# **RIVER AND STREAM ASSESSMENTS**

# CAPE FEAR RIVER HUC 03030002- HAW RIVER

Specific site summaries of the 27 benthic macroinvertebrate and fish community sites may be found at this link: **03030002**.

# CAPE FEAR RIVER HUC 03030003- DEEP RIVER

Specific site summaries of the 17 benthic macroinvertebrate and fish community sites may be found at this link: **03030003**.

# CAPE FEAR RIVER HUC 03030004- LITTLE RIVER-CAPE FEAR RIVER

Specific site summaries of the 25 benthic macroinvertebrate and fish community sites may be found at this link: **03030004**.

# CAPE FEAR RIVER HUC 0303005 - LOWER CAPE FEAR RIVER

Specific site summaries of the 6 benthic macroinvertebrate and fish community sites may be found at this link: **03030005**.

# BLACK RIVER HUC 03030006 - BLACK RIVER

Specific site summaries of the 5 benthic macroinvertebrate and fish community sites may be found at this link: **03030006**.

# CAPE FEAR RIVER HUC 03030007- NORTHEAST CAPE FEAR RIVER

Specific site summaries of the 11 benthic macroinvertebrate and fish community sites may be found at this link: **03030007**.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/08	10494		20		4.82	Good-Fair
07/06/98	7621		17		4.92	Good-Fair

#### **Taxonomic Analysis**

Two more mayfly taxa and one more caddisfly taxon were collected in 2008 than in 1998. Taxa common or abundant in 2008 and not collected in 1998 were *Pseudocloeon propinquum, Tricorythodes, Triaenodes perna/helo,* and *Polycentropus*. Both *Maccaffertium integrum* and *Hydropsyche venularis* were common in 1998 and uncollected in 2008.

#### Data Analysis

The site is seven miles SSE of Reidsville in the southeast corner of Rockingham County, and directly above the oufall for the City of Reidsville WWTP. A portion of Reidsville is within the catchment, as are portions of three suburban towns northwest of Greensboro (Summerfield, Oak Ridge, and Stokesdale).

There was little change in the EPT BI between the two basinwide sampling events at the site. Three more EPT taxa were collected during the most recent sampling event at the site; an additional taxon would have resulted in a classification of Good for 2008.

Waterbo	dy	Locatio	tion Station ID		Date	Bioclassification	
HAW	R	NC 8	37	BB16	63 O	7/15/08	Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Lev	vel IV Ecoregion
ALAMANCE	1	03030002	36.182500	-79.509444	16-(1)c	South	ern Outer Piedmont
Stream Classifica	ition [	Drainage Area (mi2)	) Elev	vation (ft)	Stream Width	n (m)	Stream Depth (m)
C;NSW		185		590	20		0.3
	Fo	rested/Wetland	Urban	1	Agriculture	0	ther (describe)
Visible Landuse	(%)	80	20		0		0
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	NPDES Nu	mber	Volume (MGD)
City of Reidsville WW	TP				NC00248	81	7.5
Altamahaw/Ossipee E	lementary Sch	ool			NC00451	61	0.012
Water Quality Parame	eters				Site Pho	otograph	
Temperature (°C)		25.5			The state of the	10 P 300	1 1 1 1 W 2 1 3 3
Dissolved Oxygen (mg	g/L)	9.0	and the second second	ALC: N	COMPANY.	and the set	
Specific Conductance	(µS/cm)	211			ALC S	and and the	A Bart mart
pH (s.u.)		7.6	and the state			S.C.	
Water Clarity		turbid	A STATE				MILLING
Habitat Assessment	Scores (max)				and the second	and the second s	Martin and a start
Channel Modification (	(5)	5		-	THE ALL PR		- Bellen
Instream Habitat (20)		16	A.	alla.			- The second sec
Bottom Substrate (15)		10	The second		- Andrew		Without - Dive
Pool Variety (10)		10	and the second	- Aller	A Company		
Riffle Habitat (16)		12			and the	ALL STATE AND AND AND	The second second second
Left Bank Stability (7)		7	and the second			1000	how a way to a way to a

2 5 5 79 Substrate

7

primarily boulder and cobble; some gravel, silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/08	10491	59	14	6.31	5.79	Good-Fair
09/15/03	9319	57	15	6.29	5.40	Good-Fair
07/07/98	7623	57	17	6.69	5.98	Fair
07/13/93	6239	69	22	5.85	5.12	Good-Fair
07/09/90	5335	63	12	7.13	5.58	Fair

## **Taxonomic Analysis**

Right Bank Stability (7)

Light Penetration (10)

Left Riparian Score (5)

Right Riparian Score (5)

**Total Habitat Score (100)** 

The standard for EPT richness during summer sampling since 1987 was set in 1993 when 22 EPT taxa were collected. Acroneuria abnormis, Leucotrichia pictipes and Triaenodes ignitus were either common or abundant in that year but have been uncollected during subsequent sampling efforts. Several taxa that were rare in the 1993 sample have been since uncollected as well: Ceratopsyche sparna, Ironoquia punctatissima, and Nyctiophylax moestus.

### Data Analysis

The site is 7.5 miles northwest of downtown Burlington in northwest Alamance County, and directly downstream of a low-head dam (Glen Raven Mills Dam). There are plans by the Alamance County Recreation and Parks Department to develop the area around the site as an access point for paddlers. A portion of Reidsville is within the catchment, as are portions of three suburban towns northwest of Greensboro (Summerfield, Oak Ridge, and Stokesdale).

Since 1993 the number of EPT taxa collected has declined with each successive sampling event. However, NCBI values have not shown such a clear trend, though all three values since 1993 are higher than the value for 1993. Agriculture and residential areas are sources for impact to the stream at the site.



Substrate

Bedrock with equal mix of boulder, cobble, gravel and sand, silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/08	10489	68	18	6.30	5.48	Good-Fair
07/10/98	7663	73	21	6.10	5.34	Good-Fair
07/12/93	6233	64	19	6.12	5.39	Good-Fair
08/08/89	5051	58	14	6.16	5.56	Good-Fair
07/09/87	4089	74	20	6.29	5.50	Good-Fair

#### **Taxonomic Analysis**

The macroinvertebrate community has remained stable over the course of the last 15 years with all metrics staying virtually the same with only very small differences. Indeed, even the EPT community has remained mostly constant with a slight drop in richness and abundance from 1998 to 2008 (21 vs. 18 and 135 vs. 105, respectively). A few taxa previously collected were not found in 2008 such as the caddisflies Nectopsyche exquisita, Leucotrichia pictipes, and Cyrnellus fraternus and the mayfliy Caenis. No stoneflies have been collected in this portion of the Haw River since Acroneuria abnormis was collected in 1987.

#### **Data Analysis**

Sampling of benthos in 2003 was not performed due to continuous high flows. This middle segment of the Haw River has only one major NPDES permitted discharger upstream, although it drains the major urban areas of northern Greensboro and the entirety of Burlington. Despite growth of these cities, water quality has remained consistantly Good-Fair since 1987 suggesting some input of higher quality waters from the northern portion of the watershed. Habitat at this site was deficient particularly in regards to poor quality riffles with a high degree of embeddedness. Siltation was also of concern but is typical in urbanized rivers.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10516	72	25	5.49	4.81	Good
07/07/98	7642	65	20	6.17	4.77	Good-Fair
07/28/93	6318	60	18	5.92	5.28	Good-Fair
07/09/90	5334	71	20	6.12	5.02	Good-Fair
08/08/89	5052	60	18	6.23	5.43	Good-Fair

#### **Taxonomic Analysis**

EPT richness increased by 25 % in 2008 over the last sample collection made in 1998. This increase was driven by a substantial increase in mayfly species (8 in 1998 to 13 in 2008) particularly heptageniid mayflies with *Leucrocuta* and *Maccaffertium lenati* being collected at this site for the first time. The caddisflies *Protoptila*, *Oecetis nocturna*, and *Cyrnellus fraternus* were also collected for the first time at SR 1005. Despite a slight rise in the tolerance of the EPT community, the overall tolerance of the benthos decreased significantly due to lower richness and abundance of tolerant midges and oligochaetes.

#### **Data Analysis**

This site lies on the Alamance-Orange County line and drains all of Alamance County and the entirety of Burlington and Graham. Upstream dischargers contribute to the elevated specific conductance of the waters particularly in times of reduced flow. Sampling in 2008 resulted in an increase in the bioclassification from the historically consistant rating of Good-Fair to Good indicating a slight increase in water quality. Water levels were down from previous years and habitat score increased from a low of 56 in 1998 to the current score of 72. Also, siltation is a chronic problem in areas of slow flow and pools of this river.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10515	82	32	5.22	4.25	Excellent
07/10/98	7651	65	25	5.41	4.40	Good
07/29/93	6319	63	24	5.19	4.43	Good
07/17/90	5382	60	24	5.47	4.30	Good
07/13/88	4625	81	28	6.02	4.71	Good

### **Taxonomic Analysis**

The significant increase in EPT taxa in 2008 from 1998 was due to an increase in mayfly and caddisfly richness and led to a decrease in the Biotic Index. Three mayflies, *Callibaetis*, *Anthopotamus*, and *Serratella deficiens*, as well as two caddisflies *Neophylax oligius* and *Polycentropus* had never before been collected at this site until 2008. Tolerant taxa such as odonates, midges and oligochaetes either increased or remained essentially unchanged in richness and abundance providing evidence that the EPT community has become more intolerant over the past 10 years.

#### **Data Analysis**

US 64 is the last site on the Haw River before it enters Jordan Lake reservoir and is composed of multiple channels. Habitat is good at 77 with decent riparian and stable banks. However, siltation continues to be a problem in the Haw River. Water quality has improved to Excellent for the first time since sampling on the Haw River began in 1983 and is due, in part, to the highest EPT richness ever recorded at this site. The Haw River at US 64 was not sampled in 2003 due to high summer flows.

Waterboo	dy	Locati	on	Station ID Date		Date	Bioclassification	
TROUBLESC	OME CR	SR 24	22	BB3	96	07	//16/08	Good-Fair
County ROCKINGHAM	Subbasin 1	8 digit HUC 03030002	Latitude 36.307222	Longitude -79.738056	<b>AU N</b> 5 16-0	<b>lumber</b> 6-(0.3)	Le North	vel IV Ecoregion nern Inner Piedmont
Stream Classifica WS-III;NSW	ition I	Drainage Area (mi2 31	) Elev	ration (ft) 695	Strea	am Width 6	(m)	Stream Depth (m) 0.2
Visible Landuse	Fo (%)	rested/Wetland 100	Urban 0		Agricult 0	ure	c	Other (describe) 0
Upstream NPD	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	NP	DES Nun	nber	Volume (MGD)
Water Quality Parama Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.) Water Clarity	eters y/L) (μS/cm)	23.0 8.1 100 7.2 slightly turbid				Site Pho	tograph	
Channel Modification ( Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5)	5) 5) ) 5) 5) 5)	4 13 12 10 15 5 5 10 5 5 84	Substra	ate mix (	of bedrock	k, boulder,	cobble; some s	and, silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/16/08	10496		17		4.58	Good-Fair
04/09/02	8685	58	17*	5.89*	4.86	Good-Fair
07/06/98	7620		14		4.86	Good-Fair
07/14/93	6244		18		5.12	Good-Fair

\* values corrected for seasonality

# **Taxonomic Analysis**

EPT taxa collected at the site for the three summer EPT sampling events in 1993, 1998, and 2008 were similar. The only notable absence in 2008 was *Hexagenia*, which was abundant and common in 1993 and 1998 respectively. A few taxa were collected for the first time at the site in 2008 (all were rare in the sample): *Paragnetina kansesis, Triaenodes perna/helo,* and *Pycnopsyche*.

### **Data Analysis**

The site is 5.5 miles southwest of downtown Reidsville in southern Rockingham County, and 1.2 stream-miles above Lake Reidsville. Sampling in July 2008 was done above the road crossing; the bridge was being rebuilt by DOT. Landcover includes forest, agriculture, and suburban residential areas.

No long-term trends in water quality are exhibited by the benthic community between 1993 and 2008.

oody Location			Station ID		Date		Bioclassification	
CR	SR 26	600		BB4	00	07	07/16/08 Good-F	
basin	8 digit HUC	Latitude Longitude A		AU	Number Le		vel IV Ecoregion	
	03030002	36.28	32500	-79.611944	1	6-7b	North	ern Inner Piedmont
Dr	ainage Area (mi2)	)	Elev	vation (ft)	Stre	am Width	(m)	Stream Depth (m)
	12			655		4 0.2		0.2
Fore	ested/Wetland		Urban		Agricul	ture	Ot	ther (describe)
	30		20	50				0
charger	s (>1MGD or <1M	GD an	d withir	n 1 mile)	N	PDES Nun	nber	Volume (MGD)
		_				Site Pho	tograph	
	21.3					RAN		The states
	CR	Locati CR SR 26 Dasin 8 digit HUC 1 03030002 Drainage Area (mi2 12 Forested/Wetland 30 Schargers (>1MGD or <1M 21.3	Location CR SR 2600 Dasin 8 digit HUC Lati 1 03030002 36.28 Drainage Area (mi2) 12 Forested/Wetland 30 schargers (>1MGD or <1MGD an 21.3	Location CR SR 2600 Dasin 8 digit HUC Latitude 1 03030002 36.282500 Drainage Area (mi2) Elev 12 Forested/Wetland Urban 30 20 Schargers (>1MGD or <1MGD and within 21.3	Location   Station     CR   SR 2600   BB40     Dasin   8 digit HUC   Latitude   Longitude     1   03030002   36.282500   -79.611944     Drainage Area (mi2)   Elevation (ft)   Elevation (ft)     12   655     Forested/Wetland   Urban     30   20     schargers (>1MGD or <1MGD and within 1 mile)	Location Station ID   CR SR 2600 BB400   Dasin 8 digit HUC Latitude Longitude AU I   1 03030002 36.282500 -79.611944 1   Drainage Area (mi2) Elevation (ft) Stre   12 655   Forested/Wetland Urban Agricul   30 20 50   schargers (>1MGD or <1MGD and within 1 mile)	Location   Station ID     CR   SR 2600   BB400   07     Dasin   8 digit HUC   Latitude   Longitude   AU Number     1   03030002   36.282500   -79.611944   16-7b     Drainage Area (mi2)   Elevation (ft)   Stream Width     12   655   4     Forested/Wetland   Urban   Agriculture     30   20   50     schargers (>1MGD or <1MGD and within 1 mile)   NPDES Nun     Site Pho	Location   Station ID   Date     CR   SR 2600   BB400   07/16/08     Dasin   8 digit HUC   Latitude   Longitude   AU Number   Levent     1   03030002   36.282500   -79.611944   16-7b   North     Drainage Area (mi2)   Elevation (ft)   Stream Width (m)     12   655   4     Forested/Wetland   Urban   Agriculture   O     30   20   50   50     schargers (>1MGD or <1MGD and within 1 mile)   NPDES Number   Site Photograph     21.3   13   14   14

Dissolved Oxygen (mg/L)	8.2				
Specific Conductance (µS/cm)					
pH (s.u.)	6.8				
Water Clarity	bid				
water Clarity Signify turbid					
Habitat Assessment Scores (max)					

# F

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	5
Left Bank Stability (7)	6
Right Bank Stability (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	58



Substrate

sand dominant; some silt, gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/16/08	10495	77	20	6.47	5.59	Good-Fair
08/26/03	9280		12		5.83	Fair
07/09/01	8465	55	10	6.85	5.58	Fair
04/11/01	8407	62	12*	6.70*	4.66	Fair
08/22/00	8175	58	12	6.70	5.61	Fair
07/06/98	7618	42	3	7.60	7.02	Poor
07/14/93	6243	41	3	7.22	7.23	Poor

\* values corrected for seasonality

# **Taxonomic Analysis**

The most EPT taxa collected at the site by the BAU since 1993 was in 2008. All three insect orders were represented by the greatest number of taxa for summer sampling (i.e. excepting the April 2001 sample which is influenced by seasonality). EPT taxa collected for the first time at the site were: Baetis flavistriga, Isonychia, Neoperla, Paragnetina fumosa, Phylocentropus, Hydroptila, Oecetis nocturna, and Triaenodes helo/perna.

### **Data Analysis**

The site is six miles SSE of downtown Reidsville in the southeast corner of Rockingham County. The stream segment is on the 303(d) list for fecal coliform and impaired biological integrity. The site is about three miles downstream of the former outfall for Reidsville WWTP, which was moved to discharge into Haw River in November 1998.

A comparison of EPT Richnes and NCBI values before and after removal of the WWTP discharge show clear improvements. In particular the high EPT richness value in 2008 relative to other sampling events is suggestive of improving conditions at the site, as is the lower NCBI value.

Waterbody		Locati	Location		Station ID		Date	Bioclassification
STINKING QUA	RTER CR	SR 1136	/1131	BB	505	03/11/09		Good-Fair
-								
County	Subbasin	8 digit HUC	Latitude	Longitu	de AU	Number		Level IV Ecoregion
Orange	3	03030002	36.002630	-79.4676	580 ·	16-9-8	So	uthern Outer Piedmont
Stream Classifica	tion	Drainage Area (mi2	) Elev	Elevation (ft) Stream Width (m)		(m)	Stream Depth (m)	
C; NSW		81.0/62.8	,	620		8		0.3
		na sta d/M/stion d	linker		A	14	•	Other (decerite)
		20	Urban		Agricu	liture		Other (describe)
VISIBle Landuse	(%)	30	70		0			
Upstream NPE	DES Discharg	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	IPDES Nur	nber	Volume (MGD)
None		•						
Water Quality Parame	eters	15.1			AND	Site Pho	otograph	ATP - A
Dissolved Oxygen (mg	1/L)	11.7	DER	+1.120	MAK.	XI		
Specific Conductance	(uS/cm)	96			HAR	VN	一是是引用	
pH (s.u.)	(µ0,011)	6.7		1 La	NAL	KAN		IN CONTRACTOR
					W IST	11-1-		N VICE X TZ
Water Clarity		Clear.			RA/1	IV	TANK	NA STORE AND
			041	AL INC.	MA I	JV/ II		The part of the pa
Habitat Assessment	Scores (max)				And And			
Channel Modification (	(5)	4						TAN A CONTRACT
Instream Habitat (20)		16	1	-	for the			
Bottom Substrate (15)		3	and the second	p di i			Same and the second	
Pool Variety (10)		4			and the			
Riffle Habitat (16)		5				E La		
Left Bank Stability (7)		4			The second	- Carton	N artes	and the second second
Right Bank Stability (7	)	4	and the second		The second	The search	- Stand	
Light Penetration (10)		10	Carefa 2	- The second	La la	The second	1	and the second second
Left Riparian Score (5)	)	1		151 -	the set	P. Jones		
Right Riparian Score (	5)	4						
Total Habitat Score (*	100)	55	Substra	ate M	lostly sand	with small a	amounts of co	bble, gravel and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/11/09	10643		20		4.46	Good-Fair
11/21/03	9312		21		4.86	Good-Fair
07/07/03	9159		13		5.59	Fair
07/10/98	7665		23		5.08	Good
07/12/93	6235		16		5.04	Good-Fair

# **Taxonomic Analysis**

Baetis flavistriga, B. intercalaris and B. pluto were present in the November 2003 collection but not in the 2009 collection, whereas Heterocloeon amplum were present in the 2009 collection but not in the November 2003 collection. Other than this minor shift in Baetid taxa and the site being moved upstream, the November 2003 and 2009 benthological communities were similar.

### **Data Analysis**

Stinking Quarter Creek is a large tributary to the Haw River. Due to deep water and no flow at the original basin site at SR 1136, this site was moved upstream to SR 1131. In order to find a site that was wadable and had sufficient flow, the site had to be moved several miles upstream and above the confluences of Little Alamance Creek and Rock Creek. This reduced the drainage area from 81.0 sq mi at the SR 1136 location to xx sq mi at the new location. This site received Good-Fair ratings in 2009, November 2003, and 1993. A Good rating in 1998 and a Fair rating in July 2003. The Fair rating in 2003 was most likely due to effects from the 2002 drought and is supported by the absence of edge species in the sample.

Waterbody		Locati	Location		Station ID			Date		Bioclassification
REEDY	FK	SR 21	28	B	B362	2	07/16/08		8 GOOD-FAIR	
		•								
County	Subbasin	8 digit HUC	Latitude	Longit	ude	AU N	umber		Leve	el IV Ecoregion
Guilford	2	03030002	36.172778	-79.953	3333	333 16-11-(1)a			Northe	ern Inner Piedmont
Stream Classifica	ation I	Drainage Area (mi <sup>2</sup> )	Elevation (ft)		Strea	m Width	(m)		Stream Depth (m)	
WS-III; NS 08/03/9	92: W	20.5		785			4	ļ		0.1
	Fo	rested/Wetland	Urban		4	Aaricultu	ıre		Ot	her (describe)
Visible I anduse	(%)	50	20		· · ·	0			30	) (fallow fields)
	(70)			Ļ						· · · · ·
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and within	n 1 mile)		NPI	DES Nun	nber		Volume (MGD)
		none								
Water Quality Param	eters						Site Pho	tograph	1. 200-001 - TOURDAY	
Temperature (°C)		22.8								P. A. Martin
Dissolved Oxygen (mg	g/L)	8.2	and the	A.		No.	THE.			E ASSALE BOAT
Specific Conductance	(µS/cm)	111	1200					Prage 1	1 30	and the second particular
pH (s.u.)		7.0	Contraction of the		F.					William Horas
							1			Contraction of the second
Water Clarity		clear		bix.		denner	1.2 A			
					04		-	-		
Habitat Assessment	Scores (max)		1. A							
Channel Modification	(5)	5		To all			1	Jelinger Mile		HO ANA
Instream Habitat (20)		10		and the	120		Ale and	about the		
Bottom Substrate (15)	1	3			120	23			_3	
Pool Variety (10)		4		and the second		and the second			- 4	Contraction of
Riffle Habitat (16)		3	Contraction of the second						- Same	
Left Bank Stability (7)		5		to the						
Right Bank Stability (7	<b>'</b> )	5								
Light Penetration (10)		10								
Left Riparian Score (5	)	3			4	- Dava	die 1			Charles and
Right Riparian Score (	(5)	5								
Total Habitat Score (	100)	53	Substra	ate				Sand;	some s	ilt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/16/08	10497		16		4.29	Good-Fair
07/10/03	9189		15		4.68	Good-Fair
07/08/98	7631		19		4.07	Good-Fair
07/14/93	6247		19		4.88	Good-Fair

### **Taxonomic Analysis**

The macroinvertebrate community at this site remains stable with only a small increase in EPT Richness. Also, EPT abundance increased from 54 in 2003 to 78 in 2008 indicating slightly higher benthic productivity. Along with *Seratella deficiens*, an ephemerelid mayfly collected again in 2008 after being absent in 2003, the perlid stoneflies, *Acroneuria*, *Neoperla* and *Perlesta* as well as the caddisfly *Chimarra* helped contribute to a lower BI value than was received in 2003. Overall, the benthic community present is relatively intolerant.

### **Data Analysis**

Reedy Fork is a main feeder stream for Lake Brandt. This is the most upstream reach of Reedy Fork sampled for basinwide monitoring and is also the most urban as outward growth of Kernersville encroaches on much of the traditionally agricultural catchment. Reedy Fork at SR 2128 suffers from poor macroinvertebrate habitat reflective in the shifting sand substrate and lack of riffles. This site has maintained a Good-Fair water quality rating since 1993 despite these habitat deficiencies. Coupled with the presence of a relatively intolerant EPT community, this suggests that poor habitat may limit the benthic fauna more than urban runoff.

Waterbody		Locati	Location		n ID		Date Bioclassif		Bioclassification
REEDY	FK	SR 27	<b>'</b> 28	BB4	04	07/15/08		3	GOOD-FAIR
		-							
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU	Number		Leve	el IV Ecoregion
Guilford	2	03030002	36.179444	-79.647778	B 16-	16-11-(9)a2		Southern Outer Piedmont	
Stream Classifica	ation	Drainage Area (mi <sup>2</sup> )	) Elev	Elevation (ft)		Stream Width (m)			Stream Depth (m)
C; NSW		125.0		650		10			0.3
	E	aroatad/Watland	Urbon		Agricul	turo		01	har (dagariba)
Vicible Lenduce		60			Agricu	ture		Ut	
VISIDIE Landuse	(%)	00	40		0				0
Upstream NPI	DES Dischard	iers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber		Volume (MGD)
		none		,					
Water Quality Param	eters					Site Pho	otograph		
Temperature (°C)		24.4		Star Frank	1.1.1				
Dissolved Oxygen (mg	g/L)	8.1			C.S.A.				
Specific Conductance	(µS/cm)	98		×2	S. S. C.	The star	111		
pH (s.u.)		6.7		A Star					
			12 De		and the second second			NOV.	
Water Clarity		slightly turbid			1			C.C.	
				they are		A		and and	and the second second
Habitat Assessment	Scores (max)		- Palet		The second				
Channel Modification	(5)	4	And the area	College California				-	Sacal and the second
Instream Habitat (20)		16			-		E B L		
Bottom Substrate (15)	)	12				200	Sec. 1		
Pool Variety (10)		6		a a second	100		**		
Riffle Habitat (16)		6	and the						
Left Bank Stability (7)		6		Services	-		-		
Right Bank Stability (7	')	6		and and	-2-	12 12 14	1	the lot	and the second second
Light Penetration (10)		10	a Containe	The s	-				about the second
Left Riparian Score (5	)	3							STREET, STREET
Right Riparian Score (	(5)	2							
Total Habitat Score (	100)	71	Substra	ate	Equ	al mix of b	oulder, co	bble, gra	avel, and sand; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/08	10493		18		5.24	Good-Fair
07/11/03	9194		8		6.27	Fair
07/07/98	7624		18		5.64	Good-Fair
07/13/93	6241		16		5.99	Good-Fair

#### **Taxonomic Analysis**

A more than 2-fold increase in EPT taxa richness and abundance (75 in 2008 from 37 in 2003) occurred since the site's historic low in 2003. The primary taxa gained were moderately intolerant caddisflies such as the leptocerids *Oecetis cinerascens*, *O. nocturna*, *Triaenodes ignitus*, and *T. perna/helo*. These species helped to drive the Biotic Index significantly lower than in any previous sampling cycle. The addition of the silt loving mayflies *Caenis* and *Tricorythodes* to the benthos helped to mitigate the reduction of the BI.

### **Data Analysis**

Located in northeastern Guilford County, this middle reach of Reedy Fork is the outflow of Townsend Lake and therefore indicative of the condition of Greensboro's drinking water supply. Entering more rural areas of the county, this station has much better habitat qualities than the site at SR 2128, the absence of wide riparian buffers being the most glaring deficiency. The bioclassification of this segment has historically been Good-Fair with the exception of a Fair rating in 2003 when the stream was sampled during high flow. Sampling in 2008 resulted in Reedy Fork once again rating Good-Fair.

Waterbody		Locatio	Location		Station ID		Date	Bioclassification
REEDY	FK	NC 8	37	BB3	2	07	7/15/08	GOOD-FAIR
		•						
County	Subbasin	8 digit HUC	Latitude	Longitude	de AU Number		Lev	el IV Ecoregion
Alamance	2	03030002	36.173056	-79.510556	16-	11-(9)b	South	ern Outer Piedmont
		<b>.</b>			•			
Stream Classifica	Stream Classification Drainage A		) Elev		Strea	am width	(m)	Stream Deptn (m)
C; N5W		255.0		600		27		0.3
	Fo	rested/Wetland	Urban		Agricul	ture	0	ther (describe)
Visible Landuse	(%)	30	0		30		40 (20	fallow fields, 20 mill)
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	NF	PDES Nur	nber	Volume (MGD)
	Horner	's Mobile Home Park	ĸ			NC00779	68	0.04
Water Quality Param	otors					Site Pho	otograph	
Target and the second s	eters	26.2		10018.81		Sile The	lograph	
Disastered Output of (*C)	- /1 .)	20.3	and the second		C.C.		1 - C - 2 - 3	
Dissolved Oxygen (mg	J/L) (₩S/am)	9.0			and Particulation		and the second	
Specific Conductance	(µ5/cm)	7.0				1 A		
μπ (s.u.)		7.0						A CALLER MAN
Water Clarity		turbid		and the second second				A ALE AND A
Habitat Assessment	Scores (max)				her			
Channel Modification (	(5)	4		-		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
Instream Habitat (20)	( )	15						
Bottom Substrate (15)		8		1002			77	
Pool Variety (10)		10		- 67	NTER .	in the	- Java	
Riffle Habitat (16)		13			2			
Left Bank Stability (7)		7				110		
Right Bank Stability (7	)	7			05	1		a constant
Light Penetration (10)		2		2.100		1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -		
Left Riparian Score (5)	)	4			and the second second	- and		
Right Riparian Score (	5)	2						
Total Habitat Score (	100)	72	Substra	ate	F	Bedrock ar	nd boulder, with s	ome cobble: silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/08	10492	56	16	6.34	5.81	Good-Fair
07/07/98	7622	53	11	7.11	6.16	Fair
07/13/93	6240	68	20	6.42	5.59	Good-Fair
08/08/89	5053	67	14	6.88	6.04	Fair
07/07/86	3825	59	10	6.78	6.03	Fair

### **Taxonomic Analysis**

The increase in EPT from 1998 to 2008 as well as a significant drop in the Biotic Index can be primarily attributed to the addition of the caddisflies *Ceraclea enodis*, *Leucotrichia pictipes* (1st stream record), *Neureclipsis* (1st stream record), and *Oecetis persimilis* to the benthic community. Additionally, a decrease in midge taxa richness and abundance helped lower the BI to the lowest value in over 20 years despite an increase in oligochaetes.

### **Data Analysis**

Reedy Fork flows primarily through rural and agricultural lands, although it originates from Kernersville. This site lies 1/4 mile below a low-head dam and 3/4 mile from the confluence with the Haw River. The increase in the bioclassification from Fair to Good-Fair indicates improving water quality. However, it is important to note that water quality has historically fluctuated between these two bioclassifications. This site was not sampled in 2003 due to continuous high flows.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/16/08	10498		10		6.34	Fair
07/10/03	9190		6		5.99	Poor
07/08/98	7630		7		6.46	Fair
07/14/93	3246		9		6.11	Fair

#### **Taxonomic Analysis**

EPT richness in 2008 was the highest ever recorded for a basinwide sample at this station. A total of 5 mayflies and 5 caddisflies were collected in 2008 with the mayfly *Stenacron interpunctatum* and caddisfly *Triaenodes perna/helo* being new records for this site. The EPT BI, contrary to the EPT richness, worsened due to the presence of more tolerant taxa which, although more tolerant, were not collected at all in 2003. This increase in richness helped nudge this site back to a Fair rating.

#### **Data Analysis**

A drinking water supply stream for Lake Brandt, Horsepen Creek is an exclusively urban stream. Draining the northeastern portion of Greensboro including PTI airport, this stream has very little catchment area that is not developed. Recent development pressures have been very heavy due to growth and has helped eliminate habitat for macroinvertebrates. Much of the poor habitat of Horsepen Creek is due to natural sandy substrates although high urban development has contributed to high water velocities after a rain event resulting from high percentages of impervious surfaces. High water velocities lead to severely eroded banks and stream incision which then loads the water with high amounts of silt thereby affecting the benthic fauna. It is clear that water quality of Horsepen creek is directly impacted by increasing urbanization. This stream may be a good candidate for a stream bank stabilization project.

