Elder Creek Stormwater Facility Performance Efficiency Evaluation

Final Report

September 2010

Prepared for:

Seminole County, Florida

Prepared by:

Environmental Research & Design, Inc.
3419 Trentwood Blvd., Suite 102
Orlando, FL 32812
407 855-9465

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Environmental Research and Design, Inc.
Harvey H. Harper, III, Ph.D., P.E.
3419 Trentwood Blvd., Suite 102
Orlando, FL 32812
Phone: 407-855-9465

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SECTION 1

INTRODUCTION

1.1 Project Description

This document provides a summary of work efforts conducted by Environmental Research & Design, Inc. (ERD) for Seminole County (County) to conduct a performance efficiency evaluation of the Elder Creek Regional Stormwater Facility. This facility was constructed by the County to reduce pollutant loadings discharging from the Elder Creek and Elder Ditch watersheds into Lake Monroe. The Elder Creek regional stormwater system consists of an off-line wet detention pond constructed along the historical flow path of Elder Creek to provide retrofit water quality treatment. Elder Creek is a natural stream which has been piped in some areas to accommodate development.

Section 303(d) of the Clean Water Act requires states to submit lists of surface waterbodies that do not meet applicable water quality standards. These waterbodies are defined as "impaired waters" and total maximum daily loads (TMDLs) must be established for these waters on a prioritized schedule. Lake Monroe (WBID #2893D) has been designated as an "impaired water" due to elevated nutrient and TSI values. A nutrient TMDL for Lake Monroe was developed by FDEP during 2009. The Elder Creek stormwater facility was constructed to assist in reducing nutrient loadings to Lake Monroe in an effort to improve in-lake nutrient concentrations.

General location maps for the Elder Creek stormwater facility are given on Figure 1-1. The project site is located in Seminole County, east of I-4, north of S.R. 46, west of S.R. 15 (Monroe Road), and south of U.S. 17-92 at the intersection of North Elder Road and Narcissus Avenue. Construction of the facility was completed during June 2007. The project lies within the Lake Monroe basin and the Lockhart-Smith Canal sub-basin.

The stormwater facility collects and treats flow discharging through Elder Creek and Elder Canal in an 11.35-acre wet detention pond, containing both deep open water and shallow vegetated areas. The pond contains a north-south berm which is used to maximize the flow path for inputs into the pond. Water discharged from the pond is released back into the historic flow path of Elder Creek. The drainage basin for areas discharging to the pond consists of approximately 234 acres of commercial, medium-density residential, and light industrial areas, with an impervious percentage of approximately 80%. The regional wet detention pond was constructed to provide both retrofit water quality treatment and flood attenuation. Design criteria for the Elder Creek stormwater facility are summarized in Table 1-1 (CDM, 2002).

An aerial overview of the Elder Creek regional stormwater facility is given on Figure 1-2, and a schematic of significant inflows and flow patterns is given on Figure 1-3. The treatment system consists of an 11.35-acre wet detention pond which was constructed on-line along the historical flow path for Elder Creek. A north-south peninsula was added to prevent short-circuiting and to maximize the flow path within the pond. Inflows into the pond first enter the open water segment which consists of a wet detention pond with a maximum depth of approximately 8 ft.

Figure 1-1. Location Maps for the Elder Creek Stormwater Facility.

TABLE 1-1

DESIGN CRITERIA FOR THE ELDER CREEK STORMWATER FACILITY

PARAMETER	INFORMATION
Treatment System Type	On-line wet detention pond
Pond Area	11.35 acres at NWL
Drainage Basin Area	234 acres
Drainage Basin Land Use	Commercial, medium-density residential, light industrial
Basin Impervious Area	188 acres (80%)
Treatment Volume	1” over basin area 1.2” over impervious area
Permanent Pool Volume	79.2 ac-ft below NWL
Pond Depth: a. Maximum b. Mean	a. 8 ft b. 6.6 ft (79.2 ac-ft/12 ac)
Treatment Volume Recovery	50% of treatment volume released in 24-30 hours
Pond Residence Time	23 days (wet season conditions)
Littoral Zone	Approximately 30% of pond area

Figure 1-2. Aerial Overview of the Elder Creek Regional Stormwater Pond.

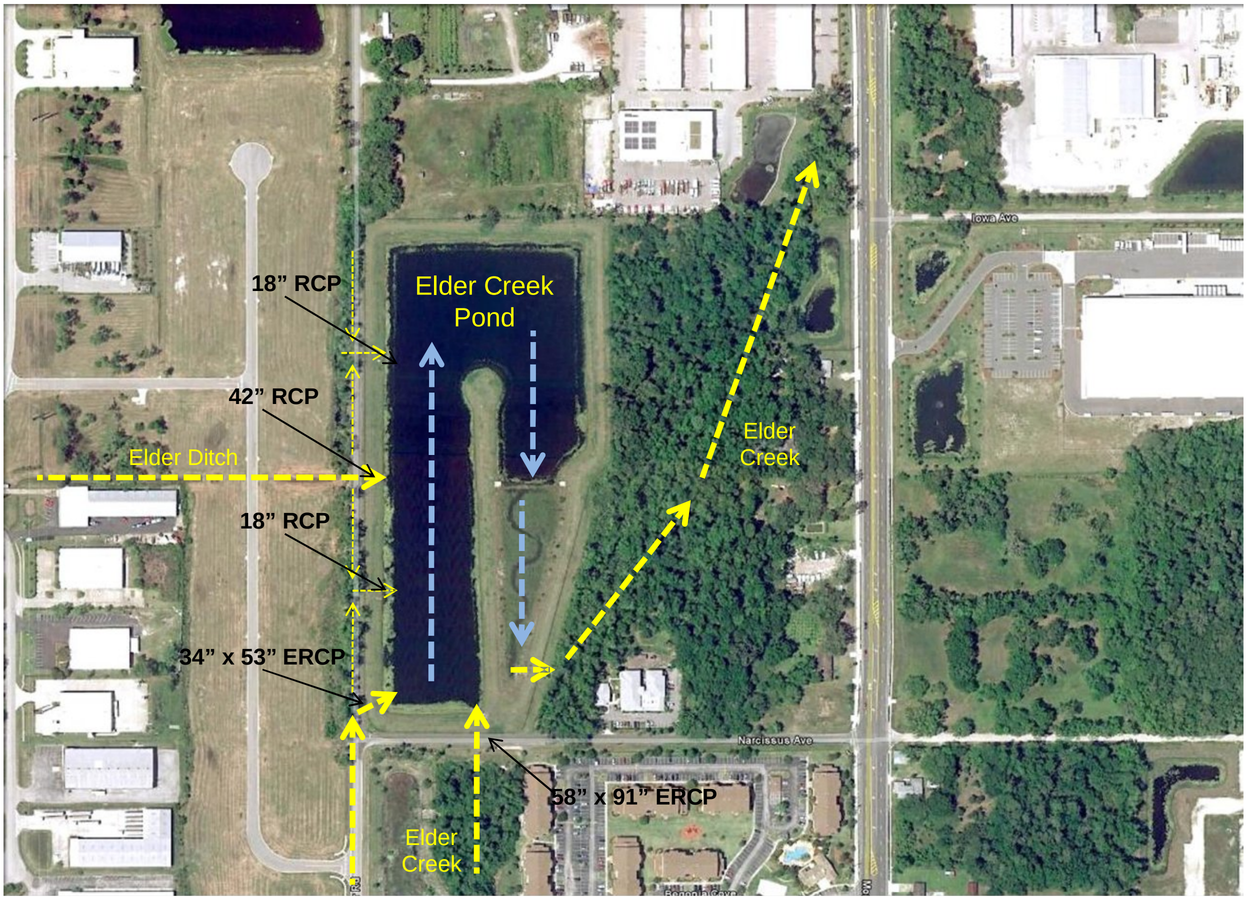


Figure 1-3. Significant Inflows and Water Movement in the Elder Creek Wet Detention Pond.

A photograph of open water areas on the west side of the Elder Creek pond is given on Figure 1-4. The open water portion of the pond is approximately 9.90 acres in size. Discharges from the open water area occur over the 181-ft long broad-crested weir structure indicated on Figure 1-5 which is located on the east side of the peninsula. A fiberglass skimmer is located upstream from the weir structure to prevent floating material from discharging over the weir. Discharges over the weir enter a 1.45-acre shallow wetland littoral zone is intended to provide final polishing for the creek inflows prior to reaching the outfall structure for the pond. A photograph of the shallow wetland littoral zone area is given on Figure 1-6.

A photograph of the pond outfall structure is given on Figure 1-7. The outfall structure contains a compound rectangular weir which provides for slow release of water from the system during small rain events and larger release rates during conditions of high inflow rates into the pond. Discharges through the outfall structure travel through a 42-inch RCP and ultimately rejoin the historic flow path of Elder Creek. Photographs of the pond discharge and the point of inflow to Elder Creek are given on Figure 1-8. The design of the pond requires that all discharge through Elder Creek must pass through the treatment pond even under high flow conditions.

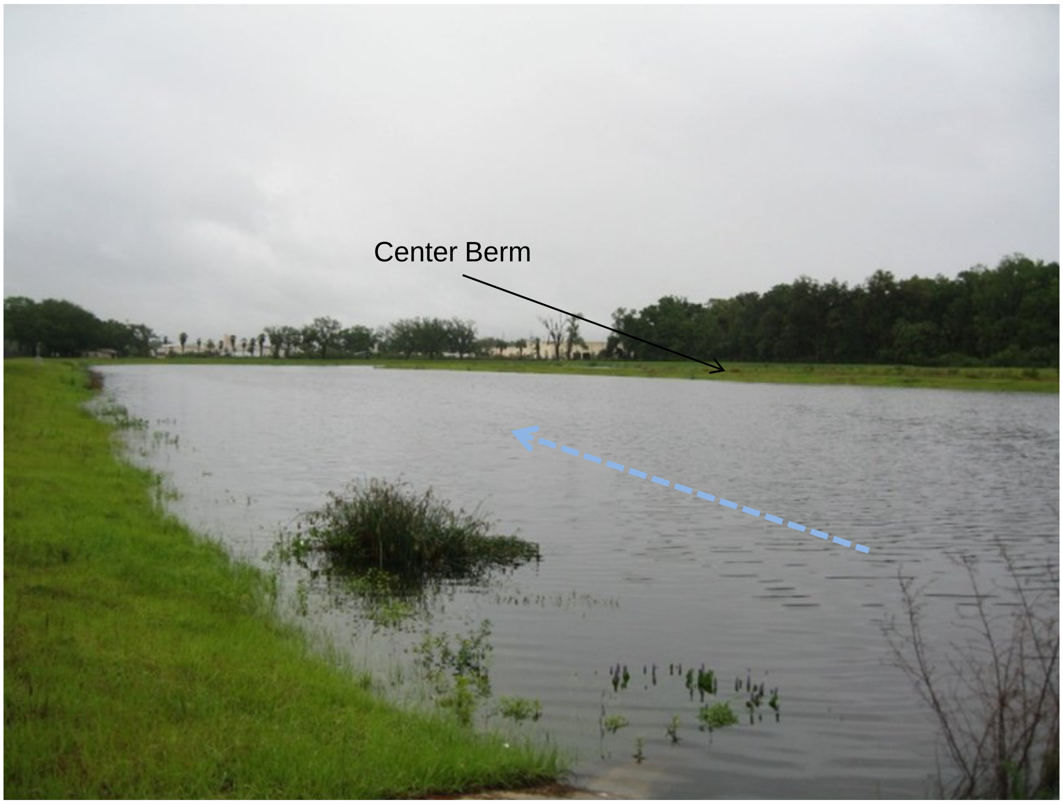


Figure 1-4. Open Water Areas of the Elder Creek Pond.

Figure 1-5. Broad-crested Weir Structure.

Figure 1-6. Shallow Wetland Littoral Zone.

Figure 1-7. Pond Outfall Structure.

a. Outfall Discharge Pipe

b. Inflow to Elder Creek

Figure 1-8. Pond Discharge and Inflow to Elder Creek.

An overview of the contributing drainage basin area for the Elder Creek wet detention pond is given on Figure 1-9. The basin area includes approximately 74.6 acres of the 220-acre Elder Ditch sub-basin which is located west and southwest of the Elder Creek pond and approximately 147.8 acres of the 396-acre Elder Creek sub-basin which is located primarily south and east of the pond. In addition, the pond also provides treatment for approximately 12 acres of sub-basin areas associated with CR-15 (Monroe Road), located immediately east of the Elder Creek pond. Overall, the contributing drainage basin area to the pond is approximately 234.4 acres. According to CDM (2002), approximately 80% of the sub-basin areas consist of impervious surfaces.

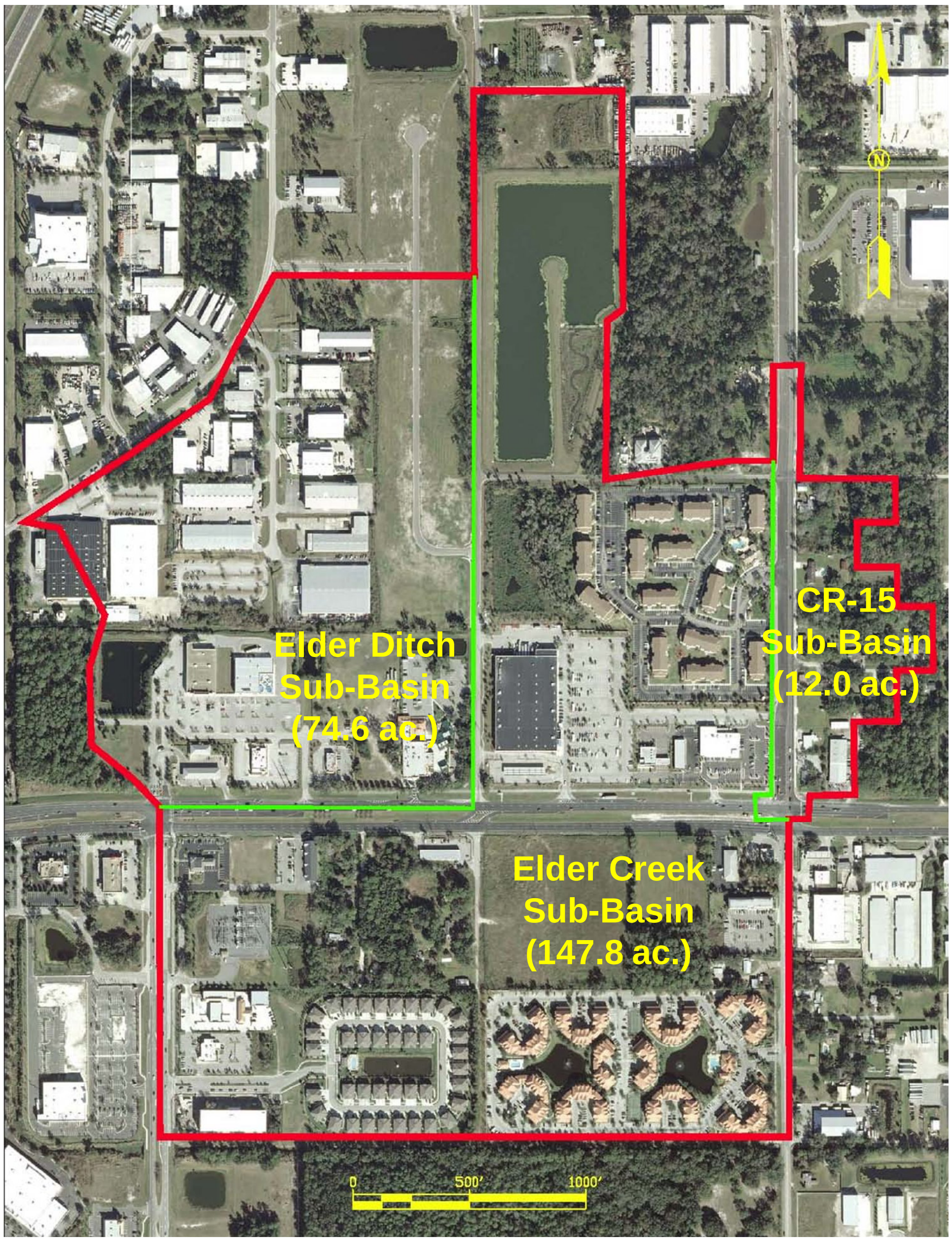


Figure 1-9. Overview of the Elder Creek Pond Basin Area.

As indicated in Table 1-1, the Elder Creek pond is designed to provide treatment equivalent to 1 inch over the 234-acre basin area, or approximately 1.2 inches over the impervious area within the basin. According to the construction drawings (CDM, 2005), the open water portion of the pond has a maximum water depth of approximately 8 ft at the normal water level of 17.0 ft. The shallow littoral zone area has a water depth of approximately 1 ft or less. The total permanent pool volume provided in the pond is approximately 79.2 ac-ft which provides a residence time of approximately 23 days during wet season conditions. The outfall control system is designed such that one-half of the treatment volume is released between 24-30 hours through a 9-inch compound rectangular weir.

A summary of existing land use in the Elder Creek basin area is given on Table 1-2. Approximately 20.7% of the basin area is covered by low-density residential, with 15.1% by commercial uses, and 14.1% by upland mixed hardwood forests. Each of the remaining land use categories listed on Table 1-2 contribute approximately 10% or less of the total basin area. Soils within the drainage basin consist primarily of fine sands which are classified in either Hydrologic Soil Group (HSG) D or B/D. Soils in these classifications are classified as having a relatively high runoff potential with a low infiltration rate.

TABLE 1-2

EXISTING LAND USE IN THE ELDER CREEK BASIN AREA
(Source: CDM, 2002)

LAND USE DESCRIPTION	FLUCCS CODE	AREA (acres)	PERCENT COVERAGE (%)
Abandoned Tree Crops	224	19.1	8.1
Commercial and Services	140	35.4	15.1
Herbaceous Range	310	3.7	1.6
Improved Pastures	211	19.7	8.4
Pine Flatwoods	411	3.0	1.3
Low-Density Residential (<2 dwellings/acre)	110	48.5	20.7
Medium-Density Residential (2-5 dwellings/acre)	120	1.5	0.6
Roads and Highways	814	11.8	5.0
Row Crops	214	22.1	9.4
Shrub and Brushland	320	6.3	2.7
Upland Mixed Coniferous/Hardwood	434	33.2	14.1
Wetland Forested Mixed	630	20.5	8.7
Woodland Pastures	213	10.0	4.2
	TOTALS:	**234.4**	**100**

Construction of the Elder Creek stormwater facility was completed during June 2007. Funding for design and construction of the Elder Creek stormwater facility was provided by Seminole County in the amount of $3,420,423. Funding for post-construction monitoring of the Elder Creek facility was provided by the Florida Department of Environmental Protection (FDEP) under Agreement No. S0341 in the amount of $92,756.38.

1.2 Work Efforts Performed by ERD

A Quality Assurance Project Plan (QAPP) was developed by ERD during February 2008 which provides details concerning the proposed field monitoring and laboratory analyses. Monitoring equipment was installed at the Elder Creek stormwater facility site during March 2009. Routine monitoring was initiated at the Elder Creek site on April 1, 2009 and was continued for a period of 12 months until March 31, 2010.

This report has been divided into four separate sections. Section 1 contains an introduction to the report, a description of the Elder Creek stormwater facility, and a summary of work efforts performed by ERD. Section 2 provides a detailed discussion of the methodologies used for field and laboratory evaluations. Section 3 provides a discussion of the hydrologic and water quality results, and a summary is provided in Section 4.

SECTION 2

FIELD AND LABORATORY ACTIVITIES

Field and laboratory investigations were conducted by ERD over a 12-month period from April 2009-March 2010 to evaluate the effectiveness of the Elder Creek stormwater management facility. Field monitoring was conducted at the inflows and outflow for the pond system and included a continuous record of significant inflows into the system and outflows through the discharge structure. Laboratory analyses were conducted on collected samples for general parameters and nutrients to assist in quantifying concentration-based and mass removal efficiencies. Specific details of monitoring efforts conducted at the Elder Creek stormwater facility site are given in the following sections.

2.1 Field Instrumentation and Monitoring

A schematic of monitoring locations used to evaluate the performance efficiency of the Elder Creek stormwater facility is given on Figure 2-1. Inflow into the stormwater facility was monitored at three significant inflows which included the 58-inch x 91-inch ERCP that conveys Elder Creek into the south side of the pond, the 34-inch x 53-inch ERCP on the southwest corner of the pond which conveys inflow from Elder Ditch, and the 48-inch RCP which enters on the west side of the pond and conveys inflow from Elder Ditch and portions of Elder Road. These locations are referred to on Figure 2-1 as Site 1, Site 2, and Site 3, respectively. Two smaller 18-inch RCP inflows along the west side of the pond, which provide localized drainage for small portions of Elder Road, were not monitored directly as part of this project. Discharges from the pond were monitored at the outfall weir structure, which is designated as Site 4 on Figure 2-1. In addition, a water level recorder was installed upstream from the broad-crested weir to provide a continuous record of water elevations within the open water portion of the pond. A rain gauge and pan evaporimeter were installed adjacent to the pond to provide information on rainfall inputs and evaporation losses.

Stormwater samplers with integral flow meters were installed at each of the three inflow (Sites 1, 2, and 3) and outflow (Site 4) monitoring sites indicated on Figure 2-1. The inflow monitoring site for Elder Creek (Site 1) was located in the 58-inch x 91-inch ERCP approximately 15 ft upstream from the point of inflow to the pond. An automatic sequential stormwater sampler with integral flow meter, manufactured by Sigma (Model 900MAX), was installed adjacent to the pipe inflow. The autosampler was housed inside an insulated aluminum shelter, and sensor cables and sample tubing were extended approximately 15 ft inside the 58-inch x 91-inch ERCP. This autosampler was used to provide a continuous measurement of inflow into the treatment pond from Elder Creek under both storm event and baseflow conditions, as well as to collect flow-weighted samples at the inflow over a wide range of flow conditions. The internal flow meter was programmed to provide a continuous record of inflow into the pond, with measurements stored into internal memory at 10-minute intervals. The automatic sampler contained a single 20-liter polyethylene bottle and was programmed to collect samples in a flow-weighted mode, with 500 ml aliquots piped into the collection bottle with every programmed increment of flow. Since 120 VAC power was not available at the site, the automatic sampler was operated on 12 VDC batteries which were replaced on a periodic basis. Photographs of inflow monitoring equipment used to monitor the 58-inch x 91-inch ERCP Elder Creek inflow at Site 1 are given on Figure 2-2.

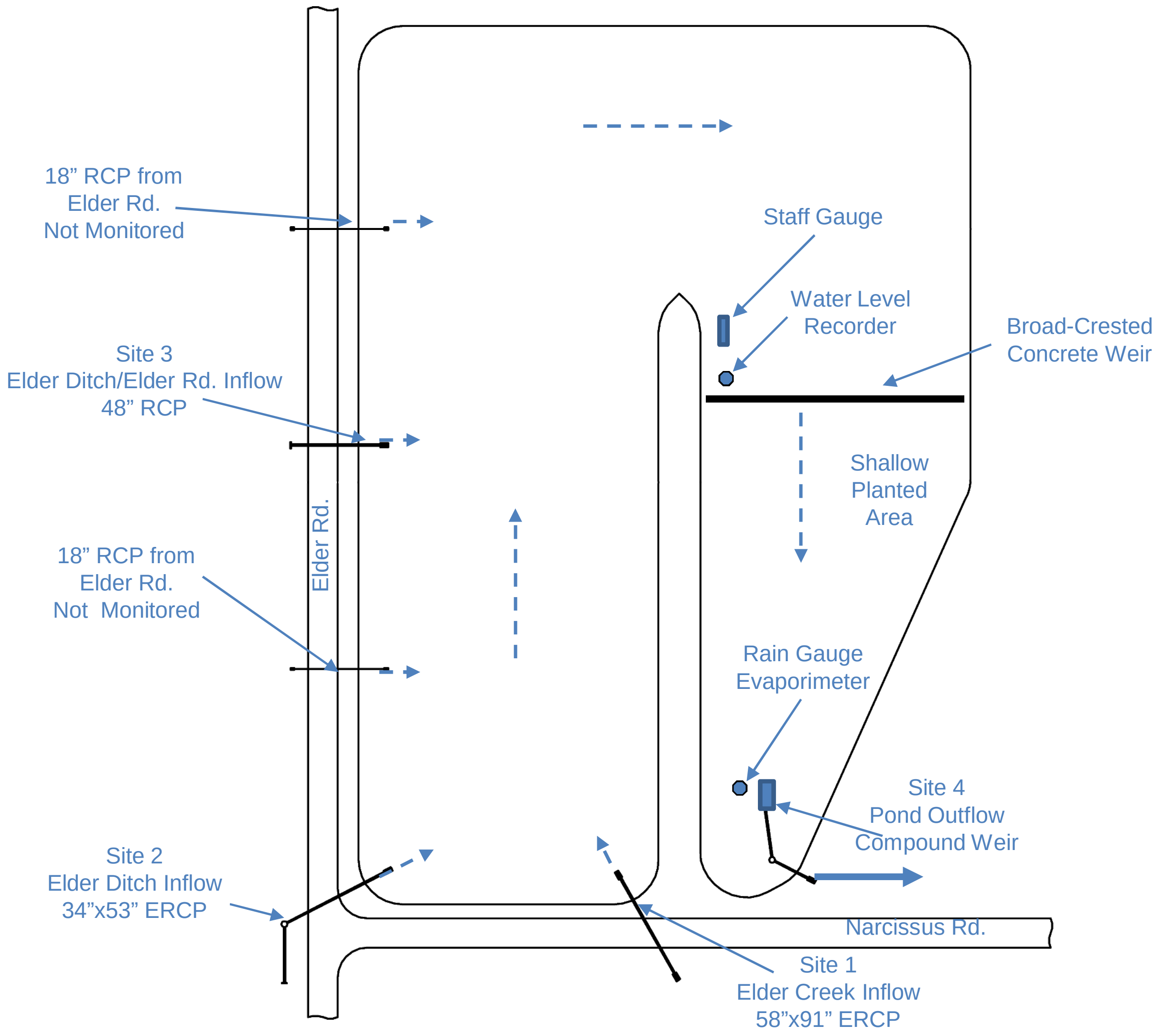


Figure 2-1. Monitoring Locations for the Elder Creek Site.

a. Equipment Location

b. Sampling Equipment

c. Housing for Sample Tubing and Flow Probes

d. Sample Intake and Flow Probe Extended into Pipe

Figure 2-2. Inflow Monitoring Equipment at Site 1.

Inflow monitoring Site 2 was located inside the 34-inch x 53-inch ERCP which discharges into the southwest side of the Elder Creek pond. Photographs of this monitoring site are given on Figure 2-3. The monitoring site was located outside of the fenced perimeter of the pond at an upstream stormsewer junction located on the west side of Elder Road. This location was selected so that the flow monitoring site would be upstream from any significant tail water effects caused by the pond under typical rainfall conditions. An automatic sequential stormwater sampler with internal flow meter, manufactured by Sigma (Model 900MAX), was installed on top of the grate structure for the junction box. The autosampler was housed inside an insulated aluminum shelter, and sensor cables and sample tubing were extended from the sampler through the top grate to the flow monitoring site located approximately 15 ft upstream in the 34-inch x 53-inch ERCP. The integral flow meter was programmed to provide a continuous record of inflow, with measurements stored into internal memory at 10-minute intervals. The automatic sampler contained a single 20-liter polyethylene bottle, and was programmed to collect samples in a flow-weighted mode, with 500-ml aliquots pumped into a collection bottle with every programmed increment of flow. Since 120 VAC power was not available at the site, the automatic sampler was operated on 12 VDC batteries which were replaced on a periodic basis.

a. Equipment location

b. Sampling equipment

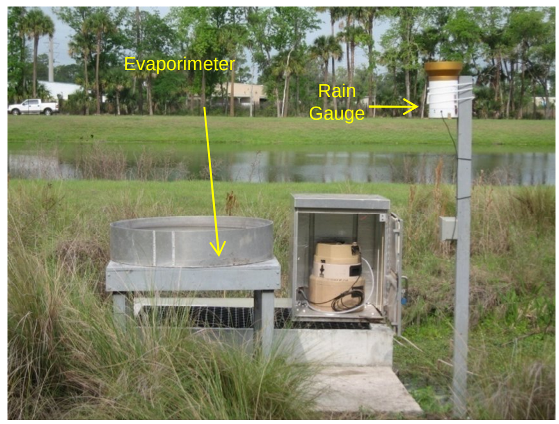
Figure 2-3. Inflow Monitoring Equipment at Site 2.

Inflow monitoring Site 3 was located on the west central portion of the pond. This site provides inflow from Elder Ditch, which enters the pond through a 48-inch RCP, as well as a relatively small amount of direct runoff from Elder Road. A photograph of monitoring equipment used at Site 3 is given on Figure 2-4. An automatic sequential stormwater sampler with internal flow meter, manufactured by Sigma (Model 900MAX), was installed adjacent to the inflow for the 48-inch RCP. The autosampler was housed inside an insulated aluminum shelter, and sensor cables and sample tubing were extended from the sampler approximately 15 ft upstream in the 48-inch RCP to avoid tail water impacts from the pond during routine storm events. The integral flow meter was programmed to provide a continuous record of inflow at this site, with measurements stored into internal memory at 10-minute intervals. The automatic sampler contained a single 20-liter polyethylene bottle, and was programmed to collect samples in a flow-weighted mode, with 500-ml aliquots pumped into a collection bottle with every programmed increment of flow. Since 120 VAC power was not available at the site, the automatic sampler was operated on 12 VDC batteries which were replaced on a periodic basis. The bulk precipitation collector was also located at this site and is indicated on Figure 2-4.

Figure 2-4. Inflow Monitoring Equipment at Site 3.

The outflow monitoring site (Site 4) was located at the pond outfall structure on the southwest side of the Elder Creek pond. Photographs of the monitoring equipment installed at Site 4 are given on Figure 2-5. An automatic sequential stormwater sampler with internal flow meter, manufactured by Sigma (Model 900MAX), was installed on top of the outfall structure. The autosampler was housed inside an insulated aluminum shelter, and sensor cables and sample tubing were extended from the sampler to the front side of the outfall structure adjacent to the horizontal bleed-down weir device. The integral flow meter was programmed to provide a continuous record of discharges from the pond, with measurements stored into internal memory at 10-minute intervals. The automatic sampler installed at this time contained a single 20-liter polyethylene bottle, and was programmed to collect samples in a flow-weighted mode, with 500-ml aliquots pumped into a collection bottle with every programmed increment of flow. Since 120 VAC power was not available at the site, the automatic sampler was operated on 12 VDC batteries which were replaced on a periodic basis.

a. Equipment location



b. Sampling equipment

Figure 2-5. Inflow Monitoring Equipment at Site 4.

Flow measurements at the 58-inch x 91-inch ERCP inflow monitoring site (Site 1) were performed using the area/velocity method. The flow probe utilized at this monitoring site provides simultaneous measurements of water depth and flow velocity. The depth measurements were converted into a cross-sectional area based upon the geometry of the pipe, and the velocity of flow is measured directly by the probe. Discharge is then calculated by the flow meter using the Continuity Equation (Q = A x V) in cubic feet per second (cfs).

Flow measurements at the inflow monitoring Sites 2 and 3 were performed using a pressure transducer sensor which transforms sensitive measurements of water depth into a flow rate using the Manning Equation and pipe geometry. The pressure transducer depth probe was inserted approximately 15 ft upstream in each stormsewer. This probe provided continuous measurements of water depth and converted measured water depths into an approximate flow rate.

Flow measurements at the pond outfall monitoring site (Site 4) were performed using a rating curve based on the geometry of the compound rectangular weir bleed-down structure. Modeling was conducted for the configuration of the bleed-down weir device using a standard rectangular weir equation, and the data were used to develop a rating curve of discharge vs. depth of flow over the weir.

Rainfall at the Elder Creek site was monitored using a continuous rainfall recorder attached to a 4-inch x 4-inch wooden post adjacent to the outfall structure. The location of the rainfall recorder is indicated on Figure 2-5. The rainfall recorder (Texas Electronics Model 1014-C) produced a continuous record of all rainfall which occurred at the site, with a resolution of 0.01 inch. Rainfall data were stored inside a digital storage device (HOBO Event Rainfall Logger) which was attached to the wooden post inside a waterproof enclosure. The rainfall record is used to provide information on general rainfall characteristics in the vicinity of the monitoring site and to assist in evaluation of hydrologic inputs from the watershed area.

In addition to the rainfall recorder, a Class A pan evaporimeter was also installed adjacent to the pond outfall site. Measurements of water level within the evaporation pan were recorded on a weekly basis and corrected for measured rainfall to provide estimates of evaporation from the pond surface. Information stored in the rainfall data logger, as well as evaporimeter water level measurements, were retrieved on a weekly basis. A photograph of the pan evaporation equipment is given on Figure 2-6.

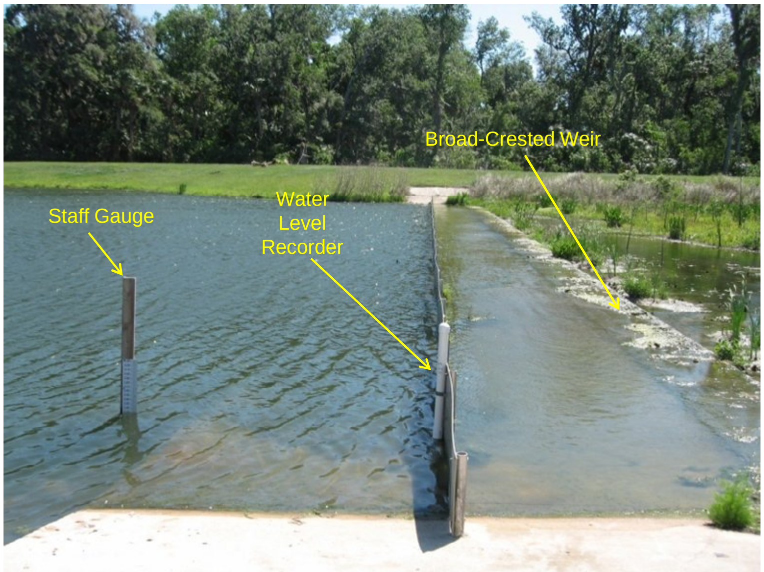


Figure 2-6. Pan Evaporation Equipment.

ERD field personnel visited the Elder Creek site at least once each week to retrieve collected stormwater, baseflow, and outflow samples and to download stored hydrologic data from each of the two automatic samplers as well as the rain gauge and evaporimeter. This information was evaluated for quality control purposes and compiled into a continuous data set for use in evaluating the hydrologic performance efficiency of the system.

In addition to the equipment summarized previously, a fixed staff gauge and digital water level recorder were also installed on the broad-crested weir structure which separates the open water portion from the littoral zone area. The digital water level recorder (Global Water Model WL16) collected continuous water level measurements at 15-minute intervals. This information was used to assist in completing the hydrologic budget for the pond and to determine when water level elevations exceeded the spillway weir elevation. Manual readings of staff gauge elevations were conducted on a weekly basis to corroborate the readings from the digital water level recorder. A photograph of the staff gauge and water level recorder is also given on Figure 2-6.

2.2 Laboratory Analyses

A summary of laboratory methods and MDLs for analyses conducted on water samples collected during this project is given in Table 2-1. All laboratory analyses were conducted in the ERD Laboratory which is NELAC-certified (No. 1031026). Details on field operations, laboratory procedures, and quality assurance methodologies are provided in the FDEP-approved Comprehensive Quality Assurance Plan for Environmental Research & Design, Inc. In addition, a Quality Assurance Project Plan (QAPP), outlining the specific field and laboratory procedures to be conducted for this project, was submitted to and approved by FDEP prior to initiation of any field and laboratory activities.

TABLE 2-1

ANALYTICAL METHODS AND DETECTION LIMITS FOR LABORATORY ANALYSES

PARAMETER	METHOD OF ANALYSIS	METHOD DETECTION LIMITS (MDLs)[1]
pH	EPA-83, Sec. 150.1[2]	N/A
Conductivity	EPA-83, Sec. 120.1[2]	0.3 μmho/cm
Alkalinity	EPA-83, Sec. 310.1[2]	0.5 mg/l
Ammonia	EPA-83, Sec. 350.1[2]	0.005 mg/l
NO_x	EPA-83, Sec. 353.2[2]	0.005 mg/l
Total Nitrogen	SM-21, Sec. 4500-N C[3]	0.01 mg/l
Ortho-P	EPA-83, Sec. 365.1[2]	0.001 mg/l
Total Phosphorus	SM-21, Sec. 4500-P B.5/F[3]	0.001 mg/l
Turbidity	EPA-83, Sec. 180.1[2]	0.1 NTU
Color	SM-21, Sec. 2120 C[3]	1 Pt-Co Unit
TSS	EPA-83, Sec. 160.2[2]	0.7 mg/l

1. MDLs are calculated based on the EPA method of determining detection limits
2. Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, Revised March 1983.
3. Standard Methods for the Examination of Water and Wastewater, 21st ed., 2005.

2.3 Field Measurements

During each weekly monitoring visit, vertical field profiles of pH, temperature, specific conductivity, dissolved oxygen, and oxidation-reduction potential (ORP) were conducted near the center of the wet detention pond using a Hydrolab Datasonde 4a water quality monitor. Field measurements were conducted at depths of 0.25 m and 0.5 m, and continued at 0.5-m intervals to the pond bottom. This information is used to evaluate potential stratification and anoxic conditions in bottom portions of the wet detention pond.

2.4 Routine Data Analysis and Compilation

All data generated during this project, including hydrologic, hydraulic, and water quality information, were entered into a computerized database and double-checked for accuracy. Hydrologic and hydraulic information was tabulated and summarized on monthly intervals. This information is used to develop a hydrologic budget for the pond for use in evaluating system performance.

Data collected during this project were analyzed using a variety of statistical methods and software. Simple descriptive statistics were generated for runoff inflow, pond outflow, rainfall, and pond water levels to examine changes in water quality characteristics and system performance throughout the research period. The majority of these analyses were conducted using statistical procedures available in Excel.

Statistical procedures such as multiple regression were also conducted to examine predicted relationships between water quality characteristics and hydrologic or hydraulic factors, such as pond water elevation, antecedent dry period, cumulative event rainfall, and other variables. The majority of these analyses were conducted using the SAS (Statistical Analysis System) package.

Distribution patterns for the inflow, outflow, and bulk precipitation data sets were evaluated using both normal probability and log probability plots. These analyses indicated that the data most closely observe a log-normal distribution which is commonly observed with environmental data. As a result, statistical analyses were conducted using log transformations of each of the data sets. The data were then converted back to untransformed data at the completion of the statistical analyses.

SECTION 3

RESULTS

Field monitoring, sample collection, and laboratory analyses were conducted by ERD from April 1, 2009-March 31, 2010 to evaluate the hydraulic and pollutant removal efficiencies of the Elder Creek stormwater facility. A discussion of the results of these efforts is given in the following sections.

3.1 Site Hydrology

3.1.1 Rainfall

A continuous record of rainfall characteristics was collected at the Elder Creek pond monitoring site from April 1, 2009-March 31, 2010 using a tipping bucket rainfall collector with a resolution of 0.01 inch and a digital data logging recorder. The characteristics of individual rain events measured at the Elder Creek pond site are given in Table 3-1. Information is provided for event rainfall, event start time, event end time, event duration, average rainfall intensity, and antecedent dry period for each individual rain event measured at the monitoring site. For purposes of this analysis, average rainfall intensity is calculated as the total rainfall divided by the total event duration.

A total of 51.05 inches of rainfall fell in the vicinity of the Elder Creek pond over the 365-day monitoring period from a total of 125 separate storm events. A summary of rainfall event characteristics measured at the Elder Creek rain gauge site from April 1, 2009-March 31, 2010 is given in Table 3-2. Individual rainfall amounts measured at the pond site range from 0.01-7.79 inches, with an average of 0.41 inches/event. Durations for events measured at the site range from 0.02-49.32 hours, with antecedent dry periods ranging from 0.1-22.9 days.

A comparison of measured and typical "average" rainfall in the vicinity of the Elder Creek pond is given in Figure 3-1. Measured rainfall presented in this figure is based upon the field-measured rain events at the pond site presented in Table 3-1, summarized on a monthly basis. "Average" rainfall conditions are based upon historical average monthly rainfall recorded at the Sanford Airport over the 30-year period from 1971-2000. Historical average annual rainfall in the Sanford area is approximately 51.31 inches/year.

As seen in Figure 3-1, measured rainfall in the vicinity of the Elder Creek pond site was greater than "normal" during May, August, and March, with lower than "normal" rainfall during April, June, July, September, October, and November, and approximately normal rainfall during December, January, and February. A tabular comparison of measured and average rainfall for the Elder Creek pond site is given in Table 3-3. The total annual rainfall of 51.05 inches measured at the Elder Creek site is very close to the "normal" rainfall which typically occurs on an annual basis in the Sanford area. As seen in Table 3-1, a single rain event of 7.79 inches was measured at the Elder Creek pond site during May 2009.

TABLE 3-1

SUMMARY OF RAINFALL MEASURED AT THE ELDER CREEK MONITORING SITE FROM APRIL 2009 – MARCH 2010

EVENT START		EVENT END		EVENT RAINFALL (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
DATE	TIME	DATE	TIME				
4/1/09	15:46	4/1/09	16:16	0.18	0.49	0.8	0.37
4/3/09	8:50	4/3/09	9:01	0.11	0.17	1.7	0.64
4/14/09	10:04	4/14/09	13:12	0.55	3.14	11.0	0.18
4/20/09	14:47	4/20/09	15:16	0.07	0.48	6.1	0.15
5/13/09	13:37	5/13/09	14:25	0.87	0.80	22.9	1.09
5/14/09	12:45	5/14/09	16:00	0.11	3.25	0.9	0.03
5/17/09	10:01	5/17/09	10:09	0.03	0.14	2.8	0.22
5/17/09	20:35	5/18/09	0:32	0.34	3.95	0.4	0.09
5/18/09	7:02	5/20/09	8:21	7.79	49.32	0.3	0.16
5/20/09	12:22	5/20/09	13:23	0.51	1.02	0.2	0.50
5/20/09	17:40	5/20/09	23:52	0.88	6.20	0.2	0.14
5/21/09	6:43	5/21/09	8:12	0.06	1.48	0.3	0.04
5/22/09	4:05	5/22/09	8:31	0.24	4.43	0.8	0.05
5/22/09	12:30	5/22/09	17:12	0.32	4.70	0.2	0.07
5/23/09	10:34	5/23/09	11:17	0.53	0.72	0.7	0.73
5/24/09	18:02	5/24/09	20:17	0.36	2.25	1.3	0.16
5/25/09	18:30	5/25/09	19:03	0.82	0.55	0.9	1.49
5/26/09	16:29	5/26/09	17:00	0.27	0.52	0.9	0.52
5/26/09	20:52	5/26/09	21:03	0.04	0.18	0.2	0.22
5/27/09	20:16	5/27/09	20:20	0.05	0.06	1.0	0.82
5/28/09	12:40	5/28/09	13:15	0.06	0.59	0.7	0.10
5/29/09	14:54	5/29/09	14:54	0.01	---	1.1	---
6/3/09	18:58	6/3/09	20:11	0.06	1.23	5.2	0.05
6/4/09	12:55	6/4/09	20:35	1.38	7.66	0.7	0.18
6/5/09	14:40	6/5/09	15:16	0.26	0.61	0.8	0.42
6/6/09	10:47	6/6/09	12:07	0.32	1.32	0.8	0.24
6/6/09	18:09	6/6/09	18:46	0.13	0.61	0.3	0.21
6/8/09	21:05	6/8/09	22:26	0.49	1.35	2.1	0.36
6/13/09	18:11	6/13/09	20:04	0.21	1.88	4.8	0.11
6/14/09	20:59	6/14/09	20:59	0.01	---	1.0	---
6/15/09	18:24	6/15/09	18:27	0.02	0.06	0.9	0.35
6/16/09	18:50	6/16/09	21:40	0.33	2.83	1.0	0.12
6/18/09	14:11	6/18/09	14:56	0.39	0.74	1.7	0.53
6/23/09	16:33	6/23/09	16:35	0.04	0.02	5.1	2.06
6/26/09	11:19	6/26/09	11:19	0.01	---	2.8	---
6/27/09	11:49	6/27/09	12:56	0.07	1.11	1.0	0.06
6/29/09	11:46	6/29/09	11:54	0.09	0.14	2.0	0.63
6/29/09	18:29	6/29/09	18:41	0.31	0.20	0.3	1.52
6/30/09	10:40	6/30/09	16:49	0.54	6.14	0.7	0.09

TABLE 3-1 -- CONTINUED

SUMMARY OF RAINFALL MEASURED AT THE ELDER CREEK MONITORING SITE FROM APRIL 2009 – MARCH 2010

EVENT START		EVENT END		EVENT RAINFALL (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
DATE	TIME	DATE	TIME				
7/3/09	16:19	7/3/09	16:26	0.02	0.12	3.0	0.17
7/6/09	15:12	7/6/09	15:13	0.02	0.03	2.9	0.79
7/7/09	12:02	7/7/09	12:05	0.06	0.05	0.9	1.14
7/7/09	19:12	7/7/09	19:12	0.01	---	0.3	---
7/8/09	13:30	7/8/09	18:09	0.36	4.66	0.8	0.08
7/9/09	9:06	7/9/09	10:52	0.17	1.78	0.6	0.10
7/10/09	19:02	7/10/09	19:02	0.01	---	1.3	---
7/11/09	8:02	7/11/09	8:02	0.01	---	0.5	---
7/11/09	18:22	7/11/09	18:22	0.01	---	0.4	---
7/12/09	17:08	7/12/09	18:33	1.27	1.42	0.9	0.90
7/18/09	12:23	7/18/09	12:30	0.07	0.12	5.7	0.58
7/19/09	21:24	7/19/09	22:13	0.04	0.82	1.4	0.05
7/20/09	5:39	7/20/09	7:01	0.02	1.37	0.3	0.01
7/28/09	21:31	7/28/09	23:25	1.07	1.89	8.6	0.57
7/29/09	18:01	7/29/09	22:05	1.36	4.07	0.8	0.33
7/30/09	1:22	7/30/09	1:22	0.01	---	0.1	---
7/30/09	19:03	7/30/09	19:49	0.52	0.78	0.7	0.67
7/31/09	13:09	7/31/09	13:22	0.21	0.22	0.7	0.98
7/31/09	19:01	7/31/09	19:01	0.01	---	0.2	---
8/3/09	16:19	8/3/09	19:03	1.46	2.74	2.9	0.53
8/4/09	15:47	8/4/09	15:50	0.05	0.06	0.9	0.79
8/6/09	17:30	8/6/09	19:18	1.78	1.79	2.1	0.99
8/7/09	16:55	8/7/09	18:31	0.64	1.61	0.9	0.40
8/13/09	14:34	8/13/09	14:34	0.01	---	5.8	---
8/13/09	18:29	8/13/09	20:21	0.62	1.87	0.2	0.33
8/14/09	4:46	8/14/09	4:46	0.01	---	0.4	---
8/14/09	13:01	8/14/09	14:29	2.78	1.46	0.3	1.90
8/15/09	18:37	8/15/09	22:55	0.12	4.30	1.2	0.03
8/18/09	13:00	8/18/09	14:01	0.05	1.02	2.6	0.05
8/19/09	13:03	8/19/09	14:17	0.36	1.24	1.0	0.29
8/20/09	20:17	8/20/09	22:42	1.62	2.42	1.2	0.67
8/21/09	15:11	8/21/09	16:18	0.10	1.13	0.7	0.09
8/24/09	19:31	8/24/09	19:44	0.24	0.22	3.1	1.07
8/25/09	21:10	8/25/09	23:17	0.02	2.10	1.1	0.01
8/26/09	12:58	8/26/09	14:18	0.02	1.33	0.6	0.02
9/5/09	19:58	9/5/09	20:04	0.08	0.10	10.2	0.82
9/6/09	15:35	9/6/09	16:16	0.43	0.69	0.8	0.62
9/12/09	19:13	9/12/09	19:13	0.01	---	6.1	---
9/13/09	15:19	9/13/09	15:33	0.15	0.24	0.8	0.62
9/21/09	7:42	9/21/09	7:49	0.03	0.12	7.7	0.25
10/5/09	16:26	10/5/09	16:28	0.07	0.05	14.4	1.55
10/15/09	14:49	10/15/09	16:19	0.03	1.50	9.9	0.02
10/27/09	18:54	10/27/09	18:58	0.11	0.06	12.1	1.77

