ILLINOIS POLLUTION CONTROL BOARD
July 25, 2019

SOUTHERN ILLINOIS POWER COOPERATIVE,	)	
Petitioner,	)	
v.	)	PCB 18-75 (Thermal Demonstration)
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY,	)	
Respondent.	)	

OPINION AND ORDER OF THE BOARD (by C.M. Santos):

Southern Illinois Power Cooperative (SIPC) filed a petition (Pet.) requesting that the Board grant an alternative thermal effluent limitation for discharges from its Marion Generating Station (MGS) to Lake of Egypt. MGS is in Williamson County; Lake of Egypt is located in both Williamson and Johnson Counties. SIPC requests that its proposed alternative limitations apply instead of those in its National Pollutant Discharge Elimination System (NPDES) permit based on the Board's water quality standards for temperature. The Illinois Environmental Protection Agency (IEPA) recommends that the Board grant the request.

Based on the record before it, the Board grants SIPC alternative thermal effluent limitations as modified for the month of March and described in its order below.

GUIDE TO THE BOARD'S OPINION

The Board first provides a table of abbreviations and acronyms at page 2 and the procedural background at pages 2-6. The Board then summarizes the factual background, including SIPC's NPDES permit and its detailed plan of study, at pages 6-14. The Board presents SIPC's requested alternative standard at pages 14-15 and addresses the legal background at pages 15-17.

The Board's discussion first addresses SIPC's Biotic Category Identification at pages 19-38. Next, the Board reviews SIPC's Retrospective Demonstration at pages 38-39. At pages 39-65, the Board then reviews SIPC's Predictive Demonstration, which includes an analysis of Representative Important Species (RIS). At pages 65-86, the Board makes findings regarding the Biotic Category Criteria and SIPC's Master Rationale before making its overall determination. In these sections, the Board applies draft guidance prepared by the United States Environmental Protection Agency (USEPA) entitled Interagency 316(a) Technical Guidance Manual and Guide for Thermal Effects Section of Nuclear Facilities Environmental Impact Statements (DRAFT) dated May 1, 1977 (USEPA 316(a) Manual). *See* 35 Ill. Adm. Code 106.1120(e).

The Board reaches its conclusion and issues its order at pages 86-88.

TABLE OF ABBREVIATIONS AND ACRONYMS

CFB	circulating fluidized bed
CPUE	catch per unit effort
CSHE	Coefficient of Surface Heat Exchange
CWA	Clean Water Act
GLLVHT	Generalized Longitudinal Lateral Vertical Hydrodynamic Transport
IEPA	Illinois Environmental Protection Agency
INHS	Illinois Natural History Survey
MGS	Marion Generating Station
MW	megawatt
MWAT	mean weekly average temperature
NPDES	National Pollutant Discharge Elimination System
RIS	Representative Important Species
SAV	submerged aquatic vegetation
SIPC	Southern Illinois Power Cooperative
T_{eq}	equilibrium temperature
UILT	upper incipient lethal temperature
USEPA	United States Environmental Protection Agency

PROCEDURAL BACKGROUND

2014 Petition

On May 13, 2014, SIPC filed a petition for alternative thermal effluent standards for discharges from MGS.[1] SIPC v. IEPA, PCB 14-129; *see* Exh. B, App. C; Pet. at 14.

The Board found that SIPC had not provided sufficient information to support a low potential impact determination for the following four biotic categories: phytoplankton, zooplankton and meroplankton, macroinvertebrates and shellfish, and habitat formers. SIPC v. IEPA, PCB 14-129, slip op. at 21-22 (Nov. 20, 2014); *see* Exh. B at 1-2; Rec. at 4. Accordingly,

[1] On February 20, 2014, the Board adopted procedural rules for alternative thermal effluent limitations. 35 Ill. Adm. Code 106.Subpart K; Procedural Rules for Alternative Thermal Effluent Limitations under Section 316(a) of the Clean Water Act, R 13-20. These rules include requirements that a petitioner submit early screening information and a detailed plan of study to IEPA. 35 Ill. Adm. Code 106.1115, 106.1120. IEPA had discussed the relief proposed in PCB 14-129 with SIPC since before February 2010. SIPC v. IEPA, PCB 14-129 (May 13, 2014) (Exh. E to petition). IEPA concluded that SIPC had met the requirements of the procedural rules before the Board adopted them. SIPC v. IEPA, PCB 14-129, slip op. at 10 (June 26, 2014) (IEPA recommendation).

the Board found that SIPC's demonstration lacked "sufficient information to make a successful criterion determination for a site *not* considered low potential impact" for those four biotic categories. SIPC v. IEPA, PCB 14-129, slip op. at 21-22 (Nov. 20, 2014) (emphasis in original).

The Board also determined that SIPC had not considered all necessary RIS of fish. SIPC v. IEPA, PCB 14-129, slip op. at 26 (Nov. 20, 2014). The Board agreed with IEPA's recommendation that SIPC study a thermally sensitive species and also study the effect of thermal loadings on common carp as a potential nuisance species. *Id*. at 27.

On November 20, 2014, the Board denied the petition. The Board found that SIPC had not demonstrated that thermal effluent limitations in its NPDES permit are more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the Lake of Egypt. The Board found that SIPC had not proven that proposed alternative discharge limitations "will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on that body of water." SIPC v. IEPA, PCB 14-129, slip op. at 28 (Nov. 20, 2014), citing 33 U.S.C. § 1326; *see* 35 Ill. Adm. Code 106.1160(b), 106.1160(c).

Procedure Before Filing Petition with the Board

Early Screening Information. Before filing a petition for alternative thermal standards, a petitioner must submit specified early screening information to IEPA. 35 Ill. Adm. Code 105.1115(a). Within 30 days after submitting it, the petitioner must consult with IEPA on that information. 35 Ill. Adm. Code 106.1115(b).

In 2004, SIPC retained AMEC Environment & Infrastructure, Inc. (AMEC) to conduct studies and collect data. Pet. at 14. AMEC began performing this work in 2006 and continued through 2010. *Id*. From 2010 to 2014, SIPC consulted with IEPA on AMEC's findings. *Id*. On May 13, 2014, SIPC filed its petition in PCB 14-129. *Id*., citing Exh. B, App. C (AMEC report).

After the Board denied SIPC's petition in PCB 14-129, SIPC retained ASA Analysis & Communication, Inc. (ASA) to perform supplemental studies. Pet. at 14. ASA prepared a draft Plan of Study, and SIPC submitted it as early screening information to IEPA on November 2, 2015. *Id*.; Exh. B at 1-3. On December 2, 2015, SIPC met with IEPA to review the information and solicit comments. Exh. B. at 1-3; *see* Rec. at 4.

Detailed Plan of Study. After submitting early screening information to IEPA, a petitioner must submit a detailed plan of study to support its request. 35 Ill. Adm. Code 106.1120(a). SIPC submitted its detailed plan of study to IEPA on January 29, 2016. Pet. at 14, citing Exh. B, App. A (ASA plan). The plan reflects IEPA's comments and suggestions. Exh. B. at 1-3; *see* Rec. at 4.

IEPA Response. Within 90 days after receiving a detailed plan of study, IEPA must respond in writing by approving it or "recommending necessary revisions." 35 Ill. Adm. Code 106.1120(f). By letter dated March 24, 2016, IEPA approved SIPC's plan. Pet. at 14, citing Exh. E. However, IEPA reserved comment on SIPC's characterizing Lake of Egypt as an area of low potential impact for zooplankton and meroplankton. IEPA recommended two years of sampling for dissolved oxygen and temperature instead of the proposed single year. Exh. E; *see* Rec. at 7.

Completing Plan. After receiving IEPA's response, SIPC implemented its detailed plan of study. 35 Ill. Adm. Code 106.1120(g). ASA retained Dr. Robert E. Colombo of Eastern Illinois University (EIU) to perform field sampling and analysis. Exh. B at 1-2 – 1-3. EIU conducted studies during the summer and fall of 2016 and prepared a report of the results. *Id*. at 1-3, 3-1; Pet. at 14; *see* Exh. B, App. B (EIU report). During the spring of 2017, SIPC met with IEPA to review the results. Pet. at 14. Although IEPA recommended two years of sampling for dissolved oxygen and temperature, IEPA reviewed results of the 2016 sampling season and concluded that it represented a typical year. Rec. at 10. IEPA agreed that SIPC should complete its demonstration and prepare a petition for alternative thermal effluent limitations. *Id*. at 14-15; *see* Exh. B at 1-3.

Petition to the Board

On April 12, 2018, SIPC filed its petition accompanied by five exhibits and nine appendices to Exhibit B:

Exhibit A: NPDES permit No. IL0004315 issued to SIPC for MGS (Exh. A);

Exhibit B: Updated 316(A) Variance Demonstration report for MGS (Nov. 8, 2017) prepared by ASA (Exh. B);

- Appendix A MGS 316(A) Study Plan (Jan. 29, 2016) prepared by ASA (Exh. B, App. A);

- Appendix B Supplemental Data Collection for MGS 316(a) Studies (June – Oct. 2016), prepared by EIU (Exh. B, App. B);

- Appendix C Evaluation of Site-Specific Thermal Standards at MGS (Oct. 2013) prepared by AMEC (Exh. B, App. C);

  - Appendix A MGS 316(b) Impingement Mortality Characterization Report (Feb. 4, 2008) prepared by MACTEC Engineering and Consulting, Inc.[2] (Exh. B, App. C, App. A);

  - Appendix B Surface Water Temperatures Along Five Transects in the Lower Portion of Lake of Egypt, 2006 (Exh. B, App. C, App. B);

  - Appendix C AmerenCIPS Newton Lake Project 15 August 1997 – 30 August 1999 (Exh. B, App. C, App. C);

[2] MACTEC is now Amec Foster Wheeler or "AMEC".

Appendix D Current Status of Sport Fish Populations in Lake of Egypt – 1988 (Exh. B, App. C, App. D);

Appendix E Status of Sport Fish Populations in Lake of Egypt and Management Recommendations – 1990 (Exh. B, App. C, App. E);

Appendix F Supplemental Spring and Fall Hydrothermal Modeling (Feb. 6, 2013) (Exh. B, App. C, App. F);

Exhibit C Map of Lake of Egypt and Official Lake of Egypt Rules and Regulations, September 12, 2012 (Exh. C);

Exhibit D Map of Shawnee National Forest, United States Forest Service (Exh. D); and

Exhibit E Letter from IEPA to SIPC Approving Detailed Plan of Study (Mar. 24, 2016) (Exh. E).

Notice and Opportunity to Request Hearing

SIPC served a copy of the petition on IEPA and the Illinois Department of Natural Resources (IDNR). *See* 35 Ill. Adm. Code 106.1125. On April 23, 2018, SIPC filed a certificate of publication stating that the *Southern Illinoisan*[3] of Carbondale published notice of the filing of the petition on April 15, 2018. *See* 35 Ill. Adm. Code 106.1135(a), 106.1140. The notice stated that any person may within 21 days after the date of publication request that the Board hold a public hearing. *See* 35 Ill. Adm. Code 106.1135(b)(7). A request was to be received by the Board on or before Monday, May 7, 2018. The Board did not receive a request to hold a public hearing and did not hold one.

Board Order Accepting Petition

On June 21, 2018, the Board found that SIPC had provided timely and sufficient notice of filing the petition. The Board also noted that it had not received a request to hold a hearing. The Board accepted the petition but stated that it had not determined whether it would hold a hearing. The order added that the Board "may submit questions to SIPC through a Board or hearing officer order."

IEPA Recommendation

On May 23, 2018, IEPA filed its recommendation (Rec.) that the Board grant the relief requested by SIPC. Rec. at 4, citing 35 Ill. Adm. Code 106.1145. The Board received no response to IEPA's recommendation. *See* 35 Ill. Adm. Code 106.1145(c).

Board Questions and SIPC Responses

[3] The certificate states that the *Southern Illinoisan* is published daily in Jackson County and is a newspaper of general circulation in eight counties including Williamson and Johnson.

On December 7, 2018, the Board's hearing officer issued an order, attached to which were 32 questions addressed to SIPC. The order directed SIPC to file written responses to the questions on or before January 7, 2019 (Board Questions). On January 2, 2019, the hearing officer granted SIPC's unopposed motion to extend the deadline to February 6, 2019. On February 7, 2019, SIPC filed its responses to the Board's questions (SIPC Resps.).

FACTUAL BACKGROUND

Marion Generating Station

Petitioner

"SIPC is a consumer-owned generation and transmission cooperative" based in Marion, Illinois. Pet. at 7; Exh. B at 1-3.

Site

MGS is located approximately seven miles south of the City of Marion. *Id*. The plant withdraws cooling water from and discharges cooling water to the Lake of Egypt, which SIPC created in 1963 by impounding the South Fork of the Saline River. Exh. B. at 1-3; Exh. B, App. C at 1.

SIPC owns 4,674 acres near MGS and around the Lake of Egypt up to the 50-year high water elevation. Pet. at 7; Exh. B. at 1-3; Exh. B, App. C at 2; *see* Exh. B at 1-5 (Figure 1-1: Location of MGS); Exh. B, App. C at Figure 1-1 (map).

Lake of Egypt

SIPC created Lake of Egypt in 1963 to provide cooling water for and to cool heated effluent from MGS. SIPC created Lake of Egypt before Illinois adopted surface water quality standards. Pet. at 11 (citations omitted). SIPC states that it created the lake "before artificial cooling lakes were deemed waters of the State." Pet. at 11 (citation omitted).

Because the South Fork of the Saline River runs north, the dam impounding the lake is at its northern end. MGS is located on the northwest bank, which is considered the lower end of the lake. Pet. at 11; Exh. B. at 1-3; Exh. B., App. C at 1; *see* Exh. B at 1-5 (Figure 1-1: Location of MGS); Exh. B, App. C at 64 (Figure 1-1: map). The Lake of Egypt "has a surface area of approximately 2,300 acres and approximately 93 miles of shoreline." Pet. at 11, citing Exh. B, App. C at 2; *see* Exh. B at 1-3. The lake has an average depth of 18 feet and a maximum depth of 52 feet. *Id*.

In addition to cooling water withdrawn for MGS, "[t]he Lake of Egypt Water District withdraws water from the lake to supply approximately 1 million gallons per day of drinking water to Union, Jackson, and Williamson Counties." Pet. at 11. Although the lake is privately owned, SIPC allows public access for fishing and recreational activities. Exh. B at 1-3; Exh. B, App. C at 2. One marina on the lake hosted 62 official fishing tournaments between October 2016 and May 2017, and SIPC reports that the lake hosted other tournaments that were undocumented or held at other marinas. Pet. at 10. One access point, the Hickory Ridge boat launch and campground, is located within the Shawnee National Forest. Pet. at 12; *see* Exhs. C, D (maps).

IEPA reports that the Lake of Egypt is classified as a General Use Water. IDNR has not listed the lake as a biologically significant stream or given it an integrity rating. Rec. at 3. The draft 2016 Illinois Integrated Water Quality Report and Section 303(d) List includes lake segment RAL as "impaired for fish consumption use with potential causes given as mercury and polychlorinated biphenyls." *Id*. The lake fully supports aquatic life, public and food processing water supply, and aesthetic quality uses. *Id*. "Lake of Egypt is not subject to enhanced dissolved oxygen standards." *Id*.

Generating Capacity

The MGS "consists of two coal-fired units (Units 4 and 123) and 2 combined-cycle units (Units 5 and 6)." Exh. B at 1-3; *see* Pet. at 7; *see also* 35 Ill. Adm. Code 106.1130(a)(1).

Unit 123. "Unit 123 is a 109 MW net circulating fluidized bed (CFB) boiler which came on line in 2003 and provides steam to three small turbines." *Id*.; *see* Exh. B, App. C at 1. Unit 123 replaced three 33 MW cyclone boilers. Pet. at 7. "Before the new boiler came on line, Units 1, 2, and 3 served primarily as peaker units, operating during the times of highest demand in the summer and winter months. The new boiler, Unit 123, now operates around the clock." Pet. at 7.

The 2013 Demonstration states that "[t]he additional boiler that became operational in 2003 resulted in increases of water use and volume of thermal water discharged into the lake." Exh. B, App. C at 1. However, the petition states that operating Unit 123 beginning in 2003 did not appreciably increase effluent volume but dramatically increased "the frequency of thermal discharges." Pet. at 7. The Board asked SIPC to "clarify the effect that operation of Unit 123 beginning in 2003 had on the frequency and volume of thermal discharges to the lake." Board Questions at 2.

SIPC responded that neither the new boiler nor a repowering project for Unit 123 "changed the original design in a manner that changed the volume of the thermal discharge." SIPC Resps. at 5. SIPC reported that original turbines remain in place and that "[t]here were no modifications to the circulating water pumps or the three condensers." *Id*. SIPC added that repowering affected the discharge frequency. *Id*. The capacity factor was 33% and 23% in 2001 and 2002, respectively, and 87% and 92% in 2004 and 2005, respectively. *Id*. at 5-6. Based on these increases, SIPC estimates that "the discharge was two to three time more frequent after the repowering." *Id*. at 6.

Unit 4. "Unit 4 is a 173-megawatt (MW) net cyclone boiler which came on line in 1978 and provides steam to one large turbine." Exh. B at 1-3; *see* Exh. B, App. C at 1; Pet. at 7.

Units 5 and 6. "Units 5 and 6 are nominally rated at approximately 83 MW." Exh. B at 1-3; *see* Pet. at 7. The Board noted that SIPC did not include Units 5 and 6 in its discussion of heated effluent, method for heat dissipation, load factor, or shutdowns. Board Questions at 2. The Board asked SIPC to indicate "whether Units 5 and 6 contribute to the thermal loading of the heated effluent to the Lake of Egypt." *Id*. SIPC responded that "Units 5 and 6 are natural gas-fired simple cycle turbines which do not require cooling water to operate. Therefore, they do not contribute to the heated effluent discharged to Lake of Egypt." SIPC Resps. at 5.

Fuel

MGS, a coal-fired power plant, "uses Illinois basin bituminous coal." Pet. at 8; *see* 35 Ill. Adm. Code 106.1130(a)(2).

Load Factors

"MGS operates as a base load facility." Exh. B at 1-4.

SIPC reports the load factor of Unit 123 as 79% in 2009, 85% in 2010, 84% in 2011, 82% in 2012, 78% in 2013, 81% in 2014, 82% in 2015, 76% in 2016, and 64% in 2017. Pet. at 8; *see* 35 Ill. Adm. Code 106.1130(a)(4); Exh. B at 1-4.

SIPC reports the load factor of Unit 4 as 75% in 2009, 76% in 2010, 80% in 2011, 74% in 2012, 75% in 2013, 73% in 2014, 77% in 2015, 71% in 2016, and 73% in 2017. Pet. at 8; Exh. B at 1-4; *see* 35 Ill. Adm. Code 106.1130(a)(4).

SIPC projects that "load factors should follow past load factors for each unit for the life of the plant." Pet. at 8; *see* 35 Ill. Adm. Code 106.1130(a)(5).

The Board asked SIPC whether it foresees "any factors that may cause projected load factors to vary from past load factors instead of following them." Board Questions at 2. If it does foresee any factors, the Board asked SIPC to identify them. *Id*. SIPC responded that "[p]rojected load factors are lower than past load factors. SIPC Resps. at 5. SIPC expects that projected load will be affected by decreased demand for coal sources resulting from "lower market prices due to lower natural gas prices." *Id*. SIPC reports that the U.S. Energy Information Administration also generally projects lower capacities for coal-fired units. *Id*. (citation omitted).

Estimated Retirements

SIPC states that it "has no plans to retire either unit, or to add units." Pet. at 8; *see* 35 Ill. Adm. Code 106.1130(a)(6).

Shutdowns

For the last five years, SIPC reported for both Unit 123 and Unit 4 the number of shutdowns and the number of the scheduled and unscheduled hours. Pet. at 9; *see* 35 Ill. Adm.

Code 106.1130(a)(7), (a)(8). Planned shutdowns are included in scheduled hours reported and unplanned or emergency shutdowns in unscheduled hours. Pet. at 9.

For Unit 123 in 2013, SIPC reports nine shutdowns with 1,129 scheduled and 98 unscheduled hours. In 2014, there were 10 shutdowns with 842 scheduled and 18 unscheduled hours. In 2015, SIPC reports eight shutdowns with 840 scheduled and one unscheduled hour. In 2016, there were eight shutdowns with 1,076 scheduled and 56 unscheduled hours. In 2017, SIPC reports 10 shutdowns with 939 scheduled and 76 unscheduled hours. Pet. at 9.

For Unit 4 in 2013, SIPC reports 13 shutdowns with 864 scheduled and 330 unscheduled hours. In 2014, there were nine shutdowns with 1,855 scheduled and 133 unscheduled hours. In 2015, SIPC reports eight shutdowns with 987 scheduled and 143 unscheduled hours. In 2016, there were 16 shutdowns with 1,337 scheduled and 298 unscheduled hours. In 2017, SIPC reports 13 shutdowns with 1,097 scheduled and 347 unscheduled hours. Pet. at 9.

SIPC also projected shutdowns for Unit 123 and Unit 4. Pet. at 10; *see* 35 Ill. Adm. Code 106.1130(a)(9). In each year from 2018 to 2023, SIPC projects that Unit 123 will be shut down twice for 840 scheduled hours. Pet. at 10. For Unit 4, SIPC projects two shutdowns in each of those years with 888 scheduled hours in 2018, 768 scheduled hours in 2019, 1,584 scheduled hours in 2020, and 768 scheduled hours in both 2021 and 2022. *Id*.

Heat Dissipation

Type of System

MGS uses "once-through cooling for all four turbines." Pet. at 12; *see* 35 Ill. Adm. Code 106.1130(b)(1). The system uses a "common intake from and discharge to Lake of Egypt to dissipate waste heat from the Station." Pet. at 12.

Condenser Cooling System

The cooling system at MGS consists of "the main condenser, two condensate pumps, air ejection equipment, drain cooler, two low pressure heaters and associated piping and valves." Pet. at 8; *see* 35 Ill. Adm. Code 106.1130(a)(3). "Circulating water serves as the coolant." Pet. at 8.

Discharges

MGS discharges water to Lake of Egypt "at an average flow rate of approximately 173,000 gallons per minute." Pet. at 12; Rec. at 3; *see* Exh. A at 4 (Outfall 003 Condenser Cooling Water). When Unit 123 began operating in 2003, "the frequency of thermal discharges increased dramatically." Pet. at 7.

Cooling water discharges into a cove "separated from the intake structure by a narrow peninsula." Exh. B at 1-3; *see id*. at 1-6 (Figure 1-2); Exh. B, App. C (Figure 1-2). The Board asked SIPC to address the configuration and operation of the discharge outfall under Section

3.5.3.4 of the USEPA 316(a) Manual. Board Questions at 2. SIPC provided the configuration, including the length of the discharge pipe or canal; the area, dimensions, and spacing of two discharge ports; the mean and extreme depths; and the angle of discharge. SIPC Resps. at 4. SIPC also submitted a drawing of the weir and outfall plan and elevation. *Id*., Attachment B.

Over the last 10 years, the monthly maximum instantaneous temperature of the discharge at the outfall ranged from 78°F to 124°F. Pet. at 12. Discharge temperature is typically 25°F to 30°F above the intake temperature. *Id*.; *see* 35 Ill. Adm. Code 106.1130(b)(2).

Heated water discharged into the lake settles into an upper layer with some mixing at the boundary with the lower layer. Pet. at 12. These layers result from differences in density, and the phenomenon is known as stratification. *Id*. "The heated water is cooled by evaporation, convective heat transfer with the air, convective heat transfer with the lower water layers, and thermal radiation to the atmosphere." *Id*. at 12-13. Cooling can also result from mixing heated water with cooler water from other areas of the lake and precipitation and runoff into the lake. *Id*. at 13. The discharge peninsula constructed by SIPC provides "a flow path for warm discharge water to allow for a greater duration of mixing, evaporative cooling, and convective heat dissipation before the water is recirculated back to the plant." *Id*. at 12; *see* Exh. B at 1-3, 1-6 (Figure 1-2); Exh. B, App. C (Figure 1-2).

Local weather conditions can affect the lake's ability to dissipate heat. Droughts lower lake levels, "reducing the total surface area available for heat transfer." Pet. at 13. High air temperatures reduce the difference from the heated water temperature "so convective and conductive heat transfer is less effective." *Id*. High humidity also reduces the heat transfer resulting from evaporative cooling. *Id*. SIPC cites unusual weather conditions in December 2012, when unusually high temperature and humidity resulted "in the lake behaving as a thermal energy storage device rather than as a means to dissipate heat." *Id*.

NPDES Permit

IEPA issued NPDES Permit No. IL0004316 to MGS on February 1, 2007, with an effective date of March 1, 2007. Exh. A at 2. The permit expired on February 29, 2012.[4] *Id*. The permit authorizes seven discharges including Outfall 003 of Condenser Cooling Water to Lake of Egypt. *Id*. The permitted discharge from Outfall 003 includes a temperature limit at Special Condition 4 and an additional thermal discharge requirement at Special Condition 7, which are summarized in the following subsections.

Special Condition 4

[4] For the purposes of this opinion and order, the Board assumes that SIPC initiated NPDES permit renewal "not later than 180 days prior to the expiration date" in order to "receive authorization to discharge beyond the expiration date." Exh. A at 2 (NPDES permit). The Board notes that the 2013 demonstration supports both site-specific thermal standards and permit renewal, although its October 2013 date is later than the permit's expiration. Exh. B, App. C.

Special Condition 4 requires that "[d]ischarge of wastewater from this facility must not alone or in combination with other sources cause the receiving water to violate" specified thermal limitations at the edge of the mixing zone. Exh. A at 7, citing 35 Ill. Adm. Code 302.211.

Condition 4(A). This special condition provides that "[m]aximum temperature rise above natural temperature must not exceed 5°F (2.8°C)." Exh. A at 7; *see* 35 Ill. Adm. Code 302.211(d); Pet. at 15, 34; Exh. B at 1-7; Exh. B, App. C at 2; Rec. at 2. SIPC states that, because it constructed Lake of Egypt to cool discharges, "baseline lake conditions are manmade." Pet. at 15.

Condition 4(B). This special condition based on Section 302.211(e) of the Board's water pollution regulations provides that "[w]ater temperatures at representative locations in the lake shall not exceed the maximum limits in the following table during more than one (1) percent of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature at such locations exceed the maximum limits in the following table by more than 3°F (1.7 C)."

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
60	60	60	90	90	90	90	90	90	90	90	60°F
16	16	16	32	32	32	32	32	32	32	32	16°C

Exh. A at 7; *see* 35 Ill. Adm. Code 302.211(e); Exh. B at 1-7; Exh. B, App. C at 2; Rec. at 2.

SIPC argues that "the Board has held that the seasonal temperature limits found in Section 302.211(e) do not apply to lakes." Pet. at 34, citing Board of Trustees of SIU v. IEPA, PCB 02-105, slip op. at 13 (Aug. 4, 2005). SIPC concludes that these limits do not apply to Lake of Egypt and should not be included in a reissued permit. Pet. at 34.

Special Condition 7

This special condition cites increased thermal discharge volume and requires that SIPC must comply with 35 Ill. Adm. Code 302.211(f) and Section 316(a) of the Clean Water Act (CWA) by demonstrating that the MGS thermal discharge "will not cause and cannot reasonably be expected to cause significant ecological damage to Lake of Egypt. Pursuant to 35 Ill. Adm. Code 302.211g no additional monitoring or modification is being required for reissuance of this NPDES permit." Exh. A at 7; *see* 35 Ill. Adm. Code 302.211(f), (g); Pet. at 15.

To satisfy this requirement, SIPC began performing studies in 2006. Pet. at 2, 15. SIPC's 2013 demonstration states that their purpose "is to fulfill the requirements of Special Condition No. 7, which asks SIPC to perform a heated effluent demonstration, and to support a request for a less stringent thermal effluent limit." Exh. B, App. C at 1. Studies continued through 2016, and the 2017 demonstration includes the final results. Pet. at 2.

Thermal Compliance History

SIPC's current NPDES permit provides that compliance with the permitted temperature limits must be demonstrated using a computer model, "PDS program." The model estimates the area of the thermal plume and surface temperatures at the edge of the mixing zone. Pet. Exh. A at 7 (Special Condition 4(D)). SIPC states that MGS "has not received any violation notices related to the discharge temperature during the last five years." Pet. at 13; *see* 35 Ill. Adm. Code 106.1130(c).

Implementing the Detailed Plan of Study

SIPC retained ASA and EIU to prepare and implement the detailed plan of study approved by IEPA on March 24, 2016. Exh. B, Exh. E, Rec. at 7. The plan assessed previous data collections and studies as well as new biological and water quality studies. Exh. B, App. A at A-4.

Heidinger/Southern Illinois University Studies

From 1977 to 2007, Dr. Roy Heidinger of Southern Illinois University (SIU) studied Lake of Egypt and the effects of MGS's thermal discharge. Pet. at 16. Dr. Heidinger conducted fish studies in 1977, 1986, 1988, 1990, 1995, 2000, and 2007. Exh B. at 1-1; *see* Pet. at 16. Based on data collected from 1997 to 1999, SIU's 2000 study examined the effects of thermal loading on fish conditions in three Illinois lakes including Lake of Egypt. Pet. at 16-17, citing Exh. B, App. C, App C at 9-1 – 9-22 (fish health); *see* Exh. B at 1-1.

SIU also studied temperature and dissolved oxygen in Lake of Egypt from 1997 to 1999. Pet. at 17, citing Exh. B, App. C, App. C at 1-14, 15-1 – 15-7; *see* Exh. B at 1-1. The study documented lake temperature stratification near the intake structure. Exh. B, App. C at 24, citing *id*. at 76 (Figure 5-1). The study also found the "normal seasonal pattern of higher temperatures/lower dissolved oxygen concentrations in the summer and the inverse pattern of these conditions in the winter." *Id*. at 24, citing *id*. at 73-74 (Figures 5-2, 5-3). SIU also "conducted age-growth studies on several species of fish" between 1997 and 1999. Pet. at 17, citing Exh. B, App. C, App. C at 11-1 – 11-11.

AMEC Studies

In 2006, SIPC retained AMEC to conduct thermal studies of the Lake of Egypt. Pet. at 17. AMEC collected data regarding the fishery and water quality, including temperature and dissolved oxygen. *Id.*; Exh. B, App. C at 24, 74 (Figure 5-3). AMEC measured temperature three times along each of five transects. Exh. B, App. C at 24; *see id*. at 75-77 (Figures 5-4, 5-5, 5-6: lower zone surface water temperatures); Exh. B, App. C, App. B.

AMEC also performed hydrothermal modeling of lake temperatures under normal and stressed conditions. *Id*., citing Exh. B, App. C at 81-84 (Figures 5-10 – 5-13); *see* Exh. B, App. C at 26-38. SIPC proposed temperature limits based on results of the modeling. Pet. at 17, 18.

