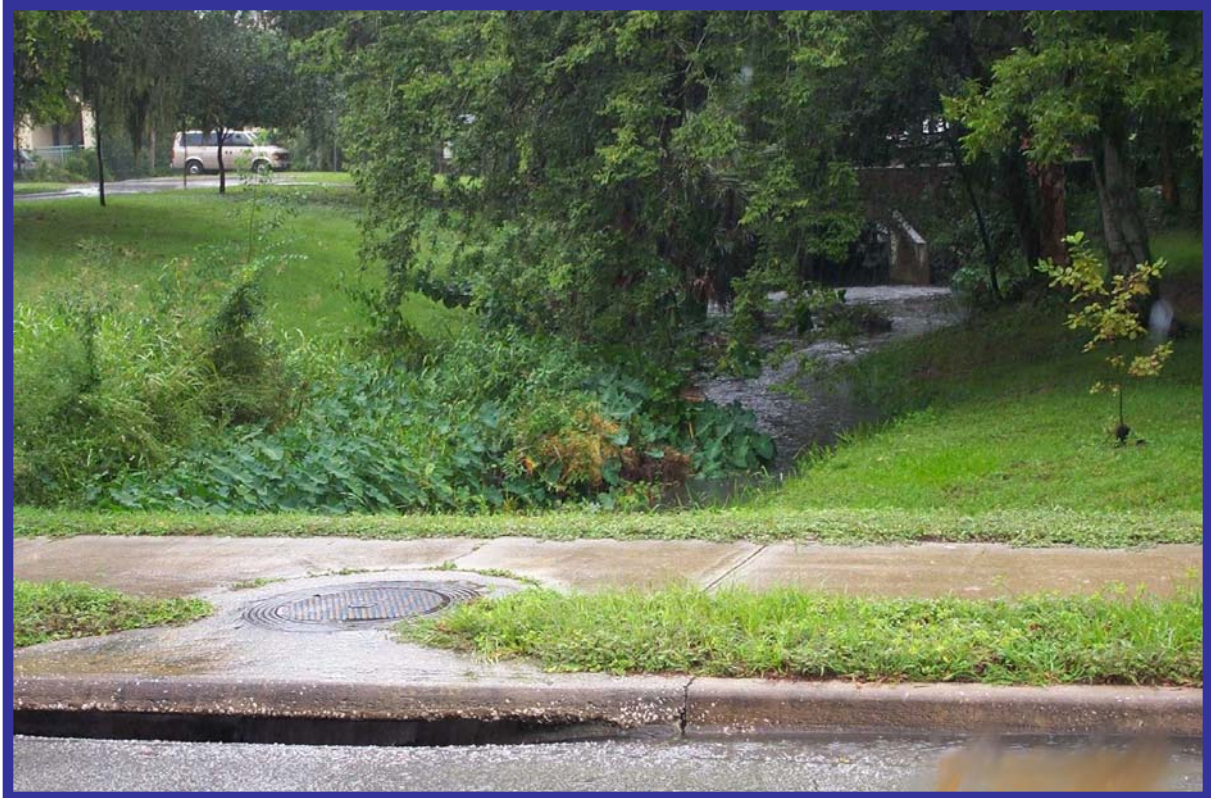


Gainesville Creeks: Storm Event Monitoring Data 2003



Prepared by the:
Alachua County Environmental Protection Department
For Contract No. SF672AA



Prepared for the:
St. Johns River Water Management District

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Executive Summary

St. Johns River Water Management District scientists have been involved in surface water investigations of the Gainesville creeks, part of the larger Orange Creek Basin, since the early 1990's. As an ongoing component of this effort, ACEPD conducted baseflow and stormwater monitoring from October 2002 through September 2003. This report summarizes the storm event sampling results for selected streams monitored during calendar year 2003. During this time period, storm event sampling was conducted on Hatchet Creek, Little Hatchet Creek and Lake Forest Creek in the Newnans Lake Watershed; Sweetwater Branch and Tumblin Creek in the Paynes Prairie Watershed; and Hogtown Creek in the Hogtown Creek Watershed. In addition, soil samples were collected from selected sites at an "Old Landfill" located adjacent to Tumblin Creek in Tumblin Creek Park.

Water quality changes during storm event monitoring were observed at all sample sites. Hatchet and Little Hatchet Creek sites were monitored over a three-day period due to the slow rise in stage. As suspected, minimal water quality changes were observed in Hatchet and Little Hatchet Creeks during the storm event.

Lake Forest Creek, Hogtown Creek, and Sweetwater Branch responded more rapidly to rainfall with notable increases in turbidity and suspended solids during the event. Changes in nutrient concentrations were observed in Sweetwater Branch during the storm event, as rainfall diluted the nutrients that were typically observed under baseflow conditions.

Analyses for Tumblin Creek included selected organic constituents, trace metals, and fecal coliform bacteria. Tumblin Creek showed a rapid response to rainfall. Organic constituents and metals were generally not detected or observed in relatively low concentrations, both upstream and downstream of the "Old Landfill" at Tumblin Creek Park. Fecal coliform bacteria samples indicated elevated concentrations of bacteria during the event, likely due to external loading. Soil samples collected in the waste materials at the former landfill revealed low concentrations of polycyclic aromatic hydrocarbons (PAHs).

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Water Quality Monitoring in the Orange Creek Basin
SJRWMD Contract SF672AA
PROJECT OVERVIEW

Introduction

The Alachua County Environmental Protection Department (ACEPD) conducted stormwater sampling and soil assessment activities in partial fulfillment of SJRWMD Contract SF672AA. The ACEPD collected stormwater quality, level, and flow data at eight sites in the Orange Creek Basin during 2003. The sites included six water bodies: Hatchet Creek, Little Hatchet Creek, Lake Forest Creek, Hogtown Creek, Sweetwater Branch, and Tumblin Creek (Table 1). One station on each water body was sampled once, with the exception of Tumblin Creek in which three stations were simultaneously sampled during two storm events. The following report sections summarize the 2003 storm event monitoring data for all of the previously mentioned water bodies. Stormwater sampling began in March 2003 with the Newnans Lake tributaries and ended in August 2003 with two events on Tumblin Creek.

Table 1. Storm Event Summary Calendar Year 2003

Event Date	Watershed	Station Location	Station ID
3/3 - 6/03	Newnans Lake	Hatchet Creek at SR 26	HAT26
3/3 - 6/03	Newnans Lake	Little Hatchet Creek West at SR 26	LHAT26
6/4 - 5/03	Newnans Lake	Lake Forest Creek at CR329B	LFC329B
06/19/03	Hogtown Creek	Hogtown Creek at SW 2 nd Avenue	HOGSW2
07/22/03	Paynes Prairie	Sweetwater Branch north of Paynes Prairie	SWBNPP
08/05/03	Paynes Prairie	Tumblin Creek – Tumblin Creek at SW 5 th Avenue Tumblin Creek at SW Depot Avenue Tumblin Creek at US Highway 441	TUMSW5 TUMDEPOT TUM441
08/21/03	Paynes Prairie	Tumblin Creek – Tumblin Creek at SW 5 th Avenue Tumblin Creek at SW Depot Avenue Tumblin Creek at US Highway 441	TUMSW5 TUMDEPOT TUM441

Field Sampling Methodology

Procedures used for storm event sampling are those set forth in SJRWMD Contract #SF672AA, Exhibit A, Scope of Work and agreed upon in the Supplemental Instructions dated 12/10/02. A minimum of five samples were used to characterize each storm event. Samples were collected during the event in an attempt to capture the first flush, other pre-peak conditions (two additional samples on the rising side of the hydrograph), the peak stage, and post-peak conditions (one sample on the receding side of the hydrograph). Streams where there was a delayed response to rainfall, Hatchet and Little Hatchet creeks, were sampled over a three-day

time period. On streams where the response to rainfall was immediate, stormwater sampling activities were completed within a 24-hour period.

Field measurements for pH, specific conductance, dissolved oxygen (DO), temperature, turbidity, and stage (staff gage reading), were conducted throughout the storm events at differing intervals based on the type of stream sampled. Field measurements for DO, pH, specific conductance, and temperature were conducted using ACEPD’s YSI 600XL environmental monitoring system. Field turbidity was conducted using Hach 2100P portable turbidimeters. Samples for laboratory analyses were collected at mid-depth in the center of the stream channel. On streams where there was a delayed response to rainfall, Hatchet and Little Hatchet creeks, the field parameters were measured when samples were collected for laboratory analyses. Field parameters were generally measured every 15 minutes during storm event sampling conducted on Lake Forest Creek, Hogtown Creek, Sweetwater Branch and Tumblin Creek. One exception being the last (post-peak) sample collected at Lake Forest Creek, which was collected the day following the rainfall event.

Water velocities were measured with a Marsh-McBirney Flowmate 2000 current meter. Stream flow was calculated using the velocity measurements and the cross-sectional area of the stream channel at the location where the velocity measurements were made (Table 2). Where streams were wadable and time permitted, velocity measurements were made at 0.25 meter increments across the entire width of the stream channel slightly below mid-depth (0.6 of the total water depth) at the measurement point. Where the streams were not wadable and/or time did not permit, the velocity measurements were made at four points across the stream at least three times during the storm event. These velocity measurements were made as close as possible to mid-depth. The assumption for the latter methodology was that storm water velocities, which are typically much greater than those observed under baseflow conditions, are relatively uniform throughout the channel.

Table 2. Channel Cross-section Profiles

Station ID	Channel Bottom Width	Channel Width at Maximum Stage Level	Channel Width at Mid-stage Level
HAT26	7.3 m	25.6 m	23.8 m
LHAT26	4.0 m	4.4 m*	4.6 m*
LFC329B	**	**	**
HOGSW2	9.0 m	12.1 m	11.0 m
SWBNPP	3.8 m	4.0 m	4.0 m
TUMSW5 (8/5/03)	0.6 m	4.1 m	2.8 m
TUMDEPOT (8/5/03)	2.1 m	6.1 m	3.6 m

Table 2 (cont'd). Channel Cross-section Profiles

Station ID	Channel Bottom Width	Channel Width at Maximum Stage Level	Channel Width at Mid-stage Level
TUM441 (8/5/03)	1.0 m	8.5 m	8.5 m
TUMSW5 (8/21/03)	0.5 m	2.9 m	2.0 m
TUMDEPOT (8/21/03)	2.0 m	5.5 m	4.0 m
TUM441 (8/21/03)	1.0 m	1.7 m	1.3 m

*Staff gage reading increased, but the width actually decreased

**At LFC329B stream became braided; flow site was moved to culvert. Total width was not determined; velocity measured in culvert openings only.

Laboratory Analyses

Severn Trent Laboratories, Inc. (STL Tallahassee) analyzed water samples collected by ACEPD for chemical constituents. The laboratory parameters for basic stormwater monitoring can be separated into two categories, inorganic indicators and nutrients. All laboratory analyses were conducted on unfiltered samples and reported as “totals.” Inorganic indicator constituents included alkalinity, color, specific conductance, turbidity, total suspended solids (TSS), total dissolved solids (TDS), chloride, and sulfate. Nutrients analyzed included ortho-phosphate, total phosphorus, ammonia nitrogen, nitrate plus nitrite nitrogen (NO_x), total Kjeldahl nitrogen (TKN), and total organic carbon (TOC). Total nitrogen was calculated by adding the reported concentrations of TKN and NO_x. In addition to “total” ortho-phosphate, samples from Hatchet Creek, Little Hatchet Creek, and Sweetwater Branch were collected, field filtered (during the sample collection process), and analyzed for “dissolved” ortho-phosphate.

Assessment of the “Old Landfill” at Tumblin Creek Park included sampling and analyses of stormwater upstream and downstream of Tumblin Creek Park and analyses of soils in the landfilled area. The stormwater events on Tumblin Creek included sampling and analyses of volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), selected metals, and fecal coliform bacteria. Chemical analyses of these constituents, VOCs (EPA Method 8260), PAHs (EPA Method 8270), chlorinated pesticides and PCBs (EPA Method 8081/8082) and metals (EPA Method 6010 for cadmium, copper iron, lead, silver, and zinc; EPA Method 7470 for mercury; SM Method 3500 for hexavalent chromium) were conducted by STL Tallahassee. Analyses of fecal coliform were conducted by ABC Research, Inc., Gainesville. These same constituents, with the exception of fecal coliform, were analyzed in soil samples collected at the “Old Landfill.” Metals analyses for the soils were conducted by EPA Method 6010 using Toxicity Characteristic Leaching Procedure (TCLP) extract.

Quality Assurance

The sample containers used by ACEPD were provided pre-preserved by STL Tallahassee. Sample containers were filled sequentially to avoid cross contamination. The first containers filled were unpreserved, followed by those containers that contained sulfuric acid as a preservative for nutrients. The final container filled was used for metals analyses and contained nitric acid as a preservative. All samples were chilled to 4° C immediately after collection with ice and shipped via common carrier to STL Tallahassee for analyses.

A minimum of one field equipment blank for all parameters was prepared and submitted for each sampling event. The field equipment blank was prepared with analyte-free water obtained from STL Tallahassee. All equipment used for sampling, in this case the filter apparatus, was cleaned according to SJRWMD protocols between sampling events and rinsed between sampling stations with SJRWMD analyte-free water. The results of the analyses of the field equipment blanks are provided with the analytical data for the individual storm events.

Data Management

The field and laboratory data discussed in this report and provided in electronic format should be considered preliminary data. Although ACEPD has reviewed these data, an outlier analyses and a detailed review of the associated quality assurance data have not been conducted. This work was not part of our agreement with the SJRWMD, but must be performed before the data are uploaded to Storet or used in other publicly available formats.

Field data have been compiled into MS Excel spreadsheet files. STL Tallahassee provided the laboratory data to ACEPD in hard copy and electronic format (comma delimited files) by event/date. Both field and laboratory data have been formatted in MS Excel for transmittal to the SJRWMD and are included in electronic format on CD in Appendix D of this report. Spreadsheets summarizing field and laboratory data for the first five storm events are included in Appendix A. Field and laboratory data summaries for the two storm events on Tumblin Creek are presented in Appendix B. Field Boring logs, photographs, and laboratory data for the soil assessment conducted at the “Old Landfill” at Tumblin Creek Park are presented in Appendix C. Excel spreadsheets of all field and laboratory data are included on CD in Appendix D.

Analytical Results

There were minimal water quality changes in Hatchet Creek and Little Hatchet Creek during storm event monitoring conducted by ACEPD in March 2003. Field parameters with the exception of temperature and DO showed little variation. Temperature was observed to increase throughout the event, and DO decreased. Inorganic indicators, alkalinity, specific conductance, turbidity, TSS, TDS, chloride, and sulfate were also relatively stable. Color increased over the duration of the event for both streams sampled. Nutrients, with the exception of TOC, showed little variation during the events. Neither ammonia nitrogen nor NO_x were detected in samples from either stream. The TKN concentrations increased slightly, with the highest concentrations reported for peak flow. Ortho-phosphate, total and dissolved, and total phosphorus showed little variation over the event.

Lake Forest Creek, Hogtown Creek, and Sweetwater Branch responded more dramatically to rainfall with rapid changes in concentrations of indicator parameters. Specific conductance and alkalinity decreased, while turbidity and TSS increased. Nutrients showed little variation, with the exception of total ortho-phosphate and total phosphorus, which varied greatly in some post peak stage samples. In samples from Sweetwater Branch, NO_x concentrations decreased over time, with the initial concentration, 3.7 mg/L, decreasing to 0.62 mg/L at peak flow. Total phosphorus values reported for samples collected in Sweetwater Branch also decreased with increasing flow.