Waterbody		Locati	Location		n ID		Date	Bioclassification
N BUFFAL	O CR	SR 28	332	BB4	07	07/23/08		Fair
						•		
County	Subbasin	8 digit HUC	Latitude	Longitude	gitude AU Number		Lev	el IV Ecoregion
GUILFORD	2	03030002	36.120278	-79.708333	3 16-1	1-14-1b	South	ern Outer Piedmont
Stream Classifica	ation E	Drainage Area (mi2	2) Elev	ation (ft)	Stre	am Width	(m)	Stream Depth (m)
C; NSW		37.1		700		25		0.3
	_						_	
	For	rested/Wetland	Urban		Agricul	ture	O	ther (describe)
Visible Landuse	(%)	100	0		0			
Unstroom NDI		ve (> 1MCD or <1N	ICD and within	n 1 milo)	NI		abor	Volume (MCD)
North Buffalo Cr WW			n i iiiie)		NC00243			
	11					140002402	20	10.0
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C)		24.9	The Sector	and the second	ALL A	A.Y.	A A	
Dissolved Oxygen (mg	a/L)	6.2	100	State 1	and the	The	And A	and the second states
Specific Conductance	(uS/cm)	377	10 100 100		a der	4-17:		No. 16 m
pH (s.u.)	(µ0,0)	6.9				之 作	Niller 1	
p (0.0.)				1987-			A. M	
Water Clarity		clear		A fait		ALC: A	A free	
						See als		
Habitat Assessment	Scores (max)		6. 7 14		Sec. 8-		N. Tarray	
Channel Modification	(5)	5			A. M.	le ad set	and the second second	Marker July 13
Instream Habitat (20)	(-)	16						-> / 75 /
Bottom Substrate (15)	)	12					INA ANTINA	A standard
Pool Variety (10)	·	6	and the	-	1.10	Sec. 19		Mar and a
Riffle Habitat (16)		7	- A	- And				the state of the s
Left Bank Stability (7)		6	C - 34	The last			e e	
Right Bank Stability (7)	7)	6	15-15-16					and the second
Light Penetration (10)	,	7		al al a		-		AND STATES
Left Riparian Score (5	)	5	and the second			11 - 16 · ·		
Right Riparian Score	, (5)	5	the second s			A Alera		A CONTRACTOR OF THE SECOND
Total Habitat Score (	(0)	75	Substra	ate Mos	stlv sand v	vith some	bedrock. boulder	rubble and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10510	43	6	7.37	6.77	Fair
07/10/03	9191	41	3	7.73	6.80	Poor
07/08/98	7627	37	3	8.00	7.00	Poor
07/13/93	6242	40	4	8.11	6.67	Poor

### **Taxonomic Analysis**

No major changes in the benthic community were observed. New taxa collected in 2008 that were not previously collected include Heterocloeon curiosum and Hydroptila. Abundant taxa were Baetis flavistriga, B. intercalaris, Cheumatopsyche, Hydropsyche betteni, Hydroptila, Argia, Enallagma, Ancyronyx variegatus, Ablabesmyia mallochi, Cricotopus bicinctus, Polypedilum halterale, P. illinoense group, Rheocricotopus robacki, Rheotanytarsus, Tanytarsus sp. A and T. sp. U.

## Data Analysis

This site is located in northwest Guilford County and downstream of the North Buffaloe Creek WWTP. It is also an ambient monitoring location. Since 1993, this site had consistently rated Poor. In 2008, EPT taxa richness doubled increasing the bioclassification to Fair.

Waterbody		Locatio	Location		n ID		Date	Bioclassification
S BUFFA	LO CR	SR 28	321	BB4	-06	07/23/08		Fair
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU	AU Number		vel IV Ecoregion
GUILFORD	2	03030002	36.059722	-79.72555	6 16-	11-14-2a	South	ern Outer Piedmont
					_			
Stream Classific	ation [	Drainage Area (mi2)	Elevation (ft)		Stro	eam Width	(m)	Stream Depth (m)
C; NSW		43.5		750		15		0.5
	Fo	ested/Wetland	Urban		Agricu	lturo	0	ther (describe)
Visible Landus	a (%)	70	0		30	)		
VISIBLE Landus	. ( /0)		, v					
Upstream NP	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	IPDES Nur	nber	Volume (MGD)	
City of Greensboro W	City of Greensboro WWTP					NC00473	84	40.0
Water Quality Paran	neters					Site Pho	otograph	
Temperature (°C)		26.5			192		A. 15 32	A
Dissolved Oxygen (m	ng/L)	4.7						
Specific Conductance	e (µS/cm)	815				1 A A	A	
pH (s.u.)		7.4	<b>法</b> //	1.21		A Dec		Arris all and
		- · · ·	JA .		100		FS 311	
Water Clarity	:	slightly turbid	A NE		1		S 100	A State State and
Habitat Assessment	t Scores (max)		2 A LAN	1		Hills in	and the	
Channel Modification	(5)	4	and a state	1 2	19 g 1			
Instream Habitat (20)	)	12			-	and the second		
Bottom Substrate (15	5)	5	- E.S.					
Pool Variety (10)		6		+				
Riffle Habitat (16)		5						The Car
Left Bank Stability (7)	)	6	1					ALL A
Right Bank Stability (	7)	7						A MARKEN
Light Penetration (10	)	7						
Left Riparian Score (	5)	4	Se					
Right Riparian Score	(5)	5						
Total Habitat Score	(100)	61	Substra	ate Mos	stlv bould	er with som	e rubble, sand a	nd silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10509	46	8	7.06	6.65	Fair
07/11/03	9193	38	4	7.13	7.00	Poor
07/07/98	7626	26	1	8.55	7.80	Poor
07/12/93	6237	50	2	8.23	6.20	Poor

### **Taxonomic Analysis**

Eight EPT taxa were collected in 2008; the highest ever recorded for this site. Taxa collected for the first time include the mayfies, *Paracloeodes* minutus and *Tricorythodes*, and the caddisfly, *Hydropsyche venularis*.

## Data Analysis

Most of the flow at this site, which is also an ambient monitoring site, is due to the 40 MGD discharge from the city of Greensboro's WWTP discharge. With the exception of the 1998 sample, which was taken immediately after a fish kill, EPT taxa richness has been gradually increasing since 1993 suggesting an improvement in water quality. The highest number of EPT taxa ever recorded from this site were collected in 2008, thereby increasing the bioclassification rating to Fair.

Waterbody		Locat	ion	n Station ID			Date	Bioclassification
STONY CR		SR 1	104	BB	503	03	3/09/09	Good-Fair
County Subb	asin 8 d	<b>ligit HUC</b> 3030002	Latitude 36.257309	Longitude AU Number		S	Level IV Ecoregion	
Stream Classification	Draina	ge Area (miž	2) Elev	vation (ft)	Str	eam Width	(m)	Stream Depth (m)
WS-II; HQW, NSW		23.9	,	600		5		0.8
Visible Landuse (%)	Forested	<b>/Wetland</b>	Urban 0		Agricu 0	ilture		Other (describe)
Unstream NPDES Dise	hargers (>1	MGD or <1	IGD and withir	1 mile)			abor	Volume (MGD)
None	anargers (>1			i i iiiie)				Volume (MGD)
Water Quality Parameters Temperature (°C) Dissolved Oxygen (mg/L) Specific Conductance (µS/cm) pH (s.u.) Water Clarity	Slightly	13.4 9.4 100 6.7				Site Pho	tograph	
Habitat Assessment Scores ( Channel Modification (5) Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5) Total Habitat Score (100)	max)	4 14 3 8 7 3 3 3 7 4 5 58	Substra	ate M	lostly sand	with a small	l amount of	boulder and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/09/09	10634		23		4.85	Good-Fair
07/10/03	9188		11		6.34	Not Rated
07/06/98	7633		21		5.40	Good
07/13/93	6238		21		4.69	Good
02/10/93	6080		27		4.04	Good

### **Taxonomic Analysis**

The decline in bioclassification from 1998 to 2009 is due to the absence of rare species that were present in the 1998 collection but absent in the 2003 and 2009 collections. Rare species are defined as taxa that are represented by one or two individuals. Those species include *Maccaffertium pudicum*, *Stenonema femoratum*, *Habrophlebiodes* spp., *Neoperla* spp., *Ceraclea ancylus*, *Oecetis persimilis* and *Polycentropus* spp.

#### **Data Analysis**

From 1993 to 2003, Stony Creek was sampled at SR 1100. It was suggested that in 2009, the site be moved to SR 1104 because the riffle located at SR 1100 was atypical for this reach of the stream. The bioclassification at this site was Good from 1993 to1998 then declined to Good-Fair in 2009. This part of the state experienced droughts in 2003 and 2008, thus the collection in 2003 was Not Rated. Although EPT richness in 2009 (23) was similar to those recorded in 1993 and 1998, whether the 2008 drought had any impact on Stony Creek is inconclusive.

JORDAN CR     SR 1002     BB214     03/09/09     Not Rated       County     Subbasin     8 digit HUC     Latitude     Longitude     AU Number     Level IV Ecoregion       ALAMANCE     2     03030002     36.205000     -79.383889     16-14-6-(0.5)     Southern Outer Piedmont       Stream Classification     Drainage Area (mi2)     Elevation (t)     Stream Width (m)     Stream Depth (m)       WS-II; HQW, NSW     13.8     600     6     0.3       Forested/Wetland     Urban     Agriculture     Other (describe)       Visible Landuse (%)     100     0     0     0     0       Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)     NPDES Number     Volume (MGD)       None     114.4     9.3     87     6.5     Site Photograph       Water Clarity     [14.4]     9.3     87     6.5     Site Photograph       Water Clarity     [14.4]     9.3     87     6.5     Site Photograph       Water Clarity     [14.4]     9.3     87     7     5	Waterboo	dy	Locat	ion	Statio	n ID		Date	Bioclassification	
County     Subbasin     8 digit HUC     Latitude     Longitude     AU Number     Level IV Ecoregion       ALAMANCE     2     03030002     36.205000     -79.383889     16-14-6-(0.5)     Southern Outer Piedmont       Stream Classification     Drainage Area (mi2)     Elevation (ft)     Stream Width (m)     Stream Depth (m)       WS-II; HQW, NSW     13.8     600     6     0.3       Forested/Wetland     Urban     Agriculture     Other (describe)       Visible Landuse (%)     100     0     0     0       Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	JORDAN	I CR	SR 10	002	BB2	14	03	3/09/09	Not Rated	
Stream Classification     Drainage Area (mi2)     Elevation (ft)     Stream Width (m)     Stream Depth (m)       WS-II; HQW, NSW     13.8     600     6     0.3       Visible Landuse (%)     100     0     0     0       Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)		Subbasin	8 digit HUC	Latitude	Longitude	Longitude AU Number		S	Level IV Ecoregion	
WS-II; HQW, NSW     13.8     600     6     0.3       Forested/Wetland     Urban     Agriculture     Other (describe)       Visible Landuse (%)     100     0     0     0       Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	Stream Classifica	tion [	)rainage Area (mi2	2) Elev	Elevation (ft) Stream Width (m)			(m)	Stream Depth (m)	
Forested/Wetland   Urban   Agriculture   Other (describe)     Visible Landuse (%)   100   0   0     Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)   NPDES Number   Volume (MGD)     None   Vater Quality Parameters   Site Photograph     Temperature (°C)   14.4   9.3     Dissolved Oxygen (mg/L)   9.7   6.5     Water Clarity   Clear.   East     Habitat Assessment Scores (max)   7   6.5     Channel Modification (5)   5   7     Bottom Substrate (15)   3   7     Pol Variety (10)   8   5     Riffle Habitat (16)   5   6     Left Bank Stability (7)   6   6     Light Bank Stability (7)   6   6     Light Penetration (10)   10   10	WS-II; HQW, N	SW	13.8	,	600		6		0.3	
Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)     NPDES Number     Volume (MGD)       None     Site Photograph     Site Photograph       Temperature (°C)     14.4     9.3     Specific Conductance (µS/cm)     87       PH (s.u.)     6.5     6.5     Site Photograph     Site Photograph       Water Clarity     Clear.     Clear.     Specific Conductance (µS/cm)     6.5       Water Clarity     Clear.     Specific Conductance (µS/cm)     7     Specific Conductance (µS/cm)     7       Bottom Substrate (15)     3     3     Specific Conductance (µS/cm)     8     Specific Conductance (µS/cm)     8       Piffle Habitat (16)     5     5     Specific Conductance (µS/cm)     5     Specific Conductance (µS/cm)     8       Bottom Substrate (15)     3     3     Specific Conductance (µS/cm)     8     Specific Conductance (µS/cm)     5       Left Bank Stability (7)     6     5     Specific Conductance (µS/cm)     5       Left Bank Stability (7)     6     5     Specific Conductance (µS/cm)     5       Left Bank Stability (7)     6     5	Visible Landuse	For (%)	rested/Wetland 100	Urban 0		Agricult 0	ure		Other (describe)	
None     Site Photograph       Water Quality Parameters     14.4       Dissolved Oxygen (mg/L)     9.3       Specific Conductance (µS/cm)     87       pH (s.u.)     6.5       Water Clarity     Clear.       Habitat Assessment Scores (max)     7       Channel Modification (5)     5       Instream Habitat (20)     7       Bottom Substrate (15)     3       Pool Variety (10)     8       Riffle Habitat (16)     5       Left Bank Stability (7)     6       Right Bank Stability (7)     6       Light Penetration (10)     10	Upstream NPE	DES Discharge	rs (>1MGD or <1M	IGD and withir	n 1 mile)	NP	DES Nur	nber	Volume (MGD)	
Water Quality Parameters     Site Photograph       Temperature (°C)     14.4       Dissolved Oxygen (mg/L)     9.3       Specific Conductance (µS/cm)     87       pH (s.u.)     6.5       Water Clarity     Clear.       Habitat Assessment Scores (max)     7       Channel Modification (5)     5       Instream Habitat (20)     7       Bottom Substrate (15)     3       Pol Variety (10)     8       Riffle Habitat (16)     5       Left Bank Stability (7)     6       Light Penetration (10)     10	None									
Habitat Assessment Scores (max)Channel Modification (5)5Instream Habitat (20)7Bottom Substrate (15)3Pool Variety (10)8Riffle Habitat (16)5Left Bank Stability (7)6Right Bank Stability (7)6Light Penetration (10)10	Water Quality Parama Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.) Water Clarity	eters I/L) (µS/cm)	14.4 9.3 87 6.5 Clear.				Site Pho	tograph		XXX
Left Riparian Score (5) 5   Right Riparian Score (5) 5   Total Habitat Score (100) 60   Substrate mix of bedrock, boulder, rubble, gravel, sand and silt	Habitat Assessment : Channel Modification ( Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (6)	Scores (max) 5) ) ) 5) 100)	5 7 3 8 5 6 6 6 10 5 5 5 60	Substra	ate mix	of bedrock			el sand and silt	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/09/09	10635		13		4.34	Not Rated
08/26/03	9281		16		4.90	Good-Fair
07/06/98	7634		16		5.03	Good-Fair
02/10/93	6079		23		4.78	Good-Fair

### **Taxonomic Analysis**

EPT richness, when corrected for season, decreased 50% from 2003 (16) to 2009 (8). The biotic index decreased, possibly due to the winter stonfly taxa present in the sample having lower tolerance values. Abundant taxa were *Ameletus lineatus*, *Prostoia*, *Clioperla clio* and *Isoperla transmarina*. All are considered winter taxa.

### Data Analysis

Jordan Creek, which suffers from substantial bank erosion and habitat degradation, is a tributary to Stony Creek below Lake Burlington. It drains primarily rural, northern Alamance County. The site at SR 1002 is located three miles upstream of Lake Burlington. Taxa typically found in flowing water, such as Heptageniid mayflies, were absent from the 2009 sample suggesting the stream still has lingering impacts from the 2008 drought. Because of the low number of EPT taxa (eight, when corrected for seasonality) and the absence of flow dwelling species, Jordan Creek was Not Rated in 2009. Previously, the site has consistently received Good-Fair ratings.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/08	10487		9		6.11	Fair
08/26/03	9282		12		6.23	Fair
07/10/98	7666		18		5.82	Good-Fair
07/12/93	6234		19		5.24	Good-Fair

### **Taxonomic Analysis**

There has been a decline in the number of EPT taxa collected after each summer sampling event from prior sampling events from 1993 through 2008. The loss of taxa is most pronounced in the stoneflies (two, one, one, and zero taxa collected in 1993, 1998, 2003, and 2008 respectively) and the caddiflies (ten, eight, six, and four taxa collected in subsequent sampling events).

#### **Data Analysis**

The site is 4.5 miles south of downtown Burlington in central Alamance County. The catchment includes a portion of Burlington and several small towns. The stream segment was added to the 303(d) list in 2006 for impaired biological integrity.

As in 2003, the stream shows degradation in 2008. A continued reduction in the number of EPT taxa collected suggests that water quality at the site continues to deteriorate, though the negligibly lower EPT BI value in 2008 over 2003 is somewhat confounding. Development and agriculture in the watershed are likely sources of impact to the benthic community.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/08	10488	49	7	7.04	6.53	Not Rated
09/12/06	10111	46	5	6.79	6.19	Poor
06/23/03	9084	41	5	6.70	6.70	Fair
07/10/98	7667		6		6.86	Poor
07/29/85	3527	45	8	7.34	6.63	Fair

# **Taxonomic Analysis**

The EPT portion of the benthic community has been similar for each sampling event. Over the five sampling events at the site a total of 11 taxa have been collected.

#### **Data Analysis**

The site is 2.5 miles south of downtown Graham in central Alamance County. Portions of Graham and Greensboro are within the catchment. The stream is on the 303(d) list for impaired biological integrity.

The site was not rated in 2008 due to low streamflow as the result of drought; the site would have rated as Fair otherwise.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/08	10490		12		4.78	Fair
07/07/03	9187		14		5.47	Good-Fair
07/10/98	7664		22		4.79	Good

#### **Taxonomic Analysis**

A continuous loss of EPT taxa has occurred since 1998, noticibly with caddisfly larvae which dropped from 12 species in 1998 to only 5 in both 2003 and 2008, with only hydropsychid caddisflies remaining in 2008. A steady reduction in mayfly taxa has also occurred since 1998 (from 8 to 6 to 4) with the remaining taxa being silt tolerant species such as *Caenis* and *Maccaffertium modestum*. Only 2 perild stonelfy taxa have been collected in each sampling year. Finally, the overall EPT abundance value has decreased each successive sampling from 92 in 1998 to 58 in 2008, although those taxa present are slightly less tolerant than those present in 2003.

#### **Data Analysis**

This site drains eastern Alamance and western Orange Counties, areas of high development pressures. Siltation of the waterway, coupled with the lack of any dischargers on the stream, is highly suggestive that watershed development is a primary cause of the reduction in the integrity of the macroinvertebrate community. Habitat deficiencies, which contribute to siltation and that are typical in areas of high development, were noted including moderate to severe bank erosion and lack of good riparian vegetation. The consistent drop in Bioclass from Good in 1998 to Fair in 2008 supports this hypothesis. However, it must be noted that a lack of community recovery from the extreme 2007 drought may also contribute to the Fair rating.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/09/09	10636		27		4.03	Good
07/15/03	9195		18		5.03	Good-Fair
03/10/03	9069		18		4.05	Not Rated
10/19/00	8319	76	25	5.72	4.59	Good-Fair
02/10/98	7492		17		3.88	Fair

#### **Taxonomic Analysis**

Minor shifts in EPT taxa occurred between July 2003 and 2009. For example, *Baetis flavistriga*, *B. intercalaris* and *B. pluto* were present in the July 2003 collection but not in the 2009 collection, whereas *Heterocloeon amplum* and *Plauditis dubius* were present in the 2009 collection but not in the July 2003 collection. In addition stonefly richness increased from 3 taxa in July 2003 to eight taxa in 2009. Also, four species of Hydropsychid mayflies were present in the July 2003 collection versus one species in the 2009 collection. These shifts in the EPT community are partly due to cessation of flow during warmer drier months as well as seasonality.

#### **Data Analysis**

Marys Creek, a tributary of the Haw River, is located in eastern Alamance County. Water quality has improved to Good for the first time since sampling on Marys Creek began in 1998 and is due, in part, to the highest EPT richness ever recorded at this site. However, five of those taxa are winter stoneflies, thus removed from the analysis. Since Slate Belt streams often stop flow in the summer as well as in periods of drought, the fluctuation in the bioclassification is most likely due to the hydrologic regime of Marys Creek. Marys Creek was part of a drought recovery study (BAU memo B-20040823), that occurred after the 2002 drought to determine benthic community recovery times. The March 2003 sample was Not Rated



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/11/09	10642		18	5.19		Good-Fair
08/14/03	9279		15	4.94		Good-Fair
07/15/03	9196		18	5.19		Good-Fair
07/07/98	7656		27	4.36		Good
02/26/98	7506	77	37	4.89	3.79	Excellent

#### **Taxonomic Analysis**

No major changes in the benthic community were observed. Abundant taxa included *Plauditus dubius*, *Leucrocuta*, *Stenonema femoratum* and *Prostoia*. *Stenonema femoratum* is a Slate Belt indicator species that is tolerant of low dissolved oxygen and low flow conditions. Many of the small tributary streams in the Slate Belt are prone to extremely low flow conditions during the summer due to low base flows and may often dry up completely during prolonged low flow periods.

### Data Analysis

Cane Creek drains rural southern Orange County and feeds into Cane Creek Reservoir. This site is located above the reservoir. Although down from the Excellent bioclassification in the winter of 1998 and the Good bioclassification in the summer of 1998, Cane Creek has exhibited a relatively stable macoinvertebrate community with all samples since July 2003 producing Good-Fair bioclassifications.



mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10614	17	17	5.21	5.21	Fair
07/15/03	9197	14	14	5.33	5.33	Good-Fair
02/02/98	7477	19	19	4.53	4.53	Good-Fair
12/10/86	3971	44	4	7.16	4.12	Poor

#### **Taxonomic Analysis**

Collins Creek does not appear to have ceased flowing in 2008 since Cheumatopsyche spp were abundant and another hydropsychid caddisfly, Hydropsyche betteni was also present. The seasonal stonefly, Amphineumura sp, and the caddisfly Ironoquia punctatissima were the other abundant taxa collected here in 2009. EPT species composition differed little from the other spring sample collected here (1998). Differences between the 2009 sample and 2003 were largely the result of seasonality. There were no EPT taxa that suggested a water quality problem, nor any taxa that are particularly sensitive to aquatic pollution.

#### **Data Analysis**

Collins Creek declined from Good-Fair in 2003 to Fair in 2009. The EPT Biotic Index actually went down a little suggesting some water quality improvement but the absence of just one, non-seasonal, EPT taxa resulted in the drop in bioclassification. When compared to 1998, a small decline in EPT taxa and an increase in EPT Biotic Index suggest that conditions are not improving here. Though water levels may have dropped during the drought, there is ample evidence that flow was not interrupted here. Given this observation and a high habitat score, more EPT taxa should have been residing in this reach.



mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10613	21	21	4.90	4.90	Good-Fair
03/10/09	10640	20	20	4.35	4.35	Good-Fair
03/12/08	10385	13	13	4.05	4.05	Fair
11/21/03	9313	18	18	4.42	4.42	Good-Fair
07/15/03	9200	12	12	5.26	5.26	Fair

### **Taxonomic Analysis**

Abundant taxa collected here, such as the caddisfly Cheumatopsyche sp, suggest that Terrells Creek did not stop flowing in 2008 through spring of 2009. Though not as diverse as other streams, the taxa collected here are typical of the aquatic communities found in this part of North Carolina. Other abundant taxa included mayflies (Heterocloeon amplum, Plauditus dubius group) and stoneflies (Amphinemura sp, Perlesta sp, Isoperla burksi, I. namata).

#### **Data Analysis**

Terrells Creek rated Good-Fair in 2009. This was an improvement from 2008 and one of the 2003 samples. The number of EPT taxa collected here in 2009 was higher than in previous collections yet only placed Terrells Creek near the average in terms of macroinvertebrate diversity for other Slate Belt streams sampled in 2009 in this part of North Carolina.

Waterbo	dy	Locati	Location		Station ID			Date Bioclassific	
DRY C	R	SR 15	520	BB	307	03	3/19/09	•	Fair
County	Subbasin	8 digit HUC	Latitude	Longitu	de	AU Number		Lev	el IV Ecoregion
CHATHAM	4	03030002	35.803611	-79.2119	44	4 16-34-(0.7)		Carolina Slate Belt	
Stream Classifica	ation	Drainage Area (mi2	2) Elevation (ft)			Stream Width	(m)		Stream Depth (m)
WS-IV;NSV	V	17.7		410		12			0.5
	Ба	reated (Matlend	l lub on		٨			0	har (daaariha)
		100	Orban		AÇ	o		01	ner (describe)
VISIBle Landuse	(%)	100	0			0			
Upstream NPI	DES Discharg	ers (>1MGD or <1M	GD and withir	n 1 mile)		NPDES Nun	nber		Volume (MGD)
	g	none		,		n/a			n/a
Water Quality Param	eters					Site Pho	tograph		
Temperature (°C)		13.3			-				
Dissolved Oxygen (mg	g/L)	12.8	10 m		2. 18	All and the			
Specific Conductance	(µS/cm)	95		and the	i		1.	WAR IN	
pH (s.u.)		6.3				Read L		1	
			1.5					10	
Water Clarity		Turbid					Sec. 14		
			Con the						
Habitat Assessment	Scores (max)				and the second		£ - 2		
Channel Modification	(5)	3		in the		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
Instream Habitat (20)		15	1	COS MA					
Bottom Substrate (15)	)	11	State State						and the set
Pool Variety (10)		3		Port	- and			No	Contraction in
Riffle Habitat (16)		7		A La Contra			-45		
Left Bank Stability (7)		4							
Right Bank Stability (7	")	7		Ser Star	1		2 M		
Light Penetration (10)		9			1				
Left Riparian Score (5	)	5		-	-	- Allow	1 - N	Ser.	
Right Riparian Score (	(5)	5	Ar star			- distant	2435	at the set	
Total Habitat Score (	100)	69	Substra	ate mi	ix of be	edrock, boulder,	, rubble, g	ravel, s	and and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10606	17	17	5.02	5.02	Fair
11/21/03	9314	13	13	5.06	5.06	Fair
07/15/03	9199	9	9	5.62	5.62	Fair
02/02/98	7478	21	21	3.98	3.98	Good-Fair
02/08/93	6072	31	31	4.62	4.62	Good

### **Taxonomic Analysis**

There were 17 EPT taxa collected from this site in 2009, an increase from the 13 found in 2003. From the taxa collected it appears that this site may cease flowing. For example, the caddisfly *Cheumatopsyche* sp was rare here while being common or abundant at most other Slate Belt sites in 2009. These caddisflies require constant flow in order to feed. Another caddisfly, *Ironoquia punctatissima* was abundant in 2009. This taxon can withstand periods of intermittant stream flow. A commonly collected mayfly in Slate Belt streams is Stenonema femoratum. This taxon was absent here.

#### **Data Analysis**

Dry Creek received a Fair bioclassification in 2009. This stream rated Poor in 1986 and since then has been Fair, Good and Good-Fair. As its name implies, Dry Creek, appears to stop flowing in some years. Flow, or the lack thereof, would be the most obvious cause of lower biological diversity here since habitat features appear within normal ranges and there are no point sources upstream of the sampling location.

Waterbody		Locati	Location Statio		on ID	n ID Date		Bioclassification	
POKEBER	RY CR	SR 17	/11	BB	320	03	3/19/09	Good-Fair	
			· · · · · · · · · · · · · · · · · · ·						
County	Subbasin	8 digit HUC	Latitude	Longitud	e AU I	Number	Le	evel IV Ecoregion	
CHATHAM	4	03030002	35.774167	-79.12000	0 1	6-37	C	arolina Slate Belt	
Stream Classifica	ation	Drainage Area (mi2	2) Elevation (ft)		Stre	am Width	(m)	Stream Depth (m)	
WS-IV;NSV	V	13.0		310		12		0.5	
	Fo	erested/Wetland	Urban		Agricul	ture		Other (road)	
Visible Landuse	(%)	90	0		0			10	
Linetreem ND			CD and within	1 mile)	NI				
	DES Discharg		GD and within	i i mile)		PDES Null	nber		
		Tione				11/4		11/4	
Water Quality Param	eters					Site Pho	tograph		
Temperature (°C)		10.5	and the second	100.000	1000	State State	Sales Balling	1. Martin Re	
Dissolved Oxygen (m	a/L)	11.6	1000	1		1	and the	ALL CARENE	
Specific Conductance	(uS/cm)	71	COLOR HIS	-	10 PR		destri		
pH (s.u.)	( )	6.0	1000		÷ 1	1			
F ( )			Test and		1.60	AL INC.	ALC: NOT		
Water Clarity		Slightly Turbid	10000	-	1000	1000	THE PARA		
		0,	100		1.11		MELL	A CONTRACTOR	
Habitat Assessment	Scores (max)			A 18	199	See.	10.00	and the state	
Channel Modification	(5)	5			1.11	-		A CONTRACTOR	
Instream Habitat (20)	· · ·	17		1000	-	Antest			
Bottom Substrate (15)	)	12	No. 1 and	and the second	are hito	20VIERI		States and the states of the	
Pool Variety (10)		5	-		and the second			Contraction of the local division of the loc	
Riffle Habitat (16)		16						COLUMN TO A	
Left Bank Stability (7)		2						No. of Concession, Name	
Right Bank Stability (7	<b>'</b> )	6						Courses of the	
Light Penetration (10)		7	the same in					and the second division of the local divisio	
Left Riparian Score (5	)	5	and the	4-5-	Par -		-		
Right Riparian Score	(5)	5							
Total Habitat Score (	100)	80	Substra	ate mix	of bedroc	k, boulder	, rubble, gravel,	sand and silt	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10592	27	27	4.24	4.24	Good-Fair
07/15/03	9198	19	19	5.28	5.28	Good-Fair
03/05/03	9061	21	21	4.66	4.66	Good-Fair
02/02/98	7479	30	30	3.92	3.92	Good
02/08/93	6071	23	23	4.68	4.68	Good-Fair

#### **Taxonomic Analysis**

Regardless of wet or dry years, Pokeberry Creek contains a greater diversity of EPT taxa than most other Slate Belt streams. A total of 27 EPT taxa were collected here including the mayflies *Diphetor hageni* and *Serratella deficiens*. These taxa were not collected at other streams in the area. Also, this stream contained high stonefly diversity (n=10) which included the only collections of *Eccoptura xanthesnes* and *Diploperla duplicata* in this part of the Cape Fear basin in 2009.

### **Data Analysis**

Pokeberry Creek has been sampled seven times since 1985. The stream rated Good in 1986 and 1998. Recent samplings, including 2009, rated Good-Fair. Only one stream in this part of the Cape Fear River basin contained a greater number of EPT (Mill Creek). Previous reports noted the resilence of the benthic community at Pokeberry Creek through drought. The geology underlying Pokeberry Creek's watershed is mainly Granite rather than slate. This may account for the increase flows here compared with other nearby streams.

Waterboo	dy	Locati	Location		Station ID		Date	Bioclassification
NEW HOP	PE CR	SR 11	07	BB238		07	/22/08	Fair
							,	
County	Subbasin	8 digit HUC	Latitude	Longitud	e AU I	Number	Lev	el IV Ecoregion
DURHAM	5	03030002	35.884722	-78.96666	7 16-41	-1-(11.5)c	Т	riassic Basins
					-			
Stream Classifica	ation	Drainage Area (mi2	:) Elev	ation (ft)	Strea	am Width	(m)	Stream Depth (m)
WS-IV; NSV	V	74.4		250		8		0.4
	F	orested/Wetland	Urban		Agricul	ture	Of	her (describe)
Visible I and use	(%)	90	0		0			10
	(70)		-					
Upstream NPE	DES Dischar	uers (>1MGD or <1M	IGD and withir	n 1 mile)	NF	PDES Num	ber	Volume (MGD)
South Durham Water	Reclamation	Facility				NC004759	7	20.0
Water Quality Param	eters					Site Phot	ograph	
Temperature (°C)		25.8					AND	
Dissolved Oxygen (mc	a/L)	5.0	~	Ge St	- Carlos		A set as	
Specific Conductance	(µS/cm)	340	1 1				A Star Della	
, pH (s.u.)	<b>u</b> ,	7.1	a fallente	Paris A				
					5			
Water Clarity		turbid	5	The ware	Nor Ag			A A A
			De la	S - 2 1				11 Carlos Carlos
Habitat Assessment	Scores (max	)			213.050	CAR BAR		
Channel Modification (	(5)	2	}	a strat			2010	
Instream Habitat (20)	( )	11			IF THE		C.C.	Harry Contraction
Bottom Substrate (15)		1			Par 13			
Pool Variety (10)		4	1		e rener			
Riffle Habitat (16)		3	C. Martin	and the second			A STREET	
Left Bank Stability (7)		5	Nº					
Right Bank Stability (7	.)	5					1 3 .	
Light Penetration (10)		10						
Left Riparian Score (5)	)	3	Same?					
Right Riparian Score (	5)	5						
Total Habitat Score (	100)	49	Substra	ate Cla	y and silt.			

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10505	38	6	6.76	5.92	Fair
07/07/03	9167	32	6	6.64	6.32	Fair
07/07/98	7640	38	10	6.78	5.76	Fair

## **Taxonomic Analysis**

Six EPT taxa were collected in both 2003 and 2008; however, there was a shift in the community composition. Mayfly taxa increased from two taxa in 2003 to four taxa in 2008 and caddisfly taxa decreased from four taxa in 2003 to two taxa in 2008. Two mayfly taxa not previously collected at this site, *Paracloeodes minutus* and *Tricorythodes*, were collected in 2008.

