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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Beaver Valley Power Station, Unit No. 1 and No. 2
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
Beaver Valley Power Station Annual Environmental Report, Non-Radiological

The 2001 Annual Environmental Report, Non-Radiological for Beaver Valley Power Station Units 1 and 2 is being forwarded, as required by Appendix B of our Unit 2 Operating License Section 5.4.1. We are pleased to report that the Beaver Valley Power Station continues to have no adverse environmental impact to the aquatic life in the Ohio River. Specifically, the 2001 monitoring efforts continue to show BVPS has had no observed negative effects on the local aquatic ecology of this part (New Cumberland Pool) of the Ohio River.

If there are any questions concerning this report, please contact Mr. Larry R. Freeland, Manager, Regulatory Affairs/Corrective Action at 724-682-5284.

Sincerely,

L.W. Pearce for LWM

Lew W. Myers

Enclosure

c: Mr. D. S. Collins, Project Manager
Mr. D. M. Kern, Sr. Resident Inspector
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2001 ANNUAL ENVIRONMENTAL REPORT

NON-RADIOLOGICAL

BEAVER VALLEY POWER STATION

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

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NON-RADIOLOGICAL

BEAVER VALLEY POWER STATION

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

EXECUTIVE SUMMARY

The 2001 Beaver Valley Power Station (BVPS) Units 1 and 2 Non-Radiological Environmental 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 an annual program conducted to 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 26th year of operational environmental monitoring for Unit 1 and the 15th for Unit 2. In 2001 all sampling was curtailed after September 11 due to security concerns. 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 2001 benthic macroinvertebrate surveys conducted in May did not indicate any abnormal community structure in the Ohio River either upstream or downstream of the BVPS. These benthic surveys are a continuation of a Fate and Effects Study conducted from 1990 through 1992 for the Pennsylvania Department of Environmental Protection (PADEP) to assess the ecosystem impacts of the molluscicides Betz Clamtrol CT-1 and CT-2 that is used to control biofouling organisms at BVPS. To date the benthic studies have not indicated any impacts of operation at the BVPS including the use of CT-1 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 2001 and previous years was conducive to segmented worm (oligochaete) and midge (chironomid) proliferation. In 2001, 43 macroinvertebrate taxa were identified. Eight new taxa were added to the cumulative list of benthic macroinvertebrates collected near BVPS. Oligochaetes and chironomids were the most frequently collected groups in May at the control and non-control stations. There were no 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 in the vicinity of the BVPS was sampled in May and July, of 2001 with night electrofishing and daytime seining. Results from the 2001 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 77 for the New Cumberland Pool.

During the survey, forage species were collected in the highest numbers, principally gizzard shad and redhorse suckers. This indicated a healthy fish community since game species rely on the availability of abundant forage for survival. 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 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 2001, species composition remained comparable among control and non-control stations. Common taxa collected included gizzard shad, golden redhorse sucker, and sauger. The catch per unit effort (number of fish per minute) for electrofishing sampling in 2001 was 2.55 fish. This compared favorably with results of the previous year when electrofishing resulted in 2.33 fish per minute. These differences may be the result of population changes or caused by environmental conditions (e.g. turbidity, waves, water temperature, flow) on specific electrofishing sampling dates that affected fish distribution or collective 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). Habitat preference and availability were probably the most important factors affecting where and when fish were collected. ***There was no indication that the BVPS was affecting the near station fish community in the Ohio River.***

The monthly reservoir ponar samples collected in Units 1 and 2 cooling towers and the intake during 2001 indicated *Corbicula* were entering and colonizing the reservoirs. Overall the numbers of *Corbicula* collected in the samples were 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 have 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 were less than in 2000. The trend of a year-to-year increase in the number of zebra mussels in the Ohio River may have leveled off, however BVPS should maintain their diligent zebra mussel monitoring and control program.

During 2001, 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.

1.0 INTRODUCTION

This report summarizes the Non-Radiological Environmental Program conducted by the Beaver Valley Power Station1 (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.

1.1 Objectives of the Program

The objectives of the 2001 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 minimal 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.

a. Scope of Services

Beak Consultants Incorporated (Beak) was contracted to perform the 2001 Aquatic Monitoring Program as specified in the Environmental Programs Manual Procedure (EPMP) 5.01 - Aquatic Ecological Monitoring Procedures. Although the 2001 sampling program was scheduled to be conducted throughout 2001, security concerns necessitated suspending all on-site and near-field river sampling efforts for the rest of the year after September 11, 2001. This EPMP 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.

1.2.1 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 1.1 and 1.2). 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 the samples, replacing the standard Ponar dredge used in prior studies. This sampling was conducted in May 2001. A total of 18 benthic samples was collected and processed in the laboratory, as described in the EPMP. The sampling effort that was scheduled to take place in September was not conducted due to security concerns.

1.2.2 Fish Monitoring

The fish monitoring program consisted of seasonal sampling (scheduled for 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 1.3). Seining occurred at Stations 1 and 2B during the day and generally was performed in early evening. All field procedures and data analysis were conducted in accordance with the EPMP. Only the May and July efforts were completed in 2001. The September and November fisheries efforts were not conducted because of security concerns.

1.2.3 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 at the request of BVPS personnel.

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, 2000 and 2001, these added sites were scheduled to be 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. A schedule of 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 basin and splash pool 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 1999, 2000 and 2001, these additional locations were scheduled to be 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 a more efficient aquarium style biobox. An additional biobox was set up outside the intake building to monitor untreated (i.e. river water prior to it entering the BVPS system) water flow. These bioboxes, as well a an additional biobox set up in the raw water system were also used to determine the efficacy of the periodic treatments to control zebra mussels and Corbicula in the facility. The biobox program was scheduled to be continued through 2001.

Security concerns prevented on site sampling from taking place after September 11, 2001. All zebra mussel and Corbicula sampling scheduled prior to that date was completed. In September 2001, sampling was completed except for the work in the intake structure.

1.2.4. *Corbicula*/Zebra Mussel Density Determinations

During the scheduled shutdown period for each unit, each cooling tower reservoir bottom is scheduled to be sampled by petite Ponar at standardized locations within the reservoir. Counts of live and dead clams and determination of density were made. In 2001, only the cooling tower for Unit One was shutdown so sampling could take place.

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

1.2.5 Monthly Activity Reports

Activity reports were prepared each month that summarized the activities that took place 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.

1.3 Site Description

BVPS is located on a 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 1.4 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 3,500.

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 are a closed cycle system 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.

2.0 AQUATIC MONITORING PROGRAM

2.1 Introduction

The environmental study area, established to assess potential impacts, consists of four sampling stations each having a north and south shore (Figure 1.1). 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 2 miles (3.2 km) downstream of BVPS.

Dates when sampling was successfully completed for each of the program elements are presented in Table 2.1.

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

2.2 Benthic Macroinvertebrate Monitoring Program

2.2.1 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.

2.2.2 Methods

Benthic surveys were scheduled and performed in May 2001. The scheduled September effort was not completed because of security concerns. Benthic samples were collected at Stations 1, 2A, 2B, and 3 (Figure 1.2), using a petite Ponar grab sampler. Triplicate samples were taken off the south shore at Stations 1, 2A, and 3. Sampling at Station2B, 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 densities (number/m^2) for each taxon were 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.

2.2.3 Habitats

Substrate type is an important factor in determining the composition of the benthic community. Two distinct benthic habitats existed in the Ohio River near BVPS. These habitats are the result of damming, channelization, and river traffic. 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.

2.2.4 Results

Forty-three (43) macroinvertebrate taxa were identified during the 2001 monitoring program (Tables 2.2 and 2.3). There were an average of 3,741 macroinvertebrates/m^2 collected in May (Table 2.4). As in previous years, the macroinvertebrate assemblage during 2001 was dominated by burrowing organisms typical of soft unconsolidated substrates. Oligochaetes (segmented worms), chironomid (midge fly) larvae, and mollusca (bivalve mussels) were abundant (Table 2.4).

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 in annually increasing numbers during the 1997-2001 sampling program (see Section 2.5, Zebra Mussel Monitoring Program). Both Asiatic clam and zebra mussel adults were collected in the 2001 benthic macroinvertebrate samples.

In 2001, eight taxa, three oligochaetes, four chironomids, and a gastropod, were added to the cumulative taxa list of macroinvertebrates collected near BVPS (Table 2.2). No state or Federal threatened or endangered macroinvertebrate species were collected during 2001.

2.2.5 Community Structure and Spatial Distribution

Chironomids accounted for the highest mean density of macroinvertebrates (Table 2.4) in May (1,942/m^2). Oligochaetes had the second highest mean density in (1,032/m^2). Mollusks (predominately Asiatic clam and zebra mussels) had also were relatively abundant (408/ m^2) although their density varied appreciably among samples.

Station 2B2 had the highest mean density of macroinvertebrates with a total of 9,074 organisms/m^2.Relatively high densities of oligochaetes and chironomids accounted for much of the overall high density in benthic macroinvertebrates at this station. Station 2A had the lowest mean density of organisms (1,505/m^2).

2.2.6 Comparison of Control and Non-Control Stations

For this analysis, Station 1 was designated the control station since it was 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 was the station subjected most to BVPS's discharge. 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 density of macroinvertebrates found at the non-control station (3,862/ m^2) was comparable to the control station (3,139/ m^2). Unlike most years, the species composition between these two locations was noticeably different. The most significant difference was in the relative density of mollusks. The density of mollusks at the control station (1,376/ m^2 or 44 percent of all organisms) was much higher than the average at the non-control stations (215/ m^2). The presence of a colony of zebra mussels in the control sample contributed to this difference. The density of oligochaetes was lower at the control station (473/m^2) than the average at the non-control stations (1,144/m^3). Oligochaetes contributed to 15 percent of the macroinvertebrates collected at the control station, and twice as much at the non-control stations (30 percent). Chironomids were also present at lower densities at the control station (1,075/m^2) than the mean of the non-control stations (2,116/m^2). These minor differences probably reflected the natural differences in substrate and water flow between the stations rather than project-related impacts. Also due to the habit of zebra mussels to form colonies of many individuals in aggregates, typically there are significant density differences in these organisms among areas where they a found.

Indices were calculated to determine the relative diversity, evenness, and richness of the macroinvertebrate population structure among stations and between control and non-control sites. The Shannon-Weiner diversity indices in May 2001 collections ranged from 1.57 at Station 2A to 2.33 at Station 2B2, both non-control stations (Table 2.6). The diversity index at the control station (Station 1) was 1.88. The indices for all of the non-control locations were comparable to the control station. A higher 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 more even the community. Evenness was moderate at all locations and ranged from 0.43 at Station 1 to 0.56 at Station 2B2. The community richness, another estimate of the quality of the macroinvertebrate community, was greatest at control Station 1 (4.43) and lowest at Station 3 (2.06). These indices were consistent with those calculated in previous years.

2.2.7 Seasonal Comparison

No seasonal comparisons could be made in 2001 since September sampling could not be completed because of security concerns.

2.2.8 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 exist along the shoreline are conducive to oligochaete, chironomid, and mollusk proliferation and limit species of macroinvertebrates that require a more stable bottom. The density of macroinvertebrates in May 2001 fell well within the range of densities of macroinvertebrates collected at BVPS in previous years (Table 2.7). 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 .

2.3 Fish

2.3.1 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.

2.3.2 Methods

Adult fish surveys were scheduled to be performed in May, July, September, and November 2001. Only the May and July efforts were completed due to security concerns after September 11. During each survey, fish were sampled by standardized electrofishing techniques at four stations (Figure 1.3). 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 species 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 completed 2001 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.

2.3.3 Results

Fish population surveys have been conducted in the Ohio River near BVPS annually from 1970 through 2001. These surveys have resulted in the collection of 72 fish species and five different hybrids (Table 2.8). In 2001, only the May and July efforts were completed.

In 2001, 198 fish representing 18 taxa were collected (i.e., handled) during BVPS surveys by electrofishing and seining (Tables 2.9 and 2.10). An estimated additional 11 fish were observed but not handled during the May electrofishing survey (Table 2.15). Thousands of gizzard shad (*Dorosoma cepedianum*) were observed but not boated during the July electrofishing effort. The most common species in the 2001 BVPS surveys, collected by electrofishing and seining combined, were black buffalo (mostly juveniles) (36.9 percent), smallmouth bass (15.7 percent), golden redhorse sucker (11.6 percent), gizzard shad (7.5 percent), and shorthead redhorse sucker (6.1 percent).The remaining 13 species combined accounted for 22.2 percent of the total handled catch. The most frequently observed (handled and not handled combined) fish in 2001 were gizzard shad.(Tables 2.9, 2.10, and 2.15). The only other fish observed but not handled was a single longnose gar. The large schools of juvenile gizzard shad observed in 2001 were not present during the 2000 electrofishing or seining efforts however were commonly observed in past years. Game fishes collected during 2001 included , channel catfish, flathead catfish, bluegill, sauger, walleye, smallmouth and spotted bass. Game fishes represented 25.3 percent of the total handled catch with 15.7 percent being smallmouth bass.

