PrairieIslandNPEm Resource

From: Nathan Goodman
Sent: Wednesday, December 03, 2008 12:36 PM
To: PrairieIslandNPEm Resource
Subject: FW: Prairie Island 316b Proposal for Information Collection
Attachments: 120308_PINGP_PIC_NPDES.pdf

From: Asah, Raelynn S. [mailto:Raelynn.Asah@xenuclear.com]
Sent: Wednesday, December 03, 2008 12:07 PM
To: Nathan Goodman
Cc: Kuhl, Brent A; Holthaus, James J.; Eckholt, Gene F.
Subject: Prairie Island 316b Proposal for Information Collection

Good Afternoon Nate,

In response to inquiries from our conference call this morning I have attached the Proposal for Information Collection that was submitted to the Minnesota Pollution Control Agency as part of our 316b Phase II studies. This is a public document.

Please feel free to contact me or James Holthaus, Environmental Project Manager (james.holthaus@xenuclear.com 651-388-1121 ext 7268) with any questions or concerns.

Thank you,

RaeLynn S. Asah
Environmental Consultant
Major Projects-Nuclear
Prairie Island Nuclear Generating Plant
1717 Wakonade Drive East
13 – Plex (License Renewal)
Welch, MN 55089

651-388-1121 ext 7269
Fax: 612-330-5801

As of July 1, 2008, my new email address is: raelynn.asah@xenuclear.com

Hearing Identifier: Prairie_Island_NonPublic
Email Number: 148

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Xcel Energy Prairie Island Nuclear Generating Plant

Proposal for Information Collection

Submitted in Accordance with the NPDES Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities

NPDES Permit MN0004006

July 2006

Prepared by:

Xcel Energy
Environmental Services

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1) INTRODUCTION

EPA signed into regulation new requirements for existing electric power generating facilities for compliance with Section 316(b) of the Clean Water Act on July 9, 2004 (the Rule). These regulations became effective on September 7, 2004 and are based on numeric performance standards. The Rule at 125.94(a) (1-5) provides facilities with five compliance alternatives as follows:

1. A facility can demonstrate it has or will reduce cooling water flow commensurate with wet closed-cycle cooling and be determined to be in compliance with all applicable performance standards. A facility can also demonstrate it has or will reduce the maximum design through-screen velocity to less than 0.5 ft/s in which case it is deemed in compliance with the impingement mortality (IM) performance standard (the entrainment standard still applies).
2. A facility can demonstrate that it has in place technologies and/or operational measures and/or restoration measures that will meet the applicable performance standards.
3. A facility can propose to install new technologies and/or operational measures and/or restoration measures to meet applicable performance standards.
4. A facility can propose to install, operate and maintain an approved design and construction technology.
5. A facility can request a site-specific determination of Best Technology Available (BTA) by demonstrating that either the cost of installing technologies and/or operational measures and/or restoration measures are significantly greater than the cost for the facility listed in Appendix A of the rule or that the cost is significantly greater than the benefits of complying with the applicable performance standards.

All facilities that use compliance alternatives 2, 3 and 4 are required to demonstrate a minimum reduction in impingement mortality (IM) of 80% (125.94(b) (1)). Facilities with a capacity factor that is greater than 15% that are located on oceans, estuaries or the Great Lakes or on rivers and have a design intake flow that exceeds 5% of the mean annual flow must also reduce entrainment by a minimum of 60% (125.94(b)(2)).

The Rule further requires that facilities using compliance alternatives 2, 3, and 5 prepare a Comprehensive Demonstration Study (CDS) as described at 125.95(b) of the Rule. There are seven components of the CDS and all facilities are required to submit components 1 (PIC), 2 (Source Waterbody Information if facility is on a river or reservoir), 3 (IM&E Characterization Study) and 7 (Verification Monitoring Plan). Facilities using compliance alternative 1 are not required to submit a CDS and those using compliance alternative 4 are only required to submit the Technology Installation and Operation Plan (TIOP) and Verification Monitoring Plan. All facilities that use compliance alternatives 2, 3 and 5 are required to prepare and submit components 1, 2, 3 and 7 but depending on the compliance alternative(s) selected will submit either component 4 (Design and Construction Technology Plan and Technology Installation and Operation Plan), 5 (Restoration Plan) or 6 (information to support site-specific BTA determination). The first component required for submittal is the "Proposal for

Information Collection" (PIC), the first component of the CDS. The Rule at 125.95(b) (1) requires that the PIC include:

1. A description of the proposed and/or implemented technologies, operational measures, and/or restoration measures to be evaluated in the Study.
2. A list and description of any historical studies characterizing impingement mortality and entrainment (IM&E) and/or the physical and biological conditions in the vicinity of the cooling water intake structures (CWIS) and their relevance to this proposed Study. If you propose to use existing data, you must demonstrate the extent to which the data are representative of current conditions and that the data were collected using appropriate quality assurance/quality control procedures.
3. A summary of any past or ongoing consultations with appropriate Federal, State, and Tribal fish and wildlife agencies that are relevant to this Study and a copy of written comments received as a result of each consultation.
4. *A sampling plan for any new studies you plan to conduct in order to ensure that you have sufficient data to develop a scientifically valid estimate of IM&E at your site. The sampling plan must document all methods and quality assurance/quality control procedures for sampling and data analysis. The sampling and data analysis methods you propose must be appropriate for a quantitative survey and include consideration of the methods used in other studies performed in the source waterbody. The sampling plan must include a description of the study area (including the area of influence of the CWIS(s)), and provide a taxonomic identification of the sampled or evaluated biological assemblages (including all life stages of fish and shellfish).*

This PIC has been developed to be responsive the regulatory requirements stated above.

2) DESCRIPTION OF THE FACILITY

Facility Description

The Prairie Island Nuclear Generating Plant (PINGP), Units 1 and 2, each employ a 2-loop pressurized water reactor. Full commercial operation began on December 16, 1973 for Unit 1 and on December 21, 1974 for Unit 2. Both units are licensed with the Nuclear Regulatory Commission (NRC) for operation at 1650 MWt per reactor, which is equivalent to a gross electrical output of 575 Mwe for each unit. Northern States Power Company d/b/a Xcel Energy (Xcel Energy) owns the facility, while Nuclear Management Company (NMC) operates the facility.

PINGP is located on the Mississippi River in Goodhue County near Red Wing, Minnesota (Figure 1). The site (approximately 578 acres) is located within the city limits of Red Wing, Minnesota on the West bank of the Mississippi River. The plant site is located about 26 miles SE of the Twin Cities Metropolitan Area.

The principal surface waters in the vicinity of the site are the Mississippi River, Sturgeon Lake, the Vermillion River and the Cannon River (Figure 2). The levels of the Mississippi River and Sturgeon Lake are controlled by Lock and Dam Number 3 which is located approximately one and one-half miles downstream of the plant. Water is withdrawn from the Mississippi River for condenser/circulation water system and cooling water systems. The condenser/circulating water system provides high volume cooling water flow for the turbine-condenser steam cycle whenever a unit is operating. The cooling water system supplies other plant equipment, such as pumps, motors, and heat exchangers.

River water enters the plant through the Intake Screenhouse and the Plant Screenhouse. Circulating water discharge to the river is controlled by the sluice gates and recycle gates. When cooling towers are in operation, some of the plant waste heat is transferred to the air and the remainder is transferred to the river. During the period the towers are out of service, the waste heat is transferred to the river or recycled back to the intake canal to temper the incoming cold water.

Intake Design

Plant intake flow from the Mississippi River enters the Intake Screenhouse through eight 18.5 foot by 11.2 foot bay openings. The bottom of the inlet skimmer wall is at elevation 667.0 feet. Each bay is equipped with a raked trash rack and a traveling water screen with low-pressure fish wash sprays and high-pressure trash wash sprays. Traveling water screens are equipped with fish lift buckets to remove debris and organisms from the intake water. Each screen is 10 foot wide and extends from the operating deck (elevation 685 feet) to the floor (elevation 648.5 feet). Screen panels are replaceable. During the period of April 1 through August 31 fine mesh (0.5 mm) screens are used. The remainder of the year 3/8 inch (9.5 mm) coarse mesh screens are in service. The screens are capable of operation at several different speeds, as necessitated by trash loading.

During fine mesh screen operation, the screens continuously run at 3 fpm when screen differential is 4 inches or less. During coarse screen operation, the traveling screens, fish spray wash system and trash spray wash system do not operate when the differential level is less than 4 inches. The screens will automatically rotate with sprays operating, 1-1/3 revolutions if 8 hours pass without screen operation. For both fine and coarse screen operation, if the differential level exceeds 4 inches, screen speed increases proportionally up to a maximum of 20 fpm at 8 inches differential level.

Bypass gates are available to maintain a continuous flow in the event that flow through the screens is reduced due to high debris loading. The bypass gates are vertical lift gate type with rollers. The gates open automatically when the head differential across the traveling water screens reaches 18 inches or when the head differential across the intake screenhouse reaches 24 inches.

A deicing system is utilized to distribute warm water across the inside face of the intake structure to prevent formation of ice on the exposed surfaces. Aquatic organisms, washed off the traveling water screen, are collected in a trough which flows into the fish return line for return to the river. (Stone and Webster, 1983).

Fish protection measures designed into the vertical traveling screens includes fish collection buckets and low-pressure fish sprays. Aquatic organisms impinged on the traveling water screens are lifted in the collection buckets to the level of fish sprays and are then washed into a fish collection trough. Removal of the fish and organisms is accomplished on the upward travel side with a low pressure (10 psi) inside spray when fine mesh is used and with a low pressure (20 psi) outside spray when coarse mesh screen is used. Debris is removed by a backside interior high-pressure (50 psi for fine mesh and 100 psi for coarse mesh) spray system. The organisms and debris washed off the traveling water screens collect in a common trough and return to the river through a buried pipe approximately 2200 feet long. The pipe discharges into the Mississippi River at a point approximately 1500 feet south (downriver) of the intake screenhouse.

The Circ water flows from the intake canal into the plant screenhouse and to the suction of the Circ water pumps. Four Circ water pumps, two for each unit, supply water to the condensers to condense the turbine exhaust steam. Each pump has a capacity of 147,000 gpm at 45 ft total head. The condenser inner and outer pass discharge flows from each unit combine into a common header and are directed to the Discharge Basin (Figure 3). The discharge basin serves as a stilling surge basin for the condenser discharge and provides the suction head for the cooling tower pumps. Four cooling tower pumps take water from the discharge basin and discharge into individual cooling tower distribution pipes. Four crossflow cooling towers remove some of the heat from the Circ water.

The distribution basin receives Circ water flow from the cooling tower return canal during closed cycle operation and from the discharge basin during open cycle operation (Figure 3). During the transition from closed cycle to open cycle, the distribution basin receives flow from both sources. The Circ water in the distribution basin normally flows either to the recycle canal for return to the plant via the intake canal or to the discharge canal for return to the river. The recycle canal directs the Circ water flow from the distribution basin to the intake canal for return to the plant.

The discharge canal directs the Circ water flow from the distribution basin to the discharge structure for return to the river via the sluice gates. The canal is designed for flow between 150 cfs to 1390 cfs. Discharge flow rates are limited during specified periods of the year as follows:

April 15-30	150-300 cfs
May 1-31	300 cfs
June 1-15	400 cfs
June 16-30	800 cfs

The remaining periods of the year flow is limited to the design flow of 1410 cfs.

Operation of the Circ water system complies with Minnesota Pollution Control Agency (MPCA) regulations NPDES permit No. MN0004006.

Intake Velocities

The design of the intake screenhouse structure minimizes the impact of the PINGP on aquatic organisms in the Mississippi River. The approach canal to the intake screenhouse is 575 feet wide and extends from the main flow of the river (see Figure 3). The canal is designed for a maximum flow of 3360 cfs. Actual flow is limited to a maximum of 1410 cfs resulting in a flowrate of less than 1 fps. The system design requirements change based on various times of the year and screen mesh size.

During 1983 and 1984 velocity profiles were obtained at flow rates specified in the NPDES permit. All flow measurements were less than or equal to 0.2 meters per second (0.6 fps). Most data points recorded were less than or equal to 0.1 meters per second. Design criteria for the fine mesh screen states the average face velocity through the gross area of the screen material should not exceed 0.5 fps based on low water level and a discharge rate of 800 cfs. The average velocity of the water approaching the fine mesh screen was determined to be within the design criteria for all blowdown flows measured (150 cfs to 1145 cfs). (NSP, 1984).

Intake velocities were also measured in 2003 (Staley, 2004). One set of measurements was taken at 1006 cfs blowdown and the other at 815 cfs. Both sets were taken while the traveling screens were in the coarse-mesh mode of operations. Intake velocities measured during 1006 cfs blowdown averaged 0.388 fps to 0.599 fps across all eight bays. Intake velocities averaged 0.337 fps to 0.427 fps across all eight bays measured during 815 cfs blowdown. The study concluded that intake flows are not outside design requirements and average flows do not differ substantially between intake screen bays.

Intake Volumes

Prairie Island is regulated by the amount of river water that may be used for condenser and equipment cooling. The design of the various plant cooling systems does not allow for direct measurement or river intake flow but does allow for calculation of discharge flow based on discharge sluice gate positions and canal water elevation. River water withdrawal rates are controlled indirectly by imposing limitations on discharge flow, which approximate intake flow. The discharge flows are limited from April 15 through June 30 in order to minimize the impingement of fish and fish larvae.

The plant cooling water discharge flows are limited as follows during specified periods.

April 15 to 30:	300 cfs (194 mgd) if the flow in the river is at or above 15,000 cfs
	150 cfs (97 mgd) if the flow in the river is below 15,000 cfs
May 1 to 31:	300 cfs (194 mgd)
June 1 to 15:	400 cfs (259 mgd)
June 16 to 30:	800 cfs (517.5 mgd)

The remaining periods of the year flow is limited to the design flow of 1410 cfs. However, the plant is also limited in the amount of heat it may discharge to the river. Therefore, thermal limitations as stated in the NPDES permit regulate the plant cooling water discharge (thus intake flows) during the remaining time periods.

Hydrology

Xcel Energy provides Mississippi River flow data in its annual Prairie Island Environmental Monitoring Report. Average Mississippi River flows (as measured by U.S. Army Corps of Engineers at Lock and Dam 3) from 1983 through 2005 are presented in Table 1. Annual average river flow ranges from a low of 8,709 cfs in 1988 to a high of 37,772 cfs in 1986. The maximum monthly average flow of 112,703 cfs occurred in April of 2001 and the minimum monthly average flow of 2,903 cfs occurred in July 1988. The annual mean flow for the site was 22,565 cfs for the period presented in Table 1. The amount of water appropriated by PINGP varies based on the NPDES permit and the time of year (Table 2). Mean percentage of river flow entering the plant intake ranges from 0.9 percent in April to 9.0 percent in August (Table 3). From 1983 to 2005 appropriation has ranged from a low of 0.3 percent during the months of April and May to a high of 38.5 percent in July. Since PINGP design intake flow is greater than five percent of the mean annual river flow, both the IM&E reduction standards will be applicable.

3) COMPLIANCE ALTERNATIVES TO BE EVALUATED

Xcel has selected Compliance Alternative (2) of 40CFR 125.94 (a) to meet the impingement and entrainment reduction requirements for PINGP. Alternative (2) requires that Xcel Energy demonstrate that existing design and construction technologies, operational measures, and/or restoration measures at Prairie Island meet the impingement and entrainment performance standards.

Xcel Energy will submit a comprehensive demonstration study (CDS) in accordance with 316 (b) of the Clean Water Act. The CDS will demonstrate that the location, design, construction, and capacity of the cooling water intake structure at Prairie Island reflects the best technology available for minimizing adverse environmental impact.

If analysis of data concludes that existing design and construction technologies, operational measures, and/or restoration measures at PINGP do not meet the impingement and entrainment performance standards, Xcel Energy may request evaluation of a second option. This option would be to demonstrate compliance under Alternative (5) of the rule, in which the Director determines that the design, operational and restoration measures in place represent BTA for the site.

Components of Comprehensive Demonstration Study

Xcel Energy will submit results of Impingement Mortality and Entrainment (IM&E) Characterization Studies conducted before and after construction of the intake screenhouse. The IM&E study will include taxonomic identifications and characterizations of all life stages of fish, shellfish, and any species protected under Federal, State, or Tribal Law that are in the vicinity of the cooling water intake structure and susceptible of impingement and entrainment.

Xcel Energy will submit a Design and Construction Technology Plan (DCT). The DCT plan will describe the technologies and/or operational measures in place to meet the impingement and entrainment performance requirements. The DCT plan will include:

a. A narrative description of the design and operation of existing design and construction technologies and operational measures. This will include fish handling and return systems that are in place.
b. Calculations of the reduction in impingement mortality and entrainment of all life stages of fish and shellfish achieved by the technologies and operational measures in place.
c. Design and engineering drawings of structures in place.

Xcel Energy will submit a Technology Installation and Operation (TIO) plan which will include:

a. A schedule for the maintenance of the current intake screenhouse.
b. List of operational parameters that are monitored and the frequency for monitoring.

c. List of activities undertaken to ensure the efficacy of the intake screenhouse is maintained.

Overview of Current Technologies and Operational Measures

During the period of April 1 through August 31, 0.5 mm fine mesh screens are used. The remainder of the year 3/8 inch (9.5 mm) coarse mesh screens are in service. During fine mesh screen operation, the screens run continuously. During coarse screen operation, the traveling screens, fish spray wash system, and trash spray wash system do not operate when the differential level is less than 4 inches. The screens will automatically rotate with sprays operating, 1-1/3 revolutions if 8 hours pass without screen operation.

