

BIOLOGICAL ASSESSMENT UNIT BASINWIDE ASSESSMENT REPORT

SAVANNAH RIVER BASIN



NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT
AND NATURAL RESOURCES
Division of Water Quality
Environmental Sciences Section

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INTRODUCTION TO PROGRAM METHODS

The Environmental Sciences Section collects a variety of biological, chemical, and physical data that can be used in many ways to assist the basinwide planning program. This report addresses the results of benthic macroinvertebrate monitoring in the Savannah River for the period 2004-2009. The basin has been sampled by the Biological Assessment Unit (BAU) three times prior to this study for basinwide monitoring, in 1994, 1999, and 2004. Details of biological sampling methods (including habitat evaluation) and rating criteria can be found in the appendices of this report. Technical terms are defined in the Glossary.

This document is structured with physical, geographical, and biological data discussions presented in hydrologic units (HUs). General water quality conditions are given in an upstream to downstream format. Lakes data, ambient chemistry data and aquatic toxicity data, with summaries, are presented in separate reports.

BASIN DESCRIPTION

The portion of the Savannah River Basin located in North Carolina lies almost entirely within the Southern Crystalline Ridges and Mountains ecoregion¹ (a small portion of the Tallulah River catchment lies within the High Mountains ecoregion) and occupies 171 square miles. Much of the land (74 square miles) is contained within Nantahala National Forest—including Southern Nantahala Wilderness and Ellicott Rock Wilderness—and Gorges State Park. Southeast portions of Clay and Macon, southern Jackson, and southwestern Transylvania counties are included within the basin. The largest community wholly contained within the basin is Cashiers; southern and eastern portions of Highlands are also within the basin. Additional areas of commercial, residential, and golf course development can be found scattered throughout the US 64 corridor between Lake Toxaway and Highlands. Outstanding Resource Waters located in the basin include Big Creek and its tributaries, Overflow Creek and its tributaries, and the mainstem of Chattooga River. In addition, a portion of Horsepasture River downstream from NC 281 and most of the North Carolina portion of Chattooga River are included in the National Wild and Scenic River System. No 303(d)-listed waters exist in the basin. There are two 8-digit HUs in this basin: 03060101 (Seneca River), and 03060102 (Tugaloo River). Waters from the two HUs flow to Hartwell Lake (actually a reservoir) in Georgia, joining to form Savannah River. Eight benthic sites were sampled between the two HUs in 2009.

¹ 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, VA, U.S. Geological Survey (map scale 1:1,500,000).

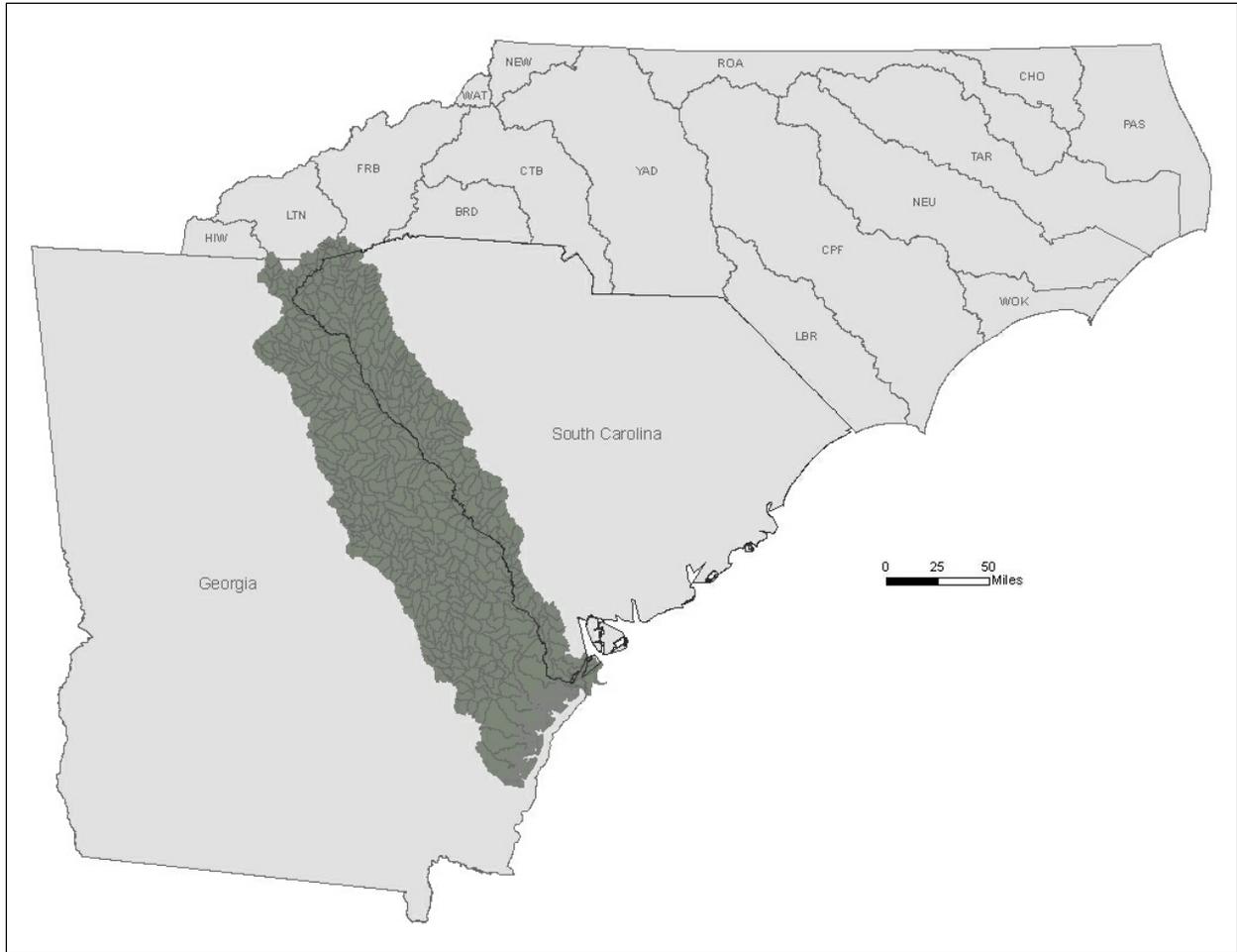


Figure 1. Geographical relationships of the Savannah River basin.

