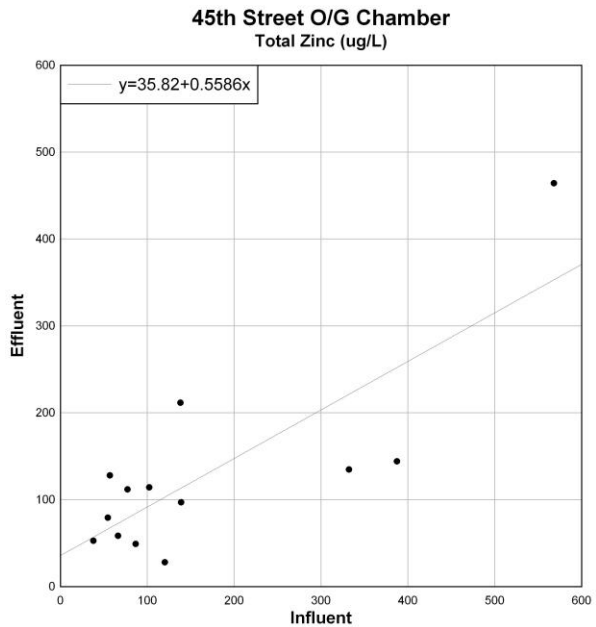
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	208.2	181.0
	Upper Quartile	57.3	41.1
	Median	31.0	24.3
	Lower Quartile	16.0	11.9
	Minimum	6.4	1.0
	Efficiency	21.60%	
	Mann-Whitney	0.4549	
	Wilcoxon (paired)	0.3757	
Arithmetic	UCL	88.9	69.4
	Mean	53.5	40.2
	LCL	18.0	11.0
	Std. Dev.	61.4	50.6
	Wilk (p-value)	0.0005 **	0.0005 **
	Efficiency	24.87%	
	t-Test (equal var.)	0.5370	
	t-Test (unequal var.)	0.5372	
	t-test (paired)	0.7647	
	Levene Test	0.6327	
Log Transformed	UCL	106.5	135.2
	Mean	51.7	45.1
	LCL	25.1	15.0
	Std. Dev.	58.4	74.0
	Wilk (p-value)	0.8290	0.8475
	Efficiency	12.72%	
	t-Test (equal var.)	0.2927	
	t-Test (unequal var.)	0.2935	
	t-Test (paired)	0.3515	
	Levene Test	0.3287	
Bootstrap	UCL	84.6	66.6
	Mean	52.5	40.1
	LCL	20.3	13.6
	Std. Dev.	55.7	45.8
	Efficiency	23.63%	

45th Street O/G Chamber - Total Zinc (ug/L)



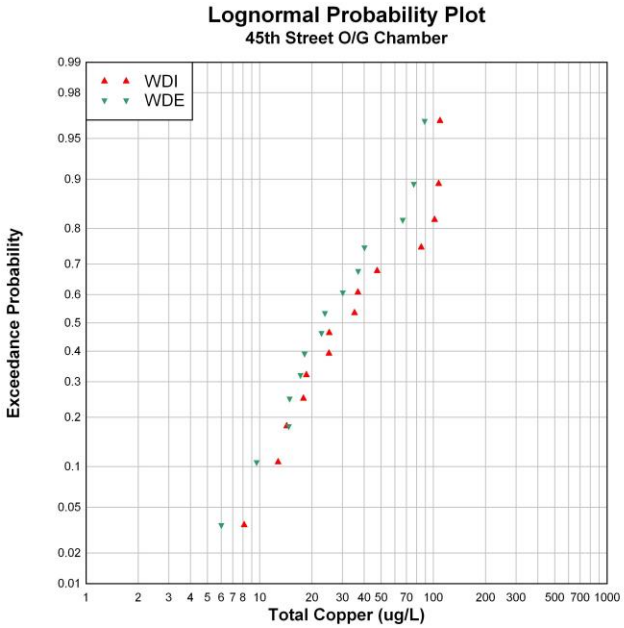


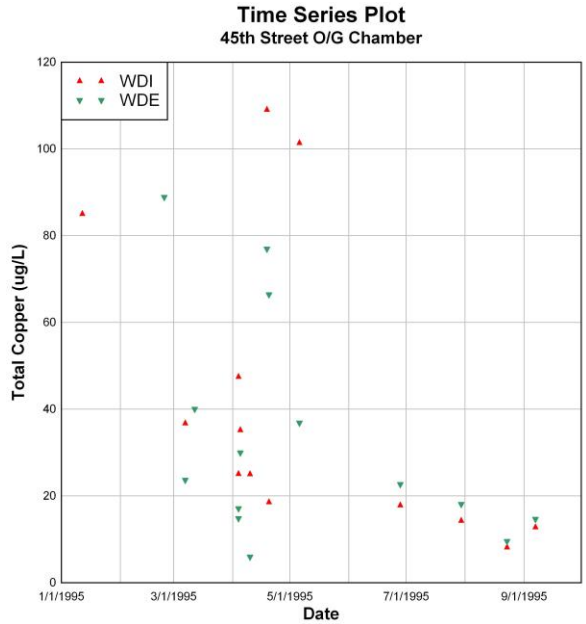


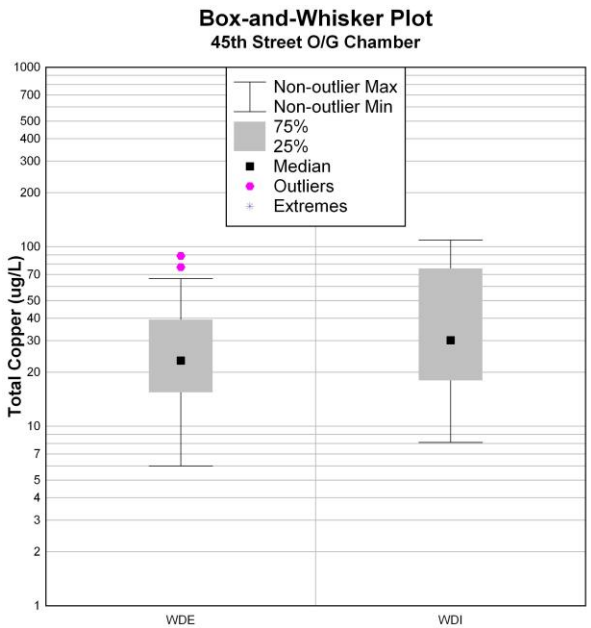


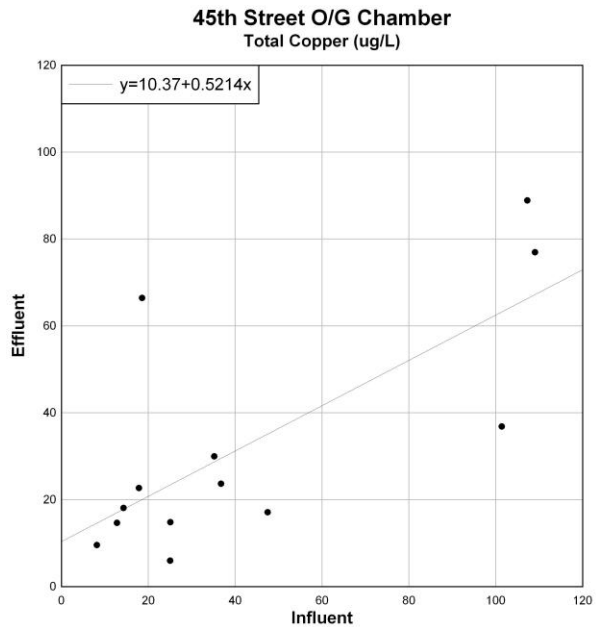
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	568.0	464.4
	Upper Quartile	332.0	135.0
	Median	111.0	113.1
	Lower Quartile	66.2	58.6
	Minimum	37.7	28.0
	Efficiency	-1.84%	
	Mann-Whitney	0.5705	
	Wilcoxon (paired)	0.3396	
Arithmetic	UCL	295.1	190.2
	Mean	191.2	128.0
	LCL	87.2	65.7
	Std. Dev.	180.0	107.8
	Wilk (p-value)	0.0024 **	0.0004 **
	Efficiency	33.06%	
	t-Test (equal var.)	0.2701	
	t-Test (unequal var.)	0.2723	
	t-test (paired)	0.1894	
	Levene Test	0.1648	
Log Transformed	UCL	341.4	196.0
	Mean	186.5	125.7
	LCL	101.9	80.7
	Std. Dev.	179.4	91.3
	Wilk (p-value)	0.2142	0.7711
	Efficiency	32.58%	
	t-Test (equal var.)	0.3939	
	t-Test (unequal var.)	0.3943	
	t-Test (paired)	0.3890	
	Levene Test	0.3028	
Bootstrap	UCL	286.1	182.7
	Mean	188.9	127.8
	LCL	91.7	73.0
	Std. Dev.	168.3	95.0
	Efficiency	32.34%	

45th Street O/G Chamber - Total Copper (ug/L)



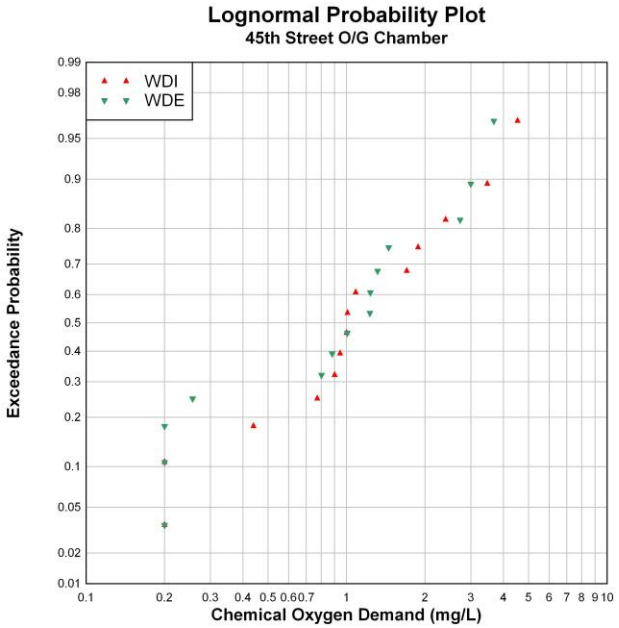


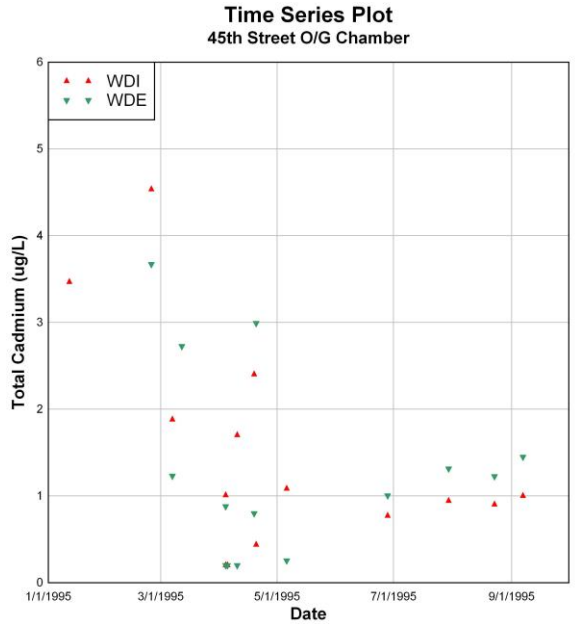


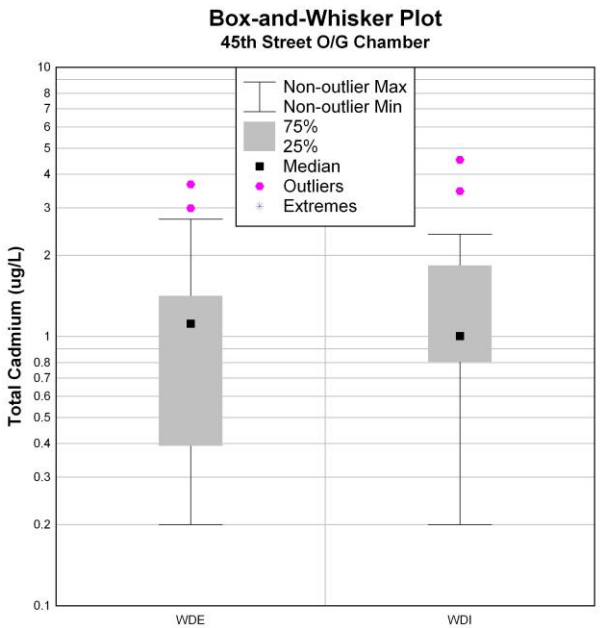


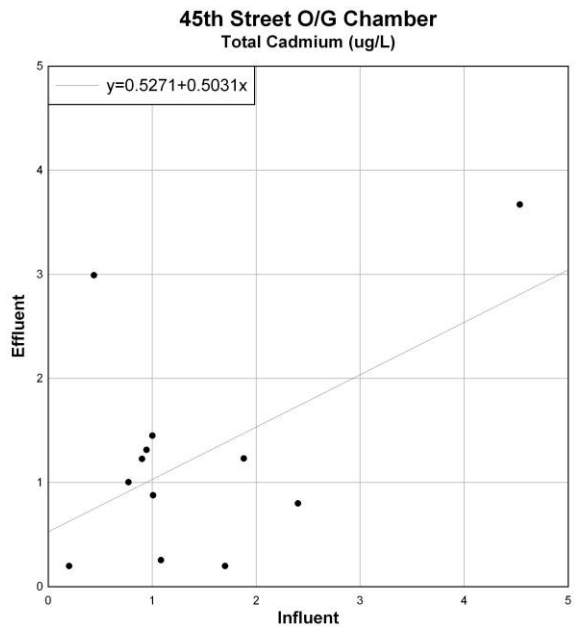
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	109.0	88.9
	Upper Quartile	85.0	40.1
	Median	30.1	23.2
	Lower Quartile	17.8	14.9
	Minimum	8.1	6.0
	Efficiency	22.96%	
	Mann-Whitney	0.4284	
	Wilcoxon (paired)	0.1099	
Arithmetic	UCL	67.7	48.4
	Mean	46.0	33.3
	LCL	24.2	18.2
	Std. Dev.	37.7	26.1
	Wilk (p-value)	0.0070 **	0.0187 **
	Efficiency	27.58%	
	t-Test (equal var.)	0.3105	
	t-Test (unequal var.)	0.3117	
	t-test (paired)	0.1823	
	Levene Test	0.1193	
Log Transformed	UCL	82.9	56.3
	Mean	46.2	33.4
	LCL	25.8	19.8
	Std. Dev.	43.1	28.2
	Wilk (p-value)	0.3392	0.9049
	Efficiency	27.73%	
	t-Test (equal var.)	0.3899	
	t-Test (unequal var.)	0.3899	
	t-Test (paired)	0.2478	
	Levene Test	0.6575	
Bootstrap	UCL	66.3	47.4
	Mean	45.5	33.2
	LCL	24.8	18.9
	Std. Dev.	35.9	24.7
	Efficiency	27.13%	

45th Street O/G Chamber - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: WDI**	**EFF: WDE**
	Site Count	14	14
	Pairs Count	13	13
Non-Parametric	Maximum	4.5	3.7
	Upper Quartile	1.9	1.5
	Median	1.0	1.1
	Lower Quartile	0.8	0.3
	Minimum	0.2	0.2
	Efficiency	-11.23%	
	Mann-Whitney	0.8734	
	Wilcoxon (paired)	0.5879	
Arithmetic	UCL	2.2	1.9
	Mean	1.5	1.3
	LCL	0.7	0.7
	Std. Dev.	1.3	1.1
	Wilk (p-value)	0.0183 **	0.0286 **
	Efficiency	11.52%	
	t-Test (equal var.)	0.7080	
	t-Test (unequal var.)	0.7081	
	t-test (paired)	0.6785	
	Levene Test	0.6802	
Log Transformed	UCL	2.9	2.9
	Mean	1.5	1.4
	LCL	0.8	0.7
	Std. Dev.	1.6	1.6
	Wilk (p-value)	0.4679	0.0740 *
	Efficiency	9.31%	
	t-Test (equal var.)	0.6343	
	t-Test (unequal var.)	0.6343	
	t-Test (paired)	0.5418	
	Levene Test	0.6525	
Bootstrap	UCL	2.1	1.9
	Mean	1.4	1.3
	LCL	0.8	0.7
	Std. Dev.	1.2	1.0
	Efficiency	10.51%	

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Appendix F Other Stormwater Control Measures

Brodie Lane Grassed Swale, Upper Reach (BLI-BLM)

This control was originally installed and monitored by the Travis County Transportation and Natural Resources Department (TNRD) to treat runoff from an extension of Brodie Lane. The monitoring was continued by the City when the area was annexed. These results are for the upper portion of the control; for information on the lower portion of the swale (BLM-BLE) or the entire swale (BLI-BLE), see those summaries elsewhere in this section.

The swale is a trapezoidal channel planted with native vegetation primarily used to convey runoff. This study was intended to evaluate the possible water quality benefits of vegetated channels. The inflow (BLI) was measured using a 90° v-notch weir. Flow was not measured at the mid-point of the swale (BLM); the automatic sampler at BLM was triggered by flow at BLI. The channel was designed so that no additional flow (other than rainfall, would enter the channel after BLI. This reach of the swale was approximately 85 ft. in length.

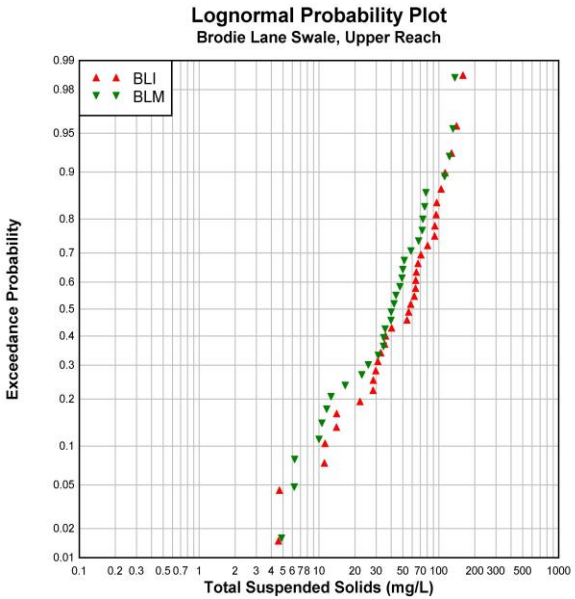
The City collected more than 30 paired samples at the influent and effluent stations between 2000 and 2005

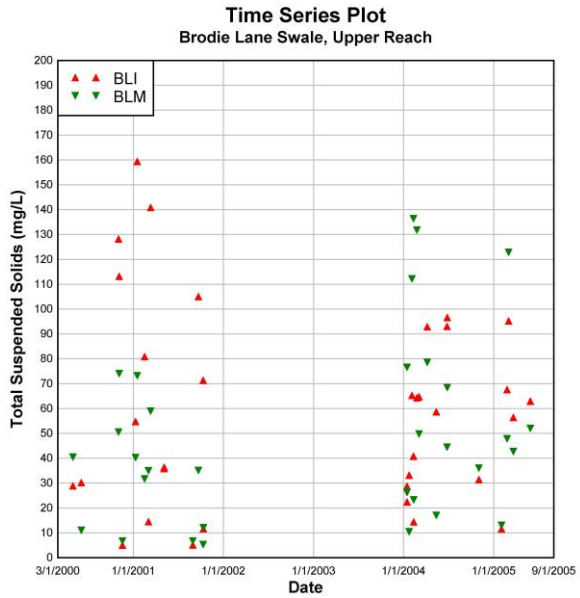
Performance Summary

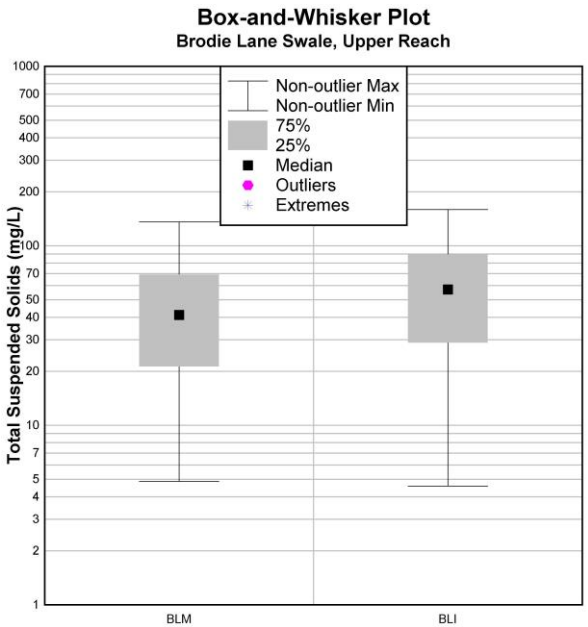
Concentrations of most water quality parameters were marginally but not significantly reduced based on the statistical analyses. Concentrations of phosphorus (total and dissolved) and fecal coliform increased in this reach of the swale, but not significantly.

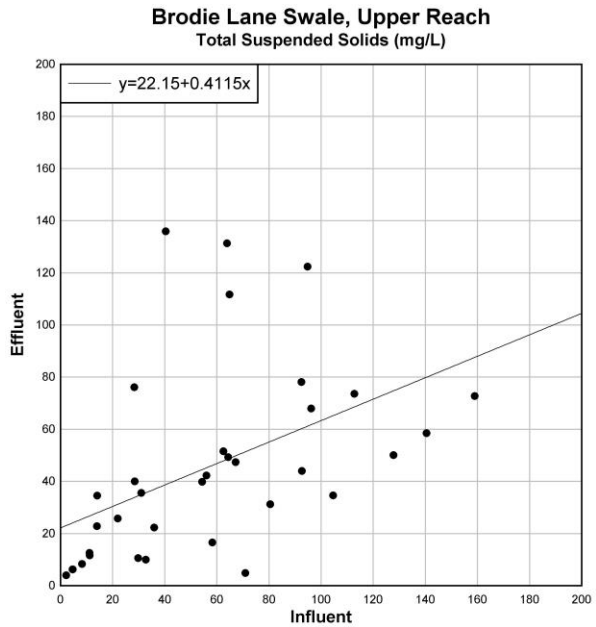
The only water quality parameter that demonstrated a significant change in concentration in this reach was total copper (Cu). However, the reduction in total copper in the reach must be discounted because when TNRD originally installed the monitoring station, the suction line for BLI was copper tubing while the suction line installed by SWQM was Teflon lined tubing. The statistical difference in concentrations could be a result of contamination at BLI.

Brodie Lane Swale, Upper Reach - Total Suspended Solids (mg/L)



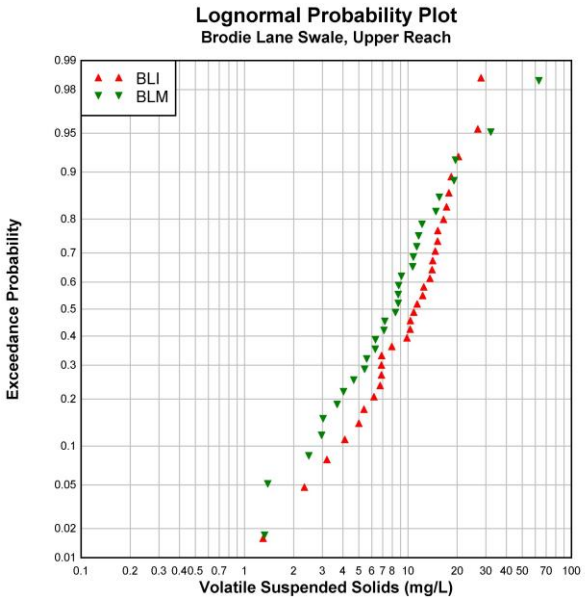


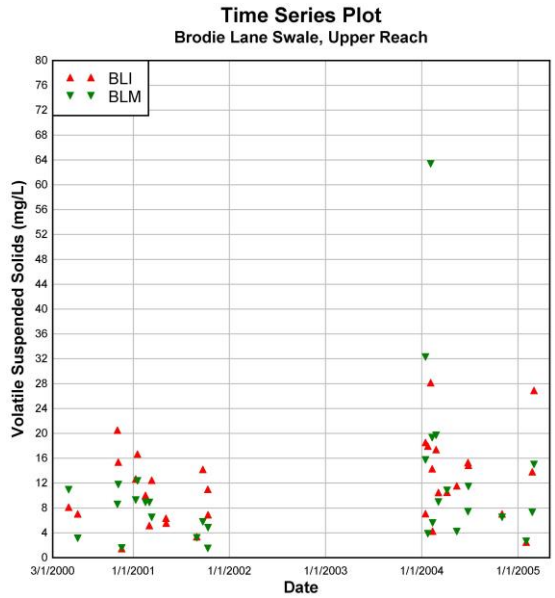


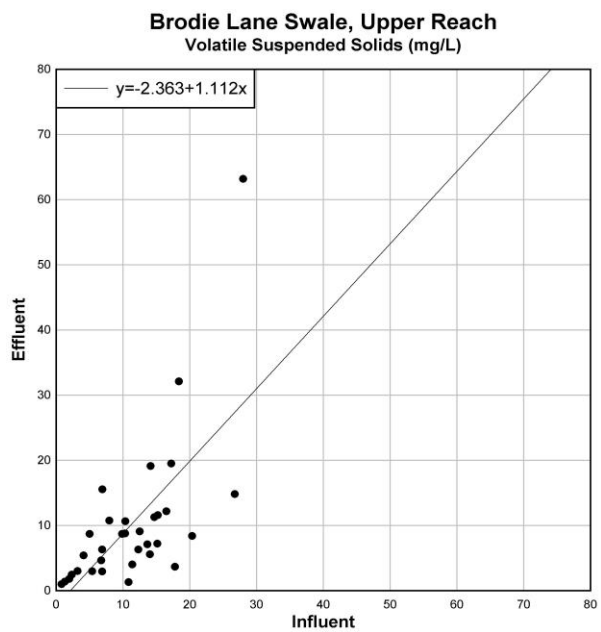


	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	159.0	135.9
	Upper Quartile	92.4	70.4
	Median	57.1	41.2
	Lower Quartile	28.4	19.7
	Minimum	4.6	4.9
	Efficiency	27.89%	
	Mann-Whitney	0.3237	
	Wilcoxon (paired)	0.0918 *	
Arithmetic	UCL	73.1	61.8
	Mean	59.0	48.6
	LCL	45.0	35.4
	Std. Dev.	40.3	36.6
	Wilk (p-value)	0.0795 *	0.0047 **
	Efficiency	17.60%	
	t-Test (equal var.)	0.2782	
	t-Test (unequal var.)	0.2768	
	t-test (paired)	0.1126	
	Levene Test	0.5810	
Log Transformed	UCL	94.3	77.4
	Mean	64.5	52.0
	LCL	44.1	35.0
	Std. Dev.	69.0	56.0
	Wilk (p-value)	0.0211 **	0.0777 *
	Efficiency	19.27%	
	t-Test (equal var.)	0.3358	
	t-Test (unequal var.)	0.3359	
	t-Test (paired)	0.1261	
	Levene Test	0.9724	
Bootstrap	UCL	72.6	61.9
	Mean	58.9	49.0
	LCL	45.2	36.1
	Std. Dev.	39.2	35.8
	Efficiency	16.88%	

Brodie Lane Swale, Upper Reach - Volatile Suspended Solids (mg/L)

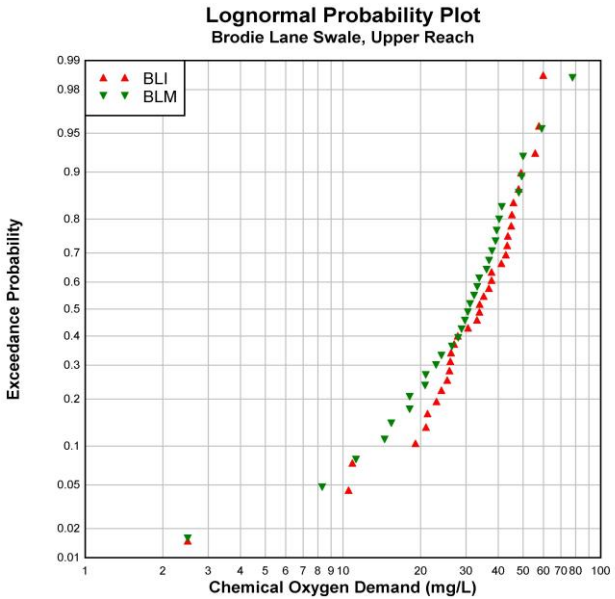


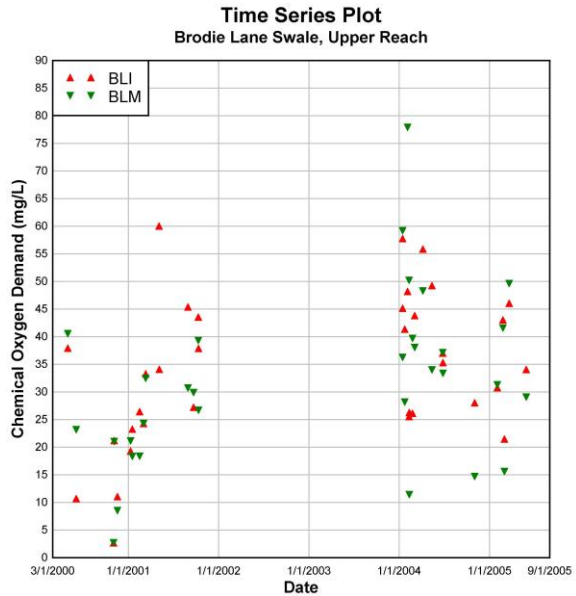


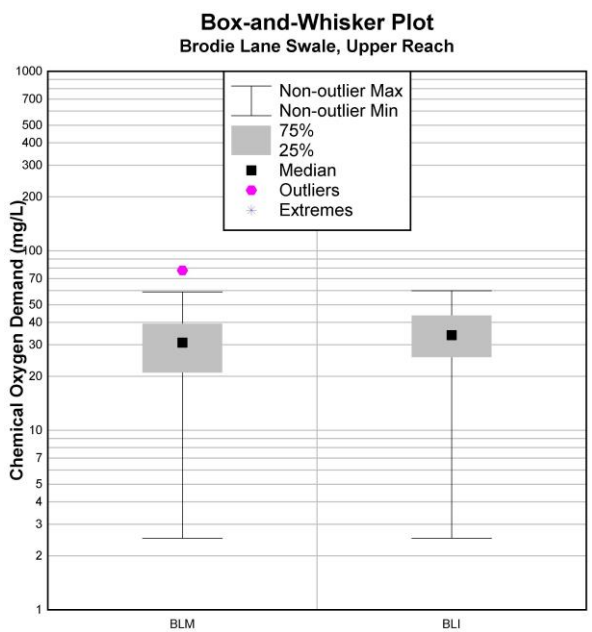


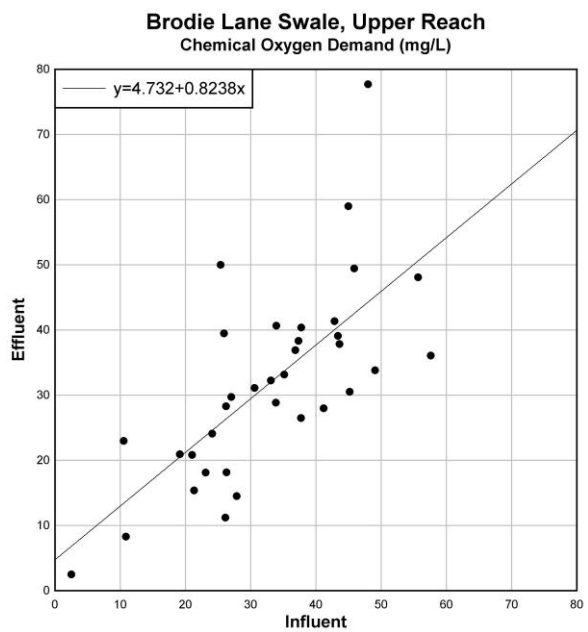
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	32	30
	Pairs Count	33	33
Non-Parametric	Maximum	28.0	63.2
	Upper Quartile	15.2	11.6
	Median	11.1	8.6
	Lower Quartile	6.8	4.7
	Minimum	1.3	1.3
	Efficiency	23.05%	
	Mann-Whitney	0.1500	
	Wilcoxon (paired)	0.0719 *	
Arithmetic	UCL	14.0	15.3
	Mean	11.6	10.9
	LCL	9.3	6.5
	Std. Dev.	6.5	11.8
	Wilk (p-value)	0.2304	0.0001 **
	Efficiency	6.54%	
	t-Test (equal var.)	0.7522	
	t-Test (unequal var.)	0.7567	
	t-test (paired)	0.4682	
	Levene Test	0.2958	
Log Transformed	UCL	16.0	15.4
	Mean	12.1	10.7
	LCL	9.2	7.4
	Std. Dev.	9.2	10.3
	Wilk (p-value)	0.0592 *	0.8095
	Efficiency	11.73%	
	t-Test (equal var.)	0.2347	
	t-Test (unequal var.)	0.2379	
	t-Test (paired)	0.0273 **	
	Levene Test	0.3541	
Bootstrap	UCL	14.0	15.0
	Mean	11.7	10.9
	LCL	9.4	6.8
	Std. Dev.	6.3	10.9
	Efficiency	6.71%	

Brodie Lane Swale, Upper Reach - Chemical Oxygen Demand (mg/L)



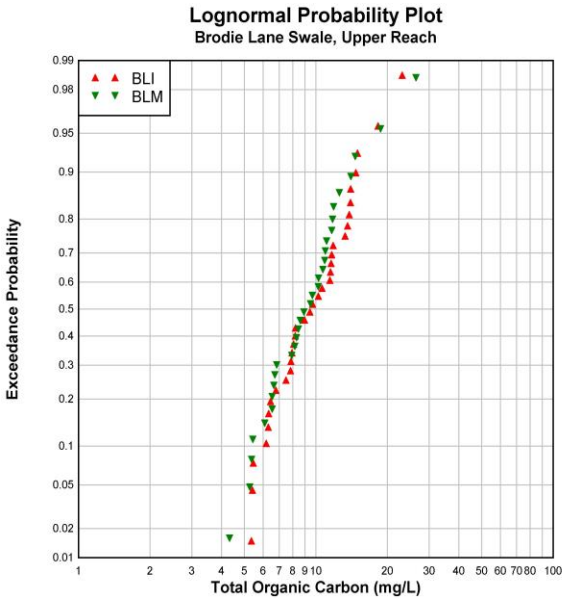


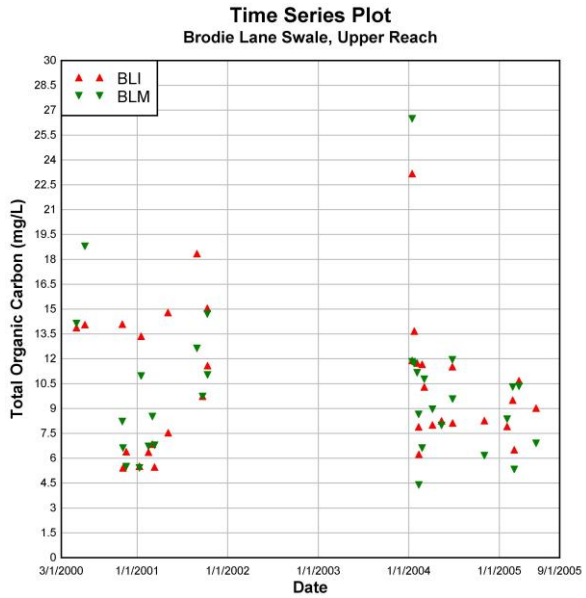


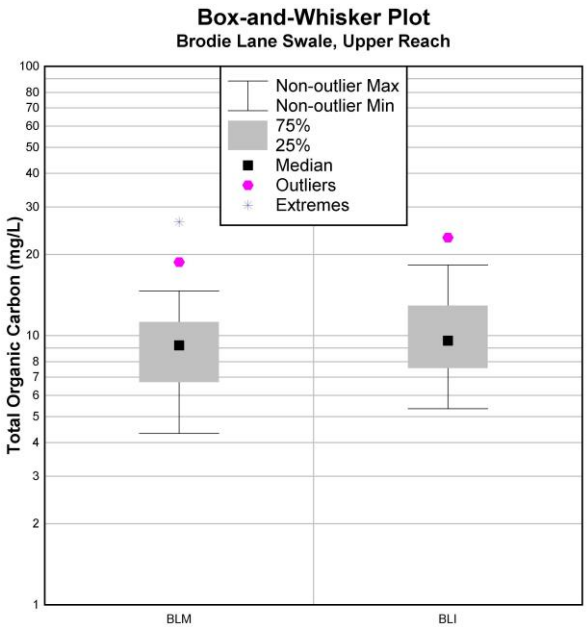


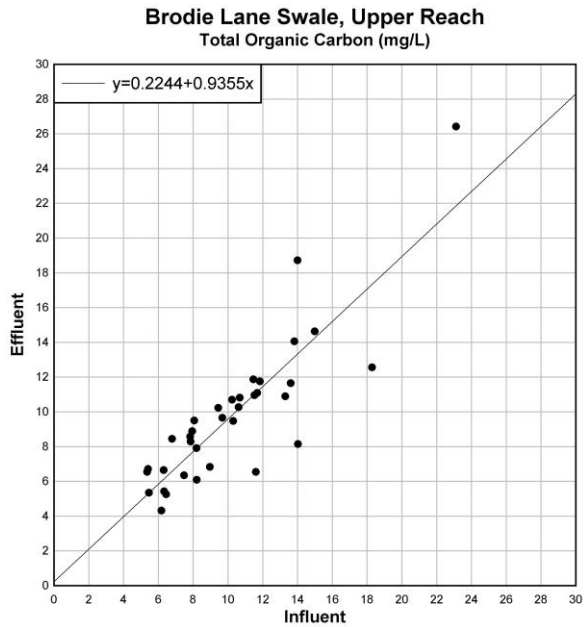
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	59.83	77.69
	Upper Quartile	43.62	39.30
	Median	33.88	30.81
	Lower Quartile	25.37	20.88
	Minimum	2.50	2.50
	Efficiency	9.06%	
	Mann-Whitney	0.4038	
	Wilcoxon (paired)	0.3090	
Arithmetic	UCL	38.46	36.99
	Mean	33.74	31.45
	LCL	29.01	25.90
	Std. Dev.	13.55	15.37
	Wilk (p-value)	0.8976	0.4165
	Efficiency	6.79%	
	t-Test (equal var.)	0.5224	
	t-Test (unequal var.)	0.5241	
	t-test (paired)	0.5640	
	Levene Test	0.5348	
Log Transformed	UCL	44.66	42.65
	Mean	35.53	33.00
	LCL	28.27	25.53
	Std. Dev.	22.93	23.06
	Wilk (p-value)	0.0001 **	0.0014 **
	Efficiency	7.13%	
	t-Test (equal var.)	0.5176	
	t-Test (unequal var.)	0.5186	
	t-Test (paired)	0.3037	
	Levene Test	0.8379	
Bootstrap	UCL	38.40	36.99
	Mean	33.79	31.63
	LCL	29.19	26.26
	Std. Dev.	13.19	14.89
	Efficiency	6.41%	

Brodie Lane Swale, Upper Reach - Total Organic Carbon (mg/L)



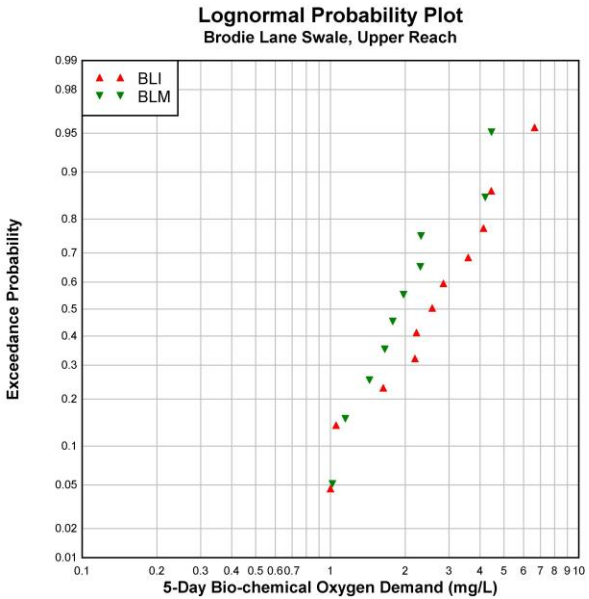


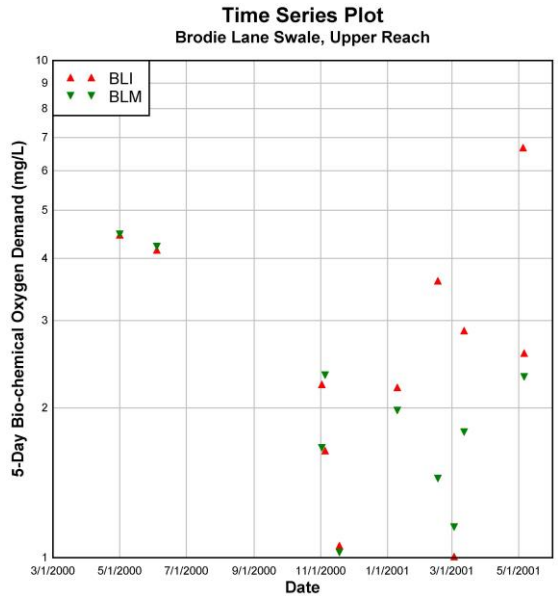


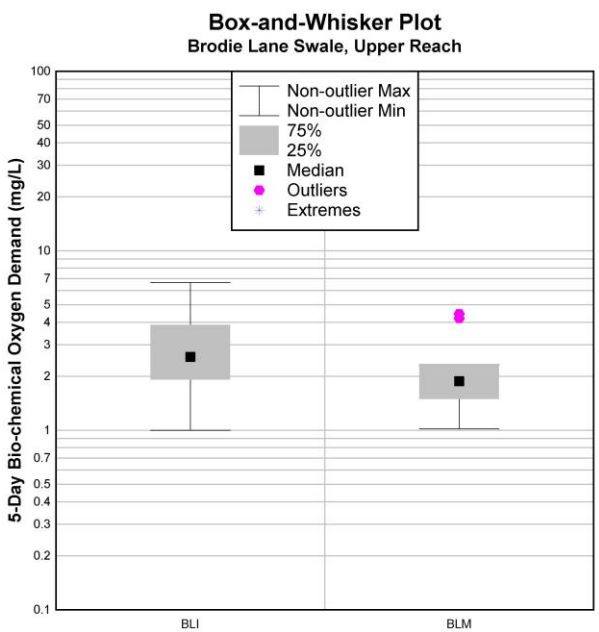


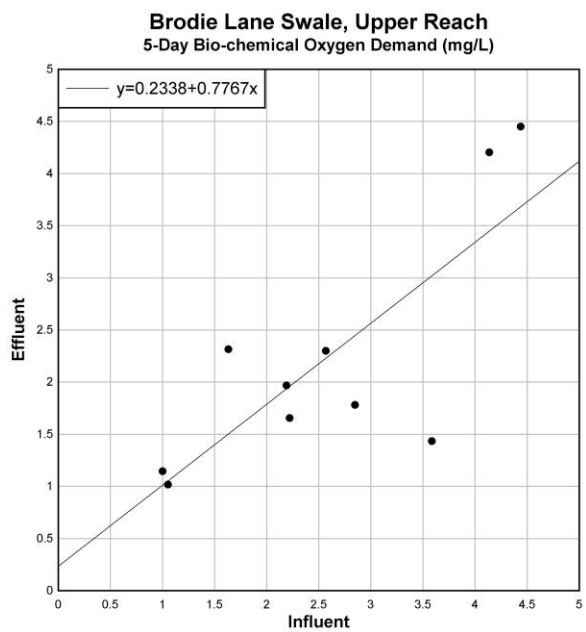
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	23.11	26.41
	Upper Quartile	13.29	11.38
	Median	9.56	9.20
	Lower Quartile	7.48	6.68
	Minimum	5.35	4.33
	Efficiency	3.78%	
	Mann-Whitney	0.5962	
	Wilcoxon (paired)	0.3580	
Arithmetic	UCL	11.71	11.41
	Mean	10.31	9.85
	LCL	8.92	8.28
	Std. Dev.	4.00	4.35
	Wilk (p-value)	0.0092 **	0.0002 **
	Efficiency	4.53%	
	t-Test (equal var.)	0.6513	
	t-Test (unequal var.)	0.6522	
	t-test (paired)	0.2419	
	Levene Test	0.7761	
Log Transformed	UCL	11.76	11.33
	Mean	10.30	9.80
	LCL	9.01	8.48
	Std. Dev.	3.90	3.90
	Wilk (p-value)	0.4220	0.6420
	Efficiency	4.82%	
	t-Test (equal var.)	0.5504	
	t-Test (unequal var.)	0.5510	
	t-Test (paired)	0.1360	
	Levene Test	0.7890	
Bootstrap	UCL	11.67	11.43
	Mean	10.32	9.90
	LCL	8.96	8.37
	Std. Dev.	3.89	4.24
	Efficiency	4.09%	

Brodie Lane Swale, Upper Reach - 5-Day Bio-chemical Oxygen Demand (mg/L)



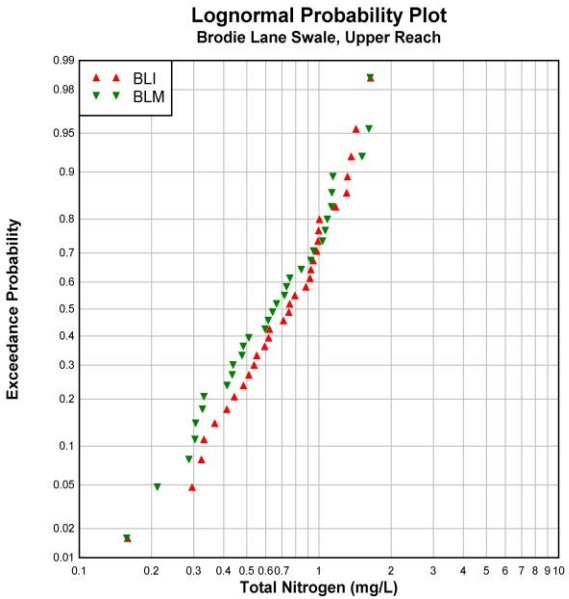


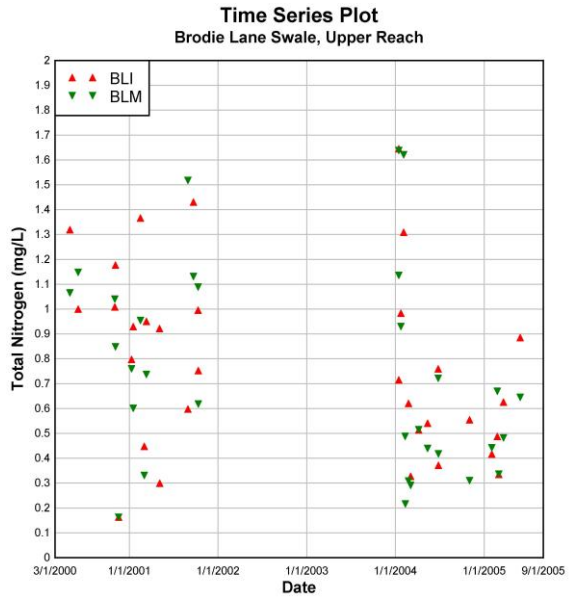


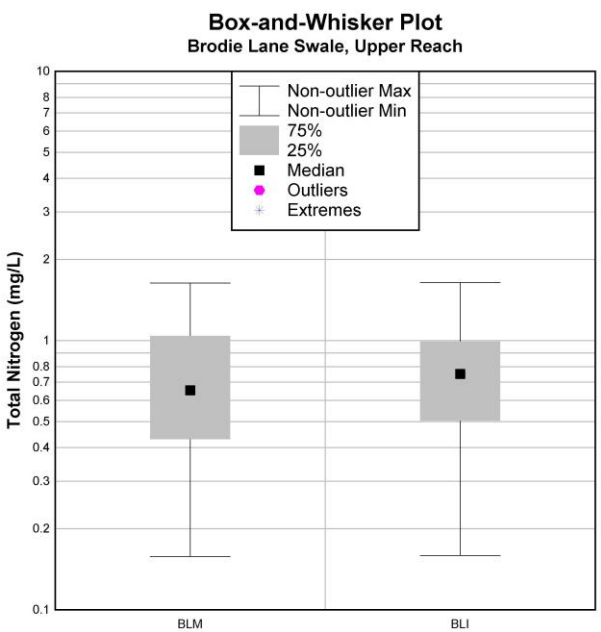


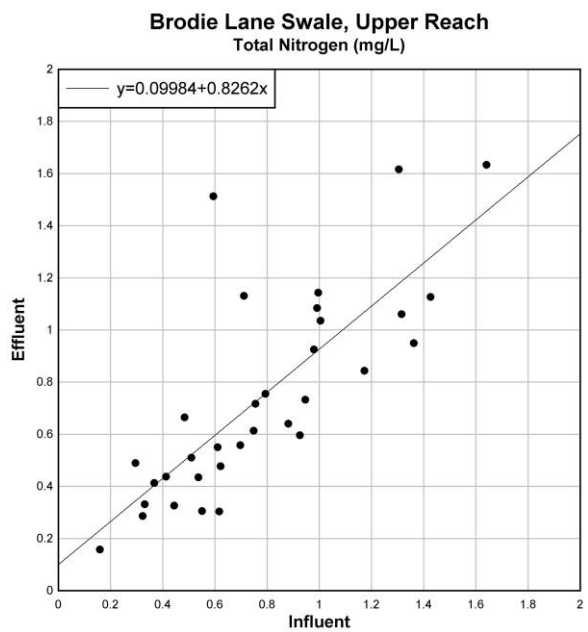
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	11	10
	Pairs Count	10	10
Non-Parametric	Maximum	6.64	4.45
	Upper Quartile	4.14	2.32
	Median	2.57	1.87
	Lower Quartile	1.63	1.44
	Minimum	1.00	1.02
	Efficiency	26.99%	
	Mann-Whitney	0.4276	
	Wilcoxon (paired)	0.2754	
Arithmetic	UCL	4.06	3.08
	Mean	2.94	2.23
	LCL	1.81	1.38
	Std. Dev.	1.68	1.19
	Wilk (p-value)	0.3519	0.0343 **
	Efficiency	24.17%	
	t-Test (equal var.)	0.2813	
	t-Test (unequal var.)	0.2743	
	t-test (paired)	0.2047	
	Levene Test	0.3559	
Log Transformed	UCL	4.55	3.21
	Mean	2.95	2.21
	LCL	1.92	1.52
	Std. Dev.	1.80	1.10
	Wilk (p-value)	0.8504	0.5029
	Efficiency	25.06%	
	t-Test (equal var.)	0.3283	
	t-Test (unequal var.)	0.3240	
	t-Test (paired)	0.2320	
	Levene Test	0.4707	
Bootstrap	UCL	3.96	2.98
	Mean	2.93	2.21
	LCL	1.90	1.45
	Std. Dev.	1.53	1.07
	Efficiency	24.49%	

Brodie Lane Swale, Upper Reach - Total Nitrogen (mg/L)



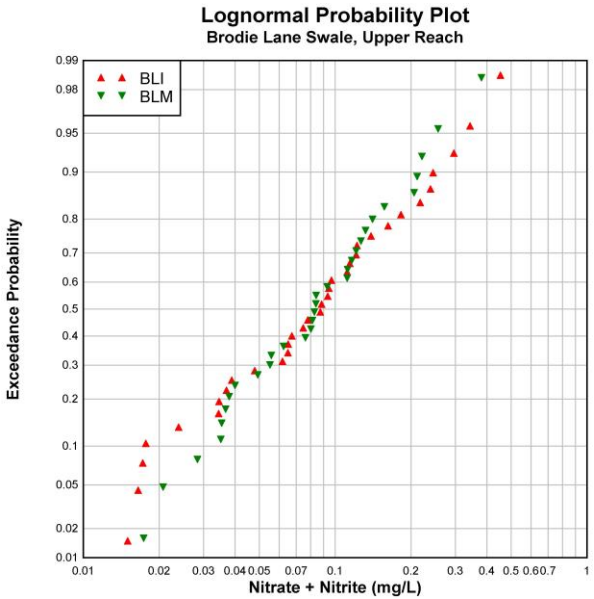


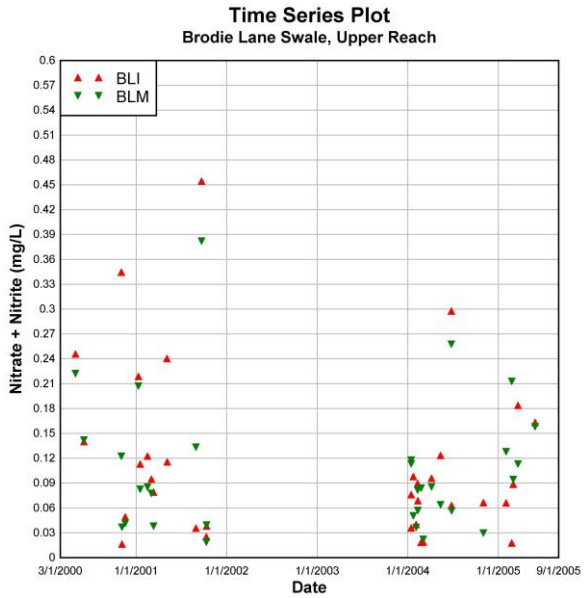


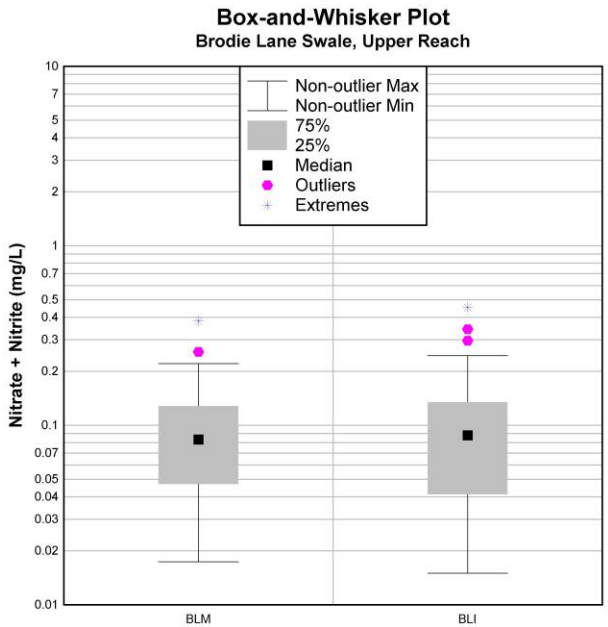


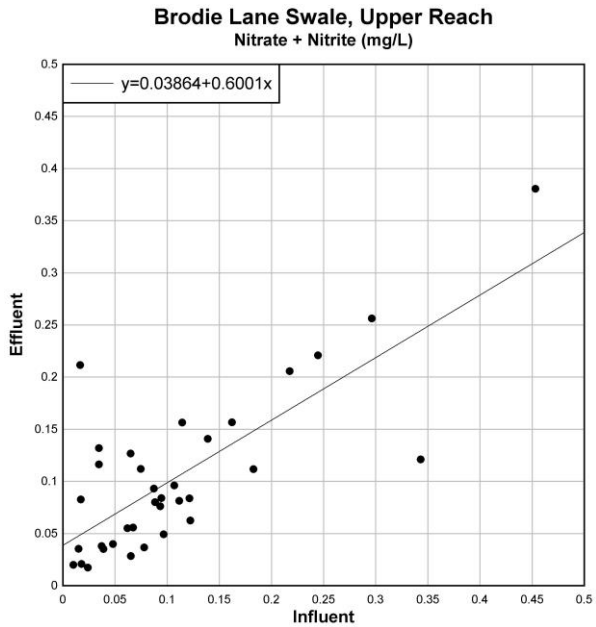
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	32	32
	Pairs Count	33	33
Non-Parametric	Maximum	1.641	1.634
	Upper Quartile	0.993	1.048
	Median	0.752	0.653
	Lower Quartile	0.497	0.424
	Minimum	0.159	0.158
	Efficiency	13.15%	
	Mann-Whitney	0.5173	
	Wilcoxon (paired)	0.1028	
Arithmetic	UCL	0.919	0.879
	Mean	0.785	0.733
	LCL	0.651	0.587
	Std. Dev.	0.372	0.405
	Wilk (p-value)	0.4211	0.0454 **
	Efficiency	6.57%	
	t-Test (equal var.)	0.5978	
	t-Test (unequal var.)	0.5978	
	t-test (paired)	0.4431	
	Levene Test	0.5866	
Log Transformed	UCL	0.980	0.940
	Mean	0.796	0.742
	LCL	0.647	0.587
	Std. Dev.	0.452	0.477
	Wilk (p-value)	0.3280	0.5373
	Efficiency	6.75%	
	t-Test (equal var.)	0.4685	
	t-Test (unequal var.)	0.4686	
	t-Test (paired)	0.2464	
	Levene Test	0.5075	
Bootstrap	UCL	0.915	0.879
	Mean	0.785	0.735
	LCL	0.654	0.592
	Std. Dev.	0.363	0.397
	Efficiency	6.28%	

Brodie Lane Swale, Upper Reach - Nitrate + Nitrite (mg/L)



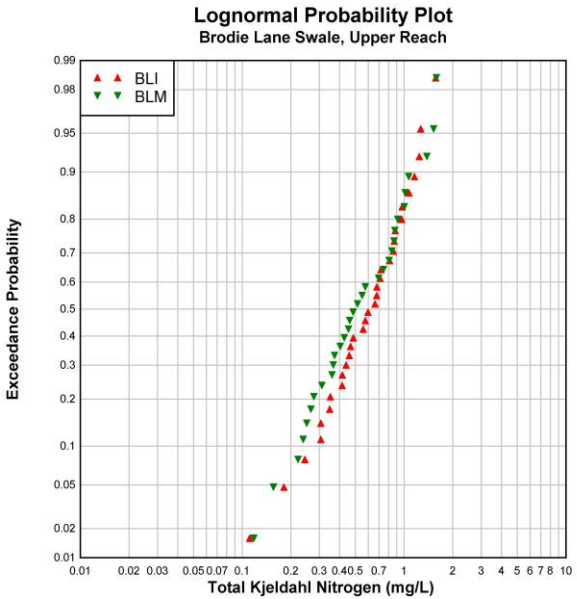


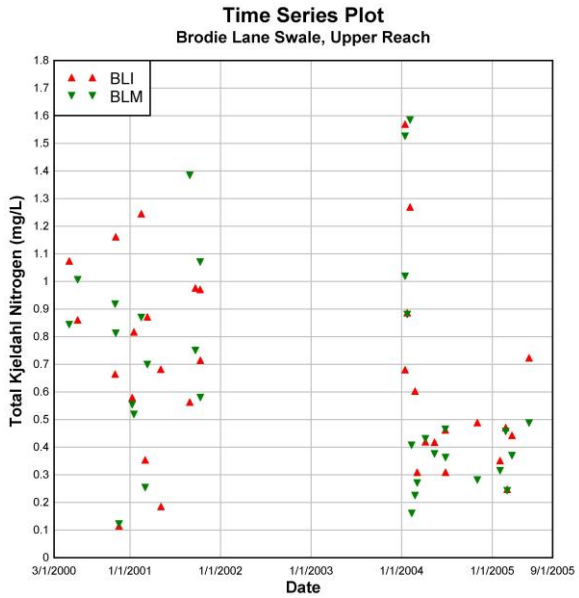


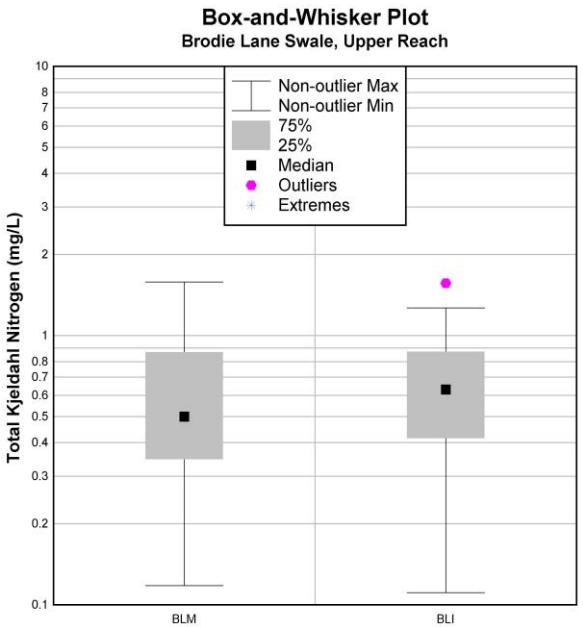


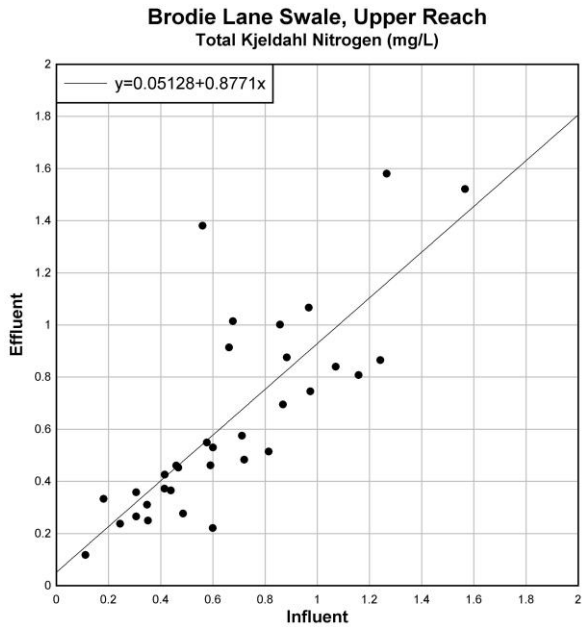
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	0.453	0.381
	Upper Quartile	0.139	0.129
	Median	0.088	0.083
	Lower Quartile	0.039	0.045
	Minimum	0.015	0.017
	Efficiency	5.23%	
	Mann-Whitney	0.9949	
	Wilcoxon (paired)	0.2372	
Arithmetic	UCL	0.150	0.133
	Mean	0.115	0.105
	LCL	0.079	0.076
	Std. Dev.	0.102	0.080
	Wilk (p-value)	0.0001 **	0.0004 **
	Efficiency	8.84%	
	t-Test (equal var.)	0.6549	
	t-Test (unequal var.)	0.6525	
	t-test (paired)	0.6766	
	Levene Test	0.3805	
Log Transformed	UCL	0.171	0.143
	Mean	0.118	0.106
	LCL	0.081	0.078
	Std. Dev.	0.124	0.087
	Wilk (p-value)	0.5492	0.9427
	Efficiency	10.39%	
	t-Test (equal var.)	0.9480	
	t-Test (unequal var.)	0.9477	
	t-Test (paired)	0.5219	
	Levene Test	0.2155	
Bootstrap	UCL	0.148	0.133
	Mean	0.114	0.105
	LCL	0.079	0.077
	Std. Dev.	0.098	0.077
	Efficiency	7.41%	

Brodie Lane Swale, Upper Reach - Total Kjeldahl Nitrogen (mg/L)



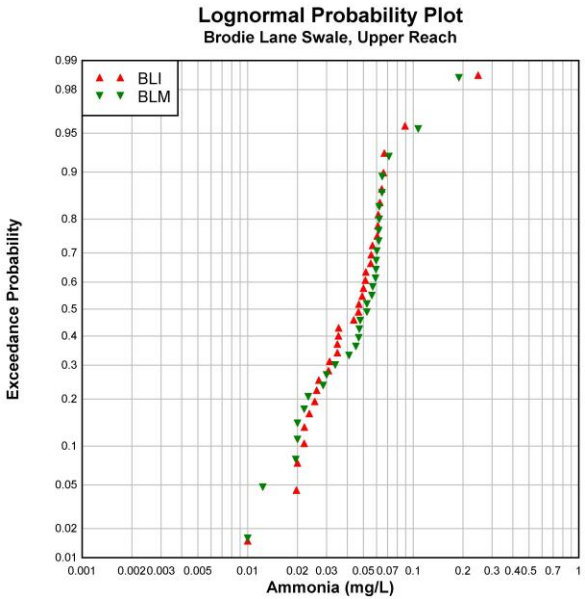


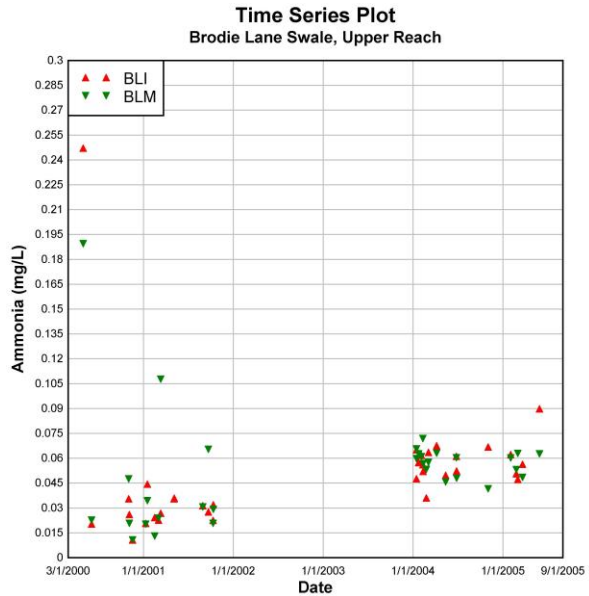


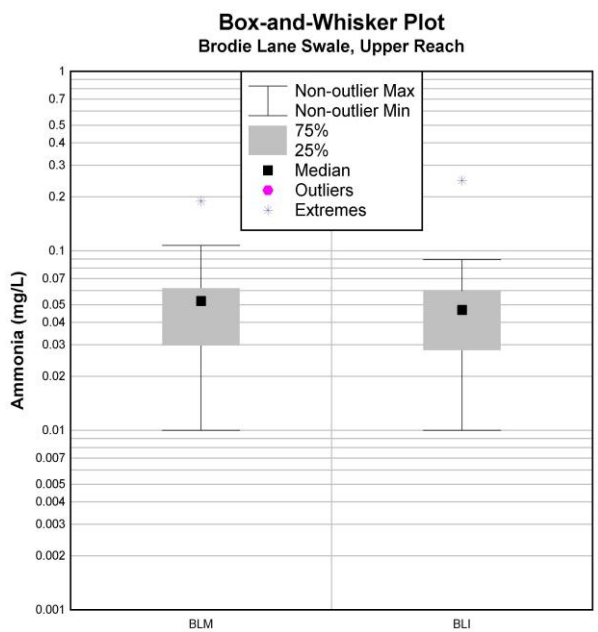


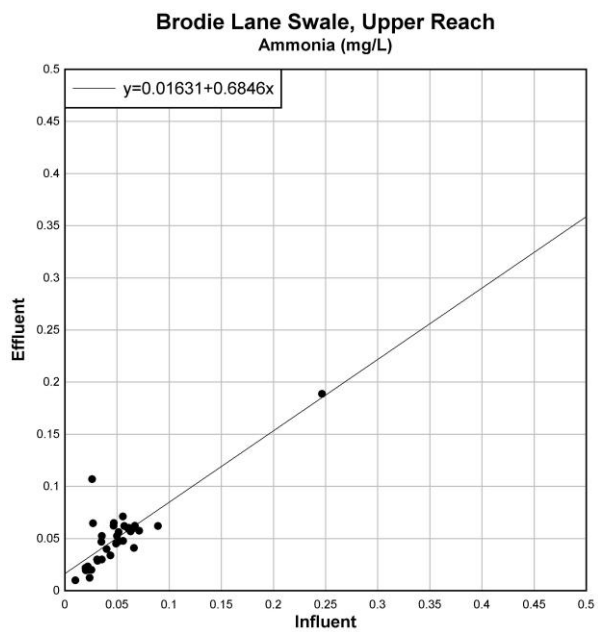
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	32	32
	Pairs Count	33	33
Non-Parametric	Maximum	1.566	1.581
	Upper Quartile	0.875	0.871
	Median	0.630	0.499
	Lower Quartile	0.415	0.335
	Minimum	0.111	0.118
	Efficiency	20.76%	
	Mann-Whitney	0.4918	
	Wilcoxon (paired)	0.1151	
Arithmetic	UCL	0.793	0.770
	Mean	0.668	0.629
	LCL	0.542	0.487
	Std. Dev.	0.347	0.391
	Wilk (p-value)	0.3367	0.0115 **
	Efficiency	5.86%	
	t-Test (equal var.)	0.6738	
	t-Test (unequal var.)	0.6738	
	t-test (paired)	0.4657	
	Levene Test	0.5094	
Log Transformed	UCL	0.860	0.827
	Mean	0.681	0.636
	LCL	0.540	0.490
	Std. Dev.	0.433	0.454
	Wilk (p-value)	0.4153	0.7625
	Efficiency	6.56%	
	t-Test (equal var.)	0.5013	
	t-Test (unequal var.)	0.5013	
	t-Test (paired)	0.2200	
	Levene Test	0.5531	
Bootstrap	UCL	0.790	0.768
	Mean	0.668	0.630
	LCL	0.546	0.492
	Std. Dev.	0.339	0.383
	Efficiency	5.69%	

Brodie Lane Swale, Upper Reach - Ammonia (mg/L)



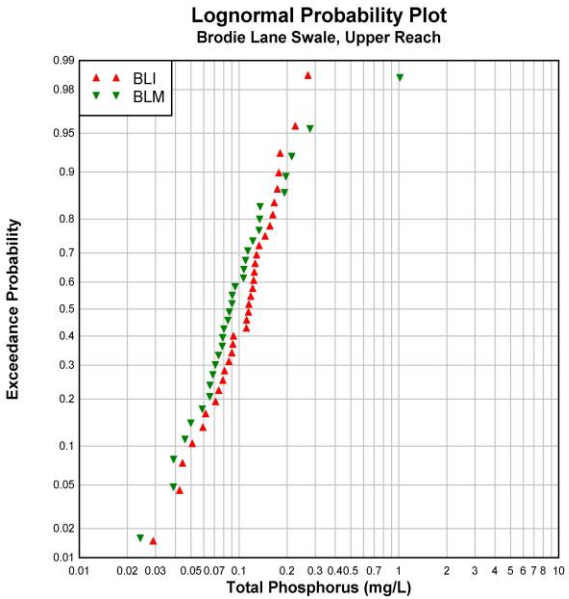


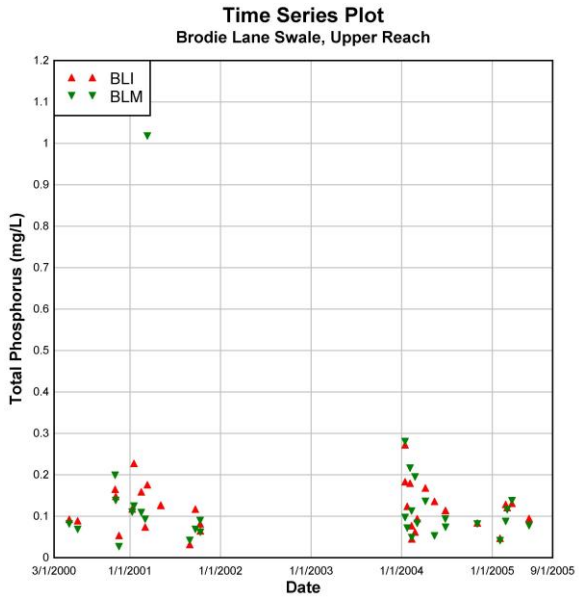


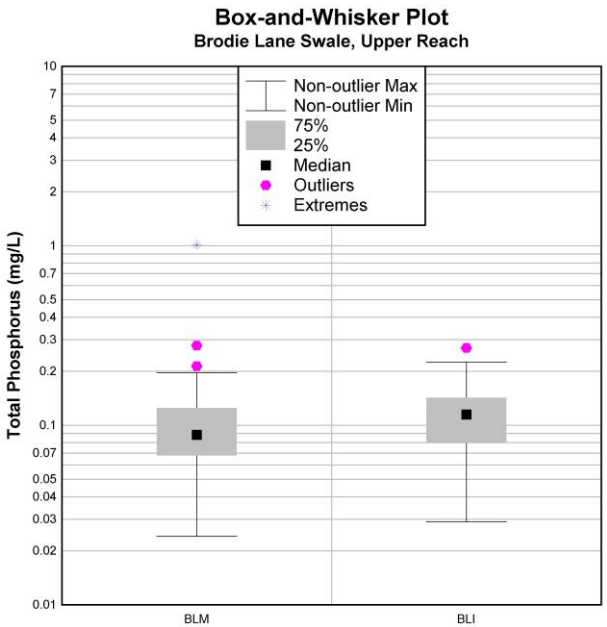


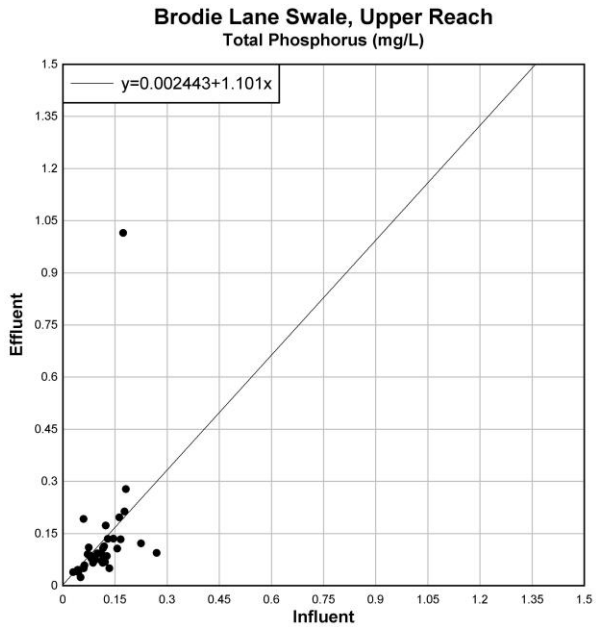
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	0.247	0.189
	Upper Quartile	0.061	0.062
	Median	0.047	0.053
	Lower Quartile	0.027	0.029
	Minimum	0.010	0.010
	Efficiency	-12.23%	
	Mann-Whitney	0.5401	
	Wilcoxon (paired)	0.5226	
Arithmetic	UCL	0.063	0.063
	Mean	0.050	0.052
	LCL	0.036	0.040
	Std. Dev.	0.039	0.033
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-3.99%	
	t-Test (equal var.)	0.8250	
	t-Test (unequal var.)	0.8240	
	t-test (paired)	0.9022	
	Levene Test	0.7237	
Log Transformed	UCL	0.060	0.066
	Mean	0.049	0.052
	LCL	0.039	0.041
	Std. Dev.	0.029	0.034
	Wilk (p-value)	0.0663 *	0.0254 **
	Efficiency	-7.00%	
	t-Test (equal var.)	0.7581	
	t-Test (unequal var.)	0.7586	
	t-Test (paired)	0.7394	
	Levene Test	0.7538	
Bootstrap	UCL	0.062	0.063
	Mean	0.050	0.052
	LCL	0.037	0.041
	Std. Dev.	0.035	0.031
	Efficiency	-4.00%	

Brodie Lane Swale, Upper Reach - Total Phosphorus (mg/L)



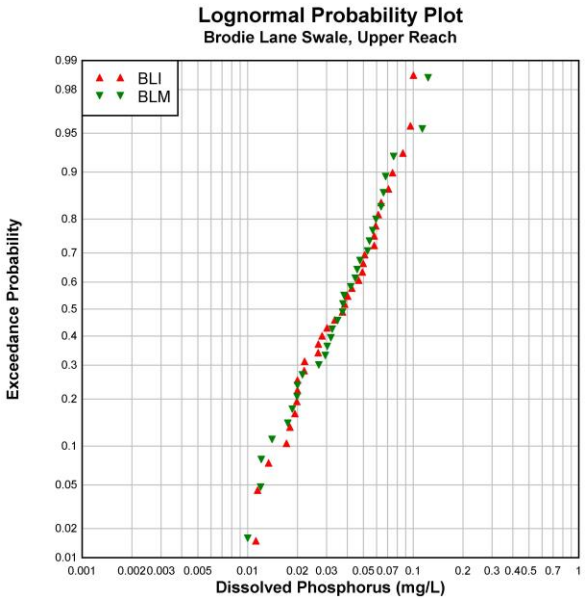


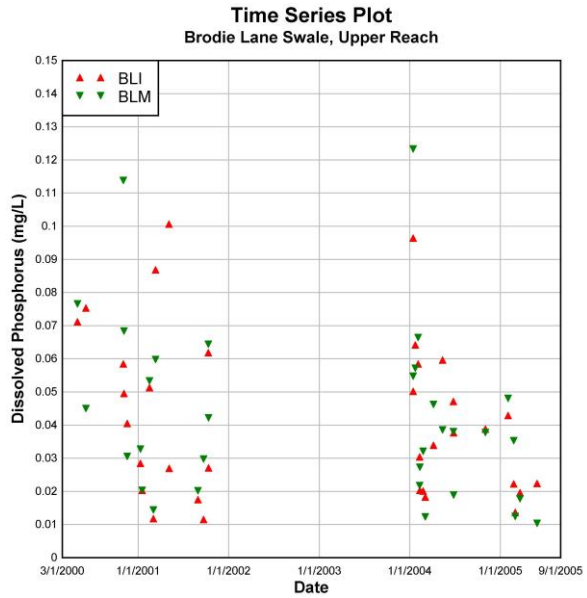


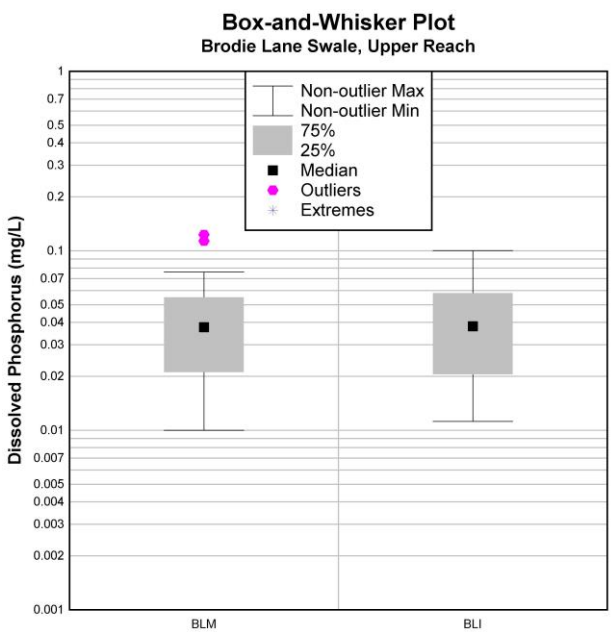


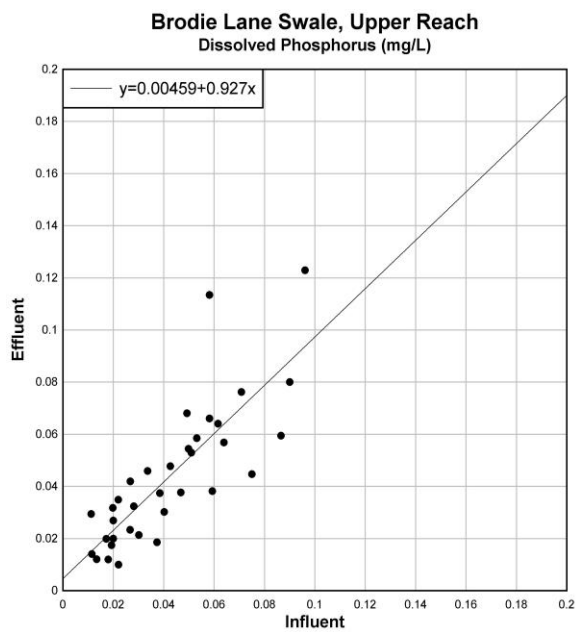
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	0.270	1.015
	Upper Quartile	0.146	0.128
	Median	0.115	0.089
	Lower Quartile	0.079	0.067
	Minimum	0.029	0.024
	Efficiency	22.82%	
	Mann-Whitney	0.2018	
	Wilcoxon (paired)	0.2059	
Arithmetic	UCL	0.134	0.191
	Mean	0.116	0.129
	LCL	0.097	0.068
	Std. Dev.	0.053	0.171
	Wilk (p-value)	0.2127	0.0001 **
	Efficiency	-11.81%	
	t-Test (equal var.)	0.6577	
	t-Test (unequal var.)	0.6669	
	t-test (paired)	0.5941	
	Levene Test	0.2850	
Log Transformed	UCL	0.140	0.156
	Mean	0.117	0.119
	LCL	0.097	0.090
	Std. Dev.	0.061	0.088
	Wilk (p-value)	0.5565	0.0194 **
	Efficiency	-1.59%	
	t-Test (equal var.)	0.5499	
	t-Test (unequal var.)	0.5539	
	t-Test (paired)	0.4576	
	Levene Test	0.2677	
Bootstrap	UCL	0.134	0.181
	Mean	0.116	0.128
	LCL	0.098	0.076
	Std. Dev.	0.052	0.145
	Efficiency	-10.84%	

Brodie Lane Swale, Upper Reach - Dissolved Phosphorus (mg/L)



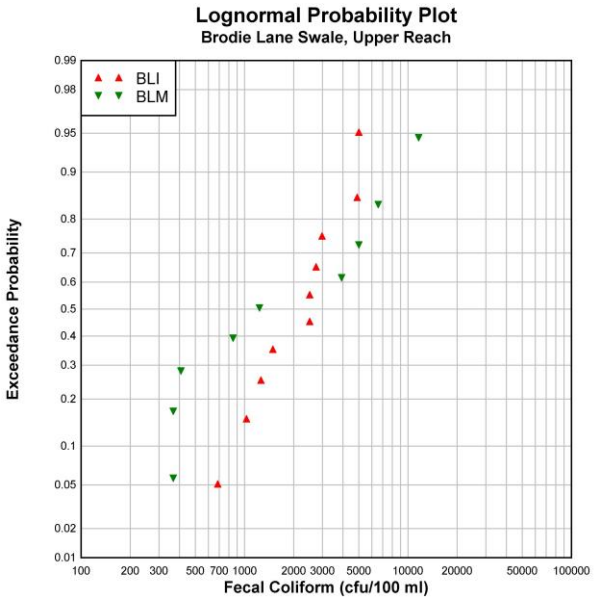


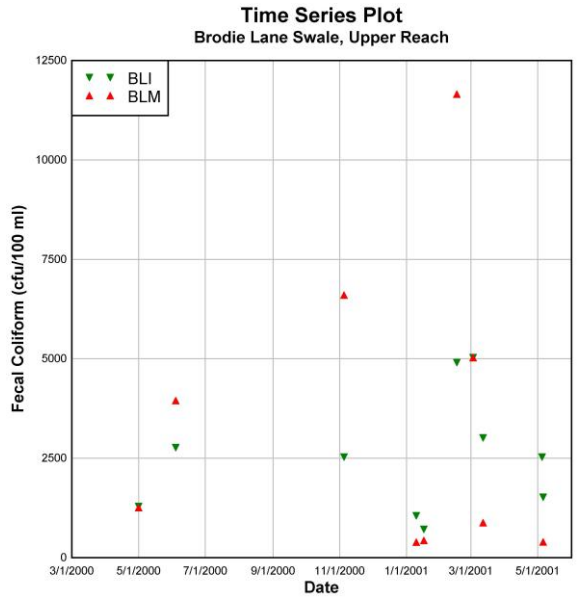


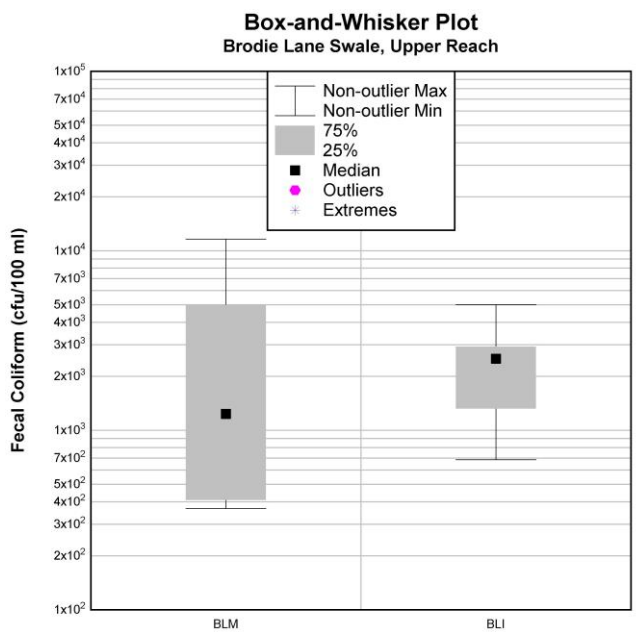


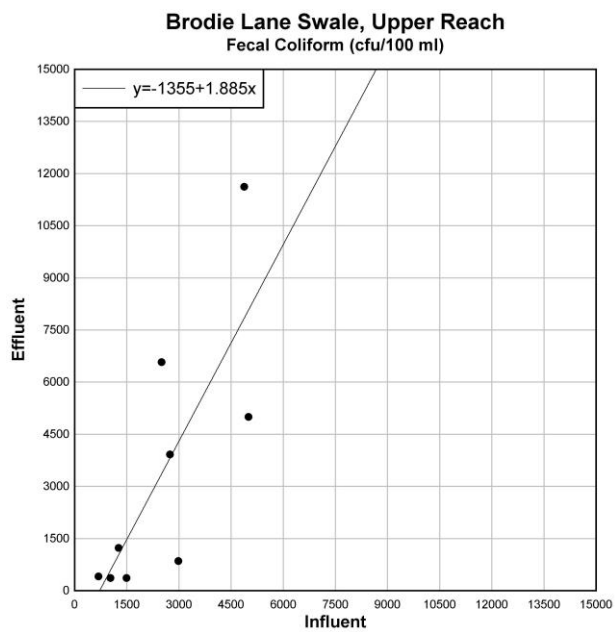
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	0.100	0.123
	Upper Quartile	0.058	0.056
	Median	0.038	0.038
	Lower Quartile	0.020	0.021
	Minimum	0.011	0.010
	Efficiency	1.00%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	0.6213	
Arithmetic	UCL	0.050	0.052
	Mean	0.042	0.042
	LCL	0.033	0.033
	Std. Dev.	0.024	0.027
	Wilk (p-value)	0.0178 **	0.0024 **
	Efficiency	-1.36%	
	t-Test (equal var.)	0.9285	
	t-Test (unequal var.)	0.9287	
	t-test (paired)	0.5688	
	Levene Test	0.6623	
Log Transformed	UCL	0.053	0.055
	Mean	0.042	0.043
	LCL	0.033	0.033
	Std. Dev.	0.028	0.029
	Wilk (p-value)	0.3746	0.7830
	Efficiency	-1.26%	
	t-Test (equal var.)	0.9986	
	t-Test (unequal var.)	0.9986	
	t-Test (paired)	0.7849	
	Levene Test	0.8047	
Bootstrap	UCL	0.050	0.052
	Mean	0.042	0.042
	LCL	0.033	0.033
	Std. Dev.	0.024	0.026
	Efficiency	-2.00%	

Brodie Lane Swale, Upper Reach - Fecal Coliform (cfu/100 ml)



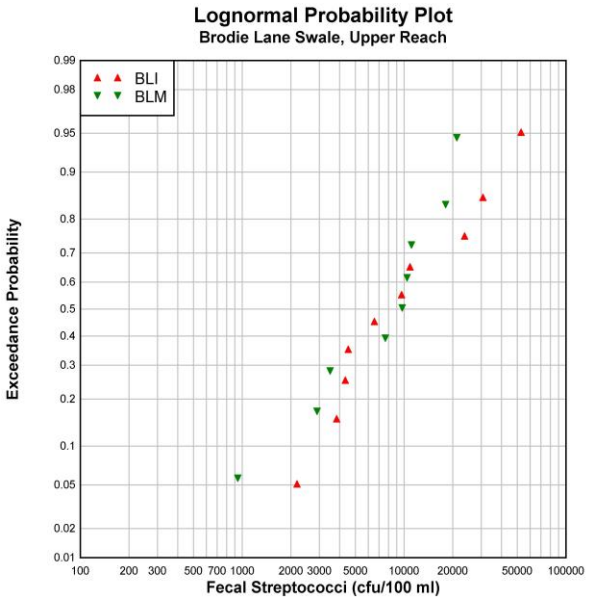


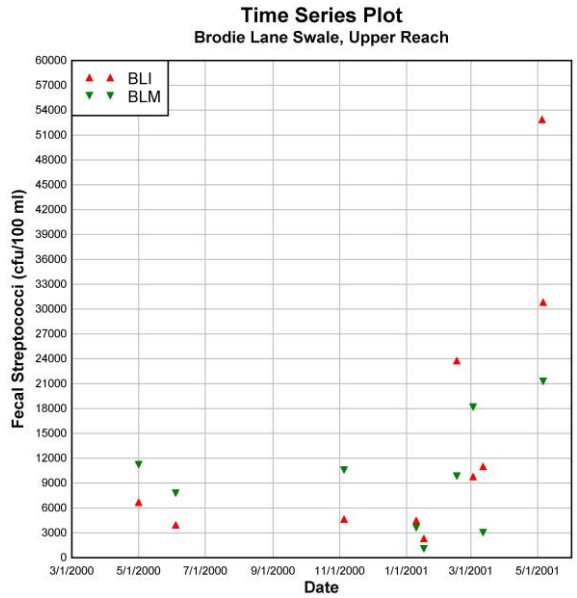


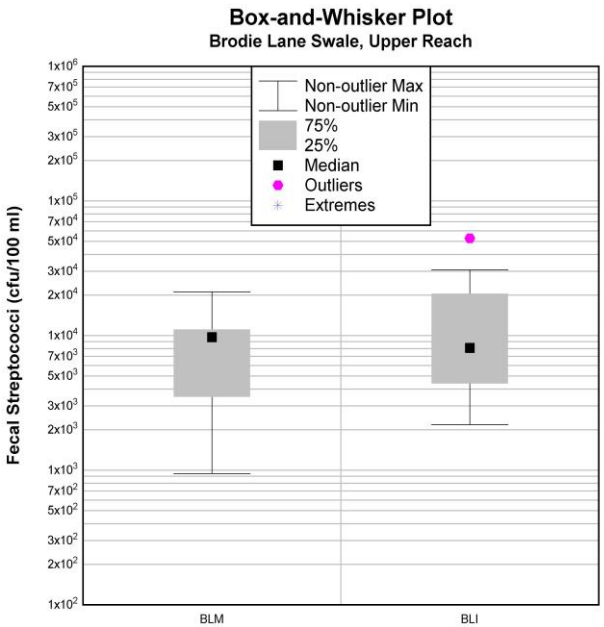


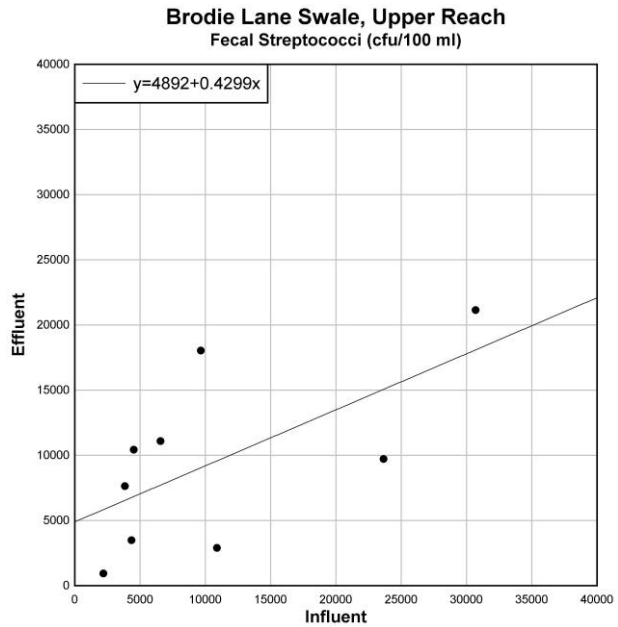
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	10	9
	Pairs Count	9	9
Non-Parametric	Maximum	5,000	11,624
	Upper Quartile	2,982	5,000
	Median	2,500	1,233
	Lower Quartile	1,261	408
	Minimum	686	366
	Efficiency	50.66%	
	Mann-Whitney	0.7783	
	Wilcoxon (paired)	0.9102	
Arithmetic	UCL	3,578	6,337
	Mean	2,506	3,371
	LCL	1,435	406
	Std. Dev.	1,498	3,858
	Wilk (p-value)	0.2174	0.0290 **
	Efficiency	-34.51%	
	t-Test (equal var.)	0.5195	
	t-Test (unequal var.)	0.5419	
	t-test (paired)	0.3829	
	Levene Test	0.1084	
Log Transformed	UCL	4,269	15,516
	Mean	2,536	3,509
	LCL	1,506	793
	Std. Dev.	1,715	5,224
	Wilk (p-value)	0.6315	0.1898
	Efficiency	-38.37%	
	t-Test (equal var.)	0.6151	
	t-Test (unequal var.)	0.6303	
	t-Test (paired)	0.4636	
	Levene Test	0.0050 **	
Bootstrap	UCL	3,508	6,044
	Mean	2,509	3,352
	LCL	1,510	659
	Std. Dev.	1,397	3,503
	Efficiency	-33.60%	

Brodie Lane Swale, Upper Reach - Fecal Streptococci (cfu/100 ml)



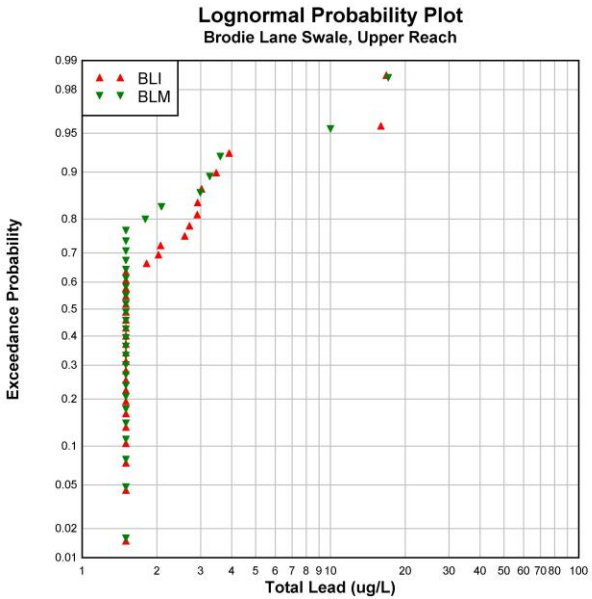


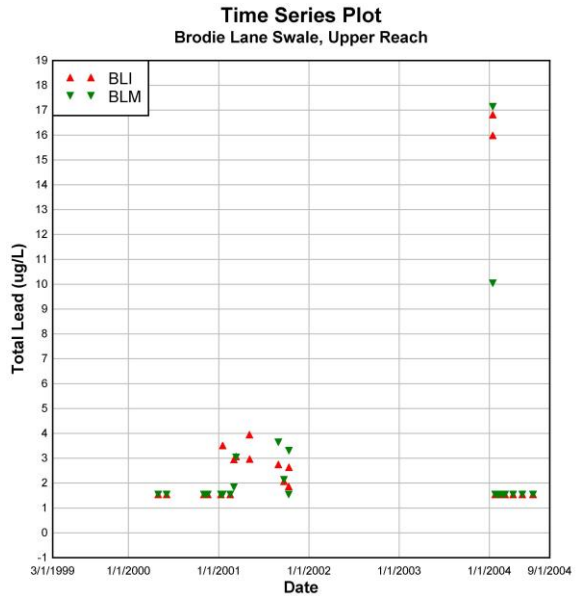


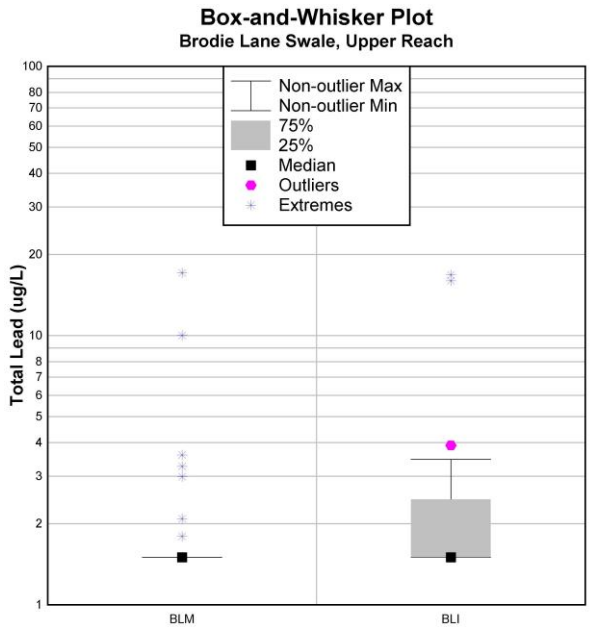


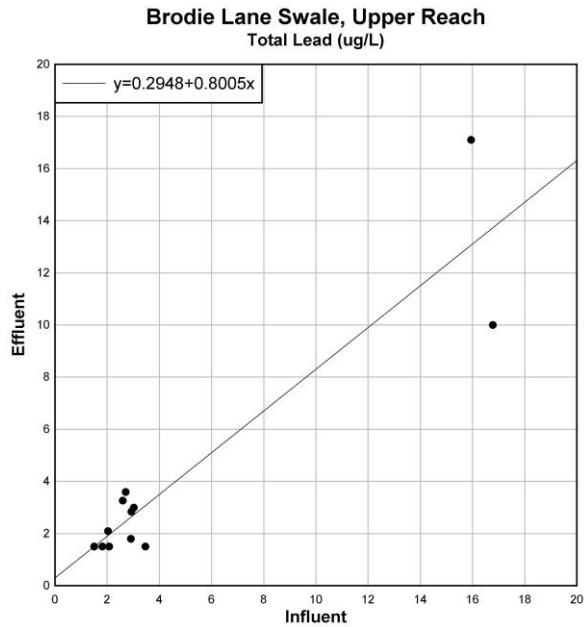
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	10	9
	Pairs Count	9	9
Non-Parametric	Maximum	52,754	21,153
	Upper Quartile	23,642	11,102
	Median	8,104	9,721
	Lower Quartile	4,337	3,496
	Minimum	2,181	940
	Efficiency	-19.95%	
	Mann-Whitney	0.7176	
	Wilcoxon (paired)	0.7344	
Arithmetic	UCL	26,529	14,711
	Mean	14,907	9,493
	LCL	3,285	4,275
	Std. Dev.	16,247	6,788
	Wilk (p-value)	0.0071 **	0.5482
	Efficiency	36.32%	
	t-Test (equal var.)	0.3667	
	t-Test (unequal var.)	0.3534	
	t-test (paired)	0.6516	
	Levene Test	0.1866	
Log Transformed	UCL	36,407	26,854
	Mean	14,478	10,366
	LCL	5,757	4,001
	Std. Dev.	15,975	10,887
	Wilk (p-value)	0.6941	0.3393
	Efficiency	28.40%	
	t-Test (equal var.)	0.5250	
	t-Test (unequal var.)	0.5244	
	t-Test (paired)	0.7003	
	Levene Test	0.8946	
Bootstrap	UCL	25,740	14,388
	Mean	15,216	9,519
	LCL	4,691	4,650
	Std. Dev.	14,713	6,335
	Efficiency	37.44%	

Brodie Lane Swale, Upper Reach - Total Lead (ug/L)



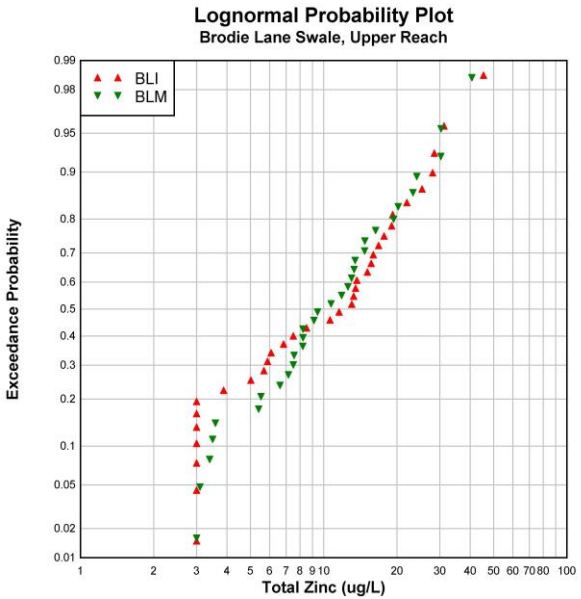


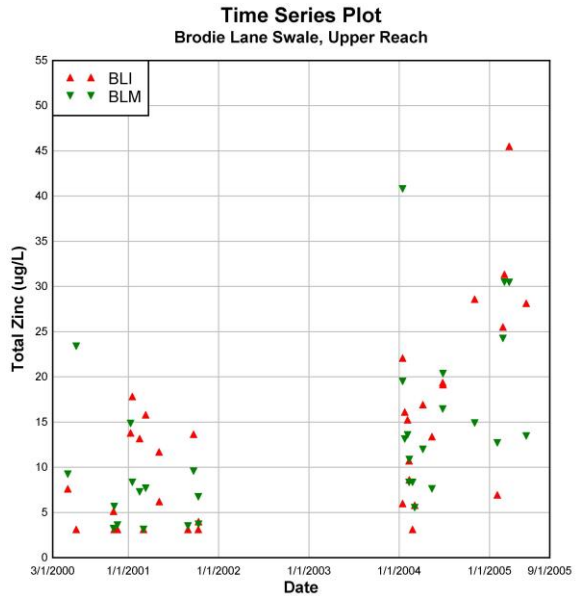


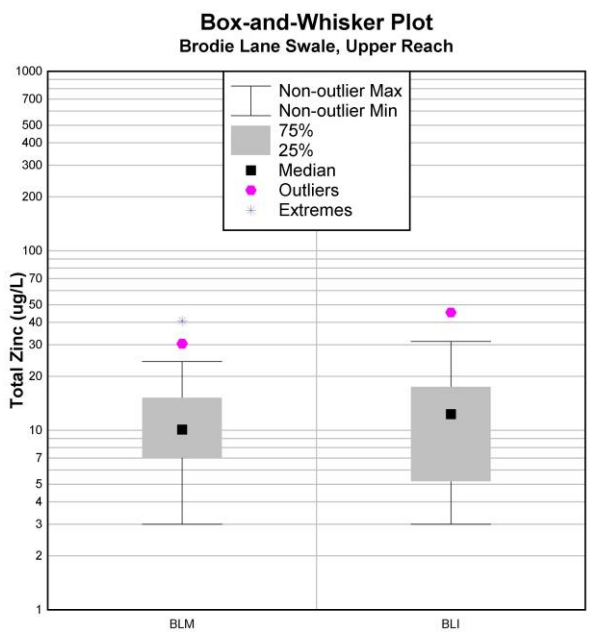


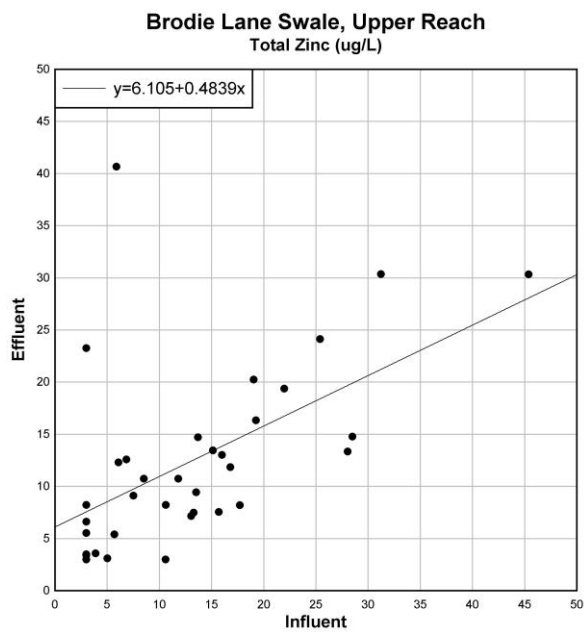
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	16.8	17.1
	Upper Quartile	2.6	1.5
	Median	1.5	1.5
	Lower Quartile	1.5	1.5
	Minimum	1.5	1.5
	Efficiency	0.00%	
	Mann-Whitney	0.4475	
	Wilcoxon (paired)	0.7379	
Arithmetic	UCL	4.0	3.6
	Mean	2.7	2.4
	LCL	1.5	1.3
	Std. Dev.	3.5	3.1
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	10.67%	
	t-Test (equal var.)	0.7220	
	t-Test (unequal var.)	0.7210	
	t-test (paired)	0.2773	
	Levene Test	0.7891	
Log Transformed	UCL	3.1	2.7
	Mean	2.4	2.2
	LCL	1.9	1.8
	Std. Dev.	1.6	1.3
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	10.23%	
	t-Test (equal var.)	0.5526	
	t-Test (unequal var.)	0.5518	
	t-Test (paired)	0.1465	
	Levene Test	0.8571	
Bootstrap	UCL	3.9	3.5
	Mean	2.8	2.5
	LCL	1.6	1.4
	Std. Dev.	3.3	2.8
	Efficiency	10.61%	

