ATTACHMENT A
Report Approval Form

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Document Review and Approval

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Ecological Field Observations Harris Nuclear Plant

Prepared for

Progress Energy Carolinas

CH2MHILL

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1.0 Terrestrial Ecology

1.1 Introduction

CH2M HILL conducted a site investigation during the week of August 14, 2006 to characterize the habitats that occur between elevations 220 feet and 240 feet surrounding Harris Reservoir at the Shearon Harris Nuclear Plant in North Carolina. These habitats were characterized as a baseline for analysis to determine the impacts that would result from raising the elevation of the reservoir to 240 feet.

CH2M HILL biologists did not observe any important terrestrial aquatic or vegetative species during an informal survey of the area.

1.2 Forest Community

The land within the proposed location for HAR 2 and HAR 3 is not conducive for wildlife habitat. The woodlots within the area are managed for timber. HAR 2 is proposed for an area that is primarily paved and gravel covered with mowed vegetation consisting of non-native grasses and lawn weeds. Limited numbers of native pioneering species exist in this area. The area proposed for HAR 3 has been cut and replanted to loblolly pine within the last 5 years.

The land surrounding Harris Reservoir between 220 and 240 feet elevation consists primarily of forested land, with minor open areas for boat access and utility transmission rights-of-way. Forests surrounding Harris Reservoir consist of hardwood regrowth forest, and loblolly pine plantation. Where streams with relatively broad valleys extended away from the reservoir, bottomland hardwood or alluvial forests occur. Wetlands occurred around the reservoir where beaver activity had created impounded water and also where there were generally level areas just above the 220 foot elevation. At the 220 foot elevation contour, there are numerous shallow wetland areas that fringe the lake that are within the normal pool of the reservoir.

The topography near the dam is rather steep on both sides. To the south and west of the dam the land is forested and a historic roadbed cuts through the area creating steep slopes to either side. Forest is primarily mixed pine-hardwood, giving way to sub-xeric hardwood on upper slope positions. To the east and north of the dam vegetation is similar to that on the opposite side of the dam, although this area appears to have been burned in early 2006 and is thus more open.

1.2.1 Hardwood Forest Areas

Hardwood forests of three types occur around Harris Reservoir: Mesic Mixed Hardwood Forest - Piedmont Subtype, Dry-Mesic Oak-Hickory Forest, and Dry Oak-Hickory Forest (Schafale and Weakley, 1990). These habitat types are discussed separately. These three hardwood forest types are considered common in North Carolina and throughout the region (NC Natural heritage Program, 2006).

Hardwood forest areas occurred in various age conditions ranging from recently clearcut (lacking almost all vegetation except for scattered seed trees and with extensive logging debris remaining on the ground), early successional (clearcut areas with dense stands of shrubs, saplings, and ruderal herbaceous plants), early regrowth (relatively small trees with diameter at breast height averaging 8 to 12 inches but with closed canopy), and mature regrowth (large trees with diameter at breast height greater than 12 inches. Early regrowth and mature area had similar composition of woody species, but the younger stands would typically have a more vigorous groundcover. No areas around Harris Reservoir appeared to contain virgin timber and all appeared to have been harvested or cleared for other purposes in the past.

Around the reservoir, the Piedmont Subtype of Mesic Mixed Hardwood Forest is dominated by American beech (*Fagus grandifolia*), northern red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*) and red maple (*Acer rubrum* var. *rubrum*). The understory contained flowering dogwood (*Cornus florida*), American holly (*Ilex opaca*), hophornbeam (*Ostrya virginiana)* and young trees of the overstory components. Ground cover included strawberry bush (*Euonymous americana*), Christmas fern (*Polystichum acrostichoides*), little brown jugs (*Hexastylis arifolia*), and scattered grasses (*Dichanthelium* spp.). Some areas had been invaded by Nepal grass (*Microstegium vimineum*).

Dry-Mesic Oak-Hickory Forest was dominated by white oak (*Quercus alba*) northern red oak, black oak (*Quercus velutina*), sweet pignut hickory (*Carya ovalis*) and mockernut hickory (*Carya alba*). Loblolly pine (*Pinus taeda*), sweetgum (*Liquidambar styraciflua*), and tulip poplar also were common components of the overstory, although these species were never dominant in mature or late regrowth stands. Flowering dogwood and sourwood (*Oxydendrum arboreum*) were the major understory species. Blueberries (*Vaccinnium* spp.), spotted wintergreen (*Chiamphila maculata*), rattlesnake plantain (*Goodyera pubescens*), poison ivy (*Toxicodendron radicans*), and grapes *(Vitis* spp.) provided most of the ground cover.

Dry Oak-Hickory Forest was limited to the northwestern portion of the site and was dominated by white oak, southern red oak (*Quercus falcata*), and mockernut hickory. Loblolly pine and sweetgum occurred commonly but were not dominant species. Flowering dogwood and sourwood were the major understory species. Blueberries (*Vaccinnium* spp.), spotted wintergreen (*Chiamphila maculata*), goat rue (*Tephrosia virginiana*), poison ivy, and grapes provided most of the ground cover.

Early successional areas typically were dominated by dense growth of sapling sweetgum, tulip poplar, red maple, and black cherry (*Prunus serotina*). Blackberries (*Rubus* spp.), wingstem (*Verbesina alternifolia*), horseweed (*Conyza canadensis*), and common and giant ragweed (*Ambrosia artemisiifolila* and *A. tridentata*) also were abundant in these areas.

1.2.2 Loblolly Pine Plantation Areas

Loblolly pine has been planted around Harris Reservoir in areas that have been logged and placed into timber production. As with the fringe wetland areas around the reservoir, overstory communities of loblolly pine monoculture do not occur naturally in North Carolina, but loblolly pine can occur naturally as a component of other forest types (Schafale and Weakley, 1990).

Loblolly stands range from those planted within the past 5 years to stands in excess of 25 years of age. Loblolly pine is the only dominant tree in these areas, but in areas where timber management has not been implemented, young hardwood species including sweetgum, tulip poplar, red maple, and sycamore (*Platanus occidentalis*) have begun to establish beneath the pines. In young pine stands, blackberries and cat-briers (*Smilax* spp.) are frequently encountered. Occasionally, there were small clusters of longleaf pine (*Pinus palustris*) among the loblolly pines, either remnants of historic Piedmont longleaf pine communities, now considered critically imperiled in north Carolina (NC Natural heritage Program, 2006) or the result of seedling identification error at the tree nursery. Typically, plantation pine areas do not extend to the edge of Harris Reservoir. A strip of hardwood forest or pine/hardwood forest would remain adjacent to the waters edge.

The Holleman's Crossroads slopes are a series of narrow ridges and ravines along the edge of Harris Reservoir just north of Holleman's Crossroads and SR 1130. Most of the slopes support mature hardwoods, and chalk maple (*Acer leucoderme*), which is rare in the eastern Piedmont, is common here (NCDENR 2006a). The Utley Creek slopes are located immediately south of Utley Creek and east of Holleman's Crossroads slopes. Much of this area consists of mature hardwood forests along north-facing slopes, especially dry oak-hickory forest, which is not usually found in large stands in Wake County. Several slopes contain Virginia spiderwort (*Tradescantia virginiana*), which is rare in Wake County (NCDENR 2006a). The Jim Branch/Buckhorn Creek forests lie approximately two miles south of the Holleman's Crossroads slopes. This natural area consists of two separate portions: slopes along Buckhorn Creek, and slopes along Jim Branch. Both areas contain mature mesic mixed hardwood forest and dry-mesic oak-hickory forests (NCDENR 2006a).

1.2.3 Alluvial Forest Areas

Forests have developed in the alluvial floodplain along some of the larger drainages that apparently experience frequent flood events. These forest areas are classified as Piedmont/ Mountain alluvial forest by Schafale and Weakley (1990). This forest type is considered common in North Carolina and throughout the region (NC Natural heritage Program, 2006).

All of these areas had open understories and had extensive deposits of sand extending to well away from the stream channel. Typical overstory species included red maple, river birch (*Betula nigra*), tulip poplar, sweetgum, green ash (*Fraxinus pennsylvanica*), and bitternut hickory (*Carya cordiformis*). Sycamores would occur along the channel, but typically would not extend away from the channel. Understory species include saplings of the overstory components and also boxelder (*Acer negundo*), American holly, and inland American hornbeam (*Carpinus caroliniana* var. *virginianum*). Ground cover included the shrubs pawpaw (*Asimina tril*oba), hazelnut (*Corylus cornuta*), and spicebush (*Lindera benzoin*) as well as herbaceous plant and vines: wood oats *(Chasmanthium latifolium* and *C. laxum*), false nettle (*Boehmeria cylindrica*), Christmas fern, orange jewelweed (*Impatiens capensis*), cat-briers, poison ivy, Virginia creeper (*Parthenocissus quinquefolia*) and various grapes. Some areas had infestations of Japanese honeysuckle (*Lonicera japonica*) and Nepal grass ranging from moderate to severe.

1.2.4 Bottomland Forest Areas

Bottomland forest areas are considered Piedmont/Mountain bottomland forest by Schafale and Weakley (1990). This forest type is considered possibly rare or uncommon in North Carolina but common throughout the region (NC Natural heritage Program, 2006).

These areas had more dense understories than the alluvial forest areas. Overstory species included cherrybark oak (*Quercus pagoda*), sugarberry (*Celtis laevigata*), naturally occurring loblolly pine, tulip poplar, green ash, and sweetgum. The understory consisted of sapling of the species in the overstory layer plus boxelder, American holly, inland American hornbeam. Ground cover was similar to the alluvial forests with the addition of extensive patches of giant cane (*Arundinaria gigantea*) and the presence of many sedges (*Carex* spp.). In addition to encroachment by Japanese honeysuckle and Nepal grass, bottomland forest areas also were being invaded by Chinese privet (*Ligustrum sinense*).