AMEC summarized data including the hydrothermal modeling to prepare the 2013 demonstration. Pet. at 18, citing Exh. B, App. C.

Impingement Sampling (2005-2007)

Fish and other larger organisms may be drawn into a facility's intake and become entrapped by the screening system intended to keep floating materials from entering the cooling water system. This impingement may cause these organisms to experience suffocation, injury, and physical stress. Exh. B, App. C, App. A at 1. MACTEC conducted weekly impingement sampling at MGS from May 2005 to May 2007. *Id*. at 16; *see* Exh. B at 1-1. Results of the study include fish collected in impingement samples. Exh. B, App. C, App. A at 19-28.

2010 Fish Studies

AMEC performed electrofishing surveys at nine stations within Lake of Egypt in 2010. Exh. B, App. C at 22. The survey intended to supplement data previously collected by Dr. Heidinger in the 1990s and by the impingement study. *Id*. at 6; *see id*. at 8-10 (Tables 3-1, 3-2, 3-3). "Water temperatures were measured at depths of 2 and 8 feet at each of the electrofishing sampling stations during fisheries surveys in July and August 2010." Exh. B, App. C at 24; *see id*. at 25 (Table 5-1).

Bathymetry Study (2010)

In 2010, AMEC performed a bathymetric study to specify the physical configuration of the discharge area and the mixing zone. Exh. B, App. C at 25. The study shows "the narrowness of the shallow (less than [<] 10 feet) nearshore littoral zone habitat in the lower half of the lake." *Id*.; *see id*. at 80 (Figure 5-9: bathymetric profile). Many areas of the main body of the lake are 25 to 40 feet deep, including the cove containing the MGS intake structure. *Id*. The station discharges water into a cove that is mostly less than 20 feet deep. *Id*. The cove has "a very shallow fringe area" two to five feet deep and a channel ranging from 10 to 25 feet deep. *Id*.

ASA Supplemental Studies (2016)

SIPC retained ASA to determine whether more detailed studies were necessary to address the biotic categories for which site-specific data was not available. Pet. at 19; *see* SIPC v. IEPA, PCB 14-129, slip op. at 21-22 (Nov. 20, 2014); Exh. B at 1-2. During 2016, EIU conducted supplemental studies to collect site-specific data on the four biotic categories and the fish species addressed in the Board's 2014 order. Pet. at 19-20; *see* Exh. B at 1-2 – 1-3, 3-1; Exh. B, App. A at A-8 – A-15.

During three sampling events, EIU collected samples of phytoplankton, zooplankton and meroplankton, and macroinvertebrates and shellfish. Pet. at 19; *see* Exh. B at 3-1; Exh. B, App. B at B-10 – B-12, B-15 – B-17. EIU also performed one survey of habitat formers. Pet. at 19; *see* Exh. B, App. B at B-12 – B-13, B-17. ASA performed electrofishing targeting common carp as a nuisance species. Pet. at 20. To address white crappie and black crappie as thermally sensitive species, EIU conducted additional electrofishing and sampling. *Id.*; *see* Exh. B, App. B at B-13 – B-14, B-18 – B-19.

EIU also monitored dissolved oxygen and temperature weekly from June to September 2016 at five sampling locations in each of the three lake zones. EIU sampled at 0.5-meter intervals from the surface to the bottom of the lake. Exh. B, App. B at B-10.

SIPC'S PROPOSED ALTERNATIVE THERMAL EFFLUENT LIMITATION

SIPC proposed the following alternative thermal effluent limitation:

> In lieu of the temperature water quality standards defined by Section 302.211, the thermal discharge to Lake of Egypt from SIPC's Marion Generating Station shall not exceed the following maximum temperatures, measured at the outside edge of the 26-acre mixing zone in Lake of Egypt, by more than 1 percent of the hours in a 12-month period ending in any month.
>
> 1. 72°F from December through March;
>
> 2. 90°F from April through May;
>
> 3. 101°F from June through September; and
>
> 4. 91°F from October through November.
>
> At no time shall the water temperature at the edge of the mixing zone exceed these maximums by more than 3°F.

Pet. at 34-35; Exh. B at i, 1-7 – 1-8; Exh. B, App. C at 55-56; Rec. at 3.

SIPC proposed to determine compliance with the alternative thermal effluent limitations "through temperature monitoring at the outside edge of the mixing zone." Pet. at 35; *see* Exh. B, App. C at 55. "SIPC monitors temperature using a continuous monitoring device on a buoy placed in Lake of Egypt" and will use data from this device. Pet. at 35. SIPC's current NPDES permit provides that "[t]he computer model, PDS program, shall be used to predict plume trajectory and the area enclosed by the surface isotherms to determine compliance with the above [permitted] temperature limitations." Pet. Exh. A at 7.

By requesting relief generally from 35 Ill. Adm. Code 302.211, SIPC appears to request relief from all requirements under Section 302.211. *See* Pet. at 12. However, SIPC's NPDES permit imposes only the numeric standards based on subsections (d) and (e). Section 302.211 includes additional requirements to perform studies as required by IEPA (35 Ill. Adm. Code 302.211(h)) and to take corrective measures if the thermal effluent causes significant ecological damage (35 Ill. Adm. Code 302.211(i)).

The Board asked SIPC to explain whether it requests "relief from the entirety of Section 302.211." SIPC responded that "it specifically requests that the proposed alternative thermal effluent limits apply to SIPC's discharge in lieu of the temperature limits in 35 Ill. Adm. Code 302.211(d). SIPC Resps. at 12. SIPC argues that temperature limits at 35 Ill. Adm. Code 302.211(e) "do not apply to lakes" and requests that its renewed NPDES permit not include Condition 4(B). *Id*. SIPC "does not seek relief from the remaining subsections of Section 302.211." *Id*.

LEGAL BACKGROUND

Statutory and Regulatory Background

The CWA makes it unlawful for any person to discharge a pollutant from a point source into waters of the United States without a permit. 33 U.S.C. § 1311(a). Heat is a pollutant (33 U.S.C. § 1362(6)), and heated discharges require a permit. In general, discharge limitations in a permit are technology-based or water-quality based. 33 U.S.C. § 1311(b). Technology-based effluent limits generally are developed for an industry and reflect the "best available technology economically achievable." 33 U.S.C. § 1311(b)(2)(A); *see, e.g.*, 40 C.F.R. Parts 405-471.

Water quality-based effluent limits ensure that water quality standards are met regardless of technology or economics considered in establishing technology-based limits. Water quality-based effluent limits are defined as "any more stringent limitation, including those necessary to meet water quality standards, treatment standards, or schedules of compliance, established pursuant to any State law or regulations . . . or any other Federal law or regulation, or required to implement any applicable water quality standard." 33 U.S.C. § 1311(b)(1)(C).

Accordingly, if a discharge from a point source interferes with attainment or maintenance of a water quality standard, an effluent limitation is established for that discharge notwithstanding any other technology-based standard. 33 U.S.C. §§ 1311(b)(1)(C), 1312(a); *see* 35 Ill. Adm. Code 304.105 (Violation of Water Quality Standards). Water quality standards are set under authority provided in Section 303 of the CWA. 33 U.S.C. § 1313. Illinois law authorizes the Board to adopt water quality standards, including thermal standards. 415 ILCS 5/13 (2016). The Board's water quality temperature standards for general use waters are found at 35 Ill. Adm. Code 302.211.

Since adoption of the CWA in 1972, Section 316(a) has allowed a point source with thermal discharge to obtain relief from otherwise applicable thermal effluent limitations. Specifically, Section 316(a) provides that,

> [w]ith respect to any point source otherwise subject to the provisions of section 1311 of this title or section 1316 of this title, whenever the owner or operator of any such source, after opportunity for public hearing, can demonstrate to the satisfaction of the Administrator (or, if appropriate, the State) that any effluent limitation proposed for the control of the thermal component of any discharge from such source will require effluent limitations more stringent than necessary to assure the projection (sic) and propagation of a balanced, indigenous population

> of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made, the Administrator (or, if appropriate, the State) may impose an effluent limitation under such sections for such plant, with respect to the thermal component of such discharge (taking into account the interaction of such thermal component with other pollutants), that will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on that body of water. 33 U.S.C. § 1326(a) (Thermal Discharges); *see* Pet. at 3-4.

The Board's regulations define "balanced, indigenous community" or "BIC" as synonymous with the term "balanced, indigenous population" in the CWA:

> a biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species, and a lack of domination by pollution tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community will not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the CWA; and may not include species whose presence or abundance is attributable to alternative thermal effluent limitations imposed under this Subpart or to regulatory relief, granted by the Board, from otherwise applicable thermal limitations or standards under 35 Ill. Adm. Code 301 through 312. 35 Ill. Adm. Code 106.1110; *see* 40 C.F.R. § 125.71(c); *see* Pet. at 4.

Accordingly, Section 304.141(c)[5] of the Board's rules provides that

> [t]he standards of this Chapter shall apply to thermal discharges unless, after public notice and opportunity for public hearing, in accordance with section 316 of the CWA, applicable federal regulations, and procedures in 35 Ill. Adm. Code 106.Subpart K, the Board has determined that different standards shall apply to a particular thermal discharge. 35 Ill. Adm. Code 304.141(c); *see* Pet. at 3.

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[5] The Board originally adopted 35 Ill. Adm. Code 304.141(c) on August 29, 1974, as Rule 410(c) of Chapter 3 of the Board's Water Pollution Regulations, which provided that

> [t]he standards of Chapter 3 shall apply to thermal discharges unless, after public notice and opportunity for public hearing, in accordance with Section 316 of the [Federal Water Pollution Control Act] and applicable federal regulations, the Administrator and the Board have determined that different standards shall apply to a particular thermal discharge.

Thus, under Section 316(a) of the CWA and Section 304.141(c) of the Board's general effluent standards, the Board may establish an alternative thermal effluent limitation based on a demonstration that the alternate limit will assure the protection and propagation of a balanced and indigenous population of shellfish, fish, and wildlife in the receiving water. Part 106, Subpart K of the Board's procedural rules provides for review of a petition for an alternative thermal effluent standard. 35 Ill. Adm. Code 106.1100 – 106.1180. Establishing alternative thermal effluent limitations is not a change in a water quality standard.

In 1977, USEPA issued a draft manual on demonstrations under CWA Section 316(a). The draft manual provides that it "is intended to be used as a general guidance and as a starting point for discussions," and that delegated state agencies "are not rigidly bound by the contents of this document." USEPA 316(a) Manual at 8-9; *see* Pet. at 6. This guidance has not been finalized and remains a draft. Nevertheless, the Board has found that its decision criteria are a useful guide and followed its decision-making outline. *See* Exelon Generation LLC v. IEPA, PCB 15-204, slip op. at 2 (Mar. 3, 2016); Exelon Generation LLC v. IEPA, PCB 14-123, slip op. at 2 (Sept. 18, 2014). Also, a petitioner seeking alternative thermal effluent limitations must consider guidance published by USEPA in making its demonstration. 35 Ill. Adm. Code 106.1120(e).

In 1979, USEPA promulgated rules implementing CWA Section 316(a), which are codified at 40 C.F.R. § 125.Subpart H.

SIPC constructed Lake of Egypt as an Artificial Cooling Lake, and it is deemed waters of the State. Pet. at 11. SIPC seeks relief under Section 304.141(c) of the Board's rules and Section 316(a) of the CWA. Pet. at 7-8, Rec. at 3. Section 304.141(c) allows the Board to set thermal discharge standards different from the Board's water pollution regulations "in accordance with 316 of the CWA." Section 302.211(j) allows the Board to establish specific standards for thermal discharges to artificial cooling lakes. 35 Ill. Adm. Code 302.211(j); *see* Water Quality and Effluent Standards Amendments, Cooling Lakes, R75-2 (Aug. 14, 1975). USEPA considers a Section 316(a) alternate limitation under Section 304.141(c) as a variance, but a standard under Section 302.211(j) as permanent. Ameren Energy Generating Company, Coffeen Power Station v. IEPA, PCB 09-38 (Oct. 19. 2011) (USEPA letter to IEPA). USEPA points out that a Section 316(a) alternative limitation must be renewed with reissuance of each NPDES permit. SIPC is the first discharger to an artificial cooling lake to request a Section 316(a) alternate limitation under Section 301.141(c), and the Board notes USEPA's distinction.

Burden of Proof

The burden of proof is on SIPC. 35 Ill. Adm. Code 106.1160(a); *see* Pet. at 5. SIPC must demonstrate that an otherwise applicable thermal effluent limitation is "more stringent than necessary to assure the protection and propagation of a balanced, indigenous community of shellfish, fish, and wildlife in and on the body of water into which the discharge is made." 35 Ill. Adm. Code 106.1160(b). SIPC must also demonstrate that the requested alternative thermal effluent limitation, "considering the cumulative impact of its thermal discharge, together with all other significant impacts on the species affected, will assure the protection and propagation of a balanced indigenous community of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made." 35 Ill. Adm. Code 106.1160(c), 40 CFR § 125.73.

An applicant may demonstrate that its proposed alternative thermal effluent limitations will assure protection and propagation of the BIC based on a Predictive Demonstration. An existing discharger may demonstrate the absence of prior appreciable harm instead of using predictive studies. 35 Ill. Adm. Code 106.1160(d). This demonstration may be referred to as a Retrospective Demonstration and must show either:

> (A) That no appreciable harm has resulted from the normal component of the discharge, taking into account the interaction of such thermal component with other pollutants and the additive effect of other thermal sources to a balanced, indigenous community of shellfish, fish, and wildlife in and on the body of water into which the discharge has been made; or
>
> (B) That despite the occurrence of such previous harm, the desired alternative thermal effluent limitation (or appropriate modifications thereof) will nevertheless assure the protection and propagation of a balanced, indigenous community of shellfish, fish, and wildlife in and on the body of water into which the discharge is been made. 35 Ill. Adm. Code 106.1160(d)(1); *see* 40 C.F.R. § 125.73(c) (Criteria and standards for the determination of alternative effluent limitations under section 316(a)). USEPA 316(a) Manual at 17.

SIPC states that, as an existing discharger that has not changed operation since 2003, it can base its demonstration on the absence of prior appreciable harm. Pet. at 6. However, SIPC states that, because it requests alternative thermal limitations for the first time, "it has also prepared predictive studies to show the requested relief will assure the protection and propagation of the BIC in Lake of Egypt in the future." Pet. at 6; *see id.* at 22, citing Exh. B, App. C at 26-38 (§ 5.2: Hydrothermal Modeling).

BOARD DISCUSSION

As explained above, SIPC must demonstrate that the current standard is more stringent than necessary to assure and the requested alternative thermal effluent limitations will assure the protection and propagation of a balanced and indigenous population of shellfish, fish, and wildlife in the Lake of Egypt. *See* 33 U.S.C. § 1326(a).

The USEPA 316(a) Manual sets forth the main components for such demonstrations, beginning with a biotic category identification and early screening process to determine which type or types of demonstrations are appropriate for the site: Type I (Retrospective/Absence of Prior Appreciable Harm), Type II (Predictive/Representative Important Species), Type III (Low Potential Impact), and Other Type III (Biological, Engineering, and Other Data). The applicant synthesizes information from the demonstrations into a master rationale for the proposed alternate thermal effluent limitations.

SIPC begins with the Biotic Category Identification and then relies on both a Type I Retrospective/Absence of Prior Appreciable Harm Demonstration and a Type II Predictive/Representative Important Species Demonstration. In SIPC's retrospective approach, AMEC and ASA used historical data to demonstrate that the current discharge has resulted in no "prior appreciable harm" to the BIC. SIPC then uses a predictive approach, coupling hydrothermal modeling and dissolved oxygen surveys with biothermal response data for RIS, to evaluate the potential effects of SIPC's proposed alternative thermal effluent limitations.

In the following sections of the opinion, the Board summarizes the record on these elements of the demonstration and makes its findings as to whether SIPC's Type I Retrospective and Type II Predictive Demonstrations show that the current limitations are more stringent than necessary and that the requested alternative limitations meet the Biotic Category Criteria to assure the protection and propagation of the balanced, indigenous community.

Master Rationale

For a Section 316(a) demonstration to be successful under the Master Rationale, the demonstration as a whole must show that: (1) the demonstration is acceptable for the considerations under the decision train outlined in Section 3.2.2 of the USEPA 316(a) Manual; (2) the demonstration shows there will be no appreciable harm to the balanced indigenous community; (3) receiving water temperatures outside any mixing zone will not be in excess of the upper temperature limits for the life cycles of the RIS; (4) the absence of the proposed thermal discharge would not result in excessive growth of nuisance organisms; (5) a zone of passage provides for the normal movement of RIS; (6) there will be no adverse impact on threatened or endangered species; (7) there will be no destruction of unique or rare habitat without convincing justification; and (8) the use of biocides will not result in appreciable harm to the balanced, indigenous community. USEPA 316(a) Manual at 70-71.

Biotic Category Identification

A Section 316(a) demonstration begins by identifying the balanced, indigenous community in the receiving water. Biotic communities may contain numerous species. USEPA suggests that applicants assess thermal impacts on a community-by-community basis. The USEPA 316(a) Manual identifies six biotic categories - habitat formers (aquatic vegetation); phytoplankton; zooplankton and meroplankton; macroinvertebrates and shellfish; fish; and other vertebrate wildlife - that must be evaluated to determine whether a demonstration meets criteria for protecting and propagating the BIC. Exh. B. at 4-1; *see* USEPA 316(a) Manual at 18-32 (§§ 3.3 - 3.3.6). After completing the early screening process and making a preliminary assessment of the amount of additional work needed in each biotic category, the applicant determines the most appropriate type of demonstration for the site. *Id*. at 33-34 (§ 3.4). A demonstration describes the impact of the thermal discharge on each biotic category. USEPA 316(a) Manual at 16.

For the demonstration to be successful, it must show that each biotic category meets specified decision criteria. USEPA 316(a) Manual at 16. The USEPA 316(a) Manual sets forth decision criteria for each biotic category. *E.g.*, USEPA 316(a) Manual at 18 (phytoplankton).

"[T]he applicant should address each decision criteria for the biotic category in question." *Id*. at 34. The demonstration must show that impacts to each biotic category "are sufficiently inconsequential that the protection and propagation of the balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water will be assured." *Id.*

If a site is a low potential impact area for each biotic category, the applicant may conduct a relatively streamlined demonstration. USEPA 316(a) Manual at 6, 14, 33; *see id*. at 63 (§ 3.6: Type III Low Potential Impact Demonstrations). If a site is not a low potential impact area for each biotic category, the applicant must conduct a more comprehensive analysis. *Id.* at 15, 33; *see id*. at 34-61, 72 (§ 3.9: Type I Demonstration (Retrospective/Absence of Prior Appreciable Harm); § 3.5: Type II Demonstration (Predictive/Representative Important Species); § 3.7: Other Type III Demonstration (Biological, Engineering, and Other Data)).

<u>Habitat Formers (Aquatic Vegetation)</u>

Habitat formers are the plants and animals that stabilize sediments and provide cover areas, food sources, spawning sites, and nursery areas. USEPA 316(a) Manual at 76-77. Their role is "unquestionably unique and essential to the propagation and well-being of fish, shellfish, and wildlife." *Id*. at 57. Habitat formers may be vulnerable to the temperature, velocity, or turbidity of a heated discharge and may also be damaged by biocides in the discharge. *Id*.

Some sites may lack habitat formers as a result of "low levels of nutrients, inadequate light penetration, sedimentation, scouring stream velocities, substrate character, or toxic materials." USEPA 316(a) Manual at 22. These conditions may lead to designation as a low impact area. *Id*. If an applicant can show that a site is a low impact area for habitat formers, then that section of the demonstration "will be judged successful." USEPA 316(a) Manual at 22. If the limiting factors may be overcome and habitat formers established in the area, then "the applicant will be required to demonstrate that the heated discharge would not restrict re-establishment." *Id*.

A site will not be considered low impact for habitat formers if "there is a possibility that the power plant will impact a threatened or endangered species through adverse impacts on habitat formers." *Id*. For sites that are not low impact for habitat formers, the USEPA 316(a) Manual lists information that an applicant should provide and separate criteria for the demonstration to be judged successful. This information includes aerial mapping to identify species distribution and composition, dominant species, standing crop, and threatened and endangered species. USEPA 316(a) Manual at 22-23, 57-58.

A request may be denied if there is "[a]ny probable thermal elimination of habitat formers" or "if important fish, shellfish, or wildlife are thermally excluded from the use of the habitat." *Id*. at 22.

<u>2013 Demonstration.</u> In its 2013 demonstration, SIPC acknowledged that it did not include "systematic studies of aquatic vegetation." Exh. B, App. C at 18. However, it noted field observation of vegetation along shallow shorelines in the lower zone of the lake. *Id*. Because this is the area nearest the discharge, the demonstration cited this as an indication that the thermal effluent has not harmed and will not appreciably harm habitat formers. *Id.*; *see* Exh. B at 4-9. The 2013 demonstration referred to a study reporting "that communities in warmer areas of the upper Illinois River drainage were not impaired in comparison to the sampled communities in cooler areas." Exh. B, App. C at 18 (citation omitted); *see* Exh. B at 4-9. The 2013 demonstration also noted the importance of habitat formers to small fish. It argued that, since the fish population had remained stable, "it is reasonable to conclude that there has not been a deterioration of the habitat former community." Exh. B, App. C at 18, 40. Finally, the 2013 demonstration argued that "no threatened or endangered fish species are present in the Lake of Egypt, thus no adverse impact would be expected to species of concern even if the thermal discharge had a negative effect on habitat formers." *Id.*; Exh. B at 4-9. SIPC concluded that the Lake of Egypt is a low impact area for habitat formers. Exh. B, App C at 15, 18.

Board's 2014 Determination. The Board found that a thriving macrophyte community near the MGS discharge prevents this site from being considered a low impact area for habitat formers. SIPC v. IEPA, PCB 14-129, slip op. at 16 (Nov. 20, 2014), citing USEPA 316(a) Manual at 22 (§ 3.3.3.2). The Board also found that SIPC had not provided a site-specific study of the Lake of Egypt and that it had failed to address the likelihood of "thermal elimination of habitat formers." *Id.* The Board concluded that SIPC "failed to provide support for its determination that any effect of the thermal discharge on Lake of Egypt will be sufficiently inconsequential that the protection and propagation of the habitat formers and aquatic vegetation community will be assured." SIPC v. IEPA, PCB 14-129, slip op. at 16 (Nov. 20, 2014).

2017 Demonstration. For the 2017 demonstration, EIU performed supplemental studies "to collect site-specific data on the presence and relative abundance of habitat formers within the three lake zones to evaluate differences that may be attributed to temperature increases resulting from the thermal discharge." Exh. B at 4-8; *see* Exh. B, App. A at A-6, A-12.

EIU collected data on emergent and submerged aquatic vegetation (SAV) by surveying the entire main shoreline of the lake. Exh. B. at 4-8; *see* Exh. B, App. A at A-12 (study plan); Exh. B. App. B. at B-12 – B-13 (EIU data collection). The Illinois Natural History Survey (INHS) used a Lowrance HD-10 sidescan sonar at a speed no greater than five miles per hour. *Id.* In each lake zone, INHS mapped up to two randomly selected areas of SAV at a speed no greater than three miles per hour "to provide a higher resolution map." *Id.* Within those areas, INHS also assessed three transects for SAV species composition. *Id.*

"INHS researchers used the slow speed side-scan imaging in concert with the transect data to draw a vegetation map of the different areas of the Lake." Exh. B, App. B at B-13. SIPC's supplemental data included "[a] habitat formers vegetation map of physical transects" coupled with slow speed imaging performed in August 2016. SIPC Resps. at 2, citing Exh. B, App. B. at B-55 (Figure 7-15). SIPC added that the map includes information on species composition and percent coverage, which show coverage in the lower lake of 66% water willow and 44% slender naiad; in the middle lake of 90.2% water willow, 14% milfoil, and 21% pondweed; and in the upper lake of 80% water willow, 6% milfoil, and 2% filamentous algae. SIPC Resps. at 2; Exh. B, App. B. at B-55.

The survey found SAV along approximately 22 percent of the shoreline. Exh. B at 4-8. EIU attributed this amount to rapid increase in depth along most of the shoreline. *Id*.; *see* Exh. B, App. B at B-22. Where SAV is present, exotic milfoil was dominant in the upper zone, pondweed in the middle zone, and slender naiad in the lower zone. *Id*. at 4-8 – 4-9.; *see* Exh. B, App. B at B-22, B-35 (Table 9: proportion of shoreline with different macrophytes), B-55 (Figure 7-15: vegetation map).

The survey found that emergent vegetation covered approximately 81 percent of the shoreline. Exh. B at 4-8; *see* Exh. B, App. B at B-17, B-22, B-34 (Table 8: summary of macrophyte density). In all three zones, this vegetation was dominated by water willow, which is common to Illinois shorelines. Exh. B at 4-8; *see* Exh. B. App. B. at B-22, B-35, B-55. Although the lower zone had a higher proportion of SAV, EIU found a lower percentage of water willow along the lower lake shoreline. Exh. B at 4-8; *see* Exh. B, App. B at B-35. EIU attributed this to "the presence of the dam and other habitat unsuitable for shoreline plant growth." *Id*. at 4-9.

The 2017 demonstration states that, "[b]ased on the presence of both emergent and submerged aquatic vegetation in all lake zones with suitable habitat, the MGS thermal discharge does not appear to be affecting habitat formers." Exh. B at 4-9; *see* Exh. B, App. B at B-22. SAV "appeared to be limited by a rapid increase in water depth immediately offshore." Exh. B at 4-9. SIPC argued that absence of suitable habitat rather than the thermal discharge limits establishment of habitat formers. *Id*. The 2017 demonstration concluded that these factors show "that the habitat former community meets the criteria set forth by the USEPA for no appreciable harm from the MGS thermal discharge." *Id*.; *see* Rec. at 5.

<u>Phytoplankton</u>

Phytoplankton are "[p]lant microorganisms such as certain algae, living unattached in the water." USEPA 316(a) Manual at 78. Phytoplankton are "a principal food source for most zooplankton and for some fish species." *Id*. at 55.

The USEPA 316(a) Manual states that systems where the food chain base is detrital material rather than phytoplankton, such as most rivers and streams, are areas of low potential impact for this category. USEPA 316(a) Manual at 18-19; *see id*. at 55. An area is not considered low impact for phytoplankton if:

1. The phytoplankton contribute a substantial amount of the primary photosynthetic activity supporting the community;

2. A shift towards nuisance species[6] may be encouraged; or

[6] The USEPA Manual states that "[a]ny microbial, plant or animal species which indicates a hazard to ecological balance or human health and welfare that is not naturally a dominant feature of the indigenous community may be considered a nuisance species. Nuisance species of the phytoplankton include those algae taxa which in high concentration are known to produce toxic, foul tasting, or odiferous compounds to a degree that the quality of water is impaired." USEPA

3. Operation of the discharge may alter the community from a detrital to a phytoplankton based system. *Id*. at 19.

If an applicant can show that a site is a low impact area for phytoplankton, then that section of the demonstration "will be judged successful." USEPA 316(a) Manual at 18.

For sites that are not low impact, the USEPA 316(a) Manual lists information that an applicant should provide and separate criteria for that section of the demonstration to be judged successful. This includes information characterizing species composition, abundance, and dominant species, as well as presence and abundance of pollution-tolerant and nuisance forms for comparison to the phytoplankton community as a whole. USEPA 316(a) Manual at 19-20, 55-56.

2013 Demonstration. In its 2013 demonstration, SIPC acknowledged that it had not performed studies specific to phytoplankton in Lake of Egypt. Exh. B, App. C at 15. SIPC argued that, even without these studies, there was a sufficient basis to conclude that Lake of Egypt is a low impact area for phytoplankton. *Id*.

First, SIPC cited a study of Lake Sangchris, an artificial cooling lake in central Illinois similar in size to Lake of Egypt, which determined that a larger generating station "did not appear to be deleterious to its phytoplankton community." Exh. B, App. C at 15 (citation omitted). Second, SIPC cited a study of Newton Lake, which "found that rates of photosynthesis were notably higher during the summer months but were similar to the range of values from other lakes." *Id*. (citation omitted). The study also noted lower mean phytoplankton densities in July and August, although "there was not a significant change in the rate of photosynthesis." *Id*. at 15-16.

Third, SIPC stated that the phytoplankton community had developed under conditions similar to those that will be present in the future. Exh. B, App. C at 16. SIPC argued that there has been no indication that the community has been impaired. *Id*. Fourth, SIPC stated that phytoplankton reproduce rapidly and have short life spans. *Id*. If temporary thermal effects occur, SIPC argues that "there are extensive areas outside the zone of thermal influence that could act as either refugia or sources of recolonization potential." *Id*.

Fifth, there have been no recent algal blooms suggesting that the lake is susceptible to a shift to the predominance of nuisance populations of phytoplankton. Exh. B, App. C at 16, 40. Reported blooms occurred before lakeside residences shifted from septic systems to a combined

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Manual at 77.[7] "Macroinvertebrates" may be considered synonymous with "aquatic macroinvertebrates," which are "those invertebrates that are large enough to be retained by a U.S. Standard No. 30 sieve (0.595-mm openings) and generally can be seen by the unaided eye." USEPA Manual at 73, 77. "Shellfish" are "[a]ll mollusks and crustaceans (such as oysters, clams, shrimp, crayfish, and crabs) which, in the course of their life cycle, constitute important components of the benthic, planktonic, or nektonic fauna in fresh and salt water." USEPA Manual at 79.

sewer system and before improvements to the Goreville wastewater treatment plant. *Id*. With nutrient loading reduced, SIPC argues that previous blooms are not attributable to the thermal discharge. *Id*. In 2016, EIU sampled one bloom of thermally tolerant phytoplankton (Dinophyta). However, the bloom occurred in the upper lake and not in the lower lake. Exh. B, App. B at B-21. Because the fish population has remained similar over time, SIPC also argues that food base of phytoplankton has not significantly changed. Exh. B, App. C at 16, 40.

Sixth, SIPC argued that the composition of the phytoplankton community would be similar to other cooling lakes in the region. Exh. B, App. C at 16. SIPC acknowledges that the composition of the community may vary among the regions of the lake, but significant differences are expected to be limited to the mixing zone. *Id*. SIPC argues that variations beyond the mixing zone "are likely to be insignificant in altering the overall primary productivity of the ecosystem." *Id*.

Board's 2014 Determination. The Board cited the USEPA 316(a) Manual, which provides that "[a]reas of low potential impact for phytoplankton are defined as open ocean areas or systems in which phytoplankton is *not* the food chain base." USEPA 316(a) Manual at 18 (§ 3.3.1.2) (emphasis added). The Board found that, because AMEC's evaluation states that Lake of Egypt has a phytoplankton-based food web, and the record lacked information to the contrary, Lake of Egypt may not be considered as low potential impact for phytoplankton. SIPC v. IEPA, PCB 14-129, slip op. at 17 (Nov. 20, 2014). The Board also found that "while SIPC asserts that no algal blooms have occurred since the change in wastewater management in areas surrounding the Lake of Egypt, the petition lacks support for the other two necessary findings: that there is little likelihood of altering the community from detrital to phytoplankton-based system; and appreciable harm to the community is not likely to occur as a result of phytoplankton changes." *Id*. The Board concluded that SIPC's petition "failed to show that the effect of the thermal discharge is sufficiently inconsequential that the protection and propagation of the phytoplankton community will be assured." *Id*.

