Exhibit 11

Final Report: Mussel Bed Monitoring Results

Exelon Nuclear

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
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PM-07-011

June 28, 2007

Mr. Roger Callaway
Illinois Environmental Protection Agency
Compliance Assurance Section
Bureau of Water – Water Pollution Control
1021 North Grand Avenue East, MC#19
Springfield, Illinois 62794-9276

Subject: Final Report dated June 2007 – Results of Unionid Mussel Monitoring in 2006 near Quad Cities Nuclear Station, Mississippi River Miles 504 to 507.5

References: IEPA Order 07-01 dated July 19, 2006 related to Quad Cities Nuclear Power Station Provisional Variance Request Letter dated July 17, 2006

IEPA Order 07-03 dated August 2, 2006 related to Quad Cities Nuclear Power Station Provisional Variance Request Letter dated August 1, 2006

Dear Mr. Callaway:

Special Condition "C" of the Agency's Order 07-01 dated July 19, 2006 and Special Condition "C" of the Agency's Order 07-03 dated August 2, 2006 regarding the provisional variances for Quad Cities Station require the station to conduct a mussel study specific to the provisional variances and to submit the documentation for the mussel study to the Agency and the Dept. of Natural Resources within 60 days after completing the survey. Quad Cities Letter PM-06-020 transmitted the summary of mussel study that took place August 3-5, 2006. Quad Cities Letter SVP-06-109 transmitted the summary of mussel study that took place September 20-25, 2006.

Attached is the final report from Ecological Specialists Inc. of the Unionid Mussel Monitoring near the Quad Cities Nuclear Station that was performed August 3-5, 2006 and September 20-25, 2006. The final report concludes the elevated water temperature downstream of the Quad Cities Station discharge did not cause acute mortality to mussels in either the Steamboat Slough Bed or the Cordova Bed to either adult or young mussels.

48 Pages

If you should have any questions regarding these study plans, please contact Vicki Neels at (309) 227-3200, Mark Stuhlman at (309) 227-2765, or John Petro at (630) 657-3209.

Very truly yours,

William R. Gideon
Plant Manager
Quad Cities Station

WRG/MS/jas

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Final Report: Results of Unionid Mussel Monitoring in 2006 near Quad Cities Nuclear Station, Mississippi River Miles 504 to 507.5, 2006

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ESI Project #06-008

June 2007

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Acknowledgements

Exelon Generation Company (Exelon) provided funds for this study. Mr. John Petro (Exelon) managed the project and Mr. Mark Stuhlman provided substrate data and intake and discharge records from Quad Cities Nuclear Station (QCNS). Mr. Petro and Mr. Stuhlman provided valuable comments on the report. Ecological Specialists, Inc. (ESI) was contracted by Exelon to monitor three unionid beds near their power plant. Ms. Heidi Dunn (ESI) was the principle investigator and primary author of this report.

Mr. Charles Howard (malacologist), Mr. Nathan Badgett (aquatic biologist), Mr. Michael Kaminski (aquatic biologist), Mr. Kendall Cranney (dive supervisor), Mr. Dewey Mason (diver), Mr. Brandon Jalali (diver) of ESI assisted with field studies. Mr. Belt (GIS analysis and map preparation) and Mr. Nathan Badgett (data management) assisted with the report.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

In July and August 2006, Illinois Environmental Protection Agency (Illinois EPA) granted Exelon Generation Company (Exelon) provisional variances that allowed additional excursion hours (beyond the annual allotment of 87.6 hours allowed by regulation) and higher thermal discharge limits for Exelon's Quad Cities Nuclear Station (QCNS). The provisional variances were needed to address periods of low Mississippi River flows and high ambient River temperatures experienced in the summer of 2006. As a condition to the issuance of the provisional variances, Illinois EPA ordered that Exelon monitor and study whether mussel beds near the QCNS discharge were impacted because of the thermal exposures authorized by the provisional variances. Exelon requested that Ecological Specialists, Inc. (ESI) conduct the monitoring program ordered by Illinois EPA.

Three freshwater mussel beds occur in the vicinity of QCNS: the Steamboat Slough Bed, located approximately 675 to 1125 m downstream of the end of the QCNS mixing zone; the Upstream Bed, located approximately 730 to 1130 m upstream of the QCNS diffuser pipe; and the Cordova Bed, located about 3000 m downstream of QCNS (Figure 1-1). ESI sampled and studied each of these mussel beds in 2004, 2005, and 2006. As shown on Table 1-1, since 2000, only in 2006 did QCNS use more than its annual allotment of 87.4 excursion hours; in 2001 and 2005, QCNS used about ½ of its allotted hours and in other years QCNS did not use any excursion hours. Thus, data and information concerning the mussel beds and unionid (freshwater mussel) community characteristics obtained by ESI in prior years (when significant numbers of excursion hours were not used by QCNS) provide important and valuable information on which to base an evaluation of possible impacts related to QCNS operations allowed by the 2006 provisional variances.

This report describes the methods employed to conduct the 2006 monitoring program and the results of the program, and assesses the extent to which QCNS operations under the 2006 provisional variances may have impacted mussel beds in the vicinity of the plant. The report concludes that the most notable adverse impacts that appear related to summer 2006 elevated temperatures and low river flows were observed in the Upstream Bed, which is located above the QCNS discharge and thus not effected by provisional variance operations. Overall, mussel community characteristics in the Steamboat Slough Bed, which is located immediately downstream of the QCNS discharge, remained fairly consistent with characteristics observed in prior years, suggesting that provisional variance operations did not adversely impact the bed. Changes in community characteristics that were observed appear more related to siltation that occurred due to low current velocity. Provisional variance operations effects on the Cordova Bed were unclear due to the added effect of zebra mussel infestation. Planned studies for 2007 and 2008 may clarify the effects of the provisional variance that occurred in the summer of 2006 on unionid communities.

2.0 Sampling and Analytical Methods

The Cordova, Upstream and Steamboat Slough beds were sampled August 3, 4, and 5, 2006, using the same methods ESI used in July 2005 to sample these same beds. The beds were also sampled from September 20 to 25, 2006, using the same methods ESI used in October 2005 to sample the beds. Density, age distribution, and observed mortality were estimated using quantitative sampling methods. Species richness was estimated from qualitative samples.

Quantitative samples were obtained as follows. Forty and ninety quantitative samples were collected in each bed in August and September 2006, respectively. Random quantitative sampling locations in each bed were generated using GIS and plotted on a Hummingbird Depthfinder with GPS matrix 76. Quantitative samples were obtained from each location by a diver who excavated all substrate material from a $0.25m^2$ quadrat to a depth of 15cm and placed the material into a bucket. The surface crew retrieved the material and rinsed it through 6mm and 12mm sieves. Substrate and debris were searched and unionids removed. All live unionids were identified to species, measured (length in mm), aged (external annuli count), and returned to the river. Freshly dead shells (FD – dead within the past year - : nacre shiny, hinge flexible, valves attached, with or without tissue) were identified, counted, and classified as young unionids (Ambleminae $\leq$5 years old; Lampsilinae and Anodontinae $\leq$3 years old). Weathered shells (WD: nacre chalky, hinge brittle, valves typically separated, periostracum intact) and subfossil shells (SF: periostracum eroded, valves separate, very chalky) were noted as present. Substrate characteristics (Wentworth scale) and sample retrieval depth (pneumometer) were recorded for each sample location.

The qualitative sampling approach was designed to collect as many individuals as possible, thereby increasing the probability of finding rare species (Kovalak *et al.*, 1986). For each qualitative sample, a diver searched for and collected unionids for 5-minute intervals at 20 and 25 locations throughout each bed in August and September, respectively. All live and fresh shells of unionids were identified, designated as adults or young unionids, and counted. Live unionids were returned to the river. The position of each qualitative sample location was recorded with a Trimble Pathfinder XP or Hummingbird depthfinder GPS. Additionally, surface and bottom water temperature, dissolved oxygen (DO) levels, and current velocity were recorded at each location.

The extent of infestation by zebra mussels in the beds was also observed and recorded during monitoring events.

In addition to obtaining water temperature data upstream and downstream of QCNS and over the mussel beds, temperature recorders were installed in the substrate at the north and south ends of the Steamboat Slough and Upstream beds to measure with greater precision the temperatures to which unionids actually were exposed. The substrate temperature recorders were installed on June 28 and removed on August 28, 2006. Temperature data from the Steamboat Slough recorders were obtained for the entire June 28 – August 28 time period. Data from the north Upstream Bed recorder were obtained for the June 28 - July 25 time period. Data from the south Upstream Bed recorder were obtained for the July 15 - August 28 time period.

Data regarding the mussel bed community characteristics were analyzed using Analysis of Variance methodology (ANOVA). The following parameters were analyzed: (1) differences in total, young and adult density; (2) differences in Ambleminae and Lampsilinae density; and (3) differences in density of freshly dead shells based on sampling dates and bed location. The data were Log (x+1) transformed for ANOVAs and significance level was deemed to be $p<0.05$ for all tests. Regression analysis was used to determine the slope (rate of increase) of species with respect to cumulative individuals, using the equation: cumulative species = slope * log (cumulative individuals). The intercept constant was set to zero, as no species are present if no individuals are collected.

3.0 Results and Discussion

3.1 River Flow Rates and Water and Substrate Temperatures

July and August 2006 river conditions included very low river flows and elevated ambient water temperatures (see Tables 3-1, 3-2, 3-3, and 3-4). River flow rates in July and August 2006 were lower than flow rates recorded in the corresponding months of 2000 through 2005 (Figure 3-1). Minimum flows recorded for June through October 2006 were: 42,023cfs in June; 19,780 cfs in July; 12,650 cfs in August; 21,239 in September; and 21,335 in October. Intake Bay temperatures were very high in July and August 2006. July intake temperatures averaged 81.9°F, and maximum temperature reached 91.1°F (see Table 3-2). As a consequence, QCNS used 117.25 excursion hours in July 2006 (see Table 3-2). The low flow and high temperature conditions persisted in August 2006; intake water temperature averaged 81°F and reached 91.6°F (see Table 3-3). As a result, an additional 105.5 excursion hours were used in August (see Table 3-3). In September 2006, intake water temperature declined to < 77°F and river flows were above 20,000 cfs; excursion hours were not used in September (Table 3-4). The total excursion hours used by QCNS in 2006 was 222.75.

Temperatures measured on substrate temperature recorders indicate that the substrate serves as a buffer on temperature. Average substrate temperature in the Upstream Bed was similar to, but less variable than the intake bay water temperature, as peaks and valleys were not as extreme in the substrate (Figure 3-2). During low flow conditions, experienced from July 31, 2006 through August 3, 2006, intake bay temperature reached a high of 91°F compared to high ambient river temperature of 88°F measured ¼ mile upstream of intake. The higher water temperatures recorded at the intake were due to recirculation of water discharged from the plant, which may occur during periods of extreme low river flows. Intake bay water temperatures ranged from 76.9°F to 91.1°F in July (a range of 14.2°) and averaged 81.9°F (see Table 3-2). Upstream bed substrate temperatures ranged from 77.4°F to 87.4°F (a range of 10°) and averaged 81.4°F. Similarly, in August, intake bay temperature averaged 81°F and ranged from 73.8 to 91.6°F, a range of 17.8°F (see Table 3-3). In contrast, Upstream bed substrate temperature averaged 80.6°F and ranged from 75.2 to 88.4°F, a range of 13.2°F (see Table 3-3). The difference between the intake bay and Upstream Bed substrate temperature averaged 1.1°F and 1.2°F cooler in July and August, respectively. The minimum Upstream Bed substrate temperature was equal to or 0.2°F warmer than the intake bay water temperature, while maximum Upstream Bed substrate temperature was cooler than intake bay water temperature by 2.6°F and 3.9°F in July and August, respectively.

Downstream of the QCNS discharge, maximum calculated water temperatures in July and August ranged from 77 to 96°F (a range of 19°F), and averaged 85.6° and 84.4°F in July and August, respectively (see Tables 3-2 and 3-3). Substrate temperature measured in the north end of the Steamboat Slough bed during the same period ranged from 77.7°F to 91.4°F (a range of 13.7°F), and averaged 84.5 and 83.6°F in July and August, respectively. In the south end of the Steamboat Slough bed, substrate temperatures ranged from 77.8 to 90.4°F (a range of 12.6°F), and averaged 84.3F° and 83.3F° in July and August, respectively. Steamboat Slough bed north end substrate temperature averaged 1.4 and 1.7°F lower than the calculated maximum river temperatures in July and August, respectively. The temperature difference between the calculated maximum river temperature and the Steamboat Slough substrate temperature ranged from 0 to 6.1°F lower in the north end and 0 to 6.3°F lower in the south end. Substrate temperature in the north end of

Steamboat Slough bed was most similar to measured downstream river temperature (see Figure 3-2 and Tables 3-2 and 3-3). The north end Steamboat Slough substrate temperature was 1.4°F less than to 2.5°F greater than the maximum downstream measured river temperatures.

Substrate temperatures in the north and south end of the Steamboat Slough bed were ≤1°F different (see Table 3-2 and 3-3). Maximum substrate temperature in the north end of Steamboat Slough bed was 4.2°F warmer than the Upstream Bed (see Figure 3-2 and Tables 3-2 and 3-3). Maximum south end Steamboat Slough substrate temperature was <4°F warmer than the Upstream Bed.

The differences between substrate temperatures and ambient water temperatures above the substrate may be important with respect to understanding the possible effects of elevated water temperatures on unionids. First, unionids buried in the substrate are not exposed to the more extreme water temperatures. Second, the buffering effect of the substrate allows unionids to acclimate to temperature changes.

3.2 Upstream Bed

The Upstream Bed habitat has remained consistent from one monitoring event to the other (July 2004, July and October 2005, and August and September 2006; Table 3-5). The Upstream Bed is located near the mouth of the Wapsipinicon River and upstream of QCNS diffuser discharge (see Figure 1-1). Substrate in the bed is a mixture of sand, silt, and clay, with sand being the major constituent (see Table 3-5). However, substrate constituents varied considerably among sample points (CV [coefficient of variation] near or exceeding 100 except for sand).

Depth from water surface within the sampled area ranged from 0.6 to 7.3m. DO levels were slightly below saturation during July 2004, October 2005, and September 2006, and supersaturated in July 2005 and August 2006. The high DO during July/August 2005 and 2006 is possibly a result of higher levels of aquatic flora associated with the low flow and high temperature conditions that occurred in both years. River current velocity averaged ≤0.5m/sec in July during all monitoring events, ranging from a low of 0 m/sec in August 2006 to 0.6m/sec in July 2004 and 2005 (see Table 3-1). Average current velocity over the Upstream Bed was lowest in 2006, averaging 0.04 and 0.1 m/sec in August and September, respectively.

Water temperature (measured approximately 0.5m above the substrate) on August 5, 2006 averaged 85.3°F, 4.9° higher than in 2005 and slightly higher (0.7°F) than the intake bay temperature (84.6°C) on the same day (see Tables 3-3 and 3-5). Substrate temperature exceeded 84.2°F for 57 hours between July 16 and 19, and for 247 hours between July 28 and August 7 (Figure 3-3). Substrate temperature did not exceed 86°F in mid July, but exceeded 86°F for 86 hours, and 87.8°F for 2 hours in late July/early August (see Figure 3-3). The maximum temperature (88.3°F) recorded in the Upstream Bed substrate occurred on August 1, 2006 (see Table 3-3).

Zebra mussel (*Dreissena polymorpha*) infestation was moderate (a few zebra mussels on most unionids) in 2004, but declined to an average of <1 and a maximum of 10 zebra mussels per unionid in 2005. Zebra mussels were similarly low in 2006, averaging 0.8 and 1.4 zebra mussels per unionid in August and September, respectively (see Table 3-6).

Most Upstream Bed unionid community characteristics have remained consistent across monitoring events; however, as discussed below, in 2006, certain changes were noted that appear to be attributable to higher ambient water temperatures experienced that year. The bed is species rich and moderately dense. Most species show evidence of recent recruitment into the community, and mortality generally is low. The slope of the cumulative individuals vs. cumulative species regression was high and consistent across monitoring events, averaging near seven (see Table 3-6). At least 25 species reside in the Upstream Bed, with 21 species (84%) collected during each sampling event. No new species were collected in 2006. The community averages 57% Lampsilinae species and 40% Ambleminae species (see Table 3-6). In 2006, the percent Ambleminae (43.4% in August and 45.2% in September) was slightly higher than average (40.3%), and percent Lampsilinae was slightly lower (53.0% in August and 49.6% in September) than average (56.5%). When sample data covering 3 years of monitoring are considered, Lampsilinae density is significantly higher than Ambleminae density (t=-2.314, df=612, $p<0.05$). In 2005, Lampsilinae density was also significantly higher than Ambleminae density ($p<0.10$). In contrast, in 2006 the density of Lampsilinae and Ambleminae did not differ significantly in 2006 ($p=0.472$ and 0.986 in August and September, respectively). This suggests that Lampsilinae species in the Upstream Bed may be declining. Further monitoring is needed to determine whether the decreased abundance of Lampsilinae in the Upstream Bed is real or due to stochastic factors. Exelon's ongoing QCNS monitoring program scheduled for 2007 and 2008 should provide useful data to answer this question.

Obliquaria reflexa (average 30% of the community) was the dominant Lampsilinae species, and *Amblema plicata* (average 21% of the community) was the dominant Ambleminae species in the Upstream Bed throughout the 2004 to 2006 time period. The federally endangered *Lampsilis higginsii* was collected in both 2005 and 2006 in the Upstream Bed. *Ellipsaria lineolata* (Illinois and Iowa threatened species) and *Ligumia recta* (Illinois threatened species) were collected during each monitoring event.

Unionid density in the Upstream Bed averaged near 9 unionids/m^2 and did not differ significantly across sampling events (see Table 3-6). Young unionids were abundant in the community with 35 to 50% of unionids collected being ≤5 years old. Density of unionids ≤5 years old was significantly lower in July 2004 than in October 2005 and October 2006, but not significantly different from other summer monitoring events. Density of unionids >5 years old has remained constant. The increased density of young unionids observed during October sampling events probably is because young unionids are likely larger and more susceptible to capture later in the summer and fall.

Mortality in the Upstream Bed, which had generally been low (<10%) increased in September 2006. In September 2006, average density of freshly dead unionids was significantly higher than during other monitoring events. The average percent mortality increased to 15.1%, mostly due to mortality of young unionids (24.8%). In August 2006, young

unionid mortality was only 2.6%. When subject to stress, unionids are able to "clam up" and shift from metabolism to catabolism until energy reserves are depleted. Smaller and younger unionids have less reserve than larger unionids, and Ambleminae (which are not dominant in the Upstream Bed) can remain in a catabolic state for longer periods than Lampsilinae due to their ability to tightly close their valves. The elevated July and August 2006 ambient river temperatures are likely to have contributed to the significantly higher than normal mortality rates observed in the Upstream Bed in October 2006, particularly with regard to Lampsilinae and smaller unionids.

Community characteristics within the subfamilies Lampsilinae and Ambleminae were also similar across monitoring events, with the exception of young Ambleminae and mortality of Lampsilinae (see Table 3-6). Density of Ambleminae >5 years old, and both juvenile and adult groups of Lampsilinae remained consistent over time. The density of ≤5 year old Ambleminae has fluctuated but increased with time. When all collected Ambleminae (both qualitative and quantitative samples) are considered, all six species found in July 2004, four of the six species found in July 2005, and all of the five species found in October 2005 were represented by youngsters. Five of the six species found in 2006 were represented by youngsters (see Table 3-6).

Warmer July and August temperatures in 2006 did not appear to affect the condition of Ambleminae, as all individuals collected were behaving normally (no gaping, slow response time, or excess mucous), and no freshly dead Ambleminae were collected. Additionally, total density and adult density did not differ across monitoring events. Young unionid density increased compared to previous monitoring events. Mortality remained less than 10%, and density of freshly dead shells did not differ across sampling dates (see Table 3-6).

Warmer ambient temperatures experienced in 2006 appear to have affected Lampsilinae in the Upstream Bed. No freshly dead Lampsilinae were collected in July 2005, and only a few adult Lampsilinae were found freshly dead in October 2005. In 2006, density of freshly dead Lampsilinae was significantly higher in September than in other sampling dates, suggesting acute mortality (see Table 3-6). The increase in mortality appeared to be mostly young unionids. Percent mortality increased to 21.7%, with 12.5% adult mortality and 39.6% young unionid mortality. Additionally, the percent live young Lampsilinae decreased from 50% in August to 26% in September. However, live unionids collected on both 2006 dates did not show any signs of stress (gaping, warm to the touch, excessive mucous). However, Lampsilinae total, adult, and juvenile density did not differ across monitoring events (see Table 3-7). When all collected unionids are considered, young of nine of 11 and 12 Lampsilinae species were collected in July 2004 and October 2005, respectively, and half of the Lampsilinae species collected in July 2005 were represented by young animals. In 2006, all species were represented by young unionids in August, and eight of 11 were represented by young unionids in September.

3.3 Steamboat Slough Bed

The Steamboat Slough bed is located approximately 750m downstream of the QCNS mixing zone (see Figure 1-1). Substrate in the Steamboat Slough bed was primarily sand, but in 2006 silt increased from <10% to >20%, forming a layer over the sand (Table 3-8). During 2006 monitoring, this silt layer was cooler to the touch than the water.

Depth from the water surface ranged from 0.9 to 4.3m on all study dates. Current velocity varied from 0.1 to 0.6 m/sec in pre-2006 studies, however, in 2006, current velocity was only zero to 0.2 m/sec due to low river flow rates. The low current velocity is likely the cause of silt accumulation over the substrate observed in 2006. DO ranged from a low of 5.1 mg/L in August 2006 to a high of 12.8 mg/L in July 2005, and was similar to observed Upstream Bed DO measurements. Very few zebra mussels were found in the Steamboat Slough bed; none were observed in August 2006 and an average of only 0.02 zebra mussels/unionid was observed in September 2006. As in previous years, zebra mussels increased with distance from the QCNS discharge. The paucity of zebra mussels in the Steamboat Slough Bed may be due to higher water temperature or fluctuating conditions with respect to substrate, current velocity, DO, and temperature.

Water temperatures during sampling events in 2006 were higher, for longer time periods, than in 2005. Water temperature in the Steamboat Slough bed averaged 1.8°F, 4.7°F, 3.2°F, 2.7°F, and 4.3°C higher than in the Upstream Bed in July 2004, July 2005, October 2005, August 2006, and September 2006, respectively (Tables 3-5 and 3-8). Steamboat Slough water temperature measured on August 5, 2006 (approximately 0.5m above the substrate) averaged 88°F, 2.9° degrees higher than in 2005 (see Table 3-8). Substrate temperature between June 28 and August 28, 2006 exceeded 84.2°F (29°C) twice: between July 6 and 21, for 14 days and 18 hours, and between July 24 and August 10, for 16 days and 8 hours (Figure 3-3). Substrate temperature exceeded 86°F (30°C) for 4 days and 9 hours between July 15 and 20, and for 9 days and 12 hours between July 28 and August 7. Substrate temperature in Steamboat Slough exceeded 87.8°F (31°C) for 1 day and 3 hours between July 19 and 20, and 6 days and 14 hours between 29 July and August 7. Substrate temperature exceeded 89.6°F (32°C) for 5 days and 8 hours between 30 July and 5 August (see Figure 3-3).

The Steamboat Slough Bed unionid community changed slightly from 2004 to 2006, but the changes do not reflect those that would be expected from elevated water temperatures. If unionids in the Steamboat Slough bed were affected by increased water temperatures, higher mortality or lower density of Lampsilinae and younger unionids, as observed in the Upstream Bed in October 2006, would be expected. However, some of the changes in Steamboat Slough unionid characteristics appear to be the opposite of what would have been expected in light of the persistent high substrate temperatures in 2006. Characteristics in the bed that were similar from year to year (fluctuating, but with no increasing or declining trend) include density of freshly dead shells and number of species collected each year. However, both Ambleminae (5.5/m^2) and Lampsilinae (3.4/m^2) density increased from October 2005 (2.6/m^2 and 1.6/m^2, respectively). Adult Ambleminae density declined, while Lampsilinae density did not differ significantly between August and September 2006 (Table 3-8). Mortality did not increase significantly and was similar between adults and young unionids within each subfamily. The percentage of young unionids for both subfamilies was higher than in previous years. None of the unionids collected in either August or September were warm to the touch, gaping, or excreting excessive mucous. The only sign of stress observed was one *A. plicata* and one *Q. quadrula* collected in August were lighter than normal (possibly emaciated).

Thus, high water temperature did not seem to result in any acute effects within the Steamboat Slough Bed. Future monitoring will facilitate evaluation of chronic effects. Other factors that may be affecting unionids in this bed include low current velocity, which is necessary to deliver food and oxygen to the unionids, and the heavy siltation, which can smother heavier shelled unionids if the condition persists. As previously mentioned, silt was over 20% of the substrate in both August and September 2006, compared to <10% during previous monitoring events (see Table 3-8).

The percentage of Lampsilinae in the Steamboat Slough Bed seems to be increasing, which is consistent with high silt load effects, but not consistent with high temperature effects (Table 3-9). Before 2006, Lampsilinae comprised <40% of the community and Ambleminae comprised >60%. Lampsilinae were less abundant than Ambleminae in 2005, with average density in 2005 significantly different between Ambleminae ($3.2/m^2$) and Lampsilinae ($1.9/m^2$). In August and September 2006, density of Lampsilinae and Ambleminae were not significantly different. Total density of both subfamilies was significantly higher than previous years in August 2006, but declined in September; as a result, overall densities for 2006 were not significantly different from those observed in 2005. In September 2006, Ambleminae comprised 54.3% of the community, whereas Lampsilinae comprised 44.7%.

Density of both young and adult Ambleminae in the Steamboat Slough Bed fluctuated in 2006. The percentage of young Ambleminae increased substantially in Steamboat Slough, from <10% in prior years to 22% in August and 33% in September 2006. Density of young Ambleminae increased from $0.2/m^2$ in prior years to $1.2/m^2$ in August, and $0.8/m^2$ in September. However, due to the high variability within the bed, the variations observed in 2006 were not significantly different (see Table 3-9). Adult Ambleminae increased from $<2.5/m^2$ in prior years to $4.3/m^2$ in August 2006, then declined to $1.5/m^2$ in September. The increase was not significantly different from other dates, but the decline in density between August and September was significant. However, no change in either density or percentage of freshly dead shells occurred, and percent mortality of adult and young Ambleminae were similar. The decline in larger heavier shelled adult Ambleminae could be a result of silt smothering these unionids. Shells may be buried beneath the silt layer. The lack of decline in young Ambleminae and thinner shelled Lampsilinae is also consistent with a heavy silt layer, as lighter and smaller unionids are able to remain on or migrate to the silt water interface and not be smothered.

Lampsilinae density observed in August 2006 increased significantly compared to prior years, but in September 2006, density declined such that density was not significantly different for 2006 compared to prior years (see Table 3-9). The same pattern was observed in the case of the Ambleminae. However, most of the decline in Lampsilinae density seemed to be due to a decline in adult density rather than density of young Lampsilinae, as was seen in the Upstream Bed. This suggests that silt cover may be affecting the unionid community in the Steamboat Slough Bed more than the elevated substrate temperature.

Lampsilis higginsii has not been observed in the Steamboat Slough Bed. Both Illinois threatened species *L. recta* and *E. lineolata* were collected in both beds in both August and September 2006. No fresh shell of *L. higginsii* and *L. recta*

were found in either the Upstream or Steamboat Slough beds, but one fresh shell of *E. lineolata* was collected in the Upstream Bed.

3.4 Cordova Bed

The Cordova Bed is one of the Essential Habitat Areas designated in the *L. higginsii* recovery plan (USFWS, 2004). This bed has historically harbored a dense and diverse unionid community. However, density within this bed has declined in recent years primarily due to heavy zebra mussel infestation. The portion of the Cordova Bed sampled in this study is approximately 3000m downstream of QCNS mixing zone, on the Illinois bank of the river.

Zebra mussels (*Dreissena polymorpha*) were more abundant in the Cordova Bed than in either the Upstream and Steamboat Slough bed during monitoring events in this study (Table 3-10, and see Tables 3-5 and 3-8). Zebra mussel density has also been high in past studies (Table 3-11). Zebra mussels represent perhaps the most serious threat to all large river unionid populations. The zebra mussel's high reproductive rate and its ability to attach to hard surfaces make this species a particular threat to unionids. This mussel uses an epoxy like glue to attach elastic threads (byssal threads) to any hard surface, including other zebra mussels, crayfish, snails, and unionids. Although this mussel only reaches a maximum length of 4 cm, hundreds of thousands can colonize a square meter.

Zebra mussels can be detrimental to unionid communities (Schloesser and Kovalak, 1991; Hunter and Bailey, 1992; Haag *et al.*, 1993; Nalepa *et al.*, 1996; Ricciardi *et al.*, 1996; Schloesser *et al.*, 1996; Strayer and Smith, 1996). High unionid mortality in Lake Erie (Schloesser and Nalepa, 1994), Lake St. Claire (Nalepa *et al.*, 1996), and the lower Illinois River (Whitney *et al.*, 1996) was attributed to high zebra mussel density, and unionid mortality has been observed in areas of high zebra mussel density (>1,000/m^2) in the Ohio River (ESI, 2002a; Morrison, [USFWS, Parkersburg, WV], pers. comm.) and in the upper Mississippi River (Tucker and Theiling, 1999). Ricciardi *et al.* (1995) found that unionid mortality was strongly correlated with zebra mussel density >1000/m^2, and predicted >90% mortality when density reaches 6000/m^2 and infestation reaches 100 zebra mussels/unionid.

Zebra mussels appear to have a greater impact on some species than others. Haag *et al.* (1993), in a test of six species, found Anodontinae to be the most sensitive to zebra mussel infestation, followed by Lampsilinae and Ambleminae. Hunter (1993) also found some species to be more sensitive to infestation than other species. Giant floater (*Pyganodon grandis*) was the most sensitive, followed by fragile paper shell (*Leptodea fragilis*), fat mucket (*Lampsilis siliquoidea*), pink heelsplitter (*Potamilus alatus*), and black sand shell (*Ligumia recta*).

Zebra mussels were first reported in the upper Mississippi River in 1991 (Cope *et al.*, 1997). Infestation of the study area was reported in 1994, and zebra mussel density averaged <10/m^2 in the Cordova Bed (Miller and Payne, 1995). In 1999, most unionids in the Cordova Bed had <50 zebra mussels attached (Table 3-11). By 2000, zebra mussels encrusted all unionids and covered the substrate in most of the Cordova Bed. In 2001, few zebra mussels were found within 20 m of the bank, but density further from the bank averaged 3000 to 4000/m^2. However, in 2002, zebra mussels

declined appreciably and only one-third of the unionid had a few zebra mussels attached. Zebra mussel density in 2003 had declined to <1000/m^2. Zebra mussel density increased in the Cordova Bed in 2004, as they encrusted most unionids. Density declined in 2005 and remained low in 2006 (see Table 3-10). In 2005, an average of 0.3 and 1.3 zebra mussels per unionids was observed in July and October, respectively, and an average of 0.1 and 0.3 zebra mussel per unionid was observed in August and September 2006 (see Table 3-10).

Zebra mussel infestation has resulted in high unionid mortality and reduced density within the Cordova Bed. Before heavy zebra mussel infestation (1994), density in the Cordova Bed ranged from 51 to 83 unionids/m^2 and recruitment (measured as percentage of unionids ≤30 mm) ranged from 10 to 49% (Miller and Payne, 1996). In 1999, zebra mussel density was extremely high, unionid mortality was near 50%, and recruitment was near zero at MRM 504.3 (ESI, 1999). Zebra mussel density declined between 2001 and 2003, unionid density and recruitment increased, and mortality declined. Density in 2002 and 2003 ranged from 3.6 to 8.1 unionids/m^2 and, in 2003, recruitment was near 44% (Farr *et al.*, 2002 draft and ERDC, 2003 preliminary data). Unionid density has remained at a similar level since 2003, averaging 4.3/m^2 and percentage young unionids (≤5 years old) averaging 44% (see Table 3-10).

The Cordova Bed differs from the Upstream and Steamboat Slough beds in that it occurs along a slight outside bend in the river and its substrate is coarser (see Table 3-10). Substrate in the Cordova Bed averages 12.2% shell material, both zebra mussels and unionids. Emergent vegetation was present in 2006. Depth within the sampled portion of the Cordova Bed averaged 2.2m and ranged from 0.6 to 6.7m. Unionids were historically more abundant in deeper water, however density has declined in the deeper areas, likely due to zebra mussel infestation. Unionids are now also abundant in siltier shallow areas. Silt accumulation was not apparent in the Cordova Bed as it was in the Steamboat Slough Bed in 2006. Current velocity averaged 0.2m/sec during 2004 and 2005, but averaged <0.1 m/sec in 2006 (see Table 3-10). DO was 6.0mg/L in July 2004 and 8.3mg/L in October 2005, similar to both the Steamboat Slough and Upstream beds. In 2006, DO average was similar to previous years, but ranged from 4.3mg/L to 18.1mg/L in October, most likely due to the increase in vegetation.

Water temperature in the Cordova Bed averaged 77.5°F in July 2004 and 2005, 87.3°F in August 2006, 65.5°F in October 2005, and 64.2°F in September 2006 (see Table 3-10). These temperatures were lower than both Upstream Bed and Steamboat Slough Bed temperatures in 2004 and 2005, but in 2006, Cordova Bed temperatures were higher than temperatures recorded in the Upstream Bed. Cordova Bed temperature did exceed 87.8°F in some samples in August 2006.

Unionid community characteristics in the Cordova Bed differ from the Upstream and Steamboat Slough beds, primarily due to more heterogeneous substrate and less variable current velocity. Species composition is approximately 50% Ambleminae and 50% Lampsilinae, and density between subfamilies did not differ significantly for any of the sample dates (Table 3-12). Similar to the other beds, *A. plicata* was the dominant Ambleminae (Table 3-13). *Leptodea fragilis* was the dominant Lampsilinae species in 2004 and 2005. However, the percentage of *L. fragilis* seemed to decline in

2006 and the percentage of *O. reflexa* increased in September 2006 (see Table 3-12). *Obliquaria reflexa* has a thicker shell than *L. fragilis* and may be less affected by stressors. *Obliquaria reflexa* is the dominant species in both the Upstream and Steamboat Slough beds (see Table 3-13). *Megalonaias nervosa* was collected consistently in the Cordova Bed, whereas *Q. nodulata*, which is abundant in the Steamboat Slough Bed, was only collected in 2006. *Lampsilis siliquoidea* was collected in the Cordova Bed in 2006, but not in other beds. Although not found in this study, *Plethobasus cyphyus* was reported from the Cordova Bed in 2006 (D. Sallee, pers. comm.). *Lampsilis higginsii* and *L. recta* seem more abundant in the Cordova Bed, whereas *E. lineolata* seems less abundant, but all three species were collected in the Cordova Bed in 2006. Most species found in the Cordova Bed (24 total) have also been collected in the Upstream Bed, with the exception of *L. siliquoidea* (see Table 3-13). *Quadrula metanevra* and *L. teres* were absent in the Cordova Bed during this study, although these species were collected in the Cordova Bed in previous studies (ESI, 2005).

