GEI Consultants

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FINAL Water Quality Monitoring Report

Badger-Rapide Croche Hydroelectric Project FERC No. 2677-030 Kaukauna, Wisconsin

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GEI Consultants, Inc.
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Green Bay, Wisconsin 54311

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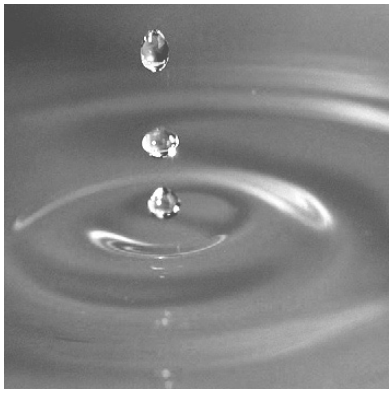

Roger A. Miller, P.G., C.P.G.
Senior Hydrogeologist

John Pizzimenti
Senior Consultant

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1. Project Background

On May 18, 2011, City of Kaukauna, Wisconsin (Kaukauna Utilities), received a new License from the Federal Energy Regulatory Commission (FERC) for its Badger-Rapide Croche Hydroelectric Project (Project). The Project consists of two separate developments, Badger and Rapide Croche both located on the Fox River. The new Badger development was completed in February 2014 and replaces two adjacent and decommissioned powerhouses located within the City of Kaukauna. Rapid Croche is 4.5 miles downstream and consists of a single powerhouse integral with dam.

Under Article 406 of the new license, Kaukauna Utilities completed an approved Water Quality Monitoring Plan (WQMP) in 2012. The WQMP directed the licensee to monitor dissolved oxygen (DO), pH, and temperature variables on an hourly and daily basis upstream and downstream of the project for the period from June 15 through September 30 for the three consecutive years (2014-2016). This is the first annual report for 2014. The Report is organized in four sections: 1.0 Project Background; 2.0 Methods and Instruments; 3.0 Results; and 4.0 Conclusions.

1.1 Organization of the Report

This Section 1.0 is a description of the project; with purpose and organization of the report.

Section 2.0 summarizes the instrumentation and methods used to collect and analyze the data.

Section 3.0 (Results) describes the data including (1) hydrology and (2) compares hourly and daily upstream and downstream water quality of: DO; pH; and temperature data. The data are placed in context of (1) compliance criteria; (2) quality assurance data; and a communications with agencies as required by the WQMP. The tables and graphs of the data presented in Section 3.0 appear in Appendix A. Corresponding raw data are presented in Appendix B in CD-ROM in Excel format. An electronic copy of this report is also saved as PDF file in Appendix B.

Section 4.0 (Conclusions) addresses quality of the data, equipment, conclusions regarding compliance and recommendations for future monitoring.

2. Methods and Instrumentation

2.1 Data Collection Sites

Badger powerhouse is approximately 0.35 miles downstream of Kaukauna Dam. Water passing Kaukauna Dam is controlled upstream by the US Army Corps of Engineers. The Dam discharges a minimum flow and flood flow components into (1) the historic channel and (2) available discharge into a power canal that supplies the Badger powerhouse. Monitoring of Badger occurred at three agency-approved locations: upstream of Kaukauna Dam; downstream of Badger Powerhouse prior to confluence with the historic channel; and at the downstream end of the Kaukauna Dam bypass (historic) channel prior to confluence with the tailrace of the Badger Powerhouse (Table 1 and Figure 1). The location of the upstream sampling station was moved about 500 feet upstream from the original location because the intended standpipe was unable to provide access to moving water. The alternative location is still within the Kaukauna flowage near the intake of the power canal. There it has access to upstream water quality in a free flowing environment and one that is protected from vandalism or damage behind a fenced and locked property belonging to Kaukauna Utilities. The downstream sonde at Badger tailrace was replaced on two occasions for mechanical failure during 2014 (Appendix C).

Rapid Croche development consists of a single dam and integral powerhouse. Monitoring occurred at two agency-approved locations upstream and downstream of the Dam near the intake and discharge points of the powerhouse (Table 1 and Figure 1). The downstream sonde was damaged and replaced five times in the 2014 season (Appendix C) as this is not a privately secured site. The unit was moved approximately 100 feet to a less publically accessible point and behind locked fencing.

2.2 Water Quality Criteria

The WQMP requires that Kaukauna Utilities monitor and report to WDNR during the sampling season on when data exceed the following criteria:

- Dissolved Oxygen - The dissolved oxygen (DO) content in surface waters may not be lowered to less than 5 milligrams per liter (mg/l) at any time. Differences in DO daily averages upstream and downstream of Kaukauna and Rapid Croche dams shall be no greater than 2 mg/l for five consecutive days. Calibration of the dissolved oxygen sensors was performed every two weeks with a variance criterion goal of less than 1 mg/l 70% of the time.

- Temperature - There shall be no temperature changes that may adversely affect aquatic life. Natural daily and seasonal temperature fluctuations shall be maintained. The temperature shall not exceed 89° F (31.5° C) for warmwater fish.
- pH - The pH shall be within the range of 6.0 to 9.0, with no daily average change greater than 0.5 units outside the estimated natural seasonal maximum and minimum.

2.3 Instrumentation and Data Collection

Instrumentation consisted of five Hach Mini Sonde-5 (MS-5) outfitted with sensors to record hourly temperature, pH and dissolved oxygen (DO) data. Each unit had a backup temperature probe to the real time data probe and was equipped with LDO (Luminescent Dissolved Oxygen) technology. Data were stored onboard the sonde data logger and downloaded at biweekly intervals to a computer for in-season analysis and compliance purposes. After the download the DO probe and pH probes were calibrated against standard solutions then adjusted prior to redeployment. The 2014 pH data showed some chronic calibration drift for pH at several units. Details are discussed in Sections 3.0 Results and 4.0 Conclusions.

Reserve sondes of the same design were kept on hand for rapid redeployment and were utilized seven times during the study when sondes were damaged or compromised. Data losses and calibration issues are discussed and logged in Appendix A.

Sondes were first deployed on June 11 at five agency approved locations (Table 1 and Figure 1). Data collection began June 15 and the first results were downloaded on June 27. Sondes had been factory calibrated and were installed as delivered. Pre-season test data were downloaded to confirm all probe operations. Data were downloaded biweekly through the study period (June 15 to September 30) and were calibrated according to manufacturer recommendations in each subsequent biweekly period and analyzed for WQMP compliance. Sondes were retrieved and removed from operation on October 1, 2014. In 2015, these units will be replaced by new technology (H4) that has improved accuracies over the MS-5 units, are more compact, and have longer battery life.

3. Results

3.1 Overview of Results

This section of the report describes the actual data displayed in graphic form for each of the three variables at upstream and downstream locations within each project. Badger Hydro water quality is described for all three variables and calibration (3.2, 3.3, 3.4, 3.5, and 3.6). Then Rapid Croche Hydro water quality is described for all three variables and calibration (3.7, 3.8, 3.9, and 3.10). Anomalies occurred in calibration data, especially in the first deployment as factory calibrations were erratic. Other problems with calibrations occurred later in the season and are discussed in detail in section 3.5 and 3.10. There were no raw data gaps for upstream and downstream locations at Badger.

3.2 Daily Average Dissolved Oxygen and Discharge Data Badger Hydro

Figure 6 shows daily discharge in the Fox River during the study period, as measured at a U.S. Geological Survey monitoring station in Appleton, Wisconsin (USGS Station 04084445). Fox River discharge exceeded 12,000 cfs in June. It dropped precipitously July 1-15 to 2,000 cfs where it remained steady from July 15-Aug 15 before rising rapidly again to 6,000 cfs in September. Fox River inflows are outside the control of Badger Hydro and outflows are basically equal to inflows. Changes in discharge affect water clarity, water velocity temperature, and algal abundance and these affect DO levels in the Fox River. Despite large changes in the system, upstream and downstream levels of DO at Badger hydro remain closely correlated (Figure 6).

From July 17 to August 18 (one month) the DO in the bypass reach remained between 8 and 9 mg/l, compared to 11to12 mg/l peaks in upstream and downstream locations. During this period, the forebay and hydro went through two matching cycles of rapid rises/declines in DO that are nearly identical. During this time, most upstream water flowed through the hydro.

Downstream DO averaged 8.79 compared to 9.04 mg/l upstream (Table 2). Reduced downstream DO levels are attributable to tailrace turbulence releasing dissolved oxygen to the atmosphere. DO hourly data is more variable than daily averages due to spikes in photosynthesis during daylight hours.

The maximum daily average DO (mg/l) was 12.16 and 11.63 and the minimum was 7.37 and 6.64 for upstream and downstream respectively (Table 2). The largest daily average DO difference (mg/l) from one day to the next was 1.92 on (August 11), 1.70 (July 12), 0.82 (September 19) for the upstream, downstream and bypass respectively. There were no daily

changes that exceeded 2.0 mg/l at any location (Tables 4, 5, and 6). The lowest DO average was 6.64 mg/l recorded on July 2.

Conclusions: The data show Fox River seasonal DO variation is much greater than difference upstream and downstream of Kaukauna Dam (Figure 6). Daily data demonstrate Badger Hydro meets WQMP criteria for absolute (5 mg/l minimum DO) and no more than 2 mg/l average difference even for one day. There were no upstream or downstream missing DO data (n=108 daily averages).

3.3 Temperature Data - Badger

Figure 7 shows daily average temperature data and the discharge in the Fox River during the study period. The seasonal variation of temperature at the three sensors viewed collectively spans a low of 20 °C (50 °F) in June to a summer peak that fluctuates between 22 and 25 °C (77 °F) from mid-June to early September before dropping below 17 °C (63 °F). The summer temperature peaks and troughs are synchronous with DO peaks at upstream and downstream locations (Figure 6). This is not surprising as dissolved oxygen saturation is dependent on temperature.

Upstream temperatures and downstream daily average temperatures (Figure 7) are nearly identical every day of the season. Table 2 provides details of the data showing an average daily difference between upstream and downstream is less than 0.1 °F. Hourly temperature patterns are similar to daily averages with diurnal sawtooth patterns visible (Figure 3; Tables 2 and 3).

Bypass temperatures are slightly warmer than either upstream or downstream locations in mid-summer due to the smaller mass of water in the bypass channel and warm weather. Hourly and daily graphs verify that there was not a single day in which upstream daily temperature of any of the sensors exceeded 26 °C (79 °F).

Conclusions: Daily data confirm that the Badger Hydro meets WQMP criteria for temperature. The data thus verify that at all three locations, the peak temperature was much cooler than the WQMP criterion 31.5 °C (89 °F). There is practically no variation among the three sensors at Badger hydro on a daily and hourly basis. Differences in average daily temperatures are less than 0.1 °F between locations up and downstream of the hydro and bypass. There were no upstream or downstream missing temperature data (n=108 daily averages).

3.4 pH Data - Badger

The seasonal variation of pH ranges from lows of 8.5 - 10.7 and 8. 7 - 10.1 for upstream vs. downstream locations respectively. The daily average pH at the upstream (8.85) and downstream (9.06) locations differed by an average of 0.18 pH units during the study (less

than the accuracy of the pH probe). The upstream sonde exceeded a pH 10.0 on seven days at the end of the first calibration period; and downstream only exceeded a pH 10.0 on one day. Comparing upstream and downstream, averaged daily minimums and maximums were also less than1.0 pH units apart (Table 2). There were only eight days (July 31-August 7) in which upstream and downstream average pH differed by more than one pH unit (Table 2 and Figure 8).

Values also remained very constant from day to day at both sondes changing only 0.0 - 0.2 pH units at both upstream and downstream locations (Tables 7 and 8). For both upstream and downstream data, the one daily average difference exceeded WQMP criterion of 0.5 pH daily units change (June 26 to 27, -1.71 pH units upstream, -0.84 pH units downstream). We attribute this to a factory calibration error during startup (Section 3.5). The remaining 107 days showed a daily difference of less than 0.32 pH units upstream and downstream.

Conclusions: Although some daily average pH values exceeded 9.0 during the study; seasonal averages were less than 9.0. Calibration errors from some contaminated probes and locations exaggerated pH values, especially in the second week after recalibration (Section 3.5). The natural pH of the Fox River is at times "naturally" in excess of 9.0 when algae are abundant (summer). Upstream pH averages were higher (more frequently above 9.0) than downstream values and likely attributed to higher concentrations of nutrients and algae in the reservoir.

The Fox River is a calcium/magnesium rich stream that contributes to the higher alkalinity compared with other Wisconsin State waters. Temporary conditions when slightly exceeds pH > 9.0 should not be considered unnatural for this watershed (https://www.uwgb.edu/watershed/data/monitoring/ph.htm). The carbonate geology of the Fox River contributes to atypically higher pH compared to other Wisconsin streams. Calibration data (see Section 3.5 Summary) suggest that actual pH was overestimated up to 1.0 to 1.5 pH units greater than actual values during some periods and locations of the study.

3.5 Calibration and Performance of Badger Sondes Upstream, Downstream and Bypass

3.5.1 Calibration Technique

Tables 15, 16, and 17 show the Badger calibration data for upstream, downstream and bypass sondes respectively. Performance and calibration data are provided for three variables plus conductivity. Conductivity is used in computation of DO and pH values by the sonde technology (Figures 5 and 9). Temperature did not require calibration or adjustment during the study period.

GEI followed Hach calibration techniques every biweekly period except at initiation of the study when factory calibration was accepted. Typically the probes were visibly contaminated

with sediment and algae that needed cleaning after each biweekly period. After the probe was cleaned, the instrument was electronically "recalibrated" and the "restored" instrument calibration difference was also recorded. These represent the "in-check" and the "post-cleaning" data in the tables.

After the data were compiled, they were inspected and summarized in Tabular form. The pre-cleaning and post cleaning measurements were recorded and expressed in % difference from standards. For example the LDO Hach probe has an accuracy of 0.2 mg/l. A reading of 8.0 is not statistically different from 7.8 to 8.2. Accuracy for conductivity probe was +/- 0.5%; and pH probe was +/- 0.2 pH units.

3.5.2 Conductivity Calibrations Badger Upstream

Conductivity calibrations Badger upstream showed very low instrument drift during the entire study with only one reading (6/27) above 1.5%. Although the in-check calibrations for two of the eight sample periods were outside the probe accuracy of 1% (+/- 0.5%), after cleaning all calibrations were within the probe accuracy. Conductivity ranged from 320 to 390 μS/cm (Figure 9). This is indicative of moderate levels of dissolved ions which help stabilize pH.

3.5.3 Dissolved Oxygen Calibrations Badger Upstream

Dissovled oxygen calibrations Badger upstream in-check difference ranged from a low of -2.9% to +4.5% with an average of -0.4% prior to cleaning. After cleaning statistics were a low of -4.4% to a high of 4.5% with an average of +0.2% after cleaning and redeployment. The post-cleaning before and after readings were within the probe accuracy of 0.4 mg/L (+/- 0.2 mg/L). Additionally, the variances before and after in-check and post-cleaning did not exceed 1 mg/L for any of the calibrations. Accordingly, DO calibrations exceeded the WQMP variance criterion goal of less than 1 mg/L 70% of the time by having no variances > 1mg/L 100% of the time (Table 15).

3.5.4 pH Calibrations Badger Upstream

Although in-check calibrations for two of eight sample periods were outside the probe accuracy of +/- 0.2 pH units relative to the 7.0 standard (6.80-7.20 for the 7.0 standard), after cleaning all the calibrations were within the probe accuracy for the 7.0 standard. In-check and post-cleaning calibrations were also all within the probe accuracy for the pH 10 standard (9.8-10.2; see Table 15).

3.5.5 Conductivity Calibrations Badger Downstream

The in-check and post-cleaning calibrations were within the instrument accuracy of 1% (+/- 0.5%) (not including the newly deployed sonde on 7/24).

3.5.6 Dissolved Oxygen Calibrations Badger Downstream

As shown on Table 16, the variances before and after for the in-check and post-cleaning did not exceed 1 mg/L for any of the calibrations. Accordingly, DO calibrations exceeded the WQMP variance criterion goal of less than 1 mg/L 70% of the time by having no variances > 1mg/L 100% of the time (Table 16).

3.5.7 pH Calibrations Badger Downstream

Although in-check calibrations for five of seven sample periods were outside the probe accuracy of +/- 0.2 pH units relative to the 7.0 standard (6.80-7.20 for the 7.0 standard), after cleaning all the calibrations were within the probe accuracy for the 7.0 standard (not including the newly deployed sonde on 7/24). In-check and after cleaning calibrations were also all within the probe accuracy for the pH 10.0 standard (9.8-10.2; see Table 16).

3.5.8 Conductivity Calibrations Badger Bypass

Although the in-check calibrations for three of the seven sampling periods were outside the probe accuracy of 1% (+/- 0.5%), all but one of the post-cleaning calibrations were within the probe accuracy (Table 17). The final deployment post cleaning calibration (13.7%) was associated with a newly replaced sonde that had failed.

3.5.9 Dissolved Oxygen Calibrations Badger Bypass

As shown on Table 17, the variances before and after for the in-check and post-cleaning did not exceed 1 mg/L for any of the calibrations. Accordingly, DO calibrations exceeded the WQMP variance criterion goal of less than 1 mg/L 70% of the time by having no variances > 1mg/L 100% of the time (Table 17).

3.5.10 pH Calibrations Badger Bypass

Although in-check calibrations for two of seven sample periods were outside the probe accuracy of +/- 0.2 pH units relative to the 7.0 standard (6.80-7.20 for the 7.0 standard), all eight post-cleaning calibrations were within the probe accuracy for the 7.0 standard. In-check and post-cleaning calibrations were all within the probe accuracy for the pH 10 standard (9.8-10.2; see Table 17).

3.6 Summary of Badger Data

Badger met WQMP criteria for Temperature and Dissolved Oxygen in 2014. The pH seasonal averages were less than 9.0 at all three probes. Daily averages were at times above the standard of 9.0 pH units. The carbonate geology of the Fox River makes it a more

alkaline environment and the "normal pH" for Fox River is higher than many other waters of Wisconsin. University of Wisconsin at Green Bay has this to say about the Fox River:

> "Calcium and magnesium ions dissolved from the surrounding limestone bedrock in the Fox River Basin increases the buffering capacity of the stream to resist changes in pH…
>
> Photosynthesis also influences stream pH because carbon dioxide is used by that process during daylight hours and given off by respiration at night. Because carbon dioxide dissociates in water to create carbonic acid, decreased levels of CO2 during the day results in alkaline water conditions, and increased levels of CO2at night create acidic pH values. This pH dynamic is most visible during algal blooms, with pH in some cases exceeding 9.0…
>
> Streams in Northeast Wisconsin typically have pH values between 7.0 and 9.0, depending on the time of year that sampling occurs." https://www.uwgb.edu/watershed/data/monitoring/ph.htm

The pH data were biased high at all locations in the first sample period, and also at the downstream location for pH after July 23. WDNR was contacted to discuss calibration issues and agreed that the data were suspect but advised to continue the study. After the initial biweekly period, the pH calibrations consistently met WQMP calibration criteria at the upstream and bypass locations but calibrations exceeded limits at the downstream location 71% of the sample periods. The data were biased high at the downstream location and hence gave exaggerated estimates of the true pH at this location. The cause of pH values above 9.0 are the result of excessive amounts of algae and other biotic materials in mid-summer affecting probe accuracy, especially during the second biweekly period.

We have reviewed our calibration methods with the manufacturer before and after the study. Except for relying on the factory settings on initial startup, calibration **"**in-check" errors in the first pH data set, we are confident we are doing procedures correctly. In 2015, we will be replacing all the sondes used in 2014 with newer Hach H4 technology.

3.7 Dissolved Oxygen - Data Rapid Croche

Upstream average DO for the season was 9.52 vs. 9.24 mg/L downstream; upstream DO averaged 0.28 mg/L higher than downstream (Table 10). This pattern was also observed at Badger and attributed to tailrace turbulence that releases some DO to the atmosphere.

The daily average DO levels both upstream and downstream were always greater than 6 mg/L and less than 14 mg/l during the study. Rapid Croche daily DO data were similar both upstream and downstream most of the season. Differences were less than 2 mg/L every day of the study period except on August 2 when downstream was lower (2.03 mg/l); and when

downstream was higher on August 22 (3.05 mg/l); and August 24 (3.10 mg/L). Deviations of 2 mg/l never occurred on sequential days.

Hourly data show higher DO readings upstream from July 20 to August 20 that we suspect are driven by phytoplankton diurnal cycles (Figure 10). The plunge in upstream DO in both daily and hourly data August 20-24 was probably driven by a 4,000 cfs freshet of water that affected air/water mixing in the Fox River as well as phytoplankton and algae that drive DO up during warm low water conditions. There is no evidence of calibration distortions in the upstream sonde.

The downstream sonde has numerous data gaps in the second, third and fourth biweekly periods and all data were lost after September 5 (Figure 14). A total of 70 days of data were collected downstream and thus only 70 comparisons with upstream. This sonde was subject to human disturbance on multiple occasions and due to mechanical failures was replaced four times during the sampling period after initial installation. Despite data losses, the available data show that both variables were tightly correlated throughout most of the season except for 3 days noted above when differences exceeded 2 mg/l.

Conclusions: Available DO data met the WQMP criterion of 5.0 mg/L minimum at Rapid Croche. There were no cases of even two consecutive days when upstream vs. downstream daily average DO differed by more than 2.0 mg/L. Therefore available DO data met the WQMP criteria. Missing data on 38 days are not suspected to have missed any data that would contradict this conclusion.

3.8 Temperature Data - Rapid Croche

Seasonal weather and discharge affect the overall temperatures in the Fox River. These were nearly identical to patterns and extremes observed 4 miles upstream at Badger. Figure 15 shows upstream and downstream daily temperatures at Rapid Croche were nearly identical except for a two week period in early August when upstream warmed slightly higher than downstream daily average. The graph verifies temperatures never exceeded 26 °C (79 °F) and thus met the 89 °F maximum criterion in the WQMP.

The average daily upstream vs. downstream temperature was 22.7 °C vs. 22.4 °C, a difference of 0.3 °C (1 °F). The maximum difference was 1.16 °C (2 °F) on August 2 (Table 10).

Hourly temperature patterns are similar to daily averages with diurnal sawtooth patterns visible (Figure 11; Table 10). Hourly temperatures were more variable in the upstream location especially in early August as the reservoir warmed during low flow conditions. The hourly maximum temperature was 28 °C (83 °F) on August 2 (Figure 11).

Data gaps in downstream temperature were similar as reported for DO; gaps occurred in second, third and fourth biweekly periods and all data were lost after September 19. A total

of 84 daily temperature averages were documented; 24 daily averages were lost at different times of the season. The sonde was subject to human disturbance on multiple occasions and due to mechanical failures was replaced five times during the sampling period. The extremely tight correlations of upstream and downstream patterns are indicative that missing data would be unlikely to contradict the conclusions made from the sample of 84 days as collected.

Conclusions: Daily and hourly data confirm that the Rapid Croche met WQMP criteria for temperature.

3.9 pH Data - Rapid Croche

The seasonal minimum and maximum daily average pH ranged from of 7.6 to 9.4 upstream and 8.6 to 10.0 downstream. Figure 16 show daily average pH data and the discharge in the Fox River during the study period and Table 10 shows pH data and statistics. The average upstream pH is 8.62 vs. 8.93 downstream with an average difference of 0.33 pH units (Table 10). Both seasonal averages meet the WQMP criterion of a pH between 6.0 and 9.0. The pH exceeded 10.0 only on one day (June 26) when the downstream probe was significantly biased high as shown by calibration data (Section 3.10) due to factory calibration errors. During this second week of sampling, pH differences between upstream and downstream were consistently greater than 1.0, but are again attributable to calibration error.

Figure 16 illustrates that pH of the upstream location was predominantly between pH 8 and 9 and reflects stable/consistent performance of this sonde all season that met every calibration criterion. The downstream sonde was frequently out of criteria and was missing many calibrations due to problems with human disturbance and other causes of pH probe failure (Section 5.10).

Despite the missing data and calibration bias, daily shifts in pH were 0.5 pH units or less upstream and downstream on all days when there were data to compare.

Conclusion: Rapid Croche *upstream* probably provided the most accurate pH data set for the season of all the locations in the study. A perfect calibration record (based on calibrations after the initial factory calibration) plus no mechanical outages or replacements made it the most reliable record. The pH daily average maximum was 9.44 and the seasonal average was 8.62.

Conversely, the Rapid Croche *downstream* pH probe was the most problematic of the all the probes in that it provided only five calibrations (missing three) and three of the five calibrations resulted in noteworthy calibration adjustments to the pH probe after cleaning.

Nonetheless, most of the pH data that was collected at Rapid Croche was near the compliance standard of 9.0. Additionally pH shifts that occurred in adjacent days were less

than 0.5 pH. We conclude that better data are needed but there is no pattern suggestive that upstream and downstream differences exist outside the criteria of the WQMP.

3.10 Calibration and Performance of Rapid Croche Sondes Upstream and Downstream

3.10.1 Calibration Technique

Calibration data records for the upstream and downstream sondes are shown in Tables 18 and 19 respectively. Refer to section 3.5.1 for general calibration procedures. The upstream unit performed well and was undisturbed during the study as it was inside the confines of the hydroelectric project. The downstream unit was replaced five of the eight sampling periods as a result of human disturbance and mechanical problems involving data loss (see Appendix A for details). Despite these problems, conductivity and dissolved oxygen calibrated quite well. Downstream pH however exhibited a record of biased calibrations and missing data due to human disturbance and instrument failures. The details follow.

3.10.2 Conductivity Calibrations Rapid Croche Upstream

Conductivity calibrations Rapid Croche upstream showed very low instrument drift during the entire study with only one reading (6/27) above 1% for the in-check calibration (Table 18). All values (100%) are within1% (+/- 0.5%) instrument accuracy for the post-cleaning calibrations. Conductivity ranged from 330 to 410 µS/cm (Figure 13). This is indicative of moderate levels of dissolved ions which help stabilize pH.

