MACROINVERTEBRATE AND MUSSEL REPORT

PARR FAIRFIELD HYDROELECTRIC PROJECT
FERC No. 1894

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

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1.0 INTRODUCTION

The Parr Fairfield Hydroelectric Project ("Parr Fairfield" or "Project") (FERC No. 1894) is a federally licensed hydroelectric facility owned and operated by South Carolina Electric & Gas Company (SCE&G), a subsidiary of SCANA Corporation. The Parr Fairfield Project consists of two separate developments, including the Parr Hydroelectric Development and the Fairfield Pumped Storage Development. Since 1954, the Project has maintained a Federal Energy Regulatory Commission (FERC) license for operation and is actively seeking renewal for the current license, which expires in June, 2020.

Originating in the Blue Ridge Mountains of North Carolina, the Broad River predominately flows southeasterly into South Carolina to meet the Saluda River, forming the Congaree River and later the Santee River, along its course to the Atlantic Ocean. The Project is located in Fairfield and Newberry Counties, South Carolina, near the town of Jenkinsville. Situated on the Broad River, Parr Shoals Dam creates the 4,400 acre Parr Reservoir, which acts as the lower reservoir for the Fairfield Pumped Storage Development. Lake Monticello, formed by a series of four earthen dams at Frees Creek, is the 6,800 acre upper reservoir of the Fairfield Pumped Storage Development. The Project Boundary Line is depicted in Figure 1-1.

As part of the relicensing process, SCE&G is examining the water quality within the Project area by assessing the macroinvertebrate and mussel populations within the project area waterways, including the Broad River, Parr Reservoir, Parr Shoals Dam tailrace, and Monticello Reservoir. This report includes a compilation of the mussel surveys conducted by the South Carolina Department of Natural Resources (SCDNR) and SCANA Services personnel with Alderman Environmental Services, Inc., and macroinvertebrate studies conducted by SCANA Services personnel with Carnagey Biological Services, LLC.

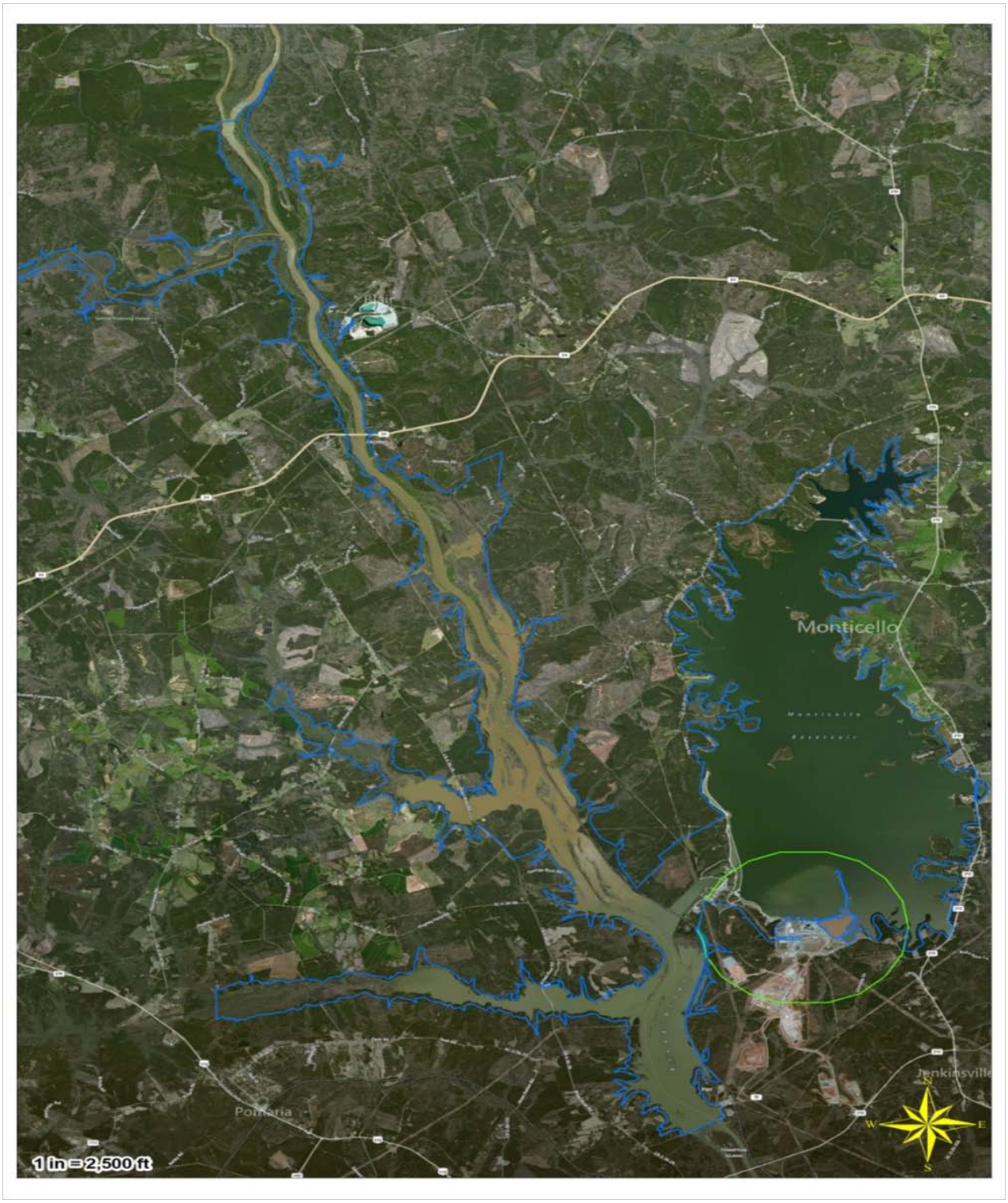


FIGURE 1-1 PARR FAIRFIELD PROJECT BOUNDARY LINE

1.1 GOALS AND OBJECTIVES

The goal of this report is to collect and present existing macroinvertebrate and mussel data for the Parr Reservoir, Lake Monticello, and the downstream reach of the Broad River below the Parr Dam, to assist in describing the past and current water quality of these areas. In addition, this report serves to establish a baseline for the macroinvertebrate and mussel communities found within the Project Area.

1.2 BACKGROUND INFORMATION

Mussel and macroinvertebrate surveys were conducted to evaluate the condition of the waters associated with the Project. Freshwater mussels and benthic organisms commonly serve as indicators, or biological monitors, of water quality. As natural filter feeders, mussels strain out suspended particles and pollutants from the water column and help improve water quality (NRCS, 2007). The presence or absence of certain species can indicate the level of water quality in a specific area.

Macroinvertebrates are also excellent indicators of water quality. As with mussels, the taxonomic composition of the macroinvertebrate community at a specific site can accurately depict the health of that waterbody. Since macroinvertebrates have limited mobility, a site-specific assessment is assured.

2.0 METHODOLOGY

2.1 MUSSELS

2.1.1 SCDNR MUSSEL SURVEY

During 2007, a survey was conducted by the SCDNR to assess the status of freshwater mussels on the Broad River and Parr Reservoir. The team, led by a SCDNR malacologist, surveyed 60 sites along the Broad River, and 5 sites on selected tributaries. The survey sites are depicted on Figure 2-1.

Search methods for this survey differed based on water depth and clarity, and included visual searches, and searches utilizing snorkeling, SCUBA diving, and bathyscopes. Depending on various factors such as suitable habitat present, water clarity and search effectiveness, the amount of time spent searching each site varied. Repeated trips were made to the sites at the Parr Reservoir so that SCUBA could be utilized to examine the deeper areas of the reservoir. Identification of the mussel species collected occurred on site by the survey team.

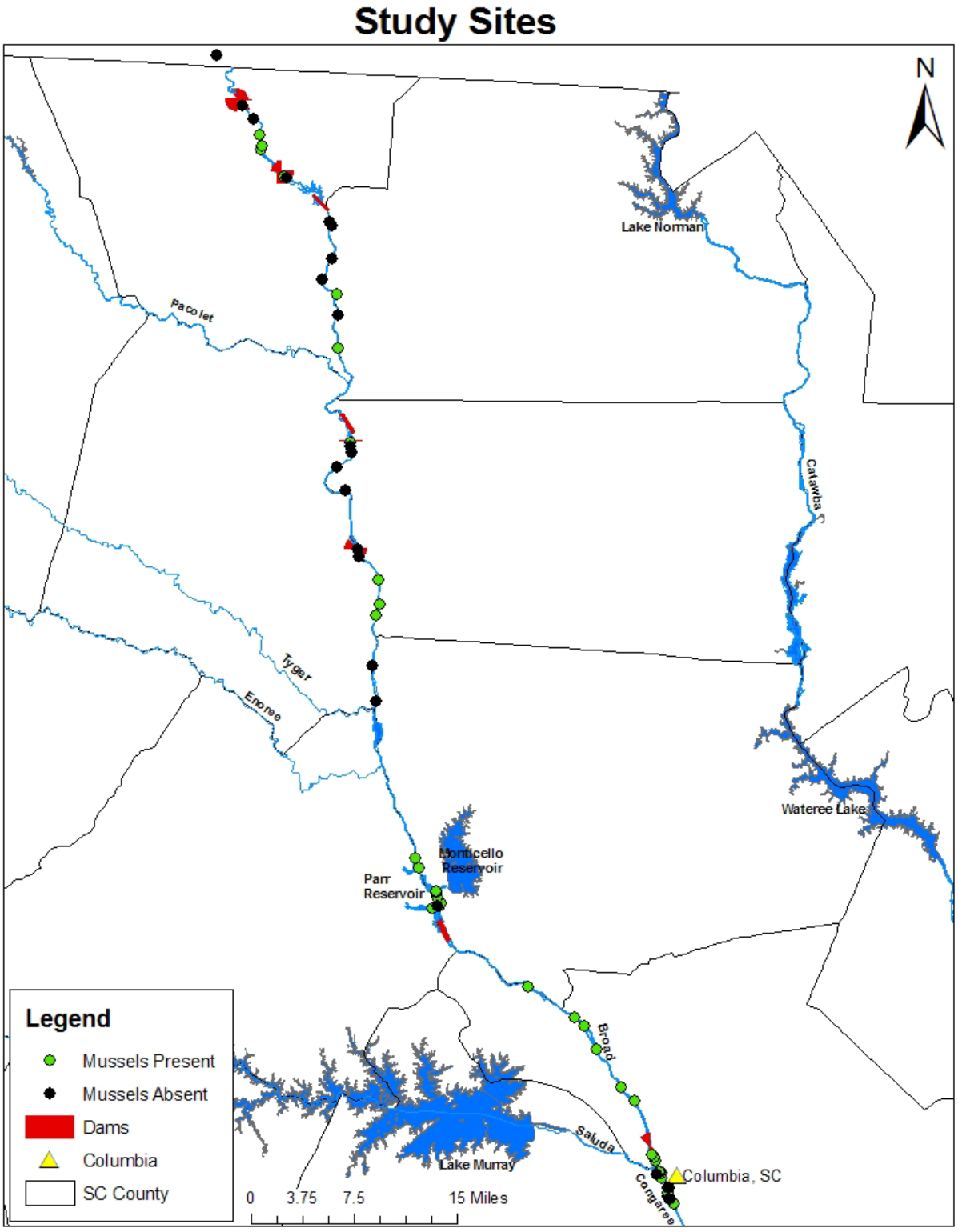


FIGURE 2-1 MUSSEL SURVEY SITES ON THE BROAD RIVER AND PARR RESERVOIR

2.1.2 SCANA MUSSEL SURVEY

In 2012, Alderman Environmental Services Inc. was contracted by SCANA Services, Inc. to perform a freshwater mussel survey on the Broad River immediately downstream of the Parr Shoals Dam, as a follow-up to the macroinvertebrate community assessment conducted by Carnagey Biological Services, LLC (see Section 2.2). The survey area included the Broad River east of Hampton Island on the Fairfield/Newberry county line and immediately downstream of the Parr Hydroelectric Development. The exact survey area is displayed in Figure 2-2.

During the study, flows were maintained by SCE&G at low levels to facilitate the surveys. Thirteen areas were surveyed by a team of four malacologists for freshwater mussels using bathyscopes and tactile techniques. Specific sites within the survey areas were selected due to various mussel species' microhabitat needs. The survey was conducted on October 22 and 23, 2012.

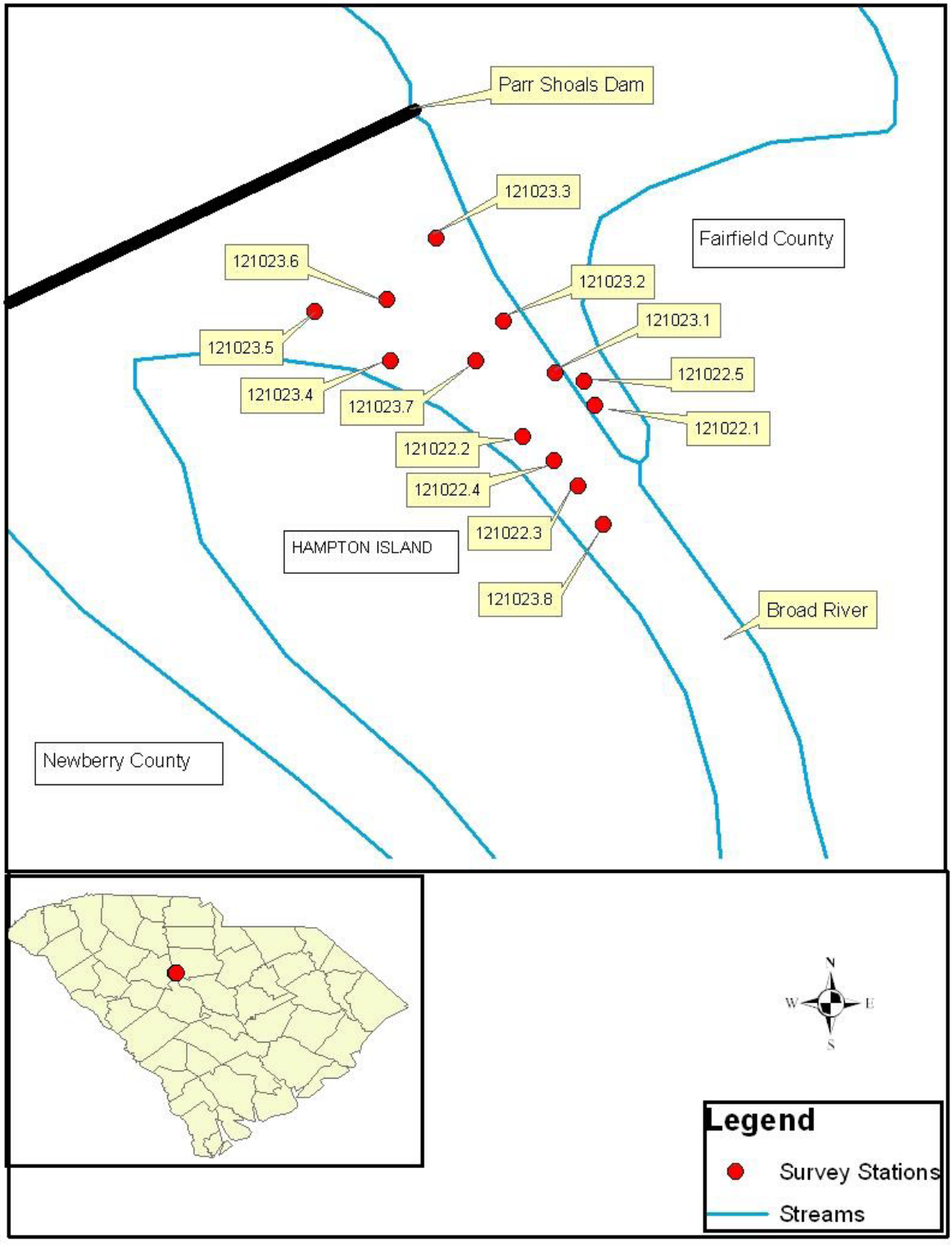


FIGURE 2-2 MUSSEL STUDY AREA AND SURVEY STATIONS

2.2 MACROINVERTEBRATES

In association with the Virgil C. Summer Nuclear Station (VCSNS) expansion, SCE&G conducted baseline studies to examine the macroinvertebrate communities within Parr Reservoir and Lake Monticello. In order to maintain the provisions of the Clean Water Act Section 401 water quality certification issued to the VCSNS Units 2 & 3, SCE&G has continued to monitor these macroinvertebrate populations in Parr Reservoir.

2.2.1 BASELINE STUDIES

In conjunction with the Nuclear Regulatory Commission (NRC) licensing process for the expansion of VCSNS, SCE&G conducted macroinvertebrate community assessments at various locations on Lake Monticello and Parr Reservoir during 2008 and 2009. The objective of these assessments was twofold with the first objective being to determine the condition of the macroinvertebrate community at the new water treatment intake and new raw water intake in Lake Monticello, as well as the condition of the macroinvertebrate community at the new cooling tower blowdown discharge location in Parr Reservoir. The second objective of this study was to document the macroinvertebrate community in and around the VCSNS.

In order to accomplish these objectives, SCANA Services personnel collected petite Ponar macroinvertebrate samples from five locations within Lake Monticello and Parr Reservoir on several different occasions. Samples were collected on June 18, 2008, September 18, 2008, January 22-23, 2009, April 27, 2009, and September 11, 2012. The collected samples were identified and the data analyzed by Carnagey Biological Services, LLC.

Macroinvertebrate sampling was performed at five sites within Parr Reservoir and Lake Monticello. The Parr Reservoir Control site was located upstream of Hellers Creek, approximately 9.0 kilometers above the Parr Shoals Dam. The Parr Reservoir New Blowdown Discharge site was located at the location of the proposed new cooling tower blowdown discharge from the proposed two new nuclear units at the VCSNS, and approximately 1.0 kilometers upstream of the Parr Shoals Dam. The Monticello Reservoir Control was located on the western side of the lake, approximately 5.0 kilometers north of the VCSNS. The Monticello Reservoir New Water Treatment Intake was located at the proposed intake point for the water

treatment plant. The Monticello Reservoir Raw Water Intake was located at the proposed intake point for the VCSNS. These five sample sites are shown on Figure 2-3.

Quantitative sampling was performed using a petite Ponar grab sampler, as described in method 10500 (APHA, 1995). Five random replicate (15 X 15 cm) Ponar grab samples of sediment were collected from the lake at each location. Replicates were sieved in the field with a U.S. Standard No. 35 sieve (0.500 mm mesh), then placed individually in plastic bags, preserved with 85% ethanol, and transported to the laboratory for analysis. Upon return to the laboratory, all samples were washed over a U.S. Standard No. 35 sieve and organisms were sorted from the remaining material using forceps and the aid of a stereomicroscope. The organisms were preserved in 70% ethanol, and identified to the lowest positive taxonomic level.

In order to extract the greatest amount of information possible from the data collected, several types of analyses were performed. Bioassessment metrics allow for the comparison of macroinvertebrate communities at the various sampling sites and are based the overall taxonomic composition and the known tolerance levels and life history strategies of the organisms encountered. Changes in taxonomic composition were determined using the metrics outlined in Rapid Bioassessment Protocol III of *Rapid bioassessment protocols for use in streams and rivers* (Plafkin et al. 1989). These metrics include taxa richness, EPT index, Chironomidae taxa and abundance, ratio of EPT and Chronomidae abundance, ratio of scraper/scraper and filtering collectors, percent contribution of dominant taxon, and the North Carolina biotic index (NCBI). Single factor ANOVA analyses were also performed on the data, to detect trends and differences between the two bodies of water, Lake Monticello and Parr Reservoir.

