Division of Water Quality
Biological Assessment Unit
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Memorandum

To: Rob Breeding

Through: Jimmie Overton
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From: Cathy Tyndall

Subject: Little Lick Creek-Neuse Subbasin 01; EEP Special Study

Background
The Division of Water Quality's Watershed Assessment Team (WAT) requested benthic samples from the Little Lick Creek watershed as part of Phase I of the Local Watershed Plan initiated by the Ecosystem Enhancement Program. Five benthic sites were sampled on April 5-6, 2005 by the Biological Assessment Unit (BAU) in the Little Lick Creek watershed (Figure 1). Smith Creek (SR 1710, Granville County), which is located in a relatively undisturbed watershed, was initially considered as a reference comparison, but further investigation revealed that the majority of its watershed was not located within the Triassic Basin, as is the Little Lick Creek watershed. WAT provided BAU with a monitoring plan of Little Lick Creek including a list of recommended benthic sites (Table 1).

Table 1. WAT Benthic Monitoring Recommendations:

Monitoring Location	Drainage Area (mi^2)	Sample Type
Little Lick Cr at Gibson Rd	1.2	Qual 4
UT at Lynn Rd	1.8	Qual 4
Little Lick Cr at Mineral Springs Rd	5.9	Full Scale
Little Lick Cr at Stallings Rd	9.4	Full Scale
UT west of Santee Rd.	0.8	Qual 4

Based on level IV Ecoregions (Griffith *et al* 2000), Little Lick Creek is located in the Triassic Basin of the Piedmont. Triassic Basin streams tend to have clay substrates with low permeability and low base flows, especially during summer months. During the summer they can experience low dissolved oxygen levels.

Historical
Little Lick Creek is classified as WS-IV NSW and the lower portion is WS-IV NSW CA. It is on the 303(d) list of impaired streams from its source to Falls Lake, Neuse River. The reasons for impairment of Little Lick Creek are low dissolved oxygen and impaired biological integrity. Stressors may include urban runoff, storm sewers, and runoff from construction. Data from the City of Durham and USGS indicate that low dissolved oxygen occasionally occurs in Little Lick Creek during the warmer months, and may be one of the causes of biological impairment.

BAU has sampled Little Lick Creek for benthos eight times since 1985, most recently in 2000. The 2000 sampling was conducted during basinwide sampling due to its inclusion on the 303(d) list. In 2000, Little Lick Creek received a Poor rating. BAU benthic sampling has been conducted exclusively at two of the recommended WAT sites, Mineral Springs Rd and Stallings Rd. In all, there have been two Fair ratings and six Poor ratings since 1985. Currently, BAU is not assigning bioclassifications to streams in the Triassic Basin. After 2000, BAU stopped assigning bioclassifications to Triassic Basin streams because of their characteristic low flow in summer months and low dissolved oxygen levels and the associated effects on the macroinvertebrate community.

Methods

The Qual 4 protocol was used at three sites and BAU's Full scale protocol was used at the remaining two sites. None of the sites were rated since Little Lick Creek is located within the Triassic Basin. The Qual 4 method is an abbreviation of the standard qualitative method, where all organisms are picked. This method was designed for use in small streams, defined as having a drainage area $\leq$ 3 square miles. In this method, four samples are collected: one kick, one sweep, one leaf-pack, and visuals. All organisms are picked in the field. Typically, a Not Impaired rating is given if the stream would receive a bioclassification of Good-Fair or better using DWQ EPT criteria developed for larger streams. Small streams that would have a minimum bioclassification of Fair or Poor continue to be assigned the classification of Not Rated.

Benthic macroinvertebrates were collected at two sites using the Division of Water Quality's standard qualitative (Full-Scale) method. This collection method is comprised of ten composite samples and includes the collection of two kicks, three sweeps, one leafpack, two rock-log washes, one sand sample and visuals. All organisms are picked in the field.

The purpose of these collections is to inventory the aquatic fauna and produce an indication of the relative abundance for each taxon. Organisms are classified as Rare (1-2 specimens, denoted by "R" on taxa tables), Common (3-9 specimens, "C"), or Abundant (>10 specimens, "A").

Several data-analysis summaries (metrics) can be produced from benthos samples to detect water quality problems. These metrics are based on the idea that unstressed streams and rivers have many invertebrate taxa and are dominated by intolerant species. Conversely, polluted streams have fewer numbers of invertebrate taxa and are dominated by tolerant species. The diversity of the invertebrate fauna is evaluated using taxa richness counts; the tolerance of the stream community is evaluated using a biotic index.