3.10.3 Dissolved Oxygen Calibrations Rapid Croche Upstream

Dissolved oxygen claibrations Rapid Croche upstream showed very low instrument drift during the entire study with only one reading (6/27) above the 0.4 mg/L (+/- 0.2 mg/L) instrument accuracy. All values (100%) are within +/- 1% instrument accuracy. As shown on Table 18, the variances before and after for the in-check and post-cleaning did not exceed 1 mg/L for any of the calibrations. Accordingly, DO calibrations exceeded the WQMP variance criterion goal of less than 1 mg/L 70% of the time by having no variances > 1mg/L 100% of the time (Table 18). The two out of range calibrations were the result of inaccurate factory calibrations.

3.10.4 pH Calibrations Rapid Croche Upstream

The pH calibrations Rapid Croche upstream for both in-check and post-cleaning were all within the probe accuracy for the 7.0 and 10.0 standards of +/- 0.2 pH units (Table 18).

3.10.5 Conductivity Calibrations Rapid Croche Downstream

Twelve (12 calibrations of 13 performed (92%) are within 1% (+/- 0.5%) instrument accuracy (Table 19). Data are missing from four of the downstream sampling periods due to malfunction and human interference with the unit during deployment.

3.10.6 Dissolved Oxygen Calibrations Rapid Croche Downstream

In-check and post-cleaning calibrations were within the probe accuracy of 0.4 mg/L (+/- 0.2 mg/L) (not including the calibration data for a newly deployed replacement sonde on 7/15). As shown on Table 19, the variances before and after for the in-check and post-cleaning did not exceed 1 mg/L for any of the calibrations (not including the calibration data for a newly deployed replacement sonde on 7/15). Accordingly, DO calibrations exceeded the WQMP variance criterion goal of less than 1 mg/L 70% of the time by having no variances > 1mg/L 100% of the time (Table 19).

3.10.7 pH Calibrations Rapid Croche Downstream

In-check calibrations for three of the available five sampling periods were outside the probe accuracy of +/- 0.2 pH units for the 7.0 standard. However, post-cleaning calibrations were all within the probe accuracy for the 7.0 standard except for the newly deployed sonde on 8/8. In-check and post-cleaning calibrations were all within the probe accuracy for the 10.0 standard of +/- 0.2 pH units (Table 19).

4. Conclusions

This is the first year of a three-year sampling program. The goal of the program is to determine whether operations of the new Badger Hydroelectric Project and the downstream Rapid Croche Hydroelectric project are meeting the Water Quality Management Plan criteria established by FERC in its Order for New License.

The data provide confidence that the projects in 2014 met the following WQMP criteria (1) temperatures are within the natural range of the river and no greater than 89 F and (2) dissolved oxygen is always above 5 ppm (mg/l). Although there are missing data, eye-fit connections of the missing data suggest these two criteria never violated the WQMP criteria.

The data also confirm that the two hydroelectric projects are not affecting upstream versus downstream dissolved oxygen differences due to operations. DO averages both up- and downstream are typically around 8.0 to 9.0 mg/l and rise to 11.0 to 12.0 mg/l as photosynthesis accelerates in mid-summer. DO averages in the downstream locations average of 0.25 mg/l less DO than upstream. Tailrace turbulence increases atmospheric release of highly saturated dissolved oxygen. In no observable case did the DO upstream/downstream difference exceed 2.0 mg/l for more than 1 day at Rapid Croche (n=3 events) and it never achieved 2.0 mg/l difference at any time at Badger (n=0 events). Thus, DO was in compliance with the WQMP criterion of a five consecutive day limitation of less than 2 mg/l difference.

Mid-season biofouling of the pH probes with algae and debris caused parameter drift at both downstream locations and thus compromised or biased some of the data. When algae contaminate the probes, they cause significant pH shifts in the local environment of the probe. This cause is evidenced by increasing deviations in pH from early samples to the end of the sampling period with sudden shifts downward in the pH readings after cleaning.

Biofouling led to pH averages that were at times biased high, especially at Badger. We observed calibrations that had before / after cleaning shifts downward of up to 1.5 pH units.

The seasonal averages at all five locations were less than 9.0 and thus in general compliance. There were some days when daily averages did exceed 9.0 at all locations. Values up to 9.2 are equivalent statistically to 9.0 in terms of instrument accuracy. Review of the 2014 pH data including calibration records support the conclusion that most readings higher than 9.2 were biased by the algae/debris contaminated probes. Research from University of Wisconsin at Green Bay verified that the Fox River is more alkaline than many other Wisconsin streams and not unusual to exceed 9.0 during algal blooms.

Human disturbance together with other mechanical failures led to replacement of five sondes at downstream Rapid Croche during the study and lessened the quality of the data. In 2015

season Kaukauna Utilities will deploy new H-4 Sondes, Hach's latest technology. The new sondes are smaller, more compact and have improved electronics and battery life compared to the older MS-5 sondes employed in 2014. We will relocate the Rapid Croche downstream sonde to minimize human disturbance. We will also investigate whether there are ways to deploy Sondes to make them less subject to hydraulic disturbance and bio-fouling.

In summary, we conclude that the Badger and Rapid Croche projects are meeting the WQMP criteria. We believe that the 9.0 pH criteria was not met during some daily periods, due to a combination of high natural pH conditions that occur in the Fox River basin and pH drift/calibrations that demonstrated readings as high as 1.5 pH units too high at the end of sampling periods.

Appendix A – Tables and Figures

List of Tables

List of Figures

Table 1.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Sonde Locations

		GPS Coordinates	
		Latitude	Longitude
Badger	Upstream	44.2814	-88.2734
	Downstream	44.2768	-88.2652
	Bypass	44.2797	-88.2641
Rapide Croche	Upstream	44.3157	-88.1986
	Downstream	44.3148	-88.1958

Table 2.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Badger Daily Averages of Upstream and Downstream Dissolved Oxygen, Temperature, and pH Data
Difference = Upstream - Downstream
**Note: Shaded dates = service date (data downloads and calibration)

	Dissolved Oxygen (mg/L)			Temperature (°C)			pH		
Date	Upstream	Downstream	Difference	Upstream	Downstream	Difference	Upstream	Downstream	Difference
6/15/2014	8.64	8.55	0.09	20.05	20.12	-0.07	9.55	9.64	-0.08
6/16/2014	8.26	8.14	0.12	20.71	20.78	-0.07	9.53	9.49	0.04
6/17/2014	7.69	7.49	0.20	21.93	21.95	-0.02	9.47	9.29	0.18
6/18/2014	7.37	7.01	0.36	22.08	22.09	-0.01	9.50	9.20	0.30
6/19/2014	7.83	7.40	0.42	21.97	21.98	-0.01	9.82	9.45	0.37
6/20/2014	7.74	7.30	0.44	21.85	21.89	-0.04	10.04	9.62	0.42
6/21/2014	7.84	7.32	0.51	21.31	21.36	-0.05	10.11	9.56	0.55
6/22/2014	7.90	7.34	0.56	21.12	21.17	-0.05	10.24	9.54	0.70
6/23/2014	8.12	7.61	0.51	21.78	21.82	-0.04	10.39	9.53	0.86
6/24/2014	8.15	7.77	0.39	22.62	22.66	-0.04	10.46	9.68	0.79
6/25/2014	8.10	7.78	0.32	23.12	23.06	0.06	10.57	9.83	0.74
6/26/2014	8.19	7.98	0.21	22.85	22.89	-0.04	10.65	9.90	0.74
6/27/2014	8.43	8.15	0.28	23.29	23.42	-0.13	8.94	9.06	-0.12
6/28/2014	8.42	8.15	0.28	24.34	24.38	-0.04	8.79	8.83	-0.05
6/29/2014	8.12	7.84	0.28	24.94	24.99	-0.05	8.89	8.86	0.03
6/30/2014	7.73	7.43	0.29	24.79	24.85	-0.06	8.90	8.83	0.07
7/1/2014	7.77	7.35	0.42	24.03	24.10	-0.07	8.85	8.77	0.08
7/2/2014	7.65	6.64	1.01	23.29	23.34	-0.05	8.79	8.69	0.10
7/3/2014	8.32	7.58	0.74	22.62	22.69	-0.07	8.81	8.70	0.11
7/4/2014	8.83	8.30	0.53	22.81	22.87	-0.06	8.92	8.84	0.08
7/5/2014	8.95	8.58	0.37	23.25	23.33	-0.08	9.01	8.93	0.08
7/6/2014	8.10	7.76	0.35	22.89	22.98	-0.09	9.00	8.91	0.09
7/7/2014	8.32	7.81	0.51	23.03	23.11	-0.08	8.97	8.88	0.09
7/8/2014	8.09	7.68	0.41	23.48	23.56	-0.08	8.97	8.88	0.09
7/9/2014	8.31	7.94	0.37	23.00	23.08	-0.08	8.93	8.85	0.08
7/10/2014	8.87	8.53	0.34	22.82	22.88	-0.07	8.96	8.91	0.05
7/11/2014	8.78	8.53	0.25	23.22	23.31	-0.09	8.70	8.80	-0.10
7/12/2014	8.23	8.05	0.17	23.19	23.29	-0.10	8.64	8.76	-0.12
7/13/2014	8.55	8.35	0.20	23.09	23.18	-0.09	8.65	8.74	-0.08
7/14/2014	8.78	8.56	0.22	22.97	23.06	-0.09	8.73	8.78	-0.06
7/15/2014	8.42	8.22	0.20	22.12	22.21	-0.09	8.75	8.80	-0.05
7/16/2014	8.88	8.63	0.25	21.44	21.55	-0.11	8.75	8.80	-0.05
7/17/2014	9.02	8.72	0.30	21.31	21.39	-0.08	8.73	8.79	-0.06
7/18/2014	9.27	8.89	0.38	22.13	22.17	-0.05	8.78	8.85	-0.07
7/19/2014	9.28	8.98	0.31	23.18	23.26	-0.08	8.81	8.88	-0.07
7/20/2014	9.00	8.72	0.29	23.48	23.55	-0.08	8.71	8.79	-0.08
7/21/2014	9.30	8.99	0.31	23.99	24.06	-0.07	8.70	8.79	-0.09
7/22/2014	9.30	9.12	0.19	24.67	24.75	-0.08	8.69	8.80	-0.11
7/23/2014	9.44	9.09	0.35	24.63	24.69	-0.07	8.68	8.80	-0.12
7/24/2014	9.77	9.47	0.30	24.41	24.46	-0.05	8.58	8.93	-0.36
7/25/2014	9.14	9.00	0.15	23.73	23.85	-0.12	8.51	9.26	-0.75
7/26/2014	9.03	8.87	0.16	23.27	23.34	-0.07	8.54	9.39	-0.85
7/27/2014	9.40	9.20	0.19	23.31	23.36	-0.05	8.52	9.43	-0.90
7/28/2014	9.72	9.49	0.23	22.77	22.82	-0.05	8.57	9.51	-0.94
7/29/2014	9.80	9.61	0.19	22.42	22.48	-0.06	8.54	9.52	-0.98
7/30/2014	9.75	9.53	0.22	22.30	22.34	-0.05	8.54	9.54	-1.00
7/31/2014	10.05	9.75	0.30	22.72	22.77	-0.05	8.61	9.63	-1.02
8/1/2014	9.53	9.28	0.25	23.06	23.11	-0.06	8.62	9.65	-1.03
8/2/2014	9.53	9.33	0.20	23.46	23.52	-0.06	8.63	9.66	-1.03
8/3/2014	9.75	9.51	0.24	23.98	24.02	-0.04	8.65	9.67	-1.03
8/4/2014	9.37	9.18	0.19	23.99	24.09	-0.10	8.65	9.70	-1.05
8/5/2014	9.90	9.45	0.45	23.99	24.01	-0.02	8.72	9.78	-1.06
8/6/2014	10.47	10.23	0.24	24.10	24.17	-0.07	8.77	9.85	-1.08
8/7/2014	11.34	10.91	0.43	24.17	24.22	-0.04	8.97	10.06	-1.08
8/8/2014	11.86	11.42	0.44	24.50	24.55	-0.05	9.14	9.55	-0.41
8/9/2014	12.16	11.63	0.53	24.83	24.89	-0.06	9.24	9.52	-0.28
8/10/2014	11.61	11.08	0.54	25.07	25.11	-0.05	9.27	9.61	-0.34
8/11/2014	10.69	10.27	0.42	25.29	25.35	-0.07	9.27	9.65	-0.38
8/12/2014	8.77	8.57	0.20	24.30	24.37	-0.07	9.19	9.60	-0.41

Table 2.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Badger Daily Averages of Upstream and Downstream Dissolved Oxygen, Temperature, and pH Data
Difference = Upstream - Downstream
**Note: Shaded dates = service date (data downloads and calibration)

	Dissolved Oxygen (mg/L)			Temperature (°C)			pH		
Date	Upstream	Downstream	Difference	Upstream	Downstream	Difference	Upstream	Downstream	Difference
8/13/2014	9.10	8.81	0.29	23.61	23.67	-0.06	9.13	9.55	-0.42
8/14/2014	9.95	9.66	0.29	23.12	23.19	-0.07	9.15	9.63	-0.48
8/15/2014	10.65	10.23	0.42	22.65	22.69	-0.04	9.18	9.70	-0.52
8/16/2014	10.71	10.40	0.32	23.18	23.26	-0.08	9.25	9.78	-0.53
8/17/2014	9.76	9.48	0.28	22.94	23.03	-0.09	9.22	9.74	-0.53
8/18/2014	9.05	8.75	0.30	22.11	22.19	-0.08	9.08	9.64	-0.55
8/19/2014	8.49	8.18	0.31	22.11	22.14	-0.04	9.00	9.58	-0.58
8/20/2014	9.35	9.06	0.28	22.18	22.25	-0.07	8.98	9.58	-0.60
8/21/2014	9.16	9.01	0.15	22.25	22.36	-0.11	9.00	9.61	-0.61
8/22/2014	8.82	8.75	0.07	22.64	22.73	-0.09	8.88	9.18	-0.30
8/23/2014	8.54	8.55	-0.01	23.28	23.34	-0.06	8.86	9.07	-0.21
8/24/2014	8.64	8.63	0.02	23.85	23.88	-0.04	8.93	9.13	-0.20
8/25/2014	8.47	8.55	-0.07	24.24	24.27	-0.04	8.99	9.18	-0.19
8/26/2014	8.71	8.80	-0.09	24.24	24.29	-0.05	9.03	9.22	-0.19
8/27/2014	8.87	8.97	-0.10	24.01	24.08	-0.06	9.06	9.25	-0.19
8/28/2014	8.62	8.63	-0.01	23.19	23.26	-0.07	9.04	9.24	-0.20
8/29/2014	8.58	8.57	0.01	22.83	22.89	-0.05	8.97	9.18	-0.20
8/30/2014	8.56	8.57	-0.01	23.49	23.53	-0.04	8.98	9.18	-0.20
8/31/2014	8.71	8.80	-0.09	23.42	23.46	-0.04	8.99	9.21	-0.21
9/1/2014	8.41	8.44	-0.03	23.37	23.42	-0.05	8.99	9.23	-0.24
9/2/2014	8.80	8.74	0.06	23.05	23.10	-0.04	8.99	9.24	-0.25
9/3/2014	9.48	9.41	0.07	23.22	23.26	-0.04	9.03	9.30	-0.26
9/4/2014	8.90	8.76	0.14	23.23	23.31	-0.08	8.87	9.05	-0.18
9/5/2014	8.43	8.18	0.24	22.97	23.05	-0.08	8.73	8.89	-0.16
9/6/2014	9.11	8.84	0.27	22.30	22.38	-0.08	8.69	8.85	-0.17
9/7/2014	9.62	9.27	0.35	22.07	22.15	-0.08	8.70	8.88	-0.18
9/8/2014	9.69	9.34	0.35	22.27	22.32	-0.05	8.78	8.97	-0.19
9/9/2014	9.45	9.09	0.36	22.35	22.39	-0.03	8.79	8.99	-0.20
9/10/2014	8.48	8.20	0.28	22.06	22.16	-0.09	8.77	8.98	-0.21
9/11/2014	8.39	8.18	0.21	19.81	19.91	-0.10	8.66	8.87	-0.22
9/12/2014	8.88	8.69	0.19	17.60	17.71	-0.12	8.61	8.84	-0.23
9/13/2014	9.42	9.20	0.22	16.61	16.72	-0.11	8.62	8.86	-0.25
9/14/2014	9.79	9.51	0.28	16.65	16.76	-0.11	8.64	8.91	-0.27
9/15/2014	9.63	9.40	0.22	16.75	16.87	-0.12	8.65	8.93	-0.28
9/16/2014	9.94	9.74	0.20	16.61	16.72	-0.11	8.65	8.94	-0.29
9/17/2014	10.06	9.82	0.24	16.85	16.95	-0.10	8.68	8.97	-0.29
9/18/2014	9.87	9.65	0.21	16.79	16.90	-0.11	8.67	8.96	-0.29
9/19/2014	9.93	9.63	0.30	16.64	16.74	-0.10	8.68	8.86	-0.18
9/20/2014	9.48	9.13	0.35	17.27	17.36	-0.09	8.76	8.85	-0.09
9/21/2014	9.38	9.01	0.37	17.34	17.42	-0.09	8.74	8.81	-0.07
9/22/2014	9.72	9.36	0.37	16.46	16.56	-0.10	8.72	8.78	-0.06
9/23/2014	9.90	9.53	0.37	16.76	16.85	-0.09	8.80	8.85	-0.05
9/24/2014	9.92	9.54	0.38	17.22	17.31	-0.09	8.83	8.88	-0.05
9/25/2014	9.96	9.55	0.40	17.63	17.73	-0.09	8.83	8.86	-0.04
9/26/2014	9.97	9.58	0.39	18.31	18.38	-0.07	8.88	8.91	-0.03
9/27/2014	9.89	9.51	0.38	19.04	19.11	-0.07	8.95	8.98	-0.03
9/28/2014	9.84	9.46	0.38	19.57	19.64	-0.07	9.01	9.04	-0.03
9/29/2014	9.46	9.09	0.38	19.61	19.69	-0.08	9.01	9.03	-0.03
9/30/2014	9.26	8.87	0.39	17.33	17.45	-0.12	8.93	8.95	-0.02
Minimum	7.37	6.64	-0.10	16.46	16.56	-0.13	8.51	8.69	-1.08
Average	9.04	8.79	0.25	21.69	21.76	-0.07	8.85	9.06	-0.18
Maximum	12.16	11.63	1.01	25.29	25.35	0.06	10.65	10.06	0.86
Standard Deviation	0.85	0.84	0.17	2.30	2.29	0.03	0.44	0.36	0.37
Number of Data Points	108	108	108	108	108	108	108	108	108

Table 3.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Daily Averages of Bypass Dissolved Oxygen, Temperature, and pH Data

Date (shading = service date)	Temp °C	pH Units	LDO mg/l
6/15/2014	20.10	10.10	8.84
6/16/2014	20.89	9.96	8.67
6/17/2014	22.06	9.77	8.18
6/18/2014	22.22	9.75	8.35
6/19/2014	22.07	10.13	8.63
6/20/2014	21.91	10.27	8.55
6/21/2014	21.37	10.25	8.60
6/22/2014	21.18	10.29	8.61
6/23/2014	21.86	10.37	8.49
6/24/2014	22.76	10.38	8.27
6/25/2014	23.21	10.49	7.84
6/26/2014	22.97	10.56	7.88
6/27/2014	23.43	9.67	8.25
6/28/2014	24.45	8.78	8.42
6/29/2014	25.03	8.87	8.26
6/30/2014	24.87	8.91	8.14
7/1/2014	24.09	8.94	8.26
7/2/2014	23.31	8.95	8.16
7/3/2014	22.71	9.05	8.43
7/4/2014	22.91	9.23	8.72
7/5/2014	23.38	9.38	8.66
7/6/2014	22.98	9.40	8.23
7/7/2014	23.19	9.43	8.25
7/8/2014	23.53	9.46	8.22
7/9/2014	23.13	9.44	8.44
7/10/2014	22.95	9.49	8.81
7/11/2014	23.33	9.07	8.59
7/12/2014	23.33	8.64	8.12
7/13/2014	23.24	8.59	8.33
7/14/2014	23.08	8.60	8.42
7/15/2014	22.20	8.54	8.02
7/16/2014	21.54	8.54	8.43
7/17/2014	21.53	8.52	8.66
7/18/2014	22.25	8.55	8.64
7/19/2014	23.33	8.60	8.57
7/20/2014	23.65	8.52	8.38
7/21/2014	24.18	8.52	8.40
7/22/2014	24.88	8.51	8.32
7/23/2014	24.75	8.52	8.44
7/24/2014	24.56	8.50	8.62
7/25/2014	23.80	8.48	8.49
7/26/2014	23.48	8.51	8.50

Table 3.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Daily Averages of Bypass Dissolved Oxygen, Temperature, and pH Data

Date (shading = service date)	Temp °C	pH Units	LDO mg/l
7/27/2014	23.50	8.51	8.56
7/28/2014	22.90	8.54	8.84
7/29/2014	22.64	8.53	8.91
7/30/2014	22.57	8.52	8.80
7/31/2014	22.92	8.59	8.74
8/1/2014	23.27	8.60	8.56
8/2/2014	23.69	8.63	8.56
8/3/2014	24.19	8.62	8.40
8/4/2014	24.03	8.60	8.41
8/5/2014	23.98	8.67	8.54
8/6/2014	24.23	8.72	8.70
8/7/2014	24.24	8.89	8.88
8/8/2014	24.50	9.08	8.92
8/9/2014	24.80	9.20	8.93
8/10/2014	25.09	9.21	8.81
8/11/2014	25.29	9.21	8.50
8/12/2014	24.25	9.12	8.10
8/13/2014	23.73	9.07	8.44
8/14/2014	23.34	9.09	8.63
8/15/2014	22.92	9.11	8.82
8/16/2014	23.36	9.16	8.69
8/17/2014	23.01	9.12	8.43
8/18/2014	22.19	8.99	8.22
8/19/2014	22.21	8.86	8.00
8/20/2014	22.39	8.85	8.24
8/21/2014	22.35	8.84	7.93
8/22/2014	22.69	8.84	8.41
8/23/2014	23.35	8.94	8.67
8/24/2014	23.87	8.98	8.67
8/25/2014	24.34	9.01	8.47
8/26/2014	24.36	9.03	8.64
8/27/2014	24.08	9.04	8.72
8/28/2014	23.25	8.99	8.66
8/29/2014	22.98	8.91	8.72
8/30/2014	23.58	8.89	8.53
8/31/2014	23.54	8.90	8.59
9/1/2014	23.42	8.87	8.41
9/2/2014	23.14	8.88	8.74
9/3/2014	23.33	8.94	9.08
9/4/2014	23.32	8.85	8.51
9/5/2014	23.08	8.72	8.23
9/6/2014	22.40	8.69	8.68

Table 3.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Daily Averages of Bypass Dissolved Oxygen, Temperature, and pH Data

Date (shading = service date)	Temp °C	pH Units	LDO mg/l
9/7/2014	22.18	8.72	8.99
9/8/2014	22.30	8.78	8.97
9/9/2014	22.48	8.79	8.72
9/10/2014	22.16	8.76	8.21
9/11/2014	19.83	8.65	8.50
9/12/2014	17.66	8.59	8.97
9/13/2014	16.69	8.61	9.38
9/14/2014	16.70	8.63	9.51
9/15/2014	16.82	8.67	9.36
9/16/2014	16.68	8.68	9.56
9/17/2014	16.97	8.73	9.53
9/18/2014	16.88	8.75	8.71
9/19/2014	16.70	8.95	9.60
9/20/2014	17.30	9.14	9.35
9/21/2014	17.32	9.10	9.35
9/22/2014	16.53	9.08	9.62
9/23/2014	16.81	9.12	9.69
9/24/2014	17.22	9.14	9.61
9/25/2014	17.71	9.11	9.56
9/26/2014	18.32	9.15	9.49
9/27/2014	19.06	9.19	9.29
9/28/2014	19.60	9.23	9.18
9/29/2014	19.59	9.22	8.97
9/30/2014	17.34	9.19	9.26

Minimum	16.53	8.48	7.84
Average	22.16	9.03	8.65
Maximum	25.29	10.56	9.69
Standard Deviation	2.41	0.50	0.42
Number of Data Points	108	108	108

Table 4.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Upstream Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
8/6/2014	8/7/2014	10.47	11.34	0.88
8/19/2014	8/20/2014	8.49	9.35	0.86
8/13/2014	8/14/2014	9.10	9.95	0.84
8/14/2014	8/15/2014	9.95	10.65	0.71
9/5/2014	9/6/2014	8.43	9.11	0.68
9/2/2014	9/3/2014	8.80	9.48	0.68
7/2/2014	7/3/2014	7.65	8.32	0.67
8/5/2014	8/6/2014	9.90	10.47	0.56
7/9/2014	7/10/2014	8.31	8.87	0.56
9/12/2014	9/13/2014	8.88	9.42	0.54
8/4/2014	8/5/2014	9.37	9.90	0.54
8/7/2014	8/8/2014	11.34	11.86	0.52
7/3/2014	7/4/2014	8.32	8.83	0.51
9/6/2014	9/7/2014	9.11	9.62	0.51
9/11/2014	9/12/2014	8.39	8.88	0.49
7/15/2014	7/16/2014	8.42	8.88	0.46
6/18/2014	6/19/2014	7.37	7.83	0.45
9/1/2014	9/2/2014	8.41	8.80	0.39
9/13/2014	9/14/2014	9.42	9.79	0.37
7/26/2014	7/27/2014	9.03	9.40	0.37
9/21/2014	9/22/2014	9.38	9.72	0.34
8/12/2014	8/13/2014	8.77	9.10	0.33
7/23/2014	7/24/2014	9.44	9.77	0.33
7/12/2014	7/13/2014	8.23	8.55	0.33
7/27/2014	7/28/2014	9.40	9.72	0.32
9/15/2014	9/16/2014	9.63	9.94	0.31
7/30/2014	7/31/2014	9.75	10.05	0.30
7/20/2014	7/21/2014	9.00	9.30	0.30
8/8/2014	8/9/2014	11.86	12.16	0.30
7/17/2014	7/18/2014	9.02	9.27	0.25
6/26/2014	6/27/2014	8.19	8.43	0.25
8/25/2014	8/26/2014	8.47	8.71	0.23
8/2/2014	8/3/2014	9.53	9.75	0.23
7/13/2014	7/14/2014	8.55	8.78	0.22
7/8/2014	7/9/2014	8.09	8.31	0.22
7/6/2014	7/7/2014	8.10	8.32	0.22
6/22/2014	6/23/2014	7.90	8.12	0.22
9/22/2014	9/23/2014	9.72	9.90	0.18
8/26/2014	8/27/2014	8.71	8.87	0.17
8/30/2014	8/31/2014	8.56	8.71	0.15
7/16/2014	7/17/2014	8.88	9.02	0.14

