BIOLOGICAL MONITORING OF
BATTLE BR, CHAPEL CR and MEETING of the WATERS
UNIVERSITY OF NORTH CAROLINA
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Introduction

This study uses information about freshwater macroinvertebrates – “bugs” to the non-biologist. Invertebrates are animals without a backbone; “macro” means they are large enough to be seen with the naked eye. “Benthic” refers to the water and sediments on the bottom of a waterbody. The bottom-dwelling visible insects constitute a large proportion of the aquatic life in streams and can be used as an indicator of the health of the entire stream community. Furthermore, they are indicators of the ability of the stream to support fishing, swimming and other uses by the UNC community.

There are several reasons for using biological surveys in monitoring water quality. Conventional water quality surveys do not integrate fluctuations in water quality between sampling periods. Therefore, short-term critical events may often be missed. The biota, especially benthic macroinvertebrates, reflect both long and short-term conditions. Since many species in a macroinvertebrate community have life cycles of a year or more, the effects of a short-term pollutant will generally not be overcome until the following generation appears.

Macroinvertebrates are useful biological monitors because they are found in all aquatic environments, they are less mobile than many other groups of organisms, and they are small enough to be easily collectable. Moreover, chemical and physical analysis for a complex mixture of pollutants is generally not feasible. The aquatic biota, however, show responses to a wide array of potential pollutants, including those with synergistic or antagonistic effects. Additionally, the use of benthic macroinvertebrates has been shown to be a cost-effective monitoring tool (Lenat 1988). The sedentary nature of the benthos ensures that exposure to a pollutant or stress reliably denotes local conditions, and allows for comparison of sites that are in close proximity (Engel and Voshell 2002). With increasing levels of pollution, we expect to see both fewer species and a shift in community structure to more tolerant groups.

Analysis of stream life is one way to detect water quality problems (Rosenberg et al 1986). Different kinds of stress will often produce different benthic macroinvertebrate communities. For example, the species associated with organic loading (and low dissolved oxygen) are well known. More recent studies have begun to identify the biological impacts of sedimentation and toxic stress. Identification at, or near, the species level is desirable for many groups of organisms (Resh and Unzicker 1975), and recent work by Lenat and Resh (2001) has shown the benefits of precise taxonomy for both pollution monitoring and conservation biology.

Organisms cannot always be identified at the species level, thus counts of the number of kinds of stream organisms often include identifications at higher levels (genus, family, etc.). Each different type of organism in these situations is called a “taxon” and the plural form of this word is “taxa”. Thus “taxa richness” is a count of the number of different types of organisms. EPT taxa richness is the number of taxa within the most intolerant groups: Ephemeroptera, Plecoptera and Trichoptera. Higher EPT Taxa richness is associated with good water quality; lower EPT taxa richness is associated with poor water quality.

Three sites were sampled on the UNC campus using macroinvertebrates to assess parts of streams that have been restored in the past. These sites, on Battle Branch, Chapel Creek and Meeting of the Waters Creek are shown in Figure 1 at the end of the report.

Methods

The Qual-4 method is a rapid collection technique, limited to 4 samples: 1 kick, 1 bank sweep, 1 leaf pack and visuals. All benthic macroinvertebrates are collected from these samples. DWR uses this method to evaluate small streams (drainage area < 3 square miles) and assigns ratings based solely on the biotic index values. This method is intended for use, however, only in perennial streams. For this reason, some of the ratings given here are tentative, supplemented by best professional judgment.

The ultimate result of a benthos sample is a bioclassification. Bioclassifications used by NC DWR are Excellent, Good, Good/Fair, Fair or Poor. Small streams (<4 meters wide) are expected to have lower EPT taxa richness relative to larger streams. NC DWR has developed criteria for small piedmont stream based solely on biotic index values:

The North Carolina Biotic Index (NCBI) was derived as another (independent) method of bioclassification to support water quality assessments (Lenat 1993). This index is similar to the Hilsenhoff Biotic Index (Hilsenhoff, 1987), but with tolerance values derived from NC collections. Biotic indices are based on a 0-10 scale, where 0 represents the best water quality and 10 represents the worst water quality. Abundance values used in the biotic index calculation are 10 for Abundant taxa, 3 for Common taxa, and 1 for Rare taxa. The highest Biotic Index values (>6.9) indicate the worst water quality and receive a Bioclassification of Poor; the lowest values (<4.3) indicate Excellent water Quality (see below).

Excellent:	<4.3
Good:	4.3-5.1
Good-Fair:	5.2-5.8
Fair:	5.9-6.9
Poor:	>6.9

Sites

. Battle Branch. This site was located behind the Forrest Theater. This stream was very small, only about 1m wide, and generally the stream appeared to be in good shape. With only 2 EPT taxa and a very high Biotic Index (8.06) there appears to beissuess in this stream. This stream appears to have flow problems as evidenced by the dytiscid beetles and the damselfly *Ischnura*, which tend to prefer standing water. It is possible that in drought years this stream could go completely dry. The presence of the midges *Chironomus* and *Goeldichironomus*, plus the snail *Physa* also suggest a possible eutrophication component to the water quality problems as well

Battle Br, June 2017.

