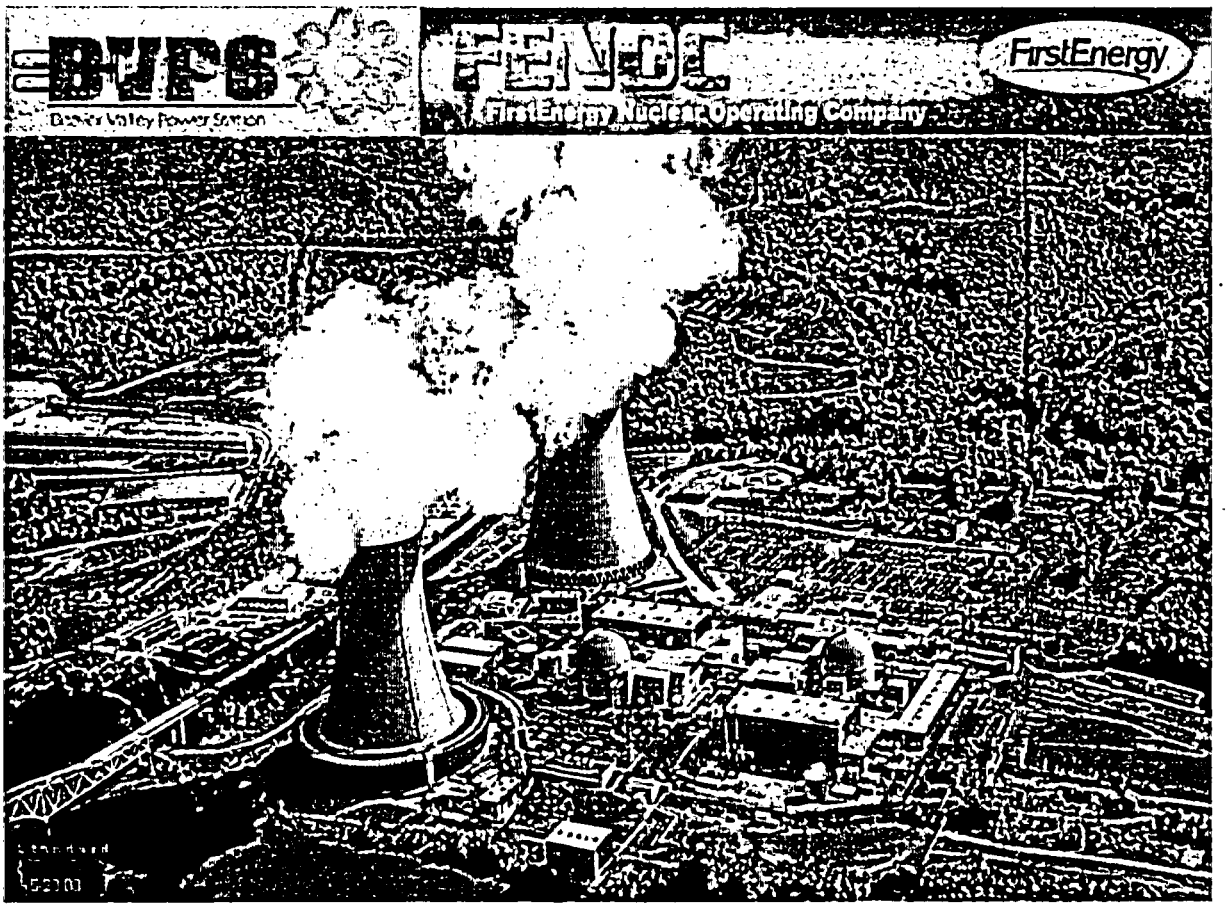
FIRSTENERGY NUCLEAR OPERATING COMPANY

BEAVER VALLEY POWER STATION



2003 ANNUAL ENVIRONMENTAL OPERATING REPORT

NON-RADIOLOGICAL

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report is submitted in accordance with Section 5.4.1 of Appendix B To Facility Operating License No. NPF-73, Beaver Valley Power Station Unit 2, Environmental Protection Plan (Non-Radiological). Beaver Valley Power Station (BVPS) is operated by FirstEnergy Nuclear Operating Company (FENOC). The Objectives of the Environmental Protection Plan (EPP) are:

- Verify that the facility is operated in an environmentally acceptable manner, as established by the Final Environmental Statement-Operating License Stage (FES-OL) and other NRC environmental impact assessments.
- Coordinate NRC requirements and maintain consistency with other Federal, State, and local requirements for environmental protection.
- Keep NRC informed of the environmental effects of facility construction and operation and of actions taken to control those effects.

To achieve the objectives of the EPP, FirstEnergy Corporation, FENOC, and BVPS, have written programs and procedures to comply with the EPP, protect the environment, and comply with governmental requirements- primarily including the US Environmental Protection Agency (EPA), and the Pennsylvania Department of Environmental Protection (PA DEP). Water quality matters identified in the Final Environmental Statements-Operating License Stage (FES-OL) are regulated under the National Pollutants Discharge Elimination System (NPDES) Permit No. PA0025615. Waste is regulated under EPA Identification No. PAR000040485. Attachment 1 contains a listing of permits and registrations for environmental compliance.

The BVPS programs and procedures include pre-work and pre-project environmental evaluations, operating procedures, pollution prevention and response programs procedures and plans, process improvement and corrective action programs, and human performance programs. Technical and managerial monitoring of tasks, operations, and other activities are performed. Any identified challenges, concerns, or questions, are captured in the FENOC Problem Identification and Resolution Program with a Condition Report. Condition Reports include investigations, cause determinations, and corrective actions to fix and prevent recurrence.

During 2003 BVPS continued an Aquatic Monitoring Program to evaluate its potential impact on the New Cumberland Pool of the Ohio River, and to provide information on potential impacts to BVPS operation from macrofoulers such as Asian clams and Zebra mussels.

1.2 SUMMARY AND CONCLUSIONS

There were no significant environmental events during 2003. One spill occurred that, though reported to the Pennsylvania Department of Environmental Protection (PA DEP), caused no measurable impact to the environment, and isdetailed in Section 4.0 of this report. Corrective actions were identified for each through the FENOC Process Improvement Program.

During 2003, no significant changes to operations that could affect the environment were made at Beaver Valley Power Station. ***As in previous years, results of the BVPS environmental programs did not indicate any adverse environmental impacts from station operation.***

1.3 ANALYSIS OF SIGNIFICANT ENVIRONMENTAL CHANGE

During 2003, no significant changes to were made at BVPS to cause significant negative affect on the environment.

1.4 AQUATIC MONITORING PROGRAM

The 2003 Beaver Valley Power Station (BVPS) Units 1 and 2 Non-Radiological Monitoring Program consisted of an Aquatic Program that included surveillance and field sampling of the Ohio River's aquatic life in the vicinity of the station. The Aquatic Program is conducted annually provide baseline aquatic resources data, to assess the impact of the operation of BVPS on the aquatic ecosystem of the Ohio River, and to monitor for potential impacts of biofouling organisms (*Corbicula* and zebra mussels) on BVPS operations. This is the 28th year of operational environmental monitoring for Unit 1 and the 17th for Unit 2. As in previous years, the results of the program did not indicate any adverse environmental impact to the aquatic life in the Ohio River associated with the operation of BVPS.

The results of the 2003 benthic macroinvertebrate survey conducted in May and September indicated a normal community structure existed in the Ohio River both upstream and downstream of the BVPS. These benthic surveys are also a continuation of a Fate and Effects Study conducted from 1990 through 1992 for PA DEP to assess the ecosystem impacts of the molluscicides Betz Clamtrol CT-1, CT-2, and Powerline 3627, used to control biofouling organisms at BVPS. ***To date the results of the benthic studies have not indicated any impacts of operation at the BVPS, including the use these biocides, on the benthic community below the BVPS discharge.***

Substrate was probably the most important factor influencing the distribution and abundance of the benthic macroinvertebrates in the Ohio River near BVPS. Soft muck-type substrate along the shoreline found in 2003 and previous years was conducive to segmented worm (oligochaete) and midge (chironomid) proliferation. In 2003, 53 macroinvertebrate taxa were identified. ***One new taxon was added to the cumulative list of benthic macroinvertebrates collected near BVPS since the inception of this program.*** Chironomids were the most frequently collected groups in May for both the control and non-control stations. Oligochetes were the most frequently collected groups in September for both the control and non-control stations. There were no major differences in the community structure between control and non-control stations that could be attributed to operation of BVPS. ***The overall community structure has changed little since pre-operational years, and program results did not indicate that BVPS operations were affecting the benthic community of the Ohio River.***

The fish community of the Ohio River near the BVPS was sampled in May, July, September and November of 2003 with night electrofishing and daytime seining. ***Results from the 2003 fish***

surveys indicated that a normal community structure for the Ohio River existed near BVPS based on species composition and relative abundance. Since monitoring began in the early 1970's, the number of identified fish taxa has increased from 43 to 78 for the New Cumberland Pool.

During the survey, forage species were collected or observed in the highest numbers, principally emerald shiner, spottail shiner, and gizzard shad. This indicated a healthy fish community, since game species rely on the availability of abundant forage for survival. Shorthead redhorse, sauger, and Golden redhorse were also commonly collected in 2003. Variations in the annual catch were probably attributable to normal fluctuations in the population size of the forage species and the predator populations that depend on them. Forage species, such as gizzard shad, spottail shiner, and emerald shiners, which have high reproductive potential, frequently respond to changes in the environment with large fluctuations in population size. This in turn influences the population of predator species.

In 2003, species composition remained comparable among control and non-control stations. Common taxa collected included shorthead redhorse, spottail shiner, sauger, and golden redhorse sucker. The catch per unit effort (number of fish per minute) for electrofishing sampling in 2003 was 1.28 fish. This was slightly lower compared with results of the previous year when electrofishing resulted in 1.98 fish collected per minute. These differences may have been the result of population changes, differences in sampling schedule, or caused by environmental conditions (e.g. turbidity, waves, water temperature, flow) on specific electrofishing sampling dates that affected fish distribution or collection gear efficiency.

Little difference in the species composition of the catch was observed between the control (Station 1) and non-control (Stations 2A, 2B and 3) collections. Habitat preference and availability were probably the most important factors affecting where and when fish were collected. ***In 2003, there was no indication of negative impact to the fish community in the Ohio River from the operation of BVPS.***

The monthly reservoir ponar samples collected in Units 1 and 2 cooling towers and the intake during 2003 indicated that *Corbicula* were entering and colonizing the reservoirs. ***Overall, the numbers of Corbicula collected in the samples were comparatively low, which continued the trend over the past few years of fewer Corbicula and reflected a water-body-wide trend observed in the Ohio River.***

Since 1991, zebra mussels progressively moved upstream in the Ohio River. In 1993, zebra mussels were identified 50 miles downstream of BVPS. In 1995, live zebra mussels were collected for the first time by divers in the BVPS main intake and auxiliary intake structures during scheduled cleanings. Densities were generally low. During 1997, zebra mussel veligers, juveniles and adults were observed for the first time in sample collections. Densities of zebra mussels in samples increased significantly in 1998 and 1999.

Overall, both the number of observations of settled mussels and the densities of veligers at BVPS in 2003 were similar to that found in 2002. If trends continue and the number of zebra mussels in

the Ohio River should remain high in 2004, BVPS should maintain their diligent zebra mussel monitoring and control program.

As in previous years, data from the BVPS environmental programs did not indicate any adverse environmental impacts from station operation.

2.0 ENVIRONMENTAL PROTECTION PLAN NON-COMPLIANCES

There were no Environmental Protection Plan non-compliances identified in 2003.

3.0 CHANGES INVOLVING UNREVIEWED ENVIRONMENTAL QUESTIONS

No Unreviewed Environmental Questions were identified in 2003. Therefore, there were no changes involving an Unreviewed Environmental Question.

4.0 NONROUTINE ENVIRONMENTAL REPORTS

During 2003, BVPS made one non-routine environmental report to the Pennsylvania Department of Environmental Protection (PA DEP).

NOTE 1: The BVPS National Pollutants Discharge Elimination System (NPDES) Permit No. PA0025615 was amended and made effective on June 1, 2003. A copy of the draft permit for public comment and the final permit as amended, were submitted to the USNRC in accordance with the EPP.

NOTE 2: Required reports under the National Pollutants Discharge Elimination System (NPDES) Permit are not included in this section. They are included with the applicable submittal of the monthly Discharge Monitoring Reports (DMR). Copies of DMRs and attached reports are submitted to the USNRC, and are, therefore, not included in this report.

4.1 Spill from the Unit 1 Sewage Treatment Plant:

A release of approximately 800 gallons of semi-treated liquid occurred from the plant on January 17, 2003. The liquid had completed three steps in its processing, and was released just prior to the final step of chlorination. The incident was documented and investigated in the FENOC Problem Identification & Resolution Program under Condition Report CR-03-00540. Human performance and mechanical problems were identified as causes, and corrective actions were implemented. No harm to the environment was identified. In accordance with spill response regulations, the PA DEP was initially notified by telephone, and a letter report was submitted on January 19, 2003 under BVPS Letter Number NPD3VPO:1239.

5.0 AQUATIC MONITORING PROGRAM

5.1 INTRODUCTION

This section of the report summarizes the Non-Radiological Environmental Program conducted for the Beaver Valley Power Station 1 (BVPS) Units 1 and 2; Operating License Numbers DPR-66 and NPF-73. This is a non-mandatory program, because on February 26, 1980, the Nuclear Regulatory Commission (NRC) granted BVPS's request to delete all of the Aquatic Monitoring Program, with the exception of the fish impingement program (Amendment No. 25), from the Environmental Technical Specifications (ETS). In 1983, BVPS was permitted to also delete the fish impingement studies from the ETS program of required sampling along with non-radiological water quality requirements. However, in the interest of providing an uninterrupted database, BVPS has continued the Aquatic Monitoring Program.

5.1.1 Objectives of the Program

The objectives of the 2003 environmental program were:

(1) To monitor for any possible environmental impact of BVPS operation on the benthic macroinvertebrate and fish communities in the Ohio River;

(2) To provide a low level sampling program to continue an uninterrupted environmental database for the Ohio River near BVPS, pre-operational to present; and

(3) To evaluate the presence, growth, and reproduction of macrofouling *Corbicula* (Asiatic clam) and zebra mussels (*Dreissena* spp.) at BVPS.

5.1.2 Scope of Services

Stantec Consulting Inc. (Stantec) was contracted to perform the 2003 Aquatic Monitoring Program as specified in BVBP-ENV-001 - Aquatic Monitoring (procedural guide). This procedural guide references and describes in detail the field and laboratory procedures used in the various monitoring programs, as well as the data analysis and reporting requirements. These procedures are summarized according to task below.

5.1.3 Benthic Macroinvertebrate Monitoring

The benthic macroinvertebrate monitoring program consisted of benthic sampling using a Ponar grab sampler at four stations on the Ohio River. Prior to 1996, duplicate sampling occurred at Stations 1, 2A, and 3, while triplicate sampling occurred at Station 2B (i.e., one sample at each shoreline and mid-channel) (Figures 5.1 and 5.2). In 1996, a review of the sampling design indicated that sampling should be performed in triplicate at each station to conform to standardized U.S. Environmental Protection Agency (USEPA) procedures. Therefore, starting in 1996, triplicate samples were taken at Stations 1, 2A, and 3, as in 1995, with triplicate samples also collected at each shore and mid-channel location at Station 2B. A petite Ponar dredge was used to collect these samples, replacing the standard Ponar dredge used in prior studies. This

sampling was conducted in May and September 2003. For each 2003 field effort, 18 benthic samples were collected and processed in the laboratory.

5.1.4 Fish Monitoring

The fish monitoring program consisted of seasonal sampling (May, July, September, and November) using boat electrofishing and seining techniques. Boat electrofishing was conducted at night along both shorelines at Stations 1, 2A, 2B, and 3 (Figure 5.3). Seining occurred at Stations 1 and 2B during the day and generally was performed in late afternoon or early evening. All field procedures and data analysis were conducted in accordance with the procedural guide.

5.1.5 Larval Cages/Zebra Mussel Scraper/Bridal Veil Samplers/Pump/Biobox Sampling

Larval cages (two long term and two short term) were set in the project intake structure to sample for *Corbicula* beginning in 1996. The cages continued to be used to monitor for *Corbicula* through August 1997. Results from a study conducted from April through June 1997 to compare short-term larval cage and petite Ponar sample results indicated that Ponar sampling provided comparable results to short-term larval cages for monthly sampling. In August 1997, Ponar sampling replaced short-term larval cage sampling. Long-term cages were used until May 1998 when all larval cages were removed.

Wall scraping samples were collected monthly from the Unit 1 cooling tower, the Unit 2 cooling tower, the barge slip, and the intake wall in 1996 and 1997. Wall scrapings were taken with a D-frame scraper, with five scrapes of approximately 2 ft each made per sample at the sampling locations. In 1998, two additional locations were added; the emergency outfall (June through November) and the emergency outfall impact basin (August through November). In 1999 through 2003, these added sites were sampled from March through November.

The intake sampling and wall scraping sampling was historically conducted once per month, yearlong. Beginning in December 1997, it was decided to forego sampling in December and January of each year, since buildup of the target organisms, *Corbicula* and zebra mussels, does not occur in these cold water months. Monthly sampling has been maintained throughout the balance of the year.

A pump sample for zebra mussel veligers was collected at the barge slip location monthly from April through October in 1996 and 1997. The scope of the sampling was expanded in 1998 to also include the intake structure. In June 1998, the emergency outfall and emergency outfall impact basin locations were also added. Additional pump samples were collected from the cooling tower of Unit 1 and Unit 2 in October 1998. At the request of BVPS, sampling was extended through November in 1998. In 2003, these additional locations were sampled from March through November.

In April 1998, a biobox was set up at the emergency outfall basin to monitor for settling zebra mussels. The biobox was checked each month, and four substrate plates were removed and analyzed in November 1998. In 2001, the biobox set up at the emergency outfall basin was replaced with two more efficient aquarium style bioboxes. These bioboxes continued to be used

at this location through 2002. The bioboxes were also used to determine the efficacy of the periodic treatments to control zebra mussel and *Corbicula* in the facility. In 2003 the bioboxes were used during zebra mussel and *Corbicula* treatments to monitor the treatment's efficacy only.

5.1.6 *Corbicula*/Zebra Mussel Density Determinations

During the scheduled shutdown period for each unit, each cooling tower reservoir bottom was sampled by petite Ponar at standardized locations within the reservoir. Counts of live and dead clams and determination of density were made.

During all *Corbicula*/zebra mussel sampling activities, observations were made of the shoreline and other adjoining hard substrates for the presence of macrofouling species.

5.1.7 Monthly Activity Reports

Each month activity reports were prepared summarizing the activities that took place during the previous month. The reports included the results of the monthly *Corbicula*/zebra mussel monitoring including any trends observed and any preliminary results available from the benthic and fisheries programs. The reports addressed progress made on each task, and reported any observed biological activity of interest.