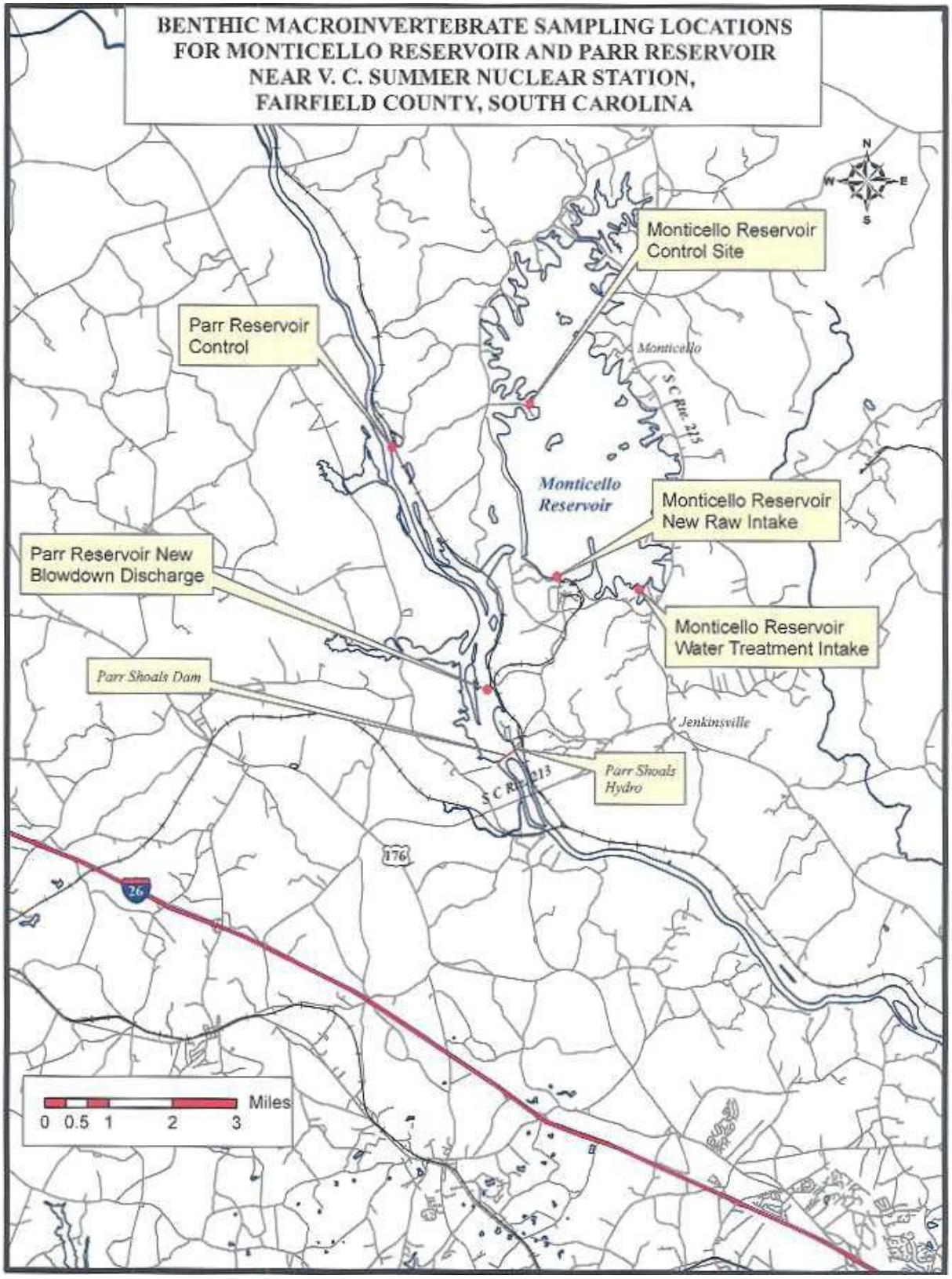


FIGURE 2-3 BASELINE MACROINVERTEBRATE ASSESSMENT SAMPLING LOCATIONS

2.2.2 ONGOING STUDIES

In addition to the baseline studies performed in 2008 and 2009, SCE&G has continued its study of Parr Reservoir with a macroinvertebrate assessment completed on September 11, 2012, to satisfy provisions of the Clean Water Act Section 401 water quality certification issued by the South Carolina Department of Health and Environmental Control (SCDHEC) for the VCSNS expansion. The objective of this and future assessments is to monitor the condition of the macroinvertebrate community in Parr Reservoir and the Broad River immediately below the Parr Shoals Dam to determine if there are any effects due to construction and operation of the cooling tower blowdown discharge diffuser associated with the VCSNS expansion. Samples will continue to be collected on an annual basis between the months of August and October until 5 years after the start-up of the VCSNS Unit 3. Unit 3 is scheduled to come online in 2018.

Collections of macroinvertebrates were made from two sampling transects in Parr Reservoir near the VCSNS and one location below Parr Shoals Dam. Parr Upstream sampling site was located upstream of Hellers Creek, approximately 9.0 kilometers above Parr Shoals Dam. Units 2 & 3 Discharge sampling site was located within the area of the proposed new cooling tower blowdown discharge from the two new nuclear units at the VCSNS, and approximately 1.0 kilometers upstream of the Parr Shoals Dam. Parr Tailrace sampling site is located approximately 75 meters below Parr Shoals Dam. Sampling sites are shown in Figure 2-4.

FIGURE 2-4 ONGOING MACROINVERTEBRATE ASSESSMENT SAMPLING LOCATIONS

Quantitative sampling of the macroinvertebrate communities from the Parr Upstream and Units 2 & 3 Discharge sampling transects was performed using a petite Ponar grab sampler, as described in method 10500 (APHA, 1995). Five random replicate (15 X 15 cm) Ponar grab samples of sediment were collected from the reservoir at each sampling point along the two transects. Replicates were sieved in the field with a U.S. Standard No. 35 sieve (0.500 mm mesh), then placed individually in plastic bags, preserved with 85% ethanol, and transported to the laboratory for analysis.

Due to the rocky substrate at the Parr Tailrace sampling site, dredge samples were not collected. Instead an instream macroinvertebrate community rapid bioassessment was conducted at this location. Macroinvertebrates were qualitatively collected at the Parr Tailrace location from all available habitats (e.g., stream margins, leaf packs, aquatic vegetation, water soaked logs and sand deposits) using a D-frame aquatic dip net and by picking organisms from substrates with forceps. Collections from all habitat types were combined to form one aggregate sample and preserved in the field with 80% ethanol.

Upon return to the laboratory, all petite Ponar samples were washed over a U.S. Standard No. 35 sieve to remove any remaining fine debris. Organisms from all three sample locations were sorted from the remaining material using forceps and the aid of a stereomicroscope. The organisms were retained in 80% ethanol, and identified to the lowest positive taxonomic level.

In order to extract the greatest amount of information possible from the data collected, several types of analyses were performed. Bioassessment metrics allow for the comparison of macroinvertebrate communities at the two transects and are based the overall taxonomic composition and the known tolerance levels and life history strategies of the organisms encountered. Changes in taxonomic composition were determined using the metrics outlined in Rapid Bioassessment Protocol III of *Rapid bioassessment protocols for use in streams and rivers* (Plafkin et al. 1989). These metrics include taxa richness, EPT index, Chironomidae taxa and abundance, ratio of EPT and Chronomidae abundance, ratio of scraper/scraper and filtering collectors, percent contribution of dominant taxon, and the North Carolina biotic index (NCBI). Single factor ANOVA analyses were also performed on the data, to detect trends and differences between the two Parr Reservoir transects. Data from Parr Tailrace was analyzed separately.

SCE&G is also conducting a macroinvertebrate study in the Broad River below the Neal Shoals Dam, located above the Parr Reservoir. The collected samples have been identified and the data analyzed by Carnagey Biological Services, LLC. This study is ongoing, but information collected thus far is presented in Appendix A.

3.0 RESULTS

3.1 MUSSELS

3.1.1 SCDNR MUSSEL SURVEY

The habitat of the surveyed stretch of the Broad River above Parr Dam was turbid, with lower substrate heterogeneity and less stable river bed substrates. Because of this many of the sites surveyed yielded few or no mussel species.

The section of the river from Parr Reservoir down to the Columbia Dam contained dense populations of mussels, although the diversity was low compared to other surveyed areas. The habitat within this area included fairly clear water and very stable substrates of gravel beds and large boulders. Shoals and rapids were also abundantly present in this stretch of the river, which contributed to an increased dissolved oxygen content. Within Parr Reservoir, the habitat is unique due to the water level fluctuations caused by the Fairfield Pumped Storage Development. Because of this, and the riverine characteristic of the reservoir, the species composition of Parr Reservoir is similar to that of the non-impounded sections of the Broad River.

A general inventory of species collected during the study is displayed in Table 3-1.

TABLE 3-1 GENERAL INVENTORY OF MUSSELS IN BROAD RIVER, 2007[A B]

site no.	latitude	longitude	date	person-hours	species	no. live	no. shells	CPUE
Upper Congaree River								
1	33.9688	-81.04007	5/31	0.4	*E. lanceolata* complex	1	0	2.5
					E. roanokensis	1	0	2.5
2	33.97004	-81.03893	5/31	0.5	*E. complanata*	2	0	4.0
					E. lanceolata complex	3	0	6.0
					E. roanokensis	2	0	4.0
					V. delumbis	1	0	2.0
3	33.97513	-81.04359	5/31	0.33	*E. lanceolata* complex	1	0	3.0
					E. roanokensis	5	0	15.0
					L. cariosa	1	0	3.0
4	33.97782	-81.04698	5/16	0.67	*E. roanokensis*	1	0	1.5
5	33.97812	-81.04536	5/16	1.67	*E. complanata*	5	0	3.0
					E. lanceolata complex	1	1	0.6
					E. roanokensis	26	0	15.6
					L. cariosa	2	0	1.2
					V. delumbis	1	0	0.6
6	33.98165	-81.04714	4/25	0.47	*E. complanata*	0	1	0.0
					E. lanceolata complex	1	0	2.1
7	33.98669	-81.04763	5/16	1.25	none	-	-	-
8	33.98708	-81.04551	5/16	3.75	*E. complanata*	9	0	2.4
					E. congaraea	1	0	0.3
					E. lanceolata complex	2	0	0.5
					E. roanokensis	73	0	19.5
					L. cariosa	1	0	0.3
					V. delumbis	1	0	0.3
			5/31	0.83	*E. complanata*	5	0	6.0
					E. lanceolata complex	3	0	3.6
					E. roanokensis	51	0	61.4
			8/14	1.5	*L. cariosa*	1	0	1.2
					E. complanata	1	0	0.7
					E. lanceolata complex	3	0	2.0
					E. roanokensis	12	0	8.0
					L. cariosa	4	0	2.7
					V. delumbis	1	0	1.2
9	33.996	-81.052	5/16	0.67	*E. complanata*	1	0	1.5
					E. lanceolata complex	1	1	1.5
10	33.99732	-81.05421	4/25	0.43	*E. complanata*	0	2	-
					E. lanceolata complex	0	2	-
					E. roanokensis	0	1	-
11	34.00077	-81.06044	4/25	0.17	None	-	-	-
12	34.00301	-81.05532	6/20	1.0	*E. complanata*	1	0	1
					E. roanokensis	1	0	1
13	34.00421	-81.05748	5/15	5.0	*E. complanata*	8	0	1.6
					E. congaraea	3	0	0.6
					E. lanceolata complex	21	1	4.2
					E. roanokensis	22	0	4.4
					L. radiata	2	0	0.4
					L. nasuta	1	0	0.2
					Villosa delumbis	14	1	2.8
Broad River below Parr Reservoir								
18	34.07909	-81.08981	3/27	1.5	*E. complanata*	48	1	32
					E. lanceolata complex	26	0	17.3
					V. delumbis	1	0	0.4
19	34.0934	-81.10606	3/27	1.17	*E. complanata*	27	6	23.1
					E. lanceolata complex	1	14	0.9
					U. carolinamus	10	0	8.5
20	34.13413	-81.13848	3/28	0.5	*E. complanata*	37	0	74
					E. lanceolata complex	14	0	28

21	34.15881	-81.15317	3/28	0.5	*E. complanata* *E. lanceolata complex*	4 4	0 0	8 8
22	34.16693	-81.16542	3/28	0.75	*E. complanata* *E. lanceolata complex* *U. carolinanus* *V. delumbis*	44 4 1 2	0 0 0 0	58.7 5.3 1.3 2.6
23	34.19955	-81.22483	3/28	1.33	*E. complanata* *E. lanceolata complex* *U. carolinanus* *V. delumbis*	3 8 38 7	0 0 0 0	2.3 6.0 28.5 5.3
24	missing	missing	3/29	0.75	*E. complanata* *E. lanceolata complex* *V. delumbis*	13 24 2	0 0 0	17.3 32.0 2.7
25	missing	missing	3/29	1.0	*E. complanata* *E. lanceolata complex* *V. delumbis*	63 35 11	0 0 0	63.0 35.0 11.0
Parr Reservoir								
26	34.28227	-81.34766	8/31 9/26	0.75 2.17	*E. complanata* *E. lanceolata* complex *V. delumbis* *E. complanata* *E. lanceolata* complex *U. carolinanus* *V. delumbis*	1 47 3 1 25 1 4	0 16 0 0 9 0 1	1.3 62.7 4.0 0.5 11.5 0.5 1.8
27	34.28503	-81.34099	9/26	2.33	none	0	0	-
28	34.2859	-81.33821	8/31 9/26	0.33 2.0	*E. lanceolata* complex *E. lanceolata* complex *U. carolinanus*	1 4 2	6 4 0	3.0 2.0 1.0
					U. imbecillis *V. delumbis*	0 1	1 0	- 0.5
29	34.29477	-81.34232	9/27	2.0	*E. lanceolata* complex *U. carolinanus* *V. delumbis*	16 2 2	7 0 0	8.0 1.0 1.0
30	34.30006	-81.34343	8/31 9/26	0.58 2.0	*E. complanata* *E. lanceolata* complex *E. lanceolata* complex *V. delumbis*	1 18 2 16	0 3 0 0	1.7 31.0 1.0 8.0
31	34.32524	-81.36617	9/7 9/27	0.5 2.0	*E. lanceolata* complex *V. delumbis* *E. lanceolata* complex	3 1 1	0 0 0	6.0 2.0 0.5
32	34.33614	-81.37004	9/7	0.5	*E. lanceolata* complex	0	2	4.0
Broad River above Parr Reservoir								
33	34.50299	-81.42056	4/26	0.27	none	0	0	-
34	34.54028	-81.42664	4/26	0.67	none	0	0	-
35	34.5933	-81.42075	7/16	1.33	*E. lanceolata* complex *V. delumbis*	11 1	0 0	8.3 0.8
36	34.60525	-81.4172	7/16	0.67	*E. lanceolata* complex	1	0	1.5
37	34.63086	-81.41812	7/16	0.67	*E. lanceolata* complex	1	0	1.5
38	34.65604	-81.44328	7/16	0.5	none	0	0	-
39	34.66316	-81.44566	7/16	0.33	none	0	0	-
40	34.72609	-81.46175	8/16	0.17	none	0	0	-
41	34.75092	-81.47244	8/16	0.5	none	0	0	-

42	34.76659	-81.45328	8/16	0.67	none	0	0	-
43	34.77276	-81.45538	8/16	0.67	none	0	0	-
44	34.77607	-81.45499	8/16	1.0	*E. lanceolata* complex	3	1	3.0
45	34.8766	-81.47118	8/22	1.0	*E. lanceolata* complex	2	0	2.0
46	34.91208	-81.47171	8/22	1.0	none	0	0	0.0
47	34.93425	-81.47374	8/22	1.67	*E. lanceolata* complex	5	1	3.0
48	34.94893	-81.49248	7/19	0.5	none	0	0	-
49	34.97158	-81.48045	7/19	0.33	none	0	0	-
50	35.00663	-81.48038	7/19	0.5	none	0	0	-
51	35.01047	-81.48329	7/19	0.57	none	0	0	-
52	35.02319	-81.21877	7/19	0.67	none	0	0	-
53	35.05651	-81.5395	9/13	0.83	none	0	0	-
54	35.05773	-81.54175	9/13	1.25	*E. lanceolata* complex	1	0	0.8
55	35.08725	-81.57247	9/5	0.5	*E. lanceolata* complex	3	0	6.0
56	35.09025	-81.57183	9/5	1.0	*E. complanata* *E. lanceolata* complex *E. roanokensis*	1 2 1	2 0 0	1.0 2.0 1.0
57	35.10257	-81.57387	9/5	0.83	*E. complanata* complex	0	1	-
58	35.11959	-81.58197	9/5	0.5	none	0	0	-
59	35.1335	-81.59599	9/5	0.33	none	0	0	-
60	35.1869	-81.6302	9/18	1.5	none	0	0	-
Selected tributaries of the Upper Broad								
Guyon Moore Creek	34.98664	-81.47167	10/9	1.0	none	0	0	-
Buffalo Creek	35.1275	-81.55068	10/9	1.33	none	0	0	-
Kings Creek	35.04171	-81.47832	10/9	1.5	none	0	0	-
Thickety Creek	34.92847	-81.52916	10/11	1.0	none	0	0	-
Pacolet River	34.8736	-81.53146	10/11	2.5	none	0	0	-

[a] CPUE= catch per unit effort in live mussels per person hour
[b] Data from SCDNR's 2009 Fish Passage on the Broad River: an assessment of the benefits to freshwater mussels

3.1.2 SCANA MUSSEL SURVEY

According to Alderman, the survey reach provides significant freshwater mussel habitat. During the survey, the highest freshwater mussel diversity in the Broad River Subbasin in North and South Carolina upriver from the Columbia Canal Dam was observed. For many of the species, their highest recorded abundances also occur within this specific river reach. Also, this survey found the most upriver occurrence of the yellow lampmussel (*Lampsilis cariosa*) within the Broad River Subbasin to date. Also, it seems the Roakoke slabshell (*Elliptio roanokensis*) juveniles, which require an anadromous fish host, is being recruited to this area of the Broad

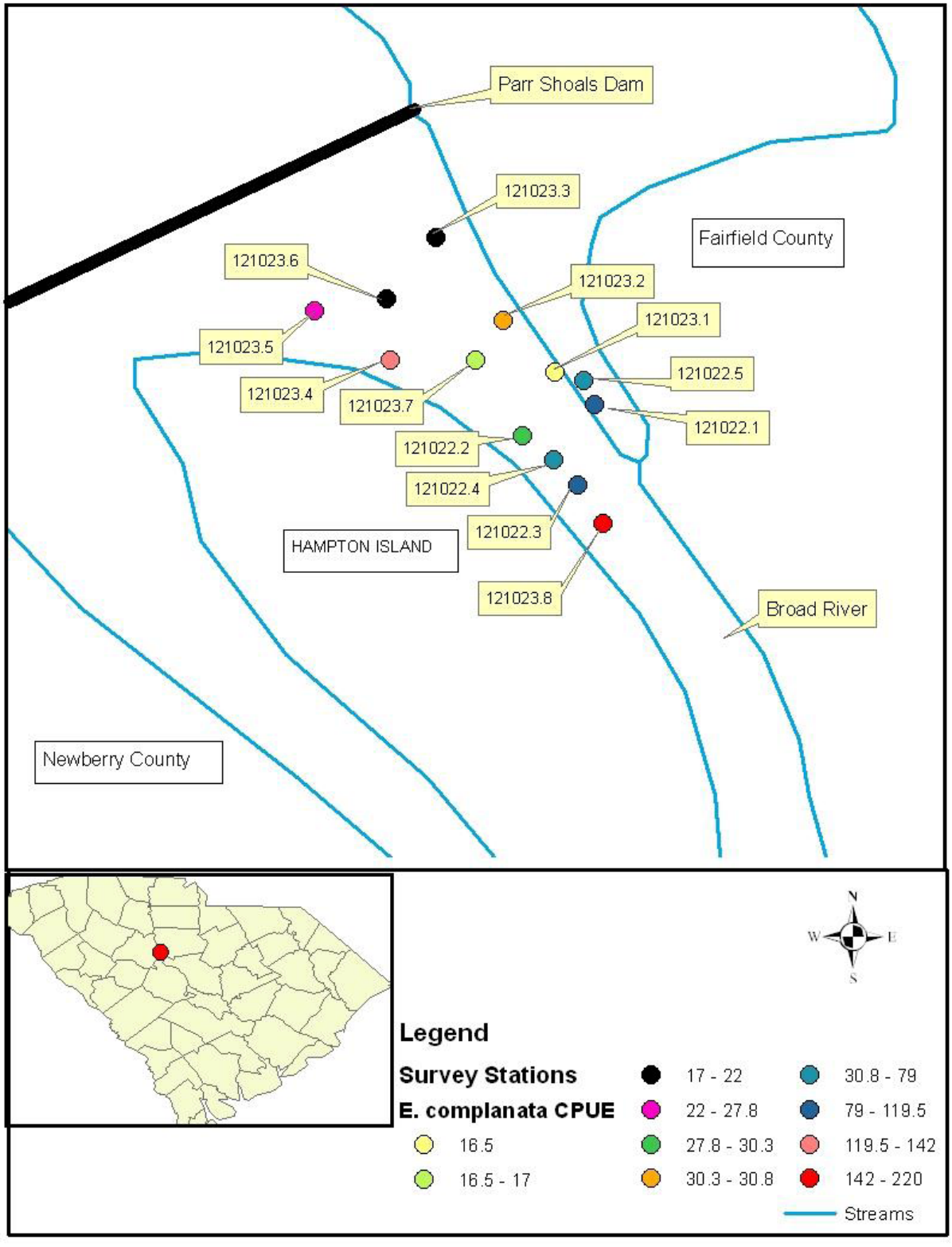
River. This study also found the greatest large river extant eastern creekshell (*Villosa delumbis*) population within the entire Santee Cooper River Basin in North and South Carolina.

Nine freshwater mussel species were documented as existing within the areas surveyed and are listed in Table 3-2.