SAVANNAH RIVER HU 03060101 – SENECA RIVER

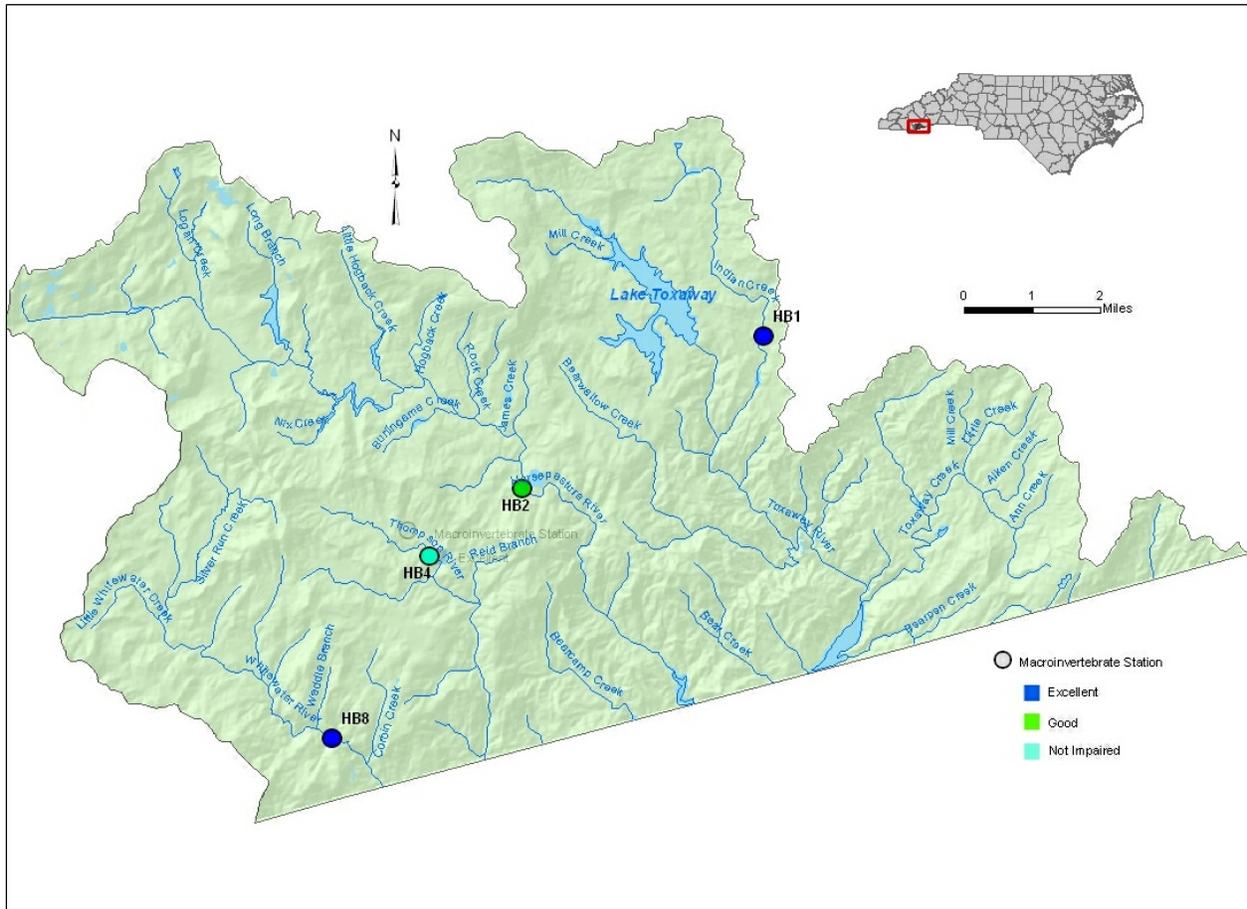


Figure 2. Sampling sites in HU 03060101 in the Savannah River basin. Monitoring sites are listed in Table 1.

River and Stream Assessment

Specific summaries of the four benthic macroinvertebrate basinwide sampling events may be found in [Appendix S-1](#).

Four basinwide collections were made in August 2009 in the HU (Table 1). Two sites were rated as Excellent, one as Good, and one (Thompson River at NC 281) was assigned a classification of Not Impaired. The drainage area above the Thompson River site is 2.5 square miles (which puts the site into the small-stream category) and has always been collected outside of the seasonal window for use of small stream criteria for assessment, therefore all prior classifications for the site have been changed to Not Impaired as well. Classifications did not change at any of the sites between the basinwide sampling events in 2004 and those in 2009.

Table 1. Waterbodies monitored in HU 03060101 in the Savannah River basin for basinwide assessment, 2004 and 2009.

SiteID	Waterbody	County	Location	2004	2009
HB1	Indian Cr	Transylvania	US 64	Excellent	Excellent
HB2	Horsepasture R	Transylvania	NC 281	Good	Good
HB8	Whitewater R	Transylvania	NC 281	Excellent	Excellent
HB4	Thompson R	Transylvania	NC 281	Not Impaired*	Not Impaired

* Reported as "Excellent" in the prior basinwide report.

Special Studies

2006 ORW Reclassification Study for the Horsepasture River Drainage

To assess the biological condition of the Horsepasture River drainage to consider Outstanding Resource Waters (ORW) protection, eleven sites were selected for benthic sampling within the drainage.² Six were small-stream sites; of those, two were assigned a classification of Not Rated, the remaining four were Not Impaired. At the time these streams were sampled no criteria existed for evaluating small-stream sites with disturbance within the drainage. Such small-stream sites receive a classification of "Not Impaired" if they would attain a classification of Excellent, Good, or Good-Fair using EPT criteria, or "Not Rated" otherwise. Two of the large-stream sites received a classification of Good-Fair, and two other sites were Good. Only the site on lowermost segment of the mainstem of Horsepasture River (AU designation 4-13-(12.5)) received an Excellent. Based upon that result, the state designation of Natural and Scenic River, and the federal designation of National Wild and Scenic River, the stream segment was recommended for the additional classification of Outstanding Resource Waters.

² Ausley, L. 2006. Horsepasture River Drainage Use Attainability Request Benthic Macroinvertebrate Special Study, Horsepasture River Watershed, Savannah River Subbasin 02, Jackson and Transylvania Counties, June 2006. Internal, unpublished BAU memorandum dated 1 November 2006.