Brodie Lane Swale, Upper Reach - Total Zinc (ug/L)



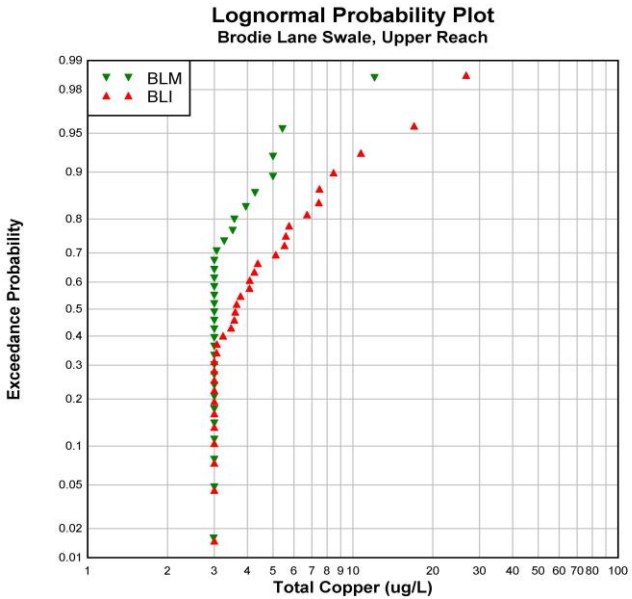


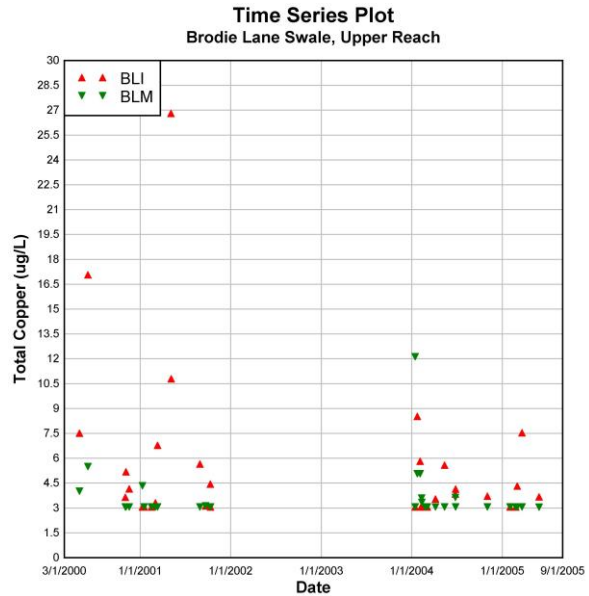


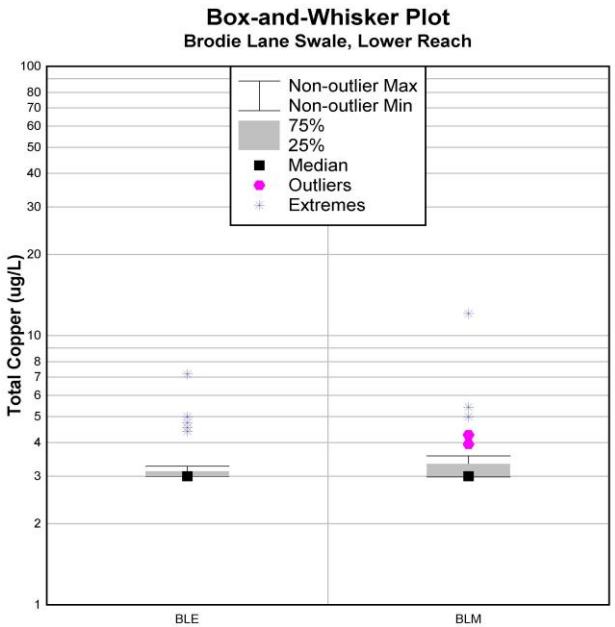


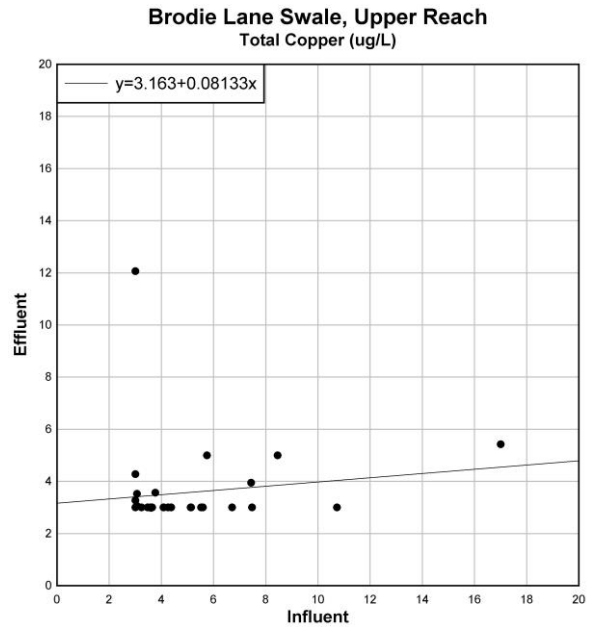
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	45.4	40.7
	Upper Quartile	17.7	15.6
	Median	12.3	10.1
	Lower Quartile	5.0	6.9
	Minimum	3.0	3.0
	Efficiency	18.06%	
	Mann-Whitney	0.8680	
	Wilcoxon (paired)	0.1668	
Arithmetic	UCL	16.6	16.0
	Mean	13.1	12.8
	LCL	9.6	9.5
	Std. Dev.	10.0	9.0
	Wilk (p-value)	0.0013 **	0.0011 **
	Efficiency	2.66%	
	t-Test (equal var.)	0.8826	
	t-Test (unequal var.)	0.8822	
	t-test (paired)	0.6782	
	Levene Test	0.6566	
Log Transformed	UCL	18.7	17.1
	Mean	13.4	12.9
	LCL	9.6	9.7
	Std. Dev.	12.6	9.9
	Wilk (p-value)	0.0263 **	0.5733
	Efficiency	4.38%	
	t-Test (equal var.)	0.8165	
	t-Test (unequal var.)	0.8156	
	t-Test (paired)	0.9114	
	Levene Test	0.2130	
Bootstrap	UCL	16.6	16.2
	Mean	13.2	13.0
	LCL	9.8	9.8
	Std. Dev.	9.8	8.9
	Efficiency	1.72%	

Brodie Lane Swale, Upper Reach - Total Copper (ug/L)



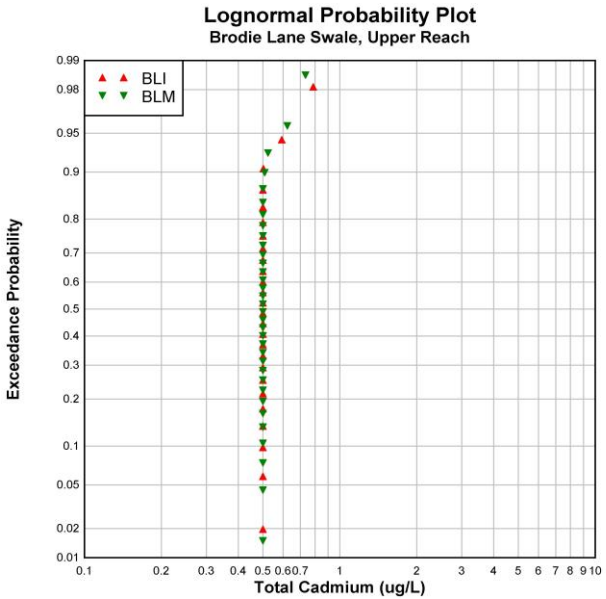


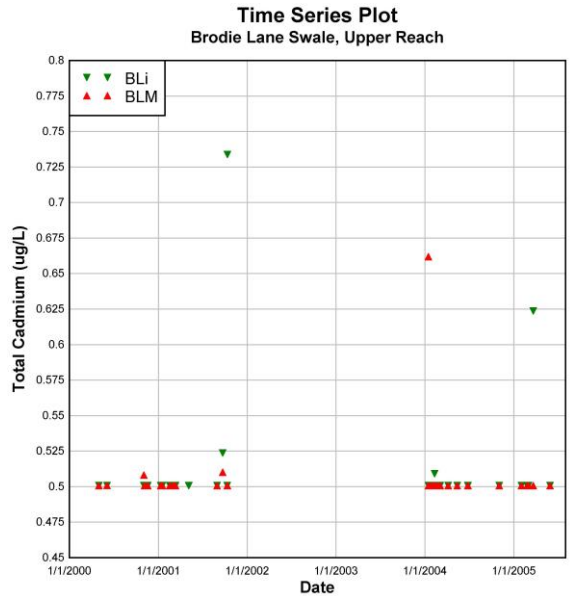


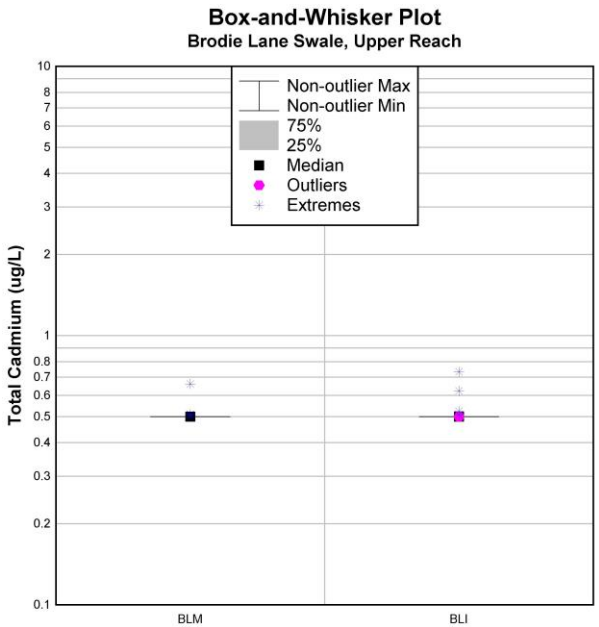


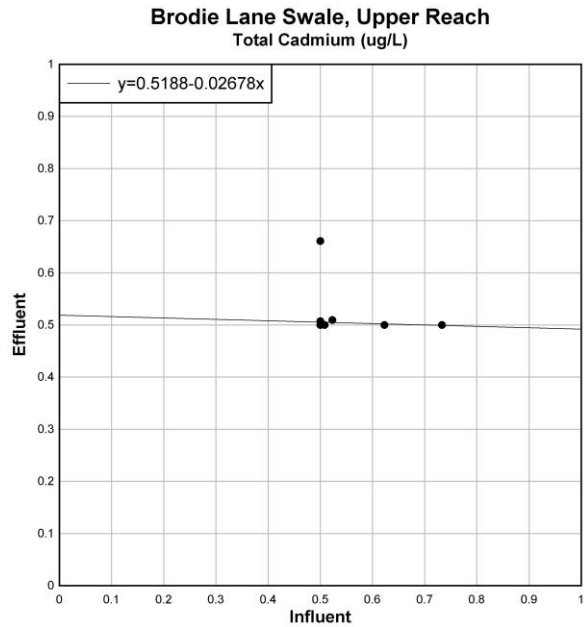
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLM**
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	26.7	12.1
	Upper Quartile	5.6	3.4
	Median	3.6	3.0
	Lower Quartile	3.0	3.0
	Minimum	3.0	3.0
	Efficiency	17.24%	
	Mann-Whitney	0.0219 **	
	Wilcoxon (paired)	0.0008 **	
Arithmetic	UCL	7.1	4.2
	Mean	5.4	3.6
	LCL	3.8	3.0
	Std. Dev.	4.7	1.7
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	33.44%	
	t-Test (equal var.)	0.0453 **	
	t-Test (unequal var.)	0.0427 **	
	t-test (paired)	0.0297 **	
	Levene Test	0.1886	
Log Transformed	UCL	6.3	3.9
	Mean	5.1	3.5
	LCL	4.2	3.2
	Std. Dev.	2.9	1.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	31.11%	
	t-Test (equal var.)	0.0122 **	
	t-Test (unequal var.)	0.0114 **	
	t-Test (paired)	0.0066 **	
	Levene Test	0.0970 *	
Bootstrap	UCL	6.9	4.1
	Mean	5.4	3.6
	LCL	3.9	3.1
	Std. Dev.	4.3	1.5
	Efficiency	32.85%	

Brodie Lane Swale, Upper Reach - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	Statistic	INF: BLI	EFF: BLM
	Site Count	34	32
	Pairs Count	35	35
Non-Parametric	Maximum	0.7	0.7
	Upper Quartile	0.5	0.5
	Median	0.5	0.5
	Lower Quartile	0.5	0.5
	Minimum	0.5	0.5
	Efficiency	0.00%	
	Mann-Whitney	0.6406	
	Wilcoxon (paired)	0.8000	
Arithmetic	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	1.14%	
	t-Test (equal var.)	0.5330	
	t-Test (unequal var.)	0.5280	
	t-test (paired)	0.5076	
	Levene Test	0.5006	
Log Transformed	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	1.12%	
	t-Test (equal var.)	0.5377	
	t-Test (unequal var.)	0.5330	
	t-Test (paired)	0.5113	
	Levene Test	0.5168	
Bootstrap	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.0
	Efficiency	1.18%	

Brodie Lane Grassed Swale, Lower Reach (BLM-BLE)

This control was originally installed and monitored by the Travis County Transportation and Natural Resources Department (TNRD) to treat runoff from an extension of Brodie Lane. The monitoring was continued by the City when the area was annexed. These results are for the lower portion of the control; for information on the upper portion of the swale (BLI-BLM) or the entire swale (BLI-BLE), see those summaries elsewhere in this section.

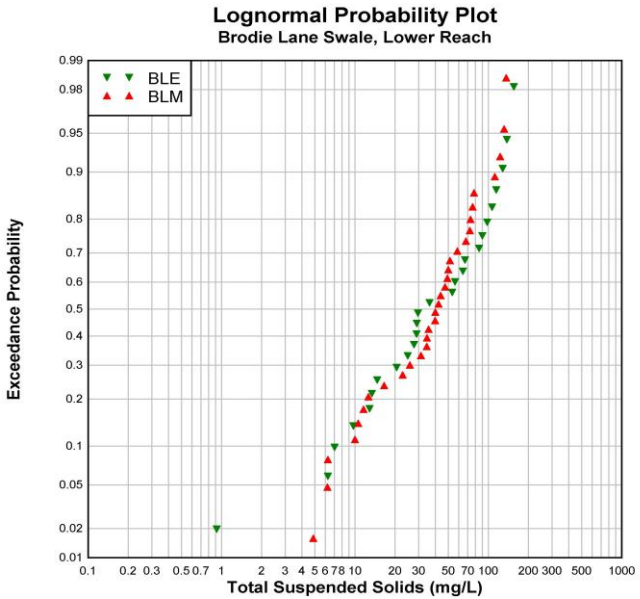
The swale is a trapezoidal channel planted with native vegetation primarily used to convey runoff. This study was intended to evaluate the possible water quality benefits of vegetated channels. Flow was not measured at the mid-point of the swale (BLM); the automatic sampler at BLM was triggered by flow at upper inflow to the swale (BLI). Flow at the outlet of this reach (BLE) was measured using an H-flume. This reach of the swale was approximately 85 ft. in length.

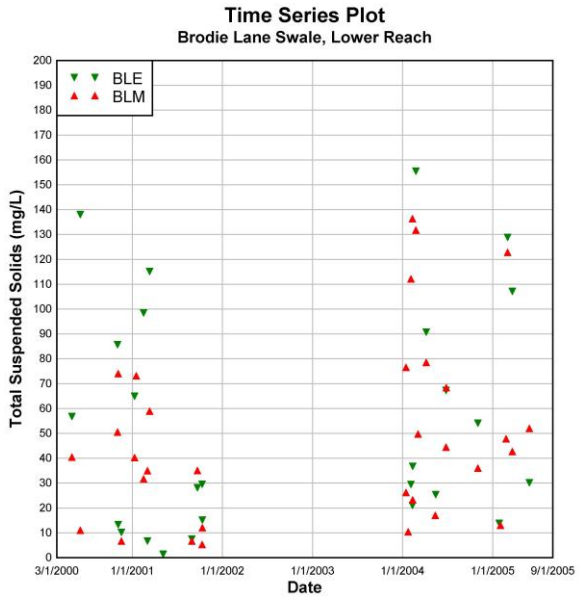
The City collected more than 30 paired samples at the influent and effluent stations between 2000 and 2005

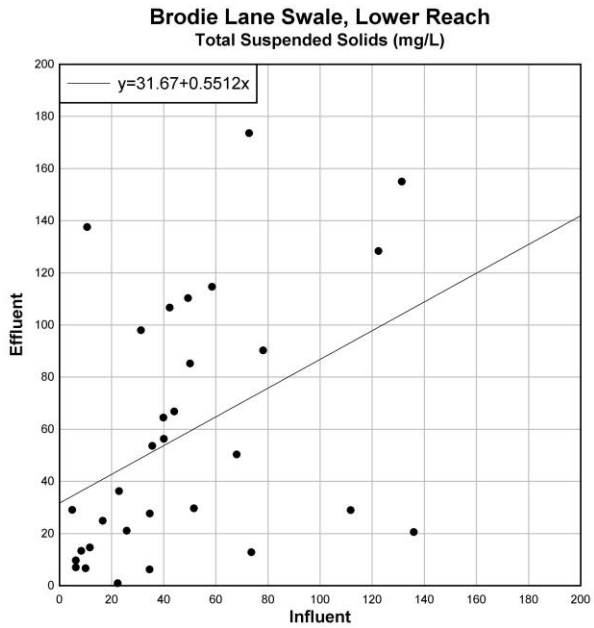
Performance Summary

Not unlike the upper reach, there were few significant differences between influent and effluent concentrations in this portion of the swale. There were no significant differences for TSS, VSS, COD, TOC, BOD, TN, TKN, NH_3, bacteria, Cd, Cu, and Pb. TP and DP were significantly different when using paired tests and indicated increased concentration of 5% and 15% respectively. There was a significant export of NO_2 + NO_3 (80%). There was also a significant increase in Zn, which is assumed to be related to the galvanized metal near BLE.

Brodie Lane Swale, Lower Reach - Total Suspended Solids (mg/L)

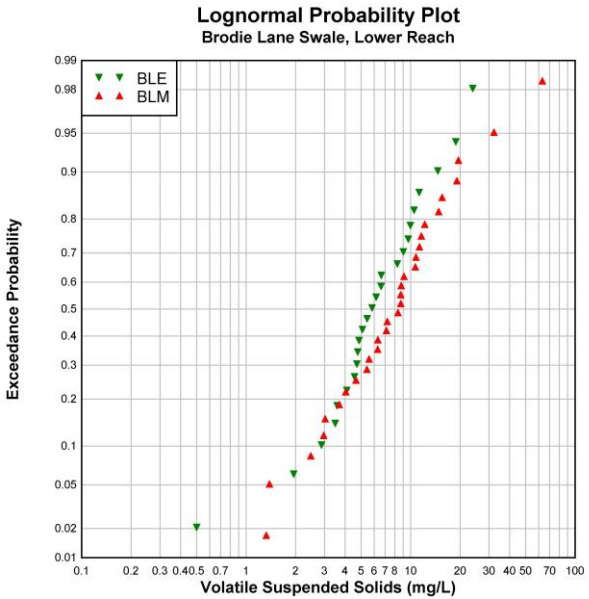


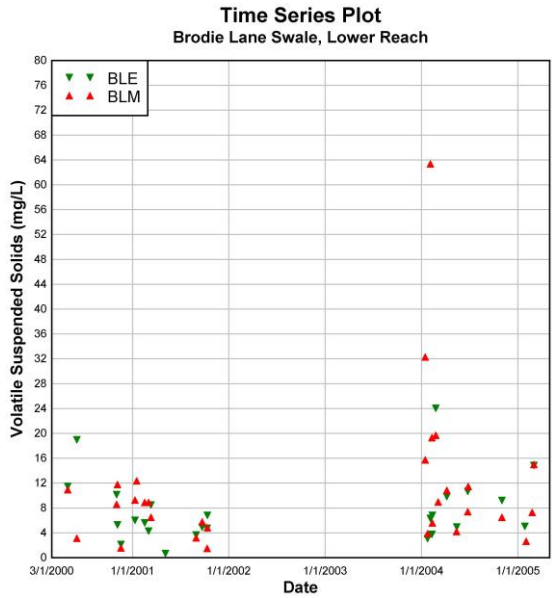


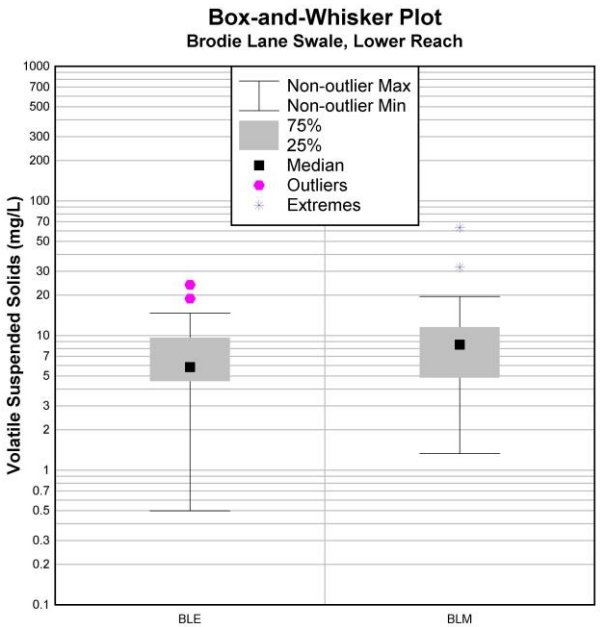


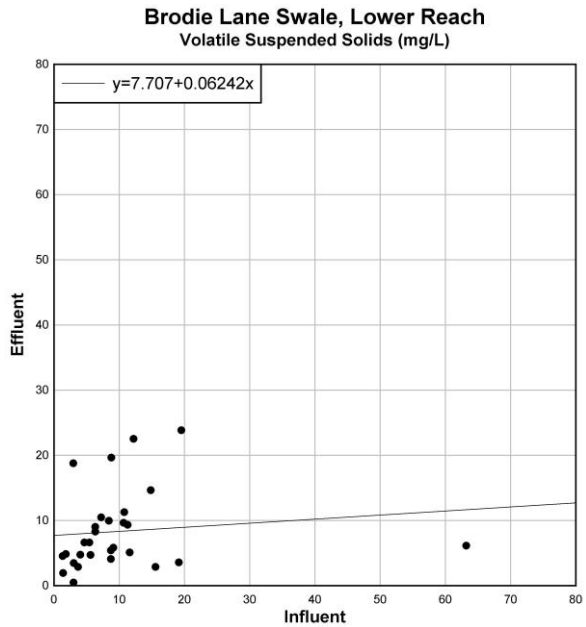
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	135.9	155.1
	Upper Quartile	70.4	90.3
	Median	41.2	33.0
	Lower Quartile	19.7	14.6
	Minimum	4.9	.9
	Efficiency	19.89%	
	Mann-Whitney	0.8824	
	Wilcoxon (paired)	0.1171	
Arithmetic	UCL	61.8	73.1
	Mean	48.6	54.6
	LCL	35.4	36.0
	Std. Dev.	36.6	45.9
	Wilk (p-value)	0.0047 **	0.0121 **
	Efficiency	-12.23%	
	t-Test (equal var.)	0.5852	
	t-Test (unequal var.)	0.5942	
	t-test (paired)	0.2371	
	Levene Test	0.2017	
Log Transformed	UCL	77.4	124.6
	Mean	52.0	65.6
	LCL	35.0	34.6
	Std. Dev.	56.0	100.8
	Wilk (p-value)	0.0777 *	0.0447 **
	Efficiency	-26.13%	
	t-Test (equal var.)	0.8860	
	t-Test (unequal var.)	0.8891	
	t-Test (paired)	0.8131	
	Levene Test	0.2434	
Bootstrap	UCL	61.9	72.2
	Mean	49.0	54.2
	LCL	36.1	36.3
	Std. Dev.	35.8	44.5
	Efficiency	-10.78%	

Brodie Lane Swale, Lower Reach - Volatile Suspended Solids (mg/L)



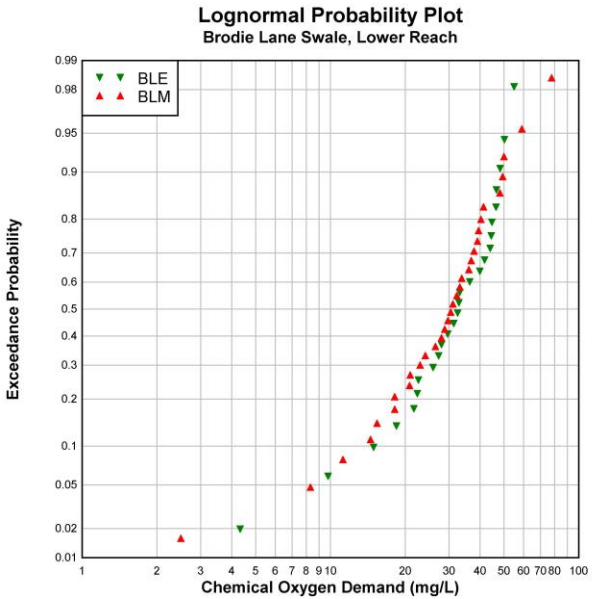


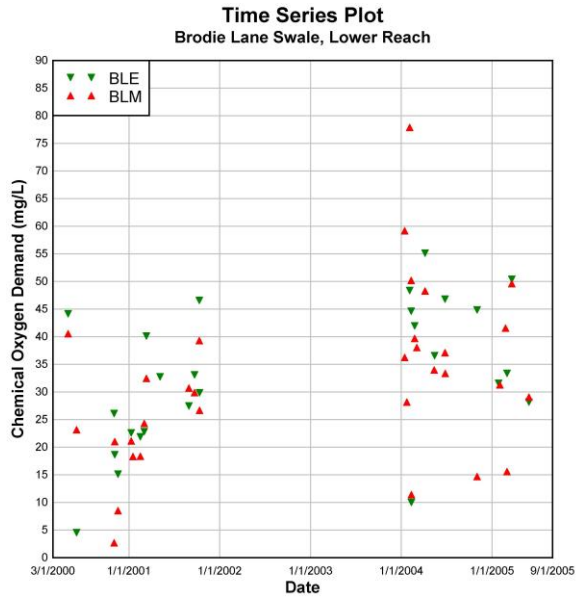


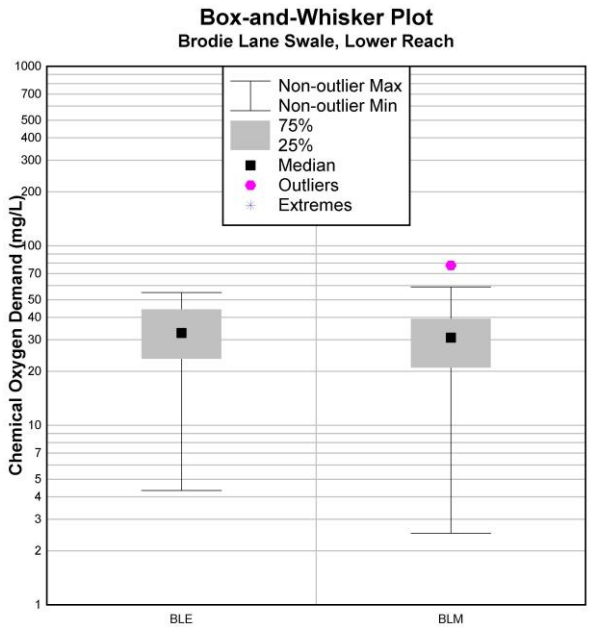


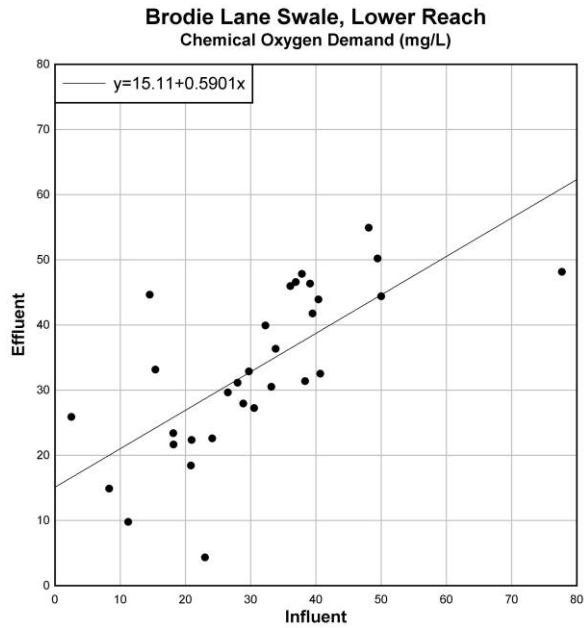
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	30	25
	Pairs Count	28	28
Non-Parametric	Maximum	63.2	23.8
	Upper Quartile	11.6	9.7
	Median	8.6	5.8
	Lower Quartile	4.7	4.6
	Minimum	1.3	.5
	Efficiency	31.90%	
	Mann-Whitney	0.2257	
	Wilcoxon (paired)	0.9647	
Arithmetic	UCL	15.3	9.7
	Mean	10.9	7.5
	LCL	6.5	5.3
	Std. Dev.	11.8	5.3
	Wilk (p-value)	0.0001 **	0.0020 **
	Efficiency	31.12%	
	t-Test (equal var.)	0.1908	
	t-Test (unequal var.)	0.1661	
	t-test (paired)	0.4710	
	Levene Test	0.2890	
Log Transformed	UCL	15.4	11.3
	Mean	10.7	7.8
	LCL	7.4	5.4
	Std. Dev.	10.3	6.7
	Wilk (p-value)	0.8095	0.0675 *
	Efficiency	26.76%	
	t-Test (equal var.)	0.2454	
	t-Test (unequal var.)	0.2420	
	t-Test (paired)	0.5816	
	Levene Test	0.7347	
Bootstrap	UCL	15.0	9.6
	Mean	10.9	7.5
	LCL	6.8	5.4
	Std. Dev.	10.9	5.1
	Efficiency	30.87%	

Brodie Lane Swale, Lower Reach - Chemical Oxygen Demand (mg/L)



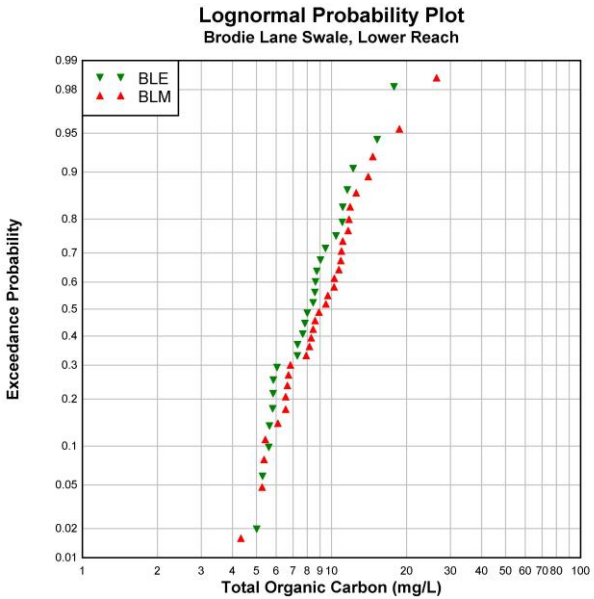


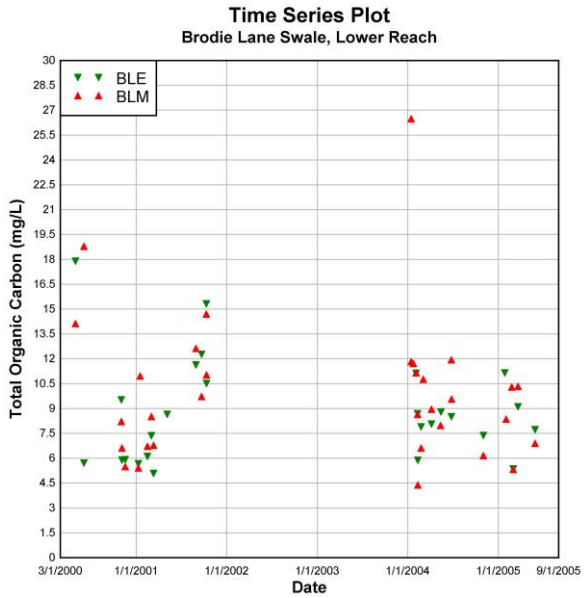


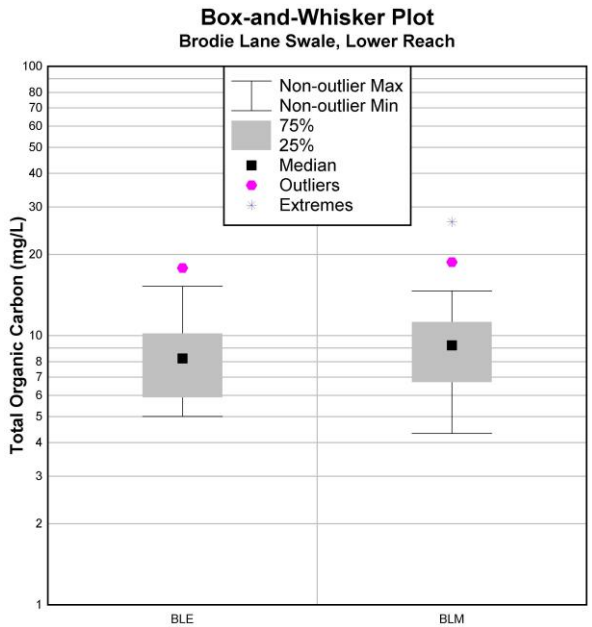


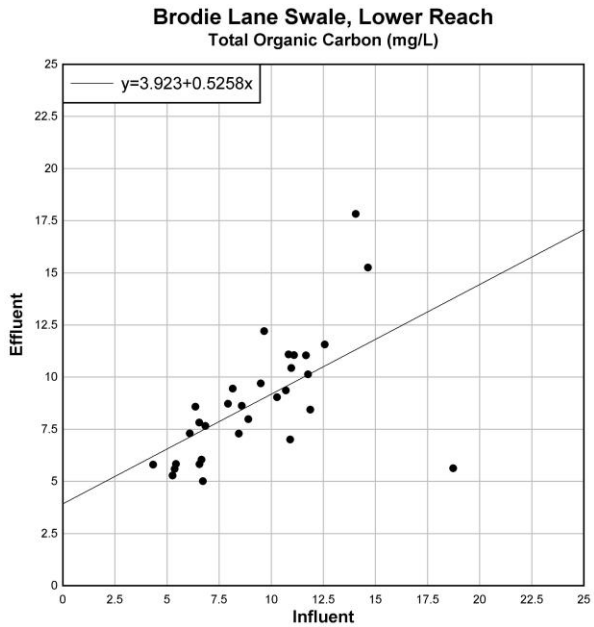
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	77.69	54.91
	Upper Quartile	39.30	44.40
	Median	30.81	32.72
	Lower Quartile	20.88	22.61
	Minimum	2.50	4.33
	Efficiency	-6.21%	
	Mann-Whitney	0.5190	
	Wilcoxon (paired)	0.0940 *	
Arithmetic	UCL	36.99	38.05
	Mean	31.45	32.78
	LCL	25.90	27.50
	Std. Dev.	15.37	13.06
	Wilk (p-value)	0.4165	0.7142
	Efficiency	-4.23%	
	t-Test (equal var.)	0.7275	
	t-Test (unequal var.)	0.7230	
	t-test (paired)	0.2283	
	Levene Test	0.4613	
Log Transformed	UCL	42.65	43.51
	Mean	33.00	34.01
	LCL	25.53	26.59
	Std. Dev.	23.06	20.31
	Wilk (p-value)	0.0014 **	0.0007 **
	Efficiency	-3.06%	
	t-Test (equal var.)	0.6289	
	t-Test (unequal var.)	0.6241	
	t-Test (paired)	0.2665	
	Levene Test	0.6828	
Bootstrap	UCL	37.08	38.05
	Mean	31.69	32.92
	LCL	26.30	27.79
	Std. Dev.	14.95	12.71
	Efficiency	-3.89%	

Brodie Lane Swale, Lower Reach - Total Organic Carbon (mg/L)



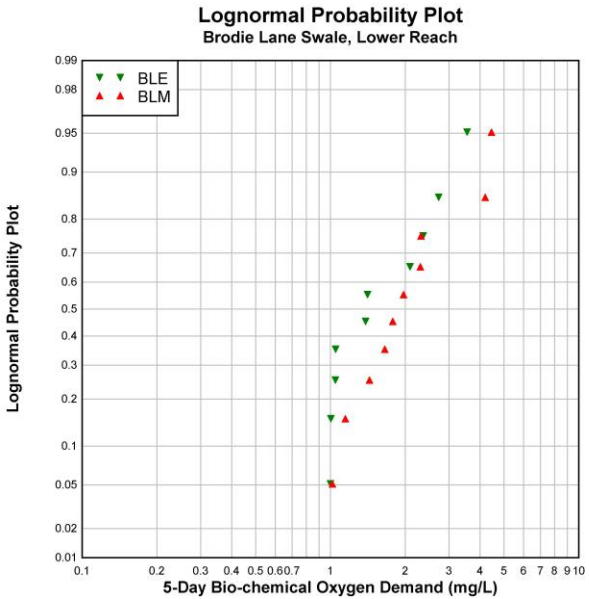


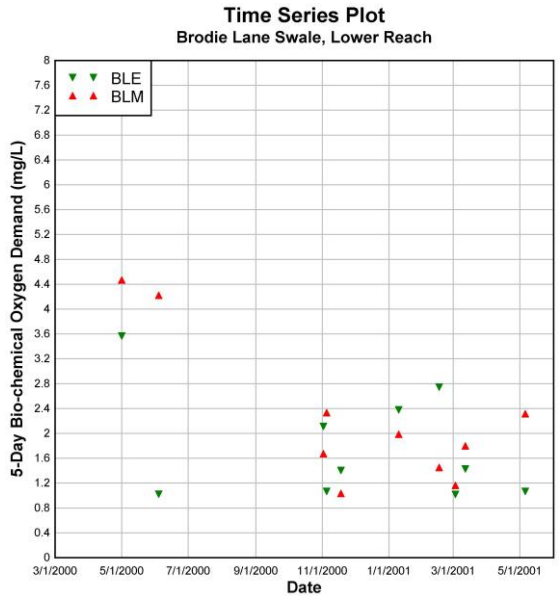


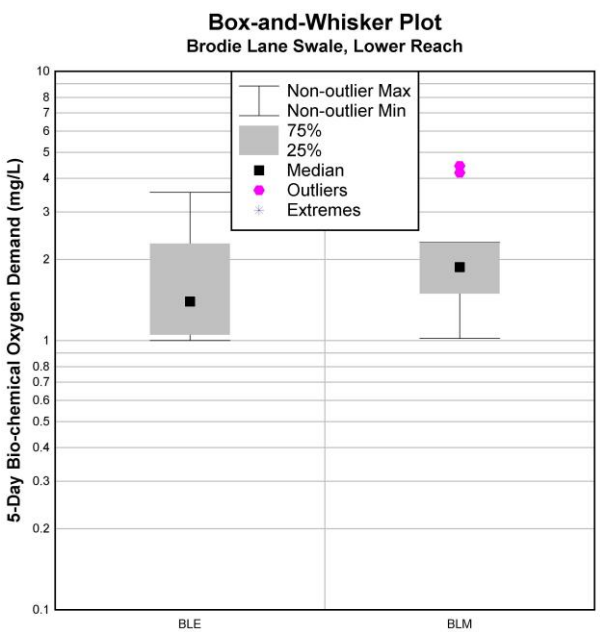


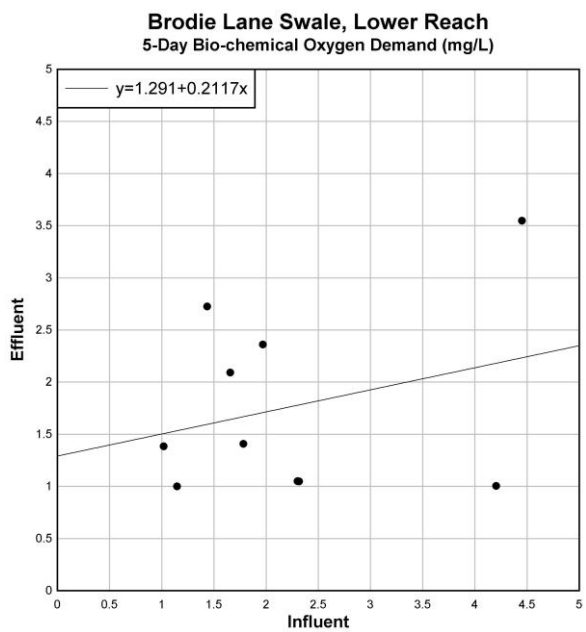
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	26.41	17.83
	Upper Quartile	11.38	10.44
	Median	9.20	8.22
	Lower Quartile	6.68	5.84
	Minimum	4.33	5.01
	Efficiency	10.68%	
	Mann-Whitney	0.2683	
	Wilcoxon (paired)	0.5943	
Arithmetic	UCL	11.41	9.93
	Mean	9.85	8.67
	LCL	8.28	7.41
	Std. Dev.	4.35	3.12
	Wilk (p-value)	0.0002 **	0.0082 **
	Efficiency	11.94%	
	t-Test (equal var.)	0.2527	
	t-Test (unequal var.)	0.2371	
	t-test (paired)	0.3332	
	Levene Test	0.3799	
Log Transformed	UCL	11.33	9.92
	Mean	9.80	8.65
	LCL	8.48	7.54
	Std. Dev.	3.90	2.92
	Wilk (p-value)	0.6420	0.3049
	Efficiency	11.76%	
	t-Test (equal var.)	0.2763	
	t-Test (unequal var.)	0.2686	
	t-Test (paired)	0.3572	
	Levene Test	0.4403	
Bootstrap	UCL	11.36	9.93
	Mean	9.86	8.71
	LCL	8.36	7.49
	Std. Dev.	4.16	3.02
	Efficiency	11.60%	

Brodie Lane Swale, Lower Reach - 5-Day Bio-chemical Oxygen Demand (mg/L)



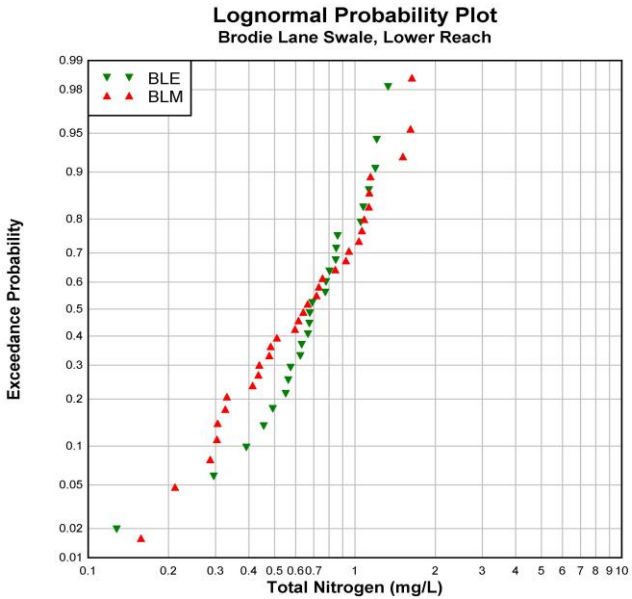


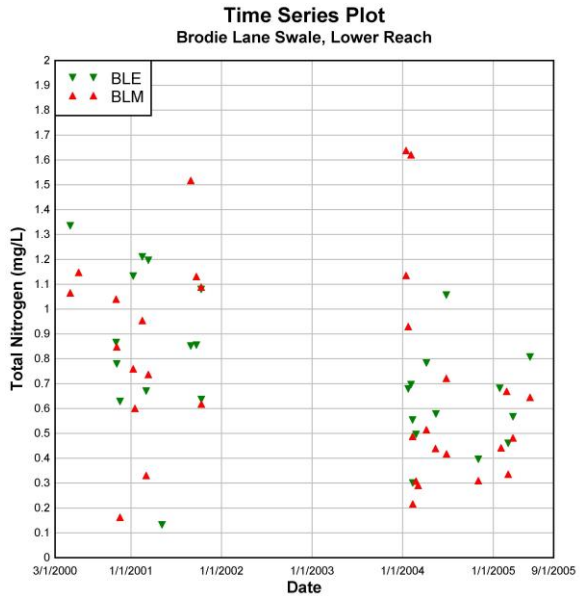


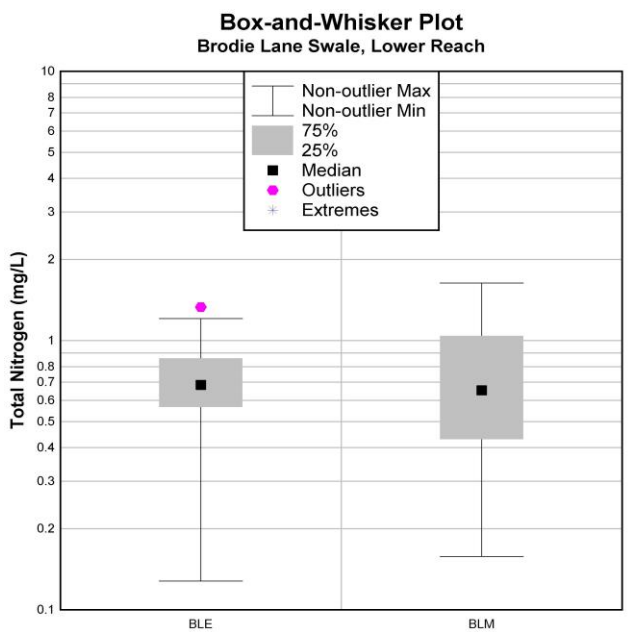


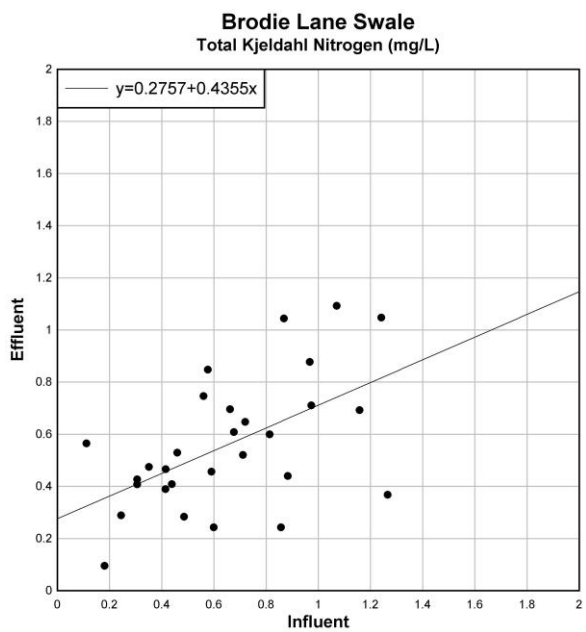
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	10	10
	Pairs Count	10	10
Non-Parametric	Maximum	4.45	3.55
	Upper Quartile	2.32	2.36
	Median	1.87	1.40
	Lower Quartile	1.44	1.05
	Minimum	1.02	1.00
	Efficiency	25.48%	
	Mann-Whitney	0.3203	
	Wilcoxon (paired)	0.4922	
Arithmetic	UCL	3.08	2.39
	Mean	2.23	1.76
	LCL	1.38	1.13
	Std. Dev.	1.19	0.88
	Wilk (p-value)	0.0343 **	0.0526 *
	Efficiency	20.88%	
	t-Test (equal var.)	0.3339	
	t-Test (unequal var.)	0.3350	
	t-test (paired)	0.2742	
	Levene Test	0.3741	
Log Transformed	UCL	3.21	2.50
	Mean	2.21	1.75
	LCL	1.52	1.23
	Std. Dev.	1.10	0.84
	Wilk (p-value)	0.5029	0.1173
	Efficiency	20.80%	
	t-Test (equal var.)	0.3093	
	t-Test (unequal var.)	0.3093	
	t-Test (paired)	0.2857	
	Levene Test	0.8533	
Bootstrap	UCL	2.98	2.33
	Mean	2.21	1.75
	LCL	1.45	1.17
	Std. Dev.	1.07	0.81
	Efficiency	20.89%	

Brodie Lane Swale, Lower Reach - Total Nitrogen (mg/L)



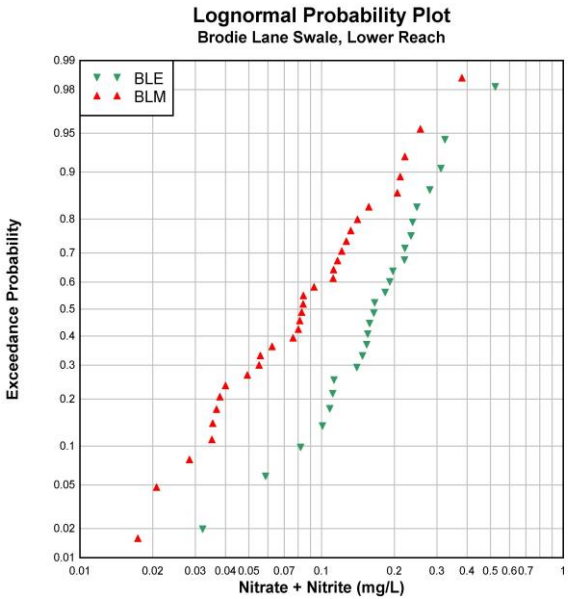


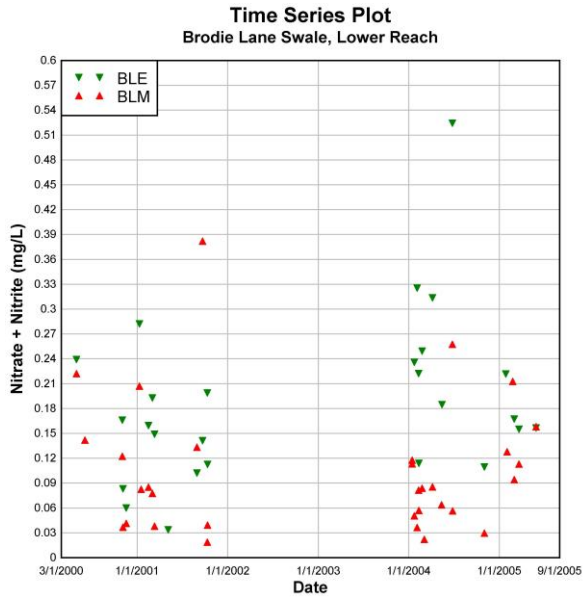


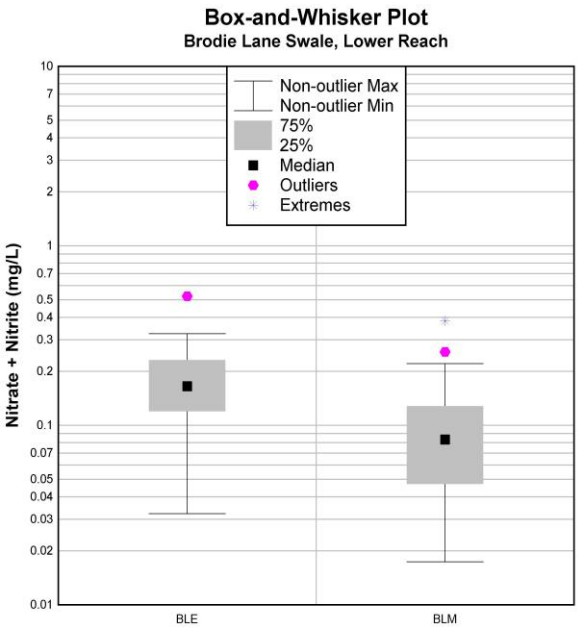


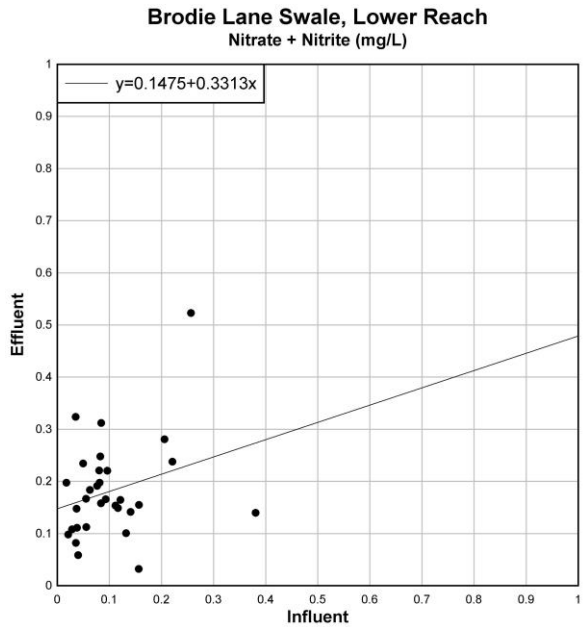
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	1.634	1.331
	Upper Quartile	1.048	0.861
	Median	0.653	0.685
	Lower Quartile	0.424	0.563
	Minimum	0.158	0.128
	Efficiency	-4.88%	
	Mann-Whitney	0.5496	
	Wilcoxon (paired)	0.3581	
Arithmetic	UCL	0.879	0.861
	Mean	0.733	0.743
	LCL	0.587	0.624
	Std. Dev.	0.405	0.293
	Wilk (p-value)	0.0454 **	0.8326
	Efficiency	-1.31%	
	t-Test (equal var.)	0.9197	
	t-Test (unequal var.)	0.9170	
	t-test (paired)	0.8200	
	Levene Test	0.0920 *	
Log Transformed	UCL	0.940	0.939
	Mean	0.742	0.759
	LCL	0.587	0.613
	Std. Dev.	0.477	0.393
	Wilk (p-value)	0.5373	0.0079 **
	Efficiency	-2.20%	
	t-Test (equal var.)	0.5997	
	t-Test (unequal var.)	0.5925	
	t-Test (paired)	0.4177	
	Levene Test	0.3768	
Bootstrap	UCL	0.879	0.857
	Mean	0.735	0.743
	LCL	0.592	0.628
	Std. Dev.	0.397	0.284
	Efficiency	-1.04%	

Brodie Lane Swale, Lower Reach - Nitrate + Nitrite (mg/L)



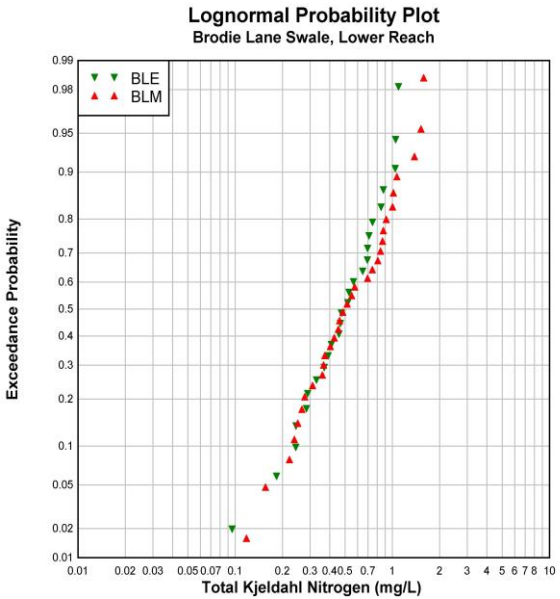


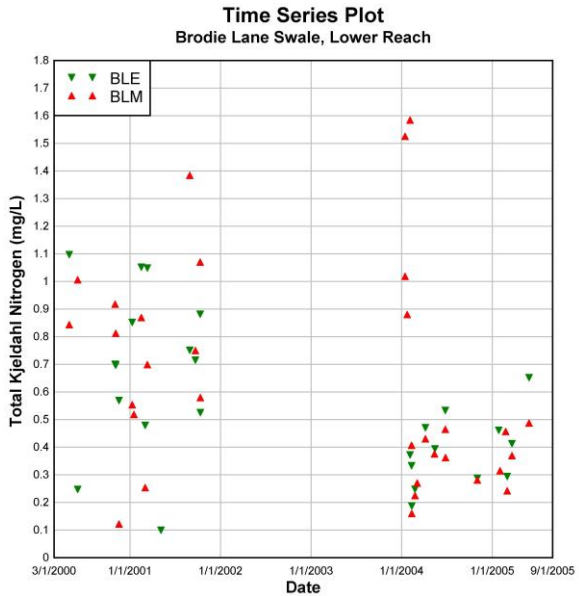


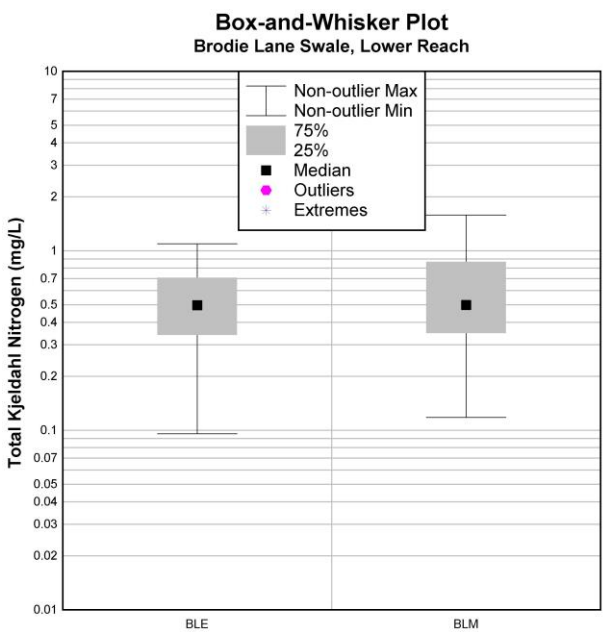


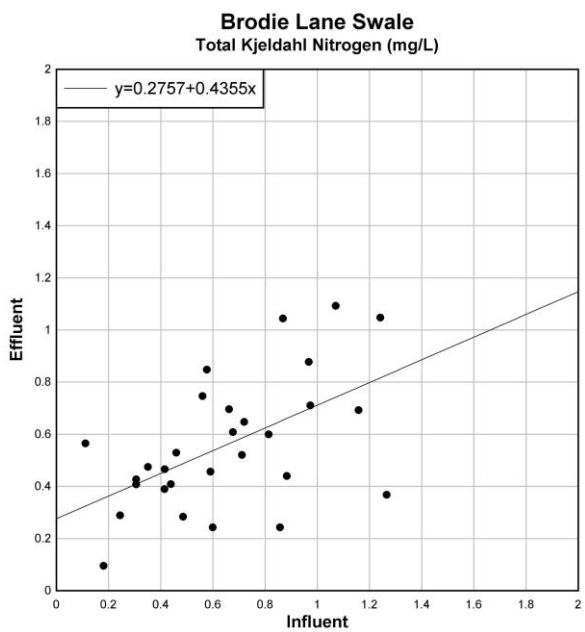
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.381	0.523
	Upper Quartile	0.129	0.234
	Median	0.083	0.165
	Lower Quartile	0.045	0.113
	Minimum	0.017	0.032
	Efficiency	-98.44%	
	Mann-Whitney	0.0007 **	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	0.133	0.228
	Mean	0.105	0.187
	LCL	0.076	0.147
	Std. Dev.	0.080	0.100
	Wilk (p-value)	0.0004 **	0.0165 **
	Efficiency	-78.78%	
	t-Test (equal var.)	0.0009 **	
	t-Test (unequal var.)	0.0013 **	
	t-test (paired)	0.0003 **	
	Levene Test	0.4605	
Log Transformed	UCL	0.143	0.244
	Mean	0.106	0.190
	LCL	0.078	0.148
	Std. Dev.	0.087	0.115
	Wilk (p-value)	0.9427	0.3413
	Efficiency	-79.95%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0002 **	
	t-Test (paired)	0.0001 **	
	Levene Test	0.1757	
Bootstrap	UCL	0.133	0.226
	Mean	0.105	0.187
	LCL	0.077	0.149
	Std. Dev.	0.077	0.095
	Efficiency	-78.37%	

Brodie Lane Swale, Lower Reach - Total Kjeldahl Nitrogen (mg/L)



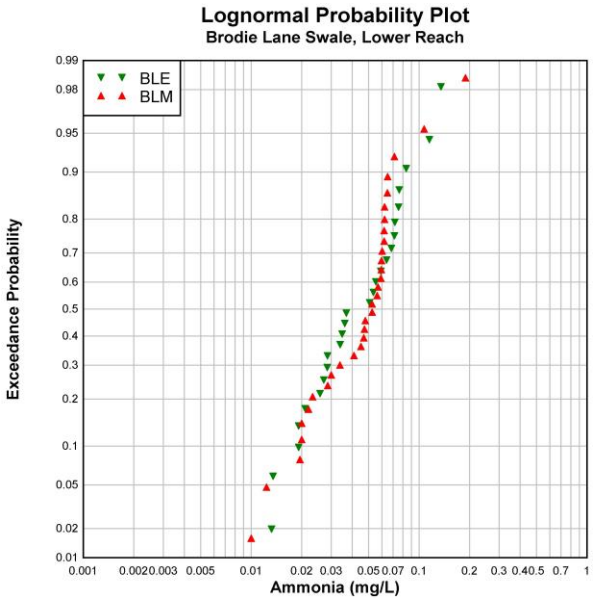


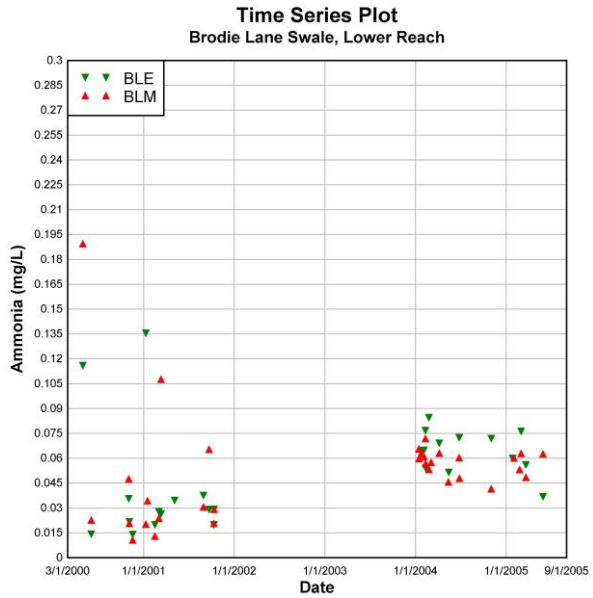


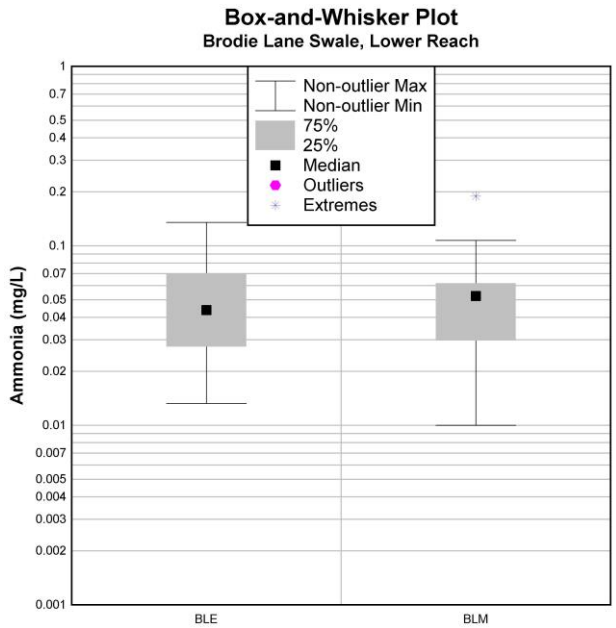


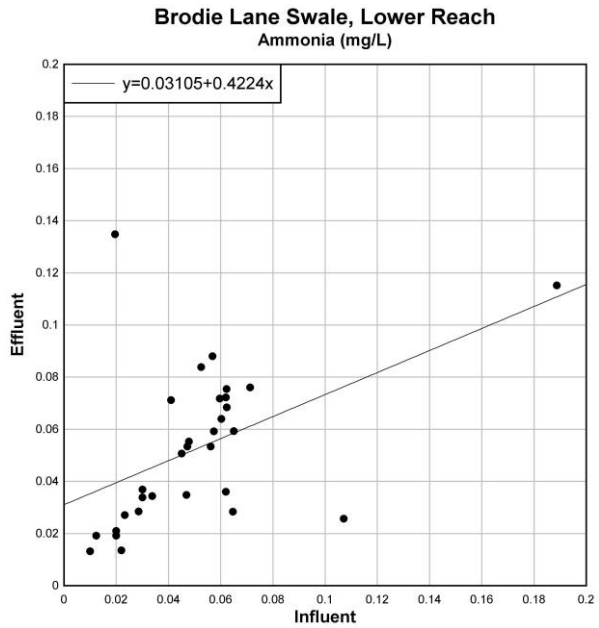
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	1.581	1.093
	Upper Quartile	0.871	0.711
	Median	0.499	0.498
	Lower Quartile	0.335	0.329
	Minimum	0.118	0.096
	Efficiency	0.32%	
	Mann-Whitney	0.7263	
	Wilcoxon (paired)	0.9281	
Arithmetic	UCL	0.770	0.660
	Mean	0.629	0.548
	LCL	0.487	0.436
	Std. Dev.	0.391	0.277
	Wilk (p-value)	0.0115 **	0.3312
	Efficiency	12.79%	
	t-Test (equal var.)	0.3813	
	t-Test (unequal var.)	0.3647	
	t-test (paired)	0.3234	
	Levene Test	0.1007	
Log Transformed	UCL	0.827	0.724
	Mean	0.636	0.559
	LCL	0.490	0.432
	Std. Dev.	0.454	0.349
	Wilk (p-value)	0.7625	0.2978
	Efficiency	12.11%	
	t-Test (equal var.)	0.6070	
	t-Test (unequal var.)	0.6027	
	t-Test (paired)	0.6429	
	Levene Test	0.5172	
Bootstrap	UCL	0.766	0.655
	Mean	0.629	0.547
	LCL	0.492	0.438
	Std. Dev.	0.381	0.269
	Efficiency	13.07%	

Brodie Lane Swale, Lower Reach - Ammonia (mg/L)



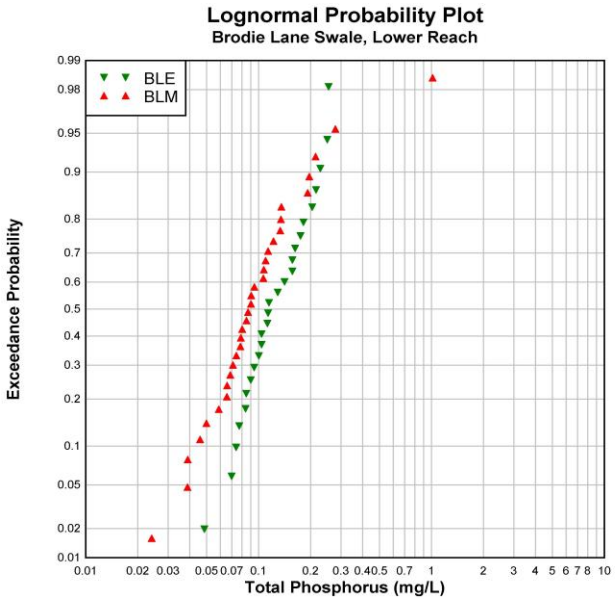


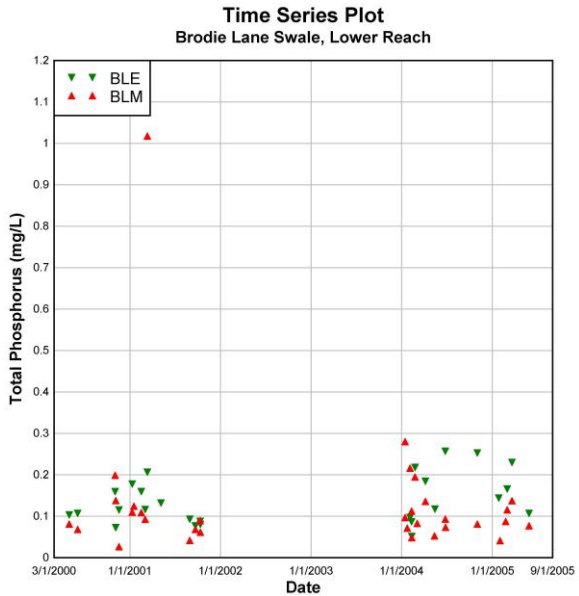


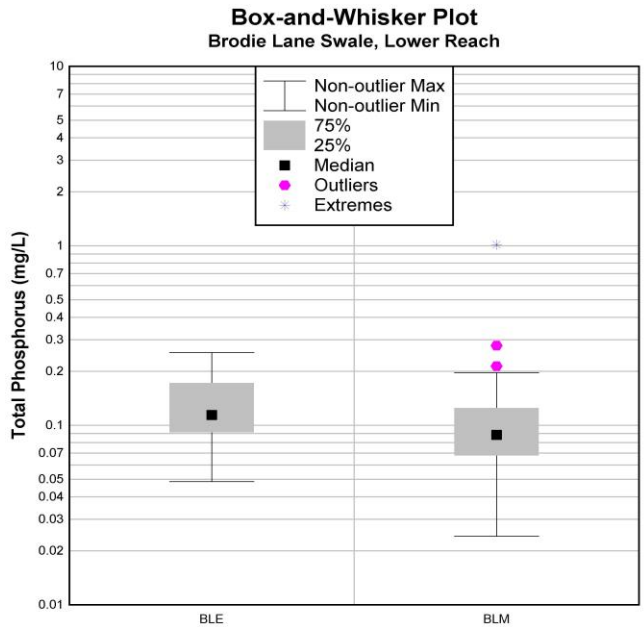


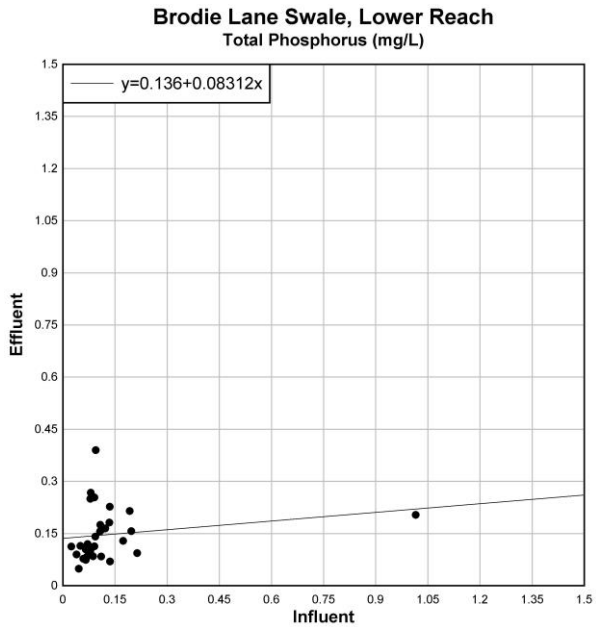
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.189	0.135
	Upper Quartile	0.062	0.071
	Median	0.053	0.044
	Lower Quartile	0.029	0.027
	Minimum	0.010	0.013
	Efficiency	16.61%	
	Mann-Whitney	0.9938	
	Wilcoxon (paired)	0.1823	
Arithmetic	UCL	0.063	0.063
	Mean	0.052	0.051
	LCL	0.040	0.038
	Std. Dev.	0.033	0.031
	Wilk (p-value)	0.0001 **	0.0233 **
	Efficiency	1.74%	
	t-Test (equal var.)	0.9156	
	t-Test (unequal var.)	0.9151	
	t-test (paired)	0.7705	
	Levene Test	0.8741	
Log Transformed	UCL	0.066	0.068
	Mean	0.052	0.051
	LCL	0.041	0.039
	Std. Dev.	0.034	0.035
	Wilk (p-value)	0.0254 **	0.5566
	Efficiency	1.90%	
	t-Test (equal var.)	0.8478	
	t-Test (unequal var.)	0.8485	
	t-Test (paired)	0.6284	
	Levene Test	0.8498	
Bootstrap	UCL	0.063	0.063
	Mean	0.052	0.051
	LCL	0.041	0.039
	Std. Dev.	0.031	0.030
	Efficiency	1.84%	

Brodie Lane Swale, Lower Reach - Total Phosphorus (mg/L)



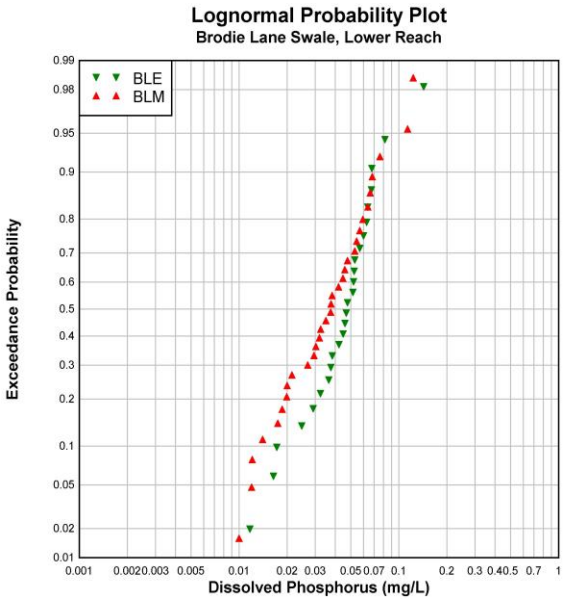


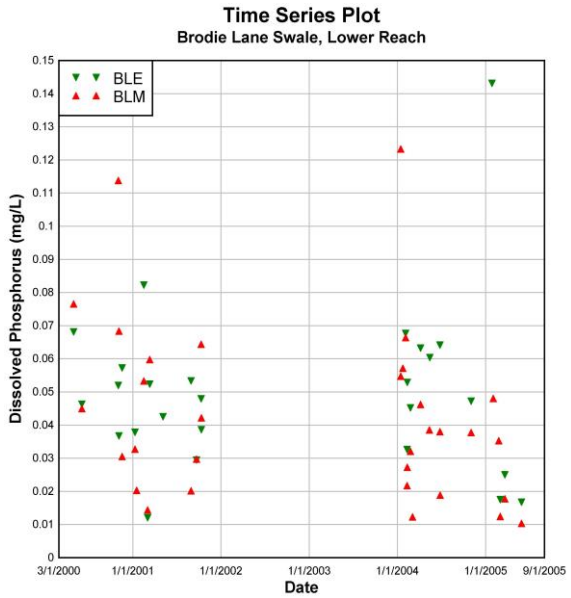


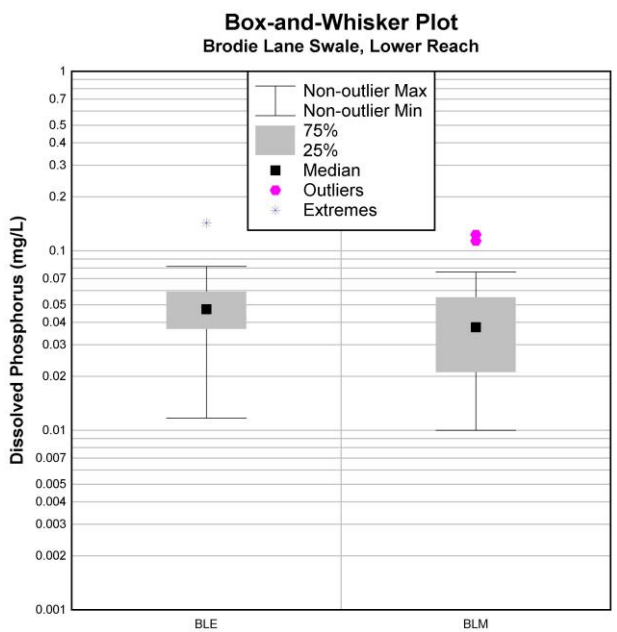


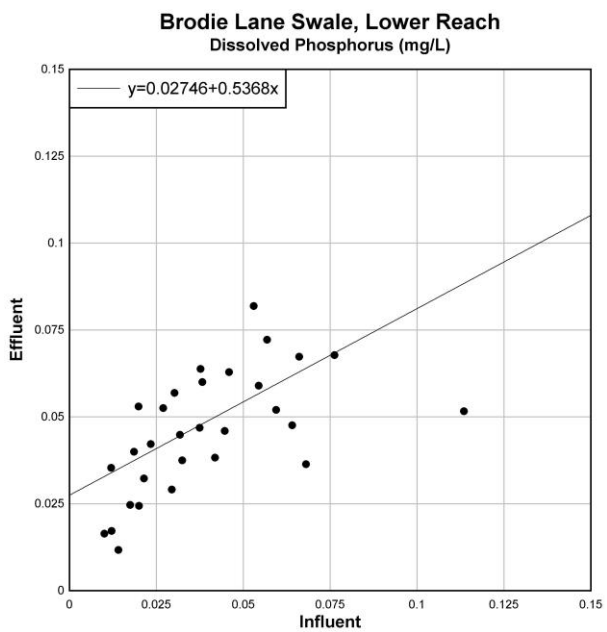
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	1.015	0.254
	Upper Quartile	0.128	0.175
	Median	0.089	0.114
	Lower Quartile	0.067	0.090
	Minimum	0.024	0.049
	Efficiency	-28.90%	
	Mann-Whitney	0.0333 **	
	Wilcoxon (paired)	0.0106 **	
Arithmetic	UCL	0.191	0.159
	Mean	0.129	0.136
	LCL	0.068	0.112
	Std. Dev.	0.171	0.058
	Wilk (p-value)	0.0001 **	0.0776 *
	Efficiency	-4.71%	
	t-Test (equal var.)	0.8626	
	t-Test (unequal var.)	0.8510	
	t-test (paired)	0.6232	
	Levene Test	0.3611	
Log Transformed	UCL	0.156	0.163
	Mean	0.119	0.136
	LCL	0.090	0.113
	Std. Dev.	0.088	0.061
	Wilk (p-value)	0.0194 **	0.7073
	Efficiency	-14.30%	
	t-Test (equal var.)	0.0898 *	
	t-Test (unequal var.)	0.0768 *	
	t-Test (paired)	0.0224 **	
	Levene Test	0.2014	
Bootstrap	UCL	0.180	0.158
	Mean	0.128	0.135
	LCL	0.076	0.112
	Std. Dev.	0.145	0.057
	Efficiency	-5.77%	

Brodie Lane Swale, Lower Reach - Dissolved Phosphorus (mg/L)



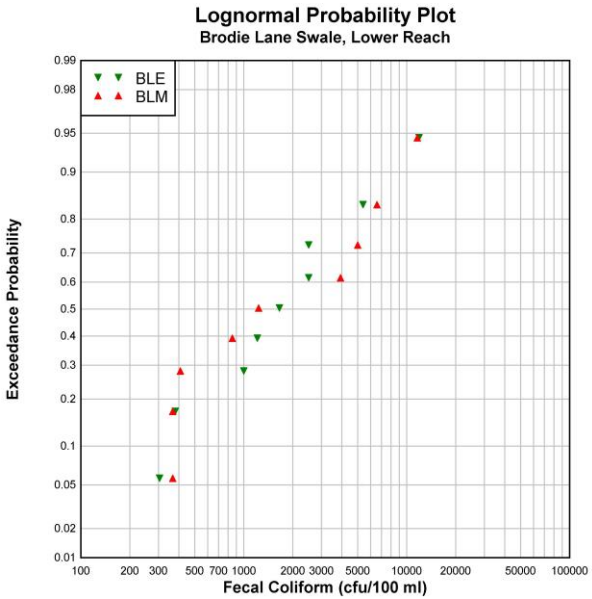


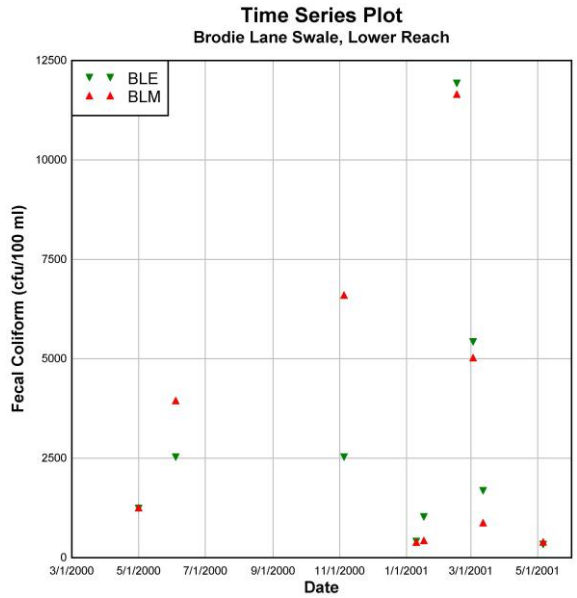


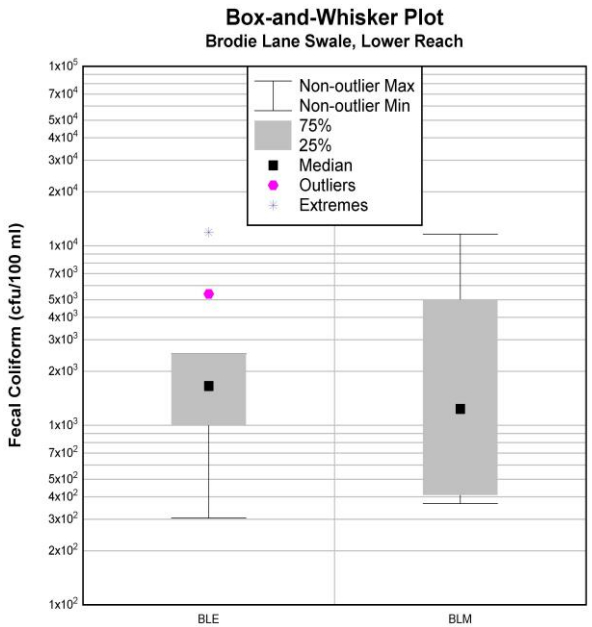


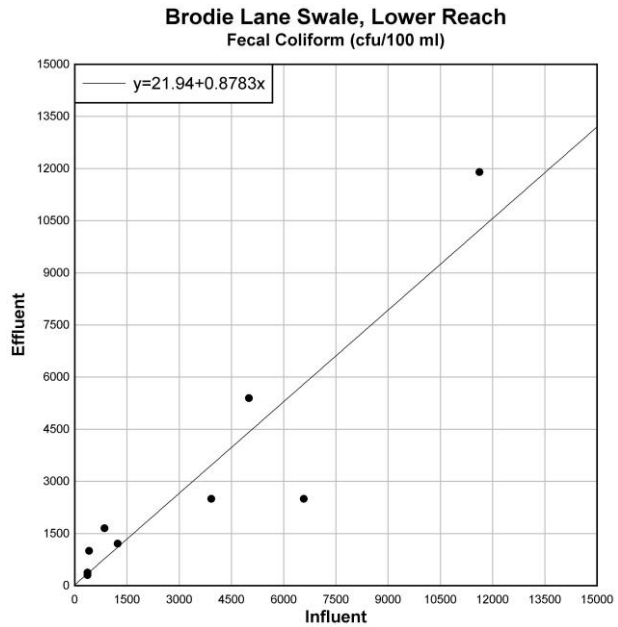
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.123	0.143
	Upper Quartile	0.056	0.060
	Median	0.038	0.047
	Lower Quartile	0.021	0.036
	Minimum	0.010	0.012
	Efficiency	-25.80%	
	Mann-Whitney	0.1866	
	Wilcoxon (paired)	0.0086 **	
Arithmetic	UCL	0.052	0.060
	Mean	0.042	0.049
	LCL	0.033	0.039
	Std. Dev.	0.027	0.026
	Wilk (p-value)	0.0024 **	0.0017 **
	Efficiency	-16.22%	
	t-Test (equal var.)	0.3259	
	t-Test (unequal var.)	0.3236	
	t-test (paired)	0.0591 *	
	Levene Test	0.8659	
Log Transformed	UCL	0.055	0.063
	Mean	0.043	0.050
	LCL	0.033	0.040
	Std. Dev.	0.029	0.028
	Wilk (p-value)	0.7830	0.1556
	Efficiency	-16.45%	
	t-Test (equal var.)	0.1773	
	t-Test (unequal var.)	0.1692	
	t-Test (paired)	0.0037 **	
	Levene Test	0.3260	
Bootstrap	UCL	0.052	0.059
	Mean	0.042	0.049
	LCL	0.033	0.039
	Std. Dev.	0.026	0.024
	Efficiency	-15.85%	

Brodie Lane Swale, Lower Reach - Fecal Coliform (cfu/100 ml)



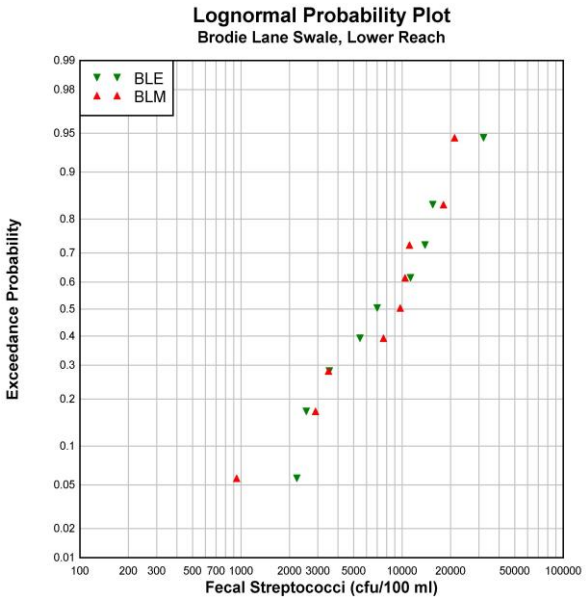


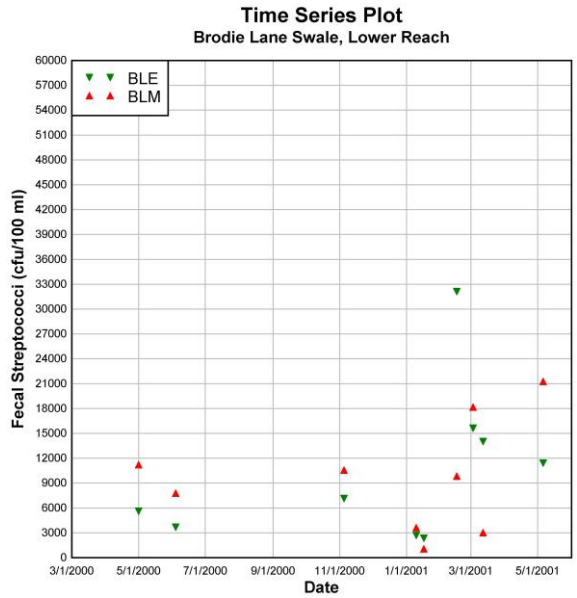


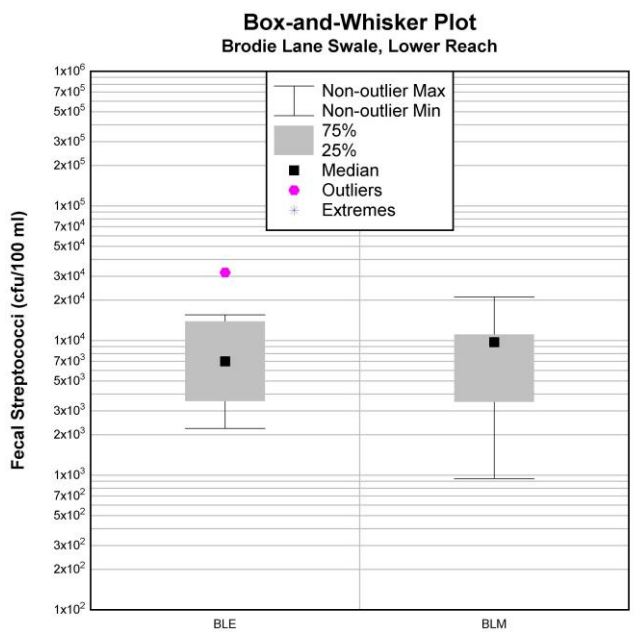


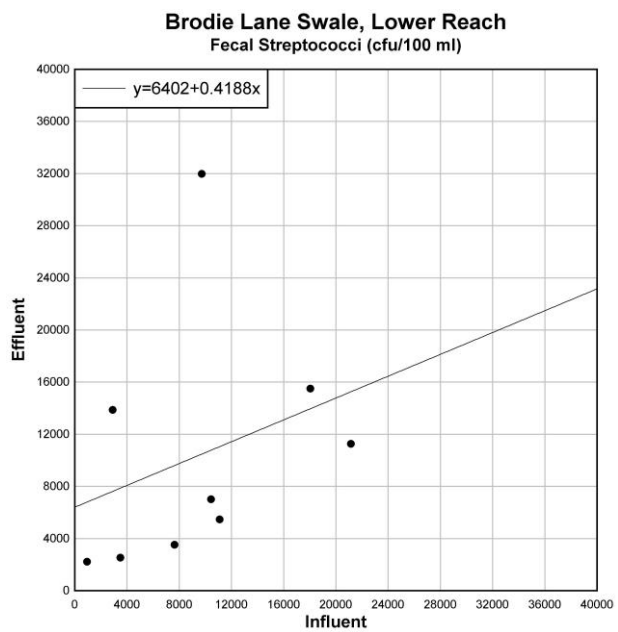
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	9	9
	Pairs Count	9	9
Non-Parametric	Maximum	11,624	11,900
	Upper Quartile	5,000	2,500
	Median	1,233	1,656
	Lower Quartile	408	1,000
	Minimum	366	304
	Efficiency	-34.23%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	6,337	5,815
	Mean	3,371	2,983
	LCL	406	151
	Std. Dev.	3,858	3,685
	Wilk (p-value)	0.0290 **	0.0028 **
	Efficiency	11.52%	
	t-Test (equal var.)	0.8299	
	t-Test (unequal var.)	0.8299	
	t-test (paired)	0.4656	
	Levene Test	0.9167	
Log Transformed	UCL	15,516	9,814
	Mean	3,509	2,952
	LCL	793	888
	Std. Dev.	5,224	3,730
	Wilk (p-value)	0.1898	0.8986
	Efficiency	15.87%	
	t-Test (equal var.)	0.9885	
	t-Test (unequal var.)	0.9885	
	t-Test (paired)	0.9630	
	Levene Test	0.5137	
Bootstrap	UCL	6,044	5,455
	Mean	3,352	2,988
	LCL	659	521
	Std. Dev.	3,503	3,210
	Efficiency	10.84%	

Brodie Lane Swale, Lower Reach - Fecal Streptococci (cfu/100 ml)



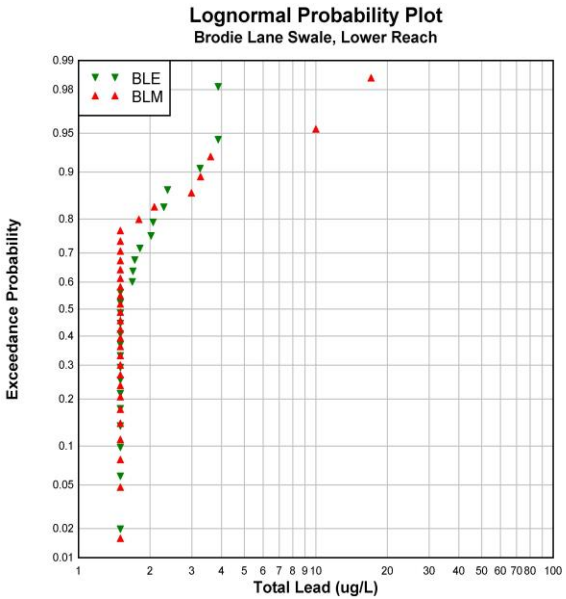


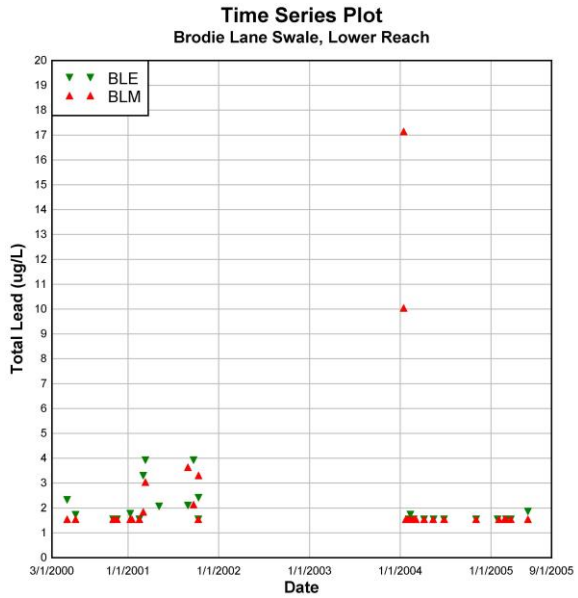


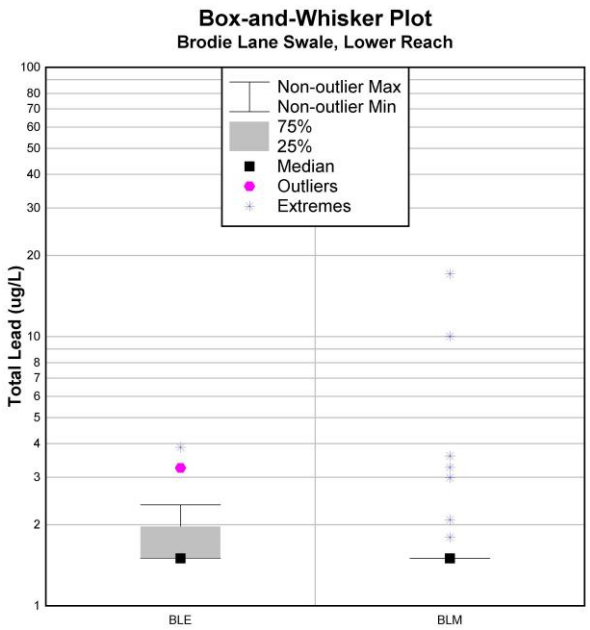


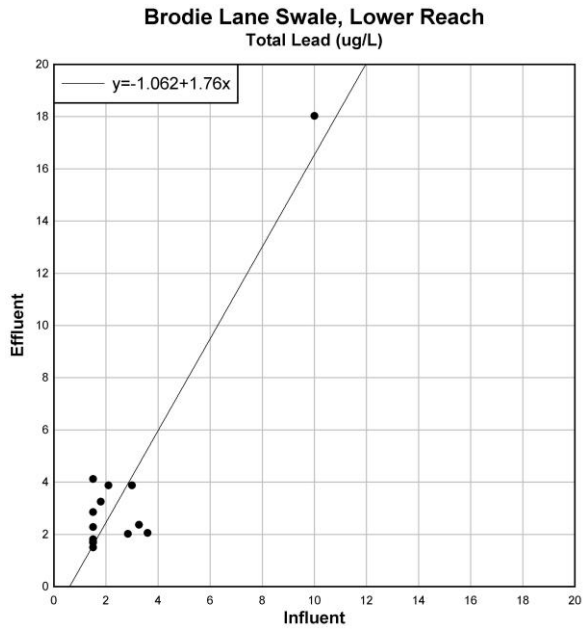
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	9	9
	Pairs Count	9	9
Non-Parametric	Maximum	21,153	31,973
	Upper Quartile	11,102	13,879
	Median	9,721	7,006
	Lower Quartile	3,496	3,532
	Minimum	940	2,220
	Efficiency	27.93%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	0.7344	
Arithmetic	UCL	14,711	17,648
	Mean	9,493	10,377
	LCL	4,275	3,106
	Std. Dev.	6,788	9,460
	Wilk (p-value)	0.5482	0.0403 **
	Efficiency	-9.32%	
	t-Test (equal var.)	0.8226	
	t-Test (unequal var.)	0.8229	
	t-test (paired)	0.7944	
	Levene Test	0.4633	
Log Transformed	UCL	26,854	23,878
	Mean	10,366	10,352
	LCL	4,001	4,488
	Std. Dev.	10,887	9,777
	Wilk (p-value)	0.3393	0.7973
	Efficiency	0.13%	
	t-Test (equal var.)	0.8760	
	t-Test (unequal var.)	0.8761	
	t-Test (paired)	0.8173	
	Levene Test	0.7458	
Bootstrap	UCL	14,388	16,990
	Mean	9,519	10,498
	LCL	4,650	4,006
	Std. Dev.	6,335	8,445
	Efficiency	-10.28%	

Brodie Lane Swale, Lower Reach - Total Lead (ug/L)



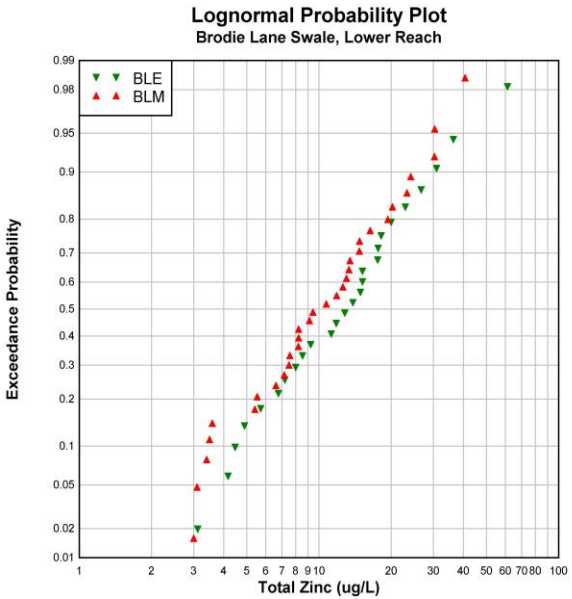


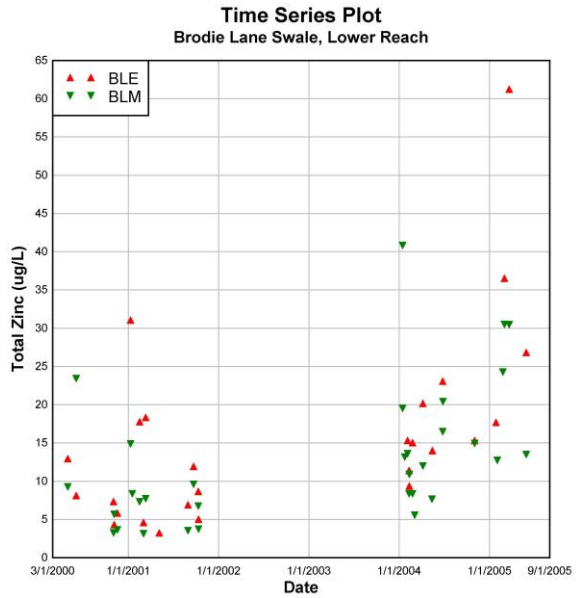


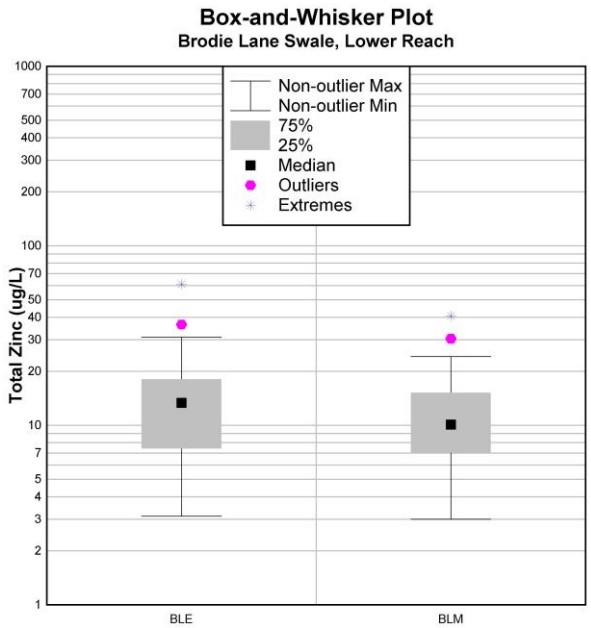


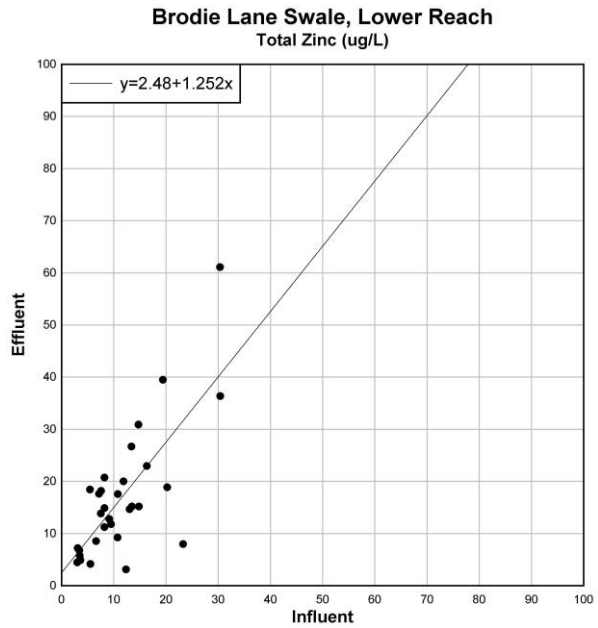
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	17.1	3.9
	Upper Quartile	1.5	2.0
	Median	1.5	1.5
	Lower Quartile	1.5	1.5
	Minimum	1.5	1.5
	Efficiency	0.00%	
	Mann-Whitney	0.9752	
	Wilcoxon (paired)	0.1774	
Arithmetic	UCL	3.6	2.2
	Mean	2.4	1.9
	LCL	1.3	1.6
	Std. Dev.	3.1	0.7
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	22.73%	
	t-Test (equal var.)	0.3739	
	t-Test (unequal var.)	0.3311	
	t-test (paired)	0.1122	
	Levene Test	0.2532	
Log Transformed	UCL	2.7	2.1
	Mean	2.2	1.9
	LCL	1.8	1.7
	Std. Dev.	1.3	0.6
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	14.25%	
	t-Test (equal var.)	0.7327	
	t-Test (unequal var.)	0.7171	
	t-Test (paired)	0.0557 *	
	Levene Test	0.2474	
Bootstrap	UCL	3.5	2.2
	Mean	2.5	1.9
	LCL	1.4	1.6
	Std. Dev.	2.8	0.7
	Efficiency	23.20%	

Brodie Lane Swale, Lower Reach - Total Zinc (ug/L)



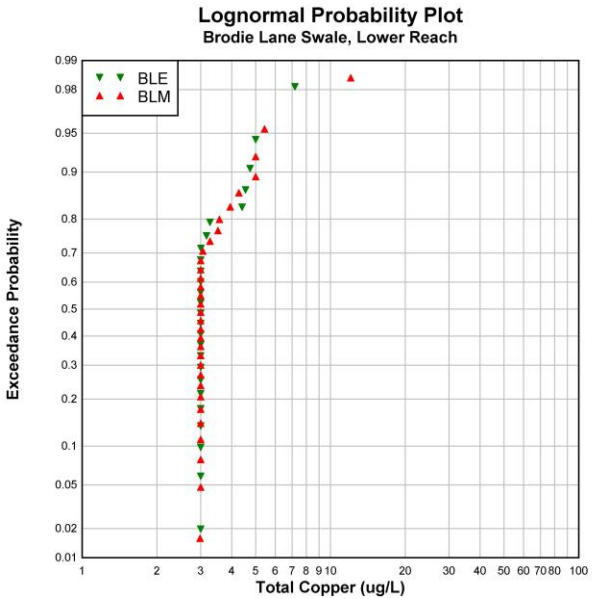


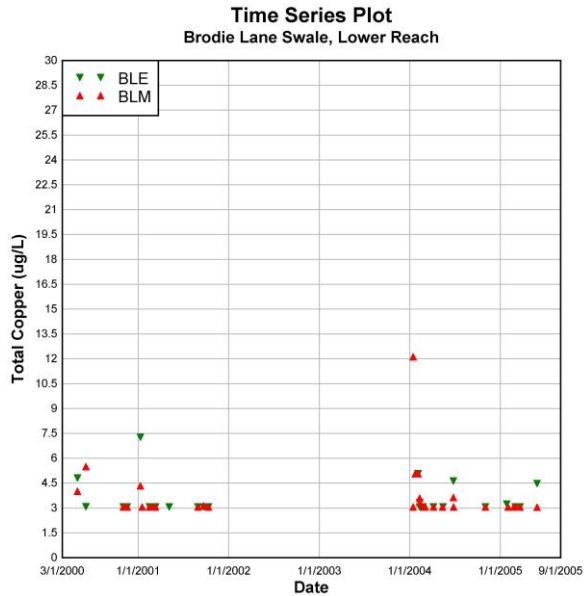


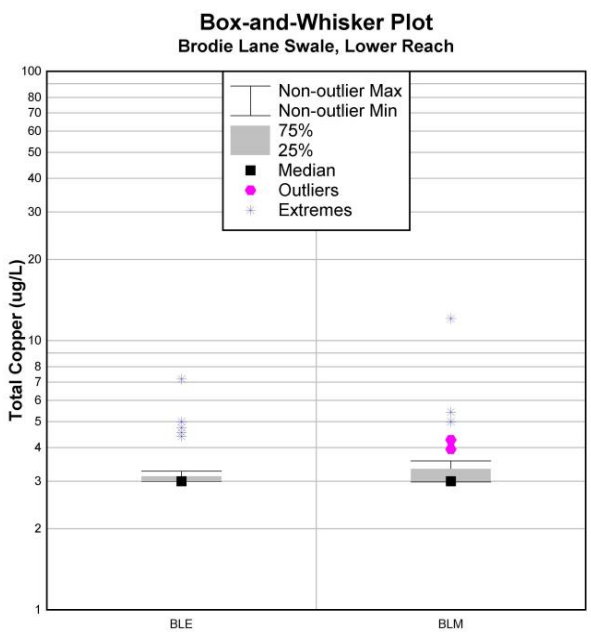


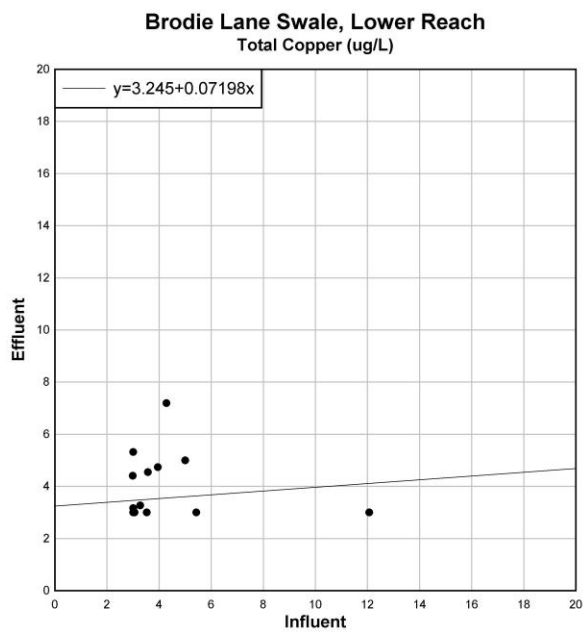
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	40.7	61.1
	Upper Quartile	15.6	18.2
	Median	10.1	13.3
	Lower Quartile	6.9	7.2
	Minimum	3.0	3.1
	Efficiency	-32.18%	
	Mann-Whitney	0.3326	
	Wilcoxon (paired)	0.0001 **	
Arithmetic	UCL	16.0	20.8
	Mean	12.8	15.7
	LCL	9.5	10.7
	Std. Dev.	9.0	12.5
	Wilk (p-value)	0.0011 **	0.0002 **
	Efficiency	-22.99%	
	t-Test (equal var.)	0.3041	
	t-Test (unequal var.)	0.3212	
	t-test (paired)	0.0019 **	
	Levene Test	0.3534	
Log Transformed	UCL	17.1	21.7
	Mean	12.9	15.7
	LCL	9.7	11.3
	Std. Dev.	9.9	12.3
	Wilk (p-value)	0.5733	0.9904
	Efficiency	-21.83%	
	t-Test (equal var.)	0.3242	
	t-Test (unequal var.)	0.3259	
	t-Test (paired)	0.0022 **	
	Levene Test	0.8787	
Bootstrap	UCL	16.1	20.6
	Mean	12.9	15.8
	LCL	9.8	11.0
	Std. Dev.	8.8	11.9
	Efficiency	-21.96%	

Brodie Lane Swale, Lower Reach - Total Copper (ug/L)



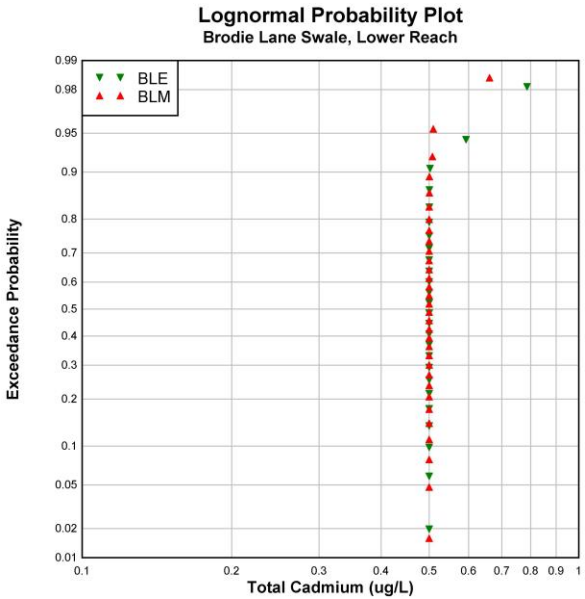


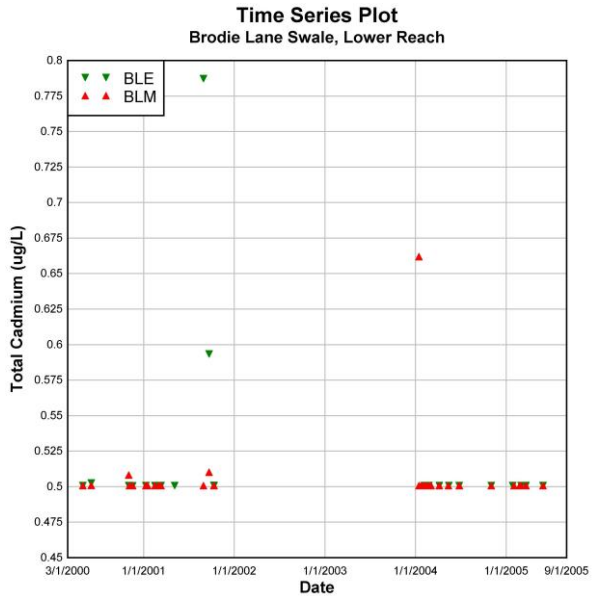


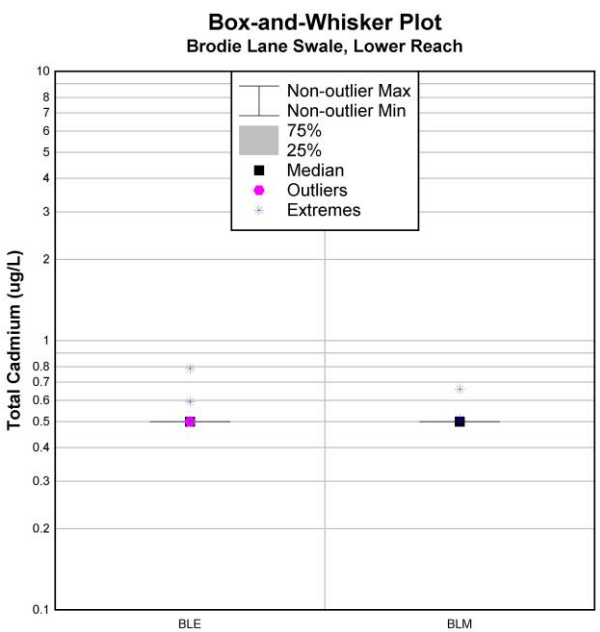


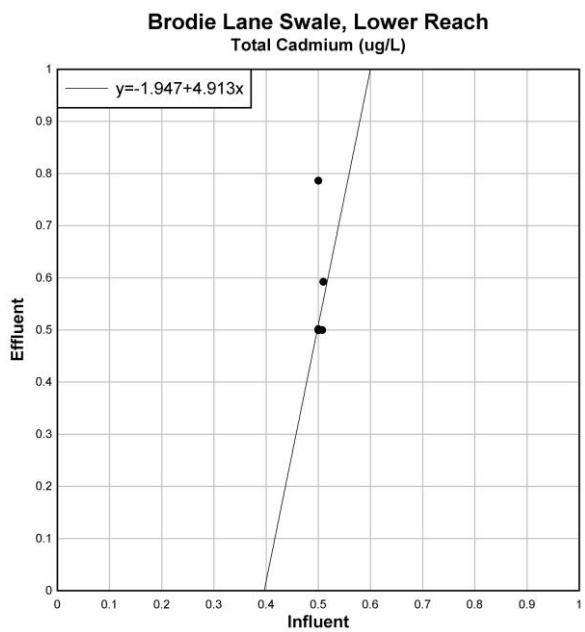
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	12.1	7.2
	Upper Quartile	3.4	3.2
	Median	3.0	3.0
	Lower Quartile	3.0	3.0
	Minimum	3.0	3.0
	Efficiency	0.00%	
	Mann-Whitney	0.4465	
	Wilcoxon (paired)	0.2432	
Arithmetic	UCL	4.2	3.8
	Mean	3.6	3.4
	LCL	3.0	3.0
	Std. Dev.	1.7	1.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	4.49%	
	t-Test (equal var.)	0.6669	
	t-Test (unequal var.)	0.6506	
	t-test (paired)	0.7426	
	Levene Test	0.4748	
Log Transformed	UCL	3.9	3.8
	Mean	3.5	3.4
	LCL	3.2	3.1
	Std. Dev.	1.0	0.8
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	3.49%	
	t-Test (equal var.)	0.7727	
	t-Test (unequal var.)	0.7671	
	t-Test (paired)	0.9127	
	Levene Test	0.6002	
Bootstrap	UCL	4.2	3.8
	Mean	3.6	3.4
	LCL	3.1	3.1
	Std. Dev.	1.6	0.9
	Efficiency	5.19%	

Brodie Lane Swale, Lower Reach - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: BLM**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.7	0.8
	Upper Quartile	0.5	0.5
	Median	0.5	0.5
	Lower Quartile	0.5	0.5
	Minimum	0.5	0.5
	Efficiency	0.00%	
	Mann-Whitney	0.3518	
	Wilcoxon (paired)	0.3799	
Arithmetic	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-1.79%	
	t-Test (equal var.)	0.4421	
	t-Test (unequal var.)	0.4731	
	t-test (paired)	0.2297	
	Levene Test	0.3579	
Log Transformed	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-1.75%	
	t-Test (equal var.)	0.4589	
	t-Test (unequal var.)	0.4868	
	t-Test (paired)	0.2218	
	Levene Test	0.3789	
Bootstrap	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Efficiency	-1.82%	

Brodie Lane Grassed Swale (BLI-BLE)

This control was originally installed and monitored by the Travis County Transportation and Natural Resources Department (TNRD) to treat runoff from an extension of Brodie Lane. The monitoring was continued by the City when the area was annexed. These results are for the entire swale; for information on the upper portion of the swale (BLI-BLM) or the lower swale (BLM-BLE), see those summaries elsewhere in this section.