TABLE 3-2 SCANA SURVEY FRESHWATER MUSSEL INVENTORY

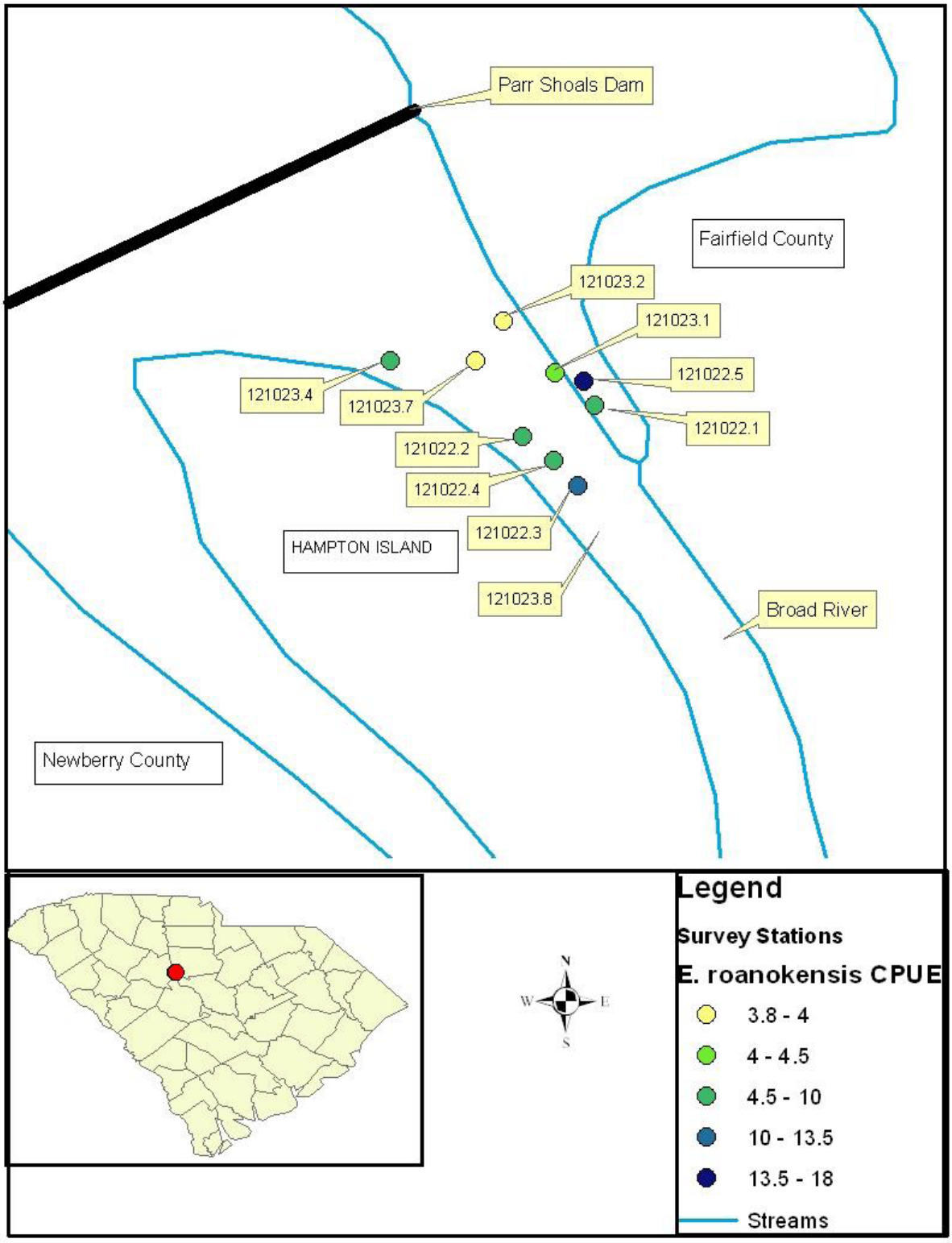
SPECIES DOCUMENTED
Elliptio complanata
E. roanokensis
E. icterina
E. angustata
E. fisheriana
Uniomerus carolinianus
Utterbackia imbecillis
Villosa delumbis
Lampsilis cariosa

The catch-per-unit-effort (CPUE) at each sampling site, for each species, is documented in the figures below.