TABLE 3-1 -- CONTINUED

SUMMARY OF RAINFALL MEASURED AT THE ELDER CREEK MONITORING SITE FROM APRIL 2009 – MARCH 2010

EVENT START		EVENT END		EVENT RAINFALL (inches)	DURATION (hours)	ANTECEDENT DRY PERIOD (days)	AVERAGE INTENSITY (inches/hour)
DATE	TIME	DATE	TIME				
11/10/09	20:07	11/10/09	21:22	0.24	1.25	14.0	0.19
11/11/09	4:45	11/11/09	4:45	0.01	---	0.3	---
11/22/09	18:45	11/22/09	19:07	0.11	0.36	11.6	0.31
11/25/09	10:20	11/25/09	14:23	0.41	4.05	2.6	0.10
11/25/09	22:42	11/25/09	22:42	0.01	---	0.3	---
12/2/09	20:56	12/3/09	3:06	0.23	6.16	6.9	0.04
12/4/09	7:22	12/5/09	9:56	2.31	26.56	1.2	0.09
12/7/09	5:42	12/7/09	6:58	0.04	1.27	1.8	0.03
12/10/09	9:20	12/10/09	12:06	0.22	2.75	3.1	0.08
12/10/09	15:21	12/10/09	15:21	0.01	---	0.1	---
12/11/09	16:17	12/11/09	16:17	0.01	---	1.0	---
12/18/09	2:46	12/18/09	2:46	0.01	---	6.4	---
12/18/09	7:54	12/18/09	9:16	0.24	1.37	0.2	0.18
12/25/09	7:36	12/25/09	9:03	0.46	1.46	6.9	0.31
12/25/09	15:01	12/25/09	15:12	0.02	0.18	0.2	0.11
1/1/10	4:37	1/1/10	7:19	0.26	2.70	6.6	0.10
1/1/10	10:30	1/1/10	13:10	0.92	2.66	0.1	0.35
1/5/10	12:04	1/5/10	12:04	0.01	---	4.0	---
1/9/10	9:49	1/9/10	10:37	0.02	0.80	3.9	0.03
1/16/10	22:46	1/17/10	3:03	0.33	4.28	7.5	0.08
1/21/10	18:59	1/21/10	21:04	0.49	2.08	4.7	0.24
1/22/10	0:18	1/22/10	6:49	0.68	6.51	0.1	0.10
1/24/10	22:54	1/24/10	22:54	0.01	---	2.7	---
1/25/10	6:22	1/25/10	8:28	0.11	2.09	0.3	0.05
1/30/10	13:59	1/30/10	15:22	0.12	1.38	5.2	0.09
2/1/10	12:15	2/1/10	17:44	0.22	5.48	1.9	0.04
2/1/10	22:25	2/1/10	22:49	0.04	0.40	0.2	0.10
2/2/10	10:24	2/2/10	11:57	0.09	1.55	0.5	0.06
2/5/10	15:44	2/5/10	19:42	0.36	3.97	3.2	0.09
2/9/10	13:00	2/9/10	17:02	0.90	4.03	3.7	0.22
2/11/10	9:39	2/11/10	9:39	0.01	---	1.7	---
2/12/10	11:21	2/12/10	16:38	0.77	5.28	1.1	0.15
2/22/10	18:48	2/22/10	19:51	0.48	1.05	10.1	0.46
2/24/10	14:35	2/24/10	20:32	0.10	5.95	1.8	0.02
2/27/10	11:00	2/27/10	13:01	0.12	2.00	2.6	0.06
3/2/10	6:17	3/2/10	7:31	0.32	1.23	2.7	0.26
3/11/10	9:07	3/11/10	18:17	2.01	9.17	9.1	0.22
3/12/10	3:32	3/12/10	16:35	0.59	13.04	0.4	0.05
3/12/10	23:33	3/13/10	0:21	0.23	0.81	0.3	0.28
3/21/10	13:49	3/21/10	16:22	0.69	2.54	8.6	0.27
3/25/10	21:39	3/26/10	0:10	0.48	2.52	4.2	0.19
3/28/10	15:32	3/28/10	19:30	0.91	3.97	2.6	0.23
3/29/10	0:55	3/29/10	8:45	0.55	7.84	0.2	0.07
			TOTAL:	**51.05**			

TABLE 3-2

SUMMARY OF RAINFALL CHARACTERISTICS IN THE VICINITY OF THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

PARAMETER	UNITS	MINIMUM VALUE	MAXIMUM VALUE	MEAN EVENT VALUE
Event Rainfall	inches	0.01	7.79	0.41
Event Duration	hours	0.02	49.3	2.76
Average Intensity	inches/hour	0.01	2.06	0.37
Antecedent Dry Period	days	0.13	22.9	2.80

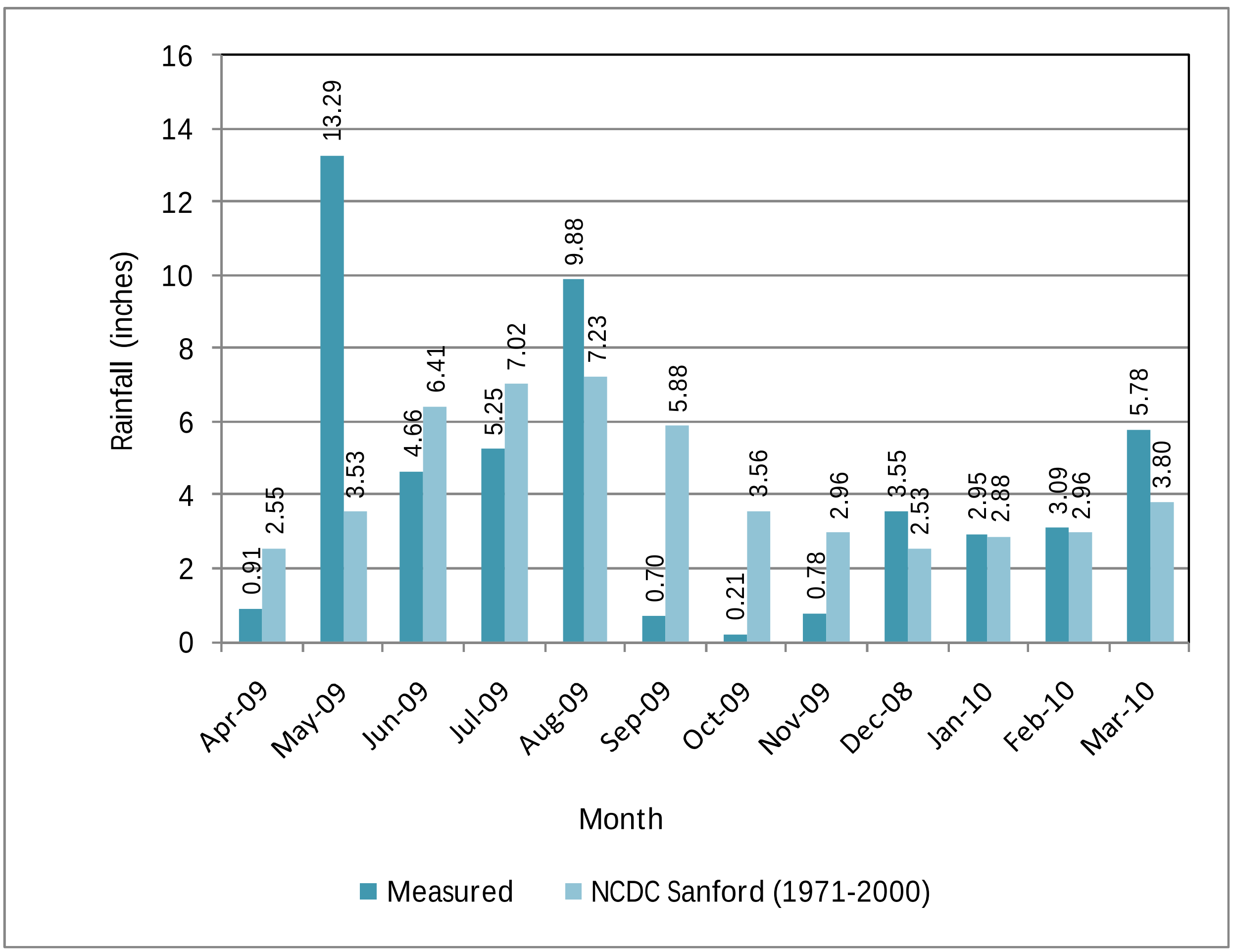


Figure 3-1. Comparison of Average and Measured Rainfall in the Vicinity of the Elder Creek Pond Site.

TABLE 3-3

MEASURED AND AVERAGE RAINFALL FOR THE ELDER CREEK POND SITE

MONTH	MEAN MONTHLY RAINFALL[1] (inches)	MEASURED SITE RAINFALL[2] (inches)	MONTH	MEAN MONTHLY RAINFALL[1] (inches)	MEASURED SITE RAINFALL[2] (inches)
April	2.55	0.91	October	3.56	0.21
May	3.53	13.29	November	2.96	0.78
June	6.41	4.66	December	2.53	3.55
July	7.02	5.25	January	2.88	2.95
August	7.23	9.88	February	2.96	3.09
September	5.88	0.70	March	3.80	5.78
			TOTAL:	**51.31**	**51.05**

1. Measured at the Sanford Airport from 1971-2000
2. Measured at the Elder Creek Pond from April 2009-March 2010

A summary of calculated hydrologic inputs to the Elder Creek pond from direct precipitation is given in Table 3-4. These inputs were calculated by multiplying the measured total monthly rainfall times the pond area of 11.35 acres. Calculated hydrologic inputs from direct precipitation range from a low of 0.20 ac-ft during October 2008 to a high of 12.57 ac-ft during May 2008. The values summarized in Table 3-4 are utilized in a subsequent section to develop a hydrologic budget for the pond.

TABLE 3-4

SUMMARY OF HYDROLOGIC INPUTS TO THE ELDER CREEK POND SITE FROM DIRECT RAINFALL DURING THE PERIOD FROM APRIL 2009 – MARCH 2010

MONTH	RAINFALL (inches)	RAINFALL VOLUME[1] (ac-ft)	MONTH	RAINFALL (inches)	RAINFALL VOLUME[1] (ac-ft)
April	0.91	0.86	October	0.21	0.20
May	13.29	12.57	November	0.78	0.74
June	4.66	4.41	December	3.55	3.36
July	5.25	4.97	January	2.95	2.79
August	9.88	9.34	February	3.09	2.92
September	0.70	0.66	March	5.78	5.47
			TOTAL:	**51.05**	**48.28**

1. Based on a pond surface area of 11.35 acres

3.1.2 Water Level Elevations

Water surface elevations in the Elder Creek pond were monitored on a continuous basis from April 2009-March 2010 using a sensitive water level pressure transducer with a digital data logger. As discussed in Section 2, this water level recording device was located at the broad-crested weir which separates the open water and littoral zones of the pond and was used to evaluate pond response to common rain events within the watershed and to indicate when water discharge occurred over the weir structure.

A graphical summary of fluctuations in water levels in the Elder Creek pond from April 2009-March 2010 is given on Figure 3-2. Total daily rainfall is also summarized on this figure to illustrate changes in water surface elevations resulting from monitored rainfall events.

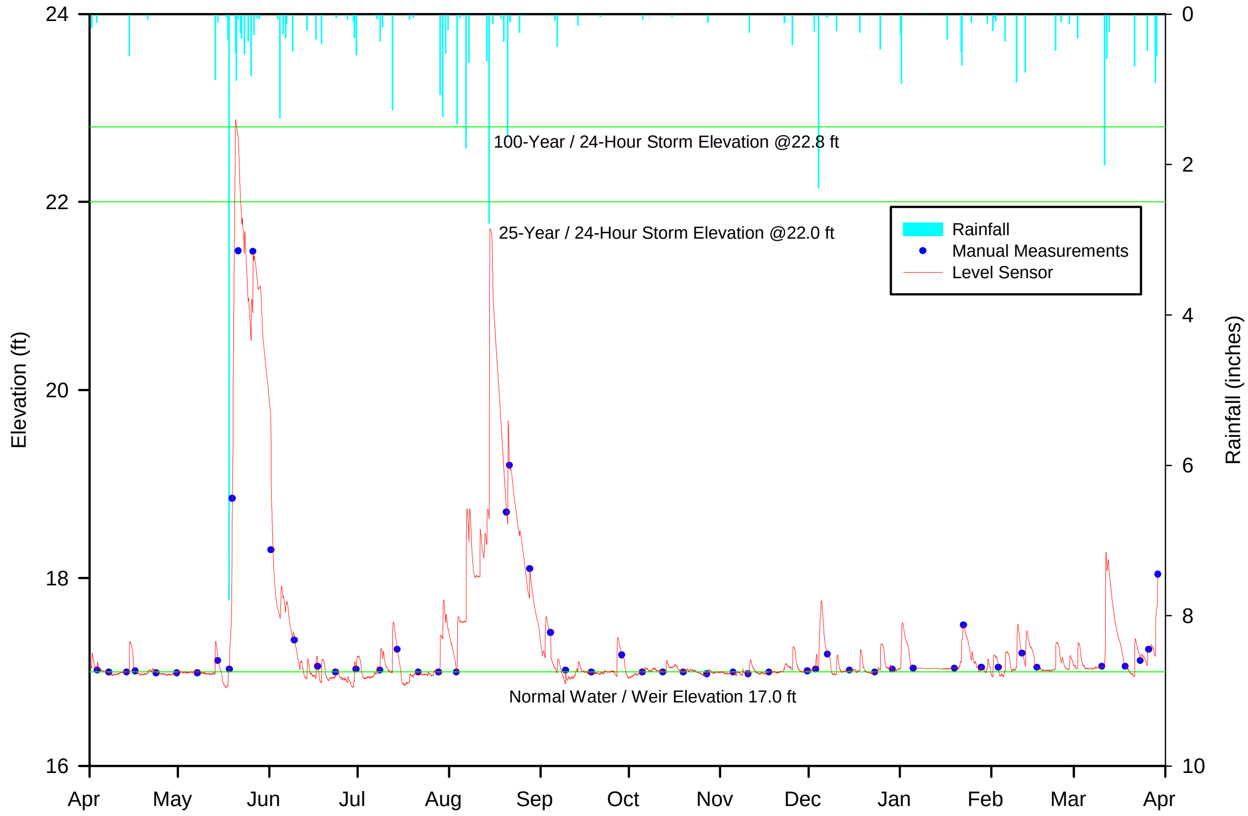


Figure 3-2. Fluctuations in Water Levels in the Elder Creek Pond from April 2009-March 2010.

As seen in Figure 3-2, pond water levels were either slightly above or slightly below the normal water/weir elevation of 17.0 ft throughout much of the 12-month monitoring program. Pond surface elevations responded rapidly to rain events in excess of approximately 0.5 inches within the watershed, with a gradual drawdown occurring over a period of several days. Substantial increases in water elevations were observed within the Elder Creek pond as a result of the 7.79-inch rain event which occurred over the period from May 18-20, 2009, with water elevations briefly exceeding the 100-year/24-hour storm elevation of 22.8 ft during this event. A second significant peak in water surface elevations occurred during August as a result of multiple storm events during the first few weeks of the month. Pond water level elevations approached, but did not exceed, the 25-year/24-hour storm elevation of 22.0 ft. However, water drawdown from each of these events occurred relatively rapidly, with normal water surface elevations achieved within a period of approximately 2-3 weeks following the peak measured elevations. Water surface elevations within the pond exhibited a fluctuation of approximately 6 ft during the study period.

Photographs of the Elder Creek pond during high water conditions in May 2009 are given on Figure 3-3. Flooding conditions within the pond resulted in complete submergence of the outfall structure, and the high rate of water discharged through the outfall structure during this event damaged the fiberglass skimmer. A floating palm tree entered the pond through the 58-inch x 91-inch ERCP at Site 1 and dislodged and damaged the sample intake and flow sensor, requiring repair and replacement, respectively. The flooding conditions also partially submerged the equipment shelter installed at Site 1.

Measured minimum, maximum, and average water surface elevations during the monitoring program are summarized in Table 3-5. The minimum water surface elevation of 16.83 ft is slightly lower than the stated control elevation of 17.0 ft with the mean water level elevation of 17.33 ft slightly greater than the control elevation. During periods of low rainfall, the pond water surface elevation exhibited a gradual decline and fluctuated slightly above and below the control elevation.

TABLE 3-5

SUMMARY OF WATER LEVEL DATA FOR THE ELDER CREEK POND SITE

PARAMETER	ELEVATION (ft, NGVD)
Control Elevation	17.0
Measured Minimum Water Stage	16.83
Measured Maximum Water Stage	22.88
Mean Water Level	17.33
Design Peak Stage (25-yr, 24-hr storm)	22.0

a. Floating palm tree relocated sample intake and flow sensor

b. Flooding conditions at the outfall structure

c. High flows damaged outfall skimmer

d. Flooding conditions at Site 1

Figure 3-3. Photographs of the Elder Creek Pond During High Water Level Conditions in May 2009.

3.1.3 <u>Pond Inflow</u>

Continuous inflow hydrographs were recorded at three significant inflows to Elder Creek pond at 10-minute intervals from April 1, 2009-March 31, 2010. In addition to the continuous inflow hydrographs, information was also provided on total daily volume and cumulative total volume for the period of record.

A graphical summary of inflow hydrographs to the Elder Creek pond through the 58-inch x 91-inch ERCP (Site 1) which discharges from Elder Creek into the pond is given on Figure 3-4. Inflows into the pond were typically 3-4 cfs or less during common storm events. However, inflows as high as 36 cfs occurred as a result of the 7.79-inch rain event which occurred during May 2009. An inflow rate of approximately 25 cfs was observed as a result of multiple rain events which occurred during the first few weeks of August.

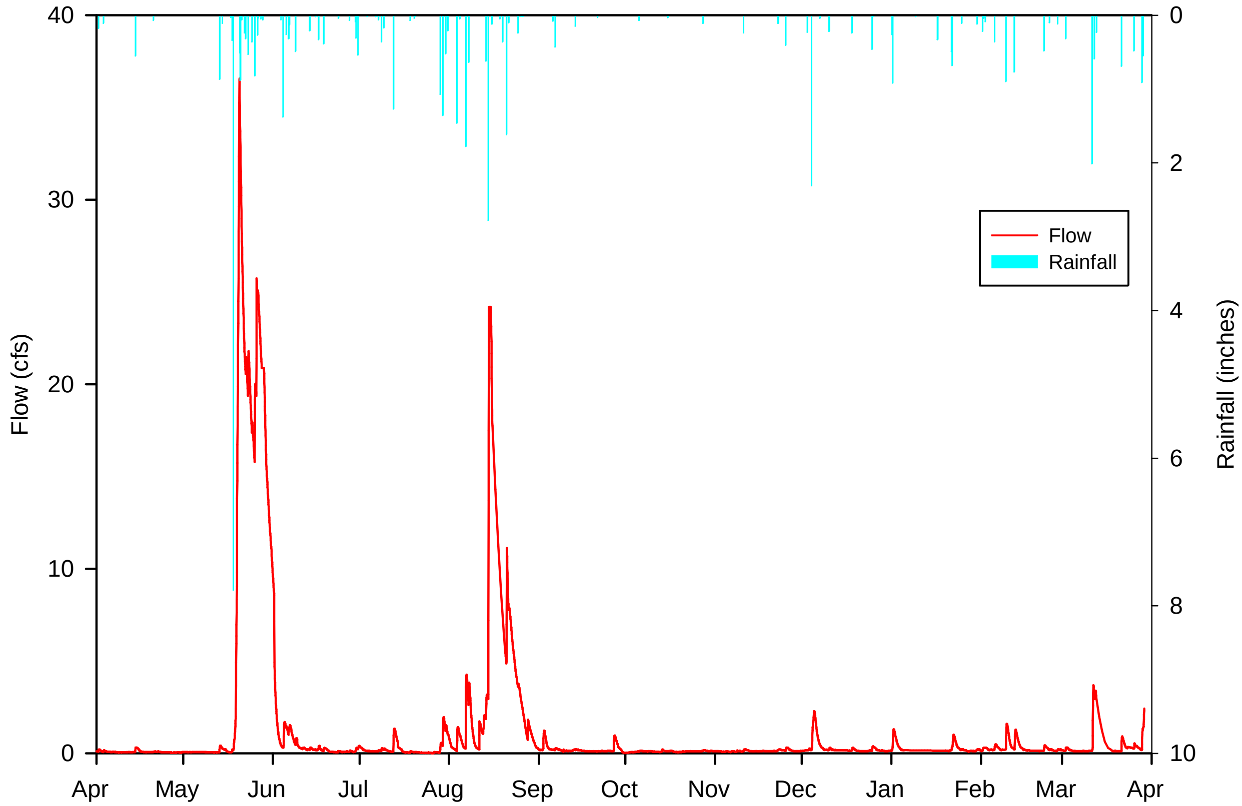


Figure 3-4. Inflow Hydrographs to the Elder Creek Pond from Site 1 (Elder Creek).

A graphical summary of inflow hydrographs for the Elder Ditch inflow (Site 2) over the period from April 2009-March 2010 is given on Figure 3-5. Inflows into the pond from this site were typically approximately 0.5 cfs or less during a majority of the measured common rain events. However, inflow rates in excess of 5 cfs were observed at this site as a result of the 7.79-inch rain event which occurred during May 2009. Inflows of approximately 3.5 cfs were observed as a result of multiple storm events during the first few weeks of August 2009. Inflows from this site essentially ceased during extended periods of little or no rainfall.

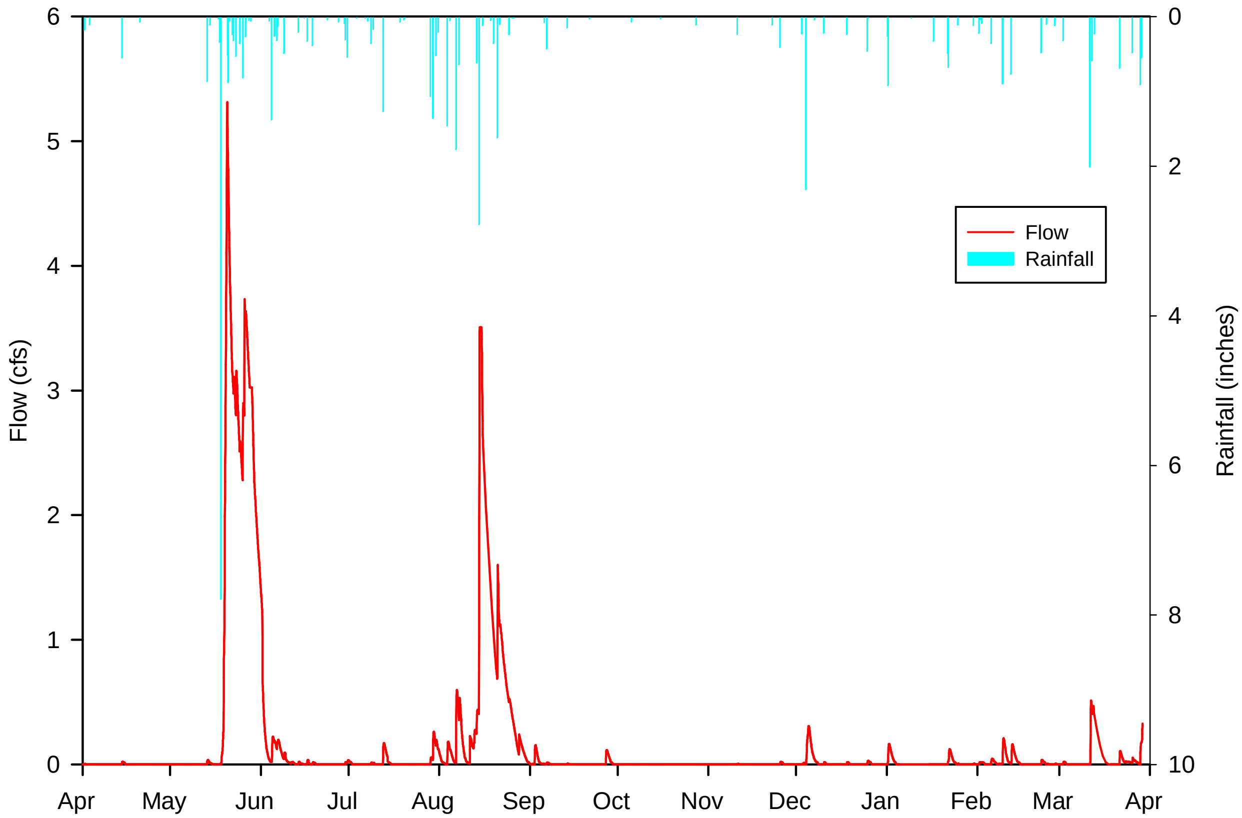


Figure 3-5. Inflow Hydrographs to the Elder Creek Pond from Site 2 (Elder Ditch).

A graphical summary of inflow hydrographs to the Elder Creek pond from Site 3 (Elder Ditch) over the period from April 2009-March 2010 is given on Figure 3-6. In general, inflow hydrographs measured at this site are similar to the inflow hydrographs measured as Sites 1 and 2. Discharges into the pond during typical storm events were approximately 1 cfs or less. However, inflow rates in excess of 11 cfs were observed as a result of the 7.79-inch rain event during May 2009, with inflow rates of approximately 8 cfs resulting from the extended period of rainfall during August 2009.

As discussed in Section 2.1 and illustrated on Figure 2-1, two smaller 18-inch RCP inflows, which provide drainage for portions of Elder Road, were not directly monitored as part of this project. These inflows were thought to be relatively minimal in comparison with the larger inflows which were included in the monitoring program. As a result, inflows from the smaller inputs were estimated using hydrologic modeling of the estimated runoff volume generated during each of the individual monitored rainfall events summarized in Table 3-1. This modeling exercise is used to represent the total runoff volume which discharged into the Elder Creek pond from the two 18-inch RCP inflows along the west side of Elder Road.

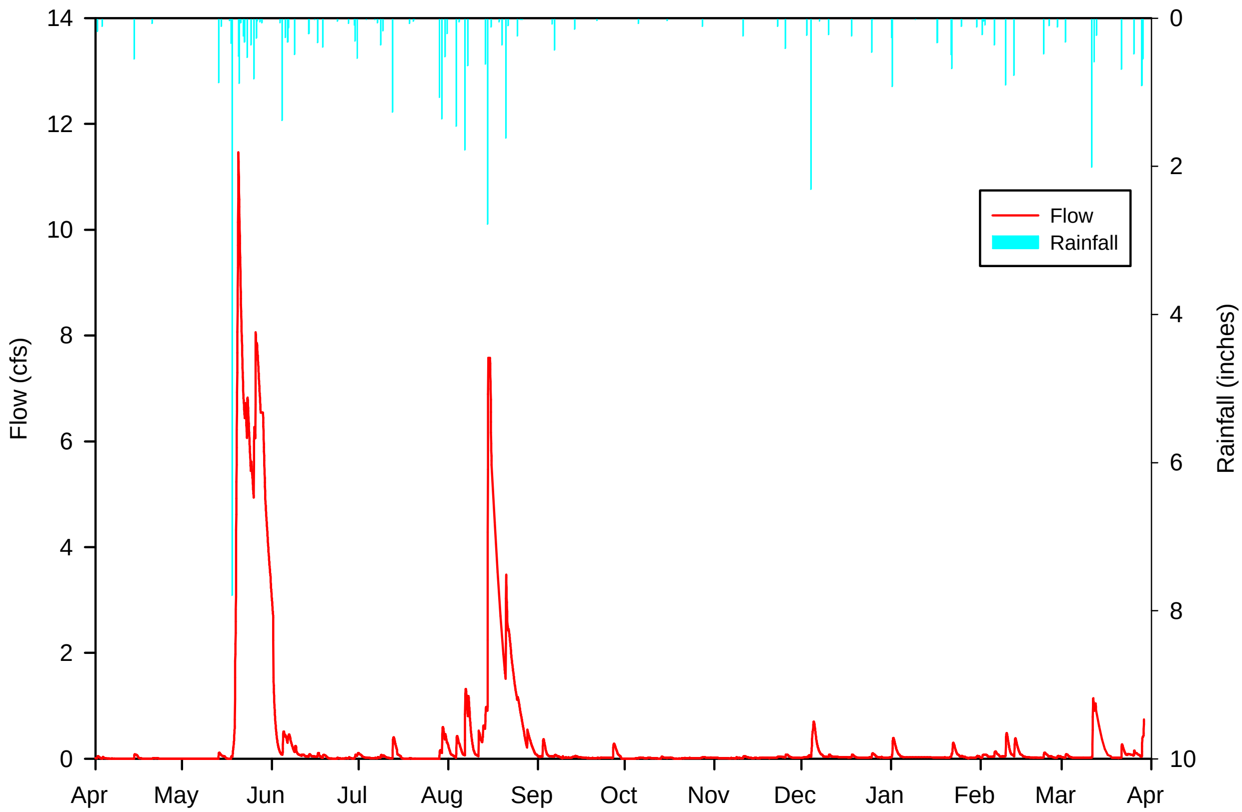


Figure 3-6. Inflow Hydrographs to the Elder Creek Pond from Site 3 (Elder Ditch).

The SCS curve number methodology was used to generate estimates of the runoff volumes produced within the two drainage sub-basin areas for each of the monitored rainfall events listed in Table 3-1. The SCS methodology utilizes the hydrologic characteristics of the drainage basin, including impervious area, directly connected impervious area (DCIA), and soil curve numbers (CN value) to estimate runoff volumes for modeled storm events. Hydrologic characteristics were developed by ERD for each of the two sub-basin areas associated with the 18-inch RCP inflows. Information on drainage basin boundaries was obtained from the construction drawings for the project. Hydrologic characteristics were developed for each of the two sub-basins for use in hydrologic modeling. Hydrologic characteristics for the sub-basin areas were determined by ERD based upon a review of the construction drawings and available aerial photography.

A summary of general hydrologic characteristics for each of the two sub-basin areas is given in Table 3-6. For purposes of this analysis, the sub-basin areas are referred to as "north" and "south" which reflects the general locations of the inflows along Elder Road. The drainage basin areas for these inflows are relatively small, with a 0.38-acre drainage basin for the north inflow and a 0.46-inch drainage basin for the south inflow. Approximately 50% of each sub-basin is impervious, although none of the impervious areas are considered to be DCIA for modeling purposes. Soils within the two small drainage basins are classified in HSG D which is reflected in the selected CN values listed in Table 3-6.

TABLE 3-6

HYDROLOGIC CHARACTERISTICS OF THE NORTH AND SOUTH INFLOWS ALONG ELDER ROAD

PARAMETER	NORTH SUB-BASIN	SOUTH SUB-BASIN
Total Area (acres)	0.38	0.46
Impervious Area (acres)	0.19	0.23
DCIA (acres)	0.00	0.00
DCIA (%)	0.00	0.00
Pervious CN	80	80
Non-DCIA CN	89	89
S (inches)	1.24	1.24

After estimating the hydrologic characteristics of the basin area, the runoff volume for each rainfall event is calculated by adding the rainfall excess from the non-directly connected impervious area (non-DCIA) portion to the rainfall excess created from the DCIA portion for the basin. Rainfall excess from the non-DCIA areas is calculated using the following set of equations:

$$Soil\ \ Storage,\ S\ =\ \left(\frac{1000}{nDCIA\ \ CN}\ -\ 10\right)$$

$$nDCIA\ \ CN\ =\ \frac{[CN\ *\ (100\ -\ IMP)]\ +\ [98\ (IMP\ -\ DCIA)]}{(100\ -\ DCIA)}$$

$$Q_{nDCIA_i}\ =\ \frac{(P_i\ -\ 0.2S\ )^2}{(P_i\ +\ 0.8S)}$$

where:

CN	=	curve number for pervious area
IMP	=	percent impervious area
DCIA	=	percent directly connected impervious area
nDCIA CN	=	curve number for non-DCIA area
P_i	=	rainfall event depth (inches)
Q_{nDCIAi}	=	rainfall excess for non-DCIA for rainfall event (inches)

For the DCIA portion, rainfall excess is calculated using the following equation:

$$Q_{DCIA_i} = (P_i - 0.1)$$

When P_i is less than 0.1, Q_{DCIAi} is equal to zero. This methodology was used to estimate the generated runoff volume within each of the delineated sub-basin areas for each of the rainfall events listed in Table 3-1.

A summary of modeled hydrologic inputs for the north and south sub-basins along Elder Road is given in Table 3-7. References to the associated inflow structures on the design plans are also included. In general, inflows through the two 18-inch RCP stormsewers are relatively small, with a total of approximately 1.2 ac-ft of runoff discharged into the Elder Creek pond over the 12-month monitoring program.

TABLE 3-7

MODELED HYDROLOGIC INPUTS FOR THE "NORTH" AND "SOUTH" SUB-BASINS ALONG ELDER ROAD

MONTH	HYDROLOGIC INPUTS (ac-ft)		
	North (Structure S-23)	South (Structure S-26)	Total
April	0.002	0.002	0.004
May	0.228	0.276	0.504
June	0.021	0.025	0.046
July	0.044	0.053	0.097
August	0.129	0.156	0.285
September	0.001	0.001	0.002
October	0.000	0.000	0.000
November	0.001	0.001	0.002
December	0.042	0.051	0.093
January	0.012	0.015	0.027
February	0.014	0.016	0.030
March	0.049	0.060	0.109
		TOTAL:	**1.199**

A summary of total monthly runoff generated inputs to the Elder Creek pond from April 2009-March 2010 is given in Table 3-8. Inputs are included for monitoring Sites 1, 2, and 3 as well as the combined modeled inflows from the Elder Road inflows. Overall, the total runoff generated input into the Elder Creek pond during the monitoring program was approximately 1,192 ac-ft. Approximately 70% of this inflow was contributed by the Elder Creek inflow at Site 1, with 9% contributed by the Elder Ditch inflow at Site 2 and 21% contributed by the Elder Ditch inflow at Site 3. Roadway inflows along Elder Road contributed less than 1% of the total runoff inputs to the pond. The information summarized in Table 3-8 is utilized in a subsequent section for estimation of hydrologic and nutrient budgets for the pond.

TABLE 3-8

SUMMARY OF MONTHLY RUNOFF INPUTS TO THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

MONTH	INPUTS (ac-ft)				
	Site 1	Site 2	Site 3	Elder Road Inflows	Total Runoff Inputs
April	4.62	0.04	0.40	0.004	5.06
May	510.4	73.44	159.1	0.504	743.4
June	36.51	4.08	10.42	0.046	51.1
July	15.43	1.33	3.86	0.097	20.7
August	174.6	24.18	53.95	0.285	253.0
September	12.59	0.62	2.86	0.002	16.1
October	6.10	0.00	0.72	0.000	6.82
November	7.52	0.04	1.20	0.002	8.76
December	17.12	1.10	4.22	0.093	22.5
January	11.65	0.75	2.87	0.027	15.3
February	16.79	1.14	4.29	0.030	22.3
March	19.78	1.90	5.37	0.109	27.2
TOTALS:	**833.1**	**108.6**	**249.3**	**1.20**	**1,192**
% of TOTAL:	**70**	**9**	**21**	**< 1**	**100**

A summary of calculated monthly runoff coefficients for the Elder Creek drainage basin is given in Table 3-9. These values are calculated as the ratio of the measured runoff inflow to the calculated rainfall volume which fell onto the 234-acre drainage basin during each month of the study. This analysis includes all measured inflow into the pond from the inflow summarized on Table 3-8. In general, runoff coefficients for the Elder Creek basin appear to be elevated during each month of the monitoring program compared with values commonly observed in urban drainage basins with similar rainfall amounts. Runoff coefficients in excess of 1 were observed during May, August, September, and October during the monitoring program. The overall mean runoff coefficient for the Elder Creek drainage basin is 1.197 which exceeds the theoretical maximum value of 1.0.

The values summarized on Table 3-9 suggest that the contributing drainage basin area to the pond has been underestimated, resulting in runoff contributions from a substantially larger area than the 234-acre estimated drainage basin. This is further supported by the water surface elevation data (summarized in Figure 3-2) which indicate that water surface elevations exceeded the 100-year/24-hour storm elevation of 22.8 ft resulting from a 7.79-inch rain event which occurred over a 48-hour period. The 100-year storm event would have substantially more rainfall which would occur over a 24-hour period rather than a 48-hour period. Therefore, based upon pond performance observed during the monitoring program, and the calculated monthly runoff coefficients summarized in Table 3-9, it appears likely that the actual drainage basin area discharging to the Elder Creek pond is substantially greater than the estimated basin area of 234 acres.

TABLE 3-9

CALCULATED MONTHLY RUNOFF COEFFICIENTS FOR THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

MONTH	TOTAL RUNOFF INFLOW (ac-ft)	RAINFALL (inches)	RUNOFF COEFFICIENT (C Value)
April	5.06	0.91	0.285
May	743.4	13.29	2.87
June	51.1	4.66	0.562
July	20.7	5.25	0.202
August	253.0	9.88	1.31
September	16.1	0.70	1.18
October	6.82	0.21	1.67
November	8.76	0.78	0.576
December	22.5	3.55	0.325
January	15.3	2.95	0.266
February	22.3	3.09	0.370
March	27.2	5.78	0.241
TOTALS:	**1,192**	**51.05**	**1.197**

3.1.4 Pond Outflow

Discharges from the Elder Creek pond occur through an outfall structure located at the southwest corner of the pond. This outfall structure contains a compound horizontal weir which regulates discharges from the pond during common storm events. Discharges through the outfall structure were monitored using a standard broad-crested weir equation based upon the outfall weir configuration and depth of water over the weir.

A graphical summary of discharge hydrographs measured at the pond outfall structure is given on Figure 3-7. The vast majority of measured discharge rates at this site are less than approximately 1 cfs, with the exception of the significant rain events which occurred during May and August 2009. During the 7.79-inch rain event which occurred during May, discharge through the outfall structure exceeded approximately 50 cfs for a brief period. During the period of extended rainfall which occurred during early August, discharges through the discharge structure reached approximately 35 cfs. An expanded view of the outfall discharge hydrographs is given on Figure 3-8. In the absence of storm events, a constant baseflow was observed at the pond outfall which ranged from approximately 0.1-0.25 cfs.

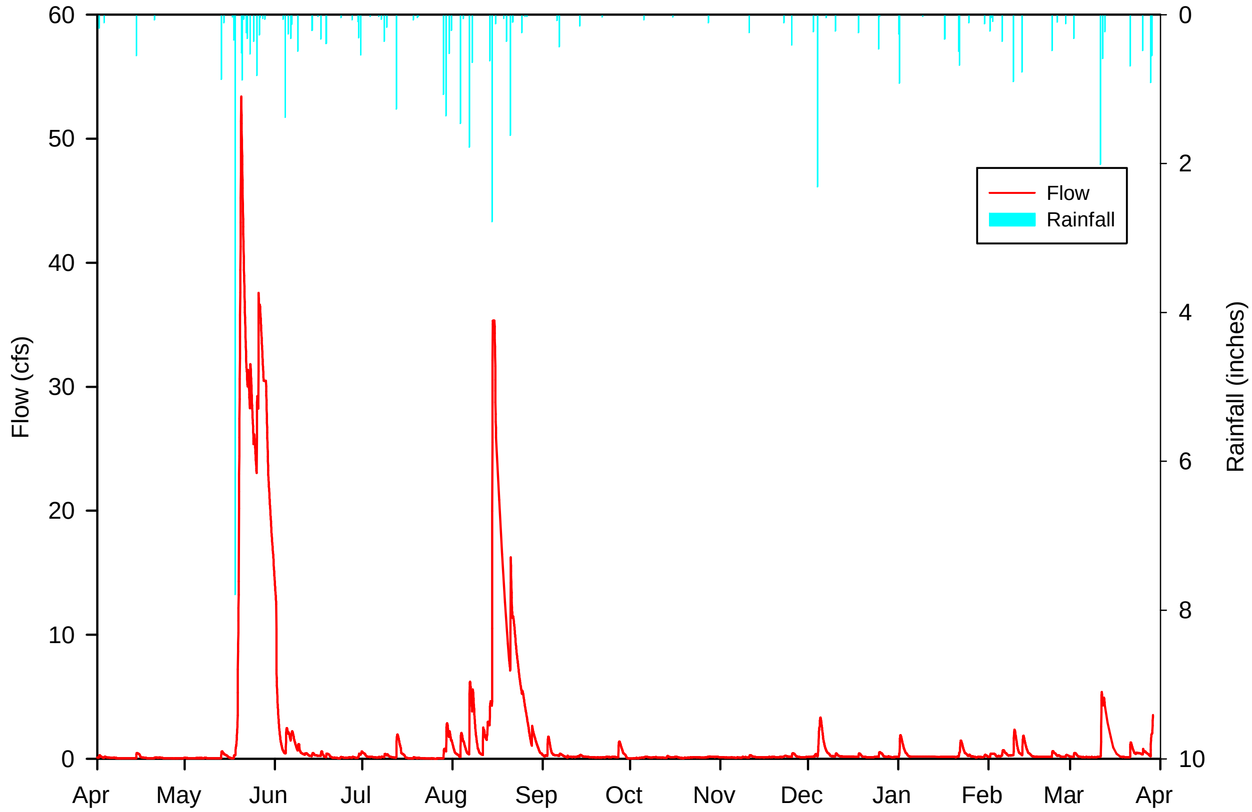


Figure 3-7. Discharge Hydrographs through the Pond Outfall.

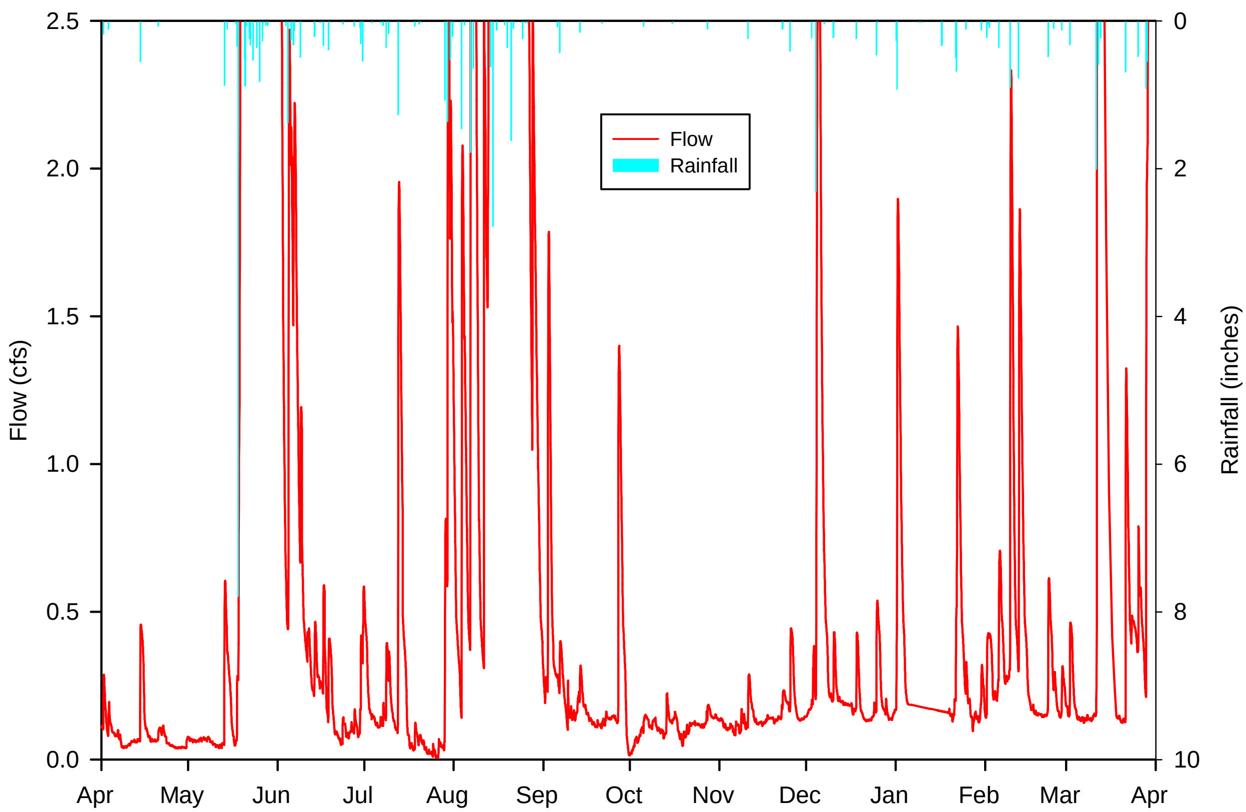


Figure 3-8. Expanded View of Outfall Discharge Hydrographs.

A summary of monthly discharges from the Elder Creek pond during the monitoring program from April 2009-March 2010 is given in Table 3-10. In general, outfall discharge appears to correlate well with rainfall within the basin area. Overall, a discharge of approximately 1201 ac-ft occurred from the pond outfall during the field monitoring program.

TABLE 3-10

SUMMARY OF MONTHLY DISCHARGE FROM THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

MONTH	RAINFALL (inches)	OUTFALL DISCHARGE (ac-ft)
April	0.91	5.29
May	13.29	744.2
June	4.66	52.49
July	5.25	21.33
August	9.88	254.8
September	0.70	16.76
October	0.21	6.93
November	0.78	8.90
December	3.55	22.89
January	2.95	15.74
February	3.09	23.33
March	5.78	27.85
TOTALS:	**51.05**	**1200.5**

3.1.5 Pond Evaporation

As discussed in Section 2, a Class A pan evaporimeter was installed on a level wooden platform adjacent to the Elder Creek pond outfall structure. Changes in water level within the pan were recorded at approximately 1-week intervals and corrected for rainfall which occurred during the preceding period to obtain estimates of pan evaporation. The pan evaporation measurements were then multiplied by the standard factor of 0.7 to produce estimates of evaporation from the pond surface.

A graphical summary of monthly lake evaporation measured at the Elder Creek pond site from April 2009-March 2010 is given on Figure 3-9. The values summarized in this figure reflect the measured pan evaporation rates multiplied by 0.7. Monthly evaporation rates measured at the Orlando International Airport (OIA) meteorological station over the period from 1956-1970 are also provided on Figure 3-9 for comparison purposes. In general, a relatively close agreement was observed between the field-measured values at the Elder Creek site and the OIA monitoring station. The total evaporation measured at the Elder Creek site during the 12-month monitoring program was 52.71 inches compared with an annual average of 51.21 inches measured at the OIA monitoring site.

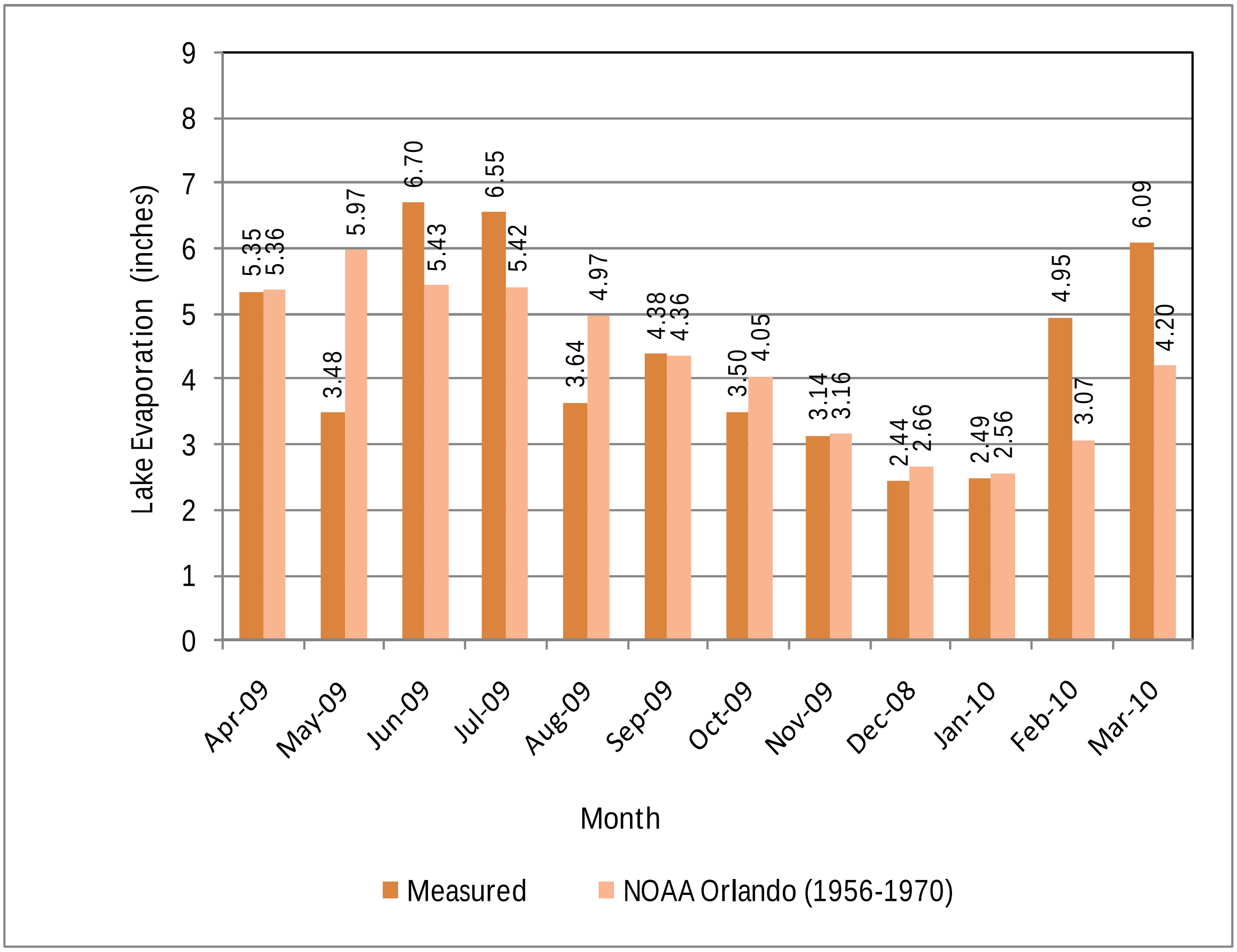


Figure 3-9. Monthly Lake Evaporation Measured at the Elder Creek Pond from April 2009-March 2010.