5.1.8 Site Description

BVPS is located on an approximately 501-acre tract of land on the south bank of the Ohio River in the Borough of Shippingport, Beaver County, Pennsylvania. The Shippingport Atomic Power Station once shared the site with BVPS before being decommissioned. Figure 5.4 is a plan view of BVPS. The site is approximately 1 mile (1.6 km) from Midland, Pennsylvania; 5 miles (8 km) from East Liverpool, Ohio; and 25 miles (40 km) from Pittsburgh, Pennsylvania. The population within a 5-mile (8 km) radius of the plant is approximately 18,000. The Borough of Midland, Pennsylvania has a population of approximately 12,617.

The site lies along the Ohio River in a valley, which has a gradual slope that extends from the river (Elevation 665 ft (203 m) above mean sea level) to an elevation of 1,160 ft (354 m) along a ridge south of BVPS. The plant entrance elevation at the station is approximately 735 ft (224 m) above mean sea level.

The station is situated on the Ohio River at River Mile 34.8 (Latitude: 40° 36' 18"; Longitude: 80° 26' 02") at a location on the New Cumberland Pool that is 3.3 river miles (5.3 km) downstream from Montgomery Lock and Dam and 19.4 miles (31.2 km) upstream from New Cumberland Lock and Dam. The Pennsylvania-Ohio-West Virginia border is 5.2 river miles (8.4 km) downstream from the site. The river flow is regulated by a series of dams and reservoirs on the Beaver, Allegheny, Monongahela, and Ohio Rivers and their tributaries.

Ohio River water temperatures generally vary from 32°F to 84°F (0°C to 29°C). Minimum and maximum temperatures generally occur in January and July/August, respectively.

BVPS Units 1 and 2 have a thermal rating of 2,660 megawatts (MW). Units 1 & 2 have a design electrical rating of 835 MW and 836 MW, respectively. The circulating water systems for each unit are considered a closed cycle system with continuous overflow, using a cooling tower to minimize heat released to the Ohio River. Commercial operation of BVPS Unit 1 began in 1976 and Unit 2 began operation in 1987.

5.2 AQUATIC MONITORING PROGRAM

The environmental study area, established to assess potential impacts, consists of four sampling stations each having a north and south shore (Figure 5.1). Station 1 is located at River Mile (RM) 34.5, approximately 0.3 mile (0.5 km) upstream of BVPS and is the control station. Station 2A is located approximately 0.5 mile (0.8 km) downstream of the BVPS discharge structure in the main channel. Station 2B is located in the back channel of Phillis Island, also 0.5 mile downstream of the BVPS discharge structure. Station 2B is the principal non-control station because the majority of discharges from BVPS Units 1 and 2 are released to this back channel. Station 3 is located approximately two miles (3.2 km) downstream of BVPS.

Sampling dates for each of the program elements are presented in Table 5.1.

The following sections summarize the findings for each of the program elements.

5.2.1 Benthic Macroinvertebrate Monitoring Program

5.2.1.1 Objectives: The objectives of the benthic surveys were to characterize the benthic macroinvertebrates of the Ohio River near BVPS and to determine the impacts, if any, of BVPS operations.

5.2.1.2 Methods: Benthic surveys were scheduled and performed in May and September 2003. Benthic samples were collected at Stations 1, 2A, 2B, and 3 (Figure 5.2), using a petite Ponar grab sampler. Triplicate samples were taken off the south shore at Stations 1, 2A, and 3. Sampling at Station 2B, in the back channel of Phillis Island, consisted of triplicate petite Ponar grabs at the south side, middle, and north side of the channel (i.e., sample Stations 2B1, 2B2, and 2B3, respectively).

The contents of each grab were gently washed through a U.S. Standard No. 30 sieve and the retained contents were placed in a labeled bottle and preserved in ethanol. In the laboratory, rose bengal stain was added to aid in sorting and identifying the benthic organisms. Macroinvertebrates were sorted from each sample, identified to the lowest taxon practical and counted. Mean density (number/m2) for each taxon was calculated for each replicate. Four indices used to describe the benthic community were calculated: Shannon-Weiner diversity index, evenness (Pielou, 1969), species richness, and the number of taxa. These estimates provide an indication of the relative quality of the macroinvertebrate community.

5.2.1.3 Habitats: Substrate type is an important factor in determining the composition of the benthic community. Two distinct benthic habitats exist in the Ohio River near BVPS. These habitats are the result of damming, channelization, and river traffic. During sampling, shoreline habitats were generally soft muck substrates composed of sand, silt, and detritus. An exception occurred along the north shoreline of Phillis Island at Station 2A where clay and sand dominated. The other distinct habitat, hard substrate (gravel and cobble), was located in mid-channel of the back channel of Phillis Island. The hard substrate is probably the result of channelization and scouring by river currents.

5.2.1.4 Results: Fifty-three (53) macroinvertebrate taxa were identified during the 2003 monitoring program (Tables 5.2, 5.3.1 and 5.3.2). A mean density of 9,532 macroinvertebrates/m2 was collected in May and 4,243/m2 in September (Table 5.4). As in previous years, the macroinvertebrate assemblage during 2003 was dominated by burrowing organisms typical of soft unconsolidated substrates. Oligochaetes (segmented worms) and chironomid (midge fly) larvae were abundant (Table 5.4).

Forty-one (41) taxa were present in the May samples, and thirty-five (35) taxa in the September samples (Table 5.3.1 and 5.3.2). Nineteen (19) of the 53 taxa were present in both May and September.

The Asiatic clam (*Corbicula* sp.) has been observed in the Ohio River near BVPS from 1974 to present. Zebra mussels were first collected in the BVPS benthic samples in 1998. Adult zebra mussels, however, were detected in 1995 and 1996 by divers in the BVPS main and auxiliary intake structures during scheduled cleaning operations. Zebra mussel veligers, adults and juveniles were collected during the 1997-2003 sampling programs (see Sections 5.1.4 and 5.1.5, Zebra Mussel Monitoring Program).

In 2003, one taxon, a mollusk was added to the cumulative taxa list of macroinvertebrates collected near BVPS (Table 5.2). No state or Federal threatened or endangered macroinvertebrate species were collected during 2003.

5.2.1.5 Community Structure and Spatial Distribution for May 2003 (Table 5.4): Chironomids accounted for the highest mean density of macroinvertebrates and oligochaetes had the second highest (5,060/m2 and 3,906/m2, respectively) in May 2003. Organisms other than oligochaetes, chironomids and mollusks had the third highest mean density in May 2003 (294/m2) while mollusks had the fourth highest mean density (272/m2).

For September 2003 (Table 5.4): Oligochaetes accounted for the highest mean density of macroinvertebrates and mollusks had the second highest (1,591/m2 and 1,383/m2, respectively). Chironomids had the third highest mean density in September 2003 (846/m2) while the "others" category had the fourth highest mean density (423/m2). In May, the highest density of macroinvertebrates (22,188 organisms/m2) occurred at Station 2B1. In September, the highest density of macroinvertebrates occurred at Station 2B2 (8,600/ m2). The lowest mean density of organisms in May (4,128/m2) occurred at Station 2B3, while in September the lowest mean density of macroinvertebrates occurred at station 2A (1,247/m2).

5.2.1.6 Comparison of Control and Non-Control Stations: For this analysis, Station 1 was designated the control station, because it is always out of the influence of the BVPS discharge and Station 2B (mean density of Station 2B1, 2B2, and 2B3) the non-control station, since it is the station subjected to BVPS's discharge most regularly. Stations 3 and 2A may be under the influence of the plume under certain conditions, but it is unlikely that they are regularly influenced by BVPS.

The mean number of macroinvertebrates in the non-control station was approximately 1.5 times higher than that of the control station in May (Table 5.5). The density of macroinvertebrates found at the non-control station (10,750/ m2) versues the control station (7,095/ m2). The density of oligochaetes was about 3.2 times higher at the non-control station (4,615/m2) than at the control station (1,462/m3). Chironomids was the dominant group at both locations although they contributed to 79 percent of the macroinvertebrates collected at the control station, and only 49 percent at the non-control station. These differences probably reflect the natural differences in substrate and natural heterogeneous distributions of these organisms between the stations rather than project-related impacts.

In September, the density of macroinvertebrates present was about 2.9 times higher at the non-control (6,464/m2) than at the control station (2,193/m2). Oligochaetes, chironomids, mollusks, and others occurred at higher densities at the non-control than the control stations. As in May, the differences observed between Station 1 (control) and Station 2B (non-control) were probably related to observed differences in habitat at each station. Differences were within the expected range of variation for natural populations of macroinvertebrates.

Indices that describe the relative diversity, evenness, and richness of the macroinvertebrate population structure among stations and between control and non-control sites were calculated. A higher Shanon-Weiner diversity index indicates a relatively better structured assemblage of organisms, while a lower index generally indicates a low quality or stressed community. Evenness is an index that estimates the relative contribution of each taxon to the community assemblage, the closer to one, the healthier the community. The community richness is another estimate of the quality of the macroinvertebrate community with a higher richness number indicating a healthier community

In May the diversity, evenness and richness indices were higher (i.e. indicative of a healthier community) in the 2B (non-control) than in the control station (Station 1) (Table 5.6). In September, the reverse was true, although all of the indices were generally higher at the control and non-control station, compared to May. The differences in the various indices were within the range that would normally be present in a waterbody such as the Ohio River. No impacts of the BVPS on the benthic community, as measured by differences between control and non-control zones, were evident in either May or September.

5.2.1.7 Seasonal Comparison: The density of benthic organisms observed was slightly lower in May 2003 as compared to September 2003 (Table 5.3.1 and 5.3.2). Forty-one (41) taxa were identified in May, and 35 in September. Chironomids were the most commonly collected macroinvertebrates in May and oligochaetes were the most common in September.

The Shannon-Weiner diversity indices in May 2003 collections ranged from 0.27 at Station 1 to 0.79 at Station 2B3, a non-control station (Table 5.6). In May evenness ranged from 0.46 at Station 1 to 0.67 at Station 2B3. Richness was greatest at Station 2B32 (4.10) and lowest at Station 1 (0.59). The Shannon-Weiner diversity indices in May 2003 collections ranged from 0.27 at Station 1 to 0.79 at Station 2B3 (Table 5.6). In May evenness ranged from 0.46 at Station 1 to 0.67 at Station 2B3. Richness was greatest at non-control Station 2B32 (4.10) and lowest at Station 1 (0.59). The diversity of the macroinvertebrate community in September was generally higher than in May. Diversity ranged from 0.70 at Station 2B2 to 0.94 at Station 1. Evenness was also greater in September than in May and ranged from 0.63 at Station 2B2 to 0.89 at Station 2A. Richness was greatest at Station 1 (3.03) and lowest at Station 2B2 (2.00). The higher indices in September compared to May are typical and due to the recruitment of many species (e.g. aquatic insects) over the summer months.

5.2.1.8 Discussion: Substrate was probably the most important factor controlling the distribution and abundance of the benthic macroinvertebrates in the Ohio River near BVPS. Soft, mucky substrates that existed along the shoreline are conducive to oligochaete, chironomid, and mollusk habitation and limit species of macroinvertebrates that require a more stable bottom.

The density of macroinvertebrates in May and September 2003 fell within the range of densities of macroinvertebrate collected at BVPS in previous years. The introduction of zebra mussels and *Corbicula* into the Ohio River may impact the benthic community structure. ***However, the community structure has changed little since pre-operational years, and the available evidence does not indicate that BVPS operations have affected the benthic community of the Ohio River (Table 5.7).***

5.3 FISH

5.3.1 Objectives

Fish sampling was conducted to provide a continuous baseline of data and to detect possible changes that may have occurred in the fish populations in the Ohio River near BVPS.

5.3.2 Methods

Adult fish surveys were scheduled and performed in May, July, September, and November 2003. During each survey, fish were sampled by standardized electrofishing techniques at four stations (Stations 1, 2A, 2B and 3) (Figure 5.3). Seining was performed at Station 1 (north shore) and Station 2B (south shore of Phillis Island), to sample species that are generally under-represented in electrofishing catches (e.g., young-of-the-year fish and small cyprinids).

Night electrofishing was conducted using a boom electroshocker and floodlights mounted to the bow of the boat. A Coffelt variable voltage, pulsed-DC electrofishing unit powered by a 3.5-kW generator was used. The voltage selected depended on water conductivity and was adjusted based on the amperage of the current passing through the water. The north and south shoreline areas at each station were shocked for at least 10 minutes of unit "on" time (approximately five minutes along each shore) during each survey.

When large schools of fish of a single non-game species such as gizzard shad and shiners were encountered during electrofishing efforts, all of the stunned fish were not netted and retrieved onboard the boat. A few fish were netted for verification of identity, and the number of observed stunned fish remaining in the water was estimated. The size range of the individual fish in the school was also estimated and recorded. This was done in an effort to expedite sample processing and cover a larger area during the timed electrofishing run. Regardless of the number of individuals, all game fish were boated when observed.

Fish seining was performed at Station 1 (control) and Station 2B (non-control) during each scheduled 2003 BVPS fishery survey. A 30-ft long bag seine made of 1/4-inch nylon mesh netting was used to collect fish located close to shore in 1 to 4 ft of water. Three seine hauls were performed at both Station 1 (north shore) and Station 2B (south shore of Phillis Island) during each survey.

Fish collected during electrofishing and seining efforts were processed according to standardized procedures. All captured game fishes were identified, counted, measured for total length (nearest 1 mm), and weighed (nearest 1 g). Non-game fishes were counted, and a random subsample of lengths was taken. Live fish were returned to the river immediately after processing was completed. All fish that were unidentifiable or of questionable identification and were obviously not on the endangered or threatened species list were placed in plastic sample bottles, preserved, labeled and returned to the laboratory for identification. Any fish that had not previously been collected at BVPS was retained for the voucher collection. Any threatened or endangered species (if collected) would be photographed and released.

5.3.3 Results

Fish population surveys have been conducted in the Ohio River near BVPS annually from 1970 through 2003. These surveys have resulted in the collection of 73 fish species and 5 different hybrids (Table 5.8).

In 2003, 252 fishes representing 26 taxa were collected (i.e., handled) during BVPS surveys by electrofishing and seining (Tables 5.9 and 5.10). All taxa collected in 2003 were previously encountered at BVPS. An estimated additional several hundred individuals were observed but not handled during electrofishing surveys (Table 5.15). In addition, large schools of emerald shiners were observed during sampling runs. The most common species in the 2003 BVPS surveys, collected by electrofishing and seining combined, were shorthead redhorse sucker (26.2 percent of the total catch), sauger (16.3 percent), spottail shiner (13.9 percent), and black buffalo (13.1 percent). The remaining 23 species combined accounted for 30.5 percent of the total handled catch. The most frequently observed (handled and not handled combined) fish in 2003 were emerald shiner (Tables 5.9, 5.10, and 5.15). Game fishes collected during 2003 included channel catfish, flathead catfish, white bass, bluegill, largemouth bass, smallmouth bass, rock bass, sauger, walleye, black crappie and spotted bass hybrid. Game fishes represented 33.0 percent of the total handled catch, 11.8 percent of which were sauger.

A total of 211 fish, representing 26 taxa, was collected by electrofishing in 2003 (Table 5.9).

Shorthead redhorse and sauger accounted for the largest portion of the 2003 electrofishing catch (19.4 percent and 11.8, respectively) followed by golden redhorse sucker (11.4 percent). None of the other species collected contributed to greater than six (6) percent of the total catch.

A total of 41 fish representing 4 taxa was collected by seining in 2003 (Table 5.10). Fish taxa collected were spottail shiner (85.4 percent of the total catch), emerald shiner (7.4 percent), bluntnose minnow (4.9 percent) and freshwater drum (2.3 percent). No game species were collected during seining.

A total of 80 fish representing 15 species was captured during the May 2003 sample event (Table 5.11). A total of 43 fish was collected during electrofishing and 37 during seine netting. Golden redhorse (20.9 percent of the total catch) was the most common species boated during the electrofishing effort. Spottail shiner (94.6 percent of the total catch) was the most frequently collected species during the seining efforts.

A total of 53 fish representing 15 species was captured during the July 2003 sample event (Table 5.12). A total of 50 fish was collected during electrofishing and three (3) during seining. Shorthead redhorse (28.0 percent of the total catch) was the most common species boated during the electrofishing effort. Emerald shiner (66.7 percent of the total catch) was the most frequently collected species during the seining efforts.

During the September sample event, 31 fish representing 12 taxa were collected (Table 5.13). This was the lowest total catch during the four months that were sampled in 2003 (May, July, September and November). A total of 31 fish was collected during electrofishing and none during seining. Shorthead redhorse (22.6 percent of the total catch), gizzard shad and black buffalo (12.8 percent each) were the most common species boated during the electrofishing effort.

During the November sample event, 88 fish representing 17 taxa were captured (Table 5.14). A total of 87 fish were collected during electrofishing and one during seining. Shorthead redhorse (19.5 percent of the total catch) and freshwater drum (17.2 percent) were the most common species boated during the electrofishing effort. Emerald shiner was the only species collected during the seining efforts in November.

At the request of the Pennsylvania Fish and Boat Commission (PFBC), electrofishing catch rates were calculated as fish per minute (i.e., power on time) of sampling for 2001 through 2003. Electrofishing catch rates are presented in Tables 5.16, 5.17, and 5.18 for fish that were boated and handled during the 2001 through 2003 surveys by season. Note that because of security concerns after September 11, 2001 fisheries efforts were not completed in September and November 2001.

In 2003, the annual catch rate was 1.28 fish per minute. The greatest catch rate in 2003 occurred in November (winter) (2.12 fish/ electrofishing minute). A large number of shorthead redhorse, freshwater drum, and golden redhorse contributed to this total. The lowest catch rate occurred in September (fall) with a rate of 0.77 fish/ electrofishing minute.

In 2002, the annual catch rate was 1.98 fish per minute. The greatest catch rate in 2002 occurred in November (winter)(3.63 fish/electrofishing minute). This was the highest seasonal catch rate of the three years that were compared. A large number of gizzard shad contributed to this total. The lowest catch rate occurred in July (summer) with a rate of 1.08 fish/electrofishing minute.

In 2001, the annual catch rate was 1.28 fish per electrofishing minute; however, this is not directly comparable to 2002 and 2003 catch rates, since September and November were not sampled. The greatest electrofishing catch rate was in May (1.70 fish/electrofishing minute). The lowest catch rate was observed in July (0.85 fish/electrofishing minute).

5.3.4 Comparison of Control and Non-Control Stations

The results of the electrofishing sampling effort (Table 5.9) did not indicate any major differences in species composition between the control station (1) and the non-control Stations 2A, 2B, and 3.

A greater number of fish representing more species was captured at non-control stations than control stations. This was most likely due to the extra effort expended at non-control stations versus control stations (i.e., there are three non-control stations and only one control station).

The seine data for 2003 (Table 5.10) indicated no major differences in species composition between control and non-control stations. The total number of fish captured at the control station was larger than at the non-control station 91.9 percent of those fish (spottail shiner) were collected during a May 2003 collection.

5.3.5 Discussion

The results of the 2003 fish surveys indicated that there is a normal community structure in the Ohio River in the vicinity of BVPS based on species composition and relative abundance of fish observed during the surveys. Forage species were collected in the highest numbers. Variations in annual catch were probably attributable to normal fluctuations in the population size of the forage species and the predator populations that rely on them. Forage species, such as spottail shiner and emerald shiner with high reproductive potentials, frequently respond to changes in natural environmental factors (competition, food availability, cover, and water quality) with large fluctuations in population size, which could be the reason for the large numbers of emerald shiners and spottail shiner observed in 2003. This, in turn, influences their appearance in the sample populations during annual surveys. Spawning/rearing success due to abiotic factors is usually the determining factor of the size and composition of a fish community.

