

**Division of Water Quality
Watershed Assessment Team**
January 29, 2008

Memorandum

To: Steve Kroeger

Through: Trish MacPherson *Tm*

From: Cathy Tyndall

Subject: EEP Benthic Macroinvertebrate pre-restoration Study, Little River Watershed, New River Subbasin 03, Alleghany County, October 2007

Background and Historical Sampling

Macroinvertebrate sampling was conducted on October 2, 2007 for pre-restoration monitoring of an Ecosystem Enhancement Program (EEP) on a UT to Crab Creek (UTCC)). Macroinvertebrates were collected at two locations on the UTCC, at one site on an unnamed tributary (UT) to the UTCC, at one site on Crab Creek, and in Brush Creek (Figure 1). Brush Creek is a macroinvertebrate basinwide site and was chosen as a comparison site for seasonal taxa considerations. The restoration project is the result of EEP local watershed planning in the Little River watershed. The overall project will include approximately 6000 feet of stream length, associated riparian buffers, wetland and stream buffer work, and bog turtle habitat enhancement. Construction is scheduled to begin during the latter part of 2008.

The Biological Assessment Unit (BAU) has conducted benthic sampling in the Little River watershed since the 1980's for basinwide monitoring and planning. In 2006, DWQ's Watershed Assessment Team (WAT) requested benthic samples at eleven sites in the Little River watershed to support EEP local watershed planning (BAU Memo B060815). Nine of the sites had high water quality and were rated Good, Excellent, or Not Impaired. Two urban sites on Bledsoe Creek rated Good-Fair. In 2003, BAU conducted macroinvertebrate assessments at ten sites in the Little River watershed during August for basinwide monitoring and in November to support local watershed planning efforts of the Wetlands Restoration Program, which is now EEP (BAU memo B040203). All sites sampled in the Little River watershed in 2003, except Pine Swamp Creek, supported a diverse and pollution intolerant macroinvertebrate community, with ratings of Good or Excellent. The decline in the community of Pine Swamp Creek (Good-Fair) was attributed to the impact of drought conditions in 2002 and compromised riparian zones. The report concluded that even though the benthic data collected did not indicate any water quality degradation, if the riparian areas are not restored and farm animals are allowed continued access to the streams, these benthic communities could decline over time.

Methods

Benthic Macroinvertebrates

BAU's Full Scale, Qual 4, and EPT protocols were used for this study. The Full Scale 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 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, which are defined as having a drainage area ≤ 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