A summary of estimated evaporation losses at the Elder Creek pond from April 2009-March 2010 is given on Table 3-11. Monthly evaporation is provided for each month included in the 12-month study period. Pond evaporation is calculated by multiplying the evaporation depth (in inches) times the pond area of 11.35 acres. Evaporation losses removed approximately 49.86 ac-ft of water from the Elder Creek pond over the monitoring period.

TABLE 3-11

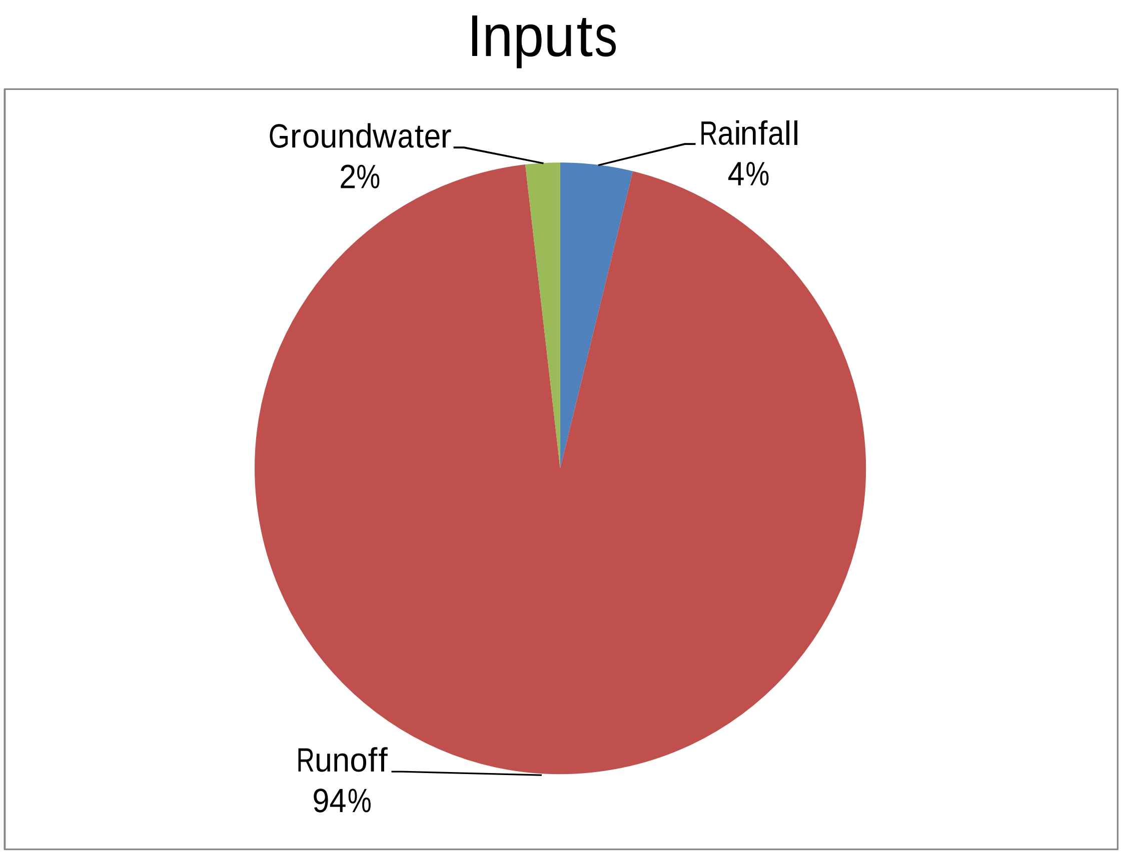
ESTIMATED EVAPORATION LOSSES AT THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

MONTH	EVAPORATION (inches)	EVAPORATION (ac-ft)	MONTH	EVAPORATION (inches)	EVAPORATION (ac-ft)
April	5.35	5.06	October	3.50	3.31
May	3.48	3.29	November	3.14	2.97
June	6.70	6.34	December	2.44	2.31
July	6.55	6.20	January	2.49	2.36
August	3.64	3.44	February	4.95	4.68
September	4.38	4.14	March	6.09	5.76
			TOTAL:	**52.71**	**49.86**

3.1.6 Hydrologic Budget

A monthly hydrologic budget for the Elder Creek pond is given in Table 3-12. Inputs into the pond include direct rainfall and inflows from Elder Creek and Elder Ditch. Losses from the pond include evaporation and discharges through the pond outfall structure. Differences between measured inputs and losses for a given month are assumed to be a result of either groundwater inflow or loss from the pond. During months when the measured hydrologic inputs are less than the measured hydrologic losses, the difference is assumed to be groundwater inflow into the pond. During months where the inputs exceed the measured losses, then the difference is assumed to be a result of groundwater discharge from the pond. In general, a small groundwater inflow into the pond was observed throughout the 12-month monitoring program with the exceptions of the months of May, August, and December when a small outflow occurred.

A graphical comparison of hydrologic inputs and losses for the Elder Creek pond is given on Figure 3-10. Approximately 94% of the hydrologic inputs originated as a result of runoff entering the pond through the evaluated inflows. Approximately 3.8% of the inputs were contributed by rainfall, with 1.8% contributed by groundwater inflow. Approximately 95% of the losses from the pond occurred through the outfall structure, with 3.9% lost due to evaporation and 1% lost due to groundwater discharge from the pond.



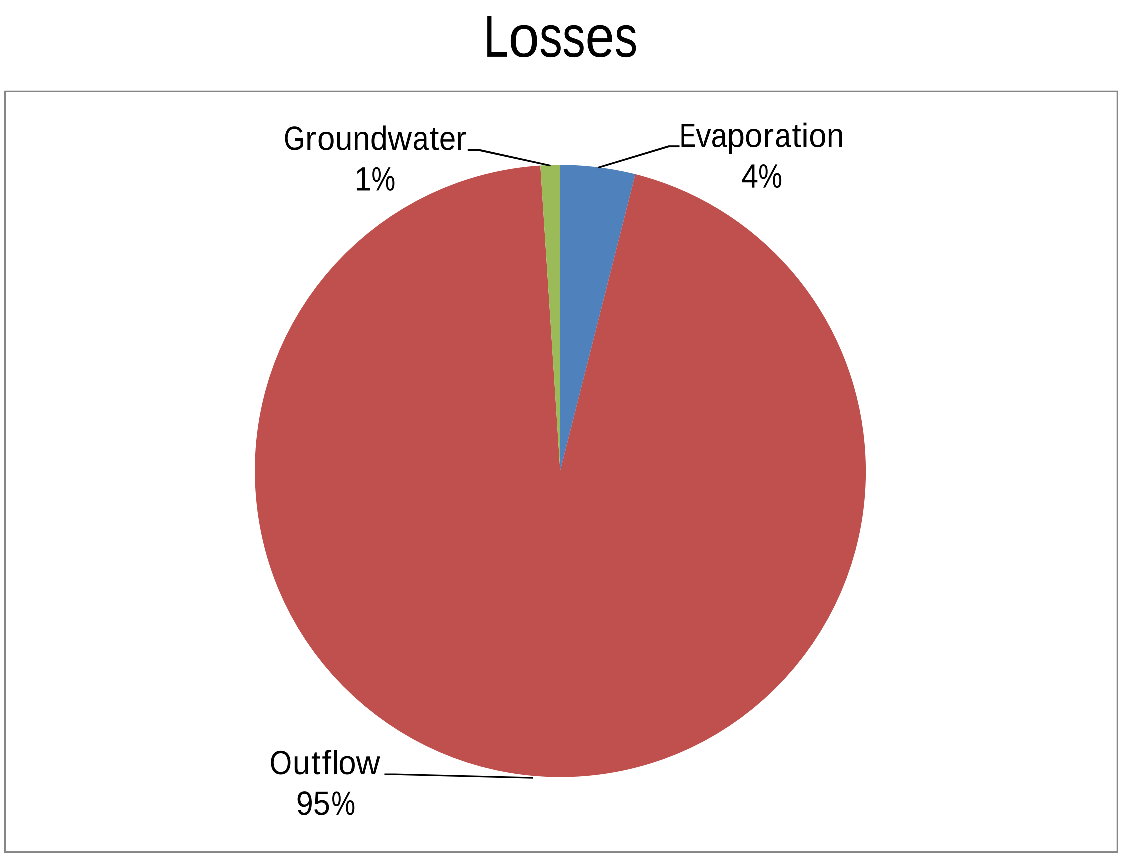


Figure 3-10. Comparison of Hydrologic Inputs and Losses for the Elder Creek Pond from April 2009-March 2010.

TABLE 3-12

MONTHLY HYDROLOGIC INPUTS AND LOSSES AT THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

MONTH	HYDROLOGIC INPUTS (ac-ft)				HYDROLOGIC LOSSES (ac-ft)			
	Rainfall	Runoff	Ground-water	Total	Evapor-ation	Outflow	Ground-water	Total
April	0.86	5.06	4.43	10.35	5.06	5.29	0.00	10.35
May	12.57	743.4	0.00	756.0	3.29	744.2	8.48	756.0
June	4.41	51.1	3.32	58.83	6.34	52.49	0.00	58.83
July	4.97	20.7	1.86	27.53	6.20	21.33	0.00	27.53
August	9.34	253.0	0.00	262.3	3.44	254.8	4.1	262.3
September	0.66	16.2	4.04	20.9	4.14	16.76	0.00	20.90
October	0.20	6.82	3.22	10.24	3.31	6.93	0.00	10.24
November	0.74	8.76	2.37	11.87	2.97	8.90	0.00	11.87
December	3.36	22.5	0.00	25.86	2.31	22.89	0.66	25.86
January	2.79	15.3	0.01	18.1	2.36	15.74	0.00	18.10
February	2.92	22.3	2.79	28.01	4.68	23.33	0.00	28.01
March	5.47	27.2	0.94	33.61	5.76	27.85	0.00	33.61
TOTALS:	**48.29**	**1,192.3**	**23.0**	**1263.6**	**49.86**	**1200.5**	**13.2**	**1263.6**

3.1.7 Hydraulic Residence Time

An estimate of the average annual detention time within the wet detention pond was conducted by dividing the estimated pond volume of 79.2 ac-ft (as summarized in Table 1-1) by the sum of the total monthly inputs (summarized in Table 3-12). Based upon this analysis, the mean annual residence time within the pond was approximately 23 days. It is interesting to note that the design calculations for the pond also predicted a mean residence time of approximately 23 days, although the calculations were intended to reflect wet season conditions.

3.2 Chemical Characteristics of Monitored Inputs and Outputs

A summary of sample collection activities conducted at the Elder Creek pond site from April 2009-March 2010 is given in Table 3-13. A total of 45 flow-weighted composite inflow samples was collected at the Elder Creek inflow (Site 1), with 28 flow-weighted composite samples collected at the Elder Ditch inflow at Site 2, 37 samples collected at the Elder Ditch inflow at Site 3, and 38 bulk precipitation samples. A total of 56 flow-weighted composite samples was also collected at the pond outflow. A complete listing of the results of laboratory analyses conducted on inflow, outflow, and bulk precipitation samples is given in Appendix B.

TABLE 3-13

SUMMARY OF SAMPLE COLLECTION PERFORMED AT THE ELDER CREEK POND SITE

SAMPLE TYPE	NUMBER OF SAMPLES COLLECTED
Elder Creek Inflow (Site 1)	45
Elder Ditch Inflow (Site 2)	28
Elder Ditch Inflow (Site 3)	37
Pond Outfall	56
Bulk Precipitation	38
Vertical Field Profiles	34

In addition to the samples listed previously, 37 vertical field profiles were also collected within the pond to evaluate vertical variability in water quality characteristics. A complete listing of vertical field profiles collected at the Elder Creek pond site from April 2009-March 2010 is given in Appendix C.

3.2.1 Vertical Field Profiles

As discussed in Section 2.3, vertical field profiles of pH, temperature, specific conductivity, dissolved oxygen, and oxidation-reduction potential (ORP) were conducted near the center of the Elder Creek pond on approximately a weekly basis during the monitoring program. Field measurements were conducted at depths of 0.25 m and 0.5 m, and continued at 0.5-m intervals to the pond bottom. A complete listing of vertical field profiles collected during the monitoring program is given in Appendix C.

A graphical summary of vertical depth profiles collected in the Elder Creek pond from April 2009-March 2010 is given on Figure 3-11. The vertical profiles summarized in this figure reflect the average of profiles collected during winter, spring, summer, and fall conditions to illustrate seasonal changes in vertical water quality within the pond. For purposes of this analysis, winter is assumed to reflect the months of January-March, with spring reflecting the months of April-June, summer conditions reflected by July-September, and fall conditions reflected by October-December. Water depth within the pond ranged from approximately 2.5-3 m during the monitoring program.

In general, a slight decrease in temperature was observed with increasing water depth during a majority of the field monitoring events. The differences between top and bottom temperatures were most pronounced during spring conditions, although no evidence of thermal stratification was observed during any of the field monitoring events. Differences in temperature between top and bottom measurements ranged from approximately 1-2^{o}C during winter, summer, and fall conditions. However, during spring conditions, the temperature difference between top and bottom measurements ranged from 3-4^{o}C.

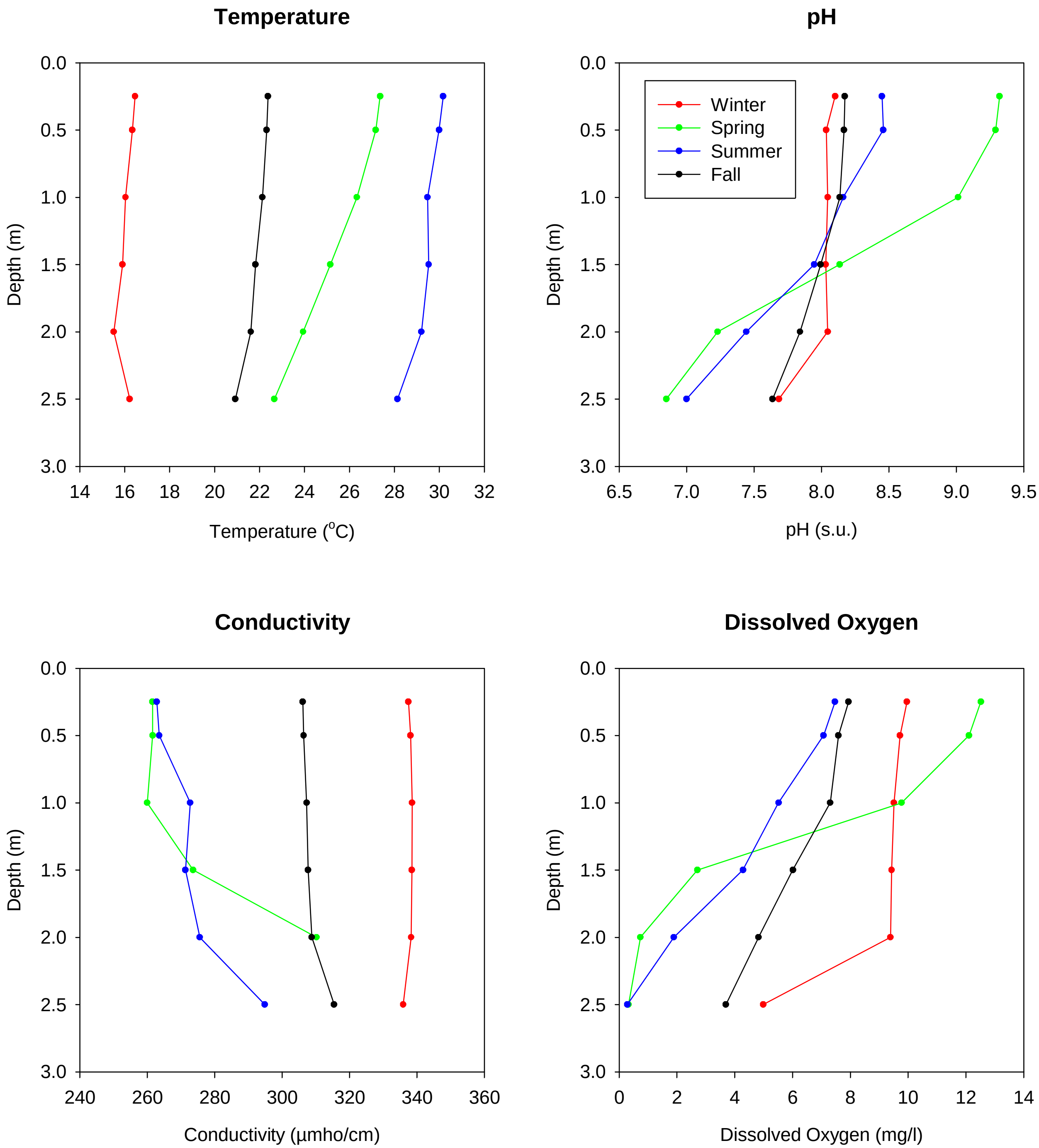


Figure 3-11. Compilation of Vertical Depth Profiles Collected in the Elder Creek Pond from April 1, 2009-March 31, 2010.

In general, a trend of decreasing pH with increasing water depth was observed during most of the monitoring events. Differences in pH between top and bottom measurements were relatively small during winter and fall conditions. This phenomenon, combined with the relatively isograde temperature profiles measured during these seasons, suggests that the pond exhibited well-mixed characteristics during winter and fall conditions. Differences in pH between top and bottom measurements were more pronounced during spring and summer conditions, with a pH range of approximately 6.7-9.4 during spring conditions and 7-8.2 during summer conditions.

Relative isograde conductivity measurements were observed within the Elder Creek during winter and fall conditions. A slight increase with increasing water depth was observed during both spring and summer conditions, although a decrease in conductivity was observed near the bottom sediments during the spring measurements. No evidence of significant internal release of ions is apparent in the measured conductivity values.

A general trend of decreasing dissolved oxygen concentrations with increasing water depth was observed during each of the seasonal conditions. The relative decrease in dissolved oxygen appears to be less during winter and fall conditions than during spring and summer conditions. Dissolved oxygen concentrations less than 2 mg/l were observed within the water column at water depths in excess of 2 m during spring and summer conditions. Aerobic conditions appear to exist throughout the water column of the pond during winter and fall conditions.

In general, the Elder Creek pond appears to be relatively well-mixed, particularly during winter and fall conditions, as evidenced by the relatively isograde conditions observed for temperature, pH, and conductivity during these periods. Dissolved oxygen levels within the pond appear to be adequate to support decomposition processes for biologically degradable materials and for support of aquatic wildlife. Areas of low dissolved oxygen were observed near the pond bottom during spring and summer conditions, although anoxic conditions appear to be limited to the bottom 0.5 m of the pond. No significant increases in specific conductivity were observed in lower layers of the pond, suggesting that internal recycling is not significant within the pond at this time.

3.2.2 Pond Inflows

Inflow into the Elder Creek wet detention pond was monitored at three significant tributaries which enter the pond. A complete listing of the characteristics of each of the inflow samples collected at the Elder Creek pond site is given in Appendix B.1. A discussion of the chemical characteristics of inflows at each of these sites is given in the following sections.

3.2.2.1 Elder Creek Inflow (Site 1)

A summary of laboratory measurements conducted on stormwater runoff samples collected at the Elder Creek inflow (Site 1) from April 2009-March 2010 is given in Table 3-14. Runoff inputs into the pond were approximately neutral in pH, with a mean pH value of 7.50, and well buffered, with a mean alkalinity of 125 mg/l. The measured alkalinity values at this site are somewhat higher than alkalinity values commonly observed in tributaries in urban areas and suggest an alkaline input somewhere within the basin area. Measured conductivity values are similar to values commonly observed in urban runoff.

TABLE 3-14

SUMMARY OF LABORATORY MEASUREMENTS CONDUCTED ON ELDER CREEK INFLOW (SITE 1) SAMPLES COLLECTED FROM THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

PARAMETER	UNITS	MEAN	RANGE OF VALUES
pH	s.u.	7.50	6.86 – 8.20
Conductivity	μmho/cm	303	179 – 434
Alkalinity	mg/l	125	61.6 – 187
NH_3	μg/l	95	<5 – 280
NO_x	μg/l	157	<5 – 674
Diss. Organic N	μg/l	448	106 – 1002
Particulate N	μg/l	453	165 – 1813
Total N	μg/l	1153	516 – 2929
SRP	μg/l	237	49 – 538
Diss. Organic P	μg/l	32	1 – 241
Particulate P	μg/l	307	18 – 1618
Total P	μg/l	576	199 – 1870
TSS	mg/l	57.2	2.8 - 378
Turbidity	NTU	22.4	2.5 - 201

Low levels of inorganic nitrogen species were observed in the Elder Creek inflow, with a mean ammonia concentration of 95 μg/l and a mean NO_x concentration of 157 μg/l. The dominant nitrogen species present were organic nitrogen and particulate nitrogen, each of which contributed 39% of the measured total nitrogen. Particulate nitrogen concentrations measured in the Elder Creek inflow are somewhat lower than commonly observed in urban runoff, and suggest deposition of nitrogen within the channel prior to reaching the Elder Creek pond site. The overall mean total nitrogen concentration of 1153 μg/l is somewhat lower than nitrogen levels commonly observed in urban runoff.

Extremely elevated levels of total phosphorus were observed in the Elder Creek inflow. The mean soluble reactive phosphorus (SRP) concentration of 237 μg/l is 2-5 times higher than SRP concentrations commonly observed in urban runoff. The dominant phosphorus species measured at the site was particulate phosphorus which comprised approximately 53% of the total phosphorus measured. The mean total phosphorus concentration of 576 μg/l is approximately twice the total phosphorus value commonly observed in tributary inflows in urban areas. Moderate to elevated levels of TSS and turbidity were observed at the Elder Creek inflow site, with a mean TSS concentration of 57.2 mg/l and a mean turbidity value of 22.4 NTU.

3.2.2.2 Elder Ditch Inflow (Site 2)

A summary of laboratory measurements conducted on inflow samples collected from the Elder Ditch inflow at Site 2 over the period from April 2009-March 2010 is given in Table 3-15. Runoff inputs at Site 2 were approximately neutral in pH, with a mean pH value of 7.54. Inflows into the pond from Site 2 were extremely well buffered, with a mean alkalinity of 147 mg/l. This value is substantially higher than alkalinity values commonly observed in urban runoff, and suggests an alkaline input within the basin area. The mean measured conductivity value of 365 μmho/cm is typical of values commonly observed in urban runoff.

TABLE 3-15

SUMMARY OF LABORATORY MEASUREMENTS CONDUCTED ON ELDER DITCH INFLOW (SITE 2) SAMPLES COLLECTED FROM THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

PARAMETER	UNITS	MEAN	RANGE OF VALUES
pH	s.u.	7.54	7.08 – 8.41
Conductivity	μmho/cm	364	168 – 571
Alkalinity	mg/l	147	64.2 – 240
NH_3	μg/l	92	<5 – 329
NO_x	μg/l	85	<5 – 346
Diss. Organic N	μg/l	471	251 – 750
Particulate N	μg/l	213	<25 – 545
Total N	μg/l	860	549 – 1284
SRP	μg/l	298	27 – 632
Diss. Organic P	μg/l	28	1 – 254
Particulate P	μg/l	169	27 – 380
Total P	μg/l	494	162 – 928
TSS	mg/l	10.7	1.6 – 31.0
Turbidity	NTU	8.3	1.7 – 25.2

Inflows from Elder Ditch at Site 2 were characterized by low levels of inorganic nitrogen species, with a mean ammonia concentration of 92 μg/l and mean NO_x concentration of 85 μg/l. The dominant nitrogen species present at this site was dissolved organic nitrogen which comprised 55% of the total nitrogen measured. Particulate nitrogen comprised approximately 25% of the total nitrogen, with the remainder contributed by ammonia and NO_x. The mean total nitrogen concentration of 860 μg/l is less than half of the nitrogen concentrations commonly observed in urban runoff.

Elevated levels of total phosphorus were observed at this inflow, particularly for SRP. The mean SRP concentration of 298 µg/l is 2-6 times higher than SRP concentrations commonly observed in urban runoff. SRP reflects the dominant phosphorus species at this site, comprising approximately 60% of the total phosphorus measured at Site 2. Approximately 34% of the phosphorus was contributed by particulate phosphorus, with the remainder by dissolved organic phosphorus. The mean total phosphorus concentration of 494 µg/l is substantially higher than phosphorus concentrations commonly observed in urban runoff.

Low to moderate levels of TSS and turbidity were observed at this site, with a mean TSS concentration of 10.7 mg/l and a mean turbidity of 8.3 NTU. These values are somewhat lower than concentrations commonly observed in urban runoff.

3.2.2.3 Elder Ditch Inflow (Site 3)

A summary of laboratory measurements conducted on Elder Ditch inflow at Site 3 over the period from April 2009-March 2010 is given in Table 3-16. Inflow collected at this site was approximately neutral in pH, with a mean pH value of 7.31, and well buffered, with a mean alkalinity of 105 mg/l. The mean conductivity value of 310 µmho/cm is typical of values commonly observed in urban runoff.

TABLE 3-16

SUMMARY OF LABORATORY MEASUREMENTS CONDUCTED ON ELDER DITCH INFLOW (SITE 3) SAMPLES COLLECTED FROM THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

PARAMETER	UNITS	MEAN	RANGE OF VALUES
pH	s.u.	7.31	6.76 – 7.76
Conductivity	µmho/cm	310	91 – 695
Alkalinity	mg/l	105	29.4 – 232
NH_3	µg/l	43	<5 – 182
NO_x	µg/l	17	<5 – 134
Diss. Organic N	µg/l	481	179 – 903
Particulate N	µg/l	157	20 – 513
Total N	µg/l	698	316 – 1088
SRP	µg/l	44	4 – 268
Diss. Organic P	µg/l	11	1 – 39
Particulate P	µg/l	30	2 – 75
Total P	µg/l	85	12 – 340
TSS	mg/l	13.3	1.0 – 128
Turbidity	NTU	6.9	0.6 – 56.6

Low levels of inorganic nitrogen species were observed at this site, with a mean ammonia concentration of 43 μg/l and a mean NO_x of 17 μg/l. Dissolved organic nitrogen was the dominant nitrogen species at this site, comprising approximately 69% of the total nitrogen measured. Particulate nitrogen contributed approximately 22% of the total nitrogen, with the remainder contributed by ammonia and NO_x. The mean total nitrogen concentration of 698 μg/l was substantially lower than nitrogen values commonly observed in urban runoff.

In contrast to the trends observed at Sites 1 and 2, relatively low levels of total phosphorus were measured at the inflow at Site 3. The largest phosphorus species at this site was SRP which contributed approximately 52% of the total phosphorus. The mean SRP concentration of 44 μg/l is typical of values commonly observed in urban runoff. Particulate phosphorus contributed approximately 35% of the total phosphorus at this site. The mean total phosphorus concentration of 85 μg/l reflects a low value for urban runoff.

Low to moderate levels of both TSS and turbidity were observed at this site, with a mean TSS concentration of 13.3 mg/l and mean turbidity of 6.9 NTU. These values are relatively low compared with concentrations commonly observed in urban runoff.

3.2.2.4 Comparison of Inflow Characteristics

A comparison of mean characteristics of significant inflows to the Elder Creek pond is given on Table 3-17. In general, the highest mean concentrations of nitrogen and phosphorus were observed at the Elder Creek inflow at Site 1, with concentrations measured at the Elder Ditch inflow at Site 2 slightly lower than values measured at Site 1. Total nitrogen concentrations measured at each of these sites are somewhat lower than values commonly observed in urban runoff, while mean total phosphorus concentrations are substantially higher. The lowest mean values for nutrients were measured at the Elder Ditch inflow at Site 3 which exhibited a slightly lower total nitrogen concentration and substantially lower total phosphorus concentrations compared with characteristics measured at Sites 1 and 2.

TABLE 3-17

COMPARISON OF MEAN CHEMICAL CHARACTERISTICS OF SIGNIFICANT INFLOWS TO THE ELDER CREEK POND

PARAMETER	UNITS	ELDER CREEK (SITE 1)	ELDER DITCH (SITE 2)	ELDER DITCH (SITE 3)
pH	s.u.	7.50	7.54	7.31
Conductivity	μmho/cm	303	364	310
Alkalinity	mg/l	125	147	105
NH_3	μg/l	95	92	43
NO_x	μg/l	157	85	17
Diss. Organic N	μg/l	448	471	481
Particulate N	μg/l	453	213	157
Total N	μg/l	1153	860	698
SRP	μg/l	237	298	44
Diss. Organic P	μg/l	32	28	11
Particulate P	μg/l	307	169	30
Total P	μg/l	576	494	85
TSS	mg/l	57.2	10.7	13.3
Turbidity	NTU	22.4	8.3	6.9

3.2.3 Bulk Precipitation

A total of 38 bulk precipitation samples was collected at the Elder Creek pond site during the 12-month monitoring program. A complete listing of the characteristics of each of the monitored bulk precipitation samples is given in Appendix B.3.

A summary of laboratory measurements conducted on bulk precipitation samples collected from the Elder Creek pond site over the period from April 2009-March 2010 is given on Table 3-18. The mean pH value of 5.63 measured in bulk precipitation is typical of pH values commonly observed in urban precipitation. Precipitation collected at the site was poorly buffered, with low conductivity values.

Measured nitrogen concentrations in the bulk precipitation samples ranged from low to elevated during the field monitoring program. Bulk precipitation collected at the site was characterized by elevated mean concentrations of ammonia, NO_x, and dissolved organic nitrogen. In general, the mean total nitrogen concentration of 1295 μg/l measured in bulk precipitation at the site is approximately 2-3 times higher than nitrogen concentrations commonly observed in precipitation from urban areas.

TABLE 3-18

SUMMARY OF LABORATORY MEASUREMENTS CONDUCTED ON BULK PRECIPITATION SAMPLES COLLECTED FROM THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

PARAMETER	UNITS	MEAN	RANGE OF VALUES
pH	s.u.	5.63	4.47 – 7.02
Conductivity	μmho/cm	22	7 – 95
Alkalinity	mg/l	4.4	0.1 – 19.8
NH_3	μg/l	464	3 – 3936
NO_x	μg/l	224	4 – 557
Diss. Organic N	μg/l	461	<25 – 3273
Particulate N	μg/l	148	<25 – 830
Total N	μg/l	1295	111 – 6917
SRP	μg/l	104	1 – 829
Diss. Organic P	μg/l	13	1 – 101
Particulate P	μg/l	22	1 – 71
Total P	μg/l	136	2 – 900
TSS	mg/l	4.2	0.1 – 23.0
Turbidity	NTU	1.7	0.6 – 6.9

Measured total phosphorus concentrations in bulk precipitation were also elevated compared with concentrations observed in other watersheds. The dominant phosphorus species was SRP which comprised approximately 76% of the total phosphorus measured at the site. The mean total phosphorus concentration of 136 μg/l in bulk precipitation is approximately 5 times higher than phosphorus concentrations normally observed in precipitation collected from urban areas.

In general, bulk precipitation collected at the Elder Creek pond site exhibited relatively low concentrations for both TSS and turbidity, with values typical of precipitation measured in other parts of Central Florida.

Graphical comparisons of the chemical characteristics of bulk precipitation samples collected at the Elder Creek pond site were developed for general parameters, nitrogen species, and phosphorus species in the form of Tukey box plots, also often called "box and whisker plots". The bottom line of the box portion of each plot represents the lower quartile, with 25% of the data points falling below this value. The upper line of the box represents the 75% upper quartile, with 25% of the data falling above this value. The **blue** horizontal line within the box represents the median value, with 50% of the data falling both above and below this value. The **red** horizontal line within the box represents the mean of the data points. The vertical lines, also known as "whiskers", represent the 5 and 95 percentiles for the data sets. Individual values which fall outside of the 5-95 percentile range, sometimes referred to as “outliers”, are indicated as **red dots**.

A statistical comparison of general parameters measured in bulk precipitation collected at the Elder Creek pond site is given on Figure 3-12. In general, bulk precipitation samples were characterized by a relatively high degree of variability for pH, alkalinity, and conductivity, with measured values for each of these parameters higher than concentrations commonly observed in bulk precipitation at other locations. In contrast, measured turbidity values in bulk precipitation were relatively low in value.

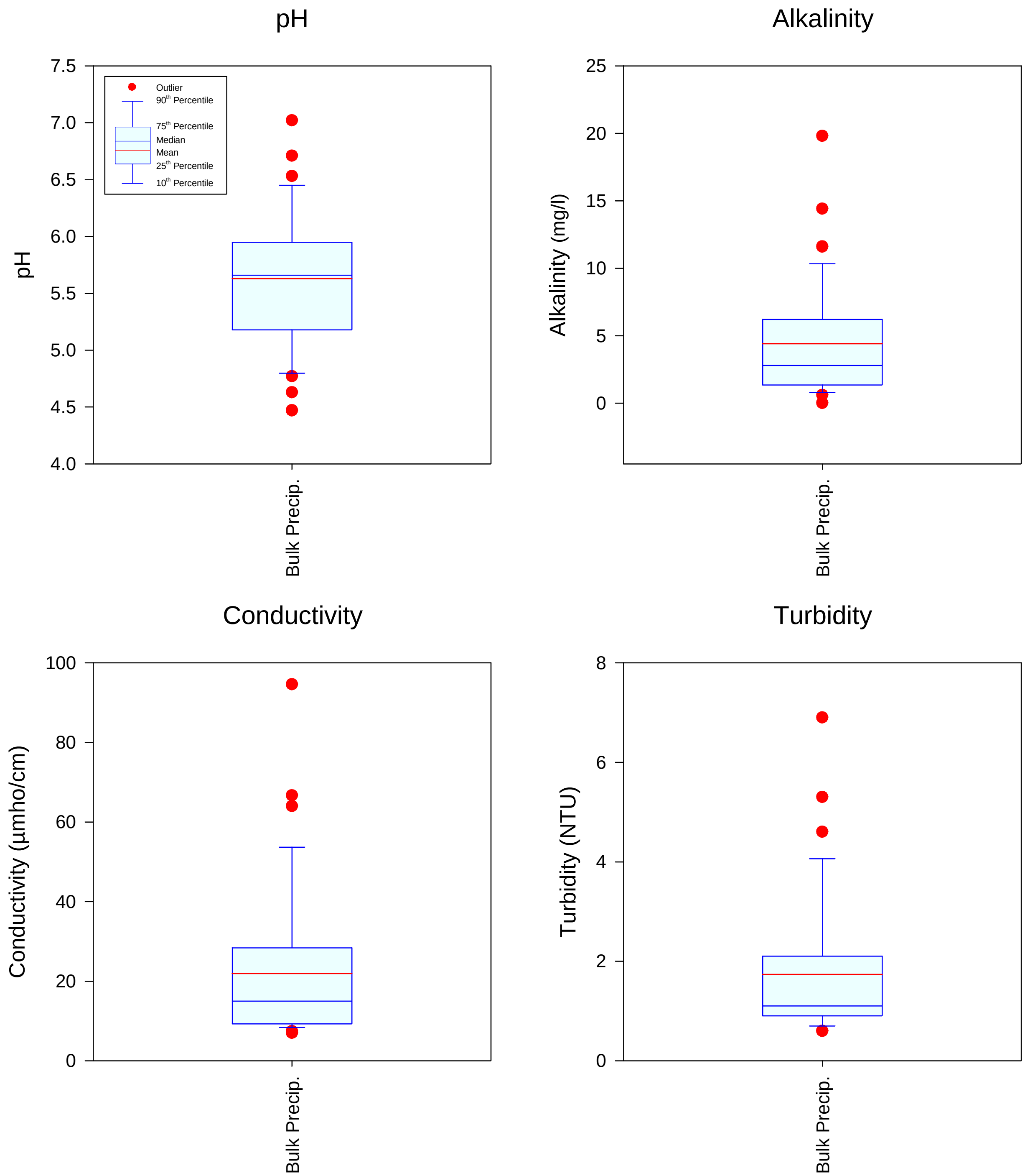


Figure 3-12. Statistical Comparison of General Parameters Measured in Bulk Precipitation at the Elder Creek Pond Site.

A statistical comparison measured in bulk precipitation at the Elder Creek site is given on Figure 3-13. The majority of measured concentrations for ammonia, NO_x, particulate nitrogen, and total nitrogen fall within a relatively narrow range of values. However, substantially elevated values for these parameters were observed during 2-3 events measured at the site.

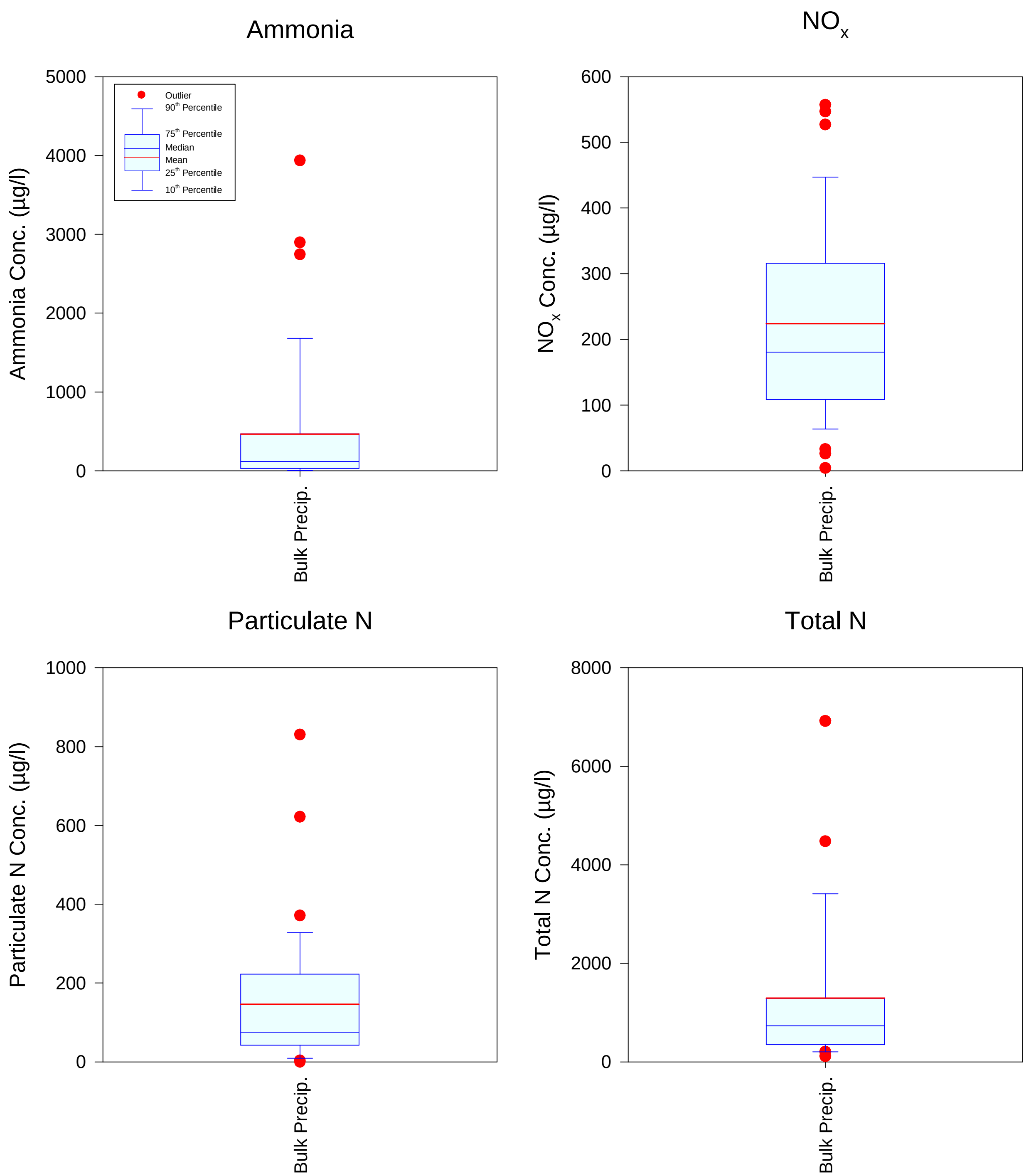


Figure 3-13. Statistical Comparison of Nitrogen Species Measured in Bulk Precipitation at the Elder Creek Pond Site.

A statistical comparison of phosphorus species measured in bulk precipitation at the Elder Creek site is given on Figure 3-14. In general, the majority of collected samples exhibited measured concentrations for SRP, dissolved organic phosphorus, particulate phosphorus, and total phosphorus which fell within a relatively narrow range and were relatively low in value. However, similar to the trend observed for nitrogen species, elevated levels of phosphorus species were also observed during 2-3 of the monitored bulk precipitation events.

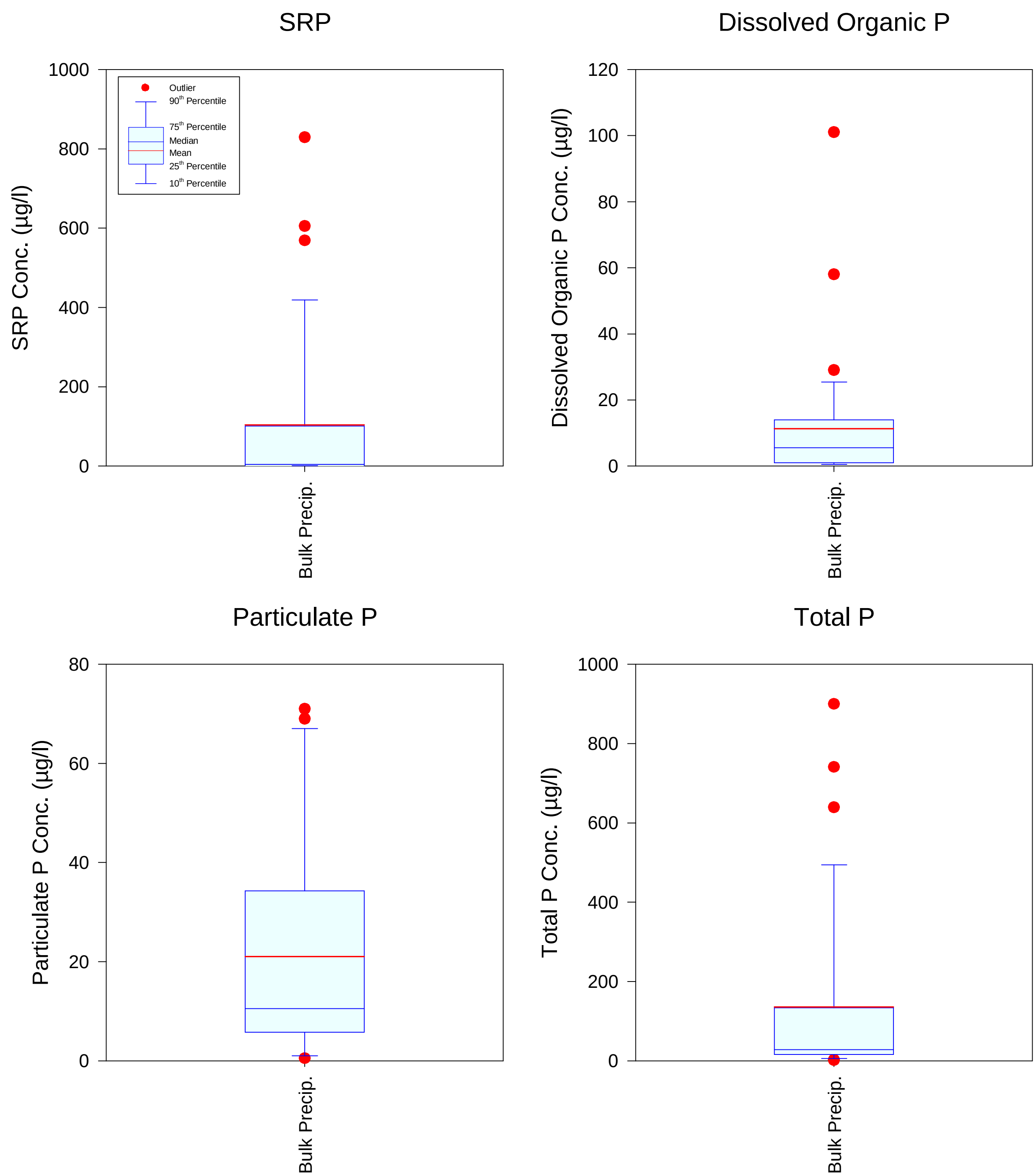


Figure 3-14. Statistical Comparison of Phosphorus Species Measured in Bulk Precipitation at the Elder Creek Pond Site.

3.2.4 Pond Outflow

A total of 56 flow-weighted composite outflow samples were collected at the Elder Creek pond site during the 12-month monitoring program. A complete listing of the characteristics of each of the monitored outflow samples is given in Appendix B.2. A summary of laboratory measurements conducted on outflow samples collected at the Elder Creek pond site is given on Table 3-19. The collected outflow samples exhibited pH values ranging from approximately neutral to alkaline, with an overall mean pH value of 7.62. Discharges from the pond were well buffered, with a mean alkalinity of 110 mg/l and conductivity values similar to those observed in other wet detention ponds.

TABLE 3-19

SUMMARY OF LABORATORY MEASUREMENTS CONDUCTED ON POND OUTFLOW SAMPLES COLLECTED FROM THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

PARAMETER	UNITS	MEAN	RANGE OF VALUES
pH	s.u.	7.62	6.67 – 9.88
Conductivity	μmho/cm	282	180 – 353
Alkalinity	mg/l	110	66.2 – 151
NH_3	μg/l	93	<5 – 582
NO_x	μg/l	51	<5 – 427
Diss. Organic N	μg/l	507	124 – 1022
Particulate N	μg/l	489	31 – 1408
Total N	μg/l	1140	455 – 2523
SRP	μg/l	177	5 – 355
Diss. Organic P	μg/l	22	1 – 247
Particulate P	μg/l	94	3 – 312
Total P	μg/l	293	57 – 519
TSS	mg/l	13.1	0.8 – 51.7
Turbidity	NTU	7.4	1.0 – 30.1

Discharges from the pond were characterized by relatively low levels of inorganic nitrogen species, with a mean ammonia concentration of 93 μg/l and mean NO_x concentration of 51 μg/l. Dissolved organic nitrogen appears to be the dominant nitrogen species in discharges from the pond, with the mean value of 507 μg/l comprising 44% of the nitrogen in the discharge. Particulate nitrogen comprised approximately 43% of the total nitrogen discharged from the pond.

Relatively elevated levels of SRP and total phosphorus were observed in discharges from the wet detention pond. The mean SRP concentration of 177 μg/l is substantially higher than SRP concentrations commonly observed in the discharges from wet detention ponds which often range from 1-10 μg/l. The mean measured values for dissolved organic phosphorus and particulate phosphorus are also substantially higher than concentrations commonly observed in pond discharges. The mean total phosphorus concentration of 293 μg/l in the pond discharge is more than 10 times higher than total phosphorus concentrations commonly observed in discharges from wet detention ponds.