2017 Demonstration. For the 2017 demonstration, EIU collected site-specific data on phytoplankton species composition and relative abundance within the three lake zones. Exh. B. at 4-1. EIU sought to determine whether these differ among the zones in a way that can be attributed to the thermal discharge. *Id*. EIU also sought to evaluate any thermally tolerant or nuisance species in the lower lake zone compared to the other zones. *Id*. at 4-2; *see* Exh. B, App. A at A-9 (study plan).

EIU collected phytoplankton samples monthly from June through August 2016. During each of the three periods, EIU collected samples for both phytoplankton and water chemistry nutrient analysis from three locations in each of the three lake zones. Exh. B at 4-2; *see id*. at 4-4 (Figure 4-1: map of phytoplankton sample collection locations); Exh. B, App. A at A-18 (map); Exh. B, App. B at B-41 (map). There were no known locations of previous phytoplankton sampling to consider when selecting these locations. Exh. B at 4-2; Exh. B, App. A at A-9.

Diatoms, the most common freshwater phytoplankton, dominate the community in Lake of Egypt. Exh. B. at 4-2; Exh. B, App. B at B-21, B-29 (Table 3: abundance of phytoplankton phyla). Because of the relatively low level of nutrients in the lake, the community favors species such as blue-green algae that can fix atmospheric nitrogen. Exh. B, App. B at B-21. While the three lake zones had similar phytoplankton abundance, the three zones had significant differences in community structure. EIU attributed a higher proportion of blue-green algae in the middle and upper zones to lower nutrient levels than the lower zone. Exh. B at 4-2; *see* Exh. B, App. B at B-15, B-21, B-29, B-61 – B-62 (Appendix: abundance by zone and month). While EIU found one heat-tolerant phylum (Dinophyta) in all three zones, it was most abundant in the upper lake farthest from the thermal discharge. Exh. B. at 4-2; *see* Exh. B, App. B at B-15.

SIPC argues that phytoplankton data show that the community in Lake of Egypt "is similar to that expected in midwestern lakes." Exh.B at 4-3. Differences in composition between the lake zones result from lower nutrient levels in the middle and upper zones. *Id*. All zones showed similar relative abundance and do not show proliferation of nuisance or heat tolerant species. *Id*. SIPC concludes that data "demonstrate that the phytoplankton community meets the criteria set forth by the USEPA for no appreciable harm from the MGS thermal discharge." *Id*.; Rec. at 5.

Zooplankton and Meroplankton

Zooplankton are "[a]nimal microorganisms living unattached in water. They include small crustacea such as daphnia and cyclops, and single-celled animals such as protozoa, etc." USEPA 316(a) Manual at 79. Zooplankton provide "a primary food source for larval fish and shellfish and also makes up a portion of the diets of some adult species." *Id*. at 56. Many fish species have a planktonic life stage termed meroplankton, which distinguishes those species from organisms that remain planktonic for their entire life cycle. USEPA 316(a) Manual at 56, 77. "If a heated discharge kills or prevents development of the meroplankton, fewer adult fish and shellfish will be produced each year." *Id*. at 56.

If an applicant can show that a site is a low impact area for zooplankton, then that section of the demonstration "will be judged successful," and no further studies are necessary. USEPA 316(a) Manual at 20, 21. "Areas of low potential impact for zooplankton and meroplankton are defined as those characterized by low concentrations of commercially important species, rare and endangered species, and/or those forms that are important components of the food web or where the thermal discharge will affect a relatively small proportion of the receiving water body." *Id*. at 20-21.

For sites that are not low impact for zooplankton and meroplankton, the USEPA 316(a) Manual lists information that an applicant should provide and separate criteria for the demonstration to be judged successful. This information includes estimates of the standing crop, species composition and abundance, seasonal variations in abundance and distribution, and daily changes in depth distribution for comparison to the community as a whole. USEPA 316(a) Manual at 21, 56-57; *see* Exh. B at 4-3.

2013 Demonstration. In its 2013 demonstration, SIPC acknowledged that it had not performed studies specific to zooplankton and meroplankton in Lake of Egypt. Exh. B, App. C at 17. SIPC argued that, even without these studies, there was a sufficient basis to conclude that Lake of Egypt is a low impact area for this category. *Id*.

First, SIPC cited studies of Lake Sangchris demonstrating that, in comparison with Lake Shelbyville, an unheated manmade reservoir, "the diversity of zooplankters did not differ significantly between heated and unheated arms of Lake Sangchris." Exh. B, App. C at 17 (citation omitted); *see* Exh. B. at 4-5. While the studies associated thermal loading with decreased biomass and abundance, the thermal effluents "provided for enhanced zooplankton communities during autumn, winter and spring." *Id*. Second, SIPC cited a study of Newton Lake, which "found that zooplankton densities varied widely among segments within the lake, but there were no specific trends between seasons, location or by water temperatures." Exh. B, App. C at 17; *see* Exh. B. at 4-5.

Third, SIPC stated that the fish community in Lake of Egypt has remained similar and stable, suggesting that "the underlying trophic levels represented by zooplankton (food source for many fish species) and fish meroplankton have not been appreciably harmed by the thermal discharge." Exh. B, App. C at 17; *see* Exh. B. at 4-5. SIPC considers it likely that any shifts in the standing crop or relative abundance "have been naturally induced." Exh. B, App. C at 17.

Fourth, SIPC stated that the community had developed under conditions similar to those that will be present in the future. Exh. B, App. C at 17. SIPC argued that there has been no indication that the community has been impaired. *Id*. Fifth, SIPC states that zooplankton reproduce rapidly and have short life spans. Exh. B, App. C at 17, 40. If temporary thermal effects occur, SIPC argues that "there are extensive areas outside the zone of thermal influence that could act as either refugia or sources of recolonization potential." *Id*. at 17. Sixth, SIPC notes that MGS discharges into the downstream end of the lake, which reduces the possibility that the thermal plume is a barrier to movement throughout the lake. *Id*.; *see* Exh. B at 4-5.

Finally, SIPC argued that the composition of the zooplankton and meroplankton community would be similar to other cooling lakes in the region. Exh. B, App. C at 16. SIPC acknowledges that the composition of the community may vary among the regions of the lake, but significant differences are expected to be limited to the mixing zone. *Id*. at 16-17. SIPC argued that variations beyond the mixing zone "are likely to be insignificant in altering the overall primary productivity of the ecosystem." *Id*. at 17.

Board's 2014 Determination. The Board noted that the first criterion for low potential impact for zooplankton is that the area has low concentrations of species that are commercially important, rare, endangered, or important components of the food web. USEPA 316(a) Manual at 20-21 (§ 3.3.2.2). AMEC stated that Lake of Egypt contains recreationally and commercially important species. The Board also noted that SIPC characterized Lake of Egypt as a "'vibrant recreational resource for public use' based largely on the recreational fishing that takes place through the year." SIPC v. IEPA, PCB 14-129, slip op. at 18 (Nov. 20, 2014). The Board found that SIPC's petition lacked support for a determination that Lake of Egypt is of low potential impact for this category.

The Board found that SIPC's petition lacked support for findings that: "changes in zooplankton will not result in appreciable harm to the balanced, indigenous community; the heated discharge is not likely to alter the standing crop or relative abundance; and the thermal plume does not constitute a lethal barrier to free movement of zooplankton." SIPC v. IEPA, PCB 14-129, slip op. at 18 (Nov. 20, 2014). The Board concluded that SIPC failed to show that zooplankton impacts would be sufficiently inconsequential that protecting and propagating the zooplankton community would be assured. *Id*.

2017 Demonstration. For the 2017 demonstration, EIU collected site-specific data on zooplankton and meroplankton species composition and relative abundance within the three lake zones. Exh. B. at 4-3; *see* Exh. B, App. B at B-11, B-41 (Figure 7-1: map of sampling locations). EIU sought to determine whether these differ among the zones in a way that can be attributed to the thermal discharge. *Id*. EIU also sought to evaluate any thermally tolerant or nuisance species in the lower lake zone compared to the other zones. *Id*.; *see* Exh. B, App. A at A-9 (study plan).

Monthly from June to August of 2016, EIU collected zooplankton and meroplankton samples concurrently with phytoplankton and water chemistry nutrient samples. Exh. B. at 4-3 – 4-5. During each of the three months, EIU collected samples from three locations within each of the three lake zones. *Id*. at 4-5; *see id*. at 4-4 (Figure 4-1: sample collection locations). There were no known locations of previous zooplankton and meroplankton sampling to consider when selecting these locations. Exh. B at 4-5.

From its sampling, EIU identified nine zooplankton taxa. Rotifers dominated the community. Exh. B at 4-5; *see* Exh. B, App. B at B-16, B-30 (Table 4: zooplankton density). EIU observed the highest density in June, after which density declined in all three zones. Exh. B at 4-5; *see* Exh. B, App. B at B-16, B-49 (Figure 7-9: average density by month). Although density was highest in the lower zone, there was no difference in community structure between the zones. Exh. B at 4-5; *see* Exh. B, App. B at B-16 – B-17, B-51 (Figure 7-11); *see* Pet. at 20. SIPC argued that these factors suggest that the discharge is not a lethal barrier to movement. Exh. B at 4-6. SIPC argued that the composition of the community was similar to what is found in other Illinois cooling reservoirs. *Id*.

SIPC concludes that "[t]he absence of any changes to, or differences in, the zooplankton and meroplankton community related to the thermal discharge means no resulting appreciable harm to the balanced indigenous population" in Lake of Egypt. Exh. B. at 4-6. Based on the results of its demonstration, SIPC argues that the community "meets the criteria set forth by the USEPA for no appreciable harm from the MGS thermal discharge." *Id*.

Macroinvertebrates and Shellfish

Macroinvertebrates including shellfish [7] are an important part of aquatic food webs and provide a source of bait for sport and commercial fishing. USEPA 316(a) Manual at 58.

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[7] "Macroinvertebrates" may be considered synonymous with "aquatic macroinvertebrates," which are "those invertebrates that are large enough to be retained by a U.S. Standard No. 30 sieve (0.595-mm openings) and generally can be seen by the unaided eye." USEPA Manual at 73, 77. "Shellfish" are "[a]ll mollusks and crustaceans (such as oysters, clams, shrimp, crayfish,

Thermal discharges may have a number of effects on macroinvertebrates, including reproduction and survival. *Id*. at 59.

An area with low potential impact for macroinvertebrates and shellfish is defined as one that can meet five requirements:

1. Shellfish/macroinvertebrate species of existing or potential commercial value do not occur at the site. This requirement can be met if the applicant can show that the occurrence of such species is marginal.

2. Shellfish/macroinvertebrates do not serve as important components of the aquatic community at the site.

3. Threatened or endangered species of shellfish/macroinvertebrates do not occur at the site.

4. The standing crop of shellfish/macroinvertebrates at the time of maximum abundance is less than one gram ash-free dry weight per square meter.

5. The site does not serve as a spawning or nursery area for the species in 1, 2, or 3 above. USEPA 316(a) Manual at 25.

If an applicant shows that a site is a low impact area for macroinvertebrates and shellfish and that no appreciable harm to the balanced indigenous population will occur as a result of macroinvertebrate community changes caused by the heated discharge, then that section of the demonstration will be judged successful. USEPA 316(a) Manual at 23, 25.

For sites that are not low impact, the USEPA 316(a) Manual lists information that an applicant should provide and separate criteria for the demonstration to be judged successful. This information includes estimates of standing crop, an assessment of community structure based on relative abundance of individual species, evaluation of the impact of the thermal plume on drifting organisms in flowing waters of riverine sites, and mapping substrates to evaluate suitability for various benthic forms. USEPA 316(a) Manual at 25-28, 58-60.

2013 Demonstration. In its 2013 demonstration, SIPC acknowledged that it had not performed studies specific to macroinvertebrates and shellfish in Lake of Egypt. Exh. B, App. C at 19. SIPC argued that, even without these studies, there was a sufficient basis to conclude that Lake of Egypt is a low impact area for this category. *Id*.

First, based on similar impoundments in Illinois, AMEC noted that there are no macroinvertebrate or shellfish species of commercial or recreational value present in the lake. Exh. B, App, C at 19. While the 2007 impingement study found various taxa, none is a federally

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and crabs) which, in the course of their life cycle, constitute important components of the benthic, planktonic, or nektonic fauna in fresh and salt water." USEPA Manual at 79.

or state listed threatened or endangered species. *Id.*; *see* Exh. B, App. C, App. A at 20-21 (Tables 4-2, 4-4, 4-6).

Second, SIPC argued that the "[t]he area of thermal influence is very small in relation to the 2,300-acre lake." Exh. B, App. C at 19. SIPC added that the plume "is mostly surficial" and does not have a marked effect on water temperatures of the benthic environment even under stressed conditions. *Id.* SIPC stated that "heated water flows into the lake mixing zone where it settles into an upper layer of heated water over the existing lake water with some amount of mixing at the boundary between the two layers." Pet. at 12.

SIPC also cited Lake Sangchris, where "macroinvertebrate assemblages were similar between areas influenced by thermal discharge and uninfluenced control areas." *Id.* SIPC expects a similar result in the Lake of Egypt. *Id.*

Third, SIPC notes that macroinvertebrates are an important part of forage in the lake. Exh. B, App. C at 19. SIPC argues that the relatively stable composition and abundance of the fish community in the lake show that availability of food is not limiting the fish population. *Id.* at 19, 40. Fourth, SIPC stated that, since there are no important macroinvertebrate or shellfish species in the lake, "there are no spawning or nursery sites associated with them." *Id.*

Board's 2014 Determination. The Board found that SIPC's petition lacked support for the conclusion that Lake of Egypt should be considered low potential impact for this category. SIPC v. IEPA, PCB 14-129, slip op. at 19 (Nov. 20, 2014). The Board noted that "macroinvertebrates likely serve as an important food source for other species in the lake." *Id.* at 20. To be considered low potential impact for this category, shellfish or macroinvertebrates cannot "serve as important components of the aquatic community." *Id.*, citing USEPA 316(a) Manual at 25. The Board concluded that SIPC failed to support a determination that Lake of Egypt is low potential impact for shellfish/macroinvertebrates. SIPC v. IEPA, PCB 14-129, slip op. at 20 (Nov. 20, 2014).

The Board further noted that SIPC lacked a scientific basis to conclude that there has been no reduction in the abundance or diversity of shellfish and macroinvertebrates. SIPC v. IEPA, PCB 14-129, slip op. at 21 (Nov. 20, 2014). The Board stated that, other than the 2007 impingement study, SIPC's assessment of this category did not include site-specific information in support of the low potential impact determination, or the more demanding determination for sites not considered low potential impact under Section 3.3.4.1 of the USEPA 316(a) Manual. *Id.*, citing USEPA 316(a) Manual at 23. In addition, the Board stated that SIPC's petition lacked continuity from before 2003 to the present to show that impacts to shellfish and macroinvertebrates are sufficiently inconsequential that the protection and propagation of that community will be assured. SIPC v. IEPA, PCB 14-129, slip op. at 21 (Nov. 20, 2014).

2017 Demonstration. For the 2017 demonstration, EIU collected site-specific data on macroinvertebrate and shellfish species composition and relative abundance within the three lake zones. Exh. B. at 4-6; *see* Exh. B, App. B at B-12, B-41 (Figure 7-1: map of sampling locations). EIU sought to determine whether these differ among the zones in a way that can be attributed to the thermal discharge. Exh. B at 4-6. EIU also sought to evaluate any thermally tolerant or nuisance species in the lower lake zone compared to the other zones. *Id.*; *see* Exh. B, App. A at A-10 – A-11 (study plan).

Monthly from June to August of 2016, EIU collected macroinvertebrate and shellfish samples. Exh. B. at 4-6. During each of the three months, EIU sampled one transect in each of the three lake zones. *Id.* at 4-5; *see id.* at 4-4 (Figure 4-1: sample collection locations). Along each transect, EIU collected three to five dredge samples to account for differences based on depth and substrate. *Id.* at 4-6 – 4-7. "[A] separate dredge sample was used to characterize the substrate." Exh. B, App. B at B-12. There were no known locations of previous macroinvertebrate and shellfish sampling to consider when selecting these sampling locations. Exh. B at 4-7.

EIU found that the benthic macroinvertebrate community consists largely of bloodworms, midges, and glassworms. Exh. B. at 4-7; *see* Exh. B. App. B at B-17, B-31 (Table 5: macroinvertebrate abundance). EIU also collected crustaceans and bivalves throughout the lake. *Id.* Abundance of benthic macroinvertebrates was low in the lake. Exh. B at 4-7. The macroinvertebrate community had relatively low scores based on taxa diversity, richness, and evenness, and these scores did not differ between the three lake zones. Exh. B at 4-7; *see* Exh. B, App. B at B-17, B-22, B-32 (Table 6: macroinvertebrate indices). ASA cross-referenced species found during lake surveys with lists of species on IDNR and U.S. Fish and Wildlife Service websites. ASA found that no threatened or endangered fish or macroinvertebrate species are present in Lake of Egypt. Exh. B at 4-9; Exh. B, App. C at 18 (§ 4.3), 40 (§ 6.2.2); *see* SIPC Resps. at 2.

Fine sediments dominate the substrate of the lake. Exh. B at 4-7; *see* Exh. B, App. B at B-17, B-22, B-33 (Table 7: substrate abundance). EIU attributed the paucity of benthic macroinvertebrates to "the lack of substrate heterogeneity" throughout the lake. Exh. B at 4-7; *see* Exh. B, App. B at B-22.

SIPC argued that these data show that the macroinvertebrate and shellfish abundance and diversity in Lake of Egypt have not been adversely affected by the thermal discharge. Exh. B at 4-7. No commercially or recreationally important species have been identified in the lake, so there are no spawning or nursery sites associated with them. *Id.* at 4-7 – 4-8. SIPC argued that, with no changes or differences in the community resulting from the thermal discharge, there has been no resulting harm to the balanced indigenous community in the lake. *Id.* at 4-8; *see* Pet. at 20; Rec. at 5, 7. SIPC concluded that these findings meet the criteria in the USEPA 316(a) Manual. Exh. B at 4-8.

<u>Fish</u>

"The discharge of waste heat can affect fish populations in many ways." USEPA 316(a) Manual at 60. If an applicant can show that a site is a low impact area for fish, then that section of the demonstration "will be judged successful." *Id.* at 28. A discharge may be determined to be in an area of low potential impact for fishes if it meets the following conditions:

1. The occurrence of sport and commercial species of fish is marginal;

2. The discharge site is not a spawning or nursery area;

3. The thermal plume . . . will not occupy a large portion of the zone of passage which would block or hinder fish migration under the most conservative environmental conditions (based on 7-day, 10-year low flow or water level and maximum water temperature);

4. The plume configuration will not cause fish to become vulnerable to cold shock or have an adverse impact on threatened or endangered species. *Id*. at 29.

For sites that are not low impact, the USEPA 316(a) Manual lists information that an applicant should provide and separate criteria for the demonstration to be judged successful. USEPA 316(a) Manual at 29-32, 60-61. The study requirements include appropriate sampling methods and gear "to provide a basis for identifying the Representative Important Species (RIS) of fish. . . ." *Id*. at 29; *see id*. at 60. Depending on the RIS selected, studies may include information on reproduction, life stage habitat utilization, condition factors, disease and parasitism, age and growth, spatial and temporal distribution, relative abundance, principal associations between species, and maps depicting areas used by fish and influenced by thermal discharge. USEPA 316(a) Manual at 29-32.

2013 Demonstration. Although previous studies "focused on game fish and issues relating to recreational fishing," the results included general assessment of sport fish species and age and growth characteristics. Exh. B, App. C at 20 (citations omitted). From 2005 through 2007 and again in 2010, AMEC performed additional fish surveys. In 2007, AMEC collected impingement samples from the MGS intake. *Id*. In combination with the earlier studies, these later results compare the fish community before and after the 2003 boiler replacement. *Id*.

SIPC reported that species composition in the two periods before and after the 2003 boiler replacement was similar, as 22 of 31 species were collected in both periods. Exh. B, App. C at 20, citing *id*. at 21 (Table 4-1: species collected before and after replacement). SIPC stated that the exceptions were species present in low numbers. *Id*. at 20. The fish community continues to be dominated by centrarchids (sunfish). *Id*.

SIPC's 2013 demonstration prepared by ASA reported that "[n]o threatened or endangered species have been collected in previous surveys of the lake." Exh. B, App. C at 6; *see* Exh. B, App, C, App. A at 8 (impingement mortality report).

Regarding species abundance, SIPC observed that bluegill, largemouth bass and redear sunfish have consistently been the most abundant over the two periods. Exh. B, App. C at 20, citing *id*. at 11 (Table 3-4: electrofishing catch rates 1997-2010).

During July and August in 2010, SIPC performed electrofishing surveys at nine stations in the lake, five in the lower region and four in the upper. Exh. B, App. C at 22, citing *id*. at 71 (Figure 4-1: map). Composition and abundance were similar in both July and August surveys.

Id. at 22, citing *id*. at 8 (Table 3-1: composition and abundance). Taxonomic richness was also similar, with 13 and 15 species collected in July and August, respectively. *Id*. at 22; *see id*. at 8. Growth was assessed by measuring average length, and a slight increase was observed from July to August for most species except inland silverside, warmouth, longear sunfish, hybrid sunfish, and black crappie. Biomass decreased during the same time for most species except common carp, black bullhead, redear sunfish, sunfish hybrid, largemouth bass, and black crappie. *Id.* at 22.

In fish surveys during July and August, the most abundant species (bluegill, redear sunfish, and largemouth bass) had similar catch rates in the upper and lower lake. However, catch rates were higher in the upper lake for black and yellow bullheads and lower in the lower lake for threadfin shad, channel catfish, green sunfish, longear sunfish, and black crappie. Overall, the catch-per-effort was 260.9 per hour in the upper lake and 213.5 per hour in the lower lake. Exh. B, App. C at 22, citing *id*. at 9 (Table 3-2: composition and catch-per-effort). SIPC Resps. at 2. In terms of growth, the average lengths of the various species were nearly the same in the upper and lower lake. Exh. B, App. C at 22. Largemouth bass averaged 50 mm longer in the lower lake, and SIPC attributed this to the presence of the species' preferred habitat near the discharge. *Id*. AMEC observed that the spatial patterns in the 2010 surveys were comparable to previous studies and indicate that the fish community in Lake of Egypt remained stable from 1997 to 2010 even with the increased frequency and volume of thermal discharge, which began in 2003 when Unit 123 came on line. *Id.*

Board's 2014 Determination. Although SIPC stated that Lake of Egypt exhibits characteristics of a low impact area for fish, it "performed an in-depth study of fish due to the presence of sport and commercial species." SIPC v. IEPA, PCB 14-129, slip op. at 21, 22 (Nov. 20, 2014). However, the Board found that SIPC had not "considered all necessary RIS and not provided sufficient support for a conclusion that the selected RIS will not suffer appreciable harm." *Id*. at 26. The Board stated that SIPC had studied only two of the RIS categories listed in the USEPA 316(a) Manual. *Id*., citing USEPA 316(a) Manual at 36-39 (§ 3.5.2.1).

The Board agreed with IEPA's recommendation that SIPC must study a thermally sensitive RIS. SIPC v. IEPA, PCB 14-129, slip op. at 27 (Nov. 20, 2014). The Board also agreed with IEPA's recommendation that SIPC study "the effects of the thermal loading on the common carp as a potential nuisance species." *Id*

2017 Demonstration.

Threatened and Endangered Species: For SIPC's 2017 updated demonstration, ASA cross-referenced surveys of the lake with lists of species on IDNR and U.S. Fish and Wildlife Service websites. ASA reaffirmed that no threatened or endangered fish or macroinvertebrate species are present in Lake of Egypt. Exh. B at 4-9; Exh. B, App. C at 18 (§ 4.3), 40 (§ 6.2.2); *see* SIPC Resps. at 2.

Nuisance Species. SIPC assessed trends in the abundance of common carp as a nuisance species. To collect site-specific data, SIPC conducted electrofishing targeting common carp once during the fall of 2016, which coincided with the time of earlier surveys in 1997 and 1998 by SIU in 2000 and AMEC in 2013. Exh. B at 4-10; *see* Exh. B, App. A at A-6, A-12 – A-13; Exh. B, App. B at B-13, B-42 (Figure 7-2: map). SIPC used sampling locations that were the same as or similar to previous sampling locations in the upper and lower lake and added locations in the middle zone. Exh. B at 4-10.; *see id*. at 4-11 (Figure 4-2); *see* Exh. B, App. A at A-6. While SIPC's supplemental study focused on common carp, it identified all species collected. Exh. B at 4-10.

Earlier studies found Catch per Unit Effort (CPUE) of 1.2 and 1.4 in 1997 and 1998 by SIUC and 2.0 and 4.0 in 2005 and 2006 by MACTEC. The increase was cited by IEPA as an indication that nuisance species may have proliferated after Unit 123 came on line in 2003. EIU's supplemental 2017 testing collected a total of two common carp, both from the lower zone of the lake. Exh. B at 4-14; *see* Exh. B, App. B at B-18, B-23, B-36 (Table 4-1: CPUE comparisons; Table 10: abundance and CPUE); Rec. at 5. Based on all three lake zones, this represents a CPUE of 0.53. Exh. B, App. B at B-18, B-36. Based only on the lower zone, it represents a CPUE of 1.14. *Id*. Based on 2017 CPUE similar to 1997 and 1998 and lower than 2005 and 2006, ASA states that the increased thermal discharge does not appear to be causing common carp to proliferate. *Id*.; *see* Rec. at 5.

In addition, IEPA identified the rusty crayfish as an invasive species that could show increased abundance in Lake of Egypt as a result of the thermal discharge. Exh. B. at 4-16, citing Exh. B, App. C, App. A at 19-23 (impingement of shellfish). SIPC agreed to perform a desktop evaluation of the potential for the species to proliferate. Exh. B at 4-16. SIPC reviewed literature on the spawning, habitat requirements, preferred water temperatures, juvenile growth and survival, and heat tolerance of the rusty crayfish. *Id*.

ASA found that, although rusty crayfish could survive elevated temperatures that may be experienced near the discharge in warm summer weather, its "preferred temperature and those for maximum juvenile growth and survival are well below 30°C." *Id*. ASA stated that, even if rusty crayfish can survive elevated temperatures, "those conditions would not be conducive to their increased reproduction and growth." *Id*. ASA notes that water in the lake has clarified since 1990 when nutrient rich discharges from a sewage treatment facility and septic systems ceased. Because rusty crayfish prefer clear water, this factor may account for any potential increase in their population. *Id*. ASA concluded that the species is not expected to proliferate as a result of the thermal discharge. *Id*. at 4-17; *see* Rec. at 5.

In its recommendation, IEPA noted that the 2016 study only collected two common carp. IEPA agreed with ASA that the thermal discharge has not led to the proliferation of nuisance species, and that the proposed alternative thermal effluent limitations are not expected to do so. IEPA found that the aquatic community in the lower lake zone is not dominated by heat-tolerant or nuisance species, but rather is similar to aquatic communities in the middle and upper lake zones. IEPA noted that the only substantial differences between the zones were the increased zooplankton productivity and greater fish abundance in the lower lake zone.

Thermally Sensitive Species. In 2016, to evaluate the potential effects of the thermal discharge on thermally-sensitive black crappie and white crappie, EIU collected two sets of data: (1) temperature and dissolved oxygen, and (2) electrofishing and netting.

First, EIU monitored temperature and dissolved oxygen to consider the availability of thermal refuge habitat in deeper waters during times of high surface water temperatures. Exh. B at 4-10; *see* Exh. B, App. A at A-6, A-13 – A-14. EIU collected these measurements weekly from June to September 2016 from five locations in each of the three lake zones. Exh. B at 4-10; *see id*. at 4-12 (Figure 4-3: sampling locations), Exh. B, App. B at B-10. These locations approximated the locations of previous data collection. Exh. B at 4-10. EIU provided graphs of the measured dissolved oxygen concentrations and temperatures for the various depths and lake zones. Exh. B, App, B at B-43 – B-46 (Figures 7-3 – 7-6); SIPC Resp. at 3, Att. A.

EIU reported that "[w]ater temperature and [dissolved oxygen] profiles were stratified with depth in all lake zones during all sampling months." Exh. B. at 4-14. During each month of sampling, dissolved oxygen concentrations were consistently lower in the lower zone than in the middle and upper zones. *Id*. While July and August water temperatures approached or exceeded 30°C (86°F) in all zones, temperatures were consistently higher in the lower zone near the thermal discharge. *Id*. In September, temperatures remained near 30°C in the lower zone while falling below that level in the middle and upper zones. *Id*. at 4-14 – 4-15. EIU reported that peak water temperatures in the lower zone coincided with the lowest measured dissolved oxygen concentrations of approximately 3.0 mg/L. *Id*. at 4-15. When August water temperatures exceeded 30°C, dissolved oxygen concentrations measured more than 4.0 mg/L in the middle zone and more than 6.0 mg/L in the upper zone. Exh. B at 4-15, App. B at B-15. Areas outside the cooling zone, especially in the upper zone, had "both moderate summer temperatures and sufficient dissolved oxygen throughout the summer for temperate aquatic flora and fauna." Exh. B, App. B at B-20.

ASA found that the temperature and dissolved oxygen data show that black crappie might avoid the lower zone during July and August and the middle zone during August due to low dissolved oxygen and high temperatures above their thermal tolerance limits. However, portions of the middle lake and all of the upper lake provide lower temperatures and dissolved oxygen concentrations above 4.0 mg/L. Exh. B at 4-17. EIU concluded that the upper lake "had temperature and dissolved oxygen conditions suitable for black crappie growth and survival throughout the summer." Exh. B, App. B at B-20. Because of the availability of areas with higher dissolved oxygen and lower temperatures in the middle and upper lake, ASA and EIU concluded that the lake provides ample areas of thermal refuge during peak temperatures and low dissolved oxygen. Exh. B at 4-17; Exh. B, App. B at B-15; *see* Rec. at 5, 10.

SIPC noted that dissolved oxygen approaches zero at a depth of approximately 26.4 feet. Exh. B, App. B at B-43 to B-46 (Figures 7-3 – 7-6); SIPC Resps. at 3. The Board asked SIPC to comment on the conclusion that "'deeper waters would be suitable' and that gizzard shad would need to descend to depths of up to 35 feet in the lower half of the lake." *Id*., citing Exh. B, App. C at 42-43. SIPC responded that this conclusion considered temperature "only based on the modeling results conducted by AMEC." SIPC Resps. at 3. Based on data collected in 2016,

> an average temperature of 30° C (86° F), well below both the mean weekly average temperature for growth (MWAT) and upper incipient lethal temperature (UILT) endpoints cited in the 2013 demonstration (89° F and 96° F, respectively),

> was reached at a water depth of approximately 16 feet in the lower lake zone during July (Figure 7-4) and approximately 13 feet in the lower and middle lake zones during August (Figure 7-5). *Id*.