Aquatic organisms impinged on the traveling water screens and in the attached buckets are lifted to the level of fish sprays and washed into a fish collection trough. Removal of the fish and organisms is accomplished on the upward travel side with a low pressure (10 psi) inside spray when fine mesh is used and with a low pressure (20 psi) outside spray when coarse mesh screen is used. The organisms and debris washed off the traveling water screens collect in a common trough and return to the river through a buried pipe approximately 2200 feet long. The pipe discharges into the Mississippi River at a point approximately 1500 feet south (downriver) of the intake screenhouse.

River water withdrawal rates are controlled indirectly by imposing limitations on discharge flow, which approximate intake flow. The discharge flows are limited from April 15 through June 30 in order to minimize the impingement of fish and fish larvae.

The plant cooling water discharge flows are limited as follows during specified periods.

April 15 to 30:	300 cfs (194 mgd) if the flow in the river is at or above 15,000 cfs
	150 cfs (97 mgd) if the flow in the river is below 15,000 cfs
May 1 to 31:	300 cfs (194 mgd)
June 1 to 15:	400 cfs (259 mgd)
June 16 to 30:	800 cfs (517.5 mgd)

The remaining periods of the year flow is limited to the design flow of 1410 cfs. However, the plant is also limited in the amount of heat it may discharge to the river. Therefore, thermal limitations as stated in the NPDES permit regulate the plant cooling water discharge (thus intake flows) during the remaining time periods.

Utilizing existing data, Xcel Energy will demonstrate that the current Prairie Island intake design meets the national performance standards as defined in the Rule. Impingement performance standards are defined as a reduction in impingement mortality for all life stages of fish and shellfish by 80 to 95 percent from the calculation baseline. Entrainment performance standards are defined as the reduction of entrainment of all life stages of fish and shellfish by 60 to 90 percent from the calculation baseline.

Calculation baseline means an estimate of impingement mortality and entrainment that would occur at the site assuming that:

a. The cooling water system has been designed as a once-through system;
b. The opening of the cooling water intake structure is located at, and the face of the standard 3/8-inch mesh traveling screen is oriented parallel to, the shoreline near the surface of the source waterbody;
c. The baseline practices, procedures, and structural configuration are those that your facility would maintain in the absence of any structural or operational controls including flow or velocity reductions, implemented in whole or in part for the purposes of reducing impingement mortality and entrainment.

During the period April 1 through August 31, Prairie Island is required to operate the intake vertical traveling screens in continuous mode and using fine-mesh (0.5 mm) screen material in order to minimize entrainment of larval fish, fish eggs, and other aquatic organisms. In addition, intake flows are limited from April 15 through June 30 in order to minimize the impingement of fish and fish larvae. During the remaining months (September through March) when entrainment of larval fish and eggs is not expected standard 3/8-inch mesh screens are installed. The fish handling and return system is in service during both time periods.

Based on the calculation baseline definition, only juvenile fish (or fish large enough to be impinged on 3/8-inch mesh) will be included for impingement mortality estimates. The size range for juvenile fish impinged on fine mesh screens from 1984 to 1989 is presented on Table 4. Representative size ranges of fish impinged from Prairie Island (1973 to 1984), Black Dog (2005 to 2006) and Allen S. King (2004 to 2005) impingement samples are presented on Table 5. Minimum size of fish collected from fine mesh screens identified as juveniles was typically less than 20 mm, whereas minimum size of fish impinged on 3/8-inch mesh screens was 20 mm or greater. In comparison, impingement mortality estimates calculated from fine mesh screens would be more conservative since minimum length of juvenile fish impinged on fine mesh screens during 1984 to 1988 were less than lengths for taxa collected from 3/8 inch mesh screens.

Prairie Island data collected from fine mesh screens during 1984 through 1990 will be examined to determine impingement survival of juvenile and larger fish. During study years 1989 and 1990, test fish were introduced into samples to assess sampling induced mortality. Data from these studies will also be incorporated into calculations to determine impingement mortality in reference to performance standards.

4) BIOLOGICAL STUDIES

The Rule requires that a summary of historical IM&E studies and/or physical and biological studies conducted in the vicinity of the cooling water intake structure at PINGP be provided.

The following provides a listing of previous physical and biological studies related to the operation of PINGP conducted from 1970 through 2005.

Physical

1970 –1986	Water chemistry and physical parameters
1973 – 2005	Water temperature and flow
1973	Preliminary evaluation of flow through Sturgeon Lake
1974 – 1975	Thermal plume
1977	Analysis of flow through Sturgeon Lake
1981 – 1986	Lake Pepin ice and water temperature
1983 – 1984	Intake screenhouse velocity profiles
2004	Approach canal dredging project

Biological

1970 – 1976	Phytoplankton
1970 – 1976	Zooplankton and aquatic macrophytes
1970 – 1979	Benthic macroinvertebrates
1970 – 2005	Fish population study
1972 – 1981	Periphyton
1973 – 1984	Fish impingement (and other organisms) "old" traveling screens
1973 – 1984	Summer creel census
1975	Fish deterrent/exclusion device (air curtain)
1975	316(b) Demonstration entrainment and impingement studies including: • fish (adult, juvenile, larvae, eggs) • zooplankton • phytoplankton • macroinvertebrates
1979	Laboratory evaluation of larval fish impingement and diversion systems
1981 – 1985	Walleye/Sauger reproduction (gonads)
1981 – 1987	Winter creel census
1984 – 1989	Fine mesh vertical traveling screens impingement and survival
1989 – 1990	Fine mesh vertical traveling screens sampling mortality assessment
1992 – 2005	Fine mesh vertical traveling screens impingement study to evaluate effects of increased water appropriation during April

IM&E studies at Prairie Island were conducted before and after the construction of the intake screenhouse in 1983. From 1973 to 1984 impingement sampling was conducted from 3/8 inch coarse mesh screens at the old plant screenhouse. Impingement sampling was conducted from fine mesh screens during the critical time period of April through August during 1984 to 1989.

Xcel plans to utilize past impingement/entrainment and engineering studies conducted at PINGP to demonstrate that performance standards are already met with the system and operational measures in place.

A detailed summary of existing biological information is provided in Attachment A.

5) SUMMARY OF CONSULTATIONS WITH FISH AND WILDLIFE AGENCIES RELEVANT TO THE STUDY

The Rule requires that "a summary of any past or ongoing consultations with appropriate Federal, State, and Tribal fish and wildlife agencies that are relevant to the CDS and a copy of written comments received as a result of such consultations be provided".

Xcel initiated discussions during the preparation of the Prairie Island NPDES permit renewal application with the MPCA regarding which compliance alternative of Part 125.94 of the Rule relates best with the intake technology and operational measures currently in place at Prairie Island (See Attachment B). Two options were presented:

- One option would be to demonstrate under Alternative (2) of the rule that the existing design and operational measures meet the impingement and entrainment performance standards of the rule.
- The second option would be to demonstrate compliance under Alternative (5) of the rule, in which the Director determines that the design, operational and restoration measures in place represent BTA for the site.

As stated in the Prairie Island NPDES final permit issued by MPCA September 23, 2005, Xcel has tentatively selected Alternative (2) to meet the impingement and entrainment reduction requirements.

6) SCHEDULE FOR INFORMATION COLLECTION

Xcel selected Compliance Alternative (2) of 40CFR 125.94 (a) to meet the impingement and entrainment reduction requirements at PINGP. Alternative (2) requires that Xcel demonstrate that existing design and construction technologies, operational measures, and/or restoration measures meet the impingement mortality and entrainment performance standards. Xcel Energy is scheduled (per NPDES permit) to provide submittals associated with the Phase II 316(b) by October 28, 2006. Submittals include the following:

- Source water physical data, cooling water intake structure data, and cooling water system data in accordance with the NPDES Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities.
- Comprehensive Demonstration Study (CDS). The CDS will demonstrate that the implementation and/or operation of technology and operational measures will reduce cooling water intake impingement mortality of all life stages of fish and shellfish by 80 to 95 percent and will reduce entrainment by 60 to 90 percent from the baseline calculation.
- Impingement Mortality and Entrainment Characterization Study (IM&E). The IM&E will describe the calculated baseline for impingement mortality and entrainment and verify the calculated baseline based on the total acquired impingement and entrainment data.
- Design and Construction Technology Plan (DCT). The DCT will describe the technologies and/or operational measures in place to meet the impingement and entrainment performance requirements.
- Technology Installation and Operation Plan (TIO). The TIO will include a list of operational and other parameters that are monitored and a list of activities undertaken to ensure to the degree practicable the efficacy of design and construction technologies and operational measures.
- Verification Monitoring Plan (VM). The VM will describe monitoring, if necessary, to be conducted over a period of 2 years to verify that design and operational measures are successful in meeting the performance standards.

ATTACHMENT A—Summary of Existing Biological Information

1) IMPINGEMENT

Impingement of Fishes and Other Organisms on the PINGP Plant Traveling Screens 1973 to 1980

Fish and other organisms impinged on the traveling screens of the PINGP cooling water intake have been monitored and reported annually since 1974. In addition, impingement sampling was conducted in 1973 during preoperational testing and after commercial production began. Impingement data included taxonomic composition, weekly impingement rates, seasonal impingement rates, and length frequencies of fish measured. Non-fish organisms impinged (e.g. crayfish, turtles, clams, and small mammals) were also reported.

Procedures for collection, identification, and enumeration of impinged organisms from 1973 to 1980 were similar. Trash baskets were emptied on Monday, Wednesday, and Friday each week. Debris and organisms were separated, fishes were taxonomically enumerated, and non-fish organisms were recorded. Fishes removed from the bar racks were also included in impingement data.

A summary of total number and percent composition of predominant fish taxa impinged at the PINGP from 1973 to 1980 is presented in Table A-1. Since the plant became operational in 1973, 93.9 to 99.8 percent of fishes impinged annually were from seven taxa. Gizzard shad was the most frequently impinged taxon from 1973 to 1980, followed by freshwater drum (1973, 1974, 1977, 1978, 1979, and 1980), white bass (1976), or channel catfish (1975).

Impingement of Fishes and Other Organisms on the PINGP Plant Traveling Screens 1981 to 1984

Impingement samples were collected every other week during 1981 through 1984. Trash baskets were emptied Monday, Wednesday, and Friday each sampling week. Annual impingement loss was estimated by multiplying actual numbers of fish collected by two. Observations were made during weeks not sampled to assure no catastrophic losses occurred. Debris and organisms were separated, fish were taxonomically enumerated, and non-fish organisms were recorded.

A summary of estimated total number and percent composition of predominant fish taxa impinged at PINGP from 1981 to 1984 is presented in Table A-2. During 1981 to 1984, 98.6 to 99.6 percent of fishes impinged annually were from seven taxa. Similar to previous sample years, gizzard shad represented the highest estimated total number impinged from 1981 to 1984, with freshwater drum and channel catfish also represented by moderate numbers.

Summary of Representative Fish Taxa and Length Frequencies of Fish Impinged at PINGP from 1973 to 1984

A total of 65 species representing 19 different families were impinged during 1973 to 1984 (Table A-3). A summary of total length ranges and representative number of fish is presented in Table A-4. Minimum length of fish impinged was 20 mm, represented by taxa most frequently encountered in impingement samples (gizzard shad, channel catfish, white bass, crappie, and freshwater drum).

Summary of Non-fish Species Impinged at PINGP from 1973 to 1984

A summary of non-fish species (excluding mammals, insects, and birds) is presented in Table A-5. Shellfish included nine identified species of clams. Other species impinged included various species of turtles, crayfish, mudpuppies, and frogs.

Impingement of Fishes and Other Organisms on the PINGP Intake Traveling Screens 1984 to 1989

In 1983, a new screenhouse was constructed at the PINGP. There are presently two complete screening facilities operating at PINGP. The old, or original, traveling screens and screenhouse (plant screenhouse) were designed to prevent debris, fish, and other organisms from entering the plant via the cooling water intake. The new screenhouse and screens (intake screenhouse), completed in 1983, were designed and located to exclude fish from the warm circulating water system. Location of both systems are shown in Figure A-1. Monitoring of fish and other organisms impinged on the old traveling screens was conducted annually since the plant became operational in 1973 and continued through 1984. Impingement and survival of fish at the new intake screenhouse was also studied beginning in 1984.

The intake screenhouse vertical traveling screens employ fine mesh (0.5 mm) panels with continuous screen operation during the larval season (mid-April through August) and course mesh (9.5 mm) panels for the remainder of the year. During the larval season, fish impinged on the fine mesh screens are washed off the front side of the screen into a trough on the screenhouse operating deck. Flow in the front trough, which contains the impinged fish is returned to the Mississippi River downstream of the plant intake or can be diverted into fish collection tanks in the environmental laboratory.

During November 1983 through March 1984 impingement samples were collected from coarse mesh screens at the intake screenhouse. Total number of fish impinged was estimated by expanding the numbers collected during weekly samples over an entire month. In addition, fish collected were recorded as live or dead, live fish were held in aquaria for up to 96 hours. To determine the efficiency of the screen wash in removing fish on the front side of the coarse mesh screens, a dip net was used to collect material washed off the backside of screens. The results of the samples indicate the front spray wash system was nearly 80 percent effective in removing fish.

An estimated 12,641 fish from 17 taxa were collected on the intake coarse mesh screens (Table A-6). Gizzard shad comprised more than 75 percent of the total. Other major taxa collected were channel catfish, freshwater drum, shiners, and crappies. Survival studies conducted on fish collected from the screens indicated low survival of gizzard shad (1.1 percent) and high survival of channel catfish (83.5 percent). Excluding gizzard shad, survival rates averaged 46.0 percent. The majority of fish collected were juveniles less than 200 mm total length (Table A-7).

During sample years 1984 to 1989, sample collection of fish impinged on the fine mesh screens started in April and continued through August. Samples were collected 2 to 3 days a week by diverting 25 percent of the screen wash water into collection tanks in the basement of the environmental lab. Screen wash water flows by gravity from the screen wash trough, into a drop structure, and through an 18-inch diameter pipe into the environmental lab basement. Screen wash water was channeled from the 18-inch diameter pipe through a larval collection tank. The collection tank filters screen wash water through 0.5 mm mesh nylon screen material.

Three types of samples were collected to provide various data. Sample types included abundance, initial survival, and latent survival. Following a designated sampling duration, all fish and any debris were rinsed into two collection baskets located in the collection area of the tank (Figure A-2). These baskets were then removed from the tank, the contents transferred to four-liter beakers, and transported to the fish handling and sorting area for further processing.

Initial survival samples were collected at night or early morning to determine night density of fish and eggs and initial survival of fish impinged on the fine mesh screens. Initial samples underwent a "first and second" sort. The first sort was designed to remove live and dead fish, with emphasis placed on removing all live fish in a time efficient manner. The second sort was designed to assure removal of all remaining fish and eggs. Abundance samples were collected during early to midmorning to estimate day density of fish and eggs impinged on the fine mesh screens. After the sample was collected, all fish, eggs, and debris were preserved in 10 percent buffered formalin solution containing rose bengal stain and were sorted after the stain had an opportunity to penetrate all organisms.

Latent survival samples were collected to determine the latent survival of fish impinged on the fine mesh screens. Samples were collected during early morning. After the sample was collected, aliquots were placed in Pyrex baking dishes and sorted over a light table. Only live fish were removed and placed in 250 ml wide mouth jars or six gallon aquaria containing filtered river water. Jars and aquaria were kept in acrylic plastic water baths receiving a constant supply of river water. This allowed fish to be maintained at ambient temperatures throughout the holding period. Fish collected for latent survival estimates were held for 48 or 96 hours and checked at selected time increments. Number of live and dead fish were recorded during each time interval.

During 1984, back wash samples from fine mesh screens were also collected. Back wash samples were collected while an abundance sample was collected. This sample was collected using a 0.5 mm mesh ichthyoplankton drift net placed in the high pressure trash removal return trough. Comparing data from the abundance and back wash samples was utilized to determine the efficiency of the low pressure front wash in removing fish impinged on the fine mesh screens. Twenty-four pairs of samples compared indicated that the front spray wash removal system was more than 98 percent efficient in removing fish from the front side of the fine mesh screens.

Quality assurance sample sorts were performed randomly on more than five percent of the initial and abundance samples collected in 1984. After staining, sort efficiency exceeded 98 percent for all samples.

Fish and egg densities were calculated on a day and night basis using data from abundance and initial survival samples, respectively. Estimates of the number of fish and fish eggs impinged on the fine mesh screens were calculated by averaging data from initial and abundance samples. These values were expanded to weekly and yearly impingement estimates. All fish and eggs collected were identified to the lowest practical taxon by life stage and developmental phase. Life stages included egg, larvae, juvenile, and adult.

Fine Mesh Estimated Screen Impingement 1984 to 1988

The estimated number and percent composition of all taxa/life stage combinations collected during the months of April through August (1984 to 1988) are presented in Table A-8. In 1984, more than ten million eggs and nearly 500 million fish were estimated to have been impinged on the fine mesh screens. Juvenile channel catfish, carp prolarvae, and juvenile cyprinids were the most abundant taxa/life stage combinations impinged. More than 17 million eggs and nearly 25 million fish were estimated to have been impinged during 1985. Freshwater drum prolarvae, juvenile channel catfish, and cyprinid post larvae comprised 64 percent of all fish impinged. More than six million eggs and 55 million fish were estimated impinged during 1986. Two taxa/life stage combinations, carp and freshwater drum prolarvae, accounted for over one-half of all organisms impinged. During 1987, more than 14 million eggs and 62 million fish were estimated to have been impinged. Freshwater drum prolarvae comprised 27.7 percent of the total, followed by cyprinid postlarvae with 18.6 percent. More than 12 million eggs and 54 million fish were estimated to be impinged on fine mesh screens during 1988. Freshwater drum prolarvae comprised 42.6 percent of the total, followed by freshwater drum eggs and Cyprinidae postlarvae with 14.5 percent and 11.6 percent of the total, respectively.