SAVANNAH RIVER HU 03060102 – TUGALOO RIVER

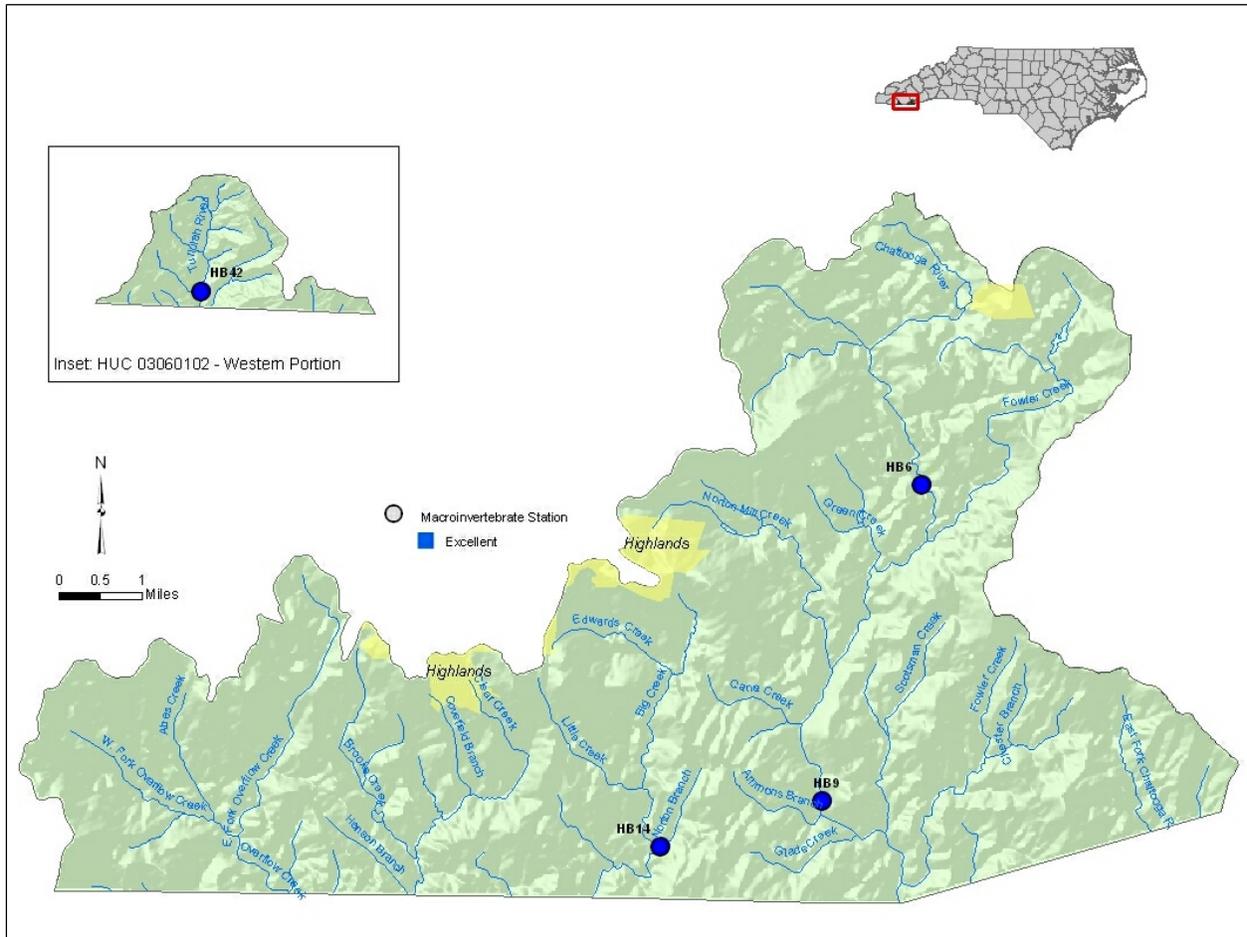


Figure 3. Sampling sites in HU 03060102 in the Savannah River basin. Monitoring sites are listed in Table 2.

River and Stream Assessment

Specific summaries of the four benthic macroinvertebrate basinwide sampling events may be found in **Appendix S-1**. There have been no special studies in the HU since the prior basinwide cycle.

Four basinwide collections were made in August 2009 in the HU (Table 2). All received classifications of Excellent. The basinwide site on Norton Mill Creek was not sampled in 2009 due to beaver activity, both upstream and downstream of the road crossing, which greatly reduced normal streamflow and velocity at the site. The Tallulah River catchment was sampled for the first time by the BAU in 2009; the site will be added to the list of basinwide sites for the HU.

Table 2. Waterbodies monitored in HU 03060102 in the Savannah River basin for basinwide assessment, 2004 and 2009.

Site ID	Waterbody	County	Location	2004	2009
HB6	Chattooga R	Jackson	SR 1107	Excellent	Excellent
HB9	Chattooga R	Jackson	SR 1100	Excellent	Excellent
HB14	Big Cr	Macon	SR 1608	Excellent	Excellent
HB42	Tallulah R	Clay	off Tate City Rd	---	Excellent

GLOSSARY

Assessment Unit	A stream or a segment of a stream. Assessment Unit designations are used to uniquely identify streams or stream segments for the purpose of classifying waters for protection by use (such as for drinking water supply or trout waters).
BI or NCBI	North Carolina Biotic Index. This is one of two metrics used extensively to evaluate the results of benthic sampling, and is the weighted sum of tolerance values for taxa found in the sample relative to their abundance.
Bioclassification	A classification assigned to a stream site following biological sampling of either fish or macroinvertebrates. Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each sample. For invertebrates the bioclassification is based on the number of taxa present in the intolerant groups (EPT) and the North Carolina Biotic Index (BI or NCBI) value. For fish the classification is based on abundance, condition of specimens, species richness, composition, pollution-tolerance, trophic composition, and reproductive function.
Ecoregion	An area of relatively homogeneous environmental conditions, usually defined by elevation, geology, vegetation, and soil type. Examples include Mountains, Piedmont, Coastal Plain, Sand Hills, and Carolina Slate Belt.
EPT	The insect orders Ephemeroptera, Plecoptera, and Trichoptera. As a whole, these are the most intolerant insects present in the benthic community. EPT also refers to taxa richness within the three insect orders, a metric used extensively to derive bioclassifications. Higher EPT taxa richness values are associated with better water quality.
EPT BI	North Carolina Biotic Index for the EPT portion of the benthic community. This is the weighted sum of the tolerance values of taxa in the insect orders Ephemeroptera, Plecoptera, and Trichoptera found in the sample, relative to their abundance.
HQW	High Quality Waters. Such waters are rated Excellent based on biological and physical/chemical characteristics through Division monitoring or special studies and have been approved for such designation by the state Environmental Management Commission; also, primary nursery areas designated by the Marine Fisheries Commission, and all Class SA waters.
MGD	Million gallons per day. This is generally the unit in which effluent discharge flow is measured.
NPDES	National Pollutant Discharge Elimination System.
NCIBI	North Carolina Index of Biotic Integrity (NCIBI); a summary measure of the effects of factors influencing the fish community.
ORW	Outstanding Resource Waters. These are unique and special waters of exceptional state or national recreational or ecological significance that require special protection to maintain existing uses and have been approved for such designation by the Environmental Management Commission.

GLOSSARY (continued)

Specific Conductance	The measure of the resistance of a solution to electrical flow. Resistance is reduced with increasing content of ionized salts. Reported in the units of $\mu\text{mhos/cm}$ at 25 °C.
ST	Total invertebrate richness. The total number of different taxa present in a Full Scale benthic macroinvertebrate sample.
UT	Unnamed tributary.
WTP	Water treatment plant.
WWTP	Wastewater treatment plant

Appendix B-1. Summary of benthic macroinvertebrate data, sampling methods and criteria.

Savannah River Basin Summary

For 2009, eight long-term benthic macroinvertebrate samples were collected in the Savannah River Basin as part of the Basinwide Assessment program. Graphical representations of bioclassification trends from 2009-1994 among these long-term basinwide benthos stations can be found in Figure 4. As can be seen from these data, the 2009 benthic macroinvertebrate community bioclassifications have generally remained unchanged since 1994. The primary change in this basin from 1994 to 2009 is mainly due to the additional of new basinsites each year from a low of five in 1994 to eight in 2009. The excellent and stable water quality found throughout most of this basin is primarily a function of the mostly forested landuse coupled with a generally sparse population and lack of any large-scale agriculture.

