Division of Water Quality
Biological Assessment Unit
November 13, 2008

MEMORANDUM

To: Jimmie Overton

Through: Trish MacPherson

From: Bill Crouch

Subject: Benthic sampling results for EEP study in Lincoln County, NC (Catawba River subbasins 33, 35; HUC 03050102, 03050101)

BACKGROUND

The NC Ecosystem Enhancement Program (EEP) requested biological samples from six sites in four streams in Lincoln County, NC (Table 1, Figure 1). Data from these samples may be used by EEP in the development of local watershed plans. EEP is especially interested in the current biological condition of one stream segment, Indian Creek at SR 1177, which rated Good-Fair in 2003 but declined to Fair when next sampled in 2006. Additional sites that EEP requested were: Indian Creek at SR 1252; Indian Creek at SR 1168; Little Indian Creek at SR 1129; Howards Creek at SR 1200; and Leepers Creek at SR 1354.

Prior to 2008, the Biological Assessment Unit (BAU) had sampled Indian Creek on 12 separate occasions since 1983. The two sites sampled in this water body ranged from Fair to Good during that time period. The eight samples collected at SR 1252 suggest improving water quality whereas the four samples collected at SR 1177 show no clear pattern. No historical BAU samples exist for Indian Creek at SR 1168. This site remains unsampled due to an observed lack of flow in October 2008. Howards Creek at SR 1200 has been sampled four times between 1992 and 2006. Three of these samples rated Good and one rated Good-Fair. Leepers Creek has been sampled six times from 1984 to 2006 at four different road crossings. The requested sampling location on Leepers Creek, SR 1354, rated Excellent in 1994 and Good in both 2003 and 2006. Little Indian Creek had not been sampled by BAU previously. There is one major (Cherryville WWTP, NC0044440; 2 MGD to Indian Creek) and four minor NPDES dischargers are present upstream of sites in this study. The Cherryville WWTP on Indian Creek is located four miles upstream of SR 1177 (Figure 1).

Table 1: Geographical data for five benthic sites in Lincoln County, NC, October 2008.

Stream	HOWARDS CR	INDIAN CR	INDIAN CR	L INDIAN CR	LEEPERS CR
Site Location	SR 1200	SR 1177	SR 1252	SR 1129	SR 1354
County	Lincoln	Lincoln	Lincoln	Lincoln	Lincoln
Site ID	CB185	CB187	CB188	CB294	CB137
Basin	Catawba	Catawba	Catawba	Catawba	Catawba
Subbasin	35	35	35	35	33
Latitude (º)	35.4983	35.4281	35.4228	35.5091	35.4989
Longitude (º)	-81.3406	-81.3036	-81.2592	-81.4126	-81.1456
Drainage area (mi²)	17.0	62.1	69.7	11.7	16.9
Stream Segment AU	11-129-4	11-129-8-(6.5)	11-129-8-(6.5)	11-129-8-2	11-119-1-(1)
Level 4 Ecoregion	45b	45b	45b	45b	45b
Stream Classification	C	C	C	WS-II, HQW	C

