APPENDIX II

CONTENTS:

DEM Water Quality Monitoring Programs:

- **Benthic Macroinvertebrate Sampling**
- **Fisheries Studies**
- **Lakes Assessment**

BENTHIC MACROINVERTEBRATES

Benthic macroinvertebrates, or benthos, are organisms, mostly aquatic insect larvae, that live in and on the bottom substrates of rivers and streams. The use of benthos data has proven to be a reliable monitoring tool as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since many taxa in a community have life cycles of six months to one year, the effects of short term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPT S). Likewise, ratings can be assigned with a "biotic index". This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification. Higher taxa richness values are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is poorly assessed by a taxa richness analysis. Different criteria have been developed for different ecoregions (mountains, piedmont and coastal) within North Carolina.

Classification Criteria by Ecoregion*

A. EPT taxa richness values

	10-sample Qualitative Samples			4-sample EPT samples		
	Mountains	Piedmont	Coastal	Mountains	Piedmont	Coastal
Excellent	>41	>31	>27	>35	>27	>23
Good	32-41	24-31	21-27	28-35	21-27	18-23
Good-Fair	22-31	16-23	14-20	19-27	14-20	12-17
Fair	12-21	8-15	7-13	11-18	7-13	6-11
Poor	0-11	0-7	0-6	0-10	0-6	0-5

B. Biotic Index Values (Range = 0-10)

	Mountains	Piedmont/Coastal
Excellent	<4.18	<5.24
Good	4.17-5.09	5.25-5.95
Good-Fair	5.10-5.91	5.96-6.67
Fair	5.92-7.05	6.68-7.70
Poor	>7.05	>7.71

*These criteria apply to flowing water systems only. Biotic index criteria are only used for full-scale (10-sample) qualitative samples

Table 1 presents a summary of benthic macroinvertebrate samples collected in the Catawba River Basin.

Table 1. Benthic macroinvertebrate collections in the Catawba River basin, 1983-1992.

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Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba R ab Old Fort, SR 1273, McDowell	3/B-1	11-(1)	04/85	99/49	4.28/2.95	Good
Mill Cr at Graphite ab RR bridge, McDowell	-/B-2	11-7	07/92	85/49	2.39/1.87	Excellent
			02/92	-/39	-/1.76	Good
Catawba R ab Curtis Cr, McDowell	4/B-3	11-(8)	04/85	82/39	4.65/3.24	Good-Fair
Catawba R be Old Fort, McDowell, I-40 or SR 1234	5, N/B-4	11-(8)	07/92	102/41	3.98/2.82	Excellent
			07/90	84/38	4.31/3.47	Good
			07/87	74/30	5.78/4.63	Good-Fair
			04/85	86/28	6.41/4.12	Fair
Catawba R nr Pleasant Gardens, SR 1221, McDowell	A/B-5	11-(8)	07/92	90/42	4.33/3.39	Good
			07/90	77/43	4.36/3.80	Good
			08/88	86/31	5.81/4.91	Good-Fair
			07/88	-/27	-/3.99	Good-Fair
			07/86	78/26	5.93/4.24	Good-Fair
			08/85	73/24	5.58/4.49	Good-Fair
			08/84	63/23	5.04/4.47	Good-Fair
			08/83	70/27	5.69/4.68	Good-Fair
Curtis Cr be Newberry Cr, McDowell	-/B-6	11-10-(6)	02/92	-/42	-/2.21	Good
Curtis Cr ab WWTP, SR 1227, McDowell	1/B-7	11-10-(6)	04/85	97/44	3.88/2.57	Good
Curtis Cr be WWTP, McDowell	2/B-8	11-10-(14)	04/85	56/25	6.00/3.24	Fair
Crooked Cr, SR 1135, McDowell	-/B-9	11-12	07/92	-/33	-/3.29	Good*
Mackey Cr, SR 1453, McDowell	-/B-10	11-15-(2)	02/92	-/45	-/2.07	Excellent*
Buck Cr, NC 80 ab L Tahoma, McDowell	-/B-11	11-19-(1)	02/92	-/42	-/2.30	Good
L Buck Cr, SR 1436	-/B-12	11-19-11	02/92	-/43	-/2.11	Excellent
			07/91	60/37	2.48/2.02	Excellent
Toms Cr, SR 1434, McDowell	-/B-13	11-21-(2)	07/92	75/37	3.28/2.28	Excellent
			02/92	-/49	-/2.38	Excellent*
N Fk Catawba R @ Linville Caverns, McDowell	-/B-14	11-24-(1)	01/91	-/37	-/1.96	Good
N Fk Catawba R, NC 221, McDowell	-/B-15	11-24-(1)	01/91	-/42	-/2.67	Good
N Fk Catawba R, SR 1573, McDowell	-/B-16	11-24-(1)	01/91	-/37	-/2.96	Good
N Fk Catawba R, SR 1560, McDowell	-/B-17	11-24-(1)	07/92	95/41	4.12/3.22	Excellent
			01/91	-/44	-/2.67	Excellent
N Fk Catawba R, be Sevier dischargers, McDowell	-/B-18	11-24-(1)	07/92	88/43	4.00/3.20	Excellent
Laurel Br, NC 221, McDowell	-/B-19	11-24-3	01/91	-/32	-/1.13	Good
Pond Br, SR 1560, McDowell	-/B-20	11-24-4	01/91	-/24	-/1.36	Good
Stillhouse Br, SR 1560, McDowell	-/B-21	11-24-6	01/91	-/25	-/1.45	Good
~~Honeycutt Cr, SR 1568, McDowell~~	~~-/B-22~~	~~11-24-8~~	~~01/91~~	~~-/44~~	~~-/2.73~~	~~Good~~
Pepper Cr, NC 221, McDowell	-/B-23	11-24-10	01/91	-/42	-/2.63	Good
Armstrong Cr, end of FS Rd, McDowell	-/B-24	11-24-14-(1.5)	07/92	-/38	-/2.11	Excellent
Linville R, nr NC 105 nr Brier Kn, Avery	93/B-25	11-29-(1)	11/89	-/27	-/3.54	Good-Fair
Linville R, NC 221, Avery	94/B-26	11-29-(1)	07/92	-/30	-/3.15	Good*
			11/89	-/22	-/4.33	Good-Fair
W Fk Linville R, SR 1349, Avery	91/B-27	11-29-4	11/89	-/39	-/1.90	Good
Grandmother Cr, SR 1511, Avery	92/B-28	11-29-5-(2)	11/89	-/30	-/2.73	Good
Linville R, nr Nebo, NC 126, Burke	B/B-29	11-29-(16)	07/92	108/48	4.19/3.15	Excellent
			07/91	84/43	4.10/3.05	Excellent
			10/90	94/47	3.85/2.78	Excellent
			07/90	104/46	4.32/3.26	Excellent
			04/90	113/54	3.61/2.45	Excellent
			01/90	94/56	3.57/2.53	Excellent
			11/89	100/54	3.47/2.67	Excellent
			08/89	99/46	4.15/2.90	Excellent
			03/89	89/43	3.62/3.08	Excellent
			02/89	113/59	3.88/2.91	Excellent