## Data Analysis

New Hope Creek is located in the Triassic Basin. Streams in this ecoregion have silty clay soils and tend to dry up in the summer months. The site at SR 1107 is located below the City of Durham's South Water Reclamation Facility. The reach was a long, slow-flowing run. No riffles or pools were present. Banks were steep and eroding and instream habitat was limited to woody debris. This site has consistently rated Fair. Based on the Biotic Index values, water quality has not changed at this site.

Waterbody		Locatio	Location		Station ID			Bioclassification
MORGAN	N CR	NC 5	54	BB1	46	03	3/11/09	Good
County	Subbasin	8 digit HUC	Latitude	Longitude	AU I	AU Number		evel IV Ecoregion
ORANGE	6	03030002	35.923611	-79.115556	6 16-4	11-2-(1)	C	Carolina Slate Belt
Stream Classifica	ation [	Drainage Area (mi2 9.0	Elevation (ft)		Strea	Stream Width (m)		Stream Depth (m)
Forested/ Visible Landuse (%)		rested/Wetland 100	Urban 0		Agricul 0	Agriculture		Other (describe)
Upstream NPI	ers (>1MGD or <1M	GD and withir	n 1 mile)	NF	DES Nur	nber	Volume (MGD)	
None								
Water Quality Param	eters	137		1.000		Site Pho	otograph	
Dissolved Oxygen (mo	g/L)	11.8	14-27	A PARTIN	A.C.	in the	RACES,	A DAY
Specific Conductance	(µS/cm)	108		1 AND		X	W. C. ANK	
pH (s.u.)	. ,	6.6			AND	A LAR LAND	1 242 44	1071 10.9.1.1.39
Water Clarity		Clear.						
Habitat Assessment	Scores (max)			Sector Sector	BORN IS NOT	an and the		1. 1. 10 - 1 ( A S. 1)
Channel Modification	(5)	5				400-	1	
Instream Habitat (20)		14	- 10-	-		2		
Bottom Substrate (15)	)	8	Deal		Lenil P	A AN	and the second	Alexandre (
Pool Variety (10)		6	A Parties		a second second			and the second second
Riffle Habitat (16)		14	a at	- mar		Charles and		an a share
Left Bank Stability (7)		2		-		A New Y	the master of	and the second
Right Bank Stability (7	")	2		No and	A The real of	-	and the	
Light Penetration (10)		10			4			and the second second
Left Riparian Score (5		5	1 more	- 1-19		Selfer 1	Section 199	
Right Riparian Score (	(5)	5						
Total Habitat Score (	100)	71	Substra	ate Mix	of cobble.	gravel, sa	and and bedroc	k.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/11/09	10641		26		4.36	Good
03/12/08	10387		12		3.55	Fair
06/02/04	9390		18		4.43	Good-Fair
10/01/03	9284		22		4.22	Good
07/07/03	9169		20		4.61	Good-Fair

#### **Taxonomic Analysis**

Increases occurred in the number of Mayfly and Caddisfly taxa collected from 2008 to 2009. Mayfly richness increased from 3 taxa in 2008 to 12 taxa in 2009 and Caddisfly richness increased from 3 taxa in 2008 to 8 taxa in 2009. Abundant taxa included *Heterocloeon amplum*, *Plauditus dubius*, *Stenacron interpunctatum*, *Amphinemura*, *Acroneuria abnormis*, *Isoperla namata*, *Cheumatopsyche* and *Ironoquia punctatissima*.

### **Data Analysis**

The March 2008 sample was taken during the 2008 drought. It should not have been rated but was assigned a Fair bioclassification. A year later in 2009, the bioclassification increased from Fair to Good. The biological community was very similar to the 2003 collection and appears to have recovered from the drought. When corrected for season, the EPT richness (23) and the biotic index (4.36) recorded from the 2009 collection were similar to those recorded in November 2003 (EPT = 22, EPT BI = 4.22).

Waterbo	dy	Locati	Location Station ID				Date	Bioclassification
DEEP	R	SR 26	615	BB4	452	07	7/22/08	GOOD
County	Subbasin	8 digit HUC	Latitude	Longitud	le AU	Number	L	evel IV Ecoregion
Randolph	9	03030003	35.727778	-79.65277	′8 17-	·(10.5)d2		Carolina Slate Belt
Stream Classifica	ation	Drainage Area (mi <sup>2</sup>	) Elev	ation (ft)	Stre	eam Width	(m)	Stream Depth (m)
С		351.0		425		43		0.3
	Fo	rested/Wetland	Urban		Agricu	lture		Other (describe)
Visible Landuse	(%)	50	30		0		2	0 (sewer easement)
								· · · · · · · · · · · · · · · · · · ·
Upstream NPI	DES Discharge	ers (>1MGD or <1M	IGD and withir	n 1 mile)		NPDES	Number	Volume (MGD)
	Randleman La	ke WTP; Randlema	n WWTP		N	C0087866;	NC0025445	1.5; 1.75
Water Quality Param	eters					Site Pho	otograph	
Temperature (°C)		30.9			Setting.	ALS T		
Dissolved Oxygen (mg	g/L)	6.2		and the		1	Sector 2	
Specific Conductance	(µS/cm)	265		C. S. S. S.	S. Lee	and the	A Prove Prov	
pH (s.u.)		7.0		1			The second	A STATE OF A SALE
				And S	the Part of the	a se a	- page 1	Contraction of the contraction
Water Clarity		clear				-	A ST	A STATE STA
				and the second second				
Habitat Assessment	Scores (max)		3 di Te					
Channel Modification	(5)	5		dinite 1	the state	and and	11-2-2	
Instream Habitat (20)		16	STATE!		A AMP	TP-" A		
Bottom Substrate (15)	)	12			ALC: A			Contraction of the
Pool Variety (10)		7	1. SUD 5	ALT AND	-	1	10-	CONTRACT OF STREET
Riffle Habitat (16)		7	C. S.		Central State	-a-	and the s	
Left Bank Stability (7)		6	all and the second second	No.	1 million		and show	
Right Bank Stability (7	")	6			E	-	13.4	
Light Penetration (10)		3		3-0		2 Stanford	- 6¢	
Left Riparian Score (5	)	5	the second			1	and the second	
Right Riparian Score (	(5)	4						
Total Habitat Score (	100)	71	Substra	ate	M	ostly bould	er and cobble \	with some gravel; silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10501	72	26	5.72	4.52	Good
07/22/03	9180	57	19	5.72	5.24	Good
07/06/98	7636	71	20	5.92	4.77	Good-Fair
07/26/93	6306	67	17	6.22	5.13	Good-Fair
07/26/89	4996	73	18	6.11	5.44	Good-Fair

# **Taxonomic Analysis**

EPT taxa richness increased significantly in 2008 in this segment of the Deep River from relatively stable values. An increase in heptageniid mayflies as well as leptocerid and net spinning caddisflies explains the difference between 2003 and 2008 EPT S. A few taxa not previously collected at this site included the mayflies *Serratella deficiens* and *Maccaffertium lenati*, the stoneflies *Acroneuria arenosa* and *Neoperla*, and the caddisflies *Lepidostoma* and *Oecetis sp. A*. Despite the increase in intolerant EPT taxa, the biotic index did not change from 2003 levels due to an increase in tolerant gastropod and oligochaete richness and abundance.

#### **Data Analysis**

This site passes through rural and agricultural land after exiting Randleman Lake which integrates water from both High Point and Greensboro. Also, two major NPDES permitted dischargers in the vicinity of Randleman and water from eastern Asheboro contribute to the high specific conductance measured at this Deep River site. Nutrient enrichment also appears to be a problem as high biomass of algae and aquatic macrophytes were noted in the river channel. Water quality of the Deep River at SR 2615 has remained Good over the last 5 years and may, in fact, be improving slightly based on the increased EPT richness and abundance seen in 2008.

		Location		Station ID			Date	Bioclassification
DEEP R		SR 1456		BB2	98	07	7/22/08	Good
County Subb	asin 8 di	git HUC 030003	Latitude 35.500278	Longitude -79.581111	e AU Number 1 17-(10.5)e2		Le	vel IV Ecoregion arolina Slate Belt
Stream Classification	Drainage	Drainage Area (mi2) Elevation (ft) Stream Width (m)		(m)	Stream Depth (m)			
Visible Landuse (%)	Forested/V 90	Vetland	Urban 10	400	Agricultu 0	ure	c	0.4 other (describe)
Upstream NPDES Dis	chargers (>1N	GD or <1M	GD and within	1 mile)	NPI	DES Nun	nber	Volume (MGD)
None	<b>U</b> (			,				<b>`</b>
Water Quality Parameters Temperature (°C) Dissolved Oxygen (mg/L) Specific Conductance (µS/cm) pH (s.u.) Water Clarity	clea	31.1 7.5 219 8.3				Site Pho	tograph	
Habitat Assessment Scores Channel Modification (5) Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5) Total Habitat Score (100)	(max)	5 18 8 6 10 3 7 2 2 2 5 66	Substra	ate Goo	d mix of bo			i sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10508	67	25	5.39	4.12	Good
07/22/03	9181	66	26	5.03	4.40	Excellent
07/06/98	7639	82	33	5.27	4.54	Good
07/26/93	6304	80	32	5.04	4.23	Excellent

### **Taxonomic Analysis**

The decrease in EPT from 1993 to 2008 can be attributed to the loss of mayflies from the benthic community. *Pseudocloeon propinquum*, *Serratella deficiens* and *Caenis* had been either Common or Rare in the past. Since 2002, they have been either Rare or absent from the community. Additionally, two species of hydropsychid caddisflies, *Hydropsyche demora* and *H. rossi*, abundant in previous samples were not present in 2008.

# Data Analysis

This site is located in north central Moore County. Since 1993 this site has alternated between Excellent and Good. The bioclassification decreased from Excellent in 2003 to Good in 2008; however, this does not necessarily reflect a change in water quality. Since 1993, EPT taxa richness has decreased slightly and the Biotic Index has increased suggesting that the water quality may be declining.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10500		14		5.92	Good-Fair
05/20/03	9137	48	8	6.94	6.52	Fair
07/09/98	7662		13		6.01	Fair

#### **Taxonomic Analysis**

The EPT richness rebounded in 2008 to 14 taxa from from the low of 8 recorded in 1998. Comprising the difference, baetid mayflies and leptocerid caddisflies reappeared, although no stoneflies were collected. The mayfly *Baetis pluto* and the caddisfly *Oecetis persimilis* were collected for the first time at this site in 2008. Taxonomically, the EPT community was very similar to that collected in 1998 as were the EPT metrics of richness and abundance (76 in 2008; 77 in 1998).

### Data Analysis

As a source for High Point Lake, West Fork Deep River drains the highly urbanized western portion of Greensboro. The catchment has a high percentage of impervious surface resulting from increased residential and industrial development. This has also served to reduce riparian vegetation to narrow strips and further degrade the habitat (= 52) with sedimentation and erosion. A TMDL study performed in 2003 (full scale sampling) resulted in a Fair rating. The 2003 sampling was performed during high flows and turbid conditions which may have scoured much of the benthos away thereby reducing EPT richness and abundance. This site received a low Good-Fair rating in 2008 indicating increasingly better water quality.

Waterbo	dy	Locat	ion	Static	Station ID Date		Date	Bioclassification	
W FK DE	EP R	SR 1850 (S	SR 1818)	BB3	333	07/22/08			GOOD-FAIR
								•	
County	Subbasin	8 digit HUC	Latitude	Longitud	e AU	Number		Leve	el IV Ecoregion
Guilford	8	03030003	36.056389	-80.02166	7 17	7-3-(0.3)		Southe	rn Outer Piedmont
Stream Classifica	ation	Drainage Area (mi	) Elev	ation (ft)	Str	eam Width	(m)		Stream Depth (m)
WS-IV: *		16.4		800		5			0.1
	F	orested/Wetland	Urban		Agricu	ulturo		0+1	har (dascriba)
Visible Landuse	(%)	80	0					20	(fallow fields)
VISIBle Landuse	(70)	00	5		0			20	
Upstream NPI	DES Dischar	gers (>1MGD or <1M	IGD and within	n 1 mile)	N	IPDES Nur	nber		Volume (MGD)
		none							
Water Quality Param	eters					Site Pho	tograph		
Temperature (°C)		22.7	P. Cal	here		All and a		[	
Dissolved Oxygen (mg	g/L)	6.0	the second	e (11/2-	143	a North	10 S.	198 - A	
Specific Conductance	(µS/cm)	103	S. 73			-		h zan	Carlo Maria
pH (s.u.)		6.7				1		And the	
					A.				Allen Allen
Water Clarity		clear		1					
			15	1	a de contra	3			
Habitat Assessment	Scores (max	x)		9	201	X		1	
Channel Modification	(5)	4		Ala -		A Sol	A 100		
Instream Habitat (20)		10		Same and		-	a West		
Bottom Substrate (15)	1	3		and the second second		and the second	- and - and	91	CALL COL
Pool Variety (10)		4	and the second	And the second	A SA	a a	- the second	-	
Riffle Habitat (16)		3	5-22		-		The		
Left Bank Stability (7)		4							a
Right Bank Stability (7	')	5	2		in		and the second		
Light Penetration (10)		10		The second	*	and to			and the
Left Riparian Score (5	)	3							
Right Riparian Score (	(5)	4							
Total Habitat Score (	100)	50	Substra	ate		Sand wit	h some co	bble (rij	p-rap) and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10499		20		5.16	Good-Fair
07/07/03	9170		14		5.14	Good-Fair
07/09/98	7661		12		4.36	Fair
07/15/93	6280		15		4.67	Good-Fair

## **Taxonomic Analysis**

EPT richness in 2008 was much higher than in previous collections with gains in each taxonomic order. New taxa, however, were not more intolerant as a group than in previous years. New taxa collected at West Fork Deep River were dominated by longhorned caddisflies and included *Nectopsyche exquisita*, *Oecetis nocturna*, and *O. persimilis*. Four stonelfy taxa were recorded in 2008 all of which are present in previous collections. Mayflies were dominated by heptageniid taxa with *Stenacron interpuntatum* collected here for the first time.

#### **Data Analysis**

The basinwide site at SR 1850 was moved 3/4 mile downstream to SR 1818 in 2008 due to presence of a beaverdam at SR 1850. This source stream for Oak Hollow Lake reservoir drains west central Guilford County and a moderately urbanized landscape. Despite the growth in residential development, the catchment area remains relatively forested thereby mitigating nonpoint source runoff. Water quality has remained relatively constant at Good-Fair with the exception of a Fair rating in 1998. However, a high stonefly richness in 1998 may suggest a higher bioclass than the Fair it received. A low habitat score of 50 in 2008 was due primarily to a homogeneous sandy substrate while the elevated specific conductance is typical of urban streams.

Waterbody	ody Location Station ID Da		Date	Bioclassification				
HICKORY CR		SR 11	31	BB	247	03/09/09		Not Rated
County Sub	basin 8	8 digit HUC 03030003	Latitude 35.964167	Longituc -79.86583	<b>le AU</b> 33 17	Number 7-8.5-(3)	Losout	evel IV Ecoregion hern Outer Piedmont
Stream Classification WS-IV; CA	Draiı	nage Area (mi2 9.2	) Elev	ration (ft) 700	Stre	eam Width 7	(m)	Stream Depth (m) 0.3
Visible Landuse (%)	Forest	ed/Wetland	Urban 10	1 milo)	Agricu 0		abor	Other (describe) 10
None	schargers (		GD and within	i i mile)		PDES NUI	nber	volume (MGD)
Water Quality Parameters Temperature (°C) Dissolved Oxygen (mg/L) Specific Conductance (µS/cm pH (s.u.) Water Clarity	)	11.3 10.3 188 6.9 Clear.				Site Pho	tograph	
Habitat Assessment Scores Channel Modification (5) Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5) Total Habitat Score (100)	(max)	5 15 3 4 10 5 5 10 5 5 67	Substra	ate Mc	with sand	with a smal	l amount of gra	<image/>

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/09/09	10633		19		4.78	Good-Fair
04/16/03	9096	35	17	5.01	4.09	Good-Fair
07/09/98	7660		12		5.31	Not Rated
02/17/93	6096		18		3.33	Fair

### **Taxonomic Analysis**

With the exception of presence/absence of rare species, the benthic community changed very little from 2003 to 2009. Species that were not collected previously from this site include the mayfly *Leptophlebia*, the stonefly *Prostoia* and the caddisfly *Ptilostomis*. Abundant taxa were *Ameletus lineatus*, *Eurylophella doris*, *Prostoia*, *Clioperla clio*, *Isoperla namata*, *I. transmarina*, *Cheumatopsyche* and *Hydropsyche betteni*.

## Data Analysis

Hickory Creek's watershed includes south-central Guilford County, south of Greensboro, south of I-85 and east of US 220. The lower portion of the watershed is rural. A TMDL stressor study, conducted in April 2003, identified sedimentation, habitat degradation, and urban runoff as the main impacts to this watershed. The Good-Fair bioclassifications in 2009 and 2003, up from the Fair bioclassification in 1993 suggest water qulaity may be improving. The site was Not Rated in July 1998 due to low flows.

Waterbody		Location		Station ID			Date	Bioclassification
SANDY CR		SR 24	181	BB	398	03/10/09		Good
County Subb	asin 8 di	git HUC	Latitude	Longitu	de AU	Number	L	evel IV Ecoregion
RANDOLPH	03	030003	35.785000	-79.6658	33 17	-16-(1)a	(	arolina Slate Belt
Stream Classification	Drainag	e Area (mi2	) Elev	vation (ft)	Stre	eam Width	(m)	Stream Depth (m)
WS-III	4	45.3		500		18		0.3
	Forested/	Wetland	Urban		Agricu	lture		Other (describe)
Visible Landuse (%)	100	)	0		0			
Upstream NPDES Dis	chargers (>1M	/IGD or <1M	IGD and withir	n 1 mile)	N	PDES Nur	nber	Volume (MGD)
None								
Water Quality Parameters Temperature (°C) Dissolved Oxygen (mg/L) Specific Conductance (µS/cm) pH (s.u.)		13.2 9.5 106 6.4				Site Pho	tograph	
Water Clarity	Clea	ar.			ALCONTRACTOR			
Habitat Assessment Scores Channel Modification (5) Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5) Total Habitat Score (100)	(max)	5 20 15 10 14 7 7 7 5 5 95	Substra	ate M	bostly boulder	and cobble v	vith small amount	s of gravel, sand, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/09	10637		35		4.04	Good
07/08/03	9172		20		4.92	Good-Fair
04/16/03	9083	71	27	4.98	3.81	Good
09/30/02	9025		21		4.73	Good
04/19/01	8417	124	43	5.33	4.26	Excellent

## **Taxonomic Analysis**

The absence of edge species, *Triaenodes* and *Pycnopsyche*, in the 2002, April 2003 and July 2003 collections suggest the stream had lower than normal flows. *Triaenodes* and *Pycnopsyche* were present in the in 2001 and 2009 collections. After the 2002 drought, EPT richness had increased from 21 in 2002 to 27 in April 2003 but dropped to 20 in July 2003 and increased to 35 in 2009. Since Slate Belt streams typically have much lower flows during the summer, this decline in EPT taxa in July 2003 is due to the hydrologic nature of the stream.

### **Data Analysis**

The Sandy Creek watershed drains northeastern Randolph County. After seasonal corrections were applied, Sandy Creek had a total of 27 EPT taxa (13 mayflies, 4 stoneflies, 10 caddisflies) and a biotic index of 4.04. Due to the increase in EPT taxa and the lower biotic index, Sandy Creek received a Good rating in 2009, up from the Good-Fair rating in 2003. Previously the site rated Good or Excellent.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/09	10639		25		3.75	Good
07/08/03	9173		27		4.49	Good
07/06/98	7637		29		3.92	Excellent
07/26/93	6305		26		3.91	Good
02/18/93	6093		23		3.60	Good

#### **Taxonomic Analysis**

Although Richland Creek rated Good, several species of Hydropsychid mayflies (i.e. *Hydropsyche Betteni*, *H. venularis*) and edge taxa (*Oecetis* spp., *Triaenodes* spp.) that had been collected in previous years were absent from the 2009 sample and is likely the result of lingering drought effects. Abundant taxa included Heterocloeon amplum, *Eurylophella doris*, *E. enoensis*, *Maccaffertium modestum*, *Neoperla*, *Cheumatopsyche* and *Chimarra*.

#### **Data Analysis**

Richland Creek is located in southeast Randolph County. This location drains a forested watershed just upstream of the confluence with the Deep River. Water quality has remained relatively constant at Good with the exception of a borderline Excellent rating in 1998.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/09	10638		22		4.81	Good-Fair
07/08/03	9174		19		5.30	Good-Fair
07/06/98	7638		26		4.27	Good
02/18/93	6092		23		3.58	Good
05/18/90	5288		28		4.29	Excellent

#### **Taxonomic Analysis**

Oecetis persimilis, Triaenodes ignitus, T. perna/helo and Pycnopsyche are edge species that were collected in 1998. Droughts ocurred in 2003 and 2008 suggesting that low flows reduced the amount of edge habitat prior to sampling in 2003 and 2009. This is supported by the absence of these species in the 2003 and 2009 collections. Taxa present in 2009 that had not been previously collected include the mayflies, *Eurylophella doris* and *E. enoensis*, the stoneflies *Prostoia* and *Isoperla transmarina* and the caddisfly *Ironoquia punctissima*.

### **Data Analysis**

Brush Creek is a tributary of the Deep River in Randolph County. A total of 22 EPT taxa were collected. Five winter stoneflies were eliminated from the analysis because of seasonality, reducing the total richness to 17. This location rated Good-Fair in 2003 and 2009, down from the Good ratings received in 1993 and 1998.
Waterbody		Locati	Statio		Date		Bioclassification			
BEAR (	CR	NC 7	NC 705		BB152		07/24/08		Not Rated	
County MOORE	Subbasin 10	8 digit HUC 03030003	Latitude 35.440833	Longitud -79.58916	e AUI 7 17-	Number Le 7-26-(6) Ca		Lev Car	evel IV Ecoregion Carolina Slate Belt	
Stream Classifica	ition D	erainage Area (mi2 139.0	) Elev	ration (ft) 400	Strea	am Width 8	(m)		Stream Depth (m) 0.2	
Visible Landuse	For (%)	ested/Wetland 80	Urban 0		Agricul 10			Ot	her (describe) 10	
Upstream NPL	DES Discharge	rs (>1MGD or <1M	GD and within	n 1 mile)		DES Nun	nber		Volume (MGD)	
Water Quality Parama Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.) Water Clarity	eters g/L) (μS/cm)	24.3 3.4 77 6.2 clear		*		Site Pho	tograph			
Habitat Assessment 3 Channel Modification ( Instream Habitat (20) Bottom Substrate (15) Pool Variety (10) Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5)	Scores (max) (5) ) ) 5) <b>100)</b>	5 20 12 4 10 6 5 10 5 4 81	Substra	ate Rut	bble, silt, b	oulder and	d gravel			

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/24/08	10512	75	11	6.90	5.95	Not Rated
07/09/03	9175	84	27	5.66	4.48	Good
07/21/98	7683	82	25	5.71	4.49	Good
08/09/93	6331	73	22	6.26	4.99	Good-Fair

### **Taxonomic Analysis**

No major changes in the benthic community were observed, other than the loss of flow dependent taxa.

## Data Analysis

Bear Creek is a large tributary of the Deep River in Moore County. This site is on the outskirts of Robbins with forest, commercial and residential development in the immediate watershed. The site was not rated in 2008 due to low streamflow as the result of drought. After the sample was collected, the lack of flow dependent taxa strongly suggested that flow had ceased or slowed to the point that the benthos was responding mainly to the drought. Another sample will be taken in 2009.

Waterbo	Waterbody		Location		Station ID		Date		Bioclassification	
MILL	CR	SR 12	275	BB	167	03	3/23/09		Excellent	
County	Subbasin	8 digit HUC	Latitude	Longitue	de	AU Number		Level IV Ecoregion		
MOORE	10	03030003	35.401667	-79.6611	111 17-26-5-4			Car	rolina Slate Belt	
Stream Classifica	ation	Drainage Area (mi2	?) Elev	ation (ft)	_	Stream Width	(m)		Stream Depth (m)	
WS-III		16.0				12			0.5	
	F	waata d/Mation d	l lub an		٨			04	har (dagariha)	
		100	Orban		Ag	o		Ut	ner (describe)	
VISIDIE Landuse	(%)	100	0			0				
Upstream NP	DES Dischard	ers (>1MGD or <1N	IGD and withir	n 1 mile)		NPDES Nun	nber		Volume (MGD)	
		none		· · · · · · · · · · · · · · · · · · ·		n/a			n/a	
Water Quality Param	neters					Site Pho	tograph			
Temperature (°C)		9.5	E 2014							
Dissolved Oxygen (m	g/L)	12.3	1.00	No. S.	10	- And		Sto.	the first the	
Specific Conductance	e (µS/cm)	48					and the second	135	E dates both	
pH (s.u.)		5.9			-			The second		
				2. A.			1.3	a 7		
Water Clarity		Clear						-		
			X 7		No.	2 mars			Real A	
Habitat Assessment	Scores (max)			1.8		Streets To Ball	Service 11	The second		
<b>Channel Modification</b>	(5)	5			and a	and the factor		See.	a property to the	
Instream Habitat (20)		20	Sec.	Sea. Sec.						
Bottom Substrate (15	)	8			1.1		and the second	Terry		
Pool Variety (10)		6	A CONTRACTOR	Carlo III		the state	- Constant		and the second second	
Riffle Habitat (16)		14	The second	the play	F	and a set of the	Cart			
Left Bank Stability (7)		5		16 1		the second designed	WERE AND	a the constant		
Right Bank Stability (7	7)	7				A CONTRACT		arta i	The state	
Light Penetration (10)	)	10	- Televe	A Start	- Mark	and the	2	3 32	the second second	
Left Riparian Score (5	5)	5	1	an in		State -			and the second second	
Right Riparian Score	(5)	5	The second		the star					
Total Habitat Score	(100)	85	Substra	ate mi	x of be	edrock, boulder,	, rubble, grav	vel, sa	and and silt	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/23/09	10616	32	32	3.77	3.77	Excellent
02/05/08	10378	14	14	3.49	3.49	Not Rated
07/09/03	9177	26	26	3.76	3.76	Good
07/21/98	7684	20	20	4.17	4.17	Good-Fair
03/05/98	7509	76	31	4.79	4.09	Good

### **Taxonomic Analysis**

In the six collections at this site since 1993, there have been a number of uncommonly collected taxa. In 2009 these inclued the mayflies *Ephemerella needhami* and *Rhithrogena uharia* and the caddisfly *Ceraclea neffi*. Also, there were several taxa that, though not uncommon in the North Carolian Piedmont, were less common in Slate Belt samples in 2009. Many more pollution-intolerant macroinvertebrates were collected here in 2009 than in nearby sites.

### **Data Analysis**

Mill Creek rated Excellent in 2009, the same rating it recieved in winter of 1993. A sample collected in 2008 (during the drought) reflects the susceptability of the aquatic community here to hydrologic reductions. This is a possible reference site for Slate Belt streams as it rates Good or Excellent in recent years (with good flow) yet reduced flows have a suppressing effect on EPT taxa as evident by the winter 2008 sample. This site had a very low EPT Biotic index in 2009 similiar to prior years, reflecting the pollution-intolerant aquatic community that resides here.

Waterboo	Waterbody		Locat	Location S		Sta	ation ID		Date		Bioclassification	
BUFFALC	) CR		NC 2	22		BE	315	9	03	8/23/09	)	Good-Fair
County	Subba	sin	8 digit HUC	Latitu	ude	Longit	ude	AU N	lumber		Lev	el IV Ecoregion
MOORE	10		03030003	35.470	0833	-79.516	944	1	7-28		Ca	rolina Slate Belt
Stream Classifica	ation	Drai	nage Area (mi2	2)	Eleva	ation (ft)		Strea	am Width	(m)		Stream Depth (m)
С			22.0			270			12			0.5
	_	Forest	ted/Wetland		Urban			Agricult	ture		Ot	her (describe)
Visible Landuse	(%)		80		20							
Upstream NPE	DES Disch	argers	(>1MGD or <1N	IGD and	within	1 mile)		NP	DES Nur	nber		Volume (MGD)
			none						n/a			n/a
Water Quality Parame	eters		10.5			10 TO - 10		14 1 10	Site Pho	tograph		
Temperature (°C)	-// )		10.5							S. Mary .		
Dissolved Oxygen (mg	g/L) (~~Q(~~~)		11.8		-					66 <sup>4</sup>		
Specific Conductance	(µS/cm)		12			4 - <sup>10</sup> al	N.			and the second s		
рн (s.u.)			6.2					1	1	1	and the second	
Water Clarity		Sligh	ntly Turbid		No. 16	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1						
Habitat Assessment	Scores (n	nax)				there		-	- Contraction		Reiser	The Part of the
Channel Modification (	(5)		5						ANSI IN			
Instream Habitat (20)			18		-12			- Marine,		- 19- 18- E		
Bottom Substrate (15)			8			A CON	100		- intering	and the second		
Pool Variety (10)			5					1999 A.	at plus a		Marile.	
Riffle Habitat (16)			8								1.1	
Left Bank Stability (7)			5	1	7 84	and the second	2 T		1 Sec		-	
Right Bank Stability (7	<i>'</i> )		7	1	E al	a Bergin	-		and and			
Light Penetration (10)			10	12					10		-	
Left Riparian Score (5)	)		5					5.33	and the second		and the second s	
Right Riparian Score (	(5)		5		ny a substantia			16 B				
Total Habitat Score (	100)		76	S	Substra	ite r	nix of	boulder	, rubble, g	ravel, sa	nd and s	ilt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/23/09	10617	25	25	4.17	4.17	Good-Fair
07/09/03	9176	20	20	4.89	4.89	Good-Fair
02/16/98	7501	27	27	3.93	3.93	Not Rated
02/23/93	6101	20	20	3.51	3.51	Not Rated

# **Taxonomic Analysis**

The EPT taxa collected in this reach of Buffalo Creek are similar to other Slate Belt sites in this part of the Cape Fear Basin. *Eurylophella* sp, *Amphinemura* sp, Perlesta sp and seasonal taxa such as *Leucrocuta* sp, and *Isoperla namata* were abundant here. Also, the mayfly Stenonema femoratum was abundant here. This species appears to be adapted to the low water bearing hydrology found in the Slate Belt ecoregion.

## Data Analysis

Buffalo Creek rated Good-Fair in 2009, the same rating as in 2003. Two previous samples were Not Rated. The increase in the number of EPT from 2003 to 2009 reflects both seasonality and the higher flows compared to 2003, a drought year.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/23/09	10618	19	19	4.07	4.07	Good-Fair
03/10/03	9056	17	17	4.52	4.52	Not Rated
02/25/93	6117	15	15	4.83	4.83	Not Rated

## **Taxonomic Analysis**

Slightly more EPT taxa were collected here than in two previous sampling efforts. Most taxa were typical of nearby Slate Belt streams with some exceptions. The mayfly *Paraleptophlebia* sp, not found at most streams in this area was abundant here in 2009. Uncommonly collected caddisflies found here included *Leptidostoma, Wormaldia, Rhyacophila glaberrima/montana,* and *Neophylax oligius*. The fact that the net spinning caddisfly *Cheumatopsyche* sp was rare suggests that this stream likely ceased flowing in 2008.

#### Data Analysis

Georges Creek rated Good-Fair in 2009 after being Not Rated in 1993 and 2003. This site had a low EPT Biotic Index compared with other streams in this area suggesting an intolerant macroinvertebrate community here. A high habitat score balances out the fact that this site has a hydrology that includes flow stoppages in drier years.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/23/08	10511	70	13	6.75	5.73	Not Rated
07/22/03	9204	72	15	6.01	4.99	Good-Fair
09/30/02	9024		8		4.87	Not Rated
07/09/98	7649	66	18	6.28	5.07	Good-Fair
06/27/97	7312	80	19	6.44	5.50	Good-Fair

#### **Taxonomic Analysis**

No major changes in the benthic community were observed.

### **Data Analysis**

This site is located three miles below its confluence with Loves Creek. Data from this site and the US 64 site (upstream of Loves Creek) are used to assess impacts from Siler City's WWTP. Droughts occurred in 2002 and in 2008. Both samples were clearly impacted by the drought because of the lower EPT richness and increased Biotic Index. As a result, the two samples were Not Rated. During non-drought years this site has consistently rated Good-Fair. This site will be resampled in 2009.