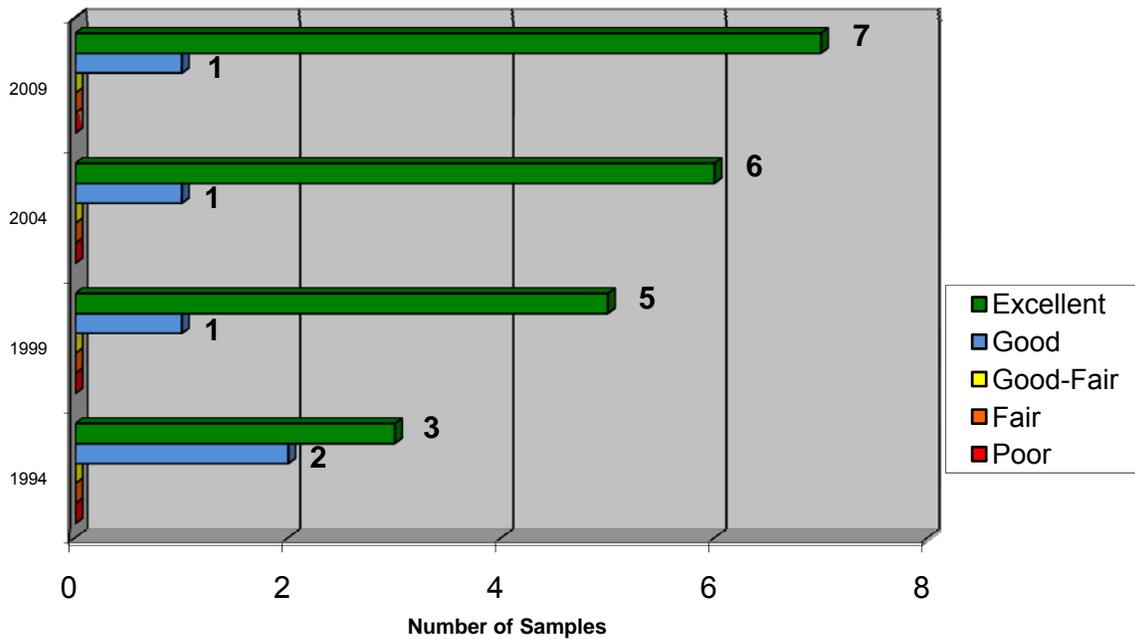


Figure 4. Bioclassification trends in the Savannah River Basin (HU 03060101 and HU 03060102): 1994-2009.

Numerous rare invertebrate taxa were collected in the Savannah River basin in 2009. These data are presented below in Table 3.

Table 3. Rare taxa collected in the Savannah River Basin (rare taxa are defined as those taxa which occur less than or equal to 0.5% of approximately 6,500 NCDWQ benthic collections).

CC Num	Sample Type	Date	Waterbody	Location	County	Subbasin	HU	Scientific Name
10825	EPT	8/20/09	TALLULAH R	OFF TATE CITY RD	Clay	1	03060102	<i>GOERA FUSCULA</i>
10825	EPT	8/20/09	TALLULAH R	OFF TATE CITY RD	Clay	1	03060102	<i>CERATOPSYCHE SPP</i>
10825	EPT	8/20/09	TALLULAH R	OFF TATE CITY RD	Clay	1	03060102	<i>EPEORUS SUBPALLIDUS</i>
10825	EPT	8/20/09	TALLULAH R	OFF TATE CITY RD	Clay	1	03060102	<i>HANSONOPERLA APPALACHIA</i>
10823	Full Scale	8/19/09	CHATTOOGA R	SR 1100	JACKSON	1	03060102	<i>NANOCLADIUS BRANCHICOLUS</i>
10822	EPT	8/19/09	CHATTOOGA R	SR 1107	JACKSON	1	03060102	<i>HEXAGENIA LIMBATA</i>
10823	Full Scale	8/19/09	CHATTOOGA R	SR 1100	JACKSON	1	03060102	<i>OPTIOSERVUS TRIVITTATUS</i>
10823	Full Scale	8/19/09	CHATTOOGA R	SR 1100	JACKSON	1	03060102	<i>PARATANYTARSUS LONGISTYLUS</i>
10823	Full Scale	8/19/09	CHATTOOGA R	SR 1100	JACKSON	1	03060102	<i>EUKIEFFERIELLA TIROLENSIS</i>
10823	Full Scale	8/19/09	CHATTOOGA R	SR 1100	JACKSON	1	03060102	<i>DEMICRYPTOCHIRONOMUS SP B</i>
10823	Full Scale	8/19/09	CHATTOOGA R	SR 1100	JACKSON	1	03060102	<i>CRICOTOPUS NOSTOCICOLA</i>
10823	Full Scale	8/19/09	CHATTOOGA R	SR 1100	JACKSON	1	03060102	<i>MICROPSECTRA SP A</i>
10820	Full Scale	8/18/09	HORSEPASTURE R	NC 281	TRANSYLVANIA	2	03060101	<i>PARACLADOPELMA SP 1</i>
10820	Full Scale	8/18/09	HORSEPASTURE R	NC 281	TRANSYLVANIA	2	03060101	<i>TANYTARSUS SP Y</i>
10820	Full Scale	8/18/09	HORSEPASTURE R	NC 281	TRANSYLVANIA	2	03060101	<i>EPEORUS SUBPALLIDUS</i>
10820	Full Scale	8/18/09	HORSEPASTURE R	NC 281	TRANSYLVANIA	2	03060101	<i>TANYTARSUS SP M</i>
10820	Full Scale	8/18/09	HORSEPASTURE R	NC 281	TRANSYLVANIA	2	03060101	<i>DJALMABATISTA PULCHRA</i>
10819	EPT	8/18/09	WHITEWATER R	NC 281	TRANSYLVANIA	2	03060101	<i>HELICOPSYCHE PARALIMNELLA</i>

Sampling Methods

Benthic macroinvertebrates can be collected from wadeable, freshwater, flowing streams and rivers using several sampling procedures, two of which are used for basinwide sampling in the mountainous region of western North Carolina.

Standard Qualitative (Full Scale) Method

The Biological Assessment Unit's standard qualitative (Full Scale) sampling procedure comprises 10 components: two kick-net collections, three sweeps, two rock or log washes, one sand collection, one leaf-pack collection, and visual collections from large rocks and logs.³ Invertebrates are removed from the matrix ("picked") on-site. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1 - 2 specimens), Common (3 - 9 specimens), or Abundant (≥ 10 specimens).

EPT Method

Benthic macroinvertebrates can also be collected using the EPT sampling procedure. Four, rather than 10, composit qualitative samples are taken at each site: one kick, one sweep, one leaf-pack, and visual collections (NCDENR 2006). Only EPT taxa are collected and identified and only EPT taxa richness is used to assign a bioclassification.