1.2.5 Marsh Areas

Harris Reservoir provides some limited marsh habitat in shallow backwaters. These marshes and adjacent shallows are used by waterfowl such as the mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), and Canada goose (*Branta canadensis*), and wading birds such as herons and egrets. A great blue heron (*Ardea herodias*) rookery had been noted in the past at the mouth of Jim Branch in the southeastern portion of Harris Reservoir, an area that was not observed during this sampling effort.

Makeup Water Pipeline

The proposed makeup water pipeline ROW crosses two primary habitat types, old field community and forest. The existing transmission line ROW was cleared of woody vegetation beyond the sapling stage and is regularly maintained as an old field community. The forested area adjacent to the roadway consists of mixed-age hardwoods primarily composed of early re-growth and mature re-growth

1.3 Wetlands

Wetlands that occurred in the zone between 220 and 240 feet elevation around Harris Reservoir included:

- forested flatlands
- beaver impoundments
- isolated roadbed wetlands

Forested flatlands were wooded wetlands that occurred in the relatively broad stream valleys immediately upstream of Harris Reservoir. These areas receive frequent overbank flooding and typically are dominated by river birch, black willow, swamp red maple (*Acer rubrum* var. *trilobum*), and green ash in the canopy layer. Buttonbush (*Cephalanthus occidentalis*) and hazel alder (*Alnus serrulata*) commonly occurred as shrubs, along with saplings of the overstory dominants. Soft rush (*Juncus effusus*), fringed sedge (*Carex crinita*), greater bladder sedge (*Carex intumescens*), longhair sedge (*Carex comosa*), three-ranked sedge (Dulichium arundinaceum) and the exotic Asian dayflower (*Murdannia keisak*) provide a dense groundcover in these wetlands. Woolgrass (*Scirpus cyperinus*) occurs frequently in more open areas. All forested flatlands are classified as palustrine forested wetlands according to the US FWS system (Cowardin et al., 1979).

Beaver impoundments were of two types: active beaver impoundments and abandoned beaver impoundments. The two types of beaver impoundments are classified differently (Cowardin et al., 1979). Active beaver impoundments contain riverine systems of standing water lacking emergent vegetation (Riverine permanently flooded impoundment) and also had fringing wetland vegetation typically comprising buttonbush, hazel alder, soft rush, and woolgrass. These fringing areas are considered palustrine emergent or palustrine scrub-shrub wetlands depending on the dominant vegetation. Abandoned beaver impoundments are considered palustrine wetlands and all observed around Harris Reservoir are scrub-shrub wetlands.

One isolated wetland was identified within an abandoned roadbed near the dam and spillway of Harris Reservoir. This wetland was contained entirely within the abandoned roadbed that increased in elevation on either side of the wetland. There was no connection to the pool of Harris Reservoir. This wetland contained sedges (*Carex* spp.), Asian dayflower, and extensive mats of sphagnum moss (*Sphagnum* sp.).

1.3.1 Harris Reservoir Fringe Wetland Areas

In areas where gentle slopes or generally level benches occur at or just below the 220 foot contour, lacustrine littoral emergent wetlands (Cowardin et al., 1979) occur periodically around the lake. Such wetlands are not natural in North Carolina, occurring only in man-made impoundments (Schafale and Weakley, 1990). These wetland areas typically are vegetated with broadleaf cat-tail (*Typha latifolia*), pepperweed (*Polygonum hydropiperoides*), lizard's tail (*Saururus cernuus*), woolgrass (*Scirpus cyperinus*), and spike rushes (*Eleocharis obtusa*). Frequently Brazilian waterweed (*Ergeria densa*) occurs as a submerged component of these wetlands. River birch, buttonbush, and black willow commonly occur at the 220 foot contour.

The proposed project will result in the loss of approximately 117 acres of forested, emergent, and scrub-shrub wetlands as a result of the increased surface elevation of the reservoir. This project will inundate 6 emergent wetlands (6.5 acres), 1 emergent/scrub-shrub wetland (5.0 acres), and 21 forested wetlands (105.8 acres). In addition, a riverine wetland along the Cape Fear River would be impacted temporarily by trenching to install the water line. This wetland is typically inundated and dominated by sweetflag. This wetland would quickly recover following installation of the water line because it spreads through propagation of rhizomes. A second wetland occurs surrounding a pond in the existing cleared utility right-of-way; this wetland is composed of open water with a narrow fringe of sedges.

Table 1. Wetlands Inundated by Raising the Reservoir Level to 240 feet msl
Progress Energy Biological Assessment

Wetland Number	Wetland Type	Acreage	Project Impacts
W01	PEM	0.07	Inundated
W02	PFO	0.07	Inundated
W03	PFO	0.45	Inundated
W04	PFO	0.95	Inundated

W05	PEM	0.18	Inundated
W06	PEM	1.60	Inundated
W07	PFO	13.42	Inundated
W08	PEM/SS	4.98	Inundated
W09	PFO	2.09	Inundated
W10	PEM	0.75	Inundated
W11	PFO	14.62	Inundated
W12	PFO	4.37	Inundated
W13	PFO	3.29	Inundated
W14	PFO	0.14	Inundated
W15	PFO	23.99	Inundated
W16	PFO	1.27	Inundated
W17	PFO	10.37	Inundated
W18	PFO	1.92	Inundated
W19	PFO	2.48	Inundated
W20	PFO	3.74	Inundated
W21	PFO	6.08	Inundated
W22	PFO	3.03	Inundated
W23	PFO	1.43	Inundated
W24	PFO	10.53	Inundated
W25	PFO	1.48	Inundated
W26	PEM	3.45	Inundated
W27	PFO	0.09	Inundated
W28	RUB	1.62	Temporary disturbance from trenching to install water line
W29	PEM	0.48	Inundated

Increasing the elevation of the reservoir from 220 to 240 feet would result in inundation of approximately 89, 450 linear feet of ephemeral stream channel along 139 drainages (Table 2), approximately 96,860 linear feet of intermittent stream channel along 103 drainages (Table 3), and approximately 171,490 linear feet of perennial stream along 59 drainages (Table 4).

Construction of the water line from the Cape Fear River would cross seven streams, with impacts limited to the temporary effects of trenching to place the pipe. After construction, the stream bottoms would be returned to pre-disturbance contours. The seven streams include two ephemeral channels, four intermittent channels, and one perennial channel.

Table 2. Ephemeral Streams Inundated by Raising the Reservoir Level to 240 feet msl
Progress Energy Biological Assessment

Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated
E001	452	E049	611	E094	339
E002	298	E050	584	E095	466
E003	530	E051	283	E096	441
E004	296	E052	234	E097	251
E005	639	E053	234	E098	232
E006	519	E054	879	E099	594
E007	586	E055	377	E100	710
E008	878	E056	396	E101	867
E009	334	E057	661	E102	677
E010	375	E058	488	E103	653
E011	366	E059	247	E104	621
E012	467	E060	627	E105	633
E013	738	E061	958	E106	539
E014	955	E062	285	E107	454
E015	1,756	E063	322	E108	32
E016	1,526	E064	304	E109	330
E017	871	E065	679	E110	253
E018	932	E066	289	E111	220
E019	625	E067	276	E112	568
E020	718	E068	2,294	E113	752
E021	1,124	E069	849	E114	159
E022	1,004	E070	305	E115	151
E023	1,062	E070	950	E116	115
E024	528	E071	1,817	E117	170
E025	1,176	E072	912	E118	155
E026	1,575	E073	402	E119	364
E027	263	E074	1,475	E120	562
E028	1,166	E075	1,347	E121	436
E029	1,702	E076	1,604	E122	189
E030	784	E077	1,320	E123	144
E031	716	E078	1,103	E124	304
E033	563	E079	995	E125	467
E034	1,184	E080	778	E126	188
E035	994	E081	683	E127	286
E036	640	E082	518	E128	653
E037	835	E083	987	E129	226
E038	763	E084	839	E130	439
E039	507	E085	1,042	E131	121
E040	587	E086	964	E132	213
E041	571	E087	1,210	E133	563
E042	272	E088	1,008	E134	345

Table 2. Ephemeral Streams Inundated by Raising the Reservoir Level to 240 feet msl
Progress Energy Biological Assessment

Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated
E043	605	E089	1,204	E135	694
E044	593	E090	523	E136	222
E045	497	E091	675	E137	381
E046	724	E092	765	E138	256
E047	871	E093	467	E141	479
E048	607				

Table 3. Intermittent Streams Inundated by Raising the Reservoir Level to 240 feet msl
Progress Energy Biological Assessment

Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated
I001	810	I037	613	I073	342
I002	476	I038	696	I074	1,363
I003	587	I039	1,926	I075	1,115
I004	336	I040	1,411	I076	612
I005	370	I041	1,325	I077	677
I006	756	I042	1,764	I078	1,592
I007	468	I043	776	I079	878
I008	458	I045	848	I080	1,674
I009	948	I046	2,372	I081	858
I010	761	I047	2,555	I082	450
I011	572	I048	1,163	I083	204
I012	492	I049	1,243	I084	1,337
I013	1,786	I050	292	I085	306
I014	327	I051	1,880	I086	800
I015	230	I052	1,327	I087	1,533
I016	877	I053	1,129	I088	733
I017	582	I054	594	I089	776
I018	620	I055	1,024	I090	821
I019	488	I056	642	I091	1,224
I020	826	I057	935	I092	690
I021	1,056	I058	821	I093	1,052
I022	2,128	I059	2,354	I094	485
I023	2,416	I060	1,031	I095	1,349
I024	1,494	I061	2,525	I096	796
I025	344	I062	1,524	I097	433
I026	1,603	I063	727	I098	12
I027	1,611	I064	769	I099	424
I028	1,100	I065	366	I100	393
I029	916	I066	867	I101	1,017
I030	698	I068	658	I102	467
I032	1,007	I069	1,069	I103	564
I033	777	I070	1,720	I104	881

Table 3. Intermittent Streams Inundated by Raising the Reservoir Level to 240 feet msl
Progress Energy Biological Assessment

Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated
I034	997	I071	1,341	I109	24
I035	735	I072	21	I110	7
I036	1,007				

Table 4. Perennial Streams Inundated by Raising the Reservoir Level to 240 feet msl
Progress Energy Biological Assessment

Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated	Stream Number	Linear Feet Inundated
P001	756	P021	2,248	P041	449
P002	620	P022	7,067	P042	576
P003	1,370	P023	1,887	P043	2,346
P004	1,305	P024	2,228	P044	1,196
P005	2,057	P025	4,714	P045	290
P006	1,236	P026	5,372	P046	5,482
P007	2,205	P027	2,404	P047	2,388
P008	1,422	P028	1,038	P048	652
P009	2,794	P029	11,237	P049	1,333
P010	7,828	P030	2,915	P050	882
P011	1,500	P031	367	P051	379
P012	3,243	P032	292	P052	3,502
P013	3,892	P033	549	P053	1,181
P014	6,693	P034	199	P054	930
P015	9,283	P035	5,529	P055	477
P016	3,102	P036	8,479	P056	943
P017	4,580	P037	1,386	P057	1,048
P018	8,496	P038	1,356	P059	2,686
P019	9,189	P039	3,687	P060	601
P020	8,730	P040	894		

Table 5. Streams Crossed by Makeup Water Line from Cape Fear River to Harris Reservoir
Progress Energy Biological Assessment

Stream Number	Stream Type
P058	Perennial
I105	Intermittent
I106	Intermittent
I107	Intermittent
I108	Intermittent
E1319	Ephemeral
E140	Ephemeral

2.0 Aquatic Ecology

2.1 Introduction

The purpose of the stream based biological assessment associated with the Progress Energy reservoir expansion is to take into account potential inundation impacts to streams. CH2M HILL conducted a site investigation during the week of August 14, 2006 to characterize the habitats that occur between elevations 220 feet and 240 feet surrounding Harris Reservoir at the Shearon Harris Nuclear Plant in North Carolina. Sites were selected from preliminary analysis of the projected reservoir footprint after expansion to an elevation of 240 feet from the previous elevation of 220 feet. Streams and substantial drainages that fell within this expansion area and that would become inundated by reservoir waters were selected for field reconnaissance as potential points of survey. After the initial map analysis, selected sites were visited in the field to determine if they were perennial streams that would support viable aquatic communities. Seven stations were selected for study and a complete list and description of the sample localities can be found in Table 6.

No important vegetative or wildlife species were observed during informal surveys by CH2M HILL biologists. In addition, no significant aquatic habitat was observed at the locations proposed for HAR 2 and HAR 3. There are small areas where water temporarily pools and hydrophitic vegetation may occur but would not be a dominant component of the vegetation at these sites.

Table 6. Aquatic Sample Station Description
Progress Energy Biological Assessment

Station	Stream	Location/Description
BH-1	*Buckhorn Creek*	At SR 1117 crossing, this moderate sized stream has an abundance of shallow glide habitat and few riffles, with substrate comprised primarily of bedrock.
NB-2	*Norris Branch*	At SR 1127 crossing, this small stream is approximately 3 m wide with a meandering channel and a pool/riffle complex with substrate comprised primarily of sand.
LW-3	*Little White Oak Creek*	At SR 1149 crossing, this stream habitat consisted primarily of a series of solitary pools separated by large areas of gravel, cobble, and sand bed sediment.
WO-4	*White Oak Creek*	At SR 1152 crossing, this stream consists entirely of pool and run habitat with no discernable flow and substrate comprised primarily of sand and large cobble.
BB-5	*Big Branch*	At Shearon Harris Plant Rd., this stream was nearly dry at the time of sampling. The habitat consisted of a series of small pools and one large pool at the downstream end of the road culvert separated by dry channel. The substrate is primarily sand and gravel.
JB-6	*Jim Branch*	In proximity to SR 1116, this small stream is just upstream of the reservoir backwaters. The habitat is primarily pool and run with few riffles with substrate comprised of primarily sand and gravel.
UC-7	*Utley Creek*	In proximity to the end of unnamed road off of Holly Thorn Trace, this stream follows a meandering channel with pool/riffle complex with substrate comprised primarily of gravel and cobble with sand and silt in pool areas.

The major components of the evaluation included in situ water quality monitoring, habitat assessment, benthic macroinvertebrate community monitoring, and fish community monitoring. The field sampling and analytical methods used were taken from the North Carolina Standard Operating Procedures (SOPs) for fish and macroinvertebrates (NCDENR, 2006b, 2006c).

2.2 In Situ Water Quality

In situ measurements of DO, temperature, pH, conductivity, and turbidity were taken at mid-stream and mid-depth at each station. A YSI 650 MDS multi-parameter sonde was used to collect the measurements. Field teams followed the manufacturers' guidelines for proper calibration and instrument maintenance. In situ measurements were collected prior to all other sampling so as not to disturb sediments or cause potential interference with the measurements. The in situ sampling consisted of placing the multi-probe in 6 to 10 inches of flowing water while facing upstream and allowing the meter to equilibrate before collecting measurements. Calibration and quality control checks of the YSI 650 MDS were conducted in the morning before each sampling event. The results of the equipment calibration and quality control checks were recorded on field sheets.

Table 7 presents temperature, DO, pH, conductivity, and turbidity data recorded at each sampling station. The in situ measurements are collected to provide information on the surface water properties that influence the natural life history of the biota at the time of sampling. The assessment of a potential concern was based on comparing results with the applicable state standards, which are also presented in Table 7. An appropriate literature value was used for those water quality parameters where no state standards exist.

Table 7. Summary of In Situ Results
Progress Energy Biological Assessment

Station	Stream	Temperature (°C)	DO(mg/L)	pH(SU)	Conductivity (µmhos/cm)	Turbidity (NTU)
BH-1	*Buckhorn Creek*	23.97	8.14	7.40	89	16.2
NB-2	*Norris Branch*	22.80	5.29	7.18	89	10.7
LW-3	*Little White Oak Creek*	21.39	1.12	7.06	152	18.0
WO-4	*White Oak Creek*	22.72	2.23	6.94	110	91.8
BB-5	*Big Branch*	21.98	1.47	7.32	96	12.0
JB-6	*Jim Branch*	24.09	4.02	6.99	155	35.0
UC-7	*Utley Creek*	24.04	4.10	7.30	448	3.4
North Carolina State Standards (NCDENR, 2004)		Not to exceed 32.0 °C	Daily average 5.0 mg/L and 4.0 mg/L at any one time	6.00 to 9.00 SU**	N/A	50 NTU in receiving waters

Notes: °C = degrees Celsius, mg/L = milligram(s) per liter, NTU = nephelometric turbidity unit

* Lower values are permissible if caused by natural conditions
** Swamp waters may have a pH as low as 4.3 if caused by natural conditions

The following is a brief review of the in situ results. Overall, none of the measurements collected exceeded applicable state standards.

2.2.1 Temperature

North Carolina's water quality standards establish 32.0°C as a maximum value for temperature. No temperatures above that standard occurred in locations tested by CH2M HILL. The highest temperature (24.09°C) was recorded at Station JB-6.

2.2.2 Dissolved Oxygen

The DO water quality standard for North Carolina is a daily average of at least 5.0 mg/L and no less than 4.0 mg/L at all times. Lower dissolved oxygen values are allowed if they are naturally occurring, as would be the case in swamp waters, backwaters, and lake coves. Dissolved oxygen values were below the State standard of 4.0 mg/L at 3 of the 7 stations sampled. The lentic state at these stations likely caused all oxygen in the water to be depleted by aerobic bacteria and biological processes and would occur in most natural settings.

2.2.3 pH

The standard for pH is 6.00 to 9.00 Standard Units (SU). At tested locations, pH values ranged between 6.94 and 7.40 SU, within the range required by North Carolina's water quality standards.

2.2.4 Conductivity

At present, there are no state standards for conductivity; however, the EPA has indicated that streams supporting good mixed fisheries have a range of 0.150 to 0.500 mS/cm (USEPA, 1997). Conductivity outside this range could indicate that the water is unsuitable for certain species of fish and macroinvertebrates. Conductivity values recorded at the sampled streams did not exceed values in this range during the sampling event.

2.2.5 Turbidity

Currently, North Carolina identifies 50 NTU as a maximum limit for turbidity in receiving waters. Laenen and Dunnette (1997) suggest 30 NTUs as a point above which the potential for water quality degradation exists. Characterizing in situ water turbidity is critical to stream quality and habitat for biota. However, the effect of turbidity is generally observed during a rainfall event that produces runoff. Turbidity at Station WO-4 was high, likely occurring through recent runoff from the dirt/gravel roadway adjacent to the station.

2.3 Habitat Assessment

Habitat assessments were conducted at the seven study stations following the draft SOP (NCDENR, 2006b). These procedures include an evaluation of the local watershed, land use channel substrates, stream width, bank height, bank stability, vegetation and general water quality conditions.

2.3.1 Data Collection

The protocols involve rating each of the 8 metrics used to measure various riparian and in-stream parameters (Table 8). The SOPs include habitat assessment protocols for

Mountain/Piedmont streams and Coastal Plain streams. All streams in this area were evaluated using the mountain/piedmont specific protocol. Habitat metrics and descriptions are listed in the following table.