Samples from Tumblin Creek at all three stations showed results similar to the other urban creeks for field parameters, inorganic indicators, and nutrients. The only VOCs detected as part of the August 5, 2003 sampling event were benzene (1.7 ug/L at TUMDEPOT) and tetrachloroethene (1.0 ug/L at TUM441). No VOCs were detected in any of the samples obtained during August 21, 2003 storm event on Tumblin Creek. Low concentrations of PAHs, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i) pyrene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluornathene, indeno (1,2,3-cd) pyrene, phenanthrene, and pyrene, were detected at or slightly before peak stage for samples collected at all three sites on Tumblin Creek during both events. The fluoranthene, ranging from 5.7 to 0.4 ug/L, and pyrene, ranging from 4.4 to 0.34 ug/L, exceeded the surface water cleanup target criteria of 0.3 micrograms per liter (ug/L) set forth in the Florida Administrative Code (FAC) Chapter 62-302 for samples at peak stage during both events.

Concentrations of the eight metals analyzed were found to be relatively low. Cadmium (<0.0005 mg/L), hexavalent chromium (<0.010 mg/L), mercury (<0.000020 mg/L), and silver (<0.010 mg/L), were not detected in any of the samples collected. Iron, copper, lead, and zinc, although low in concentrations in the stormwater samples, did show increased concentrations at or near peak stage.

Fecal coliform bacteria were sampled in Tumblin Creek as part of the storm event monitoring conducted August 5, 2003. Concentrations of fecal coliform bacteria ranged from 2,300 colonies per 100 milliliters (col/100 mL) under baseflow conditions to 92,000 col/100 mL at peak stage during the storm event.

Soil samples from the "Old Landfill" in Tumblin Creek Park were found to contain low concentrations of PAHs. Five compounds, benzo (a) anthracene, benzo (a) pyrene, benzo (g,h,i) perylene, dibenzo (a,h) anthracene, and indo (1,2,3-cd) pyrene, were found to be present above residential soil cleanup target levels set forth in FAC Chapter 62-777. Four organochlorine pesticides, Aldrin, 4,4'-DDE, 4,4'-DDT, and Endrin ketone, were present in samples from four of the seven soil borings conducted at the "Old Landfill". All concentrations of organochlorine pesticides were well below established soil cleanup target levels set forth in FAC Chapter 62-777. No PCBs were detected in the soil samples. Metals, from TCLP extraction, were all reported as nondetectable.

Summary and Discussion

The storm events conducted on Hatchet Creek and Little Hatchet Creek showed little change in water quality throughout the event. The relatively low relief in the upper reaches of the watershed, the lack of impervious area, and large expanse of wetlands associated with these two streams attenuated the impacts of the storm events. Samples from Lake Forest Creek, Hogtown Creek, Sweetwater Branch and Tumblin Creek showed increased levels of turbidity, TSS, and total phosphorus during the storm event. Decreased concentrations of specific conductance, alkalinity, and TDS were also observed. Samples collected from Sweetwater Branch showed a decrease in concentration of NO_x, total ortho-phosphate, and total phosphorus at peak stage, diluting the elevated nitrogen and phosphorus concentrations present at baseflow from the reclaimed water discharged to Sweetwater Branch from the Gainesville Regional Utilities (GRU) Main St. Water Reclamation Facility.

Polycyclic aromatic hydrocarbons (PAHs) were detected in all samples collected from Tumblin Creek at or prior to peak stage. There was no difference in the concentrations of the PAHs between the sites, indicating that these compounds were likely present from a uniform source, such as road runoff, and not leached from the “Old Landfill” at Tumblin Creek Park. Neither organochlorine pesticides nor PCBs were detected in any of the stormwater samples from Tumblin Creek during either event. Metals concentrations in the stormwater were low; cadmium, hexavalent chromium, mercury, and silver were not detected.

Soil samples from the “Old Landfill” at Tumblin Creek Park showed the presence of low concentrations of PAHs and organochlorine pesticides. No PCBs or metals were detected in the soil samples. The objective in sampling soils at the landfill was to sample above and below the waste materials, this was not possible. The waste was generally present at land surface and extended below the water table. Based on the presence of PAHs and the visible materials observed, ACEPD recommends further assessment of the landfill and removal of landfilled materials in the Tumblin Creek flood plain, particularly along the west bank of the str

Project Overview
Summary of Flow and Stage per Sampling Event

HAT26 – Hatchet Creek at SR 26

Station Name	Date	Time	Staff gage (feet)	Flow (cms)	Flow (cfs)
HAT26	4-Mar-03	1210	14.96	6.812	240.564
	4-Mar-03	1343	15.02	7.683	271.323
	4-Mar-03	1500	15.06	7.607	268.639
	5-Mar-03	1130	15.52	8.056	284.495
	5-Mar-03	1530	15.48	9.714	343.047
	6-Mar-03	1030	15.14	8.665	306.002
	6-Mar-03	1230	15.08	6.933	244.837

LHAT26 - Little Hatchet Creek West Branch at SR 26

Station Name	Date	Time	Staff gage (feet)	Flow (cms)	Flow (cfs)
LHAT26	4-Mar-03	1100	13.04	0.595	21.012
	4-Mar-03	1300	13.10	0.752	26.557
	4-Mar-03	1435	13.12	0.810	28.605
	5-Mar-03	1225	13.22	0.794	28.040
	5-Mar-03	1500	13.22	0.749	26.451
	6-Mar-03	1000	13.32	0.356	12.572
	6-Mar-03	1315	13.28	0.300	10.594

HOGSW2 - Hogtown Creek at SW 2nd Avenue

Station Name	Date	Time	Staff gage (feet)	Flow (cms)	Flow (cfs)
HOGSW2	19-Jun-03	1315	6.66	1.031	36.409
	19-Jun-03	1350	6.74	NR	NR
	19-Jun-03	1405	6.76	0.937	33.090
	19-Jun-03	1420	6.68	NR	NR
	19-Jun-03	1435	6.67	NR	NR
	19-Jun-03	1450	6.68	NR	NR
	19-Jun-03	1505	6.69	NR	NR
	19-Jun-03	1520	6.67	0.823	29.064
	19-Jun-03	1535	6.66	NR	NR
	19-Jun-03	1550	6.67	0.869	30.688

SWBNPP - Sweetwater Branch, North Paynes Prairie

Station Name	Date	Time	Staff gage (feet)	Flow (cms)	Flow (cfs)
SWBNPP	15-Jul-03	1200	1.58	0.411	14.514
	22-Jul-03	1200	1.70	0.411	14.514
	22-Jul-03	1230	1.76	0.425	15.009
	22-Jul-03	1310	2.80	NR	NR
	22-Jul-03	1325	2.78	NR	NR
	22-Jul-03	1355	2.40	NR	NR
	22-Jul-03	1420	2.12	0.819	28.923

Project Overview Continued**Summary of Flow and Stage per Sampling Event****TUMSW5 - Tumblin Creek at SW 5th Avenue**

Station Name	Date	Time	Staff gage (feet)	Flow (cms)	Flow (cfs)
TUMSW5	5-Aug-03	1220	7.52	0.001	0.035
	5-Aug-03	1345	7.63	NR	NR
	5-Aug-03	1400	8.50	0.441	15.574
	5-Aug-03	1415	9.30	NR	NR
	5-Aug-03	1430	9.15	NR	NR
	5-Aug-03	1445	7.90	0.179	6.321
	5-Aug-03	1500	7.85	NR	NR
	5-Aug-03	1515	NR	NR	NR
	5-Aug-03	1530	NR	NR	NR
	5-Aug-03	1545	7.68	NR	NR
	5-Aug-03	1600	7.66	0.015	0.530
	21-Aug-03	1245	7.55	NR	NR
	21-Aug-03	1430	7.52	0.002	0.071
	21-Aug-03	1730	NR	NR	NR
	21-Aug-03	1745	7.80	0.106	3.743
	21-Aug-03	1750	8.02	NR	NR
	21-Aug-03	1800	7.80	0.048	1.695
	21-Aug-03	1815	NR	NR	NR
	21-Aug-03	1820	7.64	0.029	1.024
	21-Aug-03	1830	NR	NR	NR

LFC329B - Lake Forest Creek at CR 329B

Station Name	Date	Time	Staff gage (feet)	Flow (cms)	Flow (cfs)
LFC329B	4-Jun-03	945	11.58	0.223	7.875
	4-Jun-03	1000	11.54	NR	NR
	4-Jun-03	1015	11.54	NR	NR
	4-Jun-03	1030	11.56	NR	NR
	4-Jun-03	1045	11.54	NR	NR
	4-Jun-03	1100	11.54	NR	NR
	4-Jun-03	1115	11.56	NR	NR
	4-Jun-03	1130	11.60	NR	NR
	4-Jun-03	1145	11.60	NR	NR
	4-Jun-03	1200	11.60	NR	NR
	4-Jun-03	1215	11.62	NR	NR
	4-Jun-03	1230	11.62	0.224	7.910
	4-Jun-03	1245	11.64	NR	NR
	4-Jun-03	1300	11.66	NR	NR
	4-Jun-03	1315	11.66	NR	NR
	4-Jun-03	1330	11.68	0.132	4.662
	4-Jun-03	1345	11.68	NR	NR
	4-Jun-03	1400	11.68	NR	NR
	4-Jun-03	1415	11.68	NR	NR
	4-Jun-03	1430	11.68	NR	NR
	4-Jun-03	1445	11.70	NR	NR
	4-Jun-03	1500	11.70	NR	NR
	5-Jun-03	1120	11.50	NR	NR

Project Overview Continued
Summary of Flow and Stage per Sampling Event

TUMDEPOT - Tumblin Creek at Depot Avenue

Station Name	Date	Time	Staff gage (feet)	Flow (cms)	Flow (cfs)
TUMDEPOT	5-Aug-03	1242	12.12	0.063	2.225
	5-Aug-03	1345	12.42	NR	NR
	5-Aug-03	1400	NR	NR	NR
	5-Aug-03	1415	14.48	1.996	70.488
	5-Aug-03	1430	NR	NR	NR
	5-Aug-03	1445	NR	NR	NR
	5-Aug-03	1500	12.40	0.223	7.875
	5-Aug-03	1515	NR	NR	NR
	5-Aug-03	1530	12.28	0.181	6.392
	5-Aug-03	1545	NR	NR	NR
	21-Aug-03	1245	12.14	0.011	0.388
	21-Aug-03	1450	12.12	0.008	0.283
	21-Aug-03	1730	NR	NR	NR
	21-Aug-03	1745	12.54	0.288	10.171
	21-Aug-03	1800	12.60	0.168	5.933
	21-Aug-03	1815	NR	NR	NR
	21-Aug-03	1830	12.30	0.152	5.368
	21-Aug-03	1845	NR	NR	NR

TUM441 – Tumblin Creek at 441

Station Name	Date	Time	Staff gage (feet)	Flow (cms)	Flow (cfs)
TUM441	5-Aug-03	1235	0.04	NR	NR
	5-Aug-03	1252	0.04	0.020	0.706
	5-Aug-03	1337	0.04	NR	NR
	5-Aug-03	1355	0.40	NR	NR
	5-Aug-03	1410	0.36	1.231	43.472
	5-Aug-03	1425	0.80	NR	NR
	5-Aug-03	1440	1.20	NR	NR
	5-Aug-03	1455	0.80	NR	NR
	5-Aug-03	1505	0.30	NR	NR
	5-Aug-03	1525	0.20	0.462	16.315
	5-Aug-03	1540	NR	NR	NR
	5-Aug-03	1554	0.10	0.168	5.933
	20-Aug-03	1205	NR	NR	NR
	21-Aug-03	1507	0.23	0.019	0.671
	21-Aug-03	1547	0.23	NR	NR
	21-Aug-03	1605	0.24	NR	NR
	21-Aug-03	1620	0.23	NR	NR
	21-Aug-03	1635	0.23	NR	NR
	21-Aug-03	1720	0.23	NR	NR
	21-Aug-03	1735	0.40	NR	NR
	21-Aug-03	1740	0.80	NR	NR
	21-Aug-03	1750	0.60	NR	NR
	21-Aug-03	1800	0.50	0.078	2.755
	21-Aug-03	1825	0.43	NR	NR
	21-Aug-03	1845	1.00	NR	NR
	21-Aug-03	1850	0.95	0.210	7.416

ORANGE CREEK BASIN STORM EVENT SUMMARY 2003
SJRWMD Contract SF672AA
Water Quality Monitoring in the Orange Creek Basin

Introduction

The ACEPD collected stormwater quality, level, and flow data at five sites in the Orange Creek Basin between March and July 2003. The sites were located on the following water bodies: Hatchet Creek, Little Hatchet Creek, Lake Forest Creek, Hogtown Creek, and Sweetwater Branch (Table 1 and Figure 1). One station on each water body was sampled sequentially during one storm event. The following report section summarizes the storm event monitoring data for these sites. The individual storm events are discussed below.

Table 1. Storm Event Summary March through June 2003

Date	Station ID	Station Location	Baseflow/ Stormwater Samples	Rainfall (inches)	Maximum Stage Change (feet)
3/3-6/03	HAT26	Hatchet Creek	0/7	3.70**	0.56
3/3-6/03	LHAT26	Little Hatchet Creek	0/7	3.70**	0.28
6/4-5/03	LFC329B	Lake Forest	1/5	0.22	0.16
6/19/03	HOGSW2	Hogtown Creek	0/5	0.40	0.10
7/22/03	SWBNPP	Sweetwater Branch	1/5*	0.95	1.10

* Baseline samples collected 7/15/03

** Cumulative rainfall from 2/27 – 3/4/03

Storm Event Summary for Hatchet Creek at SR 26 on March 4 – 6, 2003

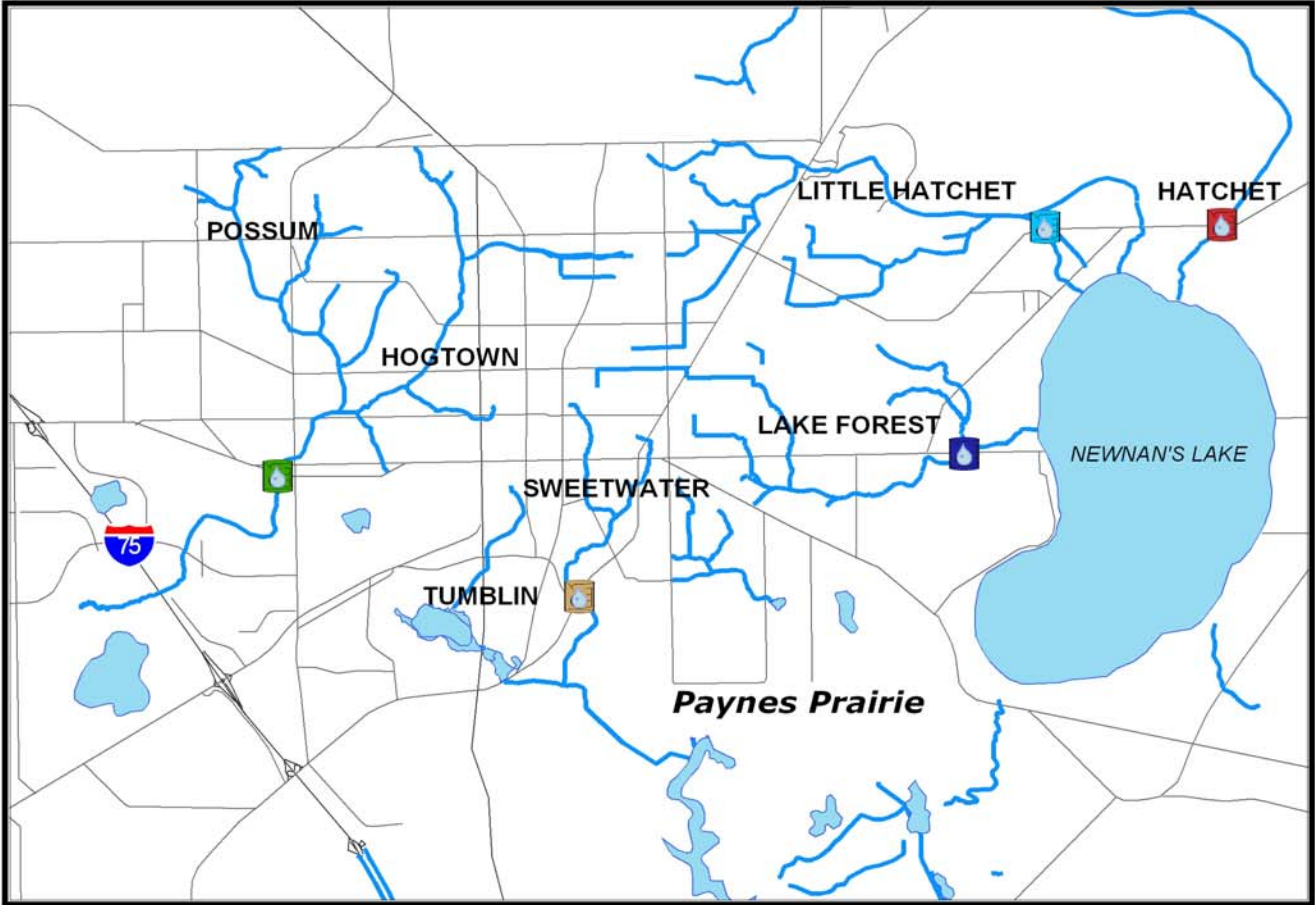
Event Description

Based on a rain gage installed at Hatchet Creek at SR 26, total rainfall from February 27, 2003 through March 4, 2003 was estimated to be 3.70 inches. No baseline samples were collected as part of this event; however, the SJRWMD has historical baseflow data from this site that can be used for comparative purposes. The baseline stage for Hatchet Creek at SR 26 was 14.82 feet, recorded on March 3, 2003. A total of seven samples were collected over three days, March 4, 2003 through March 6, 2003, for this particular storm event.