EPT taxa richness (EPT S) criteria have been developed by DWQ to assign water quality ratings (bioclassifications) for Full-Scale samples. "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect orders that are generally intolerant of many kinds of pollution. Higher EPT taxa richness values usually indicate better water quality. Bioclassifications for Full-Scale samples are also based on the relative tolerance of the macroinvertebrate community as summarized by the North Carolina Biotic Index (NCBI). Both tolerance values for individual species and the final biotic index values have a range of 0-10, with higher numbers indicating more tolerant species or more polluted conditions. EPT abundance (EPT N) and total taxa richness calculations also are used to help examine between-site differences in water quality. Criteria for Piedmont streams were used.

For Full Scale samples, a correction factor is applied during times of the year other than summer. In the case of piedmont spring samples, a correction factor of 0.2 is added to the biotic index and spring/winter stoneflies are subtracted from the EPT richness prior to determining the bioclassification. For Qual 4 samples, winter/spring stoneflies are subtracted, the same as EPT samples.

A final assessment of the stream habitat and of the landuse within the catchment is also completed at each site sampled. More specifically, these habitat evaluations assess the quality and quantity of instream habitat, the quality and quantity of the stream's riparian zone, and also evaluate detrimental impacts on stream habitat such as bank erosion and substrate embeddedness. Habitat evaluations result in a score between 1 and 100.

Site Locations

Little Lick Creek at Gibson Road

This was the most upstream site on Little Lick Creek, having a drainage area of 1.2 square miles. The catchment was largely urban with moderate to high-density residential and some commercial development in the headwaters. The conductivity was 136 μmhos /cm. There was one riffle area in the sampling reach containing a small amount of boulder (10%), rubble (10%) and a trace of gravel. The remainder of the substrate was sand. The habitat score was 57.

Little Lick Creek off Mineral Springs Road

The site receives water from the western quarter of the Little Lick Creek watershed west of Mineral Springs Road and southwest beyond Miami Boulevard and is inclusive of the entire southeastern corner of Durham. The drainage area is 5.9 square miles. At the time of sampling the conductivity was 192 μmhos /cm. There was one man-made riffle and the remainder of the substrate was sand (80%). The banks were eroded and the riparian zones contained breaks. The habitat scored 47.

Little Lick Creek at Stallings Road

This site receives water from the three large tributaries that drain the entire upstream half of the Little Lick Creek watershed, including most of the urban areas of southeastern Durham as well as some suburban and rural areas. The drainage area of this location is 9.4 square miles. The conductivity was 186 μmhos /cm. The substrate was 100% sand, the banks were severely eroded, and the riparian zones was wide but was not intact. The habitat received the lowest score of the study (40).

UT to Little Lick Creek at Lynn Road

This sampling location, downstream of a City/County park, drains the western-most corner of the Little Lick Creek watershed south of NC 98 across Miami Boulevard and represents about 10% of the Little Lick Creek watershed. The catchment is largely urban with residential and commercial development in the headwaters. The drainage area is 1.8 square miles. Conductivity measured 265 μmhos /cm, the highest recorded conductivity value in the study. There was one riffle area containing boulder and cobble within the sampling reach. The majority (70%) of the substrate was sand. Both stream banks were incised and the canopy provided approximately 40% shade. The riparian zones were wide, but were not intact. The habitat scored 59.

UT to Little Lick Creek off Santee Road

This small tributary drains an area along the southeastern edge of the Little Lick Creek watershed. The catchment is rural and relatively undisturbed unlike the majority of the Little Lick Creek watershed. The drainage area at this location is 0.8 square miles. The majority of the substrate was sand (65%), but there was one riffle in the sampling reach which contained mostly rubble and gravel with a small amount of boulder. Erosional areas were present on both stream banks and shading was partial. The riparian zones were wide and intact. Of the five sites sampled, this site received the highest habitat score (63) and the lowest conductivity (53 μmhos /cm).

Results

The three Little Lick Creek sites and the UT at Lynn Road exhibited signs of stress in their macroinvertebrate communities. All four of the sites contained only tolerant taxa. No stoneflies were collected and only two taxa of mayflies (*Caenis* and *Centroptilum*) were collected. Two caddisfly taxa were collected (*Cheumatopsyche* and *Ironoquia punctatissima*). *Cheumatopsyche* is a tolerant facultative filter feeder and *I. punctatissima* is commonly found in temporary streams. The biotic indexes were high (6.8-7.0) which indicate tolerant communities. In addition, conductivity values were high (136, 186, 192, and 265 μmhos /cm) indicating disturbed watersheds. It is most likely that Little Lick Creek and the UT at Lynn Road are showing signs of stress from urban impacts as well as Triassic Basin conditions.