Table 8. Aquatic Habitat Assessment Parameters and Descriptions for Mountain/Piedmont Streams
Progress Energy Biological Assessment

Metric	Description
1. Channel Modification	A measurement of how much, if any, a stream has been altered by anthropogenic, hydrologic, or other events that may lead to an overall loss of habitat.
2. In-stream Habitat	A measurement of the relative quantity and variety of natural structures in the stream that are available for refugia, or feeding, spawning, or nursery functions for macroinvertebrates and fish.
3. Bottom Substrate	A measurement of the dominance of bed material (e.g. gravel, sand, and silt) which directly correlates to the diversity and abundance of fish and macroinvertebrates.
4. Pool Variety	A measurement of the types and quality of various combinations of pools in a stream that promote biotic diversity and density, especially among the fish community.
5. Riffle Habitats	A riffle is an area of reaeration, this can be a debris dam, or narrow channel area.
6. Bank Stability and Vegetation	A measurement of the amount of vegetation on stream banks available to resist erosion and control scouring and the potential of the banks to erode, causing increased sedimentation and loss of habitat. Each bank is scored separately for this metric.
7. Light Penetration	A measurement of the vegetative overstory of a stream. A loss of canopy coverage can lead to increased algal production, lower dissolved oxygen levels, and a general decline in species diversity and abundance.
8. Riparian Vegetative Zone Width	A measurement of the width and condition of the vegetation or land use from the edge of the upper stream bank through the floodplain and riparian region which serves as a buffer to potential stream degradation factors (e.g., runoff from surrounding impervious areas). Each bank is scored separately for this metric.

The stream segments evaluated for the habitat conditions were also sampled for macroinvertebrates and fish. The length of the study reaches were proportional to 3 times the width and comprised a minimum of 100 meters. For quality assurance/quality control (QA/QC) purposes, two biologists independently performed the assessment and the results were averaged. If habitat scores deviated by 30% or more between investigators, the evaluators reviewed each metric and adjusted the individual scores based on their consensus.

To obtain an overall assessment of habitat quality at each station, individual habitat metrics were summed to yield a total score. The total score for an assessed stream cannot exceed 100 points and the minimum score is 1. Scoring is not associated with an impairment rating, but it is assumed that the higher the score the better the habitat (NCDENR 2006b).

2.3.2 Results

While many of the streams and their basins have experienced relatively few direct impacts in recent times, the historic impact of agriculture and other land uses has led to a decline in available habitat to the aquatic biota. Many of the streams sampled in this study exhibited signs of channelization and erosion, indicating anthropogenic impacts on the watersheds and to the streams.

The sampling station condition scores for habitat ranged from 35 (BB-5) to 81 (UC-7) out of a possible total of 100. The habitat results are summarized in the following table. The habitat conditions at five of the seven study stations were rated below 50, indicating that habitat was impaired to some degree such that less than 50% of viable cover was available to the aquatic organisms present. Habitat assessment results at the sampled stations demonstrate that the biotic community is significantly impacted, probably as a result of past silvicultural practices.

Table 9. Summary of Habitat Assessment Statistics
Progress Energy Biological Assessment

Station	Stream	Total Score
BH-1	*Buckhorn Creek*	66
NB-2	*Norris Branch*	47
LW-3	*Little White Oak Creek*	41
WO-4	*White Oak Creek*	39
BB-5	*Big Branch*	35
JB-6	*Jim Branch*	39
UC-7	*Utley Creek*	81

Note: Ratings were assigned based on NCDENR SOPs (2006b).

Commonly low scoring parameters for most or all of the streams sampled were channel modification, bottom substrate, and riffle habitats. Stations BH-1 and UC-7 scored high in these categories and scored the highest of the seven stations. Channel modification scores were generally low at most stations due to evidence of anthropogenic channelization and incising caused by flashy flows associated with impervious land use and/or a history of intensive agriculture. Bottom substrate and riffle habitat scores were typically low due to similar factors. Typically, large volumes of silt and sand bed sediments have limited the availability of benthic habitat and have reduced the variability of benthic structure contributing to a loss in riffles throughout most of the reaches. Sand and silt have likely entered these systems in larger volumes than natural processes would dictate due to anthropogenic influences from land use and increased erosive forces associated with these influences.

2.4 Benthic Macroinvertebrate Community

Macroinvertebrates were sampled at the seven sampling stations following techniques from the SOP's (NCDENR, 2006b). This assessment involves a multi-habitat approach that maximizes the efficiency of fieldwork and analysis. It is consistent with EPA's Rapid Bioassessment Protocols (RBPs [Barbour, et al., 1999]) and involves obtaining samples from various habitat types for analysis and data evaluation.

2.4.1 Data Collection

Benthic macroinvertebrate collections were made upstream of road crossings. The sampled area was generally 100m in length depending on the availability of habitat types, particularly riffles, and overlapped the 100-meter habitat reach. Samples were collected by creating a composite sample from six sampling techniques: two riffle kicks, three sweep net bank jabs, one leaf pack sample, two rock/log washes, one sand kick, and visual collections (NCDENR, 2006b). The purpose of using these sampling techniques is to collect organisms from as many habitats as possible to represent the community structure of the stream reach.

Multi-habitat samples provide the broad-based information necessary to make the best assessment of biotic integrity and water quality.

To minimize variability in the data as a result of sampling, the equipment used, collection methods, site length (or area), and unit effort were comparable among the sampling stations. The major habitat types (e.g. undercut banks, rocks, vegetation, glides, and pools) at each site, as well as the proportion of each habitat type sampled, were recorded on the field sheets and were comparable among the stations.

The following are brief descriptions of the six sampling techniques and the types of habitats that were sampled. The organisms collected were evaluated briefly in the field for type and relative number. Samples were bagged, preserved, and shipped to the laboratory for identification and enumeration.

2.4.2 Kick Net

Kick net samples were collected from 1 square meter of riffle areas of different current speeds using a kick net that is washed through a fine (250 micron) mesh sieve bucket. This technique is intended primarily to collect species that require highly oxygenated waters such as those in the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) orders.

Sweep Net

Undercut banks, root mats, and macrophyte bed samples were collected using a 500-micron D-frame dipnet. Bank samples are particularly important for collection of species that prefer low current environments because many species of aquatic insects—such as damselflies, dragonflies, and some dipteran and coleopteran species—are adapted to these microhabitats.

Leaf-Pack

The CPOM/leaf-pack sample included clumps of leaves, small sticks, and parts of logs. The material was collected from various sources throughout the study reach, including around rocks or snags in rapid and low-flow current. Leaf-packs are important for collecting shredders such as species in the orders Plecoptera and Trichoptera.

Rock/Log Wash

In these samples, different rocks and/or logs at each station were sampled. Organisms found in and on these materials were washed, scraped into buckets, and poured through a fine-mesh net (250 microns). This method was used to collect small organisms that pass through standard kick and sweep net devices (about 500 microns), such as species in the families Chironomidae, Baetidae, Hydroptilidae as well as oligochaetes and other scrapers/grazers and clinger taxa.

Sand Sample

Sand kick samples were collected with a fine-mesh net bag (250-micron) or kick net. The bag or net was held open near the substrate while sandy habitats just upstream were vigorously agitated. This technique is especially useful for collecting small organisms, such as species in the family Chironomidae that inhabit sandy substrates.

Visual Collections

Any habitat present that was not sampled by the other techniques, such as large rocks and snags, were visually inspected and hand-picked for additional species. A variety of species, including flatworms, beetles, dragonflies, snails, and leeches, can be collected from these habitats by this method. A trained biologist familiar with benthic macroinvertebrate sampling and life history and habitat requirements for benthos performed these collections.

Macroinvertebrate Data Analysis

The macroinvertebrate samples were identified to the lowest taxonomic level practical, and the results were used to assign a bioclassification value for the two community metrics following the criteria published in the SOP (NCDENR, 2006b). Each metric represents a slightly different component of community structure and/or function and provides a measure of biotic integrity. The following table presents the description of the metrics and the response to water quality changes.

Table 10. Macroinvertebrate Community Metrics
Progress Energy Biological Assessment

Metric	Description	Response Interpretation
EPT Taxa Criteria	The EPT taxa index is the total number of distinct taxa within the EPT orders (Ephemeroptera, Plecoptera, and Trichoptera). This value summarizes taxa richness within the insect orders that are generally considered to be pollution-sensitive	The EPT taxa metric increases with good water quality.
North Carolina Biotic Index (NCBI) Criteria	The biotic index is used to summarize the overall pollution tolerance of the macroinvertebrate community with a single value.	The biotic index generally increases with poor water quality.

The following table lists the range of bioclassification values for the two metrics and a corresponding condition rating scores. Equal weight is given to both metric values when assigning the bioclassification value to the sampled streams (NCDENR, 2006b). The scores are averaged to obtain a final bioclassification rating score. Prescribed rounding is used when the Biotic Index (BI) and EPT scores differ by exactly one bioclassification value (NCDENR, 2006b).

Table 11. Macroinvertebrate Community Ratings and Attributes for Mountain/Piedmont Streams
Progress Energy Biological Assessment

Condition Rating Score	Bioclassification Values	
	BI	EPT
5	<5.14	>33
4.6	5.14-5.18	32-33
4.4	5.19-5.23	30-31
4	5.24-5.73	26-29
3.6	5.74-5.78	24-25
3.4	5.79-5.83	22-23
3	5.84-6.43	18-21
2.6	6.44-6.48	16-17
2.4	6.49-6.53	14-15
2	6.54-7.43	10-13
1.6	7.44-7.48	8-9
1.4	7.49-7.53	6-7
1	>7.53	0-5

Note: Seasonality correction factors are not necessary in this assessment since the expectation criteria established by NCDENR is based on summer (June-September) collections (NCDENR, 2006b).

Final bioclassification scores are assigned after combining the BI and EPT values and adjusting any rounding decisions. One of five community Biological Condition Categories are derived ranging from "Poor," indicating a highly disturbed system, to "Excellent," indicating little disturbance. The other condition categories represent slight to moderate levels of disturbance within this range (following table).