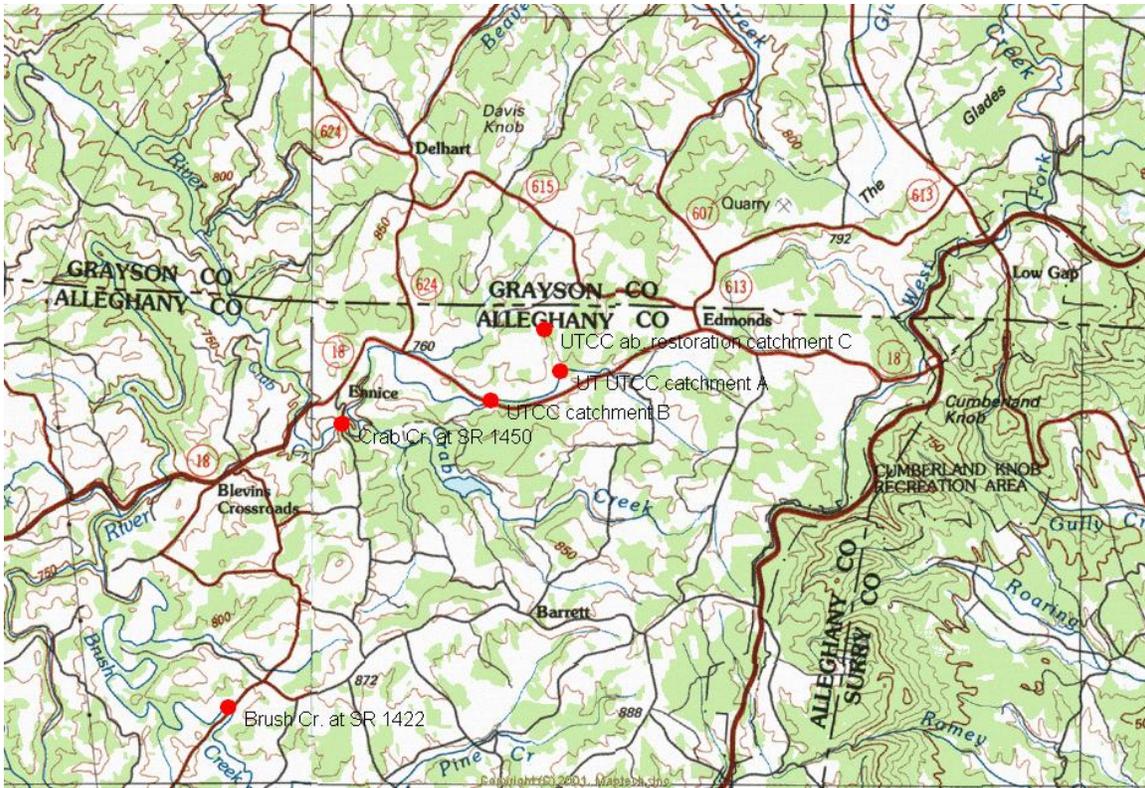


Figure 1. Location of Benthic Macroinvertebrate Sampling Location, Allegheny County EEP Study, October 2007.

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. The EPT sampling method is identical to the Qual 4 method and consists of one kick, one sweep, one leaf pack, and visuals, but only EPT taxa are collected. 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 evidence 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) in addition to those derived from Full Scale samples. "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect orders that are generally intolerant of many kinds of pollution. These orders are mayflies, stoneflies and caddisflies, respectively. Higher EPT taxa richness values usually indicate better water quality. Bioclassifications for Full Scale samples are based on the relative tolerance of the macroinvertebrate community as summarized by the North Carolina Biotic Index (NCBI) and taxa richness criteria. 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 Mountain streams were used.

For Full Scale samples, a correction factor is applied during times of the year other than summer. In the case of mountain fall samples, a correction factor of 0.4 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 for EPT samples.

Habitat Assessments

Habitat assessments were performed at each sampling location using DWQ's Mountain/Piedmont Habitat Evaluation Form. This evaluation quantifies eight habitat metrics including four measures of in-stream habitat, one concerning streambank stability, two regarding the riparian zones, and an analysis of channel modification. The scores for each of the eight metrics are totaled, with a possible overall score of 100. Summary information for habitat assessments is included in Table 1. Bar graphs depicting each individual metric of the habitat assessment are shown in part A. of Figure 2.

Habitat conditions are important when assessing aquatic communities, as streams essentially flow through a terrestrial landscape. The physical features of a stream or small river are largely influenced by geology and the areas immediately adjacent to the water body (i.e. riparian zone). Documentation of the habitat characteristics of a site can identify factors that could limit or enhance a stream's ability to support a diverse macroinvertebrate community. The habitat assessment also provides documentation from which future changes in the physical conditions of the stream or riparian zone can be measured.

Physical-Chemical

Field measurements were taken at the time of sampling for temperature, dissolved oxygen, specific conductance corrected to 25⁰C (reported throughout this memo as conductivity values), and pH using a YSI 85 meter and an Accumet pH meter.

Site Locations

The catchments refer to the WAT Stream Restoration Monitoring Plan for UTCC, July 2007.

UTCC above restoration (catchment C)



The drainage area of the UTCC at this location is 0.44 square miles. The stream width was three meters. The substrate was mostly rubble (30%), gravel (20%), and sand (20%). Riffles were frequent and well defined and bank erosion was minimal. The canopy provided ample shading. Left and right riparian buffers were greater than 18 meters, although breaks allowing sediment to enter the stream were present. The overall habitat at this site was favorable, scoring 82 of 100 possible points. This monitoring location received the highest habitat score of the five sites sampled. The conductivity was 44 μ S/cm.

UT UTCC (catchment A)



This site is located on an unnamed tributary (UT) to UTCC. At this location, the drainage area is 1.66 square miles and the stream was four meters wide. The substrate was mostly rubble (40%), gravel (20%), and sand (20%). The riparian zone width was greater than 18 meters on both banks and intact. The canopy provided good shading and the conductivity was $47\mu\text{S}/\text{cm}$. Severe erosion was noted on the left bank. Overall, this second highest habitat score (81) reflected a favorable habitat.