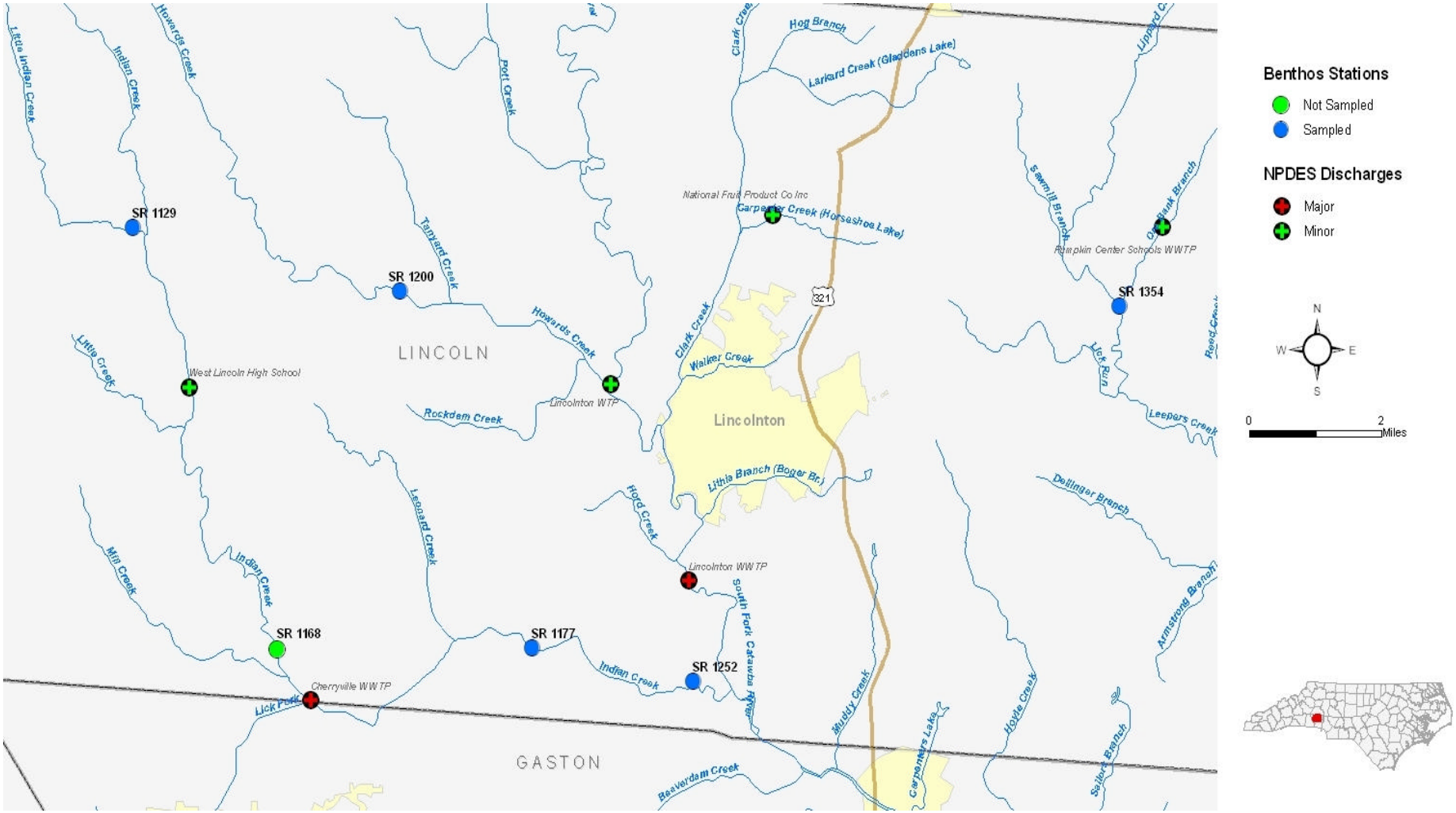

Figure 1: Biological sampling locations requested by EEP to be sampled in October 2008.

METHODS

Habitat Evaluation

Habitat analyses are important when investigating aquatic communities, since streams flow through a terrestrial landscape. The physical features of a stream or 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 even enhance a stream's ability to support a diverse macroinvertebrate community. Habitat analyses also provide a baseline from which future changes in the physical conditions of the stream or riparian zone can be compared, since these changes can result in an altered macroinvertebrate assemblage.

Habitat evaluations were made using the Biological Assessment Unit's Habitat Assessment for Mountain and Piedmont streams. This assessment assigns a numerical score from 1-100 for the stream reach sampled, based on channel modification, in-stream habitat, bottom substrate, pool and riffle variety, bank stability and vegetation, light penetration, and width of the riparian zone. No criteria have been developed to rate habitat scores. However, higher habitat scores generally indicate better overall habitat.

Physical-Chemical

Field measurements were taken at the time of sampling for temperature, dissolved oxygen, conductivity, and pH using a YSI 85 meter and an Accumet pH meter.

Benthos

Benthic macroinvertebrates were collected using the Standard Qualitative (i.e. Full Scale) method[1]. The Standard Qualitative method is comprised of 10 separate samples: two kick-nets; three bank sweeps; two rock/log washes; one leafpack; one sand substrate; and visual collections of larger substrates not sampled thoroughly by the other procedures (e.g. boulders, submerged logs). All taxa were retained. The primary output is a taxa list, with a measure of relative abundance for each taxon. Aquatic fauna at each site were counted, by individual taxon, as Rare (1 or 2 individuals), Common (3 to 9 individuals), or Abundant (10 or more individuals).