Table 12. Macroinvertebrate Community Ratings and Attributes
Progress Energy Biological Assessment

Biological Condition Category	Condition Score	Attributes
Excellent	5	Comparable to the best situation to be expected within an ecoregion. A balanced trophic structure, with an optimum community composition for the stream size and habitat. Exceptional or unusual assemblages of species are usually present, with sensitive species abundant. Species richness is high and the stream exhibits outstanding conditions.
Good	4	A relatively balanced community composition, with a balanced trophic structure. Species richness is relatively high for the stream size and habitat present, and sensitive species are present.
Good-Fair	3	Community composition is lower than expected due to a loss of intolerant taxa, with an increase in the percent contribution of tolerant forms. The community structure (composition and dominance) for stream size and habitat quality is adequate. Some expected species are absent or in low abundance. Sensitive species are also absent or in very low abundance.
Fair	2	Fewer taxa due to the loss of most intolerant forms. An overall reduction in EPT taxa. Community structure and habitat quality are less than desirable but do meet expectations in some areas. Expected species absent or in low numbers. Streams in this category exhibit low species richness, with tolerant species predominating. Sensitive species are absent. These streams exhibit significant levels of habitat degradation at increasing frequencies.

Table 12. Macroinvertebrate Community Ratings and Attributes
Progress Energy Biological Assessment

Biological Condition Category	Condition Score	Attributes
Poor	1	Assigned to streams with few species present, with only the most tolerant species remaining. The community is lacking diversity, with few or no EPT taxa. Extreme habitat degradation has substantially altered the stream's characteristics.

2.4.3 Results

Results of the benthic macroinvertebrate sampling indicate a range of ecological conditions in the sampled streams. Taxa richness varied between stations with station BH-1 containing the greatest diversity of macroinvertebrate taxa with 54 and station UC-7 containing the smallest number of taxa with 24.

Only one of the stations scored above "fair", two stations scored "fair", and four stations scored "poor" in the final analysis. These results indicate that habitat conditions at most of the sampled stations were not conducive to supporting a robust macroinvertebrate community. Biotic index (NCBI) scoring was equal to or higher than the EPT score at all stations. This reflects the weight given to taxa not in the EPT group and incorporates the wide range of tolerance values assigned to taxa included in the NCBI. A comparison of the BI (NCBI) and EPT index values and associated scores, as well as the final scoring created by the averaging of these metric scores and the associated ecological condition can be found in the following table.

Table 13. Summary of Benthic Macroinvertebrate Bioassessment Scores
Progress Energy Biological Assessment

Station	NCIBI Value	EPT Value	NCIBI Score	EPT Score	Final Score (Average)	Ecological Condition
BH-1	5.72	11	4	2	3	Good-Fair
NB-2	6.95	5	2	1	1.5*	Poor
LW-3	8.02	1	1	1	1	Poor
WO-4	8.00	0	1	1	1	Poor
BB-5	7.96	1	1	1	1	Poor
JB-6	6.70	6	2	1.4	1.7	Fair
UC-7	6.22	5	2.6	1	1.8	Fair

*Rounded down in accordance with the NCIBI specifications for EPT abundance.

Low scores observed in throughout study area were reflected in the attributes of both macroinvertebrate community values (EPT and BI).

EPT taxa are relatively intolerant of pollution and sedimentation, and they require high levels of DO. The number and diversity of EPT taxa are expected to decrease as streams become increasingly degraded. All stations were characterized as having low EPT taxa richness. NCDENR indicates that a North Carolina stream exhibiting an "excellent' benthic macroinvertebrate community will have as many as 33+ species of EPT taxa (NCDENR, 2006b). These intolerant orders are reduced in the sampled streams indicating increased degradation.

The BI of a community is based on tolerance values ranging from 0 to 10 assigned by NCDENR for various species of benthic macroinvertebrates. Higher values are given to the most tolerant macroinvertebrates, while the lowest numbers are reserved for the most intolerant taxa. The entire community composition of tolerance is calculated using the BI resulting in a finalized score ranging from 0 (most intolerant community) to 10 (most tolerant community). NCDENR SOPs requires that "excellent" benthic macroinvertebrate communities have a BI of less than 5.14 (NCDENR, 2006b). High BI scores were present at 5 streams indicating that the benthic macroinvertebrate community at the sampling stations has experienced a substantial degree of stress.

2.5 Fish Community

The North Carolina Index of Biotic Integrity (NCIBI) was used to evaluate the health of the fish communities at the sampling stations. The NCIBI integrates a broad range of fish community attributes into an assessment of stream biotic integrity. The methodology involves a fish community survey using standard field techniques; species identification, enumeration, and external examination of the collected fish; and assignment of ratings to a variety of fish community attributes (metrics), which are summed to obtain an overall measure of biotic integrity.

2.5.1 Data Collection

Fish sampling was conducted in August 2006 at stations in accordance with NCDENR protocols (NCDNER, 2006c). Sample reach length was approximately 200m at each station when habitat was available. The principal sampling method was backpack electrofishing, supplemented by seining. The unit sampling effort (i.e., time spent electroshocking and seining) varied from to 3 to 49 minutes depending on the accessibility and complexity of habitats present at each sampling reach.

During backpack electrofishing, electricity is used to stun fish so they can be easily captured using dipnets. Fish sampling progressed upstream, so as not to disturb sediments and decrease visibility while sampling. Team members were careful not to walk through the sampling area prior to sampling to minimize movement of fish out of the sampling area. All habitats were sampled in the reach using the backpack shocker. An experienced biologist operated the electrofishing unit and was assisted by other team members who helped capture stunned fish, carried a live bucket for all captured fish, and transported fish to a processing area on the bank at the beginning of the reach.

After backpack electrofishing was completed, the lead fisheries biologist selected areas to use a minnow seine for further sampling if the habitat was conducive for seining. Seining is particularly effective in collecting darters, minnows, and other smaller fish generally not as vulnerable to backpack electrofishing. Two seining methods were used: kick sets and down-stream hauls. Both methods required two to three field team members. For kick sets, the minnow seine was placed in the stream perpendicular to the current such that the lead line of the seine was located on the bottom of the stream and no fish could escape by going under the net. Two field members held the net, while a third kicked and disturbed the substrate from 2 to 3 meters upstream of the net downstream to the net. This action causes fish to move downstream away from the disturbance into the net. Once the third field member had completed disturbing the substrate, the net was lifted and the fish were removed. Downstream hauls required two field members to pull the net downstream slightly faster than the current, keeping the lead line close to the bottom, through runs and pools; and either lifting mid-stream or continuing to a point where the seine could be dragged up on the bank.

Fish were identified and enumerated in the field to the extent practical, with some voucher specimens being preserved in a 4 percent formalin solution for laboratory confirmation of species identifications. Most specimens were released alive at the collection site. A data sheet that included size and external anomalies of the species collected was completed at each station, along with detailed notes on habitat and surrounding watershed conditions.

2.5.2 Fish Analysis

NCIBI scores were derived for each station by rating 12 metrics of fish community structure in five broad categories: (1) species richness and composition, (2) indicator species, (3) trophic function, (4) abundance and condition, and (5) reproductive function. These metrics were modified from Karr et al (1986) and currently are used by the NCDENR in their fish sampling protocols (NCDENR, 2006c). The NCIBI assumes that each metric correlates either positively or negatively with increased stream degradation. The 12 metrics integrate attributes of the entire fish community that are differentially sensitive to various levels of stream perturbation. For example, some metrics distinguish throughout the low to intermediate range of biotic integrity (e.g., percentage of diseased fish), while others are more sensitive in the intermediate to high range of biotic integrity (e.g., number of intolerant species) (Karr et al., 1986; NCDENR, 2006c). The 12 metrics rated in this assessment and their descriptions/rationales are listed in the following table.

Table 14. IBI Metrics Used to Evaluate Fish Communities in Outer Piedmont Streams
Progress Energy Biological Assessment

Metric	Description/Rationale
Species Richness and Composition:	
1. Number of Species	This number decreases with increasing environmental degradation, and is considered to be one of the most powerful IBI metrics.
3. Number of Species of Darters	This metric is a count of all species of darters (Etheostoma and Percina). These species typically feed and reproduce in benthic habitats, and are sensitive to degradation from channelization, siltation, and DO reduction. Species number decreases with increasing degradation.
4. Number of Species of Sunfish	These pool-dwelling species decrease in number with increasing siltation and degradation of pool habitats and in-stream cover. This metric is an effective measure of losses of in-stream cover and pool habitat and of decreases in the terrestrial food supply due to disruption of the riparian zone (Ohio EPA, 1987).
5. Number of Species of Suckers	Suckers are known to be sensitive to habitat modification, sedimentation, and changes in water quality. In addition, the relatively long life span of most sucker species provides a long-term assessment of past and present environmental conditions.

Table 14. IBI Metrics Used to Evaluate Fish Communities in Outer Piedmont Streams
Progress Energy Biological Assessment

Metric	Description/Rationale
Indicator Species:	
6. Number of Intolerant Species	Intolerant or sensitive species include those that are highly or moderately intolerant of water quality and habitat degradation. They are among the first to disappear following a disturbance.
7. Percentage of Tolerant Individuals	Tolerant species occur readily in disturbed systems. These species tend to dominate degraded streams and the percentage of tolerant individuals in the fish community increases.
Trophic Function:	
8. Percentage of Omnivorous and Herbivorous Individuals	Omnivores are opportunistic feeders, consuming significant quantities of both plant and animal materials. Omnivores often become abundant in small, highly degraded streams, as specific components of the food base become less reliable. Herbivores consume plant materials (specifically algae) which may become abundant as stream canopy decreases. A dominance of these two trophic guilds in a community could indicate a degraded system.
9. Percentage of Insectivores	The relative abundance of these species decreases with degradation, in response to reductions in the invertebrate food supply.
10. Percentage of Piscivores	These species (e.g., bass, pickerel) feed as adults primarily on fish, other vertebrates, or crayfish, and indicate a trophically diverse community. Their proportion decreases with increasing degradation.
Abundance and Condition:	
2. Number of Fish	This metric measures general fish abundance. Sites with greater disturbance generally support fewer fish.
11. Percentage of Diseased Fish	Sites with severe environmental degradation often yield a high number of fish in poor health, as manifested by heavy parasitism, damaged fins, lesions, or other external physical deformities.
Reproductive Function:	
12. Percentage of Species with Multiple Age Groups	This metric measures the suitability of the habitat for reproduction in the fish community. A balanced stream with high integrity will support a robust assemblage of age cohorts of the species present.