CTB 30, continued.

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Linville R nr Nebo, cont.			08/87	-/42	-/3.49	Excellent
			07/87	113/48	4.61/3.49	Excellent
			08/85	101/41	5.23/3.70	Good
			08/83	105/45	4.64/3.49	Excellent
Catawba R, Glen Alpine, SR 1147, Burke	O/B-30	11-(31)	08/88	82/35	4.91/3.44	Good
N Muddy Cr, SR 1750 , McDowell	8/B-31	11-32-1-(0.5)	07/92	81/33	5.03/4.38	Good
			04/85	85/35	5.64/4.08	Good-Fair
Corpening Cr (Youngs Fk), SR 1819, McDowell	6/B-32	11-32-1-4	09/90	55/17	6.37/5.51	Fair
			04/85	64/19	6.91/4.95	Fair
Corpening Cr (Youngs Fk), SR 1794, McDowell	7/B-33	11-32-1-4	09/90	44/8	7.53/6.82	Poor
			04/90	58/17	6.82/4.76	Fair
S Muddy Cr, SR 1764, McDowell	-/B-34	11-32-2-(8.5)	07/92	-/27	-/3.90	Good-Fair
High Shoals Cr, SR 1798, McDowell	9/B-35	11-32-2-6	07/86	76/32	4.32/3.07	Good

*These sites showed signs of sediment problems and/or enrichment. They might have received a lower bioclassification with a full-scale survey invertebrate collection or a fisheries survey.

CTB 31

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba R, NC 181, Burke	-/B-1	11-(31)	07/92	76/30	4.93/3.89	Good
Canoe Cr, SR 1250, Burke	-/B-2	11-33-(2)	08/92	-/25	-/3.09	Good-Fair*
Silver Cr, SR 1149, Burke	-/B-3	11-34	08/92	71/29	5.65/4.45	Good-Fair
Clear Cr, ab Hospital Reservoir, Burke	-/B-4	11-34-6-(1)	12/91	-/30	-/2.51	Good
Bailey Fk, SR 1102, Burke	-/B-5	11-34-8-(2)	08/92	-/24	-/3.46	Good-Fair
Upper Cr, NC181 nr Jonas Ridge, Burke	73/B-6	11-35-2-(1)	09/88	-/46	-/2.57	Excellent
Upper Cr, USFS Rd 128 (Raven Cliff Rd), Burke	74/B-7	11-35-2-(1)	03/89	-/44	-/2.62	Good
			10/88	-/34	-/3.00	Good
			09/88	-/26	-/3.68	Good-Fair
Timbered Br, USFS Rd 928, Burke	80/B-8	11-35-2-9	09/88	-/20	-/3.15	Good-Fair
Upper Cr, ab Optimists Park, Burke	75/B-9	11-35-2-(10)	09/88	108/45	4.63/3.22	Excellent
Steels Cr, USFS Rd 128, Burke	78/B-10	11-35-2-12-(1)	05/90	-/48	-/1.79	Excellent
			09/88	-/38	-/2.94	Excellent
Gingercake Cr, USFS Rd 496, Burke	81/B-11	11-35-2-12-3	05/90	-/39	-/1.72	Excellent
			10/88	-/31	-/1.40	Excellent
Buck Cr, USFS Rd, ab Steels Cr, Burke	-/B-12	11-35-2-12-4	05/90	-/40	-/1.59	Excellent
Little Fk, USFS Rd 128, Burke	10/B-13	11-35-2-12-6	09/88	-/38	-/2.61	Excellent
			03/86	102/45	3.23/2.40	Excellent
Steels Cr, ab NC 181, Burke	79/B-14	11-35-2-12-(7)	05/90	-/49	-/2.17	Excellent
			09/88	105/43	4.69/3.39	Good
Upper Cr, SR 1407, Burke	76/B-15	11-35-2-(13)	10/88	-/34	-/3.55	Good
Upper Cr, SR 1439 nr Worry, Burke	77/B-16	11-35-2-(13)	09/88	100/42	4.90/3.69	Good
Johns R, SR 1367, Caldwell	95/B-17	11-38-(1)	03/89	-/45	-/2.28	Good
Johns R, SR 1356, Caldwell	96/B-18	11-38-(9)	08/92	-/43	-/3.12	Excellent
			03/89	-/40	-/2.54	Good
			10/84	108/48	4.16/2.92	Excellent
Anthony Cr, ab Gragg, Caldwell	98/B-19	11-38-10-3	03/89	-/30	2.35	Good-Fair
Anthony Cr (= Gragg Pr), SR 1462, Caldwell	99/B-20	11-38-10	03/89	-/47	2.38	Good
Johns R, SR 1438, Burke	97/B-21	11-38-(28)	03/89	116/63	3.93/2.75	Excellent
			08/83	89/43	4.20/3.48	Excellent
Mulberry Cr, SR 1368, Caldwell	100/B-22	11-38-32-(11)	03/89	-/53	-/2.62	Excellent
Mulberry Cr, SR 1310, Caldwell	101/B-23	11-38-32-(15)	03/89	-/43	-/2.93	Good
Wilson Cr, NC 221, Avery	C1/B-24	11-38-34	07/90	65/32	2.99/1.75	Excellent
			08/88	81/37	3.26/1.67	Excellent
			07/86	67/36	2.62/1.56	Excellent
			08/84	38/20	2.85/1.45	Good
Wilson Cr, SR 1358, Caldwell	C2/B-25	11-38-34	07/91	92/50	3.76/2.67	Excellent
			03/89	-/57	-/2.19	Excellent
			07/86	106/49	3.67/2.55	Excellent
N Harper Cr, USFS Rd 58, Avery	11/B-26	11-38-34-14-2	08/86	90/43	3.54/2.24	Excellent