UTCC below restoration at NC 18 (catchment B)



This location on UTCC is below where the restoration activity will be constructed. The drainage area is 2.7 square miles and the stream width was 1.5 meters. This portion of UTCC has been channelized and was very straight. There was no functioning riparian zone and full light penetration can occur in all but a few areas. The substrate was mostly gravel (30%), rubble (20%), sand (20%), and silt (20%). Due to an absence of riparian zones, there was very little woody debris in the stream. The low habitat score (55) indicated that this location has numerous habitat concerns. The conductivity was $49\mu\text{S}/\text{cm}$.

Crab Creek at SR 1450



At this location on Crab Creek, the drainage area is 8.6 square miles. The width was four meters. Beaver dams were located upstream and downstream of the sampling reach and significantly decreased velocity. The mixed substrate was predominately rubble (30%), gravel (20%), and sand (20%). Riffle areas were reduced because of the beaver activity and the remaining riffle areas were moderately embedded. The habitat score was 64 and the conductivity was $50\mu\text{S}/\text{cm}$.

Brush Creek at SR 1422



Brush Creek is a large tributary to the Little River; the drainage area at SR 1422 is 31.5 square miles. At the time of sampling the width was 10 meters. The substrate was mixed with mostly sand (25%) and rubble (25%). Pools were infrequent, and riffle areas were as wide as the stream, but not twice as wide. The riparian buffers on both stream banks were compromised and reduced due to the presence of pastureland and cows. The overall habitat was of moderate quality and scored 69 points out of 100. The canopy was reduced at the bridge with sunlight and shade essentially equal. The conductivity was 38 µmhos/cm.

Results and Discussion

Benthic Macroinvertebrates

Summary information of benthic macroinvertebrates can be found in Table 1 and a complete taxa list with abundance values can be found in Table 2. Part B. of Figure 2. depicts the biological metrics for each site. For the five sites sampled, there were two ratings of Good, one Good-Fair, and two ratings of Not Impaired.

Table 1. Summary data for benthic macroinvertebrates, site and habitat characteristics for the Alleghany County EEP Study, October 2007.

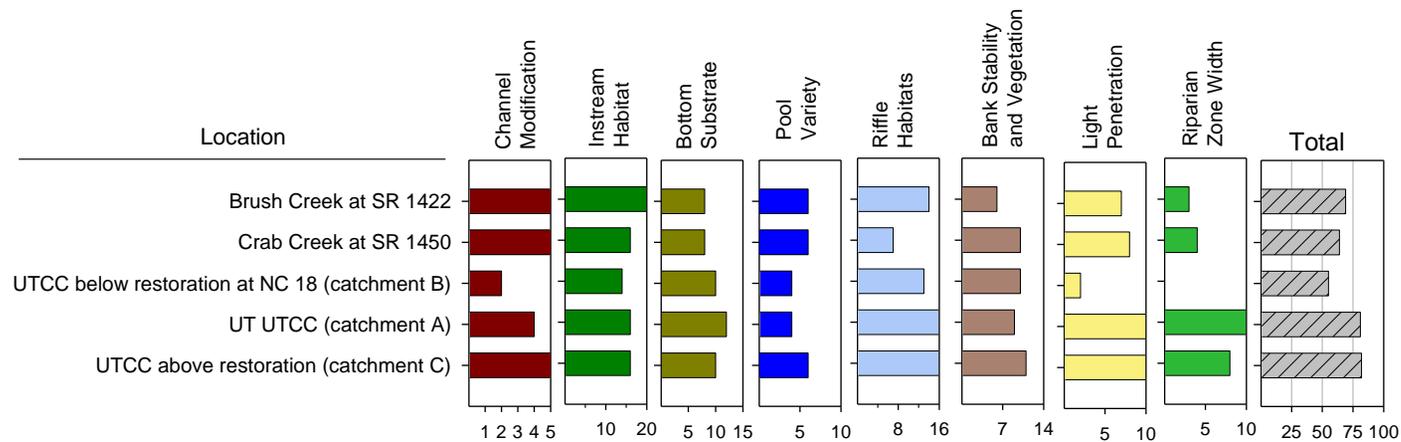
Station	UT Crab Creek	UT UT Crab Creek	UT Crab Creek	Crab Creek	Brush Creek
Sample Type	Qual 4	Qual 4	Full Scale	EPT	Full Scale
Location	above restoration "C"	"Catchment A"	NC 18 "B"	SR 1450	SR 1422
Ephemeroptera	10	12	20	8	19
Plecoptera	2	3	3	4	5
Trichoptera	9	6	11	8	13
Coleoptera	3	7	6	-	9
Odonata	1	3	4	-	5
Megaloptera	3	1	1	-	2
Diptera: Chironomidae	10	4	12	-	21
Misc. Diptera	5	3	7	-	5
Oligochaeta	2	1	2	-	2
Crustacea	1	1	1	-	1
Mollusca	1	2	2	-	2
Other	1	0	0	-	1
Total Taxa Richness	48	43	69	20	88
EPT Richness (S)	21	21	34	20	37
Seasonally corrected EPT S	21	21	33	19	36
EPT Abundance	89	73	149	57	156
Biotic Index	4.08	4.05	3.99	-	4.48
EPT BI	2.84	3.75	3.31	3.92	3.45
Seasonally corrected BI	-	-	4.39	-	4.88
Bioclassification	Not Impaired	Not Impaired	Good	Good-Fair	Good
Drainage Area	0.44	1.66	2.72	8.6	31.5
Width	3	4	1.5	4	10
Depth					
Canopy	80	80	0	70	10