In addition, differences in electrofishing catch rate can be attributed to environmental conditions that prevail during sampling efforts. High water, increased turbidity, and swift currents that occur during electrofishing efforts in some years can decrease the collection efficiency of this gear.

In 2003, species composition remained comparable among stations. Common taxa collected in the 2003 surveys by all methods included spottail shiner, emerald shiner, redhorse sucker species,

golden redhorses sucker, sauger, quillback, and smallmouth bass. Little difference in the species composition of the catch was observed between the control (1) and non-control stations (2A, 2B and 3). Habitat preference and availability were probably the most important factors affecting where and when different species of fish are collected.

5.4 CORBICULA MONITORING PROGRAM

5.4.1 Introduction

The introduced Asiatic clam (*Corbicula fluminea*) was first detected in the United States in 1938 in the Columbia River near Knappton, Washington (Burch 1944). It has since spread throughout most of the country, inhabiting any suitable freshwater habitat. Information from prior aquatic surveys has demonstrated the presence of *Corbicula* in the Ohio River in the vicinity of the BVPS, and the plant is listed in NUREG/CR-4233 (Counts 1985).

One adult Asiatic clam is capable of producing many thousands of young called early juveniles. These early juveniles are very small (approximately 0.2 mm) and will easily pass through the water passages of a power plant. Once the juveniles settle on the substrate, rapid growth occurs. If *Corbicula* develop within a power plant's water passages, they can impede the flow of water through the plant, especially through blockage of condenser tubes and small service water piping. Reduction of flow may be so severe that a plant shutdown is necessary. *Corbicula* are of particular concern when they develop undetected in emergency systems where the flow of water is not constant (NRC, IE Bulletin 81-03).

The *Corbicula* Monitoring Program at BVPS includes sampling the circulating river water and the service water systems of the BVPS (intake structure and cooling towers). This report describes this Monitoring Program and the results of the field and plant surveys conducted in 2003.

5.4.2 Monitoring

5.4.2.1 Objectives: The objectives of the ongoing Monitoring Program are to evaluate the presence of *Corbicula* at BVPS, and to evaluate the potential for and timing of infestation of the BVPS. This program is conducted in conjunction with a program to monitor for the presence of macrofouling zebra mussels (see Sections 5.15 and 5.1.6).

5.4.2.2 Methods: Cooling Towers - Monthly Reservoir Sampling

Corbicula enter the BVPS from the Ohio River by passing through the water intakes, and eventually settle in low flow areas including the lower reservoirs of the Units 1 and 2 cooling towers. The density and growth of these *Corbicula* were monitored by collecting monthly samples from the lower reservoir sidewalls and sediments. The sampler used on the sidewalls consisted of a D-frame net attached behind a 24-inch long metal scraping edge. This device was connected to a pole long enough to allow the sampler to extend down into the reservoir area from

the outside wall of the cooling tower. Sediments were sampled with a petite ponar.

In 2003, once each month (March through November), a single petite ponar grab sample was scheduled to be taken in the reservoir of each cooling tower to obtain density and growth information on Corbicula present in the bottom sediment. Due to unit outage, no samples were collected from Unit 1 during September or Unit 2 in March and April 2003. The samples collected from each cooling tower were returned to the laboratory and processed. Samples were individually washed, and any *Corbicula* removed and rinsed through a series of stacked U.S. Standard sieves that ranged in mesh size from 1.00 mm to 6.29 mm. Live and dead clams retained in each sieve were counted and the numbers were recorded. The size distribution data obtained using the sieves reflected clam width, rather than length. Samples containing a small number of *Corbicula* were not sieved; individuals were measured and placed in their respective size categories.

Cooling Towers - *Corbicula* Density Determination

Population surveys of both BVPS cooling tower reservoirs have been conducted during scheduled outages (1986 through 2003) to estimate the number of *Corbicula* present in these structures. Unit 1 was sampled in 2003.

5.4.2.3 Results:

Unit 1 Cooling Tower - Monthly Reservoir Sampling

In 2003, 86 *Corbicula* (47.7 percent alive) were collected from the Unit 1 cooling tower basin during monthly reservoir sampling. The largest live *Corbicula* collected was retained in a sieve with a 4.75-6.29 mm length size range (Table 5.10 and Figure 5.5). The greatest numbers of *Corbicula* were collected in May (22 individuals). *Corbicula* were collected in lower numbers in the other months sampled. Scheduled collections were not made in March or April because of unit outage.

Unit 2 Cooling Tower - Monthly Reservoir Sampling

In 2003, 276 *Corbicula* (13.8 percent alive) were collected from the Unit 2 cooling tower reservoir during monthly sampling. The largest live *Corbicula* collected was within the 4.75-6.29 mm length size range. *Corbicula* collected were retained by a sieve with a 4.75-6.29 mm length size range (Table 5.20 and Figure 5.6). Individuals were collected from March through November. No collections were made in September because of unit outage.

In 2003, BVPS continued its *Corbicula* control program (year 14), which included the use of a molluscicide (i.e., Betz CT-1, Betz Powerline 3627) to prevent the proliferation of *Corbicula* within BVPS. Initially, BVPS was granted permission by the Pennsylvania Department of Environmental Protection to use CT-1 to target the Unit 1 river and raw water systems, and the Unit 2 service water systems. BVPS phased out the use of CT-1 beginning in 1997 and now uses Powerline 3627.

In 1990 through 1993, the molluscicide applications focused on reducing the *Corbicula* population throughout the entire river water system of each BVPS plant (Units 1 and 2). Beginning in 1994 and 1995, the applications targeted only the internal water systems (i.e., not circulating water); therefore, the clamicide concentrations in the cooling towers were reduced during clamicide applications. Consequently, adult and juvenile *Corbicula* in the cooling towers often survived the clamicide applications. Reservoir sediment samples taken after clamicide applications represent mortality of *Corbicula* in the cooling tower only and do not reflect mortality in BVPS internal water systems.

The current clamicide strategy includes three rotations of treatments per year. Each rotation includes separately targeting and treating a unit and sub-system per treatment. For example, the Unit 1 "A" train sub-systems are treated and detoxified before setting up and performing a treatment on the next target, e.g., Unit 2 "B" train sub-system. In 2003, clamicide treatments of sub-systems occurred on May 5, June 4, July 22, August 9, October 14, and October 28, 2003 for Unit 1; and April 25, May 8, July 16, August 8, October 22, and November 4, 2003 for Unit 2 (Table 5.20.1).

Population surveys of both BVPS cooling tower reservoirs were scheduled to be conducted during scheduled outages (1986 through 2003) to estimate the number of Corbicula present in these structures. A population survey of Unit 1 Cooling Tower was conducted on March 14, 2003 during a scheduled unit outage, 1,318 Corbicula (46.0 percent alive) were collected from the Unit 1 cooling tower basin during the March outage sampling. The largest clam collected was in the 4.75-6.29 mm length size range (Figure 5.6A).

5.4.2.4 Discussion: The monthly reservoir sediment samples collected in Units 1 and 2 cooling towers during 2003 demonstrated that *Corbicula* were entering and colonizing the reservoirs. Overall, densities in Unit 1 were similar to that in 2001 and 2002 and in Unit 2 densities were somewhat greater than in 2001 and 2002. The maximum monthly density of *Corbicula* in Unit 1 was 946/m^2, which occurred in May. The maximum density of clams in Unit 2 was 4,730/m^2, which occurred in July. The lower density of *Corbicula* in Unit 1 compared to Unit 2 was consistent with previous years results. The recent decrease of *Corbicula* at the BVPS returns densities to levels more consistent with densities in the Ohio River in the mid 1990's, but well below those present during the 1980's.

5.4.2.5 Corbicula Juvenile Study:

(1) Objective

The *Corbicula* juvenile study was designed to collect data on *Corbicula* spawning activities and growth of individuals entering the intake from the Ohio River.

(2) Methods

Specially constructed clam cages were initially utilized for this study. Each cage was constructed of a 1 ft durable plastic frame with fiberglass screening (1 mm mesh) secured to cover all open areas. Each cage contained approximately 10 lbs of industrial glass beads (3/8-inch diameter) to

provide ballast and a uniform substrate for the clams. The clam cage mesh size permitted only very small clams to enter and colonize the cage.

In 1988 through 1994, the cages were left in place for five months following initial placement. Changes in procedure were made to better define the time period when *Corbicula* were spawning in the Ohio River and releasing larvae that could enter BVPS through the intake structure.

Larval cages were maintained in the BVPS intake structure in 1995 according to the following procedure. Each month, two empty clam cages were placed in the intake structure bays. Each cage was left in place for two months, after which time it was removed and examined for clams. Four clam cages were maintained in the intake structure bays each month throughout 1995-1996.

In February 1996, it was decided to modify the sampling regime so that two of the four cages in the forebay were long-term samplers and the other two were monthly short-term samplers. Each month, the two long-term samplers were pulled; the fine sediment was carefully washed from the cage and any *Corbicula* present were measured. The cages were immediately redeployed along with any identified *Corbicula*. The two short-term cages were pulled monthly and the contents removed for laboratory analyses. New short-term cages were then deployed.

Each short-term clam cage removed after the one or two-month colonization period was returned to the laboratory where it was processed to determine the number of clams that had colonized the cage. *Corbicula* obtained from each cage were rinsed through a series of stacked U.S. Standard sieves ranging in mesh size from 9.5 mm to 0.6 mm. Live and dead clams on each sieve were counted and the numbers were recorded. The largest and smallest clams were measured to establish a length range for the sample. The size distribution data obtained using the sieves reflected clam width, rather than length.

Observational-based concerns that the clam cages could quickly clog with sediment during high sediment periods and, as a result, not sample effectively, led to an evaluation of an alternate sampling technique. From April through June 1997, a study was conducted to compare the results of the clam cage samplers to a petite ponar dredge technique to determine *Corbicula* presence and density in the BVPS intake bays. It was hypothesized that using a ponar sampler to collect bottom sediments and analysis of those sediments would provide a more representative sample of *Corbicula* settlement and growth rates, and had the added benefit of not requiring confined space entry to conduct the sampling.

During the 1998 sampling season, at the request of BVPS personnel, all clam cages were removed after the May 18, 1998 collection. Monthly petite ponar grabs from the forebay in the intake building continued thereafter.

In 2002, the sampling with petite ponar was moved to the Ohio River basin directly in front of the Intake Structure. Collections were made in conjunction with the fisheries sampling (May, July, September, and November). During each sampling month two ponar grabs were taken approximately 20 feet off shore of the intake building. These grab samples were processed in the same manner as when they were collected from within the Intake Structure Building.

(3) Results

Figure 5.7 presents the abundance and size distribution data for samples collected in the Ohio River near the intake structure by petite ponar in 2003. *Corbicula* were collected during all four collections (May, July, September, and November). The presence of small individuals (0.01-0.99, 1.00-1.99 and 2.00-3.34) of *Corbicula* indicated that successful spawning had occurred. The number of individuals collected was comparable to 2001 and 2002 (14 in 2001, 25 in 2002 , and 8 in 2003).

(4) Discussion

A spring/early-summer spawning period typically occurs in the Ohio River near BVPS each year when preferred spawning temperatures (60-65° F are reached (Figure 5.8). The offspring from this spawning event generally begin appearing in the sample collections in late-April (Figure 5.7). The settled clams generally increase in size throughout the year. ***The overall low numbers of live Corbicula collected in the intake and cooling towers in 2003, compared to levels in the 1980's, likely reflects a natural decrease in the density of Corbicula in the Ohio River near BVPS.***

5.5 ZEBRA MUSSEL MONITORING PROGRAM

5.5.1 Introduction

Zebra mussels (*Dreissena polymorpha*) are exotic freshwater mollusks that have ventrally flattened shells generally marked with alternating dark and lighter bands. They are believed to have been introduced into North America through the ballast water of ocean-going cargo vessels probably from Eastern Europe. They were first identified in Lake St. Clair in 1988 and rapidly spread to other Great Lakes and the Mississippi River drainage system, becoming increasingly abundant in the lower, middle, and upper Ohio River in recent years.

Adult zebra mussels can live up to five years and grow to 2 inches in length. North American research suggests that each female may be capable of producing over one million microscopic (veliger larvae) offspring per year, which can easily pass through water intake screens. They use strong adhesive byssal threads, collectively referred to as the byssus, to attach themselves to any hard surfaces (e.g., boat hulls, intake pipes and other mussels). Transport of these organisms between water bodies is accomplished in part by boats that have adult mussels attached to their hulls or larvae in their live wells and/or bilges. In anticipation of zebra mussel infestation and responding to NRC Notice No. 89-76 (Biofouling Agent-Zebra Mussel, November 21, 1989), BVPS instituted a Zebra Mussel Monitoring Program in January 1990.

The Zebra Mussel Monitoring Program included the Ohio River and the circulating river water system of the BVPS (intake structure and cooling towers). This section describes this Monitoring Program and the results obtained during Ohio River and BVPS surveys conducted through 2003.

5.5.2 Monitoring

5.5.2.1 Objectives: The objectives of the Monitoring Program were:

(1) To identify if zebra mussels were in the Ohio River adjacent to BVPS and provide early warning to operations personnel as to their possible infestation;

(2) To provide data as to when the larvae were mobile in the Ohio River and insights as to their vulnerability to potential treatments; and

(3) To provide data on their overall density and growth rates under different water temperatures and provide estimates on the time it requires these mussels to reach the size and density that could impact the plant.

5.5.2.2 Methods:

5.5.2.2.1 Intake Structure and Barge Slip: The surveillance techniques used on site were:

- Wall scraper sample collections on a monthly basis (March through November) from the barge slip and the riprap near the intake structure to detect attached adults;
- Pump sample collections from the barge slip and outside the intake structure, to detect the planktonic early life forms (March through November); and
- Sampling of substrate plates used for detection of settled stages in the impact basin below the Emergency outfall (March through November).
- Sampling of an artificial substrate (bridal veil material) suspended in the Ohio River from the Barge Slip (April through November).

5.5.2.2.2 Cooling Towers: The techniques used in the Unit 1 and Unit 2 cooling tower locations were:

- Monthly reservoir scraper sample collections in each cooling tower (March through November); and
- Pump samples in March through November to detect planktonic life forms.

5.5.2.2.3 Emergency Outfall:

- Monthly scraper sample collections in the emergency outfall impact basin (March through November); and
- Pump samples in March through November to detect planktonic life forms.

5.5.2.2.4 Splash Pool:

- Monthly scraper sample collections in the Splash Pool (March through November); and

- Pump samples in March through November to detect planktonic life forms.

5.5.3 Results

Zebra mussels were detected in both pump samples (Figures 5.9 and 5.10) and substrate samples (Figure 5.11 and 5.12) in 2003.

Zebra mussel veliger pump samples were collected from March through November 2003 (Figures 5.9 and 5.10). Densities of veligers generally peaked in July and August. The greatest density of veligers was present in the sample collected from the Ohio River at the Intake Structure in July (52,560/m^3). Veligers were present in all samples collected in July. For August and September, veligers were found in five of the six collection locations. Overall, veliger densities were higher in 2003 than in 2002. In 2002, the greatest density collected was 10,693/m^3. Whether this was due to an overall increase in numbers of veligers in the Ohio River in 2003 or due to the limited number of samples and the propensity of veligers to be non-uniformly distributed in the water is uncertain.

In 2003, settled zebra mussels were collected in scrape samples at the Barge Slip from June through November and the Unit 2 Cooling Tower Reservoir in April. None were collected at the Ohio River/ Intake Structure, Unit 1 Cooling Tower Reservoir, the Splash Pool, or the Emergency Outfall Impact Basin (Figures 5.11 and 5.12). The highest density collected from the Barge Slip was 11/m^2 in September. The mussels collected at the Barge Slip were adult mussels capable of reproducing. Compared with 2002, the collection of adult zebra mussels was similar at the Barge slip and lower at the Intake/Ohio River where zebra mussels were collected in June and August 2002. Densities, however, remained similar compared to past years.

5.5.4 Discussion

From 1991 through 1993, based on reports, zebra mussels moved progressively upstream from the lower to upper Ohio River. In 1994, there were confirmed zebra mussel sightings at locations both upstream and downstream of BVPS, including the Allegheny River. The July 1995 sighting of zebra mussels at Maxwell Lock and Dam on the Monongahela River established the presence of these organisms within the Allegheny, Monongahela and Ohio Rivers in Western Pennsylvania.

In 1995, live zebra mussels were found by divers in the BVPS main intake structure and auxiliary intake structure during scheduled cleaning operations. The 1996 Zebra Mussel Monitoring Program at BVPS did not collect any live zebra mussels at BVPS. During the first quarter 1996 (January and February) intake bay cleaning, divers observed an undetermined number of zebra mussels in the intake bays. During the second quarter 1996 cleaning, no mussels were reported. During the third and fourth quarter 1996 intake bay cleanings, about one dozen mussels were observed each time in Bay C only. None were collected by the divers for confirmation.

During 1997, zebra mussel veligers were observed in June. Juvenile zebra mussels appeared in the clam cage and ponar dredge samples. In November 1997, adult zebra mussels were found in the intake ponar dredge samples.

During the 1998 Zebra Mussel Monitoring Program at BVPS, zebra mussel veligers, juveniles, and an adult were observed in sample collections. A moderate density of zebra mussel veligers was observed during the August through November 1998 samples, indicating that spawning occurred sometime during the late summer. Juvenile zebra mussels appeared during March sampling. These mussels were 3.5, 3.5, and 4.5 mm in length, which indicates that they were probably young-of-the-year in 1997. Young-of-the-year zebra mussels appeared in September through November. This observation confirms successful zebra mussel spawning in the area around BVPS.

During 1998, zebra mussels were also found on the walls of the main intake structure during each of the quarterly inspections that took place. During the first quarter, greater than 100 zebra mussels/ft^2 were present in Bay B, although fewer were present in the other bays. Less than 5 mussels/ft^2 were observed during the second quarter inspection that took place in April. Only Bays A and B were inspected, however. A few small zebra mussels were observed during the third quarter inspection; however, any recently settled mussels would be easily missed during a visual inspection. Few (>10/ft^2) mussels were also observed during the fourth quarter inspection. *Corbicula* were also present in the main intake structure during each quarterly inspection. Zebra mussels were also observed in low densities in the alternate intake structure during the last three quarters of 1998.

In 1999, the number of both veligers and settled zebra mussel increased significantly in the Ohio River near the BVPS. For the first time, the settled zebra mussels were collected in groups rather than as individuals. The density of veligers exceeded 1000/m^3 on many occasions for the first time in 1999.

Overall, both the number of observations of settled mussels were similar in 2003 and 2002. The density of veligers was less in 2002 than 2003 but similar to 2001. Densities, however, remain high compared to past years. Zebra mussels densities in other water systems display significant annual variations due to environmental variables including water temperature and flow conditions. Whether the population of zebra mussels in this reach of the Ohio River is plateauing and only yearly fluctuations are present cannot be determined. In any case, the densities of mussels that presently exist are sufficient to impact the BVPS, if continued prudent monitoring and control activities are not conduced.