Gizzard shad descending to a depth of 16 feet in the lower lake zone would reach acceptable temperatures. *Id*.

SIPC added that "average [dissolved oxygen] levels at the depths where temperatures were 30° C or below in the lower lake in July and August were approximately 3 mg/L. But [dissolved oxygen] levels at depths with temperatures of 30° C or below in the middle and upper lake zones were above 5 mg/L." SIPC Resps. at 4. Based on the 2016 data, SIPC argued that "gizzard shad would have ample areas of thermal refuge with acceptable levels of dissolved oxygen in the middle and upper lake zones during the hottest times of the year." *Id*.

Second, EIU also performed additional electrofishing and netting in October and November 2016 to collect black crappie and white crappie for an age-growth study. Exh. B at 4-10, 4-11; *see* Exh. B, App. A at A-6, A-14 – A-15; Exh. B, App. B at B-13, B-42 (Figure 7-2: map). Although the supplemental sampling did not collect any white crappie, it collected 46 black crappie, 91 percent of which were greater than "quality" length of 200 mm. Age ranged from one to five years, with 2 years the dominant age. Exh. B at 4-15; *see* Exh. B, App. B at B-18, B-23, B-39 (Table 12: age structure); B-57 (Figure 7-17: length), B-58 (Figure 7-18: age structure). EIU reported that black crappie were in excellent condition and had an average weight of 100 +/-2. Exh. B at 4-15; *see* Exh. B, App. B at B-19, B-23, B-38 (Table 11: relative weights); B-59 (Figure 7-19: mean length at age); *see also* Rec. at 5. EIU found black crappie to be growing faster than expected by Hedinger (2000). Exh. B, App. B at B-19, B-59 (Figure 5-20 (mean length). ASA attributes the shift in abundance from white to black crappie to reduced nutrients in the lake. The reduction led to clearer water preferred by black crappie and increasing predation of white crappie young of year. Exh. B at 4-15 -- 4-17; Exh. B, App. B at B-23.

In its recommendation, IEPA stated that the additional fish studies satisfied IEPA's concerns with health and abundance of the crappie population. IEPA found that the 2016 study demonstrated that white and black crappie living in Lake of Egypt are of excellent body condition with a mean relative weight of 100, which indicates a "healthy, unstressed population." Rec. at 7. Black crappie exhibited similar age structure and greater growth in the 2016 study compared to earlier studies. IEPA noted that monitoring for temperature and dissolved oxygen in the lake showed areas of thermal refuge for sensitive taxa. IEPA attributed the healthy body condition and growth rates of white and black crappie to the availability of thermal refuge. Rec. at 7.

<u>Fish Species Assessed in 2013 Demonstration.</u> SIPC stated that its 2013 demonstration "concluded that there was no appreciable harm to fish species in the commercially and recreationally important (Largemouth Bass, Bluegill, and Channel Catfish) and food chain/prey (Threadfin and Gizzard Shad) RIS categories." Exh. B at 4-13. Although the 2017 supplemental studies did not focus on these species, electrofishing efforts collected data on them. *Id*. Based on CPUE, the four most abundant species continued to be the same. Exh. B. at 4-13, citing *id*. at

4-14 (Table 4-1: electrofishing comparison). ASA asserted that the supplemental fish data from EIU in 2017 show that the community in the lower lake has been consistent during the last 20 years. *Id*. at 4-13. As before, ASA concluded that continued presence and abundance of commercially and recreationally important species demonstrate a lack of appreciable harm to these fish categories. *Id*.

SIPC Summary. ASA concluded that the thermal discharge "does not appear to be causing appreciable harm to the fish community." Exh. B at 4-17. ASA cites the relatively consistent composition of the community since 1997, similar composition of the community between lake zones, higher density of fish in the lower zone, and the condition of fish. *Id*. ASA stated that the lake has experienced no proliferation of nuisance species. ASA added that the black crappie population may avoid the lower and middle lake when temperatures and dissolved oxygen are outside their tolerance limits. The upper and middle lake provide ample areas of refuge with lower temperatures and dissolved oxygen concentrations above 4.0 mg/L. ASA also noted that there have been no reported fish kills related to the thermal discharge. Exh. B at 4-3, 4-17; *see* Pet. at 21-22.

Other Vertebrate Wildlife

"Other vertebrate wildlife" includes species such as ducks and geese, but not fish. USEPA 316(a) Manual at 32, 77. If an applicant can show that a site is a low impact area for other vertebrates, then that section of the demonstration "will be judged successful." *Id*. at 32. Most U.S. sites will be considered low potential impact for other vertebrate wildlife because the projected thermal plume "will not impact large or unique populations of wildlife." *Id*. These sites can rely on brief site inspections and literature reviews to demonstrate that the site can be considered one of low potential impact for other vertebrate wildlife. Exceptions include the "few sites" where important, threatened, or endangered wildlife may be affected by the discharge. *Id*. Exceptions may also include sites in the northern U.S. that attract species such as ducks and geese and encourage them to stay through the winter. *Id*. These sites may be considered low potential impact areas if there is a demonstration that a wildlife protection plan or other method would protect those species from specified harms. *Id*.

For sites that are not considered low impact for other vertebrate wildlife, the decision criteria for this section require an applicant to demonstrate "that other wildlife community components will not suffer appreciable harm or will actually benefit from the heated discharge." USEPA 316(a) Manual at 32. For these sites, the USEPA 316(a) Manual lists study requirements that an applicant should meet and separate criteria for the demonstration to be judged successful. *Id*. at 33, 61. The applicant would need to undertake investigations and planning to demonstrate what factors or wildlife management plan will ensure that other vertebrate wildlife will not suffer appreciable harm from:

1. Excess heat or cold shock;

2. Increased disease and parasitism;

3. Reduced growth or reproductive success;

4. Exclusion from unique or large habitat areas; or

5. Interference with migratory patterns. USEPA 316(a) Manual at 32-33.

2013 Demonstration. SIPC noted that sport species including ducks and Canada geese are regularly observed on Lake of Egypt, as are waterfowl including herons and shorebirds. Exh. B, App. C at 23; *see id*. at 40; Pet. at 20. SIPC also expects migrating water fowl to use the lake for foraging and resting during spring and fall. Exh. B, App. C at 23. Beaver and muskrat lodges have not been observed, suggesting that they are either uncommon or not present at Lake of Egypt. *Id*. SIPC also cited studies of other cooling lakes such as Lake Sangchris, which found that waterfowl concentrations were approximately equal in areas in areas influenced by the thermal discharge and in uninfluenced areas. *Id/*

SIPC concludes that use of the lake by numerous species, "coupled with the lack of negative effects of plant operations on truly aquatic species, indicate that the proposed thermal standard will not cause appreciable harm to the balanced indigenous community for this biotic category." Exh. B, App. C at 23; *see* Pet. at 20-21.

Board's 2014 Determination. The Board found that SIPC had demonstrated "that Lake of Egypt should be considered as low potential impact for other vertebrate wildlife." SIPC v. IEPA, PCB 14-129, slip op. at 20, 21 (Nov. 20, 2014); *see* Exh. B. at 4-1; Pet. at 18-19, 20.

2017 Demonstration. Based on the Board's 2014 finding, SIPC did not conduct additional site-specific studies. Exh. B. at 4-18; Exh. B, App. B at A-6. SIPC relied on its 2013 demonstration for this biotic category. Exh. B at 1-8.

SIPC Summary of Biotic Category Identification

SIPC argued that supplemental studies for the categories of phytoplankton, zooplankton and meroplankton, macroinvertebrates and shellfish, and habitat formers show no differences among the three lake zones attributable to the thermal discharge. Exh. B at 4-18. SIPC concluded that the thermal discharge has not caused appreciable harm to these categories. *Id*. IEPA's recommendation agreed that the supplemental studies show that these biotic categories have not and will not be significantly impacted under the proposed alternative thermal effluent limitations. Rec. at 7.

SIPC stressed that, although the supplemental studies did not focus on fish generally, those studies show that that the fish community has not changed over time. Exh. B at 4-18. SIPC argued that this confirms the 2013 demonstration, which concluded that "there has been no appreciable harm to the recreationally and commercially important and forage/prey species." *Id*. SIPC added that the thermal discharge does not appear to have caused a proliferation of nuisance species. *Id*. Finally, SIPC argued that thermally sensitive black crappie are surviving, growing, and reproducing in the lake, indicating that the discharge is not having an adverse effect on them. *Id*.

Demonstration to Show Alternative Limitation Will Assure Protection and Propagation of BIC

SIPC must demonstrate that its requested alternative thermal effluent limitations will assure the protection and propagation of the BIC in Lake of Egypt. SIPC's Demonstration uses both a Type I (Retrospective/Absence of Prior Appreciable Harm) and Type II (Predictive/Representative Important Species) Demonstration.

First, SIPC relies on its Type I Retrospective Demonstration. MGS has not changed operations affecting its heated effluent since 2003 and is not planning to do so. SIPC relies on historical data to demonstrate that the current heated effluent resulted in no "prior appreciable harm." Second, since SIPC seeks its first alternative limitation, it relies on a Type II Predictive/RIS Demonstration. Pet. at 16; *see* Exh. B, App. C at 24-38. SIPC uses hydrothermal modeling and dissolved oxygen surveys compared to biothermal response data for RIS to evaluate the potential effects of the proposed limitations. Exh. B at 1-1, 2-2, 4-10, App. C at 26-51.

The Board first reviews SIPC's retrospective demonstration to show absence of prior appreciable harm. Then the Board reviews SIPC's predictive demonstration to show the proposed alternative thermal effluent limitations will assure the protection and propagation of BIC. The Board then makes its findings on the Biotic Category Criteria based on the Type I Retrospective and Type II Predictive/RIS Demonstrations.

Type I Demonstration: Retrospective/Absence of Prior Appreciable Harm

Since the MGS has a pre-existing discharge, SIPC's petition relies in part on a Type I Demonstration (Retrospective/Absence of Prior Appreciable Harm). To show the absence of prior appreciable harm, the retrospective demonstration reflects conditions before and after Unit 123 was brought online in 2003. Pet. at 6, 22, citing 40 C.F.R. § 125.73(c)(1)(i).

SIPC's retrospective demonstration relies on three groups of biological studies to evaluate effects of the thermal discharge on aquatic biota: Dr. Heidinger's studies from 1977 to 2007, AMEC's studies for the 2013 demonstration, and ASA's supplemental studies for the 2017 demonstration. Pet. at 16-20. ASA states that its 2016 supplemental studies on phytoplankton, zooplankton and meroplankton, macroinvertebrates and shellfish, and habitat formers "showed no difference in these communities among lake zones that could be attributable to the MGS thermal discharge." Exh. B at i; *see id*. at 4-1 – 4-9 (biotic category rationales). ASA states that its supplemental studies show a stable fish community over the last 20 years. Exh. B. at i; *see id*. at 4-13; Pet. at 21; Rec. at 6. ASA asserts that a consistent fish community indicates that lower trophic levels such as phytoplankton and zooplankton exist in sufficient quality and quantity to support the upper trophic level. Pet. at 21; Rec. at 6. ASA observes that electrofishing data show that the nuisance species of common carp has not proliferated. Exh. B at i; *see id*. at 4-14, 4-16; Rec. at 5. ASA adds that data show black crappie "surviving, naturally reproducing, and growing quickly" in the lake without apparent adverse effects from the thermal discharge. Exh. B at i; *see id*. at 4-14 – 4-15, 4-17. IEPA states that these supplemental studies satisfied its concerns with the thermally sensitive white and black crappie. Rec. at 5. Considering both the supplemental studies and historical data, ASA concludes that "the MGS operation and thermal discharge have not caused appreciable harm to the balanced, indigenous community" in Lake of Egypt. Exh. B. at i; *see* Pet. at 16.

In its recommendation, IEPA noted that SIPC's Type I Retrospective Demonstration covers 20 years and shows that a consistent fish community has "adapted and thrived in the thermal environment of Lake of Egypt." Rec. at 8. IEPA noted results showing more fish in the warmer lower lake zone near the discharge than in the middle and upper lake zones. IEPA added that fish abundance is not dominated by heat-tolerant or nuisance species. IEPA explains that this indicates the quality and quantity of the lower trophic levels that support the fish. Rec. at 7-8.

Type II Demonstration (Predictive / Representative Important Species)

For the Type II Predictive/RIS Demonstration, the Board first reviews the engineering and hydrological data. The Board then reviews the hydrothermal model SIPC used to predict the thermal regime in Lake of Egypt under MGS's proposed alternative limitations. To assess the predicted impact of the modeled thermal regime on the biotic community, the Board reviews SIPC's RIS analysis.

Engineering and Hydrological Data

Engineering and hydrological data provide a baseline for parameters to be used in predictive models. The engineering information for MGS describes the station's generating capacity and load factors, engineering design of the condenser cooling system, cooling water intake and outfall, as well as discharge flow. The hydrological data include the thermal plume and the profiles for depth, temperature, and dissolved oxygen in Lake of Egypt. It also considers meteorological data and the interaction between chemicals, such as chlorine, and other pollutants in the water with the thermal component of the discharge.

The engineering information for MGS is based on the two coal-fired Units 4 and 123, which are rated at 173 and 109 MW with load factors ranging from 71-80% and 76-85%, respectively, as recorded from 2009 to 2017. Exh. B at 1-3, 1-4; *see* Exh. B, App. C at 1; Pet. at 7. Cooling water is drawn from and discharged to Lake of Egypt in a once-through system using a main condenser and condensate pumps at an average flow rate of 173,000 gallons per minute. Pet. at 8, 12. The intake and outfall structures are located in separate coves divided by a narrow peninsula in the south end of the lower lake. Exh. B at 1-3. The outfall consists of two 6-foot diameter discharge ports. SIPC Resps. at 4. SIPC notes that Lake of Egypt does not have a flowing current other than the flow from the cooling water intake and discharge. SIPC Resps. at 4.

Meteorological conditions affect the ability of the lake to dissipate heat. The heated discharge is designed to settle into the upper layer of the lake where it can be cooled by evaporation and thermal radiation to the air, as well as convective heat transfer with the air and lower water layers. Pet. at 12-13. Weather conditions affecting the lake's cooling efficiency include droughts that reduce the lake surface area, high ambient air temperatures that reduce heat transfer to the air, and high humidity that makes evaporative cooling less effective. Pet. at 13. As explained below, meteorological data is used in SIPC's hydrothermal modeling to predict the impact of the heated discharge on lake temperatures under both normal and stressed seasonal weather conditions.

Lake of Egypt is a relatively narrow water body with several tributary branches. SIPC shows the bathymetric profile graphically, with an average depth of 18 feet and a maximum depth of 52 feet. The lake covers 2,300 acres and is approximately 6.2 miles long from the dam at the north end of the lower lake to the south end of the upper lake. AMEC further studied the bathymetry of the lower lake in July 2010 to characterize the physical configuration of the intake area, discharge area, and mixing zone. In the cove containing the intake structure, the water is 25 to 40 feet deep. The discharge cove is narrower and shallower with water less than 20 feet deep. Exh. B, App. C at 2, 24-25, Fig. 1-2, 5-9.

Water temperature profiles were surveyed in the summers of 2006, 2010, and 2016 to describe the extent of the thermal plume and thermal conditions throughout Lake of Egypt both horizontally and vertically. Depending on the survey, measurements were taken at several locations across the lake at intervals of 0.5 meters to 3.28 feet from the surface to the bottom of the lake as deep as 40 feet. Exh. B, App. C, App. B; Exh. B, App. B at B-10; SIPC Resps. Att. E. The surveys showed temperatures decreasing with distance from the discharge and depth. At the surface, AMEC mapped the measured temperature gradients across the Lake of Egypt for the 2006 and 2010 surveys. Exh. B, App. C, Fig. 5-4 through 5-8; Exh. B, App. C, App. B; SIPC Resps. Att. E. AMEC states that surface water temperatures at the edge of the mixing zone in the August 2006 MACTEC survey reached 98°F, while the MACTEC data table shows 85.1°F at the surface near the edge of the mixing zone. Exh. B, App. C at 24-25 (Figure 5-5); Exh. B, App. C, App. B (T3-C). In July 2010, surface temperatures reached 94°F at the eastern edge of the mixing zone in the discharge cove, while surface temperatures of the intake cove reached the upper 80s°F. Exh. B, App. C at 24-25, Fig. 5-7, 5-8. Below the surface, temperatures dropped with increasing depth. For example, the MACTEC August 2006 data at the T3-C location near the edge of the mixing zone showed temperatures dropping from 85.10°F at the surface to 81.32°F at a depth of 10 feet and 72.86°F at a depth of 20 feet. Exh. B, App. C, App. B. EIU plotted the measured temperature gradients and depths graphically for the 2016 survey. Exh. B at B-10, B-43 to B-46.

Dissolved oxygen profiles were surveyed by SIU from 1997 to 1999, MACTEC from 2005 to 2007, and EIU in 2016. The surveys showed a normal seasonal pattern of lower concentrations of dissolved oxygen in the warmer waters of the summer and higher concentrations in cooler waters of the winter. Exh. B, App. C at 24, Figures 5-2, 5-3; Pet. at 17. Dissolved oxygen concentrations were consistently lower in the lower lake zone than in the middle and upper zones. Exh. B at 4-14. At the surface near the cooling water intake structure, dissolved oxygen levels were generally greater than 8 mg/L in the spring and summer but below 5 mg/L in late summer and early fall. Exh. B, App. C at 24. At the surface near the outside edge of the mixing zone area, dissolved oxygen levels ranged from 5.44 mg/L to as low as 4.02 mg/L in the summer of 2006 when water temperatures reached 84°F. Exh. B, App. C, App. B. In the summer of 2016, EIU reported peak water temperatures near 30°C (86°F) with dissolved oxygen concentrations as low as approximately 3.0 mg/L in the lower lake but above 4.0 mg/L in the middle zone and over 6.0 mg/L in the upper zone. Exh. B at 4-15. Additionally, the surveys documented decreasing dissolved oxygen concentrations with depth. Dissolved oxygen concentrations approached zero at a depth of 26.4 feet in both the MACTEC and EIU surveys. Exh. B, App. B at B-43 to B-46 (Figures 7-3 – 7-6); Exh. B., App. C, App. B; SIPC Resps. at 3.

As to the discharge of chemicals, including chlorine, that might interact with the thermal component of the discharge, SIPC's permit contains limits and special conditions. Special Condition 12 provides that the non-contact cooling water must be free from additives other than chlorine unless the use and aquatic toxicity results are approved by IEPA. The permit limits total residual chlorine to a daily maximum of 0.2 mg/L, and Special Condition 5 restricts the discharge of chlorine to no more than two hours per day. App. A at 3, 6.

Predictive Hydrothermal Modeling

SIPC's predictive demonstration modeled the thermal conditions in Lake of Egypt. The model sought "to provide information for the Lake of Egypt for both potential summer and winter conditions that would result in higher than normal seasonal water temperatures due to maximum heat loading and infrequent summer and winter weather climate conditions." Exh. B, App. C at 26. Normal conditions were considered to be those present during June and July 2010 for summer and January and February 2011 for winter. Exh. B at 2-2. Stressed conditions were defined using "95% non-exceedence values for a 20-year record of environmental parameters reflecting a set of weather/climactic conditions that are considered to be rarely exceeded in terms of generating warmer lake temperatures." *Id.*; *see* Pet. at 24, citing Exh. B, App. C, App. B (2006 surface water temperatures); *see* Exh. B, App. C at 27. The assessment compared the thermal tolerance of the RIS to temperatures that could exist under normal and stressed conditions. Pet. at 24.

Model Used. SIPC used the Generalized Longitudinal Lateral Vertical Hydrodynamic Transport (GLLVHT) model to predict lake temperatures during normal and stressed conditions. Pet. at 24. "The model calculates an energy balance based on lake mixing and surface heat losses (or gains) from three-dimensional cells formed by a horizontal grid and vertical layers." Exh. B. App. C at 27. SIPC suggests that configuration of and conditions in the lake necessitated using this hydrodynamic model. *Id*. at 26. "A plume type of model, while applicable to a near-field area within the northern end of the lake, would not be able to model the overall lake configuration, including boundaries, and would not be appropriate to analyze far-field thermal conditions for this water body." *Id*. SIPC reports that USEPA concurred in the use of this model. Pet. at 24.

To calibrate the model, AMEC simulated a time period ending on July 22, 2010 to match the actual temperature data from the lake and cooling water discharges measured on that date. When the measured field temperatures and modeled results agreed, AMEC was confident that the model predictions simulated both normal and more extreme "stressed" weather conditions. Exh. B, App. C at 27. To predict "normal conditions" for summer and winter, AMEC ran the model using inputs based on summer weather in the 30 days before June 22, 2010, and on winter weather during February 2011. Exh. B, App. C at 27-28, 36-37. For stressed conditions, inputs are statistical estimates based on local long-term data. *Id*. at 28. To develop surface equilibrium temperature (T_{eq}) to model stressed conditions, AMEC obtained daily data for summer and winter to calculate the maximum 30-day running average T_{eq} for both seasons during each year. *Id.*; *see* Pet. at 24-25. AMEC then performed a frequency analysis to estimate the probability of exceedance. Model inputs for summer and winter "were based on the 95% non-exceedence event corresponding to an average occurrence frequency of approximately once in 20 years," except where 98% was used for winter. Exh. B, App. C at 28; *see id.* at 31 (Table 6-2: percentile data and non-exceedence probability).

Model Inputs for Summer and Winter. In the 2013 Demonstration, Tables 5-5 and 5-6 summarize model inputs for summer and winter under normal and stressed conditions. Exh. B, App. C at 34-35. Figures 5-10 – 5-17 depict the modeling results graphically. *Id.* at 81-88.

The Board asked SIPC to "[p]rovide directly from the model a printout showing inputs used and outputs obtained for summer and winter normal and stressed conditions. In the printout, the Board asked SIPC to highlight the numbers used in the summaries of the modeling inputs and the numbers used to produce the figures." Board Questions at 3. SIPC submitted requested information with its responses. SIPC Resps., Attachment C (Summer and Winter Model Input and Output Data).

Bathymetric Data. AMEC approximated the shape of the lake by using a U.S. Geological Survey map of the shoreline. Exh. B, App. C at 28. AMEC used a horizontal grid of 500-foot squares and a maximum of 27 vertical layers of 18 inches to complete a three-dimensional representation of the lake. Exh. B, App. C at 26, 27, 28; *see id.* at 34 (Table 5-5: summer inputs), 35 (Table 5-6: winter inputs). AMEC based this input in part on its 2010 bathymetric study of the lower lake. *See id.* at 25.

Weather and Climate Data. Weather and climate data used to define model inputs include dewpoint temperature, wind velocity and direction, and solar radiation. Exh. B, App. C at 26, 27. This information is not put directly into the model. *Id.* at 28. Instead, these parameters are used to calculate a Coefficient of Surface Heat Exchange (CSHE) and T_{eq} that are employed as inputs for the model. *Id.* CSHE "is the rate at which heat is gained or lost at the lake surface. When lake surface temperature is above the equilibrium temperature, the lake loses heat to the atmosphere at the rate of CSHE times the temperature difference between the lake equilibrium temperature and the actual lake water temperature." *Id.*; *see id.* at 26.

Lake Inflow and Outflow. AMEC assumed lake inflow and outflow to be zero during the summer and winter modeled conditions. Exh. B, App. C at 27. AMEC based this assumption on U.S. Geological Survey stream flow records and observed water levels in the lake that are often below the spillway level. *Id.* During dry late summer months, the Lake of Egypt is "essentially a closed system with little water inflow and outflow relative to lake volume." *Id.* at 26.

Heat Load to Lake. AMEC based heat load from the MGS thermal discharge under normal conditions on July 2010 records from the station. Exh. B, App. C at 29. For stressed conditions, AMEC calculated heat loads of 724 MW for summer and 674 MW for winter based on plant data recorded for July and August 2010 and January and February 2011, respectively.

Id. These values are approximately equal to the maximum 14-day running average heat loads and equal to the 66th percentile values of the instantaneous heat load rates for those periods. *Id*.; *see id*. at 32 (Table 5-3: winter heat load), 33 (Table 5-4: summer heat load). Modeling of stressed conditions "did not include any increase in generation capacity or thermal load to the lake from SIPC plant operations." *Id*. at 27.

Initial Water Temperatures. Water temperature profiles collected on June 12, 2010, extended 9,000 feet upstream from the dam. Exh. B, App. C at 29. AMEC used these to establish initial temperatures in the layers for the start of summer conditions. *Id*. For modeled winter conditions, only cooling water intake temperatures were available, and AMEC estimated an initial temperature profile based on literature values. *Id*. at 28.

Model Results Depicted Graphically. Using inputs including those summarized above, AMEC modeled normal and stressed lake conditions in summer and winter and depicted the results graphically. Exh. B, App. C at 30; *see id*. at 34 (Table 5-5: summer inputs), 35 (Table 5-6: winter inputs), 81-88 (Figures 5-10 through 5-17). In the 2013 Demonstration, Figures 5-10 through 5-17 illustrate lake surface temperatures generated by the model. Exh. B, App. C at 81-88. Figures 5-14 through 5-17 show model results at cross sections. *Id*. at 85-88.

In its questions, the Board noted that Transect A appears to pass through the mixing zone, while Transect B appears to pass approximately 700 feet east of the mixing zone shown in Figures 5-10 through 5-13. *Id*. at 81-84. The Board asked SIPC to "explain the reasons for locating Transect B beyond the edge of the mixing zone." Board Questions at 3. Transect B runs "north-south through the dam at the downstream end of the lake" to provide a cross-section of the deeper water there. SIPC Resps. at 7. SIPC noted that the model generates results based on 500-foot square grid cells. *Id*. SIPC explains that AMEC first established transects and then analyzed data to determine the edge of the mixing zone. *Id*. Although Figures 5-10 through 5-13 show an average edge of the mixing zone, the edge is expected to change based on factors such as "lake inflow and outflow over the spillway, cooling water discharge, wind speed and direction, etc." *Id*.

The Board also asked SIPC to "[a]ddress whether a north-south cross section otherwise similar to Transect B at the eastern edge of the mixing zone would show temperatures greater than those along Transect B." Board Questions at 4. SIPC responded that, based on Figures 5-10 through 5-17, "it does not appear that temperature would be higher if the transect was moved to the eastern edge of the mixing zone based on the model data." SIPC Resps. at 7. SIPC stated that "[t]he modeled stressed condition shows the same surface temperature across the whole isotherm depicted in the lower lake." *Id*. SIPC projected that "moving the transect within the same isotherm would result in the same basic temperature profile." *Id*.

However, based on 2006 water temperature profiles, SIPC acknowledged that temperatures along a transect closer to the edge of the mixing zone could show higher temperatures. SIPC Resps. at 8, citing Exh. B, App. C at 75-77 (Figures 5-4 – 5-6). SIPC indicated that "[a]n approximation of temperatures at the edge of the mixing zone can be seen by drawing a vertical line through the mixing zone identified in transect A-A' in Figures 5-14 and 5-

16." SIPC Resps. at 8, citing Exh. B. App. C at 85, 87; *see also* SIPC Resps., Attachment E (revised Figures 5-14 and 5-16 indicating mixing zone).

For Figures 5-14 through 5-17, the Board asked that SIPC "provide a scale for depth and surface distance" and "the location of the edge of the mixing zone." Board Questions at 4. SIPC submitted to the Board revised Figures 5-14 through 5-17 with added scales for depth and horizontal distance. SIPC Resps., Attachment E. Revised Figures 5-14 and 5-16 also show the width of the mixing zone along Transect A-A'. *Id*. SIPC stressed that transect B-B' does not intersect with the boundary of the mixing zone. *Id*. at 8.

Model Results for Winter Conditions. AMEC simulated both normal and stressed winter conditions for the months of December to March.

Normal. AMEC simulated normal conditions for late February 2011 using weather data and plant discharge records. Exh. B, App. C at 37. Because lake temperature data were not available, AMEC compared simulated temperatures with data from influent cooling water. *Id*. Estimated temperatures show a maximum lower lake surface temperature of 52°F. *Id*., citing *id*. at 83 (Figure 5-12: normal winter hydrothermal model output). In the upper lake, temperatures ranged from 40 to 49°F. *Id*. Along cross section B east of the mixing zone, the model predicted mid-depth temperatures of approximately 48°F, "which are similar to the recorded intake water temperatures." *Id*., *see id*. at 88 (Figure 5-17: modeled cross section of normal winter temperatures).

Stressed. AMEC first based the simulation of stressed winter conditions on modeled surface temperatures. Exh. B, App. C at 37, citing *id*. at 84 (Figure 5-13). AMEC then applied a T_{eq} of 64.8°F, the 98 percent non-exceedance value of annual maximum 30-day T_{eq} values for Carbondale for January to March from 1990 to 2012. *Id*. at 37.

AMEC explained that data for the stressed winter simulations extend to the end of March, so that winter temperatures include late March temperatures higher than February 2011 results. *Id*. Modeled temperatures for winter stressed conditions "range from 15 to 18°F warmer than the February 2011 predicted temperatures." *Id*.; *see id*. at 87 (Figure 5-16), 88 (Figure 5-17). Differences were larger in the lower lake than in the upper. *Id*. at 37.

In the 2013 Demonstration, Figure 5-13 shows simulated surface temperatures under stressed winter conditions. Exh. B, App. C at 37, 84. The warmest isotherm in Figure 5-13 is 68.1-69°F. *Id*. at 84. Figures 5-16 and 5-17 provide cross-sectional diagrams of modeled results along Transects A and B, respectively, under normal and stressed winter conditions. *Id*. at 87-88. The warmest isotherm in Figure 5-16 is 69.1-70°F at Transect A, which passes through the mixing zone. *Id*. at 87.

The Board asked SIPC to "identify the modeled winter maximum temperature at the edge of the mixing zone." Board Questions at 4. Under normal winter conditions, the maximum temperature at the edge of the mixing zone is within the 52.5° F isotherm, and under stressed winter conditions, the maximum temperature is within the 69° F isotherm. SIPC Resps. at 8, citing Exh. B, App. C at 83-84 (Figures 5-12, 5-13).

The Board also asked SIPC to explain why it "proposed 72°F as the winter maximum instead of the highest modeled result of 70°F which passes through the mixing zone or the highest temperature at the edge of the mixing zone as indicated by the hydrothermal model." *Id*. SIPC responded that it based modeled conditions on estimated 95% annual non-exceedence of parameters from historic data. SIPC Resps. at 8. With an annual five percent chance of exceedance, "the probability of having at least one exceedance during a five-year period is 23% and the probability of at least one exceedance during a 20-year period is 64%." *Id*. at 8-9. Considering these risks and factors such as climate change and operational limitations that are not factored into the model, "SIPC requested variance temperatures slightly elevated from the modeled 'stressed' condition predictions." *Id*. at 9.