Table 4.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Upstream Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
7/22/2014	7/23/2014	9.30	9.44	0.13
7/4/2014	7/5/2014	8.83	8.95	0.12
9/16/2014	9/17/2014	9.94	10.06	0.12
8/23/2014	8/24/2014	8.54	8.64	0.10
6/20/2014	6/21/2014	7.74	7.84	0.09
7/28/2014	7/29/2014	9.72	9.80	0.09
6/25/2014	6/26/2014	8.10	8.19	0.08
9/7/2014	9/8/2014	9.62	9.69	0.08
9/18/2014	9/19/2014	9.87	9.93	0.07
6/21/2014	6/22/2014	7.84	7.90	0.06
8/15/2014	8/16/2014	10.65	10.71	0.06
6/30/2014	7/1/2014	7.73	7.77	0.05
9/24/2014	9/25/2014	9.92	9.96	0.04
6/23/2014	6/24/2014	8.12	8.15	0.04
9/23/2014	9/24/2014	9.90	9.92	0.01
7/18/2014	7/19/2014	9.27	9.28	0.01
9/25/2014	9/26/2014	9.96	9.97	0.01
7/21/2014	7/22/2014	9.30	9.30	0.00
8/1/2014	8/2/2014	9.53	9.53	0.00
6/27/2014	6/28/2014	8.43	8.42	-0.01
8/29/2014	8/30/2014	8.58	8.56	-0.02
8/28/2014	8/29/2014	8.62	8.58	-0.03
6/24/2014	6/25/2014	8.15	8.10	-0.05
9/27/2014	9/28/2014	9.89	9.84	-0.05
7/29/2014	7/30/2014	9.80	9.75	-0.05
9/26/2014	9/27/2014	9.97	9.89	-0.08
6/19/2014	6/20/2014	7.83	7.74	-0.08
7/10/2014	7/11/2014	8.87	8.78	-0.09
9/10/2014	9/11/2014	8.48	8.39	-0.09
9/20/2014	9/21/2014	9.48	9.38	-0.10
7/25/2014	7/26/2014	9.14	9.03	-0.11
7/1/2014	7/2/2014	7.77	7.65	-0.12
9/14/2014	9/15/2014	9.79	9.63	-0.16
8/24/2014	8/25/2014	8.64	8.47	-0.17
8/20/2014	8/21/2014	9.35	9.16	-0.19
9/17/2014	9/18/2014	10.06	9.87	-0.19
9/29/2014	9/30/2014	9.46	9.26	-0.21
7/7/2014	7/8/2014	8.32	8.09	-0.23
9/8/2014	9/9/2014	9.69	9.45	-0.25
8/27/2014	8/28/2014	8.87	8.62	-0.26
8/22/2014	8/23/2014	8.82	8.54	-0.28

Table 4.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Upstream Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
7/19/2014	7/20/2014	9.28	9.00	-0.28
6/28/2014	6/29/2014	8.42	8.12	-0.30
8/31/2014	9/1/2014	8.71	8.41	-0.30
6/17/2014	6/18/2014	7.69	7.37	-0.32
8/21/2014	8/22/2014	9.16	8.82	-0.34
7/14/2014	7/15/2014	8.78	8.42	-0.36
9/28/2014	9/29/2014	9.84	9.46	-0.37
6/15/2014	6/16/2014	8.64	8.26	-0.38
8/3/2014	8/4/2014	9.75	9.37	-0.39
6/29/2014	6/30/2014	8.12	7.73	-0.40
9/19/2014	9/20/2014	9.93	9.48	-0.45
9/4/2014	9/5/2014	8.90	8.43	-0.47
7/31/2014	8/1/2014	10.05	9.53	-0.52
8/9/2014	8/10/2014	12.16	11.61	-0.54
7/11/2014	7/12/2014	8.78	8.23	-0.55
8/18/2014	8/19/2014	9.05	8.49	-0.56
6/16/2014	6/17/2014	8.26	7.69	-0.57
9/3/2014	9/4/2014	9.48	8.90	-0.58
7/24/2014	7/25/2014	9.77	9.14	-0.62
8/17/2014	8/18/2014	9.76	9.05	-0.71
7/5/2014	7/6/2014	8.95	8.10	-0.85
8/10/2014	8/11/2014	11.61	10.69	-0.92
8/16/2014	8/17/2014	10.71	9.76	-0.95
9/9/2014	9/10/2014	9.45	8.48	-0.96
8/11/2014	8/12/2014	10.69	8.77	-1.92
9/30/2014		9.26		

Table 5.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Downstream Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
7/2/2014	7/3/2014	6.64	7.58	0.94
8/19/2014	8/20/2014	8.18	9.06	0.88
8/13/2014	8/14/2014	8.81	9.66	0.84
8/5/2014	8/6/2014	9.45	10.23	0.78
7/3/2014	7/4/2014	7.58	8.30	0.72
8/6/2014	8/7/2014	10.23	10.91	0.68
9/2/2014	9/3/2014	8.74	9.41	0.66
9/5/2014	9/6/2014	8.18	8.84	0.66
7/9/2014	7/10/2014	7.94	8.53	0.59
8/14/2014	8/15/2014	9.66	10.23	0.57
9/11/2014	9/12/2014	8.18	8.69	0.51
9/12/2014	9/13/2014	8.69	9.20	0.51
8/7/2014	8/8/2014	10.91	11.42	0.51
9/6/2014	9/7/2014	8.84	9.27	0.43
7/15/2014	7/16/2014	8.22	8.63	0.41
6/18/2014	6/19/2014	7.01	7.40	0.39
7/23/2014	7/24/2014	9.09	9.47	0.38
9/21/2014	9/22/2014	9.01	9.36	0.35
7/26/2014	7/27/2014	8.87	9.20	0.34
9/15/2014	9/16/2014	9.40	9.74	0.33
9/13/2014	9/14/2014	9.20	9.51	0.31
9/1/2014	9/2/2014	8.44	8.74	0.30
7/12/2014	7/13/2014	8.05	8.35	0.30
7/27/2014	7/28/2014	9.20	9.49	0.28
7/4/2014	7/5/2014	8.30	8.58	0.28
7/20/2014	7/21/2014	8.72	8.99	0.27
6/22/2014	6/23/2014	7.34	7.61	0.27
8/4/2014	8/5/2014	9.18	9.45	0.27
7/8/2014	7/9/2014	7.68	7.94	0.26
8/25/2014	8/26/2014	8.55	8.80	0.25
8/12/2014	8/13/2014	8.57	8.81	0.24
8/30/2014	8/31/2014	8.57	8.80	0.23
7/30/2014	7/31/2014	9.53	9.75	0.22
8/8/2014	8/9/2014	11.42	11.63	0.21
7/13/2014	7/14/2014	8.35	8.56	0.21
6/25/2014	6/26/2014	7.78	7.98	0.20
8/2/2014	8/3/2014	9.33	9.51	0.18
9/22/2014	9/23/2014	9.36	9.53	0.17
8/26/2014	8/27/2014	8.80	8.97	0.17
7/17/2014	7/18/2014	8.72	8.89	0.17
6/26/2014	6/27/2014	7.98	8.15	0.17

Table 5.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Downstream Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
8/15/2014	8/16/2014	10.23	10.40	0.17
6/23/2014	6/24/2014	7.61	7.77	0.16
7/21/2014	7/22/2014	8.99	9.12	0.13
7/28/2014	7/29/2014	9.49	9.61	0.12
7/16/2014	7/17/2014	8.63	8.72	0.10
7/18/2014	7/19/2014	8.89	8.98	0.08
9/16/2014	9/17/2014	9.74	9.82	0.08
8/23/2014	8/24/2014	8.55	8.63	0.07
9/7/2014	9/8/2014	9.27	9.34	0.07
7/6/2014	7/7/2014	7.76	7.81	0.06
8/1/2014	8/2/2014	9.28	9.33	0.05
9/25/2014	9/26/2014	9.55	9.58	0.02
6/20/2014	6/21/2014	7.30	7.32	0.02
6/24/2014	6/25/2014	7.77	7.78	0.02
6/21/2014	6/22/2014	7.32	7.34	0.02
9/24/2014	9/25/2014	9.54	9.55	0.01
9/23/2014	9/24/2014	9.53	9.54	0.01
8/29/2014	8/30/2014	8.57	8.57	0.00
6/27/2014	6/28/2014	8.15	8.15	0.00
7/10/2014	7/11/2014	8.53	8.53	-0.01
9/10/2014	9/11/2014	8.20	8.18	-0.02
9/18/2014	9/19/2014	9.65	9.63	-0.02
7/22/2014	7/23/2014	9.12	9.09	-0.03
9/27/2014	9/28/2014	9.51	9.46	-0.05
8/28/2014	8/29/2014	8.63	8.57	-0.05
8/20/2014	8/21/2014	9.06	9.01	-0.06
9/26/2014	9/27/2014	9.58	9.51	-0.07
8/24/2014	8/25/2014	8.63	8.55	-0.08
7/29/2014	7/30/2014	9.61	9.53	-0.08
6/30/2014	7/1/2014	7.43	7.35	-0.08
6/19/2014	6/20/2014	7.40	7.30	-0.10
9/14/2014	9/15/2014	9.51	9.40	-0.11
9/20/2014	9/21/2014	9.13	9.01	-0.12
7/7/2014	7/8/2014	7.81	7.68	-0.13
7/25/2014	7/26/2014	9.00	8.87	-0.13
9/17/2014	9/18/2014	9.82	9.65	-0.16
8/22/2014	8/23/2014	8.75	8.55	-0.20
9/29/2014	9/30/2014	9.09	8.87	-0.21
9/8/2014	9/9/2014	9.34	9.09	-0.25
8/21/2014	8/22/2014	9.01	8.75	-0.26
7/19/2014	7/20/2014	8.98	8.72	-0.26

Table 5.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Downstream Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
6/28/2014	6/29/2014	8.15	7.84	-0.30
8/3/2014	8/4/2014	9.51	9.18	-0.33
7/14/2014	7/15/2014	8.56	8.22	-0.34
8/27/2014	8/28/2014	8.97	8.63	-0.34
8/31/2014	9/1/2014	8.80	8.44	-0.37
9/28/2014	9/29/2014	9.46	9.09	-0.37
6/29/2014	6/30/2014	7.84	7.43	-0.41
6/15/2014	6/16/2014	8.55	8.14	-0.41
7/24/2014	7/25/2014	9.47	9.00	-0.47
7/31/2014	8/1/2014	9.75	9.28	-0.47
7/11/2014	7/12/2014	8.53	8.05	-0.48
6/17/2014	6/18/2014	7.49	7.01	-0.48
9/19/2014	9/20/2014	9.63	9.13	-0.50
8/9/2014	8/10/2014	11.63	11.08	-0.55
8/18/2014	8/19/2014	8.75	8.18	-0.57
9/4/2014	9/5/2014	8.76	8.18	-0.57
6/16/2014	6/17/2014	8.14	7.49	-0.65
9/3/2014	9/4/2014	9.41	8.76	-0.65
7/1/2014	7/2/2014	7.35	6.64	-0.71
8/17/2014	8/18/2014	9.48	8.75	-0.73
8/10/2014	8/11/2014	11.08	10.27	-0.81
7/5/2014	7/6/2014	8.58	7.76	-0.82
9/9/2014	9/10/2014	9.09	8.20	-0.89
8/16/2014	8/17/2014	10.40	9.48	-0.91
8/11/2014	8/12/2014	10.27	8.57	-1.70
9/30/2014		8.87		

Table 6.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Bypass Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
9/18/2014	9/19/2014	8.71	9.60	0.89
8/21/2014	8/22/2014	7.93	8.41	0.48
9/11/2014	9/12/2014	8.50	8.97	0.48
9/5/2014	9/6/2014	8.23	8.68	0.45
9/12/2014	9/13/2014	8.97	9.38	0.40
7/15/2014	7/16/2014	8.02	8.43	0.40
7/9/2014	7/10/2014	8.44	8.81	0.36
6/26/2014	6/27/2014	7.88	8.25	0.36
9/2/2014	9/3/2014	8.74	9.08	0.34
8/12/2014	8/13/2014	8.10	8.44	0.34
9/1/2014	9/2/2014	8.41	8.74	0.33
9/6/2014	9/7/2014	8.68	8.99	0.31
7/3/2014	7/4/2014	8.43	8.72	0.29
9/10/2014	9/11/2014	8.21	8.50	0.29
9/29/2014	9/30/2014	8.97	9.26	0.28
6/18/2014	6/19/2014	8.35	8.63	0.28
7/27/2014	7/28/2014	8.56	8.84	0.28
9/21/2014	9/22/2014	9.35	9.62	0.28
7/2/2014	7/3/2014	8.16	8.43	0.28
8/22/2014	8/23/2014	8.41	8.67	0.26
8/19/2014	8/20/2014	8.00	8.24	0.23
7/16/2014	7/17/2014	8.43	8.66	0.23
7/8/2014	7/9/2014	8.22	8.44	0.23
7/12/2014	7/13/2014	8.12	8.33	0.21
9/15/2014	9/16/2014	9.36	9.56	0.20
8/13/2014	8/14/2014	8.44	8.63	0.19
7/23/2014	7/24/2014	8.44	8.62	0.19
8/14/2014	8/15/2014	8.63	8.82	0.19
8/6/2014	8/7/2014	8.70	8.88	0.18
8/25/2014	8/26/2014	8.47	8.64	0.17
6/27/2014	6/28/2014	8.25	8.42	0.17
6/17/2014	6/18/2014	8.18	8.35	0.17
8/5/2014	8/6/2014	8.54	8.70	0.16
9/13/2014	9/14/2014	9.38	9.51	0.14
8/4/2014	8/5/2014	8.41	8.54	0.13
6/30/2014	7/1/2014	8.14	8.26	0.12
7/22/2014	7/23/2014	8.32	8.44	0.12
7/13/2014	7/14/2014	8.33	8.42	0.10
8/26/2014	8/27/2014	8.64	8.72	0.07
7/28/2014	7/29/2014	8.84	8.91	0.07
9/22/2014	9/23/2014	9.62	9.69	0.06

Table 6.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Bypass Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
8/30/2014	8/31/2014	8.53	8.59	0.06
8/28/2014	8/29/2014	8.66	8.72	0.06
7/26/2014	7/27/2014	8.50	8.56	0.05
6/20/2014	6/21/2014	8.55	8.60	0.05
6/25/2014	6/26/2014	7.84	7.88	0.04
8/7/2014	8/8/2014	8.88	8.92	0.03
7/6/2014	7/7/2014	8.23	8.25	0.02
7/20/2014	7/21/2014	8.38	8.40	0.02
7/25/2014	7/26/2014	8.49	8.50	0.02
8/8/2014	8/9/2014	8.92	8.93	0.01
8/1/2014	8/2/2014	8.56	8.56	0.01
6/21/2014	6/22/2014	8.60	8.61	0.00
8/3/2014	8/4/2014	8.40	8.41	0.00
8/23/2014	8/24/2014	8.67	8.67	0.00
9/20/2014	9/21/2014	9.35	9.35	0.00
7/17/2014	7/18/2014	8.66	8.64	-0.02
9/7/2014	9/8/2014	8.99	8.97	-0.02
9/16/2014	9/17/2014	9.56	9.53	-0.03
7/7/2014	7/8/2014	8.25	8.22	-0.03
9/24/2014	9/25/2014	9.61	9.56	-0.05
7/30/2014	7/31/2014	8.80	8.74	-0.06
8/27/2014	8/28/2014	8.72	8.66	-0.06
7/4/2014	7/5/2014	8.72	8.66	-0.06
9/25/2014	9/26/2014	9.56	9.49	-0.07
7/18/2014	7/19/2014	8.64	8.57	-0.07
7/21/2014	7/22/2014	8.40	8.32	-0.08
9/23/2014	9/24/2014	9.69	9.61	-0.08
6/19/2014	6/20/2014	8.63	8.55	-0.08
7/1/2014	7/2/2014	8.26	8.16	-0.10
7/29/2014	7/30/2014	8.91	8.80	-0.11
9/27/2014	9/28/2014	9.29	9.18	-0.11
6/22/2014	6/23/2014	8.61	8.49	-0.12
6/29/2014	6/30/2014	8.26	8.14	-0.12
8/9/2014	8/10/2014	8.93	8.81	-0.12
8/15/2014	8/16/2014	8.82	8.69	-0.13
7/24/2014	7/25/2014	8.62	8.49	-0.14
9/14/2014	9/15/2014	9.51	9.36	-0.15
8/2/2014	8/3/2014	8.56	8.40	-0.16
6/28/2014	6/29/2014	8.42	8.26	-0.16
6/15/2014	6/16/2014	8.84	8.67	-0.17
8/31/2014	9/1/2014	8.59	8.41	-0.18

Table 6.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Bypass Day to Day Differences for Dissolved Oxygen Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
7/31/2014	8/1/2014	8.74	8.56	-0.19
8/29/2014	8/30/2014	8.72	8.53	-0.19
7/19/2014	7/20/2014	8.57	8.38	-0.19
9/26/2014	9/27/2014	9.49	9.29	-0.19
8/24/2014	8/25/2014	8.67	8.47	-0.20
9/28/2014	9/29/2014	9.18	8.97	-0.20
8/18/2014	8/19/2014	8.22	8.00	-0.21
8/17/2014	8/18/2014	8.43	8.22	-0.22
6/23/2014	6/24/2014	8.49	8.27	-0.22
7/10/2014	7/11/2014	8.81	8.59	-0.22
9/8/2014	9/9/2014	8.97	8.72	-0.25
9/19/2014	9/20/2014	9.60	9.35	-0.25
8/16/2014	8/17/2014	8.69	8.43	-0.26
9/4/2014	9/5/2014	8.51	8.23	-0.28
8/10/2014	8/11/2014	8.81	8.50	-0.30
8/20/2014	8/21/2014	8.24	7.93	-0.31
8/11/2014	8/12/2014	8.50	8.10	-0.40
7/14/2014	7/15/2014	8.42	8.02	-0.40
6/24/2014	6/25/2014	8.27	7.84	-0.43
7/5/2014	7/6/2014	8.66	8.23	-0.43
7/11/2014	7/12/2014	8.59	8.12	-0.47
6/16/2014	6/17/2014	8.67	8.18	-0.49
9/9/2014	9/10/2014	8.72	8.21	-0.51
9/3/2014	9/4/2014	9.08	8.51	-0.57
9/17/2014	9/18/2014	9.53	8.71	-0.82
9/30/2014		9.26		

Table 7.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Upstream Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
6/18/2014	6/19/2014	9.50	9.82	0.32
6/19/2014	6/20/2014	9.82	10.04	0.22
8/6/2014	8/7/2014	8.77	8.97	0.21
8/7/2014	8/8/2014	8.97	9.14	0.17
6/22/2014	6/23/2014	10.24	10.39	0.14
6/21/2014	6/22/2014	10.11	10.24	0.13
7/3/2014	7/4/2014	8.81	8.92	0.12
6/24/2014	6/25/2014	10.46	10.57	0.11
6/28/2014	6/29/2014	8.79	8.89	0.11
7/4/2014	7/5/2014	8.92	9.01	0.09
8/8/2014	8/9/2014	9.14	9.24	0.09
9/22/2014	9/23/2014	8.72	8.80	0.08
6/23/2014	6/24/2014	10.39	10.46	0.08
6/25/2014	6/26/2014	10.57	10.65	0.08
9/19/2014	9/20/2014	8.68	8.76	0.07
7/30/2014	7/31/2014	8.54	8.61	0.07
9/7/2014	9/8/2014	8.70	8.78	0.07
9/26/2014	9/27/2014	8.88	8.95	0.07
6/20/2014	6/21/2014	10.04	10.11	0.07
7/13/2014	7/14/2014	8.65	8.73	0.07
8/4/2014	8/5/2014	8.65	8.72	0.07
8/15/2014	8/16/2014	9.18	9.25	0.07
8/23/2014	8/24/2014	8.86	8.93	0.07
8/24/2014	8/25/2014	8.93	8.99	0.06
9/25/2014	9/26/2014	8.83	8.88	0.05
9/27/2014	9/28/2014	8.95	9.01	0.05
7/17/2014	7/18/2014	8.73	8.78	0.05
8/5/2014	8/6/2014	8.72	8.77	0.05
8/25/2014	8/26/2014	8.99	9.03	0.05
9/2/2014	9/3/2014	8.99	9.03	0.05
7/27/2014	7/28/2014	8.52	8.57	0.04
7/18/2014	7/19/2014	8.78	8.81	0.04
6/17/2014	6/18/2014	9.47	9.50	0.03
9/23/2014	9/24/2014	8.80	8.83	0.03
8/9/2014	8/10/2014	9.24	9.27	0.03
7/9/2014	7/10/2014	8.93	8.96	0.03
8/26/2014	8/27/2014	9.03	9.06	0.03
8/14/2014	8/15/2014	9.15	9.18	0.03
7/25/2014	7/26/2014	8.51	8.54	0.03
9/13/2014	9/14/2014	8.62	8.64	0.02
7/14/2014	7/15/2014	8.73	8.75	0.02

Table 7.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Upstream Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
9/16/2014	9/17/2014	8.65	8.68	0.02
8/13/2014	8/14/2014	9.13	9.15	0.02
8/20/2014	8/21/2014	8.98	9.00	0.02
7/2/2014	7/3/2014	8.79	8.81	0.02
9/6/2014	9/7/2014	8.69	8.70	0.02
8/1/2014	8/2/2014	8.62	8.63	0.02
8/2/2014	8/3/2014	8.63	8.65	0.02
9/18/2014	9/19/2014	8.67	8.68	0.01
7/12/2014	7/13/2014	8.64	8.65	0.01
8/30/2014	8/31/2014	8.98	8.99	0.01
9/8/2014	9/9/2014	8.78	8.79	0.01
6/29/2014	6/30/2014	8.89	8.90	0.01
9/14/2014	9/15/2014	8.64	8.65	0.01
8/29/2014	8/30/2014	8.97	8.98	0.01
9/12/2014	9/13/2014	8.61	8.62	0.01
9/15/2014	9/16/2014	8.65	8.65	0.00
7/31/2014	8/1/2014	8.61	8.62	0.00
7/7/2014	7/8/2014	8.97	8.97	0.00
8/10/2014	8/11/2014	9.27	9.27	0.00
8/3/2014	8/4/2014	8.65	8.65	0.00
7/29/2014	7/30/2014	8.54	8.54	0.00
7/15/2014	7/16/2014	8.75	8.75	0.00
9/28/2014	9/29/2014	9.01	9.01	0.00
8/31/2014	9/1/2014	8.99	8.99	0.00
9/1/2014	9/2/2014	8.99	8.99	0.00
9/24/2014	9/25/2014	8.83	8.83	-0.01
9/17/2014	9/18/2014	8.68	8.67	-0.01
7/22/2014	7/23/2014	8.69	8.68	-0.01
7/21/2014	7/22/2014	8.70	8.69	-0.01
7/5/2014	7/6/2014	9.01	9.00	-0.01
7/26/2014	7/27/2014	8.54	8.52	-0.01
7/20/2014	7/21/2014	8.71	8.70	-0.02
8/19/2014	8/20/2014	9.00	8.98	-0.02
9/21/2014	9/22/2014	8.74	8.72	-0.02
9/20/2014	9/21/2014	8.76	8.74	-0.02
8/22/2014	8/23/2014	8.88	8.86	-0.02
6/15/2014	6/16/2014	9.55	9.53	-0.02
9/9/2014	9/10/2014	8.79	8.77	-0.02
8/27/2014	8/28/2014	9.06	9.04	-0.02
7/16/2014	7/17/2014	8.75	8.73	-0.02
7/6/2014	7/7/2014	9.00	8.97	-0.03

Table 7.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Upstream Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
7/28/2014	7/29/2014	8.57	8.54	-0.03
8/16/2014	8/17/2014	9.25	9.22	-0.04
7/8/2014	7/9/2014	8.97	8.93	-0.04
9/5/2014	9/6/2014	8.73	8.69	-0.04
9/11/2014	9/12/2014	8.66	8.61	-0.05
8/12/2014	8/13/2014	9.19	9.13	-0.05
6/30/2014	7/1/2014	8.90	8.85	-0.06
7/1/2014	7/2/2014	8.85	8.79	-0.06
7/11/2014	7/12/2014	8.70	8.64	-0.06
6/16/2014	6/17/2014	9.53	9.47	-0.06
8/28/2014	8/29/2014	9.04	8.97	-0.07
7/24/2014	7/25/2014	8.58	8.51	-0.07
9/29/2014	9/30/2014	9.01	8.93	-0.07
8/11/2014	8/12/2014	9.27	9.19	-0.08
8/18/2014	8/19/2014	9.08	9.00	-0.09
7/19/2014	7/20/2014	8.81	8.71	-0.10
7/23/2014	7/24/2014	8.68	8.58	-0.10
9/10/2014	9/11/2014	8.77	8.66	-0.11
8/21/2014	8/22/2014	9.00	8.88	-0.12
8/17/2014	8/18/2014	9.22	9.08	-0.13
9/4/2014	9/5/2014	8.87	8.73	-0.14
6/27/2014	6/28/2014	8.94	8.79	-0.15
9/3/2014	9/4/2014	9.03	8.87	-0.16
7/10/2014	7/11/2014	8.96	8.70	-0.26
6/26/2014	6/27/2014	10.65	8.94	-1.71
9/30/2014		8.93		