Data Analyses

Macroinvertebrate data were summarized by calculating several metrics including the total number of taxa (ST), EPT taxa richness (EPT S) and EPT abundance (EPT N), which describes the number and relative abundance of distinct taxa in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These groups of macroinvertebrates are generally intolerant to many forms of pollution. Higher EPT taxa richness values typically indicate better water quality. It is generally understood that unstressed streams have a higher overall diversity of benthic macroinvertebrates, particularly of the EPT orders, and taxa found at those sites have a low threshold for tolerance to aquatic pollution. Water quality ratings are also based on a value that is derived from the pollution tolerances of the number of each taxon found in the sample. This is known as the North Carolina Biotic Index[2] (NCBI or BI). The more tolerant the macroinvertebrate community is to pollutants, the higher the overall tolerance score will be. Scores range from 0 (pollution sensitive) to 10 (very tolerant of pollution).

These metrics enable comparisons between reference sites and study sites as well as the determination of bioclassification. The water quality scores assigned by the Biotic Index are combined with EPT taxa richness scores to produce a final bioclassification using Piedmont criteria. Since these samples were collected in October, seasonal corrections were applied to the data: adding 0.1 to the NCBI and removing winter stoneflies. There are five possible classifications; Excellent; Good; Good-Fair; Fair; and Poor.

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[1] NCDWQ.2006. Standard Operating Procedures for Benthic Macroinvertebrates. NC Dept. of Environment and Natural Resources, Division of Water Quality, Water Quality Section, Environmental Sciences Branch. July, 2006.

[2] Lenat, D.R. 1993. A biotic index for the southeastern United States; derivation and list of tolerance values, with criteria for assigning water quality ratings. JNABS 12: 279-290.

STUDY SITES

All five sampled sites were located in Lincoln County, NC in the Catawba River Basin. These watersheds are contained within the Southern Outer Piedmont level IV ecoregion[3], an area of lower relief than the Southern Inner Piedmont. The area around the study sites is largerly agricultural areas with a patchwork landscape of forested and low density residential. The sampled waterbodies had drainage areas of between 11.7mi^2 (Little Indian Creek) and 69.7 mi^2 (Indian Creek at SR 1252). Most waterbodies in this study are incised with steep banks that are up to four meters high. Howards Creek and Indian Creek (SR 1177) had lower current velocities than the stronger flows observed at Leepers and Little Indian Creeks. These two waterbodies, along with Indian Creek at SR 1252, have a mixed substrate consisting of boulder, rubble and gravel, whereas Indian Creek at SR 1177 and Howards Creek have a benthos dominated by sand.

Howards Creek at SR 1200

Indian Creek at SR 1177

Indian Creek at SR 1252

Little Indian Creek at SR 1129

Leepers Creek at SR 1354

3 Griffith, G.E., Omernik, J.M., Comstock, J.A., Schafale, M.P., McNab, W.H., Lenat, D.R., MacPherson, T.F., Glover, J.B., and Shelburne, V.B., 2002, Ecoregions of North Carolina and South Carolina, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

RESULTS

Habitat Evaluation

A summary of habitat data collected at the five sites shows overall scores ranged from 62 to 93 (Table 2). Little Indian Creek scored the highest, while Howards Creek had the lowest score. The main differences between sites that scored higher and those that scored lower included benthic substrate and the presence of riffles. Lower scoring sites tended to have a uniform substrate consisting of sand, with little gravel, cobble or boulders unlike higher scoring sites (Little Indian and Leepers Creeks). The lower scoring sites also lacked sufficient riffles. Indian Creek at SR 1252 has a high percentage of clay, particularly along the edges of the channel. Temperature, pH, and dissolved oxygen levels were similar at the five sites, but specific conductance was higher in Indian Creek due to the presence of Cherryville WWTP located four miles upstream of SR 1177.

Table 2: Habitat summary for Lincoln County EEP sites, October 2008

Stream	HOWARDS CR	INDIAN CR	INDIAN CR	L INDIAN CR	LEEPERS CR
Site Location	SR 1200	SR 1177	SR 1252	SR 1129	SR 1354
Habitat Scores					
Channel modification (5)	3	4	5	5	5
In-stream habitat (20)	11	15	17	19	15
Bottom substrate (15)	3	3	12	15	8
Pool variety (10)	10	10	6	6	4
Riffle habitats (16)	7	3	14	16	12
Bank stability/vegetation (14)	12	12	11	14	10
Light penetration (10)	10	10	10	10	10
Riparian zone width (10)	6	10	8	8	4
Total Habitat (100)	**62**	**67**	**83**	**93**	**68**
Other Habitat					
Average stream width (m)	8	11	11	10	8
Average stream depth (m)	0.2	0.2	0.2	0.2	0.2
Canopy (%)	75	50	60	90	80
Substrate (%)					
Boulder	0	0	10	15	5
Cobble	0	0	30	35	25
Gravel	15	10	20	20	25
Sand	80	90	30	30	40
Silt	5	0	10	0	5
Physicochemical					
Temperature (ºC)	16.4	15.9	15.9	14.4	16.9
Dissolved oxygen (mg/L)	8.2	8.3	9.3	9.3	8.9
Specific conductance (µmhos/cm)	59	95	86	56	68
pH	6.2	6.5	6.3	6.0	6.4