Habitat Evaluation

An assessment form has been developed by the Biological Assessment Unit to evaluate the physical habitat of a stream. The habitat score, which ranges between 1 and 100, is based on the qualitative evaluation of channel modification, amount of instream habitat, type of bottom substrate, pool variety, bank stability, light penetration, and riparian zone width. Higher numbers suggest better habitat quality, but no criteria have been developed to assign impairment ratings.

Data Analysis

Bioclassifications for the Full Scale assessment method are based on EPT Richness and North Carolina Biotic Index (NCBI, sometimes just identified as BI) values. Both tolerance values for individual taxa and community biotic index values have a range of zero through 10, with higher numbers indicating more tolerant taxa and more polluted conditions respectively. NCBI scores are averaged with EPT taxa richness scores to produce a final bioclassification. Bioclassifications for the EPT sample method are based on the total number of EPT taxa present in the sample. EPT abundance and overall taxa richness can also be used to help examine between-site differences in water quality.

EPT Richness and BI values are affected by seasonal changes. DWQ criteria for assigning bioclassifications are based on summer sampling, which occurs from June through September. For samples collected outside the summer sampling period, EPT Richness is often adjusted by removing the number of winter/spring Plecoptera taxa present to give a seasonally corrected value. Adjustments for seasonality may also be performed based upon site-specific differences between summer and non-summer samples if such data are available. The BI values also are seasonally adjusted for samples outside the summer season.

No criteria are in place for small-stream samples collected from sites with a drainage area less than or equal to 3.0 square miles that are subject to anthropogenic disturbance and collected outside of the April to June seasonal window. Such sites are assigned a "Not Impaired" if they would earn a classification of either Excellent, Good, or Good-Fair using EPT criteria for larger stream sites, and a "Not Rated" otherwise.

³ NC DWQ. 2006. Standard Operating Procedures for Benthic Macroinvertebrates. North Carolina Department of Environment and Natural Resources, Division of Water Quality, Biological Assessment Unit. July 2006. Unpublished. <http://www.esb.enr.state.nc.us/BAUwww/benthossop.pdf>

Table 4. Benthic macroinvertebrate data collected from Savannah River Basin through 2009. Basinwide sites sampled in 2009 are in bold font.

HU/Waterbody	Location	County	SiteID	Date	ST	EPT	BI	EPTBI	BioClass
03060101 Seneca River									
Bearwallow Cr	FS Road lowest road crossing	Transylvania	HB13	05/08/91	---	44	---	1.67	Excellent
				06/08/88	93	45	3.43	2.60	Excellent
Bearwallow Cr	FS Road nr Hogback Valley	Transylvania	HB36	09/13/89	---	25	---	2.00	Good-Fair
Bearwallow Cr	Gorges State Park	Transylvania	HB5	07/20/04	---	41	---	2.47	Excellent
Burlingame Cr	SR 1152	Transylvania	HB15	06/14/06	30	5	6.12	4.16	Not Rated
Hogback Cr	US 64	Jackson	HB20	06/15/06	29	9	3.78	2.95	Not Rated
Horsepasture R	above Logan Cr	Jackson	HB23	06/12/06	72	26	5.18	3.68	Good-Fair
Horsepasture R	above Windy Falls	Transylvania	HB22	06/15/06	100	51	4.00	2.73	Excellent
Horsepasture R	below Trays Island Cr	Jackson	HB21	06/13/06	---	20	---	4.43	Good-Fair
Horsepasture R	NC 281	Transylvania	HB2	08/18/09	103	38	4.29	2.76	Good
				06/14/06	96	39	4.30	2.83	Good
				07/19/04	98	41	4.15	2.91	Good
				07/19/99	76	43	3.93	3.22	Excellent
				07/25/94	89	36	4.35	3.06	Good
				07/25/89	53	24	4.71	3.12	Good-Fair
				08/04/87	78	28	4.68	3.21	Good
				07/21/86	92	36	4.48	2.92	Good
				08/06/85	53	16	5.32	3.59	Fair
				08/20/84	61	25	4.37	3.18	Good-Fair
Horsepasture R	SR 1152	Transylvania	HB24	06/14/06	82	32	4.75	3.06	Good
Indian Cr	US 64	Transylvania	HB1	08/17/09	---	39	---	2.63	Excellent
				07/20/04	---	40	---	2.22	Excellent
				07/19/99	---	34	---	2.06	Good
				07/25/94	---	31	---	1.96	Good
L Hogback Cr	US 64	Jackson	HB25	06/13/06	48	28	4.54	3.72	Not Impaired
Logan Cr	US 64	Jackson	HB26	06/12/06	77	45	3.34	2.22	Not Impaired
Rock Cr	US 64	Transylvania	HB28	06/15/06	43	25	4.32	3.61	Not Impaired
Thompson R	downstream of NC 281	Transylvania	HB40	09/12/89	74	29	5.56	3.55	Good-Fair
				02/24/88	79	38	4.60	2.62	Good-Fair
Thompson R	NC 281	Transylvania	HB4	08/18/09	---	48	---	2.16	Not Impaired
				07/19/04	---	46	---	2.00	Not Impaired
				09/12/89	84	43	3.17	2.17	Not Impaired
				02/23/88	68	41	2.95	1.81	Not Impaired
Thompson R	NC-SC state line	Transylvania	HB38	02/24/88	85	41	3.29	1.91	Good
Toxaway R	Gorges State Park	Transylvania	HB3	07/20/04	---	36	---	2.71	Excellent
Trays Is Cr	US 64	Jackson	HB31	12/10/91	---	31	---	1.45	Excellent
Trays Island Cr	above Camp Merrie Woode	Jackson	HB30	06/13/06	58	36	2.45	2.14	Not Impaired
UT Bearwallow Cr	off US 64 downstream site	Transylvania	HB32	10/01/01	41	20	2.97	1.73	Not Impaired
UT Bearwallow Cr	off US 64 upstream site	Transylvania	HB39	10/01/01	29	19	2.16	1.23	Not Impaired
UT Thompson R	NC 281	Transylvania	HB33	02/24/88	---	31	---	1.94	Good
Whitewater R	NC 281	Transylvania	HB8	08/18/09	---	49	---	2.75	Excellent
				07/19/04	---	46	---	2.31	Excellent
				07/19/99	---	48	---	2.16	Excellent
				07/25/94	---	47	---	1.95	Excellent