Station	UT Crab Creek	UT UT Crab Creek	UT Crab Creek	Crab Creek	Brush Creek
Sample Type	Qual 4	Qual 4	Full Scale	EPT	Full Scale
Location	above restoration "C"	"Catchment A"	NC 18 "B"	SR 1450	SR 1422
Substrate (%)					
Boulder	15	10	10	15	15
Rubble	30	40	20	30	25
Gravel	20	20	30	20	15
Sand	20	20	20	20	25
Silt	15	10	20	15	10
Bedrock	-	-	-	-	10
County	Alleghany	Alleghany	Alleghany	Alleghany	Alleghany
Latitude	363338	363320	363308	363258	1422
Longitude	805757	805749	805825	805943	363058
Physical/Chemical					
Temperature (°C)	15.4	12.3	14.2	13.7	11.9
DO (mg/l)	8.5	9.45	8.9	9.2	9.4
Conductivity (µmhos/cm)	44	47	49	50	38
pH	6.5	6.4	6.1	6.2	6.2
Habitat characteristics					
Channel modification	5	4	2	5	5
Instream habitat	16	16	14	16	20
Bottom substrate	10	12	10	8	8
Pool variety	6	4	4	6	6
Riffle habitats	16	16	13	7	14
Bank stability & Vegetation	11	9	10	10	6
Light penetration	10	10	2	8	7
Riparian zone width	8	10	0	4	3
Total score	82	81	55	64	69