A total of 102 fish, representing 18 taxa, was collected by electrofishing in 2001 (Table 2.9). Golden redhorse sucker accounted for the largest percentage of the electrofishing catch (22.5 percent), followed by gizzard shad (13.7 percent). Shorthead redhorse sucker was the only other species that contributed greater than 10 percent of the total catch.

A total of 96 fishes representing 4 taxa was collected by seining in 2001 (Table 2.10). Fish taxa collected were black buffalo juveniles (74 percent), smallmouth bass (24 percent), spotted bass (1.0 percent) and gizzard shad (1.0 percent). All of the fish collected by seines were netted at the non-control station.

A total of 68 fish representing 12 species was captured during the May 2001 sample event (Table 2.11). All fish collected in May were taken by electrofishing. Golden redhorse sucker (25.0 percent of the catch) and gizzard shad (20.6 percent) were the most common species collected during electrofishing efforts. No fish were collected by seining in May

A total of 130 fish representing 13 species was captured during the July 2001 sample event (Table 2.12). A total of 34 fish were collected during electrofishing and 96 during seining. Sauger (23.5 percent) and golden redhorse sucker (17.6 percent) were the most common species boated during electrofishing the effort. Black buffalo (74.0 percent) and smallmouth bass were the most frequently collected species during the seining efforts.

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 1999 through 2001. Electrofishing catch rates are presented in Tables 2.14, 2.15, and 2.16 for fish that were boated and handled during the 1999 through 2001 surveys by season. As previously noted because of security concerns after September 11, fisheries efforts were not completed in September or November 2001.

2.3.4 Comparison of Control and Non-Control Stations

The electrofishing data (Table 2.9) 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, a pattern seen in the past. 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 2001 (Table 2.10) showed that no fish were caught in the control area and 170 fish were netted in the non-control areas. Patchy spatial distribution is the likely cause of the zero catch in the control area. This pattern of larger catches in the non-control stations is not unique to this year.

2.3.5 Discussion

The results of the 2001 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 gizzard shad 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 reduction in the numbers of gizzard shad observed in 2001 compared to 1999 and 2000. 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.

Also, 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 2001, species composition remained comparable among stations. Common taxa collected in the 2001 surveys by all methods included gizzard shad, redhorse sucker species, sauger, 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.

2.4 *Corbicula* Monitoring Program

2.4.1 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 2001.

2.4.2 Monitoring

(a) 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 also used to monitor for the presence of macrofouling zebra mussels (see Section 2.5).

(b) Methods

(1) 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 side-walls and sediments. The sampler used on the side-walls 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 2001, each month (February 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 any *Corbicula* in the bottom sediment. No samples were collected in October or November because of security concerns. Due to a unit outage, no samples were collected from Unit 1 in September. 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 16.0 mm to 0.6 mm. Live and dead clams on 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.

(2) Cooling Towers - *Corbicula* Density Determination

Population surveys of both BVPS cooling tower reservoirs have been conducted during scheduled outages (1986 through 2001) in order to estimate the number of *Corbicula* present in these structures. In 2001 the BVPS cooling tower for Unit 1 was sampled during its scheduled outage to estimate the *Corbicula* population. The sediment and *Corbicula* were removed from the drained cooling tower reservoir after the population survey sampling was completed for each respective outage.

Unit 1 Cooling Tower

The *Corbicula* population in the basin of the Unit 1 cooling tower was estimated based on sampling performed during the scheduled outage. Samples consisting of a petite ponar grab at were collected at 17 standardized sampling locations within the drained reservoir basin on September 5, 2001. These sampling locations were consistent with previous Unit 1 cooling tower populations surveys.

Unit 2 Cooling Tower

Unit 2 was not shut down for scheduled maintenance in 2001, so no sampling was conducted.

(c) Results

(1) Unit 1 Cooling Tower - Monthly Reservoir Sampling

In 2001, a total of 290 *Corbicula* (46.6 percent alive) was collected from the Unit 1 cooling tower basin during monthly reservoir sampling. The largest live *Corbicula* collected measured 6.2 mm in length (Figure 2.1). The greatest numbers of *Corbicula* were collected in June (144 individuals). *Corbicula* were collected in lower numbers in the other months sampled.

(2) Unit 2 Cooling Tower - Monthly Reservoir Sampling

In 2001, 4 *Corbicula* (100 percent alive) were collected from the Unit 2 cooling tower reservoir during monthly sampling. The largest *Corbicula* collected measured 3.0 mm in length (Figure 2.2). Individuals were collected from February through September.

(3) Cooling Towers - *Corbicula* Density Determination

Population surveys of both BVPS cooling tower reservoirs have been conducted during scheduled outages (1986 through 2001) to estimate the number of *Corbicula* present in these structures. Both units were sampled in 2000. In 2001, only Unit 1 was sampled.

In 2001, BVPS continued its *Corbicula* control program (eleventh year), which included the use of a molluscicide (CT-1) to prevent the proliferation of *Corbicula* within BVPS. BVPS was granted permission by the Pennsylvania Department of Environmental Protection to use CT-2 **to target the Unit 1 river water system and the Unit 2 service water system.**

In 1990 through 1993, the molluscicide applications (CT-1) focused on reducing the *Corbicula* population throughout the entire river water system of each BVPS plant (Units

1 and 2). In 1994 and 1995, the CT-1 applications targeted the internal water systems; therefore the CT-1 concentrations in the cooling towers were reduced during CT-1 applications. Consequently, adult and juvenile *Corbicula* in the cooling towers often survived the CT-1 applications. Reservoir sediment samples taken after CT-1 applications represent mortality of *Corbicula* in the cooling tower only and do not reflect mortality in BVPS internal water systems. CT-2 applications occurred on April 25 and November 6-7.

Unit 1 Cooling Tower

The results of the September 05, 2001 *Corbicula* density determination in Unit 1 cooling tower reservoir are presented in Table 2.19. Based on the seventeen ponar dredge samples collected from the reservoir, the estimated number of *Corbicula* inhabiting the reservoir area was 67,982,400 clams (5,278/m^2). Of the *Corbicula* collected 0.19% (10/m^2) were alive. Only one collected *Corbicula* (dead) was greater than 12.50 mm.

(d) Discussion

The monthly reservoir sediment samples collected in Units 1 and 2 cooling towers during 2001 demonstrated that *Corbicula* were entering and colonizing the reservoirs. Overall densities in Units 1 and 2 were similar to 1999 and 2000. The maximum monthly density of *Corbicula* in Unit 1 was 6,200/m^2, which occurred in July. The maximum density of clams in Unit 2 was 86 which occurred in August, much less than the year 2000 maximum of 1,982/m^2. The lower density of *Corbicula* in Unit 2 compared to Unit 1 was consistent with 1999 and 2000. The small increase of *Corbicula* at the BVPS over the last year returns densities to level more consistent with densities in the Ohio River in the mid 1990's, but well below those present during the 1980's.

2.4.3 <u>*Corbicula* Juvenile Study</u>

(a) 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.

(b) 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 permited 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 continued thereafter. In 2001, monthly sampling was scheduled to take place from February though November. Due to security concerns sampling was not conducted in September-November.

(c) Results

Figure 2.3 illustrates the abundance and size distribution data for samples collected in the intake structure by petite ponar in 2000. *Corbicula* were first collected in June, with the highest numbers being collected in the intake in September. The presence of small individuals (1.00-1.99 and 2.00-3.34) of *Corbicula* indicated that successful spawning had occurred. The numbers of individuals were higher than in 2000 (3 in 2000 vs. 14 in 2001).

(d) Discussion

A spring/early-summer spawning period typically occurs in the Ohio River near BVPS each year when optimal spawning temperatures are reached (Figure 2.4). The offspring from this spawning event generally begin appearing in the sample collections in late April (Figure 2.3). The settled clams generally increased in size during the year. Cleaning of plant intake structure throughout the year and collection from a different location (intake bay C rather than intake bay D) than in past years (except 2000) could account for the low *Corbicula* numbers in the area of the intake. The overall low numbers of *Corbicula* collected in the intake and cooling towers compared to levels in the 1980's more likely reflects a natural decrease in the density of *Corbicula* in the Ohio River near BVPS.

2.5 Zebra Mussel Monitoring Program

2.5.1 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 2001.

2.5.2 Monitoring

(a) 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 for these mussels to reach the size and density that could impact the plant.

(b) Methods

(1) Intake Structure and Barge Slip

The surveillance techniques used in the intake structure and open water were:

- Wall scraper sample collections on a monthly basis (scheduled for 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 intake structure, to detect the planktonic early life forms (scheduled for March through November); and

- A biobox was installed outside the intake building in April 2001. Sampling of substrate plates used for detection of settled mussels from this biobox is scheduled for May through November.

(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 (scheduled for February through November); and

- Monthly pump samples scheduled from March through November to detect planktonic life forms.

(3) Emergency Outfall

- Monthly scraper sample collections in the emergency outfall structure (March through November)

- Sampling of substrate plates used for detection of settled mussels from a biobox installed at the emergency outfall (scheduled for April through November); and

- Monthly pump samples scheduled from March through November to detect planktonic life forms.

(4) Splash Pool

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

- Monthly pump samples scheduled from March through November to detect planktonic life forms.

(c) Results

Scheduled zebra mussel sampling was not conducted in October or November, 2001 because of security concerns. The intake structure scraping samples could not be collected in February and March due to unsafe conditions resulting from high flow conditions in the Ohio River. High flow conditions also precluded collection of scraping samples at the intake building in April. Samples (scraping and pump) were not collected in September from the Unit 1 cooling tower because the unit was on outage.

Zebra mussels were detected in pump samples (Figures 2.5 and 2.6) and in substrate samples (Figure 2.7 and 2.8) in 2001.

Zebra mussel veligers were present in pump samples collected from May through September (Figures 2.5 and 2.6). In each of these months, veligers were collected in all locations sampled. Densities of veligers generally peaked in June through August.. The greatest density of veligers was present in the sample collected at the emergency outfall basin in June (117,900/m^3). This is the highest density of mussels collected at BVPS in any year. Overall, veliger densities were greater in 2001 than in 1999 or 2000. In 1999, the greatest density collected was 34,500/m^3 and in 2000, 81,000/ m^3

In 2001, attached zebra mussels were collected in scrape samples taken from the Barge Slip and the outside wall of the Intake Structure (Figures 2.7 and 2.8). None were collected at either cooling tower, the Splash Pool, or the Emergency Outfall Basin.

Attached zebra mussels were collected at the Barge Slip in all sampled months except September. The highest density collected from the Barge Slip was $32/m^2$ in June. Zebra mussels were collected from scraping samples from the Intake Structure beginning in May. The highest density was collected in June ($18/m^2$.) The mussels collected at the intake and Barge Slip were adult mussels capable of reproducing with the largest being 31 mm.

(d) 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 from BVPS, including the Allegheny River. The July 1995 sighting of zebra mussels at Maxwell Locks 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 the alternate intake structure during the last three quarters of 1998, however, densities were low.

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 and the densities of veligers were less in 2001 than in 2000. Densities however remained high compared to past years. Zebra mussel 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 cannot be determined. In any case, the densities of mussels that presently exist are more than sufficient to impact the BVPS if continued prudent monitoring and control activities are not conducted.

2.6. Zebra Mussel and Corbicula Control Activities

In 2001, BVPS continued its *Corbicula* and zebra mussel control program (eleventh year), which included the use of a molluscicide (CT-1) to prevent the proliferation of *Corbicula* within BVPS. BVPS was granted permission by the Pennsylvania Department of Environmental Protection to use CT-2 to target the Unit 1 river water system and the Unit 2 service water system.

In 1990 through 1993, the molluscicide applications (CT-1) focused on reducing the *Corbicula* population throughout the entire river water system of each BVPS plant (Units 1 and 2). In 1994 through 2001, the CT-1 or 2 applications targeted zebra mussels and *Corbicula* in the internal water systems; therefore the molluscicide concentrations in the cooling towers were reduced during CT-1 or 2 applications. Consequently, adult and juvenile *Corbicula* in the cooling towers often survived the applications. Reservoir sediment samples taken after CT-1 or 2 applications represented mortality of *Corbicula* in the cooling tower only and do not reflect mortality in BVPS internal water systems.