Table 6. —continued—

HU/Waterbody	Location	County	SiteID	Date	ST	EPT	BI	EPTBI	BioClass
03060102 Tugaloo River									
Abes Cr	near Little Scaly	Macon	HB10	06/24/99	---	28	---	1.14	Not Impaired
Big Cr	off SR 1608 above Little Cr	Macon	HB37	07/18/99	---	45	---	1.86	Excellent
				07/25/94	---	45	---	1.97	Excellent
				01/20/88	---	38	---	2.29	Excellent
				08/05/87	102	47	3.17	2.05	Excellent
Big Cr	SR 1608 above Norton Br	Macon	HB14	08/19/09	---	42	---	2.74	Excellent
				07/21/04	---	45	---	2.47	Excellent
				08/05/87	99	49	3.17	2.18	Excellent
Chattooga R	above Cashiers WWTP	Jackson	HB11	11/06/01	40	19	4.28	3.72	Not Impaired
Chattooga R	below Cashiers WWTP	Jackson	HB12	11/06/01	31	9	6.08	5.11	Not Rated
Chattooga R	SR 1100	Jackson	HB9	08/19/09	118	51	3.86	2.44	Excellent
				07/20/04	124	64	3.60	2.80	Excellent
				07/18/99	107	57	3.29	2.76	Excellent
				07/26/94	94	47	3.90	2.73	Excellent
				08/07/90	92	44	3.44	2.43	Excellent
				08/09/88	114	50	3.97	2.42	Excellent
				01/19/88	83	45	3.17	2.47	Excellent
				08/19/09	---	47	---	2.58	Excellent
Chattooga R	SR 1107	Jackson	HB6	07/20/04	---	48	---	2.21	Excellent
				01/18/88	96	48	3.63	2.96	Excellent
				06/23/99	82	44	3.93	3.13	Excellent
Clear Cr	SR 1618	Macon	HB16	01/21/88	---	34	---	3.58	Good
E Fk Chattooga R	NC 107	Jackson	HB17	01/19/88	---	31	---	2.16	Good
Fowler Cr	SR 1100	Jackson	HB19	01/19/88	64	37	3.38	2.47	Good
Fowler Cr	SR 1107	Jackson	HB18	06/23/99	98	50	3.82	2.78	Excellent
				01/18/88	---	34	---	3.19	Good
				07/21/04	108	40	4.24	2.69	Good
Norton Mill Cr	SR 1107	Jackson	HB7	06/23/99	71	44	3.58	2.86	Excellent
				01/18/88	---	19	---	2.95	Good-Fair
				07/10/91	68	42	2.55	2.06	Excellent
Overflow Cr	FS Road	Macon	HB27	07/25/89	78	44	3.02	2.25	Excellent
				01/21/88	---	43	---	2.17	Excellent
				06/23/99	---	46	---	1.95	Excellent
Scotsman Cr	SR 1100	Jackson	HB29	01/19/88	---	42	---	2.12	Excellent
				08/20/09	---	48	---	1.93	Excellent
Tallulah R	off Tate City Rd	Clay	HB42	08/20/09	---	48	---	1.93	Excellent
UT W Fk Overflow Cr	FS Road	Macon	HB34	01/20/88	---	35	---	1.80	Excellent
W Fk Overflow Cr	FS Road	Macon	HB35	01/20/88	68	46	2.50	1.96	Excellent

Appendix S-1. Benthic site summaries for basinwide sites collected in the Savannah River basin for the 2009 cycle.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
INDIAN CR	US 64	HB1	08/17/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
TRANSYLVANIA	2	03060101	35.126667	-82.914722	4-5-(3)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	4.1	2730	4	0.3

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	18.7
Dissolved Oxygen (mg/L)	8.0
Specific Conductance (µS/cm)	20
pH (s.u.)	6.0

Water Clarity	slightly turbid
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Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	13
Pool Variety (10)	10
Riffle Habitat (16)	14
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Substrate	even mix of cobble, gravel, sand; some silt present
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Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/17/09	10817	---	39	---	2.63	Excellent
07/20/04	9416	---	40	---	2.22	Excellent
07/19/99	7907	---	34	---	2.06	Good
07/25/94	6596	---	31	---	1.96	Good

Taxonomic Analysis

A few new taxa were identified for the first time from the site in 2009, including: *Dipheter hageni*, *Serratella serrata*, *Litobranchea recurvata*, *Eccoptura xanthenes*, *Trienodes ignitus*, and *Lype diversa*. Two taxa which had been collected during each prior sampling event were not recorded for 2009: *Baetis pluto* and *Perlesta*. Differences in the number of Trichoptera identified from the site has been driving differences in EPT richness for three most recent sampling events. Trichoptera richness is 10, 16, and 14 taxa for 1999, 2004, and 2009 respectively.

Data Analysis

The site is five miles west of Rosman and 1.9 stream-miles above the confluence with Toxaway River.

The site has supported a diverse EPT community, particularly observed with the two most recent sampling events in 2004 and 2009. The increasing EPT BI with each sampling event might be cause for concern; low levels of nutrient enrichment or small increases in the presence of fine sediments can be reflected by increasing diversity and biotic index values.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HORSEPASTURE R	NC 281	HB2	08/18/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
TRANSYLVANIA	2	03060101	35.092222	-82.975833	4-13-(0.5)b	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	24	2860	18	0.4

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

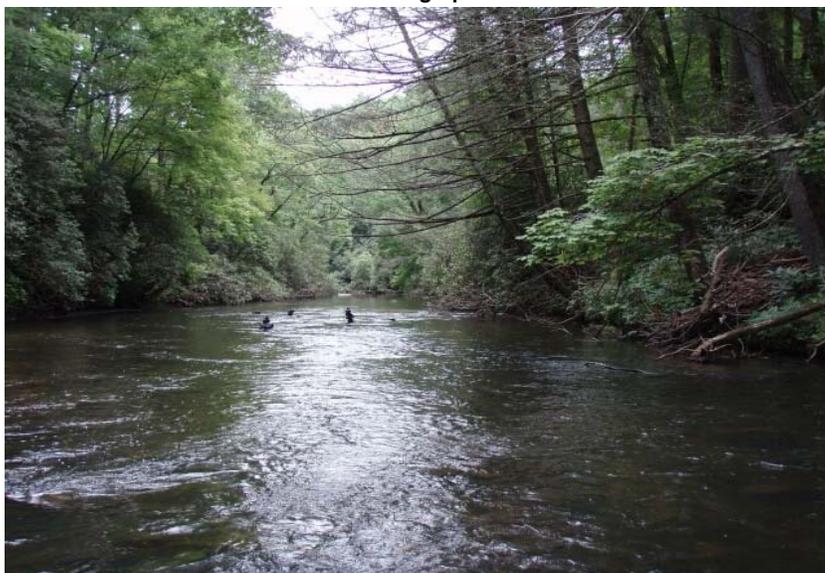
Temperature (°C)	21.7
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	24
pH (s.u.)	6.1

Water Clarity	clear
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Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	9
Riffle Habitat (16)	15
Bank Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	6
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	87

Site Photograph



Substrate	mostly cobble/gravel with some boulder and sand
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Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/18/09	10820	103	38	4.29	2.76	Good
06/14/06	9934	96	39	4.30	2.83	Good
07/19/04	9412	98	41	4.15	2.91	Good
07/19/99	7908	76	43	3.93	3.22	Excellent
07/25/94	6597	89	36	4.35	3.06	Good
07/25/89	5025	53	24	4.71	3.12	Good-Fair

Taxonomic Analysis

Rhyacophila nigrita, a free-living caddisfly, was recorded from the site for the first time in 2009, as were the midges *Chironomus*, *Djalmabatista pulchra*, *Lopescladius*, and *Pseudochironomus*.