Sources: NCDENR, 2006c; Karr et al., 1986; Plafkin et al., 1989; Ohio EPA, 1987

Ratings of 1, 3, or 5 were assigned to each IBI metric based on the degree of deviation from "expected" metric values for relatively undisturbed reference criteria of similar size streams established in the NCDENR fish biomonitoring protocols (NCDENR, 2006c; Karr et al., 1986; Barbour et al., 1999; and Plafkin et al., 1989). The 12 metric ratings were then summed, yielding an overall IBI site score for each station. Scores could range from a low of 12, indicating "Poor" biotic integrity, to a high of 60, indicating "Excellent" conditions. The biotic integrity classes for ranges of IBI scores as recommended by NCDENR (2006c) are listed in the following table.

Table 15. IBI Scores, Integrity Classes, and Associated Attributes of Outer Piedmont Streams
Progress Energy Biological Assessment

Total IBI Score	Integrity Class	Attributes
54-60	Excellent	Comparable to the best situations without human disturbance; all regionally expected species, including most intolerant ones; balanced trophic structure.
45-52	Good	Species richness somewhat below expectations due to loss of some intolerant species; trophic structure showing some signs of stress.
40-44	Good-Fair	Fewer species than expected, including loss of intolerant species; skewed trophic structure.
34-38	Fair	Dominated by tolerant species, habitat generalists, or omnivores; few top carnivores; hybrids and diseased fish often present.
≤32	Poor	Few fish present, mostly introduced or tolerant forms; hybrids; disease, and other health-related anomalies. Stream community is highly stressed.

Source: NCDENR, 2006c

2.5.3 Results

The August 2006 sampling produced a combined total of 21 fish species and 1 hybrid from the seven stations. Species richness was greatest among the sunfishes and basses (7 species), minnows (6 species), and catfishes (3 species). Sites with the highest species richness were stations BH-1, and NB-2 with 11 and 18 species, respectively. Sites LW-3, BB-5, and JB-6 had the lowest species richness (5, 2, and 8 species, respectively), likely a reflection of the limited connective habitat in these streams due to dry weather and stream geomorphology.

The following table summarizes the fish results (IBI metric values, ratings, and total IBI scores) calculated for the stations sampled in August 2006. The highest scoring station was BH-1 and was assigned biotic integrity rating of "Good". The lowest scoring stations included BB-5 and JB-6, which received a rating of "Poor".

Table 16. Fish Community NCIBI Metric Values, Ratings, and Total Scores for Progress Energy Stations, August 2006
Progress Energy Biological Assessment

Metric	Absolute Metric Value (Metric Rating)													
	BH-1		NB-2		LW-3		WO-4		BB-5		JB-6		UC-7	
1. Number of Species	12	(3)	18	(5)	5	(1)	10	(3)	2	(1)	8	(1)	10	(3)
2. Number of Fish	211	(3)	85	(1)	28	(1)	46	(1)	4	(1)	54	(1)	68	(1)
3. Number of Species of Darters	1	(3)	1	(3)	0	(1)	0	(1)	0	(1)	0	(1)	1	(3)
4. Number of Species of Sunfish	4	(5)	7	(5)	2	(1)	6	(5)	0	(1)	5	(5)	5	(5)
5. Number of Species of Sucker	1	(3)	1	(3)	0	(1)	1	(3)	0	(1)	0	(1)	0	(1)
6. Number of Intolerant Species	0	(1)	0	(1)	0	(1)	0	(1)	0	(1)	0	(1)	0	(1)
7. Percentage of Tolerant Individuals	17%	(5)	41%	(3)	0.0%	(5)	23.9%	(5)	75%	(1)	78%	(1)	11.8%	(5)
8. Percentage of Omnivorous and Herbivorous Individuals	29%	(5)	16%	(5)	14.3%	(5)	17.4%	(5)	0.0%	(1)	37.0%	(3)	7.4%	(1)

Table 16. Fish Community NCIBI Metric Values, Ratings, and Total Scores for Progress Energy Stations, August 2006
Progress Energy Biological Assessment

	Absolute Metric Value (Metric Rating)													
Metric	**BH-1**		**NB-2**		**LW-3**		**WO-4**		**BB-5**		**JB-6**		**UC-7**	
9. Percentage of Insectivores	68%	(5)	78%	(5)	75.0%	(5)	63.0%	(3)	75.0%	(5)	61%	(3)	85.3%	(5)
10. Percentage of Piscivores	3%	(5)	6%	(5)	10.7%	(5)	19.6%	(1)	25.0%	(1)	2%	(5)	5.9%	(5)
11. Percentage of Diseased Fish	0	(5)	1%	(5)	0	(5)	0	(5)	0	(5)	0	(5)	0	(5)
12. Percentage of Species with Multiple Age Groups	42%	(3)	22%	(1)	40.0%	(3)	30.0%	(1)	0.0%	(1)	13%	(1)	40.0%	(3)
NCIBI Score (sum of 12 metric ratings)	**46**		**42**		**34**		**34**		**20**		**28**		**38**	
Integrity Class	**Good**		**Good-Fair**		**Fair**		**Fair**		**Poor**		**Poor**		**Fair**	

* The first number is the absolute metric value and the number in parentheses is the metric rating (1, 3, or 5)

The low scoring NCIBI metrics across most of the sampled stations are due primarily to the following attributes of the fish assemblages. These metrics tended to receive the lowest rating (1).

- **Number of Species and Number of Fish**. These two metrics reflect the abundance and diversity of the fish present in the aquatic community. Several stations sampled scored the lowest rating possible for these two metrics. As the integrity of a stream deteriorates, the types and numbers of fish present begin to decline as well.
- **Number of Darter Species**. There were no darter species found at four of the seven study stations. Streams with high biotic integrity often have several species darters inhabiting well-oxygenated areas (e.g., riffles and swift glides). When habitat conditions decline from environmental stressors, such as sedimentation from nonpoint source runoff, benthic food sources and rocky spawning areas become smothered and less available. Conditions often become less favorable for darter species, causing their numbers to decline. At most stations, the lack of clean gravel bed sediment and the general lack of riffle habitat likely contributed to the absence of darters in these streams.
- **Number of Intolerant Species**. Intolerant species, or species rated by NCDENR as being exceptionally sensitive to aquatic environmental impacts, were not found at any site in the study area. These species are most susceptible to declining stream integrity and are among the first to disappear from an impacted aquatic community.

3.0 References

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APPENDIX TABLE A-1

Fish Community Species Observed for Progress Energy Stations, August 2006

Progress Energy Carolinas Biological Assessment

Scientific Name	Common Name	Tolerance Ranking	Feeding Guild	BH-1	NB-2	LW-3	WO-4	BB-5	JB-6	UC-7
CYPRINIDAE (MINNOWS)										
Clinostomus funduloides	rosyside dace		insectivore	1						
Luxilus albeosus	white shiner		insectivore	57	5					
Nocomis leptocephalus	bluehead chub		omnivore	58	1					4
Notemigonus crysoleucas	golden shiner	Tolerant	omnivore		2		6		19	
Notropis hudsonius	spottail shiner		omnivore		4	4			1	1
Semotilus atromaculatus	creek chub	Tolerant	insectivore	15	16					1
CATOSTOMIDAE (SUCKERS)										
Erimyzon oblongus	creek chubsucker		omnivore	4	2		1			
ICTALURIDAE (CATFISHES)										
Ameiurus natalis	yellow bullhead	Tolerant	omnivore		5		1			
Ameiurus platycephalus	flat bullhead	Tolerant	insectivore		1					1
Noturus insignis	margined madtom		insectivore	15						
APHREDODERIDAE (PIRATE PERCH)										
Aphredodurus sayanus	pirate perch		insectivore	1						
ESOCIDAE (PIKES)										
Esox americana	redfin pickerel		piscivore		1	2	3	1		
POECILIIDAE (LIVE BEARERS)										
Gambusia holbrooki	eastern mosquitofish	Tolerant	insectivore		1	9		3	16	
CENTRARCHIDAE (SUNFISHES)										
Lepomis sp.	sunfish hybrid	Tolerant	insectivore							1
Lepomis auritus	redbreast sunfish	Tolerant	insectivore	20	3					4
Lepomis cyanellus	green sunfish	Tolerant	insectivore		7		4		7	1
Lepomis gulosus	warmouth		insectivore	1	4		5			
Lepomis macrochirus	bluegill		insectivore	6	17	12	18		8	49
Lepomis microlophus	redear sunfish		insectivore		1		1		1	1
Enneacanthus gloriosus	bluespotted sunfish		insectivore		9		1		1	
Micropterus salmoides	largemouth bass		piscivore	6	4	1	6		1	4

APPENDIX TABLE A-1
Fish Community Species Observed for Progress Energy Stations, August 2006
Progress Energy Carolinas Biological Assessment

Scientific Name	Common Name	Tolerance Ranking	Feeding Guild	BH-1	NB-2	LW-3	WO-4	BB-5	JB-6	UC-7
PERCIDAE (DARTERS)										
Etheostoma olmstedi	tessellated darter		insectivore	27	2					1
Number of Diseased Fish					1					
Number of Species with Multiple Age Groups				5	4	2	3	0	1	4
1. Number of Species				12	18	5	10	2	8	11
2. Number of Fish				211	85	28	46	4	54	68
3. Number of Species of Darters				1	1	0	0	0	0	1
4. Number of Species of Sunfish				4	7	2	6	0	5	6
5. Number of Species of Sucker				1	1	0	1	0	0	0
6. Number of Intolerant Species				0	0	0	0	0	0	0
7. Percentage of Tolerant Individuals				17%	41%	32%	24%	75%	78%	12%
8. Percentage of Omnivorous and Herbivorous Individuals				29%	16%	14%	17%	0%	37%	7%
9. Percentage of Insectivores				68%	78%	75%	63%	75%	61%	87%
10. Percentage of Piscivores				3%	6%	11%	20%	25%	2%	6%
11. Percentage of Diseased Fish				0%	1%	0%	0%	0%	0%	0%
12. Percentage of Species with Multiple Age Groups				42%	22%	40%	30%	0%	13%	36%