The UT to Little Lick Creek off Santee Road supported a less impacted macroinvertebrate community. Tolerant taxa were collected at this site, but intolerant taxa were also present. Twelve EPT taxa were collected here while only 2 to 4 EPT taxa were collected at the other four sites in the study. One of the most obvious differences was that four taxa of stoneflies (*Amphinemura, Clioperla clio, Leuctra*, and *Perlesta*) were collected in this UT while none were collected at the other sites. Another difference was that seven caddisfly taxa were collected, including *Diplectrona modesta*, *Neophylax consimilis*, *Rhyacophila glaberrina*, and *R. ledra*. All of these are considered intolerant. The biotic index was lower at this site (6.2) and the lowest conductivity (53 μmhos /cm) was observed at this location compared to the other four sites in the study. This watershed was noticeably more rural and less disturbed than the other four sites.

Conclusions

It would be difficult to determine the relative degrees to which Triassic Basin characteristics and urban impacts affect the macroinvertebrate communities at the five study sites. However, since all five sites are within the Triassic Basin, the differences between the macroinvertebrate communities at the UT to Little Lick Creek off Santee Road and the other four sites suggest that urbanization is contributing to the stress indicated by the benthic communities at the more urban four sites.

Cc: Steve Kroeger
Darlene Kucken

Table 2. Benthic Macroinvertebrate Results and Site Characteristics. Little Lick Creek Watershed, Neuse River Basin, 2005.

	L Lick Cr Gibson Rd 4/5/2005	L Lick Cr off Mineral Springs Rd 4/5/2005	L Lick Cr Stallings Rd 4/6/2005	UT L Lick Cr Lynn Rd 4/6/2005	UT L Lick Cr off Santee Rd 4/5/2005
		Biological Community			
Ephemeroptera	1	1	2	0	1
Plecoptera	0	0	0	0	4
Trichoptera	2	2	2	2	7
Coleoptera	3	2	5	3	3
Odonata	1	4	3	1	3
Megaloptera	0	0	0	0	0
Diptera: Chironomidae	8	20	17	14	7
Misc. Diptera	2	3	2	3	6
Oligochaeta	4	5	4	3	3
Crustacea	0	2	2	1	2
Mollusca	2	4	3	0	1
Other	0	0	1	0	2
Total Taxa Richness	23	43	41	27	39
EPT Richness	3	3	4	2	12
EPT Abundance	14	21	15	11	35
Biotic Index	6.96	6.8	6.9	6.87	6.15
Sample Type	Qual 4	Full Scale	Full Scale	Qual 4	Qual 4
		Habitat			
Stream Width (m)	2	3	4	2	1
Drainage Area (mi^2)	1.2	5.9	9.4	1.8	0.8
Average Depth (m)	0.2	0.2	0.3	0.1	0.1
Canopy %	50	50	40	40	50
Substrate (%)					
Boulder	10	10	0	10	5
Rubble	10	10	0	20	15
Gravel	0	0	0	0	15
Sand	80	80	100	70	65
Silt	0	0	0	0	0
Habitat Score (out of 100)	57	47	40	59	63
		Physical			
Temp (°C)	14	17	16	17	12
DO (mg/L)	10.6	9.7	7.8	12.6	10.7
Conductivity (μmhos/cm)	136	192	186	265	53
pH	7.0	7.1	7.2	8.0	6.9
		General/Location			
County	Durham	Durham	Durham	Durham	Durham
Latitude	355826	355902	355912	355854	355934
Longitude	785014	784858	784801	785028	784646
Collection Date	4/5/2005	4/5/2005	4/6/2005	4/6/2005	4/5/2005

Table 3. Benthic Macroinvertebrates collected from Little Lick Creek watershed, Neuse River Basin, 2005.