Both zebra mussel and high water temperature stress should affect Lampsilinae and young unionids before adult Ambleminae, and the effects of these stresses is difficult to differentiate. Unionid mortality in the Cordova Bed (range 3 to 31.6%) has been consistently higher than in the Steamboat Slough (1.1 to 8.7%) and Upstream (1.4 to 15.1%) beds, indicating stress is higher in this bed than in the others, most likely due to the higher zebra mussel infestation. Within the Cordova Bed, most community characteristics fluctuated across monitoring events, but consistent trends over time were not apparent. Lampsilinae density fluctuated between a low of 1.1 (July 2005) and a high of 3.3 unionids/m^2 (July 2004 and October 2005; see Table 3-12), but no trend of increasing or decreasing density was apparent, as 2006 density averaged 1.8 and 1.5 unionids/m^2 in August and September, respectively. Likewise, the density of young unionids was highest in July 2004 (2.2/m^2) and lowest in July 2005 (0.6/m^2), with 1.1 and 0.8 young unionids/m^2 in August and September 2006, respectively. A similar fluctuation occurred within the Lampsilinae (range 0.1 and 1.6 young/m^2, and 0.5 and 0.4 young/m^2 in August and September 2006, respectively). The density and percentage of young Ambleminae was fairly consistent across monitoring events: range 0.4 to 0.8/m^2 and 21.6% to 33.3%.

The only consistent trend in the Cordova Bed was a decline in the regression slope of the species area curve (see Table 3-12). The slope of the cumulative individuals vs. species regression was higher than for other beds, but seemed to decline over time, ranging from 7.7 in 2004 to 6.0 in September 2006; indicating that the number of species is not increasing as quickly with the number of individuals collected. Future monitoring may clarify whether this trend is real or due to stochastic factors.

The Cordova Bed is experiencing more stress than the other beds in this study, as indicated by higher mortality. However, the effects on unionid community characteristics were not consistently higher than other monitoring years with lower water temperatures. Acute mortality was observed in 2006, but also observed in other monitoring events. Whether changes in community characteristics are due to the stress of zebra mussels or other potential stressors or are due to stochastic events is unclear at this time. Future monitoring will include two additional beds upstream of the diffuser and one additional bed downstream. One of the factors in selecting the sites to be studied will be the level of

zebra mussel infestation. The addition of sites will facilitate understanding how various potential stressors may be impacting the bed.

4.0 Conclusions

The high ambient water temperature and low river flows over almost a month in July/August 2006 resulted in the use of 222.75 excursion hours in 2006. Substrate temperature increased and decreased slower than water temperature, and high and low temperatures were not as severe. Upstream Bed substrate temperature was lower than the intake bay water temperature, and Steamboat Slough substrate temperature was lower than the calculated downstream maximum temperature. Although buffered compared to water temperature, substrate temperature in the north end of the Steamboat Slough Bed reached over 91.4°F for a few hours, exceeded 84.2°F from July 6 to August 10, and fell below 84.2°F for only three day in this time period. Upstream Bed temperature exceeded 87.8°F for a few hours, and exceeded 84.2°F between July 16 and 19 and July 28 through August 7, 2006.

Changes to unionid community characteristics were observed in all three beds in 2006 compared to prior years. Some of these changes may be, at least in part, attributable to the high temperatures experienced in 2006. However, not all changes appear to have been caused by thermal discharges from QCNS. In fact, the most notable changes to the beds were observed in the Upstream Bed, which is not affected by the QCNS discharge or by operations authorized by the provisional variances.

First, species composition of the Upstream and Steamboat Slough beds appears to be approaching similarity. Density of Ambleminae and Lampsilinae in the Upstream and Steamboat Slough beds was similar in 2006. In prior years, the Upstream Bed supported more Lampsilinae and the Steamboat Slough Bed previously supported more Ambleminae. If the QCNS discharge were adversely affecting downstream mussel beds, one would expect that the Steamboat Slough and Upstream beds would be becoming increasingly dissimilar in terms of community characteristics. The increasing similarity between the two beds' characteristics suggests that the QCNS discharge is not solely responsible for differences in these two unionid communities.

Second, comparing the nature of the decrease in unionid density observed in the Steamboat Slough bed with a similar decrease in the Upstream bed following the July and August 2006 thermal episode suggests that exposure to the QCNS discharge was not the sole cause of the Steamboat Slough decrease . Density of Lampsilinae in the Upstream Bed, (total, young, and adult) did not differ across sample dates in 2006. However, the percentage of young Lampsilinae in the Upstream Bed increased to 50% in August, and then declined to 26% in September. In addition, Lampsilinae mortality in the Upstream Bed increased considerably in September 2006. While percent mortality of adults was similar between August and September 2006, young Lampsilinae mortality in the Upstream bed increased from 4.3% in August to 39.6% in September. This increase in young mortality suggests acute mortality resulting from the warm water conditions in July and August, as young unionids seem to be more susceptible to thermal exposures. In contrast, .most of the decline in density of Lampsilinae in the Steamboat Slough bed in September 2006 was due to a decline in adult rather than young Lampsilinae, and the percent of young Lampsilinae in the bed increased in October 2006. This suggests that some factor other than heat impacted Steamboat Slough bed Lampsilinae, such as the increased siltation observed in 2006 in that bed.. In the Cordova Bed, total Lampsilinae density and young unionid density declined, but the decline occurred in

August and density remained consistent in September 2006. A similar decline in total and young Lampsilinae was also observed in July 2005, perhaps attributable to latent mortality from the heavy 2004 zebra mussel infestation.

With regard to Ambleminae, in the Upstream Bed, neither overall, adult, nor freshly dead Ambleminae density changed with time. In the Steamboat Slough Bed, total, young, and adult Ambleminae density increased in August 2006, then declined in September 2006, while mortality of Ambleminae did not increase, but rather remained consistent with prior sampling results. In the Cordova Bed, Ambleminae density, adult density, young density, and freshly dead shell density has not changed over time. However, percent mortality increased from ≤10% in 2004 and 2005 to 12% in August 2006 and 18% in September 2006. Most of this mortality was experienced by young Ambleminae, particularly in September, when young Ambleminae mortality was 36% and adult mortality was 8%. Overall, changes to the Ambleminae community do not appear to be significant, though some of the variations observed during the course of 2006 require further study. The ongoing monitoring studies of the of mussel beds near the QCNS should provide additional useful information to help explain these circumstances.

In sum, the high temperatures experienced in 2006 seem to have had the greatest impact on Lampsilinae, and the impacts seem to have been most significant in the Upstream Bed, before any contribution of heat from QCNS. If the temperature downstream of the QCNS discharge was affecting Lampsilinae adversely, the effect on density and mortality should have been greater in the Steamboat Slough Bed than what was observed. However, in the Steamboat Slough Bed, the percent young Lampsilinae increased in October 2006 and mortality was only slightly higher than in previous years. Ambleminae in the Upstream and Steamboat Slough beds do not appear to have been impacted measurably by 2006 events . With regard to the Cordova bed, young Lampsilinae also declined, but the decline in 2006 was not as great as was observed in July 2005 after heavy zebra mussel infestation.

Threatened and endangered species did not seem affected by the warm temperature in July/August 2006. *Lampsilis higginsii* were alive in both the Cordova and Upstream beds. *Ellipsaria lineolata* and *L. recta* were also in the Cordova and Upstream beds. However, one freshly dead *E. lineolata* shell was in the Upstream Bed, and two were found in the Cordova Bed. Two fresh shells of *L. recta* were in the Cordova Bed. No fresh shells of T&E species were in the Steamboat Slough Bed, but live *L. recta* were collected. Additionally, one live *Pleurobema sintoxia*, endangered in Iowa, was collected from the Steamboat Slough Bed. No live or shells of *E. lineolata* have been collected from the Steamboat Slough Bed since July 2005.

Substrate seemed to buffer temperature such that unionids were not exposed to the high temperature levels seen in the water column. Further, the rate of temperature increase and decrease in the substrate compared to the water allowed longer acclimation times. The 227.75 excursion hours used from mid-July to early August did not appear to cause acute mortality in the unionid communities downstream of the discharge even though water temperature was higher than in previous years. However, acute mortality of Lampsilinae (thinner shelled) and young unionids was consistent with heat stress upstream of the discharge. Heavy siltation due to low current velocity in the Steamboat Slough Bed seemed to

influence the community composition in the Steamboat Slough Bed more than high exposure temperature.

Future monitoring will include two additional upstream unionid beds and one additional downstream unionid bed. Monitoring these beds will provide additional information on zebra mussel and siltation effects outside of the areas influenced by warmer water due to QCNS discharge. Monitoring will also include the beds studied in 2004 to 2006 to estimate long-term effects of the elevated 2006 temperature.

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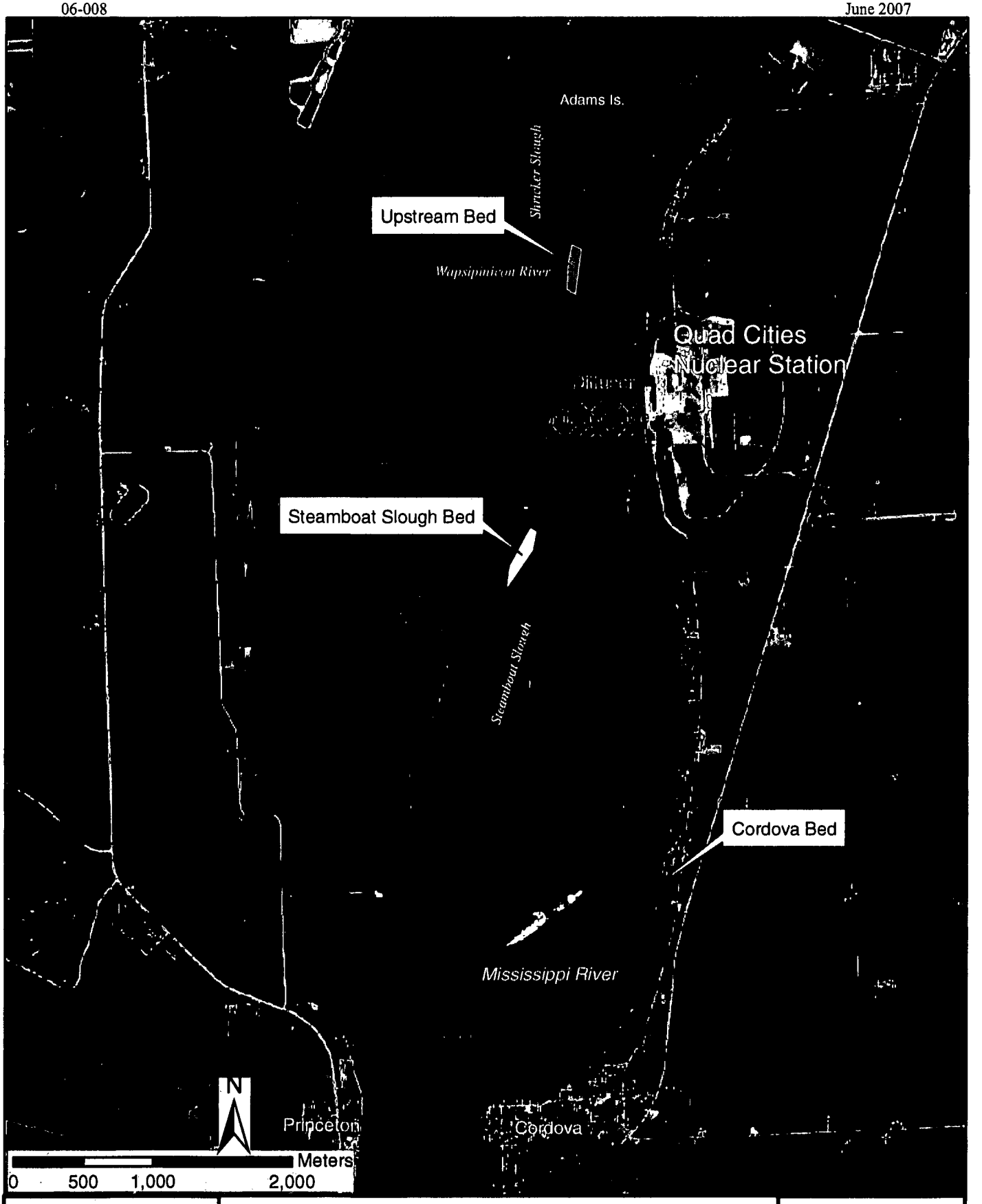

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Figure 1-1. Upstream, Steamboat Slough, and Cordova Bed sample areas, July 2004, July 2005, October 2005, August 2006, and September 2006.

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Table 1-1. Summary of QCNS excursion hours used between 2000 and 2006.

	River discharge (cfs)		Intake temp °F		Calc. Dn temp °F		Measured Dn Temp (°F)	Cumulative excursion hours	Cumulative excursion %
	Min	Max	Min	Max	Min	Max	Max		
2000									
June	55400	131000	66.4	74.6	67.8	75.7		0	
July	39500	102000	73.4	82.1	74.9	82.7		0	
August	26500	55100	73.8	82.8	77.0	84.7		0	
September	22000	50000	59	81.4	62.5	83.1		0	
2001									
June	94900	129000	60	80.4	60.7	80.8		0	
July	43300	131000	75.2	86.4	77.3	87.7	87	25.25	0.3
August	25600	56800	73.5	87.8	76.1	88.3	87	57.35	0.7
September	25.8	45200	59.7	76.9	63.2	78.9		57.35	0.7
2002									
June	67000	154000	64.5	82.1	66.3	82.7	81	0	
July	62700	104000	77.3	84.8	79.3	85.5	83	0	
August	54300	80800	74.7	84.2	76.9	85.2	84	0	
September	38900	74400	63.6	79.6	66.2	80.5	80.5	0	
2003									
June	39600	94300	64.7	80.3	66.1	80.8		0	
July	41500	89900	74.9	83.2	76.7	84		0	
August	16200	34100	77	86.2	80.6	89.6	86	0	
September	16100	43500	59.9	81.6	66.3	86.3	82	0	
2004									
June	103000	169000	64.9	76.6	66.1	76.8		0	
July	32100	100000	72.5	81.2	75.4	82.1		0	
August	31700	49300	68.2	79.6	71.7	81		0	
September	23100	58300	65.2	78.8	68.3	81.1		0	
2005									
June	64500	81718	67.4	83	69.7	83.4	82	0	
July	27980	74820	75.2	86.4	77.7	88.1	88	42.5	0.5
August	18030	34998	77	85.4	79.6	87.8	85	42.5	0.5
September	19064	45317	63.6	79.8	66.1	82.5	79	42.5	0.5
2006									
June	42023	72849	68	79.1	72.1	80.2	80	0	0.0
July	12,700	37,600	76.9	91.1	80.2	95.8	91	117.25	1.3
August	12,600	39,800	73.8	91.6	77	96	91	222.75	2.5
September	21,200	37,600	60	76.6	63.6	79.4		222.75	2.5

Exelon discharge records 2000 to 2006

Table 3-1. Intake, discharge, and substrate temperature in SS and Upstream bed, June 2006.

Time[2]	Discharge[1] (CFS) Day	Night	Intake temp. (*F)	Discharge temp. (*F)	Max. calc. Downstream temp. (*F)	Upstream N, substrate temp (°F) Day	Night	SS bed N, substrate temp. (°F) Day	Night	SS bed S, substrate temp. (°F) Day	Night
Date											
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
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18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28	46000	42000	76.0	104.4	78.5	77.4	76.4	79.6	78.6	79.4	78.5
29	42000	42000	76.4	105.0	79.2	77.6	76.8	79.4	79.3	79.3	79.2
30	40167	37000	77.2	105.8	80.2	78.6	77.8	80.5	80.7	80.4	80.7
31											
Average	42722.3	40333.3	76.5	105.1	79.3	77.9	77.0	79.8	79.5	79.7	79.5
Min	46000.0	37000.0	74.8	103.2	78.5	76.5	76.1	77.4	77.3	77.3	77.2
Max	46000.0	42000.0	78.8	107.5	80.2	79.2	78.9	82.4	82.3	82.0	81.7

[1]Mississippi River at Lock and Dam 14 (LeClaire,IA); www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI14&fid=LECI4&dt=S; all other data collected by QCNS, 2006

[2]Day = 08:00-19:59, Night = 20:00-07:59

Table 3-1. Intake, discharge, and substrate temperature in SS and Upstream bed , June 2006 (cont.).

Time[2]	Up bed-intake (°F)	SS N bed-calc. down (°F)	SS S bed-calc. down. (°F)	SS N - Up bed N Day	SS N - Up bed N Night	SS S - Upstream N Day	SS S - Upstream N Night
Date							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28	1.4	1.1	0.9	2.2	2.2	2.0	2.1
29	1.2	0.2	0.1	1.8	2.5	1.7	2.4
30	1.4	0.3	0.2	1.9	2.9	1.8	2.9
31							
Average	1.3	0.5	0.4	2.0	2.5	1.8	2.5
Min	1.7	-1.1	-1.2	0.9	1.2	0.8	1.1
Max	0.4	2.2	1.8	3.2	3.4	2.8	2.8

[1]Mississippi River at Lock and Dam 14 (LeClaire,IA);
www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI14&fid=LECI4&dt=S;
all other data collected by QCNS, 2006
[2]Day = 08:00-19:59, Night = 20:00-07:59
Note: Cordova bed predicted to be 1.3°C > ambient; SS bed predicted to be 2.4°C > ambient

Table 3-2. Intake, discharge, and substrate temperature in SS and Upstream bed , July 2006.

Time[2]	Discharge[1] (CFS) Day	Night	Intake temp. (*F)	Discharge temp. (*F)	Max. calc. Downstream temp. (*F)	Max Downtream Measured (°F)	Upstream N substrate (°F) Day	Night	SS bed N substrate (°F) Day	Night	SS bed S substrate (°F) Day	Night
Day												
1	34000	32000	77.7	106.3	80.2		79.0	78.5	81.2	81.4	81.1	81.4
2	32000	33000	77.9	107.1	80.7		78.4	78.4	81.1	81.4	81.2	81.5
3	33000	33000	77.9	105.5	80.5		78.5	78.8	81.1	81.7	81.1	81.6
4	34667	34000	78.7	106.9	81.6		79.8	79.4	82.3	82.4	82.2	82.4
5	32264	31100	78.9	107.5	81.4		79.9	79.2	82.6	82.5	82.4	82.3
6	30198	25600	79.0	107.5	82.0		79.6	80.0	82.2	83.1	81.9	82.9
7	24475	22000	80.4	108.7	84.1		78.7	80.4	82.9	83.7	82.6	83.4
8	20594	20500	81.7	110.0	85.6	82	79.8	80.1	83.3	83.5	83.1	83.3
9	20781	21400	82.5	110.6	86.8		79.8	80.5	83.5	84.4	83.3	84.2
10	21400	21400	81.9	109.9	85.5		79.8	79.9	84.0	83.5	83.8	83.2
11	23179	27500	80.8	108.9	84.5		79.8	79.3	83.2	82.3	83.0	82.2
12	27500	27500	78.5	107.0	81.3	80	78.8	79.0	81.8	82.2	81.6	82.0
13	27317	25300	79.0	107.3	82.2		78.8	80.0	82.0	83.0	81.7	82.8
14	25248	22800	81.2	109.9	85.2		80.4	81.4	83.5	84.7	83.3	84.5
15	21950	21100	83.8	111.9	87.9	84	81.8	83.0	85.3	86.5	85.1	86.3
16	21004	21000	85.9	114.0	90.4	87	83.3	84.5	86.8	87.9	86.5	87.5
17	21000	21000	87.3	115.7	91.7	89	84.7	85.2	88.2	88.7	88.0	88.4
18	21854	22000	86.6	114.4	90.1	88	84.6	84.2	88.6	87.7	88.4	87.4
19	22000	19500	84.9	112.3	88.9	87	83.4	82.6	86.8	85.9	86.5	85.6
20	19563	21000	84.1	112.2	87.9		81.7	81.5	85.7	85.0	85.3	84.7
21	22000	26333	81.8	110.1	86.0		80.6	79.5	84.1	82.4	83.8	82.2
22	27500	27500	78.9	107.8	82.6		79.7	79.2	82.7	82.2	82.4	82.0
23	27500	27500	79.7	108.2	83.6		79.5	80.4	82.5	83.4	82.2	83.2
24	26281	26000	80.9	109.5	84.5		80.3	81.2	83.4	84.5	83.1	84.3
25	26327	26400	81.8	110.2	85.3		81.1	81.8	83.8	84.4	83.7	84.2
26	26400	26400	82.2	110.5	86.0		81.7	82.6	84.4	85.3	84.3	85.2
27	27467	28000	82.5	111.1	85.8	84	82.6	83.1	85.2	85.7	85.1	85.6
28	28000	28000	83.4	112.1	87.2	85	83.6	84.6	86.1	87.3	86.1	87.2
29	28000	28000	85.0	113.7	88.7	87	84.9	86.1	87.6	88.7	87.6	88.6
30	27971	26275	86.2	114.8	89.7	87	85.9	86.9	88.6	89.6	88.6	89.5
31	18717	12700	88.7	115.6	95.8	91	86.4	87.0	89.6	90.1	88.9	89.7
Average	25811.5	25348.6	81.9	110.2	85.6	85.9	81.2	81.6	84.3	84.7	84.1	84.5
Min	12700	12700	76.9	103.9	80.2		77.4	77.6	79.9	80.6	79.8	80.4
Max	37000	34000	91.1	118.6	95.8	91.0	87.4	87.5	91.0	91.2	89.8	90.1

[1]Mississippi River at Lock and Dam 14 (LeClaire,IA); www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI14&fid=LECI4&dt=S;
all other data collected by QCNS, 2006
[2]Day = 08:00-19:59, Night = 20:00-07:59

Table 3-2. Intake, discharge, and substrate temperature in SS and Upstream bed , July 2006 (cont.).

Time[2]	Up bed-intake (°F)	SS N bed-calc. down. (°F)	SS S bed-calc. down. (°F)	SS N - Up bed		SS S - Up bed		SS N-SS S		Accumulated hours	Max Dnstream Calc.-Meas.	SS bed N-Dn measured
Date				Day	Night	Day	Night	Day	Night			
1	0.8	1.2	1.2	2.2	2.9	2.1	2.9	0.1	0.0			
2	0.5	0.7	0.8	2.7	3.0	2.8	3.1	-0.1	-0.1			
3	0.9	1.2	1.1	2.6	2.9	2.6	2.8	0.0	0.1			
4	0.7	0.8	0.8	2.5	3.0	2.4	3.0	0.1	0.0			
5	0.3	1.1	0.9	2.7	3.3	2.5	3.1	0.2	0.2			
6	1.0	1.1	0.9	2.6	3.1	2.3	2.9	0.3	0.2			
7	0.0	-0.4	-0.7	4.2	3.3	3.9	3.0	0.3	0.3			
8	-1.6	-2.1	-2.3	3.5	3.4	3.3	3.2	0.2	0.2	0	2.7	1.3
9	-2.0	-2.4	-2.6	3.7	3.9	3.5	3.7	0.2	0.2			
10	-2.0	-2.0	-2.3	4.2	3.6	4.0	3.3	0.2	0.3			
11	-1.5	-2.2	-2.3	3.4	3.0	3.2	2.9	0.2	0.1			
12	0.5	0.9	0.7	3.0	3.2	2.8	3.0	0.2	0.2	0	2.3	2.0
13	1.0	0.8	0.6	3.2	3.0	2.9	2.8	0.3	0.2			
14	0.2	-0.5	-0.7	3.1	3.3	2.9	3.1	0.2	0.2			
15	-0.8	-1.4	-1.6	3.5	3.5	3.3	3.3	0.2	0.2	0		2.3
16	-1.4	-2.5	-2.9	3.5	3.4	3.2	3.0	0.3	0.4	10.25	3.2	0.5
17	-2.1	-3.0	-3.3	3.5	3.5	3.3	3.2	0.2	0.3	24	3.1	-0.6
18	-2.4	-2.4	-2.7	4.0	3.5	3.8	3.2	0.2	0.3	24	2.8	-0.6
19	-2.3	-3.0	-3.3	3.4	3.3	3.1	3.0	0.3	0.3	3	2.7	-1.4
20	-2.6	-2.9	-3.2	4.0	3.5	3.6	3.2	0.4	0.3			
21	-2.3	-3.6	-3.8	3.5	2.9	3.2	2.7	0.3	0.2			
22	0.3	-0.4	-0.6	3.0	3.0	2.7	2.8	0.3	0.2			
23	0.7	-0.2	-0.4	3.0	3.0	2.7	2.8	0.3	0.2			
24	0.3	0.0	-0.2	3.1	3.3	2.8	3.1	0.3	0.2			
25	0.0	-0.9	-1.1	2.7	2.6	2.6	2.4	0.1	0.2			
26	0.4	-0.7	-0.8	2.7	2.7	2.6	2.6	0.1	0.1			
27	0.6	-0.1	-0.2	2.6	2.6	2.5	2.5	0.1	0.1	0	2.3	1.6
28	1.2	0.1	0.0	2.5	2.7	2.5	2.6	0.0	0.1	0	2.2	2.2
29	1.1	0.0	-0.1	2.7	2.6	2.7	2.5	0.0	0.1	8	1.8	1.6
30	0.7	-0.1	-0.2	2.7	2.7	2.7	2.6	0.0	0.1	24	1.9	2.5
31	-1.7	-5.7	-6.1	3.2	3.1	2.5	2.7	0.7	0.4	24	3.8	-1.3
Average	-1.1	-1.4	-1.6	3.1	3.1	2.9	2.9	0.2	0.2	Total July	117.25	2.6	0.6
Min	0.0	0.0	0.0	2.2	2.6	2.1	2.4	0.0	0.0	Cumulative	117.25	1.8	-1.4
Max	-2.6	-5.7	-6.1	4.2	3.9	4.0	3.7	0.7	0.4	%	1.30%	3.8	2.5

[1]Mississippi River at Lock and Dam 14 (LeClaire,IA); www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI14&fid=LECI4&dt=S;
all other data collected by QCNS, 2006

[2]Day = 08:00-19:59, Night = 20:00-07:59

Note: Cordova bed predicted to be 1.3°C > ambient; SS bed predicted to be 2.4°C > ambient

Table 3-3. Intake, discharge, and substrate temperature in SS and Upstream bed, August 2006.

Time[2]	Discharge[1] (CFS) Day	Night	Ave Intake temp (°F)	Ave Discharge temp (°F)	Max. calc. Downstream temp (°F)	Average Upstream S substrate (°F) Day	Night	Average SS Bed N substrate (°F) Day	Night	Average SS Bed S substrate (°F) Day	Night
Day											
1	12700	12700	91.0	110.7	95.5	87.2	87.5	90.6	89.8	89.6	89.5
2	12700	18500	90.6	112.6	96.0	86.8	86.7	90.1	89.9	89.4	89.7
3	25427	28000	87.1	115.2	93.4	85.5	85.3	88.8	88.3	88.6	88
4	32667	35000	84.9	113.5	87.8	85	85.6	87.9	88.1	87.8	87.9
5	35000	35000	84.6	113.1	87.3	84.7	84.9	87.5	87.4	87.3	87.1
6	35000	35000	83.4	111.9	86.6	83.6	83.7	85.9	85.8	85.7	85.7
7	39479	40000	82.6	111.1	85.1	83.3	83.5	85.4	85.7	85.3	85.5
8	39378	39000	82.1	109.8	84.6	82.9	82.5	84.9	84.7	84.7	84.6
9	38813	36000	81.3	108.2	83.7	81.8	81.9	83.9	83.9	83.8	83.8
10	35333	32000	80.1	107.0	82.8	80.6	80.7	83	83.2	82.8	83.1
11	30667	28000	79.3	106.3	81.8	80.1	79.7	82.6	82.5	82.5	82.3
12	24667	24000	79.4	106.3	82.5	79.2	79.8	82.1	82.9	81.9	82.6
13	20000	18000	80.7	108.8	84.4	79.2	79.6	82.8	83	82.2	82.7
14	18000	18000	82.0	110.4	86.0	79.5	78.9	83.1	82.5	82.8	82.3
15	19333	22000	81.4	109.4	85.8	78.4	78.9	82.2	82.4	81.9	82.2
16	23500	26500	80.3	108.5	83.9	79.1	79.5	82	82.5	81.9	82.4
17	26500	26500	79.3	107.7	82.0	78.8	78.8	81.8	81.9	81.7	81.7
18	26500	26500	78.5	106.9	81.3	78.2	77.7	81	80.7	81	80.6
19	25750	22000	77.8	106.2	81.0	77.6	77.6	80.4	80.9	80.3	80.7
20	22000	22000	78.8	107.0	82.2	77.7	78	80.9	81.2	80.8	81
21	22000	22000	79.3	107.6	82.7	77.6	78.1	80.9	81.5	80.8	81.3
22	20750	20500	80.4	108.8	84.2	77.9	78.7	81.5	82.4	81.3	82.1
23	20500	20500	81.7	110.1	85.8	79.1	79.9	82.4	83.2	82.1	82.8
24	19250	19000	82.1	110.6	86.3	79.6	80	83.1	83.5	82.6	82.9
25	19000	19833	82.3	110.9	86.5	79.6	80.1	83.2	83.1	82.7	82.9
26	28333	34000	80.2	108.7	84.8	79.6	79.2	82.4	81.8	82.4	81.7
27	36000	36000	78.1	106.7	80.1	79	78.4	81.5	80.9	81.3	80.8
28	36333	38000	76.4	104.9	79.5	76.9	76	79.6	78.6	79.5	78.6
29	38000		75.0	103.5	77.0	75.4		77.8		77.8	
30			75.1	103.7	77.4						
31			74.7	103.3	77.3						
Average	27020	26948	81.0	108.7	84.4	80.5	80.8	83.4	83.7	83.2	83.4
Min	12700	12700	73.8	102.8	77.0	75.2	75.2	77.7	77.9	77.8	77.9
Max	40000	40000	91.6	117.1	96.0	88.4	88	91.4	91.2	90.2	90.4

[1]Mississippi River at Lock and Dam 14 (LeClaire,IA); www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI14&fid=LECI4&dt=S; all other data collected by QCNS, 2006

[2]Day = 08:00-19:59, Night = 20:00-07:59

3esitmated from Holly *et al.* (2004); upstream bed temperature assumed 84.0°F and 84.6°F, estimate at upper end of SS bed

Table 3-3. Intake, discharge, and substrate temperature in SS and Upstream bed , August 2006.

Date[2]	Up bed-intake (°F)	SS N bed-calc. down. (°F)	SS S bed-calc. down. (°F)	SS N - Up bed Day	Night	SS S - Up bed Day	Night	SS N-SS S Day	Night		Accumulated hours	Max Downtream Measured (°F)	Max Dnstream Calc.-Meas.	SS bed N-Dn measured
1	-3.5	-5.7	-6.0	3.4	2.3	2.4	2.0	1.0	0.3		24	91	3.9	-0.4
2	-3.9	-6.1	-6.3	3.3	3.2	2.6	3.0	0.7	0.2		24	91	4.1	-0.9
3	-1.8	-5.1	-5.4	3.3	3.0	3.1	2.7	0.2	0.3		24	90	3.1	-1.2
4	0.7	0.3	0.1	2.9	2.5	2.8	2.3	0.1	0.2		16.5	86	2.2	1.9
5	0.3	0.1	-0.2	2.8	2.5	2.6	2.2	0.2	0.3		15*			
6	0.3	-0.8	-0.9	2.3	2.1	2.1	2.0	0.2	0.1		2*			
7	0.9	0.6	0.4	2.1	2.2	2.0	2.0	0.1	0.2					
8	0.4	0.1	0.0	2.0	2.2	1.8	2.1	0.2	0.1					
9	0.6	0.2	0.1	2.1	2.0	2.0	1.9	0.1	0.1					
10	0.6	0.4	0.3	2.4	2.5	2.2	2.4	0.2	0.1					
11	0.4	0.7	0.5	2.5	2.8	2.4	2.6	0.1	0.2					
12	0.4	0.4	0.1	2.9	3.1	2.7	2.8	0.2	0.3					
13	-1.1	-1.4	-1.7	3.6	3.4	3.0	3.1	0.6	0.3					
14	-3.1	-3.5	-3.7	3.6	3.6	3.3	3.4	0.3	0.2					
15	-2.5	-3.4	-3.6	3.8	3.5	3.5	3.3	0.3	0.2		0	82	3.2	0.2
16	-0.8	-1.4	-1.5	2.9	3.0	2.8	2.9	0.1	0.1					
17	-0.5	-0.1	-0.3	3.0	3.1	2.9	2.9	0.1	0.2					
18	-0.8	-0.6	-0.7	2.8	3.0	2.8	2.9	0.0	0.1					
19	-0.2	-0.1	-0.3	2.8	3.3	2.7	3.1	0.1	0.2					
20	-0.8	-1.0	-1.2	3.2	3.2	3.1	3.0	0.1	0.2					
21	-1.2	-1.2	-1.4	3.3	3.4	3.2	3.2	0.1	0.2					
22	-1.7	-1.8	-2.1	3.6	3.7	3.4	3.4	0.2	0.3					
23	-1.8	-2.6	-3.0	3.3	3.3	3.0	2.9	0.3	0.4					
24	-2.1	-2.8	-3.4	3.5	3.5	3.0	2.9	0.5	0.6		0	83	3.1	0.1
25	-2.2	-3.4	-3.6	3.6	3.0	3.1	2.8	0.5	0.2					
26	-1.0	-3.0	-3.1	2.8	2.6	2.8	2.5	0.0	0.1					
27	0.3	0.8	0.7	2.5	2.5	2.3	2.4	0.2	0.1					
28	-0.4	-0.9	-0.9	2.7	2.6	2.6	2.6	0.1	0.0					
29				2.4		2.4		0.0	0.0					
30														
31														
Average	-1.2	-1.7	-1.8	3.0	2.9	2.7	2.7	0.2	0.2	Hours Aug	105.00			0.2
Min	-0.2	±0.1	0.0	2.0	2.0	1.8	1.9	0.0	0.0	Cum. Hrs.	222.25			-1.2
Max	-3.9	-6.1	-6.3	3.8	3.7	3.5	3.4	1.0	0.6	%	2.5	91.0	4.1	1.9

[1]Mississippi River at Lock and Dam 14 (LeClaire,IA); www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI14&fid=LECI4&dt=S;
all other data collected by QCNS, 2006

[2]Day = 08:00-19:59, Night = 20:00-07:59

Note: Cordova bed predicted to be 2.3°F > ambient; SS bed predicted to be 4.3°F > ambient

Table 3-4. Intake and discharge temperatures for QCNS, September 2006.[1]