Benthos
A total of 152 taxa were collected at the five sites (Appendix A). Three sites rated Good-Fair: Howards Creek at SR 1200; and both Indian Creek sites. Little Indian Creek at SR 1129 and Leepers Creek at SR 1354 received a bioclassification of Good (Table 3). The total number of mayfly taxa was one difference between the sites that rated Good and Good-Fair. Pollution intolerant mayflies found at Little Indian and Leepers Creek that were not collected at the other sites included: *Acentrella ampla, Baetisca* and *Stenacron pallidum*. The two sites that rated Good also contained the pollution sensitive and small stream stonefly, *Eccoptura xanthenes*.

Table 3: Benthic data summary for Lincoln County EEP sites, October 2008

Stream	HOWARDS CR	INDIAN CR	INDIAN CR	L INDIAN CR	LEEPERS CR
Site Location	SR 1200	SR 1177	SR 1252	SR 1129	SR 1354
Richness					
Ephemeroptera	10	7	9	17	16
Plecoptera	4	3	1	2	2
Trichoptera	6	6	6	7	8
Total EPT	20	16	16	26	26
Seasonally corrected EPT	19	16	16	26	26
Odonata	6	9	6	9	8
Megaloptera	2	0	0	3	2
Coleoptera	7	6	3	9	7
Chironomidae	17	14	15	25	25
non-Chironomidae Diptera	5	3	3	5	4
Oligochaeta	0	4	1	4	2
Mollusca	1	2	1	3	2
Other taxa	1	3	2	2	2
Total taxa richness	59	57	47	86	78
Other biological metrics					
EPT abundance	71	85	112	114	81
EPT Biotic Index	4.79	5.14	5.31	4.38	5.27
NCBI	5.61	6.02	5.88	5.33	5.69
Seasonal Correction	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*
Corrected NCBI	*5.71*	*6.12*	*5.98*	*5.43*	*5.79*
Bioclassification	**Good-Fair**	**Good-Fair**	**Good-Fair**	**Good**	**Good**

Drought
Over the 52 weeks prior to the sampling effort, this area of Lincoln County experienced a D4 drought approximately 50% of the time (The Drought Monitor, http://drought.unl.edu/dm/index.html, accessed 6 November 2008). This level is the most severe category of drought. Additionally, these sites experienced a D3 drought for an additional 42% of this time. Beginning in October 2007, one year prior to the current sampling effort, severe drought conditions persisted in this part of North Carolina until the first week of September 2008 (one month prior to the sampling effort). That is when Lincoln County was classified as having a D2 or less according to the Drought Monitor.

A previous drought study (B-20040823) suggested that drought can cause temporary declines in Bioclassification. Individual sampling sites assessed during October 2008 should be viewed in light of the recent low water levels.

Howards Creek at SR 1200
Four previous samples have been collected here since 1992. The 1992 and 1997 EPT samples rated Good and declined to Good-Fair in 2002. A full scale sample in 2006 rated Good with 36 (seasonally corrected since this sample was collected in May) EPT taxa and a biotic index of 5.8 (corrected). The biotic index compares well between the 2006 (5.8) and 2008 (5.6) samples suggesting that the water quality itself remains unchanged. It was the reduced number of EPT taxa in 2008 (20) that resulted in a lower bioclassification. This site has active sand mining operations that have been present since at least 2006 (WBC pers. obs).

Indian Creek at SR 1177
This segment of Indian Creek rated Fair in 2006 (B-061027). The Good-Fair rating in 2008 does not appear to indicate any improvement in water quality since the species composition and the biotic index are similar between the two samplings. For example, lower relative abundances of EPT taxa in 2008 compared with 2006 (58 versus 79) was offset by a slightly lower biotic index (6.0) in the current sample compared with 6.5 in 2006. The five samples collected here (two Full Scale, and three EPT samples) suggest that this site may continue to vacillate between Fair and Good-Fair.