Table 8.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Downstream Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
7/24/2014	7/25/2014	8.93	9.26	0.32
6/18/2014	6/19/2014	9.20	9.45	0.25
8/6/2014	8/7/2014	9.85	10.06	0.20
6/19/2014	6/20/2014	9.45	9.62	0.17
6/24/2014	6/25/2014	9.68	9.83	0.15
6/23/2014	6/24/2014	9.53	9.68	0.15
7/3/2014	7/4/2014	8.70	8.84	0.14
7/25/2014	7/26/2014	9.26	9.39	0.13
7/23/2014	7/24/2014	8.80	8.93	0.13
7/4/2014	7/5/2014	8.84	8.93	0.10
9/7/2014	9/8/2014	8.88	8.97	0.09
8/9/2014	8/10/2014	9.52	9.61	0.09
7/30/2014	7/31/2014	9.54	9.63	0.09
7/27/2014	7/28/2014	9.43	9.51	0.09
8/13/2014	8/14/2014	9.55	9.63	0.08
8/4/2014	8/5/2014	9.70	9.78	0.08
9/22/2014	9/23/2014	8.78	8.85	0.08
6/25/2014	6/26/2014	9.83	9.90	0.07
8/15/2014	8/16/2014	9.70	9.78	0.07
8/5/2014	8/6/2014	9.78	9.85	0.07
9/26/2014	9/27/2014	8.91	8.98	0.07
8/14/2014	8/15/2014	9.63	9.70	0.07
7/9/2014	7/10/2014	8.85	8.91	0.06
8/23/2014	8/24/2014	9.07	9.13	0.06
7/17/2014	7/18/2014	8.79	8.85	0.06
9/2/2014	9/3/2014	9.24	9.30	0.05
9/27/2014	9/28/2014	8.98	9.04	0.05
8/24/2014	8/25/2014	9.13	9.18	0.05
9/25/2014	9/26/2014	8.86	8.91	0.05
9/13/2014	9/14/2014	8.86	8.91	0.05
7/13/2014	7/14/2014	8.74	8.78	0.05
8/10/2014	8/11/2014	9.61	9.65	0.04
8/25/2014	8/26/2014	9.18	9.22	0.04
7/26/2014	7/27/2014	9.39	9.43	0.04
8/20/2014	8/21/2014	9.58	9.61	0.04
7/18/2014	7/19/2014	8.85	8.88	0.03
8/26/2014	8/27/2014	9.22	9.25	0.03
8/30/2014	8/31/2014	9.18	9.21	0.03
9/16/2014	9/17/2014	8.94	8.97	0.03
6/28/2014	6/29/2014	8.83	8.86	0.03
9/6/2014	9/7/2014	8.85	8.88	0.03

Table 8.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Downstream Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
9/12/2014	9/13/2014	8.84	8.86	0.03
8/3/2014	8/4/2014	9.67	9.70	0.03
9/23/2014	9/24/2014	8.85	8.88	0.02
7/31/2014	8/1/2014	9.63	9.65	0.02
8/31/2014	9/1/2014	9.21	9.23	0.02
7/29/2014	7/30/2014	9.52	9.54	0.02
9/14/2014	9/15/2014	8.91	8.93	0.02
9/8/2014	9/9/2014	8.97	8.99	0.01
8/2/2014	8/3/2014	9.66	9.67	0.01
9/1/2014	9/2/2014	9.23	9.24	0.01
7/14/2014	7/15/2014	8.78	8.80	0.01
9/15/2014	9/16/2014	8.93	8.94	0.01
8/1/2014	8/2/2014	9.65	9.66	0.01
7/28/2014	7/29/2014	9.51	9.52	0.01
7/22/2014	7/23/2014	8.80	8.80	0.01
7/2/2014	7/3/2014	8.69	8.70	0.01
7/15/2014	7/16/2014	8.80	8.80	0.01
7/7/2014	7/8/2014	8.88	8.88	0.01
7/21/2014	7/22/2014	8.79	8.80	0.00
8/29/2014	8/30/2014	9.18	9.18	0.00
8/19/2014	8/20/2014	9.58	9.58	0.00
7/20/2014	7/21/2014	8.79	8.79	0.00
9/28/2014	9/29/2014	9.04	9.03	0.00
9/17/2014	9/18/2014	8.97	8.96	-0.01
9/9/2014	9/10/2014	8.99	8.98	-0.01
6/22/2014	6/23/2014	9.54	9.53	-0.01
8/27/2014	8/28/2014	9.25	9.24	-0.01
9/24/2014	9/25/2014	8.88	8.86	-0.01
7/16/2014	7/17/2014	8.80	8.79	-0.01
9/19/2014	9/20/2014	8.86	8.85	-0.02
7/12/2014	7/13/2014	8.76	8.74	-0.02
7/5/2014	7/6/2014	8.93	8.91	-0.02
6/21/2014	6/22/2014	9.56	9.54	-0.02
6/29/2014	6/30/2014	8.86	8.83	-0.03
7/6/2014	7/7/2014	8.91	8.88	-0.03
9/21/2014	9/22/2014	8.81	8.78	-0.03
8/16/2014	8/17/2014	9.78	9.74	-0.03
9/11/2014	9/12/2014	8.87	8.84	-0.03
9/5/2014	9/6/2014	8.89	8.85	-0.04
8/8/2014	8/9/2014	9.55	9.52	-0.04
7/8/2014	7/9/2014	8.88	8.85	-0.04

Table 8.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Downstream Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
9/20/2014	9/21/2014	8.85	8.81	-0.04
7/11/2014	7/12/2014	8.80	8.76	-0.04
8/12/2014	8/13/2014	9.60	9.55	-0.05
8/11/2014	8/12/2014	9.65	9.60	-0.05
6/20/2014	6/21/2014	9.62	9.56	-0.05
8/18/2014	8/19/2014	9.64	9.58	-0.06
8/28/2014	8/29/2014	9.24	9.18	-0.07
6/30/2014	7/1/2014	8.83	8.77	-0.07
7/1/2014	7/2/2014	8.77	8.69	-0.08
9/29/2014	9/30/2014	9.03	8.95	-0.08
6/17/2014	6/18/2014	9.29	9.20	-0.09
7/19/2014	7/20/2014	8.88	8.79	-0.09
9/18/2014	9/19/2014	8.96	8.86	-0.10
9/10/2014	9/11/2014	8.98	8.87	-0.10
8/17/2014	8/18/2014	9.74	9.64	-0.11
7/10/2014	7/11/2014	8.91	8.80	-0.11
8/22/2014	8/23/2014	9.18	9.07	-0.12
6/15/2014	6/16/2014	9.64	9.49	-0.15
9/4/2014	9/5/2014	9.05	8.89	-0.16
6/16/2014	6/17/2014	9.49	9.29	-0.20
6/27/2014	6/28/2014	9.06	8.83	-0.23
9/3/2014	9/4/2014	9.30	9.05	-0.25
8/21/2014	8/22/2014	9.61	9.18	-0.43
8/7/2014	8/8/2014	10.06	9.55	-0.50
6/26/2014	6/27/2014	9.90	9.06	-0.84
9/30/2014		8.95		

Table 9.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Bypass Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
6/18/2014	6/19/2014	9.75	10.09	0.34
9/19/2014	9/20/2014	8.90	9.14	0.25
8/7/2014	8/8/2014	8.87	9.07	0.20
7/3/2014	7/4/2014	9.04	9.22	0.18
6/19/2014	6/20/2014	10.09	10.27	0.17
8/6/2014	8/7/2014	8.71	8.87	0.17
7/4/2014	7/5/2014	9.22	9.38	0.16
9/18/2014	9/19/2014	8.75	8.90	0.14
8/8/2014	8/9/2014	9.07	9.20	0.12
6/24/2014	6/25/2014	10.38	10.49	0.11
7/2/2014	7/3/2014	8.94	9.04	0.10
8/22/2014	8/23/2014	8.84	8.93	0.09
6/28/2014	6/29/2014	8.77	8.86	0.09
8/4/2014	8/5/2014	8.59	8.67	0.08
6/22/2014	6/23/2014	10.29	10.36	0.07
6/25/2014	6/26/2014	10.49	10.56	0.07
7/30/2014	7/31/2014	8.51	8.58	0.07
9/7/2014	9/8/2014	8.71	8.78	0.07
9/2/2014	9/3/2014	8.87	8.93	0.06
8/15/2014	8/16/2014	9.10	9.16	0.06
7/18/2014	7/19/2014	8.54	8.60	0.05
9/16/2014	9/17/2014	8.67	8.73	0.05
9/22/2014	9/23/2014	9.07	9.12	0.05
6/21/2014	6/22/2014	10.24	10.29	0.05
9/26/2014	9/27/2014	9.14	9.19	0.04
6/29/2014	6/30/2014	8.86	8.90	0.04
7/9/2014	7/10/2014	9.44	9.48	0.04
9/14/2014	9/15/2014	8.63	8.67	0.04
9/27/2014	9/28/2014	9.19	9.23	0.04
8/5/2014	8/6/2014	8.67	8.71	0.04
8/23/2014	8/24/2014	8.93	8.97	0.04
8/24/2014	8/25/2014	8.97	9.01	0.04
7/7/2014	7/8/2014	9.42	9.45	0.04
7/27/2014	7/28/2014	8.50	8.53	0.03
6/30/2014	7/1/2014	8.90	8.94	0.03
7/25/2014	7/26/2014	8.48	8.51	0.03
9/25/2014	9/26/2014	9.11	9.14	0.03
8/1/2014	8/2/2014	8.59	8.62	0.03
9/17/2014	9/18/2014	8.73	8.75	0.03
7/17/2014	7/18/2014	8.52	8.54	0.02
7/5/2014	7/6/2014	9.38	9.40	0.02

Table 9.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Bypass Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
9/13/2014	9/14/2014	8.60	8.63	0.02
8/25/2014	8/26/2014	9.01	9.03	0.02
9/6/2014	9/7/2014	8.69	8.71	0.02
7/6/2014	7/7/2014	9.40	9.42	0.02
7/13/2014	7/14/2014	8.58	8.60	0.02
8/13/2014	8/14/2014	9.07	9.09	0.02
9/23/2014	9/24/2014	9.12	9.13	0.02
8/14/2014	8/15/2014	9.09	9.10	0.02
8/9/2014	8/10/2014	9.20	9.21	0.02
6/23/2014	6/24/2014	10.36	10.38	0.01
9/12/2014	9/13/2014	8.59	8.60	0.01
7/31/2014	8/1/2014	8.58	8.59	0.01
9/8/2014	9/9/2014	8.78	8.79	0.01
7/22/2014	7/23/2014	8.50	8.51	0.01
8/30/2014	8/31/2014	8.89	8.90	0.01
9/15/2014	9/16/2014	8.67	8.67	0.01
8/26/2014	8/27/2014	9.03	9.03	0.00
8/21/2014	8/22/2014	8.84	8.84	0.00
7/1/2014	7/2/2014	8.94	8.94	0.00
9/1/2014	9/2/2014	8.87	8.87	0.00
8/2/2014	8/3/2014	8.62	8.62	0.00
7/20/2014	7/21/2014	8.51	8.51	0.00
7/15/2014	7/16/2014	8.54	8.53	0.00
8/10/2014	8/11/2014	9.21	9.20	-0.01
7/28/2014	7/29/2014	8.53	8.52	-0.01
7/21/2014	7/22/2014	8.51	8.50	-0.01
8/20/2014	8/21/2014	8.85	8.84	-0.01
7/29/2014	7/30/2014	8.52	8.51	-0.01
9/28/2014	9/29/2014	9.23	9.22	-0.01
7/26/2014	7/27/2014	8.51	8.50	-0.01
7/16/2014	7/17/2014	8.53	8.52	-0.01
7/8/2014	7/9/2014	9.45	9.44	-0.02
8/19/2014	8/20/2014	8.86	8.85	-0.02
6/17/2014	6/18/2014	9.77	9.75	-0.02
7/24/2014	7/25/2014	8.49	8.48	-0.02
7/23/2014	7/24/2014	8.51	8.49	-0.02
8/29/2014	8/30/2014	8.91	8.89	-0.02
6/20/2014	6/21/2014	10.27	10.24	-0.02
9/24/2014	9/25/2014	9.13	9.11	-0.02
8/31/2014	9/1/2014	8.90	8.87	-0.02
9/21/2014	9/22/2014	9.10	9.07	-0.03

Table 9.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Badger Bypass Day to Day Differences for pH Data

Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
8/3/2014	8/4/2014	8.62	8.59	-0.03
9/5/2014	9/6/2014	8.72	8.69	-0.03
9/29/2014	9/30/2014	9.22	9.18	-0.03
9/9/2014	9/10/2014	8.79	8.75	-0.03
8/27/2014	8/28/2014	9.03	8.99	-0.04
8/16/2014	8/17/2014	9.16	9.12	-0.04
9/20/2014	9/21/2014	9.14	9.10	-0.05
8/12/2014	8/13/2014	9.12	9.07	-0.05
7/12/2014	7/13/2014	8.64	8.58	-0.05
9/11/2014	9/12/2014	8.65	8.59	-0.06
7/14/2014	7/15/2014	8.60	8.54	-0.06
7/19/2014	7/20/2014	8.60	8.51	-0.08
8/28/2014	8/29/2014	8.99	8.91	-0.08
8/11/2014	8/12/2014	9.20	9.12	-0.09
9/3/2014	9/4/2014	8.93	8.84	-0.10
9/10/2014	9/11/2014	8.75	8.65	-0.10
9/4/2014	9/5/2014	8.84	8.72	-0.11
8/18/2014	8/19/2014	8.99	8.86	-0.12
8/17/2014	8/18/2014	9.12	8.99	-0.13
6/15/2014	6/16/2014	10.09	9.96	-0.13
6/16/2014	6/17/2014	9.96	9.77	-0.19
7/11/2014	7/12/2014	8.89	8.64	-0.26
6/27/2014	6/28/2014	9.03	8.77	-0.26
7/10/2014	7/11/2014	9.48	8.89	-0.59
6/26/2014	6/27/2014	10.56	9.03	-1.53
9/30/2014		9.18		

Table 10.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Rapide Croche Daily Averages of Upstream and Downstream Dissolved Oxygen, Temperature, and pH Data

Difference = Upstream - Downstream

**Note: Shaded dates = service date (data downloads and calibration)

Date (shading = service date)	Dissolved Oxygen (mg/L)			Temperature (°C)			pH		
	Upstream	Downstream	Difference	Upstream	Downstream	Difference	Upstream	Downstream	Difference
6/15/2014	8.66	8.47	0.19	20.16	20.13	0.03	8.25	9.43	-1.18
6/16/2014	8.46	8.45	0.01	21.00	20.97	0.04	8.02	9.37	-1.34
6/17/2014	7.80	7.67	0.13	22.13	22.08	0.04	7.86	9.08	-1.22
6/18/2014	7.00	6.94	0.06	22.25	22.21	0.04	7.61	8.92	-1.30
6/19/2014	7.68	7.57	0.11	22.00	21.95	0.05	7.80	9.08	-1.29
6/20/2014	7.53	7.38	0.15	21.92	21.87	0.05	8.05	9.34	-1.29
6/21/2014	7.61	7.66	-0.05	21.32	21.27	0.05	7.93	9.28	-1.35
6/22/2014	7.91	7.77	0.13	21.21	21.17	0.04	8.01	9.41	-1.40
6/23/2014	8.13	7.70	0.43	21.80	21.75	0.05	8.07	9.56	-1.49
6/24/2014	8.08	7.49	0.59	22.82	22.77	0.04	8.02	9.71	-1.69
6/25/2014	7.62	7.36	0.26	22.77	22.70	0.07	7.91	9.87	-1.95
6/26/2014	8.04	7.94	0.09	23.08	23.03	0.05	8.03	10.04	-2.01
6/27/2014	8.14	7.96	0.18	23.23	23.17	0.06	8.32	9.13	-0.81
6/28/2014	8.47	8.22	0.25	24.51	24.48	0.03	8.81	8.70	0.11
6/29/2014	8.26	8.04	0.22	25.11	25.07	0.04	8.85	8.76	0.08
6/30/2014	7.93	7.78	0.15	25.04	25.01	0.03	8.77	8.82	-0.06
7/1/2014	8.22	7.99	0.23	24.16	24.12	0.04	8.77	8.83	-0.06
7/2/2014	8.01	7.94	0.07	23.32	23.25	0.08	8.64	8.78	-0.13
7/3/2014	8.72	8.56	0.16	22.93	22.81	0.12	8.62	8.84	-0.22
7/4/2014	8.68			23.08			8.45		
7/5/2014	9.19			23.53			8.68		
7/6/2014	8.31			23.20			8.81		
7/7/2014	8.35			23.46			8.80		
7/8/2014	8.60			23.67			8.77		
7/9/2014	8.68			23.41			8.83		
7/10/2014	9.61			23.30			8.87		
7/11/2014	9.39	10.05	-0.67	23.32	23.72	-0.40	8.88	8.69	0.19
7/12/2014	8.84	8.91	-0.07	23.62	23.56	0.06	8.83	8.62	0.21
7/13/2014	9.18	9.29	-0.11	23.54	23.48	0.05	8.82	8.63	0.19
7/14/2014	9.73	9.87	-0.14	23.40	23.35	0.05	8.86	8.68	0.18
7/15/2014	9.32	9.45	-0.13	22.48	22.43	0.05	8.84	8.72	0.13
7/16/2014	9.51	9.40	0.11	21.79	21.71	0.08	8.86	8.80	0.06
7/17/2014	10.03	9.98	0.05	21.93	21.86	0.07	8.86	8.80	0.06
7/18/2014	10.55	10.14	0.42	22.39	22.16	0.23	8.89	8.80	0.09
7/19/2014	10.32	10.25	0.08	23.02	22.95	0.07	8.90	8.85	0.05
7/20/2014	10.65	10.23	0.41	23.94	23.62	0.32	8.95	8.87	0.08
7/21/2014	10.54			24.32			8.86		
7/22/2014	10.42			25.07			8.84		
7/23/2014	11.34			25.20			8.87		
7/24/2014	11.65	11.12	0.53	24.50	24.76	-0.26	8.90	8.88	0.04
7/25/2014	10.19	10.12	0.07	23.93	23.91	0.02	8.93	8.84	0.09
7/26/2014	10.26	10.12	0.14	23.71	23.66	0.05	8.93	8.87	0.06
7/27/2014	11.19	10.64	0.55	24.11	24.00	0.11	9.03	8.91	0.12
7/28/2014	11.17	10.40	0.78	23.23	23.04	0.19	9.02	8.88	0.14
7/29/2014	11.84	11.26	0.58	23.03	22.88	0.16	9.09	8.98	0.11
7/30/2014	12.16	10.35	1.81	23.26	22.77	0.49	9.08	8.88	0.21
7/31/2014	11.71	10.22	1.49	23.32	22.86	0.46	9.08	8.87	0.21
8/1/2014	10.96	9.77	1.18	23.77	23.24	0.52	8.99	8.87	0.13
8/2/2014	11.27	9.24	2.03	24.36	23.21	1.16	8.88	8.86	0.07
8/3/2014	11.28	10.40	0.88	24.51	23.98	0.52	8.86	8.93	-0.06
8/4/2014	8.93	9.89	-0.97	24.32	24.26	0.06	8.64	8.88	-0.24
8/5/2014	10.12	10.49	-0.37	24.40	24.09	0.31	8.72	8.85	-0.10
8/6/2014	10.25			24.54			8.82		
8/7/2014	12.14			25.22			9.07		
8/8/2014	13.07	11.37	1.70	25.30	24.78	0.52	9.04	9.06	0.06
8/9/2014	12.14	10.65	1.49	24.95	24.64	0.31	9.30	9.09	0.23
8/10/2014	13.00	10.76	2.24	25.69	25.05	0.65	9.44	9.17	0.29
8/11/2014	11.77	9.92	1.84	25.48	25.15	0.34	9.39	9.15	0.26
8/12/2014	9.13	8.93	0.20	24.36	24.36	0.00	9.28	9.13	0.16

Table 10.

Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin

Rapide Croche Daily Averages of Upstream and Downstream Dissolved Oxygen, Temperature, and pH Data

Difference = Upstream - Downstream

**Note: Shaded dates = service date (data downloads and calibration)

Date (shading = service date)	Dissolved Oxygen (mg/L)			Temperature (°C)			pH		
	Upstream	Downstream	Difference	Upstream	Downstream	Difference	Upstream	Downstream	Difference
8/13/2014	10.60	8.96	1.64	24.24	23.60	0.64	9.29	9.08	0.22
8/14/2014	10.11	9.79	0.32	23.61	23.58	0.03	9.25	9.09	0.16
8/15/2014	11.25	10.74	0.51	23.48	23.45	0.03	9.28	9.12	0.16
8/16/2014	11.63	10.92	0.71	23.51	23.39	0.12	9.28	9.16	0.12
8/17/2014	10.66	10.39	0.26	23.23	23.24	-0.01	9.27	9.20	0.07
8/18/2014	10.14	9.91	0.23	22.56	22.55	0.01	9.29	9.19	0.09
8/19/2014	8.75	8.70	0.05	22.34	22.36	-0.03	9.12	9.01	0.11
8/20/2014	9.68	9.23	0.45	22.70	22.63	0.07	9.08	8.96	0.12
8/21/2014	9.87	9.84	0.02	22.72	22.73	-0.01	9.09	9.01	0.08
8/22/2014	6.34	9.39	-3.05	22.93	22.89	0.04	8.88	9.00	-0.09
8/23/2014	8.33	8.98	-0.65	23.48	23.51	-0.04	8.64	9.07	-0.43
8/24/2014	6.10	9.21	-3.10	23.95	23.96	-0.01	8.50	9.23	-0.70
8/25/2014	8.59	8.92	-0.32	24.52	24.55	-0.03	8.98	9.37	-0.38
8/26/2014	9.42	9.51	-0.09	24.62	24.64	-0.03	9.12	9.52	-0.40
8/27/2014	9.47	9.52	-0.06	24.37	24.40	-0.03	9.15	9.61	-0.46
8/28/2014	8.48	8.61	-0.13	23.43	23.44	-0.01	9.16	9.76	-0.61
8/29/2014	8.56	8.63	-0.07	23.13	23.16	-0.03	9.09	9.80	-0.70
8/30/2014	8.44	8.53	-0.09	23.56	23.59	-0.02	9.04	9.77	-0.74
8/31/2014	8.54	8.76	-0.23	23.61	23.62	-0.02	9.06	9.81	-0.75
9/1/2014	8.21	8.42	-0.21	23.42	23.44	-0.02	9.00	9.78	-0.78
9/2/2014	8.76	8.91	-0.15	23.20	23.21	-0.01	9.03	9.79	-0.76
9/3/2014	9.33	9.40	-0.07	23.34	23.37	-0.03	9.08	9.81	-0.73
9/4/2014	9.18	9.43	-0.25	23.59	23.61	-0.02	9.06	9.15	-0.34
9/5/2014	8.58			23.28	23.30	-0.02	8.97	8.78	0.19
9/6/2014	9.35			22.67	22.71	-0.04	8.94	8.74	0.20
9/7/2014	10.00			22.41	22.45	-0.04	8.94	8.73	0.21
9/8/2014	10.05			22.34	22.36	-0.02	9.00	8.76	0.24
9/9/2014	10.03			22.67	22.62	0.05	9.06	8.80	0.25
9/10/2014	8.51			22.43	22.45	-0.02	8.98	8.73	0.25
9/11/2014	8.34			19.87	19.89	-0.03	8.93	8.65	0.28
9/12/2014	9.13			18.05	18.03	0.02	8.89	8.58	0.31
9/13/2014	9.73			16.79	16.77	0.03	8.94	8.57	0.37
9/14/2014	10.05			16.74	16.78	-0.04	8.96	8.61	0.35
9/15/2014	9.80			16.95	16.98	-0.02	8.95	8.62	0.34
9/16/2014	10.26			16.75	16.71	0.04	8.98	8.62	0.36
9/17/2014	10.38			17.13	17.13	0.01	9.00	8.63	0.37
9/18/2014	10.02			16.95	16.99	-0.04	9.00	8.64	0.36
9/19/2014	10.05			16.87			8.94	8.60	
9/20/2014	9.58			17.37			8.90		
9/21/2014	9.45			17.49			8.87		
9/22/2014	9.93			16.87			8.85		
9/23/2014	9.98			16.88			8.87		
9/24/2014	9.80			17.33			8.90		
9/25/2014	9.80			17.87			8.86		
9/26/2014	9.78			18.32			8.89		
9/27/2014	9.64			19.11			8.97		
9/28/2014	9.55			19.67			9.01		
9/29/2014	9.02			19.65			9.05		
9/30/2014	9.18			17.62			9.01		
Minimum	6.10	6.94	-3.10	16.74	16.71	-0.40	7.61	8.57	-2.01
Average	9.52	9.24	0.22	22.35	22.66	0.09	8.62	8.93	-0.22
Maximum	13.07	11.37	2.24	25.69	25.15	1.16	9.44	10.04	0.37
Standard Deviation	1.34	1.10	0.85	2.46	1.99	0.21	0.37	0.37	0.60
Number of Data Points	108	70	70	108	84	84	108	85	84

Table 11.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Upstream Day to Day Differences for Dissolved Oxygen Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
8/24/2014	8/25/2014	6.10	8.59	2.49
8/22/2014	8/23/2014	6.34	8.33	1.99
8/6/2014	8/7/2014	10.25	12.14	1.89
8/12/2014	8/13/2014	9.13	10.60	1.47
8/4/2014	8/5/2014	8.93	10.12	1.20
8/14/2014	8/15/2014	10.11	11.25	1.14
8/19/2014	8/20/2014	8.75	9.68	0.93
7/9/2014	7/10/2014	8.68	9.61	0.93
8/7/2014	8/8/2014	12.14	13.07	0.93
7/26/2014	7/27/2014	10.26	11.19	0.93
7/22/2014	7/23/2014	10.42	11.34	0.92
8/9/2014	8/10/2014	12.14	13.00	0.87
8/25/2014	8/26/2014	8.59	9.42	0.82
9/11/2014	9/12/2014	8.34	9.13	0.79
9/5/2014	9/6/2014	8.58	9.35	0.77
7/2/2014	7/3/2014	8.01	8.72	0.70
6/18/2014	6/19/2014	7.00	7.68	0.68
7/28/2014	7/29/2014	11.17	11.84	0.67
9/6/2014	9/7/2014	9.35	10.00	0.65
9/12/2014	9/13/2014	9.13	9.73	0.60
9/2/2014	9/3/2014	8.76	9.33	0.57
7/13/2014	7/14/2014	9.18	9.73	0.55
9/1/2014	9/2/2014	8.21	8.76	0.55
7/16/2014	7/17/2014	9.51	10.03	0.53
7/17/2014	7/18/2014	10.03	10.55	0.52
7/4/2014	7/5/2014	8.68	9.19	0.51
9/21/2014	9/22/2014	9.45	9.93	0.48
9/15/2014	9/16/2014	9.80	10.26	0.45
6/25/2014	6/26/2014	7.62	8.04	0.41
8/15/2014	8/16/2014	11.25	11.63	0.39
7/12/2014	7/13/2014	8.84	9.18	0.34
6/27/2014	6/28/2014	8.14	8.47	0.33
9/13/2014	9/14/2014	9.73	10.05	0.32
7/19/2014	7/20/2014	10.32	10.65	0.32
7/29/2014	7/30/2014	11.84	12.16	0.32
8/1/2014	8/2/2014	10.96	11.27	0.32
7/23/2014	7/24/2014	11.34	11.65	0.31
6/21/2014	6/22/2014	7.61	7.91	0.30
6/30/2014	7/1/2014	7.93	8.22	0.29
7/7/2014	7/8/2014	8.35	8.60	0.25
6/22/2014	6/23/2014	7.91	8.13	0.22