In 2001, control treatments occurred in April, July, and November. To determine the efficacy of the treatments, live, adult zebra mussels were placed into bioboxes set up to sample the BVPS water flow. The biobox set at the Emergency Outfall Basin sampled treated flow and served as a control.

In April, the system was treated at 16ppm of CT-2 for 16 hours. The river water temperature was 55^0 C. The zebra mussel kill rate in the treated biobox was 96 percent after seven days. A seven-day post treatment evaluation was conducted to determine latent effects of treatment on mortality.

In November, the system was treated for 18 hours at a CT-2 concentration that varied between 6 and 10.5 ppm. The river water temperature was 52^0 C. A seven-day latent mortality of 77 percent was achieved. Although the mortality was less than desired, some mortality did occur. Any mussels that remain in the system will not grow through the winter months. An early, effective spring 2002 treatment is recommended to prevent these mussels from growing and causing problems to the BVPS.

The mortality of mussels resulting from the July program was not determined because of the failure of the pump that supplied water to the treated box. Based on planned parameters, mortality was likely comparable to that achieved in April.

Periodic bay cleaning and inspections were performed throughout 2001 to ensure that fouling in this area fell within acceptance criteria (less than 25 individual zebra mussels per square foot) set to limit the probability of in plant fouling. Inspections indicated that cleaning was performed so that the acceptance criteria were attained.

3.0 REFERENCES

Burch, J. Q., 1944. Checklist of West American Mollusks. Minutes, Conchology Club of Southern California 38:18.

Commonwealth of Pennsylvania, 1994. Pennsylvania's Endangered Fishes, Reptiles and Amphibians. Published by the Pennsylvania Fish Commission.

Counts, C. C. III, 1985. Distribution of *Corbicula fluminea* at Nuclear Facilities. Division of Engineering, U.S. Nuclear Regulatory Commission. NUREGLCR. 4233. 79 pp.

Dahlberg, M. D. and E. P. Odum, 1970. Annual cycles of species occurrence, abundance and diversity in Georgia estuarine fish populations. Am. Midl. Nat. 83:382-392.

DLC, 1976. Annual Environmental Report, Non-radiological Volume #1. Duquesne Light Company, Beaver Valley Power Station, 132 pp.

DLC, 1977. Annual Environmental Report, Non-radiological Volume #1. Duquesne Light Company, Beaver Valley Power Station, 123 pp.

DLC, 1979. Annual Environmental Report, Non-radiological Volume #1. Duquesne Light Company, Beaver Valley Power Station. 149 pp.

DLC, 1980. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 160 pp.

DLC, 1981. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 105 pp. + Appendices.

DLC, 1982. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 126 pp.

DLC, 1983. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 124 pp. + Appendix.

DLC, 1984. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1. 139 pp.

DLC, 1985. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 106 pp.

DLC, 1986. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 152 pp.

DLC, 1987. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 145 pp.

DLC, 1988. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 161 pp.

DLC, 1989. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 145 pp.

DLC, 1990. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 181 pp.

DLC, 1991. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 165 pp.

DLC, 1992. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 164 pp.

DLC, 1993. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 90 pp.

DLC, 1994. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 78 pp.

DLC, 1995. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 77 pp.

DLC, 1996. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 67 pp.

DLC, 1997. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 68 pp.

DLC, 1998. Annual Environmental Report, Non-radiological. Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 & 2. 63 pp.

FENOC, 1999. Annual Environmental Report, Non-radiological. First Energy Nuclear Operating Company, Beaver Valley Power Station, Unit No. 1 & 2. 76 pp.

FENOC, 2000. Annual Environmental Report, Non-radiological. First Energy Nuclear Operating Company, Beaver Valley Power Station, Unit No. 1 & 2. 76 pp.

Hutchinson, G. E., 1967. A treatise on limnology. Vol. 2, Introduction to lake biology and the limnoplankton. John Wiley and Sons, Inc., New York. 1115 pp.

Hynes, H. B. N., 1970. The ecology of running waters. Univ. Toronto Press, Toronto.

NRC, IE Bulletin 81-03: Flow Blockage of Cooling Tower to Safety System Components by *Corbicula sp.* (Asiatic Clam) and *Mytilus sp.* (Mussel).

Pielou, E. C., 1969. An introduction to mathematical ecology. Wiley Interscience, Wiley & Sons, New York, NY.

Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott, 1991. Common and Scientific Names of Fishes from the United States and Canada (fifth edition). American Fisheries Society Special Publication No. 20:1-183.

Shiffer, C., 1990. Identification Guide to Pennsylvania Fishes. Pennsylvania Fish Commission, Bureau of Education and Information. 51 pp.

Winner, J. M., 1975. Zooplankton. In: B. A. Whitton, ed. River ecology. Univ. Calif. Press, Berkely and Los Angeles. 155-169 pp.

TABLE 2.1

BEAVER VALLEY POWER STATION (BVPS)
SAMPLING DATES FOR 2001

Study	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic Macroinvertebrate					7							
Fish					7		18					
Corbicula and Zebra Mussel		20	22	13	7	21	18	17	5			
Corbicula CT Density		20	22	13	7	21	18	17	5			
Zebra Mussel Veliger			22	12	7	21	18	8	4			

TABLE 2.2

SYSTEMATIC LIST OF MACROINVERTEBRATES COLLECTED FROM 1973 THROUGH 2001 IN THE OHIO RIVER NEAR BVPS

Taxa	Collected in Previous Years	Collected in 2001	New in 2001
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		
Aeolosomatidae	X		
Tubificida	X		
Enchytraeidae	X	X	
Naididae			
Allonais pectinata	X		
Amphichaeta leydigi	X		
Amphichaeta sp.	X		
Arcteonais lomondi	X	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		
N. pardalis	X	X	
N. pseudobtusa	X		
N. simplex	X		

TABLE 2.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2001	New in 2001
N. variabilis	X		
Nais sp.	X		
Ophidonais serpentina	X		
Paranais frici	X		
Paranais litoralis			
Paranais sp.	X		
Piguetiella michiganensis	X		
Pristina idrensis	X		
Pristina longisoma	X		
Pristina longiseta	X		
P. osborni	X		
P. sima	X		
Pristina sp.	X		
Pristinella jenkinae		X	X
Pristinella osborni			
Ripistes parasita	X		
Slavina appendiculata	X		
Specaria josinae			
Stephensoniana trivandrana	X		
Stylaria fossularis	X		
S. lacustris	X		
Uncinais uncinata	X		
Vejdovskyella comata	X		
Vejdovskyella intermedia	X		
Vejdovskyella sp.	X		
Tubificidae	X		
Aulodrilus limnobius	X		
A. pigueti	X		
A. pluriseta	X		
Aulodrilus sp.	X		
Bothrioneurum vejdovskyanum	X		
Branchiura sowerbyi	X		
Ilyodrilus templetoni	X		
Limnodrilus cervix	X	X	
L. cervix (variant)	X		
L. claparedianus	X		
L. hoffmeisteri	X	X	
L. maumeensis	X		
L. profundicla	X		
L. spiralis	X		
L. udekemianus	X		
Limnodrilus sp.	X		
Peloscolex multisetosus longidentus	X		
P. m. multisetosus	X		
Potamothrix moldaviensis	X		
P. vejdovskyi	X	X	
Psammoryctides curvisetosus	X		
Tubifex tubifex	X		
Unidentified immature forms:	X	X	
with hair chaetae	X		
without hair chaetae	X		
Lumbriculidae	X	X	
Hirudinae	X	X	
Glossiphoniidae	X		
Helobdella elongata	X		

TABLE 2.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2001	New in 2001
H. stagnalis	X		
Helobdella sp.	X		
Erpobdellidae			
Erpobdella sp.	X		
Mooreobdella microstoma	X		
Haplotaxidae			
Stylodrilus heringianus		X	X
Lumbricina		X	X
Lumbricidae		X	X
Arthropoda			
Acarina	X		
Ostracoda	X	X	
Isopoda			
Asellus sp.	X		
Amphipoda			
Talitridae			
Hyalella azteca	X		
Gammaridae			
Crangonyx pseudogracilis	X		
Crangonyx sp.	X		
Gammarus fasciatus	X		
Gammarus sp.	X	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		
Serattella sp.	X		
Potamanthidae			
Potamanthus sp.			
Tricorythidae			
Tricorythodes sp.	X		
Megaloptera			
Sialis sp.	X		
Odonata			
Gomphidae			
Argia sp.	X		
Dromogomphus spoliatus	X		
Dromogomphus sp.	X		
Gomphus sp.	X		

TABLE 2.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2001	New in 2001
Libellulidae			
Libellula sp.	X		
Trichoptera		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			
Ancyronyx variegatus	X		
Dubiraphia sp.	X		
Helichus sp.	X		
Stenelmis sp.	X		
Psephenidae	X		
Diptera			
Unidentified Diptera	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	X	
Chironominae	X		
Tanytarsini pupa	X		
Chironominae pupa	X	X	
Axarus sp.	X		
Chironomus sp.	X	X	
Cladopelma sp.	X		
Cladotanytarsus sp.			
Cryptochironomus sp.	X	X	
Dicrotendipes nervosus	X		
Dicrotendipes sp.	X		
Glyptotendipes sp.	X		
Harnischia sp.	X		

TABLE 2.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2001	New in 2001
Microchironomus sp.	X		
Micropsectra sp.	X		
Microtendipes sp.	X		
Parachironomus sp.	X	X	
Paracladopelma sp.	X		
Paratanytarsus sp.			
Paratanytarsus sp.		X	X
Paratendipes albimanus	X		
Phaenopsectra sp.	X		
Polypedilum (s.s.) *convictum* type	X		
P. (s.s.) *simulans* type	X		
Polypedilum sp.	X		
Rheotanytarsus sp.	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		
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		
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	X	
Parametriocnemus sp.	X		
Paraphaenocladius sp.	X		
Polypedilum sp.		X	X
Psectrocladius sp.	X		
Psectrotanypus sp.			
Pseudorthocladius sp.	X		
Pseudosmittia sp.	X		
Smittia sp.	X		
Theinemannimyia sp.		X	X

TABLE 2.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2001	New in 2001
Diamesinae			
Diamesa sp.	X		
Potthastia sp.	X		
Ceratopogonidae	X	X	
Bezzia sp.	X		
Culicoides sp.	X	X	
Dolichopodidae	X		
Empididae	X		
Clinocera sp.		X	X
Wiedemannia sp.	X		
Ephydridae	X		
Muscidae	X		
Rhagionidae	X		
Tipulidae	X		
Stratiomyidae	X		
Syrphidae	X		
Lepidoptera	X		
Hydrachnidia	X		
Mollusca			
Hyrobiidae	X		
Amnicolinae			
Amnicola sp.	X	X	X
Amnicola limosa	X	X	X
Gastropoda	X		
Physacea	X		
Physidae	X		
Physa sp.	X		
Ancylidae	X	X	
Ferrissia sp.	X		
Planorbidae	X		
Valvatidae	X		
Valvata perdepressa	X		
Valvata piscinalis		X	X
Valvata sincera sincera	X		
Pelecypoda	X		
Sphaeriacea	X		
Corbiculidae			
Corbicula fluminea	X	X	
Corbicula sp.	X	X	
Sphaeriidae	X		
Pisidium ventricosum	X		
Pisidium sp.	X	X	
Sphaerium sp.	X	X	
Unidentified immature Sphaeriidae	X		
Dreissenidae			
Dreissena polymorpha	X	X	
Unionidae	X		
Anodonta grandis	X		
Anodonta (immature)	X		
Elliptio sp.	X		

TABLE 2.2
(Cont'd)

Taxa	Collected in Previous Years	Collected in 2001	New in 2001
Unidentified immature Unionidae	X		