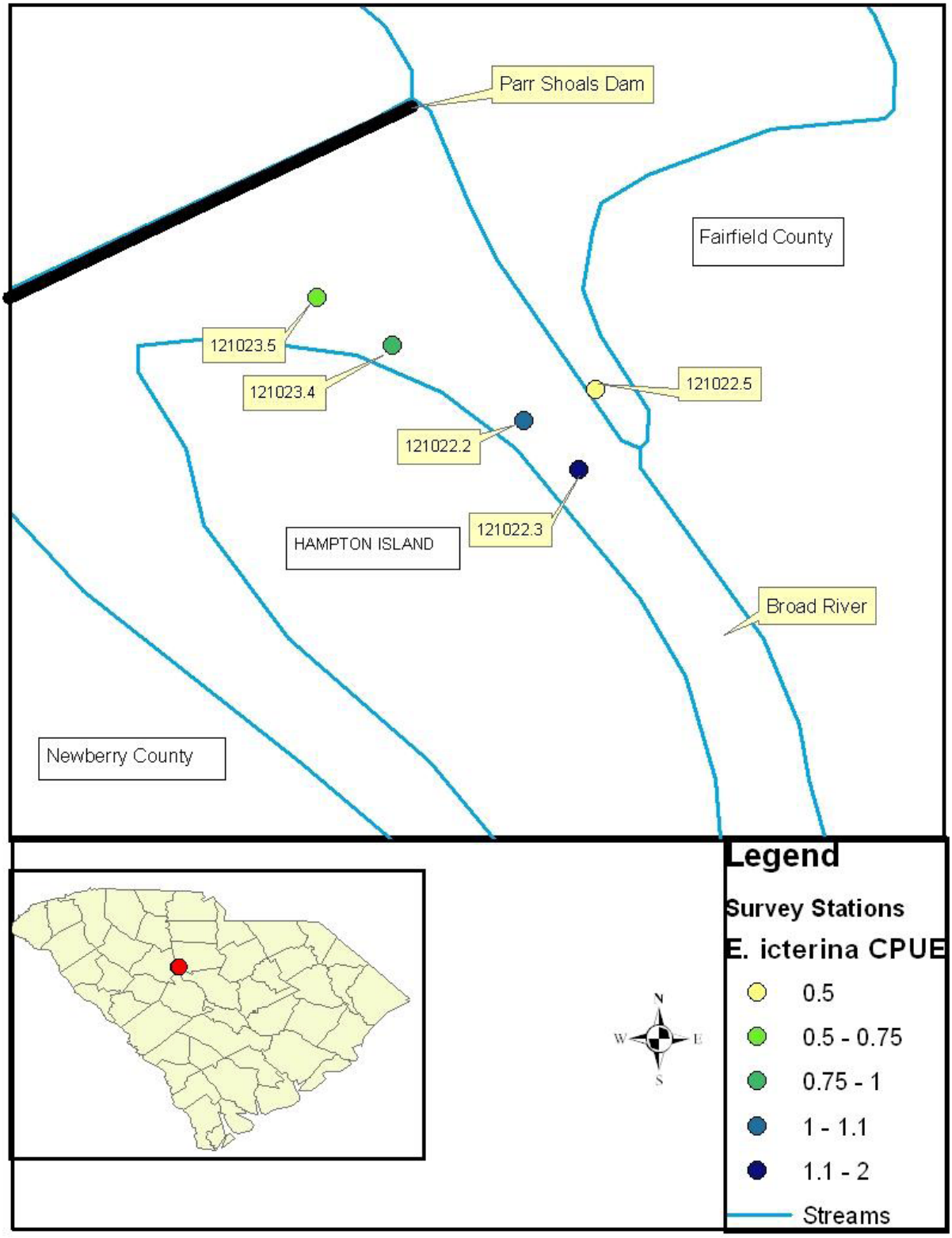
Source: 2012 Alderman Study

FIGURE 3-1 CPUE FOR *ELLIPTIO COMPLANATA*



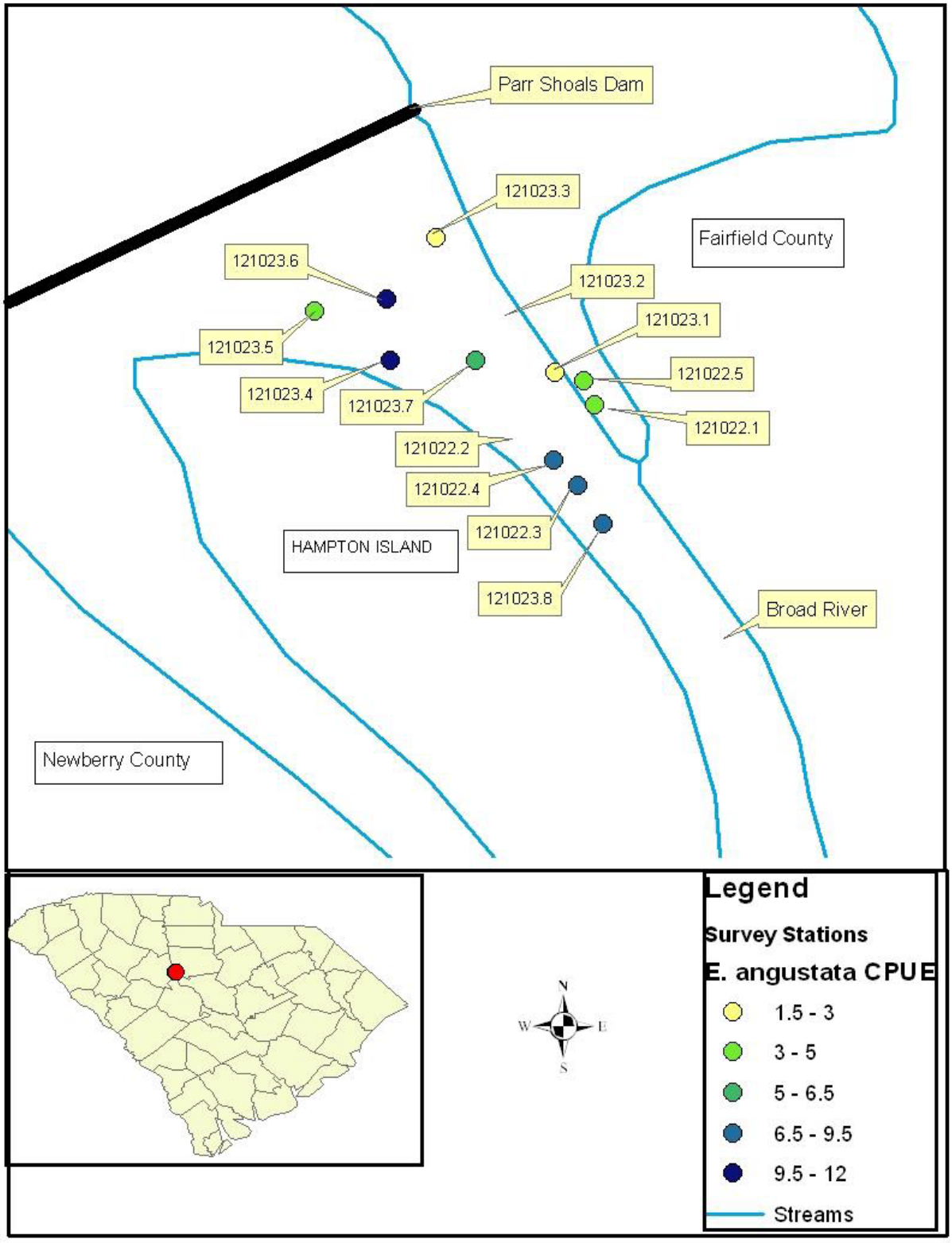
Source: 2012 Alderman Study

FIGURE 3-2 CPUE FOR *ELLIPTIO ROANOKENSIS*



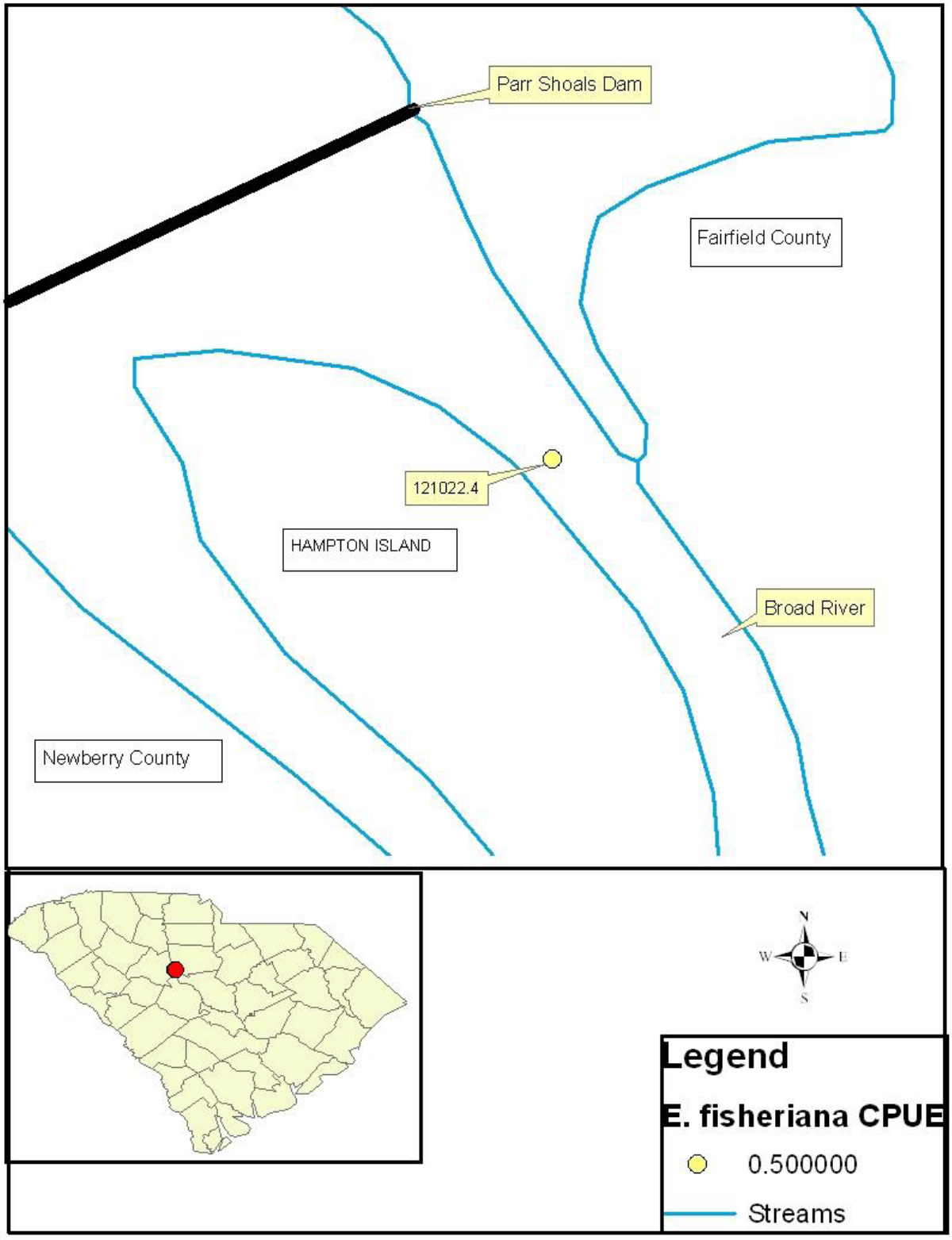
Source: 2012 Alderman Study

FIGURE 3-3 CPUE FOR *ELLIPTIO ICTERINA*



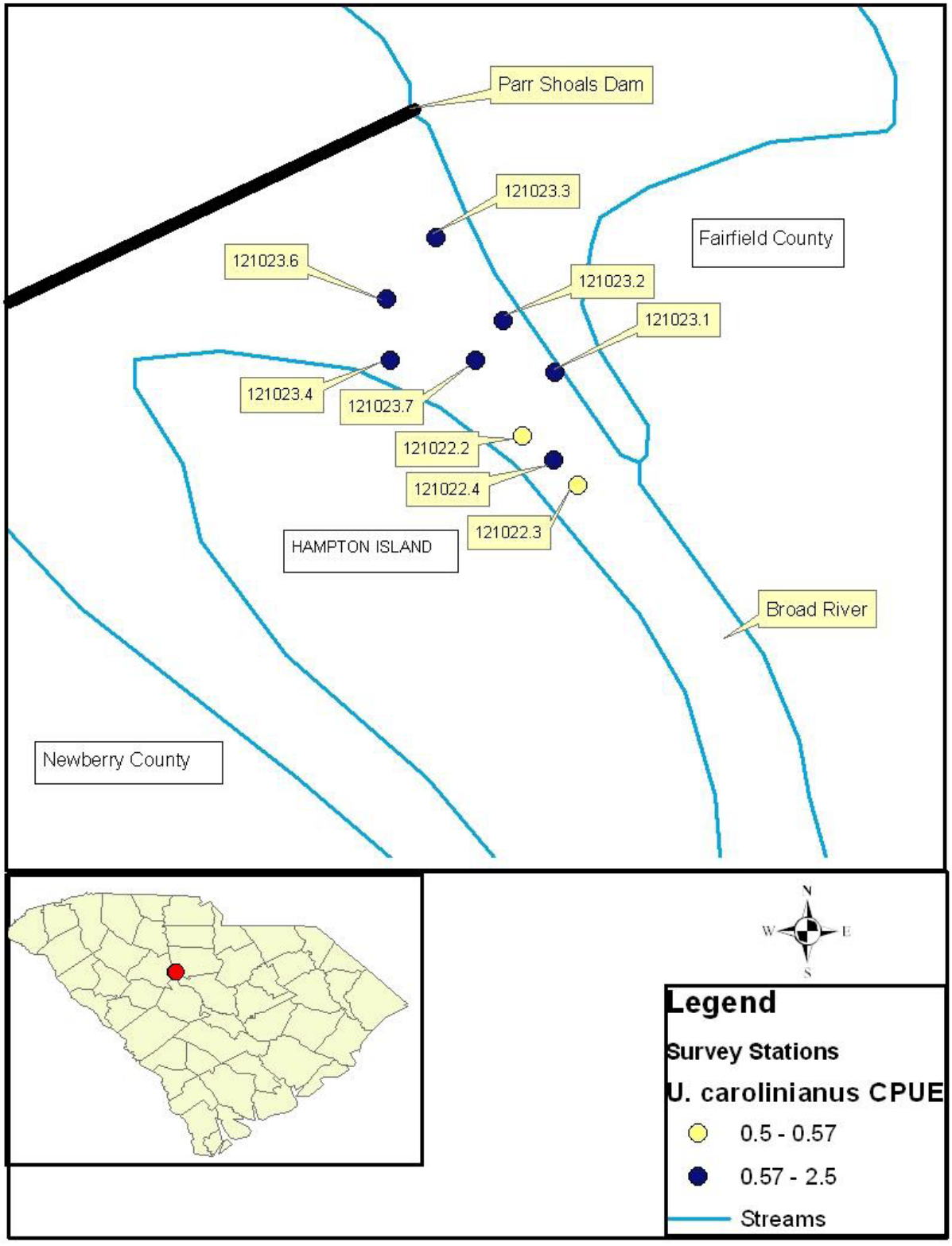
Source: 2012 Alderman Study

FIGURE 3-4 CPUE FOR *ELLIPTIO ANGUSTATA*



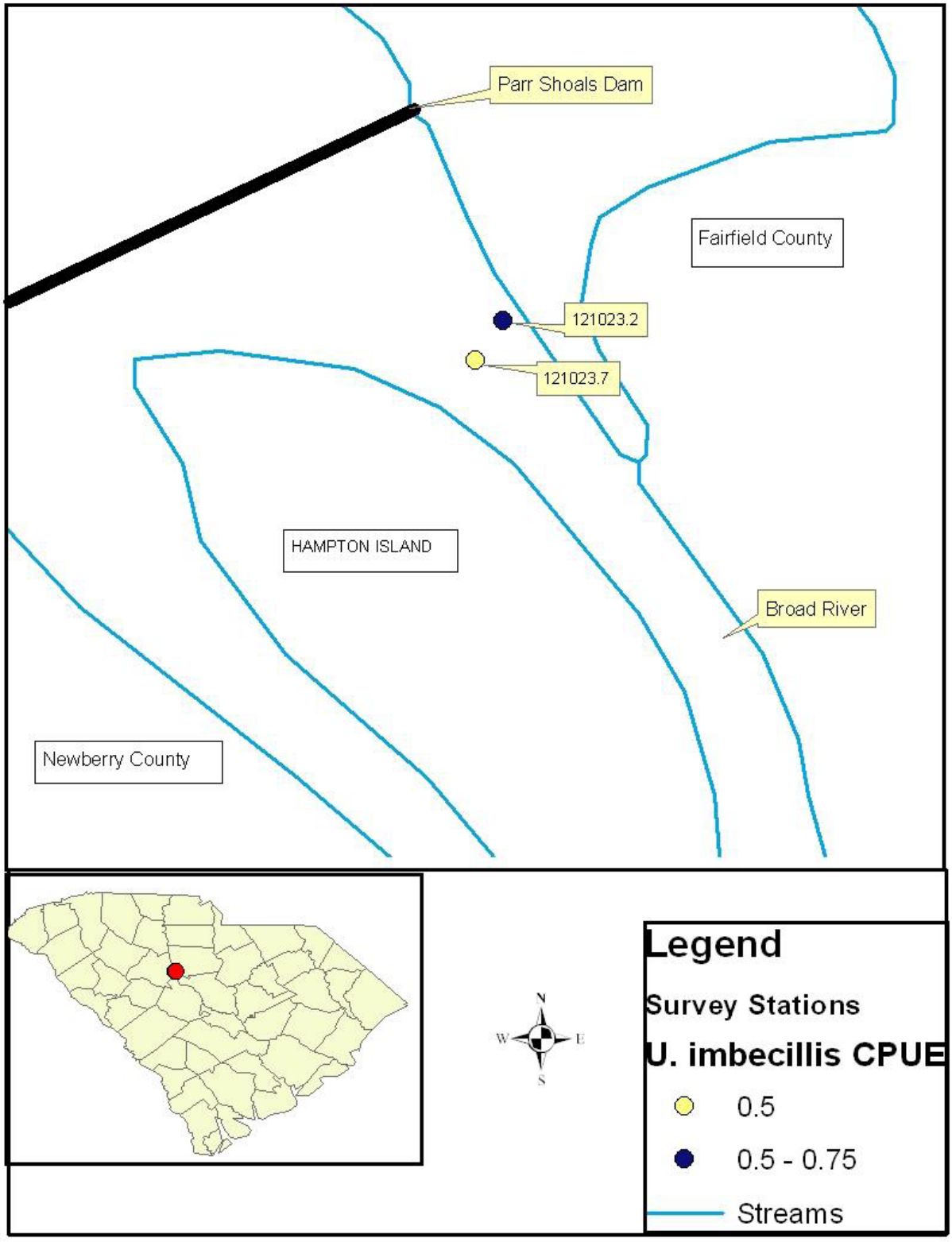
Source: 2012 Alderman Study

FIGURE 3-5 CPUE FOR *ELLIPTIO FISHERIANA*



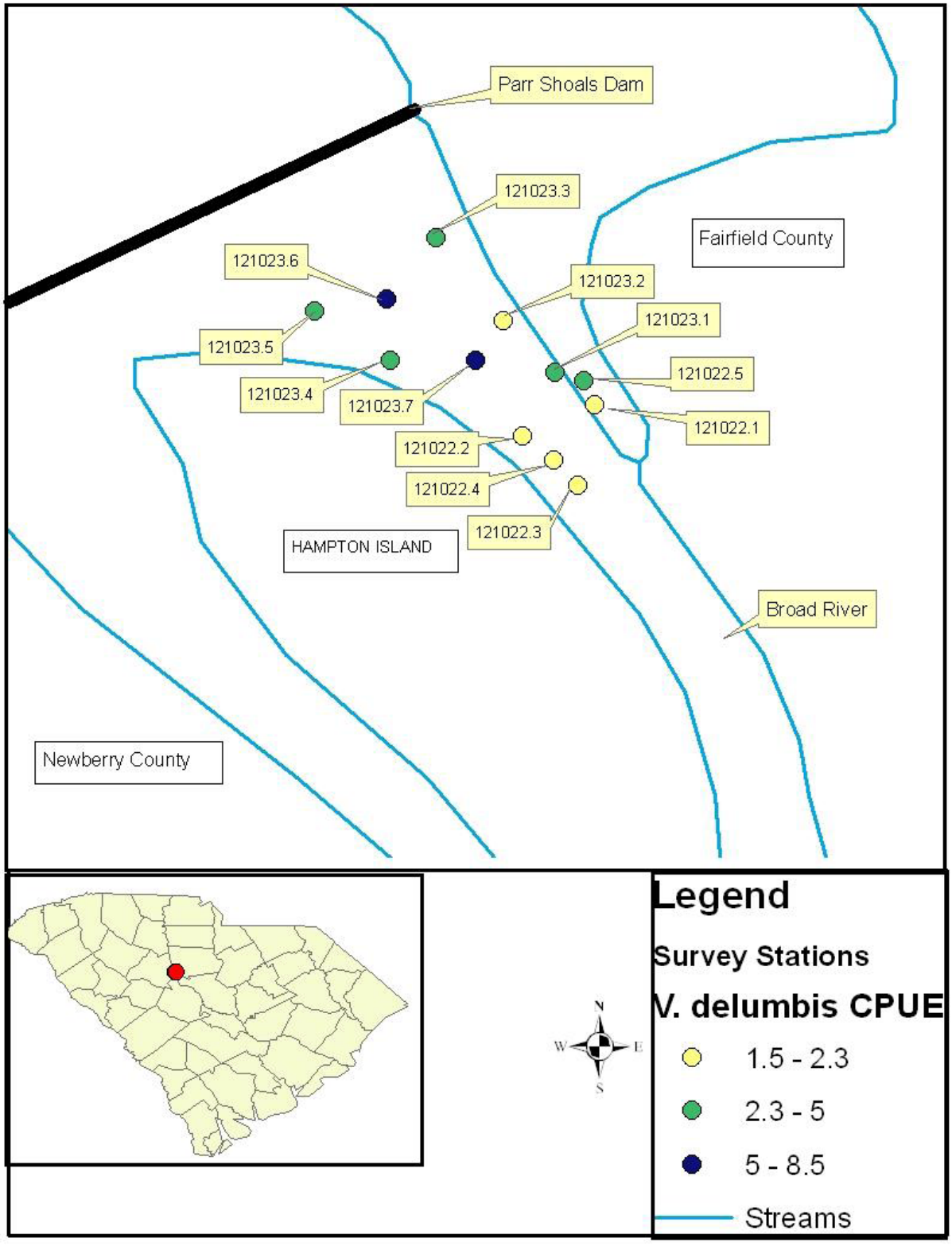
Source: 2012 Alderman Study

FIGURE 3-6 CPUE FOR *UNIOMERUS CAROLINIANUS*



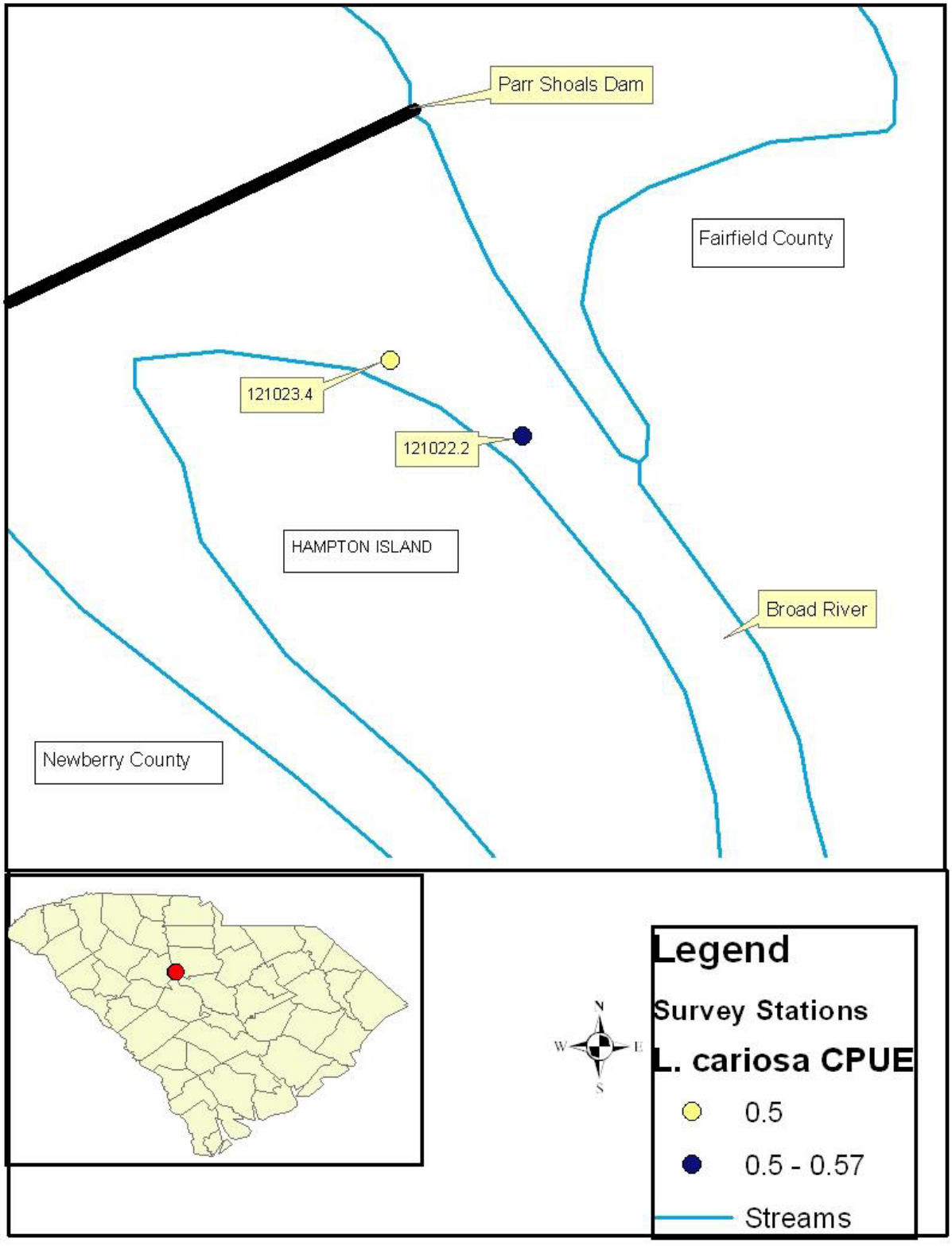
Source: 2012 Alderman Study

FIGURE 3-7 CPUE FOR *UTTERBACKIA IMBECILLIS*



Source: 2012 Alderman Study

FIGURE 3-8 CPUE FOR *VILLOSA DELUMBIS*



Source: 2012 Alderman Study

FIGURE 3-9 CPUE FOR *LAMPSILIS CARIOSA*

3.2 MACROINVERTEBRATES

3.2.1 BASELINE STUDIES

3.2.1.1 PARR RESERVOIR

The macroinvertebrate community in Parr Reservoir was sampled on June 18, 2008, September 18, 2008, January 22-23, 2009 and April 27, 2009. The number of specimens collected and the number of taxa represented from each sample date are shown in Table 3-3.

TABLE 3-3 TOTAL MACROINVERTEBRATE SPECIMENS AND TAXA REPRESENTED IN PARR RESERVOIR

SAMPLE DATE	TOTAL # OF SPECIMENS	TOTAL # OF TAXA
June 18, 2008	400	26
September 18, 2008	321	13
January 22-23, 2009	254	19
April 27, 2009	201	12

The number of specimens collected, their NCBI tolerance values, bioassessment metrics, and functional feeding groups for each sample date are included in Table 3-4 through Table 3-11.

The bioassessment metrics conducted by Carnagey on June 18, 2008 indicated some differences between the two sampling locations on Parr Reservoir. The control location was dominated by scrapers in two of the replicates and by collector-filterers in three of the replicates. The blowdown discharge location was dominated by collector-filterers in all five replicates.

On September 18, 2008, bioassessment metrics indicated that the Parr Reservoir control point and the discharge were similar. The EPT index values for the blowdown discharge point were somewhat higher than at the control. The control had three replicates at 0 and two replicates with indices of 1, while the blowdown discharge point had three replicates with a value of 1 and two replicates with values of 2. All five replicates at the Parr Reservoir control were collector-filterers. At the blowdown discharge point, two replicates were majority collector-filterers, two scrapers and one predator. The blowdown discharge also showed a correspondingly higher EPT abundance.

On January 22-23, 2009, the bioassessment metrics indicated very few differences between sampling locations. The control was dominated by predators in three of the replicates and by collector-filterers in two replicates (Table 3-4). The blowdown discharge point was dominated by collector-filterers in four replicates and predators in one.

The bioassessment metrics from the April 27, 2009 survey indicated very few differences between sample locations. The control was dominated by scrapers in four of the replicates and by collector-filterers in one replicate. The blowdown discharge location was dominated by scrapers in all five replicates.

TABLE 3-4 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE TWO PARR RESERVOIR SAMPLE LOCATIONS FOR JUNE 18, 2008[A]

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida													
Hirudinea													
Rhynchobdellida													
Glossiphoniidae													
1	Helobdella stagnalis	8.63	P										8
Oligochaeta													
Lumbriculida													
Lumbriculidae													
2	Lumbriculidae Genus species	7.03	SC			1			1				3
Tubificida													
Tubificidae													
3	Tubifex tubifex	10.00	SC	14	2	1		8	1	6	7	9	3
Arthropoda													
Crustacea													
Amphipoda													
Talitridae													
4	Hyalella azteca	7.75	OM										1
Isopoda													
Asellidae													
5	Caecidotea sp.	9.11	SC										2

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Hexapoda													
Diptera													
Ceratopogonidae													
6	Bezzia/Palpomyia sp.	6.86	P	2									2
Chironomidae													
7	Ablabesmyia annulata	2.04	P						1				
8	Ablabesmyia mallochi	7.19	P										1
9	Chironomus sp.	9.63	CG						7	6	10	6	5
10	Clinotanypus sp.		P										
11	Cryptochironomus sp.	6.40	P		1				1				1
12	Cryptotendipes sp.	6.19	CG										
13	Dicrotendipes sp.	8.10	CG										
14	Fissimentum sp. A		CG	2									
15	Microtendipes sp.	5.53	CF	3			2						
16	Paracladopelma undine	4.93	CG	2									1
17	Polypedilum halterale gr.	7.31	SH								1		
18	Procladius sp.	9.10	P						4	2			7
19	Rheotanytarsus exiguus gr.	5.89	CF						1				1
20	Tanytarsus sp.	6.76	CF										
21	Tribelos sp.	6.31	CG		1		1	1					

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Ephemeroptera													
Ephemeridae													
22	Hexagenia limbata	4.90	CG						3				1
Odonata													
Gomphidae													
23	Gomphus sp.	5.80	P						1				
Mollusca													
Bivalvia													
Unionoida													
Corbiculidae													
24	Corbicula fluminea	6.12	CF	5	4	3	5	3	72	31	18	13	97
Gastropoda													
Limnophila													
Physidae													
25	Physa sp.	8.84	SC										1
Planorbidae													
26	Promenetus exacuous		SC						2	1			1

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-5 BIOASSESSMENT METRICS FOR PARR RESERVOIR FOR JUNE 18, 2008[A]

	Station									
	Control					New Blowdown Discharge				
Metric	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
Taxa Richness	6	4	3	3	3	11	5	4	3	16
Number of Specimens	28	8	5	8	12	94	46	36	28	135
EPT Index	0	0	0	0	0	0	0	0	0	1
EPT Abundance	0	0	0	0	0	0	0	0	0	1
Chironomidae Taxa	3	2	0	2	1	5	3	3	3	7
Chironomidae Abundance	7	2	0	3	1	82	43	35	28	116
EPT/Chironomidae Abundance	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.01
North Carolina Biotic Index	8.15	6.85	7.08	6.04	7.81	6.66	5.84	6.11	5.84	6.35
SCDHEC Bioclassification	1.0	1.5	1.5	2.0	1.0	1.5	2.0	2.0	2.0	2.0
Percent Collector-Filterers	28.57	50.00	60.00	87.50	25.00	77.66	67.39	50.00	46.43	74.07
Percent Collector-Gatherers	14.29	12.50	0.00	12.50	8.33	3.19	13.04	19.44	32.14	4.44
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48
Percent Predators	7.14	12.50	0.00	0.00	0.00	9.57	15.22	30.56	21.43	4.44
Percent Scrapers	50.00	25.00	40.00	0.00	66.67	9.57	4.35	0.00	0.00	9.63
Percent Shredders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.93
Scraper/Scraper & Collector-Filterers	1.75	0.50	0.67	0.00	2.67	0.12	0.06	0.00	0.00	0.13
Percent Dominant Taxon	50.00	50.00	60.00	62.50	66.67	76.60	67.39	50.00	46.43	71.85
Number Of Dominant Taxa	6	4	3	3	3	2	3	3	3	3

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-6 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE TWO PARR RESERVOIR SAMPLE LOCATIONS FOR SEPTEMBER 18, 2008[A]

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida													
Hirudinidae													
1	Hirudinea Genus species		P	1					6	3	14	14	4
Oligochaeta													
Lumbriculida													
Lumbriculidae													
2	Lumbriculidae Genus species	7.13	SC			1							
Tubificida													
Tubificidae													
3	Tubifex tubifex	10.10	SC			2	5	7		11	7	6	17
Arthropoda													
Hexapoda													
Coleoptera													
Elmidae													
4	Dubiraphia sp.	6.03	CG					1					
Diptera													
Athericidae													
5	Atherix sp.	2.20	P			1							
Ceratopogonidae													
6	Culicoides sp.	7.80	P					1					

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Chironomidae													
7	Clinotanypus sp.		P	5	1	4	4	3		2		1	1
8	Procladius sp.	9.20	P								1	1	1
9	Rheotanytarsus exiguus gr.	5.99	CF								1		1
Ephemeroptera													
Ephemerellidae													
10	Ephemerella sp.	2.14	CG	1					3	5	2	2	5
Odonata													
Gomphidae													
11	Gomphus sp.	5.90	P					1					
Trichoptera													
Leptoceridae													
12	Oecetis inconspicua complex	1.95	P					1			2		1
Mollusca													
Bivalvia													
Unionoida													
Corbiculidae													
13	Corbicula fluminea	6.22	CF	36	21	8	33	9	5	8	17	18	16

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-7 BIOASSESSMENT METRICS FOR PARR RESERVOIR FOR SEPTEMBER 18, 2008[A]

	Station									
	Control					New Blowdown Discharge				
Metric	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
Taxa Richness	4	2	5	3	7	3	5	7	6	8
Number of Specimens	43	22	16	42	23	14	29	44	42	46
EPT Index	1	0	0	0	1	1	1	2	1	2
EPT Abundance	1	0	0	0	1	3	5	4	2	6
Chironomidae Taxa	1	1	1	1	1	0	1	2	2	3
Chironomidae Abundance	5	1	4	4	3	0	2	2	2	3
EPT/Chironomidae Abundance	0.20	0.00	0.00	0.00	0.33	-	2.50	2.00	1.00	2.00
North Carolina Biotic Index	5.85	6.22	6.35	7.12	7.06	4.18	7.88	6.58	6.92	7.18
SCDHEC Bioclassification	2.0	2.0	2.0	1.5	1.5	3.0	1.0	1.5	1.5	1.5
Percent Collector-Filterers	83.72	95.45	50.00	78.57	39.13	35.71	27.59	40.91	42.86	36.96
Percent Collector-Gatherers	2.33	0.00	0.00	0.00	4.35	21.43	17.24	4.55	4.76	10.87
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	13.95	4.55	31.25	9.52	26.09	42.86	17.24	38.64	38.10	15.22
Percent Scrapers	0.00	0.00	18.75	11.90	30.43	0.00	37.93	15.91	14.29	36.96
Percent Shredders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.00	0.00	0.38	0.15	0.78	0.00	1.38	0.39	0.33	1.00
Percent Dominant Taxon	83.72	95.45	50.00	78.57	39.13	42.86	37.93	38.64	42.86	36.96
Number Of Dominant Taxa	2	1	5	3	3	3	5	3	3	4

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-8 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE TWO PARR RESERVOIR SAMPLE LOCATIONS FOR JANUARY 22-23, 2009[A]

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5
Annelida													
Hirudinea													
1	Hirudinea Genus species		P							5	11		
Oligochaeta													
Tubificida													
Naididae													
2	Branchiura sowerbyi	8.38	SC	1					3			2	
3	Limnodrilus hoffmeisteri	9.57	SC	6	1	3	1	6	5	2	1	5	
4	Tubifex tubifex	10.10	SC	4	1	2	1	2	3		1	4	
Arthropoda													
Insecta													
Coleoptera													
Elmidae													
5	Macronychus glabratus	4.68	CG					1					
Diptera													
Ceratopogonidae													
6	Bezzia/Palpomyia sp.	6.96	P				2						
7	Culicoides sp.	7.80	P				2						
Chaoboridae													
8	Chaoborus sp.	8.60	P	1									

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5
Chironomidae													
9	Chironomus sp.	9.73	CG		2	4	4	1		5	1		
10	Clinotanypus sp.		P	8		1	7	12			2		
11	Cryptochironomus sp.	6.50	P						1			1	
12	Polypedilum illinoense gr.	9.10	SH						1				
13	Procladius sp.	9.20	P	3		4	4	2					
Ephemeroptera													
Ephemeridae													
14	Hexagenia sp.	5.00	CG					1	2				
Odonata													
Gomphidae													
15	Stylurus plagiatus		P			1	1						
Trichoptera													
Hydroptilidae													
16	Hydroptilidae Genus species		0		2		1						
Leptoceridae													
17	Oecetis sp.	4.80	P								2		

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5
Mollusca													
Bivalvia													
Unionoida													
Corbiculidae													
18	Corbicula fluminea	6.22	CF	2	2	1	13	17	12	39	4	12	1
Sphaeriidae													
19	Sphaeriidae Genus species		CF			2							

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-9 BIOASSESSMENT METRICS FOR PARR RESERVOIR FOR JANUARY 22-23, 2009[A]

	Station									
	Control					New Blowdown Discharge				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	7	5	8	10	8	7	4	7	5	1
Number of Specimens	25	8	18	36	42	27	51	22	24	1
EPT Index	0	1	0	1	1	1	0	1	0	0
EPT Abundance	0	2	0	1	1	2	0	2	0	0
Chironomidae Taxa	2	1	3	3	3	2	1	2	1	0
Chironomidae Abundance	11	2	9	15	15	2	5	3	1	0
EPT/Chironomidae Abundance	0.00	1.00	0.00	0.07	0.07	1.00	0.00	0.67	0.00	-
North Carolina Biotic Index	9.15	8.91	9.26	7.67	7.20	7.59	7.21	7.55	7.56	6.22
SCDHEC Bioclassification	1.0	1.0	1.0	1.0	1.5	1.0	1.5	1.0	1.0	2.0
Percent Collector-Filterers	8.00	50.00	16.67	38.89	40.48	44.44	76.47	18.18	50.00	100.00
Percent Collector-Gatherers	0.00	25.00	22.22	11.11	7.14	7.41	9.80	4.55	0.00	0.00
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	48.00	0.00	33.33	44.44	33.33	3.70	9.80	68.18	4.17	0.00
Percent Scrapers	44.00	25.00	27.78	5.56	19.05	40.74	3.92	9.09	45.83	0.00
Percent Shredders	0.00	0.00	0.00	0.00	0.00	3.70	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	5.50	0.50	1.67	0.14	0.47	0.92	0.05	0.50	0.92	0.00
Percent Dominant Taxon	32.00	25.00	22.22	36.11	40.48	44.44	76.47	50.00	50.00	100.00
Number Of Dominant Taxa	5	5	8	6	3	5	3	4	4	1