CTB 31, continued.

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Lower Cr, Harrisburg St, Caldwell	58/B-27	11-39-(0.5)	09/87	65/22	6.23/5.00	Fair
Lower Cr, SR 1501, Burke	D/B-28	11-39-(6.5)	08/92	55/20	6.03/4.89	Fair
			07/90	62/19	6.83/5.49	Fair
			07/87	61/18	7.00/5.06	Fair
			08/84	60/20	6.64/5.20	Fair
Zacks Fk Cr, NC 18A, Caldwell	59/B-29	11-39-1	09/87	55/19	6.22/5.55	Fair
Smoky Cr, SR 1515, Burke	-/B-30	11-41-(1)	08/92	-/30	-/3.23	Good
McGalliard Cr, Church St, Burke	-/B-31	11-44-(0.5)	08/92	66/22	5.80/4.59	Good-Fair

CTB 32

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Huffman Br, #2, be Huffman Finishing, Caldwell	12/B-1	11-(51)-1	10/84	13/0	9.12/-	Poor
Huffman Br, #3, Caldwell	12/B-2	11-(51)-1	10/84	19/1	9.19/-	Poor
Huffman Br, #3A (recovery), Caldwell	12/B-3	11-(51)-1	10/84	20/0	9.13/-	Poor
UT Huffman Br, Caldwell	12/B-4	11-(51)-1	10/84	54/15	-/-	Good?
Upper Little R, SR 1744, Caldwell	-/B-5	11-58	08/92	74/38	4.17/3.53	Good
Middle Little R, SR 1153, Alexander	-/B-6	11-62	08/92	-/32	-/4.20	Good
Duck Cr, NC 127, Alexander	-/B-7	11-62-2-(4)	08/92	-/26	-/3.61	Good-Fair
Lower Little R, SR1313, Alexander	E/B-8	11-69	07/88	88/33	5.13/3.61	Good-Fair
			08/85	53/18	5.97/5.48	Fair
Lower Little R, SR 1131, Alexander	-/B-9	11-69	08/92	70/29	4.85/4.06	Good
Muddy Fk, ab Schneider Mills, Alexander	-/B-10	11-69-4	06/92	70/19	5.73/4.65	Good-Fair
Muddy Fk, be Schneider Mills, NC 16, Alexander	-/B-11	11-69-4	06/92	66/19	6.91/5.07	Fair
Elk Shoal Cr, SR 1605, Alexander	-/B-12	11-73-(1.5)	08/92	-/15	-/5.05	Good-Fair
Lyle Cr, NC 64/70, Catawba	-/B-13	11-76-(3.5)	08/92	63/22	5.83/5.09	Good
Big Br (Rocky Cr), SR 1303, ab Troutman, Iredell	60/B-14	11-83-1-(1)	02/87	-/12	-/4.29	Good-Fair
Big Br (Rocky Cr), SR 1303, be Troutman, Iredell	61/B-15	11-83-1-(1)	02/87	-/0	-	Poor

CTB 33

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
McDowell Cr, SR 2136, Mecklenburg	114/B-1	11-115-1.5	09/90	55/15	6.84/6.02	Fair
McDowell Cr, SR 2128, Mecklenburg	115/B-2	11-115-1.5	09/90	54/17	6.57/5.50	Good-Fair
Gar Cr, SR 2074, Mecklenburg	-/B-3	11-116-(1)	08/92	86/24	5.72/4.68	Good
Dutchmans Cr, SR 1918, Gaston	P/B-4	11-119-(0.5)	08/92	77/33	5.72/4.82	Excellent
			07/88	83/34	5.47/4.73	Excellent
Leepers Cr, NC 150, Lincoln	26/B-5	11-119-1-(1)	06/84	86/30	5.14/4.32	Good
Killian Cr, SR 1511, Lincoln	-/B-6	11-119-2-(0.5)	08/92	-/28	-/5.30	Excellent