Date	Upstream/Intake Bay Temperatures			Discharge Bay Temperatures			Avg Discharge - Avg Inlet Delta "T"	Max Discharge Max Inlet Delta "T"	Discharge Flow MGD	Discharge Flow CFS	River Flow CFS	Calculated Maximum Downstream Delta T	Calculated Maximum Downstream Temperature	Maximum Downstream Temperature Measured	Hours Accumulated	Maximum Downstream Delta T Measured
	Minimum	Average	Maximum	Minimum	Average	Maximum										
1	73.8	74.7	75.3	102.5	103.2	103.8	28.5	28.5	1,416	2191	25,400	2.5	77.8			
2	74.8	75.4	76.1	103.1	103.8	104.6	28.4	28.5	1,416	2191	25,100	2.5	78.6			
3	75.6	75.7	76.0	101.1	103.4	104.5	27.7	28.5	1,416	2191	23,400	2.7	78.7			
4	75.4	76.0	76.5	103.7	104.3	104.7	28.3	28.2	1,416	2191	21,200	2.9	79.4			
5	75.0	75.5	76.1	102.9	103.6	104.2	28.1	28.1	1,416	2191	21,200	2.9	79.0			
6	74.8	75.2	75.5	102.8	103.3	103.8	28.1	28.3	1,416	2191	23,700	2.6	78.1			
7	74.2	75.1	76.1	102.5	103.4	104.2	28.3	28.1	1,416	2191	27,700	2.2	78.3			
8	74.8	75.7	76.6	103.1	103.9	104.9	28.2	28.3	1,416	2191	27,600	2.2	78.8			
9	75.0	75.7	76.0	103.5	104.0	104.3	28.3	28.3	1,416	2191	25,000	2.5	78.5			
10	73.1	74.4	75.3	101.4	102.7	103.7	28.3	28.4	1,416	2191	22,800	2.7	78.0			
11	70.2	72.1	73.2	99.1	100.5	101.5	28.4	28.3	1,416	2191	22,500	2.8	76.0			
12	68.5	69.3	70.2	96.9	97.7	99.1	28.4	28.9	1,416	2191	28,200	2.2	72.4			
13	67.9	68.2	68.5	96.3	96.7	97.0	28.5	28.5	1,396	2160	37,600	1.6	70.1			
14	67.1	67.9	68.7	95.5	96.5	97.3	28.6	28.6	1,396	2160	34,900	1.8	70.5			
15	67.7	68.7	69.8	96.4	97.5	98.4	28.8	28.6	1,396	2160	28,200	2.1	72.0			
16	68.6	69.7	70.9	97.2	98.2	99.4	28.5	28.5	1,396	2160	27,000	2.3	73.2			
17	70.1	70.6	71.6	96.1	98.3	100.2	27.7	28.6	1,416	2191	24,300	2.6	74.2			
18	68.7	69.8	70.7	97.1	98.0	99.1	28.2	28.4	1,416	2191	24,400	2.6	73.3			
19	63.8	66.2	68.9	92.3	94.5	97.0	28.3	28.1	1,396	2160	24,400	2.5	71.4			
20	62.5	63.0	63.7	88.7	91.1	92.3	28.1	28.6	1,396	2160	30,100	2.1	65.8			
21	62.0	62.7	63.3	88.1	89.5	91.9	NA	28.6	1,396	2160	28,700	2.2	65.5			
22	63.3	64.7	65.1	91.9	92.9	93.4	28.2	28.3	1,396	2160	24,000	2.5	67.6			
23	64.4	64.9	65.4	92.5	93.1	93.5	28.2	28.1	1,396	2160	21,200	2.9	68.3			
24	62.9	63.6	64.3	91.6	92.0	92.5	28.4	28.2	1,396	2160	22,600	2.7	67.0			
25	62.4	63.0	63.5	91.3	91.6	91.9	28.6	28.4	1,396	2160	25,800	2.4	65.9			
26	62.2	63.1	64.3	90.9	91.7	92.7	28.6	28.4	1,396	2160	27,900	2.2	66.5			
27	63.1	63.4	64.2	91.6	92.0	92.7	28.6	28.5	1,396	2160	27,700	2.2	66.4			
28	62.1	62.5	63.1	90.5	90.9	91.6	28.4	28.5	1,396	2160	28,000	2.2	65.3			
29	60.7	61.5	62.4	89.3	90.1	90.8	28.6	28.4	1,396	2160	27,800	2.2	64.6			
30	60.0	60.4	61.1	89.0	90.1	91.1	29.7	30.0	1,396	2160	25,900	2.5	63.6			
31																
	Monthly Maximum		76.6			104.9		30.0				2.9	79.4	0.0	Total Hrs = 0	0.0

[1]Data from QCNS 2006

Table 3-5. Comparison of Upstream bed habitat conditions between July 2004, July and October 2005, and August and September 2006.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Average
Sample date	July 15- 16, 2004	July 28, 2005	Oct. 6, 2005	Aug. 5, 2006	Sept. 22-25, 2006	
Discharge (cfs)[1]	67,226; 65,969	41,262	52,887	35,139	21,257;25,820	
Intake temp (F)[2]		79.2		84.6	63 to 64.9	
Substrate temp (°F)				84.7		
Dist from bank (m)	45 to 115	45 to 115	45 to 115	45 to 115	45 to 115	
Dist from mix zone (m)	730 to 1130	730 to 1130	730 to 1130	730 to 1130	730 to 1130	
Substrate Ave % (CV)[3]						
% Boulder	-	-	-	-	-	
% Cobble	-	-	-	-	-	
% Gravel	1 (300)	0.3 (632)	2 (192)	1(268)	0.3(410)	0.9
% Sand	57 (66)	88 (18)	56 (67)	71(50)	64(55)	67.2
% Silt	36 (99)	11 (126)	15 (159)	9(143)	12(88)	16.6
% Clay	5 (224)	1 (304)	26 (121)	18(142)	21(140)	14.2
% Detritus	0.1 (755)	-	0.1 (954)	0	1(881)	0.2
% Shell	0.7 (343)	-	1 (215)	1(496)	0.5(396)	0.6
Depth (m)						
Ave.	3.4	2.7	4.9	3.3	3.4	3.5
Range	(0.9 to 6.4)	(0.6 to 5.8)	(0.9 to 7.3)	(0.9 to 5.8)	(0.6 to 6.4)	
CV	16	51	102	36	30	
Temp (°F)						
Ave.	77.9	80.4	67.8	85.3	62.1	74.7
Range	(77.5 to 79.0)	(79.7 to 80.6)	(67.5 to 68.2)	(84.6 to 85.6)	(61.0 to 62.2)	
CV	2	1	1	1	1	
DO (mg/L)						
100% saturation for temp.	8.2	8.0	9.1	7.6	9.7	8.5
Ave.	6.2	12.1	8.4	11.3	8.1	9.2
Range	(6.0 to 7.2)	(11.1 to 12.5)	(8.1 to 8.9)	(9.7 to 11.8)	(7.1 to 9.4)	
CV	22	2	3	1	6	
Current velocity (m/sec)						
Ave.	0.5	0.3	0.4	0.04	0.1	0.3
Range	(0.2 to 0.6)	(0.03 to 0.60)	(0.19 to 0.54)	(0 to 0.2)	(0.1 to 0.2)	
CV	30	53	27	165	25	
Rel. zebra mussel inf.[4]	Moderate	0.1 (0 to 2)	0.7 (0 to 7)	0.8 (0 to 15)	1.4 (0 to 30)	

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)
[2]Calculated temperatures represent Upstream/Intake Bay temperatures (see Table 3-3)
[3]CV=coefficient of variation (Standard deviation*100/mean)
[4]Moderate=a few zebra mussels attached to most unionids
2005 and 2006, average and range of zebra mussels per unionid

Table 3-6. Comparison of temperature records during August 2006 sampling.

		4-Aug-06	5-Aug-06
Intake	(°F)	84.9	84.6
Up Bed bottom	(°F)		85.3
Up Bed substrate	(°F)	85.6	84.9
Max. calc. downstrm	(°F)	87.8	87.3
QCNS measured	(°F)	86.0	
SS Bed bottom	(°F)	88.0	
SS Bed N substrate	(°F)	88.1	87.7
SS Bed S substrate	(°F)	87.9	87.4
Cordova bottom	(°F)	87.3	

Table 3-7. Comparison of Upstream bed unionid community characteristics between July 2004, July and October 2005, and August and September 2006

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Average
Species rel. abundance (%)[1]						
Ambleminae						
Amblema plicata	17.5	20.3	18.7	22.9	25.0	20.9
Fusconaia ebena	WD	-	WD	WD		WD
Fusconaia flava	6.2	1.4	5.2	4.8	4.8	4.5
Megalonaias nervosa	-	1.4	-	X	X	0.3
Pleurobema sintoxia				WD		WD
Quadrula metanevra	1.0	-	WD			0.2
Quadrula nodulata	1.0	X	1.2	2.4	0.8	1.1
Quadrula p. pustulosa	8.2	4.3	9.1	6.0	5.2	6.6
Quadrula quadrula	6.2	4.3	6.7	7.2	9.3	6.8
Tritogonia verrucosa	WD	-	WD			WD
Total Ambleminae	40.1	31.9	40.9	43.4	45.2	40.3
Anodontinae						
Arcidens confragosus	X	X	0.4	1.2	X	0.3
Lasmigona c. complanata	X	1.4	2.4	2.4	2.8	1.8
Pyganodon grandis	X	<0.5	1.2	X	X	0.2
Strophitus undulatus	WD	-	-			WD
Utterbackia imbecillis	1.0	<0.5	0.4	X	2.4	0.8
Total Anodontinae	1.0	1.4	4.4	3.6	5.2	3.1
Lampsilinae						
Actinonaias ligamentina	X	-	-			X
Ellipsaria lineolata	**1.0**	**1.4**	**X**	**X**	**X**	**0.5**
Lampsilis cardium	5.2	11.6	7.9	6.0	9.3	8.0
Lampsilis higginsii	-	**X**	**0.4**	**X**	**0.8**	**0.2**
Lampsilis teres	WD	1.4	WD		WD	0.3
Leptodea fragilis	6.2	11.6	7.1	6.0	4.8	7.1
Ligumia recta	**1.0**	**X**	**0.8**	**1.2**	**1.2**	**0.8**
Obliquaria reflexa	38.1	30.4	27.8	27.7	25.4	29.9
Obovaria olivaria	5.2	2.9	2.4	2.4	1.2	2.8
Potamilus alatus	X	X	X	2.4	X	0.5
Potamilus ohiensis	1.0	2.9	0.8	2.4	0.8	1.6
Toxolasma parvus	-		1.2	WD		0.2
Truncilla donaciformis	X	4.3	5.6	4.8	4.8	3.9
Truncilla truncata	1.0		0.8	WD	1.2	0.6
Total Lampsilinae	58.7	66.7	54.8	53.0	49.6	56.5

Table 3-7. Comparison of Upstream bed unionid community characteristics between July 2004, July and October 2005, and August and September 2006 (cont.)

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Average
Total no.[2]	902	399	822	609	508	648.0
Ave. no./m^{2}[,1]	8.1±3.1A	6.9±3.2A	11.2±2.6A	8.3±4.2A	11.0±4.3A	9.1
Ave. CPUE [3]	57.5	15.7	22.8	26.2	12.4	26.9
No. species/qual sample	10.7	6.0	6.3	7.4	6.0	7.3
Total no. species[2]	21	21	21	20	21	20.8
Cumulative live/FD species	21	24	25	25	25	24.0
Theoretical species richness[3]						
100	13	16	14	15	14	14.3
250	15	19	17	18	17	17.0
500	17	21	19	20	19	19.2
1000	19	24	21	22	21	21.3
5000	23	29	26	27	26	26.2
Regression slope	6.53	7.85	6.99	7.3	7.1	7.2
Ave. no.≤5yrs/m^{2}[,1]	1.3 ±0.9B	1.5 ±0.9AB	3.7 ±1.1A	3.8±2.2AB	3.9±1.2A	2.8
Ave. no.>5yrs/m^{2}[,1]	6.7 ±2.5A	5.4 ±2.8A	7.5±1.9A	4.5±2.5A	7.2±3.5A	6.3
%≤3 years old[1]	3.1	18.6	24.2	37.3	23	21.2
%≤5 years old[1]	36.1	42.0	50.4	56.6	50	47.0
% of species w/ ≤5 yrs[1]	73.3	46.7	80.0	47	81	65.6
Ave. no. FD/m^{2}[,1]	0.6 ±0.5A	0.1±0.2A	0.4±0.3A	0.6±0.5A	2.0±0.8B	0.7
%Mortality[1]	6.7	1.4	3.1	6.7	15.1	6.6
% adult mortality				10	8.9	9.5
% juvenile mortality				2.6	24.8	13.7
<u>Ambleminae</u>						
Total no.[1]	39	22	103	36	112	62.4
Total no.[3]	396	145	236	230	128	227.0
Ave. no./m^{2}[,1]	3.3±1.6A*	2.2±1.3A*	4.6±1.4A*	3.6±2.1A*	5.0±1.8A*	3.7*
Ave. no.≤5yrs/m^{2}[,1]	0.5±0.4AB	0.1±0.2A	1.7±0.7BC	1.6±1.1ABC	2.1±0.8C	1.2
Ave. no.>5yrs/m^{2}[,1]	2.8±1.3A	2.1±1.2A	2.9±0.9A	2.0±1.6A	2.9±1.4A	2.5
% young	15.4	4.5	36.9	44.4	42.0	28.6
Total no. species[2]	6	6	5	6	6	5.8
Total no. juv species	6	4	5	5	5	5.0
Total no. adult species	5	6	5	6	6	5.6
Ave. no. FD/m^{2}[,1]	0.1±0.2A	0A	0.1±0.1A	0.1±0.2A	0.3±0.3A	0.1
%Mortality[1]	2.5	0	1.9	2.7	5.9	2.6
% adult mortality				4.8	3.0	3.9
% juvenile mortality				0	9.6	4.8
<u>Lampsilinae</u>						
Total no.[1]	57	46	138	44	123	81.6
Total no.[3]	378	169	321	273	154	259.0
Ave. no./m^{2}[,1]	4.7±2.0A*	4.6±2.1A#	6.1±1.5A#	4.4±2.1A*	5.5±2.5A*	5.06#
Ave. no.≤3yrs/m^{2}[,1]	0.8±0.7A	1.4±0.9A	2.0±0.8A	2.2±1.5A	1.5±0.8A	1.6
Ave. no.>3yrs/m^{2}[,1]	3.9±1.6A	3.2±1.7A	4.1±1.3A	2.2±1.1A	3.9±2.0A	3.5
% young	17.5	30.4	32.6	50.0	26.0	31.3
Total no. species[2]	11	10	12	10	11	10.8
Total no. juv species	9	5	9	10	8	8.2
Total no. adult species	11	9	11	7	10	9.6
Ave. no. FD/m^{2}[,1]	0.4±0.5A	0A	0.2±0.2A	0.4±0.4A	1.5±0.6B	0.6
%Mortality[1]	8.1	0	3.5	8.3	21.7	8.3
% adult mortality				12.0	12.5	12.3
% juvenile mortality				4.3	39.6	22.0

[1]Quantitative data only; [2]Quantitative and Qualitative combined; [3]Qualitative data only
Different letters within a row indicates a significant difference (ANOVA, $p<0.05$)
Different symbols within a column indicates a significant difference (t-test; $p<0.10$)

Table 3-8. Comparison of Steamboat Slough bed habitat conditions between July 2004, July and October 2005, and August and September 2006.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Average
Sample date	July 16, 2004	July 26 -28, 2005	Oct 5- 6, 2005	Aug 4-5, 2006	Sept 20-24, 2006	
Discharge (cfs)[1]	65,969	39,203; 41,262	54,383; 52,887	27,695;35,189	21,257;30,178	
Calc. downstream temp (F)[2]	79.9	81.8, 77.9		87.3, 86.6	65.5,68.3	
Substrate temp N end				88.0, 87.4		
Substrate temp S end				88.0, 87.1		
Dist from bank (m)	35 to 115	35 to 115	35 to 115	35 to 115	35 to 115	
Dist from mix zone (m)	675 to 1125	675 to 1125	675 to 1125	675 to 1125	675 to 1125	
Substrate Ave % (CV)[3]						
% Boulder	-	-	2 (22)	-	-	0.4
% Cobble	0.2 (762)	-	-	-	-	0.0
% Gravel	0.5 (645)	-	-	-	-	0.1
% Sand	90 (21)	91 (21)	95 (16)	69(35)	71(29)	83.2
% Silt	6 (200)	9 (211)	3 (166)	23(83)	26(67)	13.4
% Clay	3 (281)	0.1 (632)	-	6(105)	2(174)	2.2
% Detritus	0.7 (313)	1 (371)	-	2(207)	1(352)	0.9
% Shell	-	-	0.1 (954)	-	-	0.0
Depth (m)						
Ave.	2.4	1.8	2.7	2.0	2.1	2.2
Range	(1.7 to 3.7)	(0.9 to 2.7)	(0.9 to 4.3)	(1.2 to 3.4)	(1.2 to 3.3)	
CV	24.3	20.0	74.1	32	18	
Temp (°F)						
Ave.	79.7	85.1	71.1	88.0	66.4	78.0
Range	(77.0 to 80.6)	(81.5 to 86.0)	(69.4 to 73.2)	(87.4 to 88.7)	(64.6 to 67.1)	
CV	1.2	3.0	4.4	0.6	1.3	
DO (mg/L)						
100% saturation for temp.	8.0	7.7	9.1	7.4	9.3	8.2
Ave.	6.7	9.1	8.1	10.9	8.5	8.7
Range	(6.4 to 7.4)	(7.5 to 12.8)	(7.8 to 8.9)	(5.1 to 12.0)	(7.9 to 9.5)	
CV	10.9	20.7	3.1	14	4	
Current velocity (m/sec)						
Ave.	0.4	0.2	0.3	0.03	0.1	0.2
Range	(0.2 to 0.6)	(0.11 to 0.30)	(0.14 to 0.45)	(0 to 0.19)	(0.09 to 0.2)	
CV	15.7	20.7	30.5	185	22.6	
Rel. zebra mussel inf.[4]	Minor	0.1 (0 to 1)	0.1 (0 to 10)	-	0.02 (0 to 1)	

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)
[2]Calculated temperatures represent downstream of discharge (see Table 3-3)
[3]CV=coefficient of variation (Standard deviation*100/mean)
[4]Minor=a few zebra mussels attached to a few unionids
2005 and 2006, average and range of zebra mussels per unionid

Table 3-9. Comparison of Steamboat Slough bed unionid community characteristics between July 2004, July and October 2005, and August and September 2006.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Average
Species rel. abundance (%)[1]						
Ambleminae						
Amblema plicata	41.5	26.8	30.9	32.2	22.3	30.7
Fusconaia ebena	-	-	-			
Fusconaia flava	X	9.8	2.1	1.1	3.2	3.2
Megalonaias nervosa	-	-	-			
Pleurobema sintoxia				X		X
Quadrula metanevra	-	-	-			
Quadrula nodulata	9.8	2.4	6.4	11.1	13.8	8.7
Quadrula p. pustulosa	4.9	7.3	5.3	4.4	3.2	5.0
Quadrula quadrula	4.9	14.6	17.0	12.2	11.7	12.1
Tritogonia verrucosa	-	-	-			
Total Ambleminae	61.1	61.0	61.7	61.1	54.3	59.8
Anodontinae						
Arcidens confragosus	X	2.4	X			0.5
Lasmigona c. complanata	2.4	X	X	X	1.1	0.7
Pyganodon grandis	X	2.4	X	1.1	FD	0.7
Strophitus undulatus	-	-	-			
Utterbackia imbecillis	-	X	X		FD	X
Total Anodontinae	2.4	4.9	0.0	1.1	1.1	1.9
Lampsilinae						
Actinonaias ligamentina	-	-	-		X	X
Ellipsaria lineolata	**2.4**	**X**	-			0.5
Lampsilis cardium	4.9	X	5.3	4.4	7.4	4.4
Lampsilis higginsii	-	-	-			
Lampsilis teres	-	-	-			
Leptodea fragilis	X	2.4	4.3	2.2	3.2	2.4
Ligumia recta	-	-	**1.1**	X	1.1	0.4
Obliquaria reflexa	26.8	22.0	22.3	23.3	19.1	22.7
Obovaria olivaria	2.4	-	X	X	2.1	0.9
Potamilus alatus	-	-	X	1.1		0.2
Potamilus ohiensis	X	7.3	3.2	4.4	7.4	4.5
Toxolasma parvus	-	-	WD			WD
Truncilla donaciformis	-	2.4	2.1	2.2	4.3	2.2
Truncilla truncata	-	X	X			
Total Lampsilinae	36.5	34.1	38.3	37.8	44.7	38.3

Table 3-9. Comparison of Steamboat Slough bed unionid community characteristics between July 2004 (cont.), July and October 2005, and August and September 2006.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	
Total no.[2]	547	426	657	398	537	513.0
Ave. no./m^{2,1}	3.4±2.0A	4.1±1.2A	4.2±0.9A	9.0±2.6B	4.2±1.0A	5.0
Ave. CPUE [3]	36.4	19.3	22.5	15.4	17.7	22.3
Ave. no. species/qual sample[3]	7.8	5.6	7.2	6.0	6.3	6.6
Total no. species[2]	15	16	18	16	16	16.2
Cumulative live/FD species	15	18	19	20	21	
Theoretical species richness[3]						
100	12	11	13	12	10	11.7
250	14	14	16	14	12	14.0
500	16	15	18	16	14	15.8
1000	17	17	20	18	15	17.4
5000	22	21	24	22	19	21.6
Regression slope	5.8	5.6	6.5	6.0	5.1	5.8
Ave. no.≤5yrs/m^{2,1}	0.2 ±0.2A	0.4 ±0.4A	0.4 ±0.2A	1.8±0.8B	1.5±0.5B	0.9
Ave. no.>5yrs/m^{2,1}	3.3 ±2.0A	3.7 ±1.2A	3.8 ±0.9A	7.2±2.3B	2.7±0.8A	4.1
%≤3 years old[1]	2.4	4.8	6.4	10	28	10.3
%≤5 years old[1]	9.8	11.9	11.7	23	37	18.8
% of species w/ ≤5 yrs[1]	33.3	41.7	63.6	67	85	58.0
Ave. no. FD/m^{2,1}	0.2 ±0.2A	0.1 ±0.2A	0.1 ±0.2A	0.1±02A	0.5±0.3A	0.2
%Mortality[1]	4.7	2.4	3.1	1.1	8.7	4.0
% adult mortality				1.4	9	5.2
% young mortality				0	8.3	4.2
Ambleminae						
Total no. [1]	25	25	58	55	51	42.8
Total no. [3]	335	259	347	207	275	284.6
Ave. no./m^{2,1}	2.1±1.4A*	2.5±1.0A*	2.6±0.7A*	5.5±2.2B*	2.3±0.7A*	3*
Ave. no.≤5yrs/m^{2,1}	0.2±0.2A	0.2±0.3AB	0.2±0.2AB	1.2±0.7B	0.8±0.4BC	0.5
Ave. no.>5yrs/m^{2,1}	2.0±1.3A	2.3±1.0AB	2.4±0.7AB	4.3±1.9B	1.5±0.6A	2.5
% young	8.0	8.0	6.9	21.8	33.3	15.6
Total no. species[2]	5	5	5	6	5	5.2
Total no. juv species	5	4	4	4	5	4.4
Total no. adult species	5	5	5	6	5	5.2
Ave. no. FD/m^{2,1}	0.1±0.2A	0A	0.04±0.09A	0.1±02A	0.04±0.09A	0.1
%Mortality[1]	3.8	0	1.7	1.8	1.9	1.8
% adult mortality				2.3	2.9	2.6
% young mortality				0	0	0.0
Lampsilinae						
Total no. [1]	15	14	36	34	42	28.2
Total no. [3]	163	123	197	99	265	169.4
Ave. no./m^{2,1}	1.3±0.9A*	1.4±0.8A#	1.6±0.6A#	3.4±1.3BC*	1.9±0.7AC*	1.92#
Ave. no.≤3yrs/m^{2,1}	0A	0.2±0.3AB	0.2±0.2AB	0.6±0.5B	0.7±0.4B	0.3
Ave. no.>3yrs/m^{2,1}	1.3±0.9A	1.2±0.7A	1.4±0.6A	2.8±1.3A	1.2±0.5A	1.6
% young	0	14.3	11.1	17.6	35.7	15.7
Total no. species[2]	9	7	10	8	8	8.4
Total no. juv species	7	3	5	6	6	5.4
Total no. adult species	7	7	10	6	8	7.6
Ave. no. FD/m^{2,1}	0.1±0.2A	0.1 ±0.2A	0.1±0.1A	0A	0.3±0.2A	0.1
%Mortality[1]	6.3	6.7	7.1	0	12.5	6.5
% adult mortality				0	12.9	6.5
% young mortality				0	11.8	5.9

[1]Quantitative data only; [2]Quantitative and Qualitative combined; [3]Qualitative data only
Different letters within a row indicates a significant difference (ANOVA, $p<0.05$)
Different symbols within a column indicates a significant difference (t-test; $p<0.10$)

Table 3-10. Comparison of Cordova bed habitat conditions between July 2004, July and October 2005, and August and September 2006

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Average
Sample date	Jul 13-14, 2004	July 27, 2006	Oct 3-4, 2005	Aug 3-4, 2006	Sept 20-24, 2006	
Discharge (cfs)[1]	72,916; 69,220	38,153	47,125; 52,245	18,544;27,695	21,257;30,178	
Dist from bank (m)	10 to 90	10 to 90	10 to 90			
Dist from mix zone (m)	3030 to 3365	3030 to 3365	3030 to 3365			
Substrate Ave % (CV)[2]						
% Boulder	0.5	3 (2.6)	2 (700)	0	0	1.1
% Cobble	2 (377)	-	1 (663)	0.5(624)	0.3(500)	0.8
% Gravel	13 (152)	6 (118)	10 (142)	13(120)	8(113)	10.0
% Sand	33 (105)	77 (29)	66 (39)	40(64)	43(66)	51.8
% Silt	27 (106)	6 (128)	9 (212)	9 (116)	21(86)	14.4
% Clay	13 (185)	-	-	19(131)	7(208)	7.8
% Detritus	0.7 (332)	-	0.3 (412)	0	0	0.2
% Shell	12 (181)	8 (171)	13 (143)	18(135)	18(147)	12.2
% vegetation				0.3(624)	1(479)	0.3
Depth (m)						
Ave.	2.0	2.1	3.0	1.7	2.2	2.2
Range	(0.6 to 3.4)	(1.2 to 3.7)	(0.6 to 6.7)	(0.6 to 3.0)	(0.1 to 6.4)	
CV	28.3	85.7	146.7	45	57	
Temp (°F)						
Ave.	77.5	77.5	65.5	87.3	64.2	74.4
Range	(73.4 to 79.3)	(73.4 to 80.2)	(54.0 to 67.1)	(85.6 to 89.1)	(63.9 to 65.3)	
CV	0.6	5.9	5.3	2.8	1.0	
DO (mg/L)						
100% saturation for temp.	8.3	8.3	9.4	7.5	9.4	8.5
Ave.	6.0		8.3	8.5	7.8	7.7
Range	(5.7 to 6.6)		(7.2 to 14.0)	(7.7 to 9.6)	(4.3 to 18.1)	
CV	12.6		3.7	7.3	55.6	
Current velocity (m/sec)						
Ave.	0.2	0.2	0.2	0.04	0.06	0.1
Range	(0.1 to 0.4)	(0.06 to 0.30)	(0.05 to 0.45)	(0 to 0.2)	(0.01 to 0.13)	
CV	48.2	41.6	53.6	127	52	
Rel. zebra mussel inf.[3]	Very heavy	0.3 (0 to 5)	1.3 (0 to 50)	0.1 (0 to 20)	0.3 (0 to 12)	

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)
[2]CV=coefficient of variation (Standard deviation*100/mean)
[3]Very heavy=most unionids coated or encased with zebra mussels; 2005 and 2006, average and range of zebra mussels per unionid

Table 3-11. Zebra mussel occurrence in the Cordova Bed, 1991 to 2003.

Year	Density (no./m2)	% of unionids infested	Ave. no/unionid	Source
1991	0			Miller and Payne (1993)
1992	0			Miller and Payne (1994)
1993				
1994	8.2			Miller and Payne (1995)
1999		74	<50	ESI (1999a)
2000 (near bank)	Substrate covered	100	<30 near bank	Helms (2000), ESI (2001)
2000 (riverward)			encrusted	
2001		Few	<5	ESI (2002)
2001	3000 to 4000			Farr *et al.* (2002)
2002		33	<10	ESI (2004)
2003	813			ERDC (2003)

Table 3-12. Comparison of Cordova bed unionid community characteristics between July 2004, July and October 2005, and August and September 2006

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Average
Species rel. abundance (%)[1]						
Ambleminae						
Amblema plicata	27.9	50.0	24.6	27.0	35.8	33.1
Fusconaia ebena	WD	-	-	-	-	WD
Fusconaia flava	X	3.3	3.1	2.7	4.5	2.7
Megalonaias nervosa	2.9	X	4.6	2.7	4.5	2.9
Quadrula metanevra	WD	-	-	-	-	WD
Quadrula nodulata	-	-	-	2.7	FD	0.5
Quadrula p. pustulosa	5.9	6.7	4.6	2.7	4.5	4.9
Quadrula quadrula	2.9	X	2.3	2.7	X	1.6
Tritogonia verrucosa	SF	-	WD	-	-	WD
Total Ambleminae	39.6	60.0	39.2	40.5	49.3	45.7
Anodontinae						
Arcidens confragosus	X	3.3	X	X	X	0.7
Lasmigona c. complanata	1.5	X	1.5	WD	1.5	0.9
Pyganodon grandis	X	X	0.8	8.1	X	1.8
Strophitus undulatus	-	-	-	-	-	-
Utterbackia imbecillis	X	FD	1.5	2.7	FD	0.8
Total Anodontinae	1.5	3.3	3.8	10.8	1.5	4.2
Lampsilinae						
Actinonaias ligamentina	X	-	-	-	1.5	0.3
Ellipsaria lineolata	**WD**	-	**X**	2.7	-	0.5
Lampsilis cardium	7.4	6.7	5.4	16.2	6	8.3
Lampsilis higginsii	**1.5**	**X**	**0.8**	2.7	4.5	1.9
Lampsilis siliquoidea	-	-	-	-	X	X
Lampsilis teres	-	-	-	-	-	-
Leptodea fragilis	33.8	16.7	29.2	8.1	10.4	19.6
Ligumia recta	**1.5**	**X**	**6.2**	5.4	7.5	4.1
Obliquaria reflexa	8.8	3.3	6.9	5.4	14.9	7.9
Obovaria olivaria	X	X	0.8	X	WD	0.2
Potamilus alatus	X	X	0.8	5.4	1.5	1.5
Potamilus ohiensis	1.5	3.3	X	-	FD	1.0
Toxolasma parvus	1.5	6.7	3.8	-	1.5	2.7
Truncilla donaciformis	2.9	-	2.3	X	1.5	1.3
Truncilla truncata	WD	-	0.8	2.7	-	0.7
Total Lampsilinae	58.9	36.7	56.9	48.6	49.3	50.1

Table 3-10. Comparison of Cordova bed unionid community characteristics between July 2004, July and October 2005, and August and September 2006

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Average
Total no.[2]	320	164	375	430	745	406.8
Ave. no./m^{2,1}	5.7±1.9A	3.1±1.3AB	5.8±1.5A	3.7±1.5AB	3.0±1.1B	4.3
Ave. CPUE [3]	15.8	6.7	10.2	19.7	27.1	15.9
Ave. no. species/qual sample[3]	6.6	3.3	5.1	7.4	7.4	6.0
Total no. species[2]	20	18	21	19	20	19.6
Cumulative live/FD species	20	20	22	23	24	
Theoretical species richness[3]						
100	15	15	15	14	12	14.0
250	18	18	17	16	14	16.8
500	21	20	20	18	16	19.0
1000	23	22	22	20	18	21.1
5000	28	27	27	25	22	25.9
Regression slope	7.7	7.4	7.3	6.8	6.0	7.0
Ave. no.≤5yrs/m^{2,1}	2.2±1.0A	0.6 ±0.4AB	2.1 ±0.9A	1.1±0.6AB	0.8±0.4B	1.4
Ave. no.>5yrs/m^{2,1}	3.5 ±1.4AB	2.5±1.2AB	3.7 ±0.9A	2.6±1.4AB	2.2±0.9B	2.9
%≤3 years old[1]	33.8	0	29.2	18.9	14.9	19.4
%≤5 years old[1]	58.8	25.7	47.7	43.2	43.2	43.7
% of species w/ ≤5 yrs[1]	53.8	55.6	61.1	62.5	71.4	60.9
Ave. no. FD/m^{2,1}	1.8 ±1.6AB	0.8 ±0.9AB	0.2 ±0.2A	0.6±0.5AB	1.4±0.6B	1.0
%Mortality[1]	24.4	21.1	3.0	14.0	31.6	18.8
% adult mortality				13.3	30.6	21.0
% juvenile mortality				15.4	32.0	23.7
Ambleminae						
Total no. [1]	27	18	51	15	33	28.8
Total no. [3]	120	79	151	221	497	213.6
Ave. no./m^{2,1}	2.3±1.1A*	1.8±1.1A*	2.3±0.8A*	1.5±0.8A*	1.5±0.7A*	1.9*
Ave. no.≤5yrs/m^{2,1}	0.8±0.6A	0.5±0.4A	0.5±0.4A	0.5±0.4A	0.4±0.3A	0.5
Ave. no.>5yrs/m^{2,1}	1.5±0.8A	1.3±1.0A	1.8±0.7A	1.0±0.6A	1.1±0.6A	1.3
% young	33.3	27.8	21.6	33.3	27.3	28.7
Total no. species[2]	6	5	5	6	5	5.4
Total no. juv species	4	2	4	6	5	4.2
Total no. adult species	6	5	5	5	5	5.2
Ave. no. FD/m^{2,1}	0.3±0.3A	0.3±0.5A	0.2±0.2A	0.2±0.3A	0.3±0.3A	0.3
%Mortality[1]	10.0	14.3	7.8	11.8	17.5	12.3
% adult mortality				9.1	7.7	8.4
% juvenile mortality				16.7	35.7	26.2
Lampsilinae						
Total no. [1]	40	11	74	18	33	35.2
Total no. [3]	116	50	72	147	147	106.4
Ave. no./m^{2,1}	3.3±1.3A*	1.1±0.7B*	3.3±1.0A*	1.8±0.9AB*	1.5±0.6B*	2.2*
Ave. no.≤3yrs/m^{2,1}	1.4±0.7A	0.1±0.2B	1.6±0.7A	0.5±0.4AB	0.4±0.2B	0.8
Ave. no.>3yrs/m^{2,1}	1.9±0.8A	1.0±0.6A	1.7±0.6A	1.3±0.8A	1.1±0.5A	1.4
% young	42.5	9.1	47.3	27.8	24.2	30.2
Total no. species[2]	11	9	12	10	10	10.4
Total no. juv species	8	4	4	7	6	5.8
Total no. adult species	9	9	12	10	9	9.8
Ave. no. FD/m^{2,1}	1.5±1.2B	0.4±0.5AB	0A	0.2±0.3AB	0.9±0.5B	0.6
%Mortality[1]	37.5	26.7	0	10.0	38.9	22.6
% adult mortality				7.1	43.2	25.2
% juvenile mortality				16.7	20.0	18.4

[1]Quantitative data only; [2]Quantitative and Qualitative combined; [3]Qualitative data only
Different letters within a row indicates a significant difference (ANOVA, $p<0.05$)

Table 3-13. Species composition comparison among study sites.