Site Specific Sampling Methodologies

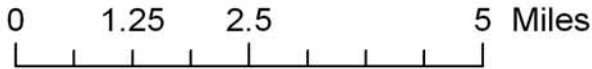
The storm event sampling protocol for Hatchet Creek was slightly different than that of the smaller creeks in urban Gainesville due to the fact that Hatchet Creek responds much slower to rainfall events. This lag time is primarily due to the large size of the Hatchet Creek watershed, the relatively low relief in the upper portion of the basin, reduced impervious area, and the presence of

Orange Creek Basin Storm Event Project 2003 Sampling Site Location Map



Legend

- HAT26 Hatchet Creek
- HOGSW2 Hogtown Creek
- LFC329B Lake Forest
- LHAT26 Little Hatchet Creek
- SWBNPP Sweetwater Branch
- Lakes
- Streams
- Paved roads
- Major roads



Map for the October 2003 Draft Report (11/5/03)

Figure 1. Location of sampling sites within the Orange Creek Basin

extensive wetlands that attenuate storm-related flows. Because of this lag time, after the creek rises the required 0.1 feet in response to the rain event, three days of sampling was required to adequately characterize the effects of the event. The sampling protocol dictated that three samples should be collected the first day after the creek rose 0.1 feet, two samples collected the next day, and two samples collected the final day. For each discrete sample, field parameters, water quality samples, and velocity measurements (for flow calculation) were collected.

Stage and Flow Data

Sampling commenced on March 4, 2003 at 1210. The initial staff gage reading was 14.96 feet (Table 2). Hatchet Creek continued rising and a peak was recorded on March 5, 2003 at 1130 with a staff gage reading of 15.52 feet. Field notes from the morning of March 6, 2003 reported a high wet mark at 16.10 feet, indicating that the peak stage for this event likely occurred sometime after 1530 on March 5, 2003 or during the early morning of March 6, 2003. The stage had dropped to 15.08 feet at the time the last sample was collected on March 6, 2003 at 1230. The maximum change in stage over the three-day sampling event was 0.56 feet.

Table 2. Storm Event Sample Collection Summary for Hatchet Creek at SR 26

Date	Time	Sample Collected/ Designation	Stage (feet)	Flow (cms)***	Flow (cfs)****	Rainfall (inches)
02/27/03	1300	No	13.10	NR	NR	1.10
02/28/03	1045	No	13.96	NR	NR	0.80
03/03/03	0822	No	14.82	NR	NR	0.50*
03/04/03	1210	Yes/ #1 HAT26	14.96	6.812	240.564	0.70**
03/04/03	1343	Yes/ #2 HAT26	15.02	7.683	271.323	0.70
03/04/03	1500	Yes/ #3 HAT26	15.06	7.607	268.639	0.70
03/05/03	1130	Yes/ #4 HAT26	15.52	8.056	284.495	0
03/05/03	1530	Yes/ #5 HAT 26	15.48	9.714	343.047	0
03/06/03	1030	Yes/ #6 HAT 26	15.14	8.665	306.002	0
03/06/03	1315	Yes/ #7 HAT 26	15.08	6.933	244.837	0

* Cumulative rainfall from 3/1 – 3/3

** Cumulative rainfall for 3/4/03

*** (cms) cubic meters per second

**** (cfs) cubic feet per second

Note: NR = Not Reported

Due to the extremely high water, it was very difficult to obtain point velocity measurements for flow calculations. The total width of the stream was approximately 50 meters with depths up to 2 meters. Attempts were made to suspend the velocity probe via an extender pole within the concentrated flow portion of the channel. After the event, these point velocity measurements were used along with cross-sectional area measurements to calculate the estimated flows for Hatchet Creek.

Analytical Results

Field parameters showed some variability over the duration of the event. Water temperature ranged from 15.5° C when the first sample was collected to 19.2° C when the last sample was collected (Appendix A-1). The initial field pH was 4.92 standard units (SU). The field pH gradually decreased throughout the event with the last reading being the lowest at 4.80 SU. Field specific conductance showed the least variability, ranging from 66 to 67 µmhos/cm. Dissolved oxygen (DO) values ranged from 6.33 to 7.37 mg/L with the higher values recorded early in the event and decreasing as water temperature increased. The maximum value recorded for field turbidity was 3.8 Nephelometric turbidity units (NTU) and the minimum was 1.9 NTU.

Inorganic indicator constituents monitored during the storm event included alkalinity, color, specific conductance, turbidity, TSS, TDS, chloride, and sulfate. All samples analyzed for alkalinity, TSS, and sulfate resulted in undetectable concentrations of these constituents. The remaining inorganic parameters showed little variance throughout the event. Color ranged from 450 platinum cobalt units (PCU) to 600 PCU with the higher values reported on the last day of sampling. Total dissolved solids ranged from 98 mg/L to 110 mg/L. Laboratory specific conductance was similar to field-measured conductance with values ranging from 60 to 63 µmhos/cm. Laboratory turbidity values tended to be slightly higher during the first half of the event (a maximum of 3.4 NTU) decreasing to a minimum of 2.1 NTU toward the end of the event. The maximum chloride value of 18 mg/L was recorded for the majority of the samples for this event; however, the minimum of 12 mg/L was recorded for the peak stage sample.

Nutrient analyses, for ammonia nitrogen, TKN, NO_x, dissolved ortho-phosphate, total ortho-phosphate, and total phosphorus, showed little variation throughout the event. All sample results showed undetectable concentrations of ammonia and NO_x. Total Kjeldahl nitrogen values ranged from 1.3 to 1.6 mg/L with the maximum concentration occurring at peak flow. Since NO_x was not detected at reportable concentrations, the TKN is representative of the total nitrogen concentrations in the water samples collected. Minimum values for total ortho-phosphate and dissolved ortho-phosphate (0.12 and 0.11 mg/L, respectively) were observed in the first and last samples collected for the event. Maximum values of both total and dissolved ortho-phosphate, 0.15 and 0.14 mg/L, were recorded at the peak stage. Total phosphorus responded similarly, with the maximum concentration, 0.14 mg/L, occurring at the peak stage and the minimum, 0.12 mg/L, occurring prior to and post-peak. Total organic carbon (TOC) showed the greatest variance ranging from 31 mg/L to 62 mg/L during the event. The highest levels of TOC were observed toward the end of the event.

Summary and Discussion

The rural nature of the watershed, low relief in the upper portion of the basin, and the large expanse of wetlands associated with the stream attenuated both the rapid rise in stage and the increased levels of chemical constituents typically associated with urban storm event monitoring. The turbidity, which ranged from 2.1 to 3.4 NTU, remained relatively constant throughout the event. Field parameters, with the exception of temperature, which rose 3.7°C, and DO, which decreased from 7.37 to 6.33 mg/L, were extremely stable.

Inorganic constituents and nutrients detected generally showed very little change in concentration throughout the storm event. There were no significant differences in the concentrations of any of the nutrients, with the exception of TOC, throughout the event. Total organic carbon increased throughout the storm event, and along with color, was reported to be highest in the last sample collected for the event. The increase in color, from 450 to 600 PCU, was consistent with the increase in TOC, and likely due to leaching of organics (in the form of tannic and fulvic acids) from the forested wetlands associated with Hatchet Creek. Concentrations of total phosphorus, total ortho-phosphate, and dissolved ortho-phosphate were all very similar, typically differing only 0.01 to 0.02 mg/L in samples collected at the same sample sequence. The only nitrogen species reported as detectable was TKN, the sum of the ammonia and organic nitrogen, which also showed little change throughout the storm event. The presence of TKN as the dominant form of nitrogen was likely due to the breakdown of natural organic matter and bacterial/fungal transformations of nitrogen species to organic nitrogen.

Storm Event Summary for Little Hatchet Creek West Branch at SR 26 on March 4 – 6, 2003

Event Description

The total rainfall for the event was based on the nearby rain gage installed at Hatchet Creek at SR 26. Total rainfall from February 27, 2003 through March 4, 2003 was estimated at 3.70 inches. No baseline samples were collected as part of this event. However, the SJRWMD has historical baseflow data from this site that can be used for comparative purposes. A baseline stage for the event on Little Hatchet Creek at SR 26 was recorded at 12.78 feet on March 3, 2003. A total of seven samples were collected over three days, March 4, 2003 through March 6, 2003 for this particular storm event.

Site Specific Sampling Methodologies

The storm event sampling protocol for Little Hatchet Creek was similar to that for Hatchet Creek due to the fact that Little Hatchet Creek also responds slowly to rainfall events. As with Hatchet Creek, this lag time is primarily due to the size of the watershed, the relatively low relief, reduced impervious area, and the presence of extensive wetlands that attenuate storm-related flows. Due to the lag time, after the creek rises the required 0.1 feet in response to the rain event, three days of sampling was required to adequately characterize the effects of the event. This storm event was combined with the sampling conducted on Hatchet Creek and followed similar methodologies. For each discrete sample, field parameters, water quality samples, and velocity measurements (for flow calculation) were obtained. Water velocities were measured seven times during the event. Measurements were made slightly below mid-depth (0.6 of the total stream depth at the point of measurement or 0.4 above the stream bottom) at 0.25 meter intervals along a cross section of the channel and used for the calculation of stream flow.

Stage and Flow Data

Sampling commenced on March 4, 2003 at 1100. The initial staff gage reading for the sampling event was 13.04 feet (Table 3). Little Hatchet Creek continued rising and the peak stage was recorded on March 6, 2003 at 1000 with a staff gage reading of 13.32 feet, when the sixth of seven samples was collected. The stage dropped to 13.28 feet at 1315, the time last sample was collected on March 6, 2003. The maximum change in stage over the three-day period was 0.28 feet.

Table 3. Storm Event Sample Collection Summary for Little Hatchet Creek West Branch-SR 26

Date	Time	Sample Collected /Designation	Stage (feet)	Flow (cms)***	Flow (cfs)****	Rainfall (inches)
02/27/03	1255	No	12.55	NR	NR	0.90
02/28/03	1040	No	12.72	NR	NR	0.55
03/03/03	0811	No	12.78	NR	NR	1.01*
03/04/03	1100	Yes/ LHAT #1	13.04	0.595	21.012	0.70**
03/04/03	1300	Yes/ LHAT #2	13.10	0.752	26.557	0.70
03/04/03	1435	Yes/ LHAT #3	13.12	0.810	28.605	0.70
03/05/03	1225	Yes/ LHAT #4	13.22	0.794	28.040	0
03/05/03	1500	Yes/ LHAT #5	13.22	0.749	26.451	0
03/06/03	1000	Yes/ LHAT #6	13.32	0.356	12.572	0
03/06/03	1230	Yes/ LHAT #7	13.28	0.300	10.594	0

* Cumulative rainfall from 3/1 – 3/3

** Cumulative rainfall for 3/4/03

*** (cms) cubic meters per second

**** (cfs) cubic feet per second

Note: NR = Not Reported

The initial stream flow measurement on March 4, 2003 at 1100 was 0.595 cms. The maximum flow recorded, 0.810 cms, occurred March 4, 2003 at 1435 when the third sample was collected. Calculated flows were the highest, 0.749-0.810 cms from March 4, 2003 at 1100 to March 5, 2003 at 1500. Flow measured following collection of the last sample on March 6, 2003 at 1315 was 0.300 cms, the lowest flow calculated for the storm event. The highest calculated flows occurred before the peak stage.

Analytical Results

Field parameters showed little variability over the duration of the event. Water temperature ranged from 15.4° C when the first sample was collected to 21.1° C when the last sample was collected (Appendix A-2). Initial field pH was 6.47 SU. Field pH increased to a maximum of 6.52 SU prior to peak stage, and decreased to the minimum reading of 6.42 SU at peak stage. Field specific conductance under pre-peak conditions ranged from an initial field reading of 101 µmhos/cm to a maximum of 104 µmhos/cm. The lowest field specific conductance observed during the event, 91 µmhos/cm, was observed on March 5, 2003 at 1225 prior to peak stage. Dissolved oxygen (DO) values ranged from 4.16 to 2.64 mg/L, with the higher values recorded early in the event and decreasing as water temperature increased. The maximum value recorded for field turbidity was 3.5 NTU recorded approximately 24 hours after peak flow and the minimum was 2.1 NTU at the end of the storm event.

Inorganic indicator constituents analyzed in the laboratory included alkalinity, color, specific conductance, turbidity, TSS, TDS, chloride, and sulfate. All samples analyzed for TSS and sulfate resulted in undetectable concentrations of these constituents. The remaining inorganic parameters showed little variance throughout the event. Alkalinity varied between 26 and 28 mg/L. Color ranged from 250 PCU to 350 PCU with the higher values reported on the last day of sampling. Total dissolved solids ranged from 100 mg/L to 120mg/L. Laboratory specific conductance values were slightly lower than field-measured conductance with values ranging from 81 to 94 µmhos/cm. Laboratory turbidity initially reported at 2.5 NTU, increased throughout the second day of the event to a maximum of 3.7 NTU, decreasing to a minimum of 2.3 NTU with the last sample collected. The minimal chloride value of 14 mg/L was recorded for the majority of the samples for this event including the peak flow sample. The maximum chloride value of 19 mg/L was recorded on the second day of the event, approximately 22 hours after the peak flow.

Nutrient analyses, for ammonia nitrogen TKN, NO_x, dissolved ortho-phosphate, total ortho-phosphate, and total phosphorus, showed little variation throughout the event. All samples reported

undetectable concentrations for ammonia and NO_x. Total Kjeldahl nitrogen values ranged from 0.91 to 1.2 mg/L with the maximum concentration occurring on the second day of the event approximately 24 hours after peak flow. Minimum values for total and dissolved ortho-phosphate (0.18 and 0.16 mg/L respectively) were observed near the beginning of the event and in second day samples approximately 24 hours after peak flow. Maximum values of both total and dissolved ortho-phosphate, 0.24 and 0.21 mg/L, were reported at the end of the event. The maximum concentration of total phosphorus, 0.24 mg/L, was reported for initial and the final samples collected. The minimum concentration of total phosphorus, 0.20 mg/L, was reported for samples collected on the second day of the event approximately 24 hours after peak flow. Total organic carbon showed the greatest variance ranging from 30 mg/L to 46 mg/L during the event.