Waterbo	ody	Locati	on	Static	n ID		Date		Bioclassification
ROCK	YR	US 15-	·501	BB4	122	07	7/22/08		Good-Fair
County	Subbasin	8 digit HUC	Latitude	Longitud	e AU	Number		Lev	el IV Ecoregion
CHATHAM	12	03030003	35.622222	-79.188056 17-43-(8)b			Ca	rolina Slate Belt	
Stream Classific	ation	Drainage Area (mi2	) Elev	vation (ft)	Stre	am Width	(m)		Stream Depth (m)
WS-III; CA	1	237.0		300		35			0.2
	Fc	prested/Wetland	Urban		Aaricul	ture		Ot	her (describe)
Visible I anduse	· (%)	100	0		0			01	
	. ( /0)		-		-				
Upstream NP	DES Discharg	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	PDES Nur	nber		Volume (MGD)
None									
Water Quality Param	neters					Site Pho	tograph		
Temperature (°C)		30.2	As The	- dis-			Test		MALL MAL
Dissolved Oxygen (m	g/L)	7.6					Sec. 1		a horal and some
Specific Conductance	e (µS/cm)	289		S. Mine.	A STATE	L	-A-A-		States of the
pH (s.u.)		8.0		200	<b>新一次</b> 代	in the second	2 VA		
				an a		No. P	1202		
Water Clarity		clear	Alter					1 miles	A STATISTICS
			-			and the	N ME TH		the state of the second st
Habitat Assessment	Scores (max)			The set					A AND COM
Channel Modification	(5)	5							Ser And
Instream Habitat (20)		18		in the	and the second		C. Salar	Same 11	Contraction of the second
Bottom Substrate (15	)	13		The and		A Star			A CIN SYD
Pool Variety (10)		6			A				a all
Riffle Habitat (16)		10			TEST				Con Par
Left Bank Stability (7)		7			1892		W. Balanci		Mar All
Right Bank Stability (7	7)	7				Total and	4		
Light Penetration (10)	)	4		EL EL OF	75-3-			See.	
Left Riparian Score (5	5)	5	1301		A BAN			del.	
Right Riparian Score	(5)	5		1					
Total Habitat Score	(100)	80	Substra	ate Mix	of boulde	r, rubble, g	ravel and	sand.	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/22/08	10506	83	21	6.42	5.18	Good-Fair
07/21/03	9203	78	28	5.63	4.75	Good
07/09/98	7647	77	26	5.26	3.99	Good
07/27/93	6309	84	29	5.44	4.21	Good
07/03/90	5321	96	29	5.54	4.50	Good

#### **Taxonomic Analysis**

Although EPT taxa richness decreased from 28 taxa in 2003 to 21 taxa in 2008, there were no major shifts in the benthic community composition. The changes were mainly due to loss of rare taxa. Taxa that were Rare in 2003 but not collected in 2008 include *Plauditus punctiventris*, *Leucrocuta*, *Maccaffertium exiguum*, *Neoperla*, *Hydropsyche demora*, *H. rossi* and *Macrostemum*.

### **Data Analysis**

This is the most downstream basin site on the Rocky River prior to its confluence with the Deep River in Chatham County. Water quality has remained stable at Good until 2008 when the site received a Good-Fair rating. A higher specific conductance and a lower EPT taxa richness were observed in 2008. EPT taxa richness as well as the specific conductance data had been relatively uniform until 2008: 1998 (26 EPT; 126 µS/cm), 2003 (28 EPT; 130 µS/cm), 2008 (21 EPT; 289 µS/cm). The lower EPT taxa richness value observed in 2008 could be attributed to decreased instream flows from the drought or to new development in the watershed. However, *Maccaffertium modestum*, a flow indicator taxa, was present and abundant and no new development was noted in the immediate watershed. Therefore, no definitive conclusions to the decrease in water quality could



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/24/09	10626	15	15	5.31	5.31	Good-Fair
07/22/03	9205	61	20	6.46	5.93	Good-Fair
07/09/98	7648	15	15	5.93	5.93	Good-Fair

#### **Taxonomic Analysis**

The caddisfly *Cheumatopsyche* sp. and the stonefly *Perlesta* sp. were the only abundant taxa of the 15 collected in 2009. Differences between 2009 and previous samples can be explained in the timing of the samples (2009 in spring and previous samples in summer). Tick Creek did not contain the mayfly *Heterocloeon amplum* nor *Stenacron interpunctatum*, two taxa that were frequently collected in other slate belt samples in 2009. This contributed to a lower EPT richness than most slate belt streams in this part of the Cape Fear River basin.

#### **Data Analysis**

Tick Creek rated Good-Fair in 2009, the same rating it received in 2003 and 1998. EPT diversity and EPT Biotic Index were similar to previous samples. Seasonal taxonomic differences were the only differences between the summer samplings in 2003 and 1998 and the spring sample in 2009. These small differences do not appear to be related to water quality and the benthic community at Tick Creek appears stable.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/19/09	10615	24	24	4.36	4.36	Good-Fair
07/21/03	9202	16	16	4.97	4.97	Good-Fair
07/10/98	7652	23	23	4.46	4.46	Good
02/03/98	7483	22	22	4.68	4.68	Good-Fair
07/03/90	5322	15	15	3.85	3.85	Good-Fair

#### **Taxonomic Analysis**

The number of EPT taxa collected here in 2009 was the highes to date, however spring time sampling was largely the reason for this. There were five seasonal taxa, the mayfly *Eurlophella enoensis* (common) and the stoneflies *Allocapnia* spp, *Amphinuemura sp, Isoperla bilineata* and *I. namata*. Only site where the caddisfly *Wormaldia* spp was abundant. Conversely, the tolerant mayfly *Caenis* sp was absent here but collected at nearly all other Slate Belt sites in 2009. *Cheumatopsyche* sp were abundant here indicating near year-round flow. in 2008

#### **Data Analysis**

Harlands Creek rated Good-Fair in 2009. Though more EPT taxa were collected here than in any of the previous samples, seasonal corrections resulting in the same rating as in 2003 and slightly lower than that of 1998. In 2009, there was a higher EPT abundance here than in most Slate Belt streams sampled and given the compostion of EPT taxa, it appears that this site remained flowing in 2008. Habitat scores from 2003 to 2009 were very similar further suggesting that this watershed remains stable.

Waterboo	dy	Locati	Location				Date		Bioclassification	
BEAR (	CR	SR 21	55	BB	372	0	3/23/09	)	Good-Fair	
County	Subbasin	8 digit HUC	Latitude	Longitu	de	AU Number	-	Lev	el IV Ecoregion	
CHATHAM	12	03030003	35.631944	-79.2366	67	17-43-16c		Carolina Slate Belt		
			·			o				
Stream Classifica	ition L	FO 2	) Elev	ation (ft)		Stream Width (m)		Stream Depth (m)		
	50.3		310		12			0.5		
	Foi	ested/Wetland	Urban		Ag	griculture		Ot	her (describe)	
Visible Landuse	(%)	85	10			5				
							÷			
Upstream NPE	DES Discharge	rs (>1MGD or <1M	IGD and withir	n 1 mile)		NPDES Nui	nber		Volume (MGD)	
		none				n/a			n/a	
Water Quality Parama Temperature (°C) Dissolved Oxygen (mg Specific Conductance pH (s.u.) Water Clarity Habitat Assessment S Channel Modification ( Instream Habitat (20) Bottom Substrate (15) Pool Variety (10)	eters μ/L) (μS/cm) Scores (max) (5)	13.3 12.8 95 6.3 Slightly Turbid				Site Pho	btograph			
Riffle Habitat (16) Left Bank Stability (7) Right Bank Stability (7) Light Penetration (10) Left Riparian Score (5) Right Riparian Score (7)	) ) 5) <b>100)</b>	12 6 6 10 4 5 86	Substra	ate m	hix of be	edrock, boulder	r, rubble, g	Jravel ar	ad sand	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/23/09	10625	20	20	4.62	4.62	Good-Fair
03/10/03	9063	16	16	5.05	5.05	Not Rated
07/03/90	5324	15	15	4.82	4.82	Not Rated

### **Taxonomic Analysis**

Abundant EPT collected here in 2009 included the hydrosychid caddisfly *Cheumatopsyche* spp, two seasonal stoneflies (*Isoperla bilineata, I. namata*), the stonefly *Amphinemura* and three mayflies (*Caenis* spp, *Maccaffertum modestum*, *Eurylophella enoensis*- a slate belt specialist). The taxa found here in 2009 was similar to nearby slate belt streams that rated Good-Fair with two exceptions. The baetid mayfly *Plauditus dubius* and the stonefly *Perlesta* spp. were widely collected in slate belt samples but absent here. In 2009, taxa differed slightly from a spring collection in 2003 with the stonefly Strophopteryx spp abundant in 2003 but absent in 2009 and the caddiflies *Ceraclea ancylus* and *C. transversa* common in 2009 but absent in 2003.

### **Data Analysis**

Bear Creek rated Good-Fair in 2009 where previously it was Not Rated due to low summer flows. This site did not have sufficient flow in 2008 to facilitate sampling. Slate Belt geology heavily influences hydrology here such that this stream is difficult to assign a bioclassification to, with its naturally reduced flows, particularly in years of drought (like 2008). The number of EPT taxa collected in 2009 was higher than 2003 (spring sample) and 1990 (summer sample). Reductions and increases in macroinvertebrate taxa are likely more influenced by hyrdology here than by any known anthropogenic factors. Additional samples should be collected at this location in wet (non-drought) years to aid in determining the potential future effects of water quality changes.

Waterbo	dy	Locatio	on	Statio	n ID		Date	Bioclassification
PARKER	S CR	SR 14	50	BB2	97	07	7/21/08	Good
						•		
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU	Number	Lev	vel IV Ecoregion
HARNETT	7	03030004	35.539167	-78.91972	2	18-9		ern Outer Piedmont
Stream Classifica	ation I	Drainage Area (mi2)	) Elev	vation (ft)	Stre	eam Width	(m)	Stream Depth (m)
C; HQW		3.9		300		3		0.2
	Fo	rested/Wetland	Urban	I	Agriculture			ther (describe)
Visible Landuse	(%)	40	0		60	60		· · ·
		•					•	
Upstream NPI	DES Discharge	ers (>1MGD or <1M	GD and withir	n 1 mile)	N	IPDES Nur	nber	Volume (MGD)
		None				n/a		n/a
						Cite Dhe	to month	
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C)		22.9		1		1 per la		
Dissolved Oxygen (mo	g/L)	6.9			Sale Cont		10 mars	
Specific Conductance	(µS/cm)	78			A	Louis and	The second second	Second States and the second second
pH (s.u.)		6.7		New States				to state the second
						A SALE	The state of the s	RINS REAL PROV
Water Clarity		slightly turbid			- Aller		and the second	
							Ser and	KANKUMAN/AL
Habitat Assessment	Scores (max)			A to a to	and the strates	a Ale	An Swhate	ANY NY EX
Channel Modification	(15)	15	and the	and the second	1 Stande	14 11		
Instream Habitat (20)		15				MANUL	Carl Internation	All Inde
Bottom Substrate (15)	1	15	- Aleret			Methodal		
Pool Variety (10)		4	A CE TO				1	
Left Bank Stability (10	)	8			where the	1	a sea partes	
Right Bank Stability (1	0)	8	S. 2.	and the second	and the second	and the second	And States	
Light Penetration (10)		10			and the second	Ser and the second	Carl Starter	
Left Riparian Score (5	)	4	All and a	the the	-or -	Mar and		ACT AND A COL
Right Riparian Score (	Right Riparian Score (5) 4							and the second second
Total Habitat Score (								
			Substra	ate Mix	ture of ru	bble, arave	I and sand with s	ome silt present.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/21/08	10502		18		4.59	Good
04/30/03	9105		26		4.54	Excellent
07/08/98	7644		19		5.44	Good
08/10/93	6339	83	25	5.45	4.51	Good

#### **Taxonomic Analysis**

A sharp decline in the number of mayfly and caddisfly taxa was observed in 2008. Baetid species which require flow were either absent or reduced in abundance from previous samples.

## Data Analysis

Parkers Creek, which is classified as High Quality Waters, is a tributary of the Cape Fear River near Lillington. Land use at SR 1450 is primarily pasture and the riparian zone has been reduced to less than 18 meters. The site has rated Good since 1993 and had an Excellent rating in 2003 but dropped to Good again in 2008. EPT taxa richness decreased from 26 taxa in 2003 to 18 taxa in 2008; however, EPT biotic index was close to the value recorded in 2003. The decline in EPT taxa richness may be due to drought effects.



Substrate

mix of bedrock, boulder, rubble, gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
04/24/07	10156	67	9	6.09	5.50	Good-Fair
03/12/03	9072	6	6	4.25	4.25	Poor
02/11/98	7494	19	19	5.10	5.10	Good-Fair
03/02/93	6122	18	18	4.64	4.64	Good-Fair

#### **Taxonomic Analysis**

In 2003, only six EPT taxa were collected; four were winter stoneflies, leaving a seasonally corrected EPT richness of two. No mayflies, of which many are flow dependent, were collected suggesting that the stream may have stopped flowing. In 2007, mayflies were again collected in the sample.

### **Data Analysis**

This site is located above the confluence with Kenneth Creek. This upstream segment includes parts of the towns of Fuquay-Varina and Angier in its watershed. This site rated Good-Fair in 1993 and 1998. The bioclassification dropped to Poor in 2003. Because the benthic community was so sparse in 2003, there was some question to whether the stream may have stopped flowing during the 2002 drought. In 2007, the bioclassification returned to Good-Fair.



Substrate

Mix of boulder, rubble, gravel, sand, silt and bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
04/24/07	10155	76	16	6.72	6.28	Fair
03/10/03	9071	4	4	5.60	5.60	Poor
02/11/98	7493	5	5	6.22	6.22	Poor
03/02/93	6121	43	7	6.22	5.28	Poor

### **Taxonomic Analysis**

A far greater number of EPT taxa were found in 2007 than in previous years. However, these taxa are tolerant of aquatic pollution. Abundant EPT taxa here in 2007 include the mayflies *Baeits flavistriga* and *B. intercalaris*, and the caddisflies *Cheumatopsyche* spp and *Hydropsyche betteni*. Comparing Kenneth Creek at SR 1441 to an upstream site along the same waterbody (and also upstream of the Fuquay-Varina WWTP outfall) notable taxa differences occurred in the benthic communities. The mayfly *Stenacron interpunctatum*, common upstream site, was not collected at SR 1441. Also, three stoneflies collected upstream were not found here: *Eccoptura xanthenes, Haploperla brevis* and *Perlesta* spp. The absence of *Perlesta* spp is significant since this stonefly is the most tolerant of the three and was collected (Abundant) at nearby sites in 2007. There were two very pollution tolerant midges collected at SR 1441 in 2007, *Chironomus* spp and *Cricotopus bicinctus*. Both were abundant in the sample.

#### **Data Analysis**

This site rated Fair in 2007, a slight improvement from the Poor bioclassification received in 1993, 1998 and 2003. Taxa collected at sites upstream of the Fuquay-Varina WWTP outfall were not found at this SR 1441, yet habitats were similiar, suggesting that the WWTP continues to degrade water quality in Kenneth Creek. The Fuquay-Varina WWTP is scheduled to tie into a large Harnett County facility which may lead to an improvement in water quality in the Kenneth Creek watershed.

Waterboo	dy	Locati	Station	n ID		Date	sification					
UPPER LIT	TLE R	SR 12	222	BB2	61	07	7/21/08	Goo	d-Fair			
County	Subbasin	8 digit HUC	Latitude	Longitude	AU	Number	Le	vel IV Ecoreg	ion			
HARNETT	13	03030004	35.406944	-79.063333	18	-20-(8)a	North	Northern Outer Piedmont				
Stream Classifica	tion [	Drainage Area (mi2	2) Elev	ation (ft)	Stre	eam Width	(m)	Stream Depth (m)				
C		54.0		300		12		0.3				
	_						_					
					Agricu	Iture	C	other (describ	e)			
Visible Landuse	(%)	60	10		0			30				
Linstroam NPF	ES Discharge	are (>1MGD or <1N	IGD and within	n 1 mile)	Ν		nbor	Volume (I				
	Discharge			i i iiiie)		n/a		n/a				
Water Quality Parame	Nater Quality Parameters Site Photograph											
Temperature (°C)		28.3			S. Frid	A COLOR			and they			
Dissolved Oxygen (mg	ı/L)	7.7		and to the second			Sa Print - Long	and and and				
Specific Conductance	(µS/cm)	78			and the second	and the second	100	1 . T. 104				
pH (s.u.)	u ,	6.7	Theorem	and the	14 P							
			1									
Water Clarity	:	slightly turbid						1 American	9 Lan			
				The second	1973 - 197							
Habitat Assessment	Scores (max)				7		and the second		- A - A - A - A - A - A - A - A - A - A			
Channel Modification (	15)	15	1240-	15	101 2	and the second			- has a			
Instream Habitat (20)		15	ales -		- Aller		CHELL NO	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1. ···			
Bottom Substrate (15)		15		Artes and		28/20						
Pool Variety (10)		4					A DECEMBER	and the second second				
Left Bank Stability (10)	)	9		and the second		-						
Right Bank Stability (1		No. of Street	and the									
Light Penetration (10)		- Att	- and	·	The second second		in the	and the second second				
Left Riparian Score (5)												
Right Riparian Score (	5)	Mary -	and a se	T	and the	and the second second	-	and the				
Total Habitat Score (*	100)	82										

Substrate

Mostly sand with a small amount of rubble, gravel, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/21/08	10504	57	16	6.54	5.54	Good-Fair
07/22/03	9206	61	17	6.28	5.60	Good-Fair
07/13/98	7672	72	21	6.40	5.36	Good-Fair
08/10/93	6338	56	13	6.17	4.88	Good-Fair

### **Taxonomic Analysis**

Although this site has rated Good-Fair since 1993, changes have occured in the EPT community composition. No stoneflies have been collected since 1993. Five stonefly taxa were collected in 1993 and only one taxon was collected in 1998. In addition, some caddisfly species that were either common or abundant in past collections have either disappeared or only one or two individuals were collected in 2008.

## Data Analysis

This Upper Little River site is located in the headwaters but only two miles downstream of Lake Trace, a 315 acre impoundment. The site has rated Good-Fair since 1993. However, the Biotic Index has been slowly increasing. Should this trend continue, the site will likely decline in rating.

Waterboo	dy			Location		Date	•	Station	ID	В	ioclassif	ication
BARBEQU	JE CF	1	e,	SR 1285		04/16/	/08	BF12	25		Not Ra	ated
						<u></u>						
County	Subb	asin	8 digit HUC	Latitude	Long	itude		AU Numbe	ər	L	evel IV E	coregion
HARNETT	10	3	03030004	35.3379652	-79.04	55437		18-20-13			Sand	Hills
Stroom Classifica	tion	Drain	aaa Araa (mi?	) Elovatio	n (ft)	Strop	m Wie	tth (m)	٨٧٥	rago Donth	(m)	Poforonoo Sito
		Drail			II (IL)							Voc
U			47.2	290			9			0.0		165
		For	ested/Wetland	Urb	ban		Ag	riculture		C	ther (de	scribe)
Visible Landuse	(%)		100	C	)			0			0	
	-											
Upstream NPDES Di	scharge	ers (>1	MGD or <1MG	D and within 1 n	nile)			NPDES	8 Numbe	r	Vo	lume (MGD)
			None									
Water Quality Param	eters							s	ite Phot	ograph		
Temperature (°C)			13.2					A Sty				
Dissolved Oxygen (mo	a/L)		9.4	2 M/2 - 124					Eng			
Specific Conductance	(μS/cm	)	32	State of the second sec				11. J. J.	X 2			IX I to all
pH (s.u.)		,	4.9		S.C.	The second	Carlo I			and '		
	-			the second			1	F.C. I.C.	XIX		and i	
Water Clarity		Clea	r, tannin stained	ALT I	Sua a		87.	1/2/2	A AN	Ver al		
						1. Pr. ?	1		- Ares	St. I		
Habitat Assessment	Scores	(max)						· ····································				Con a start
Channel Modification	(15)		15	- 1- 5- 6		and a	-				A ST I	A total
Instream Habitat (20)			19	. /				Are A	- Ka	the lat		Lak.
Bottom Substrate (15)	)		13	5.1.30						1	V	
Pool Variety (10)			8							191		N
Left Bank Stability (10	))		10							1		
Right Bank Stability (1	10)		10	1. Jak							ie in	
Light Penetration (10)			10	1 Sale								
Left Riparian Score (5	i)		5						The Lo			
Right Riparian Score (	(5)		5			- ·						
Total Habitat Score (	(100)		95	Subs	strate	Sand, gra	vel, a	nd cobble				
Sample Date	)		Sample	ID	Spe	cies Total			NCIBI		Bio	classification
04/16/08			2008-	17		10						Not Rated
						1		Г				
Most Abundant Spe	ecies		Dusky Shiner			Exotic	Spec	ies	None			
						J		L				
Species Change Sin	re l act	Cycle	N/A									
	oo Luot	5,010										
Data Analysis					h a al a d				Autor to		Dive	
within the watershed	Habitet	y samp	high quality in	nis site. Waters	<b>nea</b> dra an habitat	INS Westeri	n Harr	lett County;	iributary	ercute and	River; no	municipalities
Quality typical for a	Sand H	lills stre	eam clear sta	ined water of low	v pH and c	conductivity	/ 200	<b>8</b> a typic:	al Sand F	Hills fauna h	ut lacking	darters. America

Eel, and intolerant species; Chain Pickerel were present, but represented only by young-of-year and not included in the total species count.

Waterbo	dy		L	Location			e	Station ID		Bioclassification		
LITTLE	R		1	NC 22		04/09	/08	BF4		Not F	Rated	
County	Subb	basin	8 digit HUC		Long	itude		AU Number		Level IV	Ecoregion	
MOURE	l.	4	03030004 3	35.26944444	-79.416	94444		18-23-(1)		San		
Stream Classifica	ation	Drai	nage Area (mi2)	Elevatio	n (ft)	Strea	m Wie	dth (m)	Average	Depth (m)	Reference Site	
WS-III;HQW			27.3	400			7		0	.6	No	
		For	astad/Watland	Lieb	an		٨٩	riculture		Other (d	escribe)	
Visible Landuse	(%)		80		)		лу	0		20 (golf	course)	
										- (0 -	/	
Upstream NPDES Di	ischarg	ers (>1	MGD or <1MGD	and within 1 n	nile)			NPDES N	umber	V	olume (MGD)	
			None									
Water Quality Param	neters							Site	Photograp	h		
Temperature (%)			14.3			CAN/	M		1/201			
Dissolved Oxygen (m	a/L)		8.9						加速家			
Specific Conductance	∍′⊏/ ∍ (uS/cm	n)	35			XX			JACE .	MANK		
pH (s.u.)	(µ0/01)	•)	4.7		3-14				112 to	THE	THE FLAT	
p (e)					XU		- Part	SX10>	Cart			
Water Clarity		Clea	r, tannin stained		KA.		N/	KAR				
Habitat Assessment	Scores	s (max)	·	SI-SA								
Channel Modification	(15)		15		1283		M. L.		#	ZAL	ALL BURGE	
Instream Habitat (20)	. ,		20		E KA	A			A.1	1 Alexander		
Bottom Substrate (15	)		14		KITAK						-	
Pool Variety (10)			8									
Left Bank Stability (10	D)		10									
Right Bank Stability (	10)		9				E	A AN				
Light Penetration (10)	)		10	43.0		Catholine -				128.3	17/1	
Left Riparian Score (5	5)		5			STA A		Section Contraction	1-		t fa	
Right Riparian Score	(5)		3									
Total Habitat Score	(100)		94	Subs	strate	Gravel an	nd san	d				
Sample Date	e		Sample I	D	Spe	cies Total	I	N	CIBI	Bi	oclassification	
04/09/08			2008-04			13					Not Rated	
09/15/03			2003-54			13					Not Rated	
Most Abundant Sp	ecies		Bluegill			Exotic	Spec	i <b>es</b> Rec	dear Sunfis	h		
Species Change Since Last Cycle Gains Golden Shiner, Redfin Pickerel, Bluespotted Sunfish, Redbreast Sunfish, Redear Sunfish, and   Largemouth Bass. Losses American Eel, Margined Madtom, Pirate Perch, Chain Pickerel, Pumpkinseed, and Piedmont Darter.												
Data Analysis												
Watershed drains of	central N	Moore (	County; no munici	palities within t	he watersł	ned. Habi	itat s	site borders the	e Little Rive	r Golf and Res	ort along the right	
riparian zones, but sti Hills stream with swift collected was more th	II mainta t flow; cl nan three	ains hig ear, bu e times	h quality instream t stained water of the number collect	and riparian h low pH; conducted in 2003 (3	abitats inc ctivity has 89 vs. 121	been 65 a ; 2.6 vs. 9	ns, riffle and 35 9.4 fish	es, pools, roots i µS/cm, pH 6.2 n/100 seconds)	and snags and 4.7 s. 72% (280/	s. Water Qua u 2008 the (389) of all the	lity a typical Sand e number of fish fish were Age 1 and	

2 Bluegill; proximity to or overflow from the golf course ponds may be the source of the Bluegill; Dusky Shiner and suckers were absent; number of species with multiple ages was low, only 4 of the 13 species were represented by multiple age classes; Chain Pickerel were present, but represented only by youngof-year and not included in the total species count. **2003 & 2008** -- 19 species are known from the site, including eight species of centrarchids.

Waterbo	dy	L	Location			Statio	n ID	Bioclassification			
JAMES	CR	off	SR 2026		04/10/0	08 BF1	17	Not	Rated		
					•	•					
County	Subbasi	in 8 digit HUC	Latitude	Long	itude	AU Numb	per	Level I	V Ecoregion		
MOORE	14	03030004 3	5.18/22222	-79.293	333333	18-23-1	3	58	and Hills		
Stream Classifica	ition D	)rainage Area (mi2)	Elevatio	on (ft)	Stream	Width (m)	Ave	rage Depth (m)	Reference Site		
WS-III		12.8	298	}		5		0.75 Ye			
		Forested/Wetland	Urt	Urban Agriculture				Other	Other (describe)		
Visible Landuse	(%)	100	(	)		0		00	0		
		( 1100 1100				NDDE		-			
Upstream NPDES DI	schargers	(>TMGD or <tmgd a<="" td=""><td>and within I r</td><td>niie)</td><td></td><td>NPDE</td><td>5 NUMDe</td><td>r I</td><td></td></tmgd>	and within I r	niie)		NPDE	5 NUMDe	r I			
		None									
Water Quality Param	neters						Site Phot	ograph			
Temperature (℃)		14.1							AT A YEST		
Dissolved Oxygen (mg	g/L)	7.9				A A A		100	Datian Un		
Specific Conductance	e (µS/cm)	28			1 Martin				的学习世界性的		
pH (s.u.)		4.5	S/ B					-V/-			
	_		5 free		Sealer and		Carlos S				
Water Clarity	C	Clear, tannin stained	1-1-1								
					-						
Habitat Assessment	Scores (m	iax)		A THE							
Channel Modification	(15)	15	S alla	I I	E	Contraction of the		THE REAL			
Instream Habitat (20)		20		here in				12 74			
Bottom Substrate (15)	)	7		1					and the second		
Pool Variety (10)		10					a state		A set		
Left Bank Stability (10	))	10									
Right Bank Stability (1	10)	10				the second	1				
Light Penetration (10)	- \	10		AN	100 100	and the second					
Left Riparian Score (5	) (=)	5		1.12				R. Sale			
Right Riparian Score	(5)	5	Cub			verencie electriture					
Total Habitat Score (	(100)	92	Sub	strate	Sand and o	rganic detritus					
Sample Date	9	Sample II	כ	Spe	cies Total		NCIBI		Bioclassification		
04/10/08		2008-07			13				Not Rated		
09/16/03		2003-57			7				Not Rated		
Most Abundant Spe	ecies	Dusky Shiner			Exotic S	pecies	None				
Species Change Sin	ce Last Cy	cle Gains S Sunfish, a	andhills Chub nd Tessellated	, Yellow B I Darter. <b>L</b>	ullhead, Flat <b>.osses</b> Blu	Bullhead, Tad	pole Madt fish and S	om, Redfin Picke awcheek Darter.	rel, Mud Sunfish, Dollar		
Data Analysis											
Watershed begins and northwestern Hok bottomland forest, sna	near the W ke counties ags, <i>Fisside</i>	eymouth Woods Sand , including Fort Bragg ens, Orontium aquatic	dhills Nature P tributary to th um (Golden C	reserve in e Little Riv lub), large	the southeaver. <b>Habitat</b>	stern area of S high quality dy debris, and	Southern F instream organic d	Pines and includes and riparian habita etritus matter. <b>W</b>	s southeastern Moore ats including mature ater Quality a typical		

Sand Hills stream with low pH and conductivity; conductivity has been 26 and 28  $\mu$ S/cm, pH 5.6 and 4.5 s.u. **2008** -- a typical Sand Hills fauna, two specimens of the Sandhills Chub, a species of Special Concern, were collected; almost twice as many fish (40 vs. 20 and 1.0 vs. 0.6 fish/100 seconds) and species (13 vs. 7) collected in 2008 than in 2003, only ~ one-fourth of the species were represented by multiple ages, 8 of the 13 species were represented by only 1 or 2 fish per species. **2003 & 2008** -- 15 species are known from the site, including four species of catfish; no exotic species have been collected at this site.

Waterbo	dy		Location			Date	Date Station ID			Bioclassification	
FLAT (	CR		Manc	hester Ro	b	04/10/0	)8	BF1	l	Not Ra	ated
County	Subb	asin	8 digit HUC	Latitude	Long	itude	AU	Number	L	evel IV E	coregion
HOKE	14	1	03030004	35.1825	-79.1	1775	18	3-23-15		Sand	Hills
Stream Classifica	tion	Draiı	nage Area (mi2)	Elevatio	on (ft)	Stream	Width (	m) Av	erage Depth	(m)	Reference Site
WS-III			7.6	209	)		4		0.5		Yes
	r	For	ested/Wetland	Urt	ban		Agricul	ture	C	)ther (de	scribe)
Visible Landuse	(%)		100	(	)		0			0	
Upstream NPDES Di	scharge	ers (>1	MGD or <1MGD a	and within 1 n	nile)			NPDES Numb	er	Va	lume (MGD)
	<u></u>		None								
Water Quality Param	otoro							Site Pho	tograph		
water Quality Param	leters			PA VE BA							
Temperature (°C)			14.7				DA.T.		AND		
Dissolved Oxygen (m	g/L)		9.1	3.40	100	人家	1-15		1000		N/ANA
Specific Conductance	e (μS/cm	)	17					AST 1/18	( the sale	1	ALC LAN
pH (s.u.)			4.5			1-2-1 44	S. Colle	Dr. Al			
Water Clarity	[	Clea	r tannin stained		国长	P 20			ATZ		
Water Olanty		oica						24世纪		A POR	
Habitat Assessment	Scores	(max)				Nor !!					
Channel Modification	(15)		15			X 4 to A					TEAR
Instream Habitat (20)	()		20	-			125				
Bottom Substrate (15)	)		13			Kake -					
Pool Variety (10)	/		10		AT -						
Left Bank Stability (10	))		10	-							
Right Bank Stability (1	10)		10							and the second	
Light Penetration (10)	- /		10								
Left Riparian Score (5	5)		5	and some							
Right Riparian Score	, (5)		5								
Total Habitat Score (	(100)		98	Sub	strate	Sand, grave	el, cobble	e, and marl (cla	ıy)		
Comula Date			Complet	•	Cma	aiaa Tatal		NOIDI		Die	eleccification
04/10/08	)		2008-09	J	Spe			NCIBI		BIO	Not Bated
09/16/03			2003-58			12					Not Rated
						-					
Most Abundant Spe	ecies		Dusky Shiner			Exotic S	pecies	None			
Species Change Sin	ce Last	Cycle	<b>Gains</b> C Pickerel, M	reek Chubsuc Iud Sunfish, a	ker. <b>Loss</b> nd Tessell	<b>ses</b> Americ lated Darter.	an Eel, I	Eastern Mudm	innow, Margir	ned Madte	om, Redfin
Data Analysis											
Watershed within the municipalities within the coarse woody debris, stream with very low of species; darters abse	he prope he water snags, a conducti nt; almo	erty of I shed. and un vity (15 st twice	Fort Bragg draining <b>Habitat</b> along w dercuts; banks ste i and 17 µS/cm) and the as many fish coll	g northeastern vith Crane and ep, may be er nd pH (4.8 and lected in 2008	Hoke Cou Muddy cre htrenched t 4.5 s.u.). than in 20	unty; site is ~ eeks, the hig from historic <b>2008</b> a ty 003 (135 vs.	~ 0.5 mile phest sco al poor la pical Sa 73 and 3	e above the cre pring fish comm anduse practice and Hills fauna 3.3 vs. 1.6 fish/	eek's confluer nunity site in 2 es. <b>Water Qu</b> with Dusky Sl 100 seconds)	ice with th 2008; hab Jality a hiner as t ; seven s	he Little River; no bitats include typical Sand Hills he dominant pecimens of the

Sandhills Chub, a Species of Special Concern, were collected in 2008 representing three age groups. **2003 & 2008** -- 13 species are known from the site; Sandhills Chub was collected in 2003 and 2008; no exotic species have been collected at this site; dominant species in 2003 was the Margined Madtom which were common in the riffles below the culvert, in 2008 the creek was sampled upstream from the culvert where the riffles and the species were absent.