Species rel. abundance (%)[1]	Upstream	Cordova	Steamboat Slough
Ambleminae			
Amblema plicata	20.9	33.1	30.7
Fusconaia ebena	WD	WD	-
Fusconaia flava	4.5	2.7	3.2
Megalonaias nervosa	0.3	2.9	-
Pleurobema sintoxia	**WD**	**-**	**X**
Quadrula metanevra	0.2	WD	-
Quadrula nodulata	1.1	0.5	8.7
Quadrula p. pustulosa	6.6	4.9	5.0
Quadrula quadrula	6.8	1.6	12.1
Tritogonia verrucosa	WD	WD	-
Total Ambleminae	40.3	45.7	59.8
No. live species	7	6	6
Anodontinae			
Arcidens confragosus	0.3	0.7	0.5
Lasmigona c. complanata	1.8	0.9	0.7
Pyganodon grandis	0.2	1.8	0.7
Strophitus undulatus	WD	-	-
Utterbackia imbecillis	0.8	0.8	X
Total Anodontinae	3.1	4.2	1.9
No. live species	4	4	4
Lampsilinae			
Actinonaias ligamentina	X	0.3	X
Ellipsaria lineolata	**0.5**	0.5	0.5
Lampsilis cardium	8.0	8.3	4.4
Lampsilis higginsii	**0.2**	1.9	-
Lampsilis siliquoidea	-	X	-
Lampsilis teres	0.3	-	-
Leptodea fragilis	7.1	19.6	2.4
Ligumia recta	**0.8**	4.1	0.4
Obliquaria reflexa	29.9	7.9	22.7
Obovaria olivaria	2.8	0.2	0.9
Potamilus alatus	0.5	1.5	0.2
Potamilus ohiensis	1.6	1.0	4.5
Toxolasma parvus	0.2	2.7	WD
Truncilla donaciformis	3.9	1.3	2.2
Truncilla truncata	0.6	0.7	X
Total Lampsilinae	56.5	50.1	38.3
No. live species (no.)	14	14	11
Total live species (no.)	25	24	21

[1]Quantitative data average over all sample dates; additional specie collected in qualitative samples are designated with an X
State or federally listed T&E species are bolded

Figure 3-1. Minimum monthly discharge, 2000 to 2006

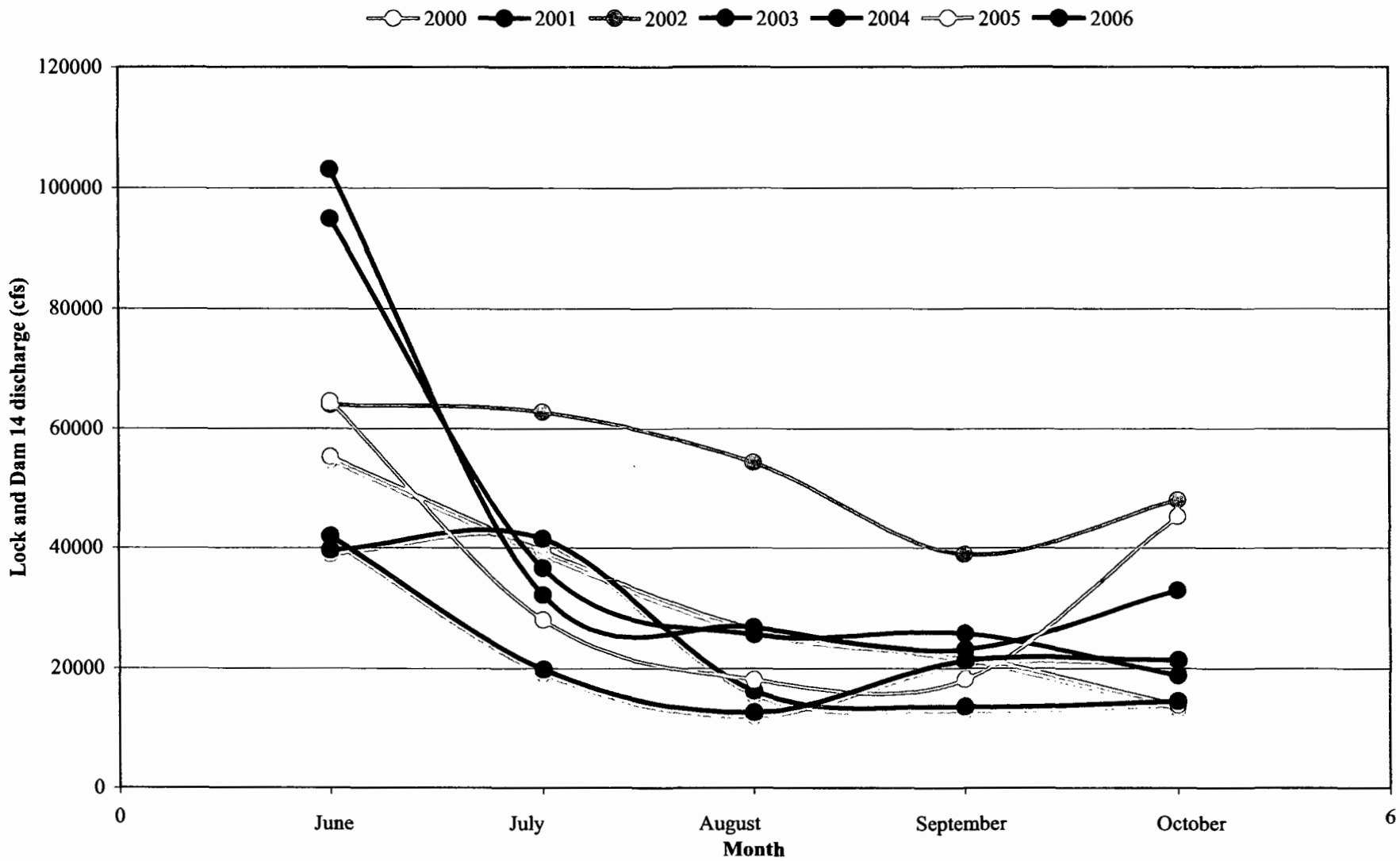

Figure 3-2. Comparison of water and substrate temperature, June to August 2006.

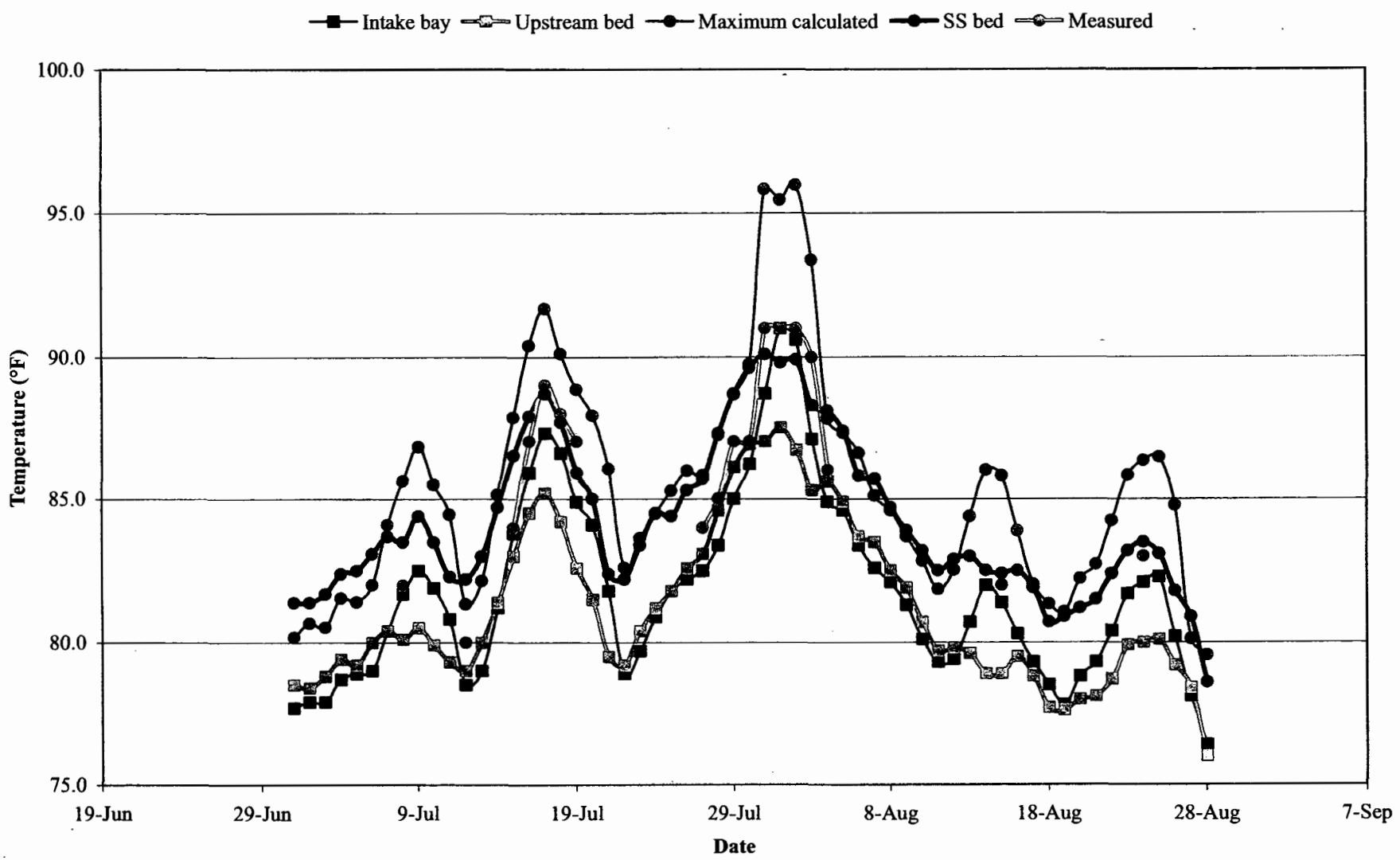

Figure 3-3. Substrate temperature duration, June to August 2006.

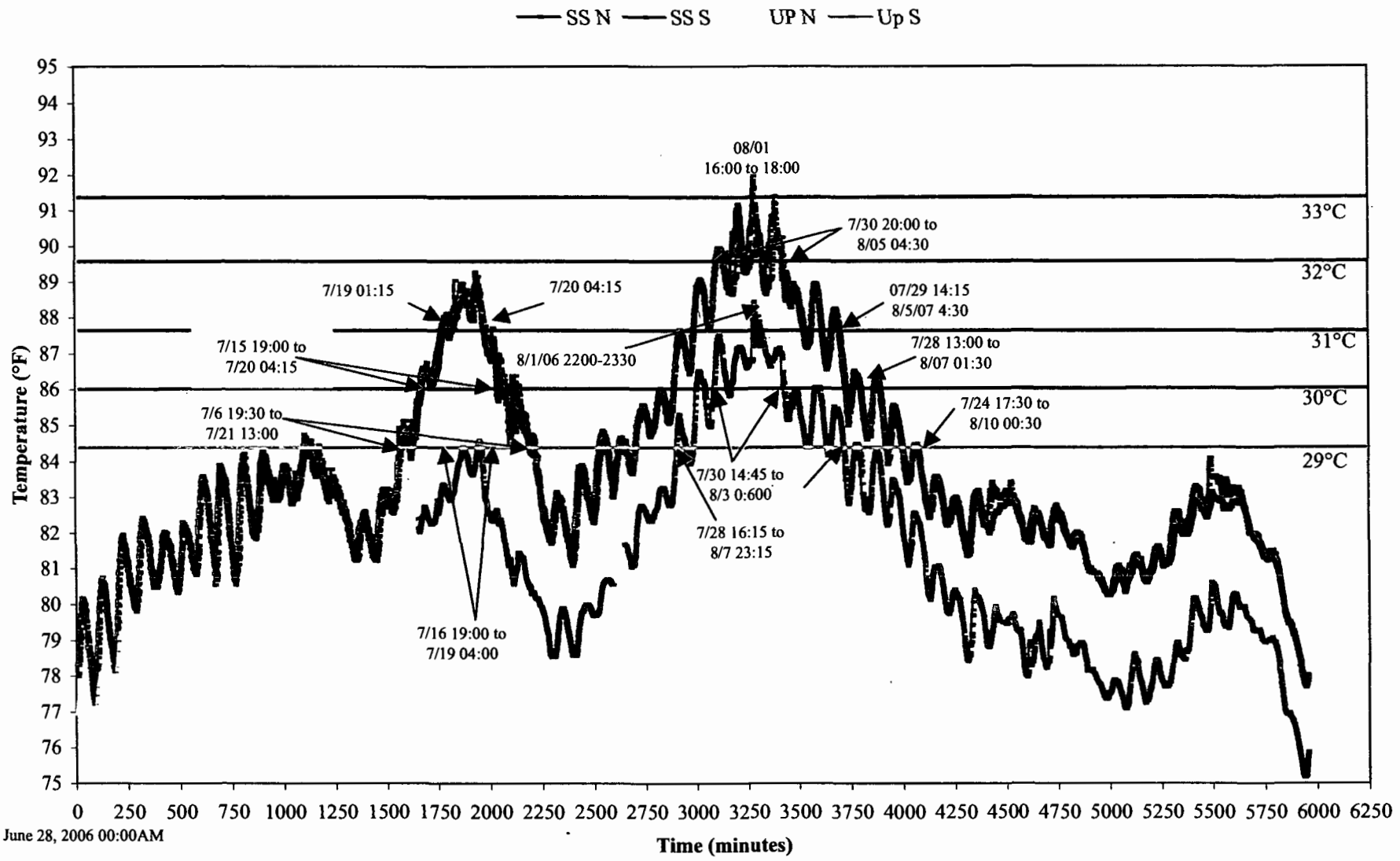

Exhibit 12

Provisional Variance IEPA 08-11

Exelon Generation
Quad Cities Generating Station
22710 206th Avenue North
Cordova, IL 61242-9740
Tel 309-654-2241

www.exeloncorp.com

Nuclear

SVP-07-050

August 10, 2007

Mr. Roger Callaway
Compliance Assurance Section
Division of Water Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, Illinois 62794

Re: Quad Cities Nuclear Power Station NPDES Permit No. IL0005037
Provisional Variance Request – Emergency Application – IEPA 08-11

Dear Mr. Callaway:

Thank you for the time, consideration and attention IEPA dedicated to Exelon's Provisional Variance Request. We sincerely appreciate all of your efforts. Below is Quad Cities Station's Certificate of Acceptance of the Provisional Variance Order issued by IEPA in this matter.

Very Truly Yours,

Timothy J. Tulon
Site Vice President
Quad Cities Station

TJT/MS/tsr

7 Pages

Certificate of Acceptance

I(We), Timothy J. Tulon, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in matter IEPA 08-11 dated August 10, 2007.

Exelon Generation Co. L.L.C/Quad Cities Station
Petitioner

Authorized Agent

Site Vice President
Title

08/10/2007
Date

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

August 10, 2007

Exelon Generation Company, L.L.C. **Quad Cities Nuclear Power Station**	)	
Petitioner,	)	
v.	)	IEPA – 08-11 (Provisional Variance-Water)
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY,	)	
Respondent.	)	

Re: Provisional Variance From Special Condition 6B of NPDES Permit IL0005037

Dear Mr. Gideon:

The Illinois Environmental Agency (Agency) has completed its technical review of the attached provisional variance request (Exhibit A) submitted by Exelon Generation Company, L.L.C. Quad Cities Nuclear Power Station (Exelon's Quad Cities Station) on August 8, 2007.

Based on the review, the Agency GRANTS the requested variance for a period of 45 days, subject to specific conditions set forth below.

Exelon's Quad Cities Station is a nuclear fueled steam electric generating facility located on the Mississippi River at River Mile 506.8 near Cordova, Illinois. It operates its cooling water system in open cycle mode. Cooling water is taken from the Mississippi River, passes through the plant system and is then discharged by diffusers into the Mississippi River. Maximum design flow of this system is 2,253 cfs. The Agency permitted the open cycle operation with diffusers on December 22, 1983.

Exelon's Quad Cities Station seeks a variance from Special Condition 6B of NPDES Permit IL0005037 (Attachment B). This condition establishes thermal discharge limits for Exelon's Quad Cities Station. Additionally, 6B allows Exelon's Quad Cities Station excursion hours from these limits. Excursion hours are periods of time in which the temperature at the edge of the mixing zone may be 3°F warmer than the temperature limit in the permit. Exelon's Quad Cities Station may only use 1% (87.6) of the hours in a 12-month period ending with any month as excursion hours.

Special Condition 6B also requires that water temperature in the Mississippi River at the edge of the mixing zone shall at no time exceed by 3°F the maximum limits of 86°F in July and August and 85°F in September. Normally, Exelon's Quad Cities Station can operate within these limits because the ambient temperature in the Mississippi River at the intake points (or above the plant) remains below the non-excursion hour temperature limit.

Under normal conditions, the Mississippi River has significant river flows. These flows enable Exelon's Quad Cities Station to meet its permit conditions even when ambient temperatures approach non-excursion hour temperature limit. At this time, however, the Mississippi River is at low flow conditions during a period of time of extreme summer heat. The river flow is currently at 31,000 cfs compared to a normal river flow of 42,000 cfs during this time of year. This low flow condition, coupled with high ambient river and air temperatures and the need to maintain power on the grid during this extreme weather condition period, have necessitated Exelon's Quad Cities Station's request for a provisional variance.

Due to the extremely hot conditions, Exelon's Quad Cities Station began using excursion hours on Thursday, August 2, 2007; it used 16.5 hours on that date. On Friday, August 3, 2007, Exelon's Quad Cities Station used an additional 17.5 hours. Exelon's Quad Cities Station expects to begin using excursion hours again during the afternoon of Thursday, August 9, 2007, and to continue to need them for the remainder of the week, given current forecasts and river flows. Exelon's Quad Cities predicts that it will use the rest of the permitted excursion hours on Saturday, August 11, 2007.

Besides needing additional excursion hours, high temperatures and low river flows have adversely affected the ability of Exelon's Quad Cities Station to meet its thermal discharge limits contain in Special Condition 6B. River flows are currently at 31,000 cfs, compared to the normal of 42,000 during this time of year. Discussions between Exelon's Quad Cities Station and the Rock Island Corps of Engineers indicate that river flow is predicted to hold in the 20,000 to 30,000 cfs range at Lock and Dam 14, with flows falling off to 14,000 cfs in about two weeks. If future forecasts are correct, the river flow will decrease even further. With mid-90's temperatures predicted over the next several days, river temperatures are expected to increase 3 to 4 degrees F. Based on a river flow of 18,000 cfs, the calculated downstream temperature rise is 3.5 degrees F. As a result, the inlet temperatures to the Exelon Quad Cities Station will approach 86 degrees F. Combined with the 3.5 degree rise by the facility, Exelon Quad Cities Station will exceed the August permitted discharge limit of 89 degrees F.

The Agency has reviewed the provisional variance request and has concluded the following:

1. Exelon's Quad Cities Station will closely monitor the environmental impact from the requested relief and will immediately notify the Agency of any significant impact, along with actions taken to remedy the problem;

2. No other reasonable alternatives appear available;

3. No public water supplies will be affected;

4. No federal regulations will preclude the granting of this request; and

5. Exelon Quad Cities Station will face an arbitrary and unreasonable hardship if the request is not granted.

The Agency hereby GRANTS Exelon's Quad Cities Station a provisional variance from Special Condition 6B of NPDES Permit IL0005037, subject to the following conditions:

1. Exelon's Quad Cities Station is granted 200 provisional variance excursion hours.

2. The provisional variance will begin on the date that Exelon's Quad Cities Station either (1) exhausts the 87.6 permitted excursion hour, or (2) on the date that Exelon's Quad Cities Station first exceeds the current permitted excursion hour temperature limits in Special Condition 6B (August 89 degrees and September 90 degrees). The provisional variance will end on the date that the 200 provisional variance excursion hours are used, but in no case later that 45 days following the start of the provisional variance period.

3. Exelon's Quad Cities Station, during the 200 provisional variance excursion hours, may exceed the maximum temperature limits stated in Special Condition 6B by no more than 5 degrees (August 91 degrees and September 90 degrees)

4. During the variance period, Exelon Quad Cities Station must continuously monitor intake, discharge and receiving water temperatures and to visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life;

5. Exelon Quad Cities Station shall document environmental conditions during the term of the provisional variance, including the activities described in 4. above of this Section, and submit the documentation to the Agency and the Department of Natural Resources within 30 days after the provisional variance expires;

6. Exelon's Quad Cities Station shall continue ongoing biological studies to characterize how fish and mussels respond to thermal conditions present in the affected portion of the Mississippi River. These studies include those mentioned on page 4 of Exelon's Quad Cities Station's August 8, 2007 Emergency Application for Provisional Variance. In addition, Exelon's Quad Cities Station must continue to conduct a mussel study specific to this provisional variance; to document this activity; and to submit the documentation for the mussel study to the Agency and the Department of Natural Resources within 60 days after completing the survey described herein. Specifically, Exelon's Quad Cities Station must prepare a study plan within three days of the beginning date of this provisional variance to address the issue of increased excursion hours (increase in thermal stress) on unionid mussels in the Mississippi River in the vicinity of the discharge. The plan must include a survey of the mussel beds identified in a recent report: Draft Report: Unionid Mussel Biothermal Assessment for the Quad Cities Nuclear Station, Mississippi River Miles 503.0 to 506.9 (attached). The survey must address the apparent health of the mussels within the mussel beds given the higher than

allowed river temperatures and longer duration of temperature excursions. Survey dives to ascertain effects on the mussel beds must begin as soon as possible after either the increase of excursion hours or maximum temperature relief afforded by the provisional variance are utilized. Conditions pertinent to the mussel populations to be recorded during the surveys will be much the same as conducted for the baseline study referenced above. These must include, but are not limited, to mussel species' occurrence and density, age, zebra mussel infestation and apparent condition, i.e., any outward signs of heat stress such as morbidity, reflex time, position in the substrate, etc. Plant discharge temperatures, upstream river temperatures, incidence of excursion hours and other pertinent information must be provided to build an understanding of the conditions to which the mussels have recently been exposed. Surveys must continue until excursion hours are no longer being used, or in other words, until the weather conditions causing the need for more excursion hours have moderated. The final report for this study must address the changes noted in mussel populations from the previous study. Verbal reports are due to the Agency at regular intervals during the surveys. These reports must include any information on mussel die-off. If mussel die-off downstream from the discharge is found and is attributable to the thermal affects of the effluent, as compared to the condition of upstream populations, a monetary settlement will be required as calculated by the formula the Illinois Department of Natural Resources uses for mussel die-off settlements;

7. Exelon Quad Cities Station shall immediately notify the Agency and the Department of Natural Resources of any unusual conditions, including mortalities to fish or other aquatic life; immediately take action to remedy the problem; investigate and document the cause and seriousness of the unusual conditions while providing updates to the Agency and the Department of Natural Resources as changes occur until normal conditions return; notify the Agency and the Department of Natural Resources when normal conditions return; and submit the documentation to the Agency and the Department of Natural Resources within 30 days after normal conditions return;

8. Exelon Quad Cities Station shall develop and implement a response and recovery plan to address any adverse environmental impact due to thermal conditions resulting from the provisional variance, including loss and damage to aquatic life;

9. By January 15, 2008, Exelon Quad Cities Station shall provide an interim report to the Agency that summarizes all additional fishery and mussel studies, and provides the status of all ongoing discussions with other agencies regarding thermal issues, and the status of research regarding long-term trends and possible alternative thermal compliance measures that will be implemented should Exelon's Quad Cities Station's request for alternate thermal limits under 316 (a) not be granted.

10. Exelon's Quad Cities Station shall notify Roger Callaway of the Agency by telephone at 217/782-9720 when the need for the 200 additional excursion hours begin and again if the excursion hours are totally used. Written confirmation of each notice shall be sent within five days to the following address:

Illinois Environmental Protection Agency
Bureau of Water - Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
Springfield, Illinois 62794-9276

11. Exelon Quad Cities Station shall sign a certificate of acceptance of this provisional variance and forward that certificate to Roger Callaway at the address indicated above within one day of the date of this order. The certification should take the following form:

I (We)_____, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in _____dated _____.

_____
Petitioner

_____
Authorized Agent

_____
Title

_____
Date

Exelon Quad Cities Station shall continue to monitor and maintain compliance with all other parameters and conditions specified in its NPDES Permit No. IL0005037.

The Illinois EPA grants this provisional variance in accordance with its authority contained in Sections 35(b), 36 (c), and 37(b) of the Illinois Environmental Protection Act (415 ILCS 5/35(b), 36(c), and 37(b) (2004). The decision to grant this provisional variance is not intended to address compliance with any other applicable laws or regulations.

Sincerely,

Robert A. Messina
Chief Legal Counsel

Exhibit 13

Provisional Variance IEPA 12-11

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740
www.exeloncorp.com

Exelon Nuclear

SVP-12-026

March 21, 2012

Mr. Roger Callaway (CAS-19)
Wastewater Compliance Unit Manager
Illinois Environmental Protection Agency
Bureau of Water
Compliance Assurance Section #19
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9274

Re: Quad Cities Nuclear Power Station NPDES Permit No. IL0005037
Provisional Variance Request – Emergency Application – IEPA 12-11

Dear Mr. Callaway:

Thank you for the time, consideration and attention IEPA dedicated to Exelon's provisional variance request. We sincerely appreciate all of your efforts. Below is Quad Cities Station's Certificate of Acceptance of the Provisional Variance Order issued by IEPA in this matter.

Very Truly Yours,

Tim Hanley
Site Vice President
Quad Cities Station

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

Certificate of Acceptance

I(We), Tim Hanley, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in matter IEPA 12-11 dated March 21, 2012.

Exelon Generation Co. L.L.C/Quad Cities Station
Petitioner

Authorized Agent

Site Vice President
Title

03/21/2012
Date

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

March 21, 2012

Exelon Generation Company, L.L.C. Quad Cities Nuclear Power Station Petitioner, v. ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, Respondent.	)	IEPA – 12-11 (Provisional Variance-Water)

Re: Provisional Variance From Discharge Limits Contained in NPDES Permit IL0005037

Dear Mr. Hanley:

The Illinois Environmental Protection Agency (Agency) has completed its technical review of the attached provisional variance request, dated March 20, 2012 (Attachment A) for Exelon Generation Company, L.L.C.'s Quad Cities Nuclear Power Station (Quad Cities). Quad Cities is seeking a provisional variance through March 31, 2012, that would allow it to exceed the maximum temperature limit in Special Condition 6B[1] of NPDES Permit IL0005037 by no more than 5° (62° for March), or 2° above ambient river temperature, whichever is greater.

Based on its review, the Agency GRANTS the District a provisional variance subject to the specific conditions set forth below.

Background

Quad Cities is a nuclear-fueled steam electric generating facility located near Cordova, Illinois, on the Mississippi River at River Mile 506.8. The two boiling water reactors have a combined maximum generating capacity of 5,914 megawatts thermal. Circulating water used to cool and condense the steam from the generating process is withdrawn from, and discharged to, the Mississippi River.

[1] In its request, Quad Cities mistakenly refers to this condition as Special Condition 7B.

Quad Cities operates a condenser cooling water system in open cycle mode. In this mode, cooling water is drawn from the Mississippi River into an intake canal, passes through the plant systems, and is discharged via diffusers into the Mississippi River (Outfalls 001 and 002). The maximum design flow is 2,253 cfs or 1,011,000 gpm. Open cycle operation with the diffusers was initially permitted by the IEPA on December 22, 1983.

Special Condition 6B of NPDES Permit IL00005037 (Attachment B) limits the temperature at the edge of the mixing zone to 57°F in March, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits. It is during periods when the ambient river temperatures are very close to or exceed the non-excursion hour limits or during periods of extreme low flows that Quad Cities is forced to use a significant number of its excursion hour allowance.

Once its allotment of excursion hours is depleted, Quad Cities must cease operating to maintain compliance with the NPDES Permit. As noted in its request (Attachment A) partial deratings or adding cooling facilities (such as cooling towers) will not allow Quad Cities to achieve compliance with a limit that already is exceeded even before any heat is added as a result of station operations.

Illinois is experiencing record breaking warm weather for this time of year; therefore Quad Cities began using excursion hours on Sunday, March 18, 2012. As of 8:00 am on March 20, 2012, Quad Cities accumulated 34.5 excursion hours due to the recent record breaking warm weather which, when combined with the 33 excursion hours Quad Cities accumulated during July of 2011, station had accumulated 67.5 excursion hours of the permit allowed 87.6 hours (1%) in a 12-month period ending with any month.

On March 21, 2012, Quad Cities reached the limit of its permitted excursion hours at approximately 4:00 am. Therefore, unless relief is granted by way of this provisional variance request, it is likely that the Quad Cities will be forced to shut down for correspondingly significant durations.

Quad Cities' request states that Unit Two has already been removed from service for the refueling outage. As a result, the number of normal AC power supplies for both Units has been reduced from four transformers to three. Removing Unit One at this time would further reduce the number of AC power supplies for both Units to two. Further reducing the number of normal AC power sources at this rime would increase the likelihood of a loss of normal AC power, reducing the margin of safety on both Units.

Relief Requested

Special Condition 6B of NPDES Permit IL0005037 limits the number of excursion hours to 1% (87.6 hours) of the hours in a 12-month period ending with any month. Specifically, Special Condition 6B provides that Quad Cities shall not cause water

temperatures in the Mississippi River (beyond the mixing zone) to exceed by more than 3°F the maximum limits of 57°F in March.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
F°	45	45	57	68	78	85	86	86	85	75	65	52

Quad Cities is requesting a provisional variance through March 31 that allows it to exceed the maximum temperature limit stated in Special Condition 6B of NPDES Permit No. IL0005037 by no more than 5° F (62°F for March) or 2°F above ambient river temperature, whichever is greater. Quad Cities had asked that the relief begin on the date that the currently permitted 87.6 excursion hours are exhausted or on the date that Quad Cities' first causes or contributes to an exceedance of the applicable permitted excursion hour temperature limit of 60°F in March. The provisional variance period will end on April 1, 2012.

Quad Cities has exhausted its excursion hours.

Agency Determinations

The Agency has reviewed the requested provisional variance and has concluded the following:

1. Any environmental impact from the requested relief shall be closely monitored and the Agency shall be immediately notified of any adverse impacts.

2. No reasonable alternatives appear available;

3. No public water supplies should be affected;

4. No federal regulations will preclude the granting of this request; and

5. Quad Cities will face an arbitrary and unreasonable hardship if the request is not granted.

Conditions

The Agency hereby GRANTS Quad Cities a provisional variance from subject to the following conditions:

A. The provisional variance shall begin on March 21, 2012, and shall end no later than April 1, 2012.

B. Quad Cities shall provide the best operation of its station to produce the best effluent possible at all times. At no time, during the variance period, shall Quad Cities cause water temperature in the Mississippi River (beyond the mixing zone) to exceed 62° or 2° F above ambient river temperature, whatever is greater.

C. During the variance period, Quad Cities must continuously monitor intake, discharge and receiving water temperatures and visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life.

D. Quad Cities shall document environmental conditions during the term of the provisional variance, including the activities described in C. above of this Section, and submit the documentation to the Agency and the Department of Natural Resources within 30 days after the provisional variance expires.

E. Quad Cities shall immediately notify the Agency and the Department of Natural Resources of any unusual conditions, including mortalities to fish or other aquatic life; immediately take action to remedy the problem; investigate and document the cause and seriousness of the unusual conditions while providing updates to the Agency and the Department of Natural Resources as changes occur until normal conditions return; notify the Agency and the Department of Natural Resources when normal conditions return; and submit the documentation to the Agency and the Department of Natural Resources within 30 days after normal conditions return.

F. Quad Cities shall develop and implement a response and recovery plan to address any adverse environmental impact due to thermal conditions resulting from the provisional variance, including loss and damage to aquatic life.

G. Quad Cities shall notify Roger Callaway of the Agency by telephone at 217/782-9720 when Quad Cities' discharge first causes or contributes to an exceedance of the applicable permitted excursion hour temperature limit of 60°F in March. Written confirmation of each notice shall be sent within five days to the following address:

Illinois Environmental Protection Agency
Bureau of Water - Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
Springfield, Illinois 62794-9276

H. Quad Cities shall sign a certificate of acceptance of this provisional variance and forward that certificate to Roger Callaway at the address indicated above within one day of the date of this order. The certification should take the following form:

I (We)_____, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in _____dated _____.

_____
Petitioner

_____
Authorized Agent

_____
Title

_____
Date

Quad Cities shall continue to monitor and maintain compliance with all other parameters and conditions specified in its NPDES Permit No. IL0005037

Conclusion

The Agency grants this provisional variance in accordance with its authority contained in Sections 35(b), 36 (c), and 37(b) of the Illinois Environmental Protection Act (415 ILCS 5/35(b), 36(c), and 37(b) (2004). The decision to grant this provisional variance is not intended to address compliance with any other applicable laws or regulations.

Sincerely,

Julie Armitage
Acting Chief Legal Counsel

cc: Marcia Willhite
Roger Callaway
Vera Herst

Exhibit 14

Special Condition G of IEPA 12-11

Exelon Nuclear

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740

www.exeloncorp.com

SVP-12-027

March 22, 2012

Illinois Environmental Protection Agency
Bureau of Water – Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
P.O. Box 19276
Springfield, Illinois 62794-9276

Subject: IEPA Order 12-11 dated March 21, 2012 related to Quad Cities Nuclear Power Station Provisional Variance Request Letter dated March 20, 2012

Dear Mr. Callaway:

In accordance with Special Condition "G" of the Agency's Order IEPA-12-11 dated March 21, 2012 regarding the provisional variance for Quad Cities Station, we are submitting written confirmation that Quad Cities Station entered the subject provisional variance on Wednesday March 21, 2012 when Quad Cities Station discharge first causes or contributes to an exceedance of the applicable permitted excursion hour temperature limit of 60°F in March. This written confirmation is a follow-up to the voice mail message and email left for you on March 21, 2012.

If you should have any questions regarding Quad Cities Station Provisional Variance IEPA-12-11, please contact Vicki Neels at (309) 227-3200 or Mark Stuhlman at (309) 227-2765 or John Petro at (630) 657-3209.

Very Truly Yours,

Tim Hanley
Site Vice President
Quad Cities Station

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

Exhibit 15

Temperatures and Fish/Aquatic Life Stress/Mortality Surveys

Exelon Nuclear

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740

www.exeloncorp.com

SVP-12-038

April 23, 2012

Illinois Environmental Protection Agency
Bureau of Water – Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
P.O. Box 19276
Springfield, Illinois 62794-9276

Subject: Provisional Variance IEPA-12-11 Temperatures and Fish/Aquatic Life Stress/Mortality Surveys

Dear Mr. Callaway:

In accordance with Special Condition "C & D" of the Agency's Order 12-11 dated March 21, 2012 regarding the provisional variance for Quad Cities Station require the following during the variance period: 1) continuously monitor intake, discharge, and receiving water temperatures, 2) visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life, 3) document environmental conditions during the term of the provisional variance, including the activities above and submit the documentation to the Agency and Department of Natural Resources within 30 days after the provisional variance expires.

Attached is the subject documentation required by provisional variance IEPA-12-11 Special Condition "C & D".

During the Variance Period there were no observations of unusual conditions including mortalities to fish or other aquatic life downstream of Quad Cities Station discharge due to station discharge.

If you should have any questions regarding Quad Cities Station Provisional Variance IEPA-12-11, please contact Vicki Neels at (309) 227-3200 or Mark Stuhlman at (309) 227-2765 or John Petro at (630) 657-3209.

Very Truly Yours,

Tim Hanley
Site Vice President
Quad Cities Station

Attachments:
Attachment 1: Quad Cities Station Provisional Variance IEPA-12-11 Temperature and Flow Data
Attachment 2: Quad Cities Station Three Times Daily Fish/Aquatic Life Stress/Mortality Surveys During Provisional Variance IEPA-12-11
Attachment 3: Time Above the Maximum Temperature Limits.