The swale is a trapezoidal channel planted with native vegetation primarily used to convey runoff. This study was intended to evaluate the possible water quality benefits of vegetated channels. The inflow (BLI) was measured using a 90° v-notch weir. Flow at the outlet (BLE) of the swale was measured using a 2 ft. H-flume. The channel was designed so that no additional flow (other than rainfall, would enter the channel after BLI. The overall length of the swale was 167 ft.

The City collected more than 30 paired samples at the influent and effluent stations between 2000 and 2005

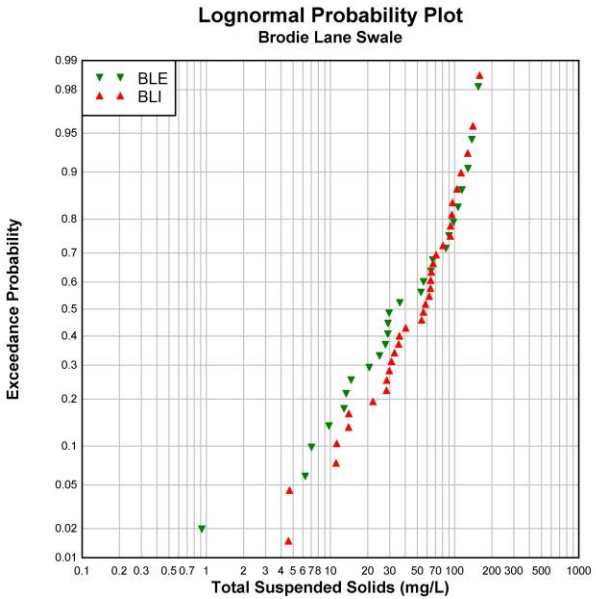
Performance Summary

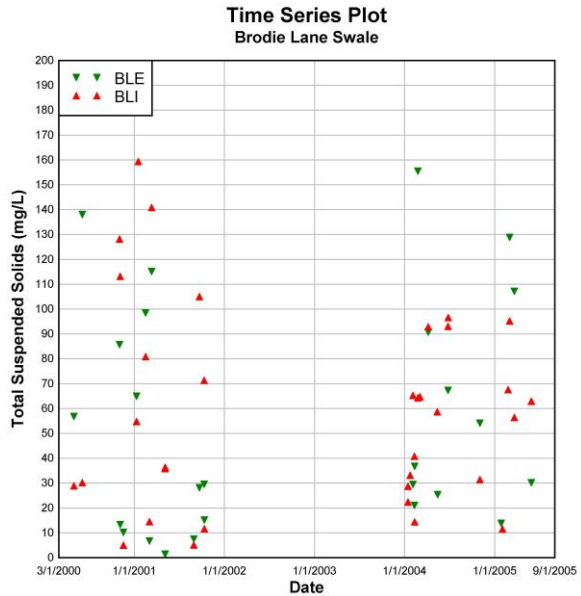
Results of the analyses of the runoff concentrations for this reach are mixed. Several parameters indicated reductions in concentration (TSS, COD, TN, TKN, FSTR, Pb) while NH3 indicated an increase. However none of these results were statistically significant. The concentrations of VSS, TOC and BOD were significantly reduced (35, 16 and 40% respectively), while concentrations of NO23, TP and DP increased significantly (65, 16 and 18%).

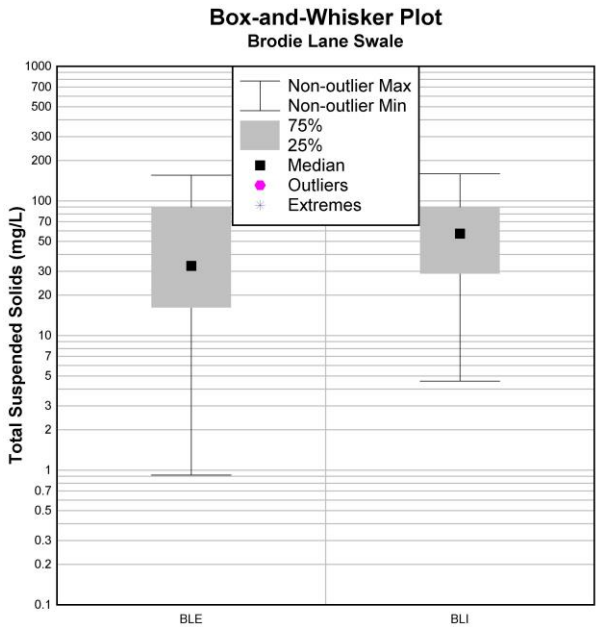
The changes in concentrations may understate the performance of the swale since the overall load may be reduced due to infiltration in the channel. To fully evaluate the effectiveness of a swale as a water quality treatment, the load should be evaluated. While outside of this report, COA and TNRD data indicate that for smaller storms, a significant amount of the runoff may be infiltrating, thus reducing the overall load in the runoff. This raises another question, should direct infiltration treatment systems be encouraged in certain areas of the City?

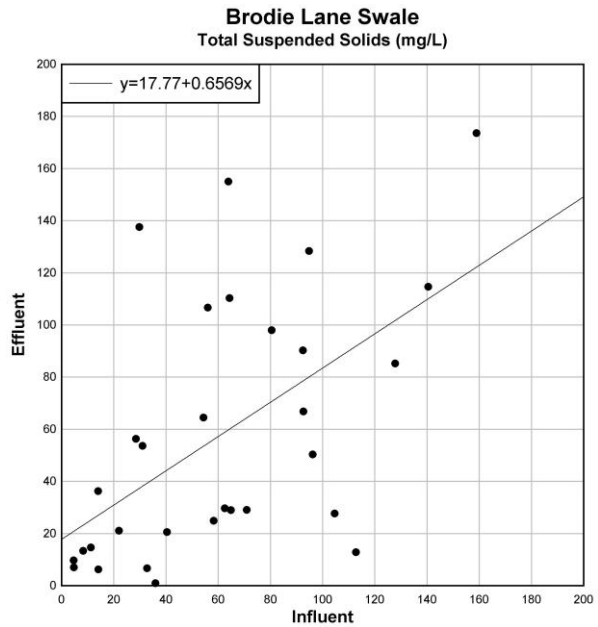
The concentrations of Zn significantly increase while those for Cu significantly deceased. Both of these may be explained due to flaws in the original design an installation of the system by TNRD. The reduction in total copper in the reach must be discounted because when TNRD originally installed the monitoring station, the suction line for BLI was copper tubing while the suction line installed by SWQM was Teflon lined tubing. The increase in Zn is likely due to galvanized steps, crossing and railings upstream of BLE. These were installed by TNRD to access the equipment shelter.

Brodie Lane Swale - Total Suspended Solids (mg/L)



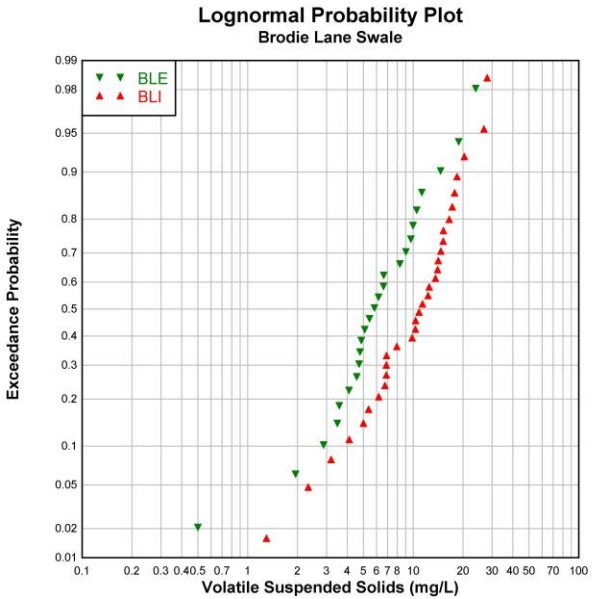


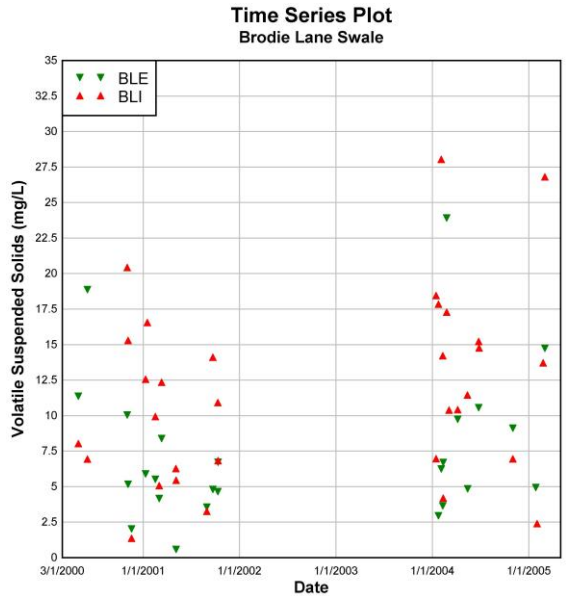


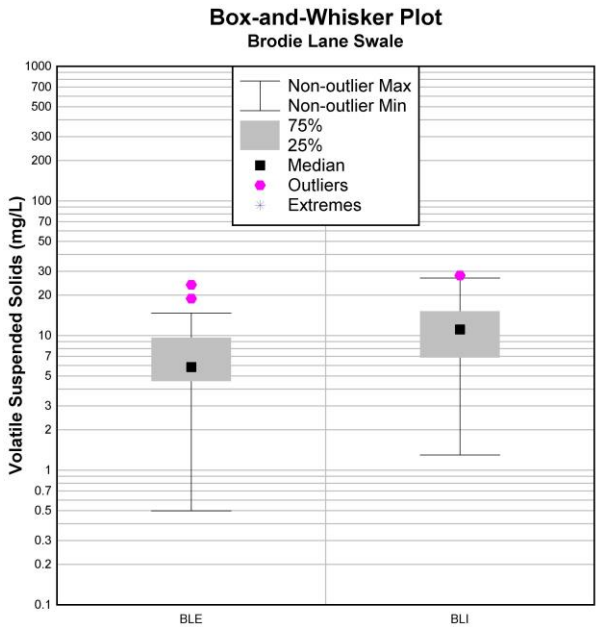


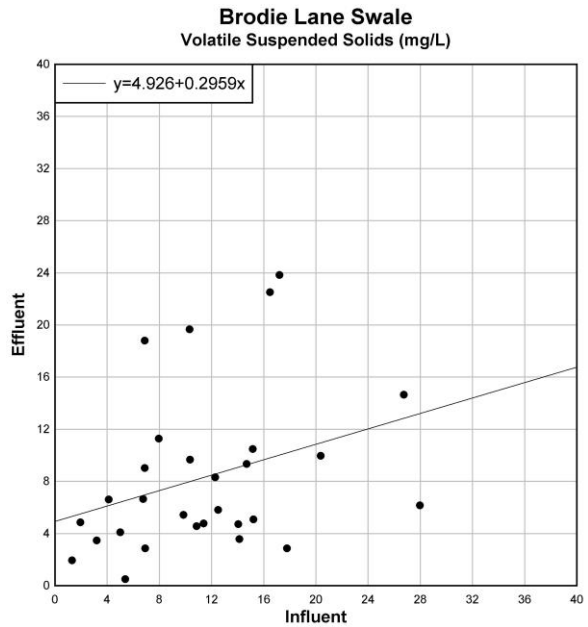
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	159.0	155.1
	Upper Quartile	92.4	90.3
	Median	57.1	33.0
	Lower Quartile	28.4	14.6
	Minimum	4.6	.9
	Efficiency	42.24%	
	Mann-Whitney	0.4722	
	Wilcoxon (paired)	0.7254	
Arithmetic	UCL	73.1	73.1
	Mean	59.0	54.6
	LCL	45.0	36.0
	Std. Dev.	40.3	45.9
	Wilk (p-value)	0.0795 *	0.0121 **
	Efficiency	7.53%	
	t-Test (equal var.)	0.6918	
	t-Test (unequal var.)	0.6971	
	t-test (paired)	0.8091	
	Levene Test	0.4345	
Log Transformed	UCL	94.3	124.6
	Mean	64.5	65.6
	LCL	44.1	34.6
	Std. Dev.	69.0	100.8
	Wilk (p-value)	0.0211 **	0.0447 **
	Efficiency	-1.82%	
	t-Test (equal var.)	0.3466	
	t-Test (unequal var.)	0.3650	
	t-Test (paired)	0.3151	
	Levene Test	0.2407	
Bootstrap	UCL	72.6	72.2
	Mean	58.9	54.2
	LCL	45.2	36.3
	Std. Dev.	39.2	44.5
	Efficiency	7.92%	

Brodie Lane Swale - Volatile Suspended Solids (mg/L)



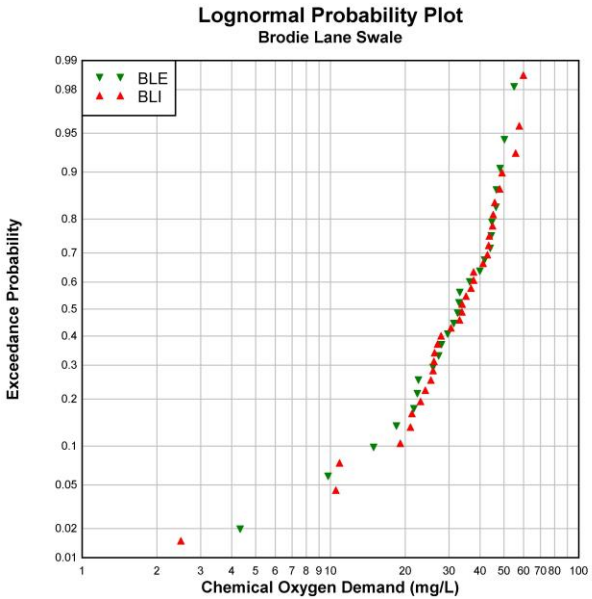


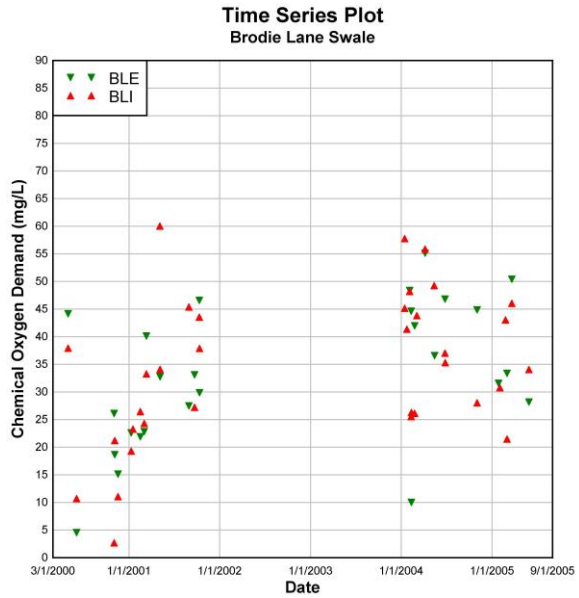


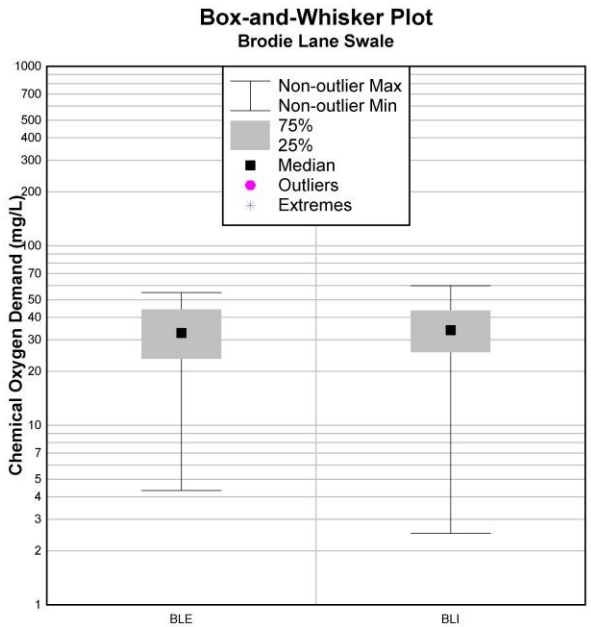


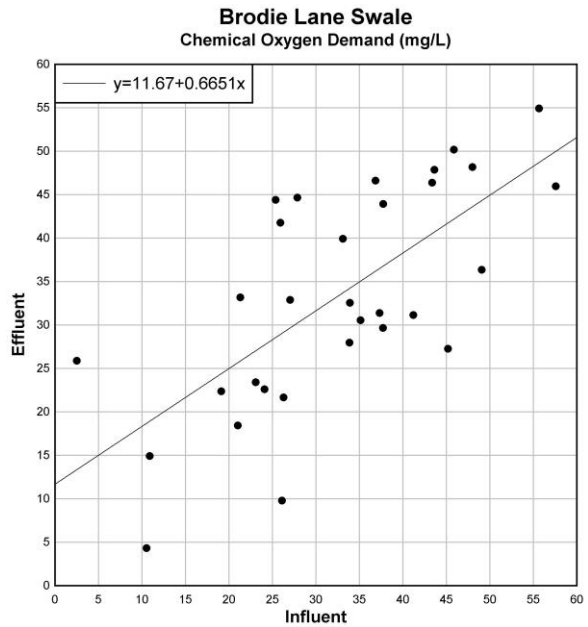
		PARAMETER	VSS (mg/L)
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	32	25
	Pairs Count	28	28
Non-Parametric	Maximum	28.0	23.8
	Upper Quartile	15.2	9.7
	Median	11.1	5.8
	Lower Quartile	6.8	4.6
	Minimum	1.3	.5
	Efficiency	47.60%	
	Mann-Whitney	0.0072 **	
	Wilcoxon (paired)	0.0428 **	
Arithmetic	UCL	14.0	9.7
	Mean	11.6	7.5
	LCL	9.3	5.3
	Std. Dev.	6.5	5.3
	Wilk (p-value)	0.2304	0.0020 **
	Efficiency	35.62%	
	t-Test (equal var.)	0.0124 **	
	t-Test (unequal var.)	0.0105 **	
	t-test (paired)	0.0421 **	
	Levene Test	0.3832	
Log Transformed	UCL	16.0	11.3
	Mean	12.1	7.8
	LCL	9.2	5.4
	Std. Dev.	9.2	6.7
	Wilk (p-value)	0.0592 *	0.0675 *
	Efficiency	35.35%	
	t-Test (equal var.)	0.0143 **	
	t-Test (unequal var.)	0.0161 **	
	t-Test (paired)	0.0254 **	
	Levene Test	0.6697	
Bootstrap	UCL	14.0	9.6
	Mean	11.7	7.5
	LCL	9.4	5.4
	Std. Dev.	6.3	5.1
	Efficiency	35.50%	

Brodie Lane Swale - Chemical Oxygen Demand (mg/L)



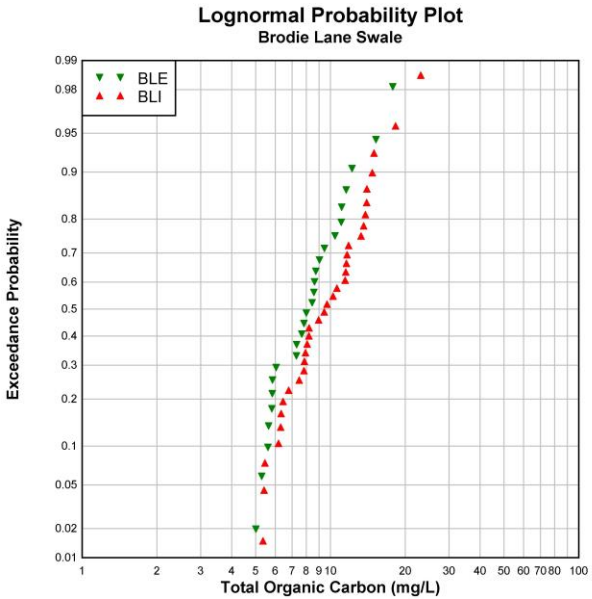


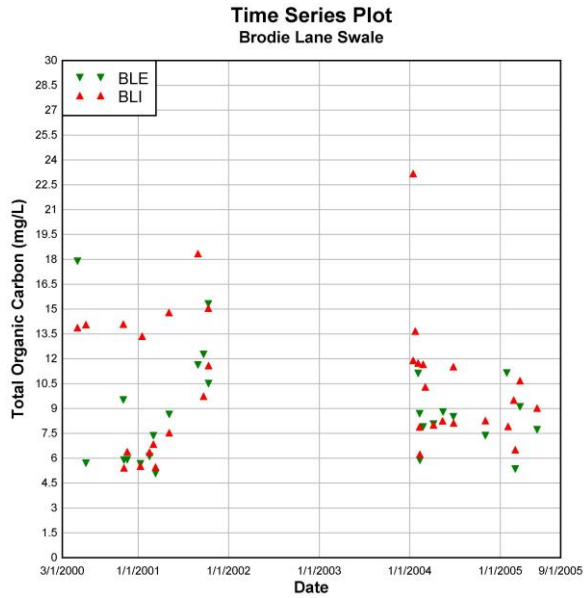


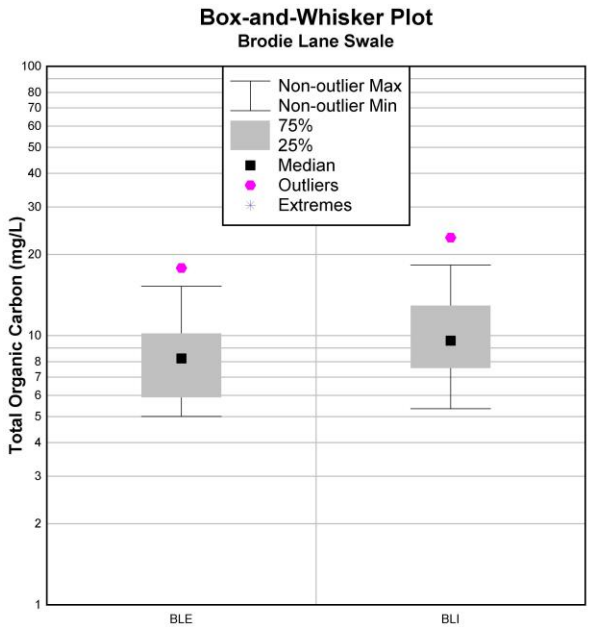


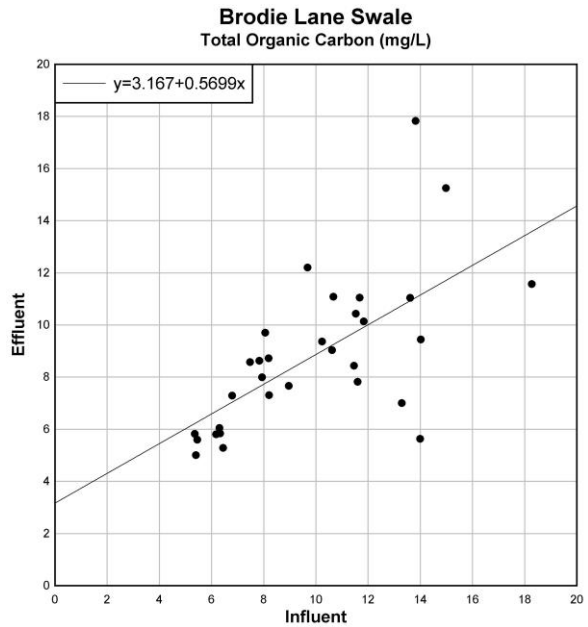
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	59.83	54.91
	Upper Quartile	43.62	44.40
	Median	33.88	32.72
	Lower Quartile	25.37	22.61
	Minimum	2.50	4.33
	Efficiency	3.41%	
	Mann-Whitney	0.8527	
	Wilcoxon (paired)	0.6513	
Arithmetic	UCL	38.46	38.05
	Mean	33.74	32.78
	LCL	29.01	27.50
	Std. Dev.	13.55	13.06
	Wilk (p-value)	0.8976	0.7142
	Efficiency	2.85%	
	t-Test (equal var.)	0.7833	
	t-Test (unequal var.)	0.7823	
	t-test (paired)	0.4950	
	Levene Test	0.8026	
Log Transformed	UCL	44.66	43.51
	Mean	35.53	34.01
	LCL	28.27	26.59
	Std. Dev.	22.93	20.31
	Wilk (p-value)	0.0001 **	0.0007 **
	Efficiency	4.29%	
	t-Test (equal var.)	0.8885	
	t-Test (unequal var.)	0.8875	
	t-Test (paired)	0.5726	
	Levene Test	0.8537	
Bootstrap	UCL	38.38	38.05
	Mean	33.78	32.92
	LCL	29.19	27.79
	Std. Dev.	13.17	12.71
	Efficiency	2.55%	

Brodie Lane Swale - Total Organic Carbon (mg/L)



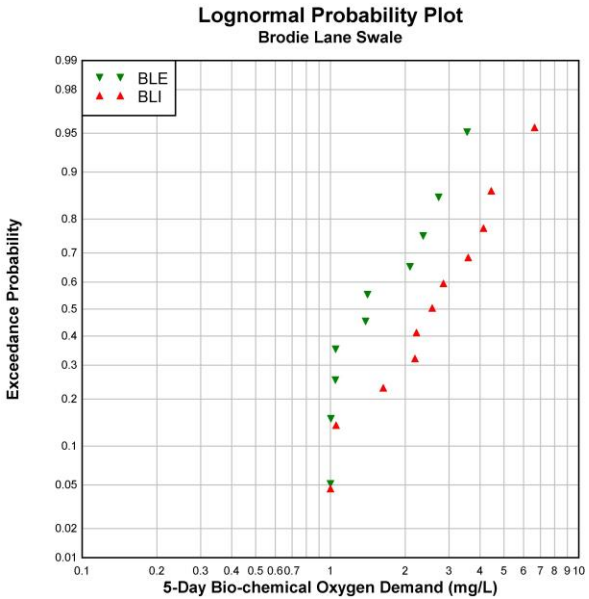


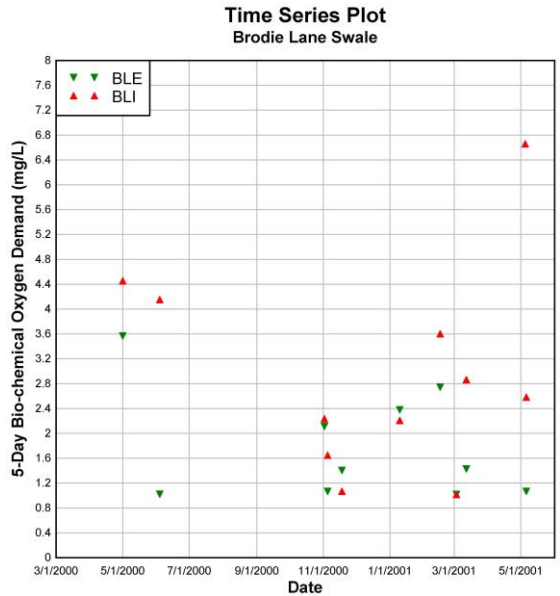


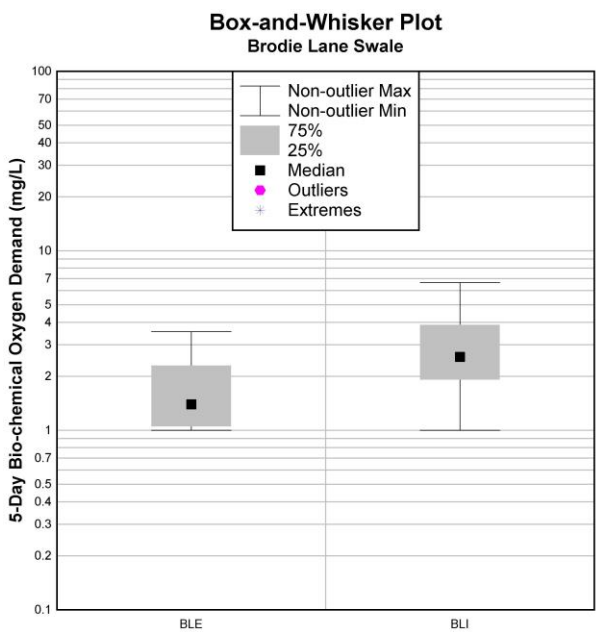


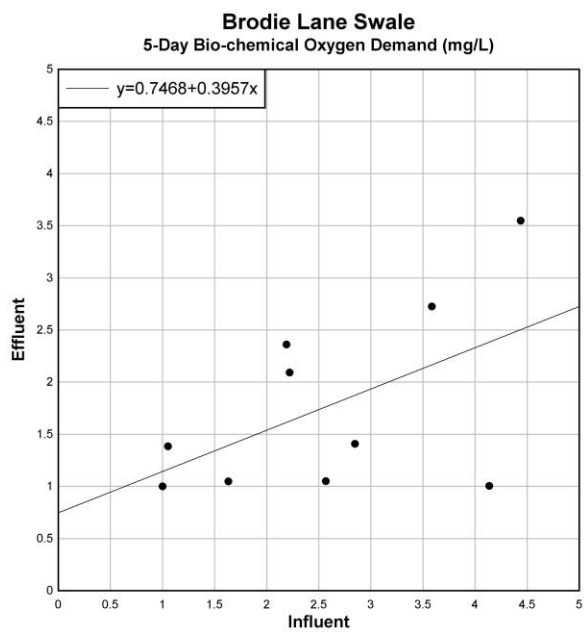
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	23.11	17.83
	Upper Quartile	13.29	10.44
	Median	9.56	8.22
	Lower Quartile	7.48	5.84
	Minimum	5.35	5.01
	Efficiency	14.06%	
	Mann-Whitney	0.0929 *	
	Wilcoxon (paired)	0.0290 **	
Arithmetic	UCL	11.71	9.93
	Mean	10.31	8.67
	LCL	8.92	7.41
	Std. Dev.	4.00	3.12
	Wilk (p-value)	0.0092 **	0.0082 **
	Efficiency	15.93%	
	t-Test (equal var.)	0.0894 *	
	t-Test (unequal var.)	0.0794 *	
	t-test (paired)	0.0271 **	
	Levene Test	0.3409	
Log Transformed	UCL	11.76	9.92
	Mean	10.30	8.65
	LCL	9.01	7.54
	Std. Dev.	3.90	2.92
	Wilk (p-value)	0.4220	0.3049
	Efficiency	16.02%	
	t-Test (equal var.)	0.0849 *	
	t-Test (unequal var.)	0.0807 *	
	t-Test (paired)	0.0192 **	
	Levene Test	0.4923	
Bootstrap	UCL	11.66	9.93
	Mean	10.31	8.71
	LCL	8.96	7.49
	Std. Dev.	3.88	3.02
	Efficiency	15.49%	

Brodie Lane Grass Swale - 5-Day Bio-chemical Oxygen Demand (mg/L)



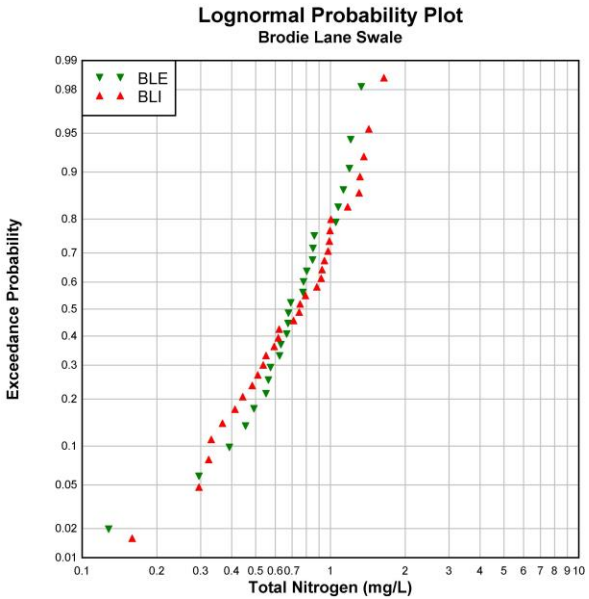


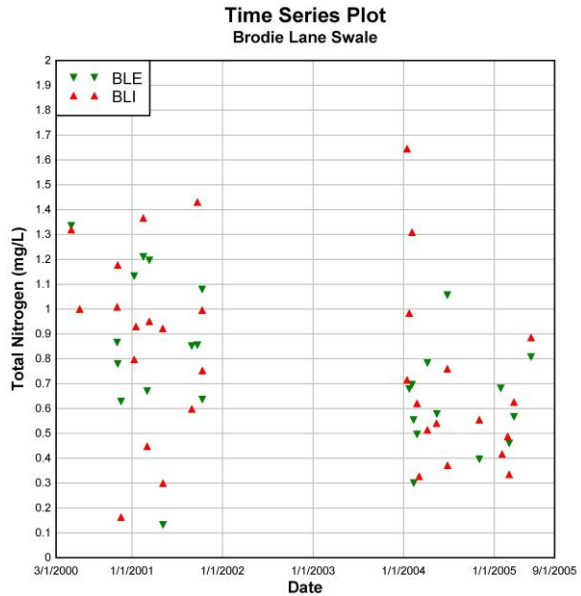


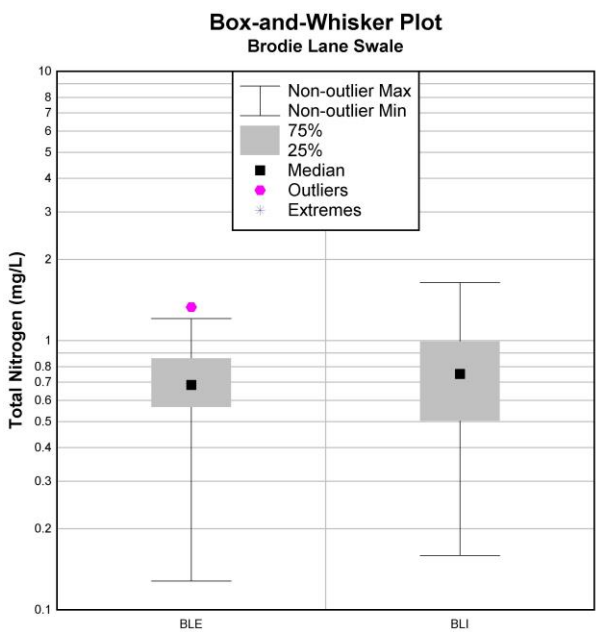


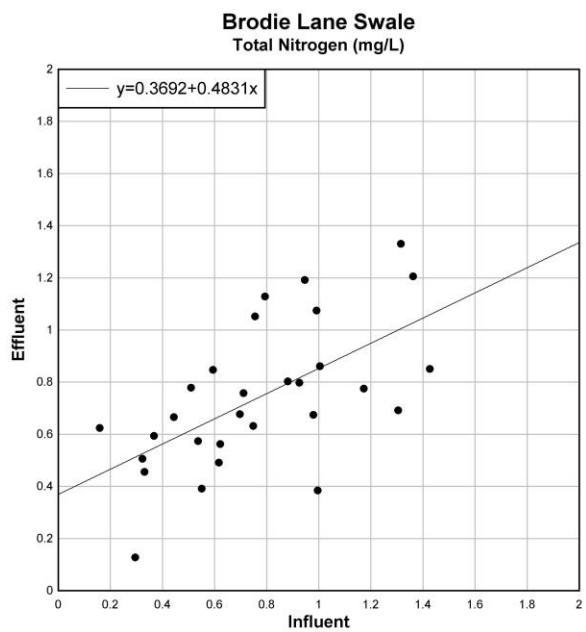
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	11	10
	Pairs Count	10	10
Non-Parametric	Maximum	6.64	3.55
	Upper Quartile	4.14	2.36
	Median	2.57	1.40
	Lower Quartile	1.63	1.05
	Minimum	1.00	1.00
	Efficiency	45.59%	
	Mann-Whitney	0.0877 *	
	Wilcoxon (paired)	0.0488 **	
Arithmetic	UCL	4.06	2.39
	Mean	2.94	1.76
	LCL	1.81	1.13
	Std. Dev.	1.68	0.88
	Wilk (p-value)	0.3519	0.0526 *
	Efficiency	40.00%	
	t-Test (equal var.)	0.0625 *	
	t-Test (unequal var.)	0.0593 *	
	t-test (paired)	0.0370 **	
	Levene Test	0.1635	
Log Transformed	UCL	4.55	2.50
	Mean	2.95	1.75
	LCL	1.92	1.23
	Std. Dev.	1.80	0.84
	Wilk (p-value)	0.8504	0.1173
	Efficiency	40.65%	
	t-Test (equal var.)	0.0627 *	
	t-Test (unequal var.)	0.0603 *	
	t-Test (paired)	0.0500 *	
	Levene Test	0.3571	
Bootstrap	UCL	3.96	2.33
	Mean	2.93	1.75
	LCL	1.90	1.17
	Std. Dev.	1.53	0.81
	Efficiency	40.26%	

Brodie Lane Swale - Total Nitrogen (mg/L)



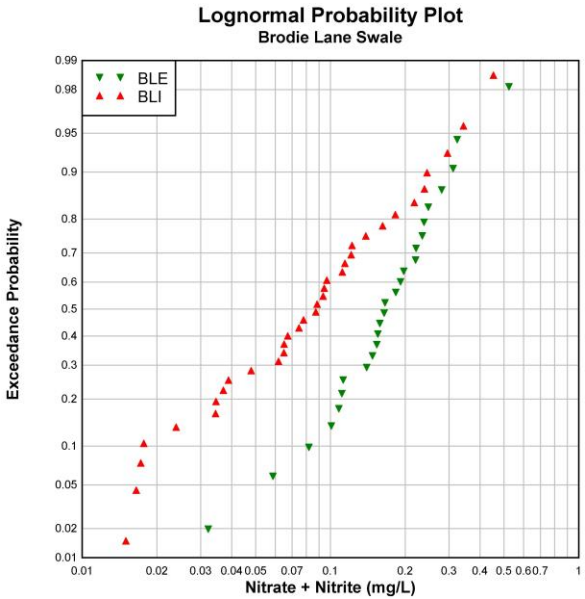


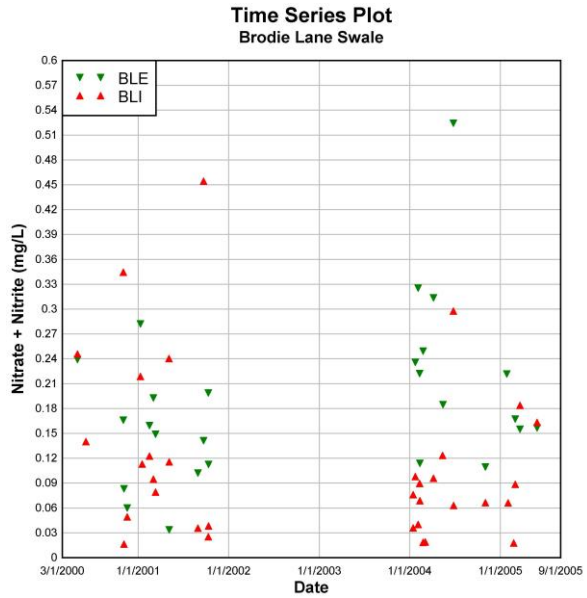


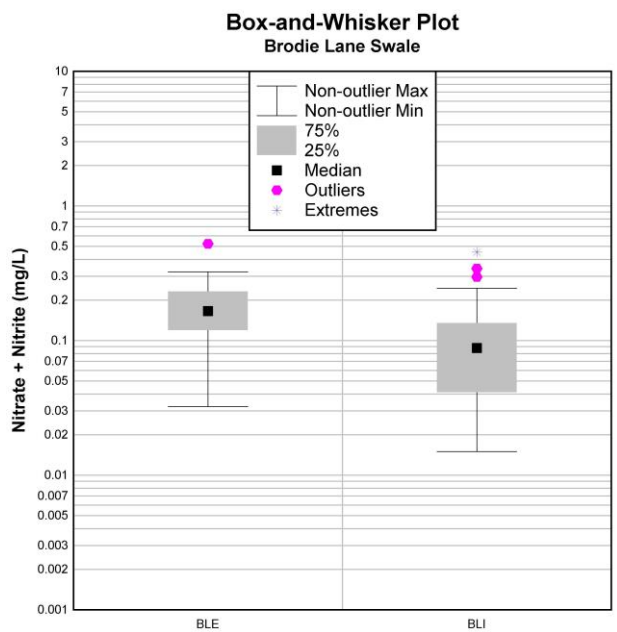


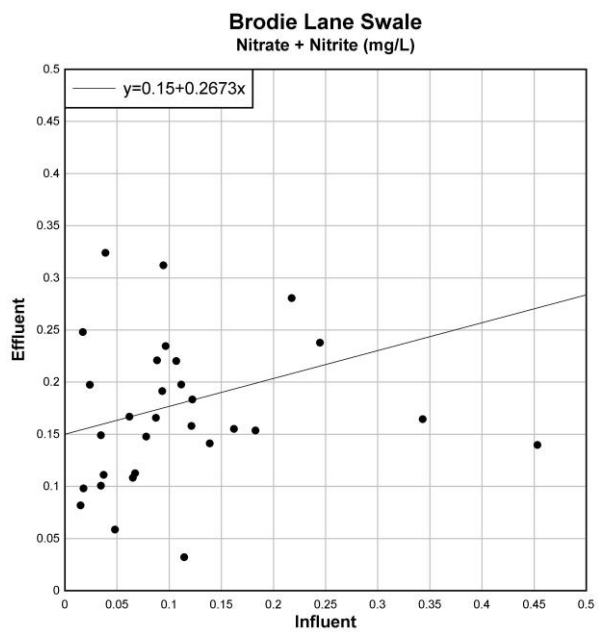
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	28	28
Non-Parametric	Maximum	1.641	1.331
	Upper Quartile	0.993	0.861
	Median	0.752	0.685
	Lower Quartile	0.497	0.563
	Minimum	0.159	0.128
	Efficiency	8.90%	
	Mann-Whitney	0.8702	
	Wilcoxon (paired)	0.8074	
Arithmetic	UCL	0.919	0.861
	Mean	0.785	0.743
	LCL	0.651	0.624
	Std. Dev.	0.372	0.293
	Wilk (p-value)	0.4211	0.8326
	Efficiency	5.35%	
	t-Test (equal var.)	0.6410	
	t-Test (unequal var.)	0.6328	
	t-test (paired)	0.5654	
	Levene Test	0.1707	
Log Transformed	UCL	0.980	0.939
	Mean	0.796	0.759
	LCL	0.647	0.613
	Std. Dev.	0.452	0.393
	Wilk (p-value)	0.3280	0.0079 **
	Efficiency	4.69%	
	t-Test (equal var.)	0.8481	
	t-Test (unequal var.)	0.8469	
	t-Test (paired)	0.9258	
	Levene Test	0.7295	
Bootstrap	UCL	0.916	0.857
	Mean	0.785	0.743
	LCL	0.654	0.628
	Std. Dev.	0.363	0.284
	Efficiency	5.34%	

Brodie Lane Swale - Nitrate + Nitrite (mg/L)



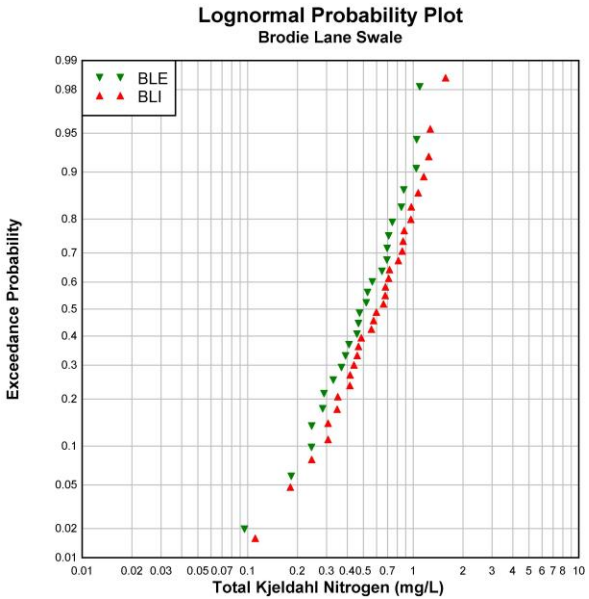


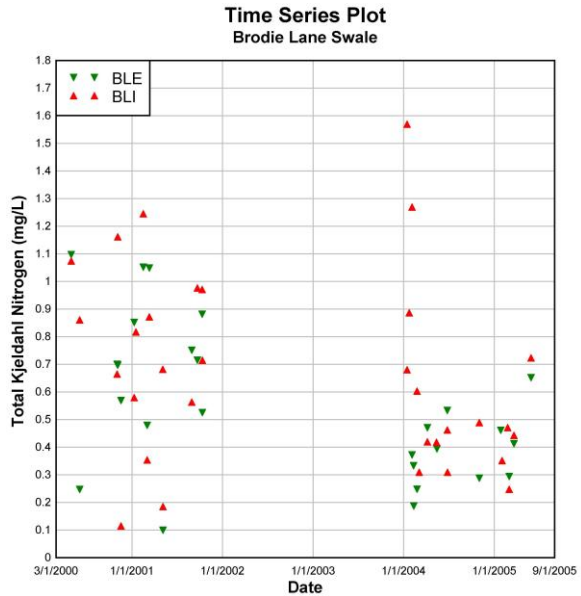


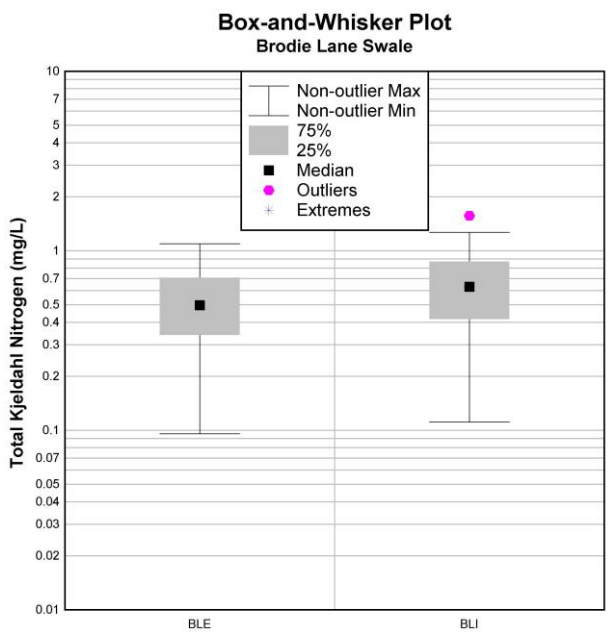


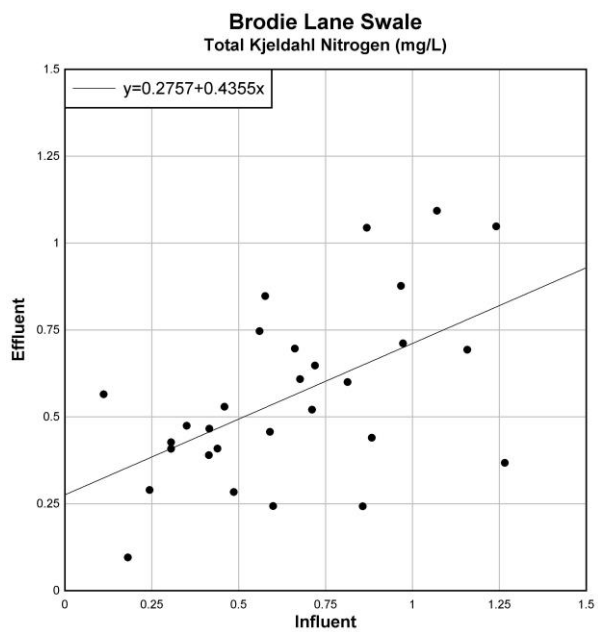
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.453	0.523
	Upper Quartile	0.139	0.234
	Median	0.088	0.165
	Lower Quartile	0.039	0.113
	Minimum	0.015	0.032
	Efficiency	-88.05%	
	Mann-Whitney	0.0019 **	
	Wilcoxon (paired)	0.0008 **	
Arithmetic	UCL	0.150	0.228
	Mean	0.115	0.187
	LCL	0.079	0.147
	Std. Dev.	0.102	0.100
	Wilk (p-value)	0.0001 **	0.0165 **
	Efficiency	-62.98%	
	t-Test (equal var.)	0.0080 **	
	t-Test (unequal var.)	0.0081 **	
	t-test (paired)	0.0056 **	
	Levene Test	0.9447	
Log Transformed	UCL	0.171	0.244
	Mean	0.118	0.190
	LCL	0.081	0.148
	Std. Dev.	0.124	0.115
	Wilk (p-value)	0.5492	0.3413
	Efficiency	-61.25%	
	t-Test (equal var.)	0.0008 **	
	t-Test (unequal var.)	0.0004 **	
	t-Test (paired)	0.0003 **	
	Levene Test	0.0257 **	
Bootstrap	UCL	0.148	0.226
	Mean	0.114	0.187
	LCL	0.079	0.149
	Std. Dev.	0.098	0.095
	Efficiency	-65.19%	

Brodie Lane Swale - Total Kjeldahl Nitrogen (mg/L)



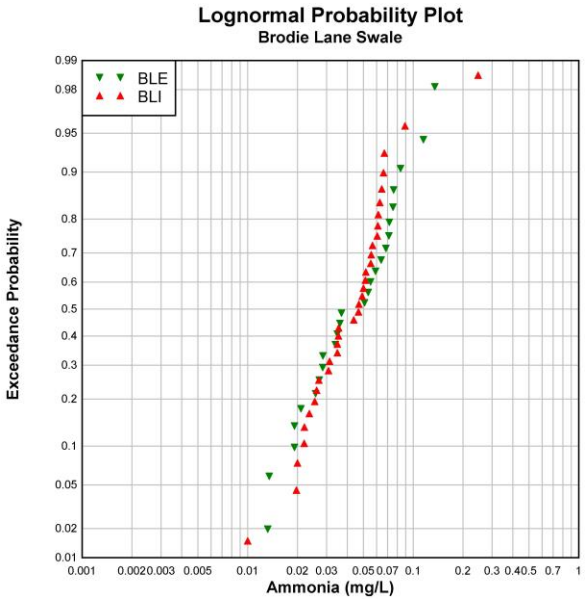


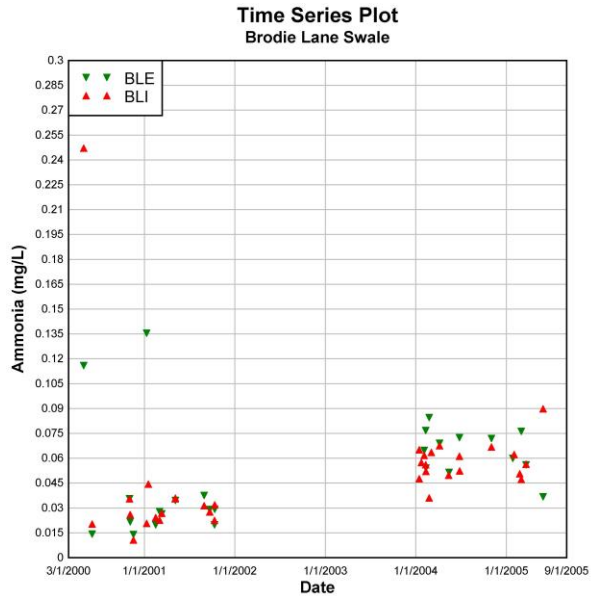


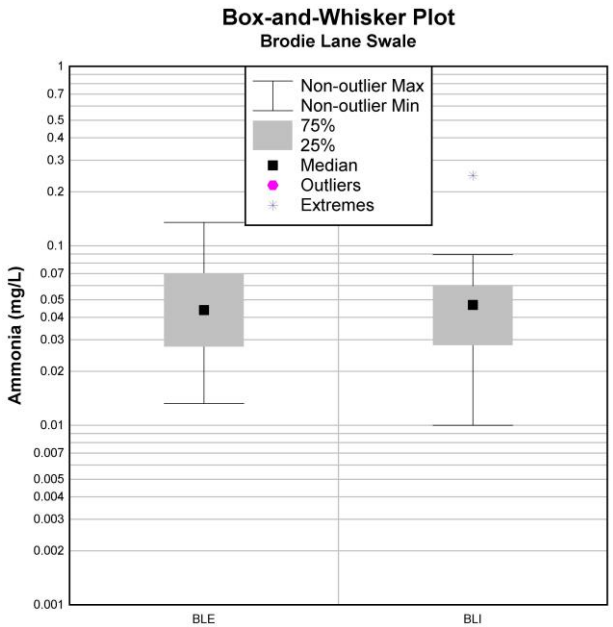


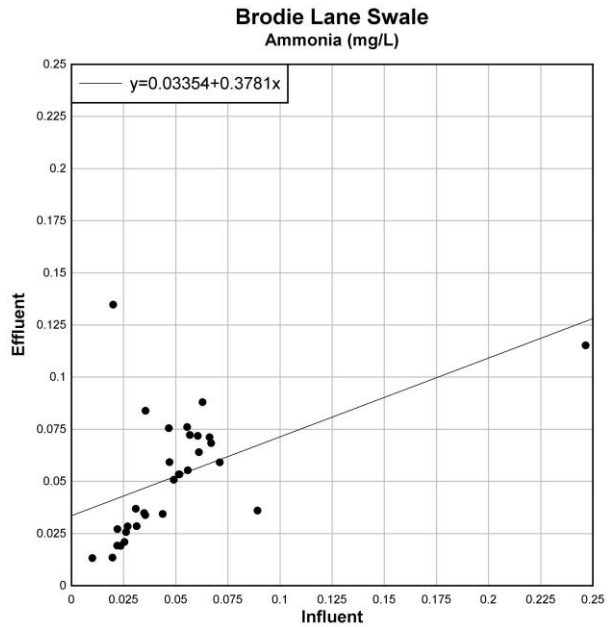
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	32	26
	Pairs Count	28	28
Non-Parametric	Maximum	1.566	1.093
	Upper Quartile	0.875	0.711
	Median	0.630	0.498
	Lower Quartile	0.415	0.329
	Minimum	0.111	0.096
	Efficiency	21.01%	
	Mann-Whitney	0.2077	
	Wilcoxon (paired)	0.1178	
Arithmetic	UCL	0.793	0.660
	Mean	0.668	0.548
	LCL	0.542	0.436
	Std. Dev.	0.347	0.277
	Wilk (p-value)	0.3367	0.3312
	Efficiency	17.90%	
	t-Test (equal var.)	0.1600	
	t-Test (unequal var.)	0.1505	
	t-test (paired)	0.0867 *	
	Levene Test	0.2253	
Log Transformed	UCL	0.860	0.724
	Mean	0.681	0.559
	LCL	0.540	0.432
	Std. Dev.	0.433	0.349
	Wilk (p-value)	0.4153	0.2978
	Efficiency	17.88%	
	t-Test (equal var.)	0.2245	
	t-Test (unequal var.)	0.2241	
	t-Test (paired)	0.2393	
	Levene Test	0.9394	
Bootstrap	UCL	0.790	0.655
	Mean	0.668	0.547
	LCL	0.546	0.438
	Std. Dev.	0.339	0.269
	Efficiency	18.16%	

Brodie Lane Swale - Ammonia (mg/L)



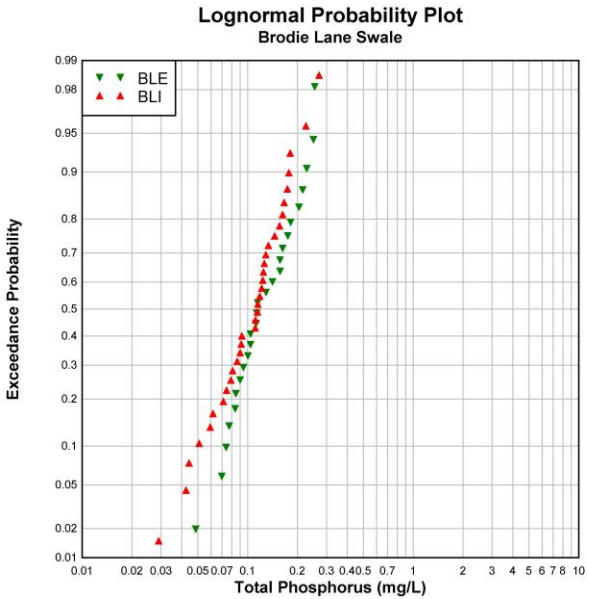


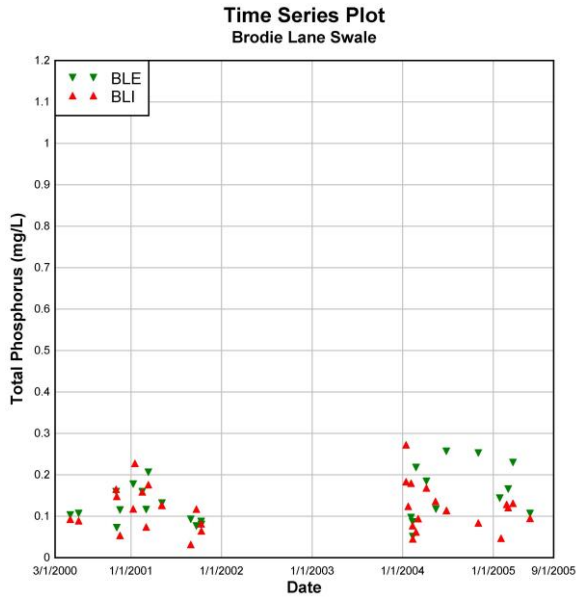


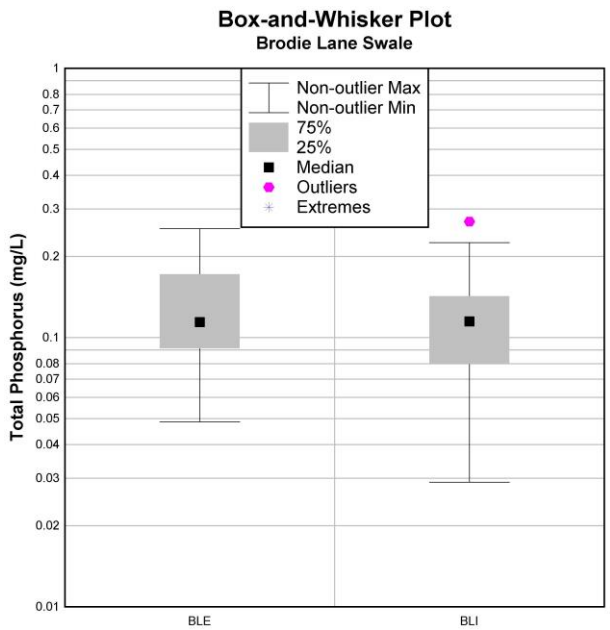


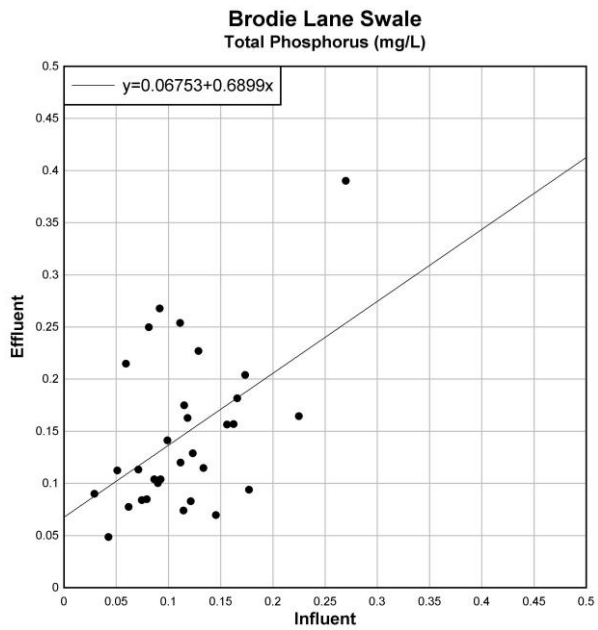
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.247	0.135
	Upper Quartile	0.061	0.071
	Median	0.047	0.044
	Lower Quartile	0.027	0.027
	Minimum	0.010	0.013
	Efficiency	6.41%	
	Mann-Whitney	0.6723	
	Wilcoxon (paired)	0.2190	
Arithmetic	UCL	0.063	0.063
	Mean	0.050	0.051
	LCL	0.036	0.038
	Std. Dev.	0.039	0.031
	Wilk (p-value)	0.0001 **	0.0233 **
	Efficiency	-2.18%	
	t-Test (equal var.)	0.9082	
	t-Test (unequal var.)	0.9052	
	t-test (paired)	0.7017	
	Levene Test	0.6664	
Log Transformed	UCL	0.060	0.068
	Mean	0.049	0.051
	LCL	0.039	0.039
	Std. Dev.	0.029	0.035
	Wilk (p-value)	0.0663 *	0.5566
	Efficiency	-4.97%	
	t-Test (equal var.)	0.9323	
	t-Test (unequal var.)	0.9333	
	t-Test (paired)	0.3855	
	Levene Test	0.6121	
Bootstrap	UCL	0.062	0.063
	Mean	0.050	0.051
	LCL	0.037	0.039
	Std. Dev.	0.035	0.030
	Efficiency	-2.08%	

Brodie Lane Swale - Total Phosphorus (mg/L)



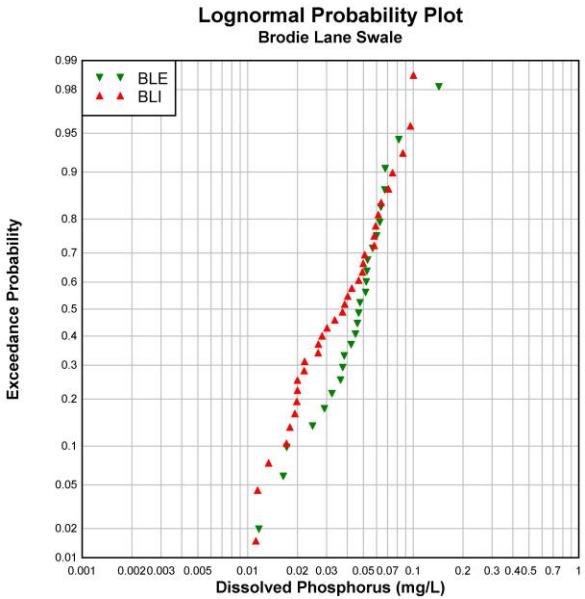


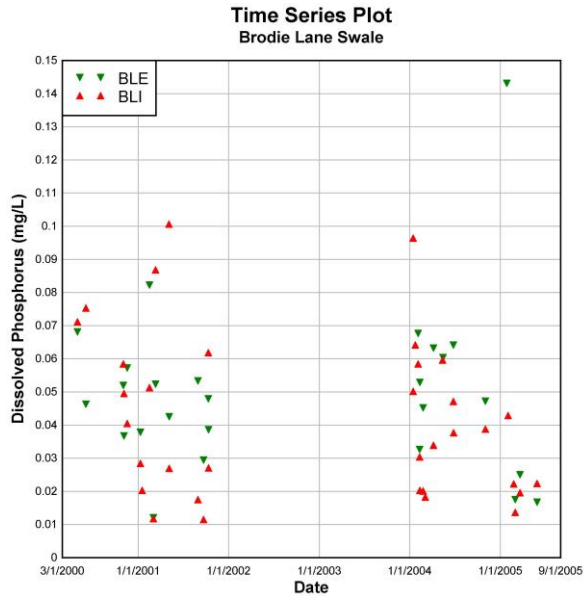


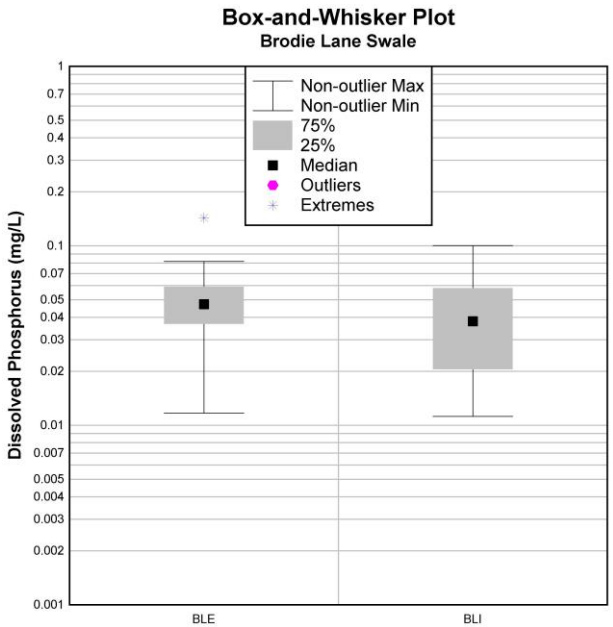


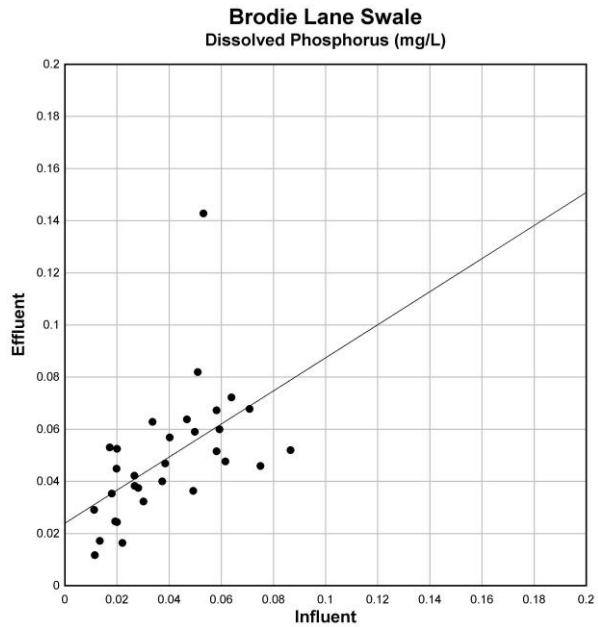
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.270	0.254
	Upper Quartile	0.146	0.175
	Median	0.115	0.114
	Lower Quartile	0.079	0.090
	Minimum	0.029	0.049
	Efficiency	0.51%	
	Mann-Whitney	0.2709	
	Wilcoxon (paired)	0.0038 **	
Arithmetic	UCL	0.134	0.159
	Mean	0.116	0.136
	LCL	0.097	0.112
	Std. Dev.	0.053	0.058
	Wilk (p-value)	0.2127	0.0776 *
	Efficiency	-17.07%	
	t-Test (equal var.)	0.1745	
	t-Test (unequal var.)	0.1808	
	t-test (paired)	0.0109 **	
	Levene Test	0.6217	
Log Transformed	UCL	0.140	0.163
	Mean	0.117	0.136
	LCL	0.097	0.113
	Std. Dev.	0.061	0.061
	Wilk (p-value)	0.5565	0.7073
	Efficiency	-16.12%	
	t-Test (equal var.)	0.1510	
	t-Test (unequal var.)	0.1440	
	t-Test (paired)	0.0108 **	
	Levene Test	0.4621	
Bootstrap	UCL	0.134	0.158
	Mean	0.116	0.135
	LCL	0.098	0.112
	Std. Dev.	0.052	0.057
	Efficiency	-16.78%	

Brodie Lane Swale - Dissolved Phosphorus (mg/L)



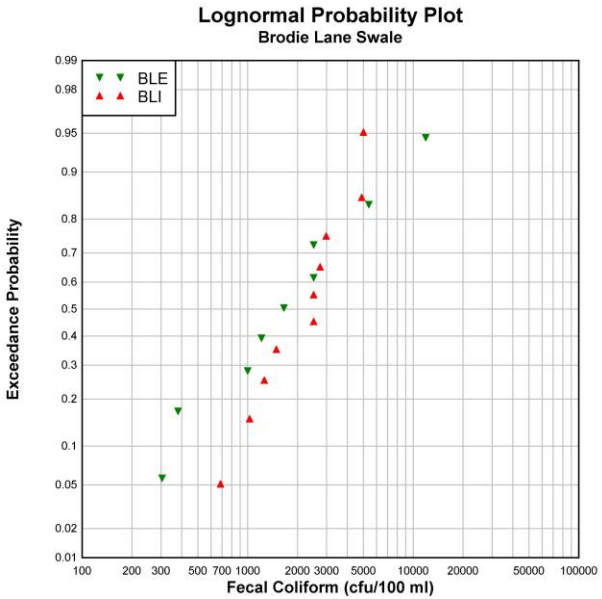


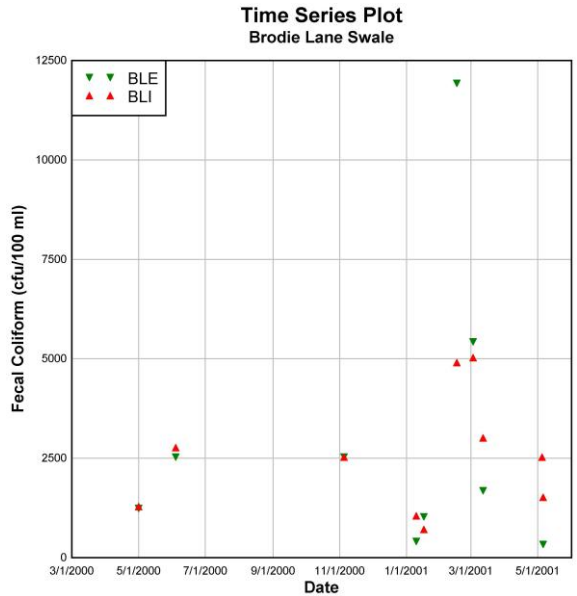


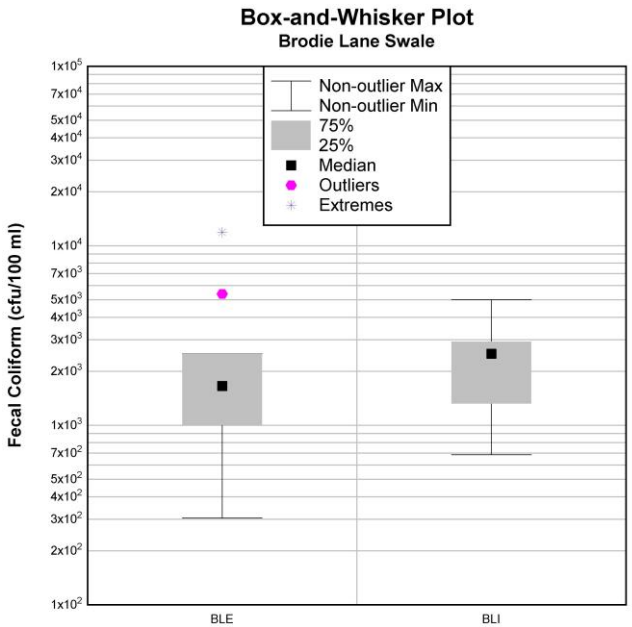


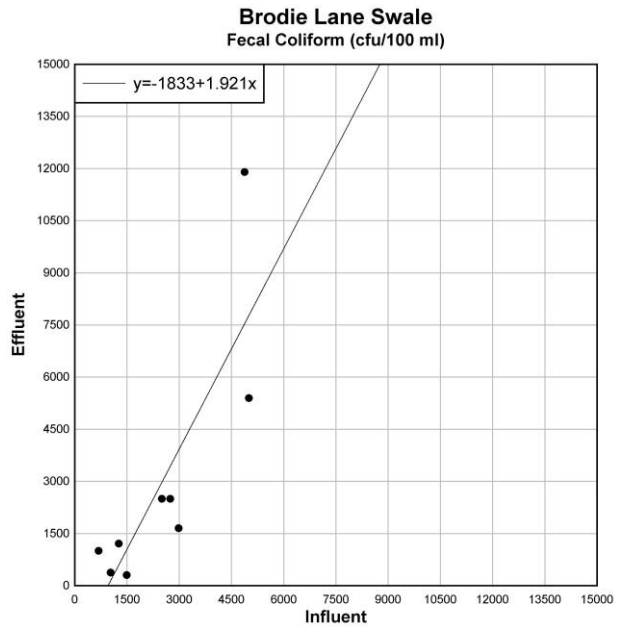
		PARAMETER	DP (mg/L)
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.100	0.143
	Upper Quartile	0.058	0.060
	Median	0.038	0.047
	Lower Quartile	0.020	0.036
	Minimum	0.011	0.012
	Efficiency	-24.55%	
	Mann-Whitney	0.2178	
	Wilcoxon (paired)	0.0069 **	
Arithmetic	UCL	0.050	0.060
	Mean	0.042	0.049
	LCL	0.033	0.039
	Std. Dev.	0.024	0.026
	Wilk (p-value)	0.0178 **	0.0017 **
	Efficiency	-17.80%	
	t-Test (equal var.)	0.2561	
	t-Test (unequal var.)	0.2596	
	t-test (paired)	0.0214 **	
	Levene Test	0.8758	
Log Transformed	UCL	0.053	0.063
	Mean	0.042	0.050
	LCL	0.033	0.040
	Std. Dev.	0.028	0.028
	Wilk (p-value)	0.3746	0.1556
	Efficiency	-17.92%	
	t-Test (equal var.)	0.1635	
	t-Test (unequal var.)	0.1554	
	t-Test (paired)	0.0025 **	
	Levene Test	0.3728	
Bootstrap	UCL	0.050	0.059
	Mean	0.042	0.049
	LCL	0.033	0.039
	Std. Dev.	0.024	0.024
	Efficiency	-18.17%	

Brodie Lane Swale - Fecal Coliform (cfu/100 ml)



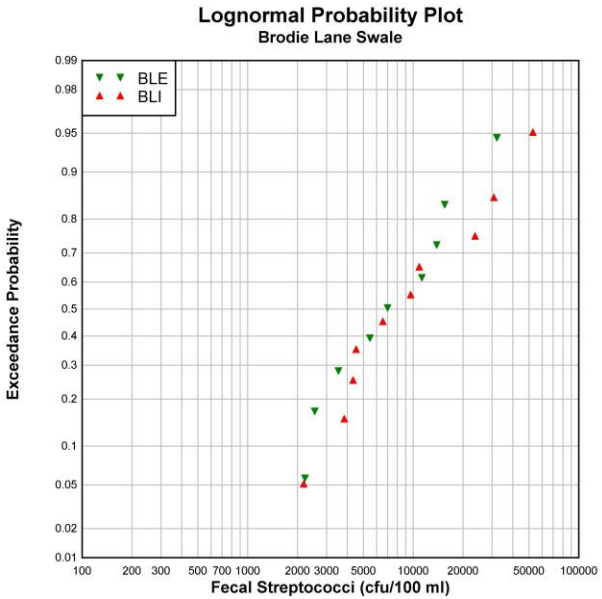


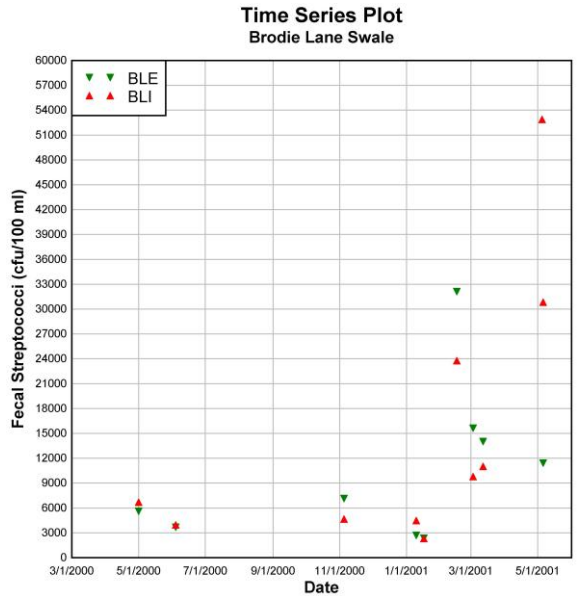


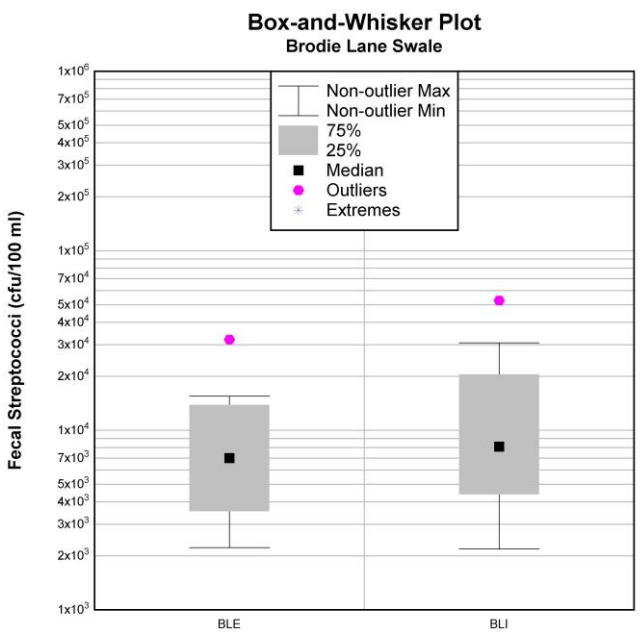


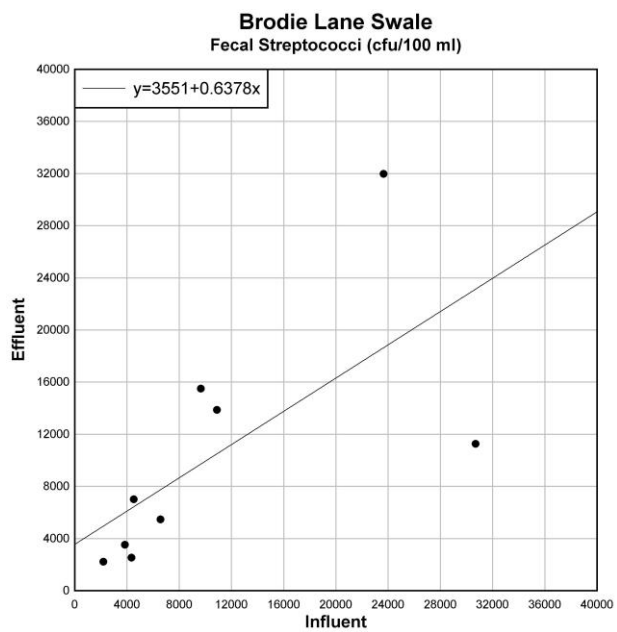
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	10	9
	Pairs Count	9	9
Non-Parametric	Maximum	5,000	11,900
	Upper Quartile	2,982	2,500
	Median	2,500	1,656
	Lower Quartile	1,261	1,000
	Minimum	686	304
	Efficiency	33.77%	
	Mann-Whitney	0.6587	
	Wilcoxon (paired)	0.7344	
Arithmetic	UCL	3,578	5,815
	Mean	2,506	2,983
	LCL	1,435	151
	Std. Dev.	1,498	3,685
	Wilk (p-value)	0.2174	0.0028 **
	Efficiency	-19.02%	
	t-Test (equal var.)	0.7109	
	t-Test (unequal var.)	0.7245	
	t-test (paired)	0.5878	
	Levene Test	0.2291	
Log Transformed	UCL	4,269	9,814
	Mean	2,536	2,952
	LCL	1,506	888
	Std. Dev.	1,715	3,730
	Wilk (p-value)	0.6315	0.8986
	Efficiency	-16.42%	
	t-Test (equal var.)	0.5882	
	t-Test (unequal var.)	0.6016	
	t-Test (paired)	0.4035	
	Levene Test	0.0957 *	
Bootstrap	UCL	3,508	5,455
	Mean	2,509	2,988
	LCL	1,510	521
	Std. Dev.	1,397	3,210
	Efficiency	-19.12%	

Brodie Lane Swale - Fecal Streptococci (cfu/100 ml)



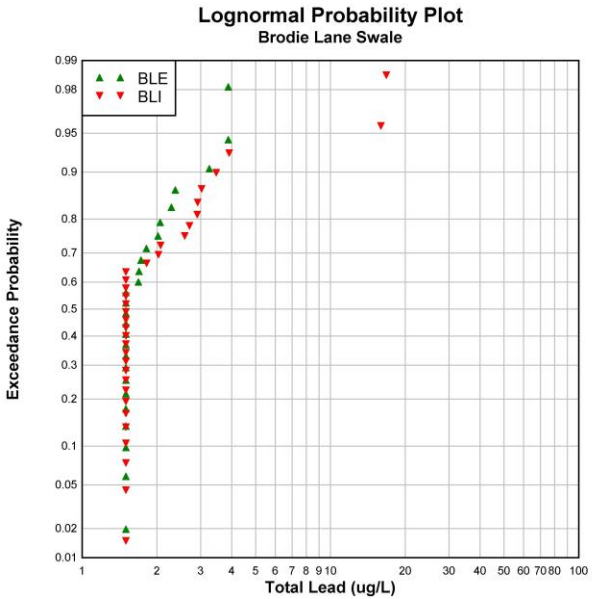


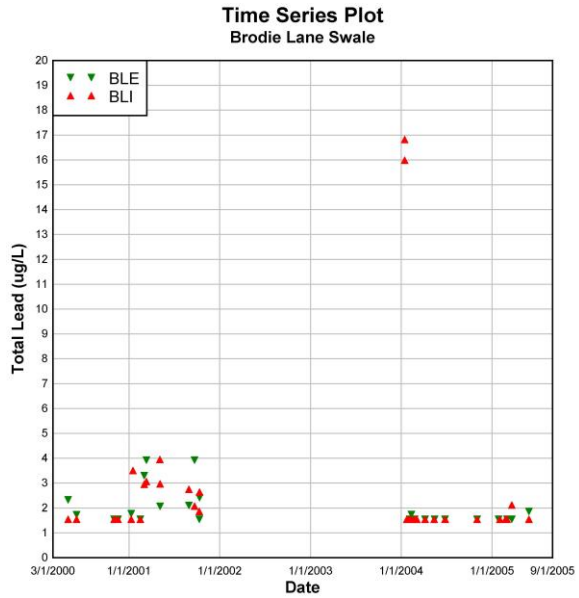


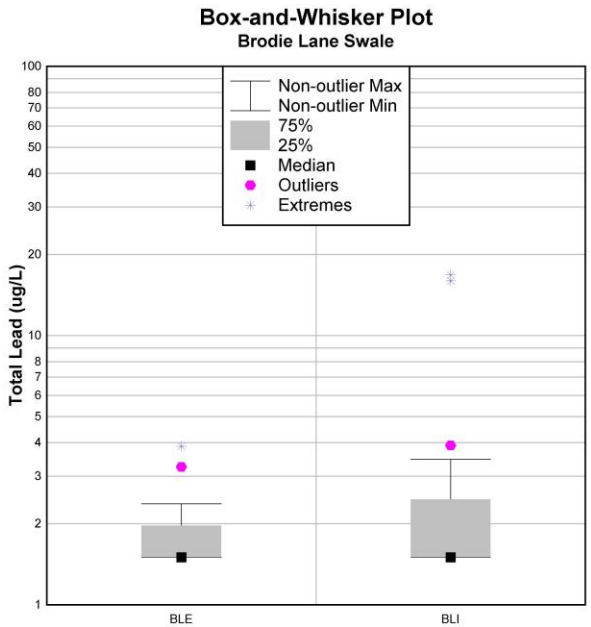


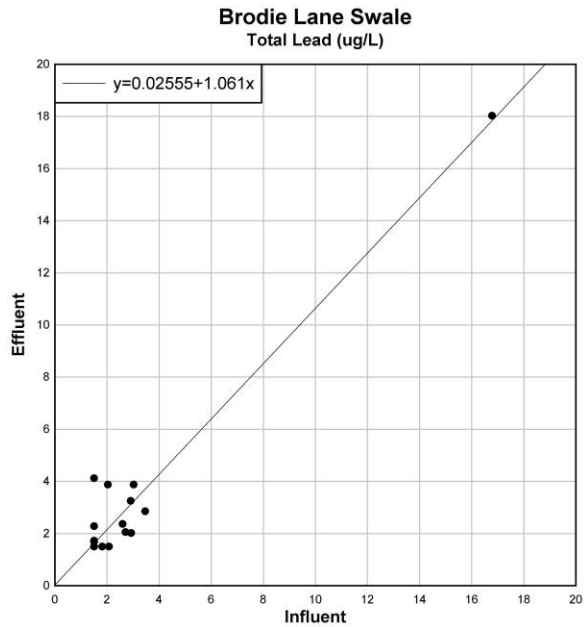
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	10	9
	Pairs Count	9	9
Non-Parametric	Maximum	52,754	31,973
	Upper Quartile	23,642	13,879
	Median	8,104	7,006
	Lower Quartile	4,337	3,532
	Minimum	2,181	2,220
	Efficiency	13.55%	
	Mann-Whitney	0.8405	
	Wilcoxon (paired)	0.6523	
Arithmetic	UCL	26,529	17,648
	Mean	14,907	10,377
	LCL	3,285	3,106
	Std. Dev.	16,247	9,460
	Wilk (p-value)	0.0071 **	0.0403 **
	Efficiency	30.39%	
	t-Test (equal var.)	0.4747	
	t-Test (unequal var.)	0.4642	
	t-test (paired)	0.9049	
	Levene Test	0.3052	
Log Transformed	UCL	36,407	23,878
	Mean	14,478	10,352
	LCL	5,757	4,488
	Std. Dev.	15,975	9,777
	Wilk (p-value)	0.6941	0.7973
	Efficiency	28.50%	
	t-Test (equal var.)	0.6114	
	t-Test (unequal var.)	0.6089	
	t-Test (paired)	0.8286	
	Levene Test	0.5841	
Bootstrap	UCL	25,740	16,990
	Mean	15,216	10,498
	LCL	4,691	4,006
	Std. Dev.	14,713	8,445
	Efficiency	31.00%	

Brodie Lane Swale - Total Lead (ug/L)