CTB 34

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Sugar Cr, SC 160, York Co., SC	F/B-1	11-137	08/92	58/21	6.92/5.77	Good-Fair
			07/91	49/14	6.91/6.24	Fair
			07/90	39/7	7.30/5.88	Fair
			07/88	53/9	8.23/6.81	Poor
			07/86	40/2	8.82/8.61	Poor
			08/84	45/9	8.30/6.49	Poor
			08/83	30/3	8.55/6.45	Poor
Irwin Cr, SR 2523, Mecklenburg	117/B-2	11-137-1	02/90	52/17	6.24/5.22	Good-Fair
Irwin Cr, Statesville Rd, ab landfill, Mecklenburg	55/B-3	11-137-1	10/84	50/13	7.58/6.41	Fair
Irwin Cr, Statesville Rd, be landfill, Mecklenburg	56/B-4	11-137-1	10/84	36/11	7.80/6.16	Fair

CTB 34, continued

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Irwin Cr, West Blvd, Mecklenburg	-/B-5	11-137-1	08/92	55/8	7.89/6.90	Poor
Irwin Cr, ab WWTP, Mecklenburg	21/B-6	11-137-1	11/83	23/2	8.61/7.39	Poor
Irwin Cr, be WWTP, SR 1156, Meck.	-/B-7	11-137-1	08/92	45/4	8.12/7.38	Poor
Stewart Cr, SR 2050, Mecklenburg	116/B-8	11-137-1-2	02/90	37/14	6.31/4.17	Fair
McCullough Br, NC 51, Mecklenburg	118/B-9	11-137-7	02/90	34/5	7.75/7.23	Poor
L Sugar Cr, SR 3657 (Archdale Rd), Mecklenburg	18/B-10	11-137-8	11/83	15/1	8.59/7.60	Poor
L Sugar Cr, NC 51, Mecklenburg	-/B-11	11-137-8	09/92	43/3	8.09/6.66	Poor
McAlpine Cr, Sardis Rd, SR 3356, Mecklenmburg	19/B-12	11-137-8	03/87	45/12	6.40/5.23	Fair
			11/83	61/12	6.92/5.97	Fair
McAlpine Cr, NC 51 ab WWTP, Meck.	-/B-13	11-137-9	08/92	55/9	7.53/6.08	Fair
McAlpine Cr, NC 521 ab WWTP, Meck	67/B-14	11-137-9	03/87	33/5	7.73/5.46	Poor
McAlpine Cr, NC 521 be WWTP, Meck.	20/B-15	11-137-9	11/83	24/3	8.83/6.70	Poor
McAlpine Cr, Dorman Rd, SC	68/B-16	11-137-9	08/92	40/11	7.31/6.68	Fair
			03/87	19/2	8.16/2.91	Poor
Walker Br, NC 49, Mecklenburg	119B-17	11-137-10-1	02/90	68/18	6.47/5.79	Good-Fair
Long Cr, SR 2042, Mecklenburg	17/B-18	11-120-(0.5)	07/89	65/17	6.44/6.02	Good-Fair

CTB 35

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
S Fk Catawba R, NC 10, Catawba	I/B-1	11-129-(0.5)	08/92	75/24	6.20/5.05	Good-Fair
			07/90	56/16	6.57/5.27	Fair
			07/88	67/24	6.25/5.07	Good-Fair
			07/86	49/12	6.59/4.68	Fair
			07/84	67/26	5.28/4.15	Good-Fair
S Fk Catawba R, NC 27, Lincoln	39/B-2	11-129-(3.5)	09/84	77/29	5.58/4.17	Good
Henry Fk, be He Cr, SR 1918, Burke	82/B-3	11-129-1-(1)	04/88	106/53	3.29/2.11	Excellent
Henry Fk, SR 1922, Burke	83/B-4	11-129-1-(2)	04/88	116/62	3.59/2.52	Excellent
Henry Fk, NC 18, Burke	84/B-5	11-129-1-(2)	04/88	127/65	3.84/2.68	Excellent
He Cr, ab water intake, Burke	85/B-6	11-129-1-4-(1)	04/88	-/45	-/2.01	Excellent
Ivy Cr, SR 1919, Burke	86/B-7	11-129-1-6	04/88	-/42	-/2.36	Good
Long Br, SR 1917, Burke	87/B-8	11-129-1-8	04/88	-/46	-/2.87	Excellent
UT Henry Fk, SR 1915, Burke	88/B-9	-	04/88	110/52	3.83/2.33	Good
Rock Cr, SR 1915, Burke	89/B-10	11-129-1-12	04/88	-/43	-/2.84	Good
Henry Fk, SR 1124, Catawba	G/B-11	11-129-1-(12.5)	08/92	74/38	4.58/3.75	Good
			07/89	64/27	4.65/4.22	Good
			07/87	73/25	5.09/4.01	Good-Fair
			07/86	79/28	5.39/3.88	Good-Fair
Henry Fk, SR 1008, be WWTP, Catawba	G/B-12	11-129-1-(12.5)	11/83	27/5	6.87/4.20	Poor
UT Henry Fk A ab Pantasote, SR 1213, Catawba	23/B-13	-	06/85	29/8	6.34/4.23	Fair
UT Henry Fk A be Pantasote, SR 1213, Catawba	24/B-14	-	06/85	31/7	6.24/2.71	Fair
UT Henry Fk B (control), SR 1148, Burke	65/B-15	-	02/87	-/36	-/2.13	Excellent
UT Henry Fk C (ab Neuville), 64 Bypass, Burke	62/B-16	-	02/87	-/0	-/-	Poor
UT Henry Fk C, be discharge, Burke	63/B-17	-	02/87	-/5	-/5.96	Poor
UT Henry Fk C, recovery, I-40, Burke	64/B-18	-	02/87	-/17	-/3.40	Good-Fair
Jacob Fk, S Mts St Pk, Burke	121/B-19	11-129-2-(1)	05/90	-/42	-/2.49	Excellent
Jacob Fk, SR 1904, Burke	122/B-20	11-129-2-(1)	05/90	-/42	-/2.31	Excellent
Jacob Fk, SR 1924, Burke	H/B-21	11-129-2-(1)	08/92	104/48	4.48/3.32	Excellent
			10/90	102/50	3.95/2.60	Excellent
			07/90	92/45	4.77/4.01	Excellent
			05/90	-/48	-/2.56	Excellent
			01/90	86/55	3.41/2.87	Excellent
			07/87	96/35	4.96/3.76	Good
			08/85	75/32	5.14/3.99	Good-Fair

CTB 35, continued.