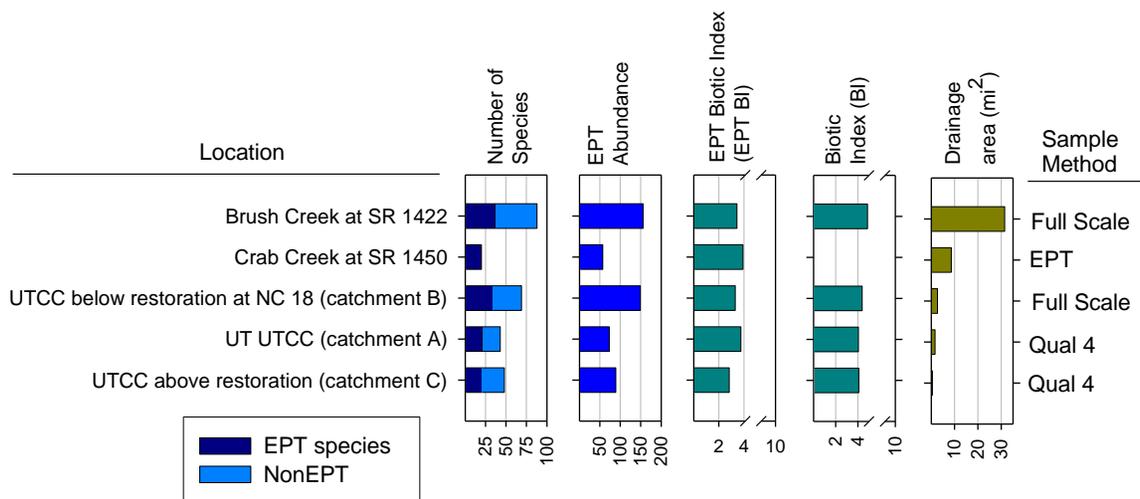
Site Results and Discussion

UTCC above restoration (catchment C) A Qual 4 sample was collected due to the small drainage area (0.44 square miles). The sample received a Not Impaired Rating, since it would have rated Good-Fair based on criteria for EPT taxa for larger streams. There were 21 EPT taxa present including a mixture of intolerant (*Paraleptophlebia*, *Stenacron carolina*, *Ephemera*, *Rhyacophila carolina*, and *Dolophilodes*) and tolerant taxa (*Isonychia*, *Baetis flavistriga*, and *Lype diversa*). The EPT abundance (89) was relatively low; most of the taxa were Rare (1-2 individuals) and Common (3-9 individuals). One taxon that is typically found in small clean headwater streams, *Diplectrona modesta*, was abundant. Only two stonefly taxa were collected, *Acroneuria abnormis* and *Tallaperla*. *A. abnormis* is a long lived stonefly that requires year round flow and *Tallaperla* is common in mountain streams and is found in leaves and detritus. The beetle, odonate, and chironomid assemblages were sparse and unremarkable. It is noteworthy that this site, with such a small drainage area, would have as many as 21 EPT taxa. The EPT BI (2.84) is the lowest of the five sites sampled, indicating an intolerant benthic community typically found in streams with high quality water.

UT UTCC (catchment A) A Qual 4 sample was collected (drainage area = 1.66 square miles). This site received a Not Impaired rating and the same number of EPT taxa (21) was collected here as at the site above the restoration (catchment C). The EPT abundance (73) was even lower at this site due to the high number of taxa that were Rare and Common. Only two of twelve mayfly taxa (*Isonychia* and *Maccaffertium ithaca*) were Abundant. Of the six caddisfly taxa that were collected, only one, *Cheumatopsyche*, which is tolerant and ubiquitous, was Abundant. The same intolerant taxa were collected at his location as at the site above the restoration, but were mostly Rare. Two long-lived stoneflies that require constant water (*Acroneuria abnormis*, *Eccoptura xanthenes*) were collected, indicating the presence of year round flowing water. *E.*



A. Habitat Assessment Scores



B. Biological Metrics

Figure 2. Bar graphs depicting: A. habitat assessment scores, and B. biological metrics.

xanthenes is also a fairly good indicator of small catchments. The stonefly, *Tallaperla*, was not collected. One noticeable difference in this site and the one above the restoration was the more diverse beetle assemblage found here (three versus seven taxa). Perhaps the larger watershed is able to support a more complex beetle community. In addition, *Elimia*, a fairly intolerant Gastropod was Abundant at this site but Rare at the site above restoration. The midge assemblage was very sparse at this site (four taxa) compared to the above location (ten taxa).

UTCC at NC 18(catchment B) A full scale sample was conducted at this site since the drainage area is nearly three square miles (2.7square miles). Although the habitat score was low (55), the sample rated Good. Thirty-four EPT taxa were collected at this location while 37 EPT taxa were collected at Brush Creek, the comparison site. This is notable since the drainage areas are so different in size (2.7 mi² versus 31.5 mi²). In terms of mayfly diversity and abundance, this sample was better than the upstream UTCC site and the UT UTCC site. Twenty mayfly taxa were collected and intolerant taxa that were not found at the upstream sites on the UTCC and UT UTCC were found here (*Leucrocuta*, *Dipheter hageni*, *Ephemera subvaria*, and *Eurylophella funeralis*). These were all Rare, but it is notable that they were found. Eleven caddisfly taxa were collected and contained mostly the same intolerant and tolerant taxa as the sites discussed previously. *Rhyacophila nigrita*, an intolerant caddisfly was found at this site and at no other in the study. Several taxa were collected only at this site and in Brush Creek. These were the mayfly, *Baetisca berneri*, and the stonefly, *Isoperla lata*. *B. berneri* was Abundant at this location, but Rare in Brush Creek. *I. lata* was Rare in both streams.

Crab Creek at SR 1450 An EPT sample was collected since an EPT was conducted in November 2003. There were 20 EPT taxa collected in 2007, producing a rating of Good-Fair. The 2007 EPT BI was 3.92 and the EPT abundance was 57. In 2003 this site rated Good and 33 EPT taxa were collected. The 2003 EPT BI was 3.72 and the EPT abundance was 159. This is a noticeable decline in taxa richness and abundance from 2003 to 2007. The overall greatest decline was in the mayfly taxa. In 2003, 16 mayfly taxa were collected and in 2007, the number of mayfly taxa declined to eight. Of the 2007 mayfly taxa collected, only one, *Maccaffertium ithaca* was Abundant. One notable intolerant mayfly, *Potamanthus distinctus*, was collected here and in Brush Creek. In 2003, eleven caddisfly taxa were collected and eight were collected in 2007. Only one taxa, *Cheumatopsyche*, which is very tolerant was Abundant in the 2007 sample. The decline in EPT taxa, the EPT BI, and the EPT abundance indicates a decline in water quality from 2003 to 2007.