In general, relatively low levels of turbidity were observed in discharges from the pond, with a mean of 7.4 NTU. Low to moderate levels of TSS were also observed in pond discharges, with a mean of 13.1 mg/l.

3.2.5 Comparison of Inflow and Outflow Characteristics

A statistical comparison of general parameters measured in significant inflows and outflow at the Elder Creek pond site during the 12-month monitoring program is given on Figure 3-15. Variability in measured pH values appear to be very similar between the three monitored inflow tributary sites. Although the pond outflow appears to have a similar median and mean value, discharges from the pond are characterized by periodically elevated pH values which are presumably related to the high rate of algal productivity occurring within the pond. A similar degree of variability also appears to exist for measured alkalinity concentrations at the three tributary inflow sites. In contrast, a relatively narrow range of variability was observed for measured alkalinity values at the outflow. A similar pattern appears to exist for conductivity, with a similar degree of variability observed at each of the three inflow monitoring sites. In contrast, conductivity measurements at the outflow appear to be relatively consistent and fall within a relatively narrow range. Measured turbidity values at both the inflow and outflow monitoring sites were typically low in value although a few substantially elevated turbidity values were monitored at inflow Sites 1 and 3.

A statistical comparison of nitrogen species measured in the tributary inflows and pond outflow samples is given on Figure 3-16. In general, measured concentrations of ammonia, particulate nitrogen, and total nitrogen appear to be similar between inflow Site 1 and the outflow from the pond. This relationship would be expected since inflow Site 1 represents the largest inflow into the pond on an annual basis. Measured nitrogen concentrations at inflow Sites 2 and 3 appear to be lower in value than observed in either Site 1 or the pond outfall.

A statistical comparison of phosphorus species measured in the tributary inflows and pond outflow samples is given on Figure 3-17. In general, measured concentrations of SRP, organic phosphorus, particulate phosphorus, and total phosphorus in the outfall appear to be lower in value than inflow concentrations measured at Sites 1 and 2, but higher in value than phosphorus concentrations measured at inflow Site 3. The variability in measured phosphorus concentrations appears to be lower at the outfall than observed at inflow Site 1 which represents the primary inflow into the pond.

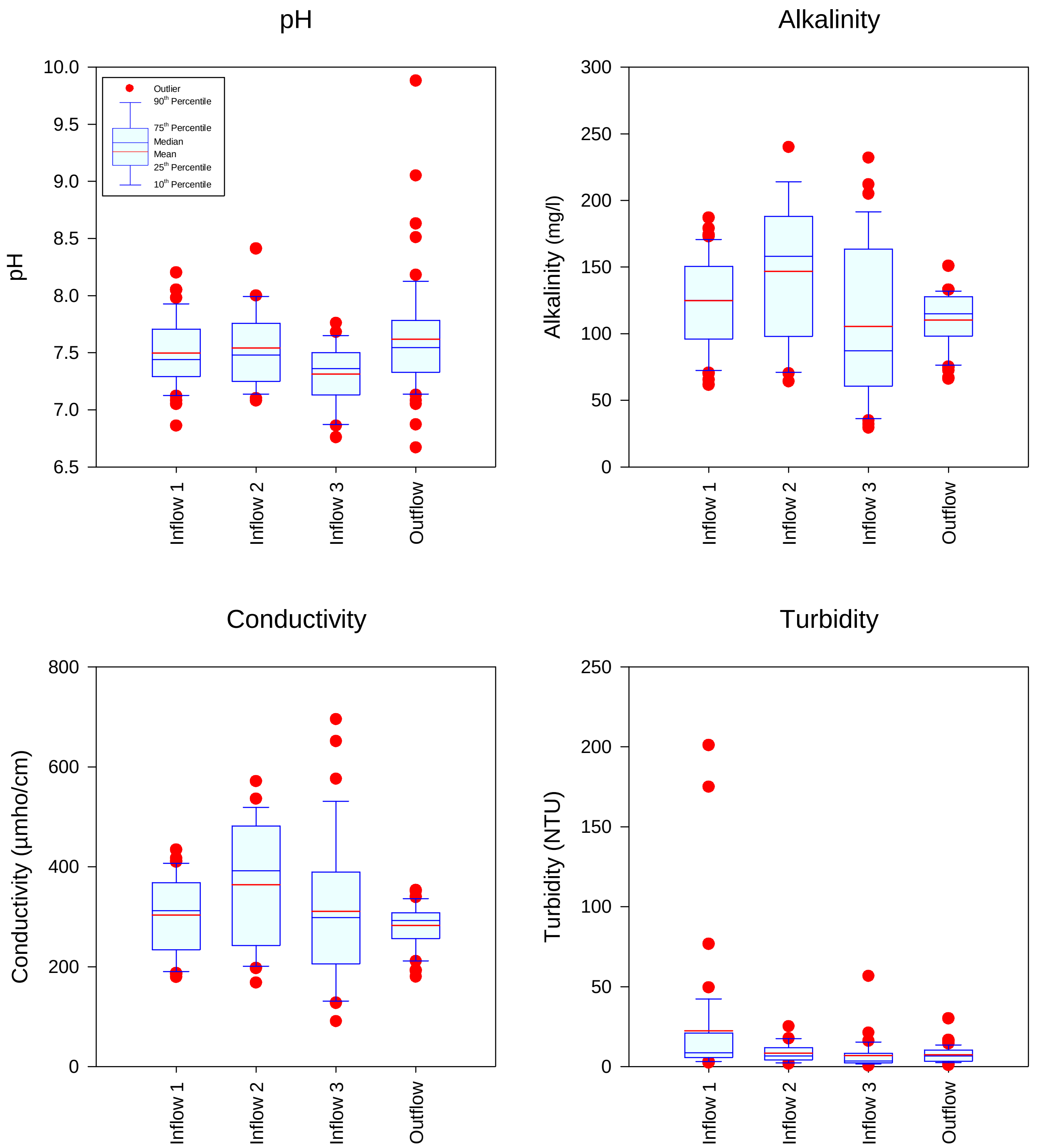


Figure 3-15. Statistical Comparison of General Parameters Measured in Pond Inflows and Outflows.

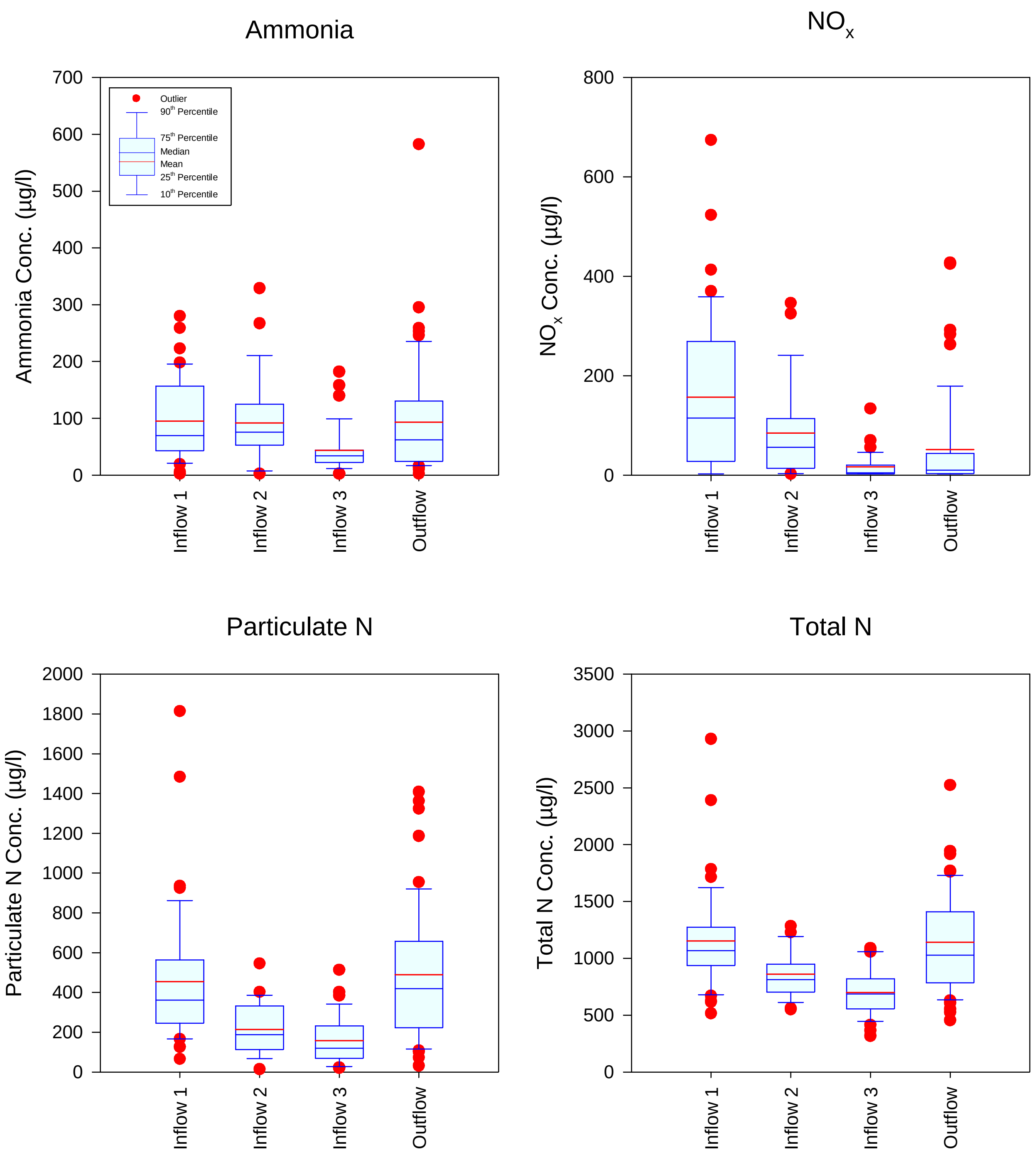


Figure 3-16. Statistical Comparison of Nitrogen Species Measured in Pond Inflows and Outflows.

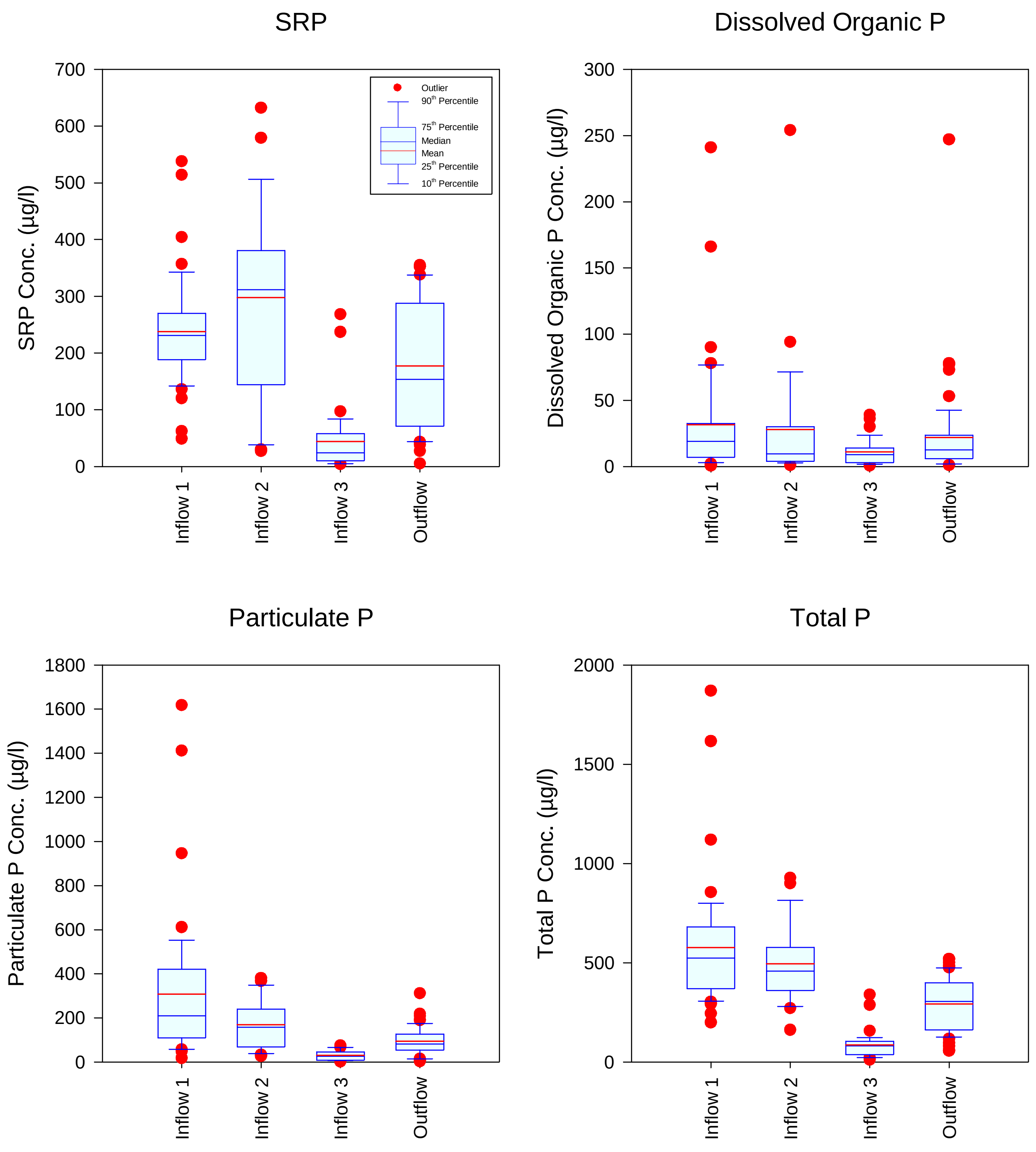


Figure 3-17. Statistical Comparison of Phosphorus Species Measured in Pond Inflows and Outflows.

3.3 Mass Inputs and Losses

Mass loadings were calculated for each of the evaluated inputs and losses at the Elder Creek pond over the 12-month monitoring program from April 2009-March 2010. Mass inputs into the pond were calculated for inflows at Sites 1-3, and the Elder Road inflows, as well as bulk precipitation. Mass losses were calculated for discharges through the pond outfall structure.

Due to the large degree of variability in the hydrologic budget for the pond, mass inputs and losses were calculated on a monthly basis. Information on monthly hydrologic inputs and losses was obtained from the information provided in Tables 3-8 and 3-12. Estimates of monthly water quality characteristics were calculated by averaging the water quality data summarized in Appendix B for inflow samples, outflow samples, and bulk precipitation on a monthly basis. Samples with collection periods that extended into two months are assumed to be associated with the month representing the largest proportion of the time interval. If samples were not collected at a site during a monthly period for which measurable flow was recorded, the mean concentration for a given parameter is calculated as the mean of concentrations measured during the preceding and following monthly periods.

A summary of mean monthly concentrations of measured parameters in pond inflow samples collected at Sites 1-3 is given on Table 3-20. Mean monthly concentrations are provided for species of nitrogen and phosphorus, as well as TSS. In general, a high degree of variability is apparent in monthly concentrations measured at each of the three inflow sites, although a distinct seasonal trend is not apparent. Mean monthly concentrations for measured parameters are not provided for Site 2 during October since no flow was observed at Site 2 during that month.

Mean monthly concentrations for TSS and species of nitrogen and phosphorus in bulk precipitation are given on Table 3-21. Nutrient concentrations in bulk precipitation appear to be substantially higher during October-January compared with values measured during the remaining portions of the year. No explanation is apparent for these elevated concentrations, although it is interesting to note that elevated levels of nutrients were also observed during this period at some of the monitored inflow sites.

A summary of mean monthly concentrations for TSS and species of nitrogen and phosphorus in pond outflow samples is given on Table 3-22. Discharges from the pond appear to be much more consistent in value than observed in the pond inflows due to the attenuation effects provided by the pond. In general, concentrations for many parameters in the outflow appear to be higher during rainy season conditions compared with months associated with low rainfall.

Estimates of monthly mass inputs and losses at the Elder Creek pond were calculated for TSS and species of nitrogen and phosphorus during the 12-month monitoring program. These monthly mass loadings were calculated by multiplying the mean monthly concentrations for the inputs and losses (summarized in Tables 3-20 to 3-22) times the measured monthly hydrologic inputs or losses for the pond (summarized in Tables 3-8 and 3-12). Chemical characteristics of inflows through the small Elder Road inflows are assumed to be similar to characteristics measured at the Elder Ditch inflow at Site 3. The calculated monthly mass loadings were then summed to provide an estimate of annual mass loadings for each of these evaluated inputs and losses.

TABLE 3-20

MEAN MONTHLY CONCENTRATIONS FOR MEASURED PARAMETERS IN POND INFLOW SAMPLES

SITE	MONTH	NH_3 (µg/l)	NO_x (µg/l)	DISS ORG N (µg/l)	PART N (µg/l)	TOTAL N (µg/l)	SRP (µg/l)	DISS ORG P (µg/l)	PART P (µg/l)	TOTAL P (µg/l)	TSS (mg/l)
1	April	146	143	440	688	1417	229	48	236	512	37
	May	120	130	577	529	1355	288	25	345	658	80
	June	118	191	377	146	831	227	131	85	442	5
	July	23	149	461	450	1083	199	17	539	755	79
	August	105	202	306	355	967	274	8	193	475	21
	September	77	40	485	629	1231	199	13	255	467	64
	October	60	21	674	1056	1811	208	18	384	609	59
	November	43	3	862	1483	2391	216	23	513	752	54
	December	61	82	333	333	808	241	19	292	553	32
	January	80	222	324	408	1033	314	34	248	595	52
	February	129	345	500	158	1132	208	33	283	524	39
	March	119	130	492	431	1172	170	59	353	582	123
2	April	81	66	410	104	661	404	23	72	499	1.9
	May	28	71	629	226	955	310	15	74	400	7.3
	June	75	179	431	182	867	254	73	222	549	14.9
	July	63	6	525	257	850	452	56	165	672	13.1
	August	83	110	320	172	685	302	4	96	401	7.0
	September	157	45	441	545	1188	490	17	296	803	9.4
	October	--[1]	--	--	--	--	--	--	--	--	--
	November	159	51	504	376	1089	419	11	244	674	12.8
	December	126	3	268	221	618	122	48	206	376	10.6
	January	160	56	567	206	989	348	5	192	545	16.3
	February	227	160	386	317	1089	65	12	331	407	12.0
	March	99	52	494	187	831	202	25	239	466	16.2
3	April	29	10	497	199	735	59	15	45	119	24.2
	May	29	8	534	149	720	105	7	31	143	4.6
	June	12	9	647	204	872	31	9	23	63	7.0
	July	25	26	436	165	652	52	13	38	103	13.9
	August	137	25	332	197	691	111	2	31	144	4.0
	September	51	3	683	74	809	22	8	20	50	2.0
	October	49	12	442	84	587	25	10	19	54	4.8
	November	58	25	439	89	612	27	8	15	50	5.0
	December	48	22	201	94	364	28	12	18	58	7.7
	January	68	38	437	94	636	29	7	11	47	5.1
	February	37	14	521	110	682	24	11	25	60	11.9
	March	30	11	460	249	750	13	24	58	95	43.8

1. No measured inflow during this month

TABLE 3-21

MEAN MONTHLY CONCENTRATIONS FOR MEASURED PARAMETERS IN BULK PRECIPITATION

MONTH	NH_3 (µg/l)	NO_x (µg/l)	DISS ORG N (µg/l)	PART N (µg/l)	TOTAL N (µg/l)	SRP (µg/l)	DISS ORG P (µg/l)	PART P (µg/l)	TOTAL P (µg/l)	TSS (mg/l)
April	532	350	454	238	1574	91	20	47	158	10.9
May	92	132	161	153	538	1	7	15	23	2.0
June	49	176	275	429	929	102	6	38	146	7.1
July	10	117	72	54	253	1	3	7	11	2.8
August	32	219	65	43	359	1	4	10	15	0.9
September	38	124	1143	55	1360	34	3	16	53	1.9
October	1987	335	1687	130	4139	431	12	33	476	3.8
November	3936	547	2230	204	6917	829	21	50	900	5.7
December	1200	318	741	147	2406	218	33	36	287	6.1
January	1238	276	1050	129	2693	344	4	17	365	2.9
February	279	238	145	96	758	44	20	8	72	1.5
March	155	204	205	75	639	17	14	9	40	5.1

TABLE 3-22

MEAN MONTHLY CONCENTRATIONS FOR MEASURED PARAMETERS IN POND OUTFLOW

MONTH	NH_3 (µg/l)	NO_x (µg/l)	DISS ORG N (µg/l)	PART N (µg/l)	TOTAL N (µg/l)	SRP (µg/l)	DISS ORG P (µg/l)	PART P (µg/l)	TOTAL P (µg/l)	TSS (mg/l)
April	94	34	563	726	1417	88	13	116	217	14.9
May	133	13	695	447	1288	143	13	79	235	10.4
June	19	76	428	316	839	294	8	74	376	12.1
July	75	121	566	702	1464	341	23	87	451	10.6
August	278	96	420	435	1229	214	13	149	376	11.1
September	138	104	514	364	1120	313	42	97	452	9.6
October	39	9	651	646	1345	212	22	152	386	15.7
November	75	94	507	1156	1832	195	100	115	410	27.2
December	88	35	434	401	958	89	14	94	197	13.2
January	97	35	397	114	643	125	10	24	159	11.8
February	47	34	374	392	847	56	12	80	148	20.1
March	28	8	384	324	744	61	19	67	147	8.3

A summary of the calculated mass inputs and losses at the Elder Creek pond from April 2009-March 2010 is given on Table 3-23. The values summarized in this table reflect the sum of the calculated monthly loadings discussed previously. Site 1 is clearly the dominant source of loadings to the Elder Creek pond, contributing the vast majority of mass loadings for the evaluated parameters. Substantially smaller loadings are contributed by inflow Sites 2 and 3, as well as the Elder Road drainage system. A graphical comparison of inputs of total nitrogen and total phosphorus to the Elder Creek pond is given on Figure 3-18.

TABLE 3-23

CALCULATED MASS INPUTS AND LOSSES AT THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

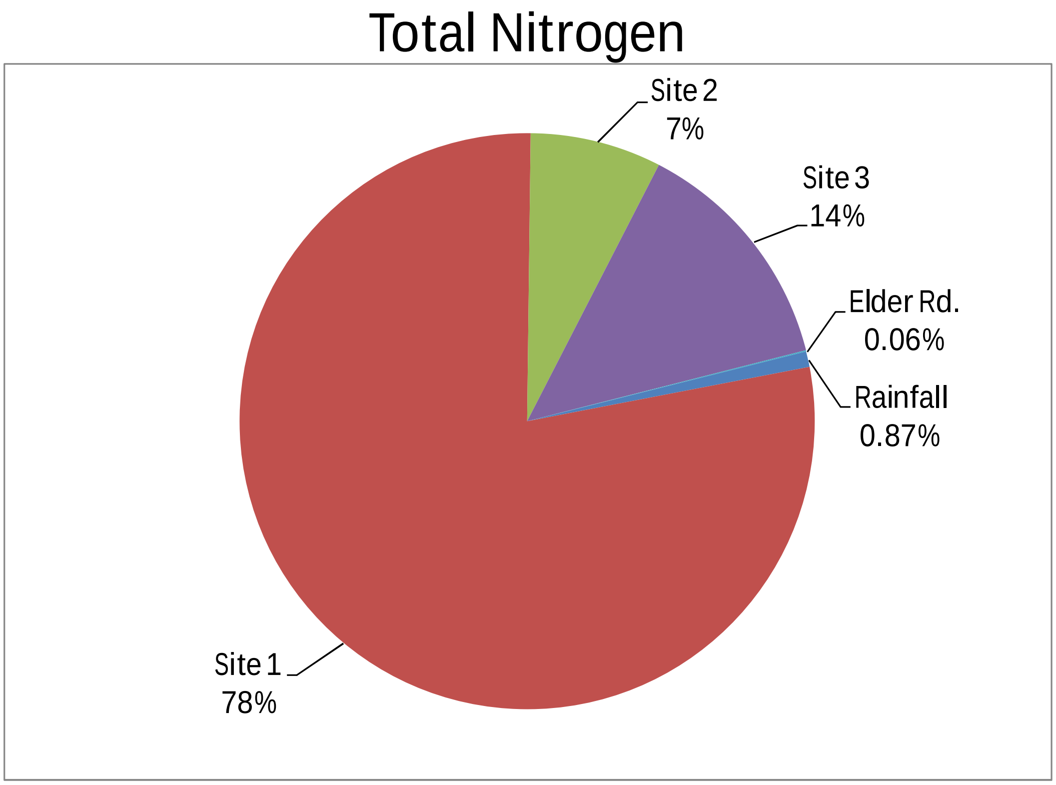
PARAMETER	MASS INPUTS (kg)					OUTFALL LOSSES (kg)
	Site 1	Site 2	Site 3	Elder Rd.	Precip.	
NH_3	115	6.5	16.4	0.08	14.1	224
NO_x	153	11.1	3.9	0.02	11.9	56.5
Diss. Organic N	512	72.5	151	0.70	16.0	884
Particulate N	487	28.8	49.4	0.25	7.8	652
Total N	1,266	119	220	1.05	49.6	1816
SRP	280	40.6	29.3	0.12	3.1	247
Diss. Organic P	27.6	2.1	0.7	0.01	0.5	21.0
Particulate P	310	12.7	9.4	0.05	0.9	139
Total P	618	55.4	40.9	0.18	4.5	407
TSS	64,007	1,057	1,876	14.4	200	16,418

3.4 Pond Performance Efficiency

Mass removal efficiencies were calculated for TSS and each of the monitored species of nitrogen and phosphorus. Mass removal efficiencies were calculated on an annual basis using the following equation:

$$Mass\ \ Removal\ =\ \frac{Input\ Mass - Outflow\ Mass}{Input\ Mass}\ x\ 100$$

A summary of mass inputs and losses and mass removal efficiencies for the Elder Creek pond is given on Table 3-24. Mass inputs into the pond reflect the sum of the mass inputs summarized on Table 3-23, while mass losses from the pond reflect the outfall losses summarized on Table 3-23.



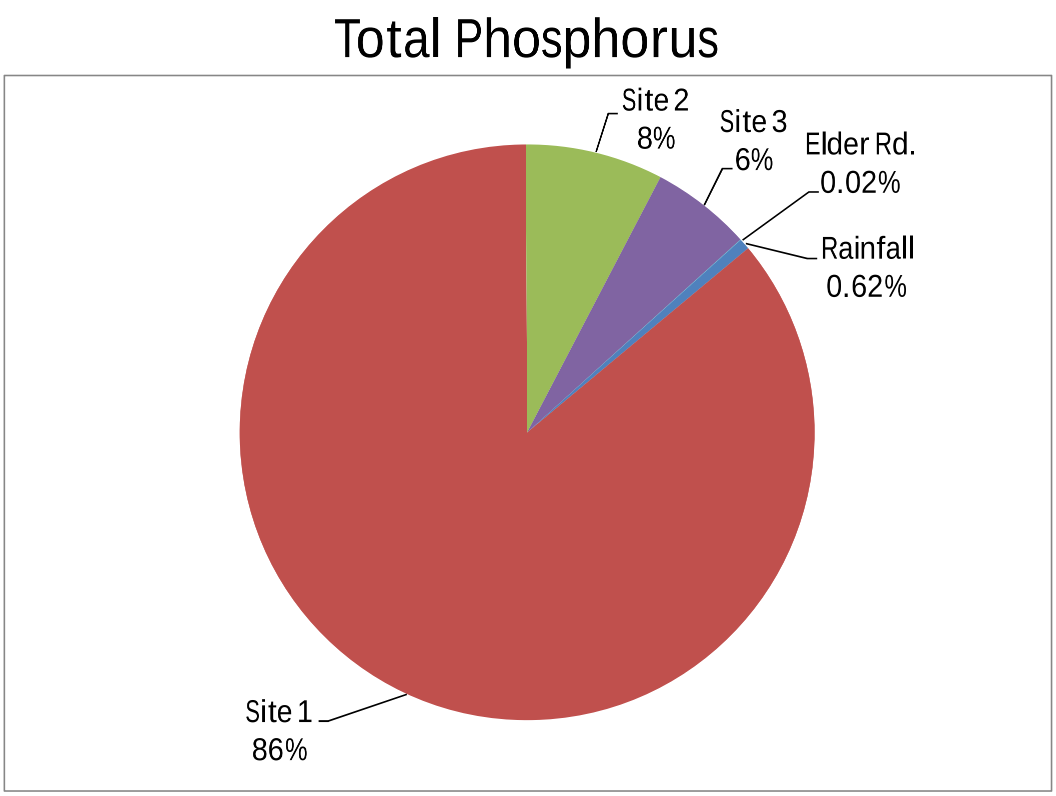


Figure 3-18. Comparison of Inputs of Total Nitrogen and Total Phosphorus to the Elder Creek Pond.

TABLE 3-24

ESTIMATED MASS REMOVAL EFFICIENCY FOR THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

PARAMETER	TOTAL MASS INPUTS (kg)	OUTFALL LOSSES (kg)	REMOVAL EFFICIENCY (%)
NH_3	152	224	-48
NO_x	180	56.5	69
Diss. Organic N	751	884	-18
Particulate N	573	652	-14
Total N	1,656	1816	-10
SRP	354	247	30
Diss. Organic P	30.7	21.0	32
Particulate P	333	139	58
Total P	719	408	43
TSS	67,060	16,418	76

In general, the pond exhibited a poor removal efficiency for the majority of nitrogen species. A net export of ammonia was observed from the pond, although mass loadings of NO_x were reduced by approximately 69%. Discharges of both dissolved organic nitrogen and particulate nitrogen exceeded the combined input mass for these parameters, with an 18% increase in dissolved organic nitrogen and a 14% increase in particulate nitrogen during migration through the pond. Overall, the Elder Creek pond received approximately 1656 kg of total nitrogen and exported 1816 kg, resulting in a mass increase of approximately 10% within the pond.

In contrast, positive removal efficiencies were obtained for all monitored phosphorus species. A 30% load reduction was achieved for SRP, with a 32% load reduction for dissolved organic phosphorus and a 58% load reduction for particulate phosphorus. Overall, the pond received approximately 719 kg of total phosphorus while discharging 408 kg, a removal efficiency of approximately 43%. This value is slightly lower than removal efficiencies commonly observed for total phosphorus in wet detention ponds.

In general, the Elder Creek pond provided a relatively good removal efficiency for TSS. During the 12-month monitoring program, approximately 67,060 kg of TSS entered the Elder Creek pond from the evaluated inputs, with 16,418 kg of TSS released through the outfall structure. This results in an estimated removal efficiency of approximately 76% for TSS. This value is also slightly lower than TSS removal efficiencies commonly observed in wet detention ponds.

3.5 Pollutant Removal Costs

Estimates of mass removal costs were generated for total phosphorus and TSS in the Elder Creek stormwater treatment facility. Annual mass removal costs were not calculated for total nitrogen since no removal of total nitrogen occurred within the pond.

A summary of design and construction costs for the Elder Creek stormwater treatment facility is given on Table 3-25, based upon information provided by Seminole County. Design fees for the wet detention pond were $249,263, with a construction cost of $3,171,160. The total cost for the facility, including both design and construction, is $3,420,423.

TABLE 3-25

SUMMARY OF DESIGN AND CONSTRUCTION COSTS FOR THE ELDER CREEK STORMWATER TREATMENT FACILITY

PARAMETER	COST[1] ($)
Design	249,263
Construction	3,171,160
TOTAL:	**3,420,423**

1. Information provided by Seminole County

Mass removal costs for the Elder Creek stormwater treatment facility are calculated based upon a 20-year lifecycle analysis. Calculated 20-year present worth costs for the Elder Creek facility are summarized on Table 3-26. Present worth costs were calculated using the relationship summarized below:

PW = Construction Cost + 20-Year O&M Cost (P/A, 4%, 20-years)

The present worth cost analysis assumes an interest rate of 4% and a 20-year lifecycle analysis. This analysis assumes an annual maintenance cost of $20,000 for periodic mowing and general upkeep of the facility. Based upon this analysis, the 20-year present worth cost for the Elder Creek stormwater treatment facility is $3,692,223.

TABLE 3-26

CALCULATED 20-YEAR PRESENT WORTH COST FOR THE ELDER CREEK STORMWATER TREATMENT FACILITY

PARAMETER	COST[1] ($)
Design and Construction	3,420,423
Annual Maintenance	20,000
20-year Present Worth Cost[1]	3,692,223

1. Based on a 20-year analysis cycle and an interest rate of 4%

Estimates of pollutant removal costs for total phosphorus and TSS were calculated by dividing the 20-year present worth costs (summarized in Table 3-26) by the estimated total mass load reductions for total phosphorus and TSS over the 20-year analysis period. A summary of this analysis is given in Table 3-27. Estimates of annual mass load reductions for total phosphorus and TSS were obtained from Table 3-24 by subtracting the annual outfall losses from the estimated total annual inputs for these parameters. The estimated annual load reduction for total phosphorus is approximately 311 kg/yr, with a load reduction of 50,751 kg/yr for TSS. The estimated mass removal of total phosphorus and TSS over the 20-year lifecycle analysis are then divided into the 20-year present worth cost to obtain estimates of load reduction costs.

TABLE 3-27

CALCULATED POLLUTANT REMOVAL COSTS FOR THE ELDER CREEK STORMWATER TREATMENT FACILITY

PARAMETER	MASS LOAD REDUCTION (kg)		PRESENT WORTH COST PER kg REMOVED
	Annual	20-year Cycle	
Total Phosphorus	311	6,220	$ 594
TSS	50,642	1,015,020	$ 3.65

A summary of estimated mass removal costs for total phosphorus and TSS is given in the final column of Table 3-27. The estimated phosphorus removal cost for the Elder Creek pond is approximately $594/kg removed, with a TSS load reduction cost of approximately $3.65/kg removed. These values are similar to mass removal costs commonly observed in wet detention systems.

3.6 Discussion

The results of the field monitoring program conducted at the Elder Creek stormwater facility site indicate that the pond achieved relatively good removal efficiencies for total phosphorus and TSS but no measurable removal for total nitrogen. As indicated on Table 3-17, concentrations of inorganic nitrogen species measured in the pond inflows were relatively low in value. In addition, the TN/TP ratio for water within the pond, based upon the characteristics of pond outflow samples summarized in Table 3-19, was approximately 4:1, which suggests nitrogen-limiting conditions and favors the growth of cyanobacteria. Evidence of cyanobacteria algal blooms was observed within the pond on multiple occasions. Photographs of typical water quality conditions within the Elder Creek pond are given on Figure 3-19, and cyanobacteria populations are clearly evident in these photographs. Cyanobacteria have the ability to fix atmospheric nitrogen during conditions of low nitrogen availability, such as those present within the Elder Creek pond. Evidence of nitrogen fixation within the pond is apparent in the estimated mass removal efficiencies summarized in Table 3-24 which indicate an increase in total nitrogen within the pond of approximately 9%.

a. Floating filamentous algae

b. Blue-green algal bloom

Figure 3-19. Photographs of Typical Water Quality Conditions within the Elder Creek Pond.

Extremely elevated levels of phosphorus species were observed in the inflows to the pond, with concentrations several times higher than commonly observed in urban runoff. The observed mass removal efficiency of 44% for total phosphorus in the Elder Creek pond is somewhat lower than phosphorus removals commonly observed in wet detention ponds which typically range from 60-80%. The lack of additional phosphorus removal is likely related to the nitrogen-limited conditions within the pond which limited the growth of phytoplankton which is one of the primary removal mechanisms available in wet detention ponds. In addition, a large percentage of the total phosphorus was present as readily available SRP, and the available nitrogen sources appear to be inadequate to support the level of algal productivity which could potentially occur at these extremely elevated SRP values.

Mass removal efficiencies within the Elder Creek pond appear to have been impacted by an imbalance in input concentrations of total nitrogen and total phosphorus with a relatively low input concentration for total nitrogen and an elevated input concentration for total phosphorus. Nitrogen-limited conditions appear to occur within the pond which create conditions favorable for growth of cyanobacteria and nitrogen fixation.

3.7 Quality Assurance

Supplemental samples were collected during the field monitoring program for quality assurance purposes. These supplemental samples include equipment blanks and duplicate samples, along with supplemental laboratory analyses to evaluate precision and accuracy of the collected data. A summary of QA data collected as part of this project is given in Appendix D.

SECTION 4

SUMMARY

A field monitoring program was conducted by ERD from April 2009-March 2010 to evaluate the performance efficiency of the Elder Creek wet detention pond facility. The wet detention pond is designed to provide treatment for a 234-acre drainage basin with a treatment volume equivalent to 1 inch over the contributing basin area. The Elder Creek pond contains both open water and expanded littoral zone areas to provide a combination of treatment alternatives.

Automatic samplers with integral flow meters were installed at three significant inflows as well as the pond outfall to provide a continuous record of hydraulic inputs and losses and to collect runoff and discharge samples in a flow-weighted mode. A recording rain gauge and evaporimeter were also installed at the monitoring site. A water level recorder was installed inside the pond to assist in evaluating changes in water surface elevations.

Continuous inflow and outflow hydrographs were recorded at the Elder Creek pond at 10-minute intervals from April 1, 2009-March 31, 2010. Over this period, runoff inputs into the pond contributed approximately 94% of the hydrologic inputs, with 4% contributed by direct rainfall, and 2% by groundwater inflow. Approximately 95% of the hydrologic inputs exited the pond through the outfall structure, with 4% lost due to evaporation and 1% lost to groundwater. The mean residence time in the pond during the study period was approximately 23 days.

Over the 12-month monitoring program, a total of 110 inflow samples was collected, with 56 pond outfall samples, and 38 bulk precipitation samples. A total of 34 vertical field profiles was also collected near the center of the pond. During the monitoring program, the pond was found to be relatively well mixed, with no evidence of significant thermal stratification. Adequate levels of dissolved oxygen were maintained within the pond with the exception of a few measurements collected near the sediment-water interface during summer and fall conditions.

Inflow into the pond was characterized by low concentrations of total nitrogen, with substantially elevated levels of total phosphorus. Over the 12-month monitoring program, the pond exhibited a net increase of 10% in total nitrogen, with a removal of 43% for total phosphorus and 76% for TSS. The lack of nitrogen removal and the lower than anticipated removal efficiency for total phosphorus are thought to be related to the nitrogen-limited conditions within the pond which favor the growth of nitrogen-fixing cyanobacteria. The unavailability of inorganic nitrogen species is directly related to the lower than anticipated removal efficiency for total phosphorus since algal production is one of the dominant mechanisms for removal of total phosphorus in wet detention ponds.

Estimated pollutant removal costs for the Elder Creek stormwater treatment facility are approximately \$594/kg of total phosphorus removed and \$3.65/kg of TSS removed. These values are typical of pollutant removal costs commonly associated with wet detention ponds.

APPENDICES

APPENDIX A

SELECTED CONSTRUCTION PLANS FOR THE ELDER CREEK STORMWATER FACILITY

JOB FILE #	SHEET No.
6116-32655	1

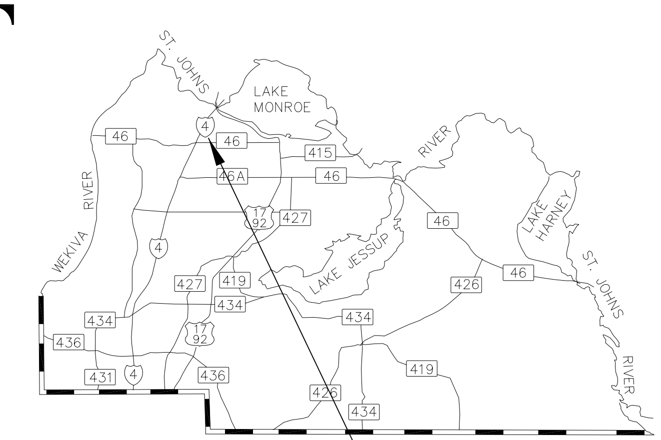
SEMINOLE COUNTY
PUBLIC WORKS DEPARTMENT
STORMWATER DIVISION

THIS CONTRACT PLAN SET INCLUDES:

REGRADING PLANS
EROSION CONTROL MEASURES

PUBLIC WORKS DIRECTOR
W. Gary Johnson, P.E.

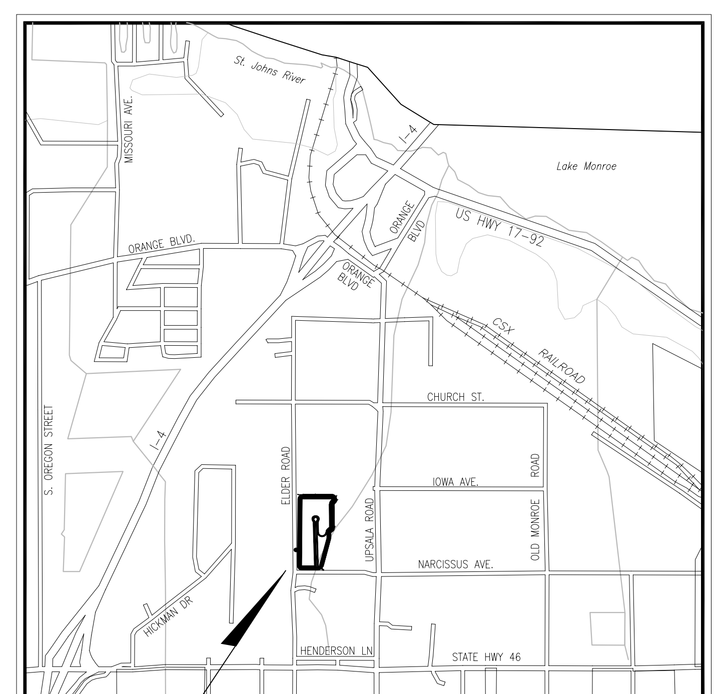
STORMWATER MANAGER
Mark Flomerfelt, P.E.



INDEX OF PLANS

ELDER CREEK
STORMWATER FACILITY

THESE PLANS HAVE BEEN PREPARED IN ACCORDANCE WITH AND ARE GOVERNED BY THE STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION DESIGN STANDARDS (BOOKLET DATED JANUARY 2004)



LOCATION MAP
SECTION 21, TOWNSHIP 19 S, RANGE 30 E

GOVERNING SPECIFICATIONS: STATE OF FLORIDA, DEPARTMENT OF TRANSPORTATION, STANDARD SPECIFICATIONS, DATED 2004 AND SUPPLEMENTS THERETO IF NOTED IN THE SPECIAL TECHNICAL PROVISIONS FOR THIS PROJECT.

ATTENTION IS DIRECTED TO THE FACT THAT THESE PLANS MAY HAVE BEEN CHANGED IN SIZE BY REPRODUCTION. THIS MUST BE CONSIDERED WHEN OBTAINING SCALED DATA.