Summary and Discussion

The rural nature of the watershed is similar in character to Hatchet Creek, but is more urbanized and the upper reaches of Little Hatchet Creek in the vicinity of Gainesville Regional Airport have been channelized. As with Hatchet Creek, the relatively low relief in the upper basin and the large expanse of wetlands associated with Little Hatchet Creek upstream of the sample collection site attenuated both the rapid rise in stage and the increased levels of chemical constituents typically associated with urban stormwater. The turbidity, which ranged from 2.3 to 3.7 NTU, remained relatively constant throughout the event. Field parameters, with the exception of temperature, which rose 5.6° C, and DO, which decreased from 4.16 to 2.64 mg/L, were extremely stable. The decrease in DO was likely caused by the increase in water temperature and the increased concentration of natural organics.

Inorganic constituents and nutrients detected generally showed very little change in concentration throughout the storm event. There were no significant differences in the concentrations of any of the nutrients, with the exception of TOC, during the storm event. Total organic carbon fluctuated throughout the storm event, and along with color, was reported to be highest in the last sample collected for the event. The increase in color, from 250 to 350 PCU, was likely due to leaching of organics (in the form of tannic and fulvic acids) from the forested wetlands associated with Little Hatchet Creek. Concentrations of total phosphorus, total ortho-phosphate, and dissolved ortho-phosphate were all very similar, typically differing only 0.04 to 0.06 mg/L in samples collected at the same sample sequence. The only nitrogen species reported as detectable was TKN, the sum of the ammonia and organic nitrogen, which also showed little change throughout

the storm event. As was observed with Hatchet Creek, the nitrogen was present only in the organic form, likely due to the breakdown of organic matter or microbial conversion.

Storm Event Summary for Lake Forest Creek at CR 329B on June 4 & 5, 2003

Event Description

The baseline stage for Lake Forest Creek at CR 329B of 11.00 feet was recorded on June 2, 2003 two days prior to the event. A total of six samples were collected over two days, June 4, 2003 and June 5, 2003, for this particular storm event. A baseline sample was collected on June 4, 2003 at 0945, followed by five storm event samples. The storm event sampling was conducted over a 23 hour period, beginning on June 4, 2003 at 1230 and ending on June 5, 2003 at 1120. The total rainfall for this event, 0.22 inches, was the cumulative total reported for June 4, 2003 at the J.R. Kelly Electrical Generating Station in downtown Gainesville. The rainfall that occurred during the event was intermittent and of relatively low intensity, resulting in a minimal stage increase.

Site Specific Sampling Methodologies

The storm event sampling protocol for Lake Forest Creek was similar to the protocol for the other smaller creeks in urban Gainesville. Two days of sampling was required to adequately characterize the effects of the event. Field parameters were measured every 15 minutes during the event on June 4, 2003 from 0945 to 1500 and during the last sample collected for the storm event on June 5, 2003 at 1120. Grab samples were obtained for laboratory analyses during the event. Velocity measurements (for flow calculation) were made as time permitted. ACEPD was unable to conduct the storm event sampling of Lake Forest Creek downstream of CR329B, closer to Newnans Lake. The sample site for the storm event has been historically used for baseflow sample collection.

Stage and Flow Data

Sampling commenced on June 4, 2003 at 0945, with collection of a baseline sample. The initial staff gage reading at baseflow conditions was 11.58 feet (Table 4). Lake Forest Creek continued rising and the peak stage was recorded on June 4, 2003 at 1500 with a staff gage reading of 11.70 feet. The stage dropped to 11.50 feet for the last sample collected on June 5, 2003 at 1120. The maximum change in stage over the event period was 0.16 feet.

A dense canopy of low branches and the braided nature of the stream made measuring stream flow accurately impossible. The velocities measurements were made in the main channel upstream of the culvert under CR329B. The calculated flow for Lake Forest Creek throughout the event ranged from 0.132 to 0.224 cms. The decreasing flow recorded throughout the storm event sampling

may have resulted from the delayed affects of rainfall that occurred on June 3, 2003, the day before the storm event sampling was conducted. The reported rainfall for that date in Gainesville was 1.00 inches.

Table 4. Storm Event Summary for Lake Forest Creek at CR 329B

Date	Time	Sample Collected/ Designation	Stage (feet)	Flow (cms)*	Flow (cfs)**
06/02/03	NR	No	11.00	NR	NR
06/04/03	0945	Yes/ No. 1 Storm Sequence	11.58	0.223	7.875
06/04/03	1230	Yes/ No. 2 Storm Sequence	11.62	0.224	7.910
06/04/03	1300	Yes/ No. 3 Storm Sequence	11.66	NR	NR
06/04/03	1330	Yes/ No. 4 Storm Sequence	11.68	0.132	4.662
06/04/03	1500	Yes/ No. 5 Storm Sequence	11.70	NR	NR
06/05/03	1120	Yes/ No. 6 Storm Sequence	11.50	NR	NR

* (cms) cubic meters per second

Note: NR = Not Reported

** (cfs) cubic feet per second

Analytical Results

Field parameters showed some variability over the duration of the event. Water temperature ranged from a low of 22.5° C during the event to a high of 22.9° C when the last sample was collected (Appendix A-3). Initial field pH was reported to be 6.91 SU. It gradually decreased on June 4, 2003 throughout the event with the lowest field pH reported at 6.82 SU. The highest reading, 6.97 SU, was taken on June 5, 2003 at the completion of the event. Field specific conductance showed a high variability, ranging from 121 to 163µmhos/cm, generally decreasing throughout the event. Dissolved oxygen (DO) values ranged from 5.16 to 5.90 mg/L with the values fluctuating throughout the event. The maximum value recorded for field turbidity was 32 NTU and the minimum was 3.1 NTU. The highest field turbidity was reported for the first sample of the event, on June 4, 2003 at 1230, and was likely indicative of a “first flush” of stormwater.

Inorganic indicator constituents analyzed in the laboratory included alkalinity, color, specific conductance, turbidity, TSS, TDS, chloride, and sulfate. All inorganic parameters showed some variance throughout the event. Color ranged from 70 PCU to 120 PCU with the higher values reported on the last day of sampling. Total dissolved solids ranged from 62 mg/L to 120 mg/L. Laboratory specific conductance was similar to field-measured conductance with values ranging from 120 to 160 µmhos/cm. Laboratory turbidity values tended to be higher during the first half of the event (a maximum 25 NTU) decreasing to a minimum of 2.9 NTU towards the end of the event. The minimum chloride value of 6.7 mg/L was recorded during the event prior to peak stage; however, the maximum of 9.5 mg/L was recorded on June 5, 2003. Alkalinity measurements ranged

from 37 mg/L during the event to 51 mg/L post-peak stage. The total suspended solids ranged from 32 mg/L prior to the peak stage to undetectable (<5 mg/L) during peak stage. Sulfate was determined to be highest, 15 mg/L, prior to the event and reached a minimum of 10 mg/L during the event.

Nutrient analyses, for ammonia nitrogen TKN, NO_x, total ortho-phosphate, and total phosphorus, showed little variation throughout the event. Total Kjeldahl nitrogen values ranged from 0.47 to 0.65 mg/L with the maximum concentration reported for the final sample collected on June 5, 2003. The minimum value for total ortho-phosphate, 0.078 mg/L, was observed prior to the peak stage. The maximum value, 0.088 mg/L, was reported for the final sample collected on June 5, 2003. Sampling and analyses were not conducted for dissolved ortho-phosphate as part of this storm event. Total phosphorus responded similarly, with the exception of the final sample collected June 5, 2003. The minimum concentration, 0.12 mg/L, occurred at the peak stage, and the maximum concentration, 2.5 mg/L was reported at the final sample, collected on June 5, 2003. Total organic carbon ranged from 11 mg/L to 17 mg/L during the event.

Summary and Discussion

The mixed rural and urban nature of the watershed makes it intermediate in character with response to rainfall. As with the other tributaries to Newnans Lake (Hatchet and Little Hatchet creeks) there is relatively low relief in the upper basin and there are wetlands associated with Lake Forest Creek upstream of the sample collection site. This to some degree attenuated both the rapid rise in stage and the increased levels of chemical constituents typically associated with urban stormwater. The turbidity, which increased an order of magnitude over background concentrations, is indicative of a relatively rapid response to rainfall with little attenuation. Temperature and DO showed minimal amounts of variability during the event, when compared to field turbidity and specific conductance.

Inorganic constituents and nutrients detected generally showed very little change in concentration throughout the storm event. There were no significant differences in the concentrations of any of the nutrients during the storm event, with the exception of total phosphorus. Total organic carbon and color were less variable than in samples collected from Hatchet and Little Hatchet creeks, although the highest reported values for both constituents were in the last sample collected for the event. Nitrogen was reportedly present in two forms, inorganic as NO_x and as the organic nitrogen component of TKN (ammonia was not detected). The highest concentration of total phosphate, 2.5 mg/L, reported for the final sample collected on June 5, 2003, appeared anomalous

when compared to other phosphorus concentrations observed during the event. In discussion with the laboratory, STL confirmed that the concentration was accurately reported.

There are a number of possible explanations for the elevated total phosphorus. Phosphatic minerals occur naturally in the Hawthorn Group sediments that underlie all eastern Alachua County, as streams down cut through these sediments, phosphatic materials are eroded and become part of the suspended load carried by the stream or are incorporated in the streambed sediments. The higher velocities observed under storm event conditions bring these sediments into suspension and retain them in the water column. After samples are collected for total phosphorus analyses, the samples are acidified to pH <2 SU with sulfuric acid, this brings the phosphorus particles into solution. Elevated total phosphorus concentrations have been reported for other stormwater sampling events conducted on Hogtown and Possum creeks, where the Hawthorn Group sediments are visually exposed along the stream banks.

Based on the data collected as part of this event, it appears that storm water influences nutrient concentrations in the lower reaches of Lake Forest Creek. Based on the lower values for total ortho-phosphate, much of this phosphorus may not be biologically available.

Storm Event Summary for Hogtown Creek at SW 2nd Avenue on June 19, 2003

Event Description

Total rainfall for the storm event was 0.4 inches, based on rainfall data obtained from the J.R. Kelly Electrical Generating Station in downtown Gainesville. Baseline samples were not collected as part of this event. Rainfall was intermittent, and field notes indicated that light rain was falling when the initial sample was collected. Some of the reported rainfall occurred in the evening, after completion of the storm event sampling. The initial stage for Hogtown Creek at SW 2nd was 6.66 feet with a stream flow of 0.514 cms, recorded on June 19, 2003 at 1315. A total of ten time intervals were recorded in the field with five grab samples collected for laboratory analyses. This particular storm event was monitored for approximately two and one-half hours.

Site Specific Sampling Methodologies

The storm event sampling protocol for Hogtown Creek was similar to the protocol for the other creeks in urban Gainesville. Only one day of sampling was needed to characterize the storm event. Field parameters were measured every 15 minutes during the event on June 19, 2003 from 1315 to 1550. Velocity measurements (for flow calculation) were conducted four times during the event. The stream was approximately 10 meters in width and velocity measurements were taken at

two-meter intervals, beginning two meters from the bank. The sample site for the storm event was one that has been historically used for baseflow sample collection and is located on the south side of SW 2nd Avenue near the pedestrian bridge.

Stage and Flow Data

Sampling commenced on June 19, 2003 at 1315. The initial staff gage reading was 6.66 feet (Table 5). Hogtown Creek continued rising and the peak stage was recorded at 1405 with a staff gage reading of 6.76 feet. The water level dropped to 6.67 feet for the last sample collected at 1550. Stream flow was calculated for three sets of velocity measurements conducted during the event.

Table 5. Storm Event Summary for Hogtown Creek at SW 2nd Avenue

Date	Time	Sample Collected/ Designation	Stage (feet)	Flow (cms)*	Flow (cfs)**
06/19/03	1315	Yes/ No. 1 Storm Sequence	6.66	1.031	36.406
06/19/03	1405	Yes/ No. 2 Storm Sequence	6.76	0.937	33.090
06/19/03	1450	Yes/ No. 3 Storm Sequence	6.68	NR	NR
06/19/03	1520	Yes/ No. 4 Storm Sequence	6.67	0.823	29.064
06/19/03	1535	No	6.66	NR	NR
06/19/03	1550	Yes/ No. 5 Storm Sequence	6.67	0.869	30.688

* (cms) cubic meters per second

Note: NR = Not Reported

** (cfs) cubic feet per second

Due to the intermittent nature of the rainfall event, the relatively large basin area, and the large amount of rainfall received in June prior to this sampling event, the flow did not show much variation throughout the event. The highest flow, 1.031 cms, was reported for the initial sample collected on June 19, 2003 at 1315.

Analytical Results

Field parameters showed some variability over the duration of the event. Water temperature ranged from 25.1°C when the first sample was collected to 27.3°C when second measurement was recorded (Appendix A-4). Temperatures fluctuated throughout the remainder of the event. Field pH fluctuated between 7.71SU and 7.91SU throughout the storm event. Field specific conductance showed great variability with an initial reading of 241 µmhos/cm, which dropped rapidly to 75 µmhos/cm in the subsequent 15-minute interval. Field specific conductance increased throughout the event after the initial drop, ending at 167 µmhos/cm. Dissolved oxygen (DO) values ranged from an initial value of 8.16 mg/L decreasing to 5.95 mg/L in the first 15-minute interval. Dissolved oxygen (DO) gradually increased throughout the remainder of the rain event. The maximum value recorded for field turbidity was 160 NTU and the minimum was 1.3 NTU.

Inorganic indicator constituents included alkalinity, color, specific conductance, turbidity, TSS, TDS, chloride, and sulfate. Alkalinity slowly declined during the storm event from a high of 97 mg/L to a low of 84 mg/L. Total suspended solids were reported at their maximum concentration, 240 mg/L, in the first sample collected. The lowest TSS value, 49 mg/L, was reported at the end of the event. Sulfate was not detected, except in the last sample, with a reported value of 8.3 mg/L. The remaining inorganic parameters showed little variance throughout the event. Color ranged from 100 PCU to 70 PCU with the higher values reported at the onset of the storm event. Total dissolved solids ranged from 180mg/L to 160mg/L. Laboratory specific conductance ranged from 240 to 230µmhos/cm and was generally higher than field specific conductance. Laboratory turbidity values were also reported to be higher than the field measured values, and ranged from 39 to 170 NTU. The chloride concentrations showed little variation, ranging from 20 to 22 mg/L.

Nutrient analysis, for ammonia nitrogen, TKN, NO_x, total ortho-phosphate, and total phosphorus showed little variation throughout the event. All samples reported undetectable concentrations for ammonia and little variation in NO_x, which ranged from 0.30 to 0.32 mg/L. Total Kjeldahl nitrogen values ranged from 0.35 to 0.24 mg/L with the maximum concentration occurring at the last sample interval. The minimum values for total ortho-phosphate, 0.71 mg/L, was observed in the first sample collected during the event. The maximum value, 1.1mg/L, was reported for samples collected midway through the event. Total phosphorus responded differently with the maximum concentration, 2.1 mg/L, reported for the first sample collected, and the minimum, 0.96 mg/L, reported for the last sample collected. Total organic carbon (TOC) and total dissolved solids (TDS) showed little variance, ranging from 11 mg/L to 12 mg/L and 160 mg/L to 180 mg/L respectively, during the event.