Waterbody		L	ocation		Date	Statio	n ID	Bioclas	ssification
CRANE CR		SI	R 1810		04/09/08	BF4	18	Not	Rated
						_			
County Subb	asin	8 digit HUC	Latitude	Long	itude	AU Numb	ber	Level I	V Ecoregion
MOORE 14	1	03030004	35.31	-79.324	144444	18-23-16	ia	Sa	and Hills
Stream Classification	Drair	nage Area (mi2)	Flevatio	n (ft)	Stream W	idth (m)	Δνο	rade Denth (m)	Beference Site
WS-III	Drail	16.8	400		6			0.8	Yes
		10.0	400		0			0.0	100
	For	ested/Wetland	Urk	ban	A	griculture		Other	(describe)
Visible Landuse (%)		100	(	)		0			0
Unotreem NDDEC Discharge			and within 1 m						
Opstream NPDES Discharge	ers (>1	None		nne)		NPDE		ir 🛛	
		None							
Water Quality Parameters			- 48 - 57 N - 57				Site Phot	ograph	
Temperature (°C)		13.7							
Dissolved Oxygen (mg/L)		9.4					XE		A CONTRACTOR
Specific Conductance (µS/cm	)	52			- Antone	SAL		///	
pH (s.u.)		5.9		1 A					
Γ				1 per		CO CO			
Water Clarity	Clea	r, tannin stained	the free free			Contra in	- Martin		
Habitat Assessment Scores	(max)							The mark the second	S
Channel Modification (15)	(	15	The set	1				"of the	the will
Instream Habitat (20)		20	1 1 2 2 A			your -	and a	and the second	Change 1
Bottom Substrate (15)		13	050					E Standie	The same
Pool Variety (10)		10	1 million			Sec. 2			a to
Left Bank Stability (10)		10			234 E	26-20	2000		and the
Right Bank Stability (10)		10	a stall of	a ser de					
Light Penetration (10)		10		15 14	No. and a second			See The	Contraction of the second
Left Riparian Score (5)		5		10.00			Sec. 1	CALL STRATE	
Right Riparian Score (5)		5	_						
Total Habitat Score (100)		98	Sub	strate	Gravel, sand,	and cobble			
Sample Date		Sample I	D	Spe	cies Total		NCIBI	I	Bioclassification
04/09/08		2008-05			4				Not Rated
04/23/02		2002-29			9				Not Rated
Most Abundant Species		Spotted Sucker			Exotic Spe	cies	None		
Spacios Change Since Last	Cuele	Gains S	potted Sucker	Losses	Bluehead Cl	ub, Highfin	Shiner, P	irate Perch, Redfir	n Pickerel, Redbreast
Species Change Since Last	Cycle	Sunfish, a	nd Tessellated	Darter.					
Data Analysis									
Watershed drains eastern I	Moore (	County; no munic munity site in 200	palities within 8: very high gu	the waters	hed; tributary t	o the Little F in habitats	River. Hal	bitat along with ols, snags, and un	Muddy and Flat

forested riparian zones, stable banks, and swift, clear flow. **Water Quality** -- highest pH of any fish community site in the Sand Hills in 2008; conductivity has been 52 and 53  $\mu$ S/cm, pH 6.3 and 5.9 s.u. **2008** -- fewest species and fish of any fish community site in the basin in 2008; only 7 fish of 4 species collected in 2008 contrasted to 281 fish of 9 species collected in 2002; the fish were 3 Spotted Sucker (383-470 mm TL), 1 Warmouth, 2 Bluegill, and 1 Creek Chub; catch per unit of effort was 0.3 fish/100 seconds shocking time vs. 8.3 in 2002; stream probably ceased flowing and dried-up during the 2007 drought. **2002 & 2008** -- both low flow years; 10 species are known from the site, including 3 species of cyprinids and centrarchids; no American Eels or exotic species have been collected at this site.

Waterbo	dy		L	ocation		Date		Station ID	В	ioclassi	fication
BEAVER	CR		SF	R 1825		04/09/0	28	BF49		Not Rated	
County	Subba	sin 8	8 digit HUC	Latitude	Longi	tude		AU Number	L	evel IV E	coregion
MOORE	14		03030004 3	5.26916667	-79.226	94444		18-23-16-8		Sand	Hills
Stream Classifica	tion	Draina	age Area (mi2)	Flevatio	n (ft)	Stream	Wid	th (m) Δι	verage Depth	(m)	Reference Site
WS-III		Dianie	13.5	252		otrouin	8		0.6	()	Yes
		_			I						
Visible Landuse	(9/)	Fores	sted/Wetland	Urb	an		Agr	of	<u> </u>	itner (de	scribe)
	(%)		75	L L	)			20		0	
Upstream NPDES Di	scharger	s (>1M	IGD or <1MGD a	nd within 1 n	nile)			NPDES Numb	ber	Vc	olume (MGD)
	<u>~</u>		None								
Water Quality Param	eters							Site Pho	otograph		
Tomporature (%)			14.6								
Dissolved Oxygon (m	a/L)		14.0								
Specific Conductance	y/∟) \(uS/cm)		36								
	; (µ3/cm)		4.6					11/Ar	No The		一件书
pri (s.u.)			4.0		3/2 N		- 44		A. 1	N	
Water Clarity		Clear,	tannin stained					AP	S-N		Jan
Habitat Assassment	Scores (	max)									at another
Channel Medification	(15)	illax)	15		at the					1 Ste	the second
Channel Woolfication	(15)		15		A sealing		-				Alerta a
Rettern Substrate (15)	\		20								
Bool Variaty (10)	)		13					IL.			
Four variety (10)	N)		9		Auge -	- The		Set All			and the second
Dight Donk Stability (10	/) 10)		10	1.1.4	Sant To			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Sterne	
Light Dank Stability (1	10)		10	- and		Zalla		A President			
Light Penetration (10)	:)		5	and the second s	1000						
Dight Diparian Score (J	(F)		5	1		- 1 - X - X	1000		See See	Contrast	
Total Habitat Score	(3) (100)		5 07	Suba	strato	Cobble ara		and and boulder			
	(100)		51	Gub			1001, 0				
Sample Date	•		Sample II	)	Spec	cies Total		NCIB		Bio	classification
04/09/08			2008-06			5					Not Rated
04/22/02			2002-26			12					Not Rated
Most Abundant Spe	ecies	в	Bluegill			Exotic S	specie	es None			
			Gaine A	merican Fel		argined Ma	odtom	Bedfin Pickerel	Chain Picker	al Blueer	ootted Sunfish
Species Change Sin	ce Last C	ycle	Redbreast	Sunfish, Warr	nouth, Larg	gemouth Ba	ass, a	and Tessellated D	arter.	, Diuesp	oueu oumish,
Data Analysis											
Watershed drains r	northeaste	ern Moo	ore, southeasterr	n Lee, and sou	thwestern	Harnett cou	unties	; no municipalities	s within the wa	tershed;	tributary to Crane
Creek. Habitat ver Quality very clear a	y high qua Ind swift f	ality ins ow; co	tream and ripariand ripariand the second structure of	an habitats, inc en 27 and 36	cluding der μS/cm, pH	nse riparian I 5.4 and 4.6	holly 6 s.u.	forests, and <i>Fiss</i> 2008 number	<i>idens</i> on the least of fish and the	ogs and b number	ooulders. Water of species
collected in 2008 was	~ 40% ai	nd 25%	o, respectively, of	the numbers	collected in	n 2002; cato	ch pei in dui	r unit effort was 3	2 and 1.0 fish	/100 seco	onds, respectively

in 2002 and 2008; declines suggested that the stream may have stopped flowing or dried-up during the 2007 drought; 20 of the 31 fish collected were Bluegill. **2002 & 2008** -- 13 species are known from the site, including 6 species of centrarchids, but no species of cyprinids; no exotic species have been collected at this site.

Waterbody			Location		Dat	е	Station	ו ID	Bioclassification			
BUFFALC	) CR			SR 1001		04/10	0/08	BF2	21		Not R	ated
County	Subb	asin	8 digit HUC	Latitude	Long	iitude		AU Numb	er	I	evel IV F	coregion
MOORE	14	4	03030004	35.18972222	-79.136	666667		18-23-18	}	-	Sand	Hills
									-			-
Stream Classifica	tion	Drain	age Area (mi	2) Elevatio	on (ft)	Strea	am Wio	dth (m)	Ave	erage Depth	( <b>m</b> )	Reference Site
WS-III			18.3	249	)		6			0.75		Yes
		For	eted/Metlanc		han		٨٩	riculture			Othor (de	scribe)
Visible Landuse	(%)	1016	100		0		лу	0				Scribe)
			100		•			•				
Upstream NPDES Di	ischarge	ers (>1I	MGD or <1MG	D and within 1 r	nile)			NPDE	S Numbe	er	V	olume (MGD)
			None									
Water Quality Param	neters							5	Site Phot	ograph		
Temperature (℃)			14.3		ANT.		14	1.7		No.	1	
Dissolved Oxygen (m	a/L)		7.7				(A)	Keller.		7		
Specific Conductance	e (μS/cm	)	34				V.		6			
pH (s.u.)		,	4.3		1 Sale is a	NISPES	here.	and the second second				
	-				AL PROPERTY	1.10		ATTR.	1			
Water Clarity		Clear	r, tannin staine	d	The states		8				- H	
	L			and the second sec		the state		the second				
Habitat Assessment	Scores	(max)			- And	1,01	1.42	1	and the		-	
Channel Modification	(15)		15	A CONTRACT				Person a				
Instream Habitat (20)			20				-			Sec. 2		
Bottom Substrate (15	)		15						Circles,		2	
Pool Variety (10)			8		2 Tomas	1.57			2Eth			
Left Bank Stability (10	D)		10			Sec.			ne the	Charles and the second		
Right Bank Stability (*	10)		10		a the se	1.2.1.1			1/2 Sh			the section of the se
Light Penetration (10)	)		10	1 distant	1-104		A A A	the fol	1	- Aller	Ser and a	
Left Riparian Score (5	5)		3	and the	1992			Phil !	and the second s	A / AND		
Right Riparian Score	(5)		5									
Total Habitat Score	(100)		96	Sub	strate	Cobble, v	white g	ravel and s	and			
Sample Date	e		Sampl	e ID	Spe	cies Tota	ıl		NCIBI		Bio	classification

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/10/08	2008-08	11		Not Rated
09/15/03	2003-56	7		Not Rated
05/07/98	98-34	6		Not Rated
Most Abundant Species	Sawcheek Darter and Pirate Pe	rch Exotic Spec	cies None	

Species Change Since Last Cycle

**Gains** -- American Eel, Yellow Bullhead, Eastern Mosquitofish, Mud Sunfish, Warmouth, and Dollar Sunfish. **Losses** -- Redfin Pickerel and Banded Sunfish.

#### Data Analysis

**Watershed** -- drains the south-central corner of Moore and southwestern Harnett counties; no municipalities with the watershed. **Habitat** -- high quality instream and riparian habitats, including runs, gravel riffles, deadfalls, snags, and roots; and open canopy at the bridge with *Juncus repens* and *Batrachospermum* abundant in the riffles at the bridge; left riparian zone was logged ~ 5 years ago, but a narrow buffer was kept intact. **Water Quality** -- swift clear flow, low pH and conductivity; conductivity has ranged from 21-34 µS/cm, pH from 4.3-4.9 s.u. **2008** -- very diverse, but no species was represented by multiple age classes; stream may have ceased flowing or gone dry in 2007; species collected for the first time were the Yellow Bullhead, Eastern Mosquitofish, Mud Sunfish, Warmouth, and Dollar Sunfish. **1998-2008** -- number of fish collected has always been very low, 14-29 fish/collection, 0.5-1.1 fish/100 seconds; 13 species are known from the site, including 5 species of centrarchids; no cyprinids or exotic species have ever been collected at this site.

Waterbo	dy		Lo	ocation	Date Station ID Bioclassification					ification	
MUDDY	CR		SF	R 1001		04/18	8/08	BF22		Not F	lated
County	Subba	sin 8	3 digit HUC	Latitude	Long	itude		AU Number		Level IV	Ecoregion
CUMBERLAND	14		03030004 3	5.19666667	-78.998	361111		18-23-26		Sand	d Hills
	_					_			_		
Stream Classifica	ition	Draina	ge Area (mi2)	Elevatio	n (ft)	Strea	am Wid	lth (m)	Average	Depth (m)	Reference Site
C			16.1	170			6		Ŭ	.5	Yes
		Fores	ted/Wetland	Urb	ban		Agr	iculture		Other (de	escribe)
Visible Landuse	(%)		100	(	)		<u> </u>	0		0	
Upstream NPDES Di	ischarger	s (>1M	GD or <1MGD a	nd within 1 n	nile)			NPDES Nu	umber	V	olume (MGD)
			None								
Water Quality Param	neters							Site	Photograp	bh	
Temperature (°C)			15.6	Here C			r.A.L	AT CIN	Ser 1	K LOSS	4 4
Dissolved Oxvgen (m	a/L)		8.8	111.		Make.		1 34	A Pty		
Specific Conductance	e (µS/cm)		31	A.		1 ALA		- All	1-2	BE / K	(土工具
, pH (s.u.)	( ,		4.3	18		MA.	145	Star 1	0		a de la come
				1- Yes	Carlos and		F-1			No. Constant	Contraction of the second seco
Water Clarity		Clear,	tannin stained	- 6 3	Ser an an	SK)		C. Martin		N. A.	
							1300	a started	Anna .		
Habitat Assessment	Scores (	max)						Contraction of the	SY-V	THE T	AND PRIM
Channel Modification	(15)		15	State of the		1	N.	Contraction of the second	, A .	*	
Instream Habitat (20)			20					<u>aug</u>			
Bottom Substrate (15	)		13			2.44		A married	JA -		
Pool Variety (10)			10				THE			-	
Left Bank Stability (10	))		10			- ME					K Er
Right Bank Stability (	10)		10		S.S.						130
Light Penetration (10)	)		10								
Left Riparian Score (5	5)		5	and the second							
Right Riparian Score	(5)		5								
Total Habitat Score	(100)		98	Subs	strate	Sand and	d gravel				
Sample Date	e		Sample ID		Spe	cies Tota	ıl	N	СІВІ	Bi	oclassification
04/18/08			2008-20			16					Not Rated
09/16/03			2003-59			14					Not Rated
		_				1					
Most Abundant Sp	ecies	D	usky Shiner, Rec	breast Sunfis	sh, and	Exotic	Speci	es Nor	ne		
		3	awcheek Dailei								
0			Gains Sa	andhills Chub,	Lake Chu	ubsucker,	Redfin	Pickerel, Mud	Sunfish, Fl	ier, and Tesse	llated Darter.
Species Change Sin	ce Last C	ycie	Losses `	Yellow Bullhea	ad, Bluesp	otted Sun	nfish, Sp	potted Bass, ar	nd Banded	Pygmy Sunfisl	h.
Data Analysis											
Watershed drains	southern I	larnett	County and a sn	nall portion of	northern (	Cumberlar	nd Cour	nty; now part of	f the Fort E	ragg property;	tributary to the Little
River, site was ~ 0.7 i	mile above	e its cor	nfluence with the	river; no mun	icipalities	within the	waters	hed. Habitat -	along wit	h Crane and Fl	at Creeks, the
typical Sand Hills stre	am with lo	Site III 2	ductivity and nH.	conductivity h	as been 2	2 and 31	uS/cm	pH 4.4 and 4.3	3 s.u. 2008	a typical Sa	nd Hills fauna: one
specimen of the Sand	hills Chub	o, a spe	cies of Special C	Concern, was	collected;	only Sand	d Hills s	ite from which	Lake Chuk	sucker (n=2) v	vas collected; two
intolerant species pre	sent (San	dhills C	hub and Sawche	ek Darter); 10	) of 16 spe	ecies repr	esented	d by only 1 or 2	fish per s	pecies; only 5 d	of 16 species were
represented by multip	ole age cla	sses.	2003 & 2008 2	20 species are	e known fr	om the sit	e, inclu	ding seven spe	ecies of ce	ntrarchids.	

Waterbo	Waterbody			Location		Dat	е	Station ID		Bioclassification		
TANK (	CR		Man	chester Ro	b	06/27	7/08	BF12	26	1	lot Ra	ted
						8	1		<u>.</u>			
County	Subb	asin	8 digit HUC	Latitude	Long	itude		AU Numb	er	Le	vel IV Ec	oregion
CUMBERLAND	14	4	03030004	35.18773	-79.0	0623		18-23-27	·		Sand I	Hills
Stroom Classifica	tion	Drai	nago Aroa (mi2)	Elovatio	n (ft)	Stro	am Wie	tth (m)	٨٧٢	orago Donth (	(m)	Poforonoo Sito
		Diali	5 8	155	(IL)	3000		aun (m)	AVE		iii)	No
0			5.0	155	,		4			0.3		NU
		For	ested/Wetland	Urt	ban		Ag	riculture		0	ther (des	cribe)
Visible Landuse	(%)		75	(	)			0		25 (milit	ary base	and WWTP)
Upstream NPDES Di	ischarge	ers (>1	MGD or <1MGE	and within 1 n	nile)			NPDES	S Numbe	er	Vol	ume (MGD)
			None									
Water Quality Param	neters							S	Site Phot	tograph		
Temperature (℃)			26.0			1 12		4	1.95			
Dissolved Oxygen (m	a/L)		5.0		ALC H		1 Al	and to	-Alton		Mr. N	
Specific Conductance	9/-/ a (uS/cm	)	70		Y	ILIX?			~			
nH (s u )	(μο/οιι	')	5.9				少食				ANT A	
	_		0.0		CA.	Con ja			-		ha	
Water Clarity		Clea	r, tannin stained		Ser 1			and the second		1 All	A	
	l		•				( see	- 1- 10		TT	$\langle \times \rangle$	
Habitat Assessment	Scores	(max)				C DE	- I-X	wet in		Zick	Xa	AM
Channel Modification	(15)		15			the second	1			- / 7	$\langle - \rangle$	
Instream Habitat (20)			15				- <u> </u>				17	SK C-D
Bottom Substrate (15	)		7			P ST		T			Xa	1 X
Pool Variety (10)			10	1				and the second second		K		
Left Bank Stability (10	D)		9	1.000	and the second	-			-12	P -	JAN.	and the
Right Bank Stability (*	10)		9		e the	2			1	A dest	Y	1 - Plan
Light Penetration (10)	)		9			·	-		-11-			A to the
Left Riparian Score (5	5)		5			P			4-17	5	1	
Right Riparian Score	(5)		5									
Total Habitat Score	(100)		84	Sub	strate	Sand and	d white	gravel				
Sample Date	e		Sample	ID	Spe	cies Tota	al		NCIBI		Biod	lassification
06/27/08			2008-7	1		9					1	Not Rated
						1						
Most Abundant Sp	ecies		Redbreast Sunf	sh		Exotic	c Spec	ies	Redear	Sunfish		
							•					
Species Change Sin	ce Last	Cycle	N/A									
Data Analysis												
This is the first fish co	ommunit	y samp	ble collected at th	is site. Waters	hed dra	ins northv	vestern	Cumberla	nd Count	ty entirely with	in the Fo	rt Bragg property;
receives runoff from F	ope AF	B; imm	ediate watershe	D is forested with	h large pin andv runs	nools a	nd Orie	ntal privet;	stream c	channel and m	outh wer	e altered, stream

now flows into the Little River at the Fort Bragg WWTP. **Habitat** -- sandy runs, pools, a few short riffles; undercuts, some urban debris in the stream. **Water Quality** -- low flow; conductivity elevated for a Sand Hills stream; highest pH of any fish community site in the Sand Hills in 2008. **2008** -- a typical altered urban stream fauna; 97% of the fish and 7 of the 9 species were sunfish of which 75% were large, tolerant Redbreast Sunfish; cyprinids, suckers, and intolerant species were absent; and the greatest percentage of tolerant fish (76%) of any Sand Hills fish community site in 2008.

Waterbody			Location Da			е	Station ID		B	Bioclassification		
ANDERSO	N CF	7		SR 2031		04/16	6/08	BF5	2		Not R	lated
County	Subb	basin	8 digit HUC	Latitude	Long	itude		AU Numb	er	L	evel IV I	Ecoregion
HARNETT	1	4	03030004	35.26583333	-78.819	944444		18-23-32		SE Floo	SE Floodplains and Low Terraces	
Stream Classifica	tion	Draiı	nage Area (mi	2) Elevatio	on (ft)	Strea	am Wie	dth (m)	Av	verage Depth (m)		Reference Site
C			34.7	98			10			0.8		Yes
		For	ested/Wetland	d Rural Re	sidential		Ag	riculture		c	Other (de	escribe)
Visible Landuse (%) 95		95	Ę	5			0			0		
Upstream NPDES Di	D and within 1 r	nile)			NPDES	6 Numb	er	v	olume (MGD)			
			None									
Water Quality Param	eters							S	Site Pho	tograph		
Temperature (°C)			12.8	3		Carlos Carlos					74	
Dissolved Oxygen (mg	g/L)		8.8	1. A. S. S.		State of						Sec. Sector
Specific Conductance	e (μS/cn	ר)	54					Steller.		Mary A.		
pH (s.u.)			5.3	100 m		a cha	S.C	in the		A BAS		
Water Clarity			Black water			. a						A STREET
Habitat Assessment	Scores	s (max)				the -			A.		The second	
Channel Modification	(15)		15	and the	Carlo and	J		Z	1		117	
Instream Habitat (20)			19				-			A DEC		
Bottom Substrate (15)	)		14	A BOOM		5	1				C. S.	
Pool Variety (10)			9		5	714	RE		all and the		-	no les series
Left Bank Stability (10	))		9	The second		1 AND	2 at	1				
Right Bank Stability (1	10)		9		No.	and n.					1.11	No of the State
Light Penetration (10)			10		1000							a this is a
Left Riparian Score (5	<b>i</b> )		4						×			and the
Right Riparian Score (	(5)		5									
Total Habitat Score (	(100)		94	Sub	strate	Cobble, r	marl (c	lay hardpar	n), grave	I, and white s	and	

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/16/08	2008-16	8		Not Rated
10/02/03	2003-63	14		Not Rated
05/06/98	98-33	12		Not Rated
Most Abundant Species	Tessellated Darter	Exotic Spec	cies None	

Species Change Since Last Cycle

Gains -- Creek Chub and Largemouth Bass. Losses -- Bowfin, Spotted Sucker, Notchlip Redhorse, Yellow Bullhead, Flat Bullhead, Redfin Pickerel, Spotted Bass, Sawcheek Darter, and Piedmont Darter.

#### **Data Analysis**

**Watershed** -- drains southern Harnett County; is on the eastern edge of the Sandhills and borders the Southeastern Floodplains and Low Terraces and the Rolling Coastal Plain ecoregions; tributary to the Little River, site is ~ 1.3 miles above the confluence with the river; no municipalities within the watershed. **Habitat** -- very high quality instream and riparian habitats; very swift water; riffles, runs, side pools, and deep mid-channel runs/pools. **Water Quality** -- dark, tea colored water; conductivity has ranged from 35-54 µS/cm, pH from 5.0 to 5.6 s.u. **2008** -- stream may have ceased flowing during the 2007 drought; number of fish collected was one-half the total in 2003; intolerant species were absent; a typical Sand Hills fauna; species collected for the first time were Spotted Sucker and Largemouth Bass. **1998-2008** -- 19 species are known from the site; Sandhills Chub, a Species of Special Concern, and Green Sunfish were last collected at the site in 1998; catch per unit effort was 1.8, 1.5, and 1.3 fish/100 seconds in 1998, 2003, and 2008, respectively.

Waterboo	dy	Locati	on	Statio	n ID		Date	Bioclassification
ANDERSO	N CR	SR 20	031	BB3	53	07	7/21/08	Good
		-						
County	Subbasin	8 digit HUC	Latitude	Longitude	e AU	Number	Lev	el IV Ecoregion
HARNETT	14	03030004	35.266111	-78.819444	4 18	8-23-32	Southeastern F	loodplains and Low Terraces
Stream Classifica	tion I	Drainage Area (mi2	2) Elev	ation (ft)	Str	eam Width	(m)	Stream Depth (m)
C		34.7		100		5		0.3
	Fo	rested/Wetland	Urban		Agricu	ulture	0	ther (describe)
Visible Landuse	(%)	50	20		30	)		
Upstream NPD	DES Discharge	ers (>1MGD or <1N	IGD and within	n 1 mile)	N	IPDES Nur	nber	Volume (MGD)
		none				n/a		n/a
Water Quality Param	otore					Site Pho	otograph	
	elers	22.0		and the second second	a la la	Onerne	(ogi upi)	
Pieroperature (°C)	. //	23.0		NET PL				
Dissolved Oxygen (mg	)/L) (⊶Q()	0.2			1 and	- server		
Specific Conductance	(µS/cm)			A PROP	the star		1.1.1	
рн (s.u.)		5.4	20.20	1× 1/2				
Water Clarity		clear				State		
Water Clarity		Clear	26.20			11- Berly		
Habitat Assessment	Scores (max)							
Channel Modification (	5)	15					-	
Instream Habitat (20)		15		and w				
Bottom Substrate (15)		15						Server
Pool Variety (10)		10						ANT COM
Left Bank Stability (7)		9			N. A			
Right Bank Stability (7)	)	9	and the second second	and the second s				
Light Penetration (10)	/	9	To		2			
Left Riparian Score (5)		4			" the off	- net		Selle La R
Right Riparian Score (	5)	4	the se	1		1	122	THE REAL PROPERTY OF
Total Habitat Score (	, 100)	90		-1	20 - Series	and the second second		

Substrate

Gravel and sand with small amounts of silt and hardpan clay.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/21/08	10503		22		3.94	Good
07/23/03	9207		20		3.78	Good
09/19/00	8176		20		3.00	Good
07/14/98	7674		18		3.62	Good-Fair
08/24/93	6353		13		2.95	Good-Fair

#### **Taxonomic Analysis**

Other than presence/absence of Rare taxa, no major shifts in the benthic community were observed. Five taxa that were not previously collected were collected in 2008. Of which, three are tolerant, *Centroptilum* (T.V.=606), *Plauditus dubius* (T.V.=5.8), and *Pseudocloeon propinquum* (T.V.=5.8); one is moderately tolerant, *Heterocloeon anoka* (T.V.=3.5); and one is intolerant, *Psilotreta frontalis* (T.V.=0).

### **Data Analysis**

Anderson Creek, located in southern Harnett County, is on the eastern edge of the Sand Hills and borders the Southeastern Floodplains and Low Terraces and the Rolling Coastal Plain ecoregions. The site rated Good-Fair in 1993 and 1998. It improved to Good in 2000 during a special study and has since rated Good. EPT taxa richness has been increasing and has nearly doubled since 1993. EPT BI has been increasing as well, suggesting a shift to a more tolerant community. Should this trend continue, the site will likely decline in rating.



Rip-rap boulder, cobble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/08	10521	7	7	5.88	5.88	Fair
08/08/03	9270	38	9	6.33	5.95	Good-Fair
08/23/93	6348	10	10	6.16	6.16	Fair

### **Taxonomic Analysis**

There have been two EPT samples and one Full-Scale sample taken at this station since 1993. Regardless of sampling effort, the EPT taxa richness and EPTBI has been quite stable. Indeed, there have been five EPT taxa collected at each sampling event and include the tolerant mayflies Pseudocloeon propinguum, Maccaffertium modestum and the tolerant caddisflies Cheumatopsyche sp., Hydropsyche betteni, and the facultative caddisly Nectopsyche exquisita.

#### Data Analysis

As is demonstrated by the stable EPTBI and EPT taxa richness, the water quality at this site appears to have remained largely unchanged since sampling commenced in 1993. This conclusion is supported by the virtually identical specific conductance and pH data from 2003 (44 µS/cm; 6.3) and 2008 (43 µS/cm; 6.0). The only metric that varied significantly in 2008 relative to the other EPT collection was the EPT abundance. The 2008 sample resulted in the lowest EPT abundance (29) and represented a modest decrease from levels measured in 1993 (43). Given the virtually uniform EPT taxa richness, EPTBI, and water chemistry data, the decline in EPT abundance was possibly the result of high flows observed during the collection which may have limited access to some habitat types. This might have also accounted for the slightly lowered EPT taxa richness seen in 2008.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/08	10523	4	4	6.91	6.91	Poor
08/04/03	9266	41	7	7.37	6.82	Fair
03/03/98	7538	37	7	6.91	6.10	Fair

### **Taxonomic Analysis**

Although Full-Scale samples have been collected here in the past, an EPT was employed in 2008 due to an extreme lack of instream habitat. While this discrepancy in sampling effort likely contributed to some of the reduction in EPT taxa present, it probably does not account for all of it as some of the reduction in EPT is suggestive of reduced flows and lessened in-stream edge habitat. For example, a strong indicator of flow (*Maccaffertium modestum*) was present in all previous collections but absent from the 2008 sample. In addition, many edge-dwelling caddisflies (*Oecetis cinerascens*, *Oecetis persimilis*, and *Pycnopsyche sp*.) were also absent in 2008 but collected from the 1998 and 2003 samples.

### Data Analysis

This station is located approximately 600 meters downstream of Glenville Lake. The lower EPT taxa richness value obsereved in 2008 is most likely attributed to reduced instream flows from the drought and may have been further compounded by a corresponding reduction in water release from Glenville Lake. This conclusion is supported by the absence of flow indicator taxa (*Maccaffertium modestum*) as well as an absence of edge taxa (*Oecetis cinerascens, Oecetis persimilis,* and *Pycnopsyche sp.*). Moreover, the specific conductance data has been relatively uniform: 1998 (39 µS/cm), 2003 (48 µS/cm), 2008 (37 µS/cm) further indicating that the reduction in EPT taxa richness is likely not related to a change in water quality but may be more related to a reduction in flow and habitat availability.