Indian Creek at SR 1252

This site was first sampled in 1983. Overall ratings improved from Fair to Good during this time with the two most recent historical collections in 1997 and 2006 rating Good. In 2008, the SR 1252 section of Indian Creek rated Good-Fair. Between 1986 and 2006 the Biotic Index, EPT taxa and Total Taxa remained stable (Figure 2). In 2008 the Biotic Index was similar to previous years. The number of EPT taxa collected in 2008 was slightly less than previous samples. However, a large decrease in the Total Taxa occurred from 2006 to 2008 (48 in 2008 compared with an average of 67 Total Taxa for the previous seven samples).

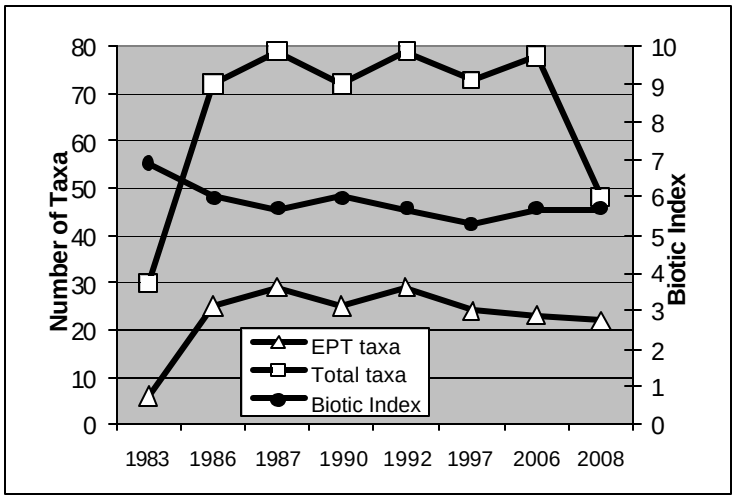

Figure 2: Indian Creek at SR 1252 (1983-2008).

An inspection of the species list for this site among all eight collections suggests that low water levels may be the reason for the large decrease in total taxa in 2008. Lower water levels can result in specific types of instream habitat being unavailable for macroinvertebrate colonization. Many aquatic macroinvertebrates favor particular habitats within the stream. For example, the caddisfly *Nectopsyche exquisita* was common or abundant in seven of the eight historical samples here, but absent in 2008. This species is generally found in root mat habitats along stream edges (or bank). Though the root mats were covered with water in October 2008, given the severity of the drought in 2007 and early 2008, it is reasonable that these root mats could have been unavailable for initial colonization. *Stenochironomus*, a midge that mines tunnels in submerged dead wood, was collected (mostly abundant or common) in the six previous collections but was absent in the 2008 sample. During the current sampling effort no snags were observed in the stream itself and the channel area covered by water in October 2008 was less than previous years. There were sticks (and leaf packs present) but it remains unclear as to when these organic microhabitats were submerged. The absence of the commonly collected beetle, *Ancyronyx variegatus*, also suggests that woody debris remained unavailable for macroinvertebrate colonizations. This species was collected during all but one previous sampling effort here. No Megalopteran species were found in 2008 here. Typically, three taxa in this group are collected here, *Corydalus cornutus*, *Nirgronia serricornis* and *Sialis*. The absence of these taxa is concerning since they are some of the few

species that can live in the stream as larvae for more than one year. Another sign that points to reduced flows is the absence of any snail or limpet species in 2008. These taxa have limited mobilities and can be stranded on the stream edges during droughts.

Little Indian Creek at SR 1129

This site had not been sampled previously by BAU. It rated Good in 2008 with the highest total taxa (87) and EPT taxa (26 taxa, equal to Leepers Creek) among the five samples in this study. The corrected biotic index at Little Indian Creek (5.4) was the lowest in the study and suggested an intolerant macroinvertebrate community resides here. Instream and riparian habitat was not lacking (scoring 93 out of 100) which likely contributed to the large numbers of macroinvertebrates collected here. Several macroinvertebrates found here that were not collected in other samples include the mayfly *Diphetor hageni*, and the caddisflies *Goera*, *Polycentropus* and *Rhyacophila fuscula*.