The 2013 Demonstration states that model inputs "were based on the 95% [annual probability of] non-exceedance event corresponding to an average occurrence frequency of approximately once in 20 years," except where 98% was used for winter. Exh. B, App. C at 28. "Given that the winter results from the hydrothermal modeling of 70°F are representative of the 98th percentile," the Board asked SIPC to "explain whether the proposed excursion temperatures (3°F) and hours (1% of 12-month period) would provide an adequate range for the alternative thermal effluent limitation for winter temperatures that might exceed 70°F during conditions that would occur above the 98th percentile." Board Questions at 4. SIPC responded that temperatures measured from 2014 to 2018 during March have exceeded 75° F, "so the proposed excursion temperatures (+3° F) and hours would not provide an adequate range if the alternative thermal effluent limitations were set at 70° F during winter months (which currently include March)." SIPC Resps. at 9.

SIPC concluded that it "could not comply with a maximum temperature limit of 70° F from December through March." SIPC Resps. at 9-10. However, because SIPC is able to comply with a 70° F limit for December to February, it proposed "setting the maximum temperature limit for the month of March at 74° F with the same excursion temperatures (no more than +3° F) and hours (1% of 12-month period)." *Id*. at 10.

If SIPC complied with a winter maximum of 70°F, the Board asked SIPC to explain whether it would require other measures, such as curtailing operations or derating, after applying allowable excursion temperatures and hours. Board Questions at 5. SIPC responded that, if it approached a maximum allowable temperature limit set at 70° F, it "could be forced to curtail operations." SIPC Resps. at 9. SIPC added that "[t]his could impact SIPC's ability to respond when called upon to meet demand and the cooperative would lose money as a result." *Id*.

Model Results for Summer Conditions. AMEC simulated both normal and stressed summer conditions for the months of June to September. To depict the change in temperature with depth, AMEC used the modeled summer results to produce cross sections within the mixing zone. Exh. B, App. C at 37, citing *id*. at 85-86 (Figures 5-14, 5-15). These show that water temperature generally decreases from 5 to 7°F from the surface to mid-depth and then remains approximately uniform to the bottom. *Id*. The patterns are nearly the same between the normal and stressed conditions, but the stressed model shows temperatures approximately 7°F higher. *Id*. In cross sections outside the mixing zones, there is less of a difference. Exh. B, App. C, citing *id*. at 84 (Figure 5-13). "The warmest water is in the center of the cross section, and it generally cools approximately 2°F moving toward either shore." *Id*; *see id*. at 85-86 (Figures 5-14, 5-15: modeled summer cross sections). Temperatures generally decrease 3 to 4°F from the surface to mid-depth. *Id*. at 38. The patterns are similar between the normal and stressed conditions, but the stressed model shows temperatures approximately 5°F higher. *Id*.

Normal. For the July 2010 actual conditions that were used to calibrate the model, the model predicts a surface temperature of 95.0°F in the mixing zone, decreasing to 94.5°F at its boundary for the summer normal conditions. "Most of the lake, and all of the upper lake, remained at an ambient temperature near or below 94°F." Exh. B, App, C at 36, citing *id*. at 81 (Figure 5-10: modeled summer normal temperatures); *see id*. at 85 (Figure 5-14: modeled cross section of normal temperatures).

Stressed. To simulate summer stressed conditions, AMEC modified model inputs to reflect "a warm summer with less cloud cover and higher humidity, low average wind speed, and [w]eather conditions based on an annual probability of non-exceedence of 95 percent, for the annual maximum 30-day running average. . . ." Exh. B, App. C at 36. AMEC assumed the MGS thermal load to be 724 MW, "based on the maximum thermal load that occurred during the July 2010 baseline simulation." *Id*. at 37.

The model of these stressed conditions "predicts an average surface temperature of 99.7°F for the area nearest the discharge." Exh. B, App. C at 37; *see id*. at 82 (Figure 5-11: modeled summer stressed temperatures). Throughout the lower lake, the model expects surface temperatures of 97°F or greater. *Id*. This differs from predicted July 2010 temperatures by approximately 6°F in the lower lake. *Id*. Under these conditions, "surface temperatures for even the distant arms of the upper lake would be expected to exceed 90°F." *Id*.; *see id*. at 82 (Figure 5-11).

The 2013 Demonstration states that the eastern (downstream) boundary of the 26-acre mixing zone "generally corresponds to the 101° F isotherm as predicted in the summer stressed condition modeling scenario." Exh. B, App. C at 55. Results for summer stressed condition modeling are shown in Figures 5-11, 5-14, and 5-15. *Id*. at 82, 85-86. The highest isotherm in these figures appears to be 99.1 – 100° F, and they do not appear to include a 101° F isotherm. Table 5-1 of the 2013 Demonstration shows the highest water temperature recorded in the chart as 100.6° F on August 17, 2010. "Measurement was taken inside the mixing zone, near the discharge outfall." Exh. B, App. C at 25 (Note b to Table 5-1).

The Board asked SIPC to "[c]larify the modeled summer maximum temperature at the edge of the mixing zone." Board Questions at 6. SIPC responded that "[t]he modeled summer maximum temperature is within the 100° F isotherm at the edge of the mixing zone." SIPC Reps. at 11.

The Board also asked SIPC to explain why it "proposes 101°F as the summer maximum, corresponding to a measurement taken near the discharge outfall, instead of the highest modeled result of 100°F or the highest temperature at the edge of the mixing zone as indicated by the hydrothermal model." Board Questions at 6. SIPC responded that recent temperatures have approached and would be rounded up to 101° F for periods of less than an hour. SIPC Resps. at 11.

If results of modeling for summer represent the 95th percentile once in 20-year frequency, the Board asked SIPC to "explain whether the proposed excursion temperatures and hours would provide an adequate range for the alternative thermal effluent limitation for summer temperatures that might exceed 100°F during conditions that would occur above the 95th percentile." Board Questions at 6. The Board also asked SIPC to "[c]omment on proposing 100°F for the maximum temperature at the edge of the mixing zone as indicated by the hydrothermal model as the summer (June-September) limit instead of 101° as requested in the petition." *Id*. Although SIPC reports summer temperatures approaching 101° F for short periods of time, it reported that it "could comply with a summer maximum of 100° F given the proposed excursion temperatures and hours." SIPC Resps. at 11.

If SIPC complies with a summer maximum of 100°F, the Board asked whether allowable excursion temperatures and hours would require other measures, such as curtailing operations or derating. *Id*. Citing AMEC's modeling results and recently measured temperatures, SIPC responded that it "should not need to take other measures such as curtailing operations." SIPC Resps. at 11.

Supplemental Modeling of Spring and Fall Conditions. At IEPA's request, SIPC performed supplemental modeling to evaluate thermal conditions during the transition months of spring (April 1 through May 31) and fall (October 1 through November 30) and recommend alternate thermal standards for those months. Exh. B, App. C at 27, 38, App. F at 2. While SIPC performed modeling in a manner similar to summer and winter modeling, it used additional recent operational data. *Id*. at 38. Because of regular temperature increases in the spring and decreases during the fall, SIPC asserted that regulatory maximum temperatures should be based on conditions at the end of spring and beginning of fall. Exh. B, App. C, App. F at 2. SIPC based climate inputs on "30-day running averages of conditions prior to May 31 (spring) and October 1 (fall)." *Id*.

The Board asked SIPC to "[p]rovide directly from the model a printout showing inputs used and outputs obtained from the Supplemental Spring and Fall Hydrothermal Modeling. In the printout, please highlight the numbers used in the summaries of the modeling inputs and the numbers reported above as the maximum surface temperatures and the temperatures at the edge of the mixing zone from the simulation of the spring and fall conditions." Board Questions at 3. SIPC submitted requested information to the Board. SIPC Resps., Attachment D (Spring and Fall Model Input and Output Data). The modeling printouts confirmed the maximum surface temperature was 29.91° C (85.8° F) resulting from the spring simulation of a May 31 date and 32.67° C (90.7° F) resulting from the fall simulation of an October 1 date. Exh. B, App. C, App. F at 2; SIPC Resps. Att. D.

At the edge of the proposed mixing zone, SIPC's supplemental modeling showed a spring surface water temperature of 86°F and a fall temperature of 91°F. Exh. B, App. C, App. F at 2; SIPC Resps., Att. D. For fall (October 1 to November 30), SIPC proposed an alternative thermal effluent limitation of 91°F as simulated by the model at the edge of the mixing zone. However, for spring (April 1 to May 30), SIPC proposed an alternative thermal effluent limitation of 90°F even though the temperature simulated by the model at the edge of the mixing zone was 86°F. Pet. at 34-35. The Board asked SIPC to explain why it "proposed 90°F as the spring alternative thermal effluent limitation instead of 86°F as the maximum indicated by the hydrothermal model at the edge of the mixing zone." Board Questions at 5. Referring to its response to the Board's question about the proposed winter limit, SIPC cited a number of factors in support of its proposed spring limit: the probability of an exceedance, climate change, model uncertainty, and operational limitations that are not factored into the model. SIPC Resps. at 10, citing *id*. at 8-9. SIPC argued that these considerations apply "to model predictions for any period of the year." *Id*. at 10. For the proposed spring limit, SIPC requested alternate limitations "slightly elevated from the modeled 'stressed' condition predictions." SIPC Resps. at 9.

If results of the supplemental modeling for spring are representative of the 95th percentile once in 20-year frequency, the Board asked SIPC to "explain whether the proposed excursion temperatures and hours would provide an adequate range for the alternative thermal effluent limitation for spring temperatures that might exceed 86°F during conditions above the 95th percentile." Board Questions at 5. SIPC responded that they would not do so. SIPC Resps. at 10. "A maximum temperature limit of 86° F would result in several exceedences of the +3° F limit." *Id.*

The Board also asked SIPC to "[c]omment on proposing 86°F for the maximum temperature at the edge of the mixing zone as indicated by the hydrothermal model as the spring (April-May) limit instead of 90°F as requested in the petition." Board Questions at 5. SIPC responded that it "cannot comply with a maximum temperature limit of 86° F at the edge of the mixing zone." SIPC Resps. at 10. With excursion hours and temperatures, SIPC proposed a 90° F maximum temperature "based on temperatures recorded in May of 2018 at the edge of the mixing zone that reached a maximum of 92.2° F." *Id.* at 10-11.

If SIPC complied with a spring maximum of 86°F, the Board asked whether allowable excursion temperatures and hours would require other measures, such as curtailing operations or derating. Board Questions at 5. Based on lake temperature data, SIPC responded that it "would likely be required to take necessary measures to reduce discharge temperatures in order to comply with a maximum limit of 86° F." SIPC Resps. at 10.

Representative Important Species Analysis

To predict the impact of SIPC's modeled thermal regime in Lake of Egypt from the requested alternative thermal effluent limitations on the BIC, SIPC selected eight RIS and an invasive species for evaluation.

Representative Important Species Selection Process. The initial Biotic Category Analysis and early screening process reveal whether it is necessary to gather more detail at a site. USEPA 316(a) Manual at 6. If a site is not one of low potential impact for all of the biotic categories, then the demonstration must address a Type II Predictive Demonstration based on RIS, or a Type III Demonstration based on biological, engineering, and other data. USEPA 316(a) Manual at 34, 52.

"RIS" means "species that are representative, in terms of their biological needs, of a balanced, indigenous community of shellfish, fish, and wildlife in the body of water into which a discharge of heat is made." 35 Ill. Adm. Code 106.1110; *see also* 40 C.F.R. § 125.71(b); USEPA 316(a) Manual at 78-79. Analysis of RIS reflects the following assumptions:

1. It is not possible to study in great detail every species at a site; there is not enough time, money, or expertise.

2. Since all species cannot be studied in detail, some smaller number will have to be chosen.

3. The species of concern are those casually related to power plant impacts.

4. Some species will be economically important in their own right, *e.g.*, commercial and sport fishes or nuisance species, and thus 'important.'

5. Some species, termed 'representative,' will be particularly vulnerable or sensitive to power plant impacts or have sensitivities of most other species and, if protected, will reasonably assure protection of other species at the site.

6. Wide-ranging species at the extremes of their ranges would generally not be considered acceptable as 'particularly vulnerable' or 'sensitive' representative species but they could be considered as 'important.'

7. Often, all organisms that might be considered 'important' or 'representative' cannot be studied in detail, and a smaller list (*e.g.*, greater than 1 but less than 15) may have to be selected as the 'representative and important' list.

8. Often, but not always, the most useful list would include mostly sensitive fish, shellfish, or other species of direct use to man or for structure or functioning of the ecosystem.

9. Officially listed 'threatened or endangered species' are automatically 'important.' USEPA 316(a) Manual at 35-36.

The USEPA 316(a) Manual lists the following considerations in selecting RIS "[w]here information pertinent to species selection is adequate:"

1. Species designated in state water quality standards as requiring protection;

2. Species identified in consultation with the USEPA Director, other governmental agencies, and other appropriate persons;

3. Any present threatened or endangered species;

4. The most thermally sensitive species (and species group) in the local area should be identified and their importance should be given special consideration, since such species (or species groups) might be most readily eliminated from the community if effluent limitations allowed existing water temperatures to be altered. Consideration of the most sensitive species will best involve a total aquatic community viewpoint;

5. Commercially or recreationally valuable species;

6. Far-field and indirect effects on the entire water body, including the additive or synergistic effects of heat combined with other existing thermal or other pollutants; and

7. Species critical to structure and function of ecological system. USEPA 316(a) Manual at 36-38.

In its definition of "RIS," the USEPA 316(a) Manual specifically includes species that are "[p]otentially capable of becoming localized nuisance species," those "[n]ecessary in the food chain for the well-being of species" considered RIS under other factors, and those "[r]epresentative of the thermal requirements of important species but which themselves may not be important." USEPA 316(a) Manual at 78-79.

In preparing a demonstration and underlying studies, federal and state agencies must be consulted to ensure that studies address appropriate wildlife. The Board's procedural rules require the petitioner to inform Illinois EPA of its proposed RIS list and data and information supporting it in its early screening information. 35 Ill. Adm. Code 106.1115(a)(4), 106.1120(b)(5). Within 60 days of submitting the early screening information, the petitioner is required to provide a detailed plan of study to Illinois EPA to support the development of its alternative thermal effluent limitation demonstration. 35 Ill. Adm. Code 106.1120. States must ensure that the detailed plan of study includes appropriate consideration of threatened or endangered species as well as other fish and wildlife resources, including species mentioned in the applicable water quality standards. USEPA 316(a) Manual at 15; 35 Ill. Adm. Code 106.1120(c).

Petitioners must collect thermal effects data for each RIS including the following:

1. high temperature survival for juveniles and adults;

2. thermal shock tolerance of selected life-history stages;

3. optimum temperature for growth;

4. minimum, optimum, and maximum temperatures allowing completion of early development;

5. normal spawning dates and temperatures; and

6. special temperature requirements for reproduction. USEPA 316(a) Manual at 43-45; *see id*. at 65 (Decision Criteria).

After completing work under the detailed plan of study, the petitioner may file a petition for an alternative thermal effluent limitation. A copy of the petition must be served on both the Agency and IDNR. *See* 35 Ill. Adm. Code 106.1125. A demonstration must show "that the RIS will not suffer appreciable harm as a result of the heated discharge." *Id.* at 35.

For the Type II Predictive/RIS Demonstration, selecting RIS should consider species that are threatened or endangered, thermally sensitive, and commercially or recreationally valuable. Pet. at 23, citing USEPA 316(a) Manual at 37-38. In addition, IEPA recommended consideration of species with potential to become a nuisance or be invasive. *Id*. at 24.

In its 2013 demonstration, SIPC selected species that represent the aquatic community and studied the effect of thermal discharges on them. Pet. at 22. AMEC selected RIS "appropriate for a lake that has been stocked since its construction." Pet. at 23, citing 35 Ill. Adm. Code 301.225 (defining "artificial cooling lake"); *see* Exh. B, App. C at 6; Rec. at 8-9. AMEC selected seven species with commercial or ecological importance that represent other species in the same trophic group: threadfin shad, gizzard shad, channel catfish, bluegill, white and black crappie, and largemouth bass. Pet. at 23. "In the Lake of Egypt, channel catfish, bluegill, largemouth bass and crappies (white and black) are recreationally important, and threadfin shad and gizzard shad are considered an important prey species for largemouth bass." Exh. B, App. C at 6; *see* Pet. at 23. "White and black crappie, in addition to being recreationally important, are thermally sensitive species." Pet. at 23. AMEC stated that RIS appropriately include channel catfish, bluegill, largemouth bass, and crappies "because their populations have been collected and analyzed in previous studies on the Lake of Egypt fishery." Exh. B, App. C at 6, citing Exh. B, App. C, App. C at 9-1 – 9-101.

To supplement AMEC's 2013 demonstration, ASA performed new studies including white and black crappie as thermally sensitive species and common carp as a species with potential to become a nuisance. Exh. B at 1-8, 24. ASA reviewed literature on rusty crayfish as an invasive species with the potential to become a nuisance. Exh. B at 4-16.

<u>Representative Important Species Selected.</u>

<u>Largemouth Bass.</u> "Largemouth bass is the primary predator species in the Lake of Egypt and is one of the most important North American warm-water sport fishes." Exh. B, App. C at 13, citing Smith, P.W, *The Fishes of Illinois* (2002). Largemouth bass typically spends the day in deeper water or near cover and in the evening hours enter shallower water to feed. Exh. B, App. C at 13, citing W.L. Pflieger, *The Fishes of Missouri* (1997). Optimal spawning temperatures range from 60 to 75°F. Exh. B, App. C. at 13 (citation omitted). "Eggs hatch in three to four days at temperatures of 60 to 67°F, and the period of larval development to the juvenile stage is 19 days at 67°F." *Id*. (citations omitted).

AMEC considers it likely that largemouth bass were first introduced into the lake after its construction in 1963, although this is not documented. Exh. B, App. C at 6. While the population may have been initiated or supplemented by stocking, it is "currently maintained by natural reproduction." *Id*. AMEC characterizes the species as one "normally associated with Southern Illinois reservoirs." *Id*., citing Exh. B, App. D at 1.

Electrofishing surveys have found largemouth bass to be common or abundant since 1997. Exh. B, App. C at 13. Based on the results of surveys from 1997 and 2006, "abundance does not appear to have decreased since the boiler replacement in 2003. . . ." *Id*., *see id*. at 11 (Table 3-4: catch rates in surveys). AMEC attributes any annual variability in abundance to relatively small sample sizes in the surveys and to regular bass fishing tournaments in Lake of Egypt. *Id*.

In 2010, catch rates for largemouth bass "were nearly identical in the upper and lower portions of the lake." Exh. B, App. C at 13, citing *id*. at 9 (Table 3-2: species composition in electrofishing samples). Surveys generated largemouth bass in all length categories 40 and 480 mm. *Id*. at 13, citing *id*. at 70 (Figure 3-5: length frequencies). "In both the upper and lower portions of the lake, individuals between 300 and 460 mm were most numerous, and probably represented III+ to V+ age fish." *Id*. at 13.

In supplemental studies, CPUE for largemouth bass "was highest in the middle lake zone followed by the lower lake zone and lowest in the upper lake zone." Exh. B at 4-13; *see* Exh. B, App. B at B-36 (Table 10: abundance and CPUE). "Largemouth bass CPUE was higher than that reported in 2010 but approximately half of the values reported in 1997, 98, and 2006." Exh. B. at 4-13; *see id*. at 4-14 (Table 4-1: CPUE comparison).

AMEC noted that over 16 percent of largemouth bass sampled had external abnormalities, more than any other species. Exh. B, App. C at 13. AMEC argued that this resulted from angling pressure rather than degraded environment. "The most frequently observed maladies were hook scars on the mouth and lesions on the mouth and body. *Id*. Because Lake of Egypt annually hosts numerous bass fishing tournaments, "it is likely that a substantial proportion of the population has been caught and handled." *Id*. at 13-14.

Threadfin Shad. "Threadfin shad is a primary forage species in the Lake of Egypt." Exh. B, App. C at 7. Beginning in 1971, it has been stocked into the lake to increase the forage base. *Id*. The population is "currently maintained by natural reproduction." *Id*. at 6; *see* Pet .at 23-24. Although not indigenous to the lake, threadfin shad were selected as RIS because they are forage for largemouth bass "and are a crucial component in support of the food web for the Lake of Egypt ecosystem." Exh. B, App. C at 7; *see* Pet. at 23.

Threadfin shad are planktivorous and are generally found in the upper five feet of water. *Id*. They "do not live as long or grow as large as gizzard shad" and are sensitive to temperatures below 45°F. *Id*. "Threadfin spawning generally occurs between April and August when temperatures are greater than 68°F. Eggs hatch in three to six days, and develop into juveniles approximately two to three weeks later, depending on water temperature." *Id*. (citations omitted).

AMEC argued that, although threadfin shad are abundant in the lake and have been collected in all surveys since 1997, they have not generally been among the most numerous species in electrofishing samples. AMEC attributes this to their small size and preference for offshore habitat. Exh. B, App. C at 7. MACTEC's 2007 impingement study report shows that they accounted for 66 percent of the total in 2005 and 77 percent in 2006. *Id*.; *see* Exh. B, App. C, App A at 20, 21 (Tables 4-3, 4-5). AMEC argued that "[t]here is no clear evidence of any population change for this species since the 2003 boiler replacement." Exh. B, App. C at 7.

During 2010 field studies, the catch rate was higher in the upper portion of the lake. Exh. B, App. C at 7, citing *id*. at 9 (Table 3-2: CPUE). In 2017, CPUE for threadfin shad was approximately six times greater than 2010. Exh. B at 4-13; *see id*. at 4014 (Table 4-1: CPUE comparison). In 2010, average length was higher in the lower lake than in the upper. Exh. B, App. C at 7, citing *id*. at 10 (Table 3-3: length comparison). "Most of the specimens collected were young-of-the-year and age 1+ fish, and were 40 to 70mm in length." Exh. B, App. C at 7, citing *id*. at 66 (Figure 3-1: length frequency).

Gizzard Shad. "Gizzard shad is a forage species in the Lake of Egypt during its young-of-year life stage," as older fish become too large for predator species. Exh. B, App. C at 11. AMEC selected gizzard shad as a RIS "because they serve as forage fish for largemouth bass and support the food web for the Lake of Egypt." *Id*.; *see* Pet. at 23. Gizzard shad are planktivorous and are generally found in the upper portion of the water column. Exh. B, App. C at 11. "Gizzard shad spawning generally occurs between April and May. Eggs hatch in two to seven days, depending on water temperature. Sexual maturity is reached at Age II or III." *Id*. (citations omitted).

AMEC considers it likely that gizzard shad were first introduced into the lake after its construction in 1963, although this is not documented. Exh. B, App. C at 6. While the population may have been initiated or supplemented by stocking, it is "currently maintained by natural reproduction." *Id*. AMEC characterizes the species as one "normally associated with Southern Illinois reservoirs." *Id*., citing Exh. B, App. D at 1.

AMEC argued that, although all surveys since 1997 have collected gizzard shad, they have not generally been common in electrofishing samples. AMEC attributes this to their preference for offshore habitat. Exh. B, App. C at 11-12. Gizzard shad were reported in both years of the impingement mortality study. *Id*., citing Exh. B, App. C, App. A at 20, 21 (Tables 4-3, 4-5). AMEC argued that "[t]here is no clear evidence of any population change for this species since the 2003 boiler replacement." Exh. B, App. C at 12.

The 2010 field studies collected more gizzard shad in July than in August. Exh. B, App. C at 12, citing *id*. at 8 (Table 3-1: species composition and abundance). The catch rate was slightly higher in the upper portion of the lake. *Id*., citing *id*. at 9 (Table 3-2: CPUE). In 2017, although ASA found that the CPUE for gizzard shad was approximately half the results from 1997 and 1998, they were more abundant in the lower lake zone than in the middle or upper zones. Exh. B at 4-13; *see id*. at 4-14 (Table 4-1: CPUE electrofishing comparison); Exh. B, App. B at B-36 (Table 10: abundance). AMEC cautioned that low electrofishing catch rates do not support firm conclusions about distribution of gizzard shad in the lake. *Id*. at 12. In 2010, average length was higher in the upper lake than in the lower. *Id*., citing *id*. at 10 (Table 3-3: length comparison). "All of the individuals collected were large adults greater than 260 mm in total length." *Id*., citing *id*. at 67 (Figure 3-2: length frequency).

Channel Catfish. AMEC selected channel catfish as a RIS "because they are a recreational species that are highly prized as a game and food fish." Exh. B, App. C at 12; *see* Pet. at 23. As adults, this species prefers habitat "with woody debris and bank cavities, and generally found in deeper water during daylight hours." Exh. B, App. C at 12. "Spawning generally occurs in the spring at temperatures ranging from 70 to 82°F, and eggs hatch in 3 to 10 days. The larval stage lasts for 12 to 16 days." *Id*. (citations omitted).

AMEC considers it likely that channel catfish were first introduced into the lake after its construction in 1963, although this is not documented. Exh. B, App. C at 6; *see* Pet. at 23. While the population may have been initiated or supplemented by stocking, it is "currently maintained by natural reproduction." Exh. B, App. C at 6. AMEC characterizes the species as one "normally associated with Southern Illinois reservoirs." *Id*., citing Exh. B, App. D at 1.

AMEC argued that, although all surveys since 1997 have collected channel catfish, they have not been collected in large numbers in daytime electrofishing samples. AMEC attributes this to their habitat preference and nocturnal habits. Exh. B, App. C at 12. AMEC argues that the 2003 boiler replacement does not appear to have decreased abundance of channel catfish. *Id*.; *see id*. at 11 (Table 3-4: catch rates).

The 2010 field studies collected slightly more channel catfish in July than in August. Exh. B, App. C at 12, citing *id*. at 8 (Table 3-1: species composition and abundance). The catch rate was higher in the upper portion of the lake. *Id*., citing *id*. at 9 (Table 3-2: CPUE). AMEC cautioned that low electrofishing catch rates do not support firm conclusions about distribution of channel catfish in the lake. *Id*. at 12. In 2010, "[a]ll but two of the individuals collected were large adults (greater than 500 mm in total length) and were probably age V+ or older." *Id*., citing *id*. at 68 (Figure 3-3: length frequency). No specimens showed external abnormalities, and all "appeared to be in excellent condition." *Id*. at 12.

Bluegill. "Bluegill is the numerically dominant species in the Lake of Egypt." Exh. B, App. C at 12, citing *id*. at 11 (Table 3-4: catch rates); *see* Exh. B, App. B at B-18. AMEC selected bluegill as a RIS because "they are a primary forage fish for predator fish such as largemouth bass and are a highly sought after recreational species." Exh. B, App. C at 12; *see* Pet. at 23. "Spawning reportedly occurs from late May through August at temperatures ranging from 67 to 80°F. Eggs hatch in about 2 days at a temperature of 77°F, and the larval stage lasts for approximately 30 days at 74.3°F." Exh. B, App. C at 12-13 (citations omitted).

AMEC considers it likely that bluegill were first introduced into the lake after its construction in 1963, although this is not documented. Exh. B, App. C at 6. While the population may have been initiated or supplemented by stocking, it is "currently maintained by natural reproduction." *Id*. AMEC characterizes the species as one "normally associated with Southern Illinois reservoirs." *Id*., citing Exh. B, App. D at 1.

Bluegill numbers have varied but have not decreased since the 2003 boiler replacement. Exh. B, App. C at 13, citing *id*. at 11 (Table 3-4: catch rates). AMEC reported slightly greater abundance in July than in August but similar catch rates in the upper and lower portions of the lake. *Id* at 13, citing *id*. at 8, 9 (Tables 3-1 and 3-2). Lengths from 60 to 79 mm and 90 to 119 mm were generally the most numerous in both portions of the lake. *Id*. at 13, citing *id*. at 69 (Figure 3-4: length frequency). Only 0.1 percent of bluegill collected showed external anomalies. *Id*. at 13.

In supplemental studies in 2017, bluegill CPUE was approximately twice the rate reported in 2010. Exh. B at 4-13, 4-14 (Table 4-1). Bluegill were more abundant in the lower lake zone than in the middle and upper zones, where abundance was similar. *Id*. at 4-13; *see* Exh. B, App. B at B-36 (Table 10: abundance and CPUE).

Thermally Sensitive Species. In 2016, EIU collected new site-specific information on thermally-sensitive species as an additional category of RIS. Exh. B, App. B at B-13; *see id*. at B-42 (electrofishing transects).

White Crappie. White crappie was selected as a RIS because it is more thermally sensitive and "a sought after sportfish for the Lake of Egypt fishery." Exh. B, App. C at 14; *see* Pet. at 23. It is often found in turbid water and low-velocity habitats and is associated with such features as submerged trees and aquatic vegetation. Exh. B, App, C at 14. Younger white crappie feed on "planktonic crustaceans and free-swimming dipterian larvae, while the older feed on small fishes." *Id*. Spawning temperatures for black crappie range from 60°F to 68°F. *Id*. (citations omitted).

White crappie tend to be more successful in turbid water "due to high young of the year mortality from predation in clear lakes." Exh. B, App. B at B-23; *see* Exh. B at 4-15. Residences around the lake have shifted from septic systems to sewer systems, limiting the nutrients discharged to the lake and resulting in less turbid water. Exh. B, App. B at B-23. The population has shifted to the black crappie that prefer a less turbid system, and EIU's supplement field studies sampled only black crappie. *Id*.; *see id*. at B-35 (electrofishing abundance), B-36 (trap net abundance); Exh. B at 4-15, 4-17.

Black Crappie. Black crappie was selected as a RIS because it is more thermally sensitive and "a sought after sportfish for the Lake of Egypt fishery." Exh. B, App. C at 14; *see* Pet. at 23. The species is generally found in clear water among vegetation over mud or sand. Exh. B, App. C at 14. Younger black crappie feed on "planktonic crustaceans and free-swimming dipterian larvae, while the older feed on small fishes. *Id*. Spawning temperatures for black crappie range from 64°F to 68°F. *Id*. "SIPC stocked Lake of Egypt with black crappie fingerlings in 2008, 2009, and 2010." *Id*.; *see* Exh. B. at 1-4 (Table 1-1: stocking summary). AMEC argues that "factors such as turbidity, water level fluctuation, the abundance of aquatic vegetation, and many other environmental factors often contribute to the cyclical nature of crappie populations in impoundments." Exh. B, App. C at 14. Within the Lake of Egypt, variation also results from relatively small sample sizes and "extensive fishing pressure." *Id*.