Survivorship 1984 to 1989

Summary of initial survival data for all taxa/life stage combinations collected from 1984 through 1989 are presented in Table A-9. It is apparent that overall, prolarvae and postlarvae exhibit lower survival while juveniles exhibit the highest survival. Catostomidae, channel catfish, and walleye exhibit relatively high survival for the life stages collected. Freshwater drum, gizzard shad, cyprinids, Lepomis, Pomoxis, and white bass exhibit relatively poor survival for prolarvae and postlarvae life stages. Survivorship of juveniles is relatively high for all taxa impinged ranging from 25 percent (gizzard shad) to 100 percent (Bullhead spp. and walleye). Juvenile survival of the six study years ranged from 66.1 to 89.7 percent with a combined survivorship of 75.1 percent (Table A-10). Survivorship of prolarvae and postlarvae for all years combined was 7.2 percent and 5.5 percent, respectively. Overall (all taxa/life stages combined) initial survival was 15.0 percent for all years combined, ranging from 4.4 percent in 1988 to 50.1 percent in 1984 (Table A-10).

Length Ranges 1984 to 1988

Total length ranges for taxa/life stage combinations established from 1984 through 1988 fine mesh impingement studies are presented in Table A-11. Minimum juvenile lengths of fish impinged on fine mesh screens measured from 12.5 mm for freshwater drum to 21.5 mm for walleye. Minimum lengths of fish classified as juveniles sampled from fine mesh screens typically measured less than 20 mm.

Sampling Mortality

Extreme low river flows and excessive debris conditions occurred during impingement sampling in 1988. It became apparent that sampling induced mortality was having a pronounced impact on initial survival estimates. Large amounts of zooplankton and phytoplankton appeared to be causing increased mortality of fish in the sampling tank and was substantially increasing sorting time (NSP, 1989). To address this concern, the larval survivorship study was adapted in 1989 and 1990 by introducing test fish into the sample collection system. To differentiate from naturally occurring larval fish in the samples, test fish were marked with a biological stain. The resultant survival of test fish was used to assess sampling induced mortality.

The effects of debris loading were studied to determine the relationship to survival of larval fish collected. Information from 1989 and 1990 documents that high debris in the collection system caused introduced test fish to suffer increased mortality and indicated survivorship of larval fish collected from the vertical traveling screens was underestimated. It was also determined that survival estimates are dependent on the hardiness of species and developmental stage of the fish (NSP, 1989).

Results of studies conducted in 1989 and 1990 indicate that sampling induced mortality caused by excessive debris in samples ranged from approximately 3 to 44 percent mortality depending upon sample period and test fish species (Figure A-3). Overall, test fish survival was 85 percent, suggesting that the sampling method may account for 15 percent mortality of all fish sampled from fine mesh screens and up to 10 percent mortality of juvenile fish (NSP, 1989).

1992 to 2005 Summary

Impingement studies from 1992 to 2005 were conducted to evaluate the effects of increased water appropriation from 150 to 300 cubic feet per second (cfs) during April on impingement of larval fish on 0.5 mm fine mesh traveling screens at PINGP. From 2002 to 2005, permit approved blowdown (discharge) reduction to 300 cfs or less was initiated on April 15th rather than on April 1st. Prior to 1992, the cooling water intake system operated with fine-mesh screens from April 16 through August 31, in accordance with plant's NPDES Permit. Since 1992, for study purposes, the plant has implemented fine-mesh screen operation on April 1 to accommodate sampling during the month of April for years 1992 through 2005. Data for this evaluation were collected by pre-dawn and daylight sampling of larval fish and fish eggs from the screenwash water.

Impingement estimates are presented for years 1992-2000 and 2002-2005 (Table A-12). No data is presented for 2001 due to river flood levels in Spring 2001 when sampling of larval fish from the fine-mesh traveling screens during April was extremely limited. Estimated impingement values during April for all years were low and represented by relatively few taxa/life stage combinations.

2) ENTRAINMENT

Larval fish were sampled in the vicinity of Prairie Island by the Minnesota Department of Natural Resources from May to September during 1974 and 1975. This data was used to estimate total numbers of young fish passing through the Sturgeon Lake outlet. Larval tows were conducted at 4 to 8 sampling locations (Figure A-4) using a conical net with one square meter frontal area with a mesh size of 787 microns or a conical net of 560 micron mesh with mouth diameter of one meter. Contents of the net were removed at the end of each run. Samples were preserved in five percent formalin solution and counted at a later date. No attempt was made to identify the larval fish.

Larval fish tows were made in an effort to determine when and where larval fish and eggs were most abundant. Abundance of larval fish in tow samples varied from week to week. It was determined that high numbers of ichthyoplankton probably indicated that certain species had good spawning success. In 1974, larval fish catches were highest during late July and early August. In 1975, maximum numbers of larval fish were caught during the first week June.

Entrainment studies were conducted by NUS Corporation for 316(b) demonstration studies in 1975 (NUS, 1976). Entrainment monitoring studies were conducted at Prairie Island between April 25 and September 5, 1975. Samples were collected during one 24-hour period each week. Samples were collected at three stations; in front of the bar rack, on the plant side of the skimmer wall, and in the middle of the recirculation canal.

All samples were collected with plankton nets constructed of 560 micron mesh. Each net was 2.5 m long attached to square 42.5 cm frame and fitted with a flow meter. All nets were fished as stationary drift nets. Between 3 and 7 nets were stacked vertically, depending on location and water depth. Samples were stained and preserved in formalin. Larvae were identified to species level when possible. The total number of eggs, larval fish and juvenile fish for each taxon entrained was calculated.

A total of 39 taxa, including at least 26 species from 12 families, were represented in collections (Table A-13). Freshwater drum eggs accounted for 89 percent of the eggs and mooneye eggs less than 0.1 percent; the remainder of the eggs were unidentified. Emerald shiners were the most abundant young fish collected, followed by gizzard shad, unidentified suckers, white bass, carp and freshwater drum. These 6 taxa comprised nearly 80 percent of the catch of young fish (Table A-14).

Peak egg density (27.5/100m^3) occurred on May 29; a secondary peak (3.34/100m^3) occurred on June 19. On both occasions the collections were dominated by freshwater drum eggs. Peak density (101/100m^3) of fish larvae occurred on May 29. Secondary peaks occurred on May 21 (72/100m^3) and June 26 (60/100m^3). On May 29, the collections were dominated by emerald shiner, white bass, and gizzard shad. Suckers (Catostomidae and *Ictiobus* spp.) were most abundant in May 21 samples, with gizzard shad and carp predominant on June 26.

Diel Variations in Fish Entrainment

During the first half of the sampling program (May 15 to July 2), there was no consistent pattern in the abundance of eggs and larvae over the 24-hour sampling period at either the Recirculating Canal Station or the Bar Rack Station. During the second half of the program, however, densities of young fish at both the Bar Rack Station and the Skimmer Wall Station were generally higher between sunset and sunrise.

An examination of the vertical distribution of eggs and larvae of the ten most abundant taxa collected at the Bar Rack Station appears to indicate that, for most taxa, densities were consistently higher near the bottom. This did not appear to be influenced by the time of day or the date the collections were made.

Estimated Entrainment

Analysis of the impact of entrainment of fish eggs and larvae at Prairie Island is based on the simple population modeling approach, described by Horst (1975) in which the number of larvae entrained is converted to an estimate of the number of adult fish that would have been produced had the larvae not been entrained.

A total of 8,371,000 fish eggs and 61,645,000 larval and juvenile fish were estimated to be entrained by PINGP between May 12 and September 10, 1975. The number of larval and juvenile fish entrained represents about 6 percent of the total number of larvae and juveniles passing through the Sturgeon Lake outlet during the same period (based on MDNR data). Weekly estimates of entrained larvae and juveniles ranged from less than 1 percent to 85 percent of the estimated Sturgeon Lake production.

The entrained eggs and larvae represent a potential loss of about 2,830,000 adult fish from at least 28 taxa. The number of eggs and young entrained, the number of adults lost and the values for fecundity and survival used to calculate the losses are summarized in Table A-15.

Over 99 percent of the potential adult fish loss consisted of 8 taxa of forage fish. Taxa of either sport or commercial importance (e.g., sauger, walleye, white bass, sunfish, crappies, freshwater drum, carp, buffaloes, and carpsuckers) represented less than 1 percent of the adults lost. Minnows (mainly emerald shiner) accounted for 80 percent of the potential adult loss. Darters (logperch, river darter, and Johnny darter) and unidentified percids comprised the next greatest proportion (18 percent) of the potential adult loss. Gizzard shad (0.1 percent) and trout perch (0.3 percent) were the remaining forage taxa.

3) ADULT FISHERY SURVEYS

Xcel Energy has completed several adult fishery studies since the original 316(b) study information was obtained. Historical fisheries studies conducted before and after completion of original 316(b) study have included trawling, gill netting, seining, trap netting, and electrofishing.

Trawling 1973-1980

Trawling was conducted seasonally in the plant intake area, discharge canal, and two stations in North Lake. A minimum of 15 minutes of trawling in two or more runs was completed in each station. The three dominant species collected during trawling for all years combined are freshwater drum, gizzard shad, and white crappie.

Gillnetting 1973-1980

Gill netting was conducted only during the spring and fall sampling seasons. Standard 250 x 6 foot experimental gill nets were used. Eight nominal 24-hour sets were made in each section by making two nominal 24-hour sets at four stations. The three dominant species for all years combined are gizzard shad, white bass, and sauger.

Seining 1973-1984

Shoreline seining was restricted to areas with water depth less than 2 meters. Sampling areas too deep to wade were seined by using a boat to pull the offshore end of the seine. Where river currents existed, the seine was pulled downstream. The seine used from 1974 to 1984 was ¼ inch knotless nylon 50 feet long by 4 feet deep, with a 4 x 4 x 4 foot bag. The seine used in 1973 was 100 foot long x 8 foot deep. The three dominant species for all years combined are emerald shiner, gizzard shad, and white bass.

Trap netting 1973-1987

River trap nets were set for four nominal 24-hour periods. The three dominant species for all years combined are freshwater drum, black crappie, and white bass.

Electrofishing 1973-present

Xcel Energy has conducted an electrofishing study on the Mississippi River in the vicinity of PINGP since 1973. The ongoing study will provide more than 30 years of data on the fish populations in the river. The study will be continued as part of the NPDES permit in the Prairie Island plant area.

To fulfill part of the continuing environmental monitoring requirements of the Prairie Island Nuclear Generating Plant, (PINGP), the Mississippi River fisheries population is sampled near Red Wing, Minnesota, May through October. The study area extends from 3.6 miles upstream of the plant (River mile 802) to 10.8 miles downstream of the plant

(River mile 787.5), (Figure A-5). The original objective of the study was to "determine existing ecological characteristics before plant operation and to assess any significant changes to the aquatic environment after operation" (NSP 1972). The objective was changed slightly after the plant became operational in 1973; to "determine environmental effects of the PINGP on the fish community in the Mississippi River and it's backwaters" (NSP, 1973). Presently, the objective is to monitor and assess the status of the fishery in the vicinity of the PINGP (NSP, 1994). Parameters analyzed and compared to previous years include species composition, length-weight regressions, percent contribution (fish/hr), length-frequency distributions, and catch per unit effort (CPUE) for selected species.

Electrofishing methods and materials have changed over the 30 plus years of the study as equipment has improved and slight plant modifications (i.e. new intake structure/discharge canal) have occurred. Fish are now collected using a Smith-Root SR-18 Electrofishing boat equipped with a 5.0 GPP electrofishing unit. The power source is a 5.0 GPP generator. The 5000 watt generator has a maximum output of 16 amps, and a range of 0-1000 volts. The generator has the capability to be either pulsed AC or DC with a pulse frequency of 7.5, 15, 30, 60, and 120 Hz. The anode consists of two umbrella arrays, each with six dropper cables. The 18 foot boat and dropper cables hung from the front of the boat serve as the cathode. Collection occurs during daylight hours with a pulsed direct current. Due to the constantly changing river conditions, Electrofisher output is varied to enhance the effectiveness.

Sampling is done monthly, May through October, within four established sectors of the study area (Figure A-5). The runs within each sector are similar to previous years sampling to ensure a similar set of relative data indices for yearly comparison. At the end of each "run", the elapsed shocking time is recorded from a digital timer, which only tallied the seconds that the electrical field was energized. A run is terminated after approximately 450 seconds shocking time or when the end of the prescribed run is reached.

Stunned fish are captured with one-inch stretch mesh landing nets equipped with eight-foot insulated handles. Starting in 1981, all cyprinids (besides carp), small percids, and all white bass, gizzard shad, and freshwater drum less than 160 mm are not sampled. Captured fish are placed in live-wells and supplied with river water constantly until the end of each run. At the end of each run fish are identified, measured to the nearest millimeter (total length), weighed to the nearest 10 grams, and released. Parameters used to describe the fisheries include species composition, length-weight regressions, percent contribution, length-frequency distributions, and catch per unit effort (CPUE). It is assumed that population dynamics and spatial distribution is represented by CPUE.

Electrofishing CPUE is computed as numbers of fish per hour for each sector. Length frequencies in 20 millimeter intervals are calculated for all fish species. Length-weight relationships are calculated using the length-weight formula:

$$\log W = \log a + b \log L,$$

where W is the weight in grams, a is the y axis intercept, b is the slope of the regression line, and L is the total length in millimeters.

Since 1973 there have been 71 species representing 20 different families collected while electrofishing. After 1980 when sampling criteria changed, 50 species from 18 families have been identified while electrofishing in the Prairie Island plant vicinity. Currently, approximately 40 species are sampled each year.

Dominant species for the study period (30+ years) has been dependant on what type of gear was used for sampling. Overall, carp, freshwater drum and white bass have been the most dominant. Important pan fish include black and white crappies, and bluegill. Important game fish include sauger, walleye, and smallmouth bass. The most dominant cyprinid besides carp is emerald shiner. Other species with occasional high catch rates include shorthead redhorse, quillback carpsucker and channel catfish. Gizzard shad have been highly variable in the catch, with higher percentages occurring when y-o-y fish were sampled. Electrofishing has been the only collection method used since 1988. Since that time, the top four species have been carp, white bass, freshwater drum and shorthead redhorse.

Attachment B – Agency Correspondence

From: Kriens, Don [Don.Kriens@state.mn.us]
Sent: Wednesday, October 06, 2004 11:50 AM
To: Coss, Terry E
Cc: Bodensteiner, James J; Orr, Daniel J; Mueller, Ken; Giese, Brad
Subject: RE: Prairie Island NPDES Application -Vs- 316(b)

Terry,

As I read the rule in preparing the King permit I concluded the same. I was uncertain which part of the rule fits the PINGP best. It appears to me that the rule in some areas and associated documents describes fine mesh vertical traveling screens with low pressure wash as BTA, although I am uncertain. It appears that alternative 5 would be the more expedient approach. I will look into this and also eventually contact EPA for guidance on how to proceed. Given the issue I think a formal letter requesdting an extension is probably needed.

I will get back to you as I learn more.

Don

-----Original Message-----
From: Coss, Terry E [mailto:terry.e.coss@xcelenergy.com]
Sent: Monday, October 04, 2004 10:41 AM
To: Kriens, Don
Cc: Bodensteiner, James J; Orr, Daniel J; Mueller, Ken; Giese, Brad
Subject: Prairie Island NPDES Application -Vs- 316(b)

Don,

We are preparing to submit the Prairie Island 316(b) NPDES permit renewal application package (due at the end of this month) and would like some feedback from you on how to address the Phase II 316(b) rule.

We believe that the intake technology and operational measures currently in place at Prairie Island represent BTA for that facility, however, it is not immediately obvious which compliance alternative of Part 125.94 of the rule fits best. At first glance, there appear to be at least two possible approaches:

* One option would be to demonstrate under Alternative (2) of the rule that the existing design and operational measures meet the impingement and entrainment performance standards of the rule. Although I subjectively believe this to be true, it will take some time & effort to cull through the volumes of historical design & study data to confirm it.

* Another option would be to demonstrate compliance under Alternative (5) of the rule, in which the Director determines that the design, operational and restoration measures in place represent BTA for the site. Given that the MPCA and MDNR were both involved in reviewing and approving the current arrangement and deemed it adequate, an argument could be made that we have already essentially gone through this process.

We need time to explore the pro's and con's of these two approaches with you and figure out with portions of Part 125.95 of the rule (PIC, CDS, TIOP, etc.) are needed. I would certainly hope that we have enough data from over 20 years of NPDES monitoring to answer any and all questions concerning plant operating impacts and the efficacy of the fine mesh screens, but we won't know for sure until we actually sort through the data. Due to our workload, we will need to hire one or more consultants to help us with this but for budgetary reasons funding will not be available until sometime next year. Accordingly, we would like at least a 24 month extension from the date of the NPDES renewal application filing. If it turns out later that we need to perform more study work to collect missing data, we may need to ask for an additional extension out to the full 3-1/2 years allowed by the rule.

What process do you want us to follow to request an extension of time to submit the 316(b) required information? Is this e-mail sufficient or do you want a formal letter? If you prefer a letter, should we submit it in advance of the NPDES filing or as part of the filing?