5.5.5 Zebra Mussel and *Corbicula* Control Activities

In 2003, BVPS continued its *Corbicula* and zebra mussel control program (thirteenth year), which included the use of a molluscicide to prevent the proliferation of *Corbicula* within BVPS. BVPS was granted permission by the Pennsylvania Department of Environmental Protection to use CT-1 to target the Unit 1 river water system and the Unit 2 service water system.

In 1990 through 1993, the molluscicide applications focused on reducing the *Corbicula* population throughout the entire river water system of each BVPS plant (Units 1 and 2). In 1994 through 2003, the clamicide applications targeted zebra mussels and *Corbicula* in the internal water systems; therefore the molluscicide concentrations in the cooling towers were reduced

during clamicide applications. Consequently, adult and juvenile *Corbicula* in the cooling towers often survived the applications. Reservoir sediment samples taken after clamicide treatments represented mortality of *Corbicula* in the cooling tower only and do not reflect mortality in BVPS internal water systems.

The current clamicide strategy includes three rotations of treatments per year. Each rotation includes separately targeting and treating a unit and sub-system per treatment. For example, the Unit 1 "A" train sub-systems are treated and detoxified before setting up and performing a treatment on the next target, e.g., Unit 2 "B" train sub-system. In 2003, clamicide treatments of sub-systems occurred on May 5, June 4, July 22, August 9, October 14, and October 28, 2003 for Unit 1; and April 25, May 8, July 16, August 8, October 22, and November 4, 2003 for Unit 2 (Table 5.20.1).

In addition to clamicide treatments, proactive preventive measures were taken that included, at a minimum, quarterly cleaning of the Intake Bays. The bay cleanings are intended to minimize the accumulation and growth of mussels within the bays. This practice prevents creating an uncontrolled internal colonization habitat.

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TABLES

TABLE 5.1

BEAVER VALLEY POWER STATION (BVPS)
SAMPLING DATES FOR 2003

Study	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic Macroinvertebrate					6				16			
Fish					6		8		16		11	
Corbicula and Zebra Mussel			14	16	6	19	8	19	16	24	11	
Corbicula CT Density			14*	16	6	19	8	19	16	24	11	
Zebra Mussel Veliger			14	16	6	19	8	19	16	24	11	

* Corbicula and zebra mussel Samles Taken during Unit 1 cooling tower reservoir outage

TABLE 5.2

SYSTEMATIC LIST OF MACROINVERTEBRATES COLLECTED FROM 1973 THROUGH 2003 IN THE OHIO RIVER NEAR BVPS

Taxa	Collected in Previous Years	Collected in 2003	New in 2003
Porifera			
Spongilla fragilis	X		
Cnidaria			
Hydrozoa			
Clavidae			
Cordylophora lacustris	X		
Hydridae			
Craspedacusta sowerbii	X		
Hydra sp.	X		
Platyhelminthes			
Tricladida	X		
Rhabdocoela	X		
Nemertea	X		
Nematoda	X	X	
Entoprocta			
Urnatella gracilis	X		
Ectoprocta			
Fredericella sp.	X		
Paludicella articulata	X		
Pectinatella sp.	X		
Plumatella sp.	X		
Annelida			
Oligochaeta	X	X	
Aeolosomatidae	X		
Tubificida	X		
Enchytraeidae	X		
Naididae	X		
Allonais pectinata	X		
Amphichaeta leydigi	X		
Amphichaeta sp.	X		
Arcteonais lomondi	X		
Aulophorus sp.	X		
Chaetogaster diaphanus	X		
C. diastrophus	X		
Dero digitata	X		
Dero flabelliger	X		
D. nivea	X		
Dero sp.	X		
Nais barbata	X		
N. behningi	X		
N. bretscheri	X		
N. communis	X	X	
N. elinguis	X	X	
N. pardalis	X		
N. pseudobtusa	X		

TABLE 5.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2003	New in 2003
N. simplex	X		
N. variabilis	X		
Nais sp.	X		
Ophidonais serpentina	X		
Paranais frici	X		
Paranais litoralis		X	
Paranais sp.	X		
Piguetiella michiganensis	X		
Pristina idrensis	X		
Pristina longisoma	X		
Pristina longiseta	X		
P. osborni	X		
P. sima	X		
Pristina sp.	X	X	
Pristinella sp.			
Pristinella jenkinae	X		
Pristinella idrensis			
Pristinella osborni		X	
Ripistes parasita	X		
Slavina appendiculata	X	X	
Specaria josinae			
Stephensoniana trivandrana	X		
Stylaria fossularis	X		
S. lacustris	X	X	
Uncinais uncinata	X		
Vejdovskyella comata	X		
Vejdovskyella intermedia	X		
Vejdovskyella sp.	X		
Tubificidae	X	X	
Aulodrilus limnobius	X		
A. pigueti	X		
A. pluriseta	X		
Aulodrilus sp.	X		
Bothrioneurum vejdovskyanum	X		
Branchiura sowerbyi	X	X	
Ilyodrilus templetoni	X		
Limnodrilus cervix	X		
L. cervix (variant)	X		
L. claparedianus	X		
L. hoffmeisteri	X	X	
L. maumeensis	X	X	
L. profundicla	X		
L. spiralis	X		
L. udekemianus	X		
Limnodrilus sp.	X		
Peloscolex multisetosus longidentus	X		
P. m. multisetosus	X		
Potamothrix moldaviensis	X		
Potamothrix sp.			
P. vejdovskyi	X	X	
Psammoryctides curvisetosus	X		
Tubifex tubifex	X		
Unidentified immature forms:	X		
with hair chaetae	X		
without hair chaetae	X	X	

TABLE 5.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2003	New in 2003
Lumbriculidae	X	X	
Hirudinae	X	X	
Glossiphoniidae	X	X	
Helobdella elongata	X		
H. stagnalis	X		
Helobdella sp.	X		
Erpobdellidae			
Erpobdella sp.	X		
Mooreobdella microstoma	X		
Haplotaxidae			
Stylodrilus heringianus	X		
Lumbricina	X		
Lumbricidae	X		
Arthropoda			
Acarina	X		
Ostracoda	X		
Isopoda			
Asellus sp.	X	X	
Amphipoda			
Talitridae			
Hyalella azteca	X		
Gammaridae			
Crangonyx pseudogracilis	X		
Crangonyx sp.	X		
Gammarus fasciatus	X		
Gammarus sp.	X	X	
Pontoporeiidae			
Monoporeia affinis	X		
Decapoda	X		
Collembola	X		
Ephemeroptera			
Heptageniidae	X		
Stenacron sp.	X		
Stenonema sp.	X		
Ephemeridae			
Ephemera sp.	X		
Hexagenia sp.	X	X	
Ephron sp.	X		
Baetidae	X		
Baetis sp.			
Caenidae			
Caenis sp.	X	X	
Serattella sp.	X		
Potamanthidae			
Potamanthus sp.			
Tricorythidae			
Tricorythodes sp.	X		
Megaloptera			
Sialis sp.	X		
Odonata			

TABLE 5.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2003	New in 2003
Gomphidae			
Argia sp.	X		
Dromogomphus spoliatus	X		
Dromogomphus sp.	X	X	
Gomphus sp.	X	X	
Libellulidae			
Libellula sp.	X		
Trichoptera	X	X	
Hydropsychidae	X		
Cheumatopsyche sp.	X		
Hydropsyche sp.	X		
Parapsyche sp.	X		
Psychomyiidae			
Psychomyia sp.			
Hydroptilidae			
Hydroptila sp.	X		
Orthotrichia sp.			
Oxyethira sp.	X		
Leptoceridae			
Ceraclea sp.	X		
Leptocerus sp.	X		
Oecetis sp.	X		
Polycentropodidae			
Cyrnellus sp.	X		
Polycentropus sp.	X		
Coleoptera	X		
Hydrophilidae	X		
Elmidae		X	
Ancyronyx variegatus	X		
Dubiraphia sp.	X		
Helichus sp.	X		
Stenelmis sp.	X		
Psephenidae	X		
Diptera			
Unidentified Diptera	X		
Probezzia	X		
Psychodidae	X		
Pericoma sp.	X		
Psychoda sp.	X		
Telmatoscopus sp.	X		
Unidentified Psychodidae pupae	X		
Chaoboridae			
Chaoborus sp.	X		
Simuliidae			
Similium sp.	X		
Chironomidae	X		
Chironominae	X	X	
Tanytarsini pupa	X		
Chironominae pupa	X		
Axarus sp.	X	X	
Chironomus sp.	X	X	
Cladopelma sp.	X		

TABLE 5.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2003	New in 2003
Cladotanytarsus sp.		X	
Cryptochironomus sp.	X	X	
Dicrotendipes nervosus	X		
Dicrotendipes sp.	X		
Glyptotendipes sp.	X		
Harnischia sp.	X		
Microchironomus sp.	X		
Micropsectra sp.	X	X	
Microtendipes sp.	X		
Parachironomus sp.	X		
Paracladopelma sp.	X		
Paratanytarsus sp.	X		
Paratendipes albimanus	X	X	
Phaenopsectra sp.	X	X	
Polypedilum (s.s.) *convictum* type	X		
P. (s.s.) *simulans* type	X		
Polypedilum sp.	X	X	
Rheotanytarsus sp.	X	X	
Stenochironomus sp.	X		
Stictochironomus sp.	X		
Tanytarsus coffmani	X		
Tanytarsus sp.	X	X	
Tribelos sp.	X		
Xenochironomus sp.	X		
Tanypodinae	X		
Tanypodinae pupae	X		
Ablabesmyia sp.	X	X	
Clinotanypus sp.	X	X	
Coelotanypus scapularis	X		
Coelotanypus sp.	X	X	
Djalmabatista pulcher	X		
Djalmabatista sp.	X		
Procladius sp.	X	X	
Tanypus sp.	X		
Thienemannimyia group	X		
Zavrelimyia sp.	X		
Orthocladiinae	X		
Orthocladiinae pupae	X		
Cricotopus bicinctus	X		
C. (s.s.) *trifascia*	X		
Cricotopus (Isocladius)- -*sylvestris* Group	X	X	
C. (Isocladius) sp.	X		
Cricotopus (s.s.) sp.	X	X	
Eukiefferiella sp.	X		
Hydrobaenus sp.	X		
Limnophyes sp.	X		
Nanocladius (s.s.) *distinctus*	X		
Nanocladius sp.	X		
Orthocladius sp.	X		
Parametriocnemus sp.	X		
Paraphaenocladius sp.	X		
Psectrocladius sp.	X		
Psectrotanypus sp.			
Pseudorthocladius sp.	X		

TABLE 5.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2003	New in 2003
Pseudosmittia sp.	X		
Smittia sp.	X		
Theinemannimyia sp.	X		
Diamesinae			
Diamesa sp.	X		
Potthastia sp.	X		
Ceratopogonidae	X	X	
Bezzia sp.	X		
Culicoides sp.	X	X	
Dolichopodidae	X		
Empididae	X		
Clinocera sp.	X		
Wiedemannia sp.	X		
Ephydridae	X		
Muscidae	X		
Limnphora sp.			
Rhagionidae	X		
Tipulidae	X		
Stratiomyidae	X		
Syrphidae	X		
Lepidoptera	X		
Hydrachnidia	X	X	
Mollusca			
Gastropoda	X		
Hydrobiidae	X		
Amnicolinae			
Amnicola sp.	X	X	
Amnicola limosa	X	X	
Physacea	X		
Pleuroceridae			X
Physidae	X		
Physa sp.	X		
Physa ancillaria			
Ancylidae	X		
Ferrissia sp.	X		
Planorbidae	X		
Valvatidae	X		
Valvata perdepressa	X		
Valvata piscinalis	X	X	
Valvata sincera sincera	X	X	
Valvata sp.			
Pelecypoda	X		
Sphaeriacea	X		
Corbiculidae			
Corbicula fluminea	X	X	
Corbicula sp.	X		
Sphaeriidae	X		
Pisidium ventricosum	X		
Pisidium sp.	X	X	
Sphaerium sp.	X		

TABLE 5.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2003	New in 2003
Unidentified immature Sphaeriidae	X		
Dreissenidae			
Dreissena polymorpha	X		
Unionidae	X		
Anodonta grandis	X		
Anodonta (immature)	X		
Elliptio sp.	X		
Unidentified immature Unionidae	X		

TABLE 5.3.1

BENTHIC MACROINVERTEBRATE COUNTS FOR TRIPLICATE SAMPLES
TAKEN AT EACH SAMPLE STATION FOR MAY 2003

Scientific name	May Location 1	2A	2B1	2B2	2B3	3	May Total
Nematoda		3	4				7
Oligochaeta						1	1
Nais communis		17	17	13	1	2	50
N. elinguis			1				1
Paranais litoralis				1			1
Pristina sp.		1					1
Pristinella osborni				1		1	2
Slavina appendiculata							0
Stylaria lacustris				1	1	3	5
Branchiura sowerbyi				1		1	2
Limnodrilus hoffmeisteri		7	7			6	20
L. maumeensis							0
Potamothrix sp.							0
Tubificidae			1				1
Tubificidae without hair chaetae	34	92	169	67	39	54	455
Limnodrilus maumeensis				1	1		2
Potamothrix vejdovskyi		2					2
Lumbriculidae		2					2
Hirundinea						1	1
Glossiphoniidae							0
Isopoda							0
Gammarus sp.	1			2		1	4
Stenonema sp.							0
Hexagenia sp.			1		15		16
Caenis sp.				1	1		2
Dromogomphus sp.							0
Gomphus sp.					1		1
Trichoptera		2					2
Elmidae			2	2			4
Chironidae							0
Chironominae		2		1			3
Axarus sp.							0
Chironomus sp.		5	59	23	5	2	94
Cladotanytarsus sp.				1			1
Cryptochironomus sp.	3	1	7	1	5	2	19
Dicrotendipes sp.							0
Micropsectra sp.				1			1
Paratendipes sp.				2			2
Phaenopsectra sp.			2				2
Polypedilum sp.	127	164	228	9	9	33	570
Rheotanytarsus sp.		1	2	1			4
Tanytarsus sp.		1		1	4	1	7
Ablabesmyia sp.							0
Clinotanypus sp.							0
Coelotanypus sp.							0
Procladius sp.				1	9		10
Tanypus sp.							0
Cricotopus (s.s) sp.		2	6				8
Cricotopus (isocladius) sp.			6				6
Ceratopogonidae					3		3
Culicoides sp.		1					1
Hydracarina							0
Amnicola sp.							0
Amnicola limosa			1		3	1	5
Pleuroceridae sp.		1					1
Valvata piscinalis							0
Valvata sincera sincera							0
Corbicula fluminea		1					1
Pisidium sp.		1	7	12	8	3	31
Monthly Total	165	306	520	143	105	112	1351

TABLE 5.3.2

BENTHIC MACROINVERTEBRATE COUNTS FOR TRIPLICATE SAMPLES
TAKEN AT EACH SAMPLE STATION FOR SEPTEMBER 2003

Scientific name	September Location						September Total	2003 Total
	1	2A	2B1	2B2	2B3	3		
Nematoda	1			1		1	3	10
Oligochaeta		2					2	3
Nais communis			1				1	51
N. elinguis							0	1
Paranais litoralis							0	1
Pristina sp.							0	1
Pristinella osborni	2	1	4			1	8	9
Slavina appendiculata			1				1	1
Stylaria lacustris							0	5
Branchiura sowerbyi	1				2	2	5	7
Limnodrilus hoffmeisteri	3		3		13		19	19
L. maumeensis					9		9	9
Potamothrix sp.							0	0
Potamothrix vejdovskyi			9		3		12	13
Tubificidae							0	1
Tubificidae without hair chaetae	20	4	34	36	64	7	165	620
Limnodrilus maumeensis							0	2
Potamothrix vejdovskyi							0	1
Lumbriculidae							0	2
Hirundinea							0	1
Glossiphoniidae	1						1	1
Isopoda				2			2	2
Gammarus sp.	3	1	5	15			24	28
Stenonema sp.				1			1	1
Hexagenia sp.		1			5		6	22
Caenis sp.			1	4	3	3	11	13
Dromogomphus sp.				1			1	1
Gomphus sp.							0	1
Trichoptera	4		1			3	8	10
Elmidae							0	4
Chironidae						1	1	1
Chironominae							0	2
Axarus sp.		4					4	4
Chironomus sp.			1				1	95
Cladotanytarsus sp.							0	1
Cryptochironomus sp.	2	1	4	8	4	4	23	42
Dicrotendipes sp.							0	0
Micropsectra sp.							0	1
Paratendipes sp.							0	2
Phaenopsectra sp.							0	2
Polypedilum sp.	4	4	37	12		4	61	631
Rheotanytarsus sp.							0	4
Tanytarsus sp.	2		1	8	1	4	16	23
Ablabesmyia sp.	1						1	1
Clinotanypus sp.					2		2	2
Coelotanypus sp.					7		7	7
Procladius sp.					2		2	12
Tanypus sp.							0	0
Cricotopus (s.s.) sp.							0	8
Cricotopus (isocladius) sp.							0	6
Ceratopogonidae							0	3
Culicoides sp.							0	1
Hydracarina	1		1				2	2
Amnicola sp.						3	3	3
Amnicola limosa					1		1	6
Pleuroceridae sp.							0	1
Valvata piscinalis	1	1		5			7	7
V. sincera sincera				2			2	2
Corbicula fluminea		2					2	3
Pisidium sp.	5	8	29	105	3	28	178	209
Monthly Total	51	29	132	200	119	61	592	1921

TABLE 5.4

MEAN NUMBER OF MACROINVERTEBRATES (NUMBER/M^2) AND PERCENT COMPOSITION OF OLIGOCHAETA, CHIRONOMIDAE, MOLLUSCA, AND OTHER ORGANISMS, 2003 BVPS

May 6	Station											
	1 (Control)		2A		2B1 (Non-control)		2B2 (Non-control)		2B3 (Non-control)		3	
	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%
Oligochaeta	1462	21	5203	40	8385	38	3655	62	1806	44	2924	61
Chironomidae	5590	79	7439	57	13158	59	1548	26	989	24	1634	34
Mollusca	0	0	129	1	344	2	516	9	473	11	172	4
Others	43	1	258	2	301	1	215	4	860	21	86	2
Total	7095	100	13029	100	22188	100	5934	100	4128	100	4816	100

September 16	Station											
	1 (Control)		2A		2B1 (Non-control)		2B2 (Non-control)		2B3 (Non-control)		3	
	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%
Oligochaeta	1118	51	301	24	2236	39	1548	18	3913	76	430	16
Chironomidae	387	18	387	31	1849	33	1204	14	688	13	559	21
Mollusca	258	12	473	38	1247	22	4816	56	172	3	1333	51
Others	430	20	86	7	344	6	1032	12	344	7	301	11
Total	2193	100	1247	100	5676	100	8600	100	5117	100	2623	100