Summary and Discussion

The urban/suburban nature of the watershed and the relatively high relief cause a relatively rapid response to rainfall. The intermittent rainfall experienced during this event reduced the typically large response one would expect to see in stage. Changes in water quality were observed by increased levels of chemical constituents typically associated with urban stormwater, such as turbidity and TSS. The inconsistency between field and laboratory turbidity measurements was likely due to differences in sample collection. Samples for field and laboratory analyses are not collected at precisely the same time; additionally the samples for field analyses were collected closer to the stream bank. Both field and laboratory data for turbidity, showed an increase of one to two

orders of magnitude above background or baseflow levels. Laboratory data for turbidity and TSS showed consistent increases in concentrations.

Inorganic constituents and nutrients detected generally showed very little change in concentration throughout the storm event. There were no significant differences in the concentrations of any of the nutrients during the storm event, with the exception of total phosphorus. Total organic carbon and color were less variable than in samples collected from Hatchet and Little Hatchet creeks, and decreased throughout the event.

The highest concentration of total phosphorus, 2.1 mg/L, reported for the second sample collected on June 19, 2003 occurred when other constituents were elevated and appeared to be a “first flush” sample. The source of elevated concentration of total phosphorus was likely the naturally occurring phosphatic minerals in the Hawthorn Group. There are numerous exposures of Hawthorn Group sediments along the stream bank in the Hogtown Creek watershed. Exposed phosphatic materials are eroded and become part of the suspended load carried by the stream or are found in the streambed sediments and are easily remobilized during rainfall events. Elevated total phosphorus concentrations have been historically reported for stormwater sampling events conducted on Hogtown and Possum creeks.

Nitrogen was reportedly present in two forms, inorganic as NO_x and organic as a component of TKN (ammonia was not detected). Concentrations of NO_x and TKN were similar, ranging from 0.30 to 0.32 and 0.24 to 0.35, respectively. Based on the data collected as part of this event, it appears that this storm event produced minimal changes in water quality, with the exception of total phosphorus.

Storm Event Summary for Sweetwater Branch, north Paynes Prairie, July 22, 2003

Event Description

Total rainfall for the storm event conducted on July 22, 2003 was 1.42 inches, based on rainfall data obtained from the J.R. Kelly Electrical Generating Station in downtown Gainesville. Baseline samples at this site were collected on July 15, 2003. Rainfall on July 22, 2003 was heavy, but intermittent. This particular storm event was monitored for approximately two and one-half hours. The maximum rise in stage for this event on July 22, 2003 was 1.10 feet.

Site Specific Sampling Methodologies

The storm event sampling protocol for Sweetwater Branch was similar to the protocol for the other creeks in urban Gainesville. Only one day of sampling was needed to characterize the storm

event. Field parameters were measured every 15 minutes during the event on July 22, 2003 from 1200 to 1420. A total of five samples were collected on the day of the storm event, July 22, 2003. Velocity measurements (for flow calculation) were conducted three times during the event. The stream was approximately 3.84 meters in width and velocity measurements were conducted at 0.25 meter intervals. The sample site for this storm event was one that had been previously used for stormwater monitoring, but not used for baseflow water quality sampling. The sample site, located on the north side of Paynes Prairie State Preserve, is downstream of both the GRU Main Street Water Reclamation Facility and Williston Road (SR 331).

Stage and Flow Data

The stormwater sampling event was conducted on July 22, 2003, from 1200 to 1355. The initial stage for Sweetwater Branch at the wooden bridge on the north side of Paynes Prairie (SWBNPP) on July 22, 2003 was 1.70 feet (Table 6). The staff gage reading when the first sample was collected was 1.76 feet. Sweetwater Branch rose to a peak stage of 2.80 feet at 1315. The water level had dropped to 2.12 feet when the last sample was collected.

Stream flow under baseflow conditions is relatively constant at this site due to the upstream contribution of reclaimed water. During baseflow sampling conducted on July 15, 2003, the stream flow was determined to be 0.411 cms, measurement on July 15, 2003 at 1200. The maximum stream flow 0.819 cms, occurred after peak stage at 1355.

Table 6. Storm Event Summary for Sweetwater Branch, north Paynes Prairie

Date	Time	Sample Collected/ Designation	Stage (feet)	Flow (cms)*	Flow (cfs)**
07/15/03	1200	Yes/ No. 2 Storm Sequence SWBNPP	1.58	0.411	14.514
07/22/03	1145	No	1.70	NR	NR
07/22/03	1230	Yes/ No. 4 Storm Sequence	1.76	0.425	15.009
07/22/03	1310	Yes/ No. 5 Storm Sequence	2.80	NR	NR
07/22/03	1325	Yes/ No. 7 Storm Sequence	2.78	NR	NR
07/22/03	1355	Yes/ No. 8 Storm Sequence	2.40	0.819	28.923
07/22/03	1420	No	2.12	NR	NR

* (cms) cubic meters per second

Note: NR = Not Reported

** (cfs) cubic feet per second

Analytical Results

Field parameters showed some variability over the duration of the event. Water temperature ranged from 27.0°C prior to peak stage to 26.5°C during and after peak stage (Appendix A-5). The initial field pH was reported to be 7.57 SU. Field pH increased to a maximum of 7.64 SU at peak

stage and decreased to the minimum reading of 7.55 SU at the time the last sample was collected. Specific conductance ranged from an initial field reading and maximum of 740 $\mu\text{mhos/cm}$ to a minimum of 144 $\mu\text{mhos/cm}$ when the final event sample was collected DO values ranged from 6.31 to 7.84 mg/L with the higher values recorded early in the event. On July 22, 2003 field turbidity ranged from 39 NTU to 140 NTU. The field turbidity of the baseline sample collected on July 15, 2003 was 2.2 NTU.

Inorganic indicator constituents, alkalinity, color, specific conductance, turbidity, TSS, TDS, chloride, and sulfate, varied in concentration throughout the event. Sulfate concentrations ranged from 28 to 120 mg/L, with the baseline sample collected on July 15, 2003 having the highest concentration. Color ranged from 10 PCU to 40 PCU with the higher values reported on the last day of sampling. Alkalinity ranged from 63 mg/L during the event to 95 mg/L prior to the event. Total suspended solids were undetectable (<5 mg/L) prior to the event, reaching a maximum of 240 mg/L during the peak stage. Total dissolved solids ranged from 170 mg/L to 440 mg/L, with the highest value reported for baseflow conditions. Laboratory specific conductance values were similar to field-measured conductance, with values ranging from 270 to 660 $\mu\text{mhos/cm}$. Laboratory turbidity showed an increasing trend similar to field turbidity. Chloride concentrations decreased during the storm event from 120 mg/L for the baseline sample collected on July 15, 2003 to 38 mg/L at peak flow.

Nutrient analyses showed considerable variation throughout the event. The NO_x values ranged from 3.7 mg/L prior to the storm event, to a minimum value of 0.62 mg/L during peak flow. Total Kjeldahl nitrogen values ranged from 0.53 to 0.87 mg/L, with the highest concentrations at peak flow. Minimum values for total ortho-phosphate and dissolved ortho-phosphate (0.60 and 0.29 mg/L) were observed during peak flow and just prior to peak flow, respectively. The maximum value for total and dissolved ortho-phosphorus, 1.2 mg/L for both samples, was recorded prior to the event. Total phosphorus ranged from a maximum of 2.9 mg/L during peak stage to 1.4 mg/L after the peak stage. Total organic carbon showed a slight variance ranging from 6.6 mg/L to 12 mg/L during the event.

Summary and Discussion

In Sweetwater Branch, downstream of the GRU Main Street Water Reclamation Facility, stream stage rises rapidly, primarily due the small basin size and the relatively large amount of impervious area and relatively high relief in the upper portions of the watershed. The baseflow of Sweetwater Branch upstream of this location is augmented by approximately 6 million gallons per

day (mgd) of reclaimed water from the GRU Main Street Water Reclamation Facility. This input dominates the flow and chemical composition of the water in Sweetwater Branch, providing 80% or more of the flow under baseline conditions.

Prior to the rainfall event, Sweetwater Branch was characterized by relatively high levels of specific conductance, TDS, sulfate, chloride, NO_x and total phosphorus. Concentrations of these constituents, with the exception of total phosphorus, decrease rapidly when diluted by rainfall during a storm event. The decrease of NO_x nitrogen concentrations is especially noticeable, with a baseline concentration of 3.7 mg/L being reduced six-fold to a concentration of 0.62 mg/L at peak stage. A similar reduction in concentrations of TDS and total ortho-phosphate was also observed. Elevated TSS and turbidity, at and before peak stage, were indicative of stormwater influences. The highest total phosphorus readings were observed at peak stage, indicating that some of the total phosphorus may be related to erosion and resuspension of the phosphatic minerals present in the Hawthorn Group sediments that are exposed along the banks or in the streambed. With the exception of total phosphorus, the concentrations of nutrients in Sweetwater Branch decreased during the event with the dilution from rainfall.

TUMBLIN CREEK STORM EVENT SUMMARY 2003
SJRWMD Contract SF672AA
Water Quality Monitoring in the Orange Creek Basin

Introduction

The Alachua County Environmental Protection Department (ACEPD) collected stormwater quality, level, and flow data at three sites on the Tumblin Creek in Gainesville during two storm events in August 2003. Tumblin Creek is a small watershed of approximately 3.2 square miles. The sites, which were simultaneously sampled during the two events, included Tumblin Creek at SW 5th Avenue (TUMSW5), Tumblin Creek at Depot Avenue (TUMDEPOT), and Tumblin Creek at US 441 (TUM441) (Table 1 and Figure 1). The following report section summarizes the storm event monitoring data for both storm events monitored on Tumblin Creek. The individual storm events are discussed below by date and station location. The purpose of these two sampling events was to monitor water quality under storm event conditions in an attempt to evaluate the potential release of contaminants from the “Old Landfill” at Tumblin Creek Park. The TUMDEPOT site is located on the north side of Depot Avenue, at the southern end (downstream) of the landfill area.

Table 1. Tumblin Creek Storm Event Summary August 2003

Date	Station ID	Baseflow/ Stormwater Samples	Rainfall Recorded at J. R. Kelly (inches)	Maximum Stage Change (feet)
08/05/03	TUMSW5	1/5	0.36	1.78
08/05/03	TUMDEPOT	1/5	0.36	2.36
08/05/03	TUM441	1/5	0.36	1.16
08/20-21/03	TUMSW5	1/5*	0.02**	0.50
08/20-21/03	TUMDEPOT	1/5*	0.02**	0.48
08/20-21/03	TUM441	1/5*	0.02**	0.77

*Baseflow sample collected on 8/20/03

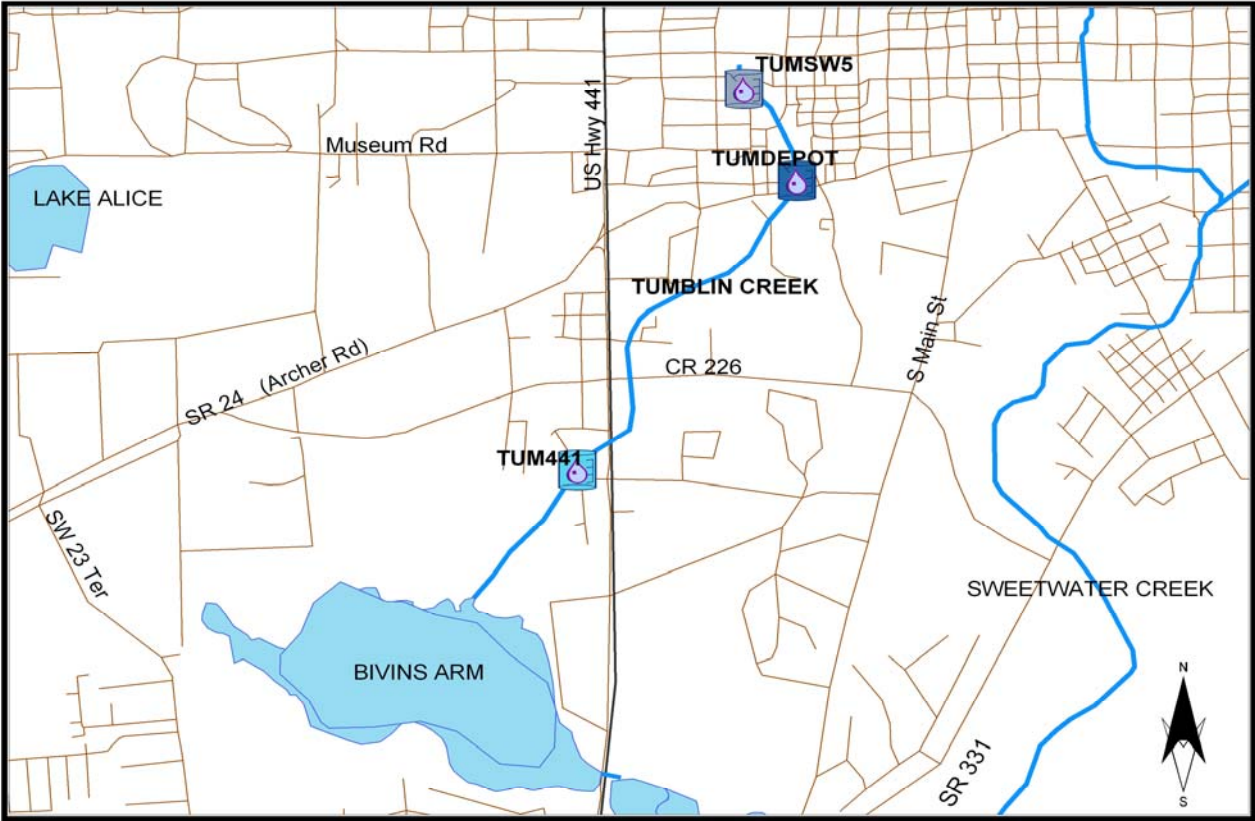
** Rainfall in the Tumblin Creek watershed was greater than reported at the J.R. Kelly Electrical Generating Station located in the adjacent Sweetwater Branch watershed.

Storm Event Summary for Tumblin Creek on August 5, 2003

Event Description







Total rainfall for the storm event was 0.36 inches, based on rainfall data obtained from the J.R. Kelly Electrical Generating Station in downtown Gainesville. The storm event sampling protocol for Tumblin Creek was similar to the protocol for the other creeks in urban Gainesville. Only one day of sampling was needed to characterize the storm event. Field parameters were measured every 15 minutes during the event on August 5, 2003 from 1220 to 1600. Five grab

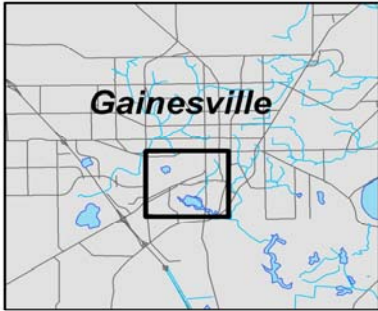
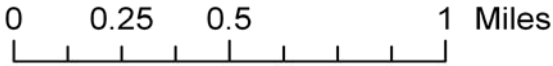
Tumblin Creek Storm Event Project 2003 Location Map



Legend

Sampling Sites

-  TUMSW5
-  TUMDEPOT
-  TUM441
-  Lakes
-  Streams
-  Roads



Map for the October 2003 Draft Report (11/7/03)

Figure 1. Location of sampling sites along Tumblin Creek

samples for analyses of laboratory parameters were collected on August 5, 2003 at each of the three stations to characterize stormwater quality as part of the event. The initial sample was collected prior to the onset of rainfall. Heavy rain reportedly began at approximately 1330, decreasing in intensity after approximately 30 minutes. Velocity measurements (for flow calculation) were conducted three times at each site during the event. Two of the sample sites for the storm event, TUMSW5 and TUM441, have been historically used for baseflow sample collection.