Waterbody		Location			Date	Date Station ID		D Bioclassification			
GUM LOG	CANA	۱L	0,	SR 1728		04/16/08	BF45		Not Rate	d	
								•			
County	Subb	asin	8 digit HUC	Latitude	Long	itude	AU Number	L	evel IV Ecore	egion	
CUMBERLAND	1	5	03030004	35.06444444	-78.8	3425	18-28	SE Floo	SE Floodplains & Low		
Stream Classifica	ition	Drai	nage Area (mi2	) Elevatio	on (ft)	Stream Wi	dth (m)	Average Depth	(m) R	eference Site	
С			30.8	72		8		0.4		No	
		For	ested/Wetland	Rural Re	sidential	Ag	riculture	c	)ther (descri	be)	
Visible Landuse	(%)		25	1	0		65		0		
Upstream NPDES Di	ischarg	ers (>1	MGD or <1MG	D and within 1 r	nile)		NPDES N	umber	Volum	e (MGD)	
			None								
Water Quality Param	neters						Site	Photograph			
Temperature (°C)			11.2				· allar	A State	A Salar		
Dissolved Oxvaen (m	a/L)		9.7	19.94	1 and		ANT	the second second	in sector	dia in	
Specific Conductance	e (μS/cm	ı)	89					C States	Service Service	Start P	
pH (s.u.)	u.		5.0	-	SALE.	A BA					
					1	Masks 1		× 31 _ 4			
Water Clarity		Clea	r, tannin staineo			1 Part	A Le			100	
Habitat Assessment	Scores	(max)		No. of the	-						
Channel Modification	(15)		15				Terris and				
Instream Habitat (20)	( - )		17	C. Secon							
Bottom Substrate (15	)		15							-	
Pool Variety (10)			8						Spartone C.	X .	
Left Bank Stability (10	D)		3								
Right Bank Stability (*	10)		3					- A MARTIN		a series of	
Light Penetration (10)	)		4			- Property and					
Left Riparian Score (5	5)		1	2 ml						1	
Right Riparian Score	(5)		1		1						
Total Habitat Score	(100)		67	Sub	strate	Cobble, gravel,	and sand				
Sample Date	e		Sample	e ID	Spe	cies Total	Ν	CIBI	Bioclas	sification	
04/16/08			2008-	15		23			Not	Rated	
10/02/03			2003-0	65		22			Not	Rated	
Most Abundant Spo	ecies		Bluegill			Exotic Spec	ies Gro	een Sunfish			
Species Change Since Last Cycle GainsGolden Shiner, Warmouth, and Dollar S Brown Bullhead, Bluesp					Sandbar S unfish. <b>Lo</b> otted Sunfi	hiner, Flat Bullh I <b>sses</b> Spottail sh, and Spotted	ead, Margined Shiner, Spotte Bass.	Madtom, Pirate P d Sucker, Snail Bi	erch, Chain F ullhead, Yello	Pickerel, w Bullhead,	

## Data Analysis

**Watershed** -- includes eastern Cumberland County, east of the Cape Fear River and west of I-95; tributary to Locks Creek; straddles the Sand Hills and the Atlantic Southern Loam Plains; no municipalities within the watershed. **Habitat** -- riffles, runs, side snag pools; very narrow riparian zones; cattle with access to stream from both banks. **Water Quality** -- greatest conductivity of any fish community site in the Sand Hills in 2008; conductivity has been 75 and 89 µS/cm, pH 6.3 and 5.0 s.u. **2008** -- most species and fish collected (n=397, 13.0 fish/100 seconds) in 2008 from any Sand Hills site; seven species of sunfish; five species (White Shiner, Bluehead Chub, Sandbar Shiner, Notchlip Redhorse, and Green Sunfish) collected in 2008 were collected only at this site; community includes Coastal Plan and Piedmont species. **2003 & 2008** -- 30 species are known from the site, including 10 species of centrarchids, 6 species of cyprinids, and 5 species of catfish; community and site are very atypical for a Sand Hills stream, if rated with Piedmont criteria, NCIBI = 58 and NCIBI Rating = Excellent, in 2003 the score was 60 and the rating was also Excellent.

Waterboo	dy	Locat	ion	Station	ID		Date	Bioclassification
ROCKFIS	H CR	SR 1	432	BB29	93	09	9/04/08	Good
County	Subbasin	8 digit HUC	Latitude	Longitude	AUN	Number	Lev	el IV Ecoregion
HOKE	15	3030004	34.96805556	-79.1097222	2 18-3	31-(18)	Atlantic	Southern Loam Plains
Stream Classifica	tion I	Drainage Area (mi	2) Elev	ation (ft)	Strea	am Width	(m)	Stream Depth (m)
В				140		9		1.3
	<b>-</b> -				A			(h = = ( -   - = = = ) )
	Fo		Urban		Agricuit	ure	0	ther (describe)
Visible Landuse	(%)	100	0		0			
Linstroam NPF	ES Discharg	are (>1MGD or <1	MGD and withir	1 mile)			nber	Volume (MGD)
City of Raeford	Discharge			i i iiiie)		C0026514	.001	3.0
ony of Haciora						00020014		0.0
Water Quality Parame	eters					Site Pho	otograph	
Temperature (°C)		21.5		P1192 6	N		AT A TE	A STATE OF A DESCRIPTION
Dissolved Oxvaen (ma	1/L)	6.7				1	A A A	a Proceeding and a second
Specific Conductance	(µS/cm)	52				The star	ALL NO.	State State
, pH (s.u.)	( )	5	Ends (A.		1	e de l	Ser Para	A NEW CREEK
						- TONG		A State of the second s
Water Clarity		Clear, tannic		5 6	100 1			A STATE STATE
			-				and the P	
Habitat Assessment	Scores (max)					1		AND SEAR PORT
Channel Modification (	15)	15			1		A AND A	Contraction of the second
Instream Habitat (20)		14		1 - S	1919		State State	State -
Bottom Substrate (15)		13	2121					+ (145-16-16)
Pool Variety (10)		5	1.00			1.1.	the states	and the second
Left Bank Stability (10)	)	10				<b>**</b>	The states	
Right Bank Stability (1	0)	10	1 68		1	1.0	A share	and the second
Light Penetration (10)		9	- 27	8.24	-	34/10	And the product of 2	And Bring and Print
Left Riparian Score (5)	)	5		11				In the Design
Right Riparian Score (5) 5		100						
Total Habitat Score (*	tal Habitat Score (100) 86		Substra	ate Sand	l, detritus	and a tra	ce of silt.	

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/04/08	10525	21	21	3.43	3.43	Good
09/03/03	9301	23	23	3.73	3.73	Good
07/15/98	7679	60	25	5.44	3.90	Good
05/19/94	6495	23	23	3.67	3.67	Good
08/24/93	6354	61	25	4.86	3.54	Good

### **Taxonomic Analysis**

Although EPT taxa richness values have been remarkably consistent at this location since sampling started in 1993, the 2008 EPT sample did result in the lowest EPT taxa richness value measured. EPT taxa absent from the 2008 collection but present in previous EPT samples (1994 and 2003) include the mayflies *Pseudocloeon propinquum*, *Attenella attenuata*, the stoneflies *Acroneuria abnormis*, *Neoperla sp.*, and *Perlesta sp.*, and the caddisflies *Oecetis georgia*, *Oecetis nocturna*, *Oecetis scala* GR, *Nyctiophylax moestus*, and *Lype diversa*.

### Data Analysis

Although this site is approximately six stream miles below the Raeford WWTP, there seems to be no adverse impact due to increased instream waste concentration as a result of drought induced low flows. This conclusion is supported by the specific conductance data which has been relatively stable through time:  $50 \ \mu$ S/cm (1994),  $41 \ \mu$ S/cm (1998),  $33 \ \mu$ S/cm (2003) and  $52 \ \mu$ S/cm (2008) and is further supported by the fact that the 2008 sample produced the lowest EPTBI yet measured (3.43). Moreover, the Raeford WWTP has been compliant for nearly three years and has addressed industrial influent problems through aggressive pretreatment. The lower EPT taxa richness documented in 2008 was very likely the result of temporary high flows and reduced access to some habitat due to deep water.

Waterbody		Location			Date	Date Station ID			ID Bioclassification			
JUNIPEF	R CR		Plank Rd			04/15	<b>60</b> %	BF2	20	Ν	ot Ra	ted
	0			1				A 1 1 A 1				
		asin		Latitude	20.25			19 21 10	ner	Sand Hills		oregion
HORL		J	03030004 3	0.000000000	-19.20			10-31-10	J	Sand Tillis		
Stream Classifica	tion	Drai	nage Area (mi2)	Elevatio	n (ft)	Strea	ım Wic	ith (m)	Ave	erage Depth (r	n)	Reference Site
С			11.3	255	i -		4			0.4 Yes		Yes
		For	ested/Wetland	Liek	an		٨٩	riculture		Other (describe)		
Visible Landuse	(%)	101	100	(	)		- Ag	0		01	0	unite)
								NDDE	C Numbe		Val	
Opstream NPDES DI	ischarge	ers (>1	None	and within I h	niie)			NPDE	5 NUMDE	er	VOI	ume (MGD) 
Water Quality Param	neters				i na kena				Site Phot	ograph		
Temperature (°C)			13.7			1 All	NorA	san 12		ATT		
Dissolved Oxygen (m	g/L)		8.3			PAR.			2.1以	THE AV		
Specific Conductance	e (μS/cm	)	14			COL ARM			X	A		<b>新水</b> 市。
pH (s.u.)			3.8					Charles /				
	Г							131×10				
Water Clarity		Clea	r, tannin stained		N.			ask.				
Habitat Assessment	Scores	(max)			Y A							
Channel Modification	(15)	(,	15		1		172		1×			
Instream Habitat (20)	(10)		20	At L		1		The states	1.4.			
Bottom Substrate (15)	)		10		1 .				#1 A			and and and
Pool Variety (10)	/		10	The The					- wiek			a second
Left Bank Stability (10	))		10		715-00							
Right Bank Stability (	10)		10		1200	en P						
Light Penetration (10)	- /		10	the second second	1							- And
Left Riparian Score (5	5)		5			1						*
Right Riparian Score	, (5)		5									
Total Habitat Score	(100)		95	Subs	strate	Sand and	d orgar	nic muck				
Sample Date	e		Sample II	D	Spe	ecies Tota	I		NCIBI		Bioc	lassification
04/15/08			2008-11			8					Ν	lot Rated
10/21/03			2003-70			10					Ν	lot Rated
Most Abundant Spo	ecies		Dusky Shiner			Exotic	Spec	ies	None			
Species Change Sin	ce Last	Cycle	<b>Gains</b> S Redfin Pic	andhills Chub, kerel, Bluespo	Creek Cl tted Sunfi	hubsucker sh, and W	, and C armou	Chain Picke th.	erel. Los	ses America	an Eel, Ye	ellow Bullhead,
Data Analysis												
Watershed drains of	central H	loke C	ounty; within the p	roperty of Fort	Bragg; tri	ibutary to F	Rockfis	sh Creek; n	o munici	palities within t	he water	shed. Habitat
very high quality instru	eam and	l riparia	an habitats includir	ng aquatic plar	nts, deadfa	alls, snags	, and o	coarse woo	dy debris	Water Qual	ity a ty	pical Sand Hills

very high quality instream and riparian habitats including aquatic plants, deadfalls, shags, and coarse woody debris. Water Quality -- a typical Sand Hills stream with clear and dark water of very low conductivity and pH, conductivity has been 13 and 14 µS/cm, pH 4.8 and 3.8 s.u, lowest pH of any Sand Hills fish community site in 2008. 2008 -- typical Sand Hills fauna; two specimens of the Sandhills Chub, a species of Special Concern, were collected; 5 of the 8 species represented by 1 or 2 fish/species, only 3 of 8 species with multiple age classes; Redfin Pickerel were present, but represented only by young-of-year and not included in the total species count. 2003 & 2008 -- 13 species are known from the site; no exotic species have been collected at this site; dominant species is the Dusky Shiner.

Waterbo	dy	Location				Date	Date Station ID Bioclassification				
NICHOLSO	ON CE	2		SR 1301		04/15/	08	BF34	I	ted	
							ł				
County	Subb	asin	8 digit HUC	Latitude	Longi	itude	AU	Number	Level IV Ecore		oregion
HOKE	18	)	03030004	35.03083333	-79.210	55556	18	3-31-14		Sand F	lills
Stream Classifica	ition	Draiı	nage Area (mi	2) Elevatio	on (ft)	Stream	Width (	m) Av	erage Depth	(m)	Reference Site
С			16.2	249	)		6		0.5		Yes
		For	ested/Wetland	Url	ban		Aaricul	ture	o	)ther (des	cribe)
Visible Landuse	(%)		100		0		0			0	
	· · · ·										
Upstream NPDES D	nile)			NPDES Numb	er	Vol	ume (MGD)				
			None								
Water Quality Param	neters							Site Pho	otograph		
Temperature (℃)			15.5					A MARKET			A CARE
Dissolved Oxvaen (m	a/L)		8.1		( 19 A A		K.	The second	the start		
Specific Conductance	e (uS/cm	)	13	San y		1 L	1 A.				A DOM MAN
, рН (s.u.)	N.	,	5.0								
	_						S and				No. State State
Water Clarity		Clea	r, tannin staine	d	1.1						S. S.
Habitat Assessment	Cooroo	(max)			and the second	C. Carl					
	Scores	(max)					~				
Channel Modification	(15)		15		J.S.						STAR SARE
Instream Habitat (20)			20							-	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Bottom Substrate (15	)		10					1. 1. 1. 1.	a maint		- 2214
Pool Variety (10)			10						1000		
Left Bank Stability (10	))		10							See 2	
Right Bank Stability (	10)		10			17.2		The second			- Station of
Light Penetration (10)	) - \		10							30	-
Left Riparian Score (5	<b>)</b>		5				Mal Ling		7 1		the stand of
Right Riparian Score	(5)		5	_	r	0 1 1					
Total Habitat Score	(100)		95	Sub	strate	Sand and d	organic de	etritus			
Sample Date	e		Sampl	e ID	Spec	cies Total		NCIBI		Bioc	lassification
04/15/08			2008-	12		11				Ν	lot Rated
10/20/03			2003-	68		10				Ν	lot Rated
Most Abundant Sp	ecies		Dusky Shiner			Exotic S	pecies	None			
			-				•				
Species Change Sin	ce Last	Cycle	Gains	Creek Chubsuc	ker, Spotte	ed Sucker, I	Margined	Madtom, Larg	emouth Bass,	, and Pied	mont Darter.
Data Analysia			Losses	American Eei,	Tadpole N	hadtom, Do	llar Sunn	sn, and Sawcr	leek Darter.		
Watershed draine	control L	loko C	ounty: is adiace	ant to and oast of	the Junine	r Crock wa	arehod	within the pres	arty of Eart Br	aga: tribut	ary to Bookfich
Creek: no municipaliti	ies withi	the w	atershed: site i	s ~ 2 miles down	stream of N	Nott Lake	Habitat -	- verv hiah aus	ality instream a	agg, indul and rinaria	n habitats
including a tall open of	anopy, i	uns, si	nags, and dead	falls. Water Qua	ality a typ	oical Sand I	Hills strea	am; conductivit	y has been 14	and 13 µ	S/cm, pH 5.6 and
5.0 s.u. a typical Sar	d Hills fa	auna; a	almost twice as	many fish collect	ed in 2008	than in 200	)3 54 vs.	30; 1.5 vs. 0.6	fish/100 seco	onds); 8 of	the 11 species
represented by 1 or 2	fish/spe	cies: o	nly 3 of 11 spe	cies represented	by multiple	age group	s: two sp	ecies of sucke	rs and darters	collected.	2003 & 2008

represented by 1 or 2 fish/species; only 3 of 11 species represented by multiple age groups; two species of suckers and darters collected. 2003 & 2 15 species are known from the site; no exotic species have been collected at this site; Dusky Shiner is the dominant species.

Waterbody		Location Da			e Station ID			Bioclassification				
PUPPY	CR			SR 1406		04/15	5/08	BF3	9		Not F	Rated
County	Subb	basin	8 digit HUC	Latitude	Long	itude		AU Numb	er	L	evel IV	Ecoregion
HOKE	1	5	03030004	34.99083333	-79.119	972222		18-31-19	)	Atlanti	c Southe	ern Loam Plains
Stream Classification Drainage		nage Area (mi	(mi2) Elevation (ft)		Strea	ım Wia	dth (m)	Ave	erage Depth	(m)	Reference Site	
Visible Landuse	C 26 Forested/W Visible Landuse (%) 75		ested/Wetland	l Subu	<b>Suburban</b> 15		Agriculture 10			Other (describe)		escribe)
Upstream NPDES Di	scharg	ers (>1	MGD or <1MG	D and within 1 n	nile)			NPDE	S Numbe	er	v	olume (MGD)
	<u> </u>		None								-	
Water Quality Param	eters							Ş	Site Pho	tograph		
Temperature (°C)			14.7									
Dissolved Oxygen (mg	g/L)		8.8	110	PAN	in and		1	- Call	AVIE	1	
Specific Conductance	e (µS/cm	ר)	20	105	3.11		- Sel	1				
pH (s.u.)			4.4		12	5 CA		BEL-	T/			
Water Clarity		Clea	r, tannin staine	<sup>,d</sup>								
Habitat Assessment	Scores	s (max)						1-2/				
Channel Modification	(15)		15		4	704						
Instream Habitat (20)			18		and the		- Area	A			113	
Bottom Substrate (15)	)		13		- Summer	416	X	10				
Pool Variety (10)			10	10.00	-		C.o.	10		Di	*	
Left Bank Stability (10	))		10	10		The second		and and				74-1
Right Bank Stability (1	10)		10	-	S and		J	2.0		A COLORED	-21	
Light Penetration (10)			10	The		6				Est -	1h-	7
Left Riparian Score (5	5)		4	The second	1 the	Carlon Contraction			16	2	1	the second
Right Riparian Score	(5)		5									
Total Habitat Score (	(100)		95	Subs	strate	Sand and	d cobb	le				

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/15/08	2008-14	8		Not Rated
10/21/03	2003-71	11		Not Rated
05/21/98	98-47	8		Not Rated

Most Abundant Species

Species Change Since Last Cycle

**Tessellated Darter** 

**Gains** -- Yellow Bullhead, Warmouth, and Piedmont Darter. **Losses** -- Creek Chubsucker, Margined Madtom, Redfin Pickerel, Bluegill, Largemouth Bass, and Banded Pygmy Sunfish.

None

**Exotic Species** 

#### **Data Analysis**

**Watershed** -- drains eastern Hoke County; transitions an area between the Sandhills and the Atlantic Southern Loam Plains; stream originates within the Fort Bragg property and then is dissected by US 401; golf course community upstream between US 401 and SR 1406; houses and subdivision built along the left bank in the past five years. **Habitat** -- very high quality instream and riparian habitats including coarse woody debris, snags, undercuts, and runs; American Holly forest along the banks. **Water Quality** -- a typical Sand Hills stream with low conductivity and pH; conductivity has ranged from 17-20 µS/cm, pH from 4.4-5.4 s.u. **2008** -- species collected for the first time were the Warmouth and Piedmont Darter; suckers and cyprinids absent; second fewest fish and lowest catch per unit effort of any Sand Hills fish community site in 2008, 21 fish and 0.8 fish/100 seconds, respectively. **1998-2008** -- 16 species are known from the site; Dusky Shiner and Spotted Sucker have not been collected since 1998; no exotic species have ever been collected at this site; catch per unit effort has ranged from 0.6 to 1.1 fish/100 seconds.

Waterbo	dy		L	ocation		Date	•	Station II	D	Bioclass	ification	
L ROCKFIS	SH C	R	Pla	Plank Rd			/08	BF19		Not R	lated	
County	Subb	oasin	8 digit HUC	Latitude	Long	itude	de AU Number			Level IV	Ecoregion	
HOKE	1	5	03030004 3	5.05444444	-79.090	083333		18-31-24-(1)		Sand Hills		
Stream Classifica	ition	Drai	nage Area (mi2)	Elevatio	n (ft)	Stream	m Wic	dth (m)	Average Dep	th (m)	Reference Site	
В			11.2	214			6		0.5	0.5 Yes		
		For	ested/Wetland	Urk	an		Ag	riculture		Other (de	escribe)	
Visible Landuse	(%)		100	(	)			0		0		
Unotroom NBDES Di	ochora	oro (~ 1		nd within 1 n	nilo)				lumbor	v	olumo (MGD)	
opstream NPDES DI	scharg	615 (21	None		ine)			INF DES I	-	<b>`</b>		
			Hono									
Water Quality Param	neters				N Marke Di Lavratica are			Sit	e Photograph			
Temperature (°C)			15.2			YARX	6					
Dissolved Oxygen (mg	g/L)		8.4		操作者	MAN	KQ.	E XCHY	A MARIA	146		
Specific Conductance	e (µS/cm	ר)	12		10.0	1. 4	TEA	HANK	N-FN-YC/		10.25 108	
pH (s.u.)			4.3		HAN SIX		( en	S. J. X	V WY	S. Contraction	1 Really	
Water Clarity		Clea	r tannin stained		對於		Í.	XI		X	SIGN.	
Water Olanty		0100		ALC: N	A to	C. Sur	Le des				AND A DA	
Habitat Assessment	Scores	s (max)		X THE								
Channel Modification	(15)		15	CAL-	THE ST						S. ANSTE	
Instream Habitat (20)			20				an a	100				
Bottom Substrate (15)	)		7				-			5 3		
Pool Variety (10)			10				100 <sup>1</sup>	and the second		-2		
Left Bank Stability (10	))		10			22			States of the	2. 7	Contraction of the	
Right Bank Stability (1	10)		10			State of the second	10			-Jacks		
Light Penetration (10)			10				Prode 1		and the second			
Left Riparian Score (5	5)		5	a subscription of the second se	and the second	to a the		AN AND	and the second	142	-	
Right Riparian Score	(5)		5									
Total Habitat Score (	(100)		92	Subs	strate	Sand and	orgar	nic muck				
Sample Date	•		Sample I	)	Spe	cies Total		I	NCIBI	Bi	oclassification	
04/15/08			2008-13			11					Not Rated	
10/20/03			2003-67			9					Not Rated	
Most Abundant Spe	ecies		Dusky Shiner			Exotic	Spec	ies N	one			
Species Change Sin	ce Last	t Cycle	Gains M Darter. Lo	argined Madto sses Yellov	om, Lined v Bullhead	Topminnov , Redfin Pi	w, Blu ickere	espotted Sun I, and Dollar S	fish, Redbreast Sunfish.	Sunfish, ar	d Tessellated	
Data Analysis												
Watershed drains e are within Fort Bragg habitats including thic debris. Water Qualit and 12 µS/cm, pH 5.7	eastern property k cane i y a ty and 4.3	Hoke a y; tribut in the ri pical sa 3 s.u. 2	nd western Cumbo ary to Rockfish Cre parian zones; <i>Vali</i> and Hills stream wi <b>2008</b> a typical Sa	erland counties eek; no munici sneria, Juncus th the lowest of and Hills fauna	s; adjacen palities wi s, <i>Batrach</i> conductivit t; almost th	t to and ea thin the wa <i>nospermum</i> y of any fis hree times	ast of t atersho n, and sh con as ma	the Puppy Cre ed. <b>Habitat</b> - I Golden Club nmunity site in any fish colled	eek River waters - very high qualit ; pools and runs n 2008, pH also I cted in 2008 thar	ned; site an y instream ; and abun ow; condu n in 2003 ({	nd the watershed and riparian dant coarse woody ctivity has been 11 30 vs. 29; 1.7 vs. 0.6	

fish/100 seconds); 8 of the 11 species represented by 1 or 2 fish/species; only 3 of 11 species represented by multiple age groups. **2003 & 2008** -- 14 species are known from the site; no exotic species have been collected at this site; dominant species is the Dusky Shiner.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
09/04/08	10526	19	19	4.30	4.30	Good
09/03/03	9300	23	23	4.48	4.48	Good
07/20/98	7681	22	22	4.07	4.07	Good
08/25/93	6356	22	22	4.23	4.23	Good

### **Taxonomic Analysis**

EPT taxa richness at this location has been remarkably stable since 1993. Indeed, eight EPT taxa have been collected here at every sampling event and an additional seven EPT taxa have been collected here on three of the four sampling events. The 2008 sample produced only one previously uncollected taxon, the stonefly *Acroneuria arenosa*.

### Data Analysis

Although the EPTBI and EPT taxa richness has been consistent since 1993, the 2008 sample did produce slightly fewer EPT taxa relative to earlier samples. This sample also resulted in the lowest EPT abundance (78) and was down from 1993 (80), 1998 (101), and 2003 (100). These two metrics were likely suppressed as a result of temporary high flows and subsequent reduced access to some habitat due to deep water and not the result in a shift in water quality. This conclusion is supported by the water chemistry data as specific conductance has been very uniform: 1998 (46 µS/cm), 2003 (44 µS/cm), and 2008 (40 µS/cm).

Waterbo	dy		Location		Date		Station ID	E	Bioclassif	ication	
BONES	CR		SR 1400		04/11/0	08	BF35		Not Ra	ated	
County	Subbasir	n 8 digit HUC	Latitude	Longi	itude		AU Number	L	evel IV E	coregion	
CUMBERLAND	15	03030004	35.06333333	-79.038	88889		18-31-24-2	Atlanti	Atlantic Southern Loam		
<b>.</b>				(***	•						
Stream Classifica	ition Di	ainage Area (mi2)	Elevatio	n (ft)	Stream	n Wid	th (m)	Average Depth	(m)	Reference Site	
C		12.2	200		4			0.8		No	
	F	orested/Wetland	Subu	ırban		Aari	iculture	C	Other (de	er (describe)	
Visible Landuse	(%)	60	4	0			0		0		
					•			•			
Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 m							NPDES Nu	ımber	Vo	lume (MGD)	
		None									
Water Quality Param	neters						Site	Photograph			
Temperature (℃)		18.0	Same Ne		MAT		N A A A				
Dissolved Oxvaen (me	a/L)	6.2									
Specific Conductance	e (μS/cm)	18	300 Lai	1	i SA	nite-	A Carlo			Les and	
рН (s.u.)	u ,	4.8				Part	TRACE STOR				
			3	限的不能。	2 - No -	1 Mar	1957-205		E SAL	The Provide and the	
Water Clarity	C	ear, tannin stained							109		
Habitat Assessment	Scores (ma	ax)		195-95 6.1				200		-11-11-	
Channel Modification	(15)	15						N. R.			
Instream Habitat (20)		20							See 2		
Bottom Substrate (15)	)	6									
Pool Variety (10)		10			- Laska		A AL	The best	X		
Left Bank Stability (10	))	10					1 22	AN .			
Right Bank Stability (1	10)	10					1 12			AND AREA	
Light Penetration (10)		7					1227	1968 P	2.15	AND	
Left Riparian Score (5	<b>b</b> )	5		An B		ALC -	REFERENCES	7.	Eren	301	
Right Riparian Score	(5)	5	Cuba		Canal and a		a mul				
Total Habitat Score (	(100)	88	Subs	strate	Sand and d	organi	C MUCK				
Sample Date		Sample	ID	Spe	cies Total		N	CIBI	Bio	classification	
04/11/08		2008-1	0		17					Not Rated	
10/20/03		2003-6	6		13					Not Rated	
Most Abundant Spe	ecies	Dusky Shiner			Exotic S	Specie	es Rec	dear Sunfish			
Species Change Sin	ce Last Cyc	Gains	Margined Madto	om, Swam	pfish, Lined	Topn	ninnow, Chain	Pickerel, Mud Su	unfish, Re	dear Sunfish, and	
Data Analysis		Largenic	. LUSS		, שמווטפט סנ	1111511	, ана г ишрки				
Watershed draine v	western Cun	berland County: th	e watershed ab	ove the site	e is on Fort	Brade	n: lower nart is	being encroache	ed unon h	v subdivisions and	

Watershed --- drains western Cumberland County; the watershed above the site is on Fort Bragg; lower part is being encroached upon by subdivisions and apartment complexes from the Fayetteville metropolitan area; site straddles the Sand Hills and the Atlantic Southern Loam Plains; tributary to Little Rockfish Creek. Habitat -- high quality instream and riparian habitats including runs, deep pools, snags, aquatic macrophytes, *Batrachospermum*, and coarse woody debris; bottomland forest, but not with a dense canopy. Water Quality -- a typical Sand Hills stream with very low conductivity and pH; conductivity has been 14 and 18 µS/cm, pH 5.8 and 4.8 s.u. 2008 -- almost three times more fish collected in 2008 than in 2003 (139 vs. 49; 2.4 vs. 0.9 fish/100seconds), of which one-third were Dusky Shiner; only Sand Hills site from which the Swampfish was collected; suckers absent; 9 of 17 species represented by only 1 or 2 fish per species; only 6 of 17 species were represented by multiple age classes. 2003 & 2008 -- 20 species are known from the site, including 10 species of centrarchids, but no species of suckers have been collected.

Waterbody			Date	)	Station	ID	Bioclassification					
HARRISO	N CR	2	S		04/04	/08	BF9	1		Not R	ated	
County	Subb	basin	8 digit HUC	Latitude	Latitude Longitude		•	AU Numb	er	L	evel IV E	coregion
BLADEN	1	16 03030005		34.747015	-78.70	09156	56 18-42a			Carolina		latwoods
Stream Classifica	Stream Classification Drainage Ar		nage Area (mi2)	Elevation (ft)		Strea	m Wid	ith (m)	A١	verage Depth	(m)	Reference Site
C;Sw			48.3	98			7			0.5		No
	Forested/Wetland		Residenti	Residential/Commercial			Agriculture			Other (describe)		
Visible Landuse	Visible Landuse (%) 75			25			0		0			
Upstream NPDES Dischargers (>1MGD or <1MGD a			) and within 1 n	nile)			NPDES	6 Numb	ber	Ve	olume (MGD)	
Water Quality Parameters								S	Site Pho	otograph		
Temperature (°C)			22.7	The second second	AS AS					CA.		
Dissolved Oxygen (m	g/L)		6.2		Nº I	1.1.1.	Tr -		The second			
Specific Conductance	e (µS/cm	ו)	58		1							THE PARTY
pH (s.u.)			3.7		1 martin	Raile		Ar -				
							17	Al and	- Pre	Sec. 161	PL	the second
Water Clarity			Black water					र हिंद्र द		2.8	4	31
Habitat Assessment	Scores	s (max)	1		A Star		120					
Channel Modification	(15)		15		1- 2-	STREE 2	1.10	all and			- (- ) 5	
Instream Habitat (20)			20			and the second					1 - 23	Adam State
Bottom Substrate (15	i)		14	100	e.					april 5	1	
Pool Variety (10)			10		and the second				X	2K		A MARS
Left Bank Stability (10) 9			Company 2	-		and the	AV.			A LET A		
Right Bank Stability (10) 7			all all			and and	1 / ]	Real	A come	Grand	State And	

Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5)

**Total Habitat Score (100)** 

15	
20	
14	AL CONTRACT
10	
9	
7	
10	S. m
5	
2	
92	Sub

Flier.

gravel, sand, clay pan. ostrate

Sample Date Sample ID **Species Total** NCIBI **Bioclassification** 04/04/08 2008-58 Not Rated 11 --05/20/98 98-44 9 ---Not Rated 05/03/94 94-13 10 ---Not Rated **Most Abundant Species** 

Dusky Shiner. **Exotic Species** None. Gains - Bluespotted Sunfish, Redbreast Sunfish, Dollar Sunfish, Tadpole Madtom. Losses - Yellow Bullhead, Species Change Since Last Cycle

# **Data Analysis**

Watershed -- A tributary to the Cape Fear River that drains the rural area of south-central Cumberland County and north-central Bladen County. Habitats -- high quality instream habitats including swift runs with root riffles and side pools with cypress knees. 2008 -- a fairly diverse fish community for a low pH, coastal watershed; as expected, low species abundances with a maximum of 15 individuals collected per species. 1994-2008 -- a total of 15 species have been collected from this site, including seven species of sunfish and three species of catfish; although Not Rated, this stream is supporting a trophically rich community of fish, and is showing no clear signs of any water quality issues.

Waterbody			Location				Dat	Date Station ID		ID	Bioclassification				
BROWNS CR				NC 87				/08	BF77		Not Rated				
County	County Subbasin 8 c		8 digit HL	digit HUC Latitude Long			gitude	itude AU Number		Level IV Ecoregion					
BLADEN	ADEN 16		03030005		34.613943 -78.58501		58501		18-45		Carolina Flatwoods				
				-											
Stream Classification		Drair	Drainage Area (mi2)		Elevation (ft)		Strea	Stream Widt		lth (m) Ave		erage Depth (m)		Reference Site	
C		15		77			8		0.3				No		
		For	ested/Wetl	and	Rural Re	sidentia	I	Ag	riculture			Other (d	escribe)		
Visible Landuse (%)			75		10			15			0				
Upstream NPDES Dischargers (>1MGD			MGD or <1	MGD a	and within 1 n	nile)			NPDES	S Numbe	r	v	olume (M	GD)	
			None			•								· ·	
Water Quality Param	neters								s	ite Phot	ograph				
Temperature (°C)				7.4				1	No. 2 D			200	1 days	42 C 2	
Dissolved Oxygen (mg/L)				8.2		- Chi	3		At it is	1-0-2				and a	
Specific Conductance (µS/cm)				113		24					1. A.M.			A.T.	
pH (s.u.)			6.3		w/2	(and a little		P.P. S			in the				
									1	and and the		1 / ×			
Water Clarity Clear, tann			r, tannin sta	ined	14	all and a second					-	Franklin -		and and	
						V.							A WAR	A Pastor	
Habitat Assessment	Scores	s (max)								an artist	- Kinty			2 Martin	
Channel Modification (15)				15	+		Contraction of the local division of the loc	-						and the	
Instream Habitat (20)				18										CITE C	
Bottom Substrate (15)				7									- Alexandre		
Pool Variety (10)				10		1.1	<b>3</b> .7 S. M				335				
Left Bank Stability (10)				9		-6			-						
Right Bank Stability (10)				9				and the second		A		-		- Comment	
Light Penetration (10)				8	to the	2000	1. 2		1. S. S. S.		1. 20	Not of		and the	
Left Riparian Score (5)				5		and a state					and the second second		-	1	
Right Riparian Score (5)				5											
Total Habitat Score (100)				86	Subs	strate	sand.								