Leepers Creek at SR 1354

Leepers Creek rated Good in 2008. This site has been assessed three previous times by BAU: 1993 (Excellent); 2003 (Good); and 2006 (Good). The biotic index was slightly higher in 2008 (5.8) than in 2006 (5.5). Accounting for the seasonal differences between the 2006 and 2008 samplings, the taxa collected here were similar with some exceptions. The stoneflies, *Perlesta* and *Pteronarcys* were common or abundant in the three previous samples but absent in 2008. *Perlesta* is a commonly collected taxon in North Carolina but it emerges from the stream before fall. *Pteronarcys* is a shredding species that inhabits leafpacks. Lower water levels may have limited the occurrence of this microhabitat in Leepers Creek, though, at that time of sampling, there were sufficient leafpacks in the stream. The shredding caddisfly *Pycnopsyche* was collected in all the historical samples here but absent in 2008. This taxon is typically found on the edges of the stream attached to larger snags. If those snags were not submerged during the latter part of 2007 and throughout most of 2008, this species could have been limited at this site.

SUMMARY

The severe drought experienced by this part of North Carolina in 2007 and 2008 affected these fives sites to different degrees. Local conditions at each site have to be taken into account when describing the results. Sites that had a mix of in-stream substrate sizes tended to have better bioclassifications than sites with a predominantly sand substrate. Little Indian Creek at SR 1129 had not been sampled previously and received a bioclassification of Good.

Indian Creek at SR 1177 rated Good-Fair, an increase in bioclassification from 2006 when it rated Fair. A report produced after the 2006 sampling effort (B-20061027) suggested that the Cherryville WWTP affected the Indian Creek site at SR 1177 to a greater degree than SR 1252 (since it is closer to the facility and that violations had occurred there during the year in which the samples were collected). In that case, habitat scores were similar between SR 1177 and SR 1252 and thus, habitat was ruled out as a reason for differences in bioclassification in 2006. From 2006 to the present, there does not appear to be any problems with this facility, and it is well maintained and operated (Parker, Michael, Surface Water Protection, Mooresville Regional Office, personal communication). Additionally, quarterly Whole Effluent Toxicity (WET) tests during this period were all passed including a WET test in September 2008, one month prior to the macrobenthic sampling (Lance Ferrell and Susan Meadows, Aquatic Toxicity Unit, DWQ). Sampling both above and below the WWTP discharge is preferable in order to determine any in-stream effects, but in this case, no samples were able to be collected upstream of the plant due to a lack of flow there.

Cc: Stratford Kay -Wetlands Unit
Larry Eaton - Wetlands Unit
Dianne Reid - Planning Section
MRO- Rob Krebs

Appendix A

		HOWARDS CR SR 1200 Lincoln County 08 Oct 2008	INDIAN CR SR 1177 Lincoln County 08 Oct 2008	INDIAN CR SR 1252 Lincoln County 08 Oct 2008	L INDIAN CR SR 1129 Lincoln County 06 Oct 2008	LEEPERS CR SR 1354 Lincoln County 06 Oct 2008
Ephemeroptera						
Baetidae	ACENTRELLA AMPLA				R	R
	ACENTRELLA PARVULA					R
	BAETIS FLAVISTRIGA	R		A	R	A
	BAETIS INTERCALARIS	A	A	A	A	A
	BAETIS PLUTO			A	R	C
	CENTROPTILUM SPP				R	
	DIPHETOR HAGENI				A	
	PLAUDITUS CESTUS					R
	PLAUDITUS DUBIUS GR	R			A	R
	PROCLOEON SPP	R	R	R		R
	PSEUDOCLOEON PROPINQUUM	R	R	R		R
Baetiscidae	BAETISCA SPP				R	R
Caenidae	CAENIS SPP				R	R
Ephemeridae	EPHEMERA SPP				R	
	HEXAGENIA SPP		A		C	
Heptageniidae	HEPTAGENIA MARGINALIS			C		
	LEUCROCUTA SPP				C	
	MACCAFFERTIUM MODESTUM	A	A	A	A	A
	STENACRON INTERPUNCTATUM	C	A	A	C	R
	STENACRON PALLIDUM				C	R
Leptophlebiidae	PARALEPTOPHLEBIA SPP	R			R	
Oligoneuriidae	ISONYCHIA SPP	A	C	A	C	A
Potamanthidae	ANTHOPOTAMUS SPP					R
Tricorythidae	TRICORYTHODES SPP	R				
Plecoptera						
Leuctridae	LEUCTRA SPP	R	R			
Perlidae	ACRONEURIA ABNORMIS	R	C	C	A	C
	ACRONEURIA ARENOSA	C				
	ECCOPTURA XANTHENES				C	R
	PARAGNETINA FUMOSA		C			
Perlodidae	YUGUS SP	R				