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Shinny Cr, (S Mts St Pk), Burke	120/B-22	11-129-2-3	05/90	-/41	-/2.13	Excellent
Jacob Fk, NC 27, Catawba	41/B-23	11-129-2-(9.5)	11/83	79/35	**	Good
Jacob Fk, SR 1139, Catawba	42/B-24	11-129-2-(9.5)	11/83	69/23	**	Good-Fair
Hop Cr, SR 1131, Catawba	23/B-25	11-129-2-14	06/85	86/36	4.56/3.44	Good
Howards Cr, SR 1200, Lincoln	-/B-26	11-129-4	08/92	-/25	-/4.33	Good
Clark Cr, SR NC 64, Catawba	27/B-27	11-129-5-0.3	09/84	57/15	6.14/5.15	Good-Fair
Clark Cr, SR 1149, Catawba	28/B-28	11-129-5-0.3	08/92	-/16	-/5.74	Good-Fair
			09/84	60/16	6.6 5/5.81	Good-Fair
Clark Cr, SR 2014, ab Newton WWTP, Catawba	25/B-29	11-129-5-0.3	09/90	50/13	7.16/6.46	Fair
			09/84	59/15	6.79/6.17	Fair
			06/84	59/16	6.25/5.80	Good-Fair
Clark Cr, SR 2012,be Newton WWTP, Catawba	25/B-30	11-129-5-0.3	09/90	40/6	7.11/5.33	Fair
			09/84	64/19	7.11/6.26	Good-Fair
			06/84	46/14	6.51/5.81	Good-Fair
Clark Cr, SR 1274, Catawba	31B-31	11-129-5-(4.5)	09/84	70/16	6.92/6.06	Fair
Clark Cr, SR 1008, Lincoln	J/C8-32	11-129-5-(4.5)	08/92	48/10	6.67/5.63	Fair
			07/88	54/11	6.78/6.11	Fair
			08/85	48/13	7.14/6.25	Fair
			09/84	79/27	6.62/5.40	Good
			11/83	38/9	**	Fair
Cline Cr, SR 1164, Catawba	33/B-33	11-129-5-2	09/84	50/11	7.16/6.21	Fair
Maiden Cr, NC 207, Catawba	34/B-34	11-129-5-7-2-(3)	09/84	86/18	6.55/5.76	Good-Fair
Shady Br, be Maiden, SR 2005, Catawba	35/B-35	11-129-5-7-3	09/84	32/1	8.86/7.37	Poor
Carpenter Cr, NC 321, Lincoln	36/B-36	11-129-5-9	09/84	85/30	4.94/4.61	Excellent
Walker Cr, SR 1405, Lincoln	37/B-37	11-129-5-10	09/84	75/18	7.09/6.11	Good-Fair
Indian Cr, SR 1252, Lincoln	K/B-38	11-129-8-(5)	08/92	79/29	6.06/5.38	Good
			07/90	72/25	6.19/5.44	Good-Fair
			07/87	67/18	6.33/5.52	Good-Fair
			07/86	77/18	6.58/5.40	Good-Fair
		11/83	50/6	6.90/5.36	Fair	
			08/83	51/12	6.39/6.00	Good-Fair
Hoyle Cr, SR 1836, Gaston	46/B-39	11-129-15-(4)	11/83	50/15	6.12/4.88	Good-Fair

CTB 36

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
S Fk Catawba R, SR 2003, Spencer Mtn, Gaston	M/B-1	11-129-(15.5)	08/83	49/19	6.51/5.65	Good-Fair
S Fk Catawba R, NC 7, McAdenville, Gaston	M/B-2	11-129-(15.5)	08/92	63/18	6.70/5.40	Good-Fair
			07/89	62/15	6.32/4.72	Good-Fair
			07/87	65/23	6.50/5.43	Good-Fair
			08/85	55/16	7.02/5.34	Fair
			11/83	37/2	7.82/5.64	Poor
Long Cr 1A, SR 1408, Gaston	-/B-3	11-129-16-(2.3)	04/92	81/29	5.28/4.39	Good
Long Cr 1, SR 1405, Gaston	-/B-4	11-129-16-(2.3)	04/92	-/22	-/5.07	Good-Fair
		04/91	89/29	5.63/4.70	Good	
Long Cr 2A, NC 274, Gaston	-/B-5	11-129-16-(4)	04/92	79/19	5.82/5.22	Good-Fair
		04/91	90/24	6.35/4.92	Good-Fair	
Long Cr 5A, SR 1446, Gaston	-/B-6	11-129-16-(4)	04/92	76/24	6.20/5.40	Good-Fair
			04/91	70/23	5.52/4.68	Good
Long Cr 6, SR 1448, Gaston	-/B-7	11-129-16-(4)	04/92	80/23	5.82/5.15	Good
		04/91	86/30	5.83/5.04	Good	
Long Cr 8A, NC 275, Gaston	-/B-8	11-129-16-(4)	04/92	72/20	6.36/5.47	Good-Fair
		04/91	84/21	6.26/5.17	Good-Fair	
Long Cr, SR 1456, Gaston	L/B-9	11-129-16-(4)	07/90	67/18	6.42/5.39	Good-Fair
			07/87	71/19	6.59/5.61	Good-Fair
			08/84	62/17	6.25/5.44	Good-Fair