Data Analysis

The site is about 10 miles east of Highlands, 5.5 stream-miles upstream of the South Carolina border, and directly downstream of the LBM Industries rock quarry. The site was sampled each summer from 1984 through 1987, then every five years from 1989. A sample was collected at the site in 2006 as part of a reclassification study.

Since 1989 both BI values and EPT Richness indicate an improving benthic community up to 1999 and a relatively stable community with successive sampling events since that year.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
WHITEWATER R	NC 281	HB8	08/18/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
TRANSYLVANIA	2	03060101	35.037500	-83.022222	4-14-(1.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr,HQW	12	2660	17	0.3

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

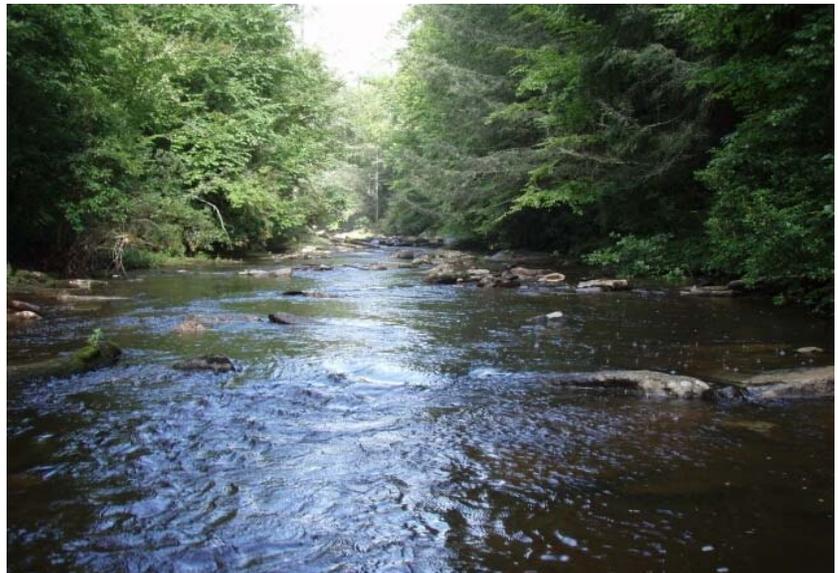
Temperature (°C)	18.0
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	14
pH (s.u.)	5.9

Water Clarity	clear
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Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	5
Riffle Habitat (16)	14
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph



Substrate mostly boulder and cobble; moderate gravel, sand also present

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/18/09	10819	---	49	---	2.75	Excellent
07/19/04	9411	---	46	---	2.31	Excellent
07/19/99	7909	---	48	---	2.16	Excellent
07/25/94	6598	---	47	---	1.95	Excellent

Taxonomic Analysis

Several taxa were identified from the site for the first time in 2009, including: *Heterocloeon amplum*, *Micrasema rickeri*, *Helicopsyche paralimnella*, *Mystacides*, and *Molanna*. The stonefly *Perlesta* was not collected from the site for the first time in 2009; specimens of the genus are most often collected May through July, so seasonality is likely a factor in its absence from the 2009 collection.

Data Analysis

The site is about 10 miles east of Highlands and about 1.1 stream-miles north of the border with South Carolina.

EPT richness has been rather stable at the site for the four sampling events. As with the basinwide site on Indian Creek, this site has shown increasing EPT BI values with successive sampling events. The high EPT richness combined with increasing EPT BI values is suggestive of nutrient enrichment upstream of the site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
THOMPSON R	NC 281	HB4	08/18/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
TRANSYLVANIA	2	03060101	35.077222	-82.998889	4-14-6	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	2.5	2880	6	0.3

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

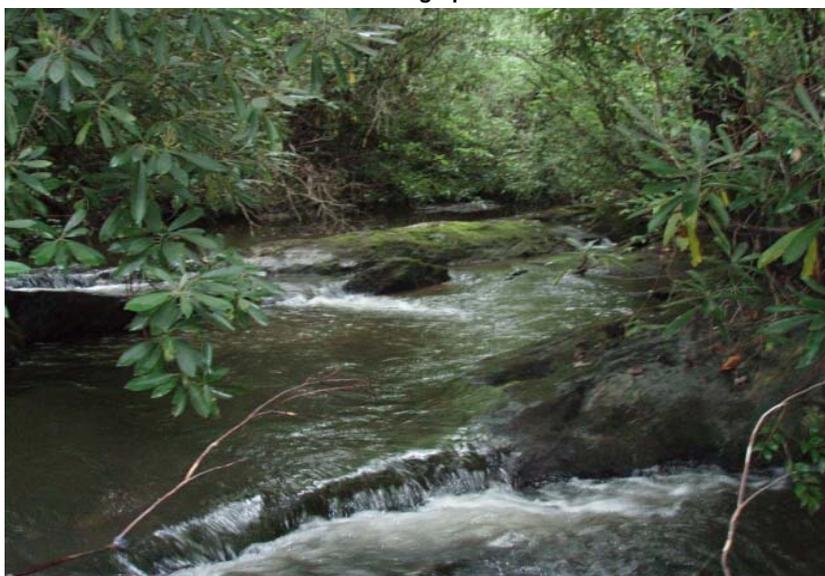
Temperature (°C)	18.2
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	10
pH (s.u.)	5.5

Water Clarity	clear
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Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	11
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph



Substrate	mostly bedrock, cobble, sand; also boulder, gravel, silt present
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Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/18/09	10821	---	48	---	2.16	Not Impaired
07/19/04	9413	---	46	---	2.00	Not Impaired
09/12/89	5072	84	43	3.17	2.17	Not Impaired
02/23/88	4489	68	41	2.95	1.81	Not Impaired

Taxonomic Analysis

Many taxa were recorded for the first time from the site in 2009, and included: the mayflies *Dipheter hageni*, *Baetisca*, *Serratella serrata*, *Epeorus vitreus*, *Maccaffertium merivulvanum*, *Rhithrogena*; the caddisflies *Cheumatopsyche*, *Hydropsyche betteni*, *Chimarra*, and *Oligostomis pardalis*.

Data Analysis

The site is about 10 miles east of Highlands, and about four stream-miles upstream of the border with South Carolina. For stream sites with a drainage area of under 3 square miles, regular biological classifications can not be assigned except by using either High-Quality Small Mountain Stream or the more general small streams criteria; due to the small amount of potential disturbance in the watershed, sampling methods used, and seasons collected, the collections thus far from the site cannot be classified.