Chapel Creek. Chapel Creek at Quail Hill Drive way is another small (1m wide) stream. This stream, however appears to be solidly perennial and with the best water quality of the three streams. The Biotic Index of 5.92 is only a few hundredths too high for a Good-Fair rating, which is a typical rating for good quality small streams in this area. While Total Taxa Richness was low (17), 5 of those taxa are EPT taxa and two of those, the caddisflies *Diplectrona modesta* and *Chimarra* sp, are very intolerant to pollution. Specific conductance here (96 μhos/cm) is relatively low for the ecoregion, also suggesting generally good water quality.

Chapel Cr June 2017.

Meeting of the Waters. This stream, sampled just off the corner of Manning Dr and Skipper Bowles Rd, is significantly larger than the other two streams (3m wide). This stream appears to fall between the other two sites in terms of water quality. On the day of sampling, the stream was slightly milky in color with some foam, which often can indicate pollutants. Specific conductance of 222 μhos/cm, about 50-100% higher than at the other sites, also suggests a water quality issue as does the Biotic Index (6.71), which is on the low end of the Fair bioclassification. The snail *Physa* being abundant here suggests that at least some of the water quality issues involve low dissolved oxygen.

Meeting of the Waters June 2017.

Table 1. Summary Parameters from Battle, Br, Chapel Cr and Meeting of the Waters

Summary Parameters	Battle Br	Chapel Cr	Meeting of Waters
Habitat Score			
Temp (oC)	24.4	23.4	22.2
Dissolved Oxygen (mg/l)	10	7.9	10
Specific Conductance (μhos/cm)	165	96	222
pH	7.2	7.3	7.6
Turbidity (NTU)	18	31	14
Total Taxa Richness	24	17	18
EPT Taxa Richness	2	5	4
EPT Abundance	13	27	33
Biotic index	8.06	5.92	6.71

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Appendix 1. Benthic Macroinvertebrates from tributaries of Battle Br, Chapel Cr and Meeting of the Waters. June 20, 2017. R=Rare, C=Common, A=Abundant.

Stream Taxa / Biotic Index Value/Site	Battle Br	Chapel Cr	Meeting of Waters
EPHEMEROPTERA			
Family Baetidae			
Baetis flavistriga (6.8)		C	C
TRICHOPTERA			
Family Hydropsychidae			
Cheumatopsyche spp (6.6)	A	A	A
Diplectrona modesta (2.3)		C	
Hydropsyche betteni (7.9)	A	R	A
Family Philopotamidae			
Chimarra spp (3.3)		A	A
MISC DIPTERA			
Family Simuliidae			
Simulium spp (4.9)			C
Family Tipulidae			
Hexatoma spp (3.5)			
Tipula spp (7.5)	C	R	C
DIPTERA; CHIRONOMIDAE			
Ablabesmyia mallochi (7.4)			R
Brillia flavifrons (3.9)			R
Chironomus spp (9.3)	C		
Eukieferiella devonica gp (3.4)	R		
Goeldichironomus sp.	R		
Microtendipes pedellus (4.6)	R		
Parametriocnemus lundbecki (3.9)	R	R	
Polypedilum flavum (5.7)			R
Polypedilum illinoense (8.7)	A	C	
Rheotanytarsus spp (6.5)		R	
Thienemaniella spp (6.4)		R	
Thienemannimyia group (8.4)	A	C	R
COLEOPTERA			
Family Dryopidae			
Helichus fastigiatus (4.1)		R	
Family Dytiscidae			
Copelatus sp	R		
Hydrovatus sp	R		
Family Elmidae			
Stenelmis spp (5.6)		R	

Haliplidae			
Peltodytes spp (8.4)	R	R	
Family Hydrophilidae			
Tropisternus sp (9.3)	R		
Family Hydraenidae		R	
ODONATA			
Family Aeshnidae			
Boyeria vinosa (5.8)			A
Family Coenagrionidae			
Argia spp (8.3)			A
Enallagma sp (8.5)	A		
Ischnura sp (9.5)	A		
Family Libellulidae			
Pachydiplax longipenis	R		
Family Corduliidae			
Somatochlora spp (8.9)	R		
OLIGOCHAETA			
Megadrile	C		C
Family Lumbriculidae (7.0)	A	A	C
Family Naidae			
Pristina (7.7)	R		
Family Tubificidae			
Immature Tubificidae w/o capilliform setae (9.4)	C		
CRUSTACEA			
Family Cambaridae			
immature crayfish (7.5)	R		
MOLLUSCA			
Family Ancylidae			
Ferrissia spp (6.6)			C
Family Physidae			
Physa spp (8.7)	C		A
OTHER TAXA			
Nematoda			R
Hirudinea			
Actinobdella pediculata			R
Total Taxa Richness	24	17	18
EPT Taxa Richness	2	5	4
EPT Abundance	13	27	33
Biotic Index	8.06	5.92	6.71

