

Appendix 1B

Biological Assessment

Macroinvertebrate and Fish Site Sample Results

The full report is available on the DWQ Environmental Sciences Section website:
<http://portal.ncdenr.org/web/wq/ess/reports>.

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

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

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
WHITWATER 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

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

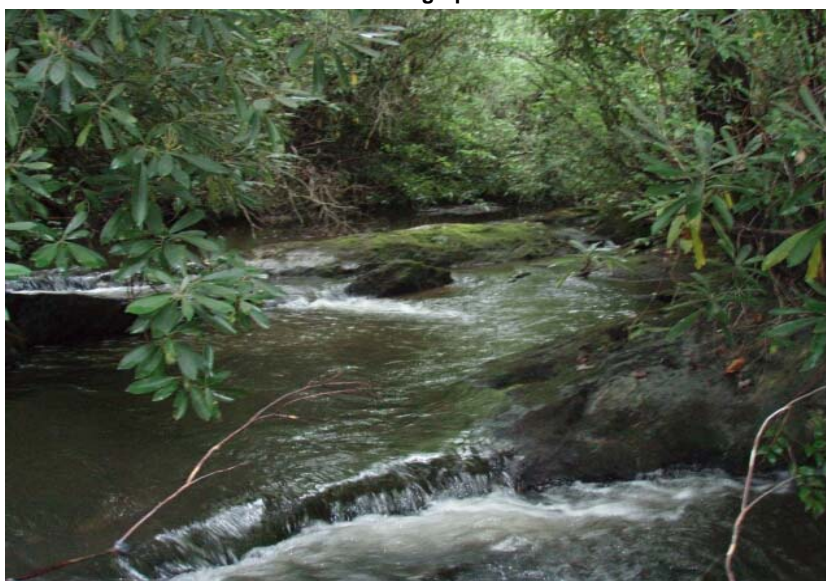
Temperature (°C)	18.2
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	10
pH (s.u.)	5.5

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 meririvulatum*, *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

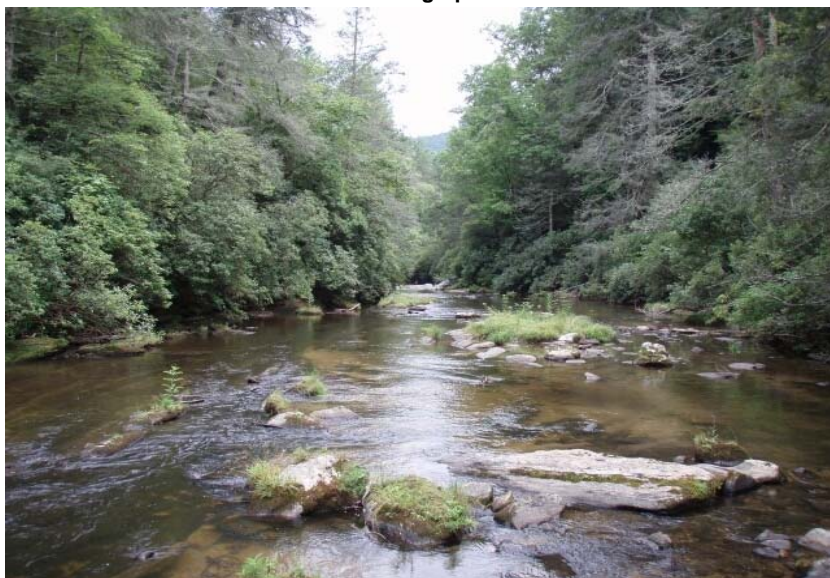
Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

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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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

Site Photograph



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.