Appendix A

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Trichoptera						
Calamoceratidae	ANISOCENTROPUS PYRALOIDES					R
Goeridae	GOERA SPP				R	
Hydropsychidae	CERATOPSYCHE SPARNA			C		
	CHEUMATOPSYCHE SPP	A	A	A	A	A
	HYDROPSYCHE BETTENI		R	A	C	C
	HYDROPSYCHE ROSSI	C	R	A		
Leptoceridae	OECETIS PERSIMILIS	R	R			R
	TRIAENODES IGNITUS	R	A	R	A	C
	TRIAENODES INJUSTUS					R
Limnephilidae	LIMNEPHILIDAE	R				
Philopotamidae	CHIMARRA SPP	A	A	A	A	C
Phryganeidae	PTILOSTOMIS SPP					R
Polycentropodidae	POLYCENTROPUS SPP				C	
Rhyacophilidae	RHYACOPHILA FUSCULA				R	
Odonata						
Aeshnidae	BOYERIA VINOSA	R	A	A	R	C
Calopterygidae	CALOPTERYX SPP	R	A	R	C	C
Coenagrionidae	ARGIA SPP	C	A	A	C	
	ENALLAGMA SPP				A	C
Cordulegasteridae	CORDULEGASTER SPP		R	R		
Corduliidae	SOMATOCHLORA SPP					R
Gomphidae	DROMOGOMPHUS SPP	R	C			
	GOMPHUS SPP	R	C		R	C
	OPHIOGOMPHUS SPP		C	R	C	C
	PROGOMPHUS OBSCURUS		C	C	R	
	STYLOGOMPHUS ALBISTYLUS				R	R
Macromiidae	MACROMIA SPP	C	R		C	R
Megaloptera						
Corydalidae	CORYDALUS CORNUTUS	A			A	C
	NIGRONIA SERRICORNIS				R	R
Sialidae	SIALIS SPP	C			C	

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		HOWARDS CR SR 1200 Lincoln County 08 Oct 2008	INDIAN CR SR 1177 Lincoln County 08 Oct 2008	INDIAN CR SR 1252 Lincoln County 08 Oct 2008	L INDIAN CR SR 1129 Lincoln County 06 Oct 2008	LEEPERS CR SR 1354 Lincoln County 06 Oct 2008
Coleoptera						
Dryopidae	HELICHUS SPP	C	R		A	C
Dytiscidae	NEOPORUS SPP	R	R		C	R
	THERMONECTUS SPP			R		
Elmidae	ANCYRONYX VARIEGATUS	C	A		A	
	DUBIRAPHIA SPP		R		R	C
	MACRONYCHUS GLABRATUS	A	A	C		C
	OULIMNIUS NITIDULUS				R	
	STENELMIS SANDERSONI				R	
	STENELMIS SPP					R
Gyrinidae	DINEUTUS SPP	C			R	A
Hydrophilidae	TROPISTERNUS SPP		C			
Psephenidae	PSEPHENUS HERRICKI	R		R	C	C
Ptilodactylidae	ANCHYTARSUS BICOLOR	R			R	
Chironomidae						
Chironomidae	ABLABESMYIA ANNULATA		R			
	ABLABESMYIA MALLOCHI		R			C
	ABLABESMYIA PARAJANTA/JANTA				R	
	BRILLIA FLAVIFRONS		R			
	CLADOTANYTARSUS SP B					C
	CLADOTANYTARSUS SP F				R	
	CLINOTANYPUS PINGUIS		R			
	CONCHAPELOPIA GROUP	C	C	R	C	C
	CORYNONEURA LOBATA	R				R
	CORYNONEURA SP B EPLER					R
	CORYNONEURA SP C EPLER				R	
	CRICOTOPUS ANNULATOR COMPLEX				C	
	CRICOTOPUS BICINCTUS					R
	CRICOTOPUS INFUSCATUS GR				R	
	CRICOTOPUS VIERRIENSIS GR			C		A
	CRYPTOCHIRONOMUS SPP			R	C	
	DICROTENDIPES NEOMODESTUS					R