Terry Coss, PE
Water Quality Manager
Xcel Energy, Minneapolis
(612) 330-6133

October 20, 2004

Minnesota Pollution Control Agency
Attn: Mr. Don Kriens
Majors and Remediation Division
520 Lafayette Road North
St. Paul, MN 55155-4194

RE: Prairie Island Nuclear Generating Plant (PINGP)
NPDES Permit - MN0004006
Phase II 316(b) Rule Extension Request

Dear Don,

With this letter Xcel Energy requests a time extension for submittal of any additional information which may be required by the Phase II 316(b) rule for PINGP. Application and supporting documentation for NPDES permit renewal, due November 1, 2004, is being prepared for submittal and will be forthcoming under separate cover.

The intake technology and operational measures presently in place at PINGP are believed to represent best technology available (BTA) for that facility. However, it is not immediately clear which compliance alternative of Part 125.94 of the rule best applies here. There appear to be at least two possible approaches. MPCA's interpretation would be most helpful in determining which of the following alternatives to pursue:

- One option would be to demonstrate under Alternative (2) of the rule that the existing design and operational measures meet the impingement and entrainment performance standards of the rule. Although we subjectively believe this to be true, it will take considerable time and effort to peruse the historical design and study data to confirm it.

- The second option would be to demonstrate compliance under Alternative (5) of the rule, in which the Director determines that the design, operational and restoration measures in place represent BTA for the site. Given that the MPCA and MDNR were both involved in reviewing and approving the current arrangement and deemed it adequate, an argument could be made that we have already essentially gone through this process.

The second option seems most feasible, and we would really appreciate having an opportunity to discuss with you the pro's and con's of these two approaches as well as try to figure out which portions of Part 125.95 of the rule (PIC, CDS, TIOP, etc.) are needed before proceeding with materials preparations for submittal. We also feel that enough data has been collected and analyzed, over the past 20+ years of NPDES monitoring, to answer any and all questions concerning plant operating impacts and efficacy of the fine mesh screens.

Depending on which option is required, staff augmentation may be necessary for compliance with the new regulations. Due to budgetary constraints, funding will not be available for hiring additional help until sometime next year. Accordingly, we request an extension of at least 24 months from the date of the NPDES renewal application filing. If it turns out later that we need to perform more field work to collect additional data, we may need to ask for another extension out to the full 3-1/2 years allowed by the rule.

Thank you for your time and consideration of our request for an extension. I look forward to working with you to resolve the outstanding issues. Please let me know if and when you prefer to meet and discuss. Or if you would rather, a reply letter and follow-up letters and/or e-mail correspondences would be acceptable to us.

Sincerely,

Ken Mueller
Senior Environmental Analyst

cc: Mike Werner – NMC, PINGP
Gary Kolle – NMC, PINGP
Robert Flynn – NMC, PINGP
Terry Coss – Xcel Energy, Mpls
Jim Bodensteiner – Xcel Energy, Mpls
ES Record Center – Xcel Energy, Mpls

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TABLES

Table 1. Summary of Monthly Mean Mississippi River Flows at Lock and Dam 3 from 1983 through 2005.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1983	14,260	13,375	55,276	56,239	38,155	24,404	36,353	14,141	14,213	17,536	18,108	16,729	26,566
1984	13,375	18,557	27,290	56,277	49,528	55,613	37,165	13,826	9,678	23,866	21,157	15,903	28,520
1985	12,526	10,239	32,265	45,317	43,518	30,105	25,676	18,226	29,665	39,590	21,337	16,094	27,047
1986	13,710	12,804	24,790	84,870	81,242	37,043	34,684	30,813	41,957	49,319	24,260	17,774	37,772
1987	13,758	12,586	17,287	20,267	13,655	14,573	11,674	10,477	7,183	7,771	8,693	9,016	12,245
1988	7,303	7,634	14,810	21,463	13,119	4,667	2,903	5,103	6,080	7,019	7,919	6,487	8,709
1989	6,294	6,529	11,300	33,264	24,287	13,237	7,690	4,658	8,307	6,358	6,793	4,961	11,140
1990	4,965	4,889	17,484	12,842	22,310	31,610	20,323	16,322	9,923	11,135	9,903	6,184	13,991
1991	5,542	5,879	15,081	34,268	44,753	44,960	33,856	21,535	25,182	15,458	22,467	20,503	24,124
1992	15,658	13,978	43,661	32,668	25,474	17,920	28,985	14,532	15,686	15,374	19,076	12,126	21,262
1993	9,326	8,936	12,513	55,473	48,571	65,377	84,123	41,135	30,717	19,516	18,773	16,490	34,246
1994	13,090	12,611	28,542	40,830	47,548	26,913	29,403	19,971	21,203	25,581	20,173	14,432	25,025
1995	11,365	9,371	29,061	48,507	45,135	30,667	27,323	29,129	19,860	31,061	30,703	17,494	27,473
1996	14,826	15,041	24,474	57,517	46,535	33,790	23,732	13,303	9,300	11,403	23,353	18,716	24,333
1997	14,823	13,954	24,177	106,073	39,316	19,487	36,119	28,074	16,663	14,155	14,160	12,694	28,308
1998	9,806	14,911	26,574	51,477	22,681	25,690	26,477	10,742	7,060	12,597	19,773	15,645	20,286
1999	10,790	12,589	17,897	42,013	47,426	34,423	27,548	24,432	18,013	14,200	13,243	9,671	22,687
2000	8,974	9,548	22,219	15,570	18,839	22,070	21,052	10,026	6,687	6,790	17,463	9,558	14,066
2001	11,271	10,471	10,948	112,703	82,661	53,177	23,981	12,164	9,193	9,577	11,040	13,813	30,083
2002	10,932	10,104	11,497	40,657	33,974	26,323	34,597	29,065	24,513	28,600	18,467	12,135	23,405
2003	9,229	7,871	13,210	25,613	42,194	27,413	32,739	10,084	7,087	6,771	8,167	8,310	16,557
2004	6,700	6,700	15,000	24,700	19,400	46,000	19,500	10,600	19,200	19,500	21,900	12,300	18,458
2005	9,900	11,600	14,700	44,700	31,000	39,200	21,900	9,800	15,200	35,900	19,200	19,100	22,683
Min	4,965	4,889	10,948	12,842	13,119	4,667	2,903	4,658	6,080	6,358	6,793	4,961	8,709
Max	15,658	18,557	55,276	112,703	82,661	65,377	84,123	41,135	41,957	49,319	30,703	20,503	37,772
Mean	10,801	10,877	22,176	46,231	38,318	31,507	28,165	17,311	16,199	18,656	17,223	13,310	22,565

Table 2. Summary of Monthly Mean Plant Intake Flows from 1983 through 2005.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1983	565	563	682	795	784	479	1180	1137	721	1074	752	325	754.8
1984	758	687	626	190	340	641	1183	1155	674	972	632	625	706.9
1985	475	312	603	219	337	638	1186	1127	750	738	859	672	659.7
1986	676	578	364	303	347	636	1201	1187	1188	979	442	683	715.3
1987	752	623	831	207	344	849	1192	1178	1152	1017	862	550	796.4
1988	357	431	573	194	348	651	1119	1058	784	1045	679	726	663.8
1989	667	639	590	191	389	610	1179	1207	1207	1129	719	635	763.5
1990	366	394	727	219	334	644	1263	1252	860	871	661	693	690.3
1991	664	655	654	152	294	490	1150	1188	1183	1150	656	728	747.0
1992	719	732	640	288	298	586	1179	1185	1186	897	167	182	671.6
1993	482	687	694	278	287	518	1112	1158	1148	1036	359	502	688.4
1994	680	730	738	294	283	544	1210	1144	1188	1132	997	811	812.6
1995	811	806	803	460	271	555	1186	1212	1218	1132	694	613	813.4
1996	365	337	498	280	279	547	1177	1207	1213	1164	791	718	714.7
1997	626	334	401	369	283	556	1134	1144	1153	947	367	520	652.8
1998	589	385	729	280	507	631	1185	1187	1192	1177	487	408	729.8
1999	559	650	743	323	290	597	1162	1182	1209	1182	1114	963	831.2
2000	950	951	969	251	284	589	1149	1171	1151	1153	999	594	850.9
2001	562	392	727	732	279	607	1234	996	1158	1263	1201	1045	849.7
2002	960	460	857	582	304	591	1230	1190	1169	1060	662	615	806.7
2003	672	633	722	525	283	566	1143	1185	857	1001	898	817	775.2
2004	804	749	759	521	285	533	1156	1180	801	577	713	749	735.6
2005	707	621	767	605	265	591	1186	1191	1172	1150	1016	821	841.0
Mean	642.0	580.4	682.5	359.0	335.4	593.4	1178.1	1166.1	1058.0	1036.8	727.3	652.0	750.9
Minimum	357	312	364	152	265	479	1112	996	674	577	167	182	653
Maximum	960	951	969	795	784	849	1263	1252	1218	1263	1201	1045	851

Table 3. Summary of Percentage of Mean River Flow Entering the Plant Intake 1983 to 2005.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1983	4.0	4.2	1.2	1.4	2.1	2.0	3.3	8.0	5.1	6.1	4.2	1.9	3.6
1984	5.7	3.7	2.3	0.3	0.7	1.2	3.2	8.4	7.0	4.1	2.3	3.9	3.6
1985	3.8	3.0	1.9	0.5	0.8	2.1	4.6	6.2	2.5	1.9	4.0	4.2	3.0
1986	4.9	4.5	1.5	0.4	0.4	1.7	3.5	3.9	2.8	2.0	1.8	3.8	2.6
1987	5.5	4.9	4.8	1.0	2.5	5.8	10.2	11.2	16.0	13.1	9.9	6.1	7.6
1988	4.9	5.6	3.9	0.9	2.7	13.9	38.5	20.7	12.9	14.9	8.6	11.2	11.6
1989	10.6	9.8	5.2	0.6	1.6	4.6	15.3	25.9	14.5	17.8	10.6	12.8	10.8
1990	7.4	8.1	4.2	1.7	1.5	2.0	6.2	7.7	8.7	7.8	6.7	11.2	6.1
1991	12.0	11.2	4.3	0.4	0.7	1.1	3.4	5.5	4.7	7.4	2.9	3.2	4.7
1992	5.0	5.0	1.0	1.0	1.0	3.0	4.0	8.0	8.0	6.0	1.0	2.0	3.8
1993	5.0	7.7	5.5	0.5	0.6	0.8	1.3	2.8	3.7	5.3	1.9	3.0	3.2
1994	5.2	5.8	2.6	0.7	0.6	2.0	4.1	5.7	5.6	4.4	4.9	3.5	3.8
1995	7.1	8.6	2.8	0.9	0.6	1.8	4.3	4.2	6.1	3.6	2.3	3.5	3.8
1996	2.5	2.2	2.0	0.5	0.6	1.6	5.0	9.1	13.0	10.2	3.4	3.8	4.5
1997	4.2	2.3	1.6	0.3	0.7	2.8	3.1	4.0	6.9	6.6	2.5	4.0	3.3
1998	6.0	2.5	2.7	0.5	2.2	2.4	4.5	11.0	16.8	9.3	2.4	2.6	5.2
1999	5.2	5.2	4.2	0.8	0.6	1.7	4.2	4.8	6.7	8.3	8.4	10.0	5.0
2000	10.5	9.9	4.3	1.6	1.5	2.6	5.4	11.6	17.2	16.9	10.4	6.2	8.2
2001	5.0	3.7	6.6	0.6	0.3	1.1	5.1	8.2	12.6	13.2	10.9	7.6	6.2
2002	8.8	4.6	7.5	1.4	0.9	2.2	3.6	4.1	4.8	3.7	3.6	5.1	4.2
2003	7.3	8.0	5.5	2.0	0.7	2.1	3.5	11.8	12.1	14.8	11.0	9.8	7.4
2004	12.0	11.2	5.1	2.1	1.5	1.2	5.9	11.1	4.2	3.0	3.3	6.1	5.6
2005	7.1	5.4	5.2	1.4	0.9	1.5	5.4	12.2	7.7	3.2	5.3	4.3	5.0
Mean	6.5	6.0	3.7	0.9	1.1	2.7	6.4	9.0	8.7	8.0	5.3	5.6	5.3
Minimum	2.5	2.2	1.0	0.3	0.3	0.8	1.3	2.8	2.5	1.9	1.0	1.9	2.6
Maximum	12.0	11.2	7.5	2.1	2.7	13.9	38.5	25.9	17.2	17.8	11.0	12.8	11.6

Table 4. Representative Total Length Ranges (mm) for Taxa/Life Stage Combinations Established in 1984 through 1988 Fine Mesh Impingement Studies at PINGP.

Taxa	Prolarvae	Post larvae	Juvenile
Channel catfish	11.0 - 18.0	N/A	15.0 - 51.0
Walleye	5.6 - 10.8	9.8 - 19.8	21.5 - 87.0
Sauger	5.1 - 10.6	8.2 - 14.6	--
Lepomis spp.	4.3 - 6.2	4.2 - 13.5	14.2 - 66.0
Pomoxis spp.	4.2 - 5.7	4.1 - 15.6	16.4 - 75.0
White bass	3.6 - 6.5	4.2 - 17.0	15.0 - 57.0
Rock bass	7.1 - 7.1	7.3 - 12.1	14.0 - 32.0
Trout perch	6.3 - 6.6	9.0 - 12.8	13.0 - 43.0
Mooneye	8.3 - 19.3	13.0 - 15.0	--
Burbot	3.8 - 7.6	--	84.0 - 84.0
Carp	4.8 - 8.5	5.9 - 18.5	19.7 - 59.0
Cyprinidae	3.1 - 6.2	5.0 - 17.0	12.9 - 60.0
Catostomidae	4.4 - 13.7	6.9 - 22.5	19.4 - 37.0
Freshwater drum	3.3 - 9.5	6.2 - 14.3	12.5 - 53.0
Flathead catfish	16.5 - 17.8	N/A	19.0 - 34.0
Tadpole madtom	10.8 - 11.8	N/A	14.5 - 21.0
Gizzard shad	3.6 - 5.6	5.5 - 21.7	19.0 - 50.0
Bullhead spp.	--	N/A	16.0 - 24.0

Table 5. Representative Total Length Ranges (mm) of Fish Collected from Impingement Samples at PINGP, A.S. King, and Black Dog Plants.

Taxa	PINGP 1973 - 1984	King 2004-2005	Black Dog 2005-2006
Longnose gar	80-839	150	60 - 503
Shortnose gar	140-939	--	73 - 222
Bowfin	140-799	--	--
Gizzard shad	20-499	28 - 419	32 - 443
Goldeye	80-419	--	--
Mooneye	100-419	--	84 - 142
Northern pike	80-979	229 - 296	473 - 546
Carp	20-859	110	34 - 235
Silver chub	40-199	140 - 141	119 - 150
minnow/shiner sp	20-179	35 - 87	28 - 124
Carpsucker sp	40-639	79	--
Carpsucker/buffalo sp	40-239	79	36 - 145
Smallmouth buffalo	40-659	49	35 - 156
Bigmouth buffalo	40-859	--	35 - 232
Buffalo sp	40-269	--	--
Shorthead redhorse	40-579	65 - 110	61 - 111
Silver redhorse	200-639	--	58
Redhorse sp	60-619	--	39 - 104
Sucker sp	40-219	--	--
White sucker	40-659	120	47 - 186
Black bullhead	40-319	123	47 - 177
Brown bullhead	80-339	122	51 - 228
Yellow bullhead	80-159	--	80 - 95
Bullhead sp	20-339	--	72 - 129
Channel catfish	20-759	46 - 68	42 - 324
Tadpole madtom	20-299	--	--
Flathead catfish	20-1119	83	47 - 138
Trout perch	40-359	73 - 120	--
Burbot	100-539	--	--
White bass	20-479	40 - 152	34 - 335
Rock bass	20-239	148	--
Green sunfish	20-359	48	32 - 112
Bluegill	20-339	43 - 168	30 - 126
Largemouth bass	60-459	98	32 - 320
Smalmouth bass	40-439	45 - 210	--
Crappie	20-439	39 - 234	21 - 242
Yellow perch	40-279	78 - 210	52 - 83
Logperch	40-179	60 - 100	--
Sauger	40-519	--	145
Walleye	60-799	--	45 - 550
Sauger/walleye	40-459	--	--
Freshwater drum	20-659	31 - 315	20 - 430

Table A-1. Total Number and Percent Composition of Predominant Fish Taxa Impinged at the PINGP from 1973 through 1980.

	1973		1974		1975		1976		1977		1978		1979		1980	
Taxa	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Gizzard Shad	65,000	93.9	136,667	93.6	70,506	75.4	152,878	58.5	456,949	82.4	93,895	88.6	9,381	37.6	97,840	88.3
Freshwater Drum	1,144	1.7	3,143	2.2	3,789	4.1	34,380	13.2	74,422	13.4	3,463	3.3	7,468	29.9	7,198	6.5
Shiner and minnow sp	581	0.8	776	0.5	2,231	2.4	5,580	2.1	386	0.1	232	0.2	311	1.2	1,084	1.0
White bass	477	0.7	1,367	0.9	2,712	2.9	44,638	17.1	9,725	1.8	2,096	2.0	2,094	8.4	1,014	1.0
Crappie spp.	445	0.6	1,704	1.2	2,030	2.2	6,852	2.6	5,530	1.0	1,551	1.5	357	1.4	905	0.8
Bluegill	147	0.2	674	0.5	242	0.3	1,601	0.6	2,317	0.4	622	0.6	398	1.6	780	0.7
Channel catfish	24	0.1	637	0.4	6,223	6.7	8,457	3.2	3,977	0.7	2,032	1.9	3,588	14.4	689	0.6
Predominant taxa total	67,818	98.0	144,968	99.3	87,733	94.0	254,386	97.3	553,306	99.8	103,891	98.1	23,597	94.5	109,510	98.9
Other taxa combined	1,408	2.0	1,095	0.7	5,733	6.1	6,908	2.6	1,284	0.2	2,092	2.0	1,370	5.5	1,254	1.1
Annual total	69,226		146,063		93,466		261,294		554,590		105,983		24,967		110,764	

Table A-2. Estimated Total Number and Percent Composition of Predominant Fish Taxa Impinged at the PINGP from 1981 through 1984.