TABLE 2.3

BENTHIC MACROINVERTEBRATE COUNTS FOR TRIPLICATE SAMPLES
TAKEN AT EACH SAMPLE STATION FOR 2001

May 7, 2001 **Scientific name**	**Location**						**Total**
	1	**2A**	**2B1**	**2B2**	**2B3**	**3**	
Nematoda			1				1
Oligochaeta							
Enchytraeidae			2				2
Naididae							
Arcteonais lomondi	1						1
Nais communis	1						1
Nais pardalis	7	2		1			10
Nais variabilis			1				1
Pristinella jenkinae	2	1					3
Tubificid		3	18	65	13	3	102
Limnodrilus cervix				1			1
Limnodrilus hoffmeisteri			3	6	4		13
Limnodrilus maumeensis					2	1	3
Potamothrix vejdovskyi				1	1	1	3
Lumbriculidae					1		1
Hirudinae					1	1	2
Stylodrilus heringianus			1				1
Lumbricina			1	1			2
Athropoda							
Ostracoda			1				1
Gammarus sp.	2	1	1	5	8		17
Hexagenia sp.			1	1	3	18	23
Tricoptera	1						1
Chironomidae	2		1				3
Chironomid pupae	1	1	2	2	4	2	12
Chironomus sp.	4		3		7	10	24
Cryptochironomus sp.	5	1	3	13	6	5	33
Parachironomus sp.	1						1
Paratendipes sp.			1	2			3
Tanytarsus sp.	2	3		2			7
Tanypodinae							
Ablabesmyia sp.					1	1	2
Coelotanypus sp.	1			2	1	1	5
Procladius sp.	4			1	11	6	22
Orthocladiinae							
Crictopus (s.s.) sp.				1			1
Orthocladius sp.	1	10		1			12
Polypedilum sp.	3	2	32	95	13		145
Theinemannimyia sp.	1						1
Ceratopogonidae	1			1			2
Culicoides sp.			1	3			4
Empididae							
Clinocera sp.	1						1
Mollusca							
Amnicolinae							
Amnicola sp.			1				1
Corbiculidae							
Corbicula sp.	4		1	2			7
Corbicula fluminea	1	11	2	5			19
Sphaeriadae							
Pisidium sp.	3			1			4
Sphaerium sp.			2				2
Dreissenidae							
Dreissena polymorpha	24						24
May 2001 Total:	73	35	79	212	76	49	468

TABLE 2.4

MEAN NUMBER OF MACROINVERTEBRATES (NUMBER/M^2) AND PERCENT COMPOSITION OF OLIGOCHAETA, CHIRONOMIDAE, MOLLUSCA, AND OTHER ORGANISMS, 2001 BVPS

	Station											
	1 (Control)		2A (Non-control)		2B1 (Non-control)		2B2 (Non-control)		2B3 (Non-control)		3 (Non-control)	
	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%
May 07												
Oligochaeta	473	15	258	17	1076	32	3183	35	946	29	258	12
Chironomidae	1075	34	731	49	1806	54	5117	56	1849	57	1075	51
Mollusca	1376	44	473	31	258	8	344	4	0	0	0	0
Others	215	7	43	3	215	6	430	5	473	14	774	37
Total	3139	100	1505	100	3355	100	9074	100	3268	100	2107	100

TABLE 2.5

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 (2A, 2B1, 2B2, 2B3, AND 3), 2001 BVPS

May 07

	Control Station (Mean)		Non-Control Station (Mean)	
	#/m^2	%	#/m^2	%
Oligochaeta	473	15	1144	30
Chironomidae	1075	34	2116	55
Mollusca	1376	44	215	6
Others	215	7	387	10
TOTAL	3139	100	3862	100

TABLE 2.6

SHANNON-WEINER DIVERSITY, EVENNESS AND RICHNESS INDICES
FOR BENTHIC MACROINVERTEBRATES COLLECTED IN THE OHIO RIVER, 2001

	Station					
	1	2A	2B1	2B2	2B3	3
Date: May 07						
No. of Taxa	20	9	17	18	13	9
Shannon-Weiner Index	1.88	1.57	1.91	2.33	1.89	1.71
Evenness	0.43	0.49	0.47	0.56	0.51	0.54
Richness	4.43	2.25	3.66	3.17	2.77	2.06

TABLE 2.7

BENTHIC MACROINVERTEBRATE DENSITIES (NUMBER/M^2) FOR STATION 1 (CONTROL) AND STATION 2B (NON-CONTROL) DURING PREOPERATIONAL AND OPERATIONAL YEARS THROUGH 2001 BVPS

Month	Preoperational Years						Operational Years									
	1973		1974		1975		1976		1977		1978		1979		1980	
	1	2B	1	2B	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	1,004	840	1,041	747
August	99	244	143	541	1,017	1,124	851	785	591	3,474	601	1,896	1,185	588		
September															1,523	448
Mean	173	376	630	1,369	1,017	1,124	889	2,223	633	2,161	476	1,011	1,095	714	1,282	598

Month	Operational Years													
	1981		1982		1983		1984		1985		1986		1987	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
May	209	456	3,490	3,026	3,590	1,314	2,741	621	2,256	867	601	969	1,971	2,649
September	2,185	912	2,956	3,364	4,172	4,213	1,341	828	1,024	913	849	943	2,910	2,780
Mean	1,197	684	3,223	3,195	3,881	2,764	2,041	725	1,640	890	725	956	2,440	2,714

TABLE 2.7 (Cont'd)

BENTHIC MACROINVERTEBRATE DENSITIES (NUMBER/M^2) FOR STATION 1 (CONTROL) AND STATION 2B (NON-CONTROL) DURING PREOPERATIONAL AND OPERATIONAL YEARS THROUGH 2001 BVPS

Month	Operational Years													
	1988		1989		1990		1991		1992		1993		1994	
	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B	1	2B
May	1,804	1,775	3,459	2,335	15,135	5,796	7,760	6,355	7,314	10,560	8,435	2,152	6,980	2,349
September	1,420	1,514	1,560	4,212	5,550	1,118	3,855	2,605	2,723	4,707	4,693	2,143	1,371	2,930
Mean	1,612	1,645	2,510	3,274	10,343	3,457	5,808	4,480	5,019	7,634	6,564	2,148	4,176	2,640

Month	Operational Years													
	1995		1996		1997		1998		1999		2000		2001	
	1	2B	1	2B	1	2B*	1	2B	1	2B*	1	2B*	1	2B*
May	8,083	9,283	1,978	1,333	1,411	2,520	6,980	2,349	879	1,002	2,987	2,881	3,139	5,232
September	1,669	3,873	1,649	2,413	1,944	2,774	1,371	2,930	302	402	3,092	2,742		
Mean	4,876	6,578	1,814	3,746	1,678	2,647	4,176	2,640	591	702	3,040	2,812	3,139	5,232

*Mean of 2B1, 2B2, 2B3

TABLE 2.8

SCIENTIFIC AND COMMON NAME[1] OF FISH COLLECTED IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1970 THROUGH 2001 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

(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. 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 2.8
(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 2.9

COMPARISON OF CONTROL VS. NON-CONTROL ELECTROFISHING CATCHES
DURING THE BVPS 2001 FISHERIES SURVEY

Common Name	Scientific Name	Control	%	Non-control	%	Total fish	%
Black buffalo	*Ictiobus niger*	2	7.1			2	2.0
Bluegill	*Lepomis macrochirus*			2	2.7	2	2.0
Channel catfish	*Ictalurus punctatus*	2	7.1			2	2.0
Common carp	*Cyprinus carpio*			1	1.4	1	1.0
Emerald shiner	*Notropis atheriniodes*			2	2.7	2	2.0
Flathead catfish	*Pylodictus olivaris*	1	3.6	1	1.4	2	2.0
Freshwater drum	*Aplodinotus grunniens*	2	7.1	2	2.7	4	3.9
Gizzard shad	*Dorosoma cepedianum*	2	7.1	12	16.2	14	13.7
Golden redhorse	*Moxostoma erythrurum*	5	17.9	18	24.3	23	22.5
Quillback	*Carpoides cyprinus*			1	1.4	1	1.0
River carp sucker	*Carpoides carpio*	1	3.6	2	2.7	3	2.9
Sauger	*Stizostedion canadense*	4	14.3	6	8.1	10	9.8
Shorthead redhorse sucker	*Moxostoma macrolepidotum*	3	10.7	9	12.2	12	11.8
Silver redhorse	*Moxostoma anisurum*			10	13.5	10	9.8
Smallmouth bass	*Micropterus dolomeiu*	2	7.1	6	8.1	8	7.8
Smallmouth buffalo	*Ictiobus bubalus*	4	14.3			4	3.9
Spotted bass	*Micropterus punctulatus*			1	1.4	1	1.0
Walleye	*Stizostedion vitreum*			1	1.4	1	1.0
Electrofishing	Gear Total:	28	100	74	100	102	100

TABLE 2.10

COMPARISON OF CONTROL VS. NON-CONTROL SEINE CATCHES
DURING THE BVPS 2001 FISHERIES SURVEY

Common Name	Scientific Name	Control	%	Non-control	%	Total fish	%
Black buffalo	*Ictiobus niger*			71	74.0	71	74.0
Gizzard shad	*Dorosoma cepedianum*			1	1.0	1	1.0
Smallmouth bass	*Micropterus dolomeiu*			23	24.0	23	24.0
Spotted bass	*Micropterus punctulatus*			1	1.0	1	1.0
Seine	Gear Total:	0		96	100	96	100
Seine and Electrofishing	Year Total	28	-------	170	-------	198	-------

TABLE 2.11

FISH SPECIES COLLECTED DURING THE MAY 2001 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	%
Channel catfish	*Ictalurus punctatus*			2						2	2.9
Freshwater drum	*Aplodinotus grunniens*				1		1			2	2.9
Gizzard shad	*Dorosoma cepedianum*			2	1	7	4			14	20.6
Golden redhorse	*Moxostoma erythrurum*			4	7	2	4			17	25.0
Quillback	*Carpoides cyprinus*				1					1	1.5
River carp sucker	*Carpoides carpio*			1	1	1				3	4.4
Sauger	*Stizostedion canadense*				1	1				2	2.9
Shorthead redhorse sucker	*Moxostoma macrolepidotum*			2	7	1				10	14.7
Silver redhorse	*Moxostoma anisurum*				1	3	3			7	10.3
Smallmouth bass	*Micropterus dolomeiu*			2		2	1			5	7.4
Smallmouth buffalo	*Ictiobus bubalus*			4						4	5.9
Walleye	*Stizostedion vitreum*						1			1	1.5
Total		0	0	17	20	17	14	0	0	68	100

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

TABLE 2.12

FISH SPECIES COLLECTED DURING THE JULY 2001 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*		71	2				71	74.0	2	5.9
Bluegill	*Lepomis macrochirus*					1	1			2	5.9
Common carp	*Cyprinus carpio*					1				1	2.9
Emerald shiner	*Notropis atheriniodes*						2			2	5.9
Flathead catfish	*Pylodictus olivaris*			1			1			2	5.9
Freshwater drum	*Aplodinotus grunniens*			2						2	5.9
Gizzard shad	*Dorosoma cepedianum*		1					1	1.0		
Golden redhorse	*Moxostoma erythrurum*			1	1	2	2			6	17.6
Sauger	*Stizostedion canadense*			4	3		1			8	23.5
Shorthead redhorse sucker	*Moxostoma macrolepidotum*			1			1			2	5.9
Silver redhorse	*Moxostoma anisurum*				2		1			3	8.8
Smallmouth bass	*Micropterus dolomeiu*		23			2	1	23	24.0	3	8.8
Spotted bass	*Micropterus punctulatus*		1				1	1	1.0	1	2.9
Total			96	11	6	6	11	96	100	34	100

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

TABLE 2.13

ESTIMATED NUMBER OF FISH OBSERVED * DURING ELECTROFISHING OPERATIONS

Common Name	Scientific Name	May	July	Total
Channel catfish	*Ictalurus punctatus*			
Common carp	*Cyprinus carpio*			
Emerald shiner	*Notropis atheriniodes*			
Gizzard shad	*Dorosoma cepedianum*	10	1000's	10
Longnose gar	*Lepisosteus osseus*	1		1
Smallmouth bass	*Micropterus dolomieu*			
Spottail shiner	*Notropis hudsonius*			
Total		11		11

* = Not boated or handled

Table 2.14

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 1999 FISHERIES SURVEY

Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Spring	40	Black buffalo	1	0.0250
		Bluegill	1	0.0250
		Channel catfish	2	0.0500
		Emerald shiner	1	0.0250
		Freshwater drum	3	0.0750
		Gizzard shad	32	0.8000
		Golden redhorse	19	0.4750
		Quillback	1	0.0250
		Sauger	7	0.1750
		Smallmouth bass	5	0.1250
		Spottail shiner	21	0.5250
		White bass	1	0.0250
		White perch	1	0.0250
		Season Total	95	2.3750

Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Summer	43.1	Brown bullhead	1	0.0232
		Emerald shiner	19	0.4408
		Freshwater drum	1	0.0232
		Gizzard shad	41	0.9513
		Golden redhorse	1	0.0232
		Quillback	1	0.0232
		Sauger	3	0.0696
		Smallmouth bass	3	0.0696
		Spottail shiner	8	0.1856
		White sucker	1	0.0232
		Season Total	79	1.8329