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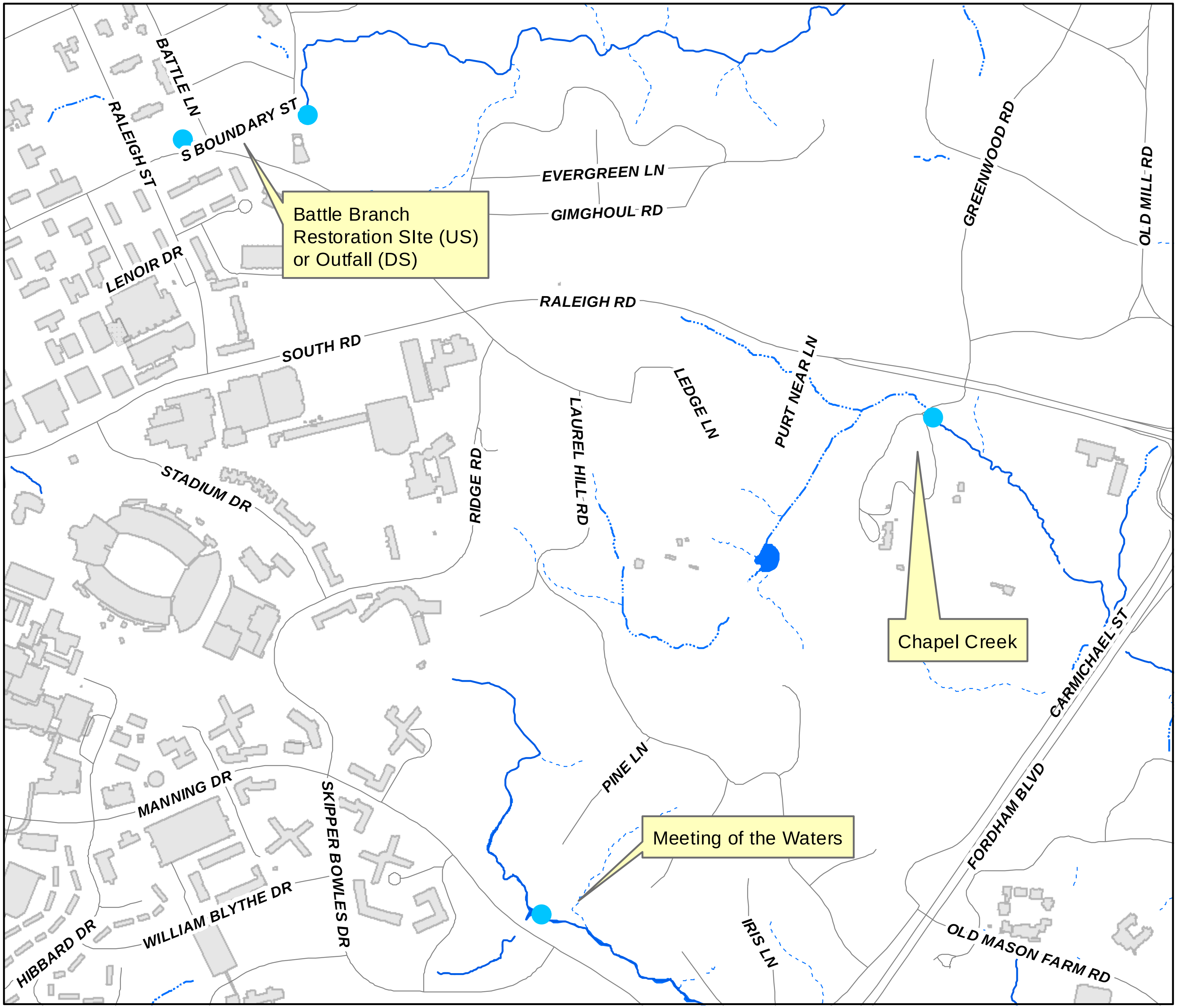
Figure 1.
UNC
Stormwater

Date: 6/16/2017



UNCproposed2017

Town of Chapel Hill Streams

Perennial Stream

Intermittent Stream

Ephemeral or Unknown Stream

Note: This map provides a schematic representation of utilities on campus and is neither complete nor accurate. The GIS maps are a work-in-progress and do not contain all known utilities on campus. This map should be used in conjunction with record drawings and site surveys to identify and obtain actual locations of all existing site utilities. Designers and Consultants utilizing these maps are subject to the standards set forth in the UNC Design & Construction Guidelines.

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1 inch = 800 feet