Appendix II

Water Quality Data Collected by DWQ

- **Benthic Macroinvertebrate Collections**
- **Fish Community Collections**

Benthic Macroinvertebrate Sampling Methodology and Bioclassification Criteria

Benthic macroinvertebrates can be collected using two sampling procedures. DWQ's standard qualitative sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs. 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).

Several data analysis summaries (metrics) can be produced from standard qualitative samples to detect water quality problems. These metrics are based on the idea that unimpaired streams and rivers have many invertebrate taxa and are dominated by intolerant species. Conversely, polluted streams have fewer numbers of invertebrate taxa and are dominated by tolerant species. The diversity of the invertebrate fauna is evaluated using taxa richness counts; the tolerance of the stream community is evaluated using a biotic index.

EPT taxa richness (EPT S) is used with DWQ criteria to assign water quality ratings (bioclassifications). "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect groups that are generally intolerant of many kinds of pollution. Higher EPT taxa richness values usually indicate better water quality. Water quality ratings are also based on the relative tolerance of the macroinvertebrate community as summarized by the North Carolina Biotic Index (NCBI). Both tolerance values for individual species and the final biotic index values have a range of 0-10, with higher numbers indicating more tolerant species or more polluted conditions.

Water quality ratings assigned with the biotic index numbers are combined with EPT taxa richness ratings to produce a final bioclassification, using criteria for mountain/piedmont/coastal plain streams. EPT abundance (EPT N) and total taxa richness calculations also are used to help examine between-site differences in water quality. If the EPT taxa richness rating and the biotic index differ by one bioclassification, the EPT abundance value is used to determine the final site rating.

Benthic macroinvertebrates can also be collected using the DWQ's EPT sampling procedure. Four composite samples are taken at each site instead of the 10 taken for the qualitative sample: 1 kick, 1 sweep, 1 leafpack and visual collections. Only intolerant EPT groups are collected and identified, and only EPT criteria are used to assign a bioclassification.

The expected EPT taxa richness values are lower in small high quality mountain streams, <4 meters in width or with a drainage area <3.5 square miles. For these small mountain streams, an adjustment to the EPT taxa richness values is made prior to applying taxa richness criteria. Both EPT taxa richness and biotic index values also can be affected by seasonal changes. DWQ criteria for assigning bioclassification are based on summer sampling (June-September). For samples collected in other seasons, EPT taxa richness can be adjusted. The biotic index values can also be seasonally adjusted for samples collected outside the summer season.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is not assessed as well by a taxa richness analysis.

Habitat Evaluation

DWQ has developed a habitat assessment form to better evaluate the physical habitat of a stream. The habitat score has a potential range of 1-100, based on 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 for assigning ratings indicating Excellent, Good, Fair or Poor habitat.

Table A-II-1 Benthic Macroinvertebrate Data Collected in the Broad River Basin, 1983-2000 (Current basinwide monitoring sites have name bolded.)