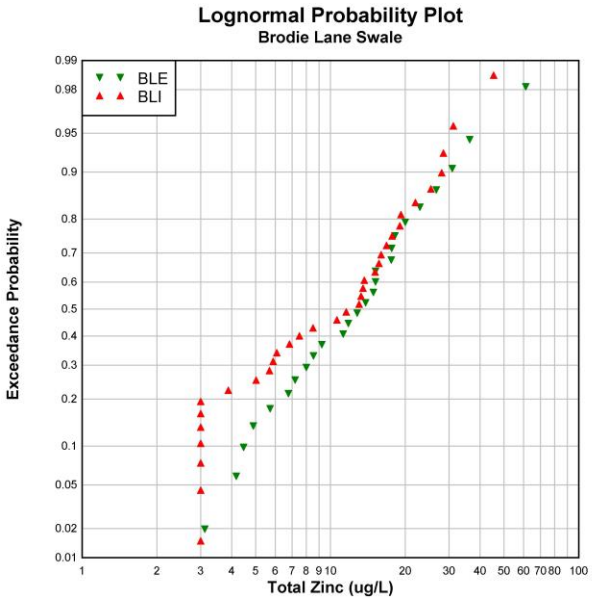


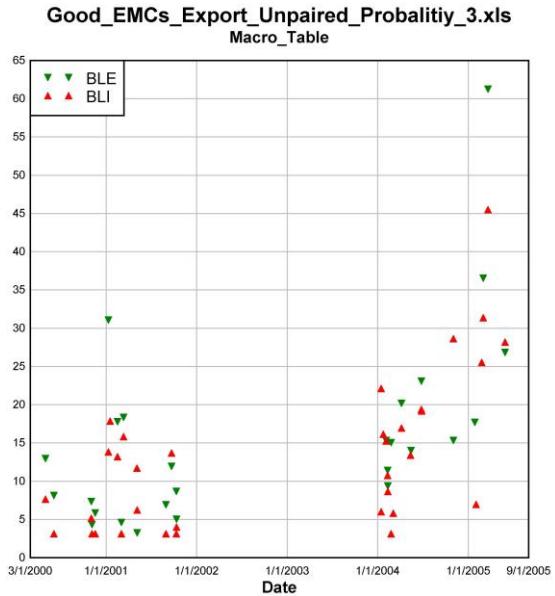


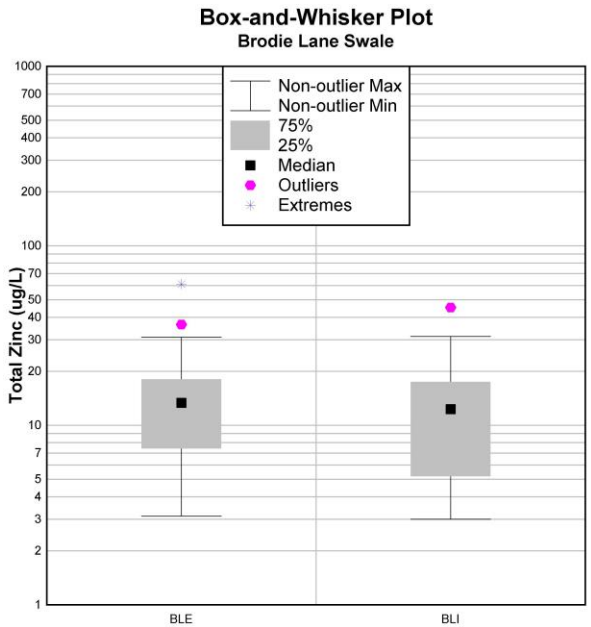


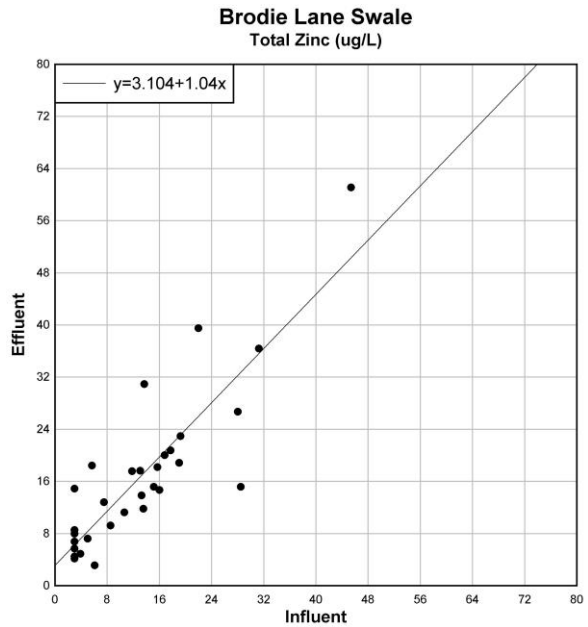
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	16.8	3.9
	Upper Quartile	2.6	2.0
	Median	1.5	1.5
	Lower Quartile	1.5	1.5
	Minimum	1.5	1.5
	Efficiency	0.00%	
	Mann-Whitney	0.3397	
	Wilcoxon (paired)	0.9245	
Arithmetic	UCL	4.0	2.2
	Mean	2.7	1.9
	LCL	1.5	1.6
	Std. Dev.	3.5	0.7
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	30.98%	
	t-Test (equal var.)	0.2319	
	t-Test (unequal var.)	0.1792	
	t-test (paired)	0.1786	
	Levene Test	0.1886	
Log Transformed	UCL	3.1	2.1
	Mean	2.4	1.9
	LCL	1.9	1.7
	Std. Dev.	1.6	0.6
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	23.02%	
	t-Test (equal var.)	0.3245	
	t-Test (unequal var.)	0.2855	
	t-Test (paired)	0.2722	
	Levene Test	0.1855	
Bootstrap	UCL	3.9	2.2
	Mean	2.8	1.9
	LCL	1.6	1.6
	Std. Dev.	3.3	0.7
	Efficiency	31.35%	

Brodie Lane Swale - Total Zinc (ug/L)



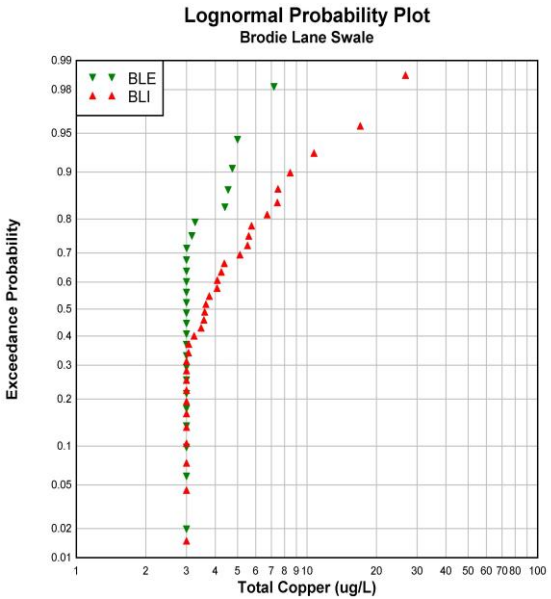


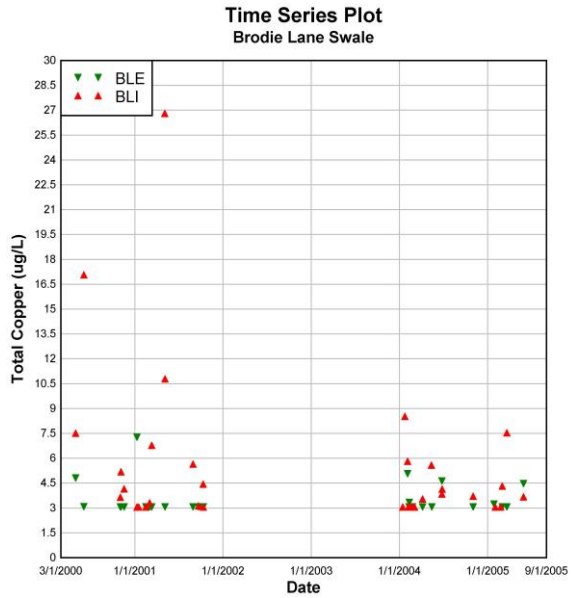


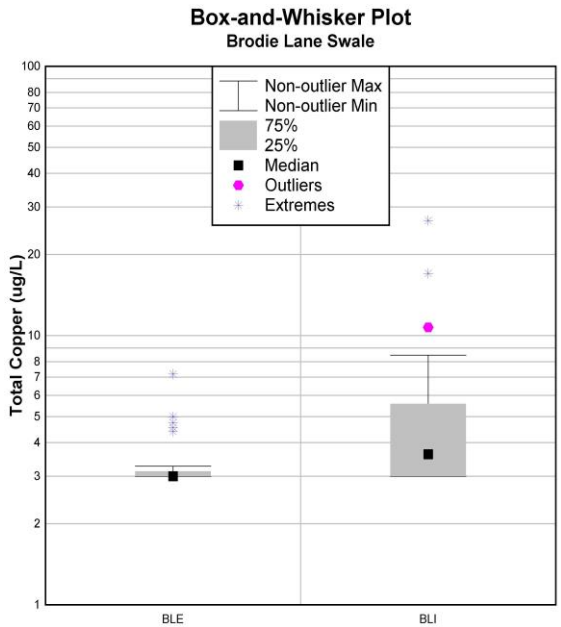


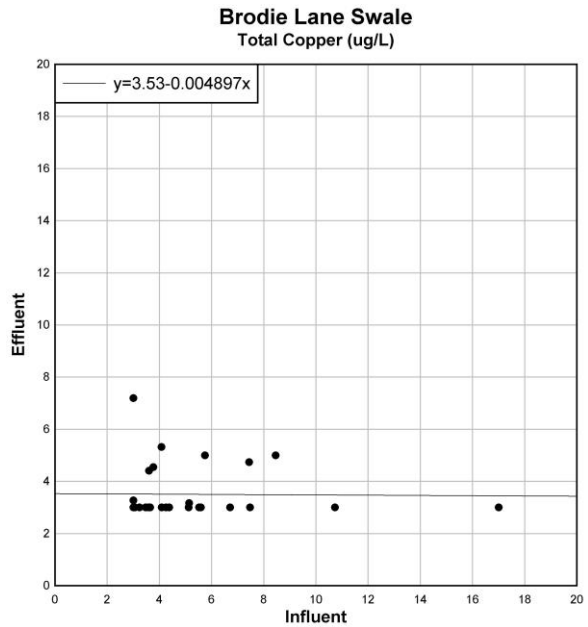
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	45.4	61.1
	Upper Quartile	17.7	18.2
	Median	12.3	13.3
	Lower Quartile	5.0	7.2
	Minimum	3.0	3.1
	Efficiency	-8.31%	
	Mann-Whitney	0.3325	
	Wilcoxon (paired)	0.0002 **	
Arithmetic	UCL	16.6	20.8
	Mean	13.1	15.7
	LCL	9.6	10.7
	Std. Dev.	10.0	12.5
	Wilk (p-value)	0.0013 **	0.0002 **
	Efficiency	-19.72%	
	t-Test (equal var.)	0.3770	
	t-Test (unequal var.)	0.3919	
	t-test (paired)	0.0032 **	
	Levene Test	0.4944	
Log Transformed	UCL	18.7	21.7
	Mean	13.4	15.7
	LCL	9.6	11.3
	Std. Dev.	12.6	12.3
	Wilk (p-value)	0.0263 **	0.9904
	Efficiency	-16.50%	
	t-Test (equal var.)	0.2618	
	t-Test (unequal var.)	0.2535	
	t-Test (paired)	0.0009 **	
	Levene Test	0.3395	
Bootstrap	UCL	16.7	20.6
	Mean	13.2	15.8
	LCL	9.8	11.0
	Std. Dev.	9.8	11.9
	Efficiency	-19.22%	

Brodie Lane Swale - Total Copper (ug/L)



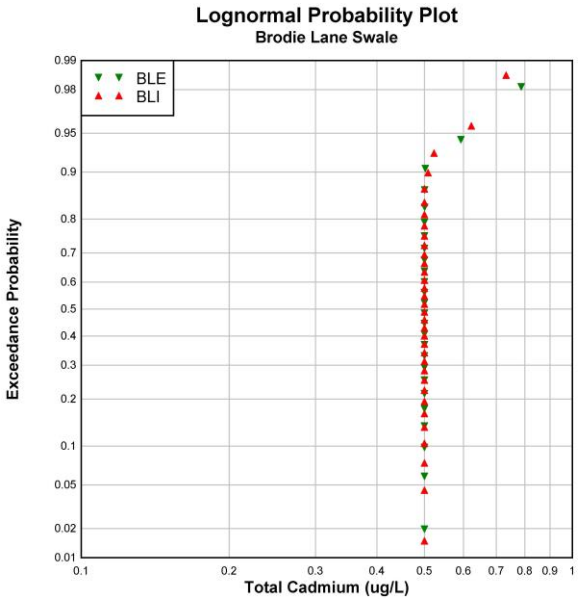


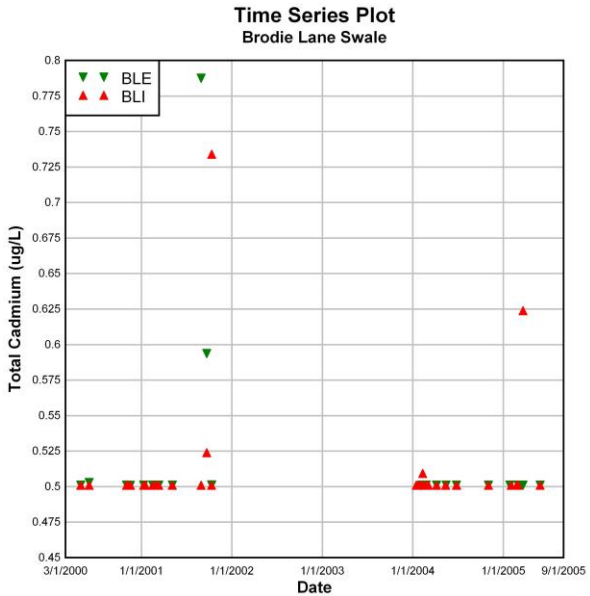


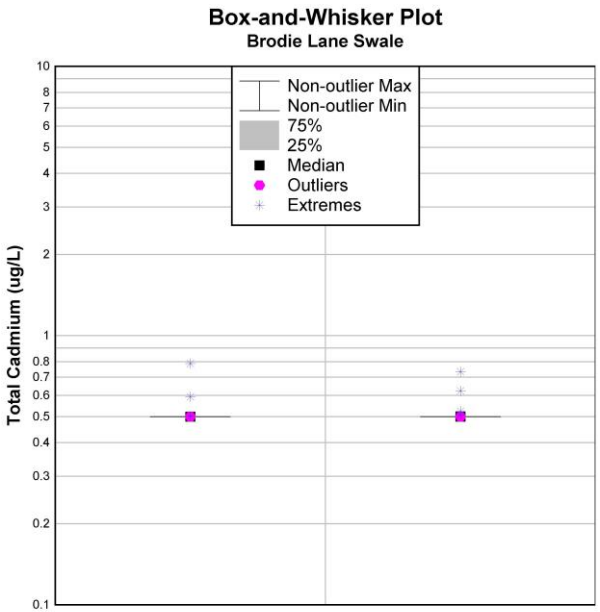


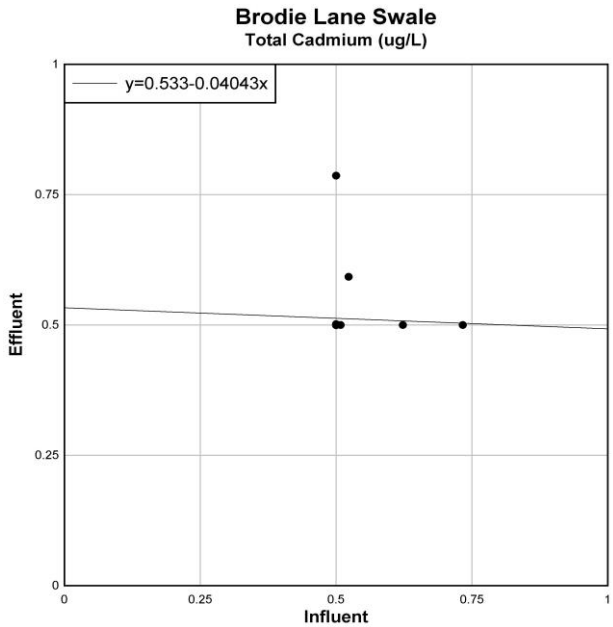
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	26.7	7.2
	Upper Quartile	5.6	3.2
	Median	3.6	3.0
	Lower Quartile	3.0	3.0
	Minimum	3.0	3.0
	Efficiency	17.24%	
	Mann-Whitney	0.0358 **	
	Wilcoxon (paired)	0.0038 **	
Arithmetic	UCL	7.1	3.8
	Mean	5.4	3.4
	LCL	3.8	3.0
	Std. Dev.	4.7	1.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	36.43%	
	t-Test (equal var.)	0.0417 **	
	t-Test (unequal var.)	0.0237 **	
	t-test (paired)	0.0222 **	
	Levene Test	0.1905	
Log Transformed	UCL	6.3	3.8
	Mean	5.1	3.4
	LCL	4.2	3.1
	Std. Dev.	2.9	0.8
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	33.52%	
	t-Test (equal var.)	0.0107 **	
	t-Test (unequal var.)	0.0057 **	
	t-Test (paired)	0.0090 **	
	Levene Test	0.0626 *	
Bootstrap	UCL	6.9	3.8
	Mean	5.4	3.4
	LCL	3.9	3.1
	Std. Dev.	4.3	0.9
	Efficiency	35.91%	

Brodie Lane Swale - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: BLI**	**EFF: BLE**
	Site Count	34	26
	Pairs Count	30	30
Non-Parametric	Maximum	0.7	0.8
	Upper Quartile	0.5	0.5
	Median	0.5	0.5
	Lower Quartile	0.5	0.5
	Minimum	0.5	0.5
	Efficiency	0.00%	
	Mann-Whitney	0.5234	
	Wilcoxon (paired)	0.2878	
Arithmetic	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-0.64%	
	t-Test (equal var.)	0.8071	
	t-Test (unequal var.)	0.8139	
	t-test (paired)	0.9867	
	Levene Test	0.6549	
Log Transformed	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.0
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	-0.61%	
	t-Test (equal var.)	0.8343	
	t-Test (unequal var.)	0.8393	
	t-Test (paired)	0.9539	
	Levene Test	0.6960	
Bootstrap	UCL	0.5	0.5
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Efficiency	-0.62%	

MoPac BMP #6, Vertical Sand Filter (BNI-BNE)

This unique BMP was constructed by Texas Department of Transportation (TXDOT) to treat runoff from an Austin-area highway. The inflow station to this basin is BNI, see the Small Watershed Report for information on the contributing watershed. The basin was design as a filtration basin using a vertical filter. The original filtration medium was concrete sand between two sets of limestone gabions. The upstream side of the filter was also lined with geotextile fabric.

It was discovered early in the monitoring of this BMP that there was not enough hydrostatic head upstream of filter to allow all of the water to pass through the filter and that the geotextile fabric became clogged with fine sediment. Subsequently, the filtration media was replaced with crushed limestone gravel and the geotextile fabric was replaced with a fabric screen to catch trash and larger debris.

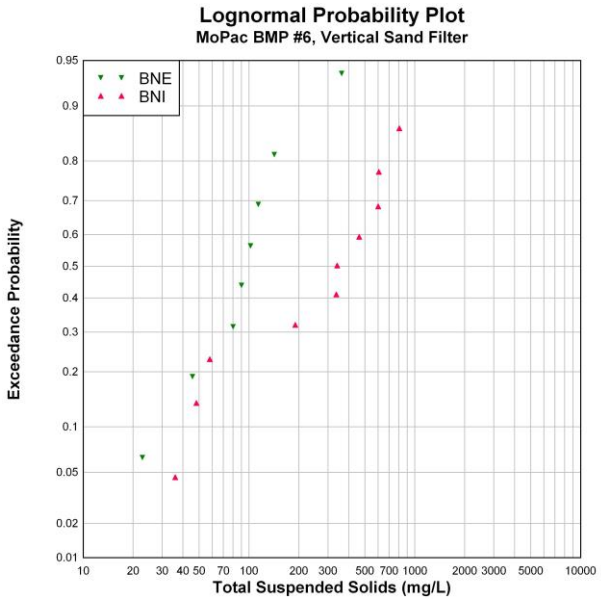
Data in this report represent only those collected by COA. Data from an initial study conducted jointly by TXDOT and COA are not include but are reported elsewhere.

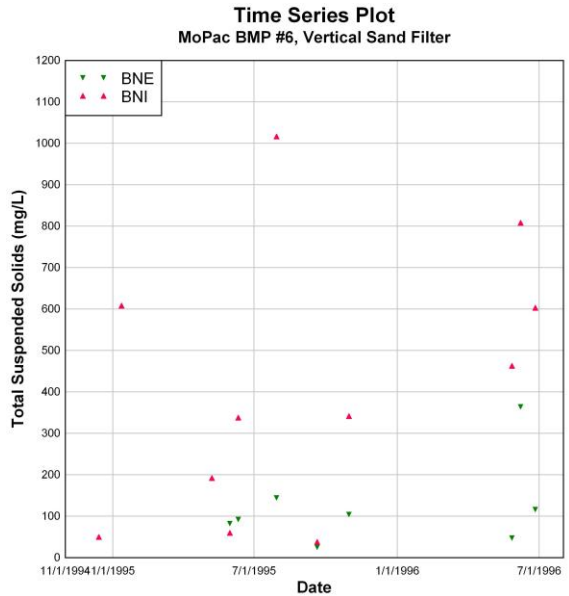
Between 1995 and 1996, the city collected 11 influent samples and 8 effluent samples, 8 samples were paired.

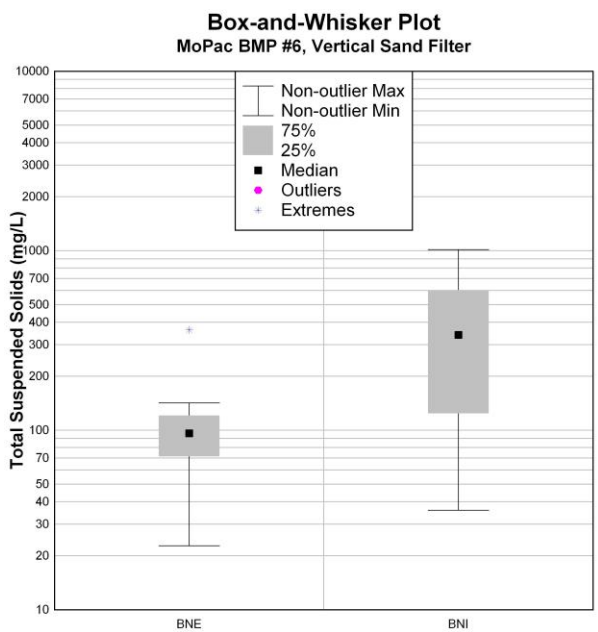
Performance Summary

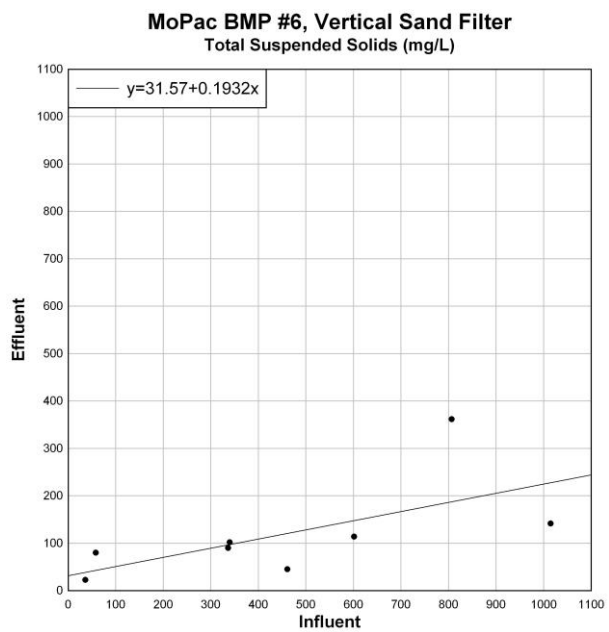
The performance of this BMP was substandard. The effluent concentrations of TSS and total Zn were significantly lower than the influent concentrations but the removal rates (70 and 65%, respectively) were below those of traditional sand filters. The mean effluent concentrations for these parameters were also higher than seen in tradition sand filter, ~5 times higher in the case of TSS. There were no significant differences between the influent and effluent concentrations for other water quality parameters. It is worth noting that this design also appears to be exporting nitrates, which is common in sand filters.

MoPac BMP #6, Vertical Sand Filter - Total Suspended Solids (mg/L)



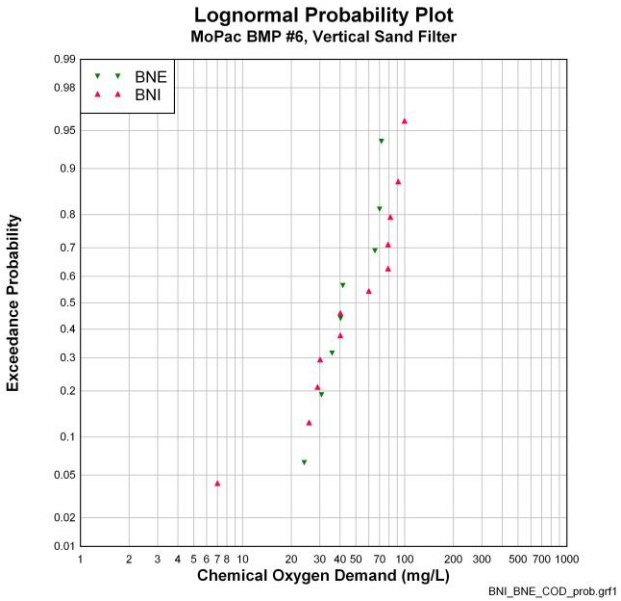


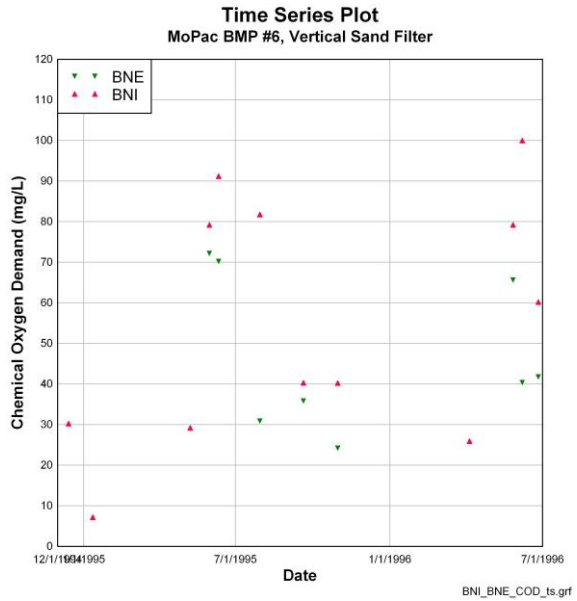


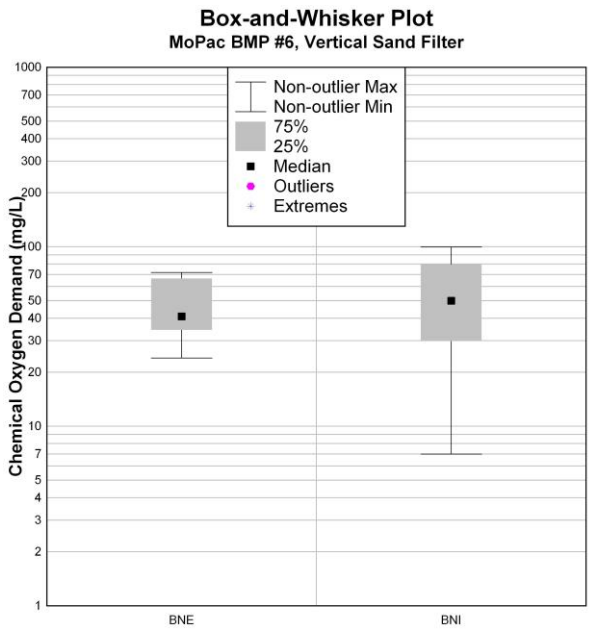


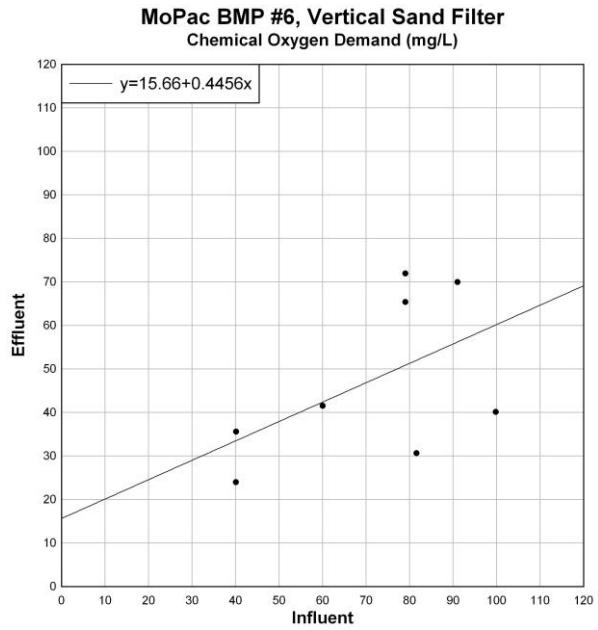
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	11	8
	Pairs Count	8	8
Non-Parametric	Maximum	1,015	361.9
	Upper Quartile	606	127.9
	Median	339.5	96.1
	Lower Quartile	58	62.8
	Minimum	35.9	22.8
	Efficiency	71.70%	
	Mann-Whitney	0.0928 *	
	Wilcoxon (paired)	0.0234 **	
Arithmetic	UCL	626.8	207.4
	Mean	408.8	119.8
	LCL	190.7	32.2
	Std. Dev.	324.6	104.8
	Wilk (p-value)	0.4295	0.0117 **
	Efficiency	70.70%	
	t-Test (equal var.)	0.0275 **	
	t-Test (unequal var.)	0.0165 **	
	t-test (paired)	0.0129 **	
	Levene Test	0.0400 **	
Log Transformed	UCL	1,364	263.9
	Mean	470.3	119.4
	LCL	162.2	54
	Std. Dev.	626.1	99.3
	Wilk (p-value)	0.0996 *	0.8508
	Efficiency	74.62%	
	t-Test (equal var.)	0.0483 **	
	t-Test (unequal var.)	0.0371 **	
	t-Test (paired)	0.0059 **	
	Levene Test	0.184	
Bootstrap	UCL	612.9	195.6
	Mean	409	120.7
	LCL	205.2	45.7
	Std. Dev.	303.4	89.6
	Efficiency	70.50%	

MoPac BMP #6, Vertical Sand Filter - Chemical Oxygen Demand (mg/L)



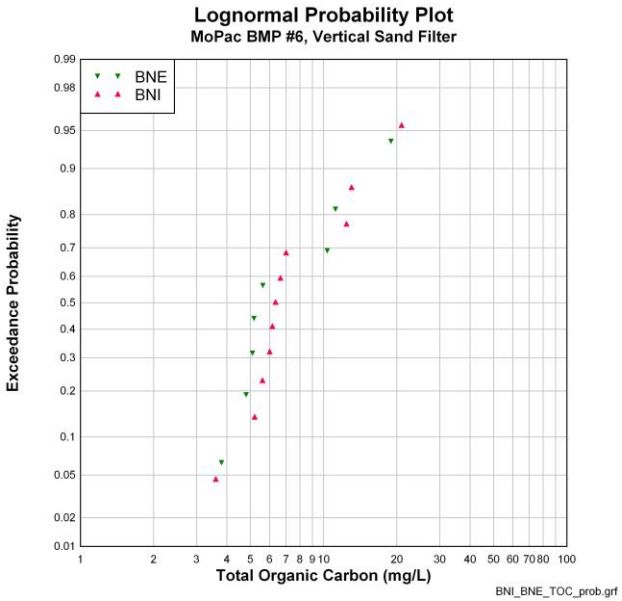


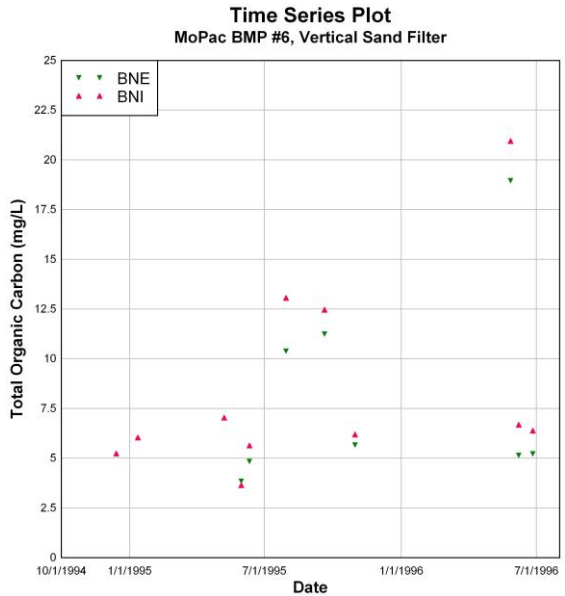


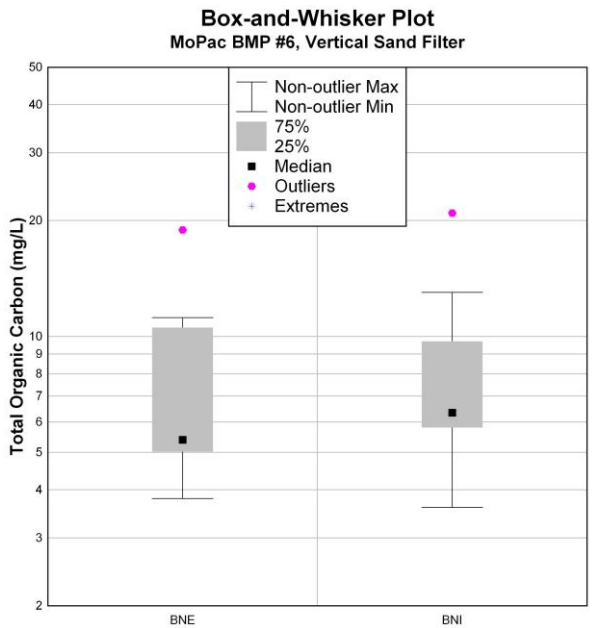


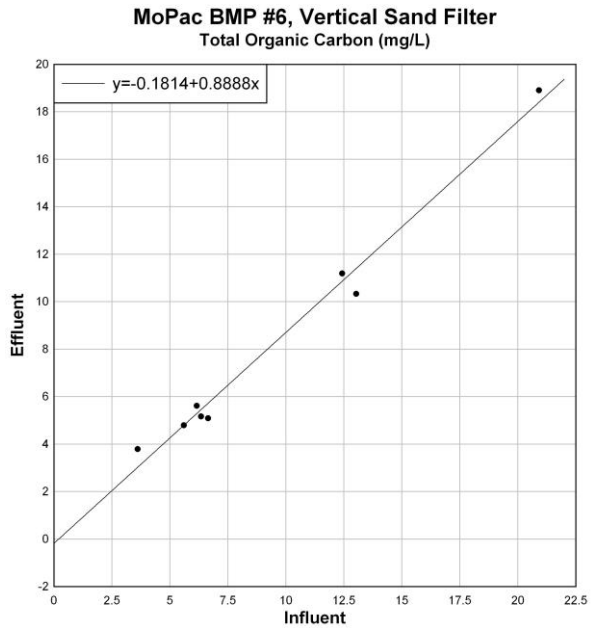
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	12	8
	Pairs Count	8	8
Non-Parametric	Maximum	99.77	72
	Upper Quartile	80.29	67.72
	Median	50.06	40.87
	Lower Quartile	29.52	33.14
	Minimum	7	24.01
	Efficiency	18.35%	
	Mann-Whitney	0.6761	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	74.43	63.22
	Mean	55.19	47.43
	LCL	35.95	31.65
	Std. Dev.	30.29	18.88
	Wilk (p-value)	0.3684	0.1789
	Efficiency	14.06%	
	t-Test (equal var.)	0.5284	
	t-Test (unequal var.)	0.4896	
	t-test (paired)	0.0125 **	
	Levene Test	0.0545 *	
Log Transformed	UCL	101.66	67.88
	Mean	58.42	47.47
	LCL	33.57	33.19
	Std. Dev.	47.02	19.56
	Wilk (p-value)	0.0573 *	0.3877
	Efficiency	18.74%	
	t-Test (equal var.)	0.9461	
	t-Test (unequal var.)	0.9395	
	t-Test (paired)	0.0100 **	
	Levene Test	0.2719	
Bootstrap	UCL	73.76	61.46
	Mean	55.66	47.1
	LCL	37.56	32.74
	Std. Dev.	28.49	17.18
	Efficiency	15.37%	

MoPac BMP #6, Vertical Sand Filter - Total Organic Carbon (mg/L)



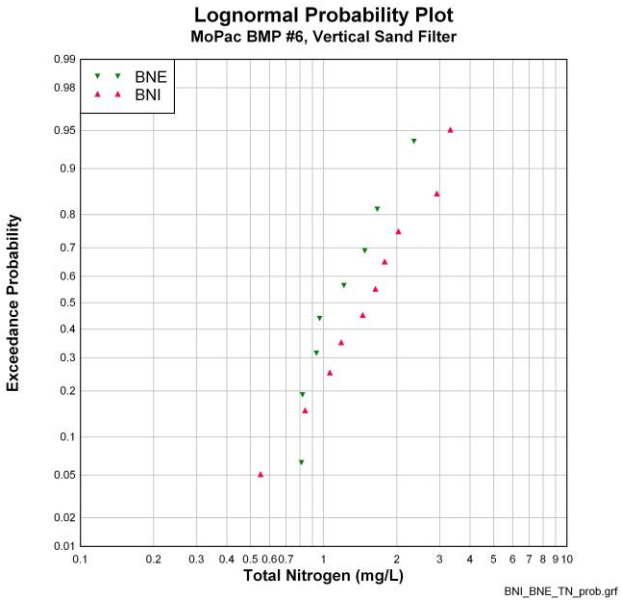


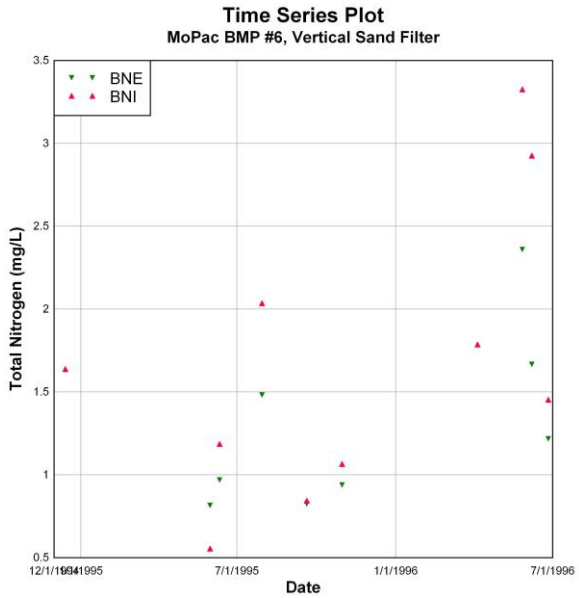


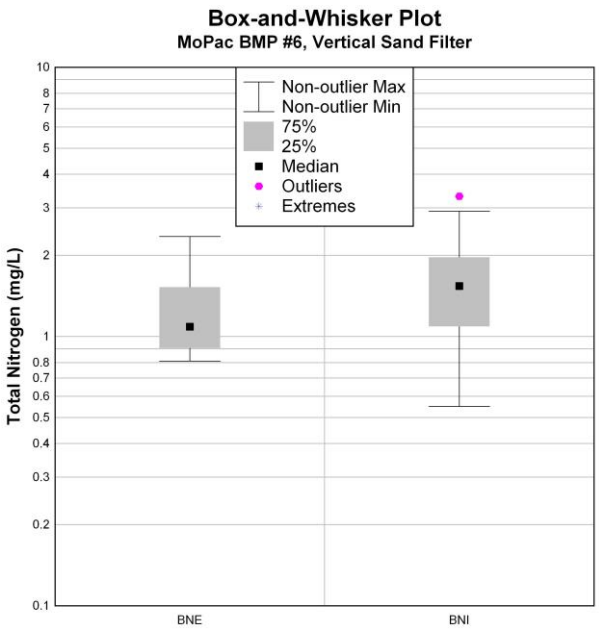


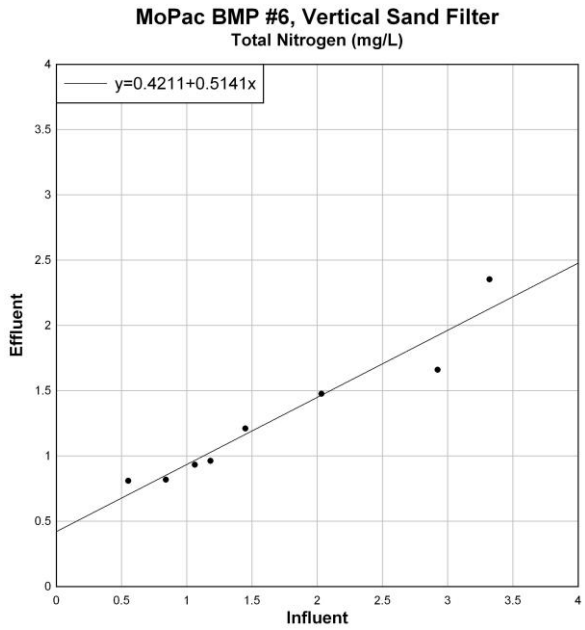
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	11	8
	Pairs Count	8	8
Non-Parametric	Maximum	20.91	18.91
	Upper Quartile	12.42	10.77
	Median	6.34	5.39
	Lower Quartile	5.6	4.95
	Minimum	3.6	3.8
	Efficiency	14.94%	
	Mann-Whitney	0.3973	
	Wilcoxon (paired)	0.0156 **	
Arithmetic	UCL	11.84	12.41
	Mean	8.44	8.12
	LCL	5.05	3.82
	Std. Dev.	5.05	5.14
	Wilk (p-value)	0.0036 **	0.0248 **
	Efficiency	3.89%	
	t-Test (equal var.)	0.8912	
	t-Test (unequal var.)	0.8917	
	t-test (paired)	0.0060 **	
	Levene Test	0.9948	
Log Transformed	UCL	11.92	13.16
	Mean	8.33	8
	LCL	5.82	4.86
	Std. Dev.	4.26	4.46
	Wilk (p-value)	0.1597	0.2029
	Efficiency	3.93%	
	t-Test (equal var.)	0.8148	
	t-Test (unequal var.)	0.8181	
	t-Test (paired)	0.0064 **	
	Levene Test	0.8051	
Bootstrap	UCL	11.54	11.9
	Mean	8.46	8.13
	LCL	5.38	4.36
	Std. Dev.	4.58	4.51
	Efficiency	3.87%	

MoPac BMP #6, Vertical Sand Filter - Total Nitrogen (mg/L)



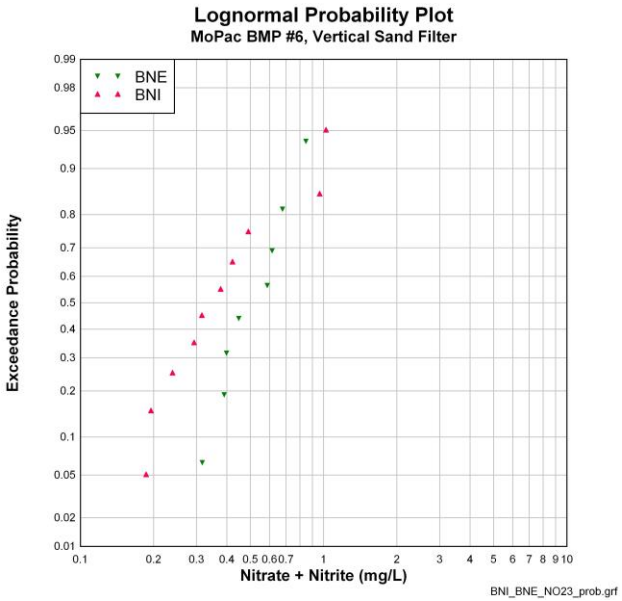


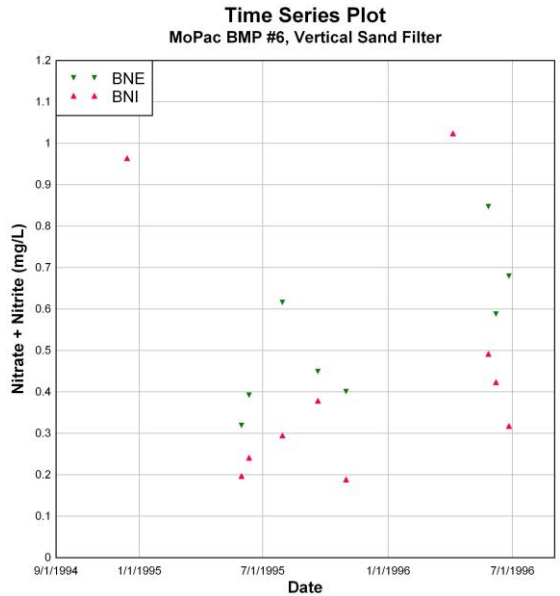


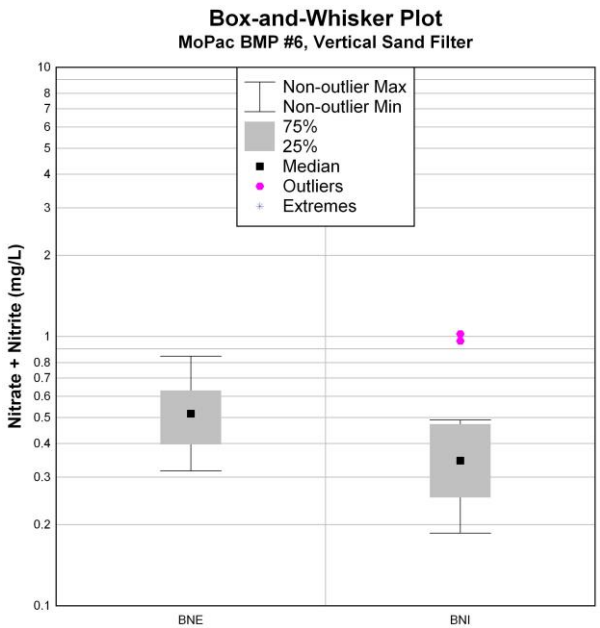


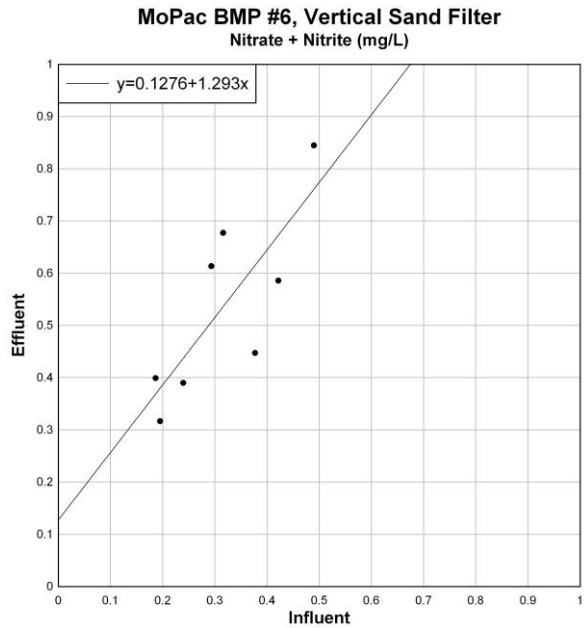
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	10	8
	Pairs Count	8	8
Non-Parametric	Maximum	3.32	2.354
	Upper Quartile	2.031	1.569
	Median	1.54	1.088
	Lower Quartile	1.06	0.877
	Minimum	0.55	0.81
	Efficiency	29.37%	
	Mann-Whitney	0.3639	
	Wilcoxon (paired)	0.0781 *	
Arithmetic	UCL	2.309	1.725
	Mean	1.676	1.279
	LCL	1.044	0.832
	Std. Dev.	0.884	0.534
	Wilk (p-value)	0.486	0.1188
	Efficiency	23.71%	
	t-Test (equal var.)	0.2814	
	t-Test (unequal var.)	0.2572	
	t-test (paired)	0.0662 *	
	Levene Test	0.1958	
Log Transformed	UCL	2.578	1.774
	Mean	1.684	1.273
	LCL	1.101	0.914
	Std. Dev.	0.949	0.488
	Wilk (p-value)	0.98	0.3762
	Efficiency	24.40%	
	t-Test (equal var.)	0.3778	
	t-Test (unequal var.)	0.3586	
	t-Test (paired)	0.1255	
	Levene Test	0.2642	
Bootstrap	UCL	2.26	1.68
	Mean	1.678	1.283
	LCL	1.096	0.887
	Std. Dev.	0.814	0.474
	Efficiency	23.52%	

MoPac BMP #6, Vertical Sand Filter - Nitrate + Nitrite (mg/L)



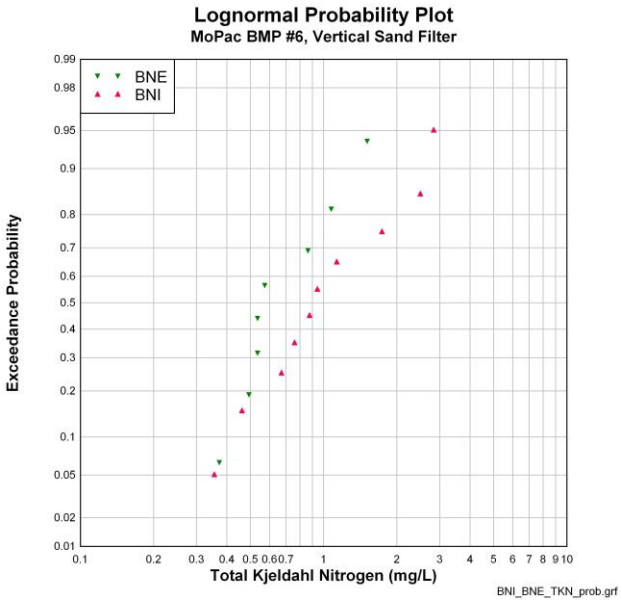


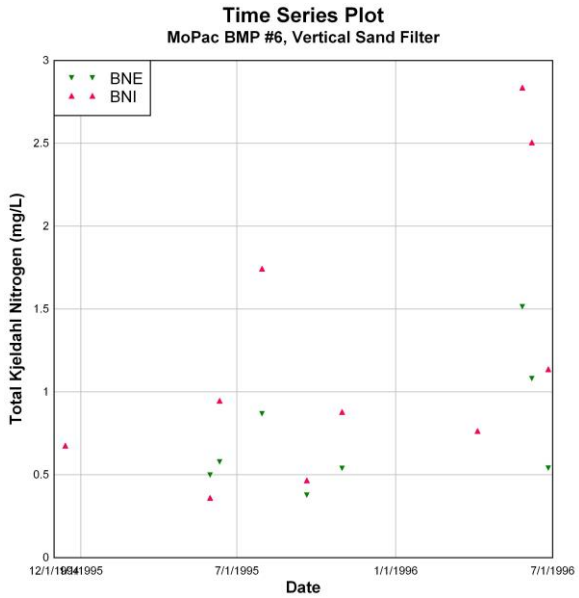


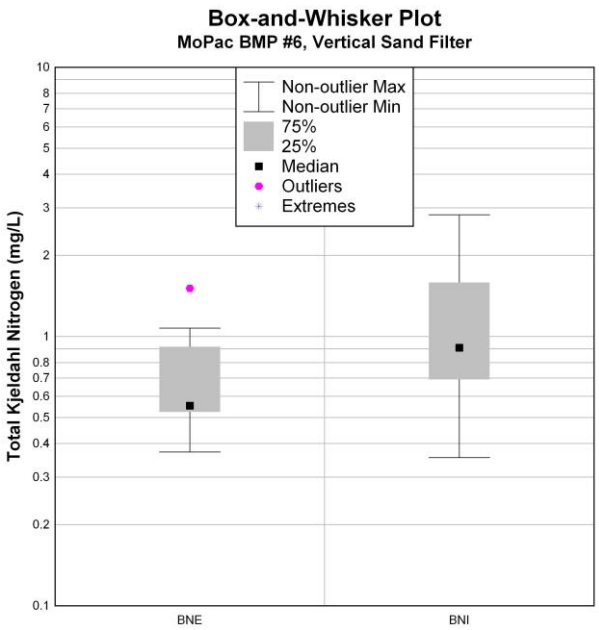


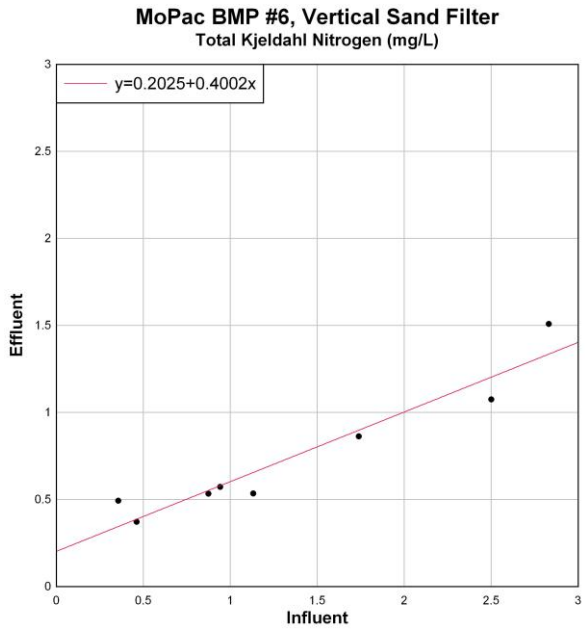
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	10	8
	Pairs Count	8	8
Non-Parametric	Maximum	1.022	0.845
	Upper Quartile	0.49	0.646
	Median	0.346	0.517
	Lower Quartile	0.239	0.395
	Minimum	0.186	0.317
	Efficiency	-49.24%	
	Mann-Whitney	0.1863	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	0.666	0.683
	Mean	0.45	0.535
	LCL	0.234	0.386
	Std. Dev.	0.302	0.177
	Wilk (p-value)	0.0106 **	0.6589
	Efficiency	-18.76%	
	t-Test (equal var.)	0.4949	
	t-Test (unequal var.)	0.471	
	t-test (paired)	0.0009 **	
	Levene Test	0.2172	
Log Transformed	UCL	0.707	0.711
	Mean	0.444	0.534
	LCL	0.278	0.402
	Std. Dev.	0.271	0.178
	Wilk (p-value)	0.3128	0.8472
	Efficiency	-20.46%	
	t-Test (equal var.)	0.2277	
	t-Test (unequal var.)	0.2025	
	t-Test (paired)	0.0002 **	
	Levene Test	0.1143	
Bootstrap	UCL	0.646	0.672
	Mean	0.45	0.537
	LCL	0.253	0.403
	Std. Dev.	0.275	0.161
	Efficiency	-19.54%	

MoPac BMP #6, Vertical Sand Filter - Total Kjeldahl Nitrogen (mg/L)



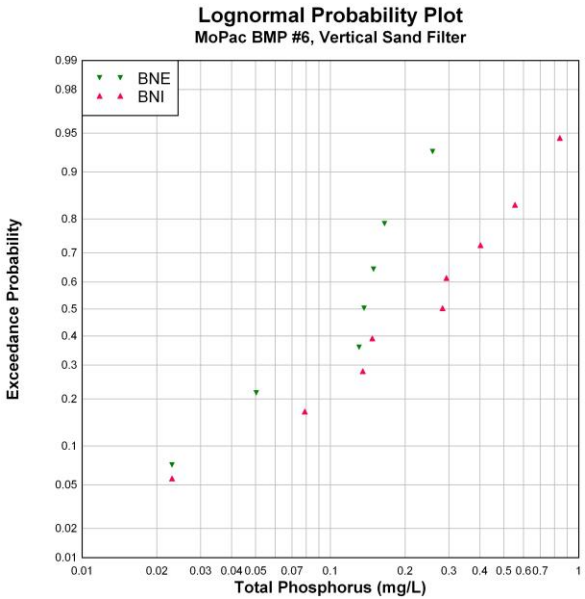


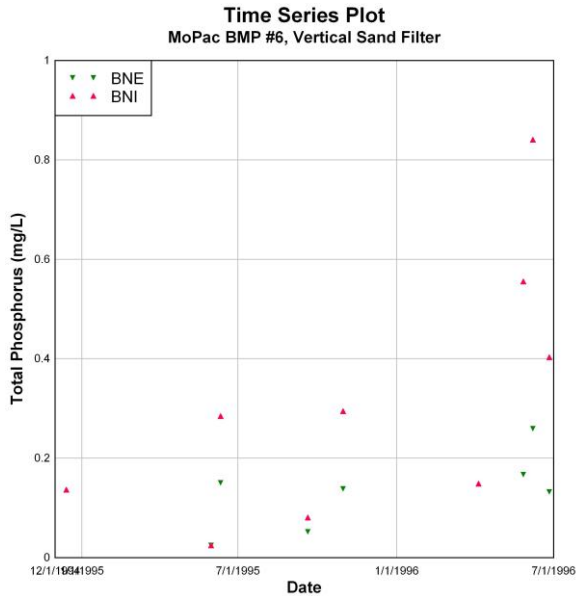


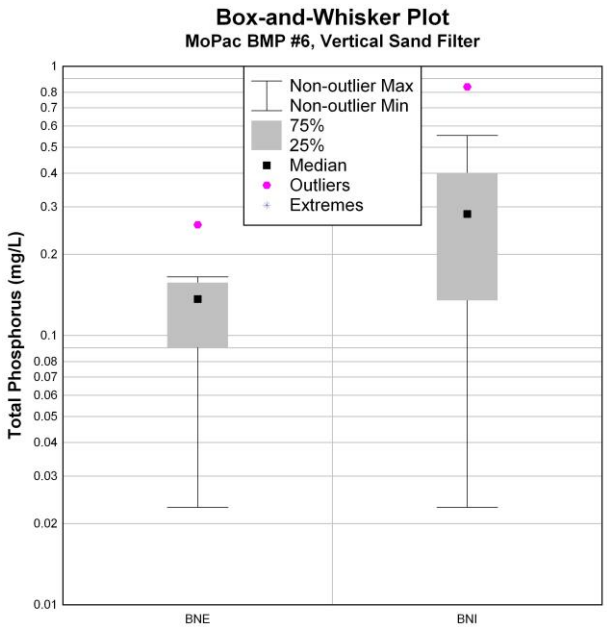


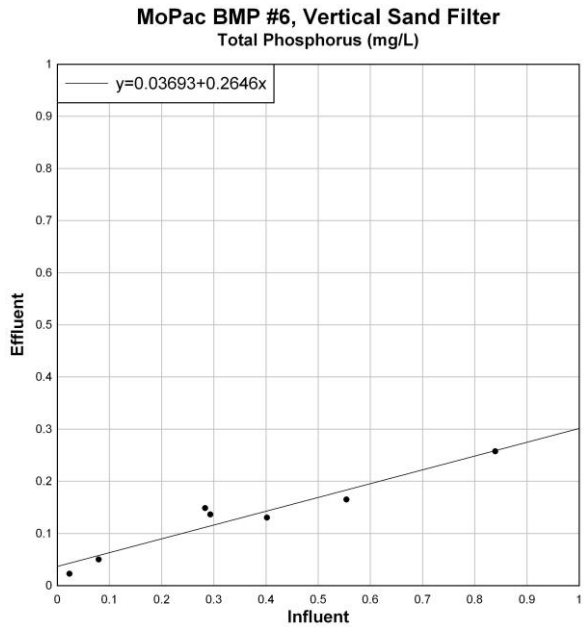
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	10	8
	Pairs Count	8	8
Non-Parametric	Maximum	2.83	1.509
	Upper Quartile	1.738	0.969
	Median	0.908	0.554
	Lower Quartile	0.671	0.514
	Minimum	0.355	0.372
	Efficiency	39.00%	
	Mann-Whitney	0.2468	
	Wilcoxon (paired)	0.0234 **	
Arithmetic	UCL	1.836	1.065
	Mean	1.226	0.744
	LCL	0.616	0.424
	Std. Dev.	0.853	0.383
	Wilk (p-value)	0.0707 *	0.0848 *
	Efficiency	39.29%	
	t-Test (equal var.)	0.1591	
	t-Test (unequal var.)	0.1342	
	t-test (paired)	0.0180 **	
	Levene Test	0.0983 *	
Log Transformed	UCL	2.109	1.116
	Mean	1.222	0.739
	LCL	0.708	0.49
	Std. Dev.	0.862	0.347
	Wilk (p-value)	0.8089	0.4507
	Efficiency	39.50%	
	t-Test (equal var.)	0.1852	
	t-Test (unequal var.)	0.1681	
	t-Test (paired)	0.0093 **	
	Levene Test	0.2042	
Bootstrap	UCL	1.788	1.03
	Mean	1.228	0.746
	LCL	0.668	0.461
	Std. Dev.	0.783	0.34
	Efficiency	39.28%	

MoPac BMP #6, Vertical Sand Filter - Total Phosphorus (mg/L)



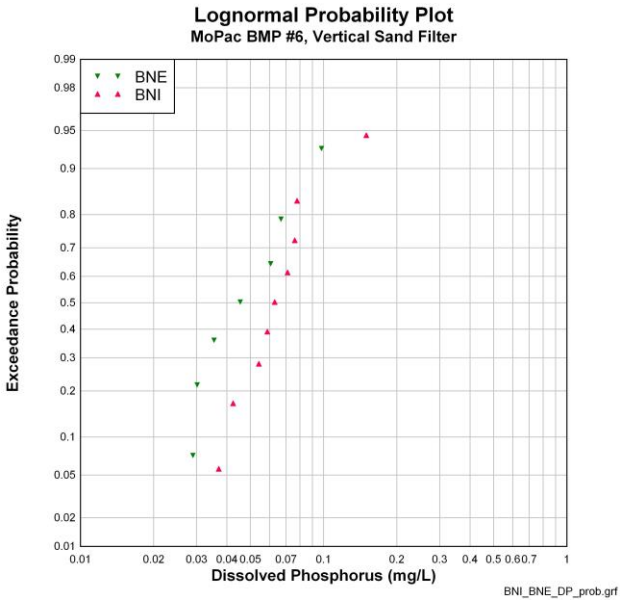


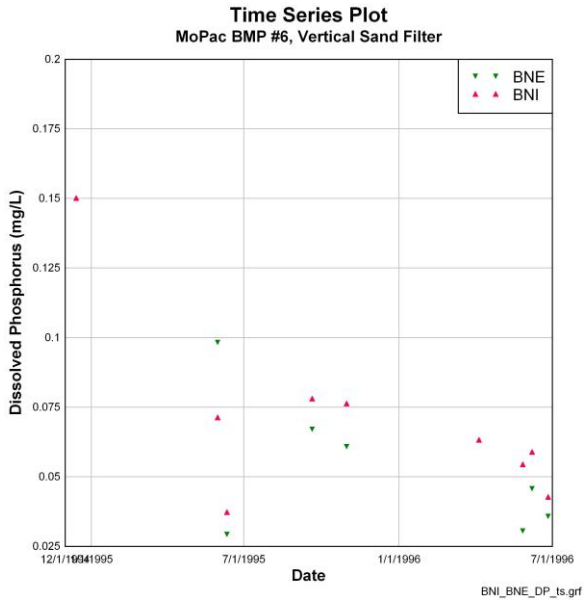


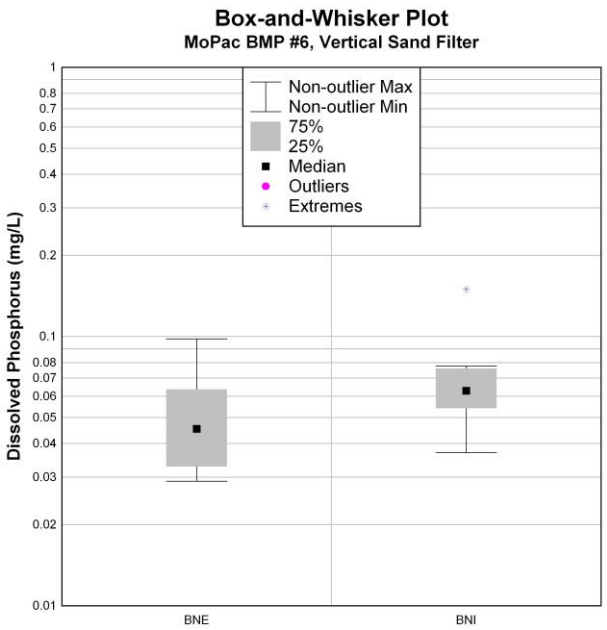


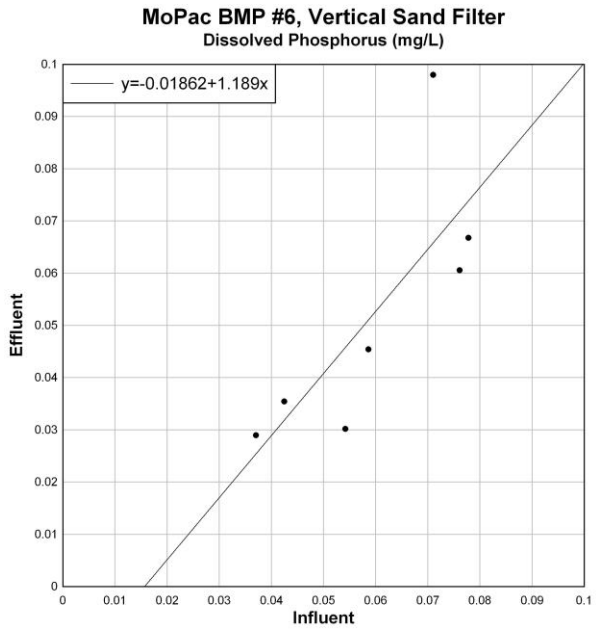
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	9	7
	Pairs Count	7	7
Non-Parametric	Maximum	0.839	0.258
	Upper Quartile	0.402	0.165
	Median	0.283	0.137
	Lower Quartile	0.135	0.05
	Minimum	0.023	0.023
	Efficiency	51.73%	
	Mann-Whitney	0.2053	
	Wilcoxon (paired)	0.0313 **	
Arithmetic	UCL	0.506	0.202
	Mean	0.306	0.13
	LCL	0.106	0.059
	Std. Dev.	0.26	0.077
	Wilk (p-value)	0.2999	0.6708
	Efficiency	57.40%	
	t-Test (equal var.)	0.1081	
	t-Test (unequal var.)	0.0846 *	
	t-test (paired)	0.0294 **	
	Levene Test	0.1253	
Log Transformed	UCL	1.003	0.341
	Mean	0.336	0.138
	LCL	0.113	0.056
	Std. Dev.	0.394	0.116
	Wilk (p-value)	0.7252	0.1751
	Efficiency	58.97%	
	t-Test (equal var.)	0.2046	
	t-Test (unequal var.)	0.1891	
	t-Test (paired)	0.0039 **	
	Levene Test	0.4554	
Bootstrap	UCL	0.494	0.194
	Mean	0.311	0.13
	LCL	0.128	0.067
	Std. Dev.	0.238	0.069
	Efficiency	58.08%	

MoPac BMP #6, Vertical Sand Filter - Dissolved Phosphorus (mg/L)



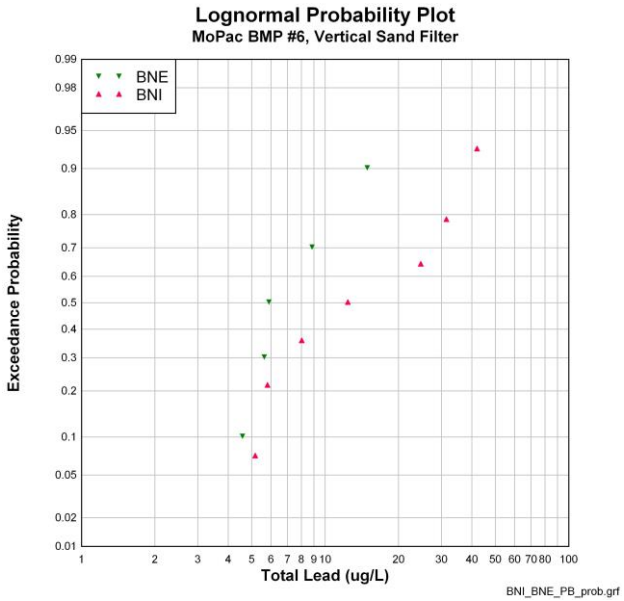


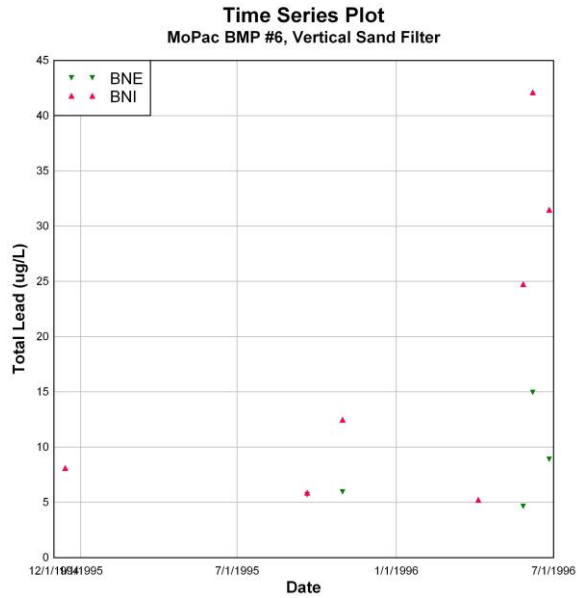


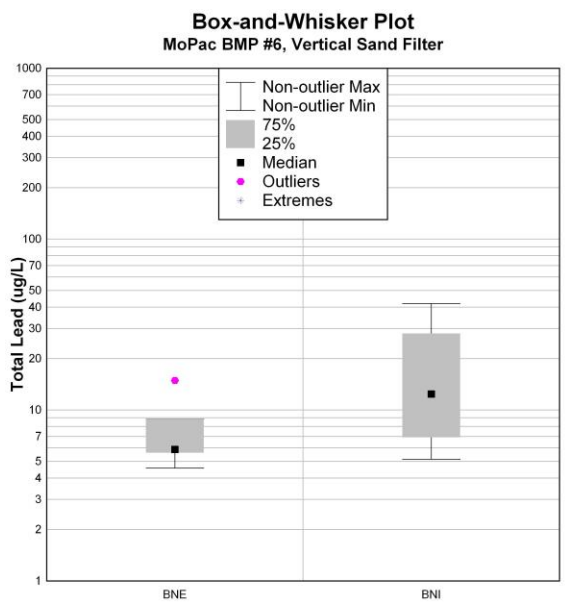


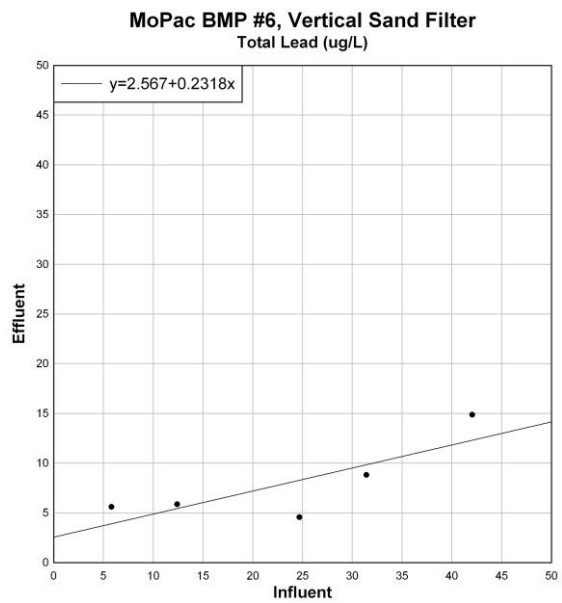
		PARAMETER	DP (mg/L)
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	9	7
	Pairs Count	7	7
Non-Parametric	Maximum	0.15	0.098
	Upper Quartile	0.076	0.067
	Median	0.063	0.045
	Lower Quartile	0.054	0.03
	Minimum	0.037	0.029
	Efficiency	27.79%	
	Mann-Whitney	0.2234	
	Wilcoxon (paired)	0.2969	
Arithmetic	UCL	0.095	0.075
	Mean	0.07	0.052
	LCL	0.045	0.029
	Std. Dev.	0.033	0.025
	Wilk (p-value)	0.0178 **	0.278
	Efficiency	25.40%	
	t-Test (equal var.)	0.2572	
	t-Test (unequal var.)	0.2406	
	t-test (paired)	0.2733	
	Levene Test	0.6003	
Log Transformed	UCL	0.096	0.081
	Mean	0.069	0.052
	LCL	0.05	0.033
	Std. Dev.	0.028	0.024
	Wilk (p-value)	0.5334	0.5932
	Efficiency	25.14%	
	t-Test (equal var.)	0.1777	
	t-Test (unequal var.)	0.1872	
	t-Test (paired)	0.1109	
	Levene Test	0.7715	
Bootstrap	UCL	0.091	0.072
	Mean	0.069	0.052
	LCL	0.048	0.032
	Std. Dev.	0.028	0.022
	Efficiency	24.99%	

MoPac BMP #6, Vertical Sand Filter - Total Lead (ug/L)



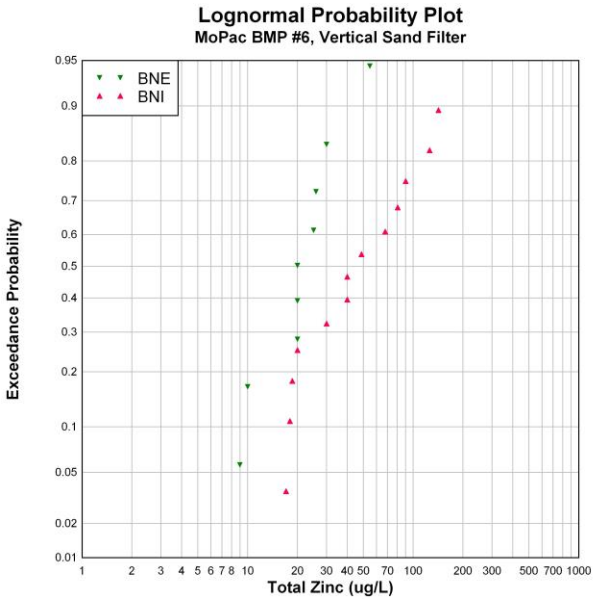


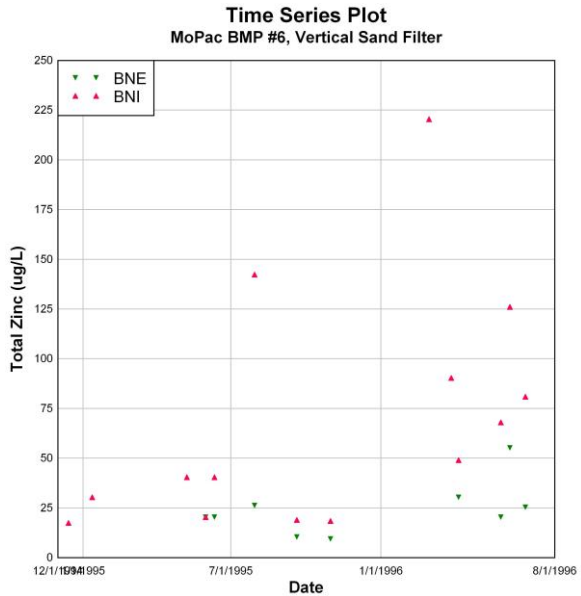


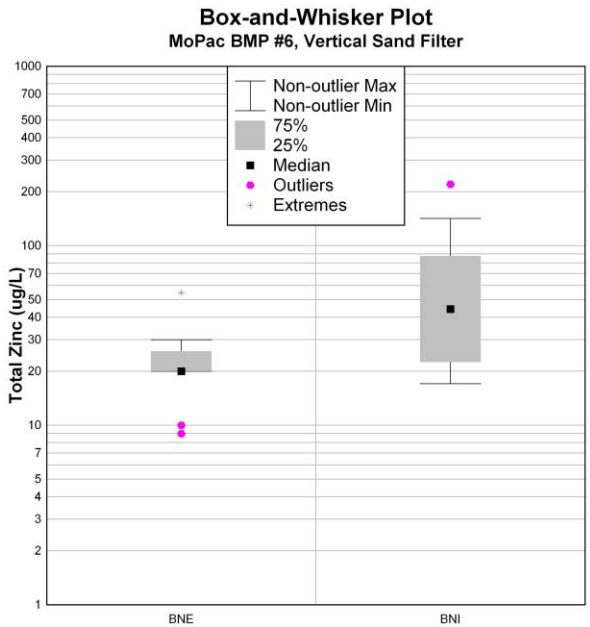


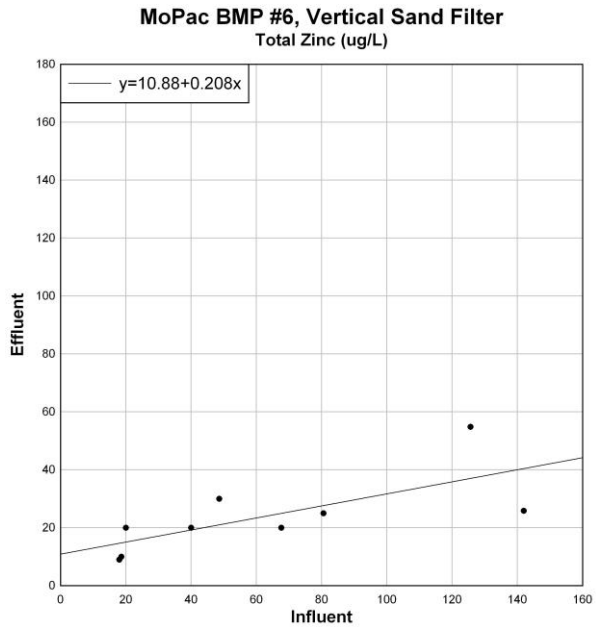
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	7	5
	Pairs Count	5	5
Non-Parametric	Maximum	42	14.9
	Upper Quartile	31.4	8.8
	Median	12.4	5.9
	Lower Quartile	5.8	5.6
	Minimum	5.2	4.6
	Efficiency	52.57%	
	Mann-Whitney	0.2798	
	Wilcoxon (paired)	0.0625 *	
Arithmetic	UCL	31.8	13.1
	Mean	18.5	8
	LCL	5.2	2.8
	Std. Dev.	14.4	4.2
	Wilk (p-value)	0.2237	0.1435
	Efficiency	56.98%	
	t-Test (equal var.)	0.1476	
	t-Test (unequal var.)	0.1078	
	t-test (paired)	0.0402 **	
	Levene Test	0.0679 *	
Log Transformed	UCL	47.1	14.7
	Mean	18.6	7.9
	LCL	7.3	4.2
	Std. Dev.	15.9	3.7
	Wilk (p-value)	0.4218	0.4668
	Efficiency	57.51%	
	t-Test (equal var.)	0.1548	
	t-Test (unequal var.)	0.1222	
	t-Test (paired)	0.0264 **	
	Levene Test	0.0610 *	
Bootstrap	UCL	30.8	12.2
	Mean	18.7	8
	LCL	6.7	3.8
	Std. Dev.	13	3.4
	Efficiency	57.45%	

MoPac BMP #6, Vertical Sand Filter - Total Zinc (ug/L)









	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BNI**	**EFF: BNE**
	Site Count	14	9
	Pairs Count	9	9
Non-Parametric	Maximum	220	54.8
	Upper Quartile	90	25.8
	Median	44.3	20
	Lower Quartile	20	20
	Minimum	17	9
	Efficiency	54.87%	
	Mann-Whitney	0.0527 *	
	Wilcoxon (paired)	0.0039 **	
Arithmetic	UCL	102.7	34.2
	Mean	68.4	23.9
	LCL	34.2	13.5
	Std. Dev.	59.3	13.5
	Wilk (p-value)	0.0127 **	0.0644 *
	Efficiency	65.15%	
	t-Test (equal var.)	0.0391 **	
	t-Test (unequal var.)	0.0163 **	
	t-test (paired)	0.0157 **	
	Levene Test	0.1303	
Log Transformed	UCL	120.3	37.6
	Mean	68.1	23.9
	LCL	38.5	15.1
	Std. Dev.	62.1	13.3
	Wilk (p-value)	0.3995	0.47
	Efficiency	64.96%	
	t-Test (equal var.)	0.0132 **	
	t-Test (unequal var.)	0.0073 **	
	t-Test (paired)	0.0010 **	
	Levene Test	0.1082	
Bootstrap	UCL	101.4	33.3
	Mean	69.3	24
	LCL	37.2	14.7
	Std. Dev.	55.5	12.1
	Efficiency	65.36%	

MoPac BMP #5, Vertical Sand Filter (BSI-BSE)

This unique BMP was constructed by Texas Department of Transportation (TxDOT) to treat runoff from an Austin-area highway. The inflow station to this basin is BSI, see the Small Watershed Report for information on the contributing watershed. The basin was designed as a filtration basin using a vertical filter. The original filtration medium was concrete sand between two sets of limestone gabions. The upstream side of the filter was also lined with geotextile fabric.

It was discovered early in the monitoring of this BMP that there was not enough hydrostatic head upstream of filter to allow all of the water to pass through the filter and that the geotextile fabric became clogged with fine sediment. Subsequently, the filtration media was replaced with coarse sand and the geotextile fabric was replaced with a fabric screen to catch trash and larger debris.

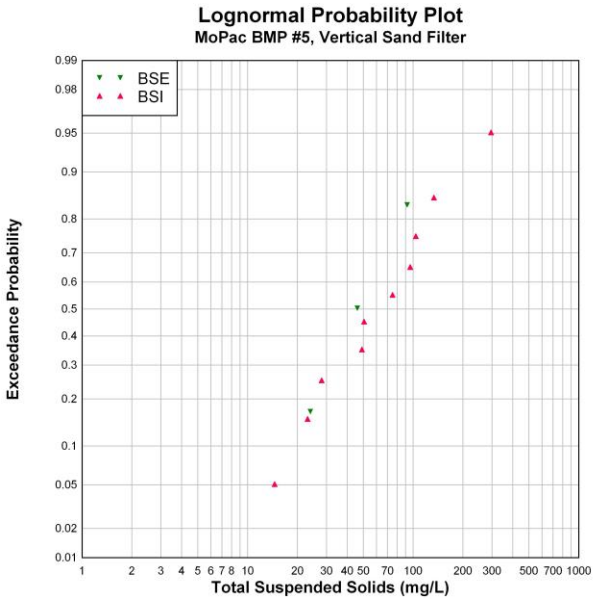
Data in this report represent only those collected by COA. Data from an initial study conducted jointly by TXDOT and COA are not include but are reported elsewhere. Those data were not use for analyses since they could not be verified or submitted for QA/QC. To verify conclusions using the limited data, the original data were added to the dataset but the conclusions were not changed.

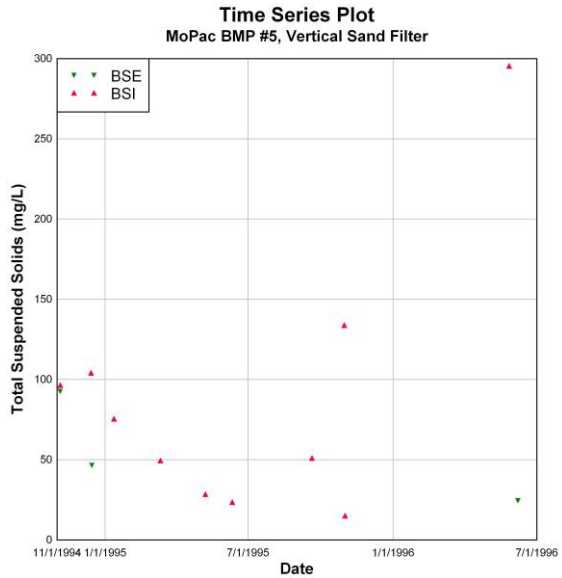
Between 1995 and 1996, the city collected 10 influent samples and 3 effluent samples, 1 sample was paired.

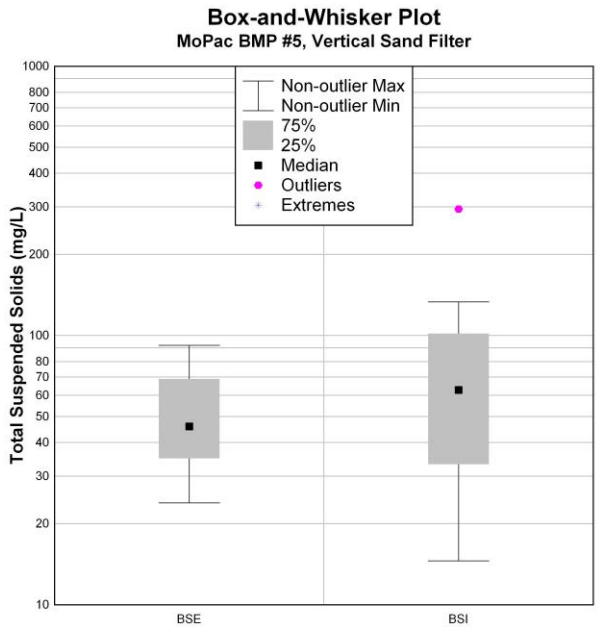
Performance Summary

This BMP design exhibited no significant treatment with the given data.

MoPac BMP #5, Vertical Sand Filter - Total Suspended Solids (mg/L)

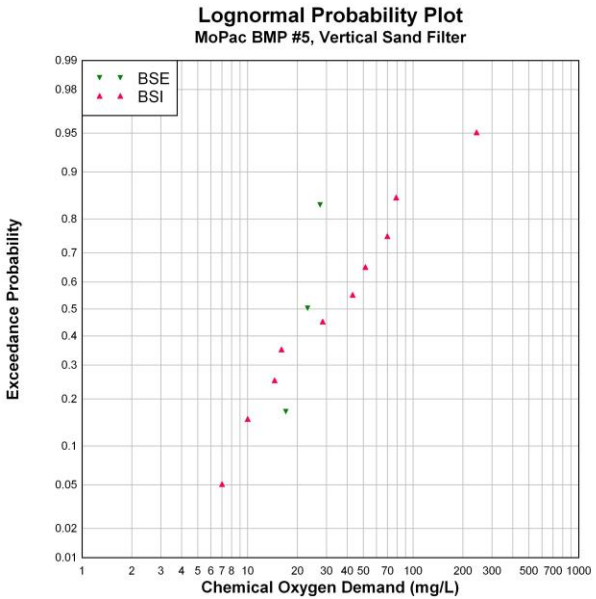


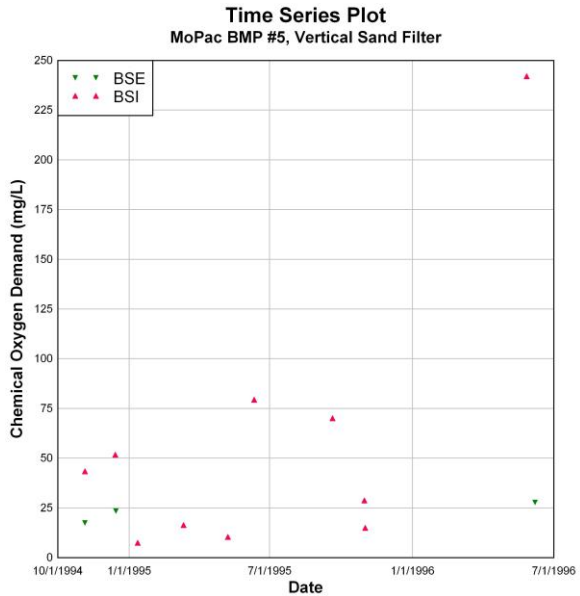


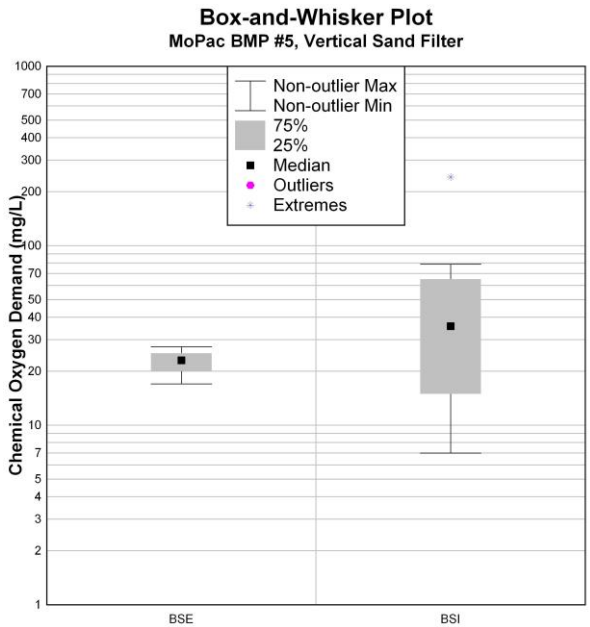


	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	10	3
	Pairs Count	1	1
Non-Parametric	Maximum	295.0	92.0
	Upper Quartile	103.6	92.0
	Median	62.8	46.0
	Lower Quartile	28.0	23.9
	Minimum	14.5	23.9
	Efficiency	26.72%	
	Mann-Whitney	0.5651	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	145.9	140.3
	Mean	86.8	54.0
	LCL	27.7	-32.3
	Std. Dev.	82.7	34.7
	Wilk (p-value)	0.0103 **	0.6177
	Efficiency	37.81%	
	t-Test (equal var.)	0.5265	
	t-Test (unequal var.)	0.3455	
	t-test (paired)	NA	
	Levene Test	0.5101	
Log Transformed	UCL	188.3	374.2
	Mean	86.6	53.9
	LCL	39.8	7.8
	Std. Dev.	82.8	34.4
	Wilk (p-value)	0.9823	0.9677
	Efficiency	37.70%	
	t-Test (equal var.)	0.6514	
	t-Test (unequal var.)	0.6099	
	t-Test (paired)	NA	
	Levene Test	0.4292	
Bootstrap	UCL	141.5	114.5
	Mean	88.0	53.5
	LCL	34.4	-7.4
	Std. Dev.	74.9	24.5
	Efficiency	39.13%	

MoPac BMP #5, Vertical Sand Filter - Chemical Oxygen Demand (mg/L)

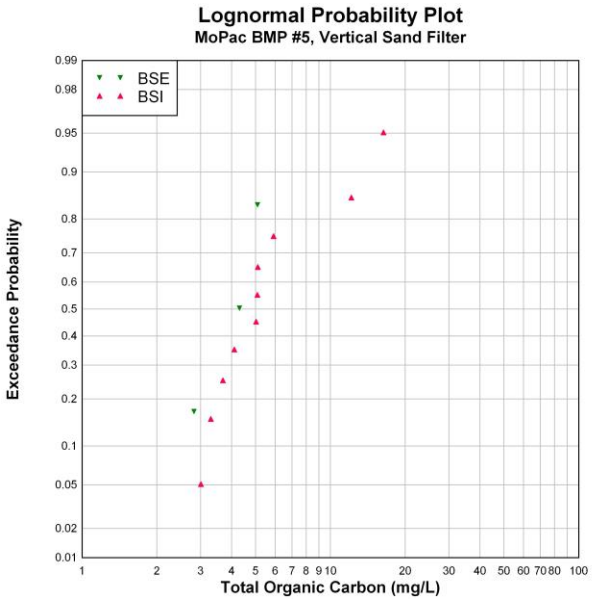


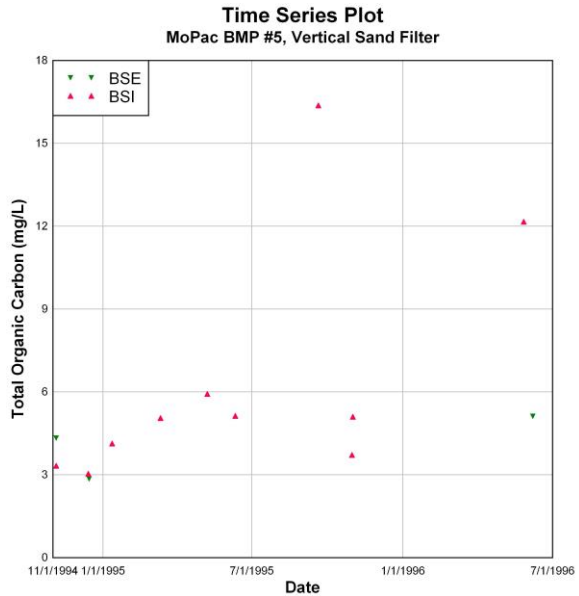


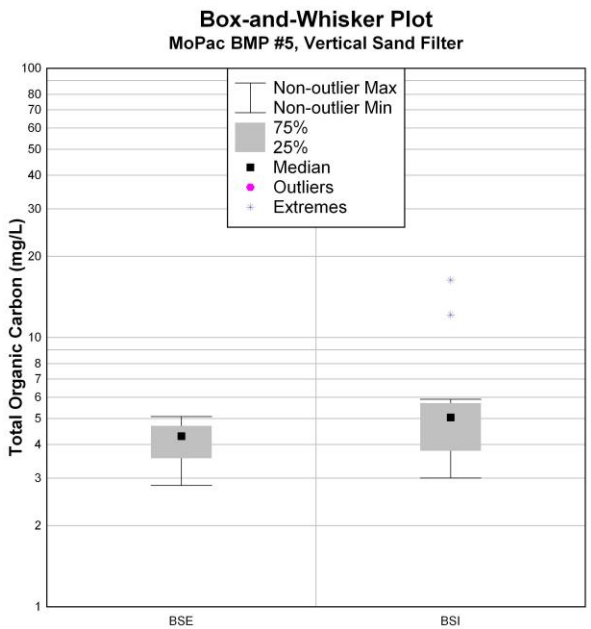


	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	10	3
	Pairs Count	1	1
Non-Parametric	Maximum	241.61	27.39
	Upper Quartile	69.71	27.39
	Median	35.68	23.00
	Lower Quartile	14.57	17.00
	Minimum	7.00	17.00
	Efficiency	35.53%	
	Mann-Whitney	0.6801	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	106.05	35.42
	Mean	56.06	22.46
	LCL	6.07	9.51
	Std. Dev.	69.89	5.21
	Wilk (p-value)	0.0007 **	0.8292
	Efficiency	59.93%	
	t-Test (equal var.)	0.4368	
	t-Test (unequal var.)	0.1651	
	t-test (paired)	NA	
	Levene Test	0.5018	
Log Transformed	UCL	146.85	41.45
	Mean	54.13	22.47
	LCL	19.95	12.18
	Std. Dev.	63.74	5.38
	Wilk (p-value)	0.8988	0.7070
	Efficiency	58.48%	
	t-Test (equal var.)	0.5587	
	t-Test (unequal var.)	0.3131	
	t-Test (paired)	NA	
	Levene Test	0.1981	
Bootstrap	UCL	102.02	31.77
	Mean	57.85	22.52
	LCL	13.68	13.27
	Std. Dev.	61.74	3.72
	Efficiency	61.07%	

MoPac BMP #5, Vertical Sand Filter - Total Organic Carbon (mg/L)

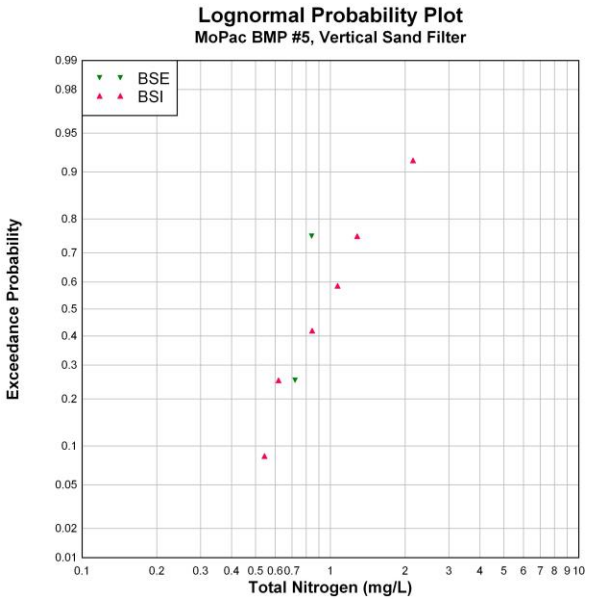


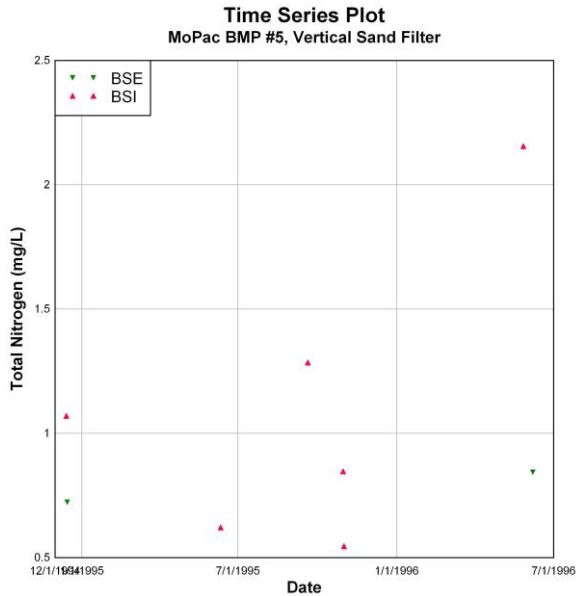


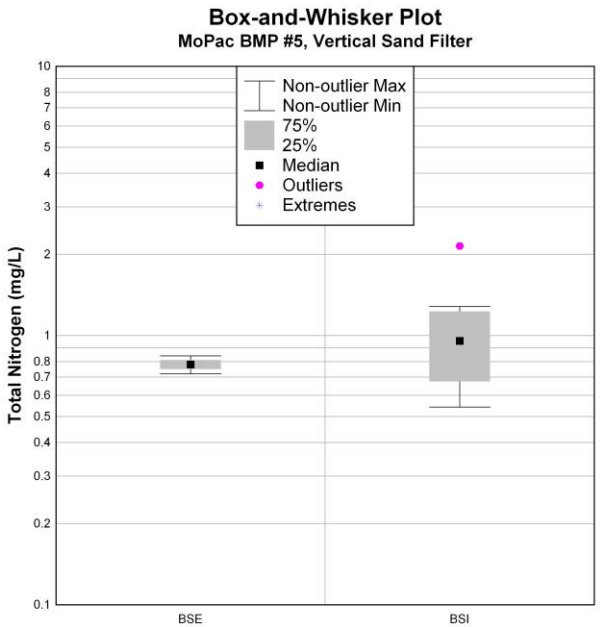


	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	10	3
	Pairs Count	1	1
Non-Parametric	Maximum	16.34	5.09
	Upper Quartile	5.90	5.09
	Median	5.05	4.30
	Lower Quartile	3.69	2.82
	Minimum	3.01	2.82
	Efficiency	14.80%	
	Mann-Whitney	0.4616	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	9.49	6.93
	Mean	6.37	4.07
	LCL	3.25	1.21
	Std. Dev.	4.36	1.15
	Wilk (p-value)	0.0019 **	0.6681
	Efficiency	36.07%	
	t-Test (equal var.)	0.3988	
	t-Test (unequal var.)	0.1617	
	t-test (paired)	NA	
	Levene Test	0.3913	
Log Transformed	UCL	9.51	8.90
	Mean	6.22	4.07
	LCL	4.07	1.87
	Std. Dev.	3.49	1.23
	Wilk (p-value)	0.0795 *	0.5364
	Efficiency	34.51%	
	t-Test (equal var.)	0.3634	
	t-Test (unequal var.)	0.2392	
	t-Test (paired)	NA	
	Levene Test	0.3863	
Bootstrap	UCL	9.32	6.13
	Mean	6.48	4.05
	LCL	3.65	1.98
	Std. Dev.	3.97	0.84
	Efficiency	37.45%	

MoPac BMP #5, Vertical Sand Filter - Total Nitrogen (mg/L)

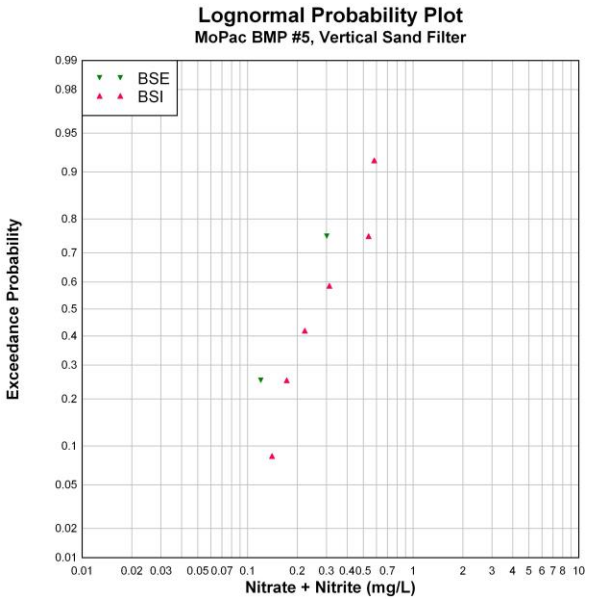


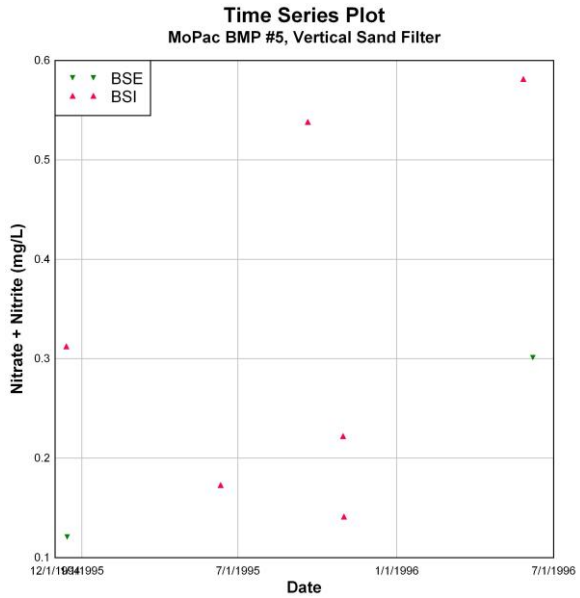


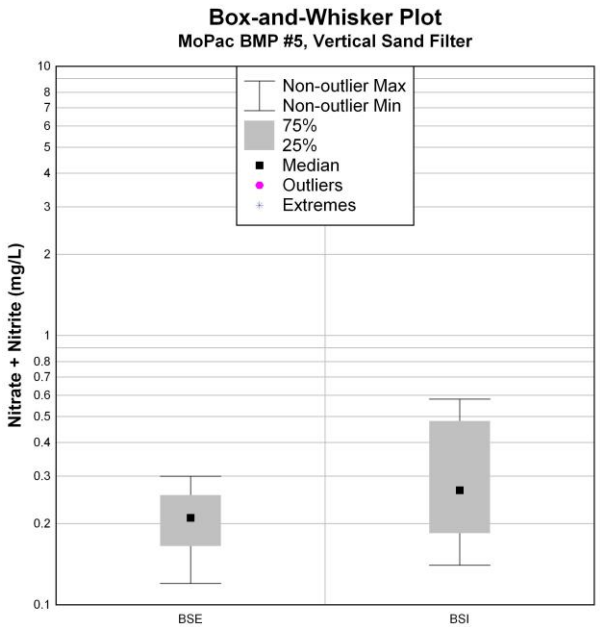


	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	6	2
	Pairs Count	0	0
Non-Parametric	Maximum	2.152	0.840
	Upper Quartile	1.281	0.840
	Median	0.955	0.780
	Lower Quartile	0.618	0.720
	Minimum	0.543	0.720
	Efficiency	18.35%	
	Mann-Whitney	0.6324	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	1.704	1.544
	Mean	1.084	0.780
	LCL	0.464	0.016
	Std. Dev.	0.591	0.085
	Wilk (p-value)	0.2722	1.0000
	Efficiency	28.04%	
	t-Test (equal var.)	0.5168	
	t-Test (unequal var.)	0.2711	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	1.906	2.093
	Mean	1.077	0.780
	LCL	0.609	0.291
	Std. Dev.	0.545	0.085
	Wilk (p-value)	0.8455	1.0000
	Efficiency	27.60%	
	t-Test (equal var.)	0.5814	
	t-Test (unequal var.)	0.3560	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	1.626	1.167
	Mean	1.094	0.780
	LCL	0.563	0.393
	Std. Dev.	0.506	0.043
	Efficiency	28.71%	

MoPac BMP #5, Vertical Sand Filter - Nitrate + Nitrite (mg/L)