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	HOWARDS CR SR 1200 Lincoln County 08 Oct 2008	INDIAN CR SR 1177 Lincoln County 08 Oct 2008	INDIAN CR SR 1252 Lincoln County 08 Oct 2008	L INDIAN CR SR 1129 Lincoln County 06 Oct 2008	LEEPERS CR SR 1354 Lincoln County 06 Oct 2008
EUKIEFFERIELLA CLARIPENNIS GR (E SP11)	R		R		
EUKIEFFERIELLA TIROLENSIS					R
LABRUNDINIA PILOSELLA			R	R	
MICROTENDIPES PEDELLUS GR	R			R	C
MICROTENDIPES RYDALENSIS GR				R	
NANOCLADIUS SPP	C				R
NILOTANYPUS FIMBRIATUS				R	
ORTHOCLADIUS DORENUS					C
ORTHOCLADIUS DUBITATUS			R		
PARACLADOPELMA LOGANAE					R
PARAKIEFFERIELLA SP B			R		C
PARALAUTERBORNIELLA NIGROHALTERALIS		R		R	
PARAMETRIOCNEMUS SPP				R	R
PARATANYTARSUS DISSIMILIS	R				
PARATANYTARSUS QUAD/GRIMM/ SP E			R		
PARATENDIPES ALBIMANUS				R	
POLYPEDILUM AVICEPS	A	C			
POLYPEDILUM FALLAX/SP. A		R	R	C	
POLYPEDILUM FLAVUM	C		C	A	C
POLYPEDILUM HALTERALE GR		R			
POLYPEDILUM ILLINOENSE GR	A		C		C
POLYPEDILUM SCALAENUM				R	
POTTHASTIA CF. GAEDII	C				
POTTHASTIA LONGIMANUS			R	R	
RHEOCRICOTOPUS ROBACKI	C			R	C
RHEOTANYTARSUS SPP	C	C	C	R	
STENOCHIRONOMUS SPP					C
STICTOCHIRONOMUS SPP					R
TANYTARSUS SP. A					R
TANYTARSUS SP. C	R	R		R	
TANYTARSUS SP. L	R	R		C	C
TANYTARSUS SP. M				R	

Appendix A

		HOWARDS CR SR 1200 Lincoln County 08 Oct 2008	INDIAN CR SR 1177 Lincoln County 08 Oct 2008	INDIAN CR SR 1252 Lincoln County 08 Oct 2008	L INDIAN CR SR 1129 Lincoln County 06 Oct 2008	LEEPERS CR SR 1354 Lincoln County 06 Oct 2008
	TANYTARSUS SP. U					C
	TANYTARSUS SP. Y			R		
	THIENEMANIELLA LOBAPODEMA		R			R
	THIENEMANIELLA XENA	A		R	C	A
	TRIBELOS JUCUNDUM	R	R		C	
	XYLOTOPUS PAR	R				
non-Chironomidae	**Diptera**					
Ceratopogonidae	ATRICHOPOGON SPP	R				
	MALLOCHOHELEA		R			
	PROBEZZIA SPP				C	
Dixidae	DIXELLA INDIANA				R	
Empididae	EMPIDIDAE					R
Simuliidae	SIMULIUM SPP	A	C	A	A	C
Tabanidae	TABANUS SPP	R				
Tipulidae	ANTOCHA SPP			R		
	HEXATOMA SPP	R			C	C
	TIPULA SPP	A	C	C	A	C
Oligocheata						
Lumbriculidae	LUMBRICULIDAE		C	A	R	C
Megadrile	MEGADRILE OLIGOCHAETE		R		R	R
Naididae	NAIS SPP		R		R	
Tubificidae	ILYODRILUS TEMPLETONI				R	
	LIMNODRILUS HOFFMEISTERI		C			
Crustacea						
Asellidae	CAECIDOTEA SPP (STREAMS)			C		
Cambaridae	CAMBARIDAE		R	R	R	R
Palaemonidae	PALAEMONETES SPP		R			
Gastropoda						
Ancylidae	FERRISSIA SPP				R	
Lymnaeidae	PSEUDOSUCCINEA COLUMELLA		R			
Pleuroceridae	ELIMIA SPP				A	C

Appendix A

		HOWARDS CR SR 1200 Lincoln County 08 Oct 2008	INDIAN CR SR 1177 Lincoln County 08 Oct 2008	INDIAN CR SR 1252 Lincoln County 08 Oct 2008	L INDIAN CR SR 1129 Lincoln County 06 Oct 2008	LEEPERS CR SR 1354 Lincoln County 06 Oct 2008
Bivalvia						
Corbiculidae	CORBICULA FLUMINEA	A	A	A	R	A
Other						
Erpobdellidae	ERPOBDELLA/MOOREOBDELLA		R			
Hydracarina	HYDRACARINA	R			A	R
Branchiobdellidae	BRANCHIOBDELLIDAE				R	