Site Specific Sampling Methodologies TUMSW5

TUMSW5 is the site highest in the watershed sampled as part of this event. The site is located approximately 30 meters south of SW 5th Avenue. The upper reaches of Tumblin Creek above SW 5th Avenue are channelized and confined to the stormwater management system, and not above grade until the stream appears from a 60-inch culvert at the southern end of a parking lot serving Shands at AGH. Due to the large amount of impervious area in the upper reaches of the watershed, the Tumblin Creek in the vicinity of SW 5th Avenue, responded rapidly to rainfall. At the sample site, the creek channel was approximately 2 to 3 meters in width. Road runoff directly entered the creek on the south side of SW 5th Avenue.

Stage and Flow Data TUMSW5, August 5, 2003

Sampling commenced on August 5, 2003 at 1220. The initial staff gage reading was 7.52 feet (Table 2). The creek continued to rise and the peak was recorded at 1415 with a staff gage reading of 9.30 feet. The water level dropped to 7.66 feet for the last sample collected at 1600. Stage rose rapidly at this site, making sample collection difficult. The maximum stage difference for the storm event was 1.78 feet. Velocity measurements were conducted four times during the sampling event. These measurements were used to calculate stream flow.

Table 2. Storm Event Summary for Tumblin Creek SW 5th Avenue, August 5, 2003

Date	Time	Sample Collected/Designation	Stage (feet)	Flow (cms)*	Flow (cfs)**
08/05/03	1220	Yes/ SS#1 TUMSW5	7.52	0.001	0.035
08/05/03	1349	Yes/ SS#2 TUMSW5	7.63	NR	NR
08/05/03	1400	No	8.50	0.441	15.574
08/05/03	1415	Yes/ SS#3 TUMSW5	9.30	NR	NR
08/05/03	1430	No	9.15	NR	NR
08/05/03	1445	No	7.90	0.179	6.321
08/05/03	1500	Yes/ SS#4 TUMSW5	7.85	NR	NR
08/05/03	1545	Yes/ SS#5 TUMSW5	7.68	NR	NR
08/05/03	1600	No	7.66	0.015	0.530

* (cms) cubic meters per second

Note: NR = Not Reported

** (cfs) cubic feet per second

Analytical Results TUMSW5, August 5, 2003

Field parameters showed large variations over the duration of the event. Water temperature ranged from 26.4°C when the first sample was collected to 28.4°C just prior to peak stage (Appendix B-1). The initial field pH was 7.49 SU. Field pH increased to a maximum of 8.28 SU at 1415 and decreased to the minimum reading of 7.49 SU at 1545. Specific conductance ranged from an initial field reading of 434 µmhos/cm at 1220 to a minimum of 23 µmhos/cm at 1415. Specific conductance had then increased to 101 µmhos/cm by 1545. Dissolved oxygen values ranged from 5.92 mg/L, for the initial sample collected, to 8.35 mg/L with the higher values recorded during peak stage and decreasing as water levels dropped. The minimum value for turbidity, 6.6 NTU, was observed at the onset of the event. The maximum value recorded for field turbidity was 75 NTU recorded at peak flow.

Inorganic indicator constituents included alkalinity, color, specific conductance, turbidity, total suspended solids, total dissolved solids, chloride, and sulfate. The inorganic parameters showed variance throughout the event. Alkalinity ranged from 28 to 150 mg/L, with the maximum concentration reported for the initial event samples and the minimum value reported at peak flow. Color ranged from 10 PCU to 20 PCU, showing little variation. Total suspended solids ranged from < 5.0 mg/L to 32 mg/L at peak flow. Total dissolved solids ranged from 22 mg/L to 250mg/L, with the highest values reported for the initial sample collected; and the lowest concentration reported for samples collected at peak stage. Laboratory specific conductance values were also similar to field-measured conductance with values ranging from 35 to 420 µmhos/cm. Laboratory turbidity values were similar to field data. The initial turbidity, 7.5 NTU, increased to 27 NTU just after the peak stage. Chloride was undetectable, <1.0 mg/L, at peak stage. The maximum chloride value of 24 mg/L was reported for the initial sample. Sulfate ranged from <5.0 mg/L after peak stage to 68 mg/L at peak stage.

Nutrient analysis, ammonia nitrogen, TKN, NO_x, total ortho-phosphate, total phosphate, and TOC showed little variation throughout the event. All samples reported undetectable concentrations for ammonia. Total Kjeldahl nitrogen values ranged from 0.24 to 0.57 mg/L with the maximum concentration occurring after peak stage. The maximum value for total ortho-phosphate, 0.24 mg/L, was reported for the initial event sample. The minimum value, 0.094 mg/L, was reported for the last sample taken on August 5, 2003 at 1545. Total organic carbon ranged from 4.3 mg/L to 7.3 mg/L. Nitrate plus nitrite (NO_x) concentrations generally increased throughout the event with the exception

of those measurements taken at peak stage. NO_x concentrations ranged from <0.05 mg/L to 0.62 mg/L.

Low concentrations of organic compounds were detected in samples collected during the event. No VOCs were detected in any of the five samples collected at TUMSW5. A number of the PAHs, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i) pyrene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluornathene, indeno (1,2,3-cd) pyrene, phenanthrene, and pyrene, were detected at very low concentrations in some samples (Appendix B-4). The largest number of PAHs and the greatest concentrations were detected in samples collected at peak stage. However, all PAHs were detected in low concentrations, with the individual compounds ranging from <0.2 to 3.4 ug/L.

Metals concentrations in the stormwater were generally low, with the exception of iron. Five of the eight metals sampled; cadmium (<0.0005 mg/L), hexavalent chromium (<0.010 mg/L), copper (< 0.020 mg/L), mercury (<0.000020 mg/L), and silver (<0.010 mg/L), were not found to be above the reporting limit of the individual compounds. Iron was the only metal reportedly present in all samples, ranging from an initial concentration of 0.2 mg/L to 1.7 mg/L before peak stage (Appendix B-5). Zinc, 0.14 mg/L, and lead, 0.037, concentrations were also reportedly highest in samples collected prior to peak stage.

Fecal coliform bacteria were found to be present at concentrations of 4,900 to 92,000 col/100 mL during the event (Appendix B-6). The initial sample, 4,900 col/100 mL, was the lowest concentration reported. The second sample, collected at 1330, after the rainfall began, was reported to contain the highest levels of fecal coliform bacteria, 92,000 col/100 mL. A sample approximately two hours later contained 54,000 col/100 mL.

Site Specific Sampling Methodologies TUMDEPOT

The site TUMDEPOT is located downstream of TUMSW5 in the southern part of Tumblin Creek Park directly north of Depot Avenue. Water quality samples were collected approximately five meters north of Depot Avenue. The staff gage is located on the pedestrian bridge in Tumblin Creek Park approximately 75 meters upstream. This is also the location where velocity measurements were conducted. Due to a large input to the creek from the east via a 72-inch culvert on the north side of Tumblin Creek Park, and the large amount of impervious area in the watershed, Tumblin Creek in the vicinity of SW Depot Avenue responded rapidly to rainfall. At the sample site, the creek channel was approximately 2 to 3 meters in width.

Stage and Flow Data TUMDEPOT, August 5, 2003

Sampling commenced on August 5, 2003 at 1220. The initial staff gage reading was 12.12 feet (Table 3). The stage at TUMDEPOT rose rapidly to a peak stage of 14.48 at 1415. The water level dropped to 12.28 feet for the last reading at 1530. The maximum stage difference for the storm event was 2.36 feet.

The initial stream flow, calculated from the velocities measured at 1220, was 0.063 cms and was also the minimum flow during the storm event. The maximum flow, calculated from velocities measured at 1415, and was 1.996 cms. The final flow reading recorded was 0.181 cms. The highest reported stream flow occurred at the time samples were collected just prior to peak stage.

Table 3. Storm Event Summary for Tumblin Creek SW Depot Ave., August 5, 2003

Date	Time	Sample Collected/ Designation	Stage (feet)	Flow (cms)*	Flow (cfs)**
08/05/03	1220	Yes/ SS#1 TUMDEPOT	12.12	0.063	2.225
08/05/03	1349	Yes/ SS#2 TUMDEPOT	12.42	NR	NR
08/05/03	1415	Yes/ SS#3 TUMDEPOT	14.48	1.996	70.488
08/05/03	1500	Yes/ SS#4 TUMDEPOT	12.40	0.223	7.875
08/05/03	1530	No	12.28	0.181	6.392
08/05/03	1545	Yes/ SS#5 TUMDEPOT	NR	NR	NR

* (cms) cubic meters per second

Note: NR = Not Reported

** (cfs) cubic feet per second

Analytical Results TUMDEPOT, August 5, 2003

Field parameters showed some variability over the duration of the event. Water temperature ranged from 26.1°C to 28.1°C at peak stage (Appendix B-2). The initial field pH was 7.37 SU. Field pH increased to a maximum of 9.36 SU at peak stage and decreased slowly throughout the remainder of the event. Specific conductance ranged from an initial field reading and maximum of 317 µmhos/cm to a minimum of 36 µmhos/cm fifteen minutes post-peak stage. Dissolved oxygen (DO) values ranged from an initial reading and minimum of 6.36 mg/L to a maximum of 8.32 mg/l fifteen minutes post-peak stage. The initial field turbidity value of 3.4 NTU was the minimum measured during the event. The maximum field turbidity, 40 NTU, was recorded at peak stage.

Inorganic indicator constituents included alkalinity, color, specific conductance, turbidity, total suspended solids, total dissolved solids, chloride, and sulfate. Alkalinity was at a maximum value of 91 mg/L at the beginning of the event and a minimum of 29 mg/L 45 minutes after peak stage. Color showed little variance ranging from 15 to 20 PCU. Lab specific conductance values were similar to field-measured values ranging from 310 µmhos/cm reported for the initial sample to 44 µmhos/cm at peak stage. Turbidity values began at a minimum of 3.2 NTU, increased to a

maximum of 71 NTU at peak stage, and then decreased to 14 NTU at the end of the event. Total suspended solids showed great variation ranging from an initial concentration of <5 mg/L to 160 mg/L at peak stage, dropping to 20 mg/L, 45 minutes after peak stage. The final reported TSS concentration, 9.5 mg/L, appears consistent with the laboratory turbidity of 14 NTU for samples collected at the same time interval. Total dissolved solids ranged from 31 mg/L to 190 mg/L with the maximum for the initial sample of the event and the minimum reported for the peak stage sample. Chloride ranged from 23 mg/L in the initial sample to 1.3 at peak stage and slowly increased to a value of 2.7 mg/L by the end of the event. Sulfate ranged from 40 mg/L reported for the initial sample to <5.0 mg/L at peak stage.

Nutrient analyses, ammonia nitrogen, TKN, NO_x, total ortho-phosphate, total phosphate, and TOC, showed little variation throughout the event. Ammonia was not detected. Nitrate plus nitrite varied from 0.29 to 0.068 mg/L, decreasing in concentration throughout the event. Total Kjeldahl nitrogen values ranged from 0.34 to 0.70 mg/L with the maximum concentration occurring at peak flow. Total ortho-phosphate ranged from 0.12 to 0.20 mg/L. Total phosphorus ranged from <0.10 to 0.46 mg/L. The highest concentrations of total ortho-phosphate and total phosphorus were reported for samples collected at peak flow. Total organic carbon ranged from 3.8 mg/L to 8.6 mg/L during the event.

Low concentrations of organic compounds were detected in samples collected during the event. With the exception of benzene at 1.7 ug/L, no VOCs were detected in any of the five samples collected at TUMDEPOT. The same PAHs, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i) pyrene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluornathene, indeno (1,2,3-cd) pyrene, phenanthrene, and pyrene, were detected at very low concentrations in some samples (Appendix B-4). The largest number of PAHs and the greatest concentrations were detected in samples collected at peak flow, just prior to peak stage. All PAHs were detected in low concentrations, with individual compounds ranging from 0.2 to 2.9 ug/L.

Metals concentrations in the stormwater were generally low, with the exception of iron. Five of the eight metals sampled were not found to be above the reporting limit of the individual compounds. These were cadmium (<0.0005 mg/L), hexavalent chromium (<0.010 mg/L), copper (<0.020 mg/L) mercury (<0.000020 mg/L), and silver (<0.010 mg/L). Iron was the only metal reportedly present in all samples, ranging from an initial concentration of 0.25 mg/L to 1.2 mg/L before peak stage (Appendix B-5). Zinc, 0.092 mg/L, and lead, 0.032, were also reportedly highest in samples collected prior to peak stage.

Fecal coliform bacteria were found to be present at concentrations of 2,300 to 92,000 col/100 mL during the event (Appendix B-6). The initial sample reportedly contained, 2,300 col/100 mL, the lowest concentration reported for the storm event. The second sample, collected at 1349, after the rainfall began, was reported to contain 3,100 col/100 mL. A sample collected at approximately 1500 reportedly contained fecal coliform bacteria in concentrations of 92,000 col/100 mL.

Site Specific Sampling Methodologies TUM441

Water samples were collected as part of this storm event on the west side of US Highway 441 in the concrete lined channel approximately 75 meters west of the roadway and referred to as Tumblin Creek at Highway 441 (TUM441). The stage was determined using a staff gage located on the box culvert on the west side of the roadway. The baseline stage for TUM441 was 0.04 ft, recorded on August 5, 2003. A total of five samples were collected on August 5, 2003 for this particular storm event. A peak stage sample for laboratory analyses was not obtained at this site during sampling, because timing of sample collection was coordinated with stages at the upstream sites; the stage at TUM441 peaked later in the sampling event.

Stage and Flow Data TUM441, August 5, 2003

Sampling commenced on August 5, 2003 at 1235. The initial staff gage reading was 0.04 feet (Table 4). On August 5, 2003 the creek continued rising and the peak was recorded at 1440 with a staff gage reading of 1.20 feet. The water level dropped off to 0.10 feet for the last sample collected at 1554. The total change in stage was 1.16 feet. Velocity measurements were conducted four times at this station during the storm event. The measurements were made at 0.25-meter increments across the width of the channel.

Table 4. Storm Event Summary for Tumblin Creek at US441, August 5, 2003

Date	Time	Sample Collected/ Designation	Stage (feet)	Flow (cms)*	Flow (cfs)**
08/05/03	1235	Yes/ SS#1 TUM441	0.04	NR	NR
08/05/03	1252	No	0.04	0.020	0.706
08/05/03	1337	Yes/ SS#2 TUM441	0.04	NR	NR
08/05/03	1355	No	0.40	NR	NR
08/05/03	1414	Yes/ SS#3 TUM 441	0.36	1.231	43.472
08/05/03	1425	No	0.80	NR	NR
08/05/03	1440	No	1.20	NR	NR
08/05/03	1455	No	0.80	NR	NR
08/05/03	1505	Yes/ SS#4 TUM441	0.30	NR	NR
08/05/03	1525	No	0.20	0.462	16.315
08/05/03	1554	Yes/ SS5#5 TUM441	0.10	0.168	5.933

* (cms) cubic meters per second

Note: NR = Not Reported

** (cfs) cubic feet per second

Analytical Results TUM441, August 5, 2003

Field parameters showed some variability over the duration of the event. Water temperature ranged from 26.9°C prior to the event to 27.8°C at peak flow (Appendix B-3). Field pH was lowest at 7.70 SU after the event and at a maximum of 8.43 SU at 1455. Specific conductance ranged from an initial field reading of 274 µmhos/cm at 1235, to a minimum of 6 µmhos/cm at peak stage, finally increasing to 29 µmhos/cm at 1554. Dissolved oxygen values ranged from 6.85 to 10.50 mg/L with the higher values recorded prior to peak stage. The maximum value recorded for field turbidity was 400 NTU at peak stage and the minimum was 4.4 NTU for the initial storm event sample.