Notes:
BH-1 = Buckhorn Creek
NB-2 = Norris Branch
LW-3 = Little White Oak Creek
WO-4 = White Oak Creek
BB-5 = Big Branch
JB-6 = Jim Branch
UC-7 = Utley Creek

APPENDIX TABLE A-2
Benthic Macroinvertebrate Species Observed - EPT
Progress Energy Carolinas Biological Assessment

SPECIES	FFG	BH-1 Species	NB-2 Species	LW-3 Species	WO-4 Species	BB-5 Species	JB-6 Species	UC-7 Species
PLATYHELMINTHES								
Turbellaria								
Tricladida								
Planariidae								
Girardia (Dugesia) tigrina					19			
NEMATODA				1				
MOLLUSCA								
Bivalvia								
Veneroida								
Corbiculidae								
Corbicula fluminea	FC	1						10
Sphaeriidae	FC							
Sphaerium sp.	FC		11		11		3	
Gastropoda								
Basommatophora								
Ancylidae	SC							
Ferrissia sp.	SC	1	3		2			
Planorbidae	SC							
Menetus dilatatus	SC		5	1			1	
Physidae								
Physella sp.	CG		1		3	3	2	
ANNELIDA								
Oligochaeta	CG							
Tubificida								
Lumbricidae	CG							1
Naididae			3	8	2	4	3	
Dero sp.			2	4	4	17	8	
Pristina leidyi	CG			2				
Slavina appendiculata	CG				1			
Stylaria lacustris	CG				14			
Tubificidae w.h.c.	CG	1	10	2			16	
Tubificidae w.o.h.c.	CG	2	20	17	17		9	7
Limnodrilus hoffmeisteri	CG	2		5	5			
Lumbriculida								
Lumbriculidae	CG		1					
Rhynchobdellida								
Glossiphoniidae	P							
Helobdella stagnalis	P						1	
ARTHROPODA								
Arachnoidea								
Acariformes								
Hygrobatidae								
Atractides sp.	-	1					2	
Lebertiidae								
Lebertia sp.							1	
Crustacea								
Ostracoda			2	12	2	1	1	
Cladocera								
Daphnidae								
Ceriodaphnia sp.						21	2	
Sidaidae								
Sida crystillina					3			
Copepoda				2	1		1	

APPENDIX TABLE A-2
Benthic Macroinvertebrate Species Observed - EPT
Progress Energy Carolinas Biological Assessment

SPECIES	FFG	BH-1 Species	NB-2 Species	LW-3 Species	WO-4 Species	BB-5 Species	JB-6 Species	UC-7 Species
Amphipoda	CG	1						
Hyalellidae								
Hyalella azteca	CG				1	2	1	1
Decapoda								
Cambaridae			2		1			
Insecta								
Collembola			1	2			1	
Ephemeroptera								
Baetidae	CG						1	
Baetis sp.	CG	1						
Baetis intercalaris	CG							9
Callibaetis sp.	CG		1					
Centroptilum sp.	CG		3				1	
Caenidae	CG							
Caenis sp.	CG		6	2			4	
Ephemerellidae	SC							
Serratella sp.	SC	1						
Ephemeridae	CG							
Hexagenia sp.	CG	1						
Heptageniidae	SC	4					1	
Leucrocuta sp.	SC	1						
Maccaffertium (Stenonema) sp.	SC		7					8
Isonychiidae	FC							
Isonychia sp.	FC	1						
Leptophlebiidae	CG							
Paraleptophlebia sp.	CG					4	11	
Odonata								
Aeshnidae	P							
Boyeria vinosa	P		2		1			
Coenagrionidae	P		3	1			1	
Argia sp.	P		1		1			
Enallagma sp.	P		1		1			
Ischnura sp.					3			
Corduliidae	P							
Epicordulia princeps	P			1	2			
Macromia sp.	P						1	
Somatochlora sp.	P			1				
Gomphidae	P							
Progomphus sp.	P		5					
Libellulidae	P	1	1	3	1	1	1	
Hemiptera								
Mesoveliidae								
Mesovelia sp.				1				
Notonectidae								
Notonecta sp.	P			1				
Veliidae	P				1		1	
Rhagovelia obesa	P							2
Megaloptera								
Corydalidae	P							
Chauliodes sp.	P			1				
Corydalus cornutus	P	2						
Sialidae	P							
Sialis sp.	P				1		3	

APPENDIX TABLE A-2
Benthic Macroinvertebrate Species Observed - EPT
Progress Energy Carolinas Biological Assessment

SPECIES	FFG	BH-1 Species	NB-2 Species	LW-3 Species	WO-4 Species	BB-5 Species	JB-6 Species	UC-7 Species
Trichoptera								
Hydropsychidae	FC							
Cheumatopsyche sp.	FC	7	5				2	88
Hydropsyche betteni gp.	FC							9
Hydroptilidae	PI							
Ochrotrichia sp.	PI	1						
Leptoceridae	CG							
Oecetis sp.	P	1						3
Philopotamidae	FC							
Chimarra aterrima	FC	1						
Chimarra obscurus	FC	1						
Coleoptera								
Curculionidae				1				2
Dryopidae								
Helichus basalis	SC			1				
Dytiscidae	P				2			
Hydroporus sp.	PI			2	1			
Elmidae	CG							
Ancyronyx variegata	SC	8	11	1	2			
Dubiraphia sp.	SC		5		3		1	
Macronychus glabratus	SH	3	1					3
Microcylloepus pusillus	SC							3
Optioservus sp.	SC	1						
Stenelmis sp.	SC	2	11	1				6
Hydrophilidae	P					1		
Paracymus sp.	CG			1				
Ptilodactylidae	SH							
Anchytarsus bicolor	SH	1						
Scirtidae	SC			1				7
Diptera								
Ceratopogonidae	P			1			2	
Bezzia/Palpomyia gp.	P	1						
Chaboridae								
Chaoborus punctipennis	P				1	5		
Chironomidae								
Ablabesmyia mallochi	P	1	12	3	1		4	
Ablabesmyia rhamphe gp.	P	4	5	2	8		6	
Chironomus sp.	CG		4	75	4	28	1	
Cladotanytarsus sp.	FC	55		1				
Clinotanypus sp.	P	1			2			
Conchapelopia sp.	P	2	7		1		9	22
Corynoneura sp.	CG		1					
Cricotopus tremulus	CG	5						
Cryptochironomus sp.	P	1			1			
Dicrotendipes neomodestus	CG	7					6	
Dicrotendipes simpsoni			1	3	1	4		
Kiefferulus sp.				7		4		
Labrundinia sp.	P	1	3				2	1
Microtendipes pedellus gp.	CG	2	6					
Natarsia sp.					5			1
Nilotanypus sp.	P			1		1		
Nilothauma sp.	CG		1					1
Orthocladius sp. *(Euorthocladius)*	CG	1						

APPENDIX TABLE A-2

Benthic Macroinvertebrate Species Observed - EPT

Progress Energy Carolinas Biological Assessment

SPECIES	FFG	BH-1 Species	NB-2 Species	LW-3 Species	WO-4 Species	BB-5 Species	JB-6 Species	UC-7 Species
Parachironomus sp.	CG				3			
Paracladopelma sp.	CG		1				2	
Parakiefferiella sp.	CG	2						
Paratanytarsus sp.	CG	1	3				3	
Paratendipes sp.	CG		1				1	
Pentaneura sp.	CG	1	2					
Phaenopsectra punctipes gp.		3			2		1	
Polypedilum flavum (convictum)	SH	3					3	10
Polypedilum fallax	SH	2						
Polypedilum halterale gp.	SH	4	4	9				
Polypedilum illinoense	SH		3	31	4	8	3	
Procladius sp.	P				12	1	17	2
Rheotanytartsus exiguus gp.		2	1				24	7
Stenochironomus sp.	SH	3	8					
Sublettea coffmani		2						
Tanypus carinatus							2	
Tanytarsus sp.	FC	24	10	7			11	4
Thienemanniella xena	CG	4						
Tribelos jucundum		2	2	1	44	3	3	
Xylotopus par	SH	1						
Culicidae	FC				2			
Anopheles sp.	FC					2	1	
Dixidae	CG							
Dixella sp.	CG	4						
Empididae	P							
Hemerodromia sp.	P						1	
Simuliidae	FC							
Simulium sp.	FC							2
Tabanidae	PI					1		
Chrysops sp.	PI			4		1		
Tipulidae	SH							
Antocha sp.	CG	1						
Hexatoma sp.	P	1						
TOTAL NO. OF ORGANISMS		**188**	**199**	**220**	**196**	**112**	**182**	**209**
TOTAL NO. OF TAXA		**54**	**46**	**39**	**42**	**20**	**47**	**24**
EPT INDEX (Sum of EPT Species)		**11**	**5**	**1**	**0**	**1**	**6**	**5**

Notes:

EPT = Ephemeroptera, Plecoptera, and Trichoptera
CG = Collector Gatherers
FC = Filter Collectors
P = Predators
PI = Piercers
SC = Scrapers
SH = Shredders
TV = Tolerance Value
FFG = Functional Feeding Group

APPENDIX TABLE A-3
Benthic Macroinvertebrate Species Observed - NCBI
Progress Energy Carolinas Biological Assessment