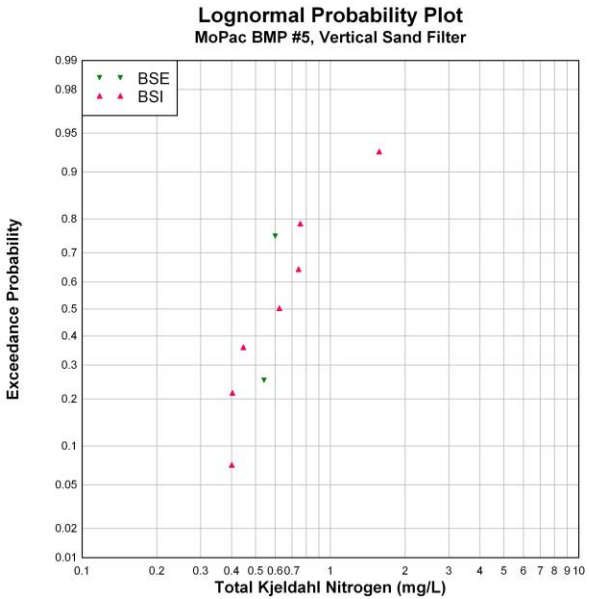


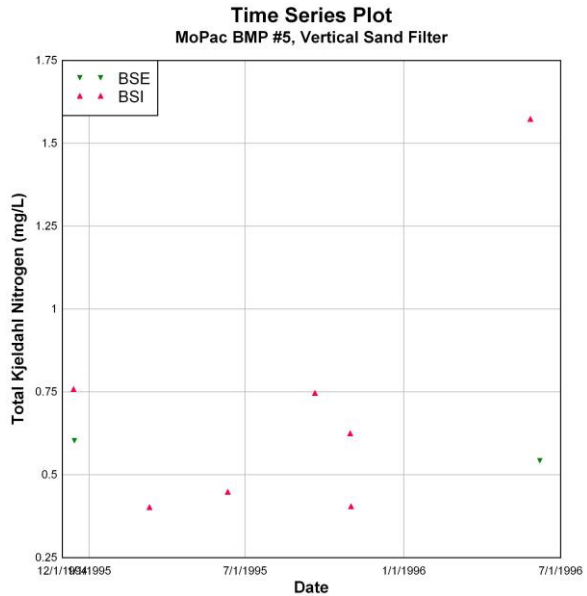


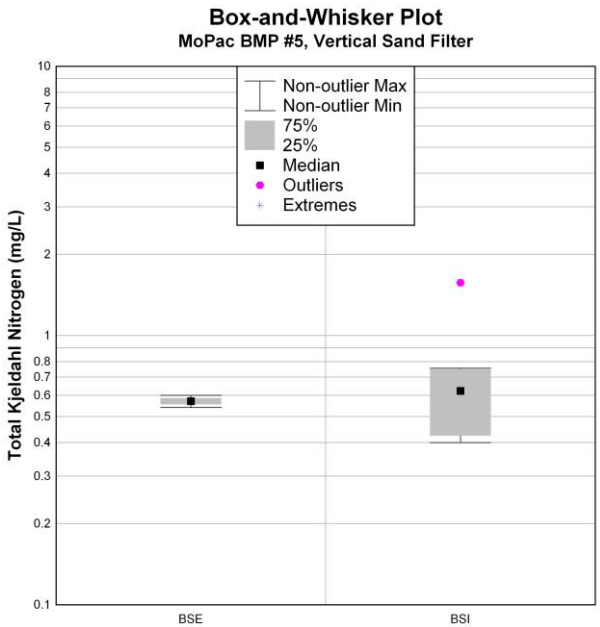


	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	6	2
	Pairs Count	0	0
Non-Parametric	Maximum	0.581	0.300
	Upper Quartile	0.537	0.300
	Median	0.266	0.210
	Lower Quartile	0.172	0.120
	Minimum	0.140	0.120
	Efficiency	21.12%	
	Mann-Whitney	0.4322	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	0.526	1.355
	Mean	0.327	0.210
	LCL	0.129	-0.935
	Std. Dev.	0.189	0.127
	Wilk (p-value)	0.2114	1.0000
	Efficiency	35.77%	
	t-Test (equal var.)	0.4569	
	t-Test (unequal var.)	0.4037	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	0.645	218.120
	Mean	0.327	0.210
	LCL	0.165	0.000
	Std. Dev.	0.192	0.127
	Wilk (p-value)	0.4926	1.0000
	Efficiency	35.68%	
	t-Test (equal var.)	0.4441	
	t-Test (unequal var.)	0.5365	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	0.507	0.791
	Mean	0.331	0.210
	LCL	0.155	-0.371
	Std. Dev.	0.168	0.065
	Efficiency	36.56%	

MoPac BMP #5, Vertical Sand Filter - Total Kjeldahl Nitrogen (mg/L)

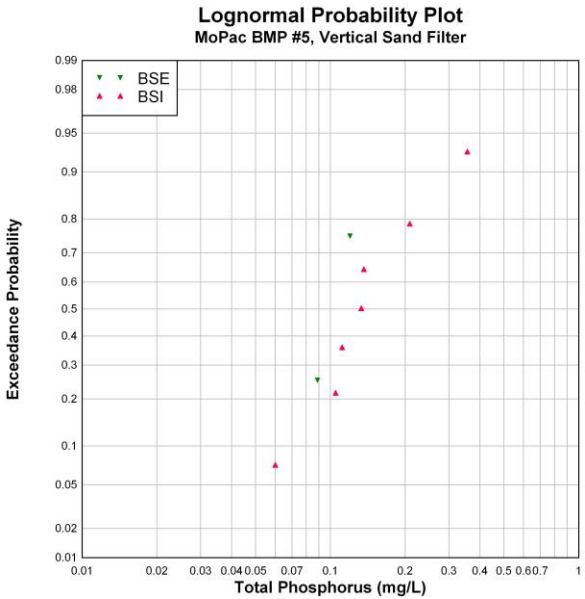


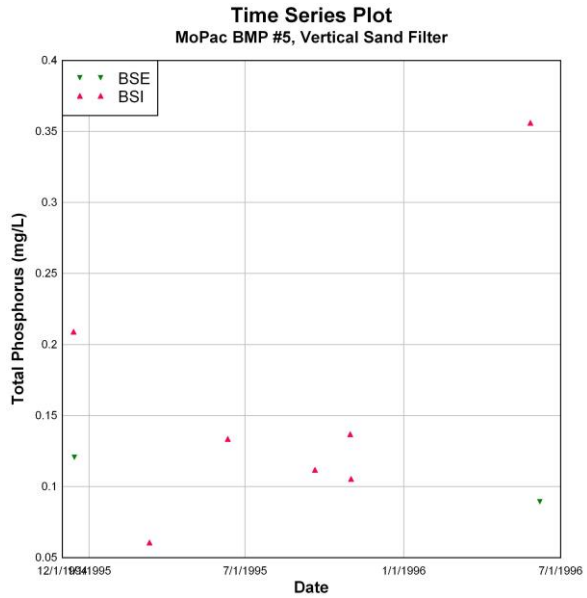


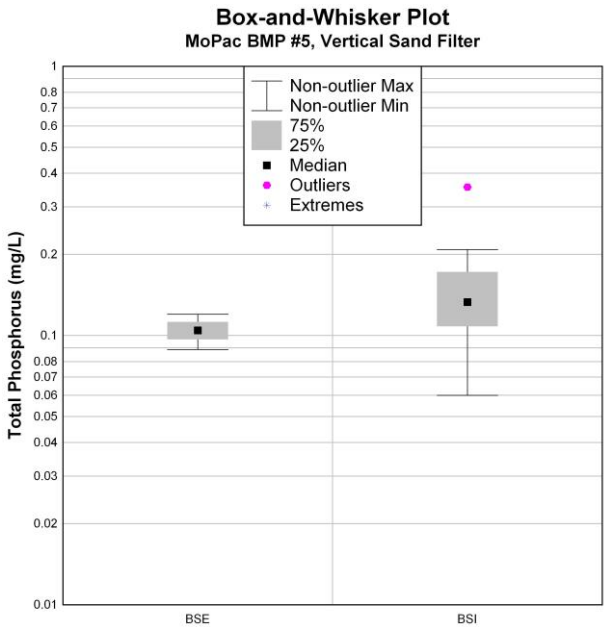


	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	7	2
	Pairs Count	0	0
Non-Parametric	Maximum	1.571	0.600
	Upper Quartile	0.756	0.600
	Median	0.622	0.570
	Lower Quartile	0.403	0.540
	Minimum	0.400	0.540
	Efficiency	8.42%	
	Mann-Whitney	0.8872	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	1.086	0.951
	Mean	0.706	0.570
	LCL	0.326	0.189
	Std. Dev.	0.411	0.042
	Wilk (p-value)	0.0172 **	1.0000
	Efficiency	19.26%	
	t-Test (equal var.)	0.6695	
	t-Test (unequal var.)	0.4210	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	1.126	1.116
	Mean	0.697	0.570
	LCL	0.431	0.291
	Std. Dev.	0.341	0.042
	Wilk (p-value)	0.2050	1.0000
	Efficiency	18.19%	
	t-Test (equal var.)	0.7867	
	t-Test (unequal var.)	0.6119	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	1.040	0.763
	Mean	0.713	0.570
	LCL	0.386	0.377
	Std. Dev.	0.354	0.022
	Efficiency	20.07%	

MoPac BMP #5, Vertical Sand Filter - Total Phosphorus (mg/L)

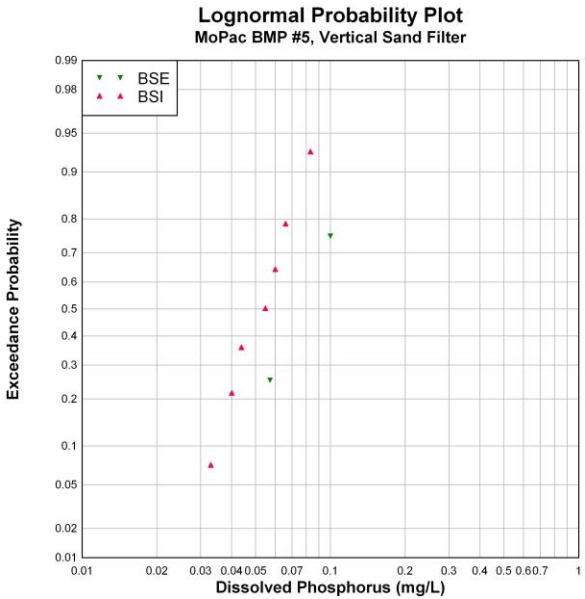


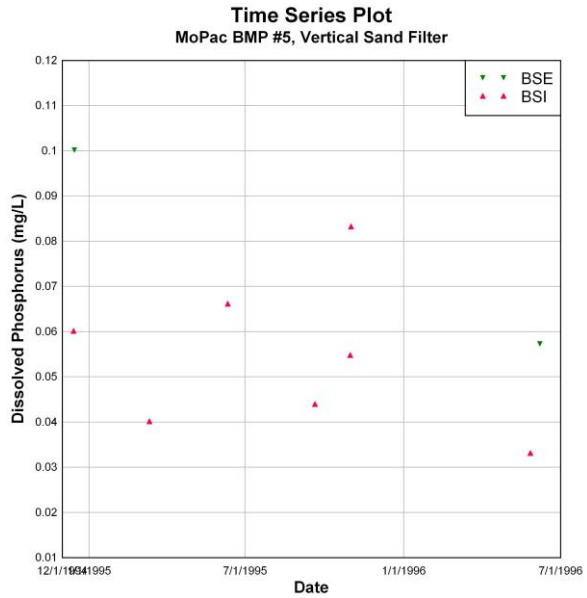


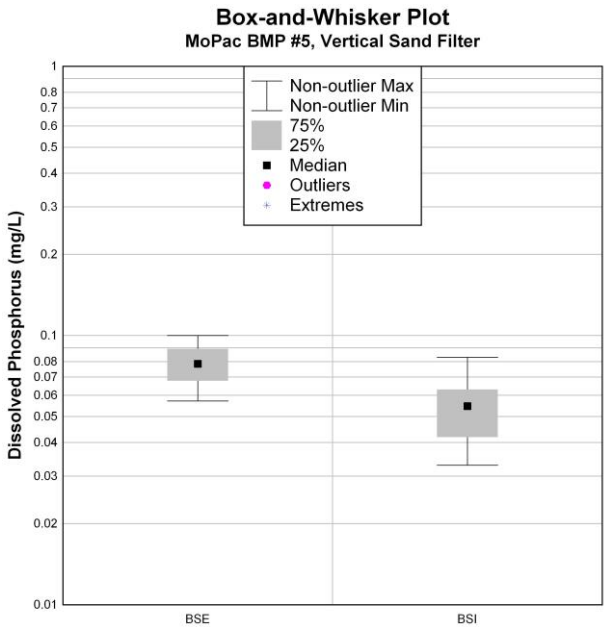


	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	7	2
	Pairs Count	0	0
Non-Parametric	Maximum	0.356	0.120
	Upper Quartile	0.208	0.120
	Median	0.133	0.104
	Lower Quartile	0.105	0.089
	Minimum	0.060	0.089
	Efficiency	21.51%	
	Mann-Whitney	0.4851	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	0.249	0.303
	Mean	0.158	0.104
	LCL	0.068	-0.094
	Std. Dev.	0.098	0.022
	Wilk (p-value)	0.0952 *	1.0000
	Efficiency	34.13%	
	t-Test (equal var.)	0.4818	
	t-Test (unequal var.)	0.2193	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	0.276	0.739
	Mean	0.157	0.104
	LCL	0.089	0.015
	Std. Dev.	0.089	0.022
	Wilk (p-value)	0.8320	1.0000
	Efficiency	33.60%	
	t-Test (equal var.)	0.5151	
	t-Test (unequal var.)	0.3142	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	0.239	0.205
	Mean	0.160	0.104
	LCL	0.082	0.004
	Std. Dev.	0.085	0.011
	Efficiency	34.94%	

MoPac BMP #5, Vertical Sand Filter - Dissolved Phosphorus (mg/L)

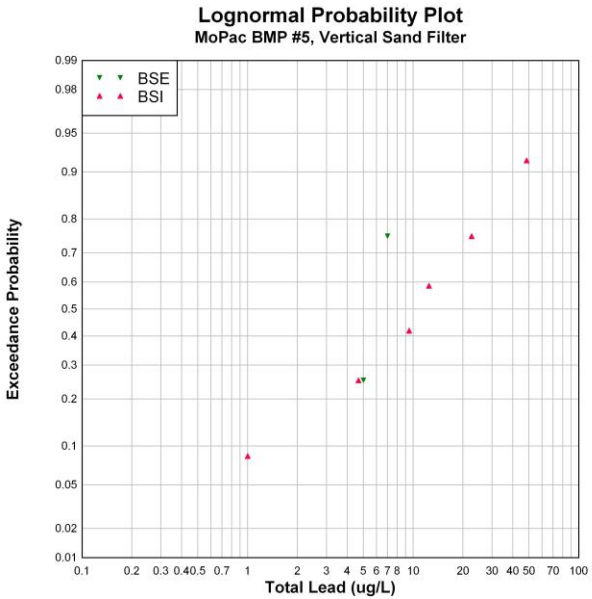


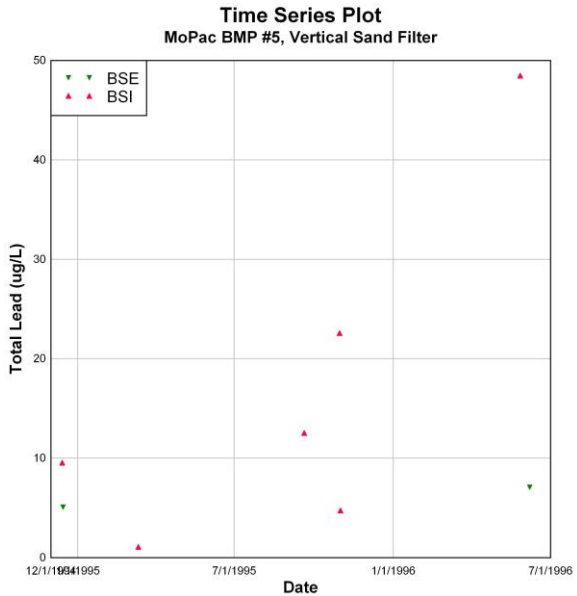


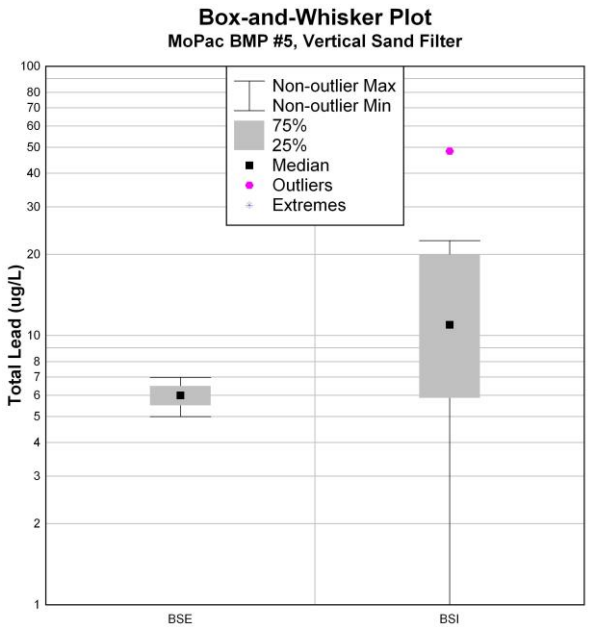


	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	7	2
	Pairs Count	0	0
Non-Parametric	Maximum	0.083	0.100
	Upper Quartile	0.066	0.100
	Median	0.055	0.079
	Lower Quartile	0.040	0.057
	Minimum	0.033	0.057
	Efficiency	-43.76%	
	Mann-Whitney	0.3355	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	0.070	0.351
	Mean	0.054	0.079
	LCL	0.038	-0.194
	Std. Dev.	0.017	0.030
	Wilk (p-value)	0.8933	1.0000
	Efficiency	-44.53%	
	t-Test (equal var.)	0.1673	
	t-Test (unequal var.)	0.4517	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	0.074	3.601
	Mean	0.054	0.079
	LCL	0.040	0.002
	Std. Dev.	0.017	0.030
	Wilk (p-value)	0.9800	1.0000
	Efficiency	-44.51%	
	t-Test (equal var.)	0.2020	
	t-Test (unequal var.)	0.3887	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	0.069	0.217
	Mean	0.054	0.079
	LCL	0.040	-0.059
	Std. Dev.	0.015	0.015
	Efficiency	-44.67%	

MoPac BMP #5, Vertical Sand Filter - Total Lead (ug/L)

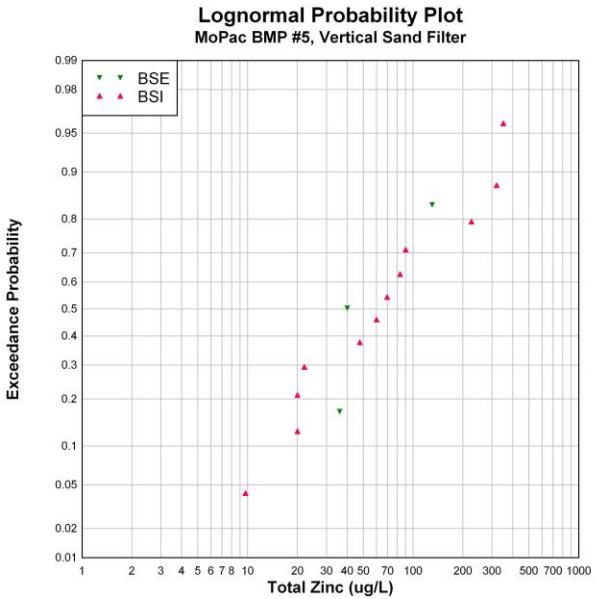


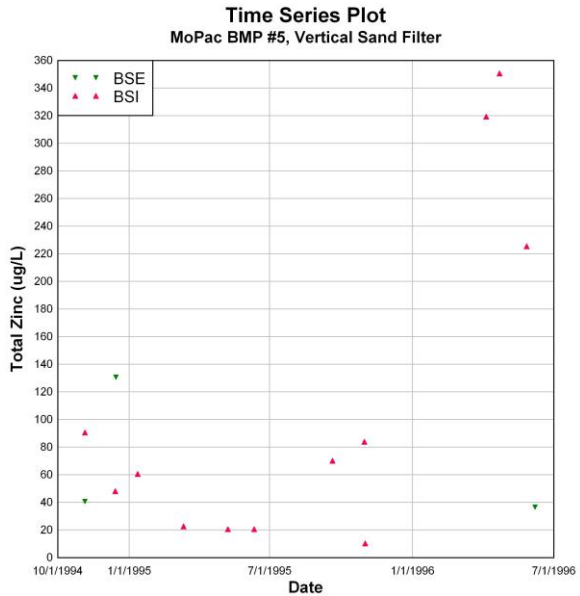


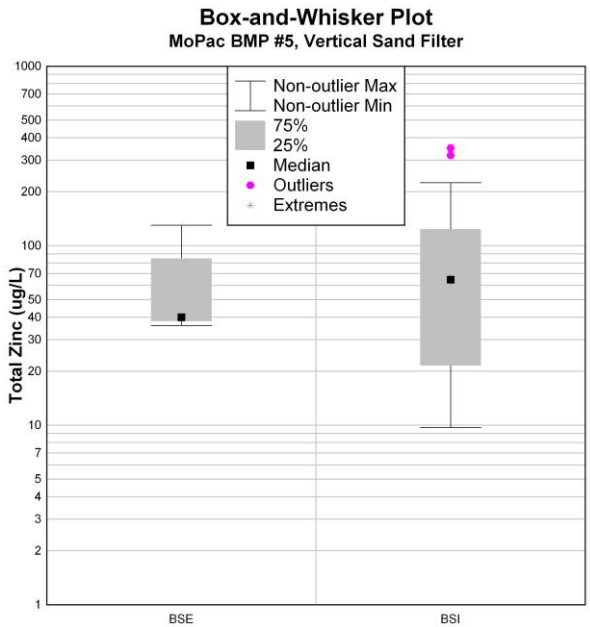


	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	6	2
	Pairs Count	0	0
Non-Parametric	Maximum	48.4	7.0
	Upper Quartile	22.5	7.0
	Median	11.0	6.0
	Lower Quartile	4.7	5.0
	Minimum	1.0	5.0
	Efficiency	45.29%	
	Mann-Whitney	0.6324	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	34.6	18.6
	Mean	16.4	6.0
	LCL	-1.8	-6.6
	Std. Dev.	17.3	1.4
	Wilk (p-value)	0.1637	1.0000
	Efficiency	63.48%	
	t-Test (equal var.)	0.4506	
	t-Test (unequal var.)	0.2021	
	t-test (paired)	NA	
	Levene Test	NA	
Log Transformed	UCL	139.8	53.4
	Mean	18.2	6.0
	LCL	2.4	0.7
	Std. Dev.	24.3	1.4
	Wilk (p-value)	0.8920	1.0000
	Efficiency	67.13%	
	t-Test (equal var.)	0.6765	
	t-Test (unequal var.)	0.4730	
	t-Test (paired)	NA	
	Levene Test	NA	
Bootstrap	UCL	32.0	12.4
	Mean	16.6	6.0
	LCL	1.3	-0.4
	Std. Dev.	14.6	0.7
	Efficiency	63.94%	

MoPac BMP #5, Vertical Sand Filter - Total Zinc (ug/L)







	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BSI**	**EFF: BSE**
	Site Count	12	3
	Pairs Count	1	1
Non-Parametric	Maximum	350.0	130.0
	Upper Quartile	157.4	130.0
	Median	64.7	40.0
	Lower Quartile	21.0	35.9
	Minimum	9.7	35.9
	Efficiency	38.21%	
	Mann-Whitney	0.9435	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	185.7	200.7
	Mean	109.6	68.6
	LCL	33.6	-63.5
	Std. Dev.	119.7	53.2
	Wilk (p-value)	0.0043 **	0.0731 *
	Efficiency	37.39%	
	t-Test (equal var.)	0.5805	
	t-Test (unequal var.)	0.4012	
	t-test (paired)	NA	
	Levene Test	0.3193	
Log Transformed	UCL	292.9	540.6
	Mean	111.4	67.3
	LCL	42.4	8.4
	Std. Dev.	145.7	45.2
	Wilk (p-value)	0.5767	0.1438
	Efficiency	39.60%	
	t-Test (equal var.)	0.9120	
	t-Test (unequal var.)	0.8859	
	t-Test (paired)	NA	
	Levene Test	0.2552	
Bootstrap	UCL	182.9	159.3
	Mean	111.6	69.5
	LCL	40.3	-20.2
	Std. Dev.	112.3	36.1
	Efficiency	37.68%	

Brodie Oaks Irrigation Pond (BI-BM)

At the time of its installation, the Brodie Oaks control was considered near non-degradation. Runoff from the shopping center (see the City of Austin report on small watershed quantity and quality (COA, 2009) for details of the contributing drainage area) entered a retention basin and was used for landscape irrigation. If the volume exceeded the volume of the retention basin, overflow was routed to a sand filter. A splitter box was not used as is required in current COA guidelines for retention irrigation which would result in higher effluent concentrations.

These analyses are for the retention-irrigation pond only; for information on the sand filter portion (BM-BE) or the overall system (BI-BE) see the Sand filter section of this report.

Because this system was monitored by the initial COA monitoring program, details on pond operations and monitoring issues are not available.

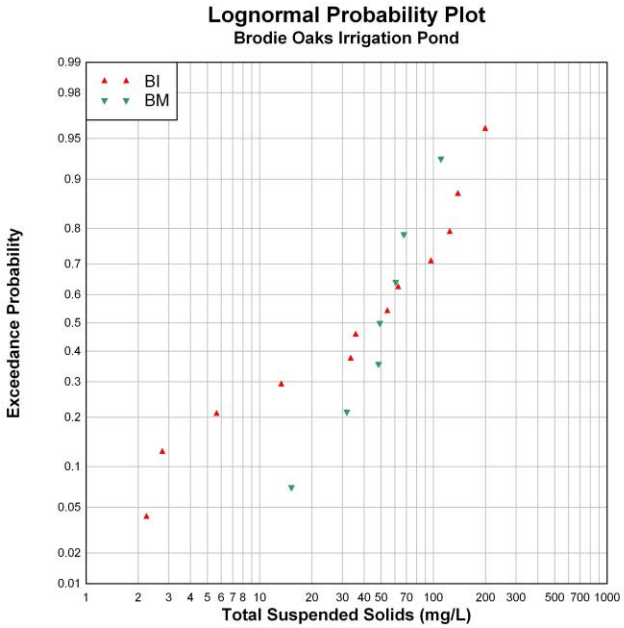
The City collected runoff and water quality data at the Brodie Oaks retention/irrigation pond (BI-BM) from 1984 to 1988. During this time 12 and 7 valid EMCs were collected at the influent (BI) and effluent (BM) respectively, of which 3 were paired.

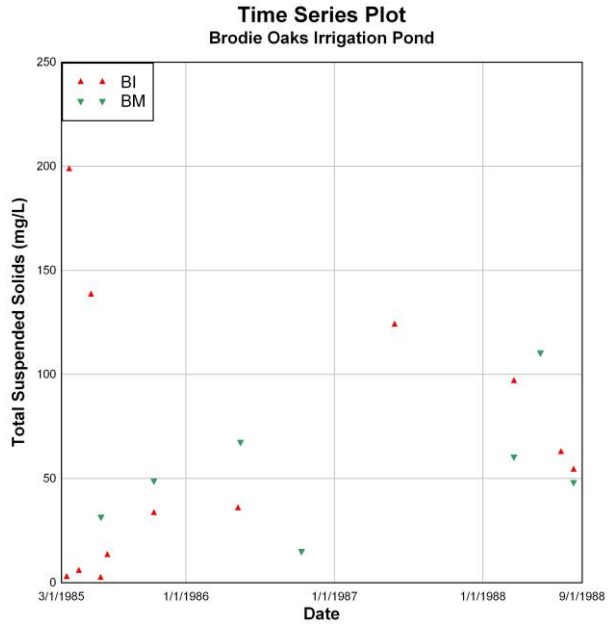
Performance Summary

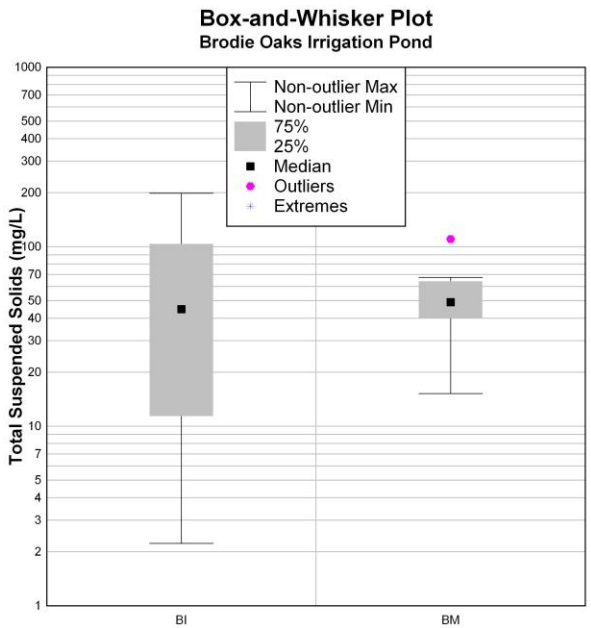
The only parameters with significant differences between influent and effluent concentrations were Pb and Zn which were reduced by 60% and 50% respectively.

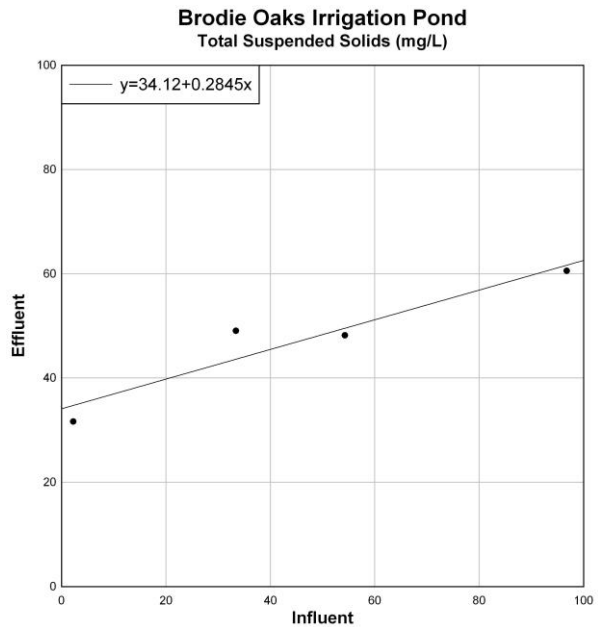
While there is little difference between the concentrations at the influent and effluent there is likely a significant reduction in pollutant load. The flow measurement structures at this SCM were not sufficiently accurate to fully test this hypothesis and a continuous record of flow at BM was not available. It does appear that many of the smaller storms were fully captured in the retention and many larger storms were attenuated.

Brodie Oaks Irrigation Pond - Total Suspended Solids (mg/L)



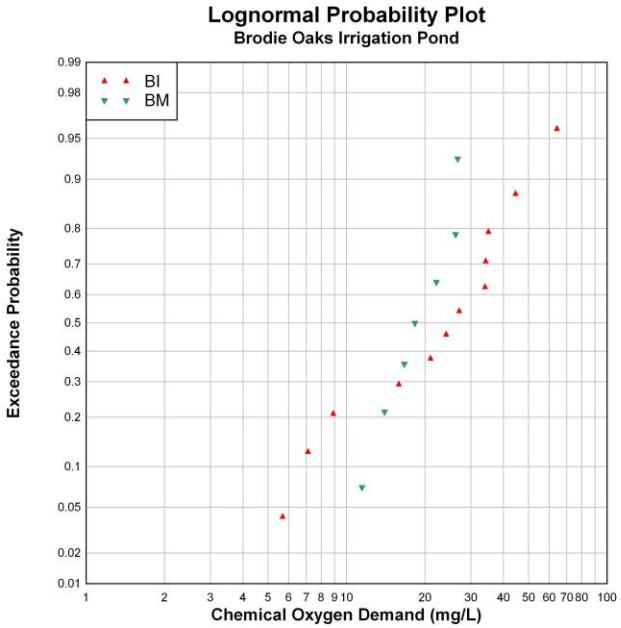


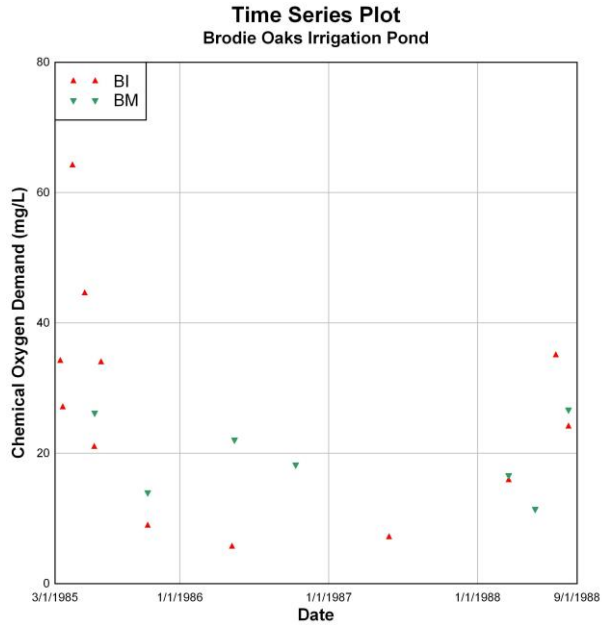


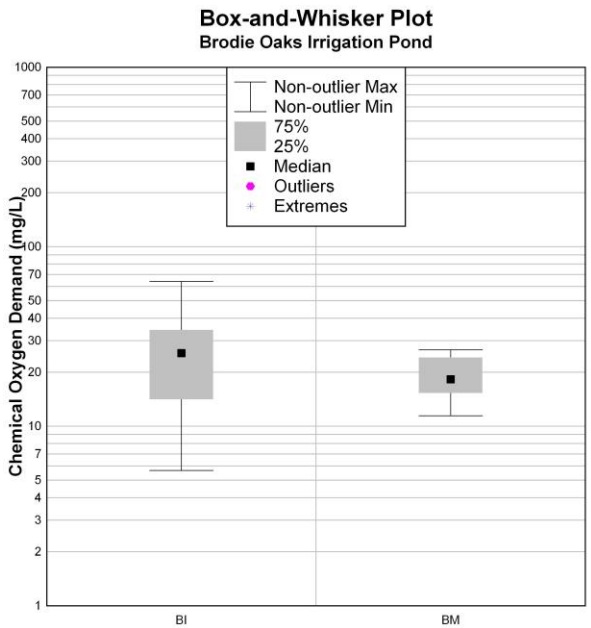


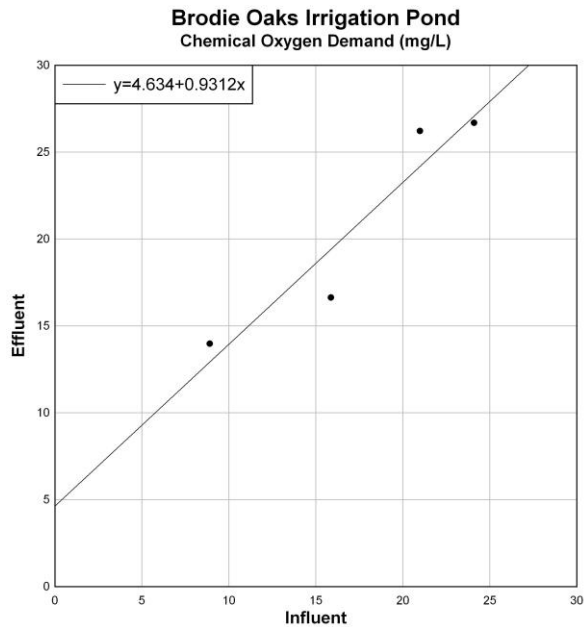
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	198.6	110.5
	Upper Quartile	110.3	67.6
	Median	45.0	49.1
	Lower Quartile	9.5	31.7
	Minimum	2.2	15.2
	Efficiency	-9.15%	
	Mann-Whitney	0.9005	
	Wilcoxon (paired)	0.7500	
Arithmetic	UCL	104.0	82.7
	Mean	64.0	54.7
	LCL	23.9	26.8
	Std. Dev.	63.0	30.2
	Wilk (p-value)	0.1084	0.6961
	Efficiency	14.47%	
	t-Test (equal var.)	0.7220	
	t-Test (unequal var.)	0.6722	
	t-test (paired)	0.6163	
	Levene Test	0.1504	
Log Transformed	UCL	369.2	105.7
	Mean	83.6	55.6
	LCL	18.9	29.2
	Std. Dev.	157.5	35.2
	Wilk (p-value)	0.1985	0.7390
	Efficiency	33.50%	
	t-Test (equal var.)	0.4846	
	t-Test (unequal var.)	0.3958	
	t-Test (paired)	0.8124	
	Levene Test	0.0486 **	
Bootstrap	UCL	100.5	79.4
	Mean	63.5	54.9
	LCL	26.5	30.4
	Std. Dev.	58.3	26.5
	Efficiency	13.55%	

Brodie Oaks Irrigation Pond - Chemical Oxygen Demand (mg/L)



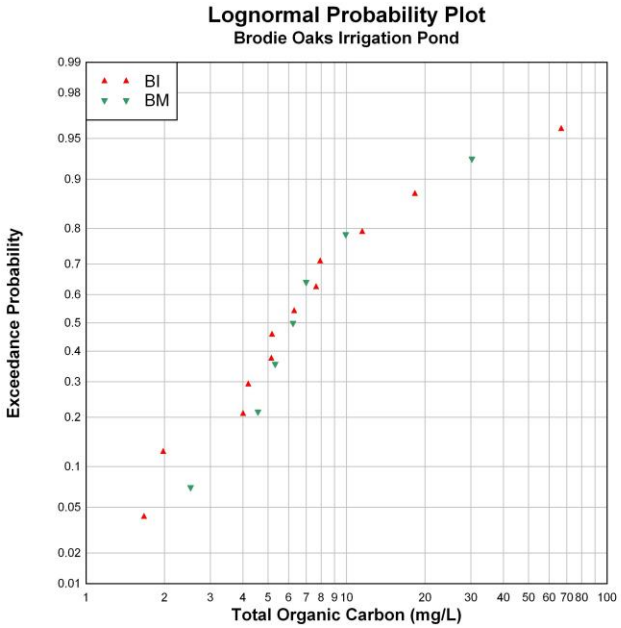


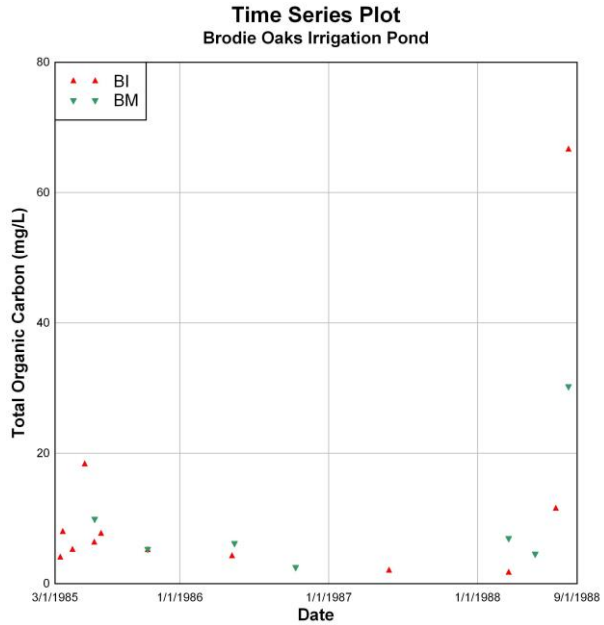


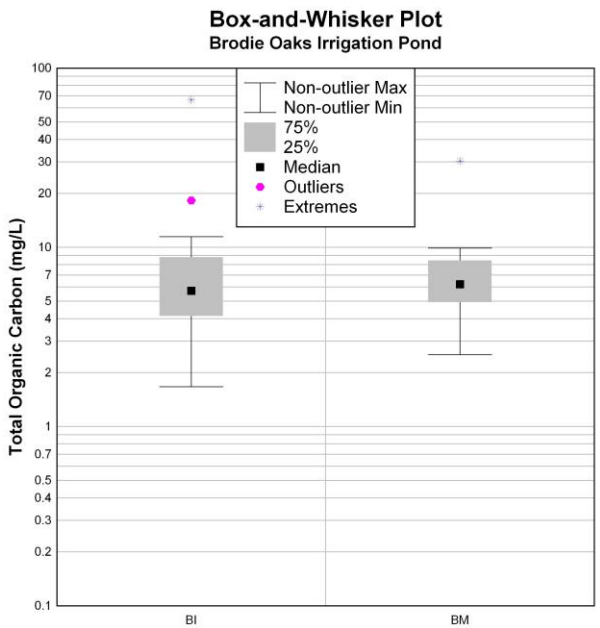


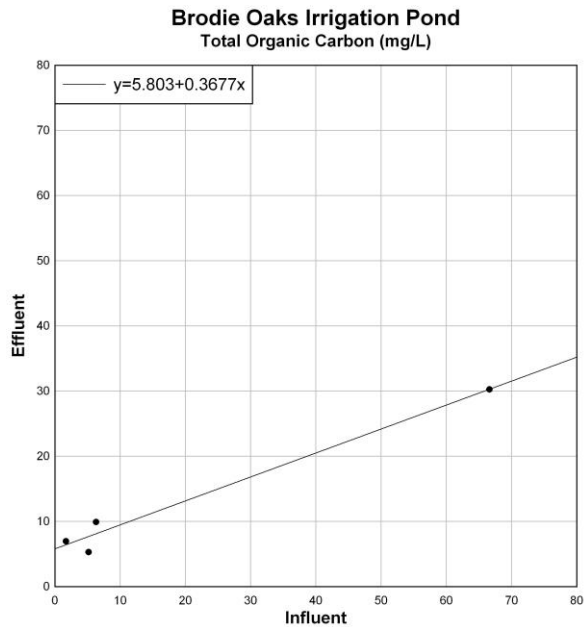
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	64.17	26.69
	Upper Quartile	34.60	26.22
	Median	25.57	18.27
	Lower Quartile	12.38	13.99
	Minimum	5.68	11.45
	Efficiency	28.54%	
	Mann-Whitney	0.3866	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	37.63	24.79
	Mean	26.79	19.34
	LCL	15.96	13.89
	Std. Dev.	17.06	5.89
	Wilk (p-value)	0.4774	0.6161
	Efficiency	27.83%	
	t-Test (equal var.)	0.2836	
	t-Test (unequal var.)	0.1881	
	t-test (paired)	0.1517	
	Levene Test	0.1313	
Log Transformed	UCL	48.05	26.21
	Mean	27.66	19.36
	LCL	15.93	14.30
	Std. Dev.	22.20	6.18
	Wilk (p-value)	0.4169	0.6903
	Efficiency	30.02%	
	t-Test (equal var.)	0.6466	
	t-Test (unequal var.)	0.5782	
	t-Test (paired)	0.2531	
	Levene Test	0.0659 *	
Bootstrap	UCL	36.42	24.38
	Mean	26.45	19.41
	LCL	16.48	14.45
	Std. Dev.	15.69	5.37
	Efficiency	26.62%	

Brodie Oaks Irrigation Pond - Total Organic Carbon (mg/L)



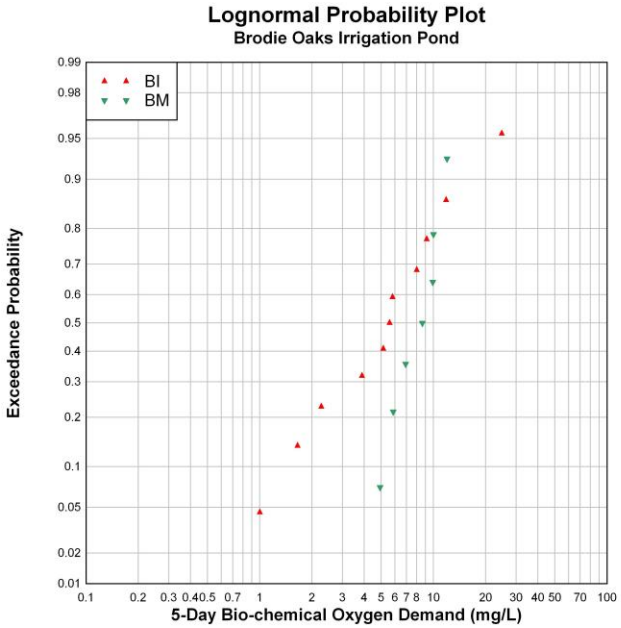


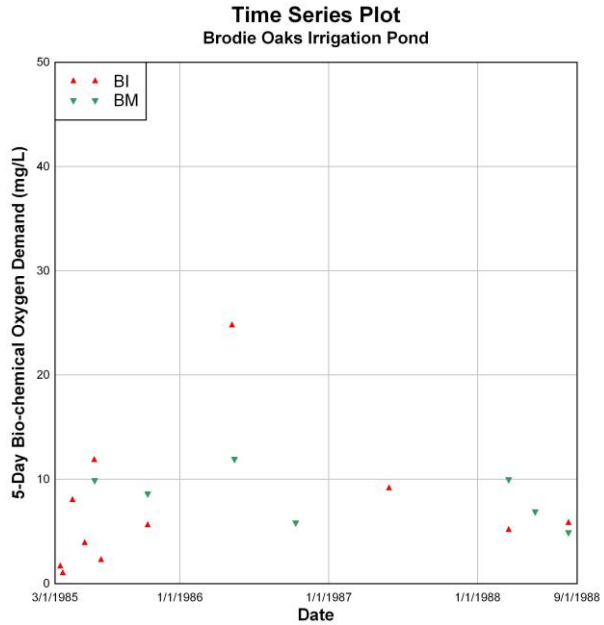


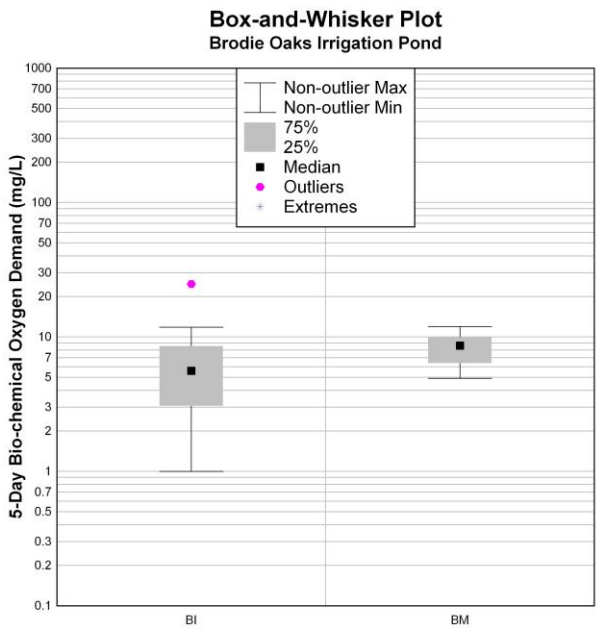


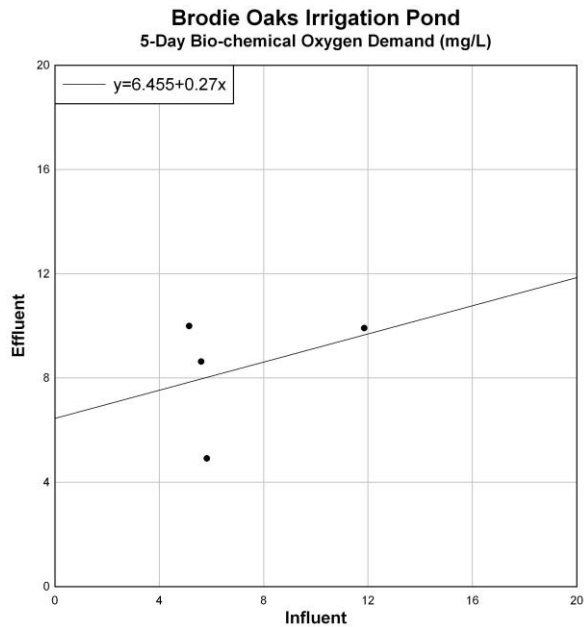
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	66.59	30.29
	Upper Quartile	9.70	9.92
	Median	5.73	6.22
	Lower Quartile	4.10	4.57
	Minimum	1.67	2.52
	Efficiency	-8.60%	
	Mann-Whitney	0.8350	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	23.05	18.18
	Mean	11.70	9.40
	LCL	0.34	0.63
	Std. Dev.	17.87	9.48
	Wilk (p-value)	0.0001 **	0.0022 **
	Efficiency	19.61%	
	t-Test (equal var.)	0.7586	
	t-Test (unequal var.)	0.7196	
	t-test (paired)	0.5153	
	Levene Test	0.5235	
Log Transformed	UCL	22.25	20.49
	Mean	10.27	8.94
	LCL	4.74	3.90
	Std. Dev.	11.08	7.00
	Wilk (p-value)	0.3758	0.5297
	Efficiency	12.96%	
	t-Test (equal var.)	0.9218	
	t-Test (unequal var.)	0.9166	
	t-Test (paired)	0.7604	
	Levene Test	0.5558	
Bootstrap	UCL	22.07	16.88
	Mean	12.13	9.59
	LCL	2.18	2.30
	Std. Dev.	15.66	7.88
	Efficiency	20.88%	

Brodie Oaks Irrigation Pond - 5-Day Bio-chemical Oxygen Demand (mg/L)



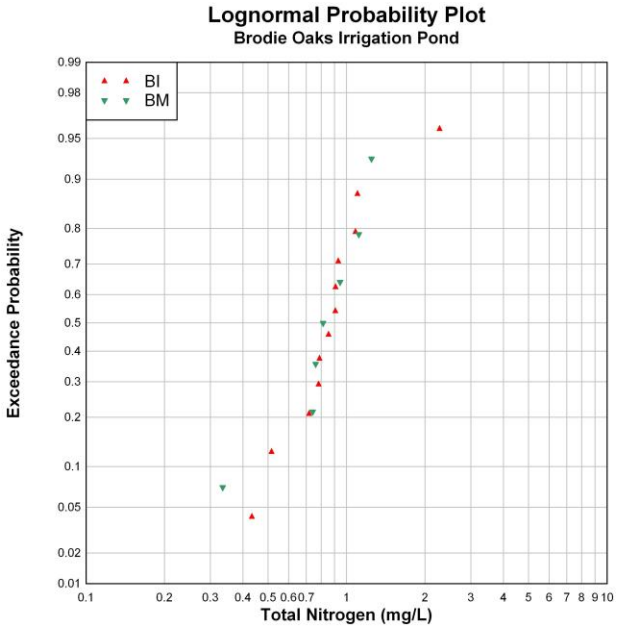


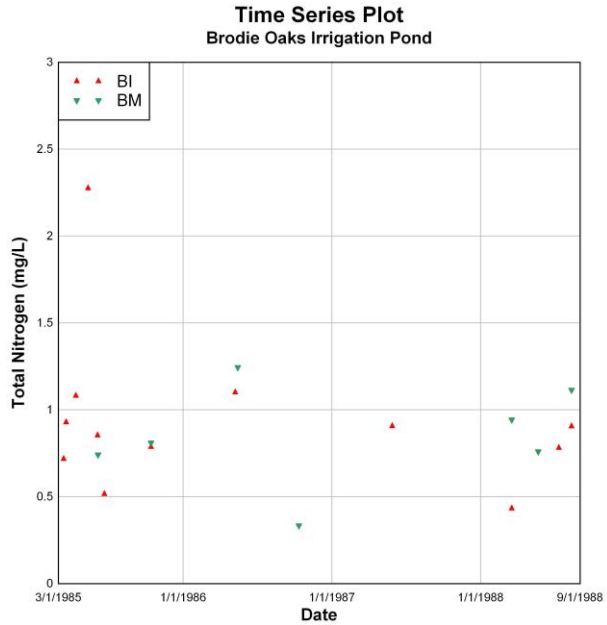


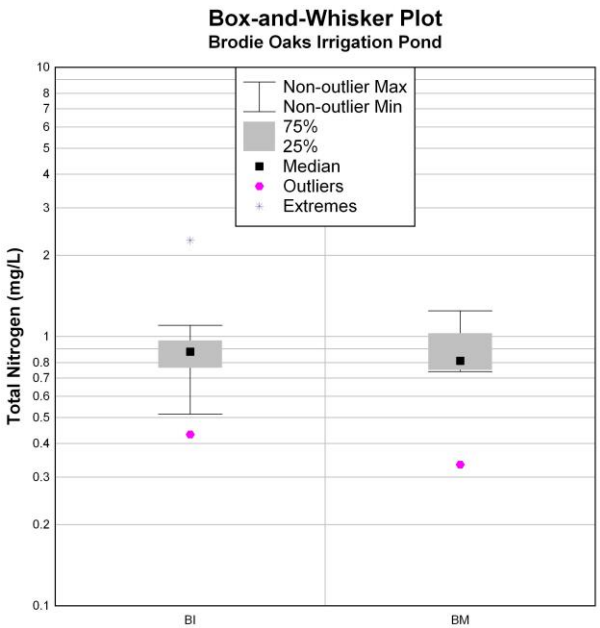


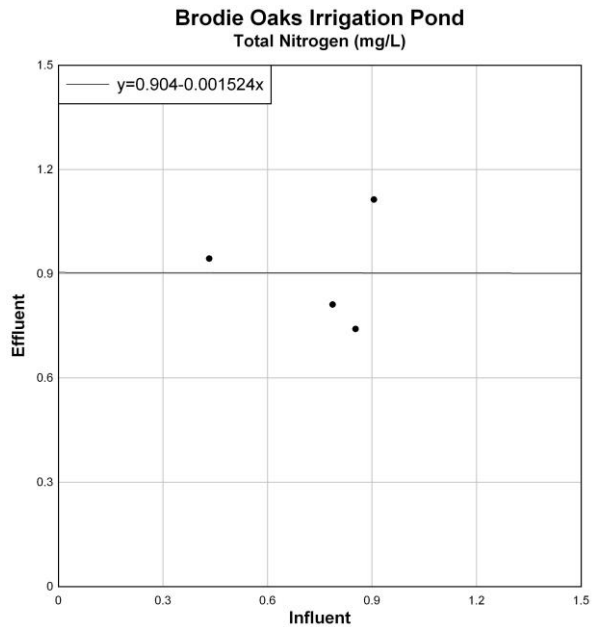
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	11	7
	Pairs Count	3	3
Non-Parametric	Maximum	24.76	11.95
	Upper Quartile	9.13	10.00
	Median	5.59	8.64
	Lower Quartile	2.26	5.86
	Minimum	1.00	4.92
	Efficiency	-54.44%	
	Mann-Whitney	0.1921	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	11.68	10.65
	Mean	7.19	8.32
	LCL	2.70	5.98
	Std. Dev.	6.69	2.52
	Wilk (p-value)	0.0083 **	0.8177
	Efficiency	-15.68%	
	t-Test (equal var.)	0.6778	
	t-Test (unequal var.)	0.6213	
	t-test (paired)	0.3024	
	Levene Test	0.3206	
Log Transformed	UCL	15.39	11.30
	Mean	7.29	8.33
	LCL	3.46	6.14
	Std. Dev.	7.20	2.68
	Wilk (p-value)	0.9770	0.7289
	Efficiency	-14.19%	
	t-Test (equal var.)	0.2232	
	t-Test (unequal var.)	0.1506	
	t-Test (paired)	0.3362	
	Levene Test	0.0872 *	
Bootstrap	UCL	11.21	10.42
	Mean	7.20	8.31
	LCL	3.20	6.20
	Std. Dev.	5.96	2.29
	Efficiency	-15.35%	

Brodie Oaks Irrigation Pond - Total Nitrogen (mg/L)



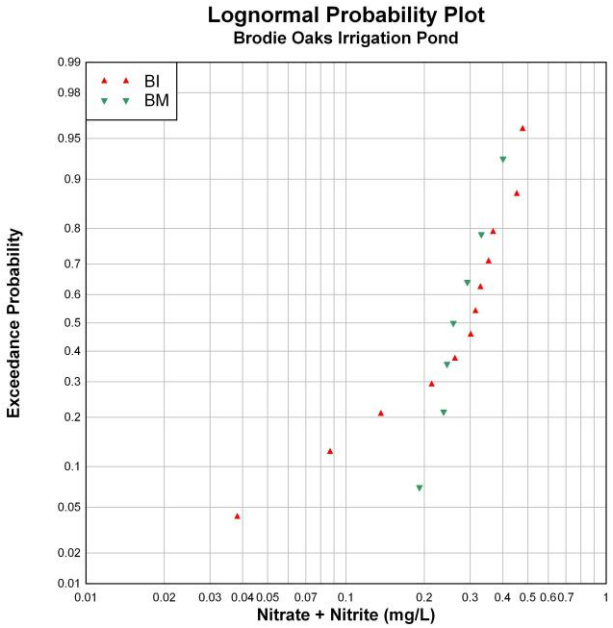


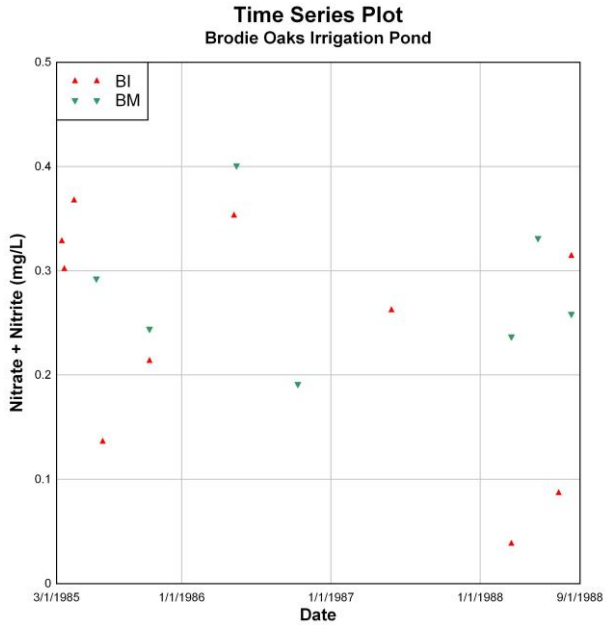


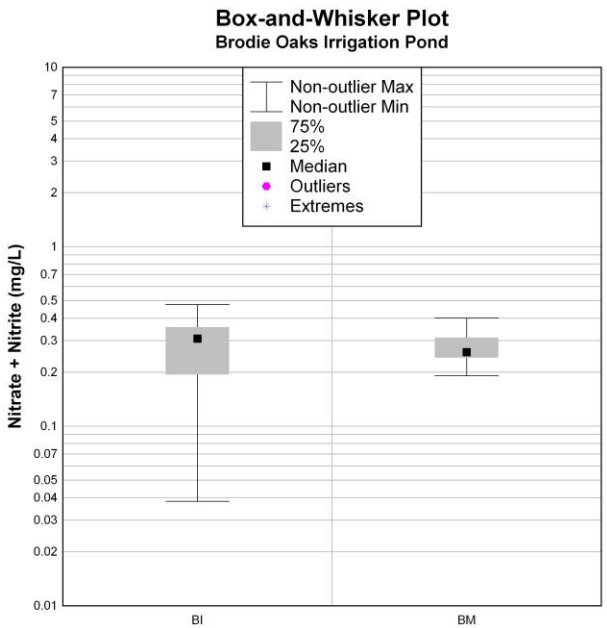


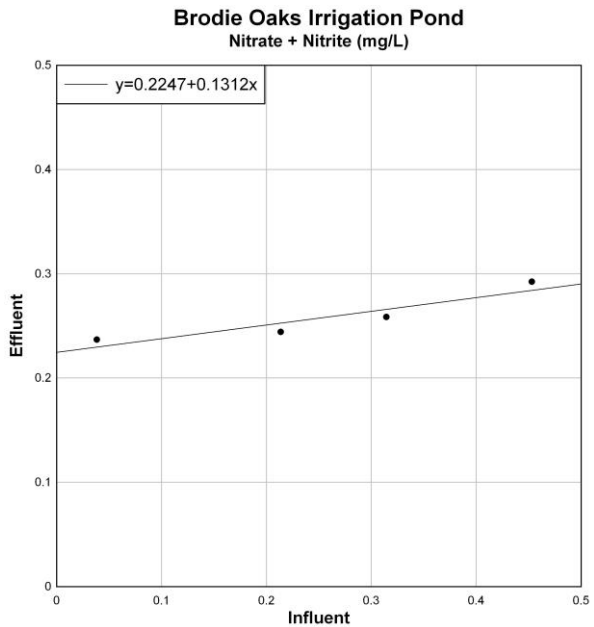
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	2.275	1.245
	Upper Quartile	1.004	1.114
	Median	0.879	0.812
	Lower Quartile	0.749	0.742
	Minimum	0.432	0.334
	Efficiency	7.62%	
	Mann-Whitney	1.0000	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	1.235	1.123
	Mean	0.940	0.850
	LCL	0.645	0.578
	Std. Dev.	0.464	0.295
	Wilk (p-value)	0.0021 **	0.7817
	Efficiency	9.55%	
	t-Test (equal var.)	0.6532	
	t-Test (unequal var.)	0.6134	
	t-test (paired)	0.2217	
	Levene Test	0.5365	
Log Transformed	UCL	1.225	1.304
	Mean	0.933	0.859
	LCL	0.710	0.566
	Std. Dev.	0.390	0.370
	Wilk (p-value)	0.2165	0.1480
	Efficiency	7.86%	
	t-Test (equal var.)	0.6808	
	t-Test (unequal var.)	0.6864	
	t-Test (paired)	0.2716	
	Levene Test	0.9834	
Bootstrap	UCL	1.194	1.096
	Mean	0.936	0.855
	LCL	0.678	0.614
	Std. Dev.	0.407	0.261
	Efficiency	8.60%	

Brodie Oaks Irrigation Pond - Nitrate + Nitrite (mg/L)



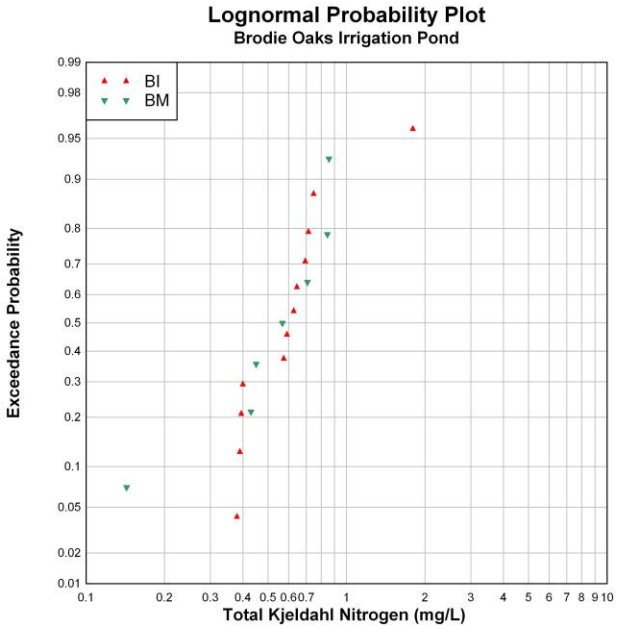


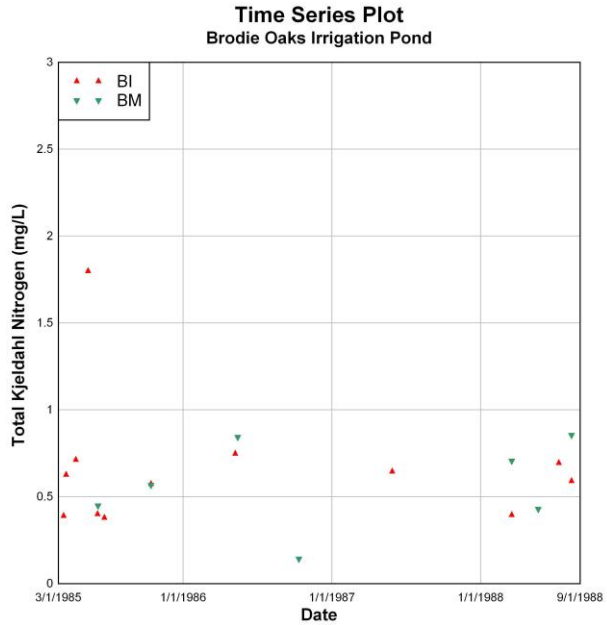


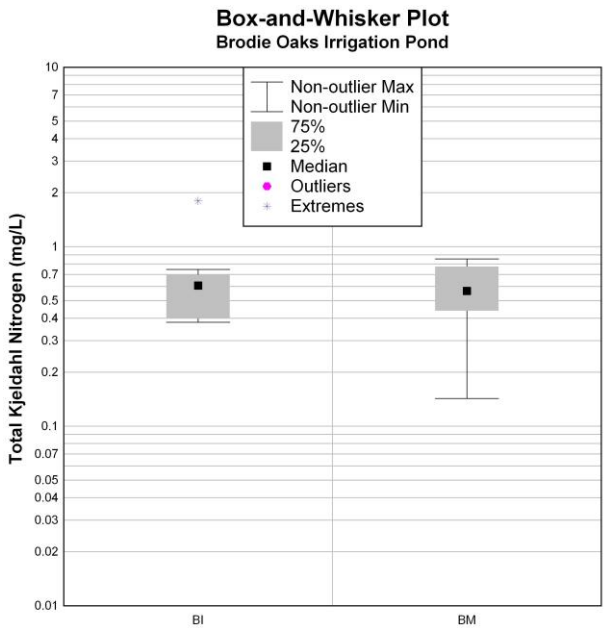


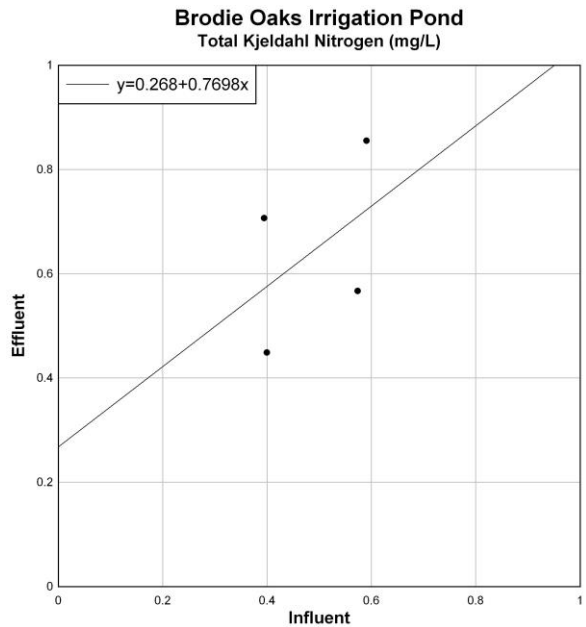
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	0.477	0.401
	Upper Quartile	0.360	0.331
	Median	0.308	0.259
	Lower Quartile	0.175	0.237
	Minimum	0.038	0.191
	Efficiency	16.01%	
	Mann-Whitney	0.7708	
	Wilcoxon (paired)	0.7500	
Arithmetic	UCL	0.365	0.344
	Mean	0.278	0.279
	LCL	0.190	0.215
	Std. Dev.	0.137	0.069
	Wilk (p-value)	0.7377	0.7721
	Efficiency	-0.68%	
	t-Test (equal var.)	0.9734	
	t-Test (unequal var.)	0.9686	
	t-test (paired)	0.5188	
	Levene Test	0.1001	
Log Transformed	UCL	0.510	0.351
	Mean	0.296	0.279
	LCL	0.172	0.222
	Std. Dev.	0.234	0.068
	Wilk (p-value)	0.0230 **	0.9736
	Efficiency	5.63%	
	t-Test (equal var.)	0.5732	
	t-Test (unequal var.)	0.4826	
	t-Test (paired)	0.4463	
	Levene Test	0.1945	
Bootstrap	UCL	0.359	0.336
	Mean	0.277	0.280
	LCL	0.195	0.223
	Std. Dev.	0.129	0.061
	Efficiency	-1.11%	

Brodie Oaks Irrigation Pond - Total Kjeldahl Nitrogen (mg/L)



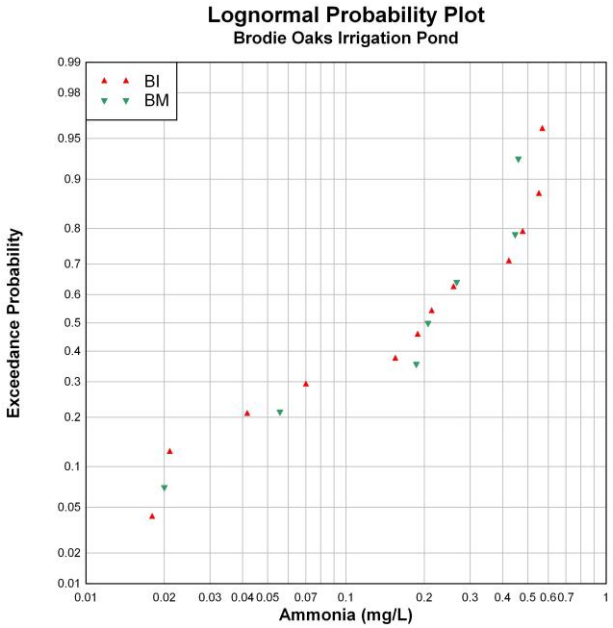


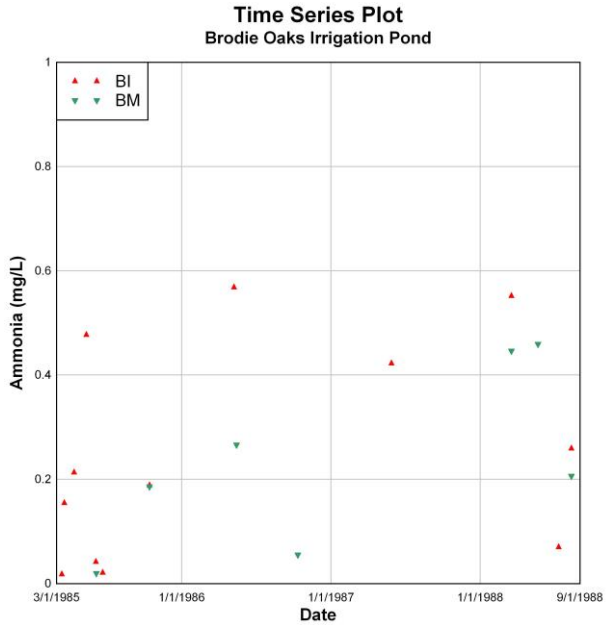


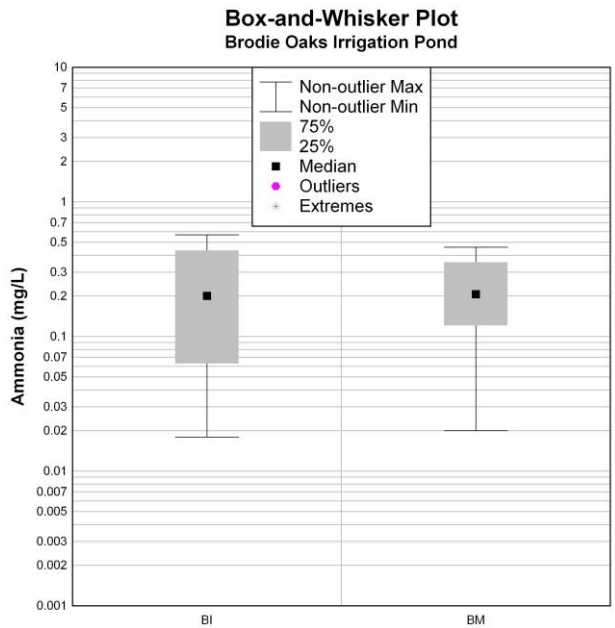


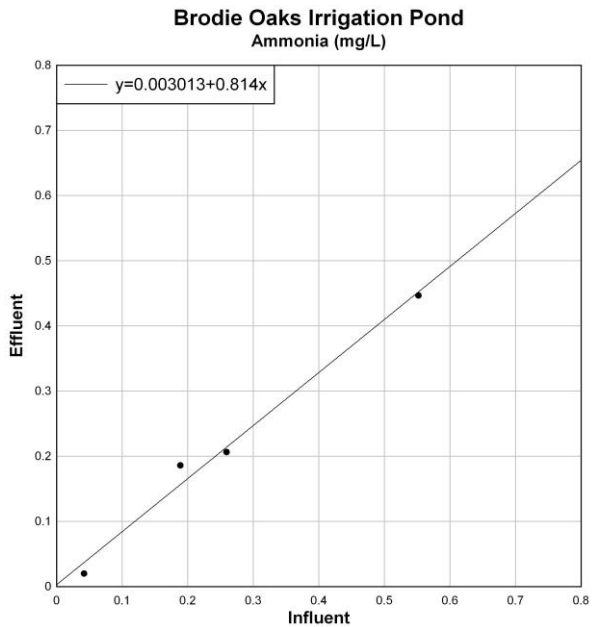
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	1.798	0.856
	Upper Quartile	0.703	0.844
	Median	0.609	0.567
	Lower Quartile	0.397	0.430
	Minimum	0.379	0.143
	Efficiency	6.78%	
	Mann-Whitney	0.9668	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	0.906	0.807
	Mean	0.662	0.571
	LCL	0.419	0.334
	Std. Dev.	0.383	0.256
	Wilk (p-value)	0.0003 **	0.6095
	Efficiency	13.84%	
	t-Test (equal var.)	0.5818	
	t-Test (unequal var.)	0.5407	
	t-test (paired)	0.1947	
	Levene Test	0.5860	
Log Transformed	UCL	0.869	1.110
	Mean	0.652	0.589
	LCL	0.488	0.313
	Std. Dev.	0.287	0.368
	Wilk (p-value)	0.0234 **	0.0835 *
	Efficiency	9.57%	
	t-Test (equal var.)	0.4730	
	t-Test (unequal var.)	0.5213	
	t-Test (paired)	0.2118	
	Levene Test	0.4520	
Bootstrap	UCL	0.869	0.787
	Mean	0.659	0.576
	LCL	0.450	0.364
	Std. Dev.	0.330	0.228
	Efficiency	12.67%	

Brodie Oaks Irrigation Pond - Ammonia (mg/L)



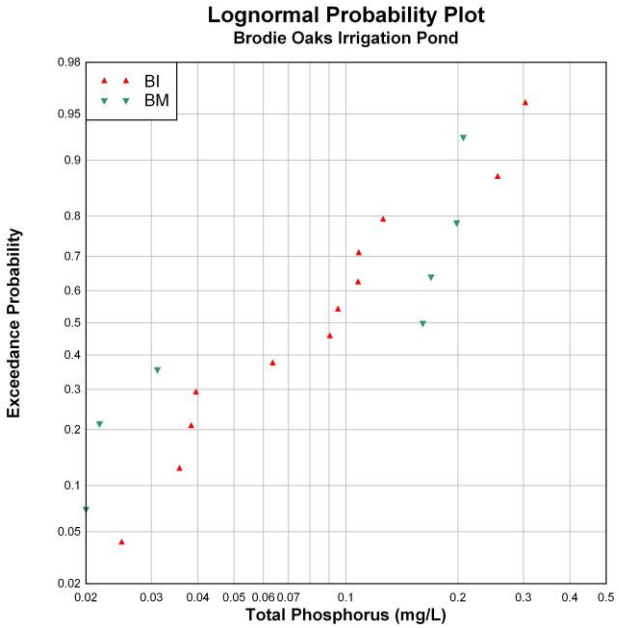


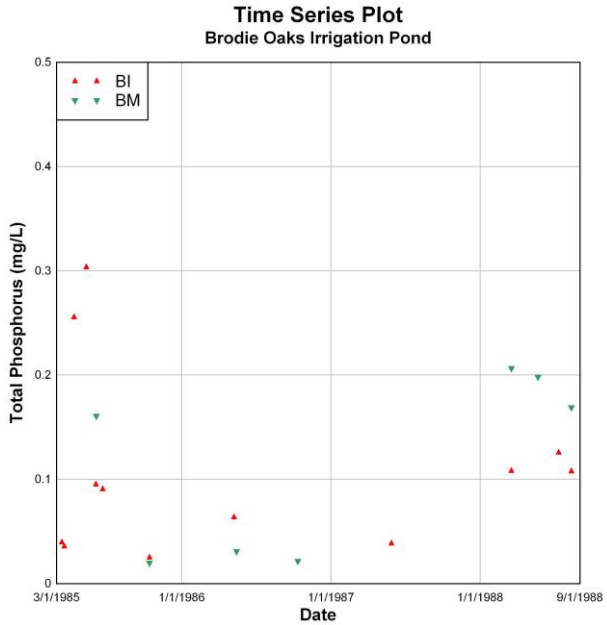


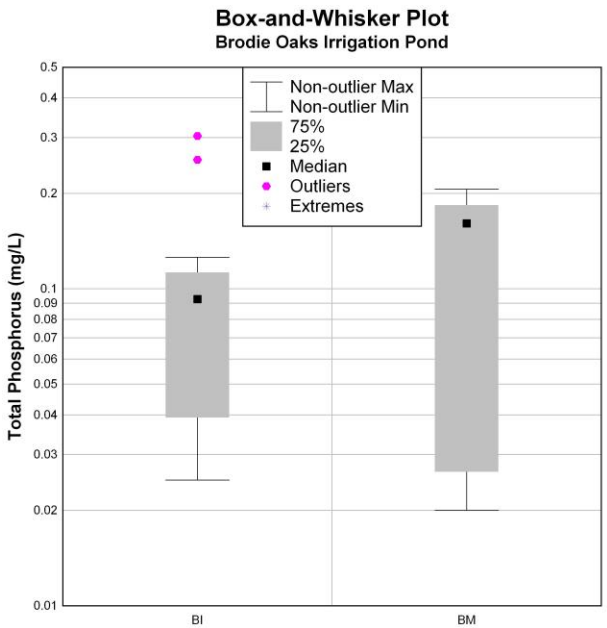


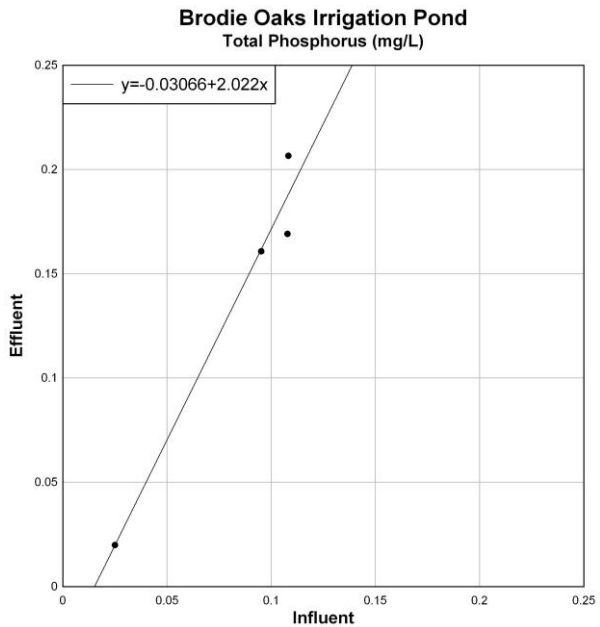
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	0.568	0.460
	Upper Quartile	0.450	0.447
	Median	0.201	0.207
	Lower Quartile	0.056	0.056
	Minimum	0.018	0.020
	Efficiency	-2.85%	
	Mann-Whitney	0.9668	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	0.380	0.394
	Mean	0.249	0.234
	LCL	0.117	0.075
	Std. Dev.	0.207	0.172
	Wilk (p-value)	0.1131	0.4440
	Efficiency	5.77%	
	t-Test (equal var.)	0.8789	
	t-Test (unequal var.)	0.8730	
	t-test (paired)	0.2141	
	Levene Test	0.3553	
Log Transformed	UCL	0.846	1.103
	Mean	0.290	0.267
	LCL	0.100	0.065
	Std. Dev.	0.414	0.315
	Wilk (p-value)	0.1233	0.1976
	Efficiency	7.85%	
	t-Test (equal var.)	0.9219	
	t-Test (unequal var.)	0.9206	
	t-Test (paired)	0.1616	
	Levene Test	0.6931	
Bootstrap	UCL	0.375	0.380
	Mean	0.250	0.236
	LCL	0.125	0.092
	Std. Dev.	0.196	0.155
	Efficiency	5.59%	

Brodie Oaks Irrigation Pond - Total Phosphorus (mg/L)



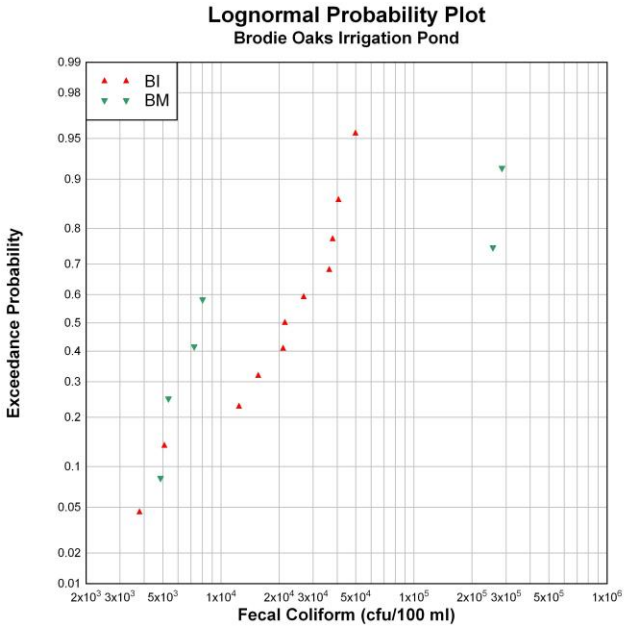


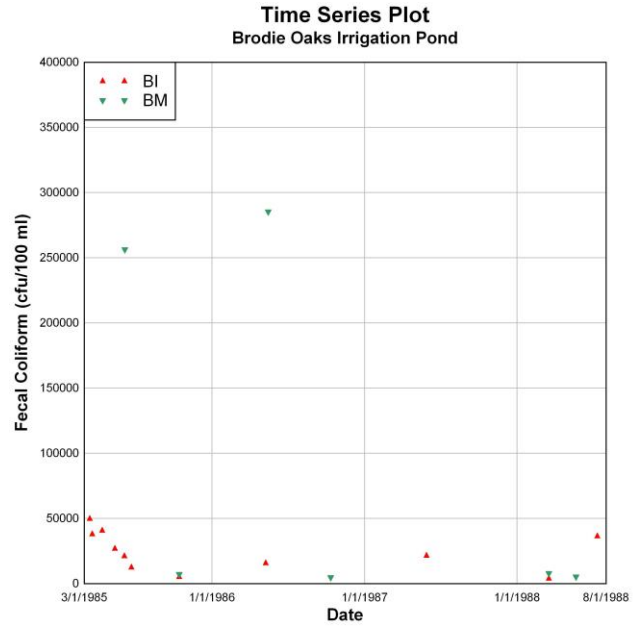


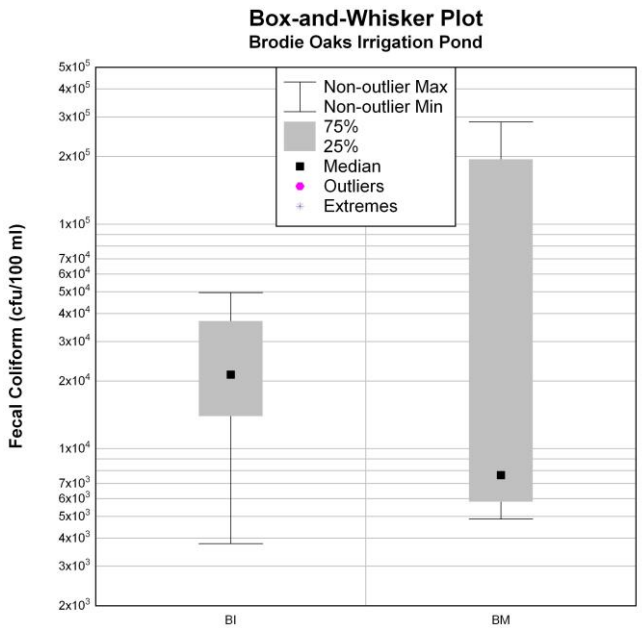


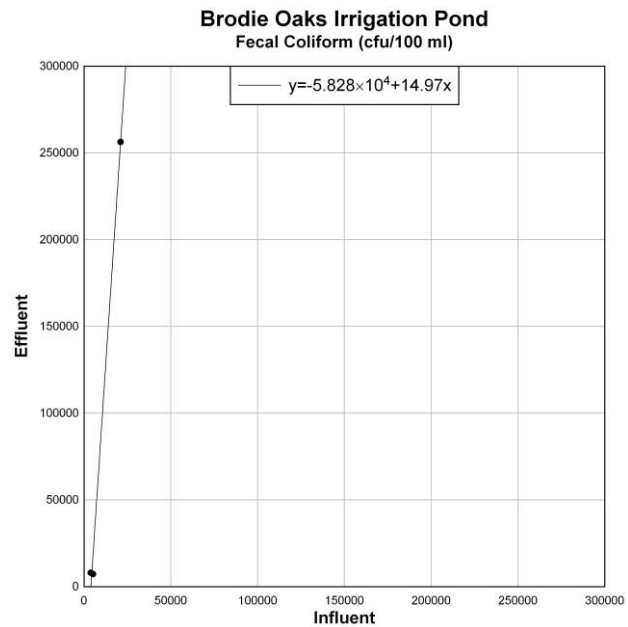
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	0.303	0.207
	Upper Quartile	0.117	0.198
	Median	0.093	0.161
	Lower Quartile	0.039	0.022
	Minimum	0.025	0.020
	Efficiency	-73.32%	
	Mann-Whitney	0.9668	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	0.163	0.196
	Mean	0.107	0.115
	LCL	0.052	0.035
	Std. Dev.	0.088	0.087
	Wilk (p-value)	0.0117 **	0.0356 **
	Efficiency	-7.52%	
	t-Test (equal var.)	0.8481	
	t-Test (unequal var.)	0.8484	
	t-test (paired)	0.2298	
	Levene Test	0.8993	
Log Transformed	UCL	0.189	0.471
	Mean	0.107	0.125
	LCL	0.060	0.033
	Std. Dev.	0.088	0.140
	Wilk (p-value)	0.6084	0.0199 **
	Efficiency	-16.71%	
	t-Test (equal var.)	0.8846	
	t-Test (unequal var.)	0.8961	
	t-Test (paired)	0.3815	
	Levene Test	0.0892 *	
Bootstrap	UCL	0.157	0.190
	Mean	0.106	0.117
	LCL	0.056	0.044
	Std. Dev.	0.079	0.079
	Efficiency	-9.69%	

Brodie Oaks Irrigation Pond - Fecal Coliform (cfu/100 ml)



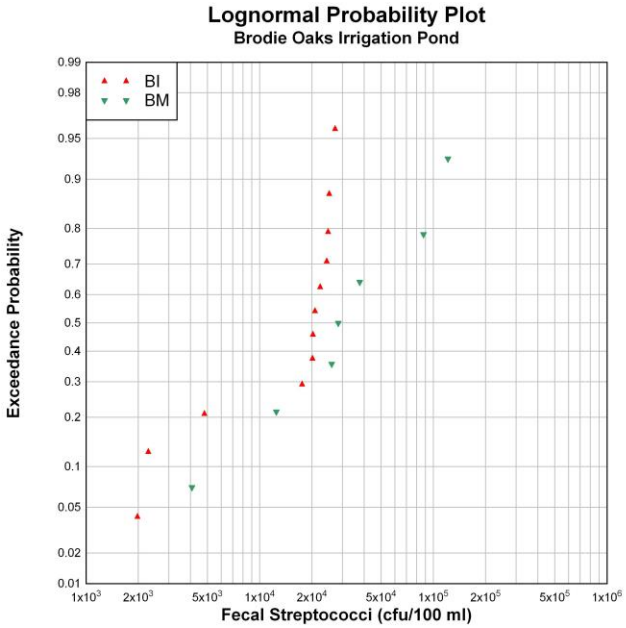


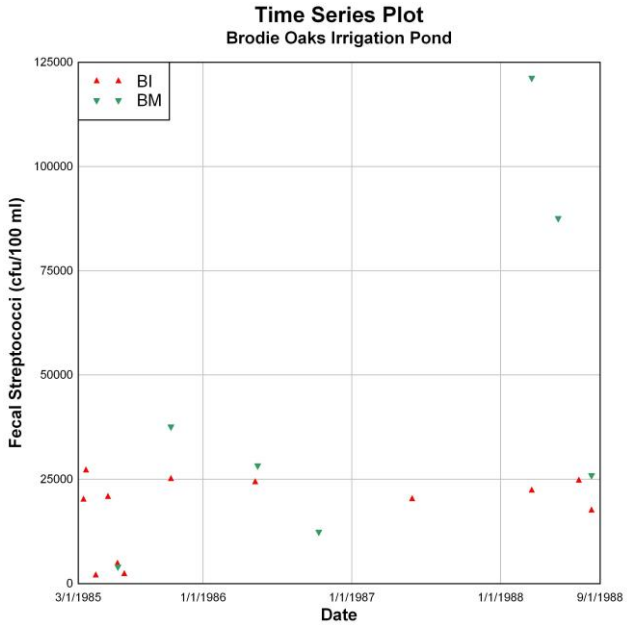


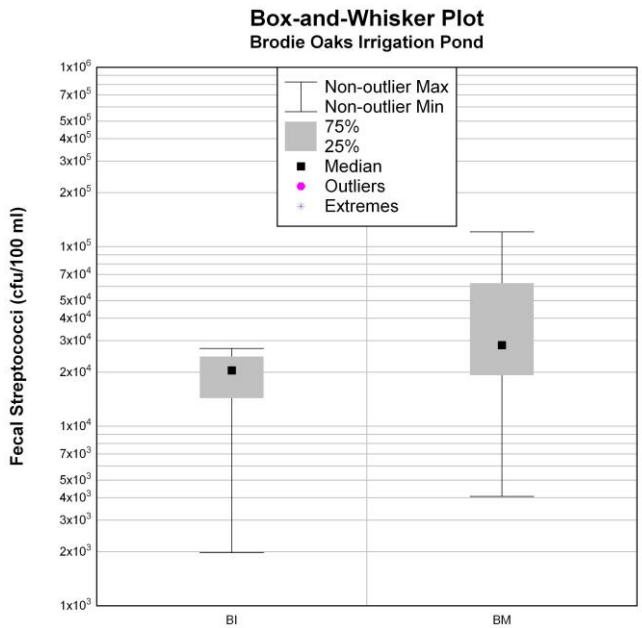


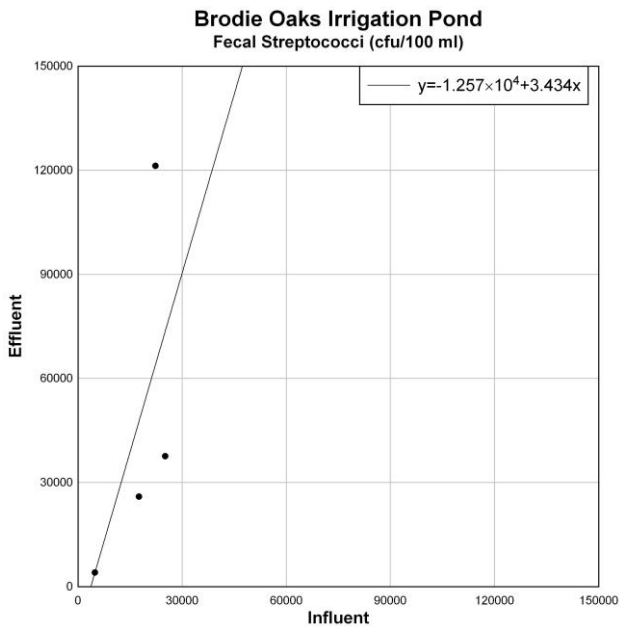
	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	11	6
	Pairs Count	2	2
Non-Parametric	Maximum	49,634	285,491
	Upper Quartile	37,784	256,345
	Median	21,412	7,637
	Lower Quartile	12,384	5,332
	Minimum	3,780	4,864
	Efficiency	64.33%	
	Mann-Whitney	0.7296	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	34,692	238,272
	Mean	24,575	94,551
	LCL	14,458	-49,170
	Std. Dev.	15,060	136,929
	Wilk (p-value)	0.7295	0.0031 **
	Efficiency	-284.75%	
	t-Test (equal var.)	0.1054	
	t-Test (unequal var.)	0.2667	
	t-test (paired)	0.1982	
	Levene Test	0.0008 **	
Log Transformed	UCL	50,997	3,485,091
	Mean	26,158	83,800
	LCL	13,417	2,015
	Std. Dev.	23,440	159,657
	Wilk (p-value)	0.1618	0.0102 **
	Efficiency	-220.37%	
	t-Test (equal var.)	0.8408	
	t-Test (unequal var.)	0.8753	
	t-Test (paired)	0.2184	
	Levene Test	0.0064 **	
Bootstrap	UCL	33,935	220,324
	Mean	24,463	95,254
	LCL	14,991	-29,816
	Std. Dev.	14,100	119,178
	Efficiency	-289.38%	

Brodie Oaks Irrigation Pond - Fecal Streptococci (cfu/100 ml)



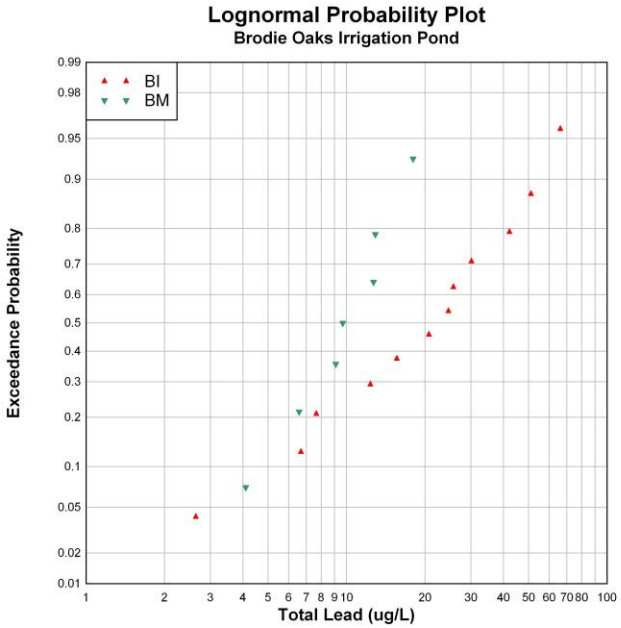


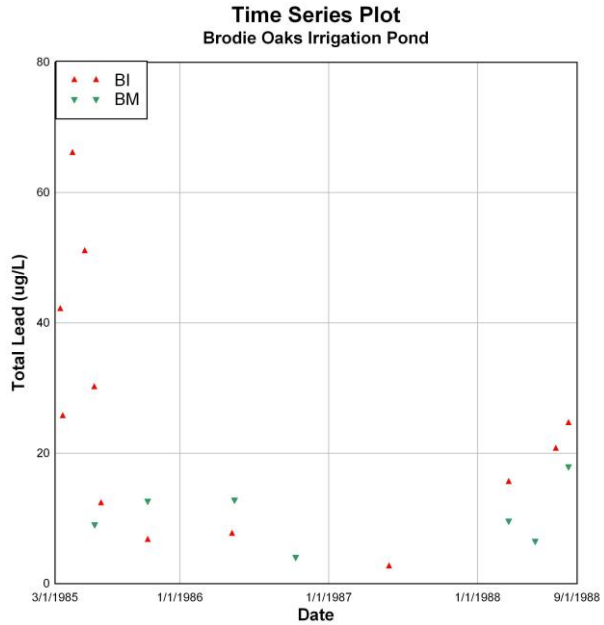


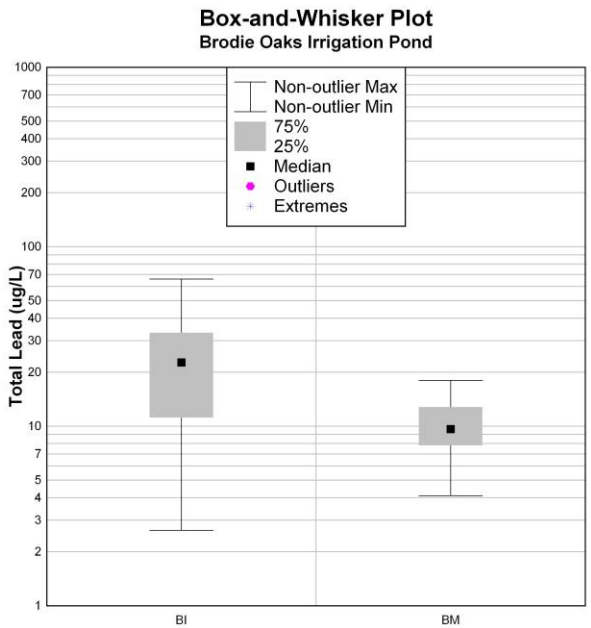


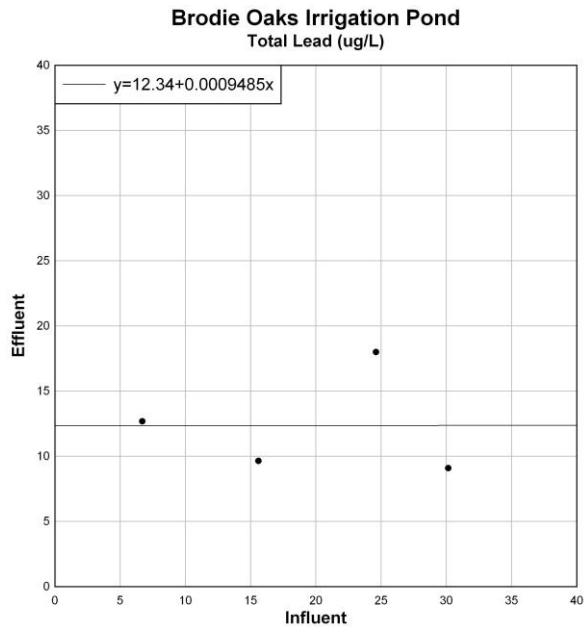
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	27,139	121,282
	Upper Quartile	24,500	87,638
	Median	20,493	28,299
	Lower Quartile	11,156	12,448
	Minimum	1,976	4,071
	Efficiency	-38.09%	
	Mann-Whitney	0.0859 *	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	23,439	85,058
	Mean	17,597	45,339
	LCL	11,755	5,621
	Std. Dev.	9,195	42,945
	Wilk (p-value)	0.0100 **	0.1467
	Efficiency	-157.65%	
	t-Test (equal var.)	0.0423 **	
	t-Test (unequal var.)	0.1401	
	t-test (paired)	0.3080	
	Levene Test	0.0153 **	
Log Transformed	UCL	42,843	198,469
	Mean	20,096	48,288
	LCL	9,427	11,749
	Std. Dev.	21,293	56,834
	Wilk (p-value)	0.0007 **	0.8283
	Efficiency	-140.28%	
	t-Test (equal var.)	0.1399	
	t-Test (unequal var.)	0.1677	
	t-Test (paired)	0.1936	
	Levene Test	0.6605	
Bootstrap	UCL	23,035	80,926
	Mean	17,634	45,630
	LCL	12,232	10,335
	Std. Dev.	8,502	38,163
	Efficiency	-158.77%	

Brodie Oaks Irrigation Pond - Total Lead (ug/L)



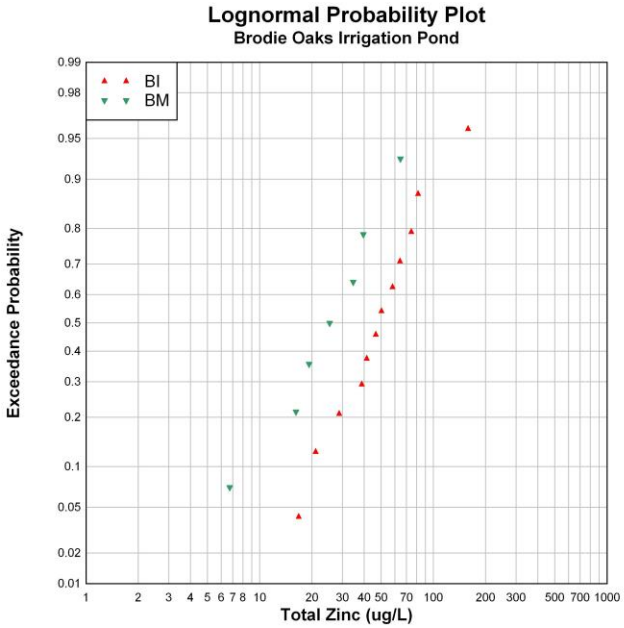


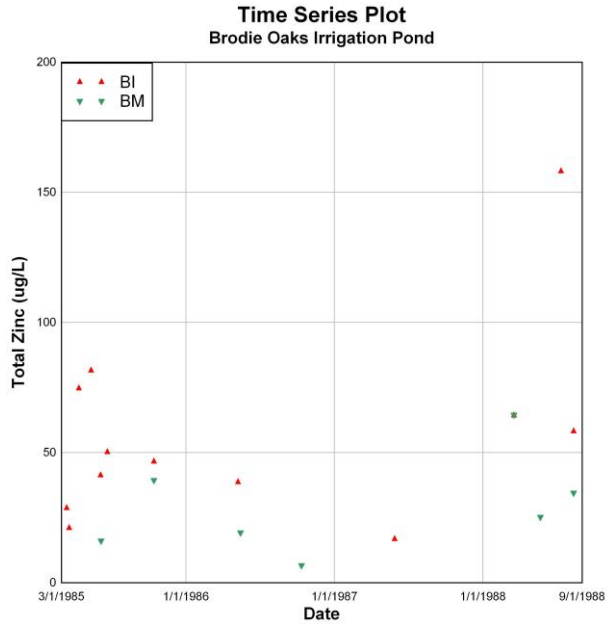


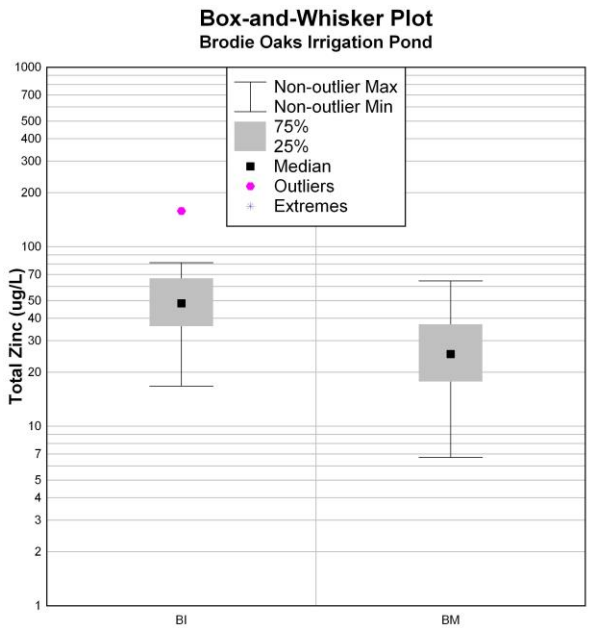


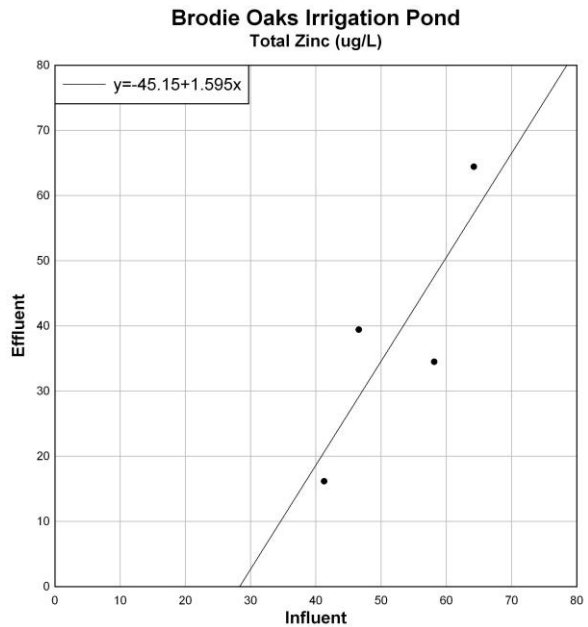
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	66.1	18.0
	Upper Quartile	36.1	12.9
	Median	22.6	9.7
	Lower Quartile	10.0	6.6
	Minimum	2.6	4.1
	Efficiency	57.36%	
	Mann-Whitney	0.1003	
	Wilcoxon (paired)	0.7500	
Arithmetic	UCL	37.7	14.7
	Mean	25.4	10.4
	LCL	13.2	6.2
	Std. Dev.	19.3	4.6
	Wilk (p-value)	0.3187	0.9409
	Efficiency	59.00%	
	t-Test (equal var.)	0.0612 *	
	t-Test (unequal var.)	0.0230 **	
	t-test (paired)	0.6481	
	Levene Test	0.0875 *	
Log Transformed	UCL	55.5	17.0
	Mean	27.0	10.5
	LCL	13.2	6.5
	Std. Dev.	27.4	5.2
	Wilk (p-value)	0.7981	0.8412
	Efficiency	61.12%	
	t-Test (equal var.)	0.1035	
	t-Test (unequal var.)	0.0599 *	
	t-Test (paired)	0.8988	
	Levene Test	0.1708	
Bootstrap	UCL	36.3	14.3
	Mean	25.1	10.5
	LCL	13.8	6.7
	Std. Dev.	17.7	4.1
	Efficiency	58.13%	

Brodie Oaks Irrigation Pond - Total Zinc (ug/L)



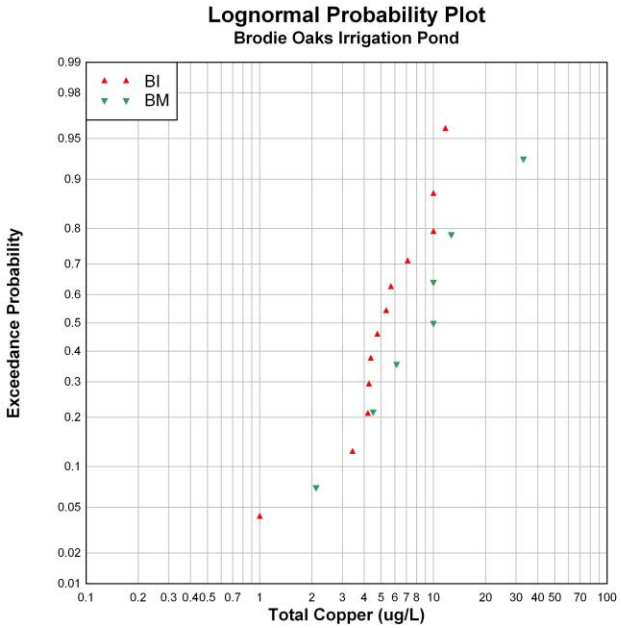


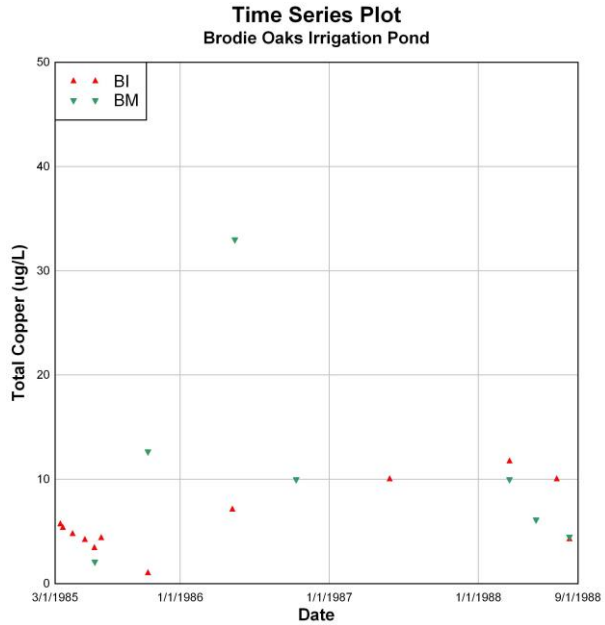


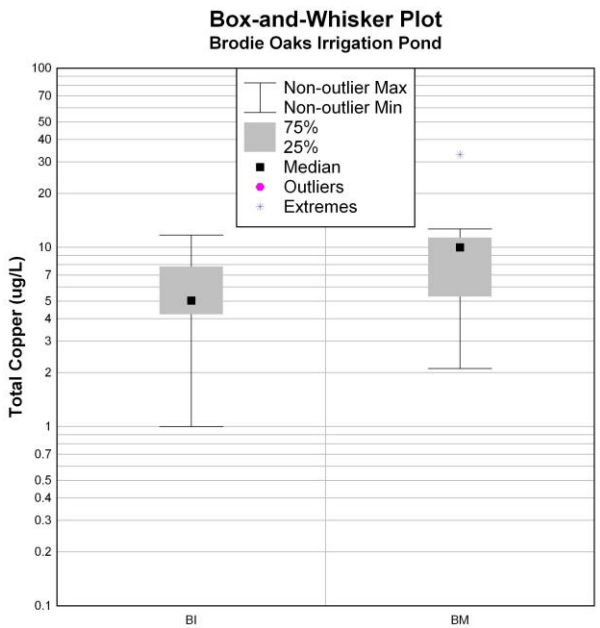


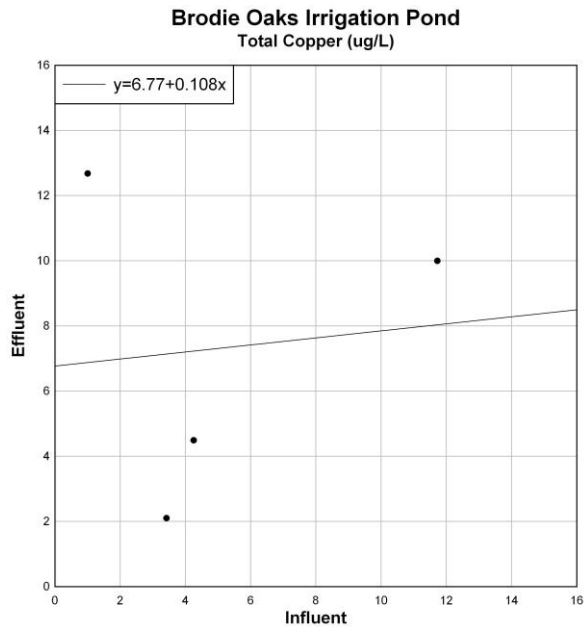
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	158.1	64.5
	Upper Quartile	69.4	39.4
	Median	48.4	25.3
	Lower Quartile	33.6	16.2
	Minimum	16.7	6.7
	Efficiency	47.72%	
	Mann-Whitney	0.0734 *	
	Wilcoxon (paired)	0.5000	
Arithmetic	UCL	80.6	47.0
	Mean	56.6	29.4
	LCL	32.7	11.8
	Std. Dev.	37.7	19.0
	Wilk (p-value)	0.0215 **	0.6645
	Efficiency	48.07%	
	t-Test (equal var.)	0.0950 *	
	t-Test (unequal var.)	0.0524 *	
	t-test (paired)	0.2866	
	Levene Test	0.3818	
Log Transformed	UCL	86.6	64.9
	Mean	56.4	30.0
	LCL	36.8	13.9
	Std. Dev.	36.0	22.1
	Wilk (p-value)	0.9928	0.9301
	Efficiency	46.84%	
	t-Test (equal var.)	0.0432 **	
	t-Test (unequal var.)	0.0613 *	
	t-Test (paired)	0.2790	
	Levene Test	0.6686	
Bootstrap	UCL	78.3	45.2
	Mean	56.7	29.6
	LCL	35.2	14.0
	Std. Dev.	33.9	16.8
	Efficiency	47.81%	

Brodie Oaks Irrigation Pond - Total Copper (ug/L)









	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: BI**	**EFF: BM**
	Site Count	12	7
	Pairs Count	3	3
Non-Parametric	Maximum	11.7	33.0
	Upper Quartile	8.5	12.7
	Median	5.0	10.0
	Lower Quartile	4.2	4.5
	Minimum	1.0	2.1
	Efficiency	-98.18%	
	Mann-Whitney	0.2354	
	Wilcoxon (paired)	0.7500	
Arithmetic	UCL	8.0	20.7
	Mean	6.0	11.2
	LCL	4.0	1.7
	Std. Dev.	3.1	10.3
	Wilk (p-value)	0.3067	0.0278 **
	Efficiency	-87.19%	
	t-Test (equal var.)	0.1152	
	t-Test (unequal var.)	0.2341	
	t-test (paired)	0.5011	
	Levene Test	0.1136	
Log Transformed	UCL	9.8	29.1
	Mean	6.2	11.1
	LCL	3.9	4.3
	Std. Dev.	4.2	9.8
	Wilk (p-value)	0.0828 *	0.9484
	Efficiency	-80.04%	
	t-Test (equal var.)	0.1963	
	t-Test (unequal var.)	0.2421	
	t-Test (paired)	0.4473	
	Levene Test	0.5055	
Bootstrap	UCL	7.9	19.1
	Mean	6.0	11.2
	LCL	4.1	3.3
	Std. Dev.	3.0	8.6
	Efficiency	-86.37%	

Rosedale StormCeptor® (SCI-SCE)

Storm water runoff from this single-family residential area went into the BMP and escaped into a large pipe which had been placed under 40th Street for conveyance into Shoal Creek. A two foot Palmer-Boulus flume was installed in the storm sewer to measure flow. There are many deciduous trees, including pecan trees in the neighborhood. The StormCeptor, a proprietary cylindrical device; twelve feet in diameter and eight feet deep, was installed during Fall months of 2006. By the spring of 2008, the unit became clogged with leaves, twigs and pecan debris requiring the unit to be pumped and cleaned. Very little sediment had accumulated by this time and the recommended inspection techniques would not have found the clogged inlet. StormCeptor® units may require more frequent inspections and maintenance to ensure the proper operations. Flow was measured at the influent only but water quality sampling was performed at both the influent and effluent locations.