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-10 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE TWO PARR RESERVOIR SAMPLE LOCATIONS FOR APRIL 27, 2009[A]

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida													
Oligochaeta													
Tubificida													
Naididae													
1	Limnodrilus hoffmeisteri	9.47	SC				2	1		3	6		4
2	Naididae Genus species		SC	5	13	16	10	11	4	13	12	15	8
Arthropoda													
Insecta													
Diptera													
Ceratopogonidae													
3	Bezzia/Palpomyia sp.	6.86	P		1		2	1					
Chironomidae													
4	Chironomus sp.	9.63	CG		1				1	1			2
5	Clinotanypus sp.		P			1	1						
6	Cryptochironomus sp.	6.40	P	1									
7	Harnischia sp.	9.07	CG		2								
8	Polypedilum halterale gr.	7.31	SH				1						
9	Procladius sp.	9.10	P		1			1					
10	Thienemannimyia gr.	8.42	P			1							

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5
Mollusca													
Bivalvia													
Unionoida													
Corbiculidae													
18	Corbicula fluminea	6.22	CF	2	2	1	13	17	12	39	4	12	1
Sphaeriidae													
19	Sphaeriidae Genus species		CF			2							

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

TABLE 3-11 BIOASSESSMENT METRICS FOR PARR RESERVOIR FOR APRIL 27, 2009[A]

	Station									
	Control					New Blowdown Discharge				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	3	6	5	6	5	3	5	3	2	4
Number of Specimens	12	25	24	21	25	8	22	21	18	25
EPT Index	0	0	1	0	0	0	1	0	0	0
EPT Abundance	0	0	1	0	0	0	1	0	0	0
Chironomidae Taxa	1	3	2	2	1	1	1	0	0	1
Chironomidae Abundance	1	4	2	2	1	1	1	0	0	2
EPT/Chironomidae Abundance	0.00	0.00	0.50	0.00	0.00	0.00	1.00	-	-	0.00
North Carolina Biotic Index	6.19	7.57	6.34	7.00	6.66	7.00	7.66	7.80	6.12	7.09
SCDHEC Bioclassification	2.0	1.0	2.0	1.5	1.5	1.5	1.0	1.0	2.0	1.5
Percent Collector-Filterers	50.00	28.00	20.83	23.81	44.00	37.50	18.18	14.29	16.67	44.00
Percent Collector-Gatherers	0.00	12.00	4.17	0.00	0.00	12.50	9.09	0.00	0.00	8.00
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	8.33	8.00	8.33	14.29	8.00	0.00	0.00	0.00	0.00	0.00
Percent Scrapers	41.67	52.00	66.67	57.14	48.00	50.00	72.73	85.71	83.33	48.00
Percent Shredders	0.00	0.00	0.00	4.76	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.83	1.86	3.20	2.40	1.09	1.33	4.00	6.00	5.00	1.09
Percent Dominant Taxon	50.00	52.00	66.67	47.62	44.00	50.00	59.09	57.14	83.33	44.00
Number Of Dominant Taxa	3	3	2	4	2	3	3	3	2	4

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

Single factor ANOVA analyses were also completed at each site. These results are shown in Table 3-12, Table 3-13, Table 3-14 and Table 3-15.

One-way ANOVA results from June 18, 2008 show significant differences in bioassessment metrics in SCDHEC bioclassification (p-value = 0.0482), and NCBI rating (p-value = 0.0333) at the Parr Reservoir blowdown discharge point. All other metrics show no significant difference. One-way ANOVA results from September 18, 2008 show significant differences in bioassessment metrics in percentage of dominant taxon (p-value = 0.0194), EPT Index values (p-value = 0.0187), EPT abundance (p-value = 0.0005) at the Parr Reservoir control point. All other metrics show no significant difference.

One-way ANOVA results from January 22-23, 2009 show significant differences in bioassessment metrics in NCBI (p-value = 0.0429), and percentage of dominant taxon (p-value = 0.0065) at the Parr Reservoir control point. All other metrics show no significant difference.

One-way ANOVA results from April 27, 2009 show no significant differences in bioassessment metrics between the points. The control point was dominated by scrapers in four of the five replicates and collector-filterers in one. The blowdown discharge point was dominated by scrapers in all five replicates.

TABLE 3-12 RESULTS OF THE SINGLE FACTOR ANOVA FOR PARR RESERVOIR, JUNE 18, 2008[A]

ANOVA for Taxa Richness

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.1079	1	0.1079	2.6291	0.1436	5.3177
Within Stations	0.3282	8	0.0410			
Total	0.4361	9				

ANOVA for EPT Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0091	1	0.0091	1.0000	0.3466	5.3177
Within Stations	0.0725	8	0.0091			
Total	0.0816	9				

ANOVA for Total Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	1.2609	1	1.2609	17.2042	0.0032	5.3177
Within Stations	0.5863	8	0.0733			
Total	1.8473	9				

ANOVA for NCBI

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0081	1	0.0081	6.5873	0.0333	5.3177
Within Stations	0.0098	8	0.0012			
Total	0.0178	9				

ANOVA for percentage of the dominant taxon

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0019	1	0.0019	0.3031	0.5970	5.3177
Within Stations	0.0496	8	0.0062			
Total	0.0515	9				

ANOVA for SCDHEC Bioclassification

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0186	1	0.0186	5.4249	0.0482	5.3177
Within Stations	0.0274	8	0.0034			
Total	0.0460	9				

ANOVA for EPT Index

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0091	1	0.0091	1.0000	0.3466	5.3177
Within Stations	0.0725	8	0.0091			
Total	0.0816	9				

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-13 RESULTS OF THE SINGLE FACTOR ANOVA FOR PARR RESERVOIR, SEPTEMBER 18, 2008[A]

ANOVA for Taxa Richness

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0388	1	0.0388	1.7165	0.2265	5.3177
Within Stations	0.1810	8	0.0226			
Total	0.2199	9				

ANOVA for EPT Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.7836	1	0.7836	32.4438	0.0005	5.3177
Within Stations	0.1932	8	0.0242			
Total	0.9769	9				

ANOVA for Total Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0132	1	0.0132	0.3441	0.5736	5.3177
Within Stations	0.3058	8	0.0382			
Total	0.3189	9				

ANOVA for NCBI

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0001	1	0.0001	0.0109	0.9194	5.3177
Within Stations	0.0372	8	0.0046			
Total	0.0372	9				

ANOVA for percentage of the dominant taxon

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.1150	1	0.1150	8.5067	0.0194	5.3177
Within Stations	0.1081	8	0.0135			
Total	0.2231	9				

ANOVA for SCDHEC Bioclassification

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0017	1	0.0017	0.2415	0.6364	5.3177
Within Stations	0.0563	8	0.0070			
Total	0.0580	9				

ANOVA for EPT Index

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.1576	1	0.1576	8.6368	0.0187	5.3177
Within Stations	0.1460	8	0.0182			
Total	0.3035	9				

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-14 RESULTS OF THE SINGLE FACTOR ANOVA FOR PARR RESERVOIR, JANUARY 22-23, 2009[A]

ANOVA for Taxa Richness

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.1096	1	0.1096	3.0905	0.1168	5.3177
Within Stations	0.2836	8	0.0355			
Total	0.3932	9				

ANOVA for EPT Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0016	1	0.0016	0.0278	0.8717	5.3177
Within Stations	0.4491	8	0.0561			
Total	0.4507	9				

ANOVA for Total Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0392	1	0.0392	0.2113	0.6580	5.3177
Within Stations	1.4827	8	0.1853			
Total	1.5219	9				

ANOVA for NCBI

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0087	1	0.0087	5.7831	0.0429	5.3177
Within Stations	0.0120	8	0.0015			
Total	0.0206	9				

ANOVA for percentage of the dominant taxon

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.2188	1	0.2188	13.3530	0.0065	5.3177
Within Stations	0.1311	8	0.0164			
Total	0.3500	9				

ANOVA for SCDHEC Bioclassification

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0031	1	0.0031	0.7516	0.4112	5.3177
Within Stations	0.0330	8	0.0041			
Total	0.0361	9				

ANOVA for EPT Index

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0091	1	0.0091	0.3333	0.5796	5.3177
Within Stations	0.2175	8	0.0272			
Total	0.2265	9				

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-15 RESULTS OF THE SINGLE FACTOR ANOVA FOR PARR RESERVOIR, APRIL 27, 2009[A]

ANOVA for Taxa Richness

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0476	1	0.0476	4.1768	0.0752	5.3177
Within Stations	0.0912	8	0.0114			
Total	0.1389	9				

ANOVA for EPT Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0000	1	0.0000	0.0000	1.0000	5.3177
Within Stations	0.1450	8	0.0181			
Total	0.1450	9				

ANOVA for Total Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0110	1	0.0110	0.4410	0.5253	5.3177
Within Stations	0.2001	8	0.0250			
Total	0.2111	9				

ANOVA for NCBI

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0011	1	0.0011	0.9349	0.3619	5.3177
Within Stations	0.0090	8	0.0011			
Total	0.0101	9				

ANOVA for percentage of the dominant taxon

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0052	1	0.0052	0.6939	0.4290	5.3177
Within Stations	0.0598	8	0.0075			
Total	0.0650	9				

ANOVA for SCDHEC Bioclassification

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0031	1	0.0031	0.5690	0.4723	5.3177
Within Stations	0.0436	8	0.0054			
Total	0.0467	9				

ANOVA for EPT Index

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0000	1	0.0000	0.0000	1.0000	5.3177
Within Stations	0.1450	8	0.0181			
Total	0.1450	9				

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

3.2.1.2 LAKE MONTICELLO

The macroinvertebrate community in Lake Monticello was sampled on June 18, 2008, September 18, 2008, January 22-23, 2009 and April 27, 2009. The number of specimens collected and the number of taxa represented from each sample date are shown in Table 3-16.

TABLE 3-16 TOTAL MACROINVERTEBRATE SPECIMENS AND TAXA REPRESENTED IN LAKE MONTICELLO

SAMPLE DATE	TOTAL # OF SPECIMENS	TOTAL # OF TAXA
June 18, 2008	341	27
September 18, 2008	262	24
January 22-23, 2009	277	16
April 27, 2009	405	24

The number of specimens collected, their NCBI tolerance values, functional feeding groups and bioassessment metrics for each sample date are included in Table 3-17 through Table 3-24.

The bioassessment metrics from June 18, 2008 indicate few differences between the sample locations. The control sample point was predominately collector-filters, but did include one replicate with a majority of scrapers. The control SCDHEC bioclassification values were the same as the other two stations when replicates were averaged. The Raw Intake point had all "fair" bioclassification ratings and had a majority (4 out of 5) of collector feeders. The Water Treatment Intake point had three "fair" and two "good-fair" bioclassification ratings. The Treatment Intake point was also dominated by collector-filterers in all five replicates.

According to the bioassessment metrics from September 18, 2008 the control sample point feeding types showed mixed dominant feeders. Collector-filters and scrapers were the largest ratio in two replicates each, and predators were majority of one. The control SCDHEC bioclassification values were the lowest of the three stations. The Raw Intake point received two "fair" and three "good-fair" bioclassification ratings. The Raw intake point contained a majority (4 out of 5) of predator feeders. Parallel to the previous sample date, the Water Treatment Intake point had three "fair" and two "good-fair" bioclassification ratings. The Treatment Intake point was also dominated by collector-filterers in three replicates, and predators in two.

On January 22-23, 2009 the control sample point was predominately collector/filters, but did include one replicate with a majority of collector/gatherers (Table). The control SCDHEC bioclassification values were slightly lower than the other two stations. The Raw intake point contained a majority of collector/filterer feeders. The raw water intake point was the only location in which any EPT taxa were collected. The Water Treatment Intake point feeding type majority was collector/filterers. The Treatment Intake point was also dominated by collector-filterers.

According to the bioassessment metrics from April 27, 2009 the control sample point was predominately collector/filters, but did include one replicate with a majority of collector/gatherers (Table). The control SCDHEC bioclassification values were slightly lower than the other two stations. The Raw intake point contained a majority of collector/filterer feeders. The raw water intake point was the only location in which any EPT taxa were collected. The Water Treatment Intake point feeding type majority was collector/filterers. The Treatment Intake point was also dominated by collector-filterers.

TABLE 3-17 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE THREE LAKE MONTICELLO SAMPLE LOCATIONS FOR JUNE 18, 2008[A]

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
Rhynchobdellida																		
Glossiphoniidae																		
1	Helobdella stagnalis	8.63	P	2														1
Oligochaeta																		
Lumbriculida																		
Lumbriculidae																		
2	Lumbriculidae Genus species	7.03	SC					2										
Tubificida																		
Tubificidae																		
3	Tubifex tubifex	10.00	SC		18	8	2	4										1
Arthropoda																		
Crustacea																		
Cladocera																		
Daphnidae																		
4	Daphnia sp.		CF												1		1	
Cyclopoida																		
Cyclopidae																		
5	Eucyclops agilis		OM		1				2	1				2	3			
Ostracoda																		
6	Ostracoda Genus species		CF												1			

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Hexapoda																		
Diptera																		
Ceratopogonidae																		
7	Bezzia/Palpomyia sp.	6.86	P												1	1		
Chaoboridae																		
8	Chaoborus sp.	8.50	P														2	
Chironomidae																		
9	Ablabesmyia annulata	2.04	P				1						1				1	
10	Chironomus sp.	9.63	CG					1	2		1	1			2	3	3	2
11	Clinotanypus sp.		P	2	1				2	2	1	1	1		1		1	1
12	Cryptochironomus sp.	6.40	P		5			1		1				4	1		1	1
13	Cryptotendipes sp.	6.19	CG		1							1	1					
14	Dicrotendipes sp.	8.10	CG		1													
15	Fissimentum sp. A		CG	1		1	2							1				
16	Microtendipes sp.	5.53	CF		1		1				1						1	1
17	Paracladopelma undine	4.93	CG												7			1
18	Polypedilum halterale gr.	7.31	SH		1	3									1		1	
19	Procladius sp.	9.10	P	3	3	1		1	2						4	1		4
20	Pseudochironomus sp.	5.36	CG		2													
21	Rheotanytarsus exiguus gr.	5.89	CF												1		1	
22	Tanytarsus sp.	6.76	CF		4	1								4			1	

Seq	Taxon	TV	FG	Control					New Water Treatment Intake					New Raw Intake				
				Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Ephemeroptera																		
Ephemeridae																		
23	Hexagenia limbata	4.90	CG	4			2		5	3	2	2	4	2	7	5	5	1
Trichoptera																		
Hydroptilidae																		
24	Orthotrichia sp.	8.29	SC			1												
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
25	Corbicula fluminea	6.12	CF	20	18	19	5	4	5	5	5	10	9	7	10	5		5
Unionidae																		
26	Elliptio complanata complex	5.14	CF		7	1				1					1			
Nematoda																		
27	Nematoda Genus species	6.02	OM												1			

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-18 BIOASSESSMENT METRICS FOR LAKE MONTICELLO FOR JUNE 18, 2008[A]

	Station														
	Control					New Water Treatment Intake					New Raw Intake				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	6	13	8	6	6	6	5	5	5	6	6	15	5	11	10
Number of Specimens	32	63	35	13	13	13	10	15	16	20	18	42	15	18	18
EPT Index	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1
EPT Abundance	4	0	1	2	0	3	2	2	4	2	5	7	5	5	1
Chironomidae Taxa	3	9	4	3	3	2	3	3	3	3	3	7	2	8	6
Chironomidae Abundance	6	19	6	4	3	3	3	3	3	9	6	17	4	10	10
EPT/Chironomidae Abundance	0.67	0.00	0.17	0.50	0.00	1.00	0.67	0.67	1.33	0.22	0.83	0.41	1.25	0.50	0.10
North Carolina Biotic Index	6.58	7.46	7.12	5.83	8.05	5.58	6.40	6.30	5.16	6.27	6.47	6.36	7.08	6.62	7.36
SCDHEC Bioclassification	1.5	1.3	1.5	2.2	1.0	2.5	2.0	2.0	2.8	2.0	1.8	2.0	1.5	1.5	1.5
Percent Collector-Filterers	62.50	47.62	60.00	46.15	30.77	46.15	60.00	66.67	56.25	55.00	27.78	33.33	33.33	22.22	33.33
Percent Collector-Gatherers	15.63	6.35	2.86	30.77	7.69	23.08	30.00	26.67	31.25	15.00	38.89	38.10	53.33	44.44	22.22
Percent Omnivores	0.00	1.59	0.00	0.00	0.00	7.69	0.00	0.00	0.00	10.00	11.11	9.52	0.00	0.00	0.00
Percent Predators	21.88	14.29	2.86	7.69	15.38	23.08	10.00	6.67	12.50	20.00	22.22	16.67	13.33	27.78	38.89
Percent Scrapers	0.00	28.57	25.71	15.38	46.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.56
Percent Shredders	0.00	1.59	8.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.38	0.00	5.56	0.00
Scraper/Scraper & Collector-Filterers	0.00	0.60	0.43	0.33	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17
Percent Dominant Taxon	62.50	28.57	54.29	38.46	30.77	38.46	50.00	66.67	56.25	35.00	27.778	23.81	33.333	27.778	27.778
Number Of Dominant Taxa	5	5	3	6	6	6	5	5	5	6	6	5	5	11	10

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-19 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE THREE LAKE MONTICELLO SAMPLE LOCATIONS FOR SEPTEMBER 18, 2008[A]

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species		P	1				14					2	11	7	14	8	8
Oligochaeta																		
Lumbriculida																		
Lumbriculidae																		
2	Lumbriculidae Genus species	7.13	SC		2	13	1	5										1
Tubificida																		
Tubificidae																		
3	Limnodrilus sp.	9.60	SC					1										
4	Tubifex tubifex	10.10	SC	1	1		2											
Arthropoda																		
Arachnoidea																		
Acariformes																		
Arrenuridae																		
5	Arrenurus sp.	5.63	P					1										
Hexapoda																		
Diptera																		
Chironomidae																		
6	Ablabesmyia peleensis	9.77	P				1	1								1		
7	Clinotanypus sp.		P		1			4		1		2	4	2	2			1
8	Cryptochironomus sp.	6.50	P			1		1								1		

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Chironomidae cont.																		
9	Fissimentum sp. A		CG		1													
10	Parachironomus sp.	9.52	P			1												
11	Polypedilum halterale gr.	7.41	SH			2												
12	Procladius sp.	9.20	P									1		1				
13	Pseudochironomus sp.	5.46	CG					2										
14	Rheotanytarsus exiguus gr.	5.99	CF	1	1	2		1										
15	Tanytarsus sp.	6.86	CF					3										
Ephemeroptera																		
Ephemerellidae																		
16	Ephemerella sp.													2	2	7	5	15
Odonata																		
Gomphidae																		
17	Gomphus sp.	5.90	P	1														
Libellulidae																		
18	Macromia taeniolata	6.26	P									7						
Trichoptera																		
Leptoceridae																		
19	Oecetis inconspicua complex	1.95	P					1										
Polycentropodidae																		
20	Cyrnellus fraternus	7.44	CF					2										

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
21	Corbicula fluminea	6.22	CF	12	4	6		15	2	2	3	7	4					
Unionidae																		
22	Elliptio lanceolata complex	5.20	CF	1														
Gastropoda														5	3	2	3	6
Limnophila																		
Physidae																		
23	Physa sp.	8.94	SC										1					
Mesogastropoda																		
Viviparidae																		
24	Bellamya japonica		SC	1		1		8								2		

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-20 BIOASSESSMENT METRICS FOR LAKE MONTICELLO FOR SEPTEMBER 18, 2008[A]