TABLE 5.5

MEAN NUMBER OF MACROINVERTEBRATES (NUMBER/M^2) AND PERCENT COMPOSITION OF OLIGOCHAETA, CHIRONOMIDAE, MOLLUSCA, AND OTHER ORGANISMS FOR THE CONTROL STATION (1) AND THE AVERAGE FOR NON-CONTROL STATIONS (2B1, 2B2, AND 2B3), 2003 BVPS

May 6

	Control Station (Mean)		Non-Control Station (Mean)	
	#/m^2	%	#/m^2	%
Oligochaeta	1462	21	4615	43
Chironomidae	5590	79	5232	49
Mollusca	0	0	444	4
Others	43	1	459	4
TOTAL	7095	100	10750	100

September 16

	Control Station (Mean)		Non-Control Station (Mean)	
	#/m^2	%	#/m^2	%
Oligochaeta	1118	51	2566	40
Chironomidae	387	18	1247	19
Mollusca	258	12	2078	32
Others	430	20	573	9
TOTAL	2193	100	6464	100

TABLE 5.6

SHANNON-WEINER DIVERSITY, EVENNESS AND RICHNESS INDICES
FOR BENTHIC MACROINVERTEBRATES COLLECTED IN THE OHIO RIVER, 2003

	Station					
Date: May 6	1	2A	2B1	2B2	2B3	3
No. of Taxa	4	19	17	21	15	15
Shannon-Weiner Index	0.27	0.57	0.62	0.66	0.79	0.63
Evenness	0.46	0.45	0.51	0.50	0.67	0.54
Richness	0.59	3.15	2.56	4.10	3.06	2.98

	Station					
Date: September 19	1	2A	2B1	2B2	2B3	3
No. of Taxa	15	11	15	13	14	12
Shannon-Weiner Index	0.94	0.92	0.83	0.70	0.76	0.83
Evenness	0.80	0.89	0.70	0.63	0.66	0.76
Richness	3.03	2.46	2.51	2.00	2.38	2.29

TABLE 5.7

BENTHIC MACROINVERTEBRATE DENSITIES (NUMBER/M^2) FOR STATION 1 (CONTROL) AND STATION 2B (NON-CONTROL) DURING PREOPERATIONAL AND OPERATIONAL YEARS THROUGH 2003
BVPS

Month	Preoperational Years						Operational Years					
	1973		1974		1975		1976		1977		1978	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
May	248	508	1,116	2,197			927	3,660	674	848	351	126
August	99	244	143	541	1,017	1,124	851	785	591	3,474	601	1,896
Mean	173	376	630	1,369	1,017	1,124	889	2,223	633	2,161	476	1,011

Month	Operational Years											
	1979		1980		1981		1982		1983		1984	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
May	1,004	840	1,041	747	209	456	3,490	3,026	3,590	1,314	2,741	621
August	1,185	588										
September			1,523	448	2,185	912	2,958	3,364	4,172	4,213	1,341	828
Mean	1,095	714	1,282	598	1,197	684	3,223	3,195	3,881	2,764	2,041	725

TABLE 5.7 (Cont'd)

BENTHIC MACROINVERTEBRATE DENSITIES (NUMBER/M^2) FOR STATION 1 (CONTROL) AND STATION 2B (NON-CONTROL) DURING PREOPERATIONAL AND OPERATIONAL YEARS THROUGH 2003 BVPS

Month	Operational Years											
	1985		1986		1987		1988		1989		1990	
	1	2B	1	2B	1	2B	1	1	1	2B	1	2B
May	2,256	867	601	969	1,971	2,649	1,1804	1,775	3,459	2,335	15,135	5,796
September	1,024	913	849	943	2,910	2,780	1,420	1,514	1,560	4,707	5,550	1,118
Mean	1,640	890	725	956	2,440	2,714	1,612	1,645	2,510	3,274	10,343	3,457

Month	Operational Years											
	1991		1992		1993		1994		1995		1996	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
May	7,760	6,355	7,314	10,560	8,435	2,152	6,980	2,349	8,083	9,283	1,987	1,333
September	3,855	2,605	2,723	4,707	4,693	2,143	1,371	2,930	1,669	3,873	1,649	2,413
Mean	5,808	4,480	5,019	7,634	6,564	2,148	4,176	2,640	4,876	6,578	1,814	1,873

*Mean of 2B1, 2B2, 2B3

TABLE 5.7 (Cont'd)

BENTHIC MACROINVERTEBRATE DENSITIES (NUMBER/M^2) FOR STATION 1 (CONTROL) AND STATION 2B (NON-CONTROL) DURING PREOPERATIONAL AND OPERATIONAL YEARS THROUGH 2003 BVPS

Month	Operational Years							
	1997		1998		1999		2000	
1	1	2B*	1	2B	1	2B*	1	2B*
May	1,411	2,520	6,980	2,349	879	1,002	2,987	2,881
September	1,944	2,774	1,371	2,930	302	402	3,092	2,742
Mean	1,678	2,647	4,176	2,640	591	702	3,040	2,812

*Mean of 2B1, 2B2, 2B3

Month	Operational Years					
	2001		2002		2003	
1	1	2B*	1	2B*	1	2B*
May	3,139	5,232	1,548	2,795	7,095	10,750
September			8,632	14,663	2,193	6,464
Mean	3,139	5,232	5,090	8,729	4,644	8,607

*Mean of 2B1, 2B2, 2B3

TABLE 5.8

SCIENTIFIC AND COMMON NAME[1] OF FISH COLLECTED IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1970 THROUGH 2003 BVPS

Family and Scientific Name	Common Name
Lepisosteidae (gars)	
Lepisosteus osseus	Longnose gar
Hiodontidae (mooneyes)	
Hiodon alosoides	Goldeye
H. tergisus	Mooneye
Clupeidae (herrings)	
Alosa chrysochloris	Skipjack herring
A. pseudoharengus	Alewife
Dorosoma cepedianum	Gizzard shad
Cyprinidae (carps and minnows)	
Campostoma anomalum	Central stoneroller
Carassius auratus	Goldfish
Ctenopharyngodon idella	Grass carp
Cyprinella spiloptera	Spotfin shiner
Cyprinus carpio	Common carp
C. carpio x C. auratus	Carp-goldfish hybrid
Luxilus chrysocephalus	Striped shiner
Macrhybopsis storeriana	Silver chub
Nocomis micropogon	River chub
Notemigonus crysoleucas	Golden shiner
Notropis atherinoides	Emerald shiner
N. buccatus	Silverjaw minnow
N. hudsonius	Spottail shiner
N. rubellus	Rosyface shiner
N. stramineus	Sand shiner
N. volucellus	Mimic shiner
Pimephales notatus	Bluntnose minnow
P. promelas	Fathead minnow
Rhinichthys atratulus	Blacknose dace
Semotilus atromaculatus	Creek chub
Catostomidae (suckers)	
Carpiodes carpio	River carpsucker
C. cyprinus	Quillback
C. velifer	Highfin carpsucker
Catostomus commersoni	White sucker
Hypentelium nigricans	Northern hogsucker
Ictiobus bubalus	Smallmouth buffalo
I. niger	Black buffalo
Minytrema melanops	Spotted sucker

TABLE 5.8
(Continued)

Family and Scientific Name	Common Name
Moxostoma anisurum	Silver redhorse
M. carinatum	River redhorse
M. duquesnei	Black redhorse
M. erythrurum	Golden redhorse
M. macrolepidotum	Shorthead redhorse
Ictaluridae (bullhead catfishes)	
Ameiurus catus	White catfish
A. furcatus	Blue catfish
A. melas	Black bullhead
A. natalis	Yellow bullhead
A. nebulosus	Brown bullhead
Ictalurus punctatus	Channel catfish
Noturus flavus	Stonecat
Pylodictis olivaris	Flathead catfish
Esocidae (pikes)	
Esox lucius	Northern pike
E. masquinongy	Muskellunge
E. lucius x E. masquinongy	Tiger muskellunge
Salmonidae (trouts)	
Oncorhynchus mykiss	Rainbow trout
Percopsidae (trout-perches)	
Percopsis omiscomaycus	Trout-perch
Cyprinodontidae (killifishes)	
Fundulus diaphanus	Banded killifish
Atherinidae (silversides)	
Labidesthes sicculus	Brook silverside
Percichthyidae (temperate basses)	
Morone chrysops	White bass
M. saxatilis	Striped bass
M. saxatilis x M. chrysops	Striped bass hybrid
Centrarchidae (sunfishes)	
Ambloplites rupestris	Rock bass
Lepomis cyanellus	Green sunfish
L. gibbosus	Pumpkinseed
L. macrochirus	Bluegill
L. microlophus	Redear sunfish
L. gibbosus x L. microlophus	Pumpkinseed-redear sunfish hybrid
Micropterus dolomieu	Smallmouth bass
M. punctulatus	Spotted bass
M. salmoides	Largemouth bass
Pomoxis annularis	White crappie
P. nigromaculatus	Black crappie

TABLE 5.8
(Continued)

Family and Scientific Name	Common Name
Percidae (perches)	
Etheostoma blennioides	Greenside darter
E. nigrum	Johnny darter
E. zonale	Banded darter
Perca flavescens	Yellow perch
Percina caprodes	Logperch
P. copelandi	Channel darter
Stizostedion canadense	Sauger
S. vitreum	Walleye
S. canadense x S. vitreum	Saugeye
Sciaenidae (drums)	
Aplodinotus grunniens	Freshwater drum

[1]Nomenclature follows Robins, et al. (1991)

TABLE 5.9

COMPARISON OF CONTROL VS. NON-CONTROL ELECTROFISHING CATCHES
DURING THE BVPS 2003 FISHERIES SURVEY

Common Name	*Scientific Name*	*Control*	*%*	*Non-control*	*%*	*Total fish*	*%*
Black buffalo	*Ictiobus niger*	1	1.8	16	10.3	17	8.1
Black crappie	*Pomoxis nigromaculatus*	1	1.8			1	0.5
Blue catfish	*Ictalurus furcatus*			1	0.6	1	0.5
Bluegill	*Lepomis macrochirus*	1	1.8	1	0.6	2	0.9
Channel catfish	*Ictalurus punctatus*			2	1.3	2	0.9
Common carp	*Cyprinus carpio*			2	1.3	2	0.9
Silver chub	*Macrhybopsis storeriana*			1	0.6	1	0.5
Emerald shiner	*Notropis atherinoides*			1	0.6	1	0.5
Flathead catfish	*Pylodictus olivaris*			1	0.6	1	0.5
Freshwater drum	*Aplodinotus grunniens*	1	1.8	15	9.6	16	7.6
Gizzard shad	*Dorosoma cepedianum*	1	1.8	13	8.3	14	6.6
Golden redhorse	*Moxostoma erythrurum*	8	14.5	16	10.3	24	11.4
Northern hog sucker	*Hypentelium nigricans*			1	0.6	1	0.5
Longnose gar	*Lepisosteus osseus*			6	3.8	6	2.8
Mooneye	*Hiodon tergisus*			4	2.6	4	1.9
Quillback	*Carpiodes cyprinus*	1	1.8	9	5.8	10	4.7
Sauger	*Stizostedion canadense*	9	16.4	16	10.3	25	11.8
Shorthead redhorse sucker	*Moxostoma macrolepidotum*	16	29.1	25	16.0	41	19.4
Silver redhorse	*Moxostoma anisurum*	3	5.5	9	5.8	12	5.7
Rock bass	*Ambloplites rupestris*			1	0.6	1	0.5
Smallmouth bass	*Micropterus dolomieu*	1	1.8	8	5.1	9	4.3
Spotted bass	*Micropterus punctulatus*			3	1.9	3	1.4
Striped bass hybrid	*Morone saxatilis x Morone chrysops*	11	20.0			11	5.2
Walleye	*Stizostedion vitreum*	1	1.8	1	0.6	2	0.9
White bass	*Morone chrysops*			3	1.9	3	1.4
White catfish	*Ameriurus catus*			1	0.6	1	0.5
Electrofishing	Gear Total:	55	100	156	100	211	100

TABLE 5.10

COMPARISON OF CONTROL VS. NON-CONTROL SEINE CATCHES
DURING THE BVPS 2003 FISHERIES SURVEY

Common Name	*Scientific Name*	*Control*	*%*	*Non-control*	*%*	*Total fish*	*%*
Bluntnose minnow	*Pimephales notatus*	2	5.4		0.0	2	4.9
Emerald shiner	*Notropis atherinoides*	1	2.7	2	50.0	3	7.3
Freshwater drum	*Aplodinotus grunniens*			1	25.0	1	2.4
Spottail shiner	*Notropis hudsonius*	34	91.9	1	25.0	35	85.4
Seine	Gear Total:	37	100	4	100	41	100
Seine and Electrofishing	Year Total	92	------	160	------	252	------

TABLE 5.11

FISH SPECIES COLLECTED DURING THE MAY 2003 SAMPLING
OF THE OHIO RIVER IN THE VICINITY OF BVPS

Common Name	Scientific Name	Sample locations *						Seine		Electrofishing	
		S-1**	S-2**	E-1	E-2A	E-2B	E-3	Total	%	Total	%
Black Buffalo	*Ictiobus niger*						2	0	0.0	2	4.7
Bluntnose minnow	*Pimephales notatus*	2						2	5.4	0	0.0
Common carp	*Cyprinus carpio*					1		0	0.0	1	2.3
Emerald shiner	*Notropis atherinoides*						1	0	0.0	1	2.3
Gizzard shad	*Dorosoma cepedianum*				3	2	1	0	0.0	6	14.0
Golden redhorse	*Moxostoma erythrurum*			2	1	3	3	0	0.0	9	20.9
Mooneye	*Hiodon tergisus*					1		0	0.0	1	2.3
Northern hogsucker	*Hypentelium nigricans*						1	0	0.0	1	2.3
Quillback	*Carpiodes cyprinus*			1			2	0	0.0	3	7.0
Shorthead redhorse sucker	*Moxostoma macrolepidotum*				2		1	0	0.0	3	7.0
Silver redhorse	*Moxostoma anisurum*				1		3	0	0.0	4	9.3
Smallmouth bass	*Micropterus dolomieu*					1	2	0	0.0	3	7.0
Spottail shiner	*Notropis hudsonius*	34	1					35	94.6	0	0.0
Striped bass hybrid	*Morone saxatilis x Morone chrysops*			8				0	0.0	8	18.6
White bass	*Morone chrysops*						1	0	0.0	1	2.3
Total		36	1	11	7	8	17	37	100	43	100

* Gear = (E) Fish captured by electrofishing; (S) captured by seining

** Seine netting could not be safely done because of high river water conditions

TABLE 5.12

FISH SPECIES COLLECTED DURING THE JULY 2003 SAMPLING OF THE OHIO RIVER IN THE VICINITY OF BVPS

Common Name	Scientific Name	Sample locations *						Seine		Electrofishing	
		S-1	S-2	E-1	E-2A	E-2B	E-3	Total	%	Total	%
Black buffalo	*Ictiobus niger*			1	1		1	0	0.0	3	6.0
Bluegill	*Lepomis macrochirus*			1	1			0	0.0	2	4.0
Channel catfish	*Ictalurus punctatus*				1		1	0	0.0	2	4.0
Emerald shiner	*Notropis atherinoides*	1	1					2	66.7	0	0.0
Freshwater drum	*Aplodinotus grunniens*		1					1	33.3	0	0.0
Longnose gar	*Lepisosteus osseus*					1		0	0.0	1	2.0
Quillback	*Carpiodes cyprinus*				1			0	0.0	1	2.0
Sauger	*Stizostedion canadense*			5	2	2	2	0	0.0	11	22.0
Shorthead redhorse sucker	*Moxostoma macrolepidotum*			4	6		4	0	0.0	14	28.0
Silver redhorse	*Moxostoma anisurum*				2	1	1	0	0.0	4	8.0
Smallmouth bass	*Micropterus dolomieu*			1	4		1	0	0.0	6	12.0
Spotted bass	*Micropterus punctulatus*				3			0	0.0	3	6.0
Striped bass hybrid	*Morone saxatilis x Morone chrysops*			1				0	0.0	1	2.0
Walleye	*Stizostedion vitreum*			1				0	0.0	1	2.0
White bass	*Morone chyrsops*						1	0	0.0	1	2.0
Total		1	2	14	21	4	11	3	100	50	100

* Gear = (E) Fish captured by electrofishing; (S) captured by seining

TABLE 5.13

FISH SPECIES COLLECTED DURING THE SEPTEMBER 2003 SAMPLING OF THE OHIO RIVER IN THE VICINITY OF BVPS

		Sample locations *						Seine		Electrofishing	
Common Name	Scientific Name	S-1	S-2	E-1	E-2A	E-2B	E-3	Total	%	Total	%
Black buffalo	*Ictiobus niger*				1		4	0	0.0	5	16.1
Black crappie	*Pomoxis nigromaculatus*			1				0	0.0	1	3.2
Flathead catfish	*Pylodictus olivaris*						1	0	0.0	1	3.2
Freshwater drum	*Aplodinotus grunniens*				1			0	0.0	1	3.2
Gizzard shad	*Dorosoma cepedianum*			1	2	2		0	0.0	5	16.1
Longnose gar	*Lepisosteus osseus*				2	1		0	0.0	3	9.7
Quillback	*Carpiodes cyprinus*					1	1	0	0.0	2	6.5
Sauger	*Stizostedion canadense*				3			0	0.0	3	9.7
Silver redhorse	*Moxostoma anisurum*				1			0	0.0	1	3.2
Shorthead redhorse sucker	*Moxostoma macrolepidotum*			2	5			0	0.0	7	22.6
White bass	*Morone chrysops*				1			0	0.0	1	3.2
White catfish	*Ameriurus catus*						1	0	0.0	1	3.2
Total		0	0	4	16	4	7	0	0	31	100

* Gear = (E) Fish captured by electrofishing; (S) captured by seining

TABLE 5.14

FISH SPECIES COLLECTED DURING THE NOVEMBER 2003 SAMPLING OF THE OHIO RIVER IN THE VICINITY OF BVPS

Common Name	Scientific Name	Sample locations *						Seine		Electrofishing	
		S-1	S-2	E-1	E-2A	E-2B	E-3	Total	%	Total	%
Black buffalo	*Ictiobus niger*						7	0	0.0	7	8.0
Blue catfish	*Ictalurus furcatus*						1	0	0.0	1	1.1
Common carp	*Cyprinus carpio*					1		0	0.0	1	1.1
Emerald shiner	*Notropis atherinoides*		1					1	100.0	0	0.0
Freshwater drum	*Aplodinotus grunniens*			1	6	6	2	0	0.0	15	17.2
Gizzard shad	*Dorosoma cepedianum*				1	1	1	0	0.0	3	3.4
Golden redhorse	*Moxostoma erythrurum*			6	8	1		0	0.0	15	17.2
Longnose gar	*Lepisosteus osseus*					2	0	0	0.0	2	2.3
Mooneye	*Hiodon tergisus*					2	1	0	0.0	3	3.4
Quillback	*Carpiodes cyprinus*				1	3		0	0.0	4	4.6
Rock bass	*Ambloplites rupestris*					1		0	0.0	1	1.1
Sauger	*Stizostedion canadense*			4	1	4	2	0	0.0	11	12.6
Silver chub	*Macrhybopsis storeriana*				1			0	0.0	1	1.1
Silver redhorse	*Moxostoma anisurum*			3				0	0.0	3	3.4
Shorthead redhorse sucker	*Moxostoma macrolepidotum*			10	2	5		0	0.0	17	19.5
Spottail shiner	*Notropis hudsonius*							0	0.0	0	0.0
Striped bass hybrid	*Morone saxatilis x Morone chrysops*			2				0	0.0	2	2.3
Walleye	*Stizostedion vitreum*				1			0	0.0	1	1.1
Total		0	1	26	21	26	14	1	100	87	100