PREPARED BY: CAMP DRESSER & MCKEE INC.
2301 MAITLAND CENTER PARKWAY, SUITE 300
MAITLAND, FLORIDA 32751
PHONE: (407) 660-2552
FAX: (407) 875-1161
FL COA NO: EB-0000020

CONSTRUCTION PLANS
OCTOBER, 2005

PLANS APPROVED BY ______________________
Mario F. Chavez, P.E. # 50713 DATE

CONSTRUCTION COMPLETION DATE ______________________

FIELD VERIFIED BY ______________________

LENGTH OF PROJECT			SIDE STREETS		TOTAL	
	LIN.FT.	MILES	LIN.FT.	MILES	LIN.FT.	MILES
DITCH REGRADING	–	–	—	—	–	–
	—	—	—	—	—	—
NET LENGTH OF PROJECT	–	–	—	—	–	–
EXCEPTIONS	–	–	—	—	–	–
GROSS LENGTH OF PROJECT	–	–	—	—	–	–

REVISIONS		
BY	DATE	DESCRIPTION

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10/27/05 10:44:35
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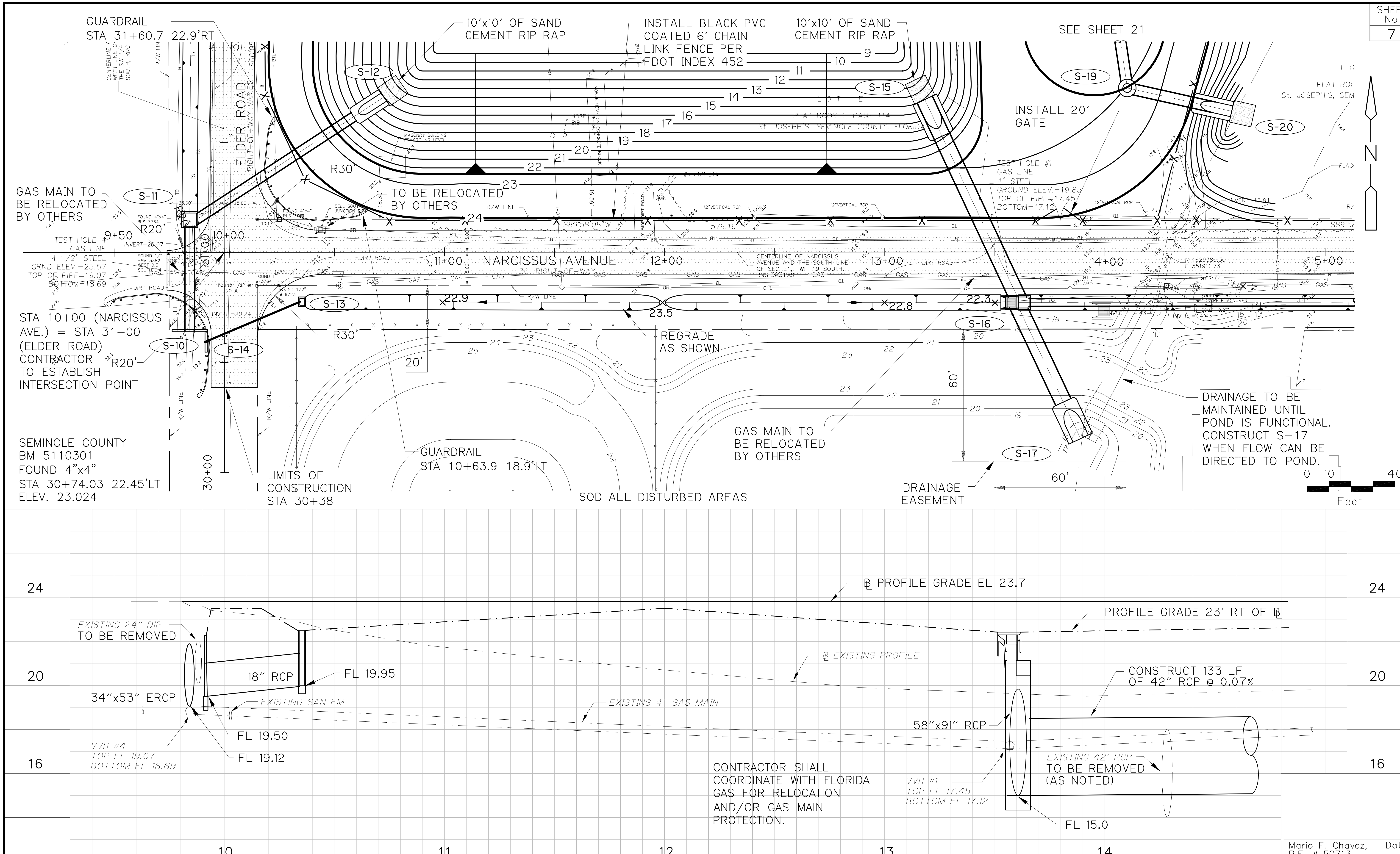

Mario F. Chavez, P.E. # 50713 Date

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. CHAVEZ
DRAWN BY: J. WILLIAMS
SHEET CHK'D BY: B. MACK
CROSS CHK'D BY: J. HICKLE
APPROVED BY: M. CHAVEZ
DATE: OCTOBER 2005

CDM Camp Dresser & McKee Inc.
consulting engineering construction operations
2301 Maitland Center Parkway
Suite 300
Maitland, Florida 32751
Tel: 407 660-2552
Fax: 407 875-1161
Fl COA No. EB-0000020

SEMINOLE COUNTY FLORIDA

ELDER CREEK STORMWATER FACILITY

PLAN AND PROFILE NARCISSUS AVENUE STA 10+00 TO STA 15+00

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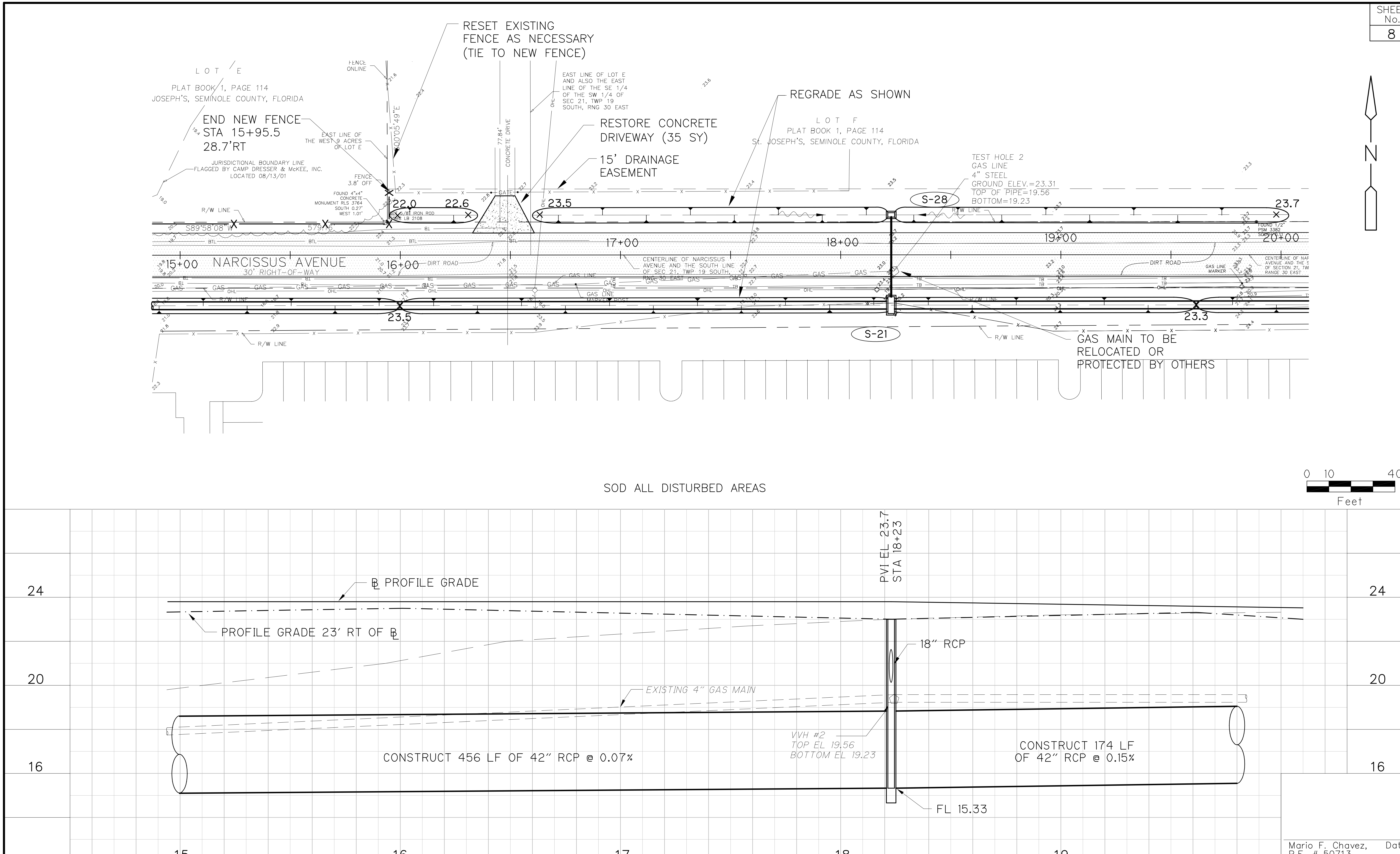

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SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

PLAN AND PROFILE
NARCISSUS AVENUE
STA 15+00 TO STA 20+00

SHEET No. 9

ID	STA	OFFSET	SIDE	ELEVATION
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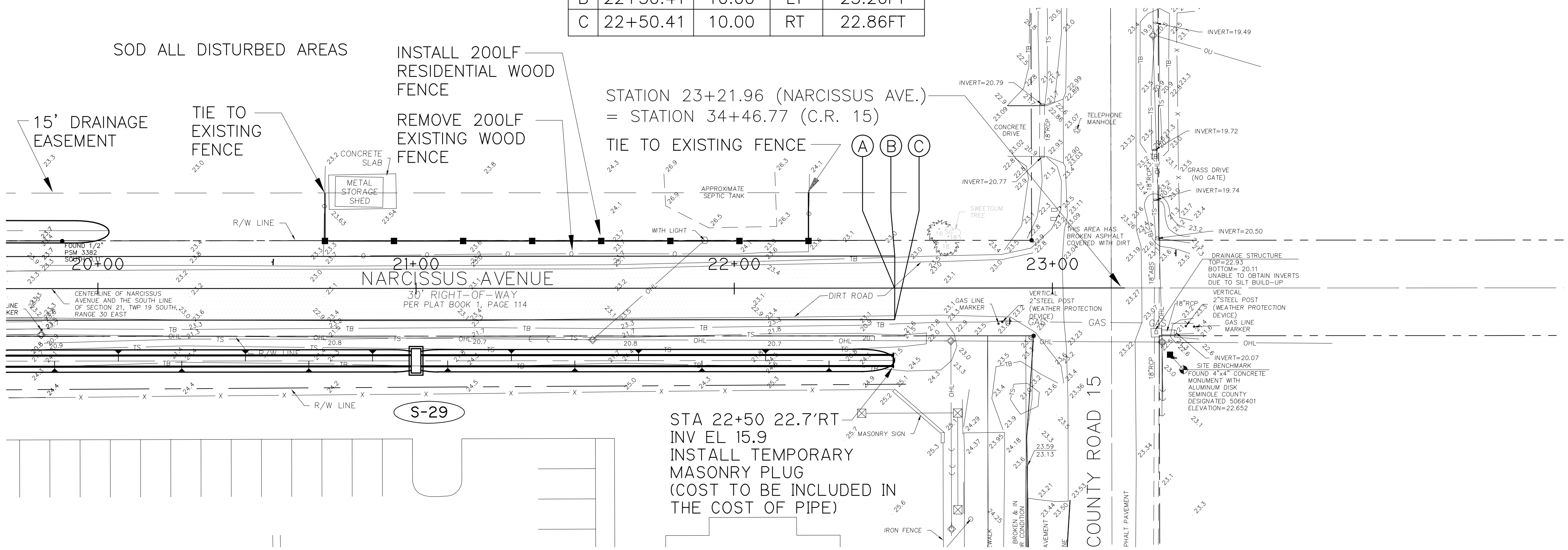
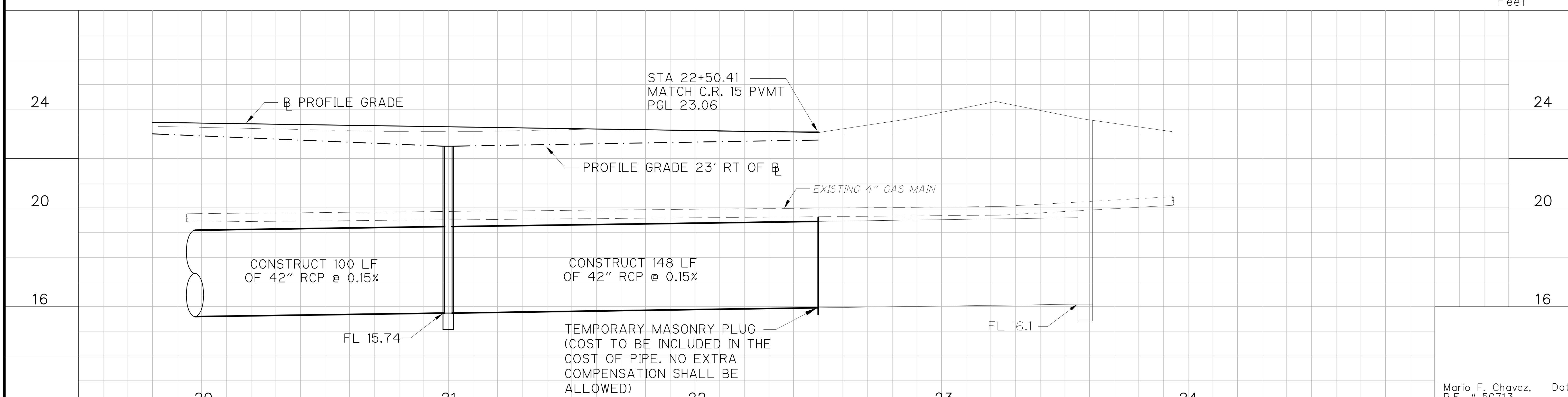
B	22+50.41	10.00	LT	23.26FT
C	22+50.41	10.00	RT	22.86FT





Mario F. Chavez, P.E. # 50713 Date

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Camp Dresser & McKee Inc.
2301 Maitland Center Parkway
Suite 300
Maitland, Florida 32751
Tel: 407 660-2552
Fax: 407 875-1161
Fl COA No. EB-0000020

SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

PLAN AND PROFILE
NARCISSUS AVENUE
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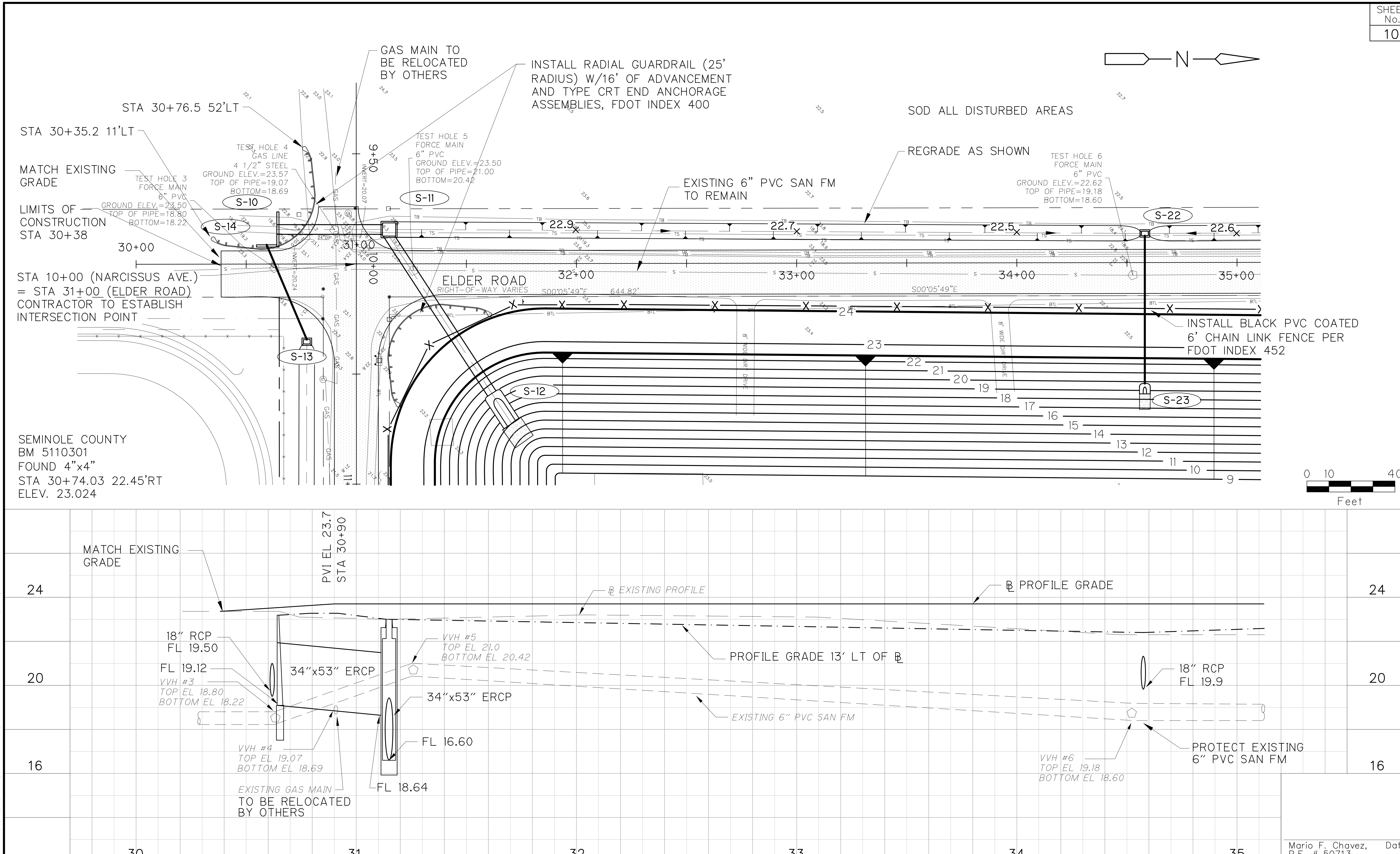

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2301 Maitland Center Parkway
Suite 300
Maitland, Florida 32751
Tel: 407 660-2552
Fax: 407 875-1161
FI COA No. EB-0000020

SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

PLAN AND PROFILE
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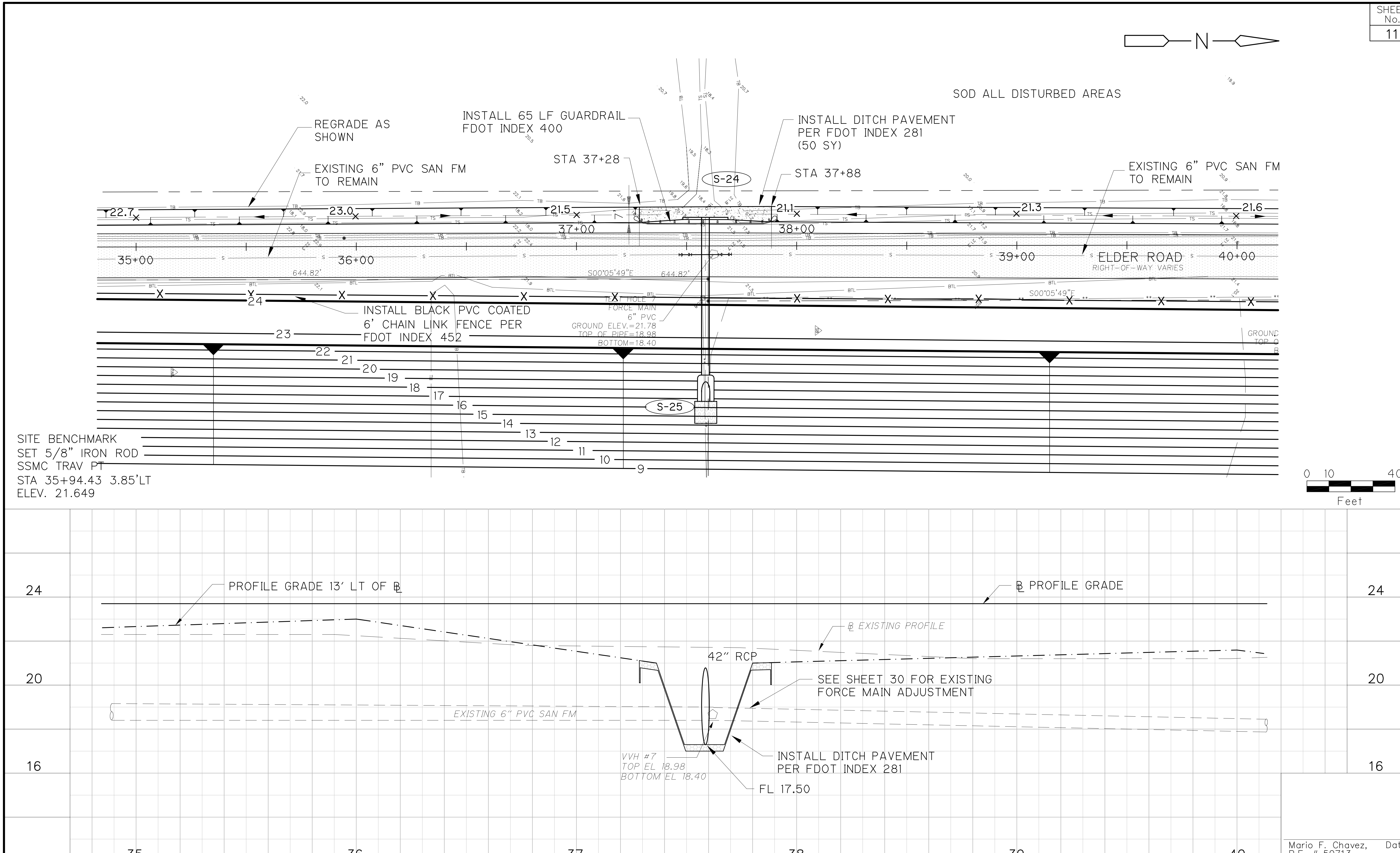

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Camp Dresser & McKee Inc.
2301 Maitland Center Parkway
Suite 300
Maitland, Florida 32751
Tel: 407 660-2552
Fax: 407 875-1161
FI COA No. EB-0000020

SEMINOLE COUNTY
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ELDER CREEK
STORMWATER FACILITY

PLAN AND PROFILE
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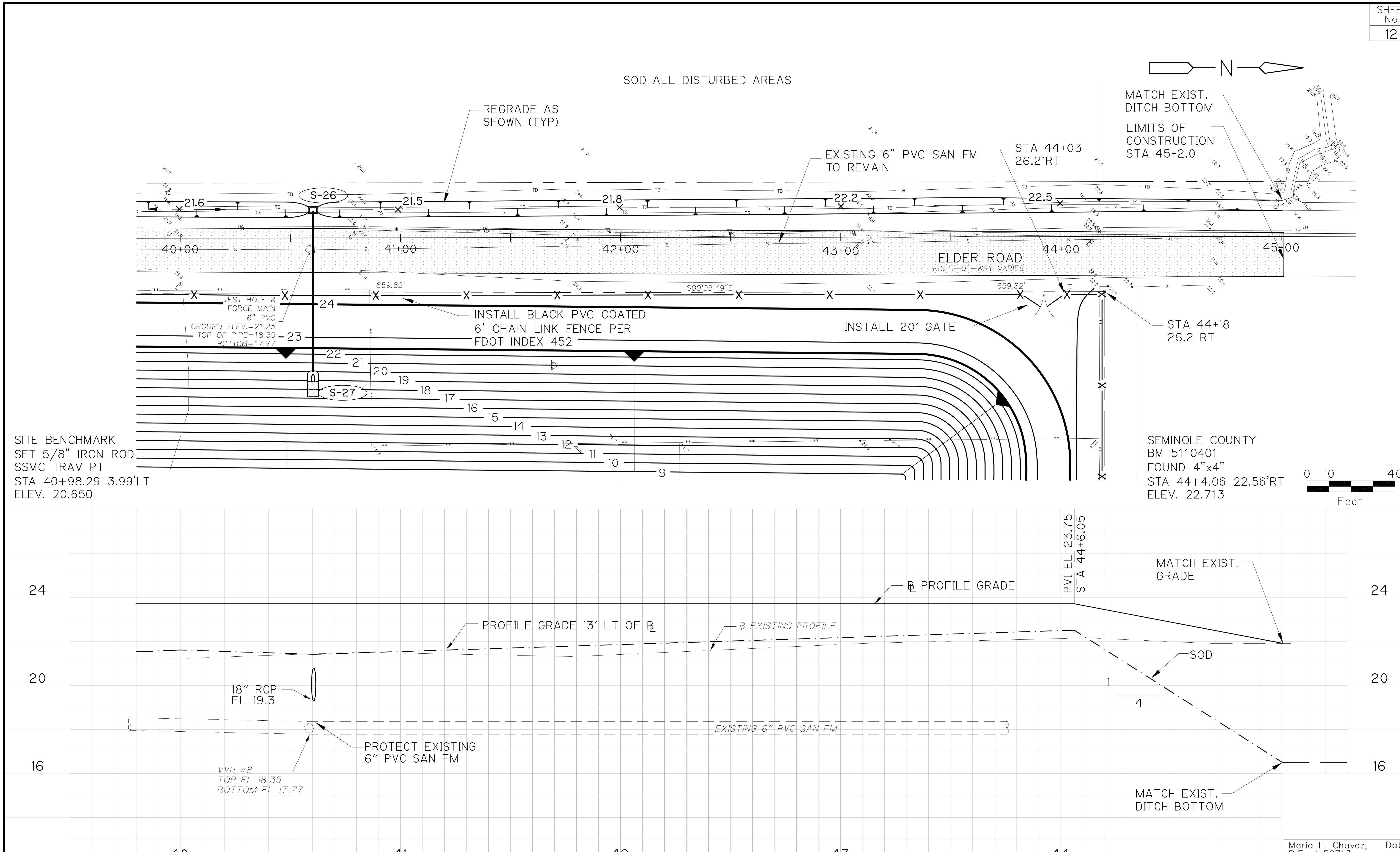

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2301 Maitland Center Parkway
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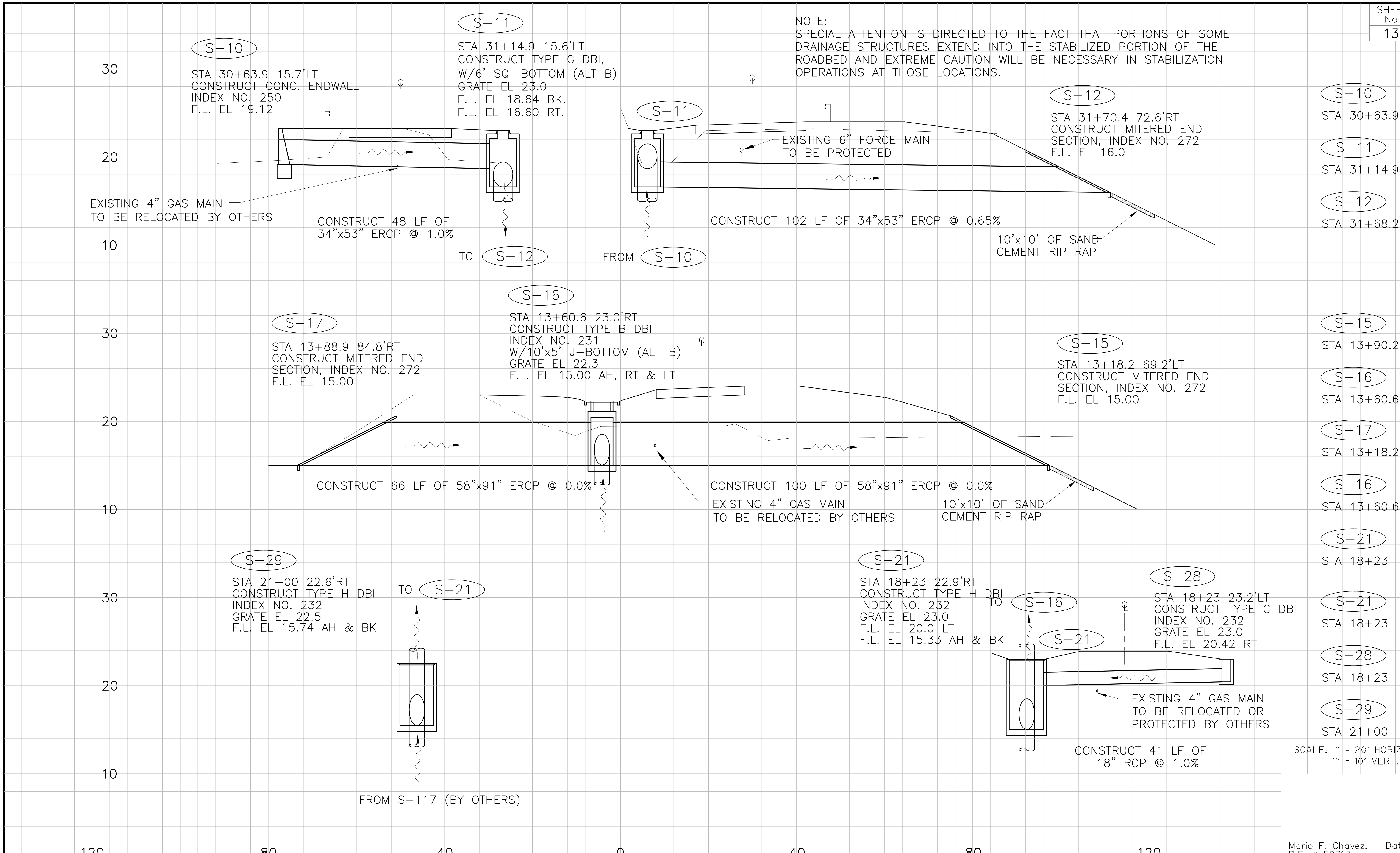
Tel: 407 660-2552
Fax: 407 875-1161
Fl COA No. EB-0000020

SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

PLAN AND PROFILE
ELDER ROAD
STA 40+00 TO STA 45+00



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Suite 300
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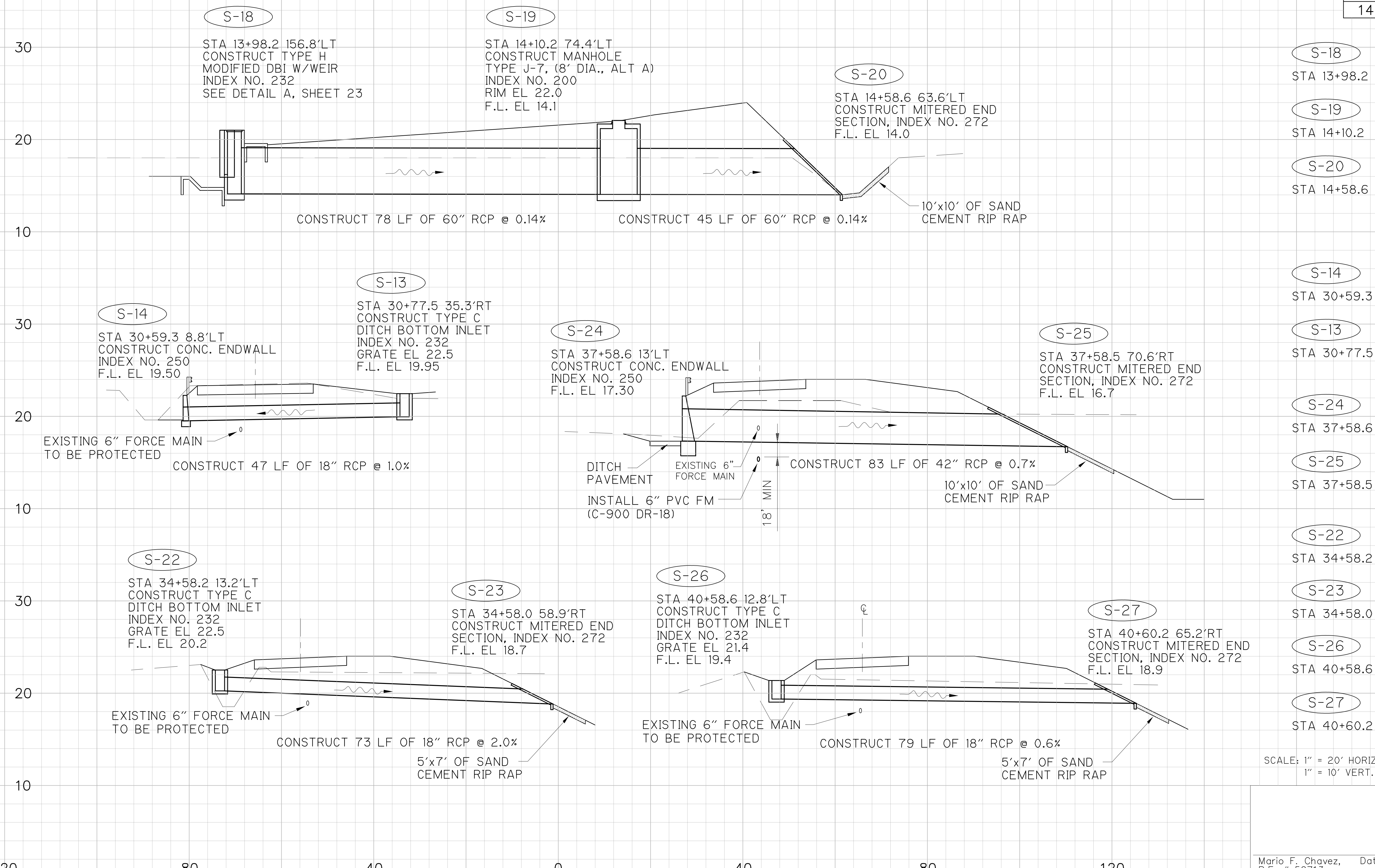
Tel: 407 660-2552
Fax: 407 875-1161
Fl COA No. EB-0000020

SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

DRAINAGE STRUCTURES



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1" = 10' VERT.

Mario F. Chavez, Date
P.E. # 50713

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2301 Maitland Center Parkway
Suite 300
Maitland, Florida 32751
Tel: 407 660-2552
Fax: 407 875-1161
FI COA No. EB-0000020

SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

DRAINAGE STRUCTURES

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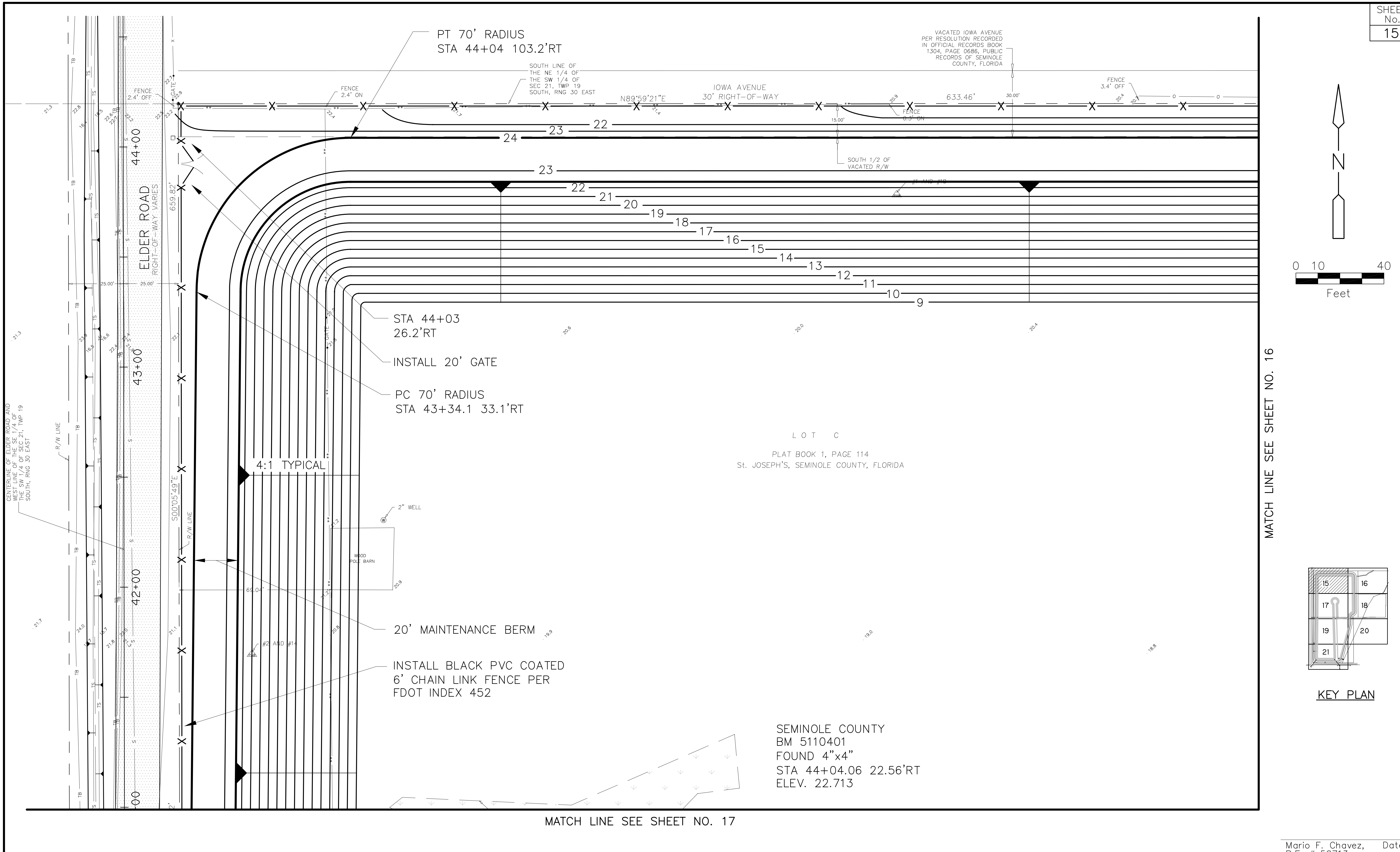

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Mario F. Chavez, P.E. # 50713 Date

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CDM Camp Dresser & McKee Inc.
consulting engineering construction operations
2301 Maitland Center Parkway
Suite 300
Maitland, Florida 32751
Tel: 407 660-2552
Fax: 407 875-1161
Fl COA No. EB-0000020

SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

POND
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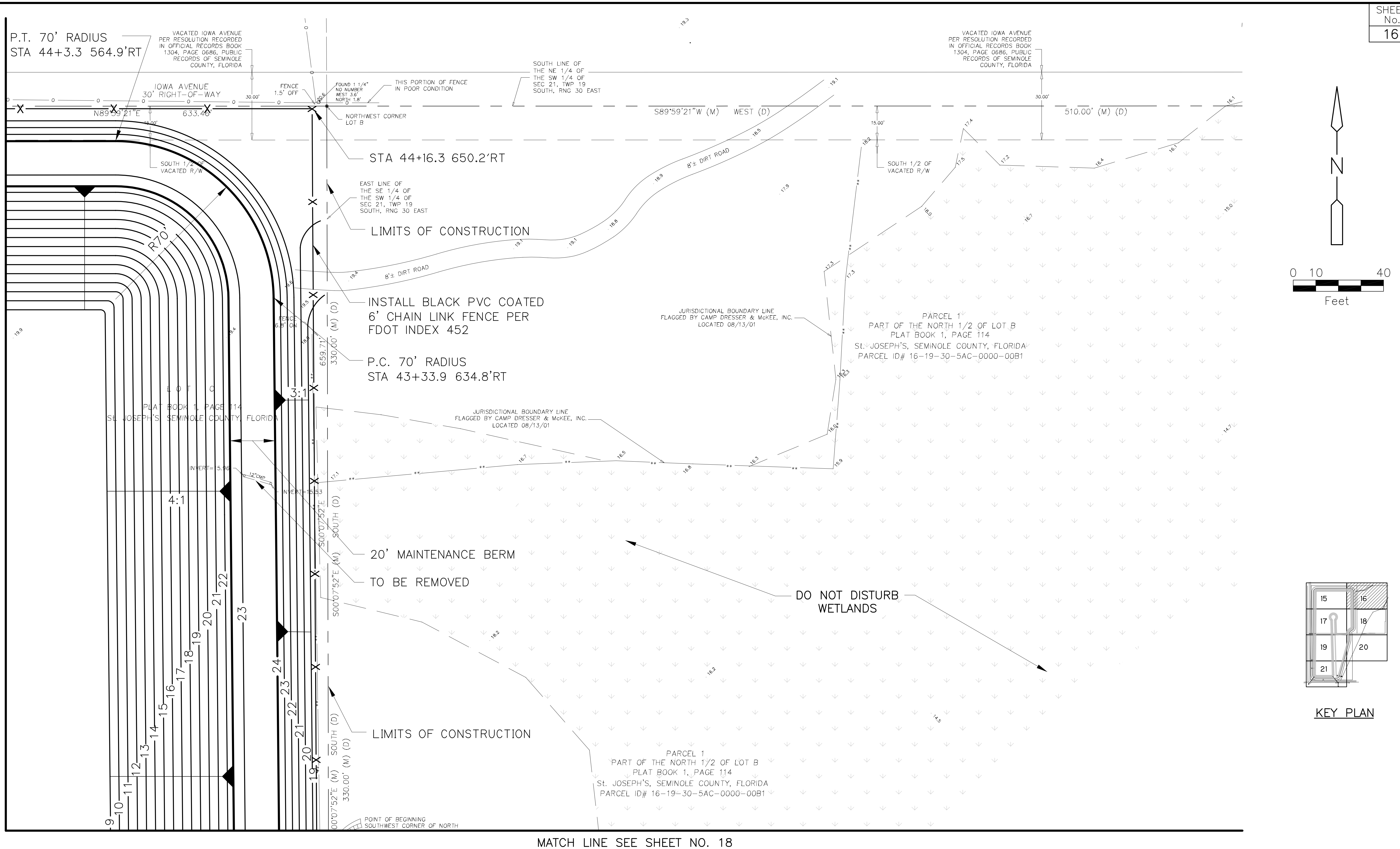

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2301 Maitland Center Parkway
Suite 300
Maitland, Florida 32751
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Fax: 407 875-1161
Fl COA No. EB-0000020

SEMINOLE COUNTY
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ELDER CREEK
STORMWATER FACILITY

POND
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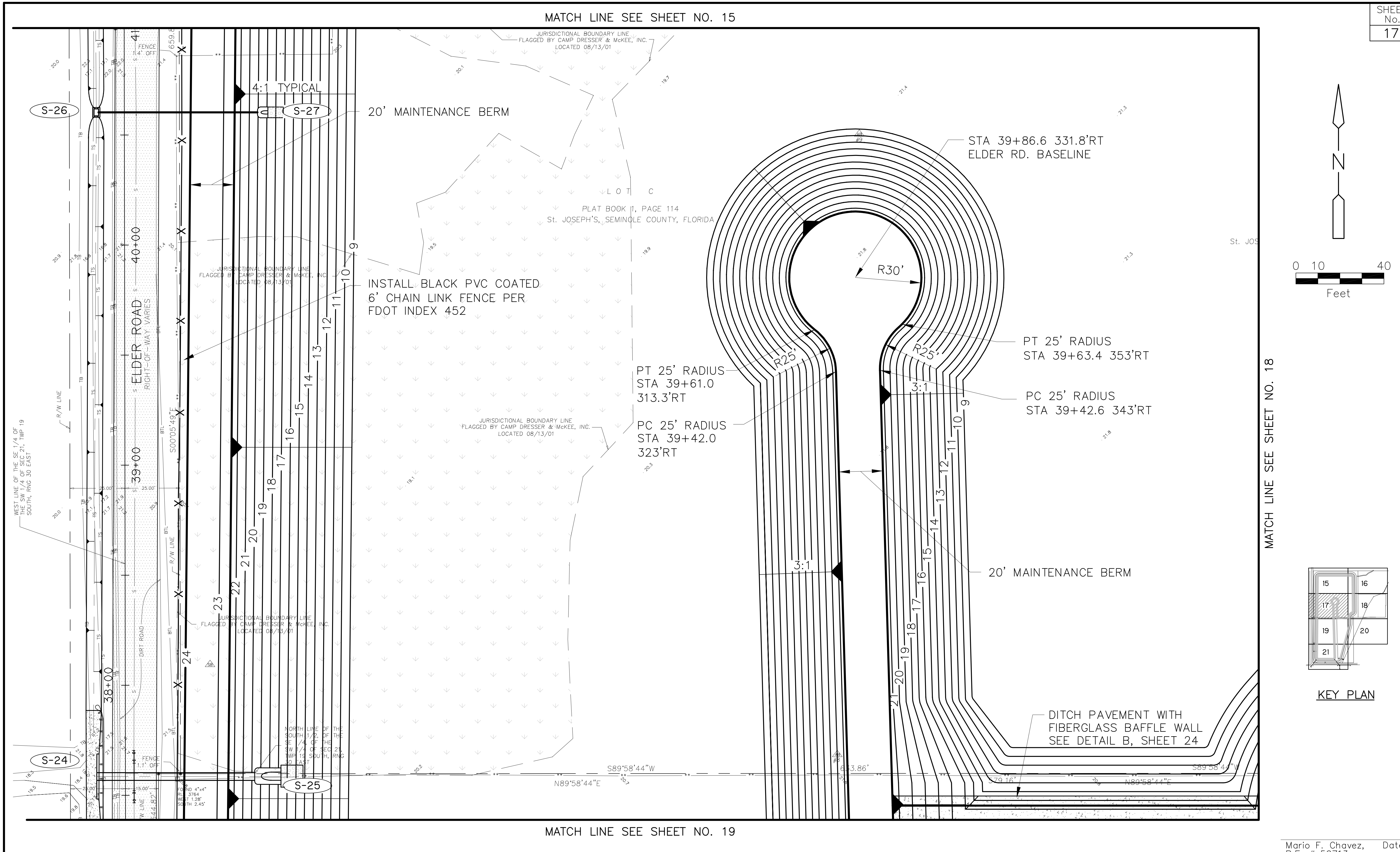

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2301 Maitland Center Parkway
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Tel: 407 660-2552
Fax: 407 875-1161
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SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

POND
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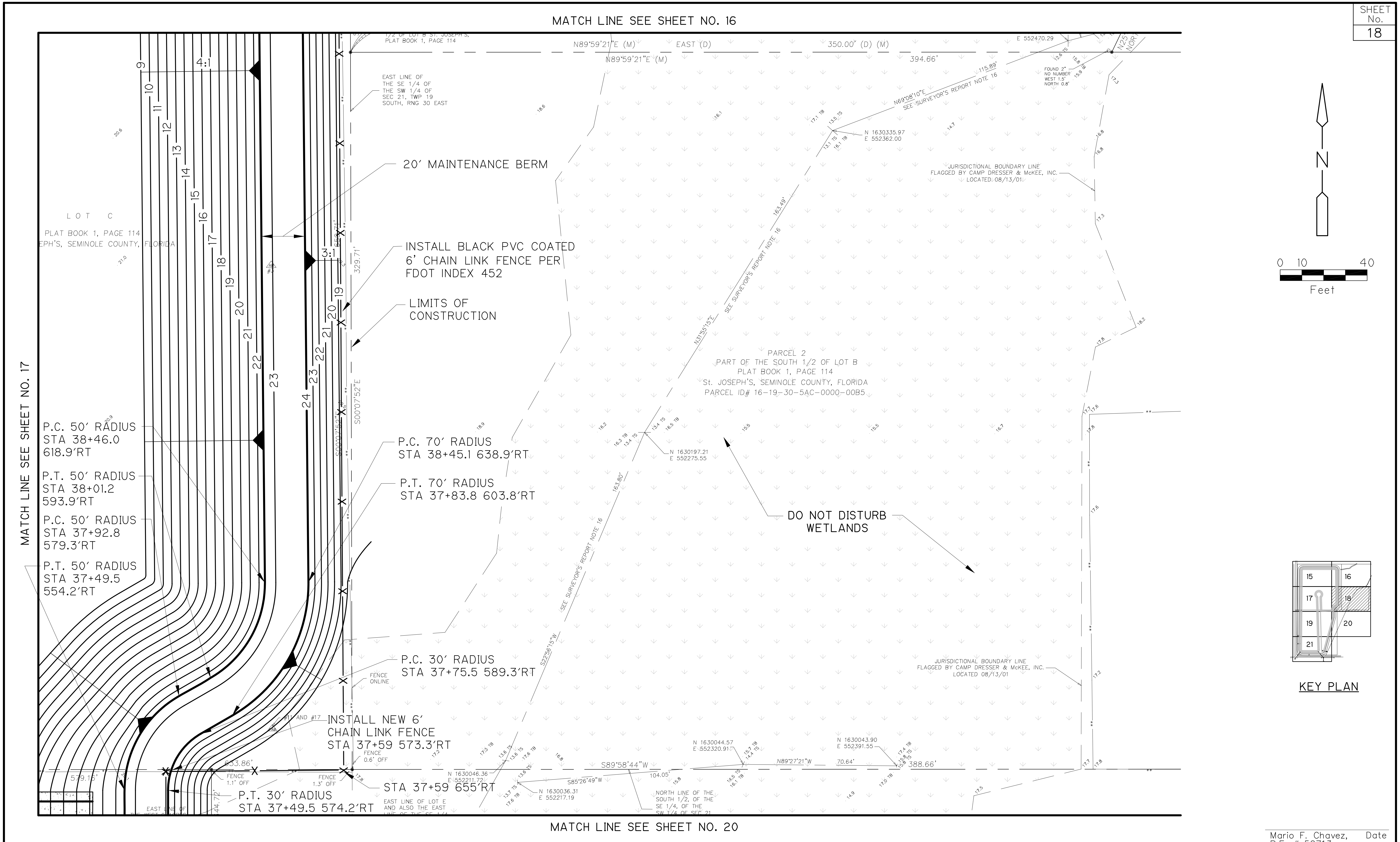

Mario F. Chavez, P.E. # 50713 Date

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SEMINOLE COUNTY
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ELDER CREEK
STORMWATER FACILITY

POND
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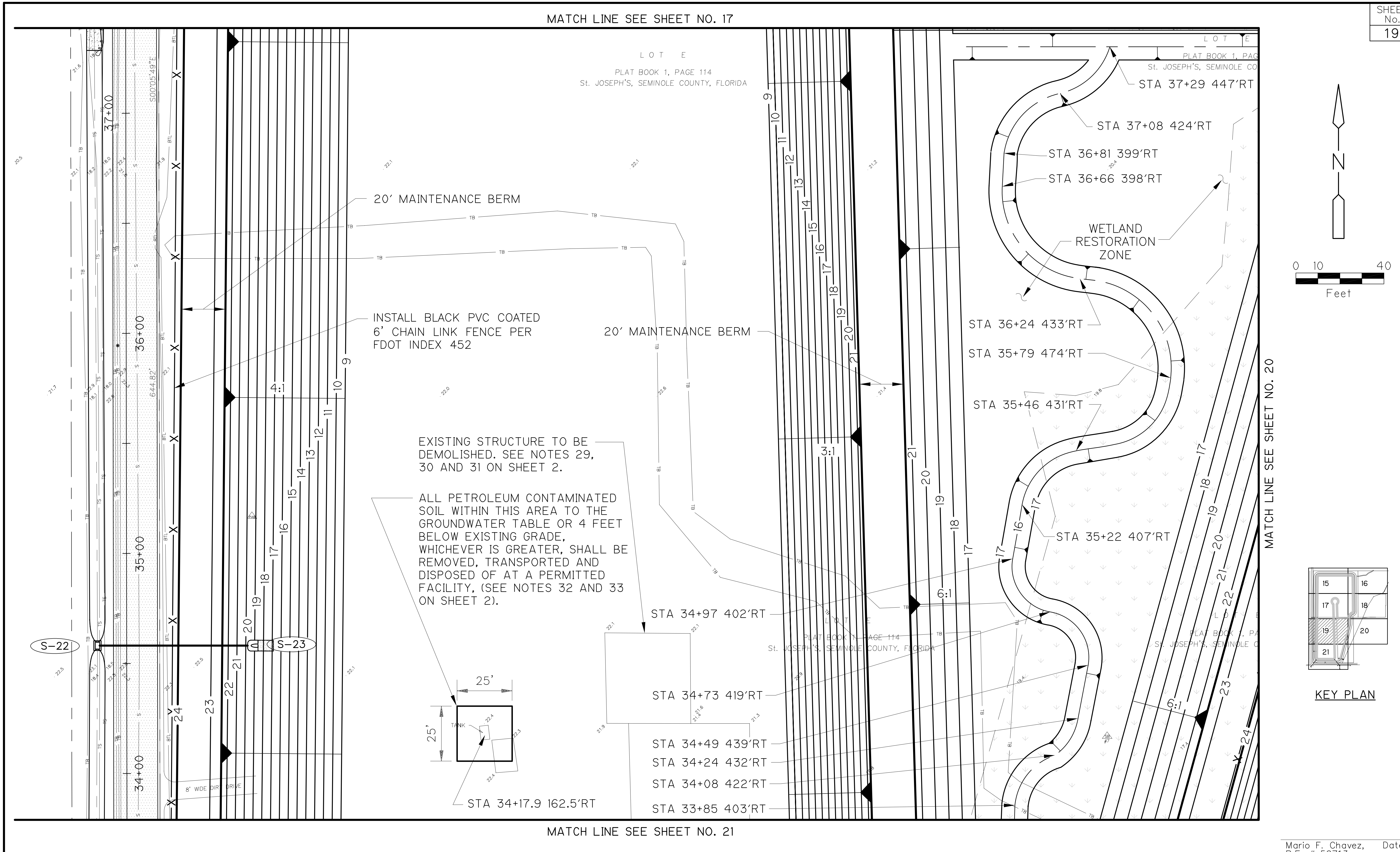