Table 2.14 (Cont'd)

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 1999 FISHERIES SURVEY

Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Fall	40	Channel catfish	1	0.0250
		Freshwater drum	9	0.2250
		Gizzard shad	19	0.4750
		Golden redhorse	3	0.0750
		Mooneye	1	0.0250
		Quillback	7	0.1750
		Sauger	4	0.1000
		Silver redhorse	4	0.1000
		Smallmouth bass	7	0.1750
		Spotted bass	3	0.0750
		Striped bass	5	0.1250
		Season Total	63	1.5750
Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Winter	40	Black redhorse	1	0.0250
		Freshwater drum	2	0.0500
		Gizzard shad	6	0.1500
		Golden redhorse	18	0.4500
		Muskellunge	1	0.0250
		Quillback	6	0.1500
		Sand shiner	1	0.0250
		Sauger	21	0.5250
		Shorthead redhorse	7	0.1750
		Silver redhorse	3	0.0750
		Smallmouth bass	4	0.1000
		Striped bass	11	0.2750
		Walleye	1	0.0250
		Season Total	82	2.0500
Year	163.1		319	7.8329

Table 2.15

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2000 FISHERIES SURVEY

Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Spring	40	Buffalo sp.	4	0.1000
		Bullheads/Catfishes	2	0.0500
		Channel catfish	11	0.2750
		Common carp	3	0.0750
		Flathead catfish	2	0.0500
		Freshwater drum	1	0.0250
		Gizzard shad	22	0.5500
		Golden redhorse	12	0.3000
		Quillback	8	0.2000
		River redhorse	4	0.1000
		Rock bass	1	0.0250
		Sauger	26	0.6500
		Shorthead redhorse sucker	8	0.2000
		Silver redhorse	9	0.2250
		Smallmouth bass	3	0.0750
		Striped bass	12	0.3000
		Walleye	13	0.3250
		Season Total	141	2.5250
Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Summer	40	Black buffalo	1	0.0250
		Channel catfish	1	0.0250
		Common carp	4	0.1000
		Emerald shiner	5	0.1250
		Flathead catfish	2	0.0500
		Gizzard shad	22	0.5500
		Golden redhorse	12	0.3000
		Highfin carpsucker	1	0.0250
		Largemouth bass	2	0.0500
		Quillback	4	0.1000
		River redhorse	3	0.0750
		Sauger	18	0.4500
		Shorthead redhorse sucker	5	0.1250
		Silver redhorse	5	0.1250
		Smallmouth bass	3	0.0750
		Smallmouth buffalo	3	0.0750
		Spotted bass	2	0.0500
		White bass	3	0.0750
		Season Total	96	2.4000

Table 2.15 (Cont'd)

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2000 FISHERIES SURVEY

Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Fall	40	Bluegill	3	0.0750
		Channel catfish	3	0.0750
		Common carp	1	0.0250
		Freshwater drum	3	0.0750
		Gizzard shad	10	0.2500
		Golden redhorse	8	0.2000
		Longnose gar	5	0.1250
		Northern hogsucker	1	0.0250
		Quillback	1	0.0250
		Sauger	8	0.2000
		Shorthead redhorse sucker	1	0.0250
		Silver redhorse	2	0.0500
		Smallmouth bass	5	0.1250
		Walleye	2	0.0500
		White bass	6	0.1500
		Season Total	59	1.4750
Season	Effort (min)	Common Name	Count of species	CPUE (fish/min)
Winter	40	Bluegill	4	0.1000
		Channel catfish	1	0.0250
		Emerald shiner	1	0.0250
		Freshwater drum	2	0.0500
		Gizzard shad	19	0.4750
		Golden redhorse	10	0.2500
		Sauger	21	0.5250
		Shorthead redhorse sucker	1	0.0250
		Silver redhorse	2	0.0500
		Smallmouth bass	3	0.0750
		Smallmouth buffalo	6	0.1500
		Spotted bass	1	0.0250
		Walleye	1	0.0250
		White bass	2	0.0500
		Season Total	74	1.8500
Year	160		370	8.2500

Table 2.16

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

TABLE 2.17

UNIT 1 COOLING RESERVOIR MONTHLY SAMPLING <u>CORBICULA</u> DENSITY DATA FOR 2001 FROM BVPS

Collection Date	Area sampled (sq ft)	Live or Dead	Count	Mean Length (mm)	Maximum Length (mm)	Minimum Length (mm)	Estimated number (per sq m)
2/20/01	0.25	Dead	13	2.68	6.2	1.2	560
		Live	36	2.76	4.7	1.3	1550
3/22/01	0.25	Dead	5	3.30	5.0	2.5	215
		Live	4	2.65	4.0	1.5	172
4/13/01	0.25	Dead	0				0
		Live	4	0.53	0.6	0.4	172
5/7/01	0.25	Dead	15	4.03	5.7	2.3	646
		Live	3	2.40	2.9	2.0	129
6/21/01	0.25	Dead	65	1.57	4.5	0.5	2799
		Live	79	0.98	5.0	0.5	3401
7/18/01	0.25	Dead	1	5.00			43
		Live	2	1.00	1.3	1.0	86
8/17/01	0.25	Dead	56	2.29	6.0	1.0	2411
		Live	7	1.86	6.0	1.0	301
Unit summary		Dead	155		6.2	0.5	6674
		Live	135		6.0	0.4	5813

TABLE 2.18

UNIT 2 COOLING RESERVOIR MONTHLY SAMPLING
CORBICULA DENSITY DATA FOR
2001 FROM BVPS

Collection Date	Area sampled (sq ft)	Live or Dead	Count	Mean Length (mm)	Maximum Length (mm)	Minimum length (mm)	Estimated number (per sq m)
2/20/01	0.25	Dead	0				0
		Live	1	2.2			43
3/22/01	0.25	Dead	0				0
		Live	0				0
4/13/01	0.25	Dead	0				0
		Live	1	1.2			43
5/7/01	0.25	Dead	0				0
		Live	0				0
6/21/01	0.25	Dead	0				0
		Live	0				0
7/18/01	0.25	Dead	0				0
		Live	0				0
8/17/01	0.25	Dead	2	2.5	3.0	2.0	86
		Live	0				0
Unit summary		Dead	0				0
		Live	4				172

TABLE 2.19

UNIT 1 COOLING RESERVOIR OUTAGE SAMPLING, <u>CORBICULA</u> DENSITY DATA FOR SEPTEMBER 05, 2001 SAMPLE 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)
1	0.25	Live										
		Dead	25			5	8	8	3	1		1078
2	0.25	Live										
		Dead	71		3	25	14	15	14			3060
3	0.25	Live										
		Dead	121			13	16	70	19	2	1	5215
4	0.25	Live										
		Dead	107	7	20	8	48	23	1			4612
5	0.25	Live										
		Dead	991		428	131	335	91	6			42715
6	0.25	Live										
		Dead	453		160	27	230	36				19526
7	0.25	Live										
		Dead	6		1	2	3					259
8	0.25	Live										
		Dead	93			30	24	38	1			4009
9	0.25	Live										
		Dead	31		1	3	7	17	3			1336
10	0.25	Live										
		Dead	69			12	20	34	3			2974
11	0.25	Live	3		1			1	1			129
		Dead	57			7	23	19	8			2457
12	0.25	Live	2				1	1				86
		Dead	84			10	40	30	4			3621
13	0.25	Live										
		Dead	99		5	34	17	37	6			4267
14	0.25	Live										
		Dead	126		57	19	9	41				5431
15	0.25	Live										
		Dead	268	1	56	13	40	151	7			11532
16	0.25	Live										
		Dead	20		1	8	2	7	2			862
17	0.25	Live										
		Dead	18		2	5	4	6	1			776
Unit Summary		Live	5		1		1	2	1			10
		Dead	2639	8	734	352	840	623	78	3	1	5278

TABLE 2.20

ZEBRA MUSSEL SUBSTRATE SETTLEMENT RESULTS FROM BVPS, 2001

Tile location	Date set	Date retrieved	Number/m^2
Intake structure	April 12	May 07	0
Intake structure	April 12	May 07	0
Emergency outfall basin	April 12	May 07	0
Emergency outfall basin	April 12	May 07	0
Intake structure	April 12	July 18	452
Intake structure	April 12	July 18	301
Emergency outfall basin	April 12	July 18	0
Emergency outfall basin	April 12	July 18	0
Emergency outfall basin	April 12	July 18	0
Emergency outfall basin	April 12	July 18	0
Emergency outfall basin	April 12	July 18	0
Emergency outfall basin	April 12	July 18	0
Intake structure	April 12	August 08	301
Intake structure	April 12	August 08	1033
Emergency outfall basin	July 18	August 08	0
Emergency outfall basin	July 18	August 08	0

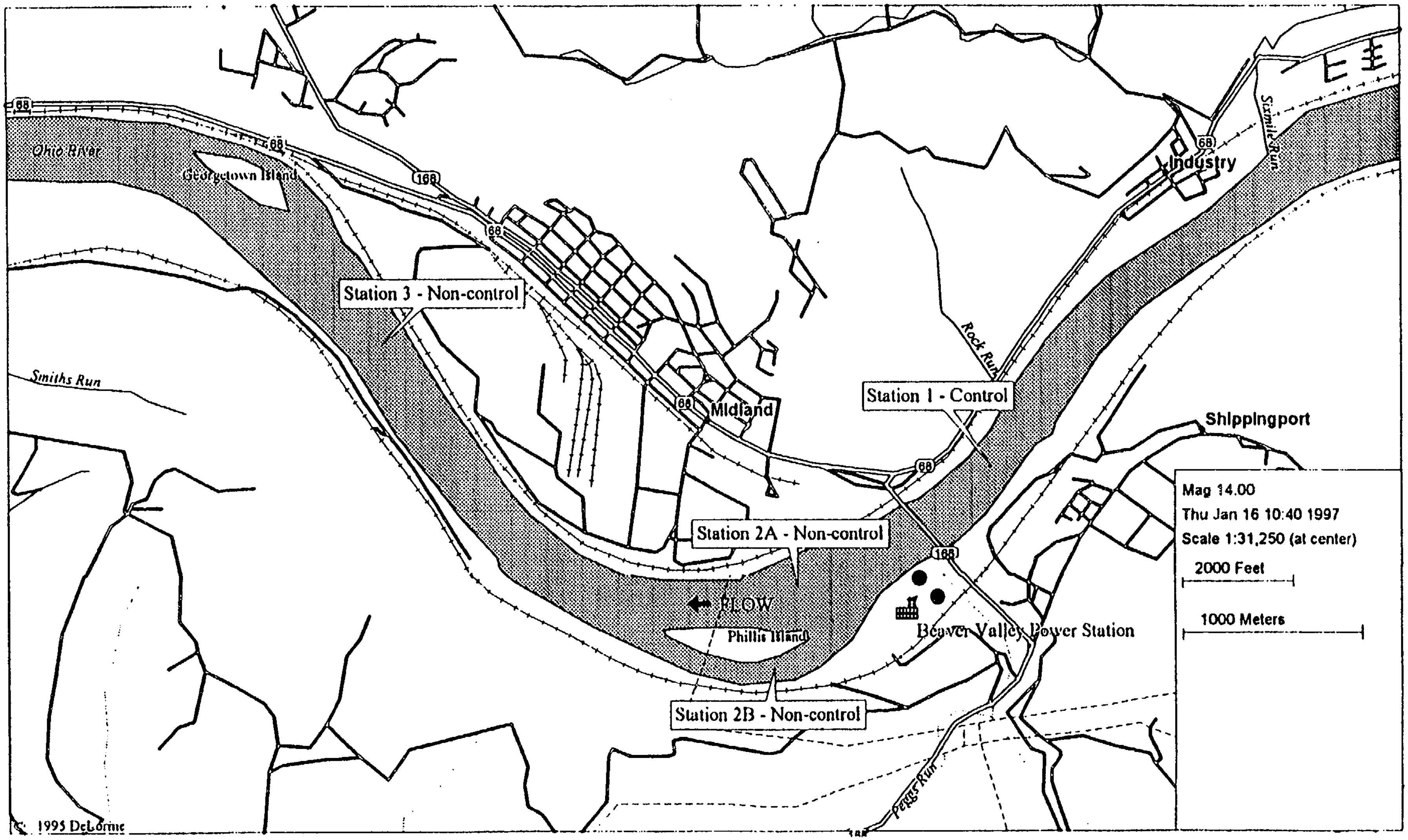


FIGURE 1.1
LOCATION MAP FOR THE 1998 BEAVER VALLEY POWER STATION AQUATIC MONITORING PROGRAM SAMPLING CONTROL AND NON-CONTROL SAMPLING STATIONS