The City collected runoff and water quality data at the influent and effluent of the Rosedale StormCeptor® between December 2006 and December 2009. During this time 33 and 28 valid EMCs were collected at the influent and effluent respectively, of which 30 were paired.

Performance Summary

Overall, the StormCeptor® had a minimal impact on water quality for the pollutants measured during this study. The device had the best performance with the reduction of the concentrations of solids and metals. TSS and VSS were reduced by 29% and 32% respectively; this is significant if a paired comparison is used but is not if the data are not paired. Cadmium, copper, lead and zinc were reduced by 36, 26, 33 and 30% respectively. The reduction in metals concentrations followed the same trend as the solids, significant only if paired, with the exception of cadmium which was significant in all cases.

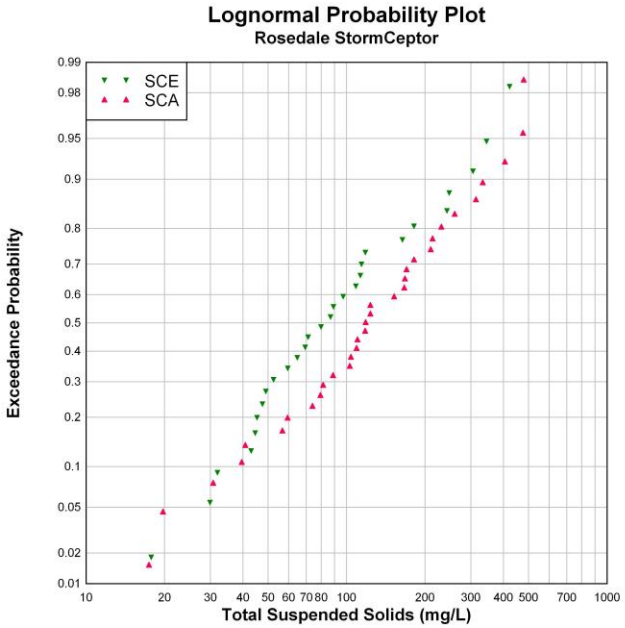
COD concentrations were reduced by 16% but this was only significant if the data are paired. The reduction (18%) in TOC concentrations was not significant in any case.

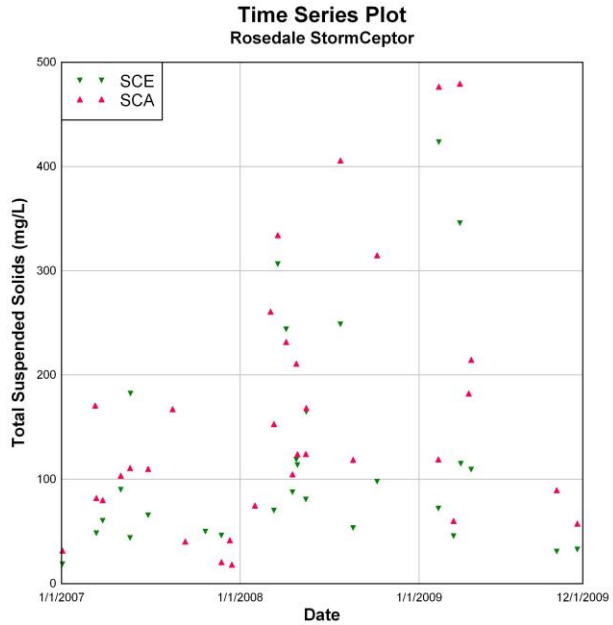
Total P concentrations were reduced by 18% but this was only significant if paired analyses were used. The reduction (21%) of the dissolved P concentration was not significant in any case.

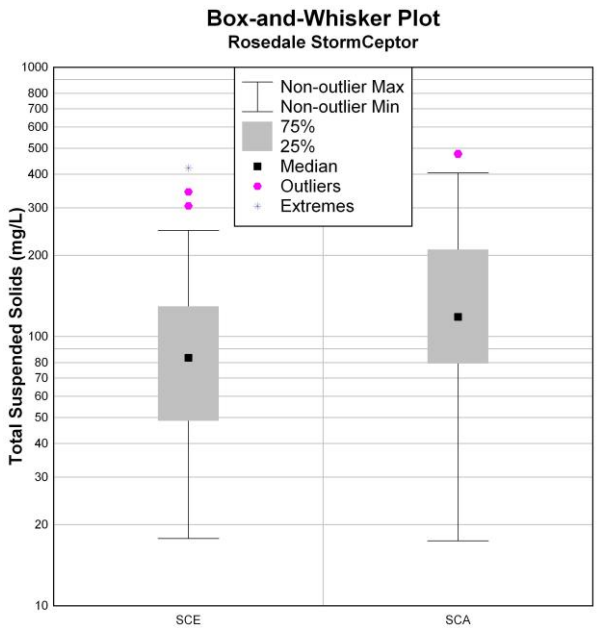
The nitrogen series was he most interesting of the pollutants measured. Nitrate + nitrite concentrations were reduced by 53%, significant in all cases. After noting this reduction early in the study, WQM staff did additional investigations. After a runoff event, the StormCeptor® quickly reaches an anaerobic state with near zero dissolved oxygen levels in as little as 48 hours. The anaerobic conditions promote de-nitrification, converting the nitrate and nitrite to ammonia. This can be seen in the data by the almost 400% increase in ammonia concentrations, however due to the variability in the data this increase is not statistically significant. Ammonia and nitrate + nitrite were also the only two pollutants were the influent and effluent concentrations poorly correlated. The 7 and 12% reductions in TKN and total N were not significant.

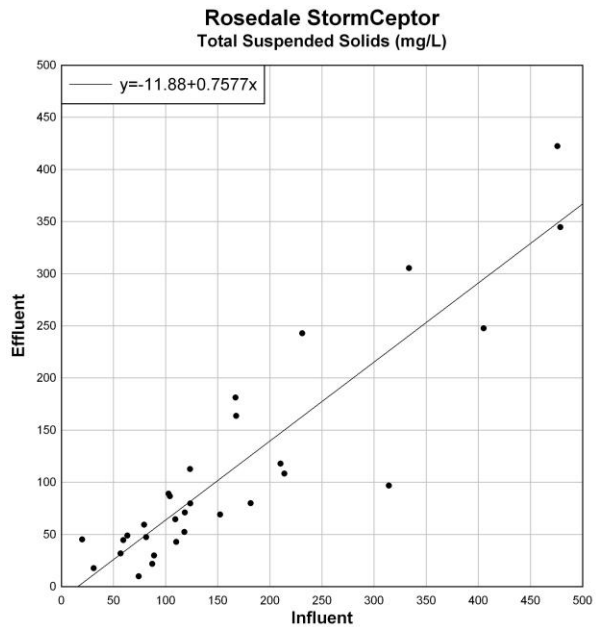
During monitoring period the inlet to the chamber became clogged with leaves requiring the unit to be pumped and cleaned. Very little sediment had accumulated by this time and the recommended inspection techniques would not have found the clogged inlet. StormCeptor® units may require more frequent inspections and maintenance to ensure the proper operations.

Rosedale StormCeptor - Total Suspended Solids (mg/L)



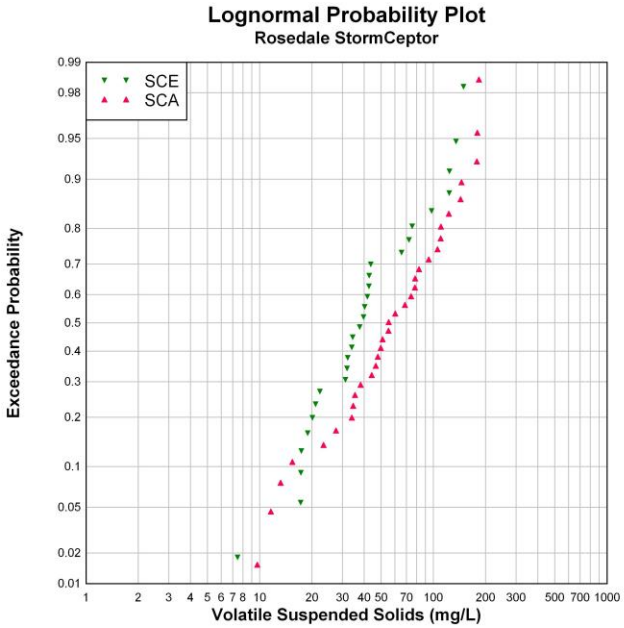


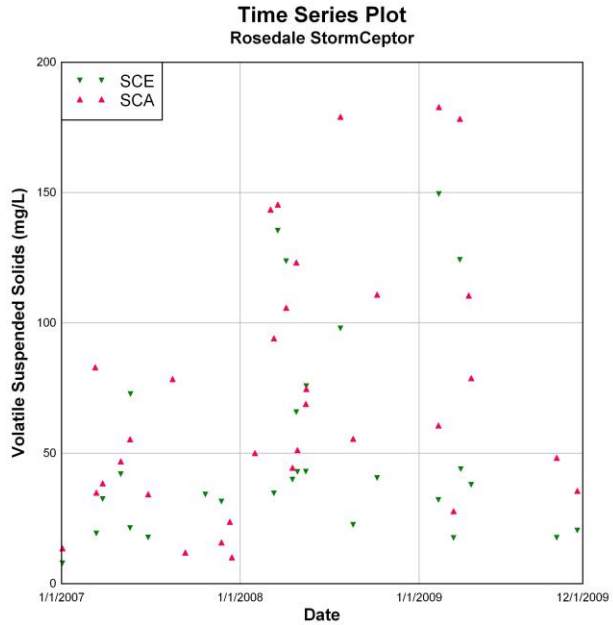


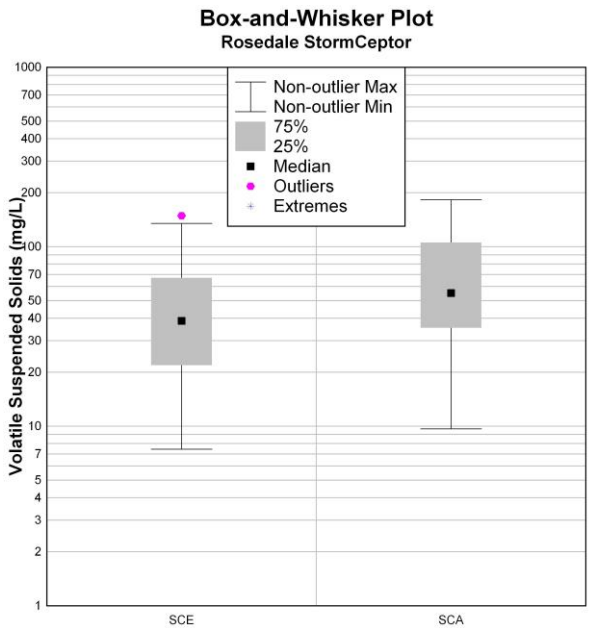


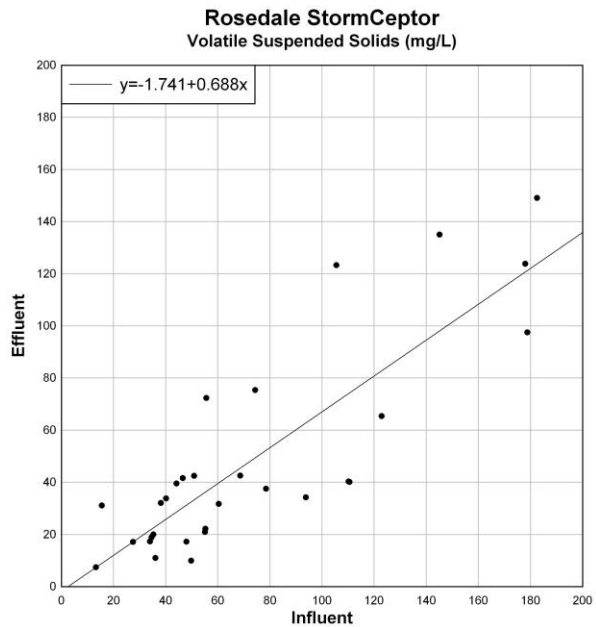
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	478.5	422.4
	Upper Quartile	210.2	140.9
	Median	118.4	83.3
	Lower Quartile	79.3	48.2
	Minimum	17.4	17.8
	Efficiency	29.61%	
	Mann-Whitney	0.1150	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	202.9	159.4
	Mean	159.2	119.3
	LCL	115.6	79.3
	Std. Dev.	123.1	103.3
	Wilk (p-value)	0.0007 **	0.0001 **
	Efficiency	25.06%	
	t-Test (equal var.)	0.1801	
	t-Test (unequal var.)	0.1739	
	t-test (paired)	0.0000 **	
	Levene Test	0.4542	
Log Transformed	UCL	233.5	167.5
	Mean	165.1	118.0
	LCL	116.7	83.2
	Std. Dev.	158.3	103.7
	Wilk (p-value)	0.5238	0.7506
	Efficiency	28.51%	
	t-Test (equal var.)	0.1666	
	t-Test (unequal var.)	0.1644	
	t-Test (paired)	0.0000 **	
	Levene Test	0.6955	
Bootstrap	UCL	203.6	158.0
	Mean	160.9	119.4
	LCL	118.3	80.7
	Std. Dev.	120.4	99.7
	Efficiency	25.84%	

Rosedale StormCeptor - Volatile Suspended Solids (mg/L)



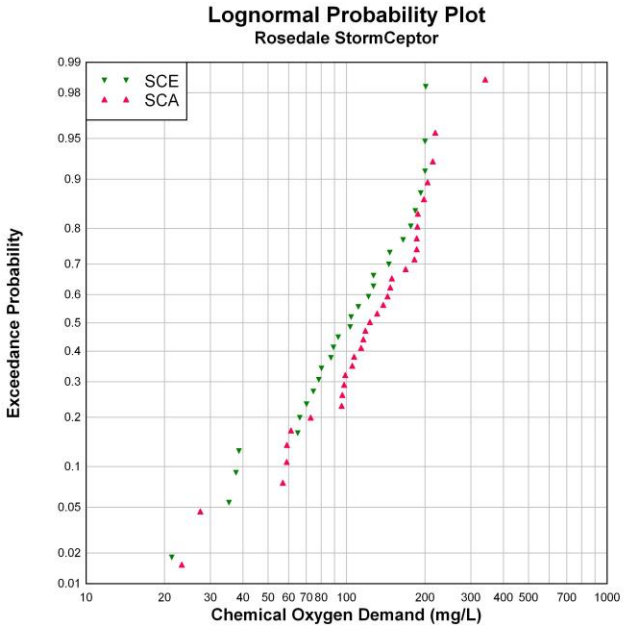


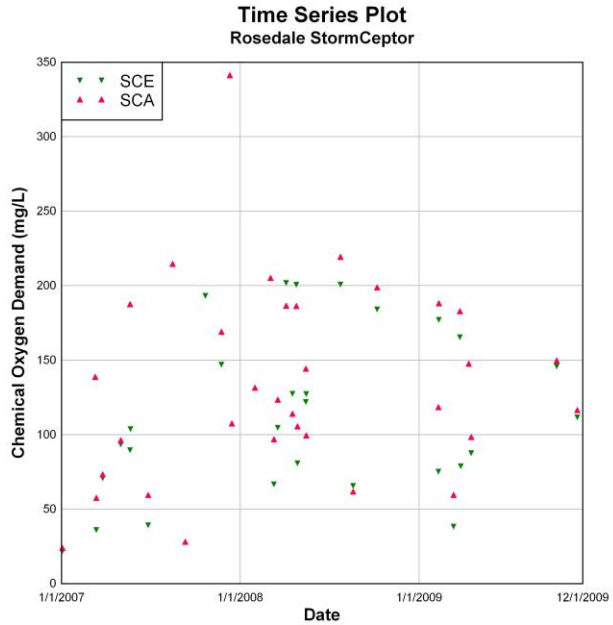


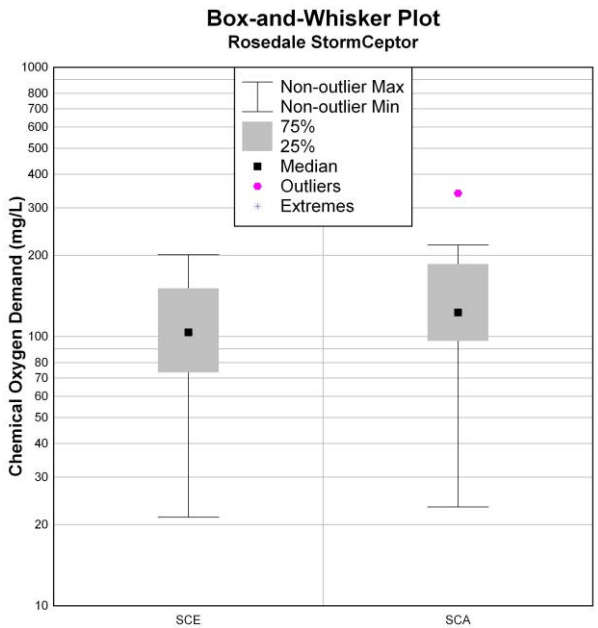


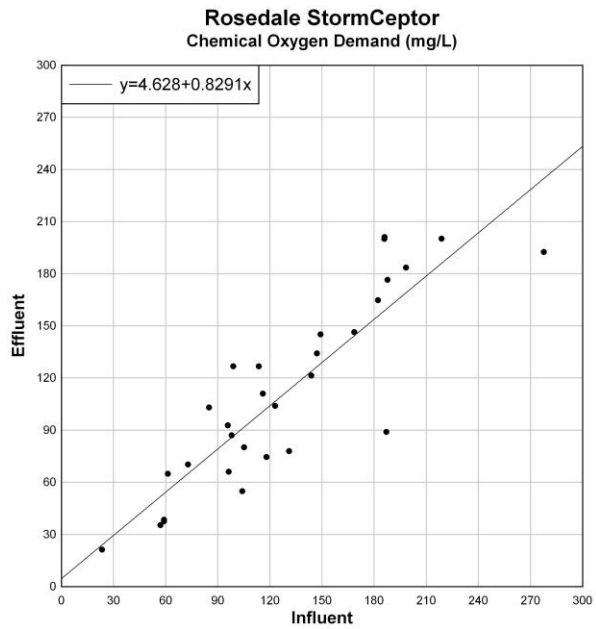
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	182.4	149.1
	Upper Quartile	105.5	68.9
	Median	55.2	38.6
	Lower Quartile	35.3	21.6
	Minimum	9.7	7.5
	Efficiency	30.00%	
	Mann-Whitney	0.0495 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	90.6	66.6
	Mean	72.9	51.2
	LCL	55.1	35.9
	Std. Dev.	50.0	39.5
	Wilk (p-value)	0.0086 **	0.0002 **
	Efficiency	29.66%	
	t-Test (equal var.)	0.0696 *	
	t-Test (unequal var.)	0.0645 *	
	t-test (paired)	0.0000 **	
	Levene Test	0.2147	
Log Transformed	UCL	104.7	70.6
	Mean	75.7	51.2
	LCL	54.8	37.1
	Std. Dev.	67.8	41.3
	Wilk (p-value)	0.2196	0.2997
	Efficiency	32.46%	
	t-Test (equal var.)	0.0837 *	
	t-Test (unequal var.)	0.0818 *	
	t-Test (paired)	0.0000 **	
	Levene Test	0.6264	
Bootstrap	UCL	91.0	66.1
	Mean	73.6	51.2
	LCL	56.2	36.4
	Std. Dev.	49.1	38.3
	Efficiency	30.39%	

Rosedale StormCeptor - Chemical Oxygen Demand (mg/L)



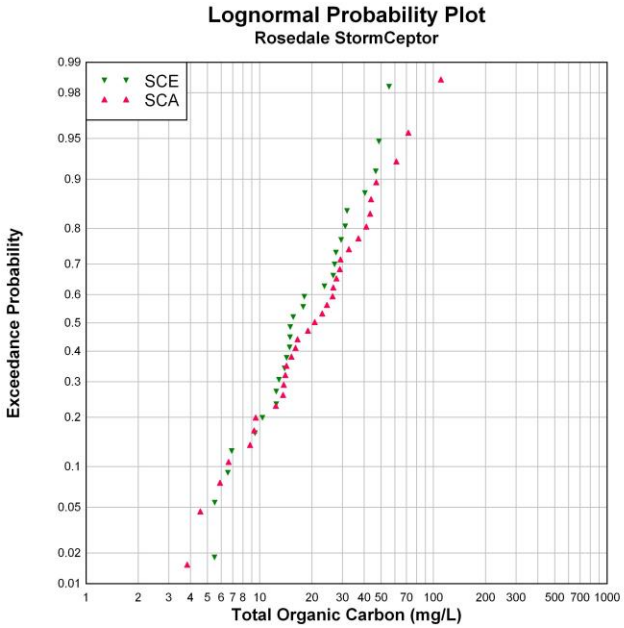


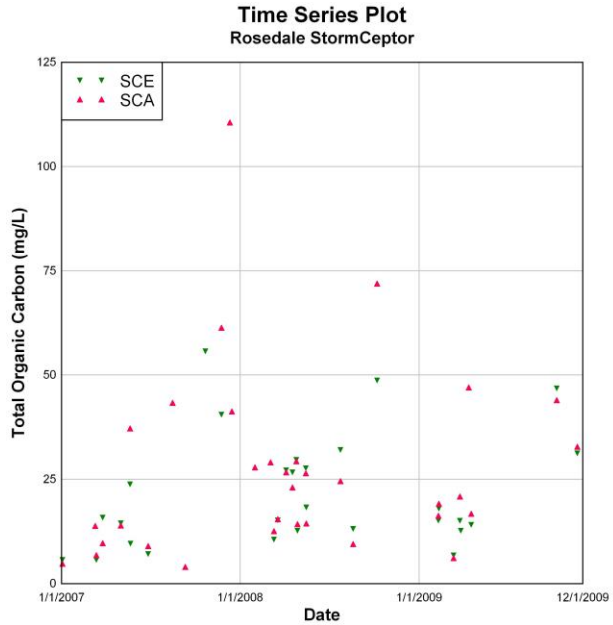


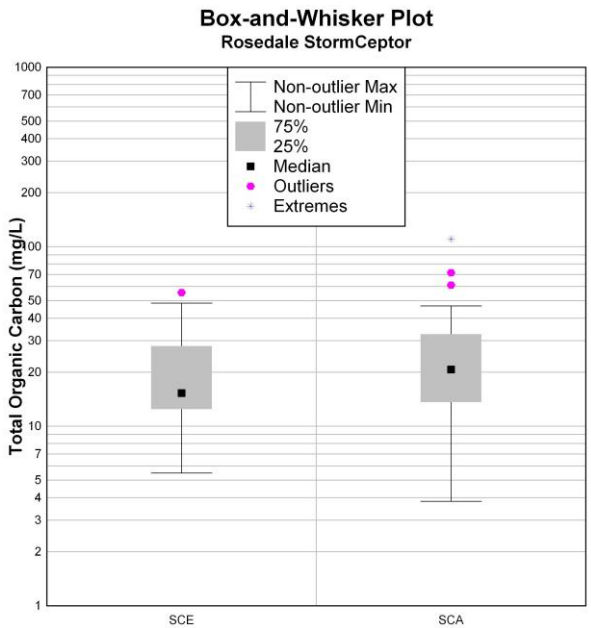


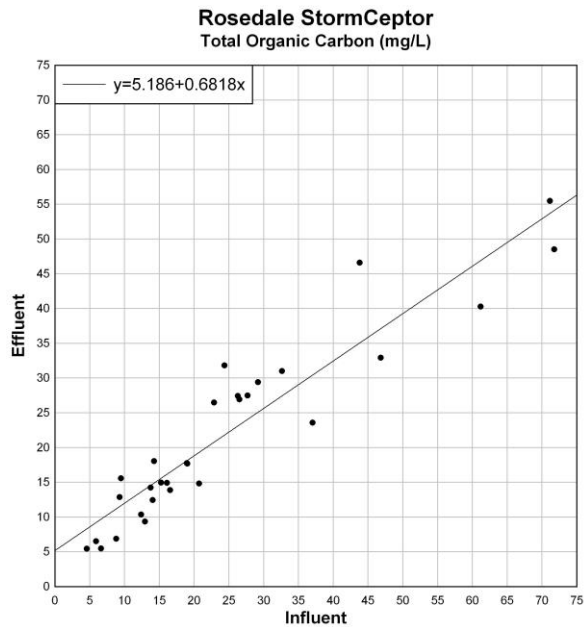
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	340.66	201.23
	Upper Quartile	185.76	155.61
	Median	122.97	103.60
	Lower Quartile	96.29	72.40
	Minimum	23.31	21.32
	Efficiency	15.75%	
	Mann-Whitney	0.2155	
	Wilcoxon (paired)	0.0006 **	
Arithmetic	UCL	157.06	133.41
	Mean	133.73	112.14
	LCL	110.40	90.88
	Std. Dev.	65.78	54.83
	Wilk (p-value)	0.1194	0.1469
	Efficiency	16.14%	
	t-Test (equal var.)	0.1737	
	t-Test (unequal var.)	0.1674	
	t-test (paired)	0.0019 **	
	Levene Test	0.3980	
Log Transformed	UCL	171.42	146.82
	Mean	137.04	114.68
	LCL	109.56	89.58
	Std. Dev.	85.18	71.64
	Wilk (p-value)	0.0278 **	0.0588 *
	Efficiency	16.31%	
	t-Test (equal var.)	0.2366	
	t-Test (unequal var.)	0.2371	
	t-Test (paired)	0.0006 **	
	Levene Test	0.9815	
Bootstrap	UCL	156.16	132.94
	Mean	133.73	112.15
	LCL	111.31	91.35
	Std. Dev.	63.25	53.64
	Efficiency	16.14%	

Rosedale StormCeptor - Total Organic Carbon (mg/L)



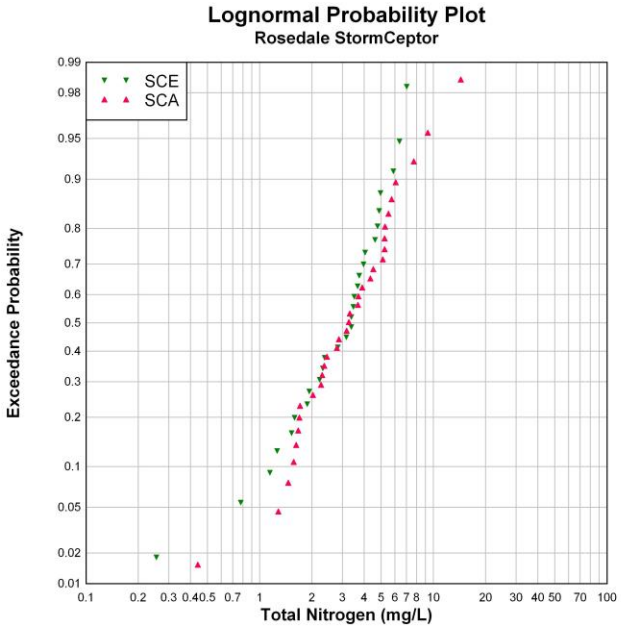


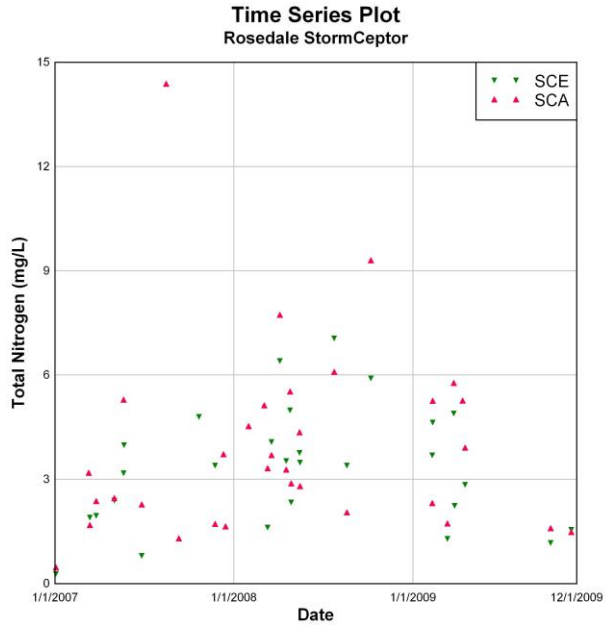


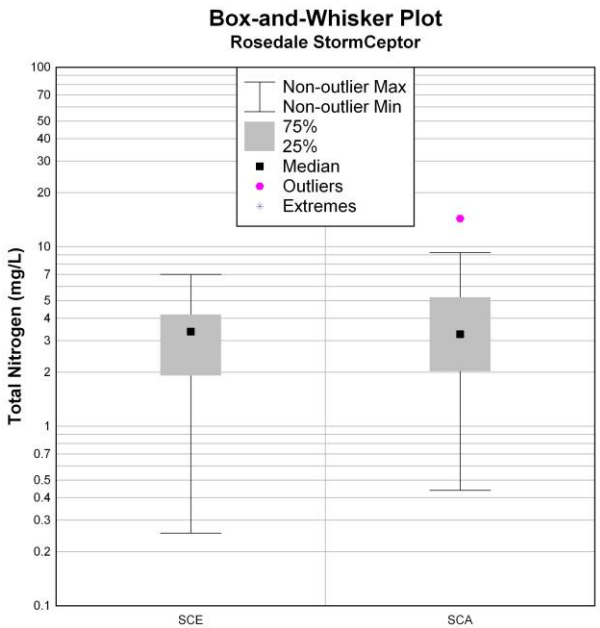


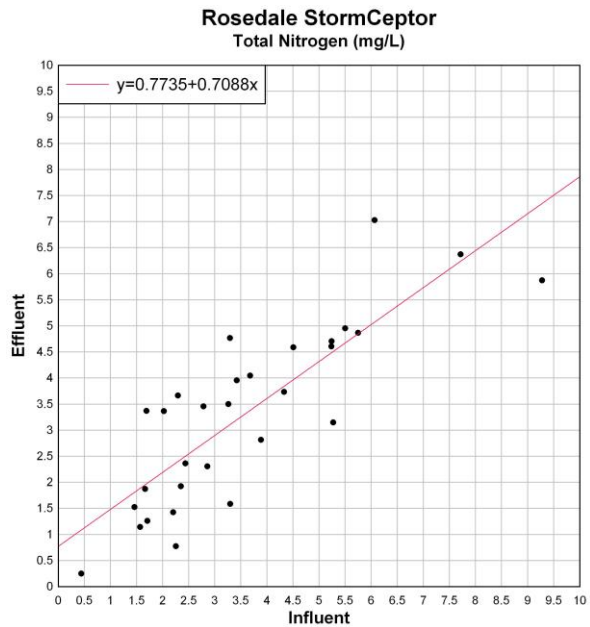
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	110.35	55.49
	Upper Quartile	32.62	28.44
	Median	20.69	15.29
	Lower Quartile	13.61	12.46
	Minimum	3.82	5.48
	Efficiency	26.13%	
	Mann-Whitney	0.5220	
	Wilcoxon (paired)	0.1688	
Arithmetic	UCL	34.42	26.48
	Mean	26.58	21.22
	LCL	18.74	15.95
	Std. Dev.	22.10	13.58
	Wilk (p-value)	0.0001 **	0.0059 **
	Efficiency	20.19%	
	t-Test (equal var.)	0.2684	
	t-Test (unequal var.)	0.2510	
	t-test (paired)	0.0597 *	
	Levene Test	0.2203	
Log Transformed	UCL	36.97	28.15
	Mean	26.82	21.34
	LCL	19.46	16.17
	Std. Dev.	23.80	14.91
	Wilk (p-value)	0.9905	0.4741
	Efficiency	20.44%	
	t-Test (equal var.)	0.4849	
	t-Test (unequal var.)	0.4779	
	t-Test (paired)	0.1831	
	Levene Test	0.2477	
Bootstrap	UCL	33.90	26.25
	Mean	26.50	21.17
	LCL	19.09	16.08
	Std. Dev.	20.89	13.11
	Efficiency	20.11%	

Rosedale StormCeptor - Total Nitrogen (mg/L)



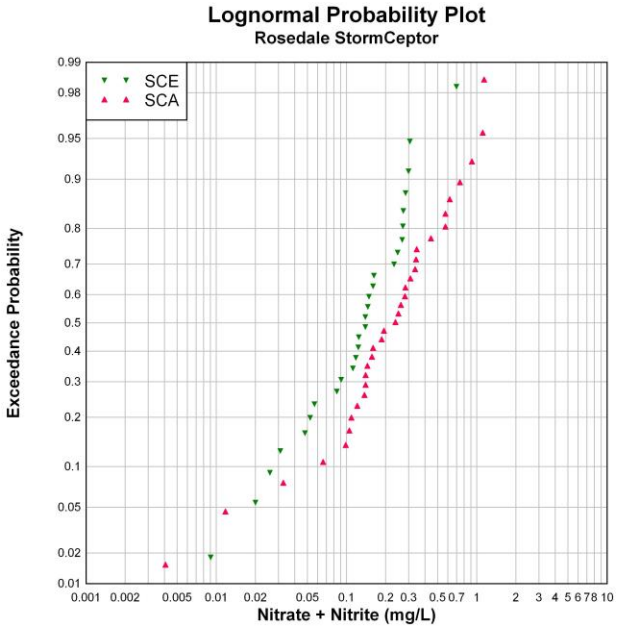


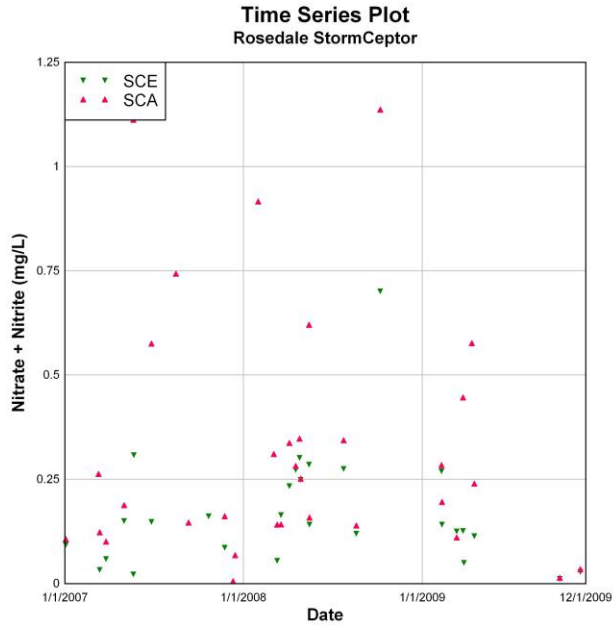


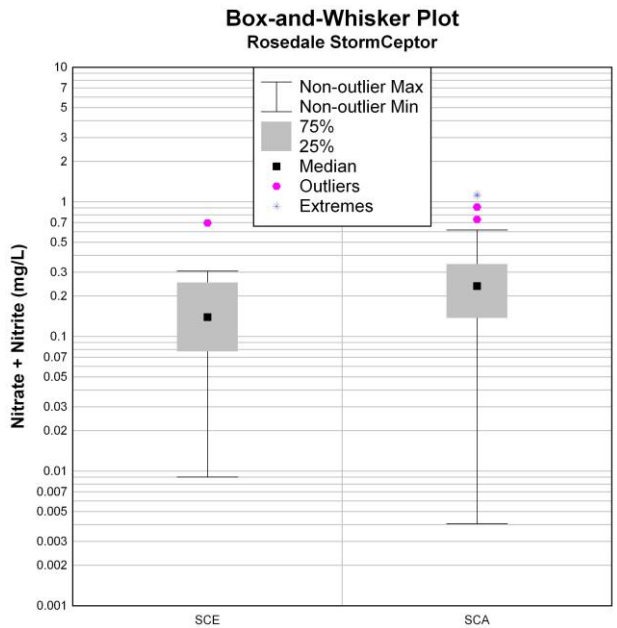


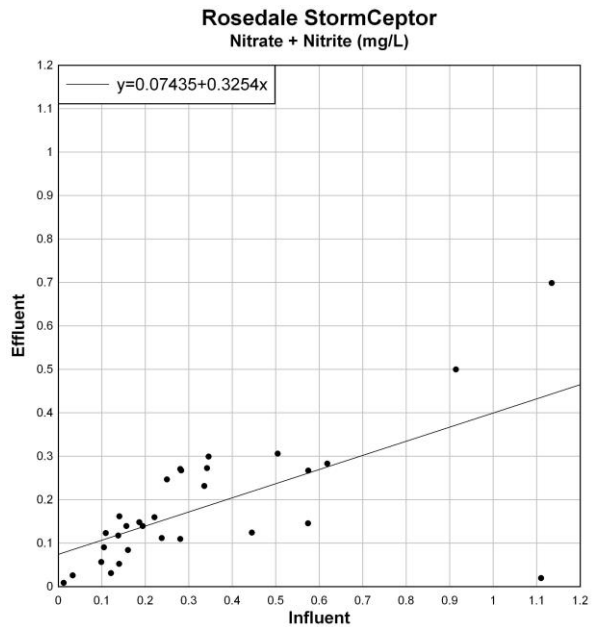
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	14.357	7.031
	Upper Quartile	5.233	4.330
	Median	3.258	3.371
	Lower Quartile	2.024	1.901
	Minimum	0.440	0.254
	Efficiency	-3.46%	
	Mann-Whitney	0.5503	
	Wilcoxon (paired)	0.2113	
Arithmetic	UCL	4.838	3.903
	Mean	3.870	3.244
	LCL	2.903	2.584
	Std. Dev.	2.728	1.701
	Wilk (p-value)	0.0001 **	0.8176
	Efficiency	16.19%	
	t-Test (equal var.)	0.2964	
	t-Test (unequal var.)	0.2793	
	t-test (paired)	0.1974	
	Levene Test	0.2361	
Log Transformed	UCL	5.109	4.691
	Mean	3.912	3.437
	LCL	2.995	2.518
	Std. Dev.	2.894	2.689
	Wilk (p-value)	0.5731	0.0077 **
	Efficiency	12.13%	
	t-Test (equal var.)	0.3985	
	t-Test (unequal var.)	0.4007	
	t-Test (paired)	0.1464	
	Levene Test	0.8446	
Bootstrap	UCL	4.797	3.889
	Mean	3.874	3.242
	LCL	2.951	2.595
	Std. Dev.	2.603	1.668
	Efficiency	16.31%	

Rosedale StormCeptor - Nitrate + Nitrite (mg/L)



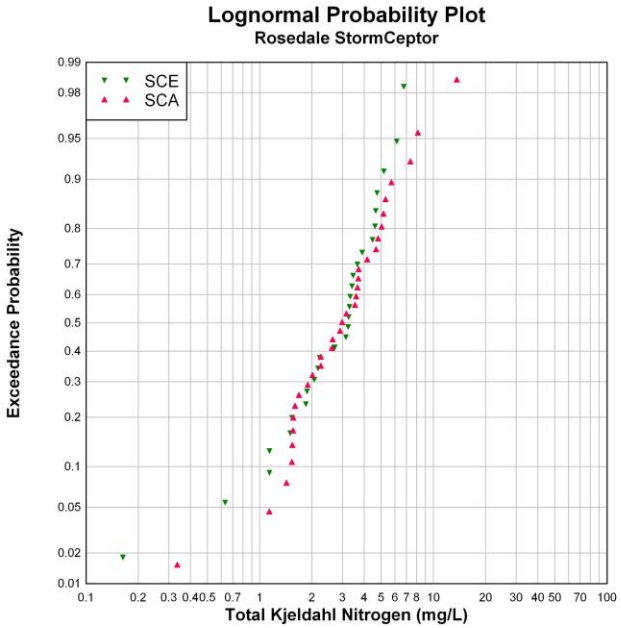


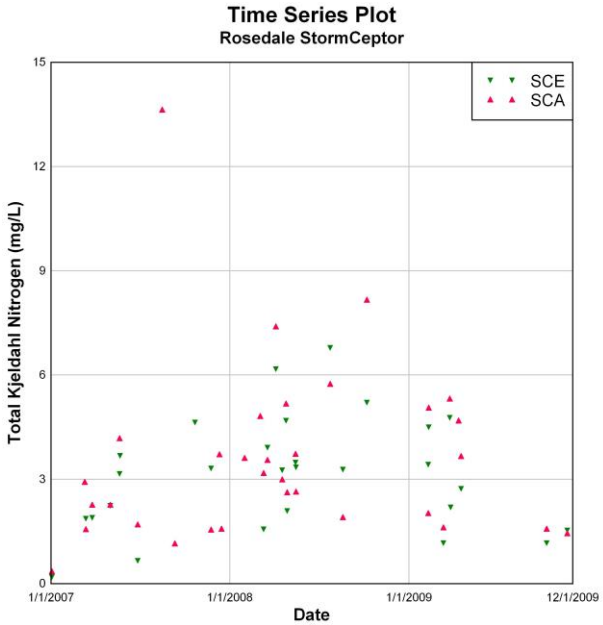


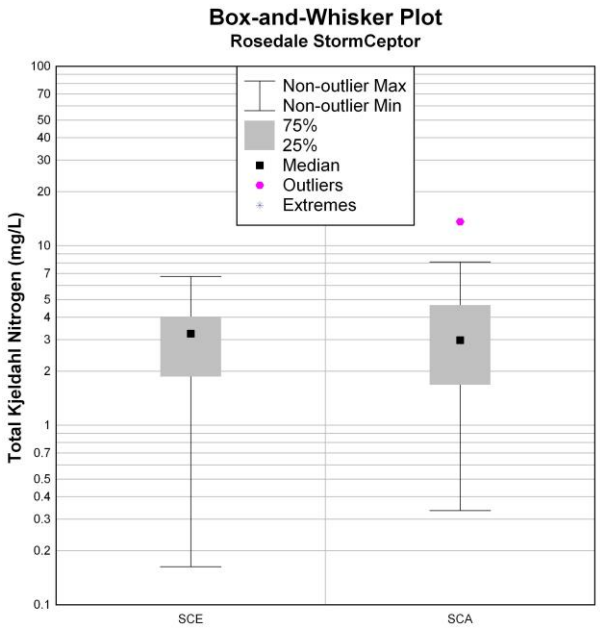


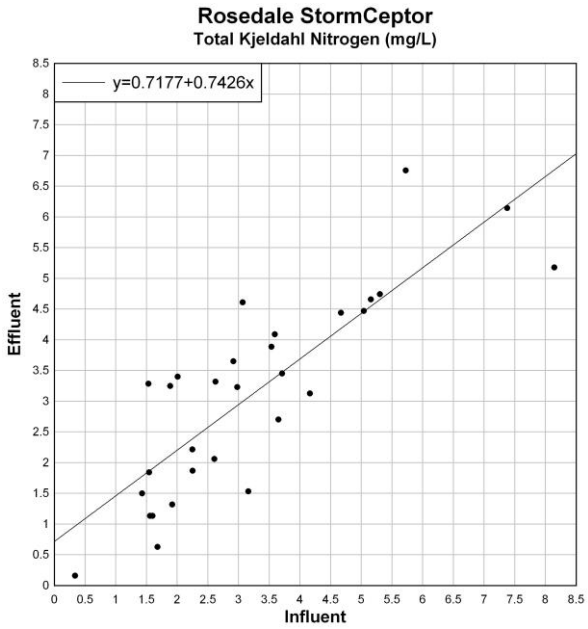
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	1.134	0.699
	Upper Quartile	0.345	0.257
	Median	0.237	0.139
	Lower Quartile	0.137	0.070
	Minimum	0.004	0.009
	Efficiency	41.31%	
	Mann-Whitney	0.0271 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.425	0.221
	Mean	0.320	0.167
	LCL	0.215	0.113
	Std. Dev.	0.296	0.139
	Wilk (p-value)	0.0001 **	0.0002 **
	Efficiency	47.89%	
	t-Test (equal var.)	0.0149 **	
	t-Test (unequal var.)	0.0110 **	
	t-test (paired)	0.0010 **	
	Levene Test	0.0389 **	
Log Transformed	UCL	0.676	0.286
	Mean	0.388	0.181
	LCL	0.222	0.115
	Std. Dev.	0.605	0.207
	Wilk (p-value)	0.0053 **	0.1038
	Efficiency	53.26%	
	t-Test (equal var.)	0.0651 *	
	t-Test (unequal var.)	0.0607 *	
	t-Test (paired)	0.0003 **	
	Levene Test	0.4323	
Bootstrap	UCL	0.420	0.220
	Mean	0.319	0.168
	LCL	0.217	0.116
	Std. Dev.	0.287	0.134
	Efficiency	47.33%	

Rosedale StormCeptor - Total Kjeldahl Nitrogen (mg/L)



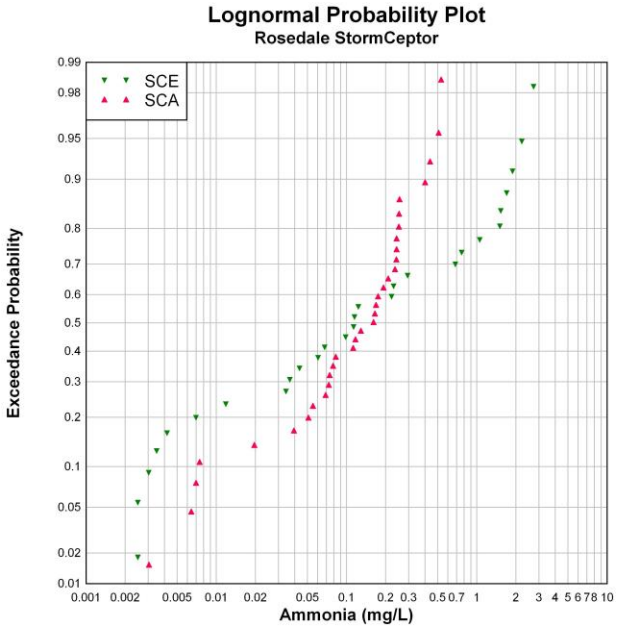


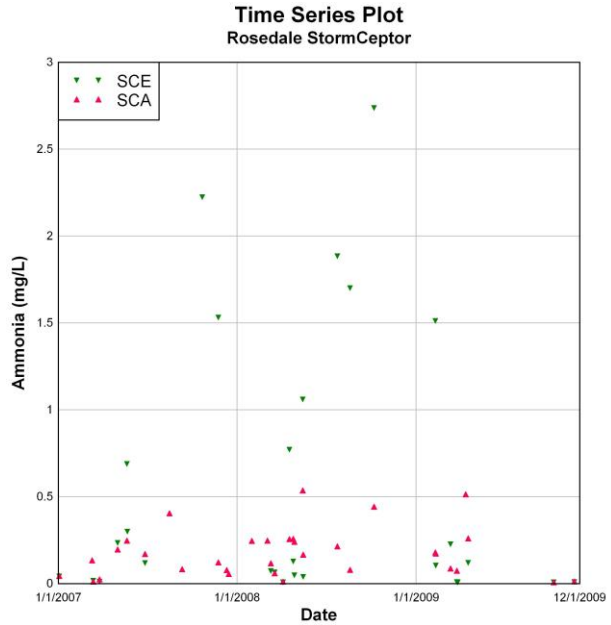


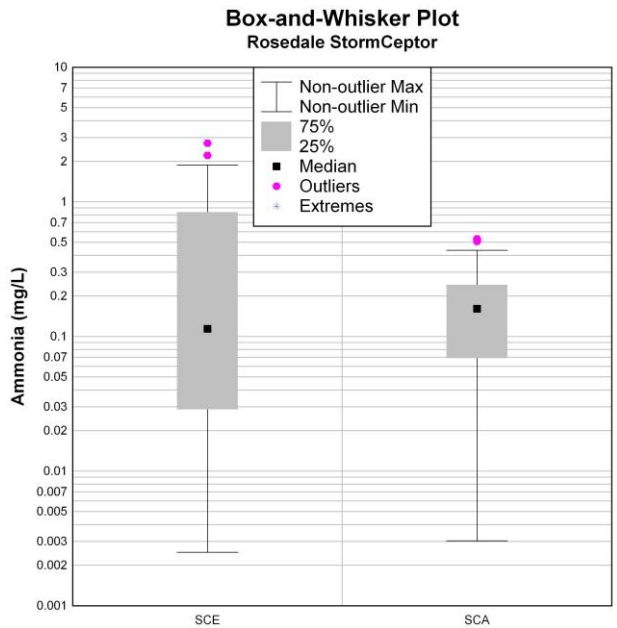


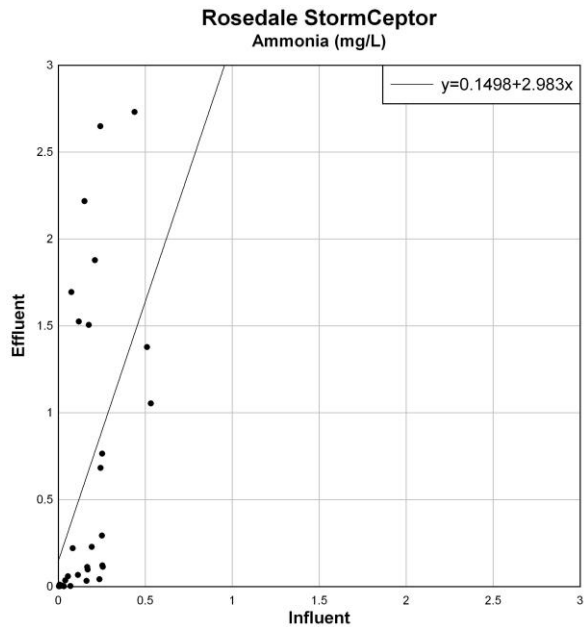
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	13.616	6.757
	Upper Quartile	4.665	4.179
	Median	2.978	3.243
	Lower Quartile	1.679	1.857
	Minimum	0.335	0.163
	Efficiency	-8.88%	
	Mann-Whitney	0.6709	
	Wilcoxon (paired)	0.5395	
Arithmetic	UCL	4.455	3.705
	Mean	3.550	3.077
	LCL	2.646	2.448
	Std. Dev.	2.550	1.621
	Wilk (p-value)	0.0001 **	0.8053
	Efficiency	13.34%	
	t-Test (equal var.)	0.4002	
	t-Test (unequal var.)	0.3838	
	t-test (paired)	0.5295	
	Levene Test	0.2691	
Log Transformed	UCL	4.745	4.706
	Mean	3.605	3.343
	LCL	2.738	2.374
	Std. Dev.	2.744	2.871
	Wilk (p-value)	0.2578	0.0010 **
	Efficiency	7.27%	
	t-Test (equal var.)	0.4995	
	t-Test (unequal var.)	0.5034	
	t-Test (paired)	0.3163	
	Levene Test	0.7204	
Bootstrap	UCL	4.416	3.690
	Mean	3.555	3.074
	LCL	2.695	2.459
	Std. Dev.	2.427	1.587
	Efficiency	13.53%	

Rosedale StormCeptor - Ammonia (mg/L)



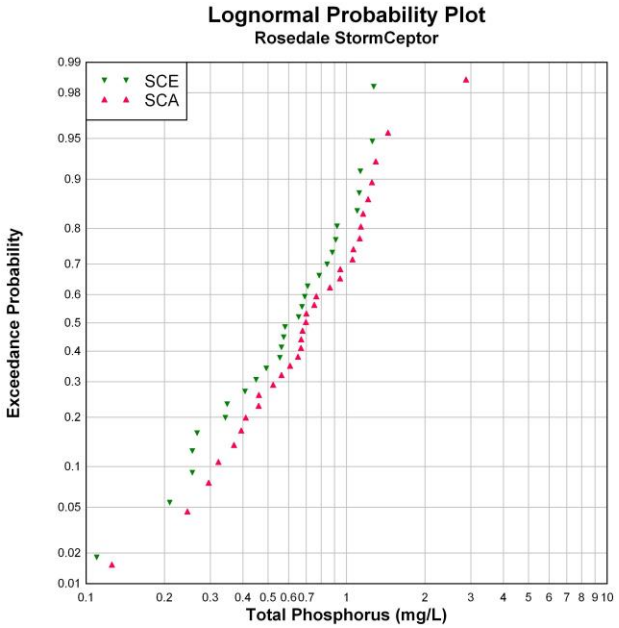


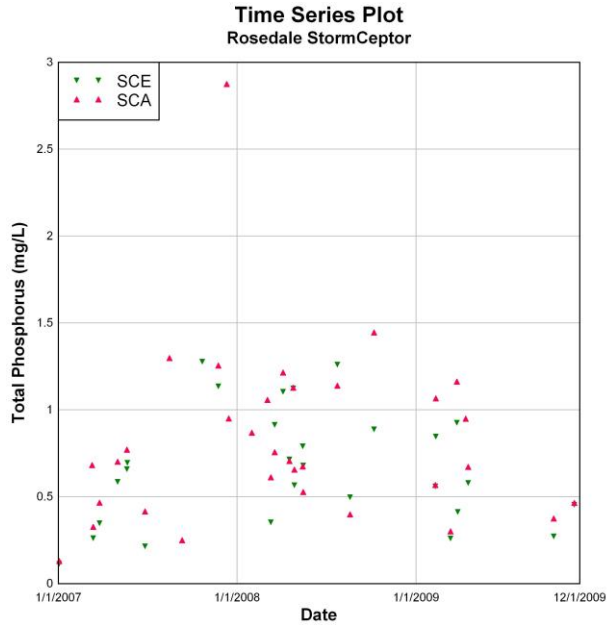


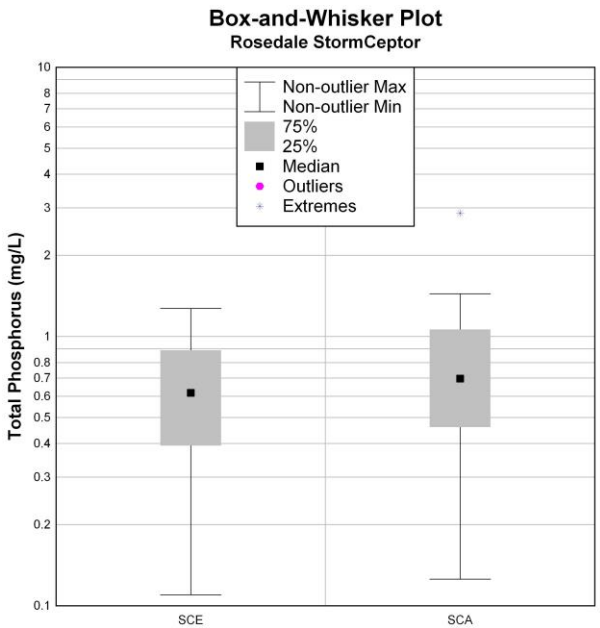


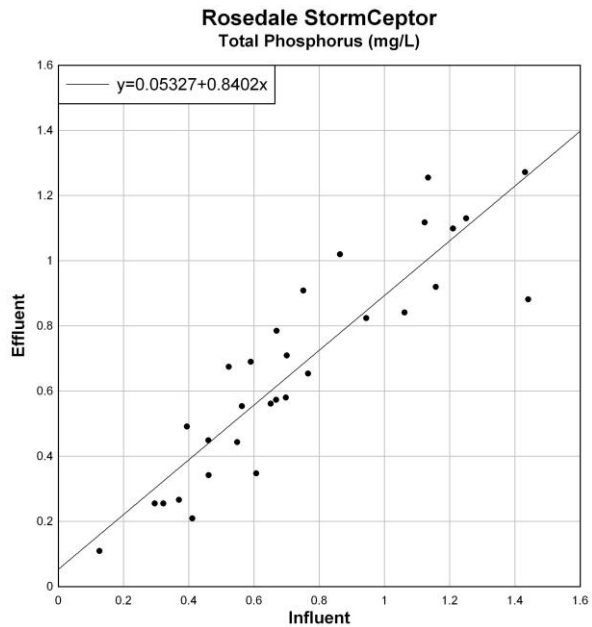
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	0.531	2.732
	Upper Quartile	0.242	0.910
	Median	0.161	0.114
	Lower Quartile	0.069	0.023
	Minimum	0.003	0.003
	Efficiency	29.34%	
	Mann-Whitney	0.9483	
	Wilcoxon (paired)	0.0645 *	
Arithmetic	UCL	0.220	0.864
	Mean	0.169	0.555
	LCL	0.119	0.245
	Std. Dev.	0.141	0.798
	Wilk (p-value)	0.0034 **	0.0001 **
	Efficiency	-227.38%	
	t-Test (equal var.)	0.0084 **	
	t-Test (unequal var.)	0.0175 **	
	t-test (paired)	0.0028 **	
	Levene Test	0.0012 **	
Log Transformed	UCL	0.430	6.325
	Mean	0.226	1.118
	LCL	0.118	0.198
	Std. Dev.	0.414	6.113
	Wilk (p-value)	0.0014 **	0.0493 **
	Efficiency	-395.56%	
	t-Test (equal var.)	0.9181	
	t-Test (unequal var.)	0.9216	
	t-Test (paired)	0.3236	
	Levene Test	0.0009 **	
Bootstrap	UCL	0.219	0.848
	Mean	0.170	0.549
	LCL	0.121	0.250
	Std. Dev.	0.138	0.772
	Efficiency	-223.62%	

Rosedale StormCeptor - Total Phosphorus (mg/L)



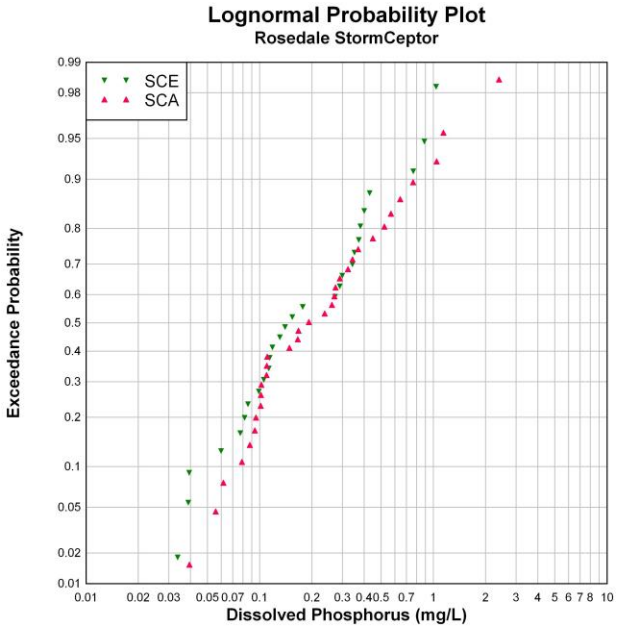


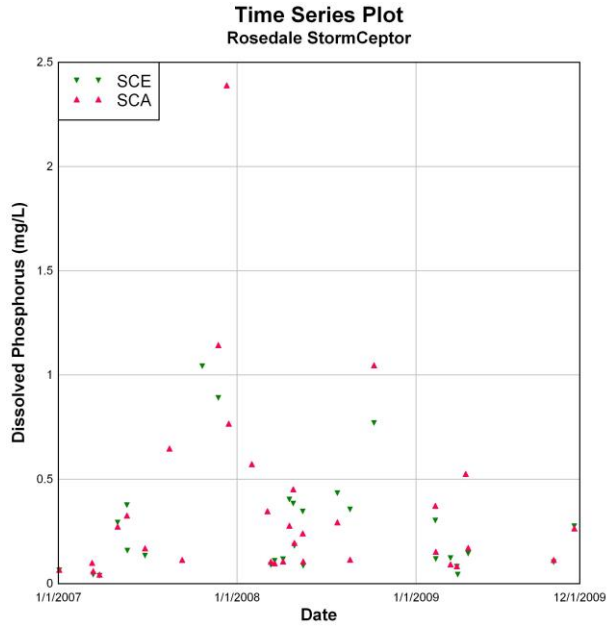


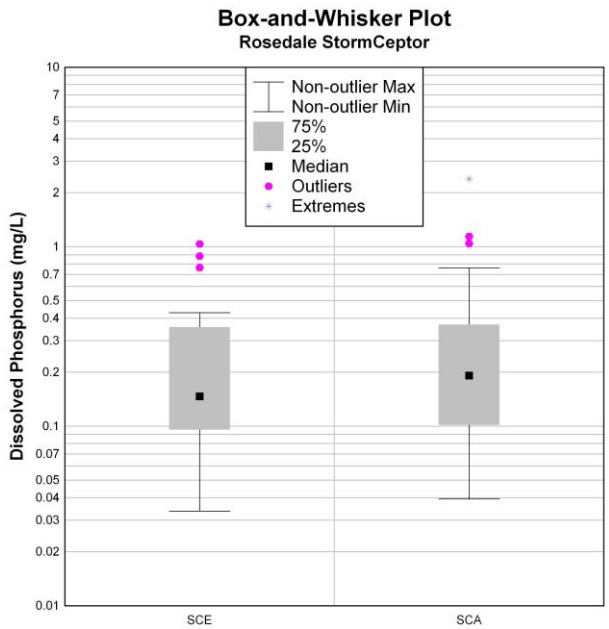


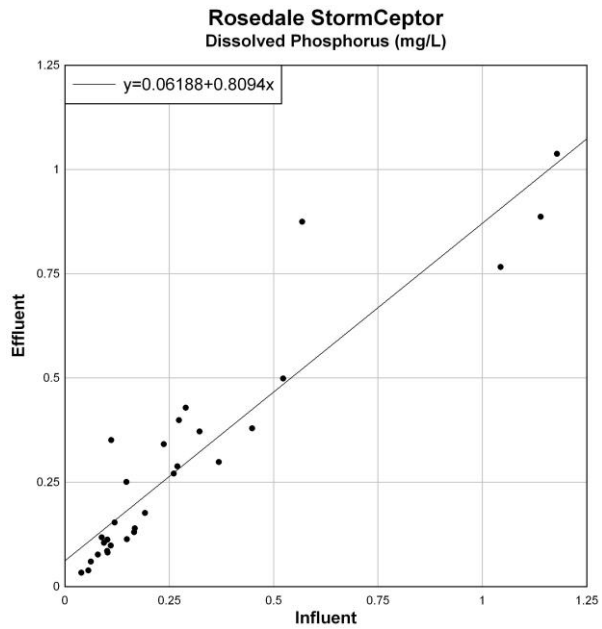
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	2.870	1.272
	Upper Quartile	1.061	0.896
	Median	0.697	0.617
	Lower Quartile	0.461	0.378
	Minimum	0.126	0.110
	Efficiency	11.46%	
	Mann-Whitney	0.2428	
	Wilcoxon (paired)	0.0344 **	
Arithmetic	UCL	0.987	0.783
	Mean	0.809	0.655
	LCL	0.631	0.527
	Std. Dev.	0.502	0.330
	Wilk (p-value)	0.0001 **	0.3810
	Efficiency	18.98%	
	t-Test (equal var.)	0.1720	
	t-Test (unequal var.)	0.1586	
	t-test (paired)	0.0263 **	
	Levene Test	0.3197	
Log Transformed	UCL	1.033	0.868
	Mean	0.817	0.672
	LCL	0.646	0.520
	Std. Dev.	0.531	0.435
	Wilk (p-value)	0.5273	0.1250
	Efficiency	17.81%	
	t-Test (equal var.)	0.2151	
	t-Test (unequal var.)	0.2153	
	t-Test (paired)	0.0100 **	
	Levene Test	0.9899	
Bootstrap	UCL	0.973	0.777
	Mean	0.806	0.653
	LCL	0.640	0.528
	Std. Dev.	0.470	0.320
	Efficiency	19.07%	

Rosedale StormCeptor - Dissolved Phosphorus (mg/L)



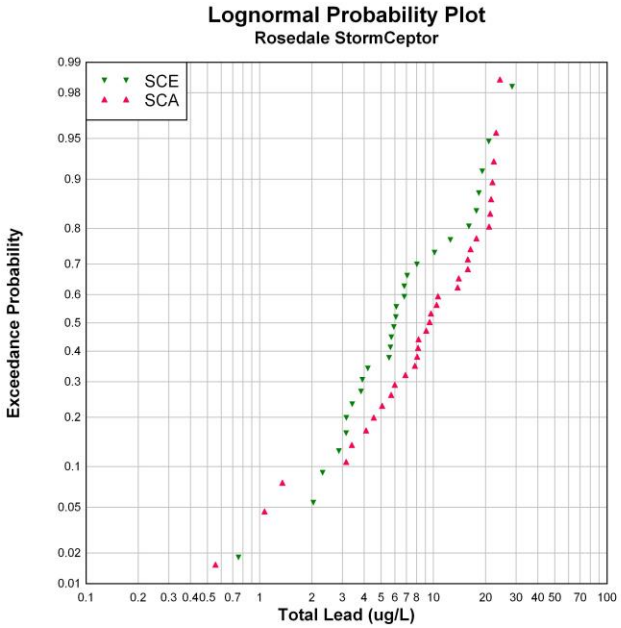


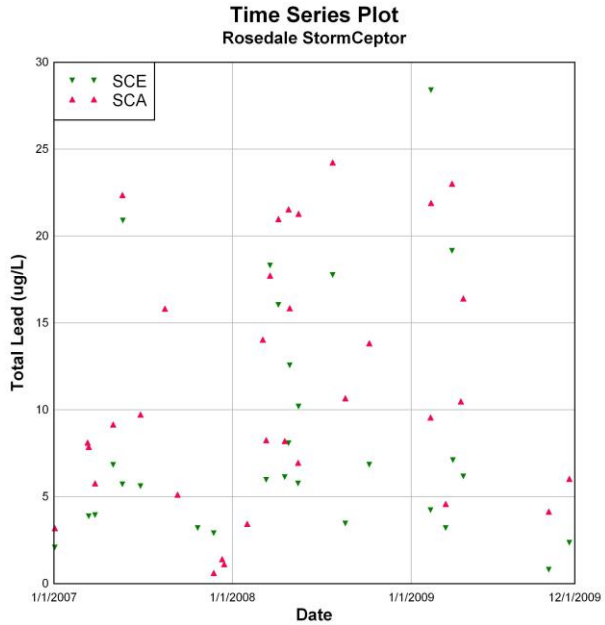


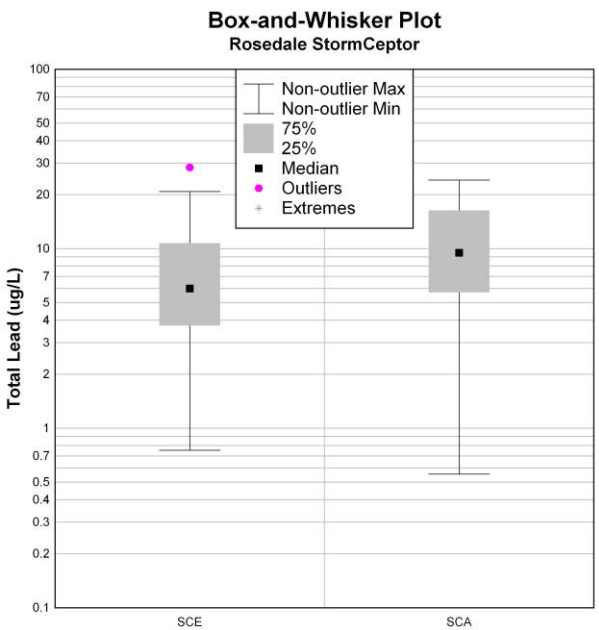


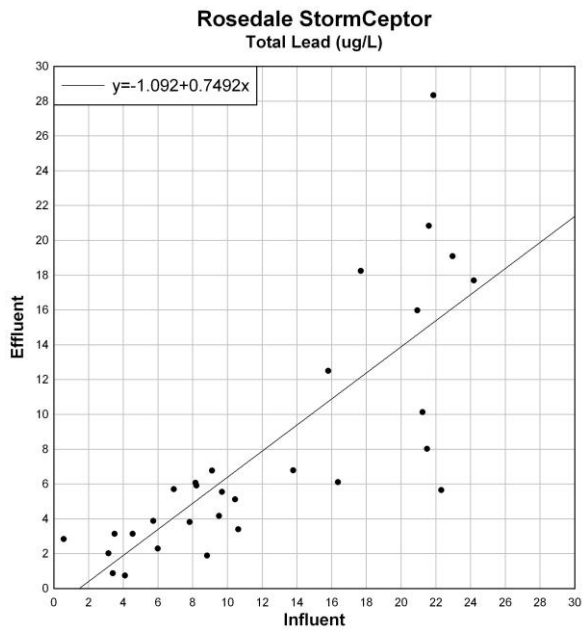
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	2.385	1.038
	Upper Quartile	0.368	0.362
	Median	0.191	0.147
	Lower Quartile	0.102	0.092
	Minimum	0.039	0.034
	Efficiency	23.23%	
	Mann-Whitney	0.5993	
	Wilcoxon (paired)	0.9920	
Arithmetic	UCL	0.516	0.364
	Mean	0.354	0.264
	LCL	0.193	0.164
	Std. Dev.	0.456	0.258
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	25.50%	
	t-Test (equal var.)	0.3566	
	t-Test (unequal var.)	0.3366	
	t-test (paired)	0.7793	
	Levene Test	0.3202	
Log Transformed	UCL	0.509	0.411
	Mean	0.335	0.265
	LCL	0.221	0.171
	Std. Dev.	0.387	0.291
	Wilk (p-value)	0.4263	0.4864
	Efficiency	20.83%	
	t-Test (equal var.)	0.4060	
	t-Test (unequal var.)	0.4049	
	t-Test (paired)	0.4362	
	Levene Test	0.8376	
Bootstrap	UCL	0.498	0.355
	Mean	0.350	0.261
	LCL	0.202	0.166
	Std. Dev.	0.418	0.243
	Efficiency	25.44%	

Rosedale StormCeptor - Total Lead (ug/L)



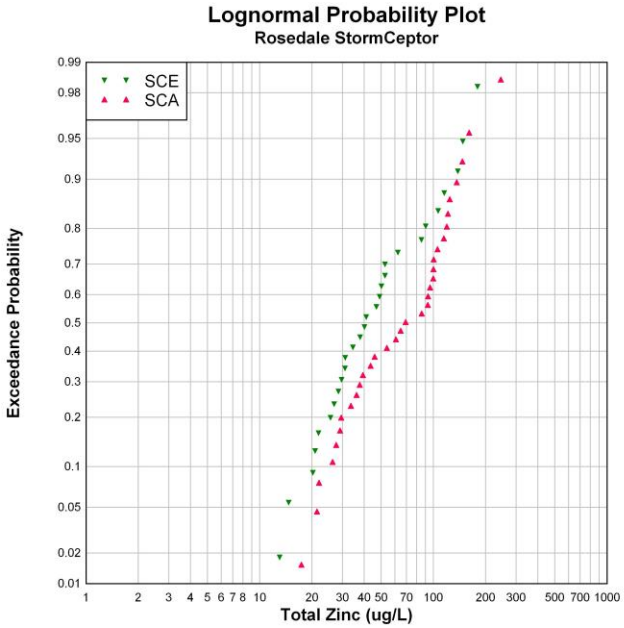


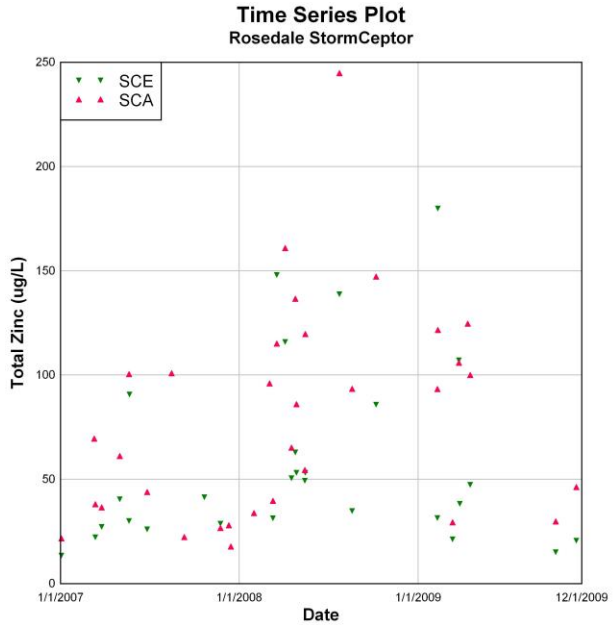


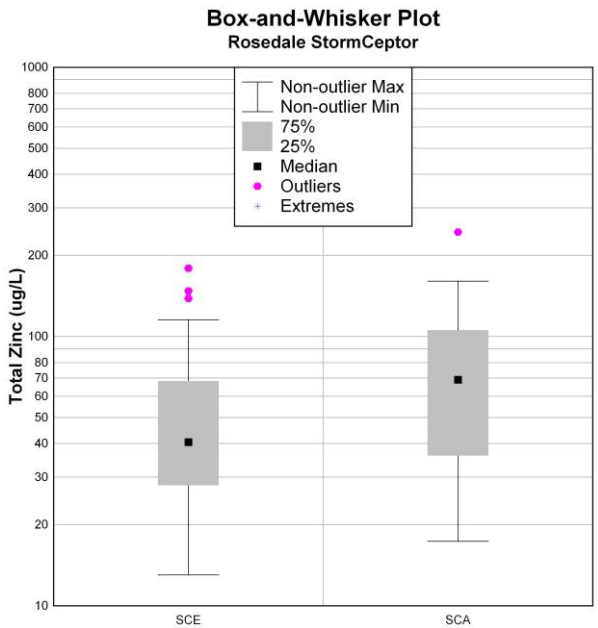


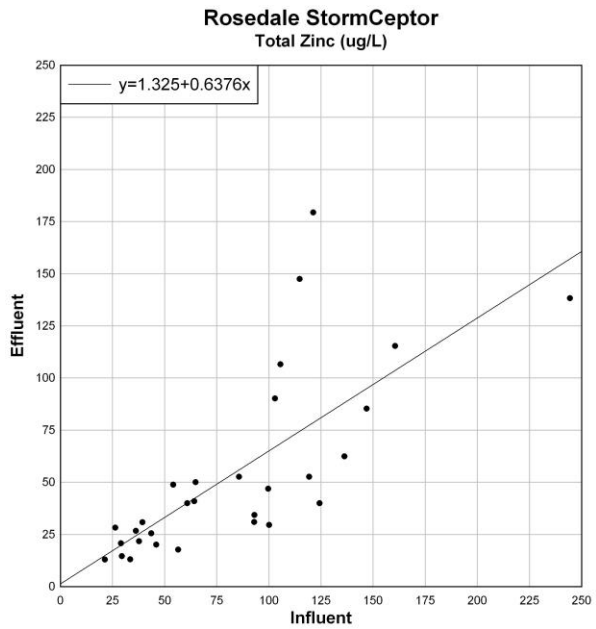
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	24.2	28.3
	Upper Quartile	16.3	11.3
	Median	9.5	6.0
	Lower Quartile	5.7	3.6
	Minimum	0.6	0.8
	Efficiency	36.87%	
	Mann-Whitney	0.0721 *	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	13.8	11.1
	Mean	11.3	8.4
	LCL	8.7	5.8
	Std. Dev.	7.2	6.9
	Wilk (p-value)	0.0365 **	0.0004 **
	Efficiency	25.08%	
	t-Test (equal var.)	0.1253	
	t-Test (unequal var.)	0.1240	
	t-test (paired)	0.0000 **	
	Levene Test	0.7730	
Log Transformed	UCL	18.6	12.4
	Mean	12.6	8.6
	LCL	8.5	5.9
	Std. Dev.	13.6	7.9
	Wilk (p-value)	0.0030 **	0.5317
	Efficiency	31.74%	
	t-Test (equal var.)	0.1950	
	t-Test (unequal var.)	0.1908	
	t-Test (paired)	0.0001 **	
	Levene Test	0.5910	
Bootstrap	UCL	13.8	11.0
	Mean	11.3	8.4
	LCL	8.8	5.9
	Std. Dev.	7.1	6.7
	Efficiency	25.52%	

Rosedale StormCeptor - Total Zinc (ug/L)



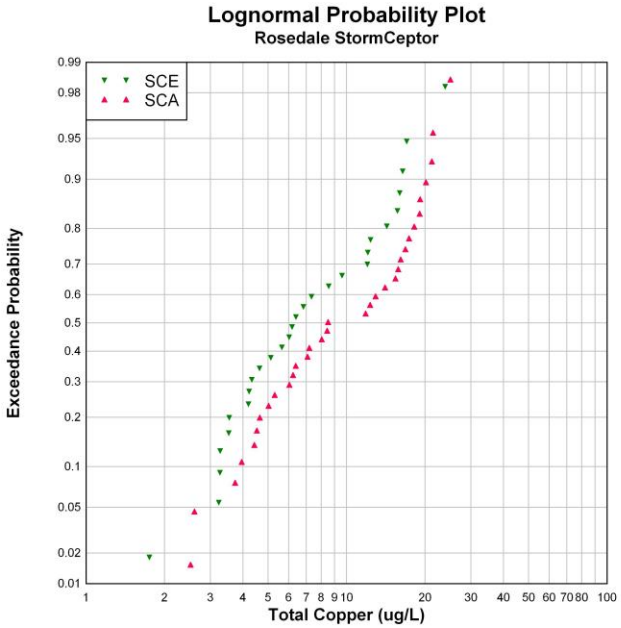


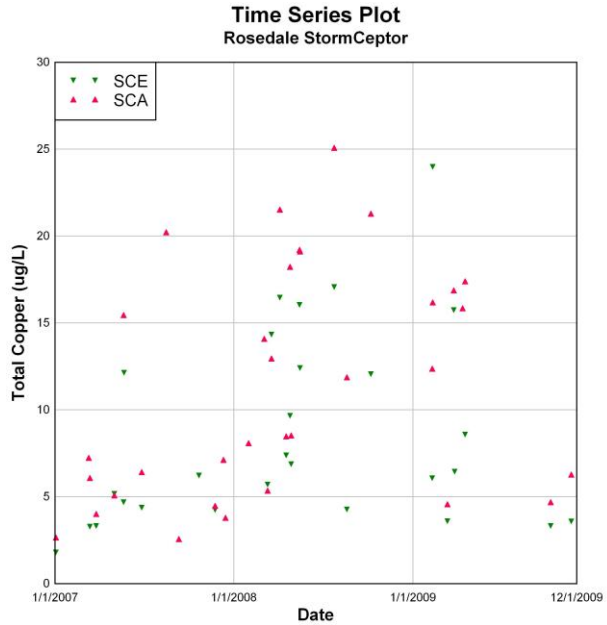


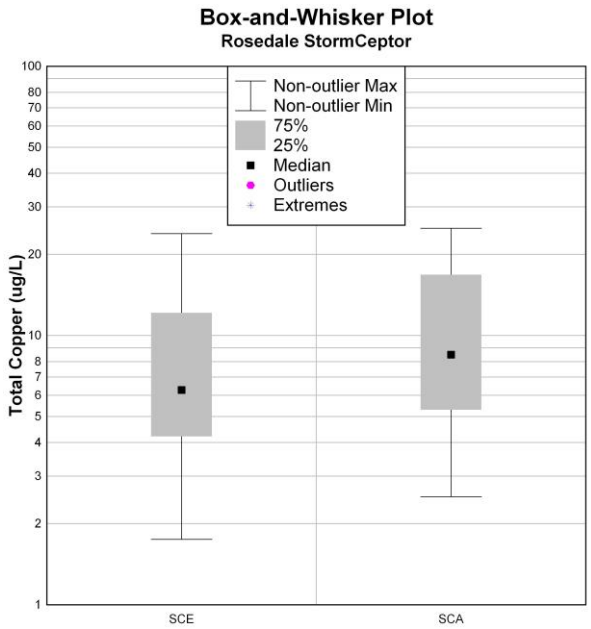


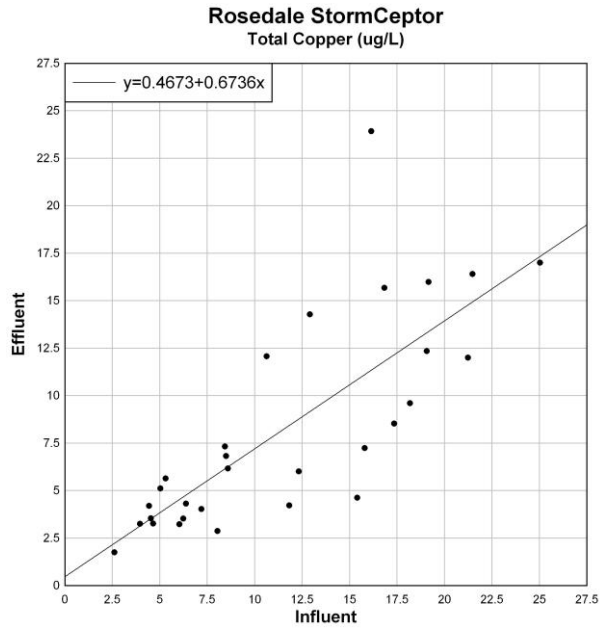
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	244.4	179.4
	Upper Quartile	105.5	73.9
	Median	69.1	40.5
	Lower Quartile	36.1	27.6
	Minimum	17.4	13.0
	Efficiency	41.35%	
	Mann-Whitney	0.0743 *	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	96.7	73.9
	Mean	78.7	56.9
	LCL	60.6	39.9
	Std. Dev.	50.9	43.8
	Wilk (p-value)	0.0054 **	0.0002 **
	Efficiency	27.69%	
	t-Test (equal var.)	0.0810 *	
	t-Test (unequal var.)	0.0773 *	
	t-test (paired)	0.0001 **	
	Levene Test	0.5309	
Log Transformed	UCL	104.9	76.2
	Mean	79.9	56.3
	LCL	60.8	41.5
	Std. Dev.	60.3	43.0
	Wilk (p-value)	0.1763	0.5086
	Efficiency	29.55%	
	t-Test (equal var.)	0.0508 *	
	t-Test (unequal var.)	0.0513 *	
	t-Test (paired)	0.0000 **	
	Levene Test	0.9306	
Bootstrap	UCL	96.9	73.3
	Mean	79.3	56.9
	LCL	61.7	40.5
	Std. Dev.	49.6	42.3
	Efficiency	28.27%	

Rosedale StormCeptor - Total Copper (ug/L)



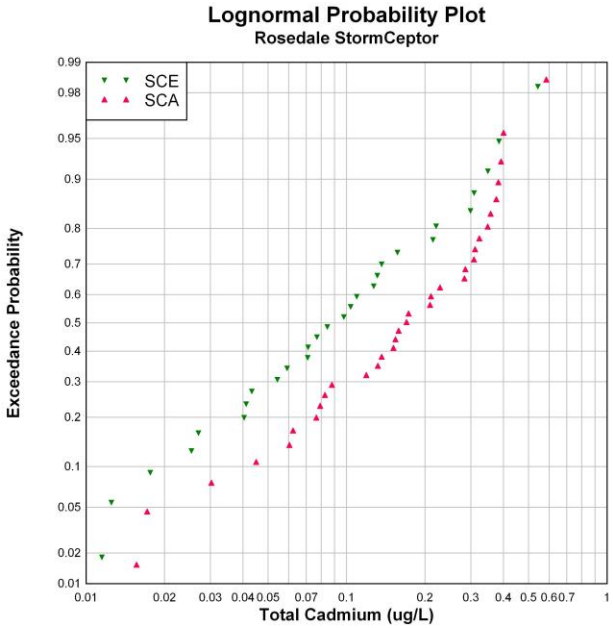


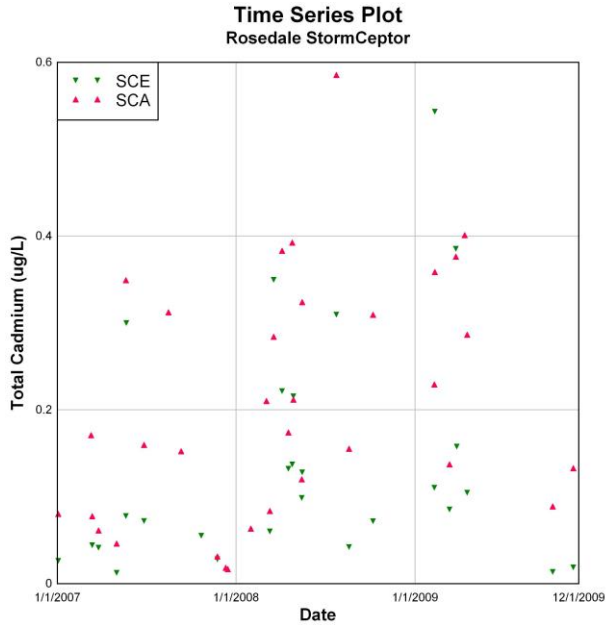


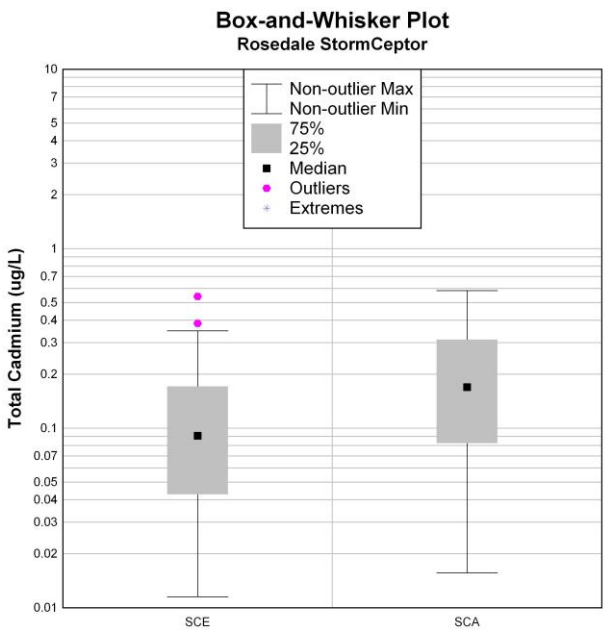


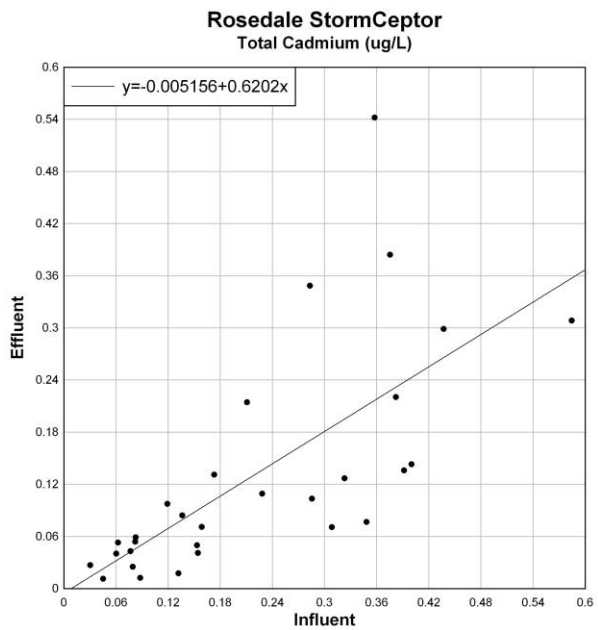
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	25.0	23.9
	Upper Quartile	16.8	12.2
	Median	8.5	6.3
	Lower Quartile	5.3	4.2
	Minimum	2.5	1.7
	Efficiency	25.93%	
	Mann-Whitney	0.0789 *	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	13.6	10.6
	Mean	11.3	8.5
	LCL	8.9	6.3
	Std. Dev.	6.6	5.6
	Wilk (p-value)	0.0169 **	0.0037 **
	Efficiency	24.68%	
	t-Test (equal var.)	0.0842 *	
	t-Test (unequal var.)	0.0801 *	
	t-test (paired)	0.0001 **	
	Levene Test	0.2599	
Log Transformed	UCL	14.9	11.3
	Mean	11.5	8.5
	LCL	8.8	6.4
	Std. Dev.	8.3	6.0
	Wilk (p-value)	0.0542 *	0.4054
	Efficiency	25.90%	
	t-Test (equal var.)	0.0921 *	
	t-Test (unequal var.)	0.0918 *	
	t-Test (paired)	0.0000 **	
	Levene Test	0.8820	
Bootstrap	UCL	13.6	10.6
	Mean	11.3	8.5
	LCL	9.0	6.4
	Std. Dev.	6.5	5.4
	Efficiency	24.82%	

Rosedale StormCeptor - Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: SCA**	**EFF: SCE**
	Site Count	33	28
	Pairs Count	30	30
Non-Parametric	Maximum	0.6	0.5
	Upper Quartile	0.3	0.2
	Median	0.2	0.1
	Lower Quartile	0.1	0.0
	Minimum	0.0	0.0
	Efficiency	46.39%	
	Mann-Whitney	0.0281 **	
	Wilcoxon (paired)	0.0000 **	
Arithmetic	UCL	0.3	0.2
	Mean	0.2	0.1
	LCL	0.2	0.1
	Std. Dev.	0.1	0.1
	Wilk (p-value)	0.0549 *	0.0003 **
	Efficiency	33.36%	
	t-Test (equal var.)	0.0561 *	
	t-Test (unequal var.)	0.0550 *	
	t-test (paired)	0.0001 **	
	Levene Test	0.7598	
Log Transformed	UCL	0.3	0.2
	Mean	0.2	0.1
	LCL	0.2	0.1
	Std. Dev.	0.2	0.2
	Wilk (p-value)	0.0250 **	0.8059
	Efficiency	36.07%	
	t-Test (equal var.)	0.0316 **	
	t-Test (unequal var.)	0.0336 **	
	t-Test (paired)	0.0000 **	
	Levene Test	0.4991	
Bootstrap	UCL	0.3	0.2
	Mean	0.2	0.1
	LCL	0.2	0.1
	Std. Dev.	0.1	0.1
	Efficiency	33.82%	

Far West Wetland (FPS-FPE)

Far West wetland is the final stage of the overall SCM. Runoff enters the wetland area at a reduced rate after passing through the sedimentation pretreatment. Discharge from the wetland travels as shallow overland flow to the monitoring point. The overall system was constructed as a retrofit of a detention basin in northwest Austin (see the COA report on small watershed quantity and quality (COA, 2009) for a detailed description of the contributing watershed). For performance summary of the overall system (FPI-FPE) refer to this section of the report; for the performance summary the sedimentation basin portion (FPI-FPS), see the Sedimentation section of this report.

The wetland was original intended to have a larger volume but bedrock was encountered and excavation was halted. The intent of the wetland was to improve the treatment of the sedimentation basin, especially with nutrients.

The City collected runoff and water quality data at the Far West wetland basin (FPS-FPE) from 1997 to 1998. During this time 10 and 12 valid EMCs were collected at the influent (FPS) and effluent (FPE) respectively, of which 8 were paired.

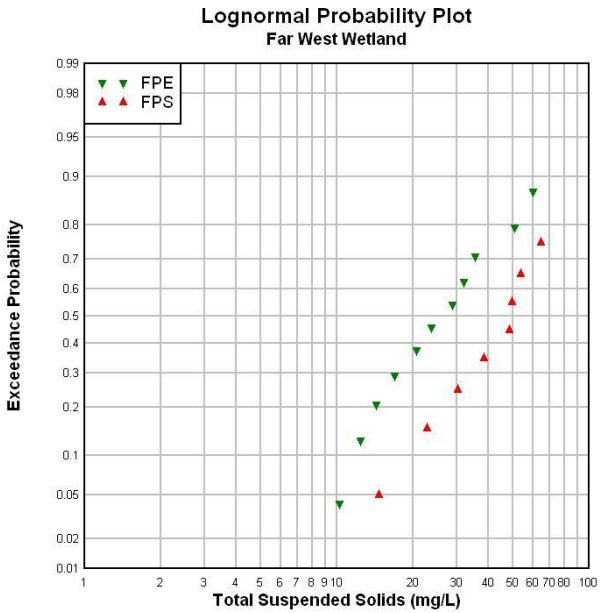
Performance Summary

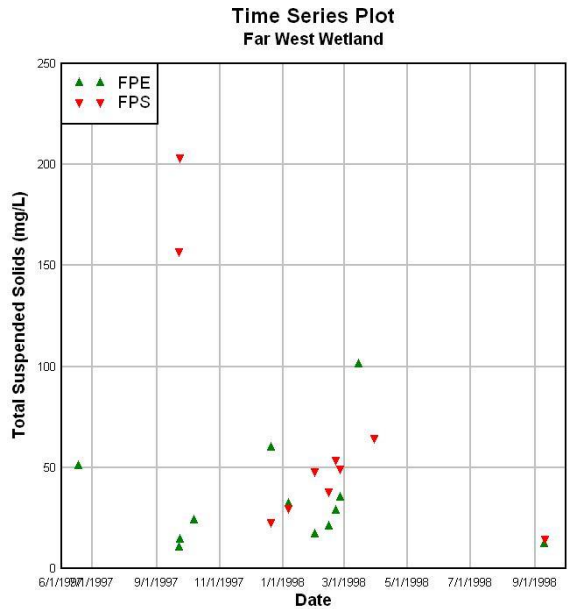
The SCM reduced TSS and VSS by 50 and 40% respectively; this was significant at the $\alpha<0.10$ level. BOD, COD and TOC were reduced but the reduction was not significant.