Copy to:

Mr. Dan Sallee
Dan.Sallee@Illinois.gov

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

ATTACHMENT 1

Month: March 2012 QUAD CITIES STATION PROVISIONAL VARIANCE IEPA-12-11 TEMPERATURE and FLOW DATA

Day	Temperature (°F) Intake Bay Avg.	Temperature (°F) Intake Bay Max.	Temperature (°F) Discharge Bay Avg.	Temperature (°F) Discharge Bay Max.	Daily Flow (MGD) Thru Intake	Mississippi River Flow CFS (06:00 @ L&D 14)	Temperature (°F) (Steamboat Island)** Receiving Water Avg.	Temperature (°F) (Steamboat Island)** Receiving Water Max.	Maximum Upstream Field Survey Temperature	Maximum Downstream Field Survey Temperature	On the Clock Y/N Provisional Variance (PV)
1	35	36	85.9	86.8	812	34,200					N
2	35	36	85.2	86.8	812	39,800					N
3	33	34	84.0	84.3	812	53,000					N
4	33	34	83.1	83.8	812	58,100					N
5	34	36	84.1	85.5	812	62,400					N
6	36	39	85.2	87.5	812	57,500					N
7	39	41	88.5	91.3	812	53,000					N
8	42	43	86.8	91.2	901	45,100					N
9	39	41	82.6	84.7	901	42,200					N
10	39	41	82.1	83.5	901	37,800					N
11	41	42	83.2	84.5	901	37,300					N
12	44	45	84.8	85.8	901	48,900					N
13	45	47	85.7	87.6	901	59,300					N
14	48.7	50.6	86.4	88.3	944	61,300					N
15	51.5	53.3	89.0	90.5	944	61,500					N
16	53.3	55.5	90.8	92.3	944	62,000					N
17	55.5	57.6	88.4	93.4	1,170	61,800			54	55	N
18	57.5	59.1	84.3	87.4	1,396	62,300			57	58	Y
19	59.2	60.7	83.1	87.9	1,170	72,500			59	59	Y
20	60.8	62.5	88.4	89.7	718	78,100			60	60	Y
21	62.3	63.2	89.1	90.0	738	79,500			61	62	Y-PV
22	63.3	63.9	90.0	90.5	738	83,800	62.4	62.9			Y-PV
23	63.2	63.9	90.1	90.6	738	85,100	62.5	63.0	62	62	Y-PV
24	63.1	63.7	89.5	90.2	738	88,100	62.3	63.0			Y-PV
25	63.3	64.1	87.8	88.7	738	88,500	62.6	63.9			Y-PV
26	61.8	63.8	86.6	88.3	738	89,000	61.3	64.4			Y-PV
27	58.4	59.3	82.9	83.7	738	84,000	57.7	58.5	57	57	Y-PV
28	59.1	60.4	83.7	84.9	738	76,600	58.5	59.2	58	59	Y-PV
29	58.3	59.0	82.9	83.5	738	73,000	57.2	58.4			Y-PV
30	56.8	58.2	81.8	82.8	738	67,600	56.3	57.1			N
31	56.2	57.1	83.3	83.9	738	67,500	55.5	56.3			N
Minimum	**33.0**	**34.0**	**81.8**	**82.8**	**718**	**34,200**	**56**	**56**	**54**	**55**	
Average	**49.9**	**51.3**	**85.8**	**87.4**	**855**	**63,574**	**60**	**61**	**59**	**59**	
Maximum	**63.3**	**64.1**	**90.8**	**93.4**	**1,396**	**89,000**	**63**	**64**	**62**	**62**	

** Receiving Water Temperature Probe located 100 yards downstream from point of Steamboat Island on channel side of island.

Attachment 2

Fish/Aquatic Life Stress/Mortality Surveys During Provisional Variance Excursions

On any date that provisional variance hours are being used, chemistry crews will make three visual inspections of the Station's intake and discharge areas. These visual surveys should be spaced such that several hours elapse between observations. Areas to be surveyed are from the barge ramp, downstream from the intake fore bay approximately 100 ft (intake area); along the Iowa shoreline from 500 to 1000 ft downstream of the diffuser; and along the Illinois shoreline 500 to 1000 ft downstream of the diffuser. Crews will document the number and general category of dead or stressed fish/aquatic life. If, during any observation, it appears a "fish kill" is occurring (numbers of individuals exhibiting difficulty in swimming or breathing), the chemistry crew will contact the Fish Lab who will dispatch a team to determine the magnitude of the event and species affected. If Fish Lab staff believe a "fish kill" is underway, the Shift Manager will be notified so that Illinois EPA and Illinois DNR can be notified as well.

Contacts & Phone Numbers:

Exelon	Jeremiah Haas	Lab: 309/227-2867
		Home/Cell: 309/236-9149
HDR	Tim Bowzer	Lab: 309/654-2284
		Home: 563/243-5278
		Cell: 563/357-6908
Exelon	John Petro	Home: 815/436-0178
		Cell: 312/813-5916
		Pager: 630/603-7060

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 3/21/12 – 3/23/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	08:00 on 3/21/12 **PV IEPA-12-11 entered 3/21/12 @ 04:06**	*60 up 60 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:00 on 3/21/12 PV IEPA-12-11	*61 up 61 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	19:30 on 3/21/12 PV IEPA-12-11	61 up 62 down **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:45 on 3/22/12 PV IEPA-12-11	*62 up 62 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:30 on 3/22/12 PV IEPA-12-11	*62 up 62 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:30 on 3/22/12 PV IEPA-12-11	*62 up 62 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:45 on 3/23/12 PV IEPA-12-11	*62 up 62 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:15 on 3/23/12 PV IEPA-12-11	62 up 62 down **(field temps)**	No mortality or presence of stress

Notes: PV IEPA-12-11 entered 3/21/12 @ 04:06.
*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 3/23/12 – 3/26/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:45 on 3/23/12 PV IEPA-12-11	*62 up 62 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	08:45 on 3/24/12	*61 up 61 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:30 on 3/24/12	*61 up 61 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	15:15 on 3/24/12	*62 up 62 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:15 on 3/25/12	*61 up 61 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:00 on 3/25/12	*62 up 62 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:00 on 3/25/12	*63 up 63 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:30 on 3/26/12	*62 up 62 down	No mortality or presence of stress

Notes: *Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 3/26/12 – 3/28/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:00 on 3/26/12	*58 up 58 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:00 on 3/26/12	*58 up 58 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 3/27/12	*58 up 58 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:40 on 3/27/12 Off the clock estimated @ 08:00 on 3/27/12	*57 up 57 down **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	15:00 on 3/27/12	*56 up 56 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	08:00 on 3/28/12	*57 up 57 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:00 on 3/28/12 On the clock estimated @ 10:00 on 3/28/12	*58 up 58 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	15:45 on 3/28/12	*58 up 59 down **(field temps)**	No mortality or presence of stress

Notes: *Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 3/29/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:00 on 3/29/12	*57 up 58 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:00 on 3/29/12 Off the clock estimated @ 07:00 on 3/29/12	*57 up 57 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:30 on 3/27/12	*56 up 56 down	No mortality or presence of stress

Notes: *Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

ATTACHMENT 3
Time Above The Maximum Temperature Limits
Page 1 of 1

1. Maximum temperature rise above natural temperature shall **not** exceed 5 °F outside the 500 ft mixing zone.

2. Water temperature at representative locations in the main river 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.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
45	45	57	68	78	85	86	86	85	75	65	52

DATE/TIME ABOVE LIMIT	DATE/TIME BELOW LIMIT	HOURS ABOVE LIMIT	HOURS ACCUMULATED	INITIALS
7/21/11 @ 10:30	7/22/11 @ 19:30	33	33	MS/
3/18/12 @ 13:00	3/18/12 @ 23:30	10.5	43.5	MS/
3/19/12 @ 08:00	3/27/12 @ 08:00	192	235.5	MS/
3/28/12 @ 10:00	3/29/12 @ 07:00	21	256.5	MS/

Reviewed By: Mark Stuhlman / _____ Date: 4/13/12

Exhibit 16

Provisional Variance IEPA 12-17

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740
www.exeloncorp.com

Exelon Nuclear

SVP-12-054

May 25, 2012

Mr. Roger Callaway (CAS-19)
Wastewater Compliance Unit Manager
Illinois Environmental Protection Agency
Bureau of Water
Compliance Assurance Section #19
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9274

Re: Quad Cities Nuclear Power Station NPDES Permit No. IL0005037
Provisional Variance Request – Emergency Application – IEPA 12-17

Dear Mr. Callaway:

Thank you for the time, consideration and attention IEPA dedicated to Exelon's provisional variance request. We sincerely appreciate all of your efforts. Below is Quad Cities Station's Certificate of Acceptance of the Provisional Variance Order issued by IEPA in this matter.

Very Truly Yours,

for Tim Hanley
Site Vice President
Quad Cities Station

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

Certificate of Acceptance

I(We), Tim Hanley, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in matter IEPA 12-17 dated March 25, 2012.

Exelon Generation Co. L.L.C/Quad Cities Station
Petitioner

Keith Davis for
Authorized Agent

Site Vice President
Title

05/25/2012
Date

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

May 25, 2012

Exelon Generation Company, L.L.C. Quad Cities Nuclear Power Station Petitioner, v. ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, Respondent.	)	IEPA – 12-17 (Provisional Variance-Water)

Re: Provisional Variance From Discharge Limits Contained in NPDES Permit IL0005037

Dear Mr. Hanley:

The Illinois Environmental Protection Agency (Agency) has completed its technical review of the attached provisional variance request, dated May 24, (Attachment A), for Exelon Generation Company, L.L.C.'s Quad Cities Nuclear Power Station (Quad Cities). Quad Cities is seeking a provisional variance from May 26, 2012 through May 29, 2012, that would allow it to exceed the maximum temperature limit in Special Condition 7B of NPDES Permit IL0005037 by no more than 5° (83° for May), or 2° above ambient river temperature, whichever is greater.

Based on its review, the Agency GRANTS Quad Cities a provisional variance subject to the specific conditions set forth below.

Background

Quad Cities Station is a base load nuclear-fueled steam electric generating facility located near Cordova, Illinois, on the Mississippi River at River Mile 506.8. The station operates two boiling water reactors which have a combined maximum generating capacity of 5,914 megawatts thermal. The station is currently operating at 100% capacity. The station's capacity factor January 1, 2012 through April 31, 2012 was 86%. Quad Cities Station generation output is transmitted to the PJM Interconnection Grid. PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

Circulating water used to cool and condense the steam from the generating process is withdrawn from, and discharged to, the Mississippi River (Receiving Stream Water ID- IL_M-02). The Mississippi River flow on May 24, 2012, was 68,000 cfs and the 7Q10 was 13,700 cfs. The incoming water is currently listed as impaired (2012 listing) due to Mercury, Polychlorinated biphenyls, and Manganese. These impaired waters have a designated use of public and food processing water as well as fish consumptions.

Quad Cities operates a condenser cooling water system in open cycle mode. In this mode, cooling water is drawn from the Mississippi River into an intake canal, passes through the plant systems, and is discharged through diffusers into the Mississippi River. The maximum design flow is 2,253 cfs or 1,011,000 gpm. The maximum temperature rise of the station from intake to effluent is 28°F at design flow of 2,253 cfs. Open cycle operation with the diffusers was initially permitted by the IEPA on December 22, 1983.

Special Condition 7B of NPDES Permit IL00005037 (Attachment B) limits the temperature at the edge of the mixing zone to 78°F in May, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits.

The available temperature data shows that the Mississippi River water temperature at the station's intake is approaching and may exceed the non-excursion hour May temperature standard of 78°F based on latest weather forecasts. The upstream Mississippi River temperature was measured at 72°F on May 23, 2012. As a result of these conditions, Quad Cities expects to exceed the non-excursion hour temperature limit for May of 78°F on May 26, 2012. Based on current weather forecast of daily maximum air temperatures near 90°F four of the next five days, ambient Mississippi River water temperature may reach 80°F. Mississippi River flow is currently 68,000 cfs and will be reduced by the Corps of Engineers to 40,000 cfs by May 29, 2012. The maximum Mississippi River ambient temperature the station will be able to comply with during the provisional variance period without the use of excursion hours is 76°F.

As a consequence of the unusually warm weather, high ambient river temperatures, and the absence of cooling during the evening hours, the capacity of the Mississippi River to dissipate heat has been reduced beyond its normal capabilities. Even at current flow rates of 68,000 cfs, the river is not cooling off during the evening hours as is typical this time of year. Without nighttime cooling, the river retains the heat introduced to it during the daytime hours, both upstream and downstream of the station.

In cooperation with the Agency's request that Exelon explore long-term thermal relief options for Quad Cities, Exelon commissioned studies of the station's thermal output and impacts. Exelon has shared those studies and its draft long-term regulatory relief proposal with Federal and State regulators, with whom related discussions are currently underway. Additionally, Quad Cities submitted a draft of its 316(a) thermal report for Agency review prior to it being submitted to the Illinois Pollution Control Board.

Relief Requested

Condition 7B of the NPDES Permit limits the number of excursion hours to 1% (87.6 hours) of the hours in a 12-month period ending with any month. Specifically, Special Condition 7B provides that the Station shall not cause water temperatures in the Mississippi River (beyond the mixing zone) to exceed by more than 3°F the non-excursion hour temperature limit for May of 78°F.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
F°	45	45	57	68	78	85	86	86	85	75	65	52

Quad Cities is requesting a provisional variance that allows it to exceed the non-excursion hour temperature limit for May of 78°F stated in Special Condition 7B of NPDES Permit No. IL0005037, for the period of May 26, 2012 through May 29, 2012, by no more than 5°F *(83°F for May)* or 2°F above ambient river temperature, whichever is greater.

Quad Cities has exhausted its excursion hours.

Necessity for Request

In its request, Exelon states that when the ambient river temperatures approach or exceed the non-excursion hour limits, Quad Cities has no option other than to use excursion hours, and once its allotment of excursion hours is depleted, Quad Cities must cease operating altogether to maintain compliance with the NPDES Permit. According to Exelon, partial deratings or adding cooling facilities (such as cooling towers) will not allow Quad Cities to achieve compliance with a limit that already is exceeded even before any heat is added as a result of Station operations.

Special Condition 7B of NPDES Permit limits the temperature at the edge of the mixing zone to 78°F in May, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits. As a rule, Quad Cities has been able to operate within its permitted thermal limits due to the fact that the ambient temperatures of the River (measured upstream of the discharge) generally remain below the non-excursion hour limit. It is only during periods when the ambient river temperatures are very close to or exceed the non-excursion hour limits or during periods of extreme low flows that Quad Cities uses its excursion hour allowance.

Illinois is experiencing unusually warm weather for this time of year which is resulting in high ambient river temperatures. In 2012 Quad Cities first began using excursion hours on Sunday, March 18th when upstream Mississippi River temperature matched the station's effluent limitation of 57.0°F. The permitted excursion hours were subsequently exhausted in March as a result of continued record breaking warm weather recorded throughout the mid-western states. Quad Cities submitted a request to the Agency on March 20, 2012, for relief from Special Condition 7B of NPDES Permit No. IL0005037 for the period of March 21, 2012, to April 1, 2012. The Agency subsequently issued Provisional Variance IEPA 12-11 to Quad Cities on March 21, 2012 allowing the station to exceed the non-excursion hour temperature limit for March of 57°F stated in Special Condition 7B of NPDES Permit No. IL0005037 for the period of

March 21, 2012 to April 1, 2012, by no more than 5°F (62°F for March) or 2°F above ambient river temperature, whichever is greater. A total of 223.5 excursion hours was accumulated by Quad Cities during March of 2012. The stations rolling 12-month excursion hour total stands at 256.5 including the 33 hours accumulated in July of 2011. The Agency also issued provisional variances to Exelon's Braidwood Station (IEPA-12-12), Dresden Station (IEPA-12-14), and LaSalle Station (IEPA-12-15) for thermal effluent relief during the March 2012 heat wave.

With the current forecast, Quad Cities predicts it will exceed the non-excursion hour temperature limit for May of 78°F starting May 26, 2012, through May 29, 2012.

Given the current forecast, Quad Cities also predicts that the Mississippi River will approach or exceed Quad Cities' permitted effluent limitation. Therefore, unless relief is granted by way of this provisional variance request, Exelon states that it is likely the station will be forced to shut down for correspondingly significant durations.

Because derating the units may not ensure compliance with the effluent limitations, Exelon states that shutting the units down may be the only alternative. Removing both units from operation will not only reduce the available power supply to the grid but will also result in the need for power from the grid to operate key nuclear safety systems. The time required to return nuclear generating units to full power can require 18-24 hours meaning the electricity generated from these systems will not be readily available in the event of an emergency.

Exelon states that under normal conditions only one of the two reactors would be removed from service at any given time allowing the operating unit to be the primary backup power source for the non-operating unit. Removing both units from service will also eliminate this redundancy and will increase the station's reliance on off-site power to support safety-related systems.

With both units offline, and unable to return to service immediately, the power that Quad Cities could generate would not be available to support the voltage requirements that could occur under changing grid conditions. PJM grid status does not currently have or project any alerts, warnings, or actions through the holiday weekend. According to Exelon, however, a number of generating stations are performing load drops over the holiday weekend. If these units were to go offline, grid stability could be affected. PJM predicts an anticipated Peak Load >14, 000 MW on Tuesday 5/29/2012.

Assessment of Environmental Impacts

Exelon has provided details on the environmental impact during the requested variance period from May 26, 2012, through May 29, 2012. Exelon has determined that there should not be any significant environmental impact during the course of this three-day variance.

Alternatives to Requested Relief

Based on river temperatures recorded so far this spring and long range weather projections for the balance of the season, it is likely that there will be a number of extended periods during which ambient river temperatures will be at or above these limits. As previously explained,

neither the option of derating the units nor of obtaining additional temporary cooling capacity will allow Quad Cities to maintain compliance if the ambient river temperatures exceed the applicable temperature limits. The only option is for Quad Cities to shut down once the ambient river temperatures are at or exceed the NPDES permit monthly limit.

In 2006, Quad Cities investigated the feasibility of installing cooling towers. Exelon states that based on analytical evaluation of historical plant, river, and meteorological data, the proposed towers performance and the resulting reduction in downstream river temperature could be quantified. When Exelon evaluated the actual days when excursion hours occurred in the last six year period (2000-2005), it found there was no appreciable reduction in the number of days when excursion hours would have occurred with the cooling towers in operation. According to Exelon, the reason for this is the high upstream river temperatures experienced on most of the days when actual excursion hours were recorded. For ~80% of the days when excursion hours were recorded, the plant intake temperature was at the permit limited temperature or above (≥86°F), and for the remaining 20% of the days, the intake temperature was within half a degree of the permit limits. For most of these occurrences, even if adequate cooling tower capacity was in operation to achieve a zero thermal impact on the river (i.e., the plant discharge temperature equaled the intake temperature), excursion hours nonetheless would have been recorded. Estimated cost in 2006 for installation of cooling towers ranged from $48 to $61 million.

Agency Determinations

The Agency has reviewed the requested provisional variance and has concluded the following:

1. Any environmental impact from the requested relief shall be closely monitored and the Agency shall be immediately notified of any adverse impacts.

2. No reasonable alternatives appear available;

3. No public water supplies should be affected;

4. No federal regulations will preclude the granting of this request; and

5. Quad Cities will face an arbitrary and unreasonable hardship if the request is not granted.

Conditions

The Agency hereby GRANTS Quad Cities a provisional variance from Special Condition 7B of NPDES Permit No. IL0005037, subject to the following conditions:

A. The provisional variance shall begin on May 26, 2012, and shall run through May 29, 2012.

B. Quad Cities shall provide the best operation of its station to produce the best effluent possible at all times. At no time, during the variance period, shall Quad Cities cause

water temperature in the Mississippi River (beyond the mixing zone) to exceed 83° or 2° F above ambient river temperature, whatever is greater.

C. During the variance period, Quad Cities must continuously monitor intake, discharge and receiving water temperatures and visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life.

D. Quad Cities shall document environmental conditions during the term of the provisional variance, including the activities described in C. above of this Section, and submit the documentation to the Agency and the Department of Natural Resources within 30 days after the provisional variance expires.

E. Quad Cities shall immediately notify the Agency and the Department of Natural Resources of any unusual conditions, including mortalities to fish or other aquatic life; immediately take action to remedy the problem; investigate and document the cause and seriousness of the unusual conditions while providing updates to the Agency and the Department of Natural Resources as changes occur until normal conditions return; notify the Agency and the Department of Natural Resources when normal conditions return; and submit the documentation to the Agency and the Department of Natural Resources within 30 days after normal conditions return.

F. Quad Cities shall develop and implement a response and recovery plan to address any adverse environmental impact due to thermal conditions resulting from the provisional variance, including loss and damage to aquatic life.

G. Quad Cities shall notify Roger Callaway of the Agency by telephone at 217/782-9720 when Quad Cities' discharge first causes or contributes to an exceedance of the applicable permitted excursion hour temperature limit of 78°F in May. Written confirmation of each notice shall be sent within five days to the following address:

Illinois Environmental Protection Agency
Bureau of Water - Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
Springfield, Illinois 62794-9276

H. Quad Cities shall sign a certificate of acceptance of this provisional variance and forward that certificate to Roger Callaway at the address indicated above within one day of the date of this order. The certification should take the following form:

I (We)_____, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in _____dated _____.

_____

Petitioner

_____
Authorized Agent

_____
Title

_____
Date

Quad Cities shall continue to monitor and maintain compliance with all other parameters and conditions specified in its NPDES Permit No. IL0005037

Conclusion

The Agency grants this provisional variance in accordance with its authority contained in Sections 35(b), 36 (c), and 37(b) of the Illinois Environmental Protection Act (415 ILCS 5/35(b), 36(c), and 37(b) (2004). The decision to grant this provisional variance is not intended to address compliance with any other applicable laws or regulations.

Sincerely,

Julie Armitage

Julie Armitage
Acting Chief Legal Counsel

cc: Marcia Willhite
Roger Callaway
Vera Herst

Exhibit 17

Temperatures and Fish/Aquatic Life Stress/Mortality Surveys

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740

www.exeloncorp.com

Exelon Nuclear

SVP-12-063

June 21, 2012

Illinois Environmental Protection Agency
Bureau of Water – Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
P.O. Box 19276
Springfield, Illinois 62794-9276

Subject: Provisional Variance IEPA-12-17 Temperatures and Fish/Aquatic Life Stress/Mortality Surveys

Dear Mr. Callaway:

In accordance with Special Condition "C & D" of the Agency's Order 12-17 dated May 25, 2012 regarding the provisional variance for Quad Cities Station require the following during the variance period: 1) continuously monitor intake, discharge, and receiving water temperatures, 2) visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life, 3) document environmental conditions during the term of the provisional variance, including the activities above and submit the documentation to the Agency and Department of Natural Resources within 30 days after the provisional variance expires.

Attached is the subject documentation required by provisional variance IEPA-12-17 Special Condition "C & D".

During the Provisional Variance period the downstream receiving stream did not exceed the Stations NPDES permit temperature limit of 78^0F for May. There were no observations of unusual conditions including mortalities to fish or other aquatic life downstream of Quad Cities Station discharge due to station discharge during the Provisional Variance period.

If you should have any questions regarding Quad Cities Station Provisional Variance IEPA-12-11, please contact Vicki Neels at (309) 227-3200 or Mark Stuhlman at (309) 227-2765 or John Petro at (630) 657-3209.

Very Truly Yours,

Tim Hanley
Site Vice President
Quad Cities Station

Attachments:
Attachment 1: Quad Cities Station Provisional Variance IEPA-12-17 Temperature and Flow Data
Attachment 2: Quad Cities Station Three Times Daily Fish/Aquatic Life Stress/Mortality Surveys During Provisional Variance IEPA-12-17
Attachment 3: Time Above the Maximum Temperature Limits.

Copy to:

Mr. Dan Sallee
Dan.Sallee@Illinois.gov

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

ATTACHMENT 1

Month: May 2012 **QUAD CITIES STATION PROVISIONAL VARIANCE IEPA-12-17 TEMPERATURE and FLOW DATA**

Day	Temperature (° F) Intake Bay Avg.	Intake Bay Max.	Temperature (°F) Discharge Bay Avg.	Discharge Bay Max.	Daily Flow (MGD) Thru Intake	Mississippi River Flow CFS (06:00 @ L&D 14)	Temperature (°F) (Steamboat Island)** Receiving Water Avg.	Receiving Water Max.	Maximum Upstream Field Survey Temperature	Maximum Downstream Field Survey Temperature	On the Clock Y/N Provisional Variance (PV)
1	55.5	56.3	85.2	88.4	1,396	62,800					N
2	56.8	58.4	85.5	86.9	1,396	62,400					N
3	58.5	61.4	88.4	90.2	1,396	62,300					N
4	62.2	63.9	91.2	92.7	1,396	62,400					N
5	64.3	66.1	93.3	94.9	1,396	62,900					N
6	65.8	67.5	94.8	96.1	1,396	63,000					N
7	66.7	67.8	95.7	96.6	1,396	65,800					N
8	66.9	68.1	95.4	96.4	1,416	74,600					N
9	66.4	67.5	95.5	98.8	1,416	80,200					N
10	66.5	67.5	95.2	95.9	1,416	85,200					N
11	66.8	67.6	95.3	95.7	1,416	86,100					N
12	66.9	68.1	95.4	96.6	1,416	88,400					N
13	67.0	68.2	95.5	96.7	1,416	91,900					N
14	68.3	69.4	96.8	97.9	1,416	97,600					N
15	69.0	69.6	97.5	98.1	1,416	102,300					N
16	69.3	70.0	97.8	98.5	1,416	103,000					N
17	69.4	69.8	97.9	98.3	1,416	102,700					N
18	69.6	70.6	98.1	99.1	1,416	102,400					N
19	70.9	71.8	99.4	100.3	1,416	99,400					N
20	72.1	72.7	100.6	101.2	1,416	94,700					N
21	71.1	71.9	99.6	100.4	1,416	93,900					N
22	71.4	72.7	100.4	100.7	1,416	89,100					N
23	71.9	72.9	100.3	101.0	1,416	77,300					N
24	71.8	73.5	100.3	101.7	1,416	65,500					N
25	72.0	73.5	100.8	102.2	1,416	53,600			72	73	N
26	71.9	73.3	100.2	101.6	1,416	52,700	71.8	73.0			N
27	72.9	75.0	99.9	102.9	1,416	52,600	71.5	74.9	72	74	N
28	74.6	76.1	103.3	104.6	1,416	57,000	74.2	76.4			N
29	74.3	75.4	102.6	103.6	1,436	57,300	73.5	75.4			N
30	72.9	74.0	101.4	102.5	1,436	62,800					N
31	70.3	72.8	99.4	100.8	1,436	67,700					N
Minimum	55.5	56.3	85.2	86.9	1,396	52,600	72	73	72	73	
Average	68.2	69.5	96.9	98.1	1,413	76,761	73	75	72	74	
Maximum	74.6	76.1	103.3	104.6	1,436	103,000	74	76	72	74	

** Receiving Water Temperature Probe located 100 yards downstream from point of Steamboat Island on channel side of island.
Provisional Variance IEPA-12-17 issued 5/25/12. PV in effect 5/26/12-5/29/12.

Attachment 2

Fish/Aquatic Life Stress/Mortality Surveys During Provisional Variance Excursions

On any date that provisional variance hours are being used, chemistry crews will make three visual inspections of the Station's intake and discharge areas. These visual surveys should be spaced such that several hours elapse between observations. Areas to be surveyed are from the barge ramp, downstream from the intake fore bay approximately 100 ft (intake area); along the Iowa shoreline from 500 to 1000 ft downstream of the diffuser; and along the Illinois shoreline 500 to 1000 ft downstream of the diffuser. Crews will document the number and general category of dead or stressed fish/aquatic life. If, during any observation, it appears a "fish kill" is occurring (numbers of individuals exhibiting difficulty in swimming or breathing), the chemistry crew will contact the Fish Lab who will dispatch a team to determine the magnitude of the event and species affected. If Fish Lab staff believe a "fish kill" is underway, the Shift Manager will be notified so that Illinois EPA and Illinois DNR can be notified as well.

Contacts & Phone Numbers:

Exelon	Jeremiah Haas	Lab: 309/227-2867
		Home/Cell: 309/236-9149
HDR	Tim Bowzer	Lab: 309/654-2284
		Home: 563/243-5278
		Cell: 563/357-6908
Exelon	John Petro	Home: 815/436-0178
		Cell: 312/813-5916
		Pager: 630/603-7060

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 5/26/12 – 5/28/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	07:00 on 5/26/12 **PV IEPA-12-17 in effect 5/26/12 – 5/29/12**	*71 up 72 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:00 on 5/26/12	*71 up 72 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:30 on 5/26/12	*72 up 73 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 5/27/12	*71 up 72 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:30 on 5/27/12	72 up 74 down **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	19:00 on 5/27/12	*74 up 75 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:30 on 5/28/12	*73 up 74 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:00 on 5/28/12 20-30 MPH winds	*74 up 75 down	No mortality or presence of stress

Notes: PV IEPA-12-17 issued 5/25/12. PV in effect 5/26/12 - 5/29/12.
*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 5/28/12 – 5/30/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	19:00 on 5/28/12	*75 up 76 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:30 on 5/29/12	*74 up 75 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:30 on 5/29/12	*75 up 76 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	19:30 on 5/29/12	*74 up 75 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:30 on 5/30/12 Steamboat Island data logger removed	*72 up 73 down	No mortality or presence of stress

Notes: *Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

ATTACHMENT 3
Time Above The Maximum Temperature Limits
Page 1 of 1

1. Maximum temperature rise above natural temperature shall **not** exceed 5 °F outside the 500 ft mixing zone.

2. Water temperature at representative locations in the main river 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.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
45	45	57	68	78	85	86	86	85	75	65	52

DATE/TIME ABOVE LIMIT	DATE/TIME BELOW LIMIT	HOURS ABOVE LIMIT	HOURS ACCUMULATED	INITIALS
7/21/11 @ 10:30	7/22/11 @ 19:30	33	33	MS/
3/18/12 @ 13:00	3/18/12 @ 23:30	10.5	43.5	MS/
PV IEPA-12-11 issued 3/21/12 valid 3/21/12 thru 3/31/12)	NA	NA	NA	MS/
3/19/12 @ 08:00	3/27/12 @ 08:00	192 (147.9 hrs on PV IEPA-12-11)	235.5 (147.9 on PV IEPA-12-11)	MS/
3/28/12 @ 10:00	3/29/12 @ 07:00	21 (21 hrs on PV IEPA-12-11)	256.5 (168.9 on PV IEPA-12-11)	MS/
PV IEPA-12-17 issued 5/25/12 valid 5/26/12 thru 5/29/12)	NA	Zero hours above May Permit Limit of 78 °F during PV	256.5 (168.9 on PV IEPA-12-11, 0 on IEPA 12-17)	MS/

Reviewed By: Randy Knight / _____ Date: 6/20/12

Exhibit 18

Provisional Variance IEPA 12-19

July 3, 2012

Exelon.
Nuclear

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740
www.exeloncorp.com

SVP-12-069

July 3, 2012

Mr. Roger Callaway (CAS-19)
Wastewater Compliance Unit Manager
Illinois Environmental Protection Agency
Bureau of Water
Compliance Assurance Section #19
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9274

Re: Quad Cities Nuclear Power Station NPDES Permit No. IL0005037
Provisional Variance Request – Emergency Application – IEPA-12-19

Dear Mr. Callaway:

Thank you for the time, consideration and attention IEPA dedicated to Exelon's provisional variance request. We sincerely appreciate all of your efforts. Below is Quad Cities Station's Certificate of Acceptance of the Provisional Variance Order issued by IEPA in this matter.

Very Truly Yours,

Tim Hanley
Site Vice President
Quad Cities Station

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

Certificate of Acceptance

I(We), Tim Hanley, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in matter IEPA-12-19 dated July 03, 2012.

Exelon Generation Co. L.L.C/Quad Cities Station
Petitioner

Scott Darin for
Authorized Agent

Site Vice President
Title

07/03/2012
Date

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

July 3, 2012

Exelon Generation Company, L.L.C. Quad Cities Nuclear Power Station Petitioner, v. ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, Respondent.	)	IEPA – 12-19 (Provisional Variance-Water)

Re: Provisional Variance From Discharge Limits Contained in NPDES Permit IL0005037

Dear Mr. Hanley:

The Illinois Environmental Protection Agency (Agency) has completed its technical review of the attached provisional variance request, dated July 3, (Attachment A), for Exelon Generation Company, L.L.C.'s Quad Cities Nuclear Power Station (Quad Cities). Quad Cities is seeking a provisional variance from July 5, 2012 through July 15, 2012, that would allow it to exceed the maximum temperature limit in Special Condition 7B of NPDES Permit IL0005037 by no more than 5° (91° for July), or 2° above ambient river temperature, whichever is greater.

Based on its review, the Agency GRANTS Quad Cities a provisional variance subject to the specific conditions set forth below.

Background

Quad Cities is a base load nuclear-fueled steam electric generating facility located near Cordova, Illinois, on the Mississippi River at River Mile 506.8. The station operates two boiling water reactors which have a combined maximum generating capacity of 5,914 megawatts thermal. The station is currently operating at 100% capacity. The station's capacity factor January 1, 2012 through May 31, 2012 was 89%. Quad Cities generation output is transmitted to the PJM Interconnection Grid. PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

Circulating water used to cool and condense the steam from the generating process is withdrawn from, and discharged to, the Mississippi River (Receiving Stream Water ID- IL_M-02). The Mississippi River flow on July 3, 2012, was 93,000 cfs and the 7Q10 was 13,700 cfs. The incoming water is currently listed as impaired (2012 listing) due to Mercury, Polychlorinated biphenyls, and Manganese. These impaired waters have a designated use of public and food processing water as well as fish consumptions.

Quad Cities operates a condenser cooling water system in open cycle mode. In this mode, cooling water is drawn from the Mississippi River into an intake canal, passes through the plant systems, and is discharged through diffusers into the Mississippi River. The maximum design flow is 2,253 cfs or 1,011,000 gpm. The maximum temperature rise of the station from intake to effluent is 28°F at design flow of 2,253 cfs. Open cycle operation with the diffusers was initially permitted by the Agency on December 22, 1983.

Special Condition 7B of NPDES Permit IL00005037 (Attachment B) limits the temperature at the edge of the mixing zone to 86°F in July, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits.

The available temperature data shows that the Mississippi River water temperature at the station's intake is approaching and may exceed the non-excursion hour July temperature standard of 86°F based on latest weather forecasts. The upstream Mississippi River temperature was measured at 83°F on July 3, 2012. As a result of these conditions, Quad Cities expects to exceed the non-excursion hour temperature limit for July of 86°F on July 5, 2012. Based on current weather forecast of daily maximum air temperatures in the upper 90's°F for the next five days, ambient Mississippi River water temperature may reach 85°F. Mississippi River flow is currently 93,000 cfs and is forecast to decrease to 85,000 cfs by July, 9, 2012. The maximum Mississippi River ambient temperature the station will be able to comply with during the provisional variance period without the use of excursion hours is 85°F.

As a consequence of the unusually warm weather, high ambient river temperatures, and the absence of cooling during the evening hours, the capacity of the Mississippi River to dissipate heat has been reduced beyond its normal capabilities. Even at current flow rates of 93,000 cfs, the river is not cooling off during the evening hours as is typical this time of year. Without nighttime cooling, the river retains the heat introduced to it during the daytime hours, both upstream and downstream of the station.

In cooperation with the Agency's request that Exelon explore long-term thermal relief options for Quad Cities, Exelon commissioned extensive studies of the Station's thermal output and impacts. Exelon has shared those studies and its draft long-term regulatory relief proposal with both Federal and State regulators. Additionally, Quad Cities submitted a draft of its 316(a) thermal report which demonstrates no harm to indigenous aquatic populations to the Agency, obtained comments, revised the report and then resubmitted the document for the Agency's final review and comment. At this time, the Agency's technical review of the Draft 316 (a) Report is nearing completion. The Agency will be presenting its technical comments on the Draft 316 (a)

Report to Exelon and the Director of the Agency. Exelon is working on finalizing the Draft Adjusted Thermal Standard (ATS) petition to the Illinois Pollution Control Board (IPCB) which will be submitted to the Agency for their internal review before the end of the week.