	1981		1982		1983		1984	
Taxa	Number	%	Number	%	Number	%	Number	%
Gizzard Shad	47,966	88.2	67,338	55.5	171,972	77.3	203,956	96.8
Freshwater Drum	2,248	4.1	45,960	37.7	41,390	18.6	2,944	1.4
Shiner and minnow spp	220	0.4	186	0.1	262	0.1	730	0.3
White bass	1,724	3.2	2,062	1.7	1,312	0.6	274	0.1
Crappie spp.	698	1.3	666	0.6	2,390	1.1	218	0.1
Bluegill	270	0.5	356	0.3	708	0.3	880	0.4
Channel catfish	502	0.9	4,092	3.4	3,458	1.6	1,014	0.5
Predominant taxa total	53,628	98.6	120,660	99.3	221,492	99.6	210,016	99.6
Other taxa combined	747	1.4	1,236	1.0	986	0.4	574	0.3
Annual total	54,375		121,896		222,478		210,590	

Table A-3. Taxonomic Listing of Fishes Impinged at PINGP from 1973 through 1984.

Common Name	**Scientific Name**
Lamprey spp.	*Ichthyomyzon spp.*
Chestnut lamprey	*Ichthyomyzon castaneus*
Silver lamprey	*Icthyomyzon unicuspus*
Shovelnose sturgeon	*Scaphirhynchus platorynchus*
Gar spp.	*Lepisosteus spp.*
Longnose gar	*Lepisosteus osseus*
Shortnose gar	*Lepisosteus platostomus*
Bowfin	*Amia calva*
American eel	*Anguilla rostrata*
Gizzard shad	*Dorosoma cepedianum*
Goldeye	*Hiodon alosoides*
Mooneye	*Hiodon tergisus*
Brown trout	*Salmo trutta*
Central mudminnow	*Umbra limi*
Northern pike	*Esox lucius*
Minnow spp.	*Cypinidae*
Carp	*Cyprinus carpio*
Silver chub	*Hybopsis storeriana*
Redbelly dace	*Phoxinus spp.*
Golden shiner	*Notemigonus crysoleucas*
Shiner spp.	*Notropis spp.*
Emerald shiner	*Notropis athernoides*
Common shiner	*Luxilus cornutus*
Pugnose minnow	*Opsopoeodus emiliae*
Blackchin shiner	*Notropis heterodon*
Blacknose shiner	*Notropis heterolepis*
Spottail shiner	*Notropis hudsonius*
Rosyface shiner	*Notropis rubellus*
Spotfin shiner	*Notropis spilopterus*
Mimic shiner	*Notropis volucellus*
Bluntnose minnow	*Pimephales notatus*
Fathead minnow	*Pimephales promelas*
Bullhead minnow	*Pimephales vigilax*
Central stoneroller	*Campostoma anomalum*
Carpsucker spp.	*Carpiodes spp.*
River carpsucker	*Carpiodes carpio*
Quillback	*Carpiodes cyprinus*
Highfin carpsucker	*Carpiodes velifer*
White sucker	*Catostomus commersoni*

Table A-3. Taxonomic listing of fishes impinged at PINGP from 1973 through 1984.

Common Name	**Scientific Name**
Buffalo spp.	*Ictiobus spp.*
Smallmouth buffalo	*Ictiobus bubalus*
Bigmouth buffalo	*Ictiobus cyprinellus*
Spotted sucker	*Minytrema melanops*
Redhorse spp.	*Moxostoma spp.*
Silver redhorse	*Moxostoma anisurum*
Golden redhorse	*Moxostoma erythrurum*
Shorthead redhorse	*Moxostoma macrolepidotum*
Bullhead spp.	*Ictalurus spp.*
Black bullhead	*Ameiurus melas*
Yellow bullhead	*Ameiurus natalis*
Brown bullhead	*Ameiurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Tadpole madtom	*Noturus gyrinus*
Flathead catfish	*Pylodictus olivaris*
Trout perch	*Percopsis omiscomaycus*
Burbot	*Lota lota*
White bass	*Morone chrysops*
Rock bass	*Ambloplites rupestris*
Green sunfish	*Lepommis cyanellus*
Pumpkinseed	*Lepomis gibbosus*
Orangespotted sunfish	*Lepomis humilis*
Bluegill	*Lepomis macrochirus*
Smallmouth bass	*Micropterus dolomieui*
Largemouth bass	*Micropterus salmoides*
Crappie spp.	*Pomoxis spp.*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Johnny darter	*Etheostoma nigrum*
Yellow perch	*Perca flavescens*
Logperch	*Percina caprodes*
River darter	*Percina shumardi*
Sauger	*Sander canadense*
Walleye	*Sander vitreum*
Freshwater drum	*Aplodinotus grunniens*

Table A-4. Representative Number of Fish and Total Length Ranges (mm) Established in 1973 through 1984 Impingement Studies at PINGP.

Taxa	Number	Length Range
Longnose gar	70	80-839
Shortnose gar	144	140-939
Bowfin	123	140-799
Gizzard shad	107805	20-499
Goldeye	22	80-419
Mooneye	138	100-419
Northern pike	707	80-979
Carp	4960	20-859
Silver chub	567	40-199
Minnow/shiner sp	5322	20-179
Carpsucker sp	792	40-639
Carpsucker/buffalo sp	44	40-239
Smallmouth buffalo	249	40-659
Bigmouth buffalo	644	40-859
Buffalo sp	16	40-269
Shorthead redhorse	850	40-579
Silver redhorse	54	200-639
Redhorse sp	36	60-619
Sucker sp	10	40-219
White sucker	69	40-659
Black bullhead	650	40-319
Brown bullhead	19	80-339
Yellow bullhead	4	80-159
Bullhead sp	2823	20-339
Channel catfish	14586	20-759
Tadpole madtom	236	20-299
Flathead catfish	432	20-1119
Trout perch	147	40-359
Burbot	94	100-539
White bass	19324	20-479
Rock bass	391	20-239
Green sunfish	713	20-359
Bluegill	5753	20-339
Largemouth bass	43	60-459
Smallmouth bass	195	40-439
Crappie	15231	20-439
Yellow perch	251	40-279
Logperch	107	40-179
Sauger	673	40-519
Walleye	439	60-799
Sauger/walleye	308	40-459
Freshwater drum	29457	20-659

Table A-5. PINGP Non-fish Species Sampled off Screens (mammals, insects and birds excluded) 1973-1984.

Year	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983+	1984*	Totals
Turtles													
Spiny softshell	9	32	59	365	403	94	35	244	89	20	15	22	1387
Map		7	4	6	9	3	2	3	5	2	4		45
Painted					21	37	16	5	7	4	5		95
Western Painted	5	4	9	14									32
Eastern Painted							1						1
False map	1	1	2	1	1	1	1						8
Snapping	2	9	1	5	1	6				1			25
Unid turtle								3					3
Mussels													
Clams				372	36	33	127	251				185	1004
Stout floater									6				6
Heelsplitter									3				3
Fawnfoot									2				2
Deer toe									1				1
Threeridge									1				1
Fragile papershell		2	5										7
Pink papershell		6	1						1				8
Pocket book											1		1
Paper floater									19	14	51		84
Corbicula											53		53
Unidentified clam		1	134						5				140
Other													
Crayfish	244	253	148	101	42	34	57	38	12	9	19	24	981
Mudpuppy	15	8	30	37	32	33	116	16	4	9	22	7	329
Leopard frog	25	11	11		1	1	7	5	2	2	1	3	69
Unid frog			2										2
Toad	1	1	7		1	1						1	12
Snake						2	2	1					5
Snail		2	2				1						5
Totals	302	337	415	901	547	245	365	566	157	61	171	242	

*Clams include: Fawns foot, corbicula, paper pond shells, floaters, fragile paper shells, unidentified
.+Corbicula not counted or recorded consistently, due to sheer numbers

Table A-6. Estimated Total Number of Fish Impinged on the PINGP Intake Coarse Mesh Screens from November 1983 through March 1984.

Taxa	Nov-83	Dec-83	Jan-84	Feb-84	Mar-84	Total
Silver lamprey	0	0	0	20	13	33
Gizzard shad	3,650	827	4,376	589	241	9,683
Minnow species	0	4	0	6	0	10
Shiner species	40	42	8	70	67	227
River carpsucker	0	0	0	0	7	7
Shorthead redhorse	0	4	4	0	7	15
Bullhead species	0	0	0	3	7	10
Channel catfish	250	319	144	177	235	1,125
Tadpole madtom	10	4	0	0	0	14
Flathead catfish	20	0	0	15	34	69
Trout perch	0	0	4	0	7	11
White bass	0	4	0	12	107	123
Green sunfish	0	21	4	0	0	25
Bluegill	20	0	16	17	27	80
Crappie species	80	21	4	35	80	220
Logperch	40	4	4	3	0	51
Freshwater drum	170	8	40	247	469	934
Total	4,280	1,258	4,604	1,194	1,301	12,637

Table A-7. Survival Rates of Fish Taxa Impinged on the PINGP Intake Coarse Mesh Screens from November 1983 through March 1984.

Taxa	Total # Collected	Initial Dead	Initial Live	Initial % Live	Live After 96 Hours	% Live 96 Hours
Silver lamprey	9	0	9	100.0%	7	77.8%
Gizzard shad	1,579	1,455	124	7.9%	17	1.1%
Minnow species	3	1	2	66.7%	1	33.3%
Shiner species	41	14	27	65.9%	11	26.8%
River carpsucker	1	1	0	0.0%	0	0.0%
Shorthead redhorse	3	0	3	100.0%	3	100.0%
Bullhead species	2	0	2	100.0%	2	100.0%
Channel catfish	194	5	189	97.4%	162	83.5%
Tadpole madtom	2	0	2	100.0%	1	50.0%
Flathead catfish	10	1	9	90.0%	4	40.0%
Trout perch	2	1	1	50.0%	0	0.0%
White bass	17	11	6	35.3%	0	0.0%
Green sunfish	5	1	4	80.0%	4	80.0%
Bluegill	13	6	7	53.8%	5	38.5%
Crappie species	32	6	26	81.3%	4	12.5%
Logperch	6	0	6	100.0%	6	100.0%
Freshwater drum	153	56	97	63.4%	17	11.1%
Total	2,072	1,558	514	24.8%	244	11.8%
Less Shad	493	103	390	79.1%	227	46.0%

Table A-8. Estimated Number and Percent Composition of Fish and Eggs Impinged on Fine Mesh Screens During April through August 1984 to 1988.

Taxa	Life Stage	1984 Number	1984 %	1985 Number	1985 %	1986 Number	1986 %	1987 Number	1987 %	1988 Number	1988 %
Bullhead spp.	juvenile	24,080	0.00%	2,688	0.01%						
Bullhead spp.	prolarvae	13,440	0.00%								
Burbot	juvenile					1,344	0.00%				
Burbot	postlarvae	448	0.00%	448	0.00%			448	0.00%	3,136	0.00%
Burbot	prolarvae	1,792	0.00%					23,744	0.03%	19,936	0.03%
Carp	juvenile	1,151,017	0.23%	5,376	0.01%	24,528	0.04%	7,644	0.01%		
Carp	postlarvae	1,174,154	0.24%	534,752	1.26%	4,172,200	6.65%	2,372,319	3.08%	552,608	0.82%
Carp	prolarvae	69,566,744	14.12%	1,503,104	3.54%	16,422,806	26.17%	2,467,071	3.20%	536,032	0.80%
Catostomidae	juvenile	992,483	0.20%			22,736	0.04%	5,292	0.01%	1,344	0.00%
Catostomidae	postlarvae	342,222	0.07%	201,576	0.47%	113,120	0.18%	51,120	0.07%	15,232	0.02%
Catostomidae	prolarvae	4,654,935	0.94%	1,748,970	4.12%	7,758,013	12.36%	327,428	0.42%	145,600	0.22%
Channel catfish	juvenile	312,432,548	63.40%	2,459,504	5.79%	860,496	1.37%	235,494	0.31%	110,656	0.16%
Channel catfish	prolarvae	15,854,289	3.22%	266,112	0.63%	20,608	0.03%	14,112	0.02%	18,816	0.03%
Centrarchidae	adult							672	0.00%		
Centrarchidae	postlarvae			2,688	0.01%					8,736	0.01%
Centrarchidae	prolarvae			448	0.00%					9,408	0.01%
Coregonus spp.	postlarvae									448	0.00%
Cyprinidae	adult	326,013	0.07%	2,688	0.01%	8,848	0.01%	14,700	0.02%	315,840	0.47%
Cyprinidae	juvenile	41,927,497	8.51%	207,712	0.49%	194,656	0.31%	1,046,346	1.36%	6,028,512	8.97%
Cyprinidae	postlarvae	4,883,385	0.99%	2,080,416	4.90%	513,080	0.82%	14,342,980	18.59%	7,789,600	11.59%
Cyprinidae	prolarvae	1,619,738	0.33%	651,264	1.53%	527,184	0.84%	6,980,864	9.05%	525,504	0.78%
Flathead catfish	juvenile	824,503	0.17%	32,256	0.08%	4,480	0.01%			2,688	0.00%
Flathead catfish	prolarvae	185,808	0.04%								
Freshwater drum	egg	9,135,760	1.85%	17,010,668	40.04%	6,175,592	9.84%	11,672,852	15.13%	9,782,976	14.56%
Freshwater drum	juvenile	2,786,320	0.57%	278,976	0.66%	653,352	1.04%	655,032	0.85%	331,968	0.49%
Freshwater drum	postlarvae	5,131,250	1.04%	984,880	2.32%	2,007,544	3.20%	7,317,102	9.48%	3,525,984	5.25%
Freshwater drum	prolarvae	6,210,510	1.26%	11,609,536	27.32%	15,306,928	24.39%	21,336,836	27.66%	28,620,928	42.60%
Gar spp.	juvenile					1,344	0.00%				
Gar spp.	postlarvae			2,688	0.01%	4,032	0.01%				
Gizzard shad	juvenile	124,972	0.03%	22,848	0.05%	38,080	0.06%	28,812	0.04%	5,376	0.01%
Gizzard shad	postlarvae	872,694	0.18%	598,800	1.41%	4,264,536	6.80%	3,627,968	4.70%	2,464,448	3.67%
Gizzard shad	prolarvae	897,568	0.18%	114,032	0.27%	269,488	0.43%	168,252	0.22%	913,024	1.36%
Lepomis spp.	juvenile	659,360	0.13%	33,600	0.08%	43,456	0.07%	10,584	0.01%	77,952	0.12%
Lepomis spp.	postlarvae	3,259,697	0.66%	237,216	0.56%	345,016	0.55%	98,952	0.13%	857,472	1.28%
Lepomis spp.	prolarvae	77,280	0.02%	58,688	0.14%	28,000	0.04%	65,856	0.09%	370,944	0.55%
Mooneye	postlarvae	1,344	0.00%								
Mooneye	prolarvae	68,992	0.01%	17,024	0.04%	71,296	0.11%	4,200	0.01%	448	0.00%
Northern pike	postlarvae					10,483	0.02%				
Percidae	adult	43,680	0.01%					1,176	0.00%		
Percidae	juvenile	504,035	0.10%	15,072	0.04%	8,512	0.01%	26,208	0.03%	4,032	0.01%
Percidae	postlarvae	218,848	0.04%	66,832	0.16%	75,072	0.12%	162,524	0.21%	17,472	0.03%
Percidae	prolarvae	227,528	0.05%	69,063	0.16%	160,334	0.26%	162,644	0.21%	41,440	0.06%
Percidae	unidentified					6,048	0.01%				
Pomoxis spp.	juvenile	403,170	0.08%			13,664	0.02%	4,116	0.01%		
Pomoxis spp.	postlarvae	208,992	0.04%	250,699	0.59%	237,040	0.38%	179,364	0.23%	61,824	0.09%
Pomoxis spp.	prolarvae	137,032	0.03%	84,896	0.20%	107,968	0.17%	13,524	0.02%	2,912	0.00%
Rock bass	juvenile	165,719	0.03%					1,176	0.00%		
Rock bass	postlarvae	30,240	0.01%	4,928	0.01%	2,240	0.00%				
Rock bass	prolarvae			1,344	0.00%	1,344	0.00%	588	0.00%		
Sauger	postlarvae			3,011	0.01%			69,056	0.09%	4,480	0.01%
Sauger	prolarvae	86,464	0.02%	25,626	0.06%	54,118	0.09%	16,800	0.02%	16,128	0.02%
Sander spp.	postlarvae	2,688	0.00%								
Sander spp.	prolarvae	19,488	0.00%	2,573	0.01%	4,032	0.01%				
Trout perch	adult	26,880	0.01%								
Trout perch	juvenile	269,953	0.05%	14,112	0.03%	41,664	0.07%	2,352	0.00%		
Trout perch	postlarvae	2,464	0.00%			4,480	0.01%				
Trout perch	prolarvae	2,240	0.00%								
Tadpole madtom	juvenile	423,986	0.09%	16,128	0.04%			1,176	0.00%		
Tadpole madtom	prolarvae			1,344	0.00%					1,344	0.00%
Unidentified	egg	2,747,032	0.56%	524,093	1.23%	328,630	0.52%	2,598,570	3.37%	2,438,464	3.63%
Unidentified	postlarvae	26,880	0.01%	2,016	0.00%	34,496	0.05%	69,732	0.09%	5,376	0.01%
Unidentified	prolarvae	158,368	0.03%	88,243	0.21%	135,232	0.22%	241,008	0.31%	433,216	0.64%
Unidentified	unidentified	71,624	0.01%	120,816	0.28%	77,997	0.12%				
White bass	juvenile	342,873	0.07%	8,064	0.02%	51,072	0.08%	101,598	0.13%	5,376	0.01%
White bass	postlarvae	1,156,512	0.23%	355,585	0.84%	1,482,336	2.36%	549,064	0.71%	637,952	0.95%
White bass	prolarvae	83,048	0.02%	149,648	0.35%	10,752	0.02%	56,592	0.07%	478,912	0.71%
Walleye	juvenile	6,720	0.00%			4,480	0.01%				
Walleye	postlarvae					17,920	0.03%	4,032	0.01%		
Walleye	prolarvae	251,328	0.05%	13,978	0.03%	30,374	0.05%	6,720	0.01%	2,688	0.00%
TOTAL		492,818,635	100.00%	42,487,029	100.00%	62,753,051	100.00%	77,144,700	100.00%	67,187,232	100.00%

Table A-9. Summary of Initial Survival Based on Taxa and Life Stage from 1984 to 1989.