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SEMINOLE COUNTY
FLORIDA

ELDER CREEK STORMWATER FACILITY

POND PLAN

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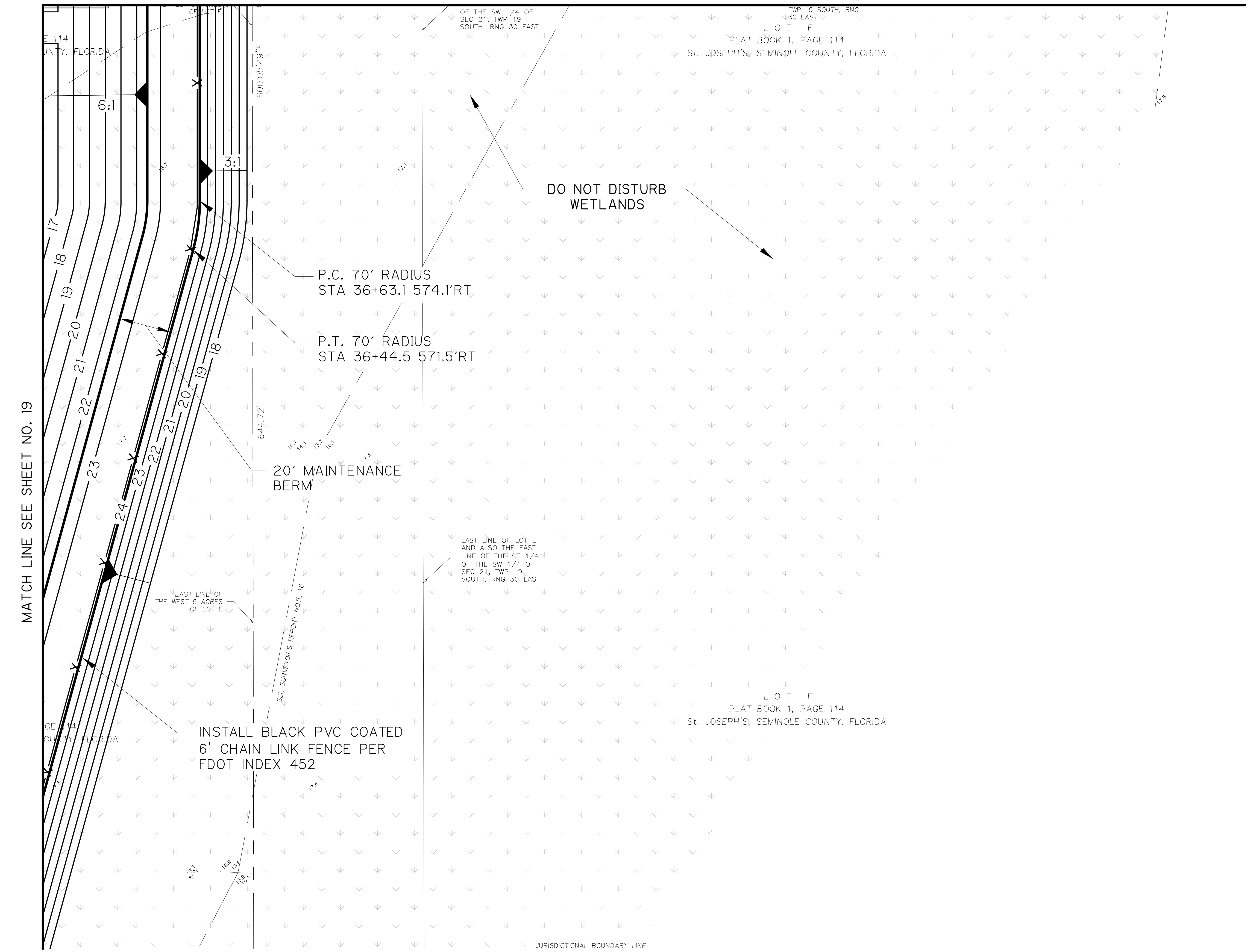

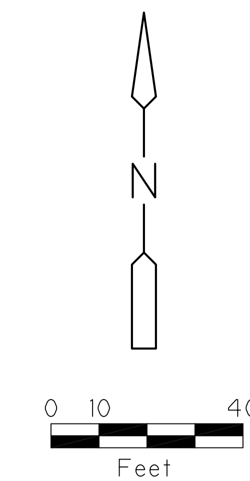

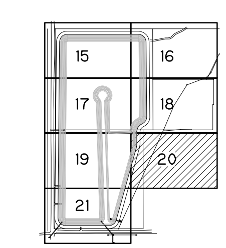

KEY PLAN

Mario F. Chavez, P.E. # 50713 Date

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SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

POND
PLAN

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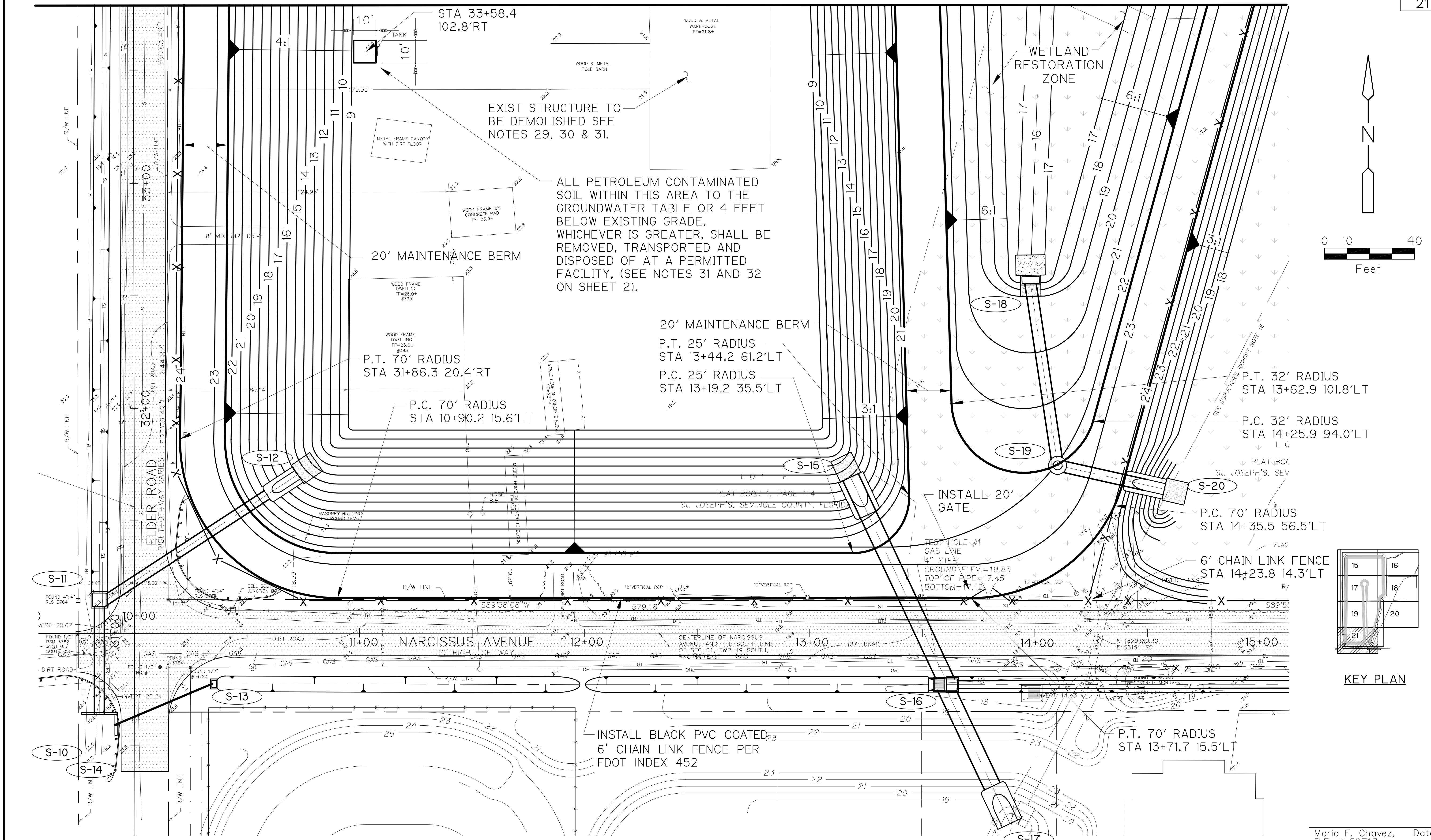

Mario F. Chavez, P.E. # 50713 — Date

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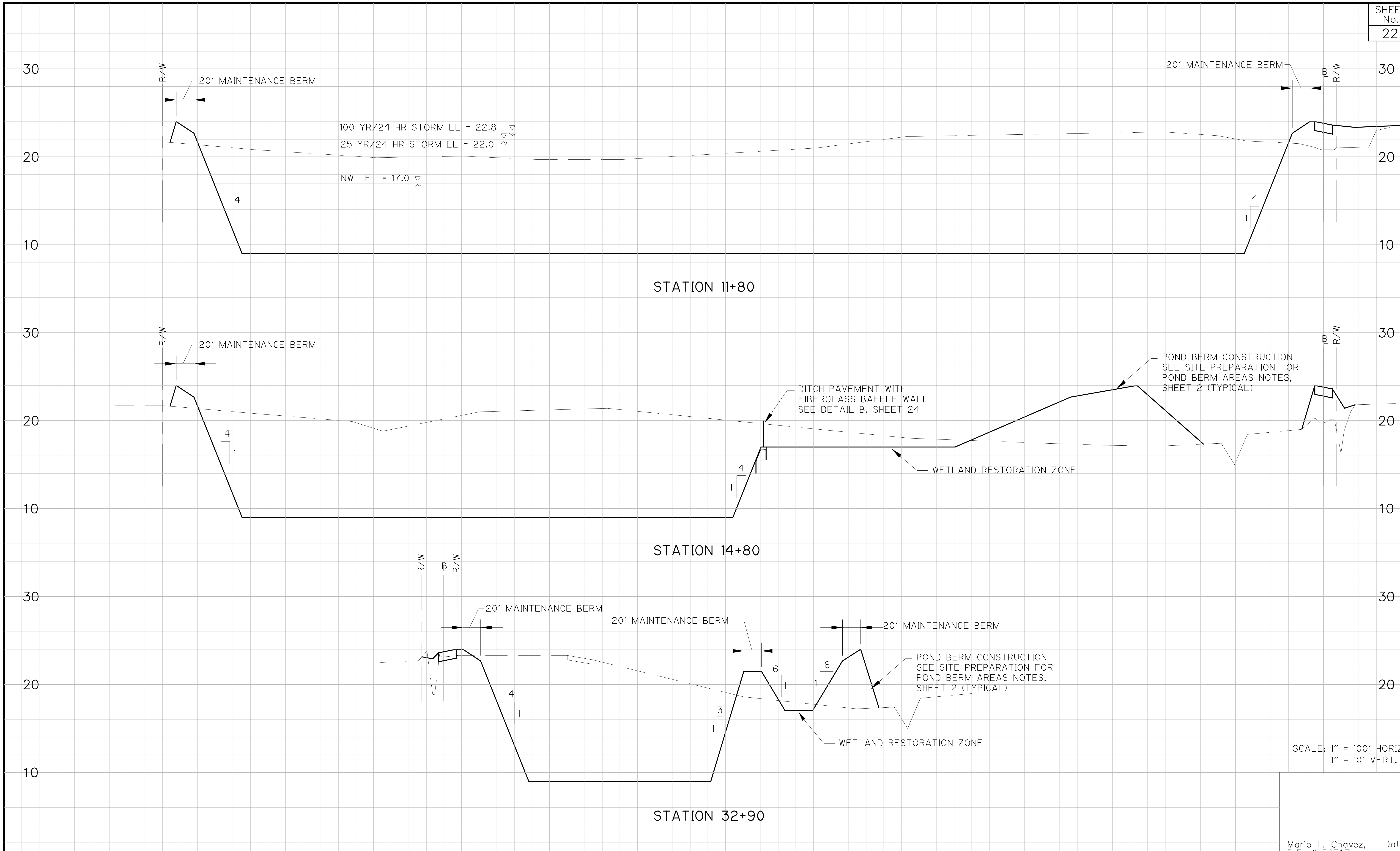
SEMINOLE COUNTY FLORIDA

ELDER CREEK STORMWATER FACILITY

POND PLAN



SHEET No. 22

SCALE: 1" = 100' HORIZ.
1" = 10' VERT.

Mario F. Chavez, P.E. # 50713 Date

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SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

POND CROSS SECTIONS

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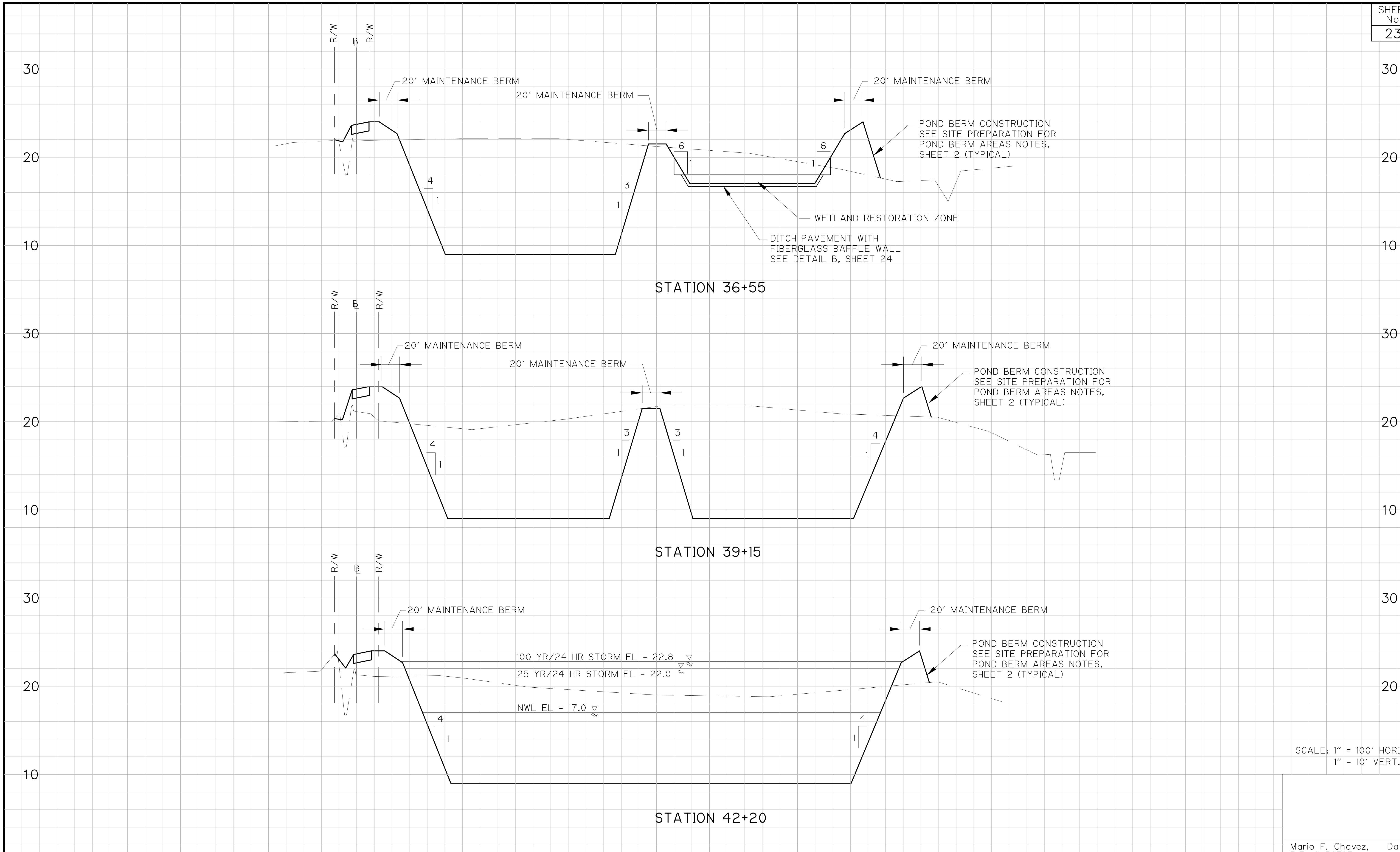

SCALE: 1" = 100' HORIZ.
1" = 10' VERT.

Mario F. Chavez, Date
P.E. # 50713

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SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

POND CROSS SECTIONS

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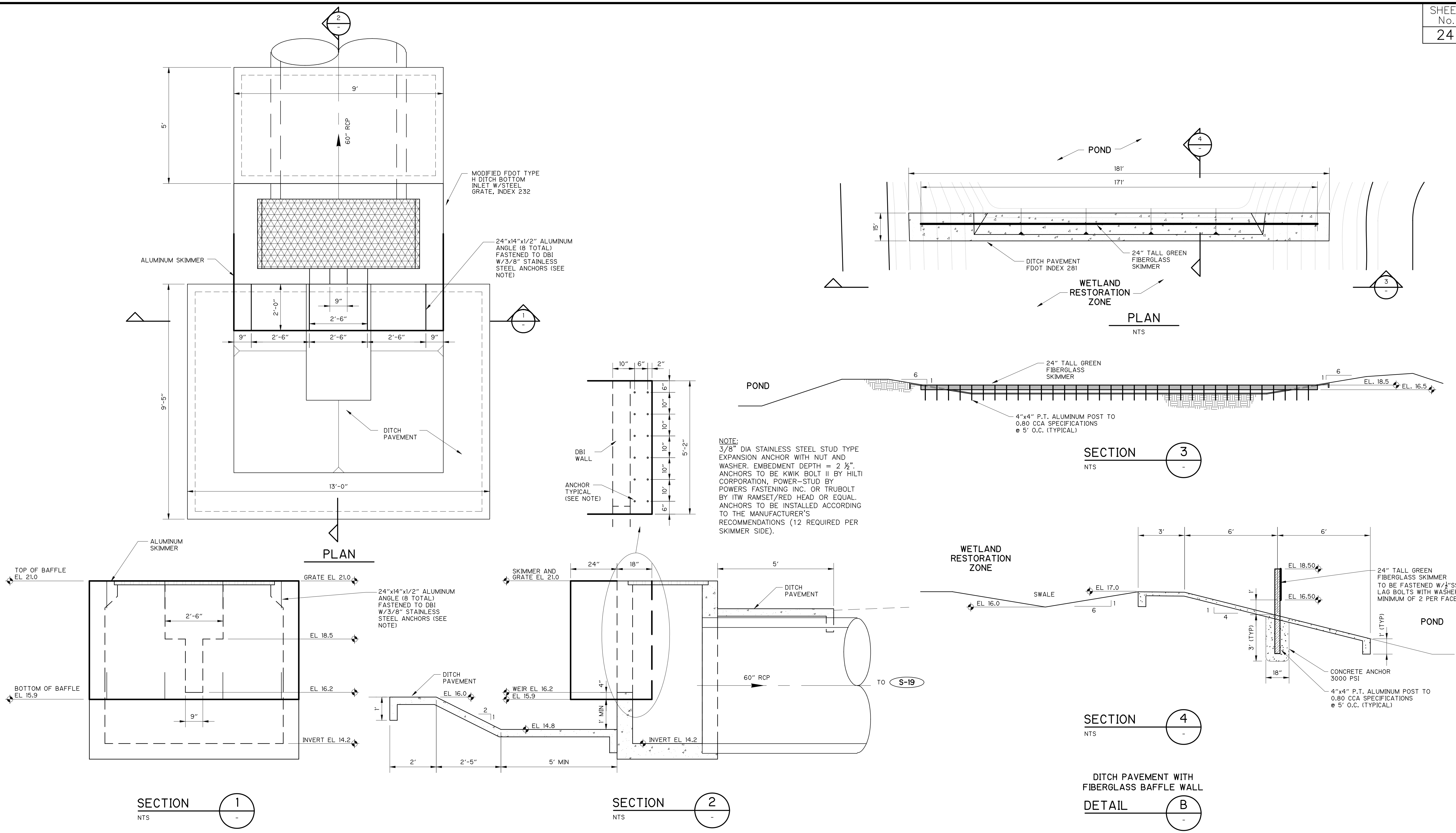

NOTE:
3/8" DIA STAINLESS STEEL STUD TYPE EXPANSION ANCHOR WITH NUT AND WASHER. EMBEDMENT DEPTH = 2 ½". ANCHORS TO BE KWIK BOLT II BY HILTI CORPORATION, POWER-STUD BY POWERS FASTENING INC. OR TRUBOLT BY ITW RAMSET/RED HEAD OR EQUAL. ANCHORS TO BE INSTALLED ACCORDING TO THE MANUFACTURER'S RECOMMENDATIONS (12 REQUIRED PER SKIMMER SIDE).

THE COST OF THE SKIMMER AND ALL ASSOCIATED HARDWARE NECESSARY FOR INSTALLATION OF THE SKIMMER IS TO BE INCLUDED IN THE COST OF THE STRUCTURE (PAY ITEM NO. 425-1-589).

Mario F. Chavez, Date
P.E. # 50713

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. CHAVEZ
DRAWN BY: J. WILLIAMS
SHEET CHK'D BY: B. MACK
CROSS CHK'D BY: J. HICKLE
APPROVED BY: M. CHAVEZ
DATE: OCTOBER 2005

CDM Camp Dresser & McKee Inc.
consulting engineering construction operations
2301 Maitland Center Parkway
Suite 300
Maitland, Florida 32751
Tel: 407 660-2552
Fax: 407 875-1161
FI COA No. EB-0000020

SEMINOLE COUNTY
FLORIDA

ELDER CREEK
STORMWATER FACILITY

DRAINAGE DETAILS

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APPENDIX B

LABORATORY ANALYSES ON INFLOW AND OUTFLOW SAMPLES

1. **Inflow Samples**
2. **Outflow Samples**
3. **Bulk Precipitation**

B-1. Inflow Samples

Elder Creek Regional Stormwater Treatment Facility
Chemical Characteristics of Site 1 Inflow Collected from April 2009 - March 2010

Sample Location	Sample Type	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH3 (µg/l)	NOX (µg/l)	Diss. Org. N (µg/l)	Part N (µg/l)	Total N (µg/l)	SRP (µg/l)	Diss. Org. P (µg/l)	Part. P (µg/l)	Total P (µg/l)	Turbidity (NTU)
Site #1	Inflow	3/31/09	8.05	308	125	70	3	168	275	516	146	6	47	199	2.6
Site #1	Inflow	04/02/09-04/07/09	7.46	345	139	194	175	291	362	1022	216	78	128	422	2.5
Site #1	Inflow	4/14/09	7.70	339	150	123	289	251	636	1299	333	76	239	648	49.5
Site #1	Inflow	4/22/09	7.59	384	156	67	34	749	935	1785	229	18	392	639	7.9
Site #1	Inflow	04/20/09-04/30/09	7.42	328	142	198	75	468	819	1560	136	18	183	337	15.0
Site #1	Inflow	04/30/09-05/07/09	7.82	367	151	82	223	405	288	998	200	9	84	293	7.3
Site #1	Inflow	05/08/09 - 05/14/09	7.80	350	147	120	76	603	248	1047	234	47	140	421	5.3
Site #1	Inflow	5/13/09	7.45	331	158	132	262	722	1813	2929	238	14	1618	1870	201
Site #1	Inflow	5/14/09	8.05	332	143	59	180	585	243	1067	357	28	135	520	2.8
Site #1	Inflow	05/15/09 - 05/17/09	7.89	297	119	159	72	599	402	1232	244	36	141	421	8.4
Site #1	Inflow	5/18/09	7.47	252	95	88	140	242	609	1079	277	7	471	755	33.1
Site #1	Inflow	5/20/09	7.38	204	65	259	46	649	254	1208	242	10	51	303	4.2
Site #1	Inflow	5/26/09	7.12	225	75	60	39	807	375	1281	514	48	121	683	5.6
Site #1	Inflow	6/9/09	7.30	337	122	155	82	612	126	975	404	20	113	537	4.3
Site #1	Inflow	6/17/09	7.26	289	113	81	300	141	165	687	49	241	56	346	5.4
Site #1	Inflow	7/12/09	7.30	192	78	3	36	303	925	1267	170	3	946	1119	175
Site #1	Inflow	7/13/09	7.73	232	100	3	21	304	342	670	203	70	80	353	10.9
Site #1	Inflow	7/18/09	7.98	378	174	23	42	282	462	809	154	7	149	310	3.2
Site #1	Inflow	7/28/09	7.58	272	110	22	523	537	437	1519	199	6	1411	1616	76.7
Site #1	Inflow	7/29/09	7.62	186	70	37	3	719	333	1092	249	7	439	695	35..4
Site #1	Inflow	7/30/09	7.58	234	125	51	267	623	203	1144	216	8	210	434	15.1
Site #1	Inflow	8/3/09	7.42	202	82	31	413	243	517	1204	240	4	611	855	32.4
Site #1	Inflow	8/6/09	8.20	326	130	43	370	374	171	958	262	1	150	413	4.1
Site #1	Inflow	8/20/09	7.61	223	95	186	208	256	362	1012	263	2	59	324	10.3
Site #1	Inflow	8/20/09	7.37	184	74	223	3	162	450	838	302	9	87	398	7.5
Site #1	Inflow	8/22/09	7.28	240	101	42	15	493	274	824	304	23	60	387	6.2
Site #1	Inflow	08/28/09-09/04/09	7.23	187	71	164	115	351	287	917	293	10	233	536	7.6
Site #1	Inflow	09/04/09-09/09/09	7.21	357	142	19	3	706	788	1516	154	8	386	548	7.1
Site #1	Inflow	09/09/09-09/18/09	7.63	335	140	48	3	398	811	1260	150	21	145	316	3.0
Site #1	Inflow	11/17/09-11/30/09	7.26	417	187	43	3	862	1483	2391	216	23	513	752	27.1
Site #1	Inflow	12/03/09-12/07/09	6.86	252	97	93	4	112	413	622	231	22	403	656	15.5
Site #1	Inflow	12/16/09-12/22/09	7.40	388	161	43	121	309	301	774	181	29	268	478	8.8
Site #1	Inflow	12/25/09-12/29/09	7.73	369	179	46	121	577	284	1028	312	6	206	524	14.5
Site #1	Inflow	12/29/09 - 01/05/10	7.08	264	112	166	3	171	696	1036	263	41	459	763	27.4
Site #1	Inflow	01/05/10-01/19/10	7.80	410	173	6	330	502	183	1021	207	19	18	244	8.7
Site #1	Inflow	01/21/10-01/22/10	7.40	312	143	113	271	350	372	1106	538	72	64	674	12.8
Site #1	Inflow	01/22/10-01/28/10	7.71	398	148	33	284	272	380	969	247	3	449	699	15.0
Site #1	Inflow	01/30/10-02/02/10	7.44	405	167	54	352	294	166	866	247	1	224	472	7.1
Site #1	Inflow	02/03/10-02/11/10	7.37	379	149	86	37	1002	206	1331	120	90	393	603	22.0
Site #1	Inflow	2/12/10	7.41	280	115	96	316	597	65	1074	185	28	254	467	17.0
Site #1	Inflow	02/16/10-03/10/10	7.59	434	169	280	674	106	195	1255	278	15	262	555	27.1
Site #1	Inflow	03/10/10-03/18/10	7.05	179	62	177	243	236	348	1004	192	22	366	580	35.1
Site #1	Inflow	3/21/10	7.24	265	106	54	196	369	734	1353	225	21	488	734	18.1
Site #1	Inflow	03/25/10-03/26/10	7.33	412	163	189	65	943	518	1715	62	166	451	679	7.3
Site #1	Inflow	03/28/10-0/29/10	7.13	234	91	54	16	419	125	614	201	25	107	333	6.9
		Mean Value:	**7.50**	**303**	**125**	**95**	**157**	**448**	**453**	**1153**	**237**	**32**	**307**	**576**	**22.4**
		Minimum Value:	**6.86**	**179**	**61.6**	**3**	**3**	**106**	**65**	**516**	**49**	**1**	**18**	**199**	**2.5**
		Maximum Value:	**8.20**	**434**	**187**	**280**	**674**	**1002**	**1813**	**2929**	**538**	**241**	**1618**	**1870**	**201**

Elder Creek Regional Stormwater Treatment Facility
Chemical Characteristics of Site 2 Inflow Collected from April 2009 - March 2010

Sample Location	Sample Type	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH3 (µg/l)	NOX (µg/l)	Diss. Org. N (µg/l)	Part N (µg/l)	Total N (µg/l)	SRP (µg/l)	Diss. Org. P (µg/l)	Part. P (µg/l)	Total P (µg/l)	Turbidity (NTU)
Site #2	Inflow	3/31/09	7.99	536	214	56	70	480	196	802	498	25	129	652	4.7
Site #2	Inflow	4/7/09	8.00	515	214	97	101	412	124	734	459	4	107	570	4.2
Site #2	Inflow	4/13/09	8.41	517	210	77	79	464	69	689	381	34	62	477	2.1
Site #2	Inflow	4/16/09	7.99	498	240	68	19	354	119	560	372	31	48	451	3.2
Site #2	Inflow	5/14/09	7.85	487	189	56	25	750	310	1141	343	55	67	465	4.2
Site #2	Inflow	5/18/09	7.90	444	173	8	14	694	229	945	298	8	32	338	6.4
Site #2	Inflow	5/19/09	7.39	207	70	13	14	528	129	684	251	3	27	281	7.2
Site #2	Inflow	5/20/09	7.19	201	64	3	71	547	99	720	291	4	39	334	5.5
Site #2	Inflow	5/26/09	7.21	373	125	62	231	627	364	1284	369	7	204	580	5.7
Site #2	Inflow	6/9/09	7.46	408	160	92	36	526	156	810	379	8	164	551	4.2
Site #2	Inflow	6/17/09	7.64	430	175	53	346	273	219	891	107	254	222	583	6.8
Site #2	Inflow	6/18/09	7.67	247	104	26	10	601	14	651	39	1	122	162	17.6
Site #2	Inflow	6/30/09	7.76	403	158	127	325	325	340	1117	492	27	380	899	13.5
Site #2	Inflow	7/12/09	7.35	241	94	3	4	493	402	902	579	94	255	928	7.3
Site #2	Inflow	7/29/09	7.48	270	96	124	8	556	111	799	325	17	74	416	3.0
Site #2	Inflow	8/3/09	7.23	197	74	77	118	287	67	549	211	3	57	271	2.3
Site #2	Inflow	08/13/09-08/14/09	7.65	273	120	97	210	421	67	795	345	1	111	457	1.7
Site #2	Inflow	8/20/09	7.10	168	71	75	3	251	383	712	349	8	119	476	6.3
Site #2	Inflow	08/28/09-09/04/09	7.75	389	171	157	45	441	545	1188	490	17	296	803	6.2
Site #2	Inflow	12/7/09	7.08	210	151	126	3	268	221	618	122	48	206	376	12.1
Site #2	Inflow	1/1/10	7.33	516	183	267	87	520	164	1038	64	6	213	283	17.5
Site #2	Inflow	1/22/10	7.48	292	117	53	25	614	248	940	632	4	170	806	8.2
Site #2	Inflow	2/3/10	7.56	465	185	125	87	386	353	951	103	9	346	458	10.9
Site #2	Inflow	2/16/10	7.16	458	189	329	232	386	280	1227	27	14	315	356	16.8
Site #2	Inflow	3/10/10	7.45	571	211	204	119	434	180	937	30	10	367	407	25.2
Site #2	Inflow	3/12/10	7.14	224	85	56	68	329	360	813	233	17	190	440	13.1
Site #2	Inflow	3/25/10	7.56	395	158	94	16	631	132	873	251	69	246	566	8.8
Site #2	Inflow	03/28/10-0/29/10	7.31	256	107	40	3	580	77	700	295	3	151	449	8.7
		Mean Value:	**7.54**	**364**	**147**	**92**	**85**	**471**	**213**	**860**	**298**	**28**	**169**	**494**	**8.3**
		Minimum Value:	**7.08**	**168**	**64.2**	**3**	**3**	**251**	**14**	**549**	**27**	**1**	**27**	**162**	**1.7**
		Maximum Value:	**8.41**	**571**	**240**	**329**	**346**	**750**	**545**	**1284**	**632**	**254**	**380**	**928**	**25.2**

Elder Creek Regional Stormwater Treatment Facility
Chemical Characteristics of Site 3 Inflow Collected from April 2009 - March 2010

Sample Location	Sample Type	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH3 (µg/l)	NOX (µg/l)	Diss. Org. N (µg/l)	Part N (µg/l)	Total N (µg/l)	SRP (µg/l)	Diss. Org. P (µg/l)	Part. P (µg/l)	Total P (µg/l)	Turbidity (NTU)
Site #3	Inflow	5/18/09	7.10	695	67.2	24	3	560	112	699	10	7	58	75	8.6
Site #3	Inflow	5/18/09	7.12	164	44.0	21	5	513	45	584	69	1	17	87	2.8
Site #3	Inflow	05/18/09 - 05/19/09	7.11	127	43.4	36	4	507	149	696	80	3	13	96	2.6
Site #3	Inflow	5/19/09	6.87	132	29.4	44	21	445	53	563	97	9	9	115	2.4
Site #3	Inflow	5/26/09	7.27	208	71.0	21	5	647	384	1057	268	13	59	340	2.4
Site #3	Inflow	6/9/09	7.36	359	143	3	3	828	255	1088	74	7	32	113	2.0
Site #3	Inflow	6/17/09	7.31	388	169	3	22	645	330	1000	4	22	15	41	2.2
Site #3	Inflow	6/18/09	7.76	261	111	19	12	764	271	1066	40	7	60	107	8.3
Site #3	Inflow	6/30/09	7.37	520	172	22	5	651	22	700	19	3	7	29	2.9
Site #3	Inflow	6/30/09	7.65	244	81.8	14	4	345	142	505	20	5	2	27	5.3
Site #3	Inflow	7/14/09	7.37	369	164	3	3	579	28	612	19	11	6	36	4.5
Site #3	Inflow	7/28/09	7.10	144	41.2	38	32	367	224	661	79	11	67	157	12.9
Site #3	Inflow	7/29/09	7.13	143	34.8	34	44	363	242	683	58	16	40	114	3.9
Site #3	Inflow	8/3/09	7.23	91	32.0	89	70	235	104	498	72	1	34	107	4.9
Site #3	Inflow	8/20/09	7.65	210	85.4	140	3	322	401	866	237	2	49	288	1.7
Site #3	Inflow	8/20/09	7.51	314	72.0	182	3	439	86	710	24	4	9	37	2.3
Site #3	Inflow	08/28/09-09/04/09	7.43	385	165	75	3	462	60	600	12	2	9	23	1.2
Site #3	Inflow	9/28/09	7.23	447	205	26	3	903	87	1019	32	13	30	75	2.7
Site #3	Inflow	12/4/09	6.76	165	40.6	42	4	179	91	316	25	20	26	71	2.3
Site #3	Inflow	12/5/09	6.87	128	36.6	27	41	182	113	363	54	14	20	88	2.3
Site #3	Inflow	12/29/09	7.48	424	188	74	21	242	77	414	4	1	7	12	2.9
Site #3	Inflow	1/1/10	7.52	391	152	37	3	394	20	454	10	3	4	17	6.5
Site #3	Inflow	1/19/10	7.68	462	163	37	3	500	94	634	7	2	15	24	1.9
Site #3	Inflow	1/22/10	7.49	298	123	158	134	410	208	910	45	12	16	73	6.9
Site #3	Inflow	01/22/10-01/28/10	7.49	317	97.4	39	12	444	53	548	52	9	9	70	0.9
Site #3	Inflow	2/3/10	7.45	492	171	27	9	472	21	529	9	3	9	21	0.6
Site #3	Inflow	2/5/10	7.16	203	58.6	34	3	512	137	686	38	17	40	95	13.3
Site #3	Inflow	2/9/10	7.39	285	81.2	47	3	516	144	710	14	14	19	47	4.8
Site #3	Inflow	2/10/10	7.40	353	103	44	3	595	156	798	5	11	41	57	8.4
Site #3	Inflow	2/12/10	7.13	214	62.8	36	56	468	174	734	58	11	33	102	5.6
Site #3	Inflow	2/13/10	7.55	327	97.2	36	12	560	28	636	20	7	10	37	2.0
Site #3	Inflow	3/10/10	7.52	651	232	49	16	480	513	1058	10	5	70	85	21.2
Site #3	Inflow	3/12/10	6.86	227	74.2	26	11	459	120	616	30	30	55	115	3.5
Site #3	Inflow	3/18/10	7.51	576	212	25	6	466	211	708	8	22	66	96	10.5
Site #3	Inflow	3/21/10	7.27	234	79.6	23	13	471	309	816	19	9	75	103	56.6
Site #3	Inflow	3/26/10	7.24	301	104	33	20	531	239	823	4	36	43	83	15.1
Site #3	Inflow	03/28/10-0/29/10	7.20	232	87.2	21	3	355	100	479	5	39	38	82	16.1
	Mean Value:		**7.31**	**310**	**105**	**43**	**17**	**481**	**157**	**698**	**44**	**11**	**30**	**85**	**6.9**
	Minimum Value:		**6.76**	**91**	**29.4**	**3**	**3**	**179**	**20**	**316**	**4**	**1**	**2**	**12**	**0.6**
	Maximum Value:		**7.76**	**695**	**232**	**182**	**134**	**903**	**513**	**1088**	**268**	**39**	**75**	**340**	**56.6**

B-2. Outflow Samples

Elder Creek Regional Stormwater Treatment Facility
Chemical Characteristics of Pond Outflow Collected from April 2009 - March 2010

Sample Location	Sample Type	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH3 (µg/l)	NOX (µg/l)	Diss. Org. N (µg/l)	Part N (µg/l)	Total N (µg/l)	SRP (µg/l)	Diss. Org. P (µg/l)	Part. P (µg/l)	Total P (µg/l)	Turbidity (NTU)
Site #4	Outflow	3/31/09	7.84	320	128	10	3	346	269	628	115	10	55	180	7.2
Site #4	Outflow	3/31/09 - 4/07/09	8.51	287	105	110	75	377	416	978	74	10	53	137	6.9
Site #4	Outflow	4/7/10 - 4/13/09	9.88	277	105	63	7	515	1186	1771	86	38	208	332	15.8
Site #4	Outflow	4/13/09 - 4/16/09	8.63	308	109	69	4	466	834	1373	113	4	97	214	11.5
Site #4	Outflow	4/16/09 - 4/23/09	7.61	265	114	162	28	796	421	1407	108	6	93	207	3.1
Site #4	Outflow	4/23/09 - 04/28/09	7.44	284	108	67	57	663	774	1561	57	6	128	191	7.3
Site #4	Outflow	4/28/09 - 05/07/09	7.70	271	98	80	6	632	364	1082	53	16	61	130	4.5
Site #4	Outflow	5/07/09 - 5/14/09	7.57	256	82	24	3	821	826	1674	27	28	137	192	8.1
Site #4	Outflow	5/14/09 - 5/18/09	7.83	257	83	180	8	786	435	1409	60	14	79	153	5.5
Site #4	Outflow	5/18/09 - 5/19/09	7.69	222	75	33	3	747	471	1254	44	3	86	133	12.0
Site #4	Outflow	5/19/09 - 5/21/09	7.25	180	67	295	36	680	261	1272	227	9	55	291	7.1
Site #4	Outflow	5/21/09 - 5/26/09	7.13	193	66	71	21	715	591	1398	257	10	130	397	10.3
Site #4	Outflow	5/26/09 - 6/01/09	7.62	211	72	246	13	484	179	922	336	12	7	355	2.5
Site #4	Outflow	6/01/09 - 6/09/09	7.52	251	93	23	3	459	318	803	333	2	66	401	5.7
Site #4	Outflow	6/09/09 - 6/17/09	7.35	272	99	3	292	202	227	724	266	6	77	349	4.3
Site #4	Outflow	6/17/09 - 6/23/09	7.66	274	104	25	7	499	344	875	280	22	62	364	3.0
Site #4	Outflow	6/23/09 - 6/30/09	7.61	303	118	25	3	551	375	954	295	1	89	385	7.9
Site #4	Outflow	6/30/09 - 7/08/09	7.66	304	118	121	23	363	453	960	355	77	42	474	6.8
Site #4	Outflow	7/08/09 - 7/14/09	8.10	298	122	33	4	514	571	1122	352	8	159	519	11.5
Site #4	Outflow	7/14/09 - 7/21/09	9.05	295	151	63	427	355	211	1056	352	2	40	394	2.8
Site #4	Outflow	7/21/09 - 7/28/09	8.09	304	128	35	143	1022	1323	2523	337	12	71	420	10.4
Site #4	Outflow	7/28/09 - 8/03/09	7.31	282	111	124	6	578	954	1662	311	16	122	449	5.7
Site #4	Outflow	8/03/09 - 8/11/09	7.08	232	86	582	283	477	373	1715	148	24	312	484	5.2
Site #4	Outflow	8/11/09 - 8/20/09	7.45	191	77	259	92	560	72	983	317	5	48	370	5.9
Site #4	Outflow	8/20/09 - 8/21/09	7.90	193	75	179	6	297	398	880	264	2	72	338	6.7
Site #4	Outflow	8/21/09 - 8/28/08	6.67	212	79	92	3	346	895	1336	128	19	164	311	7.7
Site #4	Outflow	8/28/09 - 9/04/09	7.48	237	91	74	3	524	175	776	310	15	38	363	5.0
Site #4	Outflow	9/04/09 - 9/09/09	7.25	244	89	253	9	288	101	651	326	73	119	518	2.6
Site #4	Outflow	9/09/09 - 9/18/09	7.63	263	105	69	425	264	107	865	352	33	115	500	2.5
Site #4	Outflow	9/18/09 - 9/22/09	7.37	271	107	133	3	509	906	1551	338	11	108	457	6.5
Site #4	Outflow	9/22/09 - 9/28/09	7.31	269	107	163	80	987	530	1760	241	78	103	422	3.2
Site #4	Outflow	9/28/09 - 10/05/09	6.87	266	115	42	4	578	726	1350	204	53	219	476	7.8
Site #4	Outflow	10/05/09 - 10/12/09	7.79	256	105	73	24	806	487	1390	170	14	85	269	7.3
Site #4	Outflow	10/12/09 - 10/19/09	7.14	290	121	40	3	570	616	1229	168	24	190	382	6.7
Site #4	Outflow	10/19/09 - 10/27/09	8.18	250	129	24	10	779	599	1412	226	2	107	335	11.3
Site #4	Outflow	10/27/09 - 11/05/09	7.89	304	124	16	4	521	800	1341	290	19	157	466	16.7
Site #4	Outflow	11/05/09 - 11/10/09	7.61	303	128	21	4	918	698	1641	159	247	8	414	12.3
Site #4	Outflow	11/10/09 - 11/17/09	7.14	322	133	42	16	449	1408	1915	213	37	190	440	11.5
Site #4	Outflow	11/17/09 - 11/30/09	7.42	330	132	163	263	155	1362	1943	213	16	147	376	13.0
Site #4	Outflow	11/30-09 - 12/03/09	7.63	350	132	17	22	943	669	1651	137	4	144	285	16.2
Site #4	Outflow	12/03/09 - 12/07/09	7.36	300	122	14	3	265	455	737	116	12	115	243	14.4
Site #4	Outflow	12/07/09 - 12/14/09	7.29	307	118	173	134	214	215	736	80	35	78	193	7.3
Site #4	Outflow	12/14/09 - 12/23/09	7.05	325	132	22	13	452	446	933	75	15	117	207	5.7
Site #4	Outflow	12/23/09 - 12/29/09	7.68	304	133	215	3	298	221	737	38	4	15	57	2.8
Site #4	Outflow	12/29/09 - 1/05/10	7.46	299	127	33	22	481	101	637	106	8	3	117	3.1
Site #4	Outflow	1/05/10 - 1/19/10	7.91	317	128	231	36	454	203	924	139	5	14	158	12.7
Site #4	Outflow	1/19/10 - 1/22/10	7.76	302	127	55	36	343	119	553	188	20	72	280	1.8
Site #4	Outflow	1/22/10 - 1/28/10	7.68	335	126	67	47	310	31	455	67	5	8	80	1.2
Site #4	Outflow	1/28/10 - 2/03/10	7.80	339	133	61	51	124	289	525	64	2	30	96	1.8
Site #4	Outflow	2/3/10 - 2/11/10	7.40	353	103	44	3	595	156	798	5	11	41	57	8.4
Site #4	Outflow	2/11/10 - 2/16/10	7.40	328	128	21	3	476	502	1002	43	14	79	136	3.7
Site #4	Outflow	2/16/10 - 3/10/10	7.43	353	129	62	80	299	620	1061	110	23	169	301	30.1
Site #4	Outflow	3/10/10 - 3/18/10	7.48	340	122	55	3	312	411	781	43	13	88	144	1.0
Site #4	Outflow	3/18/10 - 3/23/10	7.21	303	115	14	10	397	336	757	70	9	59	138	5.4
Site #4	Outflow	3/23/10 - 3/26/10	7.32	308	116	17	17	406	388	828	69	27	76	172	3.6
Site #4	Outflow	3/26/10 - 3/29/10	7.41	296	118	24	3	421	159	607	61	26	44	131	2.6
		Mean Value:	**7.62**	**282**	**110**	**93**	**51**	**507**	**489**	**1140**	**177**	**22**	**94**	**293**	**7.4**
		Minimum Value:	**6.67**	**180**	**66.2**	**3**	**3**	**124**	**31**	**455**	**5**	**1**	**3**	**57**	**1.0**
		Maximum Value:	**9.88**	**353**	**151**	**582**	**427**	**1022**	**1408**	**2523**	**355**	**247**	**312**	**519**	**30.1**

B-3. Bulk Precipitation

Elder Creek Regional Stormwater Treatment Facility
Chemical Characteristics of Bulk Precipitation Collected from April 2009 - March 2010