CTB 36 continued

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Long Cr, SR 2003 be WWTP, Gaston	102/B-10	11-129-16-(4)	07/90	54/14	7.33/6.30	Fair
			11/83	20/3	8.61/4.93	Poor
Dallas Br, ab Dallas WWTP, Gaston	-/B-11	11-129-16-7	06/92	42/10	6.45/6.11	Good-Fair
Dallas Br, be Dallas WWTP, SR 2275, Gaston	-/B-12	11-129-16-7	06/92	39/8	7.60/6.40	Fair
UT Long Cr 5, SR 1446, Gaston	-/B-13	-	04/91	76/25	5.46/4.39	Good
UT Long Cr 8, SR 1456, Gaston	-/B-14	-	04/91	55/26	4.44/4.25	Good

CTB 37

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba Cr, SR 2446 ab WWTP, Gaston	49/B-1	11-130	07/90	42/10	6.94/6.66	Fair
			05/85	55/16	7.09/6.13	Fair
Catawba Cr, SR 2439 be WWTP, Gaston	50/B-2	11-130	07/90	43/1	8.12/7.40	Poor
			05/85	38/5	8.55/6.07	Poor
Catawba Cr, SR 2435, Gaston	51/B-3	11-130	05/85	43/6	8.44/6.50	Poor
Crowders Cr, SR 1118, Gaston	103/B-4	11-135	09/89	50/14	6.02/4.73	Good-Fair
Crowders Cr, SR 1125, Gaston	104/B-5	11-135	09/89	55/13	7.07/6.11	Fair
Crowders Cr, SR 1131, Gaston	105/B-6	11-135	09/89	46/7	7.69/7.00	Fair
Crowders Cr, NC 321,Gaston	106/B-7	11-135	09/89	46/10	6.81/5.64	Fair
Crowders Cr, SR 2424,Gaston	107/B-8	11-135	09/89	51/15	6.86/5.87	Fair
Crowders Cr, SC 564 York Co., SC	Q-B-9	11-135	08/92	66/18	6.55/5.65	Good-Fair
		09/89	61/15	6.83/6.13	Fair	
			07/88	43/4	8.30/7.50	Poor
McGill Cr, ab WWTP, Gaston	108/B-10	11-135-2	09/89	-/4	-/7.43	Poor
McGill Cr, be WWTP, SR 1300, Gaston	109/B-11	11-135-2	09/89	-/6	-/7.09	Poor
Abernethy Cr, ab UT, SR 1302, Gaston	70/B-12	11-135-4	09/89	-/12	-/4.93	Fair
			06/87	67/13	7.40/5.81	Fair
Abernethy Cr, be UT, Gaston	71/B-13	11-135-4	09/89	-/4	-	Poor
			06/87	43/4	7.78/7.53	Poor
Abernethy Cr, ab Bessemer City WWTP, Gaston	-/B-14	11-135-4	09/89	-/3	-/6.90	Poor
Abernethy Cr, be WWTP, Gaston	110/B-15	11-135-4	09/89	-/1	-/6.57	Poor
UT Abernethy be Lithium, Gaston	72/B-16	-	06/87	25/0	7.90/-	Poor
S Crowders Cr, SR 1103, Gaston	52/B-17	11-135-10-1	05/85	89/31	5.31/4.41	Good-Fair
S Crowders Cr, SR 1109, Gaston	111/B-18	11-135-10-1	09/89	-/16	-/5.56	Good-Fair
UT Crowders Cr, SR 2416, Gaston	112/B-19	-	09/89	-/11	-/6.62	Fair

CTB 38

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Twelvemile Cr, NC 16, Union	S/B-1	11-138	02/90	-/30	-/4.93	Good-Fair
			07/89	71/20	6.25/5.37	Good-Fair
			11/83	50/7	7.15/6.33	Fair
Sixmile Cr, SR 3445, Mecklenburg	69/B-2	11-138-3	03/87	67/22	5.26/3.58	Good-Fair
Waxhaw Cr, SR 1103, Union	54/B-3	11-139	08/92	-/14	-/5.53	Good-Fair
			11/83	38/6	6.82/5.39	Fair

FISHERIES

To the public, the condition of the fishery is one of the most meaningful indicators of water quality. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web will affect the abundance, species composition, and condition of the fish population.

FISH COMMUNITY STRUCTURE METHODS

The North Carolina Index of Biotic Integrity (NCIBI) is a modification of Karr's IBI (1981) which was developed as a method for assessing a streams biological integrity by examining the structure and health of its fish community. The index incorporates information about species richness and composition, trophic composition, fish abundance and fish condition.

The NCIBI summarizes the effects of all classes of factors influencing aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While any change in a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicates additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

The assessment of biological integrity using IBI is provided by the cumulative assessment of 12 parameters, or metrics. The values provided by the metrics are converted into scores on a 1, 3, 5 scale. A score of 5 represents conditions expected for undisturbed streams in the area, while a score of 1 indicates that the conditions vary greatly from those expected in undisturbed streams of the region. The scores for each metric are summed to attain the overall IBI score.

Each metric is designed to contribute unique information to the overall assessment. A discussion of each metric is presented below; some metrics have been grouped together.