Taxa	Life Stage	Dead	Live	Total	% Survival
Bullhead spp.	Juvenile	0	1	1	100.0%
Bullhead spp.	Prolarvae	0	1	1	100.0%
Burbot	Postlarvae	2	6	8	75.0%
Burbot	Prolarvae	5	2	7	28.6%
Carp	Juvenile	4	95	99	96.0%
Carp	Postlarvae	1,804	326	2,130	15.3%
Carp	Prolarvae	2,507	1,048	3,555	29.5%
Catostomidae	Juvenile	11	28	39	71.8%
Catostomidae	Postlarvae	154	104	258	40.3%
Catostomidae	Prolarvae	1,110	1,154	2,264	51.0%
Channel catfish	Juvenile	2,557	5,779	8,336	69.3%
Channel catfish	Prolarvae	87	235	322	73.0%
Centrarchidae	Postlarvae	1	0	1	0.0%
Centrarchidae	Prolarvae	1	0	1	0.0%
Coregonus spp.	Postlarvae	0	1	1	100.0%
Cyprinidae	Adult	4	65	69	94.2%
Cyprinidae	Juvenile	611	2,307	2,918	79.1%
Cyprinidae	Postlarvae	16,975	414	17,389	2.4%
Cyprinidae	Prolarvae	3,719	18	3,737	0.5%
Flathead catfish	Juvenile	3	47	50	94.0%
Flathead catfish	Prolarvae	0	5	5	100.0%
Freshwater drum	Juvenile	313	478	791	60.4%
Freshwater drum	Postlarvae	4,361	717	5,078	14.1%
Freshwater drum	Prolarvae	32,215	703	32,918	2.1%
Gar spp.	Postlarvae	1	0	1	0.0%
Gizzard shad	Juvenile	33	11	44	25.0%
Gizzard shad	Postlarvae	5,271	23	5,294	0.4%
Gizzard shad	Prolarvae	1,279	1	1,280	0.1%
Lepomis spp.	Juvenile	26	67	93	72.0%
Lepomis spp.	Postlarvae	544	12	556	2.2%
Lepomis spp.	Prolarvae	365	0	365	0.0%
Mooneye	Prolarvae	43	13	56	23.2%
Percidae	Adult	1	1	2	50.0%
Percidae	Juvenile	19	41	60	68.3%
Percidae	Postlarvae	286	39	325	12.0%
Percidae	Prolarvae	432	45	477	9.4%
Pomoxis spp.	Juvenile	2	31	33	93.9%
Pomoxis spp.	Postlarvae	297	12	309	3.9%
Pomoxis spp.	Prolarvae	85	0	85	0.0%
Rock bass	Juvenile	1	6	7	85.7%
Rock bass	Postlarvae	0	4	4	100.0%
Rock bass	Prolarvae	1	0	1	0.0%
Sauger	Postlarvae	53	23	76	30.3%
Sauger	Prolarvae	91	25	116	21.6%
Sander spp.	Prolarvae	16	3	19	15.8%
Trout perch	Juvenile	3	34	37	91.9%
Trout perch	Postlarvae	1	0	1	0.0%
Trout perch	Prolarvae	0	1	1	100.0%
Tadpole madtom	Juvenile	2	21	23	91.3%
Tadpole madtom	Prolarvae	0	2	2	100.0%
Unidentified	Postlarvae	77	0	77	0.0%
Unidentified	Prolarvae	1,060	0	1,060	0.0%
Unidentified	Unidentified	2,083	0	2,083	0.0%
White bass	Juvenile	26	67	93	72.0%
White bass	Postlarvae	1,586	160	1,746	9.2%
White bass	Prolarvae	618	5	623	0.8%
Walleye	Juvenile	0	2	2	100.0%
Walleye	Postlarvae	2	3	5	60.0%
Walleye	Prolarvae	179	122	301	40.5%
Overall		80,927	14,308	95,235	15.0%

Table A-10. Percent Survival for Intake Screenhouse Impingement Samples by Lifestage from 1984 to 1989.

Life Stage	1984	1985	1986	1987	1988	1989	All Years
Prolarvae	26.9	12.3	7.3	2.7	0.9	8.5	7.2
Postlarvae	15.6	22.1	8.0	4.4	0.5	4.0	5.5
Juvenile	67.9	87.9	89.7	66.1	75.8	83.3	75.1
All lifestages	50.1	21.6	12.8	6.1	4.4	11.4	15.0

Table A-11. Representative Total Length Ranges (mm) for Taxa/Life Stage Combinations Established in 1984 through 1988 Fine Mesh Impingement Studies at PINGP.

Taxa	Prolarvae	Post larvae	Juvenile
Channel catfish	11.0 - 18.0	N/A	15.0 - 51.0
Walleye	5.6 - 10.8	9.8 - 19.8	21.5 - 87.0
Sauger	5.1 - 10.6	8.2 - 14.6	--
Lepomis spp.	4.3 - 6.2	4.2 - 13.5	14.2 - 66.0
Pomoxis spp.	4.2 - 5.7	4.1 - 15.6	16.4 - 75.0
White bass	3.6 - 6.5	4.2 - 17.0	15.0 - 57.0
Rock bass	7.1 - 7.1	7.3 - 12.1	14.0 - 32.0
Trout perch	6.3 - 6.6	9.0 - 12.8	13.0 - 43.0
Mooneye	8.3 - 19.3	13.0 - 15.0	--
Burbot	3.8 - 7.6	--	84.0 - 84.0
Carp	4.8 - 8.5	5.9 - 18.5	19.7 - 59.0
Cyprinidae	3.1 - 6.2	5.0 - 17.0	12.9 - 60.0
Catostomidae	4.4 - 13.7	6.9 - 22.5	19.4 - 37.0
Freshwater drum	3.3 - 9.5	6.2 - 14.3	12.5 - 53.0
Flathead catfish	16.5 - 17.8	N/A	19.0 - 34.0
Tadpole madtom	10.8 - 11.8	N/A	14.5 - 21.0
Gizzard shad	3.6 - 5.6	5.5 - 21.7	19.0 - 50.0
Bullhead spp.	--	N/A	16.0 - 24.0

Table A-12. Estimated impingement of fish collected on PINGP fine-mesh screens during April 1992-2005.

Date	Taxa	Life Stage	Estimated Impingement	No of Fish Collected
1992				
1-Apr-92	CYPR	PR	288	1
1-Apr-92	CYPR	PO	288	1
1-Apr-92	CARP	PO	576	2
2-Apr-92	X	UN	0	0
8-Apr-92	X	UN	0	0
9-Apr-92	X	UN	0	0
14-Apr-92	X	UN	0	0
16-Apr-92	X	UN	0	0
21-Apr-92	BURB	PR	576	1
23-Apr-92	X	UN	0	0
28-Apr-92	X	UN	0	0
30-Apr-92	CC	JU	288	1
30-Apr-92	PERC	AD	288	1
1993				
2-Apr-93	UN	X	0	0
6-Apr-93	BURB	PR	288	1
8-Apr-93	UN	EG	288	1
8-Apr-93	BURB	PR	288	1
13-Apr-93	UN	X	0	0
15-Apr-93	BURB	PR	288	1
19-Apr-93	UN	EG	1152	2
21-Apr-93	UN	X	0	0
27-Apr-93	UN	X	0	0
29-Apr-93	UN	EG	288	1
1994				
5-Apr-94	UNID	EG	384	1
5-Apr-94	CC	JU	384	1
5-Apr-94	CARP	PR	384	1
5-Apr-94	BURB	PR	384	1
7-Apr-94	BURB	PR	288	1
12-Apr-94	SA	PR	288	1
12-Apr-94	CARP	PR	288	1
14-Apr-94	X	X	0	0
19-Apr-94	CYPR	JU	288	1
21-Apr-94	X	X	0	0
26-Apr-94	CARP	PR	1152	4
26-Apr-94	BURB	PR	288	1
28-Apr-94	SA	PR	288	1
28-Apr-94	BURB	PR	288	1

Date	Taxa	Life Stage	Estimated Impingement	No of Fish Collected
1995				
3-Apr-95	CATO	JU	288	1
4-Apr-95	BURB	PR	288	1
4-Apr-95	CC	JU	576	1
4-Apr-95	WB	JU	1152	2
4-Apr-95	GIZ	JU	1152	2
4-Apr-95	CATO	JU	576	1
4-Apr-95	FWD	JU	9792	17
10-Apr-95	CATO	PR	288	1
17-Apr-95	UNID	EG	13248	46
20-Apr-95	UNID	EG	2880	10
24-Apr-95	UNID	EG	1152	4
26-Apr-95	UNID	EG	864	3
1996				
2-Apr-96	CARP	PR	252	1
4-Apr-96	UNID	EG	504	2
9-Apr-96	JDAR	AD	252	1
9-Apr-96	SHIN	JU	252	1
9-Apr-96	UNID	EG	252	1
11-Apr-96	FWD	JU	252	1
11-Apr-96	BURB	PR	252	1
11-Apr-96	EMSH	JU	504	2
11-Apr-96	CARP	PR	252	1
11-Apr-96	BURB	PR	252	1
11-Apr-96	CARP	PR	252	1
16-Apr-96	X	X	0	0
18-Apr-96	X	X	0	0
23-Apr-96	EMSH	JU	504	2
23-Apr-96	UNID	EG	1008	4
25-Apr-96	BURB	PR	504	2
25-Apr-96	BURB	PR	252	1
30-Apr-96	X	X	0	0
1997				
3-Apr-97	UNID	EG	17,280	30
4-Apr-97	BG	JU	1152	2
4-Apr-97	UNID	PR	576	1
25-Apr-97	BURB	PR	2304	4
29-Apr-97	CYPR	JU	864	2
30-Apr-97	BLBH	JU	432	1
30-Apr-97	CC	JU	432	1
30-Apr-97	CYPR	JU	432	1
30-Apr-97	UNID	EG	864	2

Date	Taxa	Life Stage	Estimated Impingement	No of Fish Collected
1998				
2-Apr-1998	UNID	EG	229	1
3-Apr-1998	CYPR	AD	252	1
7-Apr-1998	X	X	0	0
9-Apr-1998	EMSH	AD	229	1
14-Apr-1998	CC	JU	252	1
16-Apr-1998	CYPR	JU	229	1
16-Apr-1998	BURB	PR	229	1
21-Apr-1998	UNID	EG	1512	6
23-Apr-1998	PERC	PR	252	1
23-Apr-1998	FWD	JU	252	1
28-Apr-1998	UNID	EG	2016	8
28-Apr-1998	PERC	PR	2268	9
28-Apr-1998	STIZ	PR	2268	9
28-Apr-1998	CARP	PR	1512	6
28-Apr-1998	UNID	PR	252	1
30-Apr-1998	STIZ	PR	2016	8
30-Apr-1998	CARP	PR	14364	57
30-Apr-1998	PERC	PR	2268	9
30-Apr-1998	MOON	PR	252	1
30-Apr-1998	GORH	JU	252	1
1999				
6-Apr-99	BURB	PR	522	2
6-Apr-99	UNID	EG	4032	14
9-Apr-99	GIZ	JU	288	1
9-Apr-99	CC	JU	288	1
9-Apr-99	BURB	PR	576	2
9-Apr-99	CC	JU	288	1
13-Apr-99	UNID	EG	288	1
13-Apr-99	UNID	EG	288	1
15-Apr-99	BURB	PR	288	1
22-Apr-99	BURB	PR	576	2
27-Apr-99	PERC	PR	288	1
27-Apr-99	CC	JU	288	1
27-Apr-99	PERC	PR	288	1
30-Apr-97	PERC	PO	288	1
30-Apr-97	PERC	PR	576	2
30-Apr-97	PERC	PO	288	1

Table A-12. (cont) Estimated impingement of fish collected on PINGP fine-mesh screens during April 1992-2005.

Date	Taxa	Life Stage	Estimated Impingement	No of Fish Collected
2000				
4-Apr-2000	UNID	EG	14,688	51
4-Apr-2000	UNID	EG	1440	5
6-Apr-2000	UNID	EG	7,776	27
6-Apr-2000	Log P	AD	288	1
6-Apr-2000	UNID	EG	8023	39
6-Apr-2000	Carp	PRO	206	1
13-Apr-2000	Burb	PRO	288	1
18-Apr-2000	Shiner	JU	288	1
20-Apr-2000	Cypr.	PRO	288	1
27-Apr-2000	UNID	EG	2618	10
27-Apr-2000	UNID	EG	1440	5
27-Apr-2000	SA	PRO	576	2
27-Apr-2000	WE	PRO	288	1
2001	No values calculated~flood			
2002				
02-Apr-02	EMSH	JU	672	2
04-Apr-02	EMSH	JU	1680	5
04-Apr-02	Carp	EG	672	2
04-Apr-02	EMSH	JU	1680	5
04-Apr-02	GIZ	JU	336	1
04-Apr-02	Carp	EG	1008	3
04-Apr-02	BURB	PR	1008	3
09-Apr-02	GIZ	JU	336	1
09-Apr-02	EMSH	JU	1008	3
09-Apr-02	BURB	PRO	672	2
09-Apr-02	Carp	EG	288	1
11-Apr-02	EMSH	JU	288	1
11-Apr-02	BURB	PRO	864	3
11-Apr-02	BURB	PRO	1800	5
11-Apr-02	EMSH	JU	1800	5
11-Apr-02	Cypr	JU	360	1
16-Apr-02	EMSH	JU	336	1
16-Apr-02	GIZ	JU	336	1
18-Apr-02	EMSH	JU	336	1
23-Apr-02	BURB	PRO	672	2
23-Apr-02	BURB	PRO	1008	3
25-Apr-02	BURB	PRO	672	2
25-Apr-02	BURB	PRO	336	1

Date	Taxa	Life Stage	Estimated Impingement	No of Fish Collected
2003				
1-Apr-03	BURB	PRO	504	1
3-Apr-03	BURB	PRO	504	1
3-Apr-03	BURB	PRO	2016	4
3-Apr-03	FWD	JU	1512	3
8-Apr-03	BURB	PRO	576	1
8-Apr-03	BURB	PRO	576	1
10-Apr-03	BURB	PRO	2304	8
10-Apr-03	BURB	PRO	1152	2
10-Apr-03	Carp	EG	576	1
15-Apr-03	Carp	EG	13248	23
17-Apr-03	Carp	EG	1728	3
17-Apr-03	Carp	EG	576	1
22-Apr-03	Carp	EG	576	1
24-Apr-03	BURB	PRO	576	1
24-Apr-03	BURB	PRO	1152	2
29-Apr-03	SA	PRO	576	1
2004				
1-Apr-04	GIZ	JU	576	2
1-Apr-04	SHRH	JU	288	1
1-Apr-04	GIZ	JU	288	1
6-Apr-04	Cypr	JU	864	3
6-Apr-04	GIZ	JU	288	1
6-Apr-04	Cypr	JU	864	3
8-Apr-04	GIZ	JU	288	1
8-Apr-04	Cypr	JU	3168	11
13-Apr-04	GIZ	JU	288	1
13-Apr-04	Cypr	JU	288	1
13-Apr-04	BURB	PRO	1440	5
13-Apr-04	BURB	PRO	2304	8
15-Apr-04	Cypr	JU	288	1
15-Apr-04	UNID	EG	288	1
15-Apr-04	BURB	PRO	288	1
20-Apr-04	BURB	PRO	288	1
20-Apr-04	EMSH	AD	288	1
20-Apr-04	EMSH	AD	288	1
20-Apr-04	Cypr	JU	288	1
22-Apr-04	BURB	PRO	2016	7
27-Apr-04	YP	PRO	864	3
27-Apr-04	BURB	PRO	576	2
27-Apr-04	WE	PRO	576	2
27-Apr-04	PERC	PRO	576	2
29-Apr-04	YP	PRO	1152	4
29-Apr-04	PERC	PRO	288	1
29-Apr-04	YP	PRO	576	2
29-Apr-04	WE	PRO	288	1

Date	Taxa	Life Stage	Estimated Impingement	No of Fish Collected
2005				
5-Apr-05	FWD	JU	288	1
5-Apr-05	BURB	PRO	288	1
5-Apr-05	BURB	PRO	288	1
7-Apr-05	BURB	PRO	576	2
7-Apr-05	BURB	PRO	288	1
12-Apr-05	BURB	PRO	1728	6
12-Apr-05	CATO	PRO	288	1
12-Apr-05	BURB	PRO	8352	29
14-Apr-05	BURB	PRO	1152	4
19-Apr-05	BURB	PRO	288	1
21-Apr-05	BURB	PRO	576	2
27-Apr-05	YP	PRO	288	1
27-Apr-05	Sander	PRO	288	1
27-Apr-05	GIZ	PRO	288	1
27-Apr-05	CATO	PRO	576	2
28-Apr-05	GIZ	PRO	864	3
28-Apr-05	CATO	PRO	288	1
28-Apr-05	Sander	PRO	288	1
28-Apr-05	PERC	PRO	1152	4

LEGEND

UN = Unidentified
EG = Egg
PR = Prolarvae
PO = Postlarvae
JU = Juvenile
AD = Adult

UNID = Unidentified
CC = Channel Catfish
CYPR = Cyprinids
FHC = Flathead Catfish
PERC = Percids
BHS = Bullhead spp.
SA = Sauger
WE = Walleye
STIZ = Sander spp.
BURB = Burbot
CATO = Catostomids
CARP = Carp
MOON = Mooneye
EMSH = Emerald Shiner
YP = Yellow Perch
Giz = Gizzard Shad
FWD = Freshwater Drum

Table A-13. Fish Eggs and Young Collected in Entrainment Sampling at Prairie Island, 1975.