Sample Type	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH3 (µg/l)	NOX (µg/l)	Diss. Org. (µg/l)	Part N (µg/l)	Total N (µg/l)	SRP (µg/l)	Diss. Org. (µg/l)	Part. P (µg/l)	Total P (µg/l)	Turbidity (NTU)	TSS (mg/l)
Bulk Precip.	3/31/09 - 4/03/09	5.87	39	6.0	192	346	87	323	948	1	1	38	40	5.3	10.4
Bulk Precip.	4/3/09 - 4/14/09	6.16	37	6.2	740	265	257	102	1364	29	1	35	65	2.5	1.6
Bulk Precip.	4/14/09 - 5/13/09	5.91	30	6.2	664	438	1019	290	2411	243	58	67	368	6.9	20.8
Bulk Precip.	5/17/09 - 5/18/09	5.51	20	3.2	304	208	336	245	1093	3	11	5	19	2.4	3.6
Bulk Precip.	5/18/09 - 5/19/09	5.86	9	2.6	71	26	112	55	264	1	7	47	54	0.6	0.7
Bulk Precip.	5/19/09 - 5/21/09	5.45	14	1.4	30	33	165	58	286	1	1	1	2	0.7	0.7
Bulk Precip.	5/21/09 - 5/26/09	5.19	9	1.8	51	104	26	156	337	1	4	2	7	1.1	2.9
Bulk Precip.	5/26/09 - 5/29/09	4.82	13	0.8	4	291	168	252	715	1	10	18	28	1.5	2
Bulk Precip.	6/01/09 - 6/09/09	4.87	11	1.0	3	146	3	49	201	1	6	7	13	0.8	2
Bulk Precip.	6/09/09 - 6/17/09	4.96	16	1.2	55	4	530	622	1211	398	13	67	478	2.7	10
Bulk Precip.	6/17/09 - 6/18/09	4.63	16	0.6	66	246	305	830	1447	2	1	69	72	4.0	9.3
Bulk Precip.	6/23/09 - 6/30/09	4.80	16	1.0	74	306	263	215	858	6	2	8	16	2.4	7.1
Bulk Precip.	6/30/09 - 7/08/09	5.67	10	2.6	25	74	29	71	199	2	3	9	14	1.4	3.4
Bulk Precip.	7/08/09 - 7/14/09	5.44	13	2.2	3	143	139	62	347	1	5	11	17	1.4	2.7
Bulk Precip.	7/14/09 - 07/31/09	5.14	9	2.8	3	135	49	30	217	1	1	1	2	1.0	2.3
Bulk Precip.	8/03/09 - 8/07/09	5.41	17	2.2	10	183	3	9	205	1	1	5	6	1.6	1.2
Bulk Precip.	8/13/09 - 8/19/09	5.69	9	2.4	3	96	3	9	111	1	9	<1	9	0.9	0.1
Bulk Precip.	8/19/09 - 8/20/09	4.47	9	0.0	63	163	28	116	370	1	<1	8	8	1.0	0.6
Bulk Precip.	8/21/08 - 8/26/08	4.77	17	0.8	51	433	225	36	745	1	1	17	18	1.0	1.6
Bulk Precip.	8/28/09 - 9/04/09	5.65	7	3.6	104	136	93	89	422	5	5	12	22	0.8	2
Bulk Precip.	9/04/09 - 9/09/09	5.01	7	1.2	8	168	160	32	368	1	1	5	6	0.9	1.7
Bulk Precip.	9/22/09 - 9/27/09	6.33	25	10.2	3	67	3177	44	3291	95	<1	30	125	1.2	2
Bulk Precip.	11/22/09 - 11/25/09	7.02	67	14.4	3936	547	2230	204	6917	829	21	50	900	0.6	5.7
Bulk Precip.	12/02/09 - 12/03/09	6.71	64	19.8	2744	527	3273	371	6915	569	101	71	741	4.6	23
Bulk Precip.	12/04/09 - 12/07/09	5.70	9	5.2	316	80	3	20	419	7	14	7	28	0.9	1.8
Bulk Precip.	12/7/09 - 12/18/09	6.44	95	4.2	1560	557	87	287	2491	303	25	39	367	1.6	2.7
Bulk Precip.	12/18/09 - 12/25/09	6.32	28	3.2	870	252	136	3	1261	134	15	27	176	0.9	2
Bulk Precip.	12/25/09 - 1/1/10	5.93	14	5.0	512	173	207	56	948	77	8	34	119	0.8	0.8
Bulk Precip.	1/1/10 - 1/17/10	6.53	53	11.6	2896	407	917	255	4475	605	3	31	639	2.0	2
Bulk Precip.	1/17/10 - 1/22/10	6.27	28	8.2	464	137	2150	28	2779	402	<1	14	416	0.7	3.5
Bulk Precip.	1/22/10 - 2/02/10	6.00	29	6.2	353	284	82	103	822	25	4	5	34	0.9	3.2
Bulk Precip.	02/05/10-02/09/10	5.53	13	2.8	203	178	156	164	701	1	10	7	17	1.8	1.6
Bulk Precip.	2/9/10 - 2/12/10	5.63	10	2.6	149	186	83	48	466	10	<1	6	16	0.8	0.9
Bulk Precip.	2/12/10 - 3/02/10	5.57	18	2.6	485	351	195	77	1108	120	29	10	159	1.1	1.9
Bulk Precip.	3/2/10 - 03/13/10	5.75	7	0.8	211	76	156	66	509	2	14	8	24	0.9	5.6
Bulk Precip.	3/13/10 - 3/21/10	5.37	13	7.8	131	254	134	94	613	21	6	6	33	1.8	10
Bulk Precip.	3/21/10 - 3/25/10	5.80	22	3.6	216	377	358	73	1024	42	15	21	78	3.4	4.2
Bulk Precip.	3/258/10 - 3/29/10	5.73	9	9.8	60	110	173	66	343	1	21	1	23	0.9	0.7
Mean Value:		**5.63**	**22**	**4.4**	**464**	**224**	**461**	**148**	**1295**	**104**	**13**	**22**	**136**	**1.7**	**4.2**
Minimum Value:		**4.47**	**7**	**0.0**	**3**	**4**	**3**	**3**	**111**	**1**	**1**	**1**	**2**	**0.6**	**0.1**
Maximum Value:		**7.02**	**95**	**19.8**	**3936**	**557**	**3273**	**830**	**6917**	**829**	**101**	**71**	**900**	**6.9**	**23.0**

APPENDIX C

VERTICAL FIELD PROFILES COLLECTED IN THE ELDER CREEK POND FROM APRIL 2009 – MARCH 2010

Elder Creek Regional Stormwater Treatment Facility
Pond Vertical Field Profiles Collected from April 2009 - March 2010

Location	Site	Date MMDDYY	Time HHMMSS	Depth meters	Temp °C	pH Units	SpCond µmho/cm	TDS g/l	DO mg/l	DO% Sat	ORP mV
Elder Ck	Pond	4/13/09	11:14	0.25	24.95	9.87	284	182	17.9	200	331
Elder Ck	Pond	4/13/09	11:15	0.50	24.94	9.86	283	181	17.7	200	343
Elder Ck	Pond	4/13/09	11:17	1.00	23.98	9.24	287	183	12.2	144	332
Elder Ck	Pond	4/13/09	11:18	1.50	22.27	7.51	308	197	1.0	12	269
Elder Ck	Pond	4/13/09	11:19	2.00	21.73	7.34	318	203	0.3	4	96
Elder Ck	Pond	4/13/09	11:19	2.41	21.61	7.19	334	214	0.3	3	61
Elder Ck	Pond	4/13/09	11:23	0.25	24.88	9.83	283	181	18.1	200	319
Elder Ck	Pond	4/13/09	11:24	0.50	24.89	9.83	283	181	17.8	200	327
Elder Ck	Pond	4/13/09	11:24	1.00	24.83	9.81	283	181	17.7	200	333
Elder Ck	Pond	4/13/09	11:26	1.50	22.79	7.79	307	196	2.0	23	266
Elder Ck	Pond	4/13/09	11:27	2.00	21.84	7.35	314	201	0.5	5	89
Elder Ck	Pond	4/13/09	11:27	2.26	21.66	7.26	328	210	0.3	3	61
Elder Ck	Pond	4/23/09	11:57	0.25	24.57	10.00	285	183	16.7	200	388
Elder Ck	Pond	4/23/09	11:58	0.50	24.37	10.00	286	183	16.7	200	388
Elder Ck	Pond	4/23/09	11:59	1.00	23.70	9.78	280	179	14.8	175	384
Elder Ck	Pond	4/23/09	12:01	1.50	23.01	8.75	303	194	3.4	39	355
Elder Ck	Pond	4/23/09	12:02	2.00	22.54	7.62	319	204	1.6	19	49
Elder Ck	Pond	4/23/09	12:04	2.49	22.13	7.00	353	226	1.1	12	-48
Elder Ck	Pond	4/30/09	11:39	0.25	26.60	9.86	230	147	13.6	169	364
Elder Ck	Pond	4/30/09	11:40	0.50	26.09	9.76	230	147	12.4	153	362
Elder Ck	Pond	4/30/09	11:41	1.00	25.22	9.56	230	147	9.3	113	357
Elder Ck	Pond	4/30/09	11:43	1.50	24.63	8.74	266	170	1.4	17	337
Elder Ck	Pond	4/30/09	11:44	2.00	23.53	7.65	333	213	0.4	5	3
Elder Ck	Pond	4/30/09	11:44	2.43	22.68	6.98	392	251	0.4	4	-45
Elder Ck	Pond	5/7/09	12:11	0.25	28.89	9.85	230	147	13.3	173	359
Elder Ck	Pond	5/7/09	12:12	0.50	28.72	9.87	230	147	12.7	164	359
Elder Ck	Pond	5/7/09	12:13	1.00	27.44	9.72	225	144	11.0	140	357
Elder Ck	Pond	5/7/09	12:14	1.50	26.85	9.29	229	147	7.1	88	348
Elder Ck	Pond	5/7/09	12:15	2.00	24.81	7.22	338	216	1.6	20	133
Elder Ck	Pond	5/7/09	12:16	2.39	23.14	6.84	445	285	1.0	11	-50
Elder Ck	Pond	5/14/09	10:20	0.25	27.93	9.19	231	148	7.5	96	337
Elder Ck	Pond	5/14/09	10:21	0.50	27.88	9.16	231	148	7.2	92	335
Elder Ck	Pond	5/14/09	10:22	1.00	27.60	9.06	231	148	6.2	78	330
Elder Ck	Pond	5/14/09	10:23	1.50	27.41	8.83	234	150	3.9	49	323
Elder Ck	Pond	5/14/09	10:24	2.00	26.23	7.06	311	199	0.5	6	155
Elder Ck	Pond	5/14/09	10:25	2.46	24.08	6.61	469	300	0.3	3	-27
Elder Ck	Pond	6/1/09	12:12	0.25	28.73	7.54	255	163	6.5	85	282
Elder Ck	Pond	6/1/09	12:13	0.50	28.58	7.50	255	163	6.0	77	287
Elder Ck	Pond	6/1/09	12:14	1.00	26.39	6.96	247	158	1.6	20	267
Elder Ck	Pond	6/1/09	12:15	1.50	23.68	6.86	236	151	0.6	7	172
Elder Ck	Pond	6/1/09	12:16	2.00	22.89	6.85	230	147	0.4	4	135
Elder Ck	Pond	6/1/09	12:17	2.50	22.66	6.85	240	154	0.3	4	48
Elder Ck	Pond	6/1/09	12:18	2.91	22.56	6.78	275	176	0.3	3	12
Elder Ck	Pond	6/23/09	12:02	0.25	32.38	8.42	294	188	6.6	91	316
Elder Ck	Pond	6/23/09	12:03	0.50	31.91	8.35	295	189	6.4	88	315
Elder Ck	Pond	6/23/09	12:04	1.00	31.48	7.98	298	191	5.4	74	304
Elder Ck	Pond	6/23/09	12:05	1.50	30.58	7.31	306	196	2.4	32	279
Elder Ck	Pond	6/23/09	12:06	2.00	27.94	6.75	319	204	0.6	8	249
Elder Ck	Pond	6/23/09	12:07	2.30	25.30	6.63	357	228	0.4	4	16
Elder Ck	Pond	7/8/09	11:05	0.25	30.42	8.64	306	196	8.9	119	318
Elder Ck	Pond	7/8/09	11:06	0.50	30.22	8.64	306	196	8.8	116	319
Elder Ck	Pond	7/8/09	11:07	1.00	29.59	8.11	311	199	5.4	70	303
Elder Ck	Pond	7/8/09	11:08	1.50	29.53	8.09	311	199	5.3	69	305
Elder Ck	Pond	7/8/09	11:09	2.00	29.36	7.72	314	201	4.0	53	293
Elder Ck	Pond	7/8/09	11:10	2.36	28.24	6.79	326	209	0.3	4	18

Elder Creek Regional Stormwater Treatment Facility
Pond Vertical Field Profiles Collected from April 2009 - March 2010

Location	Site	Date MMDDYY	Time HHMMSS	Depth meters	Temp °C	pH Units	SpCond µmho/cm	TDS g/l	DO mg/l	DO% Sat	ORP mV
Elder Ck	Pond	7/14/09	7:28	0.25	29.27	8.69	295	189	8.2	108	369
Elder Ck	Pond	7/14/09	7:29	0.50	29.27	8.67	294	188	7.6	99	363
Elder Ck	Pond	7/14/09	7:30	1.00	29.22	8.59	293	188	7.2	93	357
Elder Ck	Pond	7/14/09	7:32	1.50	28.82	7.72	295	189	3.1	40	337
Elder Ck	Pond	7/14/09	7:33	2.00	28.55	7.41	292	187	1.4	18	328
Elder Ck	Pond	7/14/09	7:33	2.46	28.15	7.17	285	182	0.8	10	244
Elder Ck	Pond	7/21/09	11:36	0.25	30.31	8.70	295	189	8.7	116	332
Elder Ck	Pond	7/21/09	11:37	0.50	29.95	8.59	296	190	6.8	90	331
Elder Ck	Pond	7/21/09	11:37	1.00	29.61	8.16	302	193	4.1	54	316
Elder Ck	Pond	7/21/09	11:38	1.50	29.48	7.85	304	194	3.3	43	305
Elder Ck	Pond	7/21/09	11:39	2.00	29.40	7.62	307	197	2.5	33	298
Elder Ck	Pond	7/21/09	11:40	2.46	29.23	7.20	310	199	0.5	6	218
Elder Ck	Pond	8/3/09	10:58	0.25	31.03	8.88	271	173	8.3	112	314
Elder Ck	Pond	8/3/09	10:59	0.50	30.82	8.82	272	174	7.6	102	315
Elder Ck	Pond	8/3/09	11:00	1.00	30.13	8.57	277	177	5.8	77	307
Elder Ck	Pond	8/3/09	11:01	1.50	29.89	8.13	281	180	3.5	46	291
Elder Ck	Pond	8/3/09	11:02	2.00	29.64	7.58	287	184	1.1	14	98
Elder Ck	Pond	8/3/09	11:03	2.50	28.14	7.00	295	189	0.3	4	-28
Elder Ck	Pond	8/11/09	11:09	0.25	31.67	8.44	230	147	9.1	124	321
Elder Ck	Pond	8/11/09	11:10	0.50	31.22	8.50	226	145	9.0	122	326
Elder Ck	Pond	8/11/09	11:11	1.00	30.54	7.62	230	147	6.0	80	297
Elder Ck	Pond	8/11/09	11:12	1.50	30.18	7.33	230	147	3.9	52	290
Elder Ck	Pond	8/11/09	11:13	2.00	29.62	7.07	238	152	0.6	8	255
Elder Ck	Pond	8/11/09	11:14	2.49	27.69	6.87	263	168	0.3	4	-19
Elder Ck	Pond	8/20/09	12:05	0.25	29.04	7.20	223	142	3.4	44	283
Elder Ck	Pond	8/20/09	12:06	0.50	28.82	7.22	238	152	2.7	35	283
Elder Ck	Pond	8/20/09	12:07	1.00	27.15	6.93	304	195	1.1	14	271
Elder Ck	Pond	8/20/09	12:08	1.07	27.08	6.94	304	194	1.0	12	264
Elder Ck	Pond	9/9/09	12:06	0.25	30.33	8.46	238	152	6.9	91	350
Elder Ck	Pond	9/9/09	12:07	0.50	30.09	8.60	236	151	7.4	98	359
Elder Ck	Pond	9/9/09	12:08	1.00	29.37	8.39	238	152	6.7	87	356
Elder Ck	Pond	9/9/09	12:10	1.50	29.21	8.23	240	153	6.1	79	353
Elder Ck	Pond	9/9/09	12:11	2.00	28.73	7.34	245	157	2.7	35	319
Elder Ck	Pond	9/9/09	12:12	2.46	27.99	7.18	280	179	0.8	10	60
Elder Ck	Pond	9/18/09	8:39	0.25	29.35	8.66	250	160	6.9	90	352
Elder Ck	Pond	9/18/09	8:40	0.50	29.37	8.63	249	159	6.9	90	345
Elder Ck	Pond	9/18/09	8:41	1.00	29.37	8.59	249	159	6.7	88	341
Elder Ck	Pond	9/18/09	8:43	1.50	29.37	8.48	249	159	6.4	83	337
Elder Ck	Pond	9/18/09	8:44	2.00	28.90	7.15	265	170	0.5	7	283
Elder Ck	Pond	9/18/09	8:44	2.45	28.15	6.93	291	186	0.3	3	-64
Elder Ck	Pond	9/22/09	10:31	0.25	30.54	8.69	258	165	8.0	107	283
Elder Ck	Pond	9/22/09	10:32	0.50	30.47	8.73	255	163	8.0	107	279
Elder Ck	Pond	9/22/09	10:32	1.00	30.43	8.73	260	166	7.8	104	279
Elder Ck	Pond	9/22/09	10:33	1.50	30.12	7.93	265	169	3.4	45	255
Elder Ck	Pond	9/22/09	10:34	2.00	29.56	7.28	266	170	0.4	5	79
Elder Ck	Pond	9/22/09	10:35	2.49	28.39	6.91	300	192	0.2	3	-71
Elder Ck	Pond	9/28/09	11:56	0.25	29.69	8.14	264	169	6.3	83	292
Elder Ck	Pond	9/28/09	11:57	0.50	29.66	8.18	264	169	6.1	80	295
Elder Ck	Pond	9/28/09	11:58	1.00	29.28	7.92	265	169	4.6	60	286
Elder Ck	Pond	9/28/09	11:59	1.50	29.12	7.76	267	171	3.8	50	281
Elder Ck	Pond	9/28/09	12:00	2.00	29.06	7.82	267	171	3.9	51	284
Elder Ck	Pond	9/28/09	12:02	2.47	28.27	6.99	302	193	0.3	3	14
Elder Ck	Pond	10/5/09	12:25	0.25	28.44	8.11	277	177	6.5	84	297
Elder Ck	Pond	10/5/09	12:26	0.50	28.28	8.16	277	177	6.7	86	301
Elder Ck	Pond	10/5/09	12:27	1.00	27.81	8.15	275	176	6.2	79	303
Elder Ck	Pond	10/5/09	12:28	1.50	27.67	8.15	274	175	5.7	72	303
Elder Ck	Pond	10/5/09	12:29	2.00	27.59	7.89	276	177	4.3	55	294
Elder Ck	Pond	10/5/09	12:31	2.50	27.41	7.50	304	195	1.0	13	114

Elder Creek Regional Stormwater Treatment Facility
Pond Vertical Field Profiles Collected from April 2009 - March 2010

Location	Site	Date MMDDYY	Time HHMMSS	Depth meters	Temp °C	pH Units	SpCond µmho/cm	TDS g/l	DO mg/l	DO% Sat	ORP mV
Elder Ck	Pond	10/12/09	12:25	0.25	30.19	8.20	280	179	6.1	81	305
Elder Ck	Pond	10/12/09	12:26	0.50	30.11	8.16	279	179	6.0	79	305
Elder Ck	Pond	10/12/09	12:27	1.00	29.88	8.13	279	179	5.8	76	305
Elder Ck	Pond	10/12/09	12:28	1.50	29.11	7.37	284	181	0.5	6	260
Elder Ck	Pond	10/12/09	12:28	2.00	28.83	7.33	284	182	0.3	3	241
Elder Ck	Pond	10/12/09	12:29	2.50	27.66	7.09	305	195	0.2	2	-18
Elder Ck	Pond	10/12/09	12:30	2.55	27.78	7.13	303	194	0.2	2	-37
Elder Ck	Pond	10/19/09	11:16	0.25	23.37	8.19	283	181	7.9	93	295
Elder Ck	Pond	10/19/09	11:17	0.50	23.39	8.18	283	181	7.6	89	294
Elder Ck	Pond	10/19/09	11:18	1.00	23.38	8.18	284	182	7.4	87	294
Elder Ck	Pond	10/19/09	11:19	1.50	23.38	8.18	285	182	7.5	88	294
Elder Ck	Pond	10/19/09	11:21	2.00	23.38	8.18	285	182	7.1	84	294
Elder Ck	Pond	10/19/09	11:23	2.50	23.35	8.16	286	183	7.0	82	269
Elder Ck	Pond	10/27/09	11:05	0.25	26.18	8.38	294	188	8.5	106	307
Elder Ck	Pond	10/27/09	11:06	0.50	26.14	8.40	294	188	8.4	104	308
Elder Ck	Pond	10/27/09	11:07	1.00	25.93	8.40	294	188	8.2	101	308
Elder Ck	Pond	10/27/09	11:08	1.50	24.98	8.13	294	188	6.2	75	300
Elder Ck	Pond	10/27/09	11:09	2.00	24.48	7.58	297	190	2.4	29	273
Elder Ck	Pond	10/27/09	11:10	2.45	24.33	7.45	300	192	0.3	4	198
Elder Ck	Pond	11/10/09	11:27	0.25	23.31	8.48	312	199	9.0	105	344
Elder Ck	Pond	11/10/09	11:28	0.50	23.29	8.49	312	199	8.7	103	342
Elder Ck	Pond	11/10/09	11:29	1.00	23.20	8.49	311	199	8.7	102	341
Elder Ck	Pond	11/10/09	11:30	1.50	23.11	8.42	312	200	8.0	93	339
Elder Ck	Pond	11/10/09	11:31	2.00	22.97	8.19	315	202	6.0	70	333
Elder Ck	Pond	11/10/09	11:34	2.47	22.90	8.02	317	203	4.8	56	207
Elder Ck	Pond	11/17/09	12:31	0.25	22.30	8.75	308	197	11.6	133	440
Elder Ck	Pond	11/17/09	12:32	0.50	21.91	8.64	310	198	10.4	119	434
Elder Ck	Pond	11/17/09	12:33	1.00	21.37	8.66	309	198	9.9	112	437
Elder Ck	Pond	11/17/09	12:34	1.50	21.20	8.26	318	203	5.8	66	426
Elder Ck	Pond	11/17/09	12:35	2.00	21.18	8.27	317	203	5.7	65	426
Elder Ck	Pond	11/17/09	12:36	2.47	21.18	8.29	317	203	5.8	65	419
Elder Ck	Pond	12/3/09	9:33	0.25	21.17	8.35	323	207	9.3	104	534
Elder Ck	Pond	12/3/09	9:34	0.50	21.17	8.36	323	206	8.7	98	531
Elder Ck	Pond	12/3/09	9:35	1.00	21.13	8.32	324	207	8.2	93	528
Elder Ck	Pond	12/3/09	9:36	1.50	20.98	8.14	328	210	7.1	79	519
Elder Ck	Pond	12/3/09	9:37	2.00	20.44	7.89	330	211	5.1	56	510
Elder Ck	Pond	12/3/09	9:38	2.50	20.08	7.54	335	214	1.6	17	303
Elder Ck	Pond	12/7/09	10:19	0.25	18.20	7.67	311	199	6.3	66	524
Elder Ck	Pond	12/7/09	10:20	0.50	18.20	7.68	311	199	5.9	62	522
Elder Ck	Pond	12/7/09	10:21	1.00	18.21	7.69	311	199	5.8	62	522
Elder Ck	Pond	12/7/09	10:21	1.50	18.19	7.68	311	199	5.6	59	520
Elder Ck	Pond	12/7/09	10:22	2.00	18.15	7.67	311	199	5.4	58	520
Elder Ck	Pond	12/7/09	10:23	2.50	18.15	7.67	311	199	5.3	55	518
Elder Ck	Pond	12/7/09	10:24	2.55	18.16	7.65	311	199	5.1	54	491
Elder Ck	Pond	12/14/09	10:06	0.25	20.82	8.20	321	205	8.8	98	565
Elder Ck	Pond	12/14/09	10:06	0.50	20.80	8.16	321	206	8.6	96	560
Elder Ck	Pond	12/14/09	10:07	1.00	20.38	7.85	331	212	7.5	83	547
Elder Ck	Pond	12/14/09	10:08	1.50	19.34	7.95	320	205	7.4	80	551
Elder Ck	Pond	12/14/09	10:09	2.00	18.71	7.61	320	205	4.4	48	538
Elder Ck	Pond	12/14/09	10:10	2.50	18.71	7.52	322	206	3.0	32	534
Elder Ck	Pond	12/23/09	10:15	0.25	16.47	7.85	327	209	6.2	63	738
Elder Ck	Pond	12/23/09	10:16	0.50	16.47	7.85	327	209	5.9	61	720
Elder Ck	Pond	12/23/09	10:17	1.00	16.45	7.84	327	210	6.2	63	705
Elder Ck	Pond	12/23/09	10:18	1.50	16.43	7.86	327	209	6.0	61	692
Elder Ck	Pond	12/23/09	10:19	2.00	16.39	7.86	326	209	5.9	60	684
Elder Ck	Pond	12/23/09	10:20	2.50	16.38	7.85	327	209	5.5	56	655

Elder Creek Regional Stormwater Treatment Facility
Pond Vertical Field Profiles Collected from April 2009 - March 2010

Location	Site	Date MMDDYY	Time HHMMSS	Depth meters	Temp °C	pH Units	SpCond µmho/cm	TDS g/l	DO mg/l	DO% Sat	ORP mV
Elder Ck	Pond	12/29/09	11:24	0.25	15.67	7.73	334	214	7.2	73	455
Elder Ck	Pond	12/29/09	11:25	0.50	15.67	7.76	335	214	6.6	67	457
Elder Ck	Pond	12/29/09	11:26	1.00	15.66	7.78	334	214	6.4	65	458
Elder Ck	Pond	12/29/09	11:27	1.50	15.64	7.80	334	214	6.5	63	460
Elder Ck	Pond	12/29/09	11:27	2.00	15.63	7.79	335	214	6.3	63	457
Elder Ck	Pond	12/29/09	11:28	2.50	15.63	7.78	335	214	6.0	61	456
Elder Ck	Pond	12/29/09	11:29	2.60	15.64	7.79	335	214	6.0	61	353
Elder Ck	Pond	1/19/2010	12:50:19	0.25	15.64	8.12	333	213	10.9	110	596
Elder Ck	Pond	1/19/2010	12:51:15	0.50	15.34	8.08	334	214	10.4	104	588
Elder Ck	Pond	1/19/2010	12:52:10	1.00	15.12	8.12	335	214	10.4	103	578
Elder Ck	Pond	1/19/2010	12:53:21	1.50	14.90	8.15	333	213	10.4	103	569
Elder Ck	Pond	1/19/2010	12:54:38	2.00	13.52	8.27	331	212	11.3	108	564
Elder Ck	Pond	1/19/2010	12:56:40	2.58	12.89	8.23	332	212	10.2	97	506
Elder Ck	Pond	1/28/2010	14:41:59	0.25	17.94	7.61	343	220	7.7	82	523
Elder Ck	Pond	1/28/2010	14:42:50	0.50	17.65	7.59	345	220	7.5	79	520
Elder Ck	Pond	1/28/2010	14:43:45	1.00	17.27	7.51	346	221	7.1	74	524
Elder Ck	Pond	1/28/2010	14:44:44	1.50	17.07	7.49	346	222	6.8	70	523
Elder Ck	Pond	1/28/2010	14:45:36	2.00	16.98	7.46	347	222	6.6	69	525
Elder Ck	Pond	1/28/2010	14:47:10	2.44	16.87	7.32	349	223	5.5	57	440
Elder Ck	Pond	2/11/2010	10:54:52	0.25	14.65	8.10	339	217	9.6	94	446
Elder Ck	Pond	2/11/2010	10:55:47	0.50	14.65	7.75	339	217	9.4	92	445
Elder Ck	Pond	2/11/2010	10:56:34	1.00	14.62	7.74	339	217	9.3	91	444
Elder Ck	Pond	2/11/2010	10:57:20	1.50	14.57	7.77	340	217	9.6	95	441
Elder Ck	Pond	2/11/2010	10:58:41	2.00	14.53	7.80	340	218	9.6	94	439
Elder Ck	Pond	2/11/2010	11:00:16	2.50	14.51	7.57	346	222	2.1	21	320
Elder Ck	Pond	2/16/2010	11:48:02	0.25	13.53	8.37	335	214	10.6	102	407
Elder Ck	Pond	2/16/2010	11:48:49	0.50	13.52	8.38	335	214	10.4	100	405
Elder Ck	Pond	2/16/2010	11:49:45	1.00	13.44	8.39	334	214	10.3	98	403
Elder Ck	Pond	2/16/2010	11:50:38	1.50	13.43	8.40	334	214	10.2	98	402
Elder Ck	Pond	2/16/2010	11:51:38	2.00	13.36	8.40	334	214	10.1	97	400
Elder Ck	Pond	2/16/2010	11:53:03	2.45	13.32	8.37	334	214	10.1	96	385
Elder Ck	Pond	3/10/2010	15:10:46	0.25	17.88	8.46	357	228	11.5	122	420
Elder Ck	Pond	3/10/2010	15:11:41	0.50	17.76	8.48	357	229	11.4	120	416
Elder Ck	Pond	3/10/2010	15:12:52	1.00	17.57	8.55	358	229	11.0	115	408
Elder Ck	Pond	3/10/2010	15:13:57	1.50	17.43	8.52	358	229	11.0	115	408
Elder Ck	Pond	3/10/2010	15:15:30	2.00	16.68	8.48	357	228	10.1	104	410
Elder Ck	Pond	3/10/2010	15:17:25	2.46	16.47	8.00	429	274	0.4	4	407
Elder Ck	Pond	3/23/2010	12:59:08	0.25	19.12	7.95	319	204	9.5	102	392
Elder Ck	Pond	3/23/2010	13:00:06	0.50	19.10	7.93	319	204	9.2	99	392
Elder Ck	Pond	3/23/2010	13:01:13	1.00	18.21	7.97	319	204	9.0	96	390
Elder Ck	Pond	3/23/2010	13:02:12	1.50	18.01	7.86	320	205	8.6	91	394
Elder Ck	Pond	3/23/2010	13:03:13	2.00	18.00	7.87	320	205	8.7	92	395
Elder Ck	Pond	3/23/2010	13:04:37	2.50	17.94	7.80	326	208	7.9	83	382
Elder Ck	Pond	3/23/2010	13:07:59	2.54	17.95	6.97	320	205	1.3	14	111

APPENDIX D

QUALITY ASSURANCE DATA

Sample Duplicate Recovery Study
Elder Creek Regional Stormwater Treatment Facility
April 2009 - March 2010

PARAMETERS	UNITS	SAMPLE ID	SAMPLE DESCRIPTION	DATE COLLECTED	DATE RECEIVED	DATE ANALYZED	REPEAT 1	REPEAT 2	MEAN	s	% RELATIVE STD. DEVIATION (RSD)	ACCEPTANCE RANGE (% RSD)
Alkalinity	mg/l	09-1214	Site 4 Field Dup	03/31/09	03/31/09	04/13/09	129	128	128.5	0.7	0.55	0-4
Alkalinity	mg/l	09-1281	Site 1	4/2 - 4/7/09	04/07/09	04/14/09	139	138	138.5	0.7	0.51	0-4
Alkalinity	mg/l	09-1421	Site 4	4/13 - 4/16/09	04/16/09	04/17/09	109	108	108.5	0.7	0.65	0-4
Alkalinity	mg/l	09-1516	Site 4	4/16 - 4/23/09	04/23/09	04/29/09	114	115	114.5	0.7	0.62	0-4
Alkalinity	mg/l	09-1597	Site #1	4/30 - 5/7/09	05/07/09	05/08/09	151	150	150.5	0.7	0.47	0-4
Alkalinity	mg/l	09-1601	Site #4	4/30 - 5/7/09	05/07/09	05/08/09	97.8	97	97.4	0.6	0.58	0-4
Alkalinity	mg/l	09-1662	Rain	05/13/09	05/14/09	05/15/09	6.2	6.0	6.1	0.1	2.32	0-4
Alkalinity	mg/l	09-1793	Site 4	5/26 - 6/1/09	06/01/09	06/03/09	72.4	72	72.2	0.3	0.39	0-4
Alkalinity	mg/l	09-1795	Rain	5/26 - 5/29/09	06/01/09	06/03/09	0.8	0.8	0.8	0.0	0.00	0-4
Alkalinity	mg/l	09-1979	Rain	6/9 - 6/17/09	06/17/09	06/22/09	1.2	1.2	1.2	0.0	0.00	0-4
Alkalinity	mg/l	09-2124	Site #3	06/30/09	07/08/09	07/13/09	81.8	81.6	81.7	0.1	0.17	0-4
Alkalinity	mg/l	09-2192	Rain	7/8 - 7/14/09	07/14/09	07/15/09	2.2	2.2	2.2	0.0	0.00	0-4
Alkalinity	mg/l	09-2249	Site #4 Field Dup	7/14 - 7/21/09	07/21/09	07/21/09	148	147	147.5	0.7	0.48	0-4
Alkalinity	mg/l	09-2306	Rain	07/26/09	07/28/09	07/28/09	4.4	4.6	4.5	0.1	3.14	0-4
Alkalinity	mg/l	09-2413	Site #4 Field Dup	08/03/09	08/03/09	08/04/09	114	113	113.5	0.7	0.62	0-4
Alkalinity	mg/l	09-2527	Rain	8/3 - 8/7/09	08/11/09	08/12/09	2.2	2.2	2.2	0.0	0.00	0-4
Alkalinity	mg/l	09-2718	Site #4	8/13 - 8/19/9	08/21/09	08/21/09	76.4	76.8	76.6	0.3	0.37	0-4
Alkalinity	mg/l	09-2726	Rain	08/20/09	08/21/09	08/21/09	0	0	0.1	0.0	0.00	0-4
Alkalinity	mg/l	09-2978	Site #2 SB	09/04/09	09/04/09	09/04/09	0.6	0.6	0.6	0.0	0.00	0-4
Alkalinity	mg/l	09-2984	Rain SB	09/04/09	09/04/09	09/04/09	0.6	0.6	0.6	0.0	0.00	0-4
Alkalinity	mg/l	09-3439	REB	09/28/09	09/28/09	09/30/09	1.0	1.0	1.0	0.0	0.00	0-4
Alkalinity	mg/l	10-0032	Rain Blank	01/05/10	01/05/10	01/11/10	0.8	0.8	0.8	0.0	0.00	0-4
Alkalinity	mg/l	10-0083	Rain	01/17/10	01/17/10	01/22/10	11.6	11.4	11.5	0.1	1.23	0-4
Alkalinity	mg/l	10-0160	Rain	1/19 - 1/22/10	01/22/10	01/27/10	8.2	8.0	8.1	0.1	1.75	0-4
Alkalinity	mg/l	10-0230	Site #4	1/22 - 1/28/10	01/28/10	02/01/10	126	126	126.0	0.0	0.00	0-4
Alkalinity	mg/l	10-0252	Site #4	1/28 - 2/3/10	02/03/10	02/08/10	133	133	133.0	0.0	0.00	0-4
Alkalinity	mg/l	10-0258	Rain Blank	02/03/10	02/03/10	02/08/10	0.2	0.2	0.2	0.0	0.00	0-4
Alkalinity	mg/l	10-0376	Rain	02/12/10	02/16/10	02/18/10	2.6	2.6	2.6	0.0	0.00	0-4
Alkalinity	mg/l	10-0675	Rain	03/21/10	03/23/10	03/26/10	7.8	7.6	7.7	0.1	1.84	0-4

Sample Duplicate Recovery Study
Elder Creek Regional Stormwater Treatment Facility
April 2009 - March 2010

PARAMETERS	UNITS	SAMPLE ID	SAMPLE DESCRIPTION	DATE COLLECTED	DATE RECEIVED	DATE ANALYZED	REPEAT 1	REPEAT 2	MEAN	s	% RELATIVE STD. DEVIATION (RSD)	ACCEPTANCE RANGE (% RSD)
Ammonia	µg/l	09-1282	Site #2	04/07/09	04/07/09	04/16/09	97	92	94.5	3.5	3.74	0-10
Ammonia	µg/l	09-1394	Site #2	04/13/09	04/13/09	04/17/09	75	77	76.0	1.4	1.86	0-10
Ammonia	µg/l	09-1420	Site #2	04/16/09	04/16/09	04/17/09	68	68	68.0	0.0	0.00	0-10
Ammonia	µg/l	09-1603B	Rain Equipment Blank	05/07/09	05/07/09	05/12/09	0	0	0	0.0	0.00	0-10
Ammonia	µg/l	09-1663	Site #1	05/14/09	05/18/09	05/28/09	149	141	145.0	5.7	3.90	0-10
Ammonia	µg/l	09-1673	Site #2	05/19/09	05/19/09	05/28/09	59	63	61.0	2.8	4.64	0-10
Ammonia	µg/l	09-1711	Site #1	05/20/09	05/21/09	06/16/09	259	257	258.0	1.4	0.55	0-10
Ammonia	µg/l	09-1893	Site #4/Outflow Field Dup	06/01/09-06/09/09	06/09/09	06/17/09	21	19	20.0	1.4	7.07	0-10
Ammonia	µg/l	09-1976	Site #3	06/17/09	06/17/09	06/17/09	0	0	0	0.0	0.00	0-10
Ammonia	µg/l	09-2045	Site #4/Outflow Field Dup	06/23/09-06/30/09	06/30/09	07/22/09	27	23	25.0	2.2	8.79	0-10
Ammonia	µg/l	09-2187	Site #1	07/13/09	07/14/09	07/22/09	0	0	0	0.0	0.00	0-10
Ammonia	µg/l	09-2306	Site #4/Outflow	07/26/09	07/28/09	08/17/09	549	552	550.5	2.1	0.39	0-10
Ammonia	µg/l	09-2409	Site #3	07/28/09	08/03/09	08/18/09	38	39	38.5	0.7	1.84	0-10
Ammonia	µg/l	09-2720	Rain	08/13/09-08/19/09	08/21/09	08/24/09	0	0	0	0.0	0.00	0-10
Ammonia	µg/l	09-2975p	Site #1	08/28/09-09/04/09	09/04/09	09/28/09	164	157	160.5	4.9	3.08	0-10
Ammonia	µg/l	09-3438p	Rain	09/22/09-09/27/09	09/28/09	10/14/09	1517	1518	1517.5	0.7	0.05	0-10
Ammonia	µg/l	09-3888p	Site #4	10/27/09-11/05/09	11/05/09	11/30/09	21	19	20.0	1.4	7.07	0-10
Ammonia	µg/l	09-4078p	Site #1	11/17/09-11/30/09	11/30/09	12/18/09	43	42	42.5	0.7	1.66	0-10
Ammonia	µg/l	09-4188p	Rain Field Dup	12/04/09-12/07/09	12/07/09	12/18/09	337	321	329.0	11.3	3.44	0-10
Ammonia	µg/l	09-4480P	Rain	12/25/09	12/30/09	01/14/10	870	865	867.5	3.5	0.41	0-10
Ammonia	µg/l	10-0026P	Site #4	12/29/09 - 01/05/10	01/05/10	02/09/10	22	19	20.3	1.8	8.73	0-10
Ammonia	µg/l	10-0158P	Site # 3	01/22/10	01/22/10	02/09/10	158	164	161.0	4.2	2.64	0-10
Ammonia	µg/l	10-0229P	Site # 3	01/22/10-01/28/10	01/28/10	02/09/10	39	34	36.5	3.5	9.69	0-10
Ammonia	µg/l	10-0250P	Site # 2	02/03/10	02/03/10	02/09/10	125	128	126.5	2.1	1.68	0-10
Ammonia	µg/l	10-0358P	Site # 4	02/03/10-02/11/10	02/12/10	03/01/10	50	58	54.0	5.0	9.31	0-10
Ammonia	µg/l	10-0378P	Site # 3	02/12/10	02/17/10	03/01/10	36	42	39.0	3.6	9.26	0-10
Ammonia	µg/l	10-0533P	Site # 2	03/10/10	03/10/10	03/24/10	204	207	205.5	2.1	1.03	0-10
Ammonia	µg/l	10-0541P	Rain Equipment Blank	03/10/10	03/10/10	03/24/10	0	0	0.1	0.0	0.00	0-10
Ammonia	µg/l	10-0744P	Rain	03/28/10-03/29/10	03/29/10	04/12/10	60	62	61.0	1.4	2.32	0-10

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Color	PCU	09-1215F	Site 4 Blank	03/31/09	03/31/09	04/01/09	0	0	0.1	0.0	0.00	0-5
Color	PCU	09-1395F	Site 4	04/13/09	04/13/09	04/14/09	30	30	30.0	0.0	0.00	0-5
Color	PCU	09-1422F	Rain	04/14/09	04/16/09	04/17/09	12	11	11.5	0.1	0.62	0-5
Color	PCU	09-1516F	Site 4	04/16/09-04/23/09	04/23/09	04/28/09	23	23	23.0	0.0	0.00	0-5
Color	PCU	09-1560F	Site 4	4/24/09-4/28/09	04/30/09	05/01/09	39	38	38.5	0.7	1.84	0-5
Color	PCU	09-1603F	Rain Blank	05/07/09	05/07/09	05/08/09	0	0	0.1	0.0	0.00	0-5
Color	PCU	09-1661F	Site 4 F.D.	5/08/09- 5/14/09	05/14/09	05/14/09	38	38	38.0	0.0	0.00	0-5
Color	PCU	09-1673F	Site 2	05/19/09	05/19/09	05/20/09	35	34	34.5	0.7	2.05	0-5
Color	PCU	09-1729F	Rain	5/22/09-5/25/09	05/26/09	05/28/09	7	8	7.5	0.1	0.95	0-5
Color	PCU	09-1796F	Rain Blank	06/01/09	06/01/09	06/03/09	0	0	0.1	0.0	0.00	0-5
Color	PCU	09-1893F	Site 4 F.D.	6/1/09- 6/9/09	06/09/09	06/09/09	62	61	61.5	0.7	1.15	0-5
Color	PCU	09-1979F	Site Rain	6/9/09-6/17/09	06/17/09	06/18/09	10	11	10.5	0.1	0.68	0-5
Color	PCU	09-2192F	Rain	07/08/09-07/14/09	07/14/09	07/15/09	2	2	2.0	0.0	0.00	0-5
Color	PCU	09-2403F	Site #1	07/28/09	08/03/09	08/04/09	38	38	38.0	0.0	0.00	0-5
Color	PCU	09-2413F	Site#4 F.D.	07/28/09-08/03/09	08/03/09	08/04/09	41	44	42.5	1.5	3.50	0-5
Color	PCU	09-2527F	Rain	08/03/09-08/07/09	08/11/09	08/12/09	2	2	2.0	0.0	0.00	0-5
Color	PCU	09-2718F	Site# 4	08/11/09-08/20/09	08/21/09	08/21/09	41	42	41.5	0.7	1.70	0-5
Color	PCU	09-2726F	Rain	08/20/09	08/21/09	08/21/09	1	1	1.0	0.0	0.00	0-5
Color	PCU	09-2975F	Site #1	08/28/09-09/04/09	09/04/09	09/04/09	62	63	62.5	0.7	1.13	0-5
Color	PCU	09-2984F	Rain Blank	09/04/09	09/04/09	09/04/09	0	0	0.1	0.0	0.00	0-5
Color	PCU	09-3439F	Rain Blank	09/28/09	09/28/09	09/30/09	0	0	0.1	0.0	0.00	0-5
Color	PCU	10-0031F	Site #4 Blank	01/05/10	01/05/10	01/05/10	0.1	0.1	0.1	0.0	0.00	0-5
Color	PCU	10-0032F	Rain Blank	01/05/10	01/05/10	01/05/10	0.1	0.1	0.1	0.0	0.00	0-5
Color	PCU	10-0083F	Rain	01/17/10	01/19/10	01/19/10	13	13	13.0	0.0	0.00	0-5
Color	PCU	10-0160F	Rain	01/19/10-01/22/10	01/22/10	01/22/10	6	6	6.0	0.0	0.00	0-5
Color	PCU	10-0230F	Site #4	01/22/10-01/28/10	01/28/10	01/29/10	22	22	22.0	0.0	0.00	0-5
Color	PCU	10-0252F	Site #4	01/28/10-02/03/10	02/03/10	02/04/10	18	18	18.0	0.0	0.00	0-5
Color	PCU	10-0360F	Rain	02/05/10-02/09/10	02/12/10	02/12/10	4	4	4.0	0.0	0.00	0-5
Color	PCU	10-0376F	Rain	02/12/10	02/16/10	02/17/10	3	3	3.0	0.0	0.00	0-5

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Conductivity	μΩ	09-1215	Site 4 Blank	03/31/09	03/31/09	04/21/09	2.4	2.4	2.4	0.0	0.00	0-5
Conductivity	μΩ	09-1516	Site 4	4/16 - 4/23/09	04/23/09	05/05/09	265	272	268.5	4.9	1.84	0-5
Conductivity	μΩ	09-1597	Site 1	4/30 - 5/7/09	05/07/09	05/12/09	367	366	366.5	0.7	0.19	0-5
Conductivity	μΩ	09-1601	Site 4	4/30 - 5/7/09	05/07/09	05/12/09	271	273	272.0	1.4	0.52	0-5
Conductivity	μΩ	09-1662	Rain	05/13/09	05/14/09	05/18/09	30.0	30.2	30.1	0.1	0.47	0-5
Conductivity	μΩ	09-1669	Rain	05/17/09-05/18/09	05/18/09	05/26/09	20.4	20.4	20.4	0.0	0.00	0-5
Conductivity	μΩ	09-1672	Site 1	05/18/09	05/19/09	05/26/09	252	254	253.0	1.4	0.56	0-5
Conductivity	μΩ	09-1729	Rain	05/22/09-05/26/09	05/26/09	06/19/09	9.3	9.3	9.3	0.0	0.00	0-5
Conductivity	μΩ	09-1894	Rain	6/1 - 6/9/09	06/09/09	06/23/09	11.1	11.2	11.2	0.1	0.63	0-5
Conductivity	μΩ	09-2042	Site #2	06/30/09	06/30/09	07/06/09	403	405	404.0	1.4	0.35	0-5
Conductivity	μΩ	09-2124	Site #3	06/30/09	07/08/09	07/27/09	244	243	243.5	0.7	0.29	0-5
Conductivity	μΩ	09-2412	Site #4	7/28 - 8/3/09	08/03/09	07/29/09	282	282	282.0	0.0	0.00	0-5
Conductivity	μΩ	09-2416	Rain Equipment Blank	08/03/09	08/03/09	08/10/09	1.9	1.9	1.9	0.0	0.00	0-5
Conductivity	μΩ	09-2722	Site 1	08/20/09	08/21/09	08/10/09	184	184	184.0	0.0	0.00	0-5
Conductivity	μΩ	09-2978	Site 2 Sample Blank	09/04/09	09/04/09	09/01/09	1.9	1.9	1.9	0.0	0.00	0-5
Conductivity	μΩ	09-3278	Site 4 Outflow	09/09/09-09/18/09	09/18/09	09/25/09	263	263	263.0	0.0	0.00	0-5
Conductivity	μΩ	09-3436	Site 4 Outflow	09/22/09-09/28/09	09/28/09	09/25/09	269	269	269.0	0.0	0.00	0-5
Conductivity	μΩ	09-3538	Rain Equipment Blank	10/05/09	10/05/09	10/06/09	1.9	1.9	1.9	0.0	0.00	0-5
Conductivity	μΩ	09-3795	Site 4	10/19/09-10/27/09	10/27/09	10/06/09	250	250	250.0	0.0	0.00	0-5
Conductivity	μΩ	09-3890	Site 2 Sample Blank	11/05/09	11/05/09	10/29/09	2.0	2.0	2.0	0.0	0.00	0-5
Conductivity	μΩ	09-3916	Site 4	11/05/09-11/10/09	11/10/09	11/17/09	303	303	303.0	0.0	0.00	0-5
Conductivity	μΩ	09-4193	Rain Equipment Blank	12/07/09	12/07/09	12/29/09	1.9	1.9	1.9	0.0	0.00	0-5
Conductivity	μΩ	10-0027	Rain	01/01/10	01/05/10	01/25/10	14.4	14.4	14.4	0.0	0.00	0-5
Conductivity	μΩ	10-0252	Site #4	01/28/10-02/03/10	02/03/10	02/05/10	339	339	339.0	0.0	0.00	0-5
Conductivity	μΩ	10-0255	Site #2 Blank	02/03/10	02/03/10	02/05/10	1.8	1.8	1.8	0.0	0.00	0-5
Conductivity	μΩ	10-0535	Site #4	02/16/10-03/10/10	03/10/10	03/25/10	353	353	353.0	0.0	0.00	0-5
Conductivity	μΩ	10-0651	Rain F.D.	03/11/10-03/13/10	03/18/10	03/25/10	7.0	7.0	7.0	0.0	0.00	0-5
Conductivity	μΩ	10-0675	Rain	03/21/10	03/23/10	04/13/10	13.3	12.9	13.1	0.3	2.16	0-5
Conductivity	μΩ	10-0742	Site #3	03/28/10-03/29/10	03/29/10	04/13/10	232	232	232.0	0.0	0.00	0 - 3.7