1. The total number of species and individuals supported by streams of a given size in a given region decrease with environmental degradation.
2. Darters are sensitive to environmental degradation particularly as a result of their specific reproductive and habitat requirements. Darter habitats are degraded as a result of channelization, siltation, and reduced oxygen levels. Collection of fewer than expected darter species can indicates that some habitat degradation is occurring.
3. Sunfish species are used because they are particularly responsive to degradation of pool habitats and to other aspects of habitat degradation like quality of instream cover.
4. Sucker species are intolerant of habitat and chemical degradation and, because they are long lived, provide a multiyear integrated perspective.
5. Intolerant species are those which are most effected by environmental perturbations and therefore should have disappeared, at least as viable populations, by the time a stream is degraded to a fair rating.
6. Tolerant species are those which are often present in a stream in moderate numbers, but as the stream degrades they tend to dominate.
7. The three trophic composition metrics, proportion of omnivores, insectivores, and piscivores, are used to measure the divergence from expected production and consumption patterns in the fish community that can result from environmental degradation. The main cause for a shift in the trophic composition of the fish community (a greater proportion of omnivores and few insectivores) is nutrient enrichment.

8. The proportion of fish with disease, tumors, fin damage, and skeletal anomalies increases as a stream is degraded. The length distribution metric measures the amount of reproduction which is occurring in the community by looking at the number of age groups, determined by length range, present for each species.

A field methodology for fish collections to be used for NC IBI is included in the standard operating procedures of the NC Division of Environmental Management (NCDEM, 1989). A representative section of stream, 600 feet in length, is selected, measured, and blocked at the upstream and downstream ends with small mesh nets. The stream is then sampled with one or two backpack electrofishing units depending upon stream width. After collection, the fish are examined for sores, lesions, fin damage, and skeletal anomalies and preserved in 10% formalin. Once preserved the fish are identified to species, length recorded, and batch weighed by species.

Streams with larger watersheds or drainage areas can be expected to support more fish species and a larger number of fish. Figures 1 and 2 represent the relative number of species and number of fish that can be expected in the North Carolina river basins.