Inorganic indicator constituents included alkalinity, color, specific conductance, turbidity, total suspended solids, total dissolved solids, chloride, and sulfate. The inorganic parameters showed slight variance throughout the event. Alkalinity ranged from 34 mg/L to 100 mg/L. Color ranged from 15 PCU to 25 PCU. Total suspended solids ranged from < 5 mg/L to 90 mg/L. Total dissolved solids ranged from 34 mg/L to 180 mg/L. Laboratory specific conductance values were slightly higher than field-measured conductance with values ranging from 50 to 290 µmhos/cm. The initial laboratory turbidity was 3.2 NTU. The highest laboratory turbidity, 69 NTU, was collected before peak stage, turbidity dropped to 34 NTU with the last sample collected. The minimum chloride value, 1.4 mg/L, was reported after peak stage; the maximum chloride value of 18 mg/L was reported for the initial event sample. Sulfate ranged from <5.0 mg/L just after peak stage to 64 mg/L at the onset of the event sampling.

Nutrient analyses for ammonia nitrogen, TKN, NO_x, total ortho-phosphate, total phosphorus, and TOC showed little variation throughout the event. Ammonia nitrogen was not detected in any of the event samples. Total Kjeldahl nitrogen values ranged from 0.30 mg/L to 0.58 mg/L, with the maximum concentration occurring before peak stage. The minimum value for total ortho-phosphate, 0.21 mg/L, was observed in the initial event sample. The maximum value, 0.43 mg/L, was reported after the peak stage. Total phosphorus ranged from 0.19 mg/L for the initial event sample to 0.72 mg/L just after peak stage. Total organic carbon showed some variance ranging from 1.0 mg/L at the conclusion of the event to 7.4 mg/L in the initial event sample. Nitrate plus nitrite (NO_x) levels ranged from 0.07 mg/L to 0.23 mg/L, with the highest concentrations occurring one hour after the onset of the event.

Low concentrations of organic compounds were detected in samples collected during the event. No VOCs were detected in any of the five samples collected at TUM441, with the exception of tetrachloroethene at 1.0 ug/L at 1337. The same PAHs observed in samples collected further

upstream in the watershed, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i) pyrene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluornathene, indeno (1,2,3-cd) pyrene, phenanthrene, and pyrene, were detected at very low concentrations in some samples (Appendix B-4). The largest number of PAHs and the greatest concentrations were detected in samples collected at peak flow, just prior to peak stage. Individual PAH concentrations ranged from 0.2 to 2.8 ug/L.

Metals concentrations in the stormwater were generally low, with the exception of iron. Cadmium (<0.0005 mg/L), hexavalent chromium (<0.010 mg/L), mercury (<0.000020 mg/L), and silver (<0.010 mg/L) were not found to be above the reporting limit of the individual compounds. Iron was the only metal reportedly present in all samples, ranging from an initial concentration of 0.15 mg/L to 2.5 mg/L before peak stage (Appendix B-5). The highest concentrations of zinc, 2.2 mg/L, and lead, 0.12, were also reported for samples collected prior to peak stage.

Fecal coliform bacteria were found to be present at concentrations of 11,000 to 92,000 col/100 mL during the event (Appendix B-6). The initial sample, 11,000 col/100 mL being the lowest concentration reported. A second sample, initially reported a “base flow” sample, was collected after a brief period of intermittent rainfall and was reported to contain the highest levels of fecal coliform bacteria, 92,000 col/100 mL. A sample seven minutes later, originally identified as a “first flush” sample, contained 24,000 col/100 mL. A sample collected at 1505 reportedly contained 54,000 col/100 mL.

Summary and Discussion, August 5, 2003

The urban/suburban nature of the watershed and the relatively high relief cause a relatively rapid response to rainfall. Changes in water quality were observed with increased levels of chemical constituents typically associated with urban stormwater, such as turbidity and TSS. Both field and laboratory data for turbidity, showed an increase of one to two orders of magnitude above background or baseflow levels one would expect. Laboratory data for turbidity and TSS showed consistent increases in concentrations.

Inorganic constituents and nutrients detected generally showed decreased concentrations throughout the storm event as rainfall diluted the baseflow concentrations. Two VOCs were detected at very low concentrations in stormwater samples. Benzene was reported to be present at 1.7 ug/L in the final sample collected at TUMDEPOT. Tetrachloroethene was reportedly detected at 1.0 mg/L in samples collected at TUM441. Polycyclic aromatic hydrocarbons or PAHs were reportedly present

in samples from TUMSW5 and TUMDEPOT collected at peak stage and shortly thereafter. At TUM441, PAHs were reportedly present in all samples collected during the event; this was likely due to road runoff from US Highway 441. Fluoranthene was the PAH reportedly present at the highest concentration at all sites during the event, ranging from 2.8 to 3.4 ug/L. Intermittent rainfall, that occurred prior to collection of the first sample at this site, impacted water quality. This was also observed in the results of samples collected for coliform bacteria analysis.

Storm Event Summary for Tumblin Creek on August 21, 2003

Event Description

Total rainfall for the storm event was reported to be 0.02 inches, based on rainfall data obtained from the J.R. Kelly Electrical Generating Station in downtown Gainesville. The event total rainfall in the Tumblin Creek watershed was greater during an isolated thunder storm. One pre-event sample was obtained the day before, on August 20, 2003 at 1245. Field parameters were measured every 15 minutes during the event on August 21, 2003 from 1740 to approximately 1845, with initial field measurements conducted prior to the event at 1430. Five grab samples for analyses of laboratory parameters were collected on August 21, 2003 at each of the three stations to characterize stormwater quality as part of the event. The initial sample, collected on August 21, 2003 at 1740, was collected after intermittent light showers. Light rain reportedly began at approximately 1555, stopping at 1605, followed by a moderate shower at 1720, which continued to 1800. Velocity measurements (for flow calculation) were conducted three times at each site during the event.

Stage and Flow Data TUMSW5, August 21, 2003

On August 21, 2003 at 1430, prior to the event, Tumblin Creek stage was at a low of 7.52 feet, the peak was recorded on August 21, 2003 at 1750 with a staff gage reading of 8.02 feet (Table 5). The water level dropped off to 7.64 ft for the last reading at 1820. There was a stage change of 0.50 feet during the storm event.

Stream velocity was measured four times during the storm event. The calculated stream flow varied from 0.002 to 0.106 cms on August 21, 2003 during the event sampling. The initial flow was measured prior to rainfall.

Table 5. Storm Event Summary for Tumblin Creek SW 5th Ave., August 21, 2003

Date	Time	Sample Collected/ Designation	Stage (feet)	Flow (cms)	Flow (cfs)
8/20/03	1245	Yes/ SS#1 TUMSW5	7.55	0.001	0.035
8/21/03	1430	No	7.52	0.002	0.071
8/21/03	1740	Yes/ SS#2 TUMSW5	7.80	0.106	3.743
8/21/03	1750	Yes/ SS#3 TUMSW5	8.02	NR	NR
8/21/03	1800	Yes/ SS#4 TUMSW5	7.80	0.048	1.695
8/21/03	1820	Yes/ SS#5 TUMSW5	7.64	0.029	1.024
8/21/03	1845	Yes/ SS#6 TUMSW5	NR*	NR	NR

* (cms) cubic meters per second

Note: NR = Not Reported

** (cfs) cubic feet per second

Analytical Results TUMSW5, August 21, 2003

Field parameters showed some variability over the duration of the event. Water temperature ranged from 26.0°C when the first sample was collected to 30.1°C near peak stage (Appendix B-7). Field pH changed only slightly throughout the event. The initial field pH, 7.17 SU, increased to a maximum of 7.71 SU at 1800, and then decreased to 7.32 SU at 1830 toward the end of the event. Specific conductance ranged from an initial field reading of 481 µmhos/cm on August 20, 2003 at 1245 to a minimum of 121 µmhos/cm on August 21, 2003 at 1800. Dissolved oxygen values ranged from 4.63 to 6.66 mg/L with the higher values recorded at peak stage, with levels decreasing as water levels dropped. The maximum value recorded for field turbidity was 38 NTU recorded just prior to peak stage and the minimum was 1.2 NTU prior to the storm event.

Inorganic indicator constituents included alkalinity, color, specific conductance, turbidity, total suspended solids, total dissolved solids, chloride, and sulfate. The inorganic parameters showed some variance throughout the event. Alkalinity ranged from 53 to 150. Color ranged from 10 PCU to 30 PCU, showing little change. Total suspended solids ranged from <5 mg/L to 30 mg/L. Total dissolved solids ranged from 86 mg/L to 290mg/L. Laboratory specific conductance values were similar to field-measured conductance with values ranging from 130 to 480 µmhos/cm. Laboratory turbidity values ranged from 3.8 to 24 NTU. The minimum chloride value of 4.2 mg/L was recorded just after peak stage; the maximum chloride value of 41 mg/L was recorded on August 20, 2003 prior to the event. Sulfate ranged from 7.2 mg/L at the end of the event to 44 mg/L prior to the event.

Nutrient analyses showed some variation throughout the event. Ammonia was undetectable in all samples obtained during this event. Total Kjeldahl nitrogen values ranged from 0.37 to 1.4 mg/L with the maximum concentration occurring before peak flow and the minimum concentration occurring prior to the event. Nitrate plus nitrite (NO_x) levels ranged from 0.23 mg/L prior to the

event to 0.48 mg/L during the event. Total ortho-phosphate showed little variation, ranging from 0.13 to 0.19 mg/L. Total organic carbon showed the greatest variance ranging from 3.5 mg/L prior to the event to 14 mg/L at peak stage.

As with the previous event, low concentrations of organic compounds were detected in samples collected during the event. No VOCs, with the exception of p-cymene at a concentration of 1.7 ug/L, were detected in any of the five samples collected at TUMSW5. The same PAHs detected in samples from the August 5, 2003 event were detected. These PAHs included benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i) pyrene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluornathene, indeno (1,2,3-cd) pyrene, phenanthrene, and pyrene in some samples (Appendix B-10). All PAHs were detected in low concentrations with individual PAH compounds ranging from 0.2 to 1.8 ug/L. One compound in the chlorinated pesticide group, beta-BHC, was reportedly detected at low concentrations in four samples at TUMSW5, ranging in concentration from 0.071 to 0.10 ug/L. It was not detected in the initial baseflow sample collected on August 20, 2003. Reported concentrations in this range, 0.1 ug or less, are not reliable and the compounds reported may be sample collection or laboratory artifacts.

Metals concentrations in the stormwater were generally low, with the exception of iron. Cadmium (<0.0005 mg/L), hexavalent chromium (<0.010 mg/L), copper (<0.020 mg/L) mercury (<0.000020 mg/L), and silver (<0.010 mg/L) were not found to be above the reporting limit of the individual compounds. Iron was the only metal reportedly present in all samples, ranging from an initial concentration of 0.18 mg/L to 0.93 mg/L before peak stage (Appendix B-11). Zinc ranged from <0.020 to 0.032 mg/L. Lead concentrations ranged from <0.0050 mg/L to 0.076 mg/L. Concentrations of both trace metals, zinc and lead, were reported to be highest in samples collected at peak stage.

Stage and Flow Data TUMDEPOT, August 21, 2003

Sampling commenced on August 21, 2003 at 1450. The initial staff gage reading was 12.12 feet (Table 6). Tumblin Creek rose to a peak stage of 12.60 feet at 1800. The water level dropped off to 12.30 feet for the last reading at 1830. The maximum change in stage was 0.498 feet. Velocities at this site were measured four times during the storm and then used to calculate the flow rate.

Table 6. Storm Event Summary for Tumblin Creek at Depot Ave., August 21, 2003

Date	Time	Sample Collected (Y/N)	Stage (feet)	Flow (cms)	Flow (cfs)
08/20/03	1245	Yes/ SS#1 TUMDEPOT	12.14	0.011	0.388
08/21/03	1450	No	12.12	0.008	0.283
08/21/03	1740	Yes/ SS#2 TUMDEPOT	NR	NR	NR
08/21/03	1750	Yes/ SS#3 TUMDEPOT	12.54	0.288	10.171
08/21/03	1800	Yes/ SS#4 TUMDEPOT	12.60	0.168*	5.933
08/21/03	1820	Yes/ SS #5 TUMDEPOT	NR	NR	NR
08/21/03	1830	No	12.30	0.152	0.152
08/21/03	1845	Yes/ SS#6 TUMDEPOT	NR	NR	NR

* Flow measurement time 1805

* (cms) cubic meters per second

** (cfs) cubic feet per second

Note: NR = Not Reported

Analytical Results TUMDEPOT, August 21, 2003

Field parameters showed some variability over the duration of the event. Water temperature ranged from 26.7 °C fifteen minutes prior to peak stage to 29.2°C at the end of the event (Appendix B-8). The initial field pH, 7.26 SU, increased to a maximum of 7.59 SU at peak stage, and decreased slowly but did not reach baseline by the end of the event. Specific conductance ranged 105 µmhos/cm, which was recorded at the end of the event to a maximum of 319 µmhos/cm recorded at the beginning of the event. Dissolved oxygen values ranged from an initial reading and minimum of 5.80 mg/L to a maximum of 6.77 mg/L at peak stage. The minimum turbidity, 14 NTU, was measured when the initial sample was collected. Field turbidity increased to a maximum of 95 NTU fifteen minutes before peak stage.

Laboratory analyzed parameters included inorganic indicators, nutrients, VOC's, SVOC's, and chlorinated pesticides. Inorganic indicator constituents included alkalinity, color, specific conductance, turbidity, total suspended solids, total dissolved solids, chloride, and sulfate. Alkalinity was at a maximum value of 95 mg/L fifteen minutes prior to peak stage and a minimum of 64 mg/L at the end of the event. Color showed little variance during the event, beginning at 15 PCU and ending at 25 PCU. Specific conductance values ranged from 320 µmhos/cm near the beginning of the event to 180µmhos/cm at then end of the event. Laboratory turbidity values began at a minimum of 14 NTU, increased to a maximum of 33 NTU fifteen minutes prior to peak stage, then decreased to 22 NTU by the end of the event. Total suspended solids ranged from 16 mg/L at the beginning of the event to a maximum of 58 mg/L fifteen minutes prior to peak stage, decreasing slowly to 34 mg/L at the end of the event. Total dissolved solids ranged from 110 mg/L to 200 mg/L, with the maximum concentrations observed at the beginning of the event. Chloride ranged from 8.4 mg/l at

the end of the event to 22 mg/L at the beginning of the event. Sulfate ranged from 16 mg/L at the end of the event to 38 mg/L fifteen minutes prior to peak stage.

Nutrient analyses showed little variation throughout the event. Ammonia was not detected (<0.030 mg/L) in any samples obtained during the storm event. Nitrate plus nitrite varied from 0.26 to 0.42 mg/L. Total Kjeldahl nitrogen values ranged from 0.34 to 0.55 mg/L with the maximum concentration occurring at peak flow. Total ortho-phosphate ranged from 0.12 to 0.3 mg/L. Total phosphorus ranged from 0.22 to 0.45 mg/L. Total organic carbon showed the greatest variance ranging from 4.4 mg/L at the beginning of the event to 12 mg/L at the end of the event.

The results of organics analyses are similar to those reported for Tumblin TUMSW5. No VOCs were detected in any of the five samples collected at TUMDEPOT. No PAHs were reported for the baseflow samples collected on August 20, 2003. A number of the PAHs, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i) pyrene, benzo (k) fluoranthene, chrysene, fluornathene, indeno (1,2,3-cd) pyrene, phenanthrene, and pyrene, were detected at very low concentrations in storm event samples (Appendix B-10). The largest number of PAHs and the greatest concentrations were detected in samples collected at and following the peak in stage. All PAHs were detected in low concentrations, with individual PAH compounds ranging from 0.2 to 1.1 ug/L. No chlorinated pesticides were detected.