* Gear = (E) Fish captured by electrofishing; (S) captured by seining

TABLE 5.15

ESTIMATED NUMBER OF FISH OBSERVED* DURING ELECTROFISHING OPERATIONS

Common Name	Scientific Name	May	July	Sept	Nov	Total
Emerald shiner	*Notropis atherinoides*		100's			100's
Gizzard shad	*Dorosoma cepedianum*	1				1
Longnose gar	*Lepisosteus osseus*			1		1
Total		1	100's	1	0	100's

* = Not boated or handled

Table 5.16

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2001 FISHERIES SURVEY

Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Spring	40	Channel catfish	2	0.050
		Freshwater drum	2	0.050
		Gizzard shad	14	0.350
		Golden redhorse	17	0.425
		Quillback	1	0.025
		River carp sucker	3	0.075
		Sauger	2	0.050
		Shorthead redhorse sucker	10	0.250
		Silver redhorse	7	0.175
		Smallmouth bass	5	0.125
		Smallmouth buffalo	4	0.100
		Walleye	1	0.025
		Season Total	68	1.700
Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Summer	40	Black buffalo	2	0.0500
		Bluegill	2	0.0500
		Common carp	1	0.0250
		Emerald shiner	2	0.0500
		Flathead catfish	2	0.0500
		Freshwater drum	2	0.0500
		Golden redhorse	6	0.1500
		Sauger	8	0.2000
		Shorthead redhorse sucker	2	0.0500
		Silver redhorse	3	0.0750
		Smallmouth bass	3	0.0750
		Spotted bass	1	0.0250
		Season Total	34	0.8500
Year	80		102	1.2750

Table 5.17

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2002 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Spring	40.06	Channel catfish	6	0.1498
		Common carp	1	0.0250
		Flathead catfish	1	0.0250
		Freshwater drum	15	0.3744
		Gizzard shad	4	0.0999
		Golden redhorse	4	0.0999
		High fin carpsucker	11	0.2746
		Longnose gar	1	0.0250
		Quillback	6	0.1498
		Mooneye	2	0.0499
		River redhorse	3	0.0749
		Sauger	3	0.0749
		Shorthead redhorse	6	0.1498
		Silver redhorse	11	0.2746
		Walleye	2	0.0499
		White bass	6	0.1498
		Season Total	82	2.0469
Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Summer	40	Black buffalo	1	0.0250
		Common carp	2	0.0500
		Freshwater drum	1	0.0250
		Gizzard shad	4	0.1000
		Golden redhorse	15	0.3750
		Quillback	2	0.0500
		Pumpkinseed	1	0.0250
		Sauger	1	0.0250
		Shorthead redhorse	1	0.0250
		Silver redhorse	1	0.0250
		Spottail shiner	4	0.1000
		Spotted bass	4	0.1000
		Walleye	3	0.0750
		White bass	3	0.0750
		Season Total	43	1.0750

Table 5.18

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2003 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Spring	40.65	Buffalo sp.	2	0.0492
		Common carp	1	0.0246
		Emerald shiner	1	0.0246
		Gizzard shad	6	0.1476
		Golden redhorse	9	0.2214
		Mooneye	1	0.0246
		Northern hogsucker	1	0.0246
		Quillback	3	0.0738
		Shorthead redhorse sucker	3	0.0738
		Silver redhorse	4	0.0984
		Smallmouth bass	3	0.0738
		Striped bass hybrid	8	0.1968
		White bass	1	0.0246
		Season Total	43	1.0578
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Summer	43.43	Black buffalo	3	0.0691
		Blue gill	2	0.0461
		Channel catfish	2	0.0461
		Longnose gar	1	0.0230
		Quillback	1	0.0230
		Sauger	11	0.2533
		Shorthead redhorse sucker	14	0.3224
		Silver redhorse	4	0.0921
		Smallmouth bass	6	0.1382
		Spotted bass	3	0.0691
		Striped bass hybrid	1	0.0230
		Walleye	1	0.0230
		White bass	1	0.0230
		Season Total	50	1.1513

Table 5.18 (Cont'd)

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2003 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Fall	40.03	Black buffalo	5	0.1249
		Black crappie	1	0.0250
		Flathead catfish	1	0.0250
		Freshwater drum	1	0.0250
		Gizzard shad	5	0.1249
		Longnose gar	3	0.0749
		Quillback	2	0.0500
		Sauger	3	0.0749
		Silver redhorse	1	0.0250
		Shorthead redhorse sucker	7	0.1749
		White bass	1	0.0250
		White catfish	1	0.0250
		Season Total	31	0.7744
Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Winter	41.00	Black buffalo	7	0.1707
		Blue catfish	1	0.0244
		Common carp	1	0.0244
		Freshwater drum	15	0.3659
		Gizzard shad	3	0.0732
		Golden redhorse	15	0.3659
		Longnose gar	2	0.0488
		Mooneye	3	0.0732
		Quillback	4	0.0976
		Rock bass	1	0.0244
		Sauger	11	0.2683
		Shorthead redhorse sucker	17	0.4146
		Silver chub	1	0.0244
		Silver redhorse	3	0.0732
		Spotted bass hybrid	2	0.0488
		Walleye	1	0.0244
		Season Total	87	2.1220
Year	165.11		211	1.2779

TABLE 5.19

UNIT 1 COOLING RESERVOIR MONTHLY SAMPLING
CORBICULA DENSITY DATA FOR
2003 FROM BVPS

Collection Date	Area sampled (sq ft)	Live or Dead	Count	Maximum Length Range (mm)	Minimum length Range(mm)	Estimated number (per sq m)
3/14/2003	0.25	Dead	*	*	*	0
		Live	*	*	*	0
4/16/2003	0.25	Dead	*	*	*	0
		Live	*	*	*	0
5/6/2003	0.25	Dead	18	4.75-6.29	0.01-0.99	774
		Live	4	1.00-1.99	1.00-1.99	172
6/19/2003	0.25	Dead	5	0.01-0.99	0.01-0.99	215
		Live	4	3.35-4.74	0.01-0.99	172
7/8/2003	0.25	Dead	5	2.00-3.34	0.01-0.99	215
		Live	1	3.35-4.74	3.35-4.74	43
8/19/2003	0.25	Dead	8	2.00-3.34	0.01-0.99	344
		Live	1	0.01-0.99	0.01-0.99	43
9/16/2003	0.25	Dead	2	4.75-6.29	2.00-3.34	86
		Live	11	0.01-0.99	0.01-0.99	473
10/24/2003	0.25	Dead	6	1.00-1.99	0.01-0.99	258
		Live	8	1.00-1.99	0.01-0.99	344
11/11/2003	0.25	Dead	1	1.00-1.99	1.00-1.99	43
		Live	12	1.00-1.99	1.00-1.99	516
Unit summary		Dead	45	0.01-6.29	0.01-3.34	215
		Live	41	0.01-4.74	0.01-4.74	196

* Unit 2 on outage

TABLE 5.20

UNIT 2 COOLING RESERVOIR MONTHLY SAMPLING
CORBICULA DENSITY DATA FOR
2003 FROM BVPS

Collection Date	Area sampled (sq ft)	Live or Dead	Count	Maximum Length Range (mm)	Minimum length Range(mm)	Estimated number (per sq m)
3/14/2003	0.25	Dead	1	1.00-1.99	1.00-1.99	43
		Live	17	3.35-4.74	1.00-1.99	731
4/16/2003	0.25	Dead	8	1.00-1.99	1.00-1.99	344
		Live	18	3.35-4.74	1.00-1.99	774
5/6/2003	0.25	Dead	0			0
		Live	0			0
6/19/2003	0.25	Dead	49	3.35-4.74	0.01-0.99	2107
		Live	0			0
7/8/2003	0.25	Dead	107	4.75-6.29	0.01-0.99	4601
		Live	3	1.00-1.99	1.00-1.99	129
8/19/2003	0.25	Dead	73	3.35-4.74	0.01-0.99	3139
		Live	0			0
9/16/2003	0.25	Dead	*	*	*	*
		Live	*	*	*	*
10/24/2003	0.25	Dead	0			0
		Live	0			0
11/11/2003	0.25	Dead	0			0
		Live	0			0
Unit summary		Dead	238	1.00-6.29	0.01-1.99	1137
		Live	38	1.00-4.74	1.00-1.99	182

* Unit 1 on outage

Table 5. 20.1

ZEBRA MUSSEL MORTALITY DURING CLAMICIDE TREATMENTS, BVPS 2003.

Clamicide Treatment Start Date	Unit	Train	Water Temperature (degrees F)	Minimum Treatment Concentration	Duration of Injection	24 hours After Termination of Treatment	48 hours After Termination of Treatment	72 hours After Termination of Treatment	96 hours After Termination of Treatment	120 hours After Termination of Treatment	144 hours After Termination of Treatment
25-Apr-03	2	B	57	5.28 ppm	24 hours	100%	-	-	-	-	-
02-May-03	1	B	63.2	7.15 ppm	18 hours	N/A	N/A	N/A	N/A	N/A	N/A
07-May-03	2	A	64.6	7.76 ppm	18 hours	100%	-	-	-	-	-
06-Jun-03	1	A	63	8.62 ppm	18 hours	N/A	N/A	N/A	N/A	N/A	N/A
16-Jul-03	2	B	72	3.93 ppm	9 hours	100%	-	-	-	-	-
22-Jul-03	1	B	72	8.66 ppm	9 hours	N/A	N/A	N/A	N/A	N/A	N/A
07-Aug-03	2	A	N/A	4.0ppm	9 hours	100%	-	-	-	-	-
14-Oct-03	1	B	58	5.24 ppm	18 hours	N/A	N/A	N/A	N/A	N/A	N/A
22-Oct-03	2	A	55	4.0 ppm	18 hours	85%	NO DATA	NO DATA	96%	96%	100%
28-Oct-03	1	A	53.5	5.87 ppm	18 hours	N/A	N/A	N/A	N/A	N/A	N/A
04-Nov-03	2	B	53	8.6 ppm	18 hours	75%	78%	NO DATA	NO DATA	100%	-

TABLE 5.21

ZEBRA MUSSEL SUBSTRATE SETTLEMENT RESULTS FROM BVPS, 2003

Substrate location/type	Date set	Date retrieved	Number/m^2
Barge Slip-Bridal Veil	November 13, 2002	March 14	0
Barge Slip-Bridal Veil	March 14	April 16	0
Barge Slip-Bridal Veil	April 16	May 6	0
Barge Slip-Bridal Veil	May 6	June 19	0
Barge Slip-Bridal Veil	June 19	July 8	*
Barge Slip-Bridal Veil	July 8	August 19	0
Barge Slip-Bridal Veil	August 19	September 16	0
Barge Slip-Bridal Veil	September 16	October 24	0
Barge Slip-Bridal Veil	October 24	November 11	0

* bridal veil was missing from collection device

FIGURES

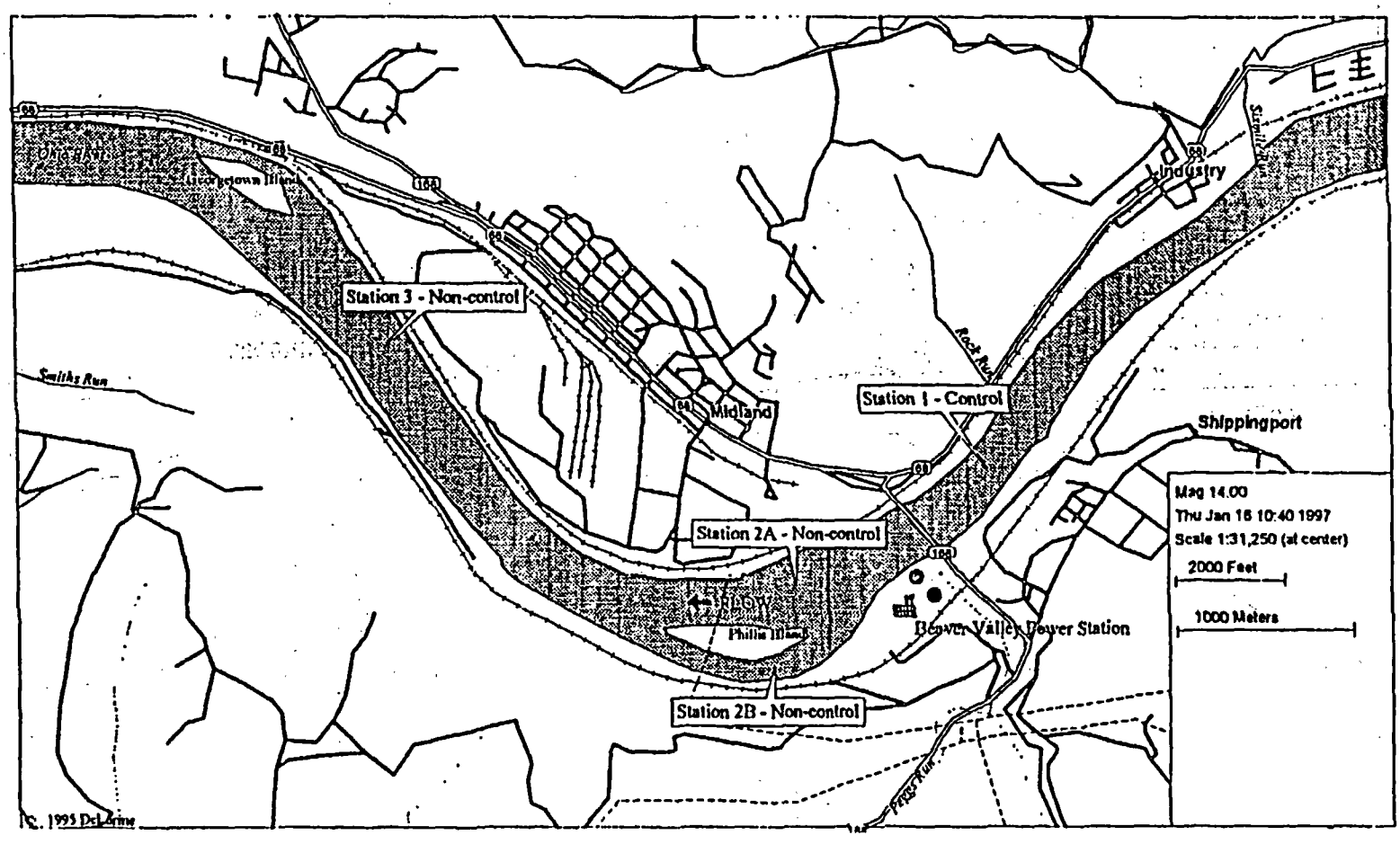


Figure 5.1: Location Map for the Beaver Valley Power Station Aquatic Monitoring Program Control and Non-Control Sampling Locations

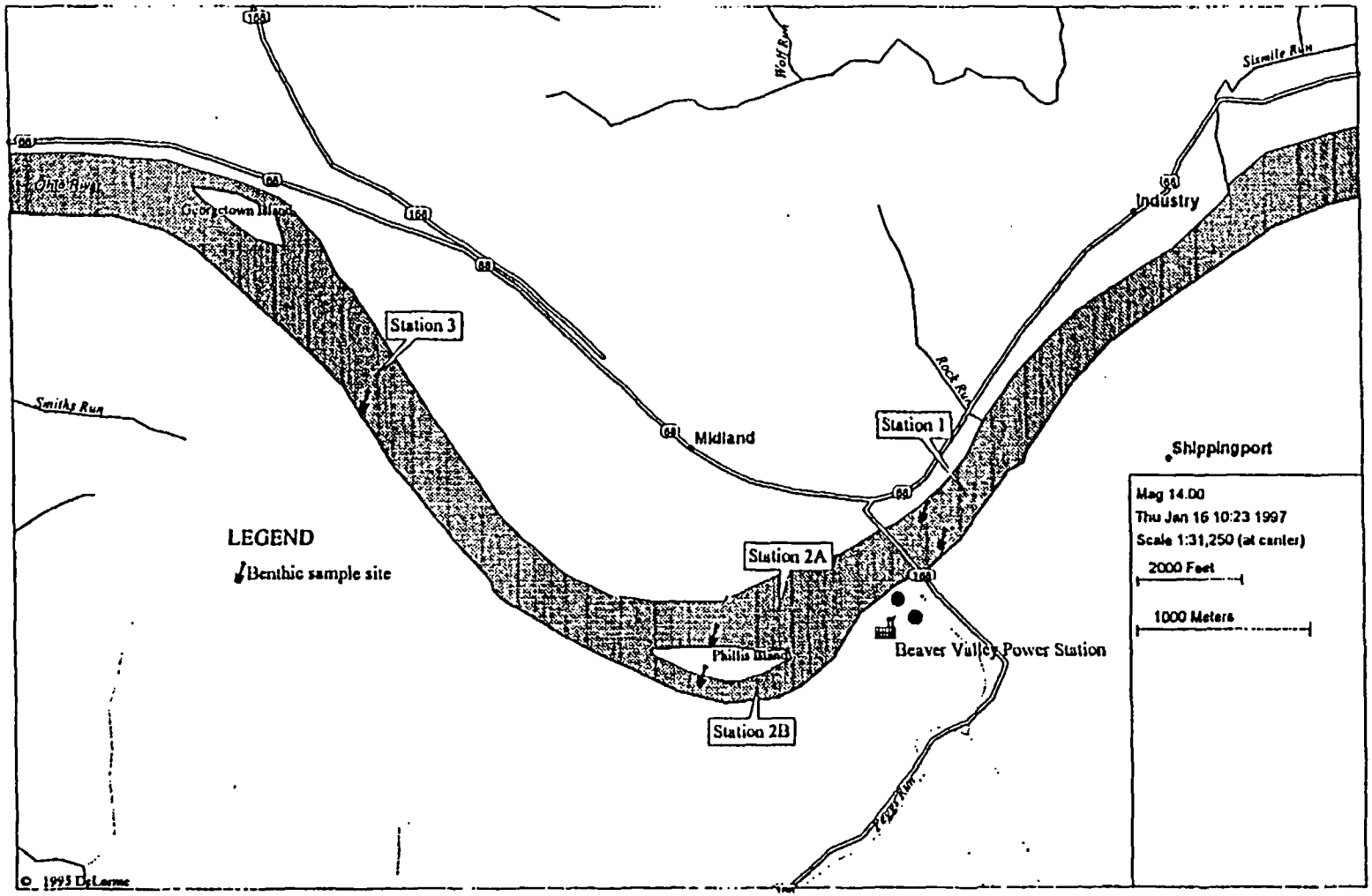


Figure 5.2: Location Map for the Beaver Valley Power Station Benthic Organism Sampling Sites