Table 11.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Upstream Day to Day Differences for Dissolved Oxygen Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
7/15/2014	7/16/2014	9.32	9.51	0.19
8/20/2014	8/21/2014	9.68	9.87	0.18
9/29/2014	9/30/2014	9.02	9.18	0.17
8/5/2014	8/6/2014	10.12	10.25	0.13
9/16/2014	9/17/2014	10.26	10.38	0.12
6/26/2014	6/27/2014	8.04	8.14	0.11
8/30/2014	8/31/2014	8.44	8.54	0.10
6/20/2014	6/21/2014	7.53	7.61	0.08
8/28/2014	8/29/2014	8.48	8.56	0.08
7/8/2014	7/9/2014	8.60	8.68	0.08
7/25/2014	7/26/2014	10.19	10.26	0.07
9/22/2014	9/23/2014	9.93	9.98	0.05
8/26/2014	8/27/2014	9.42	9.47	0.05
9/7/2014	9/8/2014	10.00	10.05	0.05
7/6/2014	7/7/2014	8.31	8.35	0.04
9/18/2014	9/19/2014	10.02	10.05	0.03
8/2/2014	8/3/2014	11.27	11.28	0.00
9/24/2014	9/25/2014	9.80	9.80	0.00
7/27/2014	7/28/2014	11.19	11.17	-0.01
9/8/2014	9/9/2014	10.05	10.03	-0.02
9/25/2014	9/26/2014	9.80	9.78	-0.02
7/3/2014	7/4/2014	8.72	8.68	-0.04
6/23/2014	6/24/2014	8.13	8.08	-0.05
9/27/2014	9/28/2014	9.64	9.55	-0.09
7/20/2014	7/21/2014	10.65	10.54	-0.11
7/21/2014	7/22/2014	10.54	10.42	-0.12
8/29/2014	8/30/2014	8.56	8.44	-0.12
9/20/2014	9/21/2014	9.58	9.45	-0.13
9/3/2014	9/4/2014	9.33	9.18	-0.15
9/26/2014	9/27/2014	9.78	9.64	-0.15
6/19/2014	6/20/2014	7.68	7.53	-0.16
9/10/2014	9/11/2014	8.51	8.34	-0.17
9/23/2014	9/24/2014	9.98	9.80	-0.18
6/15/2014	6/16/2014	8.66	8.46	-0.20
7/1/2014	7/2/2014	8.22	8.01	-0.21
6/28/2014	6/29/2014	8.47	8.26	-0.22
7/10/2014	7/11/2014	9.61	9.39	-0.22
7/18/2014	7/19/2014	10.55	10.32	-0.23
9/14/2014	9/15/2014	10.05	9.80	-0.25
8/31/2014	9/1/2014	8.54	8.21	-0.33
6/29/2014	6/30/2014	8.26	7.93	-0.33

Table 11.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Upstream Day to Day Differences for Dissolved Oxygen Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
9/17/2014	9/18/2014	10.38	10.02	-0.36
7/14/2014	7/15/2014	9.73	9.32	-0.41
7/30/2014	7/31/2014	12.16	11.71	-0.45
6/24/2014	6/25/2014	8.08	7.62	-0.46
9/19/2014	9/20/2014	10.05	9.58	-0.47
8/13/2014	8/14/2014	10.60	10.11	-0.49
8/17/2014	8/18/2014	10.66	10.14	-0.52
9/28/2014	9/29/2014	9.55	9.02	-0.53
7/11/2014	7/12/2014	9.39	8.84	-0.55
9/4/2014	9/5/2014	9.18	8.58	-0.60
6/16/2014	6/17/2014	8.46	7.80	-0.66
7/31/2014	8/1/2014	11.71	10.96	-0.76
6/17/2014	6/18/2014	7.80	7.00	-0.80
7/5/2014	7/6/2014	9.19	8.31	-0.88
8/8/2014	8/9/2014	13.07	12.14	-0.94
8/16/2014	8/17/2014	11.63	10.66	-0.98
8/27/2014	8/28/2014	9.47	8.48	-0.99
8/10/2014	8/11/2014	13.00	11.77	-1.23
8/18/2014	8/19/2014	10.14	8.75	-1.39
7/24/2014	7/25/2014	11.65	10.19	-1.46
9/9/2014	9/10/2014	10.03	8.51	-1.53
8/23/2014	8/24/2014	8.33	6.10	-2.23
8/3/2014	8/4/2014	11.28	8.93	-2.35
8/11/2014	8/12/2014	11.77	9.13	-2.64
8/21/2014	8/22/2014	9.87	6.34	-3.53
9/30/2014		9.18		

Table 12.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Downstream Day to Day Differences for Dissolved Oxygen Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
8/2/2014	8/3/2014	9.24	10.40	1.16
8/14/2014	8/15/2014	9.79	10.74	0.95
7/28/2014	7/29/2014	10.40	11.26	0.86
8/13/2014	8/14/2014	8.96	9.79	0.83
6/18/2014	6/19/2014	6.94	7.57	0.63
7/2/2014	7/3/2014	7.94	8.56	0.61
8/20/2014	8/21/2014	9.23	9.84	0.61
8/4/2014	8/5/2014	9.89	10.49	0.60
8/25/2014	8/26/2014	8.92	9.51	0.59
7/16/2014	7/17/2014	9.40	9.98	0.59
6/25/2014	6/26/2014	7.36	7.94	0.58
7/13/2014	7/14/2014	9.29	9.87	0.58
8/19/2014	8/20/2014	8.70	9.23	0.54
7/26/2014	7/27/2014	10.12	10.64	0.52
9/2/2014	9/3/2014	8.91	9.40	0.49
9/1/2014	9/2/2014	8.42	8.91	0.49
7/12/2014	7/13/2014	8.91	9.29	0.38
6/20/2014	6/21/2014	7.38	7.66	0.28
6/27/2014	6/28/2014	7.96	8.22	0.26
8/30/2014	8/31/2014	8.53	8.76	0.23
8/23/2014	8/24/2014	8.98	9.21	0.23
6/30/2014	7/1/2014	7.78	7.99	0.21
8/15/2014	8/16/2014	10.74	10.92	0.19
7/17/2014	7/18/2014	9.98	10.14	0.16
6/21/2014	6/22/2014	7.66	7.77	0.11
8/9/2014	8/10/2014	10.65	10.76	0.11
7/18/2014	7/19/2014	10.14	10.25	0.11
9/3/2014	9/4/2014	9.40	9.43	0.03
8/12/2014	8/13/2014	8.93	8.96	0.03
8/28/2014	8/29/2014	8.61	8.63	0.03
6/26/2014	6/27/2014	7.94	7.96	0.02
8/26/2014	8/27/2014	9.51	9.52	0.02
7/25/2014	7/26/2014	10.12	10.12	-0.01
7/19/2014	7/20/2014	10.25	10.23	-0.01
6/15/2014	6/16/2014	8.47	8.45	-0.02
7/1/2014	7/2/2014	7.99	7.94	-0.04
7/15/2014	7/16/2014	9.45	9.40	-0.05
6/22/2014	6/23/2014	7.77	7.70	-0.08
8/29/2014	8/30/2014	8.63	8.53	-0.10
6/24/2014	6/25/2014	7.49	7.36	-0.13
7/30/2014	7/31/2014	10.35	10.22	-0.13

Table 12.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Downstream Day to Day Differences for Dissolved Oxygen Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
6/28/2014	6/29/2014	8.22	8.04	-0.18
6/19/2014	6/20/2014	7.57	7.38	-0.19
6/23/2014	6/24/2014	7.70	7.49	-0.21
7/27/2014	7/28/2014	10.64	10.40	-0.24
6/29/2014	6/30/2014	8.04	7.78	-0.26
8/24/2014	8/25/2014	9.21	8.92	-0.29
8/31/2014	9/1/2014	8.76	8.42	-0.35
8/22/2014	8/23/2014	9.39	8.98	-0.41
7/14/2014	7/15/2014	9.87	9.45	-0.42
7/31/2014	8/1/2014	10.22	9.77	-0.45
8/21/2014	8/22/2014	9.84	9.39	-0.45
8/17/2014	8/18/2014	10.39	9.91	-0.49
8/3/2014	8/4/2014	10.40	9.89	-0.51
8/16/2014	8/17/2014	10.92	10.39	-0.53
8/1/2014	8/2/2014	9.77	9.24	-0.53
8/8/2014	8/9/2014	11.37	10.65	-0.72
6/17/2014	6/18/2014	7.67	6.94	-0.73
6/16/2014	6/17/2014	8.45	7.67	-0.78
8/10/2014	8/11/2014	10.76	9.92	-0.84
7/29/2014	7/30/2014	11.26	10.35	-0.90
8/27/2014	8/28/2014	9.52	8.61	-0.92
8/11/2014	8/12/2014	9.92	8.93	-0.99
7/24/2014	7/25/2014	11.12	10.12	-0.99
7/11/2014	7/12/2014	10.05	8.91	-1.14
8/18/2014	8/19/2014	9.91	8.70	-1.21
7/3/2014	7/4/2014	8.56		
7/4/2014	7/5/2014			
7/5/2014	7/6/2014			
7/6/2014	7/7/2014			
7/7/2014	7/8/2014			
7/8/2014	7/9/2014			
7/9/2014	7/10/2014			
7/10/2014	7/11/2014		10.05	
7/20/2014	7/21/2014	10.23		
7/21/2014	7/22/2014			
7/22/2014	7/23/2014			
7/23/2014	7/24/2014		11.12	
8/5/2014	8/6/2014	10.49		
8/6/2014	8/7/2014			
8/7/2014	8/8/2014		11.37	
9/4/2014	9/5/2014	9.43		

Table 12.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Downstream Day to Day Differences for Dissolved Oxygen Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		Dissolved Oxygen (mg/L)		
Day 1	Day 2	Day 1	Day 2	Difference
9/5/2014	9/6/2014			
9/6/2014	9/7/2014			
9/7/2014	9/8/2014			
9/8/2014	9/9/2014			
9/9/2014	9/10/2014			
9/10/2014	9/11/2014			
9/11/2014	9/12/2014			
9/12/2014	9/13/2014			
9/13/2014	9/14/2014			
9/14/2014	9/15/2014			
9/15/2014	9/16/2014			
9/16/2014	9/17/2014			
9/17/2014	9/18/2014			
9/18/2014	9/19/2014			
9/19/2014	9/20/2014			
9/20/2014	9/21/2014			
9/21/2014	9/22/2014			
9/22/2014	9/23/2014			
9/23/2014	9/24/2014			
9/24/2014	9/25/2014			
9/25/2014	9/26/2014			
9/26/2014	9/27/2014			
9/27/2014	9/28/2014			
9/28/2014	9/29/2014			
9/29/2014	9/30/2014			
9/30/2014				

Table 13.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Upstream Day to Day Differences for pH Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
6/27/2014	6/28/2014	8.32	8.81	0.49
8/24/2014	8/25/2014	8.50	8.98	0.47
6/26/2014	6/27/2014	8.03	8.32	0.29
8/8/2014	8/9/2014	9.04	9.30	0.26
6/19/2014	6/20/2014	7.80	8.05	0.25
8/6/2014	8/7/2014	8.82	9.07	0.24
7/4/2014	7/5/2014	8.45	8.68	0.23
6/18/2014	6/19/2014	7.61	7.80	0.18
8/25/2014	8/26/2014	8.98	9.12	0.14
8/9/2014	8/10/2014	9.30	9.44	0.13
7/5/2014	7/6/2014	8.68	8.81	0.13
6/25/2014	6/26/2014	7.91	8.03	0.12
8/5/2014	8/6/2014	8.72	8.82	0.10
7/26/2014	7/27/2014	8.93	9.03	0.09
8/4/2014	8/5/2014	8.64	8.72	0.09
9/26/2014	9/27/2014	8.89	8.97	0.08
6/21/2014	6/22/2014	7.93	8.01	0.08
7/28/2014	7/29/2014	9.02	9.09	0.07
7/8/2014	7/9/2014	8.77	8.83	0.07
9/7/2014	9/8/2014	8.94	9.00	0.06
6/22/2014	6/23/2014	8.01	8.07	0.06
9/2/2014	9/3/2014	9.03	9.08	0.06
7/19/2014	7/20/2014	8.90	8.95	0.06
9/12/2014	9/13/2014	8.89	8.94	0.05
9/8/2014	9/9/2014	9.00	9.06	0.05
9/27/2014	9/28/2014	8.97	9.01	0.04
7/13/2014	7/14/2014	8.82	8.86	0.04
7/22/2014	7/23/2014	8.84	8.87	0.04
6/28/2014	6/29/2014	8.81	8.85	0.04
9/28/2014	9/29/2014	9.01	9.05	0.04
7/9/2014	7/10/2014	8.83	8.87	0.04
8/14/2014	8/15/2014	9.25	9.28	0.03
9/23/2014	9/24/2014	8.87	8.90	0.03
7/24/2014	7/25/2014	8.90	8.93	0.03
8/26/2014	8/27/2014	9.12	9.15	0.03
9/1/2014	9/2/2014	9.00	9.03	0.03
9/15/2014	9/16/2014	8.95	8.98	0.03
9/16/2014	9/17/2014	8.98	9.00	0.02
9/22/2014	9/23/2014	8.85	8.87	0.02
9/25/2014	9/26/2014	8.86	8.89	0.02
7/23/2014	7/24/2014	8.87	8.90	0.02

Table 13.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Upstream Day to Day Differences for pH Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
7/17/2014	7/18/2014	8.86	8.89	0.02
8/30/2014	8/31/2014	9.04	9.06	0.02
9/13/2014	9/14/2014	8.94	8.96	0.02
8/17/2014	8/18/2014	9.27	9.29	0.02
7/18/2014	7/19/2014	8.89	8.90	0.01
7/15/2014	7/16/2014	8.84	8.86	0.01
8/20/2014	8/21/2014	9.08	9.09	0.01
8/27/2014	8/28/2014	9.15	9.16	0.01
8/12/2014	8/13/2014	9.28	9.29	0.01
7/10/2014	7/11/2014	8.87	8.88	0.01
7/25/2014	7/26/2014	8.93	8.93	0.01
7/16/2014	7/17/2014	8.86	8.86	0.01
9/6/2014	9/7/2014	8.94	8.94	0.00
7/30/2014	7/31/2014	9.08	9.08	0.00
6/30/2014	7/1/2014	8.77	8.77	0.00
8/16/2014	8/17/2014	9.28	9.27	-0.01
9/14/2014	9/15/2014	8.96	8.95	-0.01
8/15/2014	8/16/2014	9.28	9.28	-0.01
9/17/2014	9/18/2014	9.00	9.00	-0.01
7/29/2014	7/30/2014	9.09	9.08	-0.01
7/27/2014	7/28/2014	9.03	9.02	-0.01
7/12/2014	7/13/2014	8.83	8.82	-0.01
7/6/2014	7/7/2014	8.81	8.80	-0.02
7/14/2014	7/15/2014	8.86	8.84	-0.02
9/3/2014	9/4/2014	9.08	9.06	-0.02
8/2/2014	8/3/2014	8.88	8.86	-0.02
9/20/2014	9/21/2014	8.90	8.87	-0.02
7/21/2014	7/22/2014	8.86	8.84	-0.02
9/21/2014	9/22/2014	8.87	8.85	-0.02
8/7/2014	8/8/2014	9.07	9.04	-0.03
7/7/2014	7/8/2014	8.80	8.77	-0.03
7/2/2014	7/3/2014	8.64	8.62	-0.03
9/5/2014	9/6/2014	8.97	8.94	-0.03
8/19/2014	8/20/2014	9.12	9.08	-0.04
9/11/2014	9/12/2014	8.93	8.89	-0.04
9/29/2014	9/30/2014	9.05	9.01	-0.04
9/19/2014	9/20/2014	8.94	8.90	-0.04
9/24/2014	9/25/2014	8.90	8.86	-0.04
8/13/2014	8/14/2014	9.29	9.25	-0.04
8/10/2014	8/11/2014	9.44	9.39	-0.04
7/11/2014	7/12/2014	8.88	8.83	-0.05

Table 13.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Upstream Day to Day Differences for pH Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
6/23/2014	6/24/2014	8.07	8.02	-0.05
9/10/2014	9/11/2014	8.98	8.93	-0.06
8/29/2014	8/30/2014	9.09	9.04	-0.06
8/31/2014	9/1/2014	9.06	9.00	-0.06
9/18/2014	9/19/2014	9.00	8.94	-0.06
8/28/2014	8/29/2014	9.16	9.09	-0.06
9/9/2014	9/10/2014	9.06	8.98	-0.07
6/29/2014	6/30/2014	8.85	8.77	-0.08
7/31/2014	8/1/2014	9.08	8.99	-0.09
9/4/2014	9/5/2014	9.06	8.97	-0.09
7/20/2014	7/21/2014	8.95	8.86	-0.10
6/24/2014	6/25/2014	8.02	7.91	-0.11
8/11/2014	8/12/2014	9.39	9.28	-0.11
8/1/2014	8/2/2014	8.99	8.88	-0.11
6/20/2014	6/21/2014	8.05	7.93	-0.12
7/1/2014	7/2/2014	8.77	8.64	-0.12
8/23/2014	8/24/2014	8.64	8.50	-0.13
7/3/2014	7/4/2014	8.62	8.45	-0.16
6/16/2014	6/17/2014	8.02	7.86	-0.17
8/18/2014	8/19/2014	9.29	9.12	-0.17
8/21/2014	8/22/2014	9.09	8.88	-0.21
8/3/2014	8/4/2014	8.86	8.64	-0.23
6/15/2014	6/16/2014	8.25	8.02	-0.23
6/17/2014	6/18/2014	7.86	7.61	-0.24
8/22/2014	8/23/2014	8.88	8.64	-0.25
9/30/2014		9.01		

Table 14.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Downstream Day to Day Differences for pH Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
6/19/2014	6/20/2014	9.08	9.34	0.26
6/25/2014	6/26/2014	9.87	10.04	0.18
6/18/2014	6/19/2014	8.92	9.08	0.16
8/23/2014	8/24/2014	9.07	9.23	0.16
8/27/2014	8/28/2014	9.61	9.76	0.16
6/24/2014	6/25/2014	9.71	9.87	0.15
6/23/2014	6/24/2014	9.56	9.71	0.15
6/22/2014	6/23/2014	9.41	9.56	0.15
8/25/2014	8/26/2014	9.37	9.52	0.14
8/24/2014	8/25/2014	9.23	9.37	0.14
6/21/2014	6/22/2014	9.28	9.41	0.13
7/28/2014	7/29/2014	8.88	8.98	0.09
8/26/2014	8/27/2014	9.52	9.61	0.09
8/9/2014	8/10/2014	9.09	9.17	0.08
7/15/2014	7/16/2014	8.72	8.80	0.08
8/2/2014	8/3/2014	8.86	8.93	0.07
8/22/2014	8/23/2014	9.00	9.07	0.07
6/28/2014	6/29/2014	8.70	8.76	0.06
7/2/2014	7/3/2014	8.78	8.84	0.06
6/29/2014	6/30/2014	8.76	8.82	0.06
7/18/2014	7/19/2014	8.80	8.85	0.05
7/13/2014	7/14/2014	8.63	8.68	0.05
8/20/2014	8/21/2014	8.96	9.01	0.05
8/15/2014	8/16/2014	9.12	9.16	0.04
7/26/2014	7/27/2014	8.87	8.91	0.04
9/8/2014	9/9/2014	8.76	8.80	0.04
7/14/2014	7/15/2014	8.68	8.72	0.04
8/28/2014	8/29/2014	9.76	9.80	0.04
9/13/2014	9/14/2014	8.57	8.61	0.04
7/25/2014	7/26/2014	8.84	8.87	0.03
8/16/2014	8/17/2014	9.16	9.20	0.03
8/14/2014	8/15/2014	9.09	9.12	0.03
8/30/2014	8/31/2014	9.77	9.81	0.03
9/7/2014	9/8/2014	8.73	8.76	0.03
8/8/2014	8/9/2014	9.06	9.09	0.02
9/2/2014	9/3/2014	9.79	9.81	0.02
7/19/2014	7/20/2014	8.85	8.87	0.01
9/1/2014	9/2/2014	9.78	9.79	0.01
9/16/2014	9/17/2014	8.62	8.63	0.01
8/13/2014	8/14/2014	9.08	9.09	0.01
9/15/2014	9/16/2014	8.62	8.62	0.01

Table 14.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Downstream Day to Day Differences for pH Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
7/16/2014	7/17/2014	8.80	8.80	0.01
9/17/2014	9/18/2014	8.63	8.64	0.01
7/12/2014	7/13/2014	8.62	8.63	0.00
9/14/2014	9/15/2014	8.61	8.62	0.00
6/30/2014	7/1/2014	8.82	8.83	0.00
7/17/2014	7/18/2014	8.80	8.80	0.00
8/17/2014	8/18/2014	9.20	9.19	0.00
9/12/2014	9/13/2014	8.58	8.57	-0.01
7/31/2014	8/1/2014	8.87	8.87	-0.01
8/1/2014	8/2/2014	8.87	8.86	-0.01
9/6/2014	9/7/2014	8.74	8.73	-0.01
7/30/2014	7/31/2014	8.88	8.87	-0.01
8/21/2014	8/22/2014	9.01	9.00	-0.01
8/11/2014	8/12/2014	9.15	9.13	-0.02
8/10/2014	8/11/2014	9.17	9.15	-0.02
8/29/2014	8/30/2014	9.80	9.77	-0.03
8/31/2014	9/1/2014	9.81	9.78	-0.03
8/4/2014	8/5/2014	8.88	8.85	-0.03
7/27/2014	7/28/2014	8.91	8.88	-0.03
7/24/2014	7/25/2014	8.88	8.84	-0.04
9/18/2014	9/19/2014	8.64	8.60	-0.04
9/5/2014	9/6/2014	8.78	8.74	-0.04
8/12/2014	8/13/2014	9.13	9.08	-0.04
8/19/2014	8/20/2014	9.01	8.96	-0.05
7/1/2014	7/2/2014	8.83	8.78	-0.05
8/3/2014	8/4/2014	8.93	8.88	-0.06
6/20/2014	6/21/2014	9.34	9.28	-0.06
7/11/2014	7/12/2014	8.69	8.62	-0.06
6/15/2014	6/16/2014	9.43	9.37	-0.07
9/9/2014	9/10/2014	8.80	8.73	-0.07
9/11/2014	9/12/2014	8.65	8.58	-0.07
9/10/2014	9/11/2014	8.73	8.65	-0.09
7/29/2014	7/30/2014	8.98	8.88	-0.09
6/17/2014	6/18/2014	9.08	8.92	-0.16
8/18/2014	8/19/2014	9.19	9.01	-0.19
6/16/2014	6/17/2014	9.37	9.08	-0.29
9/4/2014	9/5/2014	9.15	8.78	-0.37
6/27/2014	6/28/2014	9.13	8.70	-0.43
9/3/2014	9/4/2014	9.81	9.15	-0.66
6/26/2014	6/27/2014	10.04	9.13	-0.91
7/3/2014	7/4/2014	8.84		

Table 14.
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Downstream Day to Day Differences for pH Data
Difference = Day 2 - Day 1 Value

Date Range (shading = service date)		pH		
Day 1	Day 2	Day 1	Day 2	Difference
7/4/2014	7/5/2014			
7/5/2014	7/6/2014			
7/6/2014	7/7/2014			
7/7/2014	7/8/2014			
7/8/2014	7/9/2014			
7/9/2014	7/10/2014			
7/10/2014	7/11/2014		8.69	
7/20/2014	7/21/2014	8.87		
7/21/2014	7/22/2014			
7/22/2014	7/23/2014			
7/23/2014	7/24/2014		8.88	
8/5/2014	8/6/2014	8.85		
8/6/2014	8/7/2014			
8/7/2014	8/8/2014		9.06	
9/19/2014	9/20/2014	8.60		
9/20/2014	9/21/2014			
9/21/2014	9/22/2014			
9/22/2014	9/23/2014			
9/23/2014	9/24/2014			
9/24/2014	9/25/2014			
9/25/2014	9/26/2014			
9/26/2014	9/27/2014			
9/27/2014	9/28/2014			
9/28/2014	9/29/2014			
9/29/2014	9/30/2014			
9/30/2014				

Table 15
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Badger Upstream Station - Sonde Calibration Data