In addition to stocking, EIU "found evidence of natural reproduction of crappie." Exh. B, App. B at B-23. The age structure of black crappie showed "a large recruitment class of age two individuals and some individuals age three – five." *Id*. at B-23 – B-24; *see id*. at B-39 (Table 12: age structure); Exh. B. at 4-15. This structure indicates that crappie survive and thrive in the lake. Exh. B at 4-18; Exh. B, App. B at B-24; *see id* at B-58 (Figure 7-18: age structure). Length of the black crappie collected ranged from 173 mm to 366 mm total length. Exh. B at 4-15; *see* Exh. B, App. B at B-57 (Figure 7-17: length frequency). EIU also found the black crappie to be in excellent condition based on their relative weight. Exh. B. at 4-15; *see* Exh. B, App. B at B-38 (Table 11: fish condition); Rec. at 5.

Nuisance Species. In 2016, EIU collected new site-specific information on nuisance species as an additional category of RIS. Exh. B, App. B at B-13; *see id*. at B-42 (electrofishing transects); Pet. at 24.

Common Carp. In its supplemental field studies, ASA performed electrofishing in all three zones of the lake to determine whether common carp increased in abundance because of the thermal discharge. Exh. B. at 4-14. Only two common carp were collected, both from the lower zone. *Id*.; *see* Exh. B, App. B at B-36 (abundance and CPUE). Because the CPUE of 1.1 is less than reported in 2005 and 2006 and comparable to studies in 1997 and 1998, EIU concluded that they are not proliferating as a result of thermal discharges from the MGS. Exh. B. at 4-14; *see id*. at 4-18; Exh. B, App. B at B-23.

Rusty Crayfish. IEPA identified the rusty crayfish as an invasive species that could increase in abundance and become a nuisance as a result of the MGS thermal discharge. Exh. B. at 4-16. ASA reviewed literature on the responses of rusty crayfish to thermal loading to determine the potential that thermal loading to the Lake of Egypt could increase that population. *Id*.; Exh. B. App. A at A-13.

Data from experiments on the species' temperature tolerance show that "the species is capable of surviving at elevated water temperatures that could be experienced near a thermal discharge during the warm summer months." Exh. B. at 4-16. Because the rusty crayfish's preferred temperature and temperatures for maximum juvenile growth and survival are below 30°C, "conditions would not be conducive to their increased reproduction and growth." *Id*. Eliminating nutrients from the sewage treatment plant and septic systems improved the clarity of the lake, and any increase in their population could be explained by the preference of rusty crayfish for clear water. *Id*. at 4-16 – 4-17. Based on its "desktop study," ASA concluded that rusty crayfish "would not be expected to proliferate due to the MGS thermal discharge." *Id*. at 4-17.

SIPC Summary of RIS Fish Categories. SIPC's 2013 demonstration concluded that there was no appreciable harm to fish species in the RIS categories for commercially and recreationally important (channel catfish, bluegill, largemouth bass, and crappies) and food chain or prey (threadfin shad and gizzard shad). Exh. B at 4-13; *see* Exh. B, App. C at 6-14, 22. The

2017 supplemental studies focused on thermally sensitive species (white and black crappie), nuisance species (common carp), and invasive species (rusty crayfish). EIU recorded data on all species collected in its electrofishing program. Exh. B at 4-13; *see id*. at 4-14 (Table 4-1: CPUE comparison). "[T]he top four most abundant species are the same across all surveys in the lower lake zone from 1997-98 to the current study." *Id*. at 4-13. SIPC argues that these data show that the fish community in the lower zone of the lake has been consistent over the last 20 years. SIPC further argues that the data demonstrate the lack of appreciable harm to these RIS. *Id*.

<u>SIPC Biothermal Assessment</u>

To predict the impact of SIPC's modeled thermal regime on aquatic life, ASA looked at the biological attributes of the RIS relating to the thermal environment. SIPC compared the temperatures predicted in the modeled thermal plume to the range of response temperatures of the RIS to assess the potential for mortality, blocked migration, exclusion from large areas of habitat, and effects on spawning, reproduction, and growth.

In its 2013 demonstration, SIPC focused on summer thermal conditions because they are considered to be more limiting to fish than winter conditions. Exh. B, App. C at 40. SIPC compared data on summer lake surface temperature distribution to published data on species' thermal tolerance. *Id*.; *see id*. at 41 (Table 6-1), 42 (Table 6-2). Thermal conditions may affect the reproductive cycles of RIS. *Id*. at 45. A thermal discharge may accelerate gamete formation and begin spawning before the aquatic ecosystem can support them. *Id*. SIPC evaluated this potential effect by studying published spawning temperatures and timing, reports from other Illinois cooling lakes, and "[o]bserved trends in larval fish abundance and recruitment in Lake of Egypt." *Id*. Based on its 2013 Demonstration, SIPC argues that, under normal summer conditions, almost all of the RIS would have all surface waters below their UILT and would not be excluded from any area of the lake. Exh. B at 4-15, citing Exh. B, App. C at 40-45 (biothermal assessment of RIS).

<u>Representative Important Species Assessed.</u>

<u>Largemouth Bass.</u> "Optimal spawning temperatures for largemouth bass range from 60 to 75°F," which typically occur in May and June in Illinois. Exh. B, App. C at 13, 47. Largemouth bass eggs hatch in 4 to 5 days at 60-67°F, and the larval stage is 19 days. *Id*.

For Lake of Egypt, temperature monitoring in 1998 and 1999 shows earlier warming that reached spawning temperatures near the surface in March in the lower zone and April in the upper zone. *Id*., citing *id*. at 48 (Table 6-4: reproductive temperature characteristics). Ichthyoplankton studies show that "larvae were evident in collections from late April through early June. *Id*. at 47 (citation omitted). "Early spawning by largemouth bass has been documented in other regional lakes that receive thermal effluents." *Id*. (citations omitted). Electrofishing in 2010 shows that recruitment of largemouth bass between the zones of the lake appears to be similar, and recruitment was relatively similar between 1998 and 1999. *Id*., citing *id*. at 70 (Figure 3-5: largemouth bass length frequencies).

SIPC concludes that the thermal discharge from MGS results in higher water temperatures and earlier spawning in the lower zone of Lake of Egypt. Exh. B, App. C at 47. "However, based on similar catch rates of young of the year and Age 1 fish, the thermal regime does not appear to adversely affect the recruitment of largemouth bass into the population." *Id* at 47-48.

For largemouth bass, the maximum weekly average temperature for growth (MWAT) is considered to be 86°F. Exh. B, App. C at 44. Under summer normal conditions, approximately 1,070 surface acres would be less than the MWAT for largemouth bass. The deepest third of the water column inside the mixing zone and the deeper two-thirds outside the mixing zone would be below the MWAT. *Id*. Under summer stressed conditions, however, no surface acres, or depths in the mixing zone or in areas immediately outside the mixing zone would be below the MWAT. *Id*. AMEC states that there are no barriers to the movement of largemouth bass to cooler deeper water in other areas of Lake of Egypt that provide habitat suitable to sustain these communities. *Id*.

For largemouth bass, the UILT is considered to be 94°F. Exh. B, App. C at 44, citing *id*. at 42 (Table 6-2: MWAT and UILT for RIS). Based on modeled temperatures, SIPC concludes that approximately 2,215 of the total lake surface area of approximately 2,300 acres would be below the UILT under normal summer conditions and approximately 1,029 surface acres under stressed conditions. *Id*. at 44, citing *id*. at 41 (Table 6-1: modeled surface water temperatures). Even under stressed conditions, the deepest third of the water column inside the mixing zone and the deeper two-thirds of the water column outside the mixing zone would be below the UILT short-term tolerance limits. *Id*.

July 2010 electrofishing surveys collected largemouth bass at very similar rates in the lower and upper portions of the lake. Exh. B, App. C at 44, citing *id*. at 9 (Table 3-2: CPUE). SIPC's 2017 demonstration showed largemouth bass as one of them most abundant species with CPUE higher than in 2010. Exh. B. at 4-13, citing *id*. at 4-14 (Table 4-1). SIPC argues "this species is well adapted to warmer surface temperatures." Exh. B, App. C at 44. SIPC also argues that "[t]here are no barriers to the movement of largemouth bass from areas that may be thermally less suitable to habitats characterized by cooler temperatures." *Id*. SIPC concludes that neither normal or stressed thermal conditions are likely to result in appreciable harm to this species. *Id*.; *see* Exh. B at 4-13 (categories satisfied by original demonstration).

Threadfin Shad. This species typically spawns at temperatures above 68°F and usually from 58 to 81°F. Spawning generally occurs from April through July or August. Exh. B., App. C at 7, 46 (citations omitted). "Eggs hatch in three to six days, and develop into juveniles approximately two to three weeks later, depending on water temperature." *Id*. at 7 (citation omitted).

Temperature monitoring shows earlier warming to initial spawning temperatures for *Dorosoma* spp. in the lower zone than in the upper zone. Exh. B, App. C at 46., citing *id*. at 48 (Table 6-4: reproductive temperature characteristics). Ichthyoplankton studies document the spawning cycle of *Dorosoma* spp., presumably including both gizzard shad and threadfin shad. *Id*. at 46, citing *id*. at 48 (Table 6-5: hatch characteristics). The presence of multiple species may partly explain the multiple spawning peaks experienced in each lake zone. *Id*. at 46, citing *id*. at 48 (Table 6-5: hatch characteristics). "Early spawning by *Dorosoma* spp. has been documented in other regional lakes that receive thermal effluents." *Id*. at 46 (citations omitted). Electrofishing samples in 2010 showed "good recruitment of threadfin shad," particularly in the upper zone of the lake. *Id*., citing *id*. at 66 (Figure 3-1: threadfin shad length frequency).

SIPC concludes that the thermal discharge from MGS results in higher water temperatures and earlier spawning in the lower zone of Lake of Egypt. Exh. B, App. C at 46. "However, based on similar catch rates of young of the year threadfin shad, the thermal regime does not appear to adversely affect the recruitment of this species into the population." *Id* at 46-47.

SIPC's 2017 demonstration showed that threadfin shad CPUE was approximately six times greater than in 2010 and that both shad species were more abundant in the lower lake zone than in the middle or upper zones. Exh. B. at 4-13, *see id*. at 4-14 (Table 4-1).

For threadfin shad, a 1975 study by Wrenn set the UILT at 93 to 97°F. Exh. B, App. C at 40 (citation omitted). However, the 2013 Demonstration cites a 2010 study indicating that the UILT for threadfin shad is 91.9°F. Board Questions at 3, citing Exh. B, App. C at 42 (Table 6-2: MWAT and UILT).

The Board asked SIPC to "clarify the temperature constituting UILT for this species." Board Questions at 3. SIPC responded that both values apply to threadfin shad, resulting in a UILT tolerance range of 92° to 97° F. SIPC Resps. at 6. SIPC elaborated that, with a 1° F change in the lower boundary of the range, under stressed summer conditions approximately 1606 acres of the lake surface would be below the upper range and 737 acres of the lake surface would be below the lower range. *Id*., citing Exh. B, App. C at 41 (Table 6-1: surface acreage by water temperature). Under normal summer conditions, the entire lake surface would be below the upper range of 97° F and 1812 acres below the lower range of 92° F. SIPC Resps. at 6.

Under the modeled normal summer conditions, almost no area of the lake would be above the upper boundary of the tolerance range. Exh. B, App. C at 42, citing *id*. at 41 (Table 6-1: surface water temperatures). Under stressed conditions, approximately 884 acres of the lake surface would be below the UILT. *Id*. at 40. "However, considering the vertical aspect of the water column, the lower third of the lake within the mixing zone and the lower two-thirds of the lake outside the mixing zone would be within the temperature tolerance limits for threadfin shad." *Id*.

SIPC argues that "[t]here are no barriers to the movement of threadfin shad from areas that may be thermally less suitable to habitats characterized by cooler temperatures." *Id*. SIPC concludes that neither normal or stressed thermal conditions are likely to result in appreciable harm to this species. *Id*.

Gizzard Shad. This species typically spawns at temperatures from 50 to 88°F, although optimal spawning temperatures range from 60 to 75°. Spawning typically occurs in April, May, and June in Illinois. Exh. B, App. C at 11, 46 (citation omitted). Hatching temperatures for gizzard shad ranged from 63-92°F in 1998 and 63-89°F in 1999. *Id*. at 46 (citation omitted). "Eggs hatch in two to seven days, depending on water temperature." *Id*. (citation omitted).

Temperature monitoring shows earlier warming to initial spawning temperatures for *Dorosoma* spp. Exh. B, App. C at 46, citing *id*. at 48 (Table 6-4: reproductive temperature characteristics). Ichthyoplankton studies document the spawning cycle of *Dorosoma* spp., presumably including both gizzard shad and threadfin shad. *Id*. at 46, citing *id*. at 48 (Table 6-5: hatch characteristics). The presence of multiple species may partly explain the multiple spawning peaks experienced in each lake zone. *Id*. at 46, citing *id*. at 48 (Table 6-5: hatch characteristics). "Early spawning by *Dorosoma* spp. has been documented in other regional lakes that receive thermal effluents." *Id*. at 46 (citations omitted).

Electrofishing in 2010 yielded samples of gizzard shad too small to draw conclusions about recruitment. *Id*. (citations omitted), citing *id*. at 67 (Figure 3-2: gizzard shad length frequencies). SIPC attributes this to "the pelagic, schooling nature of these species and the inefficiencies of sampling gear." *Id*. at 46. However, the 2007 impingement study yielded substantial catch rates demonstrating "good recruitment of young of the year individuals." *Id*. Also, the 2017 demonstration reports that "both shad species were more abundant in the lower lake zone than in the middle or upper lake zones." Exh. B at 4-13.

SIPC concludes that the thermal discharge from MGS results in higher water temperatures and earlier spawning in the lower zone of Lake of Egypt. Exh. B, App. C at 46. "However, based on similar catch rates of young of the year threadfin shad, the thermal regime does not appear to adversely affect the recruitment of this species into the population." *Id* at 46-47. SIPC argues that it is likely that gizzard shad is not adversely affected." *Id*. at 47.

For gizzard shad, the MWAT is considered to be 89°F. Exh. B, App. C at 42, citing *id*. (Table 6-2: MWAT and UILT for RIS). Under normal summer conditions, approximately 1,217 acres of the lake's surface area would be below the MWAT, although no surface areas would be below the MWAT under stressed conditions. *Id*. at 42. SIPC argues that "much more of the lake's area would be suitable when considering deeper water." *Id*. Under normal conditions, gizzard shad would have available the lower half of the water column inside the mixing zone and the entire water column outside it. *Id*. Under stressed condition, the species would have available in the lower lake waters deeper than 35 feet outside the mixing zone. *Id*. SIPC adds that "there are no barriers to the movement of gizzard shad from areas that may be thermally less suitable to habitats characterized by cooler temperatures." *Id*. SIPC concludes that neither normal or stressed thermal conditions are likely to result in appreciable harm to this species. *Id*.

For gizzard shad, the UILT is considered to be 96°F. Exh. B, App. C at 42, citing *id*. (Table 6-2: MWAT and UILT for RIS). Under modeled normal summer conditions, almost no area of the lake would be above the UILT. *Id*., citing *id*. at 41 (Table 6-1: surface water temperatures). Gizzard shad would have half of the water column available inside the mixing zone and the entire water column outside the mixing zone. *Id*. at 42. Under stressed conditions, approximately 1,217 acres of the lake surface would be below the UILT. *Id*. Gizzard shad would avoid the mixing zone and areas near it, as "only waters deeper than 35 feet outside the mixing zone would be available in the lower half of the lake." *Id*. at 43.

Channel Catfish. This species typically spawns between late May and mid-July when temperatures reach approximately 70°F. Exh. B, App. C at 12, 49. Based on monitored temperatures from 1998 and 1999, the lower zone of the lake reached optimum spawning temperatures in April, while the upper zone reached those temperatures in May. *Id*., at 49, citing *id*. at 48 (Table 6-4: reproductive temperatures). "At 67 to 85°F, channel catfish eggs hatch in 4 to 5 days." *Id*. (citation omitted). The optimal growth range for channel for channel catfish fry is 84-86°F. *Id*. (citation omitted).

Electrofishing catch rates for channel catfish were similar from 1998 and 1999 to 2010, although they were characteristically low and involved older and larger individuals. Exh. B, App. C at 49-50; *see id*. at 68 (Figure 3-3: channel catfish length frequency). The earlier study concluded that a lack of smaller fish did not represent a recruitment failure because "younger specimens taken in the fall of 1998 were also represented in the spring of 1999." *Id*. at 50. SIPC argues that, "[w]hile complete life history, recruitment and growth information for channel catfish is relatively lacking within Lake of Egypt, the apparent absence of effects on recruitment seem to point to the absence of thermal effects on this species." *Id*. at 50.

For channel catfish, the MWAT for growth is considered to be 92°F. Approximately 1,812 acres and 737 acres of the lake's surface would be less than the MWAT under normal and stressed conditions, respectively. *Id*. at 43. For channel catfish, the UILT tolerance is considered to be 101°F. Exh. B, App. C at 43, citing *id*. (Table 6-2: MWAT and UILT for RIS). Under the modeled normal and stressed summer conditions, almost no area of the lake would be above the UILT. *Id*., citing *id*. at 41 (Table 6-1: surface water temperatures).

Under normal modeled conditions, channel catfish would have available the lower half of the water column inside the mixing zone and the entire water column outside of it. *Id*. Under stressed modeled conditions, AMEC expects channel catfish to avoid areas in and near the mixing zone, as "only waters deeper than 35 feet outside the mixing zone would be available in the lower half of the lake." *Id*. AMEC observes that "[t]here are no barriers to the movement of channel catfish from areas that may be thermally less suitable to habitats characterized by cooler temperatures." *Id*. AMEC concludes that neither normal or stressed thermal conditions are likely to result in appreciable harm to this species. *Id*.

Bluegill. Optimal spawning temperature for this species range from 67 to 80°F. Exh. B, App. C at 12, 48. Lake of Egypt reaches these temperatures in April in the lower zone and in May in the upper zone. *Id*. at 49, citing *id*. at 48 (Table 6-4: reproductive temperatures). Optimal temperatures for successful embryo development are 72 to 81°F, with development occurring at temperatures up to 93°F. *Id*. at 12, 48. "At 67°F, bluegill eggs hatch in 2 to 3 days," and the larval stage lasts for approximately 30 days at 74.3°F." *Id*. at 12-13, 48.

Ichthyoplankton studies from 1998 to 1999 confirm the spawning cycle of *Lepomis* spp., of which bluegill is likely to be the dominant species. Exh. B, App. C at 49. In addition, 2010 electrofishing results show similar recruitment between the lower and upper zones of the lake. *Id*,, citing *id*. at 69 (Figure 3-4: bluegill length frequency). In its 2017 demonstration, ASA reported that bluegill were significantly more abundant in the lower lake zone than in the middle and upper zones, where abundance was similar. Exh. B at 4-13; *see id.* at 4-14 (Table 4-1: electrofishing comparison). In addition, bluegill CPUE was approximately double the highest previous reported value from 2010. *Id*. ASA concludes based on similar catch rates for young of the year and Age 1 fish, the MGS thermal discharge "does not appear to adversely affect the recruitment of bluegill into the population." Exh. B, App. C at 49.

AMEC states that tolerance values for bluegill vary, with MWAT ranging between 90 and 93°F and UILT ranging from 97.5 to 106.7°F for adults. Exh. B, App. C at 43, citing *id*. at 42 (Table 6-2: MWAT and UILT for RIS). Based on high bluegill catch rates near the MGS discharge where measured surface water temperatures ranged from 94-98°F, SIPC chose 93°F as the most appropriate MWAT value and 98°F as the most appropriate UILT value. *Id*. at 43.

For bluegill, AMEC observes that tolerance values vary, with UILT ranging from 97.5 to 106.7°F for adults. Exh. B, App. C at 43, citing *id*. at 42 (Table 6-2: MWAT and UILT for RIS). Based on high bluegill catch rates near the MGS discharge where measured surface water temperatures ranged from 94-98°F, AMEC chose 98°F as the most appropriate UILT value. *Id*. at 43. Under modeled normal summer conditions, the entire lake would have surface temperatures below the UILT. Exh. B, App. C at 43, citing *id*. at 41 (Table 6-1: surface water temperatures). Under modeled stressed conditions, approximately 1,892 acres of the surface would be below the UILT. *Id*. at 43. Temperatures within the lower third of the water column within the mixing zone and the lower two-thirds outside the mixing zone would be below the UILT. *Id*.

Under modeled normal summer conditions, the entire lake would have surface temperatures below the UILT, and 2,029 acres would be less than the MWAT. Exh. B, App. C at 43, citing *id*. at 41 (Table 6-1: surface water temperatures). Under modeled stressed conditions, approximately 1,892 acres of the surface would be below the UILT, and approximately 884 acres below the MWAT. *Id*. at 43. Temperatures within the lower third of the water column within the mixing zone and the lower two-thirds outside the mixing zone would be below the UILT. *Id*. Only the deepest areas of the lower lake outside the mixing zone would be below the MWAT. *Id*. AMEC observes that "[t]here are no barriers to the movement of bluegill from areas that may be thermally less suitable to habitats characterized by cooler temperatures." *Id*. AMEC concludes that neither normal or stressed thermal conditions are likely to result in appreciable harm to this species. *Id*.

White and Black Crappie. Both white and black crappie generally spawn from late May through mid-July when temperatures reach 60°for white crappie and 64°F for black crappie. Exh. B, App. C at 50 (citation omitted); *see id*. at 14. Based on monitoring from 1998 and 1999, the lower zone of the lake reaches optimum spawning temperatures in March or the first week of April and the upper zone reached those temperatures in early May. *Id*. White crappie eggs hatch in approximately 2 days at 65 to 67°F, and black crappie eggs hatch in 2 to 3 days at 65°F. *Id*. (citation omitted).

AMEC reports that electrofishing catch rates for crappie in previous studies were low and variable. Exh. B, App. C at 50. AMEC notes that Lake of Egypt lacks information on the complete life history, recruitment and growth information for crappie. *Id*. AMEC observes that the apparently successful recruitment of other centrarchid taxa with similar spawning seasons "provides indirect evidence of the absence of significant thermal effects on this species." *Id*.

For both black and white crappie, the MWAT for growth is considered to be 85.8°F, and the UILT is considered to be 90.5°F. Exh. B, App. C at 44, citing *id*. at 42 (Table 6-2: MWAT and UILT for RIS). Under modeled normal conditions, approximately 1,580 acres of the lake surface would be less than the UILT. *Id*. at 44. For both black and white crappie, the UILT is considered to be 90.5°F. Exh. B, App. C at 44, citing *id*. at 42 (Table 6-2: MWAT and UILT for RIS). Under modeled normal conditions, approximately 1,580 acres of the lake surface would be less than the UILT. *Id*. at 44; *see* Exh. B at 4-15. Under modeled stressed conditions, deeper waters would be suitable for this species. *Id*. Under both normal and stressed conditions, all surface areas would have temperatures above the MWAT, although the cooler deeper waters would provide suitable habitat. *Id*.

While previous investigations found the crappie population to be cyclical and inconsistent, their sustained presence suggests that the lake "continues to support a viable population." *Id*., citing *id*. at 45 (Table 6-3: crappie electrofishing catch). In 2007, Dr. Heidinger found that, while black crappie recruited at low levels, they were in excellent condition and growing more quickly. Exh. B at 4-17. The 2017 demonstration found an age structure of black crappie consistent with natural reproduction. *Id*. at 4-18; *see* Exh. B, App. B at B-23 – B-24. AMEC observes that "there are no barriers to the movement of crappie from areas that may be thermally less suitable to habitats characterized by cooler temperatures." Exh. B, App. C at 44-45. AMEC concludes that neither normal or stressed thermal conditions are likely to result in appreciable harm to this species. *Id*. at 45; Exh. B. at 4-18; *see* Rec. at 5.

Common Carp. ASA/EIU's supplemental 2017 testing collected a total of two common carp. Exh. B at 4-14; *see* Exh. B, App. B at B-18, B-23, B-36 (Table 10: abundance and CPUE); Rec. at 5. Based on 2017 CPUE similar to 1997 to 1998 and lower than 2005 to 06, EIU observes that the thermal discharge does not appear to be causing common carp to proliferate. Exh. B at B-14, B-18; *see* Rec. at 5.

SIPC Summary of Biothermal Assessment

As described above, SIPC used UILTs and MWATs to assess the biothermal response of RIS to temperature profiles for the different lake zones under normal and stressed weather conditions. Based on the modeled surface temperatures, AMEC calculated the acres available to RIS under their individual UILTs and MWATs for growth as summarized below. Exh. B, App. C at 40-45. SIPC also examined the suitability of temperature, dissolved oxygen, and habitat for RIS in the subsurface at various depths. Exh. B, App. B at B-15, B-20, B-24, B-43 – B-46, App. C at 40-45.

Lake of Egypt Available Surface Acreage Below UILT or MWAT Temperature								
	Normal Summer Condition				Stressed Summer Condition			
	UILT		MWAT		UILT		MWAT	
Species	**(acres)**	**(%)**	**(acres)**	**(%)**	**(acres)**	**(%)**	**(acres)**	**(%)**
Threadfin Shad	2217	100	(no MWAT data)		884	40	(no MWAT data)	

Gizzard Shad	2217	100	1217	55	1382	62	0	0
Channel Catfish	2217	100	1812	82	2217	100	737	33
Bluegill	2217	100	2029	92	1892	85	884	40
Largemouth Bass	2215	100	1070	48	1029	46	0	0
White and Black Crappie	1580	71	0	0	0	0	0	0

* % based on 2217 acres total lake surface from model boundaries.
Exh. B, App. C at 40-45.

Normal Conditions. Under modeled summer normal conditions in the 2013 demonstration, most of the RIS, except white and black crappie, would not be excluded from any areas of the surface of Lake of Egypt since 100 percent of surface water temperatures would be less than their UILTs. Exh. B, App. C at 45; *see* Exh. B. at 4-15. Based on the MWAT for growth, most RIS, except white and black crappie, would be excluded from 8 to 58 percent of the surface water temperatures. Thermally sensitive black crappie and white crappie would be excluded from 29 percent of the lake's surface area based on their UILT and 100 percent based on their MWAT for growth. Exh. B at 4-15. However, deeper waters would be below the UILT and MWAT and provide suitable habitat and sufficient dissolved oxygen to sustain the white and black crappie communities. Exh. B at 4-17, App. B at B-15, B-20, App. C at 44; SIPC Resps. at 4. AMEC stresses that "sub-surface areas would be suitable even in the mixing zone." Exh. B, App. C at 45.

Stressed Conditions. Under modeled summer stressed conditions, most RIS, except white and black crappie, would have between 40 and 100 percent of the lake's surface and a larger part of the sub-surface below their UILTs. Exh. B, App. C at 45; *see* Exh. B at 4-15. Based on the MWAT for growth, channel catfish and bluegill would have 33 to 40 percent of the lake's surface available below their MWATs, while the other RIS would have no area at the surface below their MWATs. However, deeper waters would be below the UILT and MWAT for all RIS. Exh. B, App. B at B-10. While some RIS would be confined to sub-surface waters during stressed conditions (Exh. B, App. C at 45*)*, AMEC states that "there would be extensive areas of suitable habitat available." *Id*. at 40. For RIS, and in particular for black crappie and gizzard shad, EIU found that the middle and upper lake had subsurface temperatures and dissolved oxygen conditions that would be suitable for growth and survival. Exh. B at 4-17, App. B at B-10, B-15; s*ee* Rec. at 5, 10; SIPC Resps. at 4. AMEC observes there are no barriers for fish moving to cooler temperatures in different parts of the lake. Exh. B, App. C at 44.

Based upon its hydrothermal modeling, dissolved oxygen surveys, and biothermal assessment, SIPC states that suitable habitat would be available to all RIS even under stressed conditions. Pet. at 24, citing Exh. B at 2-2. Considering the factors summarized above, SIPC concludes that fish communities will not suffer appreciable harm from the proposed alternative thermal effluent limits and that the BIC has been protected and will continue to be protected in the Lake of Egypt. Pet. at 26, citing USEPA 316(a) Manual at 65; *see* Rec. at 6.

IEPA Recommendation

IEPA guided SIPC in developing the draft study plan and the detailed plan of study. IEPA states that SIPC's petition responds to recommendations of the Board and the Agency. Rec. at 6. IEPA agreed that AMEC selected RIS that were appropriate for a lake that has been stocked since it was constructed and included additional species considered nuisance and invasive for inclusion in the study. Based on the RIS biothermal assessment and the hydrothermal modeling, IEPA accepted SIPC's findings that the proposed alternative thermal effluent limitations for MGS would pose "little or no potential threat to the BIC in Lake of Egypt and makes certain that the proposed discharge will assure protection and propagation of the BIC in Lake of Egypt." Pet. at 8-9, Rec. at 7.

BOARD FINDINGS

Based on the information in the record, the Board must determine whether SIPC has demonstrated that the effluent standards in SIPC's current NPDES permit are more stringent than necessary to assure, and that the requested alternative thermal effluent limitations will assure, the protection and propagation of a balanced and indigenous population of shellfish, fish, and wildlife in the receiving water. *See* 33 U.S.C. § 1326(a).

The Board first determines whether SIPC has justified the maximum temperature limits and excursions for the proposed alternative thermal effluent limitations. The Board then reviews the Biotic Category Criteria under the Type I Retrospective Demonstration and Type II Predictive/RIS Demonstration. The Board then considers the Master Rationale and determines whether SIPC's demonstration as a whole shows that the current standard is more stringent than necessary and that the proposed alternative thermal effluent limitations will assure protection and propagation of the balanced, indigenous community living in Lake of Egypt.

Maximum Temperature Limits for Alternative Thermal Effluent Limitations

The table below compares the General Use Standards at 35 Ill. Adm. Code 302.211(e), SIPC's current maximum temperature limits in its NPDES Permit; SIPC's modeled stressed conditions for winter, summer, spring and fall; and SIPC's proposed maximum temperature limits for the alternative thermal effluent limitations. All include an allowable excursion temperature of 3°F during 87.6 hours (1%) of a rolling 12-month period.

Months	**Daily Maximum Temperatures (°F)**				
	35 IAC 302.211(e) General Use Standards	Current NPDES Permit Limits (Pet. Exh. A at 6.)	Modeled Stressed Conditions (Exh. B, App. C at 37, 84, 87, Figs. 5-13, 5-16; Exh. B, App. C, App. F at	Initially Requested Limits (Pet. at 34-35)	Revised Requested Limits (SIPC Resp. at 9-11)

			2; SIPC Resp.)		
January	60	60	70	72	70
February	60	60	70	72	70
March	60	60	70	72	74
April	90	90	86	90	90
May	90	90	86	90	90
June	90	90	100	101	100
July	90	90	100	101	100
August	90	90	100	101	100
September	90	90	100	101	100
October	90	90	91	91	91
November	90	90	91	91	91
December	60	60	70	72	70

SIPC stated that the hydrothermal modeling AMEC conducted in 2013 "forms the basis for SIPC's requested alternate thermal limits." Pet. at 28, citing Exh. B, App. C, App. F. The modeling predicted maximum temperatures at the edge of the mixing zone under stressed conditions of 70°F (Winter: December to March), 86°F (Spring: April and May), 100°F (Summer: June to September), and 91°F (Fall: October and November). Exh. B, App. C at 37, 84, 87, Figs. 5-13, 5-16; Exh. B, App. C, App. F at 2; SIPC Resp. AMEC explained that the stressed conditions "are considered to be rarely exceeded". Exh. B, App. C at 27. SIPC stated that the proposed thermal limits "reflect current thermal conditions". Pet. at 25.