SPECIES	TV	FFG	BH-1		NB-2		LW-3		WO-4		BB-5		JB-6		UC-7	
			Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV
Girardia (Dugesia) tigrina	7.2			0		0		0	19	136.8		0		0		0
Corbicula fluminea	6.1	FC	1	6.1		0		0		0		0		0	10	61
Sphaeriidae	*8	FC		0		0		0		0		0		0		0
Sphaerium sp.	7.6	FC		0	11	83.6		0	11	83.6		0	3	22.8		0
Ferrissia sp.	6.6	SC	1	6.6	3	19.8		0	2	13.2		0		0		0
Planorbidae	*6	SC		0		0		0		0		0		0		0
Menetus dilatatus	8.2	SC		0	5	41	1	8.2		0		0	1	8.2		0
Physella sp.	8.8	CG		0	1	8.8		0	3	26.4	3	26.4	2	17.6		0
Oligochaeta	*10	CG		0		0		0		0		0		0		0
Pristina leidyi	9.6	CG		0		0	2	19.2		0		0		0		0
Slavina appendiculata	7.1	CG		0		0		0	1	7.1		0		0		0
Stylaria lacustris	9.4	CG		0		0		0	14	131.6		0		0		0
Tubificidae w.h.c.	7.1	CG	1	7.1	10	71	2	14.2		0		0	16	113.6		0
Tubificidae w.o.h.c.	7.1	CG	2	14.2	20	142	17	120.7	17	120.7		0	9	63.9	7	49.7
Limnodrilus hoffmeisteri	9.5	CG	2	19		0	5	47.5	5	47.5		0		0		0
Lumbriculidae	7	CG		0	1	7		0		0		0		0		0
Helobdella stagnalis	8.6	P		0		0		0		0		0	1	8.6		0
Acariformes	5.5			0		0		0		0		0		0		0
Hygrobatidae	5.5			0		0		0		0		0		0		0
Atractides sp.	5.5	-	1	5.5		0		0		0		0	2	11		0
Lebertiidae	5.5			0		0		0		0		0		0		0
Lebertia sp.	5.5			0		0		0		0		0	1	5.5		0
Hyalella azteca	7.8	CG		0		0		0	1	7.8	2	15.6	1	7.8	1	7.8
Cambaridae	7.5			0	2	15		0	1	7.5		0		0		0
Baetis intercalaris	7	CG		0		0		0		0		0		0	9	63
Callibaetis sp.	9.8	CG		0	1	9.8		0		0		0		0		0
Centroptilum sp.	6.6	CG		0	3	19.8		0		0		0	1	6.6		0
Caenis sp.	7.4	CG		0	6	44.4	2	14.8		0		0	4	29.6		0
Hexagenia sp.	4.9	CG	1	4.9		0		0		0		0		0		0

APPENDIX TABLE A-3

Benthic Macroinvertebrate Species Observed - NCBI

Progress Energy Carolinas Biological Assessment

SPECIES	TV	FFG	BH-1		NB-2		LW-3		WO-4		BB-5		JB-6		UC-7	
			Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV
Leucrocuta sp.	2.4	SC	1	2.4		0		0		0		0		0		0
Isonychia sp.	3.5	FC	1	3.5		0		0		0		0		0		0
Paraleptophlebia sp.	0.9	CG		0		0		0		0	4	3.6	11	9.9		0
Boyeria vinosa	5.9	P		0	2	11.8		0	1	5.9		0		0		0
Argia sp.	8.2	P		0	1	8.2		0	1	8.2		0		0		0
Enallagma sp.	8.9	P		0	1	8.9		0	1	8.9		0		0		0
Ischnura sp.	9.5			0		0		0	3	28.5		0		0		0
Epicordulia princeps	5.6	P		0		0	1	5.6	2	11.2		0		0		0
Macromia sp.	6.2	P		0		0		0		0		0	1	6.2		0
Somatochlora sp.	9.2	P		0		0	1	9.2		0		0		0		0
Notonecta sp.	8.7	P		0		0	1	8.7		0		0		0		0
Corydalus cornutus	5.2	P	2	10.4		0		0		0		0		0		0
Sialis sp.	7.2	P		0		0		0	1	7.2		0	3	21.6		0
Cheumatopsyche sp.	6.2	FC	7	43.4	5	31		0		0		0	2	12.4	88	545.6
Hydropsyche betteni gp.	7.8	FC		0		0		0		0		0		0	9	70.2
Ochrotrichia sp.	4	PI	1	4		0		0		0		0		0		0
Oecetis sp.	4.7	P	1	4.7		0		0		0		0		0	3	14.1
Chimarra aterrima	2.8	FC	1	2.8		0		0		0		0		0		0
Chimarra obscurus	2.8	FC	1	2.8		0		0		0		0		0		0
Hydroporus sp.	8.6	PI		0		0	2	17.2	1	8.6		0		0		0
Ancyronyx variegata	6.5	SC	8	52	11	71.5	1	6.5	2	13		0		0		0
Dubiraphia sp.	5.9	SC		0	5	29.5		0	3	17.7		0	1	5.9		0
Macronychus glabratus	4.6	SH	3	13.8	1	4.6		0		0		0		0	3	13.8
Microcylloepus pusillus	2.1	SC		0		0		0		0		0		0	3	6.3
Optioservus sp.	2.4	SC	1	2.4		0		0		0		0		0		0
Stenelmis sp.	5.1	SC	2	10.2	11	56.1	1	5.1		0		0		0	6	30.6
Anchytarsus bicolor	3.6	SH	1	3.6		0		0		0		0		0		0
Bezzia/Palpomyia gp.	6.9	P	1	6.9		0		0		0		0		0		0
Chaoborus punctipennis	8.5	P		0		0		0	1	8.5	5	42.5		0		0

APPENDIX TABLE A-3
Benthic Macroinvertebrate Species Observed - NCBI
Progress Energy Carolinas Biological Assessment

SPECIES	TV	FFG	BH-1		NB-2		LW-3		WO-4		BB-5		JB-6		UC-7	
			Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV
Ablabesmyia mallochi	7.2	P	1	7.2	12	86.4	3	21.6	1	7.2		0	4	28.8		0
Ablabesmyia rhamphe gp.	7.2	P	4	28.8	5	36	2	14.4	8	57.6		0	6	43.2		0
Chironomus sp.	9.6	CG		0	4	38.4	75	720	4	38.4	28	268.8	1	9.6		0
Cladotanytarsus sp.	4.1	FC	55	225.5		0	1	4.1		0		0		0		0
Conchapelopia sp.	8.4	P	2	16.8	7	58.8		0	1	8.4		0	9	75.6	22	184.8
Corynoneura sp.	6	CG		0	1	6		0		0		0		0		0
Cryptochironomus sp.	6.4	P	1	6.4		0		0	1	6.4		0		0		0
Dicrotendipes neomodestus	8.1	CG	7	56.7		0		0		0		0	6	48.6		0
Dicrotendipes simpsoni	10			0	1	10	3	30	1	10	4	40		0		0
Kiefferulus sp.	8			0		0	7	56		0	4	32		0		0
Labrundinia sp.	5.9	P	1	5.9	3	17.7		0		0		0	2	11.8	1	5.9
Microtendipes pedellus gp.	5.5	CG	2	11	6	33		0		0		0		0		0
Natarsia sp.	10			0		0		0	5	50		0		0	1	10
Nilotanypus sp.	3.9	P		0		0	1	3.9		0	1	3.9		0		0
Nilothauma sp.	5	CG		0	1	5		0		0		0		0	1	5
Parachironomus sp.	9.4	CG		0		0		0	3	28.2		0		0		0
Paracladopelma sp.	5.5	CG		0	1	5.5		0		0		0	2	11		0
Parakiefferiella sp.	5.4	CG	2	10.8		0		0		0		0		0		0
Paratanytarsus sp.	8.5	CG	1	8.5	3	25.5		0		0		0	3	25.5		0
Paratendipes sp.	5.1	CG		0	1	5.1		0		0		0	1	5.1		0
Pentaneura sp.	4.7	CG	1	4.7	2	9.4		0		0		0		0		0
Polypedilum flavum (convictum)	4.9	SH	3	14.7		0		0		0		0	3	14.7	10	49
Polypedilum fallax	6.4	SH	2	12.8		0		0		0		0		0		0
Polypedilum halterale gp.	7.3	SH	4	29.2	4	29.2	9	65.7		0		0		0		0
Polypedilum illinoense	9	SH		0	3	27	31	279	4	36	8	72	3	27		0
Procladius sp.	9.1	P		0		0		0	12	109.2	1	9.1	17	154.7	2	18.2
Stenochironomus sp.	6.5	SH	3	19.5	8	52		0		0		0		0		0
Sublettea coffmani	1.6		2	3.2		0		0		0		0		0		0
Tanytarsus sp.	6.8	FC	24	163.2	10	68	7	47.6		0		0	11	74.8	4	27.2

APPENDIX TABLE A-3
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SPECIES	TV	FFG	BH-1		NB-2		LW-3		WO-4		BB-5		JB-6		UC-7	
			Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV	Species	Species*TV
Thienemanniella xena	5.9	CG	4	23.6		0		0		0		0		0		0
Tribelos jucundum	6.3		2	12.6	2	12.6	1	6.3	44	277.2	3	18.9	3	18.9		0
Xylotopus par	6	SH	1	6		0		0		0		0		0		0
Anopheles sp.	8.6	FC		0		0		0		0	2	17.2	1	8.6		0
Empididae	7.6	P		0		0		0		0		0		0		0
Simulium sp.	6	FC		0		0		0		0		0		0	2	12
Chrysops sp.	6.7	PI		0		0	4	26.8		0	1	6.7		0		0
Antocha sp.	4.3	CG	1	4.3		0		0		0		0		0		0
Hexatoma sp.	4.3	P	1	4.3		0		0		0		0		0		0
TOTAL NO. OF ORGANISMS			**164**		**174**		**180**		**174**		**66**		**182**		**182**	
SUM OF SPECIES*TV			**902**		**1,209**		**1,552**		**1,329**		**557**		**1,174**		**1,174**	
NC BIOTIC INDEX (Assigned values)			**5.50**		**6.95**		**8.62**		**7.64**		**8.43**		**6.45**		**6.45**	

Notes:
CG = Collector Gatherers
FC = Filter Collectors
P = Predators
PI = Piercers
SC = Scrapers
SH = Shredders
TV = Tolerance Value
FFG = Functional Feeding Group
NCBI = North Carolina Biotic Index