Sonde Serial Number (Bold = Changed	Date	Conductivity (µS/cm)						LDO (mg/L)						pH											
														pH 7 Calibration						pH 10 Calibration					
		In Check			Post-Cleaning			In Check			Post-Cleaning			In Check			Post-Cleaning			In Check			Post-Cleaning		
		Before	Standard	% Difference	Before	Standard	% Difference	Before	After	% Difference	Before	After	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference
R65287	6/27/2014	1387	1412	-1.8	1413	1412	0.1	8.61	8.71	-1.1	8.74	8.65	1.0	9.07	7.0	29.6	6.95	7.0	-0.7	9.99	10.0	-0.1	9.99	10.0	-0.1
R65287	7/11/2014	1424	1412	0.8	1407	1412	-0.4	8.36	8.24	1.5	8.04	8.41	-4.4	7.29	7.0	4.1	6.92	7.0	-1.1	9.98	10.0	-0.2	10.00	10.0	0.0
R65287	7/24/2014	1403	1412	-0.6	1416	1412	0.3	8.25	8.50	-2.9	8.88	8.50	4.5	7.10	7.0	1.4	6.93	7.0	-1.0	9.98	10.0	-0.2	10.06	10.0	0.6
R65287	8/8/2014	1427	1412	1.1	1409	1412	-0.2	8.39	8.59	-2.3	8.45	8.48	-0.4	6.99	7.0	-0.1	6.99	7.0	-0.1	10.05	10.0	0.5	9.92	10.0	-0.8
R65287	8/22/2014	1406	1412	-0.4	1411	1412	-0.1	8.33	8.51	-2.1	8.44	8.46	-0.2	7.12	7.0	1.7	6.99	7.0	-0.1	10.05	10.0	0.5	9.98	10.0	-0.2
R65287	9/4/2014	1411	1412	-0.1	1417	1412	0.4	8.15	8.44	-3.4	8.70	8.40	3.6	7.15	7.0	2.1	6.93	7.0	-1.0	9.99	10.0	-0.1	10.04	10.0	0.4
R65287	9/19/2014	1414	1412	0.1	1412	1412	0.0	9.29	9.03	2.9	8.88	9.11	-2.5	6.92	7.0	-1.1	6.97	7.0	-0.4	9.93	10.0	-0.7	10.00	10.0	0.0
R65287	10/1/2014	1408	1412	-0.3				9.66	9.24	4.5				7.11	7.0	1.6				10.03	10.0	0.3			

Table 16
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Badger Downstream Station - Sonde Calibration Data

Sonde Serial Number (Bold = Changed Sondes)	Date	Conductivity (µS/cm)						LDO (mg/L)						pH											
														pH 7 Calibration						pH 10 Calibration					
		In Check			Post-Cleaning			In Check			Post-Cleaning			In Check			Post-Cleaning			In Check			Post-Cleaning		
		Before	Standard	% Difference	Before	Standard	% Difference	Before	After	% Difference	Before	After	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference
R64521	6/27/2014	1411	1412	-0.1	1416	1412	0.3	8.36	8.71	-4.0	8.54	8.3	2.9	8.32	7.0	18.9	6.90	7.0	-1.4	9.99	10.0	-0.1	10.10	10.0	1.0
R64521	7/11/2014	1412	1412	0.0	1412	1412	0.0	8.19	8.24	-0.6	8.22	8.41	-2.3	7.38	7.0	5.4	6.97	7.0	-0.4	9.90	10.0	-1.0	10.00	10.0	0.0
R62014	**7/24/2014**				1393	1412	-1.3				8.97	8.06	11.3				7.52	7.0	7.4				10.19	10.0	1.9
R62014	8/8/2014	1406	1412	-0.4	1414	1412	0.1	8.25	8.12	1.6	8.17	8.14	0.4	8.03	7.0	14.7	6.93	7.0	-1.0	9.84	10.0	-1.6	10.02	10.0	0.2
R62014	8/22/2014	1416	1412	0.3	1411	1412	-0.1	7.99	8.21	-2.7	8.18	8.17	0.1	7.75	7.0	10.7	6.95	7.0	-0.7	9.95	10.0	-0.5	10.02	10.0	0.2
R62014	9/4/2014	1415	1412	0.2	1411	1412	-0.1	8.27	8.22	0.6	8.26	8.17	1.1	7.41	7.0	5.9	7.06	7.0	0.9	10.00	10.0	0.0	10.02	10.0	0.2
R62014	9/19/2014	1409	1412	-0.2	1413	1412	0.1	9.14	9.04	1.1	9.00	9.12	-1.3	7.12	7.0	1.7	6.95	7.0	-0.7	9.98	10.0	-0.2	10.05	10.0	0.5
R62014	10/1/2014	1411	1412	-0.1				8.89	9.35	-4.9				7.15	7.0	2.1				10.02	10.0	0.2			

Table 17
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Badger Bypass Station - Sonde Calibration Data

Sonde Serial Number (Bold = Changed Sondes)	Date	Conductivity (µS/cm)						LDO (mg/L)						pH									
			In Check			Post-Cleaning			In Check			Post-Cleaning			pH 7 Calibration						pH 10 Calibration			
															In Check			Post-Cleaning			In Check			Post-Cleaning		
		Before	Standard	% Difference	Before	Standard	% Difference	Before	After	% Difference	Before	After	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference
R45270	6/27/2014	1403	1412	-0.6	1412	1412	0.0	7.79	8.02	-2.9	8.32	8.01	3.9	8.90	7.00	27.1	6.98	7.00	-0.3	10.05	10.00	0.5	10.00	10.00	0.0
R45270	7/11/2014	1422	1412	0.7	1397	1412	-1.1	8.14	8.04	1.2	8.16	7.93	2.9	7.92	7.00	13.1	6.99	7.00	-0.1	9.96	10.00	-0.4	10.01	10.00	0.1
R45270	7/24/2014	1413	1412	0.1	1406	1412	-0.4	8.05	8.12	-0.9	7.9	7.92	-0.3	7.12	7.00	1.7	6.99	7.00	-0.1	10.04	10.00	0.4	10.00	10.00	0.0
R45270	8/8/2014	1420	1412	0.6	1405	1412	-0.5	9.01	9.00	0.1	9.07	7.99	13.5	7.02	7.00	0.3	6.94	7.00	-0.9	10.00	10.00	0.0	10.00	10.00	0.0
R45270	8/22/2014	1418	1412	0.4	1406	1412	-0.4	7.39	8.03	-8.0	8.53	7.97	7.0	7.06	7.00	0.9	6.99	7.00	-0.1	10.00	10.00	0.0	10.00	10.00	0.0
R45270	9/4/2014	1416	1412	0.3	1411	1412	-0.1	8.14	8.12	0.2	8.45	8.09	4.4	7.15	7.00	2.1	7.02	7.00	0.3	10.00	10.00	0.0	10.01	10.00	0.1
R45277	**9/19/2014**				1218	1412	-13.7				9.16	8.82	3.9				6.90	7.00	-1.4				10.14	10.00	1.4
R45277	10/1/2014	1412	1412	0.0				9.21	9.43	-2.3				6.97	7.00	-0.4				9.87	10.00	-1.3			

Table 18
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Upstream Station - Sonde Calibration Data

Sonde Serial Number (Bold = Changed Sondes)	Date	Conductivity (µS/cm)						LDO (mg/L)						pH									
														pH 7 Calibration						pH 10 Calibration			
		In Check			Post-Cleaning			In Check			Post-Cleaning			In Check			Post-Cleaning			In Check			Post-Cleaning		
		Before	Standard	% Difference	Before	Standard	% Difference	Before	After	% Difference	Before	After	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference
R62239	6/27/2014	1396	1412	-1.1	1411	1412	-0.1	7.69	7.76	-0.9	8	7.79	2.7	6.84	7.00	-2.3	6.99	7.00	-0.1	9.94	10.00	-0.6	10.03	10.00	0.3
R62239	7/11/2014	1402	1412	-0.7	1423	1412	0.8	7.78	7.76	0.3	7.79	7.79	0.0	7.17	7.00	2.4	6.97	7.00	-0.4	9.98	10.00	-0.2	10.02	10.00	0.2
R62239	7/24/2014	1400	1412	-0.8	1409	1412	-0.2	7.77	7.72	0.6	7.92	7.91	0.1	7.09	7.00	1.3	7.00	7.00	0.0	10.03	10.00	0.3	10.00	10.00	0.0
R62239	8/8/2014	1416	1412	0.3	1404	1412	-0.6	7.7	7.71	-0.1	7.66	7.7	-0.5	7.43	7.00	6.1	7.01	7.00	0.1	9.74	10.00	-2.6	10.00	10.00	0.0
R62239	8/22/2014	1421	1412	0.6	1411	1412	-0.1	7.86	7.85	0.1	7.82	7.84	-0.3	7.11	7.00	1.6	7.04	7.00	0.6	10.04	10.00	0.4	9.97	10.00	-0.3
R62239	9/4/2014	1415	1412	0.2	1412	1412	0.0	7.95	7.96	-0.1	7.99	8.01	-0.2	7.10	7.00	1.4	6.94	7.00	-0.9	9.98	10.00	-0.2	10.02	10.00	0.2
R62239	9/19/2014	1399	1412	-0.9	1411	1412	-0.1	8.95	8.78	1.9	8.82	8.73	1.0	7.11	7.00	1.6	7.05	7.00	0.7	10.01	10.00	0.1	10.00	10.00	0.0
R62239	10/1/2014	1407	1412	-0.4				9.19	9.28	-1.0				7.08	7.00	1.1				10.00	10.00	0.0			

Table 19
Badger-Rapide Croche, FERC No. 2677 on the Fox River In Kaukauna, Wisconsin
Rapide Croche Tailrace Station - Sonde Calibration Data

Sonde Serial Number (Bold = Changed Sondes)	Date	Conductivity (µS/cm)						LDO (mg/L)						pH									
														pH 7 Calibration						pH 10 Calibration			
		In Check			Post-Cleaning			In Check			Post-Cleaning			In Check			Post-Cleaning			In Check			Post-Cleaning		
		Before	Standard	% Difference	Before	Standard	% Difference	Before	After	% Difference	Before	After	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference	Initial	Reference	% Difference
R65298	6/27/2014	1408	1412	-0.3	1412	1412	0.0	7.68	7.85	-2.2	8.19	7.85	4.3	8.55	7.00	22.1	6.96	7.00	-0.6	9.93	10.00	-0.7	10.02	10.00	0.2
R65298	7/11/2014	1402	1412	-0.7	1419	1412	0.5	7.48	7.76	-3.6	7.68	7.72	-0.5	7.55	7.00	7.9	6.96	7.00	-0.6	10.00	10.00	0.0	9.95	10.00	-0.5
R45277	**7/15/2014**				1386	1412	-1.8				7.65	8.75	-12.6				7.00	7.00	0.0				9.95	10.00	-0.5
R45791	**7/24/2014**	1652	1412	17.0	1412	1412	0.0	7.91	8.01	-1.2	7.95	8.02	-0.9	6.89	7.00	-1.6	7.03	7.00	0.4	9.95	10.00	-0.5	9.89	10.00	-1.1
R64521	**8/8/2014**				1413	1412	0.1				7.34	7.66	-4.2				7.25	7.00	3.6				10.00	10.00	0.0
R64521	8/22/2014	1415	1412	0.2	1411	1412	-0.1	7.83	7.82	0.1	7.84	7.80	0.5	7.20	7.00	2.9	7.00	7.00	0.0	9.99	10.00	-0.1	9.99	10.00	-0.1
R64521	9/4/2014	1413	1412	0.1	1417	1412	0.4	8.08	8.20	-1.5	8.28	8.25	0.4	7.93	7.00	13.3	7.01	7.00	0.1	10.00	10.00	0.0	10.02	10.00	0.2
R45791	9/19/2014				1406	1412	-0.4				8.85	8.76	1.0				7.00	7.00	0.0				9.99	10.00	-0.1
R45791	10/1/2014																								

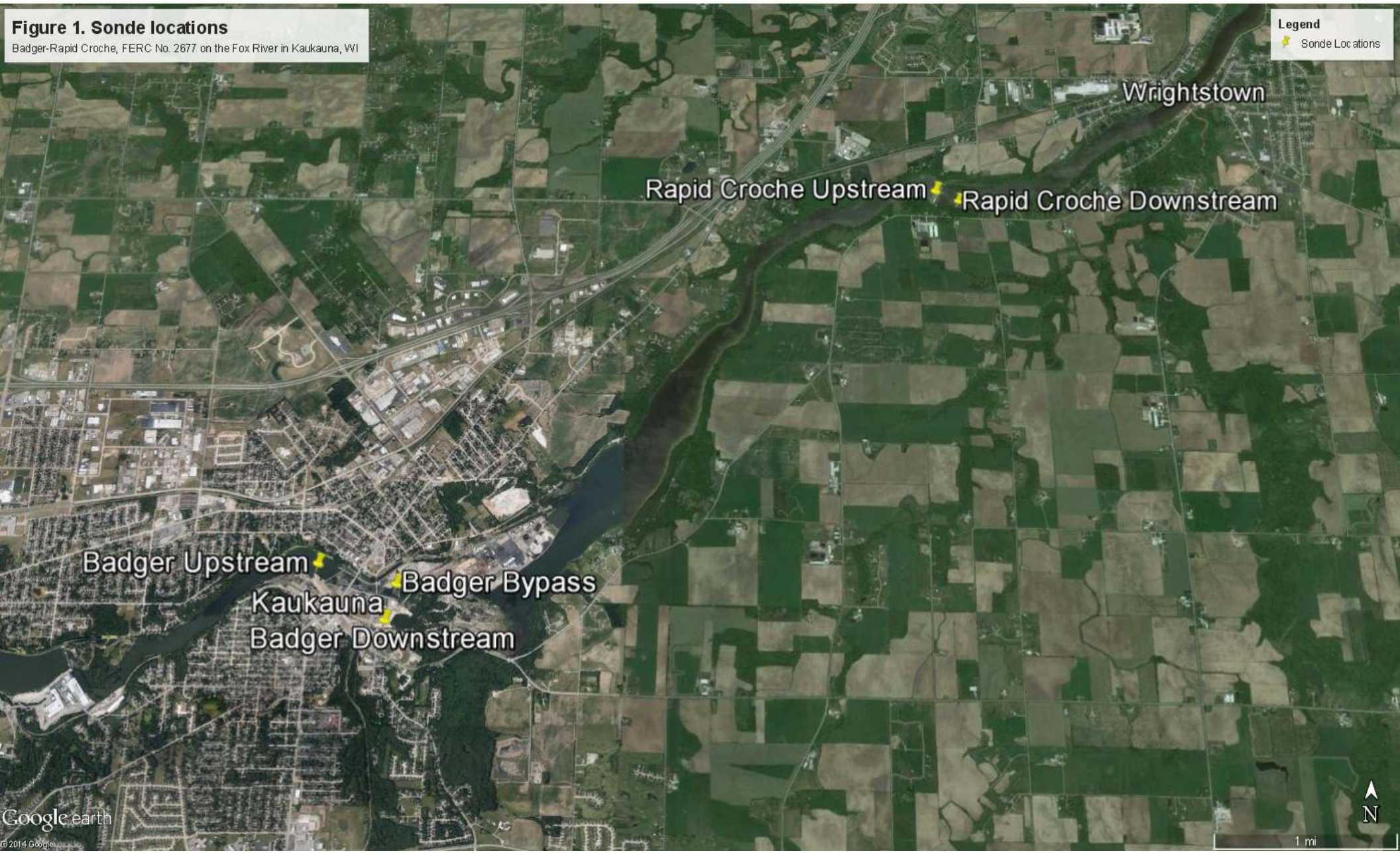
Figure 1. Sonde locations
Badger-Rapid Croche, FERC No. 2677 on the Fox River in Kaukauna, WI
Legend
Sonde Locations
Wrightstown
Rapid Croche Upstream
Rapid Croche Downstream
Badger Upstream
Badger Bypass
Kaukauna
Badger Downstream
Google earth
© 2014 Google
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Figure 2. Hourly Dissolved Oxygen Readings, Upstream, Downstream, and along the Bypass of the Badger Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

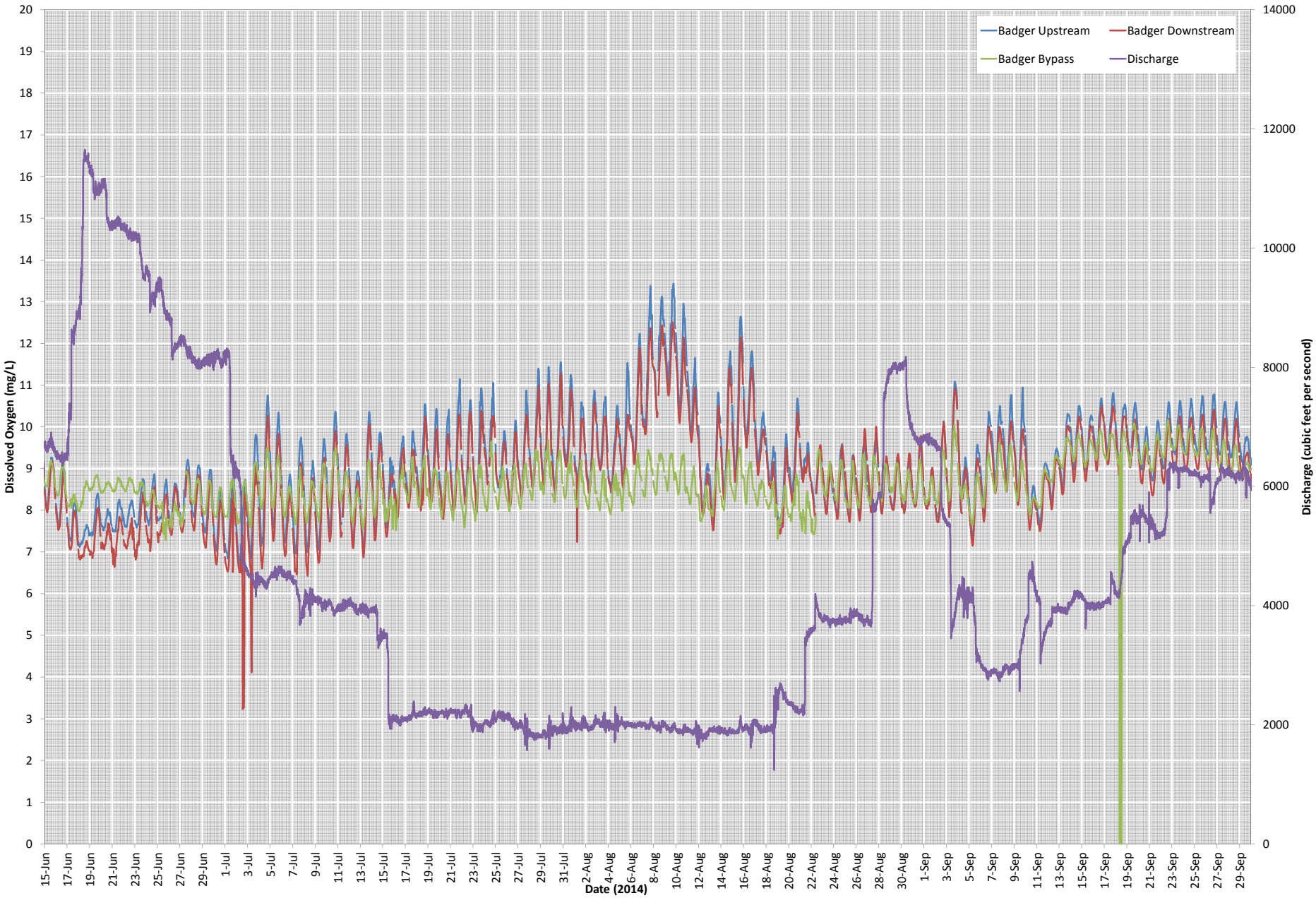


Figure 3. Hourly Temperature Readings, Upstream, Downstream, and along the Bypass of the Badger Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

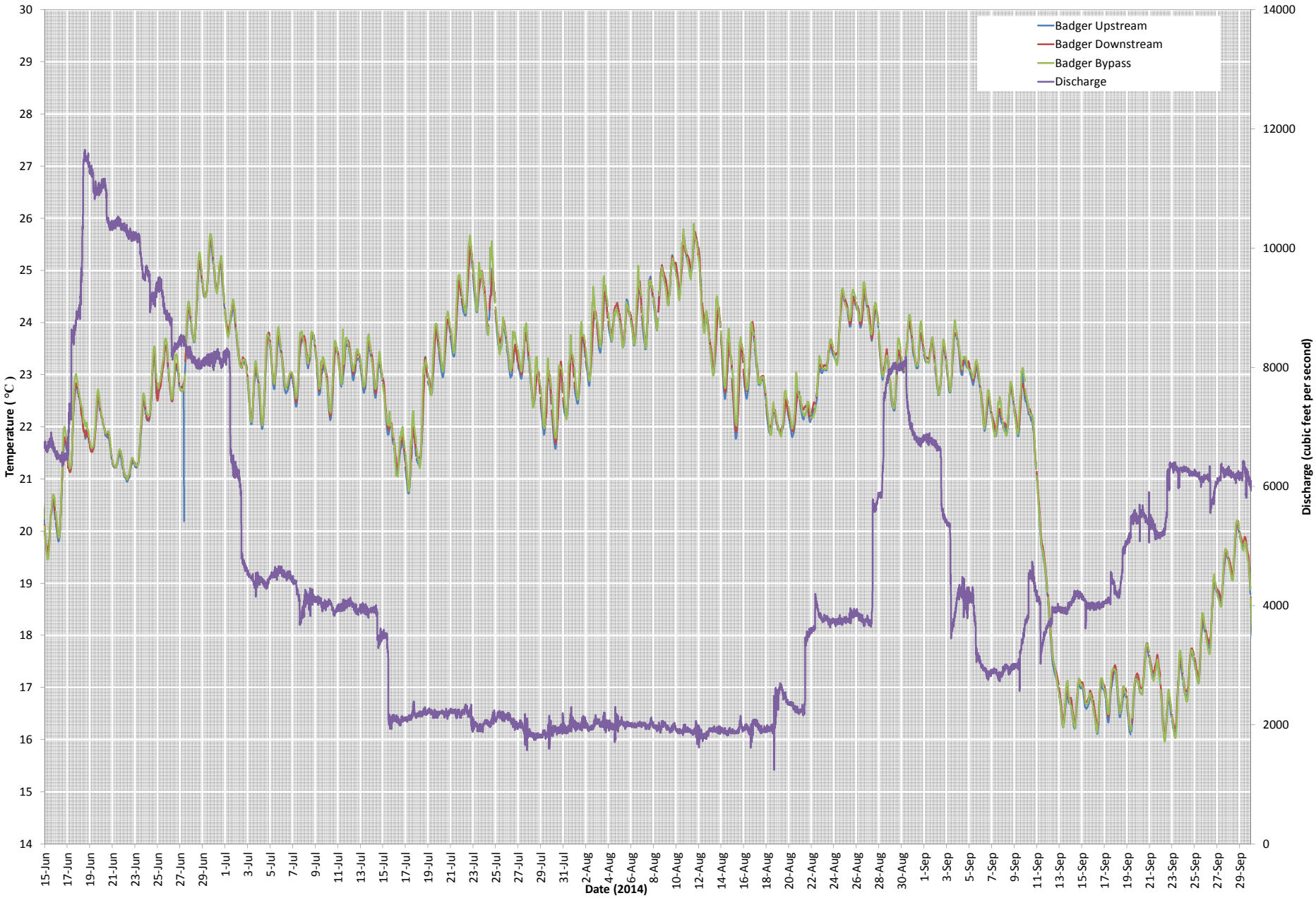


Figure 4. Hourly pH Readings, Upstream, Downstream, and along the Bypass of the Badger Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

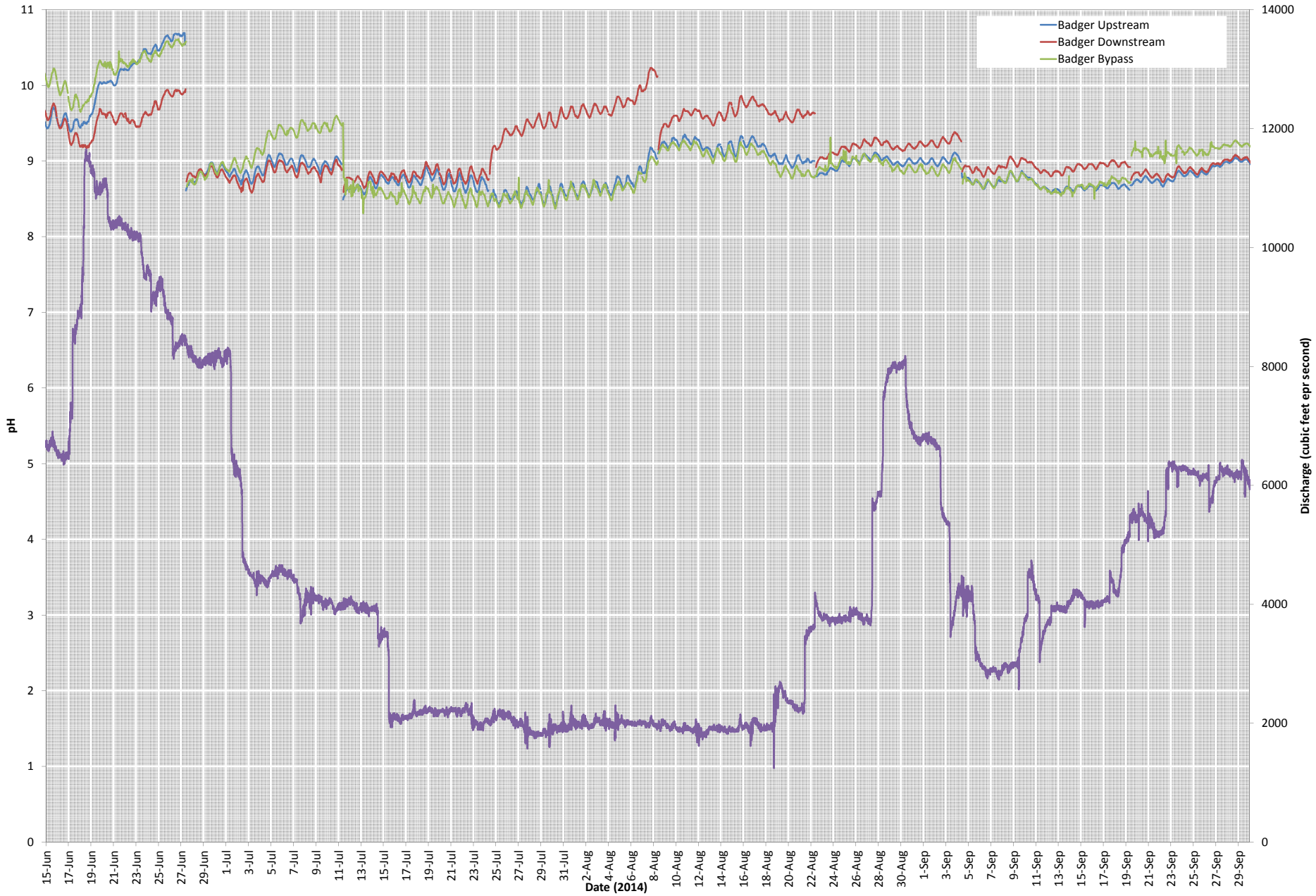


Figure 5. Hourly Electrical Conductivity Readings, Upstream, Downstream, and along the Bypass of the Badger Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