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NOx	µg/l	09-1284f	Site #4 Field Dup	03/31/09-04/07/09	04/07/09	04/09/09	70	72	71.0	1.4	1.99	0-4
NOx	µg/l	09-1560f	Site #4	04/24/09-04/28/09	04/30/09	04/30/09	1	1	1.0	0.0	0.00	0-4
NOx	µg/l	09-1662f	Rain	05/13/09	05/14/09	05/15/09	438	435	436.5	2.1	0.49	0-4
NOx	µg/l	09-1672f	Site #1	05/18/09	05/19/09	05/20/09	140	143	141.5	2.1	1.50	0-4
NOx	µg/l	09-1793f	Site #4 / Outflow	5/26/09 - 6/01/09	06/01/09	06/03/09	13	13	13.0	0.0	0.00	0-4
NOx	µg/l	09-1892f	Site #4/Outflow	06/01/09-06/09/09	06/09/09	06/11/09	0	0	0	0.0	0.00	0-4
NOx	µg/l	09-2129f	Rain	06/30/09-07/08/09	07/08/09	07/10/09	74	73	73.5	0.7	0.96	0-4
NOx	µg/l	09-2192f	Rain	07/08/09-/07/14/09	07/14/09	07/16/09	143	151	147.3	5.5	3.74	0-4
NOx	µg/l	09-2403f	Site #1	07/28/09	08/03/09	08/06/09	523	523	523.0	0.0	0.00	0-4
NOx	µg/l	09-2413f	Site #4 Field Dup	07/28/09-08/03/09	08/03/09	08/06/09	5	4	4.5	0.1	1.59	0-4
NOx	µg/l	09-2720f	Rain	08/13/09-08/19/09	08/21/09	08/21/09	96	98	97.0	1.4	1.46	0-4
NOx	µg/l	09-2977f	Site #2	08/28/09-09/04/09	09/04/09	09/04/09	80	75	77.5	2.9	3.74	0-4
NOx	µg/l	09-2983f	Rain	08/28/09-09/04/09	09/04/09	09/05/09	136	143	139.5	4.9	3.55	0-4
NOx	µg/l	09-3438f	Rain	09/22/09-09/27/09	09/28/09	09/30/09	65	67	66.0	1.4	2.14	0-4
NOx	µg/l	09-3536f	Site #4 / Outflow	09/28/09-10/05/09	10/05/09	10/07/09	0	0	0.1	0.0	0.00	0-4
NOx	µg/l	09-4078f	Site #1	11/17/09-11/30/09	11/30/09	12/02/09	0	0	0	0.0	0.00	0-4
NOx	µg/l	09-4188f	Rain Field Dup	12/04/09-12/07/09	12/07/09	12/09/09	80	85	82.7	3.3	3.93	0-4
NOx	µg/l	09-1020f	Site #1	12/25/09-12/29/09	12/30/09	03/20/09	23181	23160	23170.5	14.8	0.06	0-4
NOx	µg/l	09-4476f	Site #1	12/25/09-12/29/09	12/30/09	12/31/09	121	125	123	2.8	2.30	0-4
NOx	µg/l	10-0026f	Site #4	12/29/09 - 01/05/10	01/05/10	01/06/10	22	22	22.0	0.0	0.00	0-4
NOx	µg/l	10-0027f	Rain	01/01/10	01/05/10	01/06/10	173	172	172.5	0.7	0.41	0-4
NOx	µg/l	10-0229f	Site # 3	01/22/10-01/28/10	01/28/10	01/29/10	14	13.4	13.7	0.4	3.10	0-4
NOx	µg/l	10-0252f	Site # 4	01/28/10-02/03/10	02/03/10	02/05/10	51	51	51.0	0.0	0.00	0-4
NOx	µg/l	10-0359f	Site # 4 Field Dup	02/03/10-02/11/10	02/12/10	02/12/10	12	11	11.5	0.1	0.62	0-4
NOx	µg/l	10-0376f	Rain	02/12/10	02/16/10	02/17/10	186	196	191.0	7.1	3.70	0-4
NOx	µg/l	10-0533f	Site # 2	03/10/10	03/10/10	03/12/10	119	119	119.0	0.0	0.00	0-4
NOx	µg/l	10-0650f	Rain	03/11/10-03/13/10	03/18/10	03/19/10	76	76	76.0	0.0	0.00	0-4
NOx	µg/l	10-0744f	Rain	03/28/10-03/29/10	03/29/10	03/31/10	110	114	112.0	2.8	2.53	0-4

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pH	s.u.	09-1214	Site 4 Field Dup	03/31/09	03/31/09	04/13/09	7.85	7.83	7.8	0.0	0.18	0-2
pH	s.u.	09-1281	Site 1	04/02/09 - 04/07/09	04/07/09	04/14/09	7.46	7.47	7.5	0.0	0.09	0-2
pH	s.u.	09-1421	Site 4	04/13/09 - 04/16/09	04/16/09	04/17/09	8.63	8.60	8.6	0.0	0.25	0-2
pH	s.u.	09-1516	Site 4	04/16/09 - 04/23/09	04/23/09	04/29/09	7.61	7.65	7.6	0.0	0.37	0-2
pH	s.u.	09-1597	Site #1	04/30/09 - 05/07/09	05/07/09	05/08/09	7.82	7.80	7.8	0.0	0.18	0-2
pH	s.u.	09-1601	Site #4	04/30/09 - 05/07/09	05/07/09	05/08/09	7.70	7.69	7.7	0.0	0.09	0-2
pH	s.u.	09-1662	Rain	05/13/09	05/13/09	05/15/09	5.91	5.90	5.9	0.0	0.12	0-2
pH	s.u.	09-1793	Site 4	05/26/09 - 06/01/09	06/01/09	06/03/09	7.62	7.63	7.6	0.0	0.09	0-2
pH	s.u.	09-1795	Rain	05/26/09 - 05/29/09	06/01/09	06/03/09	4.82	4.83	4.8	0.0	0.15	0-2
pH	s.u.	09-1979	Rain	06/09/09 - 06/17/09	06/17/09	06/22/09	4.96	4.98	5.0	0.0	0.28	0-2
pH	s.u.	09-2124	Site #3	06/30/09	07/08/09	07/13/09	7.65	7.63	7.6	0.0	0.19	0-2
pH	s.u.	09-2192	Rain	07/08/09 - 07/14/09	07/14/09	07/15/09	5.44	5.43	5.4	0.0	0.13	0-2
pH	s.u.	09-2249	Site #4 f.d.	07/14/09 - 07/21/09	07/21/09	07/21/09	7.98	7.94	8.0	0.0	0.36	0-2
pH	s.u.	09-2306	Rain	07/26/09	07/26/09	07/28/09	6.02	6.00	6.0	0.0	0.24	0-2
pH	s.u.	09-2527	Rain	08/03/09 - 08/07/09	08/11/09	08/12/09	5.41	5.42	5.4	0.0	0.13	0-2
pH	s.u.	09-3439	REB	09/28/09	09/28/09	09/30/09	5.59	5.60	5.6	0.0	0.13	0-2
pH	s.u.	09-3537	Site #4 SB	10/05/09	10/05/09	10/06/09	5.59	5.59	5.6	0.0	0.00	0-2
pH	s.u.	09-3892	SB#4	11/05/09	11/05/09	11/05/09	4.96	4.99	5.0	0.0	0.43	0-2
pH	s.u.	09-3916	Site #4	11/05/09 - 11/10/09	11/10/09	11/13/09	7.61	7.61	7.6	0.0	0.00	0-2
pH	s.u.	09-4078	Site #1	11/17/09 - 11/30/09	11/30/09	12/03/09	7.26	7.24	7.3	0.0	0.20	0-2
pH	s.u.	09-4188	Rain Field Dup	12/03/09 - 12/07/09	12/07/09	12/16/09	5.71	5.73	5.7	0.0	0.25	0-2
pH	s.u.	09-4453	Rain	12/18/09	12/23/09	01/05/10	6.44	6.45	6.4	0.0	0.11	0-2
pH	s.u.	09-4477	Site #3	12/29/09	12/30/09	01/05/10	7.48	7.49	7.5	0.0	0.09	0-2
pH	s.u.	09-4480	Rain	12/25/09	12/30/09	01/05/10	6.32	6.30	6.3	0.0	0.22	0-2
pH	s.u.	10-0032	Rain	01/05/10	01/05/10	01/11/10	5.71	5.72	5.7	0.0	0.12	0-2
pH	s.u.	10-0083	Rain	01/17/10	01/17/10	01/22/10	6.53	6.51	6.5	0.0	0.22	0-2
pH	s.u.	10-0160	Rain	1/19 - 1/22/10	01/22/10	01/27/10	6.27	6.28	6.3	0.0	0.11	0-2
pH	s.u.	10-0230	Site #4	1/22 - 1/28/10	01/28/10	02/01/10	7.68	7.70	7.7	0.0	0.18	0-2
pH	s.u.	10-0252	Site #4	1/28 - 2/3/10	02/03/10	02/08/10	7.80	7.79	7.8	0.0	0.09	0-2

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SRP	µg/l	09-1284f	Site #4 Field Dup	03/31/09-04/07/09	04/07/09	04/09/09	73	72	72.5	0.7	0.98	0-5
SRP	µg/l	09-1560f	Site #4	04/24/09-04/28/09	04/30/09	04/30/09	57	57	57.0	0.0	0.00	0-5
SRP	µg/l	09-1662f	Rain	05/13/09	05/14/09	05/15/09	243	245	244.0	1.4	0.58	0-5
SRP	µg/l	09-1672f	Site #1	05/18/09	05/19/09	05/20/09	277	283	280.0	4.2	1.52	0-5
SRP	µg/l	09-1793f	Site #4 / Outflow	5/26/09 - 6/01/09	06/01/09	06/03/09	336	343	339.5	4.9	1.46	0-5
SRP	µg/l	09-1892f	Site #4/Outflow	06/01/09-06/09/09	06/09/09	06/11/09	333	332	332.5	0.7	0.21	0-5
SRP	µg/l	09-2129f	Rain	06/30/09-07/08/09	07/08/09	07/10/09	0	0	0	0.0	0.00	0-5
SRP	µg/l	09-2192f	Rain	07/08/09-/07/14/09	07/14/09	07/16/09	0.15	0.14	0.1	0.0	4.88	0-5
SRP	µg/l	09-2403f	Site #1	07/28/09	08/03/09	08/06/09	199	204	201.5	3.5	1.75	0-5
SRP	µg/l	09-2413f	Site #4 Field Dup	07/28/09-08/03/09	08/03/09	08/06/09	317	316	316.5	0.7	0.22	0-5
SRP	µg/l	09-2720f	Rain	08/13/09-08/19/09	08/21/09	08/21/09	0	0	0	0.0	0.00	0-5
SRP	µg/l	09-2977f	Site #2	08/28/09-09/04/09	09/04/09	09/04/09	490	493	491.5	2.1	0.43	0-5
SRP	µg/l	09-2983f	Rain	08/28/09-09/04/09	09/04/09	09/05/09	5	4	4.5	0.1	1.59	0-5
SRP	µg/l	09-3438f	Rain	09/22/09-09/27/09	09/28/09	09/30/09	95	94	94.5	0.7	0.75	0-5
SRP	µg/l	09-3536f	Site #4 / Outflow	09/28/09-10/05/09	10/05/09	10/07/09	204	218	211.0	9.9	4.69	0-5
SRP	µg/l	09-3888f	Site #4	10/27/09-11/05/09	11/05/09	11/06/09	290	294	292.0	2.8	0.97	0-5
SRP	µg/l	09-4078f	Site #1	11/17/09-11/30/09	11/30/09	12/02/09	216	219	217.5	2.1	0.98	0-5
SRP	µg/l	09-4188f	Rain Field Dup	12/04/09-12/07/09	12/07/09	12/09/09	7	6	6.5	0.1	1.10	0-5
SRP	µg/l	09-1342f	Site #1	12/25/09-12/29/09	12/30/09	04/09/09	15	14	14.5	0.7	4.88	0-5
SRP	µg/l	09-4476f	Site #1	12/25/09-12/29/09	12/30/09	12/31/09	312	318	315.0	4.2	1.35	0-5
SRP	µg/l	10-0026f	Site #4	12/29/09 - 01/05/10	01/05/10	01/06/10	106	105	105.5	0.7	0.67	0-5
SRP	µg/l	10-0027f	Rain	01/01/10	01/05/10	01/06/10	119	121	120.0	1.4	1.18	0-5
SRP	µg/l	10-0158f	Site # 3	01/22/10	01/22/10	01/22/10	1069	1095	1082.0	18.4	1.70	0-5
SRP	µg/l	10-0229f	Site # 3	01/22/10-01/28/10	01/28/10	01/29/10	52	50	51.0	1.4	2.77	0-5
SRP	µg/l	10-0252f	Site # 4	01/28/10-02/03/10	02/03/10	02/05/10	64	65	64.5	0.7	1.10	0-5
SRP	µg/l	10-0359f	Site # 4 Field Dup	02/03/10-02/11/10	02/12/10	02/12/10	37	37	37.0	0.0	0.00	0-5
SRP	µg/l	10-0376f	Rain	02/12/10	02/16/10	02/17/10	10	10	10.0	0.0	0.00	0-5
SRP	µg/l	10-0533f	Site # 2	03/10/10	03/10/10	03/12/10	30	31	30.5	0.7	2.32	0-5
SRP	µg/l	10-0650f	Rain	03/11/10-03/13/10	03/18/10	03/19/10	2	2	2.0	0.0	0.00	0-5

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Total N	µg/l	09-1208f	Site #1	03/31/09	03/31/09	04/30/09	269	240	254.5	20.5	8.06	0-10
Total N	µg/l	09-1284f	Site #4 Field Dup	03/31/09-04/07/09	04/07/09	05/05/09	559	611	585.0	36.8	6.29	0-10
Total N	µg/l	09-1394f	Site #2	04/13/09	04/13/09	05/04/09	644	620	632.0	17.0	2.69	0-10
Total N	µg/l	09-1422f	Rain	04/14/09	04/16/09	05/07/09	1276	1262	1269.0	9.9	0.78	0-10
Total N	µg/l	09-1422f	Rain	04/14/09	04/16/09	05/07/09	1118	1099	1108.5	13.4	1.21	0-10
Total N	µg/l	09-1975f	Site #2	06/17/09	06/17/09	07/17/09	672	652	662.0	14.1	2.14	0-10
Total N	µg/l	09-1993	Site #3	06/18/09	06/23/09	07/09/10	1066	1101	1083.5	24.7	2.28	0-10
Total N	µg/l	09-2305	Site #1	7/21/09-07/28/09	07/28/09	10/26/09	2523	2604	2563.5	57.3	2.23	0-10
Total N	µg/l	09-2526f	Site #4/Outflow	08/03/09-08/11/09	08/11/09	11/04/09	1342	1321	1331.5	14.8	1.12	0-10
Total N	µg/l	09-2827f	Site #4/Outflow	08/21/08/28/08	08/28/09	09/26/09	438	414	426.0	17.0	3.98	0-10
Total N	µg/l	09-3435f	Site #3	09/28/09	09/28/09	12/02/09	932	908	920.0	17.0	1.84	0-10
Total N	µg/l	09-4079FP	Site #4	11/17/09-11/30/09	11/30/09	12/22/09	181	187	184	4.2	2.31	0-10
Total N	µg/l	09-4191p	Site #3 Sampler Blank	12/07/09	12/07/09	02/02/10	0	0	0.1	0.0	0.00	0-10
Total N	µg/l	09-4188f	Rain Field Dup	12/04/09-12/07/09	12/07/09	02/02/10	383	409	396.0	18.4	4.64	0-10
Total N	µg/l	09-4452f	Site #4	12/14/09-12/23/09	12/23/09	02/04/10	487	423	455.0	45.3	9.95	0-10
Total N	µg/l	09-4480f	Rain	12/25/09	12/30/09	02/04/10	1111	1258	1184.5	103.9	8.78	0-10
Total N	µg/l	10-0027P	Rain	01/01/10	01/05/10	02/12/10	892	885	888.5	4.9	0.56	0-10
Total N	µg/l	10-0027FP	Rain	01/01/10	01/05/10	02/12/10	948	946	947.0	1.4	0.15	0-10
Total N	µg/l	10-0082P	Site # 4 F.D.	01/05/10-01/19/10	01/19/10	02/08/10	665	695	680.0	21.2	3.12	0-10
Total N	µg/l	10-0158FP	Site # 3	01/22/10	01/22/10	02/15/10	692	702	697.0	7.1	1.01	0-10
Total N	µg/l	10-0230FP	Site # 4	01/22/10-01/28/10	01/28/10	02/16/10	424	444	434.0	14.1	3.26	0-10
Total N	µg/l	10-0251FP	Site # 3	02/03/10	02/03/10	02/16/10	534	508	521.0	18.4	3.53	0-10
Total N	µg/l	10-0358P	Site # 4	02/03/10-02/11/10	02/12/10	02/22/10	875	909	892.0	24.0	2.70	0-10
Total N	µg/l	10-0380FP	Site # 4	02/11/10-02/16/10	02/17/10	02/22/10	497	490	493.5	4.9	1.00	0-10
Total N	µg/l	10-0532P	Site # 1	02/16/10-03/10/10	03/10/10	03/30/10	1255	1267	1261.0	8.5	0.67	0-10
Total N	µg/l	10-0532FP	Site # 1	02/16/10-03/10/10	03/10/10	03/30/10	1060	1023	1041.5	26.2	2.51	0-10
Total N	µg/l	10-0582P	Site # 1	03/12/10	03/12/10	03/30/10	813	856	834.5	30.4	3.64	0-10
Total N	µg/l	10-0729FP	Rain	03/25/10	03/26/10	04/15/10	951	965	958.0	9.9	1.03	0-10
Total N	µg/l	10-0744FP	Rain	03/28/10-03/29/10	03/29/10	04/15/10	343	352	347.5	6.4	1.83	0-10

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Total P	µg/l	09-1208f	Site #1	03/31/09	03/31/09	04/30/09	134	152	143.0	12.7	8.90	0-10
Total P	µg/l	09-1284f	Site #4 Field Dup	03/31/09-04/07/09	04/07/09	05/05/09	72.4	79.5	76.0	5.0	6.61	0-10
Total P	µg/l	09-1394f	Site #2	04/13/09	04/13/09	05/04/09	415	422	418.5	4.9	1.18	0-10
Total P	µg/l	09-1422f	Rain	04/14/09	04/16/09	05/07/09	28	30	29.0	1.4	4.88	0-10
Total P	µg/l	09-1975f	Site #2	06/17/09	06/17/09	07/17/09	361	352	356.5	6.4	1.79	0-10
Total P	µg/l	09-1993	Site #3	06/18/09	06/23/09	07/09/10	107	108	107.5	0.7	0.66	0-10
Total P	µg/l	09-2305	Site #1	7/21/09-07/28/09	07/28/09	10/26/09	420	422	421.0	1.4	0.34	0-10
Total P	µg/l	09-2526f	Site #4/Outflow	08/03/09-08/11/09	08/11/09	11/04/09	172	170	171.0	1.4	0.83	0-10
Total P	µg/l	09-2827f	Site #4/Outflow	08/21/08/28/08	08/28/09	09/26/09	147	148	147.5	0.7	0.48	0-10
Total P	µg/l	09-3435f	Site #3	09/28/09	09/28/09	12/02/09	45	42	43.5	2.1	4.88	0-10
Total P	µg/l	09-4079FP	Site #4	11/17/09-11/30/09	11/30/09	12/22/09	229	228	228.5	0.7	0.31	0-10
Total P	µg/l	09-4191p	Site #3 Sampler Blank	12/07/09	12/07/09	02/02/10	17	17	17.0	0.0	0.00	0-10
Total P	µg/l	09-4188f	Rain Field Dup	12/04/09-12/07/09	12/07/09	02/02/10	21	21	21.0	0.0	0.00	0-10
Total P	µg/l	09-4452f	Site #4	12/14/09-12/23/09	12/23/09	02/04/10	90	91	90.5	0.7	0.78	0-10
Total P	µg/l	09-4480f	Rain	12/25/09	12/30/09	02/04/10	86	79	82.5	4.9	6.00	0-10
Total P	µg/l	10-027P	Rain	01/01/10	01/05/10	02/12/10	77	78	77.5	0.7	0.91	0-10
Total P	µg/l	10-027FP	Rain	01/01/10	01/05/10	02/12/10	65	65	65.0	0.0	0.00	0-10
Total P	µg/l	10-082P	Site # 4 F.D.	01/05/10-01/19/10	01/19/10	02/08/10	133	137	135.0	2.8	2.10	0-10
Total P	µg/l	10-158FP	Site # 3	01/22/10	01/22/10	02/15/10	578	579	578.5	0.7	0.12	0-10
Total P	µg/l	10-230FP	Site # 4	01/22/10-01/28/10	01/28/10	02/16/10	68	68	68.0	0.0	0.00	0-10
Total P	µg/l	10-251FP	Site # 3	02/03/10	02/03/10	02/16/10	1	1	1.0	0.0	0.00	0-10
Total P	µg/l	10-0358P	Site # 4	02/03/10-02/11/10	02/12/10	02/22/10	142	147	144.5	3.5	2.4	0-10
Total P	µg/l	10-0376P	Rain	02/12/10	02/16/10	02/22/10	16	13	14.5	1.5	10.0	0-10
Total P	µg/l	10-0380FP	Site # 4	02/11/10-02/16/10	02/17/10	02/22/10	57	57	57.0	0.0	0.00	0-10
Total P	µg/l	10-0532P	Site # 1	02/16/10-03/10/10	03/10/10	03/30/10	555	551	553.0	2.8	0.51	0-10
Total P	µg/l	10-0532FP	Site # 1	02/16/10-03/10/10	03/10/10	03/30/10	138	147	142.5	6.4	4.47	0-10
Total P	µg/l	10-0582P	Site # 1	03/12/10	03/12/10	03/30/10	440	441	440.5	0.7	0.16	0-10
Total P	µg/l	10-0729FP	Rain	03/25/10	03/26/10	04/15/10	57	55	56.0	1.4	2.53	0-10
Total P	µg/l	10-0744FP	Rain	03/28/10-03/29/10	03/29/10	04/15/10	22	22	22.0	0.0	0.00	0-10

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TSS	mg/L	09-1214	Site 4 Field Dup	03/31/09	03/31/09	04/10/09	9.3	9.3	9.3	0.0	0.00	0 - 13
TSS	mg/L	09-1284	Site 4 Field Dup	3/31 - 4/7/09	04/07/09	04/10/09	8.8	8.5	8.7	0.2	2.45	0 - 13
TSS	mg/L	09-1395	Site #4	04/13/09	04/13/09	04/17/09	25.6	25.6	25.6	0.0	0.00	0 - 13
TSS	mg/L	09-1422	Rain	04/14/09	04/16/09	04/17/09	1.6	1.6	1.6	0.0	0.00	0 - 13
TSS	mg/L	09-1516	Site 4	4/16 - 4/23/09	04/23/09	04/27/09	9.7	9.7	9.7	0.0	0.00	0 - 13
TSS	mg/L	09-1661	Site #4 Field Dup	5/8 - 5/14/09	05/14/09	05/15/09	10.3	9.8	10.1	0.4	3.52	0 - 13
TSS	mg/L	09-1793	Site 4	5/26 - 6/1/09	06/01/09	06/01/09	4.0	4.2	4.1	0.1	3.45	0 - 13
TSS	mg/L	09-1795	Rain	5/26 - 5/29/09	06/01/09	06/01/09	2.0	2.0	2.0	0.0	0.00	0 - 13
TSS	mg/L	09-1894	Rain	6/1 - 6/9/09	06/09/09	06/11/09	2.0	2.0	2.0	0.0	0.00	0 - 13
TSS	mg/L	09-1979	Rain	6/9 - 6/17/09	06/17/09	06/19/09	10	10.5	10.3	0.4	3.45	0 - 13
TSS	mg/L	09-2124	Site #3	06/30/09	06/30/09	07/10/09	6.3	6.3	6.3	0.0	0.00	0 - 13
TSS	mg/L	09-2403	Site #1	07/28/09	08/03/09	08/15/09	139	139	139.0	0.0	0.00	0 - 13
TSS	mg/L	09-2413	Site #4 Field Dup	7/28 - 8/3/09	08/03/09	08/15/09	7.1	6.2	6.7	0.6	9.57	0 - 13
TSS	mg/L	09-2525	Site #3	08/03/09	08/11/09	08/14/09	4.4	4.4	4.4	0.0	0.00	0 - 13
TSS	mg/L	09-2720	Rain	8/13 - 8/19/09	08/21/09	08/27/09	0.1	0.2	0.1	0.0	4.88	0 - 13
TSS	mg/L	09-2978	Site #2 SB	09/04/09	09/04/09	09/10/09	0.2	0.1	0.1	0.0	4.88	0 - 13
TSS	mg/L	09-3538	Rain Equip Blank	10/05/09	10/05/09	10/05/09	0.0	0.01	0.0	0.0	0.00	0 - 13
TSS	mg/L	09-3892	Site #4 SB	11/05/09	11/05/09	11/05/09	0.1	0.1	0.1	0.0	0.00	0 - 13
TSS	mg/L	09-4078	Site #1	11/17 - 11/30/09	11/30/09	12/02/09	53.7	52.7	53.2	0.7	1.33	0 - 13
TSS	mg/L	09-4188	Rain Field Dup	12/4 - 12/7/09	12/07/09	12/11/09	1.9	2.1	2.0	0.1	3.90	0 - 13
TSS	mg/L	09-4453	Rain	12/18/09	12/18/09	12/28/09	2.7	2.7	2.7	0.0	0.00	0 - 13
TSS	mg/L	10-0027	Rain Blank	01/05/10	01/05/10	01/08/10	0.4	0.4	0.4	0.0	0.00	0 - 13
TSS	mg/L	10-0081	Site #4	1/5 - 1/19/10	01/19/10	01/20/10	34	32	33.0	1.4	4.29	0 - 13
TSS	mg/L	10-0083	Rain	01/17/10	01/19/10	01/20/10	2.0	2.0	2.0	0.0	0.00	0 - 13
TSS	mg/L	10-0160	Rain	1/19 - 1/22/10	01/22/10	01/25/10	3.5	3.5	3.5	0.0	0.00	0 - 13
TSS	mg/L	10-0230	Site #4	1/22 - 1/28/10	01/28/10	01/29/10	0.8	0.7	0.8	0.1	9.43	0 - 13
TSS	mg/L	10-0252	Site #4	1/28 - 2/3/10	02/03/10	02/04/10	4.5	4.6	4.6	0.1	1.55	0 - 13
TSS	mg/L	10-0358	Site #4	02/10/10	02/12/10	02/12/10	15	14.9	15.0	0.1	0.47	0 - 13
TSS	mg/L	10-0533	Site #2	03/10/10	03/10/10	03/12/10	27.8	26.0	26.9	1.3	4.73	0 - 13

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PARAMETERS	UNITS	SAMPLE ID	SAMPLE DESCRIPTION	DATE COLLECTED	DATE RECEIVED	DATE ANALYZED	REPEAT 1	REPEAT 2	MEAN	s	% RELATIVE STD. DEVIATION (RSD)	ACCEPTANCE RANGE (% RSD)
Turbidity	NTU	09-1285	Rain	3/31 - 4/7/09	04/07/09	04/09/09	5.3	5.3	5.3	0.0	0.00	0 - 3.7
Turbidity	NTU	09-1516	Site 4	4/16 - 4/23/09	04/23/09	04/24/09	3.1	3.1	3.1	0.0	0.00	0 - 3.7
Turbidity	NTU	09-1560	Site 4	4/24 - 4/28/09	04/30/09	05/01/09	7.3	7.1	7.2	0.1	1.96	0 - 3.7
Turbidity	NTU	09-1597	Site 1	4/30 - 5/7/09	05/07/09	05/08/09	7.3	6.9	7.1	0.2	3.09	0 - 3.7
Turbidity	NTU	09-1601	Site 4	4/30 - 5/7/09	05/07/09	05/08/09	4.5	4.7	4.6	0.1	3.07	0 - 3.7
Turbidity	NTU	09-1662	Rain	05/13/09	05/14/09	05/15/09	6.9	7	7.0	0.1	1.02	0 - 3.7
Turbidity	NTU	09-1793	Site 4	5/26 - 6/1/09	06/01/09	06/02/09	2.5	2.5	2.5	0.0	0.00	0 - 3.7
Turbidity	NTU	09-1796	Rain Blank	06/01/09	06/01/09	06/02/09	0.2	0.2	0.2	0.0	0.00	0 - 3.7
Turbidity	NTU	09-1894	Rain	6/1 - 6/9/09	06/09/09	06/10/09	0.8	0.8	0.8	0.0	0.00	0 - 3.7
Turbidity	NTU	09-1979	Rain	6/9 - 6/17/09	06/17/09	06/18/09	2.7	2.7	2.7	0.0	0.00	0 - 3.7
Turbidity	NTU	09-1996	Rain	06/18/09	06/23/09	06/24/09	4.0	3.9	4.0	0.1	1.79	0 - 3.7
Turbidity	NTU	09-2124	Site #3	06/30/09	07/08/09	07/10/09	5.3	5.3	5.3	0.0	0.00	0 - 3.7
Turbidity	NTU	09-2192	Rain	7/8 - 7/14/9	07/14/09	07/15/09	1.4	1.4	1.4	0.0	0.00	0 - 3.7
Turbidity	NTU	09-2249	Site #4 F.D.	7/14 - 7/21/09	07/21/09	07/22/09	1.5	1.6	1.5	0.0	0.46	0 - 3.7
Turbidity	NTU	09-2306	Rain	07/26/09	07/28/09	07/29/09	3.0	3.1	3.1	0.1	2.32	0 - 3.7
Turbidity	NTU	09-3439	REB	09/28/09	09/28/09	09/30/09	0.2	0.2	0.2	0.0	0.00	0 - 3.7
Turbidity	NTU	09-3537	Site #4	10/05/09	10/05/09	10/07/09	0.2	0.2	0.2	0.0	0.00	0 - 3.7
Turbidity	NTU	09-3892	Site #4 Blank	11/05/09	11/05/09	11/05/09	0.2	0.2	0.2	0.0	0.00	0 - 3.7
Turbidity	NTU	09-3916	Site #4	11/10/09	11/10/09	11/12/09	12.3	12.2	12.3	0.1	0.58	0 - 3.7
Turbidity	NTU	09-3971	Site #4	11/10 - 11/17/09	11/17/09	11/17/09	11.5	11.5	11.5	0.0	0.00	0 - 3.7
Turbidity	NTU	09-4078	Site #1	11/17 - 11/30/09	11/30/09	12/02/09	27.1	26.8	27.0	0.2	0.79	0 - 3.7
Turbidity	NTU	10-0027	Rain	01/01/10	01/05/10	01/06/10	0.8	0.8	0.8	0.0	0.00	0 - 3.7
Turbidity	NTU	10-0083	Rain	01/17/10	01/19/10	01/20/10	2.0	2.0	2.0	0.0	0.00	0 - 3.7
Turbidity	NTU	10-0160	Rain	1/19 - 1/22/10	01/22/10	01/23/10	0.7	0.7	0.7	0.0	0.00	0 - 3.7
Turbidity	NTU	10-0230	Site #4	1/22 - 1/28/10	01/28/10	01/29/10	1.2	1.2	1.2	0.0	0.00	0 - 3.7
Turbidity	NTU	10-0252	Site #4	1/28 - 2/3/10	02/03/10	02/04/10	1.8	1.7	1.7	0.0	2.27	0 - 3.7
Turbidity	NTU	10-0360	Rain	02/10/10	02/12/10	02/12/10	1.8	1.8	1.8	0.0	0.00	0 - 3.7
Turbidity	NTU	10-0536	Rain	2/22 - 3/2/10	03/10/10	03/12/10	1.1	1.1	1.1	0.0	0.00	0 - 3.7
Turbidity	NTU	10-0583	Site #3	03/12/10	03/12/10	03/14/10	3.5	3.5	3.5	0.0	0.00	0 - 3.7

Matrix Spike Recovery Study
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PARAMETER	UNITS	SAMPLE ID	SAMPLE DESCRIPTION	DATE COLLECTED	DATE RECEIVED	DATE ANALYZED	INITIAL CONC.	INITIAL VOLUME (ml)	SPIKE CONC.	SPIKE VOLUME ADDED (ml)	Dilution Factor	THEOR. CONC.	ACTUAL CONC.	PERCENT RECOVERY	ACCEPTANCE RANGE
Alkalinity	mg/l	09-2725	Site #4	08/20/09	08/21/09	08/21/09	74.6	50	1000	1	1	94.6	88.8	94%	91-105
Alkalinity	mg/l	09-2984	Rain Sample Blank	09/04/09	09/04/09	09/04/09	0.6	50	1000	0.5	1	10.6	10.6	100%	91-105
Alkalinity	mg/l	09-3892	Site #4	11/05/09	11/05/09	11/05/09	0.4	50	1000	0.4	1	8.4	8.4	100%	91-105
Alkalinity	mg/l	09-4477	Site #3	12/29/09	12/30/09	01/05/10	187	50	1000	0.3	1	193	194	101%	91-105
Alkalinity	mg/l	10-0083	Rain	01/17/10	01/19/10	01/22/10	11.4	50	1000	0.3	1	17.4	17.8	102%	91-105
Alkalinity	mg/l	10-0729	Rain	03/25/10	03/26/10	04/06/10	3.6	50	1000	0.3	1	9.6	9.2	96%	91-105
Alkalinity	mg/l	10-0160	Rain	1/19 - 1/22/10	01/22/10	01/27/10	8.0	50	1000	0.3	1	14.0	13.4	96%	91-105
Alkalinity	mg/l	10-0230	Site #4	1/22 - 1/28/10	01/28/10	02/01/10	126	50	1000	0.3	1	132	134	102%	91-105
Alkalinity	mg/l	10-0252	Site #4	1/28 - 2/3/10	02/03/10	02/08/10	133	50	1000	0.3	1	139	138	99%	91-105
Alkalinity	mg/l	09-4078	Site #1	11/17 - 11/30/09	11/30/09	12/03/09	186	50	1000	0.4	1	194.0	194	100%	91-105
Alkalinity	mg/l	09-2527	Rain	8/3 - 8/7/09	08/11/09	08/12/09	2.2	50	1000	0.5	1	12.2	11.8	97%	91-105
Ammonia	µg/l	09-1282P	Site #2	04/07/09	04/07/09	04/16/09	97	10	10000	1.0	1	1097	1013	92%	80-120
Ammonia	µg/l	09-1394P	Site #2	04/13/09	04/13/09	04/17/09	75	10	10000	1.0	1	1075	1169	109%	80-120
Ammonia	µg/l	09-1420P	Site #2	04/16/09	04/16/09	04/17/09	68	10	10000	1.0	1	1068	1162	109%	80-120
Ammonia	µg/l	09-1663P	Site #1	05/14/09	05/18/09	05/28/09	149	10	10000	1.0	1	1149	1070	93%	80-120
Ammonia	µg/l	09-2409P	Site #3	07/28/09	08/03/09	08/18/09	38	10	10000	1.0	1	1038	1060	102%	80-120
Ammonia	µg/l	10-0158P	Site # 3	01/22/10	01/22/10	02/09/10	164	10	10000	1.0	1	1164	1023	88%	80-120
Ammonia	µg/l	10-0250P	Site # 2	02/03/10	02/03/10	02/09/10	125	10	10000	0.3	1	425	390	92%	80-120
Ammonia	µg/l	10-0533P	Site # 2	03/10/10	03/10/10	03/24/10	204	10	10000	1.0	1	1204	1048	87%	80-120
Ammonia	µg/l	10-0229P	Site # 3	01/22/10-01/28/10	01/28/10	02/09/10	34	10	10000	1.0	1	1034	860	83%	80-120
Ammonia	µg/l	10-0744P	Rain	03/28/10-03/29/10	03/29/10	04/12/10	60	10	10000	0.7	1	760	751	99%	80-120
Ammonia	µg/l	09-3438P	Rain	09/22/09-09/27/09	09/28/09	10/14/09	1517	10	10000	0.15	1	1667	1535	92%	80-120
Ammonia	µg/l	09-3888P	Site #4	10/27/09-11/05/09	11/05/09	11/30/09	0	10	10000	1.75	1	1750	1781	102%	80-120
Ammonia	µg/l	10-0026P	Site #4	12/29/09 - 01/05/10	01/05/10	01/15/10	33	10	10000	1.0	1	1033	845	82%	80-120
Ammonia	µg/l	10-0026P	Site #4	12/29/09 - 01/05/10	01/05/10	01/15/10	22	10	10000	1.0	1	1022	912	89%	80-120
Color	PCU	09-1215	Site 4 Blank	03/31/09	03/31/09	04/01/09	0.4	25	500	0.5	1	10	10.5	101%	90-110
Color	PCU	09-1394	Site 4	04/13/09	04/13/09	04/14/09	30	25	500	0.5	1	40	36	90%	90-110
Color	PCU	09-1422	Rain	04/14/09	04/16/09	04/17/09	12.4	25	500	0.5	1	22	23	103%	90-110
Color	PCU	09-1603	Rain Blank	05/07/09	05/07/09	05/08/09	0.4	25	500	0.5	1	10	10.5	101%	90-110
Color	PCU	09-1796	Rain Blank	06/01/09	06/01/09	06/03/09	0.4	25	500	0.5	1	10	10.5	101%	90-110
Color	PCU	09-2130	Rain Blank	07/08/09	07/08/09	07/09/09	2	25	500	1.0	1	22	22	100%	90-110
Color	PCU	09-2726	Rain	08/20/09	08/21/09	08/21/09	1.4	25	500	0.75	1	16	17	104%	90-110
Color	PCU	10-0032	Rain Blank	01/05/10	01/05/10	01/05/10	0	25	500	1.0	1	20	20	100%	90-110
Color	PCU	09-1516	Site 4	04/16/09-04/23/09	04/23/09	04/28/09	23	25	500	0.5	1	33	34	103%	90-110
Color	PCU	09-1661	Site 4 F.D.	05/08/09-05/14/09	05/14/09	05/14/09	38	25	500	0.5	1	48	48	100%	90-110
Color	PCU	09-1729	Rain	05/22/09-05/25/09	05/26/09	05/28/09	8.4	25	500	0.5	1	18	19	103%	90-110
Color	PCU	09-1979	Rain	06/09/09-06/17/09	06/17/09	06/18/09	11.4	25	500	0.5	1	21	22	103%	90-110
Color	PCU	09-2413	Site 4 F.D.	07/28/09-08/03/09	08/03/09	08/04/09	44	25	500	1.0	2.5	130	131	101%	90-110
Color	PCU	09-2527	Rain	08/03/09-08/07/09	08/11/09	08/12/09	2	25	500	1.0	1	22	22	100%	90-110
Color	PCU	09-1560	Site 4	4/24/09-4/28/09	04/30/09	05/01/09	39	25	500	0.5	1	49	49	100%	90-110

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NOx	µg/l	09-1662f	Rain	05/13/09	05/14/09	05/15/09	438	10	50000	0.1	1	938	1030	110%	90-110
NOx	µg/l	10-0158f	Site # 3	01/22/10	01/22/10	01/22/10	134	10	11300	0.4	1	586	579	99%	90-110
NOx	µg/l	10-0533f	Site # 2	03/10/10	03/10/10	03/12/10	119	10	11300	0.2	1	345	321	93%	90-110
NOx	µg/l	10-0229f	Site # 3	01/22/10-01/28/10	01/28/10	01/29/10	14	10	11300	0.25	1	297	267	90%	90-110
NOx	µg/l	10-0359f	Site # 4 Field Dup	02/03/10-02/11/10	02/12/10	02/12/10	12	10	11300	0.2	1	238	230	97%	90-110
NOx	µg/l	09-1284f	Site #4 Field Dup	03/31/09-04/07/09	04/07/09	04/09/09	70	10	100000	0.25	1	2570	2559	100%	90-110
NOx	µg/l	09-1560f	Site #4	04/24/09-04/28/09	04/30/09	04/30/09	1	10	50000	0.25	1	1251	1142	91%	90-110
NOx	µg/l	09-2413f	Site #4 Field Dup	07/28/09-08/03/09	08/03/09	08/06/09	5	10	100000	0.2	1	2005	1867	93%	90-110
NOx	µg/l	09-2983f	Rain	08/28/09-09/04/09	09/04/09	09/05/09	136	10	50000	0.4	1	2136	2067	97%	90-110
NOx	µg/l	09-2983f	Rain	08/28/09-09/04/09	09/04/09	09/11/09	119	10	100000	0.2	1	2119	2287	108%	90-110
NOx	µg/l	09-4476f	Site #1	12/25/09-12/29/09	12/30/09	12/31/09	121	10	100000	0.35	1	3621	3482	96%	90-110
NOx	µg/l	10-0457f	Site #1	12/25/09-12/29/09	12/30/09	03/04/10	12	10	11300	0.1	1	125	130	104%	90-110
NOx	µg/l	09-1793f	Site #4 / Outflow	5/26/09 - 6/01/09	06/01/09	06/03/09	13	10	100000	0.1	1	1013	1054	104%	90-110
SRP	µg/l	09-1662f	Rain	05/13/09	05/14/09	05/15/09	243	10	10000	0.15	1	393	365	93%	90-110
SRP	µg/l	10-0158f	Site # 3	01/22/10	01/22/10	01/22/10	1069	10	10000	1.0	1	2069	2039	99%	90-110
SRP	µg/l	10-0533f	Site # 2	03/10/10	03/10/10	03/12/10	30	10	10000	0.5	1	530	479	90%	90-110
SRP	µg/l	10-0229f	Site # 3	01/22/10-01/28/10	01/28/10	01/29/10	52	10	10000	0.25	1	302	288	95%	90-110
SRP	µg/l	10-0359f	Site # 4 Field Dup	02/03/10-02/11/10	02/12/10	02/12/10	37	10	10000	0.2	1	237	245	103%	90-110
SRP	µg/l	09-1284f	Site #4 Field Dup	03/31/09-04/07/09	04/07/09	04/09/09	73	10	10000	0.25	1	323	328	102%	90-110
SRP	µg/l	09-1560f	Site #4	04/24/09-04/28/09	04/30/09	04/30/09	57	10	10000	0.5	1	557	543	97%	90-110
SRP	µg/l	09-2413f	Site #4 Field Dup	07/28/09-08/03/09	08/03/09	08/06/09	317	10	10000	0.4	1	717	696	97%	90-110
SRP	µg/l	09-2983f	Rain	08/28/09-09/04/09	09/04/09	09/05/09	5	10	10000	0.25	1	255	266	104%	90-110
SRP	µg/l	09-3888f	Site #4	10/27/09-11/05/09	11/05/09	11/06/09	290	10	10000	0.5	1	790	741	94%	90-110
SRP	µg/l	09-4476f	Site #1	12/25/09-12/29/09	12/30/09	12/31/09	312	10	10000	0.2	1	512	499	97%	90-110
SRP	µg/l	10-0457f	Site #1	12/25/09-12/29/09	12/30/09	03/04/10	774	10	10000	0.1	1	874	794	91%	90-110
SRP	µg/l	09-1793f	Site #4 / Outflow	5/26/09 - 6/01/09	06/01/09	06/03/09	336	10	10000	0.2	1	536	515	96%	90-110
Total N	µg/l	09-1792fp	Site #3 Sampler Blank	06/01/09	06/01/09	06/21/09	0	5	100000	0.05	1	1000	982	98%	90-110
Total N	µg/l	09-2125bP	Site #3 Sampler Blank	07/08/09	07/08/09	08/05/09	17	5	22600	0.05	1	243	230	95%	90-110
Total N	µg/l	09-2722p	Site #1	08/20/09	08/21/09	11/11/09	794	5	100000	0.1	1	2794	2987	107%	90-110
Total N	µg/l	09-3435F	Site #3	09/28/09	09/28/09	12/02/09	932	5	22600	0.5	1	3192	3231	101%	90-110
Total N	µg/l	10-027FP	Rain	01/01/10	01/05/10	02/12/10	948	5	22600	0.6	1	3660	3605	98%	90-110
Total N	µg/l	10-158FP	Site # 3	01/22/10	01/22/10	02/15/10	702	5	22600	0.5	1	2962	3018	102%	90-110
Total N	µg/l	10-0376P	Rain	02/12/10	02/16/10	02/22/10	872	5	22600	0.5	1	3132	3187	102%	90-110
Total N	µg/l	10-0582P	Site # 1	03/12/10	03/12/10	03/30/10	813	5	22600	0.5	1	3073	2903	94%	90-110
Total N	µg/l	10-0358P	Site # 4	02/03/10-02/11/10	02/12/10	02/22/10	875	5	22600	0.6	1	3587	3518	98%	90-110
Total N	µg/l	10-0532FP	Site # 1	02/16/10-03/10/10	03/10/10	03/30/10	1060	5	22600	0.5	1	3320	3106	94%	90-110
Total N	µg/l	09-1665p	Site #1 Field Dup	05/15/09 - 05/17/09	05/18/09	06/09/09	1204	5	100000	0.05	1	2204	2212	100%	90-110
Total N	µg/l	09-1728p	Site #4 Outflow	05/21/09 - 05/26/09	05/26/09	06/12/09	1398	5	22600	0.3	1	2754	2799	102%	90-110
Total N	µg/l	09-1892fp	Site #4/Outflow	06/01/09-06/09/09	06/09/09	07/16/09	482	5	22600	0.05	1	708	642	91%	90-110
Total N	µg/l	09-2981p	Site #4	08/28/09-09/04/09	09/04/09	11/11/09	773	5	100000	0.1	1	2773	2783	100%	90-110
Total N	µg/l	09-1516p	Site #4	4/16/09 - 4/23/09	04/23/09	05/28/09	1407	5	22600	0.05	1	1633	1571	96%	90-110

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Total P	µg/l	09-1792f	Site #3 Sampler Blank	06/01/09	06/01/09	06/21/09	21	5	10000	0.1	1	221	208	94%	90-110
Total P	µg/l	09-2125b	Site #3 Sampler Blank	07/08/09	07/08/09	08/05/09	0	5	10000	0.15	1	300	310	103%	90-110
Total P	µg/l	09-2722	Site #1	08/20/09	08/21/09	11/11/09	398	5	10000	0.2	1	798	866	109%	90-110
Total P	µg/l	10-027FP	Rain	01/01/10	01/05/10	02/12/10	65	5	50000	0.05	1	565	605	107%	90-110
Total P	µg/l	10-158FP	Site # 3	01/22/10	01/22/10	02/15/10	579	5	50000	0.05	1	1079	1102	102%	90-110
Total P	µg/l	10-0376P	Rain	02/12/10	02/16/10	02/22/10	16	5	50000	0.05	1	516	518	100%	90-110
Total P	µg/l	10-0582P	Site # 1	03/12/10	03/12/10	03/30/10	440	5	50000	0.05	1	940	957	102%	90-110
Total P	µg/l	10-0358P	Site # 4	02/03/10-02/11/10	02/12/10	02/22/10	142	5	50000	0.05	1	642	654	102%	90-110
Total P	µg/l	10-0532FP	Site # 1	02/16/10-03/10/10	03/10/10	03/30/10	138	5	50000	0.05	1	638	686	108%	90-110
Total P	µg/l	09-1665	Site #1 Field Dup	05/15/09 - 05/17/09	05/18/09	06/09/09	414	5	10000	0.1	1	614	642	105%	90-110
Total P	µg/l	09-1728	Site #4 Outflow	05/21/09 - 05/26/09	05/26/09	06/12/09	397	5	10000	0.15	1	697	690	99%	90-110
Total P	µg/l	09-1892f	Site #4/Outflow	06/01/09-06/09/09	06/09/09	07/16/09	295	5	10000	0.1	1	495	530	107%	90-110
Total P	µg/l	09-4188f	Site #4	08/28/09-09/04/09	09/04/09	11/11/09	363	5	50000	0.05	1	863	861	100%	90-110
Total P	µg/l	09-4452f	Site #4	12/14/09-12/23/09	12/23/09	02/04/10	90	5	50000	0.05	1	590	627	106%	90-110
Total P	µg/l	09-1516	Site #4	4/16/09 - 4/23/09	04/23/09	05/28/09	207	5	10000	0.1	1	407	418	103%	90-110
Turbidity	NTU	09-2414	Blank	08/03/09	08/03/09	08/05/09	0.0	50	4000	0.25	1	20.0	19.0	95%	87.4 - 110
Turbidity	NTU	09-2726	Rain	08/20/09	08/21/09	08/21/09	1.0	50	4000	0.25	1	21.0	20.9	100%	87.4 - 110
Turbidity	NTU	09-2984	Rain Equipment Blank	09/04/09	09/04/09	09/04/09	0.2	50	4000	0.25	1	20.2	19.7	98%	87.4 - 110
Turbidity	NTU	09-3892	Site #4 Sample Blank	11/05/09	11/05/09	11/05/09	0.2	50	4000	0.375	1	30.2	27.0	89%	87.4 - 110
Turbidity	NTU	09-4480	Rain	12/25/09	12/30/09	12/31/09	0.9	50	4000	0.375	1	30.9	30.7	99%	87.4 - 110
Turbidity	NTU	10-0027	Rain	01/01/10	01/05/10	01/06/10	0.8	50	4000	0.25	1	20.8	20.3	98%	87.4 - 110
Turbidity	NTU	10-0083	Rain	01/17/10	01/19/10	01/20/10	2.0	50	4000	0.25	1	22.0	22.1	100%	87.4 - 110
Turbidity	NTU	10-0160	Rain	1/19 - 1/22/10	01/22/10	01/23/10	0.7	50	4000	0.25	1	20.7	21.3	103%	87.4 - 110
Turbidity	NTU	10-0230	Site #4	1/22 - 1/28/10	01/28/10	01/29/10	1.2	50	4000	0.25	1	21.2	21.4	101%	87.4 - 110
Turbidity	NTU	09-3971	Site #4	11/10 - 11/17/09	11/17/09	11/17/09	11.5	50	4000	0.375	1	41.5	41.4	100%	87.4 - 110
Turbidity	NTU	09-4286	Site #4	12/7 - 12/14/09	12/14/09	12/16/09	7.1	50	4000	0.375	1	37.1	37.0	100%	87.4 - 110