	Station														
	Control					New Water Treatment Intake					New Raw Intake				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	7	6	7	3	14	1	2	1	4	4	5	4	6	3	5
Number of Specimens	18	10	26	4	59	2	3	3	17	11	21	14	27	16	31
EPT Index	0	0	0	0	2	0	0	0	0	0	1	1	1	1	1
EPT Abundance	0	0	0	0	3	0	0	0	0	0	2	2	7	5	15
Chironomidae Taxa	1	3	4	1	6	0	1	0	2	1	2	1	2	0	1
Chironomidae Abundance	1	3	6	1	12	0	1	0	3	4	3	2	2	0	1
EPT/Chironomidae Abundance	0.00	0.00	0.00	0.00	0.25	-	0.00	-	0.00	0.00	0.67	1.00	3.50	-	15.00
North Carolina Biotic Index	6.39	6.98	7.02	9.00	6.52	6.22	6.22	6.22	6.66	6.90	6.00	5.20	5.41	4.18	3.37
SCDHEC Bioclassification	2.0	1.5	1.5	1.0	1.7	2.0	2.0	2.0	1.5	1.5	2.0	2.7	2.5	3.0	3.0
Percent Collector-Filterers	77.78	50.00	30.77	0.00	35.59	100.00	66.67	100.00	41.18	36.36	23.81	21.43	7.41	18.75	19.35
Percent Collector-Gatherers	0.00	10.00	0.00	0.00	3.39	0.00	0.00	0.00	0.00	0.00	9.52	14.29	25.93	31.25	48.39
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	11.11	10.00	7.69	25.00	37.29	0.00	33.33	0.00	58.82	54.55	66.67	64.29	59.26	50.00	29.03
Percent Scrapers	11.11	30.00	53.85	75.00	23.73	0.00	0.00	0.00	0.00	9.09	0.00	0.00	7.41	0.00	3.23
Percent Shredders	0.00	0.00	7.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.14	0.60	1.75	-	0.67	0.00	0.00	0.00	0.00	0.25	0.00	0.00	1.00	0.00	0.17
Percent Dominant Taxon	66.67	40.00	50.00	50.00	25.42	100.00	66.67	100.00	41.18	36.36	52.381	50	51.852	50	48.387
Number Of Dominant Taxa	7	6	4	3	6	1	2	1	4	4	4	4	4	3	3

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-21 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE THREE LAKE MONTICELLO SAMPLE LOCATIONS FOR JANUARY 22-23, 2009[A]

				Control					New Water Treatment					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species		P	1									1	1		2		1
Oligochaeta																		
Lumbriculida																		
Lumbriculidae																		
2	Eclipidrilus lacustris	7.13	SC	1												1		
Tubificida																		
Naididae																		
3	Branchiura sowerbyi	8.38	SC								2	1	1	1	2	5	3	
4	Limnodrilus hoffmeisteri	9.57	SC	15	4	2		3					1		1		1	
Arthropoda																		
Insecta																		
Diptera																		
Chironomidae																		
5	Ablabesmyia mallochi	7.29	P	1														
6	Chironomus sp.	9.73	CG			1		2							1	2		1
7	Cladotanytarsus sp.	4.19	CG					2										
8	Clinotanypus sp.		P							6	3		2	1		1		
9	Cryptochironomus sp.	6.50	P	4													1	
10	Dicrotendipes neomodestus	8.20	CG															1
11	Procladius sp.	9.20	P	2									1	1				

				Control					New Water Treatment					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Chironomidae cont.																		
12	Rheotanytarsus exiguus gr.	5.99	CF				4						1			4	1	
13	Tanytarsus sp.	6.86	CF										2				1	1
Ephemeroptera																		
Ephemeridae																		
14	Hexagenia sp.	5.00	CG											2		6	6	6
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
15	Corbicula fluminea	6.22	CF	76	12	13	2	2	3	7	3	2	11	5	9	6	2	3
Gastropoda																		
Limnophila																		
Physidae																		
16	Physa sp.	8.94	SC	3											1			

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-22 BIOASSESSMENT METRICS FOR LAKE MONTICELLO FOR JANUARY 22-23, 2009[A]

	Station														
	Control					New Water Treatment Intake					New Raw Intake				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	8	2	3	2	4	1	2	3	2	8	6	5	8	7	6
Number of Specimens	103	16	16	6	9	3	13	8	3	20	11	14	27	15	13
EPT Index	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
EPT Abundance	0	0	0	0	0	0	0	0	0	0	2	0	6	6	6
Chironomidae Taxa	3	0	1	1	2	0	1	1	0	4	2	1	3	3	3
Chironomidae Abundance	7	0	1	4	4	0	6	3	0	6	2	1	7	3	3
EPT/Chironomidae Abundance	0.00	-	0.00	0.00	0.00	-	0.00	0.00	-	0.00	1.00	0.00	0.86	2.00	2.00
North Carolina Biotic Index	7.86	6.99	6.79	6.05	8.14	6.22	6.22	6.76	7.30	6.81	6.87	7.90	6.69	6.84	6.49
SCDHEC Bioclassification	1.0	1.5	1.5	2.0	1.0	2.0	2.0	1.5	1.5	1.5	1.5	1.0	1.5	1.5	1.7
Percent Collector-Filterers	73.79	75.00	81.25	100.00	22.22	100.00	53.85	37.50	66.67	70.00	45.45	64.29	37.04	26.67	30.77
Percent Collector-Gatherers	0.00	0.00	6.25	0.00	44.44	0.00	0.00	0.00	0.00	0.00	18.18	7.14	29.63	40.00	61.54
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	7.77	0.00	0.00	0.00	0.00	0.00	46.15	37.50	0.00	20.00	27.27	0.00	11.11	6.67	7.69
Percent Scrapers	18.45	25.00	12.50	0.00	33.33	0.00	0.00	25.00	33.33	10.00	9.09	28.57	22.22	26.67	0.00
Percent Shredders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.25	0.33	0.15	0.00	1.50	0.00	0.00	0.67	0.50	0.14	0.20	0.44	0.60	1.00	0.00
Percent Dominant Taxon	73.79	75.00	81.25	66.67	33.33	100.00	53.85	37.50	66.67	55.00	45.45	64.29	22.22	40.00	46.15
Number Of Dominant Taxa	2	2	3	2	4	1	2	3	2	8	6	5	6	7	6

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-23 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE THREE LAKE MONTICELLO SAMPLE LOCATIONS FOR APRIL 27, 2009[A]

				Control					New Water Treatment Intake					Raw Water Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species		P													1	1	
Oligochaeta																		
Tubificida																		
Naididae																		
2	Branchiura sowerbyi	8.28	SC						1		1	1	1	1	1	1		1
3	Limnodrilus hoffmeisteri	9.47	SC			1					4							
4	Limnodrilus sp.	9.50	SC				1											
5	Naididae Genus species		SC	1			1	2	3		5	2					1	
Arthropoda																		
Copepoda																		
6	Copepoda Genus species		OM						1									
Insecta																		
Diptera																		
Chironomidae																		
7	Ablabesmyia annulata	2.04	P												1	2		
8	Chironomus sp.	9.63	CG		2	3	5	2		1		1	1					
9	Cladopelma sp.	3.49	CG						1	3	2		2		1			
10	Cladotanytarsus sp.	4.09	CG	2	1	18	3	5	10	8	14		8					
11	Clinotanypus sp.		P								1							

				Control					New Water Treatment Intake					Raw Water Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Chironomidae cont.																		
12	Cryptochironomus sp.	6.40	P			2					1							
13	Dicrotendipes sp.	8.10	CG		1						1							
14	Nanocladius sp.	7.07	CG								1							
15	Orthocladius sp.	5.94	SH		2													
16	Phaenopsectra obediens gr.	6.50	SC											1				
17	Polypedilum halterale gr.	7.31	SH	1		2			9	3	15	1	8	1		1	2	1
18	Procladius sp.	9.10	P						1						1			
19	Rheotanytarsus exiguus gr.	5.89	CF		1				2		1		4					
20	Tanytarsus sp.	6.76	CF						2		1							
Ephemeroptera																		
Ephemeridae																		
21	Hexagenia limbata	4.90	CG											1	9	3	5	5
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
22	Corbicula fluminea	6.12	CF	15	14	18	9	11	19	12	19	10	12	6	11	10	14	4
Unionidae																		
23	Pyganodon cataracta		CF											1				

				Control					New Water Treatment Intake					Raw Water Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Gastropoda																		
Limnophila																		
Physidae																		
24	Physa sp.	8.84	SC						1			1						

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

TABLE 3-24 BIOASSESSMENT METRICS FOR LAKE MONTICELLO FOR APRIL 27, 2009[A]

	Station														
	Control					New Water Treatment Intake					Raw Water intake				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	4	6	6	5	4	11	5	13	6	7	6	6	6	5	4
Number of Specimens	19	21	44	19	20	50	27	66	16	36	11	24	18	23	11
EPT Index	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
EPT Abundance	0	0	0	0	0	0	0	0	0	0	1	9	3	5	5
Chironomidae Taxa	2	5	4	2	2	6	4	9	2	5	2	3	2	1	1
Chironomidae Abundance	3	7	25	8	7	25	15	37	2	23	2	3	3	2	1
EPT/Chironomidae Abundance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	3	1	3	5
North Carolina Biotic Index	6.05	6.32	5.93	6.90	5.94	5.74	5.78	6.24	6.80	6.11	6.48	5.81	5.85	5.94	6.08
SCDHEC Bioclassification	2.0	2.0	2.0	1.5	2.0	2.3	2.3	2.0	1.5	2.0	1.8	2.2	2.0	2.0	2.0
Percent Collector-Filterers	78.95	71.43	40.91	47.37	55.00	2.00	0.00	3.03	6.25	2.78	9.09	8.33	16.67	0.00	9.09
Percent Collector-Gatherers	10.53	19.05	47.73	42.11	35.00	62.00	59.26	59.09	87.50	58.33	72.73	45.83	61.11	73.91	45.45
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	0.00	0.00	4.55	0.00	0.00	6.00	0.00	3.03	6.25	0.00	0.00	4.17	0.00	0.00	0.00
Percent Scrapers	5.26	0.00	2.27	10.53	10.00	6.00	11.11	6.06	0.00	5.56	18.18	41.67	22.22	26.09	45.45
Percent Shredders	5.26	9.52	4.55	0.00	0.00	24.00	29.63	22.73	0.00	33.33	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.07	0.00	0.06	0.22	0.18	3.00	-	2.00	0.00	2.00	2.00	5.00	1.33	-	5.00
Percent Dominant Taxon	78.95	66.67	40.91	47.37	55.00	38.00	44.44	28.79	62.50	33.33	54.55	45.83	55.56	60.87	45.45
Number Of Dominant Taxa	4	3	3	5	4	4	4	5	6	5	6	2	6	3	4

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

Single factor ANOVA analyses were also completed at each site on Lake Monticello. These results are shown in Table 3-25, Table 3-26, Table 3-27 and Table 3-28.

The three Lake Monticello sample points (control, new water treatment intake, and new raw intake) from June 18, 2008 indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. Percentage of dominant taxon (p-value = 0.01879), EPT abundance (p-value = 0.04360), NCBI values (p-value = 0.04624), and SCDHEC bioclassification values (p-value = 0.01450) indicate significant difference between the stations. All other metrics show no significant difference.

The September 18, 2008 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. Taxa richness (p=0.01234), total abundance (p-value = 0.04412), EPT Index value (p-value=0.00676), EPT abundance (p-value = 0.00050), NCBI values (p-value = 0.00361), and SCDHEC bioclassification values (p-value = 0.00172) indicate significant difference between the stations. All other metrics show no significant difference.

The January 22-23, 2009 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. EPT Index value (p-value=0.00041), and EPT abundance (p-value = 0.00097) indicate significant difference between the stations. All other metrics show no significant difference.

The April 27, 2009 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison (Table). Taxa richness (p-value = 0.04737), EPT Index value, EPT abundance (p-value = 0.00001), and SCDHEC bioclassification values (p-value = 0.04309) indicate significant difference between the stations. All other metrics show no significant difference.

TABLE 3-25 RESULTS OF THE SINGLE FACTOR ANOVA FOR LAKE MONTICELLO, JUNE 18, 2008[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.08822	2	0.04411	2.69272	0.10814	3.88529
Within Stations	0.19658	12	0.01638			
Total	0.2848	14				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.43168	2	0.21584	4.11342	0.0436	3.88529
Within Stations	0.62967	12	0.05247			
Total	1.06135	14				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.1528	2	0.0764	1.88877	0.19358	3.88529
Within Stations	0.48538	12	0.04045			
Total	0.63818	14				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.0106	2	0.0053	4.01487	0.04624	3.88529
Within Stations	0.01585	12	0.00132			
Total	0.02645	14				

ANOVA for Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.13756	2	0.06878	5.6369	0.01879	3.88529
Within Stations	0.14643	12	0.0122			
Total	0.28399	14				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.03764	2	0.01882	6.15018	0.0145	3.88529
Within Stations	0.03673	12	0.00306			
Total	0.07437	14				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.04833	2	0.02417	2.66667	0.1101	3.88529
Within Stations	0.10874	12	0.00906			
Total	0.15707	14				

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-26 RESULTS OF THE SINGLE FACTOR ANOVA FOR LAKE MONTICELLO, SEPTEMBER 18, 2008[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.38943	2	0.19471	6.48194	0.01234	3.88529
Within Stations	0.36047	12	0.03004			
Total	0.7499	14				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	1.7058	2	0.8529	15.327	0.0005	3.8853
Within Stations	0.6678	12	0.0557			
Total	2.3735	14				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.8222	2	0.4111	4.0934	0.0441	3.8853
Within Stations	1.2051	12	0.1004			
Total	2.0273	14				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.061	2	0.0305	9.3186	0.0036	3.8853
Within Stations	0.0393	12	0.0033			
Total	0.1002	14				

ANOVA for Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.0585	2	0.0293	1.352	0.2954	3.8853
Within Stations	0.2597	12	0.0216			
Total	0.3182	14				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.0661	2	0.033	11.335	0.0017	3.8853
Within Stations	0.035	12	0.0029			
Total	0.101	14				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.2367	2	0.1183	7.7972	0.0068	3.8853
Within Stations	0.1821	12	0.0152			
Total	0.4188	14				

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-27 RESULTS OF THE SINGLE FACTOR ANOVA FOR LAKE MONTICELLO, JANUARY 22-23, 2009[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.24645	2	0.12322	3.58529	0.06016	3.88529
Within Stations	0.41243	12	0.03437			
Total	0.65887	14				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	1.20995	2	0.60498	13.0738	0.00097	3.88529
Within Stations	0.55529	12	0.04627			
Total	1.76524	14				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.33227	2	0.16613	1.52273	0.25743	3.88529
Within Stations	1.30922	12	0.1091			
Total	1.64148	14				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.00177	2	0.00089	0.7502	0.49318	3.88529
Within Stations	0.01419	12	0.00118			
Total	0.01596	14				

ANOVA for Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.09522	2	0.04761	1.92634	0.18814	3.88529
Within Stations	0.29659	12	0.02472			
Total	0.39181	14				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.00842	2	0.00421	1.27477	0.31477	3.88529
Within Stations	0.03965	12	0.0033			
Total	0.04807	14				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.19332	2	0.09666	16	0.00041	3.88529
Within Stations	0.0725	12	0.00604			
Total	0.26582	14				

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-28 RESULTS OF THE SINGLE FACTOR ANOVA FOR LAKE MONTICELLO, APRIL 27, 2009[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.09011	2	0.04506	3.9747	0.04737	3.88529
Within Stations	0.13603	12	0.01134			
Total	0.22614	14				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	1.59565	2	0.79783	35.3732	0.00001	3.88529
Within Stations	0.27065	12	0.02255			
Total	1.86631	14				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.24547	2	0.12273	3.65038	0.05776	3.88529
Within Stations	0.40347	12	0.03362			
Total	0.64893	14				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.00034	2	0.00017	0.3393	0.71889	3.88529
Within Stations	0.00601	12	0.0005			
Total	0.00635	14				

ANOVA for Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.05831	2	0.02915	2.78199	0.10171	3.88529
Within Stations	0.12575	12	0.01048			
Total	0.18406	14				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.01936	2	0.00968	4.13354	0.04309	3.88529
Within Stations	0.02811	12	0.00234			
Total	0.04747	14				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.30206	2	0.15103	65535	-	3.88529
Within Stations	0	12	0			
Total	0.30206	14				

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

3.2.2 ONGOING STUDIES

3.2.2.1 PARR RESERVOIR

On September 11-12, 2012, 1051 specimens were collected from the three sample locations on Parr Reservoir, representing 51 taxa. The number of specimens collected, their NCBI tolerance values, functional feeding groups, and bioassessment metrics are displayed in Table 3-29 through Table 3-35.

The bioassessment metrics indicated that Parr Reservoir upstream and the discharge were similar. The Parr Reservoir upstream location had much lower taxa richness than the discharge location. Bioassessment metrics for Parr Tailrace downstream of Parr Reservoir were also calculated using instream benthic macroinvertebrate community rapid bioassessment. Due to the different bioassessment sampling protocol, and environment, the metrics were not compared to those at the upstream and discharge locations.

TABLE 3-29 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV) AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE PARR UPSTREAM REPLICATES IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species	5.00	P															
Oligochaeta																		
Tubificida																		
Naididae																		
2	Branchiura sowerbyi	8.28	SC								1	1						
3	Dero sp.		SC															
4	Limnodrilus sp.	9.50	SC															
5	Naididae Genus species		SC			3			2		1		1	1				1
6	Pristina osborni		SC															
7	Spirosperma ferox	5.40	SC							1		1						
Arthropoda																		
Insecta																		
Diptera																		
Chironomidae																		
8	Ablabesmyia peleensis	9.67	P															
9	Chironomus sp.	9.63	CG															
10	Cladopelma sp.	4.09	CG															
11	Cladotanytarsus sp. B		CG										1					

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Chironomidae cont.																		
12	Clinotanypus sp.		P															
13	Cryptochironomus sp.	6.40	P	1		1	1			1	1					2		
14	Polypedilum halterale gp.	7.30	SH													1		
15	Procladius sp.	9.10	P															
16	Tanytarsus sp.	6.76	CF															
Ephemeroptera																		
Ephemeridae																		
17	Hexagenia limbata	4.90	CG									1						
Odonata																		
Gomphidae																		
18	Gomphus sp.	5.80	P															
Trichoptera																		
Hydroptilidae																		
19	Hydroptila sp.	6.22	SC															
Malacostraca																		
Cladocera																		
Sididae																		
20	Sida sp.		CF															
Cyclopoida																		
Cyclopidae																		
21	Eucyclops sp.		OM															

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
22	Corbicula fluminea	6.12	CF	30	17	20	20	20	60	21	54	67	67	2	10	11	3	1

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-30 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV) AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE UNITS 2 & 3 DISCHARGE REPLICATES IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species	5.00	P	10	1	16	24	8	2	2			5					
Oligochaeta																		
Tubificida																		
Naididae																		
2	Branchiura sowerbyi	8.28	SC			5	4	2		1			1		1		5	
3	Dero sp.		SC	1	1	1	2											
4	Limnodrilus sp.	9.50	SC		2	1	3	2	1						1			
5	Naididae Genus species		SC	6	7	3	8	18		1	3		5		5		3	3
6	Pristina osborni		SC						1			1	1				1	
7	Spirosperma ferox	5.40	SC													1	1	
Arthropoda																		
Insecta																		
Diptera																		
Chironomidae																		
8	Ablabesmyia peleensis	9.67	P												1		1	
9	Chironomus sp.	9.63	CG												1			1
10	Cladopelma sp.	4.09	CG			2	1	2										
11	Cladotanytarsus sp. B		CG			1												

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Chironomidae cont.																		
12	Clinotanypus sp.		P					1						1	1			1
13	Cryptochironomus sp.	6.40	P	1	1	1	1								2		2	1
14	Polypedilum halterale gp.	7.30	SH		1													
15	Procladius sp.	9.10	P	1		1				1								
16	Tanytarsus sp.	6.76	CF	1														
Ephemeroptera																		
Ephemeridae																		
17	Hexagenia limbata	4.90	CG											1	1			
Odonata																		
Gomphidae																		
18	Gomphus sp.	5.80	P			1												
Trichoptera																		
Hydroptilidae																		
19	Hydroptila sp.	6.22	SC														2	
Malacostraca																		
Cladocera																		
Sididae																		
20	Sida sp.		CF			2												
Cyclopoida																		
Cyclopidae																		
21	Eucyclops sp.		OM				1								1			

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
22	Corbicula fluminea	6.12	CF	19	17	4	20	22	1	13	2	5	8	2	8	7	4	2

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-31 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), FUNCTIONAL FEEDING GROUPS (FG), AND RELATIVE ABUNDANCE FOR PARR TAILRACE AT PARR RESERVOIR, SEPTEMBER 12, 2012[A]

Seq	Taxon	TV	FG	No. of Individuals	Relative Abundance
Annelida					
Hirudinea					
1	Hirudinea Genus species	5.00	P	3	0.01
Rhynchobdellida					
Glossiphoniidae					
2	Helobdella sp.	9.00	P	2	0.01
Oligochaeta					
Tubificida					
Naididae					
3	Stylaria lacustris	9.40	SC	1	0.00
Arthropoda					
Insecta					
Diptera					
Chironomidae					
4	Ablabesmyia peleensis	9.67	P	1	0.00
5	Nanocladius crassicornis/cf. rectinervis	7.07	CG	8	0.03
6	Orthocladius robacki		SH	1	0.00
7	Parachironomus carinatus	9.42	P	1	0.00
8	Polypedilum flavum	4.90	SH	2	0.01
9	Rheocricotopus robacki	7.28	CG	3	0.01
Simuliidae					
10	Simulium luggeri		CF	52	0.18
Ephemeroptera					
Baetidae					
11	Baetis intercalaris	4.99	CG	3	0.01
Heptageniidae					
12	Maccaffertium integrum	5.80	SC	2	0.01
13	Maccaffertium modestum	5.50	SC	26	0.09
Isonychiidae					
14	Isonychia sp.	3.45	CF	2	0.01
Leptohyphidae					
15	Tricorythodes sp.	5.06	CG	24	0.08