Brush Creek at SR 1422 A Full Scale sample was collected in 2007, as was in April 2006 and in August 2003. In 2007, the site rated Good. This is a decline from the Excellent ratings in 2006 and 2003. The 2007 total taxa was 88, EPT richness was 37, the corrected NCBI was 4.88, and the EPT BI was 3.45. In 2006, total taxa richness was 119, EPT taxa richness was 53, the NCBI was 4.11 and the EPT BI was 2.34. It must be taken into account that the 2006 sample was collected in spring, which can tend to have slightly higher EPT taxa richness values, even after the seasonal correction (BAU memo B060815). In 2003, total taxa richness was 83, EPT taxa richness was 42, the NCBI was 3.94 and the EPT BI was 3.34. The 2003 sample was collected in summer, which is more directly comparable to the 2007 sample. The higher EPT taxa number, lower EPT BI value, and lower NCBI in 2003 indicates that overall, the benthic community has become more tolerant in Brush Creek. This could be attributed to declining water quality, a decline in habitat, or a combination of both. In the 2007 sample the mayfly, *Neoephemera purpurea*, and the caddisflies, *Brachycentrus spinae*, *Micrasema bennetti*, and *Glossosoma* were present only at this site. These four taxa, with the exception of *Glossosoma*, tend to be found in larger streams. As in past samples, there was high midge diversity (21 taxa). In addition, there was a high diversity of beetles (9 taxa) and odonates (5 taxa).

Habitat Results

Habitat scores ranged from 55 at the UTCC at NC 18 site to 82 at the UTCC site above the restoration. The UTCC site at NC 18 scored low due to extensive channelization, no riparian zone, and no canopy. The UTCC above the restoration had plentiful habitat for colonization,

good riffles, minimal bank erosion, ample shading, and a functioning riparian zone. Crab Creek had the second lowest score (64) mostly due to poor riffle habitat from beaver dams and compromised riparian zones. Brush Creek (69) lost points due to a high amount of sand that caused embeddedness in the riffles, erosion areas on the stream banks, and compromised riparian zones. The UT UTCC had the second highest habitat score (81), which was reduced mostly due to stream bank erosion.

Physical Chemistry Results

The physical chemistry results were unremarkable. Water temperatures fluctuated with time of day sampled, as expected. Values for pH ranged from 6.1 to 6.5 s.u. Conductivity readings ranged from 38-50 $\mu\text{mhos/cm}$. The highest conductivity values were recorded in Crab Creek and the UT Crab Creek at NC 18 (50 and 49 $\mu\text{mhos/cm}$ respectively) and the lowest recorded conductivity was in Brush Creek (38 $\mu\text{mhos/cm}$). Dissolved oxygen values were all above 8.0 mg/L.

Conclusions

Of the three smaller sites that were sampled for the first time (the two UTCC sites and the UT UTCC) this was a pre-restoration sampling event to document the existing benthic community. There is no historical data for comparison to know whether the macroinvertebrates have changed over time.

At the site above the restoration and the UT UTCC, there were low abundance values for the intolerant taxa. Many of the EPT taxa were Rare in the samples. However, it is not especially unusual to encounter low abundance values in small drainage areas due to the reduced amount of habitat. The most notable feature of these small sites was the high number of EPT taxa collected (21 at both). The UTCC at NC 18 also had a high number of EPT taxa (34) for such a small stream. The low EPT BI (2.84) at the site above the restoration indicates that the benthic community is intolerant and typical of small streams with high water quality. This was the lowest EPT BI of the five sites. Long lived stoneflies were collected at both small, upper sites indicating year round flowing water.

Although UTCC at NC 18, which is located below the restoration, scored the lowest (55) of the five sites for habitat, it received a Good bioclassification. The number of EPT taxa collected (34) was close to the number collected in Brush Creek (37) and the EPT BI was lower, indicating a less tolerant community in UTCC at NC 18 than in Brush Creek. The drainage areas are considerably different in size (2.7 versus 31.5 square miles) and one would generally expect greater EPT diversity and abundance in Brush Creek assuming high water quality in both streams. Historical samples indicate the benthic community is declining in Brush Creek. A possible explanation for the Good bioclassification with the low habitat score is the combination of the two smaller watersheds (UTCC and UT UTCC) combining into a larger one that can support a more diverse and abundant community. Many of the headwaters in this area are located in higher elevations and are forested. Perhaps the water quality has maintained a Good benthic community even though the habitat is compromised. However, over time the worsening habitat will cause the water quality to decline.