Relief Requested

Condition 7B of the NPDES Permit limits the number of excursion hours to 1% (87.6 hours) of the hours in a 12-month period ending with any month. Specifically, Special Condition 7B provides that the Station shall not cause water temperatures in the Mississippi River (beyond the mixing zone) to exceed by more than 3°F the non-excursion hour temperature limit for July of 86°F.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
F°	45	45	57	68	78	85	86	86	85	75	65	52

Quad Cities is requesting a provisional variance that allows it to exceed the non-excursion hour temperature limit for July of 86°F stated in Special Condition 7B of NPDES Permit No. IL0005037, for the period of July 5, 2012 through July 15, by no more than 5°F *(91°F for July)* or 2°F above ambient river temperature, whichever is greater.

Necessity for Request

In its request, Exelon states that when the ambient river temperatures approach or exceed the non-excursion hour limits, Quad Cities has no option other than to use excursion hours, and once its allotment of excursion hours is depleted, Quad Cities must cease operating altogether to maintain compliance with the NPDES Permit. According to Exelon, partial deratings or adding cooling facilities (such as cooling towers) will not allow Quad Cities to achieve compliance with a limit that already is exceeded even before any heat is added as a result of station operations.

Special Condition 7B of NPDES Permit limits the temperature at the edge of the mixing zone to 86°F in July, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits. As a rule, Quad Cities has been able to operate within its permitted thermal limits due to the fact that the ambient temperatures of the River (measured upstream of the discharge) generally remain below the non-excursion hour limit. It is only during periods when the ambient river temperatures are very close to or exceed the non-excursion hour limits or during periods of extreme low flows that Quad Cities uses its excursion hour allowance.

Illinois and the Upper Mississippi River basin are experiencing a long stretch of hot weather, which is resulting in high ambient river temperatures. In 2012 Quad Cities first began using excursion hours on Sunday, March 18th when upstream Mississippi River temperature matched the station's effluent limitation of 57°F. The permitted excursion hours were subsequently exhausted in March as a result of continued record breaking warm weather recorded throughout the mid-western states. Quad Cities submitted a request to the Agency on March 20, 2012, for relief from Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of March 21,

2012 to April 1, 2012. The Agency subsequently issued Provisional Variance IEPA 12-11 to Quad Cities on March 21, 2012 allowing the station to exceed the non-excursion hour temperature limit for March of 57°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of March 21, 2012 to April 1, 2012 by no more than 5°F (62°F for March) or 2°F above ambient river temperature, whichever is greater. During March of 2012, Quad Cities accumulated a total of 223.5 excursion hours.

Quad Cities also submitted a request to the Agency on May 24, 2012, for relief from Special Condition 7(b) of NPDES Permit No. IL0005037, for the period of May 26, 2012, through May 29, 2012. The Agency subsequently issued Provisional Variance IEPA 12-17 to Quad Cities on May 25, 2012, allowing the station to exceed the non-excursion hour temperature limit for May of 78°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of May 26, 2012, through May 29, 2012, by no more than 5°F (78°F for May) or 2°F above ambient river temperature, whichever is greater. During the May Provisional Variance period, the Quad Cities did not exceed its effluent limitation of 78°F. Quad Cities currently has 33 excursion hours that became available July 1, 2012, when the 33 hours accumulated during July 2011 rolled off the rolling 12-month calendar.

The Agency also issued Provisional Variances to Exelon's Braidwood Station (IEPA-12-12), Dresden Station (IEPA-12-14), and LaSalle Station (IEPA-12-15) for thermal effluent relief during the March 2012 heat wave.

With the current forecast, Quad Cities says it expects to exceed the non-excursion hour temperature limit for July of 86°F starting July 5, 2012, and going through July 15, 2012, if is it to be able to continue to provide safe reliable power to the grid.

Based on current weather forecasts it is expected that the Mississippi River will approach or exceed Quad Cities' permitted effluent limitation. Therefore, unless relief is granted by way of this provisional variance request, Quad Cities states that will be forced to shut down for correspondingly significant durations.

Because derating the units will not ensure compliance with the effluent limitations, Quad Cities says that shutting the units down may be the only alternative. Removing both units from operation will not only reduce the available power supply to the grid but will also result in the need for power from the grid to operate key nuclear safety systems. The time required to return nuclear generating units to full power can require 18-24 hours, meaning the electricity generated from these systems will not be readily available in the event of an emergency. Furthermore, under normal conditions only one of the two reactors would be removed from service at any given time, to allow the operating unit to be the primary backup power source for the non-operating unit. Removing both units from service will also eliminate this redundancy and will increase the Quad Cities' reliance on off-site power to support safety related systems. With both units offline and unable to immediately return to service, the power that Quad Cities could generate as a result of the requested provisional variance would not be available to support the voltage requirements that could occur under changing grid conditions. PJM has issued a Hot Weather Alert for the entire PJM RTO through July 5, 2012, with the potential for the alert to be

extended through the weekend. PJM predicts an anticipated Peak Load >147, 000 MW on Friday, July 6, 2012.

Assessment of Environmental Impacts

Quad Cities has provided details on the environmental impact during the requested variance period from July 5, 2012, through July 15, 2012. Quad Cities has determined that there should not be any significant environmental impact during the course of this three-day variance.

Alternatives to Requested Relief

Based on river temperatures recorded so far this summer and long range weather projections for the balance of the season, it is likely that there will be a number of extended periods during which ambient river temperatures will be at or above these limits. As previously explained, neither the option of derating the units nor of obtaining additional temporary cooling capacity will allow Quad Cities to maintain compliance if the ambient river temperatures exceed the applicable temperature limits. The only option is for Quad Cities to shut down once the ambient river temperatures are at or exceed the NPDES permit monthly limit.

In 2006, Quad Cities investigated the feasibility of installing cooling towers. Exelon states that based on analytical evaluation of historical plant, river, and meteorological data, the proposed towers performance and the resulting reduction in downstream river temperature could be quantified. When Exelon evaluated the actual days when excursion hours occurred in the last six year period (2000-2005), it found there was no appreciable reduction in the number of days when excursion hours would have occurred with the cooling towers in operation. According to Exelon, the reason for this is the high upstream river temperatures experienced on most of the days when actual excursion hours were recorded. For ~80% of the days when excursion hours were recorded, the plant intake temperature was at the permit limited temperature or above (≥86°F), and for the remaining 20% of the days, the intake temperature was within half a degree of the permit limits. For most of these occurrences, even if adequate cooling tower capacity was in operation to achieve a zero thermal impact on the river (i.e., the plant discharge temperature equaled the intake temperature), excursion hours nonetheless would have been recorded. Estimated cost in 2006 for installation of cooling towers ranged from $48 to $61 million.

Agency Determinations

The Agency has reviewed the requested provisional variance and has concluded the following:

1. Any environmental impact from the requested relief shall be closely monitored and the Agency shall be immediately notified of any adverse impacts.

2. No reasonable alternatives appear available;

3. No public water supplies should be affected;

4. No federal regulations will preclude the granting of this request; and

5. Quad Cities will face an arbitrary and unreasonable hardship if the request is not granted.

Conditions

The Agency hereby GRANTS Quad Cities a provisional variance from Special Condition 7B of NPDES Permit No. IL0005037, subject to the following conditions:

A. The term of this provisional begins (1) for excursion hours: when all permitted excursion hours have been exhausted; (2) for maximum temperature limits: when the temperature exceeds 91°F. This provisional variance is granted based on the facts and circumstances described in the request dated July 3, 2012, and the update, including consecutive days of abnormally high temperatures at Quad Cities, and high water temperatures in the Mississippi River. If the facts or circumstances described in the July 3, 2012 request abate before July 15, 2012, the term of this provisional variance will end.

B. Quad Cities shall provide the best operation of its station to produce the best effluent possible at all times. At no time, during the variance period, shall Quad Cities cause water temperature in the Mississippi River (beyond the mixing zone) to exceed 91°F or 2° F above ambient river temperature, whatever is greater.

C. During the variance period, Quad Cities must continuously monitor intake, discharge and receiving water temperatures and visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life.

D. Quad Cities shall document environmental conditions during the term of the provisional variance, including the activities described in C. above of this Section, and submit the documentation to the Agency and the Department of Natural Resources within 30 days after the provisional variance expires.

E. Quad Cities shall immediately notify the Agency and the Department of Natural Resources of any unusual conditions, including mortalities to fish or other aquatic life; immediately take action to remedy the problem; investigate and document the cause and seriousness of the unusual conditions while providing updates to the Agency and the Department of Natural Resources as changes occur until normal conditions return; notify the Agency and the Department of Natural Resources when normal conditions return; and submit the documentation to the Agency and the Department of Natural Resources within 30 days after normal conditions return.

F. Quad Cities shall develop and implement a response and recovery plan to address any adverse environmental impact due to thermal conditions resulting from the provisional variance, including loss and damage to aquatic life.

G. Quad Cities shall notify Roger Callaway of the Agency by telephone at 217/782-9720 when Quad Cities' discharge first causes or contributes to an exceedence of the applicable permitted excursion hour temperature limit of 86°F in July, and again if the

water temperature exceeds 91°F . Written confirmation of each notice shall be sent within five days to the following address:

Illinois Environmental Protection Agency
Bureau of Water - Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
Springfield, Illinois 62794-9276

H. Quad Cities shall sign a certificate of acceptance of this provisional variance and forward that certificate to Roger Callaway at the address indicated above within one day of the date of this order. The certification should take the following form:

I (We)_____, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in _____dated _____.

_____
Petitioner

_____
Authorized Agent

_____
Title

_____
Date

Quad Cities shall continue to monitor and maintain compliance with all other parameters and conditions specified in its NPDES Permit No. IL0005037

Conclusion

The Agency grants this provisional variance in accordance with its authority contained in Sections 35(b), 36 (c), and 37(b) of the Illinois Environmental Protection Act (415 ILCS 5/35(b), 36(c), and 37(b) (2010). The decision to grant this provisional variance is not intended to address compliance with any other applicable laws or regulations.

Sincerely,

Julie Armitage
Acting Chief Legal Counsel

Exhibit 19

Provisional Variance IEPA 12-19 Extension

July 12, 2012

Exelon.
Nuclear

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740
www.exeloncorp.com

SVP-12-073

July 12, 2012

Mr. Roger Callaway (CAS-19)
Wastewater Compliance Unit Manager
Illinois Environmental Protection Agency
Bureau of Water
Compliance Assurance Section #19
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9274

Re: Quad Cities Nuclear Power Station NPDES Permit No. IL0005037
Provisional Variance IEPA-12-19 Extension Request – Emergency Application

Dear Mr. Callaway:

Thank you for the time, consideration and attention IEPA dedicated to Exelon's provisional variance extension request. We sincerely appreciate all of your efforts. Below is Quad Cities Station's Certificate of Acceptance of the Provisional Variance Extension Order issued by IEPA in this matter.

Very Truly Yours,

Tim Hanley
Site Vice President
Quad Cities Station

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

Certificate of Acceptance

I(We), Tim Hanley, hereby accept and agree to be bound by all terms and conditions of the provisional variance extension granted by the Agency in matter IEPA 12-19 (provisional variance extension) dated July 12, 2012.

Exelon Generation Co. L.L.C/Quad Cities Station
Petitioner


Authorized Agent

Site Vice President
Title

07/12/2012
Date

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

July 12, 2012

Exelon Generation Company, L.L.C. Quad Cities Nuclear Power Station Petitioner, v. ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, Respondent.	)	IEPA – 12-19 (Provisional Variance Extension-Water)

Re: Provisional Variance Extension From Discharge Limits Contained in NPDES Permit IL0005037

Dear Mr. Hanley:

On July 3, 2012, the Illinois Environmental Protection Agency (Agency) granted a request from Exelon Generation Company, L.L.C.'s Quad Cities Nuclear Power Station (Quad Cities) for a provisional variance (IEPA-12-19, Attachment A). This provisional variance is to end no later than July 15, 2012. On July 12, 2012, Quad Cities submitted a request for an extension to its provisional variance (Attachment B).

Quad Cities requests that the terms and conditions of this provisional variance from thermal limits in NPDES Permit IL0005037 (Attachment C) be extended, so that Quad Cities can continue operating through this unusually hot and dry period of weather and resulting high river temperatures.

The Agency has completed its technical review of the attached July 12, 2012 request for an extension of this provisional variance (Attachment B). Quad Cities is seeking a provisional variance extension from July 15, 2012 through July 25, 2012, that would allow it to exceed the maximum temperature limit in Special Condition 7B of NPDES Permit IL0005037 by no more than 5° (91° for July), or 2° above ambient river temperature, whichever is greater.

Based on its review, the Agency GRANTS Quad Cities a provisional variance extension subject to the specific conditions set forth below.

Background

Quad Cities is a base load nuclear-fueled steam electric generating facility located near Cordova, Illinois, on the Mississippi River at River Mile 506.8. The station operates two boiling water reactors which have a combined maximum generating capacity of 5,914 megawatts thermal. The station is currently operating at 100% capacity. The station's capacity factor January 1, 2012 through May 31, 2012 was 89%. Quad Cities generation output is transmitted to the PJM Interconnection Grid. PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

Circulating water used to cool and condense the steam from the generating process is withdrawn from, and discharged to, the Mississippi River (Receiving Stream Water ID- IL_M-02. The incoming water is currently listed as impaired (2012 listing) due to Mercury, Polychlorinated biphenyls, and Manganese. These impaired waters have a designated use of public and food processing water as well as fish consumptions.

Quad Cities operates a condenser cooling water system in open cycle mode. In this mode, cooling water is drawn from the Mississippi River into an intake canal, passes through the plant systems, and is discharged through diffusers into the Mississippi River. The maximum design flow is 2,253 cfs or 1,011,000 gpm. The maximum temperature rise of the station from intake to effluent is 28°F at design flow of 2,253 cfs. Open cycle operation with the diffusers was initially permitted by the Agency on December 22, 1983.

Special Condition 7B of NPDES Permit IL00005037 (Attachment B) limits the temperature at the edge of the mixing zone to 86°F in July, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits.

Temperature monitoring data shows that the Mississippi River water temperature at Quad Cities' intake exceeded the non-excursion hour July temperature standard of 86°F on July 5, 2012, and remained above 86°F through July 10, 2012. The available temperature data shows that the Mississippi River water temperature at Quad Cities' intake is approaching and may again exceed the non-excursion hour July temperature standard of 86°F based on latest weather forecasts. The upstream Mississippi River temperature was measured at 84°F on July 11, 2012 and, as a result of these conditions, Quad Cities expects to exceed the non-excursion hour temperature limit for July of 86°F on July 13, 2012. Based on current weather forecast of daily maximum air temperatures in the 90's°F starting July 13 for seven days, ambient Mississippi River water temperature may reach 86°F. Mississippi River flow is currently 68,000 cfs and forecast to decrease to 50,000 cfs by July 17, 2012. The maximum Mississippi River ambient temperature the station will be able to comply with during the provisional variance period without the use of excursion hours is 85°F.

As a consequence of the unusually warm weather, high ambient river temperatures, and the absence of cooling during the evening hours, the capacity of the Mississippi River to dissipate heat has been reduced beyond its normal capabilities. Even at current flow rates of 68,000 cfs, the river is not cooling off during the evening hours as is typical this time of year. Without nighttime cooling, the river retains the heat introduced to it during the daytime hours, both upstream and downstream of the station.

Quad Cities states that at *no time* has the difference between ambient river temperature and the temperature at the edge of the mixing zone exceeded 5° F. In fact, based on modeling, the difference between ambient river temperature and the temperature at the edge of the mixing zone has not exceeded 1° F.

In cooperation with the Agency's request that Exelon explore long-term thermal relief options for Quad Cities, Exelon commissioned extensive studies of the Station's thermal output and impacts. Exelon has shared those studies and its draft long-term regulatory relief proposal with both Federal and State regulators. Additionally, Quad Cities submitted a draft of its 316(a) thermal report which demonstrates no harm to indigenous aquatic populations to the Agency, obtained comments, revised the report and then resubmitted the document for the Agency's final review and comment. At this time, the Agency's technical review of the Draft 316 (a) Report is nearing completion. The Agency will be presenting its technical comments on the Draft 316 (a) Report to Exelon and the Director of the Agency. Exelon is working on finalizing the Draft Adjusted Thermal Standard (ATS) petition to the Illinois Pollution Control Board (IPCB) which will be submitted to the Agency for their internal review before the end of the week.

Relief Requested

Condition 7B of the NPDES Permit limits the number of excursion hours to 1% (87.6 hours) of the hours in a 12-month period ending with any month. Specifically, Special Condition 7B provides that the Station shall not cause water temperatures in the Mississippi River (beyond the mixing zone) to exceed by more than 3°F the non-excursion hour temperature limit for July of 86°F.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
F°	45	45	57	68	78	85	86	86	85	75	65	52

Quad Cities requests an extension to provisional variance IEPA-12-19 be issued to Quad Cities Station allowing the station to exceed the non-excursion hour temperature limit for July of 86°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of July 16, 2012 through July 25, 2012 by no more than 5°F (91°F for July) or 2°F above ambient river temperature, whichever is greater.

Necessity for Request

In its request, Exelon states that when the ambient river temperatures approach or exceed the non-excursion hour limits, Quad Cities has no option other than to use excursion hours, and once its allotment of excursion hours is depleted, Quad Cities must cease operating altogether to

maintain compliance with the NPDES Permit. According to Exelon, partial deratings or adding cooling facilities (such as cooling towers) will not allow Quad Cities to achieve compliance with a limit that already is exceeded even before any heat is added as a result of station operations.

Special Condition 7B of NPDES Permit limits the temperature at the edge of the mixing zone to 86°F in July, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits. As a rule, Quad Cities has been able to operate within its permitted thermal limits due to the fact that the ambient temperatures of the River (measured upstream of the discharge) generally remain below the non-excursion hour limit. It is only during periods when the ambient river temperatures are very close to or exceed the non-excursion hour limits or during periods of extreme low flows that Quad Cities uses its excursion hour allowance.

Illinois and the Upper Mississippi River basin are experiencing a long stretch of hot weather, which is resulting in high ambient river temperatures. In 2012 Quad Cities first began using excursion hours on Sunday, March 18th when upstream Mississippi River temperature matched the station's effluent limitation of 57°F. The permitted excursion hours were subsequently exhausted in March as a result of continued record breaking warm weather recorded throughout the mid-western states. Quad Cities submitted a request to the Agency on March 20, 2012, for relief from Special Condition 7(b) of NPDES Permit No. IL0005037, for the period of March 21, 2012, to April 1, 2012. The Agency subsequently issued Provisional Variance IEPA 12-11 to Quad Cities on March 21, 2012, allowing the station to exceed the non-excursion hour temperature limit for March of 57°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of March 21, 2012 to April 1, 2012 by no more than 5°F (62°F for March) **or** 2°F above ambient river temperature, whichever is greater. During March of 2012, Quad Cities accumulated a total of 223.5 excursion hours.

Quad Cities submitted a second request to the Agency on May 24, 2012, for relief from Special Condition 7(b) of NPDES Permit No. IL0005037, from May 26, 2012, through May 29, 2012. The Agency subsequently issued Provisional Variance IEPA 12-17 to Quad Cities on May 25, 2012, allowing the station to exceed the non-excursion hour temperature limit for May of 78°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of May 26, 2012, through May 29, 2012, by no more than 5°F (78°F for May) **or** 2°F above ambient river temperature, whichever is greater. During the May Provisional Variance period, Quad Cities did not exceed its effluent limitation of 78°F. Quad Cities currently has 33 excursion hours that became available July 1, 2012, when the 33 hours accumulated during July 2011 rolled off the rolling 12-month calendar.

On July 1, 2012, 33 excursion hours became available when the 33 hours accumulated during July 2011 rolled off the rolling 12-month calendar. Quad Cities submitted a third provisional variance request to the Agency on July 3, 2012, seeking relief from Special Condition 7(b) of NPDES Permit No. IL0005037, from July 5, 2012, through July 15, 2012. The Agency issued Provisional Variance IEPA 12-19 to Quad Cities on July 3, 2012, allowing the station to exceed the non-excursion hour temperature limit for July of 86°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of July 5, 2012, through July 15, 2012, by no more than 5°F (91°F for July) **or** 2°F above ambient river temperature, whichever is greater.

Provisional Variance IEPA-12-19 went into effect when Quad Cities' remaining 33 hours of the rolling 12-month calendar were exhausted. Quad Cities downstream receiving stream exceeded the non-excursion hour temperature limit for July of 86°F on July 5, 2012, at 4pm when upstream Mississippi River temperature reached 86°F. Provisional Variance IEPA-12-19 became effective July 7, 2012, at 1am when the remaining 33 hours of the rolling 12-month calendar were exhausted. Quad Cities' downstream receiving stream remained above 86°F until 12am on July 11, 2012 when the upstream Mississippi River temperature dropped back down to 85°F. Quad Cities has accumulated a total of 128 excursion hours since IEPA-12-19 was issued. During the period of July 5, 2012, through July 12, 2012, the maximum upstream Mississippi River temperature measured was 88°F. The maximum downstream receiving stream temperature measured was 89°F.

The Agency also issued Provisional Variances to Exelon's Braidwood Station (IEPA-12-12), Dresden Station (IEPA-12-14), and LaSalle Station (IEPA-12-15) for thermal effluent relief during the March 2012 heat wave. In addition, the Agency issued a Provisional Variance to Dresden Station on July 6, 2012 (IEPA-12-14).

With the current forecast, Quad Cities says it expects to exceed the non-excursion hour temperature limit for July of 86°F starting July 13, 2012, and going through July 25, 2012, if it is to be able to continue to provide safe reliable power to the grid.

Based on current weather forecasts it is expected that the Mississippi River will approach or exceed Quad Cities' permitted effluent limitation. Therefore, unless relief is granted by way of this provisional variance extension request, Quad Cities states that will be forced to shut down for correspondingly significant durations.

Because derating the units will not ensure compliance with the effluent limitations, Quad Cities says that shutting the units down may be the only alternative. Removing both units from operation will not only reduce the available power supply to the grid but will also result in the need for power from the grid to operate key nuclear safety systems. The time required to return nuclear generating units to full power can require 18-24 hours, meaning the electricity generated from these systems will not be readily available in the event of an emergency. Furthermore, under normal conditions only one of the two reactors would be removed from service at any given time, to allow the operating unit to be the primary backup power source for the non-operating unit. Removing both units from service will also eliminate this redundancy and will increase the Quad Cities' reliance on off-site power to support safety related systems. With both units offline and unable to immediately return to service, the power that Quad Cities could generate as a result of the requested provisional variance would not be available to support the voltage requirements that could occur under changing grid conditions. As of July 11, 2012, PJM grid status does not currently have or project any alerts, warnings, or actions. PJM predicts an anticipated Peak Load >146, 000 MW on Tuesday, July 17, 2012.

Assessment of Environmental Impacts

Quad Cities has provided details on the environmental impact during the requested variance extension period from July 15, 2012, through July 25, 2012. Quad Cities has determined that there should not be any significant environmental impact during the course of this extension.

Quad Cities states that there has been no biological harm to the environment as a result of provisional variance IEPA-12-19 issued to Quad Cities Station on July 3, 2012, and effective July 7, 2012 through July 15, 2012.

Alternatives to Requested Relief

Based on river temperatures recorded so far this summer and long range weather projections for the balance of the season, it is likely that there will be a number of extended periods during which ambient river temperatures will be at or above these limits. As previously explained, neither the option of derating the units nor of obtaining additional temporary cooling capacity will allow Quad Cities to maintain compliance if the ambient river temperatures exceed the applicable temperature limits. The only option is for Quad Cities to shut down once the ambient river temperatures are at or exceed the NPDES permit monthly limit.

In 2006, Quad Cities investigated the feasibility of installing cooling towers. Exelon states that based on analytical evaluation of historical plant, river, and meteorological data, the proposed towers performance and the resulting reduction in downstream river temperature could be quantified. When Exelon evaluated the actual days when excursion hours occurred in the last six year period (2000-2005), it found there was no appreciable reduction in the number of days when excursion hours would have occurred with the cooling towers in operation. According to Exelon, the reason for this is the high upstream river temperatures experienced on most of the days when actual excursion hours were recorded. For ~80% of the days when excursion hours were recorded, the plant intake temperature was at the permit limited temperature or above ($\geq$86°F), and for the remaining 20% of the days, the intake temperature was within half a degree of the permit limits. For most of these occurrences, even if adequate cooling tower capacity was in operation to achieve a zero thermal impact on the river (i.e., the plant discharge temperature equaled the intake temperature), excursion hours nonetheless would have been recorded. Estimated cost in 2006 for installation of cooling towers ranged from $48 to $61 million.

Agency Determinations

The Agency has reviewed the requested provisional variance and has concluded the following:

1. Any environmental impact from the requested relief shall be closely monitored and the Agency shall be immediately notified of any adverse impacts.

2. No reasonable alternatives appear available;

3. No public water supplies should be affected;

4. No federal regulations will preclude the granting of this request; and

5. Quad Cities will face an arbitrary and unreasonable hardship if the request is not granted.

Conditions

The Agency hereby GRANTS Quad Cities a provisional variance extension from Special Condition 7B of NPDES Permit No. IL0005037, subject to the following conditions:

A. The term of this provisional variance extension goes through July 25, 2012. This provisional variance is granted based on the facts and circumstances described in the request for an extension, dated July 12, 2012, including consecutive days of abnormally high temperatures at Quad Cities, and high water temperatures in the Mississippi River. If the facts or circumstances described in the July 12, 2012 request for a provisional variance extension, the term of this provisional variance extension will end.

B. Quad Cities shall provide the best operation of its station to produce the best effluent possible at all times. At no time, during the variance period, shall Quad Cities cause water temperature in the Mississippi River (beyond the mixing zone) to exceed 91°F or 2° F above ambient river temperature, whatever is greater.

C. During the variance period, Quad Cities must continuously monitor intake, discharge and receiving water temperatures and visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life.

D. Quad Cities shall document environmental conditions during the term of the provisional variance, including the activities described in C. above of this Section, and submit the documentation to the Agency and the Department of Natural Resources within 30 days after the provisional variance expires.

E. Quad Cities shall immediately notify the Agency and the Department of Natural Resources of any unusual conditions, including mortalities to fish or other aquatic life; immediately take action to remedy the problem; investigate and document the cause and seriousness of the unusual conditions while providing updates to the Agency and the Department of Natural Resources as changes occur until normal conditions return; notify the Agency and the Department of Natural Resources when normal conditions return; and submit the documentation to the Agency and the Department of Natural Resources within 30 days after normal conditions return.

F. Quad Cities shall develop and implement a response and recovery plan to address any adverse environmental impact due to thermal conditions resulting from the provisional variance, including loss and damage to aquatic life.

G. Quad Cities shall notify Roger Callaway of the Agency by telephone at 217/782-9720 when the discharge specified in this provisional variance extension begins and again

when it ends. Written confirmation of each notice shall be sent within five days to the following address:

Illinois Environmental Protection Agency
Bureau of Water - Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
Springfield, Illinois 62794-9276

H. Quad Cities shall sign a certificate of acceptance of this provisional variance extension and forward that certificate to Roger Callaway at the address indicated above within one day of the date of the provisional variance extension. The certification should take the following form:

I (We)_____, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in _____dated _____.

_____
Petitioner

_____
Authorized Agent

_____
Title

_____
Date

Quad Cities shall continue to monitor and maintain compliance with all other parameters and conditions specified in its NPDES Permit No. IL0005037

Conclusion

The Agency grants this provisional variance in accordance with its authority contained in Sections 35(b), 36 (c), and 37(b) of the Illinois Environmental Protection Act (415 ILCS 5/35(b), 36(c), and 37(b) (2010). The decision to grant this provisional variance is not intended to address compliance with any other applicable laws or regulations.

Sincerely,

Julie Armitage
Acting Chief Legal Counsel

cc: John Kim
Julie Armitage
Lisa Bonnet
Sonjay Sofat
Marcia Willhite
Chuck Gunnarson
Roger Callaway
Vera Herst

Exhibit 20

Provisional Variance IEPA 12-19 Extension

July 24, 2012

Exelon.
Nuclear

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740
www.exeloncorp.com

SVP-12-079

July 24, 2012

Mr. Roger Callaway (CAS-19)
Wastewater Compliance Unit Manager
Illinois Environmental Protection Agency
Bureau of Water
Compliance Assurance Section #19
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9274

Re: Quad Cities Nuclear Power Station NPDES Permit No. IL0005037
Provisional Variance IEPA-12-19 Extension Request – Emergency Application

Dear Mr. Callaway:

Thank you for the time, consideration and attention IEPA dedicated to Exelon's provisional variance extension request. We sincerely appreciate all of your efforts. Below is Quad Cities Station's Certificate of Acceptance of the Provisional Variance Extension Order issued by IEPA in this matter.

Very Truly Yours,

Tim Hanley
Site Vice President
Quad Cities Station

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

Certificate of Acceptance

I(We), Tim Hanley, hereby accept and agree to be bound by all terms and conditions of the provisional variance extension granted by the Agency in matter IEPA 12-19 (provisional variance extension) dated July 24, 2012.

Exelon Generation Co. L.L.C/Quad Cities Station
Petitioner

Authorized Agent

Site Vice President
Title

07/24/2012
Date

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

July 24, 2012

Exelon Generation Company, L.L.C. Quad Cities Nuclear Power Station Petitioner, v. ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, Respondent.	)	IEPA – 12-19 (Provisional Variance Extension-Water)

Re: Provisional Variance Extension From Discharge Limits Contained in NPDES Permit IL0005037

Dear Mr. Hanley:

On July 3, 2012, the Illinois Environmental Protection Agency (Agency) granted a request from Exelon Generation Company, L.L.C.'s Quad Cities Nuclear Power Station (Quad Cities) for a provisional variance (IEPA-12-19). This provisional variance was to end no later than July 15, 2012. On July12, 2012, the Agency granted an extension of the provisional variance through July 25, 2012.

On July, 19, 2012, Quad Cities requested a second extension (Attachment A). Quad Cities requests that the terms and conditions of this provisional variance from thermal limits in NPDES Permit IL0005037 (Attachment B) be extended a second time, so that Quad Cities can continue operating through this unusually hot and dry period of weather and resulting high river temperatures.

The Agency has completed its technical review of the attached July 19, 2012 request for another extension of this provisional variance. Quad Cities is seeking a second provisional variance extension from July 26, 2012, through August 8, 2012, to allow it to exceed the maximum temperature limit in Special Condition 7B of NPDES Permit IL0005037 by no more than 5° (91° for July and August), or 2° above ambient river temperature, whichever is greater.

Based on its review, the Agency GRANTS Quad Cities a provisional variance extension subject to the specific conditions set forth below.

Background

Quad Cities is a base load nuclear-fueled steam electric generating facility located near Cordova, Illinois, on the Mississippi River at River Mile 506.8. The station operates two boiling water reactors which have a combined maximum generating capacity of 5,914 megawatts thermal. The station is currently operating at 100% capacity. The station's capacity factor January 1, 2012 through June 30, 2012 was 90%. Quad Cities generation output is transmitted to the PJM Interconnection Grid. PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

Circulating water used to cool and condense the steam from the generating process is withdrawn from, and discharged to, the Mississippi River (Receiving Stream Water ID- IL_M-02. The incoming water is currently listed as impaired (2012 listing) due to Mercury, Polychlorinated biphenyls, and Manganese. These impaired waters have a designated use of public and food processing water as well as fish consumptions.

Quad Cities operates a condenser cooling water system in open cycle mode. In this mode, cooling water is drawn from the Mississippi River into an intake canal, passes through the plant systems, and is discharged through diffusers into the Mississippi River. The maximum design flow is 2,253 cfs or 1,011,000 gpm. The maximum temperature rise of the station from intake to effluent is 28°F at design flow of 2,253 cfs. Open cycle operation with the diffusers was initially permitted by the Agency on December 22, 1983.

Special Condition 7B of NPDES Permit IL0005037 (Attachment B) limits the temperature at the edge of the mixing zone to 86°F in July and August, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits.

Temperature monitoring data shows that the Mississippi River water temperature at the Quad Cities' intake exceeded the non-excursion hour July temperature standard of 86°F on July 5, 2012, and remained above 86°F through July 10, 2012. The Mississippi River water temperature at Quad Cities ' intake exceeded 86°F again on July 16, 2012, and remains above 86°F. Based on current weather forecast of daily maximum air temperatures in the 90's°F through July 27, ambient Mississippi River water temperature at Quad Cities' intake will remain near or above the non-excursion hour July and August temperature standard of 86°F. Mississippi River flow is currently 49,000 cfs and forecast to decrease to 35,000 cfs by July 25, 2012. The maximum Mississippi River ambient temperature that Quad Cities will be able to comply with during the provisional variance period without the use of excursion hours is 84°F.

As a consequence of the unusually warm weather, high ambient river temperatures, and the absence of cooling during the evening hours, the capacity of the Mississippi River to dissipate heat has been reduced beyond its normal capabilities. At current flow rates of 49,000 cfs, the river is not cooling off during the evening hours as is typical this time of year. Without

nighttime cooling, the river retains the heat introduced to it during the daytime hours, both upstream and downstream of the station.

Quad Cities states that at *no time* has the difference between ambient river temperature and the temperature at the edge of the mixing zone exceeded 5° F. In fact, based on modeling, the difference between ambient river temperature and the temperature at the edge of the mixing zone has not exceeded 2° F.

In cooperation with the Agency's request that Exelon explore long-term thermal relief options for Quad Cities, Exelon commissioned extensive studies of Quad Cities' thermal output and impacts. Exelon has shared those studies and its draft long-term regulatory relief proposal with both Federal and State regulators. Additionally, Quad Cities submitted a draft of its 316(a) thermal report which demonstrates no harm to indigenous aquatic populations to the Agency, obtained comments, revised the report and then resubmitted the document for the Agency's final review and comment. At this time, the Agency's technical review of the Draft 316 (a) Report is nearing completion. Exelon is working on finalizing the Draft Adjusted Thermal Standard (ATS) petition to the Illinois Pollution Control Board (IPCB) which was submitted to the Agency for its internal review on July 5, 2012.

Relief Requested

Condition 7B of the NPDES Permit limits the number of excursion hours to 1% (87.6 hours) of the hours in a 12-month period ending with any month. Specifically, Special Condition 7B provides that the Station shall not cause water temperatures in the Mississippi River (beyond the mixing zone) to exceed by more than 3°F the non-excursion hour temperature limit for July and August of 86°F.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
F°	45	45	57	68	78	85	86	86	85	75	65	52

Quad Cities requests an extension to provisional variance IEPA-12-19 be issued to Quad Cities Station allowing the station to exceed the non-excursion hour temperature limit for July and August of 86°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of July 26, 2012, through August 8, 2012, by no more than 5°F (91°F for July and August) or 2°F above ambient river temperature, whichever is greater.

Necessity for Request

In its request, Quad Cities states that when the ambient river temperatures approach or exceed the non-excursion hour limits, Quad Cities has no option other than to use excursion hours, and once its allotment of excursion hours is depleted, Quad Cities must cease operating altogether to maintain compliance with the NPDES Permit. According to Exelon, partial deratings or adding cooling facilities (such as cooling towers) will not allow Quad Cities to achieve compliance with a limit that already is exceeded even before any heat is added as a result of station operations.

Special Condition 7B of NPDES Permit limits the temperature at the edge of the mixing zone to 86°F in July and August, except when Quad Cities is using excursion hours, during which time the temperatures at the edge of the mixing zone may be 3°F warmer than these limits. As a rule, Quad Cities has been able to operate within its permitted thermal limits due to the fact that the ambient temperatures of the River (measured upstream of the discharge) generally remain below the non-excursion hour limit. It is only during periods when the ambient river temperatures are very close to or exceed the non-excursion hour limits or during periods of extreme low flows that Quad Cities uses its excursion hour allowance.