Subbasin/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
03-08-01									
Broad R	SR 2802	Henderson	9-(1)	7/10/00	99	49	4.10	3.26	Excellent
				7/10/95	82	43	3.44	2.81	Excellent
Broad R	US 64/74	Rutherford	9-(22)	9/12/00	54	18	5.98	4.75	Not Rated
				8/30/84	35	14	5.62	4.70	Fair
Reedypatch Cr	US 64	Rutherford	9-15	7/10/00	-	32	-	3.34	Good
Cove Cr	SR 1381	Rutherford	9-23-(9)	7/12/00	-	40	-	3.39	Excellent
				7/10/95	-	37	-	3.06	Excellent
Cove Cr	US 64/74	Rutherford	9-23-(9)	7/26/89	77	33	4.20	3.64	Good
				7/21/86	95	40	4.47	3.82	Good
03-08-02									
Broad R	SR 1181	Rutherford	9-(22)	7/12/00	81	31	4.78	3.40	Good
				7/12/95	57	28	4.89	4.25	Good-Fair
Mountain Cr	SR 1149	Rutherford	9-25-(5)	8/17/00	53	19	4.96	4.09	Good-Fair
				7/12/95	-	28	-	3.76	Good
Broad R	SR 1106	Rutherford	9-(25.5)	7/11/00	71	24	5.42	4.69	Good-Fair
				7/12/95	52	23	4.84	3.79	Good-Fair
Broad R	US 221	Rutherford	9-(25.5)	7/19/00	79	32	4.89	3.97	Good
				9/20/95	58	29	4.91	4.03	Good-Fair
				7/25/89	56	22	5.31	4.67	Good-Fair
				7/21/87	64	26	5.12	4.38	Good-Fair
				7/22/86	70	27	5.40	4.32	Good-Fair
				9/4/85	48	21	4.97	3.82	Good-Fair
				8/30/84	66	29	4.58	3.76	Good-Fair
				8/11/83	46	17	5.13	4.33	Fair
Cleghorn Cr	SR 1149	Rutherford	9-26	7/13/00	85	24	6.19	5.42	Good-Fair
				7/12/95	49	17	5.30	4.96	Fair
Green R	SR 1331	Polk	9-29-(33)	10/28/93	69	29	5.28	4.32	Good-Fair
Green R	SR 1302			7/12/00	70	29	4.5	3.65	Good-Fair
				7/11/95	52	27	4.48	4.03	Good-Fair
				7/26/89	83	35	4.84	4.20	Good
				7/21/87	74	33	4.83	4.15	Good
Walnut Cr	SR 1315	Polk	9-29-44	7/11/00	-	38	-	3.36	Excellent
				7/11/95	-	14	-	3.92	Fair
UT Whiteoak Cr	Upstream WWTP	Polk	9-29-46	5/15/95	84	38	4.81	4.14	Good-Fair
UT Whiteoak Cr	Downstream WWTP			5/15/95	69	35	5.51	4.44	Good-Fair
UT Whiteoak Cr	SR 1532			10/28/86	73	29	4.65	3.48	Good-Fair
UT Whiteoak Cr	SR 1519			10/28/86	51	8	6.69	2.86	Poor
Whiteoak Cr	SR 1531	Polk	9-29-46	10/29/86	76	27	5.25	4.12	Good-Fair
Whiteoak Cr	SR 1526			10/29/86	-	19	-	4.17	Good-Fair
Whiteoak Cr	SR 1352			7/11/00	96	40	4.72	3.96	Good
				7/11/95	63	36	4.69	4.14	Good
				5/15/95	84	38	4.84	3.47	Good
				10/29/86	-	24	-	3.75	Good-Fair