Common Name	Scientific Name	Egg	Larvae	Juvenile
Gizzard shad	*Dorosoma cepedianum*		X	X
Lake whitefish	*Coregonus clupeaformis*		X	
Mooneye/Goldeye	*Hiodon spp.*		X	
Mooneye	*Hiodon tergisus*	X	X	
Northern pike	*Esox lucius*		X	
Minnow spp.	Cyprinidae		X	
Carp	*Cyprinus carpio*		X	X
Speckled chub	*Hybopsis aestivalis*			X
Emerald shiner	*Notropis athernoides*		X	X
Bullhead minnow	*Pimephales vigilax*			X
Suckers	Catostomidae		X	
White sucker	*Catostomus commersoni*		X	
Carpsucker spp.	*Carpiodes spp.*		X	
Buffalo spp.	*Ictiobus spp.*		X	
Redhorse spp.	*Moxostoma spp.*		X	
Channel catfish	*Ictalurus punctatus*		X	X
Tadpole madtom	*Noturus gyrinus*		X	
Flathead catfish	*Pylodictus olivaris*		X	X
Trout perch	*Percopsis omiscomaycus*		X	
Burbot	*Lota lota*		X	
White bass	*Morone chrysops*		X	X
Sunfishes	Centrarchidae		X	
Rock bass	*Ambloplites rupestris*		X	X
Pumpkinseed	*Lepomis gibbosus*		X	
Bluegill	*Lepomis macrochirus*		X	X
Unidentified sunfish	*Lepomis spp.*		X	X
Crappie spp.	*Pomoxis spp.*		X	
White crappie	*Pomoxis annularis*		X	
Black crappie	*Pomoxis nigromaculatus*		X	X
Perches	Percidae		X	
Johnny darter	*Etheostoma nigrum*		X	
Unidentified darters	*Etheostoma spp.*		X	X
Yellow perch	*Perca flavescens*		X	
Logperch	*Percina caprodes*		X	
River darter	*Percina shumardi*		X	
Unidentified darters	*Percina spp.*		X	
Sauger	*Sander canadense*		X	
Walleye	*Sander vitreum*		X	
Walleye/Sauger	*Sander spp.*		X	
Freshwater drum	*Aplodinotus grunniens*	X	X	X

Source: NUS, 1976.

Table A-14. Mean Density and Percent of Catch of Young Fish Collected in Entrainment Sampling at Prairie Island, 1975.

Taxa	#/100m3	Percent
Notropis athernoides	4.36	22.30
Dorosoma cepedianum	4.00	20.50
Catostomidae	2.45	12.50
Morone chrysops	2.26	11.60
Cyprinus carpio	1.36	7.00
Aplodinotus grunniens	1.03	5.30
Ictiobus spp.	0.62	3.20
Sander canadense	0.55	2.80
Cyprinidae	0.51	2.60
Carpiodes spp.	0.44	2.20
Percina spp.	0.33	1.70
Hiodon tergisus	0.32	1.60
Lepomis spp.	0.26	1.30
Percidae	0.26	1.30
Percina shumardi	0.17	0.90
Pomoxis spp.	0.12	0.60
Ictalurus punctatus	0.09	0.50
Sander vitreum	0.09	0.50
Hiodon spp.	0.06	0.30
Perca flavescens	0.03	0.10
Sander spp.	0.03	0.10
Lepomis macrochirus	0.02	0.10
Percopsis omiscomaycus	0.01	*
Etheostoma nigrum	0.01	*
Etheostoma spp.	0.01	*
Percina caprodes	0.01	*
Pomoxis nigromaculatus	0.01	*
Coregonus clupeaformis	<0.01	*
Esox lucius	<0.01	*
Hybopsis aestivalis	<0.01	*
Pimephales vigilax	<0.01	*
Catostomus commersoni	<0.01	*
Moxostoma spp.	<0.01	*
Noturus gyrinus	<0.01	*
Pylodictus olivaris	<0.01	*
Ambloplites rupestris	<0.01	*
Lepomis macrochirus	<0.01	*
Pomoxis annularis	<0.01	*
Centrarchidae	<0.01	*
Unidentifiable	0.11	0.60
Unidentified	0.01	*

Source: NUS, 1976.

Table A-15. Calculation of Loss of Adult Fish Due to Entrainment of Eggs, Larvae, and Juveniles at PINGP in 1975.

Taxa	Number Entrained	Fecundity	Survival Egg to Larva	Larvae Produced by One Female	Survival Larvae to Adult	Number of Adults Lost
Dorosoma cepedianum	10,370,000	1,560,000	0.005	7,800	0.0003	3,111
Coregonus clupeaformis	4,000	178,000	0.005	900	0.002	8
Hiodon tergisus	1,221,000	60,000	0.005	300	0.007	8,547
Esox lucius	4,000	981,000	0.005	4,900	0.0004	2
Cyprinus carpio	3,257,000	7,360,000	0.005	36,800	0.00006	195
Notropis athernoides	15,961,000	2,900	0.005	15	0.13	2,075,000
Cypinidae	1,575,000	2,900	0.005	15	0.13	204,700
Carpiodes spp.	4,598,000	619,200	0.005	3,100	0.0006	2,759
Catostomus commersoni	13,000	954,000	0.005	4,800	0.0004	5
Ictiobus spp.	6,617,000	1,610,000	0.005	8,000	0.0002	1,323
Moxostoma spp.	36,000	135,000	0.005	680	0.003	108
Ictalurus punctatus	325,000	214,800	0.75	160,000	0.00001	3
Noturus gyrinus	3,000	200	0.75	150	0.01	30
Pylodictus olivaris	16,000	108,300	0.75	500	0.004	64
Percopsis omiscomaycus	25,000	1,400	0.005	7	0.3	7,500
Morone chrysops	7,297,000	3,390,000	0.005	17,000	0.0001	730
Ambloplites rupestris	5,000	63,000	0.75	300	0.007	35
Lepomis gibbosus	122,000	16,425	0.75	12,000	0.0002	24
Lepomis macrochirus	742,000	97,000	0.75	73,000	0.00003	22
Pomoxis spp.	480,000	462,200	0.75	35,000	0.00006	29
Etheostoma nigrum	67,000	1,600	0.75	1,200	0.002	134
Perca flavescens	102,000	436,800	0.03	13,100	0.0001	10
Percina caprodes	88,000	6,000	0.005	30	0.07	6,160
Percina shumardi	1,711,000	1,200	0.005	6	0.3	513,300
Sander canadense	1,881,000	159,500	0.005	800	0.003	5,643
Sander vitreum	319,000	2,257,000	0.005	11,300	0.0002	64
Percidae	956,000	477,000	0.005	2,400	0.0008	765
Aplodinotus grunniens						
Eggs	7,484,000	1,300,000	0.005	6,500	0.0003	11
Larvae/Juveniles	3,408,000	-	-	-	-	1,022
Unidentifiable larvae	403,000	-	-	-	-	-
Unidentifiable eggs	887,000	-	-	-	-	-
Unidentified larvae	39,000	-	-	-	-	-
Total Eggs	8,371,000				Total	2,831,304
Total Larvae/Juveniles	61,645,000				Forage	2,809,935
					Sport/Commercial	21,339

Source: NUS, 1976.