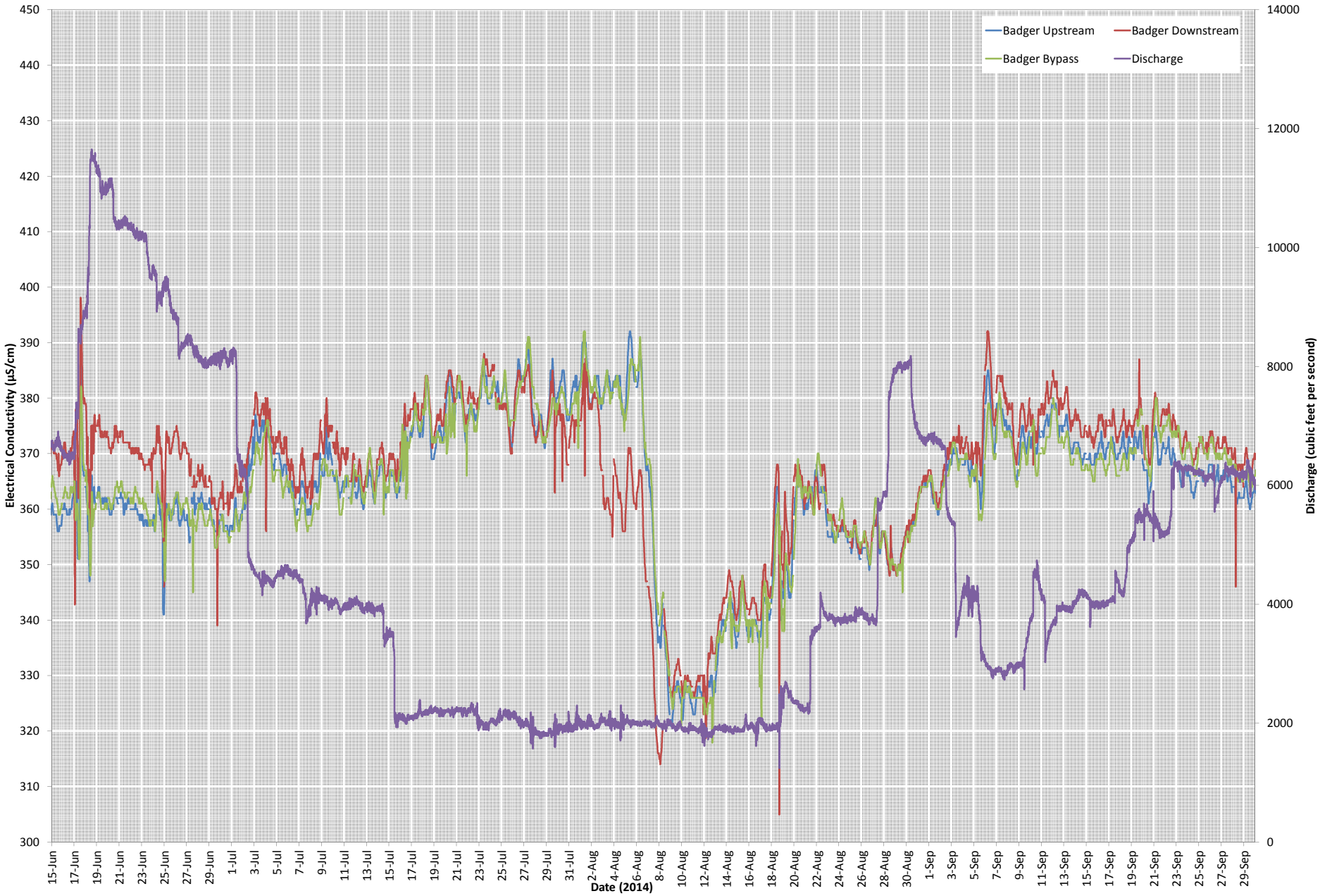


Figure 6. Average Daily Dissolved Oxygen Readings, Upstream, Downstream, and along the Bypass of the Badger Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

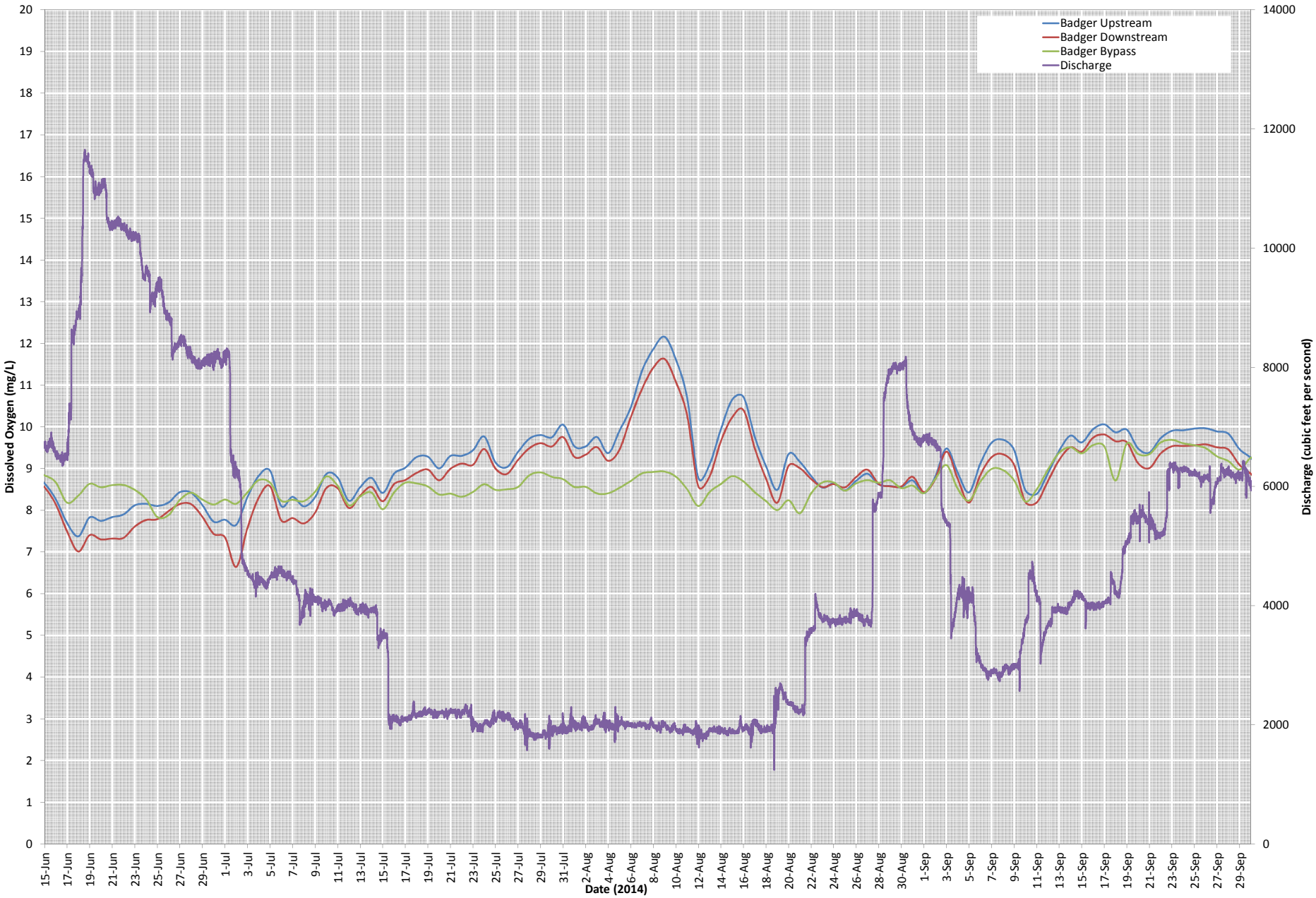


Figure 7. Average Daily Temperature Readings, Upstream, Downstream and along the Bypass of the Badger Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

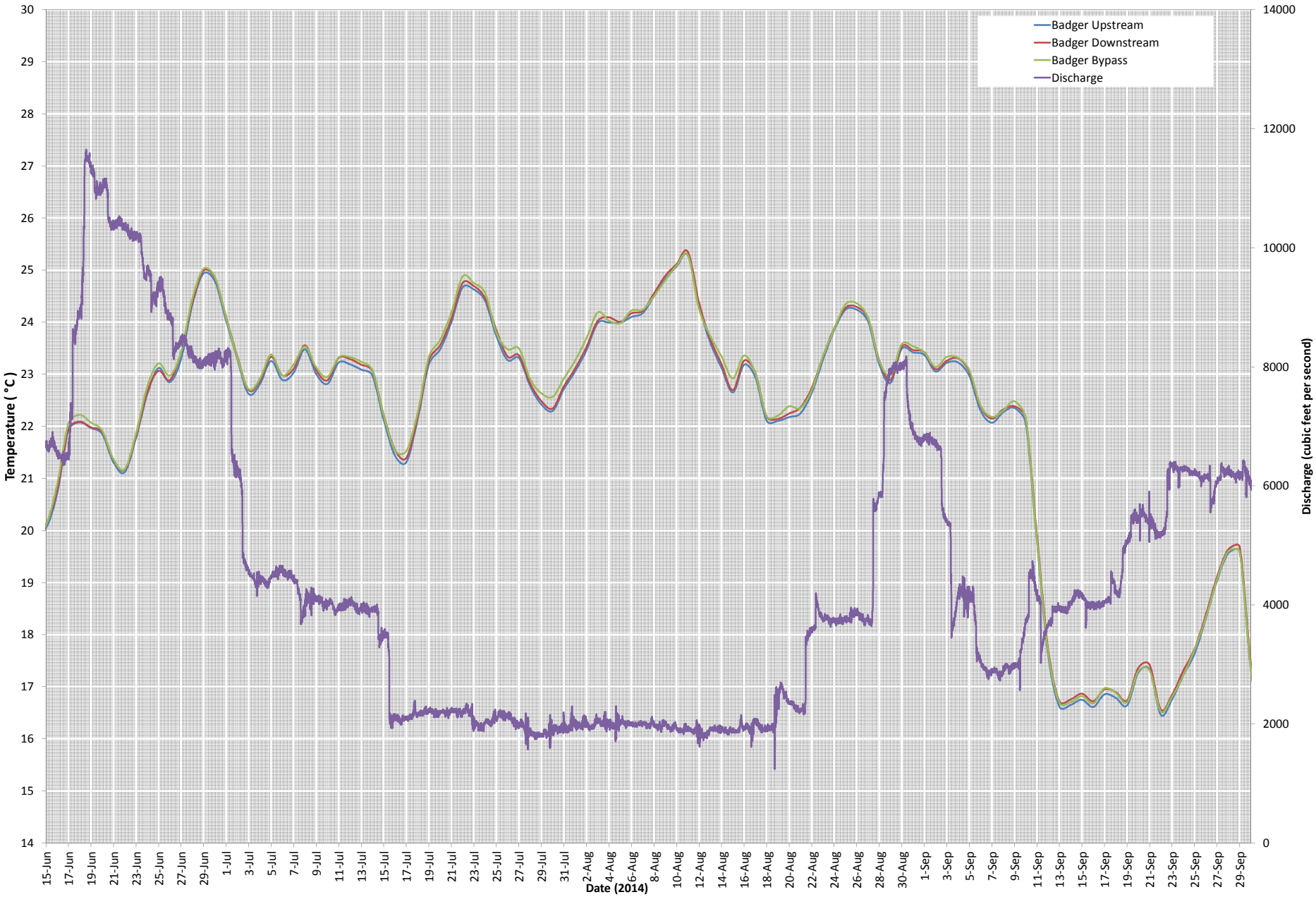


Figure 8. Average Daily pH Readings, Upstream, Downstream, and along the Bypass of the Badger Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

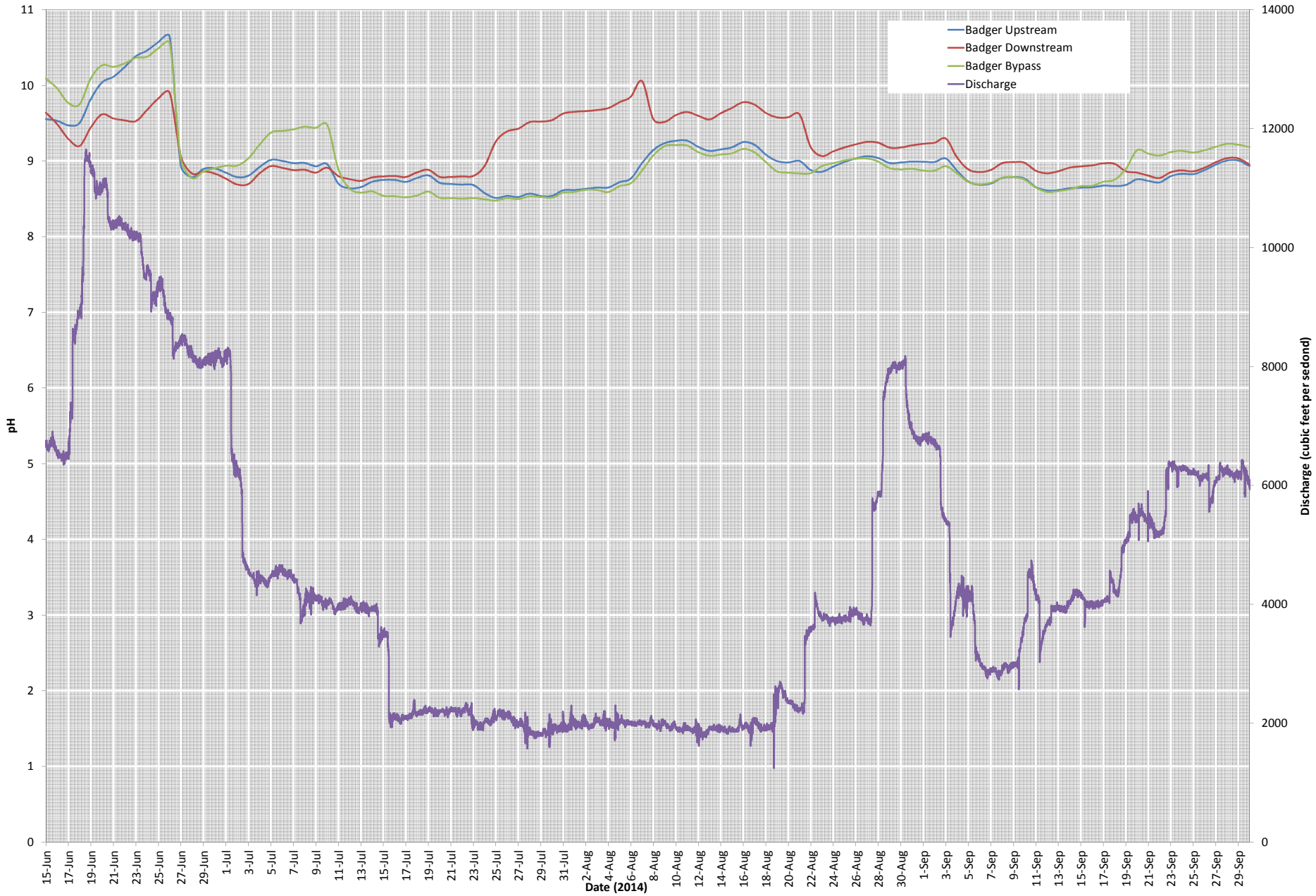


Figure 9. Average Daily Electrical Conductivity Readings, Upstream, Downstream, and along the Bypass of the Badger Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

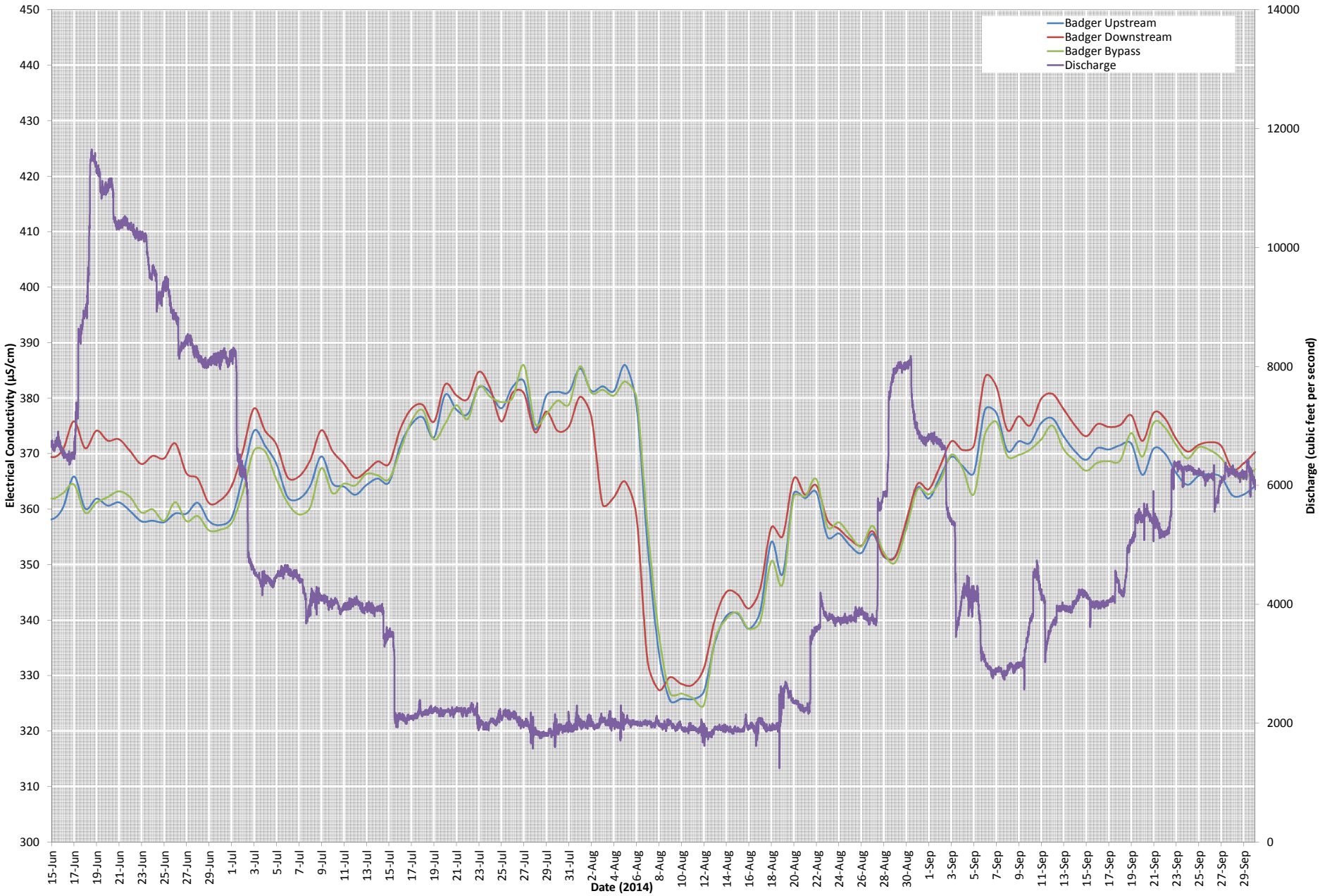


Figure 10. Hourly Dissolved Oxygen Readings, Upstream and Downstream of the Rapide Croche Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

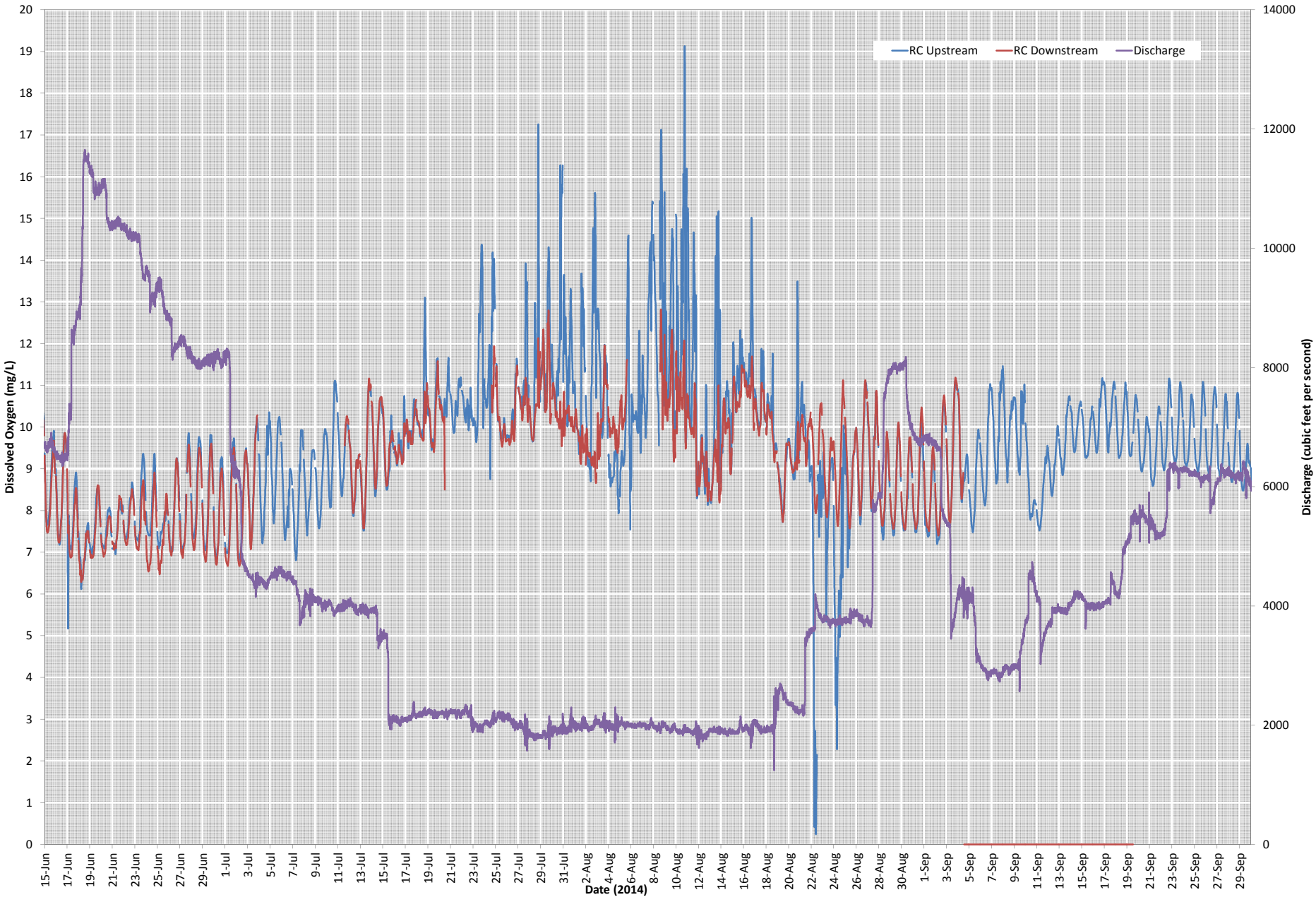


Figure 11. Hourly Temperature Readings, Upstream and Downstream of the Rapide Croche Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

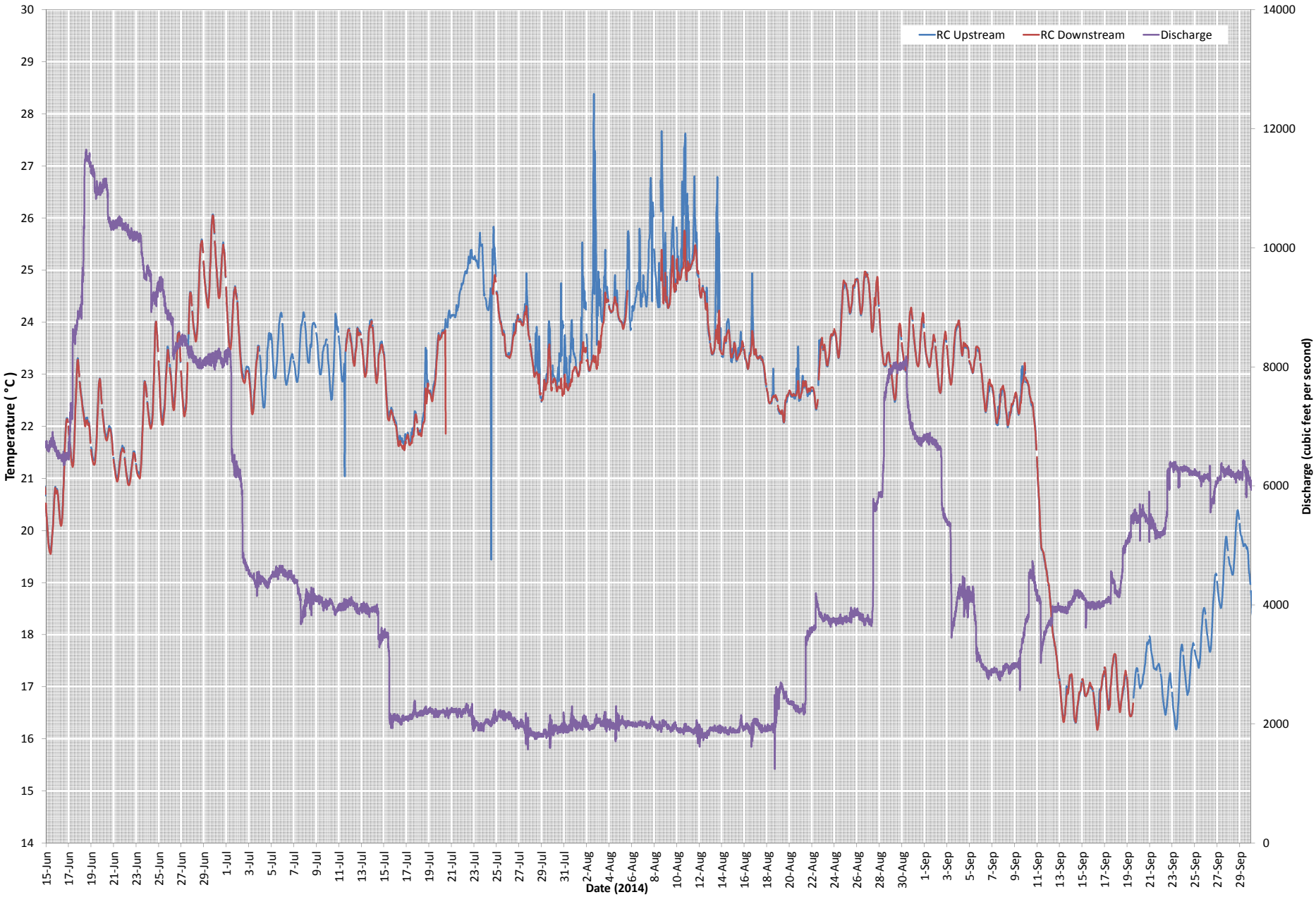


Figure 12. Hourly pH Readings, Upstream and Downstream of the Rapide Croche Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