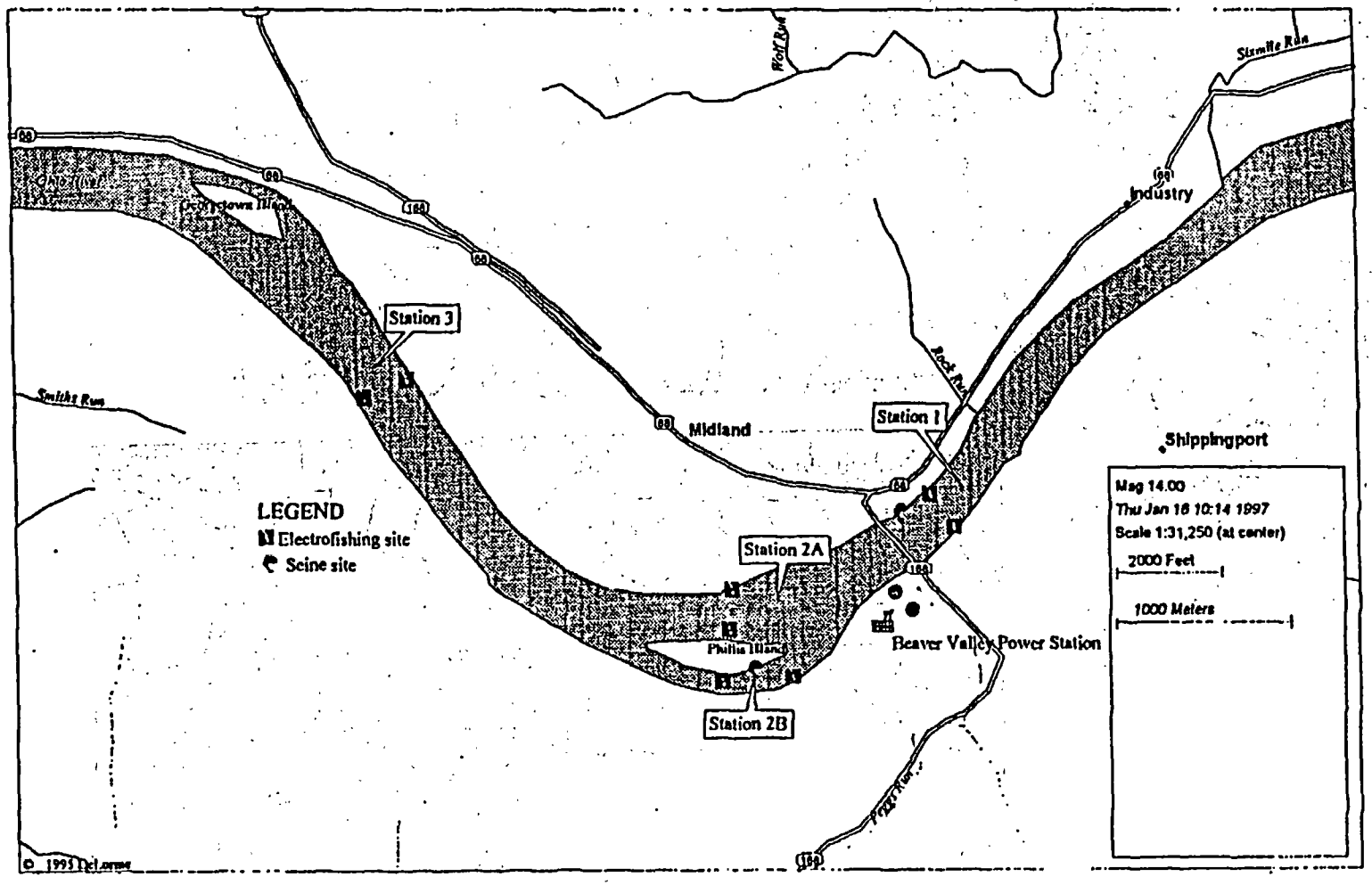
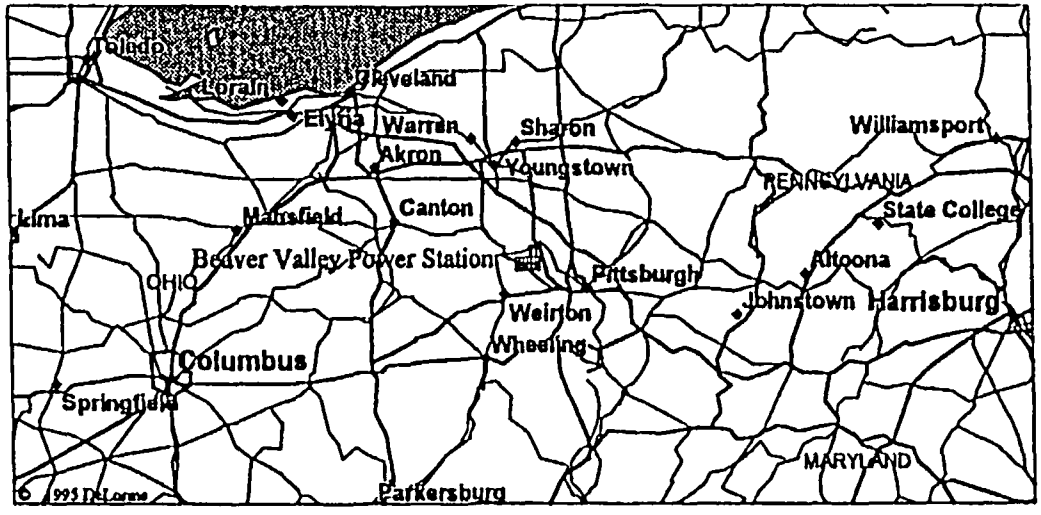


Figure 5.3: Location Map for the Beaver Valley Power Station Fish Population Sampling Sites



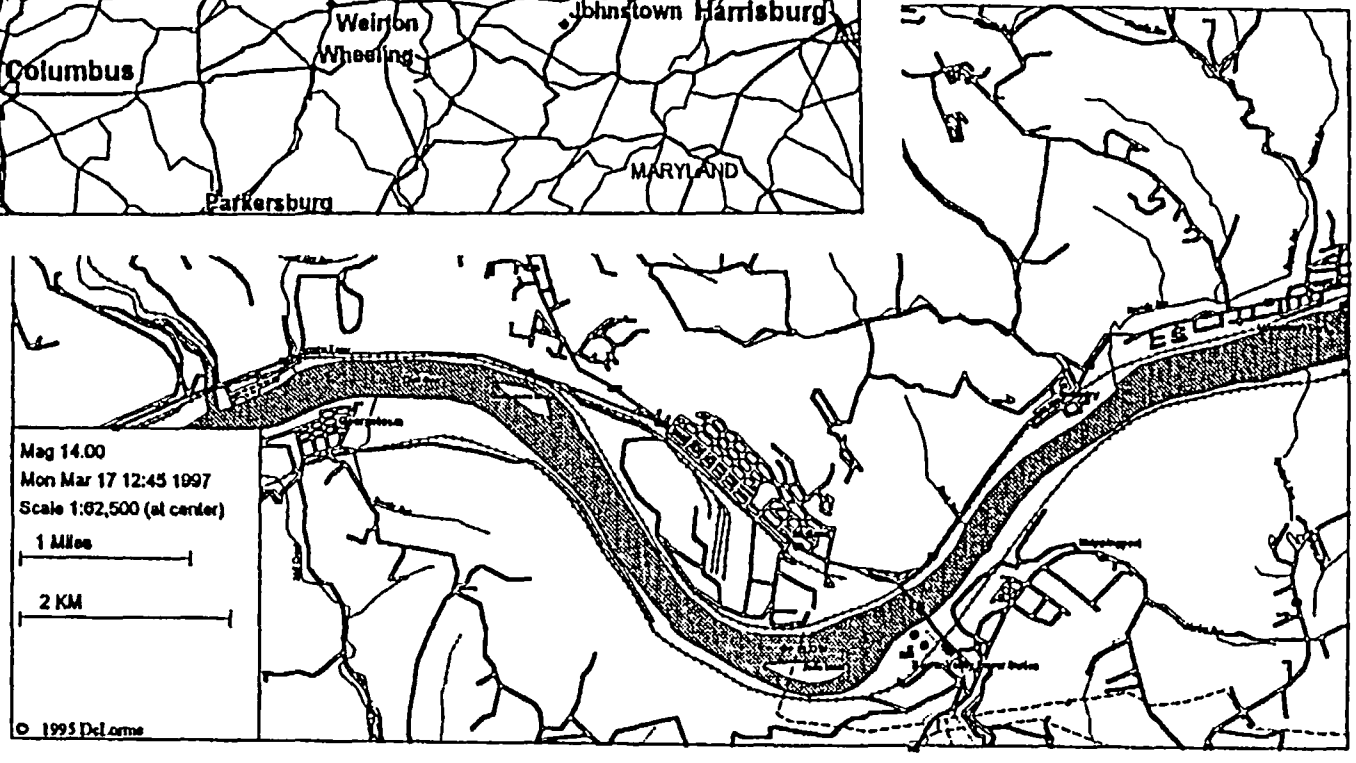
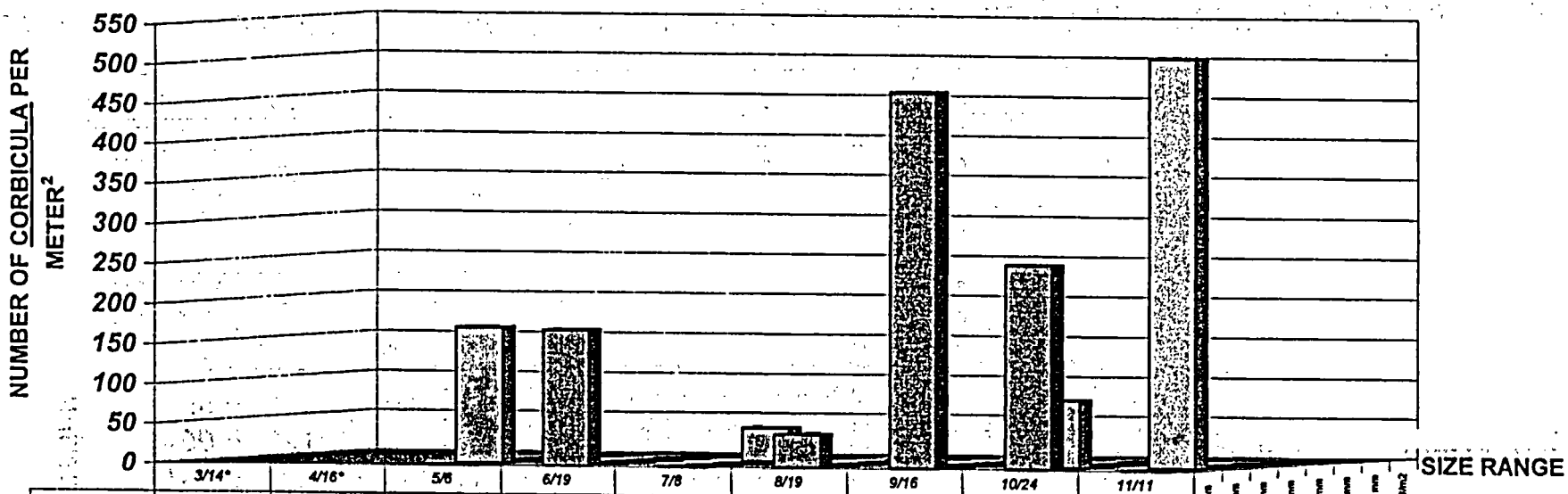


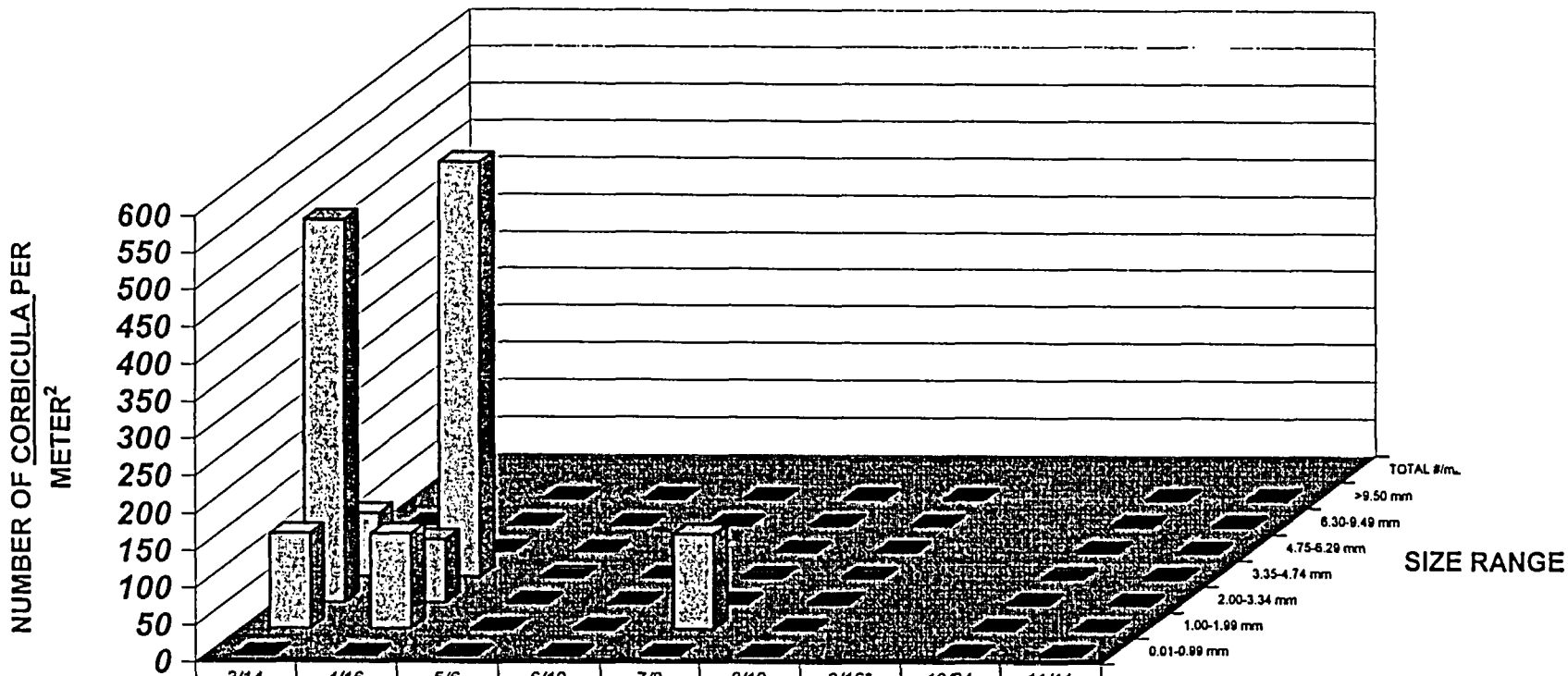
Figure 5.4: Study Area Location, Beaver Valley Power Station, Shippingport, PA



	3/14*	4/16*	5/6	6/19	7/8	8/19	9/16	10/24	11/11
0.01-0.99 mm			0	172	0	43	473	258	0
1.00-1.99 mm			172	0	0	0	0	86	516
2.00-3.34 mm			0	0	0	0	0	0	0
3.35-4.74 mm			0	0	43	0	0	0	0
4.75-6.29 mm			0	0	0	0	0	0	0
6.30-9.49 mm			0	0	0	0	0	0	0
>9.50 mm			0	0	0	0	0	0	0
TOTAL #/m2			172	172	43	43	473	344	516

Figure 5.5 Comparison of Live *Corbicula* Clam Density Estimates Among BVPS Unit 1 Cooling Tower Reservoir Sample Events, for Various Clam Shell Size Groups, 2003

*Samples were not collected on March 14 and April 16, 2003 because of unit outage.



	3/14	4/16	5/6	6/19	7/8	8/19	9/16*	10/24	11/11
0.01-0.99 mm	0	0	0	0	0	0		0	0
1.00-1.99 mm	129	129	0	0	129	0		0	0
2.00-3.34 mm	516	86	0	0	0	0		0	0
3.35-4.74 mm	86	559	0	0	0	0		0	0
4.75-6.29 mm	0	0	0	0	0	0		0	0
6.30-9.49 mm	0	0	0	0	0	0		0	0
>9.50 mm	0	0	0	0	0	0		0	0
TOTAL #/m2	731	774	0	0	129	0		0	0

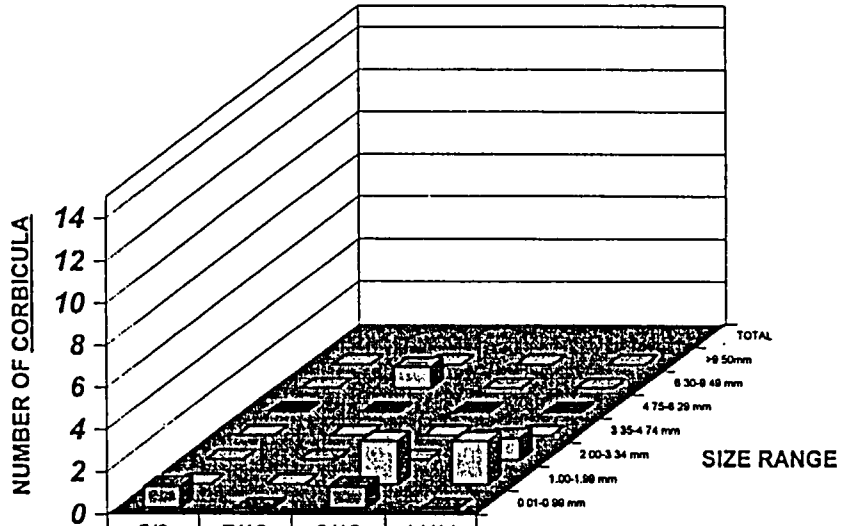
Figure 5.6 Comparison of Live *Corbicula* Clam Density Estimates Among Unit 2 Cooling Tower Reservoir Sample Events, for Various Shell Size Groups, 2003.

* Unit 2 cooling tower reservoir was on outage of 9/16/03

Figure 5.6.A

UNIT 1 COOLING TOWER RESERVOIR OUTAGE SAMPLING, *CORBICULA* DENSITY FOR MARCH 14, 2003 FROM BVPS

Station ID	Area sampled (sq ft)	Live or Dead	Count	< 1.00 (mm)	1.00-2.00 (mm)	2.00-3.35 (mm)	3.35-4.75 (mm)	4.75-6.30 (mm)	6.30-9.50 (mm)	9.50-12.50 (mm)	>12.50 (mm)	Estimated number (per sq m)	Estimated number in Reservoir
1	0.25	Live	38	13	10	15						1638	
		Dead	20	10	5	5						862	
2	0.25	Live	4	2	2							172	
		Dead	7	6	1							302	
3	0.25	Live	1		1							43	
		Dead	1		1							43	
4	0.25	Live	28	10	17		1					1207	
		Dead	56	39	15	1		1				2414	
5	0.25	Live	14	7	7							603	
		Dead	11	7	4							474	
6	0.25	Live	22	9	13							948	
		Dead	7	6	1							302	
7	0.25	Live	2	2								86	
		Dead	6	4	2							259	
8	0.25	Live											
		Dead											
9	0.25	Live	13	1	12							560	
		Dead	38	28	10							1638	
10	0.25	Live	56	10	46							2414	
		Dead	60	30	29	1						2586	
11	0.25	Live	17	15	2							733	
		Dead	19	9	10							819	
12	0.25	Live	2	2								86	
		Dead	2	2								86	
13	0.25	Live	7	2	5							302	
		Dead	9	3	6							388	
14	0.25	Live											
		Dead											
15	0.25	Live	32	14	15	3						1379	
		Dead	40	22	17	1						1724	
16	0.25	Live	3	2	1	1						129	
		Dead	5	3		2						216	
17	0.25	Live											
		Dead											
Unit Summary	Samples Total	Live	239	89	130	19	1					606	
		Dead	281	169	101	10		1				712	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	
	Reservoir Total	Live		1144184	1671280	244264	12856						7790446
		Dead		2172664	1298456	128560		12856					9159479
		[illegible]	[illegible]	3316848	2969736	372824	12856	12856					16949925



	5/6	7/16	9/16	11/11
0.01-0.99 mm	1	0	1	0
1.00-1.99 mm	0	0	2	2
2.00-3.34 mm	0	0	0	1
3.35-4.74 mm	0	0	0	0
4.75-6.29 mm	0	0	0	0
6.30-9.49 mm	0	1	0	0
>9.50mm	0	0	0	0
TOTAL	1	1	3	3

Intake structure bottom samples are collected from the Ohio River at the Intake Building.