Subbasin/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
03-08-02 (con't)									
Second Broad R	above Chip Mill	Rutherford	9-41-(10.5)	5/19/99	82	47	4.31	3.70	Good
Second Broad R	below Chip Mill			5/19/99	84	44	4.09	3.59	Good
Second Broad R	SR 1538			8/16/00	64	26	4.71	3.73	Good-Fair
				7/13/95	51	26	4.40	3.59	Good-Fair
				6/28/94	68	33	4.57	3.92	Good
Gap Br	SR 1512	Rutherford	9-41-11-1	3/18/86	88	35	3.66	2.69	Good
Second Broad R	US 74 Bus	Rutherford	9-41-(12.3)	6/28/94	71	30	5.18	4.09	Good-Fair
Catheys Cr	SR 1549	Rutherford	9-41-13-(6)	8/16/00	-	18	-	4.59	Fair
				7/13/95	-	18	-	3.94	Fair
				6/27/94	49	17	5.27	3.57	Good-Fair
				3/23/88	-	15	-	3.98	Fair
Hollands Cr	SR 1547	Rutherford	9-41-13-7-(3)	3/23/88	63	27	5.23	4.31	Good-Fair
Hollands Cr	SR 1548			7/13/00	-	17	-	3.26	Fair
				3/23/88	29	3	7.47	4.67	Poor
Roberson Cr	SR 1561	Rutherford	9-41-14	7/13/00	-	21	-	4.56	Good-Fair
				7/13/95	-	26	-	4.16	Good-Fair
Second Broad R	US 221A	Rutherford	9-41-(21.5)	6/28/94	65	23	5.58	4.41	Good-Fair
Second Broad R	SR 1973		9-41-(24.7)	7/19/00	83	29	5.80	4.69	Good-Fair
				7/13/95	42	20	5.69	4.94	Good-Fair
				7/8/91	59	25	5.41	4.56	Good-Fair
				7/25/89	60	17	6.23	5.21	Fair
				7/21/87	65	25	5.64	4.51	Good-Fair
				9/4/85	44	15	5.99	4.77	Fair
				8/11/83	26	9	7.88	4.45	Poor
03-08-03									
Green R	SR 1104	Henderson	9-29-(1)	10/27/93	103	51	3.60	2.48	Excellent
	Off SR 1106	Henderson	9-29-(1)	10/27/93	78	42	3.00	2.19	Excellent
				1/18/89	87	42	3.67	2.54	Good
				1/18/89	-	40	-	2.14	Good
	SR 1103	Henderson	9-29-(1)	10/27/93	93	38	4.04	2.89	Good
Rock Cr	SR 1106	Henderson	9-29-12	10/28/93	-	37	-	2.84	Excellent
				1/19/89	-	32	-	2.71	Good
Joe Cr	SR 1106	Henderson	9-29-14	7/10/00	-	38	-	2.97	Excellent
				1/19/89	-	28	-	2.92	Good
Bobs Cr	SR 1103	Henderson	9-29-15	1/19/89	-	35	-	2.68	Good
Freeman Cr	SR 1115	Henderson	9-29-18	1/18/89	-	20	-	3.36	Good-Fair
Green R	SR 1151	Henderson	9-29-(22)	7/11/00	71	29	4.46	3.54	Good-Fair
				7/10/95	54	25	4.44	4.07	Good-Fair
Hungry R	SR 1799	Henderson	9-29-30	9/12/00	-	34	-	3.20	Good
				7/10/00	-	34	-	2.74	Good
				7/10/95	-	25	-	2.45	Good-Fair
03-08-04									
Sandy Run Cr	SR 1195	Cleveland	9-46	7/19/00	80	38	4.71	4.00	Good
				7/11/95	61	28	5.16	4.36	Good-Fair
First Broad R	SR 1726	Cleveland	9-50-(1)	7/25/89	83	36	4.28	3.40	Good