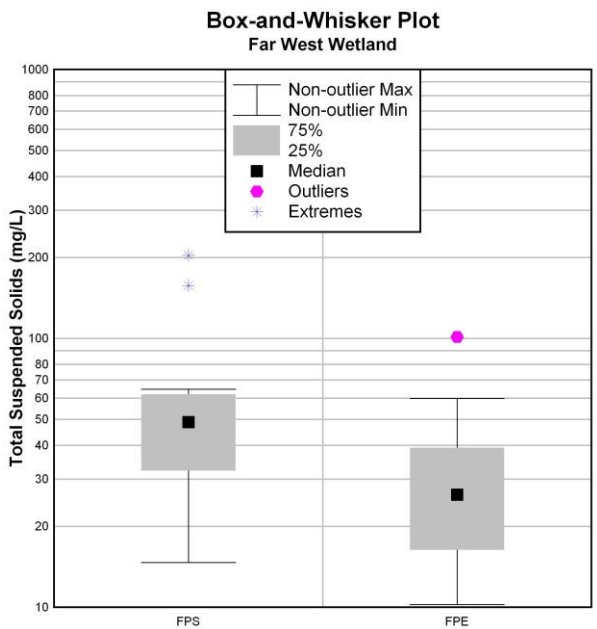
Nutrients concentrations were not significantly changed by the wetland but it should be noted that there was a slight export of total nitrogen and nitrates.

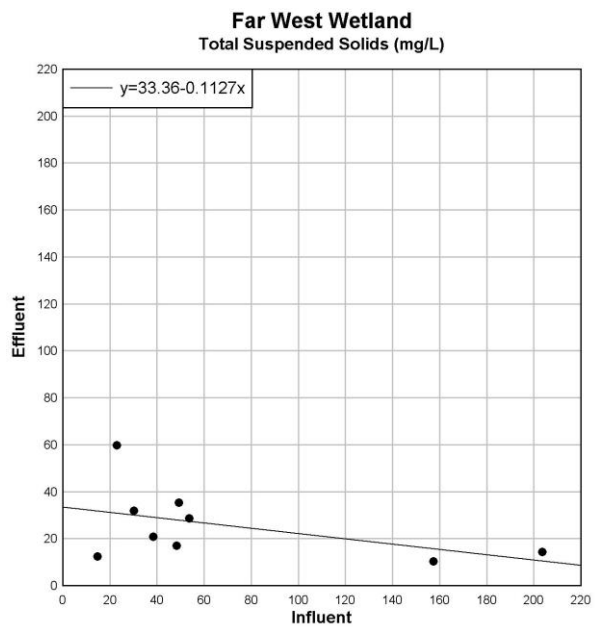
Lead, zinc and copper concentrations were reduced by 38%, 37% and 39% respectively, and were significant in all cases. Cadmium concentration was reduced by 9% and was not significant in all cases, however this was probably a result of detection limit constraints.

Far West Wetland - Total Suspended Solids (mg/L)



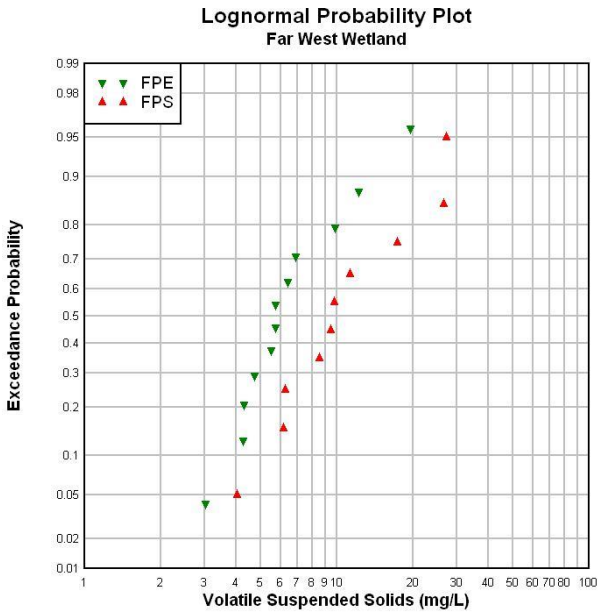


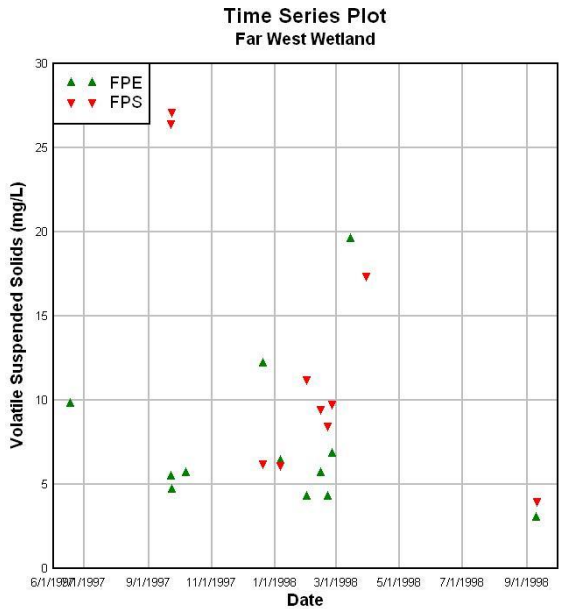


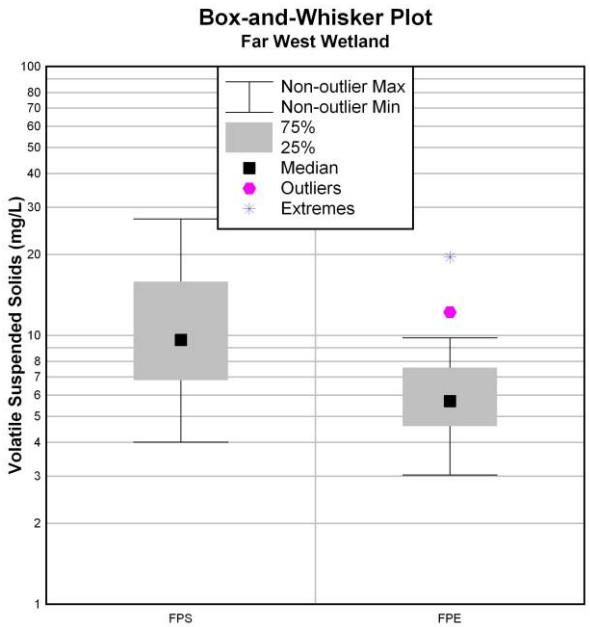


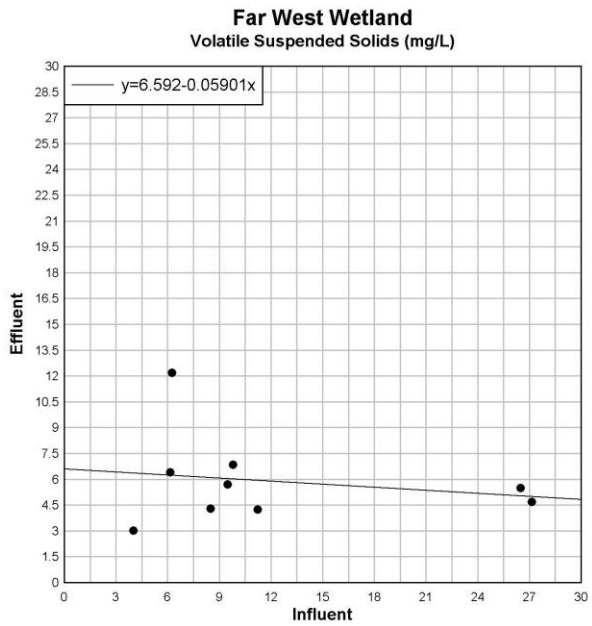
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	203.6	101.2
	Upper Quartile	64.7	43.0
	Median	48.8	26.2
	Lower Quartile	30.2	15.7
	Minimum	14.7	10.2
	Efficiency	46.29%	
	Mann-Whitney	0.0952 *	
	Wilcoxon (paired)	0.1484	
Arithmetic	UCL	112.6	50.4
	Mean	68.3	33.8
	LCL	24.0	17.3
	Std. Dev.	61.9	26.1
	Wilk (p-value)	0.0047 **	0.0149 **
	Efficiency	50.44%	
	t-Test (equal var.)	0.0944 *	
	t-Test (unequal var.)	0.1273	
	t-test (paired)	0.1232	
	Levene Test	0.1101	
Log Transformed	UCL	130.2	54.2
	Mean	66.7	33.3
	LCL	34.2	20.5
	Std. Dev.	56.1	23.9
	Wilk (p-value)	0.6873	0.9564
	Efficiency	49.99%	
	t-Test (equal var.)	0.0640 *	
	t-Test (unequal var.)	0.0695 *	
	t-Test (paired)	0.0931 *	
	Levene Test	0.5757	
Bootstrap	UCL	106.6	49.1
	Mean	67.3	34.0
	LCL	28.0	18.9
	Std. Dev.	54.9	23.8
	Efficiency	49.49%	

Far West Wetland - Volatile Suspended Solids (mg/L)



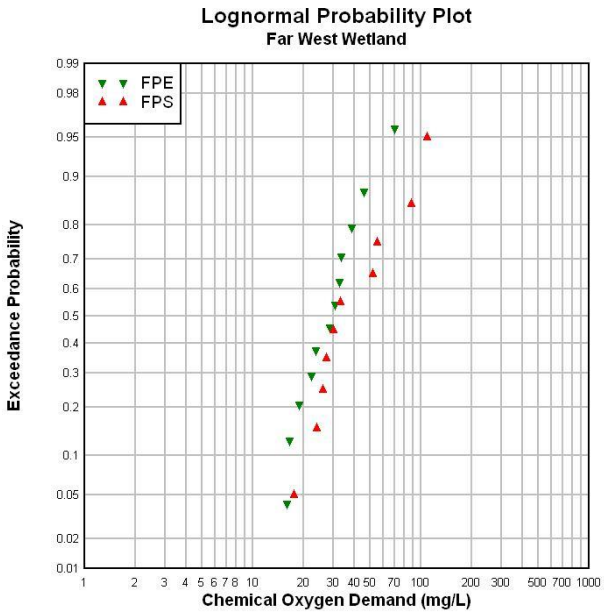


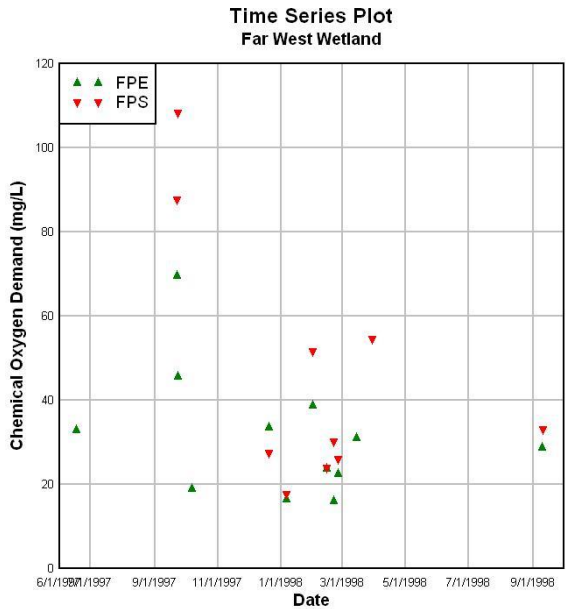


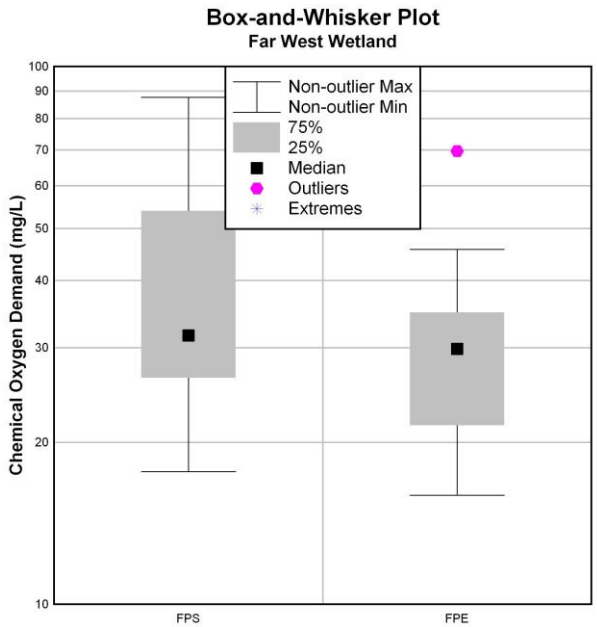


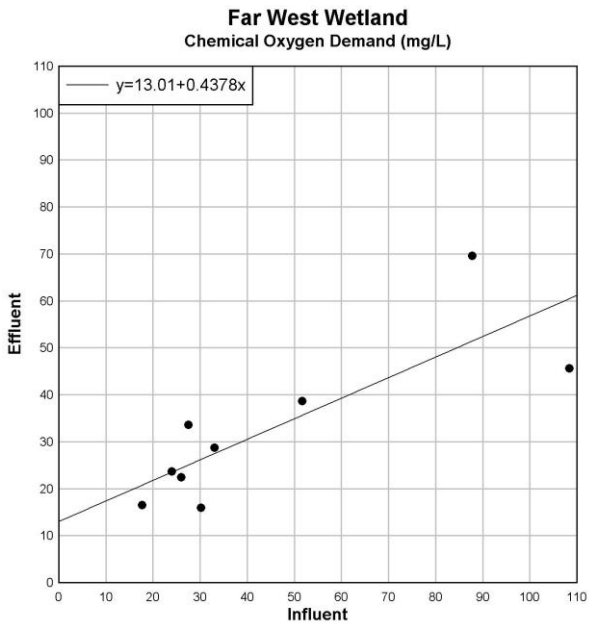
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	27.1	19.6
	Upper Quartile	17.4	8.3
	Median	9.6	5.7
	Lower Quartile	6.2	4.5
	Minimum	4.0	3.0
	Efficiency	40.86%	
	Mann-Whitney	0.0952 *	
	Wilcoxon (paired)	0.1094	
Arithmetic	UCL	18.6	10.3
	Mean	12.6	7.3
	LCL	6.7	4.4
	Std. Dev.	8.3	4.6
	Wilk (p-value)	0.0352 **	0.0045 **
	Efficiency	42.00%	
	t-Test (equal var.)	0.0721 *	
	t-Test (unequal var.)	0.0934 *	
	t-test (paired)	0.0902 *	
	Levene Test	0.1135	
Log Transformed	UCL	20.6	10.2
	Mean	12.6	7.2
	LCL	7.6	5.1
	Std. Dev.	8.1	3.8
	Wilk (p-value)	0.5910	0.4078
	Efficiency	42.60%	
	t-Test (equal var.)	0.0533 *	
	t-Test (unequal var.)	0.0597 *	
	t-Test (paired)	0.0578 *	
	Levene Test	0.4807	
Bootstrap	UCL	17.9	10.0
	Mean	12.5	7.3
	LCL	7.1	4.7
	Std. Dev.	7.5	4.2
	Efficiency	41.30%	

Far West Wetland -Chemical Oxygen Demand (mg/L)



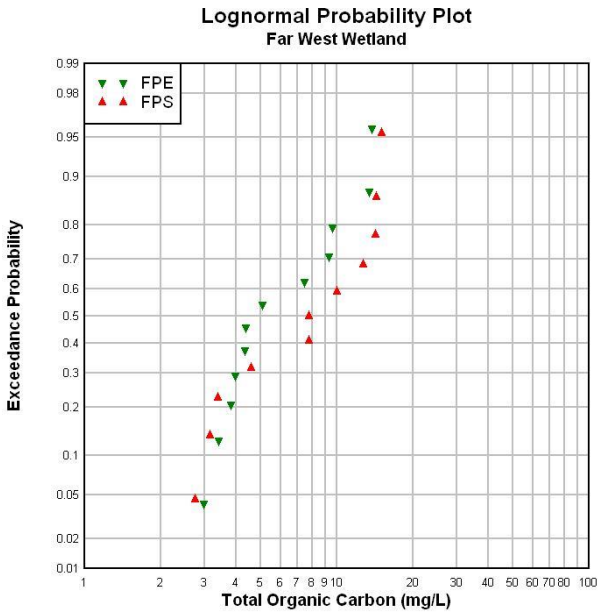


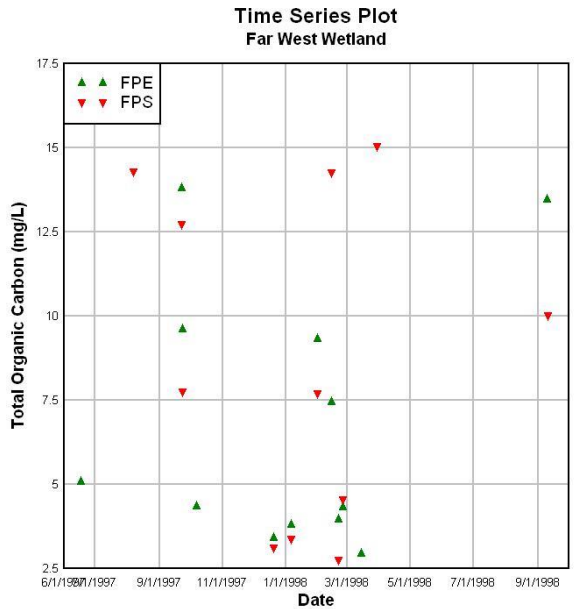


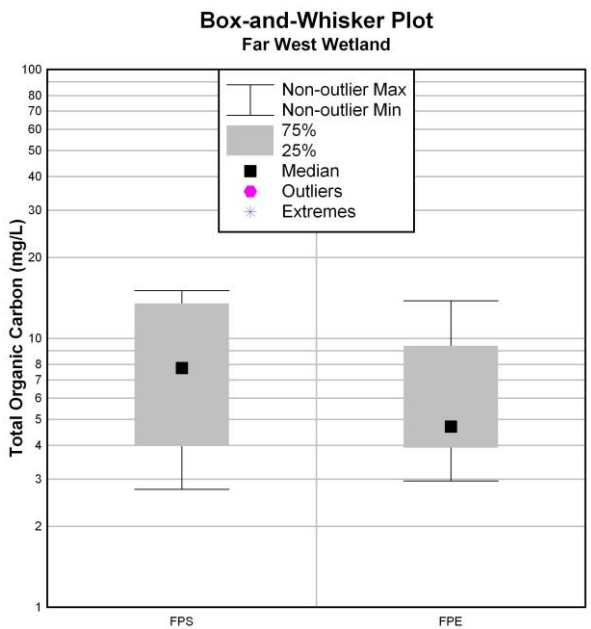


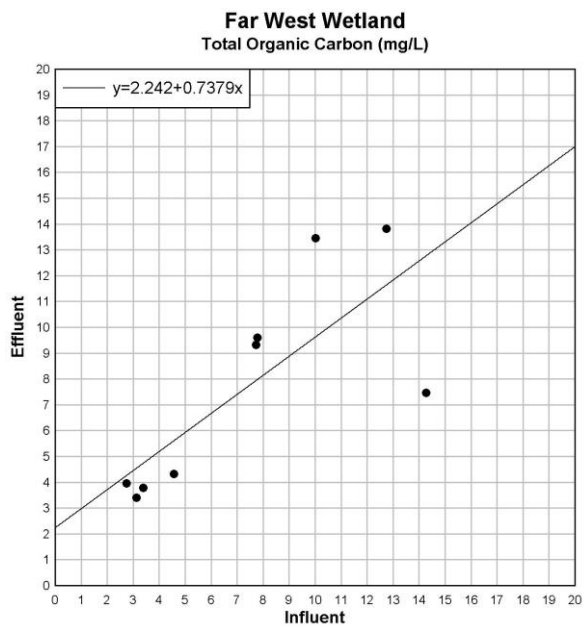
	PARAMETER	COD (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	108.33	69.60
	Upper Quartile	54.68	36.18
	Median	31.62	29.84
	Lower Quartile	26.00	20.63
	Minimum	17.64	15.94
	Efficiency	5.63%	
	Mann-Whitney	0.2889	
	Wilcoxon (paired)	0.0547 *	
Arithmetic	UCL	67.64	41.02
	Mean	46.08	31.46
	LCL	24.51	21.90
	Std. Dev.	30.15	15.04
	Wilk (p-value)	0.0304 **	0.0580 *
	Efficiency	31.72%	
	t-Test (equal var.)	0.1550	
	t-Test (unequal var.)	0.1869	
	t-test (paired)	0.1227	
	Levene Test	0.1083	
Log Transformed	UCL	72.21	41.80
	Mean	45.51	31.31
	LCL	28.69	23.45
	Std. Dev.	27.61	13.83
	Wilk (p-value)	0.4460	0.8378
	Efficiency	31.20%	
	t-Test (equal var.)	0.1783	
	t-Test (unequal var.)	0.1938	
	t-Test (paired)	0.0737 *	
	Levene Test	0.2579	
Bootstrap	UCL	65.19	39.75
	Mean	45.75	31.17
	LCL	26.31	22.59
	Std. Dev.	27.18	13.50
	Efficiency	31.86%	

Far West Wetland - Total Organic Carbon (mg/L)



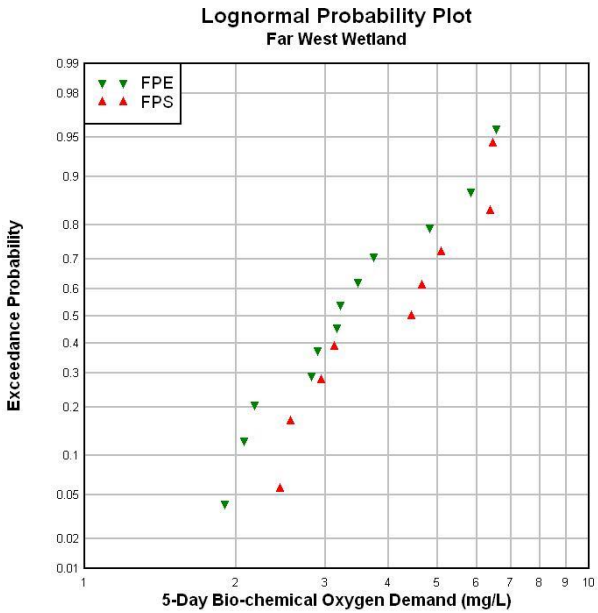


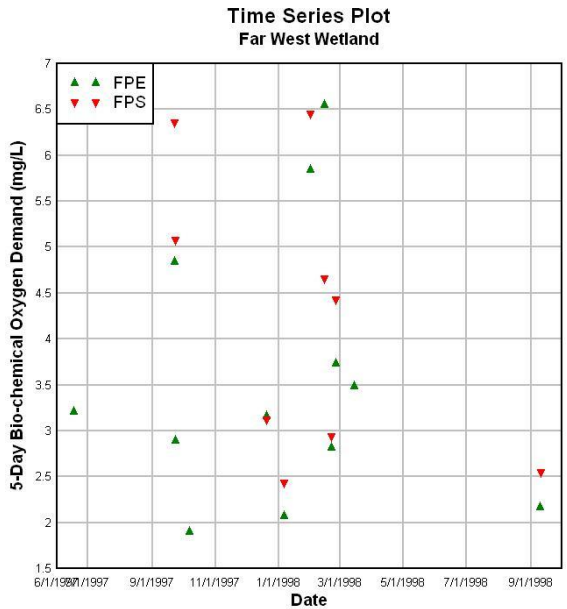


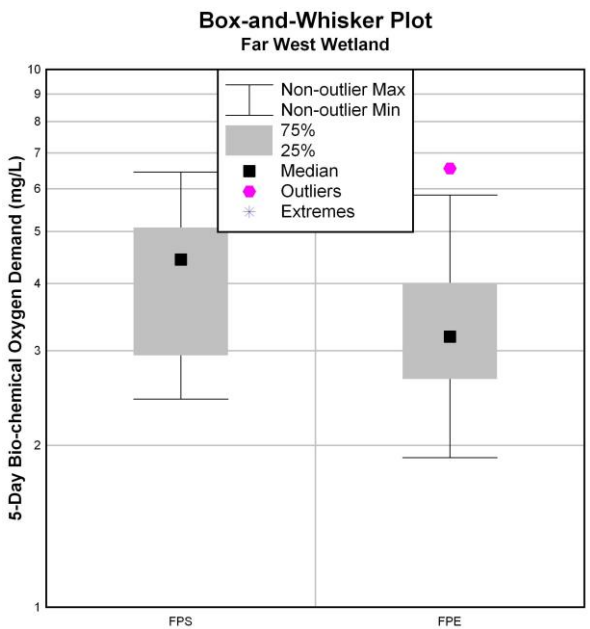


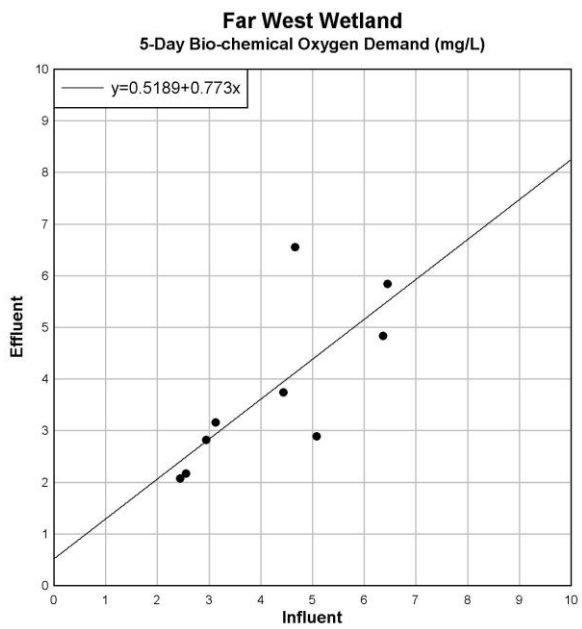
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	11	12
	Pairs Count	8	8
Non-Parametric	Maximum	15.05	13.81
	Upper Quartile	14.26	9.46
	Median	7.77	4.70
	Lower Quartile	3.38	3.88
	Minimum	2.75	2.95
	Efficiency	39.46%	
	Mann-Whitney	0.4150	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	11.95	9.26
	Mean	8.70	6.79
	LCL	5.45	4.32
	Std. Dev.	4.84	3.89
	Wilk (p-value)	0.1127	0.0253 **
	Efficiency	21.93%	
	t-Test (equal var.)	0.3076	
	t-Test (unequal var.)	0.3132	
	t-test (paired)	0.9371	
	Levene Test	0.2597	
Log Transformed	UCL	14.47	9.79
	Mean	8.85	6.75
	LCL	5.42	4.65
	Std. Dev.	6.05	3.78
	Wilk (p-value)	0.0922 *	0.1537
	Efficiency	23.78%	
	t-Test (equal var.)	0.4067	
	t-Test (unequal var.)	0.4113	
	t-Test (paired)	0.7032	
	Levene Test	0.2886	
Bootstrap	UCL	11.75	9.12
	Mean	8.70	6.79
	LCL	5.65	4.45
	Std. Dev.	4.54	3.67
	Efficiency	22.04%	

Far West Wetland – 5-Day BioChemical Oxygen Demand



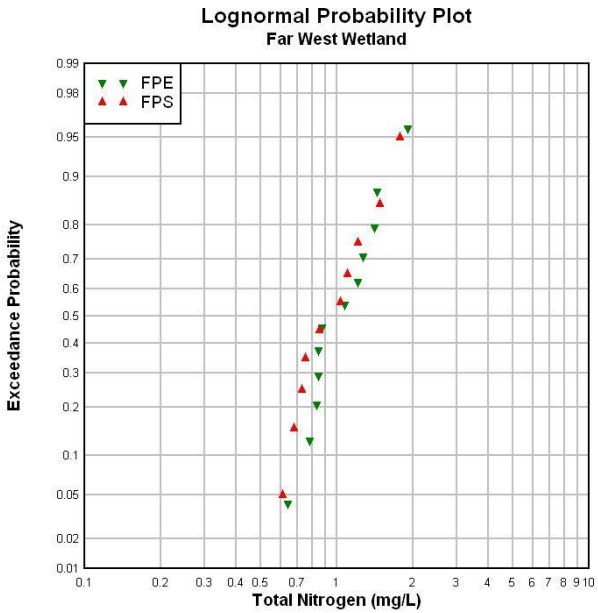


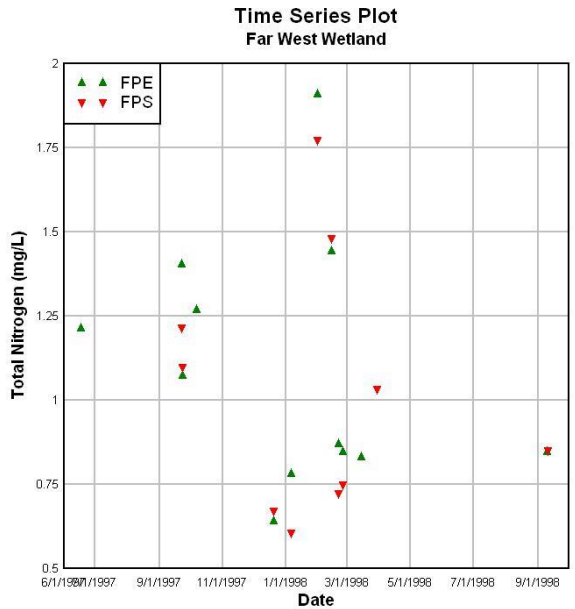


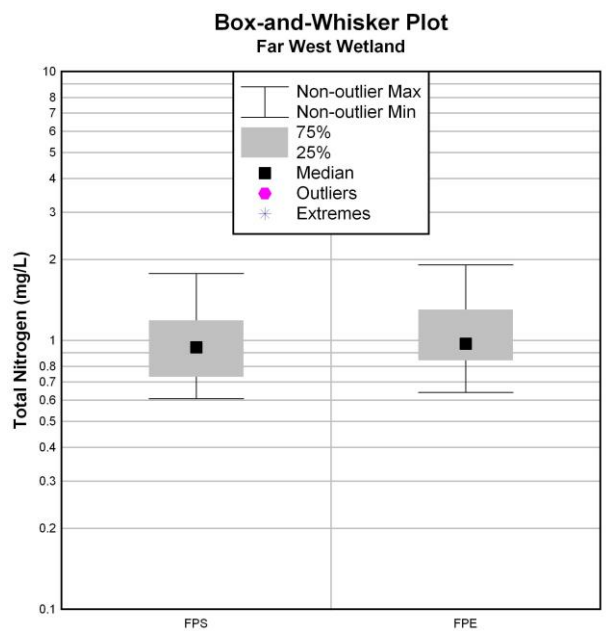


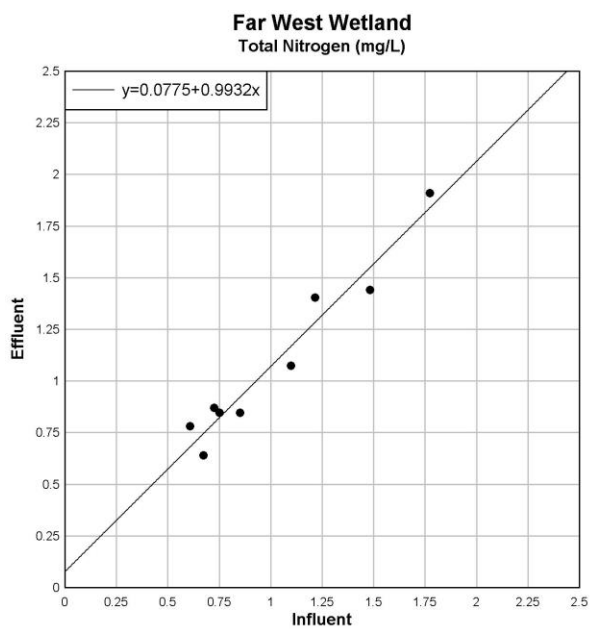
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	9	12
	Pairs Count	8	8
Non-Parametric	Maximum	6.45	6.55
	Upper Quartile	5.08	4.29
	Median	4.43	3.19
	Lower Quartile	2.94	2.50
	Minimum	2.44	1.90
	Efficiency	28.16%	
	Mann-Whitney	0.4234	
	Wilcoxon (paired)	0.1953	
Arithmetic	UCL	5.42	4.49
	Mean	4.23	3.56
	LCL	3.03	2.62
	Std. Dev.	1.55	1.48
	Wilk (p-value)	0.2414	0.1269
	Efficiency	15.88%	
	t-Test (equal var.)	0.3260	
	t-Test (unequal var.)	0.3313	
	t-test (paired)	0.3260	
	Levene Test	0.8869	
Log Transformed	UCL	5.72	4.60
	Mean	4.23	3.55
	LCL	3.13	2.73
	Std. Dev.	1.61	1.42
	Wilk (p-value)	0.2921	0.6586
	Efficiency	16.14%	
	t-Test (equal var.)	0.2943	
	t-Test (unequal var.)	0.2922	
	t-Test (paired)	0.2266	
	Levene Test	0.7969	
Bootstrap	UCL	5.32	4.43
	Mean	4.21	3.55
	LCL	3.11	2.67
	Std. Dev.	1.44	1.38
	Efficiency	15.72%	

Far West Wetland - Total Nitrogen (mg/L)



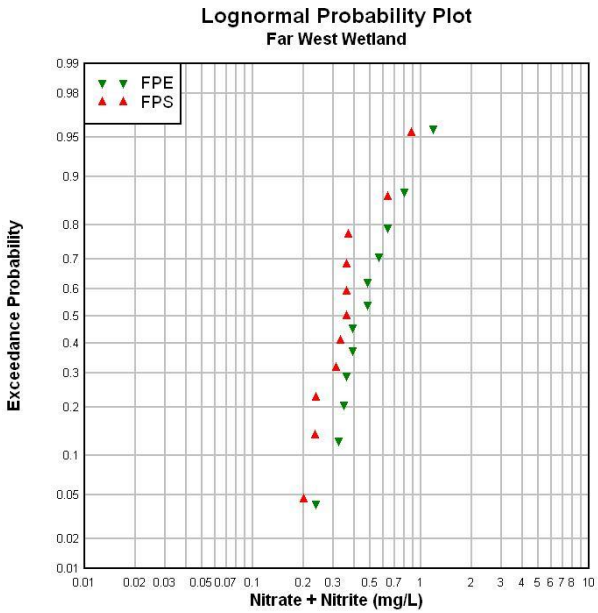


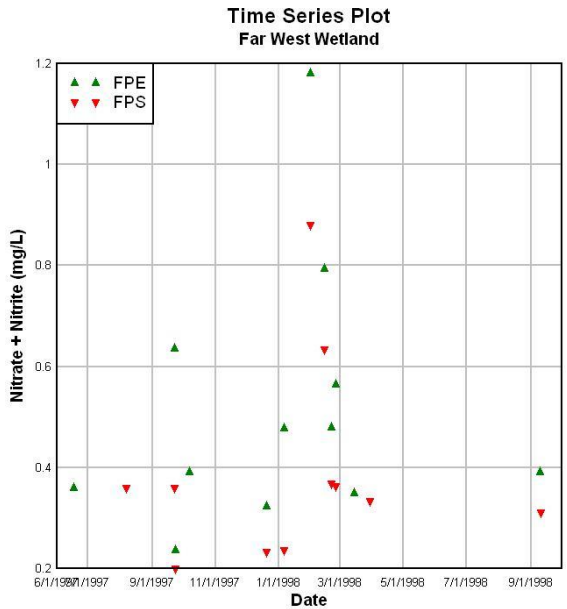


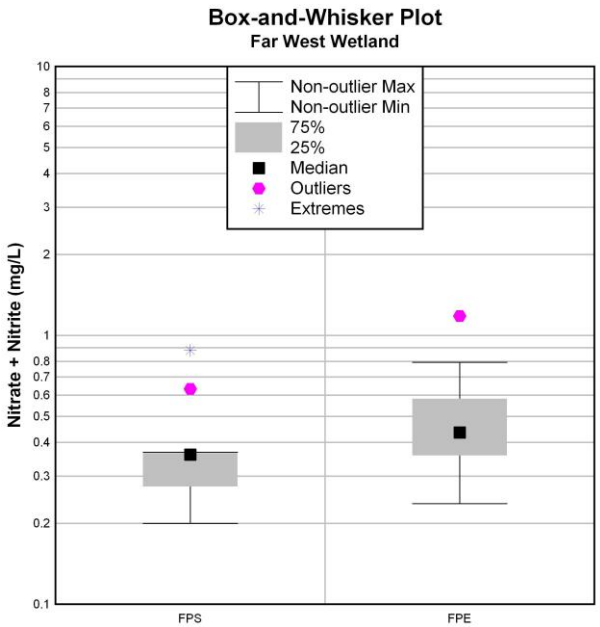


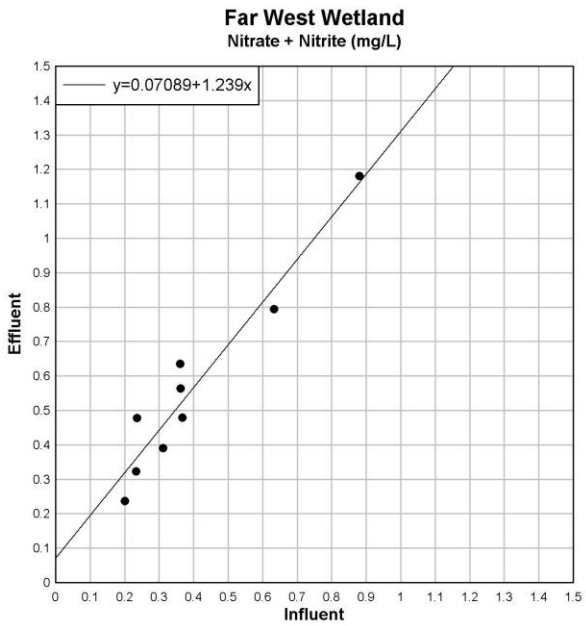
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	1.772	1.910
	Upper Quartile	1.216	1.336
	Median	0.943	0.972
	Lower Quartile	0.725	0.839
	Minimum	0.607	0.641
	Efficiency	-3.10%	
	Mann-Whitney	0.5811	
	Wilcoxon (paired)	0.1094	
Arithmetic	UCL	1.293	1.326
	Mean	1.021	1.094
	LCL	0.749	0.861
	Std. Dev.	0.381	0.366
	Wilk (p-value)	0.2912	0.1950
	Efficiency	-7.11%	
	t-Test (equal var.)	0.6538	
	t-Test (unequal var.)	0.6552	
	t-test (paired)	0.0537 *	
	Levene Test	0.9192	
Log Transformed	UCL	1.325	1.344
	Mean	1.019	1.092
	LCL	0.784	0.887
	Std. Dev.	0.366	0.351
	Wilk (p-value)	0.7066	0.6312
	Efficiency	-7.17%	
	t-Test (equal var.)	0.5864	
	t-Test (unequal var.)	0.5908	
	t-Test (paired)	0.0679 *	
	Levene Test	0.6663	
Bootstrap	UCL	1.273	1.305
	Mean	1.022	1.088
	LCL	0.770	0.872
	Std. Dev.	0.352	0.341
	Efficiency	-6.54%	

Far West Wetland -Nitrate + Nitrite (mg/L)



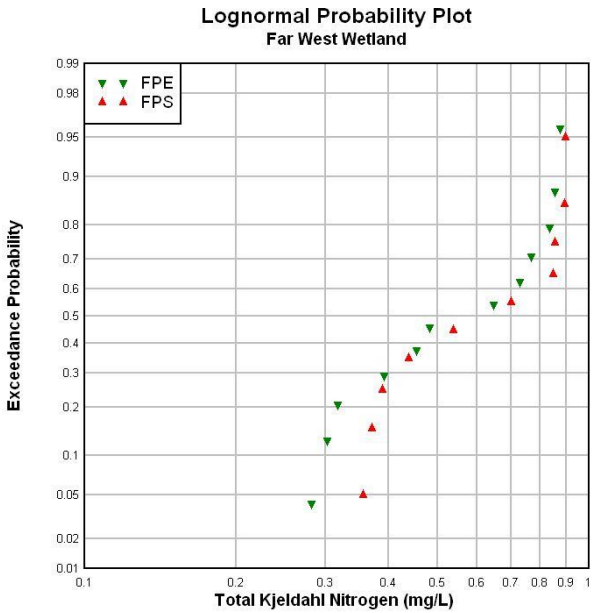


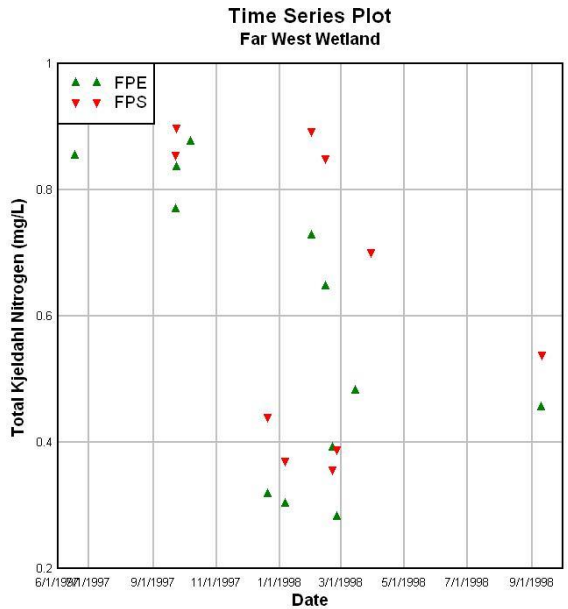


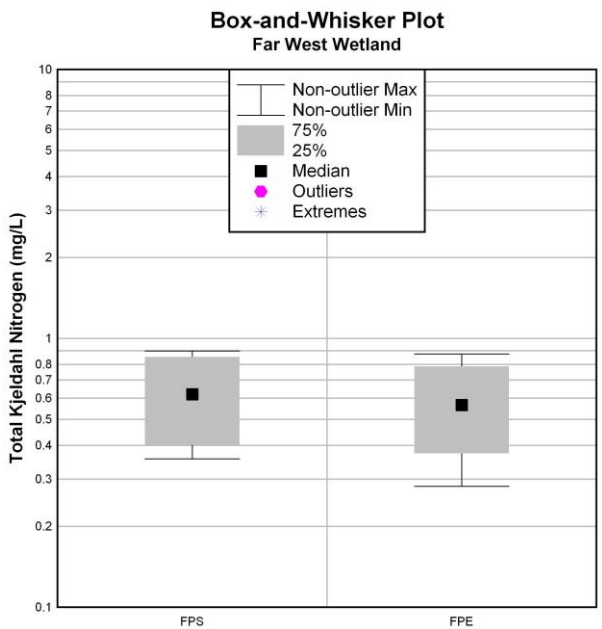


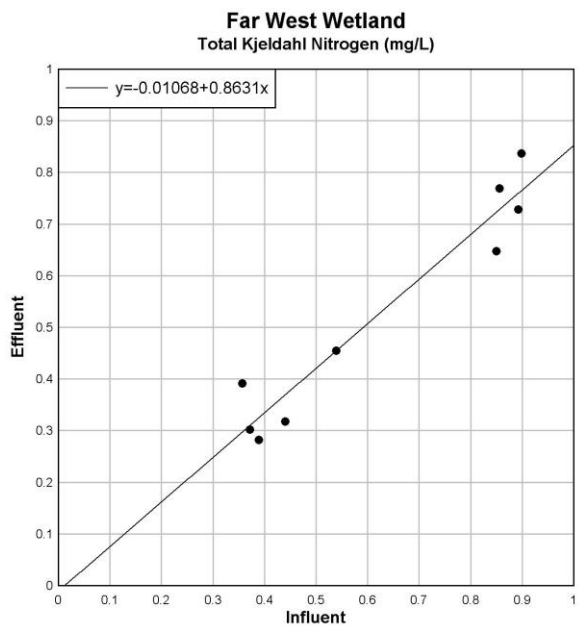
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	11	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.880	1.181
	Upper Quartile	0.368	0.600
	Median	0.360	0.435
	Lower Quartile	0.236	0.355
	Minimum	0.200	0.237
	Efficiency	-20.72%	
	Mann-Whitney	0.1171	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	0.523	0.680
	Mean	0.389	0.515
	LCL	0.255	0.351
	Std. Dev.	0.199	0.259
	Wilk (p-value)	0.0038 **	0.0227 **
	Efficiency	-32.44%	
	t-Test (equal var.)	0.2072	
	t-Test (unequal var.)	0.2025	
	t-test (paired)	0.0011 **	
	Levene Test	0.5539	
Log Transformed	UCL	0.522	0.684
	Mean	0.385	0.511
	LCL	0.284	0.382
	Std. Dev.	0.169	0.227
	Wilk (p-value)	0.1578	0.7851
	Efficiency	-32.69%	
	t-Test (equal var.)	0.1361	
	t-Test (unequal var.)	0.1360	
	t-Test (paired)	0.0007 **	
	Levene Test	0.9588	
Bootstrap	UCL	0.510	0.663
	Mean	0.390	0.515
	LCL	0.270	0.367
	Std. Dev.	0.178	0.233
	Efficiency	-32.05%	

Far West Wetland -Total Kjeldahl Nitrogen (mg/L)



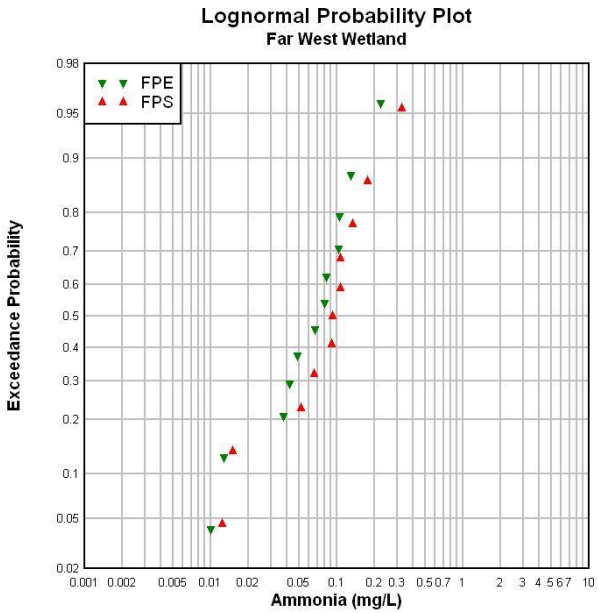


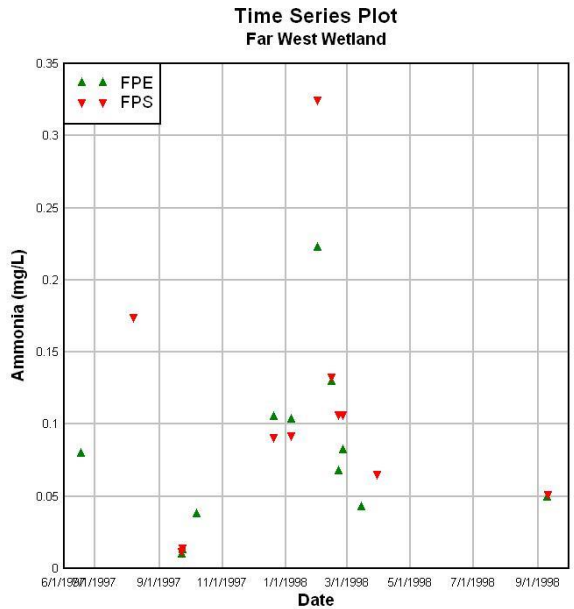


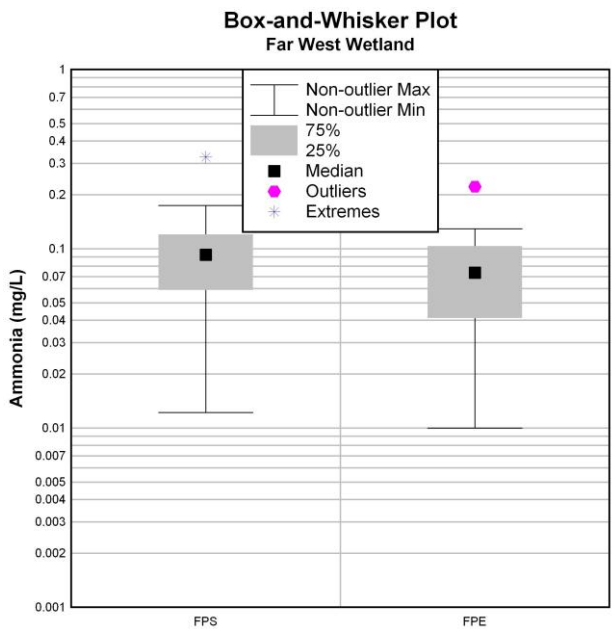


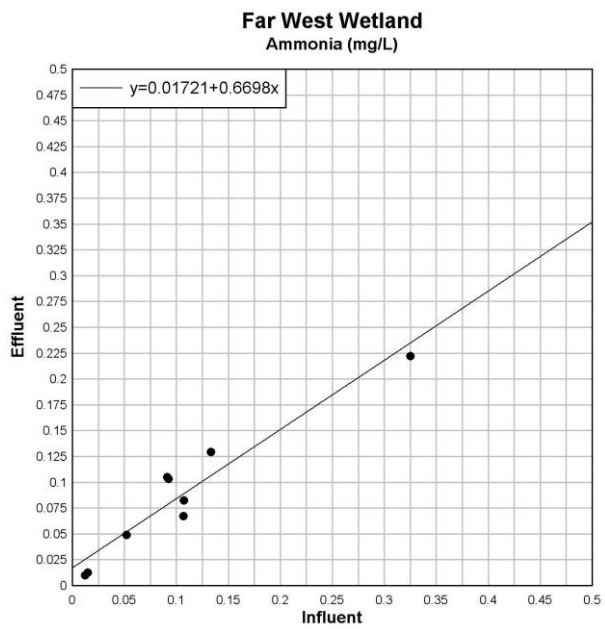
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.899	0.876
	Upper Quartile	0.856	0.803
	Median	0.620	0.565
	Lower Quartile	0.389	0.355
	Minimum	0.357	0.282
	Efficiency	8.84%	
	Mann-Whitney	0.4963	
	Wilcoxon (paired)	0.0156 **	
Arithmetic	UCL	0.796	0.725
	Mean	0.629	0.579
	LCL	0.462	0.432
	Std. Dev.	0.233	0.231
	Wilk (p-value)	0.0380 **	0.1050
	Efficiency	8.05%	
	t-Test (equal var.)	0.6156	
	t-Test (unequal var.)	0.6162	
	t-test (paired)	0.0063 **	
	Levene Test	0.9946	
Log Transformed	UCL	0.845	0.776
	Mean	0.631	0.581
	LCL	0.471	0.435
	Std. Dev.	0.250	0.257
	Wilk (p-value)	0.0444 **	0.1031
	Efficiency	7.86%	
	t-Test (equal var.)	0.5855	
	t-Test (unequal var.)	0.5821	
	t-Test (paired)	0.0100 **	
	Levene Test	0.4688	
Bootstrap	UCL	0.784	0.712
	Mean	0.628	0.573
	LCL	0.472	0.435
	Std. Dev.	0.218	0.218
	Efficiency	8.74%	

Far West Wetland -Ammonia (mg/L)



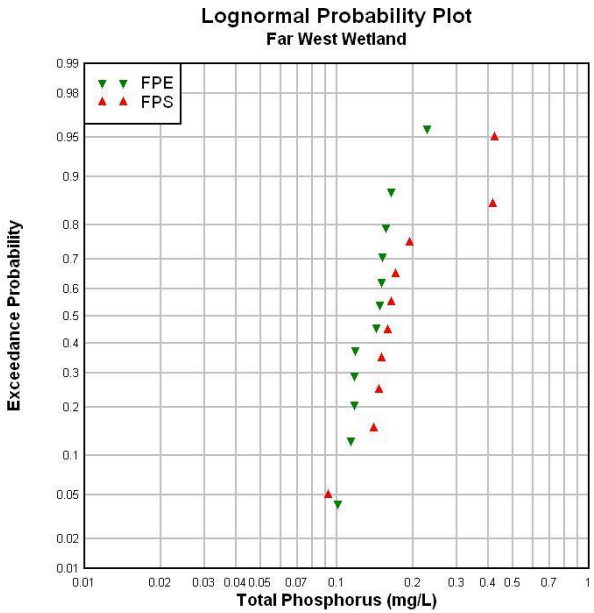


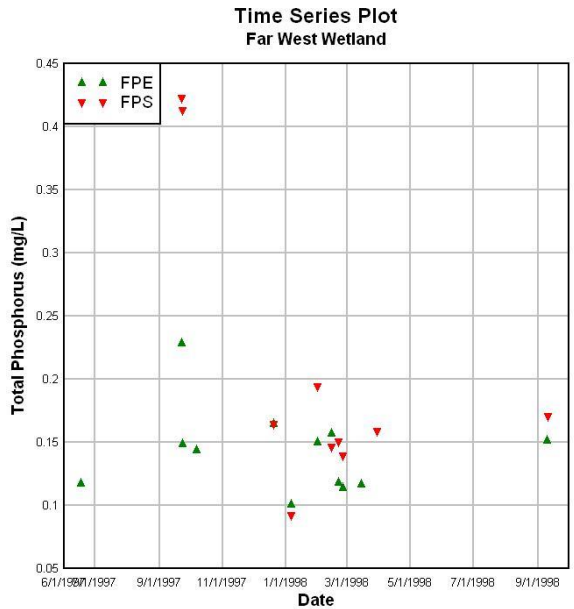


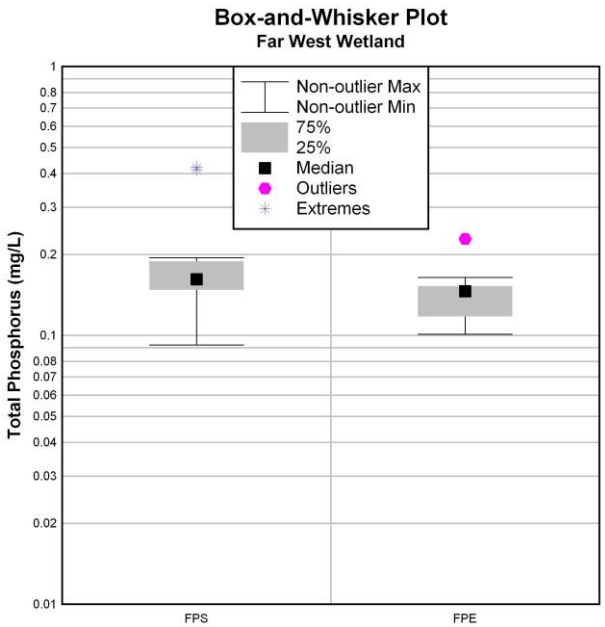


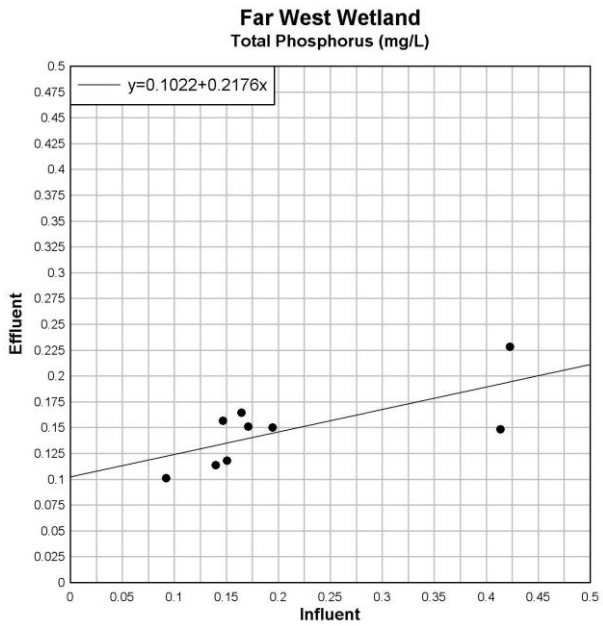
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	11	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.325	0.222
	Upper Quartile	0.133	0.104
	Median	0.093	0.074
	Lower Quartile	0.052	0.040
	Minimum	0.012	0.010
	Efficiency	20.47%	
	Mann-Whitney	0.3209	
	Wilcoxon (paired)	0.2500	
Arithmetic	UCL	0.165	0.116
	Mean	0.107	0.078
	LCL	0.048	0.041
	Std. Dev.	0.087	0.058
	Wilk (p-value)	0.0449 **	0.1593
	Efficiency	26.62%	
	t-Test (equal var.)	0.3638	
	t-Test (unequal var.)	0.3740	
	t-test (paired)	0.2059	
	Levene Test	0.4025	
Log Transformed	UCL	0.260	0.167
	Mean	0.115	0.083
	LCL	0.051	0.042
	Std. Dev.	0.122	0.082
	Wilk (p-value)	0.2164	0.3728
	Efficiency	27.53%	
	t-Test (equal var.)	0.5040	
	t-Test (unequal var.)	0.5057	
	t-Test (paired)	0.0857 *	
	Levene Test	0.8049	
Bootstrap	UCL	0.159	0.113
	Mean	0.107	0.079
	LCL	0.055	0.045
	Std. Dev.	0.078	0.053
	Efficiency	26.27%	

Far West Wetland - Total Phosphorus (mg/L)



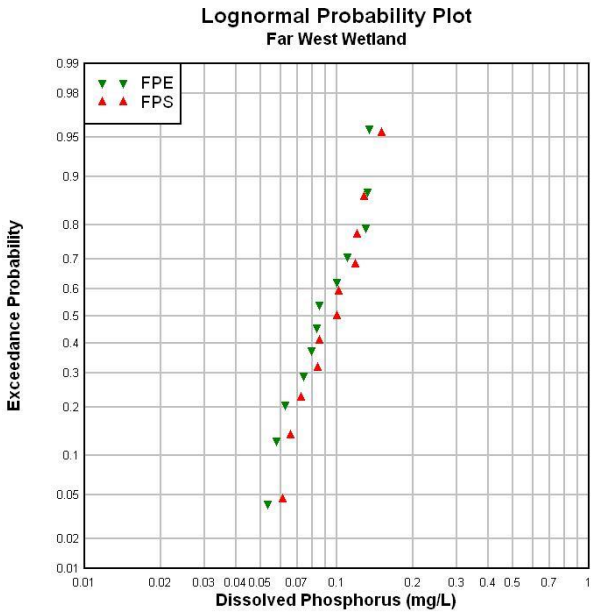


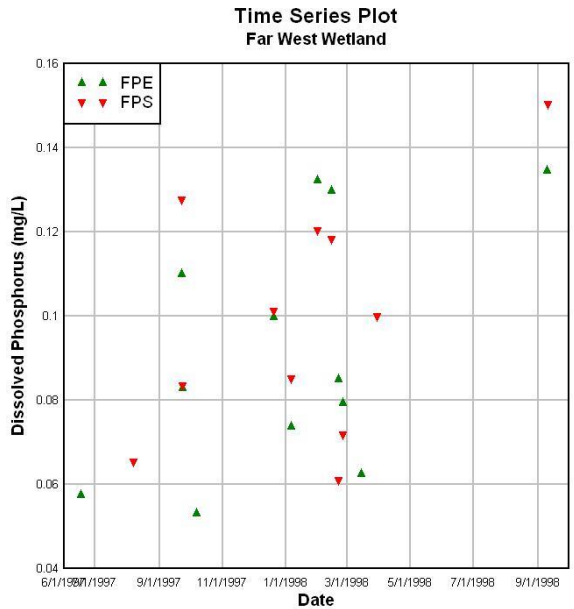


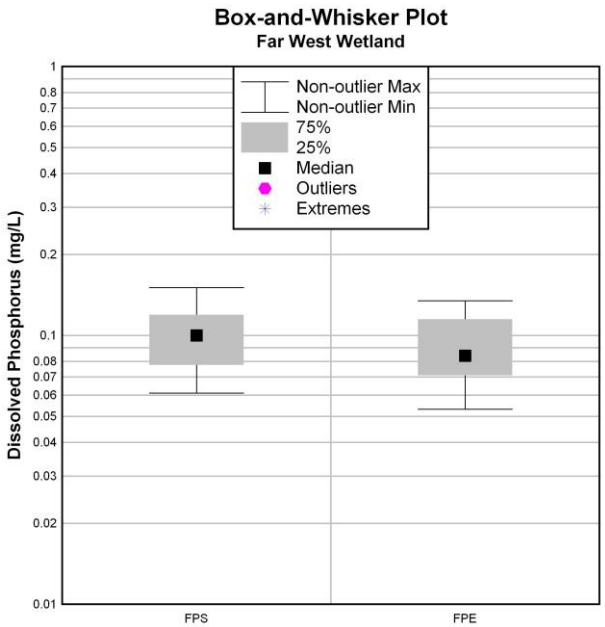


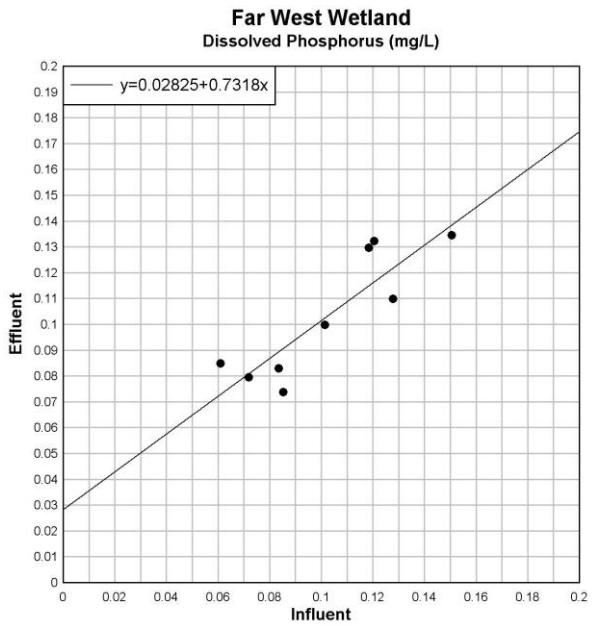
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.423	0.228
	Upper Quartile	0.195	0.154
	Median	0.162	0.146
	Lower Quartile	0.147	0.117
	Minimum	0.092	0.101
	Efficiency	9.78%	
	Mann-Whitney	0.1075	
	Wilcoxon (paired)	0.0781 *	
Arithmetic	UCL	0.288	0.164
	Mean	0.205	0.143
	LCL	0.123	0.121
	Std. Dev.	0.115	0.034
	Wilk (p-value)	0.0015 **	0.0511 *
	Efficiency	30.62%	
	t-Test (equal var.)	0.0854 *	
	t-Test (unequal var.)	0.1251	
	t-test (paired)	0.1060	
	Levene Test	0.0492 **	
Log Transformed	UCL	0.291	0.164
	Mean	0.203	0.142
	LCL	0.141	0.124
	Std. Dev.	0.098	0.032
	Wilk (p-value)	0.0458 **	0.2878
	Efficiency	29.84%	
	t-Test (equal var.)	0.0873 *	
	t-Test (unequal var.)	0.1164	
	t-Test (paired)	0.0811 *	
	Levene Test	0.0769 *	
Bootstrap	UCL	0.277	0.162
	Mean	0.204	0.142
	LCL	0.131	0.123
	Std. Dev.	0.102	0.031
	Efficiency	30.18%	

Far West Wetland – Dissolved Phosphorus (ug/L)



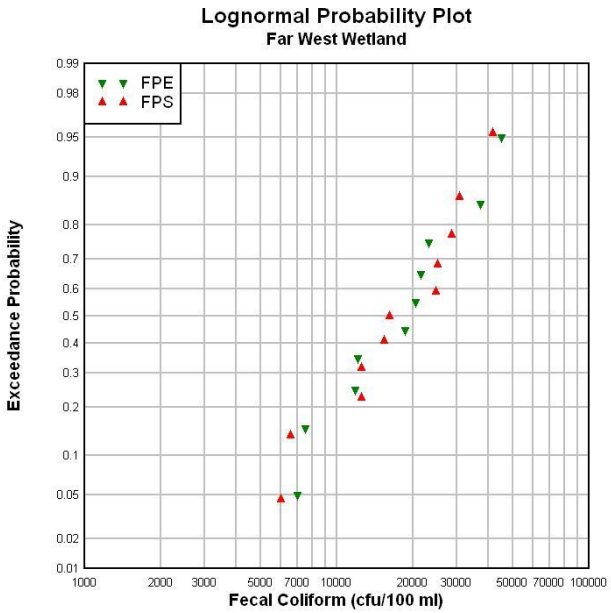


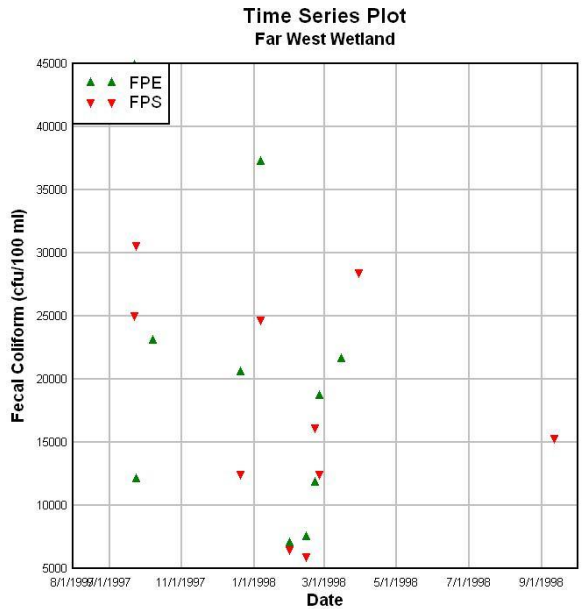


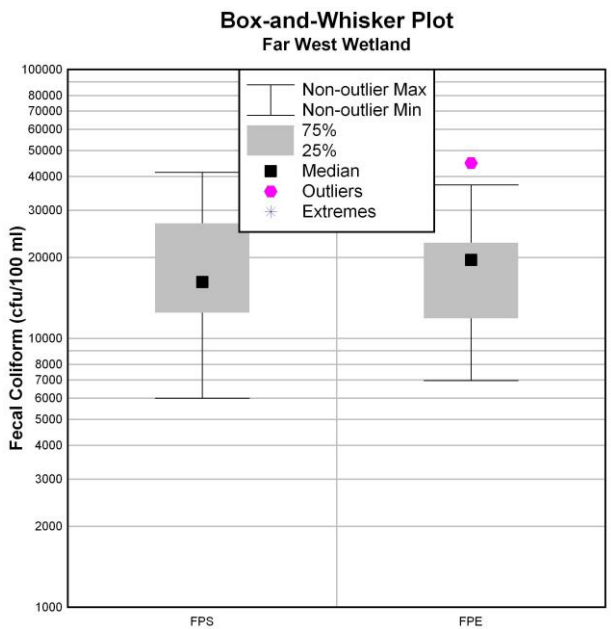


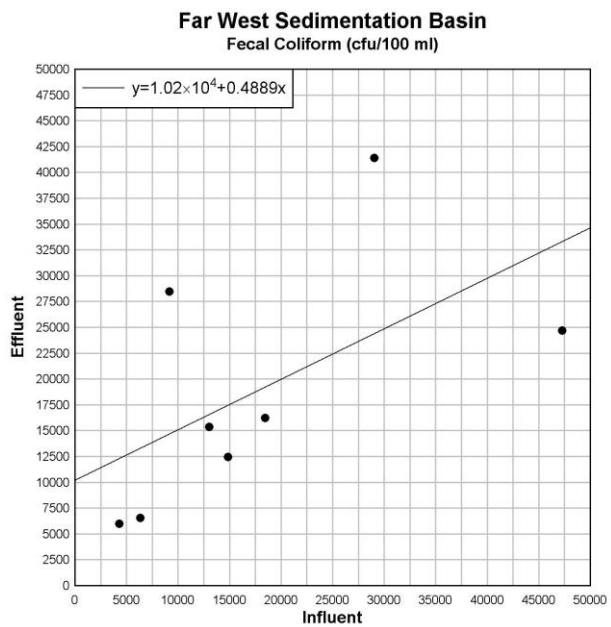
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	11	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.150	0.135
	Upper Quartile	0.120	0.120
	Median	0.100	0.084
	Lower Quartile	0.072	0.068
	Minimum	0.061	0.053
	Efficiency	16.05%	
	Mann-Whitney	0.5647	
	Wilcoxon (paired)	0.7422	
Arithmetic	UCL	0.118	0.110
	Mean	0.099	0.092
	LCL	0.080	0.073
	Std. Dev.	0.028	0.029
	Wilk (p-value)	0.7552	0.2476
	Efficiency	7.04%	
	t-Test (equal var.)	0.5701	
	t-Test (unequal var.)	0.5696	
	t-test (paired)	0.5626	
	Levene Test	0.8632	
Log Transformed	UCL	0.121	0.113
	Mean	0.099	0.092
	LCL	0.081	0.074
	Std. Dev.	0.029	0.030
	Wilk (p-value)	0.8155	0.4442
	Efficiency	7.03%	
	t-Test (equal var.)	0.5302	
	t-Test (unequal var.)	0.5283	
	t-Test (paired)	0.5181	
	Levene Test	0.5808	
Bootstrap	UCL	0.117	0.110
	Mean	0.099	0.092
	LCL	0.081	0.074
	Std. Dev.	0.027	0.028
	Efficiency	7.15%	

Far West Wetland -Fecal Coliform (cfu/100L)



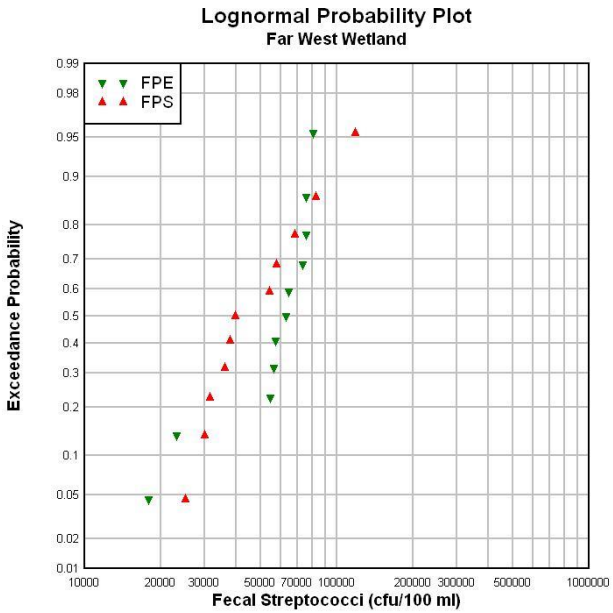


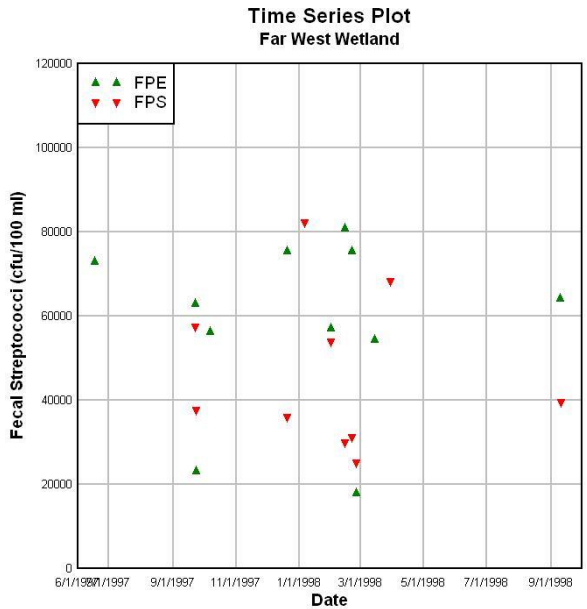


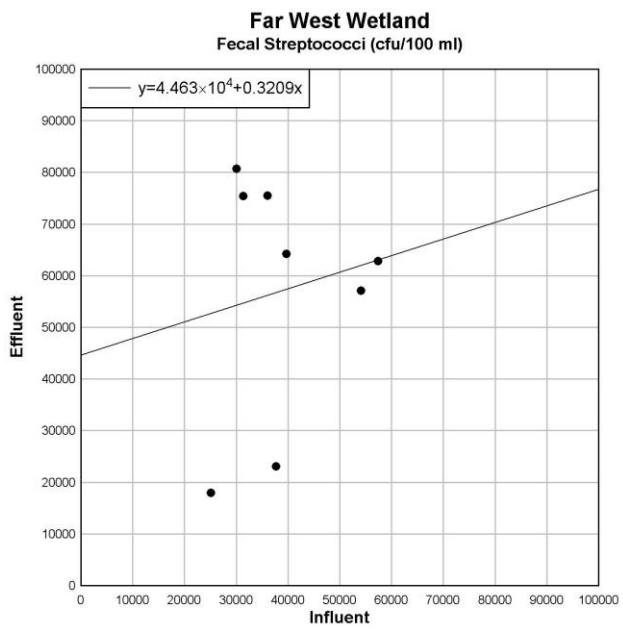


	PARAMETER	F. Coliform (cfu/100ml)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	11	10
	Pairs Count	8	8
Non-Parametric	Maximum	41,424	44,845
	Upper Quartile	28,451	23,076
	Median	16,215	19,605
	Lower Quartile	12,467	11,796
	Minimum	6,000	6,980
	Efficiency	-20.91%	
	Mann-Whitney	0.9169	
	Wilcoxon (paired)	0.3125	
Arithmetic	UCL	27,359	29,291
	Mean	19,946	20,427
	LCL	12,534	11,563
	Std. Dev.	11,034	12,392
	Wilk (p-value)	0.5628	0.1913
	Efficiency	-2.41%	
	t-Test (equal var.)	0.9261	
	t-Test (unequal var.)	0.9265	
	t-test (paired)	0.4618	
	Levene Test	0.6992	
Log Transformed	UCL	32,109	33,406
	Mean	20,234	20,491
	LCL	12,750	12,569
	Std. Dev.	13,073	13,091
	Wilk (p-value)	0.5188	0.6701
	Efficiency	-1.27%	
	t-Test (equal var.)	0.9520	
	t-Test (unequal var.)	0.9519	
	t-Test (paired)	0.5418	
	Levene Test	0.9632	
Bootstrap	UCL	26,616	28,379
	Mean	19,720	20,306
	LCL	12,824	12,233
	Std. Dev.	10,265	11,285
	Efficiency	-2.97%	

Far West Wetland -Fecal Streptococci (cfu/100L)

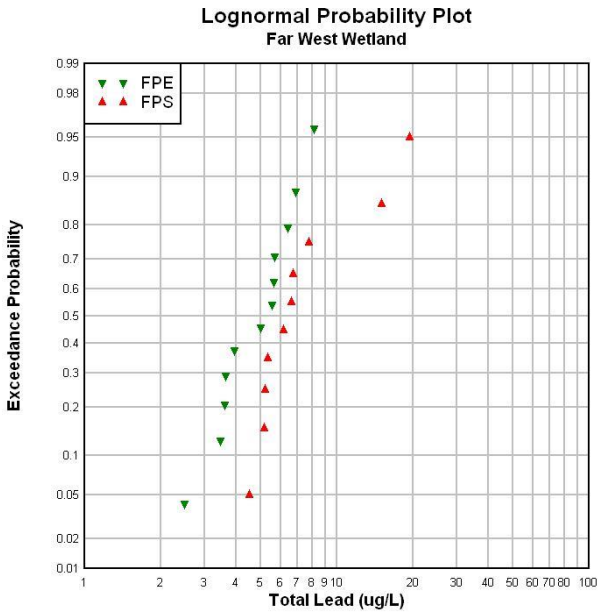


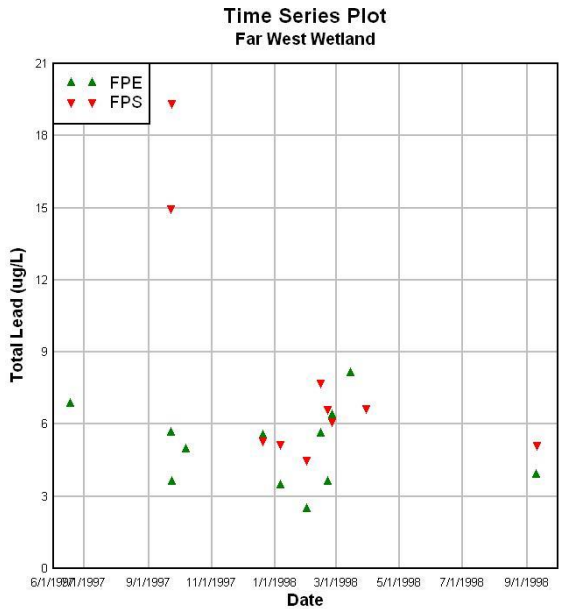


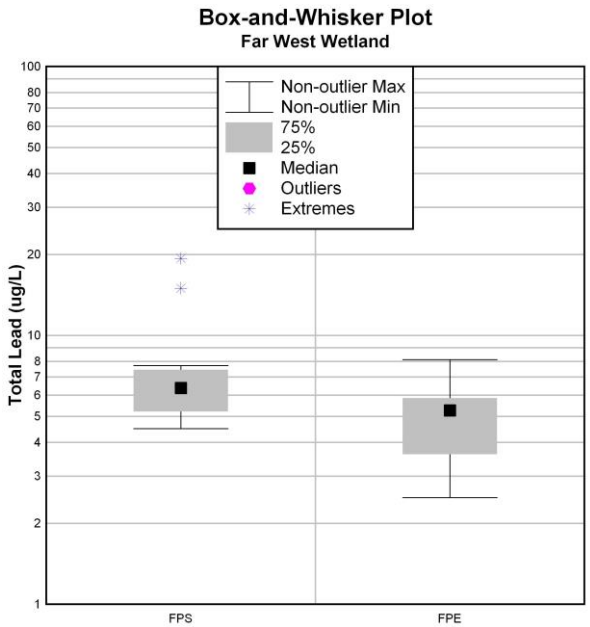


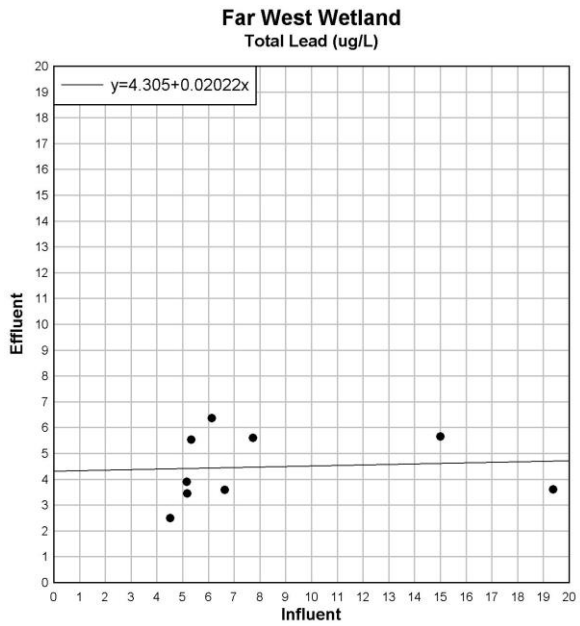
	PARAMETER	F. Strep. (cfu/100ml)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	11	11
	Pairs Count	7	7
Non-Parametric	Maximum	118,351	80,767
	Upper Quartile	68,322	75,440
	Median	39,656	62,849
	Lower Quartile	31,319	54,384
	Minimum	25,110	17,962
	Efficiency	-58.48%	
	Mann-Whitney	0.4395	
	Wilcoxon (paired)	0.2969	
Arithmetic	UCL	71,592	72,084
	Mean	52,755	58,229
	LCL	33,918	44,373
	Std. Dev.	28,041	20,625
	Wilk (p-value)	0.0541 *	0.0454 **
	Efficiency	-10.37%	
	t-Test (equal var.)	0.6077	
	t-Test (unequal var.)	0.6082	
	t-test (paired)	0.1377	
	Levene Test	0.4261	
Log Transformed	UCL	73,545	84,953
	Mean	52,360	59,534
	LCL	37,277	41,720
	Std. Dev.	25,493	30,243
	Wilk (p-value)	0.6664	0.0017 **
	Efficiency	-13.70%	
	t-Test (equal var.)	0.5704	
	t-Test (unequal var.)	0.5704	
	t-Test (paired)	0.2671	
	Levene Test	0.8978	
Bootstrap	UCL	69,535	71,243
	Mean	52,414	58,519
	LCL	35,293	45,795
	Std. Dev.	25,485	18,940
	Efficiency	-11.65%	

Far West Wetland -Total Lead (ug/L)



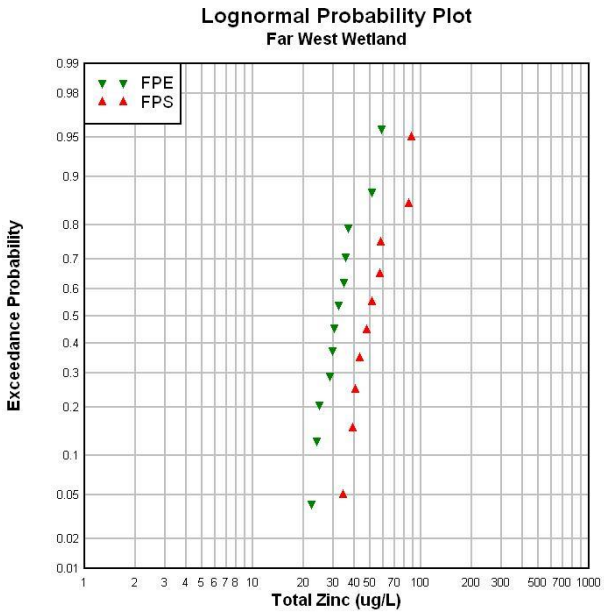


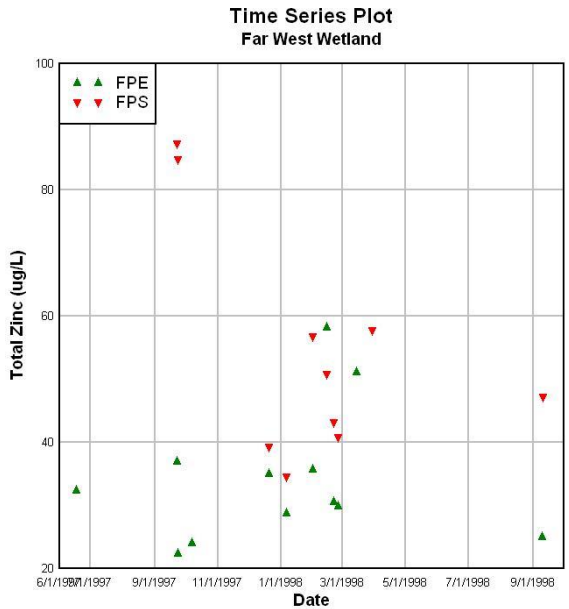


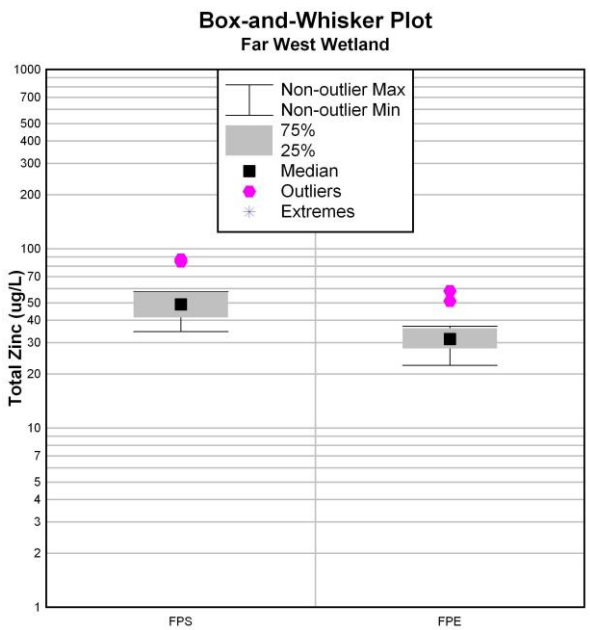


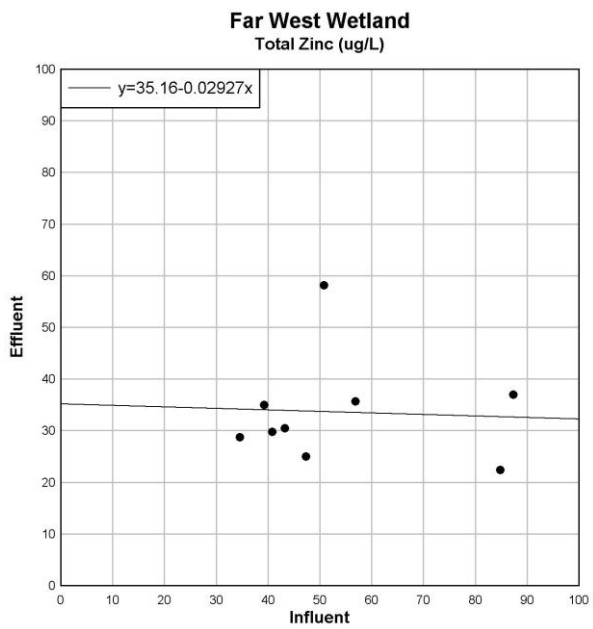
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	19.4	8.1
	Upper Quartile	7.7	6.0
	Median	6.4	5.3
	Lower Quartile	5.2	3.6
	Minimum	4.5	2.5
	Efficiency	17.52%	
	Mann-Whitney	0.0952 *	
	Wilcoxon (paired)	0.0391 **	
Arithmetic	UCL	11.7	6.1
	Mean	8.2	5.0
	LCL	4.6	4.0
	Std. Dev.	5.0	1.7
	Wilk (p-value)	0.0011 **	0.8010
	Efficiency	38.55%	
	t-Test (equal var.)	0.0508 *	
	t-Test (unequal var.)	0.0814 *	
	t-test (paired)	0.0703 *	
	Levene Test	0.0949 *	
Log Transformed	UCL	11.6	6.3
	Mean	8.0	5.0
	LCL	5.6	4.0
	Std. Dev.	3.9	1.8
	Wilk (p-value)	0.0213 **	0.7731
	Efficiency	37.29%	
	t-Test (equal var.)	0.0283 **	
	t-Test (unequal var.)	0.0359 **	
	t-Test (paired)	0.0257 **	
	Levene Test	0.3149	
Bootstrap	UCL	11.2	6.0
	Mean	8.1	5.0
	LCL	5.0	4.0
	Std. Dev.	4.4	1.5
	Efficiency	37.94%	

Far West Sedimentation Basin - Total Zinc (ug/L)



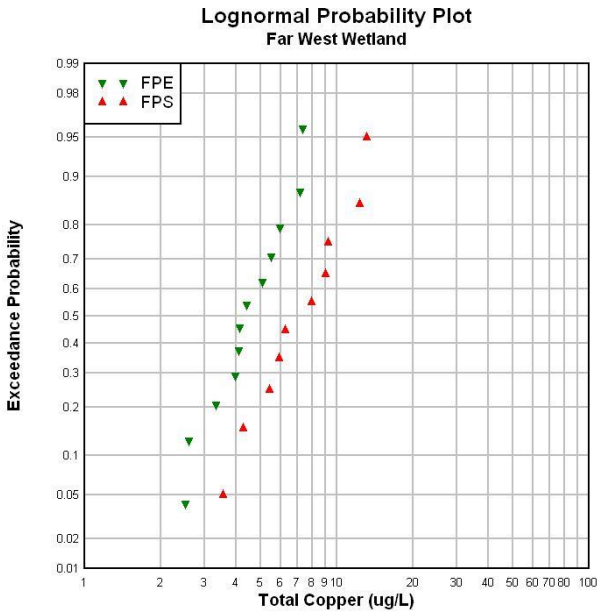


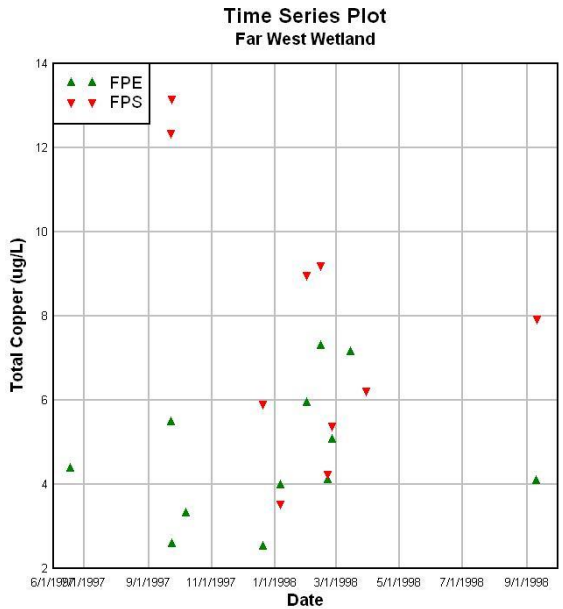


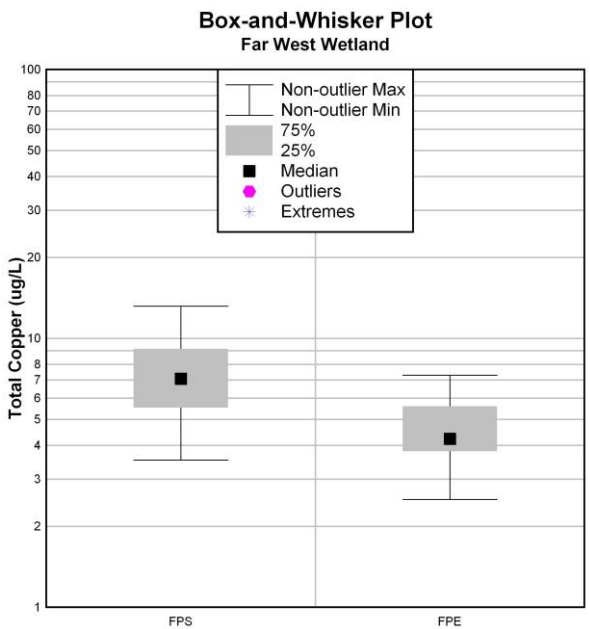


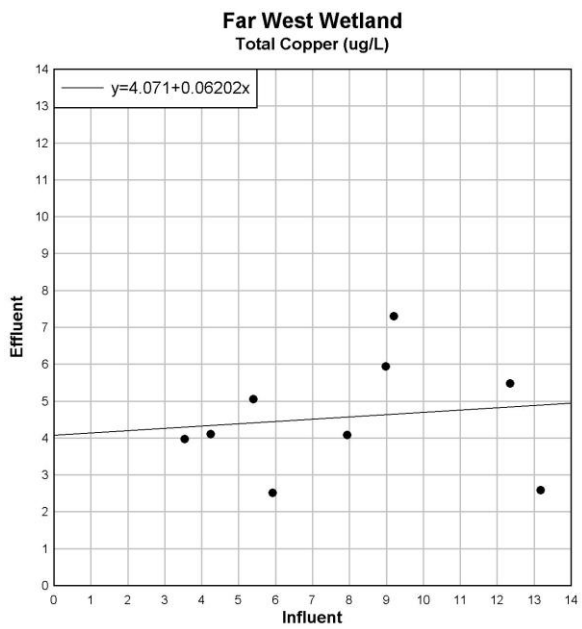
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	87.4	58.1
	Upper Quartile	57.7	36.4
	Median	49.0	31.4
	Lower Quartile	40.8	26.8
	Minimum	34.5	22.4
	Efficiency	35.96%	
	Mann-Whitney	0.0107 **	
	Wilcoxon (paired)	0.0391 **	
Arithmetic	UCL	67.4	40.9
	Mean	54.3	34.1
	LCL	41.1	27.3
	Std. Dev.	18.3	10.7
	Wilk (p-value)	0.0595 *	0.0542 *
	Efficiency	37.09%	
	t-Test (equal var.)	0.0044 **	
	t-Test (unequal var.)	0.0085 **	
	t-test (paired)	0.0506 *	
	Levene Test	0.1327	
Log Transformed	UCL	68.1	41.0
	Mean	54.1	34.1
	LCL	43.0	28.3
	Std. Dev.	17.0	9.8
	Wilk (p-value)	0.3385	0.4295
	Efficiency	37.08%	
	t-Test (equal var.)	0.0019 **	
	t-Test (unequal var.)	0.0022 **	
	t-Test (paired)	0.0323 **	
	Levene Test	0.7740	
Bootstrap	UCL	65.9	40.5
	Mean	54.1	34.2
	LCL	42.2	27.9
	Std. Dev.	16.5	9.9
	Efficiency	36.74%	

Far West Wetland -Total Copper (ug/L)



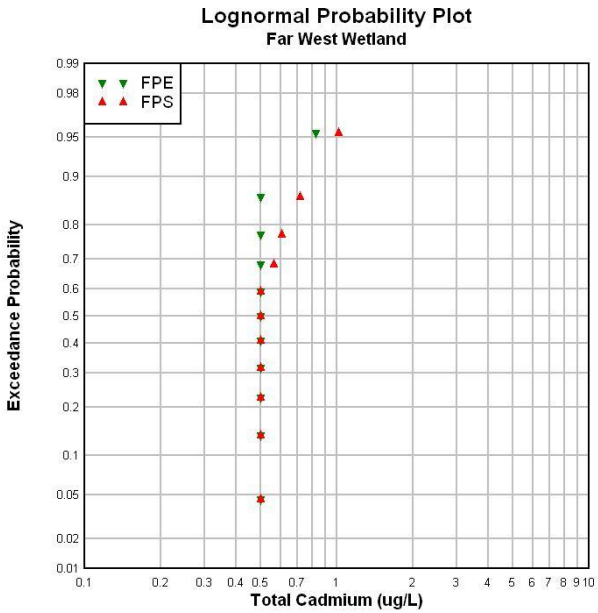


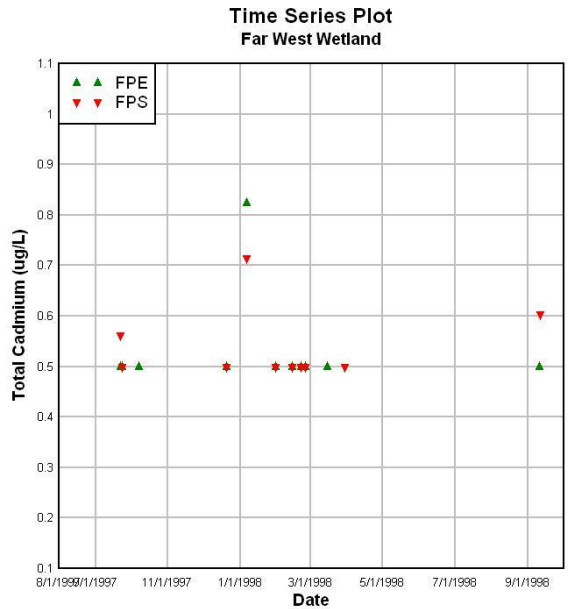


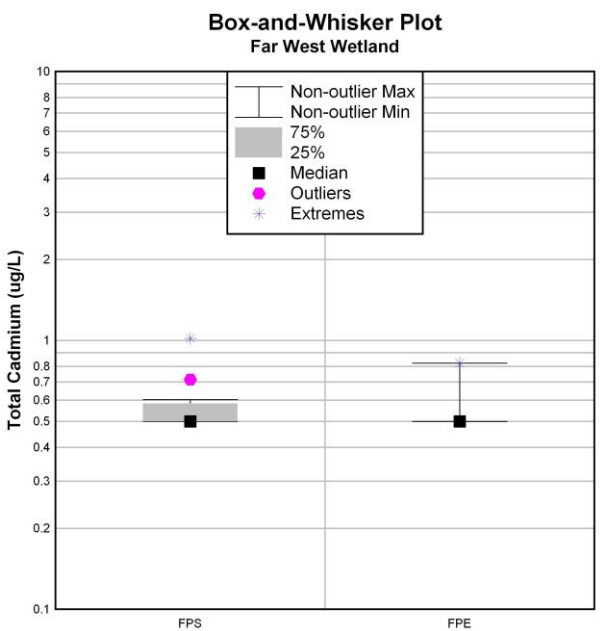


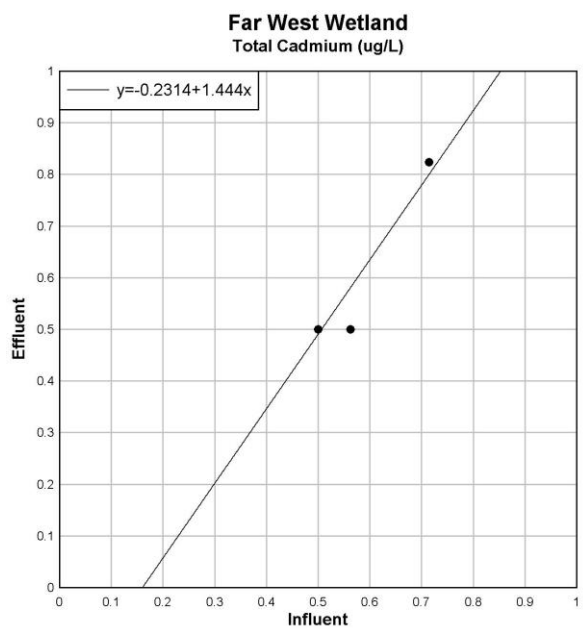
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	10	12
	Pairs Count	8	8
Non-Parametric	Maximum	13.2	7.3
	Upper Quartile	9.2	5.7
	Median	7.1	4.2
	Lower Quartile	5.4	3.6
	Minimum	3.5	2.5
	Efficiency	40.14%	
	Mann-Whitney	0.0292 **	
	Wilcoxon (paired)	0.0391 **	
Arithmetic	UCL	10.0	5.7
	Mean	7.7	4.7
	LCL	5.4	3.6
	Std. Dev.	3.3	1.6
	Wilk (p-value)	0.5171	0.5049
	Efficiency	39.51%	
	t-Test (equal var.)	0.0096 **	
	t-Test (unequal var.)	0.0188 **	
	t-test (paired)	0.0467 **	
	Levene Test	0.0278 **	
Log Transformed	UCL	10.7	5.9
	Mean	7.7	4.7
	LCL	5.6	3.7
	Std. Dev.	3.4	1.7
	Wilk (p-value)	0.8514	0.6449
	Efficiency	39.53%	
	t-Test (equal var.)	0.0101 **	
	t-Test (unequal var.)	0.0127 **	
	t-Test (paired)	0.0483 **	
	Levene Test	0.3713	
Bootstrap	UCL	9.8	5.6
	Mean	7.7	4.7
	LCL	5.5	3.7
	Std. Dev.	3.0	1.5
	Efficiency	39.15%	

Far West Wetland – Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: FPS**	**EFF: FPE**
	Site Count	11	11
	Pairs Count	8	8
Non-Parametric	Maximum	1.0	0.8
	Upper Quartile	0.6	0.5
	Median	0.5	0.5
	Lower Quartile	0.5	0.5
	Minimum	0.5	0.5
	Efficiency	0.00%	
	Mann-Whitney	0.1941	
	Wilcoxon (paired)	1.0000	
Arithmetic	UCL	0.7	0.6
	Mean	0.6	0.5
	LCL	0.5	0.5
	Std. Dev.	0.2	0.1
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	8.97%	
	t-Test (equal var.)	0.3667	
	t-Test (unequal var.)	0.3689	
	t-test (paired)	0.7367	
	Levene Test	0.4406	
Log Transformed	UCL	0.7	0.6
	Mean	0.6	0.5
	LCL	0.5	0.5
	Std. Dev.	0.1	0.1
	Wilk (p-value)	0.0001 **	0.0001 **
	Efficiency	8.81%	
	t-Test (equal var.)	0.3438	
	t-Test (unequal var.)	0.3455	
	t-Test (paired)	0.9052	
	Levene Test	0.4733	
Bootstrap	UCL	0.7	0.6
	Mean	0.6	0.5
	LCL	0.5	0.5
	Std. Dev.	0.1	0.1
	Efficiency	8.96%	

Far West Water Quality Pond (FPI-FPE)

Far West Water Quality Pond was constructed as a retrofit of a detention basin in northwest Austin (see the COA report on small watershed quantity and quality (COA, 2009) for a detailed description of the contributing watershed). The pond consists of two parts, a sedimentation basin for pretreatment and a wetlands area for final treatment. This summary is for the overall system. For performance summary of the sedimentation basin (FPI-FPS) refer to the sedimentation section of this report; for the wetland portion (FPS-FPE), refer to this section of this report.

The sedimentation basin was constructed with compacted soil with rock gabions for support. During the monitoring period it was noted that flows entering the system were not being dissipated by the gabions and the soil sides of the basin were being undermined and failing. This created two problems from a monitoring standpoint; first, there was unmeasured flow entering the system and second, a higher sediment load was probably entering the basin that was being measured at the influent station.

The City collected runoff and water quality data at the Far West sedimentation basin (FPI-FPE) from 1997 to 1998. During this time 12 valid EMCs were collected at the influent (FPI) and effluent (FPE) respectively, of which 8 were paired.

Performance Summary

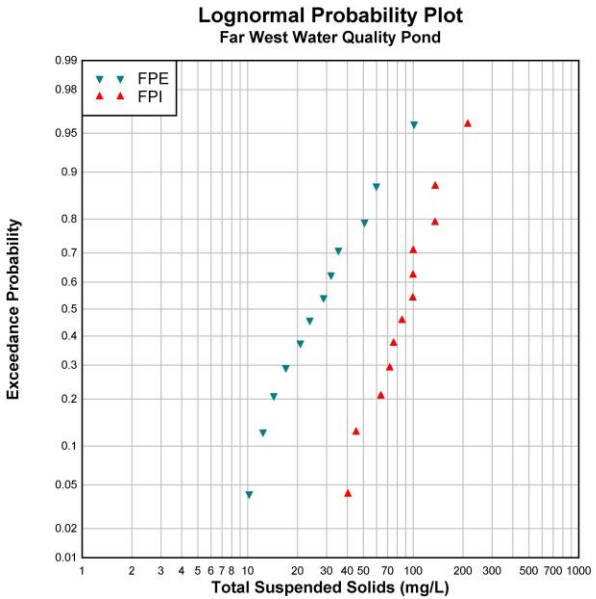
TSS and VSS concentrations were significantly reduced by 65 and 60% respectively. BOD and COD concentrations were reduced by 42 and 38% but there were no significant changes in TOC.