EPT Richness was at its highest levels in 2004 and 2009 in spite of the less intensive collection method used for those years (Full-Scale in 1988 and 1989, EPT in 2004 and 2009). There is no trend over the dates sampled with EPT BI values. All four collections would have resulted in classifications of Excellent if criteria for larger streams could be applied.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CHATTOOGA R	SR 1107	HB6	08/19/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	1	03060102	35.073889	-83.107500	3b	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;Tr,ORW	7.8	2800	6	0.4

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	80	0	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	18.8
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	38
pH (s.u.)	6.4

Water Clarity clear

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	12
Bottom Substrate (15)	5
Pool Variety (10)	9
Riffle Habitat (16)	6
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	64

Substrate mostly bedrock and sand; also boulder, cobble, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/19/09	10822	---	47	---	2.58	Excellent
07/20/04	9414	---	48	---	2.21	Excellent
01/18/88	4467	96	48	3.63	2.96	Excellent

Taxonomic Analysis

With the 2009 sampling event being only the second summer event at the site, it is not surprising that there were many taxa reported for the first time. Those taxa include: the mayflies *Procloeon*, *Pseudocloeon propinquum*, *Serratella serrata*, *Hexagenia limbata*; the stonefly *Eccoptura xanthenes*; and the caddisflies *Diplectrona modesta*, *Mystacides*, and *Rhyacophila torva*.

Most taxa collected during the first summer sampling event in 2004 and uncollected in 2009 were rare in the 2004 sample; exceptions included: *Serratella deficiens*, *Perlesta*, *Isoperla holochlora*, *Malirekus hastatus*, and *Setodes*. Seasonality is playing a role in most of those cases, with generally greater occurrences of those taxa in mountain samples collected in July (as for the 2004 sample) than August (as in 2009). The exception is the stonefly *M. hastatus*, which should be increasing its chance for collection and identification as the larvae goes through a slow growth during the summer months.

Data Analysis

The site is about three miles east of Highlands, about seven stream-miles upstream of the Georgia border, and within a reach popular for swimming and fishing. Of the eight sites sampled in the Savannah Basin in 2009, this had the lowest habitat score; large areas of bedrock and sand, and the short, infrequent riffles were the primary reasons for the low score.

Though EPT richness changed little between the summer sampling events of 2004 and 2009, more tolerant EPT taxa (especially in the families Baetidae and Hydropsychidae) were collected in 2009 than in 2004, resulting in an increase in the EPT BI.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CHATTOOGA R	SR 1100	HB9	08/19/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	1	03060102	35.018070	-83.125810	3b	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;Tr,ORW	23	2450	22	0.3

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	21.4
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	25
pH (s.u.)	6.9

Water Clarity	clear
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Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	14
Bottom Substrate (15)	9
Pool Variety (10)	6
Riffle Habitat (16)	13
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	71

Substrate	mostly bedrock, boulder, sand; also cobble, gravel, some silt
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Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/19/09	10823	118	51	3.91	2.44	Excellent
07/20/04	9415	124	64	3.60	2.80	Excellent
07/18/99	7911	107	57	3.29	2.76	Excellent
07/26/94	6600	94	47	3.90	2.73	Excellent
08/07/90	5362	92	44	3.44	2.43	Excellent
08/09/88	4674	114	50	3.97	2.42	Excellent

Taxonomic Analysis

Several midges were recorded from the site for the first time in 2009, including: *Orthocladius lignicola*, *Paratanytarsus dissimilis*, *Polypedilum aviceps*, *Potthastia longimana*, and *Stempellinella fimbriata* (the first BAU record for the state). As in 1988, three different species of *Micrasema* were collected in 2009: *M. bennetti*, *M. rickeri*, and *M. wataga*.

The difference in EPT richness between 2004 and 2009 are due to fewer Ephemerellidae and Trichoptera identified from the latter sample. Species in the family Ephemerellidae show a seasonal pattern of occurrence in BAU samples, with fewer species collected in August than July in mountain samples; therefore seasonality is likely playing a role in reduced Ephemerellidae richness in 2009.

Data Analysis

The site is about four miles southeast of Highlands, two stream-miles upstream of the Georgia state line, and within the Nantahala National Forest. In addition to the dates shown above, the site was sampled in January 1988, at which time it also received a classification of Excellent.

EPT Richness has been high during each sampling event, with the lowest value of 44 taxa recorded in 1990. The BI value for 2009 is near the high end of the range for summer samples collected at the site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BIG CR	SR 1608	HB14	08/19/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	03060102	35.008889	-83.159722	3-10-3	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr,ORW	5.1	2510	10	0.4

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	19.7
Dissolved Oxygen (mg/L)	7.4
Specific Conductance (µS/cm)	20
pH (s.u.)	5.9

Water Clarity	clear
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Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	11
Bottom Substrate (15)	5
Pool Variety (10)	9
Riffle Habitat (16)	14
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	72

Substrate	mostly bedrock, sand, boulder; some cobble and silt
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Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/19/09	10824	---	42	---	2.74	Excellent
07/21/04	9432	---	45	---	2.47	Excellent
08/05/87	4195	99	49	3.17	2.18	Excellent

Taxonomic Analysis

The EPT communities between 2004 and 2009 were similar. All taxa collected in 2004 and uncollected in 2009 were rare in the sample. Four taxa were common in the 2009 sample and uncollected in 2004: *Maccaffertium pudicum*, *Neophemera purpurea*, *Glossosoma*, and *Lepidostoma*. Those four taxa are sensitive to the presence of pollutants.

Data Analysis

The site is about three miles southeast of Highlands, and 1.6 stream-miles upstream of the Georgia state line. Much of the catchment is within the Nantahala National Forest; headwaters include the southeastern limits of Highlands. The site was sampled for basinwide assessment in 2004 and 2009; prior basinwide sampling occurred at a point about one stream-mile upstream of the current site and just upstream of Little Creek. Both sites have received classifications of Excellent following each sampling event.

Only the two most recent sampling events at the site are directly comparable (the 1987 event used Full Scale rather than EPT collection methods) with respect to EPT richness and EPT BI values. With only two data points it is not advisable to suggest trends in water quality at the site using those two metrics. Continued basinwide sampling using EPT methods is expected.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TALLULAH R	OFF TATE CITY RD	HB42	08/20/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Clay	1	03060102	34.998460	-83.556980	3-11	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	4.5	2570	7	0.3

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	17.6
Dissolved Oxygen (mg/L)	8.4
Specific Conductance (µS/cm)	20
pH (s.u.)	6.1

Water Clarity	clear
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Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	91

Substrate	mostly cobble, boulder, gravel; some sand and bedrock
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Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/20/09	10825	---	48	---	1.93	Excellent

Taxonomic Analysis

The stonefly *Hansonoperla appalachia* was collected here; this is one of only four BAU records for the genus and species in the state to date.

Data Analysis

The site is 15 miles southwest of Franklin, and 0.4 stream-miles upstream of the Georgia state line. The catchment is almost entirely contained by the Southern Nantahala Wilderness. Prior to the 2009 basinwide sample there had been no benthic data collected by the BAU for the Tallulah River catchment.

The high EPT Richness and very low EPT BI reflect the high quality of water at the site; the catchment should be considered for reclassification to High Quality Waters or Outstanding Resource Waters.