Subbasin/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
03-08-04 (con't)									
First Broad R	SR 1530	Cleveland	9-50-(1)	7/17/00	110	47	4.49	3.67	Good
				7/10/95	92	39	4.43	3.94	Good
				10/28/93	-	35	-	3.57	Good
				7/24/89	92	37	4.51	4.02	Good
				7/27/88	96	42	4.51	3.79	Good
				7/22/86	91	37	4.84	3.87	Good
N Fk First Broad R	SR 1728	Rutherford	9-50-4	7/17/00	-	36	-	3.56	Excellent
				7/10/95	84	40	3.83	3.39	Excellent
				7/24/89	-	35	-	3.21	Good
Wards Cr	SR 1525	Cleveland	9-50-12	7/17/00	-	33	-	4.17	Good
Wards Cr	SR 1533	Cleveland	9-50-12	7/24/89	-	21	-	4.82	Good-Fair
Duncans Cr	SR 1749	Rutherford	9-50-13	7/10/95	-	28	3.20	3.20	Good
Hinton Cr	NC 226	Cleveland	9-50-15	7/17/00	-	26	-	3.90	Good-Fair
				7/10/95	-	22	-	3.51	Good-Fair
First Broad R	Off SR 1809 at SR 1856	Cleveland	9-5-(15.5)	7/18/00	83	32	4.73	3.96	Good
	SR 1809	Cleveland		7/11/95	74	31	4.79	3.86	Good
Knob Cr	SR 1004	Cleveland	9-50-19-(4)	7/17/00	-	30	-	3.94	Good
				7/11/95	75	31	4.66	4.05	Good
First Broad R	SR 1140	Cleveland	9-50-(28)	7/20/00	70	23	5.37	4.11	Good
				7/12/95	51	19	5.53	4.56	Good-Fair
				7/25/89	73	23	5.75	4.57	Good-Fair
				7/21/87	69	26	5.65	4.04	Good
				9/5/85	44	12	6.79	5.28	Fair
				8/11/83	57	21	5.95	4.67	Good-Fair
Brushy Cr	above SR 1323	Cleveland	9-50-29	5/16/95	72	34	5.33	4.60	Good
Brushy Cr	below SR 1323	Cleveland	9-50-29	5/16/95	80	32	5.17	4.50	Good
Brushy Cr	SR 1308	Cleveland	9-50-29	7/20/00	62	24	5.02	3.94	Good
Brushy Cr	US 74	Cleveland	9-50-29	9/4/85	49	13	6.66	5.64	Fair
Brushy Cr	below US 74	Cleveland	9-50-29	11/9/88	12	12	5.47	5.47	Fair
Brushy Cr	below US 74	Cleveland	9-50-29	11/9/88	-	11	-	5.31	Fair
Hickory Cr	SR 1110	Cleveland	9-50-30	2/9/87	-	11	-	5.30	Fair
Hickory Cr	NC 18	Cleveland	9-50-30	7/20/00	46	12	6.23	5.87	NR
Hickory Cr	below NC 18	Cleveland	9-50-30	2/9/87	-	3	-	6.13	Poor
Beaverdam Cr	NC 150	Cleveland	9-50-32	7/19/00	68	24	5.74	5.01	Good
				7/11/95	57	20	5.87	5.09	Good-Fair
03-08-05									
Buffalo Cr	SR 1908	Cleveland	9-53-(1)	7/18/00	79	35	5.02	4.42	Excellent
				7/11/95	67	29	5.28	4.71	Good
Buffalo Cr	US 74	Cleveland	9-53-(5)	9/13/90	54	11	6.80	4.97	Fair
				11/14/83	43	7	7.32	6.07	Fair
Buffalo Cr	NC 198	Cleveland	9-53-(5)	7/20/00	75	27	5.25	4.57	Good
				7/12/95	56	24	5.37	4.83	Good
				7/27/88	80	14	6.65	5.85	Fair
				8/6/84	55	18	6.07	5.25	Good-Fair
				11/14/83	59	15	6.87	5.38	Fair

Subbasin/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
03-08-05 (con't)									
Muddy Fk	SR 2012	Cleveland	9-53-6	7/18/00	72	25	5.52	4.83	Good
				7/13/95	74	23	5.69	5.21	Good
				9/13/90	74	17	6.02	5.46	Good-Fair
				11/14/83	75	18	6.16	4.58	Good-Fair
Beason Cr	SR 2252	Cleveland	9-53-8	3/17/86	68	19	6.02	4.55	Good-Fair
Beason Cr	SR 2246	Cleveland	9-53-8	7/18/00	-	15	-	5.11	Good-Fair
				7/12/95	59	18	5.59	5.19	Good-Fair
				6/10/87	69	17	6.11	5.42	Good-Fair
Long Br	Battlewood Rd	York, SC	9-53-8-1	3/18/86	90	38	4.62	3.31	Excellent
Lick Br	SR 2227	Cleveland	9-53-11	7/20/00	68	24	5.47	4.70	Not Impaired
				7/12/95	49	6	6.21	6.39	Not Rated
				3/17/86	51	13	6.61	5.30	Not Rated
				11/15/83	35	6	7.44	6.00	Not Rated
Lick Br	SR 2229	Cleveland	9-53-11	3/17/86	33	3	7.99	6.61	Poor
Kings Cr	SR 2286	Cleveland	9-54	7/21/00	72	24	5.72	4.83	Good
				7/13/95	57	19	6.34	5.73	Good-Fair
03-08-06									
N Pacolet R	SR 1179	Polk	9-55-1-(1)	7/11/00	83	37	4.58	3.96	Good
				7/11/95	68	31	4.33	3.67	Good
N Pacolet R	SR 1517	Polk	9-55-1-(10)	8/10/83	67	24	5.73	4.87	Good-Fair
N Pacolet R	SR 1501	Polk	9-55-1-(10)	7/11/00	96	33	5.49	4.47	Good-Fair
				7/11/95	67	24	5.73	4.87	Good-Fair