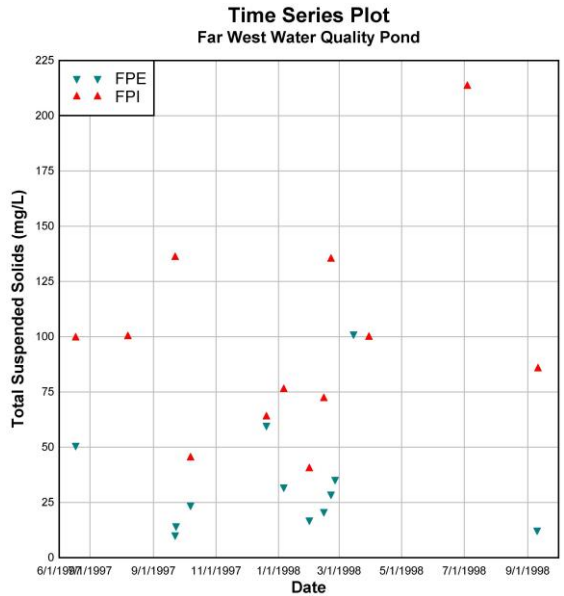
With respect to nutrients, the influent concentrations were not significantly different from the effluent for total nitrogen but ammonia and TKN were significantly reduced by 62 and 26% respectively. Nitrate concentrations at the effluent were high than at the influent but not significantly. Total phosphorus concentrations were significantly reduced by 23% but there was no significant different in the influent and effluent concentrations for dissolved phosphorus.

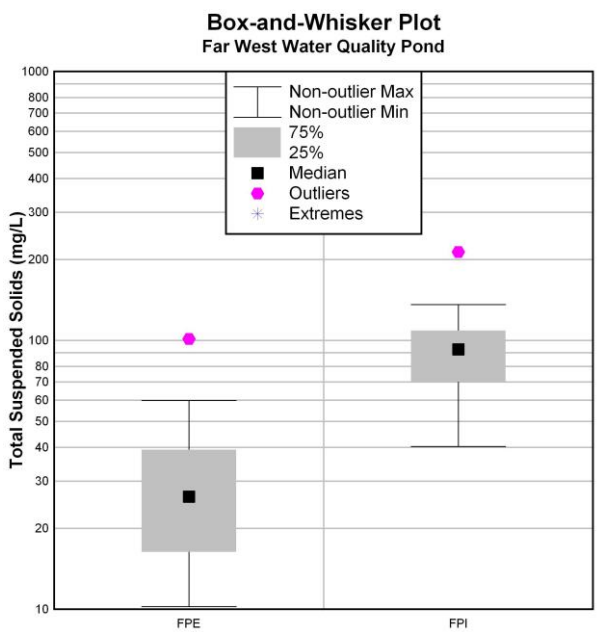
Lead, zinc and copper concentrations were significantly reduced by approximately 50%. Cadmium concentration was increased by 6% and was not significant in all case, likely due to detection limit issues.

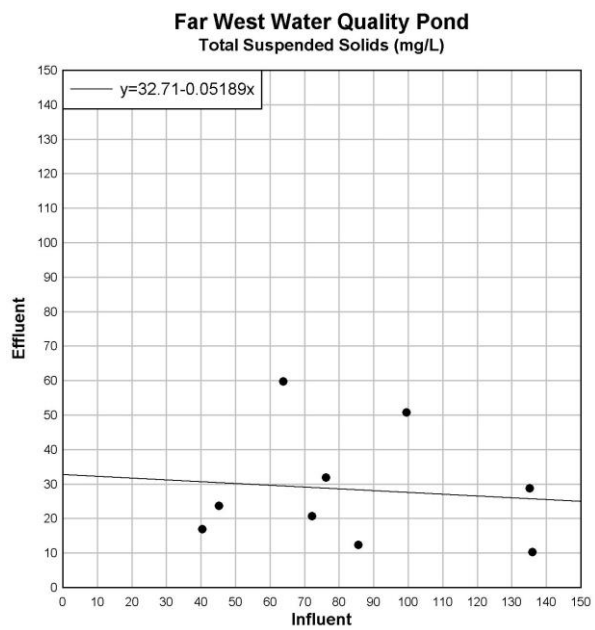
The performance of the overall system is similar to the sedimentation basin, indicating that it was responsible for most of the treatment in the system. This is likely due to the small volume and limited residence time in the wetland in comparison to the drainage area being treated.

Far West Water Quality Pond- Total Suspended Solids (mg/L)



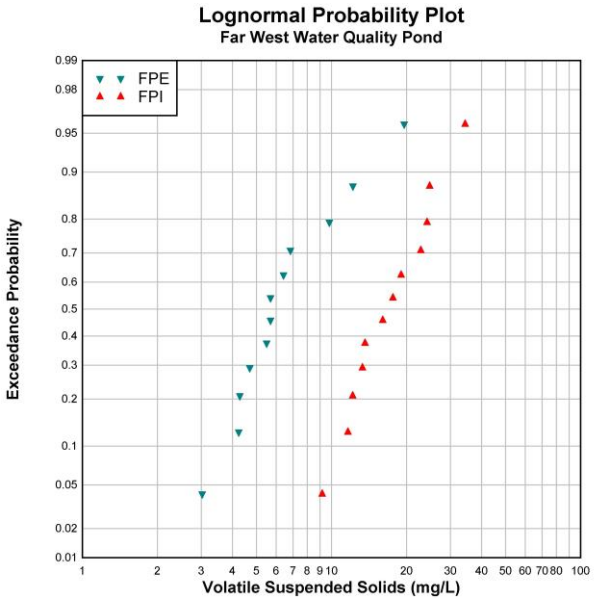


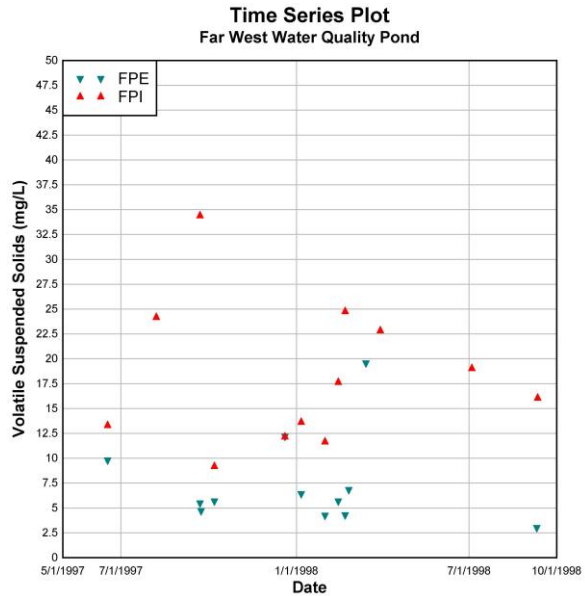


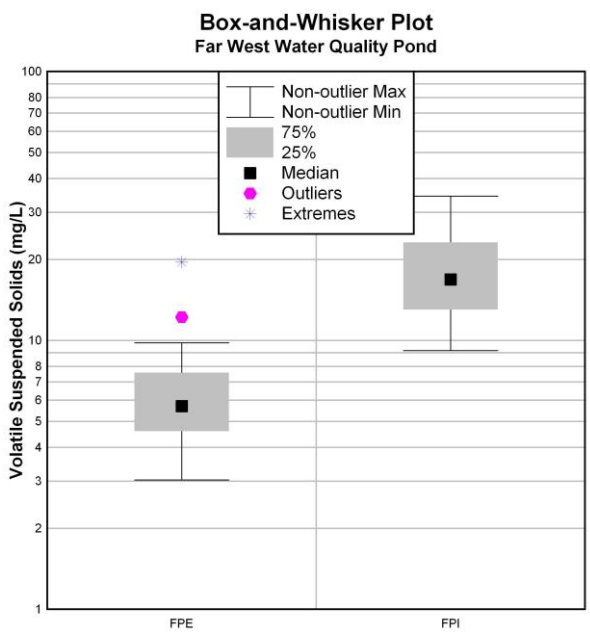


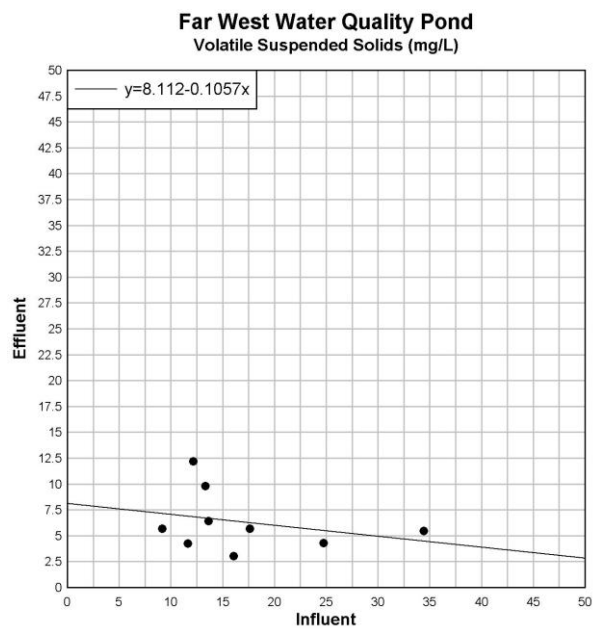
	PARAMETER	TSS (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	213.3	101.2
	Upper Quartile	117.6	43.0
	Median	92.6	26.2
	Lower Quartile	67.9	15.7
	Minimum	40.3	10.2
	Efficiency	71.68%	
	Mann-Whitney	0.0026 **	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	127.4	50.4
	Mean	97.3	33.8
	LCL	67.1	17.3
	Std. Dev.	47.4	26.1
	Wilk (p-value)	0.1349	0.0149 **
	Efficiency	65.20%	
	t-Test (equal var.)	0.0005 **	
	t-Test (unequal var.)	0.0008 **	
	t-test (paired)	0.0093 **	
	Levene Test	0.2215	
Log Transformed	UCL	133.2	54.2
	Mean	97.2	33.3
	LCL	70.9	20.5
	Std. Dev.	46.6	23.9
	Wilk (p-value)	0.9469	0.9564
	Efficiency	65.69%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0053 **	
	Levene Test	0.1887	
Bootstrap	UCL	124.9	49.1
	Mean	97.2	34.0
	LCL	69.5	18.9
	Std. Dev.	43.7	23.8
	Efficiency	65.01%	

Far West Water Quality Pond- Volatile Suspended Solids (mg/L)



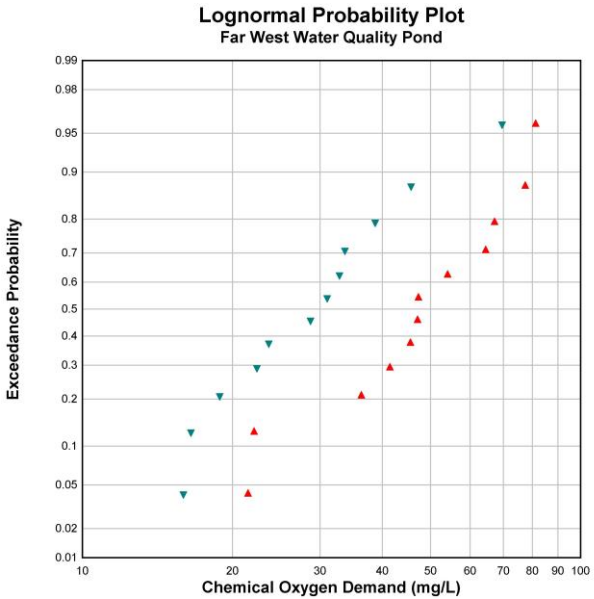


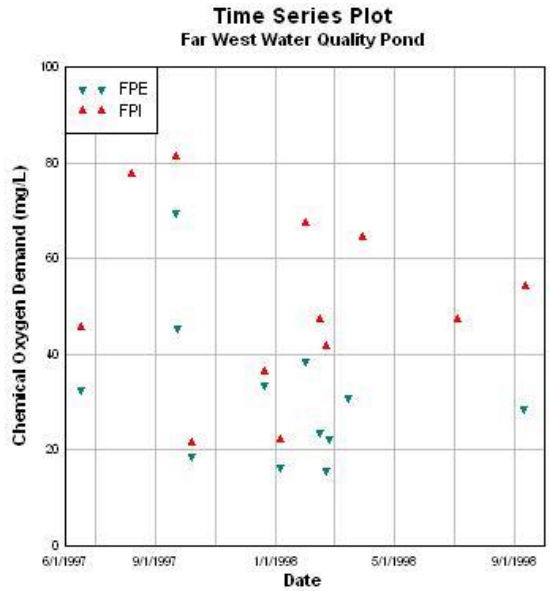


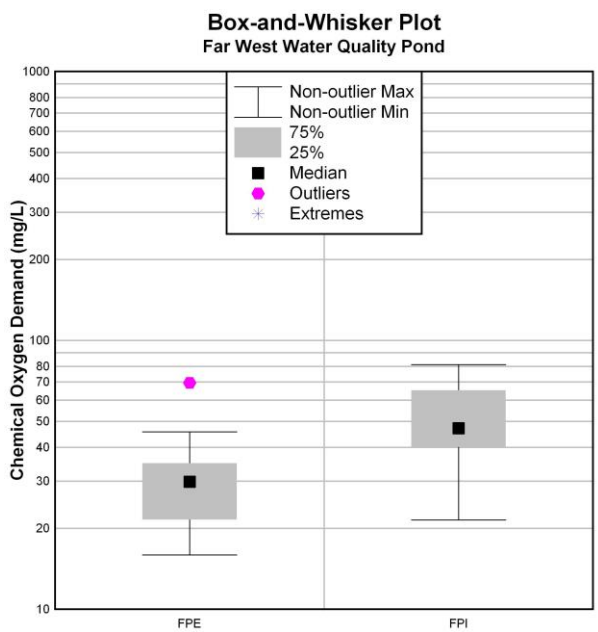


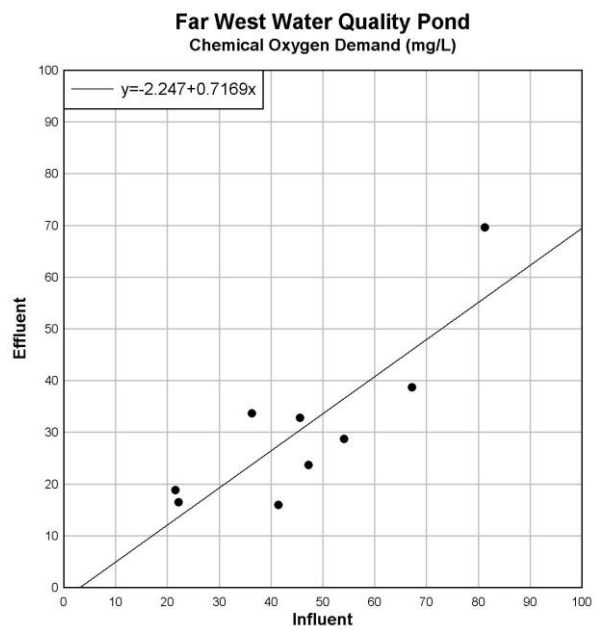
	PARAMETER	VSS (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	34.4	19.6
	Upper Quartile	23.5	8.3
	Median	16.8	5.7
	Lower Quartile	12.7	4.5
	Minimum	9.2	3.0
	Efficiency	66.19%	
	Mann-Whitney	0.0023 **	
	Wilcoxon (paired)	0.0156 **	
Arithmetic	UCL	22.8	10.3
	Mean	18.2	7.3
	LCL	13.6	4.4
	Std. Dev.	7.2	4.6
	Wilk (p-value)	0.3355	0.0045 **
	Efficiency	59.79%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0003 **	
	t-test (paired)	0.0201 **	
	Levene Test	0.2455	
Log Transformed	UCL	23.4	10.2
	Mean	18.2	7.2
	LCL	14.1	5.1
	Std. Dev.	7.1	3.8
	Wilk (p-value)	0.9722	0.4078
	Efficiency	60.39%	
	t-Test (equal var.)	0.0000 **	
	t-Test (unequal var.)	0.0000 **	
	t-Test (paired)	0.0059 **	
	Levene Test	0.3591	
Bootstrap	UCL	22.4	10.0
	Mean	18.1	7.3
	LCL	13.9	4.7
	Std. Dev.	6.6	4.2
	Efficiency	59.54%	

Far West Water Quality Pond-Chemical Oxygen Demand (mg/L)



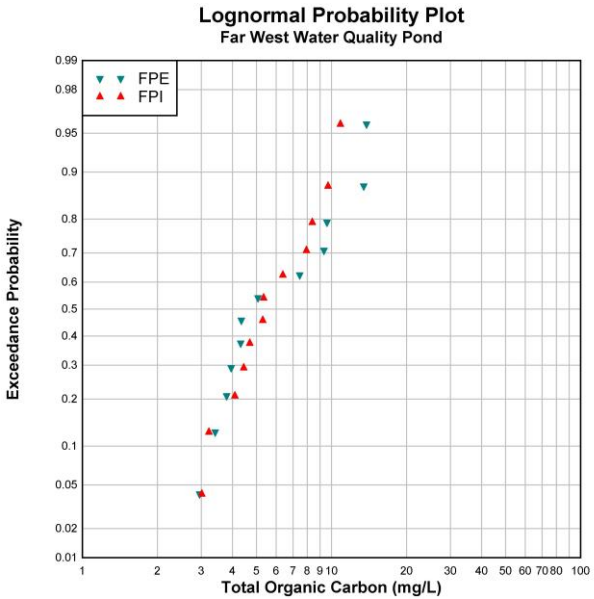


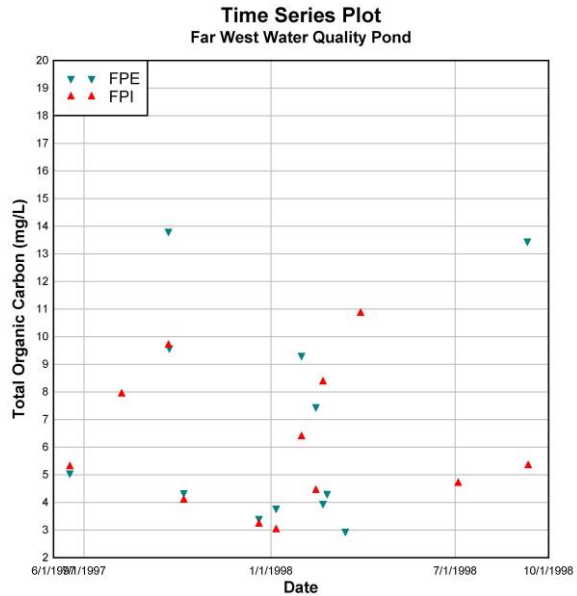


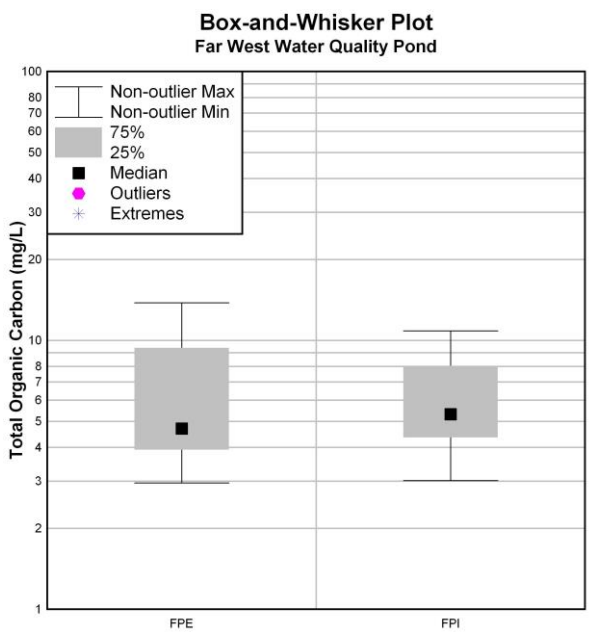


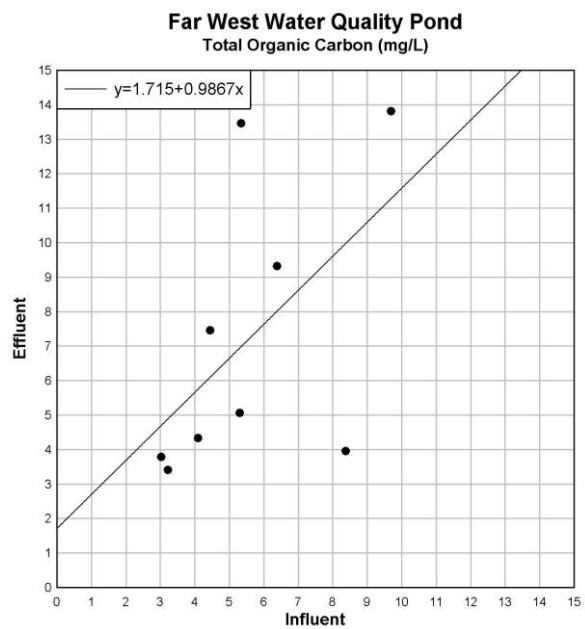
	PARAMETER	COD (mg/L)	
Type	Statistic	INF: FPI	EFF: FPE
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	81.23	69.60
	Upper Quartile	65.84	36.18
	Median	47.17	29.84
	Lower Quartile	38.85	20.63
	Minimum	21.50	15.94
	Efficiency	36.73%	
	Mann-Whitney	0.0251 **	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	62.79	41.02
	Mean	50.47	31.46
	LCL	38.15	21.90
	Std. Dev.	19.39	15.04
	Wilk (p-value)	0.6941	0.0580 *
	Efficiency	37.66%	
	t-Test (equal var.)	0.0136 **	
	t-Test (unequal var.)	0.0140 **	
	t-test (paired)	0.0067 **	
	Levene Test	0.3953	
Log Transformed	UCL	67.83	41.80
	Mean	50.82	31.31
	LCL	38.08	23.45
	Std. Dev.	22.42	13.83
	Wilk (p-value)	0.2716	0.8378
	Efficiency	38.39%	
	t-Test (equal var.)	0.0119 **	
	t-Test (unequal var.)	0.0119 **	
	t-Test (paired)	0.0084 **	
	Levene Test	0.9966	
Bootstrap	UCL	61.71	39.75
	Mean	50.25	31.17
	LCL	38.79	22.59
	Std. Dev.	18.03	13.50
	Efficiency	37.97%	

Far West Water Quality Pond- Total Organic Carbon (mg/L)



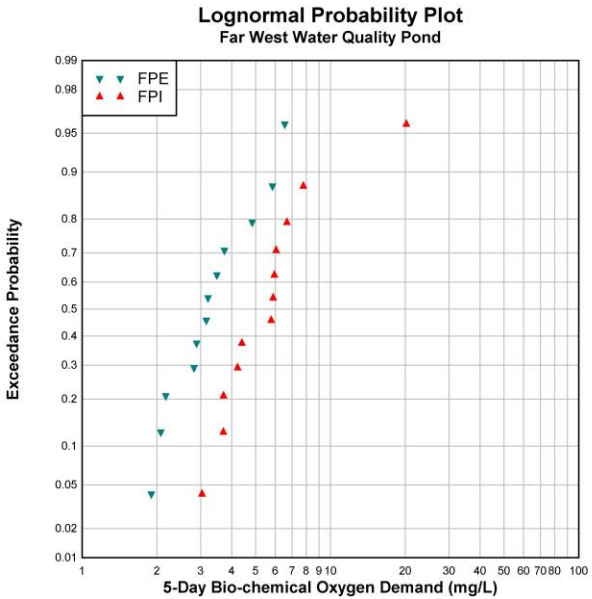


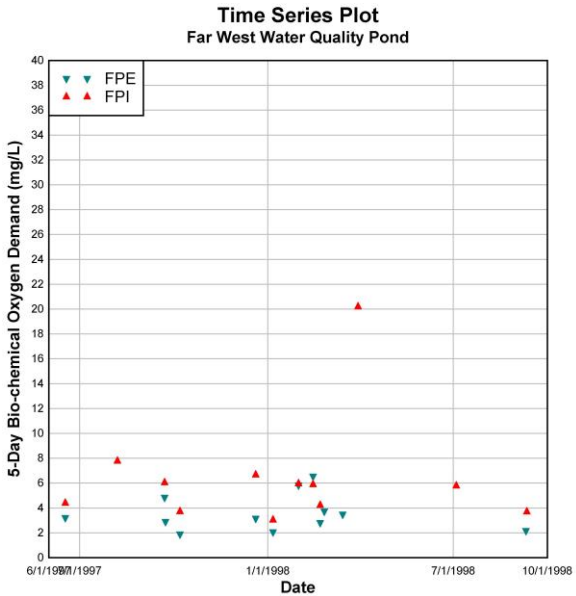


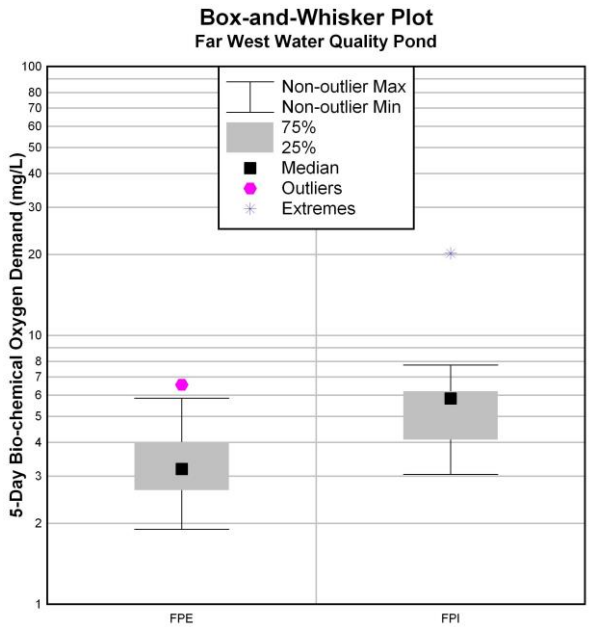


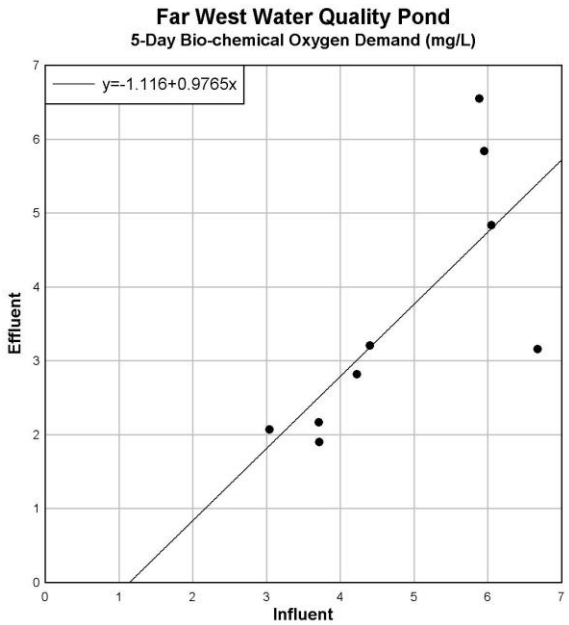
	PARAMETER	TOC (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	10.85	13.81
	Upper Quartile	8.15	9.46
	Median	5.32	4.70
	Lower Quartile	4.27	3.88
	Minimum	3.01	2.95
	Efficiency	11.57%	
	Mann-Whitney	0.8865	
	Wilcoxon (paired)	0.3125	
Arithmetic	UCL	7.73	9.26
	Mean	6.11	6.79
	LCL	4.49	4.32
	Std. Dev.	2.56	3.89
	Wilk (p-value)	0.3404	0.0253 **
	Efficiency	-11.13%	
	t-Test (equal var.)	0.6179	
	t-Test (unequal var.)	0.6187	
	t-test (paired)	0.4056	
	Levene Test	0.1246	
Log Transformed	UCL	8.06	9.79
	Mean	6.11	6.75
	LCL	4.63	4.65
	Std. Dev.	2.60	3.78
	Wilk (p-value)	0.7847	0.1537
	Efficiency	-10.44%	
	t-Test (equal var.)	0.8239	
	t-Test (unequal var.)	0.8240	
	t-Test (paired)	0.4926	
	Levene Test	0.1856	
Bootstrap	UCL	7.61	9.12
	Mean	6.08	6.79
	LCL	4.56	4.45
	Std. Dev.	2.40	3.67
	Efficiency	-11.54%	

Far West Water Quality Pond – 5-Day BioChemical Oxygen Demand



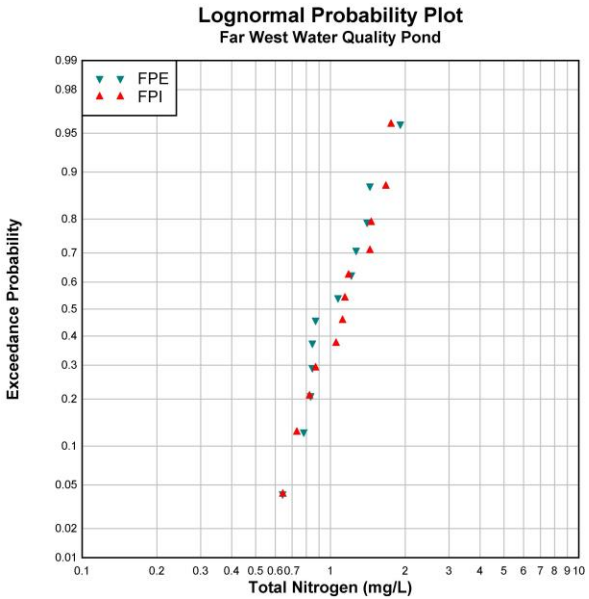


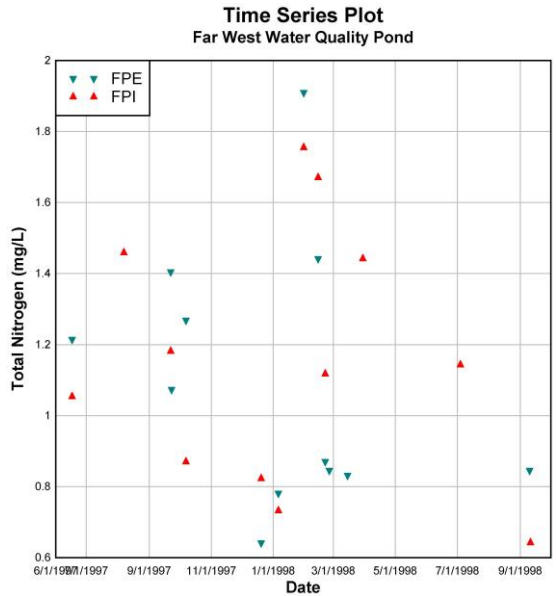


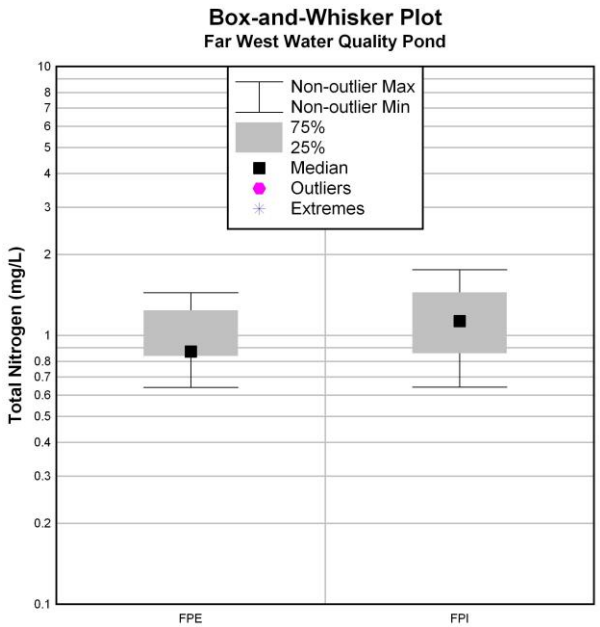


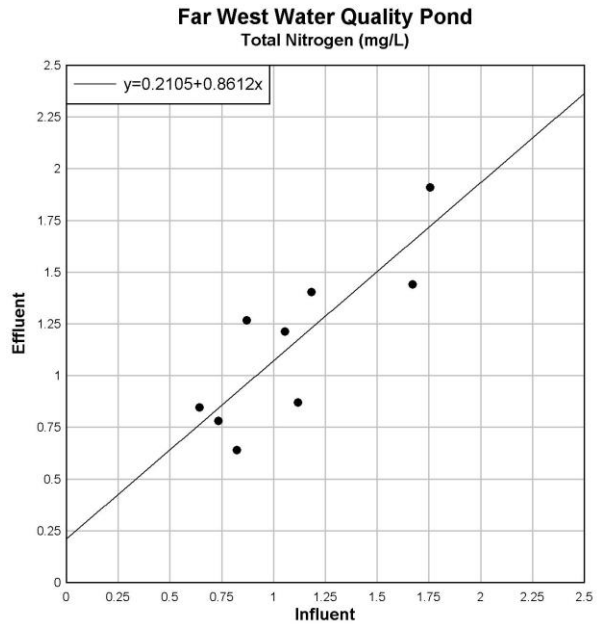
	PARAMETER	BOD (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	20.20	6.55
	Upper Quartile	6.36	4.29
	Median	5.83	3.19
	Lower Quartile	3.97	2.50
	Minimum	3.04	1.90
	Efficiency	45.34%	
	Mann-Whitney	0.0151 **	
	Wilcoxon (paired)	0.0234 **	
Arithmetic	UCL	9.34	4.49
	Mean	6.45	3.56
	LCL	3.56	2.62
	Std. Dev.	4.55	1.48
	Wilk (p-value)	0.0002 **	0.1269
	Efficiency	44.84%	
	t-Test (equal var.)	0.0481 **	
	t-Test (unequal var.)	0.0560 *	
	t-test (paired)	0.0284 **	
	Levene Test	0.2856	
Log Transformed	UCL	8.73	4.60
	Mean	6.27	3.55
	LCL	4.50	2.73
	Std. Dev.	3.15	1.42
	Wilk (p-value)	0.0445 **	0.6586
	Efficiency	43.42%	
	t-Test (equal var.)	0.0079 **	
	t-Test (unequal var.)	0.0081 **	
	t-Test (paired)	0.0149 **	
	Levene Test	0.5803	
Bootstrap	UCL	8.92	4.43
	Mean	6.45	3.55
	LCL	3.97	2.67
	Std. Dev.	3.89	1.38
	Efficiency	44.94%	

Far West Water Quality Pond- Total Nitrogen (mg/L)



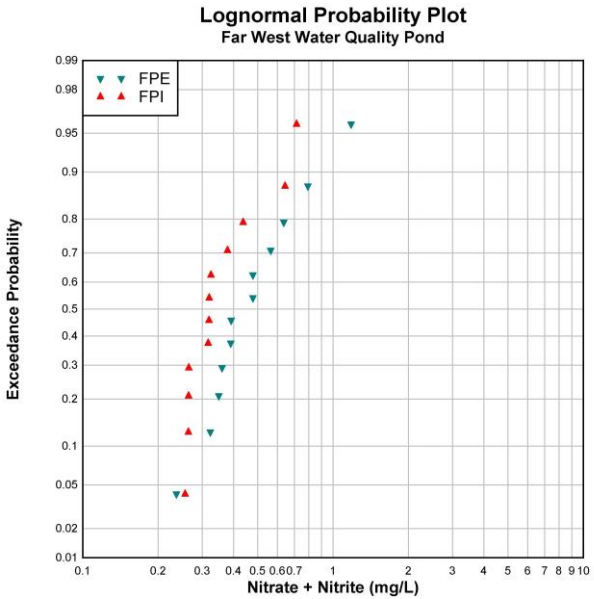


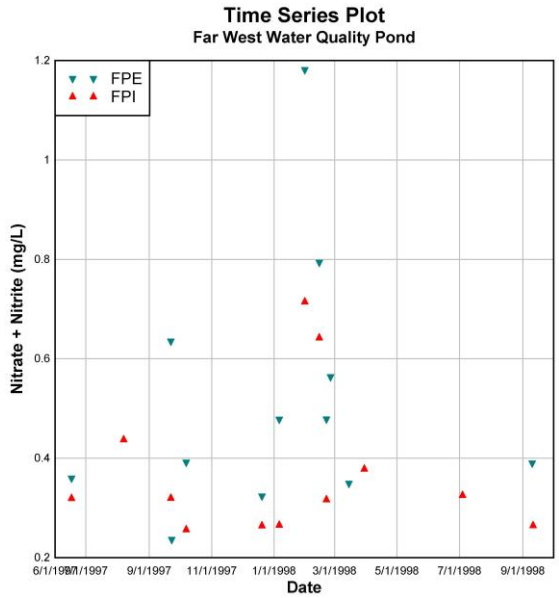


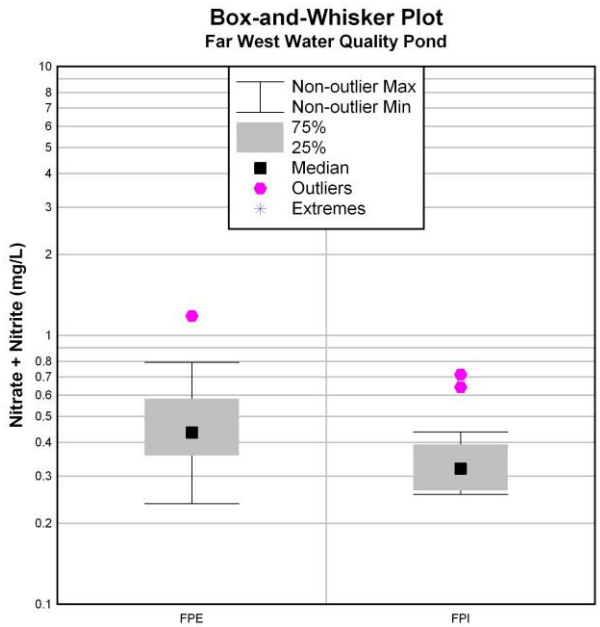


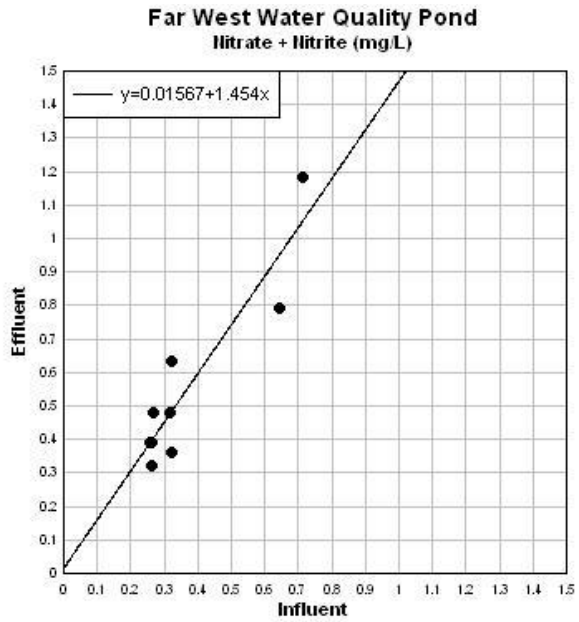
	PARAMETER	TN (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	1.755	1.910
	Upper Quartile	1.451	1.336
	Median	1.131	0.972
	Lower Quartile	0.847	0.839
	Minimum	0.642	0.641
	Efficiency	14.04%	
	Mann-Whitney	0.6690	
	Wilcoxon (paired)	0.9453	
Arithmetic	UCL	1.388	1.326
	Mean	1.158	1.094
	LCL	0.927	0.861
	Std. Dev.	0.363	0.366
	Wilk (p-value)	0.6794	0.1950
	Efficiency	5.52%	
	t-Test (equal var.)	0.6718	
	t-Test (unequal var.)	0.6718	
	t-test (paired)	0.6426	
	Levene Test	0.9716	
Log Transformed	UCL	1.431	1.344
	Mean	1.159	1.092
	LCL	0.938	0.887
	Std. Dev.	0.379	0.351
	Wilk (p-value)	0.7920	0.6312
	Efficiency	5.75%	
	t-Test (equal var.)	0.6632	
	t-Test (unequal var.)	0.6632	
	t-Test (paired)	0.7693	
	Levene Test	0.9450	
Bootstrap	UCL	1.372	1.305
	Mean	1.153	1.088
	LCL	0.934	0.872
	Std. Dev.	0.345	0.341
	Efficiency	5.63%	

Far West Water Quality Pond-Nitrate + Nitrite (mg/L)



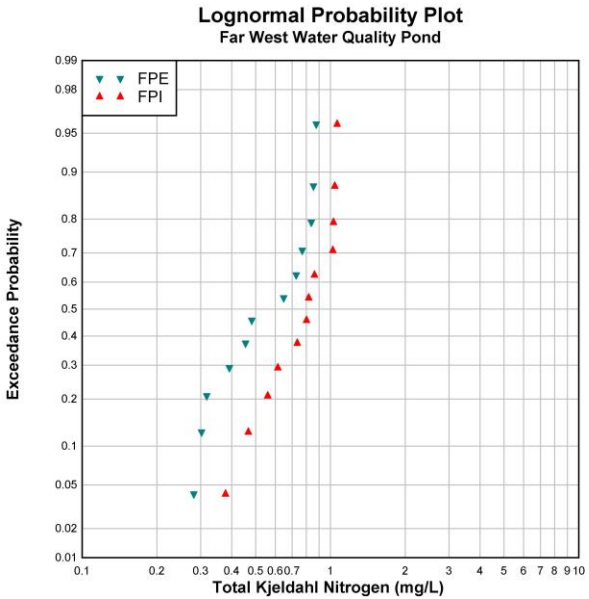


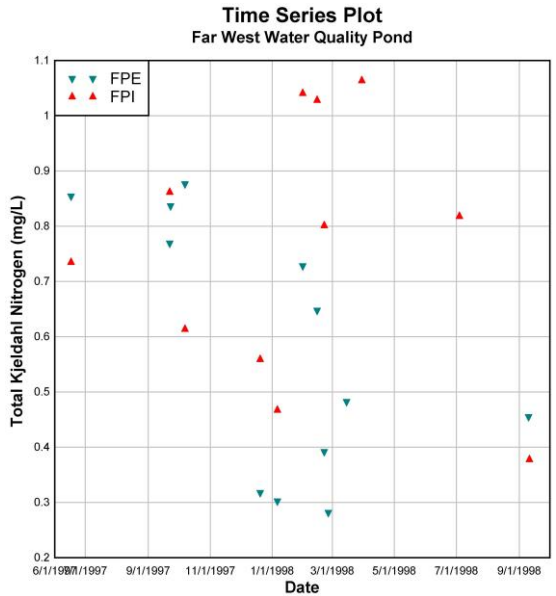


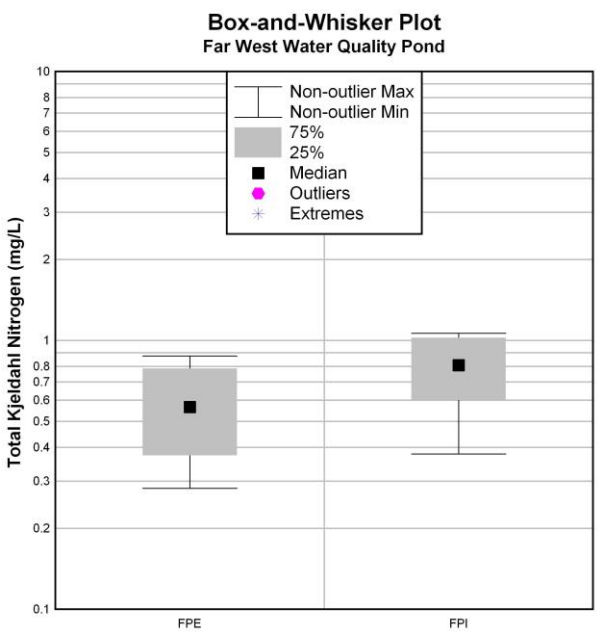


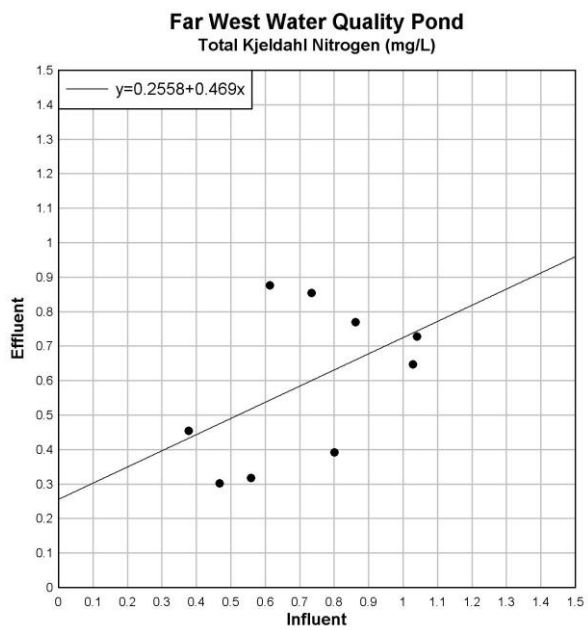
	PARAMETER	NO2 + NO3 (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.715	1.181
	Upper Quartile	0.408	0.600
	Median	0.320	0.435
	Lower Quartile	0.265	0.355
	Minimum	0.257	0.237
	Efficiency	-36.07%	
	Mann-Whitney	0.0733 *	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	0.472	0.680
	Mean	0.375	0.515
	LCL	0.279	0.351
	Std. Dev.	0.152	0.259
	Wilk (p-value)	0.0027 **	0.0227 **
	Efficiency	-37.23%	
	t-Test (equal var.)	0.1209	
	t-Test (unequal var.)	0.1243	
	t-test (paired)	0.0060 **	
	Levene Test	0.2870	
Log Transformed	UCL	0.467	0.684
	Mean	0.373	0.511
	LCL	0.298	0.382
	Std. Dev.	0.130	0.227
	Wilk (p-value)	0.0179 **	0.7851
	Efficiency	-37.05%	
	t-Test (equal var.)	0.0913 *	
	t-Test (unequal var.)	0.0921 *	
	t-Test (paired)	0.0009 **	
	Levene Test	0.4507	
Bootstrap	UCL	0.463	0.663
	Mean	0.375	0.515
	LCL	0.287	0.367
	Std. Dev.	0.139	0.233
	Efficiency	-37.41%	

Far West Water Quality Pond-Total Kjeldahl Nitrogen (mg/L)



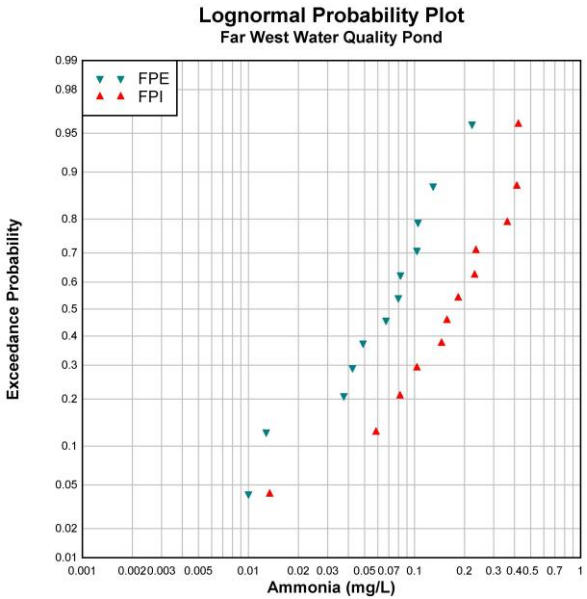


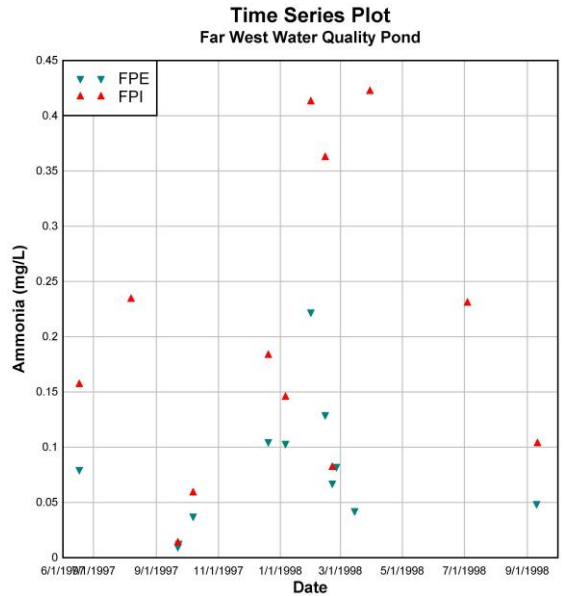


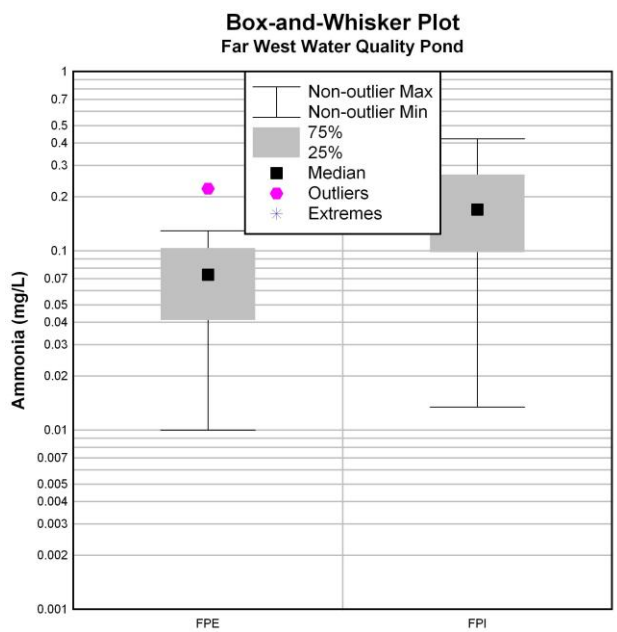


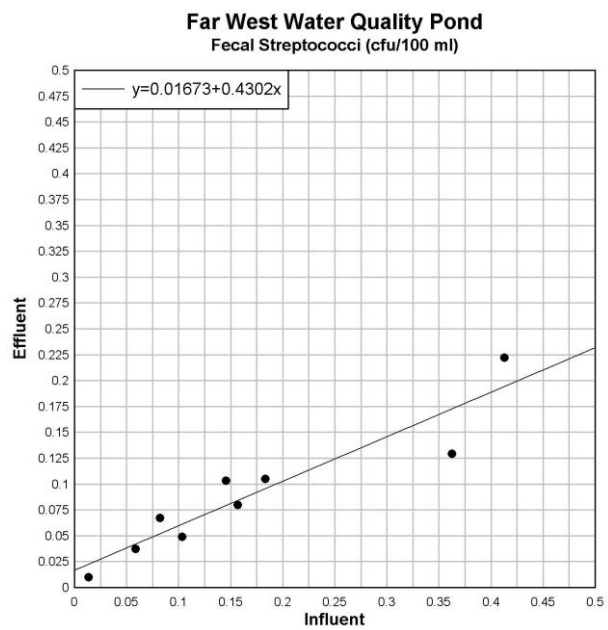
	PARAMETER	TKN (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	1.064	0.876
	Upper Quartile	1.025	0.803
	Median	0.810	0.565
	Lower Quartile	0.586	0.355
	Minimum	0.378	0.282
	Efficiency	30.20%	
	Mann-Whitney	0.0733 *	
	Wilcoxon (paired)	0.1484	
Arithmetic	UCL	0.933	0.725
	Mean	0.782	0.579
	LCL	0.632	0.432
	Std. Dev.	0.236	0.231
	Wilk (p-value)	0.3085	0.1050
	Efficiency	26.03%	
	t-Test (equal var.)	0.0442 **	
	t-Test (unequal var.)	0.0442 **	
	t-test (paired)	0.1152	
	Levene Test	0.8890	
Log Transformed	UCL	0.982	0.776
	Mean	0.785	0.581
	LCL	0.628	0.435
	Std. Dev.	0.271	0.257
	Wilk (p-value)	0.1629	0.1031
	Efficiency	26.04%	
	t-Test (equal var.)	0.0474 **	
	t-Test (unequal var.)	0.0481 **	
	t-Test (paired)	0.0791 *	
	Levene Test	0.2175	
Bootstrap	UCL	0.922	0.712
	Mean	0.779	0.573
	LCL	0.635	0.435
	Std. Dev.	0.226	0.218
	Efficiency	26.36%	

Far West Water Quality Pond-Ammonia (mg/L)



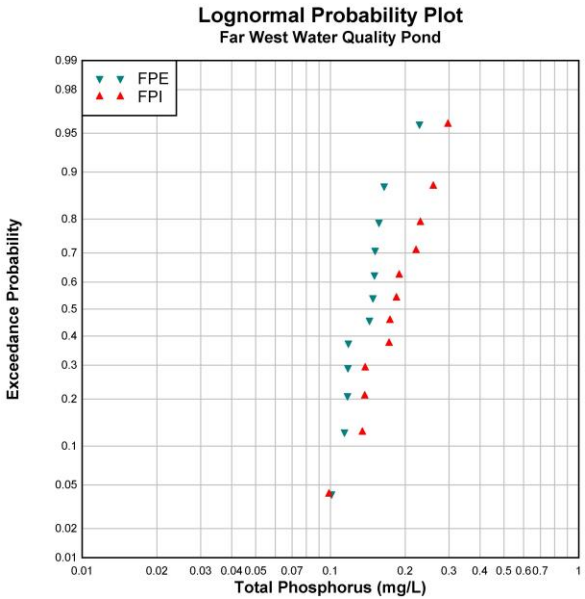


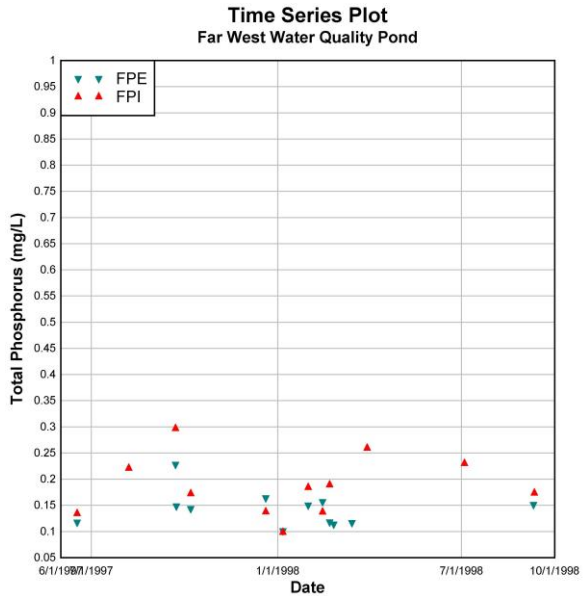


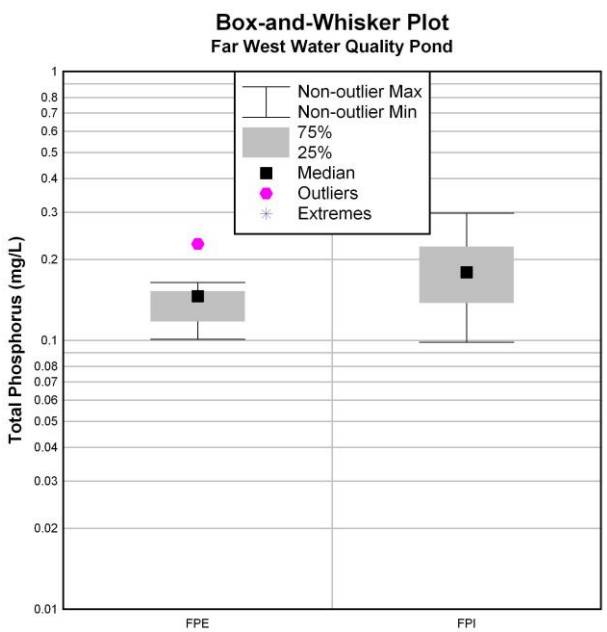


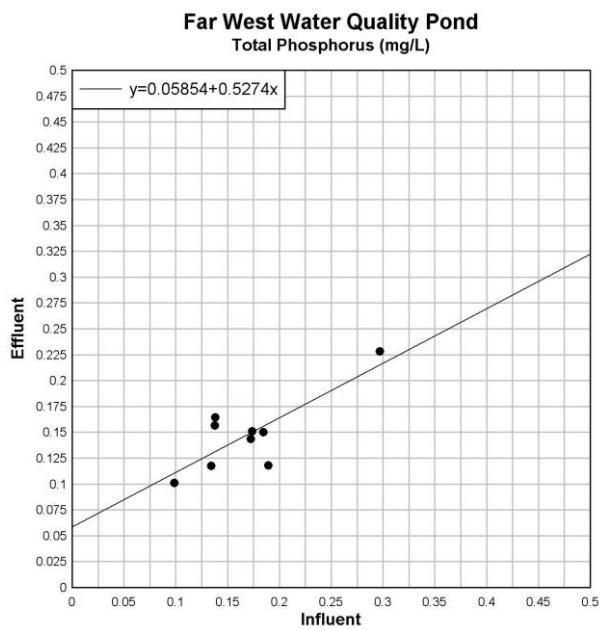
	PARAMETER	NH3 (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.422	0.222
	Upper Quartile	0.298	0.104
	Median	0.170	0.074
	Lower Quartile	0.093	0.040
	Minimum	0.013	0.010
	Efficiency	56.72%	
	Mann-Whitney	0.0195 **	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	0.287	0.116
	Mean	0.200	0.078
	LCL	0.113	0.041
	Std. Dev.	0.137	0.058
	Wilk (p-value)	0.3271	0.1593
	Efficiency	60.87%	
	t-Test (equal var.)	0.0096 **	
	t-Test (unequal var.)	0.0125 **	
	t-test (paired)	0.0287 **	
	Levene Test	0.0167 **	
Log Transformed	UCL	0.480	0.167
	Mean	0.223	0.083
	LCL	0.104	0.042
	Std. Dev.	0.239	0.082
	Wilk (p-value)	0.1289	0.3728
	Efficiency	62.65%	
	t-Test (equal var.)	0.0247 **	
	t-Test (unequal var.)	0.0247 **	
	t-Test (paired)	0.0008 **	
	Levene Test	0.8284	
Bootstrap	UCL	0.283	0.113
	Mean	0.201	0.079
	LCL	0.120	0.045
	Std. Dev.	0.128	0.053
	Efficiency	60.78%	

Far West Water Quality Pond- Total Phosphorus (mg/L)



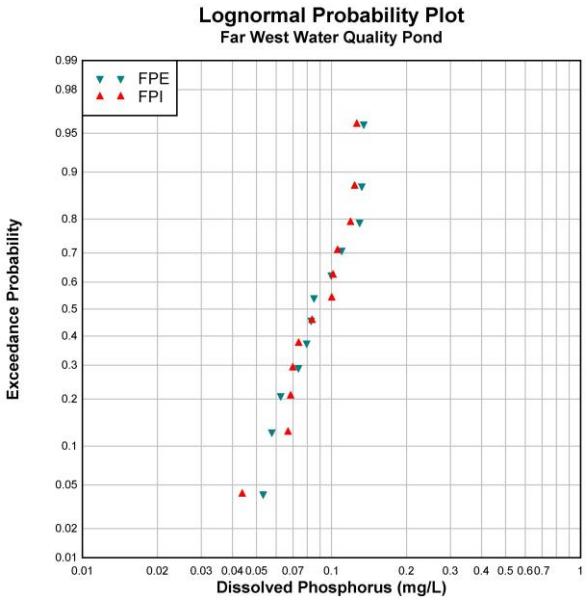


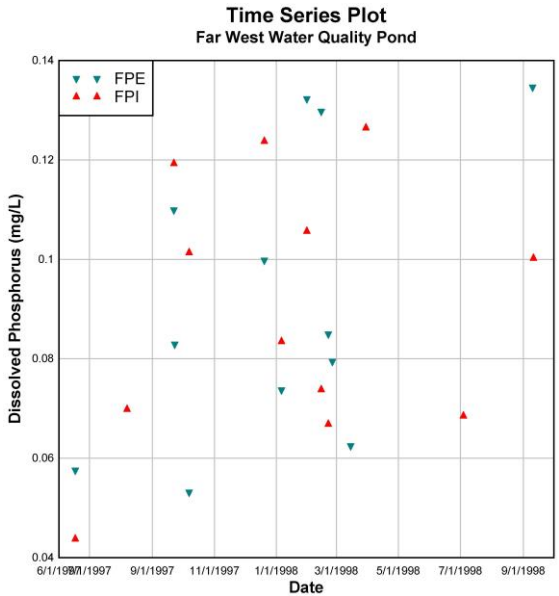


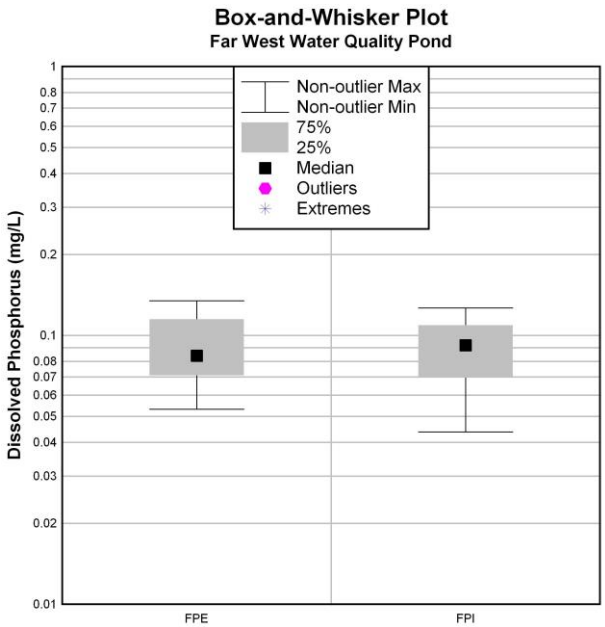


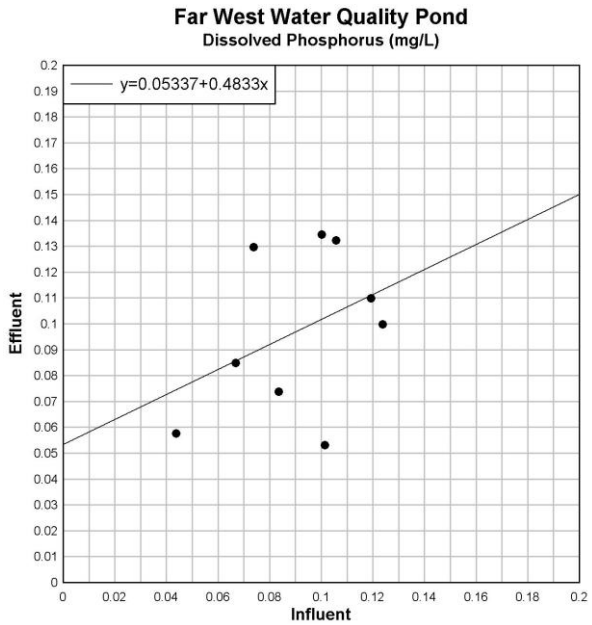
	PARAMETER	TP (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.297	0.228
	Upper Quartile	0.226	0.154
	Median	0.179	0.146
	Lower Quartile	0.138	0.117
	Minimum	0.099	0.101
	Efficiency	18.47%	
	Mann-Whitney	0.0655 *	
	Wilcoxon (paired)	0.1953	
Arithmetic	UCL	0.223	0.164
	Mean	0.186	0.143
	LCL	0.150	0.121
	Std. Dev.	0.057	0.034
	Wilk (p-value)	0.8676	0.0511 *
	Efficiency	23.49%	
	t-Test (equal var.)	0.0330 **	
	t-Test (unequal var.)	0.0355 **	
	t-test (paired)	0.1437	
	Levene Test	0.1230	
Log Transformed	UCL	0.229	0.164
	Mean	0.186	0.142
	LCL	0.152	0.124
	Std. Dev.	0.059	0.032
	Wilk (p-value)	0.9680	0.2878
	Efficiency	23.63%	
	t-Test (equal var.)	0.0364 **	
	t-Test (unequal var.)	0.0376 **	
	t-Test (paired)	0.1743	
	Levene Test	0.2352	
Bootstrap	UCL	0.220	0.162
	Mean	0.186	0.142
	LCL	0.152	0.123
	Std. Dev.	0.054	0.031
	Efficiency	23.38%	

Far West Water Quality Pond-Dissolved Phosphorus (mg/L)



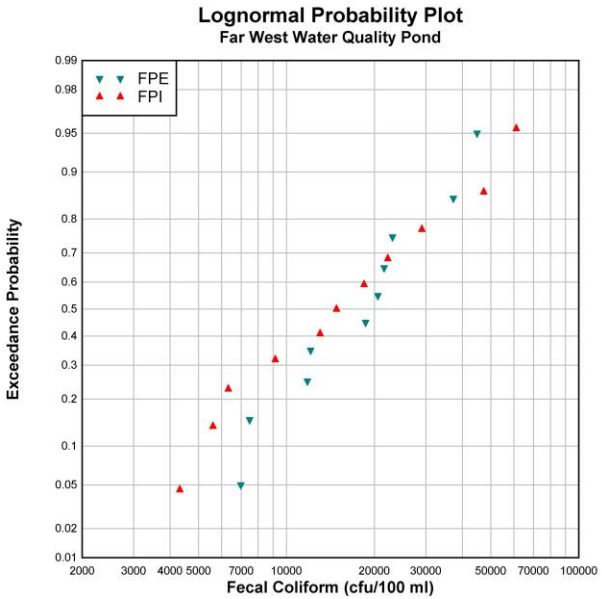


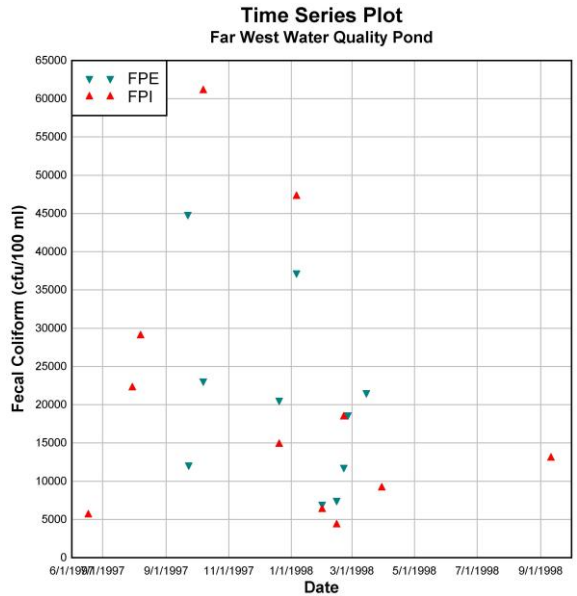


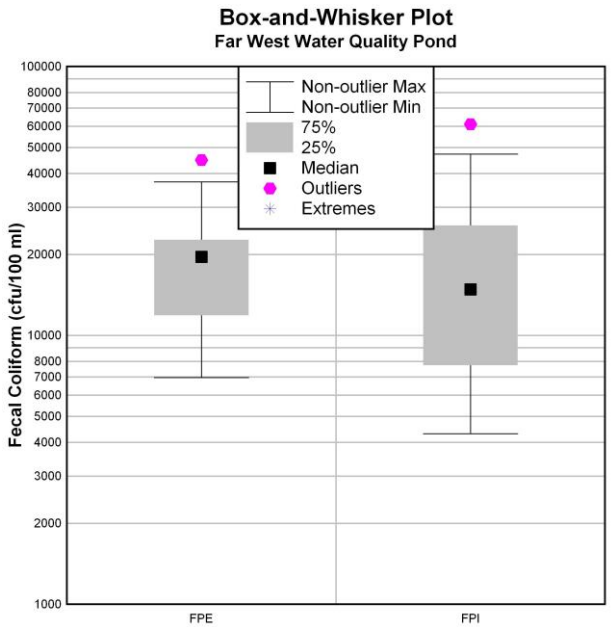


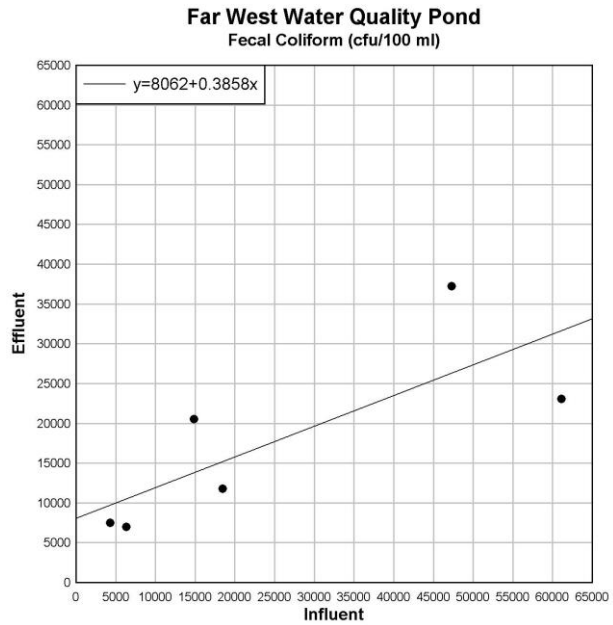
	PARAMETER	DP (mg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	0.126	0.135
	Upper Quartile	0.112	0.120
	Median	0.092	0.084
	Lower Quartile	0.069	0.068
	Minimum	0.044	0.053
	Efficiency	8.63%	
	Mann-Whitney	0.9317	
	Wilcoxon (paired)	0.7422	
Arithmetic	UCL	0.107	0.110
	Mean	0.090	0.092
	LCL	0.074	0.073
	Std. Dev.	0.026	0.029
	Wilk (p-value)	0.5101	0.2476
	Efficiency	-1.62%	
	t-Test (equal var.)	0.8989	
	t-Test (unequal var.)	0.8989	
	t-test (paired)	0.8081	
	Levene Test	0.5876	
Log Transformed	UCL	0.111	0.113
	Mean	0.091	0.092
	LCL	0.074	0.074
	Std. Dev.	0.029	0.030
	Wilk (p-value)	0.3074	0.4442
	Efficiency	-1.39%	
	t-Test (equal var.)	0.9277	
	t-Test (unequal var.)	0.9277	
	t-Test (paired)	0.8303	
	Levene Test	0.9385	
Bootstrap	UCL	0.106	0.110
	Mean	0.090	0.092
	LCL	0.075	0.074
	Std. Dev.	0.025	0.028
	Efficiency	-2.01%	

Far West Water Quality Pond-Fecal Coliform (cfu/100L)



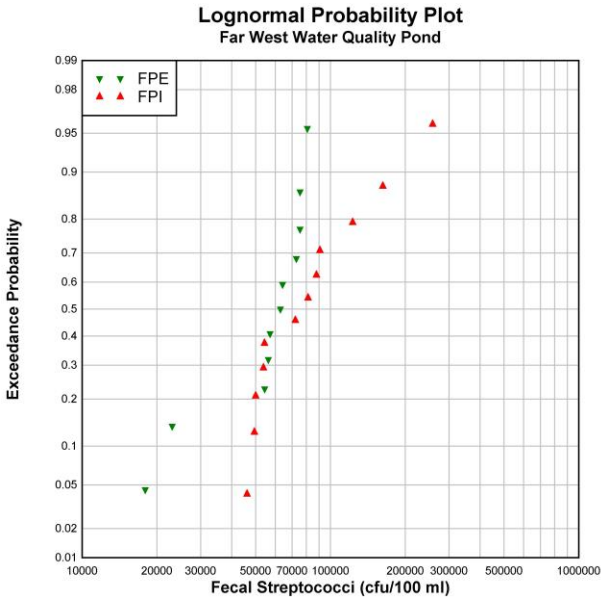


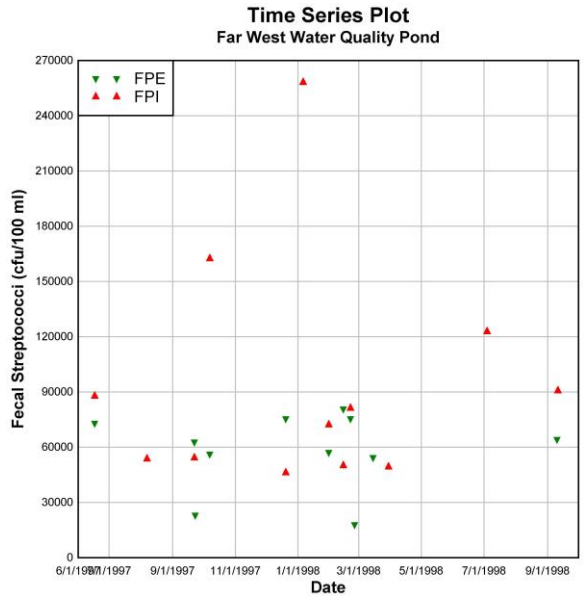


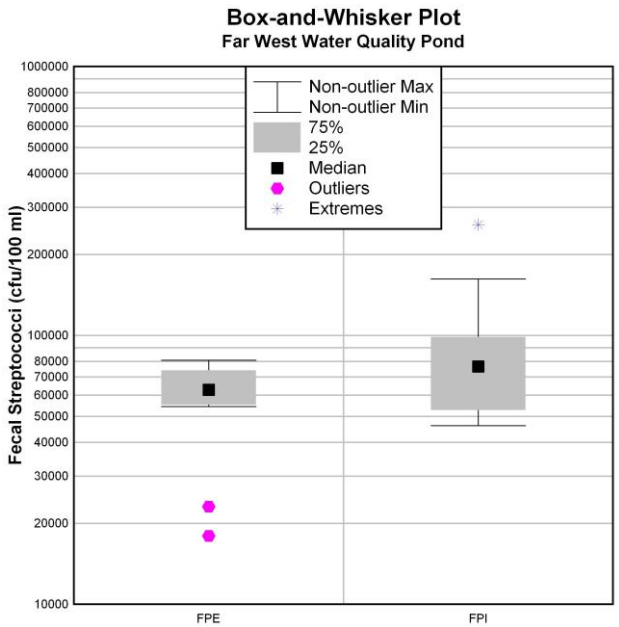


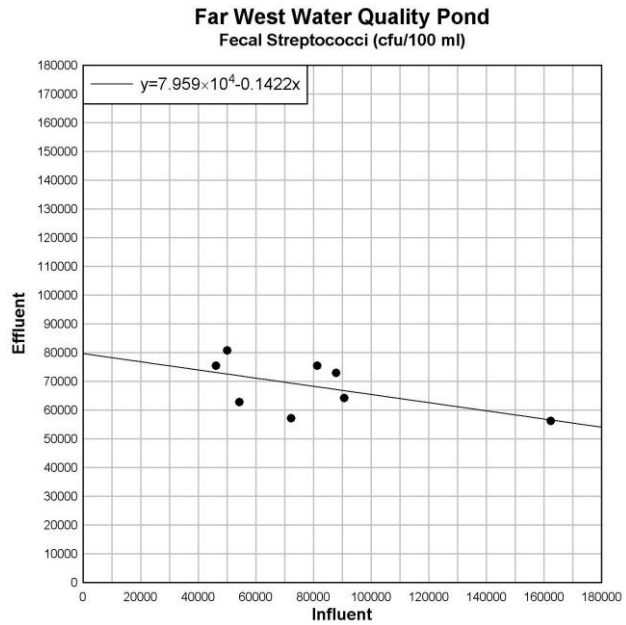
	PARAMETER	F. Coliform (cfu/100ml)	
Type	Statistic	INF: FPI	EFF: FPE
	Site Count	11	10
	Pairs Count	6	6
Non-Parametric	Maximum	61,090	44,845
	Upper Quartile	29,043	23,076
	Median	14,843	19,605
	Lower Quartile	6,319	11,796
	Minimum	4,312	6,980
	Efficiency	-32.09%	
	Mann-Whitney	0.7026	
	Wilcoxon (paired)	0.4375	
Arithmetic	UCL	33,310	29,291
	Mean	21,028	20,427
	LCL	8,747	11,563
	Std. Dev.	18,282	12,392
	Wilk (p-value)	0.0317 **	0.1913
	Efficiency	2.86%	
	t-Test (equal var.)	0.9313	
	t-Test (unequal var.)	0.9301	
	t-test (paired)	0.3037	
	Levene Test	0.3146	
Log Transformed	UCL	41,812	33,406
	Mean	20,998	20,491
	LCL	10,545	12,569
	Std. Dev.	19,332	13,091
	Wilk (p-value)	0.8713	0.6701
	Efficiency	2.41%	
	t-Test (equal var.)	0.6881	
	t-Test (unequal var.)	0.6836	
	t-Test (paired)	0.6379	
	Levene Test	0.1899	
Bootstrap	UCL	32,230	28,379
	Mean	20,914	20,306
	LCL	9,598	12,233
	Std. Dev.	16,844	11,285
	Efficiency	2.91%	

Far West Water Quality Pond-Fecal Streptococci (cfu/100L)



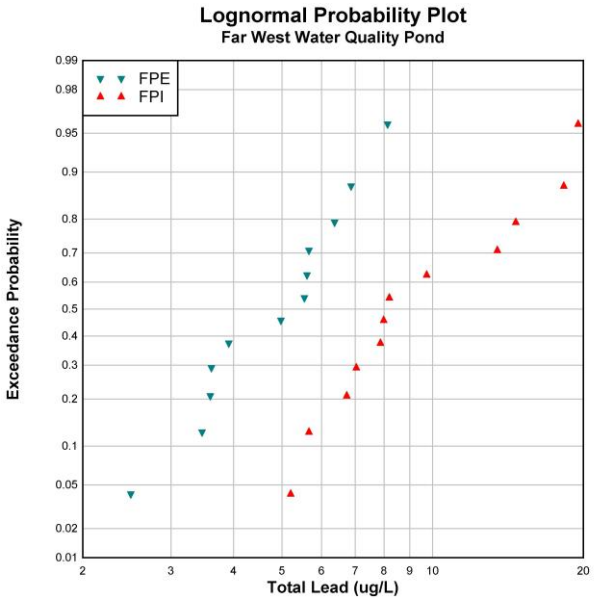


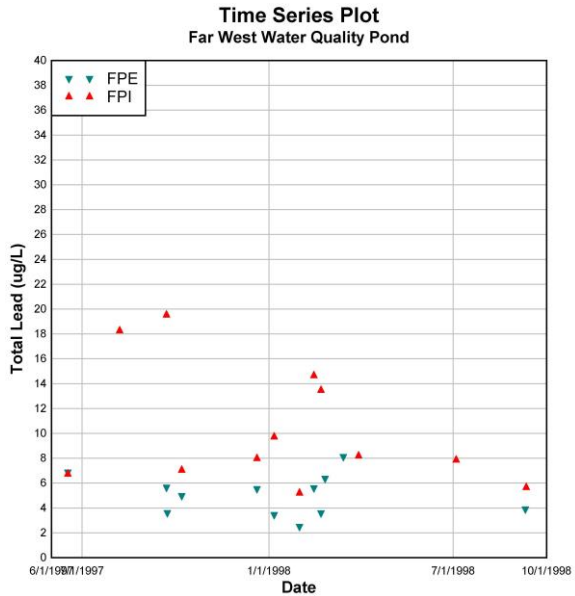


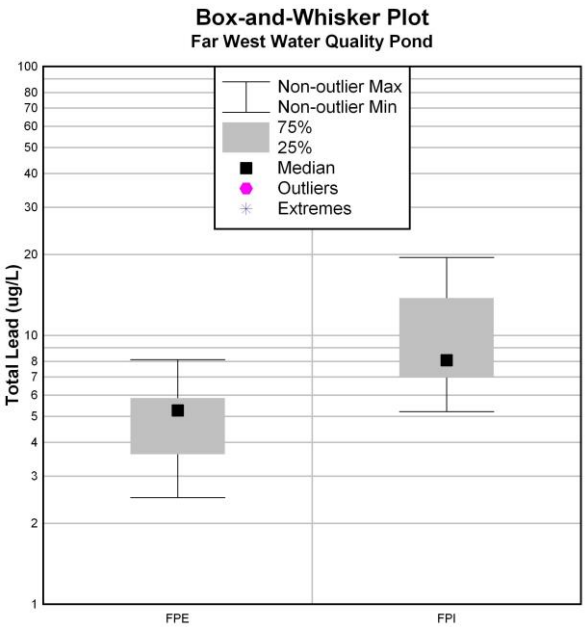


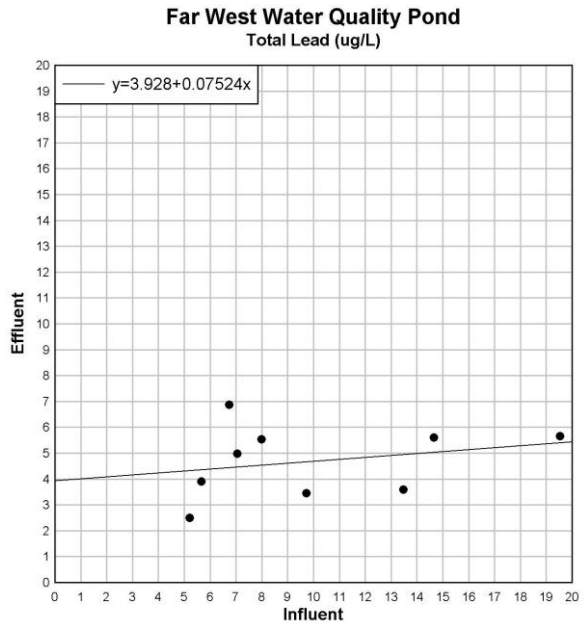
	PARAMETER	F. Strep. (cfu/100ml)	
Type	Statistic	INF: FPI	EFF: FPE
	Site Count	12	11
	Pairs Count	7	7
Non-Parametric	Maximum	258,127	80,767
	Upper Quartile	106,763	75,440
	Median	76,706	62,849
	Lower Quartile	51,852	54,384
	Minimum	46,130	17,962
	Efficiency	18.07%	
	Mann-Whitney	0.3209	
	Wilcoxon (paired)	0.9375	
Arithmetic	UCL	133,579	72,084
	Mean	94,059	58,229
	LCL	54,540	44,373
	Std. Dev.	62,199	20,625
	Wilk (p-value)	0.0035 **	0.0454 **
	Efficiency	38.09%	
	t-Test (equal var.)	0.0833 *	
	t-Test (unequal var.)	0.0809 *	
	t-test (paired)	0.5725	
	Levene Test	0.1774	
Log Transformed	UCL	133,057	84,953
	Mean	92,268	59,534
	LCL	63,983	41,720
	Std. Dev.	50,904	30,243
	Wilk (p-value)	0.1359	0.0017 **
	Efficiency	35.48%	
	t-Test (equal var.)	0.0660 *	
	t-Test (unequal var.)	0.0651 *	
	t-Test (paired)	0.7672	
	Levene Test	0.8050	
Bootstrap	UCL	129,735	71,243
	Mean	94,001	58,519
	LCL	58,266	45,795
	Std. Dev.	56,242	18,940
	Efficiency	37.75%	

Far West Water Quality Pond-Total Lead (ug/L)



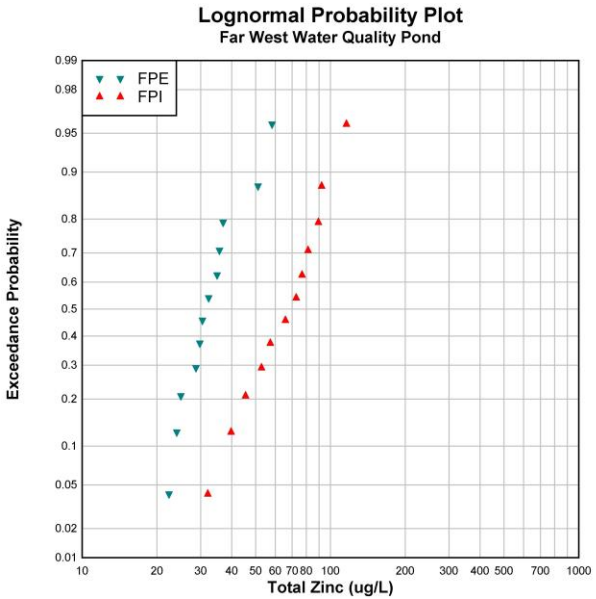


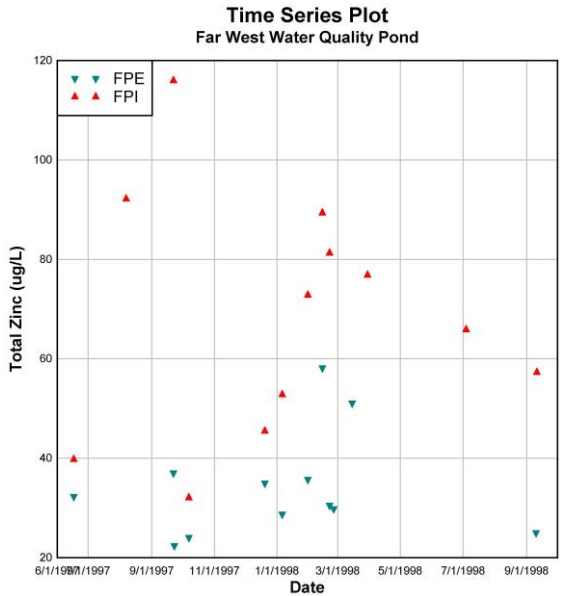


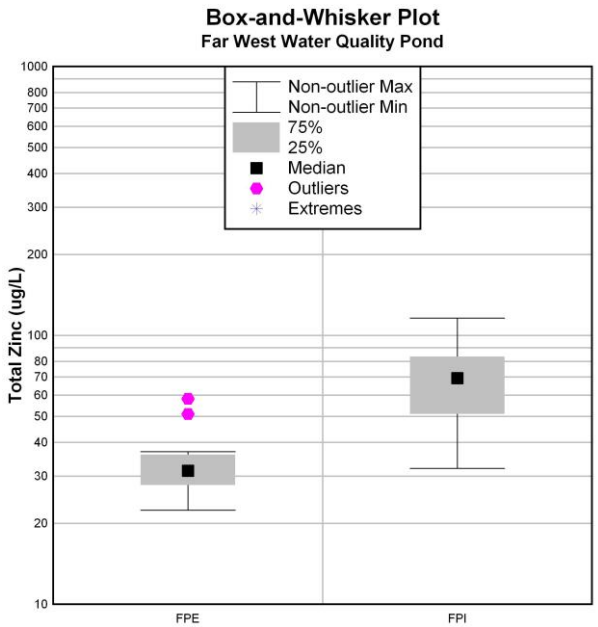


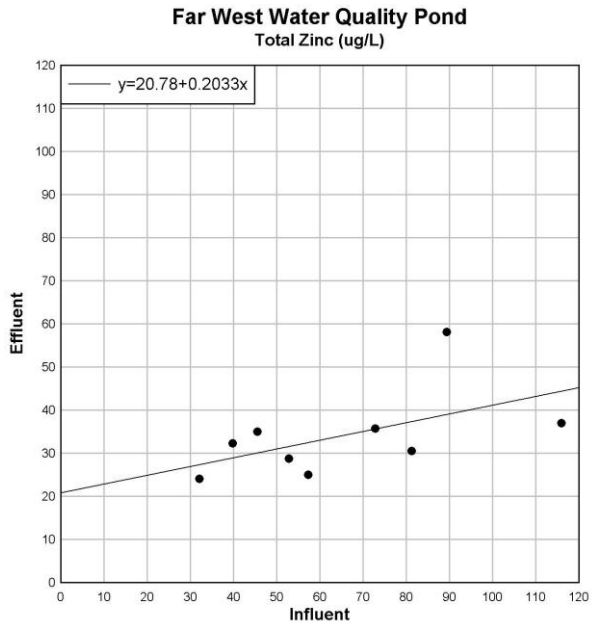
	PARAMETER	Lead (µg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	19.5	8.1
	Upper Quartile	14.1	6.0
	Median	8.1	5.3
	Lower Quartile	6.9	3.6
	Minimum	5.2	2.5
	Efficiency	34.98%	
	Mann-Whitney	0.0034 **	
	Wilcoxon (paired)	0.0156 **	
Arithmetic	UCL	13.5	6.1
	Mean	10.4	5.0
	LCL	7.2	4.0
	Std. Dev.	4.9	1.7
	Wilk (p-value)	0.0503 *	0.8010
	Efficiency	51.55%	
	t-Test (equal var.)	0.0017 **	
	t-Test (unequal var.)	0.0032 **	
	t-test (paired)	0.0117 **	
	Levene Test	0.0150 **	
Log Transformed	UCL	13.9	6.3
	Mean	10.3	5.0
	LCL	7.7	4.0
	Std. Dev.	4.7	1.8
	Wilk (p-value)	0.3115	0.7731
	Efficiency	51.26%	
	t-Test (equal var.)	0.0004 **	
	t-Test (unequal var.)	0.0004 **	
	t-Test (paired)	0.0030 **	
	Levene Test	0.2504	
Bootstrap	UCL	13.1	6.0
	Mean	10.3	5.0
	LCL	7.4	4.0
	Std. Dev.	4.5	1.5
	Efficiency	51.04%	

Far West Water Quality Pond- Total Zinc (ug/L)



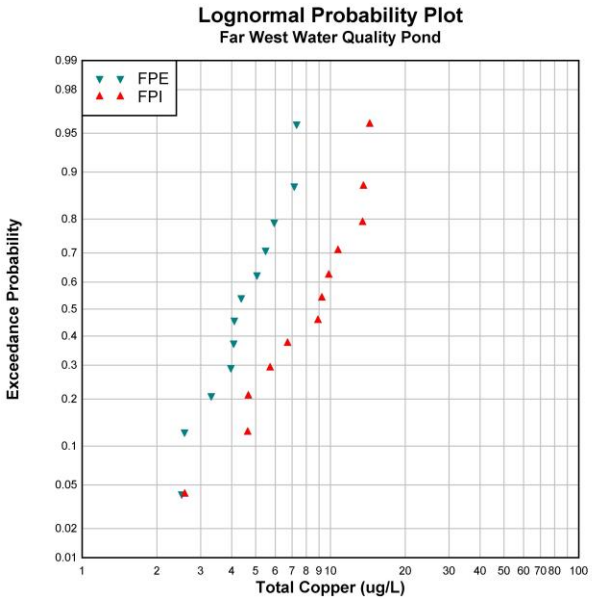


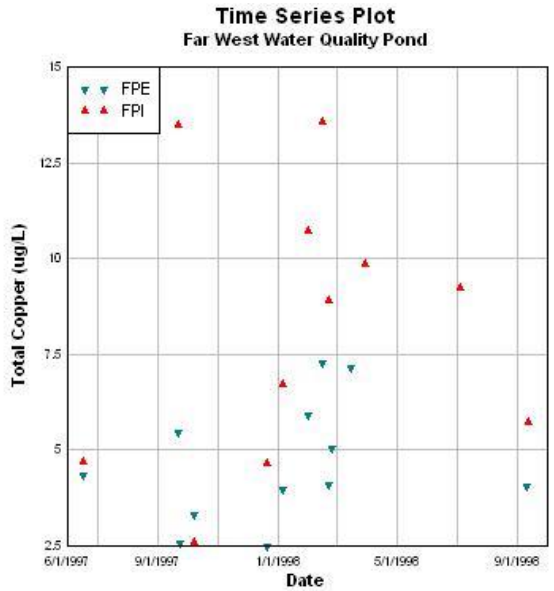


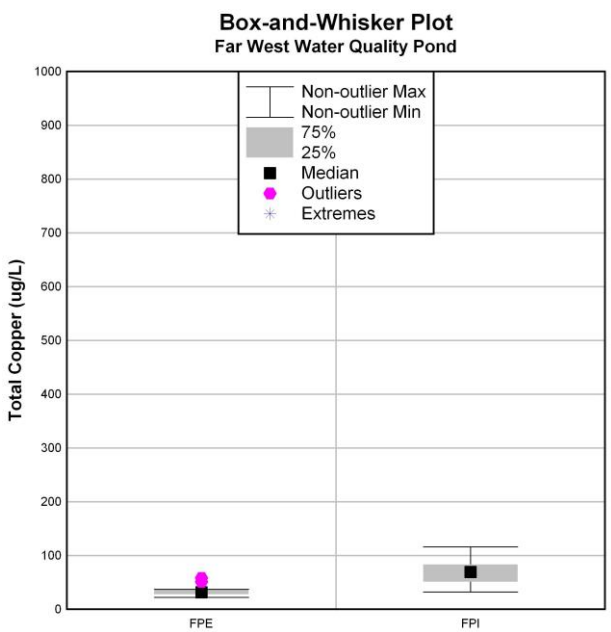


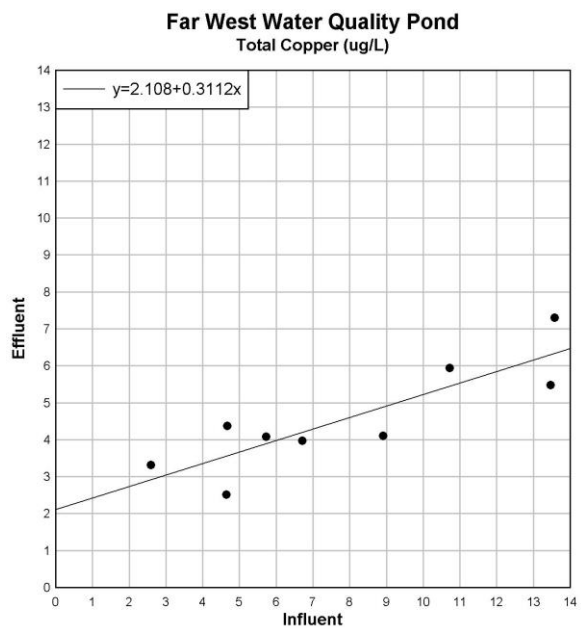
	PARAMETER	Zinc (µg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	116.0	58.1
	Upper Quartile	85.3	36.4
	Median	69.4	31.4
	Lower Quartile	49.1	26.8
	Minimum	32.1	22.4
	Efficiency	54.73%	
	Mann-Whitney	0.0023 **	
	Wilcoxon (paired)	0.0078 **	
Arithmetic	UCL	84.0	40.9
	Mean	68.5	34.1
	LCL	53.0	27.3
	Std. Dev.	24.4	10.7
	Wilk (p-value)	0.9835	0.0542 *
	Efficiency	50.16%	
	t-Test (equal var.)	0.0002 **	
	t-Test (unequal var.)	0.0005 **	
	t-test (paired)	0.0093 **	
	Levene Test	0.0357 **	
Log Transformed	UCL	88.2	41.0
	Mean	68.7	34.1
	LCL	53.5	28.3
	Std. Dev.	26.4	9.8
	Wilk (p-value)	0.9658	0.4295
	Efficiency	50.41%	
	t-Test (equal var.)	0.0001 **	
	t-Test (unequal var.)	0.0001 **	
	t-Test (paired)	0.0021 **	
	Levene Test	0.2955	
Bootstrap	UCL	82.6	40.5
	Mean	68.2	34.2
	LCL	53.8	27.9
	Std. Dev.	22.7	9.9
	Efficiency	49.85%	

Far West Water Quality Pond-Total Copper (ug/L)



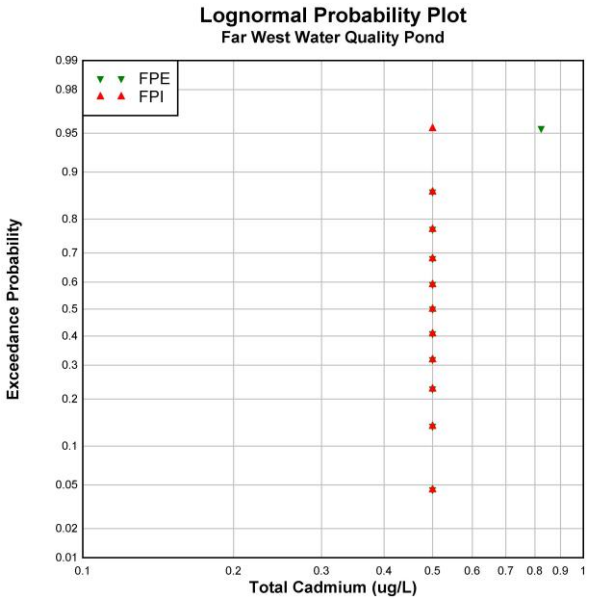


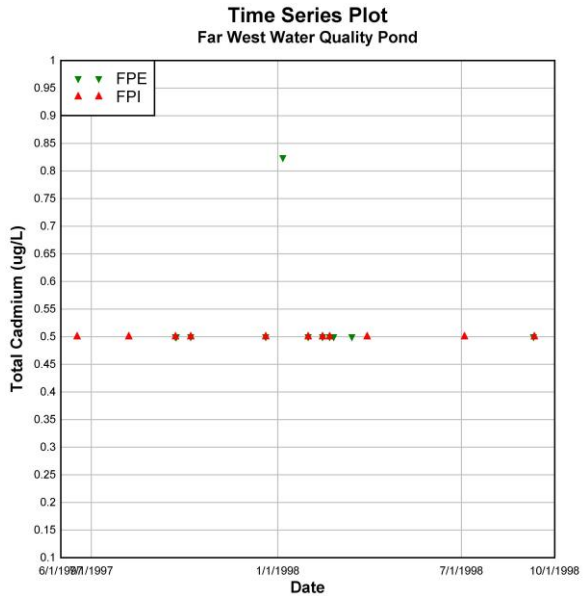


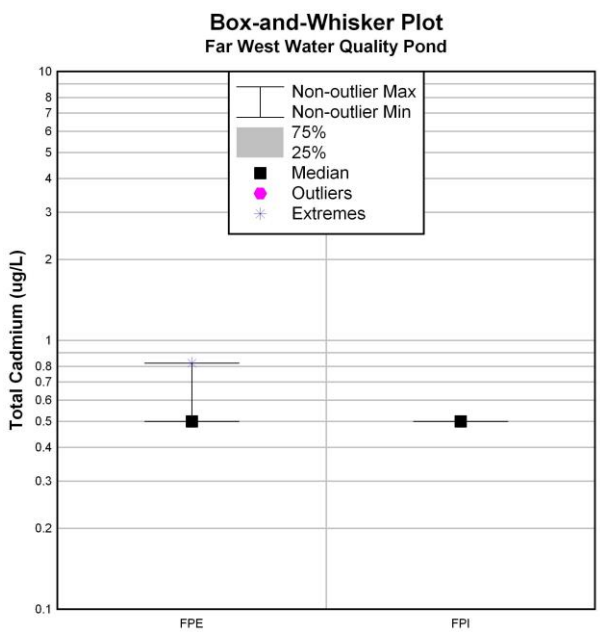


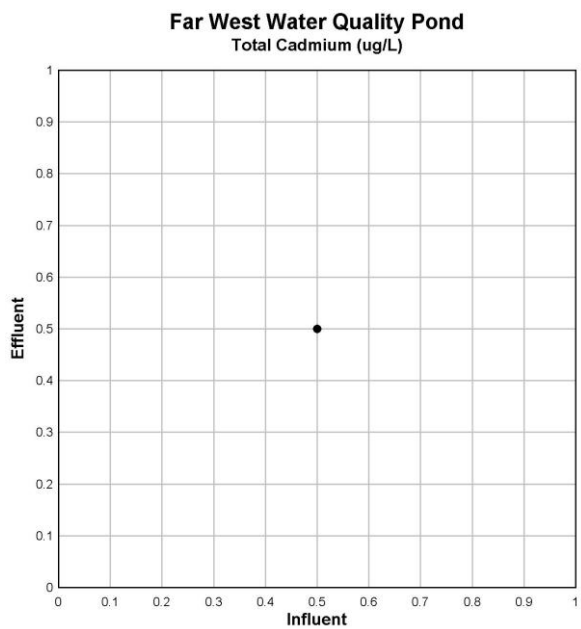
	PARAMETER	Copper (µg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	12	12
	Pairs Count	8	8
Non-Parametric	Maximum	14.4	7.3
	Upper Quartile	12.1	5.7
	Median	9.1	4.2
	Lower Quartile	5.2	3.6
	Minimum	2.6	2.5
	Efficiency	53.28%	
	Mann-Whitney	0.0132 **	
	Wilcoxon (paired)	0.0234 **	
Arithmetic	UCL	11.2	5.7
	Mean	8.7	4.7
	LCL	6.2	3.6
	Std. Dev.	3.9	1.6
	Wilk (p-value)	0.5850	0.5049
	Efficiency	46.53%	
	t-Test (equal var.)	0.0030 **	
	t-Test (unequal var.)	0.0047 **	
	t-test (paired)	0.0120 **	
	Levene Test	0.0056 **	
Log Transformed	UCL	12.6	5.9
	Mean	8.8	4.7
	LCL	6.2	3.7
	Std. Dev.	4.8	1.7
	Wilk (p-value)	0.3431	0.6449
	Efficiency	47.18%	
	t-Test (equal var.)	0.0051 **	
	t-Test (unequal var.)	0.0057 **	
	t-Test (paired)	0.0091 **	
	Levene Test	0.1742	
Bootstrap	UCL	11.0	5.6
	Mean	8.7	4.7
	LCL	6.3	3.7
	Std. Dev.	3.7	1.5
	Efficiency	46.10%	

Far West Water Quality Pond – Total Cadmium (ug/L)









	PARAMETER	Cadmium (µg/L)	
Type	**Statistic**	**INF: FPI**	**EFF: FPE**
	Site Count	11	11
	Pairs Count	6	6
Non-Parametric	Maximum	0.5	0.8
	Upper Quartile	0.5	0.5
	Median	0.5	0.5
	Lower Quartile	0.5	0.5
	Minimum	0.5	0.5
	Efficiency	0.00%	
	Mann-Whitney	0.3736	
	Wilcoxon (paired)	NA	
Arithmetic	UCL	0.5	0.6
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Wilk (p-value)	NA	0.0001 **
	Efficiency	-5.89%	
	t-Test (equal var.)	0.3293	
	t-Test (unequal var.)	0.3409	
	t-test (paired)	NA	
	Levene Test	0.2797	
Log Transformed	UCL	0.5	0.6
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Wilk (p-value)	NA	0.0001 **
	Efficiency	-5.73%	
	t-Test (equal var.)	0.3293	
	t-Test (unequal var.)	0.3409	
	t-Test (paired)	NA	
	Levene Test	0.2797	
Bootstrap	UCL	0.5	0.6
	Mean	0.5	0.5
	LCL	0.5	0.5
	Std. Dev.	0.0	0.1
	Efficiency	-5.81%	

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