Illinois and the Upper Mississippi River basin are experiencing a long stretch of hot weather, which is resulting in high ambient river temperatures. In 2012 Quad Cities first began using excursion hours on Sunday, March 18th when upstream Mississippi River temperature matched the station's effluent limitation of 57°F. The permitted excursion hours were subsequently exhausted in March as a result of continued record breaking warm weather recorded throughout the mid-western states. Quad Cities submitted a request to the Agency on March 20, 2012, for relief from Special Condition 7(b) of NPDES Permit No. IL0005037, for the period of March 21, 2012, to April 1, 2012. The Agency subsequently issued Provisional Variance IEPA 12-11 to Quad Cities on March 21, 2012, allowing the station to exceed the non-excursion hour temperature limit for March of 57°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of March 21, 2012 to April 1, 2012 by no more than 5°F (62°F for March) or 2°F above ambient river temperature, whichever is greater. During March of 2012, Quad Cities accumulated a total of 223.5 excursion hours.

Quad Cities submitted a second request to the Agency on May 24, 2012, for relief from Special Condition 7(b) of NPDES Permit No. IL0005037, from May 26, 2012, through May 29, 2012. The Agency subsequently issued Provisional Variance IEPA 12-17 to Quad Cities on May 25, 2012, allowing the station to exceed the non-excursion hour temperature limit for May of 78°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of May 26, 2012, through May 29, 2012, by no more than 5°F (78°F for May) or 2°F above ambient river temperature, whichever is greater. During the May Provisional Variance period, Quad Cities did not exceed its effluent limitation of 78°F.

On July 1, 2012, 33 excursion hours became available when the 33 hours accumulated during July 2011 rolled off the rolling 12-month calendar. Quad Cities submitted a third provisional variance request to the Agency on July 3, 2012, seeking relief from Special Condition 7(b) of NPDES Permit No. IL0005037, from July 5, 2012, through July 15, 2012. The Agency issued Provisional Variance IEPA 12-19 to Quad Cities on July 3, 2012, allowing the station to exceed the non-excursion hour temperature limit for July of 86°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of July 5, 2012, through July 15, 2012, by no more than 5°F (91°F for July and August) or 2°F above ambient river temperature, whichever is greater.

Provisional Variance IEPA-12-19 went into effect when Quad Cities' remaining 33 hours of the rolling 12-month calendar were exhausted. Quad Cities downstream receiving stream exceeded the non-excursion hour temperature limit for July of 86°F on July 5, 2012, at 4pm when upstream Mississippi River temperature reached 86°F. Provisional Variance IEPA-12-19 became

effective July 7, 2012, at 1am when the remaining 33 hours of the rolling 12-month calendar were exhausted. Quad Cities' downstream receiving stream remained above 86°F until 12am on July 11, 2012 when the upstream Mississippi River temperature dropped back down to 85°F. Quad Cities has accumulated a total of 128 excursion hours since IEPA-12-19 was issued. During the period of July 5, 2012, through July 12, 2012, the maximum upstream Mississippi River temperature measured was 88°F. The maximum downstream receiving stream temperature measured was 89°F.

Quad Cities submitted a request for extension of provisional variance IEPA-12-19 to the Agency on July 12, 2012, for relief from Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of July 16, 2012, thru July 25, 2012. The Agency subsequently issued an extension of Provisional Variance IEPA 12-19 to Quad Cities on July 12, 2012, allowing the station to exceed the non-excursion hour temperature limit for July of 86°F stated in Special Condition 7(b) of NPDES Permit No. IL0005037 for the period of July 16, 2012, thru July 25, 2012, by no more than 5°F (91°F for July) or 2°F above ambient river temperature, whichever is greater. Quad Cities' downstream receiving stream exceeded the non-excursion hour temperature limit for July of 86°F again on July 16, 2012 @ 11:00 am when upstream Mississippi River temperature reached 86°F and remains above 86°F. During the period of July 16, 2012, through July 18, 2012, the maximum upstream Mississippi River temperature measured was 86°F. The maximum downstream receiving stream temperature measured was 87°F.

The Agency also issued Provisional Variances to Exelon's Braidwood Station (IEPA-12-12), Dresden Station (IEPA-12-14), and LaSalle Station (IEPA-12-15) for thermal effluent relief during the March 2012 heat wave. In addition, the Agency issued a Provisional Variance to Dresden Station on July 6, 2012 (IEPA-12-14) and also on July 18, 2012 (IEPA 12-23). On July 19, 2012, the Agency issued a second provisional variance to LaSalle Station (IEPA 12-24).

With the current forecast, Quad Cities says it expects to exceed the non-excursion hour temperature limit for July and August of 86°F periodically through August 8, 2012, if it is to be able to continue to provide safe reliable power to the grid.

Based on current weather forecasts it is expected that the Mississippi River will approach or exceed Quad Cities' permitted effluent limitation. Therefore, unless relief is granted by way of this provisional variance extension request, Quad Cities states that will be forced to shut down for correspondingly significant durations.

Because derating the units will not ensure compliance with the effluent limitations, Quad Cities says that shutting the units down may be the only alternative. Removing both units from operation will not only reduce the available power supply to the grid but will also result in the need for power from the grid to operate key nuclear safety systems. The time required to return nuclear generating units to full power can require 18-24 hours, meaning the electricity generated from these systems will not be readily available in the event of an emergency Furthermore, under normal conditions only one of the two reactors would be removed from service at any given time, to allow the operating unit to be the primary backup power source for the non-operating unit. Removing both units from service will also eliminate this redundancy and will

increase the Quad Cities' reliance on off-site power to support safety related systems. With both units offline and unable to immediately return to service, the power that Quad Cities could generate as a result of the requested provisional variance would not be available to support the voltage requirements that could occur under changing grid conditions. As of July 18, 2012, PJM has issued a Max Emergency Generation Alert for the Mid Atlantic Zone of the PJM RTO for the day/evening periods of July 17, 2012. There are no forward looking Alerts/ Warnings/ Actions posted by PMJ as of July 18, 2012. PMJ predicts an anticipated Peak Load >147,000 MW on Tuesday, July 23.

Assessment of Environmental Impacts

Quad Cities has provided details on the environmental impact during the requested variance extension period from July 26, 2012, through August 8, 2012. Quad Cities has determined that there should not be any significant environmental impact during the course of this extension.

Quad Cities states that there has been no biological harm to the environment as a result of the first extension to provisional variance IEPA-12-19 issued to Quad Cities Station on July 12, 2012, and effective July 16, 2012, through July 25, 2012.

Alternatives to Requested Relief

Based on river temperatures recorded so far this summer and long range weather projections for the balance of the season, it is likely that there will be a number of extended periods during which ambient river temperatures will be at or above these limits. As previously explained, neither the option of derating the units nor of obtaining additional temporary cooling capacity will allow Quad Cities to maintain compliance if the ambient river temperatures exceed the applicable temperature limits. The only option is for Quad Cities to shut down once the ambient river temperatures are at or exceed the NPDES permit monthly limit.

In 2006, Quad Cities investigated the feasibility of installing cooling towers. Exelon states that based on analytical evaluation of historical plant, river, and meteorological data, the proposed towers performance and the resulting reduction in downstream river temperature could be quantified. When Exelon evaluated the actual days when excursion hours occurred in the last six year period (2000-2005), it found there was no appreciable reduction in the number of days when excursion hours would have occurred with the cooling towers in operation. According to Exelon, the reason for this is the high upstream river temperatures experienced on most of the days when actual excursion hours were recorded. For ~80% of the days when excursion hours were recorded, the plant intake temperature was at the permit limited temperature or above (≥86°F), and for the remaining 20% of the days, the intake temperature was within half a degree of the permit limits. For most of these occurrences, even if adequate cooling tower capacity was in operation to achieve a zero thermal impact on the river (i.e., the plant discharge temperature equaled the intake temperature), excursion hours nonetheless would have been recorded. Estimated cost in 2006 for installation of cooling towers ranged from $48 to $61 million.

Agency Determinations

The Agency has reviewed the requested provisional variance and has concluded the following:

1. Any environmental impact from the requested relief shall be closely monitored and the Agency shall be immediately notified of any adverse impacts.

2. No reasonable alternatives appear available;

3. No public water supplies should be affected;

4. No federal regulations will preclude the granting of this request; and

5. Quad Cities will face an arbitrary and unreasonable hardship if the request is not granted.

Conditions

The Agency hereby GRANTS Quad Cities a second provisional variance extension from Special Condition 7B of NPDES Permit No. IL0005037, subject to the following conditions:

A. The term of this second provisional variance extension goes through August 8, 2012. This extension is granted based on the facts and circumstances described in the request for an extension, dated July 19, 2012, including consecutive days of abnormally high temperatures at Quad Cities, and high water temperatures in the Mississippi River. If the facts or circumstances described in the July 19, 2012 request for a provisional variance extension abate before August 8, 2012, the term of this provisional variance extension will end.

B. Quad Cities shall provide the best operation of its station to produce the best effluent possible at all times. At no time, during the variance period, shall Quad Cities cause water temperature in the Mississippi River (beyond the mixing zone) to exceed 91°F or 2° F above ambient river temperature, whatever is greater.

C. During the variance period, Quad Cities must continuously monitor intake, discharge and receiving water temperatures and visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life.

D. Quad Cities shall document environmental conditions during the term of the provisional variance, including the activities described in C. above of this Section, and submit the documentation to the Agency and the Department of Natural Resources within seven (7) days after the provisional variance expires.

E. Quad Cities shall immediately notify the Agency and the Department of Natural Resources of any unusual conditions, including mortalities to fish or other aquatic life; immediately take action to remedy the problem; investigate and document the cause and seriousness of the unusual conditions while providing updates to the Agency and the Department of Natural Resources as changes occur until normal conditions return; notify

the Agency and the Department of Natural Resources when normal conditions return; and submit the documentation to the Agency and the Department of Natural Resources within 30 days after normal conditions return.

F. Quad Cities shall develop and implement a response and recovery plan to address any adverse environmental impact due to thermal conditions resulting from the provisional variance, including loss and damage to aquatic life.

G. Quad Cities shall notify Roger Callaway of the Agency by telephone at 217/782-9720 when the discharge specified in this provisional variance extension begins and again when it ends. Written confirmation of each notice shall be sent within five days to the following address:

Illinois Environmental Protection Agency
Bureau of Water - Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
Springfield, Illinois 62794-9276

H. Quad Cities shall sign a certificate of acceptance of this provisional variance extension and forward that certificate to Roger Callaway at the address indicated above within one day of the date of the provisional variance extension. The certification should take the following form:

I (We)_____, hereby accept and agree to be bound by all terms and conditions of the provisional variance granted by the Agency in _____dated _____.

_____
Petitioner

_____
Authorized Agent

_____
Title

_____
Date

Quad Cities shall continue to monitor and maintain compliance with all other parameters and conditions specified in its NPDES Permit No. IL0005037

Conclusion

The Agency grants this provisional variance in accordance with its authority contained in Sections 35(b), 36 (c), and 37(b) of the Illinois Environmental Protection Act (415 ILCS 5/35(b), 36(c), and 37(b) (2010). The decision to grant this provisional variance is not intended to address compliance with any other applicable laws or regulations.

Sincerely,

Julie K. Armitage
Acting Chief Legal Counsel

cc: **John Kim**
Julie Armitage
Lisa Bonnet
Sanjay Sofat
Marcia Willhite
Chuck Gunnarson
Roger Callaway
Vera Herst

Exhibit 21

Temperatures and Fish/Aquatic Life Stress/Mortality Surveys

August 14, 2012

Exelon Nuclear

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
22710 206th Avenue North
Cordova, IL 61242-9740

www.exeloncorp.com

SVP-12-086

August 14, 2012

Illinois Environmental Protection Agency
Bureau of Water – Water Pollution Control
Attention: Roger Callaway
1021 North Grand Avenue East, MC #19
P.O. Box 19276
Springfield, Illinois 62794-9276

Subject: Provisional Variance IEPA-12-19 Temperatures and Fish/Aquatic Life Stress/Mortality Surveys

Dear Mr. Callaway:

In accordance with Special Condition "C & D" of the Agency's Order 12-19 dated July 3, 2012 and associated extensions dated July 12, 2012 and July 24, 2012 regarding the provisional variance for Quad Cities Station require the following during the variance period: 1) continuously monitor intake, discharge, and receiving water temperatures, 2) visually inspect intake and discharge areas at least three times daily to assess any mortalities to fish and other aquatic life, 3) document environmental conditions during the term of the provisional variance, including the activities above and submit the documentation to the Agency and Department of Natural Resources within 7 days after the provisional variance expires.

Attached is the subject documentation required by provisional variance IEPA-12-19 and associated extensions Special Condition "C & D".

During the Provisional Variance period there were no observations of unusual conditions including mortalities to fish or other aquatic life downstream of Quad Cities Station discharge due to station discharge during the Provisional Variance period. Large numbers of dead mature northern pike were observed during this time however, across multiple Pools of the river and it was promptly reported to ILDNR. ILDNR was already aware of the situation and agreed it was not caused by station operations.

If you should have any questions regarding Quad Cities Station Provisional Variance IEPA-12-19, please contact Vicki Neels at (309) 227-3200 or Mark Stuhlman at (309) 227-2765 or John Petro at (630) 657-3209.

Very Truly Yours,

Tim Hanley
Site Vice President
Quad Cities Station

Attachments:

Attachment 1:	Quad Cities Station Provisional Variance IEPA-12-19 Temperature and Flow Data
Attachment 2:	Quad Cities Station Three Times Daily Fish/Aquatic Life Stress/Mortality Surveys During Provisional Variance IEPA-12-19
Attachment 3:	Time Above the Maximum Temperature Limits.

Copy to:

Mr. Dan Sallee
Dan.Sallee@Illinois.gov

TH/MS/sjo

CC: Mark Stuhlman
John Petro
Letterbook

ATTACHMENT 1

Month: July 2012 **QUAD CITIES STATION PROVISIONAL VARIANCE IEPA-12-19 TEMPERATURE and FLOW DATA**

Day	Temperature (°F) Intake Bay Avg.	Temperature (°F) Intake Bay Max.	Temperature (°F) Discharge Bay Avg.	Temperature (°F) Discharge Bay Max.	Daily Flow (MGD) Thru Intake	Mississippi River Flow CFS (06:00 @ L&D 14)	Temperature (°F) (Steamboat Island)** Receiving Water Avg.	Temperature (°F) (Steamboat Island)** Receiving Water Max.	Maximum Upstream Field Survey Temperature	Maximum Downstream Field Survey Temperature	On the Clock Y/N Provisional Variance (PV)
1	81.7	82.7	110.3	111.2	1,416	92,100					N
2	83.1	84.1	111.7	112.5	1,416	92,300					N
3	84.3	85.1	112.7	113.5	1,436	93,200			83	84	N
4	85.6	86.6	113.9	114.8	1,436	94,400	85.3	86.8	85	85	N
5	86.8	87.7	115.1	115.7	1,436	94,400	86.0	87.6	86	86	Y
6	87.9	88.9	116.4	117.3	1,436	93,500	87.2	89.1	87	88	Y
7	88.9	89.9	117.5	118.4	1,436	89,700	88.4	89.6	88	88	Y-PV
8	88.0	88.9	116.6	117.5	1,436	86,500	87.2	90.0	87	87	Y-PV
9	87.5	88.8	116.1	117.0	1,436	82,900	87.6	88.4	87	88	Y-PV
10	86.9	87.7	115.3	116.1	1,436	78,700	85.9	88.9	86	87	Y-PV
11	85.1	85.9	113.6	114.2	1,436	68,600	84.6	86.3	84	85	N-PV
12	84.9	86.4	113.4	114.8	1,436	64,900	84.9	86.3			N-PV
13	84.4	85.2	113.0	113.3	1,436	61,800	83.7	86.4			N-PV
14	83.7	85.0	112.3	113.6	1,436	59,100	83.1	85.4			N-PV
15	84.9	86.6	113.5	115.1	1,436	55,900	84.4	86.8	85	86	N-PV
16	86.2	87.8	114.8	116.2	1,436	53,100	85.9	88.3	86	88	Y-PV
17	86.7	88.2	115.2	116.4	1,436	50,700	86.7	88.4	86	88	Y-PV
18	87.5	89.8	115.9	117.4	1,436	49,400	87.1	89.7	86	87	Y-PV
19	87.0	88.0	115.6	116.4	1,436	48,200	86.8	88.9	87	88	Y-PV
20	84.8	86.3	113.4	114.5	1,436	46,700	85.2	86.8	85	86	Y-PV
21	84.4	85.5	113.1	114.0	1,436	45,000	84.6	86.9			N-PV
22	84.3	85.1	112.8	113.5	1,436	40,900	85.0	86.2			N-PV
23	84.2	85.2	112.6	113.5	1,436	39,900	84.5	86.1			N-PV
24	84.5	85.8	113.0	114.0	1,436	40,300	84.9	87.1	84	86	N-PV
25	84.7	86.1	113.1	114.2	1,436	39,500	85.0	87.0	85	86	N-PV
26	83.8	84.8	112.3	113.1	1,436	39,500	84.2	86.1			N-PV
27	83.3	84.3	111.8	112.7	1,436	41,000	83.6	85.3			N-PV
28	82.4	83.6	111.1	111.9	1,436	40,900	82.8	84.4			N-PV
29	82.0	82.9	110.7	111.5	1,436	37,200	82.6	84.1			N-PV
30	82.4	83.7	110.9	112.0	1,436	35,100	82.6	85.2			N-PV
31	83.4	85.1	112.0	113.3	1,436	35,400	83.6	86.7			N-PV
Minimum	**81.7**	**82.7**	**110.3**	**111.2**	**1,416**	**35,100**	**83**	**84**	**83**	**84**	
Average	**85.0**	**86.2**	**113.5**	**114.5**	**1,435**	**60,994**	**85**	**87**	**86**	**87**	
Maximum	**88.9**	**89.9**	**117.5**	**118.4**	**1,436**	**94,400**	**88**	**90**	**88**	**88**	

**** Receiving Water Temperature Probe located 100 yards downstream from point of Steamboat Island on channel side of island at depth of approximately 3-4'.**
Provisional Variance IEPA-12-19 issued 7/3/12 with extensions issued 7/12 and 7/24. PV in effect 7/7/12-8/8/12.

ATTACHMENT 1

Month: August 2012 QUAD CITIES STATION PROVISIONAL VARIANCE IEPA-12-19 TEMPERATURE and FLOW DATA

Day	Temperature (°F) Intake Bay Avg.	Temperature (°F) Intake Bay Max.	Temperature (°F) Discharge Bay Avg.	Temperature (°F) Discharge Bay Max.	Daily Flow (MGD) Thru Intake	Mississippi River Flow CFS (06:00 @ L&D 14)	Temperature (°F) (Steamboat Island)** Receiving Water Avg.	Temperature (°F) (Steamboat Island)** Receiving Water Max.	Maximum Upstream Field Survey Temperature	Maximum Downstream Field Survey Temperature	On the Clock Y/N Provisional Variance (PV)
1	83.9	85.4	112.5	113.9	1,436	35,300	84	87.3			N-PV
2	84.4	85.6	113.0	113.8	1,436	33,300	85.2	87.5	84	86	N-PV
3	84.6	85.6	113.1	114.1	1,436	33,000	85.4	87.6	84	86	N-PV
4	84.4	85.3	113.1	114.0	1,436	33,000	85.9	87.3	84	86	N-PV
5	83.2	84.2	111.9	113.0	1,436	33,400	84.6	86.3			N-PV
6	82.2	83.3	110.9	111.9	1,436	33,200	82.6	85.2			N-PV
7	81.9	83.0	111.1	112.2	1,436	33,300	82.9	85.4			N-PV
8	82.3	83.6	110.6	111.9	1,436	29,900	83.5	85.2			N-PV
9											
10											
11											
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Minimum	**81.9**	**83.0**	**110.6**	**111.9**	**1,436**	**29,900**	**83**	**85**	**84**	**86**	
Average	**83.4**	**84.5**	**112.0**	**113.1**	**1,436**	**33,050**	**84**	**86**	**84**	**86**	
Maximum	**84.6**	**85.6**	**113.1**	**114.1**	**1,436**	**35,300**	**86**	**88**	**84**	**86**	

**** Receiving Water Temperature Probe located 100 yards downstream from point of Steamboat Island on channel side of island at depth of approximately 3-4'.**
Provisional Variance IEPA-12-19 issued 7/3/12 with extensions issued 7/12 and 7/24. PV in effect 7/7/12-8/8/12.

Attachment 2

Fish/Aquatic Life Stress/Mortality Surveys During Provisional Variance Excursions

On any date that provisional variance hours are being used, chemistry crews will make three visual inspections of the Station's intake and discharge areas. These visual surveys should be spaced such that several hours elapse between observations. Areas to be surveyed are from the barge ramp, downstream from the intake fore bay approximately 100 ft (intake area); along the Iowa shoreline from 500 to 1000 ft downstream of the diffuser; and along the Illinois shoreline 500 to 1000 ft downstream of the diffuser. Crews will document the number and general category of dead or stressed fish/aquatic life. If, during any observation, it appears a "fish kill" is occurring (numbers of individuals exhibiting difficulty in swimming or breathing), the chemistry crew will contact the Fish Lab who will dispatch a team to determine the magnitude of the event and species affected. If Fish Lab staff believe a "fish kill" is underway, the Shift Manager will be notified so that Illinois EPA and Illinois DNR can be notified as well.

Contacts & Phone Numbers:

Exelon	Jeremiah Haas	Lab: 309/227-2867
		Home/Cell: 309/236-9149
HDR	Tim Bowzer	Lab: 309/654-2284
		Home: 563/243-5278
		Cell: 563/357-6908
Exelon	John Petro	Home: 815/436-0178
		Cell: 312/813-5916
		Pager: 630/603-7060

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 7/5/12 – 7/7/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 7/5/12	*85 up, 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:00 on 7/5/12	86 up, 86 down, 0.6 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:00 on 7/5/12 **Estimated On the clock at 16:00 on 7/5/12**	*86 up 87 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	07:45 on 7/6/12	86 up, 87 down, 0.8 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:45 on 7/6/12	87 up, 88 down, 0.7 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:00 on 7/6/12	*87 up 88 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South. Additional observation from RM 507-RM 522	08:30 on 7/7/12 **PV IEPA-12-19 in effect 7/7/12 @ 01:00**	*87 up 88 down	**(9) dead northern pike 24"-40": (5) upstream of station intake in channel between RM 508 & 512, (3) within 2000' upstream of diffuser in channel, (1) 1000' downstream of diffuser on Ill shore **Additional observations 06:30-09:30** - RM 519.6-522: (2) dead northern pike over 30" in Lyons Slough, (1) dead northern pike over 30" in channel
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South. Additional observation from RM 507-RM 522	12:45 on 7/7/12	88 up, 88 down, 0.5 delta T **(field temps)**	**2) dead northern pike over 30" within 1500' upstream of diffuser on Iowa side below Hansen Slough, (1) dead catfish 1500' downstream of diffuser in Steamboat Slough – dead for a few days. **Additional observations 13:00-14:00** - RM 519.6-522: (1) dead northern pike over 30" in Fulton Harbor
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:15 on 7/7/12	*88 up 89 down	**(1) dead northern pike over 30" within 1000' upstream of diffuser on Iowa side by mouth of Wapsi, (1) dead catfish in channel at diffuser – dead a few days. **Additional observations 14:00-15:30 - RM 508 - 518:** (1) dead northern pike over 30" in Hansen Slough, (1) dead walleye at mouth of south pit RM 508.2, (1) dead walleye near 3M RM 509.6, (1) dead freshwater drum approx 24" RM 516

Notes: PV IEPA-12-19 issued 7/3/12. PV in effect 7/7/12 - 7/15/12.
*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.
**Courtesy call made to IDNR on 7/9/12 regarding northern pike die off in pool 13.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 7/8/12 – 7/11/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South Additional observation from RM 507- RM 522	07:30 on 7/8/12	*86 up, 87 down	**(1) dead northern pike over 30" 1000' downstream of diffuser on Iowa side **Additional observations 07:00-08:30 - RM 520 - 521.5**: (2) fresh dead northern pike over 30" in Jacobs Slough
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	11:15 on 7/8/12	87 up, 87 down, 0.6 delta T **(field temps)**	**(1) dead northern pike over 30" 1500' upstream of diffuser in main channel
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:00 on 7/8/12	*87 up 87 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:30 on 7/9/12	86 up, 87 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:00 on 7/9/12	87 up, 87 down, 0.7 delta T **(field temps)**	**(1) dead northern pike over upstream on shore at Hass Boat landing RM 507.8, (2) dead carp 1500' upstream of diffuser in main channel, (1) dead drum 500' upstream of diffuser in main channel.
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:00 on 7/9/12	*87 up 88 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:30 on 7/10/12	*86 up 87 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South.	13:20 on 7/10/12	86 up, 87 down, 0.9 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:00 on 7/10/12	*86 up 87 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:30 on 7/11/12 **Estimated off the clock @ 00:00 on 7/11/12**	*85 up 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:30 on 7/11/12	84 up, 85 down, 0.9 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:00 on 7/11/12	*84 up 85 down	No mortality or presence of stress

Notes: PV IEPA-12-19 issued 7/3/12. PV in effect 7/7/12 - 7/15/12.*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.
**Courtesy call made to IDNR on 7/9/12 regarding northern pike die off in pool 13.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 7/12/12 – 7/15/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:30 on 7/12/12	*84 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:00 on 7/12/12	*85 up, 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	20:00 on 7/12/12	*85 up 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:30 on 7/13/12	*84 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	14:00 on 7/13/12	*84 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:20 on 7/13/12	*84 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	07:10 on 7/14/12	*83 up 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South.	13:20 on 7/14/12	*84 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:50 on 7/14/12	*84 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	09:00 on 7/15/12	*84 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	14:00 on 7/15/12	85 up, 86 down, 1.3 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:10 on 7/15/12	*85 up 86 down	No mortality or presence of stress

Notes: PV IEPA-12-19 issued 7/3/12. PV in effect 7/7/12 - 7/15/12.*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 7/16/12 – 7/19/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:20 on 7/16/12	85 up, 86 down, 1.1 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:55 on 7/16/12 **Estimated On the clock at 11:00 on 7/16/12**	86 up, 88 down, 1.2 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:00 on 7/16/12	*87 up 87 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 7/17/12	*86 up, 87 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:40 on 7/17/12	86 up, 87 down, 1.4 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	20:30 on 7/17/12	*87 up 88 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:30 on 7/18/12	86 up, 87 down, 1.1 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South.	13:00 on 7/18/12	*87 up, 88 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:30 on 7/18/12	*88 up 89 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 7/19/12	*86 up 87 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:20 on 7/19/12	87 up, 88 down, 1.3 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:45 on 7/19/12	*87 up 88 down	No mortality or presence of stress

Notes: PV IEPA-12-19 issued 7/3/12. PV IEPA-12-19 extension issued 7/12/12 valid 7/16/12-7/25/12.*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 7/20/12 – 7/23/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:25 on 7/20/12 **Off the clock @ 06:00 on 7/20/12**	85 up, 86 down, 1.0 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:00 on 7/20/12	*84 up, 85 down	One dead shad near the intake, 2 river redhorses upstream. All dead several days.
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:00 on 7/20/12	*85 up 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	08:15 on 7/21/12	*84 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	14:00 on 7/21/12	*84 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:15 on 7/21/12	*85 up 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	09:30 on 7/22/12	*83 up 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South.	12:00 on 7/22/12	*83 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:00 on 7/22/12	*84 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 7/23/12	*83 up 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:10 on 7/23/12	*83 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:00 on 7/23/12	*84 up 86 down	1 dead bluegill upstream channel (Wapsi)

Notes: PV IEPA-12-19 issued 7/3/12. PV IEPA-12-19 extension issued 7/12/12 valid 7/16/12-7/25/12.*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 7/24/12 – 7/27/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 7/24/12	*83 up, 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:20 on 7/24/12	84 up, 86 down, 1.2 delta T **(field temps)**	1 dead Northern Pike Upstream
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:45 on 7/24/12	*85 up 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 7/25/12	83 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	14:35 on 7/25/12	85 up, 86 down, 1.2 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	19:45 on 7/25/12	*84 up 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 7/26/12	*82 up 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South.	15:45 on 7/26/12	*83 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	20:00 on 7/26/12	*83 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:10 on 7/27/12	*82 up 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:00 on 7/27/12	*83 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:00 on 7/27/12	*83 up 85 down	No mortality or presence of stress

Notes: PV IEPA-12-19 issued 7/3/12. PV IEPA-12-19 2nd extension issued 7/24/12 valid 7/26/12-8/8/12.*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 7/28/12 – 7/31/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	08:00 on 7/28/12	*81 up, 83 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	11:15 on 7/28/12	*82 up, 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:20 on 7/28/12	*82 up 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	07:00 on 7/29/12	*81 up, 83 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	14:15 on 7/29/12	*82 up, 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:30 on 7/29/12	*82 up 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 7/30/12	*80 up 82 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South.	12:00 on 7/30/12	*81 up, 83 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	20:45 on 7/30/12	*83 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:00 on 7/31/12	*81 up 83 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:10 on 7/31/12	*83 up, 85 down	3 dead channel cats up, 1 down, all dead several days
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:20 on 7/31/12	*84 up 86 down	No mortality or presence of stress

Notes: PV IEPA-12-19 issued 7/3/12. PV IEPA-12-19 2nd extension issued 7/24/12 valid 7/26/12-8/8/12.*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 8/1/12 – 8/4/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South Additional observation from RM 507- RM 522	05:45 on 8/1/12	*82 up, 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:15 on 8/1/12	*83 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:30 on 8/1/12	*84 up 86 down	1 dead catfish upstream, dead several days
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:10 on 8/2/12	*82 up, 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	14:35 on 8/2/12	84 up, 86 down, 1.6 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:30 on 8/2/12	*84 up 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 8/3/12	*83 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South.	14:00 on 8/3/12	84 up, 86 down, 1.8 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	16:00 on 8/312	*84 up 86 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	08:45 on 8/4/12	*84 up 86 down	I dead walleye over diffuser, dead several days
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	12:55 on 8/4/12	84 up, 86 down, 1.2 delta T **(field temps)**	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:00 on 8/4/12	*84 up 86 down	No mortality or presence of stress

Notes: PV IEPA-12-19 issued 7/3/12. PV IEPA-12-19 2nd extension issued 7/24/12 valid 7/26/12-8/8/12.*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

Attachment 2

Quad Cities Station
Field Observation Survey

Date: 8/5/12 – 8/8/12 Crew: Chemistry / Environmental

Sampling Location	Time	Temp. (°C)	Observed Mortality or Presence of Stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South Additional observation from RM 507- RM 522	07:00 on 8/5/12	*83 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	11:45 on 8/5/12	*83 up, 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:00 on 8/5/12	*83 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 8/6/12	*80 up, 82 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:30 on 8/6/12	*82 up, 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	20:30 on 8/6/12	*83 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	05:45 on 8/7/12	*80 up 82 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South.	13:05 on 8/7/12	*82 up, 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	18:15 on 8/712	*83 up 85 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	07:20 on 8/8/12	*81 up 83 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	13:30 on 8/8/12	*82 up, 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	17:00 on 8/8/12	*82 up 84 down	No mortality or presence of stress
Illinois shoreline 1000' Upstream to power lines South & Iowa shoreline 1000' Upstream to power lines South	06:00 on 8/9/10 Steamboat Island data logger removed.	*81 up 83 down	No mortality or presence of stress

Notes: PV IEPA-12-19 issued 7/3/12. PV IEPA-12-19 2nd extension issued 7/24/12 valid 7/26/12-8/8/12.*Upstream temperature based on L&D 13 temperature recording and service water inlet temperature. Downstream temperature calculated using discharge temperature, discharge flow and Mississippi River flow.

ATTACHMENT 3
Time Above The Maximum Temperature Limits
Page 1 of 1

1. Maximum temperature rise above natural temperature shall **not** exceed 5 °F outside the 500 ft mixing zone.

2. Water temperature at representative locations in the main river 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.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
45	45	57	68	78	85	86	86	85	75	65	52

DATE/TIME ABOVE LIMIT	DATE/TIME BELOW LIMIT	HOURS ABOVE LIMIT	HOURS ACCUMULATED	Provisional Variance Days Used	Comments	INITIALS
7/21/11 @ 10:30	7/22/11 @ 19:30	33	33	0	Carryover from 2011	MS/
3/18/12 @ 13:00	3/18/12 @ 23:30	10.5	43.5	0		MS/
3/19/12 @ 08:00	3/27/12 @ 08:00	192 (44.1 on rolling 12 month calendar)	235.5 (87.6 on rolling 12 month calendar, 147.9 on PV IEPA-12-11)	7 (3/21-3/27)	PV IEPA-12-11 in effect 3/21/12 thru 3/31/12	MS/
3/28/12 @ 10:00	3/29/12 @ 07:00	21	256.5 (168.9 total hrs on PV IEPA-12-11)	4 (3/28-3/31) 11 total days		MS/
NA	NA	0	256.5 (0 on IEPA 12-17)	4 (5/26-5/29) 15 total days	PV IEPA-12-17 in effect 5/26/12 thru 5/29/12)	MS/
NA	NA	-33	223.5 (54.6 on rolling 12 month calendar)	0	33 hrs accumulated July of 2011 roll off calendar	MS/
7/5/10 @16:00	7/11/12 @ 00:00	128 (33 on rolling 12 month calendar)	351.5 (87.6 on rolling 12 month calendar, 95 on PV IEPA-12-19)	9 (7/7-7/15) 24 total days	PV IEPA-12-19 in effect 7/7/12 thru 7/15/12)	MS/
7/16/10 @11:00	7/20/12 @ 06:00	91	442.5 (91 on PV IEPA-12-19 1st extension)	10 (7/16-7/25) 34 total days	PV IEPA-12-19 extension in effect 7/16/12 thru 7/25/12)	MS/
NA	NA	0	442.5 (87.6 on rolling12 month calendar, 168.9 on PV IEPA-12-11, 95 on PV IEPA-12-19, 91 on PV IEPA-12-19 1st extension)	14 (7/26-8/8) 48 total days	PV IEPA-12-19 2nd extension in effect 7/26/12 thru 8/8/12)	MS/

Reviewed By: Randy Knight / Date: 8-14-12

Exhibit 22

2002 Zone of Passage Curve

NUMERICAL MODEL OF THE DIFFUSER PIPE SYSTEM AT QUAD CITIES NUCLEAR GENERATING STATION

By
Subhash C. Jain, Yong Lai, and Songheng Li

Submitted to
Exelon Corporation
Chicago, Illinois

Limited Distribution Report No. xxx

IIHR—Hydroscience and Engineering
College of Engineering
The University of Iowa
Iowa City, Iowa 52242

April 2002

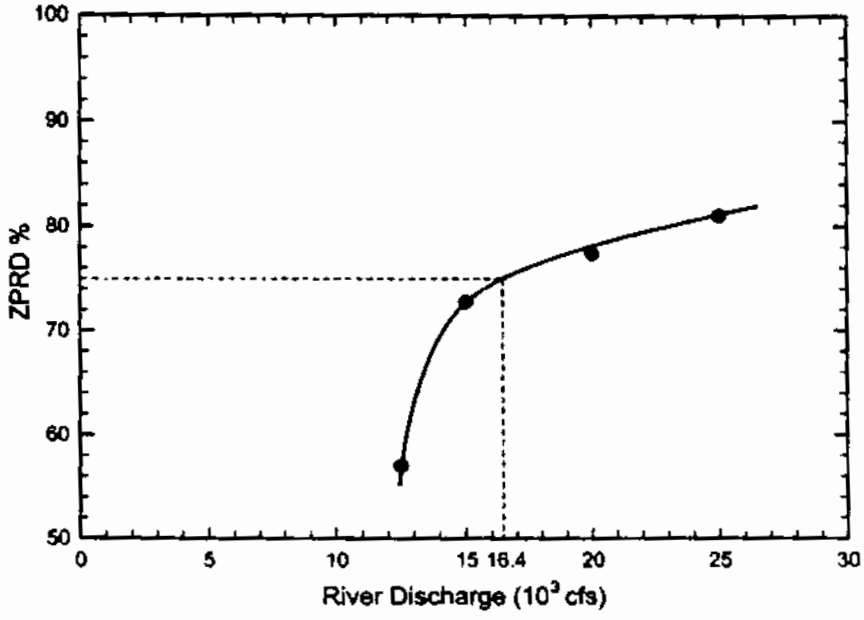


Figure 12. Minimum zone-of-passage with respect to river discharge for as-built diffuser configuration

Exhibit 23

2011 Zone of Passage Curve

Subhash C. Jain
Professor Emeritus
914 Talwrn Court
Iowa City, IA 52246

NR 5-14-11

May 11, 2011

Mike Conlon
Exelon Generation
1 Oakwood Lane
Auburn, IL 62615

Re: Zone of passage with respect to area

Mr. Conlon:

A numerical model study of the diffuser pipe system at the Quad Cities Nuclear Generating Station of the Exelon Corporation was conducted by IIHR—Hydroscience and Engineering, The University of Iowa, Iowa City, Iowa. The details of the numerical study are included in a report entitled "Numerical Model of the Diffuser Pipe System at Quad Cities Nuclear Generating Station", April 2002 by Subhash C. Jain, Yong Lai, and Songheng Li.