Table A-II-2 Fish Community Structure Data Collected in the Broad River Basin, 1994-2000 (Current basinwide sites are bolded.)

Subbasin/Stream	Location	County	Map #	Index No.	Date	NCIBI Score	NCIBI Rating
03-08-01							
Flat Cr	SR 2802	Buncombe		9-12	09/29/98	---	Not rated
Cedar Cr	SR 1371	Rutherford	F-1	9-23-14	05/11/00	44	Good-Fair
03-08-02							
Green R	SR 1302	Polk		9-29-(33)	06/19/95	46	Good-Fair
Walnut Cr	SR 1315	Polk	F-1	9-29-44	05/12/00	56	Excellent
White Oak Cr	SR 1526	Polk	F-2	9-29-46	05/12/00	46	Good-Fair
Second Broad R	SR 1500	Rutherford	F-3	9-41-(0.5)	05/11/00	52	Good
Second Broad R	SR 1538	Rutherford		9-41-(10.5)	06/20/94	56	Excellent
Second Broad R	US 74	Rutherford		9-41-(21.5)	06/20/94	50	Good
Second Broad R	US 221A	Rutherford		9-41-(24.7)	06/20/94	50	Good
Cane Cr	SR 1558	Rutherford	F-4	9-41-12-(5.5)	05/10/00	42	Good-Fair
Catheys Cr	SR 1549	Rutherford	F-5	9-41-13-(6)	05/10/00	32	Poor
					06/20/94	46	Good-Fair
Roberson Cr	SR 1561	Rutherford	F-6	9-41-14	05/10/00	54	Excellent
03-08-04							
Sandy Run	SR 1332	Cleveland	F-1	9-46	05/10/00	48	Good
N Fk First Broad R	SR 1728	Rutherford		9-50-4	06/07/99	58	Excellent
					06/20/95	56	Excellent
Brier Cr	SR 1733	Rutherford		9-50-8	09/28/98	56	Excellent
Wards Cr	SR 1525	Cleveland	F-2	9-50-12	05/09/00	54	Excellent
Knob Cr	SR 1641	Cleveland	F-3	9-50-19-(2.5)	05/09/00	42	Good-Fair
Brushy Cr	SR 1342	Cleveland	F-4	9-50-29	05/09/00	46	Good-Fair
Hickory Cr	NC 18	Cleveland	F-5	9-50-30	05/08/00	50	Good
Beaverdam Cr	NC 150	Cleveland	F-6	9-50-32	06/20/95	48	Good
					05/08/00	50	Good
03-08-05							
Buffalo Cr	SR 1906	Cleveland	F-1	9-53-(1)	05/09/00	46	Good-Fair
Muddy Fk	SR 1001	Cleveland	F-2	9-53-6	05/08/00	48	Good
03-08-06							
N Pacolet R	SR 1501	Polk		9-55-1-(10)	06/19/95	48	Good