At all five sites there appeared to be an absence or very few occurrences of what is considered to be edge taxa. These are the taxa such as *Trienodes* and *Nectopsyche* that are generally found in roots and plant material collected in sweeps along the stream edge. The drought conditions may have affected the edge habitats in that they were not submerged at the time of sampling.

Overall, the benthic communities indicated Good to moderate water quality. Habitat is certainly an issue in this watershed as noted in the habitat assessments completed in 2007 and dating back to 2003. Much of the land is in agriculture, fallow fields, and pasture for cattle. All of these land uses lead to decreased riparian zones, bank instability and erosion. The compromised riparian zones further lead to reduced canopy, increased water temperatures, and a reduction in

woody debris in the stream habitat. As stated in the 2003 BAU memo B040203, "if the riparian areas are not restored and farm animals are allowed access to the streams, these benthic communities could decline over time. It appears this decline is occurring as indicated by the sites (Crab Creek and Brush Creek) that have historical data for comparison. If restorative measures are not implemented, water quality will continue to decline.

Table 2. Benthic Macroinvertebrate Taxa List, Alleghany County EEP Study. October 2007.

	UT Crab Cr Above restoration "C"	UT UT Crab Cr "A"	UT Crab Cr NC 18 "B"	Crab Cr SR 1450	Brush Cr SR 1422
EPHEMEROPTERA					
ACENTRELLA TURBIDA		C	R		
BAETIS ANOKA					R
BAETIS FLAVISTRIGA	C	R	A		C
BAETIS INTERCALARIS		C	C	C	A
BAETIS PLUTO	C	C	A		C
BAETIS TRICAUDATUS			C		
BAETISCA BERNERI			A		R
CAENIS SPP				R	R
CENTROPTILUM SPP			R		R
DIPHETOR HAGENI			R		
EPHEMERELLA SUBVARIA			R		
EPHEMERA SPP	C	R	R		R
EURYLOPHELLA FUNERALIS			C		
HEPTAGENIA MARGINALIS	R				R
HEXAGENIA SPP					C
ISONYCHIA SPP	A	A	A		R
LEUCROCUTA SPP			R		
NEOEPHEMERA PURPUREA					A
PARALEPTOPHLEBIA SPP	R	R	C		R
PLAUDITUS DUBIUS GR		R	R	C	A
POTAMANTHUS DISTINCTUS				R	C
PSEUDOCLOEON DARDANUM		R	A		
PSEUDOCLOEON PROPINQUUM				R	C
MACCAFFERTIUM ITHACA		A	A	A	A
MACCAFFERTIUM MODESTUM	A				
MACCAFFERTIUM PUDICUM	A		A		A
SERRATELLA DEFICIENS	R		R	R	
STENACRON CAROLINA	A	R			
STENACRON PALLIDUM		C	A	C	A
PLECOPTERA (* indicates winter stonefly)					
ACRONEURIA ABNORMIS	C	A	A	A	A
CHLOROPERLIDAE				R	R
*DIPLOPERLA DUPLICATA				R	
ECCOPTURA XANTHENES		R			
*ISOPERLA NR LATA			R		R
LEUCTRA SPP		C	R		
PARAGNETINA IMMARGINATA				C	A
PTERONARCYS SPP					R
TALLAPERLA SPP	C				
TRICHOPTERA					
BRACHYCENTRUS SPINAE					A
CHEUMATOPSYCHE SPP	C	A	A	A	A
CHIMARRA SPP				R	
DIPLECTRONA MODESTA	A		C		
DOLOPHILODES SPP	A	C	A	R	R
GLOSSOSOMA SPP					C
GOERA SPP			R		R