In its response, the limitations requested by SIPC for the months of March, April, and May are higher than the maximum values in the modeled stressed scenarios for winter (March) and spring (April and May). SIPC Resp. at 9-11, Att. C, D, E.

For the winter months, SIPC stated it could comply with a the modeled 70°F maximum temperature limit for December through February but not for March. For March, SIPC proposed a 74°F maximum temperature limit along with the excursion temperatures (no more than +3°F) and hours (1% of 12-month period). SIPC stated that "measured temperatures during the month of March (2014-2018) have exceeded 75°F." SIPC Resp. at 9. SIPC reasoned that a 70°F maximum temperature limit "would not provide an adequate range" and could require curtailing operations in March even with the excursion temperatures and hours. SIPC Resp. at 9-10.

For the spring months of April – May, SIPC stated it could not comply with the modeled maximum 86°F at the edge of the mixing zone even with the excursion temperatures (no more than +3°F) and hours (1% of 12-month period) without taking "necessary measures to reduce discharge temperatures." SIPC Resp. at 10. Instead, SIPC proposed a 90°F maximum temperature limit with the same excursion temperatures and hours. SIPC based the 90°F limit on "temperatures recorded in May 2018 at the edge of the mixing zone that reached a maximum of 92.2°F." SIPC Resp. at 10-11.

<u>Board Finding on Maximum Temperature Limits for Alternative Thermal Effluent Limitations</u>

SIPC's initial petition requested maximum effluent temperature limitations greater than the modeled temperatures at the edge of the mixing zone under stressed conditions for all months except October and November. The difference between the requested maximum temperatures and the modeled stressed temperatures was 72°F instead of 70°F for winter (December to March), 90°F instead of 86°F for spring (April and May), and 101°F instead of 100°F for summer (June to September). The requested and modeled temperatures were the same at 91°F for fall (October and November). Exh. B, App. C at 37, 84, 87, Figs. 5-13, 5-16; Exh. B, App. C, App. F at 2; SIPC Resp.

In response to Board questions, SIPC revised its request for maximum effluent temperature limitations to align with the temperatures modeled under stressed conditions for all months except March, April, and May. SIPC still requests maximum effluent temperature limitations greater than the modeled temperatures under stressed conditions for the months of March, April, and May.

For April and May, "SIPC is requesting to maintain the 90°F maximum temperature limit for the spring based on temperatures recorded in May of 2018 at the edge of the mixing zone that reached a maximum of 92.2°F." SIPC Resps. at 10-11. The Board notes that SIPC did not provide specific information other than the single high temperature value in May of 2018. Although the modeling predicted 86°F at the edge of the mixing zone, the current General Use Water Quality Standard is 90°F. *See* 35 Ill. Adm. Code 302.211(e). The Board notes that SIPC's thermal demonstration is not seeking relief in the form of numerical effluent limitations that are more stringent than the current water quality standards for temperature. As such, the Board does not consider effluent limitations for the months of April and May as part of requested relief since they are the same in the current permit and the current water quality standards. However, the Board includes these in the order below for the sake of continuity and completeness in setting limitations for the entire year.

For March, SIPC is requesting 74°F instead of 70°F as modeled under stressed conditions at the edge of the mixing zone. SIPC states that "measured temperatures during the month of March (2014-2018) have exceeded 75°F". SIPC Resp. at 9. The General Use Water Quality Standard and the effluent limitation in SIPC's current NPDES permit is 60°F. Exh. A at 6; *see* 35 Ill. Adm. Code 302.211(e).

The Board notes that SIPC did not provide specific information other than the single high temperature value during March 2014 to 2018. However, SIPC based its earlier modeling on 22 years of daily weather data from 1990 to 2012. Exh. B, App. C at 28. The 2013 Demonstration states that model inputs "were based on the 95% [annual probability of] non-exceedence event corresponding to an average occurrence frequency of once in 20 years," except where 98% was used for winter, which includes March. Exh. B, App. C at 28, 37. SIPC elaborated that the 95% level yields a 5% chance of one exceedance in a year or a 64% chance of one exceedance over the course of 20 years. SIPC Resp. at 9. Since 98% was used for March, the Board notes that the modeled chance of exceedance of 70°F in March would be lower than the 5% chance of one exceedance in a year or the 64% chance of one exceedance in 20 years.

The Board also notes that actual model input temperature for March was higher than listed in the AMEC report (Exh. B, App. C). AMEC describes the modeling inputs under the winter stressed condition and indicates that the T_{eq} [Lake Equilibrium Temperature] selected was 17.0°C (62.6°F) based on a "98 percent non-exceedance value of annual maximum 30-day T_{eq} values for January-March at Carbondale, Illinois between 1990 and 2012." Exh. B., App. C at 31, 35, 37. As a basis, AMEC noted that the March 31, 2012 30-day average was 18.2°C (64.8°F) and that the modeled winter stressed condition was characterized by these warmer temperatures in later March, resulting in a maximum value of 21°C (70°F) for December to March. Exh. B, App. C at 28-29, 35, 37. By comparison, the Board notes that under the summer stressed condition, the T_{eq} selected was 32.7°C (90.86°F) and the modeled summer stressed condition resulted in a maximum value of 37.8°C (100°F) for June to September. SIPC Resps. Att. C (Summer Stressed Model Data; Summer Stressed Model Plots); Exh. B, App. C at 34. However, for modeling the winter stressed condition, the Board observes that the direct printouts of the modeling inputs provided in SIPC's Response indicate a higher T_{eq} value of 21.0°C (69.8°F) was used, which is 4°C (7.2°F) higher than represented in the AMEC report. SIPC Resps. Att. C (Winter Stressed Model Data; Winter Stressed Model Plots). While the modeled winter stressed condition produced a maximum temperature at the edge of the mixing zone of 70°F, the Board notes that this value was the result of a T_{eq} input value that appears to be already 7.2°F higher than AMEC stated was used for the winter months.

Although SIPC's Response refers to more recent episodic highs in March 2014 to 2018 that exceeded 75°F (SIPC Resp. at 9), the Board notes that SIPC has not provided any specific information regarding frequency or magnitude, such as monitoring data for water temperatures at the intake, discharge, upstream, or edge of the mixing zone. SIPC provided no technical support regarding the period of March 2014 to 2018 to attribute the episodic highs to factors such as ambient air temperatures, humidity, low lake levels, or MGS operations. SIPC also has not provided revised modeling for the requested limitation for March to support maximum temperatures that are above the values from the 2013 modeling. Additionally, SIPC did not indicate why 4°F above the modeled stressed condition of 70°F is appropriate or why the excursion hours and temperature of 3°F would not be sufficient.

In the past, the Board has granted alternative thermal effluent limitations for values that exceed the water quality standards based on the highest values in the modeled extreme-case scenarios. *See* Exelon Generation v. IEPA, PCB 15-204, slip op. at 82 (Mar. 3, 2016). To address the possibility of temperatures above modeled extreme-cases, the Board has provided excursion temperatures and hours, which SIPC requests.

Along with maximum temperature limitations based on modeling, the Board has also granted alternative thermal effluent limitations that included conditions to allow higher excursion temperatures than 3°F based on certain intake temperatures, to allow longer excursion hours than 1% of a 12-month period provided that no single episode exceeds 24 hours, and to use a calendar year instead of a 12-month rolling period for compliance. *See* Exelon Generation (Dresden Nuclear Generating Station) v. IEPA, PCB 15-204, slip op. at 102 (Mar. 3, 2016); Exelon Generation (Quad Cities Station) v. IEPA, PCB 14-123, slip op. at 54-55 (Sept. 18, 2014). However, the Board notes that SIPC has not requested or justified higher excursion temperatures based on intake temperatures or longer excursion hours.

When the Board asked SIPC about complying with a 70°F maximum temperature limit in March, SIPC replied that it could be forced to curtail operations, which could impact SIPC's ability to meet demand and result in financial losses. SIPC Resp. at 9. As explained above, the Board noted that AMEC's 2013 modeling, based on 22 years of weather data, indicated the chance of exceeding 70°F in the winter (December to March) would be less than one event in 20 years. Granting SIPC a maximum temperature limit of 74°F would allow SIPC to exceed the modeled stressed condition for the entire month of March every year. Since SIPC stated that it does not now expect to increase thermal loading from its plant operations and projects that the future thermal regime will be consistent with current conditions in Lake of Egypt, the Board finds that the requested 74°F limitation is not supported without updated modeling. Without additional technical support, the Board finds that the 70°F maximum effluent temperature limit in March, based on the 2013 modeled stressed conditions, with the allowed excursion hours and temperature of 3°F is consistent with Board decisions granting alternative limitations. *See* Exelon Generation v. IEPA, PCB 15-204, slip op. at 82 (Mar. 3, 2016).

Based on the information the record, the Board finds that SIPC has not justified the requested maximum temperature of 74°F in March, which would have been coupled with the requested excursion temperature and hours of 3°F for 1 percent of the hours in a 12-month period ending in any month. With this exception, the Board finds the requested maximum temperatures for the remaining 11 months are supported by evidence in the record. The Board finds that the following maximum temperature limits and excursions are the appropriate values based on the Board's determinations on the Biotic Category Criteria as informed by SIPC's Type I Retrospective Demonstration and Type II Predictive/RIS Demonstration. Based on these findings, the Board then examines SIPC's support for the Master Rationale and finds whether SIPC's demonstration as a whole shows that the alternative thermal effluent limitations listed below will assure protection and propagation of the balanced, indigenous community of shellfish, fish, and wildlife living in Lake of Egypt.

a. Maximum Effluent Temperature Limits

Months	**Daily Maximum (°F)**
January	70
February	70
March	70
April	90
May	90
June	100
July	100
August	100
September	100
October	91
November	91
December	70

b. Effluent temperatures must not exceed the daily maximum temperature limits in paragraph (1)(a) during more than one percent of the hours (87.6 hours) in the 12-month period ending with any month. Moreover, at no time shall the water temperature exceed the maximum limits in the applicable table by more than 1.7ºC (3.0 ºF).

Board Findings on Biotic Category Criteria based on SIPC's Type I Retrospective and Type II Predictive/RIS Demonstrations

A CWA Section 316(a) demonstration describes the impact of the thermal discharge on each biotic category: habitat formers; phytoplankton; zooplankton and meroplankton; macroinvertebrates and shellfish; fish; and other vertebrate wildlife. To be judged successful, the demonstration must show that each biotic category meets specified decision criteria to assure that impacts to each biotic category "are sufficiently inconsequential that the protection and propagation of the balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water will be assured." USEPA 316(a) Manual at 16, 34.

USEPA's Draft 316(a) Manual specifies different decision criteria for each biotic category based on whether the site can be considered a low potential impact area. To address the appropriate decision criteria, SIPC's demonstration consists of information gathered for the Biotic Category Identification, the Type I Retrospective Demonstration, and the Type II Predictive/RIS Demonstration. For five of the six biotic categories, SIPC's demonstration addresses criteria for areas not considered low impact in the USEPA 316(a) Manual: habitat formers; phytoplankton; zooplankton; macroinvertebrates and shellfish; and fish. For other vertebrate wildlife, SIPC's demonstration addresses the criteria for a low potential impact area. The Board makes findings below based on the decision criteria specified in the USEPA 316(a) Manual for each biotic category.

Type 1 Retrospective Demonstration

SIPC's Type I Retrospective Demonstration reviews studies in Lake of Egypt from 1997 to 2016. This addresses the time both before and after 2003 when Unit 123 began operating with increased frequency of thermal discharges. The increased frequency prompted IEPA to require SIPC to conduct the demonstration as a special condition of its NPDES Permit renewal. SIPC Resp. at 5-6; Exh. A at 6.

SIPC states that MGS has not altered its operations since 2003. Pet. at 6. SIPC adds that it is not expecting to increase thermal loading from the plant in the future and that the future thermal regime is likely to remain consistent with the current conditions. Pet. at 6; Exh. B, App. C at 39. As an existing discharger, SIPC bases its Type I Retrospective Demonstration on data gathered under actual conditions to demonstrate the absence of prior appreciable harm. Pet. at 6.

AMEC and ASA reviewed the historical studies and conducted new studies: Dr. Heidinger's studies from 1977 to 2007, AMEC's studies for the 2013 demonstration, and ASA's supplemental studies for the 2017 demonstration. Pet. at 16-20, Exh. B. at i. Although the thermal regime of the lake varies from the heated effluent outfall in the lower lake to the upper lake, SIPC argues that the studies showed no difference in communities located in different parts of the lake for phytoplankton, zooplankton and meroplankton, macroinvertebrates and shellfish, and habitat formers. For fish, the studies show more fish in the warmer lower lake. However, the fish community is not dominated by heat-tolerant or nuisance species and has remained a stable for 20 years. Exh. B at i; *see id*. at 4-1 – 4-9, 4-13; Pet. at 21; Rec. at 6-8. SIPC asserts attributes the stability of the fish community to the support provided by the quality and quantity of the lower trophic levels, such as phytoplankton and zooplankton. Pet. at 21; Rec. at 6.

Type II Predictive/RIS Demonstration

SIPC's Type II Predictive/RIS Demonstration first identified species for targeted study. IEPA provided SIPC guidance in the species selection to ensure that RIS included thermally sensitive species and nuisance species. The species selected were largemouth bass, threadfin shad, gizzard shad, channel catfish, bluegill, white crappie and black crappie (thermally sensitive), and common carp (nuisance), as well as rusty crayfish (invasive). For each RIS, AMEC and ASA identified the thermal tolerances for various life stages.

To predict potential conditions and availability of suitable habitat in Lake of Egypt, SIPC used both direct measurements and modeling. ASA/EIU surveyed Lake of Egypt for temperature and dissolved oxygen levels to develop profiles across the lake surface and depths. Exh. B, App. A. AMEC used a hydrothermal model, given MGS's current operations, to predict temperature profiles under normal and stressed weather conditions. Exh. B, App. C. With the results of the hydrothermal modeling and dissolved oxygen surveys, AMEC and ASA assessed the biothermal response of RIS to evaluate the potential effects of the proposed alternative limitations. The assessment compared the modeled temperatures and measured dissolved oxygen levels to the biological tolerances of RIS. The comparison evaluated the potential for mortality, blocked migration, exclusion from large areas of habitat, and effects on spawning and growth.

SIPC assessed the impact of the heated discharge on RIS by identifying the availability of areas of thermal refuge with suitable habitat for each species. Suitable habitat was characterized by species tolerances for various temperatures and dissolved oxygen levels. AMEC quantified acres of waters at the surface that would provide suitable habitat under the summer stressed condition for each RIS. Where no acreage was available at the surface, AMEC identified the availability of deeper waters with cooler temperatures and sufficient dissolved oxygen. Exh. B, App. C at 40-45. Although some species may avoid areas of the lake when temperatures and dissolved oxygen levels are outside their tolerance limits, AMEC and ASA concluded that the lake provides ample areas of thermal refuge for all RIS under both normal and stressed weather conditions for the various life stages. Exh. B at 4-17, App. C at 55. Additionally, ASA found no indication that the MGS's heated effluent was contributing to the proliferation of nuisance, heat tolerant, or invasive species. Exh. B at 4-17 – 4-18.

SIPC's Type II Predictive/RIS demonstration indicated, and IEPA agreed, that the proposed alternative thermal effluent limitations for MGS would pose "little or no potential threat to the BIC in Lake of Egypt and makes certain that the proposed discharge will assure protection and propagation of the BIC in Lake of Egypt." Pet. at 8-9, Rec. at 7.

Board Findings on Criteria for Specific Biotic Categories

Habitat Formers. The USEPA 316(a) Manual provides that the habitat formers section of a demonstration is successful if the applicant shows the site is a low potential impact area, where habitat formers are not present due to "low levels of nutrients, inadequate light penetration, sedimentation, scouring stream velocities, substrate character, or toxic materials." USEPA 316(a) Manual at 22.

For sites that are not considered low potential impact areas, the habitat formers section of a demonstration will be judged successful if the applicant can demonstrate that:

1. The heated discharge will not result in any deterioration of the habitat formers community or that no appreciable harm to the balanced indigenous population will result from such deteriorations.

2. The heated discharge will not have an adverse impact on threatened or endangered species as a result of impact upon habitat formers. *Id*.

In addition, a request may be denied if there is any probable thermal elimination of habitat formers or if important fish, shellfish, or wildlife are thermally excluded from use of the habitat. *Id.*

The Board finds that Lake of Egypt is not a low potential impact area for habitat formers because the record does not show that habitat formers are not present due to problems with nutrients, light, sedimentation, scouring, substrate, or toxic materials. *See* USEPA 316(a) Manual at 22. SIPC's demonstration for habitat formers found the presence of both emergent and submerged aquatic vegetation where suitable habitat exists in all lake zones. The submerged aquatic vegetation appeared to be affected only by the absence of suitable habitat where there was a steep drop along the shoreline and not by the thermal component of the discharge. Exh. B at 4-9. SIPC's surveys of Lake of Egypt collected no endangered species, and its search of IDNR and U.S. Fish and Wildlife Service websites identified no threatened or endangered species in Lake of Egypt. Any impact on habitat formers from the heated discharge would not affect these species. Exh. B, App. C at 6, 18, 40; Exh. B, App C., App. A at 8; SIPC Resp. at 2.

The Board finds that SIPC's demonstration meets the decision criteria of the USEPA 316(a) Manual for habitat formers at sites that are not low potential impact areas. *See* USEPA 316(a) Manual at 22. The demonstration shows that the thermal discharge from MGS will not (i) result in deterioration of habitat formers so as to cause appreciable harm to the balanced and indigenous community of fish or mussels; or (ii) have adverse impact on threatened or endangered species as a result of impact on habitat formers. Additionally, SIPC's demonstration shows no important fish, shellfish, or wildlife would be excluded from the use of the habitat outside the mixing zone.

Phytoplankton. The USEPA 316(a) Manual defines areas of low potential impact for phytoplankton as areas where phytoplankton are not the food chain base such as an ecosystem in which the food web is based on detrital material. *Id*. at 18-19. An area is not considered as low potential impact for phytoplankton if: (a) phytoplankton contribute a substantial amount of the primary synthetic activity supporting the community; (b) a shift toward nuisance species may be encouraged by the thermal discharge; or (c) the thermal discharge may alter the community from detrital to phytoplankton-based system. *Id.* at 19.

For sites that are not considered low potential impact areas, the phytoplankton section of a demonstration will be judged successful if the applicant can demonstrate that:

1. A shift towards nuisance species of phytoplankton is not likely to occur;

2. There is little likelihood that the discharge will alter the indigenous community from a detrital to a phytoplankton based system; and

3. Appreciable harm to the balanced indigenous population is not likely to occur as a result of phytoplankton community changes caused by the heated discharge. *Id.*; *see* Exh. B. at 4-1.

The Board finds that Lake of Egypt is not a low potential impact area for phytoplankton because phytoplankton are present in levels of abundance that can be compared between lake zones and assessed for nuisance species. EIU found that, while all three lake zones had similar levels of abundance in phytoplankton, levels of nutrients rather than the thermal discharge influenced their community structure. Lower levels of nutrients in the middle and upper lake zones corresponded to a higher proportion of blue-green algae than in the lower lake zone. Additionally, EIU observed that the one heat-tolerant phylum of phytoplankton found in the lake was most abundant in the upper lake farthest from the thermal discharge. Exh. B at 4-2 - 4-3, App. B at B-15 – B-16. Based on this observation, SIPC determined that the thermal discharge was not causing a shift towards nuisance species of phytoplankton. USEPA 316(a) Manual at 19.

The Board finds that SIPC's demonstration meets the decision criteria of the USEPA 316(a) Manual for phytoplankton at sites that are not low potential impact areas. *See* USEPA 316(a) Manual at 18. The demonstration shows that: (i) a shift toward nuisance species of phytoplankton is not likely to occur; (ii) there is little likelihood that the discharge will alter the community from a detrital to phytoplankton-based system; and (iii) appreciable harm to the balanced indigenous population is not likely to occur because of phytoplankton community changes caused by the thermal discharge.

Zooplankton / Meroplankton. The USEPA 316(a) Manual defines areas of low potential impact for zooplankton as areas with low concentrations of species that are commercially important, rare, endangered, or important components of the food web, or as areas where the thermal discharge will affect a relatively small portion of the receiving water. *Id.* at 20-21. The USEPA 316(a) Manual provides that the zooplankton/meroplankton section of a demonstration is successful if the applicant shows the site is a low potential impact area for zooplankton and meroplankton.

For sites that are not considered low potential impact areas, the zooplankton and meroplankton section of a demonstration will be judged successful if the applicant can demonstrate that:

1) Changes in the zooplankton and meroplankton community in the primary study area that may be caused by the heated discharge will not result in appreciable harm to the balanced indigenous fish and shellfish population.

2) The heated discharge is not likely to alter the standing crop, relative abundance, with respect to natural population fluctuations in the far field study area from those values typical of the receiving water body segment prior to plant operation.

3. The thermal plume does not constitute a lethal barrier to the free movement (drift) of zooplankton and meroplankton. *Id*. at 20; *see* Exh. B at 4-3.

The Board finds that Lake of Egypt is not a low potential impact area for zooplankton and meroplankton because the record shows that SIPC provides public access to its privately-owned lake for fishing and recreation. The presence of commercially and recreationally important fish species, which are supported by lower trophic levels such as zooplankton and meroplankton, does not qualify the site as one of low potential impact for this category. Exh. B, App. C at 2, 17.

For zooplankton and meroplankton, EIU found that the community structure was similar in all three lake zones and that density and abundance were highest in the lower lake zone. Given these findings, the study demonstrates that the thermal discharge is not expected to be a lethal barrier to free movement or result in a change in population or abundance that might harm the balanced indigenous fish and shellfish population. Exh. B, App. B at B-16 – B-17; USEPA 316(a) Manual at 20.

The Board finds that SIPC's demonstration meets the decision criteria of the USEPA 316(a) Manual for zooplankton and meroplankton at sites that are not low potential impact areas. *See* USEPA 316(a) Manual at 20. SIPC's demonstration shows that: (i) changes in the zooplankton and meroplankton community that might be caused by the heated discharge will not result in appreciable harm to the balanced and indigenous community; (ii) the heated discharge is not likely to alter the standing crop or relative abundance; and (iii) the thermal plume does not constitute a lethal barrier to free movement (drift) of zooplankton and meroplankton.

Macroinvertebrates and Shellfish. The USEPA 316(a) Manual defines areas of low potential impact as various areas where macroinvertebrates are not present or are present in low numbers. USEPA 316(a) Manual at 25. If an applicant can show that a site is a low impact area for macroinvertebrates and shellfish, then that section of the demonstration "will be judged successful."

For sites that are not considered low potential impact areas, the macroinvertebrates and shellfish section of a demonstration will be judged successful if the applicant can demonstrate that:

1. any measurable reduction of standing crop has caused no appreciable harm to the balanced indigenous populations;

2. any measurable reduction in the components of diversity have not interfered with the maintenance of critical functions of macroinvertebrates as they existed before introduction of heat;

3. where the discharge of cooling water comprises 30% or more of the 7Q10 low flow, invertebrates do not serve as a major forage for fisheries, food is not a factor limiting fish production, and drifting invertebrate fauna is not harmed by passage through a thermal plume; and

4. the discharge area does not include a spawning or nursery site for important shellfish or macroinvertebrates. USEPA 316(a) Manual at 23-25.

The Board finds that the Lake of Egypt is not a low impact area for macroinvertebrates because macroinvertebrates were found to be present and in quantities sufficient to assess community structure. USEPA 316(a) Manual at 25. For macroinvertebrates and shellfish, the 2016 EIU field sampling found consistent results across all lake zones with no difference in community structure. Abundance was consistently low, as were scores for scores for diversity, richness, and evenness. Exh. B at 4-7. Since no commercially or recreationally important benthic macroinvertebrate or shellfish species were collected during the surveys, EIU found no spawning or nursery sites for these species that would be potentially impacted by the alternate thermal effluent limit. Exh. B at 4-7. Regarding the criterion on drifting fauna, ASA asserted that this would not apply since Lake of Egypt is not a river or stream. Exh. B at 4-6. The Board notes that the USEPA 316(a) Manual specifically refers to drift as a passive function and an important survival mechanism for many species of macroinvertebrates in "flowing waters" for riverine sites. USEPA 316(a) Manual at 24, 27, 60.

The Board finds that SIPC's demonstration meets the decision criteria of the USEPA 316(a) Manual for macroinvertebrates and shellfish at sites that are not low potential impact areas. *See* USEPA 316(a) Manual at 23-24. SIPC's demonstration shows that : (i) there would be no appreciable harm to the balanced and indigenous population; (ii) critical functions of macroinvertebrates are being maintained as they existed before introduction of heat; (iii) cooling water does not comprise 30% or more of the 7Q10 flow and Lake of Egypt is not a riverine system for consideration to drifting fauna through the thermal plume; and (iv) the MGS-designated thermal mixing zone does not include a spawning or nursery site for important shellfish or macroinvertebrates.

Fish and RIS Analysis. The USEPA 316(a) Manual defines areas of low potential impact on fish as areas where: (a) the occurrence of sport and commercial species is marginal; (b) the discharge site is not a spawning or nursery area; (c) the thermal plume will not block or hinder fish migration; (d) the thermal plume will not cause fish to be vulnerable to cold shock; and (e) the thermal plume will not have an adverse impact on threatened or endangered species. USEPA 316(a) Manual at 29. The USEPA 316(a) Manual provides that a demonstration is successful if the applicant shows the site is a low potential impact area for fish.

For sites not classified as low potential impact areas for fish, the decision criteria require an applicant to demonstrate that fish communities will not suffer appreciable harm from:

1. Direct or indirect mortality from cold shocks;

2. Direct or indirect mortality from excess heat;

3. Reduced reproductive success or growth as a result of plant discharges;

4. Exclusion from unacceptably large areas; or

5. Blockage of migration. *Id*. at 28-29; *see* Exh. B at 4-10.

The Board finds that Lake of Egypt is not a low impact potential area for fish because of the potential for the thermal discharge to affect spawning or cause fish to be vulnerable to cold shock as well as the presence of recreationally and commercially important species. SIPC characterized the lake as a "vibrant recreational resource" based on the fishing and other recreational activities that take place there throughout the year. SIPC v. IEPA, PCB 14-129, slip op. at 18 (Nov. 20, 2014). SIPC addressed the fish biotic category decision criteria for sites not classified as low impact areas as described below.

Mortality from Cold Shock and Excess Heat. A fish kill may result from prolonged low temperatures. Exh. B, App. C at 52. Of the fish community in the lake, only threadfin shad and gizzard shad are vulnerable to prolonged low water temperature. *Id.* AMEC states that the thermal discharge helps protect these species by minimizing winter mortality. *Id.* To avoid cold shock, SIPC conducts planned outages for plant maintenance in spring and fall to minimize the chance of an unplanned outage in winter and the probability of winter mortality of these species. Pet. at 26; Exh. B, App C at 52.

Although a fish kill may also result when water temperatures in the lake exceed a species' short-term tolerance, AMEC stresses that for much of the year water temperatures in the lake are below the tolerance of the RIS. Exh. B, App. C at 51; *see* Pet. at 25. At the highest lake temperatures, fish can move laterally to other areas of the lake or vertically downward in the water column to avoid thermal stress. Exh. B, App. C at 52, 54; *see* Pet. at 25. AMEC adds that there have been no summer fish kills. Exh. B at 4-17, Exh. B, App. C at 52. Pet. at 26. SIPC argues that this indicates that the fish community has adapted to summer water temperatures. Pet. at 26; Exh. B, App, C at 52. With no planned increase in thermal loading to the lake, SIPC asserts that "future fish kills are extremely unlikely." Pet. at 26, citing USEPA 316(a) Manual at 43; Exh. B, App, C at 52.

Reproductive Success and Growth. AMEC noted that spawning and hatching occur somewhat earlier in the warmer portions of the lake for all RIS. Pet. at 27; *see* Exh. B, App. C at 48 (Table 6-4: reproductive temperature characteristics). On the other hand, recruitment between the different zones of the lake were similar. Exh. B, App. C at 47. In terms of growth, SIPC argues that higher water temperatures in winter and spring "may result in faster growth for several species, notably Largemouth Bass, and actually lead to improved overwinter survival for these species." Pet. at 8, citing Exh. B, App. C at 51, 54; *see* Pet. at 25. In support of this observation, EIU's 2017 report found thermally-sensitive black crappie to be growing faster than expected by Hedinger (2000), with 91% being greater than "quality" length. Exh. B at 4-15; *see* Exh. B, App. B at B-18, B-19, B-23, B-39, B-57. Comparing catch rates before and after the boiler replacement in 2003, SIPC states that catch rates in 2010 were similar to rates in 1998 and 1999. Pet. at 27, *see* Exh. B, App. C at 11 (Table 3-4), 54; Pet. at 25.

Exclusion from Unacceptably Large Areas. AMEC compared modeled summer stressed lake temperatures with thermal tolerance data. AMEC argued that the proposed limits would produce temperatures at the surface less than the UILT for most RIS throughout the lake outside of the mixing zone, and temperatures in deeper waters less than the UILT for other species. Pet. at 28; Exh. B, App. C at 40-45. SIPC asserts that avoidance or adaptive behavior would be limited to localized areas in the lower lake zone. *Id*. at 29. Even when parts of the lake would be excluded under stressed conditions, SIPC argues that there would be extensive areas available within tolerance ranges for all the RIS studied. *Id*.; *see* Exh. B, App, C at 40-50. ASA found that the bathymetry of the lake confines the impact of SIPC's discharge mainly to the lower lake, so species are not excluded from an unacceptably large area. Under stressed conditions, ASA asserts that ample thermal refugia with lower temperatures and higher dissolved oxygen is available for fish by moving vertically or laterally to other parts of the lake. Pet. at 21-22, 28-29; Exh. B at 4-17, App. C at 51-52, 56.

Blockage of Migration. SIPC reports that the Lake of Egypt covers approximately 2,300 acres and runs approximately 6.2 miles from the dam to the upstream end of the upper zone. Exh. B, App. C at 25. Lake of Egypt does not have a flowing current other than the flow from the cooling water intake and discharge, and it is essentially a closed system. Exh. B, App. C at 26; SIPC Resps. at 4. The cooling water intake and discharge are separated by a narrow peninsula both located in the northern end of the lower lake. *Id*.; *see id*. at 80 (Figure 5-9: bathymetric profile). SIPC argues that, because this discharge affects a small portion of the lake and does not have a flow-through current, the thermal plume in the lower lake "does not block or hinder fish migration even under stressed conditions." Pet. at 29, citing Exh. B, App. C at 25.

Board Finding on Fish Biotic Category Criteria. The Board finds that SIPC's demonstration meets the decision criteria of the USEPA 316(a) Manual for fish at sites that are not low potential impact areas. *See* USEPA 316(a) Manual at 28-29. SIPC's demonstration shows fish communities will not suffer appreciable harm from: (i) direct or indirect mortality from cold shock; (ii) direct or indirect mortality from excess heat; (iii) reduced reproductive success or growth as a result of heated discharge; (iv) exclusion from unacceptably large areas; or (v) blockage of migration.

Other Vertebrate Wildlife. The USEPA 316(a) Manual states that most sites in the United States will be considered to have low potential impact for other vertebrate wildlife because thermal plumes should not generally impact large or unique populations of other vertebrate wildlife. USEPA 316(a) Manual at 32. The main exception is sites where important, threatened, or endangered wildlife may be affected by the discharge and in cold areas where the thermal plume is predicted to attract geese and ducks and encourage them to stay through the winter. *Id.* The USEPA 316(a) Manual provides that this section of a demonstration is successful if the applicant shows the site is a low potential impact area for other vertebrate wildlife.

AMEC states that waterfowl including ducks and Canada geese are regularly observed on Lake of Egypt along with herons and shorebirds. Exh. B, App. C at 23; *see id*. at 40; Pet. at 20. SIPC also expects migrating birds to use the lake during spring and fall without effect on their seasonal migrating patterns. Exh. B, App. C at 23. Based on studies of other cooling lakes such as Lake Sangchris, AMEC expects the concentration of waterfowl across different parts of the lake to be generally uninfluenced by the thermal discharge into the lake. *Id*.

The Board previously found in PCB 14-129 that SIPC had demonstrated "that Lake of Egypt should be considered as low potential impact for other vertebrate wildlife." SIPC v. IEPA, PCB 14-129, slip op. at 20, 21 (Nov. 20, 2014); *see* Exh. B. at 4-1; Pet. at 18-19, 20. Based on the Board's 2014 finding, SIPC did not conduct additional site-specific studies. Exh. B. at 1-8, 4-18; Exh. B, App. B at A-6. Since the record contains no new evidence to the contrary, the Board continues to find that Lake of Egypt is a low potential impact area for other vertebrate wildlife because thermal plumes should not impact any large or unique populations of other vertebrate wildlife. Additionally, no important, threatened, or endangered species of other vertebrate wildlife have been documented at Lake of Egypt. SIPC's demonstration meets the decision criteria and shows that other vertebrate wildlife will not suffer appreciable harm from the proposed alternative thermal effluent limitations. *See* USEPA 316(a) Manual at 32.

Board Finding on Criteria for All Biotic Categories

The Board finds that SIPC's proposed alternative thermal effluent limitations as modified in the Order below meet the decision criteria of the USEPA 316(a) Manual to find a demonstration successful for each of the biotic categories: habitat formers, phytoplankton, zooplankton and meroplankton, macroinvertebrates and shellfish, fish, and other vertebrate wildlife. Although the frequency of the thermal discharges increased two to three times when Unit 123 came online in 2003, SIPC documented that many of the major attributes of the BIC in Lake of Egypt were similar before and after that occurrence. For fish, these include species composition, spatial patterns, and catch rates. Additionally, no proliferation of nuisance or invasive fish species has been evident either before or after the boiler replacement in 2003. The Board also observes that the record contains no evidence of nuisance algal blooms, abnormal phytoplankton blooms, or fish kills attributable to prior thermal discharges from MGS. Based on the Type I Retrospective and Type II Predictive/RIS Demonstrations, the Board finds that a balanced and indigenous community of aquatic life currently exists in Lake of Egypt and has remained stable since before the 2003 boiler replacement.

The Board finds that SIPC's demonstration shows that the requested alternative thermal effluent limitations as modified in the Order below, "considering the cumulative impact of its thermal discharge, together with all other significant impacts on the species affected, will assure the protection and propagation of a balanced indigenous community of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made." 35 Ill. Adm. Code 106.1160(c), 40 CFR 125.73.

Board Findings on Master Rationale, Demonstration as a Whole

For a demonstration to be successful under the Master Rationale, it must show as a whole that (1) the demonstration is acceptable for the considerations under the decision train outlined in Section 3.2.2 of the USEPA 316(a) Manual; (2) the demonstration shows there will be no appreciable harm to the balanced indigenous community; (3) receiving water temperatures outside any mixing zone will not be in excess of the upper temperature limits for the life cycles of the RIS; (4) the absence of the proposed thermal discharge would not result in excessive growth of nuisance organisms; (5) a zone of passage provides for the normal movement of RIS; (6) there will be no adverse impact on threatened or endangered species; (7) there will be no destruction of unique or rare habitat without convincing justification; and (8) the use of biocides will not result in appreciable harm to the balanced, indigenous community. USEPA 316(a) Manual at 70-71.

SIPC's Master Rationale

SIPC argues that its master rationale summarizes data to show that a BIC will be protected in the Lake of Egypt under the requested alternative thermal effluent limitations. Pet. at 29-30, citing USEPA 316(a) Manual at 52; Exh. B at 2-1 – 2-3; Exh. B, App. C at 3-5.

No Alteration to Existing Thermal Regime. SIPC does not now expect to increase thermal loading from its plant operations, so it projects that the future thermal regime will be consistent with current conditions. Exh. B, App. C at 39. Horizontally, warmer conditions will continue to occur in "a small percentage of the 2,300-acre lake." *Id*. at 56. Vertically, SIPC states that "the lake is stratified with regard to temperature for much of the year." *Id*. at 39 (citation omitted). Even under stressed conditions, SIPC argues that the discharge is not likely to affect the vertical characteristics of the thermal regime and that deeper areas of the lake would continue to be available as thermal refuge. *Id*.; *see* Exh. B at 2-2.

Adaptability and Available Refugia. SIPC argues that species-specific data suggest that "most fish species in the lake would rarely encounter their temperature maxima." Exh. B, App. C at 50; *see id*. at 40-45 (RIS). SIPC adds that the lake includes large areas of habitat available as thermal refuge, whether outside the 26-acre mixing zone or in lower depths where temperatures are 3 to 7°F lower than the surface. *Id*. at 50-51; *see id*. at 4, 54, 56; Exh. B at 2-2. Electrofishing in 2010 showed no individuals in the immediate vicinity of the MGS discharge structure, and SIPC argues that this demonstrates avoidance behavior. *Id*. at 51. Finally, SIPC argues that studies show a healthy fish population in Lake of Egypt. *Id*. at 51.

Community Structure. SIPC states that surveys show a stable fish community in Lake of Egypt. Exh. B, App. C at 4, 56; *see id*. at 11 (Table 3-4); Exh. B at 4-14 (Table 4-1) (electrofishing CPUE); Exh. B at 2-2. "There is no indication that the aquatic community has been changed in a way that makes its structure simpler or unnatural for the locality." Exh. B at 2-2. SIPC argues that stable composition and abundance indicate healthy and self-sustaining populations. Exh. B, App. C at 4, 56. SIPC expects proposed limits to maintain a similar community. *Id*. at 3.

Decrease in Formerly Abundant Species. SIPC argues that survey data show "no substantial decrease in the abundance of fish RIS." Exh. B at 2-2; *see* Exh. B, App. C at 11 (Table 3-4); Exh. B at 4-14 (Table 4-1). SIPC argues that the abundance and community structure is generally similar across the three lake zones (Exh. B at 2-2), indicating that there has been "no decrease in indigenous species in the other biotic categories." Pet. at 31.

Nuisance Species. SIPC argues that there is no evidence that nuisance species have increased in presence or abundance in the Lake of Egypt. Exh. B at ii, 2-2; *see id*. at 4-16 – 4-18; Pet. at 30. Near the discharge, the fish community is similar to the community in other zones of the lake and is not dominated by heat-resistant species. Exh. B at ii, 2-2.

Completion of Life Cycles. Based on continued abundance of fish RIS, SIPC argues that there has been no reduction in successful completion of life cycles by indigenous species in the Lake of Egypt. Exh. B at ii, 2-2, citing Exh. B, App. C at 40-50 (biothermal assessment); Pet. at 31.

Potentially Beneficial Thermal Effects. For largemouth bass, SIPC considers consistent higher water temperatures in winter and early spring to result in "earlier spawning, improved survival, and increased growth/development in the early life stages." Exh. B, App. C at 4, 51, 56. For channel catfish and bluegill, "higher temperatures may extend the spawning season and promote growth throughout the year." *Id*. at 51. This accelerated development may also improve overwinter survival. *Id*.

While threadfin shad is a valuable forage species for several game species, it was not initially able to survive through winters under normal temperatures. Exh. B, App. C at 51. Since threadfin shad were first stocked in the lake in the 1970s (*id*, at 7, 53), warmer winter water temperatures have reduced mortality (*id*. at 51). This preserves the forage base, particularly for largemouth bass, "adding to the overall condition and health of the fish community." *Id*.

Potential for Fish Kills. "Small, closed systems with little depth or habitat heterogeneity are particularly vulnerable to periodic fish kills." Exh. B, App. C at 51. SIPC argues that these are not the conditions in the lake and emphasizes that the lake includes both lateral and vertical thermal refuge areas. *Id*. at 5, 51-52, 56.

SIPC acknowledges that threadfin shad and gizzard shad may be vulnerable to mortality from prolonged periods of low temperatures. Exh. B, App. C at 52. SIPC argues that the MGS thermal discharge warms the lake water and may minimize the risk of winter mortality. *Id*.

SIPC schedules plant outages for maintenance during the spring and fall. This maintains winter water temperatures and limits the risk of temperature-induced mortality for shad species. *Id*.

Finally, SIPC notes that no summer fish kills have occurred in the Lake of Egypt. Exh. B, App. C at 5, 52, 56. SIPC argues that this "indicates that community members have adapted to the changing physical conditions." *Id*. at 52. SIPC concludes that, with no increase in thermal loading expected, the risk of future fish kills is small. *Id*.

Aesthetic Appearance, Odor, and Taste. SIPC argues that the thermal discharge from MGS "has not caused an unaesthetic appearance or odor" in the Lake of Egypt. Exh. B at ii, 2-2; Pet. at 31.

Economic or Recreational Uses. SIPC argues that its thermal discharge has not "eliminated an established or potential recreational use" in the Lake of Egypt. Exh. B at 2-2; *see* Pet. at 31. SIPC states that the lake is heavily used for recreational fishing and hosts numerous fishing tournaments. Exh. B at 2-2; *see* Exh. B., App. C at 55; Pet. at 32, 33.

Continuing SIPC Efforts. SIPC has stocked various species of fish into the Lake of Egypt since 1971. Exh. B, App. C at 52, citing *id*. at 53 (Table 6-6: stocking summary). SIPC remains committed to supporting and enhancing the lake through stocking and lake management. *Id*. at 52; *see* Pet. at 32.

SIPC Summary on Master Rationale

SIPC relies on a hybrid demonstration combining retrospective and predictive demonstrations to consider effects of its proposed thermal limits. Exh. B, App. C at 3.

SIPC states that observed temperatures in the lower zone of the lake outside the mixing zone were within tolerance limits for fish RIS. Exh. B, App. C at 3. SIPC adds that thermal refuge is available both horizontally and vertically within the lake. SIPC argues that current limits have improved overwinter survival for threadfin shad and emphasizes that the resident fish community has had stable composition and abundance. *Id*. SIPC concludes that "these patterns indicate that the thermal conditions in the Lake of Egypt have been protective of a balanced indigenous community." *Id*.

Prospectively, SIPC argues that modeling normal summer operating conditions under the proposed thermal limits shows fish RIS avoiding or adapting to localized temperatures in the lower zone of the lake. Under stressed condition, more thermally-sensitive species would seek to adapt by avoiding surface temperatures. Exh. B, App. C at 3, 4. SIPC adds that thermal refuge will continue to available. SIPC states that its proposed limits will continue to improve overwinter survival for threadfin shad. SIPC also argues that the proposed limits will continue to sustain community composition and abundance. SIPC concludes that its proposed limits "reflect current thermal conditions and will continue to be protective of the balanced indigenous community." *Id*. at 3.

SIPC addresses the other five biotic categories listed in the USEPA 316(a) Manual. SIPC states that categories such as submerged aquatic vegetation and other wildlife are unaffected or beneficially affected by the MGS thermal effluent. Exh. B, App. C at 5. Other categories include species that "are not threatened/endangered, of commercial importance (macroinvertebrates and shellfish), and/or generally have short life spans, reproduce rapidly or are expected to exhibit only localized population shifts (phytoplankton and zooplankton)." *Id*. Based on these factors, SIPC argues that "[i]t is reasonable to conclude that the plant's discharge will cause no appreciable harm to these resident communities in the lake." *Id*.

Board Findings on Master Rationale

The Board finds that SIPC's Biotic Category Analysis, Type I Predictive/RIS Demonstration, and Type II Predictive/RIS Demonstration meet the applicable decision criteria of the USEPA 316(a) Manual for the Master Rationale. *See* USEPA 316(a) Manual at 70-71. Specifically, the Board finds that SIPC's demonstration as a whole shows that for the alternative thermal effluent limitations in the Order below: (1) the demonstration followed the considerations under the decision train outlined in Section 3.2.2 of the USEPA 316(a) Manual; (2) there will be no appreciable harm to the balanced, indigenous community; (3) receiving water temperatures will not be in excess of the upper temperature limits for the life cycles of the RIS; (4) the absence of the proposed thermal discharge would not result in excessive growth of nuisance organisms; (5) a zone of passage provides for the normal movement of RIS; (6) there will be no adverse impact on threatened or endangered species; (7) there will be no destruction of unique or rare habitat, and (8) the use of biocides will not result in appreciable harm to the balanced, indigenous community.

Decision Train. The decision train in the USEPA 316(a) Manual follows steps to ensure that the demonstration is complete, required data has been submitted, the studies justify the conclusions for each of the biotic category criteria, the information shows the RIS will not suffer appreciable harm, the engineering and hydrological data justify the conclusions for the Master Rationale, technical experts were consulted that include other government agencies, and that the information is not negated by outside evidence. USEPA 316(a) Manual at 16-17, 70.

Through its Type I Retrospective and Type II Predictive/RIS Demonstrations, SIPC addressed each of the biotic category criteria for a demonstration to be judged successful. SIPC provided hydrological and engineering data to describe a baseline and parameters to model the predicted thermal regime of Lake of Egypt under seasonal stressed weather conditions. To evaluate the biothermal effects of the proposed alternative thermal effluent limitations, SIPC selected eight RIS, including two thermally-sensitive species and a nuisance species, in addition to an invasive species. SIPC's detailed plan of study was coordinated and approved by IEPA, and IDNR was served with a copy of the petition. IEPA agreed with SIPC's findings in recommending that the Board grant the requested relief.

No Appreciable Harm to the BIC. SIPC requests thermal relief for an existing discharge. SIPC states that the discharge has remained essentially unchanged since 2003 and will remain unchanged. SIPC has data for the conditions of the BIC in Lake of Egypt as it existed both before and after the boiler replacement in 2003. SIPC also has projections based on modeled data for future years. SIPC's demonstration as a whole assessed the proposed alternative thermal effluent limitations by examining studies from three different periods: before boiler replacement (1997 and 1998), after boiler replacement (2005 and 2006, 2010, 2016), and future years. Exh. B at 4-13 – 4-14.

To demonstrate that the current discharge has resulted in no "prior appreciable harm" to the BIC, SIPC's retrospective approach looked first at the BIC in 1997 and 1998 from fish studies in Lake of Egypt. Exh B. at 1-1; App. C at 20; *see* Pet. at 16. For conditions after the 2003 boiler replacement, the demonstration consulted MACTEC studies in 2005 and 2006 and 2010 and the ASA/EIU study in 2016. Pet. at 16-20, Exh. B. at i, 1-2 – 1-3, 4-13 – 4-14. Although the frequency of thermal discharges increased two to three times when Unit 123 came online in 2003, SIPC documented a stable fish community in Lake of Egypt over the last 20 years. This indicates stable lower trophic levels such as phytoplankton and zooplankton that support the fish community. Fish species composition, spatial patterns, and catch rates were similar before and after the boiler replacement. There have been no recorded fish kills and no proliferation of nuisance or invasive species. Exh. B at i, 4-1 – 4-9, 4-13 – 4-16; App. C at 22; Pet. at 21; Rec. at 5-8.

To demonstrate that the proposed alternative thermal effluent limitation will assure the protection and propagation of the balanced, indigenous community, SIPC also used a predictive approach. SIPC coupled hydrothermal modeling and dissolved oxygen surveys with biothermal response data for RIS to evaluate the potential effects of SIPC's proposed alternative limitations. Exh. B at 2-2, App. C at 26-51. SIPC evaluated RIS in Lake of Egypt under both normal and stressed weather conditions. While some of the more thermally sensitive RIS would be confined to sub-surface waters during stressed summer conditions, SIPC states that there are no barriers for fish to reach suitable habitat with cooler temperatures and sufficient dissolved oxygen levels. Exh. B at 4-17, App. B at B-10, B-15, App. C at 40, 44-45.

Upper Temperature Limits. For each of the RIS, AMEC addressed the upper temperature limits for the various life cycles from spawning and growth to mortality. AMEC listed the temperature and monthly ranges for spawning, MWAT for growth, and UILT. Exh. B, App. C at 40-45. For spawning, AMEC found that the reaches of Lake of Egypt with higher water temperatures experience earlier spawning of all RIS. However, the thermal plume does not appear to adversely affect recruitment of RIS species into the populations. Exh. C, App. A at 46 - 50.

For MWAT and UILT, SIPC assessed the amount of surface acreage and subsurface volume that would be available to RIS within their temperature tolerances under summer normal and stressed conditions. Under summer normal conditions, most RIS would not be excluded from surface areas of Lake of Egypt based on UILTs but would be excluded from 8 to 58 percent based on MWATs. Exh. B, App. C at 45; *see* Exh. B. at 4-15. The exceptions are white and black crappie which would be excluded from 29 percent of the lake's surface area based on their UILT and 100 percent based on their MWAT for growth. Exh. B at 4-15. Under summer stressed conditions, catfish and bluegill would have 33 to 40 percent of the lake's surface available below their MWATs, while the other RIS would have no area at the surface below their MWATs. However, SIPC states that deeper waters would be below the UILT and MWAT and provide suitable habitat and sufficient dissolved oxygen to sustain all RIS and that there are no barriers to movement. Exh. B at 4-17, App. B at B-10, B-15, B-20, App. C at 44-45; SIPC Resps. at 4.

Nuisance Organisms. In the absence of the thermal discharge, the only vulnerability SIPC identified was sensitivity of threadfin shad and gizzard shad to prolonged low water temperatures. To avoid cold shock, SIPC plans outages during the spring and fall to minimize temperature swings. Pet. at 26; Exh. B, App C at 52. SIPC also looked at the effect of the thermal loadings on populations and distribution of the nuisance species common carp and rusty crayfish. For common carp, catch rates in 2017 after the 2003 boiler replacement were similar to catch rates in 1997 to 1998, indicating that neither the addition or absence of the increased thermal discharge frequency was causing common carp to proliferate. Exh. B, App. B at B-18, B-36; Rec. at 5. ASA attributed any change in the population of rusty crayfish to their preference for clear water resulting from the cessation of septic and treated sewage discharges water rather than changes in the thermal regime. Exh. B. at 4-16 – 4-17.

Zones of Passage. AMEC notes that the mixing zone occupies 26 acres of the 2,300-acre lake and is limited to the north end of the lower lake. Pet. at 11, citing Exh. B, App. C at 2, 51; Exh. B at 1-3. AMEC points out Lake of Egypt is a lake, and RIS "can simply avoid areas that are above their temperature tolerance." Exh. C, App. C at 50-51. AMEC observed that, "there are no barriers to the movement [of the RIS] from areas that may be thermally less suitable to habitats characterized by cooler temperatures." Exh. B, App. C. at 43.

Threatened or Endangered Species. ASA compared species found during lake surveys with lists of species on IDNR and U.S. Fish and Wildlife Service websites. ASA found that no threatened or endangered fish or macroinvertebrate species are present in Lake of Egypt. Exh. B at 4-9; Exh. B, App. C at 18 (§ 4.3), 40 (§ 6.2.2); *see* SIPC Resps. at 2.

Unique or Rare Habitat. EIU prepared a map of habitat formers vegetation in August 2016, which includes information on species composition and percent coverage. SIPC Resps. at 2, citing Exh. B, App. B. at B-55 (Figure 7-15). SIPC did not identify any areas of unique or rare habitat. SIPC Resps. at 2; Exh. B, App. B. at B-55. Additionally, IDNR has not listed the lake as a biologically significant stream. Rec. at 3.

Biocides. SIPC's NPDES Permit for MGS contains specific limits and special conditions for the discharge of chemicals, including chlorine, that might interact with the thermal component of the discharge unless the use and aquatic toxicity results are approved by IEPA. The NPDES Permit also limits total residual chlorine to a daily maximum of 0.2 mg/L and restricts the discharge of chlorine to no more than two hours per day. App. A at 3, 6.

Board Finding that Applicable Effluent Limits are More Stringent Than Necessary

SIPC must demonstrate that the current standard is more stringent than necessary to assure the protection and propagation of the balanced and indigenous population of shellfish, fish, and wildlife in Lake of Egypt. *See* 33 U.S.C. § 1326. The effluent limitations in MGS's NPDES Permit are the standards from which SIPC seeks an alternative limitation. The NPDES

Permit provides maximum limits of 60°F in December to March, and 90°F in April to November, with excursion temperatures (+3°F) and hours (1% of 12-month period). Exh. B, App. A. The permit limits are based on Section 302.211(e) of the Board's water pollution regulations, although SIPC argues that this section does not apply to Lake of Egypt because it is not a river. Exh. C, App. C at 50-51; *see* 35 Ill. Adm. Code 302.211(e).

SIPC's NPDES Permit requires that compliance with the temperature limits be demonstrated using a specific computer model to estimate surface temperatures at the edge of the mixing zone. Pet. Exh. A at 7. In its demonstration, SIPC uses collected data as well as modeled stressed conditions to show that the permitted temperature limits are more stringent than necessary.

SIPC's demonstration looks at the past, present, and future to characterize thermal profiles and aquatic life in Lake of Egypt. SIPC requests thermal relief for an existing discharge that SIPC states has remained unchanged since 2003 and will continue. Under current operating conditions, temperatures at the edge of MGS's mixing zone have been above the permitted limits in the summer. SIPC has data for the conditions of the BIC in Lake of Egypt as it existed both before and after the boiler replacement in 2003, as well as projections based on modeled data when extreme weather could result in stressed conditions in Lake of Egypt.

To demonstrate that the current limits are more stringent than necessary, SIPC first relies on a Type I Retrospective Demonstration to show the absence of prior appreciable harm. SIPC's retrospective demonstration relies on studies over 20 years both before the 2003 boiler replacement (Dr. Heidinger in 1997 and 1998) and after it (MACTEC in 2005-2006 and 2010 and ASA/EIU in 2016). Exh. B at 4-13 – 4-14. Although the frequency of thermal discharges increased two to three times when Unit 123 came online in 2003, and temperatures at the edge of the mixing zone have been above the permitted limits in the summer, SIPC documented stable communities of fish and lower trophic levels in Lake of Egypt over the last 20 years. Fish species composition, spatial patterns, and catch rates were similar before and after boiler replacement. There have been no recorded fish kills and no evident proliferation of nuisance or invasive species. Exh. B at i, 4-1 – 4-9, 4-13 – 4-16; App. C at 22; Pet. at 21; Rec. at 5-8.

SIPC also employs a Type II Predictive Demonstration to show that not only are the current limits more stringent than necessary, but that the proposed alternative thermal effluent limitations would assure the protection and propagation of the BIC. The predictive approach models potential stressed summer and winter lake temperatures, including those represented by the proposed alternate thermal effluent limitation as modified in the Order below. Together, the demonstration compares modeled temperatures and dissolved oxygen surveys to biothermal response data for RIS to estimate the surface areas and depths from which RIS would be excluded. Exh. B at 2-2, App. C at 26-51. The biothermal assessment observed that, while some of the more thermally sensitive RIS would be confined to sub-surface waters during stressed summer conditions, there are no barriers to reaching suitable habitat with cooler temperatures and sufficient dissolved oxygen levels for growth and survival. Exh. B at 4-17, App. B at B-10, B-15, App. C at 40, 44-45. SIPC documents the existence of a balanced and indigenous population under the current MGS operating parameters, which are expected to continue under predicted stressed weather conditions.

In its recommendation, IEPA states that SIPC has satisfied the Board's and IEPA's requirements for a thermal demonstration under 35 Ill. Adm. Code 106.Subpart K. IEPA agrees with SIPC that the demonstration as a whole "shows a consistent fish community over the last 20 years suggesting that fish populations have adapted and thrived in the thermal environment of Lake of Egypt." Rec. at 7. IEPA added that the consistent fish community suggests that the lower trophic levels are of sufficient quality and quantity to support these fish. Rec. at 7. IEPA found no evidence in SIPC's demonstrations to suggest that the heated discharge from MGS has caused appreciable harm to any of the biotic categories. IEPA agreed that SIPC's predictive study shows the proposed alternative limitations will be protective. Rec. at 7. Overall, IEPA believes that SIPC "successfully demonstrated that the proposed alternative thermal effluent limitations will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the Lake of Egypt." Rec. at 6.

The Board finds that SIPC's demonstration shows that a balanced and indigenous population has existed in and on Lake of Egypt during MGS operations and has remained stable since the 2003 boiler replacement. Since 2003, MGS has not changed operations affecting the heated effluent, and it is not planning to do so. The Board finds that the effluent limitations in MGS's NPDES Permit based on 35 Ill. Adm. Code 303.211(e) are more stringent than necessary for the months of June to March to assure the protection and propagation of the balanced and indigenous population in Lake of Egypt.

In the order below, the Board grants SIPC's requested alternative thermal effluent limitations with modifications. For the months of June to February, the Board grants SIPC the maximum temperatures as requested. For the months of April and May, SIPC's requested relief is the same as the current NPDES Permit limits, so the Board does not consider those limits more stringent than necessary. They will remain the same but are included in the order below for the sake of continuity and completeness. For the month of March for which SIPC requested an alternative limitation of 74°F, the Board sets the limit at 70°F. The Board finds that, although the 60°F NPDES permitted limit is more stringent than necessary, the modeled 70°F maximum temperature limit is not more stringent than necessary based on the modeling parameters and once-in-20-year predicted exceedance.

CONCLUSION

Based on the record before it, the Board finds that SIPC has demonstrated that the limits imposed by 35 Ill. Adm. Code 302.211(d) are more stringent than necessary to assure the protection and propagation of a balanced and indigenous population of shellfish, fish, and wildlife in the Lake of Egypt. The Board finds that SIPC's retrospective determination shows that no appreciable harm has resulted from the MGS heated discharge to a balanced, indigenous community of shellfish, fish, and wildlife in the Lake of Egypt. The Board also finds that SIPC's predictive demonstration shows that alternative thermal effluent limitations, based on maximum temperature limits in the order below, will assure the protection and propagation of a balance, indigenous community of shellfish, fish, and wildlife in the Lake of Egypt. 33 U.S.C. § 1326. Accordingly, the Board grants SIPC an alternative thermal effluent limitation as described in its order below, effective today.

In granting an alternative thermal effluent limitation, the Board "may impose such conditions as may be necessary to accomplish the purposes of the Act." 35 Ill. Adm. Code 106.1170(b). As discussed above, the Board sought clarification from SIPC on structuring the thermal relief and the maximum daily temperature limits based on values produced by modeling and biotic category analysis determinations consistent with the worst-case scenarios modeled. Based on evidence currently in the record, the Board grants SIPC thermal relief consistent with the 95th or 98th percentile maximum values produced by modeling.

This opinion constitutes the Board's findings of fact and conclusions of law.

ORDER

Under 35 Ill. Adm. Code 106.Subpart K and 35 Ill. Adm. Code 304.141(c), the Board determines that the following alternative thermal effluent limitations apply to the discharge to Lake of Egypt from Southern Illinois Power Cooperative's Marion Generating Station.

1. Temperature

   a. In lieu of thermal effluent limits based on the thermal water quality standards at 35 Ill. Adm. Code 302.211(e), the following daily maximum effluent temperature limits apply:

Month	**Daily Maximum (°F)**
January	70
February	70
March	70
April	90
May	90
June	100
July	100
August	100
September	100
October	91
November	91
December	70

   b. Effluent temperatures must not exceed the daily maximum temperature limits in paragraph (1)(a), during more than 1% of the hours (87.6 hours) in the 12-month period ending with any month. Moreover, at no time shall the water temperature exceed the daily maximum temperature limits by more than 3°F.

2. The alternative thermal effluent limitations in paragraphs (1)(a) and (1)(b) apply at the edge of the 26-acre mixing zone allowed in Southern Illinois Power Cooperative's NPDES permit for the Marion Generating Station.

3. The Illinois Environmental Protection Agency must expeditiously modify Southern Illinois Power Cooperative's NPDES permit for the Marion Generating Station so that it is consistent with this opinion and order.

IT IS SO ORDERED.

Board Member B.K. Carter abstained.

Section 41(a) of the Act provides that final Board orders may be appealed directly to the Illinois Appellate Court within 35 days after the Board serves the order. 415 ILCS 5/41(a) (2016); *see also* 35 Ill. Adm. Code 101.300(d)(2), 101.906, 102.706. Illinois Supreme Court Rule 335 establishes filing requirements that apply when the Illinois Appellate Court, by statute, directly reviews administrative orders. 172 Ill. 2d R. 335. The Board's procedural rules provide that motions for the Board to reconsider or modify its final orders may be filed with the Board within 35 days after the order is received. 35 Ill. Adm. Code 101.520; *see also* 35 Ill. Adm. Code 101.902, 102.700, 102.702.

Names and Addresses for Receiving Service of Any Petition for Review Filed with the Appellate Court	
Parties	**Board**
Southern Illinois Power Cooperative Attn: Amy Antoniolli; Schiff Hardin, LLP 233 S. Wacker Dr., Suite 6600 Chicago, Illinois 60606 AAntoniolli@schiffhardin.com	Illinois Pollution Control Board Attn: Don A. Brown, Clerk James R. Thompson Center 100 West Randolph Street, Suite 11-500 Chicago, Illinois 60601
Illinois Environmental Protection Agency Attn: Stephanie Flowers, Asst. Counsel 1021 N. Grand Ave. E. PO Box 19276 Springfield, Illinois 62794-9276	

I, Don A. Brown, Clerk of the Illinois Pollution Control Board, certify that the Board adopted the above opinion and order on July 25, 2019 by a vote of 4-0.

Don A. Brown, Clerk
Illinois Pollution Control Board