FIGURES

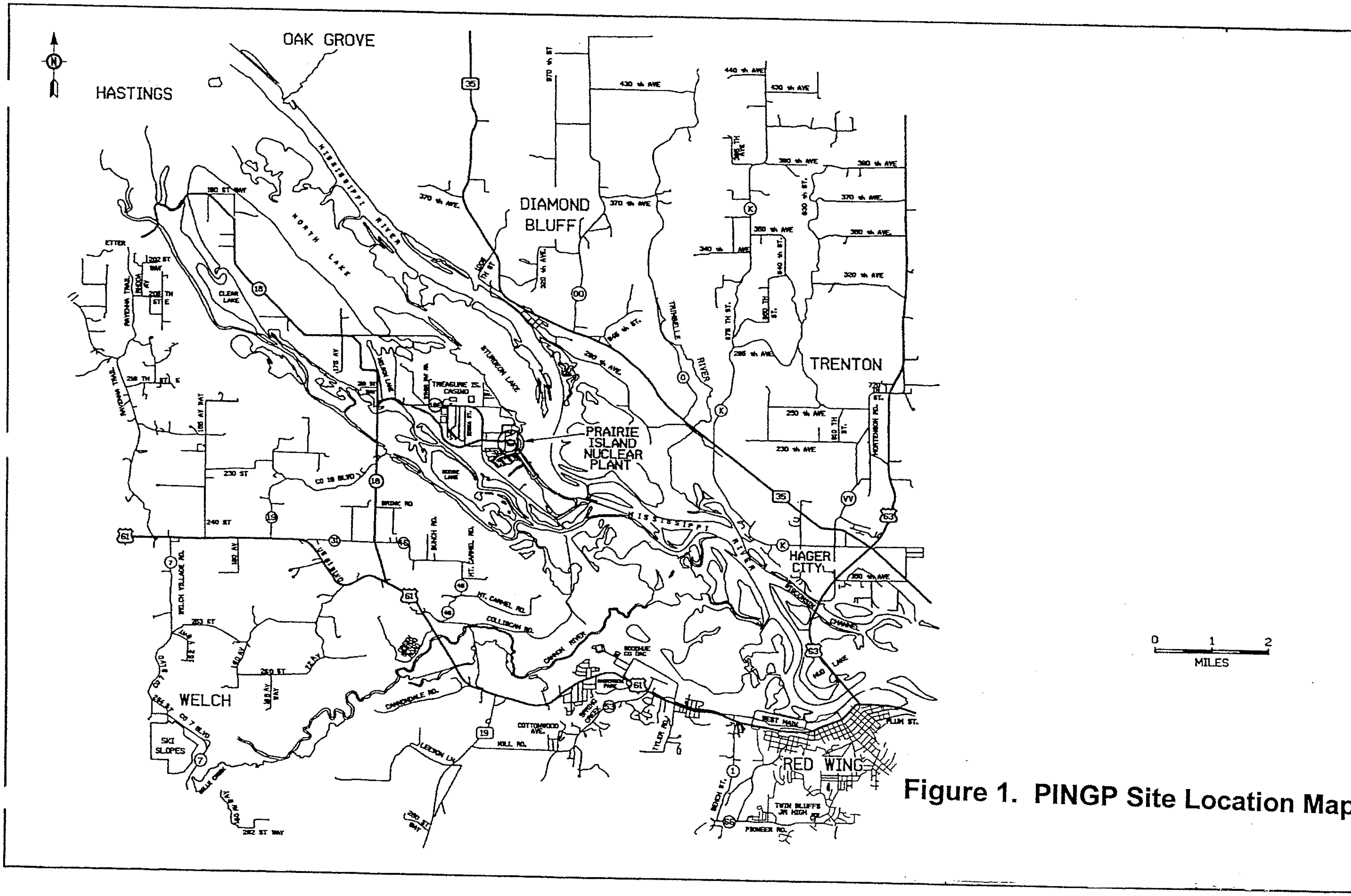


Figure 1. PINGP Site Location Map

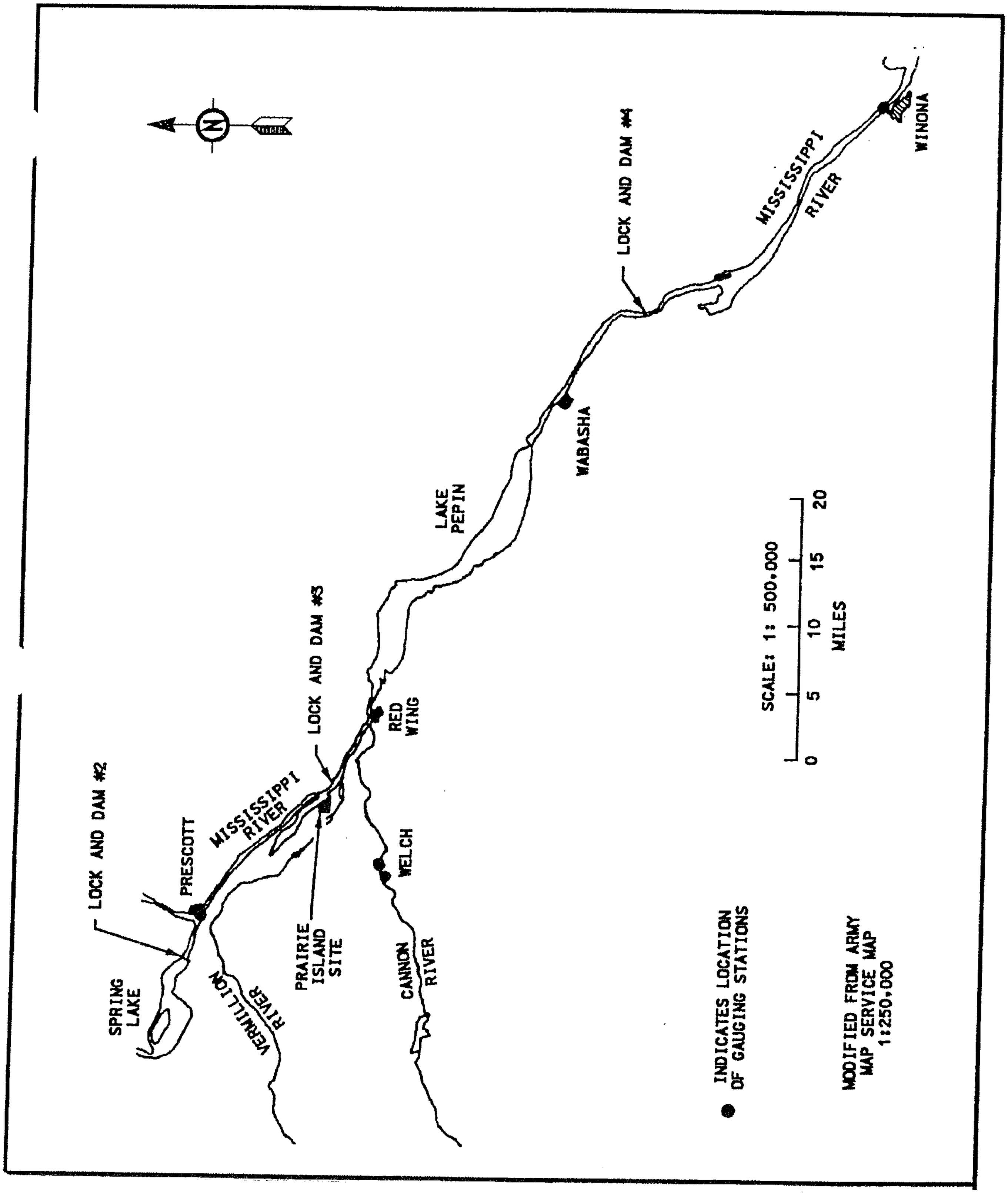


Figure 2. Principal Surface Waters in the Vicinity of PINGP

Figure 3. Location of Plant Screenhouse and Intake Screenhouse

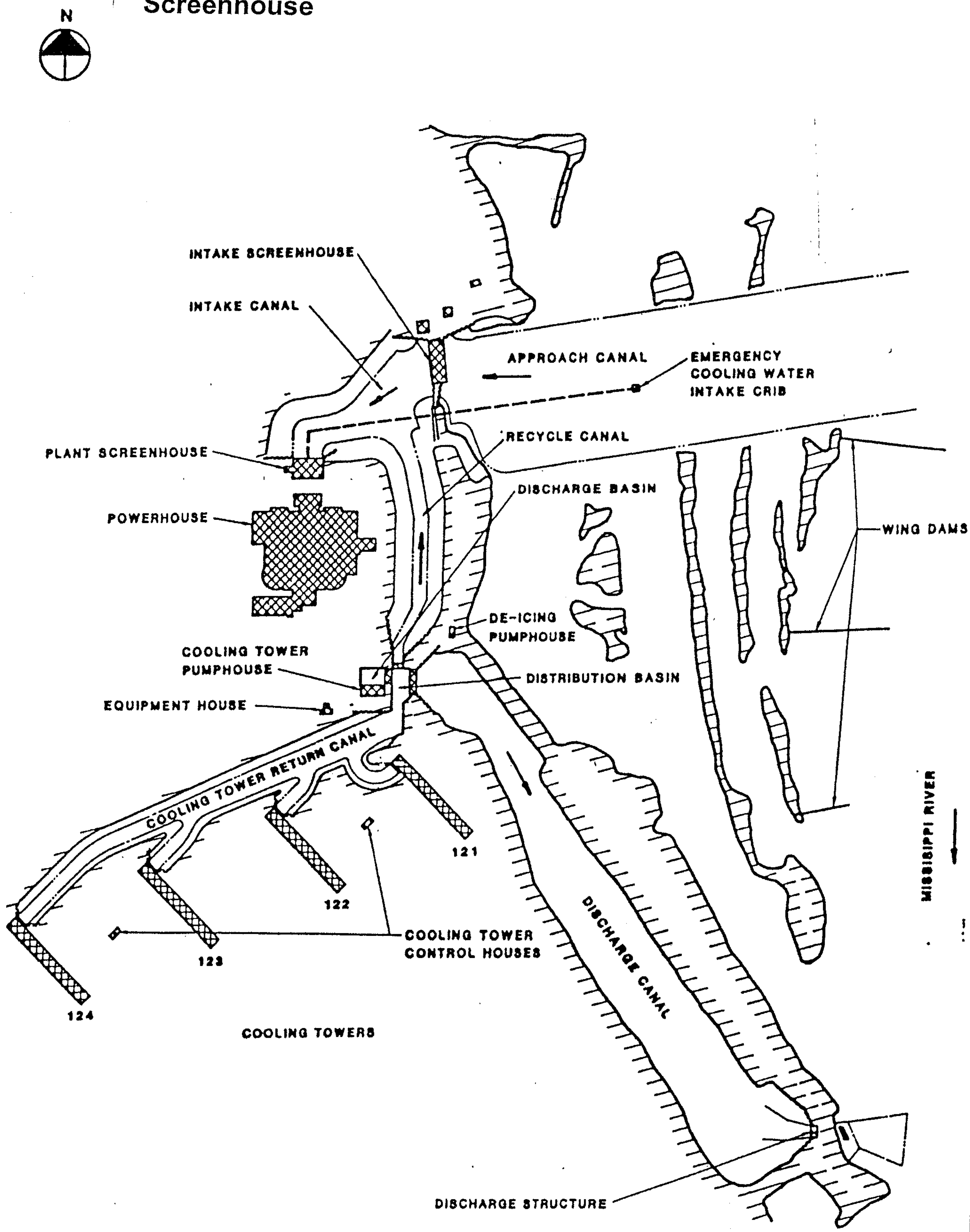
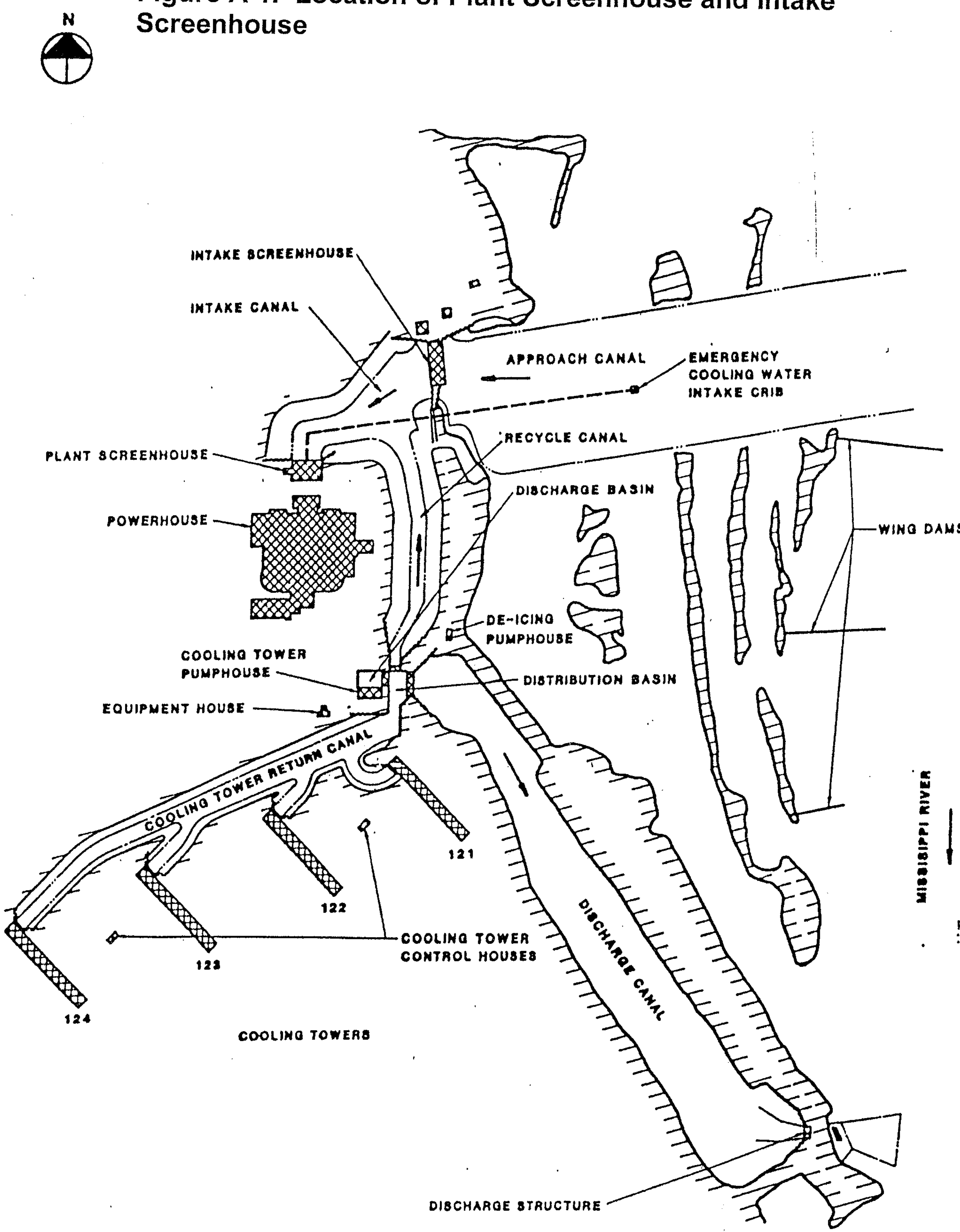


Figure A-1. Location of Plant Screenhouse and Intake Screenhouse



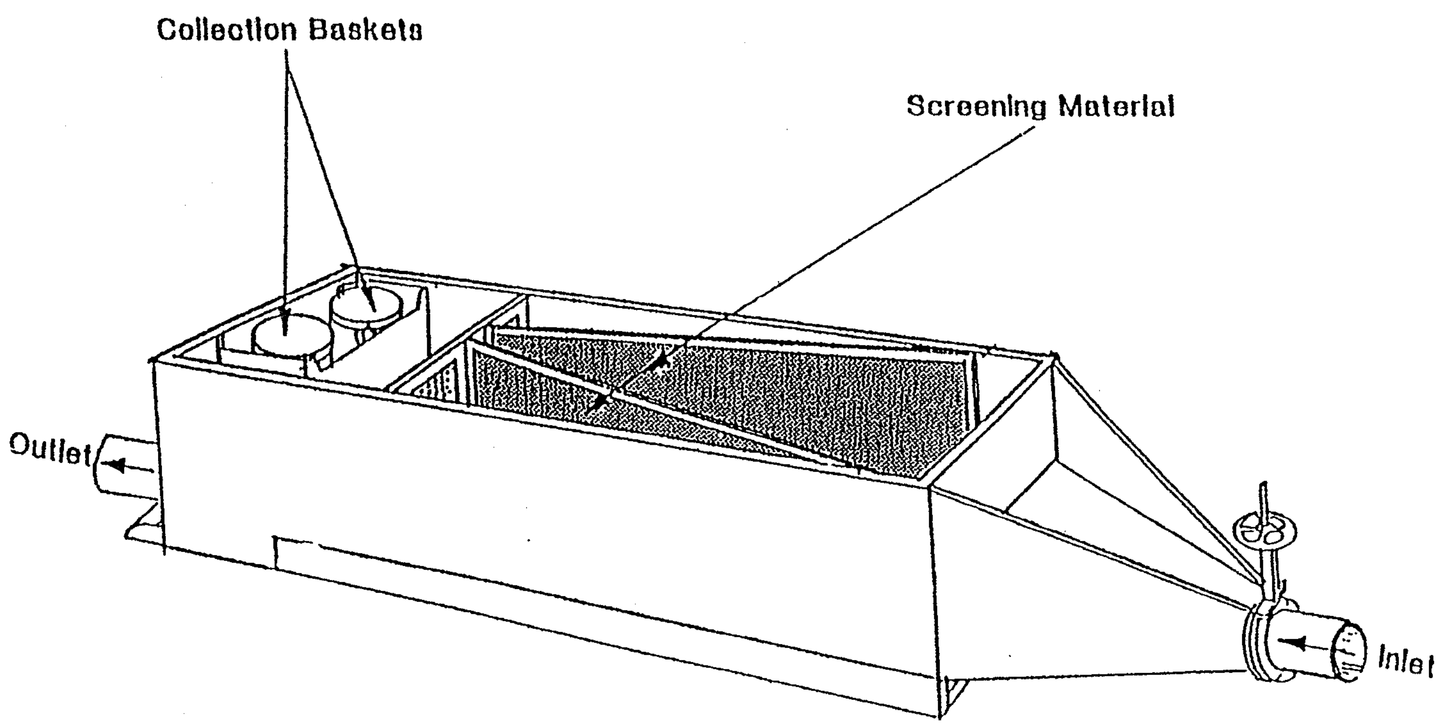


Figure A-2. Larval Fish Collection Tank

Figure A-3. Test Fish Survival

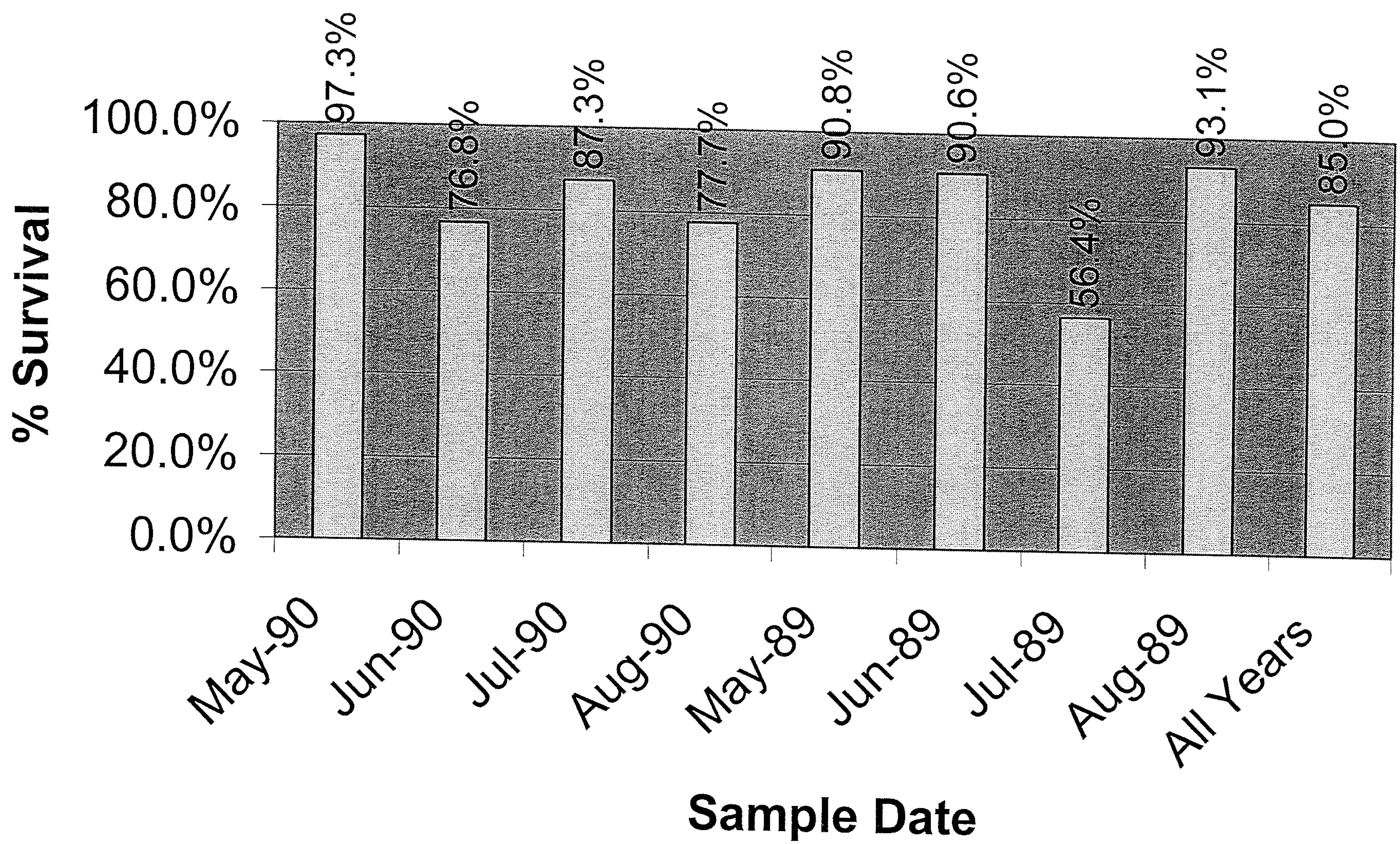


Figure A-4. Location of Larval Fish Towing Stations at PINGP, 1975

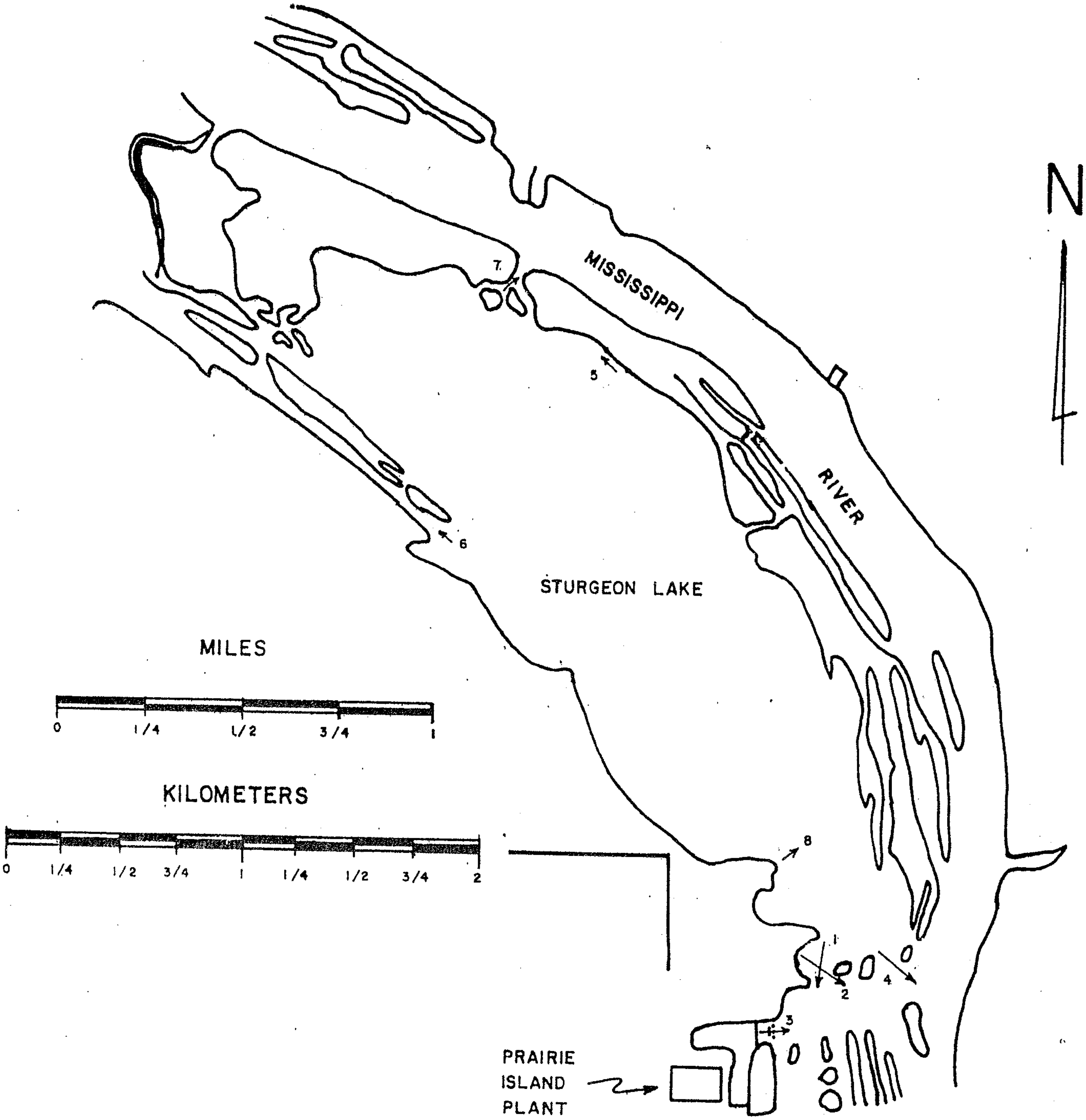


Figure A-5. PINGP Fisheries Study Area