	UT Crab Cr Above restoration "C"	UT UT Crab Cr "A"	UT Crab Cr NC 18 "B"	Crab Cr SR 1450	Brush Cr SR 1422
HYDROPSYCHE BETTENI	R	C	C	R	C
HYDROPSYCHE DEMORA LYPE DIVERSA	C				R
MICRASEMA BENNETTI					C
NEOPHYLAX SPP				R	
NEOPHYLAX OLIGIUS	R				
OECETIS PERSIMILIS					R
POLYCENTROPUS SPP		R	R	R	
PYCNOPSYCHE SPP	R		C		R
RHYACOPHILA CAROLINA	R	R			
RHYACOPHILA FUSCULA		C	R		C
RHYACOPHILA NIGRITA			R		
CERATOPSYCHE BRONTA			R	R	A
CERATOPSYCHE SPARNA	R		C	C	C
COLEOPTERA					
ANCHYTARSUS BICOLOR	C	C	R		R
ANCYRONYX VARIEGATUS					R
DINEUTUS SPP					R
ECTOPRIA NERVOSA	A	C	R		
HELICHUS SPP		R	C		A
MACRONYCHUS GLABRATUS					C
MICROCYLLOEPUS PUSILLUS		C			
OPTIOSERVUS SPP		C	A		C
PROMORESIA ELEGANS					R
PSEPHENUS HERRICKI		A	A		R
STENELMIS SPP	A	C	C		C
ODONATA					
ARGIA SPP					C
BOYERIA VINOSA		R	R		C
CALOPTERYX SPP	C		A		A
CORDULEGASTER SPP			R		R
GOMPHUS SPP		C			C
LANTHUS SPP		R	R		
MEGALOPTERA					
CORYDALUS CORNUTUS					R
NIGRONIA FASCIATUS	C				
NIGRONIA SERRICORNIS	A	C	R		A
SIALIS SPP	R				
DIPTERA: CHIRONOMIDAE					
ABLABESMYIA ANNULATA					R
ABLABESMYIA MALLOCHI					R
BRILLIA SPP	R				
ORTHOCLADIUS ROBACKI: C/O SP12		R			
CRICOTOPUS INFUSCATUS GR: C/O SP5			C		
CARDIOCLADIUS SPP					R
CONCHAPELOPIA GROUP	C		R		R
CORYNONEURA SPP					C
CORYNONEURA SP E EPLER	C				
DEMICYPTOCHIRONOMUS SPP					R
TVETENIA BAVARICA GR (E SP1)	R	C	C		
EUKIEFFERIELLA DEVONICA GR (E SP2)			R		
TVETENIA DISCOLORIPES GR (E SP3)					C
MICROTENDIPES SP2					C
NANOCLADIUS DOWNESI					R
NANOCLADIUS SPP			R		R
NANOCLADIUS SP5	C				
POLYPEDILUM AVICEPS	A	C	C		
POLYPEDILUM FALLAX			R		
PARACHAETOCCLADIUS SPP	R				C

	UT Crab Cr Above restoration "C"	UT UT Crab Cr "A"	UT Crab Cr NC 18 "B"	Crab Cr SR 1450	Brush Cr SR 1422
PARAKIEFFERIELLA SPP	R				
PARAMETRIOCNEMUS LUNDBECKI	R	C	C		
PARATANYTARSUS SPP					R
PHAENOPSECTRA FLAVIPES					R
TRIBELOS JUCUNDUM					C
POTTHASTIA GAEDI			C		
POTTHASTIA LONGIMANUS					R
PROCLADIUS SPP					R
RHEOCRICOTOPUS ROBACKI			R		C
RHEOTANYTARSUS SPP	R		R		C
STENOCHIRONOMUS SPP					R
THIENEMANIELLA SP B EPLER			R		R
THIENEMANIELLA XENA					R
MISC. DIPTERA					
ANOPHELES SPP			C		
ANTOCHA SPP			R		R
DICRANOTA SPP	R	R	R		
DIXA SPP	R	C	C		
DIXELLA INDIANA			R		R
PALPOMYIA (COMPLEX)	R		R		R
SIMULIUM SPP	C	A	A		C
TIPULA SPP	A				C
TABANUS SPP					R
HEMIPTERA					
CORIXIDAE					C
RANATRA SPP					R
OLIGOCHAETA					
CAMBARINICOLIDAE		R	R		
LUMBRICULIDAE	R				R
NAIS SPP	C		C		
TUBIFICIDAE					R
CRUSTACEA					
CAMBARIDAE	C	A	R		R
GASTROPODA					
ELIMIA SP	R	A	A		
FERRISSIA SPP		C	A		A
PHYSELLA SPP					C
OTHER					
CORIXIDAE					C
CURA FOREMANII	C				
PROSTOMA GRAECENS					R
RANATRA SPP					R

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