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/21/08	2008-21	25		Not Rated
05/20/98	98-42	11		Not Rated
08/11/92	92-36	12		Not Rated

Most Abundant Species	Redbreast Sunfish.	Exotic Species	Redear Sunfish, Spotted Bass.					
	Gains Pirate Perch, Satinfin Shir	Gains Pirate Perch, Satinfin Shiner, Whitefin Shiner, Bluespotted Sunfish, Creek Chubsucker, Lake						
Species Change Since Last Cycle	Chubsucker, Eastern Mosquitofish, Pumpkinseed, Warmouth, Dollar Sunfish, Redear Sunfish, Dusky Shiner,							
	Spottail Shiner, Sandbar Shiner, Black Crappie. Losses Bowfin.							

Data Analysis

Watershed -- a tributary to the Cape Fear River that drains central Bladen County and flows east through Elizabethtown. Habitats -- high quality instream habitats consisting of shifting sandy runs with good pool habitats where snags exist and along banks; good bank stabilities, healthy vegetated riparian habitats, and good canopy coverage. 2008 -- an extremely diverse fish community for a sandy coastal plain stream, with twice as many species collected than either previous sample, and greater than five times the total fish abundance as in 1998 (n=232 vs. 43). Previously uncollected species include five minnow species, four sunfish species and two sucker species. Redbreast Sunfish represent 25% of the sample. 1992-2008 -- a total of 28 fish species are known from this watershed; although not rated, this creek is supporting a thriving fish community and shows no signs of water quality issues.


Substrate

sand with some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/07/08	10379	73	14	6.27	4.84	Moderate
02/20/03	8881	63	15	6.70	5.10	Moderate

#### **Taxonomic Analysis**

The benthic community in Browns Creek at NC 87 has remained stable over the past 5 years in both EPT richness and abundance (69 in 2008; 65 in 2003). The taxa composition in 2008 shifted to be slightly less tolerant both within the EPT and overall benthic community. While some previously collected taxa were lost such as *Acerpenna pygmaea*, *Taeniopteryx*, and *Phylocentropus*, others were collected for the first time and included *Centroptilum*, *Shipsa rotunda*, *Perlesta*, and *Oecetis persimilis*. In addition, higher numbers of collected taxa in 2008 were explained in part by greater odonate richness which almost doubled from 6 to 11. Also, fewer tolerant midge taxa were collected in 2008 which contributed to a lower biotic index.

#### Data Analysis

Browns Creek originates within an agricultural and forested landscape in central Bladen County and drains Elizabethtown, the largest munincipality in the area. Benthic habitat in Browns Creek was good although elevated specific conductance, typical of streams passing through munincipalities, was reported. Browns Creek has maintained a Moderate rating with a slightly more intolerant benthic community than that found in 2003.

Waterbo	dy			Location		Date	Statior	Station ID Bioclassification		
HAMMON	D CR	2	S	R 1709		04/22/08	BF1	32	Not F	Rated
		_		· ··· ·	_	. <u>.</u>				
County	Subb	asin	8 digit HUC	Latitude	Long	tude	AU Numb	er	Level IV	Ecoregion
BLADEN	1	6	03030005	34.56974	-78.56	0731	18-50		Carolina	Flatwoods
Stream Classifica	tion	Drai	nage Area (mi2)	Elevatio	on (ft)	Stream Wi	dth (m)	Avera	age Depth (m)	Reference Site
С			11.6	200	)	5			0.4	No
		For	ested/Wetland	Rural Re	sidential	Ą	griculture		Other (c	lescribe)
Visible Landuse	(%)		85		5		10			0
Upstream NPDES Di	scharg	ers (>1	MGD or <1MGD	and within 1 ı	mile)		NPDE	S Number		/olume (MGD)
			None							
Water Quality Param	eters						S	Site Photo	graph	
Temperature (°C)			15.6	14				- Arec	AT THE	
Dissolved Oxygen (mg	g/L)		7.1		2	- 1				
Specific Conductance	e (µS/cm	ı)	134				119			17
pH (s.u.)			6.0							The Lord
						3-/-		1 Person		
Water Clarity			Black water					-		1 9 minus
Habitat Assessment	Scores	(max)				1 Sand	NER	E		A Section
Channel Modification	(15)		15				2225	1		A Company
Instream Habitat (20)			18				13 62	Carl Lines	1 The	R. AR
Bottom Substrate (15)	)		8			133		+1-1	-10 - 10-	
Pool Variety (10)			10					A.	That	
Left Bank Stability (10	))		9				. 5	Mr.		ET S
Right Bank Stability (1	10)		9				-			
Light Penetration (10)			10					1		C C
Left Riparian Score (5	) (-)		5						The second se	
Right Riparian Score	(5)		5	Cub	otroto	aand				
Total Habitat Score (	(100)		89	due	strate	sanu.				
Sample Date	)	_	Sample	ID	Spe	cies Total		NCIBI	В	ioclassification
04/22/08			2008-22	<u> </u>		14				Not Rated
Most Abundant Spe	ecies		Bluegill.			Exotic Spec	cies	None.		
Species Change Sin	ce Last	Cycle	N/A							
Data Analysis										
New basinwide site	Watersł	hed a	a tributary to the (	ane Fear Rive	r that drain	s rural central l	Bladen Cour	ntv: located	Liust south of the	Browns Creek

New basinvide site. Watershed -- a tributary to the Cape Fear River that drains rural central Bladen County; located just south of the Browns Creek watershed. Habitats -- high quality instream habitats with sandy runs, pools with abundant coarse woody debris, and snags throughout. **2008** -- a blackwater stream with good fish diversity and relatively few individuals per species, which is common among coastal black water streams; sample included five species of sunfish, four species of minnow, and both pickerel species. Bluegill represent 33% (n=29) of the collection. The fish community of Hammond Creek appears healthy, and is showing no apparent signs of water quality issues.

Waterboo	dy			Location		Dat	e	Statior	n ID	Bioclassification		fication
WHITES	CR			SR 1704		04/22	2/08	BF12	22		Not R	ated
County	Subb	asin	8 digit HUC	Latitude	Long	itude		AU Numb	er	L	evel IV E	Ecoregion
BLADEN	10	6	03030005	34.545834	-78.50	)5894	18-50-5 Carolina Flatwo		Flatwoods			
Stream Classifica	tion	Drair	nage Area (mi	2) Elevat	ion (ft)	Strea	am Wio	dth (m)	Ave	rage Depth	(m)	Reference Site
С			10.3	4	9		5.5			0.2		No
		For	ested/Wetland	I Rural F	esidential		Ag	riculture		C	Other (de	escribe)
Visible Landuse	(%)		90		10			0			0	
Upstream NPDES Di	scharge	ers (>1	MGD or <1MG	D and within 1	mile)			NPDE	S Numbe	er	V	olume (MGD)
			None		,							
Water Quality Param	eters							S	Site Phot	ograph		
Temperature (°C)			15.4				T		Service	14.5	1×	
Dissolved Oxygen (mg	g/L)		8.5			Parter 1	3	15	11	AN	Y. U	W Self Like of
Specific Conductance	(µS/cm	ı)	111	I date	A DON	1 PAL	11/	STEL.	Seil-	1720	XX	Carl 18
pH (s.u.)			6.1			WAR.					1	
Water Clarity	[	Clea	r, tannin staine	d							the second	1 - a
Habitat Assessment	Scores	(max)		*	John St.	A	S.C.					the second second
Channel Modification	(15)		15		W			1			-	
Instream Habitat (20)			18		$\Lambda$		Carlo I	1.1			-	
Bottom Substrate (15)	)		13			L. C.	the second					THE PARTY NO
Pool Variety (10)			9			-						
Left Bank Stability (10	))		9									Transfer
Right Bank Stability (1	0)		9		Martin Contraction	Constantly.	Section 1		and a	1 9		and the second
Light Penetration (10)			10			Ser ?		and the second	(MAL)	Ser.	-	and the second second
Left Riparian Score (5	i)		5		1 .	1.4	The -	and the second	1.1.1.1			and the second second
Right Riparian Score (	(5)		5									
Total Habitat Score (	(100)		93	Su	bstrate	sand.						

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/22/08	2008-23	16		Not Rated
05/20/98	98-45	19		Not Rated
Most Abundant Species	Dusky Shiner.	Exotic Spe	cies Redear Sunfish.	
Species Change Since Last Cycl	Gains - Eastern Mosqu Spotted Sucker, Golder	itofish, Redear Sunfish, Cr n Shiner, Sandbar Shiner.	eek Chub. Losses - Snail Bullh	ead, Flier, Sawcheek Darter,

# Data Analysis

Watershed -- a tributary to Hammond Creek that drains rural central Bladen County. Habitats -- high quality instream habitats including shallow sandy runs with long shallow side pools, course woody debris, and good root systems; good bank stabilities, extensive vegetated riparian widths, and a full canopy. 2008 -- a diverse community of fish was collected, with a species composition that is typical of Coastal Plain streams; Dusky Shiner (n=203) accounted for 60% of the sample, resulting in an increase in total abundance of the fish community (337 vs. 144). 1998-2008 -- a slight shift in trophic structure over a 10 year period to a higher percentage of insectivores (Dusky Shiner) and a lower percentage of piscivores. Although this stream is Not Rated with the NCIBI, the fish community appears healthy, and continues to exhibit good water quality.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/07/08	10380	47	12	6.94	5.58	Moderate
02/25/03	9050	42	12	6.16	5.13	Moderate
03/04/98	7522	69	20	6.00	4.78	Natural

#### **Taxonomic Analysis**

Although EPT richness remained the same as 2003 levels, overall taxa richness increased due in large part to higher numbers of tolerant midge and beetle taxa. Overall tolerance of the community also increased as intolerant species became much less abundant. EPT abundance values were less than half of 2003 levels (20 versus 56). The only abundant taxa collected were the amphipod *Gammarus* and the snail *Campeloma decisum*. Taxa lost from 2003 to 2008 were *Acerpenna pygmaea*, *Pseudocloeon frondale*, *Cheumatopsyche* and *Oecetis persimilis*. Newly collected taxa were *Callibaetis*, *Eurylophella doris*, and *Ironoquia punctatissima*.

#### Data Analysis

The catchment of Hood Creek is primarily composed of agricultural fields and forest. No major urban centers feed this creek although development is occuring throughout the watershed. Worsening water quality is indicated by a steadily increasing Biotic Index over the past ten years even though Hood Creek has maintained its Moderate rating from the previous basinwide cycle. Overall habitat was decent with the lack of good bottom substrate as the largest deficiency for colonizing macroinvertebrates.

CRANE CR         SR 1146         04/23/08         BF134         Not Rated           SAMPSON         19         03030006         34.831454         -78.231467         18-68-2-12         Rolling Coastal Plain           Stream Classification         Drainage Area (mi2)         Elevation (t)         Stream Width (m)         Average Depth (m)         Reference Site           C: Sw         12         54         5         0.4         NO           Visible Landuse (r)         60         0         40         0         0           Visible Landuse (r)         61         0         40         0         0         0           Visible Landuse (r)         60         0         40         0	Waterbo	dy		L	ocation		Date	Date Station ID Bioclassification			
County         Subbasin         8 digit HUC         Latitude         Longitude         AU Number         Level IV Ecoregion           SAMPSON         19         03030006         34.881454         -78.281467         18-68-2-12         Rolling Coastal Plain           Stream Classification         Drainage Area (mi2)         Elevation (ft)         Stream Width (m)         Average Depth (m)         Reference Site           C; Sw         12         54         5         0.4         No           Visible Landuse (%)         60         0         40         0           None         Volume (MDD)           None         Volume (MDD)           None         Site Photograph           Visite Carlity         18.1           Tannin stained            77	CRANE	CR		S	R 1146		04/23/08	BF134	No	t Rated	
County         Stabbasin         8 digit HUC         Latitude         Longitude         AU Number         Level IV Ecoregion           SAMPSON         19         0303006         34.881454         -78.281467         18-68-2-12         Rolling Coastal Plain           Stream Classification         Drainage Area (mi2)         Elevation (ft)         Stream Width (m)         Average Depth (m)         Reference Site           C: Sw         12         54         5         0.4         No           Visible Landuse (%)         60         0         40         0           Upstream NPDES Dischargers (>IMGD or <imgd 1="" and="" mile)<="" td="" within="">         NPDES Number         Volume (MGD)           None        </imgd>									ł		
SAMPSON         19         03030006         34.881454         .78.281467         19-68-2-12         Rolling Coastal Plan           Stream Classification         Drainage Area (mi2)         Elevation (ft)         Stream Width (m)         Average Depth (m)         Reference Site           C; Sw         12         54         5         0.4         No           Visible Landuse (%)         60         0         40         0           Upstream NPDES Dischargers (>1MOD or <1MOD and within 1 mile)	County	Subb	basin	8 digit HUC	Latitude	Long	itude	AU Number	Level	IV Ecoregion	
Stream Classification         Drainage Area (mi2)         Elevation (th)         Stream With (m)         Average Depth (m)         Reference Stele           C: Sw         12         54         5         0.4         No           Protected/Wetland         Urban         Agriculture         Other (describe)           Visible Landuse (%)         60         0         40         0           Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	SAMPSON	1	9	03030006	34.881454	-78.28	31467	18-68-2-12	Rolling	g Coastal Plain	
C: Sw         12         54         5         0.4         No           Forested/Wetland         Urban         Agriculture         Other (describe)           0         40         0           Uisible Landuse (%)         60         0         40         0           Upsteam NPDES Dischargers (=1MGD or <1MGD and within 1 mile)         NPDES Number         Volume (MGD)           More              Water Quality Parameters         Site Photograph            Specific Conductance (µS/cm)         18.1         7.7             Water Clarity         Tannin stained               Mabital Sacessment Scores (max)         15         15              Not that Rank Stability (10)         10         10              Substrate (5)         5         5         Substrate (5)         5         Substrate (5)          Not Rated           Mexita Alapiana Score (5)         5         5         Substrate (5)          Not Rated           Most Abundant Species         Dusky Shiner.         Exotic Species None.	Stream Classifica	tion	Drai	nage Area (mi2)	Elevatio	on (ft)	Stream Wi	dth (m)	Average Depth (m)	Reference Site	
Forested/Wetland         Urban         Agriculture         Other (describe)           Visible Landuse (%)         60         0         40         0           Uptream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	C; Sw			12	54	ļ	5		0.4	No	
Visible Landuse (%)     60     0     40     0       Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)			For	ested/Wetland	Ur	ban	Ag	griculture	Othe	r (describe)	
Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)     NPDES Number     Volume (MGD)       None         Water Quality Parameters     Site Photograph       Temperature (°C)     18.1     7.7       Dissolved Oxygen (mg/L)     96     6.1       Water Clarity     Tannin stained        Habitat Assessment Scores (max)     15        Channel Modification (15)     15     19       Instream Habitat (20)     10     10       Left Bank Stability (10)     10     10       Light Parentation (10)     4        Might Ray and Score (5)     5     5       Total Habitat Score (100)     85     Substrate       Sample Date     Sample ID     Species Total     NCIBI       Most Abundant Species     Dusky Shiner.     Exotic Species     None.	Visible Landuse	(%)		60		0		40		0	
None         Water Quality Parameters     Sile Photograph       Temperature ("C)     18.1     7.7       Specific Conductance (µS/cm)     96       (s.u.)     6.1       Water Clarity     Tannin stained       Habitat Assessment Scores (max)     6.1       Channel Modification (15)     15       Instream Habitat (20)     19       Bottom Substrate (15)     7       Pol Variety (10)     10       Left Riparian Score (5)     5       Right Riparian Score (5)     5       Sample Date     Sample ID       Sample Date     Sample ID       Most Abundant Species     Dusky Shiner.       Exotic Species     None.       Species Change Since Last Cycle     N/A	Upstream NPDES Di	scharg	ers (>1	MGD or <1MGD	and within 1	mile)		NPDES Nu	mber	Volume (MGD)	
Site Photograph         Temperature (°C)       18.1         Dissolved Oxygen (mg/L)       7.7         Specific Conductance (µS/cm)       96         Habitat Assessment Scores (max)       15         Channel Modification (15)       15         Instream Habitat (20)       19         Bottom Substrate (15)       7         Pool Variety (10)       10         Light Panetration (10)       10         Light Rank Stability (10)       10         Lift Rank Stability (10)       10         Lift Rank Stability (10				None							
Temperature (°C)       18.1         Dissolved Oxygen (mg/L)       7.7         Specific Conductance (µS/cm)       96         PH (s.u.)       6.1         Water Clarity       Tannin stained         Habitat Assessment Scores (max)       Channel Modification (15)       15         Channel Modification (15)       15         Instream Habitat (20)       19         Bottom Substrate (15)       7         Pool Variety (10)       10         Left Bank Stability (10)       10         Light Panetration (10)       4         Left Raparian Score (5)       5         Stability (10)       10         Light Panetration (10)       4         Left Raparian Score (5)       5         Stability (20)       5         Most Abundant Species       Sample ID         Most Abundant Species       Dusky Shiner.         Species Change Since Last Cycle       N/A         Data Analysis       N/A	Water Quality Param	neters			_			Site F	Photograph		
Dissolved Oxygen (mg/L) 7.7 Specific Conductance (µS/cm) 6 hf (s.u.) 6 Habitat Assessment Scores (max) Channel Modification (15) 15 Instream Habitat (20) 19 Bottom Substrate (15) 7 Pool Variety (10) 10 Left Bank Stability (10) 10 Left Bank Stability (10) 10 Left Riparian Score (5) 5 Right Rank Stability (10) 4 Left Riparian Score (5) 5 Right Rank Stability (10) 10 Left Bank St	Temperature (°C)			18.1		ANY DE	- AND -			ALTER TO	
Specific Conductance (µS/cm) 96   pH (s.u.) 6.1   Water Clarity Tannin stained   Habitat Assessment Scores (max)   Channel Modification (15) 15   Instream Habitat (20) 19   Bottom Substrate (15) 7   Pol Variety (10) 10   Light Rparian Score (5) 5   Total Habitat Score (100) 85   Sample Date Sample ID   Sample Date Sample ID   Sample Date Sample ID   Most Abundant Species Dusky Shiner.   Exotic Species None.	Dissolved Oxygen (mg	g/L)		7.7			and the second		小学		
pH (s.u.) 6.1 Water Clarity Tannin stained Habitat Assessment Scores (max) Channel Modification (15) 15 Instream Habitat (20) 19 Bottom Substrate (15) 7 Pool Variety (10) 10 Left Bank Stability (10) 10 Light Panetration (10) 4 Left Rayarian Score (5) 5 Total Habitat Score (100) 85 Substrate Sande D Sample Date Sample ID Species Total NCIBI Bioclassification 04/23/08 2008-25 18 Not Rated Most Abundant Species Dusky Shiner. Exotic Species None. Species Change Since Last Cycle N/A	Specific Conductance	e (µS/cm	ו)	96		Ser C				C. marine and a	
Water Clarity     Tannin stained       Habitat Assessment Scores (max)     Instream Habitat (20)     15       Channel Modification (15)     15       Instream Habitat (20)     19       Bottom Substrate (15)     7       Pool Variety (10)     10       Left Riparian Score (5)     5       Right Rak Stability (10)     10       Light Penetration (10)     4       Left Riparian Score (5)     5       Total Habitat Score (100)     85       Sample Date     Sample ID       Sample Date     Sample ID       Sample Date     Sample ID       Most Abundant Species     Dusky Shiner.       Exotic Species     None.	pH (s.u.)			6.1			ANA CONTRACT		and the second s		
Habitat Assessment Scores (max)         Channel Modification (15)       15         Instream Habitat (20)       19         Bottom Substrate (15)       7         Pool Variety (10)       10         Left Bank Stability (10)       10         Light Penetration (10)       4         Left Riparian Score (5)       5         Right Riparian Score (5)       5         Sample Date       Sample ID         Sample Date       Sample ID         Sample Date       Sample ID         Most Abundant Species       Dusky Shiner.         Exotic Species Change Since Last Cycle       N/A         Data Analysis       N/A	Water Clarity		Ta	annin stained							
Channel Modification (15)       15         Instream Habitat (20)       19         Bottom Substrate (15)       7         Pool Variety (10)       10         Left Bank Stability (10)       10         Light Ponetration (10)       4         Left Riparian Score (5)       5         Total Habitat Score (100)       85         Sample Date       Sample ID         Sample Date       Sample ID         Sample Date       Sample ID         Most Abundant Species       Dusky Shiner.         Kotic Species Change Since Last Cycle       N/A	Habitat Assessment	Scores	s (max)			Diff					
Instream Habitat (20) 19 Bottom Substrate (15) 7 Pool Variety (10) 10 Left Bank Stability (10) 10 Light Bank Stability (10) 10 Light Penetration (10) 4 Left Riparian Score (5) 5 Right Riparian Score (5) 5 Total Habitat Score (100) 85 Sample Date Sample ID Species Total NCIBI Bioclassification 04/23/08 2008-25 18 Not Rated Most Abundant Species Dusky Shiner. Exotic Species None. Species Change Since Last Cycle N/A	Channel Modification	(15)		15							
Bottom Substrate (15) 7 Pool Variety (10) 10 Right Bank Stability (10) 10 Light Penetration (10) 4 Left Riparian Score (5) 5 Right Riparian Score (5) 5 Total Habitat Score (100) 85 Substrate sand. Sample Date Sample ID Species Total NCIBI Bioclassification 04/23/08 2008-25 18 Not Rated Most Abundant Species Dusky Shiner. Exotic Species None.	Instream Habitat (20)			19					All All		
Pool Variety (10)       10         Left Bank Stability (10)       10         Right Bank Stability (10)       10         Light Penetration (10)       4         Left Riparian Score (5)       5         Right Riparian Score (5)       5         Total Habitat Score (100)       85         Sample Date       Sample ID         Sample Date       Sample ID         O4/23/08       2008-25         18          Not Rated         Most Abundant Species       Dusky Shiner.         Exotic Species       None.         Species Change Since Last Cycle       N/A	Bottom Substrate (15)	)		7	17. S.C.	See.		and the second	A STA	1 and	
Left Bank Stability (10) 10   Right Bank Stability (10) 10   Light Penetration (10) 4   Left Riparian Score (5) 5   Right Riparian Score (5) 5   Total Habitat Score (100) 85   Sample Date Sample ID   Sample ID Species Total   NCIBI Bioclassification   04/23/08 2008-25   18   Not Rated   Species Change Since Last Cycle N/A	Pool Variety (10)			10	C NILS	N.S.		The second	She i	1000	
Right Bank Stability (10) 10   Light Penetration (10) 4   Left Riparian Score (5) 5   Right Riparian Score (5) 5   Total Habitat Score (100) 85   Sample Date Sample ID   Sample Date Sample ID   O4/23/08 2008-25   18   Not Rated   Most Abundant Species Dusky Shiner.   Species Change Since Last Cycle N/A	Left Bank Stability (10	))		10	The M				-		
Light Penetration (10) Left Riparian Score (5) Right Riparian Score (5) Total Habitat Score (100) 85 Substrate sand.  Sample Date Sample ID Species Total NCIBI Bioclassification 04/23/08 2008-25 18 Not Rated Most Abundant Species Dusky Shiner. Exotic Species None.  Species Change Since Last Cycle N/A	Right Bank Stability (1	10)		10		TPEL	S. Bullet				
Left Riparian Score (5) 5   Right Riparian Score (5) 5   Total Habitat Score (100) 85   Sample Date Sample ID   Sample Date Sample ID   O4/23/08 2008-25   18   Not Rated   Most Abundant Species   Dusky Shiner. Exotic Species   None. Species Change Since Last Cycle   N/A	Light Penetration (10)			4	CARDA		Contraction of the second				
Sight Riparian Score (5)     5       Total Habitat Score (100)     5       Sample Date     Sample ID       O4/23/08     2008-25       Most Abundant Species     Dusky Shiner.       Exotic Species     None.	Left Riparian Score (5	5)		5		1					
Sample Date     Sample ID     Species Total     NCIBI     Bioclassification       04/23/08     2008-25     18      Not Rated       Most Abundant Species     Dusky Shiner.     Exotic Species     None.       Species Change Since Last Cycle     N/A	Right Riparian Score	(5)		5			-				
Sample Date     Sample ID     Species Total     NCIBI     Bioclassification       04/23/08     2008-25     18      Not Rated       Most Abundant Species     Dusky Shiner.     Exotic Species     None.       Species Change Since Last Cycle     N/A         Data Analysis	Total Habitat Score (	(100)		85	Sub	strate	sand.				
04/23/08     2008-25     18      Not Rated       Most Abundant Species     Dusky Shiner.     Exotic Species     None.       Species Change Since Last Cycle     N/A       Data Analysis	Sample Date	•		Sample I	D	Spe	cies Total	NC	IBI	Bioclassification	
Most Abundant Species     Dusky Shiner.     Exotic Species     None.       Species Change Since Last Cycle     N/A     Image: Comparison of the second secon	04/23/08			2008-25			18	-		Not Rated	
Species Change Since Last Cycle N/A Data Analysis	Most Abundant Spe	ecies		Dusky Shiner.			Exotic Spec	cies Non	e.		
Data Analysis	Species Change Sin	ce Last	Cycle	N/A							
	Data Analysis										

New basinwide site. **Watershed** -- a tributary to Six Runs Creek, which drains the rural easternmost edge of Sampson County. **Habitats** -- good quality instream habitats consisting of sandy runs with course woody debris, side pools, undercut banks, and submerged vegetation; great riparian widths, but the sample reach is mostly sunlit (i.e. open canopy) due to the predominance of grasses and shrubs (vs. trees) on and outside of the stream's stable banks. **2008** -- very diverse fish community for a tanic Coastal Plain stream, with five species of both sunfish and minnows; a relatively balanced trophic structure; Dusky Shiner (n=112) made up about 39% of the total abundance; although Not Rated with the NCIBI, Crane Creek appears healthy with no obvious water quality problems.

Waterbo	dy	Locat	ion	Station	ID		Date	Bioclassification
L COHAR	IE CR	SR 1	214	BB30	)1	07	7/07/08	Good
County	Subbasin	8 digit HUC	Latitude	Longitude	AU I	Number	Lev	vel IV Ecoregion
SAMPSON	19	3030006	34.88916667	-78.4425	18-68	8-68-12-(8.5) Southea		loodplains and Low Terraces
Stream Classifica	ition	Drainage Area (mi2) Ele		ation (ft)	ation (ft) Stream Width			Stream Depth (m)
C, SW				75		9		0.6
Visible Lenduse	Fo	rested/Wetland	Urban		Agricul	ture	O	ther (describe)
VISIBle Landuse	Visible Landuse (%)				0			
Upstream NP	DES Discharg	MGD and within	1 mile)	NF	DES Nun	nber	Volume (MGD)	
NONE				N/A		N/A		

#### Water Quality Parameters

Temperature (°C) Dissolved Oxygen (mg/L) Specific Conductance (µS/cm) pH (s.u.)

Water Clarity

Clear, tannic

25.3

4.5 66

5.8

#### Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	5
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

# Fabrara

Site Photograph

EPT EPT BI Bioclassification Sample Date Sample ID ST BI 86 5.66 07/07/08 10447 28 4.34 Good 09/17/03 9120 18 18 3.93 3.93 Good 08/05/98 7699 16 16 4.48 4.48 Good-Fair 4.08 08/23/93 6367 17 17 4.08 Good-Fair 10/17/89 5107 23 23 3.87 3.87 Good

#### **Taxonomic Analysis**

Although there has been very little change in the benthic macroinvertebrate community at this location since sampling started in 1989, there were several EPT taxa that were collected for the first time in 2008 and included the mayflies *Callibaetis sp., Centroptilum sp., Pseudocloeon ephippiatum, Tricorythodes sp.* the stonefly *Acroneuria arenosa*, and the caddisflies *Phylocentropus sp.* and *Oxyethira sp.* 

#### **Data Analysis**

This site is approximately seven stream miles downstream of the Roseboro WWTP (NC0026816001, 0.7 MGD). Despite the persistent drought conditions in this area of the state and the low flows observed, it appears this station is far enough below the discharger that severe deleterious effects often associated with higher instream waste concentrations due to drought induced low flows were reduced. Although the EPT taxa richness value was unchanged in 2003 from 2008, there was a large drop in EPT abundance from 2003 (86) to 2008 (48) and a large increase in EPTBI from 2003 (3.93) to 2008 (4.84). Conversely, specific conductance dropped from 2003 (81 µS/cm) to 2008 (66 µS/cm) as did pH 2003 (6.4) to 2008 (5.8). These data suggest that the increase in EPTBI and decrease in EPTN may be more related to reduced habitat and reduced flows than to discharger effects.



Sand, gravel, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/08/08	10476	86	28	5.66	4.34	Good
10/09/02	9032	12	12	4.40	4.40	Not Rated
08/04/98	7698	67	24	5.92	4.50	Good
08/25/93	6365	75	25	5.36	3.75	Good
06/07/87	4129	84	29	5.46	3.85	Excellent

Substrate

#### **Taxonomic Analysis**

**Total Habitat Score (100)** 

Although all of the Full-Scale samples collected here have resulted in very similar community metrics and bioclassifications, the 2008 sample did produce several new EPT records. These taxa included the mayfly Isonychia sp, the rare mayfly Pseudocentroptiloides usa, the stoneflies Acroneuria arenosa, Perlesta sp., and the rare and intolerant taxon Perlinella drymo. The 2008 sample also produced many new caddisfly records for this station and included the intolerant Oxyethira sp., as well as Oecetis persimilis, Oecetis Sp F, and Molanna blenda. The addition of these taxa suggest that there has been reduced nonpoint impacts as a result of the persistent drought.

#### Data Analysis

Primary landuse in this watershed is forest, swine operations, and row crops. Excluding the October 2002, less intensive EPT sample, the EPT taxa richness, BI, and EPTBI have been quite stable here through time. However, the 2008 sample did result in a somewhat higher EPT taxa richness relative to other Full-Scale samples collected in 1998 and 1993 and was only one EPT taxon short of the highest level measured here. This increase in EPT taxa richness is likely attributed to reduced levels of non-point pollution inputs associated with the drought. This hypothesis is supported by the lower specific conductance (77 µS/cm) and pH (5.7) measured in 2008 versus the specific conductance and pH measured in 1998 (121 µS/cm; 6.1) and 2002 (128 µS/cm; 6.8) respectively.

Waterbo	dy			Location		Date Station ID Bioclassification				fication	
COLLY	CR		l	JS 701		04/04/08	BF82	BF82 Not Rated			
County	Subb	asin	8 digit HUC	Latitude	Long	itude	AU Number	-	Level IV I	Ecoregion	
BLADEN	2	0	03030006	34.710853	-78.45	57305	18-68-17		Carolina Flatwoods		
					•						
Stream Classifica	tion	Drai	nage Area (mi2)	Elevatio	on (ft)	Stream Wi	dth (m)	Average Dept	:h (m)	Reference Site	
C;Sw			16.6	75		7		0.5		Yes	
		For	ested/Wetland	Liri	han	An	riculture		Other (de	ascriba)	
Visible Landuse	(%)	1.01	100		0		0		0	,301100)	
					-		-				
Upstream NPDES Di	ischarg	ers (>1	MGD or <1MGD	and within 1 r	nile)		NPDES N	umber	v	olume (MGD)	
			None								
Water Quality Param	neters						Site	Photograph			
Temperature (°C)			19.6			Same -					
Dissolved Oxygen (m	g/L)		4.8		A BAR	The second	12 34 S /				
Specific Conductance	e (µS/cm	ı)	115	1. 3		-	a and and		and a second	The states	
pH (s.u.)			3.2				Antonia		and the		
	r		-					-2216		again Selfthe	
Water Clarity			Black water	/			- Arten			X ALL ALL ALL	
	l							a the			
Habitat Assessment	Scores	(max)		- CAK		No.			~		
Channel Modification	(15)		15	- 3257	S. S.			W W A	1 des		
Instream Habitat (20)			20		the way		we have	ALX C			
Bottom Substrate (15	)		7		State -	and south					
Pool Variety (10)			10				1	and the second	20	T- ANN	
Left Bank Stability (10	D)		10	-		- /		ALL AND	-		
Right Bank Stability (	10)		10	11					14 m		
Light Penetration (10)	)		10	Y	1 3	11-5					
Left Riparian Score (5	5)		5	3	-	a set	A CONTRACTOR		and the second		
Right Riparian Score	(5)		5								
Total Habitat Score	(100)		92	Sub	strate	detritus, woody	debris.				
Sample Date	e		Sample	ID	Spe	cies Total	N	CIBI	Bio	oclassification	
04/04/08			2008-5	7		5				Not Rated	
05/19/98			98-41			7				Not Rated	
Most Abundant Spe	ecies		Redfin Pickerel.			Exotic Spec	i <b>es</b> No	ne.			
						l					
Species Change Sin	ce Last	Cvcle	Gains -	/ud Sunfish. L	osses - Ye	ellow Bullhead	Swampfish. Ye	low Perch.			