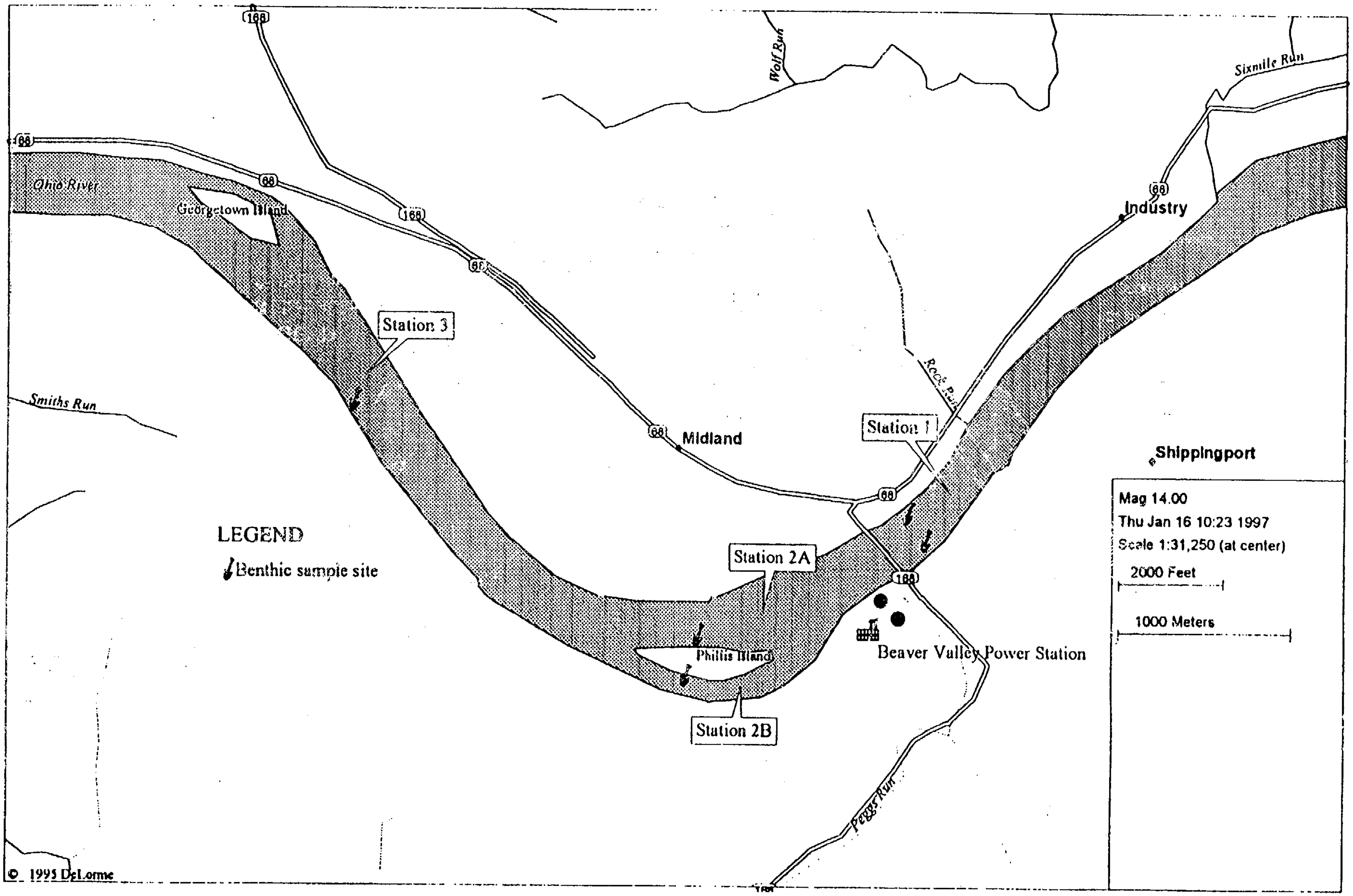


FIGURE 1.2
LOCATION MAP FOR BEAVER VALLEY POWER STATION BENTHIC ORGANISM SURVEY SAMPLING SITES FOR THE 1998 STUDY

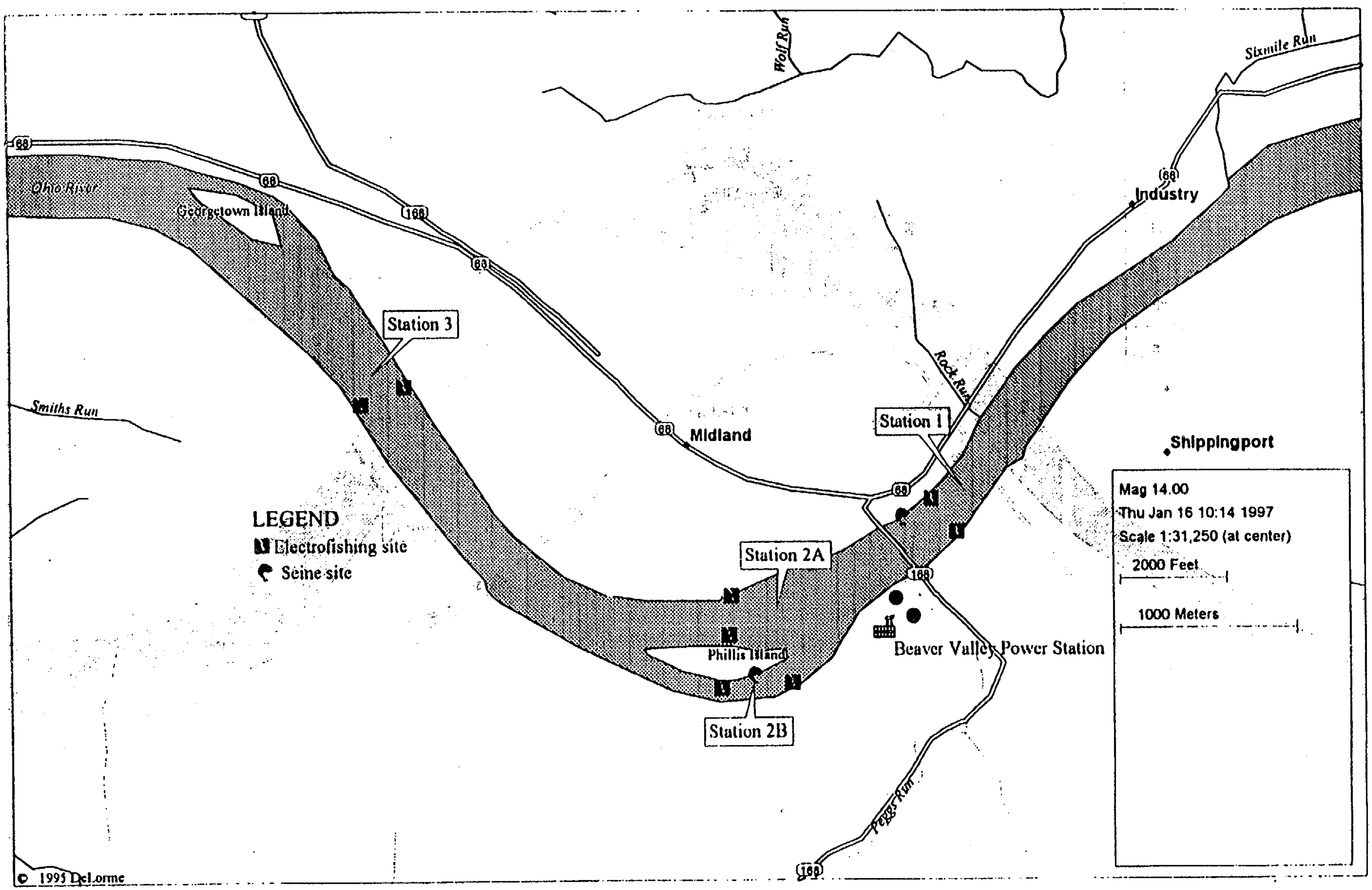


FIGURE 1.3
LOCATION MAP FOR BEAVER VALLEY POWER STATION FISH POPULATION SURVEY FISH SAMPLING SITES FOR THE 1998 STUDY

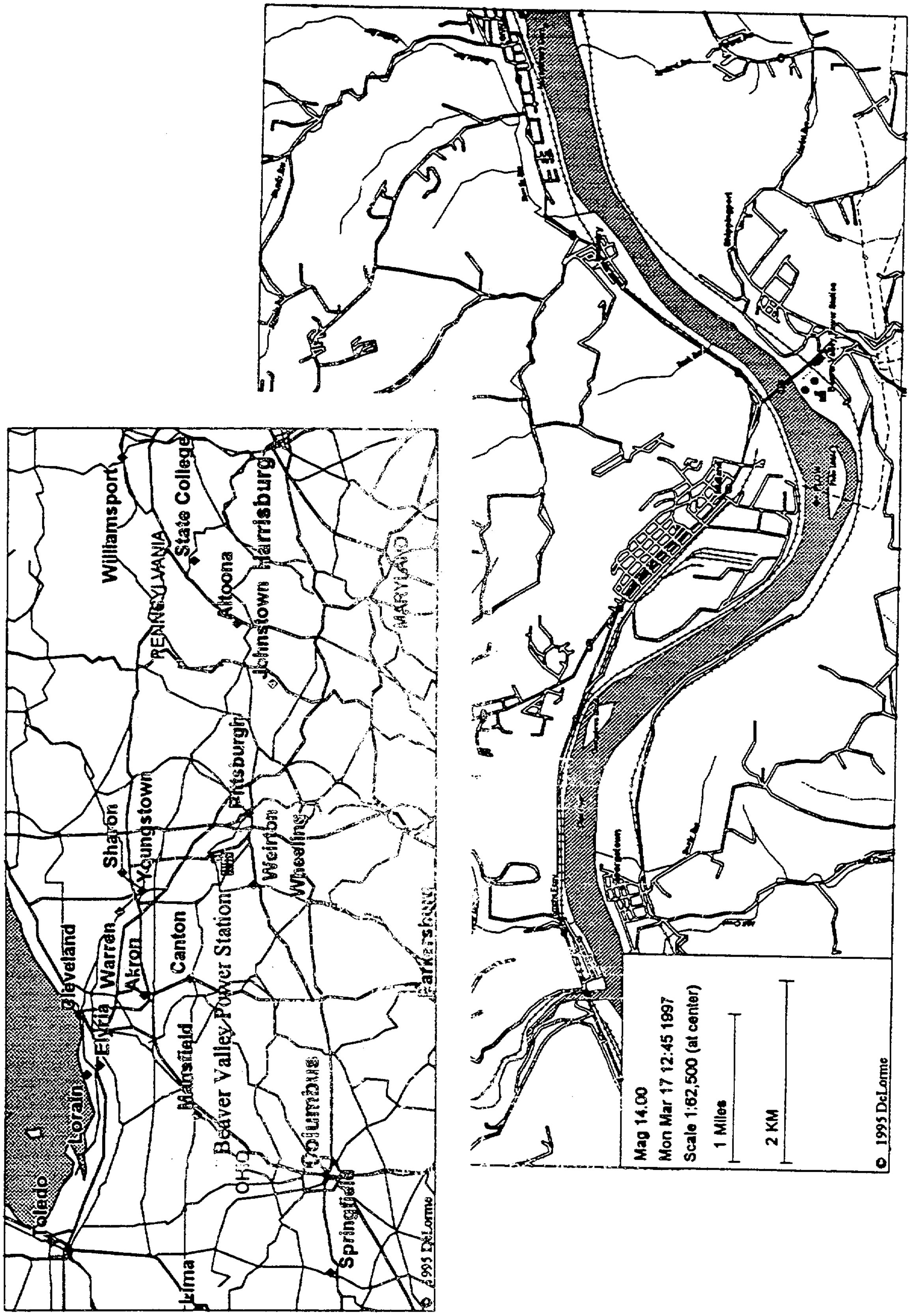
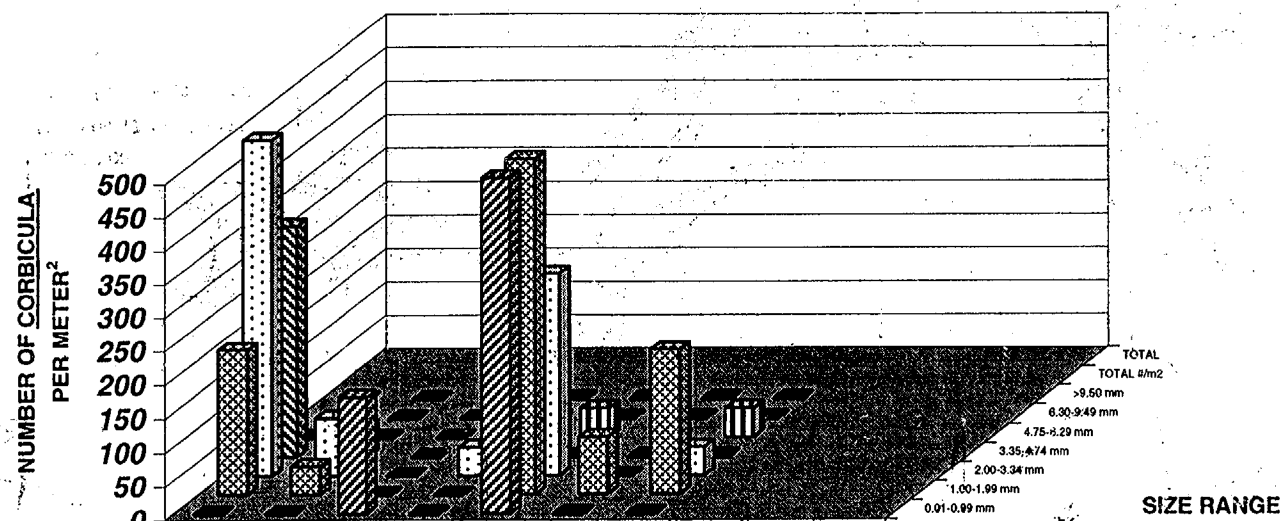