Metals concentrations in the stormwater were generally low, with the exception of iron. Five of the eight metals sampled were not found to be above the reporting limit of the individual compounds, cadmium (<0.0005 mg/L), hexavalent chromium (<0.010 mg/L), copper (< 0.020 mg/L), mercury (<0.000020 mg/L), and silver (<0.010 mg/L). Iron was the only metal reportedly present in all samples, ranging from an initial concentration of 0.3 mg/L to 1.4 mg/L before peak stage (Appendix B-11). Zinc, 0.11, and lead, 0.041 mg/L, concentrations were also reportedly highest in samples collected prior to peak stage.

Stage and Flow Data TUM441, August 21, 2003

The initial stage reading prior to the event on August 21, 2003 at 1420 was 0.23 feet (Table 7). Tumblin Creek rose to a peak stage of 1.00 feet at 1845. The water level dropped to 0.95 feet for the last reading at 1850. The maximum change in stage was 0.77 feet. No samples for laboratory analyses were obtained after the peak stage. As can be seen from the stage data, there were two peaks in stage, a small peak at 1750 and larger stage peak at 1845. Velocity measurements were conducted six times as part of this storm event. The greatest velocity was measured post peak stage.

Table 7. Storm Event Summary for Tumblin Creek at US 441, August 21, 2003

Date	Time	Sample Collected (Y/N)	Stage (feet)	Flow (cms)	Flow (cfs)
08/20/03	1245	Yes/ SS#1 Tumblin Creek at 441	0.23	NR	NR
08/21/03	1507	No	0.23	0.019*	0.671
08/21/03	1740	Yes/ SS#2 TUM441	NR	NR	NR
08/21/03	1750	Yes/ SS#3 TUM441	0.60	NR	NR
08/21/03	1800	Yes/ SS#4 TUM441	0.50	0.078**	2.755
08/21/03	1820	Yes/ SS #5 TUM441	NR	NR	NR
08/21/03	1845	Yes/ SS#6 TUM441	1.00	NR	NR
08/21/03	1850	No	0.95	0.210	7.416

* Velocity measurement time 1515

** Velocity measurement time 1810

*** (cms) cubic meters per second

**** (cfs) cubic feet per second

Note: NR = Not Reported

Analytical Results TUM441, August 21, 2003

Field parameters showed some variability over the duration of the event. Water temperature ranged from 26.9° C fifteen minutes prior to peak stage to 30.2° C at the end of the event (Appendix B-9). Initial field pH, 8.00 SU, decreased to 7.78 SU prior to peak stage. Specific conductance ranged from 133 µmhos/cm at 1750, just after the initial peak in stage to 403 µmhos/cm, recorded earlier prior to the event. Dissolved oxygen values ranged from an initial reading and maximum of 10.10 mg/L, prior to the event, to a minimum of 6.12 mg/L after the initial peak in stage. The minimum turbidity value, 2.7 NTU, was measured before peak stage. Field turbidity increased to a maximum of 60 NTU at peak stage.

Inorganic indicator constituents included alkalinity, color, specific conductance, turbidity, total suspended solids, total dissolved solids, chloride, and sulfate. Alkalinity was at a maximum value of 100 mg/L when the first sample was collected and at a minimum of 45 mg/L after the first peak in stage. Color showed little variance during the event, ranging from 20 to 25 PCU. Specific conductance values ranged from 310 µmhos/cm near the beginning of the event, to 140 µmhos/cm after the initial peak in stage. The initial laboratory turbidity value, 12 NTU, increased to a maximum of 120 NTU at peak stage. Total suspended solids ranged from nondetectable (<5.0 mg/L) for the pre-event sample collected on August 20, 2003 to a maximum of 100 mg/L at peak stage. Total dissolved solids ranged from 84 mg/L to 180 mg/L, with the maximum concentrations observed at the beginning and end of the event. Chloride concentrations ranged from 6 mg/L at the initial stage peak to 27 mg/L the day prior to the event. Sulfate ranged from 11 mg/L after the initial stage peak to 32 mg/L at the initial peak stage.

Nutrient analysis showed little variation throughout the event. Ammonia was not detected (<0.030 mg/L) in any samples obtained during the storm event. Nitrate plus nitrite varied from 0.23 to 0.33 mg/L. Total Kjeldahl nitrogen values ranged from 0.6 to 0.8 mg/L with the maximum concentration occurring at peak stage. Total ortho-phosphate ranged from 0.16 to 0.57 mg/L. Total phosphorus ranged from 0.13 to 1.5 mg/L. Total organic carbon ranged from 4.6 mg/L the day prior to the event to 7.5 mg/L for the initial sample collected on August 21, 2003.

Low concentrations of organic compounds were detected in samples collected during the event. No VOCs were detected in any of the five samples collected at TUM441. A number of the PAHs, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i) pyrene, benzo (k) fluoranthene, chrysene, dibenzo (a,h) anthracene, fluoranthene, indeno (1,2,3-cd) pyrene, phenanthrene, and pyrene, were detected at very low concentrations in some samples (Appendix B-10). The largest number of PAHs and the greatest concentrations were detected in samples collected at peak stage. However, all PAHs were detected in low concentrations. Detectable PAH concentrations for individual compounds ranged from 0.3 to 5.7 ug/L. One chlorinated pesticide, beta-BHC, was detected at very low concentrations in four samples at TUM441, ranging in concentration from 0.15 to 0.37 ug/L. Concentrations this low are frequently sample collection or laboratory artifacts.

Metals concentrations were in the stormwater and were generally low, with the exception of iron. Cadmium (<0.0005 mg/L), hexavalent chromium (<0.010 mg/L), copper (< 0.020 mg/L), mercury (<0.000020 mg/L), and silver (<0.010 mg/L) were not found to be above the reporting limit of the individual compounds. Iron was the only metal reportedly present in all samples, ranging from an initial concentration of 0.2 mg/L to 1.8 mg/L before peak stage (Appendix B-11). Zinc, 0.04 mg/L, and lead, 0.012, concentrations were also reportedly highest in samples collected prior to peak stage.

Summary and Discussion, August 21, 2003

The urban/suburban nature of the watershed and the relatively high relief cause a relatively rapid response to rainfall. Changes in water quality were observed by increased levels of chemical constituents typically associated with urban stormwater, such as turbidity and TSS. Both field and laboratory data for turbidity, showed an increase of one to two orders of magnitude above background or baseflow levels one would expect. Laboratory data for turbidity and TSS showed consistent increases in concentrations.

Inorganic constituents and nutrients detected generally showed a decrease concentration throughout the storm event as rainfall diluted the baseflow concentrations. Organic constituents and metals in low concentrations were generally present in highest concentrations at the initial peak stage. No VOCs, with the exception of p-cymene at 1.7 ug/L, were detected in any of the samples collected during the storm event. Polycyclic aromatic hydrocarbons or PAHs were reportedly present in samples from TUMSW5 and TUMDEPOT collected at peak stage and shortly thereafter. At TUM441, PAHs were reportedly present in all samples collected during the event. Their presence was likely due to road runoff from US Highway 441. Fluoranthene was the PAH reportedly present in the highest concentration during both sampling events.

Lindane is a commonly used organochlorine pesticide and is a mixture of the γ -isomer of hexachlorocyclohexane (HCH), also known as benzene hexachloride (BHC), and technical grade HCH which contains a mixture of different isomers (Sang, et al, 1999). BHC is one of the more persistent isomers and is commonly found in the environment (Sang, et al, 1999). Concentrations reportedly detected in samples from TUMSW5 and TUM441 are extremely low and may have resulted from field sample collection or were present as laboratory artifacts. These data were reported by the laboratory after confirmation with a dissimilar secondary column; third column confirmation was not conducted. All laboratory method blanks were reportedly “clean” (Preston, 2004).

References

Preston, T. 2004. Personal Communication with STL Tallahassee. January, 28, 2004.

Sang, S., Petrovic, S., and Cuddeford, V. 1999. *Lindane: A Review of Toxicity and Environmental Fate*. World Wildlife Fund. Canada.

ASSESSMENT OF THE TUMBLIN CREEK LANDFILL

SJRWMD Contract SF672AA

Water Quality Monitoring in the Orange Creek Basin

Introduction

A large amount of landfill debris is located on the west bank of Tumblin Creek just north of Depot Avenue. The majority of the debris is glass and ceramic with some mixed metal scraps. The debris is mixed with soil and present at the land surface suggesting that it may have been buried, unearthed and moved. There are numerous holes and mounds of debris caused by the excavation activities of bottle looters. The west bank of Tumblin Creek is comprised of landfill debris which is also found in the adjacent stream bed. Three soil borings were conducted on the west bank, two on the east bank and one at a nearby reference location. The borings were done to determine the composition and extent of landfill material and to collect soil samples for laboratory analyses.

Field Sampling Methods

After an initial site reconnaissance, four boring locations were selected on the west bank of Tumblin Creek, two on the east bank, and one reference location also on the east bank. All soil boring locations are shown on the map labeled Figure 1. The soil profile evaluation was conducted by sampling and characterizing the horizons in each boring location. Soil descriptions are presented in Appendix C-1.

Samples were taken at recorded intervals just below the surface and just above the water table. ACEPD was unable to collect samples above or below the landfilled material, as was initially proposed (due to the presence of a high water table causing soil to collapse into the borehole as it was advanced).

Soil samples were collected from each of the borings at two intervals for soil descriptions and laboratory analyses. Samples were analyzed in the laboratory for selected metals (TCLP extract), VOCs, PAHs, in addition to chlorinated pesticides and PCBs. The samples from the same intervals were also analyzed for organic volatiles in the field using an OVM provided by Air and Water Research of Gainesville, Florida. Photographs and GPS coordinates were taken at each soil boring location. Descriptions of field observations are listed in Appendix C-2; photo images are also located in Appendix C.

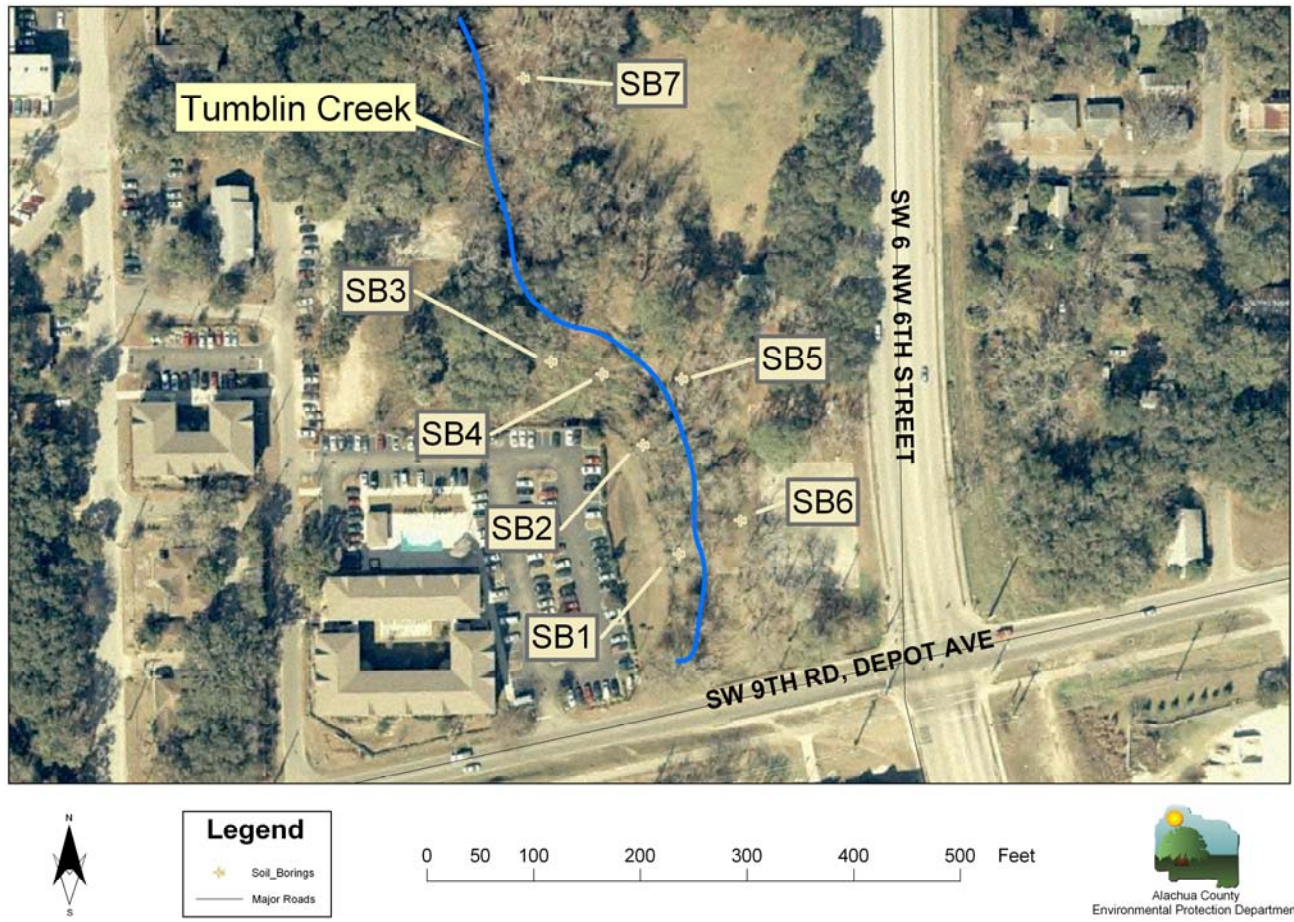


Figure 1. Location of soil boring sites near the Tumblyn Creek Landfill

Analytical Results

Soil samples from the “Old Landfill” at Tumblyn Creek Park contained low concentrations of PAHs and organochlorine pesticides. No PCBs or metals were detected above the reporting limits for the individual constituents.

The PAHs identified in soil samples included: acenaphthene, acenaphthylene, anthracene, benzo(a) anthracene, benzo(a) pyrene, benzo(b) fluoranthene, benzo(g,h,i) perylene, benzo(k) fluoranthene, chrysene, dibenzo(a,h) anthracene, fluoranthene, fluorine, indeno(1,2,3-cd) pyrene, naphthalene, phenanthrene, pyrene, 1-methyl-naphthalene, and 2-methylnaphthalene. These constituents were reportedly found in relative low concentrations (Appendix C-3). Five compounds; benzo(a) anthracene, benzo(a) pyrene, benzo(b) fluoranthene, dibenzo(a,h) anthracene, and indeno(1,2,3-cd) pyrene exceeded soil cleanup target levels set forth in FAC Chapter 62-777 for leachability based on fresh water surface water criteria. The samples with PAHs above soil cleanup target levels were noted in SB1 (from 0.9 to 1.1 meters), SB 2 (from 1.33 to 1.43 meters), SB 4 (from

0.20 to 0.35 meters), and SB 4 (from 0.59 to 0.74 meters). All three of these borings were conducted on the west side of Tumblin Creek. The maximum concentrations of the greatest number of PAHs were reported for SB1 at a depth interval of 0.9 to 1.1 meters.

Four compounds in the organochlorine pesticide group; Aldrin, 4,4'-DDE, 4,4'-DDT, and Endrin ketone, were detected at very low concentrations in some of the soil borings (Appendix C-4). None of the concentrations of these four compounds exceeded soil cleanup target levels set forth in FAC Chapter 62-777.

Summary and Discussion

Based on the detection of low concentrations of PAHs and organochlorine pesticides, ACEPD recommends additional assessment at the "Old Landfill" in Tumblin Creek. Although the compounds detected in the soils did not appear linked to elevated concentrations of constituents in storm water, monitoring the surficial aquifer in this area is recommended. Additionally, a plan should be prepared to remove and/or segregate the fill material on the west side of Tumblin Creek from the creek. This material erodes easily and is brought into suspension during storm events, not only potentially causing contamination, but also littering the stream bed with glass, metal, and other debris.

References

FDEP, 1999. FAC Chapter 62-777, *Soil Cleanup Target Levels*, Table II. Effective 8-5-99