# Data Analysis

Watershed -- Colly Creek is a tributary to the Cape Fear River that drains most of eastern Bladen County; the fish site is located in the rural north-east corner of Bladen County, just downstream of its headwaters. Habitats -- high quality instream habitats in this slow moving black water stream with dense vegetation, abundant woody debris of all sizes, and abundant organic matter; site had been de-snagged prior to the 1998 sample, but not since; very low pH. 2008 -- as expected, the fish community is exhibiting low diversity and abundance in this slow moving coastal plain stream; the predatory Redfin Pickerel (n=17), made up almost 50% of the total catch. 1998-2008 -- a total of eight species have been collected from this low diversity site; although Not Rated, the fish community in this system appears healthy and is showing no obvious signs of water quality issues.

Waterbo	dy		I	_ocation		Date	e	Station	n ID Bioclassification		lassification
DIVERSION	CAN	AL	off	SR 1536		04/22	/08	BF1	33	No	t Rated
County	Subb	asin	8 digit HUC	Latitude	Long	gitude	AU	Number		Level IV I	Ecoregion
BLADEN	2	0	03030006	34.490336	-78.3	332238	18-	68-22-1	Mi	d-Atlantic Floodpl	ains & Low Terraces
Stream Classifica	tion	Draiı	nage Area (mi2)	Flevatio	on (ft)	Strea	m Wic	tth (m)	A١	verage Depth (m)	Reference Site
C <sup>.</sup> Sw		U	indetermined	29	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		10			0.3	No
-,											
		For	ested/Wetland	Url	ban		Ag	riculture		Othe	r (describe)
Visible Landuse	(%)		75		0			25			0
Upstream NPDES Di	scharg	ers (>1	MGD or <1MGD	and within 1 r	nile)			NPDE	S Numb	per	Volume (MGD)
	eenan g		None								
Water Quality Param	neters			and the second second	Sin Back	1. P	A	- He J. C. Marine	Site Pho	otograph	
Temperature (°C)			17.5		24		1.50				
Dissolved Oxygen (m	g/L)		5.9	Tester		Mart -	(III)				
Specific Conductance	e (µS/cm	1)	79	- Retain	43		1.35	A CONTRACTOR			
pH (s.u.)			3.7		1 M	1.1.2					
					al th	6432	alle I	A States			<b>一一多</b> 出导以3.两
Water Clarity			Black water	0	A N			1	-		E-STANK
Habitat Assessment	Scores	(max)				Bacin	1			and the second second	
Channel Modification	(15)	(1114)	7		X						Contraction of the second
Instream Habitat (20)	(13)		18					-			
Bottom Substrate (15	<b>`</b>		6	- Carlore	A TRACE	THE STREET		er			and the second sec
Pool Variety (10)	/		8								
Left Bank Stability (10)			10			A Star	7 3				
Dight Bank Stability (10	/) 10)		10								and the second
Light Dank Stability (	10)		10				1	e-j-			
Light Penetration (10)	5)		1	- AL	-	A CONTRACT		- AND		and the second	
Pight Piparian Score	ッ) (5)				and and		1000	Really to here	Scale in	All and a state of the state of	1 2 a la l
Total Habitat Score	(3) ( <b>100)</b>		75	Sub	strate	sand, det	ritus				
	(100)			_	_					_	
Sample Date	9		Sample I	D	Spo	ecies Tota	1		NCIB		Bioclassification
04/22/08			2006-24	ł		10					NOI Raled
Most Abundant Spo	ecies		Bluespotted Sun	fish.		Exotic	Spec	ies	None.		
							-				
Species Change Sin	ce Last	Cycle	N/A								
Data Analysis											
New basinwide site.	Watersh	<b>ned</b> a	a tributary to Colly	Creek and ulti	mately th	e Black Riv	er tha	t flows sou	theast, o	draining part of ru	ral southeast Bladen
County; diverts part of	f French	s Cree	k; Drainage Area	is undetermine	ed becaus	se GIS flow	direct	ion and acc	cumulati	ion layers do not e	exist for this canal.
Habitats shallow sa	andy run	ns, shal nin ite e	iow side pools line	ed with organic	s, and so	ome coarse t side bas b	woody	debris; the	ere are	opvious signs of h	NISTORIC Channelization,

good diversity for a true blackwater stream, yet no minnows were collected. Otherwise, the fish community appears as expected, with three species of sunfish, two species of catfish, one species of sucker, one species of pickerel, and two darter species, including the intolerant Sawcheek Darter;

Bluespotted Sunfish made up 63% of the individuals collected (n=77) and are thriving in this tannic system; although Not Rated with the NCIBI, this stream appears healthy and is showing no obvious signs of water quality issues.

Waterbo	dy	Locat	ion	Stat	ion ID		Date	Bioclassification
NE CAPE F	EAR R	NC	41	BE	8126	80	6/05/08	Good-Fair
						•		
County	Subbasin	8 digit HUC	Latitude	Longitu	Ide	AU Number	Lev	el IV Ecoregion
DUPLIN	22	03030007	34.827778	-77.8333	333	18-74-(25.5)	Ca	rolina Flatwoods
Stream Classifica	ation	Drainage Area (mi	2) Elev	vation (ft)		Stream Width	(m)	Stream Depth (m)
C;Sw;HQW		599.0		17		30		0.3
		Forested/Wetland	Urban		Ag	griculture	Ot	her (describe)
Visible Landuse	(%)	100	0			0		
Linstroam NBI		are (>1MGD or <1	MGD and withir	a 1 milo)			bor	Volumo (MGD)
Town of Carolina Bea				i i iiiie)		NC 00232		
Guilfod Mills Guilford	East Mill W/W	(TP				NC 00232	15	1.5
Cullou Millis Cullord		11				110 000230		1.0
Water Quality Param	eters					Site Pho	tograph	
Temperature (°C)		29.4		town of				
Dissolved Oxygen (mg	n/l )	4.9		A AND A	Mallar		Contraction of the	
Specific Conductance	(uS/cm)	302	Q.				Self- March	
pH (s u )	(µ0/011)	6.6				BARE 3%	1 South State	Martin and States
		0.0	-	C. C. M	ale.		A HAR AND	
Water Clarity		clear						
			1					
Habitat Assessment	Scores (max	()				A CONTRACT		
Channel Modification	(15)	, 15				~		A CONTRACT
Instream Habitat (20)	( )	8	Contraction of the					A State of the second
Bottom Substrate (15)	1	7						
Pool Variety (10)		6						- Barris
Left Bank Stability (10	)	9						
Right Bank Stability (1	0)	9		and a second				
Light Penetration (10)	-	2					and the second	
Left Riparian Score (5	)	5					and a	
Right Riparian Score	(5)	5						
Total Habitat Score (	100)	66	Substra	ate s	and			
Sample Date		Sample ID	- ет	EDT		BI	EDT BI	Bioclassification

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/05/08	10409	92	25	6.16	4.42	Good-Fair
09/22/98	7767	40	3	7.00	4.40	Poor
08/05/98	7706	70	29	5.60	4.90	Good
08/24/93	6373	82	22	5.40	4.50	Good
08/09/89	5054	83	30	5.40	4.10	Excellent

# **Taxonomic Analysis**

The benthic community in the Northeast Cape Fear River at NC 41 continues to be affected by drought. Hydropsychid caddisflies were represented in the August 2008 sample by only a single individual. In every sample prior to the 1998 Hurricane Bonnie sample, three taxa of Hydropsychid caddisflies were found to be abundant or common. These widely distributed caddisflies require near constant flow in which to feed. Given that the microhabitats where Hydropsychid caddisflies would be found are still present (e.g. snags and logs), there is no other apparent reason for their absence. A similar pattern was seen with black flies (*Simulium*). No black flies were found in the 2008 sample, though they were present in prior samples. Blackflies are another widespread group of aquatic macroinvertebrates that require minimal amounts of flow in which to filter feed, though some species can survive for a few days in stagnant water. The absence of this generally pollution tolerant group suggests that flow interruptions occurred here during 2007 and/or 2008.

### Data Analysis

This site rated Good-Fair in 2008, an improvement from Poor in 1998. From 1985 through the summer of 1998, five benthic samples collected here rated Excellent (3) or Good (2). In 2003 and 2004 this site was not sampled due to high water levels. In spring 2008, high water levels postponed sampling. This site is still recovering from drought conditions seen throughout North Carolina in 2007 and 2008. Additional sampling should occur here to ascertain the non drought condition of this waterbody, in particular, if Good or Excellent water quality still remains (as seen prior to September 1998). Additional information can be found in BAU Memorandum B-20081020.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/09/09	10607	39	4	7.91	7.49	Severe
02/19/03	8880	42	4	7.99	6.58	Severe

#### **Taxonomic Analysis**

Taxa collected in 2009 were similar to 2003. The only abundant EPT collected in either year was *Ironoquia puntatissima* (2009). The highly pollution tolerant chironomid *Chironomus* sp and the the dipteran *Bittacomorpha* sp were abundant in 2009. Chironomids, gastropods, segmented worms and leeches dominated the benthic community in Goshen Swamp.

#### Data Analysis

Goshen Swamp rated Severe in 2009, the same rating it received in 2003. The habitat scored 79 (80 in 2003) suggesting that water quality itself is degraded. The igh biotic index indicates that the aquatic community here is one that is very tolerant to pollution. Overall diversity is low. This site is located above the outfall of the pickle processing facility in an area dominated by agriculture including several hog operations.

Waterboo	dy	Location		Location		Date	)	Station	n ID	В	ioclassi	fication
LIMESTON		2		SR 1702		06/03/	/08	BF1	27		Not R	ated
County	Subba	asin	8 digit HUC	Latitude	Long	gitude		AU Numb	er	L	evel IV E	coregion
DUPLIN	22		03030007	34.9083151	-77.83	383869		18-74-23	}	C	arolina F	latwoods
Stream Classifica	tion	Drain	nade Area (mi?	) Elevatio	on (ft)	Stream	m Wic	ith (m)	۵۷۹	rade Denth	(m)	Reference Site
C <sup>.</sup> Sw		Drail	59 7	35		Olical	7		AVC	0.3	(11)	No
0, 0W			33.1				'			0.0		140
	_	For	ested/Wetland	Rural Re	esidential		Ag	riculture		C	ther (de	scribe)
Visible Landuse	(%)		65		5			30			0	
Unstream NPDES Di	scharge	rs (~1	MGD or ~1MG	D and within 1	mile)			NPDE	S Number	r	Ve	lume (MGD)
	scharge	13 (21	None		inite)							
Water Quality Param	eters								Site Photo	ograph		
Temperature (℃)			20.8								-	
Dissolved Oxygen (mg	g/L)		7.4		States 1	the second	1					
Specific Conductance	(µS/cm)	)	105								- Cal	
pH (s.u.)			6.1								A.	
	Г				al a							V Second
Water Clarity		Clea	r, tannin staineo	the second se		- C.				A LONG		
Habitat Assessment	Scores	(max)					2		- Not		D.	
Channel Modification	(15)		10					CA AN			120	
Instream Habitat (20)			15		and the second	State I					1	
Bottom Substrate (15)	)		7									
Pool Variety (10)			4	-								
Left Bank Stability (10	)		5					4				
Right Bank Stability (1	0)		5									
Light Penetration (10)			10	-		1 the		11-1-	1. Aller			
Left Riparian Score (5	)		5			- 10/3	1	eller.			22	1
Right Riparian Score (	(5)		5									
Total Habitat Score (	100)		66	Sub	strate	Sand with	clayp	an outcrop	S			
Sample Date	•		Sample	e ID	Spe	ecies Total			NCIBI		Bio	classification
06/03/08			2008-	55		11						Not Rated
Most Abundant Spe	ecies		Dusky Shiner			Exotic	Speci	ies	Channel	Catfish		
Species Change Sin	ce Last	Cycle	N/A									
Data Analysis												
This is the first fish co	mmunity	samp	le collected at t	his site. Waters	shed dra	ains eastern	n Dupl	in County i	ncluding t	he Town of	Beulaville	e; tributary to the
Northeast Cape Fear	River; sit	te is ~	1,000 ft. above	creek's confluer	nce with th	ne river. Ha	bitat	shallow a	and bare s	andy runs; I	no large,	coarse woody

Northeast Cape Fear River; site is ~ 1,000 ft. above creek's confluence with the river. **Habitat** -- shallow and bare sandy runs; no large, coarse woody debris within the channel; deep pools were absent; old sand mining or de-snagging operation on right side of the creek; clay and sand banks stable, but sparsely vegetated; evidence of old channelization. **Water Quality** -- conductivity typical for a Coastal Plain stream. **2008** -- for its size (~ 60 square miles), total species diversity (n=11) and number of fish (n=245) collected seemed low; suckers were absent and only two species of sunfish, Redbreast and Bluegill, were present; and 3 species of cyprinids and 2 species of darters present.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/14/08	10524	17	17	4.63	4.63	Good-Fair
09/17/03	9321	12	12	4.79	4.79	Good-Fair
08/05/98	7704	14	14	4.86	4.86	Good-Fair
07/14/95	6870	4	4	5.48	5.48	Poor
08/25/93	6376	26	26	4.50	4.50	Excellent

#### **Taxonomic Analysis**

The 2008 sample produced the second highest EPT taxa richness value at this location since assessment initiated in 1993. This sample also resulted in two EPT taxa collected for the first time here and included the rare mayfly *Psaeudocentroptiloides usa* as well as *Tricorythodes sp*. In addition, the 2008 collection produced the second collection at this location of the caddisfly *Polycentropus sp*. which was found previously only from the 1993 (Excellent) sample. Aside from these additions, the 2008 benthic macroinvertebrate community structure has been largely unchanged from the 1998 and 2003 samples.

#### **Data Analysis**

The three major landuses present in this catchment are row crops, animal operations, and forest. The high EPT taxa richness measured in 2008 is likely the result of a reduction in non-point pollution inputs which corresponded to the record drought conditions that have persisted in this region of the state. The dramatic decline in bioclassification measured in 1995 was the result of a large discharge of chicken waste upstream of this station. Analysis of the substrate data from this location indicates that since 1993 boulder (25%) has disappeared and has been replaced with increasing estimates of sand: 1993 (65%), 1995 (75%), 1998 (100%), 2003 (90%), and 2008 (100%). This substrate transition is supported by the benthos community as taxa often associated with boulder habitat (*Neureclipsis sp.*, *Nyctiophylax moestus*, *Brachycentrus numerosus*, *Paragnetina kansensis*, *Acroneuria abnormis*, *Procloeon sp.*, and *Brachycercus sp.*) were collected only during the 1993 sample.

Waterboo	dy		Location		Dat	Date Station ID Bioclassification				
STOCKINGH	EAD CR		NC 50		06/03	8/08	BF128		Not R	ated
		-						•		
County	Subbasin	8 digit HUC	Latitude	Long	itude		AU Number	L	evel IV E	Ecoregion
DUPLIN	22	03030004	34.8795866	-77.89	42068		18-74-24	(	Carolina I	Flatwoods
Stream Classifica	tion Dra	inago Aroa (mi2)	Elevatio	n (ft)	Stro	am Wid	lth (m)	Average Depth	(m)	Reference Site
C: Sw		7 5	45			4		Average Deptin	(11)	No No
0, 5₩		1.5	45			4		0.2		NO
	Fo	rested/Wetland	Urt	ban		Agı	riculture	C	Other (de	escribe)
Visible Landuse	(%)	95	(	)			5		0	
Unstream NPDES Di	echargore (>	1MGD or <1MG	) and within 1 r	nilo)				umber	V	olume (MGD)
Opsilean NPDES Di	schargers (>	None		ille)			NFDE3 N	umber	~	
		None							<u>.                                    </u>	
Water Quality Param	eters				No		Site	Photograph		
Temperature (℃)		20.8				States		A THE A		the state of
Dissolved Oxygen (mg	g/L)	5.2						2-2- 0 - L		
Specific Conductance	(µS/cm)	239	and the second		Aller Mer					
pH (s.u.)		6.2			80 m	-	1 A	1		
				18 - A			and the second			
Water Clarity		Slightly turbid				A Car				- 1 - Kan -
						4.9				
Habitat Assessment	Scores (max	()	- A	1-20	CZ S				1	No contraction
Channel Modification	(15)	15							100	
Instream Habitat (20)		18			mest		A. S. S.		- 15-20	ALC: TELES
Bottom Substrate (15)		7		1 Sec			2		1	
Pool variety (10)		10		- 15: 50					1	
Left Bank Stability (10	)  0)	9		-					-	A CARE
Light Denstration (10)	0)	9	n the	*	A	1			2	
Light Penetration (10)	)	9	- 23	4			and the	and Bar	A. A	the second
Dight Dingright Control	(F)	5		Server Star	11		C. Marken			
Total Habitat Score (	(3) ( <b>100</b> )	3 87	Sub	strate	Sand					
	100)	- 01		Shale	Gund					
Sample Date	•	Sample	ID	Spe	cies Tota	ıl 👘	N	CIBI	Bio	oclassification
06/03/08		2008-5	54		16				Ĺ	Not Rated
Most Abundant Sna	ocios	Bedbreast Sunf	ish		Exotic	- Snaci	ies No	ne		
ot Asandant opt		Housidast ourn				- 0000				
Species Change Sin	ce Last Cycle	e N/A								
Data Analysis										
This is the first fish co	mmunity sam	ple collected at th	nis site. Waters	hed dra	ins south	-central	Duplin County	; tributary to the	Northeas	t Cape Fear River;

I his is the first fish community sample collected at this site. **Watershed** -- drains south-central Duplin County; tributary to the Northeast Cape Fear River; no municipalities with the watershed. **Habitat** -- high quality instream and riparian habitats; dense canopy; snags, sand bars, runs, deadfalls, and water primrose. **Water Quality** -- dissolved oxygen less than 60% saturation; conductivity elevated for a Coastal Plain stream, the greatest conductivity of any fish community site in the basin in 2008. **2008** -- intolerant species and Dusky Shiner were absent; overall diversity was fairly high for a small stream with seven species of centrarchids present.

Waterbo	ody Location				Date	e	Station ID Bioclassification				ification	
MUDDY	CR		NC	41/NC 111		06/03	/08	BF1	29		Not F	lated
County	Subb	asin	8 digit HUC	Latitude	Long	itude		AU Numb	er	L	evel IV	Ecoregion
DUPLIN	22	2	03030007	34.842698	-77.79	73039		18-74-25	5	(	Carolina	Flatwoods
Stream Classifica	tion	Drair	nage Area (mi2	) Elevatio	on (ft)	Strea	m Wie	dth (m)	Ave	rage Depth	(m)	Reference Site
C; Sw			40.8	35			5			0.8		No
		For	ested/Wetland	Urt	ban		Aa	riculture		c	Other (d	escribe)
Visible Landuse	(%)	-	100	(	0			0			C	)
				•					u			
Upstream NPDES Di	scharge	ers (>1	MGD or <1MG	D and within 1 n	nile)			NPDE	6 Numbe	r	V	olume (MGD)
			None									
Water Quality Param	eters							ę	Site Phot	ograph		
Temperature (°C)			21.3	and a state							2 Carl	2
Dissolved Oxygen (mg	g/L)		5.9		DC.			1		St. 1		
Specific Conductance	e (μS/cm	)	136							E ACO	and the second	
pH (s.u.)			6.5	and the	AND R	See -		- Maries				and the second s
					11.	Rac	Do		1 Ch			
Water Clarity		Clea	r, tannin staineo			al al h		MAG	CANE A			
	L								y	- Inder		
Habitat Assessment	Scores	(max)				1	Contra -			aller a	1	
Channel Modification	(15)		15		Contraction by	-	1		ar ha	A Com		
Instream Habitat (20)			20					Alter and a	1 1 3		Sec. 1	
Bottom Substrate (15)	)		7	and the second s								
Pool Variety (10)			10					and the				
Left Bank Stability (10	)) ( ( )		10	1.10								
Right Bank Stability (1	10)		10	-		-			1.5 M.	A A A		
Light Penetration (10)			10	_			-					
Leit niparian Score (3	) (E)		5			the second second		Sieds	100	E mar	All C	
Total Habitat Score	(5) (100)		5 02	Sub	etrato	Fine white	e sanc	1				
	(100)		32		Strate	THIC WHILE	c sanc	1				
Sample Date	•		Sample	e ID	Spe	cies Total	I		NCIBI		Bi	oclassification
06/03/08			2008-	56		14						Not Rated
Most Abundant Spe	ecies		Dusky Shiner			Exotic	Spec	ies	None			
Species Change Sin	ce Last	Cycle	N/A									
Data Analysis												
This is the first fish co	ommunity	y samp	le collected at t	his site. Waters	hed dra	ins easteri	n Dupl	in County;	tributary I	neadwaters	originate	e with the Town of
Beulaville; tributary to	the Nor	theast	Cape Fear Rive	r. Habitat ver	y high qua	ality instrea	am and	d riparian h	abitats wi	th coarse wo	oody deb	oris, several species

Beulaville; tributary to the Northeast Cape Fear River. **Habitat** -- very high quality instream and riparian habitats with coarse woody debris, several species of aquatic plants, snags, deep pools at the bends and swift flow. **Water Quality** -- water very tannin stained, but pH was not low; conductivity moderately elevated for a Coastal Plain stream. **2008** -- only Coastal Plain site from which the Swampfish was collected; total number of fish (n=79) was low for a Coastal Plain stream but the species diversity was typical with 2 species of suckers, 3 species of sunfish, 2 species of cyprinids, and 2 species of darters; Redfin Pickerel and Eastern Mudminnow were present, but represented only by young-of-year and not included in the total species count.

Waterbo	dy		Location			Date	te Station ID		В	Bioclassification		
ISLAND	CR			NC 11		06/02	2/08	BF130		Not Ra	ated	
						!			_			
County	Subb	asin	8 digit HUC	Latitude	Long	itude		AU Number	L	evel IV E	coregion	
DUPLIN	22	2	03030007	34.8023657	-77.94	19113		18-74-27	(	Carolina F	latwoods	
o. o		<b>_</b> .		· - ·	(**)	<u> </u>				<i>,</i> ,	<b>_</b> /	<b></b>
Stream Classifica	ition	Drail	nage Area (miz	Elevatio	on (ft)	Strea		ath (m)	Average Depth	(m)	Reference	Site
C; SW			16.1	20			1		0.4		NO	
		For	ested/Wetland	Urt	ban		Aq	riculture	c	Other (de	scribe)	
Visible Landuse	(%)		95	(	)			5		0		
									_			
Upstream NPDES Di	scharge	ers (>1	MGD or <1MG	D and within 1 m	nile)			NPDES Nu	nber	Vo	olume (MGD)	
			INONE									
Water Quality Param	neters							Site F	hotograph			
Temperature (℃)			26.2					and the second			1999	100
Dissolved Oxvgen (m	a/L)		5.8								2	\$ 1. 1.
Specific Conductance	e (uS/cm	)	156		We lo				the state in the		Salar Shares	
pH (s.u.)	(J	,	6.4				2	The sta		657		5 I.
	_					the very	THE P			1		1 . M
Water Clarity		Sligh	itly turbid, tanni	n					ALL A	1.		
,			stained	10		-				Par.		-
Habitat Assessment	Scores	(max)	-							5.5		
Channel Modification	(15)		15			2						-
Instream Habitat (20)			19				-		HARRING STATE			-
Bottom Substrate (15)	)		7	and a second			The	States -			Contractor	
Pool Variety (10)			10					The Provent	and the	- Mar		-
Left Bank Stability (10	))		9		and the	Par 1		Construction of the second	ALL MARK	The second		
Right Bank Stability (1	10)		9					A	and the second	Telles,		
Light Penetration (10)			10		and the second		-					1
Left Riparian Score (5	5)		5	Sec.		- martin		Notifician -				X
Right Riparian Score	(5)		5									
Total Habitat Score (	(100)		89	Sub	strate	Sand and	d mud					
Sample Date	•		Sample	e ID	Spe	cies Tota	I	NC	IBI	Bio	classificatio	n
06/02/08			2008-	53		13		-			Not Rated	
						1						
Most Abundant Spe	ecies		Eastern Mosqu	itofish and Dusky	y Shiner	Exotic	Spec	ies Non	Э			
Spacios Change Sin	00   00t	Cuele	NI/A									
opecies change 311	UC LASI	Cycle	IN/A									
Data Analysis					le e el de de			a mittalaine eta a T	m of Decis 1991	h		
(Ow = 0.45  MGD) on	Ready P	y samp Iranch	a tributary is a	nis site. Waters	nea hea m of the ci	adwaters o	priginat	e within the Tow	n of Rose Hill; t	ne town's Iabitat	wwwiP discl	narge
instream and riparian	habitats	includ	ing coarse woo	dy debris, snads.	and a dei	nse canop	y. Wa	iter Quality co	inductivity mode	rately ele	vated for a C	oastal

(Qw = 0.45 MGD) on Reedy Branch, a tributary, is ~ 5 miles upstream of the site; tributary to the Northeast Cape Fear River. **Habitat** -- high quality instream and riparian habitats including coarse woody debris, snags, and a dense canopy. **Water Quality** -- conductivity moderately elevated for a Coastal Plain stream. **2008** -- a typical, small Coastal Plain stream with 4 species of sunfish, 2 species of cyprinids, and 2 species of darters present, but suckers were absent; Chain Pickerel and Pirate Perch were present, but represented only by young-of-year and not included in the total species count.

Waterbo	dy		Location			Date	e	Station I	D	Bi	oclassifi	cation
L ROCK FI	SH C	R	1	NC 11		06/02	/08	BF13	1	Ν	lot Ra	ted
						1			-			
County	Subb	asin	8 digit HUC	Latitude	Long	jitude		AU Number	r	Le	vel IV Ec	oregion
DUPLIN	22	2	03030007	34.72242	-77.9	81597		18-74-29-6		Ca	arolina Fl	atwoods
Stream Classifica	ition	Draiı	nage Area (mi2)	Elevatio	on (ft)	Strea	m Wi	dth (m)	Avera	age Depth (	m)	Reference Site
C; Sw			9.3	20			6			0.2		No
		_					_			_		
Visible Landuse	/ø/ ) [	For	ested/Wetland	Urt	oan		Ag	riculture			ther (des	utility P O W)
VISIBle Landuse	(%)		30	3	0			0		40 (mowed	a sewer a	ulilly R-O-W)
Upstream NPDES Di	ischarge	ers (>1	MGD or <1MGD	and within 1 r	nile)			NPDES	Number		Vol	ume (MGD)
			None									
Water Quality Param	neters							Sit	te Photo	araph		
			20.2	Sec. 4				- +	10 A 4			and the set
Dissolved Oxygen (m	a/L)		6.8	Cing?		No.	10.14					A Sa
Specific Conductance	9/⊏) • (uS/cm	)	101				1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 /		Kan I			
pH (s.u.)	(1	/	6.6				115					
	r			- Andrewski	A CONTRACT	1 m 3 m		Star . N	-		*	
Water Clarity		Cle	ar, very slightly stained		1012	A States			a la la			
	L		otaniou									100
Habitat Assessment	Scores	(max)					ans. I					~
Channel Modification	(15)		7		R & P	for 1970			-	- A		
Instream Habitat (20)	<b>`</b>		15		e Y							
Pool Variety (10)	)		10				-					
Left Bank Stability (10)	))		3		and the			-				
Right Bank Stability (1	, 10)		3								* Ca-	
Light Penetration (10)			5			The second						
Left Riparian Score (5	5)		3	- AL		AC IN	-		and the second			1
Right Riparian Score	(5)		2									
Total Habitat Score (	(100)		50	Sub	strate	Sand						
Sample Date	e		Sample I	D	Spe	ecies Total	I		NCIBI		Bioc	lassification
06/02/08			2008-52			12					١	lot Rated
Most Abundant Spe	ecies		Eastern Mosquito	fish		Exotic	Spec	ies N	lone			
		ļ				-						
Species Change Sin	ce Last	Cycle	N/A									
Data Analysis												
This is the first fish co Rockfish Creek. <b>Hab</b> canopy, grass covere	ommunit <u>;</u> itat th d erodin	y samp e lowe: g bank	ble collected at this st scoring fish con s, very shallow, a	s site. Waters nmunity site in nd of uniform o	<b>hed</b> dra the basin lepth thro	ains southe in 2008; lo ughout. <b>W</b>	ern Du ow qua ater C	plin County, i ality instream <b>Quality</b> sinc	ncluding and ripa ce at leas	the Town of rian habitats it 2003, the o	Wallace chann creek no	; tributary to elized, minimal longer receives

the treated discharge from Wallace's WWTP; highest pH of any fish community site in 2008, but conductivity was typical for a Coastal Plain stream. **2008** -most fish (n=314) collected from any Coastal Plain site in 2008; 72% of all the fish were the tolerant Eastern Mosquitofish; greatest percentage of tolerant fish (89%) of any fish community site in the basin in 2008; suckers and intolerant species were absent; 6 of the 12 species were represented by only 1 or 2 fish per species.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/10/09	10609	44	11	7.04	6.19	Moderate
02/10/03	9042	41	12	6.30	4.68	Natural
02/24/97	7246	33	7	6.01	4.74	Moderate

#### **Taxonomic Analysis**

The benthic community in Lillington Creek does not appear to have differed among the three samplings. Similar EPT taxa and overall taxa were collected in 2009 compared to previous samples. The recently described mayfly, *Eurylophella oviruptis,* was abundant here in the 2009 and 2003 samples. *Leptophlebia* sp, another mayfly, was abundant here in both years as were black flies (*Simulium* sp) and the crustacean *Lirceus* spp. The chironomid *Unniella multivirga*, which prefers low pH swamps, was collected here in all three sampling efforts.

#### **Data Analysis**

Lillington Creek declined in bioclassification form Natural in 2003 to Moderate in 2009, the same rating it received in 1997. The change in bioclassification has more to do with slight differences in EPT and other taxa compositions and abundances as opposed to any change in water quality. Habitat scored well in both 2003 and 2009, in part influenced by the mostly forested catchement surrounding Lillington Creek. The pH is naturally low here, as Lillington Creek originates in Holly Shelter Swamp. In both 2003 and 2009 the naturally low pH did not appear to adversely affect the benthic macroinvertebrate communities here.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/11/09	10611	49	4	6.90	6.87	Moderate
02/11/03	9044	24	4	6.78	6.55	Not Rated

#### **Taxonomic Analysis**

Though only four EPT were collected in both samples at Island Creek, the 2009 sample contained a large number of non EPT taxa compared with 2003. The majority of this difference were midges with 22 found in 2009 and only eight in 2003. There was a large shift in other aquatic groups from 2003 to 2009. Six crustacean taxa were collected in 2003 with only two in 2009. Gastropod taxa differed from 2003 (1) to 2009 (4). Overall, taxa were typical Coastal Plain species but the large differences in whole groups of aquatic organisms suggest larger scale process such as hydrology.

#### Data Analysis

Island Creek rated Moderate in 2009. There was a large increase in the total number of taxa here in 2009 compared with 2003. This site had good flow compared with other swamp streams in this part of the Coastal Plain, along with a good habitat score. The landowner made us aware of a horse operation upstream of the sampling location that may have a supressing effect on the benthic community here given that only four EPT have been found here. Future sampling efforts should consider investigating downstream on Island Creek at the crossing of Holly Shelter Road. This location could capture most of the Island Creek watershed and have the potential to have a more stable hydrology given the increased watershed size downstream.



Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/26/08	10389	37	4	7.64	6.98	Moderate
02/26/03	9053	30	1	7.43	6.20	Severe

#### **Taxonomic Analysis**

Other than the increase in EPT taxa richness, the benthic community was similar among the two samples. The three new EPT taxa collected in 2008 include the tolerant mayflies, *Caenis* and *Pseudocloeon frondale*, and the tolerant caddisfly *Ptilostomis*.

#### **Data Analysis**

Smith Creek was sampled for the first time in 2003. A sample was taken at I-40 because a wadeable freshwater segment could not be located downstream. It received a Severe rating and placed on North Carolina's 2004 Impaired Streams list. In 2008 the site was moved upstream to SR 2165 due to low flows and salt infiltration at the I-40 location. EPT taxa richness increased from 1 in 2003 to 4 in 2008, most likely due to better instream habitat and bottom substrate than the I-40 location. This increase in EPT taxa richness resulted in a Moderate bioclassification.