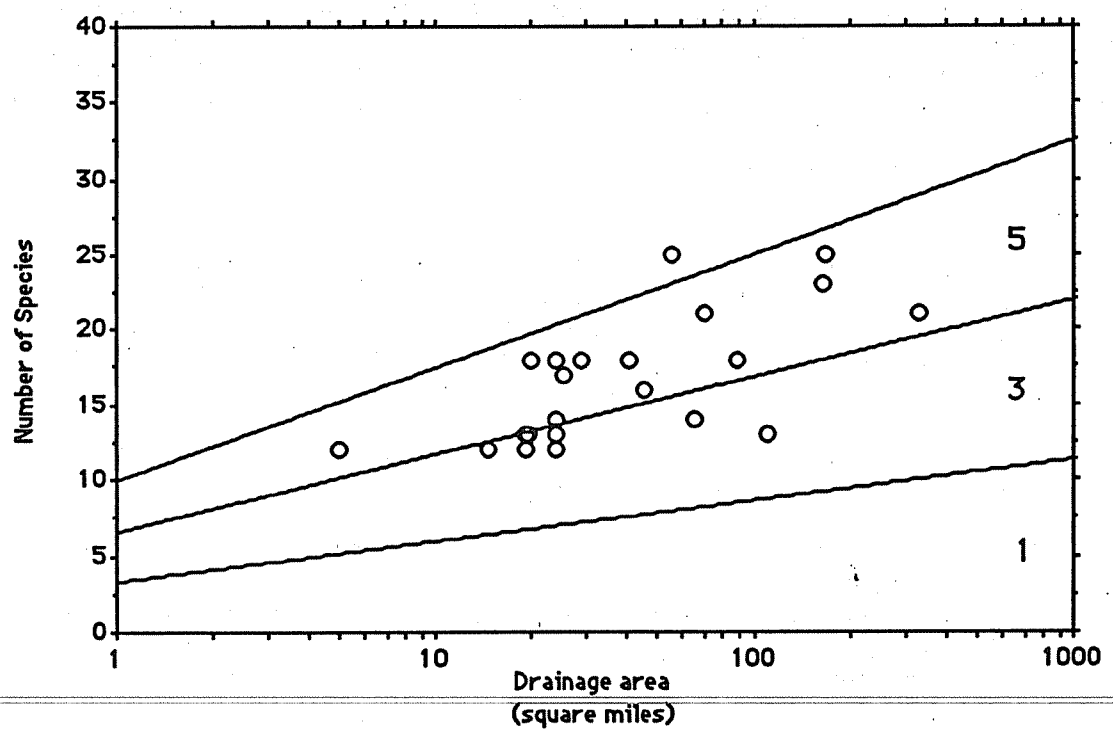

Figure 1. Expectations of the Number of Species based upon Drainage Area Size

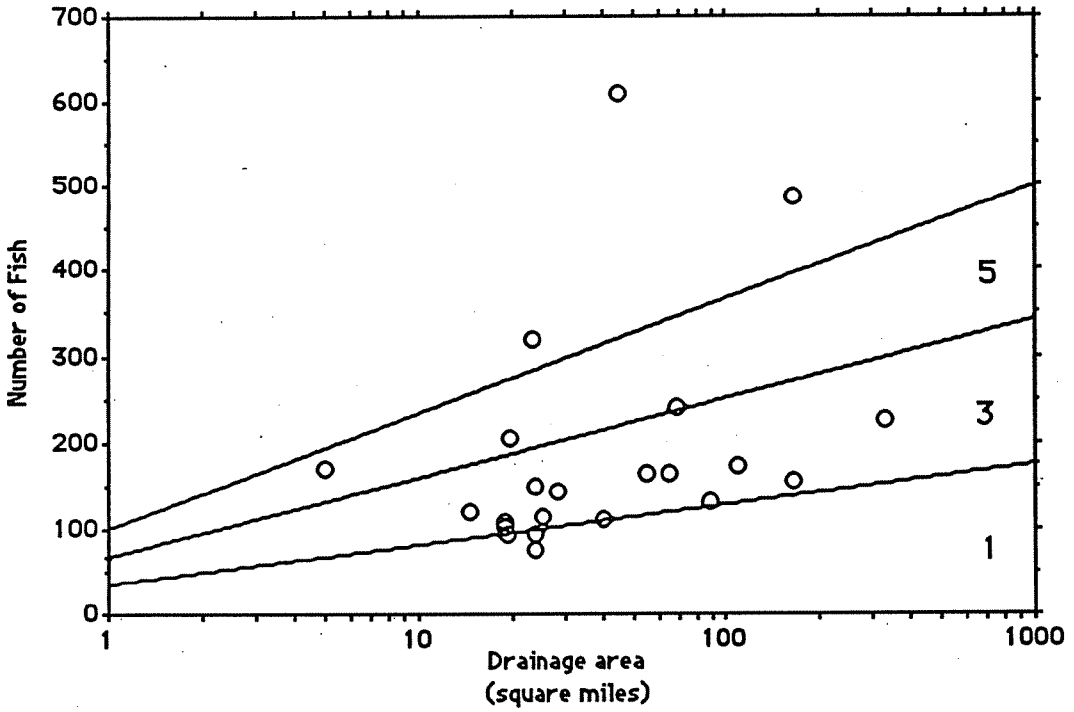

Figure 2. Expectations of the Number of Fish based upon Drainage Area Size

FISH TISSUE

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Therefore, by analyzing fish tissue, determinations about what chemicals are in the water can be made. Once contaminants reach surface waters, they may be available for bioaccumulation either directly or through aquatic food webs and may accumulate in fish and shellfish tissues. Thus results from fish tissue monitoring can serve as an important indicator of further contamination of sediments and surface water. Fish tissue analysis results are also used as indicators for human health concerns and fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem. Contamination of aquatic resources, including freshwater, estuarine, and marine fish and shellfish species have been documented for heavy metals, pesticides, and other complex organic compounds.

In evaluating fish tissue analysis results, several different types of criteria are used. Currently human health concerns related to fish consumption are screened by comparing results with Federal Food and Drug Administration (FDA) action levels. The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue parameters accompanied by their FDA criteria are presented below. Individual parameters which appear to be of potential human health concern are evaluated by the N.C. Division of Epidemiology by request of the Water Quality Section.

Metals

	FDA		FDA
Cadmium	None	Chromium	None
Nickel	None	Lead	None
Copper	None	Arsenic	None
Mercury	1.0 mg/kg	Selenium	None

Synthetic Organics

	FDA		FDA
Aldrin	0.3 mg/kg	o,p DDD	5.0 mg/kg
Dieldrin	0.3 mg/kg	p,p DDD	5.0 mg/kg
Endrin	0.3 mg/kg	o,p DDE	5.0 mg/kg
Methoxychlor	None	p,p DDE	5.0 mg/kg
Alpha BHC	None	o,p DDT	5.0 mg/kg
Gamma BHC	None	p,p DDT	5.0 mg/kg
PCB-1254	2.0 mg/kg	cis-chlordane	3.0 mg/kg
Endosulfan I	None	trans-chlordane	3.0 mg/kg
Endosulfan II	None	Hexachlorobenzene	None

The USEPA is currently developing screening values for target analytes which are formulated from a risk assessment procedure. The EPA screening value for a particular analyte is the concentration of that analyte in edible fish tissue that is associated with a maximum limit of acceptable health risk to the general population or subpopulation of concern.

LAKES ASSESSMENT PROGRAM

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lake Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed. Data are used to determine each lake's trophic status-a relative measure of nutrient enrichment and productivity, and whether the lake's uses have been threatened or impaired by pollution.

Tables presented in each subbasin summarize data used to determine the trophic status and use support status of each lake. These determinations are based on information from the most recent summertime sampling (date listed). The most recent North Carolina Trophic State Index (NCTSI) value is shown, followed by the descriptive trophic state classification (O=oligotrophic, M=mesotrophic, E=eutrophic, H=hypereutrophic, D=dystrophic).

Numerical indices are often used to evaluate the trophic status of lakes. An index was developed specifically for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NRCD 1982). The North Carolina Trophic State Index (NCTSI) is based on total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), Secchi depth (SD in inches), and chlorophyll-a (CHL in µg/l). Lakewide means for these parameters are integrated to produce a NCTSI score for each lake, using the following equations:

$$\text{TON score} = \frac{\text{Log(TON)} + (0.45)}{0.24} \times 0.90$$

$$\text{TP score} = \frac{\text{Log(TP)} + (1.55)}{0.35} \times 0.92$$

$$\text{SD score} = \frac{\text{Log(SD)} - (1.73)}{0.35} \times -0.82$$

$$\text{CHL score} = \frac{\text{Log(CHL)} - (1.00)}{0.43} \times 0.83$$

$$\text{NCTSI} = \text{TON score} + \text{TP score} + \text{SD score} + \text{CHL score}$$

In general, NCTSI scores relate to trophic classifications as follows: less than -2.0 is oligotrophic; -2.0 to 0.0 is mesotrophic; 0.0 to 5.0 is eutrophic; and greater than 5.0 is hypereutrophic. When scores border between classes, best professional judgment is used to assign an appropriate classification. NCTSI scores are also skewed by the highly colored water typical of dystrophic lakes. These acidic, "black-water" lakes are scattered throughout the coastal plain, often located in swampy areas or overlying peat deposits.