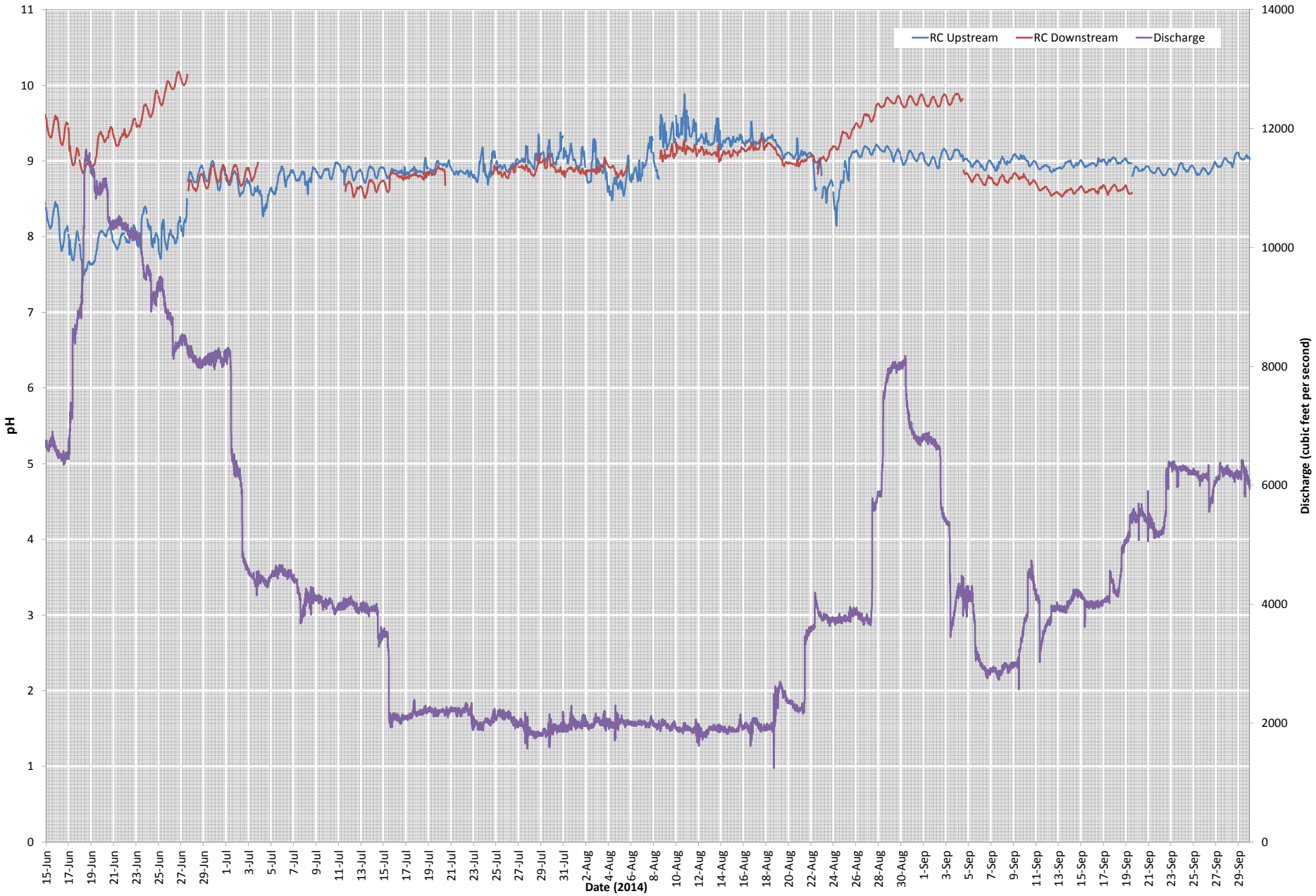


Figure 13. Hourly Electrical Conductivity Readings, Upstream and Downstream of the Rapide Croche Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

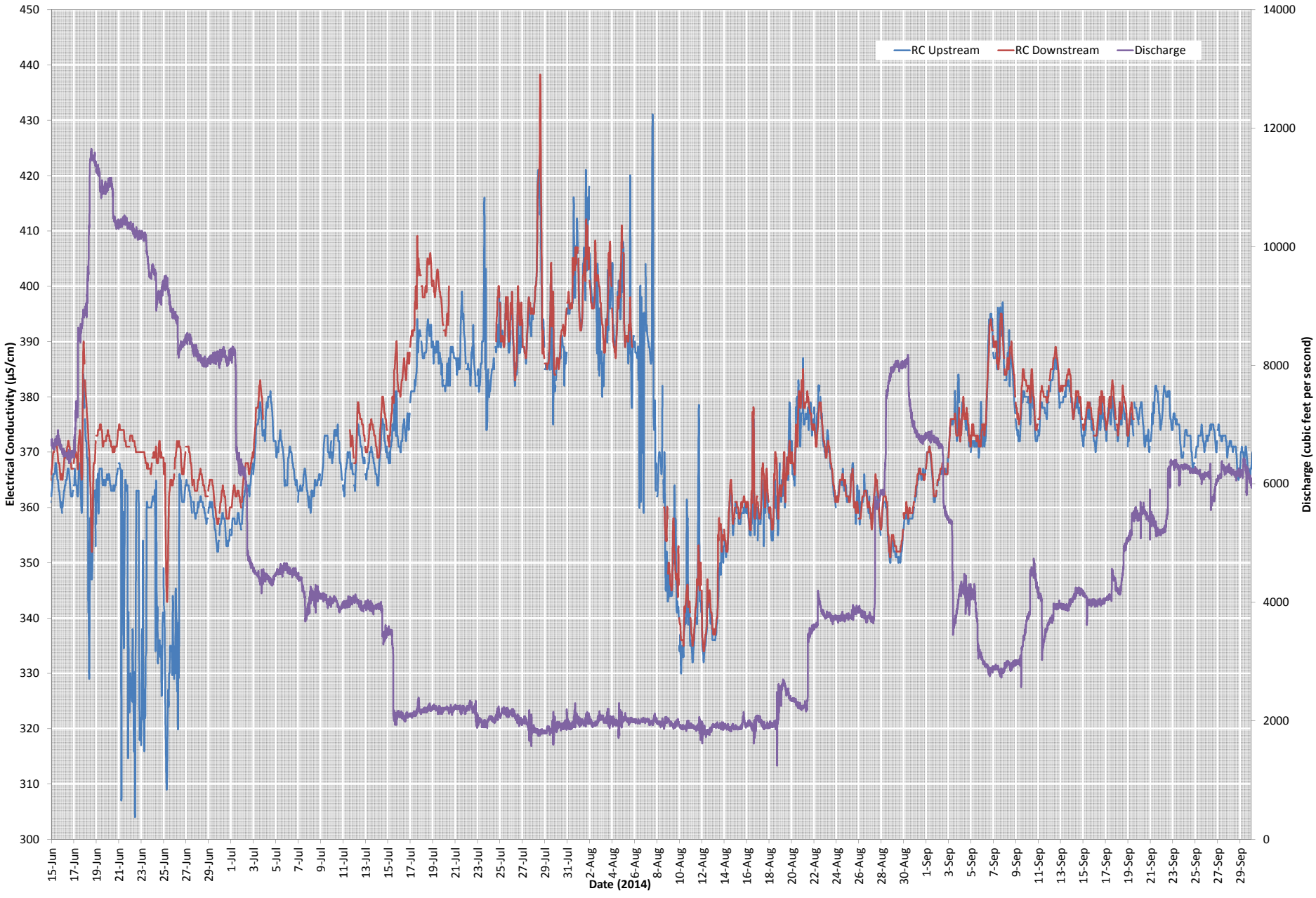


Figure 14. Average Daily Dissolved Oxygen Readings, Upstream and Downstream of the Rapide Croche Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

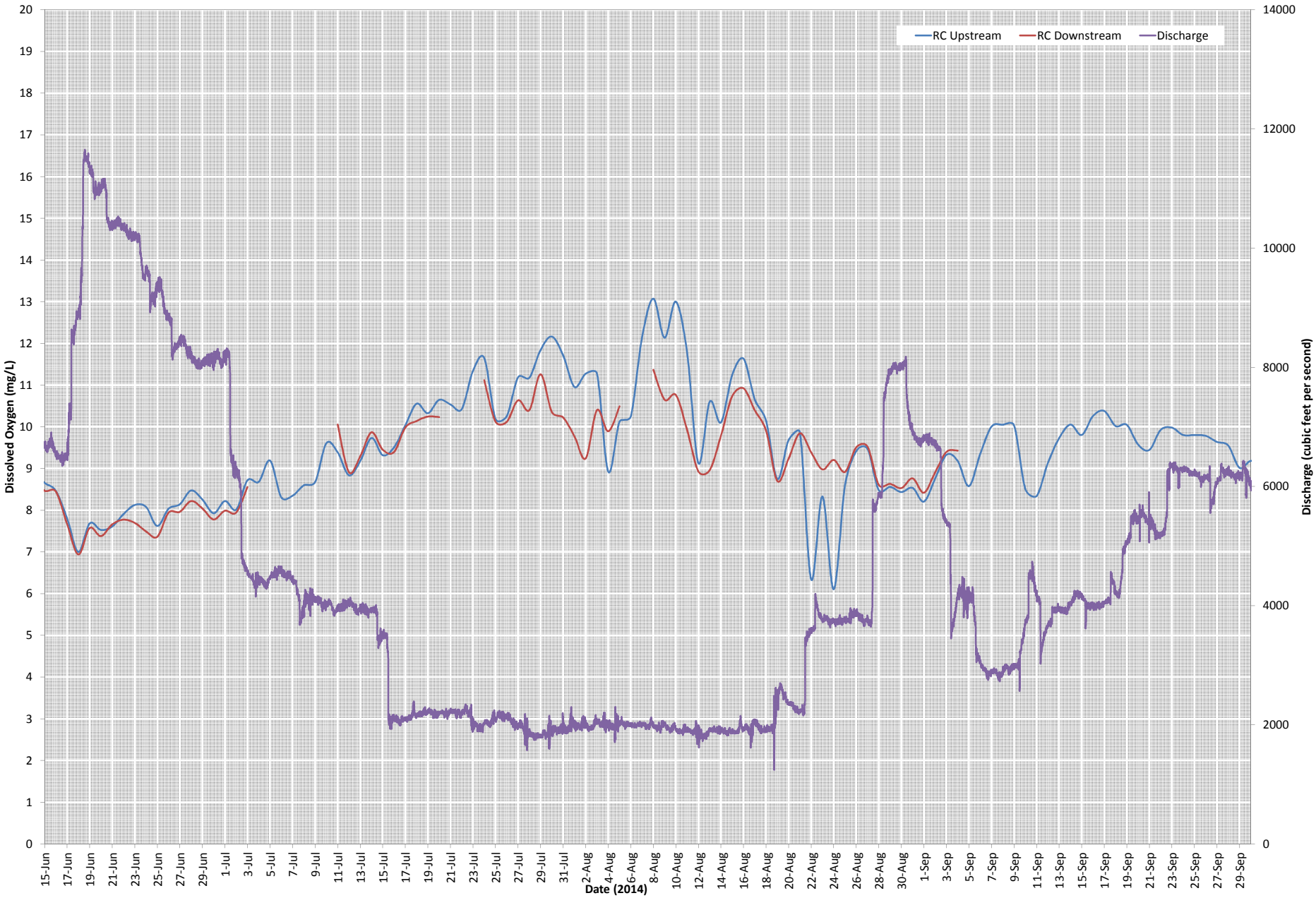


Figure 15. Average Daily Temperature Readings, Upstream and Downstream of the Rapide Croche Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

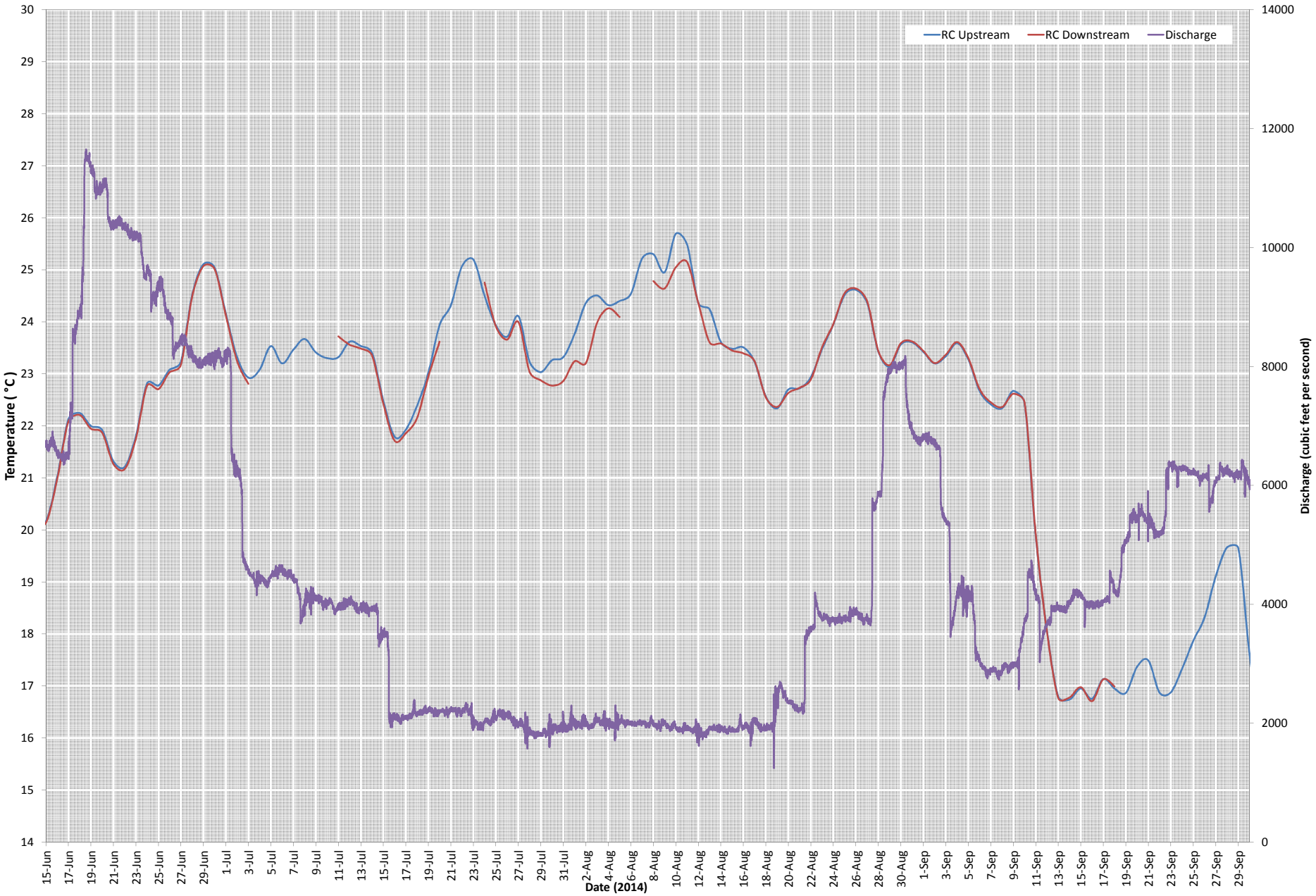


Figure 16. Average Daily pH Readings, Upstream and Downstream of the Rapide Croche Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin

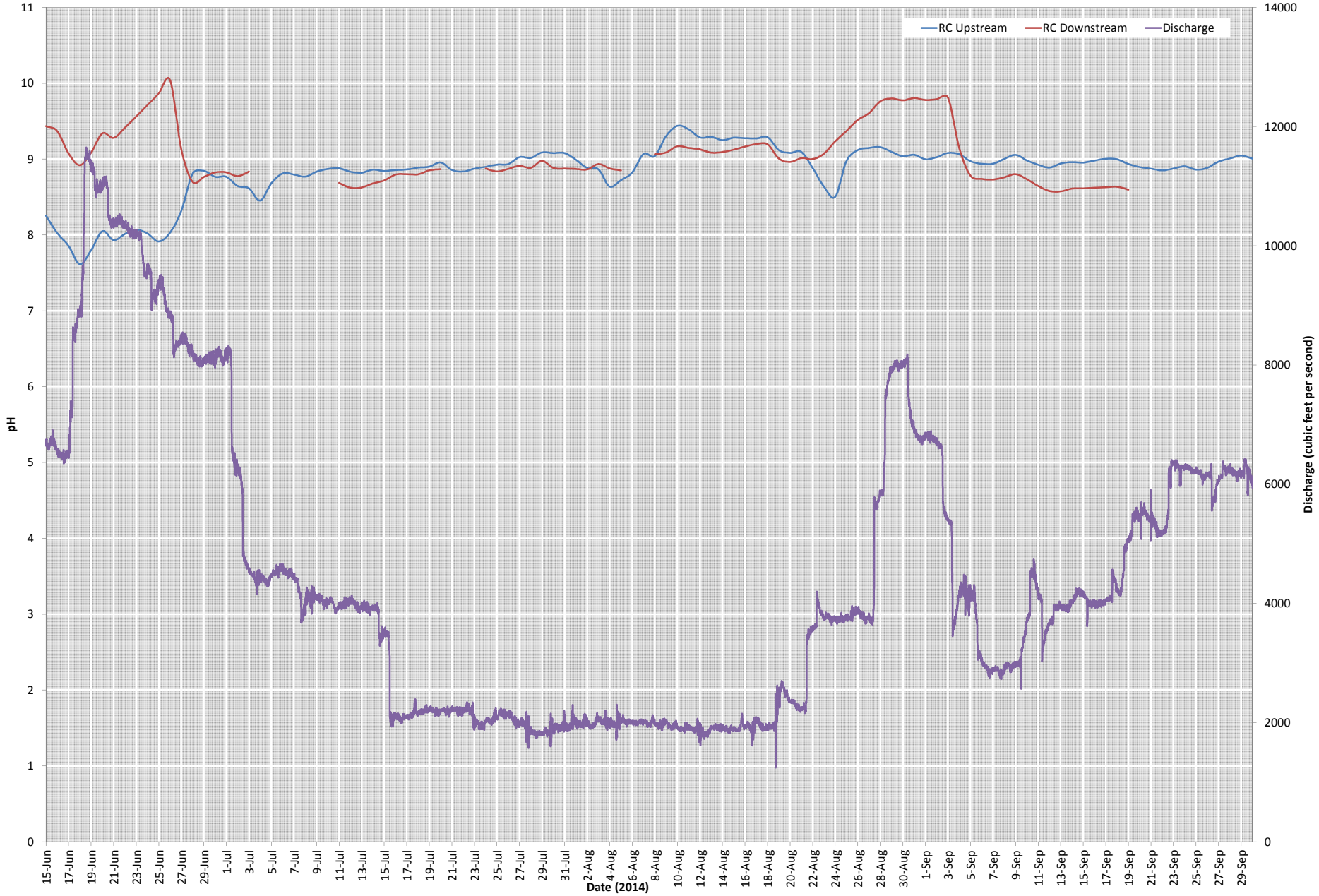
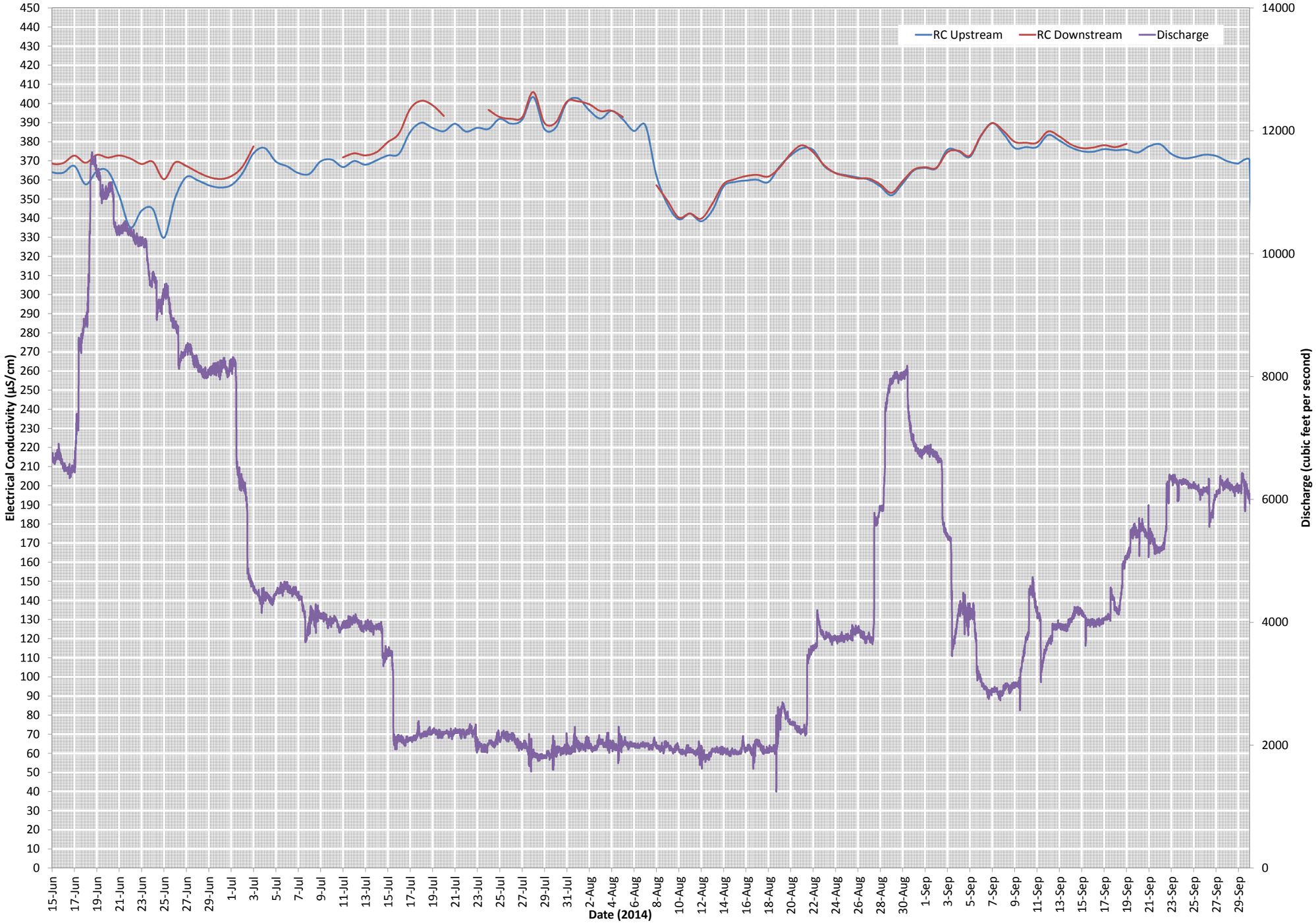


Figure 17. Average Daily Electrical Conductivity Readings, Upstream and Downstream of the Rapide Croche Hydroelectric Plant
FERC No. 2677 on the Fox River in Kaukauna, Wisconsin



Appendix B

CD-ROM of Water Quality Monitoring Report and Data

Appendix C

Description of MS-5 Sonde Outages, Replacements and Comments

APPENDIX C
Description of MS-5 Sonde Outages, Replacements and Comments

After installing new MS-5 Hach Sondes at five agency approved locations in June 2014, GEI serviced each location at biweekly intervals. As noted in the report, GEI did not initially calibrate the five instruments probes, but relied on factory pre-set calibrations for the first biweekly period. This turned out to be an error in judgment that led to significant calibration errors and unreliable data collected on June 27. Parts of the data set were also compromised by the following history of mechanical failures and replacements at two locations: Badger Downstream and Rapid Croche (RC) Upstream as follows.

7/24/14 **BADGER DOWNSTREAM SONDE S/N 64521**. LDO sensor failed during calibration. GEI was unable to physically calibrate Sonde S/N 64521. **GEI replaced Sonde S/N 64521 with S/N 45791.**

9/19/14 **BADGER DOWNSTREAM SONDE S/N 45270.** Intermittent power loss was recorded. Water leaked into battery compartment. Cause determined to be a cracked shroud. **GEI replaced sonde S/N 45270 with Sonde S/N 45277.**

7/11/14 **RC DOWNSTREAM SONDE S/N 65298.** Sonde stopped recording on 7/3/14. Calibrated Sonde S/N 65298 successfully and re-deployed following a fresh battery change.

7/15/14 **RC DOWNSTREAM SONDE S/N 65298.** Based on management concerns about minimizing loss of further data, **GEI replaced Sonde S/N 65298 with Sonde S/N 45227**.

7/24/14 **RC DOWNSTREAM SONDE S/N 45277** was removed from the water by a fisherman and the LDO sensor dried out. **GEI replaced Sonde S/N 45277 with Sonde S/N 45971.**

8/9/14 **RC DOWNSTREAM SONDE S/N 45791** was removed from the water by a fisherman and the LDO sensor dried out. **GEI replaced Sonde S/N 45791 with S/N 64521 and relocated the Sonde approximately 100 feet further upstream in a less accessible point to disturbance.**

9/19/14 **RC DOWNSTREAM SONDE S/N 64521** LDO sensor failed to calibrate. **GEI replaced Sonde S/N 64521 with Sonde S/N 65298.**

10/1/14 **RC DOWNSTREAM SONDE S/N 65298** failed to record a complete two week data set; causes unknown. This was the final day of the sampling season and it was not replaced.