The zone of passage with respect to area at different distances downstream from the centerline between the two diffuser pipes was determined from the following equation:

$$ZPRA(y) = 100[\,1 - \{\Sigma a_i(y)/A(y)\}\,]$$

where

$ZPRA(y)$ = local zone-of-passage with respect to area
y = distance downstream from the centerline between the diffuser pipes
$a_i(y)$ = area within 5 degree F isotherm
$A(y)$ = total cross-sectional area of the river channel

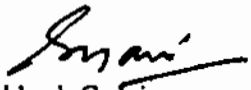
The local zone-of-passage with respect to area for a range of river discharges was determined using the above equation and the method outlined in the above-mentioned report. For each river discharge, the minimum zone-of-passage with respect to area was then equal to the minimum value of the local zone-of-passage. These results are applicable for the condenser-water discharge of 2192 cfs and temperature rise of 28 degree F.

The variation of the minimum zone-of-passage with respect to area with the river discharge is presented in Figures 1 and 2 for the as-built and optimized diffuser configurations,

respectively. The zone-of-passage with respect to area for the as-built diffuser configuration would be larger than 75 percent of the river cross-sectional area at river discharges less than about 12,700 cfs. The zone-of-passage with respect to area for the optimized diffuser configuration would be larger than 75 percent of the river cross-sectional area at river discharges below 11,000 cfs (estimated by extrapolation). It should be pointed out that the minimum zone-of-passage with respect to area is larger than the minimum zone-of-passage with respect to discharge.

Should you have any questions, please contact me at 319-351-4593 or by email.

Yours sincerely,



Subhash C. Jain
Professor Emeritus

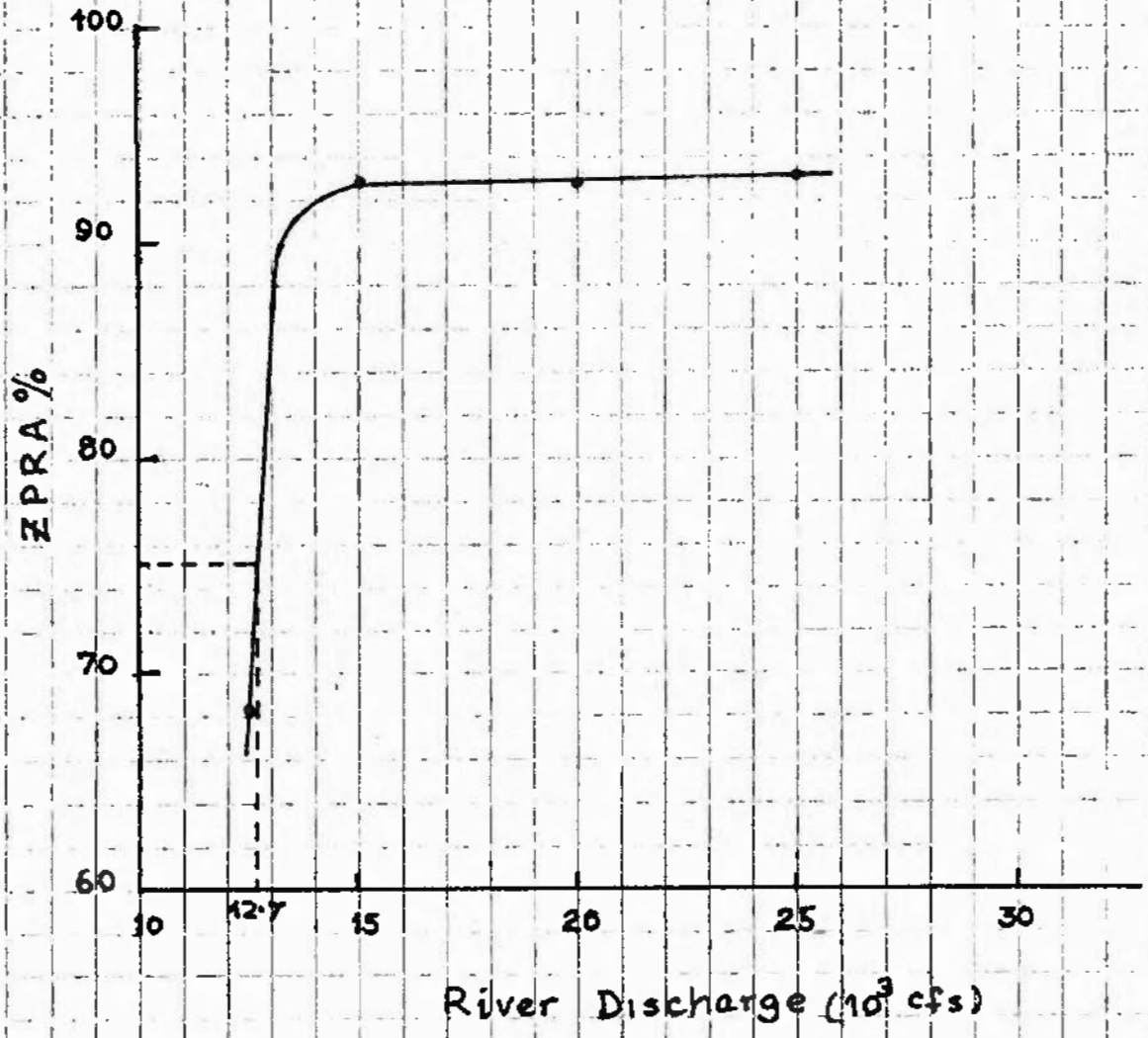


Figure 1. Minimum zone-of-passage with respect to area for the as-built diffuser configuration

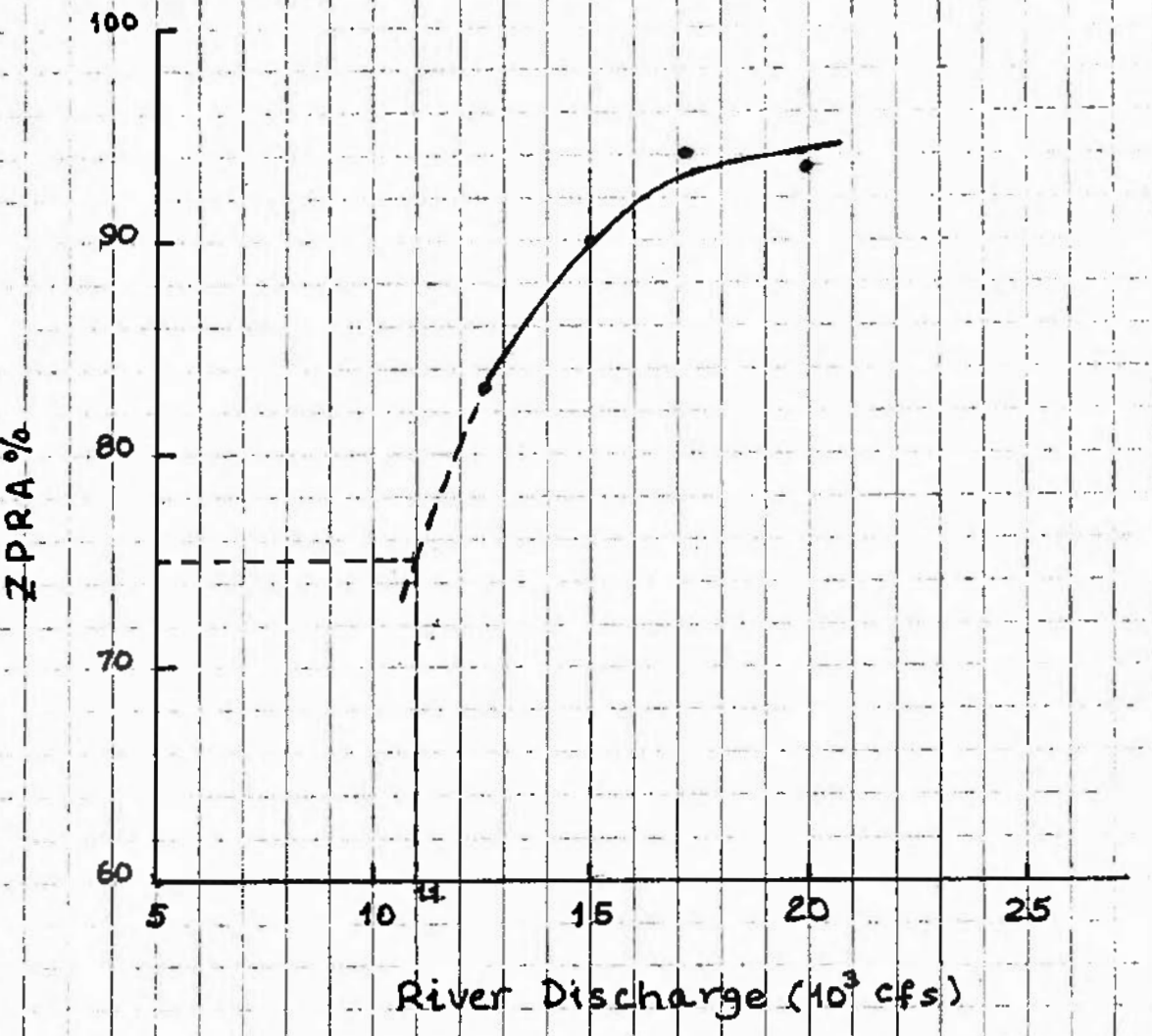


Figure 2. Minimum zone-of-passage with respect to area for the optimized diffuser configuration

Exhibit 24

Summary and Conclusions

Numeric Model of the Diffuser Pipe System

of-passage with respect to discharge would be violated at river discharge below 16,400 cfs, as indicated by the dashed lines in Figure 12.

D. Phase II Results. For the as-built diffuser configuration, a high-temperature region is present near the Iowa shore. In this phase of the numerical simulation some of the diffuser ports near the Iowa shore were blocked to eliminate the high-temperature region and to ensure a more uniform temperature distribution in the river cross section 500 ft downstream of the diffuser. The number and the locations of the diffuser ports to be blocked were determined by trial. Seven diffuser ports, L_1, L_2, L_3, L_4, L_6, L_7, and L_9 were blocked in the final optimum diffuser configuration (L_i denotes the i-th diffuser port in the long diffuser pipe; and L_1 is the port nearest to the Iowa shore).

The temperature contours at the water surface in the river and at different cross sections of the river are presented in Figures 13 for the river discharge 20,000 cfs; the high-temperature region near the Iowa shore does not exist. A comparison of the water-surface temperature distribution in the river cross section 500 ft downstream from the centerline between the diffuser pipes for the as-built and the optimized diffuser configurations is shown in Figure 14 for the river discharge of 20,000 cfs. The temperature distribution is relatively more uniform for the optimized diffuser configuration.

Figure 15 shows the minimum zone-of-passage with respect to discharge for the optimized diffuser configuration. The standard for 75 percent zone-of-passage with respect to discharge would be violated at river discharge below about 17,000 cfs, which is slightly higher than that for the as-built configuration. Though the optimized diffuser configuration improved the temperature distribution across the river, it slightly increased the value of the minimum river discharge at which the standard for the ZPRD is satisfied.

V. SUMMARY AND CONCLUSIONS

The present investigation was concerned with the development of zone-of-passage curves at the proposed power uprate conditions for both the as-built and the optimized diffuser pipe system at Quad Cities Nuclear Generating Station. For the proposed power

uprate conditions the condenser-water discharge and temperature rise are 2192 cfs and 28°F, respectively. A three-dimensional U^{2}RANS numerical model of the river reach near the plant and the diffuser pipe system was used to determine the temperature and flow distributions downstream from the diffuser pipes.

The optimized diffuser configuration with seven blocked diffuser ports, L_1, L_2, L_3, L_4, L_6, L_7, and L_9 was determined from the results of a series of numerical simulations with different blocked diffuser ports. The optimized diffuser configuration results in a more uniform temperature distribution in a river cross section 500 ft downstream of the diffuser pipes. The thermal criteria of the zone-of-passage with respect to discharge is satisfied for river discharge higher than about 16,400 cfs for the as-built diffuser configuration and 17,000 cfs for the optimized diffuser configuration.

References

Jain, S.C., Sayre, W.W., Akyeampong, Y.A., McDougall, D., and Kennedy, J.F., "Model Studies and Design of Thermal Outfall Structures, Quad Cities Nuclear Plant," IIHR Report No. 135, Iowa Institute of Hydraulic Research, The University of Iowa, Iowa City, Iowa, 1971

Jain, S.C. and Kennedy, J.F., "Evaluation of the Quad Cities Nuclear Generating Station Diffuser Pipe System at Low River Flows," IIHR Limited Distribution Report No. 174, Iowa Institute of Hydraulic Research, The University of Iowa, Iowa City, Iowa, 1990

Lai, Y.G., "Unstructured Grid Arbitrarily Shaped Element Method for Fluid Flow Simulation," *AIAA Journal*, Vol.38, No.12, pp.2246-2252, 2000

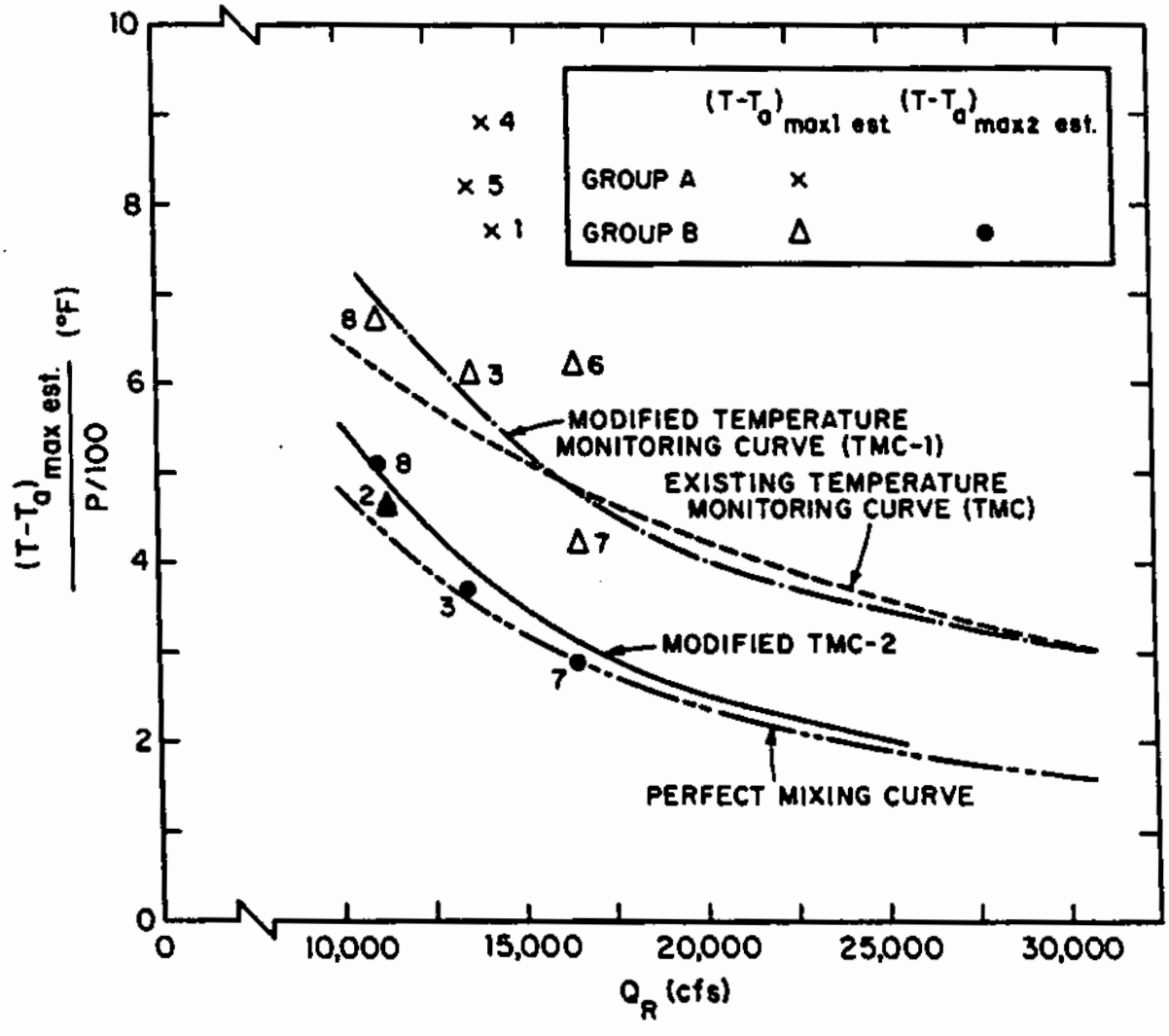
Lai, Y.G., Weber, L, Patel, V.C., "U^{2}RANS: A Comprehensive Hydraulic flow Simulation Code – Its Development and Applications," *Proceedings 4th Int. Conference on HydroInformatics*, Iowa City, IA, 2000; also under review by the *J. Hydraulic Engineering*.

Parr, A.D. and Sayre, W.W., "Prototype and Model Studies of the Diffuser-Pipe System for Discharging Condenser Cooling Water at the Quad-Cities Nuclear Power Station," IIHR Report No. 135, Iowa Institute of Hydraulic Research, The University of Iowa, Iowa City, Iowa, 1977

Rouse, H., Elementary Mechanics of Fluids, Wiley, 1946

Exhibit 25

Quad Cities Temperature Monitoring Curves



1990 TMC-1 + TMC-2

Figure 11. Modified temperature monitoring curves.

Pet. Exh. 1 App A 2 A-11

1990 Jain/Kennedy IIHR report #174

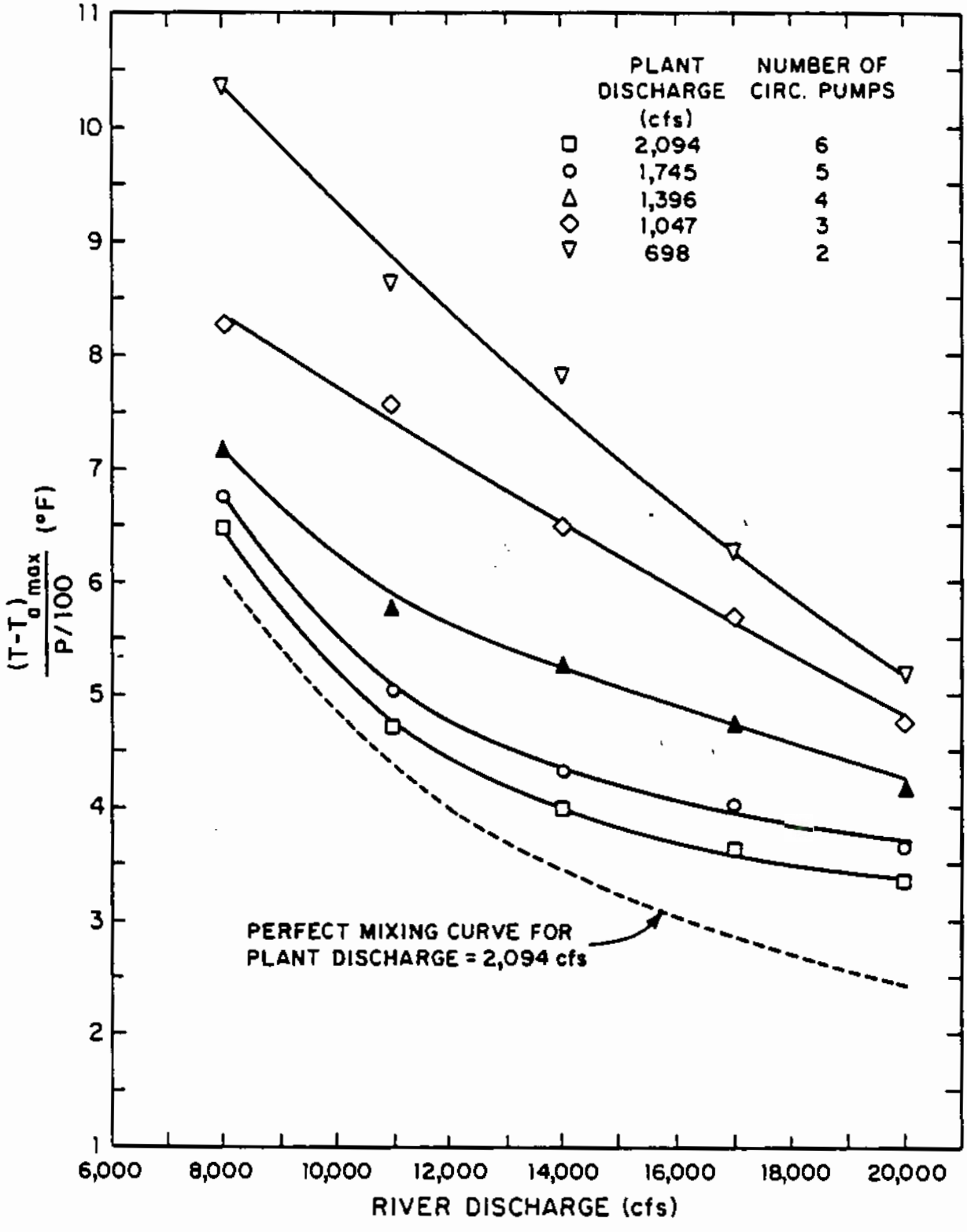
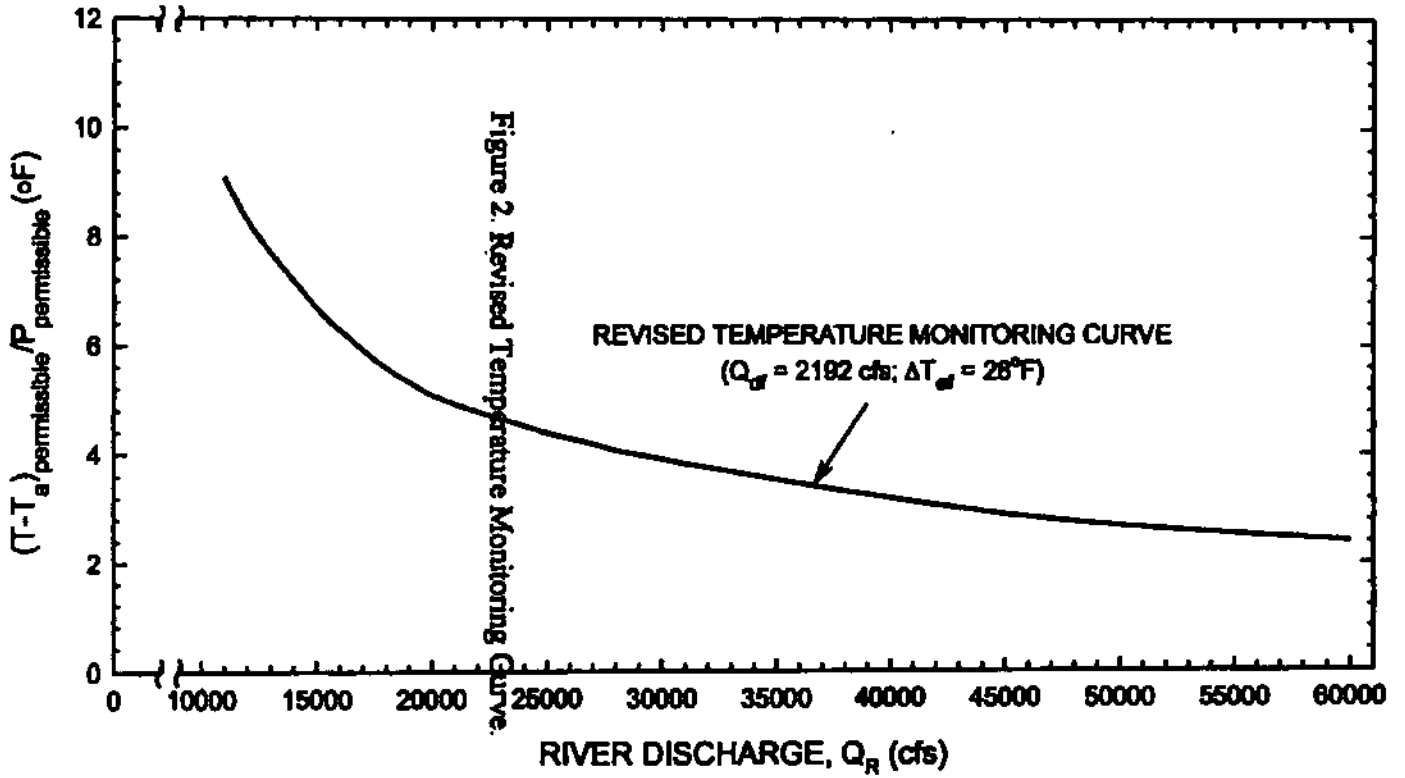


Figure 13. New temperature-monitoring curves.

Pet Exh 1 App. E D E-5
1990 Jain/Kennedy IIHR report # 125



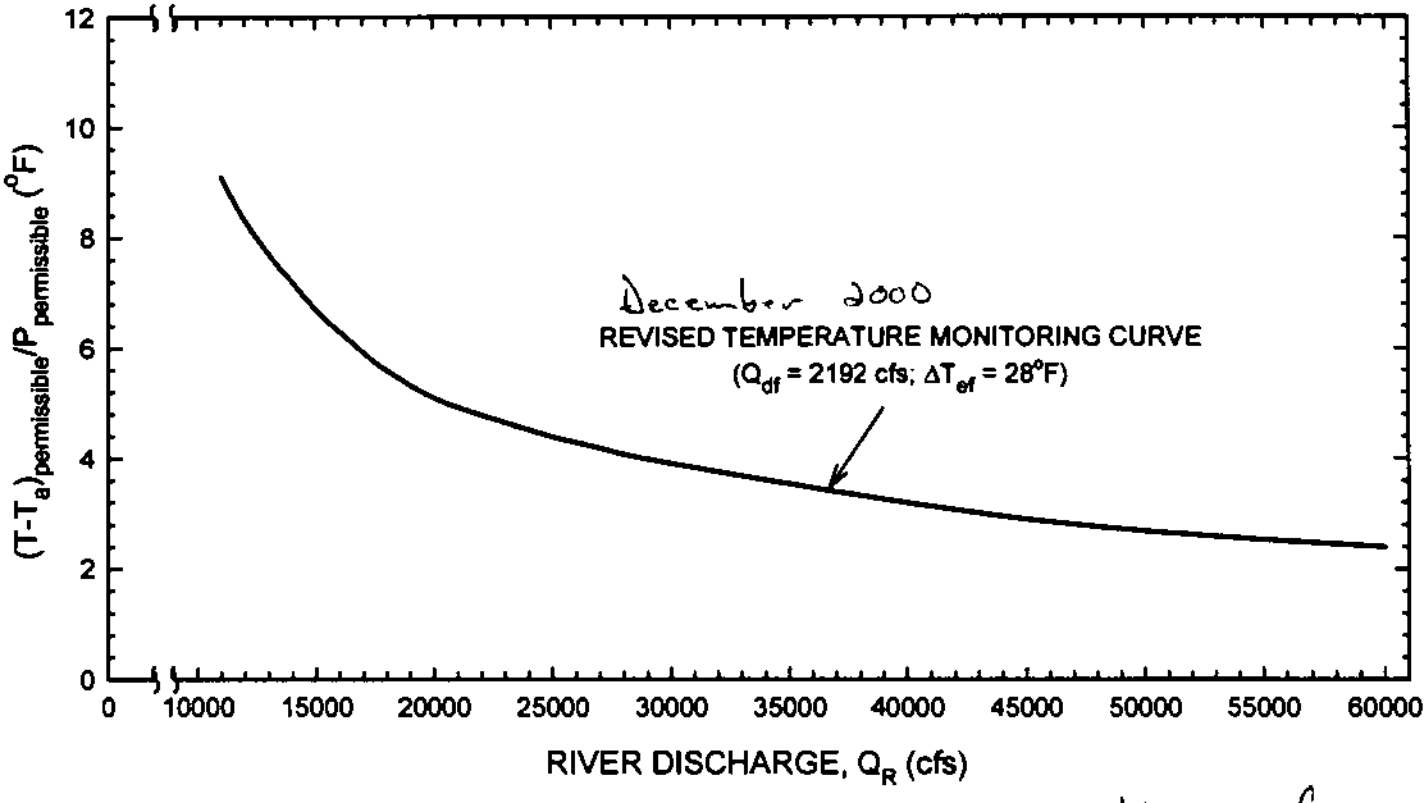
December 2000

Figure 2. Revised Temperature Monitoring Curve.

Pet Exh 1 App D 2 D-8

December 2000 Jain IIHR report #102

ATTACHMENT 5
Revised Temperature Monitoring Curve at EPU
Page 1 of 1



Temperature monitoring curve currently used for compliance - proceduralized

Exhibit 26

Figure 3 – Observed Temperatures, September 16, 2003

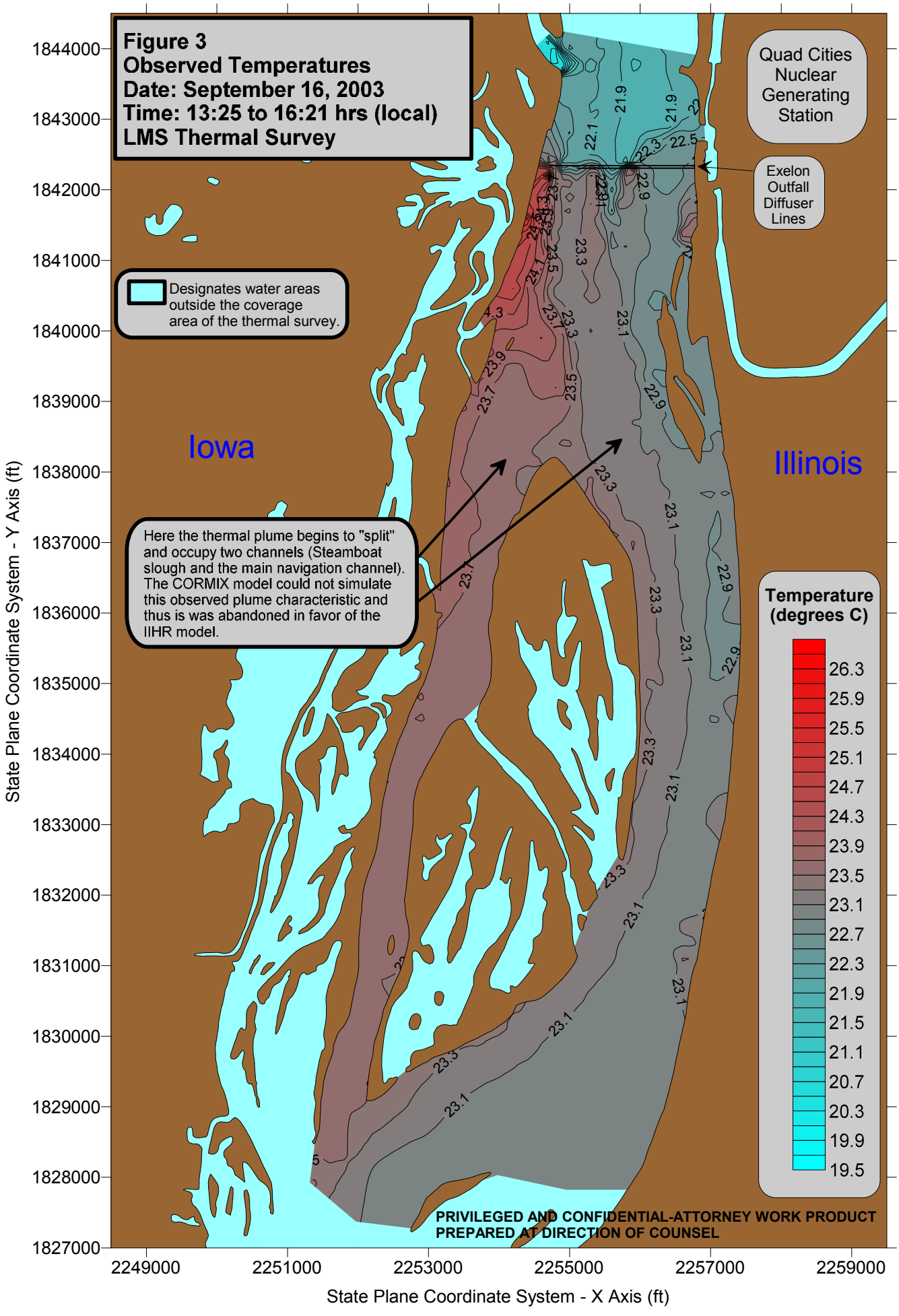


Figure 3
Observed Temperatures
Date: September 16, 2003
Time: 13:25 to 16:21 hrs (local)
LMS Thermal Survey
Quad Cities Nuclear Generating Station
Exelon Outfall Diffuser Lines
Designates water areas outside the coverage area of the thermal survey.
Here the thermal plume begins to "split" and occupy two channels (Steamboat slough and the main navigation channel). The CORMIX model could not simulate this observed plume characteristic and thus is was abandoned in favor of the IIHR model.
Iowa
Illinois
Temperature (degrees C)
26.3
25.9
25.5
25.1
24.7
24.3
23.9
23.5
23.1
22.7
22.3
21.9
21.5
21.1
20.7
20.3
19.9
19.5
PRIVILEGED AND CONFIDENTIAL-ATTORNEY WORK PRODUCT
PREPARED AT DIRECTION OF COUNSEL
State Plane Coordinate System - Y Axis (ft)
1844000
1843000
1842000
1841000
1840000
1839000
1838000
1837000
1836000
1835000
1834000
1833000
1832000
1831000
1830000
1829000
1828000
1827000
State Plane Coordinate System - X Axis (ft)
2249000
2251000
2253000
2255000
2257000
2259000