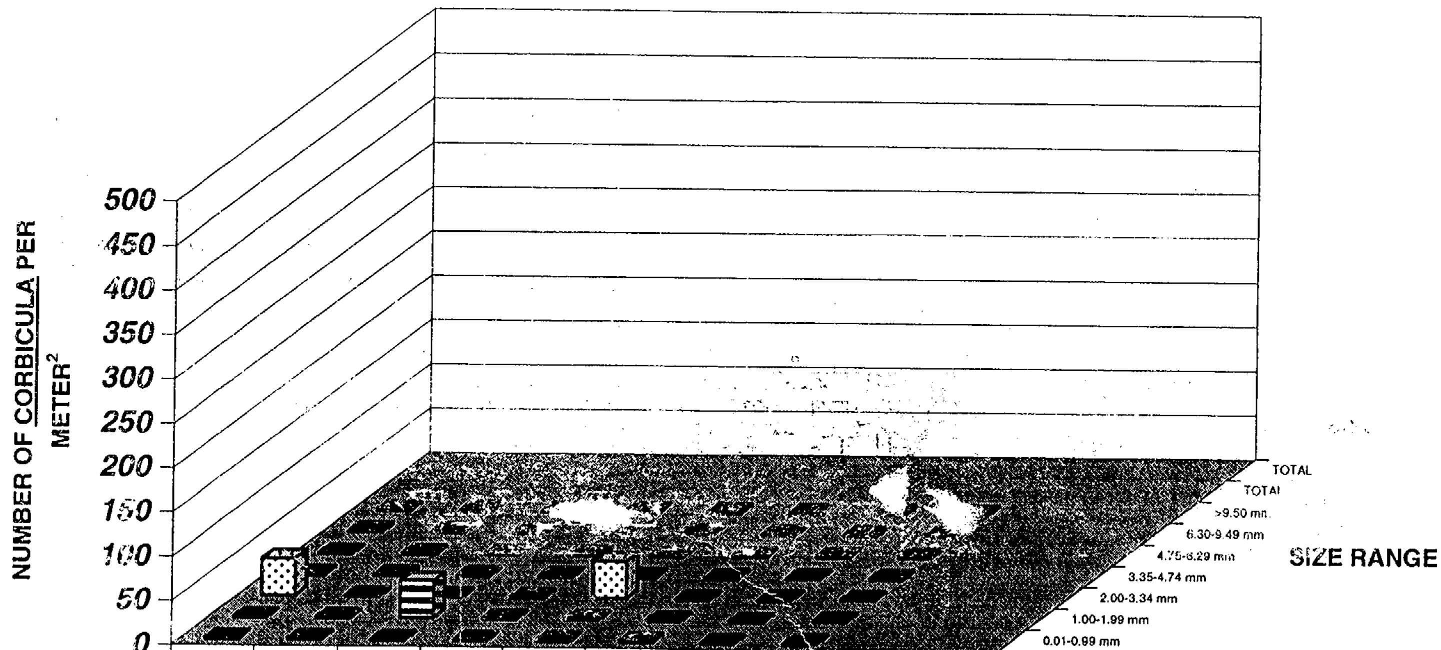
FIGURE 1.4
LOCATION OF STUDY AREA, BEAVER VALLEY POWER STATION
SHIPPINGPORT, PENNSYLVANIA
BVPS



	2/20	3/22	4/12	5/7	6/21	7/18	8/8	9/4*	----	----
0.01-0.99 mm	0	0	172	0	1849	0	0			
1.00-1.99 mm	215	43	0	0	1204	86	215			
2.00-3.34 mm	989	86	0	43	301	0	43			
3.35-4.74 mm	344	43	0	43	0	0	0			
4.75-6.29 mm	0	0	0	0	43	0	43			
6.30-9.49 mm	0	0	0	0	0	0	0			
>9.50 mm	0	0	0	0	0	0	0			
TOTAL #/m2	1548	172	172	86	3397	86	301			
TOTAL	22601	2511	2511	1256	49596	1256	4396			

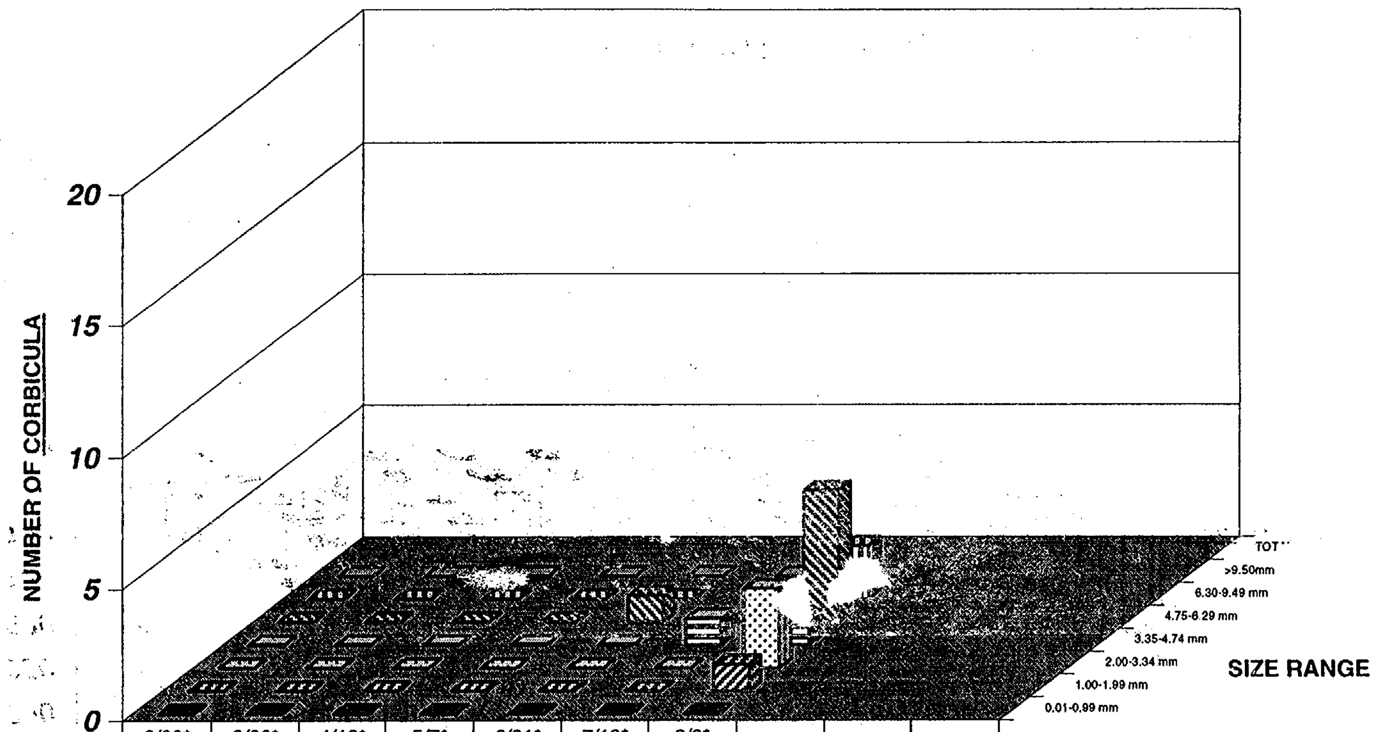
* No sample was taken due to Unit 1 outage

Figure 2.1 Comparison of Live Corbicula Clam Density Estimates among BVPS Unit 1 Cooling Tower Reservoir Sample Events, for Various Clam Shell Groups, 2001.



	2/20	3/22	4/12	5/7	6/21	7/18	8/8	9/4	----	----
0.01-0.99 mm	0	0	0	0	0	0	0	0		
1.00-1.99 mm	0	0	43	0	0	0	0	0		
2.00-3.34 mm	43	0	0	0	43	0	0	0		
3.35-4.74 mm	0	0	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	43	0	43	0	43	0	0	0		
TOTAL	550	0	550	0	550	0	0	0		

Figure 2.2 Comparison of Live Corbicula Clam Density Estimates among BVPS Unit 2 Cooling Tower Reservoir Sample Events, for Various Clam Shell Groups, 2001.



	2/20*	3/22*	4/12*	5/7*	6/21*	7/18*	8/8*	----	----	----
0.01-0.99 mm	0	0	0	0	0	0	0			
1.00-1.99 mm	0	0	0	0	0	0	1			
2.00-3.34 mm	0	0	0	0	0	0	3			
3.35-4.74 mm	0	0	0	0	0	1	1			
4.75-6.29 mm	0	0	0	0	1	0	5			
6.30-9.49 mm	0	0	0	0	0	0	2			
>9.50mm	0	0	0	0	0	0	0			
TOTAL	0	0	0	0	1	1	12			

*Sample was collected from C intake rather than D intake due to lack of access.

Figure 2.3 Comparison of Live Corbicula Clam Density Estimates among Intake Structure Sample Events, for Various Clam Shell Size Groups, 2001.