Figure 5.7 Comparison of Live *Corbicula* Clam Density Estimates Among Intake Structure Sample Events, for Various Clam Shell Size Groups, 2003.

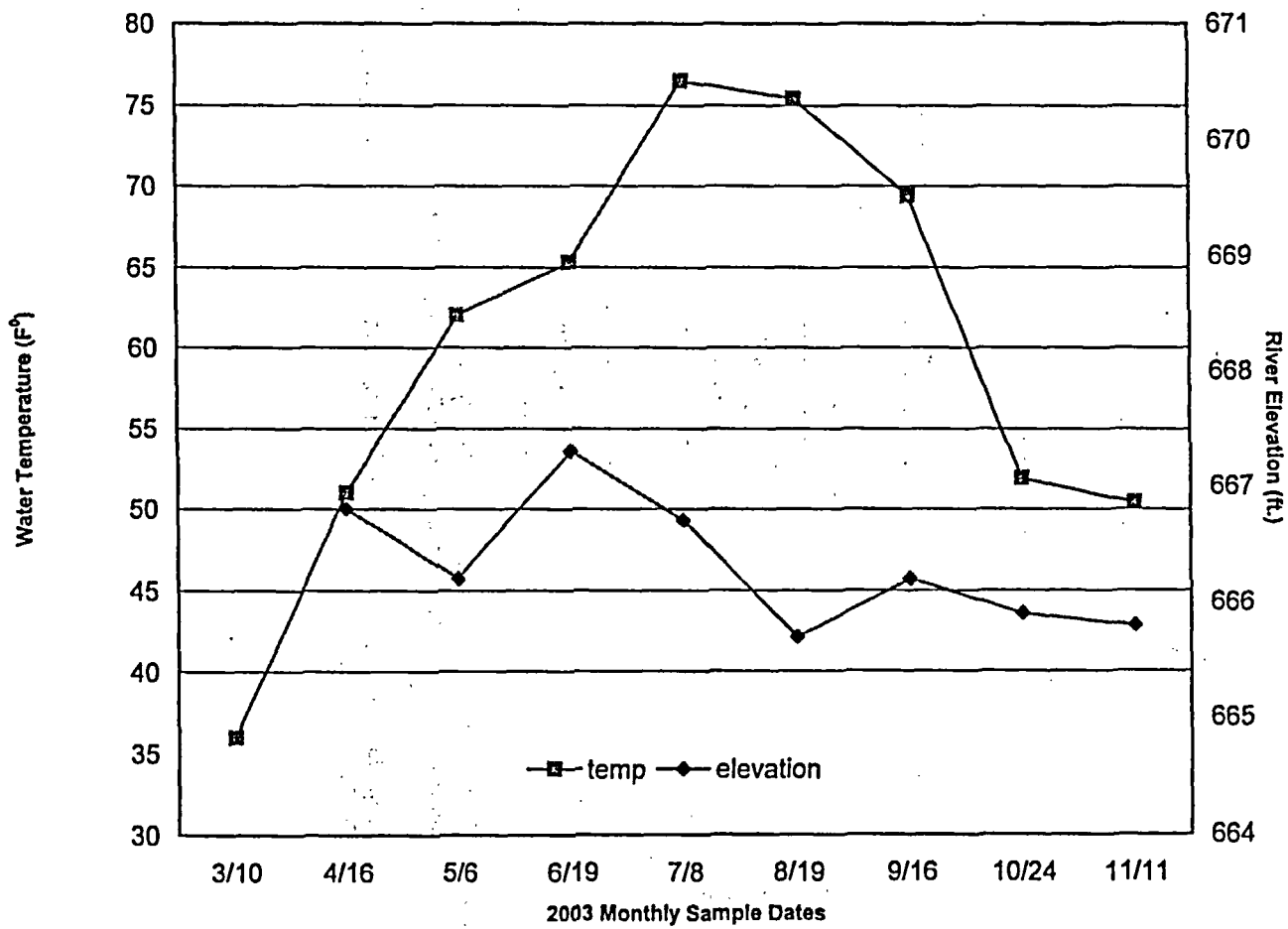
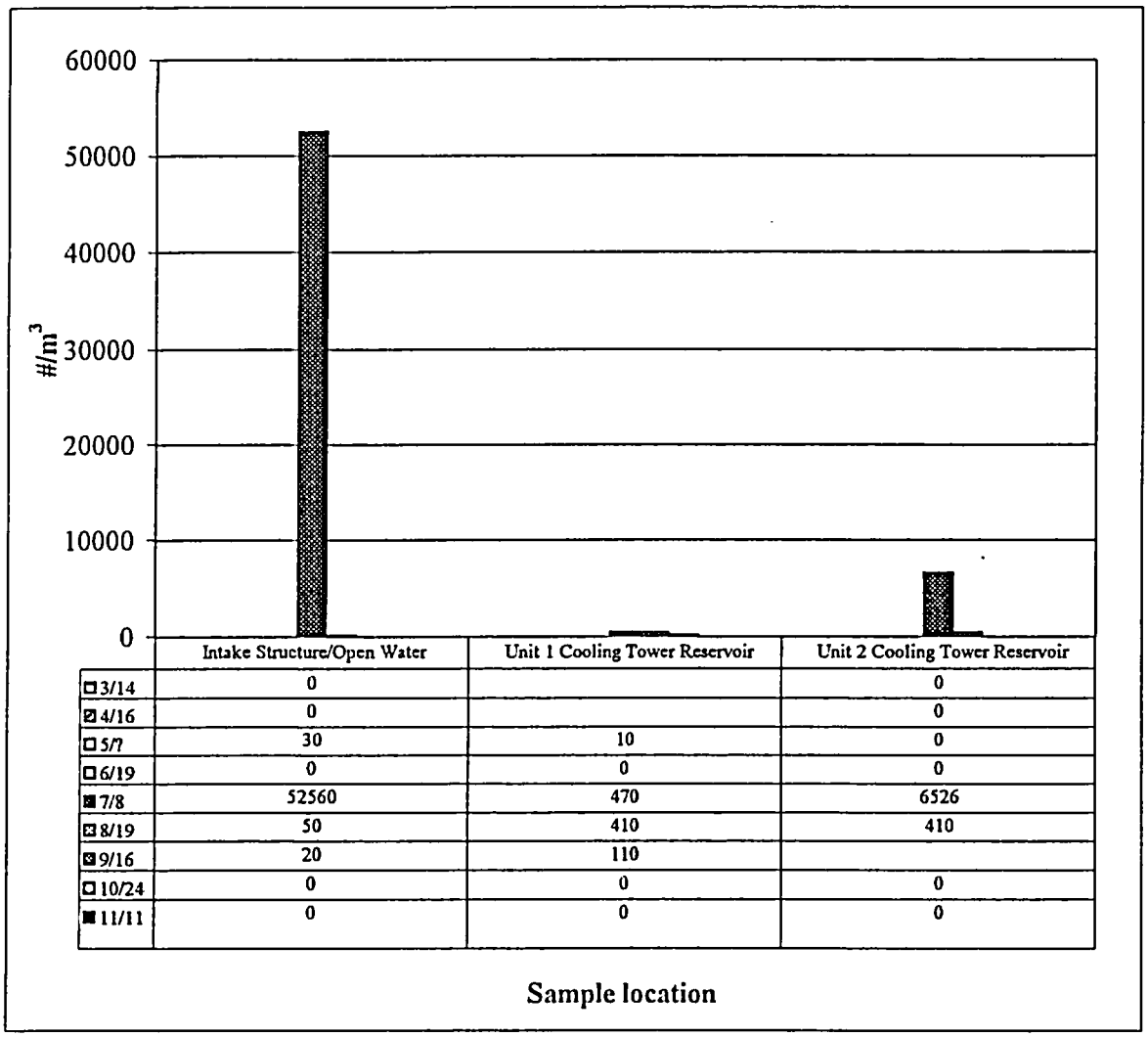


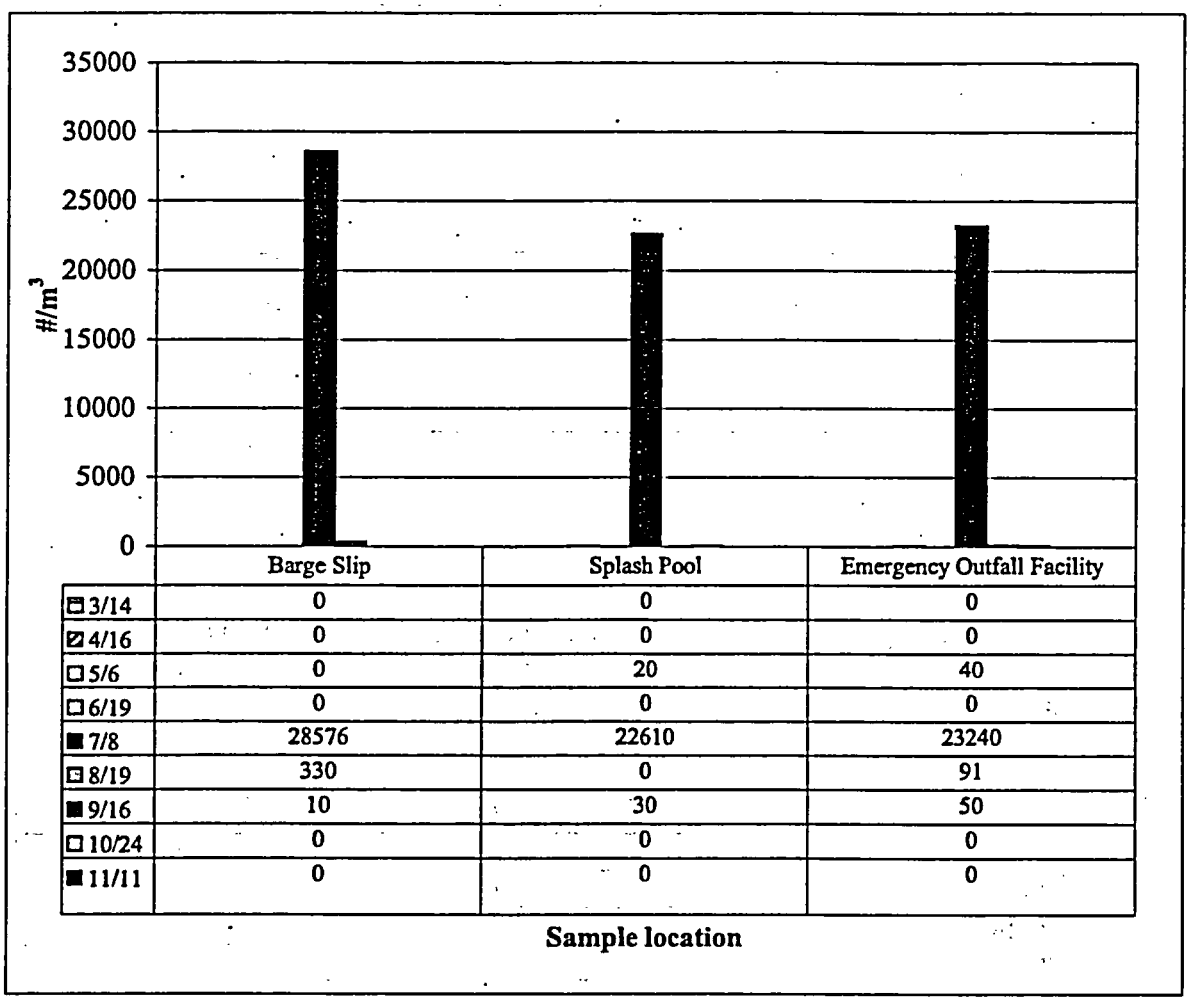
Figure 5.8 Water Temperature and River Elevation Recorded on the Ohio River at the BVPS Intake Structure, During the 2003 Monthly Sampling Dates.



	Intake Structure/Open Water	Unit 1 Cooling Tower Reservoir	Unit 2 Cooling Tower Reservoir
3/14	0		0
4/16	0		0
5/7	30	10	0
6/19	0	0	0
7/8	52560	470	6526
8/19	50	410	410
9/16	20	110	
10/24	0	0	0
11/11	0	0	0

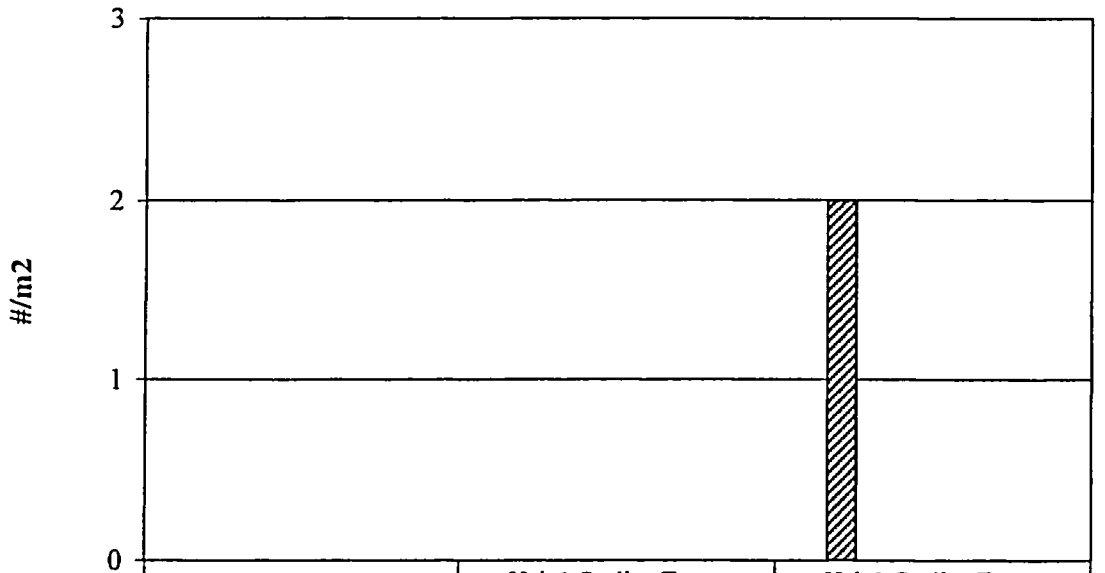
Figure 5.9 Density of zebra mussels veligers (#/m^3) collected at the Beaver Valley Power Station Intake Structure, Unit 1 Cooling Tower Reservoir and Unit 2 Cooling Tower Reservoir.

Note: No collections were made from Unit 1 Cooling Tower Reservoir on March 14 and April 16, 2003 because of unit outage



	Barge Slip	Splash Pool	Emergency Outfall Facility
3/14	0	0	0
4/16	0	0	0
5/6	0	20	40
6/19	0	0	0
7/8	28576	22610	23240
8/19	330	0	91
9/16	10	30	50
10/24	0	0	0
11/11	0	0	0

Figure 5.10 Density of zebra mussels veligers (#/m^3) collected at the Beaver Valley Power Station Barge Slip, Splash Pool, and Emergency Outfall Basin, 2003.



	Intake Structure/Open Water	Unit 1 Cooling Tower Reservoir	Unit 2 Cooling Tower Reservoir
3/14	0		0
4/16	0		2
5/6	0	0	0
6/19	0	0	0
7/8	0	0	0
8/19	0	0	0
9/16*	0	0	
10/24	0	0	0
11/11	0	0	0

Figure 5.11 Density (#/m^2) of settled zebra mussels at the Beaver Valley Power Station Intake Structure, Unit 1 Cooling Tower Reservoir and Unit 2 Cooling Tower Reservoir, 2003.

Note: No collections were made from Unit 1 Cooling Tower Reservoir on March 14 and April 16, 2003 because of unit outage

Note: No collections were made from Unit 2 Cooling Tower Reservoir on September 16, 2003 because of unit outage

	Barge Slip	Splash Pool	Emergency Outfall Facility
3/14	0	0	0
4/16	0	0	0
5/6	0	0	0
6/19	1	0	0
7/8	0	0	0
8/19	5	0	0
9/16	11	0	0
10/24	1	0	0
11/11	4	0	0

Figure 5.12 Density (#/m^2) of settled zebra mussels at the Beaver Valley Power Station Barge Slip, Splash Pool, and Emergency Outfall Basin, 2003.

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ATTACHMENTS

ATTACHMENT 1: ENVIRONMENTAL PERMITS & CERTIFICATES

Registration Number	Regulator/Description	Expiration
PAR000040485	BVPS EPA RCRA Identification number for regulated waste activity. Also used by PA DEP to monitor regulated waste activity.	Indefinite
04-02474	BVPS EPA Facility Identification Number for CERCLA/EPCRA/SARA. Used for SARA Tier II reporting and emergency planning.	Indefinite
04-02475	BVPS Offsite Warehouse (22) EPA Facility Identification Number for CERCLA/EPCRA/SARA. Used for SARA Tier II reporting and emergency planning.	Indefinite
PA0025615	BVPS NPDES Permit number under PA DEP and US EPA.	12/27/2006
PAG-2-004-03-025	General NPDES Permit for Temporary Office Building Construction at FE Long Term Storage Facility for SGRP.	12/04/2008
PAG-2-004-03-027	General NPDES Permit for Security Perimeter Expansion Project	12/24/2008
04-13281	BVPS Unit 1 PA DEP Facility Identification number for regulated storage tanks.	Indefinite
04-13361	BVPS Unit 2 PA DEP Facility Identification number for regulated storage tanks.	Indefinite
Pending Application for replacement of the following Permits 04-302-055, 04-309-004, 04-399-006 04-399-005A OP-04-00086	PA DEP Air operating permits currently under application for state-only permit for emergency diesel generators and auxiliary boilers.	Indefinite
200100242	US Army Permit for maintenance dredging	12/31/2011
N/A	PA DEP Open Burning Permit for operation of the BVPS Fire School- annual application and renewal	12/31/2003
060503 4450 004L	US Department of Transportation Hazardous Materials Registration renewed annually	06/30/2004
06786A	Encroachment Permit	Indefinite

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