Seq	Taxon	TV	FG	No. of Individuals	Relative Abundance
Megaloptera					
Corydalidae					
16	Corydalus cornutus	5.16	P	11	0.04
Odonata					
Coenagrionidae					
17	Argia moesta	8.17	P	11	0.04
Libellulidae					
18	Neurocordulia virginiensis	2.05	P	3	0.01
Trichoptera					
Hydropsychidae					
19	Cheumatopsyche sp.	6.22	CF	12	0.04
20	Hydropsyche bidens		CF	20	0.07
21	Macrostemum carolina	3.52	CF	27	0.10
Hydroptilidae					
22	Hydroptila sp.	6.22	SC	7	0.02
Lepidostomatidae					
23	Lepidostoma sp.	0.90	SH	1	0.00
Leptoceridae					
24	Ceraclea nepha/protonepha	2.01	CG	18	0.06
25	Oecetis persimilis	4.70	P	7	0.02
26	Triaenodes injustus	2.47	SH	1	0.00
Philopotamidae					
27	Chimarra sp.	2.76	CF	2	0.01
Polycentropodidae					
28	Neureclipsis crepuscularis	4.19	CF	1	0.00
Malacostraca					
Amphipoda					
Gammaridae					
29	Gammarus sp.	9.10	OM	2	0.01
Mollusca					
Bivalvia					
Unionoida					
Corbiculidae					
30	Corbicula fluminea	6.12	CF	5	0.02

Seq	Taxon	TV	FG	No. of Individuals	Relative Abundance
Gastropoda					
Mesogastropoda					
Hydrobiidae					
31	Somatogyrus virginicus	6.40	SC	8	0.03
Pleuroceridae					
32	Goniobasis catenaria catenaria		SC	12	0.04
Platyhelminthes					
Turbellaria					
Tricladida					
Planariidae					
33	Dugesia tigrina	7.50	OM	5	0.02

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-32 BIOASSESSMENT METRICS FOR THE PARR UPSTREAM REPLICATES IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

	Parr Upstream														
	Sample Point 1					Sample Point 2					Sample Point 3				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	2	1	3	2	1	2	3	4	4	3	2	1	3	1	2
Number of Specimens	31	17	24	21	20	62	23	57	70	69	3	10	14	3	2
EPT Index	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
EPT Abundance	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Chironomidae Taxa	1	0	1	1	0	0	1	1	0	1	0	0	2	0	0
Chironomidae Abundance	1	0	1	1	0	0	1	1	0	1	0	0	3	0	0
EPT/Chironomidae Abundance	0.00	-	0.00	0.00	-	-	0.00	0.00	-	0.00	-	-	0.00	-	-
North Carolina Biotic Index	6.15	6.12	6.15	6.15	6.12	6.12	6.08	6.32	6.14	6.12	6.12	6.12	6.24	6.12	6.12
SCDHEC Bioclassification	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Percent Collector-Filterers	96.77	100.00	83.33	95.24	100.00	96.77	91.30	94.74	95.71	97.10	66.67	100.00	78.57	100.00	50.00
Percent Collector-Gatherers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	1.45	0.00	0.00	0.00	0.00	0.00
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	3.23	0.00	4.17	4.76	0.00	0.00	4.35	1.75	0.00	0.00	0.00	0.00	14.29	0.00	0.00
Percent Scrapers	0.00	0.00	12.50	0.00	0.00	3.23	4.35	3.51	2.86	1.45	33.33	0.00	0.00	0.00	50.00
Percent Shredders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.14	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.00	0.00	0.15	0.00	0.00	0.03	0.05	0.04	0.03	0.01	0.50	0.00	0.00	0.00	1.00
Percent Dominant Taxon	96.77	100.00	83.33	95.24	100.00	96.77	91.30	94.74	95.71	97.10	66.67	100.00	78.57	100.00	50.00
Number Of Dominant Taxa	1	1	2	1	1	1	1	1	1	1	2	1	3	1	2

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-33 BIOASSESSMENT METRICS FOR THE UNITS 2 & 3 DISCHARGE REPLICATES IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

	Units 2 & 3 Discharge														
	Sample Point 1					Sample Point 2					Sample Point 3				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	7	7	12	9	7	4	5	2	2	5	3	10	2	8	5
Number of Specimens	39	30	38	64	55	5	18	5	6	20	4	22	8	19	8
EPT Index	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0
EPT Abundance	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0
Chironomidae Taxa	3	2	4	2	2	0	1	0	0	0	1	4	0	2	3
Chironomidae Abundance	3	2	5	2	3	0	1	0	0	0	1	5	0	3	3
EPT/Chironomidae Abundance	0.00	0.00	0.00	0.00	0.00	-	0.00	-	-	-	1.00	0.20	-	0.67	0.00
North Carolina Biotic Index	5.80	6.39	6.10	6.25	6.13	6.87	6.43	6.12	6.12	5.95	5.51	7.42	5.94	7.09	7.38
SCDHEC Bioclassification	2.2	2.0	2.0	2.0	2.0	1.5	2.0	2.0	2.0	2.0	2.5	1.5	2.0	1.5	1.5
Percent Collector-Filterers	51.28	56.67	15.79	31.25	40.00	20.00	72.22	40.00	83.33	40.00	50.00	36.36	87.50	21.05	25.00
Percent Collector-Gatherers	0.00	0.00	7.89	1.56	3.64	0.00	0.00	0.00	0.00	0.00	25.00	9.09	0.00	0.00	12.50
Percent Omnivores	0.00	0.00	0.00	1.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55	0.00	0.00	0.00
Percent Predators	30.77	6.67	50.00	39.06	16.36	40.00	16.67	0.00	0.00	25.00	25.00	18.18	0.00	15.79	25.00
Percent Scrapers	17.95	33.33	26.32	26.56	40.00	40.00	11.11	60.00	16.67	35.00	0.00	31.82	12.50	63.16	37.50
Percent Shredders	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.35	0.59	1.67	0.85	1.00	2.00	0.15	1.50	0.20	0.88	0.00	0.88	0.14	3.00	1.50
Percent Dominant Taxon	48.72	56.67	42.11	37.50	40.00	40.00	72.22	60.00	83.33	40.00	50.00	36.36	87.50	26.32	37.50
Number Of Dominant Taxa	3	3	6	4	3	4	5	2	2	5	3	3	2	8	5

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-34 BIOASSESSMENT METRICS FOR THE COMBINED DATA COLLECTED AT THE PARR UPSTREAM AND UNITS 2 & 3 DISCHARGE LOCATIONS IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

Metric	Parr Upstream	Units 2 & 3 Discharge
Taxa Richness	8	22
Number of Specimens	426	341
EPT Index	1	2
EPT Abundance	1	4
Chironomidae Taxa	3	9
Chironomidae Abundance	9	28
EPT/Chironomidae	0.11	0.14
North Carolina Biotic Index	6.25	7.08
SCDHEC Bioclassification	2.0	1.5
Percent Collector-Filterers	94.60	40.18
Percent Collector-Gatherers	0.47	2.93
Percent Omnivores	0.00	0.59
Percent Predators	1.64	25.51
Percent Scrapers	3.05	30.50
Percent Shredders	0.23	0.29
Scraper/Collector-Filterers	0.03	0.76
Percent Dominant Taxon	94.60	39.30
Number Of Dominant Taxa	1	4

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-35 BIOASSESSMENT METRICS FOR PARR TAILRACE DOWNSTREAM OF PARR RESERVOIR, SEPTEMBER 12, 2012[A]

Metric	Parr Tailrace
Taxa Richness	8
Number of Specimens	426
EPT Index	1
EPT Abundance	1
Chironomidae Taxa	3
Chironomidae Abundance	9
EPT/Chironomidae Abundance	0.11
North Carolina Biotic Index	6.25
SCDHEC Bioclassification	2.0
Percent Collector-Filterers	94.60
Percent Collector-Gatherers	0.47
Percent Omnivores	0.00
Percent Predators	1.64
Percent Scrapers	3.05
Percent Shredders	0.23
Scraper/Collector-Filterers	0.03
Percent Dominant Taxon	94.60
Number Of Dominant Taxa	1

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

Single factor ANOVA analyses were also completed at each site on Parr Reservoir. These results are shown in Table 3-36.

One-way ANOVA results show significant differences in bioassessment metrics in taxa richness (p-value = 0.00009), and percentage of dominant taxon (p-value = 0.000001) at the Parr Reservoir upstream location. At the Parr Reservoir discharge point, ANOVA results show significant differences in bioassessment metrics in percentage of dominant taxon (p-value = 0.03499), EPT Index values (p-value = 0.00592), EPT abundance (p-value = 0.00010). All other metrics show no significant difference.

TABLE 3-36 RESULTS OF THE SINGLE FACTOR ANOVA ON PARR RESERVOIR, 11 SEPTEMBER 2012[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for the Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for the Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

4.0 DISCUSSION AND CONCLUSIONS

The Parr Fairfield Project operations do not appear to affect the overall water quality of the Parr Reservoir, Lake Monticello, and the Broad River below Parr Shoals Dam, according to mussel and macroinvertebrate studies. The data presented within the report depicts an overall healthy water system, providing suitable habitat for a variety of aquatic species. Ongoing monitoring efforts within the Project area will examine the macroinvertebrate community for any changes in water quality.

4.1 MUSSELS

The two freshwater mussel surveys conducted in 2007 and 2012 covered a large portion of the Broad River and Parr Reservoir, well documenting the mussel species in and around the Project area. Because of these studies, a current and comprehensive inventory of the freshwater mussels within the Project area exists.

The 2012 study revealed that the area of the Broad River immediately downstream of the Parr Shoals Dam provides a significant freshwater mussel habitat. Species were documented never before been seen in that area of the Broad River, while diversity at the study site was the greatest recorded in the Broad River Subbasin in North and South Carolina upriver from the Columbia Canal Dam (Alderman, 2012).

The 2007 study covered an expansive area, documenting the mussel species above and below Parr Shoals Dam, as well as within Parr Reservoir. The reservoir was determined to have the same diversity as the unimpounded sections of the river below Parr Shoals Dam. The stretch of the Broad River between Parr Shoals Dam and Columbia Dam was found to provide an excellent habitat for mussels.

4.2 MACROINVERTEBRATES

Baseline studies performed in 2008 and 2009 provide an inventory of macroinvertebrate species within the Project area. Monitoring efforts resumed in 2012 and will continue throughout the construction of the VCSNS expansion, and for five years after construction is complete.

Data collection and comparison of macroinvertebrate biometrics indicate neither spatial nor temporal significant difference within the Project Vicinity. The latest data concludes a SCDHEC

score of “good-fair” and NCBI score of “good” immediately downstream of the Project location at the Parr Tailrace.

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APPENDIX A

NEAL SHOALS MACROINVERTEBRATE ASSESSMENT

MEMORANDUM

To: Alan Stuart, Kleinschmidt Associates
From: Daniel Carnagey, Carnagey Biological Services, LLC
Date: 21 June 2012
Subject: Preliminary Conclusions From the Neal Shoals Macroinvertebrate Assessment, 24-25 Apr 2012

Based on the collections made below Neal Shoals Dam, and a previous study made at Parr Reservoir (Parr) in 2008 and 2009, a number of conclusions may be drawn. However, a number of items should be noted. First, neither the North Carolina Biotic Index (NCBI), nor the SCDHEC Bioclassification index SCDHEC BI)are robust if the number of specimens collected is under 100. Their robustness is also compromised if a large number of the specimens collected are without a tolerance value. Second, because there is not a control station, nor data from before the sand release, comparisons are somewhat difficult. Finally, the Parr collections were nor made using the Rapid Bioassessment Protocol, but were petite Ponar Dredge samples. This means that they were collected from a somewhat different habitat (sediment from deeper and more open water) and that each repetition at a given stations has generally has a lower number of specimens and taxa richness.

The bioassessment metrics for the Neal Shoals collection are listed below in Table 1. Note that the NCBI and the SCDHEC BI values are suspect at Stations 2E and 2W for the reasons listed above. Otherwise all stations are quite similar in NCBI and SCDHEC BI scores.

Because most of the Parr replicates had less than 100 specimens, all the replicates at each station during each sampling event were combined. The combined data is in Table 2 and the bioassessment metrics are in Table 3. When compared to the Neal Shoals collections, the Parr samples are much poorer in nearly all metrics. In general, NCBI and SCDHEC BI were higher at Neal Shoals than at Parr. In addition, EPT indices and abundance was much higher at all Neal Shoals stations than at Parr. This is due, at least in part, to the collection methods.

In conclusion, the Neal Shoals samples showed significantly better results than the previous Parr samples. The Parr samples also indicate that the taxa richness in Neal Shoals seems to be what would be expected given the sampling constraints discussed in the Memo dated 18 June 2012.

Table 1. Bioassessment metrics for the six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 24-25 April 2012.

	Sta. 1E	Sta. 1W	Sta. 2E	Sta. 2W	Sta. 3E	Sta. 3W
Taxa Richness	31.00	38.00	16.00	16.00	42.00	16.00
Number of Specimens	194.00	127.00	73.00	119.00	106.00	106.00
EPT Index	13.00	13.00	8.00	3.00	13.00	9.00
EPT Abundance	88.00	59.00	21.00	15.00	50.00	63.00
Chironomidae Taxa	12.00	9.00	3.00	1.00	8.00	2.00
Chironomidae Abundance	82.00	21.00	3.00	1.00	25.00	19.00
EPT/Chironomidae Abundance	1.07	2.81	7.00	15.00	2.00	3.32
NCBI	6.18	6.33	5.72	7.20	6.34	5.68
SCDHEC Bioclassification	2.50	2.50	2.80	1.50	2.50	2.80
%C-F	13.92	14.17	0.00	0.00	12.26	0.94
%C-G	11.34	6.30	5.48	10.08	30.19	17.92
%OM	1.55	0.79	5.48	1.68	6.60	0.00
%P	14.95	21.26	50.68	47.90	20.75	36.79
%SC	26.29	49.61	36.99	39.50	16.98	26.42
%SH	31.96	7.87	1.37	0.84	13.21	17.92
SC/C-F	1.89	3.50	-	-	1.38	28.00
SH/Total	0.32	0.08	0.01	0.01	0.13	0.18
%Dom Taxon	24.74	11.81	36.99	37.82	16.04	20.75
# Dom Taxa	7.00	6.00	5.00	7.00	5.00	7.00

Table 2. Macroinvertebrates, their NCBI tolerance values (TV), functional feeding groups (FG), and relative abundance for Broad River petite Ponar stations near the Parr Reservoir operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY.

				Sep-08		Jun-08		Jan-09		Apr-09	
Seq	Taxon	TV	FG	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge
Annelida											
Hirudinea											
1	Hirudinea Genus species		P	1	41				16		
Rhynchobdellida											
Glossiphoniidae											
2	Helobdella stagnalis	8.63	P				8				
Oligochaeta											
Lumbriculida											
Lumbriculidae											
3	Lumbriculidae Genus species	7.03	SC	1		1	4				
Tubificida											
Naididae											
4	Branchiura sowerbyi	8.28	SC					1	5		
5	Limnodrilus hoffmeisteri	9.47	SC					17	13	3	13
6	Naididae Genus species		SC							55	52
7	Tubifex tubifex	10	SC	14	41	25	26	10	8		
Arthropoda											
Insecta											
Coleoptera											
Elmidae											
8	Dubiraphia sp.	5.93	CG	1							
9	Macronychus glabratus	4.58	CG					1			

Table 2. Continued.

				Sep-08	**Jun-08**	**Jan-09**	**Apr-09**

Seq	Taxon	TV	FG	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge
Diptera											
Athericidae											
10	Atherix sp.	2.1	P	1							
Ceratopogonidae											
11	Bezzia/Palpomyia sp.	6.86	P			2	2	2		4	
12	Culicoides sp.	7.7	P	1				2			
Chaoboridae											
13	Chaoborus sp.	8.5	P					1			
Chironomidae											
14	Ablabesmyia annulata	2.04	P				1				
15	Ablabesmyia mallochi	7.19	P				1				
16	Chironomus sp.	9.63	CG				34	11	6	1	4
17	Clinotanypus sp.		P	17	4			28	2	2	
18	Cryptochironomus sp.	6.4	P			1	2		2	1	
19	Cryptotendipes sp.	6.19	CG								
20	Dicrotendipes sp.	8.1	CG								
21	Fissimentum sp. A		CG			2					
22	Harnischia sp.	9.07	CG							2	
23	Microtendipes sp.	5.53	CF			5					
24	Paracladopelma undine	4.93	CG			2	1				
25	Polypedilum halterale gr.	7.31	SH				1			1	
26	Polypedilum illinoense gr.	9	SH						1		
27	Procladius sp.	9.1	P		3		13	13		2	
28	Rheotanytarsus exiguus gr.	5.89	CF		2		2				

Table 2. Continued.

				Sep-08		Jun-08		Jan-09		Apr-09	
Seq	Taxon	TV	FG	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge
Chironomidae cont.											
29	Tanytarsus sp.	6.76	CF								
30	Thienemannimyia gr.	8.42	P							1	
31	Tribelos sp.	6.31	CG			3					
Ephemeroptera											
Ephemerellidae											
32	Ephemerella sp.	2.04	CG	1	17						
Ephemeridae											
33	Hexagenia limbata	4.9	CG				4			1	1
34	Hexagenia sp.	4.9	CG					1	2		
Odonata											
Gomphidae											
35	Gomphus sp.	5.8	P	1			1				
36	Stylurus plagiatus		P					2			
Trichoptera											
Hydroptilidae											
37	Hydroptilidae Genus species		0					3			
Leptoceridae											
38	Oecetis inconspicua complex	1.85	P	1	3						
39	Oecetis sp.	4.7	P						2		
Malacostraca											
Amphipoda											
Talitridae											
40	Hyalella azteca	7.75	OM				1				

Table 2. Continued.

Seq	Taxon	TV	FG	Sep-08		Jun-08		Jan-09		Apr-09	
				Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge
Isopoda											
Asellidae											
41	Caecidotea sp.	9.11	SC				2				
Mollusca											
Bivalvia											
Unionoida											
Corbiculidae											
42	Corbicula fluminea	6.12	CF	107	64	20	231	35	68	34	24
Sphaeriidae											
43	Sphaeriidae Genus species		CF					2			
Gastropoda											
Limnophila											
Physidae											
44	Physa sp.	8.84	SC				1				
Planorbidae											
45	Promenetus exacuous		SC				4				
TOTAL				146	175	61	339	129	125	107	94

Table 3. Bioassessment metrics for the Broad River rapid bioassessment stations near Parr reservoir operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY.

	Sep-08		Jun-08		Jan-09		Apr-09	
	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge
Taxa Richness	11	8	9	19	15	11	12	5
Number of Specimens	146	175	61	339	129	125	107	94
EPT Index	2	2	0	1	2	2	1	1
EPT Abundance	2	20	0	4	4	4	1	1
Chironomidae Taxa	1	3	5	8	3	4	7	1
Chironomidae Abundance	17	9	13	55	52	11	10	4
EPT/Chironomidae Abundance	0.12	2.22	0.00	0.07	0.08	0.36	0.10	0.25
NCBI	7.17	5.96	7.40	8.04	8.64	8.02	7.17	7.90
SCDHEC Bioclassification	1.5	2	1.5	1	1	1	1.5	1
%C-F	73.29	37.71	40.98	68.73	28.68	54.40	31.78	25.53
%C-G	1.37	9.71	11.48	11.50	10.08	6.40	3.74	5.32
%OM	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00
%P	15.07	29.14	4.92	8.26	37.21	17.60	9.35	0.00
%SC	10.27	23.43	42.62	10.91	21.71	20.80	54.21	69.15
%SH	0.00	0.00	0.00	0.29	0.00	0.80	0.93	0.00
SC/C-F	0.14	0.62	1.04	0.16	0.76	0.38	1.71	2.71
%Dom Taxon	73.29	36.57	40.98	68.14	27.13	54.40	51.40	55.32
# Dom Taxa	3	4	3	3	6	4	2	3

MEMORANDUM

To: Alan Stuart, Kleinschmidt Associates
From: Daniel Carnagey, Carnagey Biological Services, LLC
Date: 17 May 2013
Subject: Neal Shoals Macroinvertebrate Assessment of 10-11 April 2013

On 10-11 April 2013, personnel from CARNAGEY BIOLOGICAL SERVICES, LLC (SCDHEC Laboratory Certification No. 32010) and Kleinschmidt Associates conducted an instream benthic macroinvertebrate community rapid bioassessment on the Broad River, downstream of the Neal Shoals Dam operated by South Carolina Electric & Gas Company (SCE&G).

One sample was collected from each bank in each of the three segments specified in the study plan. Sampling lasted for 30 minutes on each bank. Sampling consisted of using a D-ring dip net to sample habitat along the bank, as well as examining submerged logs and rocks for invertebrates. The water depth did not allow for sampling at any distance from the bank.

RESULTS

A total of 905 specimens representing 86 taxa were collected from the six stations during this assessment. Bioassessment metrics for the 2013 collection are listed in Table 1. The number of specimens collected, their NCBI tolerance values, functional feeding groups, and relative abundance at each station are presented in Table 3. Tables 2 and 4 are the values for the Spring 2012 collections. Both have been corrected for the season (spring) and use the most up to date available tolerance values from SCDHEC (2012).