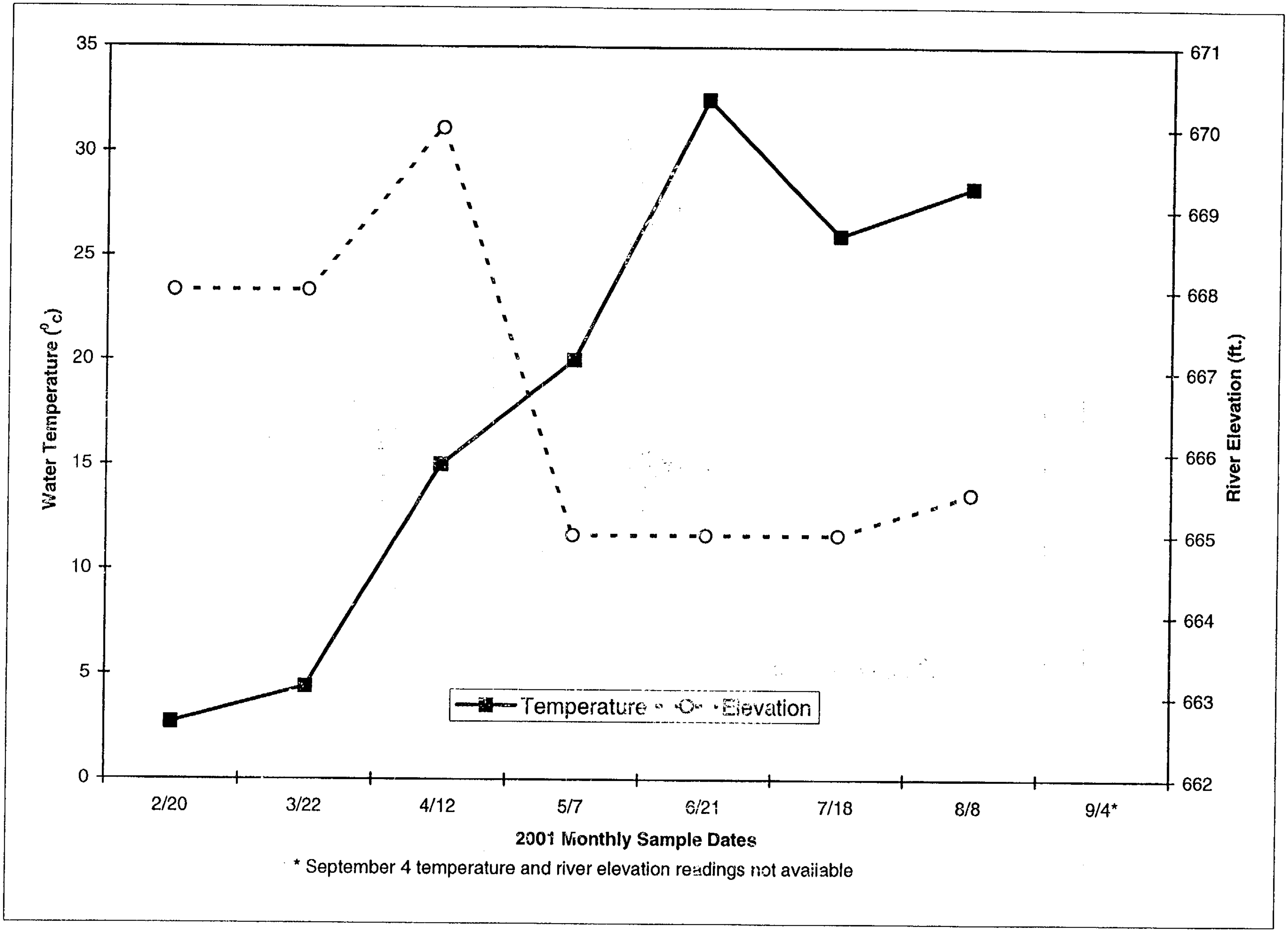
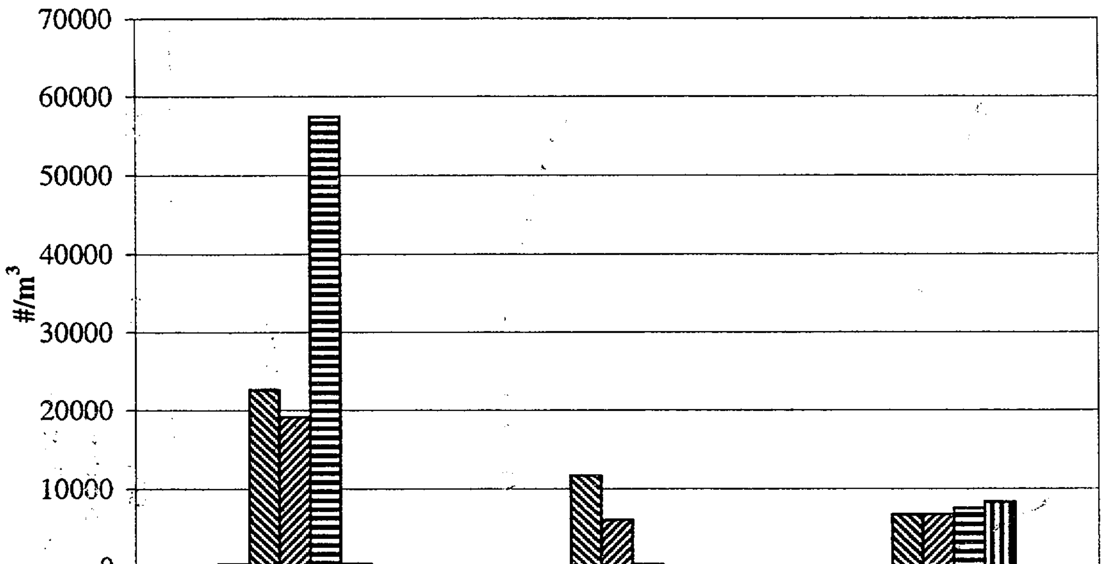


Figure 2.4. Water Temperature and River Elevation Recorded at the Ohio River at BVPS Intake Structure During the 2000 Monthly Sampling.

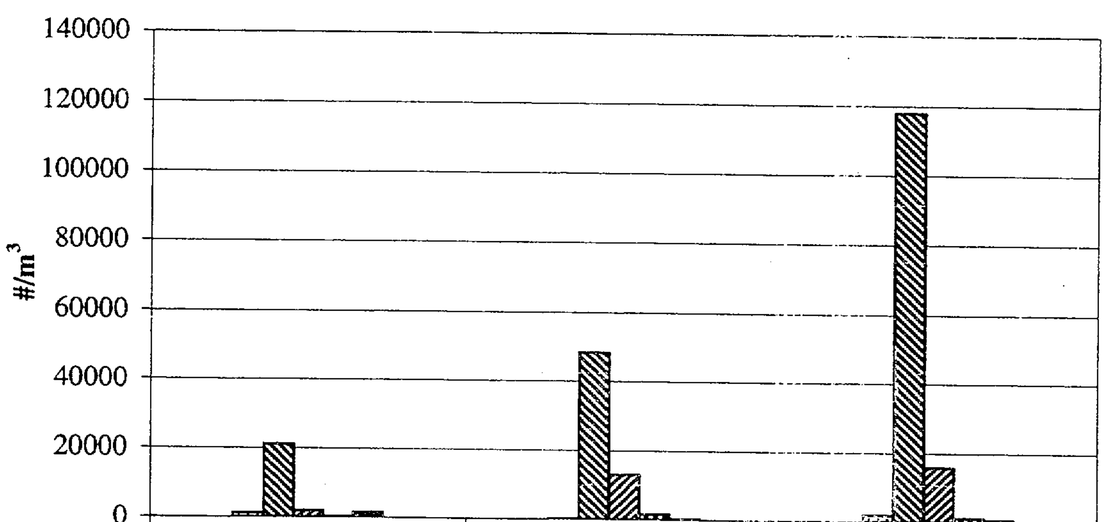


	Intake Structure/Open Water	Unit 1 Cooling Tower Reservoir	Unit 2 Cooling Tower Reservoir
3/22	0	0	0
4/12	0	0	0
5/7	360	90	60
6/21	22575	11605	6660
7/18	19110	5984	6693
8/8	57,460	310	7488
9/4	438	*	8313

Sample location

* Unit 1 cooling tower dewatered during outage, no sample

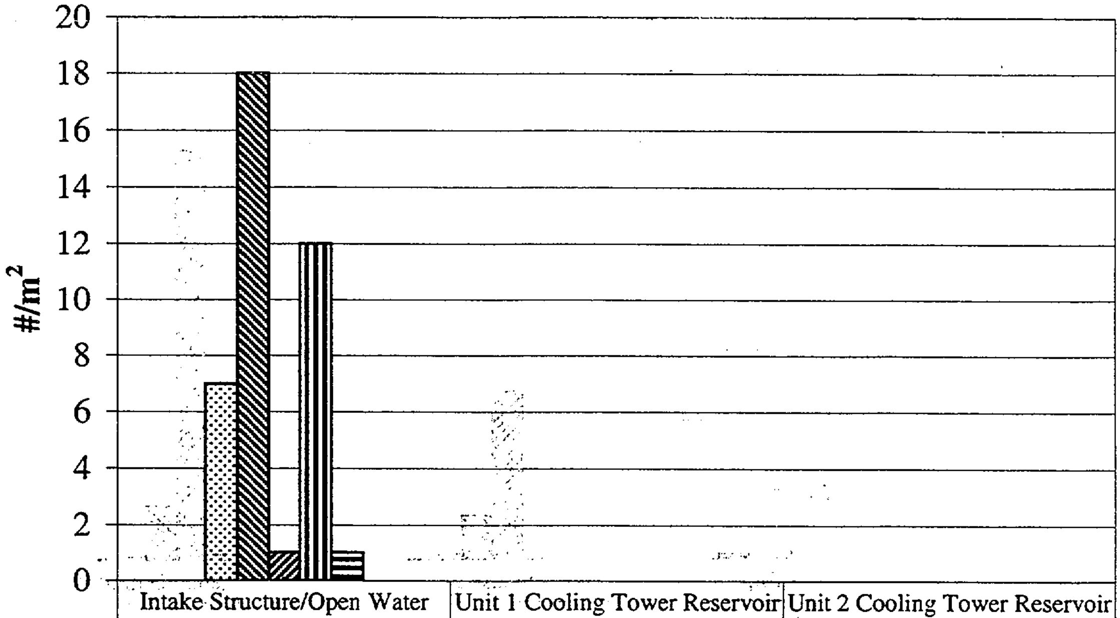
Figure 2.5 Density of Zebra Mussel Veligers (#/m^3) Collected at Beaver Valley Power Station, Intake Structure, Unit 1 Cooling Tower Reservoir, and Unit 2 Cooling Tower Reservoir, 2001.



	Barge Slip	Splash Pool	Emergency Outfall Basin
3/22	0	0	0
4/12	0	0	0
5/7	1200	200	1980
6/21	21060	48440	117900
7/18	1940	12950	15750
8/8	270	1690	1180
9/4	1540	310	620

Sample location

Figure 2.6 Density of Zebra Mussels Veligers (#/m^3) Collected at Beaver Valley Power Station, Barge Slip, Splash Pool and Emergency Outfall Basin, 2001.

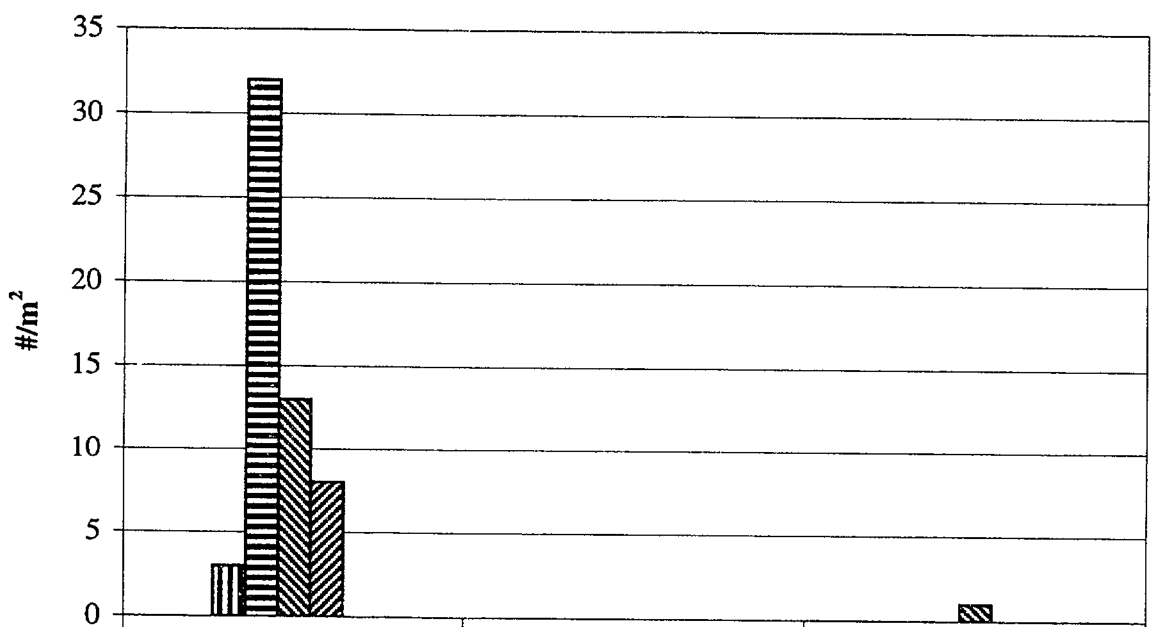


	Intake Structure/Open Water	Unit 1 Cooling Tower Reservoir	Unit 2 Cooling Tower Reservoir
3/22	0	0	0
4/12	*	0	0
5/7	7	0	0
6/21	18	0	0
7/18	1	0	0
8/8	12	0	0
9/4	1	0	0

----			

*No sample taken 4/12 because of high water

Figure 2.7 **Density (#/m^2) of Settled Zebra Mussels at Beaver Valley Power Station Intake Structure, Unit 1 Cooling Tower Reservoir, and Unit 2 Cooling Tower Reservoir, 2001.**



	Barge Slip	Splash Pool	Emergency Outfall Basin
3/22	*	0	0
4/12	*	0	0
5/7	3	0	0
6/21	32	0	0
7/18	13	0	1
8/8	8	0	0
9/4	0	0	0

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* No sample 3/22 or 4/12 due to high water

Figure 2.8. Density (#/m^2) of Settled Zebra Mussels at Beaver Valley Power Station, Barge Slip, Splash Pool, and Emergency Outfall Basin, 2001.