	L Lick Cr Gibson Rd 4/5/2005	L Lick Cr off Mineral Springs Rd 4/5/2005	L Lick Cr Stallings Rd 4/6/2005	UT L Lick Cr Lynn Rd 4/6/2005	UT L Lick Cr off Santee Rd 4/5/2005
EPHEMEROPTERA					
CAENIS SPP	R		C		
CENTROPTILUM SPP		R	R		C
PLECOPTERA					
AMPHINEMURA SPP					C
CLIOPERLA CLIO					C
LEUCTRA SPP					R
PERLESTA SPP					C
TRICHOPTERA					
CHEUMATOPSYCHE SPP	A	A	A	A	A
DIPLECTRONA MODESTA					C
HYDROPSYCHE BETTENI					R
IRONOQUIA PUNCTATISSIMA	C	A	R	R	C
NEOPHYLAX CONSIMILIS					C
RHYACOPHILA GLABERRIMA					R
RHYACOPHILA LEDRA					R
COLEOPTERA					
COPELATUS SPP	R			R	
DUBIRAPHIA VITTATA			C		
ECTOPRIA NERVOSA					C
HELICHUS SP	C	C	R	C	C
NEOPORUS SPP					A
PARACYMUS SPP			R		
PELTODYTES SPP			R		
STENELMIS SPP	R	R	C	A	
ODONATA					
ARGIA SPP		A	R		
CALOPTERYX SPP		C		A	C
CORDULEGASTER SPP					R
ENALLAGMA SPP			C		
ISCHNURA SPP	R				
PROGOMPHUS OBSCURUS		C	C		
SOMATOCHLORA SPP		R			R
DIPTERA: CHIRONOMIDAE					
ABLABESMYIA MALLOCHI		A	C		
ABLABESMYIA PELEENSIS		R			
AXARUS SPP			C		
CRICOTOPUS BICINCTUS: C/O SP1			R		
ORTHOCLADIUS OBUMBRATUS GR: C/0 SP10	C	C	R		R
ORTHOCLADIUS (EUORTHOCLADIUS): C/O SP3				R	
ORTHOCLADIUS (O) OLIVERI: C/0 SP35		R	R		
CRICOTOPUS/ORTHOCLADIUS SP7				C	
CONCHAPELOPIA GROUP	C	A	A	A	
CORYNONEURA SPP		C	C		R
DIAMESA SPP				R	
DICROTENDIPES NEOMODESTUS		R	R	R	

	L Lick Cr Gibson Rd	L Lick Cr off Mineral Springs Rd	L Lick Cr Stallings Rd	UT L Lick Cr Lynn Rd	UT L Lick Cr off Santee Rd
DICROTENDIPES NERVOSUS		R	R		
DIPLOCLADIUS CULTRIGER	R	R			R
HYDROBAENUS SPP		R			
NANOCLADIUS SPP			R		
NATARSIA SPP		C	R		
POLYPEDILUM CONVICTUM	A	A	A	A	C
POLYPEDILUM FALLAX		R	A	R	R
POLYPEDILUM HALTERALE				R	
POLYPEDILUM ILLINOENSE	R	R		A	
POLYPEDILUM SCALAENUM	A			A	
PARACLADOPELMA SPP			R		
PARACLADOPELMA NEREIS		A			
PARAMETRIOCNEMUS LUNDBECKI				A	C
TRIBELOS JUCUNDUS		A			
POTTHASTIA LONGIMANUS			C		
RHEOTANYTARSUS SPP	R			R	R
SAETHERIA TYLUS		R			
STENOCHIRONOMUS SPP		R			
TANYTARSUS SPP		C			
TANYTARSUS SP3			R		
THIENEMANIELLA SPP	R		R	R	
THIENEMANIELLA XENA		R			
TRIBELOS SPP				R	
MISC. DIPTERA					
ALLUAUDOMYIA SPP		R			
CHRYSOPS SPP					R
PALPOMYIA (COMPLEX)			R		R
PILARIA SPP			R	R	R
PROSIMULIUM SPP					R
PSEUDOLIMNOPHILA SPP		C			
SIMULIUM SPP	R	R			C
SIMULIUM VITTATUM				R	
TIPULA SPP	A			A	A
OLIGOCHAETA					
CAMBARINICOLIDAE	C	R			
LIMNODRILUS SPP					R
LUMBRICULIDAE	A	A	C	C	R
MEGADRILE OLIGOCHAETE	R		C	C	R
NAIS SPP	R	C		C	
OPHIDONAIS SERPENTINA			R		
SPIROSPERMA NIKOLSKYI		R			
STYLARIA LACUSTRIS		R	C		
CRUSTACEA					
CAMBARIDAE		A	A		C
CAMBARUS (D.) LATIMANUS				C	
PELECYPODA					
CORBICULA FLUMINEA			A		
PISIDIUM SPP	R	C	C		R
SPHAERIUM SPP		C	C		

	L Lick Cr Gibson Rd	L Lick Cr off Mineral Springs Rd	L Lick Cr Stallings Rd	UT L Lick Cr Lynn Rd	UT L Lick Cr off Santee Rd
GASTROPODA					
MENETUS DILATATUS	R				
PHYSELLA SPP		R			
PSEUDOSUCCINEA COLUMELLA		R			
OTHER					
DUGESIA TIGRINA					R
PROSTOMA GRAECENS			R		R