Comparison to Spring 2012 Assessment

With the exception of Segment 2, taxa richness and EPT index values were similar for the two years. In Segment 2, both were much higher in 2013. Spring 2013 EPT abundance was higher in Segments 2 and 3, and were very similar to 2012 in Segment 1. The 2013 North Carolina Biotic Index (NCBI) and SCDHEC bioclassifications scores were numerically better at all stations than in 2012.

Comparison to the 2008 and 2009 collections made in Parr Reservoir

As noted in a previous memo (21 June 2012), the Parr Reservoir metrics were much poorer in nearly all metrics than the Spring 2012 Neal Shoals collection. This is also true for the Spring 2013 collection. That memo should be referenced for the Parr Reservoir data and a short discussion of the difficulties in comparing these studies.

Conclusion

In conclusion, while the collections made in Spring 2012 and Spring 2013 were similar, the 2013 collections had better scores at all stations. This was especially true in Segment 2. The difference in EPT taxa between the two collections is the largest cause of this difference. Both of the Neal Shoals collections have shown much better metric scores than previous studies in Parr Reservoir.

Table 1. Bioassessment metrics for the six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 10-11 April 2013.

	Sta. 1E	Sta. 1W	Sta. 2E	Sta. 2W	Sta. 3E	Sta. 3W
Taxa Richness	24	36	40	39	39	33
Number of Specimens	118	113	173	146	175	180
EPT Index	13	13	20	14	13	11
EPT Abundance	88	58	143	75	122	123
Chironomidae Taxa	7	13	9	10	15	13
Chironomidae Abundance	24	36	15	52	36	36
EPT/Chironomidae Abundance	3.67	1.61	9.53	1.44	3.39	3.42
NCBI	5.03	6.22	5.41	6.28	5.69	5.67
SCDHEC Bioclassification	3.7	2.7	4.2	2.8	3.2	3.0
%C-F	24.58	39.82	38.73	8.90	8.57	43.33
%C-G	19.49	9.73	5.78	30.82	52.57	10.56
%OM	0.00	2.65	0.00	1.37	0.57	0.00
%P	31.36	24.78	16.18	17.81	15.43	11.11
%SC	10.17	7.96	37.57	34.25	13.14	27.78
%SH	14.41	15.04	1.73	6.85	9.71	7.22
SC/C-F	0.41	0.20	0.97	3.85	1.53	0.64
SH/Total	0.14	0.15	0.02	0.07	0.10	0.07
%Dom Taxon	24.58	20.35	19.08	21.23	17.14	17.78
# Dom Taxa	8	5	5	3	5	6

Table 2. Bioassessment metrics for the six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 24-25 April 2012.

	Sta. 1E	Sta. 1W	Sta. 2E	Sta. 2W	Sta. 3E	Sta. 3W
Taxa Richness	31	38	16	16	42	16
Number of Specimens	194	127	73	119	106	106
EPT Index	13	13	8	3	13	9
EPT Abundance	88	59	21	15	50	63
Chironomidae Taxa	12	9	3	1	8	2
Chironomidae Abundance	82	21	3	1	25	19
EPT/Chironomidae Abundance	1.07	2.81	7.00	15.00	2.00	3.32
NCBI	6.49	6.47	6.00	7.50	6.81	5.98
SCDHEC Bioclassification	2.2	2.3	2.3	1.2	2.0	2.3
%C-F	13.92	14.17	0.00	0.00	12.26	0.94
%C-G	11.34	6.30	5.48	10.08	30.19	17.92
%OM	1.55	0.79	5.48	1.68	6.60	0.00
%P	14.95	21.26	50.68	47.90	20.75	36.79
%SC	26.29	49.61	36.99	39.50	16.98	26.42
%SH	31.96	7.87	1.37	0.84	13.21	17.92
SC/C-F	1.89	3.50	-	-	1.38	28.00
SH/Total	0.32	0.08	0.01	0.01	0.13	0.18
%Dom Taxon	24.74	11.81	36.99	37.82	16.04	20.75
# Dom Taxa	7	6	5	7	5	7

Table 3. Macroinvertebrates, their NCBI tolerance values (TV), functional feeding groups (FG), and relative abundance for six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 10-11 April 2013.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Annelida															
Hirudinea															
Rhynchobdellida															
Glossiphoniidae															
1	Helobdella sp.	9.30	P						1.00						0.01
Oligochaeta															
Haplotaxida															
Lumbricidae															
2	Lumbricidae Genus species		SC			1						0.01			
Lumbriculida															
Lumbriculidae															
3	Eclipidrilus lacustris	7.33	SC			1						0.01			
Tubificida															
Naididae															
4	Branchiura sowerbyi	8.58	SC				2						0.01		
5	Dero sp.		SC		1	1	1	2	1.00		0.01	0.01	0.01	0.01	0.01
6	Limnodrilus sp.	9.80	SC				1						0.01		
7	Stylaria lacustris	9.70	SC						1.00						0.01
Arthropoda															
Arachnoidea															
Acariformes															
Hydrachnidae															
8	Hydrachna sp.	5.83	P	2						0.02					

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

Seq	Taxon	TV	FG	No. of Individuals						Relative Abundance					
				Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W	Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W
Insecta															
Coleoptera															
Elmidae															
9	Ancyronyx variegatus	6.79	CG			1		2	4.00			0.01		0.01	0.02
10	Dubiraphia quadrinotata	6.23	CG					1						0.01	
11	Macronychus glabratus	4.88	CG			1		4	2.00			0.01		0.02	0.01
Gyrinidae															
12	Dineutus discolor	5.84	P		1						0.01				
Haliplidae															
13	Peltodytes bradleyi	9.03	SH				1						0.01		
14	Peltodytes duodecimpunctatus	9.03	SH				1						0.01		
Noteridae															
15	Hydrocanthus atripennis	7.44	P	1						0.01					
Diptera															
Chironomidae															
16	Ablabesmyia mallochi	7.49	P		2	2	3	1			0.02	0.01	0.02	0.01	
17	Ablabesmyia peleensis	9.97	P		5	2		1	1.00		0.04	0.01		0.01	0.01
18	Brillia flavifrons	5.50	SH					1						0.01	
19	Chironomus sp.	9.93	CG					1	1.00					0.01	0.01
20	Corynoneura sp.		CG			2	2		2.00			0.01	0.01		0.01
21	Cricotopus sp.		SH		2			1	1.00		0.02			0.01	0.01
22	Dicrotendipes neomodestus	8.40	CG	1				2		0.01				0.01	
23	Eukiefferiella brehmi gr.	3.00	CG	2	3	1	2			0.02	0.03	0.01	0.01		
24	Hydrobaenus sp.	9.84	SC	3	1		1	1		0.03	0.01		0.01	0.01	
25	Nanocladius distinctus	7.37	CG		2				2.00		0.02				0.01
26	Omisus sp.		CG					3						0.02	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

Seq	Taxon	TV	FG	No. of Individuals						Relative Abundance					
				Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W	Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W
Chironomidae cont.															
27	Orthocladius sp.		SH	8	6	1	5	2	2.00	0.07	0.05	0.01	0.03	0.01	0.01
28	Paralauterborniella nigrohalterale	5.07	CG			1						0.01			
29	Parametriocnemus sp.	3.95	CG	1					5.00	0.01					0.03
30	Polypedilum flavum	5.20	SH	8	2	1	1	2	10.00	0.07	0.02	0.01	0.01	0.01	0.06
31	Polypedilum halterale gr.	7.60	SH		3		1	7			0.03		0.01	0.04	
32	Polypedilum illinoense gr.	9.30	SH		2			2			0.02			0.01	
33	Rheocricotopus robacki	7.58	CG		2				2.00		0.02				0.01
34	Rheotanytarsus exiguus gr.	6.19	CF		2	2			7.00		0.02	0.01			0.04
35	Stictochironomus sp.	6.82	CG				31	6	1.00				0.21	0.03	0.01
36	Tanytarsus sp.	7.06	CF				2	2	1.00				0.01	0.01	0.01
37	Zavrelimyia sp.		P	1	4	3	4	4	1.00	0.01	0.04	0.02	0.03	0.02	0.01
Simuliidae															
38	Simulium slossanae		CF	2				1		0.02				0.01	
Tipulidae															
39	Tipula sp.	7.63	SH					1						0.01	
Ephemeroptera															
Baetidae															
40	Baetis intercalaris	5.29	CG	3	1					0.03	0.01				
41	Plauditus puntiventris	4.30	CG					30						0.17	
Caenidae															
42	Caenis sp.	7.71	CG		1		4	22			0.01		0.03	0.13	
Ephemerellidae															
43	Dannella simplex	3.91	CG	6	1	1	1	4		0.05	0.01	0.01	0.01	0.02	
44	Ephemerella sp.	2.34	CG	10	1	1		15		0.08	0.01	0.01		0.09	
45	Eurylophella funeralis	2.35	CG			1	5					0.01	0.03		

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

Seq	Taxon	TV	FG	No. of Individuals						Relative Abundance					
				Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W	Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W
Ephemeridae															
46	Hexagenia limbata	5.20	CG			1						0.01			
Heptageniidae															
47	Maccaffertium integrum	6.10	SC	2	3	25	24	10	27.00	0.02	0.03	0.14	0.16	0.06	0.15
48	Maccaffertium modestum	5.80	SC	6	3	33	20	8	14.00	0.05	0.03	0.19	0.14	0.05	0.08
49	Stenacron interpunctatum	7.17	SC			1	1	2				0.01	0.01	0.01	
Isonychiidae															
50	Isonychia sp.	3.75	CF	2	5	19	1	5	24.00	0.02	0.04	0.11	0.01	0.03	0.13
Leptophlebiidae															
51	Leptophlebia sp.	6.53	CG					2						0.01	
Odonata															
Aeshnidae															
52	Boyeria vinosa	6.19	P					1						0.01	
Calopterygidae															
53	Calopteryx sp.	8.08	P					1						0.01	
Coenagrionidae															
54	Argia moesta	8.47	P				2						0.01		
55	Argia tibialis	8.47	P			3	2					0.02	0.01		
56	Enallagma sp.	9.21	P		1	1	2				0.01	0.01	0.01		
Gomphidae															
57	Erptogomphus designatus		P		1		1				0.01		0.01		
58	Gomphus sp.	6.10	P		1		1	1	1.00		0.01		0.01	0.01	0.01
Libellulidae															
59	Epicordulia princeps	5.90	P			2	1					0.01	0.01		
60	Macromia taeniolata	6.46	P		2		1		2.00		0.02		0.01		0.01

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

Seq	Taxon	TV	FG	No. of Individuals						Relative Abundance					
				Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W	Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W
Plecoptera															
Nemouridae															
61	Amphinemura sp.	3.63	SH					1						0.01	
Perlidae															
62	Agnetina sp.	0.30	P	1						0.01					
63	Neoperla sp.	1.79	P			3	1					0.02	0.01		
64	Paragnetina fumosa	3.66	P			1						0.01			
65	Perlesta sp.	5.00	P	29	7	9	6	18	12.00	0.25	0.06	0.05	0.04	0.10	0.07
Perlodidae															
66	Isoperla bilineata	5.74	P	3	3	1			2.00	0.03	0.03	0.01			0.01
Pteronarcyidae															
67	Pteronarcys sp.	1.97	SH	1						0.01					
Trichoptera															
Hydropsychidae															
68	Cheumatopsyche sp.	6.52	CF	18	23	29	6	4	32.00	0.15	0.20	0.17	0.04	0.02	0.18
69	Hydropsyche incommoda	5.07	CF	6	7	1			4.00	0.05	0.06	0.01			0.02
70	Hydropsyche simulans/rossi		CF	1		3	2	1	2.00	0.01		0.02	0.01	0.01	0.01
71	Hydropsyche venularis	5.26	CF						4.00						0.02
Hydroptilidae															
72	Hydroptila sp.	6.52	SC			1						0.01			
Leptoceridae															
73	Nectopsyche exquisita	4.40	SH		2						0.02				
74	Oecetis persimilis	5.00	P		1	1	2				0.01	0.01	0.01		
Limnephilidae															
75	Pycnopsyche sp.	2.82	SH			1	1					0.01	0.01		

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

Seq	Taxon	TV	FG	No. of Individuals						Relative Abundance					
				Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W	Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W
Philopotamidae															
76	Chimarra sp.	3.06	CF			3			1.00			0.02			0.01
Polycentropodidae															
77	Neureclipsis crepuscularis	4.49	CF			8	1		1.00			0.05	0.01		0.01
Malacostraca															
Amphipoda															
Gammaridae															
78	Gammarus sp.	9.40	OM		1						0.01				
Talitridae															
79	Hyalella azteca	8.05	OM				1						0.01		
Decapoda															
Cambaridae															
80	Cambaridae Genus species	7.80	OM					1						0.01	
Mollusca															
Bivalvia															
Unionoida															
Corbiculidae															
81	Corbicula fluminea	6.42	CF		8	2	1	2	2.00		0.07	0.01	0.01	0.01	0.01
Gastropoda															
Limnophila															
Lymnaeidae															
82	Lymnaea columella		SC	1						0.01					
Physidae															
83	Physa sp.	9.14	SC			1						0.01			
Planorbidae															
84	Helisoma anceps	6.53	SC			1						0.01			

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

Seq	Taxon	TV	FG	No. of Individuals						Relative Abundance					
				Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W	Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W
Mesogastropoda															
Pleuroceridae															
85	Goniobasis catenaria catenaria		SC		1				7.00		0.01				0.04
Platyhelminthes															
Turbellaria															
Tricladida															
Planariidae															
86	Dugesia tigrina	7.80	OM		2		1				0.02		0.01		

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Macroinvertebrates, their NCBI tolerance values (TV), functional feeding groups (FG), and relative abundance for six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 24-25 April 2012.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Annelida															
Hirudinea															
1	Hirudinea Genus species	5.30	P				1						0.01		
Rhynchobdellida															
Glossiphoniidae															
2	Helobdella sp.	9.30	P		1						0.01				
Oligochaeta															
Haplotaxida															
Lumbricidae															
3	Lumbricidae Genus species		SC					2						0.02	
Lumbriculida															
Lumbriculidae															
4	Eclipidrilus lacustris	7.33	SC		1						0.01				
5	Lumbriculus variegatus	7.33	SC		4			1			0.04			0.01	
Tubificida															
Naididae															
6	Branchiura sowerbyi	8.58	SC		1						0.01				
7	Pristina jenkinae		SC					1	1					0.01	0.01
8	Pristina osborni		SC		2						0.02				
9	Slavina appendiculata	7.36	CG	1						0.01					

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Arthropoda															
Insecta															
Coleoptera															
Dytiscidae															
10	Neoporus clypealis	8.92	P					1						0.01	
11	Neoporus dilatatus	8.92	P					6						0.06	
12	Neoporus striatopunctatus	8.92	P					1						0.01	
Elmidae															
13	Ancyronyx variegatus	6.79	CG				7						0.06		
14	Macronychus glabratus	4.88	CG		1	1	5	5	3		0.01	0.01	0.04	0.05	0.03
15	Stenelmis sp.	5.40	SC	2						0.01					
Haliplidae															
16	Peltodytes bradleyi	9.03	SH					1						0.01	
17	Peltodytes duodecimpunctatus	9.03	SH					1						0.01	
Hydrophilidae															
18	Sperchopsis tessellatus	6.43	CG					1						0.01	
Noteridae															
19	Hydrocanthus atripennis	7.44	P			1		1	1			0.01		0.01	0.01
Diptera															
Ceratopogonidae															
20	Bezzia/Palpomyia sp.	7.16	P		1			1			0.01			0.01	
Chironomidae															
21	Ablabesmyia mallochi	7.49	P	5	7			3		0.03	0.06			0.03	
22	Chironomus sp.	9.93	CG					1						0.01	
23	Corynoneura sp.		CG	3		1		2		0.02		0.01		0.02	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

Seq	Taxon	TV	FG	No. of Individuals						Relative Abundance					
				Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W	Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W
Chironomidae cont.															
24	Cricotopus sp.		SH	1						0.01					
25	Dicrotendipes neomodestus	8.40	CG	1						0.01					
26	Dicrotendipes sp.	8.40	CG			1						0.01			
27	Orthocladius sp.		SH	48	6			11		0.26	0.05			0.10	
28	Paratanytarsus sp.	8.75	CF		1						0.01				
29	Polypedilum fallax gr.	6.69	SH				1	1	16				0.01	0.01	0.15
30	Polypedilum flavum	5.20	SH	1	1					0.01	0.01				
31	Polypedilum illinoense gr.	9.30	SH	11	1	1			3	0.06	0.01	0.01			0.03
32	Polypedilum scalaenum gr.	8.70	SH	1						0.01					
33	Procladius sp.	9.40	P					2						0.02	
34	Pseudochironomus sp.	5.66	CG		1						0.01				
35	Tanytarsus sp.	7.06	CF	3	1			4		0.02	0.01			0.04	
36	Thienemanniella similis	6.20	CG	5						0.03					
37	Thienemanniella xena	6.20	CG	1	1			1		0.01	0.01			0.01	
38	Thienemannimyia gr.		P	2	2					0.01	0.02				
Ephemeroptera															
Baetidae															
39	Baetis intercalaris	5.29	CG	2	1	1		4	14	0.01	0.01	0.01		0.04	0.13
40	Heterocloeon sp.	3.78	SC	1		1		1	2	0.01		0.01		0.01	0.02
41	Procloeon sp.	5.30	OM	2	1	4	2	6		0.01	0.01	0.05	0.02	0.06	
Caenidae															
42	Caenis sp.	7.71	CG		3			17			0.03			0.16	
Ephemerellidae															
43	Dannella simplex	3.91	CG					1						0.01	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Heptageniidae															
44	Maccaffertium integrum	6.10	SC	18	13	7	12	6	8	0.10	0.11	0.10	0.10	0.06	0.08
45	Maccaffertium modestum	5.80	SC	4	10	2	1	3	1	0.02	0.09	0.03	0.01	0.03	0.01
46	Stenacron interpunctatum	7.17	SC	1	3	2				0.01	0.03	0.03			
Isonychiidae															
47	Isonychia sp.	3.75	CF	1				3		0.01				0.03	
Leptohyphidae															
48	Tricorythodes sp.	5.36	CG	3	1					0.02	0.01				
Leptophlebiidae															
49	Leptophlebia sp.	6.53	CG						2						0.02
Heteroptera															
Gerridae															
50	Rheumatobates sp.		P		7	27	45		13		0.06	0.37	0.38		0.12
Mesoveliidae															
51	Mesovelia mulsanti		P					1						0.01	
Nepidae															
52	Ranatra nigra	8.10	P					1						0.01	
Megaloptera															
Corydalidae															
53	Corydalus cornutus	5.46	P		1						0.01				
Odonata															
Aeshnidae															
54	Boyeria vinosa	6.19	P					1						0.01	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

Seq	Taxon	TV	FG	No. of Individuals						Relative Abundance					
				Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W	Sta. 1 E	Sta. 1 W	Sta. 2 E	Sta. 2 W	Sta. 3 E	Sta. 3 W
Coenagrionidae															
55	Argia apicalis	8.47	P				4						0.03		
56	Argia tibialis	8.47	P				5						0.04		
Gomphidae															
57	Gomphus consanguis	6.10	P			6		1				0.08		0.01	
58	Gomphus sp.	6.10	P				2						0.02		
Libellulidae															
59	Macromia illinoense	6.46	P		1						0.01				
Plecoptera															
Perlidae															
60	Acroneuria sp.		P		2						0.02				
61	Neoperla sp.	1.79	P		1				3		0.01				0.03
62	Perlesta sp.	5.00	P	20	4	3		2	22	0.11	0.04	0.04		0.02	0.21
Trichoptera															
Hydropsychidae															
63	Cheumatopsyche sp.	6.52	CF	12	3			1	1	0.07	0.03			0.01	0.01
64	Hydropsyche sp.		CF					4						0.04	
Hydroptilidae															
65	Hydroptila sp.	6.52	SC	16	15	1		1	10	0.09	0.13	0.01		0.01	0.09
Leptoceridae															
66	Ceraclea tarsipunctata	2.31	CG	6						0.03					
67	Oecetis persimilis	5.00	P	2						0.01					
68	Triaenodes sp.	4.76	SH		2						0.02				
Polycentropodidae															
69	Polycentropus sp.	3.83	P					1						0.01	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Malacostraca															
Amphipoda															
Gammaridae															
70	Gammarus sp.	9.40	OM	1						0.01					
Talitridae															
71	Hyalella azteca	8.05	OM					1						0.01	
Cladocera															
Sididae															
72	Sida sp.		CF	1						0.01					
Isopoda															
Asellidae															
73	Caecidotea sp.	9.40	SC		3		10	1			0.03		0.08	0.01	
Mollusca															
Bivalvia															
Unionoida															
Corbiculidae															
74	Corbicula fluminea	6.42	CF	10	13			1							
Gastropoda															
Limnophila															
Physidae															
75	Physa sp.	9.14	SC	9	5		9	1	6	0.05	0.04		0.08	0.01	0.06
Planorbidae															
76	Helisoma anceps	6.53	SC				7						0.06		
77	Menetus dilatatus	8.53	SC		1		7	1			0.01		0.06	0.01	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Mesogastropoda															
Pleuroceridae															
78	Goniobasis catenaria catenaria		SC		3	14	1				0.03	0.19	0.01		
Viviparidae															
79	Campeloma decisum	6.75	SC		2						0.02				

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder