**BEFORE THE**
**ILLINOIS POLLUTION CONTROL BOARD**

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| AMEREN ENERGY GENERATING COMPANY, | ) | |
| Petitioner, | ) | |
| v. | ) | PCB 2009-038 (Thermal Demonstration) |
| ILLINOIS ENVIRONMENTAL PROTECTION AGENCY | ) | |
| Respondent. | ) | |

**PRE-FILED TESTIMONY OF JAMES B. McLAREN, PH.D.**

A. BACKGROUND AND QUALIFICATIONS

1. My name is James B. McLaren, Ph.D. I am a Senior Scientist with ASA Analysis & Communication, Inc. ("ASA"). I have Masters and Doctorate degrees in Zoology from Pennsylvania State University. My undergraduate degree is a Bachelor of Science degree in Fisheries Sciences from Cornell University.

2. I have over 35 years consulting experience in aquatic sciences, including extensive experience with 316(a) and 316(b) demonstrations at power plants across the country. I have designed and supervised several extensive aquatic surveys of water bodies. My Curriculum Vitae is attached hereto as Attachment 1.

B. TESTIMONY

Nature of the Ecological Assessment of Impact of Thermal Discharge on the Lake

1. Ameren engaged ASA to provide an evaluation of the potential for adverse ecological impacts from a proposed modification to the current site-specific thermal standards applicable to Coffeen Lake. A thermal demonstration was completed for the Coffeen Power

Station in 1982 which established the current thermal standard. The current thermal standard for Coffeen Lake specifies that the months of May and October fall within the non-summer period extending from October through May. The current standard is depicted in Attachment 2. Ameren is proposing to modify the thermal limits for the months of May and October only. The proposed limits for May and October would be at an intermediate level between summer and non-summer standards. The relief Ameren is seeking is graphically depicted in Attachment 3.

2. ASA assessed whether increasing the thermal limits in May and October from the current to the proposed limits would be environmentally acceptable to the lake. Our report entitled "Evaluation of Potential Adverse Impacts From Revised Site-Specific Thermal Standards In May and October For Coffeen Lake," dated March 2008 (hereinafter "the ASA Report"), is attached as Exhibit 11 to the Petition in the case. It sets forth our detailed assessment which I incorporate as if fully set forth herein. In addition, also attached as Attachment 4 is a revised Figure 2-4 originally provided in the ASA Report as Figure 2-4. Revised Figure 2-4 corrects a mistake in the identification of the four sampling station locations used by SIUC for sampling water temperature and dissolved oxygen.

3. We used the EPA's 316 (a) Technical Guidance Manual as merely a guide for structuring our assessment. While Section 316(a) demonstrations are appropriate for new facilities or facilities with major changes to their operational mode, Coffeen is neither a new facility nor is it changing any design parameters of its generating equipment that would affect its thermal effluent discharge into Coffeen Lake. Ameren is not requesting a new standard, but rather merely a modification of Coffeen Lake's thermal limits for only the months of May and October. We believe that our report appropriately considered the history of Coffeen Lake and the Station and valuable empirical data in evaluating whether Ameren's requested relief will continue to support a balanced indigenous community in Coffeen Lake. Coffeen Lake supports a thriving fishery and

over a decade of data has been collected with which to evaluate the effects of Ameren's thermal discharge.

4. We focused on three primary recreational fish species (referred to as Representative Important Species or "RIS") in Coffeen Lake using an approach similar to the U.S. Environmental Protection Agency's Ecological Risk Assessment framework. (United States Environmental Protection Agency (EPA) (1998) Guidelines for Ecological Risk Assessment. EPA/630/R-95/002F. Washington, D.C.). Recent 316(a) assessments have shown that the decision criteria from the USEPA Draft 316(a) Guidance is congruent with this more recently developed guidance for evaluating the adversity of effects from a wide variety of ecological stressors. (See Electric Power Research Institute (EPRI), 2002, Evaluating the effects of power plant operations on aquatic communities: an ecological risk assessment framework for Clean Water Act §316(b) determinations, EPRI Report 1005337). The Ecological Risk Assessment framework was developed with considerable scientific and public input, and represents a well-accepted and up-to-date scientific and regulatory view on approach for assessing ecological risks.

5. In this approach, we used multiple lines of evidence for both a retrospective assessment and a prospective (or predictive) assessment of the potential risks from increasing the site-specific thermal standards in the months of May and October. The investigation relied upon data collected by Southern Illinois University-Carbondale ("SIUC") for studies ordered by the Illinois Pollution Control Board ("Board") intended to monitor the thermal effects on the lake's aquatic community arising from the 1997 five-year variance for May and October granted by the Board.

Retrospective Assessment

6. I will first summarize the results of the retrospective assessment. First, I should note that retrospective assessments of RIS provide the strongest evidence of the long-term effects of periodically higher water temperatures in that such assessments integrate all aspects of the thermal environment on the life cycle for the fish species and the lower trophic levels in the lake, such as phytoplankton, epiphyton, macrophytes, zooplankton and benthos. The data collected by SIUC and Illinois Department of Natural Resources ("IDNR") since 1997 indicate no appreciable harm to the populations of the three RIS -- largemouth bass, channel catfish, or bluegill -- caused by the ongoing thermal discharge from Coffeen Power Station. In fact, the information amassed by SIUC and IDNR confirms a rather robust and healthy fishery. This would attest to the conclusion that the lake's thermal regime is also suitable for lower trophic levels that provide forage for these top consumers.

7. Second, we found that fish populations have indeed adapted and thrived in the thermal environment of Coffeen Lake. This includes temperatures well in excess of the proposed limits being sought for May and October. Operation of the station during summer months has resulted in water temperatures that exceed the limits requested by Ameren in this proceeding, yet viable populations of these species have been maintained through natural reproduction in the lake. These species continue to support a healthy, popular recreational fishery. In fact, all three RIS exhibit characteristics such as survival, growth, body condition, population size, and recruitment of young that are comparable to or exceed those for populations in other regional and national water bodies. Some annual variability in population characteristics of fish species at Coffeen Lake has occurred, such as reported by IDNR, for the relative weight of largemouth bass. However, as with this example, there has been no sustained declining trend

in relative weight through time. Such annual variability is typical for any sustainable fish population.

8. Third, the available data show that fish passage will not be impaired by the marginal increase in water temperatures during May and October. Prior studies by ESE (1995) and SIUC (2000) demonstrated the free movement of largemouth bass during warm summer months to areas in the lake distant from the discharge area. In fact, the proposed increase in May and October temperature limits would more realistically reflect a natural thermal environment, where temperatures would increase and decrease more gradually than the abrupt change inherent in the current limits. I explain in paragraph 12 below why this smoothing out the change in the shoulder month limits will positively impact the ability of fish to move throughout the lake.

9. Fourth, in prior years where May temperatures were warmer than expected, no appreciable harm was later observed during the summer months that followed. We specifically looked at whether increasing temperatures at the edge of the mixing zone during May via higher thermal standards would necessarily result in warmer temperatures throughout the remainder of the summer. We found that it would not. Attachment 5 is Figure 2-17 of the ASA Report and is a plot of total degree days accumulated during May versus the total degree days during the subsequent June to October for each of the years 1997 through 2007. The data show there is no correlation between warmer May temperatures at the edge of the mix zone, and temperatures for the remainder of the summer, as measured in degree days. Ambient temperatures and meteorological conditions during the summer months, in addition to the capacity of this artificial cooling lake to hydrodynamically assimilate heat and dissipate it through surface heat exchange with the atmosphere, likely are the determinative factors for summer lake temperatures. Heat dissipation to the atmosphere is influenced by ambient air temperature, relative humidity, wind

and wave action, and solar radiation. Daily variations in these factors will counteract heat retention and eventually control the heat content of the lake through time.

10. In addition, we have also analyzed dissolved oxygen ("DO") data at varying depths collected by SIUC during 2000, 2001, 2003, 2004, 2005 and 2006 to evaluate whether dissolved oxygen cumulatively decreased from May through October in Coffeen Lake. Decreased dissolved oxygen levels often are biotically and abiotically associated with higher lake temperatures. The results of this analysis are attached to this testimony as Attachment 6. The graphs show the water depth at which a DO concentration of 5 mg/l was first encountered during each weekly SIUC survey in each of the two segments of Coffeen Lake within its cooling loop. The graphs illustrate appreciable weekly variability from May through October in each of the years studied. Critically, they do not demonstrate a consistent, cumulative decrease in DO as the summer months progress, (this would have appeared as continually decreasing depths on the graphs). Accordingly, an incremental increase in thermal discharge during May or October should not have a cumulative impact on levels of DO at depth during the other months. As discussed above for water temperature, meteorological conditions can modify DO on a daily basis, which accounts for the weekly variability in DO observed in the graphs.

11. Accordingly, there should be no adverse effect on the fishery by the proposed increase in the thermal standard for May and October.

<u>SIUC Conclusions Regarding the 1999, 2001 and 2002 Fish Kills</u>

12. Before turning to the prospective assessment, I would like to address the matter of historic fish kills identified in SIUC reports. SIUC studies identified three, possibly four, thermally-induced fish kills during the 10 years it studied the impact of the discharge on the lake. According to SIUC, two, possibly three, of these instances occurred in situations where sudden

changes in water temperature resulted in entrapment of fish in coves near the discharge point. These occurred in 2001 and 2002. SIUC indicated a third instance may have occurred in 2005. SIUC noted that a sudden increase in water temperature in the mixing zone main channel can lead to entrapment of small numbers of fish in coves in near the mixing zone. If high temperatures persist in the main channel long enough, water temperatures in these coves will increase until they are similar to those in the main channel leading to what SIUC called "eroded fish habitat." Again, SIUC identified two (2001, 2002) and possibly a third such event (2005) in the 10 years of its study of the lake. SIUC linked these phenomena to fish becoming trapped in refuges near the discharge because the fish kills were short-lived events that did not continue even where similar conditions persisted for prolonged periods. When temperatures increase in the eastern discharge arm of the lake, fish move away from the eastern arm toward the western arm where temperatures are typically 10 to 15 degrees cooler. The proposed modification to the thermal limit could eliminate abrupt changes in water temperatures in the area near the discharge, and would more realistically reflect the natural thermal environmental where temperatures would change more gradually, allowing fish time to acclimate to the warmer temperatures. Modifying the thermal limit for May to provide a less abrupt change in the thermal discharge may result in even fewer incidents of entrapment.

13. Apart from entrapment, SIUC did identify one other instance of a thermally induced fish kill. In July 1999, abnormal meteorological conditions (*e.g.*, prolonged heat and humidity, reduced wind/waves, and overcast sky), coupled with unusually warm water temperatures, led to a limited fish kill (*e.g.*, approximately 200 or fewer fish recovered). However, SIUC also noted fish kills arising from extreme weather conditions can be expected in this region of the country, whether in cooling or ambient lakes. In the case of the July 1999

incident, for example, similar fish kills were reported at other southern Illinois lakes, including ambient lakes. At least one of these fish kills was noted in the SIUC Reports. More important, these kinds of extreme weather conditions are not typical in May and October. Indeed, of the three or four thermally induced incidents described in the 10 years of studies done by SIUC, all occurred in July or August.

14. To put these fish kills in perspective, SIUC reported that the largemouth bass mortality from the 1999 incident represented the death of only 1 percent of the population. This percentage is insignificant as compared to the estimated 42 percent average total annual mortality rate that was recorded in Coffeen Lake from 1997 through 2004 that SIUC identified in the same report.

15. Since 1999, the Station has adopted several measures to avoid thermal conditions similar to those that might have led to the 1999 fish event. These measures include installation of a 70-acre supplemental cooling basin in 2000 and a 48-cell helper cooling tower structure in 2002, as well as intensive monitoring of water temperatures at several locations within the cooling loop. Since the installation of these enhancements, SIUC reported no cases of thermally-induced fish kills, other than the possible 2005 event.

Prospective Assessment

16. I would like to now turn to a summary of the prospective assessment. The prospective assessment incorporated existing data on the lake's thermal environment and the thermal requirements of its fish populations as reported in the literature. It assessed the thermal tolerances and requirements of the three RIS and compared them to the water temperatures that could exist during May and October under the proposed thermal standards.

17. The prospective assessment concluded that the fish species would adapt to the warmer May and October environments by finding many areas and depths within the lake with suitable temperatures and dissolved oxygen concentrations.

18. Studies done by ESE (1995) and Rush of SIUC (2000) indicate that fish indeed increase their movement in the summer, moving away from the warmer discharge area toward cooler areas of the lake, where temperatures are within their temperature tolerance. As I previously noted, historic thermal data show water temperature variation between the western and eastern arms of the lake range 10 to 15 degrees. Similarly, vertical profiling has demonstrated that temperatures at the edge of the mixing zone can be up to 18 degrees cooler at depth than at the near-surface in May, and 13 to 14 degrees lower in October.

19. In addition to the historic thermal data, we also utilized the results of thermal modeling done by Sargent & Lundy to evaluate future potential near-worst case operating conditions. The modeling done by Sargent & Lundy also demonstrated that warmer May temperatures would not necessarily result in a carryover effect into later months. Attachment 7 is an enlargement of Figure 4-4 from our report. This figure plots predicted mean daily water temperatures at the edge of the mixing zone under maximum station operation from mid-April to mid-June, and mid-September to mid-November under the existing and proposed thermal standards for May and October, while keeping the existing standards for the other months. As expected, predicted mean daily temperatures increase at the start of May under the proposed standards but quickly begin to converge by mid-June. Similarly, at the start of October the predicted mean daily temperatures increase under the proposed standards but converge again with the current temperatures by early November. This modeling shows that increasing the

thermal limits in May would not result in a carry-over effect into the summer months for the reasons I discussed earlier.

Conclusions of The Assessment

20. In summary, I note the following conclusions:

a. The studies conducted in Coffeen Lake provide evidence that fish behaviorally adapt to the warmest temperatures in the lake by avoiding them and seeking areas with cooler temperatures, such as outside the eastern discharge arm, or at greater depths when suitable DO concentrations are present, as in May.

b. Diversity in water temperatures exist in the eastern and western arms of Coffeen Lake, and at depth, providing adequate refuge; such temperature diversity would be advantageous for all fish species. Water temperatures also follow a daily cycle, with temperatures in the late morning frequently 3-4 degrees Fahrenheit lower than the high daily temperature occurring in late afternoon or early evening. This daily temperature cycle can provide opportunity for recovery by fish from warm temperatures. It is also possible that fish populations in Coffeen Lake have evolved physiologically or genetically to adapt to the higher summer temperatures.

c. There are no data that indicate that the proposed modifications to thermal limits in May and October will have a cumulative impact and result in warmer summer month lake temperatures or decreased DO levels in summer months or other months throughout the year. Further, water temperatures and dissolved oxygen levels that have been associated with past fish kills would not occur during May and October even under the proposed revised thermal limits. Accordingly, fish kills are unlikely to result from the proposed revised thermal limits.

d. The biological data (growth, body weight, size, etc.) of RIS indicate that Coffeen Lake is supporting a healthy fishery and that it would continue to do so under the proposed May and October thermal limits. Limited fish kills, as observed infrequently in the past, have had no detectable long-term effect on the fish populations. In fact, SIUC has estimated that the July 1999 fish kill for largemouth bass resulted in a short-term loss of approximately 1 percent of the population of this species, compared to a typical annual mortality (combined natural and fishing mortality) of 47 percent.

e. The viability of the RIS populations and their frequently demonstrated exemplary growth and condition attest to the conclusion that the lake's thermal regime is also suitable for lower trophic levels that provide forage for these top consumers.

f. The fish and wildlife that abound in and around Coffeen Lake provides a vibrant recreational resource for public use and indicates the general environmental quality and acceptability of the lake.

g. The proposed modification of the May and October thermal limits is not expected to adversely affect the health of the lake community and will be environmentally acceptable.

Meeting with the Illinois Department of Natural Resources

21. On July 15, 2008, I attended a meeting at the Springfield Headquarters of IDNR to discuss the relief Ameren is seeking in this proceeding as well as the ASA Report on the general health of the lake. Representatives of Ameren and IDNR were in attendance.

22. One of the outcomes of the July 15, 2008 meeting was a request by Ameren that ASA prepare the outline for a study that would monitor the status of key fish populations in the

Lake and document the long-term effects, if any, of the revised thermal standards for the months of May and October on these populations.

23. Assuming Ameren's request for relief is granted, the Company and DNR have discussed developing study plans that investigate the ability of fish to avoid exposure to stress by seeking preferred temperatures within the Lake's environment. IDNR annually monitors several fish species in the Lake and has created an extensive long-term database. The study will be designed to complement and utilize the IDNR data to the extent possible. Studies will be conducted under strict quality assurance protocols including Standard Operating Procedures to ensure reliable data collection.

24. The study will also evaluate suitable fish species for Ameren's cooling lakes in Illinois. In that regard, Ameren has committed to implement, in conjunction with IDNR, a three-year fish stocking pilot study at the Lake. This study includes Ameren's agreement to financially support a three-year pilot stocking program to introduce suitable species, such as the blue catfish, to help IDNR better assess the long term nature of maintaining a viable, recreational, resource.

# Attachment 1

# James B. McLaren

**Senior Scientist**

Dr. McLaren has over 30 years of consulting experience in the aquatic sciences. His clients have included the electric utility, oil and gas, and chemical industries, as well as international shipping, municipalities and state and federal regulatory agencies. He has served as a principal, office manager, technical director, project manager, and expert witness. He has been responsible for study design, data analysis, report preparation, and management of analytical and field staff.

## Education

Ph.D.; Penn State University; Zoology; 1979
M.S.; Penn State University; Zoology; 1970
B.S.; Cornell University; Fisheries Science; 1968

## Professional Affiliations

American Fisheries Society • International Association for Great Lakes Research

## Experience

***CWA §316(a) and (b)*** – Technical director, project manager or senior staff member on several comprehensive fish and shellfish entrainment and impingement impact studies under §316(a) or §316(b) of the Clean Water Act for power plants located in New York, New Jersey, Delaware, Illinois, Missouri, Minnesota, Wisconsin, North Dakota, Arizona, New Mexico, Texas, North Carolina, and South Carolina. Examples of water bodies involved include the Great Lakes (Superior, Michigan, Erie, and Ontario) and Niagara River; the New York Finger Lakes; the Hudson and Delaware river estuaries; Galveston Bay; major rivers such as the Mississippi, Illinois, Missouri, and Wabash in the Midwest; the Catawba, Broad, Dan, Yadkin, Saluda, and Seneca river systems in the Carolinas; and numerous constructed cooling reservoirs in the Midwest and Southwest. Recently prepared impingement mortality and entrainment (IM&E) study plans under the new Phase II 316(b) Rule for over 30 facilities, and providing supervision of current IM&E studies at 11 facilities. Prior to the new 316 Rule, prepared §316(a) and (b) demonstrations and documents for several generating facilities in New York and New Jersey, including the landmark Hudson River multiplant impact studies in the mid-1970s. Prepared evaluations of alternative intake designs, technologies, and operations of cooling water intakes located at facilities on Lake Erie, the Hackensack River and the Delaware River for NPDES permit renewals. Evaluated alternative intake screen technologies, such as fine-mesh Ristroph traveling screens or dual-flow Beaudrey-type traveling screens and fish return systems at power plants on Lake Ontario and Lake Erie, by testing impinged fish recovery and survival.

***Aquatic ecology and resource management*** – Designed and supervised several extensive aquatic surveys of water bodies such as the 140-mile Hudson River estuary, the New York Harbor and Long Island marine waters, the southwestern shoreline of Lake Ontario, and riverine systems of New York State. Served as technical advisor to the New York District of the Army Corps of Engineers on potential aquatic resource impacts from the construction of the proposed Westside Highway Project in Lower Manhattan under §404. Conducted a two-year seasonal survey of the distribution, abundance and biological characteristics of yellow perch in southern Lake Michigan to investigate the needs for closure of the commercial fishery by the Illinois Department of Natural Resources. Managed studies on the downstream migration of adult American eels in the vicinity of the St. Lawrence-FDR Hydroelectric Project. Conducted fish habitat assessments using Instream Flow Incremental Methodology (IFIM) and innovative habitat enhancement techniques.

***FERC Permitting*** — Prepared Initial Consultation Documents, Exhibit E's and other portions of FERC license application renewals for hydroelectric facilities in the Northeast and Pacific Northwest. Designed and directed studies on the impacts of turbine entrainment and fish mortality at hydroelectric developments on the Raquette and Genesee rivers, New York utilizing intake and tailrace netting and fixed location hydroacoustics. Assessed riverine impacts resulting from the operation of numerous hydroelectric developments in the Northeast and Pacific Northwest, involving water and habitat quality, flow routing and impoundment level fluctuations. Assisted in the preparation of a FERC third-party EIS for a proposed 275-mile natural gas pipeline to be routed through West Virginia, Virginia and North Carolina.

***Natural resource damage assessment*** – Served as consultant to the International Tanker Owner Pollution Federation (ITOPF), the shipping industry and their insurers, and oil and railway companies to manage the Natural Resource Damage Assessment process and to coordinate with state and federal natural resource trustees for approximately 20 accidental hazardous materials spills or ship groundings throughout the East and Gulf Coasts, central U.S. and its territories. Negotiated settlements for natural resource damages occurring from numerous marine oil or chemical spills and land-based oil pipeline ruptures, frequently relying on the application of habitat restoration techniques to offset the losses of natural resource services.

***Aquatic toxicology*** -- Laboratory Director and Project Manager for quarterly and annual toxicity monitoring of municipal and industrial wastewater treatment effluents under SPDES permit requirements, involving EPA and New York State Bioassay Monitoring guidelines. Monitored and evaluated impacts from emergency pumping of water from a collapsed western New York salt mine into the Genesee River, involving water quality and biological sampling, and intensive toxicity testing. Designed and implemented an investigation of sediment contamination of a stream that received fly ash and bottom ash from a coal-fired steam electric generating plant, using the TRIAD approach, which simultaneously analyzed sediment chemistry, toxicology, and macroinvertebrate community effects. Conducted an investigation of the cause of a fish kill in a water storage pond at a gypsum facility, as related to surface water runoff and application of herbicides in adjoining agricultural fields. Task Leader for an investigation and review of current organizational structure and practice of state regulatory agencies for water quality monitoring and watershed management in the US on behalf of the Ontario Ministry of the Environment.

**Selected Publications and Presentations**

McGrath, K.J., J.W. Dembeck IV, J.B. McLaren, A.A. Fairbanks, K. Reid, and S.J. Cluett. 2003. Surface and midwater trawling for American eels in the St. Lawrence River. In: D.A. Dixon (ed.) Biology, Management, and Protection of Catadromous Eels. American Fisheries Society Symposium 33: 307-313.

McLaren, James B. and L. Ray Tuttle, Jr. 2000. Fish survival on fine mesh traveling screens. Environmental Science and Policy 3 (2000): S369-S376.

McLaren, James B., Thomas H. Peck, William P. Dey, and Marcia Gardinier, 1988. Biology of Atlantic tomcod in the Hudson River estuary. In: Barnthouse, L.W., R.J. Klauda, D.S. Vaughn, and R.C. Kendall (eds.) Science, Law, and the Hudson River Power Plants: A Case Study in Environmental Impact Assessment. American Fisheries Society Monograph 4.

Hoff, Thomas B., James B. McLaren, and Jon C. Cooper 1988. Stock characteristics of Hudson River striped bass. In: Barnthouse, L.W., R.J. Klauda, D.S. Vaughn, and R.L. Kendall (eds.) Science, Law, and the Hudson River Power Plants: A Case Study in Environmental Impact Assessment. American Fisheries Society Monograph 4.

Klauda, Ronald J., James B. McLaren, Robert E. Schmidt, and William P. Dey, 1988.Life history of the white perch in the Hudson River, New York. In: Barnthouse, L.W., R.J. Klauda, D.S. Vaughn, and R.L. Kendall (eds.) Science, Law, and the Hudson River Power Plants: A Case Study in Environmental Impact Assessment. American Fisheries Society Monograph 4.

McLaren, James B., John R. Young, Thomas B. Hoff, Irvin R. Savidge, and William L. Kirk 1988. Feasibility of supplemental stocking of age-0 striped bass in the Hudson River. In: Barnthouse, L.W., R.J. Klauda, D.S. Vaughn, and R.L. Kendall (eds.) Science, Law, and the Hudson River Power Plants: A Case Study in Environmental Impact Assessment. American Fisheries Society Monograph 4.

McLaren, James B., Thomas B. Hoff, Ronald J. Klauda, and Marcia N. Gardinier. 1988. Commercial fishery for striped bass in the Hudson River, 1931-1980. In: C. Lavett Smith (ed.) Fisheries research in the Hudson River. Hudson River Environmental Society. State University of New York Press. Albany. pp. 89-123.

McLaren, James B., J.C. Cooper, Thomas B. Hoff, and V. Lander. 1981. Movements of Hudson River striped bass. Trans. American Fisheries Society 110 (1): 158-167.

Klauda, Ronald J., William P. Dey, Thomas B. Hoff, James B. McLaren, and Q.E. Ross. 1980. Biology of Hudson River juvenile striped bass. In: Proceedings of the Fifth Annual Marine Recreation Fisheries Symposium. Henry Clepper (ed.) Boston, Massachusetts, March 27-28, 1980.

Smith, C.E.., T.H. Peck, Ronald J. Klauda, and James B. McLaren. 1979. Hepatomas in Atlantic tomcod *Microgadus tomcod* (Walbaum) collected in the Hudson River estuary in New York. J. Fish Disease. 2(4): 313-319.

McLaren, James B. 1979. Comparative behavior of hatchery-reared and wild brown trout and its relation to intergroup competition in a stream. Ph.D. Dissertation. Pennsylvania State University. 163pp.

Campbell, K.P., Irvin R. Savidge, William P. Dey, and James B. McLaren. 1977. Recent power plant impacts on the Hudson River striped bass (Morone saxatilis) population. Proceedings of the Conference on Assessing the Effects of Power Plant Induced Mortality on Fish Populations. Presented at symposium, Gatlinburg, Tennessee.

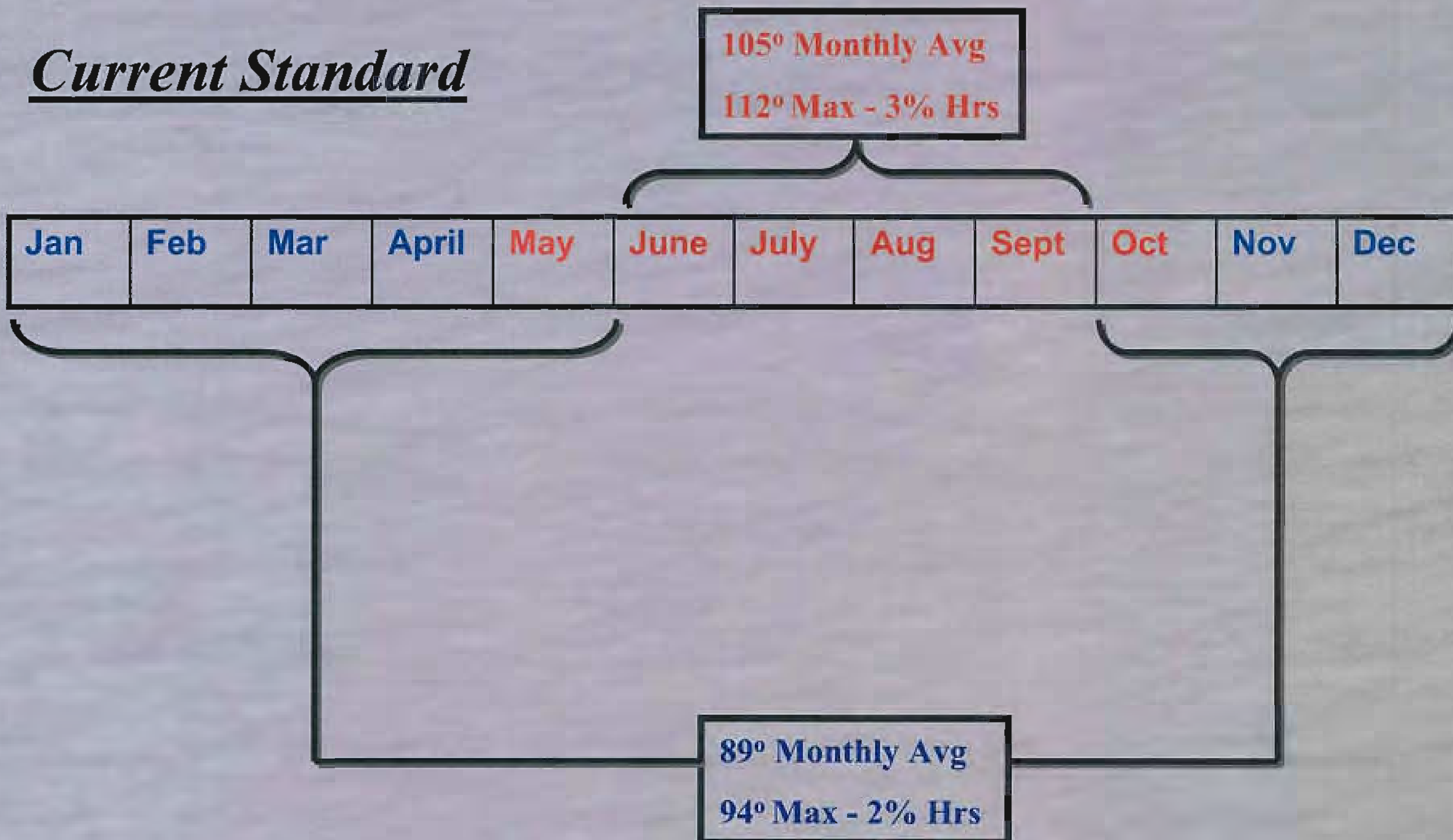
Raleigh, R.F., James B. McLaren, and D.R. Graff. 1973. Effects of topical location, branding techniques and changes in hue on recognition of cold brands in centrarchid and salmonid fish. Trans. American Fisheries Society 102 (3): 637-641.

# Attachment 2

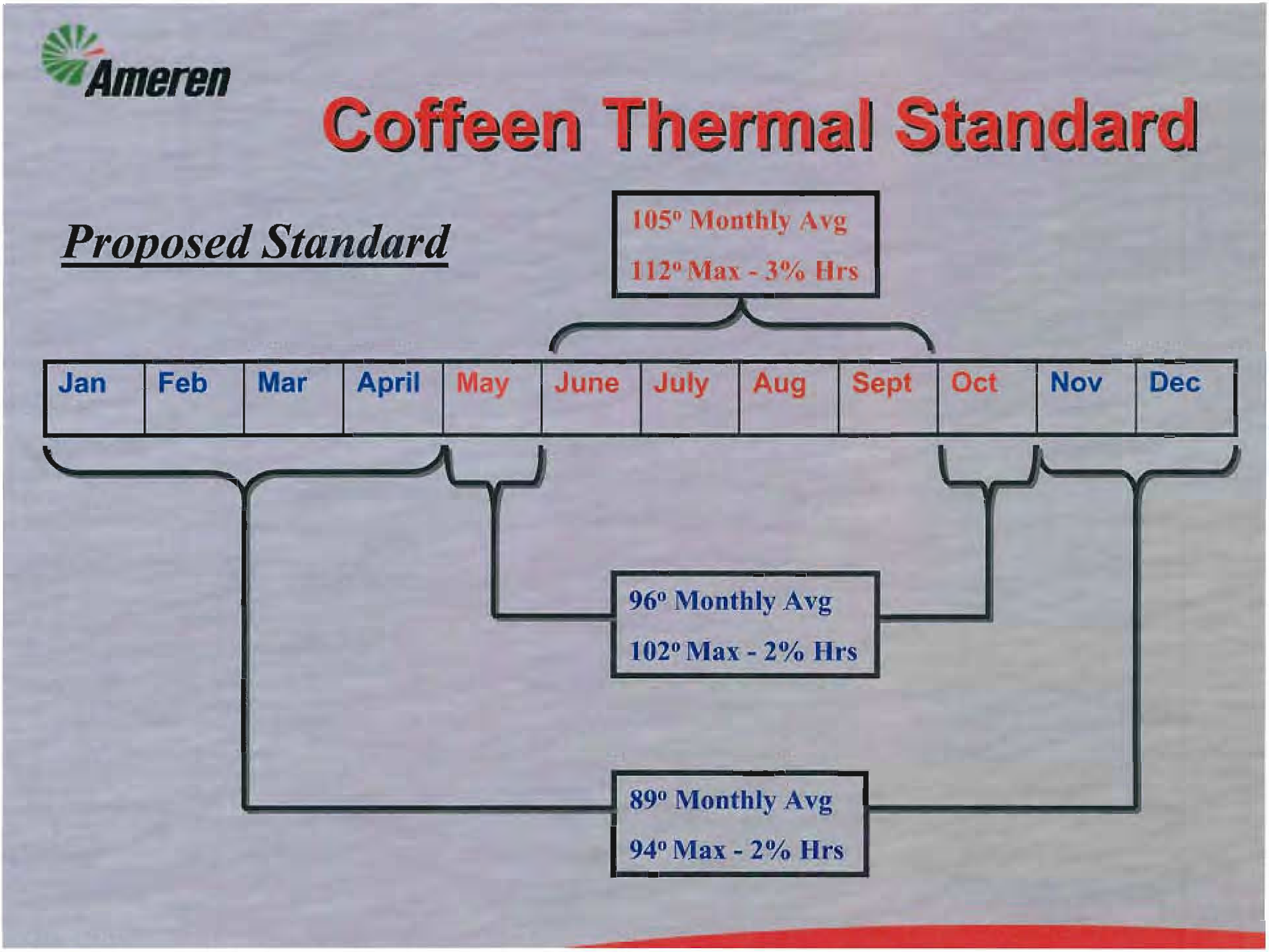
Ameren

# Coffeen Thermal Standard

## *Current Standard*



# Attachment 3


Ameren
Coffeen Thermal Standard
Proposed Standard
105° Monthly Avg
112° Max - 3% Hrs
Jan
Feb
Mar
April
May
June
July
Aug
Sept
Oct
Nov
Dec
96° Monthly Avg
102° Max - 2% Hrs
89° Monthly Avg
94° Max - 2% Hrs

# Attachment 4

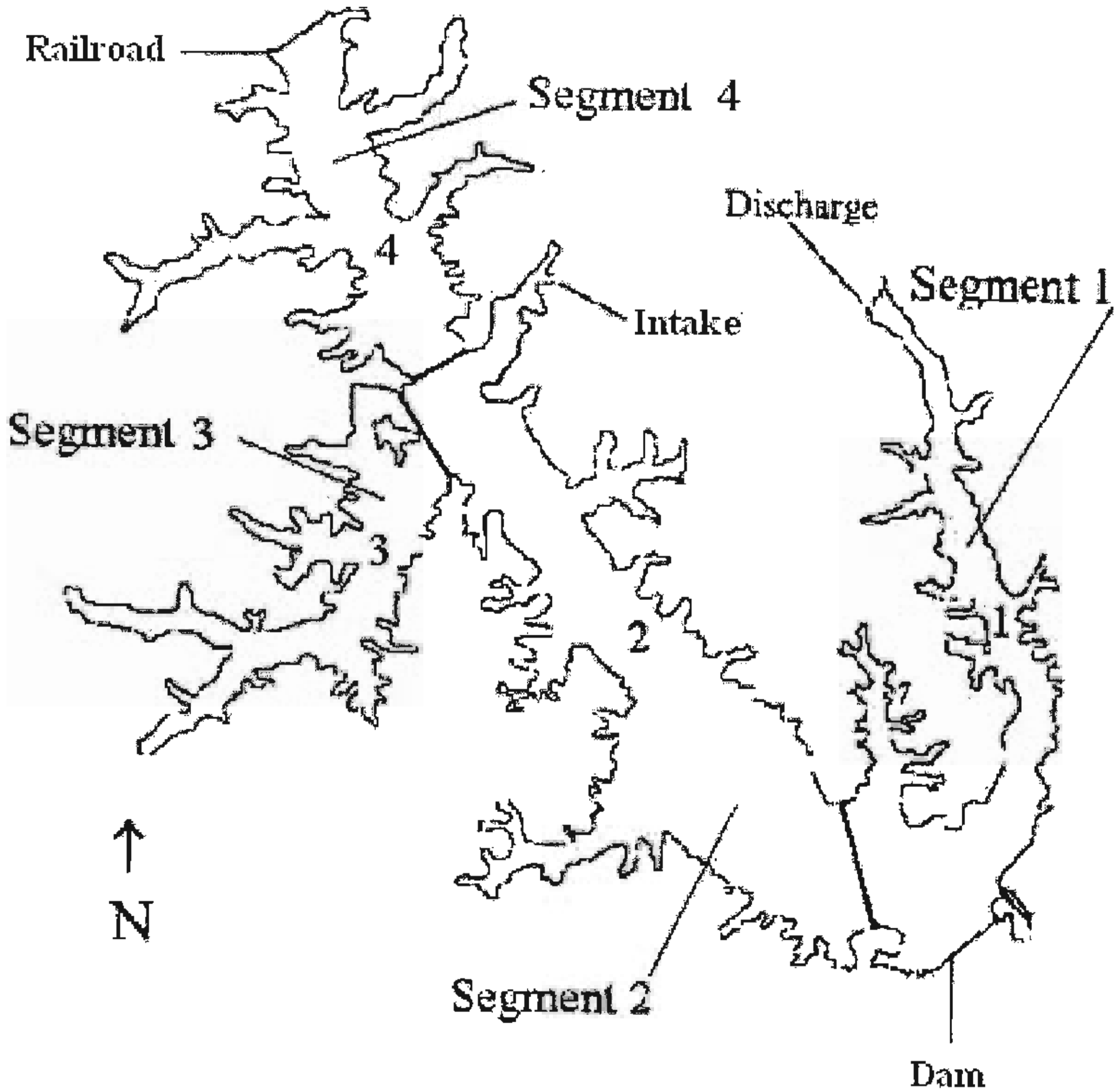



**Figure 2-4 (Revised). Map of Four Lake Segments Used by SIUC for Sampling Water Temperature and Dissolved Oxygen Concentrations (from Brooks and Heidinger 2006). Sampling Station Locations Depicted by Numerals 1-4**

# Attachment 5

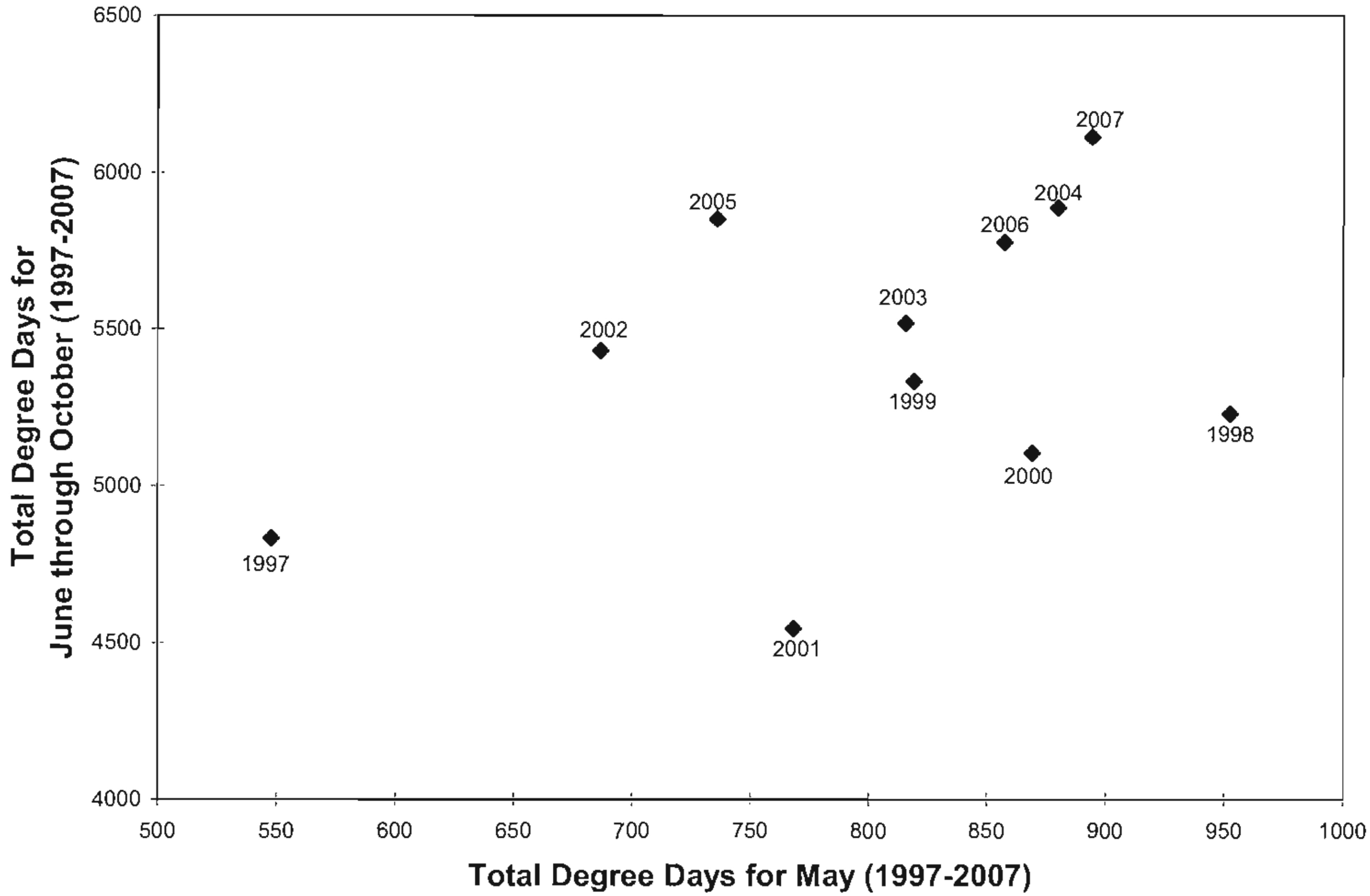
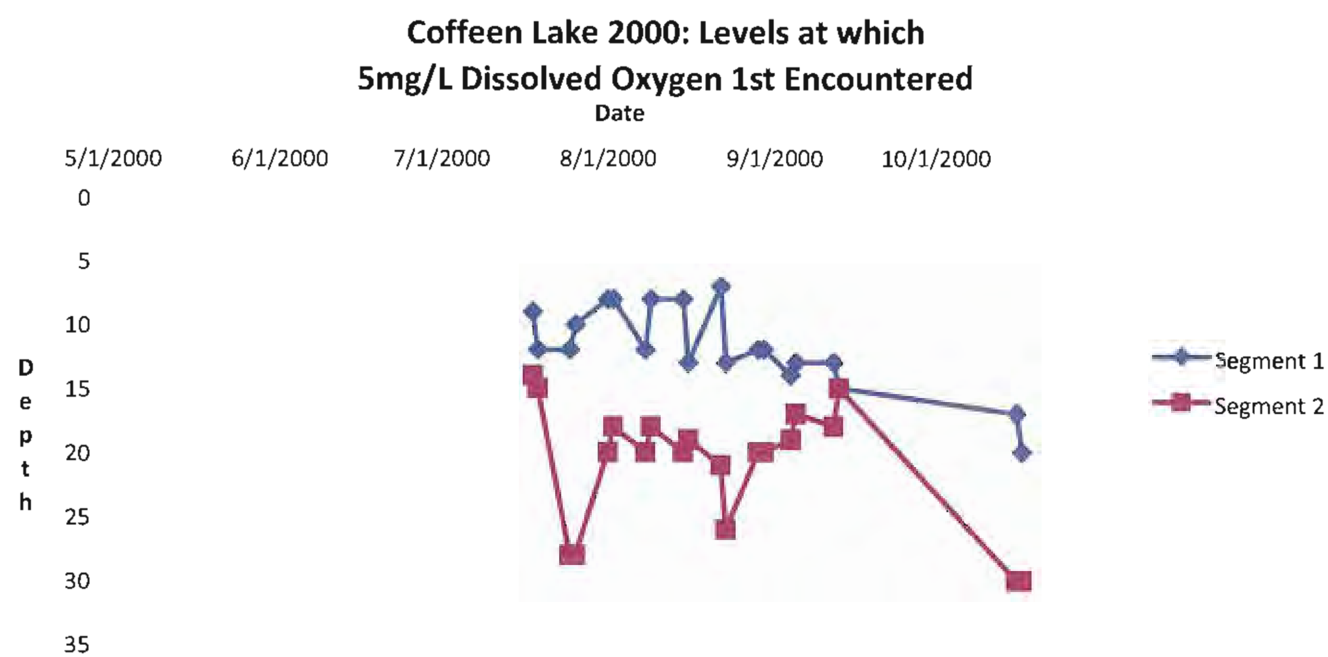


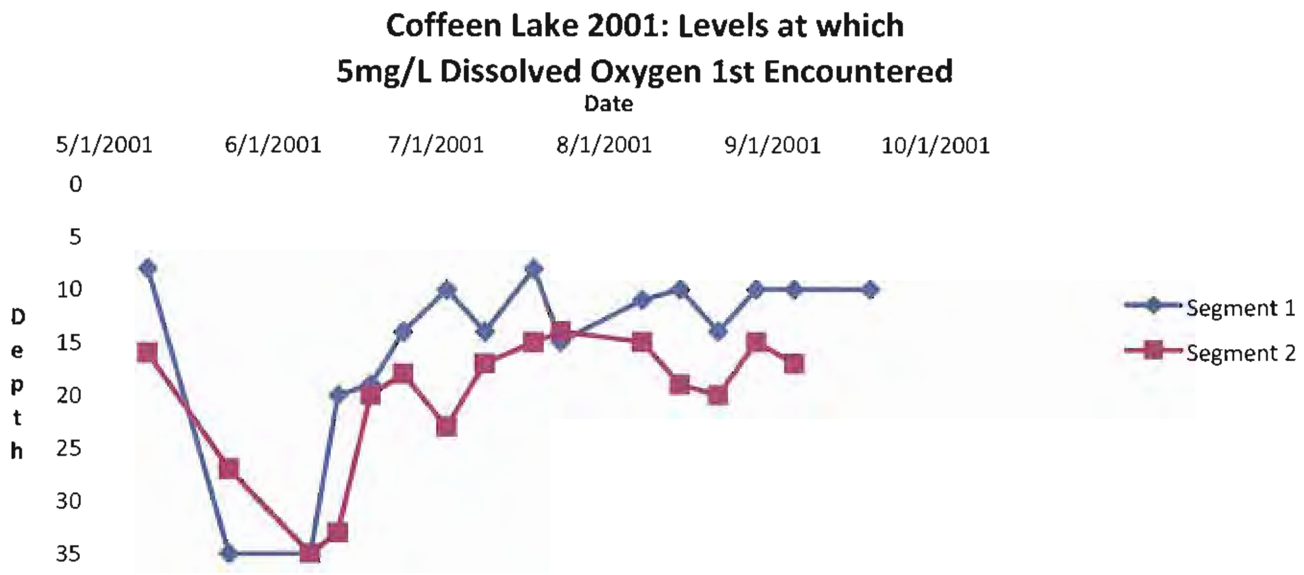

Figure 2-17. Plot of Total Degree-Days Accumulated during May and during the Subsequent June-October, 1997-2007

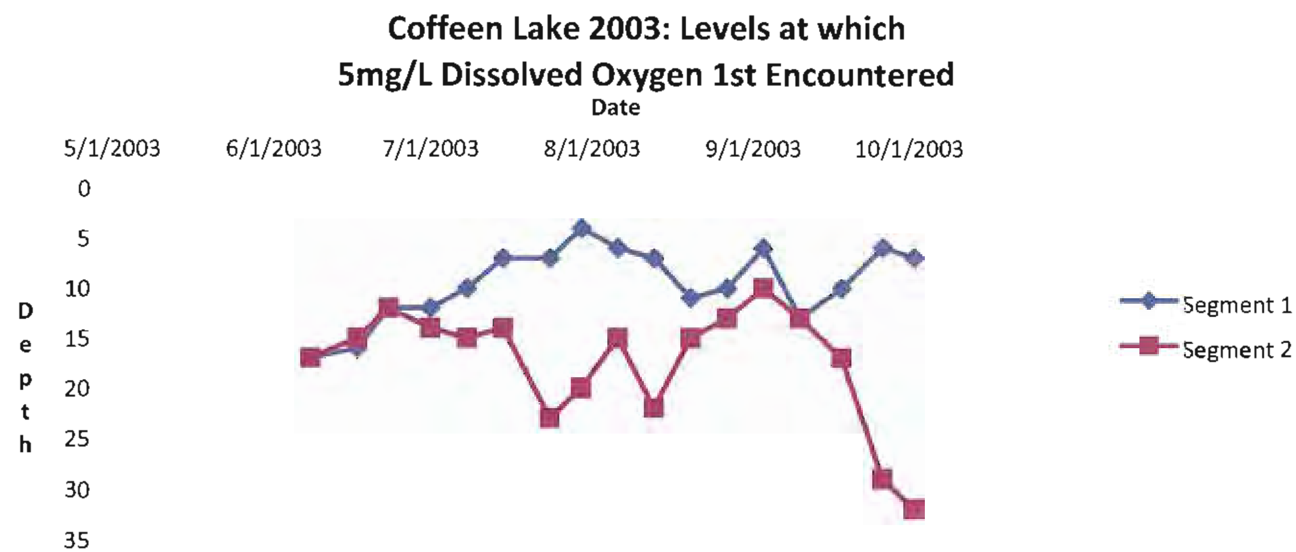
# Attachment 6

Electronic Filing - Received, Clerk's Office, May 12, 2009



Electronic Filing - Received, Clerk's Office, May 12, 2009




Coffeen Lake 2003: Levels at which
5mg/L Dissolved Oxygen 1st Encountered
Date
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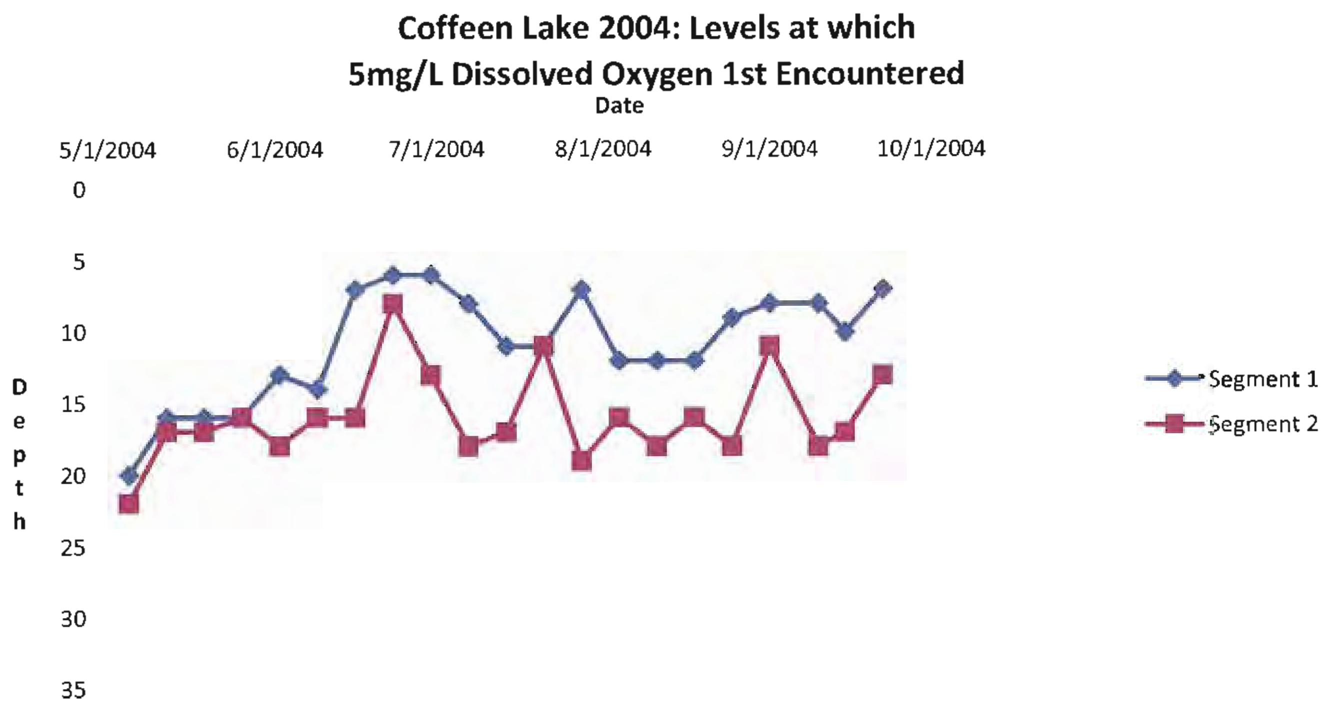
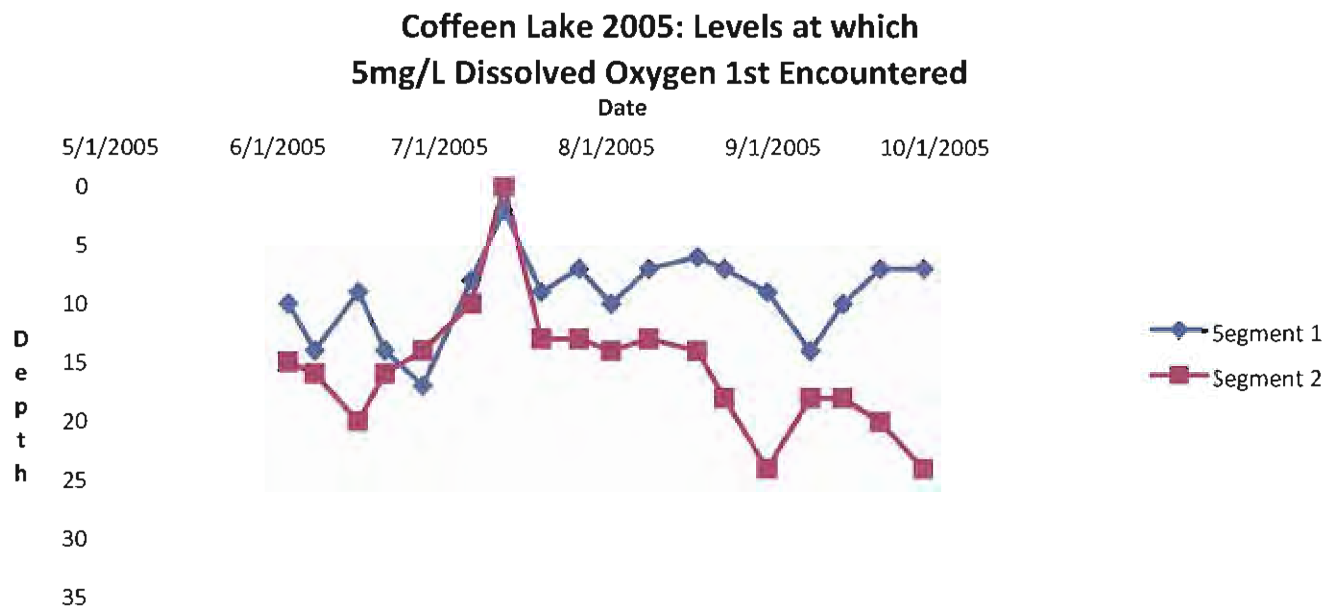
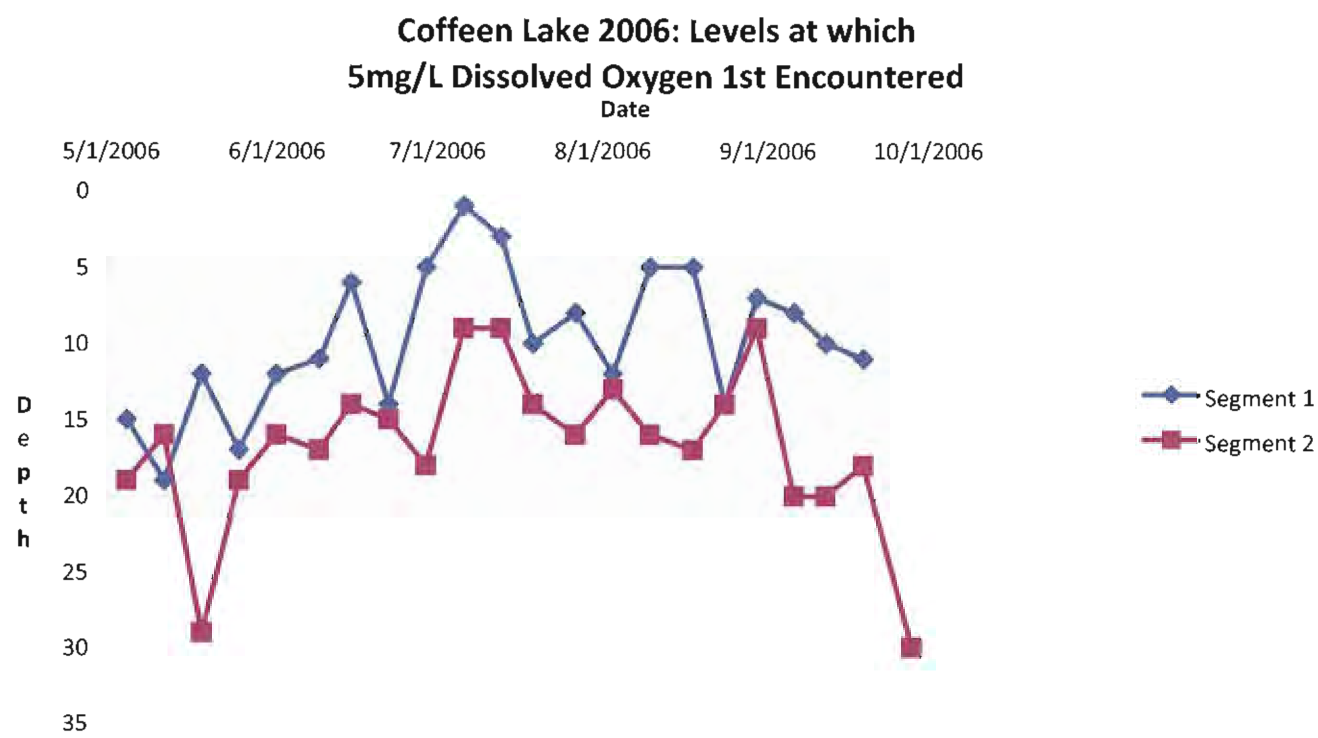
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
0
5
10
15
20
25
30
35
Depth
Segment 1
Segment 2


Coffeen Lake 2004: Levels at which
5mg/L Dissolved Oxygen 1st Encountered
Date
5/1/2004
6/1/2004
7/1/2004
8/1/2004
9/1/2004
10/1/2004
0
5
10
15
20
25
30
35
Depth
Segment 1
Segment 2


Coffeen Lake 2005: Levels at which
5mg/L Dissolved Oxygen 1st Encountered
Date
5/1/2005
6/1/2005
7/1/2005
8/1/2005
9/1/2005
10/1/2005
0
5
10
15
20
25
30
35
Depth
Segment 1
Segment 2


Coffeen Lake 2006: Levels at which
5mg/L Dissolved Oxygen 1st Encountered
Date
5/1/2006
6/1/2006
7/1/2006
8/1/2006
9/1/2006
10/1/2006
0
5
10
15
20
25
30
35
Depth
Segment 1
Segment 2

# Attachment 7

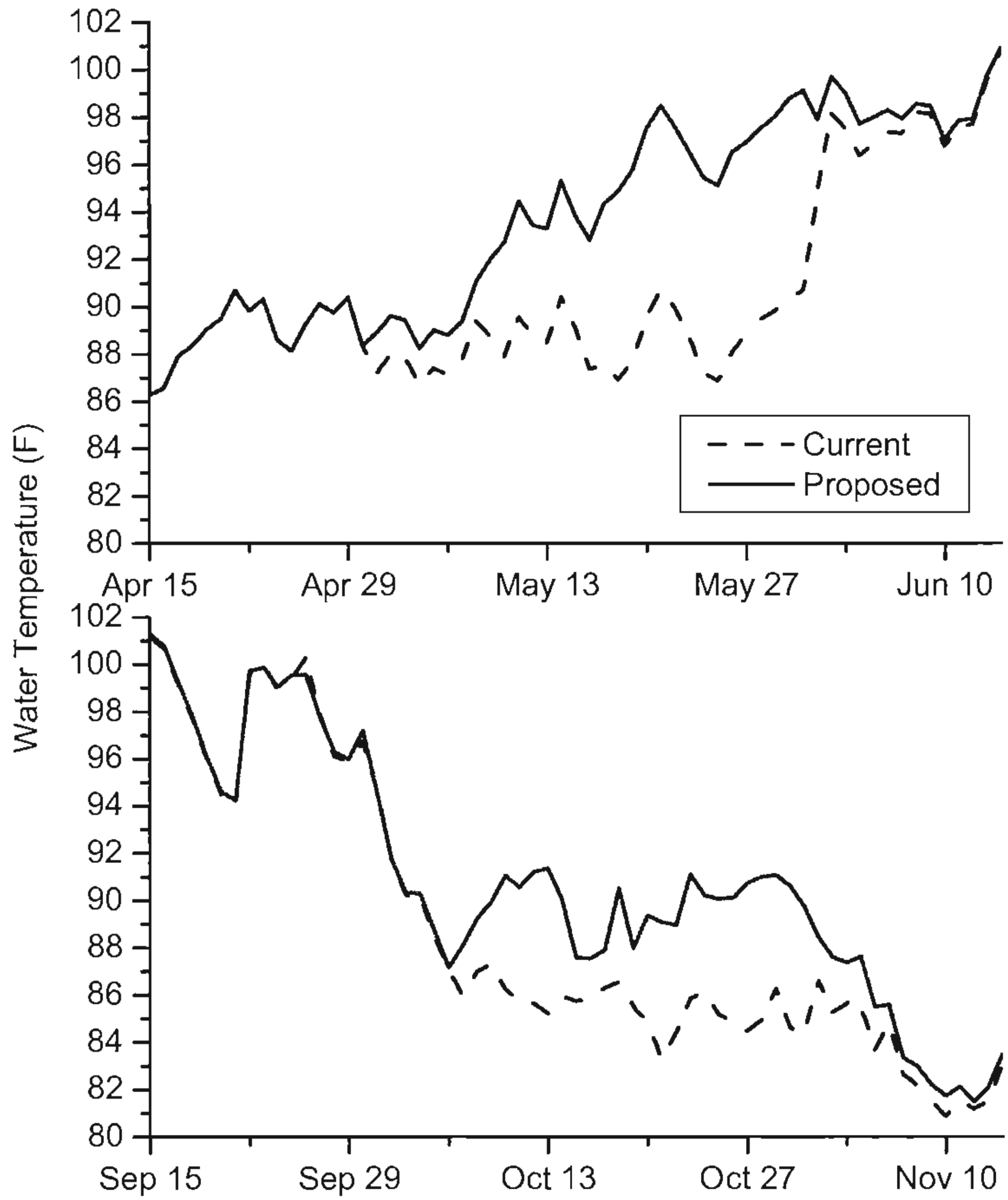



**Figure 4-4. Predicted Mean Daily Near-Surface Water Temperatures at the Mixing Zone Boundary under Current and Proposed Thermal Standards for May and October using 1987 Meteorological Conditions**